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MANUFACTURER: ROCKWELL/COLLINS

MODEL: VHF-250/250S/250F COMM TRANSCEIVER

TYPE OF PUBLICATION: INSTRUCTION BOOK

GENERAL INDEX

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523-0766705-00311A

Rockwell International

instruction book

Collins VHF-250/250S/250E Communications Transceiver

This instruction book includes:

VHF-250/250S/250E Communications Transceiver

Description	*523-0766713*
Installation	*523-0766714*
Operation	*523-0766715*
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Bulletins	*523-0766719*

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Caution

The material in this manual is subject to change. Before attempting any maintenance operation on the equipment covered in this manual, verify that you have complete and up-to-date publications by referring to the applicable Publications and Service Bulletin Indexes.

We welcome your comments concerning this instruction book. Although every effort has been made to keep it free of errors, some may occur. When reporting a specific problem, please describe it briefly and include the instruction book part number, the paragraph or figure number, and the page number.

Send your comments to: Publications Department
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Cedar Rapids, Iowa 52498

3rd edition

ATP
RECORD OF REVISIONS

REV. NO.	SECTIONS COVERED IN REVISION	REV. DATE	INSERTION DATE	BY	NOTES
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Collins Divisions
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October 8, 1984

TO: HOLDERS OF VHF-250/250S/250E COMMUNICATIONS TRANSCEIVER INSTRUCTION BOOK (523-0766705)

THIRD EDITION HIGHLIGHTS

The attached instruction book completely replaces the existing VHF-250/250S/250E Communications Transceiver instruction book. Included in this edition are numerous mechanical changes and supporting assembly/disassembly procedures, new customer acceptance/minimum performance test procedures, service tips and troubleshooting hints, a new synthesizer assembly, various electrical changes, all service bulletins and service information letters. All new material has been added in a fashion that does not destroy information required to service earlier production units. Portions of the book that have been added or revised are identified with black change bars placed in the margin adjacent to the affected text.

Retain this letter of transmittal for future reference.

PUBLICATIONS DEPARTMENT

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Rockwell International

description

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Collins General Aviation Division
523-0766713-003118
3rd Edition, 2 August 1984

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section I
description

1.1 INTRODUCTION

This instruction book contains all the specifications, installation instructions, principles of operation, and information necessary to maintain the VHF-250/250S/250E Communications Transceivers.

1.2 PURPOSE OF EQUIPMENT

The VHF-250, VHF-250S, and VHF-250E Communications Transceivers are panel-mounted voice transceivers providing AM communication over a vhf range. All radios feature a digital readout and automatic squelch; mechanical characteristics are identical.

The VHF-250 and VHF-250E provide 720-channel operation from 118.000 through 135.975 MHz in 25-kHz increments. The VHF-250E differs from the VHF-250 in that it is designed especially for use in European countries where offset carriers are used extensively.

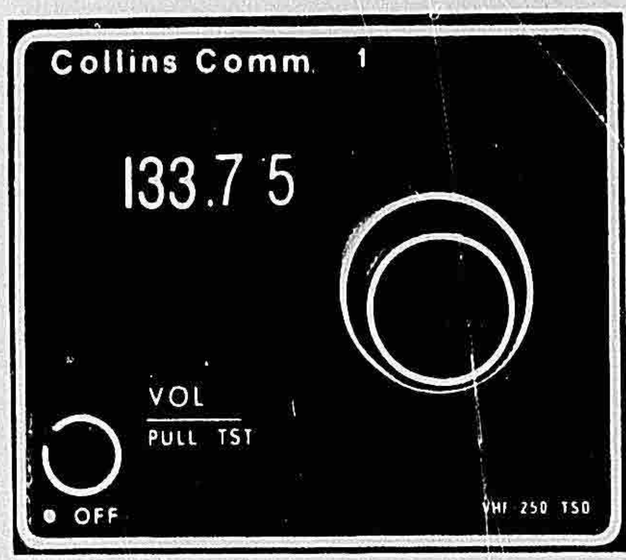
The VHF-250S provides 360-channel operation from 118.00 through 135.95 MHz in 50-kHz increments for use in South America and other countries where the ground station frequency tolerances associated with 50-kHz channel spacing are found.

1.3 DESIGN FEATURES

- Audio speech processing to assure full modulation in transmit and maximum output on weak or poorly modulated received signals
- Varactor diode-tuned receiver to eliminate the need for mechanical tuning devices
- Digital frequency synthesizer with stability determined by a single crystal-controlled oscillator
- Automatic squelch circuit to eliminate manual control of squelch threshold
- Dual-gate MOSFET rf amplifier and mixer to provide maximum sensitivity and freedom from spurious responses
- Crystal filter selectivity to ensure maximum rejection of adjacent channel interference
- High maintainability featuring modular construction and quick access to all circuits
- Front panel mounting with mounting tray installed from either front or rear of panel
- Installed as a single device, or easily combined with additional COMM or NAV equipment in dual installations
- Distinctive styling coordinated with other Collins General Aviation Division products.
- Provision for identifying radios as COMM 1 or COMM 2 in dual installations

1.4 EQUIPMENT SPECIFICATIONS

Table 1-1 lists the equipment specifications of the VHF-250/250S/250E Communications Transceivers.



VHF-250/250S/250E Communications Transceiver
Figure 1-1

Table 1-1. VHF-250/250S/250E Communications Transceiver, Equipment Specifications.

CHARACTERISTICS	SPECIFICATIONS
Related documents	
FAA TSO	-C37b class II, -C38b, DO 138, category DAPBAAEXXXXX.
Physical	
Dimensions	
Front panel	
Width	79.250 mm (3.120 in).
Height	66.290 mm (2.610 in).
Front extension, including knobs	43.690 mm (1.720 in).
Chassis	
Width	80.770 mm (3.180 in) max.
Height	67.410 mm (2.654 in) max.
Rear extension, including tray	316.20 mm (12.45 in) max.
Mounting	Panel mounted.
Kit	CPN 628-5289-001
Weight	1.5 kg (3.3 lb) max, with tray.
Panel colors	
VHF-250	
622-2079-001	Black.
622-2079-002	Gray.
VHF-250S	
622-3364-001	Black.
VHF-250E	
622-3365-001	Black.
Environmental	
Temperature range	
Continuous	-15 to +55 °C (+5 to +131 °F).
Intermittent	To +71 °C (+159.8 °F) for 30 minutes.
Storage	-40 to +85 °C (-40 to +185 °F).
Altitude	9,144 m (30,000 ft) operating.
Cooling	Convection.
Relative humidity	95% at +50 °C (122 °F).
Shock	
Operational	6 g.
Crash safety	15 g (10-ms duration).

Table 1-1. VHF-250/250S/250E Communications Transceiver, Equipment Specifications (Cont).

CHARACTERISTICS	SPECIFICATIONS
Electrical	
General	
Channels	
VHF-250/250E	720.
VHF-250S	360.
Frequency range	
VHF-250/250E	118.000 to 135.975 MHz in 25-kHz increments.
VHF-250S	118.000 to 135.95 MHz in 50-kHz increments.
Frequency stability	
VHF-250/250S	±0.0025%.
VHF-250E	±2 kHz.
Power requirements	
Receive	+13.75 V dc at 0.84 A maximum.
Transmit	+13.75 V dc at 4.5 A (85% voice modulation). **Note** The PWC-150 Power Converter must be used when the VHF-250/250S/250E is installed in a 28-volt system.
Transmitter	
Vhf power output	
VHF-250/250S	10 watts nominal.
VHF-250E	14 watts minimum.
Modulation	85% modulation capability with 95% limiting; less than 15% distortion at 85% modulation.
Audio input impedance	150 ohms unbalanced with excitation current for a 50- to 600-ohm carbon or transistorized dynamic microphone.
Sidetone	Not less than 5 mW into a 500-ohm load.
Duty cycle	1 minute transmit, 4 minutes receive.
Receiver	
Sensitivity	Not more than 3.0 μV modulated 30% with 1000 Hz will provide a 6-dB-minimum signal-plus-noise to noise ratio.
Selectivity	
VHF-250/250 E	Typical 6 dB at ±10.00 kHz, 60 dB at ±20.0 kHz.
VHF-250S	Typical 6 dB at ±17 kHz, 60 dB at ±38.0 kHz.

Table 1-1. VHF-250/250S/250E Communications Transceiver, Equipment Specifications (Cont).

CHARACTERISTICS	SPECIFICATIONS
Spurious responses	Down at least 60 dB.
Squelch	Automatic carrier type.
AGC characteristics	From 10 to 20,000 μV, audio output will not vary more than 3 dB.
Audio	
Auxiliary audio inputs	Four 500-ohm inputs which are isolated from each other by 30 dB.
Frequency responses	Within 6 dB from 350 to 2500 Hz. (VHF-250E only: response at 5 kHz at least 18 dB down with respect to 1 kHz).
Speaker output	5 watts into a 3.2-ohm speaker load.
Headphone output	50 to 150 mW into a 500-ohm load.

1.5 EQUIPMENT SUPPLIED

Supplied with the VHF-250/250S/250E Communications Transceivers is an installation kit, Collins part number 628-5289-002, that is required for installation. Figure 2-1 (refer to the installation section of this instruction book) provides an exploded view of the kit and lists the materials it contains.

Available is an optional rear connector that does not require the use of special crimping or insertion/extraction tools. If needed, specify Collins part number 371-0381-030 (Cannon part number DBR-25S).

1.6 EQUIPMENT REQUIRED BUT NOT SUPPLIED

The following or equivalent equipment is required for proper operation of the VHF-250/250S/250E but is not supplied with the equipment:

a. ANT-251 VHF Communications Antenna (Collins part number 013-1575-010), or equivalent.
b. Interconnecting cables.
c. Headphones or speaker.
d. Microphone (TELEX TEL-66T), or equivalent.

Note

The PWC-150 Power Converter, Collins part number 622-2093-001, is required for operation in a 28-volt system.

Collins VHF-250/250S/250E Communications Transceiver

Rockwell International

installation

Collins General Aviation Division

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*2-8	2 Aug 84
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section II installation

2.1 GENERAL

Installation data contained in this section consists of unpacking and inspection checks, special instructions, installation procedures, and postinstallation testing.

2.2 UNPACKING AND INSPECTING EQUIPMENT

Unpack the equipment carefully and make a careful visual inspection of each unit for possible shipping damage. All claims for damage should be filed with the transportation company involved. If claims for damage are to be filed, save the original packing carton and materials. If no defects can be detected, replace packing materials in the shipping container and save for future uses such as storage or reshipment.

2.3 SPECIAL INSTRUCTIONS

The following are special instructions which must be followed to ensure proper installation of the VHF-250/250S/250E. Damage to the equipment may occur if these instructions are not followed.

Caution

Turnlock must be in extract position prior to unit insertion in tray.

a. When inserting the VHF-250/250S/250E in its mounting tray, gently apply pressure until the rear connectors are properly mated. Using an Allen wrench, twist the turnlock into position.
b. The minimum wire size for +13.75-volt dc lines is #20 AWG.
c. Read all notes on drawings and interconnects before installing units.
d. Wires carrying alternator ripple current or 400-Hz current, if dressed close to the transceiver, may produce audible interference due to synthesizer modulation.
e. Speaker wire, if dressed close to the transceiver, may produce feedback howl due to synthesizer modulation.
f. Each vhf communication antenna should be mounted as far as possible from the vhf navigation and emergency locator transmitter antennas.

2.4 INSTALLATION

Warning

In the interest of personal safety, it is recommended that the aircraft battery master switch be turned off to disconnect power to the equipment mount before any electronic equipment is removed from or installed in the aircraft.

The following installation procedures must be performed as described to ensure proper operation and performance. Any deviation from these instructions may result in reduced performance and/or damage to the equipment.

2.4.1 VHF-250/250S/250E Communications Transceiver

a. The installation kit (CPN 628-5289-002) supplied with the VHF-250/250S/250E is required for installation. Refer to figure 2-1.
b. The VHF-250/250S/250E is rigidly mounted in the aircraft instrumentation panel. There are two methods that may be used for installing the mounting tray provided in the installation kit. Both methods position the tray with front edges extended through the panel cutout, but flush with the aircraft instrumentation panel. Refer to figure 2-2 for panel-cutout dimensions.
c. Avoid mounting close to external heating sources. If this is unavoidable, use blower or ram air cooling. Under normal installation conditions, ram air or blower cooling will increase reliability of the VHF-250/250S/250E.
d. Secure the mounting tray to the instrument panel mounting rails, using four #6-32, 100-degree flathead screws. It is recommended that rear mounting straps be used for added support. Figure 2-4 illustrates typical system installations.
e. After the mounting tray has been secured in position, slide the rear connector assembly into place and secure by tightening four screws. Snap into place the protective shroud provided in the installation kit and tie in place to prevent accidental removal due to shock or vibration. Holes are provided in the shroud and rear plate assembly for this purpose.

Caution

Do not force turnlock into position. If difficulty is experienced, remove VHF-250/250S/250E and check rear connector assembly for proper positioning.

f. Carefully slide the VHF-250/250S/250E into the mounting tray. Using a 5/64-inch Allen wrench, secure the VHF-250/250S/250E in place by twisting the turnlock into position.

Note

The following steps pertain to dual installations only.

g. Dual installations are accomplished by joining two mounting trays together using the hardware provided in the installation kit. Connecting screws should be varnished to prevent loosening due to vibration. Included in every installation kit are two straps and two screws. To join two mounting trays together, four straps and four screws are required (refer to figure 2-1).

h. Dual installation cutout dimensions are shown in figure 2-2 for both behind-the-panel and front-panel mounting installations.

2.4.2 ANT-251 VHF Communications Antenna

a. Select a suitable location for antenna mounting using the template shown in the outline and mounting dimensions drawing, figure 2-3. The ANT-251 may be installed on either the top or the bottom of the aircraft where ground clearance warrants. With a bottom-mounted antenna, communications may not be possible while the aircraft is on the ground.

b. The mounting area selected must provide a stable base for the antenna as well as clearance for the connector. An unobstructed area providing line of sight between antenna and intended receiving stations is desirable. Keep the antenna as far as possible from other communications antennas and from the vertical stabilizer. Also maintain maximum possible spacing between communications antennas, the emergency locator transmitter antenna, and the vhf navigation antenna.

c. The surface selected should provide continuous metal contact between the antenna and the aircraft. Adapter plates or shims, when used, must be metallic and shaped to interface the antenna base to the aircraft contour. Mating surfaces must be clean of paint, primer, dirt, and oxidation. Inner mounting hardware such as doublers and stop nuts must also maintain direct electrical grounding to the airframe.

d. After location has been selected, drill the antenna mounting holes and secure in place using four #6 screws.

e. If a sealant or aerodynamic smoother is used around the antenna base, ensure application is made after antenna is securely fastened in position.

2.5 CABLING

The VHF-250/250S/250E mating connector part number is shown on the outline and mounting diagram. Figure 2-5 lists mating connector pin assignments.

During preparation of the interconnect wiring cables, observe the following precautions:

a. Bond and shield all parts of the aircraft electrical system, such as generator and ignition systems.

b. Keep the interconnect cables away from circuits carrying heavy current, pulse transmitting equipment, and other sources of interference.

c. Figure 2-5 presents the VHF-250/250S/250E mating connector pin assignments. Refer to that illustration and the VHF-250/250S/250E interconnect wiring diagram, figure 2-8, when preparing the interconnect cable.

d. Leave slack in the cable to allow for movement due to vibration.

e. After installation of the cables in the aircraft and before installation of the equipment, a check should be made to ensure that the aircraft power is applied only to the pins specified. Refer to figure 2-5 for connector pin assignments.

f. Remove and install connector contacts in accordance with steps g through j. Table 2-1 lists the special tools required to perform steps g through j.

g. During installation of the mating connector, the connecting wire must be crimped in the contact so that the crimped portion of the contact can enter the connector shell and provide a positive lock of the contact in the shell. Use crimping tool (CPN 371-0382-010) and crimp each interconnect wire in a contact. Using the insertion/extraction tool (CPN 371-8445-010), insert the contact into the proper connector shell hole from the rear and press until locked. Refer to figure 2-6.

h. Do not dress speaker wire, wires carrying alternator ripple current, or wires carrying 400-Hz current alongside the transceiver. The magnetic field surrounding such wires may modulate the synthesizer, resulting in degraded audio quality or feedback howl.

Table 2-1. Special Tools.

DESCRIPTION	MANUFACTURER AND TYPE	COLLINS PART NUMBER
Crimping tool	Cannon, CCT-D*C-1	371-0382-010
Insertion/extraction tool-plastic	Cannon, CIET-20HDB	371-8445-010
Insertion/extraction tool-metal	Cannon, CIET-22	371-8445-020

i. During removal of a contact, use the insertion/extration tool to unlock the contact, and pull the contact out of the connector from the rear.

j. Refer to figure 2-7 for installation of antenna cable connector. Use RG-58A/U coaxial cable in the installation.

2.6 POSTINSTALLATION CHECKS

Warning

The potential exists for a significant reduction in, or the complete cancellation of, the received audio output signal of two vhf communications transceivers (regardless of manufacturer) in the same aircraft if all of the following conditions exist:

a. Two transceivers are tuned to ground stations that simultaneously transmit the same message.

Note

Ordinarily this occurs when both transceivers are tuned to the same frequency. However, it can also occur when more than one ground station transmitter is used to transmit a single voice message.

b. Audio outputs are adjusted to approximately the same level.

c. The audio output phase shifts of the two communications systems (including the audio panel) are approximately 180 degrees apart.

If the phase shift through both transceivers is the same (in phase) and the audio panel does not introduce phase differentials, no attenuation or cancellation of the received signal will occur.

All users of vhf communications transceivers should be aware of this potential situation and take the following precautions to prevent this problem from occurring:

a. Make a habit of avoiding simultaneous tuning of two transceivers to the same frequency or to two frequencies that carry the same voice message.

b. Test the transceiver and audio panel as described in the following procedures to determine whether or not the problem of incompatible phasing exists.

After installation of the equipment in the aircraft, perform a system check to ensure that cancellation or attenuation is not a problem.

a. Tune both transceivers to the same frequency. (In aircraft with three transceivers, each combination of two units must be tested.)

b. Set the audio panel so that both transceiver outputs are heard through the same speaker or headset.

c. Set one transceiver volume control approximately to its midpoint.

d. Slowly adjust the other transceiver volume control through its midpoint position and listen for a reduction in the level of the combined audio output.

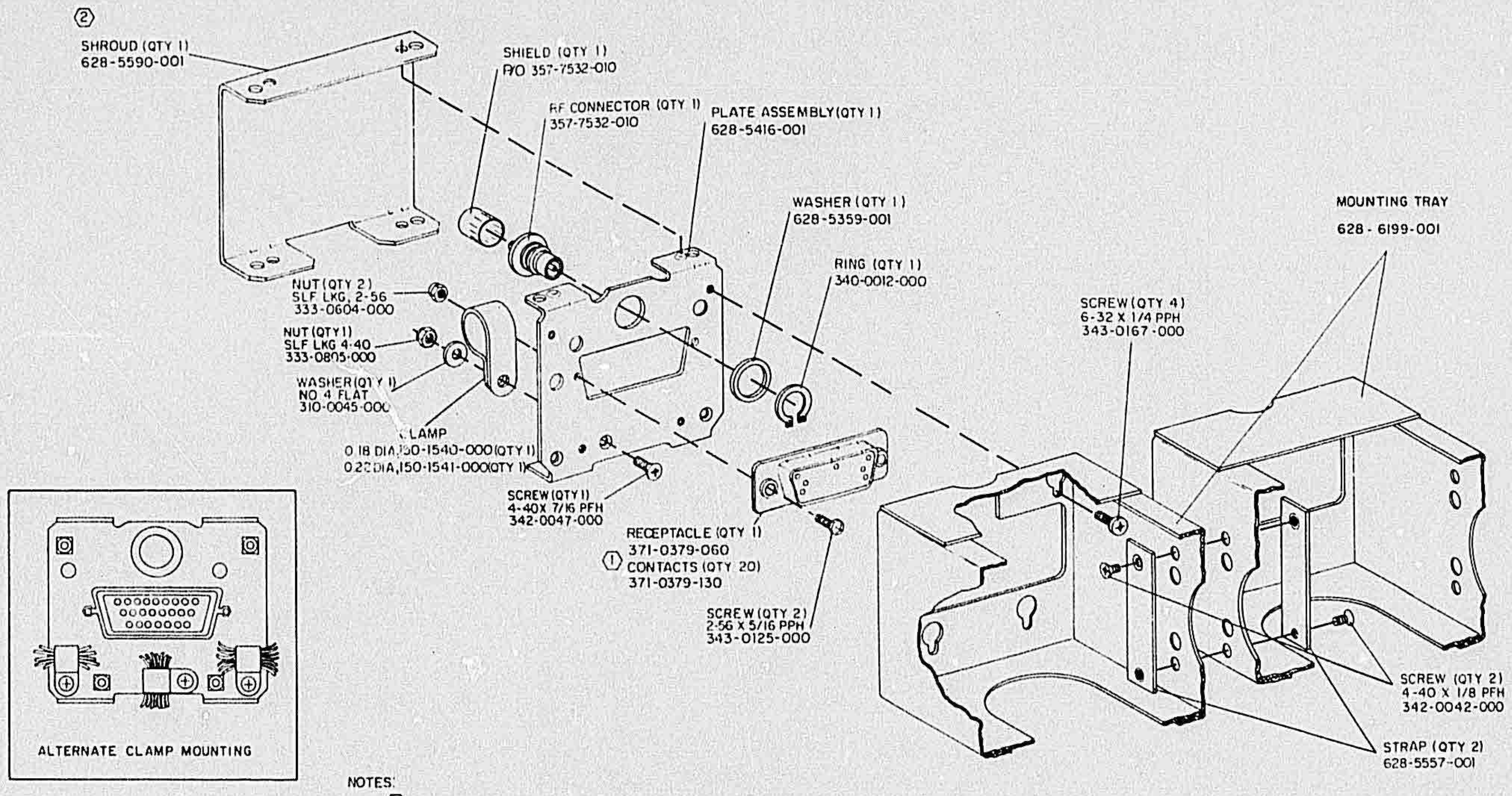
If the transceiver phase shifts are incompatible, the audio signal will be completely cancelled or appreciably reduced at the audio output level of the two transceivers approach equality. If the transceiver phase shifts are compatible, the audio output will be at least as loud as that of a single unit. The preceding test should be performed after any change of vhf communications transceiver or audio equipment.

If the attenuation/cancellation problem is detected in an installation consisting solely of Micro Line equipment, remove each transceiver and check the wiring of transformers A1T1 and A1T2. This problem indicates that a serious error in wiring has been made on one of these two components. Compare the transceiver audio output (headphone or speaker) with the rf envelope by a quick check that ensures proper wiring. If the transceiver is operating properly, the audio output will be in phase with the positive portion of the rf envelope; if this relationship does not exist, a wiring problem is present.

Normally this problem is extremely rare in a pure Micro Line system; however, extra attention should be given in a mixed system checkout. Keep in mind that any equipment interfacing with the transceiver (audio panel, line buffers, another vhf COMM transceiver, or auxiliary amplifiers) may influence the audio output phase and contribute to attenuation/cancellation.

After all cabling has been installed and the equipment has been mounted in the aircraft, make the operational check outlined below to ensure correct operation of the equipment in the aircraft. These tests may be made using the aircraft power supply with the engine running or with auxiliary power applied to the aircraft.

a. Apply power to the VHF-250/250S/250E and set volume control to its middle position (half volume).
b. Check the squelch disable circuit by pulling out the OFF/VOL/TST control. Noise from the receiver should be applied to the aircraft audio system.
c. Select the operating frequency of a known station in the immediate area. Press the microphone push-to-talk switch and obtain a signal check. Repeat this procedure with other stations on different frequencies if possible.



NOTES:

① AN OPTIONAL SOLDER POT TYPE CONNECTOR MAY BE SUBSTITUTED CPN 371-0381-030 (CANNON DBR-25 S)

② AN OPTIONAL 43MILLIMETRE (1.7 IN) DEEP SHROUD IS AVAILABLE CPN 628-5590-002

③ A LABEL (1, 2) IS INCLUDED WITH KIT BUT NOT ILLUSTRATED CPN 628-5597-001.

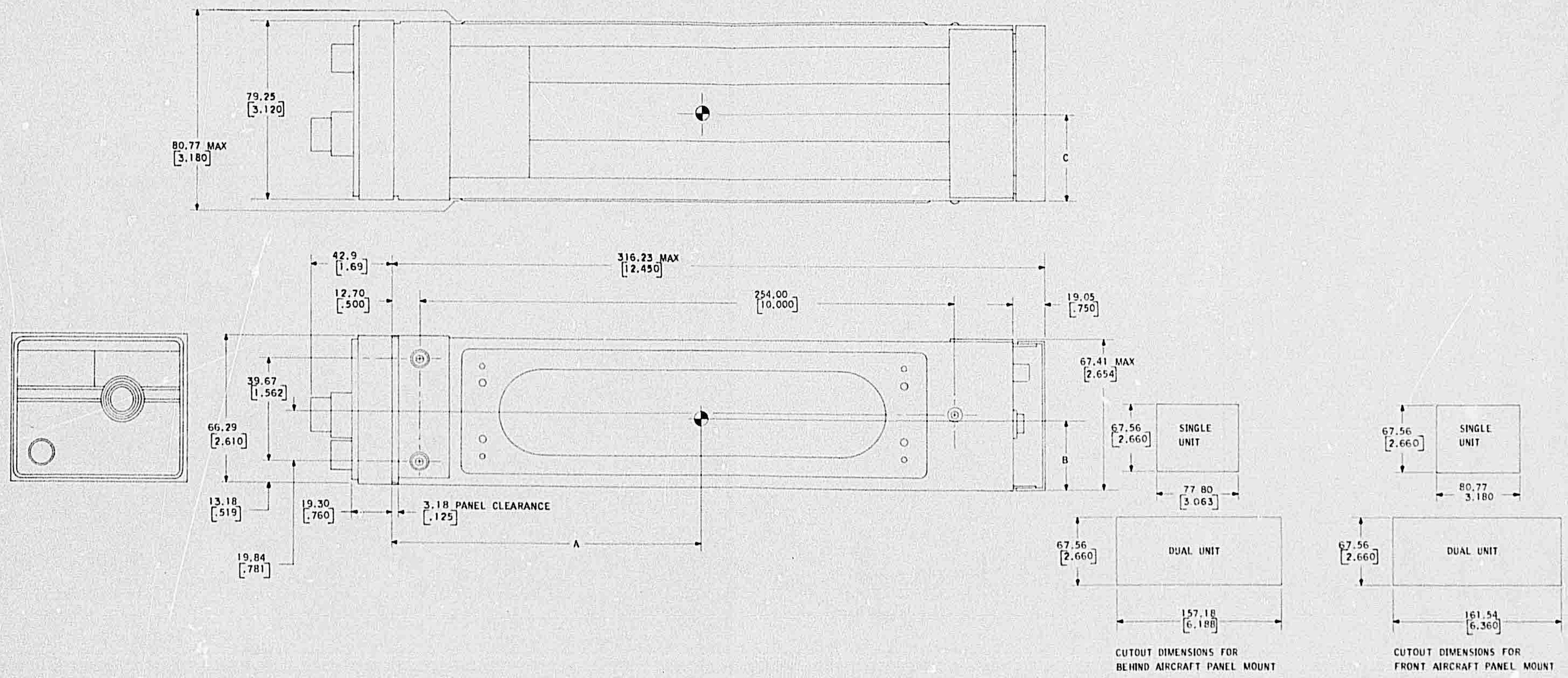
628-5762

VHF-250/250S/250E, Installation Kit
Figure 2-1

NOTES:
1. UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MILLIMETRES [INCHES].
2. CG'S ARE WITH UNIT IN TRAY.

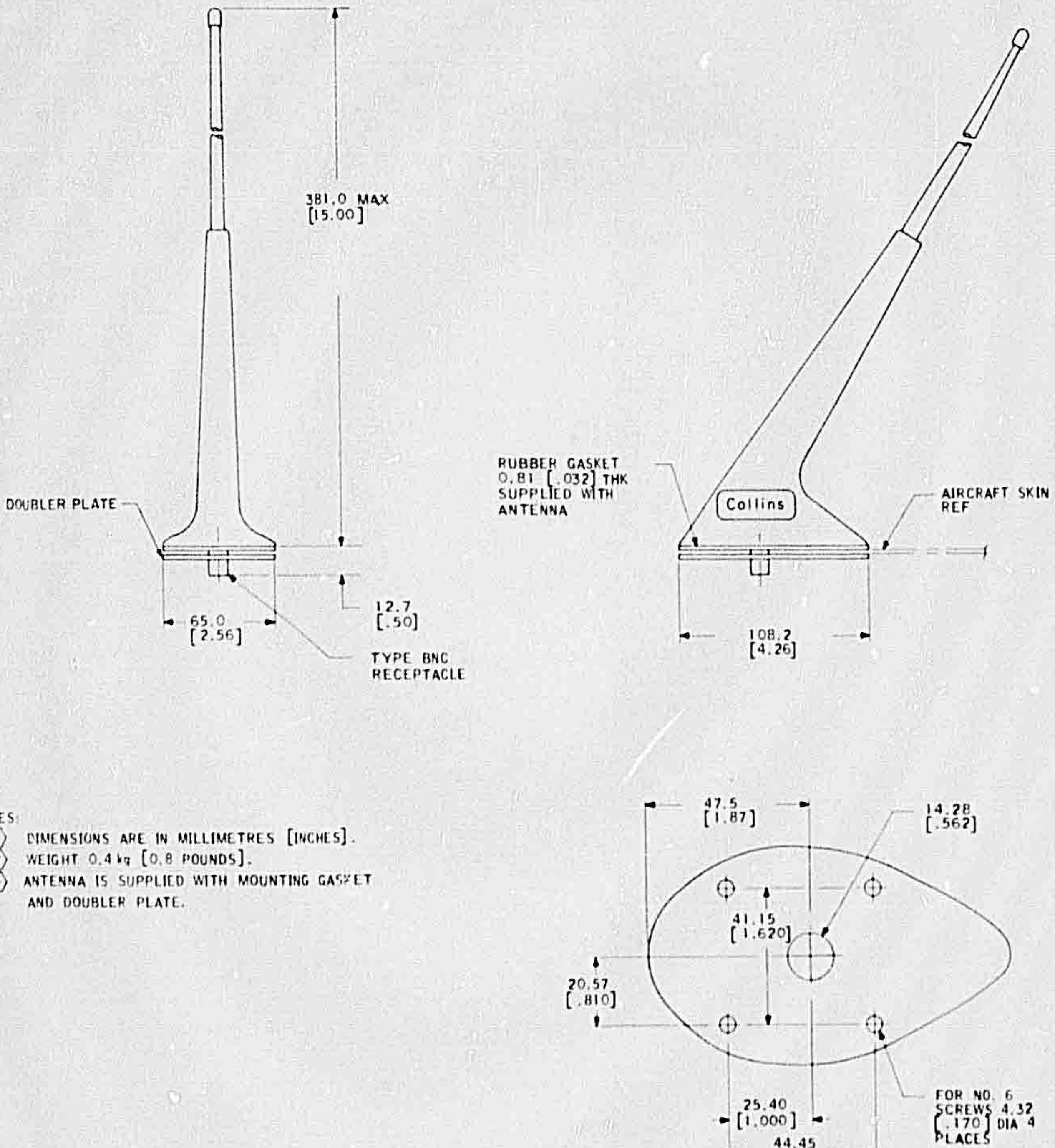
	A		B		C		UNIT WEIGHT		TRAY WEIGHT	
	mm	INCHES	mm	INCHES	mm	INCHES	kg	LBS	kg	LBS
VIR-350	143.0	5.63	33.0	1.30	38.1	1.50	1.14	2.5	0.18	0.4
VHF-250 VHF-250S VHF-250E	152.4	6.0	31.75	1.25	41.4	1.63	1.5	3.3	0.18	0.4

UNIT	UNIT CONNECTORS	MATING CONNECTORS
VHF-250 VHF-250S VHF-250E	RF - CPN 357-7532-020 SIGNAL CONN - CPN 371-0379-010 SIGNAL CONTACTS - CPN 371-0379-030	RF - CPN 357-7532-010 SIGNAL CONN - CPN 371-0379-060 SIGNAL CONTACTS - CPN 371-0379-130
VIR-350	RF - CPN 357-7532-020 SIGNAL CONN - CPN 371-0379-040 SIGNAL CONTACTS - CPN 371-0379-100	RF - CPN 357-7532-010 SIGNAL CONN - CPN 371-0379-070 SIGNAL CONTACTS - CPN 371-0379-130

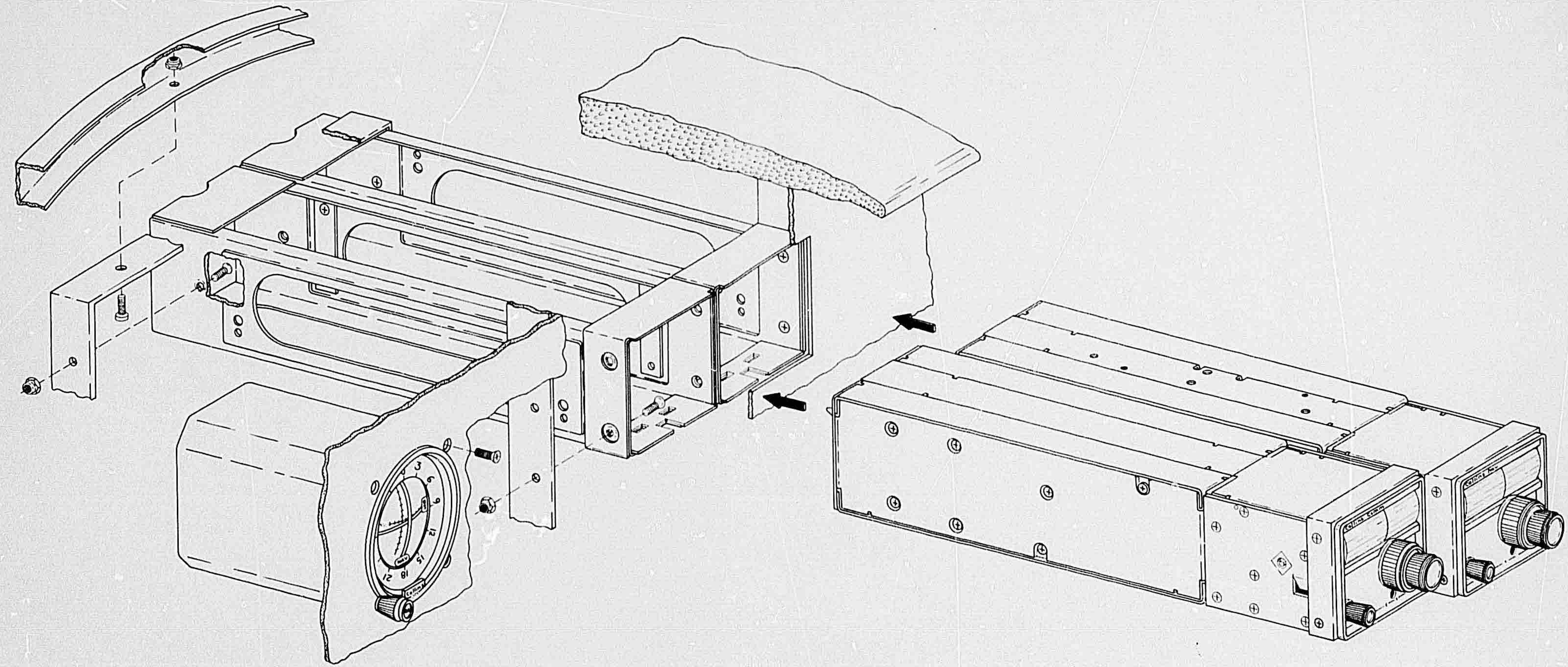


628-6545

VHF-250/250S/250E, Outline and Mounting Dimensions
Figure 2-2

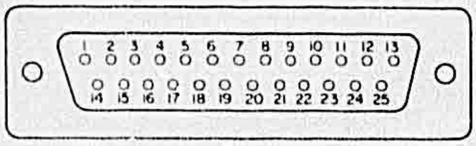


ANT-251 Antenna, Outline and Mounting Dimensions
Figure 2-3



628-6546

Typical System Installation
Figure 2-4



VHF-251( ) AND VHF-250( ) MATING CONNECTOR PIN ASSIGNMENTS

1 ICS ⟨3⟩	13 COMM AUDIO 500 OHMS
2 SPARE	14 SPARE
3 SPARE	15 SPARE
4 SPEAKER SIDETONE ⟨2⟩	16 AGC TEST POINT
5 MICROPHONE	17 AUX AUDIO 1
6 AUDIO GROUND	18 AUX AUDIO 2
7 27.5 V DIMMER ⟨1⟩	19 AUX AUDIO 3
8 13.75 V DIMMER ⟨1⟩	20 AUX AUDIO 4
9 KEYLINE	21 AUDIO GROUND
10 SWITCHED COMM POWER	22 COMM POWER IN
11 COMM 13.75 V DC	23 COMM POWER IN
12 SPEAKER	24 POWER GROUND
	25 POWER GROUND

NOTE:

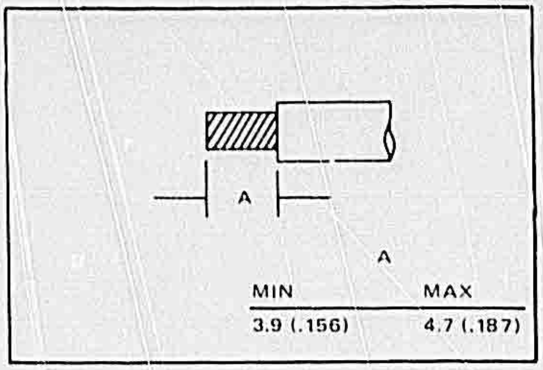
⟨1⟩ USED IN VHF-250( ) ONLY.

⟨2⟩ 622-2079-011, -012 ONLY.

⟨3⟩ SPARE PIN IN VHF-251 BELOW SN 24591, VHF-251E BELOW SN 2795, AND VHF-251S BELOW SN 2698 AND ALL VHF-250( ).

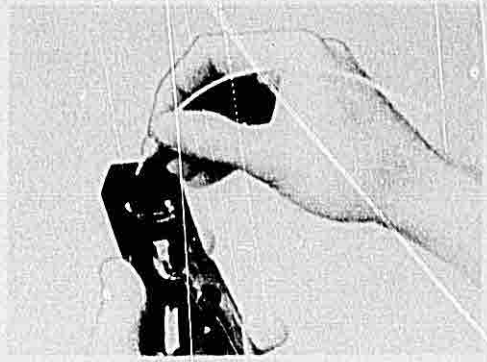
628-5665

VHF-250/250S/250E, Mating Connector Pin Assignments
Figure 2-5

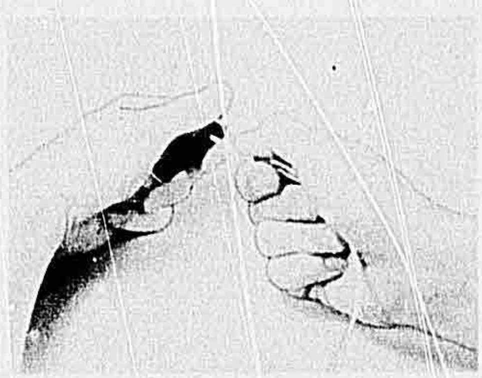


WIRE STRIPPING
1. CUT WIRES TO LENGTH. STRIP INSULATION PER ABOVE ILLUSTRATION. CHECK FOR BROKEN OR FRAYED WIRES.

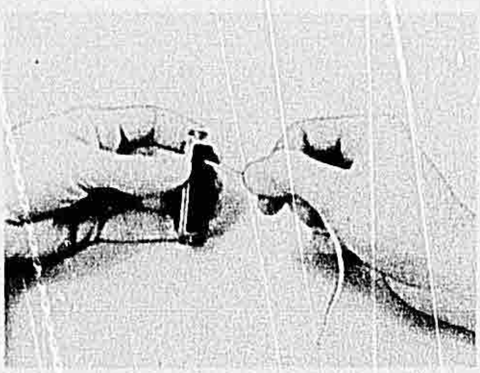
NOTE: DIMENSIONS ARE IN MM (IN.).



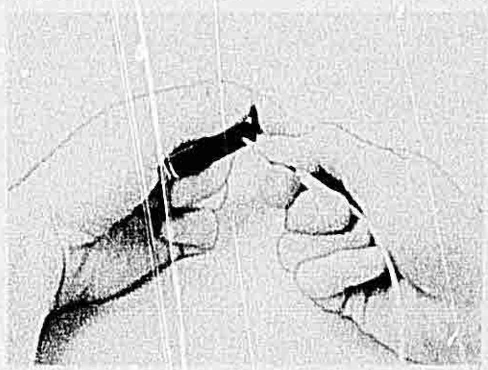
CONTACT CRIMPING
2 INSERT CONTACT AND WIRE INTO PROPER CRIMPING TOOL (AND LOCATOR, IF REQUIRED) CRIMP CONTACT TO WIRE. INSPECT CRIMP.



CONTACT INSERTION
3. CENTER WIRED CONTACT IN GROOVE OF INSERTION TOOL,WITH TOOL TIP BUTTING CONTACT SHOULDER. INSERT CONTACT INTO CAVITY UNTIL A POSITIVE STOP IS FELT INSPECT INSERTION.



4. TO BE SURE CONTACT IS LOCKED SECURELY, PULL BACK LIGHTLY ON WIRE. REPEAT FOR BALANCE OF CONTACTS, WORKING ROW BY ROW ACROSS THE INSULATOR.



CONTACT EXTRACTION
5. PLACE WIRE INTO EXTRACTION TOOL TIP. INSERT TOOL TIP INTO CONTACT CAVITY UNTIL TIP BOTTOMS AGAINST CONTACT SHOULDER, RELEASING TINES. HOLD WIRE AGAINST TOOL WITH FINGER AND REMOVE TOOL AND CONTACT. REPEAT FOR BALANCE OF CONTACTS.

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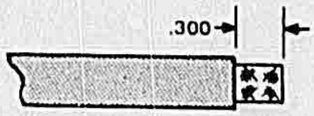
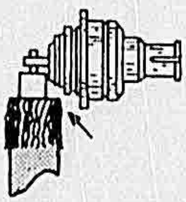
Use of Crimping and Insertion/Extraction Tools
Figure 2-6

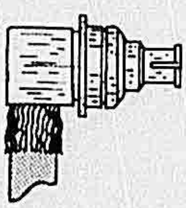


TRIM COAX CABLE OUTER INSULATION AS SHOWN.

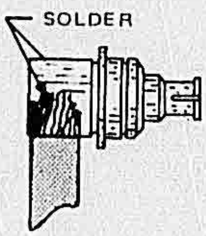
FOLD BRAID BACK OVER OUTER INSULATION OF COAX. DO NOT CROSS STRANDS.



SOLDER CENTER CONDUCTOR TO CENTER PIN OF CONNECTOR. ENSURE FRONT END OF BRAID IS EVEN WITH BOTTOM OF CONNECTOR. (SHOWN BY ARROW).



SLIDE CONNECTOR CAP, WITH CLEARENCE HOLE IN POSITION TO CLEAR DIELECTRIC, ON TO CONNECTOR UNTIL IT SNAPS INTO PLACE.



PUSH BRAID FORWARD AND FLATTEN AGAINST CONNECTOR CAP AND SOLDER 360° AROUND. SOLDER TAC CONNECTOR CAP TO CONNECTOR IN AT LEAST THREE PLACES TO INSURE GOOD ELECTRICAL CONTACT.

357-7532-010 RF CONNECTOR

NOTE: CLOSE ADHERANCE TO THIS PROCEDURE IS NECESSARY FOR AN INTERFERENCE FREE INSTALLATION.

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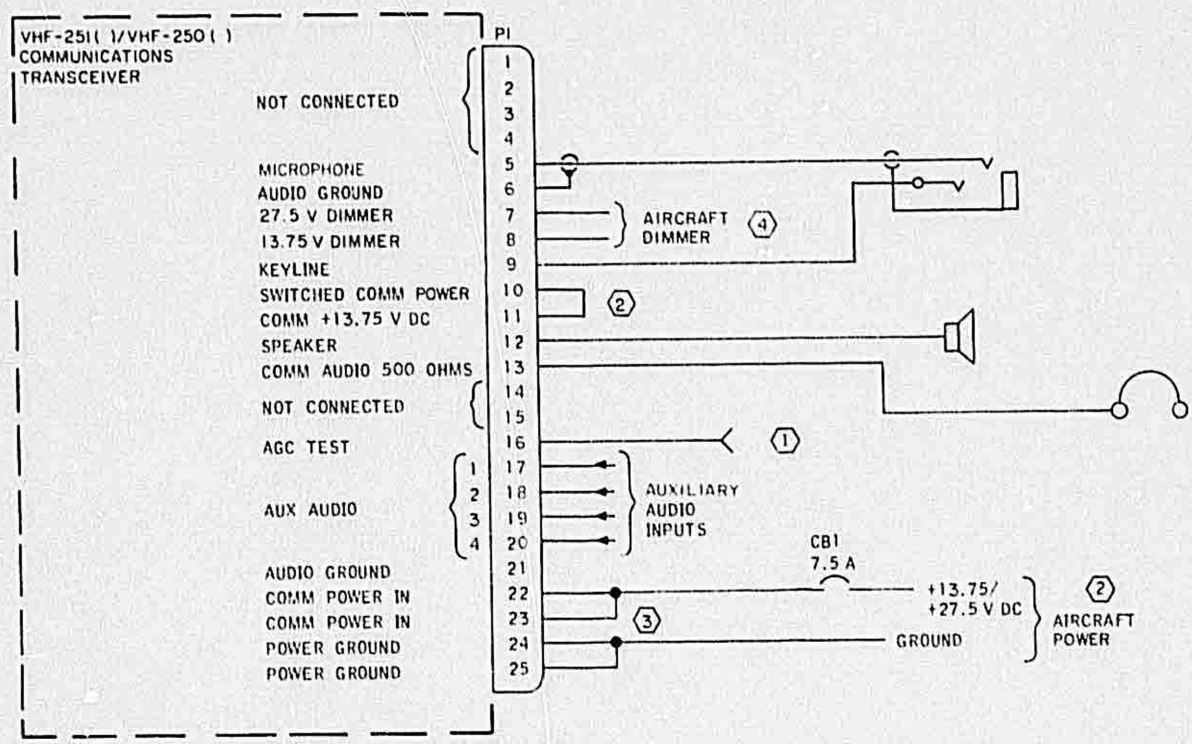
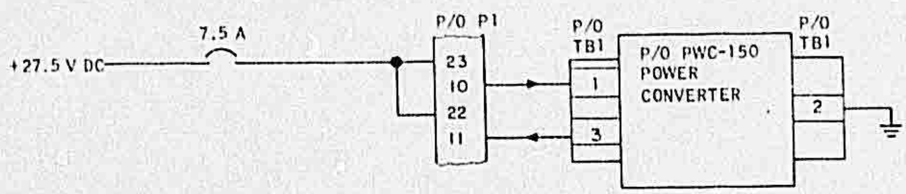
Antenna Connector Preparation
Figure 2-7



NOTES:

(1) AGC IS BROUGHT OUT TO P1-16 FOR TESTING PURPOSES ONLY.

(2) THE PWC-150 POWER CONVERTER IS CONNECTED IN SERIES WITH THE P1-10 TO P1-11 JUMPER WHEN INSTALLED IN A 28 V SYSTEM.



(3) WIRES CARRYING +13.75/+27.5 V DC INCLUDING POWER GROUND MUST BE 20 AWG OR LARGER, ALL OTHERS MUST BE 24 AWG OR LARGER.

(4) P1-7 AND P1-8 ARE NOT USED (NO INTERNAL CONNECTION) IN THE VHF-251 ( ). FOR 13.75 V LIGHTING GROUND P1-7 AND CONNECT P1-8 TO LIGHTING BUS. FOR 27.5 V LIGHTING CONNECT P1-7 TO LIGHTING BUS AND LEAVE P1-8 OPEN.

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TP4-2432-013

VHF-250/250S/250E, Interconnect Wiring Diagram
Figure 2-8

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Collins VHF-250/250S/250E Communications Transceiver

operation

Collins General Aviation Division

Printed in USA

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2nd Edition, 1 November 1978

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NOTICE: This section replaces first edition dated 1 November 1976.

List of Effective Pages

*The asterisk indicates pages changed, added, or deleted by the current change.

Page No	Issue
*Title	1 Nov 78
*List of Effective Pages	1 Nov 78
*3-1 thru 3-2	1 Nov 78
*3-3 Added	1 Nov 78
*3-4 Blank Added	1 Nov 78

Record of Revisions

RETAIN THIS RECORD IN THE FRONT OF MANUAL.
ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS.

REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	1 Nov 76		None				
2nd Ed	1 Nov 78		SB 1, 2, 3 SIL 1-77, 2-77				

section III
operation

3.1 GENERAL

The purpose of this section is to acquaint the reader with the operation of VHF-250/250S/250E Communications Transceivers. A description of displays and control functions is presented. Figure 3-1 illustrates the controls and indicators discussed in this section. Table 3-1 briefly discusses the function of each listed item.

3.2 DISPLAYS AND CONTROLS

3.2.1 VOL/PWR/TST Control

The VOL/PWR/TST control performs three separate functions: unit on/off, volume control, and squelch testing. When the control is in the fully counterclockwise position, no power is applied to the unit; turning the control clockwise applies power to the unit. Continued clockwise rotation increases the audio output level. To test squelch, simply pull the control out. In this position, noise which is normally squelched off will be heard in the aircraft audio system. For normal operation, push the control in.

3.2.2 Frequency Selector Controls

The two concentric knobs located right of center are used to select communications frequencies. The smaller knob selects kilohertz frequencies; the larger knob selects megahertz frequencies. Selected frequencies are displayed in the lighted window located above the VOL/PWR/TST knob.

3.3 OPERATING PROCEDURES

Warning

The potential exists for a significant reduction in, or the complete cancellation of, the received audio output signal of two vhf communications transceivers (regardless of manufacturer) in the same aircraft if all of the following conditions exist:

a. Two transceivers are tuned to ground stations that simultaneously transmit the same message.

Note

Ordinarily this occurs when both transceivers are tuned to the same frequency. However, it can also occur when more than one ground station transmitter is used to transmit a single voice message.

b. Audio outputs are adjusted to approximately the same level.

c. The audio output phase shifts of the two communications systems (including the audio panel) are approximately 180 degrees apart.

If the phase shift through both transceivers is the same (in phase) and the audio panel does not introduce phase differentials, no attenuation or cancellation of the received signal will occur.

All users of vhf communications transceivers should be aware of this potential situation and take the following precautions to prevent this problem from occurring:

a. Make a habit of avoiding simultaneous tuning of two transceivers to the same frequency or to two frequencies that carry the same voice message.

b. Test the transceiver and audio panel as described in the following procedures to determine whether or not the problem of incompatible phasing exists.

After installation of the equipment in the aircraft, perform a system check to ensure that cancellation or attenuation is not a problem.

a. Tune both transceivers to the same frequency. (In aircraft with three transceivers, each combination of two units must be tested.)

b. Set the audio panel so that both transceiver outputs are heard through the same speaker or headset.
c. Set one transceiver volume control to its midpoint (approximately).
d. Slowly adjust the other transceiver volume control through its midpoint position and listen for a reduction in the level of the combined audio output.

If the transceiver phase shifts are incompatible, the audio signal will be completely cancelled or appreciably reduced as the audio output level of the two transceivers approach equality. If the transceiver phase shifts are compatible, the audio output will be at least as loud as that of a single unit. The preceding test should be performed after any change of vhf communications transceiver or audio equipment.

If the attenuation/cancellation problem is detected in an installation consisting solely of Micro Line equipment, remove each transceiver and check the wiring of transformers A1T1 and A1T2. This problem indicates that a serious error in wiring has been made on one of these two components. A quick check that ensures proper wiring is to compare the transceiver audio output (headphone or speaker) with the rf envelope. If the transceiver is operating properly, the audio output will be in phase with the positive portion of the rf envelope; if this relationship does not exist, a wiring problem is present.

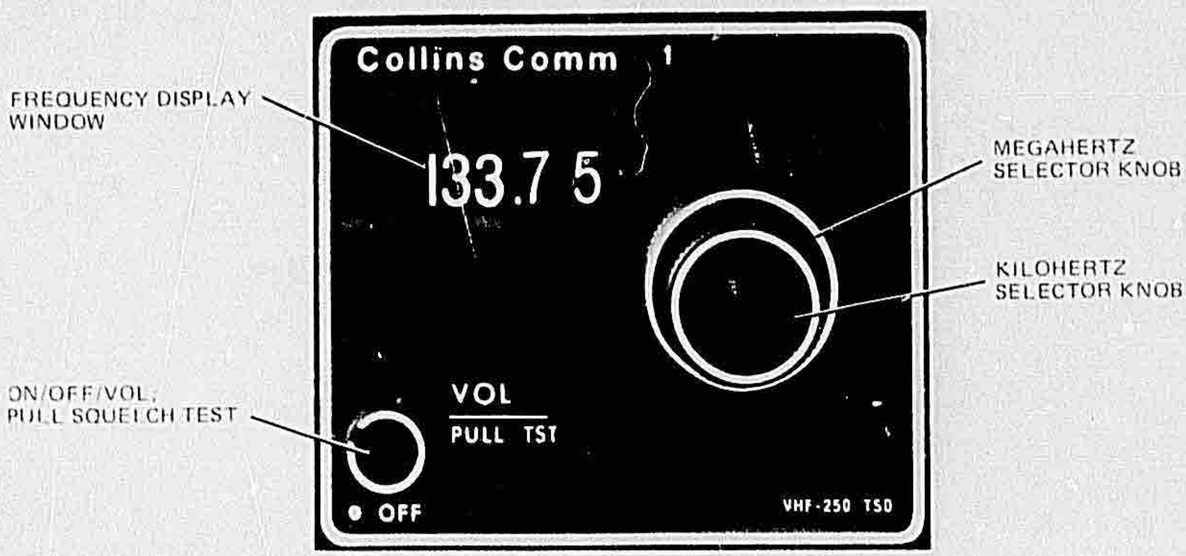
Normally this problem is extremely rare in a pure Micro Line system; however, extra attention should be given in a mixed system checkout. Keep in mind that any equipment (audio panel, line buffers, another vhf COMM transceiver, or auxiliary amplifiers) interfacing with the transceiver may influence the audio output phase and contribute to attenuation/cancellation.

The VHF-250/250S/250E is designed to provide maximum ease of operation. All operating controls are human engineered for maximum visibility and ease of use.

The VHF-250 and VHF-250E provide the pilot with 2-way communications in the vhf range of 118.000 to 135.975 MHz; 25-kHz channel spacing allows operation on 720 different frequencies. The frequency-readout display of the VHF-250/250E is five digits. The sixth digit, which is always a 0 or a 5, is redundant information not displayed on the frequency readout. The VHF-250S also provides 2-way AM vhf communication; however, the frequency range in 50-kHz increments is from 118.00 to 135.95 MHz.

To apply power to the VHF-250/250S/250E, turn the VOL/PWR/TST control clockwise. Set the unit to the desired frequency using the frequency selector controls. Pull the TST control out and adjust the volume using the available noise. Return the TST control to the operating position after volume has been adjusted.

The VHF-250/250S/250E contains sidetone audio circuitry that is used for monitoring voice transmissions. Sidetone is an audio output that corresponds with the voice transmission. This allows the pilot to check modulation level and clarity when using earphones.



VHF-250/250S/250E Communications Transceiver, Controls and Indicators
Figure 3-1

Table 3-1. VHF-250/250S/250E Communications Transceiver, Controls and Indicators.

CONTROL OR INDICATOR	FUNCTION
Frequency display	Provides a lighted digital display of the operating frequency.
VOL/PWR/TST control	Controls the application of power to the unit, varies the audio gain, and tests the squelch circuitry.
Megahertz frequency select control	Changes the frequency of operation in 1-MHz steps.
Kilohertz frequency select control	Changes the frequency of operation in 25-kHz steps (50-kHz steps in VHF-250S).

Collins VHF-250/250S/250E Communications Transceiver

Rockwell International

theory

Collins General Aviation Division

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theory

VHF-250/250S/250E

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section IV
theory

4.1 GENERAL

The theory of operation is divided into two main sections, a functional block diagram discussion and a detailed theory discussion supplemented with simplified schematics and detailed block diagrams. This section supplies all the information required for a thorough understanding of circuit operation with emphasis placed on new and unique circuits used throughout the transceiver.

4.2 FUNCTIONAL THEORY OF OPERATION (Refer to figure 4-1.)

4.2.1 Comm Control Head

The comm control head consists of all transceiver front panel controls including power on/off, volume control, squelch test, and frequency selection controls.

The frequency selection controls consist of three wafer switches mechanically coupled to a pair of concentric control knobs located on the transceiver front panel. A binary coded decimal (bcd) format is generated by these switches and applied directly to the synthesizer variable ratio divider circuitry.

4.2.2 Frequency Synthesizer

The synthesizer is a single-loop digital frequency synthesizer which phase-locks a voltage-controlled oscillator (vco) operating over the range of 118.000 to 146.475 MHz (118.000 to 146.45 MHz in the VHF-250S) to a single 4.0-MHz crystal oscillator that determines the overall frequency stability of the synthesizer. The synthesizer provides a 128.500- to 146.475-MHz injection signal (128.50 to 146.45 MHz in the VHF-250S) to the receiver mixer section and a 118.000- to 135.975-MHz drive (118.00 to 135.95 MHz in the VHF-250S) to the transmitter rf circuitry in 25-kHz increments (50-kHz increments in the VHF-250S). Separate rf outputs are provided for transmit and receive. The vco tuning voltage within the synthesizer is also used to tune the receiver rf tank circuit varactors after decoupling and filtering of that voltage.

4.2.3 Comm Receiver

The comm receiver is a single-conversion superheterodyne type with an if frequency of 10.5 MHz. Rf selectivity is determined by a pair of 2-pole varactor tuned filters to provide the required image and if rejection. The rf amplifier and mixer are dual gate MOSFET's that provide excellent front-end linearity and noise figure. Primary selectivity is determined by a 10.5-MHz crystal filter.

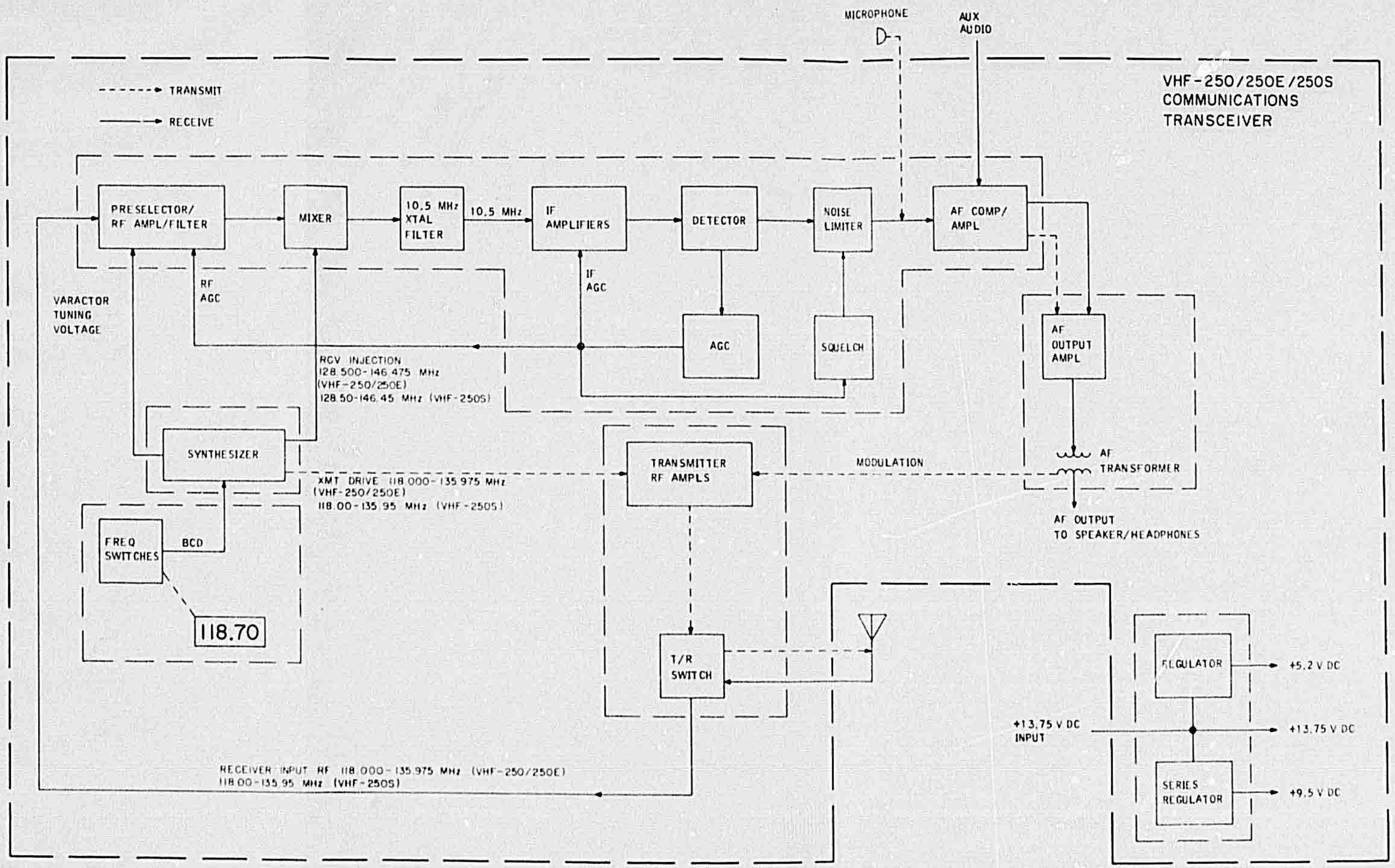
Both the VHF-250 and the VHF-250E utilize 25-kHz channel spacing for use in the present 50-kHz and future 25-kHz environment. The VHF-250E includes an active audio filter to eliminate the heterodyne whistles associated with offset carriers used in Europe.

The VHF-250S contains 50-kHz channel spacing and a crystal filter with a wider passband and is designed for operation in South America and other areas where the frequency tolerances associated with 50-kHz channel spacing are found.

Following the crystal filter are two stages of if amplification with AGC applied to each stage. Squelch is fully automatic with testing provided by a front-panel control switch. Carriers above a preset level trigger the squelch. A noise limiter with a 90-percent modulation clipping level provides suppression of pulse type interference. An audio compressor common to both transmit and receive modes eliminates loudness variations due to varying modulation depths of received signals and maintains constant transmitter modulation depth despite variations between microphones and communication techniques.

4.2.4 Power Amplifier

The power amplifier uses the 118.000- to 135.975-MHz output of the frequency synthesizer (118.000 to 135.95 MHz in the VHF-250S) to drive a four-stage rf section. Nominal carrier output of the power amplifier is 10 watts into a 50-ohm load. The output of the power amplifier is fed through a 5-pole, low-pass filter to



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VHF-250/250S/250E Communications Transceiver,
Basic Block Diagram
Figure 4-1

provide harmonic rejection in excess of 60 dB. Modulation is applied to the driver and power amplifier. Positive modulation peaks applied to the driver stage improve the upward modulation characteristics of the transmitter. Downward modulation is limited to 90 percent by a diode-resistor network which guarantees that splatter cannot occur due to downward overmodulation.

The antenna transmit-receive (tr) switch is a single diode which disconnects the receiver when a transmission occurs.

4.2.5 Power Distribution

Two power supplies are used in the VHF-250/250S/250E. The main supply is a series regulator that is supplied +13.75 V dc input power. A +9.5-V dc regulated output is produced; this regulated and filtered output is used in all low-level signal circuitry and for rf sections in the synthesizer.

A separate +5.0-volt series regulator supplies power to the frequency synthesizer dividers.

4.3 DETAILED THEORY OF OPERATION

The following discussion of the detailed theory of operation is supplemented with simplified schematics and detailed block diagrams that are correlated to the overall block diagram, figure 4-2, by component reference designators and by reference to the designator of the circuit card assembly.

4.3.1 Comm Control (Refer to figure 6-1.)

The comm control consists of a megahertz frequency select switch, a kilohertz frequency select switch, a unit on/off switch, a volume control, and a squelch test switch.

4.3.1.1 Frequency Selection and Squelch Test Control

Frequency selection switches are a rotary wafer type that supply a bcd format to the synthesizer variable ratio divider for processing. Table 4-1 provides the control logic truth table.

The OFF/PWR/TST control functions are combined in a single assembly that controls audio gain, application of unit power, and a self-test for squelch operation. Pulling the control outward disables the automatic squelch circuit gating noise or weak signals into the audio system; pushing the knob in enables the squelch, resulting in suppression of noise.

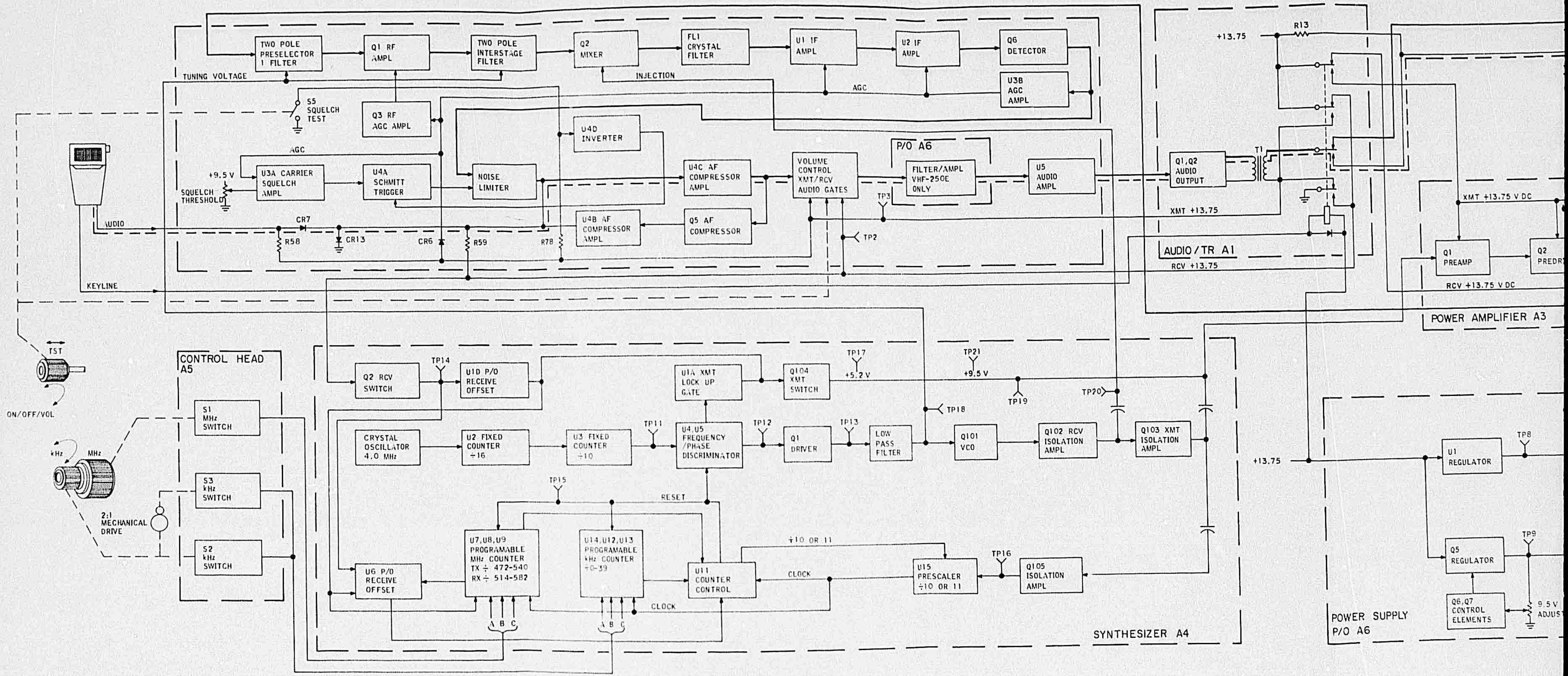
4.3.2 Frequency Synthesizer

The frequency synthesizer supplies excitation for the transmitter and local oscillator injection for the receiver mixer. The synthesizer output covers the frequency range of 118.000 to 146.475 MHz in 25-kHz increments in the VHF-250/250E and 118.000 to 146.45 MHz in 50-kHz increments in the VHF-250S. These frequencies provide the proper excitation and injection frequencies for transceiver operation from 118.000 to 135.975 MHz in the VHF-250/250E and from 118.000 to 135.95 MHz in the VHF-250S. The synthesizer output frequency is selected by parallel 8-4-2-1 bcd information from the control head frequency selector switches. Frequency stability is determined by a single crystal-controlled oscillator operating at 4.0 MHz.

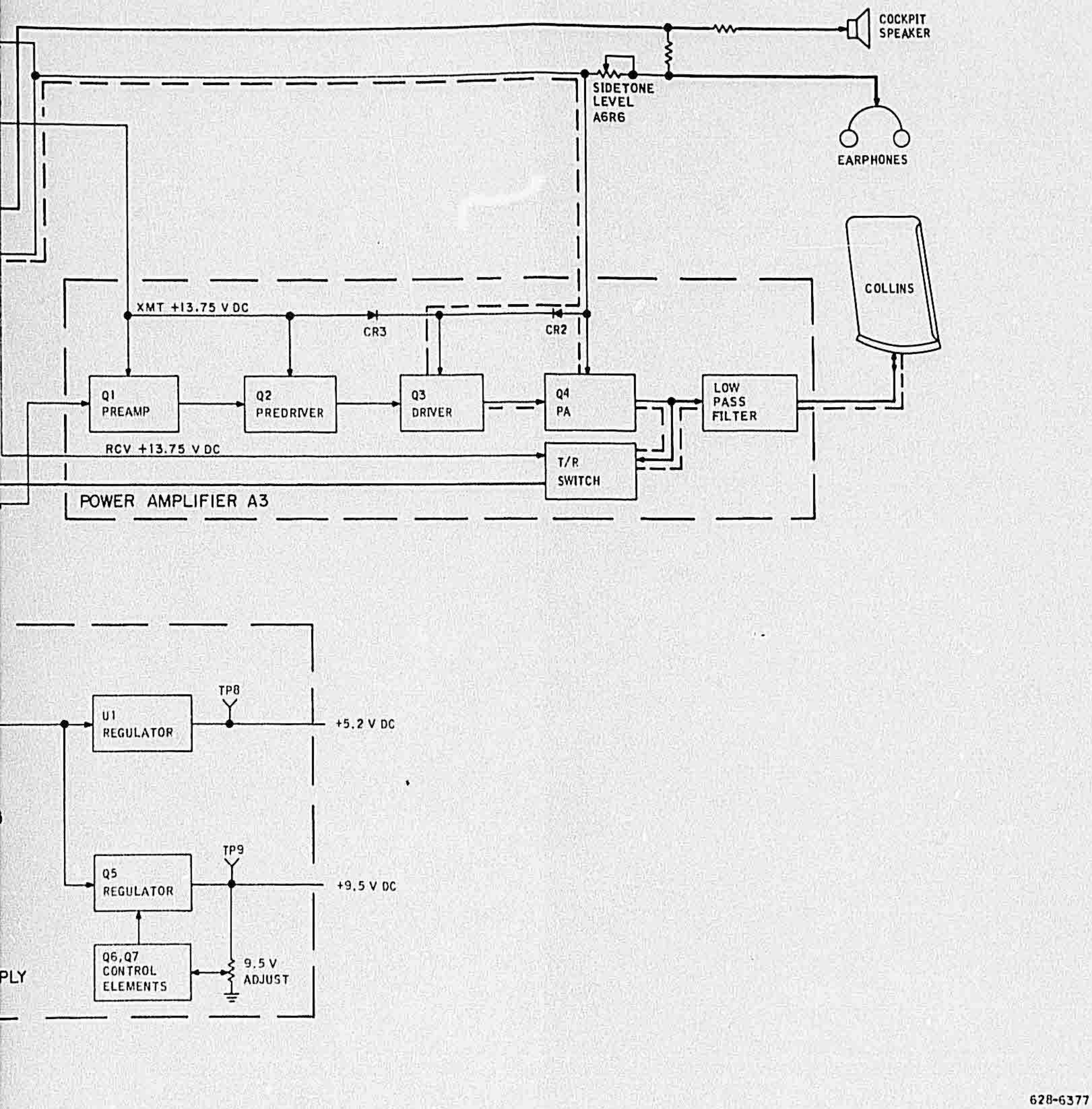
Synthesizer circuitry in the VHF-250, VHF-250S, and VHF-250E is identical even though the VHF-250S employs 50-kHz channel spacing as opposed to 25-kHz spacing in the VHF-250 and VHF-250S. The 50-kHz spacing in the VHF-250S is achieved by modifying the switching sequence of the 20-position rotary switch assembly. This modification permanently grounds the least significant bit applied to the variable ratio divider, resulting in the desired channel spacing. Since the basic synthesizer operation is the same for all units, the VHF-250 and VHF-250E, utilizing the 25-kHz channel spacing, will be discussed in the following paragraphs.

4.3.2.1 Phase-Locked Loop Fundamentals (Refer to figure 4-3.)

Basically, a digitally stabilized master oscillator loop consists of a voltage-controlled oscillator, a variable ratio digital divider, a frequency reference operating at the desired channel spacing, a phase detector, and a low-pass filter. The vco signal is applied to the variable ratio divider where the frequency is divided by the ratio, N. The divider output is one pulse for every N cycles at the input. The divider output is applied to the digital phase detector where it is compared with the reference frequency, f_r. The phase detector error signal is low-pass filtered to produce a dc voltage that controls the vco frequency. The low-pass filter provides high attenuation to harmonics of f_r while allowing the low-frequency correction components to hold the vco on the desired frequency. Thus, the frequency of the vco when phase-locked will always be equal to Nf . Therefore, since the dividing ratio, N, is variable in integral steps, the vco frequency is variable in integral multiples of f_r.



SEE BLOW-UP FICHE NO. CLQ302 - ITEM A



VHF-250/250S/250E Communications Transceiver, Functional Block Diagram
Figure 4-2

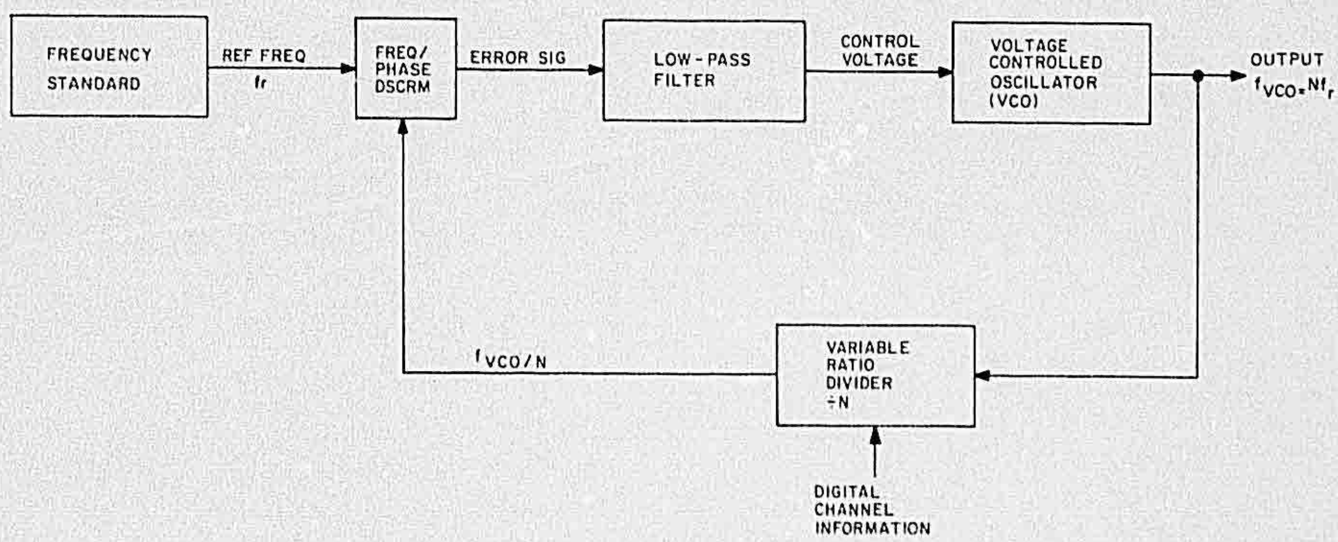
SEE BLOW-UP FICHE NO. CLQ302 - ITEM B

Table 4-1. Control Head Binary Code Format.

FREQUENCY	BINARY CODE 8	4	2	1
	10 MHz			
11X.XXX	X	X	0	1
12X.XXX	X	X	1	0
13X.XXX	X	X	1	1
	1 MHz			
1.XXX	0	0	0	1
2.XXX	0	0	1	0
3.XXX	0	0	1	1
4.XXX	0	1	0	0
5.XXX	0	1	0	1
6.XXX	0	1	1	0
7.XXX	0	1	1	1
8.XXX	1	0	0	0
9.XXX	1	0	0	1
0.XXX	0	0	0	0

FREQUENCY	BINARY CODE 8	4	2	1
	0.1 MHz			
.0XX	0	0	0	0
.1XX	0	0	0	1
.2XX	0	0	1	0
.3XX	0	0	1	1
.4XX	0	1	0	0
.5XX	0	1	0	1
.6XX	0	1	1	0
.7XX	0	1	1	1
.8XX	1	0	0	0
.9XX	1	0	0	1
	25 kHz			
.X00	X	X	0	0
*.X25	X	X	0	1
.X50	X	X	1	0
*.X75	X	X	1	1

*Not used in VHF-250S.



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Digitally Stabilized Loop Master Oscillator, Block Diagram
Figure 4-3

4.3.2.2 Variable Ratio Divider (Refer to figure 4-5.)

A portion of the vco signal is applied to isolation amplifier Q105. The isolation amplifier provides the clock pulse that is applied to the variable ratio divider, where it is divided down to approximately 25 kHz for comparison with the 25-kHz reference frequency. The variable ratio divider must therefore have a division ratio that varies from 4720 to 5859 to accommodate the 1139 25-kHz segments of the 118.000- to 146.475-MHz output signal.

The variable ratio divider, or feedback counter, is digital in form and is controlled directly by parallel 8-4-2-1 bcd information supplied by the comm control.

a. Megahertz Tuning

The logic level at counter control U11 F_{out} terminal is determined by the state of the programmable megahertz counter. Bcd supplied to the MHz counter as a function of the selected frequency determines the initial state of the counter. The programmable counter performs any number of counts from 472 through 582.

The megahertz counter, once programmed, will begin counting down toward a predetermined terminal state that is detected by the zero state detection circuitry of counter control U11. Terminal state recognition results in a negative-going pulse at the counter control F_{out} pin. The signal at F_{out} therefore will be a chain of negative-going pulses with a frequency equal to the clock frequency divided by the count ratio programmed into the megahertz counter. The signal at F_{out} is the loop feedback frequency which will be 25 kHz when the loop is phase-locked.

The programmable megahertz counter is reset by the negative pulse appearing at the counter control F_{out} terminal.

b. Kilohertz Tuning

The programmable kilohertz counter, counter control U11 zero detection circuitry, and prescaler U15 are required to control the kilohertz portion of the vco frequency. The programmable kilohertz counter processes any number of counts from 0 through 39 as determined by the bcd input from the comm control.

Prescaler U15 will divide by either 10 or 11 as dictated by counter control U11 modulus enable output at E_0. The state of the enable output is determined by the state of the kilohertz counter. The initial state of the kilohertz counter is controlled by the selected frequency. Counter state will be decreased by one for each clock pulse received from prescaler U11.

As the kilohertz counter continues counting down, a terminal state will be reached which is recognized by a zero detection circuit contained within counter control U11. Prior to terminal state recognition, the E_0 output of counter control U11 will be low (logic 0) which programs the prescaler for division by 11. When the zero state is reached, the E_0 output goes high (logic 1) and the prescaler will divide by 10. The programmable kHz counter will continue to count through the zero state; however, the modulus enable output detects only the first zero state encountered. The prescaler therefore divides by 11 for a number of clock pulses determined by the initial state of the kilohertz counter, then divides by 10 until a negative pulse from U11 F_{out} resets the counter, sets the modulus enable line low, and restarts the cycle.

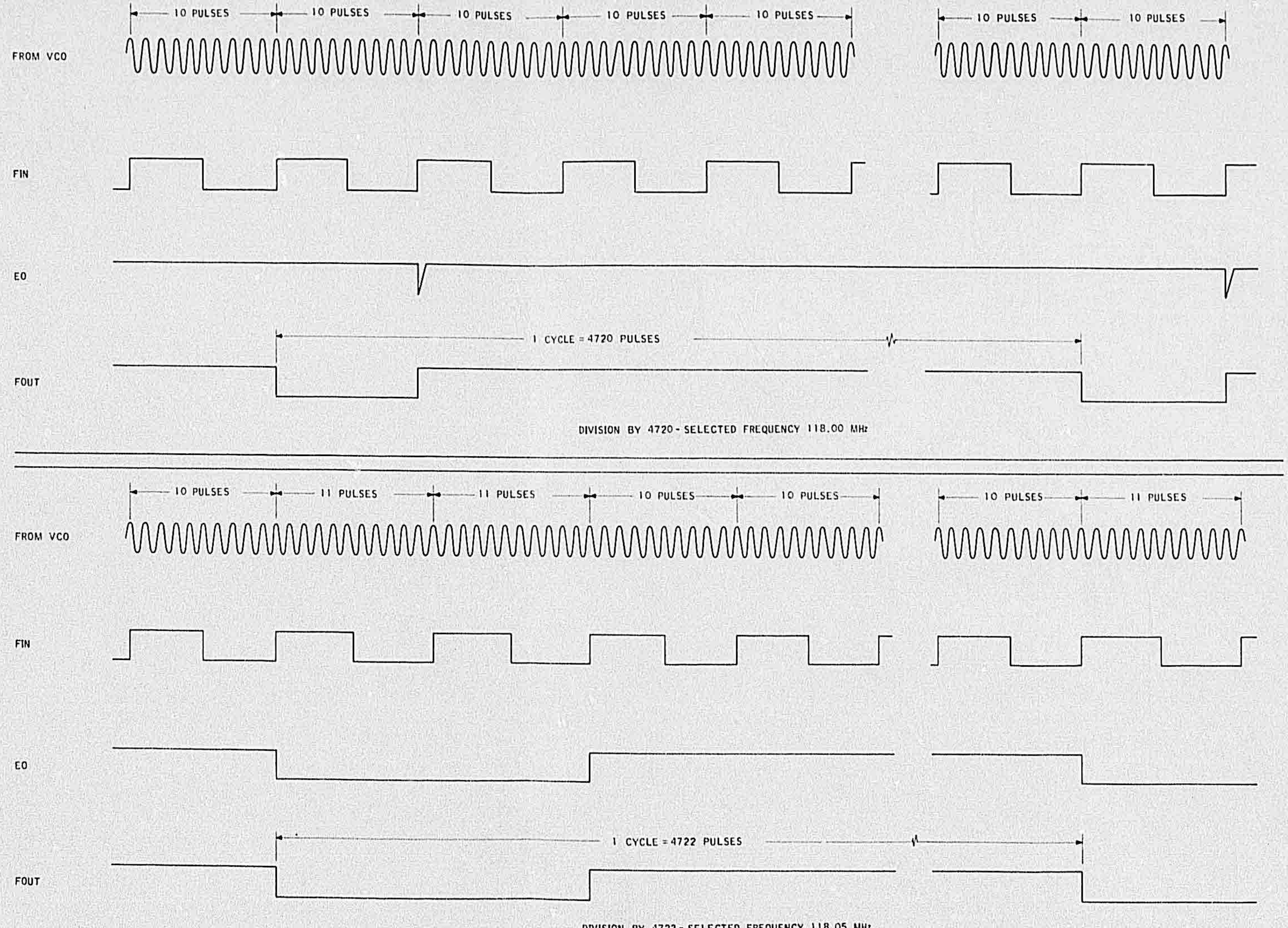
For each 11 count in the prescaler, the overall divider ratio is increased by one, increasing the vco frequency by 25 kHz. In this manner the forty 25-kHz increments within each megahertz are selected.

4.3.2.3 Transmit-Receive Division Ratios (Refer to figure 4-4 and table 4-2.)

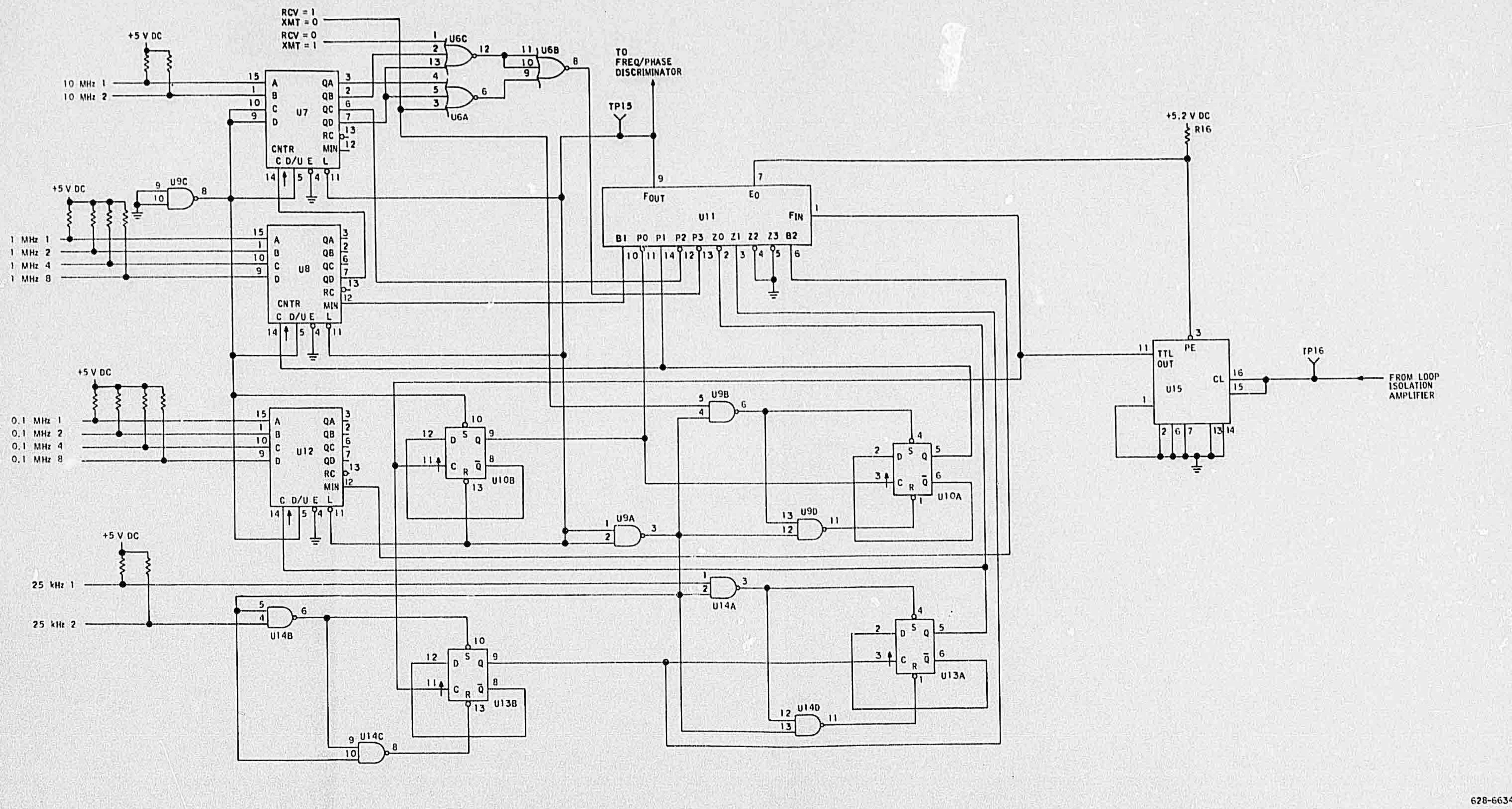
Figure 4-4 and table 4-2 illustrate several examples of the counting sequence occurring within the variable ratio divider for selected frequencies. The frequencies selected for this example are 118.000 and 118.050 MHz.

When the selected frequency is 118.000 MHz, the vco will operate at 118.000 MHz in the transmit mode and at 128.500 in the receive mode.

In the transmit mode at 118.000 MHz, the programmable megahertz counter count will be 472 and the programmable kilohertz counter count will be zero since there are no kilohertz increments in the selected frequency. This provides an overall divider ratio of 472 x 10, or 4720, which equals the 118.000-MHz vco output frequency divided by 25 kHz.



Counter Control U11, Timing Diagram
Figure 4-4



Variable Ratio Divider, Simplified Schematic Diagram
Figure 4-5

Table 4-2. Sample Division Ratios.

SELECTED FREQUENCY	FVCO		PROGRAMMABLE MHz COUNTER RATIO	PROGRAMMABLE kHz COUNTER RATIO	PRESCALER		DIVIDER RATIO = FVCO / 25 kHz
	XMT	RCV			÷10	÷11	
118.00 MHz	118 MHz		472	0	472		472 x 10 = 4720
		128.5 MHz	514	0	514		514 x 10 = 5140
118.05 MHz	118.05 MHz		472	2	470	2	(472 x 10) + 2 = 4722
		128.55 MHz	514	2	512	2	(514 x 10) + 2 = 5142

The vco frequency will be offset 10.5 MHz above the selected frequency when receiving to provide receiver injection. The programmable megahertz counter ratio is increased to 514 to provide the overall divider ratio of 5140. In the receive mode, therefore, the overall divider ratio is increased by 420 counts, which is the number of 25-kHz increments in the offset frequency of 10.5 MHz.

Changing the selected frequency from 118.000 to 118.050 MHz will not affect the programmable megahertz counter since the whole number portion of the frequency remains the same. The initial state of the programmable kilohertz counter, however, will be changed to reflect the two 25-kHz increments in the new frequency. The overall divider ratio is now 472 x 10 plus the two additional divide-by-11 prescaler counts, or 4722. The receive divider ratio for 118.050 MHz is 4722 plus the 420 offset counts, or 5142.

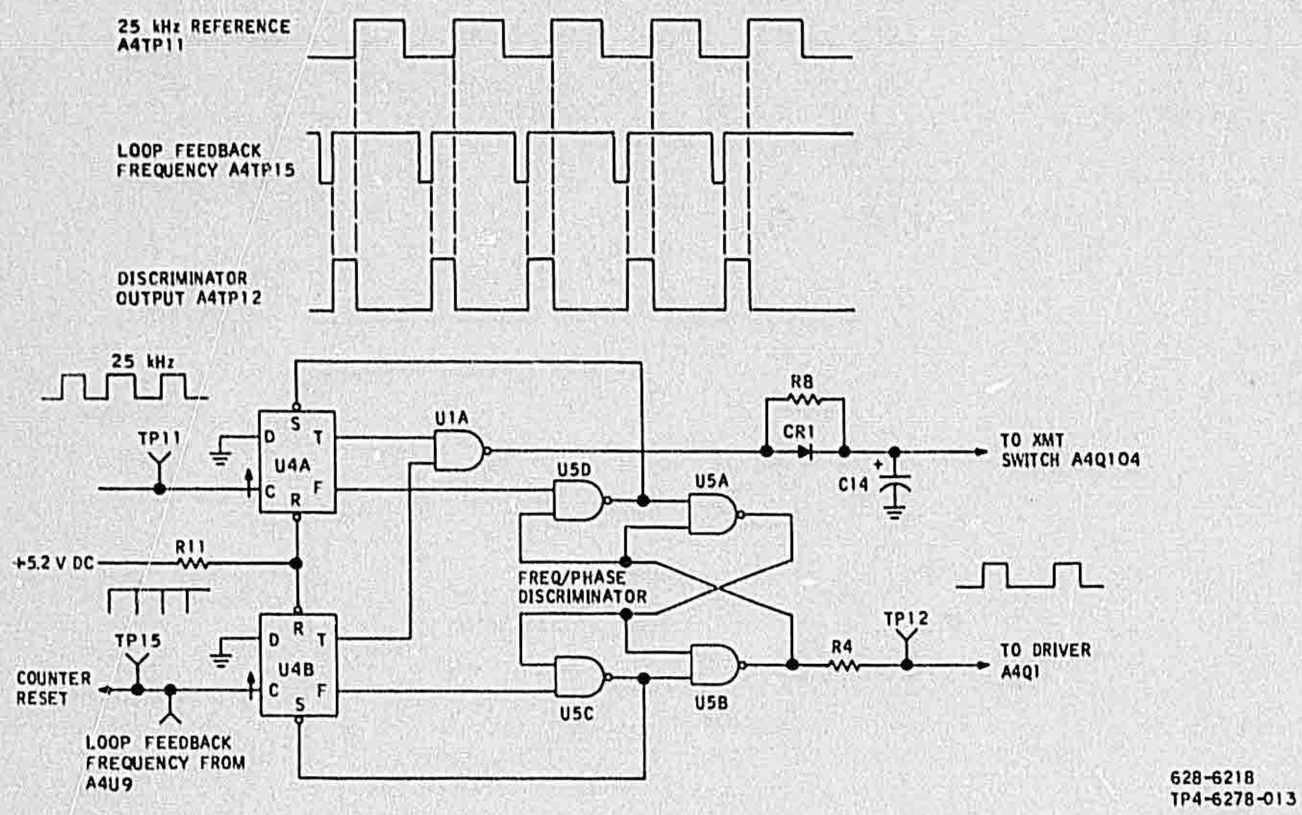
4.3.2.4 Frequency/Phase Discriminator (Refer to figure 4-6.)

The frequency discriminator consists of a dual D flip-flop, A4U4, and a NAND gate pack, A4U5, which is configured as a set-reset flip-flop. The 25-kHz input from the variable ratio divider sets the phase detector high; the 25-kHz input from the fixed divider resets the phase detector output low. Switching occurs on the leading edge of the pulses, resulting in an output with pulse width or duty cycle proportional to the phase difference between the two input pulses. During normal operation, the pulses alternate between the set and reset inputs. When the loop is not phase-locked, such as when changing frequency, the circuit acts as a frequency discriminator and produces a constant dc output level that is either +5 volts or +0.25 volt, depending upon the desired direction of tuning. Changing to a higher frequency increases the divider ratio which decreases the feedback frequency. This causes the discriminator output to latch at a low logic level until the increasing vco output nears the correct frequency and returns the discriminator to the phase mode of operation. Changing to a lower frequency decreases the divider ratio and increases the feedback frequency. The discriminator output now latches at the high level until the decreasing vco output nears the correct frequency and again returns the discriminator to the phase mode of operation. This frequency discrimination prevents the loop from locking in spurious phase modes, and forces the loop capture range to be equal to the holding range.

During normal operation, both U4 T-outputs are predominantly high, thus keeping the output of U1A predominantly low. When the loop is out of lock, one of these T-outputs will go low, causing the output of U1A to go high. The output of U1A is passed by diode CR1 to transmit switch transistor Q104, which disables the transmitter rf drive signal.

4.3.2.5 VCO Tuning (Refer to figure 4-7.)

Driver amplifier Q1 raises and inverts the frequency/phase discriminator output signal level to the level required to tune the vco over the desired range. Before being applied to the vco, the driver output is filtered by a low-pass filter which removes the switching rate components. The resulting dc output signal from the filter is applied to voltage-variable capacitor CR101 which tunes the vco. Filtered dc output is also supplied to the comm receiver to facilitate tuning of the rf selection circuits. The net result of this action is that the phase difference between the



Frequency/Phase Discriminator
Figure 4-6

25-kHz reference and the output of the variable ratio divider controls the vco frequency. As the phase difference increases, the tuning voltage and vco frequency also increase. The condition for phase lock occurs when the phase difference becomes constant at the value necessary to produce a vco frequency that, when divided, produces 25 kHz at the frequency/phase discriminator. The division ratio of the variable ratio divider determines the vco frequency where phase lock occurs. If the division ratio of the variable ratio divider changes or the vco frequency drifts, the phase difference will change, causing the vco frequency to change until the phase-lock condition is again met.

4.3.2.6 Frequency Standard (Refer to figure 4-8.)

A crystal controlled oscillator operating at 4.0 MHz is the source of the 25-kHz reference frequency. The output of the crystal oscillator is fed to a fixed divide-by-16 counter, U2, to produce a 250-kHz output. This signal is then divided by 10 in fixed counter U3. The resulting 25-kHz frequency is used as a reference within the frequency/phase discriminator for comparison with the output of the varable ratio divider.

4.3.2.7 Synthesizer Offset Operation (Refer to figure 4-9.)

From the discussion of the variable ratio divider, recall that an additional 420 counts are added to the overall divider ratio in the receive mode to accommodate the 10.5-MHz increase in vco frequency. The prescaler, contained in the loop feedback circuit, accounts for a factor of 10; however, in addition to this, an additional 42 counts must be added to the megahertz counter to arrive at the required 420-count offset. This additional counting is accomplished by delaying the counter control recognition of the programmable megahertz counter terminal state.

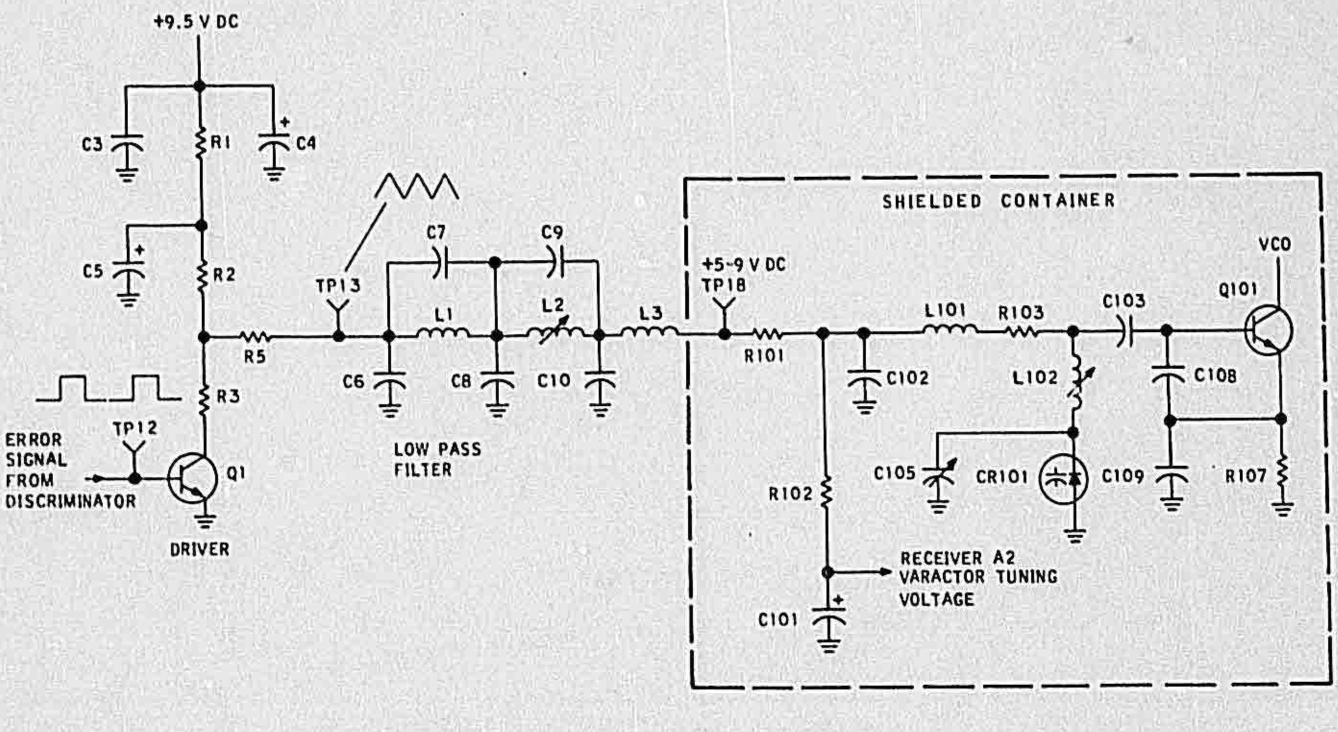
The $\overline{P3}$ input of counter control U11 recognizes the terminal state change supplied by NOR gate U6B. Logic supplied by relay A1K1 dictates the mode of operation. This logic combined with outputs from megahertz counter U7 and NOR gates U6A, B, and C control terminal state recognition of the counter control.

4.3.2.7.1 Receive Mode

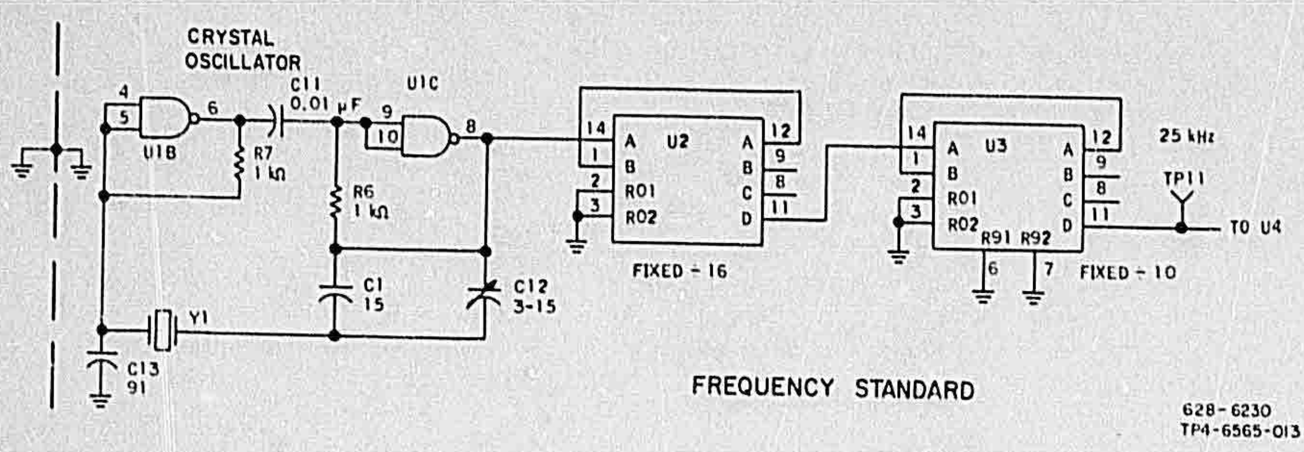
When the VHF-250 is in receive mode, +13.75 V dc is applied to the base of receive switch transistor Q2, causing it to become saturated. With transistor Q2 conducting, the pullup voltage applied to resistor R9 will be reduced, resulting in a logic 0 at the input of NAND gate U1D, which performs an inverting function, and NOR gate U6C. The inverted output of NAND gate U1D, logic 1, is applied to XMT NOR gate U6A and NAND gate U9B. The logic 1 present at pin 3 of XMT NOR gate U6A renders it insensitive to the state changes occurring at the output of the megahertz counter. RCV NOR gate U6C, however, will remain sensitive to the megahertz counter and will change states when each of its inputs is logic 0. When this condition exists, the NOR gate U6B output will change from high to low, signaling that the counter control $\overline{P3}$ detector terminal one counting sequence has been completed. The combination of inputs to RCV NOR gate U6C from the megahertz counter requires an additional 42 counts for the counter control to recognize the terminal state logic.

Local oscillator leakage in the receive mode is eliminated by grounding the pa rf drive line. NAND gate U1D saturates transistor Q104, grounding the drive signal.

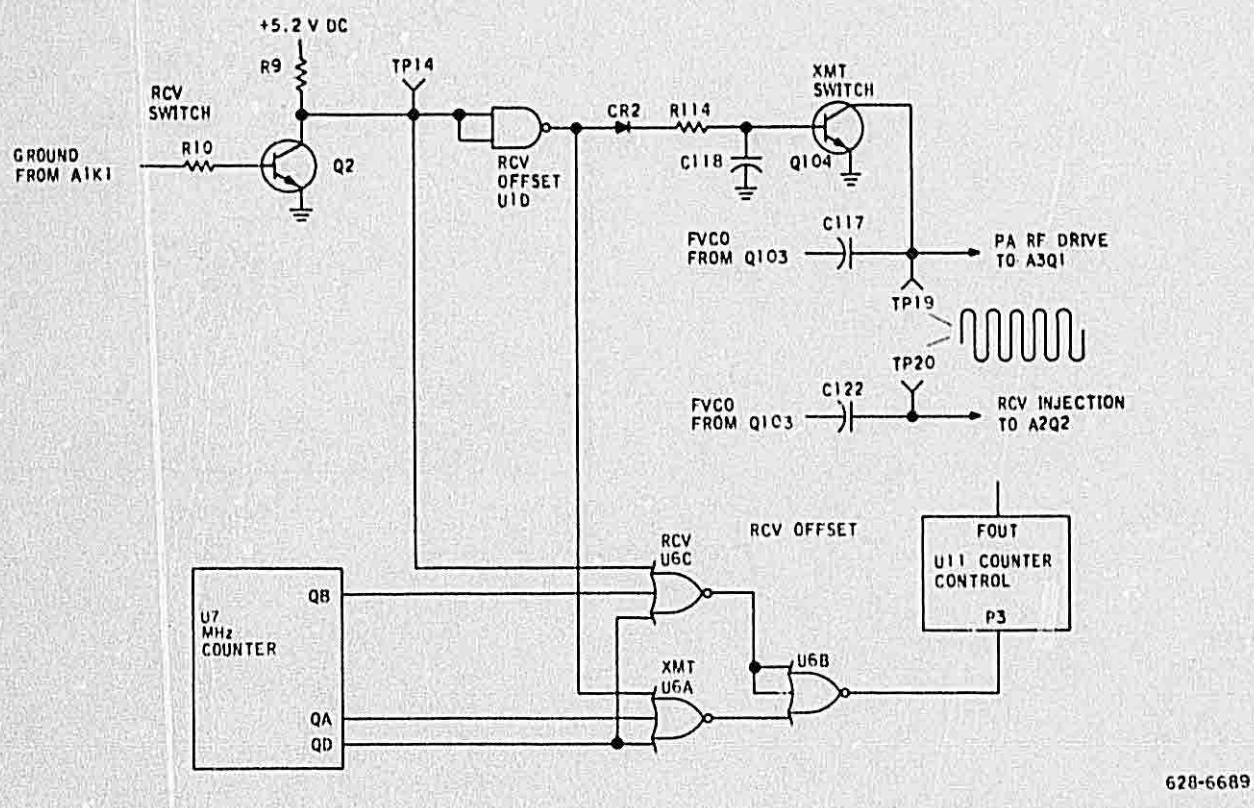
When operating in the offset receive mode, the vco frequency will be 10.5 MHz above the selected frequency, and receiver injection will range from 128.5 through 146.475 MHz.



VCO Tuning
Figure 4-7



Frequency Standard
Figure 4-8



Synthesizer Offset
Figure 4-9

4.3.2.7.2 Transmit Offset Mode

In transmit mode, the base of transistor Q2 is held at ground by transmit-receive relay A1K1. Application of a ground at the base of transistor Q2 causes it to cut off; this applies a logic 1 to the input of NAND gate U1D and RCV NOR gate U6C. The low output of NAND gate U1D is applied to XMT NOR gate U6A and NAND gate U9B. With these conditions existing, RCV NOR gate U6C will not be sensitive to megahertz counter U7 state changes; however XMT NOR gate U6A will. When the megahertz counter reaches its terminal state, the XMT NOR gate U6A output will go high, causing the RCV NOR gate U6B output to go low. Counter control U11 recognizes this negative-going transition as the end of a counting sequence. Recognition results in a negative-going output at F_{out} and resetting the programmable counter.

The low output from NAND gate U1D cuts off transmit switch transistor Q104. In this state the vco pa rf drive frequency of 118 through 135.975 MHz is allowed to pass.

The vco frequency is also fed to the receiver mixer; however, since the receiver is turned off in the transmit mode, no side effects of this action are encountered.

4.3.3 Receive Mode

Basically the mode of transceiver operation centers around relay A1K1. The switching characteristics of A1K1 control synthesizer operation, power amplifier operation, tr diode biasing, and receiver operation. In the receive mode A1K1 performs the following functions: application of +13.75 V dc to the base of transistor A4Q2 to control the synthesizer offset circuit; forward biasing of tr diode A3CR1, thereby allowing received rf to be applied to the preselector; and direct control of the transceiver audio and receiver circuits, making them operational in the receive mode.

4.3.3.1 TR Switch Receive Mode Operation (Refer to figure 4-10.)

The primary function of the tr switch is to isolate the receiver from the transmitter. In the VHF-250/250S/250E, this is accomplished by the use of a switching diode biased by current switched by relay A1K1. In the receive mode, relay A1K1 activates the RCV +13.75-V dc lines.

The +13.75 V dc supplied by relay A1K1 forward biases diodes A3CR1 and A3CR5. Forward biasing A3CR5 places the rf drive line to the base of preamplifier A3Q1 at ground and thereby attenuates any possible rf leakage from the synthesizer. Forward biasing tr diode A3CR1 allows the rf present at the antenna to pass through diode A3CR1 into the receiver preselector circuit. When the +13.75-V dc potential is removed in the transmit mode, A3CR1 will not conduct and transmitter rf will be blocked from the preselector.

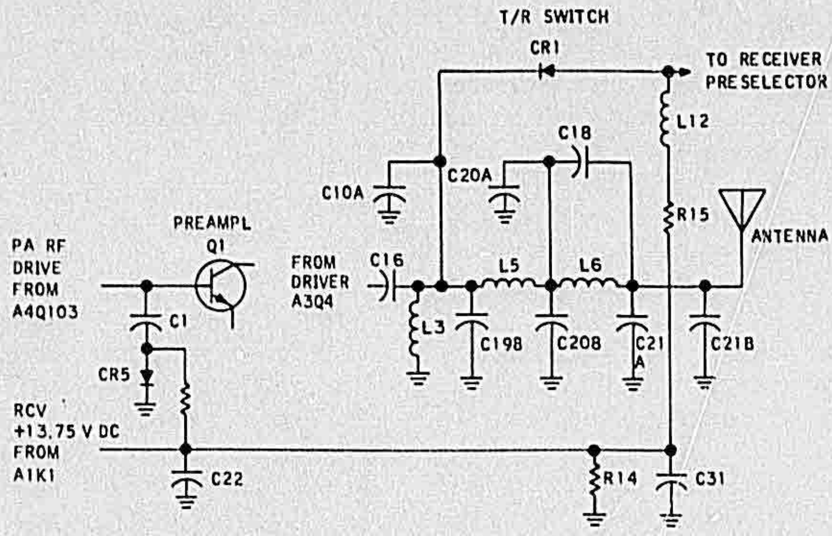
4.3.3.2 Receiver Preselector Operation (Refer to figure 4-11.)

The vhf antenna signal is filtered in a varactor-tuned, 2-pole preselector (a 2-pole filter consisting of high-Q coils tuned by voltage variable capacitance diodes). The preselector circuit selects the desired signal from the spectrum supplied from the antenna to provide an input to the rf amplifier. Positive dc tuning voltage applied to the varactors is supplied by the synthesizer. The junction capacitance of the varactor diodes varies with the bias voltage across it; as the applied voltage increases, the junction capacitance decreases. The graph included in figure 4-11 illustrates the general relationship between the bias voltage and the junction capacitance of the varactors, ranging from approximately 22 pF at +5 V dc to approximately 14 pF at +9 V dc. Specific values will vary slightly between individual radios. Diodes CR8 and CR9 limit the amplitude of the rf signal to ensure that varactor CR1 cannot be pumped into parametric oscillation by strong received signals.

4.3.3.3 RF Amplification (Refer to figure 4-11.)

The output of the 2-pole preselector is then amplified in a dual-gate MOSFET amplifier, Q1, that provides sufficient gain so signal at the mixer can overcome mixer noise. Q1 runs at maximum gain (approximately 20 dB) until the input signal is great enough to produce about a 30-dB signal-to-noise ratio. When this occurs, AGC reduces Q1 gain to prevent large input signals from overloading the if. Characteristically, MOSFET's are voltage-controlled devices that respond to an input voltage rather than to current. The voltage applied to the gate controls the drain-to-source resistance. Therefore, a MOSFET may be considered a voltage-controlled resistor, the range of which varies from a few hundred ohms, when on, to several thousand megohms, when off. An AGC inverter amplifier provides a decreasing bias on the MOSFET control gate with increasing rf input until the control gate is negative with respect to the source.

Following rf amplifier Q1 is another varactor-tuned, 2-pole interstage filter similar to the preselector



TR Switch Operation
Figure 4-10

preceding the rf amplifier. This interstage network further attenuates off-channel signals to minimize spurious responses (especially the image frequency). A total of four resonators before the mixer stage provide a minimum of 60-dB attenuation at the image frequency. Inductive top coupling is employed between resonators of each 2-pole filter.

4.3.3.4 Mixer Operation (Refer to figure 4-11.)

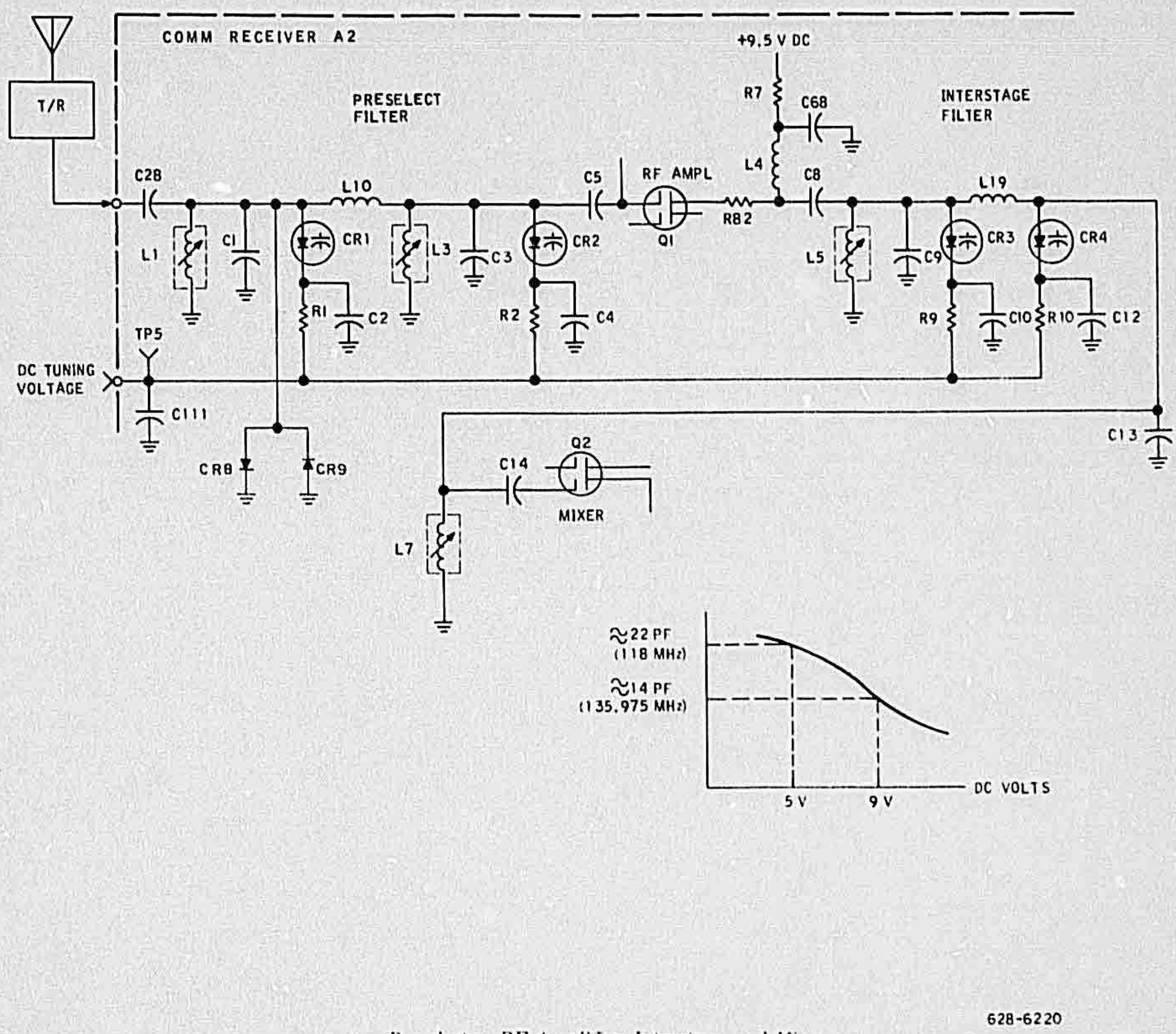
Mixer Q2 combines the rf amplified output of the preselector with the synthesizer injection to produce a 10.5-MHz difference frequency for amplification by the 10.5-MHz if section. High side injection prevents the injection frequencies from falling into the vhf navigation band. The networks on the local oscillator injection gate and on the mixer drain are critical to avoid undesired mixer oscillation or regeneration. Unwanted oscillation may totally block the receiver, while regeneration may degrade audio quality due to excessive passband ripple.

The mixer is a dual-gate MOSFET. The mixing function provided by the MOSFET is unique in that the injection frequency applied to gate number 2 modulates the transfer characteristic of input gate number 3. This action provides high gain at the conversion frequency.

The output of mixer Q2 is LC filtered and applied to crystal filter FL1, which is centered at 10.5 MHz. Receiver selectivity is determined by 8-pole crystal filter FL1. This filter contains four crystal elements that provide extremely sharp band edges for attenuation of adjacent channel signals. The -6-dB points are at least 10 kHz from the nominal channel frequency, and the -60-dB points are no more than 20 kHz from the nominal frequency. The LC matching networks on the input and output of FL1 must be properly tuned to load the filter properly. These matching circuits are tuned for maximum AGC voltage with a signal above noise level applied to the receiver. Improper termination will result in excessive amplitude ripple in the passband.

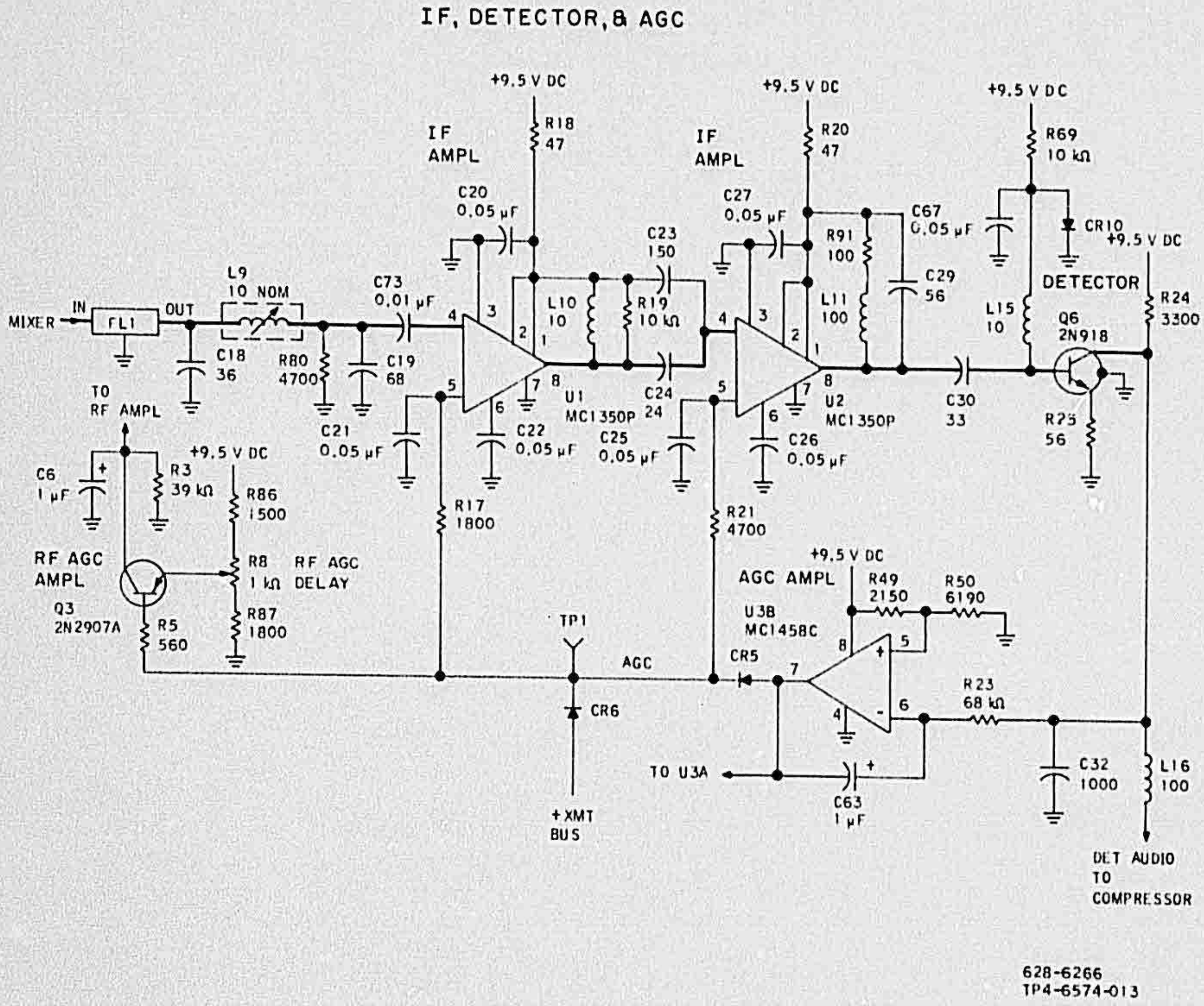
4.3.3.5 10.5-MHz IF and Detector Operation (Refer to figure 4-12.)

After filtering, the 10.5-MHz signal is amplified in two gain-controlled integrated circuits, U1 and U2. Enough gain is obtained in these two stages (U1 and U2 are capable of more than 100 dB of gain) to ensure



Preselector, RF Amplifier, Interstage, and Mixer
Figure 4-11

that the receiver is in AGC on its rf noise. AM detection is accomplished by detector Q6. Dc current through bias diode CR10 sets a voltage roughly equal to the transistor base-emitter drop; this holds Q6 on the verge of conduction. Rf upswings turn the transistor on, and down swings turn it off. Since Q6 conducts for half of each rf cycle, the base-emitter circuit is a half-wave rectifier. Capacitor C32 is incorporated to filter rf current at the collector. The function of Q6, therefore, is to provide gain at the audio frequencies of the modulation envelope. The detected dc voltage, produced by filtering the class B output of Q6, is applied to the inverting input of AGC amplifier U3B. The AGC amplifier output is fed directly to squelch amplifier U3A and through isolation diode CR5 to both if amplifiers and to the base of rf AGC amplifier Q3. Rf AGC delay potentiometer R8 sets the bias on the rf AGC amplifier that must be overcome by the AGC voltage for the control voltage to reach the rf amplifier. Diode CR26 provides the thermal stability required to compensate for Q3 gain changes over temperature. AGC, therefore, will not reduce the gain of the rf amplifier until the incoming signal strength exceeds a predetermined value. As mentioned briefly, AGC circuits are basically a feedback control system that tries to hold the average voltage at the detector collector equal to the reference voltage established by R49 and R50. When the receiver is operating properly, front-end noise amplified in the if will be enough to lower detector collector average voltage below reference so that AGC gain reduction will occur with no input signal. Potentiometer R8 is adjusted to set the collector of delay transistor Q3 at 5.0 V with a 3-μV signal applied; this sets the rf amplifier stage for



10.5-MHz IF and Detector
Figure 4-12

maximum gain. As signal strength increases, AGC voltage increases and the collector voltage decreases. The gain of Q1 will not diminish until the collector of Q3 drops to about 3 V. This delayed AGC action keeps the gain of the rf amplifier high until the signal is strong enough to guarantee a good signal-to-noise ration. At very high signal levels, the gain of Q1 is reduced approximately 30 dB to avoid overloading the if amplifier.

Diode CR6, whose anode is connected to the +XMT bus, provides receiver muting in the transmit mode.

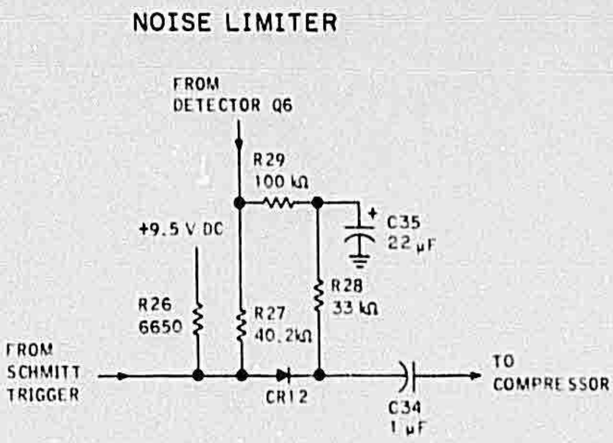
Grounding the key line input line actuates relay A1K1, causing application of the +13.75 V dc on the +XMT bus. This forward biases diode CR6 which, in turn, increases the voltage on the AGC line and cuts off the rf amplifier and both if amplifiers.

4.3.3.6 Audio Circuit Operation

The output circuits consist of a noise limiter, an audio compressor, an IC driver amplifier, and a class B output stage.

4.3.3.6.1 Noise Limiter (Refer to figure 4-13.)

Diode CR12 performs the dual function of series noise limiter and squelch gate. As a noise limiter, the detected carrier from transistor Q6 forward biases



Noise Limiter/Squelch Gate
Figure 4-13

CR12 which conducts the detected audio through CR12 and C34 to the audio compressor input. The forward bias of CR12 is controlled by the detected carrier level and is proportioned by R28 and R29 in a manner that permits negative noise peaks from the detector to back-bias CR12 when the modulation of the receiver signal exceeds 90 percent. This action effectively clips negative impulse noise at the 90-percent modulation level. Clipping of the positive impulse noise peaks occurs at the detector which saturates at a level higher than 90-percent modulation.

The squelch gate action of CR12 occurs when Schmitt trigger U4A conducts and removes the forward bias from CR12, blocking the audio path to C34.

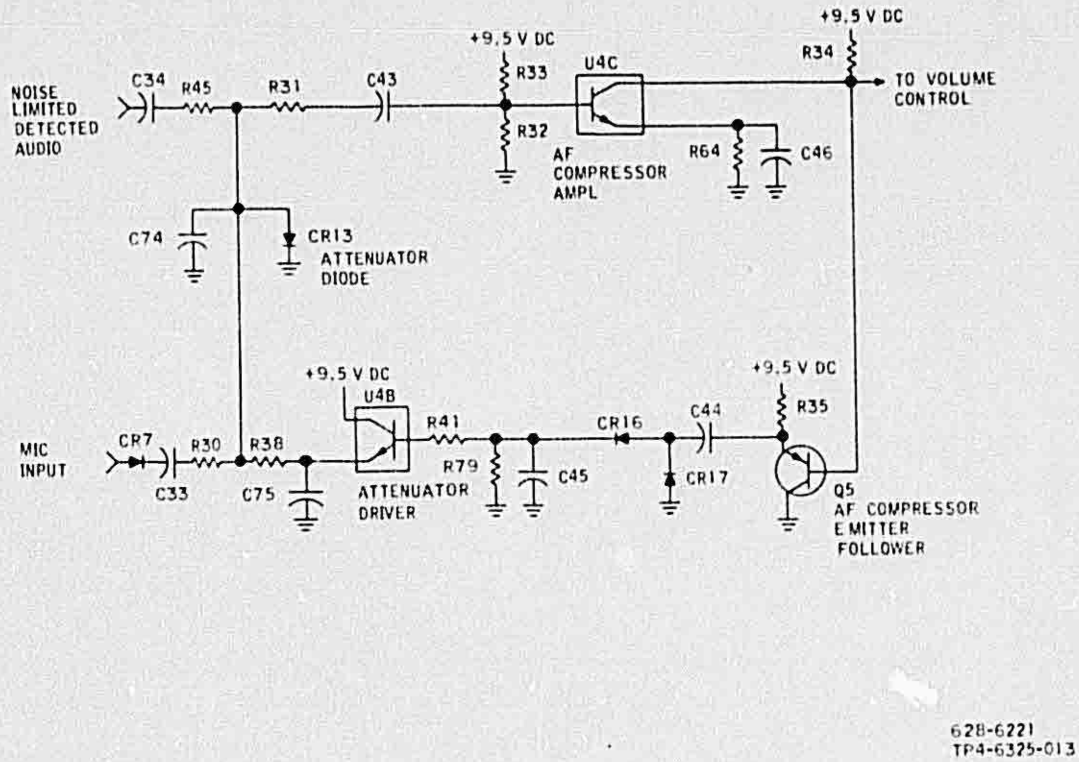
4.3.3.6.2 Audio Compressor Operation (Refer to figure 4-14.)

The audio output of the noise limiter is coupled to the audio compressor circuitry that consists of U4C, Q5, U4B, and variable attenuator network R31, R45, and CR13. The audio level into U4C is controlled by a feedback loop containing af compressor emitter-follower Q5, af compressor amplifier U4B, and the variable attenuator network. The output of U4C is connected directly to the base of emitter-follower Q5, which is used to provide isolation between U4C and U4B. The output of Q5 is rectified by the diodes, CR16 and CR17, that provide drive to attenuator driver U4B. The bias voltage applied to U4B is directly proportional to the audio signal amplitude on the collector of the af compressor amplifier U4C. U4B conducts through attenuator diode CR13 which is the compression element in the feedback loop.

Functionally, diode CR13 is the center leg of a T-attenuator comprised of itself, R45, and R30. Resistor R45 is the received audio input leg. An increase in current flow through CR13 increases the attenuation characteristics of the T; a decrease in current flow decreases attenuation. Using this process, the audio output signal amplitude range is controlled as a function of the input signal amplitude. Strong signals, therefore, as seen at the base of af compressor amplifier U4C, will be compressed while weak signals will pass at full amplitude.

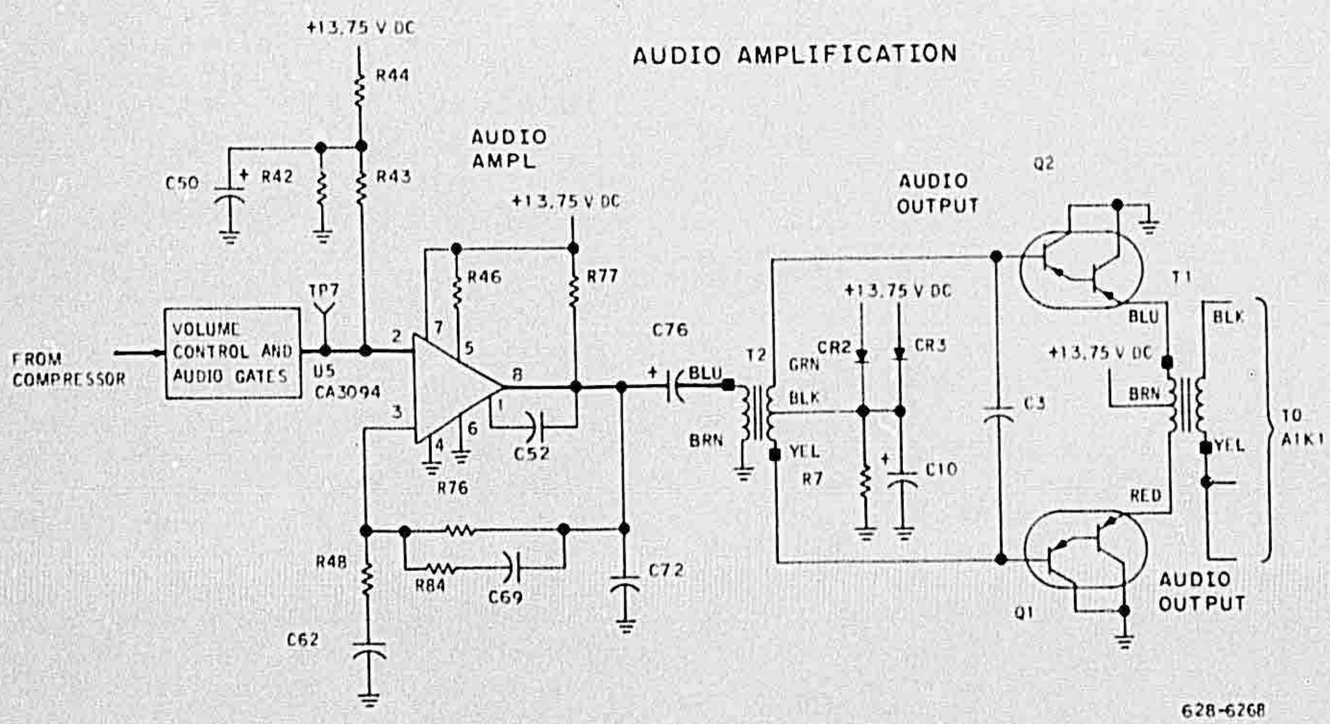
4.3.3.6.3 Audio Gating and Amplification (Refer to figures 4-15 and 6-10.)

The path followed by the processed output of af compressor amplifier U4C is dependent upon the state of gating diodes CR18 and CR19. In the receive mode, XMT audio gate CR19 will be reverse biased and RCV audio gate diode CR18 will be forward biased. This condition forces the received audio through volume control A5R1 that sets the level applied to audio amplifier U5. The VHF-250E contains a filter in series with the RCV audio gate diode and the input of audio amplifier U5. (Refer to figure 6-8.) This circuit is included to minimize heterodyne whistles encountered by conventional receivers in the offset carrier environment. Operational amplifier U21 and associated components attenuate audio signals at 5000 Hz and above by more than 18 dB. The effective audio response in the usable spectrum is the same as in the VHF-250/250S, within 6 dB from 350 through 2500 Hz.



Audio Compressor
Figure 4-14

AUDIO AMPLIFICATION



Audio Amplification
Figure 4-15

When the transmitter is keyed, relay A1K1 supplies logic that reverses the condition of the audio gates existing in the receive mode. RCV audio gate diode CR18 will be reverse biased, thereby blocking signal flow, while XMT audio gate diode CR19 becomes forward biased, providing an uninhibited path to audio amplifier U5. The filter circuit of the VHF-250E is completely bypassed in the transmit mode, thereby eliminating any effect on the transmitted signal.

The output of audio amplifier U5 is applied to a pair of class AB Darlington output transistors. In the receive mode, the secondary of transformer T1 delivers 5 watts audio output into a 3.2-ohm load. Keying the transmitter switches the transformer T1 output to provide sidetone monitoring and power amplifier modulation.

4.3.3.7 Squelch Operation

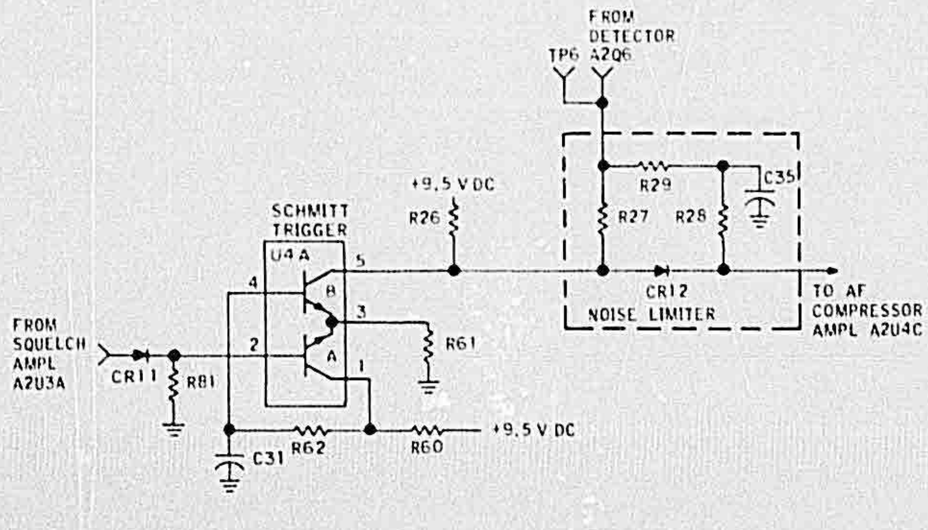
Squelch operation in the VHF-250/250S/250E is controlled by a carrier recognition circuit that drives a Schmitt trigger. The Schmitt trigger biases the squelch gate diode on when a received carrier level exceeds a selected value. Pulling the squelch test knob on the front panel also opens the squelch gate, bypassing the normal squelch circuit.

4.3.3.7.1 Schmitt Trigger and Noise Limiter/ Squelch Gate (Refer to figure 4-16.)

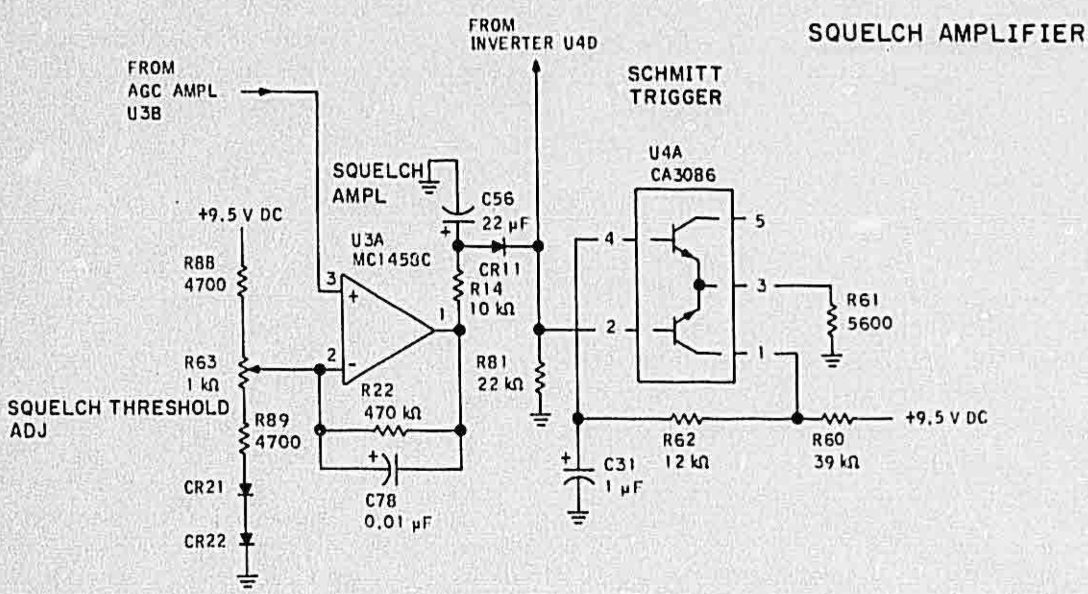
Diode CR12 performs the dual function of series noise limiter and squelch gate. As a squelch gate, Schmitt trigger U4A controls diode bias current. The high speed switching characteristics of the Schmitt trigger provide the snap-action switching required in the squelch. False triggering is eliminated by the hysteresis effect of Schmitt trigger operation.

The Schmitt trigger is a 2-stage dc amplifier with positive feedback. This positive feedback makes the gain very high when the input signal is in the narrow range between that producing saturation and that producing cutoff. The positive feedback also provides a latching action. Once a high-level signal exceeds the rising threshold and sets the trigger, the input must be reduced to a lower, falling threshold to reset. Once the signal has risen enough to open the gate, it can fall somewhat lower without closing the gate. This reduces the incidence of flutter with marginal signal levels.

If the carrier squelch does not apply voltage to the base of transistor A, R81 holds the base low and prevents the transistor from conducting. Current through R60 and R62 turns on transistor B, making its collector and emitter voltages nearly the same. The emitter of transistor B will be about 4.2 V and the collector about 4.5 V; this is the normal situation when no signal is received. Since R28 and R29 hold the cathode of CR12 at approximately 7.0 V while its anode is at 4.5 V, CR12 will not conduct and no audio passes to the compressor. If enough drive is supplied by the squelch to pull the base of transistor A up to approximately 4.7 V, transistor A begins to conduct. This shunts current away from the base of transistor B, which begins to turn off. The emitter voltage drops (R60 is larger than R26) which speeds up the turn-on of transistor A. This action proceeds rapidly until



Schmitt Trigger and Noise Limiter/Squelch Gate
Figure 4-16



Squelch Amplifier U3A
Figure 4-17

transistor A is saturated, so there is no base current for transistor B halting conduction. Current now flows through R26 and CR12, turning on CR12 and allowing passage of the audio signal to the compressor. In this state, the emitter voltage of transistor A is about 1.3 V. Since the emitter-base voltage of transistor A is approximately 0.6 V, the base is pulled down to approximately 1.9 V. The trigger-driving voltage must therefore fall at least this low before the trigger will reset. This difference between 4.7 V and 1.9 V is the hysteresis of the Schmitt trigger.

Since the Schmitt trigger output is either high or low with essentially no in-between, diode CR12 and the trigger create the desired gating effect. This effectively blocks the detector-to-compressor signal path when the trigger output is low or opens the path when the output is high.

The output of the Schmitt trigger is controlled by two independent sources. The trigger output will remain high (squelch opened) when either of the input levels overcomes the fixed bias of the trigger input transistor. For the output to go low (squelch closed) all inputs must fall below the trigger fixed bias voltage as just discussed. The inputs controlling the Schmitt trigger are the squelch test switch and the carrier squelch circuit.

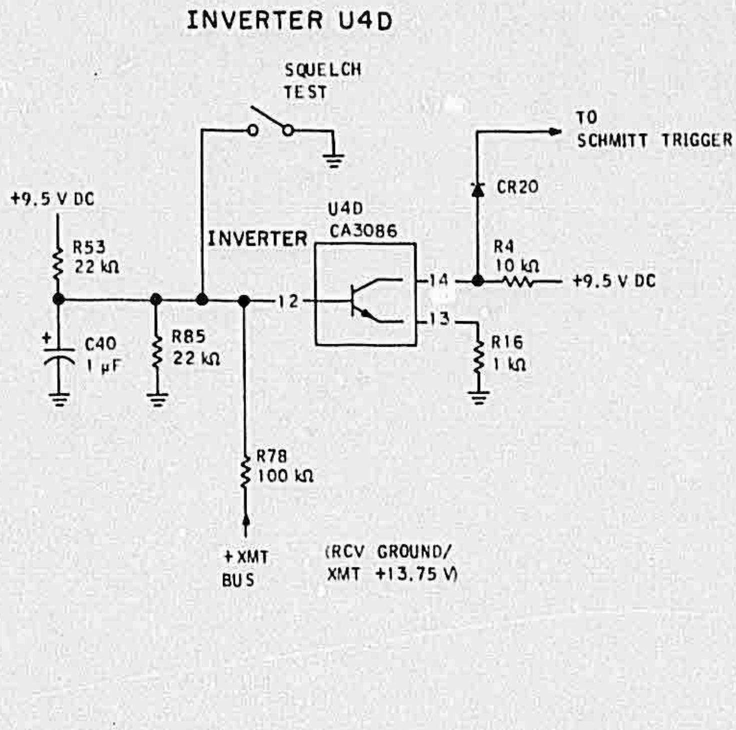
4.3.3.7.2 Squelch Amplifier U3A (Refer to figure 4-17.)

Squelch amplifier U3A is driven by AGC amplifier U3B. When the AGC voltage exceeds a predetermined point, detected carrier level increases and the squelch amplifier output becomes sufficiently positive to drive the Schmitt trigger output high, opening the squelch. Squelch threshold adjustment is provided by potentiometer R63, which sets the bias on U3A. Threshold is adjusted so that diode CR12 will be forward biased with a 10-µV signal present at the antenna. A 10-watt transmitter at a distance of 100 nautical miles produces a signal more than 10 dB above this squelch trigger point.

In the absence of a detected carrier, AGC voltage will drop off and the Schmitt trigger will change states. This removes the forward bias applied to CR12 and, in turn, blocks the signal flow to the compressor.

4.3.3.7.3 Squelch Test Inverter U4D (Refer to figure 4-18.)

Inverter U4D is normally saturated because of the bias current through R53. Pulling the VOL/TST knob



Squelch Test Inverter U4D
Figure 4-18

out to open the squelch grounds the base of U4D, cutting off the transistor. With the collector high, current flows through CR20 to activate the Schmitt trigger. The squelch gate diode then passes all received signals and front-end noise to the audio compressor.

4.3.4 Transmit Mode

The transmitter is capable of providing 10 watts nominal output power from 118.000 to 135.975 MHz in the VHF-250 and from 118.00 to 135.95 MHz in the VHF-250S. The VHF-250E covers the same frequency range as the VHF-250; however, power output is 14 W minimum. During transmission, the rf amplifiers are supplied drive from the synthesizer and modulating audio from the af transformer. Modulation limiting prevents overmodulating the transmitter.

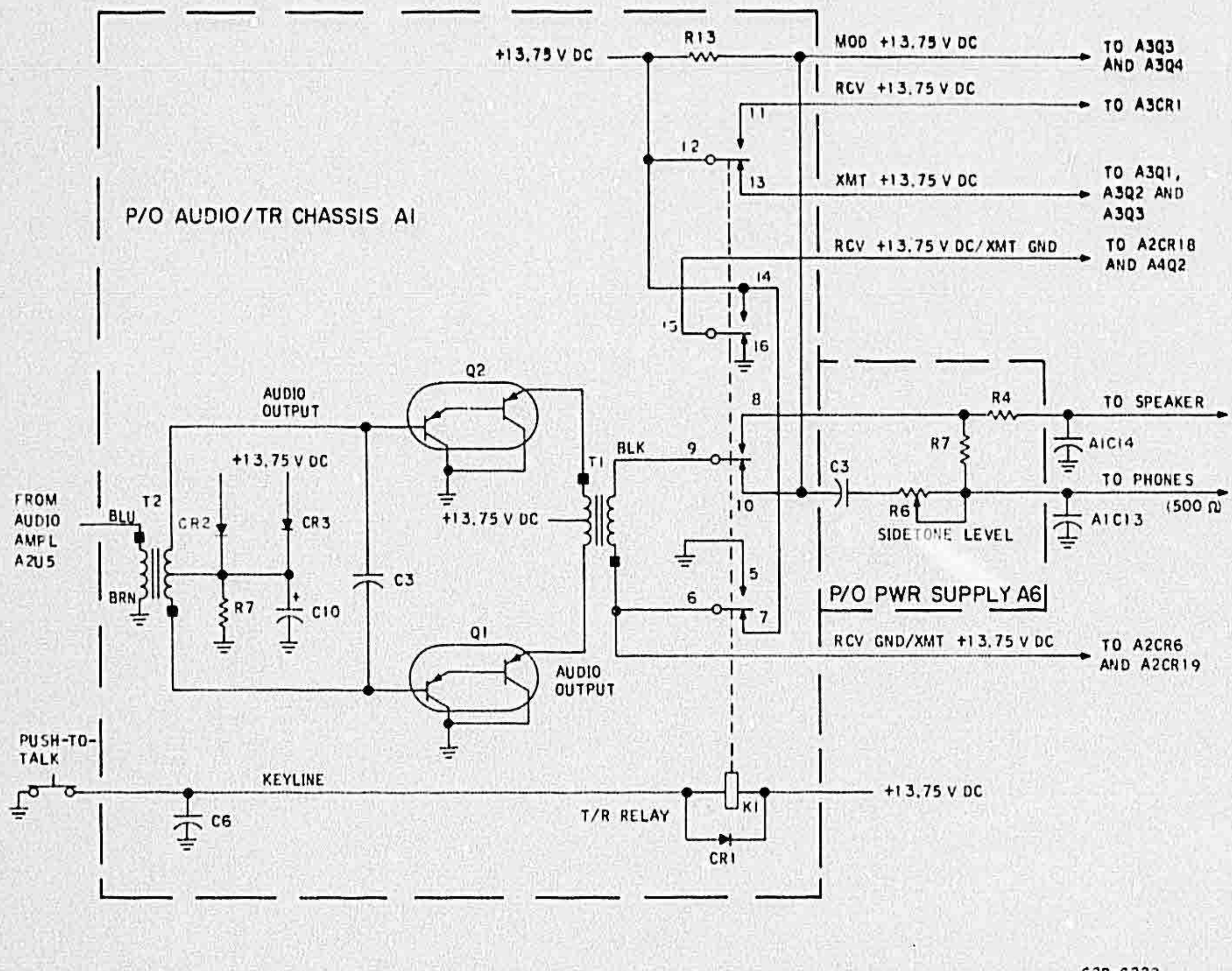
Three major functions comprise transmitter operation: transmit mode switching, modulation limiting, and power amplification. The synthesizer, also a function of the transmit mode, is discussed in detail in paragraph 4.3.2.

4.3.4.1 Transmit Mode Switching (Refer to figure 4-19.)

Receive mode to transmit mode transition occurs when the microphone push-to-talk switch is pressed. This action places a ground on the key line input and energizes relay A1K1, causing it to switch to the position shown in figure 4-19.

The bottom set of contacts (5, 6, and 7) switches the secondary of audio output transformer A1T1 and applies +13.75 V dc to the anodes of diodes A2CR6 and A2CR19. With both diodes forward biased, +13.75 V dc will be placed on the receiver AGC line, muting the receiver; microphone audio information will be processed and applied to the audio amplifier through the transmit mode audio gate.

The second set of contacts (8, 9, and 10) switches the secondary of A1T1 from the speaker output to the 500-ohm headphone output to provide sidetone monitoring. Sidetone audio output level adjustment is provided by A6R6. In addition to providing the sidetone output, A1T1 becomes a modulation transformer (the primary function of A1T1) and supplies its output to the collector of driver transistor A3Q3 and power amplifier transistor A3Q4.



Transmit Mode Switching
Figure 4-19

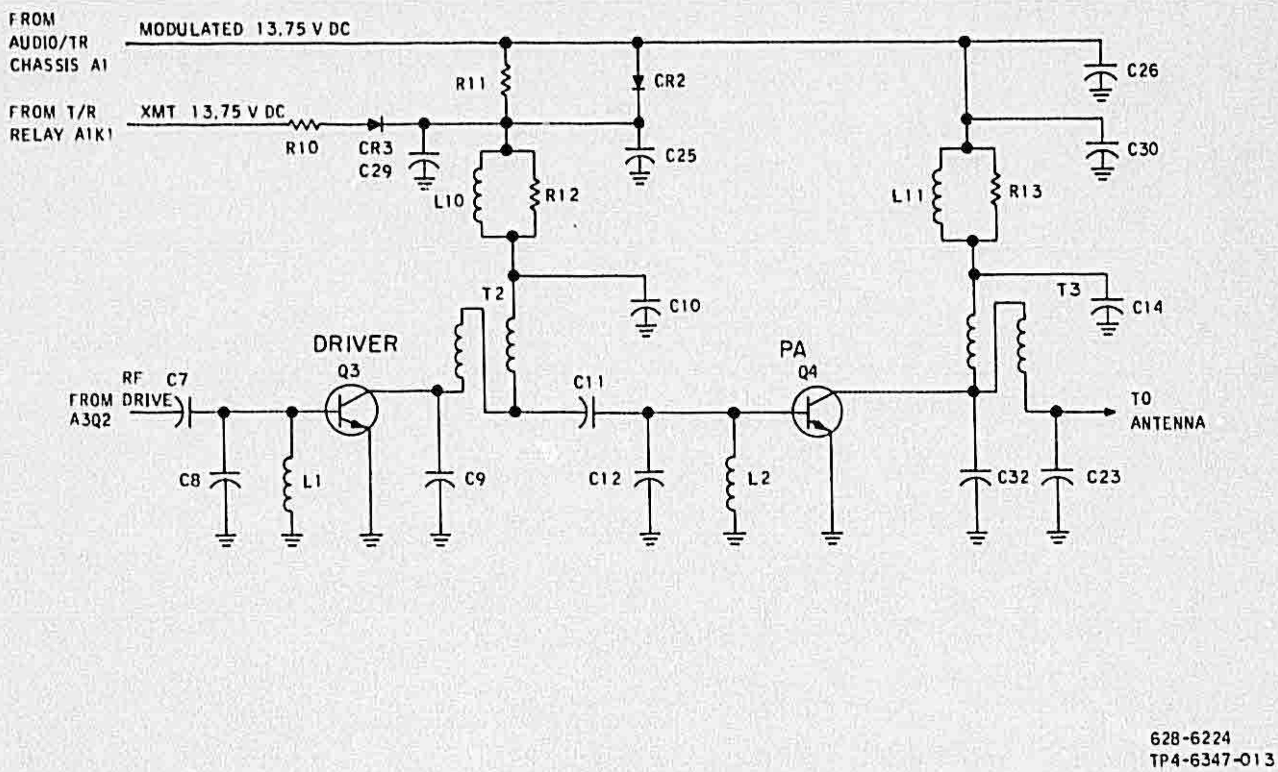
Contacts 14, 15, and 16 switch the line feeding A2CR18 and A4Q2 from +13.75 V dc to ground. This results in the blockage of the receiver audio signal at the audio gate and in the switching of the synthesizer offset circuit, lowering the vco frequency 10.5 MHz to accommodate the transmit frequency range.

The top set of contacts (11, 12, and 13) removes +13.75 V dc from tr switch A3CR1 and applies it to power amplifier transistors A3Q3 and A3Q4. This switching removes the forward bias to A3CR1 that blocks the pa output from the receiver preselector circuit and applies enabling voltage to the pa driver transistors.

4.3.4.2 *Modulation Limiting (Refer to figure 4-20.)*

Transmitted audio modulation is provided by circuitry contained in the receiver audio section. Microphone inputs are coupled to af compressor amplifier A2U4C for processing. The output of the audio processing network (discussed in paragraph 4.3.3.6) is applied to audio amplifier A2U5 that drives the final audio output stage consisting of A1Q1, A1Q2, and associated components. The modulated +13.75-V dc and transmit +13.75-V dc voltages are applied to power amplifier A3 by relay A1K1.

Actual modulation limiting occurs within the power amplifier by regulating the downward modulation in the collector circuit of A3Q3. Both driver transistor Q3 and pa Q4 collector circuits are modulated by the switched output of modulation transformer A1T1, but only Q4 is free to follow the full range of modulating signal. A limiting circuit, consisting of CR2, R11, CR3, and R10, prevents the driver collector from following the downward travel of the modulating signal. As the modulated +13.75-V dc line rises above the +13.75-volt level (which may go as high as 25 volts or as low as 0 volt), diode CR2 will remain forward biased, allowing the Q3 collector



Modulation Limiting and Amplification
Figure 4-20

voltage to follow the Q4 collector voltage. Should the modulated +13.75-volt line drop below +13.75 volts, CR2 becomes reverse biased. When this occurs, the Q3 collector current through R11 lowers the cathode voltage of diode CR3, forward biasing the diode. The Q3 collector is now connected to the +13.75-volt line through CR3 and R10. The voltage drop across R10 limits the downward travel of the Q3 collector to approximately 10 volts.

The characteristics of this circuit therefore permit transistor Q3 to conduct even though low collector voltage cuts off pa transistor Q4. Normal leakage through Q4 couples the Q3 output to the antenna, which ensures that some rf will always be present to prevent overmodulation.

4.3.4.3 Transmit Amplification (Refer to figure 6-12.)

The power amplifier consists of four stages of amplification following the synthesizer rf drive output. All stages use broadband tuned circuits. The first two stages, preamplifier Q1 and predriver Q2, are powered directly by the +13.75-V dc transmit bus. Collector modulation is applied to the last two stages, driver Q3 and power amplifier Q4. Rf power output is a nominal 10 watts (14 watts minimum in VHF-250E). Modulation levels up to 95 percent are obtainable with low envelope distortion. Variable capacitor C15 permits tuning the collector of Q4. This capacitor is adjusted to provide maximum output power at the high end of the transceiver frequency range. The rf output is low-pass filtered to provide harmonic rejection.

The antenna tr switch consists of diode CR1. During transmission, the diode is reverse biased by transmitter rf, and the receiver is isolated from the antenna.

4.3.5 Power Distribution

4.3.5.1 +5.0-V DC Voltage Regulator

The +5.0-volt supply is generated by a single monolithic silicon integrated circuit. This integrated circuit, A6U1, takes the +13.75-V dc input and reduces it to a regulated +5.0-volt level completely independent of any external components. Thermal protection and short-circuit current limiting are provided within the circuit.

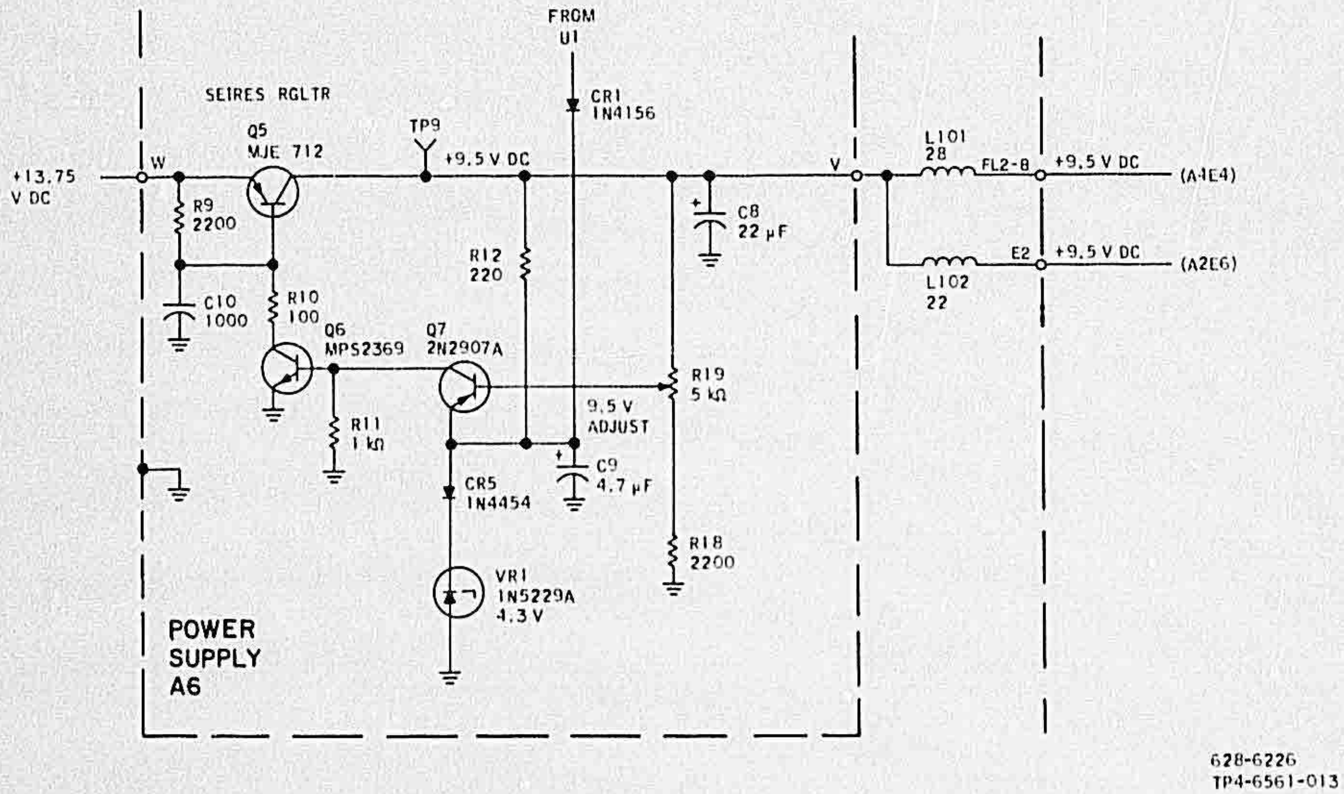
4.3.5.2 +9.5-V DC Series Regulator (Refer to figure 4-21.)

The +9.5-V dc output of the series regulator is used in all low-level-signal circuitry and in voltage-sensitive circuits contained within the synthesizer.

The power supply is a conventional series regulator producing +9.5 V dc from a filtered +13.75-V dc input voltage. The difference between the reference at the emitter of Q7 and a portion of the output is used to supply an actuating error signal to the control elements.

Comparison of the output is made to a reference voltage established by zener diode VR1. Temperature compensation is provided by diode CR5.

The filtered +13.75 V dc of input power is applied to transistor A6Q5, which is the supply control element. The regulated output of Q5 is sampled by a voltage divider network consisting of resistors R18 and R19. Resistor R19 is adjusted to provide the desired +9.5-V dc output. Any deviation from the set voltage changes the bias on the base of transistor Q7. A reduction in output voltage (below +9.5-V dc level) makes the base more negative with respect to the reference voltage and increases Q7 drive. This causes transistor Q6 to conduct more heavily, in turn increasing conduction through series regulator transistor Q5 and raising the output voltage to the desired +9.5-V dc output level. Should the +9.5-V dc output level increase, the base drive of transistor Q7 will be decreased, and the correction process is reversed. CR1 provides starting current to Q7, which ensures that the supply will be actuated under all conditions of line voltage and temperature.



+9.5-V DC Series Regulator
Figure 4-21

Collins VHF-250/250S/250E Communications Transceiver

Rockwell International

maintenance

Collins General Aviation Division

Printed in USA

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section V
maintenance

5.1 GENERAL

Caution

Remove power cable before disassembling any portion of the equipment. Disassembling the equipment with the power cable connected may cause damage to the equipment.

This section contains information necessary to maintain, repair, test, and align the VHF-250/250S/250E Communications Transceiver.

Table 5-1 lists tools needed to accomplish alignment and/or repair of the VHF-250/250S/250E.

Two testing procedures are provided in this section. The minimum performance test is performed before installation of the equipment in the aircraft, or after minor repairs have been complete. The minimum performance test is also used as a means of fault isolation. Using the minimum performance test in this way, the technician is able to select the applicable detailed test or alignment procedure in a minimum amount of time.

The detailed performance test and alignment procedures are provided for in-depth testing and alignment. Tests and alignment procedures are arranged in a manner that allows the technician to display the component layout and the selected schematic while testing. It is recommended that the minimum performance test be performed before the detailed performance test. Using this method, faults are quickly isolated to the appropriate board. Detailed performance testing and alignment procedures are then performed for that board.

5.2 REPLACEMENT OF INTEGRATED CIRCUITS

5.2.1 Troubleshooting and Replacement of MOS/CMOS Devices

All MOS devices are subject to damage by electrostatic charges. The very high resistance of the oxide insulation used within the MOS imposes a negligible load on electrostatic potentials and therefore does not provide an effective discharge path for sources of static electricity. Although some MOS devices do contain integral gate-protection systems, good practice dictates careful handling of all MOS packages. The following precautions should be observed when handling MOS devices and are applicable to both in-circuit and out-of-circuit environments.

Table 5-1. Tools Required.

DESCRIPTION	CHARACTERISTIC	FUNCTION
20-watt soldering iron	Any.	Remove/replace IC's and components.
Solder sucker	Any.	Remove solder.
Needle-nose pliers	Any.	Bend component leads.
Cutting tools	Various, small diagonal cutter, end nippers, etc (sharp tools that will not leave burrs).	Cut IC and component leads.
Adjustment tool	JFD 5284 or equivalent.	Adjust variable resistors.
Screwdrivers	Any.	Disassembly.
Special nut driver	Collins part number 628-5750-001.	Rf power transistor disassembly.

Caution

Devices such as CMOS, NMOS, MNOS, VMOS, HMOS, thin-film resistors, PMOS, and MOSFET used in many equipments can be damaged by static voltages present in most repair facilities. Most of these components contain internal gate protection circuits that are partially effective, but good practice dictates careful handling of all electrostatic sensitive components.

The following precautions should be observed when handling all electrostatic sensitive components and units containing such components.

a. Deenergize or disconnect all power and signal sources and loads used with the unit.
b. Place the unit on grounded conductive work surfaces.
c. Ground the repair operator through a conductive wrist strap or other device using a 1-MΩ series resistor to protect the operator.
d. Ground any tools (including soldering equipment) that will contact the unit. Contact with the operator's hand provides a sufficient ground for tools that are otherwise electrically isolated.
e. All electrostatic sensitive replacement components are shipped in conductive form or tubes and must be stored in the original shipping container until installed.
f. When these devices and assemblies are removed from the unit, they should be placed on the conductive work surface or in conductive containers.
g. When not being worked on, wrap disconnected circuit boards in aluminum foil or in plastic bags that have been coated or impregnated with a conductive material.
h. Do not handle these devices unnecessarily or remove from their packages until actually used or tested.

Failure to observe all of these precautions can cause permanent damage to the electrostatic sensitive device. This damage can cause the device to fail immediately or at a later date when exposed to an adverse environment.

5.2.2 Replacement of Conventional IC's

Integrated circuits (IC's) are delicate items and should not be replaced until all other defects are eliminated and it is determined that the IC is definitely defective.

Note the orientation of the IC on the board before removal to assure correct placement of the new part. Remove the old IC by clipping each lead on the IC using a small diagonal cutter. Heat the leads with a soldering iron and pull them from the board with needle-nose pliers. Clear excess solder from the holes with a solder sucker. This procedure avoids overheating the circuit board and damaging other components or the board itself.

When soldering new IC into place, avoid applying an excessive amount of heat that may cause internal damage to the IC, making it inoperable. After soldering, use a toothpick to remove any heavy rosin deposits; solder joints should be smooth, bright, and clean.

5.3 DISASSEMBLY/ASSEMBLY

The VHF-250/250S/250E is a panel-mounted unit contained in a 2-piece chassis. The front chassis, or control head, contains the frequency selection switching mechanism, on/off/test switch, and volume control. The control head is secured to the rear chassis assembly, which contains all electronics. The rear chassis assembly is designed to provide direct access to all parts with minimum effort. The synthesizer and receiver boards are hinged to swing out for servicing; chassis components and unhinged boards are arranged to provide maximum accessibility for servicing. All boards are direct-wired, thus eliminating the need for extender cables.

5.3.1 Disassembly

Before proceeding with the disassembly procedures, study the exploded view presented in figure 5-1. All numbers contained in parentheses refer to the component item numbers used in this figure.

5.3.1.1 Control Head

a. Set frequency selector to 120.00 MHz. Remove volume control knob (27) by loosening setscrews (12).
b. Remove four screws (36) securing front panel assembly to chassis. Remove front panel assembly, being careful to avoid damaging face gears.
c. Remove top front cover (59) by prying up.
d. Remove two screws (3) securing post (33) in place.
e. Remove two screws (61) securing side plate (60) to chassis assembly (2). Slide side plate off of hub assembly shaft (19) and disassemble as required.

f. Separate switch/drum assembly from chassis assembly by lifting up switch/drum assembly and sliding out of bearing (17).
g. Loosen setscrew (51) in MHz drum (46) and slide drum off shaft.
h. Remove washer (65) and slide kHz drum parts off of shaft (VHF-250S does not contain Geneva transfer mechanism; a single drum is used in its place).

Note

Prior to disassembly of wafer switch assembly, be especially careful to note switch positions. In addition to those stamped on the wafer segments, it may be helpful to place supplemental marks for reference. A felt-tipped pen works well for adding keying marks.

5.3.1.2 Rear Chassis

5.3.1.2.1 Synthesizer

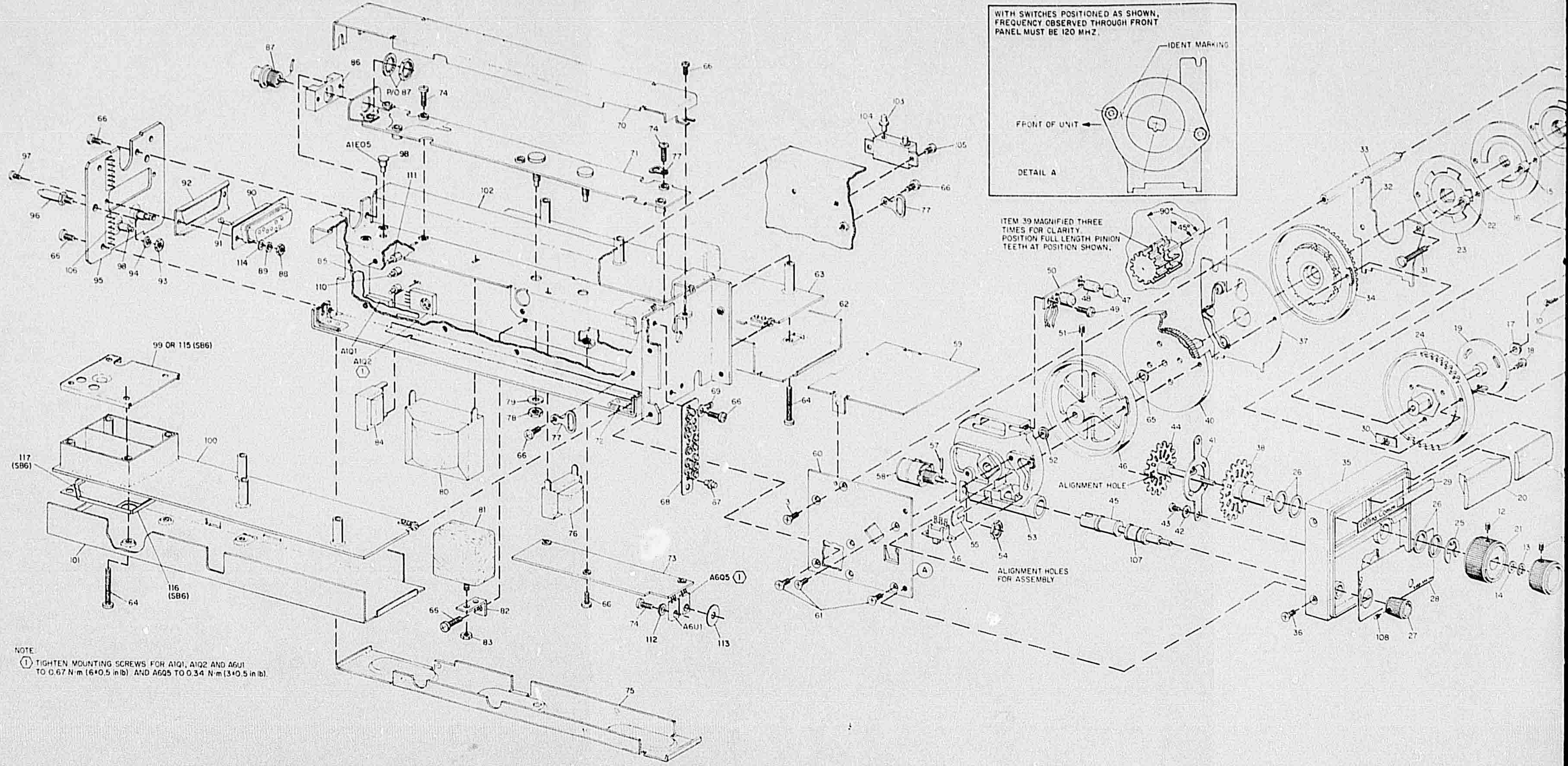
a. Remove seven screws (64) from synthesizer cover (101).
b. Remove cover (101) and swing down synthesizer circuit board assembly (100).

Note

Vco cover (99) snaps onto shield and is secured in place with screws (64) when board (100) and cover (101) are replaced. Ensure cover (99) is properly positioned before reassembly.

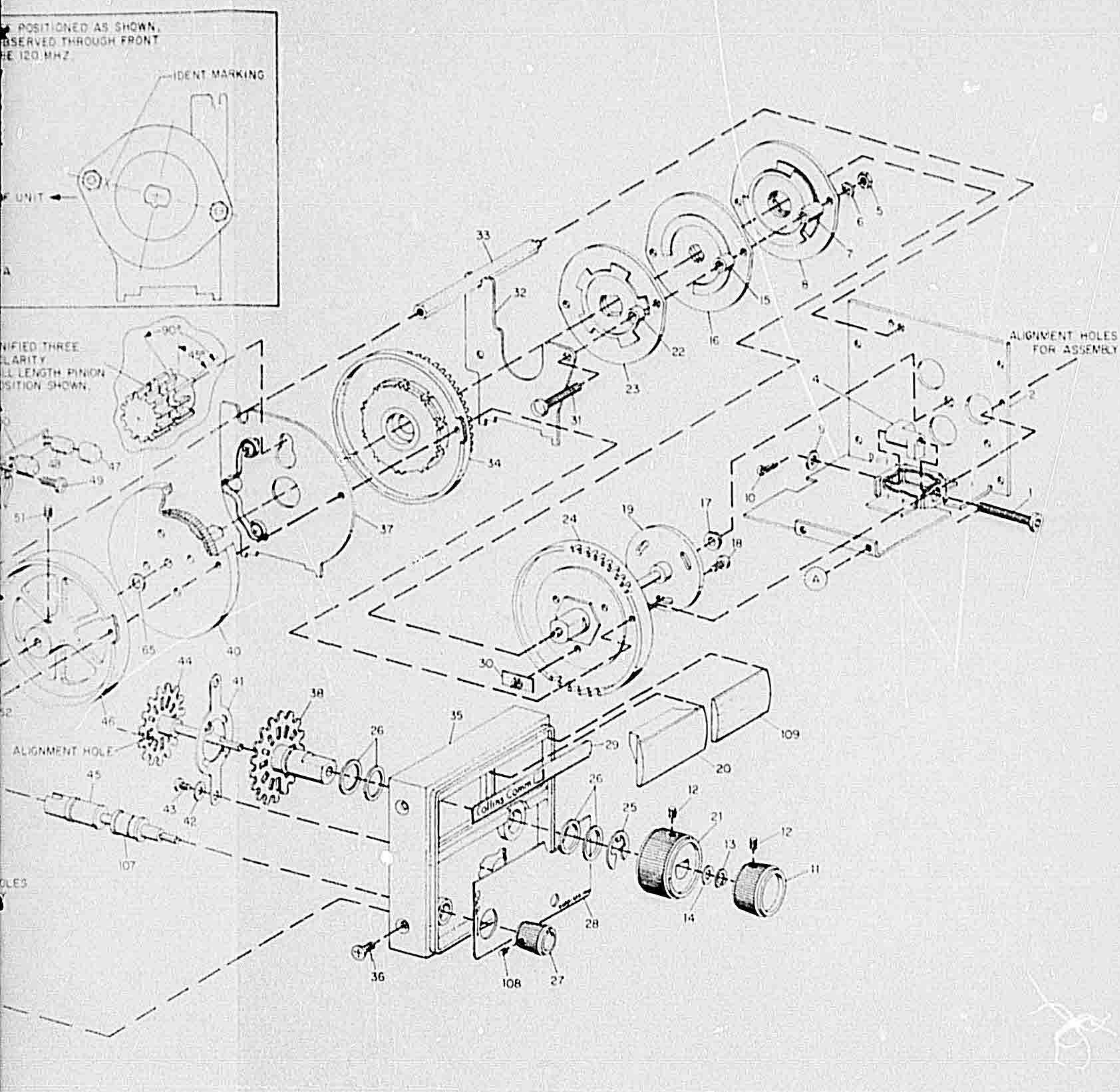
5.3.1.2.2 Power Amplifier

a. Remove top rear cover (70) by loosening three screws (66).



NOTE:
(1) TIGHTEN MOUNTING SCREWS FOR A1Q1, A1Q2 AND A6U1 TO 0.67 N·m (6±0.5 in lb) AND A6Q5 TO 0.34 N·m (3±0.5 in lb).

SEE BLOW–UP FICHE NO. CLQ302 - ITEM E



VHF-250/250S/250E, Exploded View
Figure 5-1

SEE BLOW–UP FICHE NO. CLQ302 - ITEM F

b. Remove bottom rear cover (75) by carefully prying up.
c. Remove power supply board (73) by removing three screws (66) and two screws (74).
d. Carefully remove power amplifier and driver transistor mounting nuts (78) using special nut driver, Collins part number 628-5750-001.

Note

If special nut driver is not available, an 11/32-inch nut driver may be substituted; however, extreme care must be used to avoid damaging transistors.

e. Remove seven screws (74) securing power amplifier board (71) to chassis.
f. Remove nut securing connector (87) to block, and lift out board (71).

5.3.1.2.3 Power Supply

a. Remove bottom rear cover (75).
b. Remove two screws (74) securing transistors Q5 and Q3 to chassis.
c. Remove three screws (66) securing board (73) to chassis.

5.3.1.2.4 Receiver

a. Remove three screws (64) from receiver cover (62).
b. Remove cover (62) and swing down receiver circuit board assembly (63).

5.3.2 Assembly

Table 5-2 lists the lubricants and adhesives required for assembly. Do not use substitute compounds. Parts comprising the VHF-250/250S/250E are listed in table 5-3.

Table 5-2. Lubricants and Adhesives.

DESCRIPTION	COLLINS PART NUMBER
Adhesive, Eastman 910	005-0669-000
Liquid stake, GE 7526 FPT	005-0133-010
Lubricant, GE 322 L	005-2444-010
Grease, special purpose; Cindol 2321	005-1247-020

5.3.2.1 Control Head

a. Assemble wafer switches and support (32) as shown in detail A of the exploded view. Torque nuts (5) 30 to 35 inch-ounces, and apply liquid stake to nuts (5) and exposed screw threads (31).

Note

Hub (19) must be secured to MHz face gear (24) such that when the assembly is inserted into switches the flat on the shaft of hub (19) is facing toward the rear of the chassis.

b. Before rotating new switch wafers, lubricate rotors with Cindol.
c. Slide hub (19) into MHz face gear (24) as shown. Secure assembly together using three screws (18) and speed nuts (30).

Note

With keying marks on wafer switches as shown in detail A, the frequency viewed through the front panel lens must be 120.00 MHz.

d. Slide shaft of hub (19) through wafer switch assembly, and turn slightly until keyed shaft of MHz face gear (24) seats in wafer switches.

Note

Steps e through h pertain to VHF-250/250E only.

e. Insert pinion gear (39) into gearplate (37) as shown, being careful to orient properly.
f. Using a wooden or metal dowel (approximately 0.060 in; drill bit or Allen wrench works well), line up alignment holes in 100-kHz drum and gearplate (37) and mesh pinion (39) with drum (40).
g. Line up 25-kHz drum (34) with alignment holes in drum (40) and gearplate (37). Mesh gears of 25-kHz drum (34) with pinion gear (39).
h. Slide kHz drum assembly (34, 37, 40) over hub shaft (19) and seat drum shaft in switches.

Note

Step i pertains to VHF-250S only.

i. Slide kHz drum (34, not shown) over hub shaft (19) with teeth facing support (32).

Table 5-3. VHF-250/250S/250E Communications Transceiver Mechanical Parts List.

ITEM NO	DESCRIPTION	COLLINS PART NUMBER
1	Screw, socket	324-1713-020
2	Chassis assembly	628-6359-001
3	Screw, 0.112-40 x 0.250 PFH	330-2290-000
4	Pawl	628-6658-001
5	Nut, 5-40	269-0628-090
6	Lockwasher	310-0280-000
7	Spacer, 0.285	628-5797-003
8	Switch, wafer, S3	269-2664-040
9	Washer, flat	540-3004-003
10	Pin, cotter	338-0120-010
11	Knob, kHz	628-5413-001
12	Setscrew, 0.112-40 x 0.187	328-5029-000
13	Ring, retaining	340-0088-000
14	Washer, flat (0.005) or	628-6615-001
	Washer, flat (0.010)	628-6615-002
15	Spacer, 0.187	628-5797-006
16		
VHF-250/250E	Switch, wafer 100 kHz, S2	269-2664-060
VHF-250S	Switch, wafer 50 kHz, 2x5, S2	269-2664-030
17	Bushing	628-6242-001
18	Screw, 0.112-40 x 0.250	343-0133-000
19	Hub subassembly	628-6239-001
20	Lens, display	628-6176-001
21	Knob, MHz	628-5415-001
22	Spacer, 0.100	628-5797-005
23		
VHF-250/250E	Switch, wafer 25 kHz, S1	269-2664-050
VHF-250S	Switch, wafer 50 kHz, BCD, S1	269-2664-020
24	Gear, face MHz	628-6182-001
25	Ring, retaining	340-0092-000
26	Washer, flat, 0.005 thick	628-6258-004
	or	
	Washer, flat, 0.010 thick	628-6258-001
27	Knob, volume	628-5490-003
28		
VHF-250	Panel, overlay (black)	628-9106-001
VHF-250	Panel, overlay (gray)	628-9106-005
VHF-250S	Panel, overlay	628-9106-002
VHF-250E	Panel, overlay	628-9106-003
29	Overlay, trim	628-6245-002
30	Nut, speed, rectangular	334-2102-020
31	Screw, 5-40 x 0.937	330-0543-000
32	Support	628-6234-001
33	Post	628-6372-001
*34	Drum, 25 kHz (VHF-250/250E only)	628-6193-001
**35	Panel, front	628-6175-001
36	Screw, 0.112-40 x 0.250, black, PFH	330-1773-020
*37	Secondary detent assembly (VHF-250/250E only)	628-7010-001
38	Shaft assembly, MHz	628-6539-001
*39	Gear, spur, pinion (VHF-250/250E only)	628-7011-001
*40	Drum, 100 kHz (VHF-250/250E only)	628-7013-001
41	Spring, detent	628-7281-001
42	Washer, flat	310-6320-000
43	Screw, 0.086-56 x 0.188	343-0123-000
44	Shaft assembly, kHz	628-6539-002
45	Shaft, volume	628-6191-001
46	Drum, MHz	628-6178-001
47	Filter, lamp blue/white	262-1398-040
48	Lamp, 14 V, T 1-1/4	262-1398-030
49	Screw, 0.112-40 x 0.250 PPH	330-1779-040
50	Board, printed circuit	628-6247-001

Table 5-3. VHF-250/250S/250E Communications Transceiver Mechanical Parts List (Cont).

ITEM NO	DESCRIPTION	COLLINS PART NUMBER
51	Setscrew, 0.138-32 x 0.187	328-5036-000
52	Bushing	628-6242-001
53	Hub, support	628-6177-001
54	Nut, P/O item 58	P/O item 58
55	Stop, volume, shaft	628-6241-001
56	Switch, slide, spst, S5	266-0223-010
*	Switch/pot assembly contains items 57 and 58	628-6253-003
57	Pin, coiled, 0.047 x 0.187	311-0438-000
58	Resistor, variable, 50 kΩ	376-0270-060
59	Cover, top	628-6237-002
60	Plate, side	628-6197-001
61	Screw, 0.112-40 x 0.250 PFH	330-1773-010
62	Cover, receiver	628-5360-001
63		
VHF-250	Receiver circuit board assembly A2	628-5025-004
VHF-250S	Receiver circuit board assembly A2	628-5025-005
VHF-250E	Receiver circuit board assembly A2	628-5025-006
64	Screw, 0.112-40 x 0.875 PPH	343-0140-000
65	Washer, flat	628-6614-001
66	Screw, 4-40 x 1/4 PPH	330-1779-040
67	Capacitor, feedthrough 1000 pF	913-3303-040
68	Plate, filter mounting	628-5474-001
69	Lug, #4 solder	304-0015-000
70	Cover, top rear	628-5501-002
71		
VHF-250/250S	Power amplifier circuit board assembly A3	628-5021-002
VHF-250E	Power amplifier circuit board assembly A3	628-5021-004
72	Chassis assembly, synthesizer	628-5439-002
73		
VHF-250/250S	Power supply circuit board assembly A6 (eff to REV U)	628-5005-001
VHF-250E	Power supply circuit board assembly A6 (eff to REV U)	628-5005-002
VHF-250/250S	Power supply/intercom circuit board assembly A6	628-9108-001
VHF-250E	Power supply/intercom circuit board assembly A6	628-9108-002
74	Screw, 4-40 x 5/16 PPH	343-0134-000
75	Cover, rear bottom	628-6015-001
76	Inductor, 1 MHz, A1L1	668-0262-010
77	Lug, solder	304-1089-000
78	Nut, hex, #8-32	313-0120-000
79	Lockwasher	310-0072-000
80	Transformer, A1T1	667-0251-010
81	Relay, A1K1	970-0038-020
82	Strap, relay, retaining	628-5093-001
83	Nut, hex #3-48	313-0190-000
84	Transformer	667-0252-010
85	Heat sink	628-6662-001
86	Block, coax, mounting	628-5329-001
87	Connector, rf P2	357-7532-020
88	Nut, 2-56, crescent	313-0037-000
89	Lockwasher	310-0275-000
90	Connector, 25 pin, P1	371-0379-010
91	Contact	371-0379-030
92	Strip, solder	628-5334-001
93	Nut, 4-40, crescent	313-0043-000
94	Lockwasher	310-0279-000
95	Plate, rear	628-5331-001
96	Pin, guide	628-8105-002
97	Screw, 2-56 x 1/4 PPH	343-0124-000

Table 5-3. VHF-250/250S/250E Communications Transceiver Mechanical Parts List (Cont).

ITEM NO	DESCRIPTION	COLLINS PART NUMBER
98	Terminal	306-2681-010
99	Cover, vco	628-5354-001
100		
VHF-250/250S	Synthesizer circuit board assembly A4	628-5300-002
VHF-250E	Synthesizer circuit board assembly A4	628-5300-004
101	Cover, synthesizer	628-5361-001
102	Chassis assembly, receiver	628-5418-001
103	Capacitor, feedthrough, 1000 pF	913-3303-010
104	Can, filter	628-5486-001
105	Screw, 2-56 x 3/16, PPH	330-1779-010
106	Contact strip	628-7477-001
107	Fabric strip	628-7497-001
108	Setscrew, 0.112-40 x 0.187	328-5020-000
109	Trim lens	528-6657-001
110	Insulated feedthrough terminal	306-2681-020
111	Ground terminal	306-2683-010
112	Washer, compression	352-9110-110
113	Insulator	352-9110-100
114	Flat washer, #2	310-0129-000
115	Vco cover (eff SB 6)	678-5352-001
116	Shield (eff SB 6)	628-5362-001
117	Insulator (eff SB 6)	628-5363-001

*Items 34, 37, 39, and 40 are not used in VHF-250S. Substitute 628-6181-001.
**Front panel assembly with detent assembly is CPN 628-6244-XXX, -001 is VHF-250 black, -002 is VHF-250S, -003 is VHF-250E, -005 is VHF-250 gray.

j. Slide washer (65) over hub shaft, and follow with MHz drum (46). Tighten setscrew (51) in MHz drum (46) to secure assembly together. After assembly, align MHz numbers with kHz numbers by loosening screws (18) in face gear assembly and rotating MHz drum (46) until numbers align. Be careful not to back screws out of nuts. Retighten screws (18) after alignment. Set aside switch/drum assembly.

k. Insert switch/pot assembly (58) into support hub (53). Ensure coiled pin (57) is centered in control shaft before insertion. Secure switch/pot in place with nut (54). Apply a small quantity of liquid stake to nut and threads, making sure no overflow is applied to control shaft.

l. Slide volume shaft (45) into support hub (53), making sure flat of shaft (viewed from front) faces the lower right of the assembly with control shaft (P/O 58) in full counterclockwise position.

m. Insert switch (56) into cavity of support hub (53). The lugs of switch (56) with wires attached must be facing toward front of the unit.

n. Lubricate volume shaft stop (55) and slot of hub support (53) with Cindol. Insert stop (55) into slot.

o. Seat bearing (52) into support hub (53) and secure in place with adhesive (910).

p. Position side plate (60) on hub support (53) and secure using two screws (61).

q. Insert switch/drum assembly (set aside earlier) into bearing (17) contained in chassis assembly (2). Seat support (32) and gearplate (37) into holes in bottom of chassis.

r. Position side plate assembly on chassis assembly, seating shaft in bearing, and secure with two screws (61).

s. Set post (33) in place and secure with screws (3).

t. Position light card assembly (47, 48, 50) on support assembly (53) and secure with screw (49).

Note

When reassembling front panel assembly (steps u through x), shim washers (26) must be replaced in original positions. These washers were selected for gear engagement and detent torque, and are necessary for proper operation.

u. Slide washers (26) over MHz shaft assembly (38) and insert through panel (35) from the rear. Replace washers (26) over MHz shaft assembly (38) from front and secure in place using retaining ring (25).

v. Apply a light coat of lubricant (005-2444-010) on contacting surface of detent spring (41) and position on MHz shaft assembly (38). Secure detent spring in place using washers (42) and screws (43).

w. Slide MHz knob (21) over shaft and tighten setscrews (12).
x. Slide kHz shaft assembly (44) through MHz shaft assembly (38), and secure with washer (14) and retaining ring (13).
y. Slide kHz knob (11) onto shaft and tighten setscrews (12).
z. If the unit being reassembled is a VHF-250/250E, line up alignment holes in 25-kHz drum (34), 100-kHz drum (40), MHz drum (46), hub support (53), side plate (60), and secondary detent assembly (37). Insert first alignment pin (1.5-mm (0.60-in) diameter) through these holes.

   If the unit being reassembled is a VHF-250S, line up alignment holes in kHz drum, MHz drum (46), hub support (53), and side plate (60). Insert first alignment pin (1.5-mm (0.60-in) diameter) through these holes.
aa. Loosen screws (18) securing MHz face gear (24) and hub subassembly (19) together.
ab. Line up alignment holes in MHz face gear (24) and chassis assembly (2). Insert second alignment tool through these holes.
ac. When viewing the assembled front panel assembly from the back, align the gears until a tooth-to-tooth alignment exists on the left side of the panel, as shown in figure 5-2.
ad. Slide front panel assembly onto the unit until both gear mechanisms are beginning to mesh or until front panel makes contact with first alignment pin.
ae. Remove first alignment pin and secure front panel assembly to the unit.
af. Remove second alignment pin.
ag. Loosen setscrew in MHz drum (46).
ah. Tightly mesh the kHz gears together by pushing MHz drum (46) firmly toward support (32). Hold this position and tighten setscrew in MHz drum (46).
ai. Rotate MHz drum (46) until digits are aligned. Display should show 120.00 MHz. Tighten alignment screws (18) on face gear assembly.
aj. Slide volume knob (27) over shaft (45) and tighten setscrews (12).
ak. Replace top front cover (59).

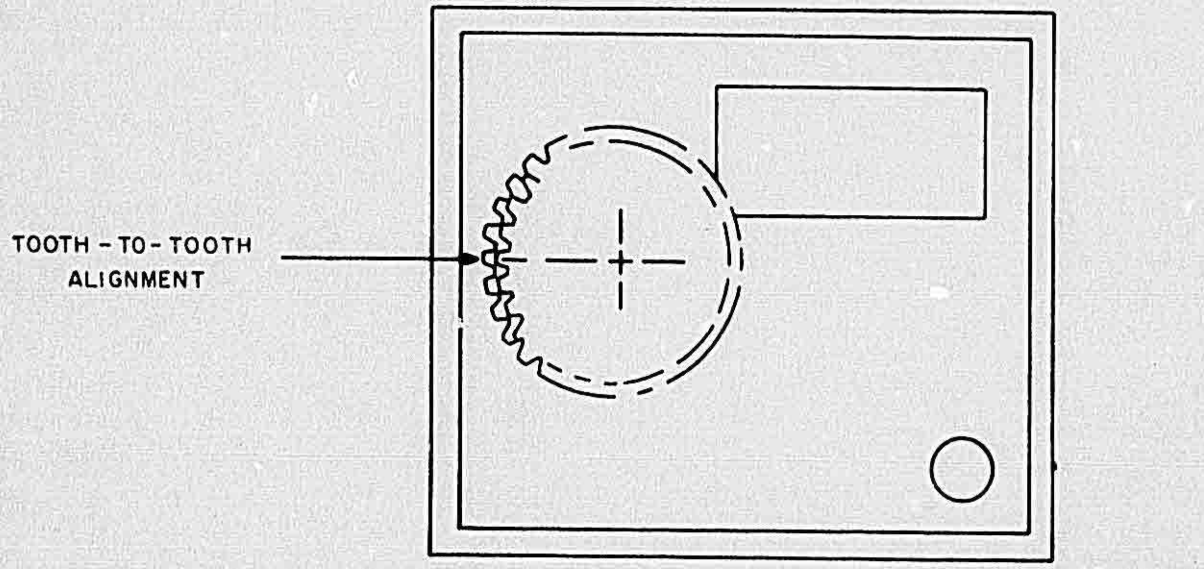
5.3.2.2 Rear Chassis

Reassembly of the rear chassis assembly can be accomplished by reversing the disassembly procedures and consulting the exploded view.

5.4 TEST EQUIPMENT

Table 5-4 is a list of test equipment required for customer acceptance/minimum performance testing of the VHF-250/250S/250E Communications Transceiver. Table 5-5 lists the test equipment required for detailed testing, alignment, and troubleshooting. In addition to the equipment listed in table 5-5, a special rf envelope detector must be fabricated as listed in table 5-6. A schematic diagram for the envelope detector is shown in figure 5-4.

The test equipment specification parameters listed for each type of testing must be met or exceeded to ensure proper results. All test equipment should be in good working condition and properly calibrated.



Front Panel Gear Alignment
Figure 5-2

Table 5-4. Customer Acceptance/Minimum Performance Test Equipment.

EQUIPMENT	CHARACTERISTIC REQUIRED
Rf generator	Frequency range: 118 through 136 MHz. Rf output range: 1 through 100 000 μV. Modulation: 0 through 95% at 1, 9, and 17 kHz. Attenuator accuracy: ±2 dB.
Power attenuator	50 Ω, 20 dB, 20 W.
Audio power meter	Power range: 10 W maximum. Accuracy: ±1.5 dB down to 50 mW. Impedance: 3.2 to 500 Ω.
Rf wattmeter	Power dissipation: not less than 20 W. Impedance: 50 Ω from 118 through 136 MHz. Accuracy: ±0.5 W.
Frequency counter	Range: 118 through 136 MHz. Accuracy: 0.0005% of displayed frequency.
Attenuator pads	50 Ω, 6 ±0.25 dB.
Power supply	0 to 20 V dc, 6 A.

Always allow sufficient time for test equipment warm-up and stabilization before testing or troubleshooting is begun.

5.5 TEST AND ALIGNMENT PROCEDURES

This portion of the maintenance section contains testing and alignment procedures for the VHF-250/250S/250E Communications Transceiver.

Two procedures are included for the VHF-250/250S/250E; both are unique and are designed to provide a specific function. The customer acceptance/minimum performance test procedures are provided to ensure proper operation of the VHF-250/250S/250E before installation in the aircraft or after minor repairs have been completed. The detailed test and alignment procedures should be used only when attempting to isolate faults or after repair has been made to realign the affected area. Ensure that test equipment is in good operating condition and properly calibrated.

5.5.1 Customer Acceptance/Minimum Performance Test Procedures

The customer acceptance/minimum performance test procedures should be performed after minor repairs have been completed or a preinstallation test procedure prior to unit installation in the aircraft. These test procedures do not require VHF-250/250S/250E cover removal or internal adjustment. A typical bench setup is shown in figure 5-3.

Note

All specified rf signal generator output levels are actual levels (hard microvolts) as indicated on the generator output meter with a 6-dB pad in series with the generator output. If a 6-dB pad is not used, divide all rf levels by 2.

5.5.1.1 Channeling

Rotate MHz and kHz selector knobs in both directions and note proper alignment of numbers for each frequency.

5.5.1.2 Power Supplies

a. Connect power supply to P1-23 (+) and P1-24 (-).
b. With supply voltage adjusted to 14 V dc, turn on the transceiver and observe current drain. Result: 0.8 A maximum.
c. Connect rf wattmeter to antenna jack. Close ptt switch and measure current drain. Result: not more than 6 A.

Table 5-5. Detailed Testing and Alignment Test Equipment.

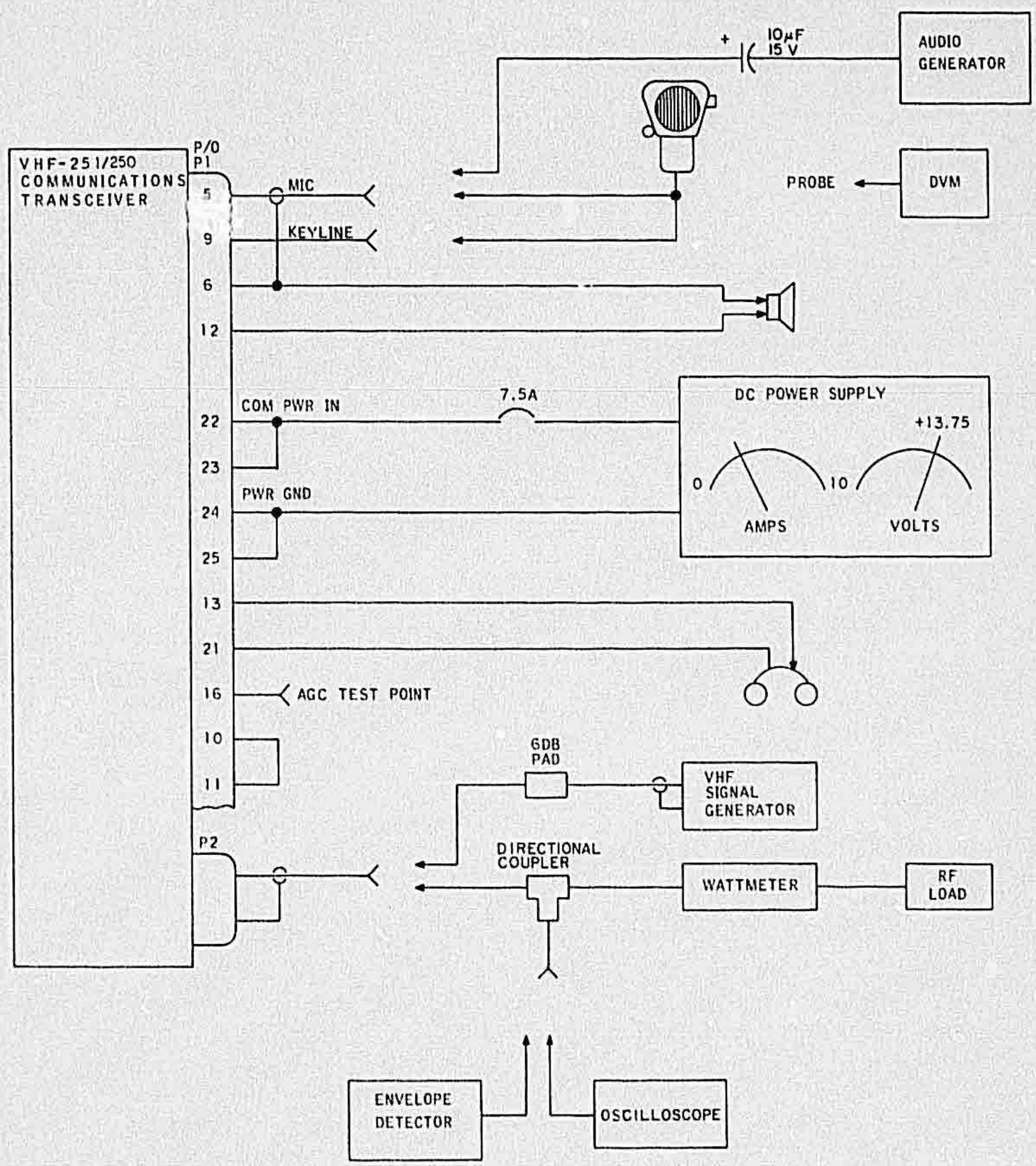
EQUIPMENT	CHARACTERISTIC DESIRED
Rf generator	Frequency range: 70 to 140 MHz.
	Rf output range: 1 to 200 000 μV.
	Modulation: 0 to 95%.
Audio generator	Range: 20 to 40 000 Hz.
	Distortion: 3% maximum.
	Capable of providing 1 V at 30 Hz and 2 V at 400 Hz across 600 Ω.
Audio power meter	Power range: 10 W maximum.
	Accuracy: ±1.5 dB down to 50 mW.
Rf load	Power dissipation: not less than 20 W.
	Impedance: 50 Ω from 118 to 136 MHz.
Frequency counter	Range: 100 to 140 MHz.
	Accuracy: 0.0005% of displayed frequency.
Attenuator pads	50 Ω, 6 dB.
Power supply	14 V, 6 A.
Digital voltmeter	Input impedance: 1 MΩ minimum shunted by a capacitance not to exceed 200 pF.
Oscilloscope	Any dc coupled scope (used for waveform observation only).
Distortion analyzer or 1000-Hz notch filter or SINAD meter	Capable of nulling out 1000-Hz audio for signal-to-noise measurement.

Table 5-6. Special Test Equipment.

EQUIPMENT	CHARACTERISTIC REQUIRED	REPRESENTATIVE TYPE
Detector	Provides detection of rf envelope.	Fabricate per figure 5-3.

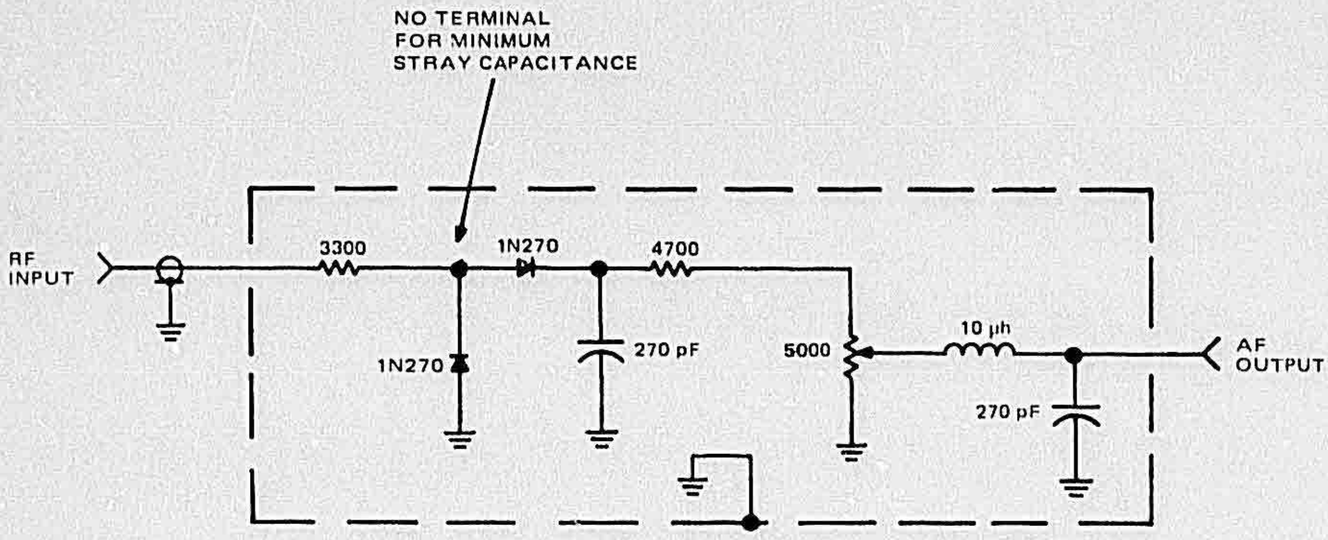
5.5.1.3 Receiver Sensitivity

a. Connect rf generator to transceiver antenna connector through a 6-dB pad.
b. Adjust the generator for a 5-μV rf signal modulated 30 percent with 1000 Hz.
c. Connect audio power meter to P1-13 and P1-6 and adjust transceiver gain for 50 mW into 500 Ω.
d. Measure signal-to-noise ratio ((s+n)/n) as the difference in audio output level with modulation-on to modulation-off. Result: Signal-to-noise ratio is not less than 8 dB.



628-5885
TP4-3181-014

VHF-250/250S/250E, Bench-Test Setup
Figure 5-3



1. ALL LEADS SHOULD BE AS SHORT AS POSSIBLE.
2. DETECTOR SHOULD BE HOUSED IN SMALL SHIELDED MINIBOX.
3. ALL RESISTORS ARE 1/4 W, 5% CARBON.

628-5816
TP4-2523-011

RF Envelope Detector
Figure 5-4

5.5.1.4 Receiver Squelch

a. Connect rf generator to transceiver antenna connector through a 6-dB pad.
b. Adjust generator for a 34-μV, 118.00-MHz rf signal modulated 30 percent with 1000 Hz.
c. Connect audio power meter to P1-13 and P1-6. Pull VOL/TST knob out and set audio gain to a convenient level on the power meter (do not adjust for more than 50 mW into 500 Ω).
d. Push VOL/TST knob in and observe presence of audio output. Remove generator input signal and observe that squelch mutes audio output.

5.5.1.5 Receiver AGC

a. Connect rf generator to transceiver antenna connector through a 6-dB pad.
b. Adjust generator for a 10-μV, 118.00-MHz rf signal modulated 30 percent with 1000 Hz.
c. Connect audio power meter to P1-13 and P1-6. Adjust VOL/TST knob to provide a convenient indication on power meter (not greater than 50 mW into 500 Ω).
d. Vary rf input level from 10 to 100 000 μV and observe audio power meter indication. Result: Output does not vary more than 6 dB over entire range.

5.5.1.6 Audio Output

a. Connect rf generator to transceiver antenna connector through a 6-dB pad.
b. Adjust generator for a 1000-μV, 118.00-MHz rf signal modulated 30 percent with 1000 Hz.
c. Connect audio power meter to P1-13 and P1-6 and set to 500 Ω.
d. Rotate VOL/TST control clockwise until an output level of 50 mW is reached. Result: 50 mW is within volume control range.
e. Connect audio power meter to P1-12 and P1-6 and set input impedance to 3.2 Ω.
f. Rotate VOL/TST control clockwise until an output level of 5 W is reached. Result: 5 W is within volume control range.

5.5.1.7 Transmitter Power Output

Caution

Observe 1-minute-transmit, 4-minute-receive duty cycle to prevent pa overheating.

a. Connect rf wattmeter to antenna connector.

Note

VHF-250E power output measurement must be measured with a length of coax no longer than 15 cm (6 in) between transceiver and wattmeter.

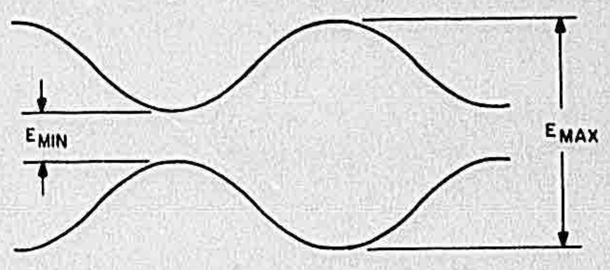
b. Key transmitter and measure unmodulated power output. Result: Output power is at least 7 W (13 W if VHF-250E).

5.5.1.8 Transmitter Modulation

Caution

Observe 1-minute-transmit, 4-minute-receive duty cycle to prevent pa overheating.

a. If an outside antenna is available, perform a talk-out test with another known-good station such as the tower or a flight service station. If this is not possible, perform steps b through d.
b. Connect an audio oscillator to microphone audio input P1-5 through a blocking capacitor (10 to 47 μF, 15 V minimum; positive lead to P1-5).
c. Set audio oscillator to 1000 Hz and adjust output level to 0.5 V rms.
d. Key transmitter by grounding key-line input pin P1-9 and observe modulation depth on oscilloscope or modulation depth monitor. Result: If using modulation depth monitor, modulation must be 80 percent minimum; if using oscilloscope, refer to figure 5-5.



$$\frac{E_{MAX} - E_{MIN}}{E_{MAX} + E_{MIN}} \times 100 \geq 85$$

628-7433

Modulation Depth Calculation
Figure 5-5

Note

If an oscilloscope is used, attenuators must be used between the transceiver and scope input. These attenuators must provide a 50-Ω load for the transceiver and reduce rf output to a level that is an acceptable input level to the scope (rf output may be as much as 155 V p-p). If excessive envelope distortion or low modulation depth is observed, the test should be repeated with additional attenuation added. This ensures that scope input nonlinearity is not introducing error.

5.5.1.9 Transmitter Frequency

Caution

Observe 1-minute-transmit, 4-minute-receive duty cycle to prevent pa overheating.

a. Connect frequency counter to antenna connector through at least 40 dB of power attenuators.
b. Key transmitter (do not modulate) and observe output frequency. Result: Frequency counter indication and selected frequency agree within ±3 kHz (±2 kHz for VHF-250E).

5.5.2 Detailed Performance Testing and Alignment Procedures

Detailed testing and alignment procedures are intended for use in troubleshooting the VHF-250( ) and realigning the repaired circuit after defective components have been replaced. Failure to obtain the specified results indicates a faulty component or misalignment. Use the component location diagrams and schematics located in the diagrams section to supplement test and alignment procedures.

5.5.2.1 Power Supplies

a. Measure voltage at test point A6TP9. Result: +9.5 ±0.05 V dc. If necessary, adjust A6R19 for correct voltage.
b. Measure voltage at test point A6TP8. Result: +5.0 ±0.25 V dc.

5.5.2.2 Frequency Synthesizer

Caution

Observe 1-minute-transmit, 4-minute-receive duty cycle, or use blower on pa.

Note

If directional coupler is not available or does not provide sufficient attenuation to prevent counter damage, additional attenuators should be inserted between transceiver and counter.

a. Connect the rf load to straight-through leg of directional coupler and the frequency counter to attenuation leg of directional coupler. Close ptt switch and measure output frequency with transceiver tuned to 135.000 MHz. Result: Within ±100 Hz of selected frequency.

If the preceding test results are not obtained, perform steps b through e of the synthesizer alignment procedures.

Caution

Observe 1-minute-transmit duty cycle or use blower on pa.

Note

If directional coupler is not available or does not provide sufficient attenuation to prevent counter damage, additional attenuators should be inserted between transceiver and counter.

b. Connect the rf load to straight-through leg of directional coupler and the frequency counter to the attenuation leg of the directional coupler. Channel transceiver to 135.000 MHz. Depress ptt switch and adjust A4C12 until a reading of 135.000 MHz ±100 Hz is observed on the frequency counter.

Note

With the synthesizer card assembly folded out, the frequency should be set 200 to 300 Hz high. Closing the synthesizer chassis will lower the frequency by this amount.

c. Channel transceiver to 118.000 MHz. Adjust A4L102 for 5.0 ±0.05 V at test point A4TP18.
d. Channel transceiver to 135.975 MHz (135.96 in VHF-250S), and adjust A4C105 for 9.0 ±0.05 at test point A4TP18.
e. If tuning A4C105 produces less than 8.950 V, increase A4L102 slightly and repeat steps c and d. Continue this procedure until 5.000 ±0.050 V is obtained at 118.000 and 9.000 ±0.050 V at 135.970 MHz (135.95 MHz in VHF-250S).

Note

Steps f and g should be performed only when components are replaced in low-pass filter.

f. Tune transceiver to 125.000 MHz. Connect wave analyzer to test point A4TP18 using a short (less than 61-cm (24-in)) length of coax. Set wave analyzer for 25 kHz.
g. Observe wave analyzer and adjust A4L2 for null of 25-kHz sideband.

Note

Steps h and i are an alternate method of performing steps f and g. They should be used only when a wave analyzer is not available.

h. Connect rf signal generator to antenna jack and apply a 10,000-μV, 125.025-MHz signal modulated 30 percent with 1000 Hz. Tune transceiver to 125.000 MHz.
i. Connect dvm to AGC test point A2TP1 and observe indication. Adjust A4L2 for minimum AGC voltage.
j. Repeat step a to ensure proper synthesizer operation.

5.5.2.3 Receiver

5.5.2.3.1 Audio Output

Note

Do not operate with more than 5-watt audio output.

Increase volume to maximum and tune transceiver to 125.000 MHz. Connect rf signal generator to antenna jack, and apply a 1000-μV, 125.000-MHz signal modulated 30 percent with 1000 Hz. Observe audio output. Result: Minimum of 5-watt audio output into a 3.2-ohm speaker load.

5.5.2.3.2 Sensitivity

a. Tune the transceiver to 118.000 MHz. Connect rf signal generator to antenna jack. Adjust rf generator for a 3-μV, 118.000-MHz signal and modulate 30 percent with 1000 Hz. Pull out the volume control and set audio phone output for 20 mW (3.16 V rms across 500-ohm load).
b. Measure signal-to-noise ratio (snr) of not less than 8 dB, using a harmonic distortion analyzer or SINAD meter.

Note

The snr measurements should be accomplished by nulling the detected audio signal at modulation frequency and measuring the remainder of the audio output as noise. Due to the audio compressor, the normal modulation-on to modulation-off ratio for snr will indicate much lower sensitivity.

If a distortion analyzer or SINAD meter is not available, ground pin 6 of A2U4 and measure the ratio using the conventional (modulation-on to modulation-off) method. Remember to remove jumper after completion of test.

5.5.2.3.3 Quieting

a. Channel transceiver to 127.600 MHz. Connect rf signal generator to antenna jack and apply a 100-μV, 127.600-MHz unmodulated output signal. Measure audio output and record the measured dB output for reference.
b. Modulate the signal generator output signal 30 percent with 1000 Hz and measure audio output increase in dB. Result: Not less than 30 dB.

Note

If the preceding test results are not obtained, perform preselector and if section alignment procedures.

5.5.2.3.4 Preselector and IF Alignment

a. Channel transceiver to 127.600 MHz. Connect rf signal generator to antenna jack and apply a 127.600-MHz signal modulated 30 percent with 1000 Hz. Connect a dvm to AGC test point A2TP1.
b. Increase generator output level until a 0.1-V increase in AGC voltage is observed.
c. Adjust A2L1, A2L3, A2L5, A2L7, A2L9, and A2L14 (in that order) for maximum AGC voltage while simultaneously reducing generator output level to maintain the 0.1-V increase over the static AGC level. Repeat tuning procedure after initial adjustments have been made.
d. Connect a dvm to gate 2 of rf amplifier Q1 (collector of Q3). Apply a 3-μV, 127.600-MHz signal modulated 30 percent with 1000 Hz to the antenna jack.
e. Adjust rf AGC delay resistor A2R8 for +5.0 ±0.05 V at gate 2 of Q1.

5.5.2.3.5 Squelch

a. Channel transceiver to 118.000 MHz. Connect rf signal generator to antenna jack and apply a 20-μV, 118.000-MHz signal modulated 30 percent with 1000 Hz.
b. With TST knob pushed in, ensure squelch operates when input signal is removed (no noise present in output).
c. If the results of step b are not obtained, perform step d.
d. Apply a 10-μV, 118.00-MHz signal modulated 30 percent with 1000 Hz to the antenna jack. Adjust A2R63 until 1000-Hz signal is present, then readjust until the 1000 Hz just disappears. Reduce input signal well below 10 μV. Slowly increase input until audio just appears, and observe input level. Result: Approximately 10 μV. Readjust A2R63 as required until result is obtained.

5.5.2.3.6 AGC Rise

a. Channel transceiver to 127.600 MHz. Connect rf signal generator to antenna jack, and apply a 10-μV, 127.600-MHz signal modulated 30 percent with 1000 Hz.
b. Monitor audio output voltage while varying generator output between 10 and 20 000 μV. Result: Not more than 3 dB.

c. Monitor audio output voltage while slowly varying generator output between 20 000 and 100 000 μV. Result: Not more than a 6-dB change.

5.5.2.3.7 Selectivity

a. Channel transceiver to 127.600 MHz. Connect rf signal generator to antenna jack and apply a 10-μV, 127.600-MHz unmodulated output signal. Measure AGC at A2TP1 and record for reference.
b. Increase generator output level to 20 μV and vary the frequency above and below 127.600 MHz until the reference voltage is obtained. Read the generator frequency above and below 127.600 MHz. Result: ±8.70 kHz minimum from 127.600 MHz.
c. Increase generator output level to 10,000 μV and vary the frequency above and below 127.600 MHz until the reference level is obtained. Read the generator frequency above and below 127.600 MHz. VHF-250/250E result: ±22.5-kHz maximum from 127.600 MHz. VHF-250S result: ±40-kHz maximum from 127.60 MHz.

5.5.2.3.8 Audio Distortion/Response

5.5.2.3.8.1 VHF-250/250S

a. Channel transceiver to 127.600 MHz. Connect rf signal generator to antenna jack, and apply a 100-μV, 127.600-MHz signal modulated 60 percent with 1000 Hz. Measure the audio distortion for a 5-watt output. Result: Not more than 15-percent distortion.
b. Measure audio response for a 30-percent modulated signal at 350, 1000, and 2500 Hz. Adjust volume control for a 2-watt output at 1000 Hz before observing variation. Result: No more than 6-dB variation between modulating frequencies.

5.5.2.3.8.2 VHF-250E

a. Channel transceiver to 127.600 MHz. Connect rf signal generator to antenna jack and apply a 100-μV, 127.60-MHz signal modulated 60 percent with 1000 Hz. Measure the audio distortion for a 5-watt output. Result: Not more than 15-percent distortion.
b. Measure audio response for a 30-percent modulated signal over a frequency range of 350 to 2500 Hz. Adjust volume control to 2 watts at 1000 Hz before observing variation. Result: Not more than 6-dB variation over range.
c. Measure audio response at 5000 Hz. Result: Output at least 18 dB below that at 1000 Hz.

5.5.2.3.9 Auxiliary Audio Inputs

a. Remove rf signal generator from antenna jack.
b. Apply a 1.5-V rms, 1000-Hz audio signal to each auxiliary input (J1 pins 17, 18, 19, 20). Result: Not less than 1.0-V rms audio output at J1-13 into 500-ohm load.

5.5.2.4 Transmitter

5.5.2.4.1 Transmitter Power Output

Note

When measuring VHF-250E power output, coax connecting transceiver to wattmeter must not exceed 15 cm (6 in) in length.

a. Connect rf wattmeter and rf load to the antenna jack. Key the transmitter and record unmodulated carrier power output for each of the following frequencies: 118.000, 127.600, and 135.975 MHz (135.95 MHz in VHF-250S). Result: VHF-250/250S, not less than 8-W output; VHF-250E not less than 13-W output. If necessary, perform the alignment procedure of step b to obtain correct results.

Caution

Observe 1-minute-transmit, 4-minute-receive duty cycle, or use blower to cool power amplifier.

b. Tune the transceiver to 135.975 MHz (135.95 MHz in VHF-250S) and peak capacitor A3C15 for a maximum output indication. Switch transmitter to 118.000 MHz and check for approximately the same output as that at 135.975 MHz (135.95 MHz in VHF-250S). Readjust A3C15, if necessary, to obtain an equal output at both frequencies.

5.5.2.5 Modulator

5.5.2.5.1 Modulation Level

a. Channel transceiver to 118.000 MHz. Connect directional coupler to antenna jack. Connect rf load to straight-through leg of coupler and oscilloscope to attenuation leg of coupler. Apply 0.5 V rms at 1000 Hz to transceiver audio input (P1-5).
b. Key transmitter and observe modulation envelope on scope. Result: 87 to 95 percent modulation.

Repeat for frequencies of 127.600 and 135.975 MHz (135.95 MHz in VHF-250S). If necessary, perform the alignment procedures of step c to obtain correct results.

c. Connect transceiver to test equipment as described in step a. Apply a 0.5-V rms, 1000-Hz audio signal to the audio input (P1-5). Channel the transceiver to 127.600 MHz. Key transmitter and observe modulation envelope. Adjust A2R67 to obtain a point where negative audio peak clipping is just beginning to occur on the rf envelope. It should not be possible to overmodulate the transmitter.

5.5.2.5.2 Envelope Distortion/Carrier Noise

a. Channel transceiver to 127.600 MHz. Connect directional coupler to antenna jack. Connect rf load to straight-through leg of coupler and envelope detector to attenuation leg of coupler. Connect distortion analyzer to envelope detector.
b. Apply a 0.5-V rms at 1000 Hz to the transceiver audio input (P1-5). Key transmitter and measure audio distortion. Result: Not more than 15 percent distortion.
c. Increase audio input signal to 1.5 V rms and observe that modulation is limited to less than 97 percent.
d. Remove modulating input signal and measure carrier noise level. Result: Not less than 40 dB below audio output reference recorded in step b.

5.5.2.6 Sidetone

a. Channel transceiver to 127.600 MHz. Connect rf load to antenna jack and apply a 0.5-V rms, 1000-Hz signal to the audio input (P1-5).
b. Key transmitter and observe audio output at P1-13. The sidetone output level may be adjusted with A6R6 to suit pilot preference.

5.6 SERVICE TIPS AND TROUBLESHOOTING

The following paragraphs are included to aid the technician in understanding and troubleshooting the more difficult sections of the VHF-250/250S/250E Communications Transceiver. Major emphasis is placed on the receiver and synthesizer portions of the radio and systems problems that will degrade overall performance.

5.6.1 Receiver VHF Section

5.6.1.1 Preselector

The preselector is double-tuned and varactor-tracked. The primary function is to attenuate off-channel signals to minimize cross-modulation and to reject image frequency signals. Minor problems in the preselector will result in degraded signal-to-noise ratio; a major failure will result in a very weak or completely dead receiver.

Back-to-back, high-speed diodes across the preselector input (CR8 and CR9) clip high-level rf signals that exist when transmitting with another vhf COMM. Failure of one or both of these diodes may result in the input tank varactors being pumped into parametric oscillation by transmitter energy from another COMM. The result of this parametric oscillation may be observed in the aircraft navigation receiver. In most installations experiencing parametric oscillation, interference will be generated on the navigation band that will result in a NAV flag even though the selected NAV signal is reliable. Identification of the parametric oscillation can be accomplished by switching off the nonkeyed COMM while observing the NAV indicator. If the flag goes out of view when the COMM is switched off, parametric oscillation exists.

5.6.1.2 RF Amplifier Q1

The rf amplifier increases vhf signal gain so the signal applied to the mixer can overcome mixer-induced noise. The rf amplifier will run at a maximum gain of about 20 dB until the input signal becomes large enough to produce about a 30-dB, signal-to-noise ratio. When the 30-dB level is obtained, AGC will begin reducing Q1 gain to prevent if overloading. A low-gain rf amplifier will degrade the receiver signal-to-noise ratio.

5.6.1.3 Interstage

The vhf interstage is a double-tuned, varactor-tracked network that attenuates off-channel signals to minimize spurious responses (especially at the image frequency). A fault in the interstage will result in inadequate quieting (quieting is the silencing of the receiver front-end noise when a carrier is received).

5.6.1.4 Mixer Q2

The mixer translates the incoming vhf signal down to the 10.5-MHz intermediate frequency. A low-gain mixer stage will result in inadequate quieting. The networks on the local oscillator injection gate and on the mixer drain are critical to avoid undesired mixer oscillation or regeneration. Oscillation may totally block the receiver (this may occur only with application of a very strong signal), which regeneration may degrade audio quality due to excessive passband ripple.

5.6.2 Receiver IF Section

5.6.2.1 Crystal Filter FL1

Receiver selectivity is concentrated in an 8-pole crystal filter that provides extremely sharp band edges. The -6-dB points are at least 10 kHz from the nominal channel, and the -60-dB points are no more than 20 kHz from the nominal frequency. To achieve the proper frequency response, the crystal filter must be properly matched at both the input and output terminals. Any change in the matching networks may result in complaints such as excessive background noise or poor audio quality. These symptoms both result from excessive amplitude ripple in the passband. To test for excessive passband ripple, apply a 100-μV signal, and slowly move the signal frequency across the receiver passband while monitoring the AGC voltage. Note the minimum and maximum AGC voltages (do not count AGC voltages when the signal is on the steep slopes at the edges of the passband). Return to the frequency at which the minimum AGC voltage was observed, and increase the signal generator attenuator setting until the AGC voltage is the same as the maximum observed. The attenuator change is equal to the passband ripple. It should not exceed 3 dB. In addition to problems in the matching networks, regeneration in the mixer or regeneration due to a severely mistuned if interstage network are known to cause excessive passband ripple.

5.6.2.2 IF Amplifier

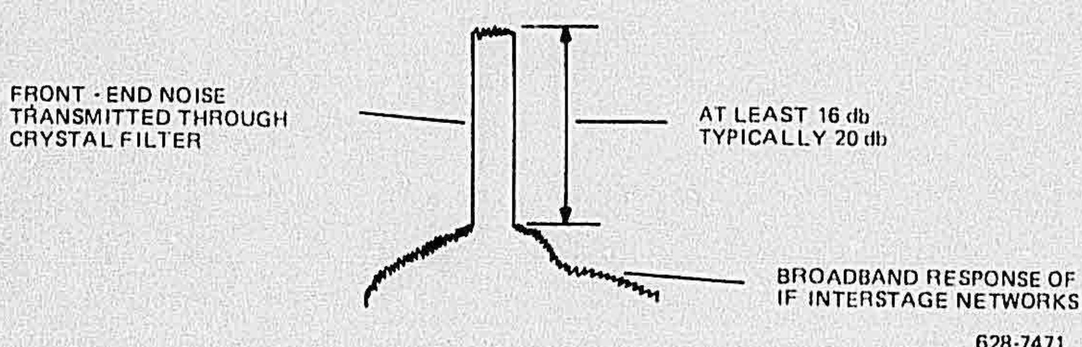
The if amplifier section, consisting of U1 and U2, is capable of producing over 100 dB of gain. The gain is high enough that AGC will cause some gain reduction with only noise present in the absence of any signal. This characteristic is essential for proper noise squelch operation. The total gain of the receiver must be distributed so that the bulk of the no-signal noise reaching the detector is generated by the front-end, rf amplifier, and mixer. If a spectrum analyzer is loosely coupled to the detector with a small loop probe, the picture, with no signal, should be as shown in figure 5-6. If the front-end noise pedestal is too low, the problem is low gain in the rf amplifier or mixer due to a defective transistor or a defect in some associated component. A value change in one or more capacitors in an if interstage network might also cause this problem. If the noise pedestal is decidedly off the peak of the if broadband response, the problem is most likely a defective component in the interstage network between the second if amplifier and the detector (most often L15). This condition often leads to regeneration, producing excessive passband ripple.

5.6.2.3 Detector Q6

Detector Q6 is a high-frequency transistor that is held on the verge of conduction by diode CR10. Any rf upswing turns the transistor on, while downswings hold Q6 off. The detector conducts for half of each rf cycle; therefore, the base-emitter circuit becomes a half-wave rectifier. Capacitor C32 filters rf current at the collector. Changes in the bias circuits or performance of Q6 will result in distorted or weak operation, while complete failure will result in a dead radio.

5.6.2.4 AGC

Receiver AGC is a feedback control system that tries to hold the average voltage at the collector of Q6 equal to the reference voltage at U3B-5 (7.0 V dc). When the receiver is operating properly, front-end noise will be sufficient to lower the detector collector average voltage below the reference level established by R49 and R50. This results in AGC gain reduction with no input signal; this characteristic is essential for proper squelch operation. With this circuit configuration, no-signal AGC voltage at TP1 provides a quick check indication of receiver gain. If gain is adequate (includes



Crystal Filter Passband for No-Signal Condition
Figure 5-6

all circuits between the antenna and the AGC amplifier), the level at TP1 will be at least 4.200 V dc with no signal applied.

Potentiometer R8 is adjusted to set the collector of delay transistor Q3 at 5.0 V with a 3-μV signal applied. This sets the rf amplifier stage for maximum gain. As the signal strength increases, the AGC voltage increases, and the collector voltage decreases.

The gain of Q1 does not diminish appreciably, however, until the collector of Q3 drops to about 3 V. This delayed AGC action keeps the gain of the rf amplifier high until the signal is strong enough to guarantee a good signal-to-noise ratio. At very high signal levels, the gain of Q1 is reduced about 30 dB to avoid overloading the if amplifier. The setting of R8 may be adjusted slightly to improve overload performance without significantly changing the signal-to-noise ratio for small signals. Defects in the AGC feedback loop are isolated by monitoring the voltages at TP1 and the collector of delay transistor Q3 while the rf input level is varied. Low dc voltage supplied by Q6 collector causes AGC voltage at TP1 to increase; increased voltage at TP1 reduces the gain of U1 and U2. As AGC voltage continues to increase, the collector voltage of Q3 will begin to decrease. When a 3.0-V dc level or lower is reached, Q1 gain will be reduced.

5.6.3 Squelch

The VHF-250( ) squelch circuits consist of a carrier (AGC) actuated squelch that is coupled to a Schmitt trigger to control audio passage to the compressor and final audio output stages.

The first step in troubleshooting a radio that exhibits squelch related problems is to ensure that the circuits on which squelch operation is dependent are operating properly. The receiver gain must be high enough that detected noise alone causes some AGC gain reduction; the receiver must be "into AGC on noise." Once front-end operation has been verified as being normal, squelch operation can then be diagnosed.

5.6.3.1 Carrier Squelch

The carrier squelch is a voltage discriminator with reference and variable voltage inputs. The reference voltage is set on the bench for the desired rf input threshold (approximately 10 μV), and AGC provides the variable input. When a signal is received, AGC voltage will increase to control receiver gain. When the threshold at the discriminator is exceeded, the carrier squelch will open.

5.6.3.2 Schmitt Trigger

The Schmitt trigger provides the high-speed switching required to achieve a positive on/off audio path that is free from flutter. Hysteresis is designed into the trigger to prevent flutter that would normally occur with small level variations. The trigger is provided with positive feedback to provide a latching action. The latching action is such that the positive voltage applied to U4A pin 2 must rise to approximately 4.7 V before the trigger sets (allows audio to pass). Once the trigger has been set, the input must be reduced well below the set voltage before the trigger will reset (block the audio path). The input level required to reset the trigger once it has been set must be 1.9 V dc or less.

5.6.3.3 DC Amplifier U4D

Dc amplifier U4D increases the rectifier output to provide the drive required to control Schmitt trigger U4A.

5.6.4 Transmitter-Distorted Modulation Problems

If a pilot gets reports of distorted modulation, the transmitter should be submitted to a talk-out test. The receiver used for the test must be a narrow-band receiver, such as another VHF-250( ) or VHF-251( ). The test can usually be run by transmitting into a dummy load and using a COMM antenna on the receiver placed a few feet away. The dummy load will usually leak enough signal for the test. Continuously tuned, aircraft-band receivers cannot be used for this test since their broadband receivers will not show up the most common cause of severe distortion (synthesizer frequency modulation). If the transmitter, itself, is the cause of a complaint, the fault will probably be due to low drive to the final transistor (Q4), failure of CR2 (so driver Q3 is not modulated upward), or failure of C24 or C26. The low impedances and high rf currents in a solid-state transmitter make signal tracing difficult. A scope probe anywhere near the transmitter generally picks up enough stray rf signal that it is difficult to locate a weak stage. Modulator problems may be detected by applying a 0.5-V rms, 1000-Hz signal to the microphone input (through a 10-μF blocking capacitor) and keying the transmitter while observing lug 10 of relay A1K1 with an oscilloscope. Set the modulation control (R67 on the receiver board) for a 25-V p-p signal. The scope trace should be a sine wave with less than 8-percent distortion. Flattening of one peak suggests a defective modulator transistor. Symmetrical distortion suggests a defective transformer or a defect in audio amplifier U5 (receiver card) or its associated components. If the modulating signal appears clean, check the rf envelope by attenuating the transmitter output and observing it with a high-frequency scope. Lack of upward modulation indicates inadequate drive to the final transistor, usually caused by a defective driver or preamplifier stage. In addition to the transmitter, itself, other system problems may be the cause of distorted transmission symptoms. Figure 5-7 is a flow diagram that provides a systematic procedure for isolating distorted transmission problems.

5.6.5 Synthesizer

Most complaints of distorted modulation have been traced to excessive frequency modulation of the synthesizer while transmitting. This undesired frequency modulation results from rf current from the transmitter leaking back to the synthesizer. In the absence of modulation, the synthesizer frequency control circuits correct for the effects of leakage currents. The varying rf currents during modulation, however, may affect the voltage-controlled oscillator at a rate too great for the feedback circuits to control. The average frequency is correct but, because of frequency modulation, the transmitted signal may rapidly move in and out of the passband of the distant receiver. This results in severe distortion of the received signal. This distortion is not visible if the modulation envelope of the transmitted signal is viewed on an oscilloscope. If a spectrum analyzer is available, a frequency modulation problem may be confirmed by modulating the transmitter about 90 percent with a 1000-Hz signal, attenuating the transmitted signal, and observing the spectrum. If the -30-dB points on the spectrum envelope are more than 15 kHz apart, frequency modulation is excessive. An alternate method for observing frequency modulation is to connect a short, insulated wire to pin 6 of U5 on the synthesizer card. This is the phase detector output. Replace the synthesizer cover, routing the wire out through one of the small relief holes at the lower edge. Replace and tighten all screws. Connect a scope probe to the short wire. Use delayed sweep, with a horizontal display of 10 ns/division. Sync the scope to the rising edge of the pulse waveform, and adjust the delay to observe the falling edge. When receiving or when transmitting without modulation, the falling edge should be very stable in time. When transmitting with modulation, a properly operating transceiver exhibits less than 10 ns of jitter of the falling edge. Transmitters which sound distorted due to excessive frequency modulation generally exhibit more than 20 ns of falling edge jitter. This jitter shows up as smearing of the vertical line (falling edge) on the scope.

Generally, VHF-250( ) Service Bulletin No 1 has eliminated the major cause of synthesizer FM; however, the following defects may also cause this problem:

a. Improperly plated synthesizer chassis. (This can normally be detected by placing a sheet of copper foil or shim stock, with clearance holes for the synthesizer cover screws, in the synthesizer chassis.)
b. Loose or missing hardware, particularly that securing the synthesizer chassis to the unit frame and the screws holding synthesizer cover in place.
c. Defective dipped mica capacitors in the vco and buffer circuits and in the transmitter.

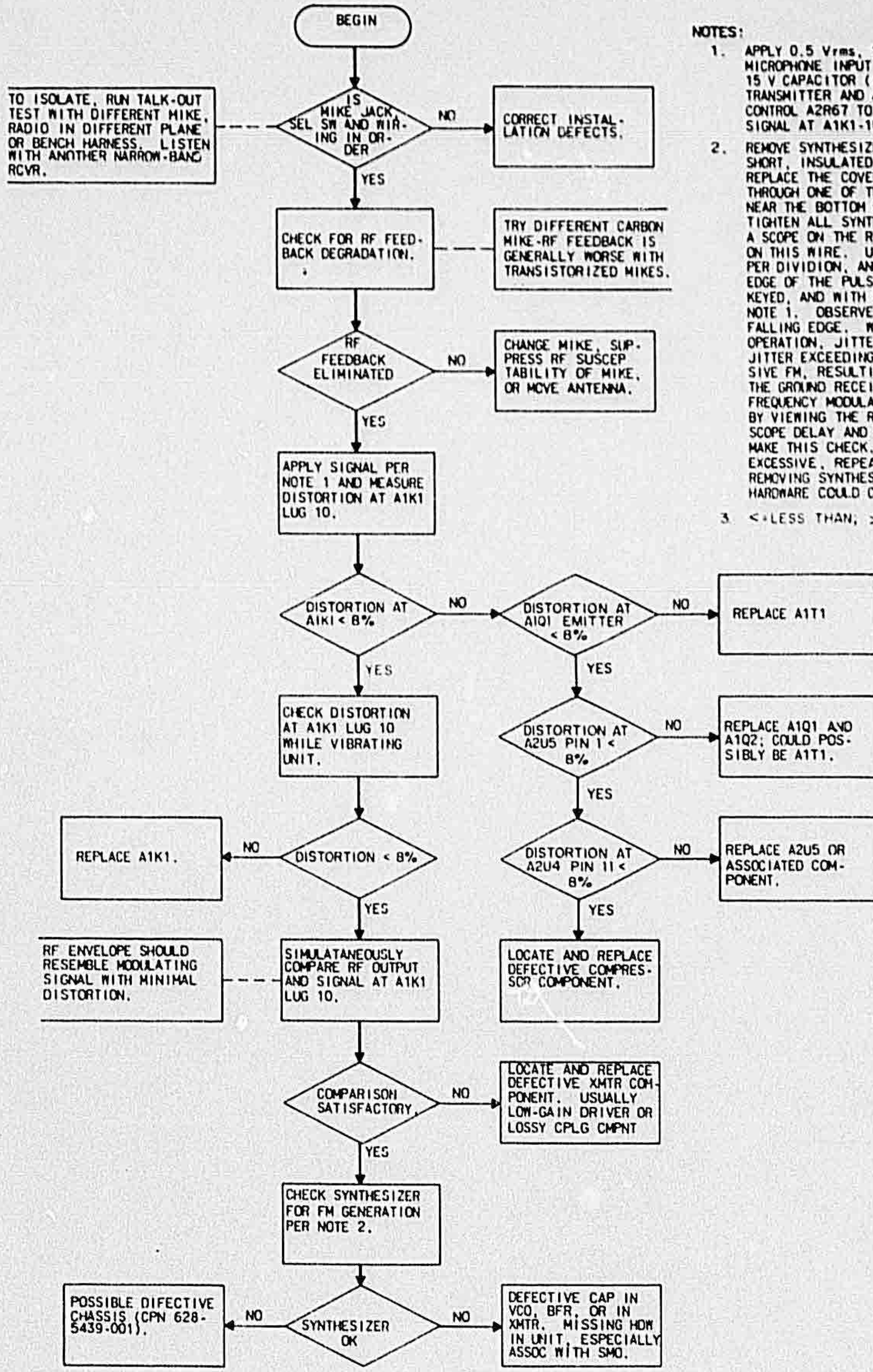
An additional source of frequency modulation, which probably would not be observed on the bench, is antenna-radiated rf signal re-entering the transceiver through the cables or the case, and affecting the voltage controlled oscillator. This problem most often occurs in helicopters and fabric-skin airplanes, but is occasionally encountered in metal airplanes, also.

This effect is often frequency sensitive: transmissions in some frequency ranges may be garbled, while in other ranges they are clear. The problem will not be observed while the transmitter operates into a shielded dummy load on the bench.

Correcting this problem requires improving the shielding around the voltage controlled oscillator, plus improving the grounding of the unit antenna connector. See service bulletin XX for implementation information.

5.6.6 RF Generator Leakage

Many signal generators leak appreciable amounts of signal out through the case. If the VHF-250( ) is open near the signal generator, the leakage field flooding the receiver may add substantially to the signal coming through the coax. A squelch threshold set in this environment will actually be higher than intended. (A higher level input signal will be required to open the squelch.) This effect will show up if the squelch threshold is rechecked with the receiver cover back in place. A higher threshold than that which was



NOTES:

1. APPLY 0.5 Vrms, 1000 Hz SIGNAL TO MICROPHONE INPUT (P1-5) THROUGH 10 uV, 15 V CAPACITOR (+SIDE TO P1-5). KEY TRANSMITTER AND ADJUST MICROPHONE GAIN CONTROL A2R67 TO PRODUCE A 25 Vp-p SIGNAL AT A1K1-10.
2. REMOVE SYNTHESIZER COVER AND CONNECT A SHORT, INSULATED WIRE TO A4U5-6. REPLACE THE COVER, ROUTING THE WIRE OUT THROUGH ONE OF THE SMALL RELIEF HOLES NEAR THE BOTTOM EDGE. REPLACE AND TIGHTEN ALL SYNTHESIZER SCREWS. SYNC A SCOPE ON THE RISING EDGE OF THE PULSE ON THIS WIRE. USE DELAYED SWEEP, 10 ns PER DIVIDION, AND EXAMINE THE FALLING EDGE OF THE PULSE WITH THE TRANSMITTER KEYED, AND WITH MODULATION APPLIED AS IN NOTE 1. OBSERVE THE TIME JITTER OF THE FALLING EDGE. WITH PROPER SYNTHESIZER OPERATION, JITTER SHOULD NOT ESCEED 10 ns JITTER EXCEEDING 20 ns INDICATES EXCESSIVE FM, RESULTING IN GARBLED AUDIO AT THE GROUND RECEIVER. THIS AMOUNT OF FREQUENCY MODULATION CANNOT BE OBSERVED BY VIEWING THE RF OUTPUT ON A SCOPE. SCOPE DELAY AND SYNC MUST BE STABLE TO MAKE THIS CHECK. IF JITTER IS NOT EXCESSIVE, REPEAT TALK-OUT TEST BEFORE REMOVING SYNTHESIZER COVER (LOOSE HARDWARE COULD CAUSE SYNTHESIZER FM).
3. < = LESS THAN; > = GREATER THAN

628-7463

Distorted Transmission Troubleshooting
Figure 5-7

originally set indicates generator case leakage. Another way to detect case leakage is to disconnect the signal coax from the receiver and monitor the AGC voltage while moving the open receiver around the generator. If the generator case is leaking, the AGC voltage will fluctuate more than the normal 5-mV movement due to normal noise fluctuations. To adjust squelch threshold with a leaky signal generator, connect the generator to the case with 6 m (20 ft) of RG-58 coax, and keep the generator about 6 m (20 ft) from the receiver while making the adjustment. The 6 m (20 ft) of good RG-58 coax with properly fitted connectors will introduce about 1 dB of loss. The attenuator setting must be increased 1 dB to compensate for this. To get 10 μV, set 11.2 μV; to get 20 μV, set 22.5 μV.

5.6.7 Hard Vs Soft Microvolts

All rf input levels specified for the testing and alignment of the VHF-250( ) are in hard microvolts; this is a measure of electromotive force. Since signal generator attenuator dials are calibrated in soft microvolts (the voltage actually seen across the output connector will agree with the attenuator only when the generator is loaded with its design load impedance), an additional device must be used to ensure a constant load impedance on the generator. Loading the generator with this constant impedance ensures that regardless of the input impedance of the unit under test, the attenuator dial setting will always be equivalent to the actual generator output, that is, hard microvolts. To use the signal generator attenuator readings as hard microvolts (what you see is what you get), a 50-Ω, 6-dB pad must be connected between the generator and the transceiver under test. If a 50-Ω, 6-dB pad is not available, the attenuator dial should be set to half the desired output in microvolts (6-dB-lower signal level).

Collins VHF-250/250S/250E Communications Transceiver

Rockwell International

diagrams

Collins General Aviation Division

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NOTICE: This section replaces second edition dated 1 November 1978.

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*6-46C thru 6-46F Added	2 Aug 84
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Record of Revisions

RETAIN THIS RECORD IN THE FRONT OF MANUAL.
ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS.

REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	1 Nov 76		None				
2nd Ed	1 Nov 78		SB 1, 2, 3 SIL 1-77, 2-77				
3rd Ed	2 Aug 84		SB 4, 5, 6 SIL 1-80, 2-80				

section VI
diagrams

6.1 CONFIGURATION STATUS CONTROL

Collins General Aviation Division of Rockwell International uses the following method of identifying the configuration status of a unit or subassembly.

A 2-character maximum alphabetic identifier will be preceded by the letters REV (revision) and will start with — if no changes have been processed. The first change will be identified as A, the second as B, and continuing through Z to AA, AB, and ultimately to ZZ. Incorporation of design changes in a unit or subassembly that has been returned to Rockwell-Collins for repair by a customer or that has been removed from the company's finished goods inventory is defined as rework. At the time of rework, the unit or subassembly will be marked again to reflect the design level to which it is being upgraded. This is done by leaving the original marking on the unit or subassembly and adding the letters RWK (rework) followed by the alphabetic identifier of the latest change incorporated in the rework. For example, unit one is marked REV B — RWK F and unit two is marked REV F. This indicates that both units are at the design level of revision F, but unit one is reworked and they may not look exactly the same.

Note

A reworked unit may not contain all design changes made to the reworked identifier, but does contain all changes required to make unit operation identical to a newly manufactured unit with the same identifier. Therefore, a unit reworked to a specific identifier may physically appear different from a newly manufactured unit with the same alphabetic identifier.

Only alphabetic identifiers that result in schematic changes are covered in this section. If a unit or subassembly has an identifier that alphabetically falls between identifiers on the schematic changes page, or after the last identifier on the schematic changes page up to and including the latest effectivity listed below, the electrical configuration is represented by the earlier identifier listed on the schematic changes page.

6.2 SCHEMATIC DIAGRAMS

The schematic diagrams and component location diagrams are provided in figures 6-1 through 6-17.

A schematic changes sheet precedes each schematic. This sheet provides a description of each schematic change, a reason for the change, the service bulletin number (if applicable) that modifies the unit, and the production cut-in effectivity for the change. Component locations are provided on facing pages.

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
	(This page will contain schematic revision information.)		

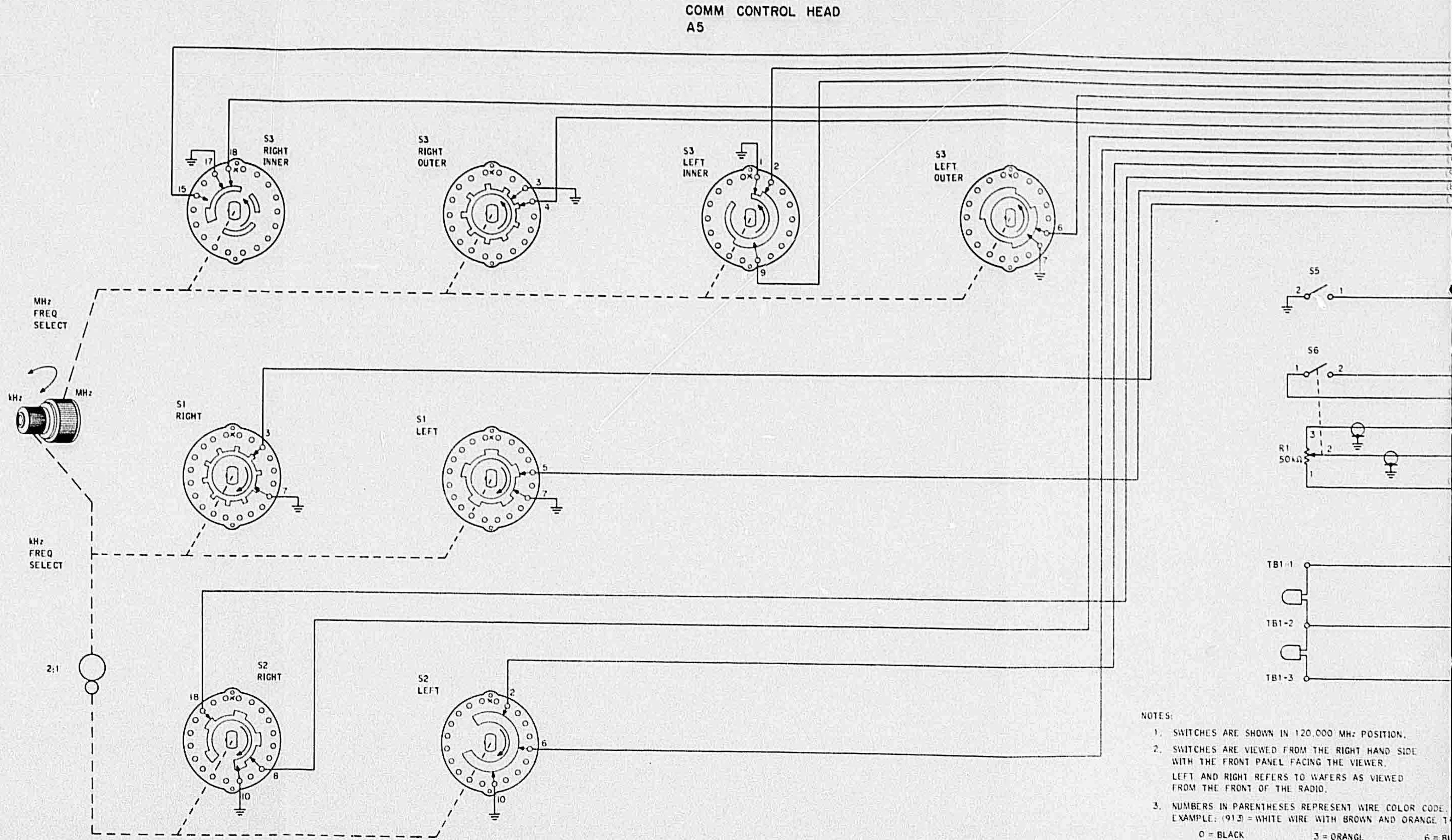
VHF-250/250E COMM Control Head A5, Schematic Diagram
Figure 6-1 (Sheet A)

PARTS LIST
VHF-250/250E CONTROL HEAD A5
NO TOP LEVEL ASSEMBLY

SYMBOL	DESCRIPTION	COLLINS PART NUMBER
DS1	LAMP, 14V, T1 1/4	262-1398-030
DS2	LAMP, 14V, T1 1/4	262-1398-030
R1	SWITCH/POT ASSEMBLY	628-6253-003
	CONTAINS: RESISTOR, VARIABLE, 50kΩ	376-0270-060
	PIN, COILED	311-0438-000
S1	WAFER SWITCH	269-2664-050
S2	WAFER SWITCH	269-2664-060
S3	WAFER SWITCH	269-2664-040
S4	NOT USED	
S5	SLIDE SWITCH, SPST	266-0223-010
S6	SWITCH, SPST, PART OF ASSEMBLY	376-0270-040

CONTROL LOGIC

FREQUENCY	BINARY CODE 8	4	2	1
	10 MHz			
11X.XXX	X	X	0	1
12X.XXX	X	X	1	0
13X.XXX	X	X	1	1
	1 MHz			
1.XXX	0	0	0	1
2.XXX	0	0	1	0
3.XXX	0	0	1	1
4.XXX	0	1	0	0
5.XXX	0	1	0	1
6.XXX	0	1	1	0
7.XXX	0	1	1	1
8.XXX	1	0	0	0
9.XXX	1	0	0	1
0.XXX	0	0	0	0
	0.1 MHz			
0.0XX	0	0	0	0
0.1XX	0	0	0	1
0.2XX	0	0	1	0
0.3XX	0	0	1	1
0.4XX	0	1	0	0
0.5XX	0	1	0	1
0.6XX	0	1	1	0
0.7XX	0	1	1	1
0.8XX	1	0	0	0
0.9XX	1	0	0	1
	25 kHz			
0.X00	X	X	0	0
0.X25	X	X	0	1
0.X50	X	X	1	0
0.X75	X	X	1	1



NOTES:

1. SWITCHES ARE SHOWN IN 120.000 MHz POSITION.
2. SWITCHES ARE VIEWED FROM THE RIGHT HAND SIDE WITH THE FRONT PANEL FACING THE VIEWER.

   LEFT AND RIGHT REFERS TO WAFERS AS VIEWED FROM THE FRONT OF THE RADIO.
3. NUMBERS IN PARENTHESES REPRESENT WIRE COLOR CODE. EXAMPLE: (913) = WHITE WIRE WITH BROWN AND ORANGE T[illegible]

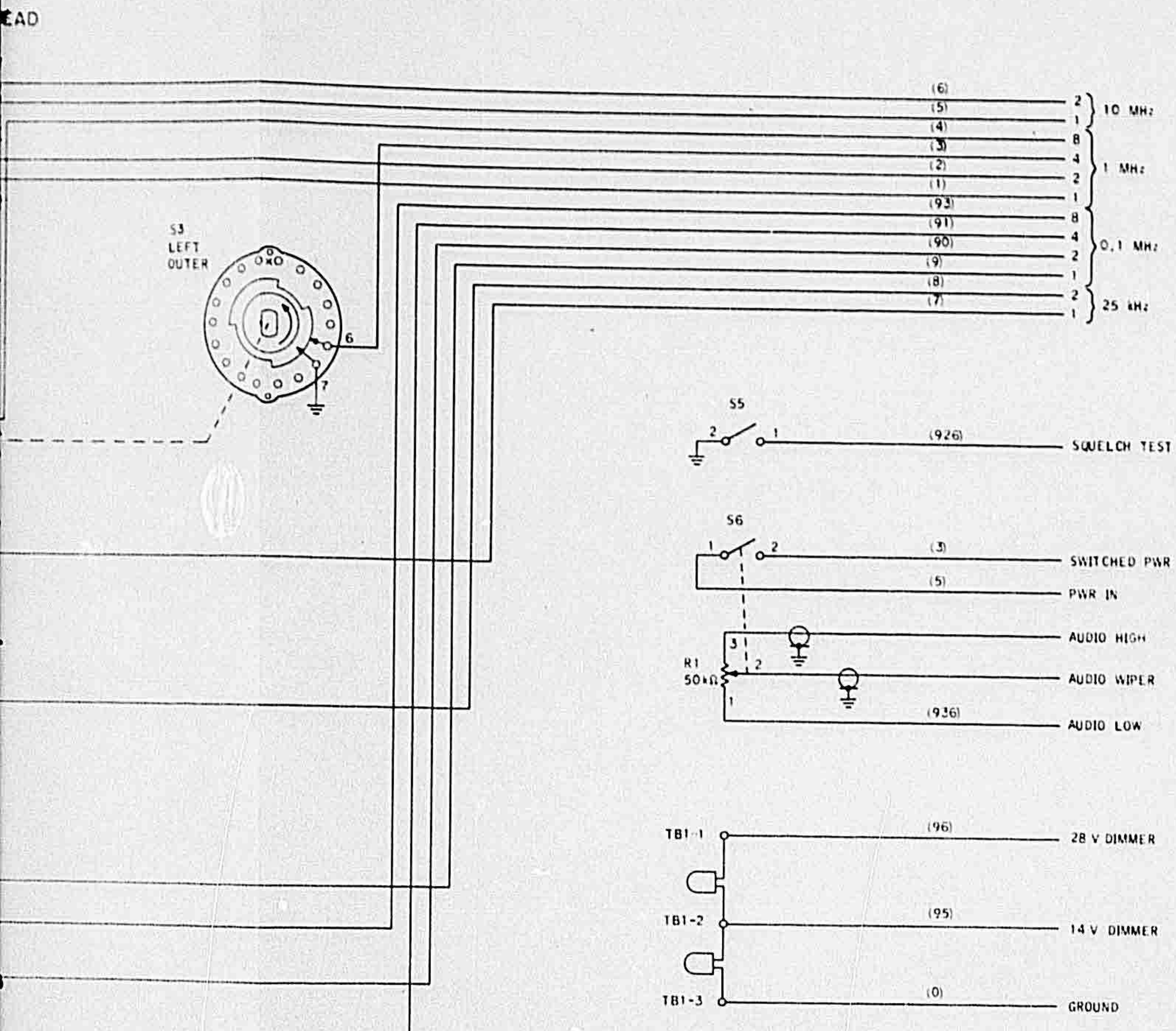
0 = BLACK	3 = ORANGE	6 = BL[illegible]
1 = BROWN	4 = YELLOW	7 = VI[illegible]
2 = RED	5 = GREEN	8 = GR[illegible]

VHF-250/250E
Sche[illegible]

SEE BLOW–UP FICHE NO. CLQ302 - ITEM 1

Revised 1 November 19[illegible]

SEE BLOW–UP FICHE NO. CLQ[illegible]



NOTES:

1. SWITCHES ARE SHOWN IN 120,000 MHz POSITION.
2. SWITCHES ARE VIEWED FROM THE RIGHT HAND SIDE WITH THE FRONT PANEL FACING THE VIEWER.
   LEFT AND RIGHT REFERS TO WAFERS AS VIEWED FROM THE FRONT OF THE RADIO.
3. NUMBERS IN PARENTHESES REPRESENT WIRE COLOR CODE.
   EXAMPLE: (913) = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

0 = BLACK	3 = ORANGE	6 = BLUE	9 = WHITE
1 = BROWN	4 = YELLOW	7 = VIOLET	
2 = RED	5 = GREEN	8 = GRAY	

628-6225
TP4-6532-015

VHF-250/250E COMM Control Head A5,
Schematic Diagram
Figure 6-1

SEE BLOW-UP FICHE NO. CLQ302 - ITEM J

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
	(This page will contain schematic revision information.)		

VHF-250S COMM Control Head A5, Schematic Diagram
Figure 6-2 (Sheet A)

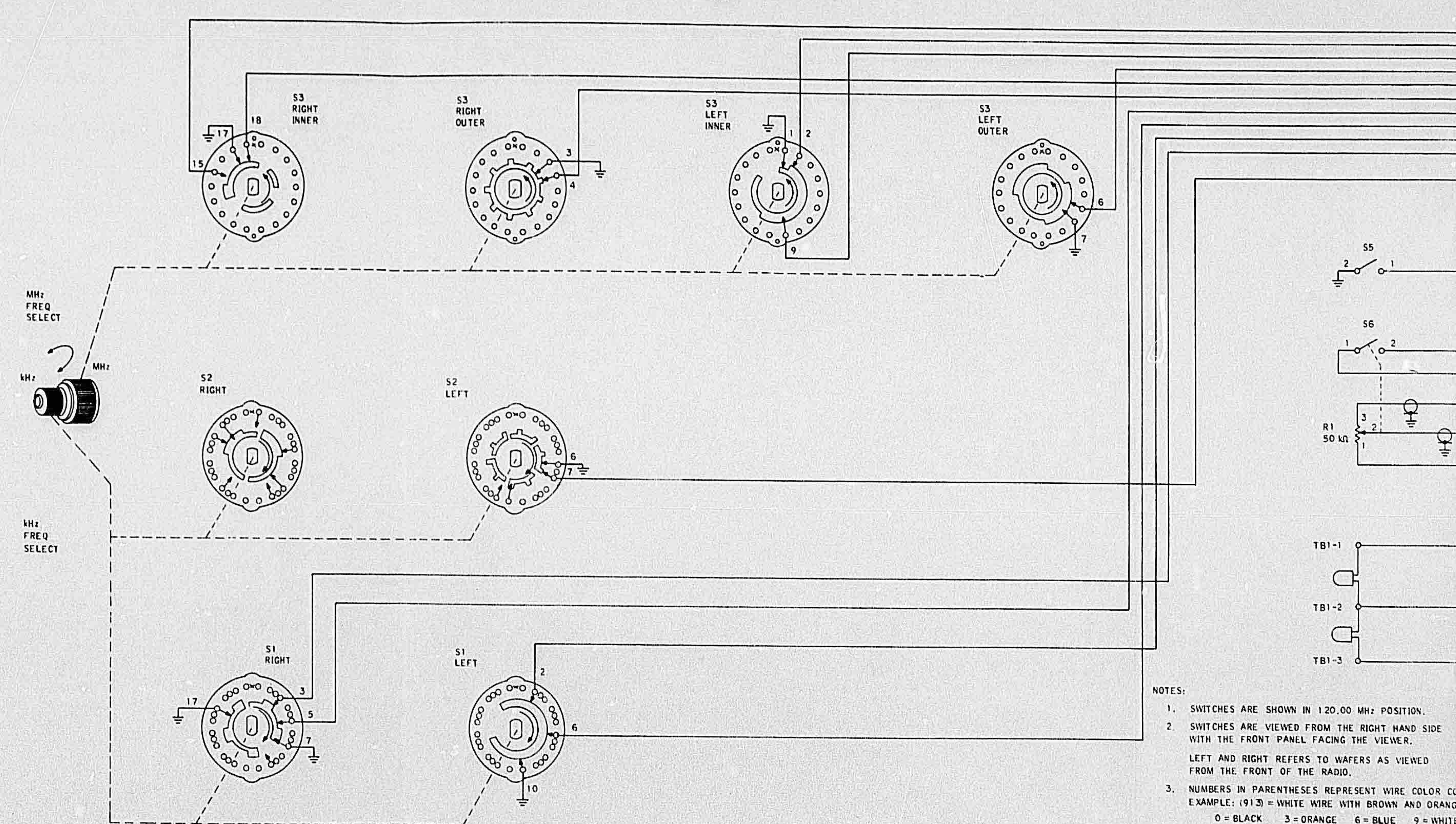
PARTS LIST
VHF-250S CONTROL HEAD A5
NO TOP LEVEL ASSEMBLY

SYMBOL	DESCRIPTION	COLLINS PART NUMBER
DS1	LAMP, 14V, T1 1/4	262-1398-030
DS2	LAMP, 14V, T1 1/4	262-1398-030
R1	SWITCH POT ASSEMBLY	628-6253-003
	CONTAINS: RESISTOR, VARIABLE, 50kΩ	376-0270-060
	PIN, COILED	311-0438-000
S1	WAFER SWITCH	269-2664-020
S2	WAFER SWITCH	269-2664-030
S3	WAFER SWITCH	269-2664-040
S4	NOT USED	
S5	SLIDE SWITCH, SPST	266-0223-010
S6	SWITCH, SPST, PART OF ASSEMBLY	376-0270-040

COMM CONTROL HEAD
A5

CONTROL LOGIC

FREQUENCY	BINARY CODE 8	4	2	1
	10 MHz			
110.XXX	X	X	0	1
120.XXX	X	X	1	0
130.XXX	X	X	1	1
	1 MHz			
1.XXX	0	0	0	1
2.XXX	0	0	1	0
3.XXX	0	0	1	1
4.XXX	0	1	0	0
5.XXX	0	1	0	1
6.XXX	0	1	1	0
7.XXX	0	1	1	1
8.XXX	1	0	0	0
9.XXX	1	0	0	1
0.XXX	0	0	0	0
	0.1 MHz			
0.0XX	0	0	0	0
0.1XX	0	0	0	1
0.2XX	0	0	1	0
0.3XX	0	0	1	1
0.4XX	0	1	0	0
0.5XX	0	1	0	1
0.6XX	0	1	1	0
0.7XX	0	1	1	1
0.8XX	1	0	0	0
0.9XX	1	0	0	1
	50 kHz			
0.X0	X	X	X	0
0.X5	X	X	X	1



NOTES:

1. SWITCHES ARE SHOWN IN 120.00 MHz POSITION.
2. SWITCHES ARE VIEWED FROM THE RIGHT HAND SIDE WITH THE FRONT PANEL FACING THE VIEWER.

   LEFT AND RIGHT REFERS TO WAFERS AS VIEWED FROM THE FRONT OF THE RADIO.
3. NUMBERS IN PARENTHESES REPRESENT WIRE COLOR CO
   EXAMPLE: (913) = WHITE WIRE WITH BROWN AND ORANG

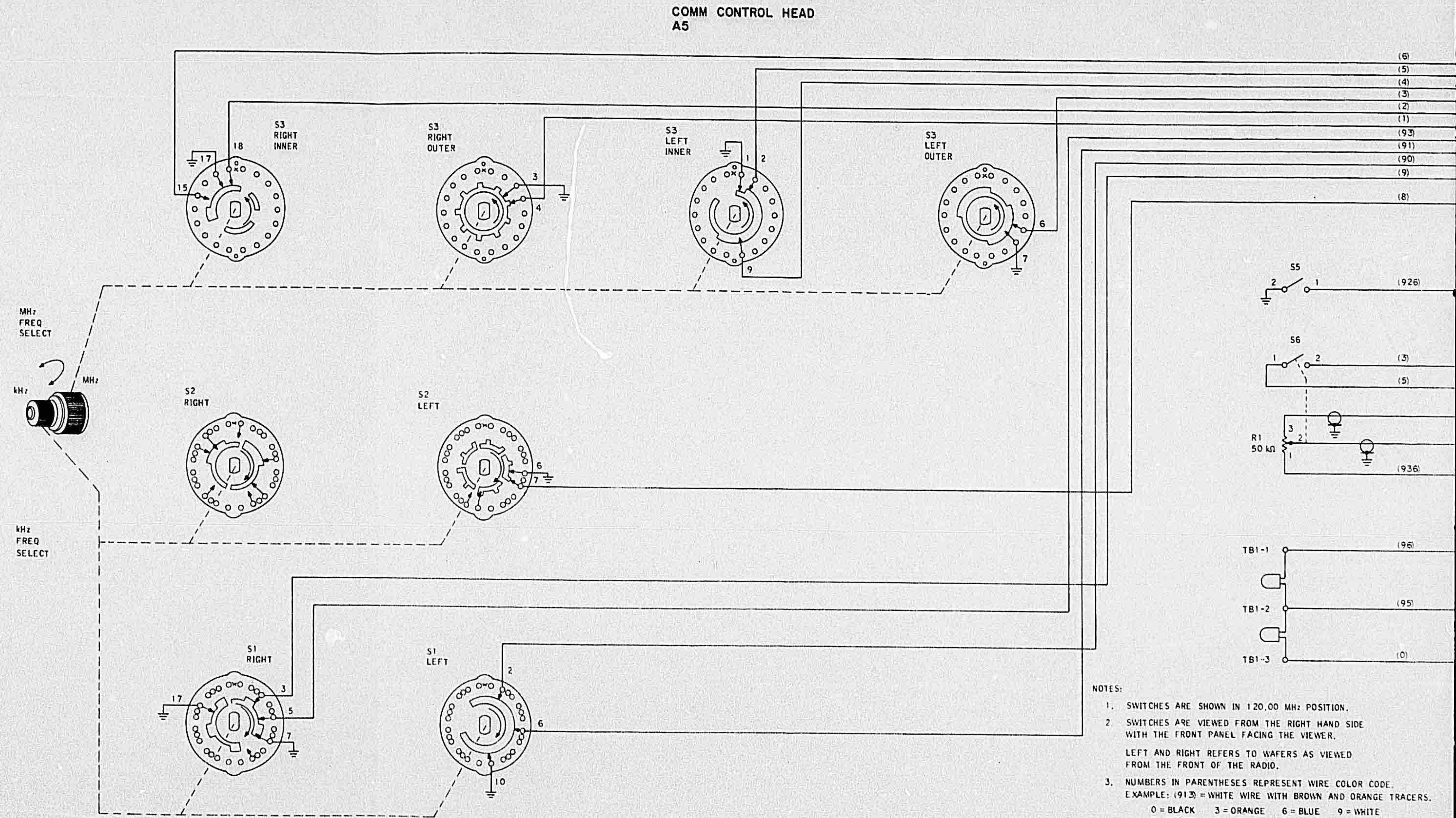
   0 = BLACK 3 = ORANGE 6 = BLUE 9 = WHITE
   1 = BROWN 4 = YELLOW 7 = VIOLET
   2 = RED 5 = GREEN 8 = GRAY

SEE BLOW–UP FICHE NO. CLQ302 - ITEM C

SEE BLOW–UP FIC

CONTROL LOGIC

FREQUENCY	BINARY CODE 8	4	2	1
	10 MHz			
110.XXX	X	X	0	1
120.XXX	X	X	1	0
130.XXX	X	X	1	1
	1 MHz			
1.XXX	0	0	0	1
2.XXX	0	0	1	0
3.XXX	0	0	1	1
4.XXX	0	1	0	0
5.XXX	0	1	0	1
6.XXX	0	1	1	0
7.XXX	0	1	1	1
8.XXX	1	0	0	0
9.XXX	1	0	0	1
0.XXX	0	0	0	0
	0.1 MHz			
0.0XX	0	0	0	0
0.1XX	0	0	0	1
0.2XX	0	0	1	0
0.3XX	0	0	1	1
0.4XX	0	1	0	0
0.5XX	0	1	0	1
0.6XX	0	1	1	0
0.7XX	0	1	1	1
0.8XX	1	0	0	0
0.9XX	1	0	0	1
	50 kHz			
0.X0	X	X	X	0
0.X5	X	X	X	1



NOTES:

1. SWITCHES ARE SHOWN IN 120.00 MHz POSITION.
2. SWITCHES ARE VIEWED FROM THE RIGHT HAND SIDE WITH THE FRONT PANEL FACING THE VIEWER.

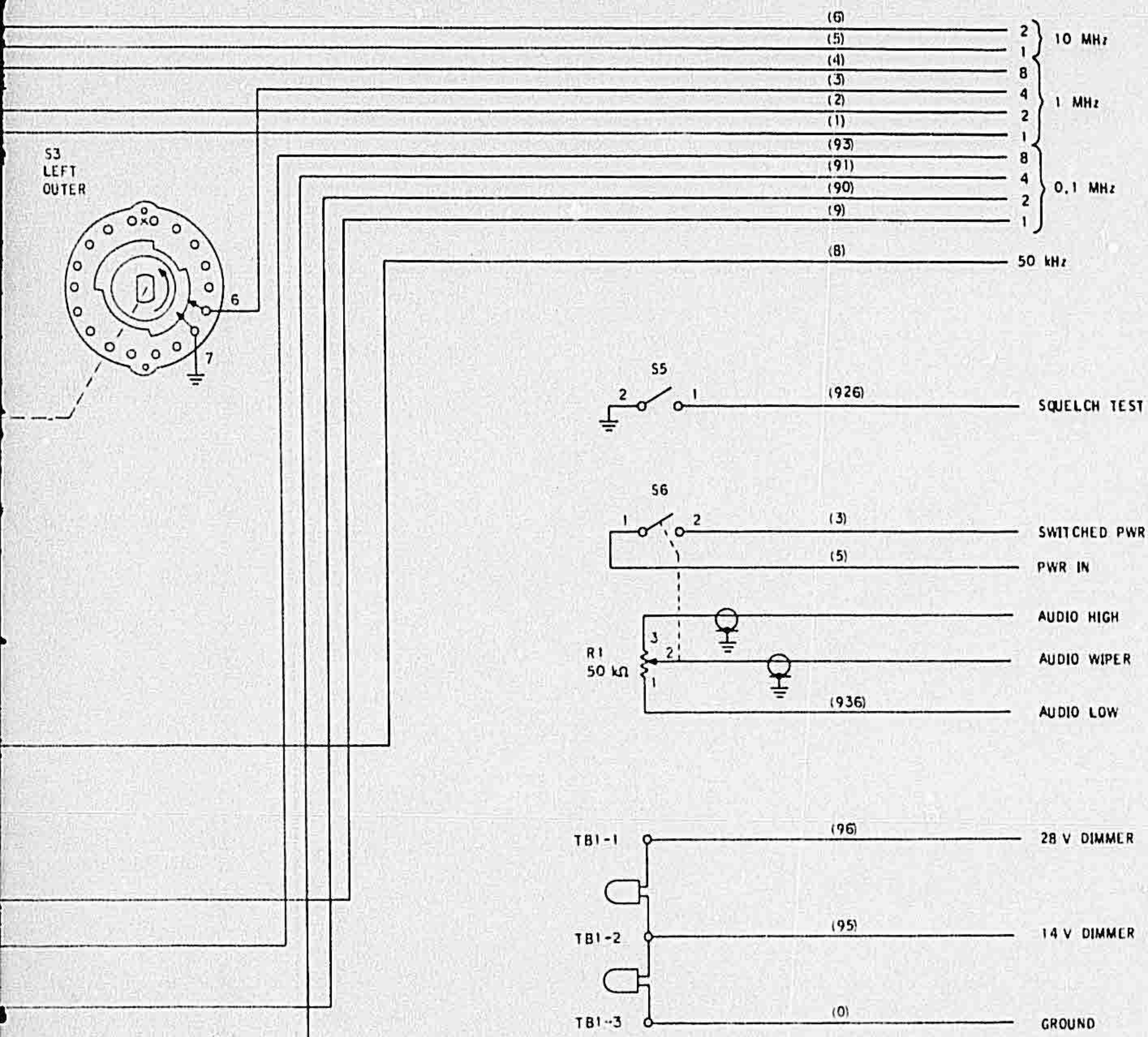
   LEFT AND RIGHT REFERS TO WAFERS AS VIEWED FROM THE FRONT OF THE RADIO.
3. NUMBERS IN PARENTHESES REPRESENT WIRE COLOR CODE. EXAMPLE: (913) = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

   0 = BLACK 3 = ORANGE 6 = BLUE 9 = WHITE
   1 = BROWN 4 = YELLOW 7 = VIOLET
   2 = RED 5 = GREEN 8 = GRAY

SEE BLOW-UP FICHE NO. CLQ302 - ITEM C

Revised 1 N

SEE BLOW-UP FICHE NO. CL



NOTES:

1. SWITCHES ARE SHOWN IN 120.00 MHz POSITION.
2. SWITCHES ARE VIEWED FROM THE RIGHT HAND SIDE WITH THE FRONT PANEL FACING THE VIEWER.

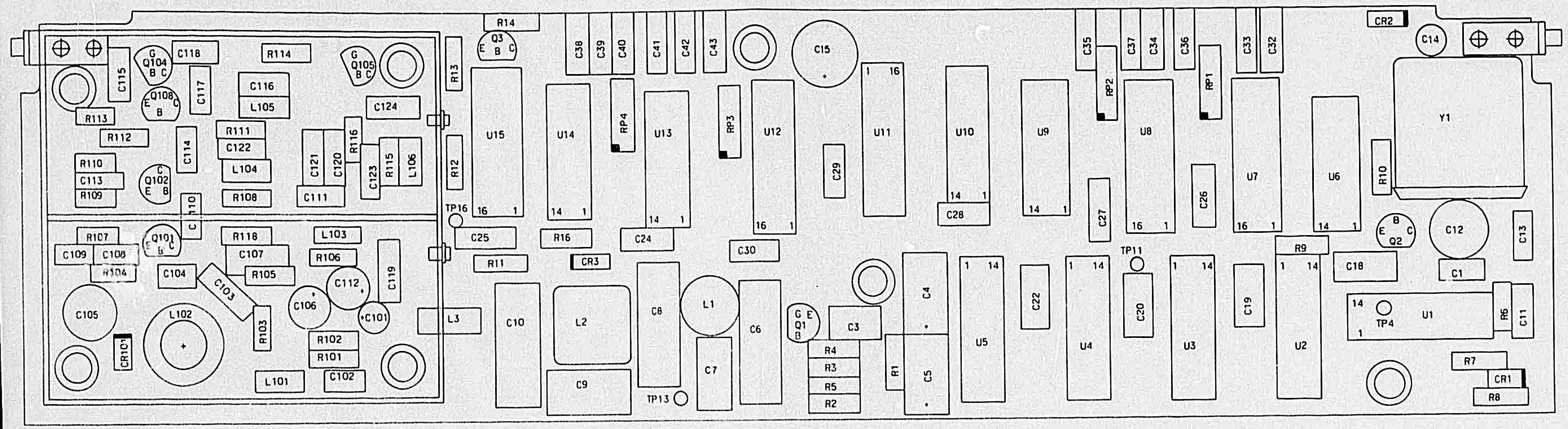
   LEFT AND RIGHT REFERS TO WAFERS AS VIEWED FROM THE FRONT OF THE RADIO.
3. NUMBERS IN PARENTHESES REPRESENT WIRE COLOR CODE. EXAMPLE: (913) = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

0 = BLACK	3 = ORANGE	6 = BLUE	9 = WHITE
1 = BROWN	4 = YELLOW	7 = VIOLET	
2 = RED	5 = GREEN	8 = GRAY	

628-6503
TP4-7658-015

VHF-250S COMM Control Head A5, Schematic Diagram
Figure 6-2

SEE BLOW-UP FICHE NO. CLQ302 - ITEM D



628-8064

Synthesizer A4, Component Location Diagram,
Board No 628-5030-004
Figure 6-8

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A	Changed value of R11 from 56 to 82 ohms and R12 from 470 to 680 ohms to optimize prescaler bias and level.	NA	REV B
	Changed C104 from 22 to 27 pF to improve synthesizer tracking.	NA	REV D
B	Changed CR101 from 353-3264-010 to 922-6131-020; 353-3264-010 no longer available.	NA	REV E

Synthesizer A4, Board No CPN 628-5030-004, Schematic Diagram
Figure 6-4 (Sheet A)

PARTS LIST
A4-SYNTHESIZER
ASSEMBLY PART NUMBER 628-5300-002, -004
BOARD PART NUMBER 628-5030-004

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C1	CAPACITOR, FXD, MICA, DIEL, 15PF, ±5%, 50V MIN		912-2099-110
C2	NOT USED		
C3	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C4	CAPACITOR, FXD, TA, 68UF, ±20%, 15V		184-9113-130
C5	CAPACITOR, FXD, TA, 68UF, ±20%, 15V		184-9113-130
C6	CAPACITOR, FXD, POLYESTER, DIEL, 0.027UF, ±10%, 100V MAX		933-1404-090
C7	CAPACITOR, FXD, MICA, DIEL, 470PF, ±5%, 50V MIN		912-2099-470
C8	CAPACITOR, FXD, POLYESTER, DIEL, 0.039UF, ±10%, 100V MAX		933-1404-100
C9	CAPACITOR, FXD, MICA, DIEL, 820PF, ±5%, 50V MIN		912-2099-510
C10	CAPACITOR, FXD, POLYESTER, DIEL, 0.033UF, ±10% 100V MAX		933-1404-050
C11	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C12	CAPACITOR, VAR, CER, DIEL, 3-5PF, 200V		917-0006-020
C13	CAPACITOR, FXD, MICA, DIEL, 91PF, ±5%, 50V MIN		912-2099-280
C14	CAPACITOR, FXD, TA, 4.7UF, ±20%, 10V		184-9113-050
C15	CAPACITOR, FXD, TA, 100UF, ±20%, 10V		184-9113-140
C16	NOT USED		
C17	NOT USED		
C18	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C19	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C20	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C21	NOT USED		
C22	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C23	NOT USED		
C24	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C25	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C26	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C27	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C28	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C29	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C30	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C31	NOT USED		
C32	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C33	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C34	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C35	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C36	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C37	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C38	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C39	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C40	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C41	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130

PARTS LIST
A4-SYNTHESIZER
ASSEMBLY PART NUMBER 628-5300-002, -004
BOARD PART NUMBER 628-5030-004

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C42	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C43	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C44-C100	NOT USED		
C101	CAPACITOR, FXD, TA, 2.2UF, ±20%, 15V		184-9113-200
C102	CAPACITOR, FXD, MICA, DIEL, 220PF, ±5%, 50V		912-2099-380
C103	CAPACITOR, FXD, CER, DIEL, 1000PF, +80-20%, 500V		913-3298-110
C104	CAPACITOR, FXD, CER DIEL, 27pF, ±10%, 100V (EFF REV D)		913-1098-570
C104	CAPACITOR, FXD, MICA, DIEL, 22PF, ±5%, 300V		912-4141-030
C105	CAPACITOR, VAR, AIR, DIEL, 1.3-5.4PF, 250V		922-1032-020
C106	CAPACITOR, FXD, TA, 22UF, ±20%, 15V		184-9113-080
C107	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C108	CAPACITOR, FXD, MICA, DIEL, 7PF, ±1/2PF, 50V MIN		912-2099-060
C109	CAPACITOR, FXD, MICA, DIEL, 18PF, ±5%, 50V MIN		912-2099-120
C110	CAPACITOR, FXD, MICA, DIEL, 10PF, ±1/2PF, 50V (EFF REV D)		912-2106-020
C111	CAPACITOR, FXD, CER, DIEL, 1000PF, +80-20%, 500V		913-3298-110
C112	CAPACITOR, FXD, TA, 22UF, ±20%, 15V		184-9113-080
C113	CAPACITOR, FXD, CER, DIEL, 330PF, +80-20%, 1000V		913-3298-030
C114	CAPACITOR, FXD, CER, DIEL, 20PF, 5%, 300V		912-2099-130
C115	CAPACITOR, FXD, CER, DIEL, 330PF, +80-20%, 1000V		913-3298-030
C116	CAPACITOR, FXD, MICA, DIEL, 2PF, ±1/2PF, 50V MIN		912-2099-010
C117	CAPACITOR, FXD, MICA, DIEL, 4PF, ±1/2PF, 300V		912-2099-030
C118	CAPACITOR, FXD, MICA, DIEL, 220PF, ±5%, 300V		912-2099-380
C119	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C120	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C121	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
C122	CAPACITOR, FXD, MICA, DIEL, 2PF, ±1/2PF, 50V		912-2099-010
C123	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C124	CAPACITOR, FXD, CER, DIEL, 470PF, +80-20%, 500V		913-3298-100
C125	CAPACITOR, FDTHRU, 1000PF, +100-20%, 50V		913-3303-040
C126	CAPACITOR, FDTHRU, 1000PF, +100-20%, 50V		913-3303-040
CR1	DIODE, 1N4454		353-3741-010
CR2	DIODE, 1N4454		353-3741-010
CR3	DIODE, 1N4454		353-3741-010
CR4-CR100	NOT USED		
CR101	VARACTOR (EFF REV E)		922-6131-020
CR101	VARACTOR (EFF TO REV E)		353-3264-010
L1	COIL, 39MH		240-0988-080
L2	COIL, 50MH		278-0417-020
L3	COIL, 33MH		240-2741-010
L4-L100	NOT USED		
L101	COIL, 15UH		240-2742-130

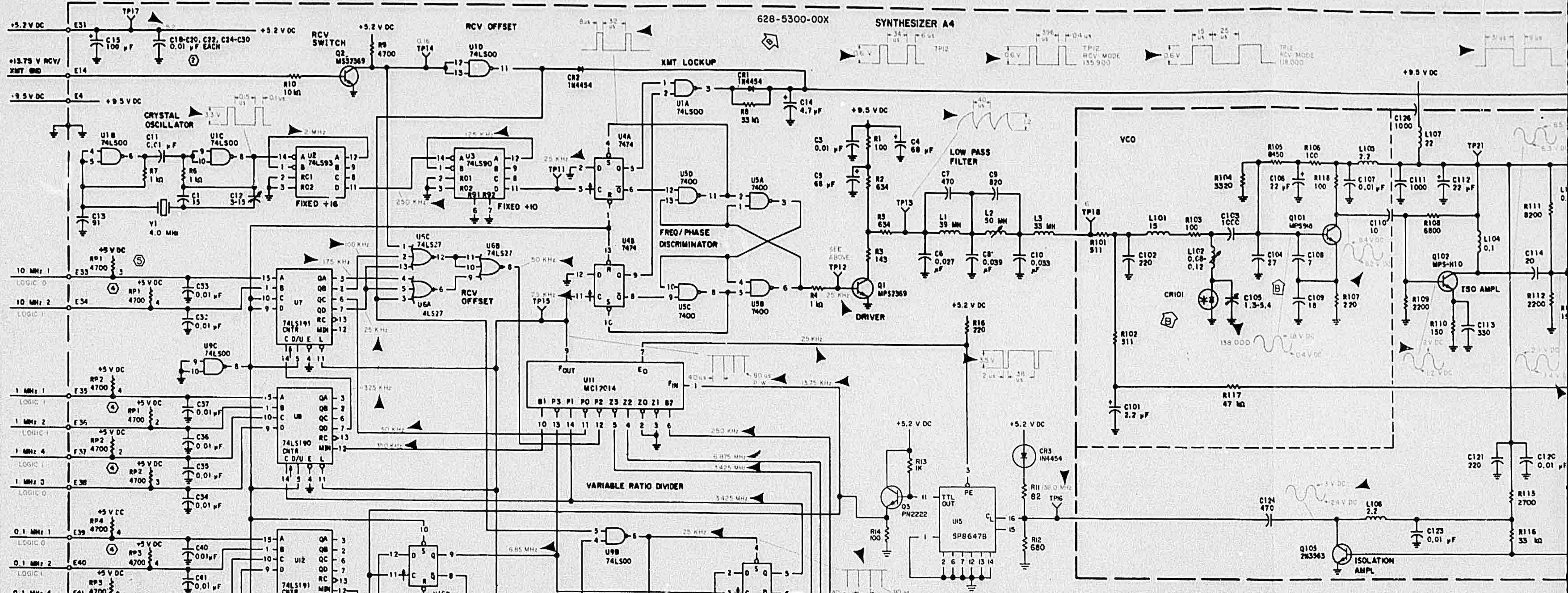
Revised 2 August 1984

PARTS LIST
A4-SYNTHESIZER
ASSEMBLY PART NUMBER 628-5300-002, -004
BOARD PART NUMBER 628-5030-004

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
L102	COIL, VARIABLE, 0.08-0.12UH		278-0418-010
L103	COIL, 2.2UH		240-2742-040
L104	COIL, 0.1UH		240-2742-090
L105	COIL, 0.15UH		240-2742-100
L106	COIL, 2.2UH		240-2742-040
L107	COIL, 22UH		240-2742-080
Q1	TRANSISTOR, MPS2369		352-5015-010
Q2	TRANSISTOR, MPS2369		352-5015-010
Q3	TRANSISTOR, PN2222A		352-5021-010
Q4-Q100	NOT USED		
Q101	TRANSISTOR, MPS918		352-5027-010
Q102	TRANSISTOR, MPS-H10		352-5031-010
Q103	TRANSISTOR, 2N3563		352-5020-010
Q104	TRANSISTOR, 2N3563		352-5020-010
Q105	TRANSISTOR, 2N3563		352-5020-010
R1	RESISTOR, FXD, CMPSN, 100 OHMS, 10%, 1/4W		745-7950-130
R2	RESISTOR, FXD, FILM, 634 OHMS, ±1%, 1/8W		745-7956-070
R3	RESISTOR, FXD, FILM, 143 OHMS, ±1%, 1/8W		745-7955-440
R4	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R5	RESISTOR, FXD, FILM, 634 OHMS, ±1%, 1/8W		745-7956-070
R6	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R7	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R8	RESISTOR, FXD, CMPSN, 33K, 10%, 1/4W		745-7950-430
R9	RESISTOR, FXD, CMPSN, 4700 OHMS, 10%, 1/4W		745-7950-330
R10	RESISTOR, FXD, CMPSN, 10K, 10%, 1/4W		745-7950-370
R11	RESISTOR, FXD, CMPSN, 82 OHMS, 10%, 1/4W (EFF REV B)		745-0710-000
R11	RESISTOR, FXD, CMPSN, 56 OHMS, 10%, 1/4W		745-7950-110
R12	RESISTOR, FXD, CMPSN, 680 OHMS, 10%, 1/4W (EFF REV B)		745-0743-000
R12	RESISTOR, FXD, CMPSN, 470 OHMS, 10%, 1/4W		745-7950-210
R13	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R14	RESISTOR, FXD, CMPSN, 100 OHMS, 10%, 1/4W		745-7950-130
R15	NOT USED		
R16	RESISTOR, FXD, CMPSN, 220 OHMS, 10%, 1/4W		745-7950-170
R17-R100	NOT USED		
R101	RESISTOR, FXD, FILM, 511 OHMS, ±1%, 1/8W		745-7955-970
R102	RESISTOR, FXD, FILM, 511 OHMS, ±1%, 1/8W		745-7955-970
R103	RESISTOR, FXD, FILM, 100 OHMS, ±1%, 1/8W		745-7955-290
R104	RESISTOR, FXD, FILM, 3320 OHMS, ±1%, 1/8W		745-7956-760
R105	RESISTOR, FXD, FILM, 8200 OHMS, ±1%, 1/8W		745-7957-160
R106	RESISTOR, FXD, CMPSN, 100 OHMS, 10%, 1/4W		745-7950-130
R107	RESISTOR, FXD, CMPSN, 200 OHMS, 10%, 1/4W		745-7950-170
R108	RESISTOR, FXD, CMPSN, 6800 OHMS, 10%, 1/4W		745-7950-350
R109	RESISTOR, FXD, CMPSN, 2200 OHMS, 10%, 1/4W		745-7950-290
R110	RESISTOR, FXD, CMPSN, 150 OHMS, 10%, 1/4W		745-7950-150
R111	RESISTOR, FXD, CMPSN, 8200 OHMS, 10%, 1/4W		745-7950-360
R112	RESISTOR, FXD, CMPSN, 2200 OHMS, 10%, 1/4W		745-7950-290

PARTS LIST
A4-SYNTHESIZER
ASSEMBLY PART NUMBER 628-5300-002, -004
BOARD PART NUMBER 628-5030-004

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
R113	RESISTOR, FXD, CMPSN, 150 OHMS, 10%, 1/4W		745-7950-150
R114	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R115	NOT USED		
R116	RESISTOR, FXD, CMPSN, 33K, 10%, 1/4W		745-7950-430
R117	RESISTOR, FXD, CMPSN, 47K, 10%, 1/4W		745-7950-450
R118	RESISTOR, FXD, CMPSN, 100 OHMS, 10%, 1/4W		745-7950-130
RP1	RESISTOR NETWORK, 4 PIN, 4.7K, ±20%, 1/8W		350-4000-040
RP2	RESISTOR NETWORK, 4 PIN, 4.7K, ±20%, 1/8W		350-4000-040
RP3	RESISTOR NETWORK, 4 PIN, 4.7K, ±20%, 1/8W		350-4000-040
RP4	RESISTOR NETWORK, 4 PIN, 4.7K, ±20%, 1/8W		350-4000-040
U1	IC, QUAD 2 INPUT NAND GATE, 74LS00		351-1709-010
U2	IC, 4-BIT BINARY COUNTER, 74LS93		351-1711-060
U3	IC, DECADE COUNTER, 74LS90		351-1711-050
U4	IC, FLIP FLOP, 7474		351-1550-020
U5	IC, QUAD 2 INPUT NAND GATE, 7400		351-1548-020
U6	IC, TRIPLE 3 INPUT NOR GATE, 74LS27		351-1709-030
U7	IC, 4-BIT BINARY COUNTER, 74LS191		351-1711-020
U8	IC, BCD COUNTER, 74LS190		351-1711-010
U9	IC, QUAD 2 INPUT NAND GATE, 74LS00		351-1709-010
U10	IC, FLIP FLOP, 74LS74		351-1710-020
U11	IC, MONOLITHIC COUNTER CONTROL, 12014		351-7829-010
U12	IC, 4-BIT BINARY COUNTER, 74LS191		351-1711-020
U13	IC, FLIP FLOP, 74LS74		351-1710-020
U14	IC, QUAD 2 INPUT NAND GATE, 74LS00		351-1709-010
U15	IC, PRESCALER, SP8646B		351-1904-010
Y1	CRYSTAL, 4MHZ (VHF-250/250S ONLY)		289-7224-010
Y1	CRYSTAL, 4MHZ (VHF-250E ONLY)		289-7224-040



NOTES:

1. UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.
2. SYMBOL REPRESENTS ELEVEN 0.01 µF CAPACITORS CONNECTED BETWEEN +5.2 V DC AND GROUND.
3. MICROCIRCUIT POWER AND GROUND PINS:

	+5.2 V DC	GROUND
U1, U4, U5, U6, U9, U10, U13, U14	14	7
U2, U3	5	10
U7, U8, U11, U12	16	8
U15	4 AND 5	12

4. VOLTAGES ARE TAKEN WITH TRANSCEIVER TUNED TO 127.600 MHz UNLESS OTHERWISE SPECIFIED. ALL MEASUREMENTS MADE USING SCOPE WITH 12.5pF, 10 M OHM PROBE. TP12 AND TP13 WAVEFORMS ARE TYPICAL.

B 5. RPI THRU RP4 USED ON 628-5300-002/-004 ONLY.

SEE BLOW-UP FICHE NO. CLQ302 - ITEM G

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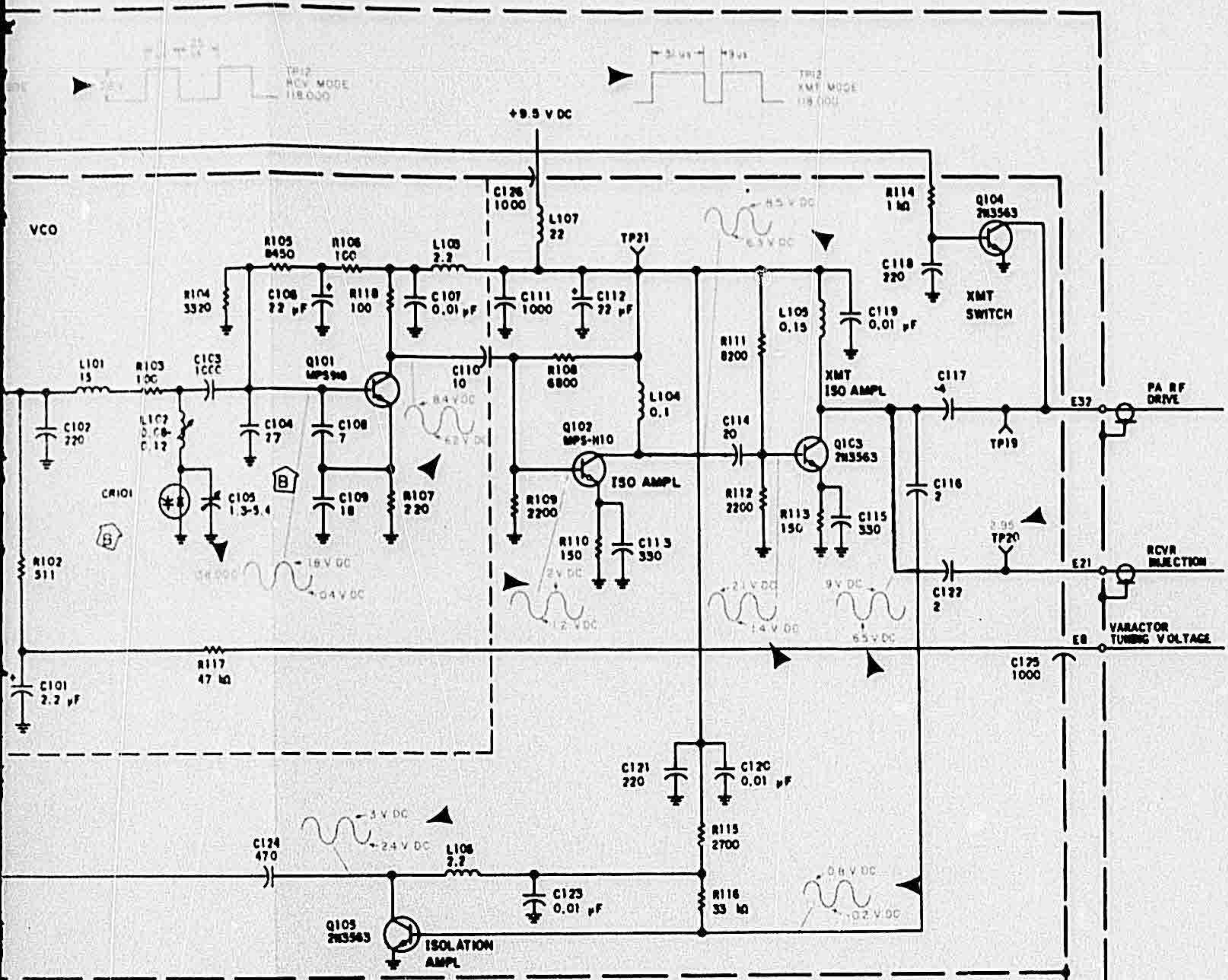
SEE BLOW-UP FICHE N



NOTES:

1. UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.
2. SYMBOL REPRESENTS ELEVEN 0.01 μF CAPACITORS CONNECTED BETWEEN +5.2 V DC AND GROUND.
3. MICROCIRCUIT POWER AND GROUND PINS;

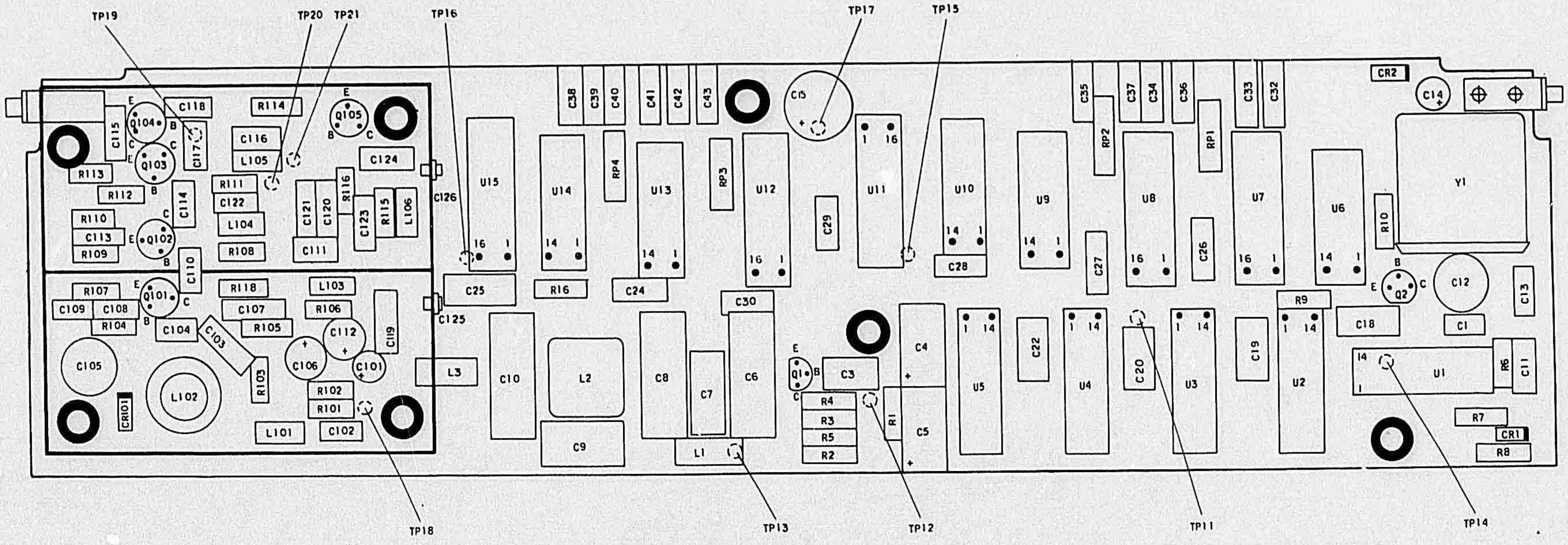
	+5.2 V DC	GROUND
U1, U4, U5, U6, U9, U10, U13, U14	14	7
U2, U3	5	10
U7, U8, U11, U12	16	8
U15	4 AND 5	12

4. VOLTAGES ARE TAKEN WITH TRANSCEIVER TUNED TO 127.600 MHz UNLESS OTHERWISE SPECIFIED. ALL MEASUREMENTS MADE USING SCOPE WITH 12.5 pF, 10 M OHM PROBE. TP12 AND TP13 WAVEFORMS ARE TYPICAL.
5. RP1 THRU RP4 USED ON 628-5300-002/-004 ONLY.

628-8070

Synthesizer A4, Board No CPN 628-5030-004, Schematic Diagram
Figure 6-4

SEE BLOW-UP FICHE NO. CLQ302 - ITEM H



628-6508
TP4-7787-014

Synthesizer A4, Component Location Diagram,
Board No CPN 628-5030-003
Figure 6-5

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
1	Changed value of C114 from 5 to 20 pF, C117 from 6 to 4 pF, C122 from 10 to 2 pF, and L105 from 0.18 to 0.15 μh to prevent unlock when signals are abruptly applied.	NA	REV F
2	Changed U5 from 74LS00 to 7400 to prevent possible unlock during transmit at very low temperatures.	NA	REV G
F	Changed C104 from 22 to 27 pF to improve synthesizer tracking.	NA	REV D
	Changed CR101 from 353-3264-010 to 922-6131-020; 353-3264-010 no longer available.	NA	REV E

Synthesizer A4, Board No CPN 628-5030-003, Schematic Diagram
Figure 6-6 (Sheet A)

PARTS LIST
A4-SYNTHESIZER
ASSEMBLY PART NUMBER 628-5069-002, -004
BOARD PART NUMBER 628-5030-003

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C1	CAPACITOR, FXD, MICA, DIEL, 15PF, ±5%, 50V MIN		912-2099-110
C2	NOT USED		
C3	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C4	CAPACITOR, FXD, TA, 68UF, ±20%, 15V		184-9113-130
C5	CAPACITOR, FXD, TA, 68UF, ±20%, 15V		184-9113-130
C6	CAPACITOR, FXD, POLYESTER, DIEL, 0.027UF, ±10%, 100V MAX		933-1404-090
C7	CAPACITOR, FXD, MICA, DIEL, 470PF, ±5%, 50V MIN		912-2099-470
C8	CAPACITOR, FXD, POLYESTER, DIEL, 0.039UF, ±10%, 100V MAX		933-1404-100
C9	CAPACITOR, FXD, MICA, DIEL, 820PF, ±5%, 50V MIN		912-2099-510
C10	CAPACITOR, FXD, POLYESTER, DIEL, 0.033UF, ±10%, 100V MAX		933-1404-050
C11	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C12	CAPACITOR, VAR, CER, DIEL, 3-5PF, 200V		917-0006-020
C13	CAPACITOR, FXD, MICA, DIEL, 91PF, ±5%, 50V MIN		912-2099-280
C14	CAPACITOR, FXD, TA, 4.7UF, ±20%, 10V		184-9113-050
C15	CAPACITOR, FXD, TA, 100UF, ±20%, 10V		184-9113-140
C16	NOT USED		
C17	NOT USED		
C18	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C19	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C20	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C21	NOT USED		
C22	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C23	NOT USED		
C24	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C25	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C26	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C27	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C28	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C29	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C30	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C31	NOT USED		
C32	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C33	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C34	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C35	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C36	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C37	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C38	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C39	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130

PARTS LIST
A4-SYNTHESIZER
ASSEMBLY PART NUMBER 628-5069-002, -004
BOARD PART NUMBER 628-5030-003

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C40	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C41	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C42	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C43	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C44-C100	NOT USED		
C101	CAPACITOR, FXD, TA, 2.2UF, ±20%, 15V		184-9113-200
C102	CAPACITOR, FXD, MICA, DIEL, 220PF, ±5%, 50V		912-2099-380
C103	CAPACITOR, FXD, CER, DIEL, 1000PF, +80-20%, 500V		913-3298-110
C104	CAPACITOR, FXD, CER DIEL, 27PF, 10%, 100V (EFF REV D)		913-1098-570
C104	CAPACITOR, FXD, MICA, DIEL, 22PF, ±5%, 50V MIN		912-2099-140
C105	CAPACITOR, VAR, AIR, DIEL, 1.3-5.4PF, 250V		922-1032-020
C106	CAPACITOR, FXD, TA, 22UF, ±20%, 15V		184-9113-080
C107	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C108	CAPACITOR, FXD, MICA, DIEL, 7PF, ±1/2PF, 50V MIN		912-2099-060
C109	CAPACITOR, FXD, MICA, DIEL, 18PF, ±5%, 50V MIN		912-2099-120
C110	CAPACITOR, FXD, MICA, DIEL, 10PF, ±1/2PF, 50V (EFF REV D)		912-2106-020
C110	CAPACITOR, FXD, MICA, DIEL, 10PF, ±1/2PF, 50V MIN		912-2099-090
C111	CAPACITOR, FXD, CER, DIEL, 1000PF, +80-20%, 500V		913-3298-110
C112	CAPACITOR, FXD, TA, 22UF, ±20%, 15V		184-9113-080
C113	CAPACITOR, FXD, CER, DIEL, 330PF, +80-20%, 1000V		913-3298-030
C114	CAPACITOR, FXD, CER, DIEL, 20PF, 5%, 300V (EFF REV F)		912-2099-130
C114	CAPACITOR, FXD, MICA, DIEL, 5PF, ±1/2PF, 50V MIN		912-2099-040
C115	CAPACITOR, FXD, CER, DIEL, 330PF, +80-20%, 1000V		913-3298-030
C116	CAPACITOR, FXD, MICA, DIEL, 2PF, ±1/2PF, 50V MIN		912-2099-010
C117	CAPACITOR, FXD, MICA, DIEL, 4PF, ±1/2PF, 300V (EFF REV F)		912-2099-030
C117	CAPACITOR, FXD, MICA, DIEL, 6PF, ±1/2PF, 50V MIN		912-2099-050
C118	CAPACITOR, FXD, MICA, DIEL, 220PF, ±5%, 300V		912-2099-380
C119	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C120	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C121	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
C122	CAPACITOR, FXD, MICA, DIEL, 2PF, ±1/2PF, 50V (EFF REV F)		912-2099-010
C122	CAPACITOR, FXD, MICA, DIEL, 10PF, ±1/2PF, 50V MIN		912-2099-090
C123	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C124	CAPACITOR, FXD, CER, DIEL, 470PF, +80-20%, 500V		913-3298-100

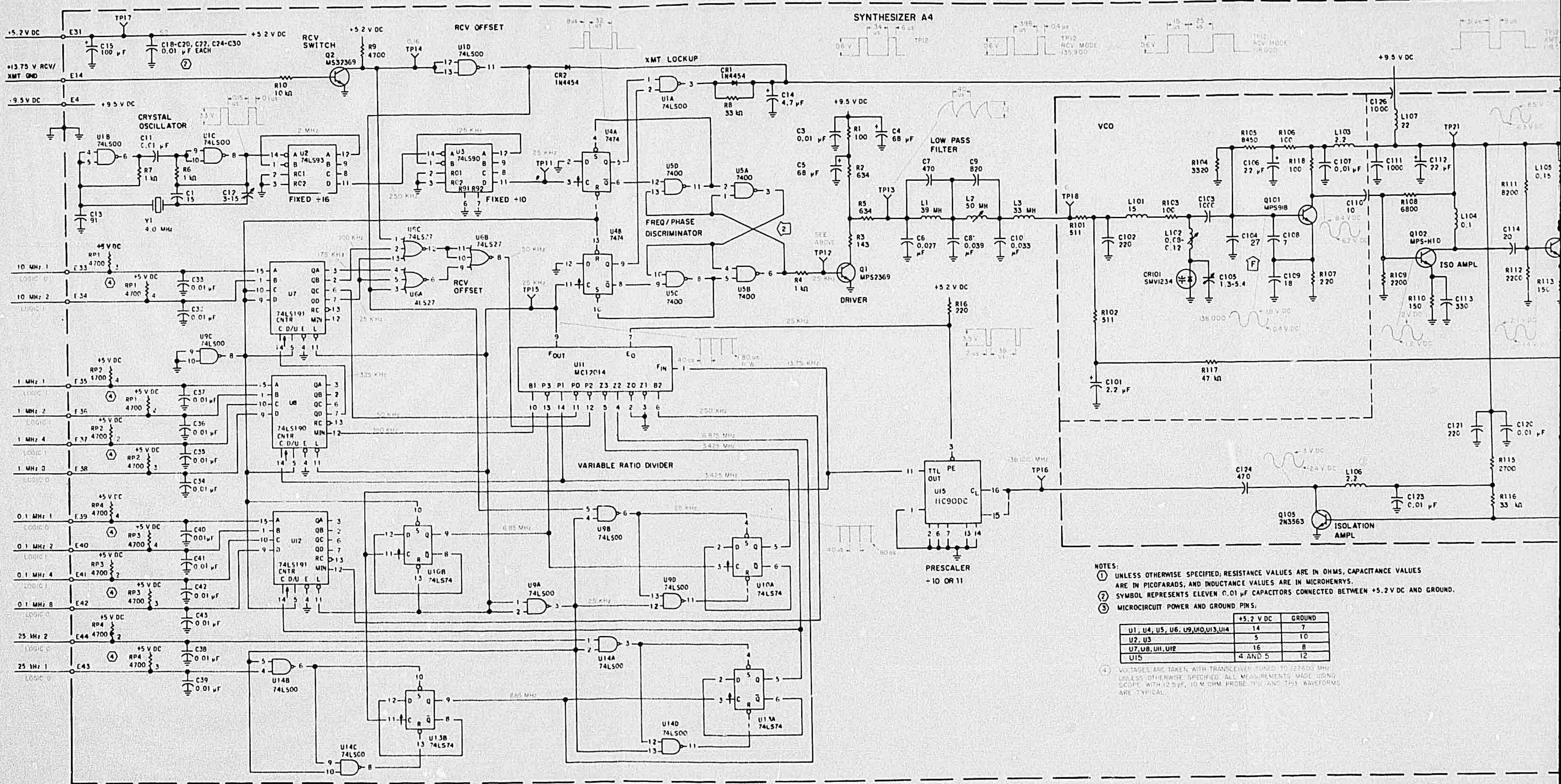
PARTS LIST
A4-SYNTHESIZER
ASSEMBLY PART NUMBER 628-5069-002, -004
BOARD PART NUMBER 628-5030-003

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C125	CAPACITOR, FDTHRU, 1000PF, +100-20%, 50V		913-3303-040
C126	CAPACITOR, FDTHRU, 1000PF, +100-20%, 50V		913-3303-040
CR1	DIODE, 1N4454		353-3741-010
CR2	DIODE, 1N4454		353-3741-010
CR3-CR100	NOT USED		
CR101	VARACTOR		353-3264-010
L1	COIL, 39MH		240-2741-020
L2	COIL, 50MH (EFF REV L)		278-0417-020
L2	COIL, 50MH (EFF REV K)		628-7878-001
L2	COIL, 50MH		278-0417-020
L3	COIL, 33MH		240-2741-010
L4-L100	NOT USED		
L101	COIL, 15UH		240-2742-130
L102	COIL, VARIABLE, 0.08-0.12UH		278-0418-010
L103	COIL, 2.2UH		240-2742-040
L104	COIL, 0.1UH		240-2742-090
L105	COIL, 0.15UH (EFF REV F)		240-2742-100
L105	COIL, 0.18UH		240-2742-110
L106	COIL, 2.2UH		240-2742-040
L107	COIL, 22UH		240-2742-080
Q1	TRANSISTOR, MPS2369		352-5015-010
Q2	TRANSISTOR, MPS2369		352-5015-010
Q3-Q100	NOT USED		
Q101	TRANSISTOR, MPS918		352-5027-010
Q102	TRANSISTOR, MPS-H10		352-5031-010
Q103	TRANSISTOR, 2N3563		352-5020-010
Q104	TRANSISTOR, 2N3563		352-5020-010
Q105	TRANSISTOR, 2N3563		352-5020-010
R1	RESISTOR, FXD, CMPSN, 100 OHMS, 10%, 1/4		745-7950-130
R2	RESISTOR, FXD, FILM, 634 OHM, ±1%, 1/8W		745-7956-070
R3	RESISTOR, FXD, FILM, 143 OHM, ±1%, 1/8W		745-7955-440
R4	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R5	RESISTOR, FXD, FILM, 634 OHM, ±1%, 1/8W		745-7956-070
R6	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R7	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R8	RESISTOR, FXD, CMPSN, 33K, 10%, 1/4W		745-7950-430
R9	RESISTOR, FXD, CMPSN, 4700 OHM, 10%, 1/4W		745-7950-330
R10	RESISTOR, FXD, CMPSN, 10K, 10%, 1/4W		745-7950-370
R11-R15	NOT USED		
R16	RESISTOR, FXD, CMPSN, 200 OHMS, 10%, 1/4W		745-7950-170
R17-R100	NOT USED		
R101	RESISTOR, FXD, FILM, 511 OHMS, ±1%, 1/8W		745-7955-970

PARTS LIST
A4-SYNTHESIZER
ASSEMBLY PART NUMBER 628-5069-002, -004
BOARD PART NUMBER 628-5030-003

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
R102	RESISTOR, FXD, FILM, 511 OHMS, ±1%, 1/8W		745-7955-970
R103	RESISTOR, FXD, FILM, 100 OHMS, ±1%, 1/8W		745-7955-290
R104	RESISTOR, FXD, FILM, 3320 OHMS, ±1%, 1/8W		745-7956-760
R105	RESISTOR, FXD, FILM, 8200 OHMS, ±1%, 1/8W		745-7957-160
R106	RESISTOR, FXD, CMPSN, 100 OHMS, 10%, 1/4W		745-7950-130
R107	RESISTOR, FXD, CMPSN, 200 OHMS, 10%, 1/4W		745-7950-170
R108	RESISTOR, FXD, CMPSN, 6800 OHMS, 10%, 1/4W		745-7950-350
R109	RESISTOR, FXD, CMPSN, 2200 OHMS, 10%, 1/4W		745-7950-290
R110	RESISTOR, FXD, CMPSN, 150 OHMS, 10%, 1/4W		745-7950-150
R111	RESISTOR, FXD, CMPSN, 8200 OHMS, 10%, 1/4W		745-7950-360
R112	RESISTOR, FXD, CMPSN, 2200 OHMS, 10%, 1/4W		745-7950-290
R113	RESISTOR, FXD, CMPSN, 150 OHMS, 10%, 1/4W		745-7950-150
R114	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R115	RESISTOR, FXD, 2700 OHMS, ±10%, 1/4W		745-7950-300
R116	RESISTOR, FXD, CMPSN, 33K, 10%, 1/4W		745-7950-430
R117	RESISTOR, FXD, CMPSN, 47K, 10%, 1/4W		745-7950-450
R118	RESISTOR, FXD, CMPSN, 100 OHMS, 10%, 1/4W		745-7950-130
RP1	RESISTOR NETWORK, 4 PIN, 4.7K, ±20%, 1/8W		350-4000-040
RP2	RESISTOR NETWORK, 4 PIN, 4.7K, ±20%, 1/8W		350-4000-040
RP3	RESISTOR NETWORK, 4 PIN, 4.7K, ±20%, 1/8W		350-4000-040
RP4	RESISTOR NETWORK, 4 PIN, 4.7K, ±20%, 1/8W		350-4000-040
U1	IC, QUAD 2 INPUT NAND GATE, 74LS00		351-1709-010
U2	IC, 4-BIT BINARY COUNTER, 74LS93		351-1711-060
U3	IC, DECADE COUNTER, 74LS90		351-1711-050
U4	IC, FLIP FLOP, 7474		351-1550-020
U5	IC, QUAD 2 INPUT NAND GATE, 7400		351-1548-020
U5	IC, QUAD 2 INPUT NAND GATE, 74LS00		351-1709-010
U6	IC, TRIPLE 3 INPUT NOR GATE, 74LS27		351-1709-030
U7	IC, 4-BIT BINARY COUNTER, 74LS191		351-1711-020
U8	IC, BCD COUNTER, 74LS190		351-1711-010
U9	IC, QUAD 2 INPUT NAND GATE, 74LS00		351-1709-010
U10	IC, FLIP FLOP, 74LS74		351-1710-020
U11	IC, MONOLITHIC COUNTER CONTROL, 12014		351-7829-010
U12	IC, 4-BIT BINARY COUNTER, 74LS191		351-1711-020
U13	IC, FLIP FLOP, 74LS74		351-1710-020
U14	IC, QUAD 2 INPUT NAND GATE, 74LS00		351-1709-010
U15	IC, ECL HIGH SPEED PRESCALER, 11C90DC		351-1249-010
Y1	CRYSTAL, 4MHZ (VHF-250/250S ONLY)		289-7224-010
Y1	CRYSTAL, 4MHZ (VHF-250E ONLY)		289-7224-040

Revised 1 November 1978



NOTES:

① UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.

② SYMBOL REPRESENTS ELEVEN 0.01 μF CAPACITORS CONNECTED BETWEEN +5.2 V DC AND GROUND.

③ MICROCIRCUIT POWER AND GROUND PINS.

	+5.2 V DC	GROUND
U1, U4, U5, U6, U9, U10, U13, U14	14	7
U2, U3	5	10
U7, U8, U11, U12	16	8
U15	4 AND 5	12

④ VOLTAGES ARE TAKEN WITH TRANSCEIVER TUNED TO 127.400 MHz UNLESS OTHERWISE SPECIFIED. ALL MEASUREMENTS MADE USING SCOPE WITH 12.5 pF, 10 M OHM PROBE. TP12 AND TP13 WAVEFORMS ARE TYPICAL.

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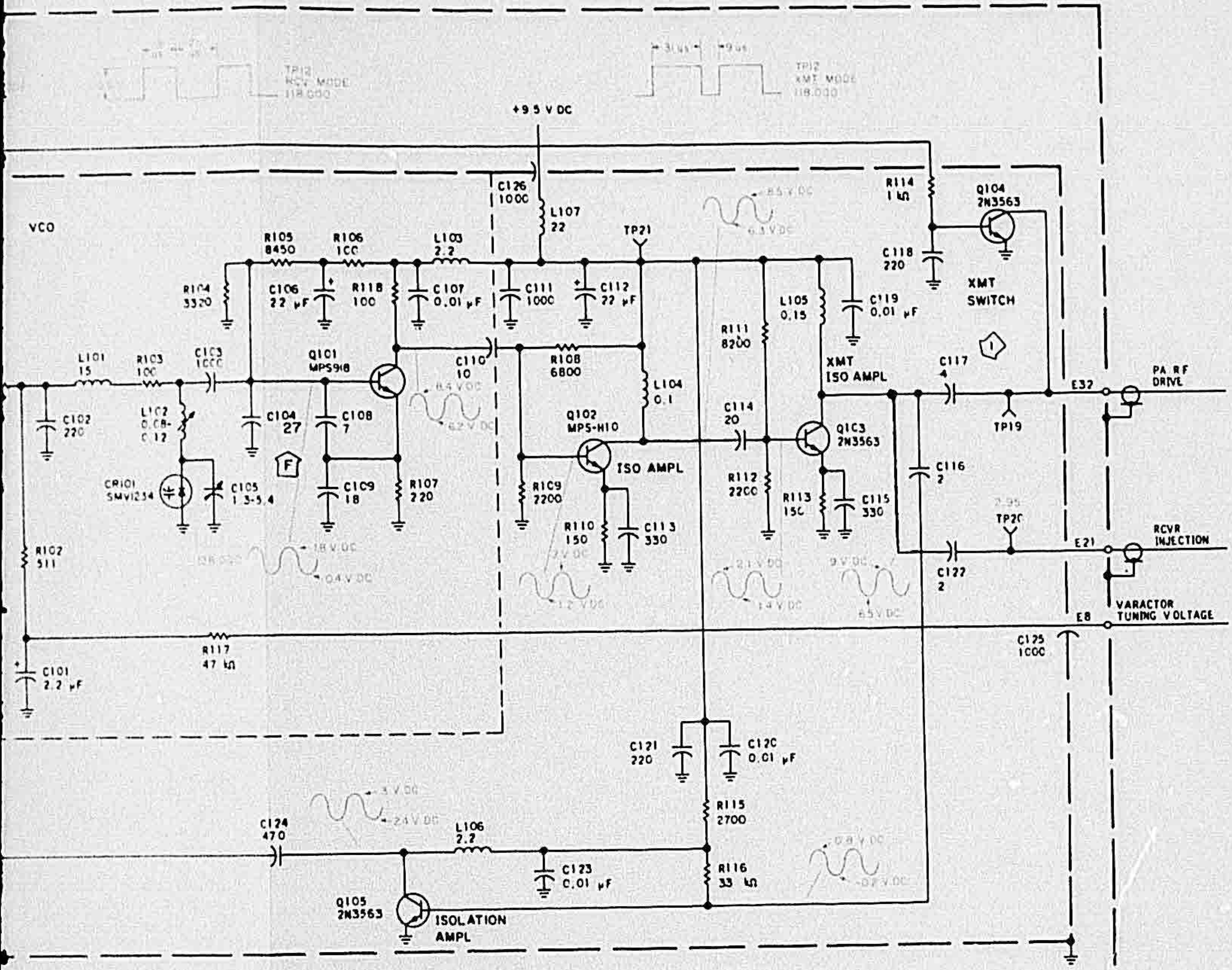
SEE BLOW-UP FIG



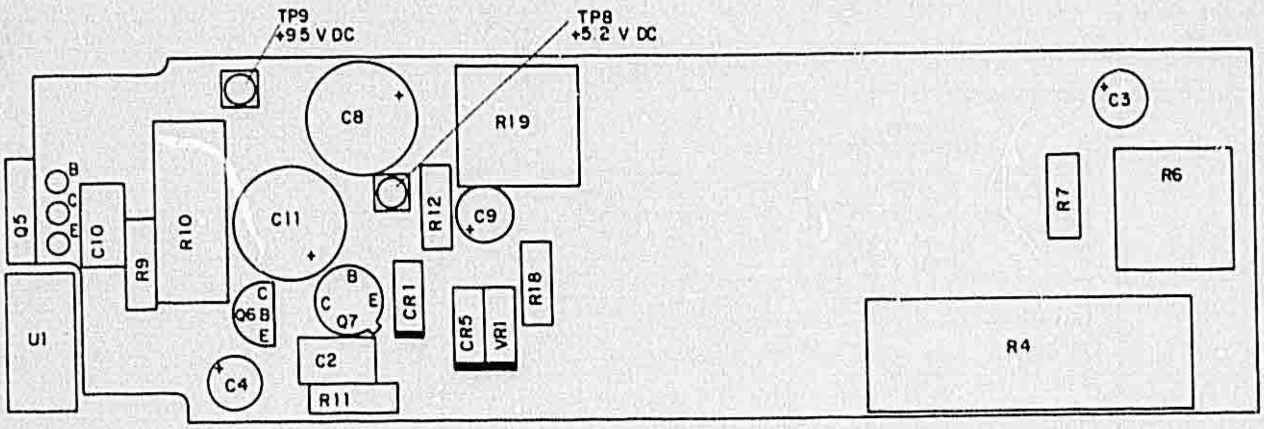
NOTES

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.
2. SYMBOL REPRESENTS ELEVEN 0.01 μF CAPACITORS CONNECTED BETWEEN +5.2 V DC AND GROUND.
3. MICROCIRCUIT POWER AND GROUND PINS:

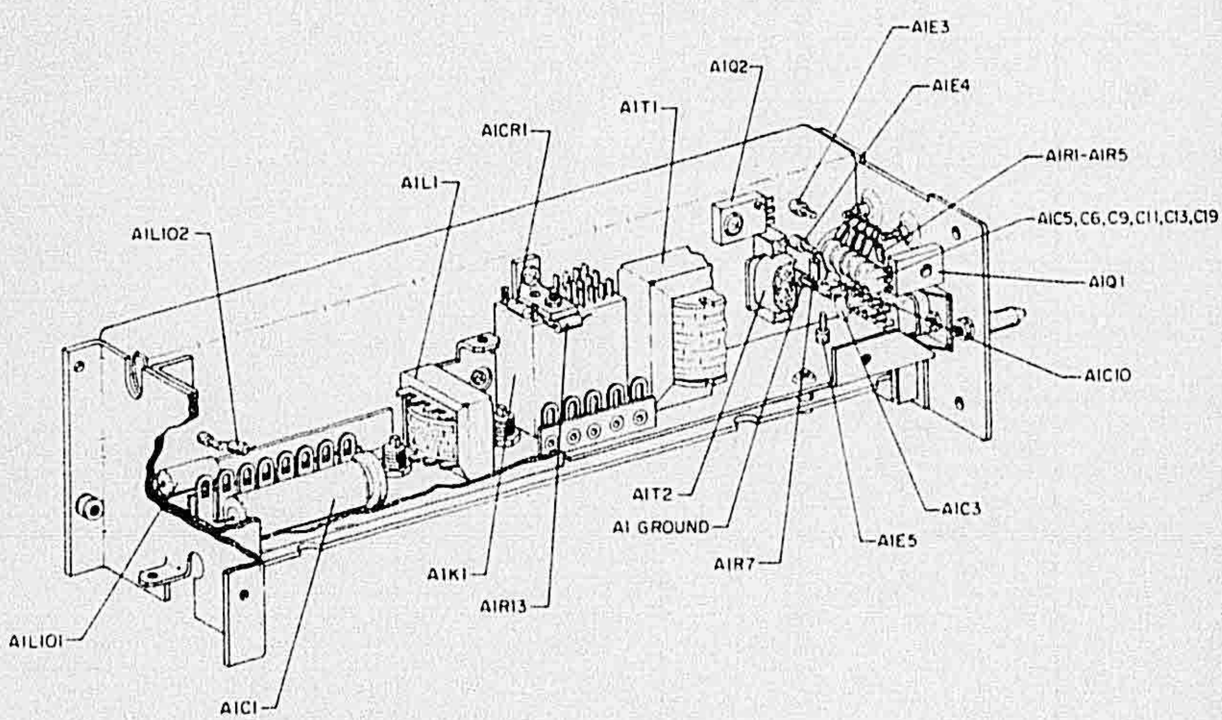
	+5.2 V DC	GROUND
U1, U4, U5, U6, U9, U10, U13, U14	14	7
U2, U3	5	10
U7, U8, U11, U12	16	8
U15	4 AND 5	12

Synthesizer A4, Board No CPN 628-5030-003, Schematic Diagram
Figure 6-6

SEE BLOW-UP FICHE NO.CLQ302-ITEMK



628-6519



628-6623

VHF-250/250S Power Supply A6 and Chassis, Component Location Diagram
Figure 6-7

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
2	Added schematic omission of A6C2.	NA	NA
3	Changed R7 from 18 to 8.2 kΩ to improve thermal stability.	NA	REV B
4	Changed MJE 200 to TIP-125 to improve reliability.	SIL 2-77	REV F
E	Changed A6C10 from 1000 pF to 0.05 μF to improve regulator stability.	SB 4	REV F

VHF-250/250S Audio/TR Chassis and Power Supply A6
(CPN 628-5005-002), Schematic Diagram
Figure 6-8 (Sheet A)

PARTS LIST
A1-CHASSIS AUDIO TR

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C1	CAPACITOR, FXD, ELCTLT, 1200UF, +100-20%, 16V		183-1471-060
C2	NOT USED		
C3	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
*C4	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
*C5	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
*C6	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
C7	NOT USED		
C8	NOT USED		
*C9	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
C10	CAPACITOR, FXD, TA, 0.33UF, ±20%, 35V		184-9113-010
*C11	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
C12	NOT USED		
*C13	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
*C14	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
*C15	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
*C16	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
*C17	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
*C18	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
*C19	CAPACITOR, FXD, CER, DIEL, 220PF, +80-20%, 250V		913-3298-090
C20-C100	NOT USED		
C101	CAPACITOR, FXD, TA, 150UF, ±20%, 15V		184-9113-160
C102-C200	NOT USED		
C201	CAPACITOR, FDTHRU, 1000PF, +100-20%, 50V		913-3303-010
C202	CAPACITOR, FDTHRU, 1000PF, +100-20%, 50V		913-3303-010
C203	CAPACITOR, FDTHRU, 1000PF, +100-20%, 50V		913-3303-010
CR1	DIODE, 1N4002		353-3736-020
CR2	DIODE, 1N4156		353-3743-010
CR3	DIODE, 1N4156		353-3743-010
K1	RELAY, 4PDT, 12V (EFF REV P)		970-0038-020
K1	RELAY, ARMATURE, 4PDT, 12V		970-0024-010
L1	INDUCTOR, 1MH		668-0262-010
L2-L100	NOT USED		
L101	COIL, 28UH		240-0958-010
L102	COIL, 22UH		240-2742-080
P1	CONNECTOR, PLUG, 25 PIN (REQUIRES 371-0379-030 CONTACT)		371-0379-010
P2	CONNECTOR, BNC TYPE RF CONNECTOR, BULKHEAD MTG		357-7532-020
Q1	TRANSISTOR, TIP125		352-5006-020
Q2	TRANSISTOR, TIP125		352-5006-020
*R1	RESISTOR, FXD, CMPSN, 470 OHMS, 10%, 1/4W		745-7950-210
*R2	RESISTOR, FXD, CMPSN, 470 OHMS, 10%, 1/4W		745-7950-210
*R3	RESISTOR, FXD, CMPSN, 470 OHMS, 10%, 1/4W		745-7950-210
*R4	RESISTOR, FXD, CMPSN, 470 OHMS, 10%, 1/4W		745-7950-210
*R5	RESISTOR, FXD. CMPSN, 33 OHMS, 10%, 1/4W		745-7950-070

PARTS LIST
A1-CHASSIS AUDIO TR

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
R6	NOT USED		
R7	RESISTOR, FXD, CMPSN, 8.2K, 10%, 1/4W (EFF REV B)		745-7950-360
R7	RESISTOR, FXD, CMPSN, 18K, 10%, 1/4W		745-7950-400
R8	NOT USED		
R9	NOT USED		
R10	NOT USED		
R11	NOT USED		
R12	NOT USED		
R13	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
T1	TRANSFORMER		667-0251-010
T2	TRANSFORMER		667-0252-010

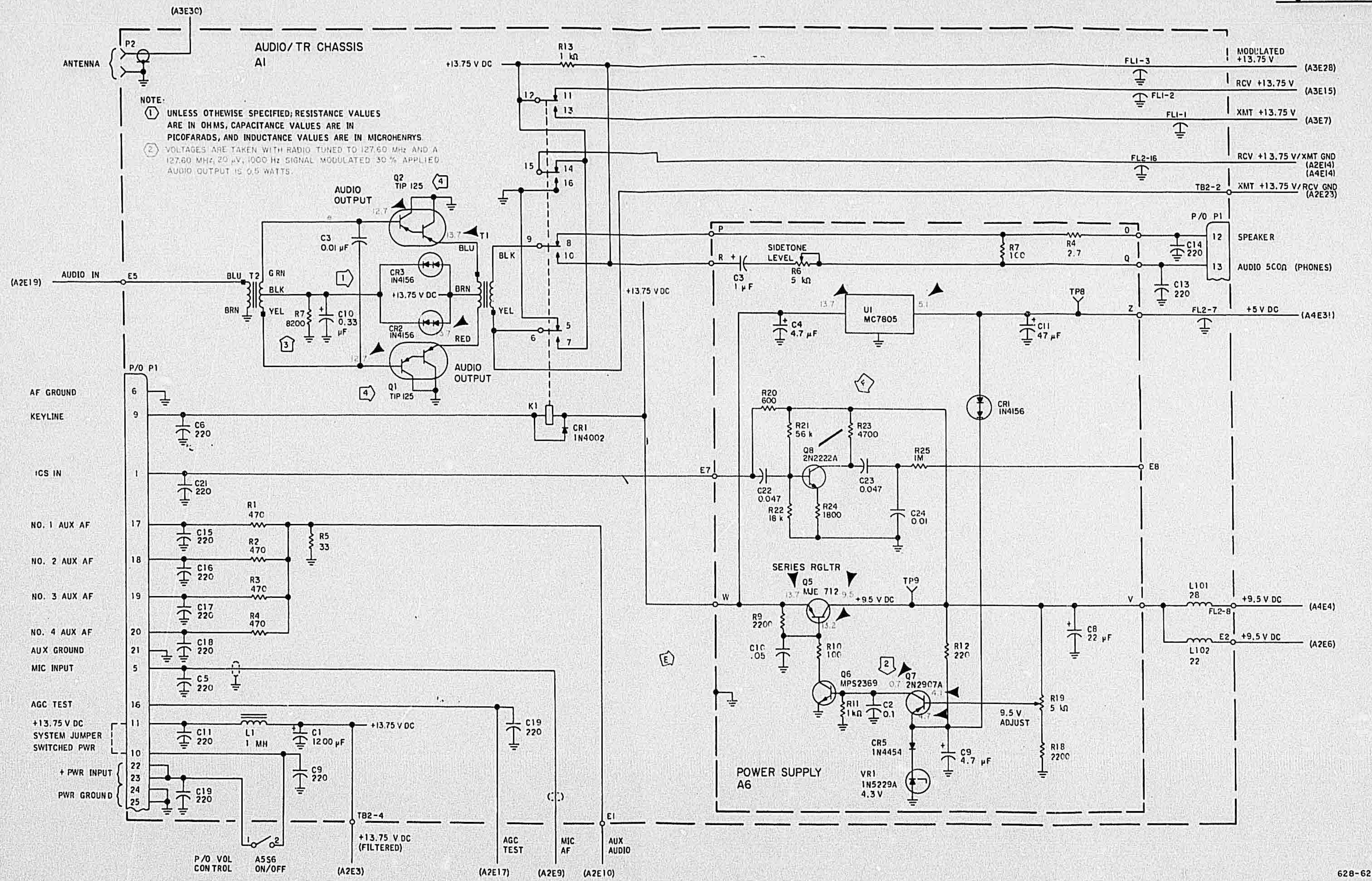
*NOT PART OF A1. PART OF REAR PLATE ASSEMBLY PART NUMBER 628-5491-0[illegible]1.

A6-POWER SUPPLY/FILTER
PART NUMBER 628-5005-002

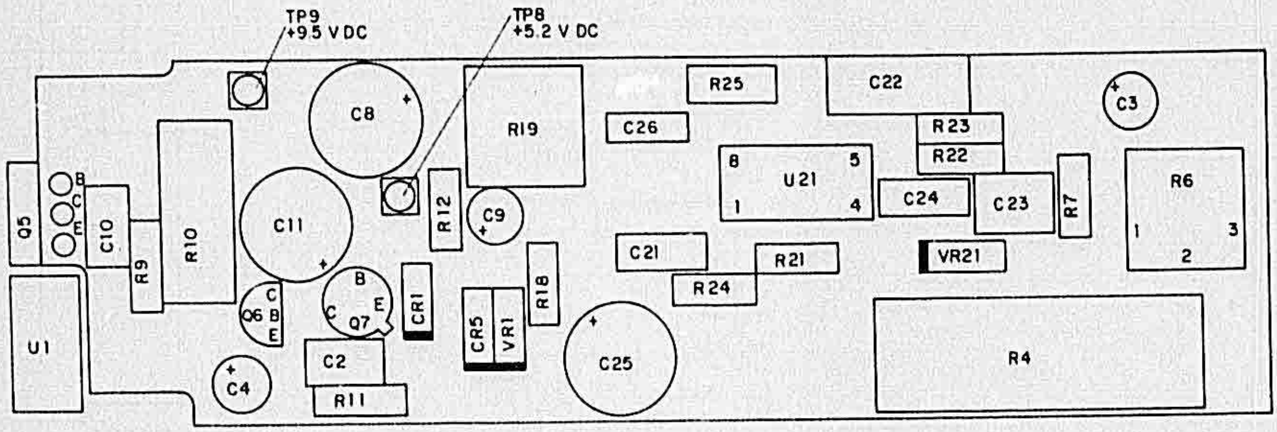
SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C1	NOT USED		
C2	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C3	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C4	CAPACITOR, FXD, TA, 4.7UF, ±20%, 20V		184-9113-060
C5-C7	NOT USED		
C8	CAPACITOR, FXD, TA, 22UF, ±20%, 15V		184-9113-080
C9	CAPACITOR, FXD, TA, 4.7UF, ±20%, 10V		184-9113-050
C10	CAPACITOR, FXD, CER, DIEL, 0.05UF, +80-20%, 12V (EFF REV F; SB 4)		913-3298-010
C10	CAPACITOR, FXD, CER, DIEL, 1000PF, +80-20%, 500 V		913-3298-110
C11	CAPACITOR, FXD, TA, 47UF, ±20%, 15V		184-9113-100
CR1	DIODE, 1N4156		353-3753-010
CR2-C4	NOT USED		
CR5	DIODE, 1N4454		353-3741-010
Q1-Q4	NOT USED		
Q5	TRANSISTOR, MJE712		352-5000-010
Q6	TRANSISTOR, MPS2369		352-5015-010
Q7	TRANSISTOR, 2N2907A		352-5019-010
R1-R3	NOT USED		
R4	RESISTOR, FXD, WW, 2.7 OHMS, ±5%, 6.5W		745-7954-030
R5	NOT USED		
R6	RESISTOR, VARIABLE, NONWW, 5K, ±70%, 1/2W		382-0041-050
R7	RESISTOR, FXD, CMPSN, 100 OHMS, ±10%, 1/4W		745-7950-130
R8	NOT USED		
R9	RESISTOR, FXD, CMPSN, 2200 OHMS, ±10%, 1/4W		745-7950-290
R10	RESISTOR, FXD, CMPSN, 100 OHMS, ±10%, 1/4W		745-7952-130
R11	RESISTOR, FXD, CMPSN, 1K, ±10%, 1/4W		745-7950-250
R12	RESISTOR, FXD, CMPSN, 200 OHMS, ±10%, 1/4W		745-7950-170

PARTS LIST
A6-POWER SUPPLY/FILTER
PART NUMBER 628-5005-002

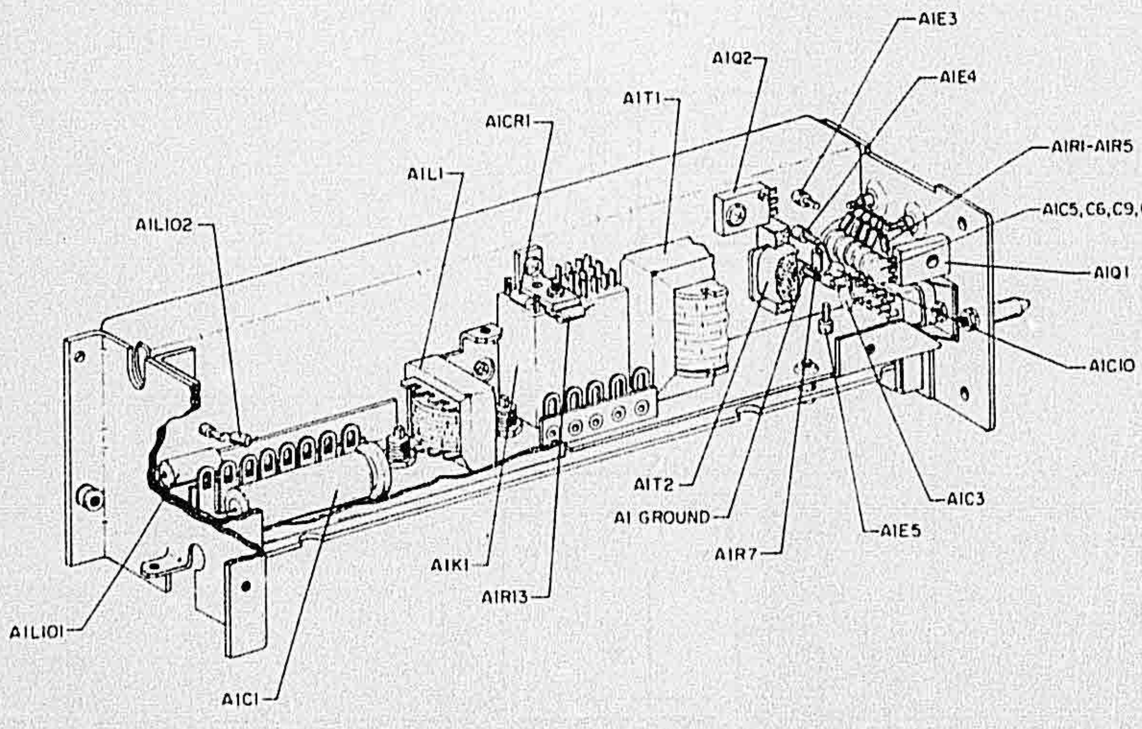
SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
R13-R17	NOT USED		
R18	RESISTOR, FXD, CMPSN, 2200 OHMS, ±10%, 1/4W		745-7950-290
R19	RESISTOR,VAR, NONWW, 5K, ±70%, 1/2W		382-0041-050
U1	INTEGRATED CIRCUIT, MC7805		351-1198-010
VR1	ZENER DIODE, 1N5229A, 4.3V		353-3740-190



VHF-250/250S Audio/TR Chassis and Power Supply A6 (CPN 628-5005-002), Schematic Diagram
Figure 6-8



628-6543



628-6623

VHF-250E Audio/TR Chassis and Power Supply/Filter A6, Component Location Diagram
Figure 6-9

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
3	Revised schematic to reflect actual component location in circuit. R25 precedes C26 on output line of U21B. Added A6C2 and A6R21.	NA	NA
4	Changed A1R7 from 18 to 8.2 kΩ to improve thermal stability.	NA	REV B
5	Changed A1Q1 and A1Q2 from MJE 2090 to TIP-125 to improve reliability.	NA	REV F
6	Changed value of R21 from 47 to 100 kΩ to increase audio output level.	NA	REV D
G	Changed A6C10 from 1000 pF to 0.05 μF to improve regulator stability.	SB 4	REV F

VHF-250E Audio/TR Chassis and Power Supply/Filter Amplifier A6
(CPN 628-5005-001), Schematic Diagram
Figure 6-10 (Sheet A)

PARTS LIST
A1-CHASSIS AUDIO TR

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C1	CAPACITOR, FXD, ELCTLT, 1200 UF, +100%-20%, 16V		183-1471-060
C2	NOT USED		
C3	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80%-20%, 50V		913-3298-130
*C4	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
*C5	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
*C6	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
C7-C8	NOT USED		
*C9	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
C10	CAPACITOR, FXD, TA, 0.33UF, ±20%, 35V		184-9113-010
*C11	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
C12	NOT USED		
*C13	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
*C14	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
*C15	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
*C16	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
*C17	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
*C18	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
*C19	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
C20-C100	NOT USED		
C101	CAPACITOR, FXD, TA, 150UF, ±20%, 15V		184-9113-160
C102-C200	NOT USED		
C201	CAPACITOR, FDTHRU, 1000PF, +100%-20%, 50V		913-3303-010
C202	CAPACITOR, FDTHRU, 1000PF, +100%-20%, 50V		913-3303-010
C203	CAPACITOR, FDTHRU, 1000PF, +100%-20%, 50V		913-3303-010
CR1	DIODE, 1N4002		353-3736-020
CR2	DIODE, 1N4156		353-3743-010
CR3	DIODE, 1N4156		353-3743-010
K1	RELAY, 4PDT, 12V (EFF REV P)		970-0038-020
K1	RELAY, ARMATURE, 4PDT, 12V		970-0024-010
L1	INDUCTOR, 1MH		668-0262-010
L2-L100	NOT USED		

PARTS LIST
A1-CHASSIS AUDIO TR

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
L101	COIL, 28UH		240-0958-010
L102	COIL, 22UH		240-2742-080
P1	CONNECTOR, PLUG, 25 PIN		371-0379-010
P2	CONNECTOR, BNC TYPE RF CONNECTOR, BULKHEAD MTG		357-7532-020
Q1	TRANSISTOR, TIP125		352-5006-020
Q2	TRANSISTOR, TIP125		352-5006-020
*R1	RESISTOR, FXD, CMPSN, 470 OHMS, 10%, 1/4W		745-7950-210
*R2	RESISTOR, FXD, CMPSN, 470 OHMS, 10%, 1/4W		745-7950-210
*R3	RESISTOR, FXD, CMPSN, 470 OHMS, 10%, 1/4W		745-7950-210
*R4	RESISTOR, FXD, CMPSN, 470 OHMS, 10%, 1/4W		745-7950-210
*R5	RESISTOR, FXD, CMPSN, 33 OHMS, 10%, 1/4W		745-7950-070
R6	NOT USED		
R7	RESISTOR, FXD, CMPSN, 8.2K, 10%, 1/4W (EFF REV B)		745-7950-360
R7	RESISTOR, FXD, CMPSN, 18K, 10%, 1/4W		745-7950-400
R8-R12	NOT USED		
R13	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
T1	TRANSFORMER		667-0251-010
T2	TRANSFORMER		667-0252-010

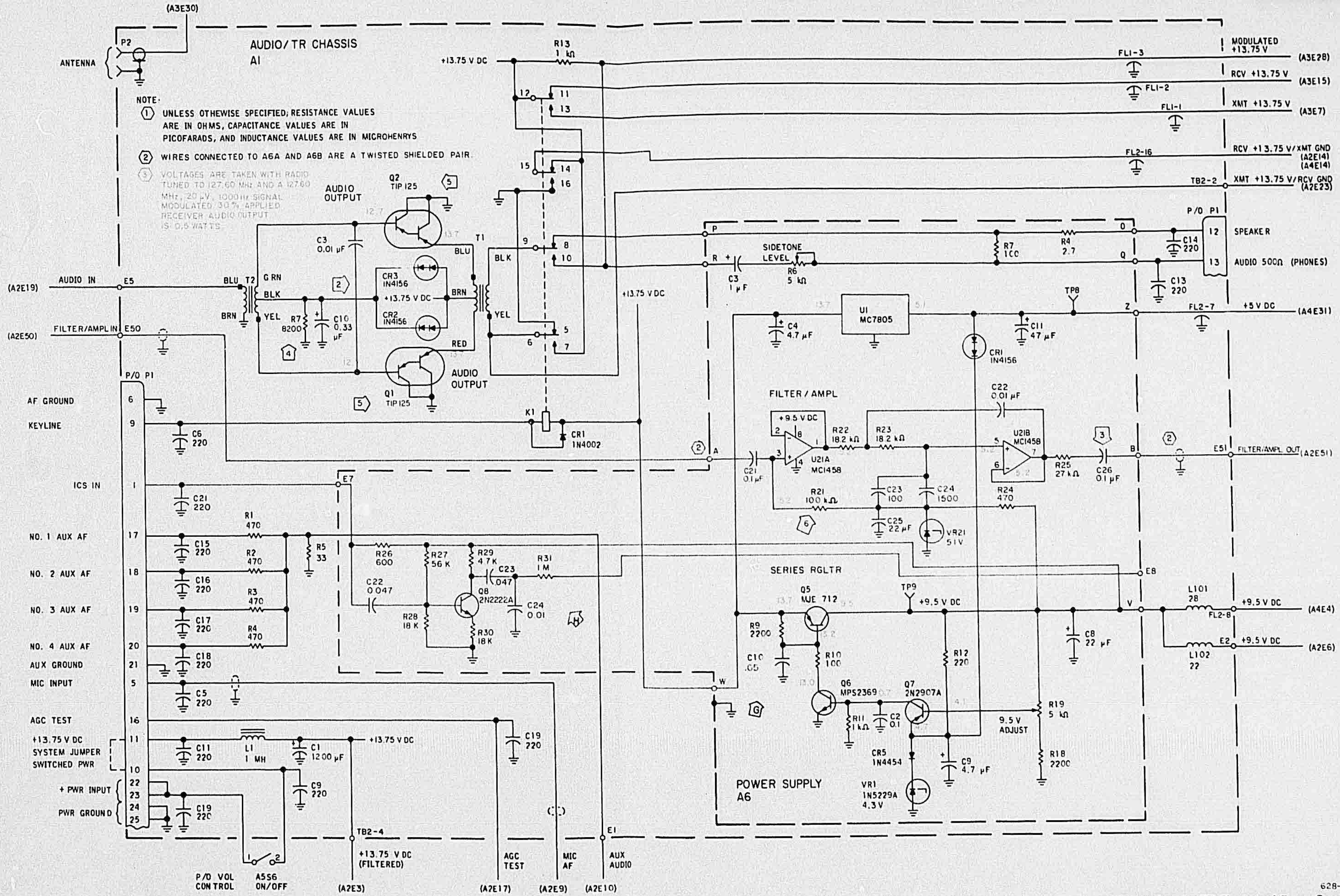
*NOT PART OF A1. PART OF REAR PLATE ASSEMBLY PART NUMBER 628-5491-001.

A6-POWER SUPPLY
PART NUMBER 628-5005-001

C1	NOT USED		
C2	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80%-20%, 50V		913-3298-130
C3	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C4	CAPACITOR, FXD, TA, 4.7UF, ±20%, 20V		184-9113-060
C5-C7	NOT USED		
C8	CAPACITOR, FXD, TA, 22UF, ±20%, 15V		184-9113-080
C9	CAPACITOR, FXD, TA, 4.7UF, ±20%, 10V		184-9113-050
C10	CAPACITOR, FXD, CER, DIEL, 0.05UF, +80%-20%, 12V (EFF REV F; SB 4)		913-3298-010
C10	CAPACITOR, FXD, CER, DIEL, 1000PF, +80%-20%, 500V		913-3298-110
C11	CAPACITOR, FXD, TA, 47UF, ±20%, 15V		184-9113-100
C12-C20	NOT USED		
C21	CAPACITOR, FXD, CER, DIEL, 0.1UF, +80%-20%, 1000V		913-3306-070
C22	CAPACITOR, FXD, POLYCARBONATE DIEL, 0.01UF, ±5%, 75V		933-1403-010
C23	CAPACITOR, FXD, MICA DIEL, 100PF, +5%, 300V		912-2099-290
C24	CAPACITOR, FXD, POLYESTER DIEL, 1500PF, ±5%, 100V		933-1404-120

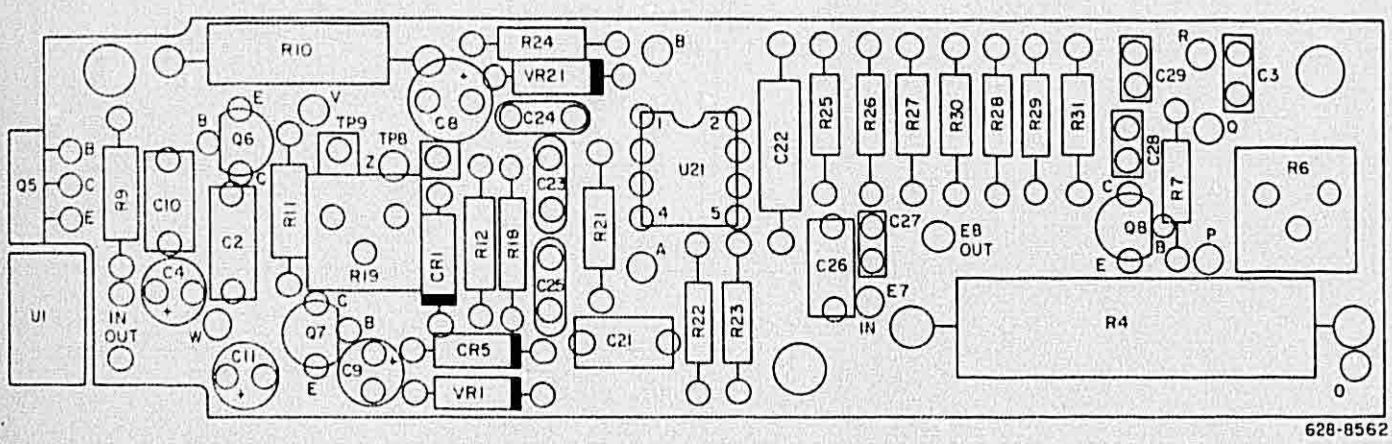
PARTS LIST
A6-POWER SUPPLY
PART NUMBER 628-5005-001

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C25	CAPACITOR, FXD, TA, 22UF, ±20%, 15V		184-9113-070
C26	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80%-20%, 1000V		913-3306-070
CR1	DIODE, 1N4156		353-3743-010
CR2-CR4	NOT USED		
CR5	DIODE, 1N4454		353-3741-010
Q1-Q4	NOT USED		
Q5	TRANSISTOR, MJE712		352-5000-010
Q6	TRANSISTOR, MPS2369		352-5015-010
Q7	TRANSISTOR, 2N2907A		352-5019-010
R1-R3	NOT USED		
R4	RESISTOR, FXD, WW, 2.7 OHMS, ±5%, 6.5W		745-7954-030
R5	NOT USED		
R6	RESISTOR, VAR, NONWW, 5K, ±70%, 1/2W		382-0041-050
R7	RESISTOR, FXD, CMPSN, 100 OHMS, ±10%, 1/4W		745-7950-130
R8	NOT USED		
R9	RESISTOR, FXD, CMPSN, 2200 OHMS, ±10%, 1/4W		745-7950-290
R10	RESISTOR, FXD, CMPSN, 100 OHMS, ±10%, 1/4W		745-7952-130
R11	RESISTOR, FXD, CMPSN, 1K, ±10%, 1/4W		745-7950-250
R12	RESISTOR, FXD, CMPSN, 200 OHMS, ±10%, 1/4W		745-7950-170
R13-R17	NOT USED		
R18	RESISTOR, FXD, CMPSN, 2200 OHMS, ±10%, 1/4W		745-7950-290
R19	RESISTOR, VAR, NONWW, 5K, ±70%, 1/2W		382-0041-050
R20	NOT USED		
R21	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W (EFF REV D)		745-7950-490
R21	RESISTOR, FXD, CMPSN, 47K, ±10%, 1/4W		745-7950-450
R22	RESISTOR, FXD, FILM, 18.2K, ±1%, 1/8W		745-7957-480
R23	RESISTOR, FXD, FILM, 18.2K, ±1%, 1/8W		745-7957-480
R24	RESISTOR, FXD, FILM, 9530 OHMS, ±1%, 1/8W		745-7950-210
R25	RESISTOR, FXD, CMPSN, 27K, ±10%, 1/4W		745-7950-420
U1	INTEGRATED CIRCUIT, MC7805		351-1198-010
U2-U20	NOT USED		
U21	INTEGRATED CIRCUIT, MC1458		351-1156-020
VR1	ZENER DIODE, 1N5229A, 4.3V		353-3740-190
VR2-VR20	NOT USED		
VR21	ZENER DIODE, 1N5231A, 5.1V		353-3740-160



628-6514

VHF-250E Audio/TR Chassis and Power Supply/Filter Amplifier A6 (CPN 628-5005-001), Schematic Diagram
Figure 6-10



VHF-250/250S/250E Power Supply/Filter Amplifier A6 (CPN 628-9108-001, -002), Component Location Diagram
Figure 6-10A

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
	(This page will contain schematic revision information.)		

VHF-250/250S/250E Audio TR Chassis and Power Supply/Filter Amplifier A6, (CPN 628-9108-001, -002), Schematic Diagram
Figure 6-10B (Sheet A)

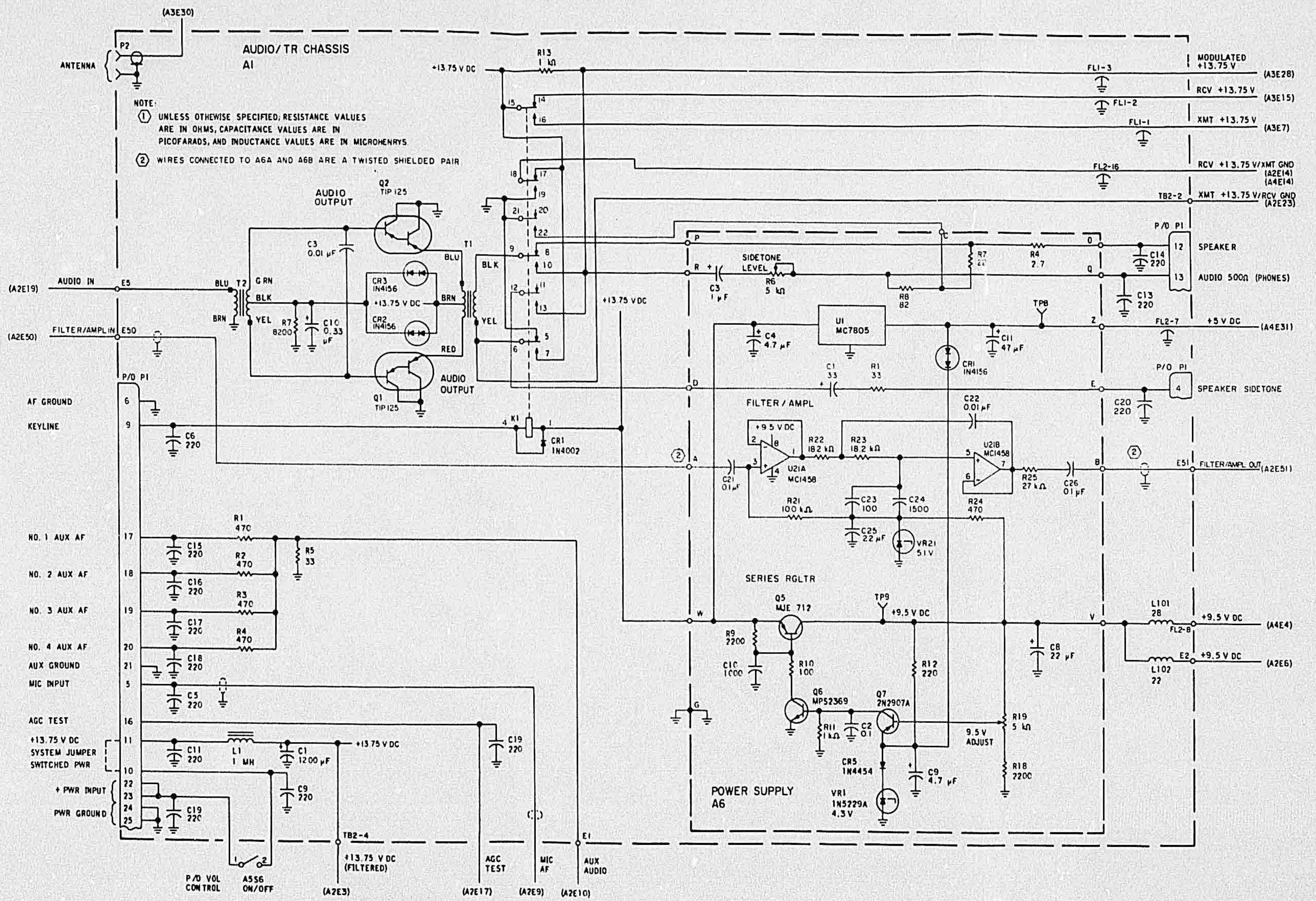
PARTS LIST
A6 - POWER SUPPLY
PART NUMBER 628-9108-001, -002

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
A6	POWER SUPPLY	A	628-9108-001
A6	POWER SUPPLY	B	628-9108-002
C1	NOT USED		
C2	CAPACITOR, FXD, CER DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C3	CAPACITOR, FXD, TA, 1UF, +20%, 20V		184-9113-030
C4	CAPACITOR, FXD, TA, 4.7UF, ±20%, 20V		184-9113-060
C5-C7	NOT USED		
C8	CAPACITOR, FXD, TA, 22UF, ±20%, 15V		184-9113-080
C9	CAPACITOR, FXD, TA, 4.7UF, ±20%, 10V		184-9113-050
C10	CAPACITOR, FXD, CER DIEL, 0.01UF, +80-20%, 50V		913-3298-130
C11	CAPACITOR, FXD, TA, 47UF, ±20%, 15V		184-9113-100
C12-C20	NOT USED		
C21	CAPACITOR, FXD, CER DIEL, 0.1UF, +80-20%, 12V	A	913-3298-020
C22	CAPACITOR, FXD, POLYCARB, 0.01UF, ±5%, 75V	A	913-1403-010
C23	CAPACITOR, FXD, MICA DIEL, 100PF, +5%, 300V	A	912-2099-290
C24	CAPACITOR, FXD, POLYESTER, 1500PF, ±5%, 100V	A	933-1404-120
C25	CAPACITOR, FXD, TA, 22UF, 20%, 15V	A	184-9113-080
C26	CAPACITOR, FXD, CER DIEL, 0.1UF, +80-20%, 12V	A	913-3298-020
CR1	DIODE, 1N4156		353-3743-010
CR2-CR4	NOT USED		
CR5	DIODE, 1N4454		353-3741-010
Q1-Q4	NOT USED		
Q5	TRANSISTOR, MJE712		352-5000-010
Q6	TRANSISTOR, MPS2369		352-5015-010
Q7	TRANSISTOR, 2N2907A		352-5019-010
Q8	TRANSISTOR, 2N2222		352-0661-020
R1-R3	NOT USED		
R4	RESISTOR, FXD, WW, 2.7OHMS, ±5%, 6.5W		745-7954-030
R5	NOT USED		
R6	RESISTOR, VAR, NONWW, 5K, ±70%, 1/2W		382-0041-050
R7	RESISTOR, FXD, CMPSN, 100OHMS, ±10%, 1/4W		745-7950-130
R8	NOT USED		
R9	RESISTOR, FXD, CMPSN, 2200OHMS, ±10%, 1/4W		745-7950-290
R10	RESISTOR, FXD, CMPSN, 100OHMS, ±10%, 1/4W		745-7952-130
R11	RESISTOR, FXD, CMPSN, 1K, ±10%, 1/4W		745-7950-250
R12	RESISTOR, FXD, CMPSN, 200OHMS, ±10%, 1/4W		745-7950-170
R13-R17	NOT USED		
R18	RESISTOR, FXD, CMPSN, 2200OHMS, ±10%, 1/4W		745-7950-290
R19	RESISTOR, VAR, NONWW, 5K, ±70%, 1/2W		382-0041-050
R20	NOT USED		
R21	RESISTOR, FXD, CMPSN, 100K, ±10%, 1/4W		745-7950-490
R22	RESISTOR, FXD, FILM, 18.2K, ±1%, 1/8W	A	745-7957-480
R23	RESISTOR, FXD, FILM, 18.2K, ±1%, 1/8W	A	745-7957-480
R24	RESISTOR, FXD, FILM, 9530OHMS, ±1%, 1/8W		745-7950-210
R25	RESISTOR, FXD, CMPSN, 27K, ±10%, 1/4W	A	745-7950-420
R26	RESISTOR, FXD, CMPSN, 560OHMS, ±10%, 1/4W		745-7950-220

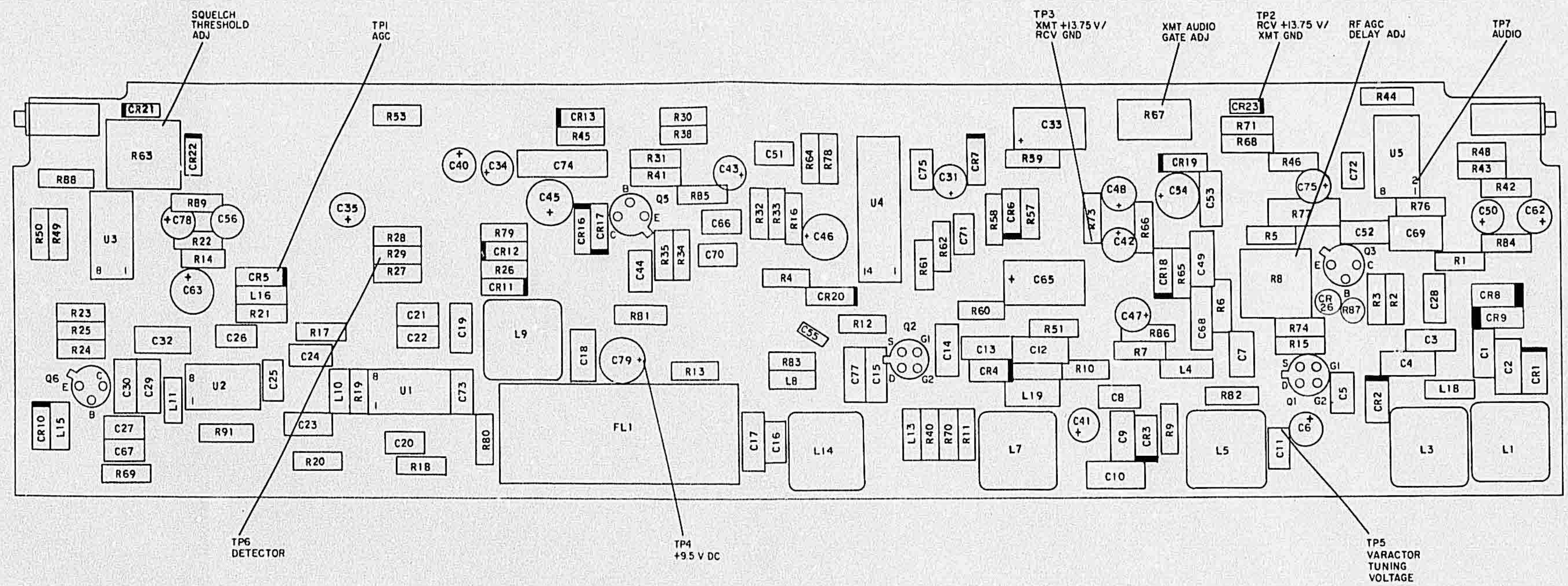
PARTS LIST
A6 - POWER SUPPLY
PART NUMBER 628-9108-001, -002

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
R27	RESISTOR, FXD, CMPSN, 18K, ±10%, 1/4W		745-7950-400
R28	RESISTOR, FXD, CMPSN, 56K, ±10%, 1/4W		745-7950-460
R29	RESISTOR, FXD, CMPSN, 4.7K, ±10%, 1/4W		745-7950-450
R30	RESISTOR, FXD, CMPSN, 1.8K, ±10%, 1/4W		745-7950-280
R31	RESISTOR, FXD, CMPSN, 1M, ±10%, 1/4W		745-7950-610
U1	INTEGRATED CIRCUIT, MC7805		351-1198-010
U2-U20	NOT USED		
U21	INTEGRATED CIRCUIT, MC1458		351-1156-020
VR1	ZENER DIODE, 1N5229		353-3740-190
VR2-VR20	NOT USED		
VR21	ZENER DIODE, 1N5231A		353-3740-160

Revised 2 August 1984



VHF-250/250S/250E Audio TR Chassis and Power Supply/ Filter Amplifier A6 (CPN 628-9108-001, -002), Schematic Diagram
Figure 6-10B



628-6520

COMM Receiver A2, Component Location Diagram
Figure 6-11

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
2	Added note 5.	NA	REV AF
3	Changed C1 from 5 to 3 pF, and C3, 9, 13 from 5 to 4 pF to improve preselector tracking. Changed R32 from 47 to 4.87 kΩ and R33 from 270 to 24.3 kΩ to stabilize compressor bias.	NA	REV AH
6	Changed value of L13 from 0.15 to 0.1 μh to prevent synthesizer unlock with abrupt signal application.	NA	REV AL
4	Changed R14 from 10 to 4.7 kΩ to allow proper adjustment of carrier squelch threshold.	NA	REV AD
5	Added CR8 and CR9 to prevent parametric oscillation with strong rf signals.	NA	All units
7	Changed value of C44 from 0.1 to 1 μf and R35 from 5.6 to 1 kΩ to eliminate compressor thump.	NA	REV AM
8	Added CR26 to improve thermal stability of carrier squelch.	NA	REV AN
K	Changed CR8 and CR9 from 1N3070 to FD700 to improve sensitivity.	NA	REV AW
J	Changed Q1 from 40481 to 3N211 to improve performance.	NA	REV AV
L	Changed CR23 from 1N4454 to 1N645 to improve reliability.	SIL 1-80	REV BB
	Changed CR01-04 from 353-3264-020 to 922-6131-020. CPN 353-3264-020 no longer available -- all diodes should be the same type for proper operation.	NA	REV BF

COMM Receiver A2, Schematic Diagram
Figure 6-12 (Sheet A)

PARTS LIST
A2-COMM RECEIVER
PART NUMBER 628-5025-004/005/006

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C1	CAPACITOR, FXD, MICA, DIEL, 3PF ±1/2PF, 50V (EFF REV AH)		912-2099-020
C1	CAPACITOR, FXD, MICA, DIEL, 5PF,±1/2PF, 50V		912-2099-040
C2	CAPACITOR, FXD, MICA, DIEL, 220PF, ±5%, 50V		912-2099-380
C3	CAPACITOR, FXD, MICA, DIEL, 4PF ±1/2PF, 50V (EFF REV AH)		912-2099-030
C3	CAPACITOR, FXD, MICA, DIEL, 5PF ±1/2PF, 50V		913-2099-040
C4	CAPACITOR, FXD, MICA, DIEL, 220PF, ±5%, 50V		912-2099-380
C5	CAPACITOR, FXD, CER, DIEL, 330PF, +80%-20%, 1000V		913-3298-030
C6	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C7	CAPACITOR, FXD, CER, DIEL, 330PF, +80%-20%, 1000V		913-3298-030
C8	CAPACITOR, FXD, CER, DIEL, 330PF, +80%-20%, 1000V		913-3298-030
C9	CAPACITOR, FXD, MICA, DIEL, 4PF ±1/2PF, 50V (EFF REV AH)		912-2099-030
C9	CAPACITOR, FXD, MICA, DIEL, 5PF ±1/2PF, 50V		912-2099-040
C10	CAPACITOR, FXD, MICA, DIEL, 220PF, ±5%, 50V		912-2099-380
C11	CAPACITOR, FXD, CER, DIEL, 330PF, +80%-20%, 1000V		913-3298-030
C12	CAPACITOR, FXD, MICA, DIEL, 220PF, ±5%, 50V		912-2099-380
C13	CAPACITOR, FXD, MICA, DIEL, 4PF ±1/2PF, 50V (EFF REV AH)		912-2099-030
C13	CAPACITOR, FXD, MICA, DIEL, 5PF, ±1/2PF, 50V		912-2099-040
C14	CAPACITOR, FXD, MICA, DIEL, 18PF, ±5%, 50V		912-2099-120
C15	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80%-20%, 50V		913-3298-130
C16	CAPACITOR, FXD, CER, DIEL, 0.01UF, +80%-20%, 50V		913-3298-130
C17	CAPACITOR, FXD, SILVERED MICA, 47PF, ±5%, 50V		912-2099-210
VHF-250/ 250E	CAPACITOR, FXD, SILVERED MICA, 33PF, ±5%, 50V		912-2099-180
VHF-250S	CAPACITOR, FXD, SILVERED MICA, 33PF, ±5%, 50V		912-2099-180
C18	CAPACITOR, FXD, SILVERED MICA, 36PF, ±5%, 50V		912-2099-190
VHF-250/ 250E	CAPACITOR, FXD, SILVERED MICA, 33PF, ±5%, 50V		912-2099-180
VHF-250S	CAPACITOR, FXD, SILVERED MICA, 33PF, ±5%, 50V		912-2099-180
C19	CAPACITOR, FXD, SILVERED MICA, 68PF, ±5%, 50V		912-2099-250
VHF-250/ 250E	CAPACITOR, FXD, SILVERED MICA, 56PF, ±5%, 50V		912-2099-230
VHF-250S	CAPACITOR, FXD, SILVERED MICA, 56PF, ±5%, 50V		912-2099-230
C20	CAPACITOR, FXD, CER, DIEL, 0.05UF, +80%-20%, 12V		913-3298-010
C21	CAPACITOR, FXD, CER, DIEL, 0.05UF, +80%-20%, 12V		913-3298-010

PARTS LIST
A2-COMM RECEIVER
PART NUMBER 628-5025-004/005/006

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C22	CAPACITOR, FXD, CER, DIEL, 0.05UF, +80%-20%, 12V		913-3298-010
C23	CAPACITOR, FXD, MICA, DIEL, 56PF, ±2%, 300V		912-2099-710
C24	CAPACITOR, FXD, MICA, DIEL, 24PF, ±2%, 300V		912-2099-750
C25	CAPACITOR, FXD, CER, DIEL, 0.05UF, +80%-20%, 12V		913-3298-010
C26	CAPACITOR, FXD, CER, DIEL, 0.05UF, +80%-20%, 12V		913-3298-010
C27	CAPACITOR, FXD, CER, DIEL, 0.05UF, +80%-20%, 12V		913-3298-010
C28	CAPACITOR, FXD, MICA, DIEL, 5PF, ±1/2PF, 50V		912-2099-040
C29	CAPACITOR, FXD, MICA, DIEL, 56PF, ±2%, 300V		912-2099-760
C30	CAPACITOR, FXD, MICA, DIEL, 33PF, ±2%, 300V		912-2099-770
C31	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C32	CAPACITOR, FXD, CER, DIEL, 1000PF, +80%-20%, 500V		913-3298-110
C33	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C34	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C35	CAPACITOR, FXD, TA, 10UF, ±20%, 20V		184-9113-070
C36-C39	NOT USED		
C40	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C41	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C42	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C43	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C44	CAPACITOR, FXD, TA, 1UF, 20%, 20V (EFF REV AM)		184-9113-030
C44	CAPACITOR, FXD, CER, DIEL, 0.1UF, ±20%, 50V		913-3306-070
C45	CAPACITOR, FXD, TA, 4.7UF, ±20%, 20V		184-9113-060
C46	CAPACITOR, FXD, TA, 4.7UF, ±20%, 20V		184-9113-060
C47	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C48	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C49	CAPACITOR, FXD, CER, DIEL, 0.1UF, ±20%, 50V (NOT USED IN VHF-250E)		913-3306-070
C50	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C51	CAPACITOR, FXD, CER, DIEL, 330PF, +80%-20%, 1000V		913-3298-030
C52	CAPACITOR, FXD, MICA, DIEL, 33PF, ±5%, 50V		912-2099-180
C53	CAPACITOR, FXD, CER, DIEL, 0.1UF, ±20%, 50V		913-3306-070
C54	CAPACITOR, FXD, ELCTLT, 33UF, +100%-20%, 16V		183-1471-040
C55	CAPACITOR, FXD, SILVERED MICA, 47PF, ±5%, 50V		912-2099-210
VHF-250/ 250E	CAPACITOR, FXD, SILVERED MICA, 51PF, ±5%, 50V		912-2099-220
VHF-250S	CAPACITOR, FXD, SILVERED MICA, 51PF, ±5%, 50V		912-2099-220
C56	CAPACITOR, FXD, TA, 2.2UF, ±20%, 20V		184-9113-200
C57	CAPACITOR, FXD, TA, 47UF, ±20%, 15V		184-9113-100
C58-C61	NOT USED		

PARTS LIST
A2-COMM RECEIVER
PART NUMBER 628-5025-004/005/006

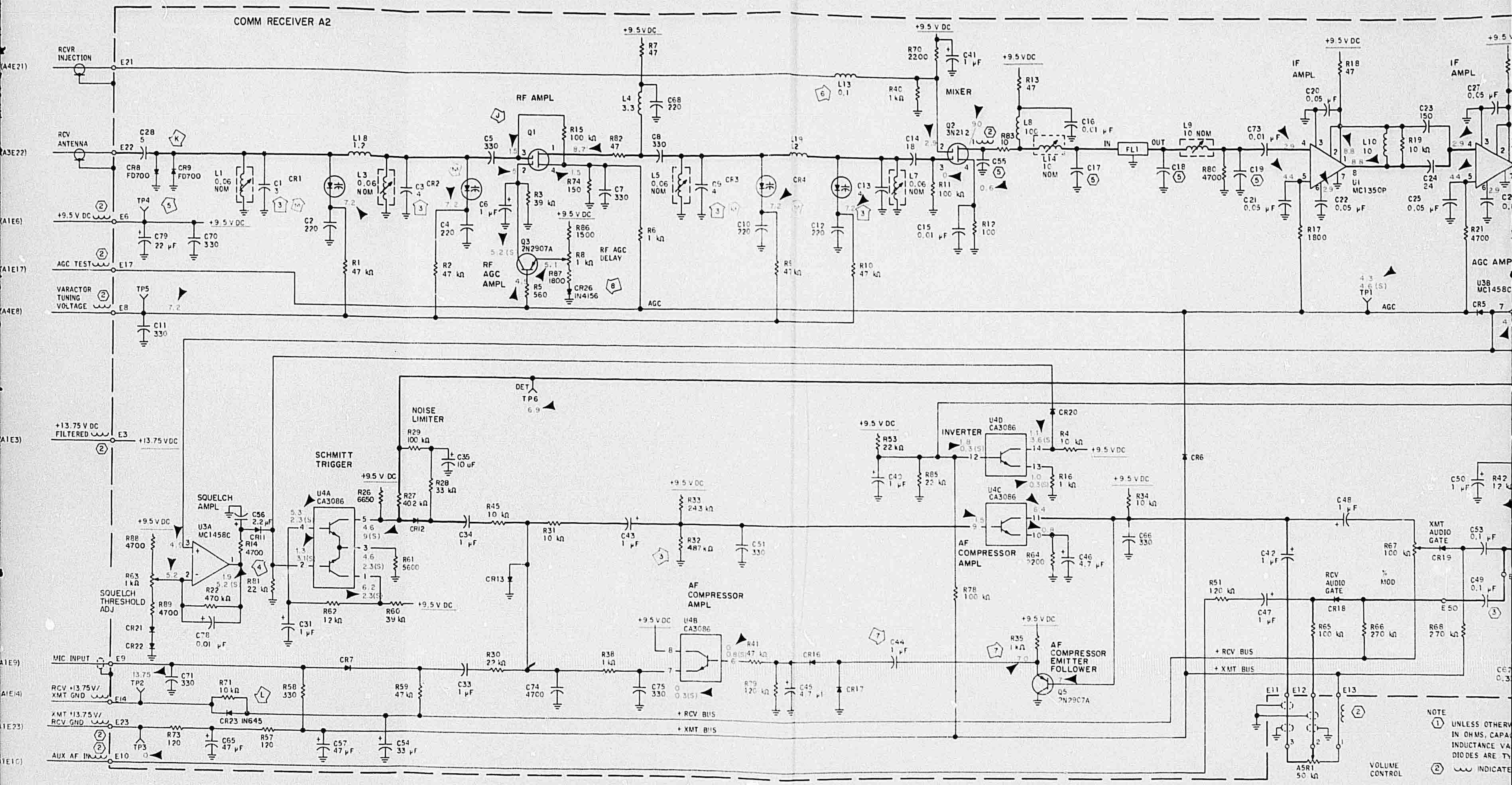
SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
R5	RESISTOR, FXD, CMPSN, 560 OHMS, 10%, 1/4W		745-7950-220
R6	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R7	RESISTOR, FXD, CMPSN, 47 OHMS, 10%, 1/4W		745-7950-090
R8	RESISTOR, VAR, NONWW, 1K, ±70%, 1/2W		382-0041-010
R9	RESISTOR, FXD, CMPSN, 47K, 10%, 1/4W		745-7950-450
R10	RESISTOR, FXD, CMPSN, 47K, 10%, 1/4W		745-7950-450
R11	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W		745-7950-490
R12	RESISTOR, FXD, CMPSN, 100 OHMS, 10%, 1/4W		745-7950-130
R13	RESISTOR, FXD, CMPSN, 47 OHMS, 10%, 1/4W		745-7950-090
R14	RESISTOR, FXD, CMPSN, 4.7K, 10%, 1/4W (EFF REV AD)		745-7950-330
R14	RESISTOR, FXD, CMPSN, 10K, 10%, 1/4W		745-7950-370
R15	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W		745-7950-490
R16	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R17	RESISTOR, FXD, CMPSN, 1800 OHMS, 10%, 1/4W		745-7950-280
R18	RESISTOR, FXD, CMPSN, 47 OHMS, 10%, 1/4W		745-7950-090
R19	RESISTOR, FXD, CMPSN, 10K, 10%, 1/4W		745-7950-370
R20	RESISTOR, FXD, CMPSN, 47 OHMS, 10%, 1/4W		745-7950-090
R21	RESISTOR, FXD, CMPSN, 4700 OHMS, 10%, 1/4W		745-7950-330
R22	RESISTOR, FXD, CMPSN, 470K, 10%, 1/4W		745-7950-570
R23	RESISTOR, FXD, CMPSN, 68K, 10%, 1/4W		745-7950-470
R24	RESISTOR, FXD, CMPSN, 3300 OHMS, 10%, 1/4W		745-7950-310
R25	RESISTOR, FXD, CMPSN, 56 OHMS, 10%, 1/4W		745-7950-100
R26	RESISTOR, FXD, FILM, 6650 OHMS, ±1%, 1/8W		745-7957-060
R27	RESISTOR, FXD, FILM, 40.2K, ±1%, 1/8W		745-7957-810
R28	RESISTOR, FXD, CMPSN, 33K, 10%, 1/4W		745-7950-430
R29	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W		745-7950-490
R30	RESISTOR, FXD, CMPSN, 22K, 10%, 1/4W		745-7950-410
R31	RESISTOR, FXD, CMPSN, 10K, 10%, 1/4W		745-7950-370
R32	RESISTOR, FXD, FILM, 4.87K, ±1%, 1/8W (EFF REV AH)		745-7956-920
R32	RESISTOR, FXD, CMPSN, 47K, 10%, 1/4W		745-7950-450
R33	RESISTOR, FXD, FILM, 24.3K ±1%, 1/8W (EFF REV AH)		745-7957-600
R33	RESISTOR, FXD, CMPSN, 270K, 10%, 1/4W		745-7950-540
R34	RESISTOR, FXD, CMPSN, 10K, 10%, 1/4W		745-7950-370
R35	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W (EFF REV AM)		745-7950-250
R35	RESISTOR, FXD, CMPSN, 5600 OHMS, 10%, 1/4W		745-7950-340
R36	NOT USED		
R37	NOT USED		
R38	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R39	NOT USED		
R40	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R41	RESISTOR, FXD, CMPSN, 47K, 10%, 1/4W		745-7950-450

PARTS LIST
A2-COMM RECEIVER
PART NUMBER 628-5025-004/005/006

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
R42	RESISTOR, FXD, CMPSN, 12K, 10%, 1/4W		745-7950-380
R43	RESISTOR, FXD, CMPSN, 270K, 10%, 1/4W		745-7950-540
R44	RESISTOR, FXD, CMPSN, 18K, 10%, 1/4W		745-7950-400
R45	RESISTOR, FXD, CMPSN, 10K, 10%, 1/4W		745-7950-370
R46	RESISTOR, FXD, CMPSN, 470K, 10%, 1/4W		745-7950-570
R47	NOT USED		
R48	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R49	RESISTOR, FXD, FILM, 2150 OHMS, ±1%, 1/8W		745-7956-580
R50	RESISTOR, FXD, FILM, 6190 OHMS, ±1%, 1/8W		745-7957-030
R51	RESISTOR, FXD, CMPSN, 120K, 10%, 1/4W		745-7950-500
R52	NOT USED		
R53	RESISTOR, FXD, CMPSN, 22K, 10%, 1/4W		745-7950-410
R54	NOT USED		
R55	NOT USED		
R56	NOT USED		
R57	RESISTOR, FXD, CMPSN, 120 OHMS, 10%, 1/4W		745-7950-140
R58	RESISTOR, FXD, CMPSN, 330 OHMS, 10%, 1/4W		745-7950-190
R59	RESISTOR, FXD, CMPSN, 47K, 10%, 1/4W		745-7950-450
R60	RESISTOR, FXD, CMPSN, 39K, 10%, 1/4W		745-7950-440
R61	RESISTOR, FXD, CMPSN, 5600 OHMS, 10%, 1/4W		745-7950-340
R62	RESISTOR, FXD, CMPSN, 12K, 10%, 1/4W		745-7950-380
R63	RESISTOR, VAR, SINGLE TURN, 1K, 20%, 1/2W		382-0041-010
R64	RESISTOR, FXD, CMPSN, 2200 OHMS, 10%, 1/4W		745-7950-290
R65	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W		745-7950-490
R66	RESISTOR, FXD, CMPSN, 270K, 10%, 1/4W		745-7950-540
R67	RESISTOR, VAR, NONWW, 100K, ±70%, 1/2W		382-0041-140
R68	RESISTOR, FXD, CMPSN, 270K, 10%, 1/4W		745-7950-540
R69	RESISTOR, FXD, CMPSN, 10K, 10%, 1/4W		745-7950-370
R70	RESISTOR, FXD, CMPSN, 2200 OHMS, ±10%, 1/4W		745-7950-290
R71	RESISTOR, FXD, CMPSN, 10K, 10%, 1/4W		745-7950-370
R72	NOT USED		
R73	RESISTOR, FXD, CMPSN, 120 OHMS, 10%, 1/4W		745-7950-140
R74	RESISTOR, FXD, CMPSN, 150 OHMS, 10%, 1/4W		745-7950-150
R75	NOT USED		
R76	RESISTOR, FXD, CMPSN, 33K, 10%, 1/4W		745-7950-430
R77	RESISTOR, FXD, CMPSN, 220 OHMS, 10%, 1/2W		745-7951-170
R78	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W		745-7950-490
R79	RESISTOR, FXD, CMPSN, 120K, 10%, 1/4W		745-7950-500
R80	RESISTOR, FXD, CMPSN, 4700 OHMS, 10%, 1/4W		745-7950-330
R81	RESISTOR, FXD, CMPSN, 22K, 10%, 1/4W		745-7950-410
R82	RESISTOR, FXD, CMPSN, 47 OHMS, 10%, 1/4W		745-7950-090
R83	RESISTOR, FXD, CMPSN, 10 OHMS, 10%, 1/4W		745-7950-010
R84	RESISTOR, FXD, CMPSN, 3900 OHMS, 10%, 1/4W		745-7950-320
R85	RESISTOR, FXD, CMPSN, 22K, 10%, 1/4W		745-7950-410
R86	RESISTOR, FXD, CMPSN, 1500 OHMS, 10%, 1/4W		745-7950-270

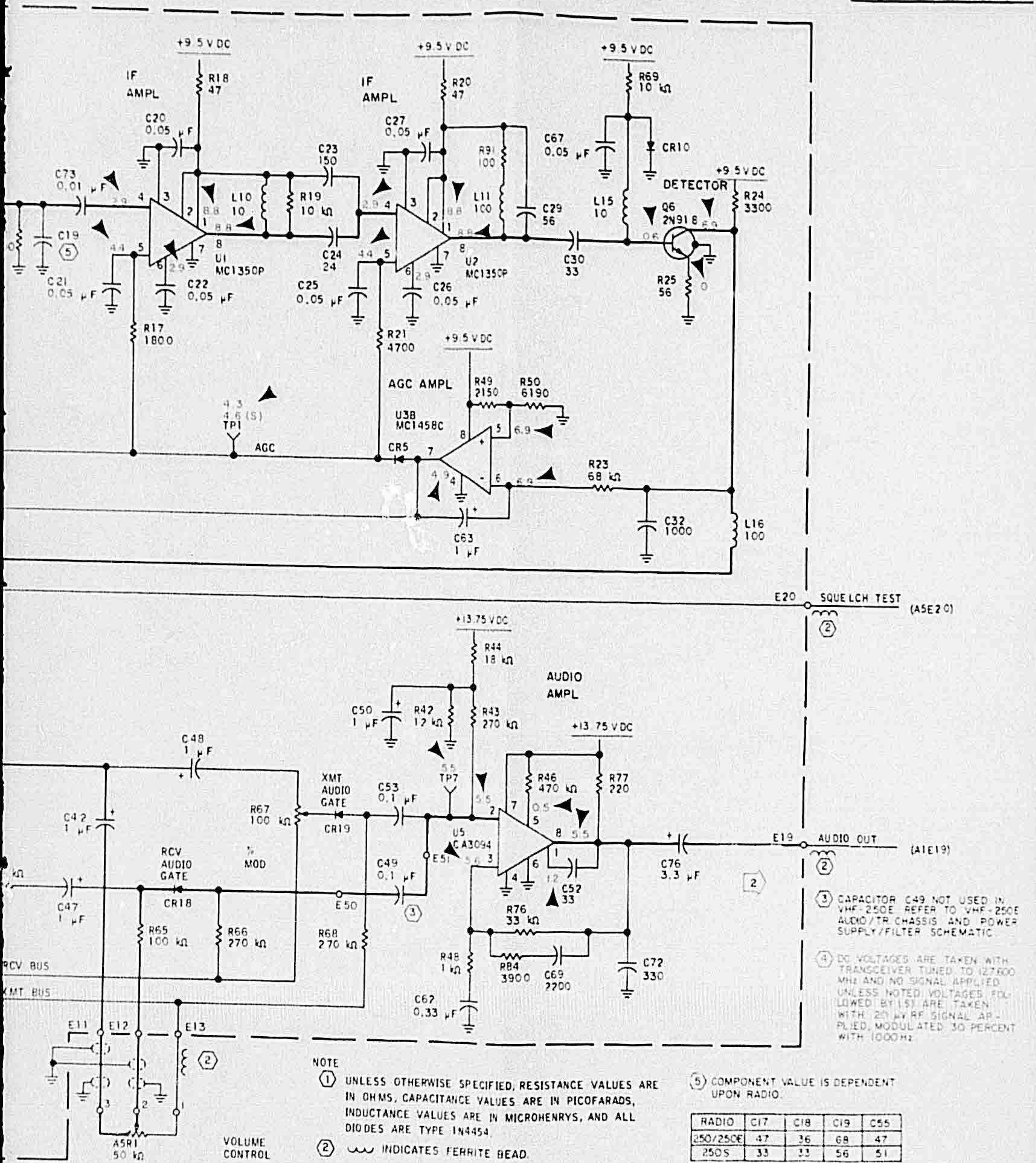
PARTS LIST
A2-COMM RECEIVER
PART NUMBER 628-5025-004/005/006

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
R87	RESISTOR, FXD, CMPSN, 1800 OHMS, 10%, 1/4W		745-7950-280
R88	RESISTOR, FXD, CMPSN, 4700 OHMS, 10%, 1/4W		745-7950-330
R89	RESISTOR, FXD, CMPSN, 4700 OHMS, 10%, 1/4W		745-7950-330
R90	NOT USED		
R91	RESISTOR, FXD, CMPSN, 100 OHMS, 10%, 1/4W		745-7950-130
U1	INTEGRATED CIRCUIT, MC1350P		351-1134-010
U2	INTEGRATED CIRCUIT, MC1350P		351-1134-010
U3	INTEGRATED CIRCUIT, MC1458CP1		351-1156-020
U4	INTEGRATED CIRCUIT, CA3086		351-1136-010
U5	INTEGRATED CIRCUIT, CA3094T		351-1135-010



SEE BLOW–UP FICHE NO. CLQ302 - ITEM M

SEE BLOW–UP FICHE NO. CLQ302 - ITEM N



NOTE

(1) UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, INDUCTANCE VALUES ARE IN MICROHENRYS, AND ALL DIODES ARE TYPE 1N4454.

(2) ꟺ INDICATES FERRITE BEAD.

(3) CAPACITOR C49 NOT USED IN VHF-250E. REFER TO VHF-250E AUDIO/TR CHASSIS AND POWER SUPPLY/FILTER SCHEMATIC.

(4) DC VOLTAGES ARE TAKEN WITH TRANSCEIVER TUNED TO 127.600 MHz AND NO SIGNAL APPLIED UNLESS NOTED. VOLTAGES FOLLOWED BY (S) ARE TAKEN WITH 20 μV RF SIGNAL APPLIED, MODULATED 30 PERCENT WITH 1000 Hz.

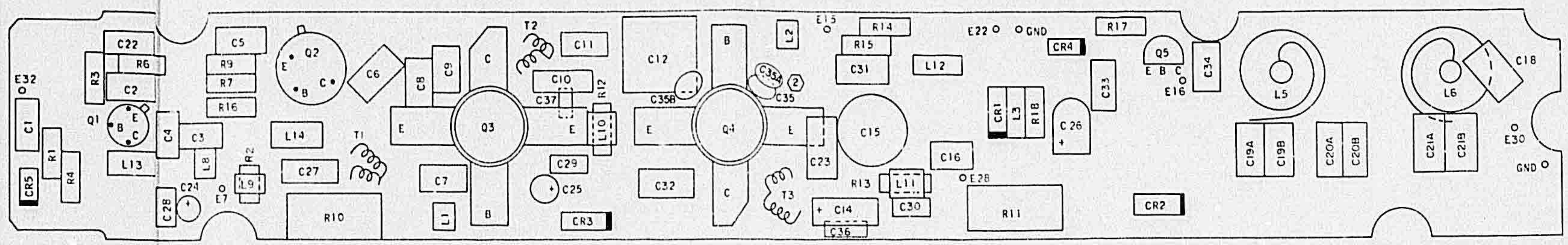
(5) COMPONENT VALUE IS DEPENDENT UPON RADIO.

RADIO	C17	C18	C19	C55
250/250E	47	36	68	47
250S	33	33	56	51

628-6212

COMM Receiver A2, Schematic Diagram
Figure 6-12

EE BLOW-UP FICHE NO. CLQ302 - ITEM N



NOTES

1. C33, C34, CR4, Q5, R17, AND R18 ARE USED IN VHF 251 ( ) ONLY.
2. C35A AND C35B INCLUDED EFF REV R.
3. DO NOT ATTEMPT TO REPAIR REVISION LETTER R BOARDS RETURN THE BOARD TO YOUR REGIONAL CUSTOMER SERVICE MANAGER A NEW ASSEMBLY WILL BE SENT IN EXCHANGE

628-5609

Power Amplifier A3, Component Location Diagram
Figure 6-13

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
None	Changed value of C7 from 100 to 120 pF; C8 from 180 to 33 pF; C9 from 5 to 15 pF; C23 from 10 to 18 pF; L10 from coil to ferrite bead; L11 from coil to ferrite bead; added C35A, C35B, 62 pF.	4	REV R
D	Changed value of C7 from 120 to 100 pF; C8 from 33 to 180 pF; C9 from 15 to 10 pF; C10 from 220 pF to 1 μF; C14 from 220 pF to 1 μF; C35A from 62 to 82 pF and changed reference designator to C35; CR1 from 1N3070 to 1N5767, L1 from coil to ferrite bead; L12 from coil to 2.2 μH coil. Deleted R14, C35B. Added C36, C37, 1000 pF chip capacitors.		REV T
2	Changed T3 from 608-6569-001 to 278-0502-010.	5	REV X

Power Amplifier A8, Schematic Diagram
Figure 6-14 (Sheet A)

PARTS LIST
A3-POWER AMPLIFIER
PART NUMBER 628-5021-002, -004

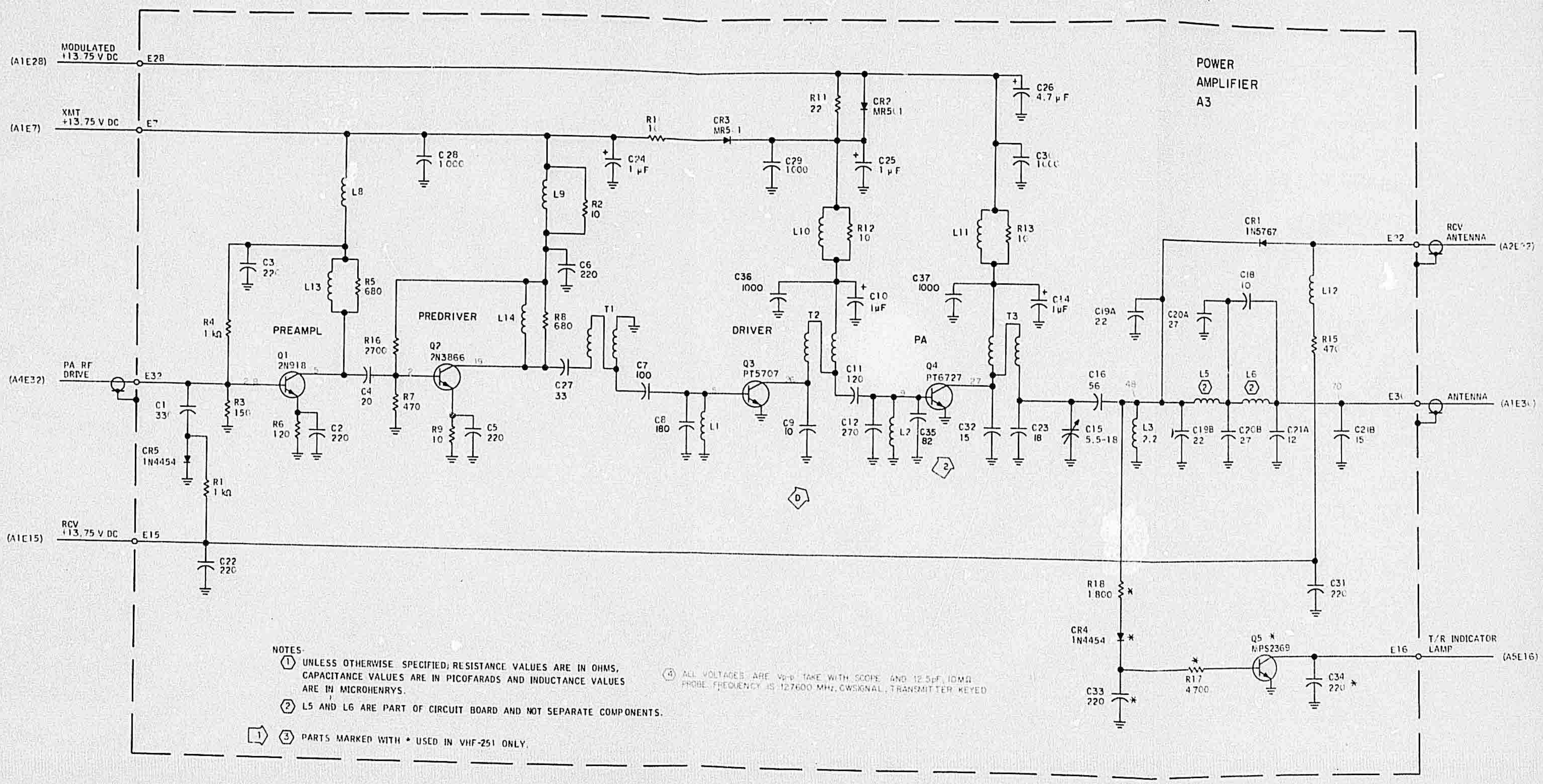
SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C1	CAPACITOR, FXD, CER, DIEL, 330PF, +80%-20%, 1000V		913-3298-030
C2	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
C3	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
C4	CAPACITOR, FXD, MICA, DIEL, 20PF, ±5%, 50V MIN		912-2099-130
C5	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
C6	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
C7	CAPACITOR, FXD, MICA, DIEL, 100PF, 5%, 50V (EFF REV T; SB 4)		912-2099-290
C7	CAPACITOR, FXD, MICA, DIEL, 120PF, 5%, 50V (EFF REV R; SB 4)		912-2099-310
C7	CAPACITOR, FXD, MICA, DIEL, 100PF, ±5%, 50V MIN		912-2099-290
C8	CAPACITOR, FXD, MICA, DIEL, 180PF, 5%, 50V (EFF REV T; SB 4)		912-2099-360
C8	CAPACITOR, FXD, MICA DIEL, 33PF, 5%, 50V (EFF REV R; SB 4)		912-2099-180
C8	CAPACITOR, FXD, MICA, DIEL, 180PF, ±5%, 50V MIN		912-2099-360
C9	CAPACITOR, FXD, MICA, DIEL, 10PF, ±1/2PF, 50V (EFF REV T; SB 4)		912-2099-090
C9	CAPACITOR, FXD, MICA, DIEL, 15PF, 5%, 50V (EFF REV R; SB 4)		912-2099-110
C9	CAPACITOR, FXD, MICA, DIEL, 5PF, ±1/2PF, 50V MIN		912-2099-040
C10	CAPACITOR, FXD, ELCTLT, 1μF, ±20%, 50V (EFF REV T; SB 4)		184-9113-460
C10	CAPACITOR, FXD, MICA, DIEL, 220PF, ±5%, 50V MIN		912-2099-380
C11	CAPACITOR, FXD, MICA, DIEL, 120PF, ±5%, 50V MIN		912-2099-310
C12	CAPACITOR, FXD, MICA, DIEL, 270PF, 10%, 100V		921-2100-030
C13	NOT USED		
C14	CAPACITOR, FXD, ELCTLT, 1μF, ±20%, 50V (EFF REV T; SB 4)		184-9113-460
C14	CAPACITOR, FXD, MICA, DIEL, 220PF, ±5%, 50V MIN		912-2099-380
C15	CAPACITOR, VAR, CER, DIEL, 5.5-18PF, 200V		917-0006-030
C16	CAPACITOR, FXD, MICA, DIEL, 56PF, ±5%, 50V MIN		912-2099-230
C17	NOT USED		
C18	CAPACITOR, FXD, MICA, DIEL, 10PF, ±0.5PF, 300V MIN		912-2099-090
C19A	CAPACITOR, FXD, MICA, DIEL, 22PF, ±5%, 50V MIN		912-2099-140
C19B	CAPACITOR, FXD, MICA, DIEL, 22PF, ±5%, 50V MIN		912-2099-140

PARTS LIST
A3-POWER AMPLIFIER
PART NUMBER 628-5021-002, -004

SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
C20A	CAPACITOR, FXD, MICA, DIEL, 27PF, ±5%, 50V MIN		912-2099-160
C20B	CAPACITOR, FXD, MICA, DIEL, 27PF, ±5%, 50V MIN		912-2099-160
C21A	CAPACITOR, FXD, MICA, DIEL, 12PF, ±5%, 50V MIN		912-2099-100
C21B	CAPACITOR, FXD, MICA, DIEL, 15PF, ±5%, 50V MIN		912-2099-110
C22	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
C23	CAPACITOR, FXD, MICA, DIEL, 18PF, 5%, 50V (EFF REV R; SB 4)		912-2099-120
C23	CAPACITOR, FXD, MICA, DIEL, 10PF, ±1/2PF, 50V MIN		912-2099-090
C24	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C25	CAPACITOR, FXD, TA, 1UF, 20%, 50V (EFF REV K)		184-9113-460
C25	CAPACITOR, FXD, TA, 1UF, ±20%, 20V		184-9113-030
C26	CAPACITOR, FXD, TA, 4.7UF, 20%, 50V (EFF REV K)		184-9113-470
C26	CAPACITOR, FXD, TA, 4.7 μF, ±20%, 20V		184-9113-060
C27	CAPACITOR, FXD, MICA, DIEL, 33PF, ±5%, 50V MIN		912-2099-180
C28	CAPACITOR, FXD, CER, DIEL, 1000PF, +80%-20%, 500V		913-3298-110
C29	CAPACITOR, FXD, CER, DIEL, 1000PF, +80%-20%, 500V		913-3298-110
C30	CAPACITOR, FXD, CER, DIEL, 1000PF, +80%-20%, 500V		913-3298-110
C31	CAPACITOR, FXD, CER, DIEL, 220PF, +80%-20%, 250V		913-3298-090
C32	CAPACITOR, FXD, MICA, DIEL, 15PF, ±5%, 300V MIN		912-2099-110
C33	NOT USED		
C34	NOT USED		
C35	CAPACITOR, FXD, MICA, DIEL, 82PF, 5%,300V (EFF REV T; SB 4)		912-2099-270
C35A	NOT USED (EFF REV T; SB 4)		
C35A	CAPACITOR, FXD, MICA, DIEL, 62PF, 5%, 300V (EFF REV R; SB 4)		912-2099-240
C35B	NOT USED (EFF REV T; SB 4)		
C35B	CAPACITOR, FXD, MICA, DIEL, 62PF, 5%, 300V (EFF REV R; SB 4)		912-2099-240
C36	CAPACITOR, FXD, MICA, 1000PF, 5%, 100V (EFF REV T; SB 4)		351-4059-290
C37	CAPACITOR, FXD, MICA, 1000PF, 5%, 100V (EFF REV T; SB 4)		351-4059-290
CR1	DIODE, 1N5767 (EFF REV T; SB 4)		922-6119-040
CR1	DIODE, 1N3070		353-3735-010
CR2	DIODE, MR501		353-6586-010
CR3	DIODE, MR501		353-6586-010
CR4	NOT USED		

PARTS LIST
A3-POWER AMPLIFIER
PART NUMBER 628-5021-002, -004

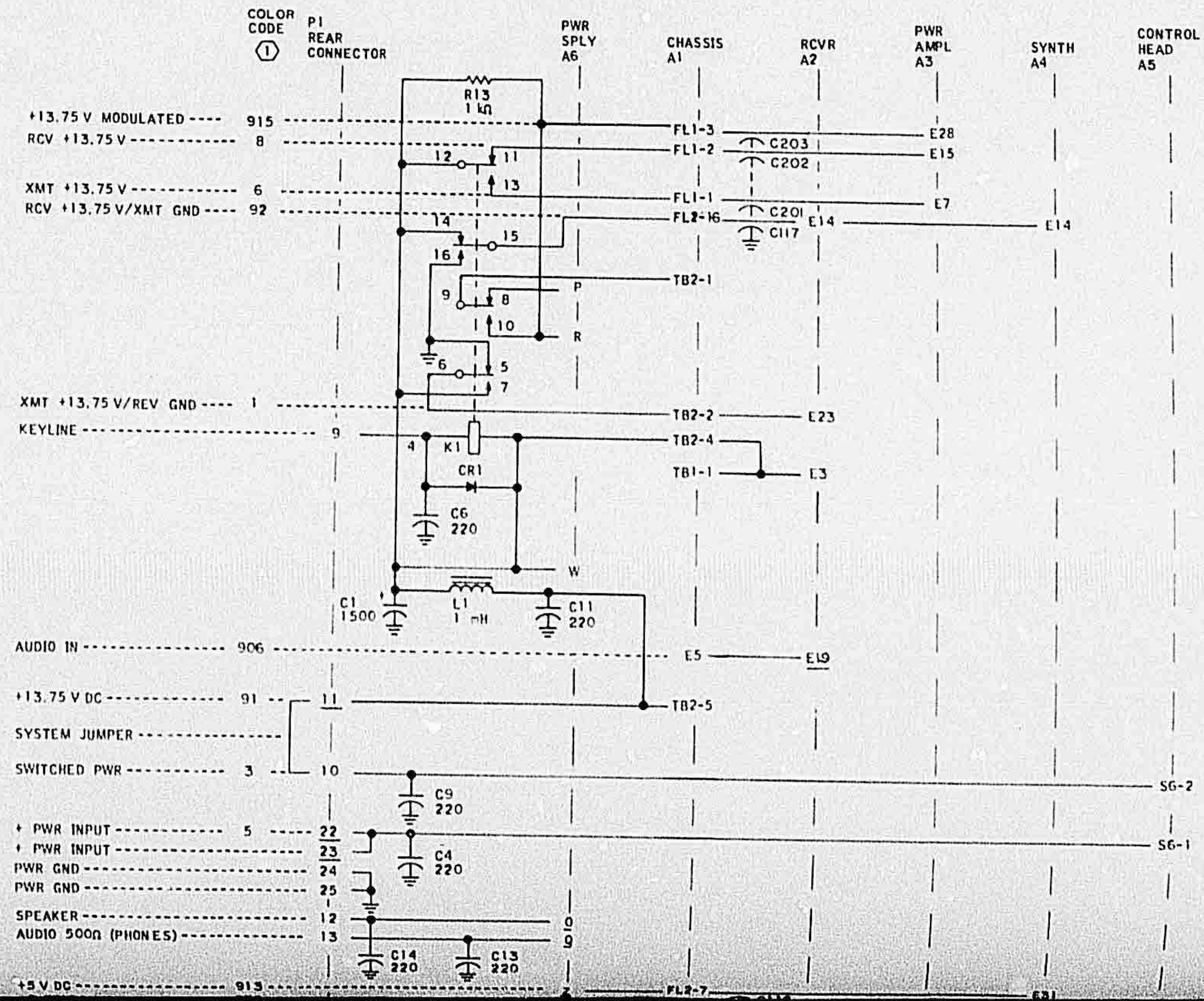
SYMBOL	DESCRIPTION	USED ON CODE	PART NUMBER
CR5	DIODE, 1N4454		353-3741-010
L1	COIL		628-5632-001
L2	COIL		628-5632-001
L3	COIL, 2.2UH		240-2742-040
L4	NOT USED		
L5	COIL, P/O BOARD		628-5022-002
L6	COIL, P/O BOARD		628-5022-002
L7	NOT USED		
L8	COIL		628-5632-001
L9	COIL		628-5632-001
L10	FERRITE BEAD (EFF REV R)		288-2154-000
L10	COIL		628-5632-001
L11	FERRITE BEAD (EFF REV R)		288-2154-000
L11	COIL		628-5632-001
L12	COIL		628-5351-002
L13	COIL		628-5351-001
L14	COIL		628-5351-001
Q1	TRANSISTOR, 2N918		352-5027-010
Q2	TRANSISTOR, 2N3866		352-5022-010
Q3	TRANSISTOR, SRF 3122 (VHF-250/250S ONLY)		352-5014-010
Q3	TRANSISTOR, SRF 3122 (VHF-250E ONLY)		352-5014-020
Q4	TRANSISTOR, PT6727 (VHF-250/250S ONLY)		352-5012-010
Q4	TRANSISTOR, PT6727 (VHF-250E ONLY)		352-5012-020
R1	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R2	RESISTOR, FXD, CMPSN, 10 OHMS, 10%, 1/4W		745-7950-010
R3	RESISTOR, FXD, CMPSN, 150 OHMS, 10%, 1/4W		745-7950-150
R4	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W		745-7950-250
R5	RESISTOR/MODIFIED, COMBINED WITH L13, 680 OHMS, 10%, 1/4W		628-5351-001
R6	RESISTOR, FXD, CMPSN, 120 OHMS, 10%, 1/4W		745-7950-140
R7	RESISTOR, FXD, CMPSN, 470 OHMS, 10%, 1/4W		735-7950-210
R8	RESISTOR/MODIFIED, COMBINED WITH L14, 680 OHMS, 10%, 1/4W		628-5351-001
R9	RESISTOR, FXD, CMPSN, 10 OHMS, 10%, 1/4W		745-7950-010
R10	RESISTOR, FXD, WW, 10 OHMS, 5%, 3W		745-7953-020
R11	RESISTOR, FXD, WW, 22 OHMS, 5%, 3W		745-7953-030
R12	RESISTOR, FXD, CMPSN, 10 OHMS, 10%, 1/4W		745-7950-010
R13	RESISTOR, FXD, CMPSN, 10 OHMS, 10%, 1/4W		745-7950-010
R14	RESISTOR, FXD, CMPSN, 1MEGO, 10%, 1/4W		745-7950-610
R15	RESISTOR, FXD, CMPSN, 470 OHMS, 10%, 1/4W		745-7950-210
R16	RESISTOR, FXD, CMPSN, 2700 OHMS, 10%, 1/4W		745-7950-300
T1	TRANSFORMER		608-6569-001
T2	TRANSFORMER		608-6569-001
T3	TRANSFORMER (EFF REV AD)		653-2170-001
T3	TRANSFORMER (EFF REV X; SB 5)		278-0502-010
T3	TRANSFORMER		608-6569-001

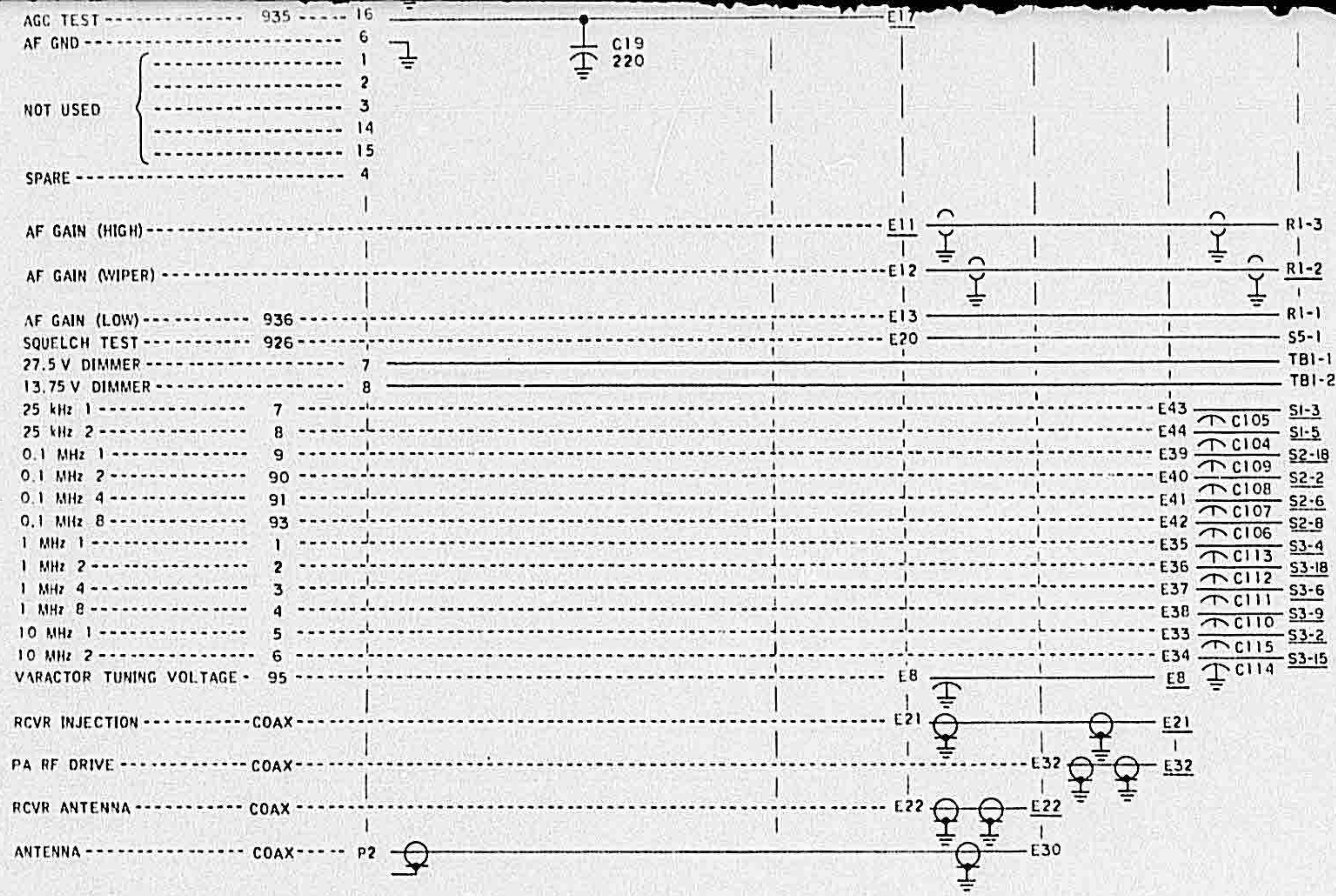


628-5572

Power Amplifier A3, Schematic Diagram
Figure 6-14

SEE BLOW-UP FICHE NO. CLQ302 - ITEM R





NOTES:

1. NUMBERS IN THIS COLUMN INDICATE WIRE COLOR CODE.

0 = BLACK	5 = GREEN
1 = BROWN	6 = BLUE
2 = RED	7 = VIOLET
3 = ORANGE	8 = GRAY
4 = YELLOW	9 = WHITE

   EXAMPLE: 913 = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

2. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.

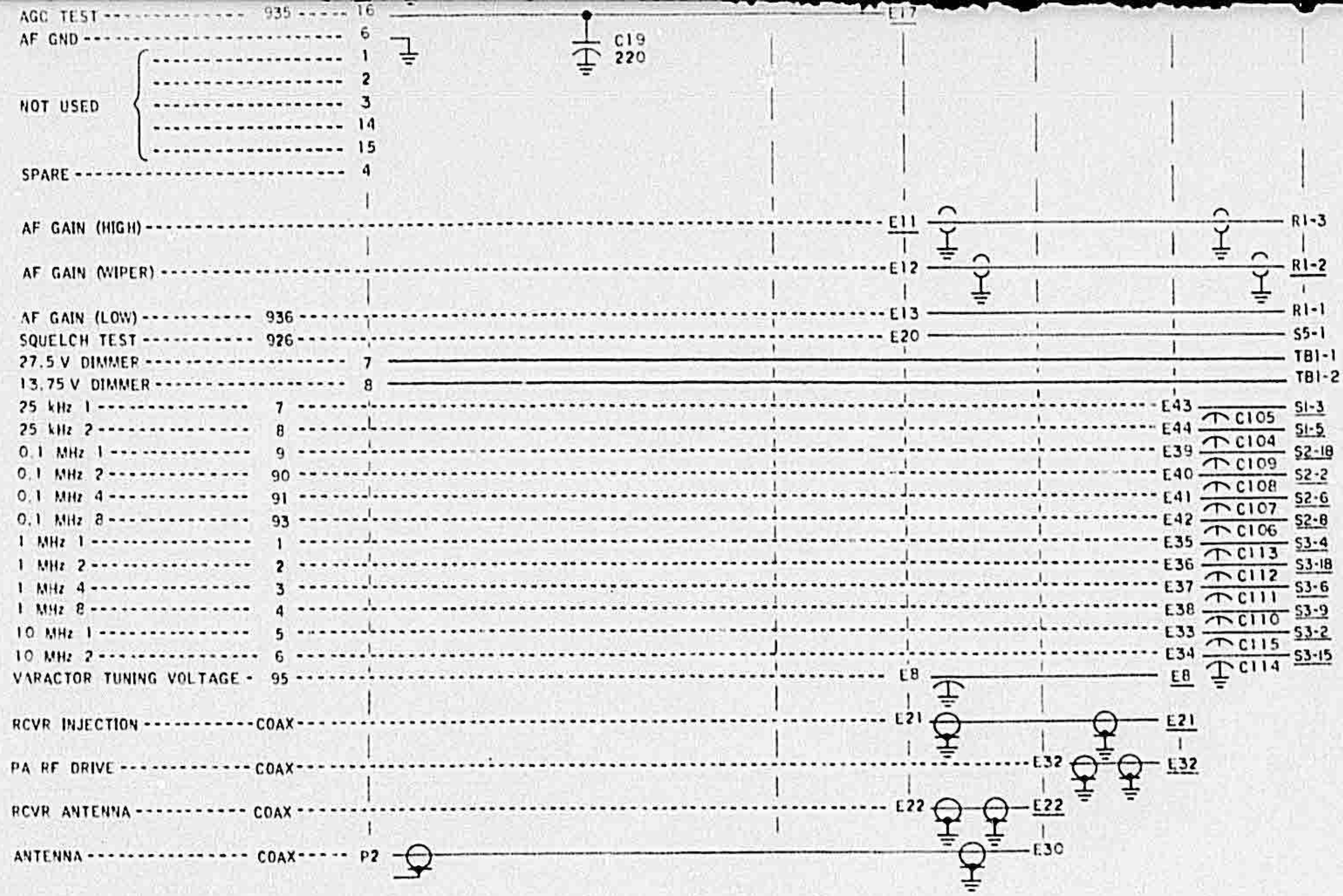
3. UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.

4. UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.

SEE BLOW-UP FICHE NO. CLQ302 - ITEM T

VHF-250 Chassis Wiring Diagram
Figure 6-15

628-6210
TP4-5822-015



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3. UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.

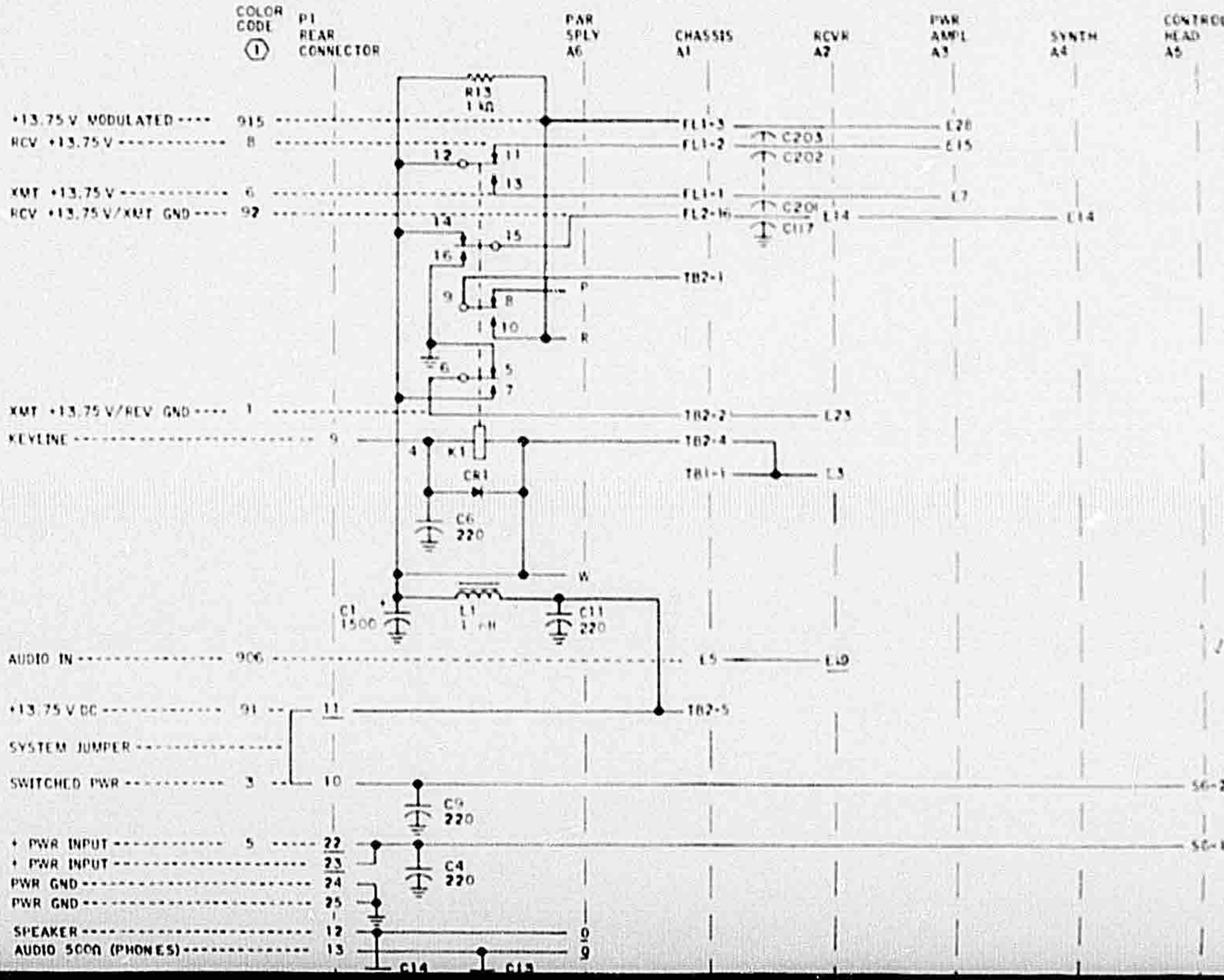
4. UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.

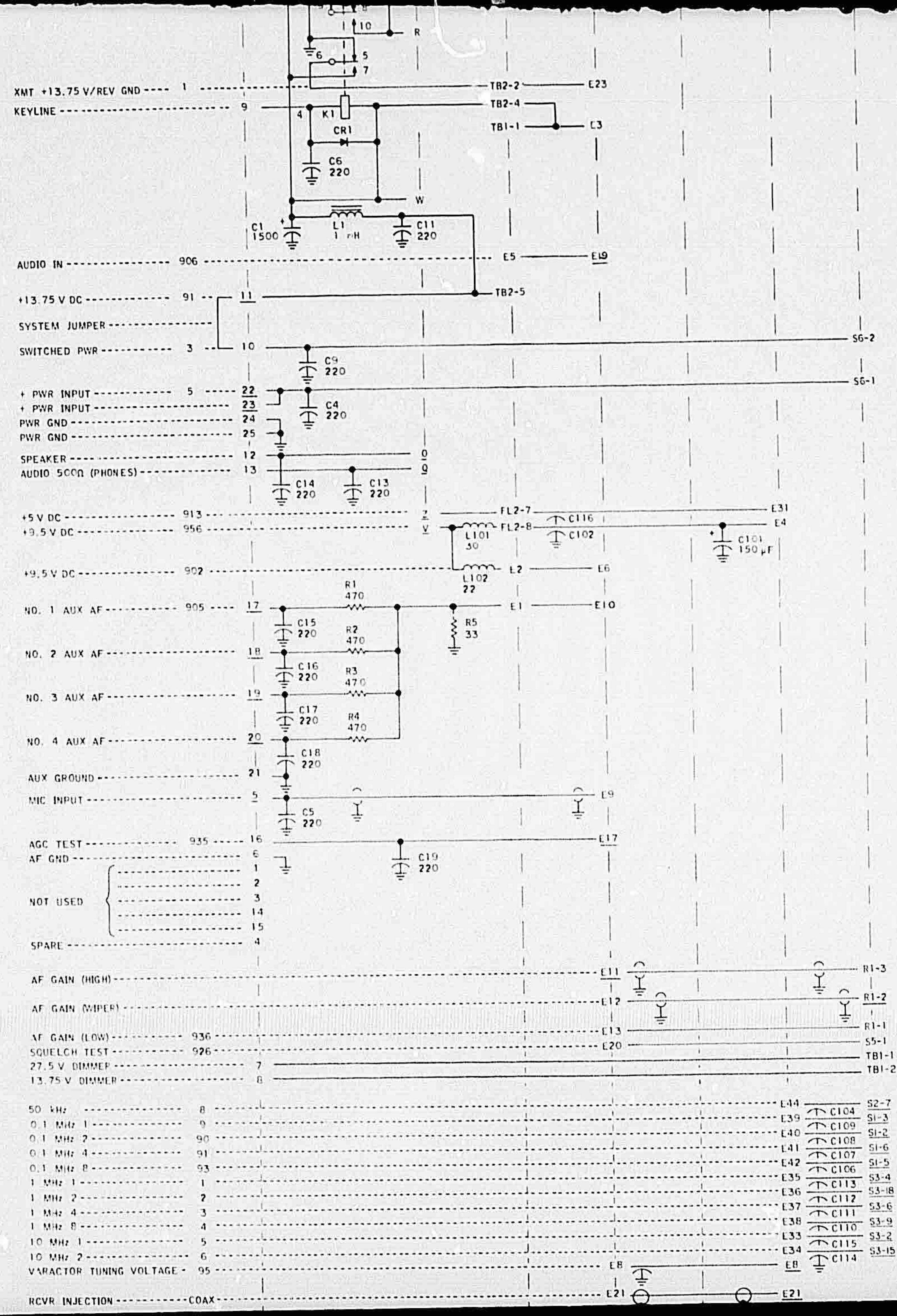
SEE BLOW-UP FICHE NO. CLQ302 - ITEM T

VHF-250 Chassis Wiring Diagram
Figure 6-15

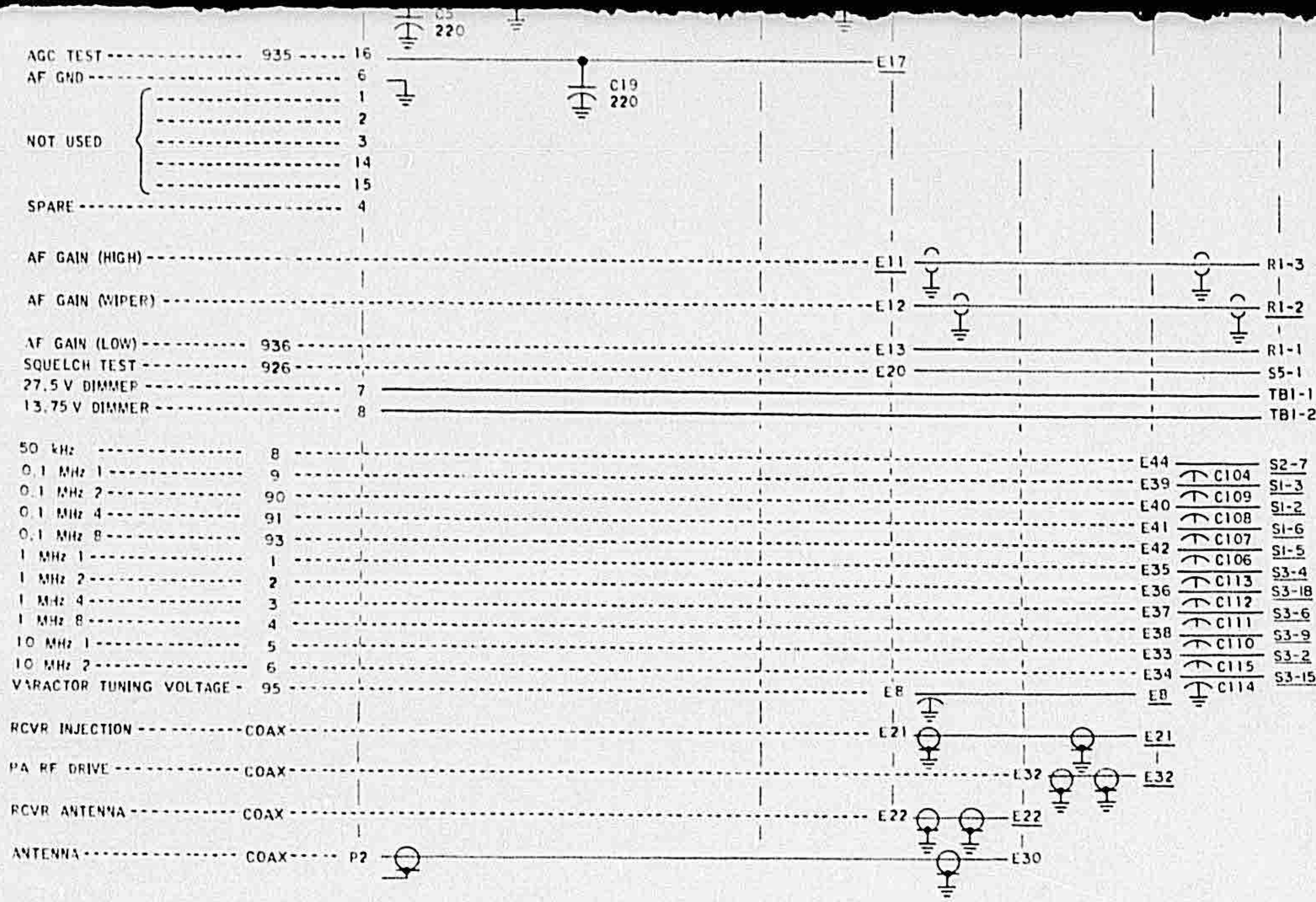
628-6210
TP4-5822-015

SEE BLOW-UP FICHE NO. CLQ302 - ITEM U





XMT +13.75 V/REV GND 1
KEYLINE 9
K1
CR1
C6 220
C1 1500
L1 1 mH
C11 220
TB2-2 E23
TB2-4
TB1-1 E3
R
W
AUDIO IN 906 E5 E19
+13.75 V DC 91 11 TB2-5
SYSTEM JUMPER
SWITCHED PWR 3 10 S6-2
C9 220
+ PWR INPUT 5 22 S6-1
+ PWR INPUT 23
C4 220
PWR GND 24
PWR GND 25
SPEAKER 12
AUDIO 500Ω (PHONES) 13
C14 220
C13 220
+5 V DC 913 Z FL2-7 C116 E31
+9.5 V DC 956 V FL2-8 C102 E4
L101 30
C101 150 µF
+9.5 V DC 902 L102 22 E2 E6
NO. 1 AUX AF 905 17 R1 470 E1 E10
R5 33
C15 220
NO. 2 AUX AF 18 R2 470
C16 220
NO. 3 AUX AF 19 R3 470
C17 220
NO. 4 AUX AF 20 R4 470
C18 220
AUX GROUND 21
MIC INPUT 5 E9
C5 220
AGC TEST 935 16 E17
AF GND 6
C19 220
NOT USED 1 2 3 14 15
SPARE 4
AF GAIN (HIGH) E11 R1-3
AF GAIN (WIPER) E12 R1-2
AF GAIN (LOW) 936 E13 R1-1
SQUELCH TEST 926 E20 S5-1
27.5 V DIMMER 7 TB1-1
13.75 V DIMMER 8 TB1-2
50 kHz 8 E44 S2-7
0.1 MHz 1 9 E39 C104 S1-3
0.1 MHz 2 90 E40 C109 S1-2
0.1 MHz 4 91 E41 C108 S1-6
0.1 MHz 8 93 E42 C107 S1-5
1 MHz 1 1 E35 C106 S3-4
1 MHz 2 2 E36 C113 S3-18
1 MHz 4 3 E37 C112 S3-6
1 MHz 8 4 E38 C111 S3-9
10 MHz 1 5 E33 C110 S3-2
10 MHz 2 6 E34 C115 S3-15
VARACTOR TUNING VOLTAGE 95 E8 E8 C114
RCVR INJECTION COAX E21 E21



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3. UNLESS OTHERWISE SPECIFIED; ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.

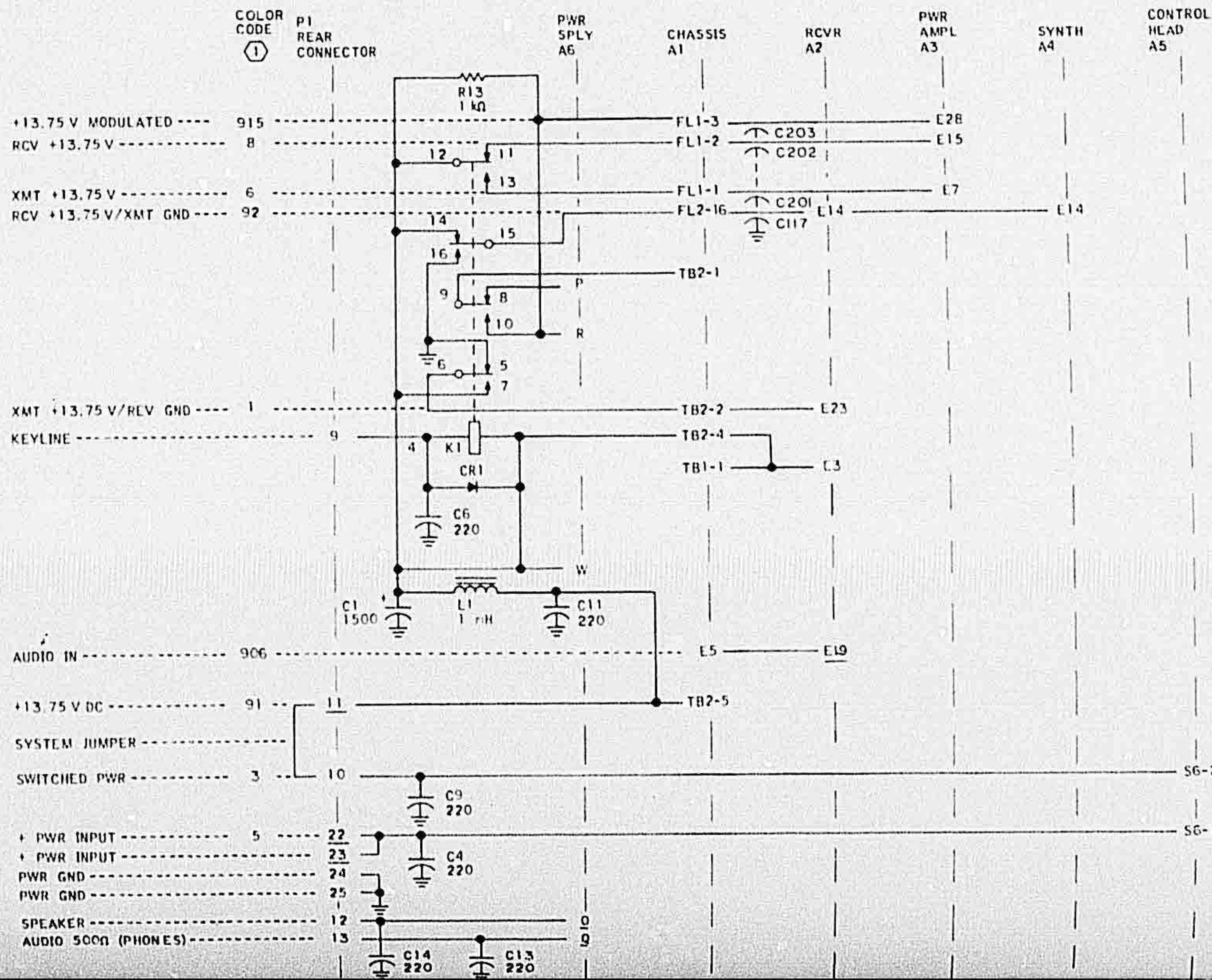
4. UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.

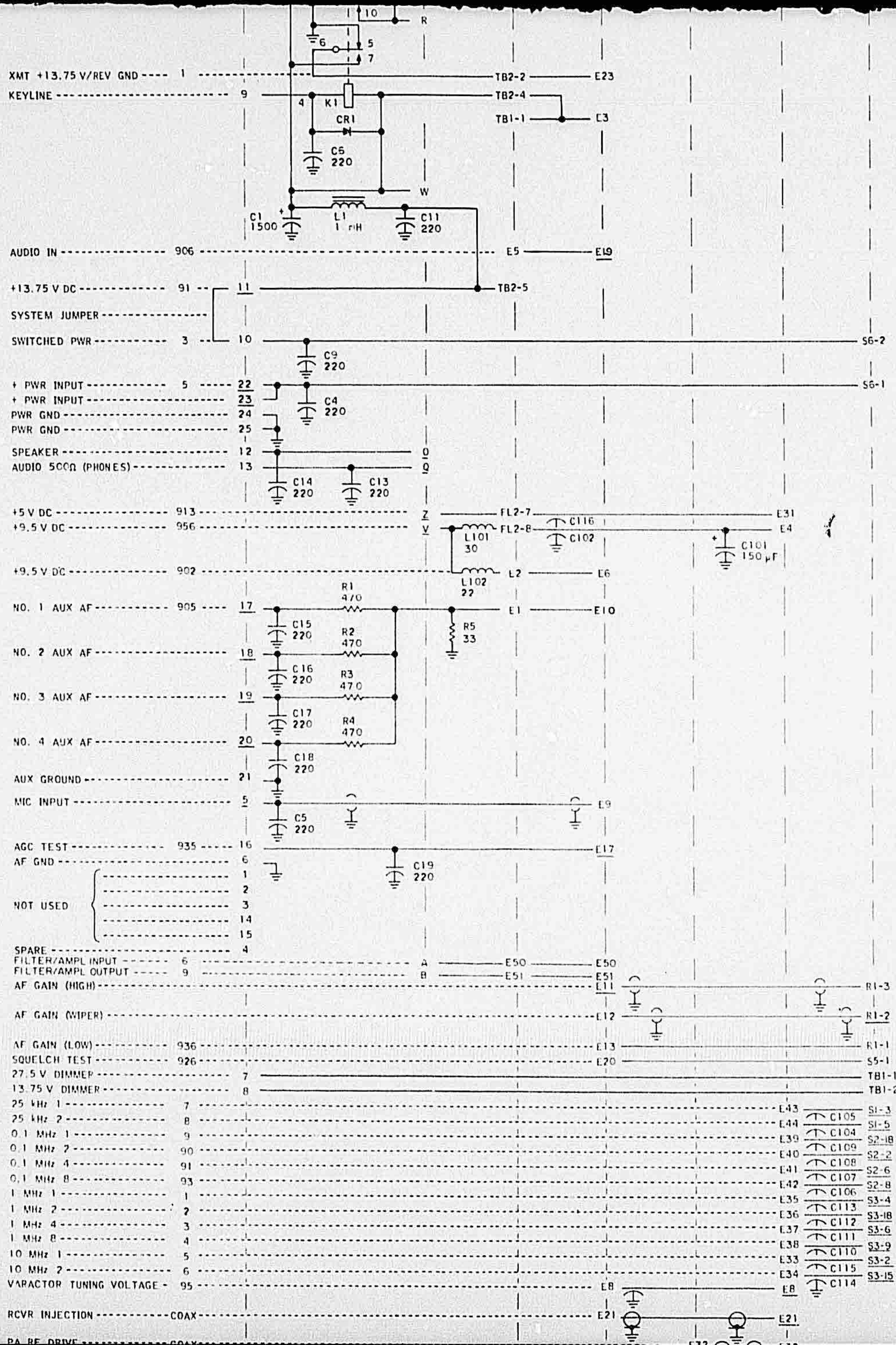
VHF-250 Chassis Wiring Diagram
Figure 6-16

628-6515

SEE BLOW-UP FICHE NO. CLQ302 - ITEM W

SEE BLOW-UP FICHE NO. CLQ302 - ITEM V

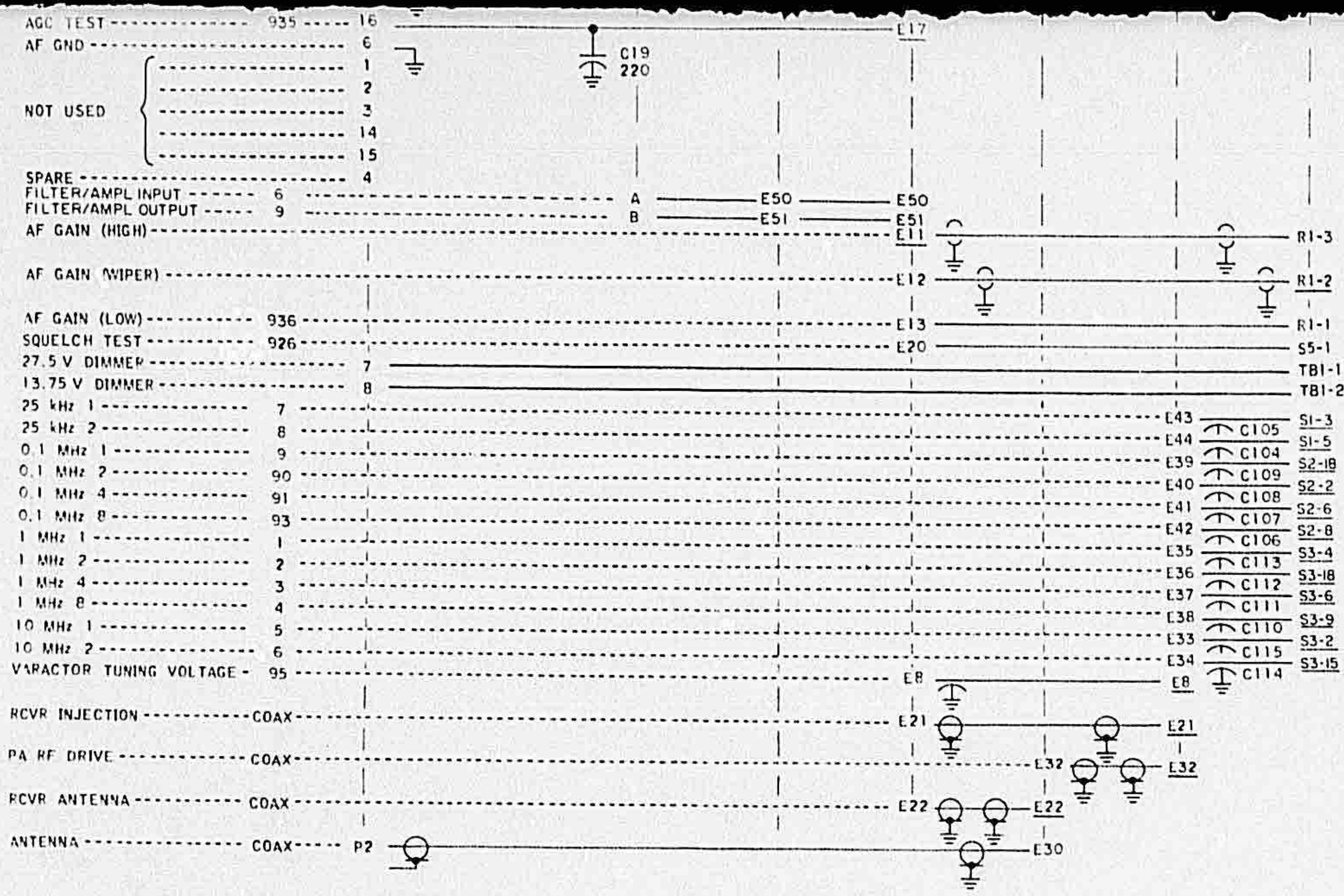



XMT +13.75 V/REV GND 1
KEYLINE 9
AUDIO IN 906
+13.75 V DC 91 11
SYSTEM JUMPER
SWITCHED PWR 3 10
+ PWR INPUT 5 22
+ PWR INPUT 23
PWR GND 24
PWR GND 25
SPEAKER 12
AUDIO 500Ω (PHONES) 13
+5 V DC 913
+9.5 V DC 956
+9.5 V DC 902
NO. 1 AUX AF 905 17
NO. 2 AUX AF 18
NO. 3 AUX AF 19
NO. 4 AUX AF 20
AUX GROUND 21
MIC INPUT 5
AGC TEST 935 16
AF GND 6
NOT USED 1 2 3 14 15
SPARE 4
FILTER/AMPL INPUT 6
FILTER/AMPL OUTPUT 9
AF GAIN (HIGH)
AF GAIN (WIPER)
AF GAIN (LOW) 936
SQUELCH TEST 926
27.5 V DIMMER 7
13.75 V DIMMER 8
25 kHz 1 7
25 kHz 2 8
0.1 MHz 1 9
0.1 MHz 2 90
0.1 MHz 4 91
0.1 MHz 8 93
1 MHz 1 1
1 MHz 2 2
1 MHz 4 3
1 MHz 8 4
10 MHz 1 5
10 MHz 2 6
VARACTOR TUNING VOLTAGE 95
RCVR INJECTION COAX
PA RF DRIVE COAX
K1 CR1 C6 220
C1 1500
L1 1 mH
C11 220
C9 220
C4 220
C14 220
C13 220
L101 30
L102 22
C116 C102
C101 150 µF
R1 470
R2 470
R3 470
R4 470
R5 33
C15 220
C16 220
C17 220
C18 220
C5 220
C19 220
TB2-2 E23
TB2-4 TB1-1 E3
W R
E5 E19
TB2-5
S6-2 S6-1
FL2-7 E31
FL2-8 E4
E2 E6
E1 E10
E9 E17
A E50 E50
B E51 E51
E11 R1-3
E12 R1-2
E13 R1-1
E20 S5-1
TB1-1 TB1-2
E43 C105 S1-3
E44 C104 S1-5
E39 C109 S2-18
E40 C108 S2-2
E41 C107 S2-6
E42 C106 S2-8
E35 C113 S3-4
E36 C112 S3-18
E37 C111 S3-6
E38 C110 S3-9
E33 C115 S3-2
E34 C114 S3-15
E8 E8
E21 E21

	50V MIN
C17	NOT USED
C18	CAPACITOR, FXD, MICA, DIEL, 10PF, ±
	300V MIN
C19A	CAPACITOR, FXD, MICA, DIEL, 22PF, ±
C19B	CAPACITOR, FXD, MICA, DIEL, 22PF, ±

Revised 2 August 1984

L 9 L 10



NOTES:

(1) NUMBERS IN THIS COLUMN INDICATE WIRE COLOR CODE.

0 = BLACK	5 = GREEN
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2 = RED	7 = VIOLET
3 = ORANGE	8 = GRAY
4 = YELLOW	9 = WHITE

EXAMPLE: 913 = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

(2) UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.

(3) UNLESS OTHERWISE SPECIFIED; ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.

(4) UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.

SEE BLOW-UP FICHE NO. CLQ302 - ITEM X

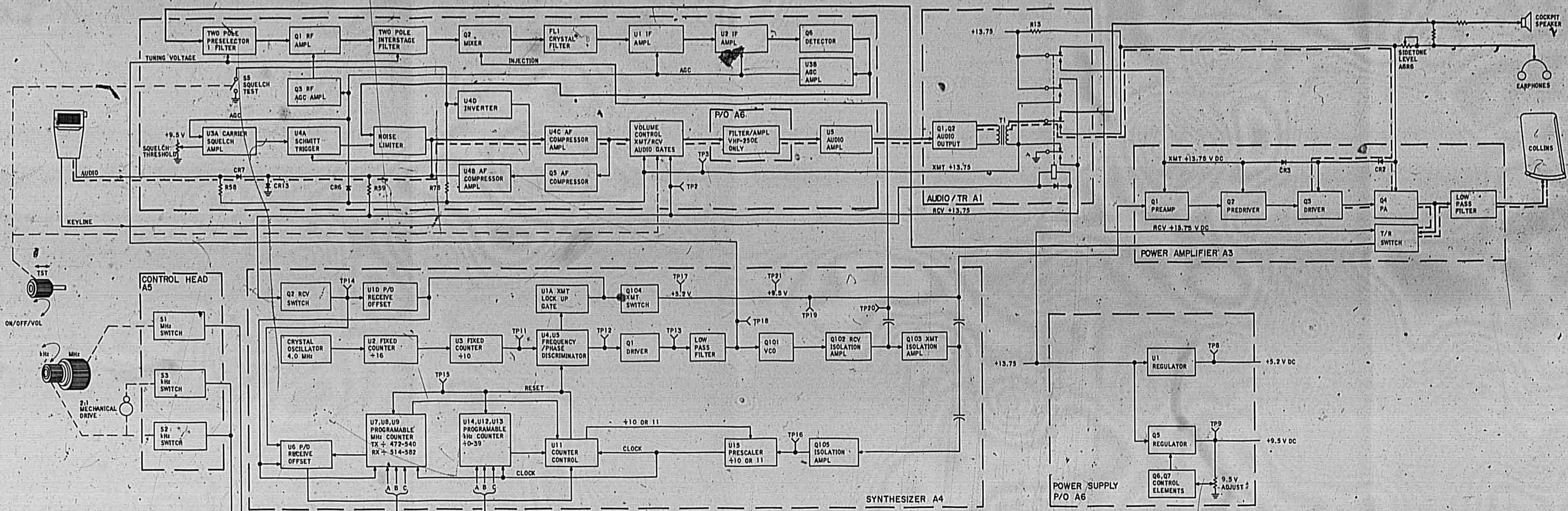
VHF-250E Chassis Wiring Diagram
Figure 6-17

628-6516

diagrams 523-0766718

M 9 M 10

A



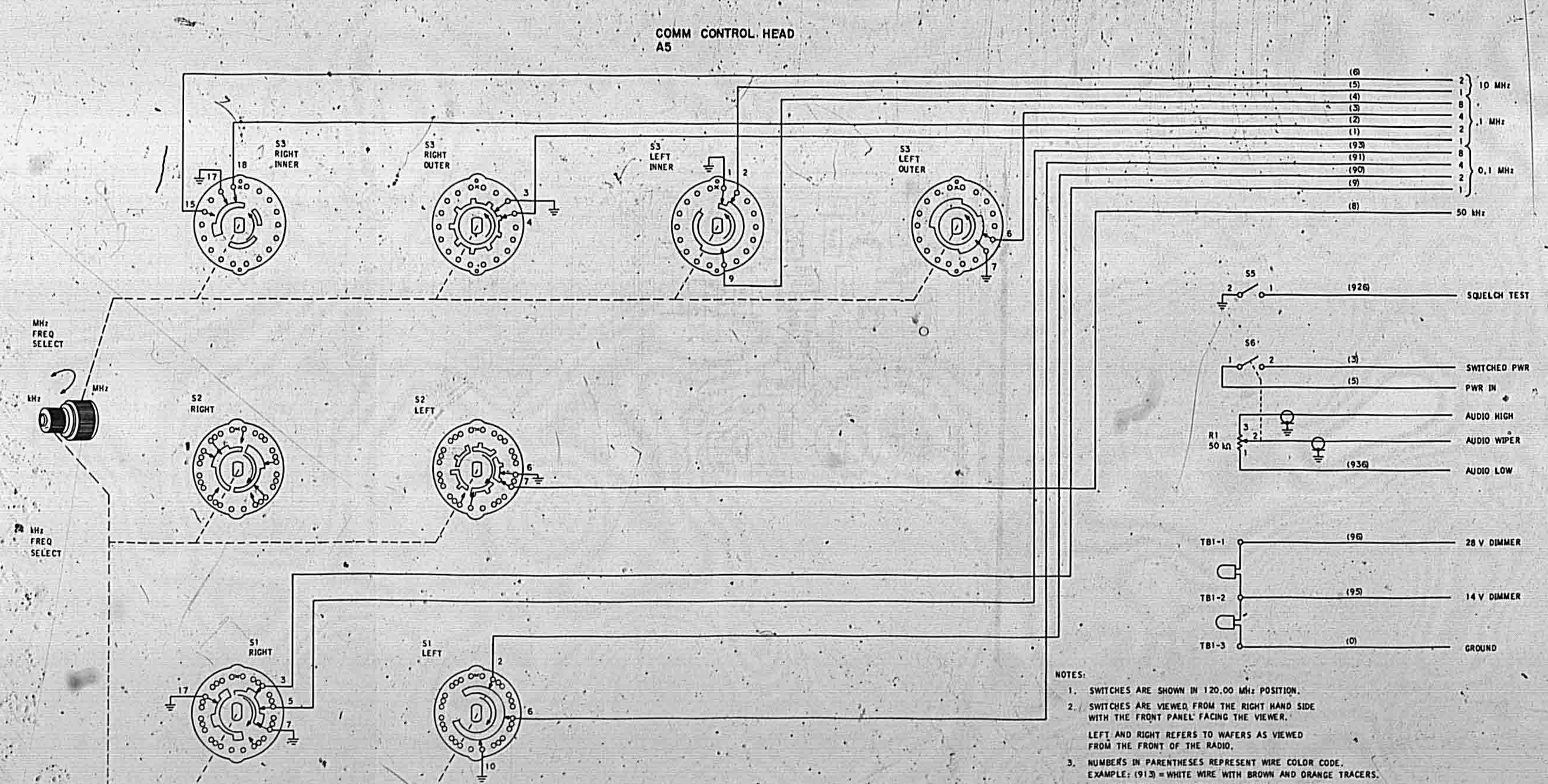
628-6377

VHF-250/250S/250E Communications Transceiver, Functional Block Diagram, Figure 4-2

C

CONTROL LOGIC

FREQUENCY	BINARY CODE 8	4	2	1
	10 MHz			
110.XXX	X	X	0	1
120.XXX	X	X	1	0
130.XXX	X	X	1	1
	1 MHz			
1.XXX	0	0	0	1
2.XXX	0	0	1	0
3.XXX	0	0	1	1
4.XXX	0	1	0	0
5.XXX	0	1	0	1
6.XXX	0	1	1	0
7.XXX	0	1	1	1
8.XXX	1	0	0	0
9.XXX	1	0	0	1
0.XXX	0	0	0	0
	0.1 MHz			
0.0XX	0	0	0	0
0.1XX	0	0	0	1
0.2XX	0	0	1	0
0.3XX	0	0	1	1
0.4XX	0	1	0	0
0.5XX	0	1	0	1
0.6XX	0	1	1	0
0.7XX	0	1	1	1
0.8XX	1	0	0	0
0.9XX	1	0	0	1
	50 kHz			
0.X0	X	X	X	0
0.X5	X	X	X	1



NOTES:

1. SWITCHES ARE SHOWN IN 120.00 MHz POSITION.
2. SWITCHES ARE VIEWED FROM THE RIGHT HAND SIDE WITH THE FRONT PANEL FACING THE VIEWER.

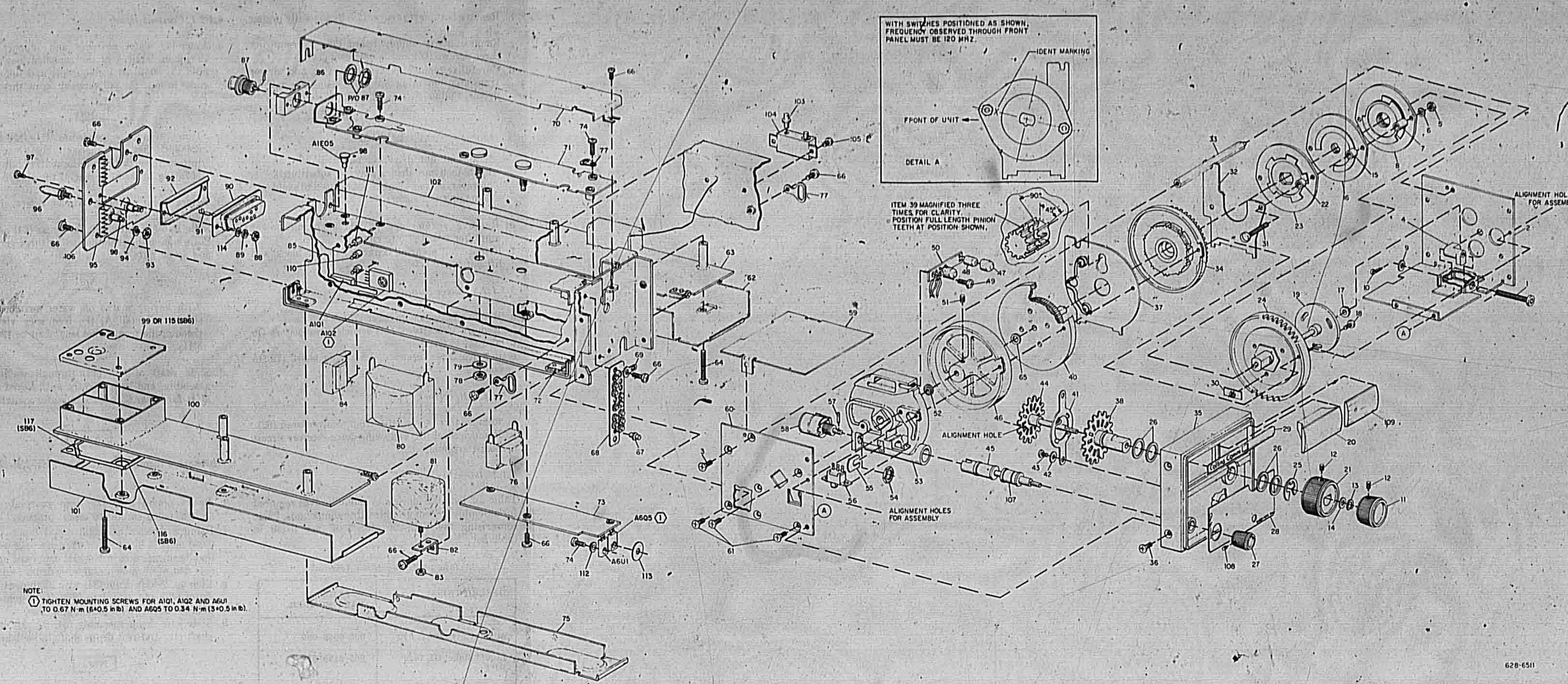
   LEFT AND RIGHT REFERS TO WAFERS AS VIEWED FROM THE FRONT OF THE RADIO.
3. NUMBERS IN PARENTHESES REPRESENT WIRE COLOR CODE. EXAMPLE: (913) = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

   0 = BLACK 3 = ORANGE 6 = BLUE 9 = WHITE
   1 = BROWN 4 = YELLOW 7 = VIOLET
   2 = RED 5 = GREEN 8 = GRAY

628-6503
TP4-7658-015

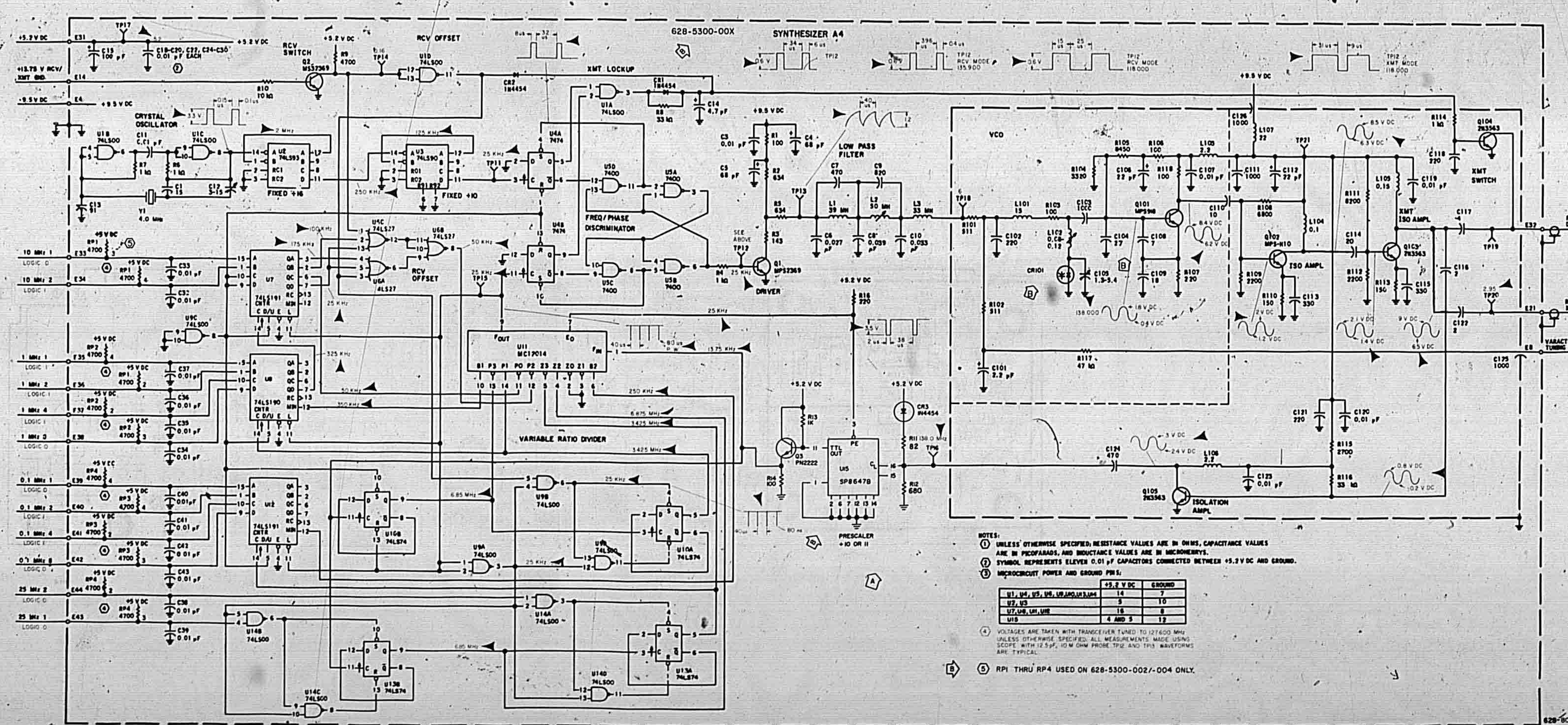
VHF-250S COMM Control Head A5, Schematic Diagram, Figure 6-2

E



VHF-250/250S/250E, Exploded View
Figure 5-1

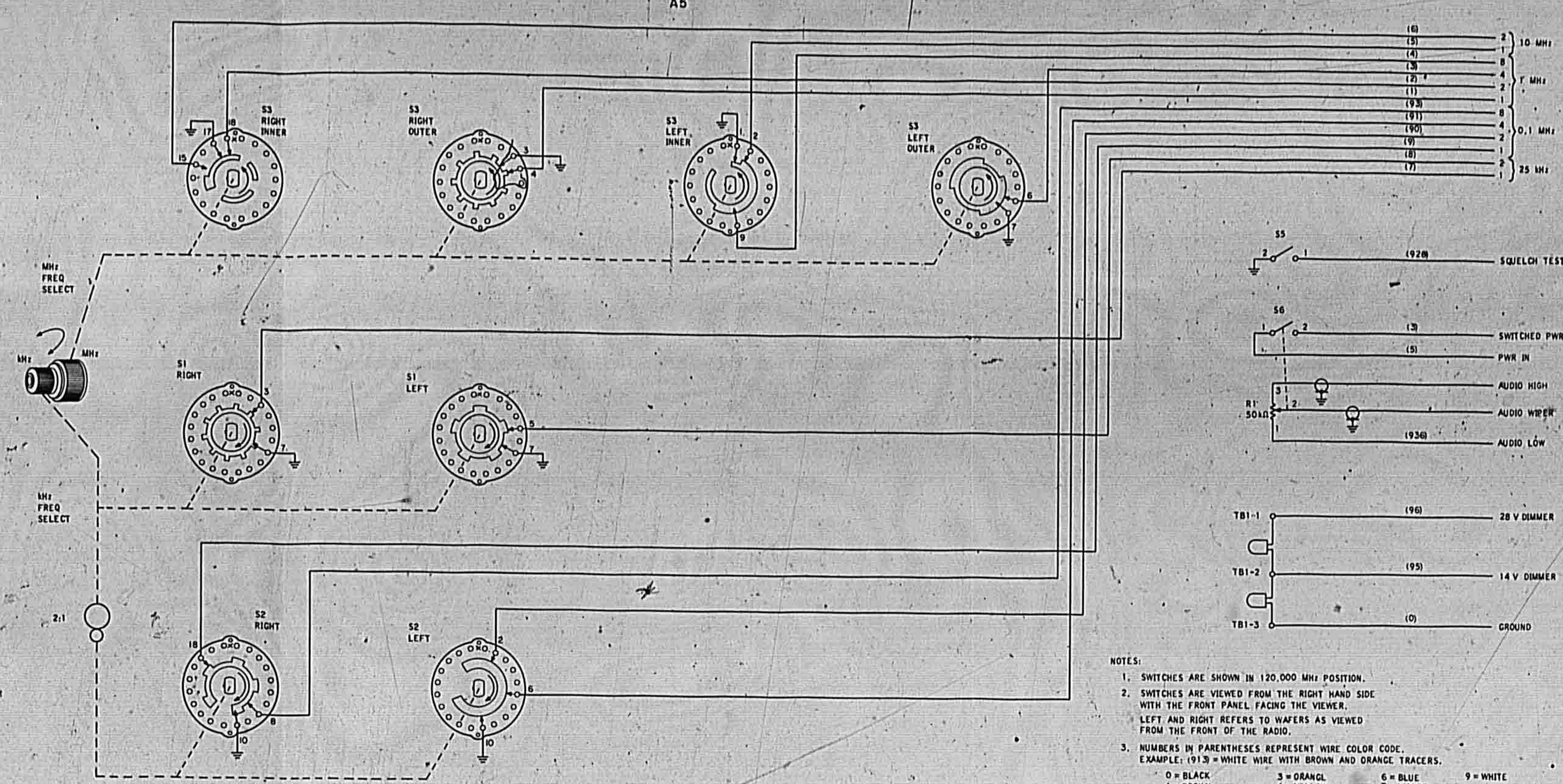
G



Synthesizer A4, Board No CPN 628-5030-004, Schematic Diagram
Figure 6-4

I

COMM CONTROL HEAD A5



CONTROL LOGIC

FREQUENCY	BINARY CODE 8	4	2	1
	10 MHz			
11X.XXX	X	X	0	1
12X.XXX	X	X	1	0
13X.XXX	X	X	1	1
	1 MHz			
1.XXX	0	0	0	1
2.XXX	0	0	1	0
3.XXX	0	0	1	1
4.XXX	0	1	0	0
5.XXX	0	1	0	1
6.XXX	0	1	1	0
7.XXX	0	1	1	1
8.XXX	1	0	0	0
9.XXX	1	0	0	1
0.XXX	0	0	0	0
	0.1 MHz			
0.0XX	0	0	0	0
0.1XX	0	0	0	1
0.2XX	0	0	1	0
0.3XX	0	0	1	1
0.4XX	0	1	0	0
0.5XX	0	1	0	1
0.6XX	0	1	1	0
0.7XX	0	1	1	1
0.8XX	1	0	0	0
0.9XX	1	0	0	1
	25 kHz			
0.X00	X	X	0	0
0.X25	X	X	0	1
0.X50	X	X	1	0
0.X75	X	X	1	1

NOTES:

1. SWITCHES ARE SHOWN IN 120.000 MHz POSITION.
2. SWITCHES ARE VIEWED FROM THE RIGHT HAND SIDE WITH THE FRONT PANEL FACING THE VIEWER. LEFT AND RIGHT REFERS TO WAFERS AS VIEWED FROM THE FRONT OF THE RADIO.
3. NUMBERS IN PARENTHESES REPRESENT WIRE COLOR CODE. EXAMPLE: (913) = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

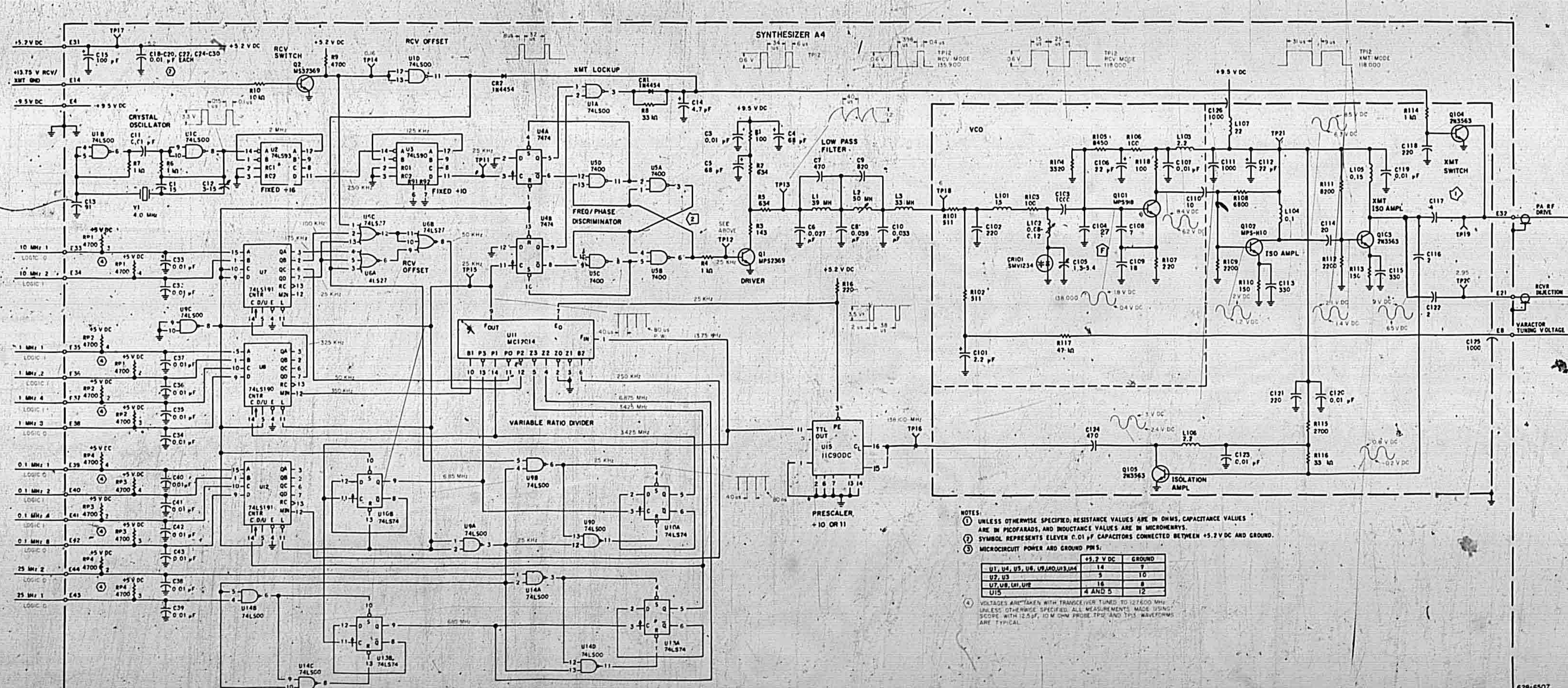
0 = BLACK, 1 = BROWN, 2 = RED, 3 = ORANGE, 4 = YELLOW, 5 = GREEN, 6 = BLUE, 7 = VIOLET, 8 = GRAY, 9 = WHITE

628-6225
TP4-6532-015

VHF-250/250E COMM Control Head A5, Schematic Diagram
Figure 6-1

K

SYNTHESIZER A4



NOTES:

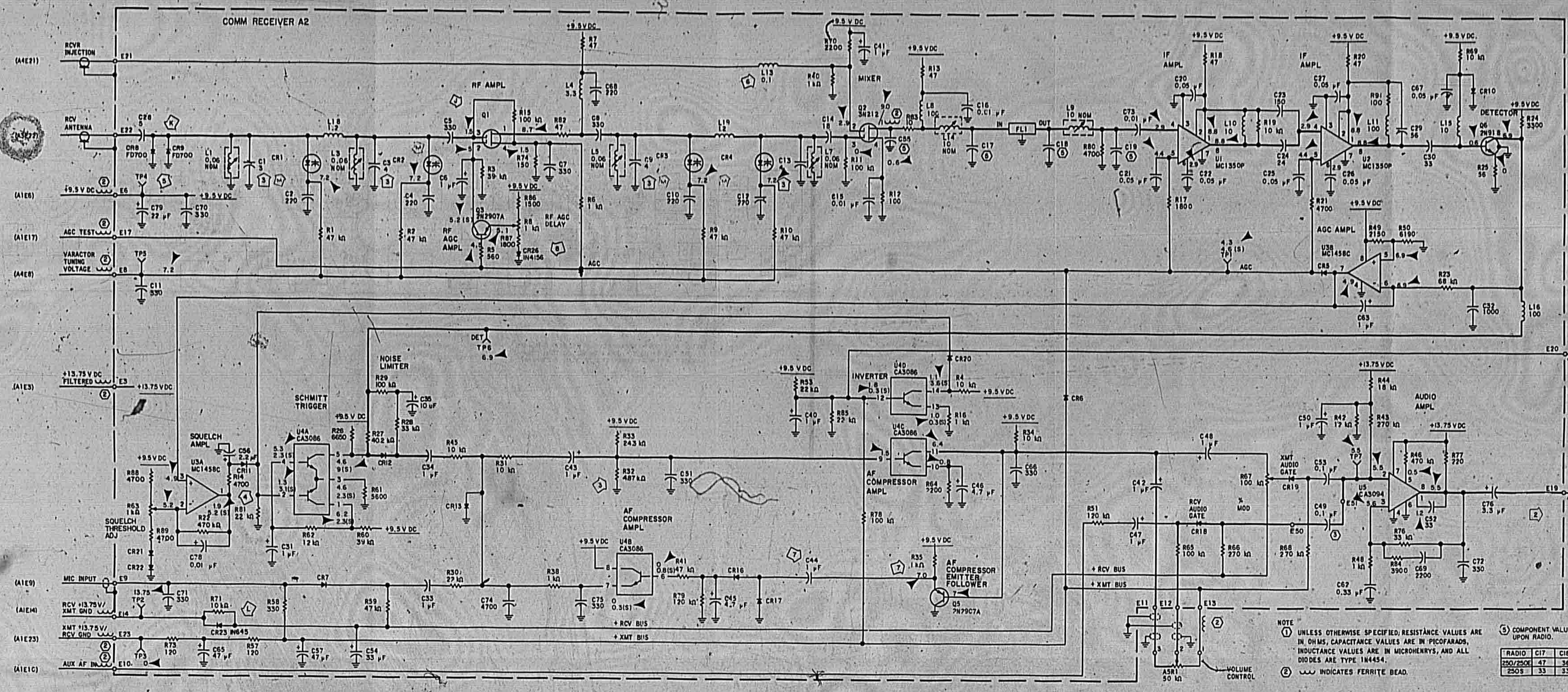
1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.
2. SYMBOL REPRESENTS ELEVEN 0.01 μF CAPACITORS CONNECTED BETWEEN +5.2 V DC AND GROUND.
3. MICROCIRCUIT POWER AND GROUND PINS.

	+5.2 V DC	GROUND
U1, U4, U5, U6, U9, U10, U13, U14	14	7
U2, U3	5	10
U7, U8, U11, U12	16	8
U15	4 AND 5	12

4. VOLTAGES ARE TAKEN WITH TRANSCEIVER TUNED TO 127.600 MHz UNLESS OTHERWISE SPECIFIED. ALL MEASUREMENTS MADE USING SCOPE WITH 12.5 pF, 10 M OHM PROBE. TP12 AND TP13 WAVEFORMS ARE TYPICAL.

Synthesizer A4, Board No CPN 628-5030-003, Schematic Diagram
Figure 6-6

M



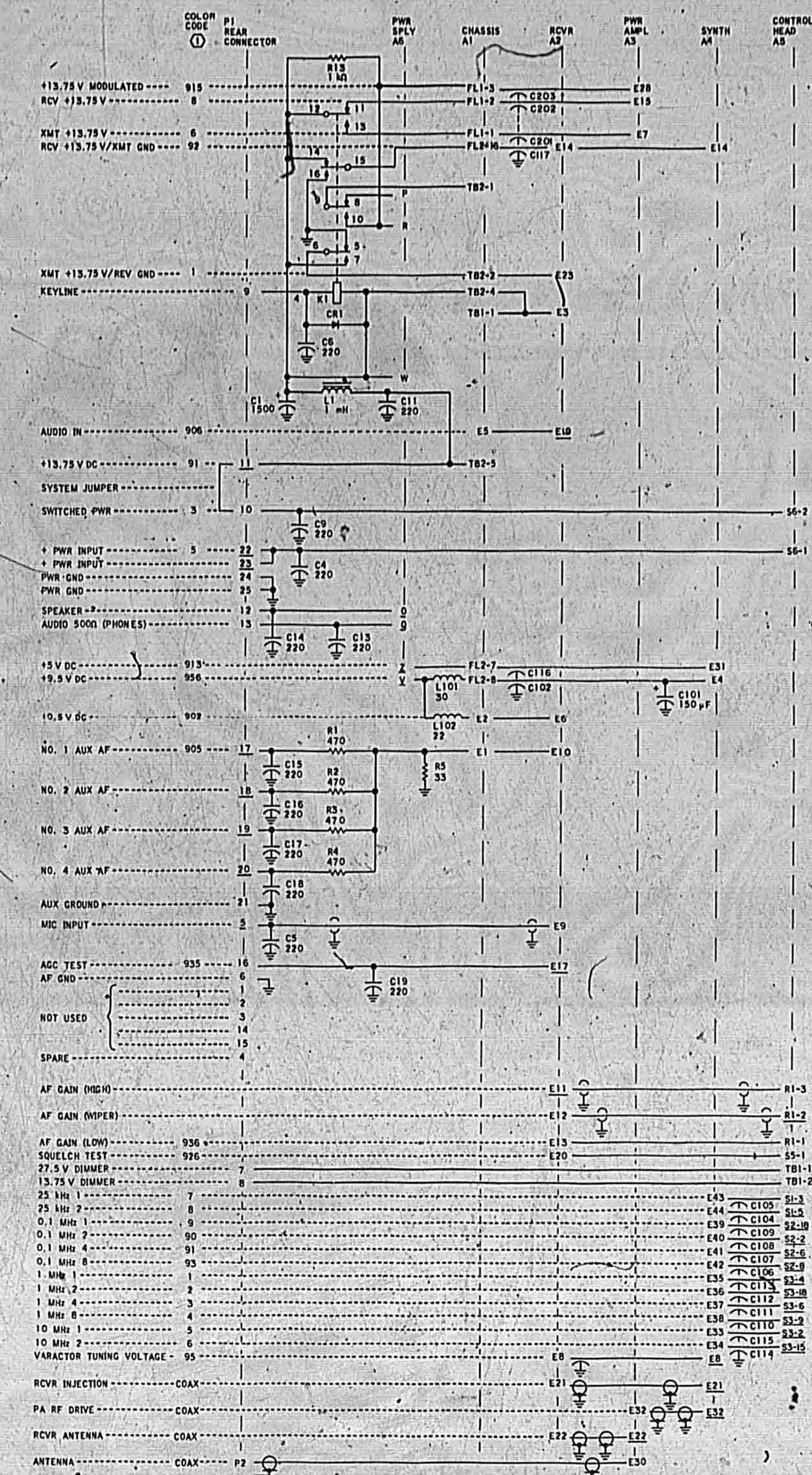
NOTE

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, INDUCTANCE VALUES ARE IN MICROHENRYS, AND ALL DIODES ARE TYPE 1N4454.
2. ꟺꟺꟺ INDICATES FERRITE BEAD.
3. CAPACITOR C49 NOT USED IN VHF-250E. REFER TO VHF-250E AUDIO/TR CHASSIS AND POWER SUPPLY/FILTER SCHEMATIC.
4. DC VOLTAGES ARE TAKEN WITH TRANSCEIVER TUNED TO 127.600 MHz AND NO SIGNAL APPLIED UNLESS NOTED. VOLTAGES FOLLOWED BY (S) ARE TAKEN WITH 20 μV RF SIGNAL APPLIED, MODULATED 30 PERCENT WITH 1000 Hz.
5. COMPONENT VALUE IS DEPENDENT UPON RADIO.

RADIO	C17	C18	C19	C55
250/250E	47	36	68	47
250S	33	33	56	51

628-6212

COMM Receiver A2, Schematic Diagram
Figure 6-12



NOTES:

(1) NUMBERS IN THIS COLUMN INDICATE WIRE COLOR CODE.

0 = BLACK	5 = GREEN
1 = BROWN	6 = BLUE
2 = RED	7 = VIOLET
3 = ORANGE	8 = GRAY
4 = YELLOW	9 = WHITE

EXAMPLE: 913 = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

(2) UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.

(3) UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.

(4) UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.

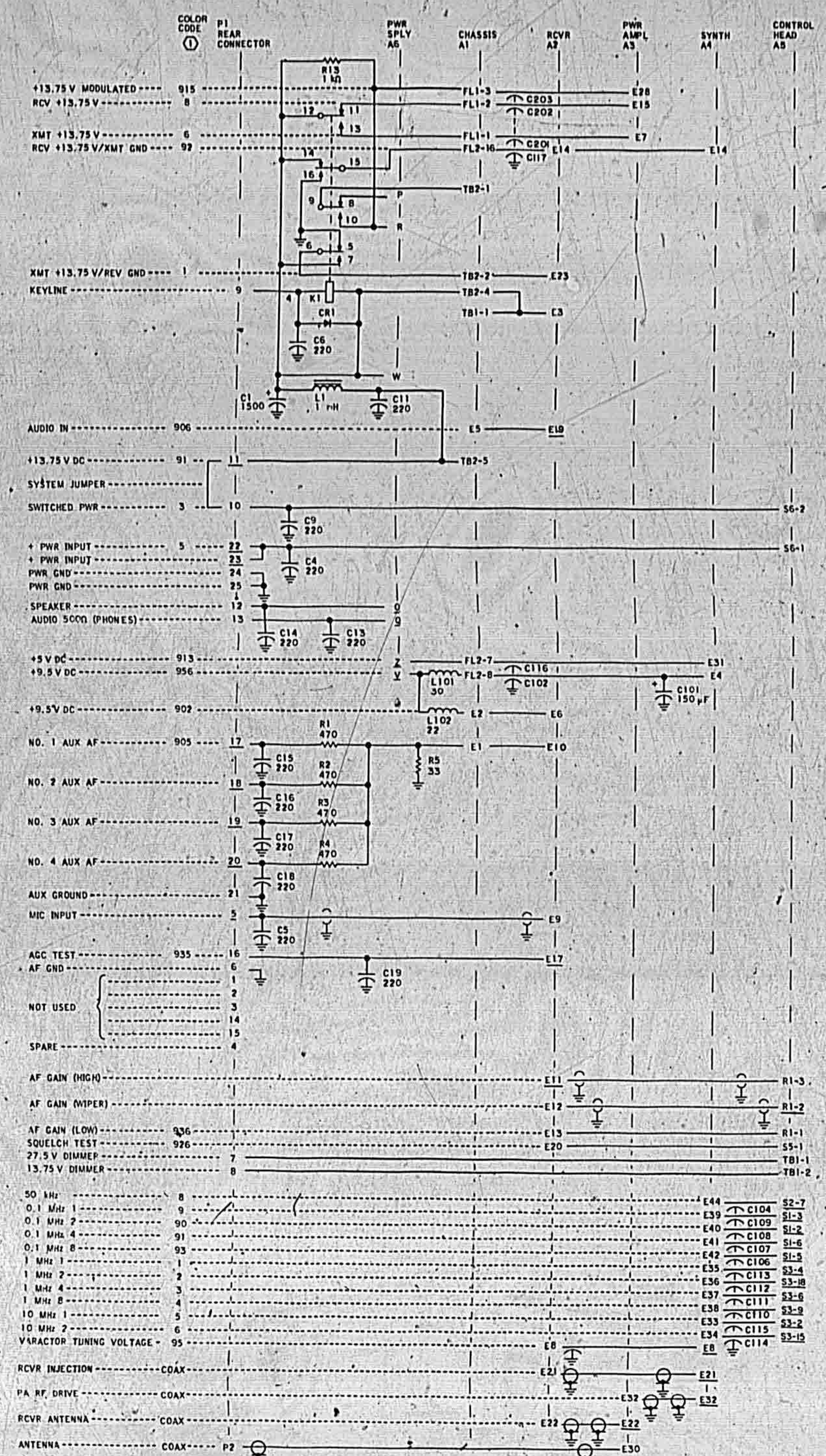
628-6210
TP4-5822-015

VHF-250 Chassis Wiring Diagram
Figure 6-15

Revised 1 November 1978

6-67/6-68

U



NOTES:

① NUMBERS IN THIS COLUMN INDICATE WIRE COLOR CODE.

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② UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.

③ UNLESS OTHERWISE SPECIFIED; ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.

④ UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.

Revised 1 November 1978

VHF-250S Chassis Wiring Diagram
Figure 6-16

628-6515

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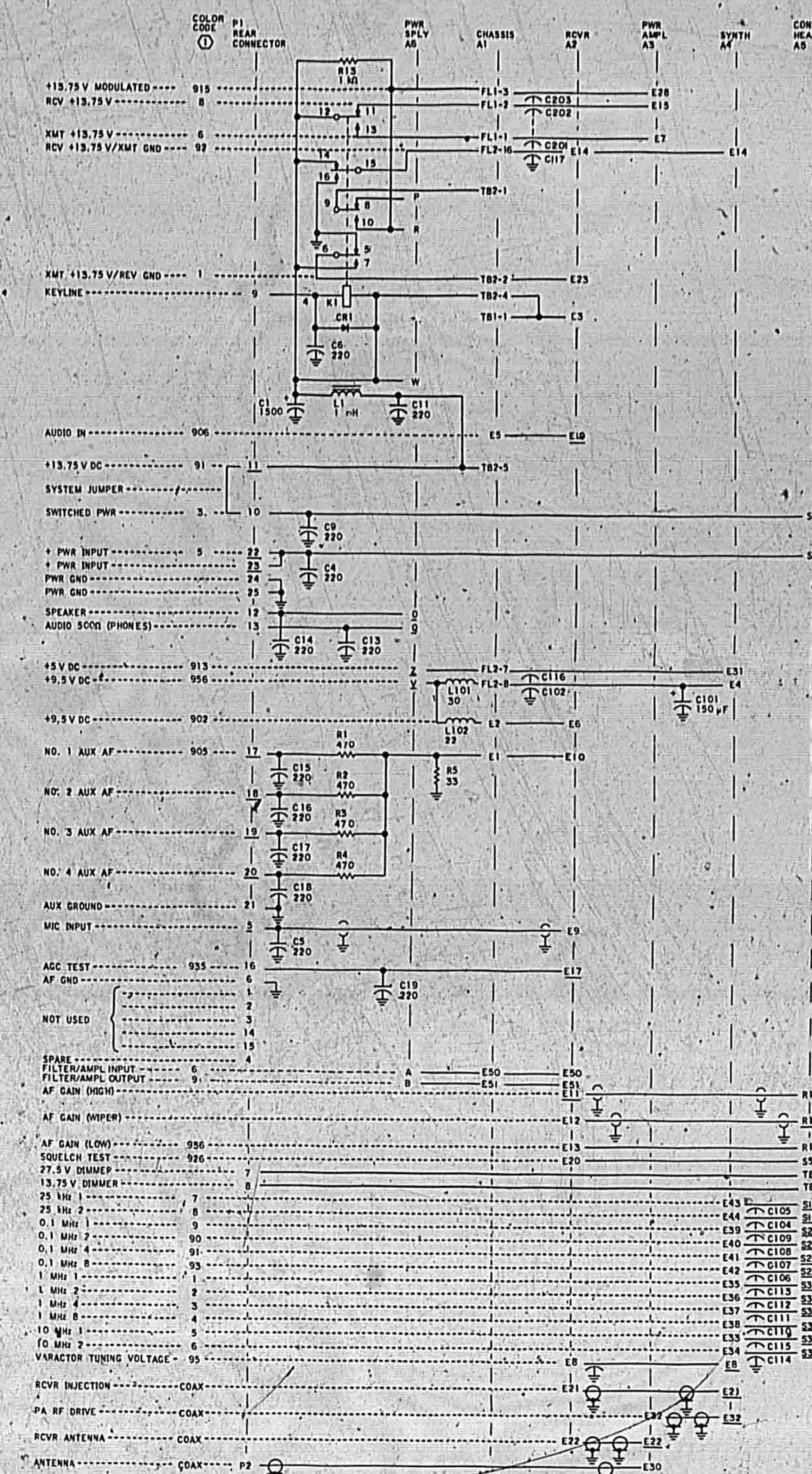
diagrams 523-0766718

V



NOTES:

① NUMBERS IN THIS COLUMN INDICATE WIRE COLOR CODE.

0 = BLACK, 5 = GREEN, 1 = BROWN, 6 = BLUE, 2 = RED, 7 = VIOLET, 3 = ORANGE, 8 = GRAY, 4 = YELLOW, 9 = WHITE

EXAMPLE: 913 = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

② UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.

③ UNLESS OTHERWISE SPECIFIED; ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.

④ UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.

Revised 1 November 1978

VHF-250E Chassis Wiring Diagram
Figure 6-17

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Collins
VHF-251/251S/251E Communications Trans/PWC-150 Power
Instruction Book

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MFG.

INTRO

S-TEC

TEC LINE AVIONICS™

VHF-251/251S/251E COMMUNICATIONS TRANSCEIVER AND PWC-150 POWER CONVERTER

This manual includes:

VHF-251/251S/251E Communications Transceiver	
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PWC-150 Power Converter	
Description	523-0766015
Installation	523-0766016
Theory	523-0766018
Maintenance	523-0766019
Diagrams	523-0766020

Caution

All information in this manual is subject to change. Before attempting any maintenance procedure on the system(s) covered in this manual, verify that you have complete and up-to-date publications by referring to the applicable Publications and Service Bulletin Indexes.

RECORD OF REVISIONS

MFG REV NO	DESCRIPTION	ISSUE DATE	ATP REV DATE	INSERTED BY
1	1st Edition	7/22/91	2/7/02	ATP/MG

RECORD OF TEMPORARY REVISIONS

TEMP REV NO	DESCRIPTION	ISSUE DATE	ATP REV DATE	INSERT BY	DATE REMOVED	REV INCOR	REMOVE BY

VHF-251/ 251S/ 251E

COMMUNICATIONS TRANSCEIVER

01

VHF-251/251S/251E Communications Transceiver

S-TEC Corporation
TEC LINE Avionics

description

Printed in USA

1st Edition, 22 July 1991

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Record of Revisions

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1st Ed	22 Jul 91		VHF-251 SB 1-3, 1-4; SIL 1-75, 1-76, 2-76; SB 1-4, 6, 7, 9-12; SIL 1-75, 1-76, 2-76, 3-76, 4-76, 1-77, 2-77, 3-77 VHF-251S SB 1-5; SIL 1-76, 1-77, 2-77 VHF-251E SB 1-6;SIL 1-76, 1-77, 2-77; SIL 1-78, 1-80, 2-80 VHF-251 SB 13, 14, 15, 16 VHF-251S SB 5, 6, 7, 8, 9 VHF-251E SB 6, 7, 8, 9, 10 VHF-251 SB 17 VHF-251S SB 10 VHF-251E SB 11	1	1 Nov 91		None

SECTION I
Description

1.1 INTRODUCTION

This instruction book contains all the specifications, installation instructions, equipment operating procedures, principles of operation and information necessary for proper maintenance of the VHF-251/251S/251E Communications Transceiver.

Table 1-1 list the equipment included in this instruction book by S-TEC part number and provides a brief, distinguishing description of each.

1.2 PURPOSE OF EQUIPMENT

The VHF-251, VHF-251S and VHF-251E Communications Transceivers are panel-mounted voice transceivers providing AM communication over a VHF range. All radios feature an electronic display and single channel memory; mechanical characteristics are identical.

The VHF-251 and VHF-251E provide 720-channel operation from 118.00 through 135.975 MHz in 25 kHz increments. The VHF-251E differs from the VHF-251 in that it is designed especially for operation in European countries where offset carriers are used extensively. In addition to this, the VHF-251E will provide a minimum 14W transmitter output power at room temperature. This ensures at least 10W out over environmental extremes for use in countries requiring 10 watts out for operations above FL200.

The VHF 251S provides 360-channel operation from 118.00 through 135.95 MHz in 50 kHz increments for use in South America and other regions where the ground

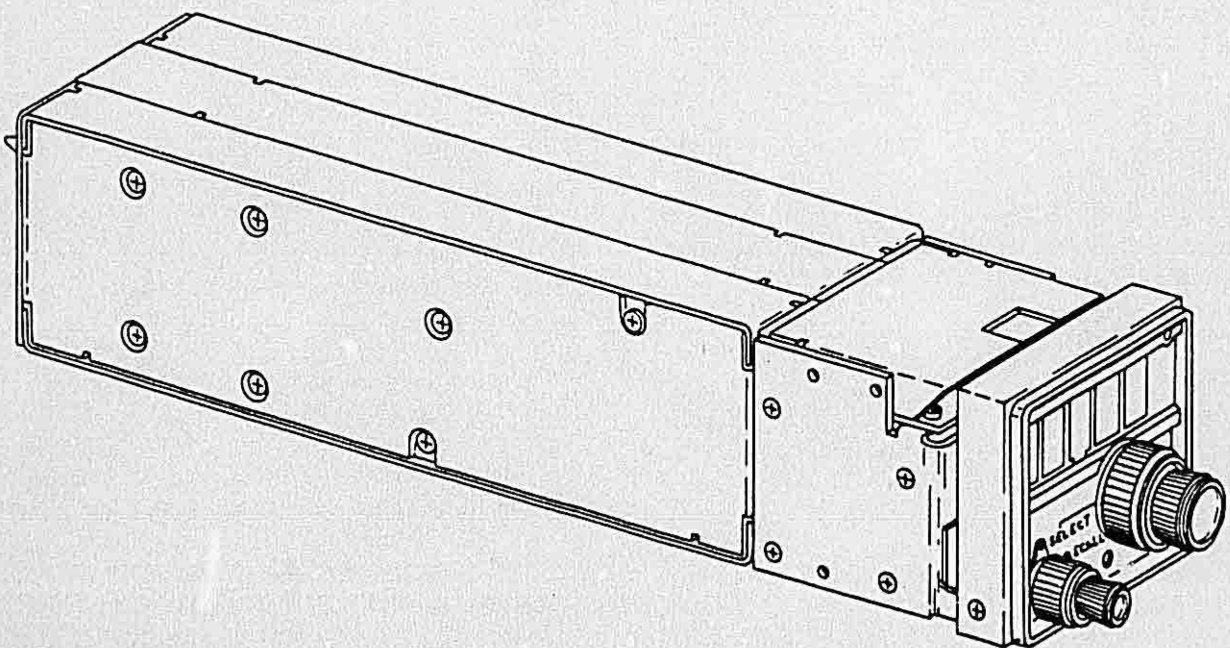

Figure 1-1 VHF-251/251S/251E Comm. Transceiver

Table 1-1, Equipment Covered in Instruction Book

UNIT/ PART NUMBER	DESCRIPTION				
	FREQ RANGE (MHz)	CHANNELS/ SPACING (kHz)	VHF PWR OUTPUT (WATTS)	PANEL COLOR	INCLUDES INSTALLATION KIT
VHF-251					
622-2078-001	118.000 thru 135.975	720/25	10 nom	Black	Yes
622-2078-002	118.000 thru 135.975	720/25	10 nom	Blue	Yes
622-2078-003	118.000 thru 135.975	720/25	10 nom	Green	Yes
622-2078-004	118.000 thru 135.975	720/25	10 nom	Red	Yes
622-2078-005	118.000 thru 135.975	720/25	10 nom	Brown	Yes
622-2078-006	118.000 thru 135.975	720/25	10 nom	Gray	Yes
VHF-251E					
622-3363-001	118.000 thru 135.975	720/25	14 min	Black	Yes
622-3363-002	118.000 thru 135.975	720/25	14 min	Blue	Yes
622-3363-003	118.000 thru 135.975	720/25	14 min	Green	Yes
622-3363-004	118.000 thru 135.975	720/25	14 min	Red	Yes
622-3363-005	118.000 thru 135.975	720/25	14 min	Brown	Yes
622-3363-006	118.000 thru 135.975	720/25	14 min	Gray	Yes
VHF-251S					
622-3307-001	118.00 thru 135.95	360/50	10 nom	Black	Yes
622-3307-002	118.00 thru 135.95	360/50	10 nom	Blue	Yes
622-3307-003	118.00 thru 135.95	360/50	10 nom	Green	Yes
622-3307-004	118.00 thru 135.95	360/50	10 nom	Red	Yes
622-3307-005	118.00 thru 135.95	360/50	10 nom	Brown	Yes
622-3307-006	118.00 thru 135.95	360/50	10 nom	Gray	Yes

station frequency tolerances associated with 50 kHz channel spacing are found.

1.3 DESIGN FEATURES

- Electronic frequency display providing highly legible readout of selected frequency under all lighting conditions.
- Frequency memory which permits recall of previously stored frequency or presetting of an expected frequency.
- Automatic display dimming to adapt to all cockpit lighting conditions.
- Varactor diode tuned receiver eliminates the need for mechanical tuning devices or other moving parts in the receiver.
- Dual gate MOSFET rf amplifier and mixer provide maximum sensitivity and freedom from spurious responses.
- Crystal filter selectivity to ensure maximum rejection of adjacent channel interference.
- Digital frequency synthesizer with stability determined by a single crystal-controlled oscillator.
- Full compatibility with present and future channel allocations in the VHF-251/251E.
- Audio compression assures full modulation in transmit and maximum output on weak, or poorly modulated received signals.
- Rf keyed transmit light provides continuous on-line monitor of transmitter output.

- Automatic squelch circuit eliminates manual control of squelch threshold.
- Front panel mounting, with mounting tray installed from either front or rear of panel.
- Installed as a single device, or easily combined with additional COMM or NAV equipment in dual installations.
- Distinctive styling coordinated with other S-TEC Corporation TEC LINE products.
- Dual concentric frequency and mode selector controls, human engineered for maximum visibility and ease of use.
- Provision for identifying radios as COMM 1 or COMM 2 in dual installations.

1.4 EQUIPMENT SPECIFICATIONS

Table 1-2 lists the equipment specifications of the VHF-251/251S/251E Communications Transceivers.

Table 1-2, VHF-251/251S/251E Equipment Specifications

CHARACTERISTICS	SPECIFICATIONS
Related documents	
FAA TSO	-C37b class II, -C38b, DO 138 environmental category DAPBAAEXXXXX.
Physical	
Dimensions (mounted in tray)	
Front panel	
Width	79.25 mm (3.120 in).
Height	66.29 mm (2.610 in).
Front extension, including knobs	43.69 mm (1.720 in).
Chassis	
Width	80.77 mm (3.180 in) max.
Height	67.41 mm (2.654 in) max.
Rear extension, including tray	316.2 mm (12.45 in) max.
Mounting	Panel mounted.
Kit	CPN 628-5289-002.
Weight	1.73 kg (3.8 lb) max, with tray.
Environmental	
Temperature range	
Continuous	-15 to +55 °C (+5 to +131 °F).

Table 1-2 VHF-251/251S/251E Equip. Specifications (Cont).

CHARACTERISTICS	SPECIFICATIONS
Intermittent	To +71 °C (+159.8 °F) for 30 minutes.
Storage	-40 to +85 °C (-40 to +185 °F).
Altitude	9144 m (30 000 ft) max.
Cooling	Convection.
Relative humidity	95% at +50 °C (122 °F).
Shock	
Operational	6 g.
Crash safety	15 g (10 ms duration).
Electrical	
General	
Channels	
VHF-251/251E	720.
VHF-251S	360.
Frequency range	
VHF-251/251E	118.000 to 135.975 MHz in 25-kHz increments.
VHF-251S	118.000 to 135.95 MHz in 50-kHz increments.
Frequency stability	
VHF-251/251S	±0.0025%.
VHF-251E	±2 kHz.
Power requirements	Receive: +13.75 V dc at 0.84 A. Transmit: +13.75 V dc at 4.5 A (85% voice modulation). **Note** The PWC-150 Power Converter must be used when the VHF-251/251S/251E is installed in a 28-V system.
Transmitter	
Vhf power output	
VHF-251/251S	10 watts nominal.
VHF-251E	14 watts minimum.
Modulation	85% modulation capability; 95% limiting; less than 15% distortion at 85% modulation.
Audio input impedance	300 ohms unbalanced with excitation current for a 50- to 600-ohm carbon or transistorized dynamic microphone.

Table 1-2 VHF-251/251S/251E Equip. Specifications (Cont.)

CHARACTERISTICS	SPECIFICATIONS
Sidetone level	Adjustable. At least 5 mW into a 500-ohm load available.
Duty cycle	1 minute transmit, 4 minutes receive.
Receiver	
Sensitivity	Not more than 3.0 μ V will provide a 12-dB minimum signal-plus-noise to noise ratio.
Selectivity	
VHF-251/251E	Receiver response flat to within 6 dB at frequencies within ± 8.7 kHz of the receive center frequency. Receiver response down 40 dB or more at frequencies greater than ± 17 kHz from the receive center frequency. Receiver response down 60 dB or more at frequencies greater than ± 22.5 kHz from the receive center frequency.
VHF-251S	Typical 6 dB at ± 15.0 kHz, 60 dB at ± 38.0 kHz.
Spurious responses	Down at least 60 dB.
Squelch	Automatic squelch (noise squelch with carrier override).
AGC characteristics	From 10 μ V to 20,000 μV, audio output will not vary more than 3 dB.
Audio	
Auxiliary audio inputs	Four 500-ohm inputs which are isolated from each other by 30 dB.
Frequency responses	
VHF-251/251S	Within 6 dB from 350 to 2500 Hz.
VHF-251E	Within 6 dB from 350 to 2500 Hz; above 5 kHz, output is at least 18 dB below maximum between 350 and 2500 Hz.
Speaker output	5 watts into a 3.2-ohm speaker load.
Headphone output	50 mW into a 500-ohm load.
Intercom input	Supplies bias voltage for carbon microphone.

1.5 EQUIPMENT SUPPLIED

Supplied with theVHF-251/251S/251E Communications Transceiver is an installation kit (S-TEC P/N 690202). Figure 2-1 in the installation section of this instruction book provides an exploded view of the kit and lists the materials it contains.

An optional rear connector is available that does not require the use of special crimping, or insertion/extraction tools. If needed, specify Cannon part number DBR-25S.

1.6 EQUIPMENT REQUIRED BUT NOT SUPPLIED

The following or equivalent equipment listed in Table 1-3 is required for proper operation of the VHF-251/251S/251E, but is not supplied with the unit.

Table 1-3 Equipment Required But Not Supplied.

EQUIPMENT	TYPE
Vhf communications antenna	S-TEC ANT-251 (P/N 696401) or equivalent
Interconnecting cables	Per interconnect wiring diagram
Headphones or speaker	Any
Microphone	Shure 488T or equivalent.

NOTE

The PWC-150 Power Converter, S-TEC part number 690107, is required for 28-volt operation.

02

VHF-251/251S/251E Communications Transceiver

S-TEC Corporation
TEC LINE Avionics

installation

Printed in USA

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SECTION II
Installation

2.1 GENERAL

Installation data contained in this section consist of unpacking and inspection checks, special instructions, installation procedures and postinstallation testing.

2.2 UNPACKING AND INSPECTING EQUIPMENT

Unpack the equipment carefully and make a careful visual inspection of each unit for possible shipping damage. All claims for damage should be filed with the transportation company involved. If claims for damage are to be filed, save the original packing carton and materials. If no defects can be detected, replace packing materials in the shipping container and save for future uses such as storage or reshipment.

2.3 SPECIAL INSTRUCTIONS

The following are special instructions which must be followed to ensure proper installation of the VHF-251/251S/251E. Damage to the equipment may occur if these instructions are not followed.

CAUTION

Turnlock must be in upward position prior to unit insertion in tray.

a. When inserting the VHF-251/251S/251E in its mounting tray, do not push on the electronic display panel. To insert, place thumbs on bottom corners and gently apply pressure until the rear connectors are properly mated. Using an Allen wrench, twist the turnlock into position.

b. When removing the VHF-251/251S/251E from its nount, do not pull on top of the front panel. Grasp the unit y the frequency selector knobs and carefully pull out.

The minimum wire size for +13.75 VDC lines is #20 WG.

Read all notes on drawings and interconnects before alling units.

e. Wires carrying alternator ripple current or 400 Hz current, if dressed close to the transceiver, may produce audible interference due to synthesizer modulation.

f. Speaker wire, if dressed close to transceiver, may produce feedback howl due to synthesizer modulation.

2.4 INSTALLATION

WARNING

In the interest of personal safety, it is recommended that the aircraft battery master switch be turned off to disconnect power to the equipment mount before any electronic equipment is removed from or installed in the aircraft.

The following installation procedures must be performed as described to ensure proper operation and performance. Any deviation from these instructions may result in reduced performance and/or damage to the equipment.

2.4.1 VHF-251/251S/251E Communications Transceiver

a. An installation kit is required to install the VHF-251/251S/251E. The dash number following the S-TEC part number denotes if unit has an installation kit.(VHF-251 with kit; 690101-1, VHF-251S with kit; 690101-3, VHF-251E with kit; 690101-5). Refer to figure 2-1.

b. The VHF-251/251S/251E is rigidly mounted in the aircraft instrument panel. There are two methods that may be used for installing the mounting tray provided in the installation kit. Both methods position the tray with front edges extended through the panel cutout, but flush with the aircraft instrument panel. Refer to figure 2-2 for panel cutout dimensions.

c. Avoid mounting close to external heating sources. If it is unavoidable, use blower or ram air cooling. Under normal installation conditions, ram air or blower cooling will increase reliability of the VHF-251/251S/251E.

d. Secure the mounting tray to the instrument panel mounting rails, using four #6-32, 100-degree Flathead screws. It is recommended that the rear mounting straps be used for added support. Figure 2-4 illustrates typical system installations.

e. After the mounting tray has been secured in position, slide the rear connector assembly into place and secure by tightening four screws. Snap into place the protective shroud provided in the installation kit and tie in place to prevent accidental removal due to shock or vibration. Holes are provided in the shroud and rear plate assembly for this purpose.

CAUTION

Do not force turnlock into position. If difficulty is experienced, remove VHF-251/251S/251E and check rear connector assembly for proper positioning.

f. Carefully slide the VHF-251/251S/251E into the mounting tray. Using your thumbs, apply pressure to the bottom corners of the VHF-251/251S/251E until the connectors are mated. Using a 5/64-inch Allen wrench, secure the VHF-251/251S/251E in place by twisting the turnlock into position. After tightening, pull the frequency selector knobs to be certain the turnlock is in the locked position.

NOTE

The following steps pertain to dual installations only.

g. Dual installations are accomplished by joining two mounting trays together, using the hardware provided in the installation kit. Connecting screws should be varnished to prevent loosening due to vibration. Included in every installation kit are two straps and two screws. To join two mounting trays together, four straps and four screws are required. (Refer to figure 2-1).

h. Dual installation cutout dimensions are shown in figure 2-2 for both behind-the-panel and front panel mounting installations.

2.4.2 ANT-251 VHF Communications Antenna

a. Select a suitable location for antenna mounting using the template shown in the outline and mounting dimensions drawing, figure 2-3. The ANT-251 may be installed on either the top or bottom of the aircraft where ground clearance warrants.

NOTE

Keep comm antennas as far as possible from VHF nav antennas. Isolation between comm and nav antennas should be at least 30 db.

b. The mounting area selected must provide a stable base for the antenna as well as clearance for the connector. An unobstructed area providing line of sight between antenna and intended receiving stations is desirable.

c. The surface selected should provide continuous metal contact between the antenna and the aircraft. Adapter plates or shims, when used, must be metallic and shaped to interface the antenna base to the aircraft contour. Mating surfaces must be clean of paint, primer, dirt and oxidation. Inner mounting hardware such as doublers and stop nuts also must maintain direct electrical grounding to the airframe.

d. After location has been selected, drill the antenna mounting holes and secure in place using four #6 screws.

e. If a sealant or aerodynamic smoother is used around the antenna base, ensure application is made after antenna is fastened securely in position.

2.5 CABLING

The VHF-251/251S/251E mating connector part number is shown on the outline and mounting diagram. Figure 2-5 lists mating connector pin assignments.

During preparation of the interconnect wiring cables, observe the following precautions:

a. Bond and shield all parts of the aircraft electrical system, such as generator and ignition systems.

b. Keep the interconnect cables away from circuits carrying heavy current, pulse transmitting equipment, and other sources of interference.

c. Figure 2-5 presents the VHF-251/251S/251E mating connector pin assignments. Refer to that illustration and the VHF-251/251S/251E interconnect wiring diagrams figure 2-8 or 2-9, when preparing the interconnect cable.

d. Leave slack in the cable to allow for movement due to vibration.

e. After installation of the cables in the aircraft and before installation of the equipment, a check should be made to ensure that the aircraft power is applied only to the pins

Table 2-1. Special Tools

DESCRIPTION	MANUFACTURER AND TYPE	PART NUMBER
Crimping tool	Cannon, CCT-D*C-1	371-0382-010
Insertion/extraction tool - plastic	Cannon, CIET-20HDB	371-8445-010
Insertion/extraction tool - metal	Cannon, CIET-22	371-8445-020

specified. Refer to figure 2-5 for connector pin assignments.

f. Remove and install connector contacts in accordance with steps g through i. Table 2-1 list the special tools required to perform the following steps.

g. During installation of the mating connector, the connecting wire must be crimped in the contact so that the crimped portion of the contact can enter the connector shell and provide a positive lock of the contact in the shell. Use crimping tool (Cannon P/N CCT-D*C-1) and crimp each interconnect wire in a contact. Using the insertion/extraction tool (Cannon P/N CIET-20HBD) insert the contact into the proper connector shell hole from the rear and press until locked. Refer to figure 2-6.

h. Do not dress speaker wire, wires carrying alternator ripple current, or wires carrying 400 Hz current alongside the transceiver. Ignoring this caution may result in synthesizer modulation that produces degraded audio quality or feedback howl.

i. During removal of a contact, use the insertion/extraction tool to unlock the contact, and pull the contact out of the connector from the rear.

j. Refer to figure 2-7 for installation of antenna cable connector. Use RG-58A/U coaxial cable in the installation.

k. Do not bundle comm or nav antenna cables together. If possible, route the cables on opposite sides of the aircraft.

2.6 POSTINSTALLATION CHECKS

WARNING

The potential exists for a significant reduction in, or the complete cancellation of, the received audio output signal of two VHF communications transceivers (regardless of manufacturer) in the same aircraft if all of the following conditions exist:

a. Two transceivers are tuned to ground stations that simultaneously transmit the same message.

NOTE

Ordinarily this occurs when both transceivers are tuned to the same frequency. However, it can also occur when more than one ground station transmitter is used to transmit a single voice message.

b. Audio outputs are adjusted to approximately the same level.

c. The audio output phase shifts of the two communications systems (including the audio panel) are approximately 180 degrees apart.

If the phase shift through both transceivers is the same (in phase) and the audio panel does not introduce phase differentials, no attenuation or cancellation of the received signal will occur.

All users of VHF communications transceivers should be aware of this potential situation and take the following precautions to prevent this problem from occurring.

a. Make a habit of avoiding simultaneous tuning of two transceivers to the same frequency or to two frequencies that carry the same voice message.

b. Test the transceiver and audio panel as described in the following procedures to determine whether or not the problem of incompatible phasing exists.

After installation of the equipment in the aircraft, perform a system check to ensure that cancellation or attenuation is not a problem.

a. Tune both transceivers to the same frequency. (In aircraft with three transceivers, each combination of two units must be tested.)

b. Set the audio panel so that both transceiver outputs are heard through the same speaker or headset.

Warning (Cont)

c. Set one transceiver volume control approximately to its midpoint.

d. Slowly adjust the other transceiver volume control through its midpoint position and listen for a reduction in the level of the combined audio output.

If the transceiver phase shifts are incompatible, the audio signal will be completely cancelled or appreciably reduced as the audio output level of the two transceivers approach equality. If the transceiver phase shifts are compatible, the audio output will be at least as loud as that of a single unit. The preceding test should be performed after any change of VHF communications transceiver or audio equipment.

If the attenuation/cancellation problem is detected in an installation consisting solely of TEC LINE equipment, remove each transceiver and check the wiring of transformers A1T1 and A1T2. This problem indicates that a serious error in wiring has been made on one of these two components.

Compare the transceiver audio output (headphone or speaker) with the rf envelope by a quick check that ensures proper wiring. If the transceiver is operating properly, the audio output will be in phase with the positive portion of the rf envelope; if this relationship does not exist, a wiring problem is present.

Normally this problem is extremely rare in a pure TEC LINE system; however, extra attention should be given in a mixed system checkout. Keep in mind that any equipment interfacing with the transceiver (audio panel, line buffers, another VHF COMM transceiver, or auxiliary amplifiers) may influence the audio output phase and contribute to attenuation/cancellation.

After all cabling has been installed and the equipment has been mounted in the aircraft, make the operational check outlined below to ensure correct operation of the equipment in the aircraft. These test may be made using the aircraft power supply with the engine running or with auxiliary power applied to the aircraft.

a. Apply power to the VHF-251/251S/251E by turning on the ON/OFF switch.

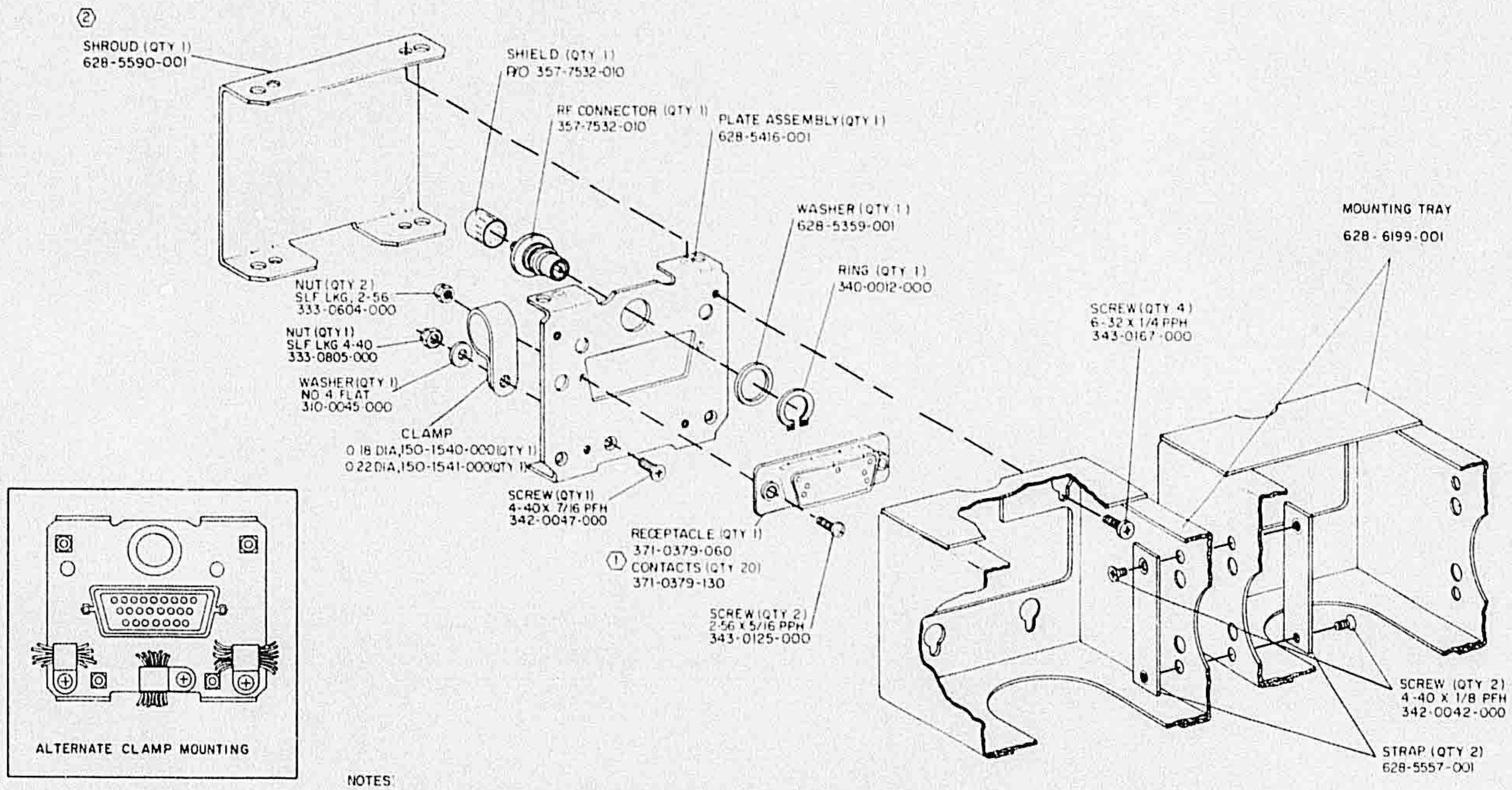
b. Check the squelch disable circuit by pulling out the OFF/VOL/TST control. Noise from the receiver should by applied to the aircraft audio system.

c. Select the operating frequency of a known station in the immediate area. Press the microphone push-to-talk switch and obtain a signal check. Repeat this procedure with other stations on different frequencies if possible.

d. The VHF-251( ) automatically dims the display in low light. The lower limit of the dimming circuit is set by adjusting a pot (located under the frequency selector knobs) with a screwdriver. This adjustment must be done at night or in a completely dark hangar. Adjust the pot for a comfortable fully dimmed display brightness level.

WARNING

Incorrect adjustment of the dimmer control may cause the display to go completely dark at night. Adjusting the pot does not change the display brightness in the daylight. All adjustments must be made under conditions no brighter than a night-lighted cockpit.



NOTES:

① AN OPTIONAL SOLDER POT TYPE CONNECTOR MAY BE SUBSTITUTED CPN 371-0381-030 (CANNON DBR-25 S)

② AN OPTIONAL 43 MILLIMETRE (1.7 IN) DEEP SHROUD IS AVAILABLE CPN 628-5590-002

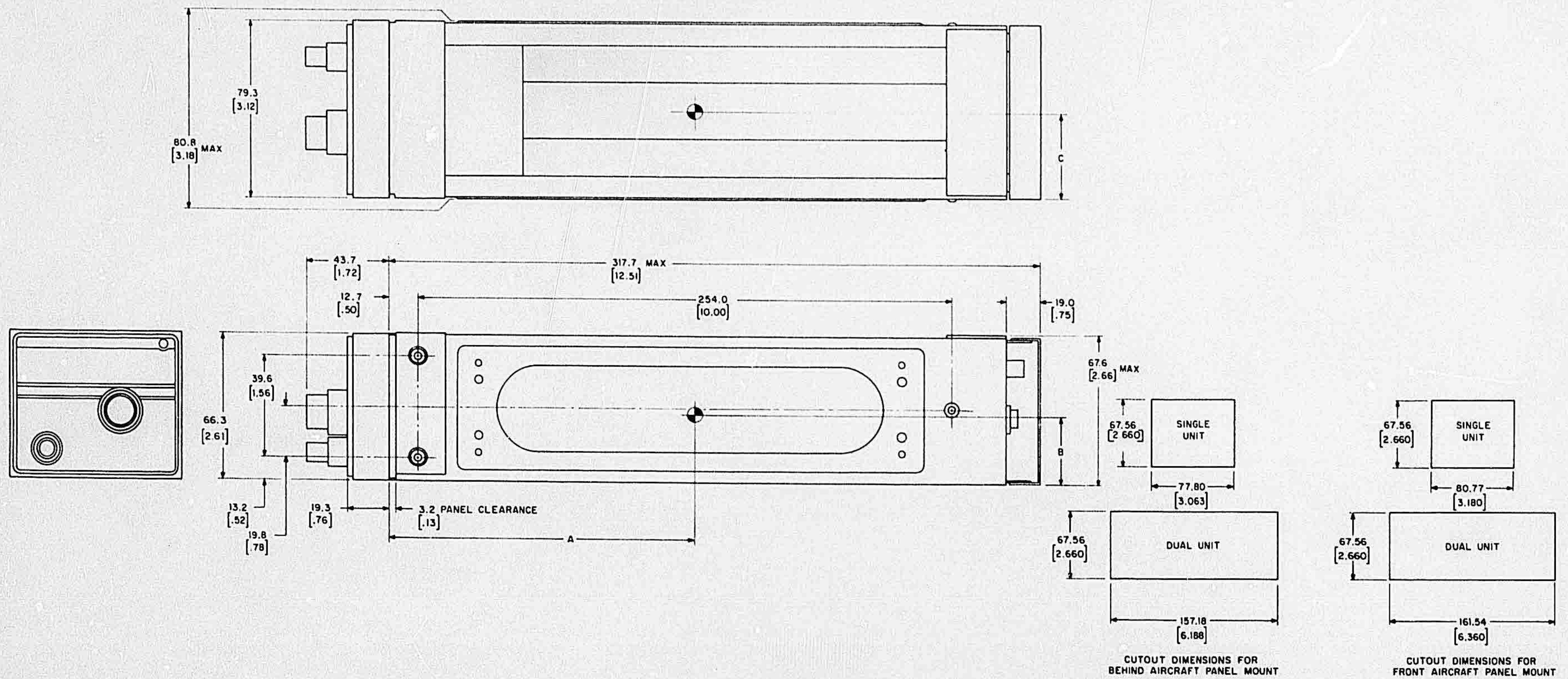
③ A LABEL (1, 2) IS INCLUDED WITH KIT BUT NOT ILLUSTRATED CPN 628-5597-001.

VHF-251/251S/251E Communications Transceiver, Installation Kit
Figure 2-1

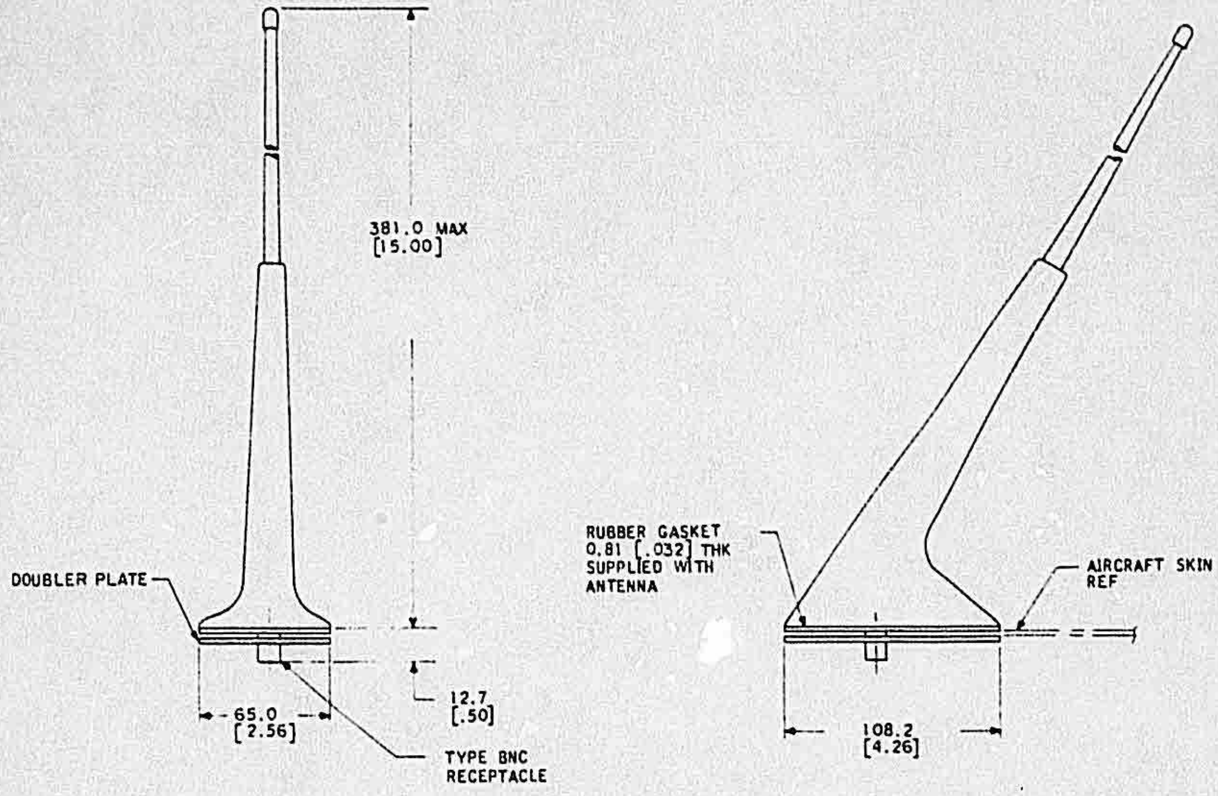
NOTES:
1. UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MILLIMETRES [INCHES].
2. CG's ARE WITH UNIT IN TRAY.

	A		B		C		UNIT WEIGHT		TRAY WEIGHT	
	mm	INCHES	mm	INCHES	mm	INCHES	kg	LB	kg	LB
VIR-351	138.94	5.47	33.27	1.31	38.10	1.50	1.31	2.9	0.18	0.4
VHF-251 VHF-251S VHF-251E	151.64	5.97	30.99	1.22	34.80	1.37	1.54	3.4	0.18	0.4

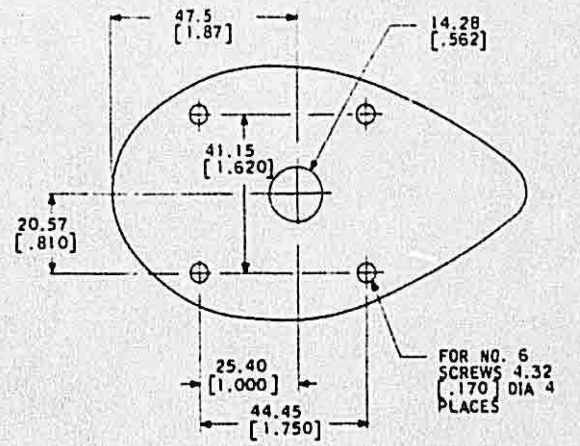
UNIT	UNIT CONNECTORS	MATING CONNECTORS
VHF-251 VHF-251S VHF-251E	RF - CPN 357-7532-020 SIGNAL CONN - CPN 371-0379-010 SIGNAL CONTACTS - CPN 371-0379-030	RF - CPN 357-7532-010 SIGNAL CONN - CPN 371-0379-060 SIGNAL CONTACTS - CPN 371-0379-130
VIR-351	RF - CPN 357-7532-020 SIGNAL CONN - CPN 371-0379-040 SIGNAL CONTACTS - CPN 371-0379-100	RF - CPN 357-7532-010 SIGNAL CONN - CPN 371-0379-070 SIGNAL CONTACTS - CPN 371-0379-130



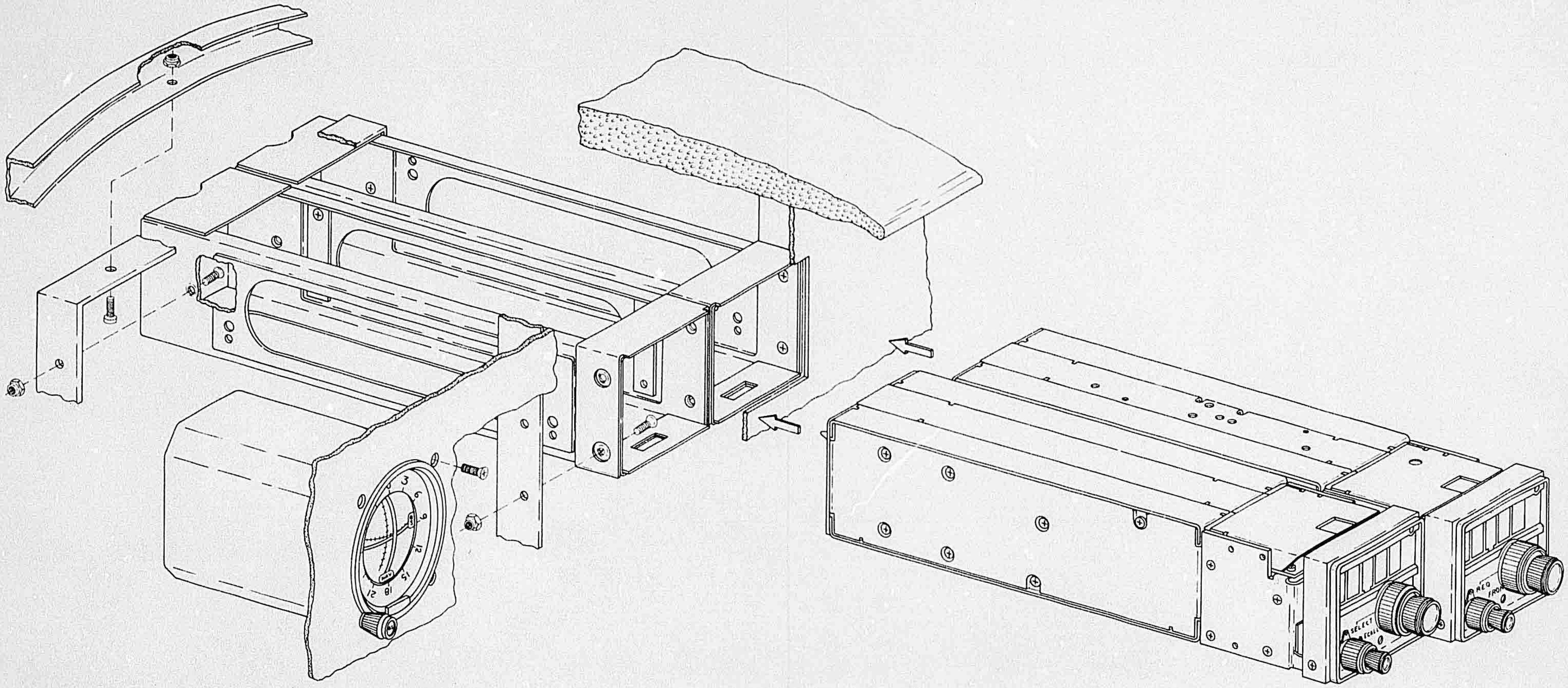
VHF-251/251S/251E Communications Transceiver, Outline and Mounting Dimensions Figure 2-2



NOTES:
1. DIMENSIONS ARE IN MILLIMETRES [INCHES].
2. WEIGHT 0.4 kg [0.8 POUNDS].
3. ANTENNA IS SUPPLIED WITH MOUNTING GASKET AND DOUBLER PLATE.



ANT-251 VHF Communications Antenna,
Outline and Mounting Dimensions
Figure 2-3



Typical System Installation
Figure 2-4

VHF-251( ) AND VHF-250( ) MATING CONNECTOR PIN ASSIGNMENTS

1	ICS ⟨3⟩	13	COMM AUDIO 500 OHMS
2	SPARE	14	SPARE
3	SPARE	15	SPARE
4	SPEAKER SIDETONE ⟨2⟩	16	AGC TEST POINT
5	MICROPHONE	17	AUX AUDIO 1
6	AUDIO GROUND	18	AUX AUDIO 2
7	27.5 V DIMMER ⟨1⟩	19	AUX AUDIO 3
8	13.75 V DIMMER ⟨1⟩	20	AUX AUDIO 4
9	KEY LINE	21	AUDIO GROUND
10	SWITCHED COMM POWER	22	COMM POWER IN
11	COMM 13.75 V DC	23	COMM POWER IN
12	SPEAKER	24	POWER GROUND
		25	POWER GROUND

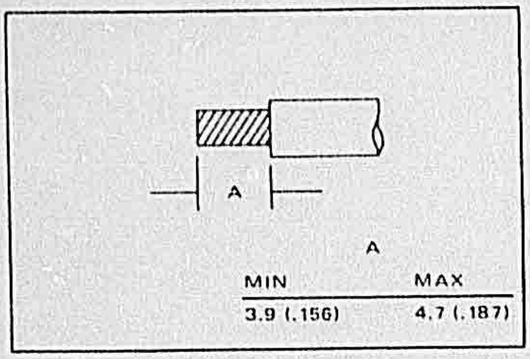
NOTE:

⟨1⟩ USED IN VHF-250( ) ONLY.

⟨2⟩ 622-2079-011,-012 ONLY

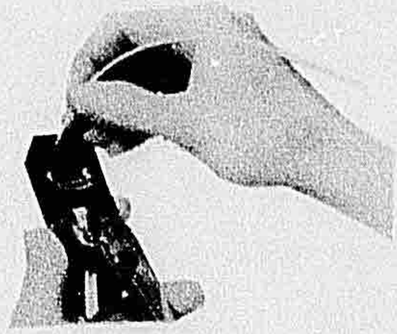
⟨3⟩ SPARE PIN IN VHF-251 BELOW SN 24591, VHF-251E BELOW SN 2795, AND VHF-251S BELOW SN 2698

VHF-251/251S/251E Mating Connector Pin Assignments Figure2-5

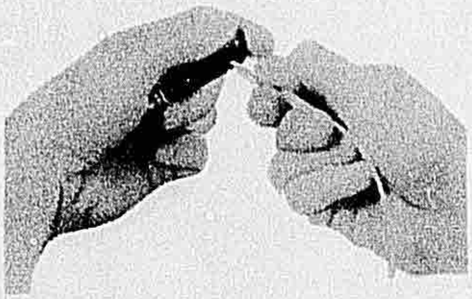


WIRE STRIPPING
1. CUT WIRES TO LENGTH. STRIP INSULATION PER ABOVE ILLUSTRATION. CHECK FOR BROKEN OR FRAYED WIRES.

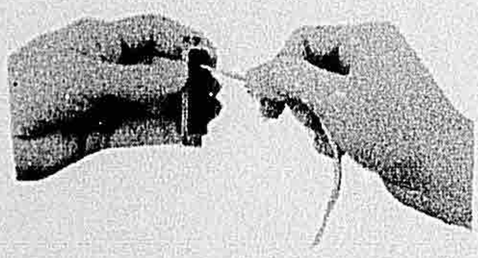
NOTE: DIMENSIONS ARE IN MM (IN.).



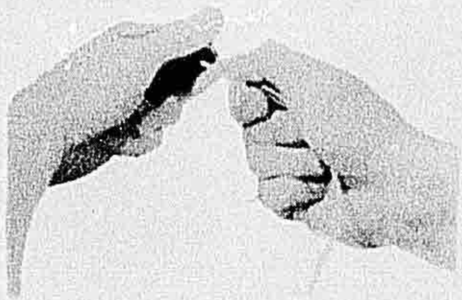
CONTACT CRIMPING
2 INSERT CONTACT AND WIRE INTO PROPER CRIMPING TOOL (AND LOCATOR, IF REQUIRED) CRIMP CONTACT TO WIRE. INSPECT CRIMP.



CONTACT INSERTION
3. CENTER WIRED CONTACT IN GROOVE OF INSERTION TOOL, WITH TOOL TIP BUTTING CONTACT SHOULDER. INSERT CONTACT INTO CAVITY UNTIL A POSITIVE STOP IS FELT INSPECT INSERTION.

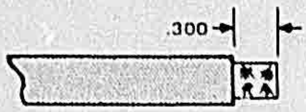


4. TO BE SURE CONTACT IS LOCKED SECURELY, PULL BACK LIGHTLY ON WIRE. REPEAT FOR BALANCE OF CONTACTS, WORKING ROW BY ROW ACROSS THE INSULATOR.

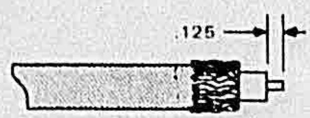


CONTACT EXTRACTION
5. PLACE WIRE INTO EXTRACTION TOOL TIP. INSERT TOOL TIP INTO CONTACT CAVITY UNTIL TIP BOTTOMS AGAINST CONTACT SHOULDER, RELEASING TINES. HOLD WIRE AGAINST TOOL WITH FINGER AND REMOVE TOOL AND CONTACT. REPEAT FOR BALANCE OF CONTACTS.

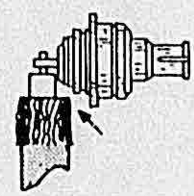
Use of Crimping & Insertion/Extraction Tools Figure 2-6



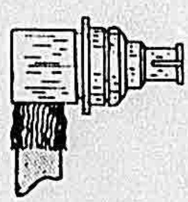
TRIM COAX CABLE OUTER INSULATION AS SHOWN.



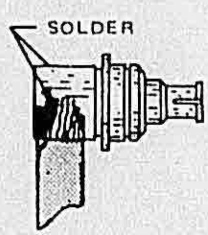
FOLD BRAID BACK OVER OUTER INSULATION OF COAX. DO NOT CROSS STRANDS.



SOLDER CENTER CONDUCTOR TO CENTER PIN OF CONNECTOR. ENSURE FRONT END OF BRAID IS EVEN WITH BOTTOM OF CONNECTOR. (SHOWN BY ARROW).



SLIDE CONNECTOR CAP, WITH CLEARANCE HOLE IN POSITION TO CLEAR DIELECTRIC, ON TO CONNECTOR UNTIL IT SNAPS INTO PLACE.

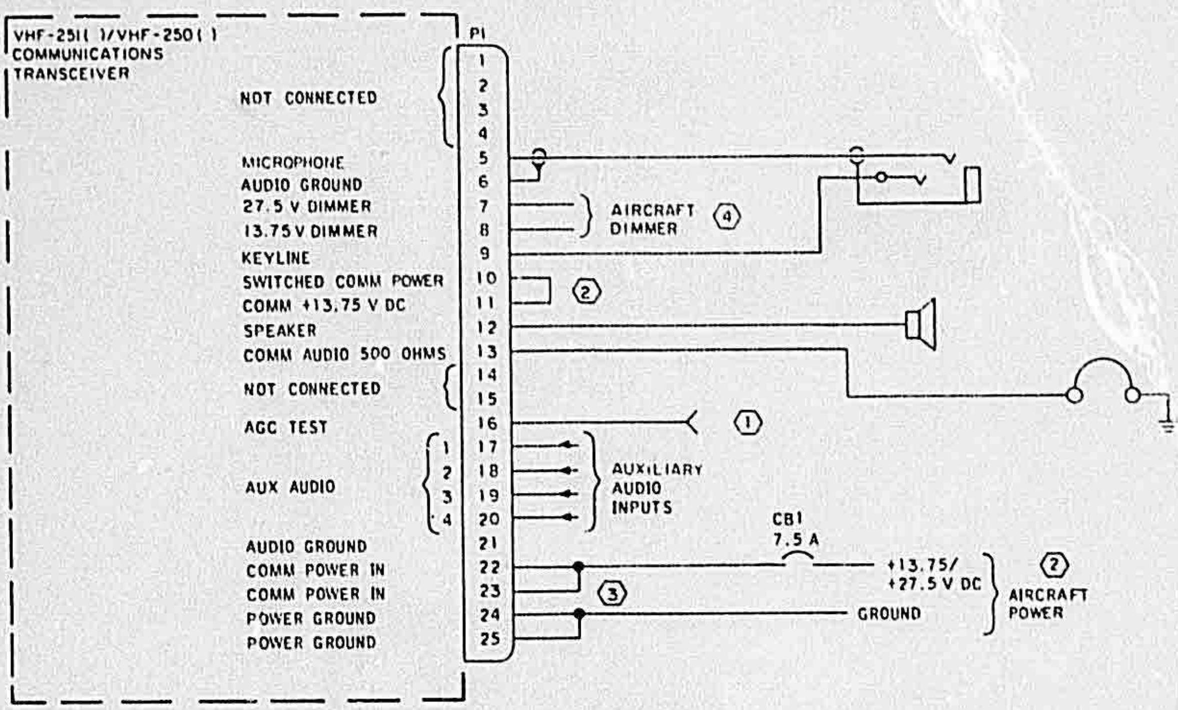


PUSH BRAID FORWARD AND FLATTEN AGAINST CONNECTOR CAP AND SOLDER 360° AROUND. SOLDER CONNECTOR CAP TO CONNECTOR IN AT LEAST THREE PLACES TO INSURE GOOD ELECTRICAL CONTACT.

357-7532-010 RF CONNECTOR

NOTE: CLOSE ADHERANCE TO THIS PROCEDURE IS NECESSARY FOR AN INTERFERENCE FREE INSTALLATION.

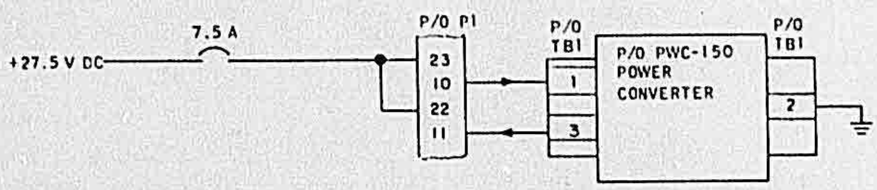
Antenna Connector Preparation Figure 2-7



NOTES:

① AGC IS BROUGHT OUT TO P1-16 FOR TESTING PURPOSES ONLY.

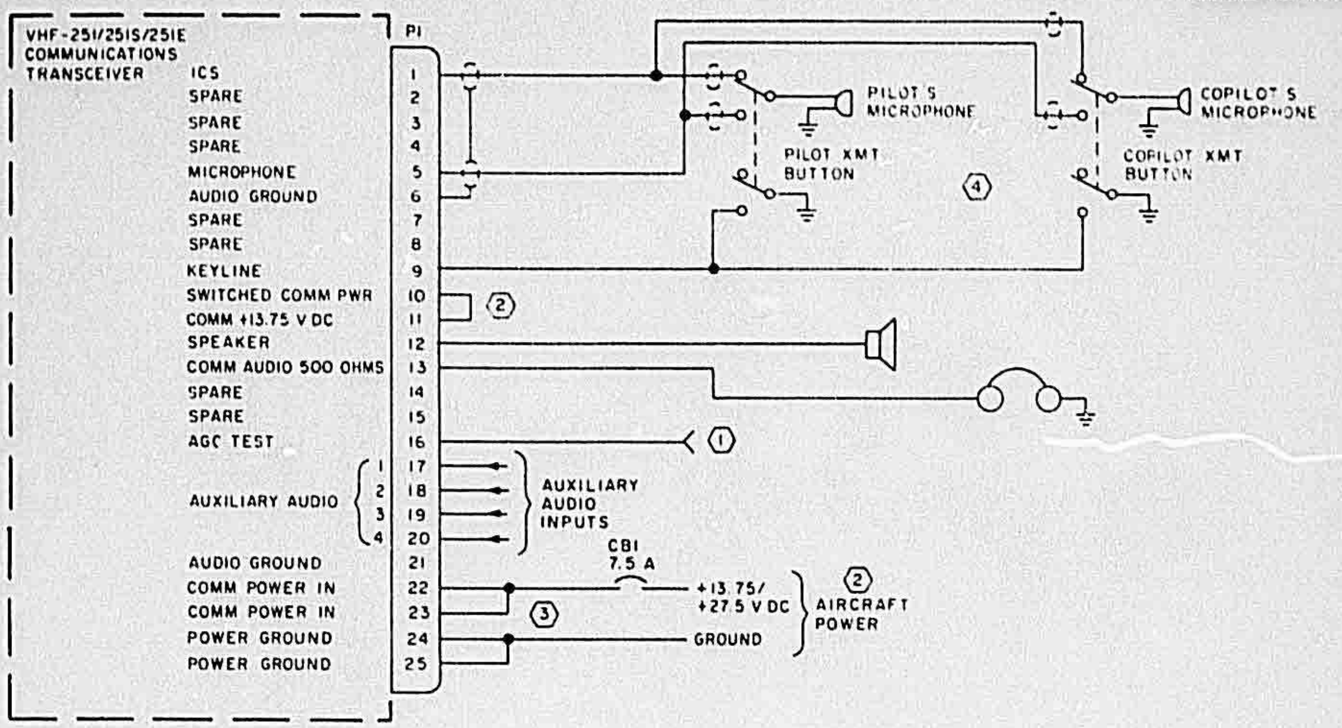
② THE PWC-150 POWER CONVERTER IS CONNECTED IN SERIES WITH THE P1-10 TO P1-11 JUMPER WHEN INSTALLED IN A 28V SYSTEM.



③ WIRES CARRYING +13.75/+27.5 V DC INCLUDING POWER GROUND MUST BE 20 AWG OR LARGER, ALL OTHERS MUST BE 24 AWG OR LARGER.

④ P1-7 AND P1-8 ARE NOT USED (NO INTERNAL CONNECTION) IN THE VHF-251 ( ).
FOR 13.75 V LIGHTING GROUND P1-7 AND CONNECT P1-8 TO LIGHTING BUS.
FOR 27.5 V LIGHTING CONNECT P1-7 TO LIGHTING BUS AND LEAVE P1-8 OPEN.

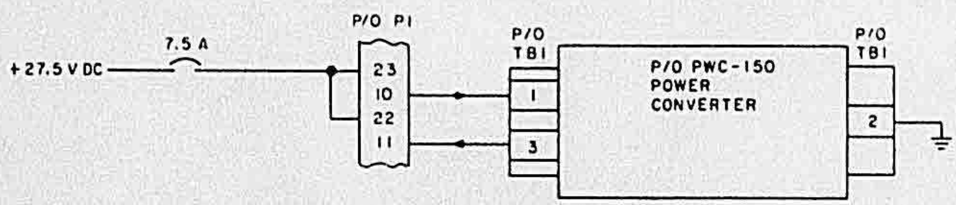
Interconnect Wiring Diagram w/o Intercom Figure 2-8



NOTES:

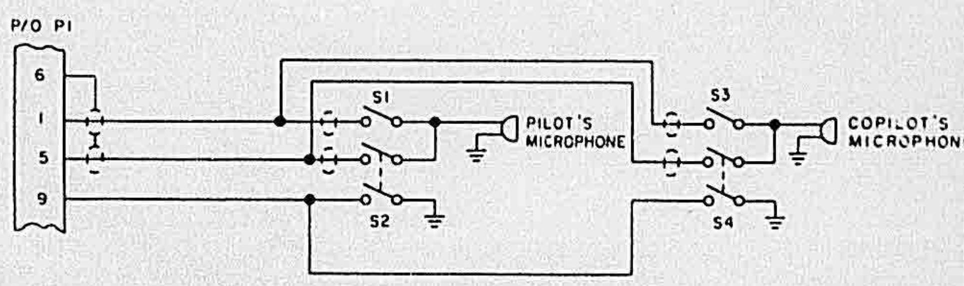
(1) AGC IS BROUGHT OUT TO P1-16 FOR TESTING PURPOSES ONLY

(2) THE PWC-150 POWER CONVERTER IS CONNECTED IN SERIES WITH THE P1-10 TO P1-11 JUMPER WHEN INSTALLED IN A 28 V SYSTEM



(3) WIRES CARRYING +13.75/+27.5 V DC INCLUDING POWER GROUND MUST BE 20 AWG OR LARGER, ALL OTHERS MUST BE 24 AWG OR LARGER.

(4) ICS WILL ALWAYS BE "HOT" IN CONFIGURATION SHOWN ABOVE, ALSO OFTEN NOISY DUE TO TWO LIVE MICROPHONES. IF SEPARATE ICS AND TRANSMIT BUTTONS ARE DESIRED, WIRE AS SHOWN BELOW.



S1 IS PILOT'S ICS BUTTON
S2 IS PILOT'S XMT BUTTON
S3 IS COPILOT'S ICS BUTTON
S4 IS COPILOT'S XMT BUTTON

Interconnect Wiring Diagram w/Intercom Figure 2-9

03

VHF-251/251S/251E Communications Transceiver

S-TEC Corporation
TEC LINE Avionics

operation

Printed in USA

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List of Effective Pages

*The asterisk indicates pages changed, added, or deleted by the current change

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3-1 thru 3-4	22 Jul 91

Record of Revisions

RETAIN THIS RECORD IN THE FRONT OF MANUAL.
ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL,
AND ENTER DATE INSERTED AND INITIALS.

REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	22 Jul 91		VHF-251 SB 1-3 VHF-251 SB 1-4; SIL 1-75, 1-76, 2-76 VHF-251 SB 1-4, 6,7, 9-12; SIL 1-75, 1-76, 2-76, 3-76, 4-76, 1-77, 2-77, 3-77 VHF-251S SB 1-5; SIL 1-76, 1-77, 2-77 VHF-251E SB 1-6; SIL 1-76, 11-77, 2-77 VHF-251 SB 13-16; VHF-251S SB 6-9; VHF-251 ( ) SIL 1-78, 2-80				

SECTION III
Operation

3.1 GENERAL

The purpose of this section is to acquaint you with the operation of the VHF-251/251S/251E Communications Transceiver. A description of the displays and control functions is presented. Figure 3-1 illustrates the controls and indicators discussed in this section. Table 3-1 briefly discusses the function of each listed item.

3.2 DISPLAYS AND CONTROLS

CAUTION

This equipment has been designed to exhibit a very high degree of functional integrity. Nevertheless, users must recognize that it is not practical to provide monitoring for all conceivable system failures and that, however unlikely, it is possible that erroneous operation could occur without a fault indication. The pilot has the responsibility to detect such an occurrence by means of cross-checks with redundant or correlated information available in the cockpit.

3.2.1 ON/OFF/VOL/TST Control

The ON/OFF/VOL/TST control performs three separate functions: unit on/off, volume control and squelch testing. When the control is in the fully counterclockwise position, no power is applied to the unit; turning the control clockwise applies power. In this state, information will be observed on the electronic display. Continued clockwise rotation increases the audio output level. To test squelch, simply pull the control out. In this position, noise which is normally squelched out will be heard in the aircraft audio system. To activate squelch, push the control in.

NOTE

Removal of transceiver primary power will erase the frequency stored in the memory circuitry. When power is reapplied, the memory will automatically store the frequency set on the frequency selector controls.

3.2.2 STORE/SELECT/RECALL Control

The VHF-251/251S/251E contains a single-channel frequency memory which is controlled by the STORE/SELECT/RECALL control. Storing a desired frequency in the memory is simply a matter of selecting the desired frequency in the SELECT position, then momentarily turning the control to the STORE position. This action causes the selected frequency to be stored in memory, replacing the previously stored frequency. When released, the control will automatically return to the SELECT position. At this time a second frequency may be selected and used by setting the frequency controls to the new frequency. Operation on the previously stored frequency is accomplished by turning the control to the RECALL POSITION. The unit may be switched between SELECT frequency and RECALL frequency as often as desired.

NOTE

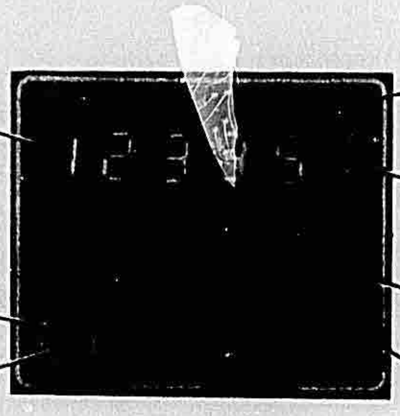
When operating in the RECALL position, always return the STORE/SELECT/RECALL control to the SELECT position before attempting to select a new frequency. If either the kHz or MHz controls are changed when in the RECALL position, the operating frequency will continue to be controlled by memory, and therefore will not change. Upon return to the SELECT position, the frequency previously in that position will no longer be present.

3.2.3 FREQUENCY SELECTOR CONTROLS

The two concentric knobs right of center are used to select communication frequencies. The smaller knob selects kHz frequencies; the larger selects MHz frequencies. There are no end stops, therefore frequencies may be selected by turning the knobs in either direction any number of times. Selection of frequencies is made when the STORE/SELECT/RECALL control is in the select position.

3.2.4 ELECTRONIC DISPLAY

The electronic display provides a 5-digit frequency display of the transceiver frequency. The displayed fre-



VHF-251/251S/251E Controls and Indicators Figure 3-1

Table 3-1 VHF-251/251-S/251-E Controls and Indicators

CONTROL OR INDICATOR	FUNCTION
On/off/volume/squelch test	Controls the application of power to the unit, varies the audio gain, and tests squelch circuitry.
STORE/SELECT/RECALL control	Controls preset capability that permits the instant choice of either of two frequencies.
kHz frequency control	Changes the frequency of operation in 25-kHz steps (or 50-kHz steps in the VHF-251S).
MHz frequency control	Changes the frequency of operation in 1-MHz steps.
Electronic display	Provides a digital readout of the operating frequency.
Ambient light sensor	Controls brightness of electronic display by monitoring the ambient light level in the cockpit.
Transmit indicator	The transmit indicator monitors transmitter rf output.

quency will always be the frequency to which the transceiver is tuned, regardless of the position of the STORE/SELECT/RECALL control.

3.2.5 TRANSMIT INDICATOR

The transmit (XMIT) indicator monitors the rf output during transmission. The intensity of the light varies with the transmitter audio to provide a modulation monitor. The transmit indicator is actuated by a circuit which detects actual rf output voltage from the transmitter.

3.2.6 AMBIENT LIGHT SENSOR

A photocell monitoring the cockpit ambient light level automatically adjust the display brightness to an optimum level. A front panel screwdriver adjustment that controls the amount of dimming may be used to match the VHF-251/251S/251E panel lighting to other instrumentation lighting

3.3 OPERATING PROCEDURES

WARNING

The potential exists for a significant reduction in, or the complete cancellation of, the received audio output signal of two VHF communications transceivers (regardless of manufacturer) in the same aircraft if all of the following conditions exist:

a. Two transceivers are tuned to ground stations that simultaneously transmit the same message.

NOTE

Ordinarily this occurs when both transceivers are tuned to the same frequency. However, it can also occur when more than one ground station transmitter is used to transmit a single voice message.

b. Audio outputs are adjusted to approximately the same level.

c. The audio output phase shifts of the two communications systems (including the audio panel) are approximately 180 degrees apart.

If the phase shift through both transceivers is the same (in phase) and the audio panel does not introduce phase differentials, no attenuation or cancellation of the received signal will occur.

All users of VHF communications transceivers should be aware of this potential situation and take the following precautions to prevent this problem from occurring:

a. Avoid simultaneous tuning of two transceivers to the same frequency or two frequencies that carry the same voice message.

b. Test the transceiver and audio panel as described in the following procedures to determine whether or not the problem of incompatible phasing exists.

After installation of the equipment in the aircraft, perform a system check to ensure cancellation or attenuation is not a problem.

a. Tune both transceivers to the same frequency (in the aircraft with three transceivers each combination of two units must be tested).

b. Set the audio panel so that both transceiver outputs are heard through the same speaker or headset.

c. Set one transceiver volume control to its midpoint (approximately).

d. Slowly adjust the other transceiver volume control through its midpoint position and listen for a reduction in the level of the combined audio output.

If the transceiver phase shifts are incompatible, the audio signal will be completely canceled or appreciably reduced as the audio output level of the two transceivers approach equality. If the transceiver phase shifts are compatible, the audio output will be at least as loud as that of a single unit. The preceding test should be performed after any change of VHF communications transceiver or audio equipment.

If the attenuation/cancellation problem is detected in an installation consisting solely of TEC LINE equipment, remove each transceiver and check the wiring of transformers A1T1 and A1T2. This problem indicates that a serious error in wiring has been made on one of these two components.

A quick check that ensures proper wiring is to compare the transceiver audio output (headphone or speaker) with the rf envelope. If the transceiver is operating properly, the audio output will be in phase with the positive portion of the rf envelope; if this relationship does not exist, a wiring problem is present.

Normally this problem is extremely rare in a pure TEC LINE system, however extra attention should be given in a mixed system checkout. Keep in mind that any equipment interfacing with the transceiver (audio panel, line buffers, another VHF comm transceiver, or auxiliary amplifiers) may influence the audio output phase and contribute to attenuation/cancellation.

The VHF-251/251S/251E is designed to provide maximum ease of operation. all operating controls and displays are designed for maximum visibility and control with minimum effort.

The VHF-251/251S/251E provides the pilot with 2-way communications in the VHF range of 118.000 to 135.975 MHz (118.00 through 135.95 MHz in VHF-251S). The 25 kHz channel spacing feature (50 kHz in VHF-251S) allows operation on 720 (360 in VHF-251S) different frequencies. The frequency-readout display of the VHF-251/251E Communications Transceiver is five digits. The sixth digit, which is always a 0 or a 5, is redundant information not displayed on the frequency readout.

To apply power to the VHF-251/251S/251E Communications Transceiver, turn the ON/OFF/VOL/TST control clockwise. Set the unit to the desired frequency using the frequency selector controls. Pull the TST control out and adjust the volume. Return the TST control to operation position after volume is adjusted.

The VHF-251/251S/251E contains a single-channel frequency storage or memory capability. To store a frequency in the memory, the pilot selects the desired frequency with the STORE/SELECT/RECALL control in the SELECT position, then momentarily turns the control to the STORE position. When released, the control will return to the SELECT position. After storage of one frequency, another may be selected. The stored frequency or the second selected frequency may be recalled any number of times by selecting the RECALL or SELECT positions. This feature allows the pilot to switch between two selected frequencies without changing the frequency select controls.

The squelch circuitry contained in the VHF-251/251S/251E is an automatic signal-to-noise system. Squelch circuitry eliminates noise which exists during a no-signal condition. Signals above the preset minimum cause the squelch to open, which allows the normal audio to be heard. Overriding the squelch is accomplished by pulling out the ON/OFF/VOL/TST knob. This action disables squelch, allowing noise to be heard in the audio system, which provides a rough check of receiver operation and a noise signal to use in making a preliminary volume control setting before an intelligible signal is heard.

The transmitter is keyed when the pilot pushes the PTT button on the microphone. Detected transmitter rf controls the XMIT indicator switching circuit; therefore the XMIT indicator is a true indicator of transmitter output. Modulated DC is used as the indicator source, which causes flickering on modulation peaks and provides a modulation check. Absence of the XMIT light on some frequencies indicates a defective antenna or coaxial cable. Complete absence of the XMIT light on all frequencies indicates that no power is being delivered to the antenna.

The VHF-251/251S/251E contains sidetone audio circuitry that is used for monitoring voice transmissions. Sidetone is an audio output that corresponds with the voice transmission. This allows the pilot to use sidetone as a check of the transmission modulation relative to its level and clarity when using earphones.

04

VHF-251/251S/251E Communications Transceiver

S-TEC Corporation
TEC LINE Avionics

theory

Printed in USA

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SECTION IV
Theory

4.1 GENERAL

The theory of operation is divided into two main sections, a functional block diagram discussion and a detailed theory discussion, supplemented with simplified schematics and detailed block diagrams. This section supplies all the information required for a thorough understanding of circuit operation with emphasis placed on new and unique circuits used throughout the transceiver.

4.2 FUNCTIONAL THEORY OF OPERATION (Refer to Figure 4-1)

4.2.1 Comm Control Head

The comm control head consists of all the transceiver front panel controls including power on/off, squelch test, frequency mode control, and frequency selection controls.

The frequency selection controls consist of three wafer switches mechanically coupled to a pair of concentric control knobs located on the transceiver front panel. A binary coded decimal (bcd) format is generated by these switches and applied to preselect board A7 where the raw bcd is stored or displayed as a function of store/select/recall switch S4. If the recall position is selected, either the frequency previously stored or the frequency present at the switches when unit power is applied will be displayed. In the select position, the frequency that is physically present on the frequency selection controls will be displayed.

The bcd output of the preselect board is used to channel the synthesizer as well as to provide frequency information to the decoding circuitry and lamp drivers contained on readout board A8.

4.2.2 Frequency Synthesizer

The synthesizer is a single-loop digital frequency synthesizer which phase locks a voltage controlled oscillator (vco) operating over the range of 118.000 to 146.475 MHz (118.00 to 146.45 MHz in the VHF-251S) to a single 4.0-MHz crystal oscillator that determines the overall frequency stability of the synthesizer. The synthesizer provides a 128.500- to 146.475-MHz injection signal (128.50 to 146.45 MHz in VHF-251S) to the receiver mixer section and a 118.000- to 135.975-MHz drive (118.00 to 135.95 MHz in the VHF-251S) to the transmitter rf circuitry in 25-kHz increments (50-kHz increments in the VHF-251S). Separate rf outputs are provided for transmit and receive. The vco tuning voltage within the synthesizer is also used to tune the receiver rf tank circuit varactors after decoupling and filtering of that voltage.

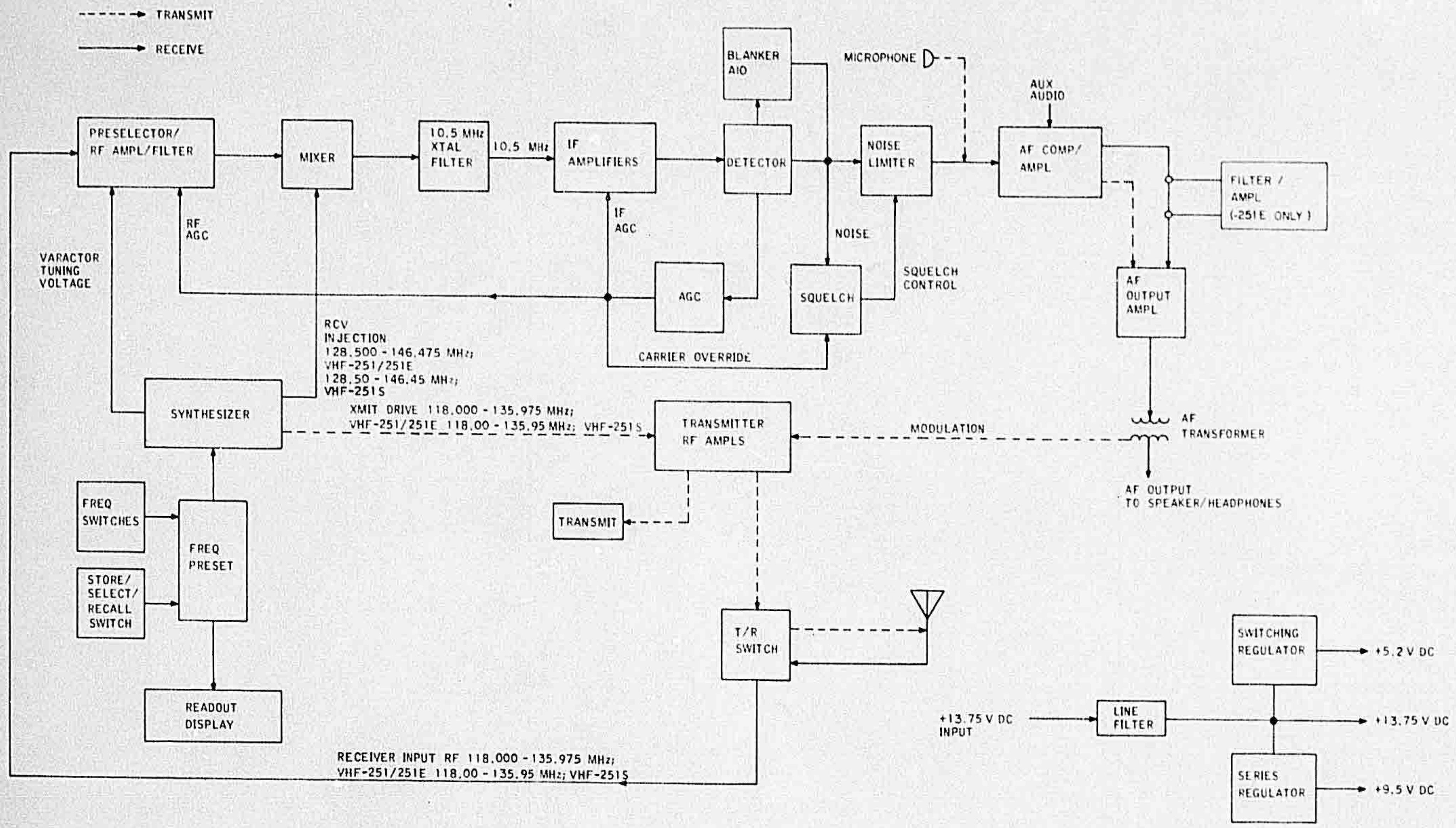
4.2.3 Comm Receiver

The comm receiver is a single-conversion superheterodyne type with an if frequency of 10.5-MHz. Rf selectivity is determined by a pair of 2-pole varactor tuned filters to provide the required image and if rejection. The rf amplifier and mixer are dual-gate MOSFET's that provide excellent front end linearity and noise figure. Primary selectivity is determined by a 10.5-MHz crystal filter.

Both the VHF-251 and VHF-251E utilize 25-kHz channel spacing for use in the present 50-kHz and future 25-kHz environment. The VHF-251E differs from the VHF-251 in that it contains an active audio filter that reduces the level of heterodyne whistles associated with offset carriers used in European countries.

The VHF-251S contains 50-kHz channel spacing an is designed for operation in South America and other countries where the frequency tolerances associated with 50-kHz channel spacing are found.

Following the crystal filter are two stages of if amplification with AGC applied to each stage. The squelch is an automatic signal-to-noise system using detected noise from a resonant circuit tuned to 9-kHz to operate the squelch gate. Carrier level is used to override the noise squelch in the event unusual modulation or noise conditions occur. In addition to both carrier and noise squelch circuits, a noise blanker is included for improved squelch operation in the presence of high-amplitude noise such as that generated by some ignition systems. A noise limiter with a 90-percent modulation clipping level provides suppression of pulse type interference. An audio compressor, common to both receive and transmit modes, provides speech processing.



VHF-251/251S/251E Communications Transceiver,
Basic Block Diagram
Figure 4-1

4.2.4 Power Amplifier

The power amplifier uses the 118.000 to 135.975 MHz output of the frequency synthesizer (118.00 to 135.95 MHz in VHF-251S) to drive a four-stage rf section. Nominal carrier output of the power amplifier is 10 watts into 50-ohm load. The output of the power amplifier is fed through a five-pole low-pass filter to provide harmonic rejection in excess of 60 dB. Modulation is applied to the driver and power amplifier. Positive modulation peaks are applied to the driver stage to improve the upward modulation characteristics of the transmitter. Downward modulation is limited to 90 percent by a diode-resistor network which guarantees that splatter due to overmodulation in the negative direction cannot occur.

The antenna transmit-receive (tr) switch is a single diode which disconnects the receiver when a transmission occurs.

4.2.5 Electronic Display

The VHF-251/251S/251E electronic display contains five 7-segment incandescent filament-type units. Automatic dimming of the display is accomplished by an internal photocell dimming circuit that senses cockpit ambient light. A screwdriver adjustment, accessible through the front panel, is provided for matching the dimmest level with other instrumentation and lighting.

WARNING

Dimming circuit setup must e done at night or in a completely dark hangar to avoid control settings that may cause the display to go completely dark at night.

4.2.6 Power Distribution

Two power supplies are used in the VHF-251/251S/251E. The main supply is a series regulator that is supplied with +13.75 VDC input power. A +9.5 VDC regulated output is produced; this regulated and filtered outpt is used in all low-level signal circuitry and in voltage-sensitive circuits contained in the synthesizer.

A +5.2 volt switching regulator supplies power to the electronic display, the display logic circuits, and the frequency synthesizer.

4.3 DETAILED THEORY OF OPERATION

The following discussion of the detailed theory of operation is supplemented with simplified schematics, and detailed block diagrams are correlated to the overall block diagram, figure 4-2, by component reference designators and by reference to the designator of the circuit card assembly.

4.3.1 Comm Control (Refer to figures 4-3 and 6-5)

The comm control consists of a megahertz frequency select switch, kilohertz frequency select switch, unit on/off switch, volume control, squelch test switch and a mode select switch (STORE/SELECT/RECALL).

4.3.1.1 Frequency Selection and Squelch Test Control

Frequency selection switches are a rotary wafer type that supply a bcd format to the preselect board to drive the electronic display and is indirectly supplied to the synthesizer variable ratio divider for processing. Table 4-1 provides the control logic in bcd format that is generated by the frequency select switches for use by the synthesizer.

Table 4-1 Control Head Binary Code Format

FREQUENCY	BINARY CODE			
	8	4	2	1
	10 MHz			
11X.XXX	X	X	0	1
12X.XXX	X	X	1	0
13X.XXX	X	X	1	1
	1 MHz			
1.XXX	0	0	0	1
2.XXX	0	0	1	0
3.XXX	0	0	1	1
4.XXX	0	1	0	0
5.XXX	0	1	0	1
6.XXX	0	1	1	0
7.XXX	0	1	1	1
8.XXX	1	0	0	0
9.XXX	1	0	0	1
0.XXX	0	0	0	0
	0.1 MHz			
.0XX	0	0	0	0
.1XX	0	0	0	1
.2XX	0	0	1	0
.3XX	0	0	1	1
.4XX	0	1	0	0
.5XX	0	1	0	1
.6XX	0	1	1	0
.7XX	0	1	1	1
.8XX	1	0	0	0
.9XX	1	0	0	1
	25 kHz			
.X00	X	X	0	0
*.X25	X	X	0	1
.X50	X	X	1	0
*.X75	X	X	1	1

*Not used in VHF-251S.

The OFF/VOL/TST control functions are combined in a single switch that controls audio gain, application of unit power and a self-test for receiver operation. Pulling the control outward disables the automatic squelch circuit, allowing passage of noise into the audio system; pushing the TST knob in enables the squelch, resulting in suppression of noise.

4.3.1.2 Preselect Operation

The 4-bit bistable latches (A7U1, A7U2 and A7U3) are used for storage of the binary information supplied to them. STORE/SELECT/RECALL switch A5S4 controls the operating state of transistors A7Q1, A7Q3 and A7Q4 which, in turn, apply the enable logic to the latches. When the SELECT position is selected, transistors A7Q3 and A7Q1 will conduct, placing the enable line (pins 13 and 4 of A7U1 and A7U3) low. Selection of the STORE position removes the bias voltage applied to transistors A7Q3 and A7Q1 causing the enable line to go high. Information present at the input terminals is transferred to the output terminals when the enable line is high. The output information will continue to follow the input as long as the latch enable line remains high (STORE position selected). When the enable line goes low (SELECT position selected), Information that is present at the input when the high-to-low transition occurred is retained within the latch.

The 2-line-to-1-line data selectors (U4, U5 and U6) are also controlled by STORE/SELECT/RECALL switch S4. Switch S4 controls the logic level applied to the select (S) input terminal of 2-line-to-1-line data selectors. When the S-input terminals are high (switch S4 in SELECT position), information present at the B-input terminals will transfer to their respective Q-output terminals. When the S-input terminals are low (switch S4 in RECALL or STORE position), the information present at the A-input terminals will be transferred to their respective Q-output terminals.

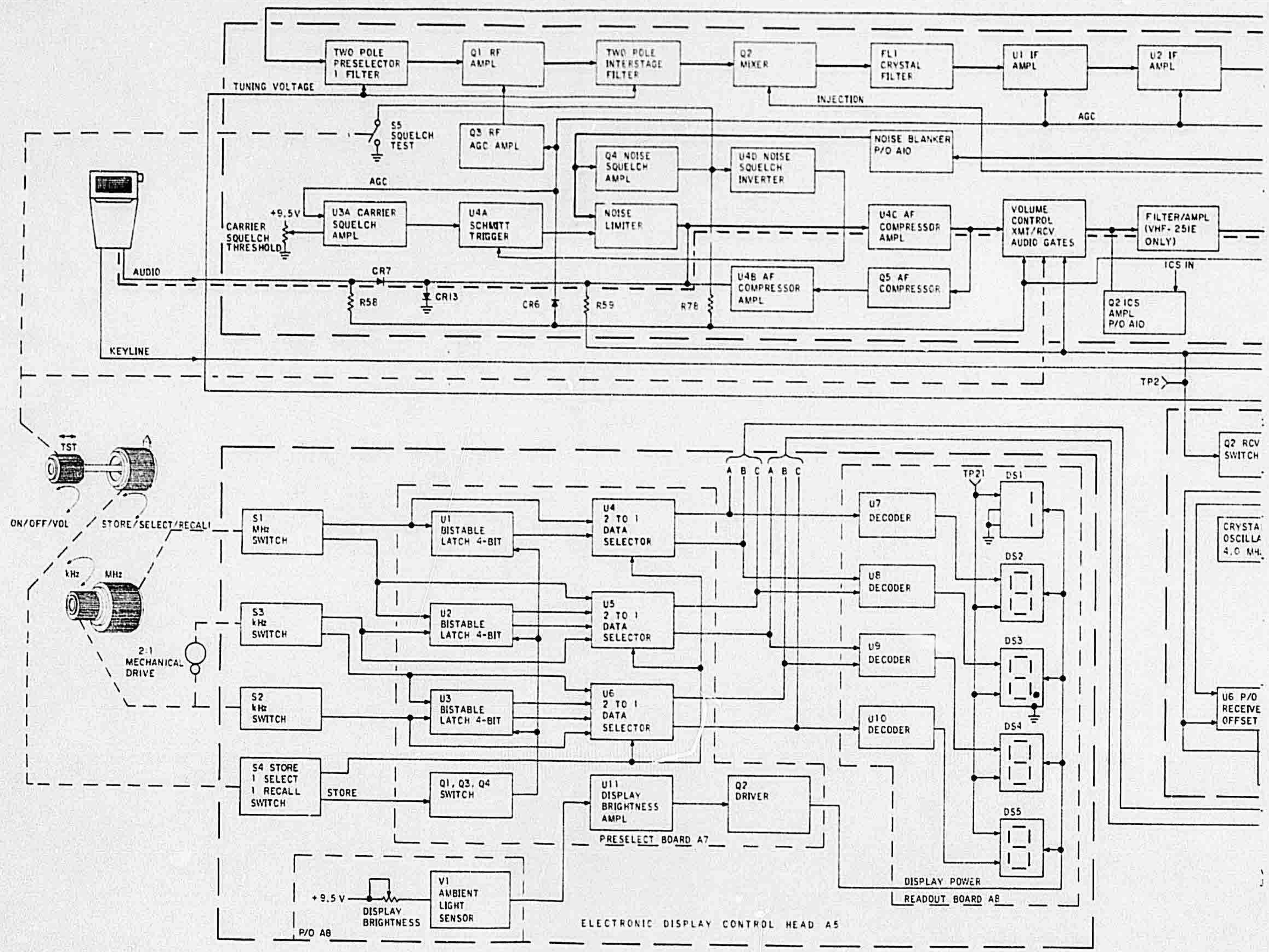
To summarize the operation of the preset board: Two independent sets of information (control logic) are present at the inputs of the 2-line-to-1-line data selectors. One control logic set is supplied directly by the frequency selection controls, the other by the output of the 4-bit bistable latches. The information to be displayed and applied to the synthesizer is controlled by the position of the STORE/SELECT/RECALL switch. At the time of storage of a selected frequency (enable input switched from high to low), the same sets of information will be present at both inputs (A and B) of the 2-line-to-1-line data selectors.

The outputs of the 2-line-to-1-line data selectors are applied to the synthesizer for channeling and to the bcd-to-7-segment decoders, U7 through U10.

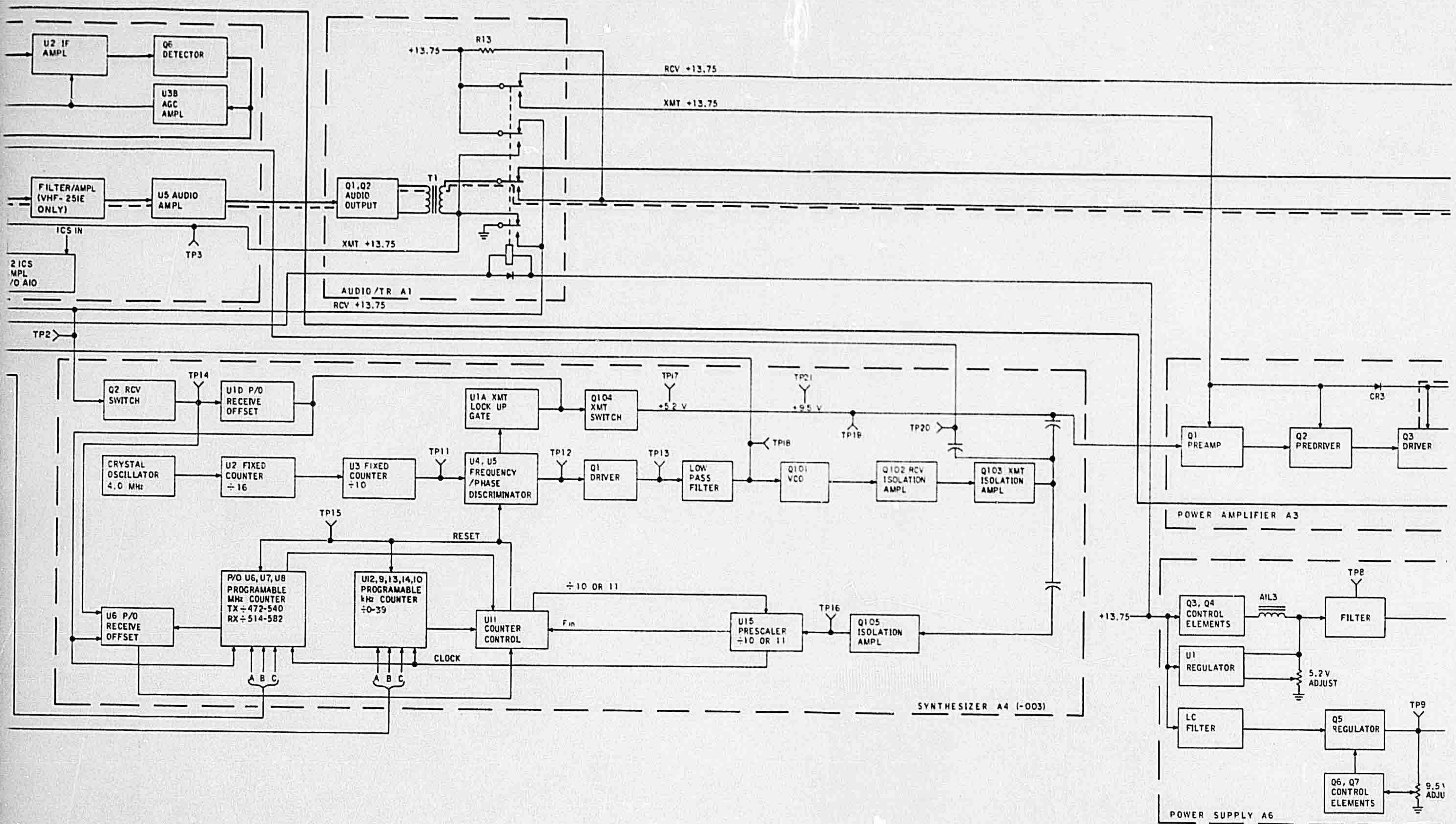
The bcd-to-7-segment decoder/drivers provide direct-drive, active low outputs to the incandescent lamps for display of frequency information. Table 4-2 lists the bcd control logic and resultant outputs of decoder/drivers U7 through U10.

4-2. Decoder/Driver Function Table

NUMBER	INPUTS				OUTPUTS						
	7	1	2	6	13	12	11	10	9	15	14
	IA	IB	IC	ID	A	B	C	D	E	F	G
1	1	0	0	0	OFF	ON	ON	OFF	OFF	OFF	OFF
2	0	1	0	0	ON	ON	OFF	ON	ON	OFF	ON
3	1	1	0	0	ON	ON	ON	ON	OFF	OFF	ON
4	0	0	1	0	OFF	ON	ON	OFF	OFF	ON	ON
5	1	0	1	0	ON	OFF	ON	ON	OFF	ON	ON
6	0	1	1	0	OFF	OFF	ON	ON	ON	ON	ON
7	1	1	1	0	ON	ON	ON	OFF	OFF	OFF	OFF
8	0	0	0	1	ON	ON	ON	ON	ON	ON	ON
9	1	0	0	1	ON	ON	ON	OFF	OFF	ON	ON
0	0	0	0	0	ON	ON	ON	ON	ON	ON	OFF


TWO POLE PRESELECTOR FILTER
Q1 RF AMPL
TWO POLE INTERSTAGE FILTER
Q2 MIXER
FL1 CRYSTAL FILTER
U1 IF AMPL
U2 IF AMPL
TUNING VOLTAGE
INJECTION
AGC
S5 SQUELCH TEST
Q3 RF AGC AMPL
Q4 NOISE SQUELCH AMPL
U4D NOISE SQUELCH INVERTER
NOISE BLANKER P/O A10
AGC
+9.5V
CARRIER SQUELCH THRESHOLD
U3A CARRIER SQUELCH AMPL
U4A SCHMITT TRIGGER
NOISE LIMITER
U4C AF COMPRESSOR AMPL
VOLUME CONTROL XMT/RCV AUDIO GATES
FILTER/AMPL (VHF-251E ONLY)
ICS IN
AUDIO
CR7
CR13
R58
CR6
R59
R78
U4B AF COMPRESSOR AMPL
Q5 AF COMPRESSOR
Q2 ICS AMPL P/O A10
KEYLINE
TP2
TST
ON/OFF/VOL
STORE/SELECT/RECALL
kHz
MHz
2:1 MECHANICAL DRIVE
S1 MHz SWITCH
S3 kHz SWITCH
S2 kHz SWITCH
S4 STORE / SELECT / RECALL SWITCH
STORE
U1 BISTABLE LATCH 4-BIT
U2 BISTABLE LATCH 4-BIT
U3 BISTABLE LATCH 4-BIT
Q1, Q3, Q4 SWITCH
U4 2 TO 1 DATA SELECTOR
U5 2 TO 1 DATA SELECTOR
U6 2 TO 1 DATA SELECTOR
U11 DISPLAY BRIGHTNESS AMPL
Q2 DRIVER
PRESELECT BOARD A7
A B C A B C
U7 DECODER
U8 DECODER
U9 DECODER
U10 DECODER
TP21
DS1
DS2
DS3
DS4
DS5
DISPLAY POWER
READOUT BOARD A8
+9.5 V
DISPLAY BRIGHTNESS
V1 AMBIENT LIGHT SENSOR
P/O A8
ELECTRONIC DISPLAY CONTROL HEAD A5
Q2 RCV SWITCH
CRYSTAL OSCILLA 4.0 MH
U6 P/O RECEIVE OFFSET

page 4-5/4-6


U2 IF AMPL
Q6 DETECTOR
U3B AGC AMPL
FILTER/AMPL (VHF-251E ONLY)
U5 AUDIO AMPL
ICS IN
TP3
2 ICS
MPL
/O A10
Q1, Q2 AUDIO OUTPUT
T1
R13
+13.75
RCV +13.75
XMT +13.75
XMT +13.75
AUDIO/TR A1
RCV +13.75
TP2
Q2 RCV SWITCH
TP14
U1D P/O RECEIVE OFFSET
U1A XMT LOCK UP GATE
Q104 XMT SWITCH
TP17
+5.2 V
TP21
+9.5 V
TP18
TP19
TP20
CRYSTAL OSCILLATOR 4.0 MHz
U2 FIXED COUNTER ÷16
U3 FIXED COUNTER ÷10
TP11
U4, U5 FREQUENCY /PHASE DISCRIMINATOR
TP12
Q1 DRIVER
TP13
LOW PASS FILTER
Q101 VCO
Q102 RCV ISOLATION AMPL
Q103 XMT ISOLATION AMPL
TP15
RESET
P/O U6, U7, U8 PROGRAMABLE MHz COUNTER TX÷472-540 RX÷514-582
U12,9,13,14,10 PROGRAMABLE kHz COUNTER ÷0-39
U6 P/O RECEIVE OFFSET
U11 COUNTER CONTROL
÷10 OR 11
Fin
U15 PRESCALER ÷10 OR 11
TP16
Q105 ISOLATION AMPL
CLOCK
A B C
A B C
SYNTHESIZER A4 (-003)
Q1 PREAMP
Q2 PREDRIVER
CR3
Q3 DRIVER
POWER AMPLIFIER A3
+13.75
Q3, Q4 CONTROL ELEMENTS
A1L3
TP8
FILTER
U1 REGULATOR
5.2V ADJUST
LC FILTER
Q5 REGULATOR
TP9
Q6, Q7 CONTROL ELEMENTS
9.5V ADJU
POWER SUPPLY A6

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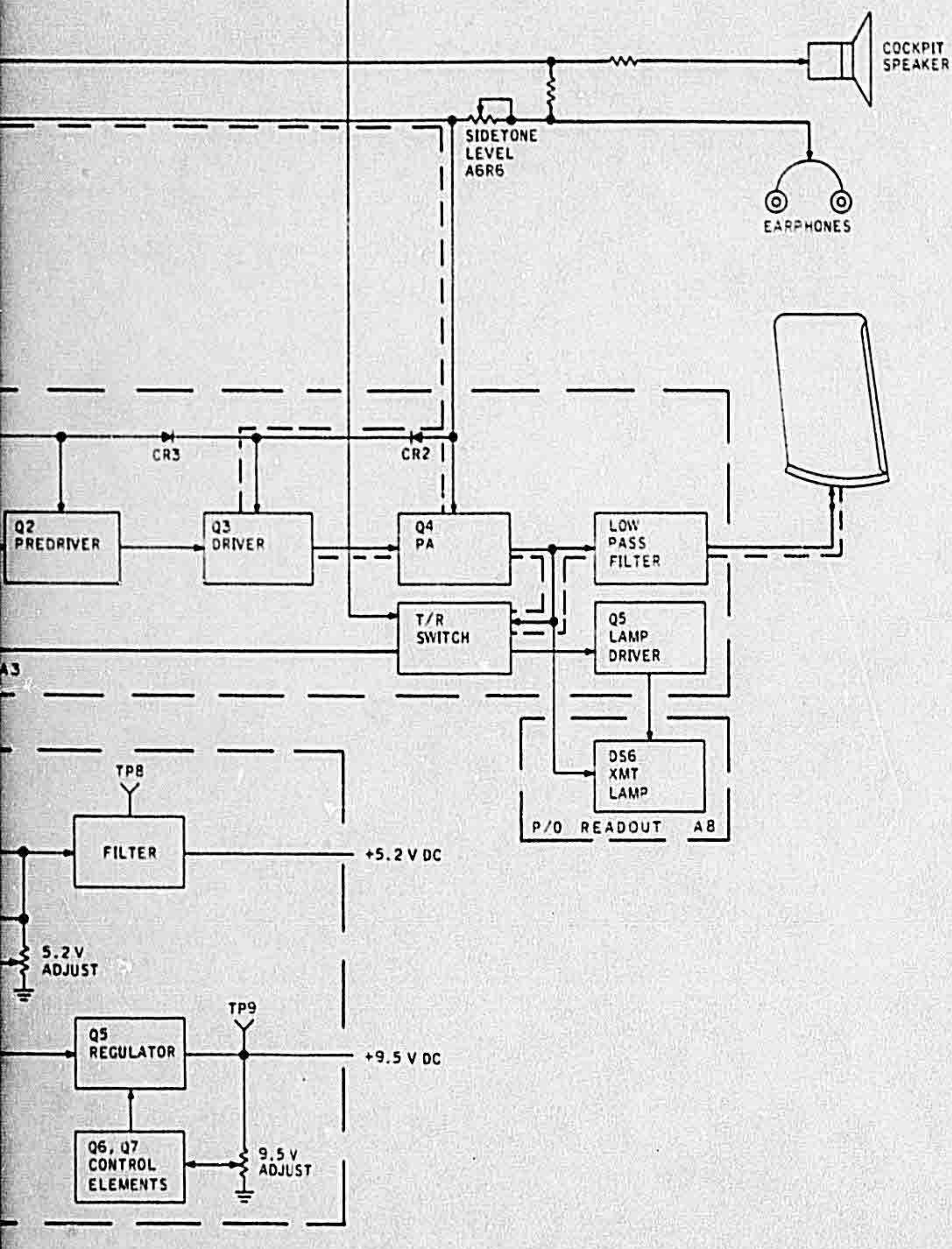
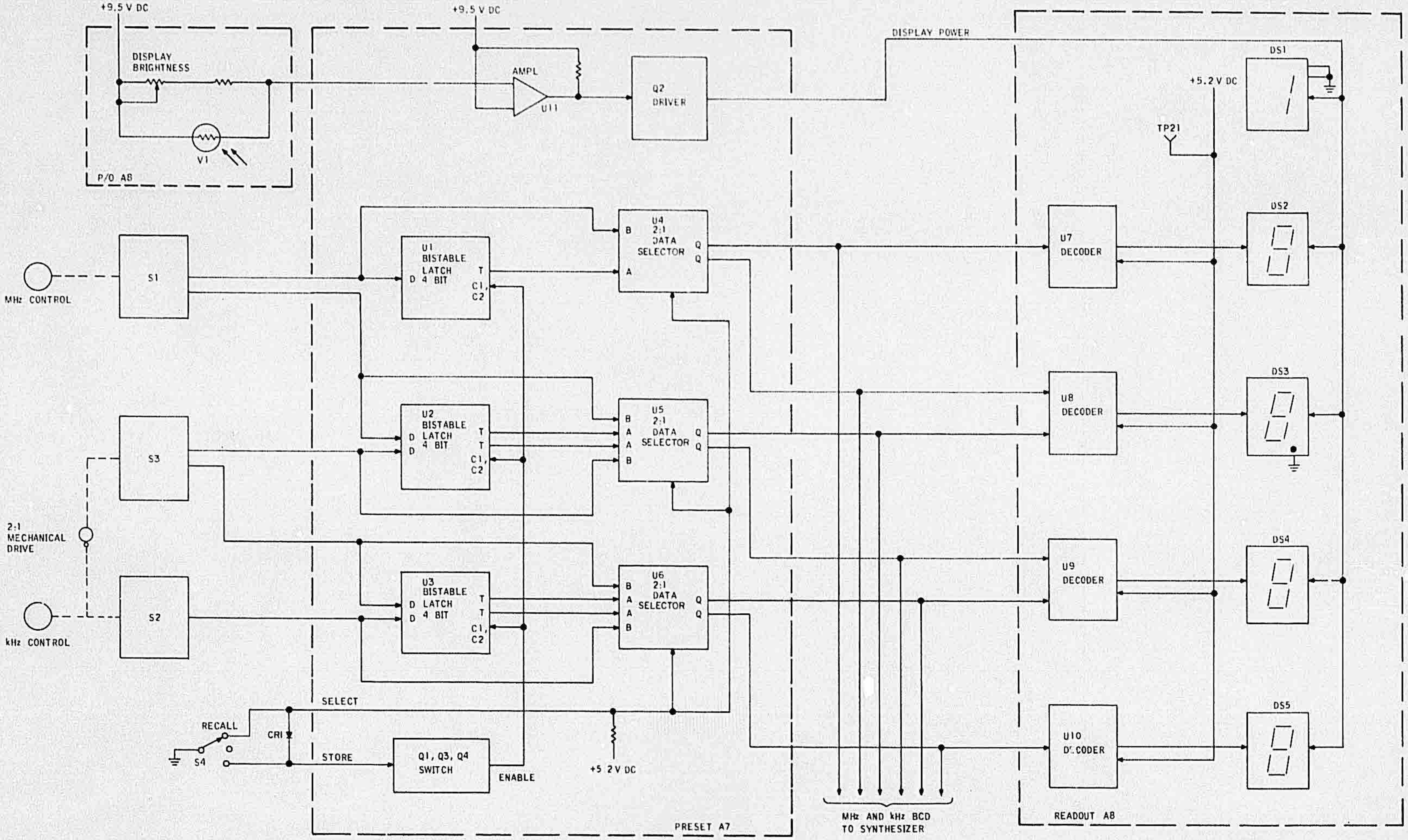


VHF-251/251S/251E Communications Transceiver, Detailed Block Diagram
Figure 4-2



Comm Control Head, Functional Block Diagram
Figure 4-3

4.3.2 Frequency Synthesizer

The frequency synthesizer supplies excitation for the transmitter and local oscillator injection for the receiver mixer. the synthesizer output covers the frequency range of 118.00 to 146.475 MHz in 25-kHz increments in the VHF-251/251E and 118.00 to 146.45 MHz in 50-kHz increments in the VHF-251S. These frequencies provide the proper excitation and injection frequencies for transceiver operation from 118.000 to 135.975 MHz in the VHF-251/251E and from 118.00 to 135.95 MHz in the VHF-251S. The synthesizer output frequency is selected by parallel 8-4-2-1 bcd information taken from the output of data selectors contained on preselect board A7. Frequency stability is determined by a single crystal-controlled oscillator operating at 4.0 MHz.

Synthesizer circuitry in the VHF-251, VHF-251S, and VHF-251E is identical even though the VHF-251S contains 50-kHz channel spacing as opposed to 25-kHz spacing in the VHF-251 and VHF-251E. The 50-kHz spacing in the VHF-251S is achieved by modifying the switching sequence of the 20-position rotary switch assembly. This modification alters the bcd format applied to the variable ratio divider, resulting in the desired channel spacing. Since the basic synthesizer operation is the same for all units, the VHF-251 and VHF-251E utilization of 25-kHz channel spacing will be discussed in the following paragraphs.

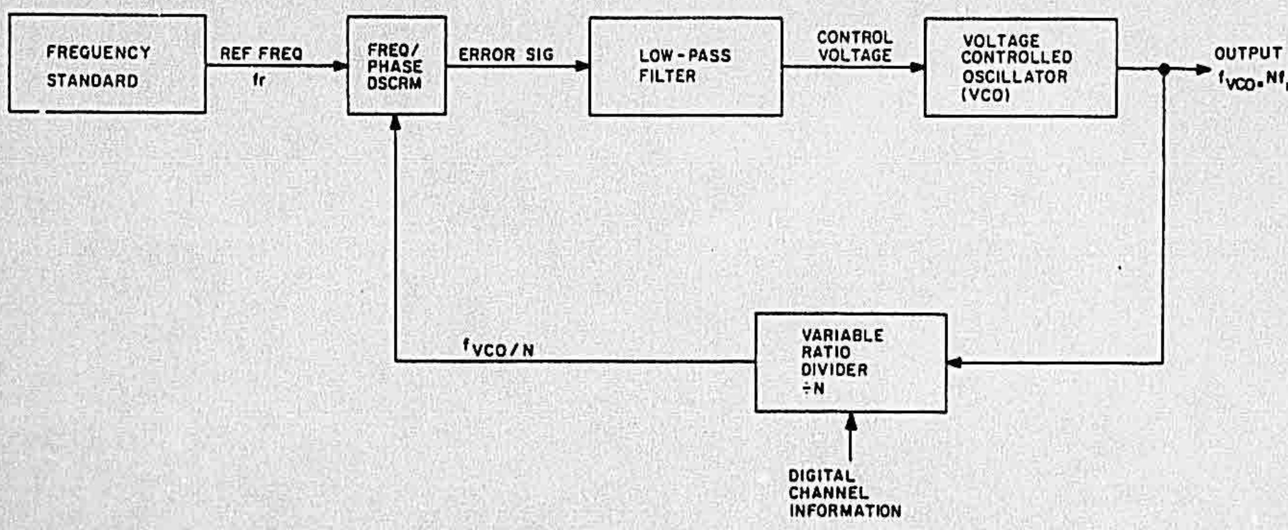
4.3.2.1 Phase-Locked Loop Fundamentals (Refer to Figure 4-4)

Basically, a digitally stabilized master oscillator loop consists of a voltage controlled oscillator, a variable ratio digital divider, a frequency reference operation at the desired frequency spacing, a phase detector, and a low-pass filter. The vco signal is applied to the variable ratio divider where the frequency is divided by the ratio, N. the divider output is one pulse for every N cycles at the input. The divider output is applied to the digital phase detector where it is compared with the reference frequency, f_r. The phase detector error signal is low-pass filtered to control the vco frequency. The low-pass filter provides high attenuation to harmonics of f_r while allowing the low-frequency correction components to hold the vco on the desired frequency. Thus, the frequency of the vco when phase locked always will be equal to Nf_r. Therefore, since the dividing ratio, N, is variable in integral steps, the vco frequency is variable in integral multiples of f_r.

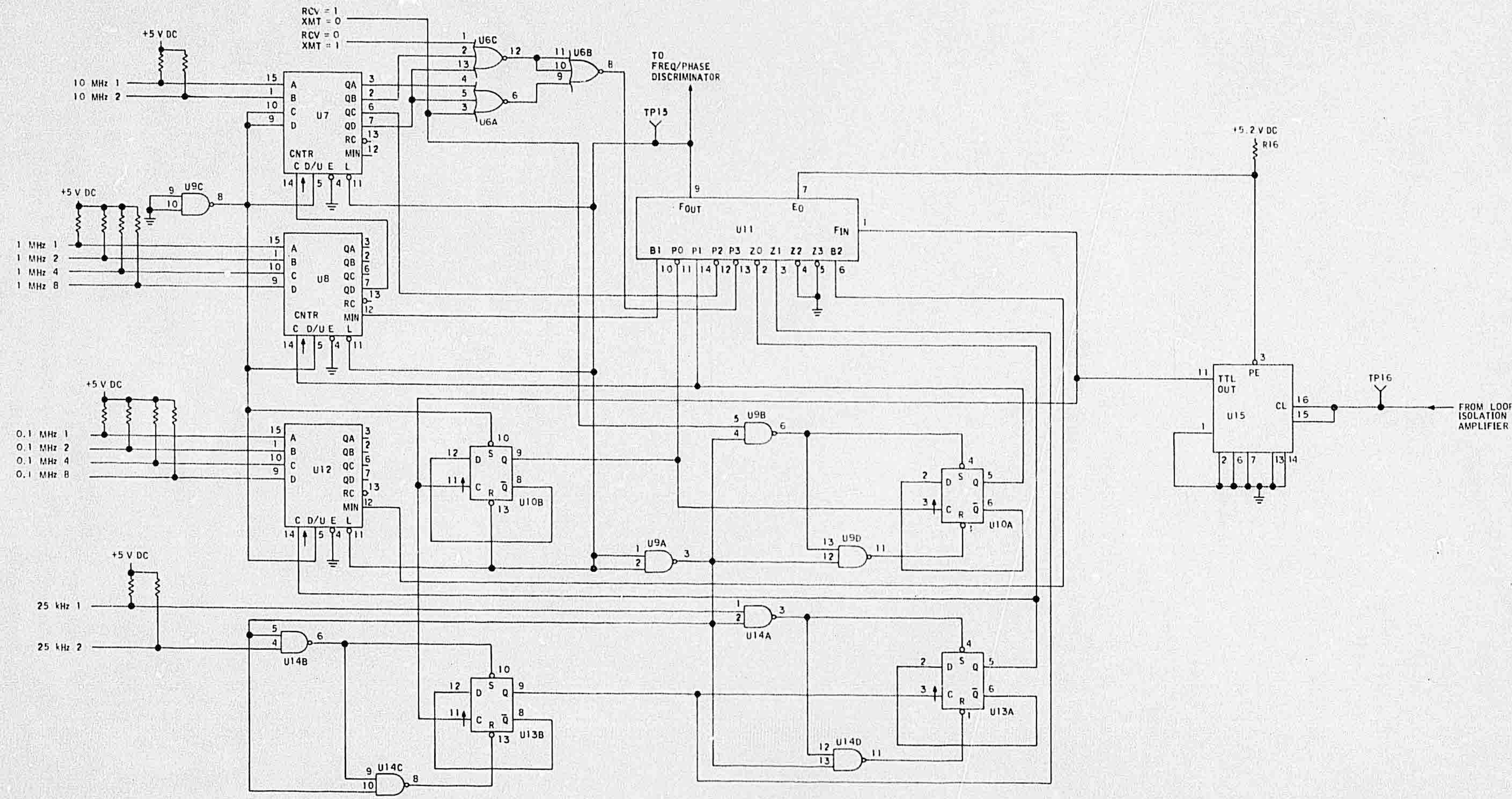
4.3.2.2 Variable Ratio Divider (Refer to Figure 4.5)

Although Figure 4.5 illustrates the variable ratio divider contained on the 628-5030-003 board, operation is nearly identical to the divider used on earlier radios. The primary difference between these two dividers is prescaler U15. In the current synthesizer, device improvements allow direct input to the counter control and clocking of the programmable dividers. Prior to this, additional buffers were required to convert the prescaler output levels to TTL input levels.

New VHF-251( ) synthesizers use low-power Schottky TTL devices. These "LS" devices are chosen to provide fast switching and to minimize power dissipation. Do not replace "LS" packages with standard 74XXX IC's or with standard Schottky TTL (74SXXX).



Digitally Stabilized Loop Master Oscillator, Block Diagram Figure 4-4



Variable Ratio Divider, Simplified Schematic
Figure 4-5

A portion of the vco signal is applied to isolation amplifier Q105. The isolation amplifier provides the clock signal that is applied to the variable ratio divider, where it is divided down to approximately 25-kHz for comparison with the 25-kHz reference frequency. The variable ratio divider, therefore, must have a division ratio that varies from 4720 to 5859 to accommodate the 1139 25-kHz segments of the 118.000 to 146.475 MHz output signal.

The variable ratio divider, or feedback counter, is digital in form and is controlled directly by parallel 8-4-2-1 bcd information supplied by the comm control.

4.3.2.2.1 Megahertz Tuning

The logic present at the counter control U11 F_{out} terminal is determined by the state of the programmable megahertz counter. Bcd supplied to the megahertz counter as a function of the selected frequency determines the initial state of the counter. The programmable counter performs any number of counts from 472 to 582.

The megahertz counter, once programmed, will begin counting down toward a predetermined terminal state that is detected by the zero state detection circuitry of counter control U11. Terminal state recognition results in a negative-going pulse at the counter control F_{out} pin. Therefore, the signal at F_{out} will be a chain of negative-going pulses with a frequency equal to the clock frequency divided by the count ratio programmed into the megahertz counter. The signal at F_{out} is the loop feedback frequency which will be 25-kHz when the loop is phase locked.

the programmable megahertz counter is reset by the negative pulse appearing at the counter control F_{out} terminal.

4.3.2.2.2 Kilohertz Tuning

The programmable kilohertz counter, counter control U11 zero detection circuitry, and prescaler U15 are required to control the kilohertz portion of the vco frequency. The programmable kilohertz counter processes any number of counts from 0 through 39 as determined by the bcd input from the comm control.

Prescaler U15 will divide by either 10 or 11 as dictated by counter control U11 modulus enable output at E_0. The state of the enable output is determined by the state of the kilohertz counter. The initial state of kilohertz counter is controlled by the selected frequency. Counter state will by decreased by one for each clock pulse received from prescaler U15.

As the kilohertz counter continues counting down, a terminal state will be reached which is recognized by zero detection circuitry contained within counter control U11. Prior to terminal state recognition, the E_0 output of counter control U11 will be low (logic 0), which programs the prescaler for division by 11. When the terminal state is reached, the E_0 output goes high (logic 1) and the prescaler will divide by 10. The programmable kilohertz counter will continue to count through the terminal state; however, the modulus enable output detects only the first terminal state encountered. The prescaler therefore divides by 11 for that number of clock pulses as determined by the initial state of the kilohertz counter, then divides by 10 until a negative pulse from U11 F_{out} resets the counter, sets the modulus enable line low, and starts the cycle over again.

For each 11 count in the prescaler, the overall divider ratio is increased by one, which increased the vco frequency by 25-kHz. In this manner, the forty 25-kHz increments within each megahertz are selected.

The prescaler output frequency, which is an integer multiple of 25-kHz, synchronizes the timing of the megahertz and kilohertz programmable counters and the counter control.

4.3.2.3 Transmit/Receive Division Ratios

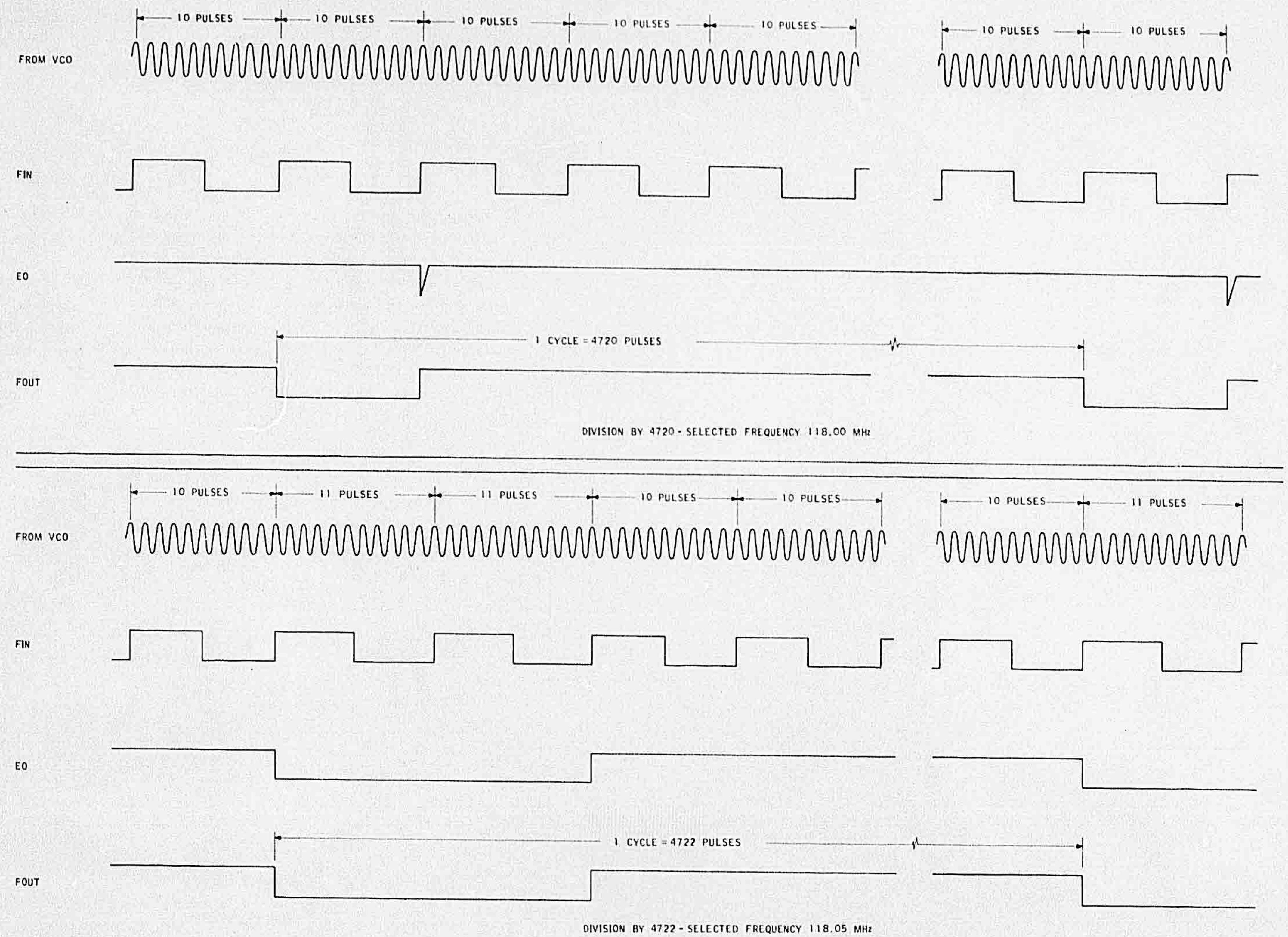
(Refer to Figure 4-6 and Table 4-3)

Figure 4-6 and Table 4-3 illustrate several examples of the counting sequence occurring within the variable ratio divider for selected frequencies. The frequencies selected for this example are 118.000 MHz and 118.050 MHz.

When the selected frequency is 118.000 MHz, the vco will operate at 118.000 MHz in the transmit mode and at 128.500 in the receive mode.

In the transmit mode at 118.000 MHz, the programmable megahertz counter count will be 472 and the programmable kilohertz counter count will be zero since there are no kilohertz increments in the selected frequency. This provides an overall divider ratio of 472 x 10, or 4720, which equals the 118.000-MHz vco output frequency divided by 25-kHz.

The vco frequency will be offset 10.5-MHz above the selected frequency when receiving to provide receiver injection. The programmable megahertz counter ratio is increased to 514 to provide the overall divider ratio of 5140. In the receive mode, therefore, the overall divider ratio is increased by 420 counts, which is the number of 25-kHz increments in the offset frequency of 10.5-MHz.



Counter Control U11, Timing Diagram
Figure 4-6

Table 4-3. Sample Division Ratios

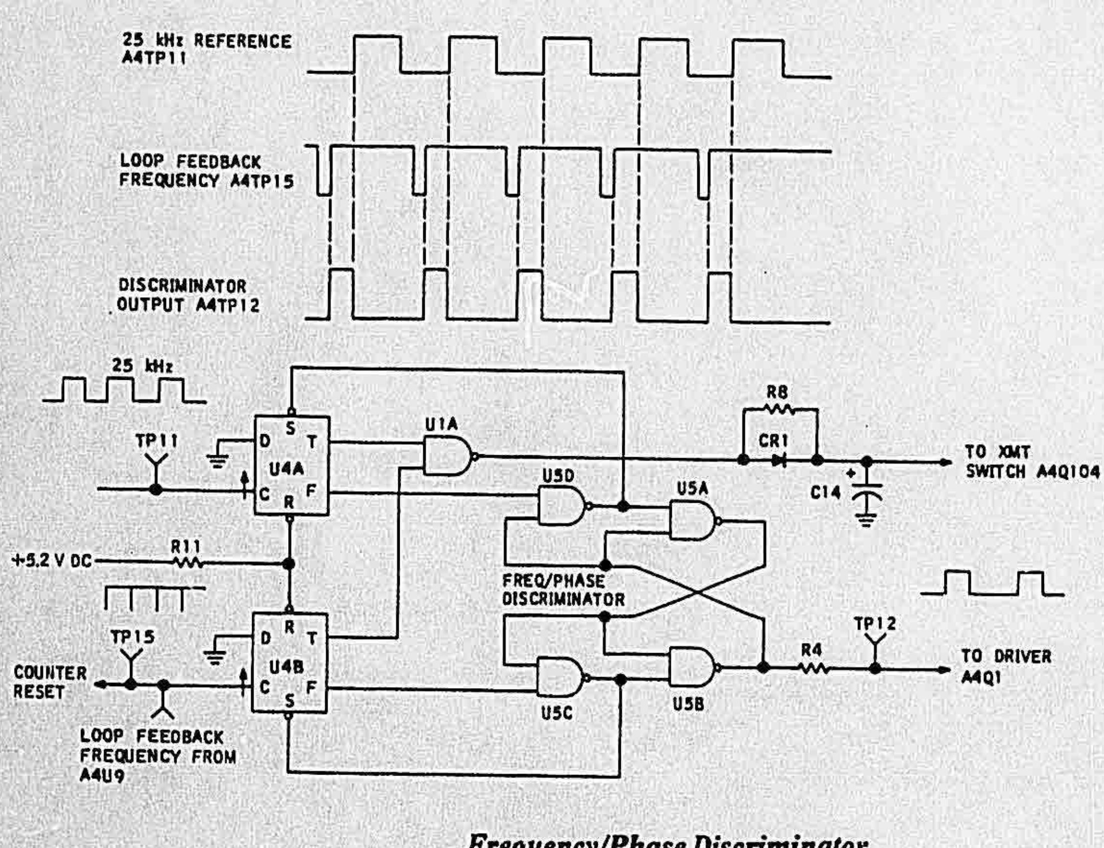
DIVIDER RATIOS							
SELECTED FREQUENCY	F_{VCO}		PROGRAMMABLE MHz COUNTER RATIO	PROGRAMMABLE kHz COUNTER RATIO	PRE-SCALER		DIVIDER RATIO = $\frac{F_{VCO}}{25 \text{ kHz}}$
	XMT	RCV			÷10	÷11	
118.00 MHz	118 MHz		472	0	472		472 X 10 = 4720
		128.5 MHz	514	0	514		514 X 10 = 5140
118.05 MHz	118.05 MHz		472	2	470	2	(472 X 10) + 2 = 4722
		128.55 MHz	514	2	512	2	(514 X 10) + 2 = 5142

Changing the selected frequency from 118.000 to 118.050-MHz will not affect the programmable megahertz counter since the whole number portion of the frequency remains the same. The initial state of the programmable kilohertz counter, however, will be changed to reflect the two 25-kHz increments in the new frequency. The overall divider ratio is now 472 x 10 plus the two additional divide-by-11 prescaler counts, or 4722. The receive divider ratio for 118.050-MHz is 4722 plus the 420 offset counts, or 5142.

4.3.2.4 Frequency/Phase Discriminator

(Refer to Figure 4-7)

The frequency discriminator consists of a dual D flip-flop, A4U4, and a NAND gate pack, A4U5, which is configured as a set-reset flip-flop. The 25-kHz input from the variable ratio divider sets the phase detector high; the 25-kHz input from the fixed divider resets the phase detector output low. Switching occurs on the rising edge of the pulses, resulting in an output



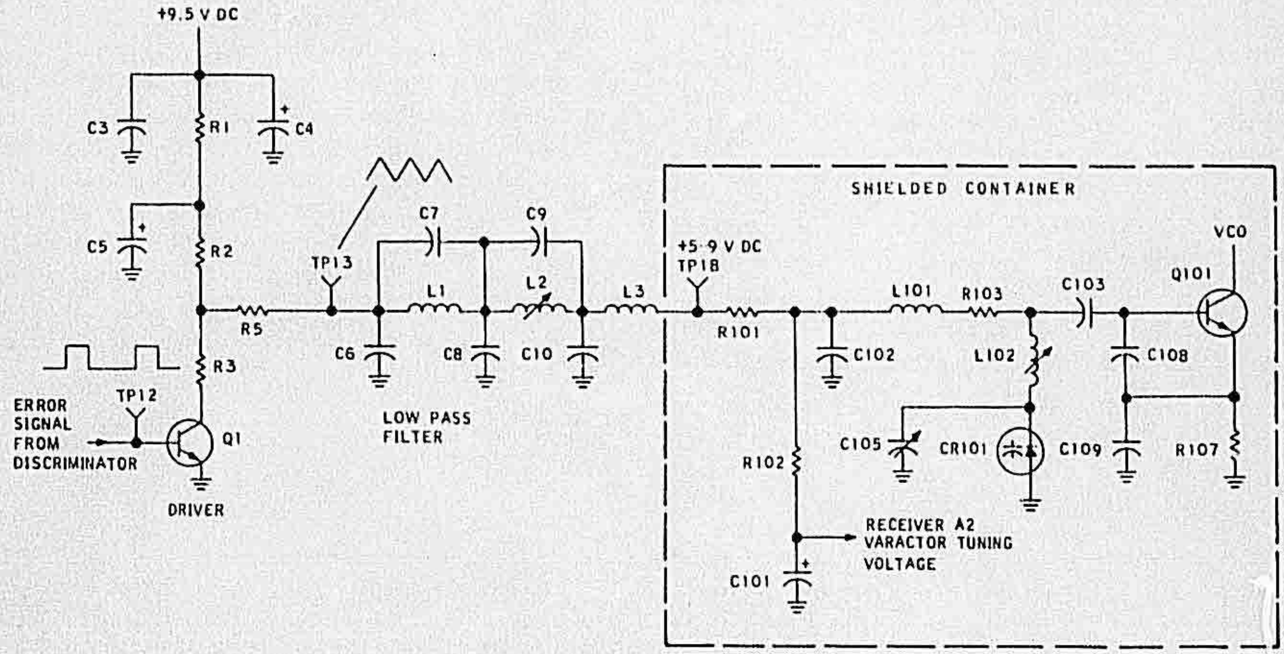
Frequency/Phase Discriminator
Figure 4-7

with pulse width or duty cycle proportional to the phase difference between the two input pulses. During normal operation, the pulses alternate between the set and reset inputs. When the loop is not phase locked, such as when changing frequency, the circuit acts as a frequency discriminator and produces a constant dc output level that is either +5 volts or +0.25 volt, depending upon the desired direction of tuning. Changing to a higher frequency increases the divider ratio, which decreases the feedback frequency. This causes the output of Q1 to latch at a high logic level until the decreasing vco output nears the correct frequency and returns the discriminator to the phase mode of operation. Changing to a lower frequency decreases the divider ratio and increases the feedback frequency. The output of Q1 now latches at the 0.25 volt level until the increasing vco output nears the correct frequency and again returns the discriminator to the phase mode of operation. This requency discrimination prevents the loop from locking in spurious phase modes and forces the loop capture range to be equal to the holding range.

During normal operation, both U4T outputs are predominantly high, thus keeping the output of U1A predominantly low. When the loop is out of lock, one of these T outputs will go low, causing the output of U1A to go high. The output of U1A is passed by diode CR1 to transmit switch transistor Q104, which disables the transmitter rf drive signal.

4.3.2.5 VCO Tuning (Refer to figure 4-8)

Driver amplifier Q1 raises and inverts the frequency/phase discriminator output signal level to the level required to tune the vco over the desired range. Before being applied to the vco, the driver output is filtered by a low-pass filter which removes the switching rate components. The re-



VCO Tuning Figure 4-8

sulting dc output signal from the filter is applied to voltage-variable capacitor CR101 which tunes the vco. Filtered dc output is also supplied to the comm receiver to tune the rf preselector circuits. The phase difference between the 25-kHz reference and the output of the variable ratio divider controls the vco frequency. The phase difference controls the tuning voltage and vco frequency. The condition for phase lock occurs when the phase difference becomes constant at the value necessary to produce a vco frequency that, when divided, produces 25 kHz at the frequency/phase discriminator. The division ratio of the variable ratio divider determines the vco frequency where phase lock occurs. If the division ratio of the variable ratio divider changes or the vco frequency drifts, the phase difference will change, causing the vco frequency to change until the phase-lock condition is again met.

4.3.2.6 Frequency Standard (Refer to figure 4-9)

A crystal controlled oscillator operating at 4.0 MHz is the source of the 25-kHz reference frequency. The output of the crystal oscillator is fed to a fixed divide-by-16 counter, U2, to produce a 250-kHz output. This signal is then divided by 10 in fixed counter U3. The 25-kHz resulting frequency is used as a reference within the frequency/phase discriminator for comparison with the output of the variable ratio divider.

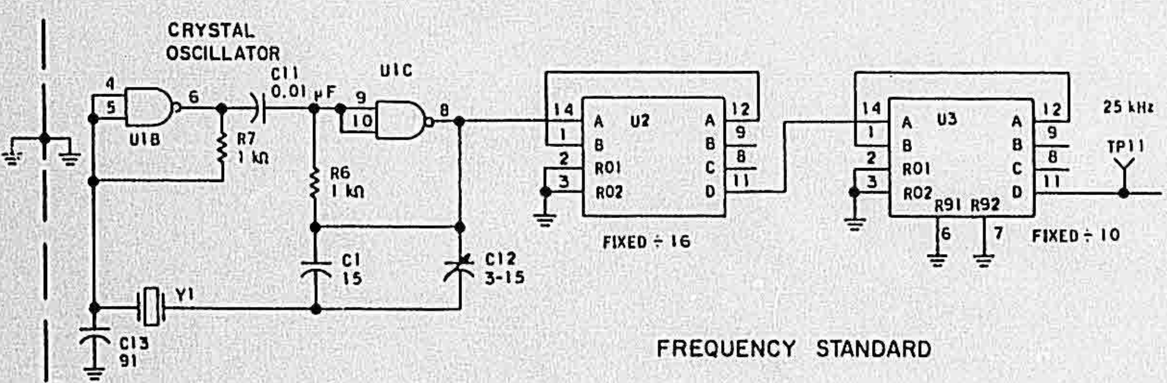
4.3.2.7 Synthesizer Offset Operation (Refer to figure 4-10)

From the discussion of the variable ratio divider recall that an additional 420 counts are added to the overall divider ratio in the receive mode to accommodate the 10.5-MHz increase in the vco frequency. The prescaler, contained in the loop feedback circuit, accounts for a factor of 10; however, in addition to this, an additional 42 counts must be added to the megahertz counter to arrive at the 420 count offset. This additional counting is accomplished by delaying the counter controls recognition of the programmable megahertz counter terminal state.

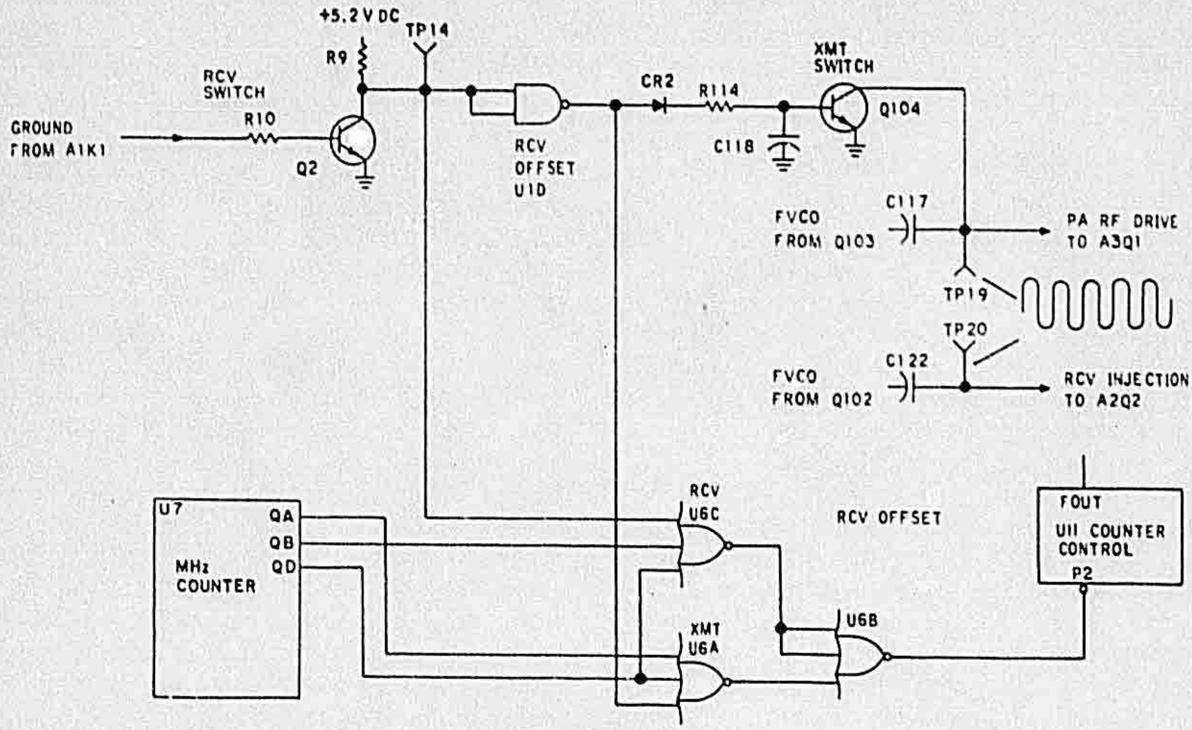
The $\overline{P2}$ input of counter control U11 recognizes the terminal state change supplied by NOR gate U6B. Logic supplied by relay A1K1 controls the offset circuit operation. This logic combined with megahertz counter U7 and NOR gates U6A/B/C control terminal state recognition of the counter control.

4.3.2.7.1 Receive Offset Mode

When the transceiver is in the receive mode of operation, +13.75 V dc is applied to the base of receive switch transistor Q2, causing it to become saturated. With transistor Q2 conducting, the pullup voltage applied to resistor R9 will be reduced, resulting in a logic 0 at the input of NAND gate U1D, logic 1, is applied to xmt NOR gate U6A. The logic 1 present at pin 3 of xmt NOR U6A renders it insensitive to the state changes occurring at the output of the megahertz counter. Rev NOR gate U6C, however, will remain sensitive to the megahertz counter and will change states when each of its inputs is logic 0. When this condition exists, the NOR gate U6B output will change from high to low, signaling the counter control P2 detector terminal that one counting sequence has been completed. The combination of inputs to rev NOR gate U6C from the megahertz counter is such that an additional 42 counts are required for the counter control to recognize the terminal state logic.



Frequency Standard Figure 4-9



Offset Operation Figure 4-10

Local oscillator leakage in the receive mode is eliminated by applying a ground to the PA rf drive line. Ground application is achieved by the output of NAND gate U1D, which saturates transistor Q104.

When operating in the offset mode, the vco frequency will be 10.5 MHz above the selected frequency, and the receiver injection will range from 128.5 through 146.475 MHz.

4.3.2.7.2 Transmit Offset Mode

While transmitting, the base of transistor Q2 will be held at ground by transmit/receive relay A1K1. Application of a ground at the base of transistor Q2 causes it to cut off, which applies a logic 1 to the input of NAND gate U1D and rcv NOR gate U6C. The low output of NAND gate U1D is applied to xmt NOR gate U6A. With these conditions existing, rcv gate U6A will not be sensitive to megahertz counter U7 state changes; however, xmt NOR gate U6C will be. When the megahertz counter reaches its terminal state, the xmt NOR gate U6C output will go high, causing the NOR gate U6B output to go low. Counter control U11 recognizes this negative-going transition as the end of a counting sequence. Recognition results in a negative-going output at F_{out} resetting of the programmable counters.

The absence of a high output from NAND gate U1D cuts off transmit switch transistor Q104. In this state, the vco PA rf drive frequency of 118 through 135.975 MHz is allowed to pass. The vco frequency is also fed to the receiver mixer; however, since the receiver is turned off in the transmit mode, no side effects of this action are encountered.

4.3.3 Receive Mode

Basically the mode of transceiver operation centers around relay A1K1. The switching characteristics of this relay control synthesizer operation, power amplifier operation, tr diode biasing, and receiver operation. In the receive mode, A1K1 performs the following functions: application of +13.75 V dc to the base of transistor A4Q2, controlling the synthesizer offset circuit; forward biasing of tr diode A3CR1, thereby allowing received rf to be applied to the preselector; and direct control of the transceiver audio and receiver circuits, making them operational in the receive mode.

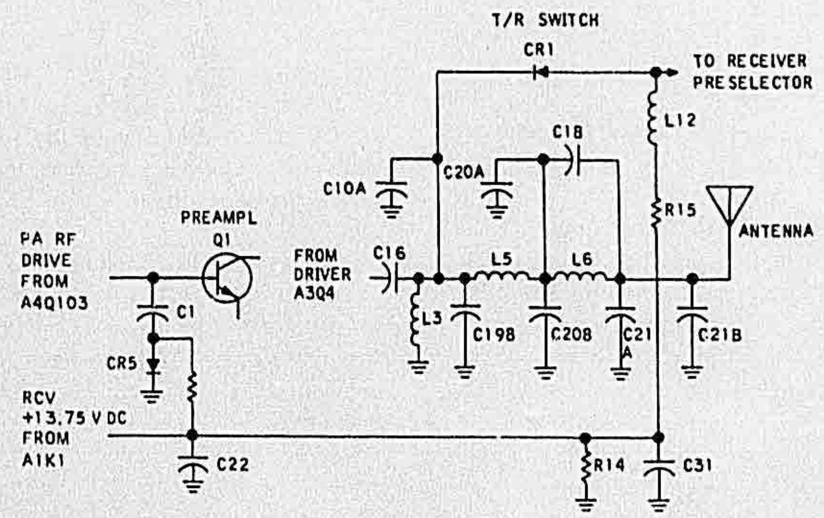
4.3.3.1 TR Switch Receive Mode Operation (Refer to figure 4-11)

The primary function of the tr switch is to isolate the receiver from the transmitter. In the VHF-251/251S/251E, this is accomplished by the use of a diode that performs the switching function in conjunction with relay A1K1, which establishes the bias applied to the diode. In the receive mode, relay A1K1 will deenergize and the rcv +13.75-V dc lines are activated.

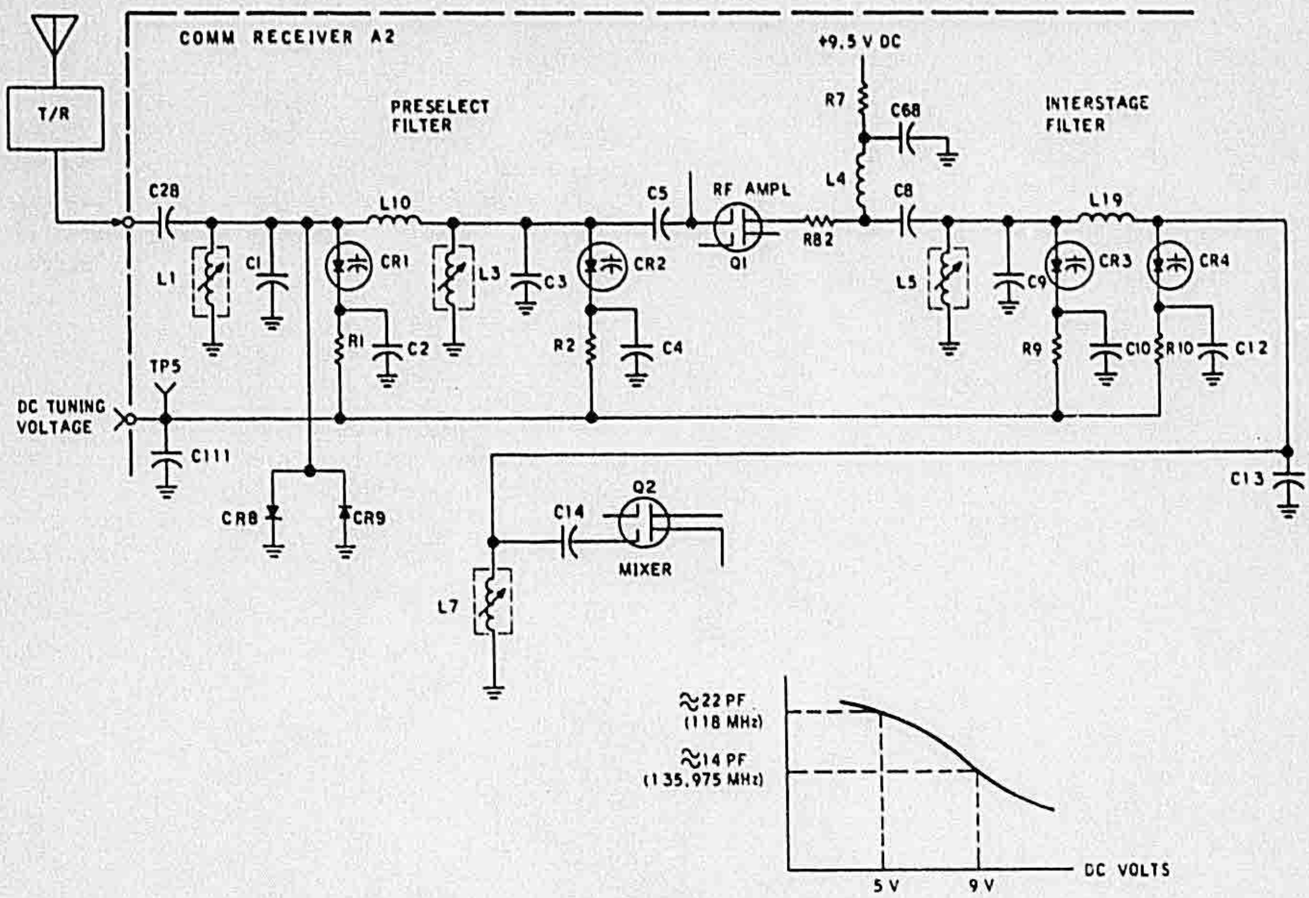
The +13.75 V dc supplied by relay A1K1 forward biases diodes A3CR1 and A3CR5 forward biasing A3CR5 places the rf drive line to the base of preamplifier A3Q1 at ground and thereby attenuates any possible rf leakage from the synthesizer. Forward biasing tr diode A3CR1 allows the rf present at the antenna to pass through diode A3CR1 into the receiver preselector circuit. Should the +13.75-V dc potential be removed, A3CR1 will not conduct and the received rf will be blocked from the preselector.

4.3.3.2 Receiver Preselector Operation (Refer to figure 4-12)

The VHF antenna signal is filtered in a varactor-tuned, 2-pole preselector (a 2-pole filter consisting of high-Q coils tuned by voltage variable capacitance diodes). The preselector circuit selects the desired signal from the spectrum supplied from the antenna to provide an input to the rf amplifier. Positive dc tuning voltage applied to the varactors is supplied by the synthesizer. The junction capacitance of the varactor diodes varies with the bias voltage across it; as the applied voltage increases, the junction capacitance decreases. The graph included in figure 4-12 illustrates the general relationship between the bias voltage and the junction capacitance of the varactors, ranging from approximately 22 pF at +5 V dc to approximately 14 pF at +9 V dc. Specific values will vary slightly between individual radios. Diodes CR8 and CR9 limit the amplitude of the rf input signal to ensure that varactor CR1 cannot be pumped into parametric oscillation by strong received signals.



TR Switch Operation Figure 4-11



Preselector, RF Amplifier, Interstage & Mixer Figure 4-12

4.3.3.3 RF Amplification (Refer to figure 4-12)

The output of the 2-pole preselector is then amplified in dual-gate MOSFET amplifier Q1 that provides sufficient gain so signal at the mixer can overcome mixer noise. Q1 runs at maximum gain (approximately 20 dB) until the input signal is great enough to produce about a 30-dB signal-to-noise ratio. When this occurs, AGC reduces Q1 gain to prevent large input signals from overloading the if. Characteristically, MOSFET's are voltage controlled devices, responding to an input voltage rather than current. The voltage applied to the gate controls the drain-to-source resistance. Therefore, a MOSFET may be considered a voltage controlled resistor, the range of which varies from a few hundred ohms, when on, to several thousand megohms, when off. An AGC inverter amplifier provides a decreasing bias on the MOSFET control gate with increasing rf input until the control gate is negative with respect to the source.

Following rf amplifier Q1 is another varactor-tuned, 2-pole interstage filter similar to the preselector preceding the rf amplifier. This interstage network further attenuates off-channel signals to minimize spurious responses (especially the image frequency). A total of four resonators before the mixer stage provide a minimum of 60-dB attenuation at the image frequency. Inductive top coupling is employed between resonators of each 2-pole filter.

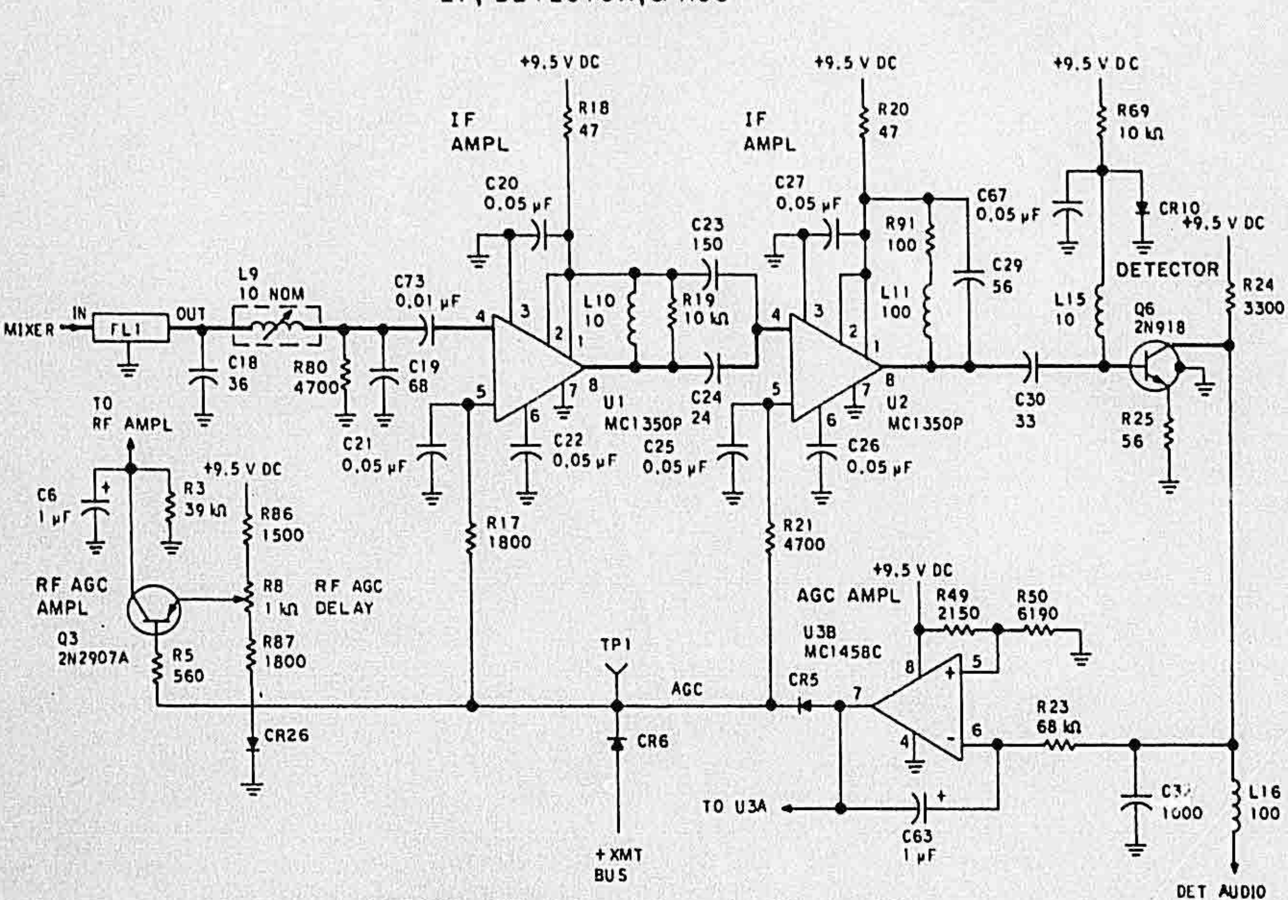
4.3.3.4 Mixer and Crystal Filter Operation (Refer to figure 4-12)

Mixer Q2 combines the rf amplified output of the preselector with the synthesizer injection to produce a 10.5 MHz difference frequency for amplification by the 10.5 MHz if section. High side injection prevents the injection frequencies from falling into the VHF navigation band. The networks on the local oscillator injection gate and on the mixer drain are critical to avoid undesired mixer oscillation or regeneration. Unwanted oscillation may totally block the receiver, while regeneration may degrade audio quality due to excessive passband ripple. The mixer is a dual-gate MOSFET. The mixing function provided by the MOSFET is unique in that the injection frequency applied to gate number 2 modulates the transfer characteristic of input gate number 3. This action provides high gain at the intermediate frequency.

The output of mixer Q2 is LC filtered and applied to crystal filter FL1, which is centered at 10.5 MHz. Receiver selectivity is determined by 8-pole crystal filter FL1. This filter contains four crystal elements that provide extremely sharp band edges for attenuation of adjacent channel signals. The -6 dB points are at least 10 kHz from the nominal channel frequency, and the -60 dB points are no more than 20 kHz from the nominal frequency. The LC matching networks on the input and output of FL1 must be properly tuned to load the filter properly. These matching circuits are tuned for maximum AGC voltage with a signal above noise level applied to the receiver. Improper termination will result in excessive amplitude ripple in the passband.

4.3.3.5 10.5 MHz IF, Detector, and AGC Operation (Refer to figure 4-13)

After filtering, the 10.5 MHz signal is amplified in two gain-controlled integrated circuits, U1 and U2. Enough gain is obtained in these two stages (U1 and U2 are capable of more than 100 dB of gain) to ensure that the receiver is in AGC on its rf noise; this is essential for proper operation of the signal-to-noise squelch circuitry. AM detection is accomplished by detector Q6. Dc current through bias diode CR10 sets a voltage roughly equal to the transistor base-emitter drop; this holds Q6 on the verge of conduction. Rf upswings turn the transistor on, and downswings turn it off. Since Q6 conducts for half of each rf cycle, the base-emitter circuit is a half-wave rectifier. Capacitor C32 is incorporated to filter rf current at the collector. The function of Q6 is therefore to provide gain at the audio frequencies of the modulation envelope. The detected dc voltage, produced by filtering the class B output of Q6, is applied to the inverting input of AGC amplifier U3B. The AGC amplifier output is fed directly to carrier squelch amplifier U3A, and through isolation diode CR5, to both



10.5 MHz IF & Detector Operation Figure 4-13 if amplifiers and the base of rf AGC amplifier Q3. Rf AGC delay potentiometer R8 sets the bias on the rf AGC amplifier that must be overcome by the AGC voltage for the control voltage to reach the rf amplifier. Diode CR26 provides the thermal stability required to compensate for Q3 gain changes over temperature. AGC therefore will not reduce the gain of the rf amplifier until the incoming signal strength exceeds a predetermined value.

As mentioned briefly, AGC circuits are basically a feedback control system that tries to hold the average voltage at the detector collector equal to the reference voltage established by R49 and R50. When the receiver is operating properly, front-end noise amplified in the if will be enough to lower detector collector average voltage below reference so that AGC gain reduction will occur with no input signal. This characteristic is essential for proper squelch operation. Potentiometer R8 is adjusted to set the collector of delay transistor Q3 at 5.0 V with a 3-μV signal applied; this sets the rf amplifier stage for maximum gain. As signal strength increases, AGC voltage increases and the collector voltage decreases. The gain of Q1 will not diminish until the collector of Q3 drops to about 3 V. This delayed AGC action keeps the gain of the rf amplifier high until the signal is strong enough to guarantee a good signal-to-noise ratio. At very high signal levels, the gain of Q1 is reduced approximately 30 dB to avoid overloading the if amplifier.

Diode CR6, the anode of which is connected to the +xmt bus, provides receiver muting in the transmit mode of operation.

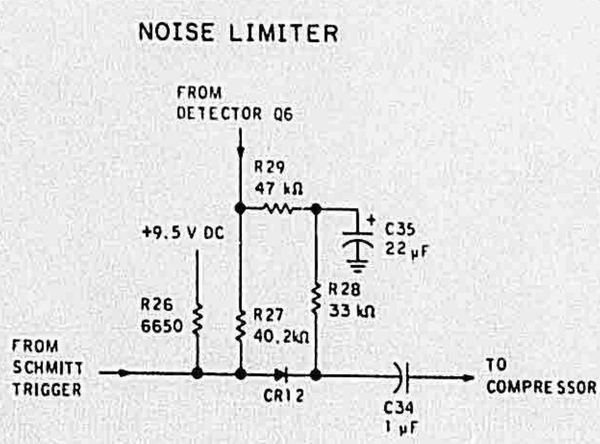
Grounding the key line input line actuates relay A1K1, causing application of the +13.75 V dc on the +xmt bus. This forward biases diode CR6 which, in turn, places the high-level positive voltage on the AGC line, cutting off the rf amplifier and both if amplifiers.

4.3.3.6 Audio Circuit Operation

The output circuits consist of a noise limiter, an audio compressor, a ICS (intercom) system preamp, a special filter/amplifier in the VHF-251E, an IC driver amplifier, and a class B output stage.

4.3.3.6.1 Noise Limiter (Refer to figure 4-14)

Diode CR12 performs the dual function of series noise limiter and squelch gate. As a noise limiter, the detected carrier from transistor Q6 forward biases CR12 conducting the detected audio through CR12 and C34 to the audio compressor input. The forward bias of CR12 is controlled by the detected carrier level and is proportioned by R28 and R29 in a manner that permits negative audio peaks from the detector to back-bias CR12 when the modulation of the receiver signal exceeds 90 percent. This action effectively clips negative impulse noise at the 90-percent



Noise Limiter/Squelch Gate Figure 4-14 modulation level. Clipping of the positive impulse noise peaks occurs at the detector which saturates at a level higher than 90-percent modulation.

The squelch gate action of CR12 occurs when Schmitt trigger U4A conducts and removes the forward bias from CR12, thereby removing the audio path to C34.

4.3.3.6.2 Audio Compressor Operation (Refer to figure 4-15)

The audio output of the noise limiter is coupled to the audio compressor circuitry that consist of U4C, Q5, U4B and variable attenuator network R31, R45 and CR13. The audio level into U4C is controlled by a feedback loop containing af compressor amplifier U4B and the variable attenuator network. The output of U4C is directly connected to the base of emitter follower Q5, which is used to provide isolation between U4C and U4B. The output of Q5 is rectified by diodes CR16 and CR17 that provide drive to attenuator driver U4B. The bias voltage applied to U4B is directly proportional to the audio signal amplitude on the collector of af compressor amplifier U4C. U4B conducts through attenuator diode CR13, which is the main link in the compressor feed back loop. Functionally, diode CR13 is the center leg of a T-attenuator comprised of itself, R45 and R30. Resistor R45 is the received audio input leg. An increase in current through CR13 increases the attenuation characteristics of the T; a decrease in current flow decreases attenuation. Using this process, the audio output signal amplitude range is controlled as a function of the input signal amplitude. Strong signals, therefore, as seen at the base of af compressor amplifier U4C, will be compressed, while weak signals will pass the compressor at full level.

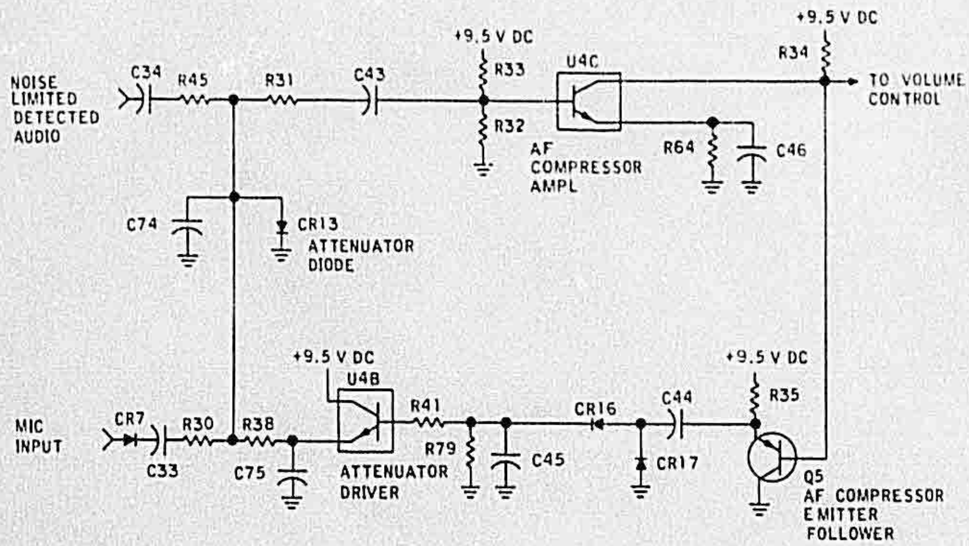
4.3.3.6.3 ICS Preamp (Refer to figure 4-15A)

The intercom system preamplifier is a simple low-level class A amplifier that is used to boost the ICS input (a microphone) prior to application to audio amplifier U5. Q2 collector voltage and emitter current are kept relatively low to reduce the circuit noise figure.

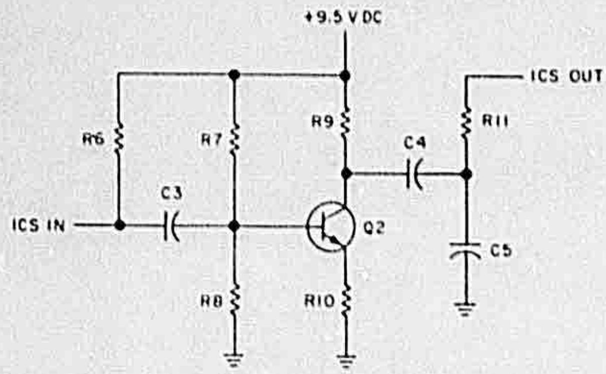
The function of the ICS preamplifier is to facilitate intercommunication between crew members via microphone/headset in high ambient cockpit noise environments.

4.3.3.6.4 VHF-251E Filter/Amplifier (Refer to figure 4-15B)

Simultaneous reception of a carrier and an offset carrier may result in a heterodyne signal, heard in the receiver as



Audio Compressor Figure 4-15



ICS Preamp Figure 4-15A

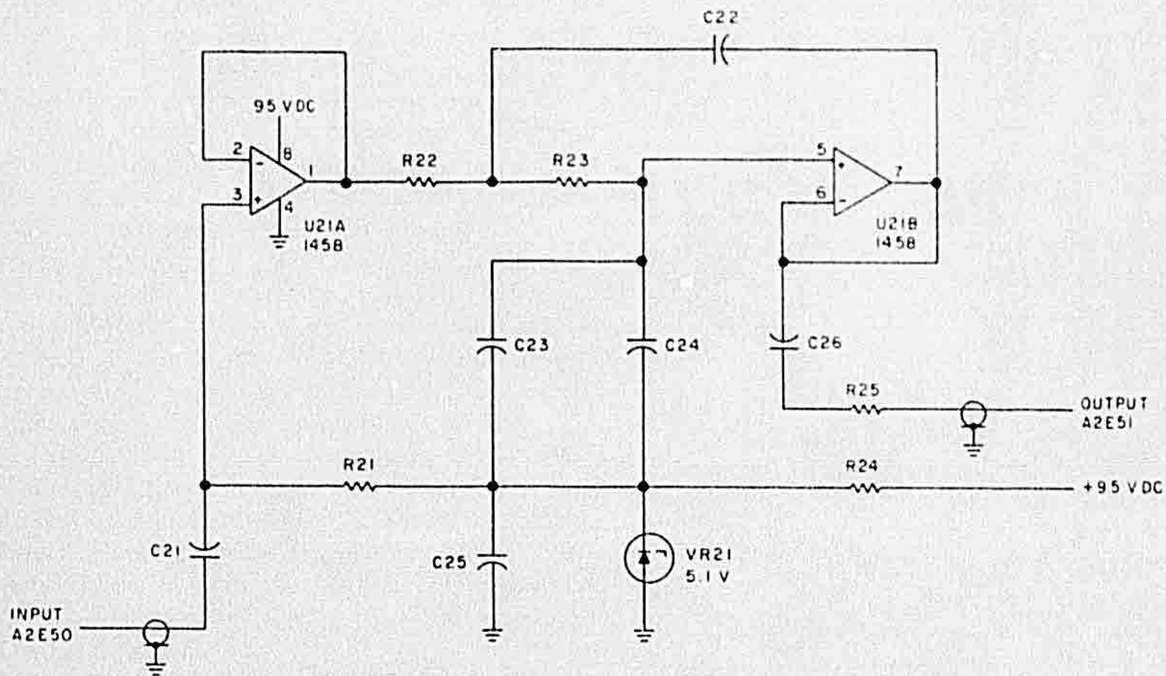
an audio whistle. The filter/amplifier shown in figure shown in figure 4-15B alters the receiver audio response curve an effectively attenuates audio signals at and above 5000 Hz by at least 18 db. The receiver audio response range will be within 6 db from 350 through 2500 Hz in the VHF-251E

4.3.3.6.5 Audio Power Amplifier (Refer to figure 4-16)

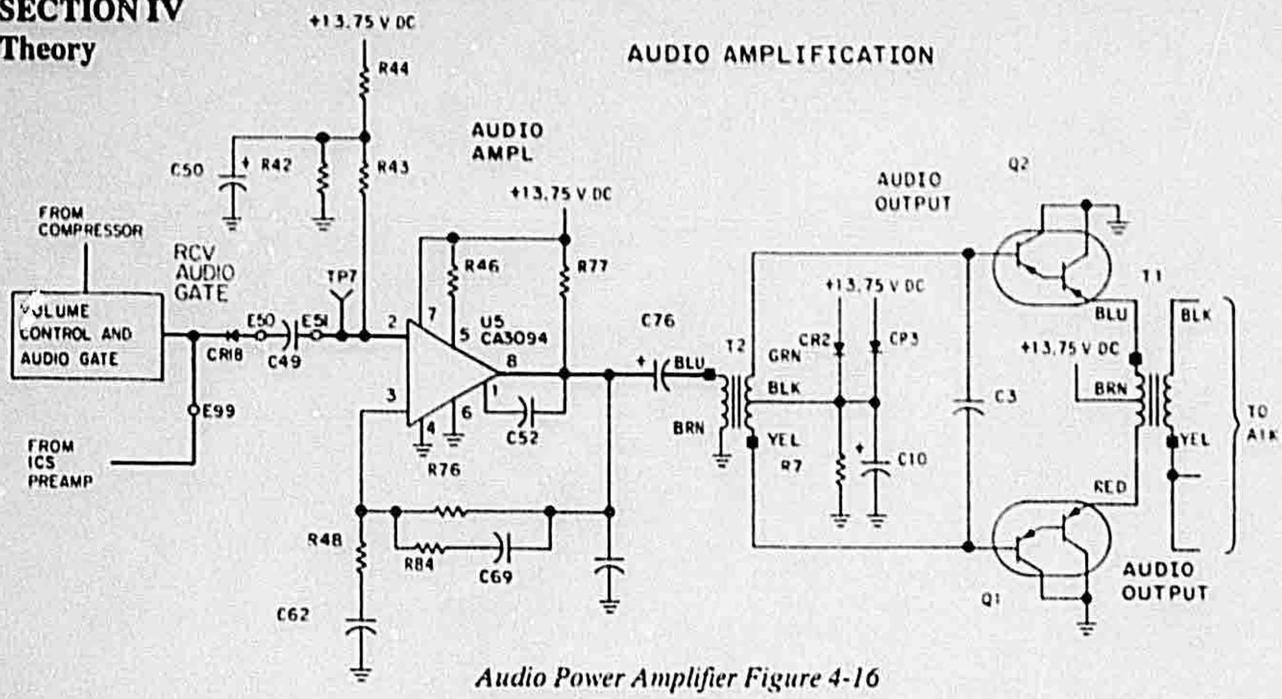
The output of af compressor amplifier U4C is coupled to the volume control, which controls the drive applied to the audio amplifier U5. The output of audio amplifier U5 is applied to the final audio amplifier contained on audio/tr chassis A1. The final audio amplifier consists of a pair of class B Darlington output transistors. Output power is a nominal 13 watts at the transformer output.

4.3.3.7 Squelch Circuit Operation

The squelch gate is directly controlled by the Schmitt trigger circuit inputs from the noise squelch and carrier squelch circuits. The noise squelch senses the output of



VHF-251E Filter/Amplifier Figure 4-15B



Audio Power Amplifier Figure 4-16

the detector, while the carrier squelch senses the output of the AGC amplifier.

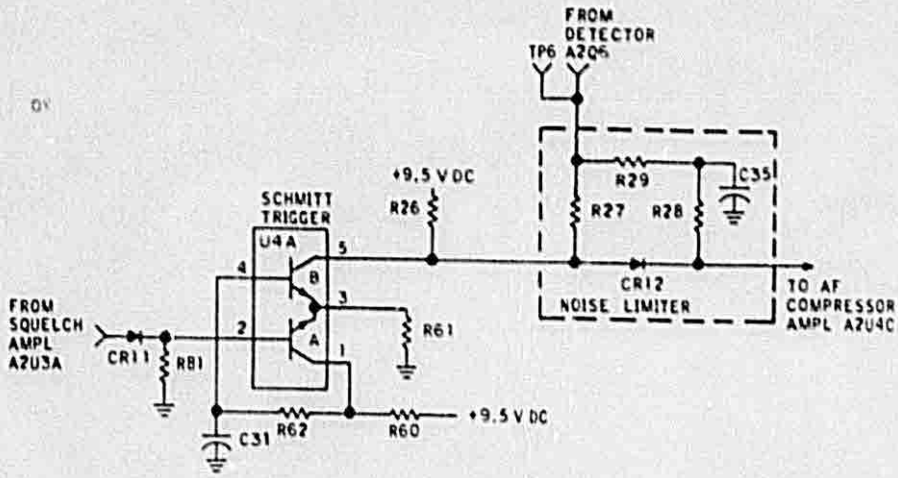
Squelch operation is divided into three sections for purposes of discussion: the noise limiter and Schmitt trigger, noise squelch and carrier squelch.

4.3.3.7.1 Schmitt Trigger and Noise Limiter/Squelch Gate (Refer to figure 4-17)

Diode CR12 performs the dual function of series noise limiter and squelch gate. As a squelch gate, the bias applied to the diode is a function of Schmitt trigger U4A. The high speed switching characteristics of the Schmitt trigger provide the "snap-action" switching required in the squelch. False triggering is eliminated by the hysteresis effect of Schmitt trigger operation.

The Schmitt trigger is a 2-stage dc amplifier with positive feedback. This positive feedback makes the gain very high when the input signal is in the narrow range between that producing saturation and that producing cutoff. The positive feedback also provides a latching action. Once a high-level signal exceeds the rising threshold and sets the trigger, the input must be reduced to a lower, falling threshold to reset. Once the signal has risen enough to open the gate, it can fall somewhat lower without closing the gate. This reduces the incidence of flutter with marginal signal levels.

If neither squelch circuit (noise or carrier squelch) applies voltage to the base of transistor A, R81 holds the base low and prevents the transistor from conducting. Current through R60 and R62 turns transistor B on, Making its collector and emitter voltages nearly the same. The emitter of transistor B will be about 4.2 V and the collector about 4.5 V; this is the normal situation when no signal is received. Since R28 and R29 hold the cathode of CR12 at approximately 7.0 V while its anode is at 4.5 V, CR12 will not conduct and no audio passes to the compressor. If one of the squelch circuits applies enough drive to pull the base of transistor A up to approximately 4.7 V, transistor A begins to conduct. This shunts current away from the base of transistor B which begins to turn off. The emitter voltage drops (R60 is larger than R26) which speeds up the turn-on of transistor A. This action proceeds rapidly until transistor A is saturated, so there is no base current for transistor B halting conduction. Current now flows through R26 and CR12 turning CR12 on and allowing passage of audio signal to the compressor. In this state, the emitter voltage of transistor A is about 1.3 V. Since the emitter-base voltage of transistor A is approximately 0.6 V, the base is pulled down to approximately 1.9 V. The trigger driving voltage must therefore fall at least this low before the trigger will reset. This difference between 4.7 V and 1.9 V is the hysteresis of the Schmitt trigger. The Schmitt trigger has a peculiar effect upon the operation of noise squelch dc amplifier U4D. When no signal is received, the noise squelch rectifier supplies enough drive to keep U4D saturated. The emitter voltage is approximately 0.8 V, and the collector approximately 1.1 V. When a received signal reduces the noise level, base drive to U4D is reduced and its collector voltage rises to approximately 5.3 V which starts the Schmitt trigger set process. As the Schmitt trigger sets, the base voltage of transistor A falls to approximately 1.9 V. This pulls the



Schmitt Trigger & Noise Limiter/Squelch Gate Figure 4-17

collector of U4D down to about 2.5 V. This entire process takes approximately 1μs for completion.

Since the Schmitt trigger output is either high or low with essentially no in-between, diode CR12 and the trigger create the desired gating effect. This effectively blocks the detector-to-compressor signal path when the trigger output is low or opens the path when the output is high.

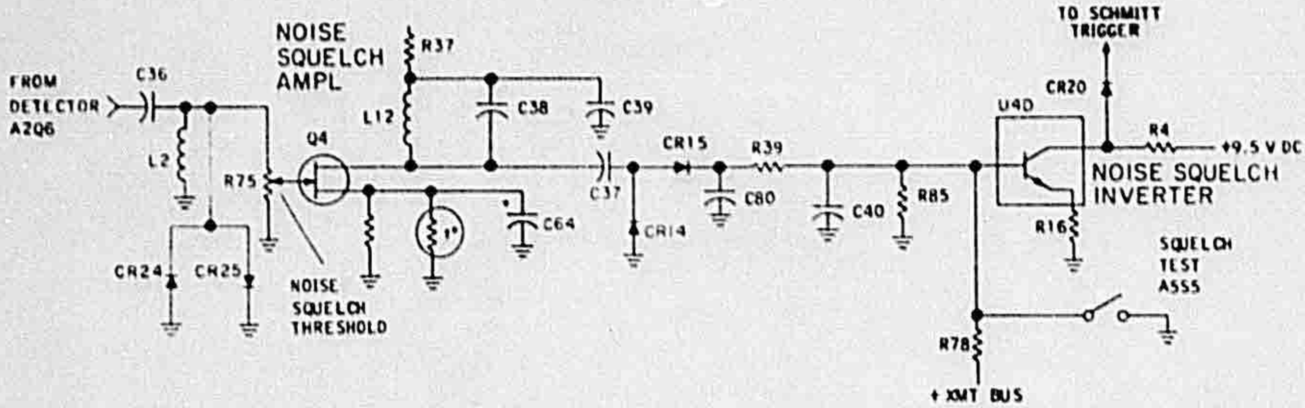
The output of the Schmitt trigger is controlled by three independent sources. The trigger output will remain high (squelch opened) when either of the input levels overcomes the fixed bias of the trigger input transistor. For the output to go low (squelch closed) all inputs must fall below the trigger fixed bias voltage as just discussed. The inputs controlling the Schmitt trigger are the squelch test switch and squelch circuits.

4.3.3.7.2 Noise Squelch (Refer to figures 4-18 and 4-19)

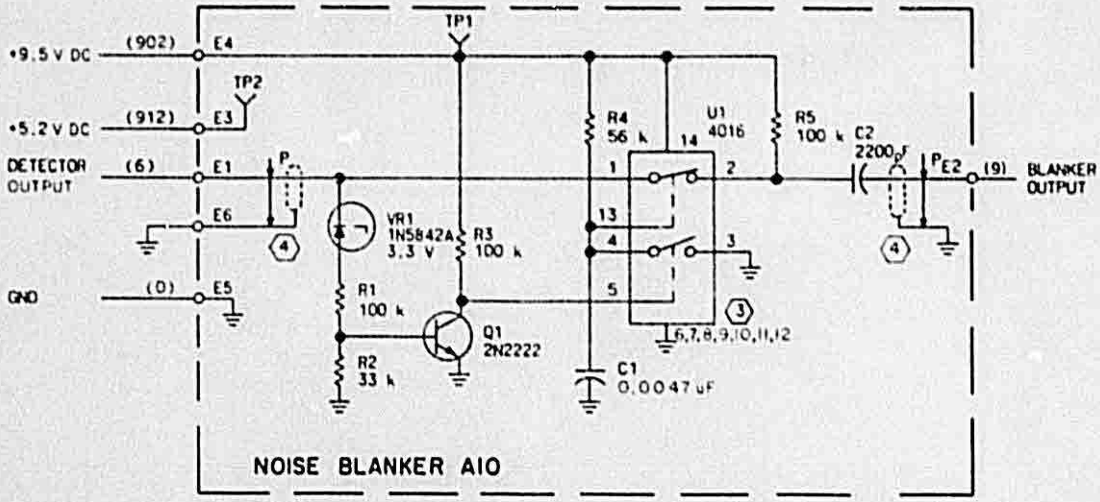
Receiver gain must be high enough that the receiver is into AGC on noise to ensure that the no-signal noise power at the detector is the same on all channels. This also ensures that the dc output of the noise squelch rectifier will be the same regardless of the channel selected. For proper operation, most of the noise at the detector must be generated by the receiver front end. This noise level will decrease very rapidly as the input signal level increases from zero. The squelch threshold is therefore not a function of receiver gain. If the receiver gain drops below threshold level, the squelch interprets this absence of noise as signal (which of course it is not) and the squelch will remain open. To review, satisfactory noise squelch operation requires that:

(1) rf amplifier and mixer circuits be working properly so that front-end noise is the main no-signal power at the detector, (2) gain capability must be high enough that detected noise alone causes some AGC gain reduction and (3) squelch filters accurately discriminate against voice frequencies.

The VHF-251( ) Communications Transceiver has undergone numerous changes in the noise squelch circuit. The bulk of these changes have been made to the circuits at the tuned input and output of noise squelch amplifier Q4. If service bulletin 10 has been installed in the VHF-251 (SB 6 in VHF-251E and SB 5 in VHF-251S) an active noise blanker module is incorporated into the noise squelch circuit. The noise blanker, which is electrically located between the detector and the input to noise squelch amplifier Q4, replaces capacitor C36 and diodes CR24 and CR25 (shown in figure 4-18). Figure 4-19 is a schematic diagram of the noise blanker circuit. Since the noise blanker is incorporated in current production units, noise squelch operation will be discussed assuming its presence. Prior to blanker installation, a noise limiter consisting of diodes CR24 and CR25 was incorporated as shown in figure 4-18. This limiter was used to clamp ignition and other spurious impulse noise to a +/- 1.2-V level and to damp out ringing in the tuned input circuit of Q4 when impulse shocks are present. The basic theory of limiter operation is that the amount of energy which an ignition pulse can deliver to the squelch is reduced, therefore squelch threshold displacement is minimized in the



Noise Squelch Without Noise Blanker
Figure 4-18



NOTES:

1. UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS
2. NUMBERS IN ( ) ARE WIRE COLOR CODES.
3. U1 IS AN ESS DEVICE-HANDLE ACCORDINGLY.
4. SYMBOL REPRESENTS TWISTED SHIELDED PAIR

Noise Blanker Figure 4-19

presence of extreme impulse noise. The noise limiter does provide a substantial guard against impulse noise, however the noise blanker to be discussed next exceeds this performance and provides other additional benefits.

The noise blanker shown in figure 4-19 replaces the noise limiter diodes with an active noise blanker circuit ahead of the noise squelch amplifier tuned input circuit. The dc level at the detector is held at approximately 7.0 V by the AGC loop. With this voltage applied, the 3.3-V zener diode normally conducts and turns transistor Q1 on, making its collector voltage low; this opens the lower switch segment of U1. Voltage applied through R4 closes the upper switch segment of U1, so the detector signal passes into noise squelch amplifier Q4. With modulation up to about 100 percent, the detector voltage will always be high enough to keep Q1 conducting which will keep the upper switch segment of U1 closed. Ignition noise pulses, however, are negative going at the detector and generally exceed the 100 percent level of modulation. During an ignition impulse, the detector voltage is low enough that Q1 stops conducting. When the collector voltage of Q1 increases, the lower switch segment of U1 will close which in turn grounds the control pin for the upper switch segment forcing it open. During the ignition impulse no signal will reach the noise squelch circuit. This prevents the noise pulse from driving energy into the squelch rectifier and raising the squelch threshold level.

When the ignition pulse ceases, transistor Q1 again conducts and opens the lower switch segment of U1. Capacitor C1 will begin charging through R4 the moment the lower segment of U1 closes. When the voltage across C1 reaches approximately 4.6 V, the upper switch segment of U1 again closes and normal signal flow is again established. The short delay in closing the top switch segment compensates for the energy driven into the squelch rectifier while the noise pulse is rising, but before it is great enough to activate the blanker.

Squelch noise amplifier Q4 is a field-effect transistor (FET) with tuned gate and drain circuits. The input circuit is series resonant. The voltage across L2 is greatest at the resonant frequency which is 9 kHz. The FET drain is also tuned to 9 kHz. Together these two tuned circuits select noise frequency components in a relatively narrow band around 9 kHz while discriminating against voice frequency components.

The output of noise squelch amplifier Q4 is applied to a voltage doubler consisting of diodes CR14 and CR15 prior to application to noise squelch inverter U4D. Inverter U4D is a dc amplifier which increases the rectifier output to provide the drive required to trigger the Schmitt trigger.

When the receiver is driven into AGC on its own noise, the power output from the detector is the summation of the signal power and the noise power, which is a constant output. In the absence of a signal, The signal out of the detector is all noise, and the detected output of squelch noise amplifier Q4 is high, keeping the squelch closed. When a carrier is received, the noise output of the detector decreases, reducing the output from the squelch noise detector and opening the squelch.

Inverter U4D responds to two independent inputs and, from these, controls the squelch operation. Both control input lines are connected directly to the inverter base and either cut off or saturated the transistor. Saturation results in removal of the forward bias applied to diode CR20, the cathode of which is connected directly to the input of the Schmitt trigger. This causes the Schmitt trigger output to go low, thereby closing the squelch. This condition will occur when the transmitter is keyed or when the detected output of Q4 exceeds the turn-on saturation point of U4D.

Inverter U4D cutoff occurs when the base is grounded. In this state diode CR20 is forward biased, placing approximately +4.7 V dc on the input element of the Schmitt trigger. The positive potential at the input causes the output to go high, opening the squelch. A ground will be present at the inverter base when the transceiver is in the receive mode or when the squelch test position is selected.

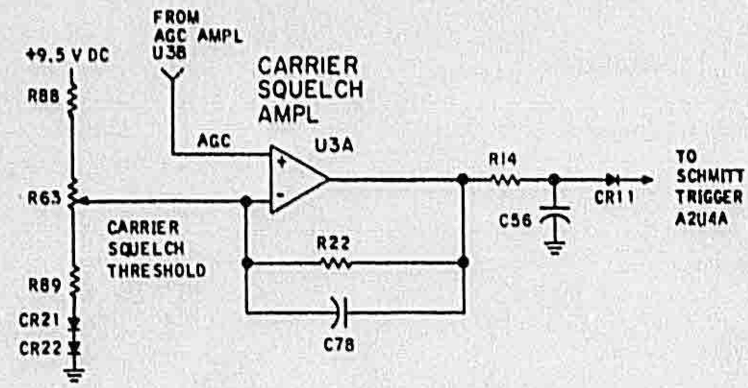
4.3.3.7.3 Carrier Squelch (Refer to figure 4-20)

Carrier override is used to activate the squelch regardless of the signal-to-noise. The carrier squelch override feature is based on a control voltage derived from the AGC line. When the AGC line reaches a predetermined point (typically 20-μV rf input or greater), the carrier squelch override will open the squelch gate even if the signal-to-noise squelch is inoperative. In the absence of a detected carrier, AGC voltage will drop off, and the Schmitt trigger will change states. This removes the forward bias applied to CR12 and, in turn, blocks signal flow to the compressor. The carrier squelch override circuit consists of operational amplifier U3A and associated components. The threshold level is set by adjusting R63 carrier squelch control to provide the proper bias to the inverting input of U3A. When the predetermined override voltage is met or exceeded, the output of carrier squelch amplifier U3A goes positive and enables the squelch.

4.3.4 Transmit Mode

The transmitter is capable of providing 10-W nominal output power from 118.000 to 135.975 MHz in the VHF-251 and from 118.00 to 135.95 MHz in the VHF-251S. The VHF-251E covers the same frequency range as the VHF-251 however power output is 14 W minimum. During transmission, the rf amplifiers are supplied drive by the synthesizer and modulating audio from the af transformer. Modulation limiting prevents overmodulating the transmitter.

Three major functions comprise transmitter operation: transmit mode switching, modulation limiting, and power amplification. The synthesizer, also a function of the transmit mode, is discussed in detail in paragraph 4.3.2.



Carrier Squelch Figure 4-20

4.3.4.1 Transmit Mode Switching (Refer to figure 4-21)

Receive mode to transmit mode transition occurs when the microphone push to talk switch is depressed. This action places a ground on the key line input and energizes relay A1K1, causing it to switch to the position shown in figure 4-21.

The bottom set of contacts (5,6 and 7) switches the secondary of audio output transformer A1T1 and applies +13.75 V dc to the anodes of diodes A2CR6 and A2CR19. With both diodes forward biased, +13.75 V dc will be placed on the receiver AGC line, muting the receiver and microphone audio information will be processed and applied to the audio amplifier through the transmit mode audio gate.

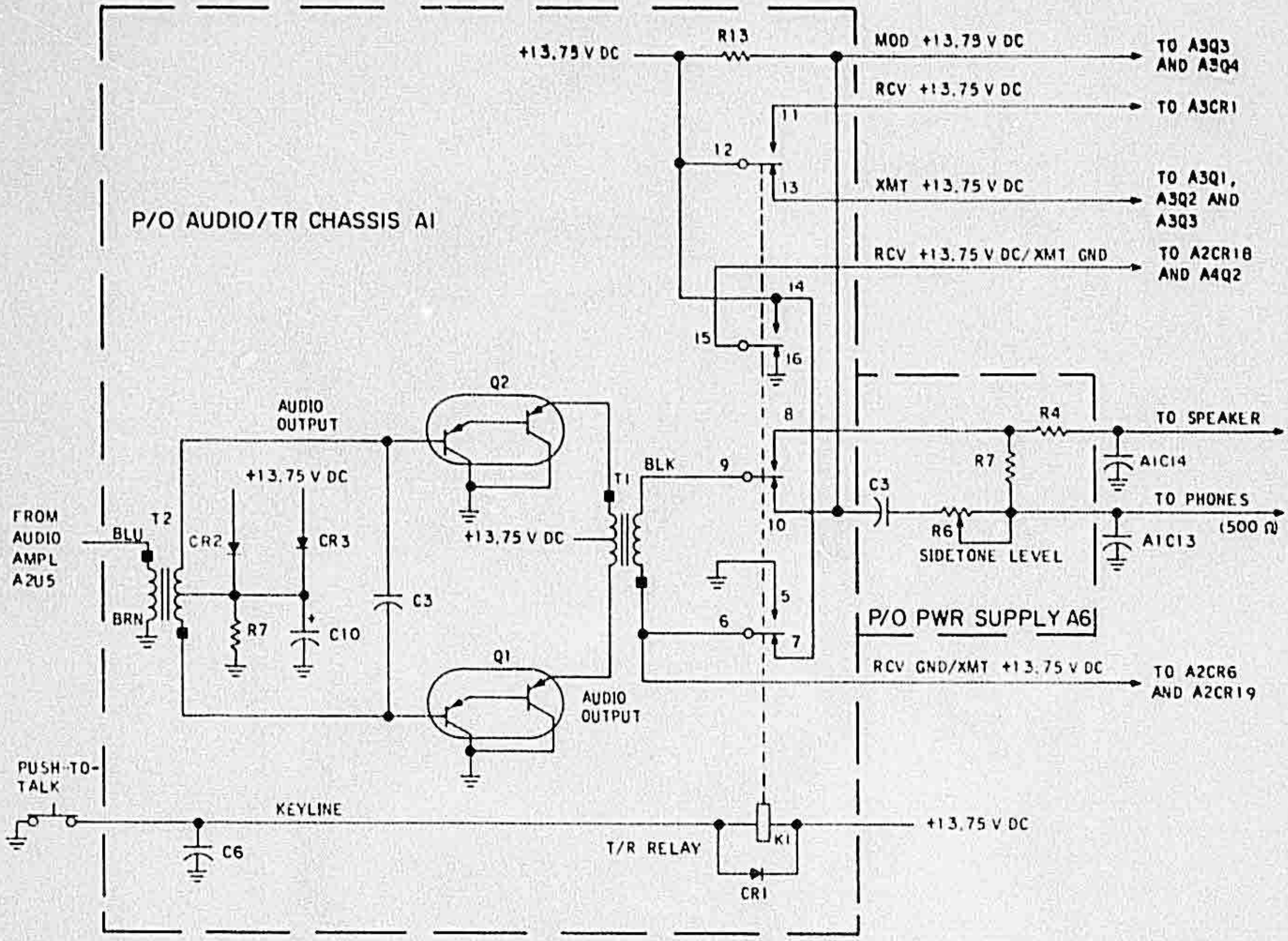
The second set of contacts (8,9 and 10) switches the secondary of A1T1 from the speaker output to the 500-ohm headphone output to provide sidetone monitoring. Sidetone audio output level adjustment is provided by A6R6. In addition to providing the sidetone output, A1T1 becomes a modulation transformer and supplies its output to the collector of driver transistor A3Q3 and power amplifier transistor A3Q4.

Contacts 14, 15 and 16 switch the line feeding A2CR18 and A4Q2 from +13.75 V dc to ground. This results in blockage of the receiver audio signal at the audio gate and switching of the synthesizer offset circuit, lowering the vco frequency 10.5 MHz to accommodate the transmit frequency range. The top set of contacts (11, 12 and 13) removes +13.75 V dc from tr switch A3CR1 and applies it to power amplifier transistors A3Q3 and A3Q4. This switching removes the forward bias to A3CR1, which blocks the PA output from the receiver preselector circuit and applies enabling voltage to the PA output transistors.

4.3.4.2 Modulation Limiting (Refer to figure 4-22)

Transmitted audio modulation is provided by circuitry contained in the receiver audio section. Microphone inputs are coupled to af compressor amplifier A2U4C for processing. The output of the audio processing network, discussed in paragraph 4.3.3.6, is applied to audio amplifier A2U5, which drives the final audio output stage consisting of A1Q1, A1Q2 and associated components. The modulated +13.75-V dc and transmit +13.75-V dc voltages are applied to power amplifier A3 by relay A1K1.

Actual modulation limiting occurs within the power amplifier by regulating the downward modulation in the collector circuit of A3Q3. Both driver transistor Q3 and PA Q4 collector circuits are modulated by the switched output of modulation transformer A1T1, but only Q4 is free to follow the full range of modulating signal. A limiting circuit (consisting of CR2, R11, CR3 and R10) prevents the driver collector from following the downward travel of the modulating signal. As the modulated +13.75-V dc line rises above the +13.75-V level (may go as high as 25 V or as low as 0 V), diode CR2 will remain forward biased allowing the collector voltage of Q3 to follow the Q4 collector voltage. When the modulated +13.75-V line drops below +13.75 V, CR2 becomes reverse biased. When this occurs, the collector current of Q3 through R11 lowers the cathode voltage of diode CR3 which forward biases the diode. The collector of Q3 is now connected to the +13.75-V line through CR3 and



Transmit Mode Switching Figure 4-21

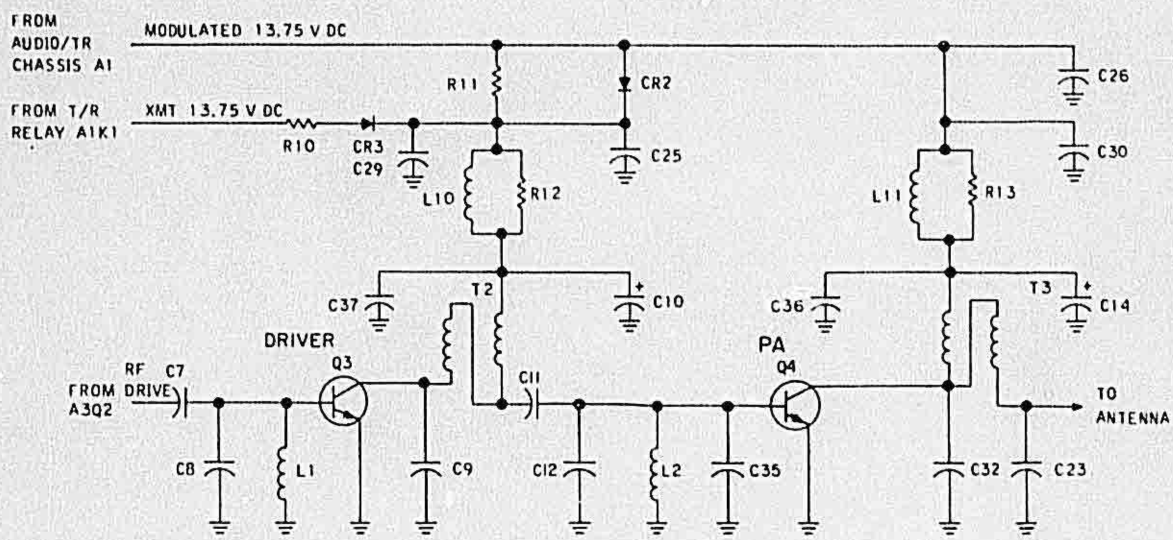
R10. The voltage drop across R10 limits the downward travel of the collector of Q3 to approximately 10 V.

The characteristics of this circuit therefore permit transistor Q3 to conduct even though low collector voltage cuts off PA transistor Q4. Normal leakage through Q4 couples the Q3 output to the antenna, which ensures that some rf will always be present to prevent overmodulation.

4.3.4.3 Transmit Amplification (Refer to diagrams section, power amplifier A3 schematic)

The power amplifier consist of four stages of amplification following the synthesizer rf drive output. All stages use broadband tuned circuits. The first two stages, preamplifier Q1 and predriver Q2, are powered directly by the 13.75-V dc transmit bus. Collector modulation is applied to the last two stages, driver Q3 and power amplifier Q4. Rf power output is a nominal 10 W (14 W minimum in VHF-251E). Modulation levels up to 95 percent are obtainable with low envelope distortion. Output tuning is provided by variable capacitor C15. This capacitor is adjusted to provide maximum output power at the high end of the transceiver frequency range. The rf output is low-pass filtered to provide harmonic rejection.

The antenna tr switch consists of diode CR1. During transmission, the diode is reverse biased by transmitter rf and the receiver is isolated from the antenna.



Modification Limiting & Amplification Figure 4-22

4.3.4.4 Transmit Indicator (Refer to figure 4.23)

The rf output of power amplifier Q4 is detected by diode CR4, which feeds lamp driver Q5. Lamp driver transistor Q5 supplies the xmt lamp, A8DS6, located on the front panel, with the ground needed for lamp illumination. Lamp drive voltage, which varies with the modulation, is supplied by audio/tr chassis A1. In this manner, xmt lamp A8DS6 may be used as a modulation monitor as well as an indication of transmit mode of operation.

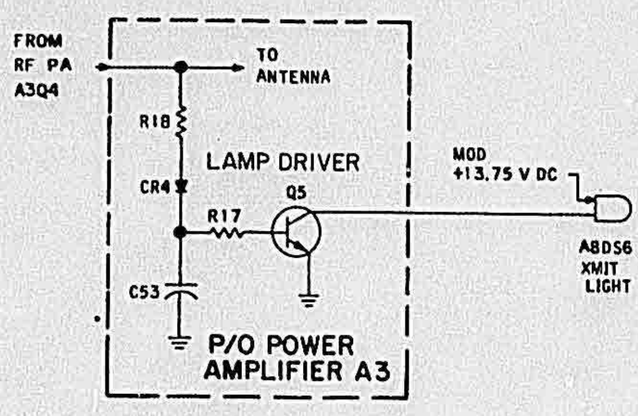
4.3.5 Electronic Display Dimming (Refer to figure 4-24)

The electronic display consists of four bcd-to-7-segment decoder/drivers and five 7-segment incandescent filament type units. Display power is supplied by the +5.2-V dc switching regulator; display brightness is controlled by photocell V1 located on the transceiver front panel. Photocell V1 senses the ambient light level within the cockpit and varies the drive applied to amplifier U11. As the ambient light level increases, the resistance of photocell V1 decreases; this, in turn, increases the drive applied to U11. Amplifier U11 controls the bias voltage applied to transistor Q2, driving displays DS1 through DS5. As the ambient light level within the cockpit decreases, the voltage applied to the display also decreases.

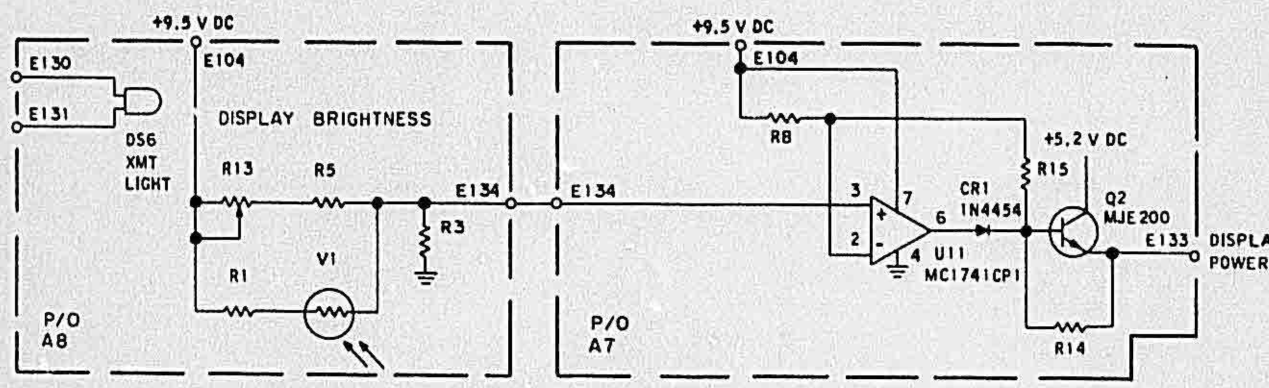
4.3.6 Power Distribution

4.3.6.1 +5.2-V DC Switching regulator (Refer to figure 4-25)

The +5.2-V dc switching regulator supplies power to the electronic display, display logic circuitry, and frequency synthesizer. The +13.75-V dc filtered input power is applied to transistors A6Q3 and A6Q4 and to pin 3 of regulator A6U1. A6U1 is a switching regulator used to control the pulse duration of a voltage applied to the base of transistor A6Q4. This pulse duration is determined by a comparison between +5.2-V dc reference voltage and the output. The sampled output is supplied to regulator



Transmit Indicator
Figure 4-23



Electronic Display Dimming Figure 4-24

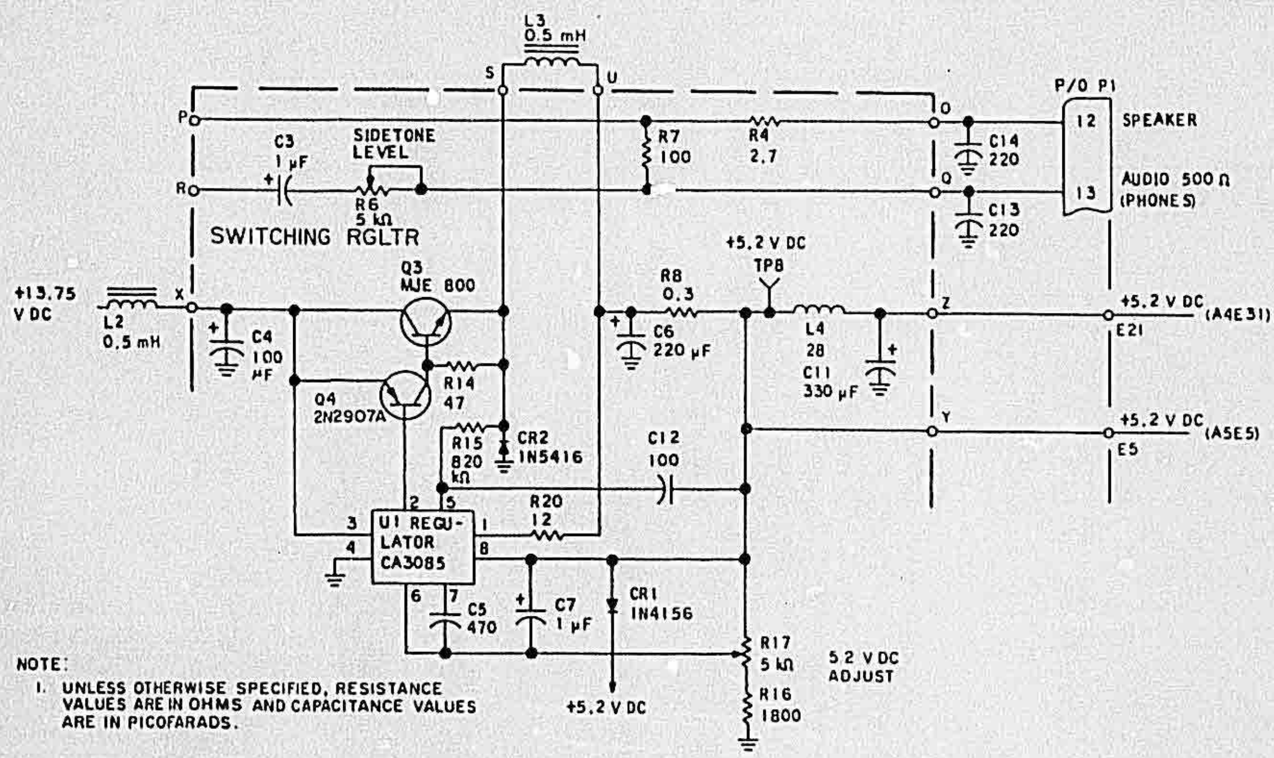
A6U1 by a voltage divider network consisting of resistors A6R16 and A6R17. The pulsed output of transistor Q4 is applied to the base of A6Q3, causing a pulsating output to occur. The +5.2-V dc signal is developed by regulator A6U1 and diode A6CR2. The LCR filter (consisting of A6C6, A6R8, A6L4 and A6C11) ensures a smooth output voltage.

4.3.6.2 +9.5-V DC Series Regulator (Refer to figure 4-26)

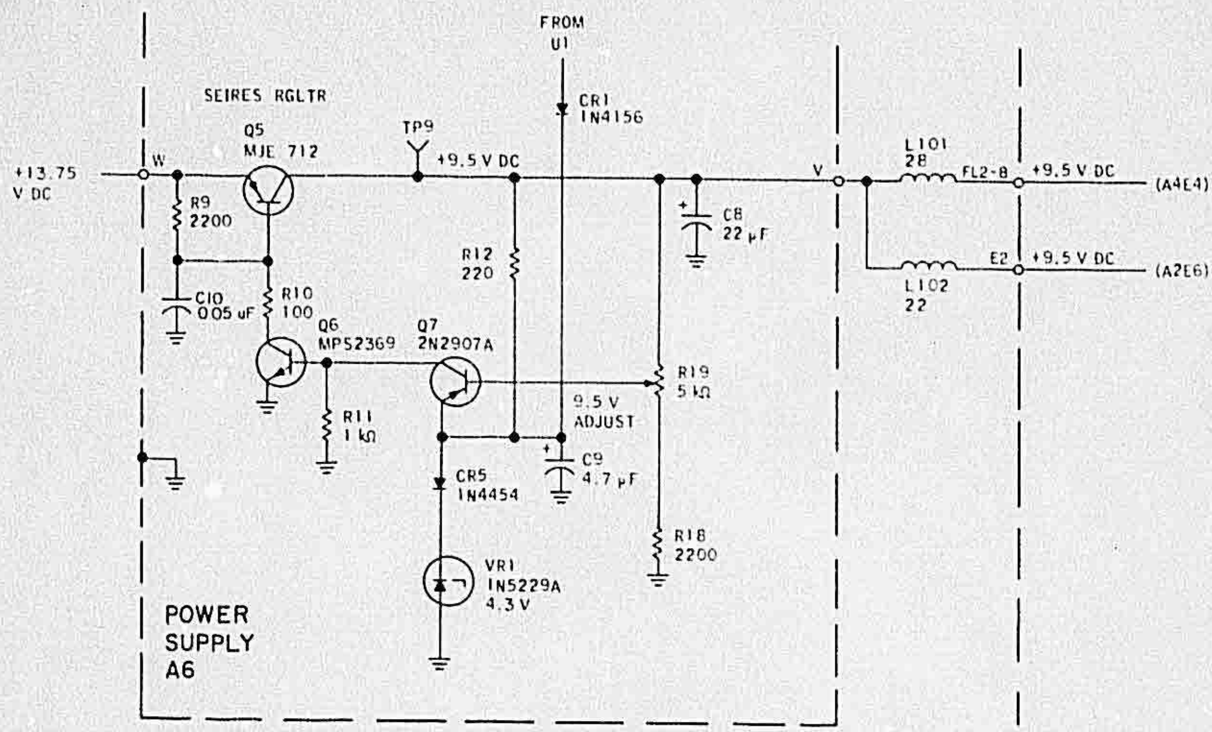
The +9.5-V dc output of the series regulator is used in all low-level signal circuitry and in voltage sensitive circuits contained in the synthesizer.

The power supply is a conventional series regulator producing +9.5 V dc from a filtered +13.75-V dc input voltage. The difference between the input and a portion of the output is used to supply an actuating error signal to the control elements.

Comparison of the output is made to a reference voltage established by zener VR1. Temperature compensation is provided by diode CR5. The amplified error signal is used to reduce the difference between the two voltages to essentially zero. The filtered +13.75-V dc input power is applied to transistor A6Q5, the supply control element. The regulated output of Q5 is sampled by a voltage divider network consisting of resistors R18 and R19. This sampled voltage will be the error voltage if the output voltage deviates from +9.5 V dc. Resistor R19 is adjusted to provide the desired +9.5-V dc output. Any deviation from the set voltage changes the bias on the base of transistor Q7. A reduction in the output voltage (below +9.5 V) makes the base more negative, with respect to the reference voltage and increases Q7 drive. This causes transistor Q6 to conduct more heavily, in turn increasing conduction through series regulator transistor Q5 and raising the output voltage to the desired +9.5-V dc level. Should the +9.5-V level increase, the base drive of transistor Q7 will be decreased, and the correction process is reversed. CR1 provides starting current to Q7, which ensures the supply will be actuated under all conditions of line voltage and temperature.



+5.2-V DC Switching Regulator Figure 4-25



+9.5-V DC Series Regulator Figure 4-26

05

VHF-251/251S/251E Communications Transceiver

S-TEC Corporation
TEC LINE Avionics

maintenance

Printed in USA

1st Edition, 22 July 1991

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AND ENTER DATE INSERTED AND INITIALS

REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	22 Jul 91		VHF-251 SB 1-3 VHF-251 SB 1-4; SIL 1-75, 1-76, 2-76 VHF-251 SB 1-4, 6,7; SIL 1-75, 1-76, 2-76, 3-76, VHF-251 SB 1-4, 6, 7, 9-12; SIL 1-75, 1-76, 2-76, 3-76, 4-76, 1-77, 2-77, 3-77 VHF-251S SB 1-5; SIL 1-76, 1-77, 2-77 VHF-251E SB 1-6; SIL 1-76, 1-77, 2-77SIL 1-78, 1-80, 2-80 VHF-251 SB 13,14, 15, 16 VHF-251S SB 5,				6, 7, 8, 9 VHF-251E SB 6, 7, 8, 9, 10
				1	1 Nov 91		None

SECTION V
Maintenance

5.1 GENERAL

Caution

Remove power cable before disassembling any portion of the equipment. Disassembling the equipment with the power cable connected may cause damage to the equipment.

This section contains information necessary to maintain, repair, test and align the VHF-251/251S/251E Communications Transceiver.

Table 5-1 lists tools needed to accomplish transceiver alignment and/or repair.

Two testing procedures are provided in this section. The minimum performance test is performed before installation of the equipment in the aircraft, or after minor repairs have been completed. The minimum performance test is also used as a means of fault isolation. Using the minimum performance test in this way, the technician is able to select the applicable detailed test or alignment procedure in a minimum amount of time.

The detailed performance test and alignment procedures are provided for in-depth testing and alignment. Tests and alignment procedures are arranged in a manner that allows the technician to display the component layout and the selected schematic while testing. It is recommended that the minimum performance test be performed before the detailed performance test. Using this method, faults are quickly isolated to the appropriate board. Detailed performance testing and alignment procedures are then performed for that board.

5.2 COMPONENT REPLACEMENT

5.2.1 Replacement of Integrated Circuits

Integrated circuits (IC's) are often difficult items to replace and therefore should not be replaced simply on a guess that the existing IC is defective. Do not replace an integrated circuit until all other defects are eliminated and it is determined the IC is definitely defective.

Caution

Devices such as CMOS, NMOS, MNOS, VMOS, HMOS, thin filmed resistors, PMOS and MOSFET used in many equipments can be damaged by static voltages present in most repair facilities. Most of these components contain internal gate protection circuits that are partially effective, but good practice dictates careful handling of all electrostatic sensitive components.

Table 5-1. Tools Required.

DESCRIPTION	CHARACTERISTIC	FUNCTION
20-watt soldering iron	Any.	Remove/replace IC's and components.
Solder sucker	Any.	Used to remove solder.
Needle-nose pliers	Any.	Bend component leads.
Cutting tools	Various, small diagonal cutter, end nippers, etc (sharp tools that will not leave burrs).	Cut IC and component leads.
Adjustment tool	JFD 5284 or equivalent.	Used to adjust variable resistors.
Screwdrivers	Any.	Disassembly.
Special nut driver	Part number 628-5750-001.	Rf power transistor disassembly.

The following precautions should be observed when handling all electrostatic sensitive components and units containing such components.

a. Deenergize or disconnect all power and signal sources and loads used with the unit.

b. Place the unit on grounded conductive work surfaces.

c. Ground the repair operator through a conductive wrist strap or other device using a 1-MΩ series resistor to protect the operator.

d. Ground any tools (including soldering equipment) that will contact the unit. Contact with the operator's hand provides a sufficient ground for tools that are otherwise electrically isolated.

e. All electrostatic sensitive replacement components are shipped in conductive foam or tubes and must be stored in the original shipping container until installed.

f. When these devices and assemblies are removed from the unit, they should be placed on the conductive work surface or in conductive containers.

g. When not being worked on, wrap disconnected circuit boards in aluminum foil or in plastic bags that have been coated or impregnated with a conductive material.

h. Do not handle these devices unnecessarily or remove from their packages until actually used of tested.

Failure to observe all of these precautions can cause permanent damage to the electrostatic sensitive device. This damage can cause the device to fail immediately or at a later date when exposed to an adverse environment.

Note the orientation of the IC on the board before removal to assure correct placement of the new part. Remove the old IC by clipping each lead on the IC using a small diagonal cutter. Heat the leads with a soldering iron and pull them from the board with needle-nose pliers. Clear excess solder from the holes with a solder sucker. This procedure avoids overheating the circuit board and damaging other components or the board itself.

When soldering new IC into place, avoid applying an excessive amount of heat which may cause internal damage to the IC, making inoperable. After soldering, use a toothpick to remove any heavy rosin deposits; solder joints should be smooth, bright, and clean.

5.2.2 Replacement of Power Amplifier A3 Capacitors A3C36 and A3C37

Capacitors A3C36 and A3C37 are soldered in place with solder containing silver. If these capacitors must be moved or replaced, use only silver bearing solder on these parts. Silver bearing solder used in the VHF-251/251S/251E is S-TEC part number 005-0809-000.

5.3 DISASSEMBLY/ASSEMBLY

Warning

> This electronic equipment may have components that contain sealed materials (such as beryllium oxide, acids, lithium, radioactive material, mercury, etc.) that can be hazardous to your health. If the component enclosure seal is broken, precautions must be taken against personal contact or inhalation, in accordance with OSHA requirements 29CFR1910.1000, during equipment maintenance, disassembly, or repair.

The VHF-251/251S/251E Communications Transceiver is a panel-mounted unit contained in a 80.7 mm (3.18 in) x 67.4 mm (2.65 in) x 316.2 mm (12.45 in) chassis. Electrical connections are made through one 25-pin connector and an antenna connector located on the rear of the chassis. The VHF-251/251S/251E is designed to provide direct access to all parts with minimum effort. The synthesizer and receiver boards are hinged to swing out for servicing. Chassis components and unhinged boards are arranged to provide maximum accessibility for servicing. All boards are direct wired, thus eliminating the need for extender cables.

5.3.1 Disassembly

Before proceeding with disassembly procedures, review the exploded view, figure 5-1.

5.3.1.1 Electronic Display A8 Removal

a. Remove front panel knobs (1, 3, 5, 32) by loosening setscrews (2, 4).

b. Remove two screws (7) and slide front panel (6) off.

c. Remove screw (8) and carefully slide A8 board (9) from front of unit.

5.3.1.2 Preset Board A7 Removal

a. Remove top front cover (11) and three screws (19).

b. Lift A7 board (20) from front of unit.

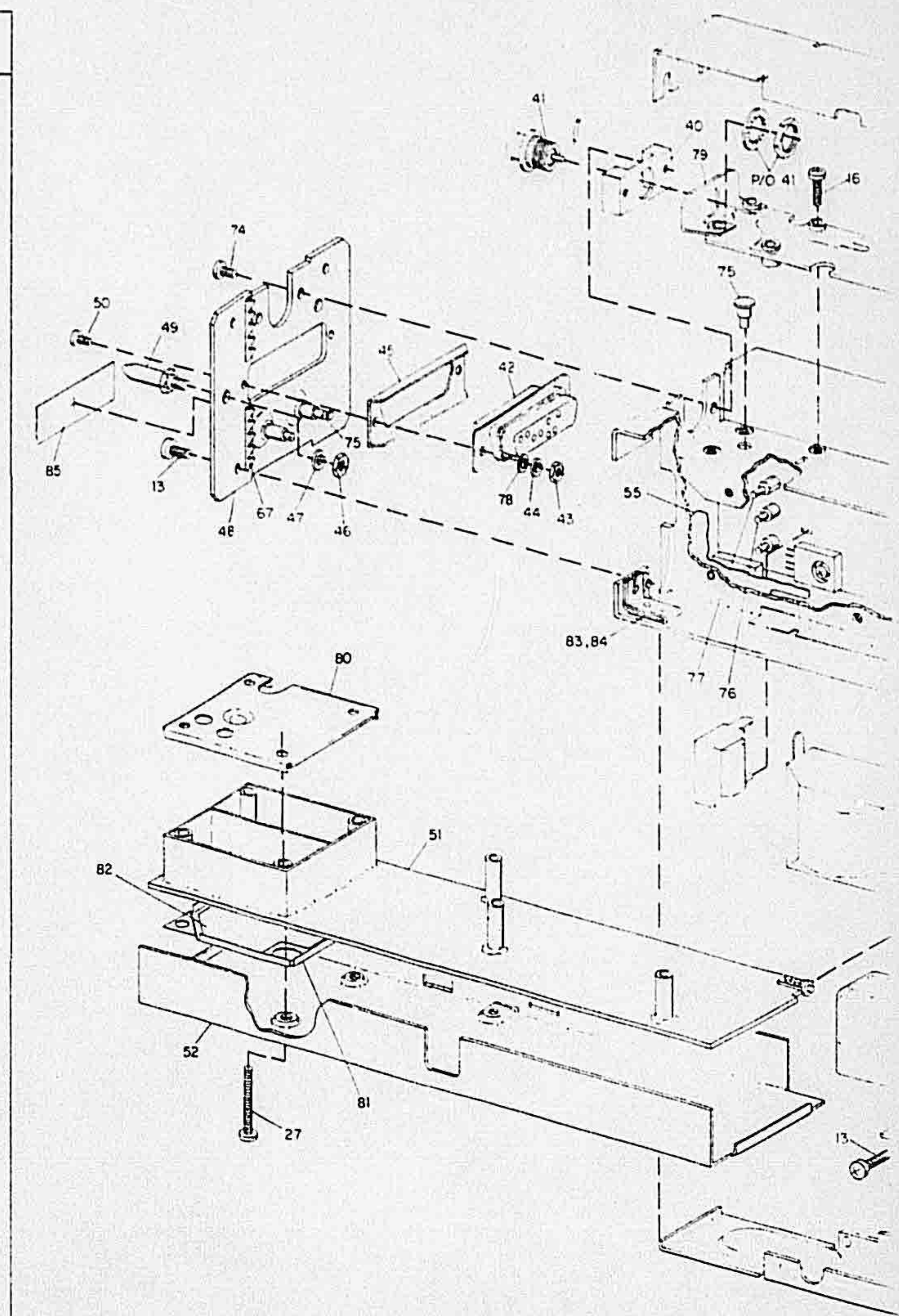
5.3.1.3 Synthesizer Board A4 Removal

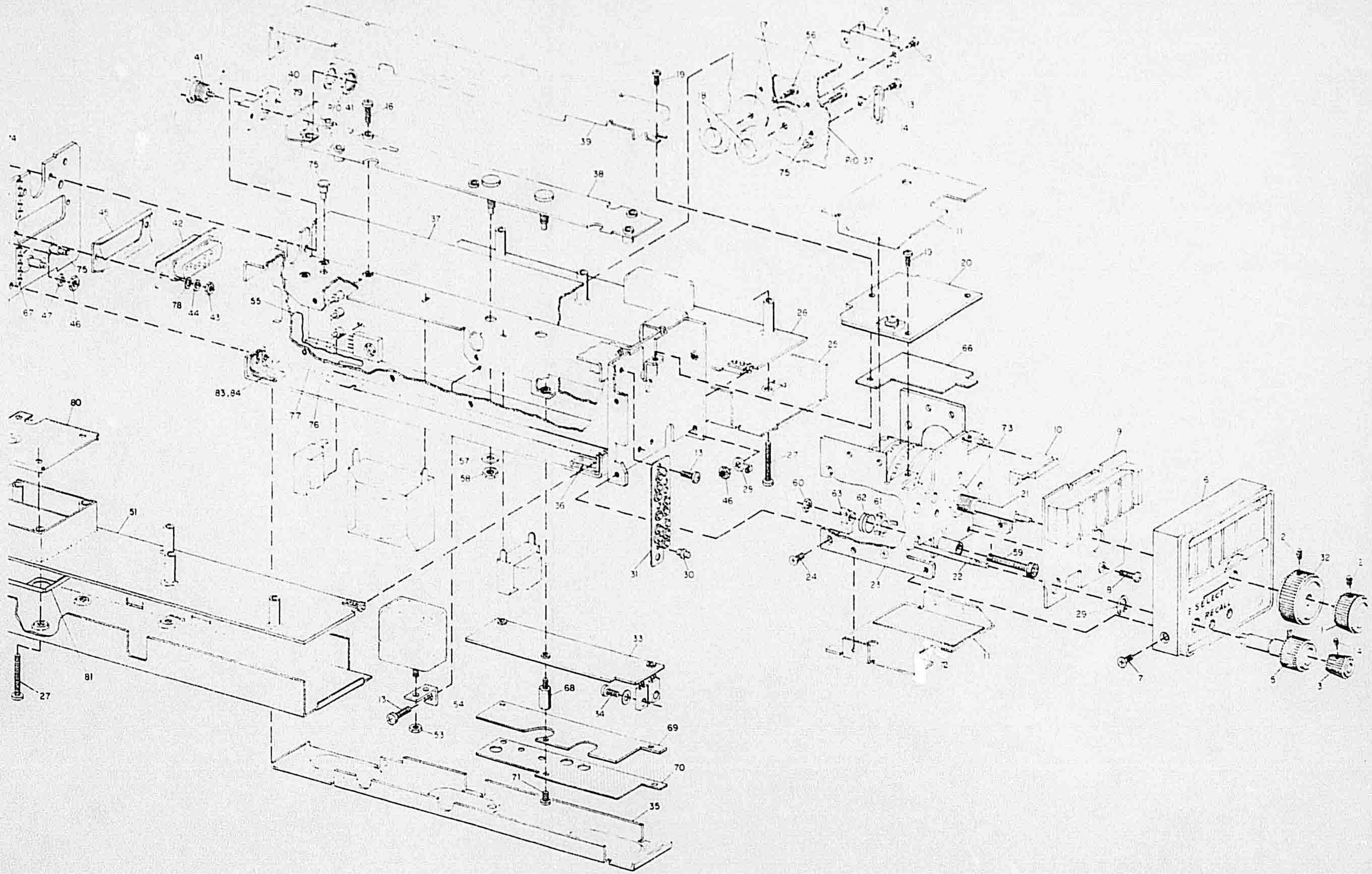
a. Remove seven screws (27) from synthesizer cover (52).

ITEM	DESCRIPTION	CPN
1	Knob, kHz	628-5413-001
2	Setscrew, #4-40 x 3/16	328-5029-000
3	Knob, volume	628-5490-002
4	Setscrew, #4-40 x 1/8	328-5020-000
5	Knob, pointer	628-5481-001
6	Front panel assy	
	VHF-251	
	Black	628-5519-001
	Blue	628-5519-003
	Green	628-5519-005
	Red	628-5519-007
	Brown	628-5519-009
	Gray	628-5519-011
	VHF-251S	
	Black	628-5519-013
	Blue	628-5519-026
	Green	628-5519-027
	Red	628-5519-028
	Brown	628-5519-029
	Gray	628-5519-030
	VHF-251E	
	Black	628-5519-014
	Blue	628-5519-021
	Green	628-5519-022
	Red	628-5519-023
	Brown	628-5519-024
	Gray	628-5519-025
7	Screw, #4-40 x 1/4 black flathead	330-1773-020
8	Screw, #4-40 x 1/2 Phh	343-0137-000
9	Display - COMM A8, printed circuit board assy	628-5045-001
10	Guide, circuit card	628-5349-001
11	Cover	628-5504-001
12	Screw, #2-56 x 3/16 Phh, TF	330-1779-010
13	Screw, #4-40 x 1/4 Phh, TF	330-1779-040
14	Lug, solder type	304-1089-000
15	Filter can	628-5486-001
16	Screw, #4-40 x 5/16 Phh	343-0134-000
17	Washer, insulator	628-5177-001
18	Retainer	150-0827-040
19	Screw, #4-40 x 1/4 Phh	330-1779-040
20	Preset, printed circuit board assy	628-5041-001
21	Switch assembly (refer to figures 5-2 and 5-3)	
	VHF-251	628-5784-001
		or
		628-5753-001
	VHF-251S	628-5441-001
22	Switch/pot assembly (refer to figure 5-4)	628-5521-001
		or
		628-6014-001
23	Control chassis	628-5450-002
24	Screw, #4-40 x 1/4 flathead	330-1773-010
25	Cover, receiver	628-5360-001

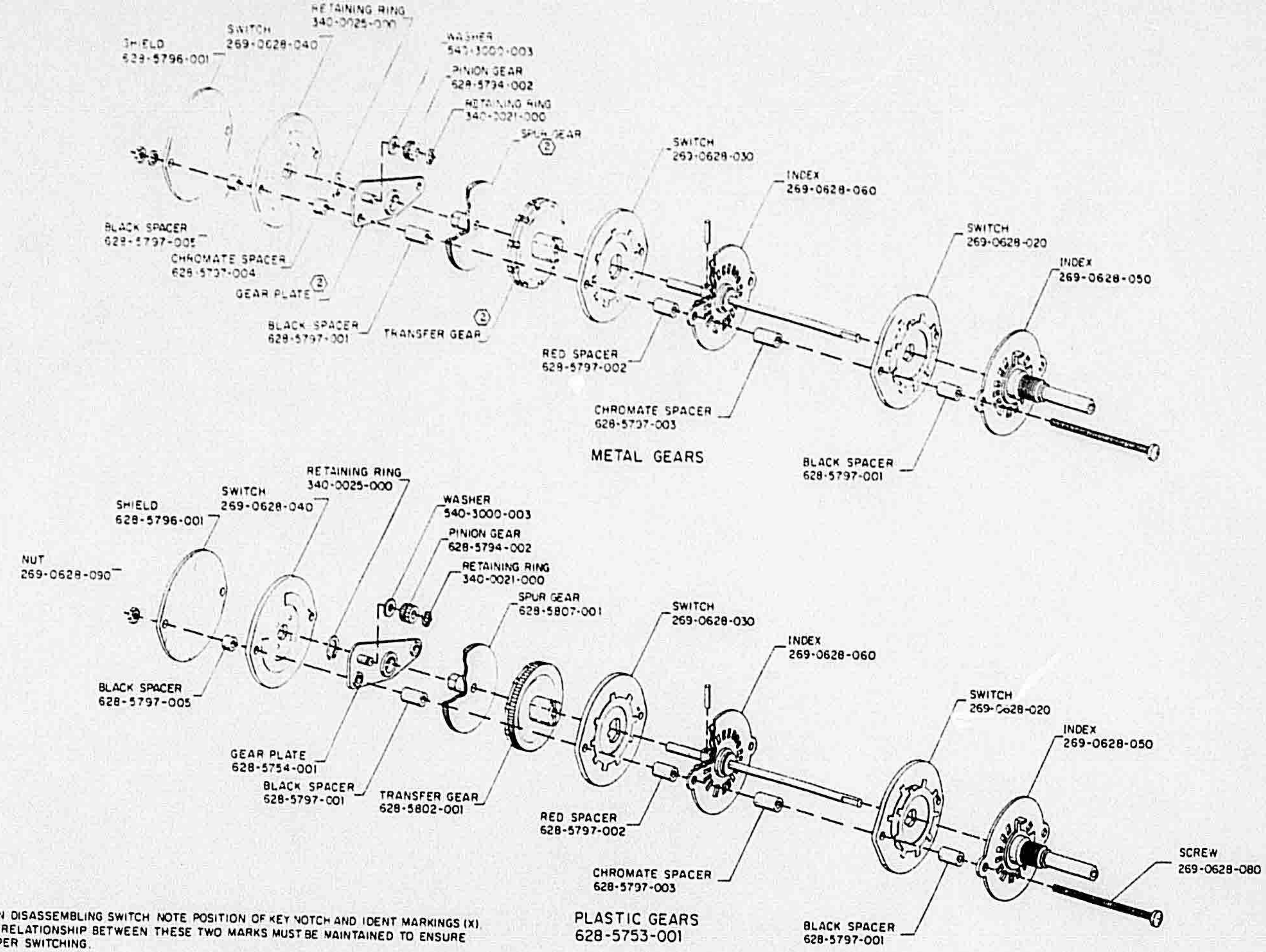
ITEM	DESCRIPTION	CPN
26	Receiver A2, printed circuit board assy	
	VHF-251	628-5025-001
	VHF-251S	628-5025-002
	VHF-251E	628-5025-003
27	Screw, #4-40 x 7/8 Phh	343-0140-000
28	Lug	304-0015-000
29	Retaining ring	340-0271-000
30	Capacitor, feedthrough	913-3303-040
31	Plate, mounting	628-5474-001
32	Knob	628-5414-001
33	Power supply, printed circuit board assy	628-5001-001
34	Screw, #4-40 x 3/8 Phh	330-1779-040
35	Cover, bottom rear	628-6015-001
36	Chassis, synth assy	628-5439-002
37	Chassis, rcvr assy	628-5418-001
38	Power ampl, printed circuit board assy	
	VHF-251/251S	628-5021-001
	VHF-251E	628-5021-003
39	Cover, top rear	628-5501-002
40	Block	628-5329-001
41	Connector, rf	357-7532-020
42	Connector, 25 pin	371-0379-010
	(contacts for item 42)	371-0379-030
43	Nut, #2-56, crescent	313-0037-000
44	Lockwasher	310-0275-000
45	Strip	628-5334-001
46	Nut, #4-40, crescent	313-0043-000
47	Lockwasher	310-0279-000
48	Plate, rear	628-5331-001
49	Pin, guide	628-8105-002
50	Screw, #2-56 x 1/4 Phh	343-0124-000
51	Synthesizer assembly	
	VHF-251/251S (bd no 628-5030-XXX)	628-5069-001
	VHF-251E (bd no 628-5030-XXX)	628-5069-003
	VHF-251 (bd no 628-5030-002)	628-5029-001
52	Cover, synth	628-5361-001
	or	or
	Cover, synth	628-9541-001
53	Nut, #3-48	313-0190-000
54	Strap	628-5093-001
55	Heat sink	628-6662-001
56	Screw, #4-40 x 3/8 Phh	343-0135-000
57	Washer, lock	310-0072-000
58	Nut, hex, #8-32	313-0120-000
59	Screw, 8-32, socket cap hd	324-1713-040
60	Nut	334-2115-010
61	Turnlock washer	628-5336-001
62	Helical spring	340-0299-010
63	Turnlock pawl	628-5338-001
64	Washer, flat, #8	540-3004-003
65	Vco cover	628-5354-001

ITEM	DESCRIPTION	CPN
66	Insulator	628-6663-001
67	Contact strip	628-7477-001
68	Standoff	312-0393-010
69	Noise blanker A10	628-7439-001
70	Insulator	628-7499-001
71	Screw, #4-40 x 1/4 Phh	343-0133-000
72	Insulator	628-7962-001
73	Nut	334-4060-000
74	Screw, 4-40 x 3/8 Pph TF	330-1779-050
75	Insulated terminal	306-2681-010
76	Insulated feedthrough terminal	306-2681-020
77	Ground terminal	306-2683-010
	Washers for item 21 (not shown)	
	Flat	628-5810-001
	Keyed	628-5978-001
78	Flat washer, #2	310-0129-000
79	Bracket	628-5437-001
80	Vco cover (eff VHF-251, SB 17; VHF-251S, SB 10; VHF-251E, SB 11)	628-5352-001
81	Shield (eff VHF-251 SB 17; VHF-251S, SB 10; VHF-251E, SB 11)	628-5362-001
82	Insulator (eff VHF-251, SB 17; VHF-251S, SB 10; VHF-251E, SB 11)	628-5363-001
83	Spring clip	628-5332-001
84	Bracket	628-7996-001
85	Ident plate (VHF-251)	628-9025-001
	Ident plate (VHF-251S)	628-9052-001
	Ident plate (VHF-251E)	628-9053-001





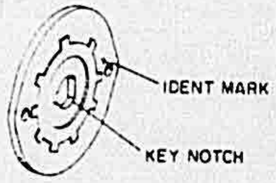
VHF-251/251S/251E Communications Transceiver, Exploded View
Figure 5-1



NOTES:

(1) WHEN DISASSEMBLING SWITCH NOTE POSITION OF KEY NOTCH AND IDENT MARKINGS (X). THE RELATIONSHIP BETWEEN THESE TWO MARKS MUST BE MAINTAINED TO ENSURE PROPER SWITCHING.

(2) PART IS NO LONGER AVAILABLE; ORDER 628-5753-001.



VHF-251/251E Rotary Switch Assembly, Exploded View
Figure 5-2

b. Remove synthesizer cover (52). Synthesizer board A4 (51) may be swung down for component access.

5.3.1.4 Power Amplifier A3 Removal

a. Remove top front cover (11). Loosen screw (19), and remove two screws (13).

b. Remove top rear cover (39).

c. Remove seven screws (16) securing power amplifier board A3 (38) to chassis.

d. Remove power supply board A6 (33).

e. Carefully remove power amplifier and driver transistor mounting nuts using special nut driver, S-TEC part number 628-5750-001.*

f. Carefully remove power amplifier board A3 (38).

Caution

When repositioning power amplifier board A3, ensure that no interconnecting wires are accidentally pinched under mounting hardware.

5.3.1.5 Power Supply A6 Removal

a. Remove bottom rear cover (35).

b. If noise blanker A10 (69) has been installed, remove attaching hardware (71) and lift blanker (69) and insulator (70) off posts (68). Remove posts (68).

c. Remove two screws (34) securing transistors A6Q5 and A6Q3 to the chassis (37).

d. Remove attaching hardware (if not already removed in step b) that secure power supply A6 to chassis.

5.3.1.6 COMM Receiver A2 Removal

a. Remove three screws (27) which secure receiver cover (25) to chassis (37).

b. Remove receiver cover (25). COMM receiver A2 (26) may now be swung down.

5.3.1.7 Switch/Pot Assembly and Wafer Switch Assembly Removal

a. Remove knobs (1, 3, 5, 32) by loosening setscrews (2, 4). Remove two screws (7) from front panel (6) and remove panel (6).

b. Remove screw (8) and slide out electronic display A8 (9).

c. Remove top and bottom front covers (11).

d. Remove four screws (24) that attach front chassis (23) to rear chassis (36, 37).

e. Remove large nut and washer that secure wafer switch (21) to front chassis (23).

f. Remove two screws attaching switch/pot assembly (22) to front chassis (23).

Note

Switch/pot assembly (22) and wafer switch assemblies (21) are illustrated in figures 5-2, 5-3 and 5-4.

5.3.2 Assembly

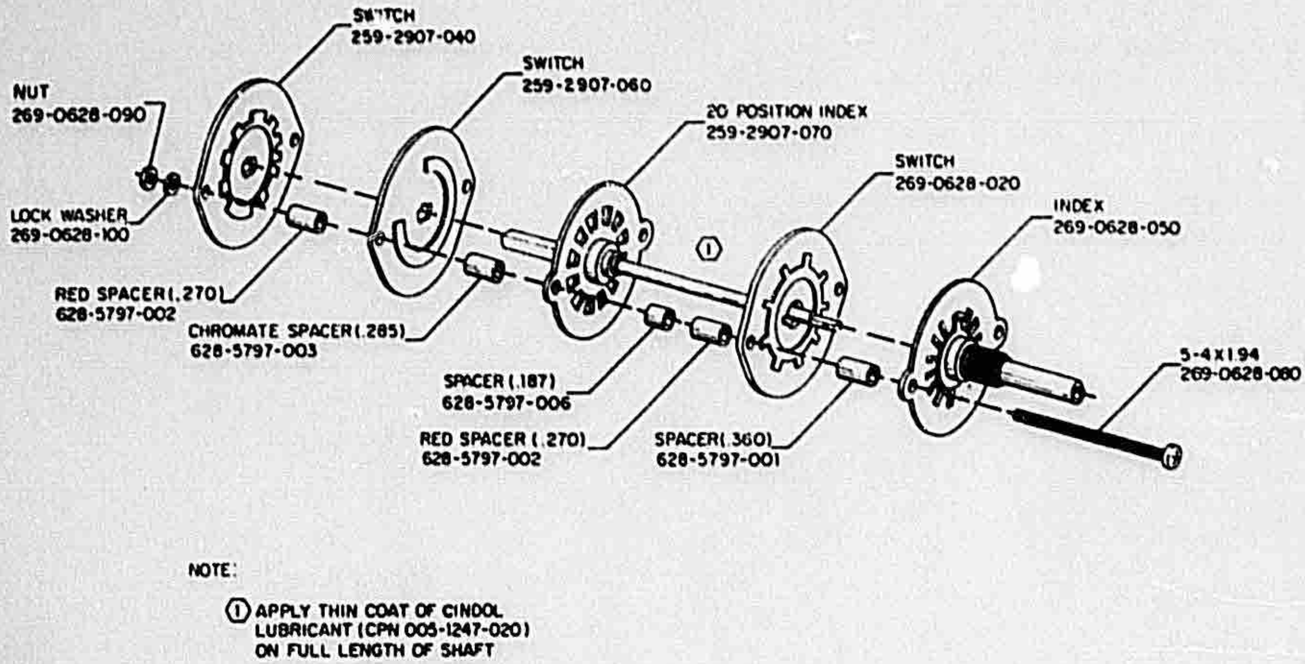
Reassembly can be accomplished by reversing the disassembly procedures and consulting the appropriate exploded view. Parts comprising the VHF-251/251S/251E Communications Transceiver are listed in the tabulation included with figure 5-1.

5.4 TEST EQUIPMENT

Table 5-2 is a list of test equipment required for customer acceptance/minimum performance testing of the VHF-251/251S/251E Communications Transceiver. Table 5-3 lists the test equipment for detailed testing, alignment, and troubleshooting. In addition to the equipment listed in table 5-3, a special rf envelope detector (table 5-4) must be fabricated. A schematic diagram for the envelope detector is shown in figure 5-6.

The test equipment specification parameters listed for each type of testing must be met or exceeded to ensure proper results. All test equipment should be in good working condition and properly calibrated. Always allow sufficient time for test equipment warm-up and stabilization before testing or troubleshooting is begun.

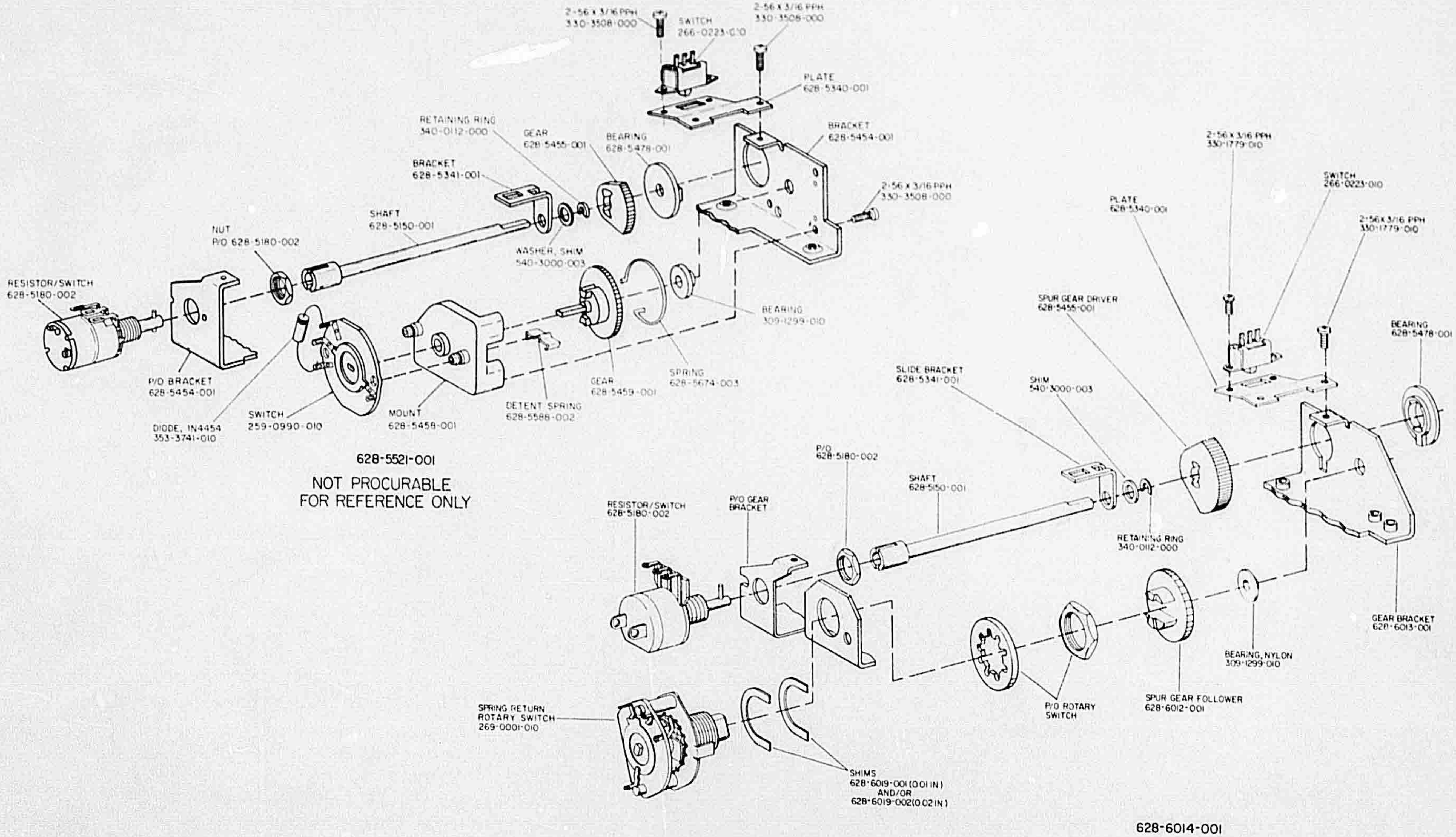
** If the special nut driver is not available, an 11/32 in nut driver may be substituted; however, extreme care must be used to avoid damaging the transistors.*



VHF-251S Rotary Switch Assembly, Exploded View, Figure 5-3

Table 5-2. Customer Acceptance/Minimum Perform. Test Equip.

EQUIPMENT	CHARACTERISTIC REQUIRED
Dc power supply	0 to 20 V dc, 6 A.
Rf generator	Frequency range: 118 through 136 MHz. Rf output range: 1 through 100 000 μV. Attenuator accuracy: ±2 dB. Modulation: 0 through 95 percent at 1, 9, and 17 kHz.
Frequency counter	Range: 118 through 136 MHz. Accuracy: 0.0005 percent of frequency.
Rf watt meter	Power dissipation: not less than 20 W. Impedance: 50 Ω ±10 percent (short term). Accuracy: ±0.5 W.
Audio power meter	Power dissipation: 10 W maximum. Impedance: 3.2 to 500 Ω. Accuracy: ±1.5 dB.
Attenuator pad	50 Ω, 6 ±0.25 dB.
Power attenuator	50 Ω, 20 dB, 20 W.



Switch/Pot Assembly, Exploded View
Figure 5-4

Table 5-3. Detailed Testing and Alignment Test Equipment.

EQUIPMENT	CHARACTERISTIC DESIRED
Rf generator	Frequency range: 70 to 140 MHz.
	RF output range: 1 to 200 000 µV.
	Modulation: 0 to 95%
Audio generator	Range: 20 to 40 000 Hz.
	Distortion: 3% maximum
	Capable of providing 1 V at 30 Hz and 2 V at 400 Hz across 600 ohms.
Audio power meter	Power range: 10 W maximum.
	Accuracy: ±1.5 dB down to 50 mW.
Rf load	Power dissipation: not less than 20 W.
	Impedance: 50 ohms from 118 to 136 MHz.
Frequency counter	Range: 100 to 140 MHz.
	Accuracy: 0.0005% of displayed frequency.
Attenuator pads	50 ohms, 6 dB.
Power supply	14 V, 6 A.
Digital voltmeter	Input impedance: 1 megohm minimum shunted by a capacitance not to exceed 200 pF.
Oscilloscope	Any dc coupled scope (used for waveform observation only).
Distortion analyzer or 1000-Hz notch filter or SINAD meter	Capable of nulling out 1000-Hz audio force.

Table 5-4. Special Test Equipment.

EQUIPMENT	CHARACTERISTIC REQUIRED	REPRESENTATIVE TYPE
Detector	Provides detection of rf envelope.	Fabricate per figure 5-6.

5.5 TESTING AND ALIGNMENT PROCEDURES

This portion of the maintenance section contains testing and alignment procedures for the VHF-251/251S/251E Communications Transceiver.

Two procedures are included for the VHF-251/251S/251E; both are unique and are designed to provide a specific function. The customer acceptance/minimum performance test procedures are provided to ensure proper operation of the VHF-251/251S/251E before installation in the aircraft or after minor repairs have been completed. The detailed test and alignment procedures should be used only when attempting to isolate faults and after repair has been made to realign the affected area. Ensure that test equipment is in good operation condition and properly calibrated.

5.5.1 Customer Acceptance/Minimum Performance Test Procedures

The customer acceptance/minimum performance test procedures should be performed after minor repairs gave been completed or as a preinstallation test procedure prior to unit installation in the aircraft.

These test procedures do not require VHF-251/251S/251E cover removal or internal adjustment. A typical bench-test setup is illustrated by figure 5-5

Note

All specified rf signal generator output levels are actual levels (hard microvolts) as indicated on the generator output meter with a 6-dB pad in series with the generator output. If a 6-dB pad is not used, divide all rf levels by 2.

5.5.1.1 Channeling

a. Apply power to the transceiver and set the STORE/SELECT/RECALL switch to SELECT.

b. Channel the kHz selector in 25-kHz increments (50-kHz in VHF-251S) and note proper sequencing from 0.00 through 0.97 MHz (0.00 through 0.95 MHz in VHF-251S).

c. Channel the MHz selector in 1-MHz increments and note proper sequencing on electronic display from 118 to 135 MHz.

5.5.1.2 Store/Recall

a. Select 118.00 MHz using the frequency selector controls.

b. Turn STORE/SELECT/RECALL switch to STORE and release.

c. Channel the transceiver to 122.10 MHz, then turn STORE/SELECT/RECALL switch to RECALL and observe display. Result: Display shows 118.00 MHz.

d. Return switch to SELECT and observe display. Result: Display shows 122.10 MHz.

5.5.1.3 Receiver Sensitivity

a. Connect rf generator to transceiver antenna connector through a 6-dB pad.

b. Adjust generator for 5-μV, 118.00-MHz rf signal modulated 30 percent with 1000 Hz.

c. Connect audio power meter to P1-13 and P1-6 and adjust transceiver gain for 50 mW into 500 Ω.

d. Measure signal-to -noise ratio (s+n/n) as the difference in audio output level with modulation-on to modulation-off. Result: Signal-to-noise ratio not less than 8-dB.

5.5.1.4 Noise Squelch

a. Connect rf generator to transceiver antenna connector through a 6-dB pad.

b. Adjust generator for a 7-μV (5-μV if noise blanker is incorporated; VHF-251 SB 10, VHF-251S SB 5, VHF-251E SB 6), 118.00-MHz rf signal modulated 30 percent with 1000 Hz.

c. Connect audio power meter to P1-13 and P1-6. Pull VOL/TST knob out and adjust knob for 50 mW into the power meter 500 Ω load.

d. Push VOL/TST knob in and observe presence of audio output. Remove generator input signal and observe that squelch mutes output.

5.5.1.5 Carrier Squelch

a. Connect rf generator to transceiver antenna connector through 6-dB pad.

b. Adjust generator for a 34-μV, 118.00-MHz rf signal modulated 85 percent with 9000 Hz (17 kHz in VHF-251S).

c. Connect audio power meter to P1-13 and P1-6. Pull VOL/TST knob out and set audio gain to a convenient level on the power meter (do not adjust for more than 50 mW into 500 Ω).

d. Push VOL/TST knob in and observe presence of audio output. Remove generator input signal and observe that squelch mutes audio output.

5.5.1.6 Receiver AGC

a. Connect rf generator to tansceiver antenna connector through 6-dB pad.

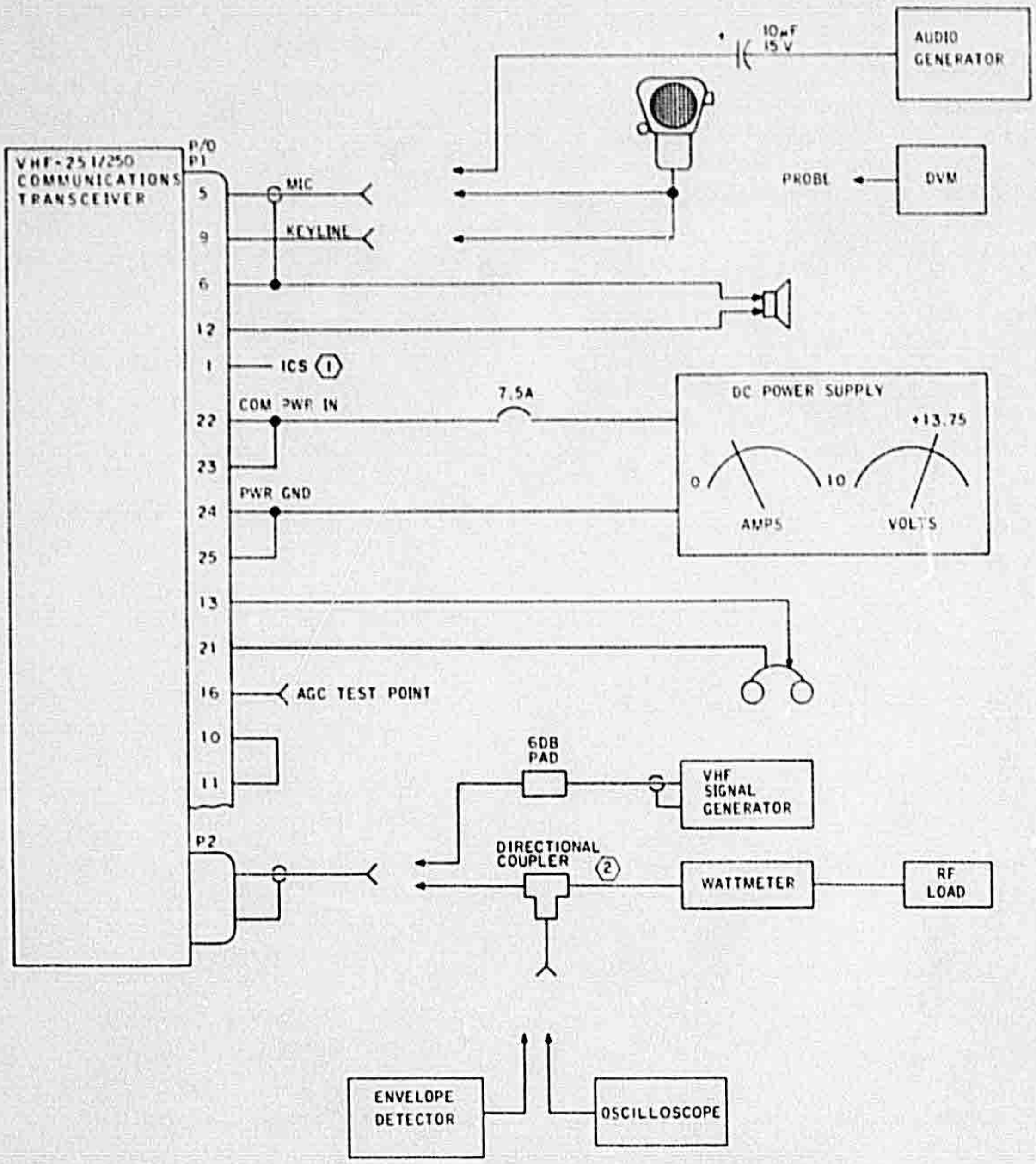
b. Adjust generator for a 10-μV, 118.00-MHz rf signal modulated 30 percent with 1000 Hz.

c. Connect audio power meter to P1-13 and P1-6. Adjust VOL/TST knob to provide a convenient indication on power meter (not greater than 50 mW into 500 Ω).

d. Vary rf input level from 10 to 100 000 μV and observe audio power meter indication. Result: Output does not vary more than 6-dB over entire range.

5.5.1.7 Audio Output

a. Connect rf generator to transceiver antenna connector through a 6-dB pad.

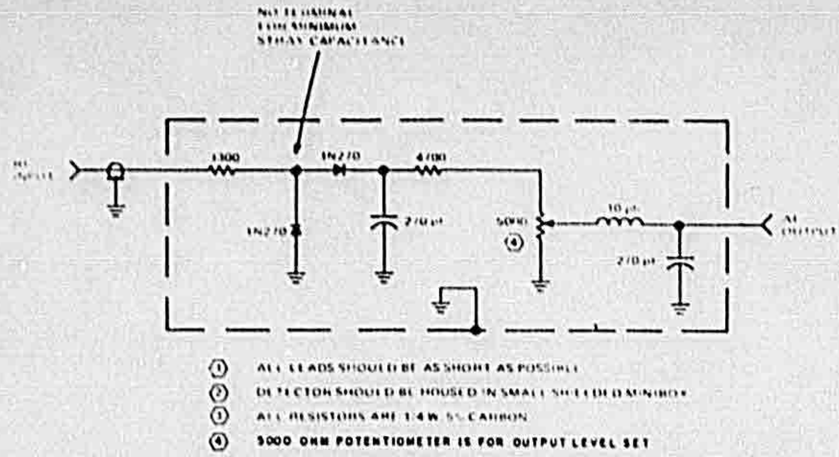


NOTE

① ICS INCLUDED IN VHF-251 ABOVE SN 24590, VHF-251E ABOVE SN 2794, AND VHF-251S ABOVE SN 2697 ONLY.

② PROVIDES 20dB ISOLATION TO ENVELOPE DETECTOR AND OSCILLOSCOPE.

VHF-251/251S/251E Comm. Trans., Bench-Test Setup Figure 5-5



RF Envelope Detector, Figure 5-6

b. Adjust generator for a 1000-µV, 118.00-MHz rf signal modulated 30 percent with 1000 Hz.

c. Connect audio power meter to P1-13 and P1-6 and set to 500 Ω.

d. Rotate VOL/TST control clockwise until an output level of 50 mW is reached. Result: 50 mW is within volume control range.

e. Connect audio power meter to P1-12 and P1-6 and set input inpedance to 3.2 Ω.

f. Rotate VOL/TST control clockwise until an output level of 5 W is reached. Result: 5 W is within volume control range.

5.5.1.8 Intercom (VHF-251 S/N 24591 and Above, VHF-251S S/N 2698 and Above, and VHF-251E S/N 2795 and Above)

5.5.1.8.1 Units Without Service Bulletin 16 (-251), 9 (-251S, or 10 (-251E)

a. Disconnect rf generator input to the transceiver and reduce audio gain to minimum.

b. Connect a 500-ohm load and ac voltmeter between P1-13 (comm audio 500 ohms) and P1-6 (audio ground).

c. Apply a 0.5 V rms (measured at P1-1), 1000-Hz signal to P1-1 (ICS) through a 0.22-µF, blocking capacitor and observe meter indication. Result: 2.5 ±0.85 V rms.

d. Remove audio input signal and connect a 150-ohm resistor from P1-1 to ground. Measure dc voltage across 150-ohm resistor. Result: 1.9 ±0.4 dc.

5.5.1.8.2 Units With Service Bulletin 16 (-251), 9 (-251S), or 10 (-251E)

a. Disconnect rf generator input to the transceiver and reduce audio gain to minimum.

b. Connect a suitable headphone and microphone to the unit.

c. Remove bottom rear cover.

d. Adjust potentiometer A10R10 located on the noise blanker/intercom board A10 for the desired audio output.

e. Install bottom cover.

5.5.1.9 Transmitter Power Output

Caution

Observe 1-minute transmit, 4-minute receive duty cycle to prevent pa overheating.

a. Connect rf watt meter to antenna connector.

Note

VHF-251E power output measurement must be measured with a length of coax no longer than 152 mm (6 in) between transceiver and watt meter.

b. Key transmitter and measure unmodulated power output. Result: Output power is at least 7 W (13 W if VHF-251E).

5.5.1.10 Transmitter Modulation

Caution

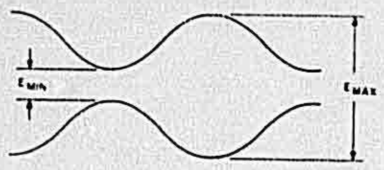
Observe 1-minute transmit, 4-minute receive duty cycle to prevent pa overheating.

a. If an outside antenna is available, perform a talk-out test with another known-good station such as the tower or flight service station. If this is not possible, perform steps b through d.

b. Connect an audio oscillator to microphone audio input P1-5 through a blocking capacitor (10 to 47 µF, 15 V minimum; positive lead to P1-5).

c. Set audio oscillator to 1000 Hz and adjust output level to 0.5 V rms.

d. Key transmitter by grounding key-line input pin P1-9 and observe modulation depth on oscilloscope or modulation depth monitor. Result: If using modulation depth monitor, modulation must be 85 percent minimum; if using oscilloscope, refer to figure 5-7.



$$\frac{E_{MAX} - E_{MIN}}{E_{MAX} + E_{MIN}} \times 100 \geq 85$$

Modulation Depth Calculation, Figure 5-7

Note

If an oscilloscope is used, attenuators must be used between the transceiver and scope input. These attenuators must provide a 50-Ω load for the transceiver and reduce rf output to a level that is an acceptable input level to the scope (rf output may be as much as 155 V p-p). If excessive envelope distortion or low modulation depth is observed, the test should be repeated with additional attenuation added. This ensures that scope input nonlinearity is not introducing error.

5.5.1.11 Transmitter Frequency

Caution

Observe 1-minute transmit, 4-minute receive duty cycle to prevent pa overheating.

a. Connect frequency counter to antenna connector through at least 40 dB of power attenuators.

b. Key transmitter (do not modulate) and observe output frequency. Result: Frequency counter indication and selected frequency agree within ±3 kHz (±2 kHz for VHF-251E).

5.5.2 Detailed Performance Testing and Alignment Procedures

Detailed testing and alignment procedures are intended for use in troubleshooting the VHF-251( ) and realigning the repaired circuit after defective components have been replaced. Failure to obtained the specified results indicates a faulty component. Use the component location diagrams and schematics located in the diagrams section to supplement test and alignment procedures.

5.5.2.1 Power Supplies

a. Measure voltage at test point A6TP9 (A10TP1 if noise blanker has been installed). Result: +9.5 ±0.05 V dc. If necessary, adjust A6R19 for correct voltage.

b. Measure voltage at test point A6TP8 (A10TP2 if noise blanker has been installed). Result: +5.2 ±0.1 V dc. If necessary, adjust A6R17 for correct voltage.

5.5.2.2 Frequency Synthesizer

a. Connect attenuator to antenna jack. Connect the rf load to straight-through leg of directional coupler, and the frequency counter to attenuation leg of directional coupler. Close ptt switch and measure output frequency with transceiver tuned to 118.000 MHz. Result: Within 500 Hz of selected frequency.

If the preceding test results are not obtained, perform the following synthesizer alignment procedures, steps b through e.

b. Connect attenuator to antenna jack. Connect the rf load to straight-through leg of directional coupler, and the frequency counter to attenuation leg of directional coupler. Channel transceiver to 135.000 MHz. Depress ptt switch and adjust A4C12 until a reading of 135.000 MHz ±100 Hz is observed on frequency counter.

Caution

Observe 1-minute transmit duty cycle, or use blower on power amplifier.

c. Channel transceiver to 118.000 MHz. Adjust A4L102 for 5.0 ±0.05 volts at test point A4TP18.

d. Channel transceiver to 15.975 MHz (135.95 MHz in VHF-251S) and set A4C105 for 9.0 ±0.05 volts at test point A4TP18.

e. If tuning A4C105 procedures less than 8.950 volts, increase A4L102 slightly and repeat steps c and d. Continue this procedure until 5.000 ±0.05 volts is obtained at 118.000 and 9.000 ±0.05 volts at 135.975 MHz (135.95 MHz in VHF-251S).

Note

Steps f and g should be performed only when components are replaced in low-pass filter.

f. Tune transceiver to 125.000 MHz. Connect wave analyzer to test point A4TP18, using a short (less than 610 mm (24 in)) length of coax. Set wave analyzer for 25 kHz.

g. Observe wave analyzer and adjust A4L2 for null of 25-kHz sideband.

Note

The following steps (h and i) are an alternate method of performing steps f and g on the VHF-251 and VHF-251E. They should be used only when a wave analyzer is not available.

h. Connect rf signal generator to antenna jack and apply a 1000-µV, 125.000-MHz signal modulated 30 percent with 1000 Hz. Tune transceiver to 125.025 MHz.

i. If necessary, increase generator output level until the 1000-Hz audio signal is heard. Adjust A4L2 for a minimum AGC output.

j. Repeat step a to ensure proper synthesizer operation.

5.5.2.3 Receiver

5.5.2.3.1 Audio Output

Increase volume to maximum and tune the receiver to 125.000 MHz. Connect rf signal generator to antenna jack and apply a 1000-µV, 125.000-MHz signal modulated 30 percent with 1000 Hz. Observe audio output. Result: Minimum of 5 watts audio output into a 3.2-ohm speaker load.

Note

Do not operate with more than 5 watts audio output.

5.5.2.3.2 Sensitivity

a. Tune the receiver to 118.000 MHz. Connect rf signal generator to antenna jack. Adjust the rf generator for a 3-µV, 118.000-MHz signal and modulate 30 percent with 1000 Hz. Set audio phone output for 20 mW (3.16 V rms into 500-ohm load).

b. Measure signal-to-noise ratio (s+n)/n of not less than 8-dB.

Note

The (s+n)/n measurements should be accomplished by filtering/nulling the detected audio signal at modulation frequency and measuring the remainder of the audio output as noise. Due to the audio compressor, the normal modulation-on to modulation-off ratio for (s+n)/n will indicate much lower sensitivity. It may be necessary to pull squelch knob out at 3-µV level.

If distortion analyzer or SINAD meter is not available, ground pin 6 of A2U4 and measure the ratio using the conventional (modulation-on to modulation-off) method. Remember to remove jumper after completion of the test.

5.5.2.3.3 Quieting

a. Channel transceiver to 127.00 MHz. Connect rf signal generator to antenna jack and apply a 100-µV, 127.600-MHz unmodulated output signal. Measure audio output and record the measured dB output for reference.

b. Modulate the signal generator output signal 30 percent with 1000 Hz and measure audio output increase in dB. Result: Not less than 30 dB.

Note

If the preceeding test results are not obtained, performed preselector and if section alignment procedures.

5.5.2.3.4 Preselctor and IF Alignment

a. Channel transceiver to 127.600 MHz. Connect rf signal generator to antenna jack and apply a 127.6000-MHz signal modulated 30 percent with 1000 Hz. Connect a dvm to AGC test point A2TP1.

b. Increase generator output level until a 0.1-volt increase in AGC voltage is observed.

c. Adjust A2L1, A2L3, A2L5, A2L7, A2L9, and A2L14 (in that order) for a maximum AGC voltage while simultaneously reducing generator output level to maintain the 0.1-volt increase over the static AGC level. Repeat tuning procedure after initial adjustments have been made.

d. Connect a dvm to gate 2 of rf amplifier Q1 (collector of Q3). Apply a 3-µV, 127.600-MHz signal modulated 30 percent with 1000 Hz to the antenna jack.

e. Adjust RF AGC DELAY resistor A2R8 for +5.0 V ±0.05 at gate 2 of Q1.

5.5.2.3.5 Squelch Disable

a. With no rf signal applied to the antenna jack and VOL/TST knob pushed in, observe audio output. Result: No noise present in output.

b. Pull VOL/TST knob out and observe audio output. Result: Noise present.

5.5.2.3.6 Carrier/Noise Squelch Threshold

5.5.2.3.6.1 Threshold With Noise Blanker Installed (VHF-251 SB 10, VHF-251S SB 5, VHF-251E SB 6)

a. Push VOL/TST knob in. Channel transceiver to 118.00 MHz. Connect rf generator to antenna jack and apply a 0-µV, 118.00-MHz signal modulated 30 percent with 1000 Hz. Set volume control to its midrange position.

b. Monitor audio output while slowly increasing generator output level. Read generator output level when audio output just appears. Result: Not more than 3 µV.

If necessary, set threshold using the following procedure: Turn CARRIER SQUELCH potentiometer A2R63 to its fully counterclockwise position.

Set rf generator level to 1.5 µV (refer to paragraph 5.6.6). Adjust NOISE SQUELCH THRESHOLD potentiometer A2R75 until audio output is triggered. Remove the input signal (disconnect antenna cable) and verify that the transceiver output is muted in the absence of signal. Apply a 20-µV, 118.00-MHz signal modulated 85 percent with 9000 Hz (17 kHz in VHF-251S) to the antenna jack. Adjust CARRIER SQUELCH potentiometer A2R63 until an audio output just appears.

5.5.2.3.6.2 Without Noise Blanker

Caution

Under no circumstances should an attempt be made to set the threshold of a radio that does not contain a noise blanker to any level less than 3.0 µV.

a. Push VOL/TST knob in. Channel transceiver to 118.000. Connect rf signal generator to antenna jack and apply a 0-µV, 118.000-MHz signal modulated 30 percent with 1000 Hz. Set volume control to its midrange position.

b. Monitor audio output while slowly increasing generator output level. Read generator output level when audio output appears. Result: Not more than 5 µV.

If necessary, set threshold using the following procedure: Turn CARRIER SQUELCH resistor A2R63 to its fully counterclockwise position. Set rf generator level to 3 uV. Adjust NOISE SQUELCH THRESHOLD resistor A2R75 until audio output is triggered. Remove the input signal and verify that the transceiver output is muted in the absence of a signal. Apply a 20-µV, 118.000-MHz signal modulated 85 percent with 9000 Hz (17 kHz if VHF-251S) to the antenna jack. Adjust CARRIER SQUELCH resistor A2R63 until an audio output just appears.

5.5.2.3.7 Carrier Override Squelch Threshold

a. Channel transceiver to 118.000 MHz. Connect rf signal generator to antenna jack; apply a 0-µV, 118.000-MHz signal modulated 85 percent with 9000 Hz (17 kHz if VHF-251S).

b. Monitor audio output while slowly increasing rf signal generator output level. Read generator output level when audio output appears. Result: 20 to 25 µV.

If necessary, adjust carrier override threshold level using the following procedure.

Apply a 20-µV, 118.000-MHz signal modulated 85 percent with 9000 Hz (17 kHz if VHF-251S) to the antenna jack. Adjust CARRIER SQUELCH resistor until audio output just appears. Reduce generator output level below the 20-µV level until the audio just disappears. Slowly increase the generator output level until the audio output just appears. Observe the generator output level. Result: 20 to 25 µV. If necessary, repeat alignment procedure until the proper results are obtained.

After threshold has been set, replace all covers and secure in place. Recheck threshold point by increasing the generator output until audio is observed. Result: 20 to 25 µV.

A different threshold point from that observed initially indicates rf leakage from the signal generator. To overcome this problem, relocate the generator at least 4.6 meters (15 feet) from the radio when setting the squelch. A 20-dB pad should replace the 6-dB pad previously used at the generator output, and the carrier squelch should break at an attenuator setting of 100 µV (refer to paragraph 5.6.6 for a complete discussion of this topic).

5.5.2.3.8 AGC Rise

a. Channel transceiver to 127.600 MHz. Connect rf signal generator to antenna jack and apply a 10-μV, 127.600-MHz signal modulated 30 percent with 1000 Hz.

b. Monitor audio output voltage while varying generator output between 10 μV and 20 000 μV. Result: Not more than 3-dB change.

c. Monitor audio output voltage while slowly varying generator output between 20 000 and 100 000 μV. Result: Not more than 6-dB change.

5.5.2.3.9 Selectivity

a. Channel transceiver to 127.600 MHz. Connect rf signal generator to antenna jack and apply a 10-μV, 127.600-MHz unmodulated output signal. Measure AGC at A2TP1 and record for reference.

b. Increase generator output level to 20 μV and vary the frequency above and below 127.600 MHz until the reference voltage is obtained. Read the generator frequency above and below 127.600 MHz. VHF-251/251E result: ±8.70 kHz minimum from 127.600 MHz. VHF-251S result: ±14 kHz minimum from 127.60 MHz.

c. Reset rf generator to precisely 127.600 MHz and apply a 20-μV unmodulated signal. Measure AGC at A2TP1 and record for reference.

d. Increase generator output to 20 000 μV and vary the frequency above and below 127.600 MHz until the reference level of step c is obtained. Read the generator frequency above and below 127.60 MHz. VHF-251/251E result: ±22.5 kHz maximum from 127.600 MHz. VHF-251S result: ±40 kHz maximum from 127.60 MHz.

5.5.2.3.10 Audio Distortion/Response

a. Channel transceiver to 127.600 MHz. Connect rf signal generator to antenna jack and apply a 100-μV, 127.600-MHz signal modulated 60 percent with 1000 Hz. Measure the audio distortion for a 5-watt output. Repeat for modulated frequencies of 350 and 2500 Hz. Result: Not more that 15-percent distortion.

b. Measure audio response for each of the above modulating frequencies for a 5-watt output. Result: Not more that 6-dB variation.

5.5.2.3.11 Intercom (VHF-251 S/N 24591 and Above, VHF-251S S/N 2698 and Above, and VHF-251E S/N 2795 and Above)

5.5.2.3.11.1 Units Without Service Bulletin 16 (-251), 9 (-251S) or 10 (-251E)

a. Disconnect rf generator input to the transceiver and turn volume control counterclockwise for minimum volume.

b. Connect a 500-ohm load and ac voltmeter between P1-13 (comm audio 500 ohms) and P1-6 (audio ground).

c. Apply a 0.5-V rms (measured at P1-1), 1000-Hz signal to P1-1 (ICS) through a 0.22-μF, 50-V blocking capacitor, and observe meter indication. Result: 2.5 ±0.85 V rms.

d. Remove audio input signal and connect a 150-ohm resistor from P1-1 to ground. Measure dc voltage across 150-ohm resistor. Result: 1.9 ±0.4 V dc.

5.5.2.3.11.2 Units With Service Bulletin 16 (-251), 9 (-251S) or 10 (-251E)

a. Disconnect rf generator input to the transceiver and reduce the audio gain to minimum.

b. Connect a suitable microphone and headphone to the unit.

c. Remove bottom rear cover.

d. Adjust potentiometer A10R10 located on the noise blanker/intercom board A10 for the desired audio output.

e. Install bottom rear cover.

5.5.2.4 Transmitter

5.5.2.4.1 Transmitter Power Output

Note

When measuring VHF-251E power output, coax connecting transceiver to watt meter must not exceed 152 mm (6 in) in length.

Connect rf wattmeter and rf load to the antenna jack. Close the ptt switch and record unmodulated carrier power output for each of the following frequencies: 118.000, 127.600, and 135.975 MHz (135.95 MHz in VHF-251S). Result: VHF-251/251S not less than 8-W output, VHF-251E not less than 13-W output.

If necessary, perform the following alignment procedure to obtain correct results.

Caution

Observe 1-minute transmit, 4-minute receive duty cycle, or use blower to cool power amplifier.

Tune the transmitter to 135.975 MHz (135.95 MHz in VHF-251S) and peak capacitor A3C15 for maximum output indication. Switch transmitter to 118.000 MHz and check for approximately the same output as that at 135.975 MHz (135.95 MHz). Readjust A3C15 if necessary to obtain an equal output at both frequencies.

5.5.2.4.2 RF Output Frequency Accuracy

Connect bidirectional coupler to antenna jack. Connect rf load to straight-through leg of coupler and frequency counter to attenuation leg of coupler. Channel transmitter to 135.000 MHz. Close ptt switch and observe output frequency. Result: 135.000 ±3375 Hz (±1985 Hz in VHF-251E).

5.5.2.5 Modulator

5.5.2.5.1 Modulation Level

a. Channel transceiver to 118.000 MHz. Connect bidirectional coupler to antenna jack. Connect rf load to straight-through leg of coupler and oscilloscope to attenuation leg of coupler. Apply 0.5 V rms at 1000 Hz to transceiver audio input (P1-5).

b. Close ptt switch and observe modulation envelope on scope. Result: 87- to 95-percent modulation. Repeat for each of the following frequencies: 127.600 and 135.975 MHz (135.95 MHz in VHF-251S).

If necessary, perform the following procedures to obtain correct results:

Connect transceiver to test equipment as described in preceding step a. Apply a 0.5-V rms, 1000 Hz audio signal to the audio input (P1-5). Channel the transceiver to 127.600 MHz. Close ptt switch and observe modulation envelope. Adjust A2R67 to obtain a point where negative audio peak clipping is just beginning to occur on the rf envelope. It should not be possible to overmodulate the transmitter.

5.5.2.5.2 Envelope Distortion/Carrier Noise

a. Channel transceiver to 127.600 MHz. Connect bidirectional coupler to antenna jack. Connect rf load to straight-through leg of coupler and envelope detector to attenuation leg of coupler. Connect distortion analyzer to envelope detector.

b. Apply 0.5 V rms at 1000 Hz to the transceiver audio input (P1-5). Close PTT switch and measure audio distortion. Results: Not more than 15 percent.

c. Increase audio input signal to 1.5 V rms and observe that modulation is limited to less than 97 percent.

d. Remove modulating input signal and measure carrier noise level. Result: Not less than 40 dB below audio output reference recorded in step b.

5.6 SERVICE TIPS AND TROUBLESHOOTING

This section is included to aid the technician in understanding and troubleshooting the more difficult sections of the VHF-251/251S/251E Communications Transceiver. Major emphasis is placed on the receiver and synthesizer portions of the radio and systems problems that will degrade overall performance.

5.6.1 Receiver VHF Section

5.6.1.1 Preselector

The preselector is double-tuned and varactor-tracked. The primary function is to attenuate off-channel signals to minimize cross modulation and to reject image frequency signals. Minor problems in the preselector will result in degraded signal-to-noise ratio; a major failure will result in a very weak or completely dead receiver.

Back to back, high-speed diodes across the preselector input (CR8 and CR9) clip high-level rf signals that exists when transmitting with another vhf comm.

Failure of one or both of these diodes may result in the input tank varactors being pumped into parametric oscillation by transmitter energy from another comm. The result of this parametric oscillation may be observed in the aircraft navigation receiver. In most installations experiencing parametric oscillation, interference will be generated on the navigation band that will result in a NAV flag even though the selected NAV signal is reliable. Identification of the parametric oscillation can be accomplished by switching off the nonkeyed comm while observing the NAV indicator. If the flag goes out of view when the comm is switched off, parametric oscillation exists.

5.6.1.2 RF Amplifier Q1

The rf amplifier increases vhf signal gain so the signal applied to the mixer can overcome mixer induced noise. The rf amplifier will run at at maximum gain of about 20 dB until the input signal becomes large enough to produce about a 30-dB, signal-to-noise ratio. When the 30dB level is obtained, AGC will begin reducing Q1 gain to prevent if overloading. A low-gain rf amplifier will degrade the receiver signal-to-noise ratio.

5.6.1.3 Interstage

The vhf interstage is a double-tuned, varactor-tracked network that attenuate off-channel signals to minimize spurious responses (especially at the image frequency). A fault in the interstage will result in the inadequate quieting (quieting is the silencing of the receiver front-end noise when a carrier is received)

5.6.1.4 Mixer Q2

The mixer translated the incoming vhf signal down to the 10.5-MHz intermediate frequency. A low-gain mixer stage will result in inadequate quieting. The networks on the local oscillator injection gate and on the mixer drain are critical to aviod undesired mixer oscillation or regeneration. Oscillation may totally block the receiver (this may occur only with application of a very strong signal), while regeneration may degrade audio quality due to excessive passband ripple.

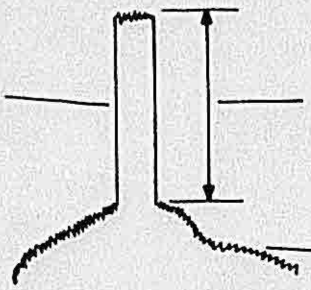
5.6.2 Receiver IF Section

5.6.2.1 Crystal Filter FL1

Receiver selectivity is concentrated in an 8-pole crystal filter that provides extremely sharp band edges. The -6-dB points are at least 10 kHz from the nominal channel; and, the -60-dB points are no more than 20 kHz from the nominal frequency. To achieve the proper frequency response the crystal filter must be properly matched at both the input and output terminals. Any change in the matching networks may result in complaints such as excessive background noise or poor audio quality. These symptoms both result from excessive amplitude ripple in the passband. To test for excessive passband ripple, apply a 100-μV signal, and slowly move the signal frequency across the receiver passband while monitoring the AGC voltage. Note the minimum and maximum AGC voltages (do not count AGC voltages when the signal is on the steep slopes at the edges of the passband). Return to the frequency at which the minimum AGC voltage was observed, and increase the signal generator attenuator setting until the AGC voltage is the same as the maximum observed. The attenuator change is equal to the passband ripple. It should not exceed 3dB. In addition to problems in the matching networks, regeneration in the mixer or regeneration due to severely mistuned if interstage network are known to cause excessive passband ripple.

5.6.2.2 IF Amplifier

The if amplifier section consisting of U1 and U2 is capable of producing over 100 dB of gain. The gain is high enough that AGC will cause some gain reduction only with noise present in the absence of any signal. This characteristic is essential for proper noise squelch operation. The total gain of the receiver must be distributed so that the bulk of the no-signal noise reaching the detector is generated by the front-end noise is not the controlling factor, the noise squelch may not work properly, because the receiver may not quiet as much as anticipated when a signal is applied. If a spectrum analyzer is loosely coupled to the detector with a small loop probe, the picture, with no signal, should be as shown in figure 5-8. If the front-end noise pedestal



Crystal Filter Passband for No-Signal Condition, Figure 5-8

is too low, the problem is low gain in the rf amplifier or mixer due to a defective transistor or a defect in some associated component. A value change in one or more capacitors in an if interstage network might also cause this problem. If the noise pedestal is decidedly off the peak of the if broadband response, the problem is most likely a defective component in the interstage network between the second if amplifier and the detector (most often L15). This condition often leads to regeneration, producing excessive passband ripple.

5.6.2.3 Detector Q6

Detector Q6 is a high-frequency transistor that is held on the verge of conduction by diode CR10. Any rf upswing turns the transistor on, while downswings hold Q6 off. The detector conducts for half of each rf cycle, therefore the base-emitter circuit becomes a half-wave rectifier. Capacitor C32 filters rf current at the collector. Changes in the bias circuits or performance of Q6 will result in distorted or weak operation, while complete failure will result in a dead radio.

5.6.2.4 AGC

Receiver AGC is a feedback control system that tries to hold the average voltage at the collector of Q6 equal to the reference voltage at U3B-5 (7.0 V dc). When the receiver is operating properly, front-end noise will be sufficient to lower the detector collector average voltage below the reference level established by R49 and R50. This results in AGC gain reduction with no input signal; this characteristic is essential for proper squelch operation. With this circuit configuration, no-signal AGC voltage at TP1 provides a quick check indication of receiver gain. If gain is adequate (includes all circuits between the antenna and the AGC amplifier), the level at TP1 will be at least 4.200 V dc.

Potentiometer R8 is adjusted to set the collector of delay transistors Q3 at 5.0 V with a 3-μV signal applied. This sets the rf amplifier stage for maximum gain. As the signal strength increases, the AGC voltage increases, and the collector voltage decreases.

The gain of Q1 does not diminish appreciably, however, until the collector of Q3 drops to about 3 V. This delayed AGC action keeps the gain of the rf amplifier high until the signal is strong enough to guarantee a good signal-to-noise ratio. At very high signal levels, the gain of Q1 is reduced about 30 dB to avoid overloading the if amplifier. The setting of R8 may be adjusted slightly to improve overload performance without significantly changing the signal-to-noise ratio for small signals. Defects in the AGC feedback loop are isolated by monitoring the voltages at TP1 and the collector of delay transistor Q3 while the rf input level is varied. Low dc voltage supplied by Q6 collector causes AGC voltage at TP1 to increase; increased voltage at TP1 reduces the gain of U1 and U2. As AGC voltage continues to increase, the collector voltage of Q3 will begin to decrease. When a 3.0-V dc lever or lower is reached, Q1 gain will be reduced.

5.6.3 Squelch

The VHF-251( ) squelch consists of a noise squelch and carrier squelch, both of which are coupled to a common Schmitt trigger that controls audio passage to the compressor and final audio output stages. Although the carrier squelch circuit is straight forward and relatively easy to troubleshoot (carrier squelch is AGC activated), the noise squelch is much more sophisticated and dependent upon proper operation of all other proceding circuits before it can perform correctly. For this reason, the first step in troubleshooting a radio that displays squelch related problems is to ensure that the circuits on which squelch operation is dependent are operating properly. The rf amplifier and mixer stages must be operating properly so that front-end noise is the main no-signal at the detector. Receiver gain must be high enough that detected noise alone causes some AGC gain reduction; the receiver must be "into AGC on noise." Finally, the noise squelch filter must adequately discriminate against voice frequencies.

A flow diagram for troubleshooting the squelch is shown in figure 5-9. This diagram, when used in conjunction with the following paragraphs, should provide all the information necessary to effectively troubleshoot the squelch circuits.

5.6.3.1 Noise Squelch

Most noise squelch circuits have two significant problems:

a. They misbehave if the receiver suffers a fault which the pilot might otherwise not notice; low gain is the most significant of these. If the receiver gain drops enough, the noise level goes down, and the squelch circuit turns audio on. The pilot then has no choice but to listen to whatever white noise remains if he wants to communicate.

b. Ignition noise pulses look like white noise to the squelch rectifier, so ignition noise can prevent the squelch from turning the audio on in the presence of a signal the pilot wants to hear.

5.6.3.1.1 Noise Squelch With Limiter (VHF-251 SB 9, VHF-251S SB 2, VHF-251E SB 2)

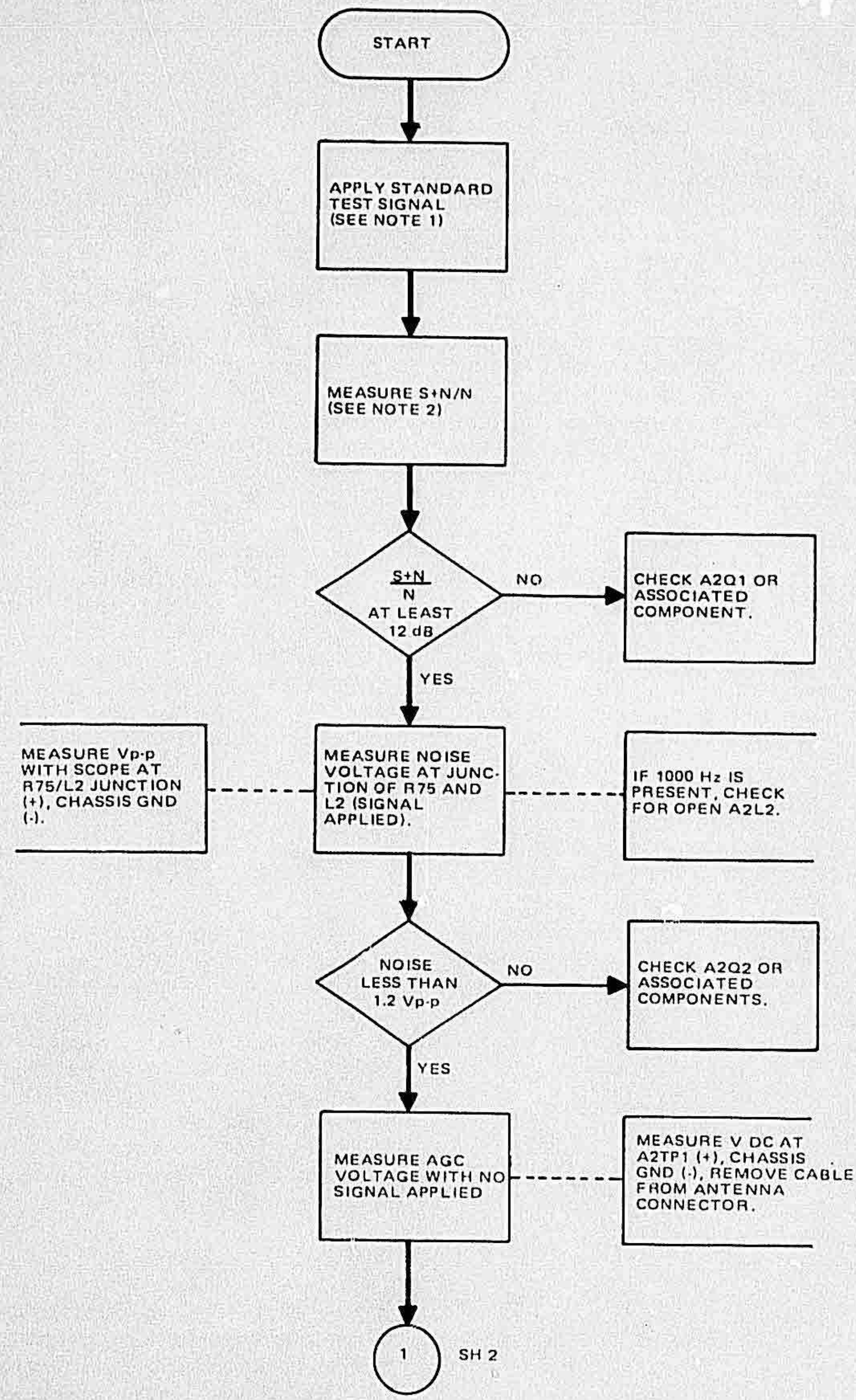
This service bulletin added the noise limiter circuit that consists of diodes CR24 and CR25. These diodes limit the voltage across L2 to approximately 2.4 V p-p regardless of the noise source, receiver white noise or ignition noise spikes. An additional function of the limiter is to damp out any ringing in the input tuned circuit that may occur when the circuit is shocked with high-energy noise pulses. A failure in the limiter or input tuned circuit will most often result in noise holding the squelch closed even when a reliable signal is being received. Such a problem would be reported as poor range or poor range with noise accompanying the actual voice transmission. Garbled audio may also result if value changes occur in the tuned input circuit (refer to step c).

5.6.3.1.2 Noise Squelch With Noise Blanker (VHF-251 SB 10, VHF-251S SB 5, VHF-251E SB 6)

The noise blanker performs the same basic function as the noise limiter just discussed (prevents passage of high-level noise spikes into the squelch rectifier), however the blanker provides greater efficiency and results in a squelch threshold that is almost unchanged by high-level noise spikes. Failure of the noise blanker will generally be one of two extremes. Either the blanker will completely block the detected signal, or it will pass it without performing the blanking function. In the aircraft, this will result in poor range or poor range with noise accompanying the actual voice transmission.

5.6.3.1.3 Noise Amplifier Q4

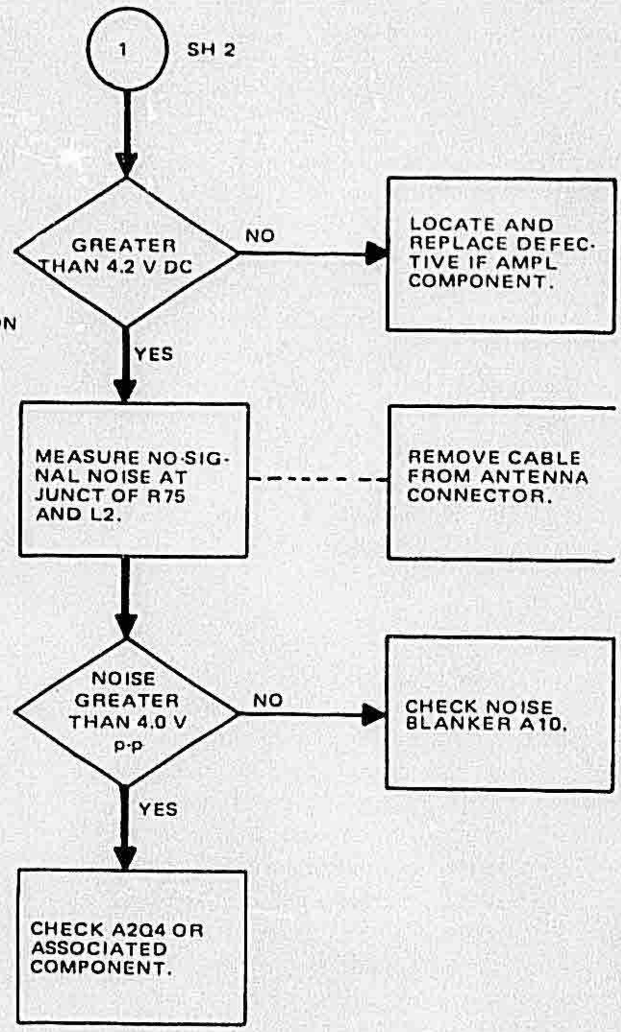
Both the gate and drain circuits of FET Q4 are tuned to a narrow band that centers around 9 kHz (17 kHz in VHF-251E). This tuning is critical for proper squelch operation in that it selects noise components in the band while at the same time discriminating against voice frequency components. A defective component in either tuned circuit may reduce the noise power applied to the rectifier enough that



Squelch Troubleshooting, Figure 5-9 (Sheet 1 of 2)

NOTES:

1. STANDARD TEST SIGNAL IS 3uV (HARD) MODULATED 30% WITH 1000 Hz. SIGNAL LEVELS ARE IN HARD MICROVOLTS (ATTENUATOR READING WITH 6 dB PAD ON GENERATOR OUTPUT). IF 6 dB PAD IS NOT AVAILABLE, DIVIDE SPECIFIED LEVELS BY TWO (USE 1.5 uV WHEN 3.0 IS SPECIFIED).
2. S+N/N MUST BE MEASURED WITH DISTORTION ANALYZER OR SINAD METER, DUE TO PRESENCE OF AUDIO COMPRESSOR. IF THESE EQUIPMENTS ARE NOT AVAILABLE GROUND U4 PIN 6 AND USE CONVENTIONAL MOD ON TO MOD OFF METHOD. REMOVE GROUND WIRE WHEN COMPLETE.
3. USE SCOPE TO MEASURE PEAK-TO-PEAK NOISE.



Squelch Troubleshooting, Figure 5-9 (Sheet 2) the squelch will open (pass audio) all the time. Other defects may allow enough voice energy to pass to the rectifier to open the squelch (cut the audio) occasionally while a signal is being received. If this happens frequently enough, the pilot will probably report it as garbled audio. Service bulletin no 6 added the input tuned circuit and changed component values in the drain tuned circuit to help discriminate against voice components.

5.6.3.1.4 Noise Squelch Rectifier CR14 and CR15

The squelch rectifier is a standard voltage doubler. Service bulletin No. 9 changed the values of C37 and C80 to make the rectifier output represent the average value of the input, rather than the peak value. This helps minimize the effect of ignition noise. Service bulletin No. 10 changes these capacitors to a type more stable at high temperature, so the squelch threshold will not vary much as temperature changes.

5.6.3.1.5 DC Amplifier U4D

The dc amplifier (U4D) increases the rectifier output to properly drive the squelch Schmitt trigger.

5.6.3.2 Carrier Squelch

The carrier squelch circuit is actually an override for the noise squelch circuit that is incorporated to overcome the noise squelch defeating effects that are encountered when two rf carriers are received simultaneously. Basically, the carrier squelch is a voltage discriminator with reference and variable voltage inputs. The reference voltage is set on the bench for the desired rf input threshold (approximately 20 μV), and AGC provides the variable input. When a signal is received, AGC voltage will increase to control front-end gain. When the threshold at the discriminator is exceeded, the carrier squelch will open. Carrier squelch troubleshooting is easily accomplished by disabling the noise squelch (jumper pins 13 and 14 of U4D together to disable noise squelch).

5.6.3.3 Schmitt Trigger

The Schmitt trigger provides the high speed switching required to achieve a position on/off audio path that is free from flutter. Hysteresis designed into the trigger to prevent flutter that would normally occur with small level variations. The trigger is provided with positive feedback to provide a latching action. The latching action is such that the positive voltage applied to U4A pin 2 must rise to approximately 4.7 V before the trigger sets (allows audio to pass). Once the trigger has been set, the input must be reduced well below the set voltage before the trigger will reset (block the audio path). The input level required to reset the trigger once it has been set must be 1.9 V dc or less. The Schmitt trigger action causes the noise squelch dc amplifier (U4D) to behave differently than might be anticipated. When no signal is received, the noise squelch rectifier supplies enough drive to keep U4D saturated. Emitter voltage is about 0.8 V, and collector is about 1.1 V. If a receiver signal, reduces the noise level, base drive to U4D is reduced, so collector voltage rises to about 5.3 V and starts the Schmitt trigger set process. As the Schmitt trigger sets, the base voltage at pin 2 of U4 falls to about 1.9 V. This pulls the collector of U4D down to about 2.5 V. The higher voltage at the collector of U4D lasts only for a microsecond or so and is difficult to observe without a storage oscilloscope. This characteristic has occasionally caused a techincian to assume that the collector voltage of U4D does not rise high enough to set the Schmitt trigger.

5.6.4 Transmitter-Distorted Modulation Problems

If a pilot gets reports of distorted modulation, the transmitter should be submitted to a talk-out test. The receiver used for the test must be a narrow-band receiver, such as another VHF-251. The test can usually be run by transmitting into a dummy load and using a comm antenna on the receiver placed a few feet away. The dummy load will usually leak enough signal for the test. Continuously tuned, aircraft-band receivers cannot be used for this test since their broadband receivers will not show up the most common cause severe distortion (synthesizer frequency modulation). If the transmitter itself it the cause of a complaint, the fault will probably be due to low drive to the final transistor (Q4), failure of CR2 (so driver Q3 is not modulated upward), or failure of C24 or C26. The low impedances and high rf currents in a solid-state transmitter make signal tracing difficult. A scope probe anywhere near the transmitter generally picks up enough stray rf signal that it is difficult to locate a weak stage. Modulator problems may be detected by applying 0.5-V rms, 1000-Hz signal to the microphone input (through a 10-μF blocking capacitor) and keying the transmitter while observing lug 10 of relay A1K1 with an oscilloscope. Set the modulation control (R67 on the receiver board) for a 25-V p-p signal. The scope trace should be a sine wave with less than 8-percent distortion. Flattening of one peak suggests a defective modulator transistor. Symmetrical distortion suggests a defective transformer or a defect in audio amplifier U5 (receiver card) or its associated components. If the modulating signal appears clean, check the rf envelope by attenuating the transmitter output and observing it with a high-frequency scope. Lack of upward modulation indicates inadequate drive to the final transistor, usually caused by a defective driver or preamplifier stage. In addition to the transmitter itself, other system problems may be the cause of distorted transmission symptoms. Figure 5-10 is a flow diagram that provides a systematic procedure for isolating distorted transmission problems.

5.6.5 Synthesizer

Most complaints of distorted modulation have been traced to excessive frequency modulation of the synthesizer while transmitting. This undesired frequency modulation results in rf currents from the transmitter leaking back to the synthesizer. In the absence of modulation, the synthesizer frequency control circuits correct for the effects of leakage currents. The varying rf currents during modulation, however, may affect the voltage controlled oscillator at a rate too great for the feedback circuits to control. The average frequency is correct, but because of frequency modulation the transmitter signal may rapidly move in and out of the passband of the distant reciver. This results in severe distortion of the received signal. This distortion is not visible if the modulation envelope of the transmitted signal is viewed on an oscilloscope. If a spectrum analyzer is available, a frequency modulation problem may be confirmed by modulating the transmitter about 90 percent with a 1000-Hz signal, attenuating the transmitted signal, and observing the spectrum. If the -30-dB points on the spectrum envelope are more than 15 kHz apart, frequency modulation is excessive. An alternative method for observing frequency modulation is to connect a short, insulated wire to pin 6 of U5 on the synthesizer card. This is the phase detector output. Replace the synthesizer cover, routing the wire out through one of the small relief holes at the lower edge. Replace and tighten all screws. Connect a scope probe to the short wire. Use delayed sweep, with a horizontal display of 10 ns/division. Sync the scope to the rising edge of the pulse waveform, and adjust the delay to observe the falling edge. When receiving or when transmitting without modulation, the falling edge should be very stable in time. When transmitting with modulations, a properly operating transceiver exhibits less that 10 ns of jitter of the falling edge. Transmitters which sound distorted due to excessive frequency modulation generally exhibits nore than 20 ns of falling edge jitter. This jitter shows up as smearing of the vertical line (falling edge) on the scope.

Generally, VHF 251 service bulletin No. 12 (VHF-251E SB 4 and VHF-251S SB 3) has eliminated the major cause of synthesizer FM, however the following defects may also cause this problem:

a. Improperly plated synthesizer chassis. (This can normally be detected by placing a sheet of copper foil or shim stock, with clearance holes for the synthesizer cover screws, in the synthesizer chassis.)

b. Loose or missing hardware, particularly that securing the synthesizer chassis to the unit frame and the screws holding synthesizer cover in place.

c. Defective dipped mica capacitors in the vco and buffer circuits and in the transmitter.

5.6.6 RF Generator Leakage

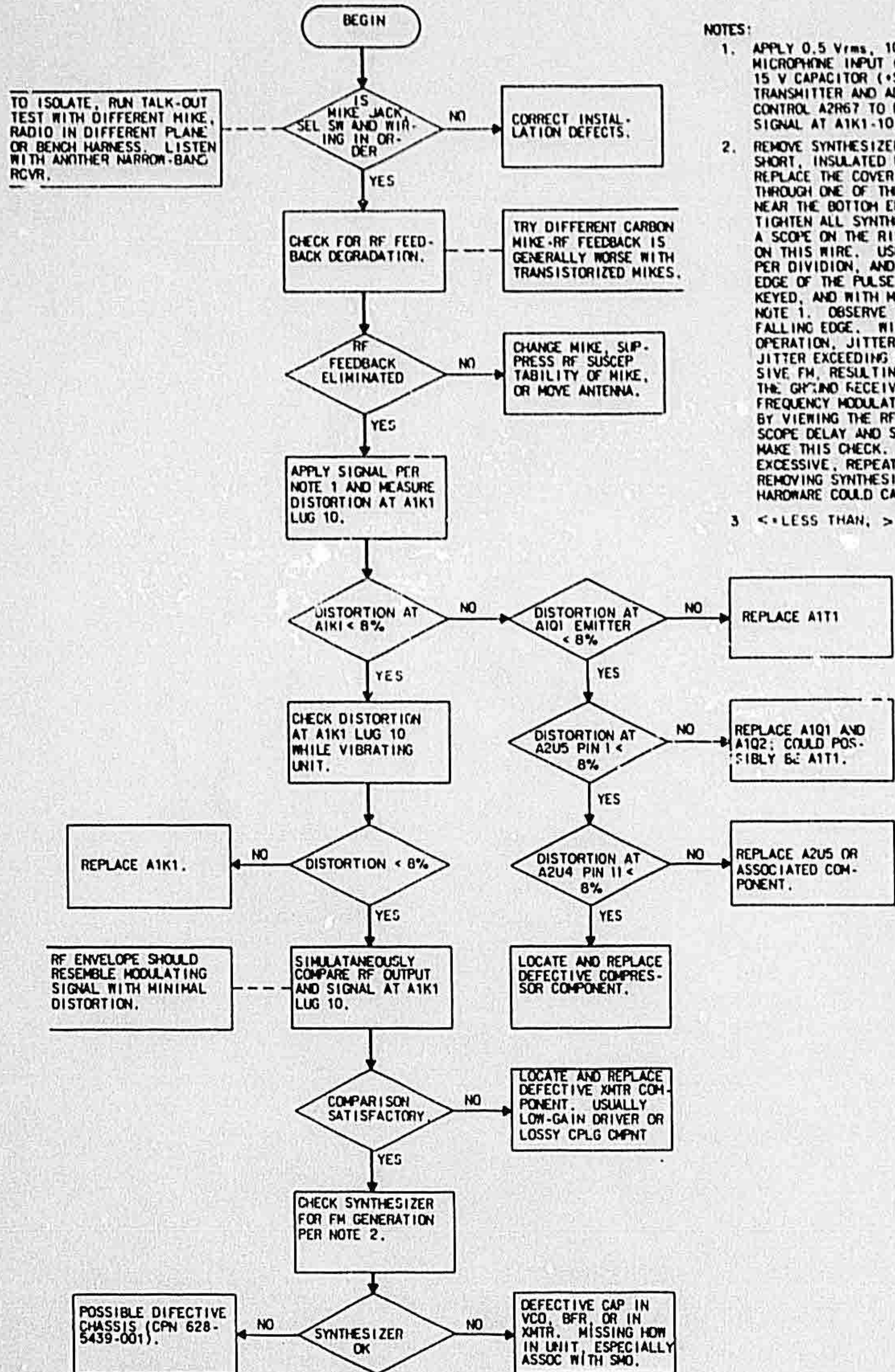
Many signal generators leak appreciable amounts of signal out through the case. If the VHF-251 is open near the signal generator, the leakage field flooding the receiver may add substantially to the signal coming through the coax. A squelch threshold set in this environment will actually be higher that intended (a higher level input signal will be required to open the squelch). This side effect will show up is the squelch threshold is rechecked with the receiver cover back in place. A higher threshold than that which was originally set indicates generator case leakage. Another way to detect case leakage is to disconnect the signal coax from the receiver and monitor the AGC voltage while moving the open receiver around the generator. If the generator case is leaking, the AGC voltage will fluctuate more than the normal 5-mV movement due to normal noise fluctuations. To adjust squelch threshold with a leaky signal generator, connect the generator to the case with 6 m (20 ft) of RG-58 coax, and keep the generator about 6 m (20 ft) from the receiver while making the adjustment. The 6 m (20 ft) of good RG-58 coax with properly fitted connectors will introduce about 1 dB of loss. The attenuator setting must be increased 1 dB to compensate for this.

a. To get 3.0 μV, set 3.4 μV.

b. To get 1.5 μV, set 1.7 μV.

c. To get 20 μV, set 22.5 μV.

Some generators leak a small smount of signal around the attenuator. This leakage usually does not produce serious errors with attenuator settings above 5 or 10 μV. At the lower settings used for noise squelch setup, this leakage



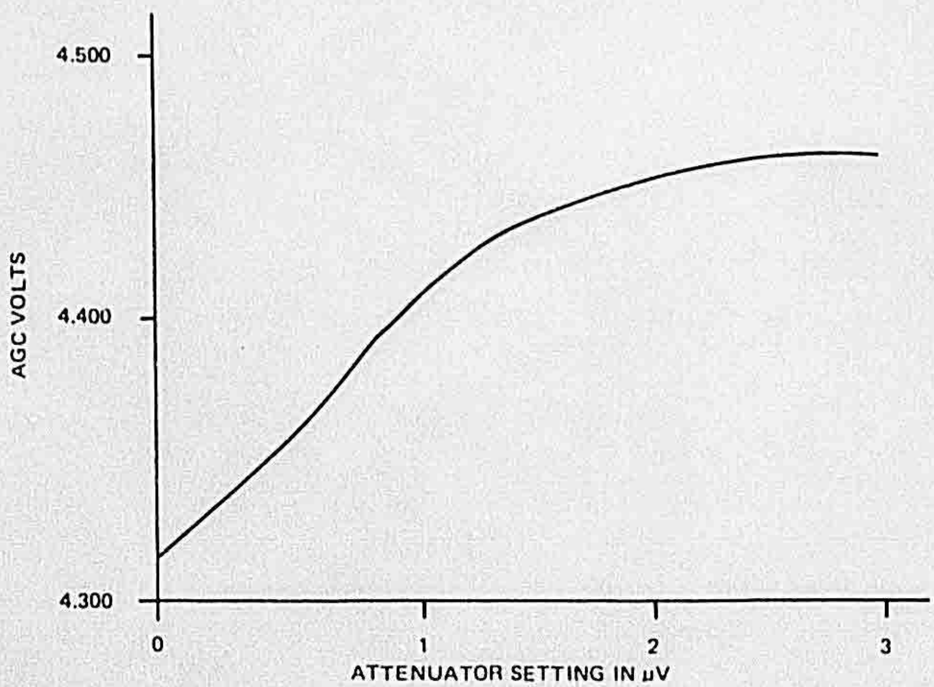
NOTES:

1. APPLY 0.5 Vrms, 1000 Hz SIGNAL TO MICROPHONE INPUT (P1-5) THROUGH 10 uV, 15 V CAPACITOR (+SIDE TO P1-5). KEY TRANSMITTER AND ADJUST MICROPHONE GAIN CONTROL A2R67 TO PRODUCE A 25 Vp-p SIGNAL AT A1K1-10.
2. REMOVE SYNTHESIZER COVER AND CONNECT A SHORT, INSULATED WIRE TO A4U5-6. REPLACE THE COVER, ROUTING THE WIRE OUT THROUGH ONE OF THE SMALL RELIEF HOLES NEAR THE BOTTOM EDGE. REPLACE AND TIGHTEN ALL SYNTHESIZER SCREWS. SYNC A SCOPE ON THE RISING EDGE OF THE PULSE ON THIS WIRE. USE DELAYED SWEEP, 10 ns PER DIVIDION, AND EXAMINE THE FALLING EDGE OF THE PULSE WITH THE TRANSMITTER KEYED, AND WITH MODULATION APPLIED AS IN NOTE 1. OBSERVE THE TIME JITTER OF THE FALLING EDGE. WITH PROPER SYNTHESIZER OPERATION, JITTER SHOULD NOT ESCEED 10 ns JITTER EXCEEDING 20 ns INDICATES EXCESSIVE FM, RESULTING IN GARBLED AUDIO AT THE GROUND RECEIVER. THIS AMOUNT OF FREQUENCY MODULATION CANNOT BE OBSERVED BY VIEWING THE RF OUTPUT ON A SCOPE. SCOPE DELAY AND SYNC MUST BE STABLE TO MAKE THIS CHECK. IF JITTER IS NOT EXCESSIVE, REPEAT TALK-OUT TEST BEFORE REMOVING SYNTHESIZER COVER (LOOSE HARDWARE COULD CAUSE SYNTHESIZER FM).
3. < = LESS THAN, > = GREATER THAN

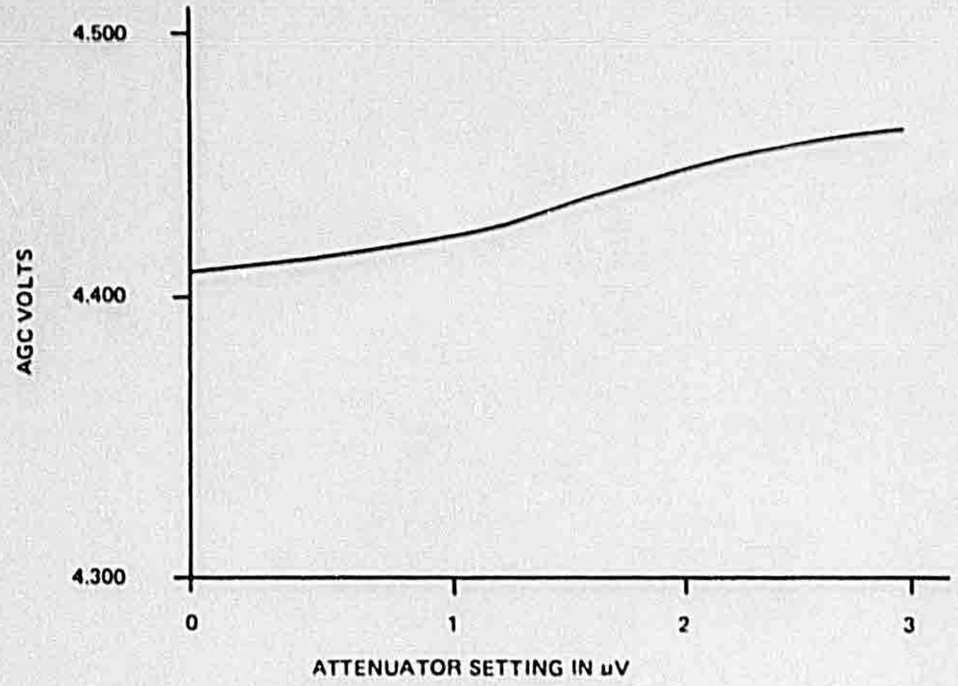
Distorted Transmission Troubleshooting, Figure 5-10 may also result in a higher-than-anticipated threshold. This type of leakage will not show up as a change in squelch threshold after the cover is replaced, because this leakage signal gets to the receiver through the coax. It can be detected by drawing a graph of VHF-251( ) AGC voltage versus attenuator setting for signal levels from about 0 to 3 µV. If leakage around the attenuator dial does not exist, a graph such as that shown in figure 5-11 will be obtained. If leakage around the attenuator is occuring, a graph similar to that shown in figure 5-12 will be obtained. This graph shows that, at attenuator settings below about 2 µV, the signal is not to be trusted. As the attenuator is turned down below 2 µV, the actual signal level does not drop very rapidly. The voltage scale may shift a tenth of a volt or so from one receiver to the next, but the shape of the graph should show an appreciable decrease in AGC voltage down to the lowest attenuator setting. To set squelch threshold with a signal generator showing this kind of leakage, use a fairly high-attenuation pad on the generator; and adjust the attenuator settings to compensate for it. The pad will reduce the leakage as well as the direct signal, and the attenuator will be operating in a region in which the direct signal considerably exceeds the leakage signal. To decide whether the pad is adequate, plot the graph again using effective hard microvolts on the horizontal scale to see if AGC voltage properly follows the attenuator setting. Table 5-5 shows the attenuator settings to use for various signal levels (hard mocrovolts) with different combinations of pads and coax lenghts.

5.6.7 Hard Vs Soft Microvolts

All rf input levels specified for the testing and alignment of the VHF-251( ) are in hard microvolts; this is a measure of electromotive force. Since signal generator attenuator dials are calibrated in soft microvolts (the voltage actually seen across the output connector will agree with the attenuator only when the generator is loaded with its design load impedance), an additional device must be used to ensure a constant load impedance on the generator. Loading the generator with this constant impedance ensures that regardless of the input impedance of the unit under test the attenuator dial setting will always be equivalent to the actual generator output, that is, hard microvolts. To use the signal generator attenuator readings as hard microvolts (what you see is what you get), a 50-Ω, 6-dB pad must be connected between the generator and the transceiver under test. If a 50-Ω, 6-dB pad is not available, the attenuator dial should be set to half of the desired output in microvolts (6 dB lower signal level).



Leakage-Free Attenuator Effects on AGC at Low-Signal Levels , Figure 5-11



Atten. Leakage Effects on AGC Low-Signal Levels, Figure 5-12

Attenuator Settings for Various Pads/Coax Lengths.

Note

Use attenuator setting from table to get hard microvolts shown at top of column.

PAD	CABLE	1.5 µV	3.0 µV	10 µV	15 µV	20 µV	100 µV
*None	Short coax 6-m (20-ft) coax	0.75 µV 0.85 µV	1.5 µV 1.7 µV	5.0 µV 5.6 µV	7.5 µV 8.4 µV	10 µV 11.2 µV	50 µV 56 µV
6 dB (2:1)	Short coax 6-m (20-ft) coax	1.5 µV 1.7 µV	3.0 µV 3.4 µV	10 µV 11.2 µV	15 µV 16.8 µV	20 µV 22.5 µV	100 µV 112 µV
10 dB (3:1)	Short coax 6-m (20-ft) coax	2.4 µV 2.7 µV	4.8 µV 5.3 µV	15.8 µV 17.8 µV	23.8 µV 26.7 µV	32 µV 36 µV	158 µV 178 µV
14 dB (5:1)	Short coax 6-m (20-ft) coax	3.8 µV 4.2 µV	7.5 µV 8.5 µV	25 µV 28 µV	38 µV 42 µV	50 µV 56 µV	250 µV 280 µV
20 dB (10:1)	Short coax 6-m (20-ft) coax	7.5 µV 8.4 µV	15.0 µV 16.9 µV	50 µV 56 µV	75 µV 84 µV	100 µV 112 µV	500 µV 560 µV

*Not recommended.

06

VHF-251/251S/251E Communications Transceiver

S-TEC Corporation
TEC LINE Avionics

diagrams

Printed in USA

list of illustrations

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Record of Revisions

RETAIN THIS RECORD IN THE FRONT OF MANUAL.
ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS.

REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	22 Jul 91		VHF-251 SB 1-3 VHF-251 SB 1-4; SIL 1-75, 1-76, 2-76 VHF-251 SB 1-4, 6,7, 9-12; SIL 1-75, 1-76, 2-76, 3-76, 4-76, 1-77, 2-77, 3-77, VHF-251 SB 1-4, SIL 1-76, 1-77,2-77, VHF-251E SB 1-6; SIL 1-76, 1-77, 2-77 SIL 1-78, 1-80, 2-80 VHF-251 SB 13, 14, 15, 16 VHF-251S SB 5, 6, 7, 8, 9				VHF-251E SB 6, 7, 8, 9, 10 VHF-251 SB 17 VHF-251S SB 10 VHF-251E SB11

SECTION VI
Diagrams

6.1 CONFIGURATION STATUS CONTROL

S-TEC Corporation used the following method for identifying the configuration status of a unit or subassembly.

A 2-character maximum alphabetic identifier will be preceded by the letters REV (revision) and will start with - if no changes have been processed. The first change will be identified as A, the second as B, and continuing through Z to AA, AB, and ultimately to ZZ. Incorporation of design changes in a unit or subassembly that has been returned to S-TEC Corporation for repair by a customer or that has been removed from the company's finished goods inventory is defined as rework. At the time of rework, the unit or subassembly will be marked again to reflect the design level to which it is being upgraded. This is done by leaving the original marking on the unit or subassembly and adding the letters RWK (rework) followed by the alphabetic identifier of the latest change incorporated in the rework. For example, unit one is marked REV B - RWK F and unit two is marked REV F. This indicates that both units are at the design level of revision F, but unit one is reworked and they may not look exactly the same.

Note

A reworked unit may not contain all design changes made to the reworked identifier, byt does contain all changes required to make unit operation identical to a newly manufactured unit with the same identifier. Therefore, a unit reworked to a specific identifier may physically appear different from a newly manufactured unit with the same alphabetic identifier.

Only alphebetic identifiers that result in schematic changes are covered in the setion. If a unit or subassembly has an identifier that alphabetically falls between identifers on the schematic changes pages, or after the last identifier on the schematic changes page up to and including the lastest effectivity listed below, the electrical configuration is represented by the earlier identifier listed on the schematic changes page.

6.2 SCHEMATIC DIAGRAMS

The VHF-251/251S/251E Communications Transceiver schematic diagrams and component location diagrams are provided in figures 6-1 through 6-34. Figures 6-32 through 6-34 are the chassis wiring diagrams for the units, and the figures 6-1 through 6-31 are individual unit/module/card schematic diagrams.

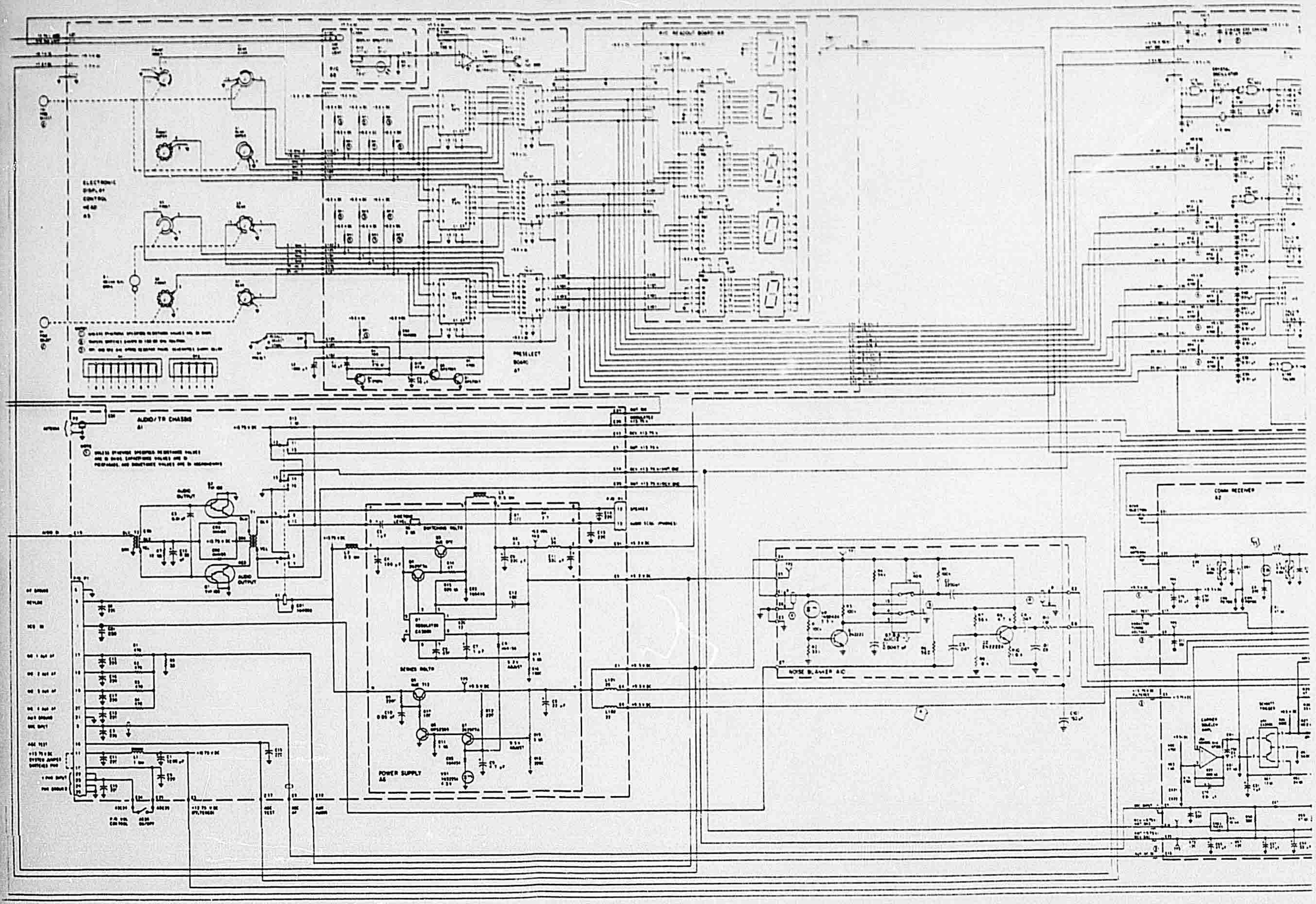
A schematic change sheet precedes each schematic. The change sheet provides a description of schematic changes, a reason for the changes, the service bulletin number (if applicable) that modifies the unit, and the production cut-in effectivity for the change.

Waveforms and components location diagrams are also provided on facing pages contained in this section. All waveforms are typical and voltages are nominal. The waveforms are not proporational and are not set up as timing diagrams. Timing diagrams are presented in the principles of operation provided in section IV. All waveforms and voltages were measured using the test input conditions noted on each applicable schematic.

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
	Note The following unit schematic shows the latest equipment configuration of the VHF-251( ) Communications Transceiver.		

VHF-251 Communications Transceiver, Unit Schematic
Figure 6-1 (Sheet A)



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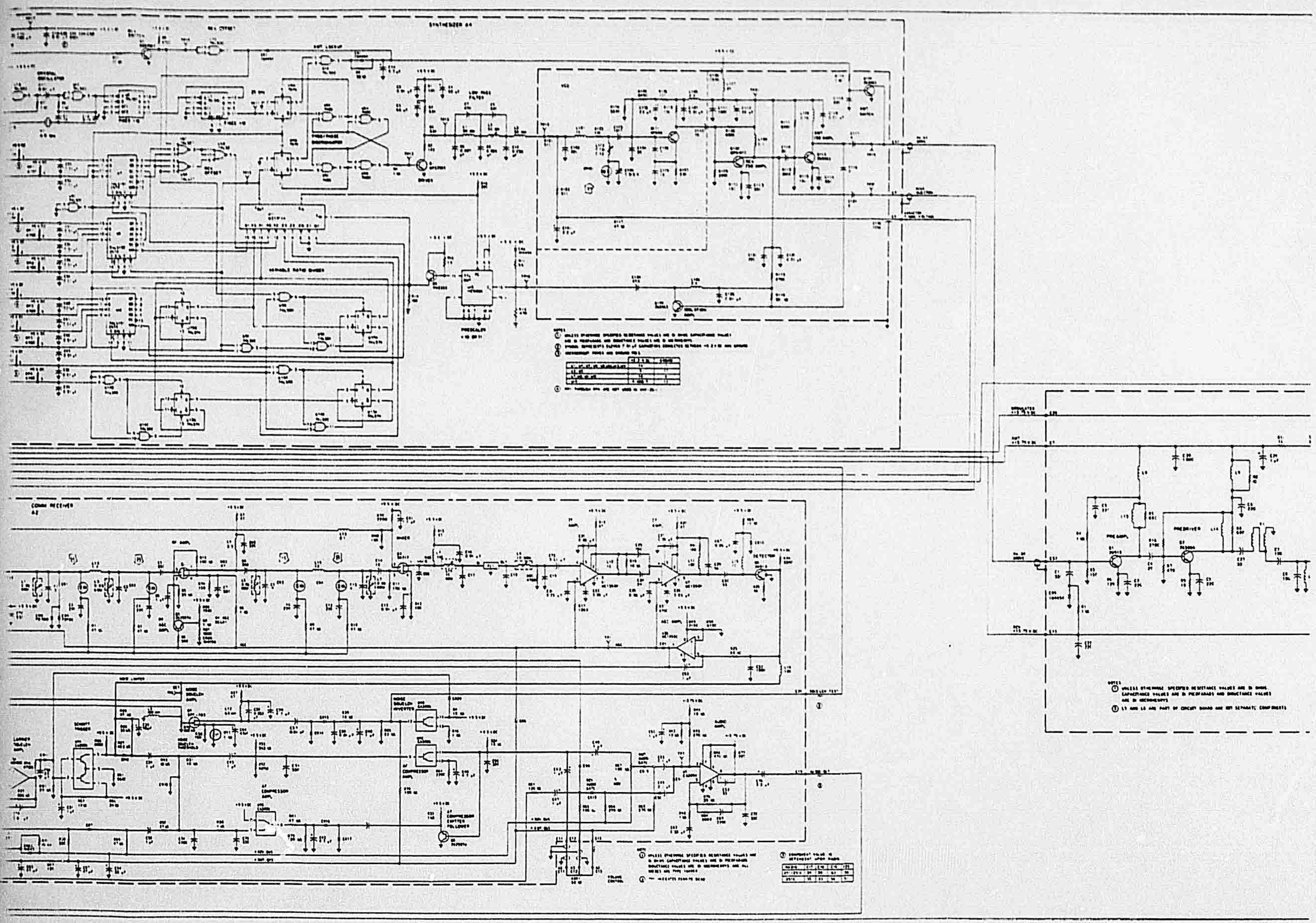

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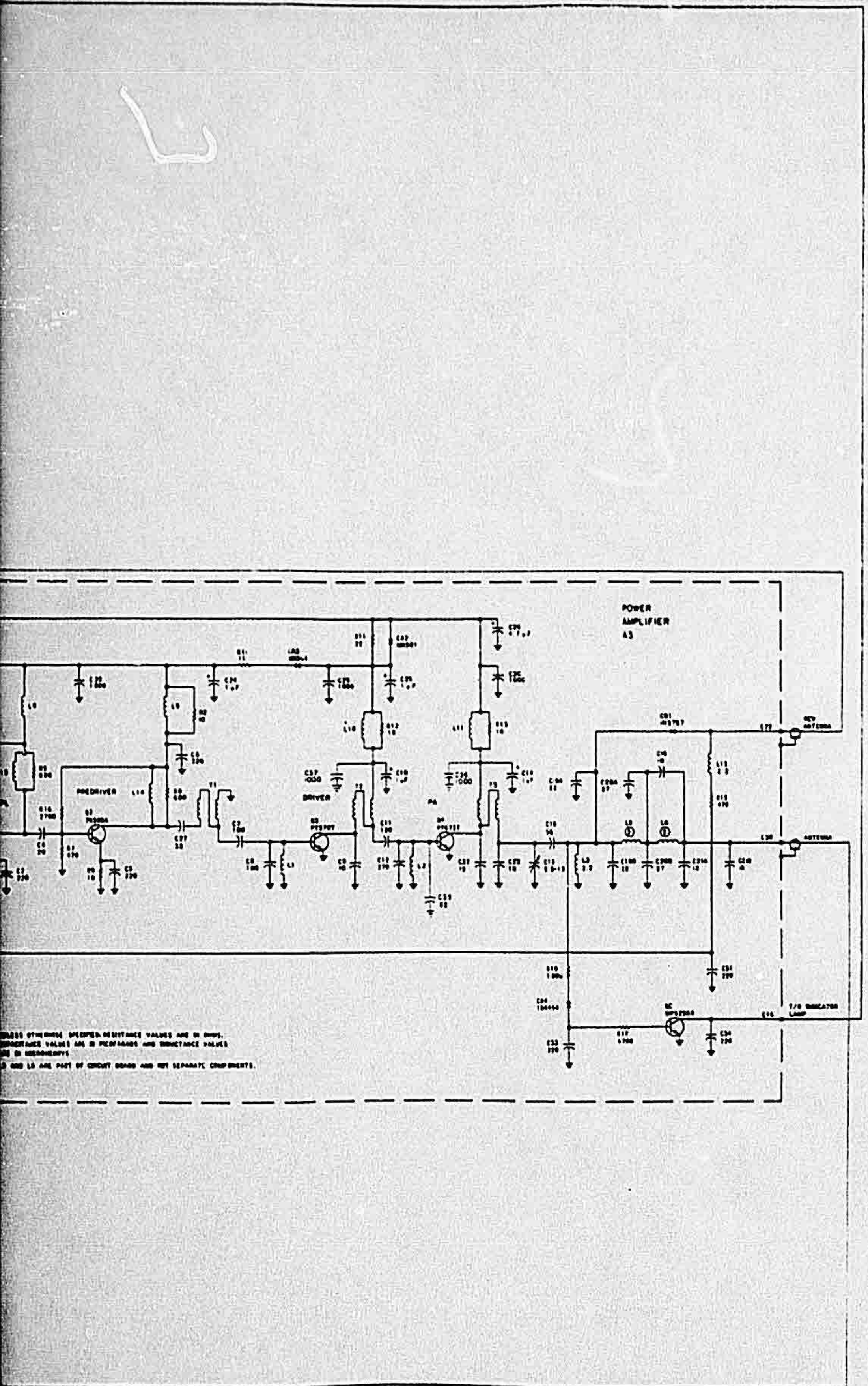
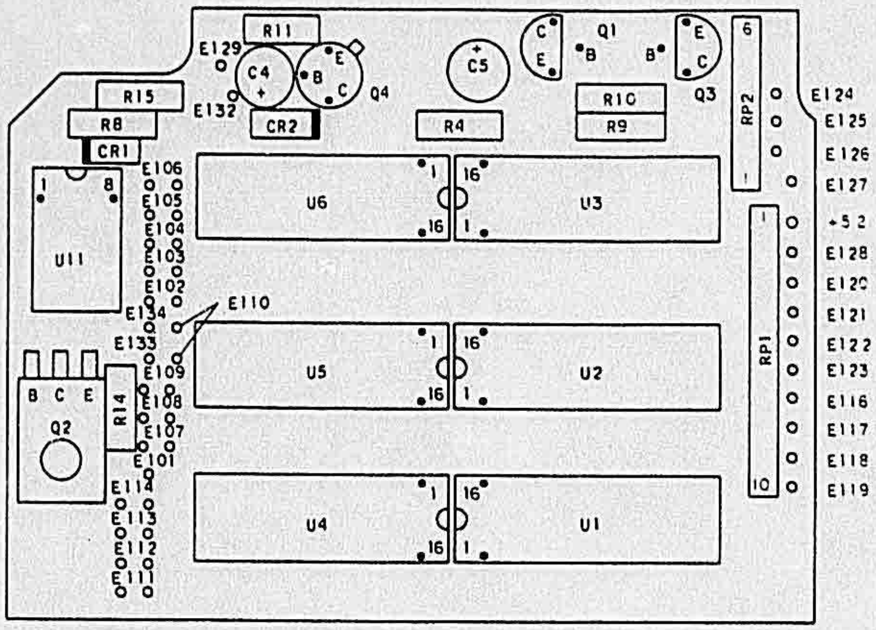
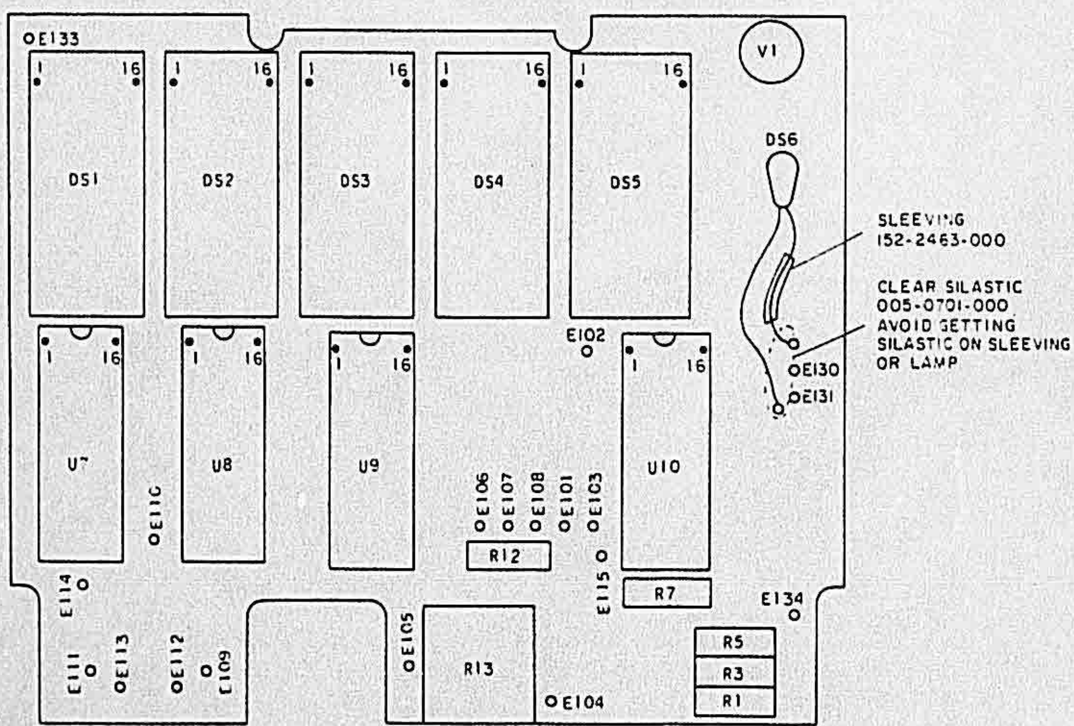


VHF-251 Communications Transceiver, Unit Schematic
Figure 6-1



VHF-251/251E Comm Preselect A7, Component Location Diagram, Effective Revision C
Figure 6-2



VHF-251/251E Electronic Display A8, Component Location Diagram
Figure 6-3

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
3	Added diode CR1, Moved E128 connection from SELECT to RECALL terminal of S4, and changed interface wiring of latch packs and data selectors. Changed to improve store/select/recall switching characteristics by electronically widening S4 positioning accuracy.	NA	REV C to A7
2	Changed value of R13 from 100 to 50 kΩ and R5 from 39 kΩ to 2700 ohms to reduce control range of display brightness.	NA	REV C to A8

VHF-251/251E Electronic Display Control Head Schematic, Effective Revision C
Figure 6-4 (Sheet A)

PARTS LIST
VHF-251/251E
A5-ELECTRONIC DISPLAY CONTROL HEAD (PART NUMBER - NO TOP LEVEL NUMBER)

SYMBOL	DESCRIPTION	PART NUMBER
A5C1	NOT USED	
A5C2	CAPACITOR, FIXED, ELECTROLYTIC, 1000UF, +100-20%, 6V	183-1471-020
A5CR1	DIODE, 1N4454 (EFF REV C)	353-3741-010
*A5R1	VOL CONT/PWR/ON/OFF	628-5180-002
A5S1	WAFER SWITCH	269-0628-020
A5S2	WAFER SWITCH	269-0628-030
A5S3	WAFER SWITCH	269-0628-040
*A5S4	PRESET SWITCH	259-0990-010
*A5S5	SQUELCH TEST SWITCH	266-0223-010
*A5S6	VOL CONT/PWR/ON/OFF	628-5180-002

VHF-251/251E
A7-PRESET BOARD (PART NUMBER 628-5041-001)

SYMBOL	DESCRIPTION	PART NUMBER
A7C1	NOT USED	
A7C2	NOT USED	
A7C3	NOT USED	
A7C4	CAPACITOR, FIXED, TANTALUM, 10UF, ±20%, 20V	184-9113-070
A7C5	CAPACITOR, FIXED, TANTALUM, 10UF, ±20%, 20V	184-9113-070
A7CR1	DIODE, 1N4454	353-3741-010
A7CR2	DIODE, 1N4002	353-3736-020
A7Q1	TRANSISTOR, MPS2369	352-5015-010
A7Q2	TRANSISTOR, MJE-200	352-5026-010
A7Q3	TRANSISTOR, MPS2369	352-5015-010
A7Q4	TRANSISTOR, 2N2907A	352-5019-010
A7RP1	RESISTOR, PAK, 4700 OHMS, ±20%, 1/8W, 9 ELEMENT	350-4001-480
A7RP2	RESISTOR, PAK, 4700 OHMS, ±20%, 1/8W, 5 ELEMENT	350-4001-020
A7R1	NOT USED	
A7R2	NOT USED	
A7R3	NOT USED	
A7R4	RESISTOR, FIXED, COMPOSITION, 100 OHMS, 10%, 1/4W	745-7950-130
A7R5	NOT USED	
A7R6	NOT USED	
A7R7	NOT USED	
A7R8	RESISTOR, FIXED, COMPOSITION, 150K, 10%, 1/4W	745-7950-510
A7R9	RESISTOR, FIXED, COMPOSITION, 4700 OHMS, 10%, 1/4W	745-7950-330
A7R10	RESISTOR, FIXED, COMPOSITION, 47K, 10%, 1/4W	745-7950-450
A7R11	RESISTOR, FIXED, COMPOSITION, 270K, 10%, 1/4W	745-7950-540
A7R12	NOT USED	
A7R13	NOT USED	
A7R14	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
A7R15	RESISTOR, FIXED, COMPOSITION, 39K, 10%, 1/4W	745-7950-440
A7U1	INTEGRATED CIRCUIT, 7475	351-1550-030
A7U2	INTEGRATED CIRCUIT, 7475	351-1550-030
A7U3	INTEGRATED CIRCUIT, 7475	351-1550-030

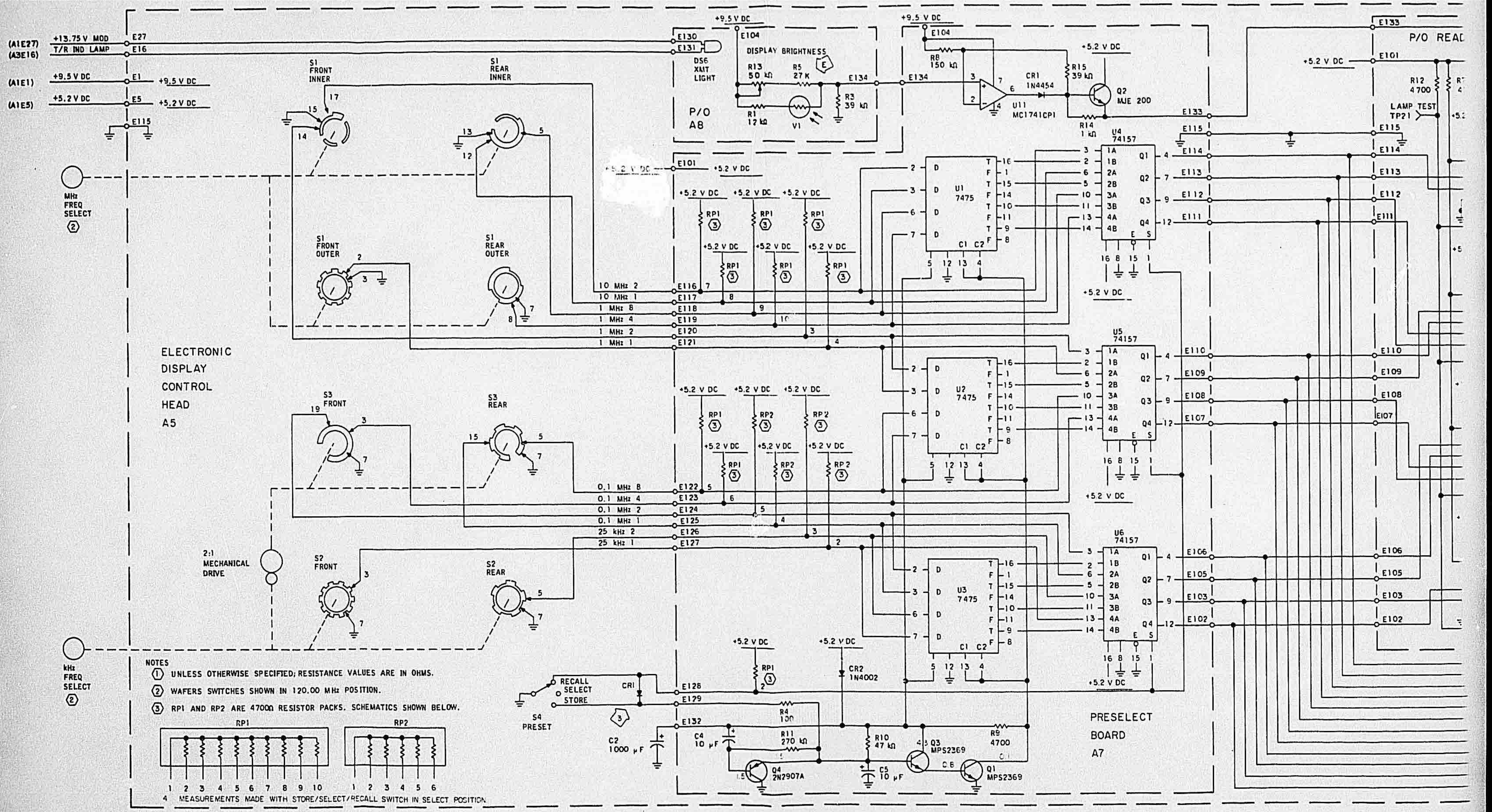
PARTS LIST
VHF-251/251E
A7-PRESET BOARD (PART NUMBER 628-5041-001)

SYMBOL	DESCRIPTION	PART NUMBER
A7U4	INTEGRATED CIRCUIT, 74157	351-1553-010
A7U5	INTEGRATED CIRCUIT, 74157	351-1553-010
A7U6	INTEGRATED CIRCUIT, 74157	351-1553-010
A7U7	NOT USED	
A7U8	NOT USED	
A7U9	NOT USED	
A7U10	NOT USED	
A7U11	INTEGRATED CIRCUIT, MC1741CP1	351-1156-010

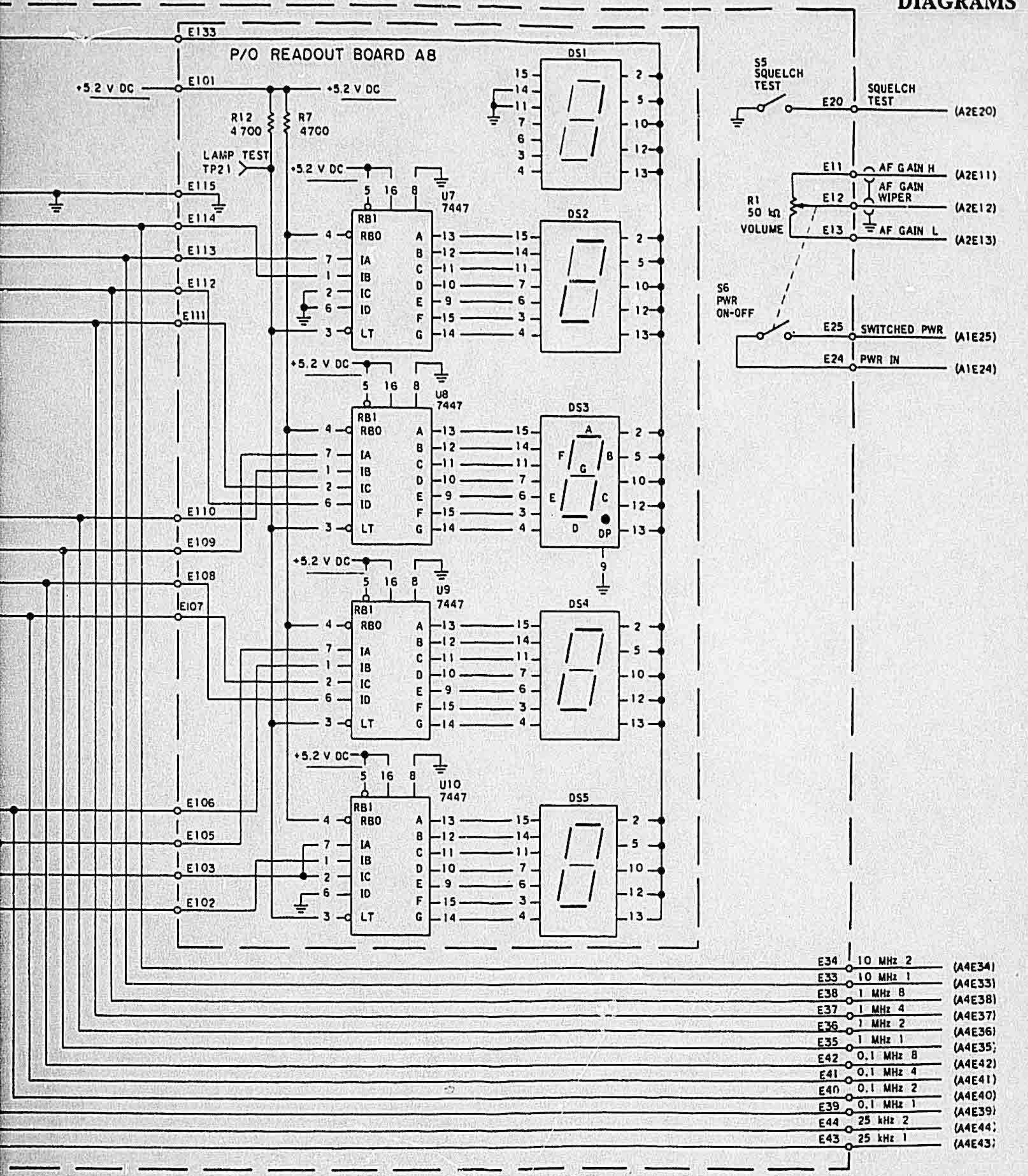
VHF-251/251E
A8-BOARD DISPLAY ASSEMBLY (PART NUMBER 628-5045-001)

SYMBOL	DESCRIPTION	PART NUMBER
A8DS1	INDICATOR, 7 SEG	262-1390-010
A8DS2	INDICATOR, 7 SEG	262-1390-010
A8DS3	INDICATOR, 7 SEG	262-1390-010
A8DS4	INDICATOR, 7 SEG	262-1390-010
A8DS5	INDICATOR, 7 SEG	262-1390-010
A8DS6	LAMP, INCANDESCENT	262-1398-060
A8R1	RESISTOR, FIXED, COMPOSITION, 12K, 10%, 1/4W	745-7950-380
A8R2	NOT USED	
A8R3	RESISTOR, FIXED, COMPOSITION, 39K, 10%, 1/4W	745-7950-440
A8R4	NOT USED	
A8R5	RESISTOR, FIXED, COMPOSITION, 27K, ±10%, 1/4 W (EFF REV C)	745-7950-420
A8R5	RESISTOR, FIXED, COMPOSITION, 39K, 10%, 1/4W	745-7950-440
A8R6	NOT USED	
A8R7	RESISTOR, FIXED, COMPOSITION, 4700 OHMS, 10%, 1/4W	745-7950-330
A8R8	NOT USED	
A8R9	NOT USED	
A8R10	NOT USED	
A8R11	NOT USED	
A8R12	RESISTOR, FIXED, COMPOSITION, 4700 OHMS, 10%, 1/4W	745-7950-330
A8R13	RESISTOR, VARIABLE, SINGLE TURN CERMET, 50K ±20%, 1/2W (EFF REV C)	382-0041-110
A8R13	RESISTOR, VARIABLE, NONWIREWOUND, 100K, ±70%, 1/2W	382-0041-130
A8U1	NOT USED	
A8U2	NOT USED	
A8U3	NOT USED	
A8U4	NOT USED	
A8U5	NOT USED	
A8U6	NOT USED	
A8U7	INTEGRATED CIRCUIT, 7447	351-1551-010
A8U8	INTEGRATED CIRCUIT, 7447	351-1551-010
A8U9	INTEGRATED CIRCUIT, 7447	351-1551-010
A8U10	INTEGRATED CIRCUIT, 7447	351-1551-010
A8V1	PHOTOELECTRIC CELL, CL907N	353-0445-010

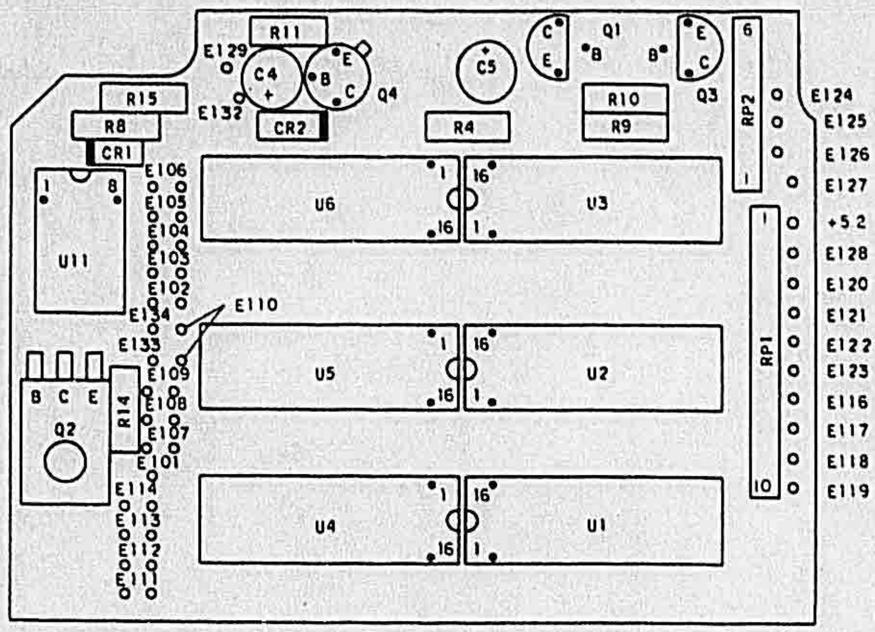
*INCLUDED WITH PART NUMBER 628-6014-001. REFER TO DISASSEMBLY PROCEDURES.


ELECTRONIC DISPLAY CONTROL HEAD A5
PRESELECT BOARD A7
P/O A8
P/O READ
(A1E27) +13.75 V MOD E27
(A3E16) T/R IND LAMP E16
(A1E1) +9.5 V DC E1
(A1E5) +5.2 V DC E5
E115
MHz FREQ SELECT ②
kHz FREQ SELECT ②
S1 FRONT INNER
S1 REAR INNER
S1 FRONT OUTER
S1 REAR OUTER
S3 FRONT
S3 REAR
S2 FRONT
S2 REAR
2:1 MECHANICAL DRIVE
DS6 XMIT LIGHT
DISPLAY BRIGHTNESS
R13 50 kΩ
R5 27 K
R1 12 kΩ
R3 39 kΩ
V1
R8 150 kΩ
U11 MC1741CP1
CR1 1N4454
R15 39 kΩ
Q2 MJE 200
R14 1 kΩ
U1 7475
U2 7475
U3 7475
U4 74157
U5 74157
U6 74157
10 MHz 2
10 MHz 1
1 MHz 8
1 MHz 4
1 MHz 2
1 MHz 1
0.1 MHz 8
0.1 MHz 4
0.1 MHz 2
0.1 MHz 1
25 kHz 2
25 kHz 1
RECALL SELECT STORE
S4 PRESET
C2 1000 µF
C4 10 µF
R4 100
R11 270 kΩ
Q4 2N2907A
CR2 1N4002
R10 47 kΩ
C5 10 µF
Q3 MPS2369
R9 4700
Q1 MPS2369
R12 4700
LAMP TEST TP21
NOTES
① UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS.
② WAFERS SWITCHES SHOWN IN 120.00 MHz POSITION.
③ RP1 AND RP2 ARE 4700Ω RESISTOR PACKS. SCHEMATICS SHOWN BELOW.
4 MEASUREMENTS MADE WITH STORE/SELECT/RECALL SWITCH IN SELECT POSITION.
RP1
RP2

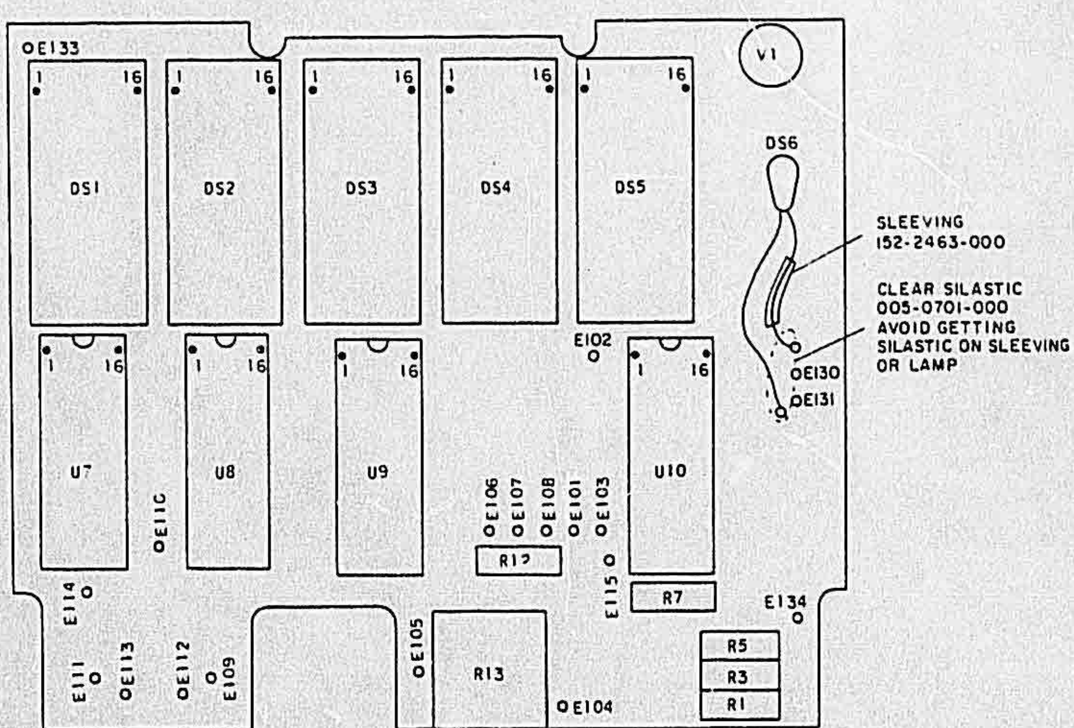
page 6-11



VHF-251/251E Electronic Display Control Head Schematic, Effective Revision C
Figure 6-4



VHF-251S Comm Preselect A7, Component Location Diagram
Figure 6-5



VHF-251S Electronic Display A8, Component Location Diagram
Figure 6-6

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
	(This page will contain schematic revision information.)		

VHF-251S Electronic Display Control Head Schematic
Figure 6-7 (Sheet A)

PARTS LIST
VHF-251S
A5-ELECTRONIC DISPLAY CONTROL HEAD (PART NUMBER - NO TOP LEVEL NUMBER)

SYMBOL	DESCRIPTION	PART NUMBER
A5C1	NOT USED	
A5C2	CAPACITOR, FIXED, ELECTROLYTIC, 1000UF, +100-20%, 6V	183-1471-020
A5CR1	DIODE, 1N4454 (EFF REV C)	353-3741-010
*A5R1	VOL CONT/PWR/ON/OFF	628-5180-002
A5S1	WAFER SWITCH	269-0628-020
A5S2	WAFER SWITCH	259-2907-060
A5S3	WAFER SWITCH	259-2907-040
*A5S4	PRESET SWITCH	259-0990-010
*A5S5	SQUELCH TEST SWITCH	266-0223-010
*A5S6	VOL CONT/PWR/ON/OFF	628-5180-002

VHF-251S
A7-PRESET BOARD (PART NUMBER 628-5041-001)

SYMBOL	DESCRIPTION	PART NUMBER
A7C1	NOT USED	
A7C2	NOT USED	
A7C3	NOT USED	
A7C4	CAPACITOR, FIXED, TANTALUM, 10UF, ±20%, 20V	184-9113-070
A7C5	CAPACITOR, FIXED, TANTALUM, 10UF, ±20%, 20V	184-9113-070
A7CR1	DIODE, 1N4454	353-3741-010
A7CR2	DIODE, 1N4002	353-3736-020
A7Q1	TRANSISTOR, MPS2369	352-5015-010
A7Q2	TRANSISTOR, MJE-200	352-5026-010
A7Q3	TRANSISTOR, MPS2369	352-5015-010
A7Q4	TRANSISTOR, 2N2907A	352-5019-010
A7RP1	RESISTOR, PAK, 4700 OHMS, ±20%, 1/8W, 9 ELEMENT	350-4001-480
A7RP2	RESISTOR, PAK, 4700 OHMS, ±20%, 1/8W, 5 ELEMENT	350-4001-020
A7R1	NOT USED	
A7R2	NOT USED	
A7R3	NOT USED	
A7R4	RESISTOR, FIXED, COMPOSITION, 100 OHMS, 10%, 1/4W	745-7950-130
A7R5	NOT USED	
A7R6	NOT USED	
A7R7	NOT USED	
A7R8	RESISTOR, FIXED, COMPOSITION, 150K, 10%, 1/4W	745-7950-510
A7R9	RESISTOR, FIXED, COMPOSITION, 4700 OHMS, 10%, 1/4W	745-7950-330
A7R10	RESISTOR, FIXED, COMPOSITION, 47K, 10%, 1/4W	745-7950-450
A7R11	RESISTOR, FIXED, COMPOSITION, 270K, 10%, 1/4W	745-7950-540
A7R12	NOT USED	
A7R13	NOT USED	
A7R14	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
A7R15	RESISTOR, FIXED, COMPOSITION, 39K, 10%, 1/4W	745-7950-440
A7U1	INTEGRATED CIRCUIT, 7475	351-1550-030
A7U2	INTEGRATED CIRCUIT, 7475	351-1550-030
A7U3	INTEGRATED CIRCUIT, 7475	351-1550-030

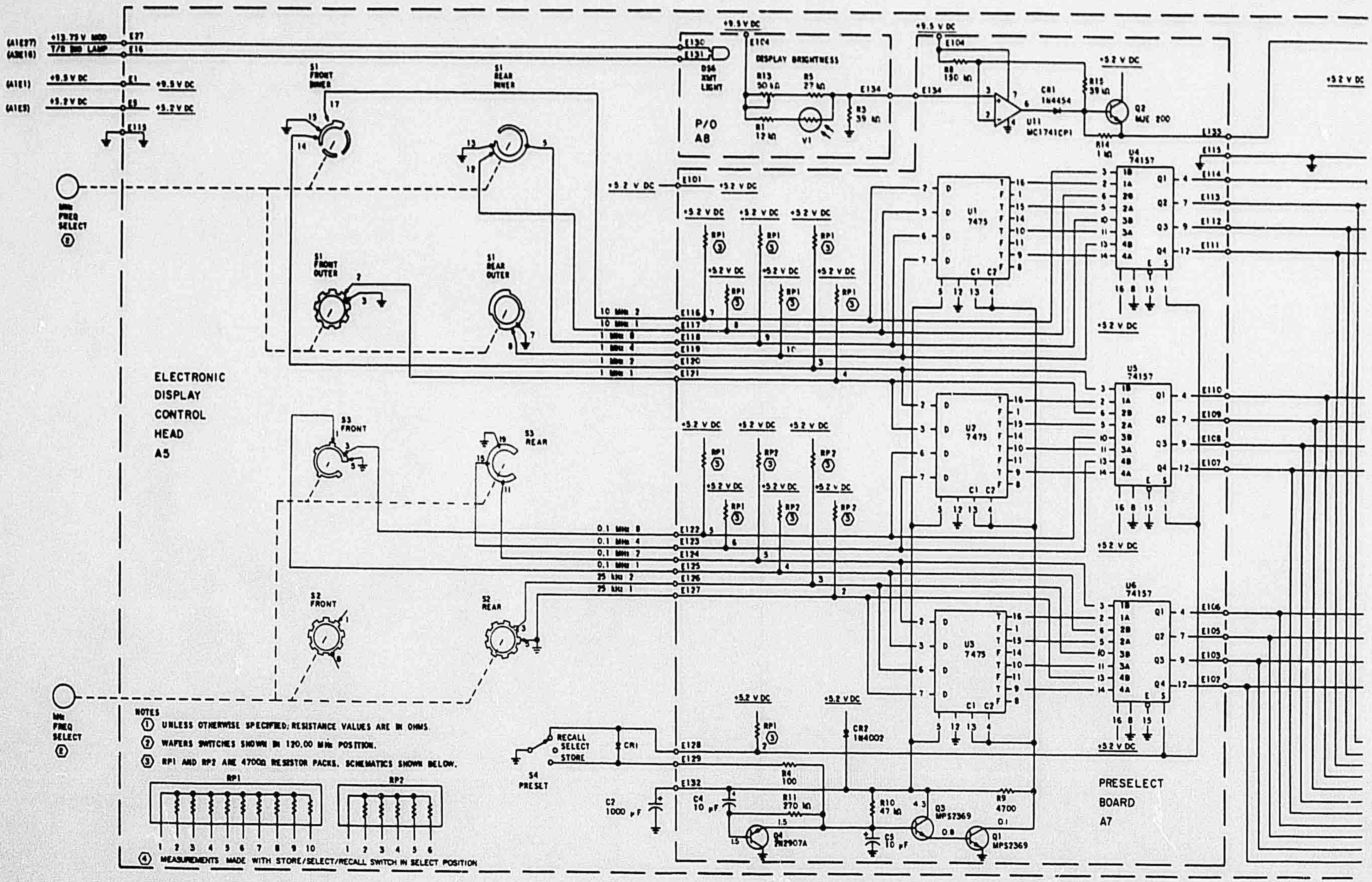
PARTS LIST
VHF-251S
A7-PRESET BOARD (PART NUMBER 628-5041-001)

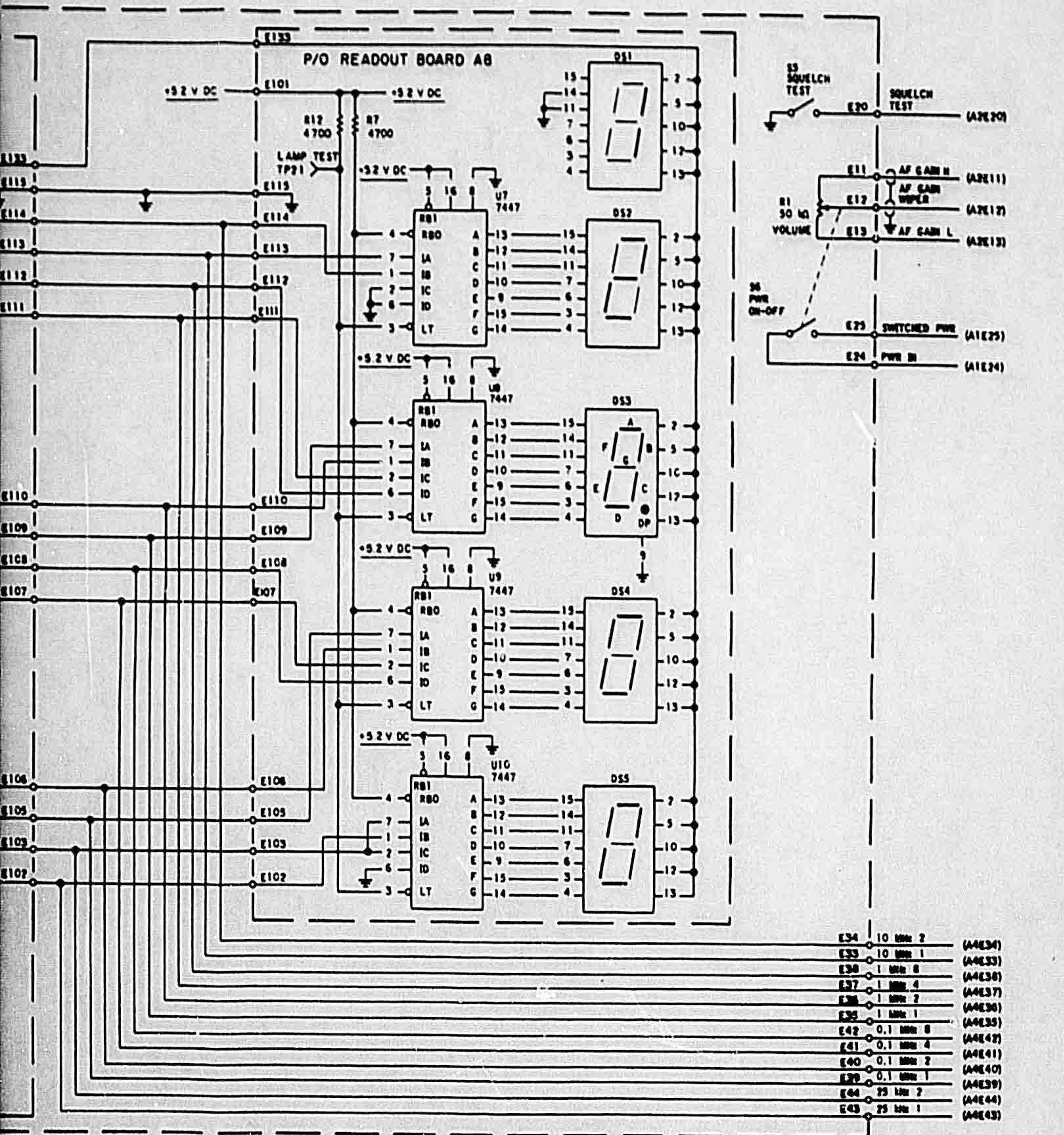
SYMBOL	DESCRIPTION	PART NUMBER
A7U4	INTEGRATED CIRCUIT, 74157	351-1553-010
A7U5	INTEGRATED CIRCUIT, 74157	351-1553-010
A7U6	INTEGRATED CIRCUIT, 74157	351-1553-010
A7U7	NOT USED	
A7U8	NOT USED	
A7U9	NOT USED	
A7U10	NOT USED	
A7U11	INTEGRATED CIRCUIT, MC1741CP1	351-1156-010

VHF-251S
A8-BOARD DISPLAY ASSEMBLY (PART NUMBER 628-5045-001)

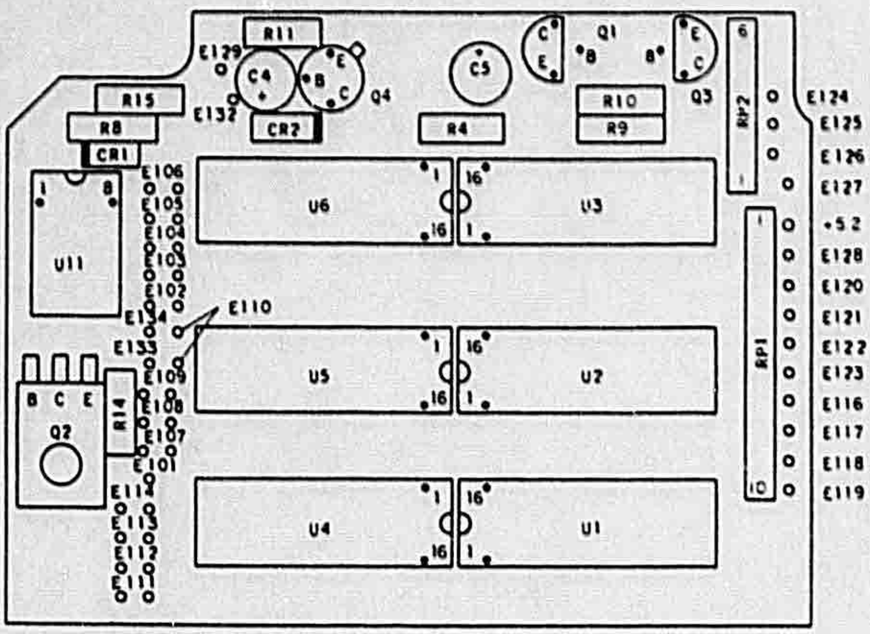
SYMBOL	DESCRIPTION	PART NUMBER
A8DS1	INDICATOR, 7 SEG	262-1390-010
A8DS2	INDICATOR, 7 SEG	262-1390-010
A8DS3	INDICATOR, 7 SEG	262-1390-010
A8DS4	INDICATOR, 7 SEG	262-1390-010
A8DS5	INDICATOR, 7 SEG	262-1390-010
A8DS6	LAMP, INCANDESCENT	262-1398-060
A8R1	RESISTOR, FIXED, COMPOSITION, 12K, 10% 1/4W	745-7950-380
A8R2	NOT USED	
A8R3	RESISTOR, FIXED, COMPOSITION, 39K, 10%, 1/4W	745-7950-440
A8R4	NOT USED	
A8R5	RESISTOR, FIXED, COMPOSITION, 39K, 10%, 1/4W	745-7950-440
A8R6	NOT USED	
A8R7	RESISTOR, FIXED, COMPOSITION, 2700 OHM ±10%, 1/2W	745-7950-420
A8R8	NOT USED	
A8R9	NOT USED	
A8R10	NOT USED	
A8R11	NOT USED	
A8R12	RESISTOR, FIXED, COMPOSITION, 4700 OHMS, 10%, 1/4W	745-7950-330
A8R13	RESISTOR, VARIABLE, SINGLE TURN CERMET, 50K ±20%, 1/2W	382-0041-110
A8U1	NOT USED	
A8U2	NOT USED	
A8U3	NOT USED	
A8U4	NOT USED	
A8U5	NOT USED	
A8U6	NOT USED	
A8U7	INTEGRATED CIRCUIT, 7447	351-1551-010
A8U8	INTEGRATED CIRCUIT, 7447	351-1551-010
A8U9	INTEGRATED CIRCUIT, 7447	351-1551-010
A8U10	INTEGRATED CIRCUIT, 7447	351-1551-010
A8V1	PHOTOELECTRIC CELL, CL907N	353-0445-010

*INCLUDED WITH PART NUMBER 628-6014-001. REFER TO DISASSEMBLY PROCEDURES.

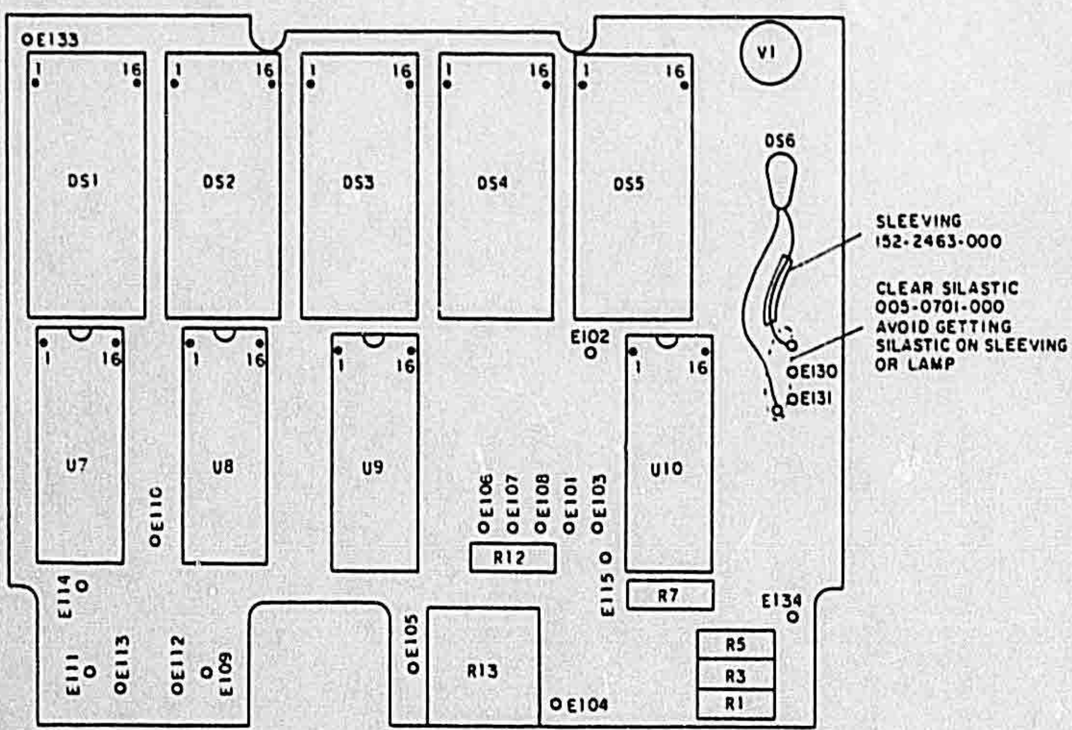

ELECTRONIC
DISPLAY
CONTROL
HEAD
A5
PRESELECT
BOARD
A7
P/O
A8
DISPLAY BRIGHTNESS
MHz FREQ SELECT
S1 FRONT INNER
S1 REAR INNER
S1 FRONT OUTER
S1 REAR OUTER
S3 FRONT
S3 REAR
S2 FRONT
S2 REAR
S4 PRESET
RECALL
SELECT
STORE
U1 7475
U2 7475
U3 7475
U4 74157
U5 74157
U6 74157
U11 MC1741CP1
Q2 MJE 200
Q3 MPS2369
Q1 MPS2369
Q4 2N2907A
CR1 1N4454
CR2 1N4002
DS6 XMT LIGHT
+13.75 V MOD
T/R SW LAMP
+9.5 V DC
+5.2 V DC
10 MHz 2
10 MHz 1
1 MHz 8
1 MHz 4
1 MHz 2
1 MHz 1
0.1 MHz 8
0.1 MHz 4
0.1 MHz 2
0.1 MHz 1
25 kHz 2
25 kHz 1
NOTES
① UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS.
② WAFERS SWITCHES SHOWN IN 120.00 MHz POSITION.
③ RP1 AND RP2 ARE 4700Ω RESISTOR PACKS. SCHEMATICS SHOWN BELOW.
RP1
RP2
④ MEASUREMENTS MADE WITH STORE/SELECT/RECALL SWITCH IN SELECT POSITION



VHF-251S
Electronic Display Control Head Schematic
Figure 6-7



VHF-251 Comm Preselect A7, Component Location Diagram, Effective Revisions A and B
Figure 6-8



VHF-251 Electronic Display A-8, Component Location Diagram
Figure 6-9

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
	(This page will contain schematic revision information.)		

VHF-251 Electronic Display Control Head Schematic, Effective Revisions A and B
Figure 6-10 (Sheet A)

PARTS LIST
VHF-251
A5-ELECTRONIC DISPLAY CONTROL HEAD (PART NUMBER - NO TOP LEVEL NUMBER)

SYMBOL	DESCRIPTION	PART NUMBER
A5C1	NOT USED	
A5C2	CAPACITOR, FIXED, ELECTROLYTIC, 1000UF, +100-20%, 6V	183-1471-020
A5CR1	DIODE, 1N4454 (EFF REV C)	353-3741-010
*A5R1	VOL CONT/PWR/ON/OFF	628-5180-002
A5S1	ROTARY SWITCH ASSEMBLY	628-5518-001
A5S2	ROTARY SWITCH ASSEMBLY	628-5518-001
A5S3	ROTARY SWITCH ASSEMBLY	628-5518-001
*A5S4	PRESET SWITCH	259-0990-010
*A5S5	SQUELCH TEST SWITCH	266-0223-010
*A5S6	VOL CONT/PWR/ON/OFF	628-5180-002

VHF-251
A7-PRESET BOARD (PART NUMBER 628-5041-001)

SYMBOL	DESCRIPTION	PART NUMBER
A7C1	NOT USED	
A7C2	NOT USED	
A7C3	NOT USED	
A7C4	CAPACITOR, FIXED, TANTALUM, 10UF, ±20%, 20V	184-9113-070
A7C5	CAPACITOR, FIXED, TANTALUM, 10UF, ±20%, 20V	184-9113-070
A7CR1	DIODE, 1N4454	353-3741-010
A7CR2	DIODE, 1N4002	353-3736-020
A7Q1	TRANSISTOR, MPS2369	352-5015-010
A7Q2	TRANSISTOR, MJE-200	352-5026-010
A7Q3	TRANSISTOR, MPS2369	352-5015-010
A7Q4	TRANSISTOR, 2N2907A	352-5019-010
A7RP1	RESISTOR, PAK, 4700 OHMS, ±20%, 1/8W, 9 ELEMENT	350-4001-480
A7RP2	RESISTOR, PAK, 4700 OHMS, ±20%, 1/8W, 5 ELEMENT	350-4001-020
A7R1	NOT USED	
A7R2	NOT USED	
A7R3	NOT USED	
A7R4	RESISTOR, FIXED, COMPOSITION, 100 OHMS, 10%, 1/4W	745-7950-130
A7R5	NOT USED	
A7R6	NOT USED	
A7R7	NOT USED	
A7R8	RESISTOR, FIXED, COMPOSITION, 150K, 10%, 1/4W	745-7950-510
A7R9	RESISTOR, FIXED, COMPOSITION, 4700 OHMS, 10%, 1/4W	745-7950-330
A7R10	RESISTOR, FIXED, COMPOSITION, 47K, 10%, 1/4W	745-7950-450
A7R11	RESISTOR, FIXED, COMPOSITION, 270K, 10%, 1/4W	745-7950-540
A7R12	NOT USED	
A7R13	NOT USED	
A7R14	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
A7R15	RESISTOR, FIXED, COMPOSITION, 39K, 10%, 1/4W	745-7950-440
A7U1	INTEGRATED CIRCUIT, 7475	351-1550-030
A7U2	INTEGRATED CIRCUIT, 7475	351-1550-030
A7U3	INTEGRATED CIRCUIT, 7475	351-1550-030

PARTS LIST
VHF-251
A7-PRESET BOARD (PART NUMBER 628-5041-001)

SYMBOL	DESCRIPTION	PART NUMBER
A7U4	INTEGRATED CIRCUIT, 74157	351-1553-010
A7U5	INTEGRATED CIRCUIT, 74157	351-1553-010
A7U6	INTEGRATED CIRCUIT, 74157	351-1553-010
A7U7	NOT USED	
A7U8	NOT USED	
A7U9	NOT USED	
A7U10	NOT USED	
A7U11	INTEGRATED CIRCUIT, MC1741CP1	351-1156-010

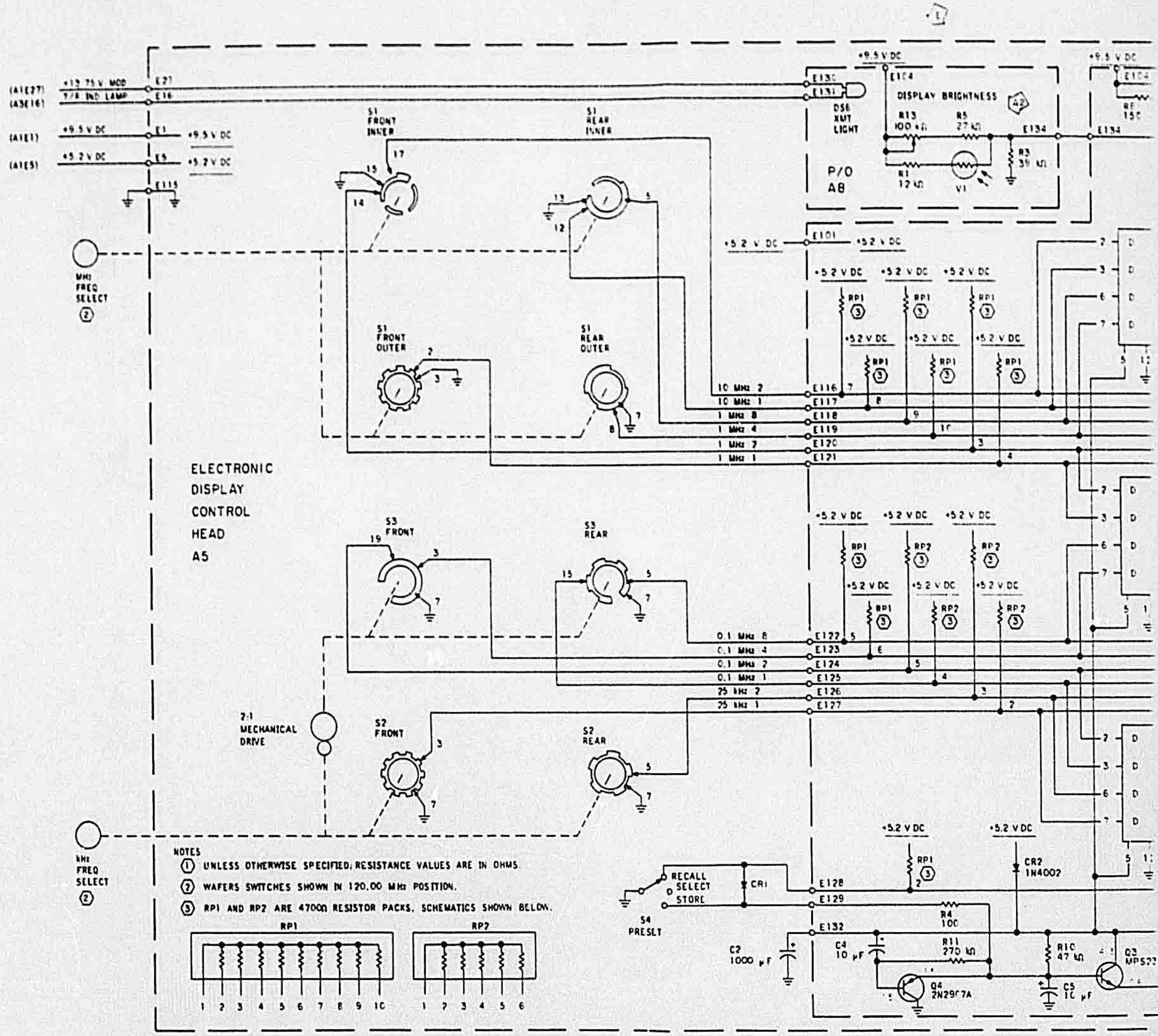
VHF-251
A8-BOARD DISPLAY ASSEMBLY (PART NUMBER 628-5045-001)

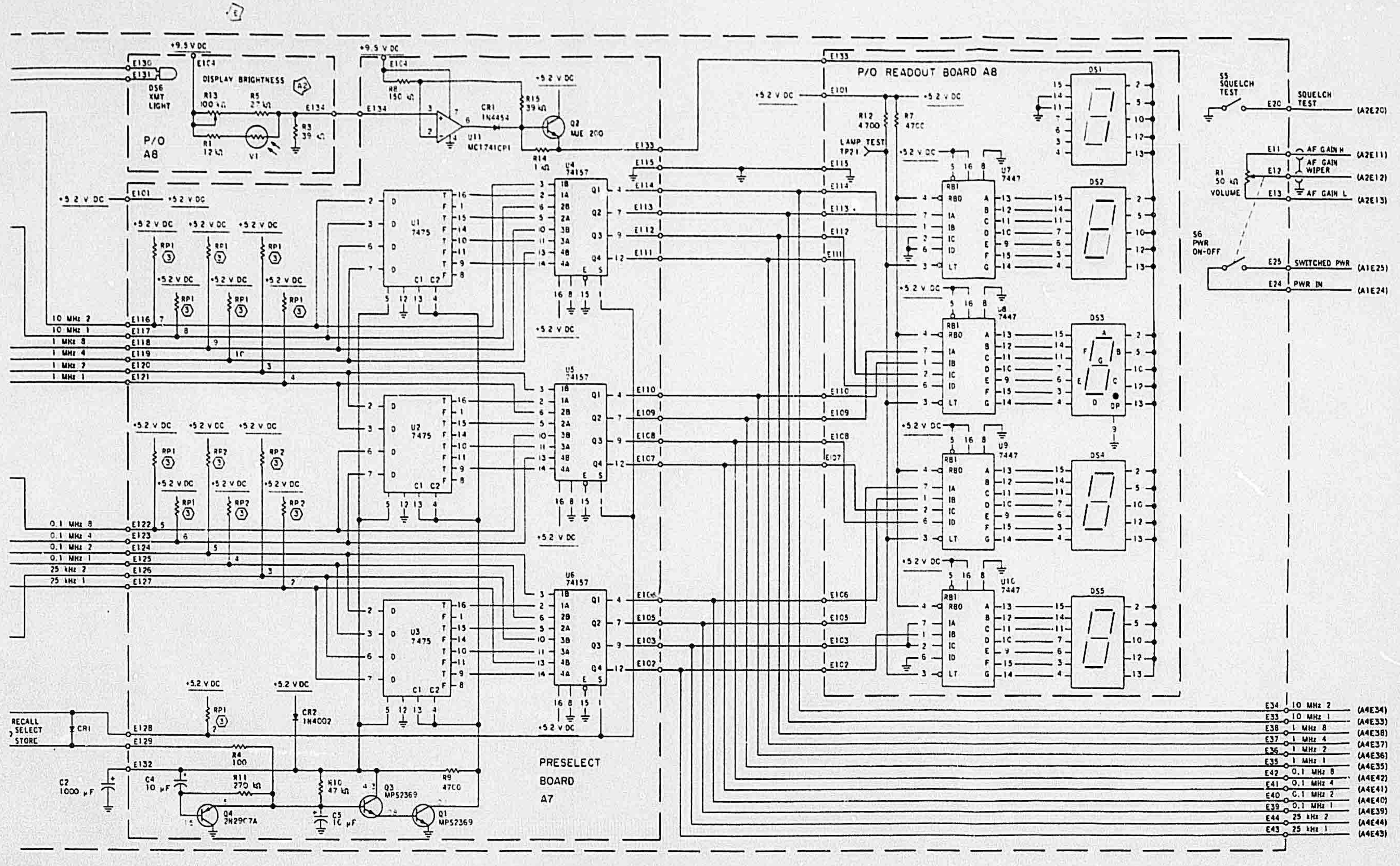
SYMBOL	DESCRIPTION	PART NUMBER
A8DS1	INDICATOR, 7 SEG	262-1390-010
A8DS2	INDICATOR, 7 SEG	262-1390-010
A8DS3	INDICATOR, 7 SEG	262-1390-010
A8DS4	INDICATOR, 7 SEG	262-1390-010
A8DS5	INDICATOR, 7 SEG	262-1390-010
A8DS6	LAMP, INCANDESCENT	262-1398-060
A8R1	RESISTOR, FIXED, COMPOSITION, 12K, 10%, 1/4W	745-7950-380
A8R2	NOT USED	
A8R3	RESISTOR, FIXED, COMPOSITION, 39K, 10%, 1/4W	745-7950-440
A8R4	NOT USED	
A8R5	RESISTOR, FIXED, COMPOSITION, 39K, 10%, 1/4W	745-7950-440
A8R6	NOT USED	
A8R7	RESISTOR, FIXED, COMPOSITION, 4700 OHMS, 10%, 1/4W	745-7950-330
A8R8	NOT USED	
A8R9	NOT USED	
A8R10	NOT USED	
A8R11	NOT USED	
A8R12	RESISTOR, FIXED, COMPOSITION, 4700 OHMS, 10%, 1/4W	745-7950-330
A8R13	RESISTOR, VARIABLE, NONWIREWOUND, 100K, ±10%, 1/2W	382-0041-130
A8U1	NOT USED	
A8U2	NOT USED	
A8U3	NOT USED	
A8U4	NOT USED	
A8U5	NOT USED	
A8U6	NOT USED	
A8U7	INTEGRATED CIRCUIT, 7447	351-1551-010
A8U8	INTEGRATED CIRCUIT, 7447	351-1551-010
A8U9	INTEGRATED CIRCUIT, 7447	351-1551-010
A8U10	INTEGRATED CIRCUIT, 7447	351-1551-010
A8V1	PHOTOELECTRIC CELL, CL907N	353-0445-010

*INCLUDED WITH PART NUMBER 628-5521-002. REFER TO DISASSEMBLY PROCEDURES.

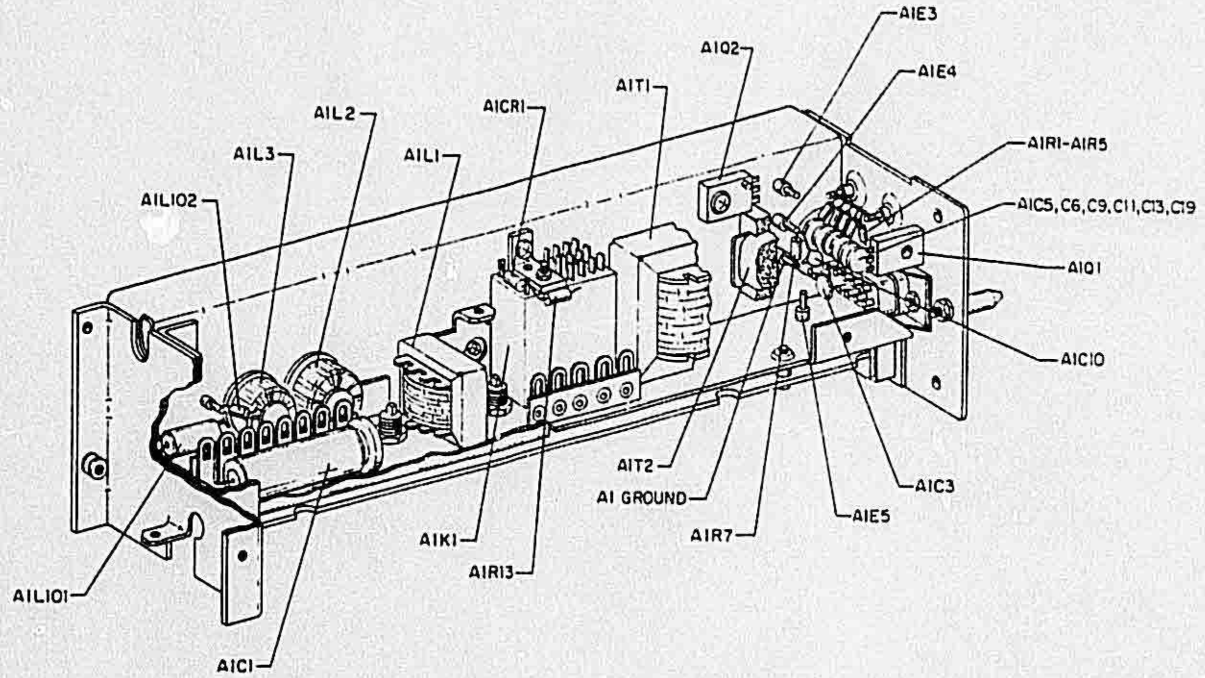
DISPLAY PINS TO SEGMENT CHART

PIN	SEGMENT
15	F
14	G
13	A
12	B
11	C
10	D
9	E
4	BLANKING HI

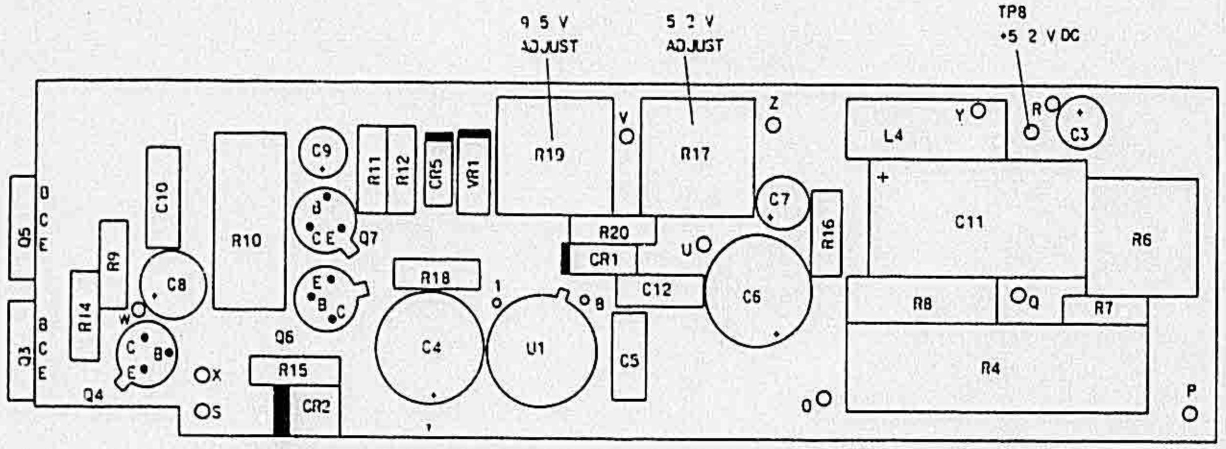




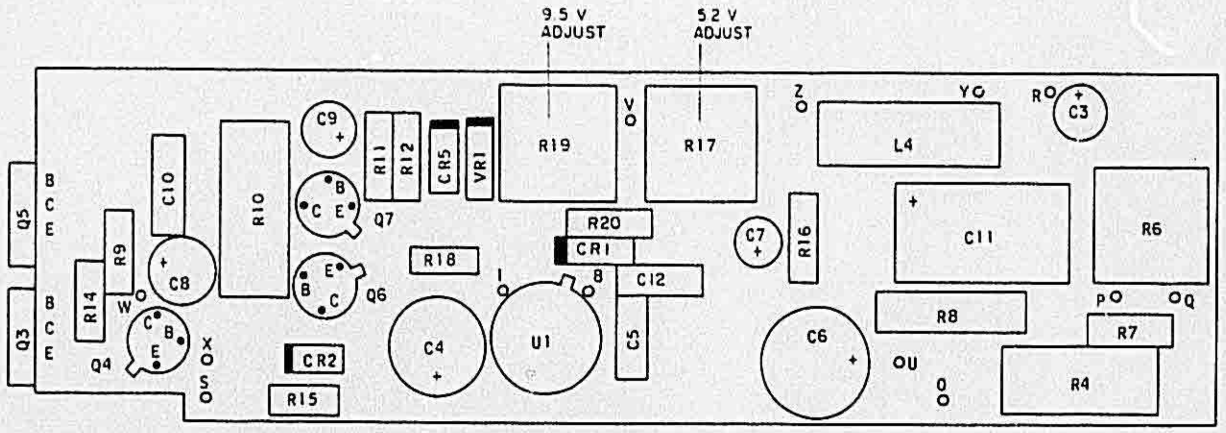
VHF-251 Electronic Display Control Head Schematic,
Effective Revisions A and B
Figure 6-10



Chassis Mounted Components A1
Figure 6-11



EFFECTIVE REVISION F



EFFECTIVE REVISIONS A THROUGH E

Power Supply A6, Component Location Diagram
Figure 6-12

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
1	Rewire relay A1K1 to prevent shorting +13.75 V dc to ground due to uncontrolled switching sequence of relay transfer.	SB 3	REV F
2	Change wire terminology to provide a more complete description of wire functions.	NA	NA
3	Changed value of R7 from 18 to 12 kΩ to reduce crossover distortion.	SB 7	REV N
4	Changed value of R7 from 12 to 8.2 kΩ to improve thermal stability.	NA	REV S
5	Added diode CR2 to improve thermal stability.	NA	REV T
6	Changed MJE200 to TIP125 to improve reliability.	VHF-251, SIL 3-77; VHF-251S and VHF-251E, SIL 2-77	REV Y
7	Changed A6C10 from 1000 pF to 0.05 μF to improve regulator stability.	VHF-251, SB 13/15; VHF-251S, SB 6/8; VHF-251E, SB 7/9	REV G

Audio/TR Chassis A1 and Power Supply A6 Schematic
Figure 6-13 (Sheet A)

PARTS LIST
VHF-251/251S/251E
A1-CHASSIS AUDIO TR (PART NUMBER 628-5061-001)

SYMBOL	DESCRIPTION	PART NUMBER
A1C1	CAPACITOR, FIXED, ELECTROLYTIC, 1200UF, +100-20%, 16V	183-1471-060
A1C2	NOT USED	
A1C3	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
*C4	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
*C5	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
*C6	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
A1C7	NOT USED	
A1C8	NOT USED	
*C9	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
A1C10	CAPACITOR, FIXED, TANTALUM, 0.33UF, ±20%, 35V	184-9113-010
*C11	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
A1C12	NOT USED	
*C13	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
*C14	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
*C15	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
*C16	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
*C17	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
*C18	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
*C19	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
A1C20-A1C100	NOT USED	
A1C101	CAPACITOR, FIXED, TANTALUM, 150UF, ±20%, 15V	184-9113-160
A1C102-A1C200	NOT USED	
A1C201	CAPACITOR, FEEDTHROUGH, 1000PF, +100-20%, 50V	913-3303-010
A1C202	CAPACITOR, FEEDTHROUGH, 1000PF, +100-20%, 50V	913-3303-010
A1C203	CAPACITOR, FEEDTHROUGH, 1000PF, +100-20%, 50V	913-3303-010
A1C204	CAPACITOR, FEEDTHROUGH, 1000PF, +100-20%, 50V	913-3303-010
A1CR1	DIODE, 1N4002	353-3736-020
A1CR2	DIODE, 1N4156 (EFF REV T)	353-3743-010
A1CR3	DIODE, 1N4156	353-3743-010
A1K1	RELAY, 4PDT, 12V (EFF REV AF)	970-0038-020
A1K1	RELAY, ARMATURE, 4PDT, 12V	970-0024-010
A1L1	INDUCTOR, 1MH	668-0262-010
A1L2	TRANSFORMER, SWITCHING, 0.3MH	664-0159-020

PARTS LIST
VHF-251/251S/251E
A1-CHASSIS AUDIO TR (PART NUMBER 628-5061-001)

SYMBOL	DESCRIPTION	PART NUMBER
A1L3	TRANSFORMER, SWITCHING, 0.3MH	664-0159-020
A1L4- A1L100	NOT USED	
A1L101	COIL, 28UH	240-0958-010
A1L102	COIL, 22UH	240-2742-080
A1P1	CONNECTOR, PLUG, 25 PIN	371-0379-010
A1P2	CONNECTOR, BNC TYPE RF CONNECTOR, BULKHEAD MTG	357-7532-020
A1Q1	TRANSISTOR, TIP-125	352-5006-020
A1Q2	TRANSISTOR, TIP-125	352-5006-020
A1R1	RESISTOR, FIXED, COMPOSITION, 470 OHMS, 10%, 1/4W	745-7950-210
A1R2	RESISTOR, FIXED, COMPOSITION, 470 OHMS, 10%, 1/4W	745-7950-210
A1R3	RESISTOR, FIXED, COMPOSITION, 470 OHMS, 10%, 1/4W	745-7950-210
A1R4	RESISTOR, FIXED, COMPOSITION, 470 OHMS, 10%, 1/4W	745-7950-210
A1R5	RESISTOR, FIXED, COMPOSITION, 33 OHMS, 10%, 1/4W	745-7950-070
A1R6	NOT USED	
A1R7	RESISTOR, FIXED, COMPOSITION, 8.2K, 10%, 1/4W	745-7950-360
A1R7	(EFF REV S) RESISTOR, FIXED, COMPOSITION, 12K, 10%, 1/4W (EFF N; SB 7)	745-7950-380
A1R7	RESISTOR, FIXED, COMPOSITION, 18K, 10%, 1/4W	745-7950-400
A1R8	NOT USED	
A1R9	NOT USED	
A1R10	NOT USED	
A1R11	NOT USED	
A1R12	NOT USED	
A1R13	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
A1T1	TRANSFORMER	667-0251-010
A1T2	TRANSFORMER	667-0252-010

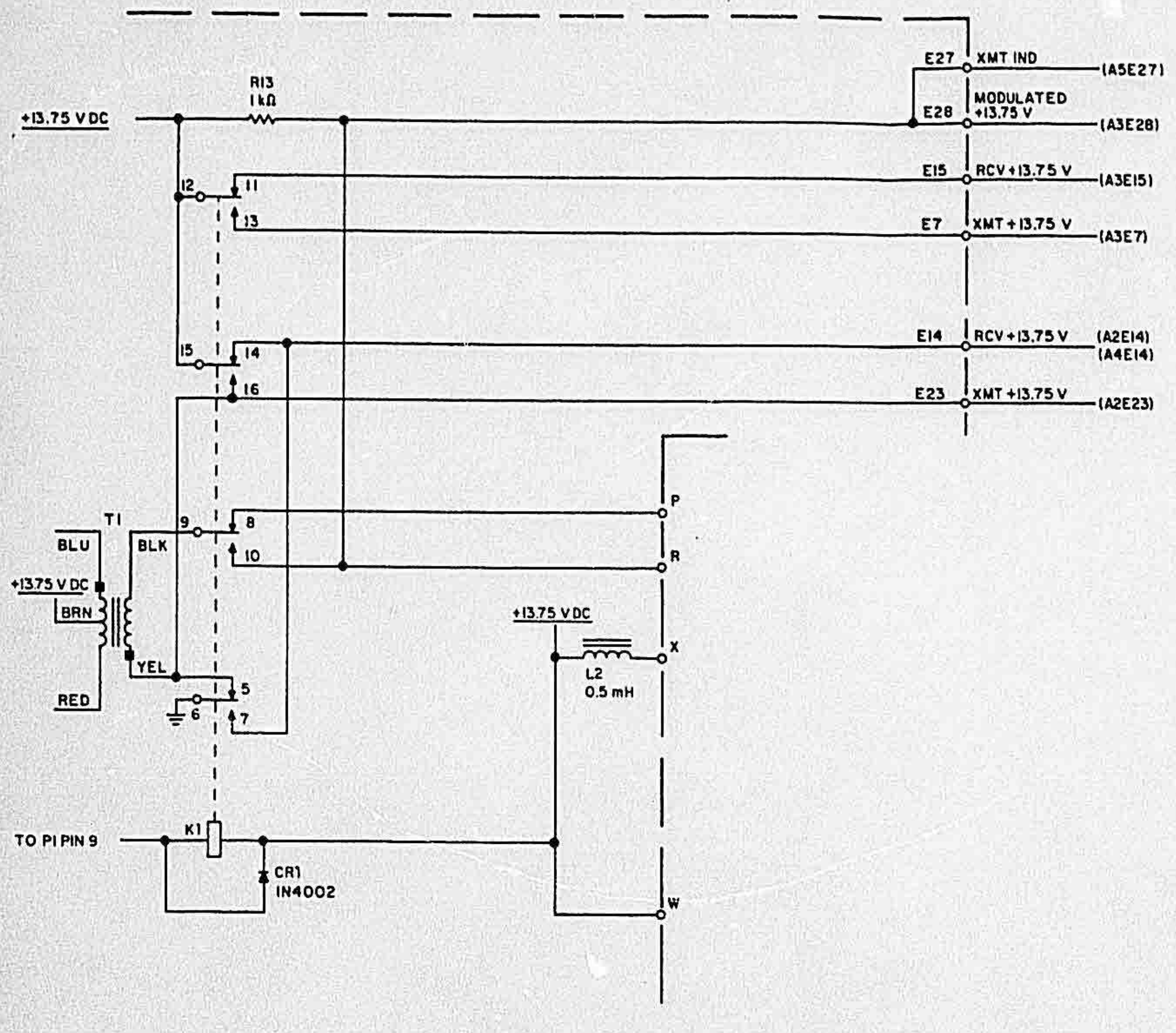
*NOT PART OF A1. PART OF REAR PLATE ASSEMBLY PART NUMBER 628-5491-001.

PARTS LIST
VHF-251/251S/251E
A6-POWER SUPPLY (PART NUMBER 628-5001-001)

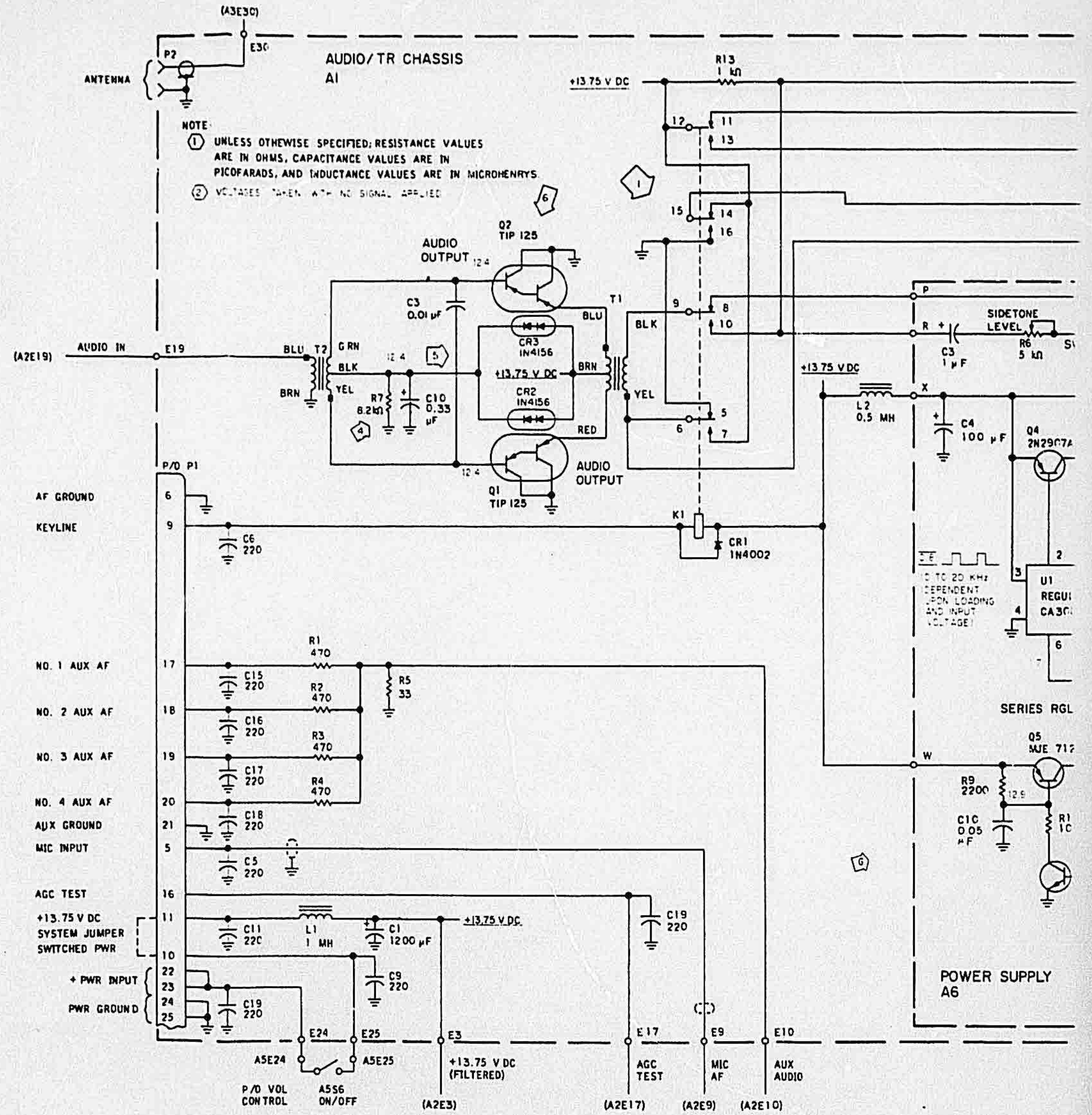
SYMBOL	DESCRIPTION	PART NUMBER
A6C1	NOT USED	
A6C2	NOT USED	
A6C3	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
A6C4	CAPACITOR, FIXED, ELECTROLYTIC, RADIAL, 100UF, +100-20%, 16V	183-1471-090
A6C5	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 470PF, +80-20%, 500V	913-3298-100
A6C6	CAPACITOR, FIXED, ELECTROLYTIC, 220UF, +100-20%, 6V	183-1471-070
A6C7	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
A6C8	CAPACITOR, FIXED, TANTALUM, 22UF, ±20%, 15V	184-9113-080
A6C9	CAPACITOR, FIXED, TANTALUM, 4.7UF, ±20%, 10V	184-9113-050
A6C10	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.05UF, +80-20%, 12V (EFF REV G; VHF-251 SB 13/15, VHF-251E SB 7/9, VHF-251S SB 6/8)	913-3298-010
A6C10	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000PF, +80-20%, 500V	913-3298-110
A6C11	CAPACITOR, FIXED, ELECTROLYTIC, 330UF, +100-20%, 6V	183-1471-010
A6C12	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 100PF, +80-20%, 500V	913-3298-070
A6CR1	DIODE, 1N4156	353-3743-010
A6CR2	DIODE, 1N5416	353-3734-010
A6CR3	NOT USED	
A6CR4	NOT USED	
A6CR5	DIODE, 1N4454	353-3741-010
A6L1-A6L3	NOT USED	
A6L4	COIL, 28UH	240-0958-010
A6Q1	NOT USED	
A6Q2	NOT USED	
A6Q3	TRANSISTOR, MJE800	352-5028-010
A6Q4	TRANSISTOR, 2N2907A	352-5019-010
A6Q5	TRANSISTOR, MJE712	352-5000-010
A6Q6	TRANSISTOR, MPS2369	352-5015-010
A6Q7	TRANSISTOR, 2N2907A	352-5019-010
A6R1	NOT USED	
A6R2	NOT USED	
A6R3	NOT USED	
A6R4	RESISTOR, FIXED, WIREWOUND, 2.7 OHMS, ±5%, 6.5W	745-7954-030
A6R4	RESISTOR, FIXED, WIREWOUND, 2.7 OHMS, ±5%, 3W	745-7953-040
A6R5	NOT USED	
A6R6	RESISTOR, VARIABLE, NONWIREWOUND, 5K, ±70%, 1/2W	382-0041-050
A6R7	RESISTOR, FIXED, COMPOSITION, 12K, 10%, 1/4W (EFF REV N; SB 7)	745-7950-380

PARTS LIST
VHF-251/251S/251E
A6-POWER SUPPLY (PART NUMBER 628-5001-001)

SYMBOL	DESCRIPTION	PART NUMBER
A6R7	RESISTOR, FIXED, COMPOSITION, 100 OHMS, 10%, 1/4W	745-7950-130
A6R8	RESISTOR, FIXED, WIREWOUND, 0.3 OHMS, ±10%, 2W	745-0909-010
A6R9	RESISTOR, FIXED, COMPOSITION, 2200 OHMS, 10%, 1/4W	745-7950-290
A6R10	RESISTOR, FIXED, COMPOSITION, 100 OHMS, 10%, 1W	745-7952-130
A6R11	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
A6R12	RESISTOR, FIXED, COMPOSITION, 200 OHMS, 10%, 1/4W	745-7950-170
A6R13	NOT USED	
A6R14	RESISTOR, FIXED, COMPOSITION, 47 OHMS, 10%, 1/4W	745-7950-090
A6R15	RESISTOR, FIXED, COMPOSITION, 820K, 10%, 1/4W	745-7950-600
A6R16	RESISTOR, FIXED, COMPOSITION, 1800 OHMS, 10%, 1/4W	745-7950-280
A6R17	RESISTOR, VARIABLE, NONWIREWOUND, 5K, ±70%, 1/2W	382-0041-050
A6R18	RESISTOR, FIXED, COMPOSITION, 2200 OHMS, 10%, 1/4W	745-7950-290
A6R19	RESISTOR, VARIABLE, NONWIREWOUND, 5K, ±70%, 1/2W	382-0041-050
A6R20	RESISTOR, FIXED, COMPOSITION, 12 OHMS, 10%, 1/4W	745-7950-020
A6U1	INTEGRATED CIRCUIT, CA3085	351-1171-020
A6VR1	ZENER DIODE, 1N5229A, 4.3V	353-3740-190



BEFORE SERVICE BULLETIN NO. 3



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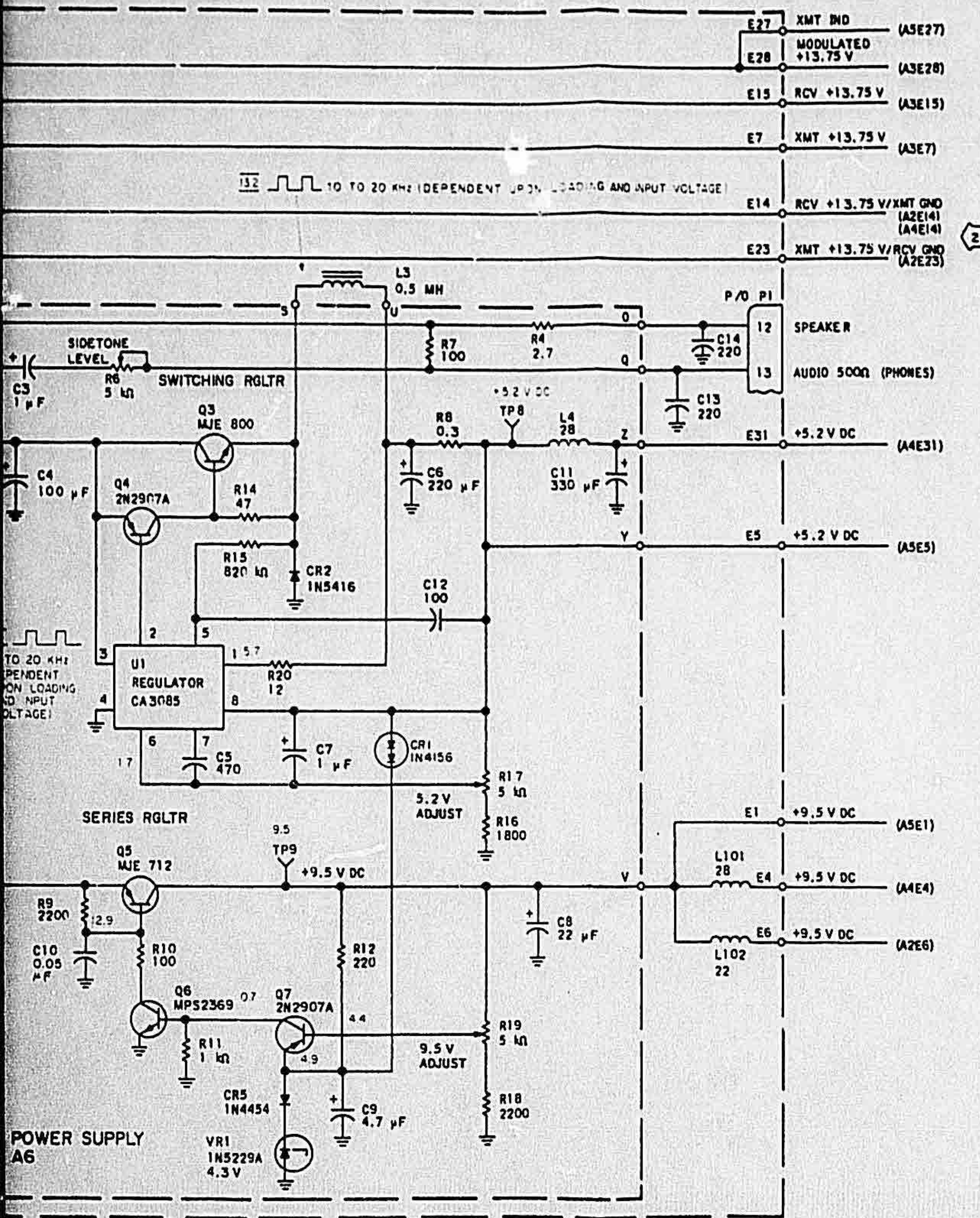
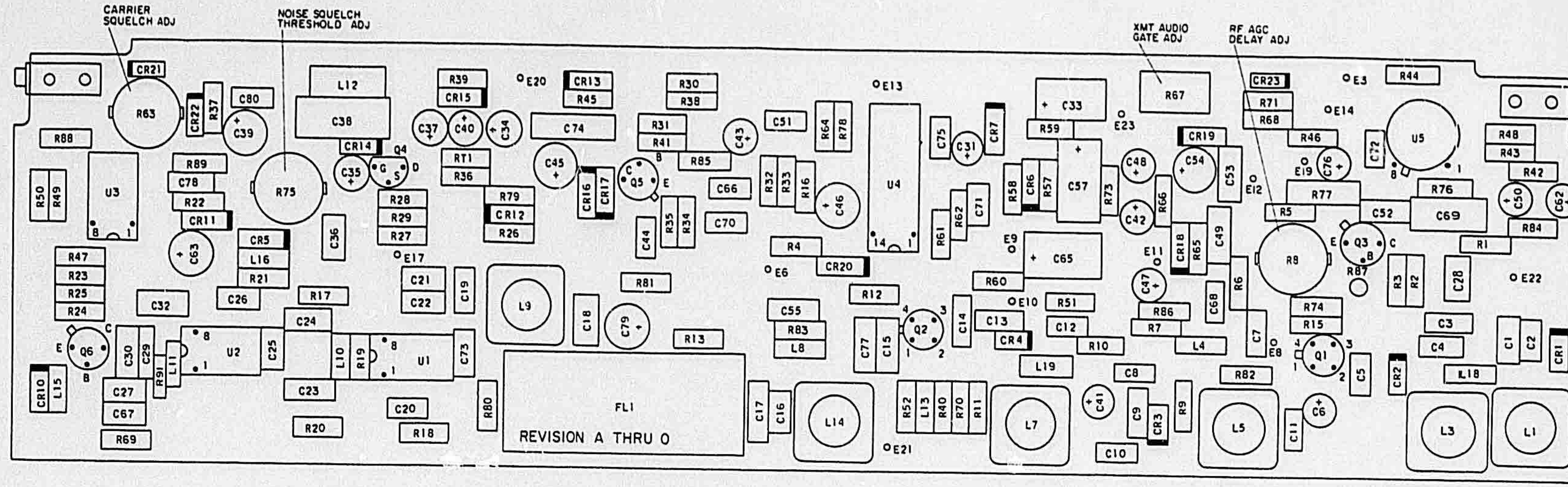
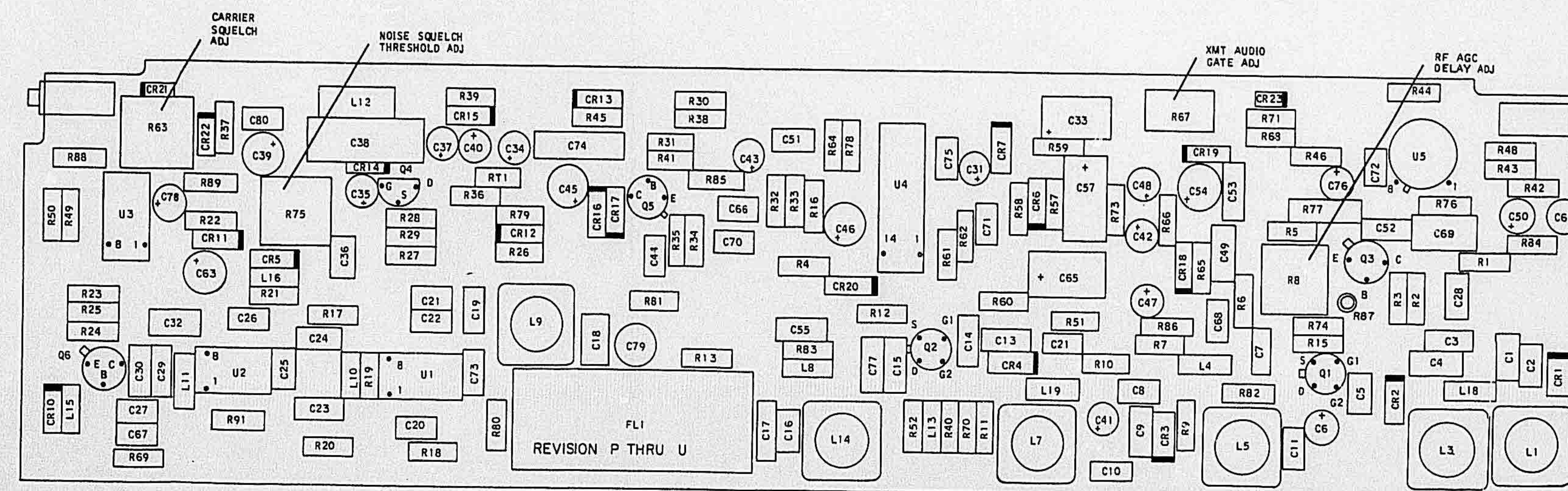
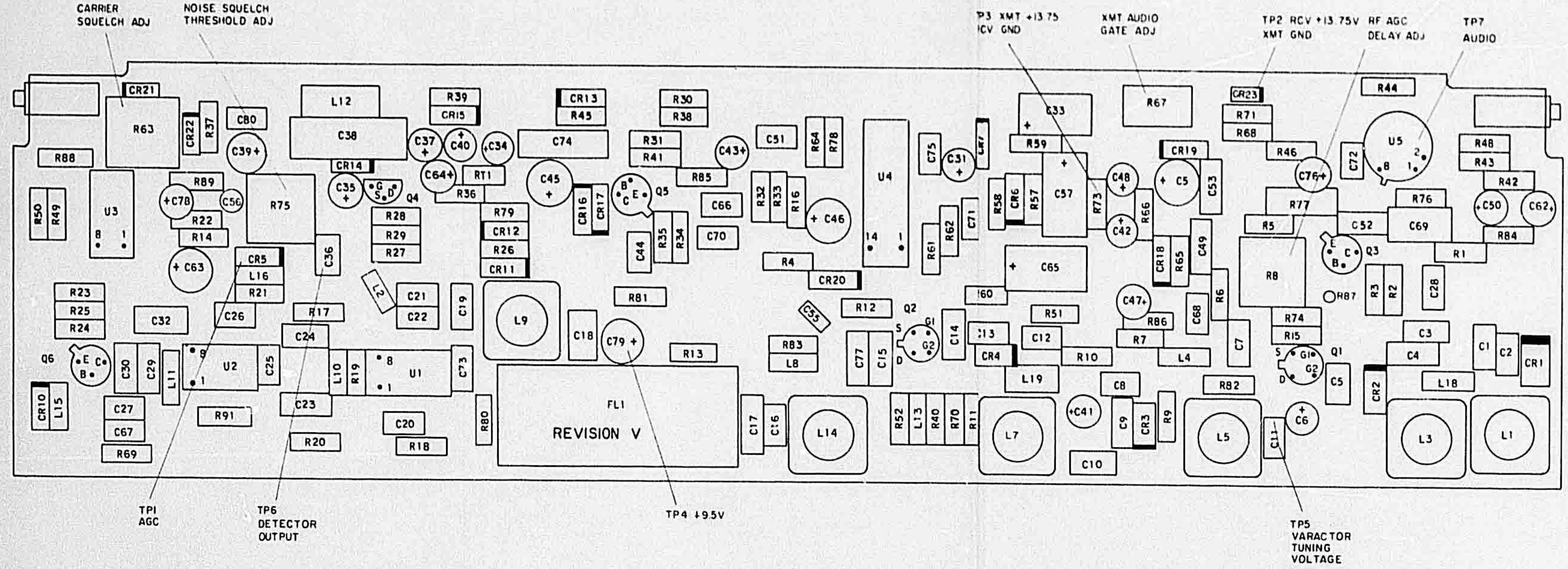


Audio/TR Chassis A1 and Power Supply A6 Schematic
Figure 6-13



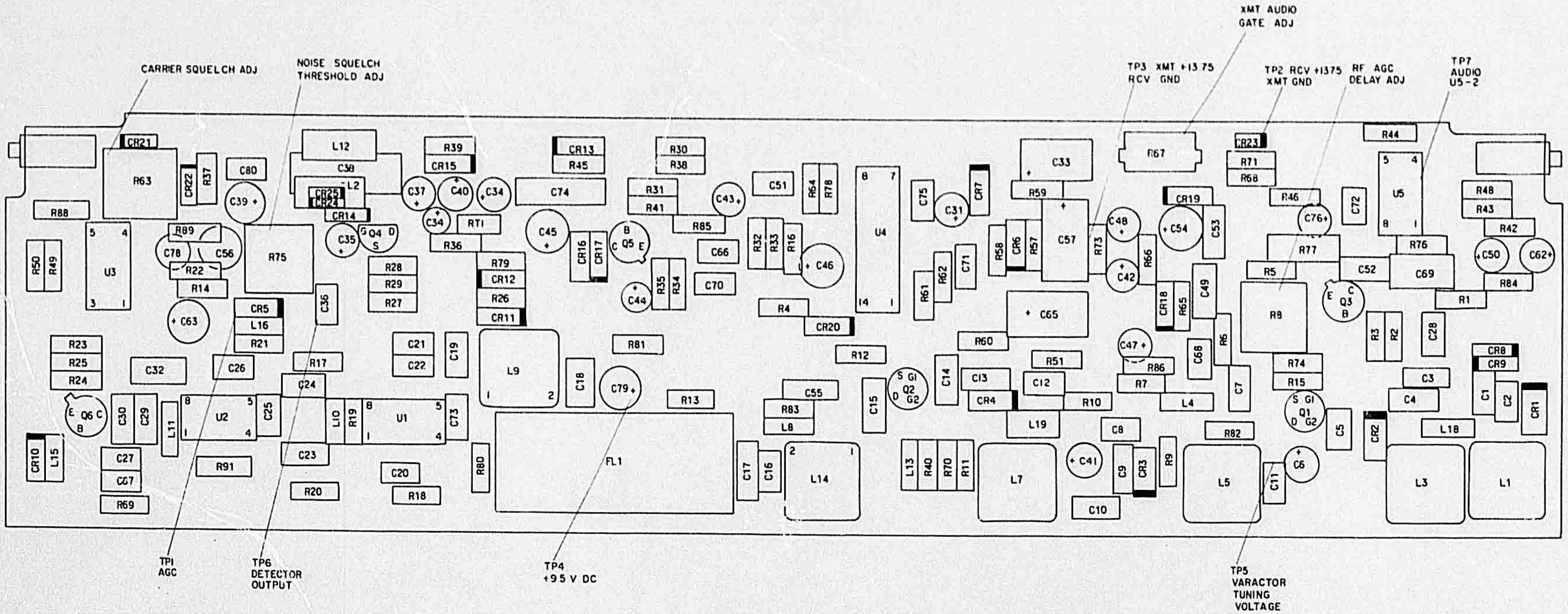


Comm Receiver A2, Component Location Diagram, Effective Revisions A Through U
Figure 6-14



NOTE:
R52 AND C57 NOT USED EFFECTIVE REVISION W.
L2 ADDED EFFECTIVE REVISION Y OR S86. C56
ADDED REVISION Z R S86.

Comm Receiver A2, Component Location Diagram,
Effective Revision V
Figure 6-15



Comm Receiver A2, Component Location Diagram,
Effective Board No. 628-5026-003
Figure 6-16

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
1	Value changes to if section passive components: C18 was 27, R80 was 560, C19 was 120, C23 was 27, C24 was 56, C30 was 36. Changed to improve if signal-to-noise ratio.	NA	All units
2	Changed value of C78 from 0.47 μF to 0.33 μF to shorten squelch tail.	SB 1	Rev J
3	Changed value of R86 from 1800 to 1500 ohms; R87 value changed from 1500 to 1800 ohms. Changes made to increase adjustment range of rf AGC delay potentiometer.	NA	Rev L
4	Values changed to improve crystal filter impedance match resulting in improved bandwidth and passband ripple characteristics; C55 was 62, C17 was 36, C18 was 47, and C19 was 47.	NA	Rev N
5	Changed terminology to provide a complete description of wire functions.	NA	NA
6	Added capacitor C64 to improve squelch amplifier gain.	NA	Rev P
7	Changed value of R63 from 10 to 5 kΩ; R88 changed from 18 to 12 kΩ. Values changed to make carrier squelch adjustment less sensitive.	NA	REV T

Comm Receiver A2 Schematic
Figure 6-17 (Sheet A)

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
8	Changed value of R83 from 47 to 10 Ω, added ferrite bead at R83, moved C55 from junction of L8 and L14 to pin 1 of Q2, and deleted R47. Changed to suppress regeneration due to high drain-to-gate 2 capacitance in Q2.	NA	REV U
9	Added R14.	NA	REV V
10	Deleted R52 and C77, changed R70 from 22 kΩ to 2200 ohms and R40 from 10 to 1 kΩ to increase audio quality.	NA	REV W
11	Added L2, changed value of C36 from 1000 to 2200 pF, C64 from 1 to 4.7 μF, and L12 from 15 to 6.8 μH to improve noise squelch rejection to audio modulation in voice frequencies.	SB 6	REV Y
12	Added C56, changed value of R88 and R89 from 12 to 4.7 kΩ, R63 from 5 to 1 kΩ, C78 from 0.33 to 0.01 μF, R22 from 1 MΩ to 680 kΩ, and R14 from 10 Ω to 10 kΩ to eliminate squelch tail.	SB 6	REV Z
13	Changed value of R29 from 100 to 47 kΩ to increase noise limiter bias current thereby reducing audio distortion at higher modulation levels.	SB 7	REV AA
14	Added terminals E50 and E51 for VHF-251E and added ferrite beads. No hardware changes were made.	NA	NA

Comm Receiver A2 Schematic
Figure 6-17 (Sheet B)

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
15	Changed value of C17 and C18 from 47 to 39 pF, C19 from 68 to 62 pF, and C55 from 47 to 56 pF to minimize passband ripple and noise bandwidth.	SB 7	REV AC
16	Added diodes CR8 and CR9 to prevent parametric oscillation with strong rf signals.	SB 8	REV AE
17	Added note 4.	NA	REV AF
18	Changed value of C37 from 1 to 0.01 μF and C80 from 0.1 to 0.01 μF; added CR24 and CR25. Change reduces effects of ignition noise on noise squelch.	VHF-251 SB 9, VHF-251S/ 251E SB 2	REV AG
19	Changed C1 from 5 to 3 pF, and C3, 9, 13 from 5 to 4 pF to improve preselector tracking. Also changed R32 from 47 to 4.87 kΩ and R33 from 270 to 24.3 kΩ to improve compressor stability.	NA	REV AH
20	Show CR24 and CR25 as dual junction diodes.	NA	NA
21	Changed R14 from 10 to 4.7 kΩ to allow proper adjustment of carrier squelch threshold.	NA	REV AD
22	VHF-251S only, changed value of C36 from 2200 to 750 pF and C38 from 0.033 to 0.01 μF to improve noise squelch operation.	NA	REV AJ
23	Changed value of L13 from 0.15 to 0.1 μH to prevent synthesizer unlock with abrupt signal application.	NA	REV AL
24	Changed value of C44 from 0.1 to 1 μF and R35 from 5.6 to 1 kΩ to eliminate compressor thump.	NA	REV AM

Comm Receiver A2 Schematic
Figure 6-17 (Sheet C)

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
25	Add CR26 to improve thermal stability of carrier squelch.	NA	REV AN
26	Changed value of C35 from 10 to 22 μF, R33 from 270 to 261 kΩ, and R32 from 47 to 54.9 kΩ to reduce no-signal audio noise.	VHF-251 SB 11, VHF-251E SB 5, VHF-251S SB 4	REV AP
27	Deleted C36, CR24, and CR25; added note 2 and revised note 6. Added noise blanker to schematic apron. Revision allows setting squelch threshold lower and improves noise rejection.	VHF-251 SB 10, VHF-251E SB 6, VHF-251S SB 5	REV AR
AL	Changed Q4 from MPF-820 to SPF-703 to eliminate no-signal audio feedthrough problem.	NA	REV AT
AJ	Changed CR8 and CR9 from 1N3070 to FD700 to improve sensitivity.	NA	REV AW
AH	Changed Q1 from 40841 to 3N211 to improve performance.	NA	REV AV
AH	Changed Q1 from 3N211 to CPN 352-5905-010.	NA	REV AY
AK	Changed CR23 from 1N4454 to 1N645 to improve reliability.	NA	REV BB
AL	Added E99 and note 7.	NA	VHF-251 S/N 24951 and above. VHF-251S S/N 2698 and above. VHF-251E S/N 2795 and above.

Comm Receiver A2 Schematic
Figure 6-17 (Sheet D)

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
None	Changed CR1 - CR4 from 353-3264-020 to 922-6131-020. CPN 353-3264-020 no longer available. All diodes (CR1 - CR4) should be same type for proper receiver operation.	NA	REV BF

Comm Receiver A2 Schematic
Figure 6-17 (Sheet E)

PARTS LIST
VHF-251/251S/251E
A2-COMM RECEIVER (PART NUMBER 628-5025-001)

SYMBOL	DESCRIPTION	PART NUMBER
C1	CAPACITOR, FIXED, MICA, DIELECTRIC, 3PF, ±1/2PF, 50V (EFF REV AH)	912-2099-020
C1	CAPACITOR, FIXED, MICA, DIELECTRIC, 5PF, ±1/2PF, 50V	912-2099-040
C2	CAPACITOR, FIXED, MICA, DIELECTRIC, 220PF, ±5%, 50V	912-2099-380
C3	CAPACITOR, FIXED, MICA, DIELECTRIC, 4PF ±1/2PF, 50V (EFF REV AH)	912-2099-030
C3	CAPACITOR, FIXED, MICA, DIELECTRIC, 5PF, ±1/2PF, 50V	912-2099-040
C4	CAPACITOR, FIXED, MICA, DIELECTRIC, 220PF, ±5%, 50V	912-2099-380
C5	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C6	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C7	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C8	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C9	CAPACITOR, FIXED, MICA, DIELECTRIC, 4PF ±1/2PF, 50V (EFF REV AH)	912-2099-030
C9	CAPACITOR, FIXED, MICA, DIELECTRIC, 5PF, ±1/2PF, 50V	912-2099-040
C10	CAPACITOR, FIXED, MICA, DIELECTRIC, 220PF, ±5%, 50V	912-2099-380
C11	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C12	CAPACITOR, FIXED, MICA, DIELECTRIC, 220PF, ±5%, 50V	912-2099-380
C13	CAPACITOR, FIXED, MICA, DIELECTRIC, 4PF ±1/2PF, 50V (EFF REV AH)	912-2099-030
C13	CAPACITOR, FIXED, MICA, DIELECTRIC, 5PF, ±1/2PF, 50V	912-2099-040
C14	CAPACITOR, FIXED, MICA, DIELECTRIC, 18PF, ±5%, 50V	912-2099-120
C15	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C16	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C17		
VHF-251/ 251E	CAPACITOR, FIXED, MICA DIELECTRIC, 39PF, ±5%, 300V (EFF REV AC; SB 7)	912-2099-670
VHF-251S	CAPACITOR, FIXED, MICA DIELECTRIC, 33PF, ±5%, 300V (EFF REV AF)	912-2099-180
C17	CAPACITOR, FIXED, SILVERED MICA, 47PF, ±5%, 50V (EFF REV N)	912-2099-210
C17	CAPACITOR, FIXED, MICA DIELECTRIC, 36PF ±5%, 50V	912-2099-190
C18		
VHF-251/ 251E	CAPACITOR, FIXED, MICA DIELECTRIC, 39PF, ±5%, 300V (EFF REV AC; SB 7)	912-2099-670
VHF-251S	CAPACITOR, FIXED, MICA DIELECTRIC, 33PF, ±5%, 300V (EFF REV AF)	912-2099-180

PARTS LIST
VHF-251/251S/251E
A2-COMM RECEIVER (PART NUMBER 628-5025-001)

SYMBOL	DESCRIPTION	PART NUMBER
C18	CAPACITOR, FIXED, SILVERED MICA, 36PF, ±5%, 50V (EFF REV N)	912-2099-190
C18	CAPACITOR, FIXED, MICA DIELECTRIC, 27PF, ±5%, 50V	912-2099-160
C19		
VHF-251/ 251E	CAPACITOR, FIXED, MICA DIELECTRIC, 62PF, ±5%, 300V (EFF REV AC; SB 7)	912-2099-240
VHF-251S	CAPACITOR, FIXED, MICA DIELECTRIC, 56PF, ±5%, 300V (EFF REV AF)	912-2099-230
C19	CAPACITOR, FIXED, SILVERED MICA, 68PF, ±5%, 50V (EFF REV N)	912-2099-250
C19	CAPACITOR, FIXED, MICA DIELECTRIC, 120PF, ±5%, 50V	912-2099-310
C20	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.05UF, +80-20%, 12V	913-3298-010
C21	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.05UF, +80-20%, 12V	913-3298-010
C22	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.05UF, +80-20%, 12V	913-3298-010
C23	CAPACITOR, FIXED, MICA, DIELECTRIC, 150PF, ±2%, 50V	912-2099-710
C24	CAPACITOR, FIXED, MICA, DIELECTRIC, 24PF, ±2%, 50V	912-2099-750
C25	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.05 UF, +80-20%, 12V	913-3298-010
C26	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.05 UF, +80-20%, 12V	913-3298-010
C27	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.05UF, +80-20%, 12V	913-3298-010
C28	CAPACITOR, FIXED, MICA, DIELECTRIC, 5PF, ±1/2PF, 50V	912-2099-040
C29	CAPACITOR, FIXED, MICA, DIELECTRIC, 56PF, ± 2%, 50V	912-2099-760
C30	CAPACITOR, FIXED, MICA, DIELECTRIC, 33PF, ±2%, 50V	912-2099-770
C31	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C32	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000PF, +80-20%, 500V	913-3298-110
C33	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C34	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C35	CAPACITOR, FXD, TA, 22UF, 20%, 15V (EFF REV AP; SEE SCH CHANGES FOR SB)	184-9113-080
C35	CAPACITOR, FIXED, TANTALUM, 10UF, ±20%, 20V	184-9113-070
C36	NOT USED (EFF REV AR; VHF-251 SB 10, VHF-251S SB 5, VHF-251E SB 6)	
C36	CAPACITOR, FIXED, POLYESTER DIELECTRIC, 2200 PF, ±10%, 100V (EFF REV Y; SB 6)	933-1404-110
C36	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000PF, +80-20%, 500V	913-3298-110

PARTS LIST
VHF-251/251S/251E
A2-COMM RECEIVER (PART NUMBER 628-5025-001)

SYMBOL	DESCRIPTION	PART NUMBER
C37	CAPACITOR, FXD, CER DIEL, 0.01UF, 10%, 50V (EFF REV AR; VHF-251 SB 10, VHF-251S SB 5, VHF-251E SB 6)	913-3306-150
C37	CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.01UF, +80-20%, 50V (EFF REV AG; VHF-251 SB 9, VHF-251S/251E SB 2)	913-3298-130
C37	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C38	CAPACITOR, FIXED, POLYESTER, DIELECTRIC, 0.033UF, 10%, 100V MAX	933-1404-050
C39	CAPACITOR, FIXED, TANTALUM, 4.7UF, ±20%, 20V	184-9113-060
C40	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C41	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C42	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C43	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C44	CAPACITOR, FXD, TA, 1UF, 20%, 20V (EFF REV AM)	184-9113-030
C44	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.1UF, +80-20%, 12V	913-3298-020
C45	CAPACITOR, FIXED, TANTALUM, 4.7UF, ±20%, 20V	184-9113-060
C46	CAPACITOR, FIXED, TANTALUM, 4.7UF, ±20%, 20V	184-9113-060
C47	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C48	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C49	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.1UF, +80-20%, 12V	913-3298-020
C50	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C51	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C52	CAPACITOR, FIXED, MICA, DIELECTRIC, 33PF, ±5%, 50V	912-2099-180
C53	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.1UF, +80-20%, 12V	913-3298-020
C54	CAPACITOR, FIXED, ELECTROLYTIC, 33UF, +100-20%, 16V	183-1471-040
C55		
VHF-251/251E	CAPACITOR, FIXED, MICA DIELECTRIC, 56PF ±5%, 300V (EFF REV AC; SB 7)	912-2099-230
VHF-251S	CAPACITOR, FXD, MICA DIEL, 51PF, ±5%, 300V (EFF REV AF)	912-2099-220
C55	CAPACITOR, FIXED, SILVERED MICA, 47PF, ±5%, 50V (EFF REV N)	912-2099-210
C55	CAPACITOR, FIXED, MICA, DIELECTRIC, 62PF, ±5%, 50V	912-2099-240
C56	NOT USED	
C57	CAPACITOR, FIXED, TANTALUM, 47UF, ±20%, 15V	184-9113-100
C58	NOT USED	
C59	NOT USED	
C60	NOT USED	
C61	NOT USED	
C62	CAPACITOR, FIXED, TANTALUM, 0.33UF, ±20%, 35V	184-9113-010
C63	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C64	CAPACITOR, FIXED, TANTALUM, 4.7UF, ±20%, 20V (EFF REV Y; SB 6)	184-9113-060

PARTS LIST
VHF-251/251S/251E
A2-COMM RECEIVER (PART NUMBER 628-5025-001)

SYMBOL	DESCRIPTION	PART NUMBER
C64	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V (EFF REV P)	184-9113-030
C65	CAPACITOR, FIXED, TANTALUM, 47UF, ±20%, 15V	184-9113-100
C66	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C67	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.05UF, +80-20%, 12V	913-3298-010
C68	CAPACITOR, FIXED, MICA, DIELECTRIC, 220PF, ±5%, 50V	912-2099-380
C69	CAPACITOR, FIXED, POLYESTER, DIELECTRIC, 2200PF, ±10%, 100V MAX	933-1404-110
C70	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C71	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C72	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C73	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C74	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 4700PF, +80-20%, 250V	913-3298-060
C75	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C76	CAPACITOR, FIXED, TANTALUM, 3.3UF, ±20%, 10V	184-9113-170
C77	NOT USED (EFF REV W)	
C77	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C78	CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.01UF, +80, -20%, 50V (EFF REV Z; SB 6)	913-3298-130
C78	CAPACITOR, FIXED, TANTALUM, 0.33UF, ±20%, 35V (EFF REV J, SB 1)	184-9113-010
C78	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.47UF, +80-20%, 50V	913-3306-130
C79	CAPACITOR, FIXED, TANTALUM, 22UF, ±20%, 15V	184-9113-080
C80	CAPACITOR, FXD, CER DIEL, 0.01UF, 10%, 50V (EFF REV AR; VHF-251 SB 10, VHF-251S SB 5, VHF-251E SB 6)	913-3306-150
C80	CAPACITOR, FIXED, CERAMIC DIELECTRIC, 0.01UF, +80-20%, 50V (EFF REV AG; VHF-251 SB 9, VHF-251S/251E SB 2)	913-3298-130
C80	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.1UF, +80-20%, 12V	913-3298-020
CR1	VARACTOR (EFF REV BF)	922-6131-020
CR1	VARACTOR (EFF TO REV BE)	353-3264-020
CR2	VARACTOR (EFF REV BF)	922-6131-020
CR2	VARACTOR (EFF TO REV BE)	353-3264-020
CR3	VARACTOR (EFF REV BF)	922-6131-020
CR3	VARACTOR (EFF TO REV BE)	353-3264-020
CR4	VARACTOR (EFF REV BF)	922-6131-020

PARTS LIST
VHF-251/251S/251E
A2-COMM RECEIVER (PART NUMBER 628-5025-001)

SYMBOL	DESCRIPTION	PART NUMBER
CR4	VARACTOR (EFF TO REV BE)	353-3264-020
CR5	DIODE, 1N4454	353-3741-010
CR6	DIODE, 1N4454	353-3741-010
CR7	DIODE, 1N4454	353-3741-010

PARTS LIST
VHF-251/251S/251E
A2-COMM RECEIVER (PART NUMBER 628-5025-001)

SYMBOL	DESCRIPTION	PART NUMBER
CR8	DIODE, FD700 (EFF REV AW)	353-3584-010
CR8	DIODE, 1N3070 (EFF REV AE; SB 8)	353-3735-010
CR8	NOT USED	
CR9	DIODE, FD700 (EFF REV AW)	353-3584-010
CR9	DIODE, 1N3070 (EFF REV AE; SB 8)	353-3735-010
CR9	NOT USED	
CR10	DIODE, 1N4454	353-3741-010
CR11	DIODE, 1N4454	353-3741-010
CR12	DIODE, 1N4454	353-3741-010
CR13	DIODE, 1N4454	353-3741-010
CR14	DIODE, 1N4454	353-3741-010
CR15	DIODE, 1N4454	353-3741-010
CR16	DIODE, 1N4454	353-3741-010
CR17	DIODE, 1N4454	353-3741-010
CR18	DIODE, 1N4454	353-3741-010
CR19	DIODE, 1N4454	353-3741-010
CR20	DIODE, 1N4454	353-3741-010
CR21	DIODE, 1N4454	353-3741-010
CR22	DIODE, 1N4454	353-3741-010
CR23	DIODE, 1N645 (EFF REV BB)	353-2607-000
CR23	DIODE, 1N4454	353-3741-010
CR24	NOT USED (EFF REV AR; VHF-251 SB 10, VHF-251S SB 5, VHF-251E SB 6)	
CR24	DIODE, 1N4156 (EFF REV AG; VHF-251 SB 9, VHF-251S/ 251E SB 2)	353-3743-010
CR25	NOT USED (EFF REV AR; VHF-251 SB 10, VHF-251S SB 5, VHF-251 SB 6)	
CR25	DIODE, 1N4156 (EFF REV AG; VHF-251 SB 9, VHF-251S/ 251E SB 2)	353-3743-010
CR26	DIODE, 1N4156 (EFF REV AN)	353-3743-010
	FERRITE BEAD (EFF REV U)	288-2154-000
	FILTER MODULE (VHF-251E ONLY)	628-6365-001
FL1	FILTER BANDPASS, CRYSTAL, 10.5MHZ	293-1286-030
L1	COIL 0.06UH (EFF REV AL)	278-0415-010
L1	COIL, 0.06UH	628-5448-001
L2		
VHF-251/ 251E	COIL, 100MH (EFF REV Y; SB 6)	240-2741-160
VHF-251S	COIL, 33MH	240-2741-010
L2	NOT USED	
L3	COIL, 0.06UH (EFF REV AL)	278-0415-010
L3	COIL, 0.06UH	628-5448-001
L4	COIL, 3.3UH	240-2742-160
L5	COIL, 0.06UH (EFF REV AL)	278-0415-010
L5	COIL, 0.06UH	628-5448-001
L6	NOT USED	
L7	COIL, 0.06UH (EFF REV AL)	278-0415-010
L7	COIL, 0.06UH	628-5448-001
L8	COIL, 100UH	240-2742-170

PARTS LIST
VHF-251/251S/251E
A2-COMM RECEIVER (PART NUMBER 628-5025-001)

SYMBOL	DESCRIPTION	PART NUMBER
L9	COIL, 10UH	278-0414-010
L10	COIL, 10UH	240-2742-290
L11	COIL, 100UH	240-2742-170
L12	COIL, 6.8MH (EFF REV Y; SB 6)	240-2741-170
L12	COIL, 15MH	240-2741-050
L13	COIL, 0.1UH (EFF REV AL)	240-2742-090
L13	COIL, 0.15UH	240-2742-100
L14	COIL, 10UH	278-0414-010
L15	COIL, 10UH	240-2742-290
L16	COIL, 100UH	240-2742-170
L17	NOT USED	
L18	COIL, 1.2UH	240-2742-280
L19	COIL, 1.2UH	240-2742-280
Q1	TRANSISTOR (EFF REV AY)	352-5005-010
Q1	TRANSISTOR, 3N211 (EFF REV AV)	352-1045-010
Q1	TRANSISTOR, 40841	352-5005-010
Q2	TRANSISTOR, 3N212	352-5016-010
Q3	TRANSISTOR, 2N2907A	352-5019-010
Q4	TRANSISTOR, SPF-703 (EFF REV AT)	352-5013-030
Q4	TRANSISTOR, MPF820	352-5013-010
Q5	TRANSISTOR, 2N2907A	352-5019-010
Q6	TRANSISTOR, 2N918	352-5027-020
R1	RESISTOR, FIXED, COMPOSITION, 47K, 10%, 1/4W	745-7950-450
R2	RESISTOR, FIXED, COMPOSITION, 47K, 10%, 1/4W	745-7950-450
R3	RESISTOR, FIXED, COMPOSITION, 39K, 10%, 1/4W	745-7950-440
R4	RESISTOR, FIXED, COMPOSITION, 10K, 10%, 1/4W	745-7950-370
R5	RESISTOR, FIXED, COMPOSITION, 560 OHMS, 10%, 1/4W	745-7950-220
R6	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
R7	RESISTOR, FIXED, COMPOSITION, 47 OHMS, 10%, 1/4W	745-7950-090
R8	RESISTOR, VARIABLE, NONWIREWOUND, 1K, ±70%, 1/2W	382-0041-010
R9	RESISTOR, FIXED, COMPOSITION, 47K, 10%, 1/4W	745-7950-450
R10	RESISTOR, FIXED, COMPOSITION, 47K, 10%, 1/4W	745-7950-450
R11	RESISTOR, FIXED, COMPOSITION, 100K, 10%, 1/4W	745-7950-490
R12	RESISTOR, FIXED, COMPOSITION, 100 OHMS, 10%, 1/4W	745-7950-130
R13	RESISTOR, FIXED, COMPOSITION, 47 OHMS, 10%, 1/4W	745-7950-090
R14	RESISTOR, FXD, CMPSN, 4.7K 10%, 1/4W (EFF REV AD)	745-7950-330
R14	RESISTOR, FIXED, COMPOSITION, 10K, ±10%, 1/4W (EFF REV Z; SB 6)	745-7950-370
R14	RESISTOR, FIXED, COMPOSITION, 10 OHMS, ±10%, 1/4W (EFF REV V)	745-7950-010
R14	NOT USED	
R15	RESISTOR, FIXED, COMPOSITION, 100K, 10%, 1/4W	745-7950-490
R16	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
R17	RESISTOR, FIXED, COMPOSITION, 1800 OHMS, 10%, 1/4W	745-7950-280
R18	RESISTOR, FIXED, COMPOSITION, 47 OHMS, 10%, 1/4W	745-7950-090
R19	RESISTOR, FIXED, COMPOSITION, 10K, 10%, 1/4W	745-7950-370
R20	RESISTOR, FIXED, COMPOSITION, 47 OHMS, 10%, 1/4W	745-7950-090
R21	RESISTOR, FIXED, COMPOSITION, 4700 OHMS, 10%, 1/4W	745-7950-330

PARTS LIST
VHF-251/251S/251E
A2-COMM RECEIVER (PART NUMBER 628-5025-001)

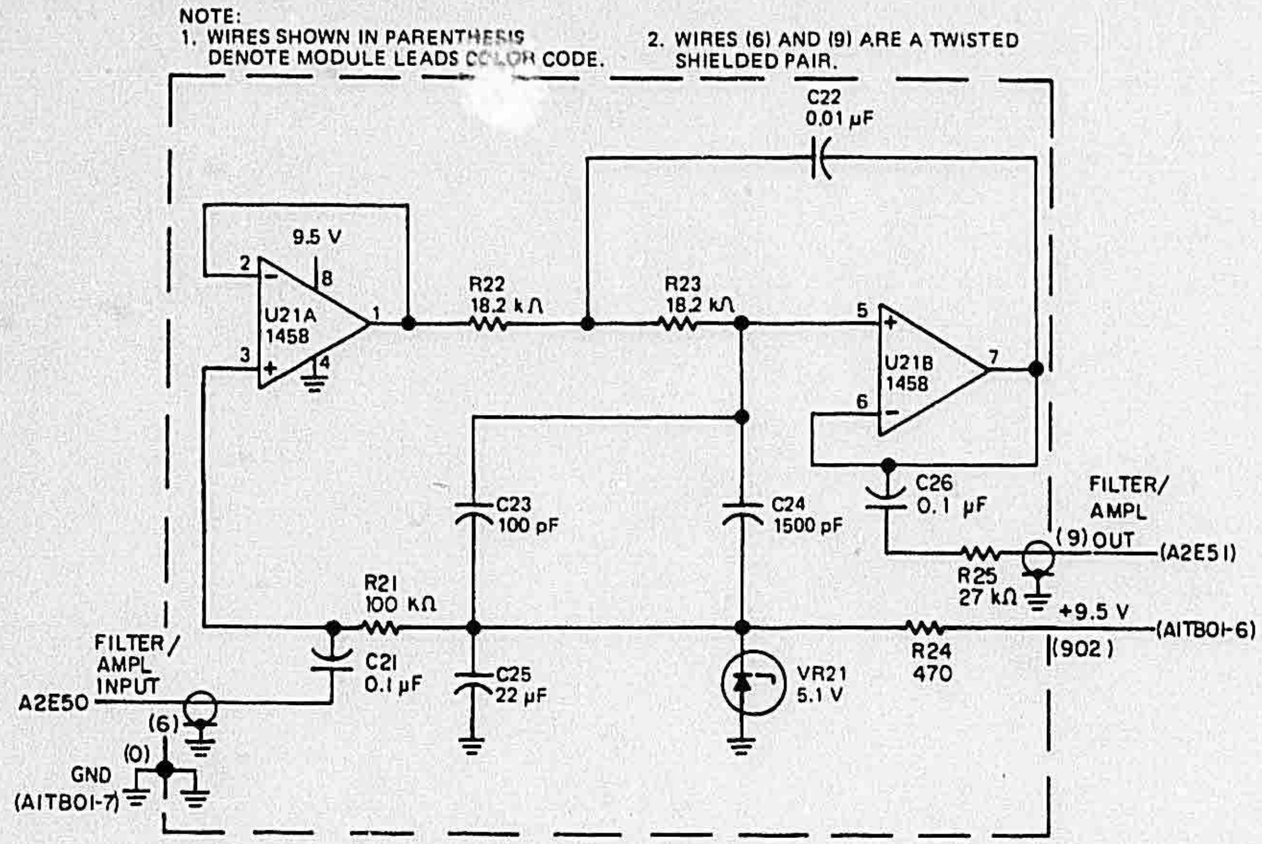
SYMBOL	DESCRIPTION	PART NUMBER
R22	RESISTOR, FIXED, COMPOSITION, 680K, ±10%, 1/4W (EFF REV Z; SB 6)	745-7950-590
R22	RESISTOR, FIXED, COMPOSITION, 1MEGO, 10%, 1/4W	745-7950-610
R23	RESISTOR, FIXED, COMPOSITION, 68K, 10%, 1/4W	745-7950-470
R24	RESISTOR, FIXED, COMPOSITION, 3300 OHMS, 10%, 1/4W	745-7950-310
R25	RESISTOR, FIXED, COMPOSITION, 56 OHMS, 10%, 1/4W	745-7950-100
R26	RESISTOR, FIXED, FILM, 6650 OHMS, ±1%, 1/8W	745-7957-060
R27	RESISTOR, FIXED, FILM, 40.2K, ±1%, 1/8W	745-7957-810
R28	RESISTOR, FIXED, COMPOSITION, 33K, 10%, 1/4W	745-7950-430
R29	RESISTOR, FIXED, COMPOSITION, 47K, 10%, 1/4W (EFF REV AA; SB 7)	745-7950-450
R29	RESISTOR, FIXED, COMPOSITION, 100K, 10%, 1/4W	745-7950-490
R30	RESISTOR, FIXED, COMPOSITION, 22K, 10%, 1/4W	745-7950-410
R31	RESISTOR, FIXED, COMPOSITION, 10K, 10%, 1/4W	745-7950-370
R32	RESISTOR, FIXED, FILM 54.9K, ±1%, 1/8W (EFF REV AP; SEE SCHEMATIC CHANGE FOR SB)	745-7957-940
R32	RESISTOR, FIXED, FILM, 4.87K, ±1%, 1/8W (EFF REV AH)	745-7956-920
R32	RESISTOR, FIXED, COMPOSITION, 47K, 10%, 1/4W	745-7950-450
R33	RESISTOR, FIXED, FILM, 261K, ±1%, 1/8W (EFF REV AP; SEE SCHEMATIC CHANGE FOR SB)	745-7403-670
R33	RESISTOR, FIXED, FILM, 24.3K, ±1%, 1/8W (EFF REV AH)	745-7957-600
R33	RESISTOR, FIXED, COMPOSITION, 270K, 10%, 1/4W	745-7950-540
R34	RESISTOR, FIXED, COMPOSITION, 10K, 10%, 1/4W	745-7950-370
R35	RESISTOR, FXD, CMPSN, 1K, 10%, 1/4W (EFF REV AM)	745-7950-250
R35	RESISTOR, FIXED, COMPOSITION, 5600 OHMS, 10%, 1/4W	745-7950-340
R36	RESISTOR, FIXED, COMPOSITION, 150 OHMS, 10%, 1/4W	745-7950-150
R37	RESISTOR, FIXED, COMPOSITION, 47 OHMS, 10%, 1/4W	745-7950-090
R38	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
R39	RESISTOR, FIXED, COMPOSITION, 10K, 10%, 1/4W	745-7950-370
R40	RESISTOR, FIXED, COMPOSITION, 1K, ±10%, 1/4W (EFF REV W)	745-7950-250
R40	RESISTOR, FIXED, COMPOSITION, 10K, 10%, 1/4W	745-7950-370
R41	RESISTOR, FIXED, COMPOSITION, 47K, 10%, 1/4W	745-7950-450
R42	RESISTOR, FIXED, COMPOSITION, 12K, 10%, 1/4W	745-7950-380
R43	RESISTOR, FIXED, COMPOSITION, 270K, 10%, 1/4W	745-7950-540
R44	RESISTOR, FIXED, COMPOSITION, 18K, 10%, 1/4W	745-7950-400
R45	RESISTOR, FIXED, COMPOSITION, 10K, 10%, 1/4W	745-7950-370
R46	RESISTOR, FIXED, COMPOSITION, 470K, 10%, 1/4W	745-7950-570
R47	NOT USED (EFF REV U)	
R47	RESISTOR, FIXED, COMPOSITION, 3300 OHMS, 10%, 1/4W	745-7950-310
R48	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
R49	RESISTOR, FIXED, FILM, 2150 OHMS, ±1%, 1/8W	745-7956-580
R50	RESISTOR, FIXED, FILM, 6190 OHMS, ±1%, 1/8W	745-7957-030
R51	RESISTOR, FIXED, COMPOSITION, 120K, 10%, 1/4W	745-7950-500
R52	NOT USED (EFF REV W)	
R52	RESISTOR, FIXED, COMPOSITION, 47 OHMS, 10%, 1/4W	745-7950-090
R53	NOT USED	
R54	NOT USED	

PARTS LIST
VHF-251/251S/251E
A2-COMM RECEIVER (PART NUMBER 628-5025-001)

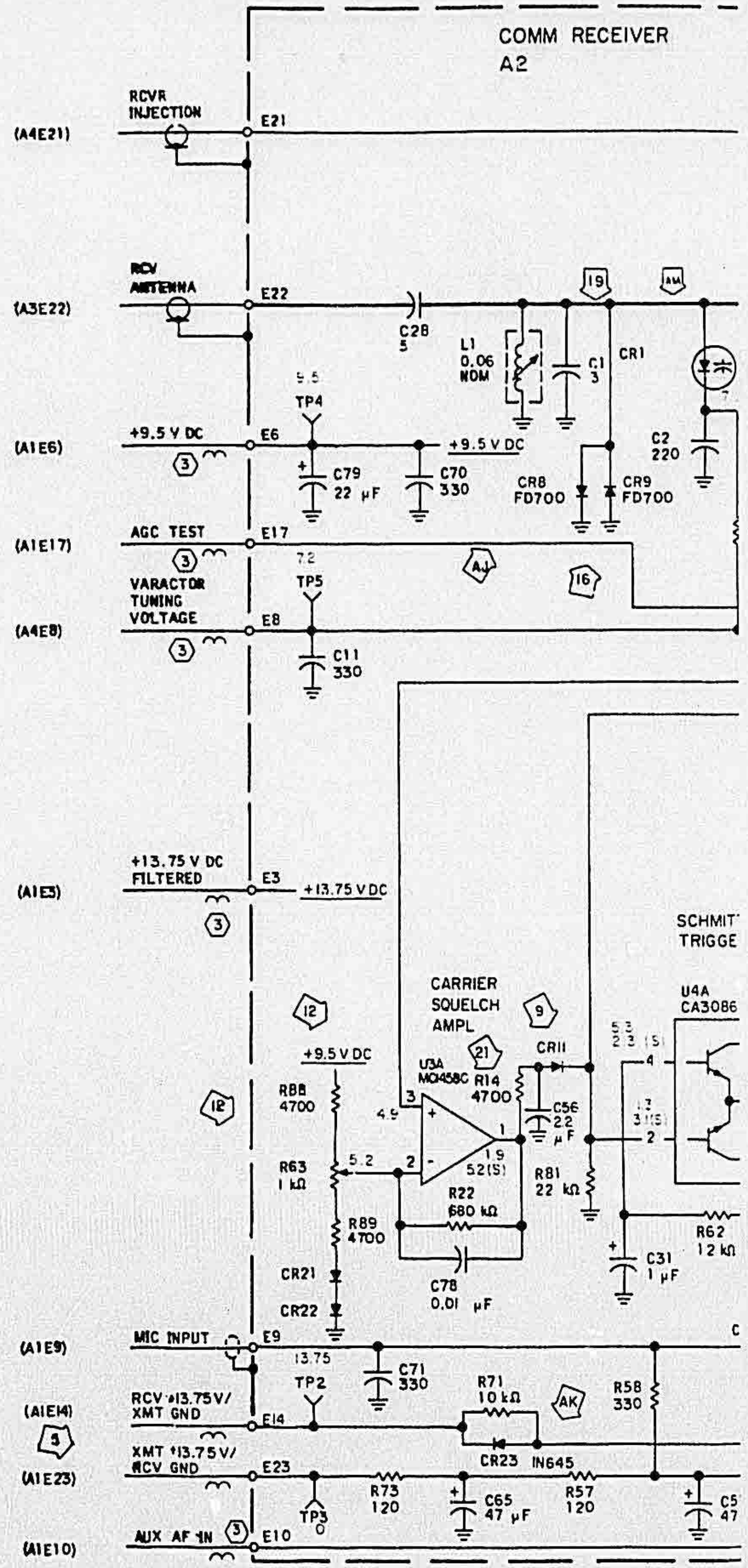
SYMBOL	DESCRIPTION	PART NUMBER
R55	NOT USED	
R56	NOT USED	
R57	RESISTOR, FIXED, COMPOSITION, 120 OHMS, 10%, 1/4W	745-7950-140
R58	RESISTOR, FIXED, COMPOSITION, 330 OHMS, 10%, 1/4W	745-7950-190
R59	RESISTOR, FIXED, COMPOSITION, 47K, 10%, 1/4W	745-7950-450
R60	RESISTOR, FIXED, COMPOSITION, 39K, 10%, 1/4W	745-7950-440
R61	RESISTOR, FIXED, COMPOSITION, 5600 OHMS, 10%, 1/4W	745-7950-340
R62	RESISTOR, FIXED, COMPOSITION, 12K, 10%, 1/4W	745-7950-380
R63	RESISTOR, VARIABLE, SINGLE TURN CERMET, 1K, 20%, 1/2W (EFF REV Z; VHF-251 SB 6)	382-0041-010
R63	RESISTOR, VARIABLE, SINGLE TURN CERMET, 5K, 20%, 1/2W (EFF REV T)	382-0041-050
R63	RESISTOR, VARIABLE, NONWIREWOUND, 10K, ±70%, 1/2W	382-0041-070
R64	RESISTOR, FIXED, COMPOSITION, 2200 OHMS, 10%, 1/4W	745-7950-290
R65	RESISTOR, FIXED, COMPOSITION, 100K, 10%, 1/4W	745-7950-490
R66	RESISTOR, FIXED, COMPOSITION, 270K, 10%, 1/4W	745-7950-540
R67	RESISTOR, VARIABLE, NONWIREWOUND, 100K, ±70%, 1/2W	382-0041-140
R68	RESISTOR, FIXED, COMPOSITION, 270K, 10%, 1/4W	745-7950-540
R69	RESISTOR, FIXED, COMPOSITION, 10K, 10%, 1/4W	745-7950-370
R70	RESISTOR, FIXED, COMPOSITION, 2200 OHMS, ±10%, 1/4W (EFF REV W)	745-7950-290
R70	RESISTOR, FIXED, COMPOSITION, 22K, 10%, 1/4W	745-7950-410
R71	RESISTOR, FIXED, COMPOSITION, 10K, 10%, 1/4W	745-7950-370
R72	NOT USED	
R73	RESISTOR, FIXED, COMPOSITION, 120 OHMS, 10%, 1/4W	745-7950-140
R74	RESISTOR, FIXED, COMPOSITION, 150 OHMS, 10%, 1/4W	745-7950-150
R75	RESISTOR, VARIABLE, NONWIREWOUND, 100K, ±70%, 1/2W	382-0041-130
R76	RESISTOR, FIXED, COMPOSITION, 33K, 10%, 1/4W	745-7950-430
R77	RESISTOR, FIXED, COMPOSITION, 220 OHMS, 10%, 1/2W	745-7951-170
R78	RESISTOR, FIXED, COMPOSITION, 100K, 10%, 1/4W	745-7950-490
R79	RESISTOR, FIXED, COMPOSITION, 120K, 10%, 1/4W	745-7950-500
R80	RESISTOR FIXED, COMPOSITION, 4.7K, 10%, 1/4W (EFF REV H)	745-7950-330
R80	RESISTOR, FIXED, COMPOSITION, 560 OHMS, 10%, 1/4W	745-7950-220
R81	RESISTOR, FIXED, COMPOSITION, 22K, 10%, 1/4W	745-7950-410
R82	RESISTOR, FIXED, COMPOSITION, 47 OHMS, 10%, 1/4W	745-7950-090
R83	RESISTOR, FIXED, COMPOSITION, 10 OHMS, ±10%, 1/4W (EFF REV U)	745-7950-010
R83	RESISTOR, FIXED, COMPOSITION, 47 OHMS, 10%, 1/4W	745-7950-090
R84	RESISTOR, FIXED, COMPOSITION, 3900 OHMS, 10%, 1/4W	745-7950-320
R85	RESISTOR, FIXED, COMPOSITION, 22K, 10%, 1/4W	745-7950-410
R86	RESISTOR, FIXED, COMPOSITION, 1500 OHMS, 10%, 1/4W (EFF REV L)	745-7950-270
R86	RESISTOR, FIXED, COMPOSITION, 1800 OHMS, 10%, 1/4W	745-7950-280
R87	RESISTOR, FIXED, COMPOSITION, 1800 OHMS, 10%, 1/4W (EFF REV L)	745-7950-280

PARTS LIST
VHF-251/251S/251E
A2-COMM RECEIVER (PART NUMBER 628-5025-001)

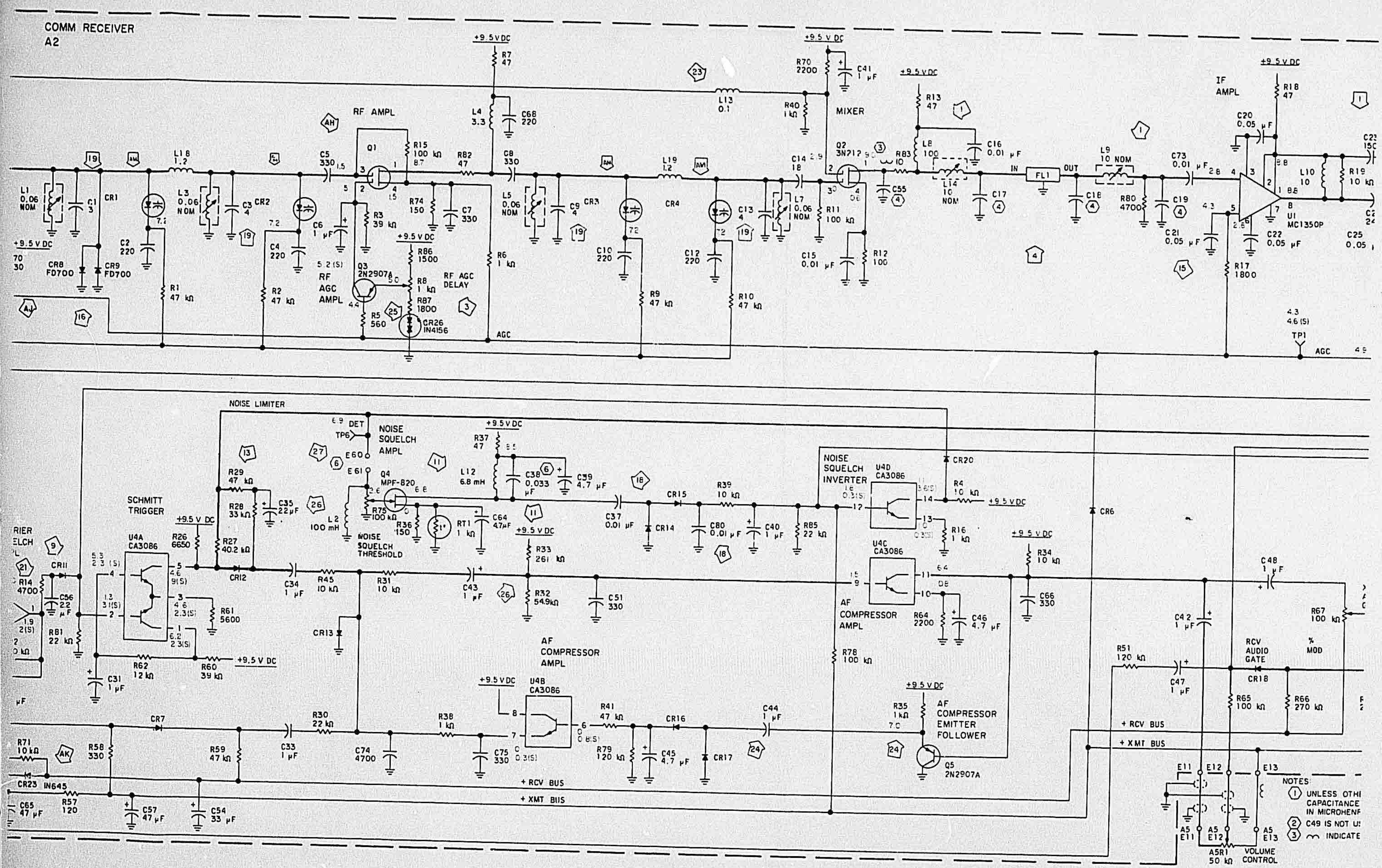
SYMBOL	DESCRIPTION	PART NUMBER
R87	RESISTOR, FIXED, COMPOSITION, 1500 OHMS, 10%, 1/4W	745-7950-270
R88	RESISTOR, FIXED, COMPOSITION, 4.7K, ±10%, 1/4W (EFF REV Z; VHF-251 SB 6)	745-7950-330
R88	RESISTOR, FIXED, COMPOSITION, 12K, ±10%, 1/4W (EFF REV T)	745-7950-380
R88	RESISTOR, FIXED, COMPOSITION, 18K, 10%, 1/4W	745-7950-400
R89	RESISTOR, FIXED, COMPOSITION, 4.7K, 10%, 1/4W (EFF REV Z; VHF-251 SB 6)	745-7950-330
R89	RESISTOR, FIXED, COMPOSITION, 12K, 10%, 1/4W	745-7950-380
R90	NOT USED	
R91	RESISTOR, FIXED, COMPOSITION, 100 OHM, 10%, 1/4W	745-7950-130
RT1	RESISTOR, THERMAL, 1K, ±10%, 1/2W	714-3255-010
U1	INTEGRATED CIRCUIT, MC1350P	351-1134-010
U2	INTEGRATED CIRCUIT, MC1350P	351-1134-010
U3	INTEGRATED CIRCUIT, MC1458CP1	351-1156-020
U4	INTEGRATED CIRCUIT, CA3086	351-1136-010
U5	INTEGRATED CIRCUIT, CA3094T	351-1135-010



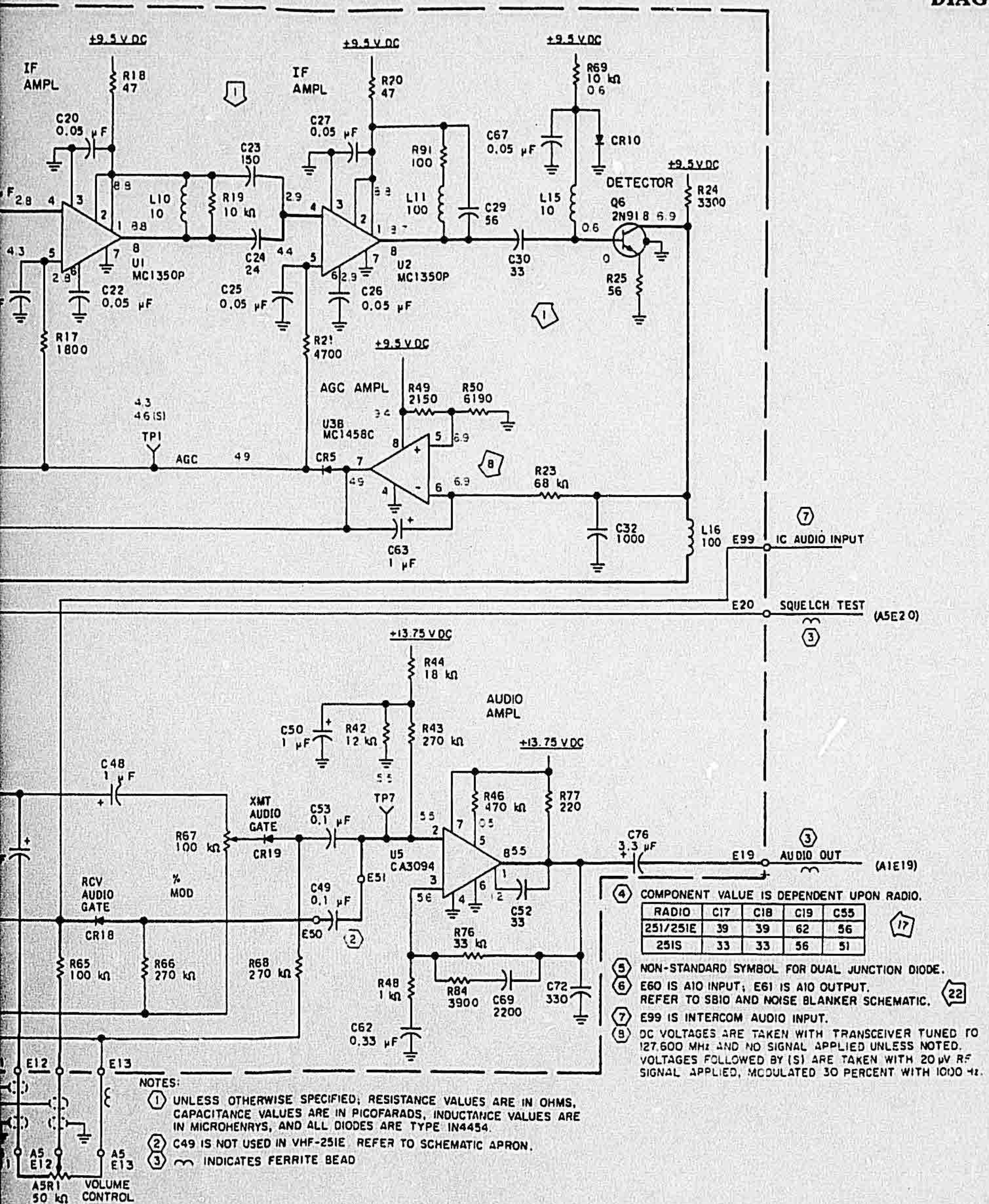
VHF-251E Filter/Amplifier,
P/N 628-6365-001



Page 6-51


COMM RECEIVER
A2
+9.5 VDC
RF AMPL
Q1
MIXER
Q2
3N212
IF
AMPL
U1
MC1350P
L1
0.06
NOM
L3
0.06
NOM
L18
1.2
L19
1.2
L13
0.1
L4
3.3
L5
0.06
NOM
L7
0.06
NOM
L8
100
L9
10 NOM
L10
10
L14
10
NOM
FL1
IN
OUT
R15
100 kΩ
R82
47
R7
47
R70
2200
R40
1 kΩ
R13
47
R18
47
R19
10 kΩ
R74
150
R3
39 kΩ
R86
1500
R8
1 kΩ
R87
1800
R5
560
R6
1 kΩ
R1
47 kΩ
R2
47 kΩ
R9
47 kΩ
R10
47 kΩ
R11
100 kΩ
R12
100
R80
4700
R17
1800
R83
10
C68
220
C5
330
C8
330
C7
330
C41
1 μF
C16
0.01 μF
C73
0.01 μF
C20
0.05 μF
C22
0.05 μF
C21
0.05 μF
C25
0.05
C15
0.01 μF
C2
220
C4
220
C10
220
C12
220
C6
1 μF
C1
3
C3
4
C9
4
C13
4
C14
18
C55
C17
C18
C19
CR1
CR2
CR3
CR4
CR8
FD700
CR9
FD700
CR26
IN4156
Q3
2N2907A
RF
AGC
AMPL
RF AGC
DELAY
AGC
TP1
NOISE LIMITER
DET
TP6
E60
E61
NOISE
SQUELCH
AMPL
Q4
MPF-820
L12
6.8 mH
L2
100 mH
R37
47
C38
0.033 μF
C39
4.7 μF
R75
100 kΩ
R36
150
RT1
1 kΩ
C64
4.7μF
NOISE
SQUELCH
THRESHOLD
C37
0.01 μF
CR15
CR14
R39
10 kΩ
C80
0.01 μF
C40
1 μF
R85
22 kΩ
NOISE
SQUELCH
INVERTER
U4D
CA3086
CR20
R4
10 kΩ
R16
1 kΩ
SCHMITT
TRIGGER
U4A
CA3086
R29
47 kΩ
R28
33 kΩ
R27
40.2 kΩ
R26
6650
C35
22μF
CR12
C34
1 μF
R45
10 kΩ
R31
10 kΩ
C43
1 μF
R33
261 kΩ
R32
54.9kΩ
C51
330
R61
5600
R62
12 kΩ
R60
39 kΩ
C31
1 μF
R14
4700
C56
22 μF
R81
22 kΩ
CR11
CR13
U4C
CA3086
AF
COMPRESSOR
AMPL
R34
10 kΩ
C66
330
R64
2200
C46
4.7 μF
R78
100 kΩ
CR6
C48
1 μF
R67
100 kΩ
%
MOD
C42
1 μF
R51
120 kΩ
C47
1 μF
RCV
AUDIO
GATE
CR18
R65
100 kΩ
R66
270 kΩ
U4B
CA3086
R41
47 kΩ
CR16
C44
1 μF
R79
120 kΩ
C45
4.7 μF
CR17
R35
1 kΩ
AF
COMPRESSOR
EMITTER
FOLLOWER
Q5
2N2907A
CR7
R30
22 kΩ
R38
1 kΩ
C74
4700
C75
330
C33
1 μF
R59
47 kΩ
R58
330
R71
10 kΩ
CR23
IN645
R57
120
C65
47 μF
C57
47 μF
C54
33 μF
+ RCV BUS
+ XMT BUS
E11
E12
E13
A5
A5R1
50 kΩ
VOLUME
CONTROL
NOTES:
UNLESS OTHE
CAPACITANCE
IN MICROHENF
C49 IS NOT U
INDICATE

page 6-51



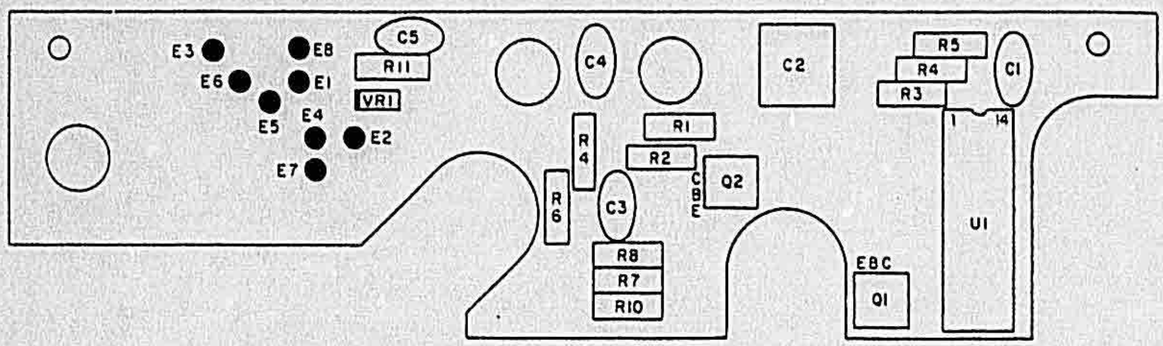
NOTES:

1. UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, INDUCTANCE VALUES ARE IN MICROHENRYS, AND ALL DIODES ARE TYPE IN4454.
2. C49 IS NOT USED IN VHF-251E. REFER TO SCHEMATIC APRON.
3. ⌒ INDICATES FERRITE BEAD
4. COMPONENT VALUE IS DEPENDENT UPON RADIO.

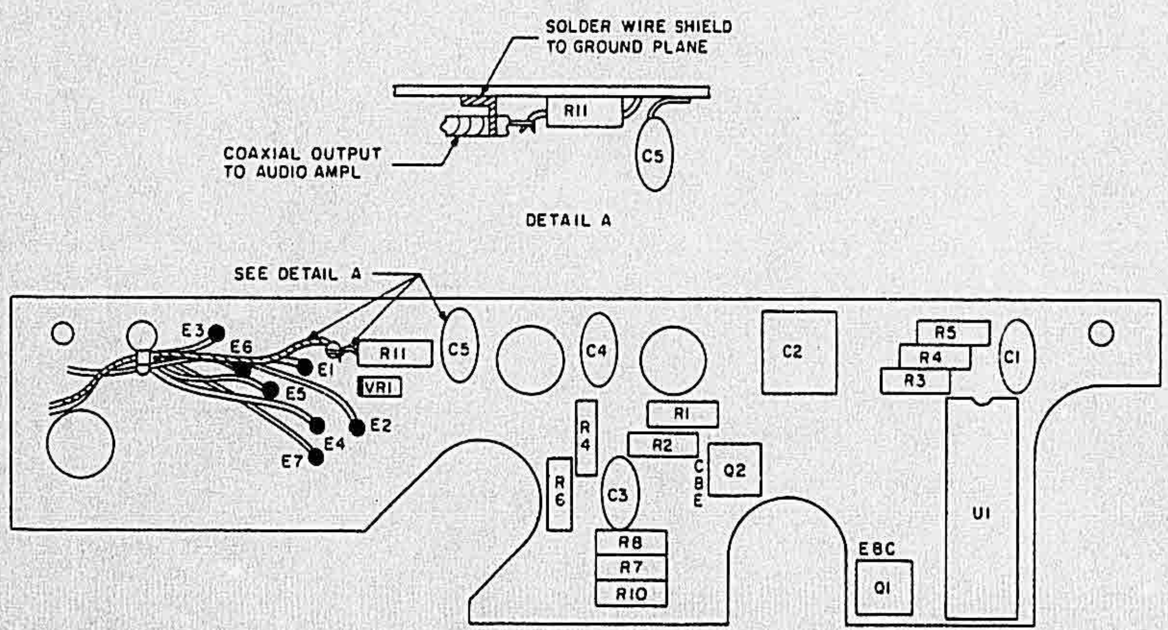
RADIO	C17	C18	C19	C55
251/251E	39	39	62	56
251S	33	33	56	51

5. NON-STANDARD SYMBOL FOR DUAL JUNCTION DIODE.
6. E60 IS A10 INPUT; E61 IS A10 OUTPUT. REFER TO SB10 AND NOISE BLANKER SCHEMATIC.
7. E99 IS INTERCOM AUDIO INPUT.
8. DC VOLTAGES ARE TAKEN WITH TRANSCEIVER TUNED TO 127.600 MHz AND NO SIGNAL APPLIED UNLESS NOTED. VOLTAGES FOLLOWED BY (S) ARE TAKEN WITH 20 μV RF SIGNAL APPLIED, MODULATED 30 PERCENT WITH 1000 Hz.

Comm Receiver A2 Schematic
Figure 6-17



Noise Blanker/Intercom A10, Component Location Diagram, Effective VHF-251 S/N 24590, VHF-251S S/N 2697 and VHF-251E S/N 2797
Figure 6-18



Noise Blanker/Intercom A10, Component Location Diagram, Effective Revision B
Figure 6-19

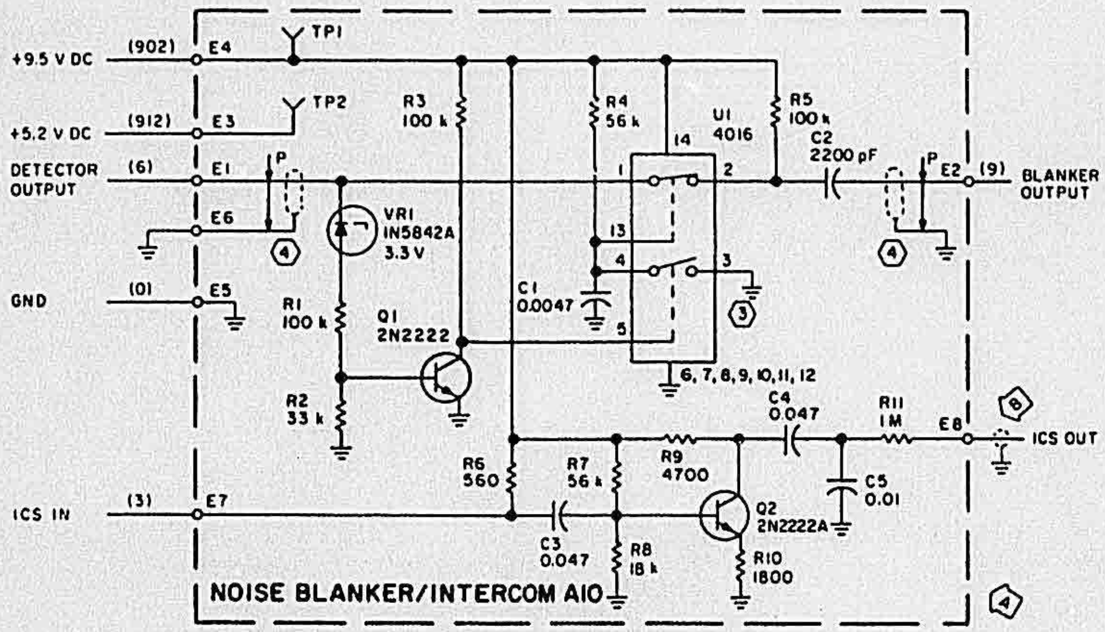
SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A	Added ICS circuit to noise blanker schematic.	NA	REV A
B	Changed ICS out lead from hookup wire to coaxial cable.	VHF-251 SB 14, VHF-251S SB 7, VHF-251E SB 8	REV B VHF-251 SERIAL NO 25909 VHF-251S SERIAL NO 2916 VHF-251E SERIAL NO 3047

Noise Blanker/Intercom A10, Schematic Diagram, Effective VHF-251 Sn 24590, VHF-251S Sn 2697, and VHF-251E Sn 2797
Figure 6-20 (Sheet A)

PARTS LIST
VHF-251/251S/251E
A10-NOISE BLANKER/INTERCOM ASSEMBLY (PART NUMBER 628-8113-001)

SYMBOL	DESCRIPTION	PART NUMBER
C1	CAPACITOR, FXD, CER DIEL, 0.0047UF, 20%, 50V	913-3306-030
C2	CAPACITOR, FXD, POLY DIEL, 2200PF, 10%, 100V	933-1404-110
C3	CAPACITOR, FXD, CER DIEL, 0.047UF, 20%, 50V	913-3279-160
C4	CAPACITOR, FXD, CER DIEL, 0.047UF, 20%, 50V	913-3279-160
C5	CAPACITOR, FXD, CER DIEL, 0.01UF, 20%, 50V	913-3279-110
Q1	TRANSISTOR, 2N2222	352-5021-010
Q2	TRANSISTOR, 2N2222	352-5021-010
R1	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W	745-7950-490
R2	RESISTOR, FXD, CMPSN, 33K, 10%, 1/4W	745-7950-430
R3	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W	745-7950-490
R4	RESISTOR, FXD, CMPSN, 56K, 10%, 1/4W	745-7950-460
R5	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W	745-7950-490
R6	RESISTOR, FXD, CMPSN, 560OHMS, 10%, 1/4W	745-7950-220
R7	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W (EFF VHF-251 SB 16; VHF-251S SB9; VHF-251E SB 10)	745-7950-490
R7	RESISTOR, FXD, CMPSN, 56K, 10%, 1/4W	745-7950-460
R8	RESISTOR, FXD, CMPSN, 18K, 10%, 1/4W	745-7950-400
R9	RESISTOR, FXD, CMPSN, 4.7K, 10%, 1/4W	745-7950-330
R10	RESISTOR, VAR, CERMET, 5K, 10%, 1/2W (EFF VHF-251 SB 16; VHF-251S SB 9; VHF-251E SB 10)	382-0027-090
R10	RESISTOR, FXD, CMPSN, 1.8K, 10%, 1/4W	745-7950-280
R11	RESISTOR, FXD, CMPSN, 330K, 10%, 1/4W (TEST SELECT; EFF VHF-251 SB 16; VHF-251S SB 9; VHF-251E SB 10)	745-7950-550
R11	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W (TEST SELECT; EFF VHF-251 SB 16; VHF-251S SB 9; VHF-251E SB 10)	745-7950-490
R11	RESISTOR, FXD, CMPSN, 1M, 10%, 1/4W	745-7950-610
U1	INTEGRATED CIRCUIT, 4016	351-8260-010
VR1	ZENER DIODE, 3.3V, 1N5226A	353-3740-130

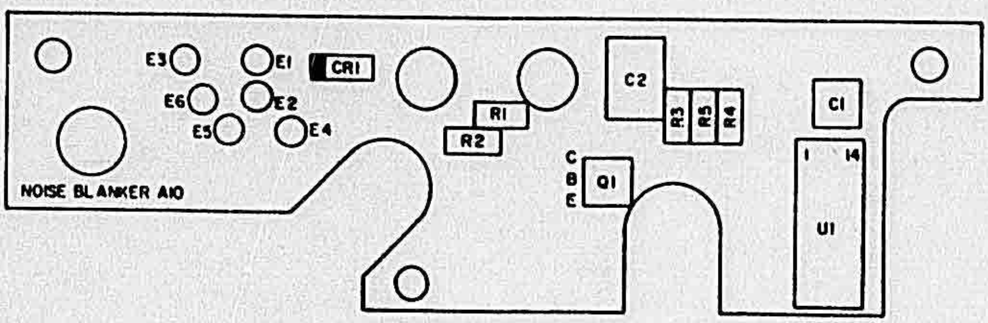


NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, AND CAPACITANCE VALUES ARE IN MICROFARADS.
2. NUMBER IN ( ) ARE WIRE COLOR CODES.
3. U1 IS AN ESS DEVICE - HANDLE ACCORDINGLY.
4. SYMBOL REPRESENTS TWISTED SHIELDED PAIR.

628-7496

Noise Blanker/Intercom A10, Schematic Diagram, Effective VHF-251 Sn 24590, VHF-251S Sn 2697, and VHF-251E Sn 2797
Figure 6-20



628-8263

Noise Blanker A10, Component Location Diagram, Effective VHF-251 Sn 14000 Through 24590 and Below 14000 With SB 10, VHF-251S Sn 2000 Through 2697 and Below 2000 With SB 5, and VHF-251E Sn 2000 Through 2793 and Below 2000 With SB 6
Figure 6-21

SCHEMATIC CHANGES

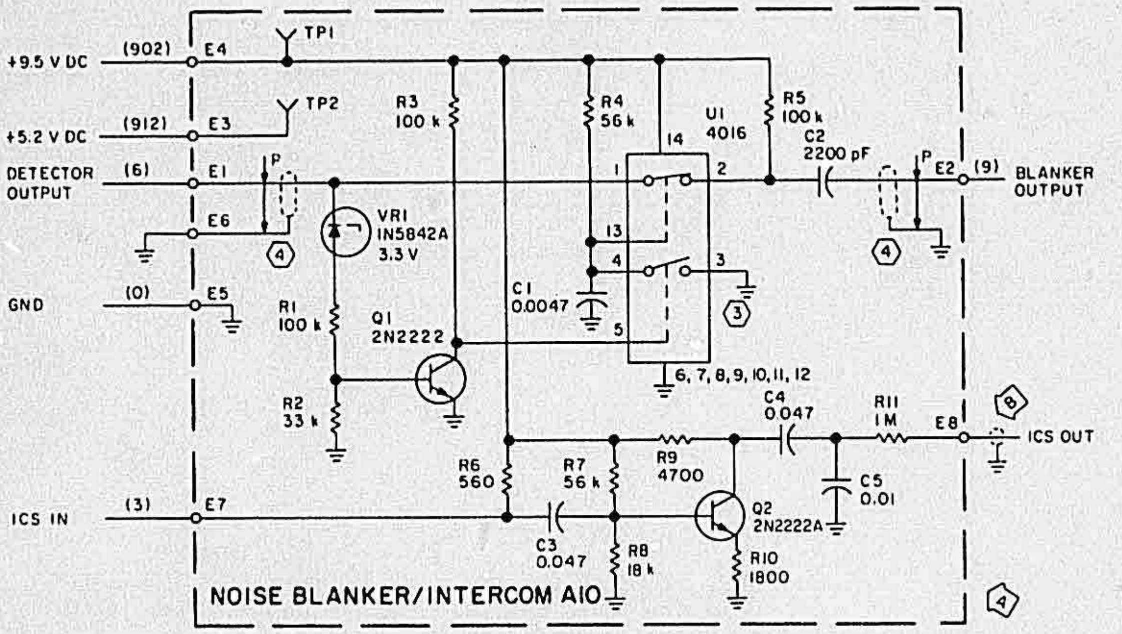
REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
	(This page will contain schematic revision information.)		

Noise Blanker A10, Schematic Diagram, Effective VHF-251 Sn 14000 Through 24590 and Below 14000 With SB 10, VHF-251S Sn 2000 Through 2697 and Below 2000 With SB 5, and VHF-251E Sn 2000 Through 2793 and Below 2000 With SB 6

Figure 6-22 (Sheet A)

PARTS LIST
VHF-251/251S/251E
A10-NOISE BLANKER ASSEMBLY (PART NUMBER 628-7439-001)

SYMBOL	DESCRIPTION	PART NUMBER
C1	CAPACITOR, FXD, CER DIEL, 0.0047UF, 20%, 50V	913-3306-030
C2	CAPACITOR, FXD, POLY DIEL, 2200PF, 10%, 100V	933-1404-110
Q1	TRANSISTOR, 2N2222	352-5021-010
R1	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W	745-7950-490
R2	RESISTOR, FXD, CMPSN, 33K, 10%, 1/4W	745-7950-430
R3	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W	745-7950-490
R4	RESISTOR, FXD, CMPSN, 156K, 10%, 1/4W	745-7950-460
R5	RESISTOR, FXD, CMPSN, 100K, 10%, 1/4W	745-7950-490
U1	INTEGRATED CIRCUIT, 4016	351-8260-010
VR1	ZENER DIODE, 3.3V, 1N5842A	353-3740-130

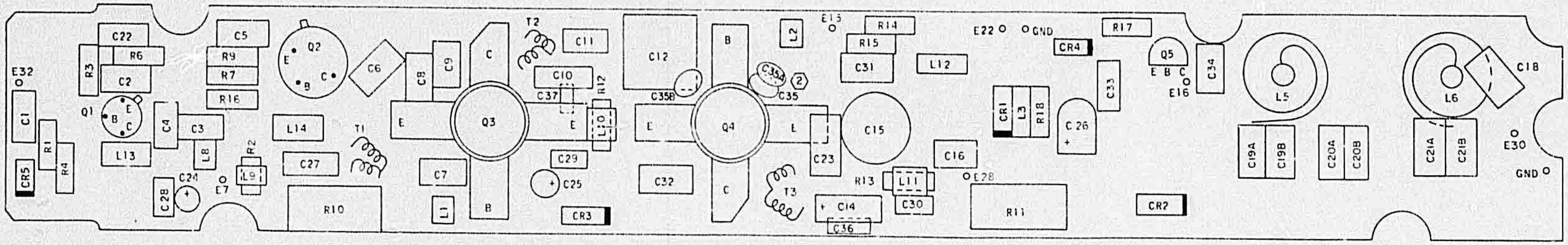


NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, AND CAPACITANCE VALUES ARE IN MICROFARADS.
2. NUMBER IN ( ) ARE WIRE COLOR CODES.
3. U1 IS AN ESS DEVICE - HANDLE ACCORDINGLY.
4. SYMBOL REPRESENTS TWISTED SHIELDED PAIR.

628-7496

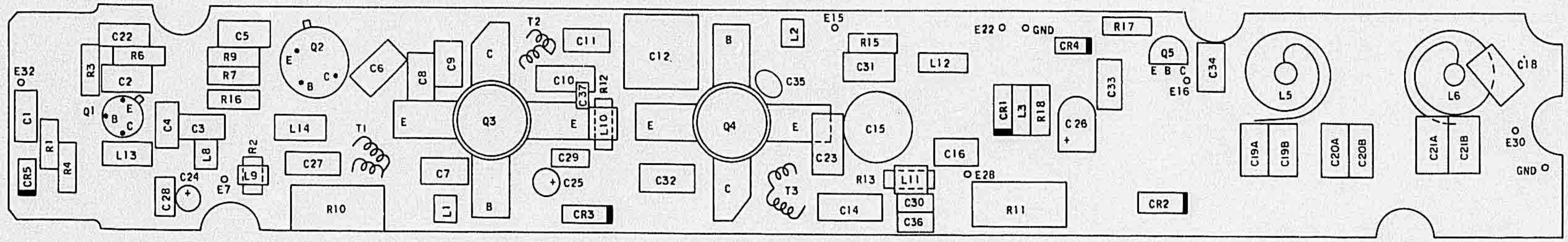
Noise Blanker A10, Schematic Diagram, Effective VHF-251 Sn 14000 Through 24590 and Below 14000 With SB 10, VHF 251S Sn 2000 Through 2697 and Below 2000 With SB 5, and VHF-251E Sn 2000 Through 2794 and Below 2000 With SB 6
Figure 6-22



NOTES

1. C33, C34, CR4, Q5, R17, AND R18 ARE USED IN VHF 251( ) ONLY.
2. C35A AND C35B INCLUDED EFF REV R.
3. DO NOT ATTEMPT TO REPAIR REVISION LETTER R BOARDS RETURN THE BOARD TO YOUR REGIONAL CUSTOMER SERVICE MANAGER A NEW ASSEMBLY WILL BE SENT IN EXCHANGE.

Power Amplifier A3, Board Revision Letters A through R,
Component Location Diagram
Figure 6-23



NOTE: C33, C34, CR4, Q5, R17, AND R18 ARE USED IN VHF-251( ) ONLY.

Power Amplifier A3, Component Location Diagram, Effective Board Rev Letter T and VHF-251 SB 13, VHF-251S SB 6 and VHF-251E SB 7
Figure 6-24

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A	Added note 3.	NA	NA
B	Changed value of C32 from 22 to 15 pF to eliminate high frequency rolloff.	NA	REV J
C	Changed value of C7 from 100 to 120pF, C8 from 180 to 33pF, C9 from 5 to 15pF, and C23 from 10 to 18pF; changed L10 and L11 from coils to ferrite beads; added C35A and C35B. Revision reduces transmitter spurious outputs.	NA•	REV R
D	Changed C7 from 120 to 100pF, C8 from 35 to 180pF, C9 from 15 to 10pF, C10 and C14 from 220pF to 1μF, C35 from 62 to 82pF, CR1 from 1N3070 to 1N5767, C23 from 10 to 18pF, and L12 changed to 2.2μH; added C36 and C37; deleted C35A and R14; L1 changed from coil to ferrite bead. Change reduces transmitter noise level. Refer to partial schematic on schematic apron for configuration prior to REV T.	VHF-251 SB 13, VHF-251S SB 6, VHF-251E SB 7	REV T VHF-251 SERIAL NUMBER 23038. VHF-251S SERIAL NUMBER 2658. VHF-251E SERIAL NUMBER 2735.
None	Changed T3 from 608-6569-001 to 278-0502-000.	VHF-251 SB 15, VHF-251S SB 8, VHF-251E SB 9	REV U

Power Amplifier A3 Schematic
Figure 6-25 (Sheet A)

PARTS LIST
VHF-251/251S/251E
A3-POWER AMPLIFIER (PART NUMBER 628-5021-001, -003)

SYMBOL	DESCRIPTION	PART NUMBER
C1	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C2	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
C3	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
C4	CAPACITOR, FIXED, MICA, DIELECTRIC, 20PF, ±5%, 50V MIN	912-2099-130
C5	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
C6	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
C7	CAPACITOR, FIXED, MICA, DIELECTRIC, 100PF, 5%, 50V (EFF REV T; VHF-251 SB 13/15, VHF-251S SB 6/8, VHF-251E SB 7/9)	912-2099-290
C7	CAPACITOR, FIXED, MICA, DIELECTRIC, 120PF, 5%, 50V (EFF REV R)	912-2099-310
C7	CAPACITOR, FIXED, MICA, DIELECTRIC, 100PF, ±5%, 50V MIN	912-2099-290
C8	CAPACITOR, FIXED, MICA, DIELECTRIC, 180PF, 5%, 50V (EFF REV T; VHF-251 SB 13/15, VHF-251S SB 6/8, VHF-251E SB 7/9)	912-2099-360
C8	CAPACITOR, FIXED, MICA, DIELECTRIC, 33PF, 5%, 50V (EFF REV R)	912-2099-180
C8	CAPACITOR, FIXED, MICA, DIELECTRIC, 180PF, ±5%, 50V MIN	912-2099-360
C9	CAPACITOR, FIXED, MICA, DIELECTRIC, 10PF, ±0.5PF, 300V (EFF REV T; VHF-251 SB 13/15, VHF-251S SB 6/8, VHF-251E SB 7/9)	912-2099-090
C9	CAPACITOR, FIXED, MICA, DIELECTRIC, 15PF, 5%, 50V (EFF REV R)	912-2099-110
C9	CAPACITOR, FIXED, MICA, DIELECTRIC, 5PF, ±1/2PF, 50V MIN	912-2099-040
C10	CAPACITOR, FIXED, TA, 1UF, 20%, 50V (EFF REV T; VHF-251 SB 13/15, VHF-251S SB 6/8, VHF-251E SB 7/9)	184-9113-460
C10	CAPACITOR, FIXED, MICA, DIELECTRIC, 220PF, ±5%, 50V MIN	912-2099-380
C11	CAPACITOR, FIXED, MICA, DIELECTRIC, 120PF, ±5%, 50V MIN	912-2099-310
C12	CAPACITOR, FIXED, MICA, DIELECTRIC, 270PF, 10%, 100V	912-2100-030
C13	NOT USED	
C14	CAPACITOR, FIXED, TA, 1UF, 20%, 50V (EFF REV T; VHF-251 SB 13/15, VHF-251S SB 6/8, VHF-251E SB 7/9)	184-9113-460
C14	CAPACITOR, FIXED, MICA, DIELECTRIC, 220PF, ±5%, 50V MIN	912-2099-380

PART LIST
VHF-251/251S/251E
A3-POWER AMPLIFIER (PART NUMBER 628-5021-001, -003)

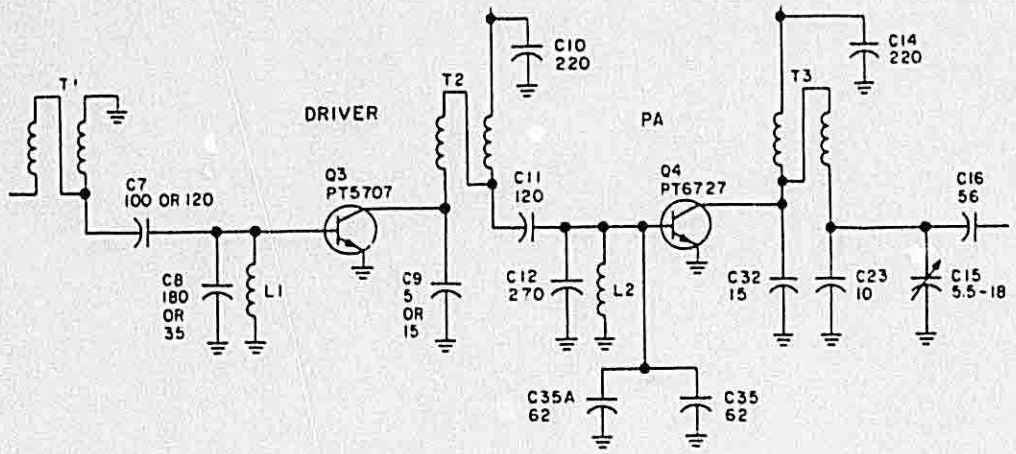
SYMBOL	DESCRIPTION	PART NUMBER
C15	CAPACITOR, VARIABLE, CERAMIC, DIELECTRIC, 5.5-18PF, 200V	917-0006-030
C16	CAPACITOR, FIXED, MICA, DIELECTRIC, 56PF, ±5%, 50V MIN	912-2099-230
C17	NOT USED	
C18	CAPACITOR, FIXED, MICA, DIELECTRIC, 10PF, ±.5PF, 300V	912-2099-090
C19A	CAPACITOR, FIXED, MICA, DIELECTRIC, 22PF, ±5%, 50V MIN	912-2099-140
C19B	CAPACITOR, FIXED, MICA, DIELECTRIC, 22PF, ±5%, 50V MIN	912-2099-140
C20A	CAPACITOR, FIXED, MICA, DIELECTRIC, 27PF, ±5%, 50V MIN	912-2099-160
C20B	CAPACITOR, FIXED, MICA, DIELECTRIC, 27PF, ±5%, 50V MIN	912-2099-160
C21A	CAPACITOR, FIXED, MICA, DIELECTRIC, 12PF, ±5%, 50V MIN	912-2099-100
C21B	CAPACITOR, FIXED, MICA, DIELECTRIC, 15PF, ±5%, 50V MIN	912-2099-110
C22	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
C23	CAPACITOR, FIXED, MICA, DIELECTRIC, 18PF, 5%, 50V (EFF REV T; VHF-251 SB 13, VHF-251S SB 6, VHF-251E SB 7)	912-2099-120
C23	CAPACITOR, FIXED, MICA, DIELECTRIC, 18PF, 5%, 50V (EFF REV R)	912-2099-120
C23	CAPACITOR, FIXED, MICA, DIELECTRIC, 10PF, ±1/2PF, 50V MIN	912-2099-090
C24	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C25	CAPACITOR, FIXED, TANTALUM, 1UF, 20%, 50V (EFF REV K)	184-9113-460
C25	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V (EFF REV R)	184-9113-030
C26	CAPACITOR, FIXED, TANTALUM, 4.7UF, 20%, 50V (EFF REV K)	184-9113-470
C26	CAPACITOR, FIXED, TANTALUM, 4.7UF, ±20%, 20V	184-9113-060
C27	CAPACITOR, FIXED, MICA, DIELECTRIC, 33PF, ±5%, 50V MIN	912-2099-180
C28	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000PF, +80-20%, 500V (EFF REV G)	913-3298-110
C28	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000PF, ±10%, 200V	913-3300-020
C29	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000PF, +80-20%, 500V (EFF REV G)	913-3298-110
C29	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000PF, ±10%, 200V	913-3300-020

PARTS LIST
VHF-251/251S/251E
A3-POWER AMPLIFIER (PART NUMBER 628-5021-001, -003)

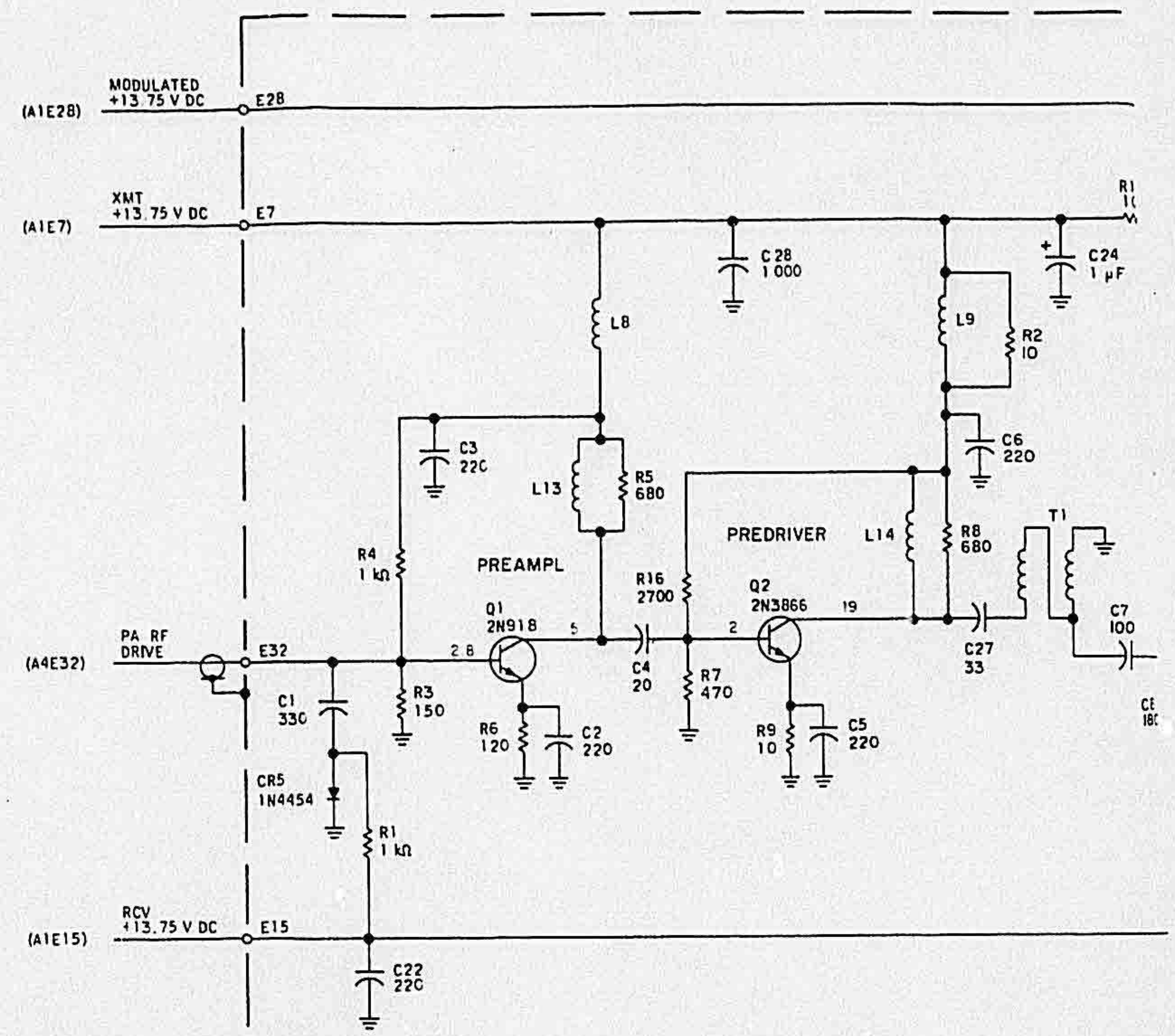
SYMBOL	DESCRIPTION	PART NUMBER
C30	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000PF, +80-20%, 500V (EFF REV G)	913-3298-110
C30	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000PF, ±10%, 200V	913-3300-020
C31	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
C32	CAPACITOR, FIXED, MICA, DIELECTRIC, 15PF, 15%, 50V (EFF REV J)	912-2099-110
C32	CAPACITOR, FIXED, MICA, DIELECTRIC, 22PF, ±5%, 50V MIN	912-2099-140
C33	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
C34	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
C35	CAPACITOR, FIXED, MICA, DIELECTRIC, 82PF, 5%, 50V (EFF REV T; VHF-251 SB 13/15, VHF-251S SB 6/8, VHF-251E SB 7/9)	912-2099-270
C35A	CAPACITOR, FIXED, MICA, DIELECTRIC, 62PF, 5%, 50V (EFF REV R)	912-2099-240
C35A	NOT USED (EFF REV T)	
C35B	CAPACITOR, FIXED, MICA, DIELECTRIC, 62PF, 5%, 50V (EFF REV R)	912-2099-240
C35B	NOT USED (EFF REV T)	
C36	CAPACITOR, FIXED, CERAMIC CHIP, 1000PF, 5%, 100V (EFF REV T; VHF-251 SB 13/15, VHF-251S SB 6/8, VHF-251E SB 7/9)	351-4059-290
C37	CAPACITOR, FIXED, CERAMIC CHIP, 1000PF, 5%, 100V (EFF REV T; VHF-251 SB 13/15, VHF-251S SB 6/8, VHF-251E SB 7/9)	351-4059-290
CR1	DIODE, 1N5767 (EFF REV T; VHF-251 SB 13/15, VHF-251S SB 6/8, VHF-251E SB 7/9)	922-6119-010
CR1	DIODE, 1N3070	353-3735-010
CR2	DIODE, MR501	353-6586-010
CR3	DIODE, MR501	353-6586-010
CR4	DIODE, 1N4454	353-3741-010
CR5	DIODE, 1N4454	353-3741-010
L1	FERRITE BEAD (EFF REV T)	288-2154-000
L1	COIL	628-5632-001
L2	COIL	628-5632-001
L3	COIL, 2.2UH	240-2742-040
L4	NOT USED	
L5	COIL, P/O BOARD	628-5022-002
L6	COIL, P/O BOARD	628-5022-002
L7	NOT USED	
L8	COIL	628-5632-001
L9	COIL	628-5632-001

PARTS LIST
VHF-251/251S/251E
A3-POWER AMPLIFIER (PART NUMBER 628-5021-001, -003)

SYMBOL	DESCRIPTION	PART NUMBER
L10	FERRITE BEAD (EFF REV R)	288-2154-000
L10	COIL	628-5632-001
L11	FERRITE BEAD (EFF REV R)	288-2154-000
L11	COIL	628-5632-001
L12	INDUCTOR, 2.2UH (EFF REV T; VHF-251 SB 13/15, VHF-251S SB 6/8, VHF-251E SB 7/9)	240-2742-040
L12	COIL	628-5351-002
L13	COIL	628-5351-001
L14	COIL	628-5351-001
Q1	TRANSISTOR, 2N918	352-5027-010
Q2	TRANSISTOR, 2N3866	352-5022-010
Q3	TRANSISTOR, SRF-3122 (VHF-251/251S ONLY)	352-5014-010
Q3	TRANSISTOR, 2N5641 (VHF-251E ONLY) (ALSO REFER TO VHF-251E SB 3)	352-5014-020
Q4	TRANSISTOR, PT6727 (VHF-251/251S ONLY)	352-5012-010
Q4	TRANSISTOR, 2N5643 (VHF-251E ONLY) (ALSO REFER TO VHF-251E SB 3)	352-5012-020
Q5	TRANSISTOR, MPS2369	352-5015-010
R1	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
R2	RESISTOR, FIXED, COMPOSITION, 10 OHMS, 10%, 1/4W	745-7950-010
R3	RESISTOR, FIXED, COMPOSITION, 150 OHMS, 10%, 1/4W	745-7950-150
R4	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
R5	RESISTOR/MODIFIED, COMBINED WITH L13, 680 OHMS, 10%, 1/4W	628-5351-001
R6	RESISTOR, FIXED, COMPOSITION, 120 OHMS, 10%, 1/4W	745-7950-140
R7	RESISTOR, FIXED, COMPOSITION, 470 OHMS, 10%, 1/4W	745-7950-210
R8	RESISTOR/MODIFIED, COMBINED WITH L14, 680 OHMS, 10%, 1/4W	628-5351-001
R9	RESISTOR, FIXED, COMPOSITION, 10 OHMS, 10%, 1/4W	745-7950-010
R10	RESISTOR, FIXED, WIREWOUND, 10 OHMS, 5%, 3W	745-7953-020
R11	RESISTOR, FIXED, WIREWOUND, 22 OHMS, 5%, 3W	745-7953-030
R12	RESISTOR, FIXED, COMPOSITION, 10 OHMS, 10%, 1/4W	745-7950-010
R13	RESISTOR, FIXED, COMPOSITION, 10 OHMS, 10%, 1/4W	745-7950-010
R14	NOT USED (EFF REV T; VHF-251 SB 13, VHF-251S SB 6, VHF-251E SB 7)	745-7950-610
R14	RESISTOR, FIXED, COMPOSITION, 1 MEGOHM, 10%, 1/4W	745-7950-210
R15	RESISTOR, FIXED, COMPOSITION, 470 OHMS, 10%, 1/4W	745-7950-300
R16	RESISTOR, FIXED, COMPOSITION, 2700 OHMS, 10%, 1/4W	745-7950-330
R17	RESISTOR, FIXED, COMPOSITION, 4700 OHMS, 10%, 1/4W	745-7950-280
R18	RESISTOR, FIXED, COMPOSITION, 1800 OHMS, 10%, 1/4W	608-6569-001
T1	TRANSFORMER	608-6569-001
T2	TRANSFORMER	608-6569-001
T3	TRANSFORMER (EFF REV AD)	653-2170-001
T3	TRANSFORMER (EFF REV U; VHF-251 SB 15, VHF-251S SB 8, VHF-251E SB 9)	278-0502-010
T3	TRANSFORMER	608-6569-001

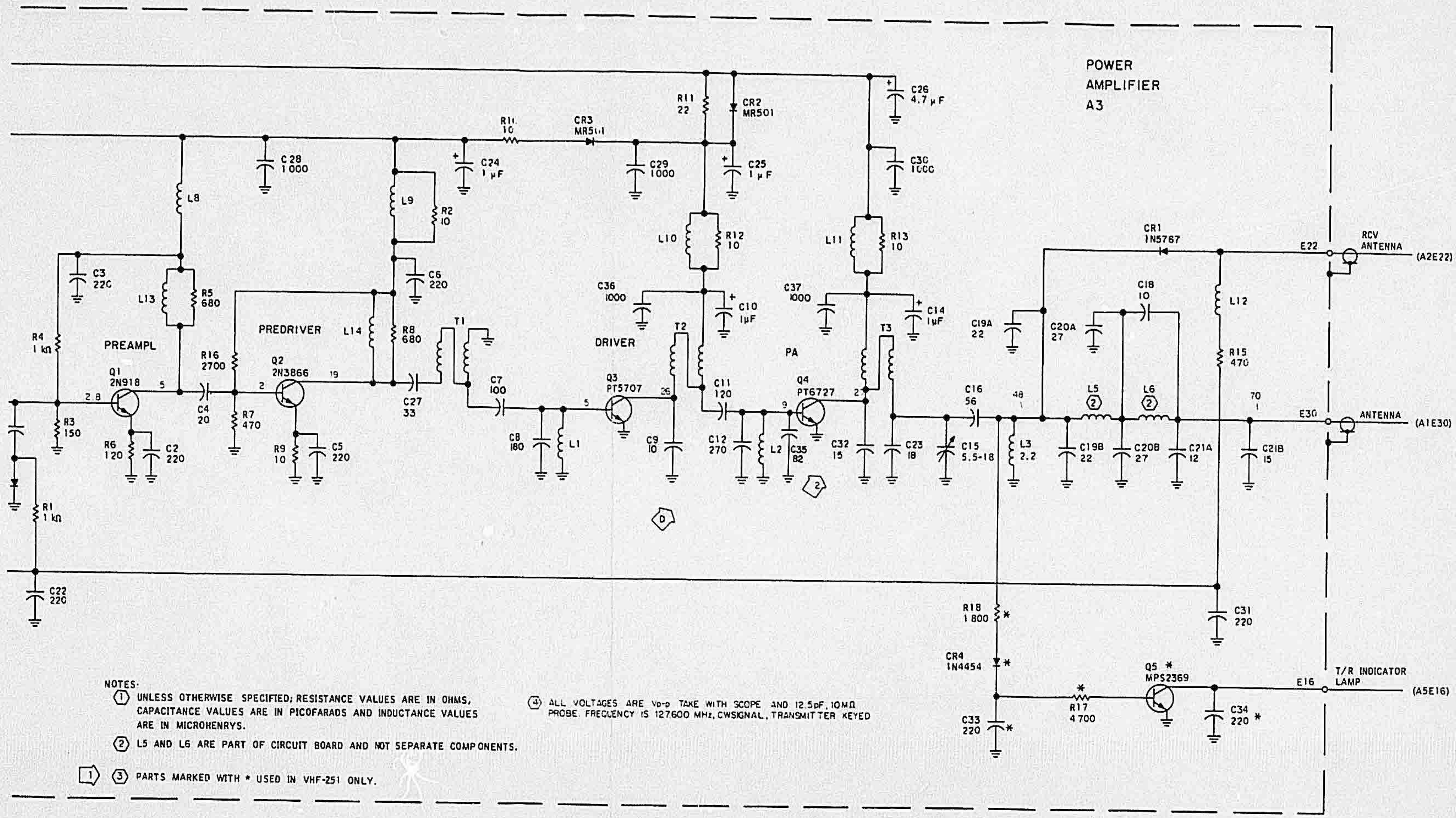


Before Revision Letter T; VHF-251 SB 13, VHF-251S SB 6, VHF-251E SB 7

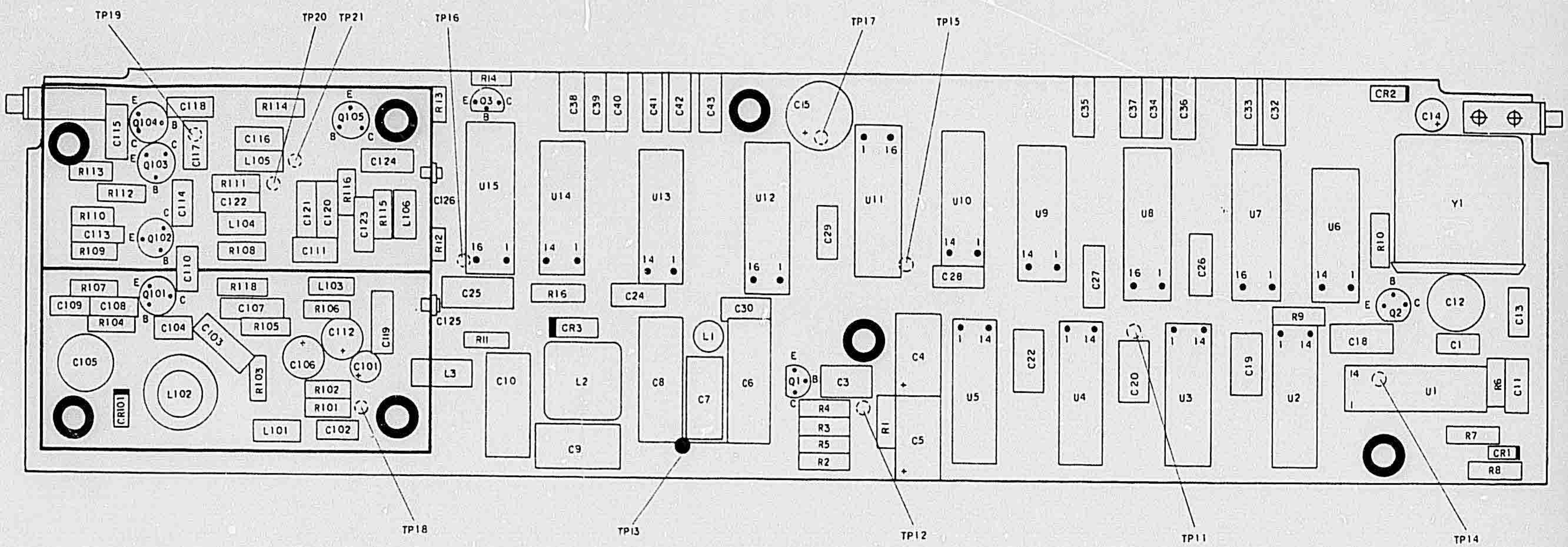


NOTES:

1. UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS AND INDUCTANCE VALUES ARE IN MICROHENRYS.
2. L5 AND L6 ARE PART OF CIRCUIT BOARD AND NOT SEPARATE COMPONENTS.
3. PARTS MARKED WITH * USED IN VHF-251 ONLY.



Power Amplifier A3 Schematic
Figure 6-25



Synthesizer A4, Component Location Diagram
Board No. 628-5030-004
Figure 6-26

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A	Changed value of R11 from 56 to 82 ohms and R12 from 470 to 680 ohms to optimize prescaler bias and level.	NA	REV B
B	Changed value of C104 from 22 to 27 pF to improve synthesizer tracking.	NA	REV D
B	Changed CR101 from 353-3264-010 to 922-6131-020. 353-3264-010 is no longer available.	NA	REV E

Synthesizer A4, Schematic Diagram, Board No 628-5030-004
Figure 6-27 (Sheet A)

PARTS LIST
A4-SYNTHESIZER
ASSEMBLY (PART NUMBER 628-5300-001/-003)
BOARD (PART NUMBER 628-5030-004)

SYMBOL	DESCRIPTION	PART NUMBER
C1	CAPACITOR, FIXED, MICA, DIELECTRIC, 15pF, ±5%, 50V MIN	912-2099-110
C2	NOT USED	
C3	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C4	CAPACITOR, FIXED, TANTALUM, 68μF, ±20%, 15V	184-9113-130
C5	CAPACITOR, FIXED, TANTALUM, 68μF, ±20%, 15V	184-9113-130
C6	CAPACITOR, FIXED, POLYESTER, DIELECTRIC, 0.027μF, ±10%, 100V MAX	933-1404-090
C7	CAPACITOR, FIXED, MICA, DIELECTRIC, 470pF, ±5%, 50V MIN	912-2099-470
C8	CAPACITOR, FIXED, POLYESTER, DIELECTRIC, 0.039μF, ±10%, 100V MAX	933-1404-100
C9	CAPACITOR, FIXED, MICA, DIELECTRIC, 820pF, ±5%, 50V MIN	912-2099-510
C10	CAPACITOR, FIXED, POLYESTER, DIELECTRIC, 0.033μF, ±10%, 100V MAX	933-1404-050
C11	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C12	CAPACITOR, VARIABLE, CERAMIC, DIELECTRIC, 3-5pF, 200V	917-0006-020
C13	CAPACITOR, FIXED, MICA, DIELECTRIC, 91pF, ±5%, 50V MIN	912-2099-280
C14	CAPACITOR, FIXED, TANTALUM, 4.7μF, ±20%, 10V	184-9113-050
C15	CAPACITOR, FIXED, TANTALUM, 100μF, ±20%, 10V	184-9113-140
C16	NOT USED	
C17	NOT USED	
C18	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C19	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C20	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C21	NOT USED	
C22	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C23	NOT USED	
C24	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C25	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C26	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C27	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C28	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130

PARTS LIST
A4-SYNTHESIZER
ASSEMBLY (PART NUMBER 628-5300-001/-003)
BOARD (PART NUMBER 628-5030-004)

SYMBOL	DESCRIPTION	PART NUMBER
C29	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C30	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C31	NOT USED	
C32	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C33	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C34	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C35	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C36	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C37	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C38	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C39	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C40	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C41	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C42	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C43	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C44-C100	NOT USED	
C101	CAPACITOR, FIXED, TANTALUM, 2.2μF, ±20%, 15V	184-9113-200
C102	CAPACITOR, FIXED, MICA, DIELECTRIC, 220pF, ±5%, 50V	912-2099-380
C103	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000pF, +80-20%, 500V	913-3298-110
C104	CAPACITOR, FIXED, MICA, DIELECTRIC, 22pF, ±5%, 300V	912-4141-030
C105	CAPACITOR, VARIABLE, AIR, DIELECTRIC, 1.3-5.4pF, 250V	922-1032-020
C106	CAPACITOR, FIXED, TANTALUM, 22μF, ±20%, 15V	184-9113-080
C107	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C108	CAPACITOR, FIXED, MICA, DIELECTRIC, 7pF, ±1/2pF, 50V MIN	912-2099-060
C109	CAPACITOR, FIXED, MICA, DIELECTRIC, 18pF, ±5%, 50V MIN	912-2099-120
C110	CAPACITOR, FIXED, MICA, DIELECTRIC, 10pF, ±1/2pF, 50V (EFF REV D)	912-2106-020

PARTS LIST
A4-SYNTHESIZER
ASSEMBLY (PART NUMBER 628-5300-001/-003)
BOARD (PART NUMBER 628-5030-004)

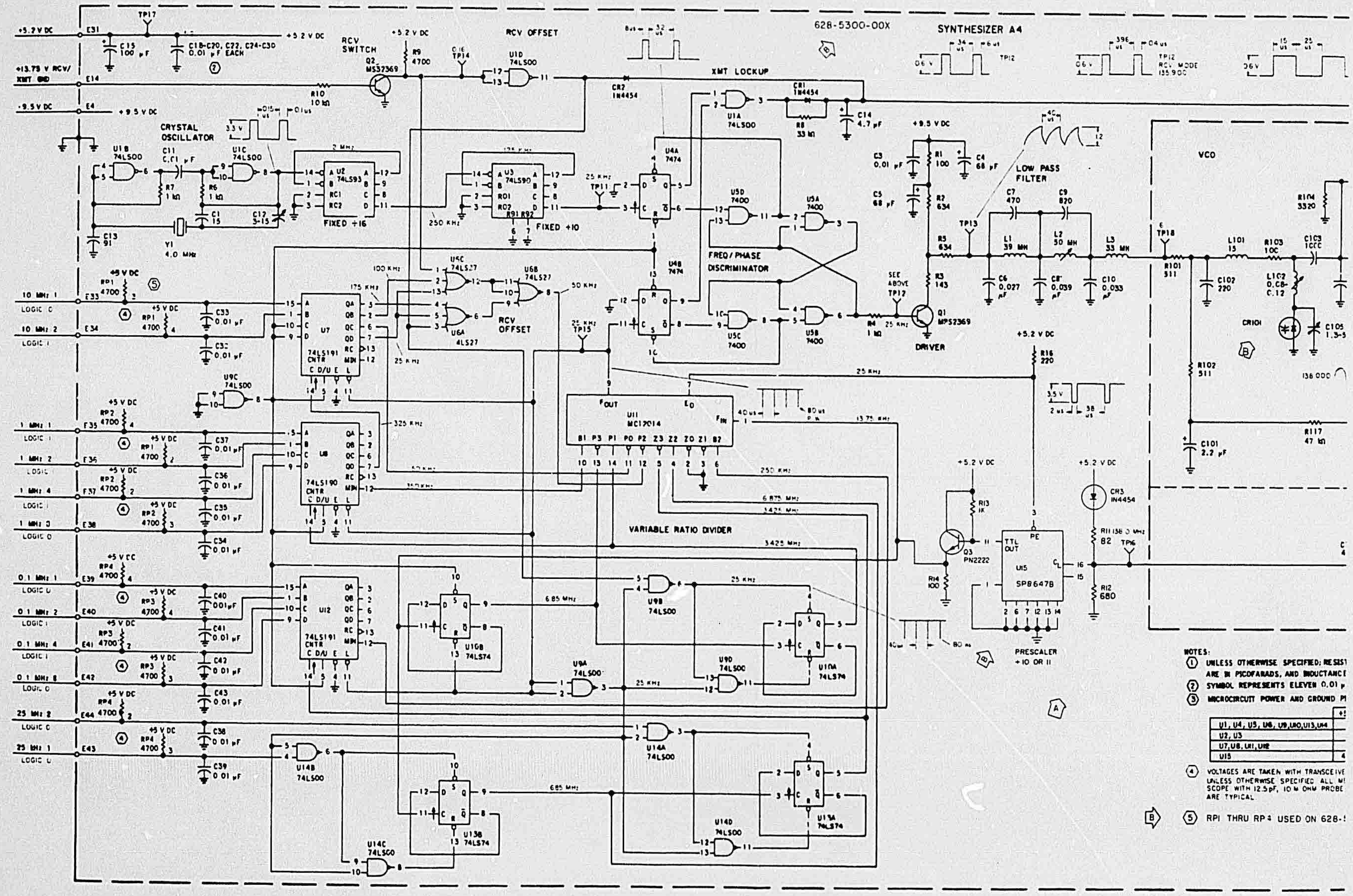
SYMBOL	DESCRIPTION	PART NUMBER
C111	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000pF, +80-20%, 500V	913-3298-110
C112	CAPACITOR, FIXED, TANTALUM, 22μF, ±20%, 15V	184-9113-080
C113	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330pF, +80-20%, 1000V	913-3298-030
C114	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 20pF, 5%, 300V	912-2099-130
C115	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330pF, +80-20%, 1000V	913-3298-030
C116	CAPACITOR, FIXED, MICA, DIELECTRIC, 2pF, ±1/2pF, 50V MIN	912-2099-010
C117	CAPACITOR, FIXED, MICA, DIELECTRIC, 4pF, ±1/2pF, 300V	912-2099-030
C118	CAPACITOR, FIXED, MICA, DIELECTRIC, 220pF, ±5%, 300V	912-2099-380
C119	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C120	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C121	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220pF, +80-20%, 250V	913-3298-090
C122	CAPACITOR, FIXED, MICA, DIELECTRIC, 2pF, ±1/2pF, 50V	912-2099-010
C123	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C124	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 470pF, +80-20%, 500V	913-3298-100
C125	CAPACITOR, FEEDTHROUGH, 1000pF, +100-20%, 50V	913-3303-040
C126	CAPACITOR, FEEDTHROUGH, 1000pF, +100-20%, 50V	913-3303-040
CR1	DIODE, 1N4454	353-3741-010
CR2	DIODE, 1N4454	353-3741-010
CR3	DIODE, 1N4454	353-3741-010
CR4-CR100	NOT USED	
CR101	VARACTOR (EFF REV E)	922-6131-020
CR101	VARACTOR (EFF TO REV D)	353-3264-010
L1	COIL, 39mH	240-0988-080
L2	COIL, 50mH	278-0417-020
L3	COIL, 33mH	240-2741-010
L4-L100	NOT USED	
L101	COIL, 15μH	240-2742-130
L102	COIL, VARIABLE, 0.08-0.12μH	278-0418-010
L103	COIL, 2.2μH	240-2742-040
L104	COIL, 0.1μH	240-2742-090
L105	COIL, 0.15μH	240-2742-100
L106	COIL, 2.2μH	240-2742-040
L107	COIL, 22μH	240-2742-080
Q1	TRANSISTOR, MPS2369	352-5015-010
Q2	TRANSISTOR, MPS2369	352-5015-010

PARTS LIST
A4-SYNTHESIZER
ASSEMBLY (PART NUMBER 628-5300-001/-003)
BOARD (PART NUMBER 628-5030-004)

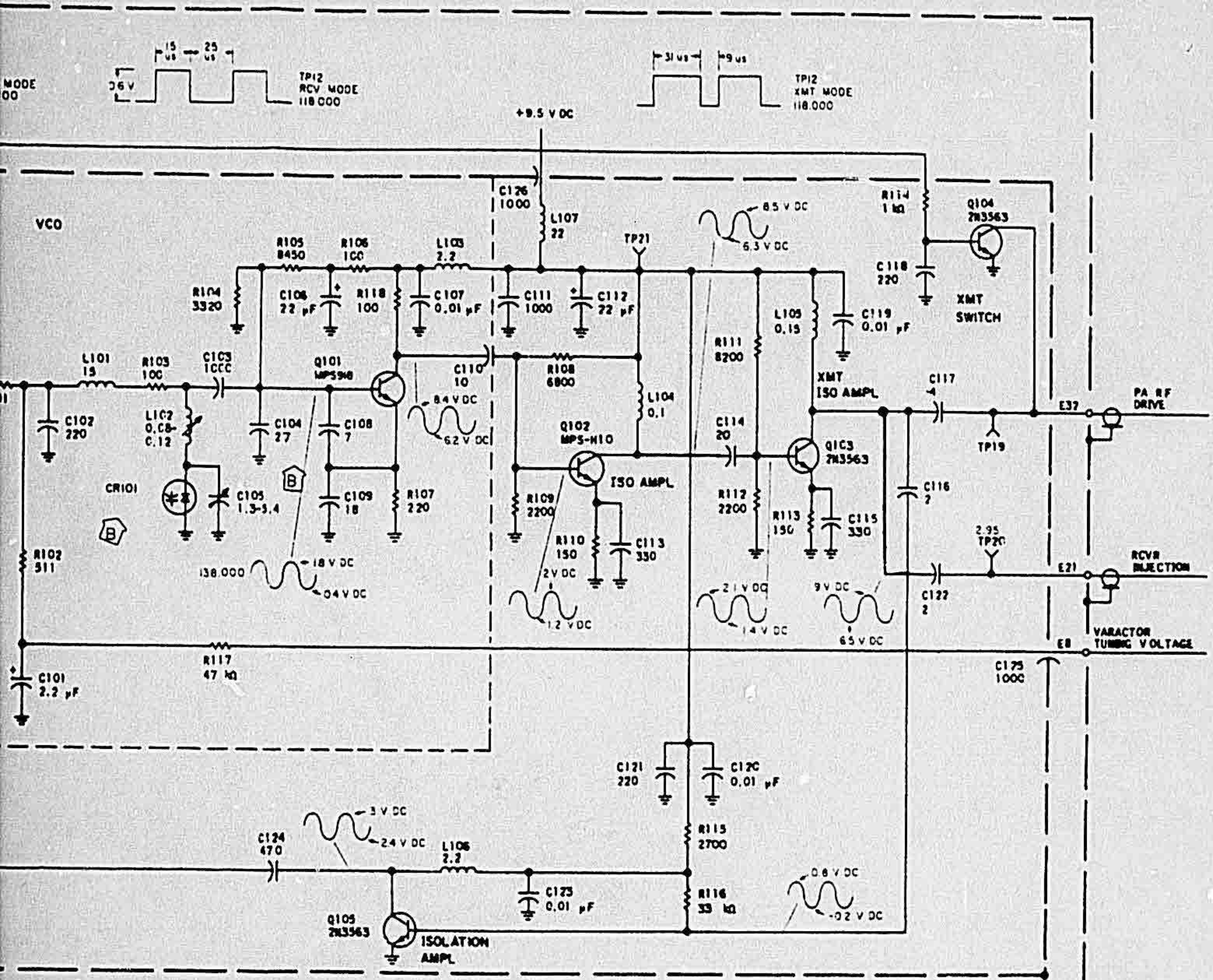
SYMBOL	DESCRIPTION	PART NUMBER
Q3	TRANSISTOR, PN222A	352-5021-010
Q4-Q100	NOT USED	
Q101	TRANSISTOR, MPS918	352-5027-010
Q102	TRANSISTOR, MPS-H10	352-5031-010
Q103	TRANSISTOR, 2N3563	352-5020-010
Q104	TRANSISTOR, 2N3563	352-5020-010
Q105	TRANSISTOR, 2N3563	352-5020-010
R1	RESISTOR, FIXED, COMPOSITION, 100Ω, 10%, 1/4W	745-7950-130
R2	RESISTOR, FIXED, FILM, 634Ω, ±1%, 1/8W	745-7956-070
R3	RESISTOR, FIXED, FILM, 143Ω, ±1%, 1/8W	745-7955-440
R4	RESISTOR, FIXED, COMPOSITION, 1kΩ, 10%, 1/4W	745-7950-250
R5	RESISTOR, FIXED, FILM, 634Ω, ±1%, 1/8W	745-7956-070
R6	RESISTOR, FIXED, COMPOSITION, 1kΩ, 10%, 1/4W	745-7950-250
R7	RESISTOR, FIXED, COMPOSITION, 1kΩ, 10%, 1/4W	745-7950-250
R8	RESISTOR, FIXED, COMPOSITION, 33kΩ, 10%, 1/4W	745-7950-430
R9	RESISTOR, FIXED, COMPOSITION, 4700Ω, 10%, 1/4W	745-7950-330
R10	RESISTOR, FIXED, COMPOSITION, 10kΩ, 10%, 1/4W	745-7950-370
R11	RESISTOR, FIXED, COMPOSITION, 82Ω, 10%, 1/4W (EFF REV B)	745-0710-000
R11	RESISTOR, FIXED, COMPOSITION, 56Ω, 10%, 1/4W	745-7950-100
R12	RESISTOR, FIXED, COMPOSITION, 680Ω, 10%, 1/4W (EFF REV B)	745-0743-000
R12	RESISTOR, FIXED, COMPOSITION, 470Ω, 10%, 1/4W	745-7950-210
R13	RESISTOR, FIXED, COMPOSITION, 1k, 10%, 1/4W	745-7950-250
R14	RESISTOR, FIXED, COMPOSITION, 100Ω, 10%, 1/4W	745-7950-130
R15	NOT USED	
R16	RESISTOR, FIXED, COMPOSITION, 220Ω, 10%, 1/4W	745-7950-170
R17-R100	NOT USED	
R101	RESISTOR, FIXED, FILM, 511Ω, ±1%, 1/8W	745-7955-970
R102	RESISTOR, FIXED, FILM, 511Ω, ±1%, 1/8W	745-7955-970
R103	RESISTOR, FIXED, FILM, 100Ω, ±1%, 1/8W	745-7955-290
R104	RESISTOR, FIXED, FILM, 3320Ω, ±1%, 1/8W	745-7956-760
R105	RESISTOR, FIXED, FILM, 8200Ω, ±1%, 1/8W	745-7957-160
R106	RESISTOR, FIXED, COMPOSITION, 100Ω, 10%, 1/4W	745-7950-130
R107	RESISTOR, FIXED, COMPOSITION, 200Ω, 10%, 1/4W	745-7950-170
R108	RESISTOR, FIXED, COMPOSITION, 6800Ω, 10%, 1/4W	745-7950-350
R109	RESISTOR, FIXED, COMPOSITION, 2200Ω, 10%, 1/4W	745-7950-290
R110	RESISTOR, FIXED, COMPOSITION, 150Ω, 10%, 1/4W	745-7950-150
R111	RESISTOR, FIXED, COMPOSITION, 8200Ω, 10%, 1/4W	745-7950-360
R112	RESISTOR, FIXED, COMPOSITION, 2200Ω, 10%, 1/4W	745-7950-290
R113	RESISTOR, FIXED, COMPOSITION, 150Ω, 10%, 1/4W	745-7950-150
R114	RESISTOR, FIXED, COMPOSITION, 1kΩ, 10%, 1/4W	745-7950-250
R115	RESISTOR, FIXED, COMPOSITION, 2.7kΩ, 10%, 1/4W	745-7950-300
R116	RESISTOR, FIXED, COMPOSITION, 33kΩ, 10%, 1/4W	745-7950-430

PARTS LIST
A4-SYNTHESIZER
ASSEMBLY (PART NUMBER 628-5300-001/-003)
BOARD (PART NUMBER 628-5030-004)

SYMBOL	DESCRIPTION	PART NUMBER
R117	RESISTOR, FIXED, COMPOSITION, 47kΩ, 10%, 1/4W	745-7950-450
R118	RESISTOR, FIXED, COMPOSITION, 100Ω, 10%, 1/4W	745-7950-130
U1	IC, QUAD 2 INPUT NAND GATE, 74LS00	351-1709-010
U2	IC, 4-BIT BINARY COUNTER, 74LS93	351-1711-060
U3	IC, DECADE COUNTER, 74LS90	351-1711-050
U4	IC, FLIP FLOP, 7474	351-1550-020
U5	IC, QUAD 2 INPUT NAND GATE, 7400	351-1548-020
U6	IC, TRIPLE 3 INPUT NOR GATE, 74LS27	351-1709-030
U7	IC, 4-BIT BINARY COUNTER, 74LS191	351-1711-020
U8	IC, BCD COUNTER, 74LS190	351-1711-010
U9	IC, QUAD 2 INPUT NAND GATE, 74LS00	351-1709-010
U10	IC, FLIP FLOP, 74LS74	351-1710-020
U11	IC, MONOLITHIC COUNTER CONTROL, 12014	351-7829-010
U12	IC, 4-BIT BINARY COUNTER, 74LS191	351-1711-020
U13	IC, FLIP FLOP, 74LS74	351-1710-020
U14	IC, QUAD 2 INPUT NAND GATE, 74LS00	351-1709-010
U15	IC, PRESCALER, PS8E46B	351-1904-010
Y1	CRYSTAL, 4MHz (VHF-251/251S ONLY)	289-7224-010
Y1	CRYSTAL, 4MHz (VHF-251E ONLY)	289-7224-040


628-5300-00X
SYNTHESIZER A4
CRYSTAL OSCILLATOR
RCV SWITCH
RCV OFFSET
XMT LOCKUP
FREQ/PHASE DISCRIMINATOR
LOW PASS FILTER
DRIVER
VCO
VARIABLE RATIO DIVIDER
PRESCALER ÷10 OR 11
FIXED ÷16
FIXED ÷10
MC12014
SP8647B
NOTES:
1 UNLESS OTHERWISE SPECIFIED: RESIST
ARE IN PICOFARADS, AND INDUCTANCE
2 SYMBOL REPRESENTS ELEVEN 0.01 µ
3 MICROCIRCUIT POWER AND GROUND PI
4 VOLTAGES ARE TAKEN WITH TRANSCEIVE
UNLESS OTHERWISE SPECIFIED. ALL M
SCOPE WITH 12.5pF, 10 M OHM PROBE
ARE TYPICAL
5 RP1 THRU RP4 USED ON 628-

page 6-83



NOTES:

① UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.

② SYMBOL REPRESENTS ELEVEN 0.01 μF CAPACITORS CONNECTED BETWEEN +5.2 V DC AND GROUND.

③ MICROCIRCUIT POWER AND GROUND PINS;

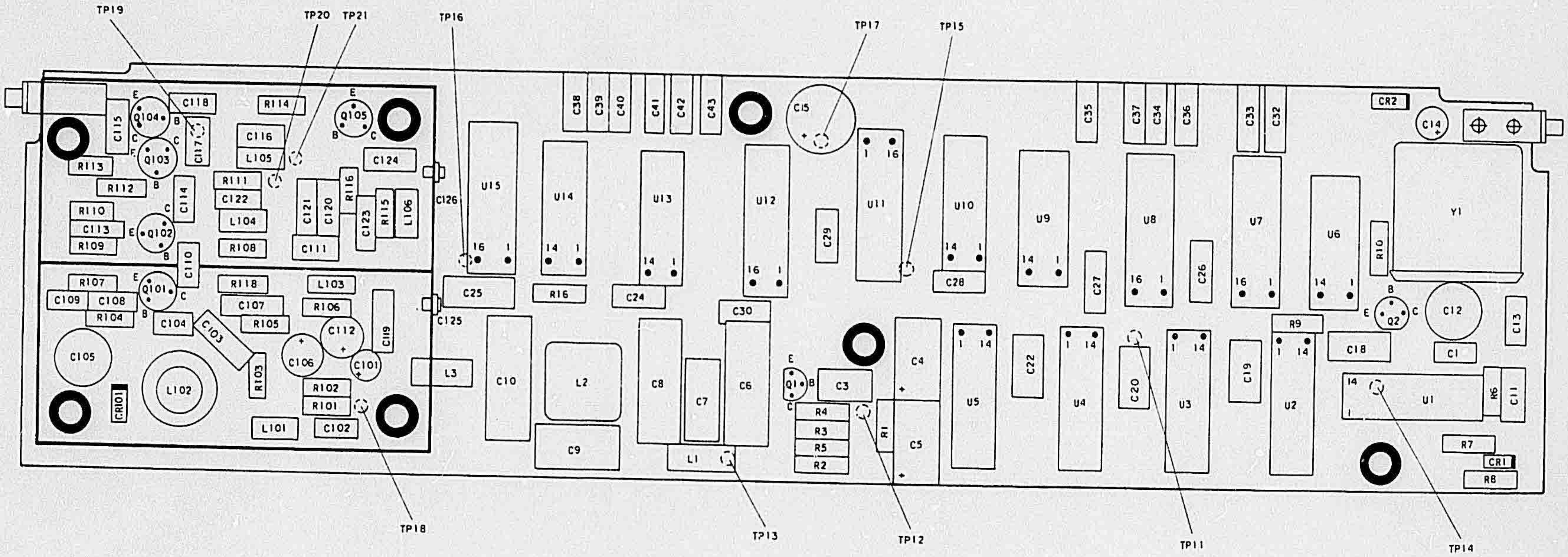
	+5.2 V DC	GROUND
U1, U4, U5, U6, U9, U10, U13, U14	14	7
U2, U3	5	10
U7, U8, U11, U12	16	8
U15	4 AND 5	12

④ VOLTAGES ARE TAKEN WITH TRANSCEIVER TUNED TO 127.600 MHz UNLESS OTHERWISE SPECIFIED. ALL MEASUREMENTS MADE USING SCOPE WITH 12.5pF, 10 M OHM PROBE. TP12 AND TP13 WAVEFORMS ARE TYPICAL.

⑤ RP1 THRU RP4 USED ON 628-5300-002/-004 ONLY.

Synthesizer A4, Schematic Diagram, Board No. 628-5030-004
Figure 6-27

SECTION VI
DIAGRAMS



Synthesizer A4, Component Location Diagram,
Board No. 628-5030-003
Figure 6-28

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
1	Changed value of C114 from 5 to 20 pF, C117 from 6 to 4 pF, C122 from 10 to 2 pF, and L105 from 0.18 to 0.15 μH to prevent unlock when signals are abruptly applied.	NA	REV F
2	Changed U5 from 74LS00 to 7400 to prevent possible unlock during transmit of very low temperatures.	NA	REV G
F	Changed C104 from 22 to 27 pF to improve synthesizer tracking.	NA	628-5030-003 REV D
None	Changed CR101 from 353-3264-010 to 922-6131-020. 353-3264-010 is no longer available.	NA	REV N

Synthesizer A4, Schematic Diagram, Board No 628-5030-003
Figure 6-29 (Sheet A)

PARTS LIST
A4-SYNTHESIZER
PART NUMBER 628-5069-001, -003

SYMBOL	DESCRIPTION	PART NUMBER
C1	CAPACITOR, FIXED, MICA, DIELECTRIC, 15PF, ±5%, 50V MIN	912-2099-110
C2	NOT USED	
C3	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C4	CAPACITOR, FIXED, TANTALUM, 68μF, ±20%, 15V	184-9113-130
C5	CAPACITOR, FIXED, TANTALUM, 68μF, ±20%, 15V	184-9113-130
C6	CAPACITOR, FIXED, POLYESTER, DIELECTRIC, 0.027μF, ±10%, 100V MAX	933-1404-090
C7	CAPACITOR, FIXED, MICA, DIELECTRIC, 470PF, ±5%, 50V MIN	912-2099-470
C8	CAPACITOR, FIXED, POLYESTER, DIELECTRIC, 0.039μF, ±10%, 100V MAX	933-1404-100
C9	CAPACITOR, FIXED, MICA, DIELECTRIC, 820PF, ±5%, 50V MIN	912-2099-510
C10	CAPACITOR, FIXED, POLYESTER, DIELECTRIC, 0.033μF, ±10%, 100V MAX	933-1404-050
C11	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C12	CAPACITOR, VARIABLE, CERAMIC, DIELECTRIC, 3-5PF, 200V	917-0006-020
C13	CAPACITOR, FIXED, MICA, DIELECTRIC, 91PF, ±5%, 50V MIN	912-2099-280
C14	CAPACITOR, FIXED, TANTALUM, 4.7μF, ±20%, 10V	184-9113-050
C15	CAPACITOR, FIXED, TANTALUM, 100μF, +20%, 10V	184-9113-140
C16	NOT USED	
C17	NOT USED	
C18	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C19	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C20	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C21	NOT USED	
C22	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C23	NOT USED	
C24	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C25	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C26	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C27	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C28	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130

PARTS LIST
A4-SYNTHESIZER
PART NUMBER 628-5069-001, -003

SYMBOL	DESCRIPTION	PART NUMBER
C29	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C30	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C31	NOT USED	
C32	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C33	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C34	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C35	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C36	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C37	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C38	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C39	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C40	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C41	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C42	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C43	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C44-C100	NOT USED	
C101	CAPACITOR, FIXED, TANTALUM, 2.2μF, ±20%, 15V	184-9113-200
C102	CAPACITOR, FIXED, MICA, DIELECTRIC, 220PF, ±5%, 50V	912-2099-380
C103	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000PF, +80-20%, 500V	913-3298-110
C104	CAPACITOR, FIXED, CERAMIC, 27PF, 10%, 100V (EFF REV D)	913-1098-570
C104	CAPACITOR, FIXED, MICA, DIELECTRIC, 22PF, ±5%, 50V MIN	912-2099-140
C105	CAPACITOR, VARIABLE, AIR, DIELECTRIC, 1.3-5.4PF, 250V	922-1032-020
C106	CAPACITOR, FIXED, TANTALUM, 22μF, ±20%, 15V	184-9113-080
C107	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C108	CAPACITOR, FIXED, MICA, DIELECTRIC, 7PF, ±1/2PF, 50V MIN	912-2099-060
C109	CAPACITOR, FIXED, MICA, DIELECTRIC, 18PF, ±5%, 50V MIN	912-2099-120

PARTS LIST
A4-SYNTHESIZER
PART NUMBER 628-5069-001, -003

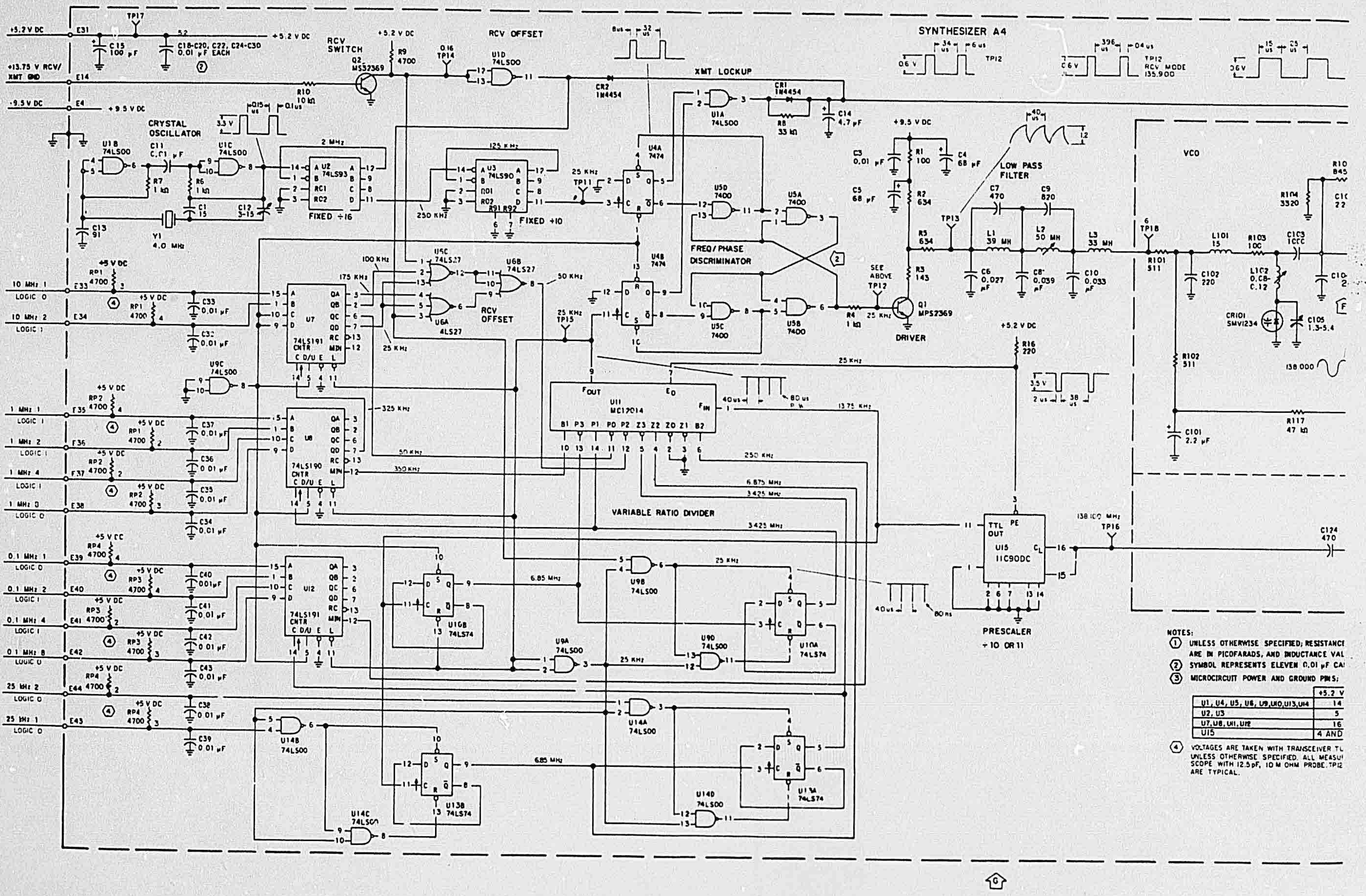
SYMBOL	DESCRIPTION	PART NUMBER
C110	CAPACITOR, FIXED, MICA, DIELECTRIC, 10PF, ±1/2PF, 50V (EFF REV D)	912-2106-020
C110	CAPACITOR, FIXED, MICA, DIELECTRIC, 10PF, ±1/2PF, 50V MIN	912-2099-090
C111	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000 PF, +80-20%, 500V	913-3298-110
C112	CAPACITOR, FIXED, TANTALUM, 22μF, ±20%, 15V	184-9113-080
C113	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C114	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 20PF, 5%, 300V (EFF REV F)	912-2099-130
C114	CAPACITOR, FIXED, MICA, DIELECTRIC, 5PF, ±1/2PF, 50V MIN	912-2099-040
C115	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C116	CAPACITOR, FIXED, MICA, DIELECTRIC, 2PF, ±1/2PF, 50V MIN	912-2099-010
C117	CAPACITOR, FIXED, MICA, DIELECTRIC, 4PF, ±1/2PF, 300V (EFF REV F)	912-2099-030
C117	CAPACITOR, FIXED, MICA, DIELECTRIC, 6PF, ±1/2PF, 50V MIN	912-2099-050
C118	CAPACITOR, FIXED, MICA, DIELECTRIC, 220PF, ±5%, 300V	912-2099-380
C119	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C120	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C121	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
C122	CAPACITOR, FIXED, MICA, DIELECTRIC, 2PF, ±1/2PF, 50V (EFF REV F)	912-2099-010
C122	CAPACITOR, FIXED, MICA, DIELECTRIC, 10PF, ±1/2PF, 50V MIN	912-2099-090
C123	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01μF, +80-20%, 50V	913-3298-130
C124	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 470PF, +80-20%, 500V	913-3298-100
C125	CAPACITOR, FEEDTHROUGH, 1000PF, +100-20%, 50V	913-3303-040
C126	CAPACITOR, FEEDTHROUGH, 1000PF, +100-20%, 50V	913-3303-040
CR1	DIODE, 1N4454	353-3741-010
CR2	DIODE, 1N4454	353-3741-010
CR3-CR100	NOT USED	
CR101	VARACTOR (EFF REV N)	922-6131-020
CR101	VARACTOR (EFF TO REV M)	353-3264-010
L1	COIL, 39mH	240-2741-020
L2	COIL, 50mH (EFF REV L)	278-0417-020
L2	COIL, 50mH (EFF REV K)	628-7878-001
L2	COIL, 50mH	278-0417-020
L3	COIL, 33mH	240-2741-010

PARTS LIST
A4-SYNTHESIZER
PART NUMBER 628-5069-001, -003

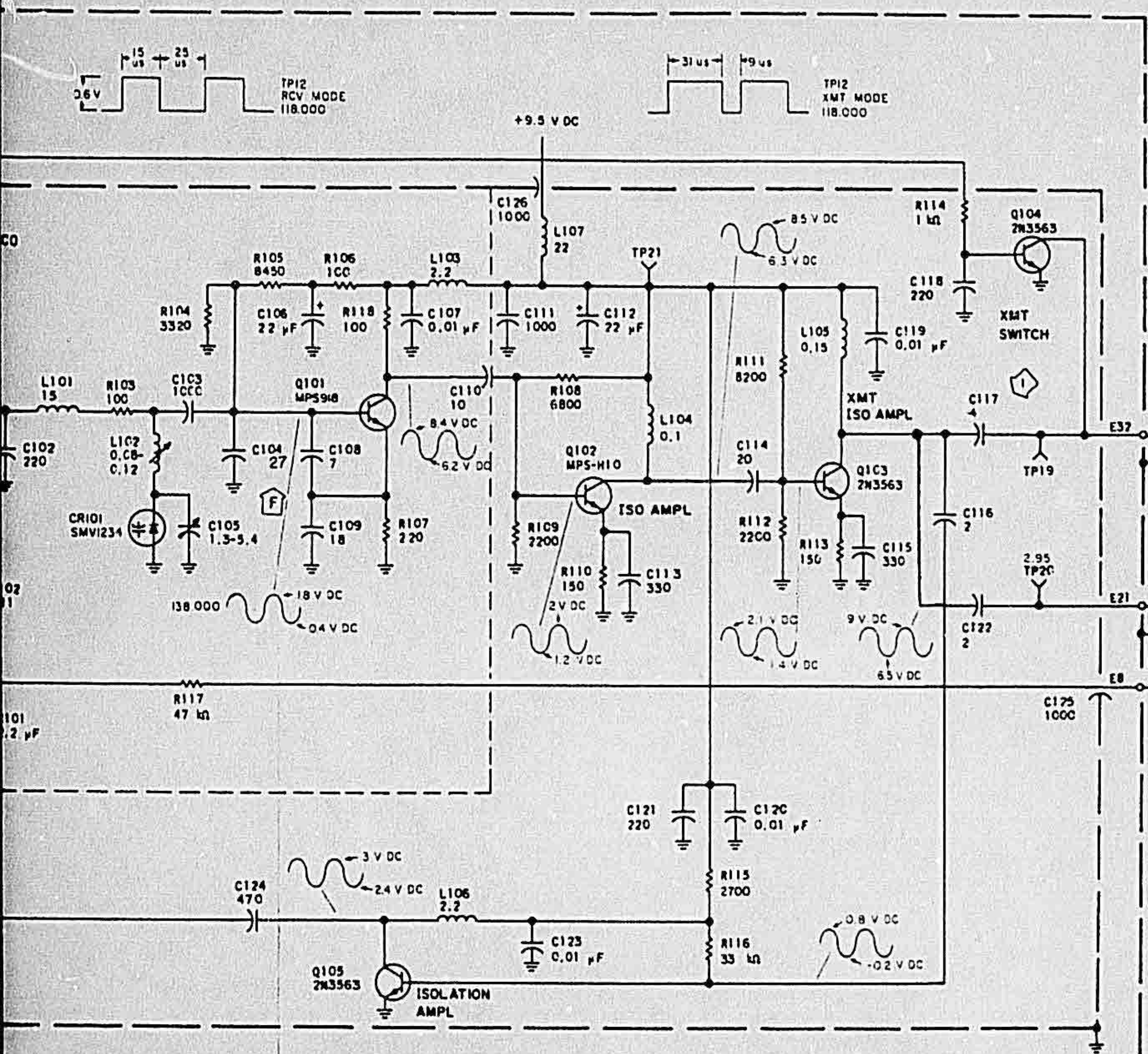
SYMBOL	DESCRIPTION	PART NUMBER
L4- L100	NOT USED	
L101	COIL, 15μH	240-2742-130
L102	COIL, VARIABLE, 0.08-0.12μH	278-0418-010
L103	COIL, 2.2μH	240-2742-040
L104	COIL, 0.1μH	240-2742-090
L105	COIL, 0.15μH (EFF REV F)	240-2742-100
L105	COIL, 0.18μH	240-2742-110
L106	COIL, 2.2μH	240-2742-040
L107	COIL, 22μH	240-2742-080
Q1	TRANSISTOR, MPS2369	352-5015-010
Q2	TRANSISTOR, MPS2369	352-5015-010
Q3- Q100	NOT USED	
Q101	TRANSISTOR, MPS918	352-5027-010
Q102	TRANSISTOR, MPS-H10	352-5031-010
Q103	TRANSISTOR, 2N3563	352-5020-010
Q104	TRANSISTOR, 2N3563	352-5020-010
Q105	TRANSISTOR, 2N3563	352-5020-010
R1	RESISTOR, FIXED, COMPOSITION, 100Ω, 10%, 1/4W	745-7950-130
R2	RESISTOR, FIXED, FILM, 634Ω, ±1%, 1/8W	745-7956-070
R3	RESISTOR, FIXED, FILM, 143Ω, ±1%, 1/8W	745-7955-440
R4	RESISTOR, FIXED, COMPOSITION, 1kΩ, 10%, 1/4W	745-7950-250
R5	RESISTOR, FIXED, FILM, 634Ω, ±1%, 1/8W	745-7956-070
R6	RESISTOR, FIXED, COMPOSITION, 1kΩ, 10%, 1/4W	745-7950-250
R7	RESISTOR, FIXED, COMPOSITION, 1kΩ, 10%, 1/4W	745-7950-250
R8	RESISTOR, FIXED, COMPOSITION, 33kΩ, 10%, 1/4W	745-7950-430
R9	RESISTOR, FIXED, COMPOSITION, 4700Ω, 10%, 1/4W	745-7950-330
R10	RESISTOR, FIXED, COMPOSITION, 10kΩ, 10%, 1/4W	745-7950-370
R11- R15	NOT USED	
R16	RESISTOR, FIXED, COMPOSITION, 200Ω, 10%, 1/4W	745-7950-170
R17- R100	NOT USED	
R101	RESISTOR, FIXED, FILM, 511Ω, ±1%, 1/8W	745-7955-970
R102	RESISTOR, FIXED, FILM, 511Ω, ±1%, 1/8W	745-7955-970
R103	RESISTOR, FIXED, FILM, 100Ω, ±1%, 1/8W	745-7955-290
R104	RESISTOR, FIXED, FILM, 3320Ω, ±1%, 1/8W	745-7956-760
R105	RESISTOR, FIXED, FILM, 8200Ω, ±1%, 1/8W	745-7957-160
R106	RESISTOR, FIXED, COMPOSITION, 100Ω, 10%, 1/4W	745-7950-130
R107	RESISTOR, FIXED, COMPOSITION, 200Ω, 10%, 1/4W	745-7950-170
R108	RESISTOR, FIXED, COMPOSITION, 6800Ω, 10%, 1/4W	745-7950-350
R109	RESISTOR, FIXED, COMPOSITION, 2200Ω, 10%, 1/4W	745-7950-290
R110	RESISTOR, FIXED, COMPOSITION, 150Ω, 10%, 1/4W	745-7950-150
R111	RESISTOR, FIXED, COMPOSITION, 8200Ω, 10%, 1/4W	745-7950-360
R112	RESISTOR, FIXED, COMPOSITION, 2200Ω, 10%, 1/4W	745-7950-290
R113	RESISTOR, FIXED, COMPOSITION, 150Ω, 10%, 1/4W	745-7950-150

PARTS LIST
A4-SYNTHESIZER
PART NUMBER 628-5069-001, -003

SYMBOL	DESCRIPTION	PART NUMBER
R114	RESISTOR, FIXED, COMPOSITION, 1kΩ, 10%, 1/4W	745-7950-250
R115	RESISTOR, FIXED, 2700Ω, ±10%, 1/4W	745-7950-300
R116	RESISTOR, FIXED, COMPOSITION, 33kΩ, 10%, 1/4W	745-7950-430
R117	RESISTOR, FIXED, COMPOSITION, 47kΩ, 10%, 1/4W	745-7950-450
R118	RESISTOR, FIXED, COMPOSITION, 100Ω, 10%, 1/4W	745-7950-130
U1	IC, QUAD 2 INPUT NAND GATE, 74LS00	351-1709-010
U2	IC, 4-BIT BINARY COUNTER, 74LS93	351-1711-060
U3	IC, DECADE COUNTER, 74LS90	351-1711-050
U4	IC, FLIP FLOP, 7474	351-1550-020
U5	IC, QUAD 2 INPUT NAND GATE, 7400 (EFF REF G)	351-1548-020
U5	IC, QUAD 2 INPUT NAND GATE, 47LS00	351-1709-010
U6	IC, TRIPLE 3 INPUT NOR GATE, 74LS27	351-1709-030
U7	IC, 4-BIT BINARY COUNTER, 74LS191	351-1711-020
U8	IC, BCD COUNTER, 74LS190	351-1711-010
U9	IC, QUAD 2 INPUT NAND GATE, 74LS00	351-1709-010
U10	IC, FLIP FLOP, 74LS74	351-1710-020
U11	IC, MONOLITHIC COUNTER CONTROL, 12014	351-7829-010
U12	IC, 4-BIT BINARY COUNTER, 74LS191	351-1711-020
U13	IC, FLIP FLOP, 74LS74	351-1710-020
U14	IC, QUAD 2 INPUT NAND GATE, 74LS00	351-1709-010
U15	IC, ECL HIGH SPEED PRESCALER, 11C90DC	351-1249-010
Y1	CRYSTAL, 4MHz (VHF-251/251S ONLY)	289-7224-010
Y1	CRYSTAL, 4MHz (VHF-251E ONLY)	289-7224-040


SYNTHESIZER A4
+5.2 V DC
+13.75 V RCV/ XMT GND
-9.5 V DC
RCV SWITCH
RCV OFFSET
XMT LOCKUP
CRYSTAL OSCILLATOR
Y1 4.0 MHz
FIXED ÷16
FIXED ÷10
2 MHz
125 KHz
250 KHz
25 KHz
FREQ/PHASE DISCRIMINATOR
LOW PASS FILTER
DRIVER
VCO
VARIABLE RATIO DIVIDER
U11 MC12014
U15 11C90DC
PRESCALER ÷10 OR 11
10 MHz 1 LOGIC 0
10 MHz 2 LOGIC 1
1 MHz 1 LOGIC 1
1 MHz 2 LOGIC 1
1 MHz 4 LOGIC 1
1 MHz 8 LOGIC 0
0.1 MHz 1 LOGIC 0
0.1 MHz 2 LOGIC 1
0.1 MHz 4 LOGIC 1
0.1 MHz 8 LOGIC 0
25 kHz 2 LOGIC 0
25 kHz 1 LOGIC 0
138.000 MHz
NOTES:
1 UNLESS OTHERWISE SPECIFIED; RESISTANC ARE IN PICOFARADS, AND INDUCTANCE VAL
2 SYMBOL REPRESENTS ELEVEN 0.01 µF CA
3 MICROCIRCUIT POWER AND GROUND PINS;
U1, U4, U5, U6, U9, U10, U13, U14 14
U2, U3 5
U7, U8, U11, U12 16
U15 4 AND
4 VOLTAGES ARE TAKEN WITH TRANSCEIVER TU UNLESS OTHERWISE SPECIFIED. ALL MEASU SCOPE WITH 12.5pF, 10 M OHM PROBE. TP12 ARE TYPICAL.

Pg 6-93



UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.

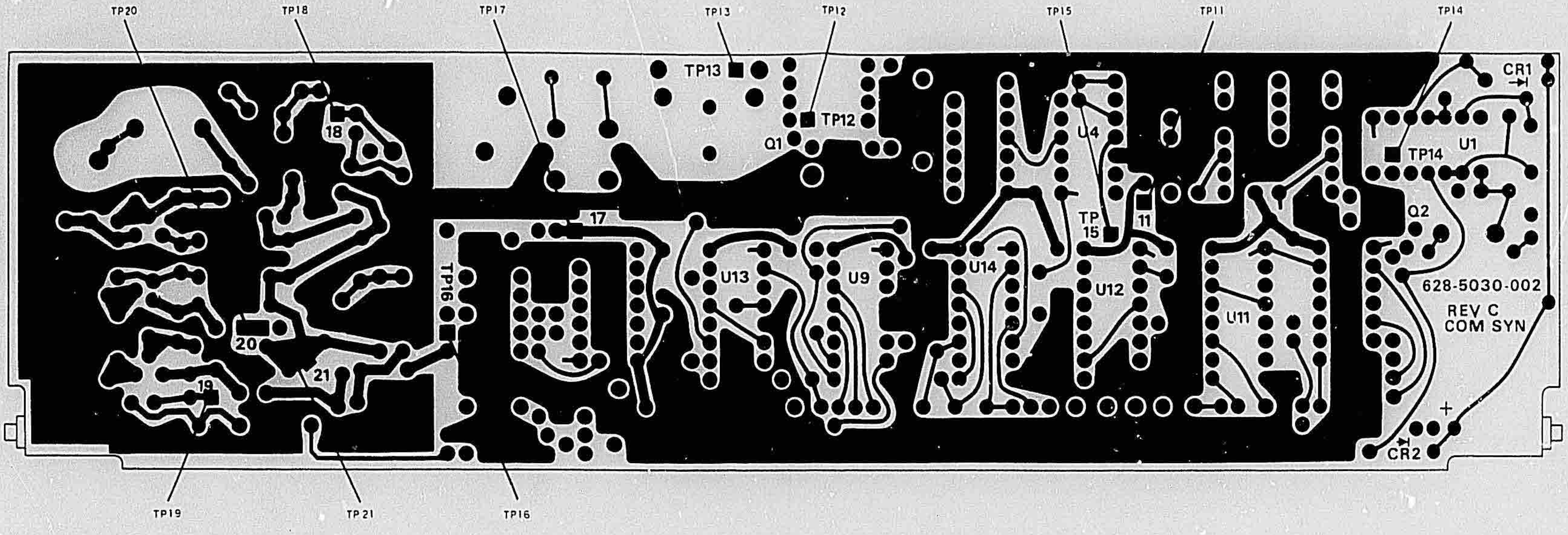
SYMBOL REPRESENTS ELEVEN 0.01 μF CAPACITORS CONNECTED BETWEEN +5.2 V DC AND GROUND.

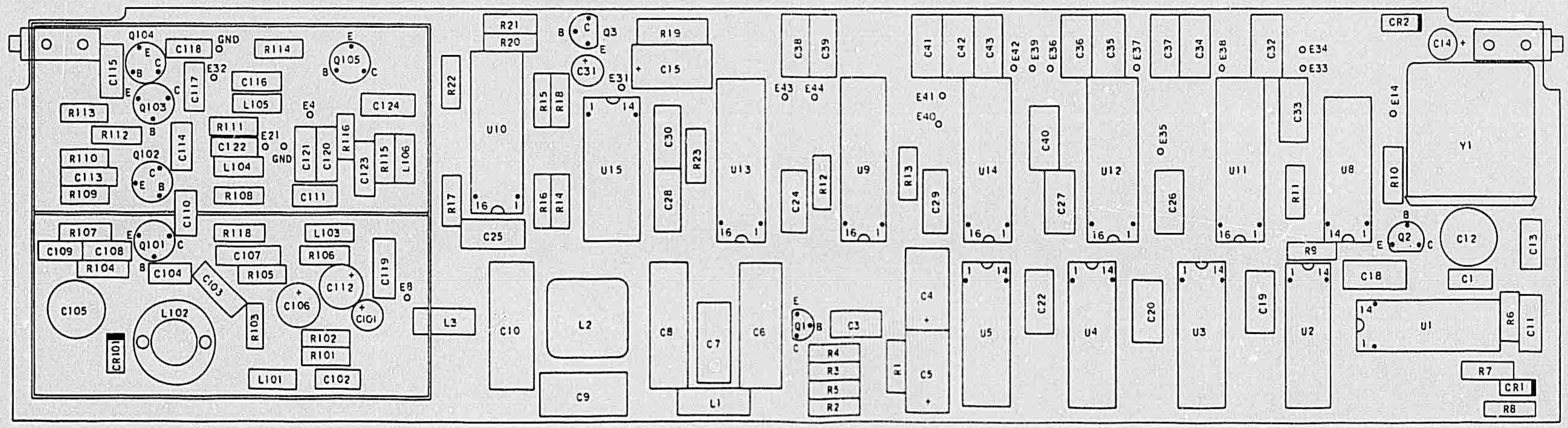
MICROCIRCUIT POWER AND GROUND PINS;

	+5.2 V DC	GROUND
U1, U4, U5, U6, U9, U10, U13, U14	14	7
U2, U3	5	10
U7, U8, U11, U12	16	8
U15	4 AND 5	12

VOLTAGES ARE TAKEN WITH TRANSCEIVER TUNED TO 127.600 MHz UNLESS OTHERWISE SPECIFIED. ALL MEASUREMENTS MADE USING SCOPE WITH 12.5 pF, 10 M OHM PROBE. TP12 AND TP13 WAVEFORMS ARE TYPICAL.

Synthesizer A4, Schematic Diagram, Board No. 628-5030-003
Figure 6-29





Synthesizer A4, Component Location Diagram,
Board No. 628-5030-002
Figure 6-30

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
1	Changed wire terminology to provide a complete description of wire functions.	NA	NA
2	Changed value of R104 from 3300 to 3320 Ω, R105 from 8200 to 8450 Ω, and type number of Q101 from 2N3563 to MPS918 to reduce vco noise.	NA	REV B
	Changed C104 from 22 to 27 pF to improve synthesizer tracking.	NA	REV D

Synthesizer A4, Schematic Diagram, Board No 628-5030-002
Figure 6-31 (Sheet A)

PARTS LIST
VHF-251/251S/251E
A4-SYNTHESIZER (PART NUMBER 628-5029-001)

SYMBOL	DESCRIPTION	PART NUMBER
C1	CAPACITOR, FIXED, MICA, DIELECTRIC, 15PF, ±5%, 50V MIN	912-2099-110
C2	CAPACITOR, FIXED, MICA, DIELECTRIC, 15PF, ±5%, 50V MIN	912-2099-110
C3	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C4	CAPACITOR, FIXED, TANTALUM, 68UF, ±20%, 15V	184-9113-130
C5	CAPACITOR, FIXED, TANTALUM, 68UF, ±20%, 15V	184-9113-130
C6	CAPACITOR, FIXED, POLYESTER, DIELECTRIC, 0.027UF, ±10%, 100V MAX	933-1404-090
C7	CAPACITOR, FIXED, MICA, DIELECTRIC, 470PF, ±5%, 50V MIN	912-2099-470
C8	CAPACITOR, FIXED, POLYESTER, DIELECTRIC, 0.039UF, ±10%, 100V MAX	933-1404-100
C9	CAPACITOR, FIXED, MICA, DIELECTRIC, 820PF, ±5%, 50V MIN	912-2099-510
C10	CAPACITOR, FIXED, POLYESTER, DIELECTRIC, 0.033UF, ±10%, 100V MAX	933-1404-050
C11	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C12	CAPACITOR, VARIABLE, CERAMIC, DIELECTRIC, 3-5PF, 200V	917-0006-020
C13	CAPACITOR, FIXED, MICA, DIELECTRIC, 91PF, ±5%, 50V MIN	912-2099-280
C14	CAPACITOR, FIXED, TANTALUM, 4.7UF, ±20%, 10V	184-9113-050
C15	CAPACITOR, FIXED, TANTALUM, 100UF, ±20%, 10V	184-9113-140
C16	NOT USED	
C17	NOT USED	
C18	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C19	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C20	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C21	NOT USED	
C22	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C23	NOT USED	
C24	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C25	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C26	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C27	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C28	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130

PARTS LIST
VHF-251/251S/251E
A4-SYNTHESIZER (PART NUMBER 628-5029-001)

SYMBOL	DESCRIPTION	PART NUMBER
C29	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01 UF, +80-20%, 50V	913-3298-130
C30	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C31	CAPACITOR, FIXED, TANTALUM, 1UF, ±20%, 20V	184-9113-030
C32	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C33	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C34	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C35	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C36	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C37	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C38	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C39	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C40	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C41	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C42	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C43	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C44-C100	NOT USED	
C101	CAPACITOR, FIXED, TANTALUM, 2.2UF, ±20%, 15V	184-9113-200
C102	CAPACITOR, FIXED, MICA, DIELECTRIC, 220PF, ±5%, 50V	912-2099-380
C103	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000PF, +80-20%, 500V	913-3298-110
C104	CAPACITOR, FIXED, CERAMIC, 27PF, 10%, 100V (EFF REV D)	913-1098-570
C104	CAPACITOR, FIXED, MICA, DIELECTRIC, 22PF, ±5%, 50V MIN	912-2099-140
C105	CAPACITOR, VARIABLE, AIR, DIELECTRIC, 1.3-5.4PF, 250V	922-1032-020
C106	CAPACITOR, FIXED, TANTALUM, 22UF, ±20%, 15V	184-9113-080
C107	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C108	CAPACITOR, FIXED, MICA, DIELECTRIC, 7PF, ±1/2PF, 50V MIN	912-2099-060
C109	CAPACITOR, FIXED, MICA, DIELECTRIC, 18PF, ±5%, 50V MIN	912-2099-120

PARTS LIST
VHF-251/251S/251E
A4-SYNTHESIZER (PART NUMBER 628-5029-001)

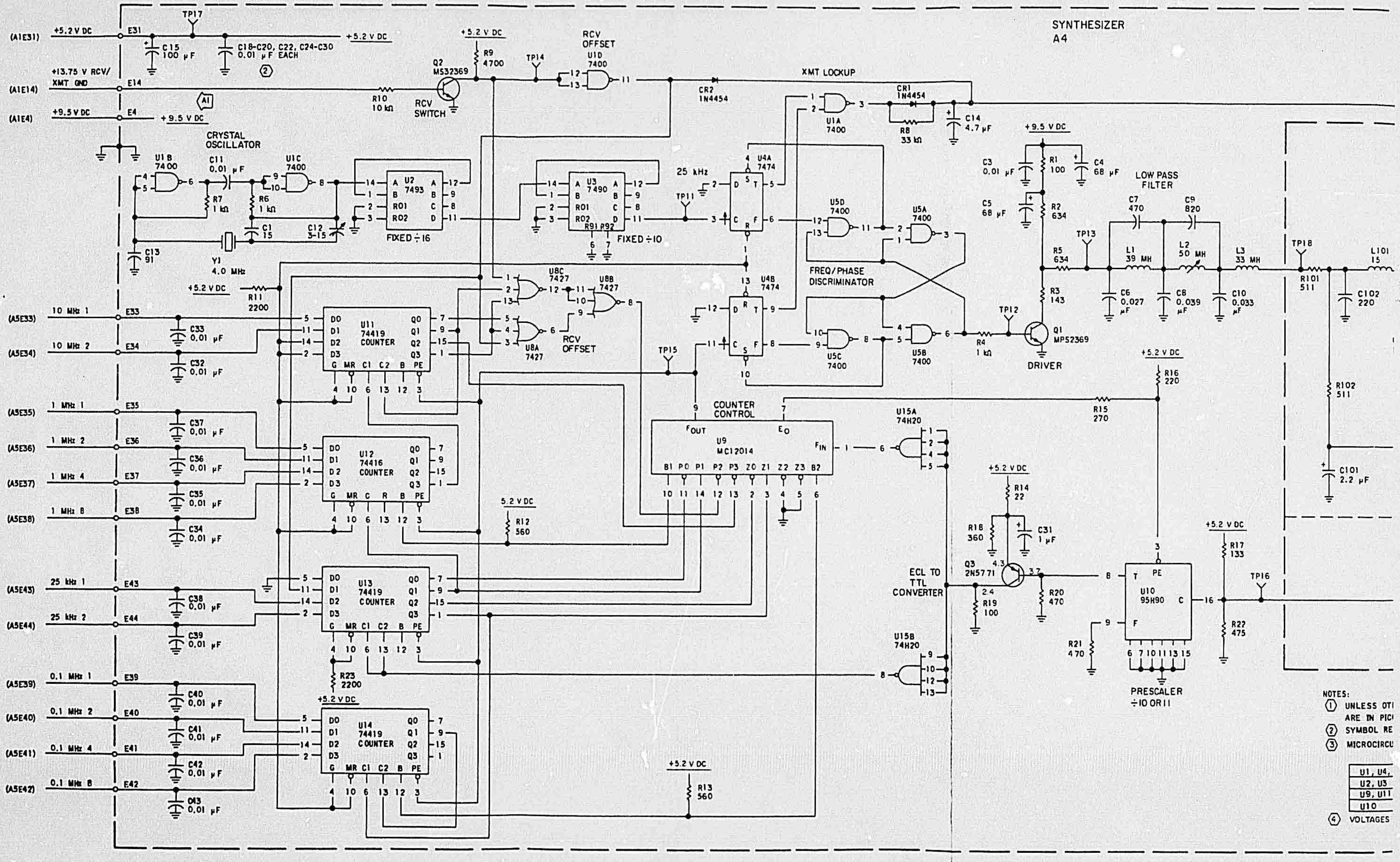
SYMBOL	DESCRIPTION	PART NUMBER
C110	CAPACITOR, FIXED, MICA, DIELECTRIC, 10PF, ±1/2PF, 50V MIN	912-2099-090
C111	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 1000PF, +80-20%, 500V	913-3298-110
C112	CAPACITOR, FIXED, TANTALUM, 22UF, ±20%, 15V	184-9113-080
C113	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C114	CAPACITOR, FIXED, MICA, DIELECTRIC, 5PF, ±1/2PF, 50V MIN	912-2099-040
C115	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 330PF, +80-20%, 1000V	913-3298-030
C116	CAPACITOR, FIXED, MICA, DIELECTRIC, 2PF, ±1/2PF, 50V MIN	912-2099-010
C117	CAPACITOR, FIXED, MICA, DIELECTRIC, 6PF, ±1/2PF, 50V MIN	912-2099-050
C118	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
C119	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C120	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C121	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 220PF, +80-20%, 250V	913-3298-090
C122	CAPACITOR, FIXED, MICA, DIELECTRIC, 10PF, ±1/2PF, 50V MIN	912-2099-090
C123	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01UF, +80-20%, 50V	913-3298-130
C124	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 470PF, +80-20%, 500V	913-3298-100
C125	CAPACITOR, FEEDTHROUGH, 1000PF, +100-20%, 50V	913-3303-010
C126	CAPACITOR, FEEDTHROUGH, 1000PF, +100-20%, 50V	913-3303-010
CR1	DIODE, 1N4454	353-3741-010
CR2	DIODE, 1N4454	353-3741-010
CR3-CR100	NOT USED	
CR101	VARACTOR	922-6131-020
L1	COIL, 39MH	240-2741-020
L2	COIL, 50MH	278-0417-020
L3	COIL, 33MH	240-2741-010
L4-L100	NOT USED	
L101	COIL, 15UH	240-2742-130
L102	COIL, VARIABLE, 0.08-0.12UH	278-0418-010
L103	COIL, 2.2UH	240-2742-040
L104	COIL, 0.1UH	240-2742-090
L105	COIL, 0.18UH	240-2742-110
L106	COIL, 2.2UH	240-2742-040

PARTS LIST
VHF-251/251S/251E
A4-SYNTHESIZER (PART NUMBER 628-5029-001)

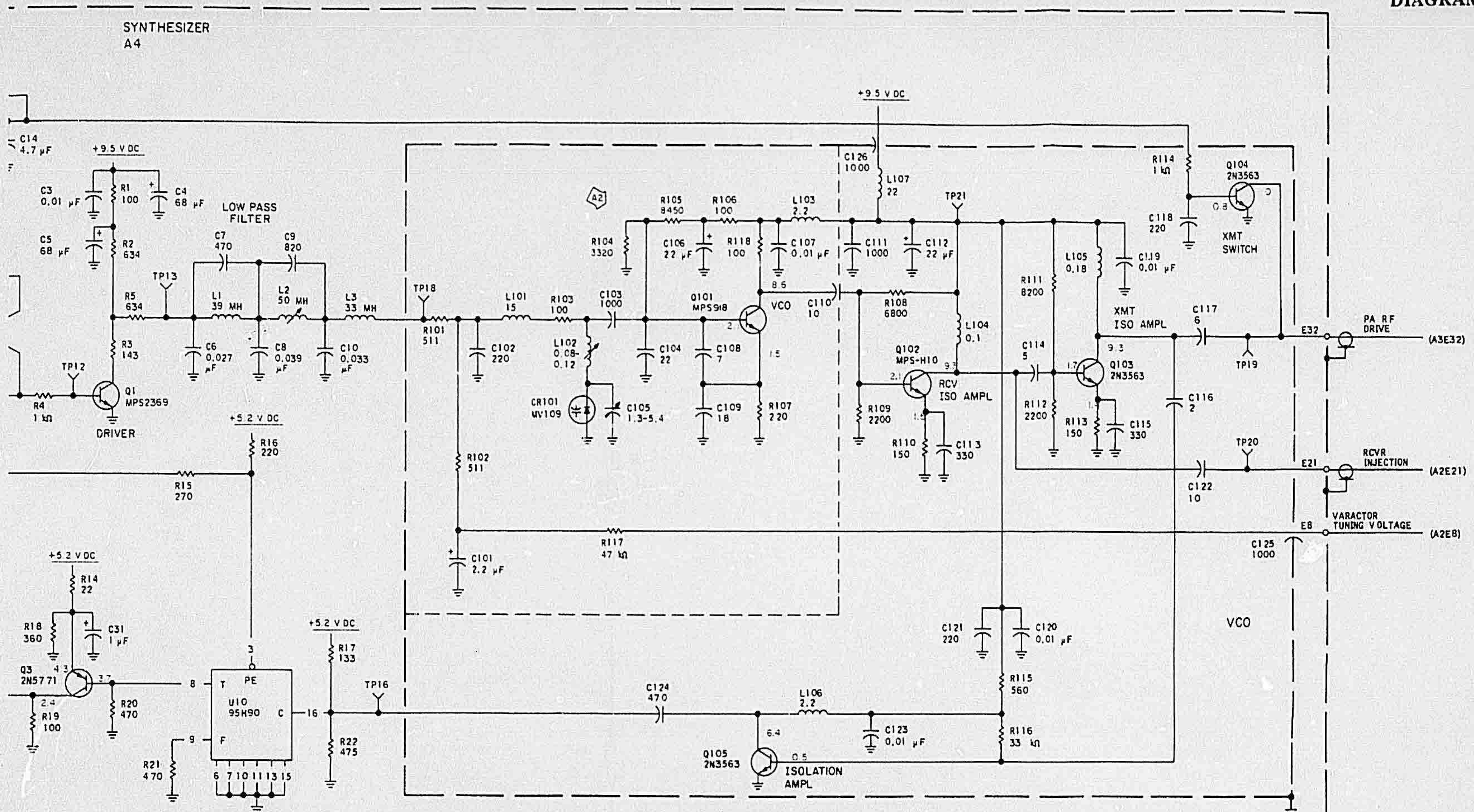
SYMBOL	DESCRIPTION	PART NUMBER
L107	COIL, 22UH	240-2742-080
Q1	TRANSISTOR, MPS2369	352-5015-010
Q2	TRANSISTOR, MPS2369	352-5015-010
Q3	TRANSISTOR, 2N5771	352-5017-010
Q4-Q100	NOT USED	
Q101	TRANSISTOR, MPS 918	352-5027-010
Q101	TRANSISTOR, 2N3563	352-5020-010
Q102	TRANSISTOR, MPS-H10	352-5031-010
Q103	TRANSISTOR, 2N3563	352-5020-010
Q104	TRANSISTOR, 2N3563	352-5020-010
Q105	TRANSISTOR, 2N3563	352-5020-010
R1	RESISTOR, FIXED, COMPOSITION, 100 OHMS, 10%, 1/4W	745-7950-130
R2	RESISTOR, FIXED, FILM, 634 OHMS, ±1%, 1/8W	745-7956-070
R3	RESISTOR, FIXED, FILM, 143 OHMS, ±1%, 1/8W	745-7955-440
R4	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
R5	RESISTOR, FIXED, FILM, 634 OHMS, ±1%, 1/8W	745-7956-070
R6	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
R7	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
R8	RESISTOR, FIXED, COMPOSITION, 33K, 10%, 1/4W	745-7950-430
R9	RESISTOR, FIXED, COMPOSITION, 4700 OHMS, 10%, 1/4W	745-7950-330
R10	RESISTOR, FIXED, COMPOSITION, 10K, 10%, 1/4W	745-7950-370
R11	RESISTOR, FIXED, COMPOSITION, 2200 OHMS, 10%, 1/4W	745-7950-290
R12	RESISTOR, FIXED, COMPOSITION, 560 OHMS, 10%, 1/4W	745-7950-220
R13	RESISTOR, FIXED, COMPOSITION, 560 OHMS, 10%, 1/4W	745-7950-220
R14	RESISTOR, FIXED, COMPOSITION, 22 OHMS, 10%, 1/4W	745-7950-050
R15	RESISTOR, FIXED, COMPOSITION, 270 OHMS, 10%, 1/4W	745-7950-180
R16	RESISTOR, FIXED, COMPOSITION, 220 OHMS, 10%, 1/4W	745-7950-170
R17	RESISTOR, FIXED, FILM, 133 OHMS, ±1%, 1/8W	745-7955-410
R18	RESISTOR, FIXED, COMPOSITION, 360 OHMS, 10%, 1/4W	745-7950-640
R19	RESISTOR, FIXED, COMPOSITION, 100 OHMS, 10%, 1/2W	745-7951-130
R20	RESISTOR, FIXED, COMPOSITION, 470 OHMS, 10%, 1/4W	745-7950-210
R21	RESISTOR, FIXED, COMPOSITION, 470 OHMS, 10%, 1/4W	745-7950-210
R22	RESISTOR, FIXED, FILM, 475 OHMS, ±1%, 1/8W	745-7955-940
R23	RESISTOR, FIXED, COMPOSITION, 2200 OHMS, 10%, 1/4W	745-7950-290
R24-R100	NOT USED	
R101	RESISTOR, FIXED, FILM, 511 OHMS, ±1%, 1/8W	745-7955-970
R102	RESISTOR, FIXED, FILM, 511 OHMS, ±1%, 1/8W	745-7955-970
R103	RESISTOR, FIXED, FILM, 100 OHMS, ±1%, 1/8W	745-7955-290
R104	RESISTOR, FIXED, FILM, 3320 OHMS, 1%, 1/8W (EFF REV B)	745-7956-760
R104	RESISTOR, FIXED, COMPOSITION, 3300 OHMS, 10%, 1/4W	745-7950-310
R105	RESISTOR, FIXED, FILM, 8450 OHMS, 1%, 1/8W (EFF REV B)	745-7957-160
R105	RESISTOR, FIXED, COMPOSITION, 8200 OHMS, 10%, 1/4W	745-7950-360

PARTS LIST
VHF-251/251S/251E
A4-SYNTHESIZER (PART NUMBER 628-5029-001)

SYMBOL	DESCRIPTION	PART NUMBER
R106	RESISTOR, FIXED, COMPOSITION, 100 OHMS, 10%, 1/4W	745-7950-130
R107	RESISTOR, FIXED, COMPOSITION, 220 OHMS, 10%, 1/4W	745-7950-170
R108	RESISTOR, FIXED, COMPOSITION, 6800 OHMS, 10%, 1/4W	745-7950-350
R109	RESISTOR, FIXED, COMPOSITION, 2200 OHMS, 10%, 1/4W	745-7950-290
R110	RESISTOR, FIXED, COMPOSITION, 150 OHMS, 10%, 1/4W	745-7950-150
R111	RESISTOR, FIXED, COMPOSITION, 8200 OHMS, 10%, 1/4W	745-7950-360
R112	RESISTOR, FIXED, COMPOSITION, 2200 OHMS, 10%, 1/4W	745-7950-290
R113	RESISTOR, FIXED, COMPOSITION, 150 OHMS, 10%, 1/4W	745-7950-150
R114	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4W	745-7950-250
R115	RESISTOR, FIXED, COMPOSITION, 560 OHMS, 10%, 1/4W	745-7950-220
R116	RESISTOR, FIXED, COMPOSITION, 33K, 10%, 1/4W	745-7950-430
R117	RESISTOR, FIXED, COMPOSITION, 47K, 10%, 1/4W	745-7950-450
R118	RESISTOR, FIXED, COMPOSITION, 100 OHMS, 10%, 1/4W	745-7950-130
U1	INTEGRATED CIRCUIT, 7400	351-1548-020
U2	INTEGRATED CIRCUIT, 7493	351-1552-020
U3	INTEGRATED CIRCUIT, 7490	351-1552-010
U4	INTEGRATED CIRCUIT, 7474	351-1550-020
U5	INTEGRATED CIRCUIT, 7400	351-1548-020
U6	NOT USED	
U7	NOT USED	
U8	INTEGRATED CIRCUIT, 7427	351-1548-050
U9	INTEGRATED CIRCUIT, MC12014	351-7829-010
U10	INTEGRATED CIRCUIT, 95H90	351-1549-010
U11	INTEGRATED CIRCUIT, 74419	351-7830-020
U12	INTEGRATED CIRCUIT, 74416	351-7830-010
U13	INTEGRATED CIRCUIT, 74419	351-7830-020
U14	INTEGRATED CIRCUIT, 74419	351-7830-020
U15	INTEGRATED CIRCUIT, 74H20	351-1548-010
Y1	CRYSTAL, 4MHZ	289-7224-010



page 6-103/6-104



NOTES:

1. UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.
2. SYMBOL REPRESENTS ELEVEN 0.01 µF CAPACITORS CONNECTED BETWEEN +5.2 V DC AND GROUND.
3. MICROCIRCUIT POWER AND GROUND PINS:

	+5.2 V DC	GROUND
U1, U4, U5, U8, U15	14	7
U2, U3	5	10
U9, U11, U12, U13, U14	16	8
U10	4 AND 5	12

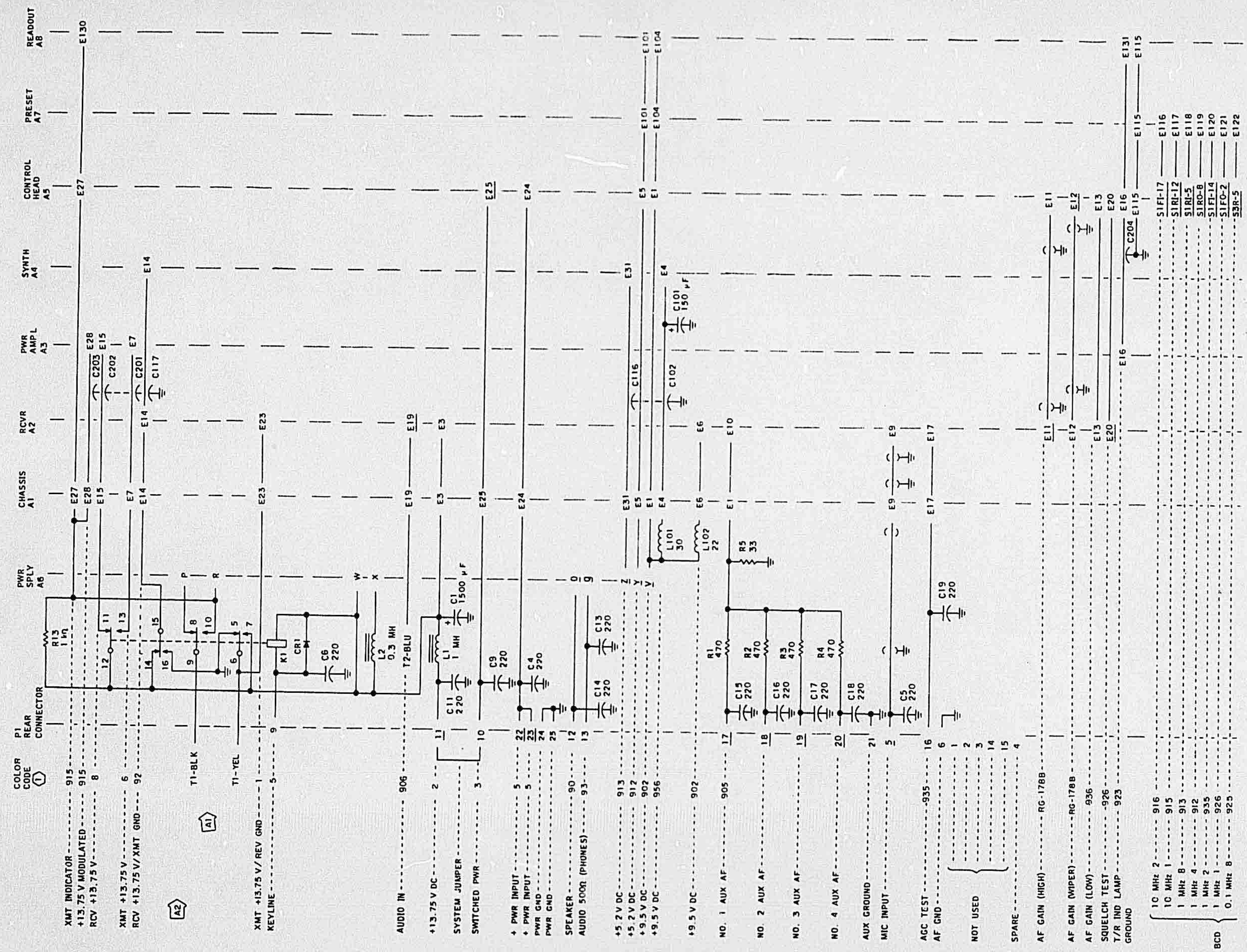
4. VOLTAGES TAKEN WITH TRANSCEIVER TUNED TO 127.600 MHz.

Synthesizer A4, Schematic Diagram, Board No. 628-5030-002
Figure 6-31

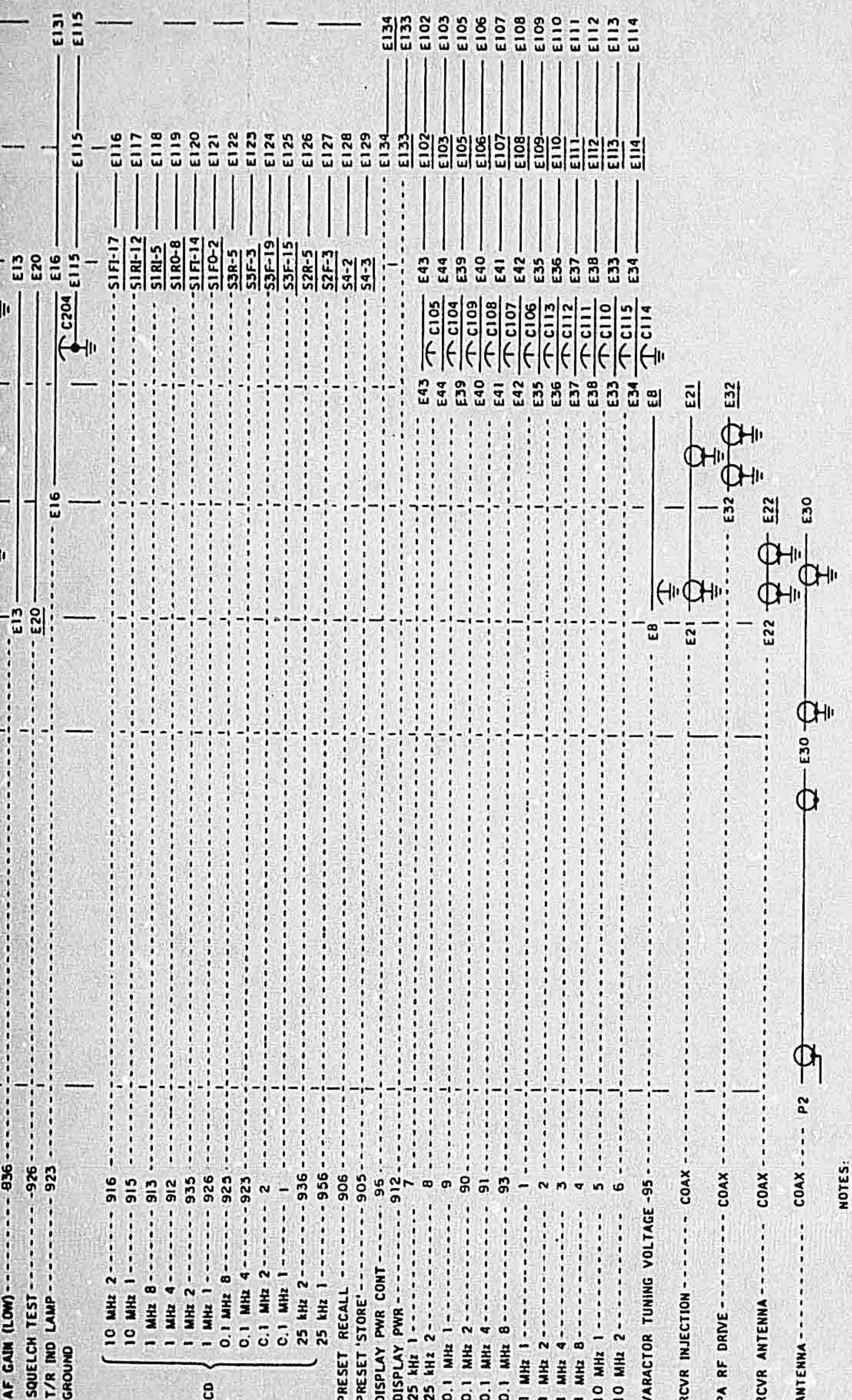
SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	Rewire relay A1K1 to prevent shorting +13.75 V dc to ground due to uncontrolled switching sequence of relay transfer.	SB 3	REV F
A2	Changed wire names to provide a more complete description of function.	NA	NA
A3	Added note 5.	NA	NA
D	Added note 6 and changed feed-through capacitors from 913-3303-010 to 913-3303-040.	NA	Above sn 24590

VHF-251 Chassis Wiring Schematic
Figure 6-32 (Sheet A)



ALSO SEE THIS PAGE AS UPPER/MIDDLE/LOWER (NEXT)



NOTES:

1. NUMBERS IN THIS COLUMN INDICATE WIRE COLOR CODE.

   0 = BLACK 5 = GREEN
   1 = BROWN 6 = BLUE
   2 = RED 7 = VIOLET
   3 = ORANGE 8 = GRAY
   4 = YELLOW 9 = WHITE

   EXAMPLE: 913 = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

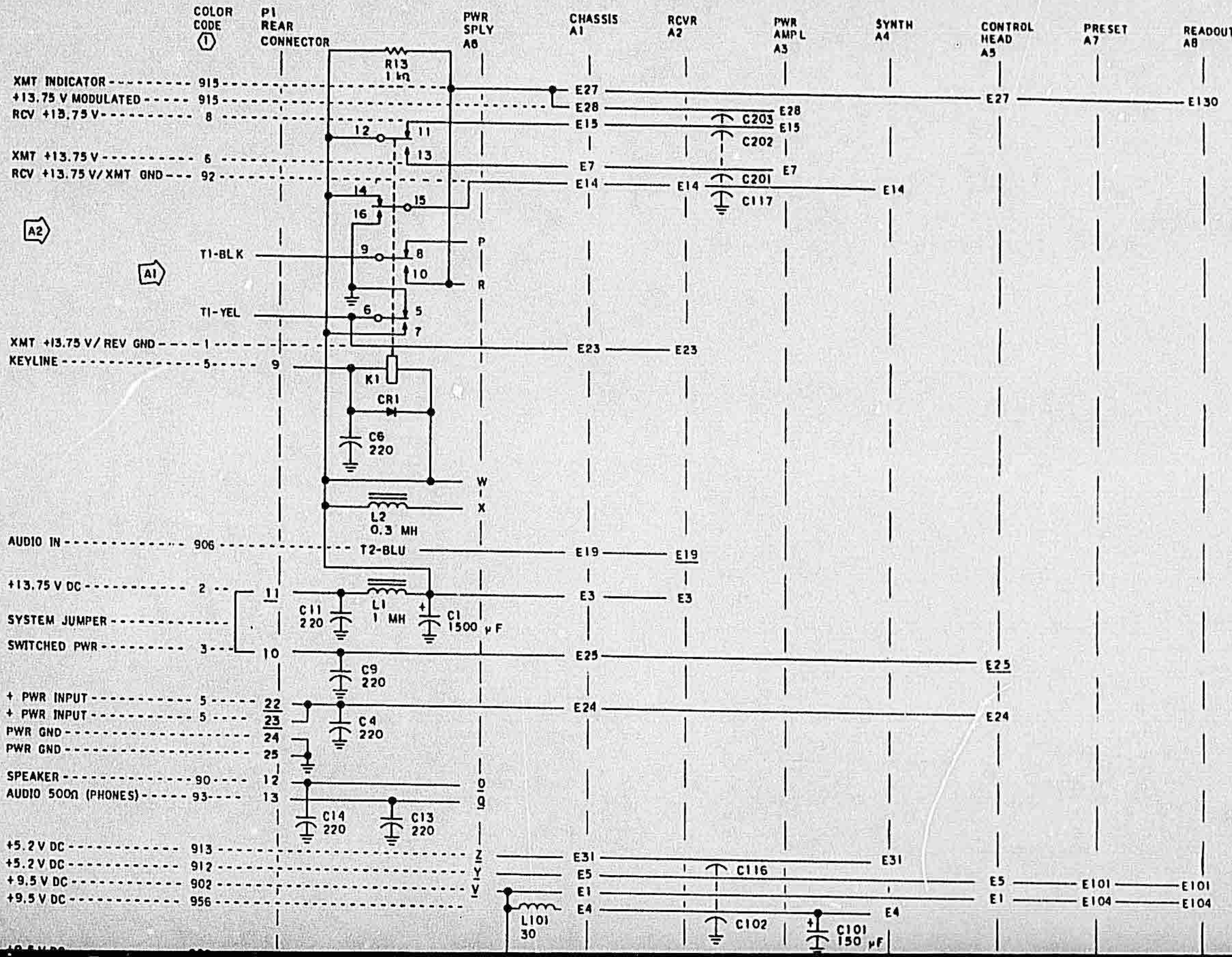
2. UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.

3. UNLESS OTHERWISE SPECIFIED; ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.

4. UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.

5. FEED-THRU CAPACITORS ARE 1000 pF, 50 V DC (COLLINS PART NUMBER 913-3303-010)

VHF-251 Chassis Wiring Schematic
Figure 6-32



UPPER

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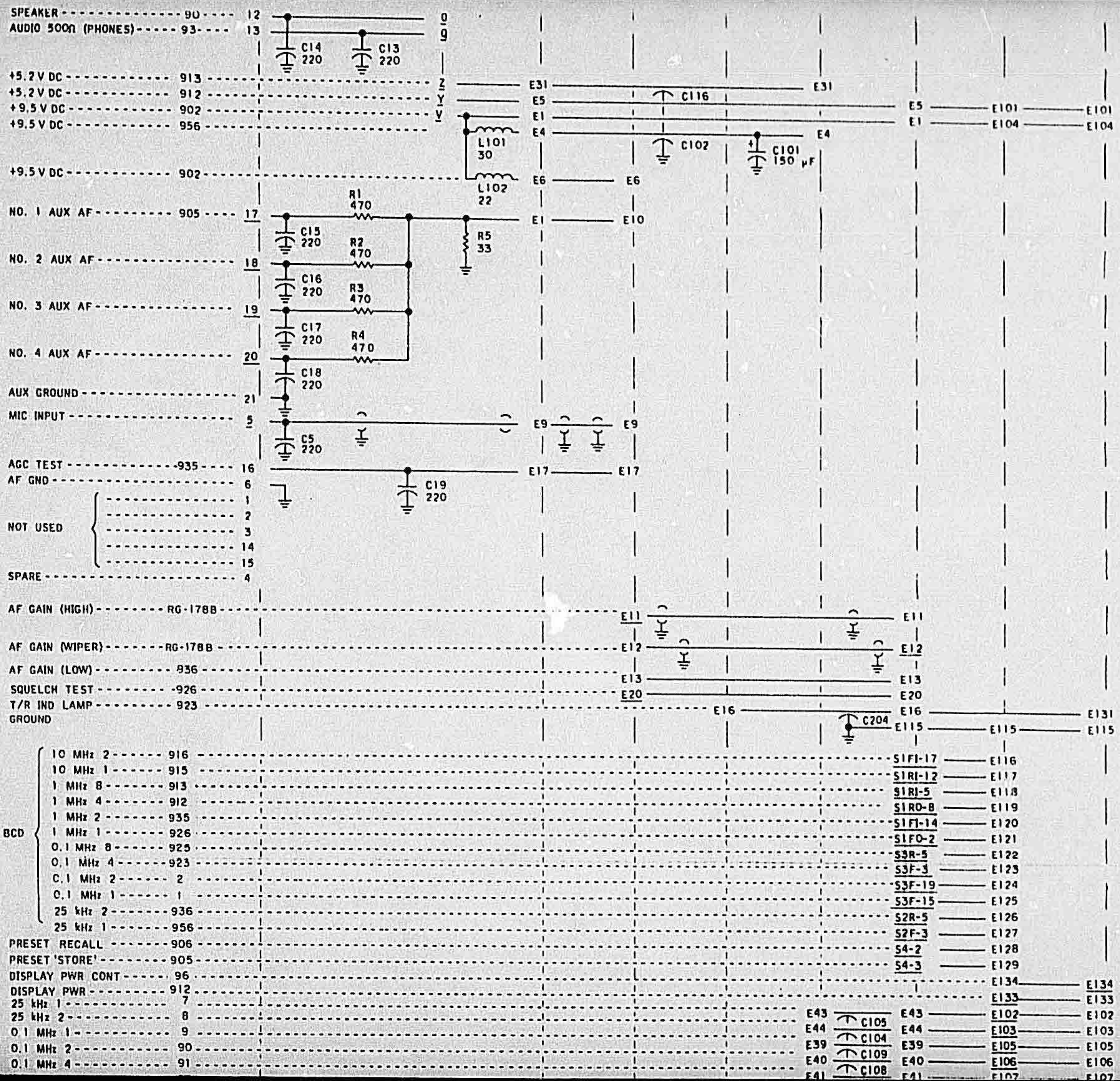
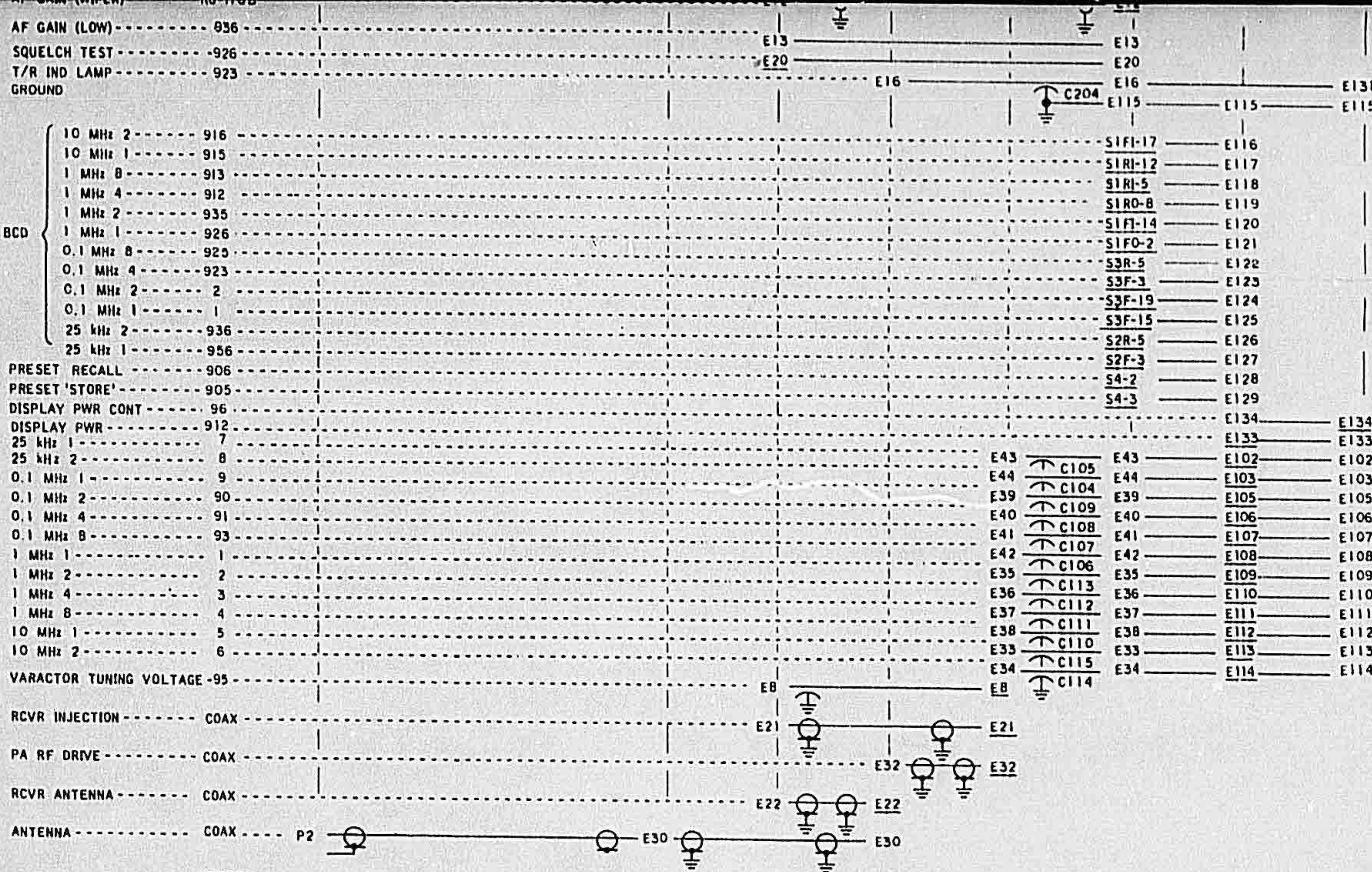

SPEAKER 90 12
AUDIO 500Ω (PHONES) 93 13
C14 220
C13 220
+5.2 V DC 913 Z
+5.2 V DC 912 Y
+9.5 V DC 902 V
+9.5 V DC 956
+9.5 V DC 902
E31
E5
E1
E4
E6
C116
C102
C101 150 μF
L101 30
L102 22
E101
E104
NO. 1 AUX AF 905 17
NO. 2 AUX AF 18
NO. 3 AUX AF 19
NO. 4 AUX AF 20
AUX GROUND 21
MIC INPUT 5
AGC TEST 935 16
AF GND 6
NOT USED 1 2 3 14 15
SPARE 4
R1 470
R2 470
R3 470
R4 470
R5 33
C15 220
C16 220
C17 220
C18 220
C5 220
C19 220
E10
E9
E17
AF GAIN (HIGH) RG-178B
AF GAIN (WIPER) RG-178B
AF GAIN (LOW) 936
SQUELCH TEST 926
T/R IND LAMP 923
GROUND
E11
E12
E13
E20
E16
E131
C204
E115
BCD
10 MHz 2 916
10 MHz 1 915
1 MHz 8 913
1 MHz 4 912
1 MHz 2 935
1 MHz 1 926
0.1 MHz 8 925
0.1 MHz 4 923
0.1 MHz 2 2
0.1 MHz 1 1
25 kHz 2 936
25 kHz 1 956
PRESET RECALL 906
PRESET 'STORE' 905
DISPLAY PWR CONT 96
DISPLAY PWR 912
25 kHz 1 7
25 kHz 2 8
0.1 MHz 1 9
0.1 MHz 2 90
0.1 MHz 4 91
S1F1-17 E116
S1R1-12 E117
S1R1-5 E118
S1R0-8 E119
S1F1-14 E120
S1F0-2 E121
S3R-5 E122
S3F-3 E123
S3F-19 E124
S3F-15 E125
S2R-5 E126
S2F-3 E127
S4-2 E128
S4-3 E129
E134
E133
E43 C105 E102
E44 C104 E103
E39 C109 E105
E40 C108 E106
E41 E107

MIDDLE



NOTES:

① NUMBERS IN THIS COLUMN INDICATE WIRE COLOR CODE.

0 = BLACK	5 = GREEN
1 = BROWN	6 = BLUE
2 = RED	7 = VIOLET
3 = ORANGE	8 = GRAY
4 = YELLOW	9 = WHITE

EXAMPLE: 913 = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

② UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.

③ UNLESS OTHERWISE SPECIFIED; ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.

④ UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.

⑤ FEED-THRU CAPACITORS ARE 1000 pF, 50 V DC (COLLINS PART NUMBER 913-3303-010)

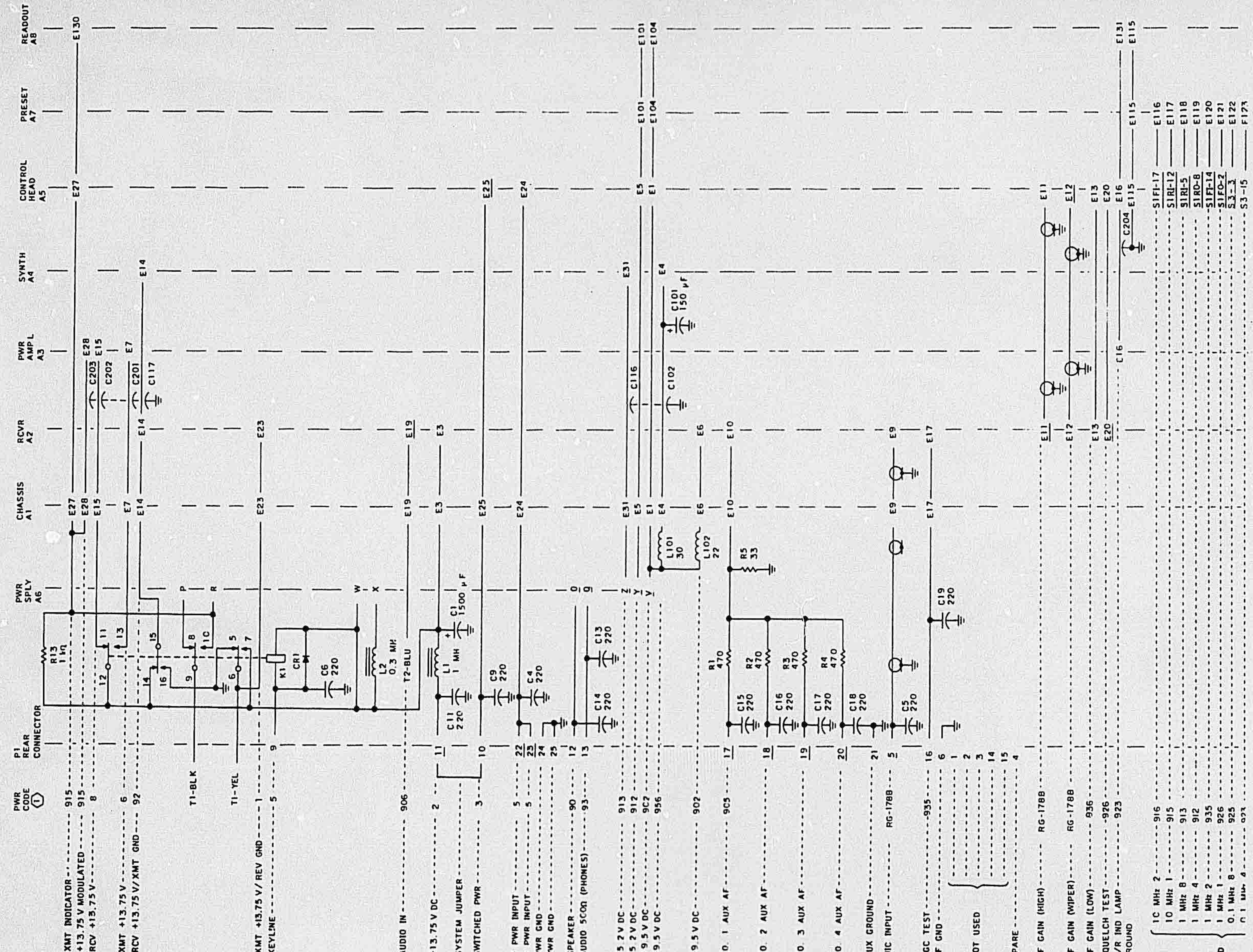
VHF-251 Chassis Wiring Schematic
Figure 6-32

LOWER

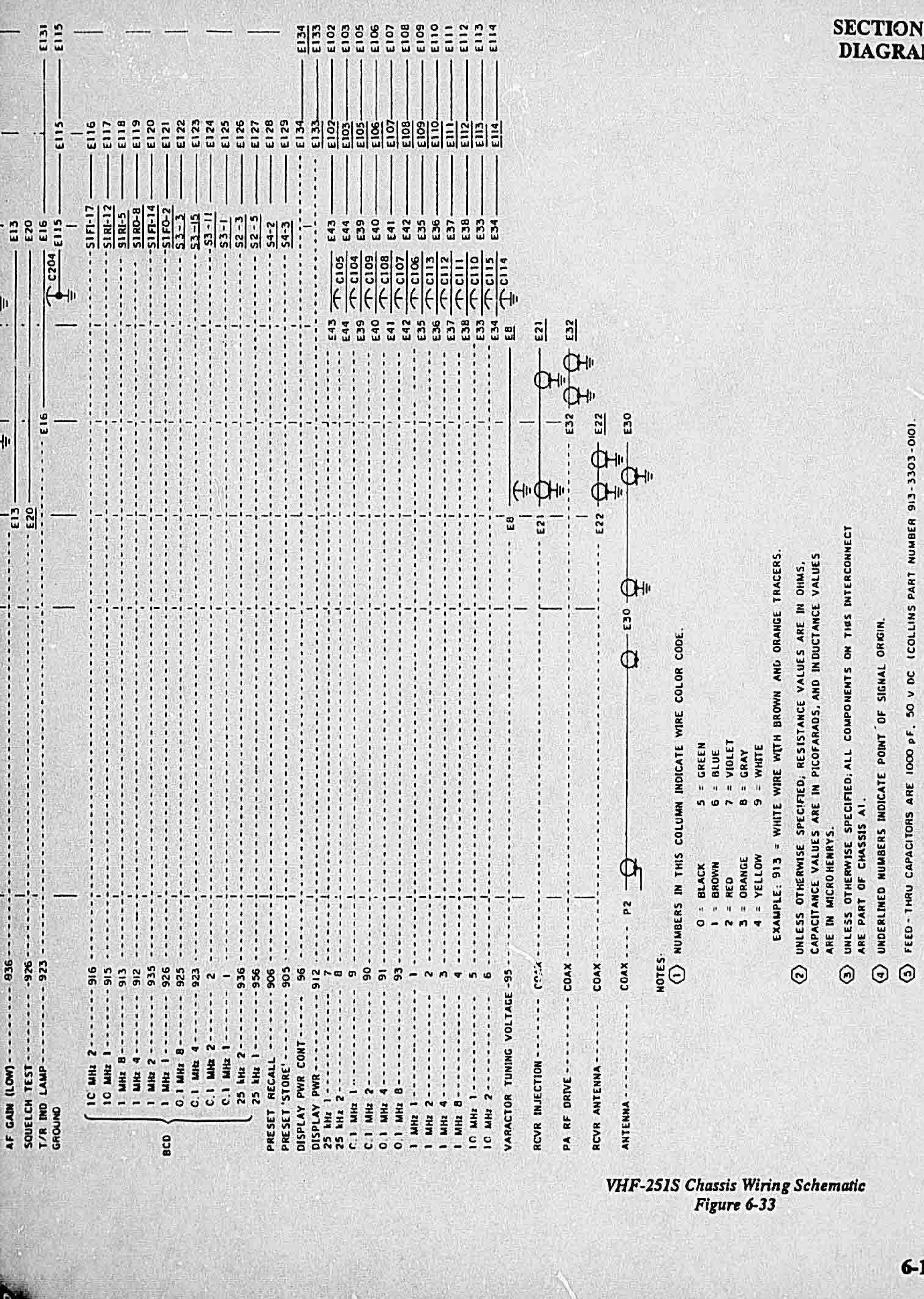
SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY

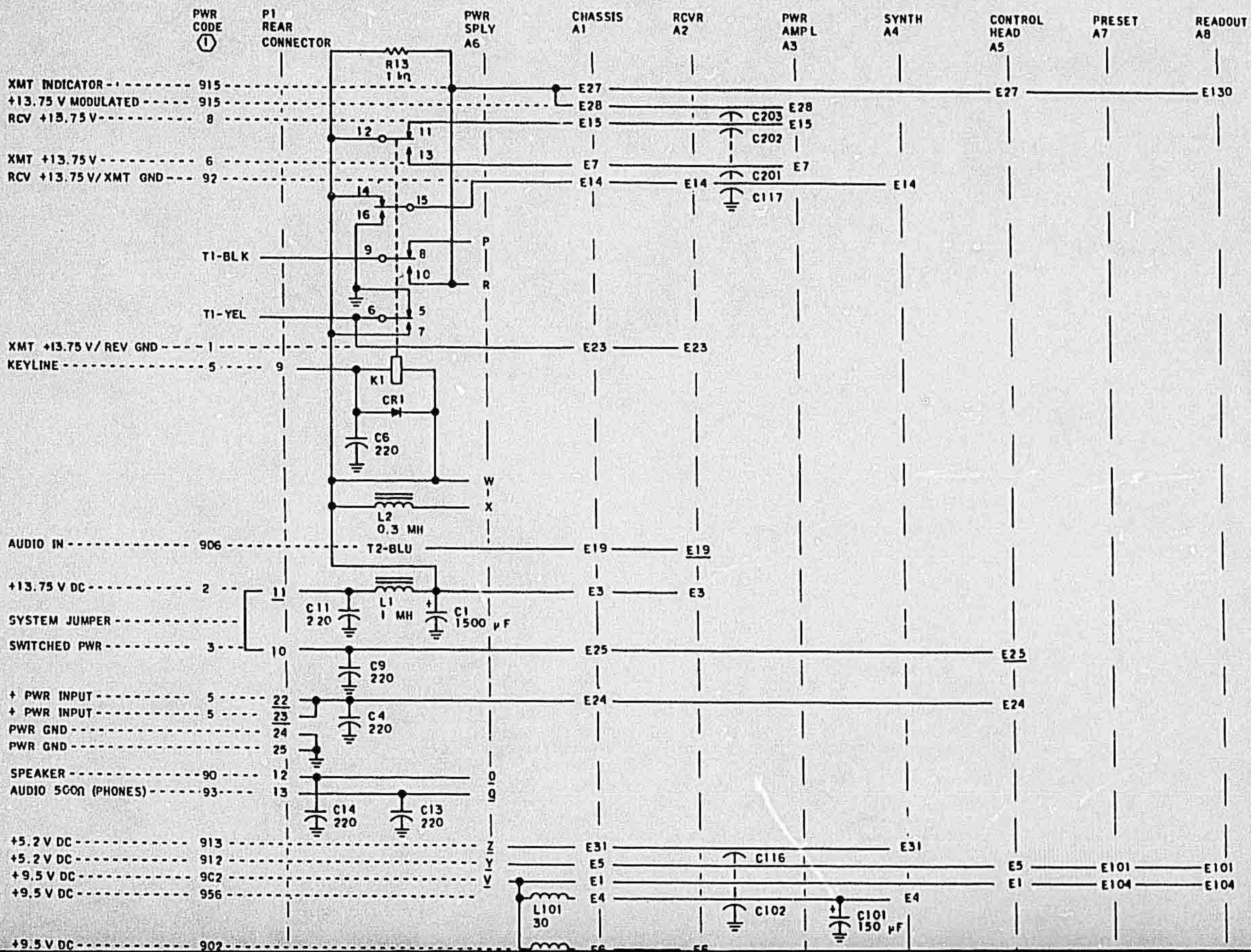
VHF-251S Chassis Wiring Schematic
Figure 6-33 (Sheet A)



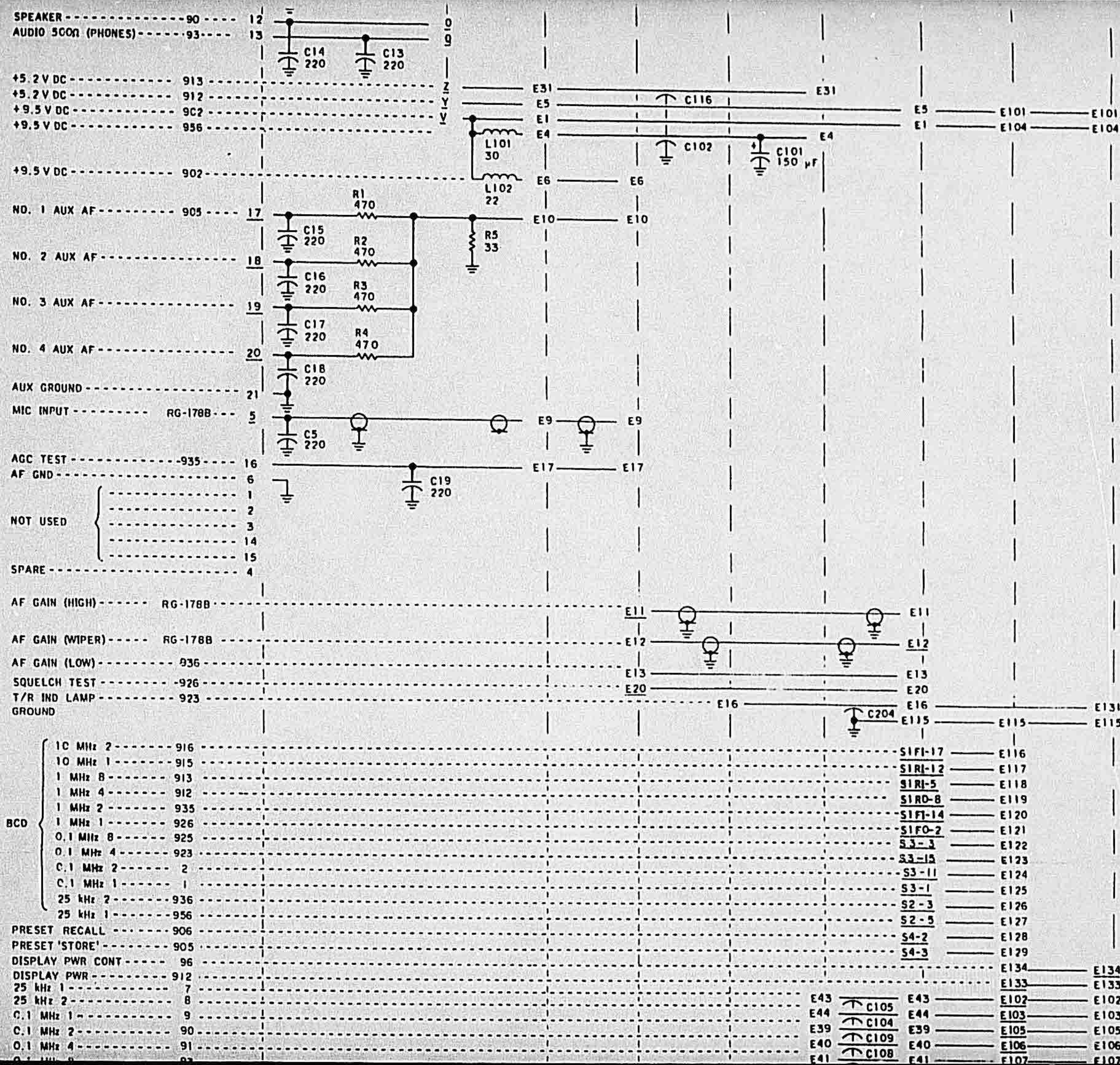
ALSO SEE THIS PAGE AS UPPER/MIDDLE/LOWER (NEXT)



VHF-251S Chassis Wiring Schematic
Figure 6-33


PWR CODE
1
P1 REAR CONNECTOR
PWR SPLY A6
CHASSIS A1
RCVR A2
PWR AMPL A3
SYNTH A4
CONTROL HEAD A5
PRESET A7
READOUT A8
R13 1 kΩ
XMT INDICATOR 915
+13.75 V MODULATED 915
RCV +13.75 V 8
XMT +13.75 V 6
RCV +13.75 V/XMT GND 92
T1-BLK
T1-YEL
XMT +13.75 V/REV GND 1
KEYLINE 5 9
K1
CR1
C6 220
L2 0.3 MH
AUDIO IN 906
T2-BLU
+13.75 V DC 2 11
SYSTEM JUMPER
SWITCHED PWR 3 10
C11 220
L1 1 MH
C1 1500 µF
C9 220
+ PWR INPUT 5 22
+ PWR INPUT 5 23
PWR GND 24
PWR GND 25
C4 220
SPEAKER 90 12
AUDIO 500Ω (PHONES) 93 13
C14 220
C13 220
+5.2 V DC 913
+5.2 V DC 912
+9.5 V DC 9C2
+9.5 V DC 956
+9.5 V DC 902
L101 30
C116
C102
C101 150 µF
E27 E28 E15 E7 E14 E23 E19 E3 E25 E24 E31 E5 E1 E4
C203 C202 C201 C117
E130 E101 E104
P R W X O Q Z Y V

UPPER


SPEAKER 90 12
AUDIO 500Ω (PHONES) 93 13
C14 220
C13 220
+5.2 V DC 913
+5.2 V DC 912
+9.5 V DC 902
+9.5 V DC 956
+9.5 V DC 902
Z
Y
V
E31
E5
E1
E4
E6
L101 30
L102 22
C116
C102
C101 150 µF
E101
E104
NO. 1 AUX AF 905 17
NO. 2 AUX AF 18
NO. 3 AUX AF 19
NO. 4 AUX AF 20
AUX GROUND 21
C15 220
C16 220
C17 220
C18 220
R1 470
R2 470
R3 470
R4 470
R5 33
E10
MIC INPUT RG-178B 5
C5 220
E9
AGC TEST 935 16
AF GND 6
C19 220
E17
NOT USED 1 2 3 14 15
SPARE 4
AF GAIN (HIGH) RG-178B
AF GAIN (WIPER) RG-178B
AF GAIN (LOW) 936
SQUELCH TEST 926
T/R IND LAMP 923
GROUND
E11
E12
E13
E20
E16
C204
E115
E131
BCD
10 MHz 2 916
10 MHz 1 915
1 MHz 8 913
1 MHz 4 912
1 MHz 2 935
1 MHz 1 926
0.1 MHz 8 925
0.1 MHz 4 923
0.1 MHz 2 2
0.1 MHz 1 1
25 kHz 2 936
25 kHz 1 956
PRESET RECALL 906
PRESET 'STORE' 905
DISPLAY PWR CONT 96
DISPLAY PWR 912
25 kHz 1 7
25 kHz 2 8
0.1 MHz 1 9
0.1 MHz 2 90
0.1 MHz 4 91
S1F1-17 E116
S1R1-12 E117
S1R1-5 E118
S1R0-8 E119
S1F1-14 E120
S1F0-2 E121
S3-3 E122
S3-15 E123
S3-11 E124
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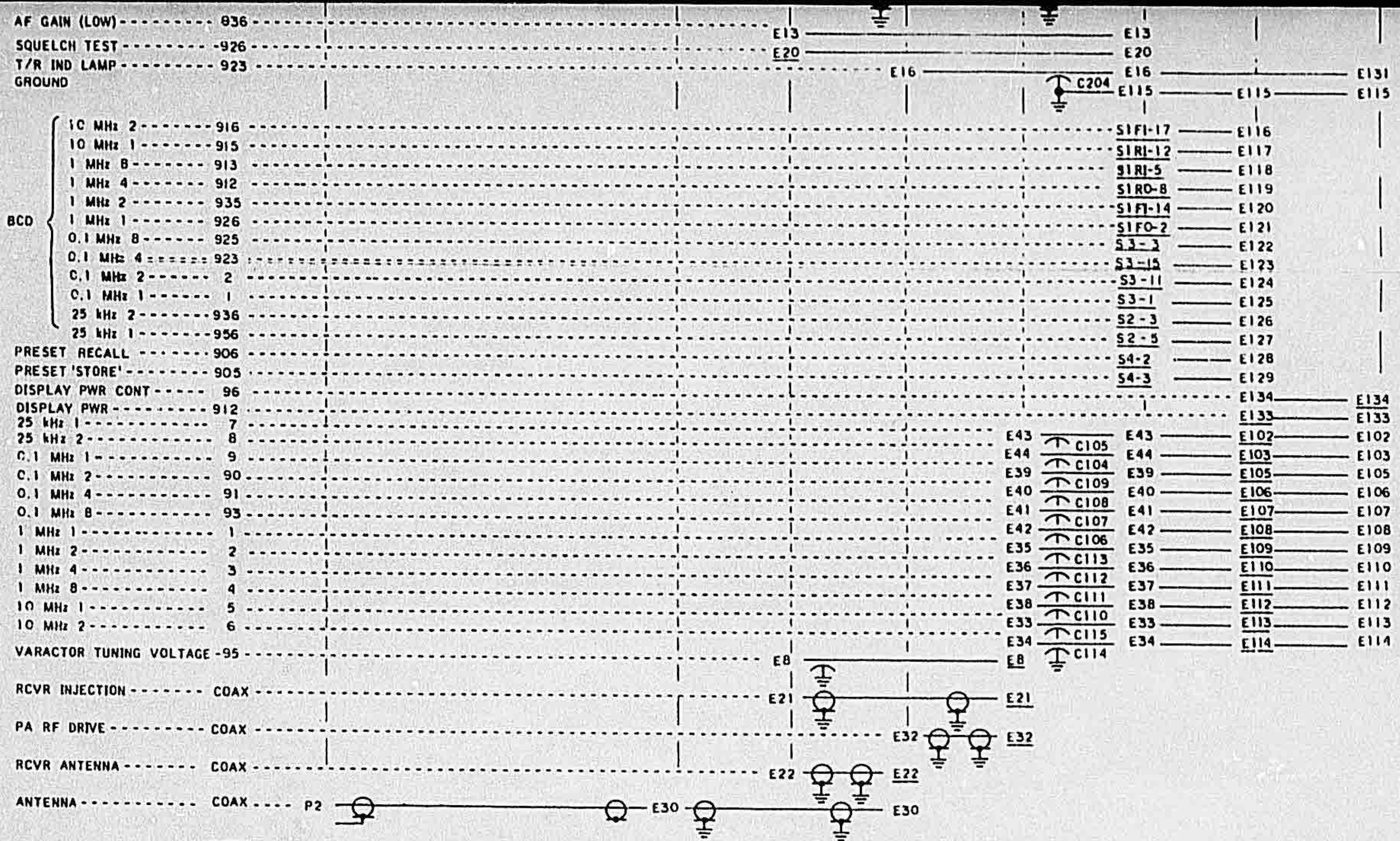
S4-3 E129
E134
E133
E43 C105 E102
E44 C104 E103
E39 C109 E105
E40 C108 E106
E41 E107

MIDDLE



NOTES:

(1) NUMBERS IN THIS COLUMN INDICATE WIRE COLOR CODE.

0 = BLACK	5 = GREEN
1 = BROWN	6 = BLUE
2 = RED	7 = VIOLET
3 = ORANGE	8 = GRAY
4 = YELLOW	9 = WHITE

EXAMPLE: 913 = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

(2) UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.

(3) UNLESS OTHERWISE SPECIFIED; ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.

(4) UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.

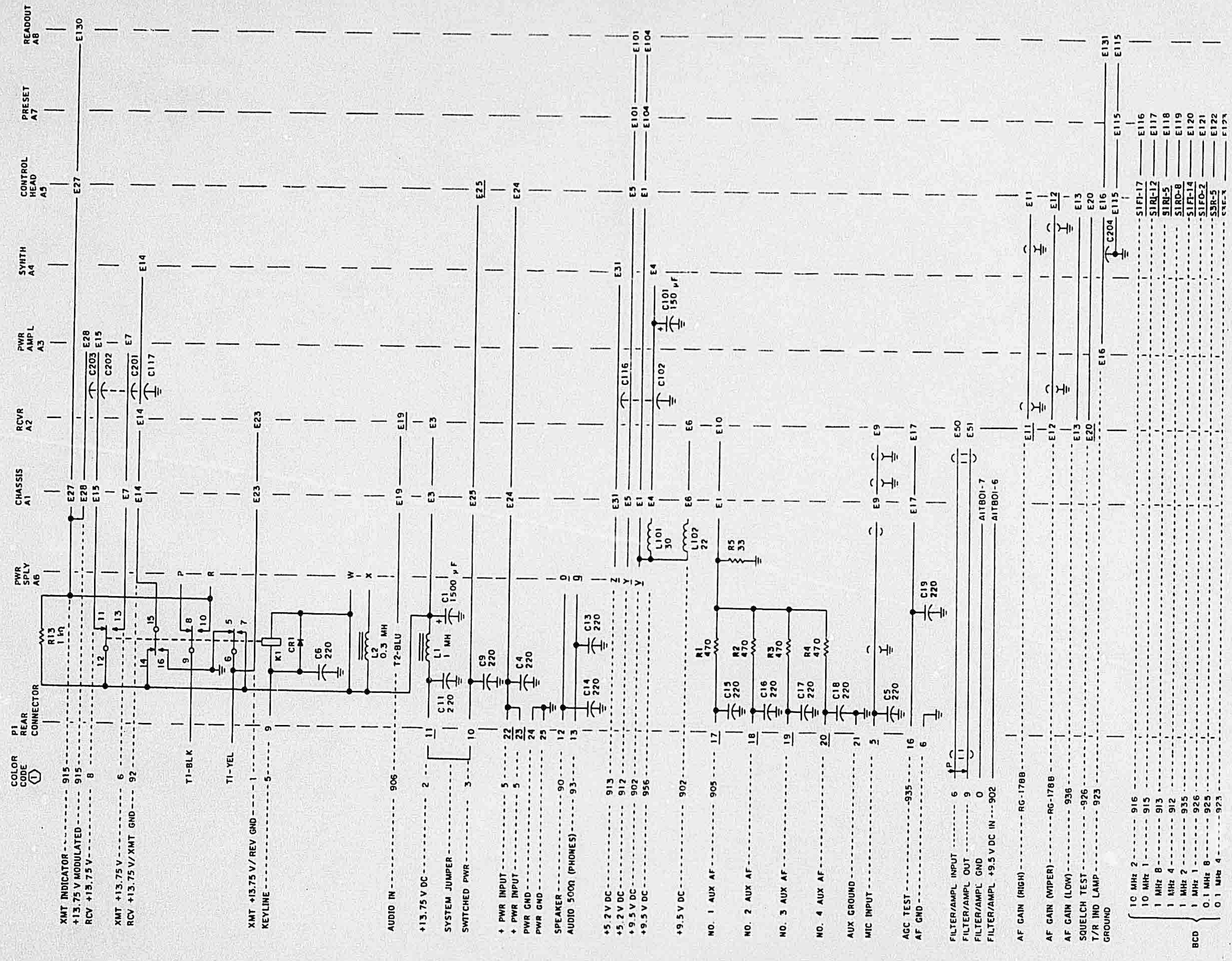
(5) FEED-THRU CAPACITORS ARE 1000 pF, 50 V DC (COLLINS PART NUMBER 913-3303-010).

VHF-251S Chassis Wiring Schematic
Figure 6-33

SCHEMATIC CHANGES

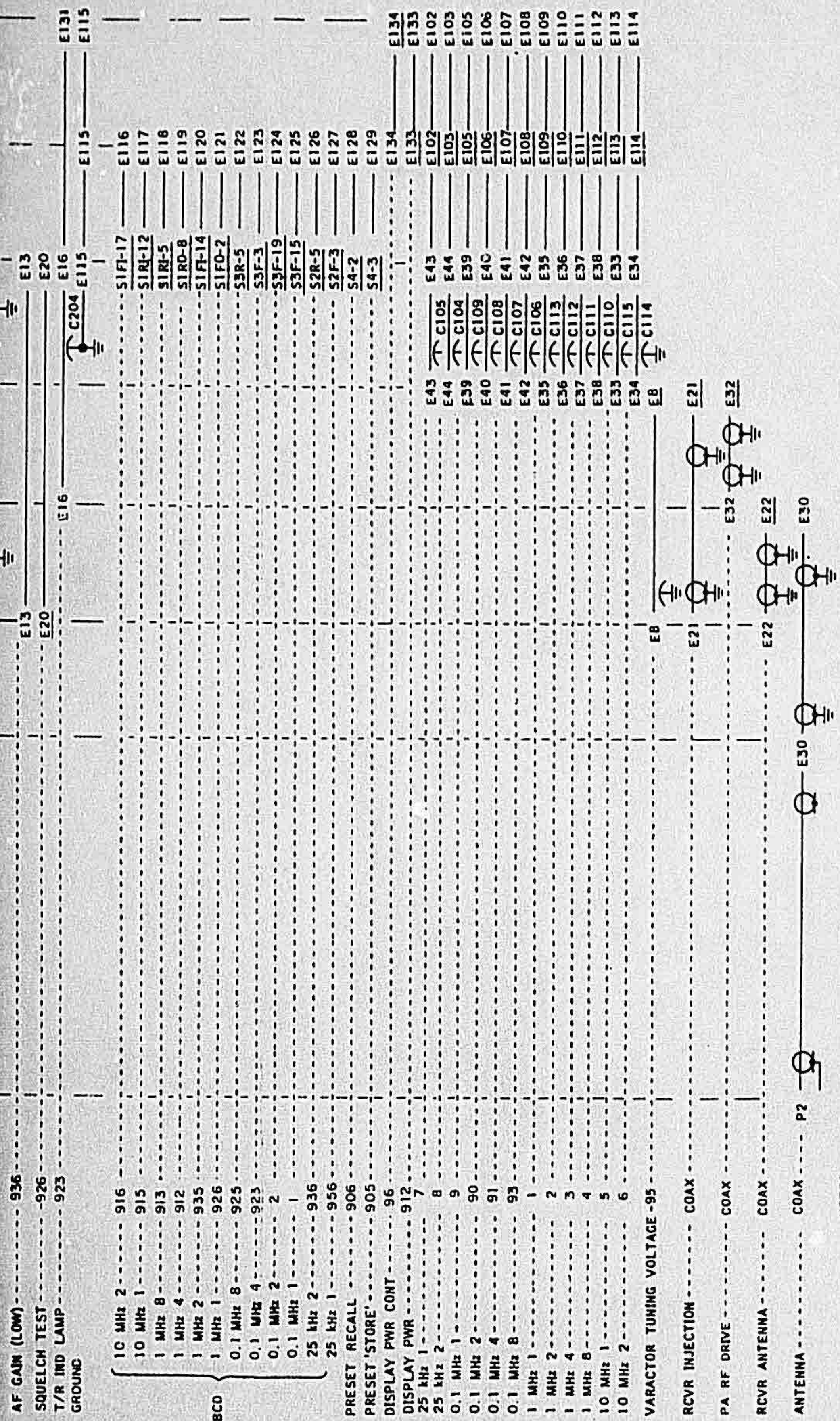
REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY

VHF-251E Chassis Wiring Schematic
Figure 6-34 (Sheet A)



ALSO SEE THIS PAGE AS UPPER/MIDDLE/LOWER (NEXT)

Page 6-111/6-112



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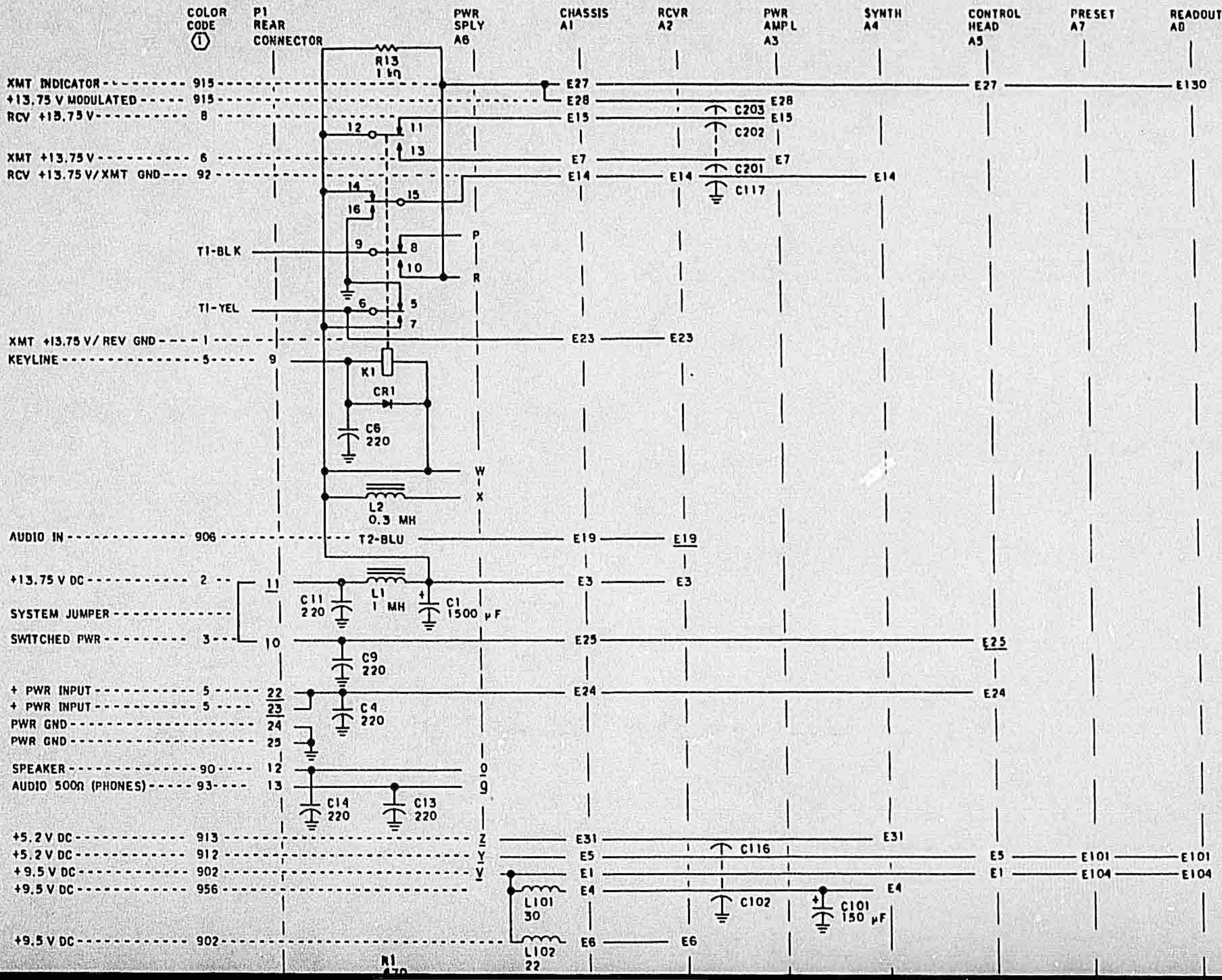
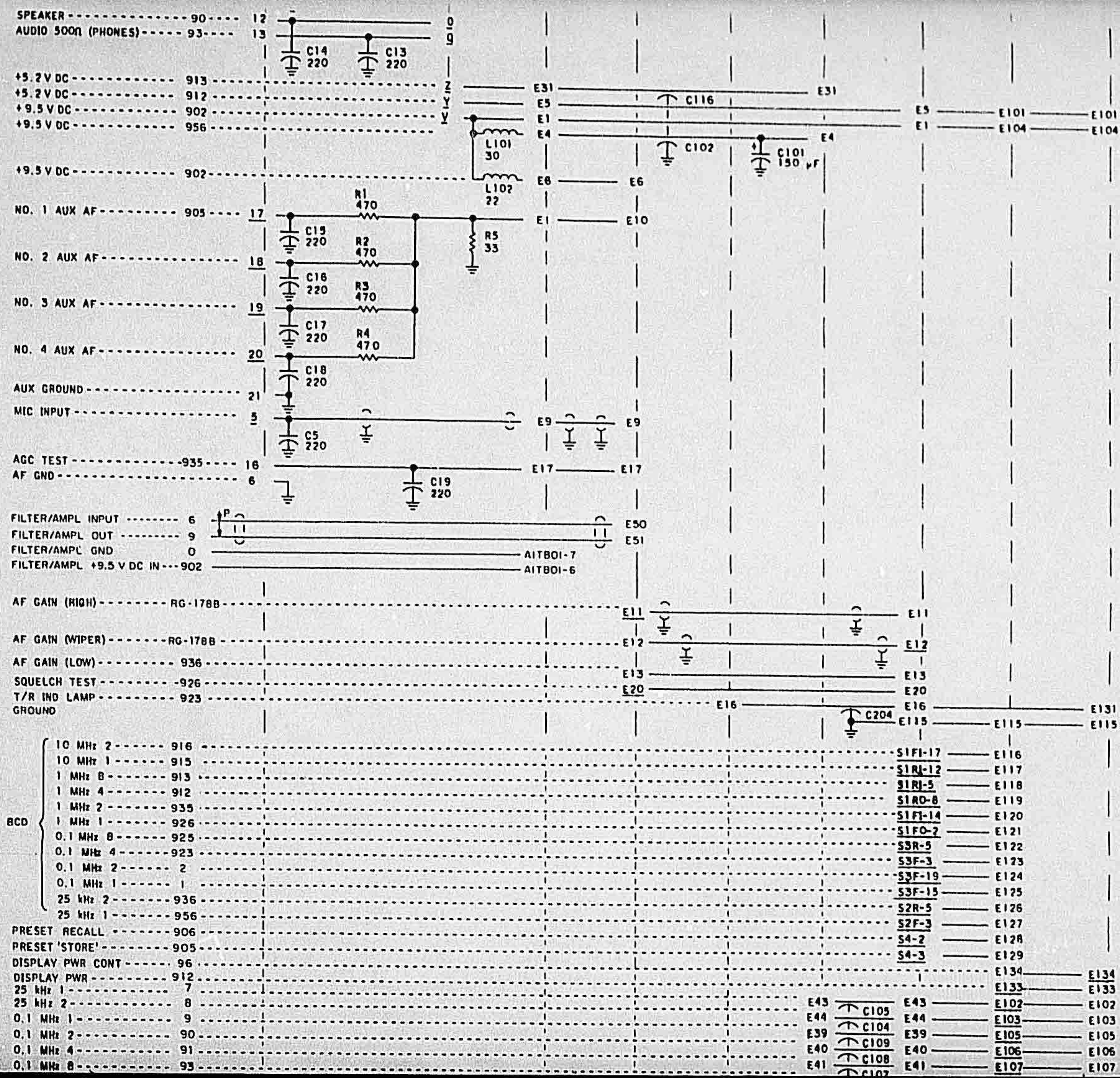
VHF-251E Chassis Wiring Schematic
Figure 6-34



UPPER

pg 6-111/6-112


SPEAKER 90 12
AUDIO 500Ω (PHONES) 93 13
C14 220
C13 220
+5.2 V DC 913
+5.2 V DC 912
+9.5 V DC 902
+9.5 V DC 956
+9.5 V DC 902
E31
E5
E1
E4
E6
E10
E101
E104
C116
C102
C101 150 μF
L101 30
L102 22
NO. 1 AUX AF 905 17
NO. 2 AUX AF 18
NO. 3 AUX AF 19
NO. 4 AUX AF 20
AUX GROUND 21
MIC INPUT 5
AGC TEST 935 16
AF GND 6
R1 470
R2 470
R3 470
R4 470
R5 33
C15 220
C16 220
C17 220
C18 220
C5 220
C19 220
E9
E17
FILTER/AMPL INPUT 6
FILTER/AMPL OUT 9
FILTER/AMPL GND 0
FILTER/AMPL +9.5 V DC IN 902
E50
E51
A1TB01-7
A1TB01-6
AF GAIN (HIGH) RG-178B
AF GAIN (WIPER) RG-178B
AF GAIN (LOW) 936
SQUELCH TEST 926
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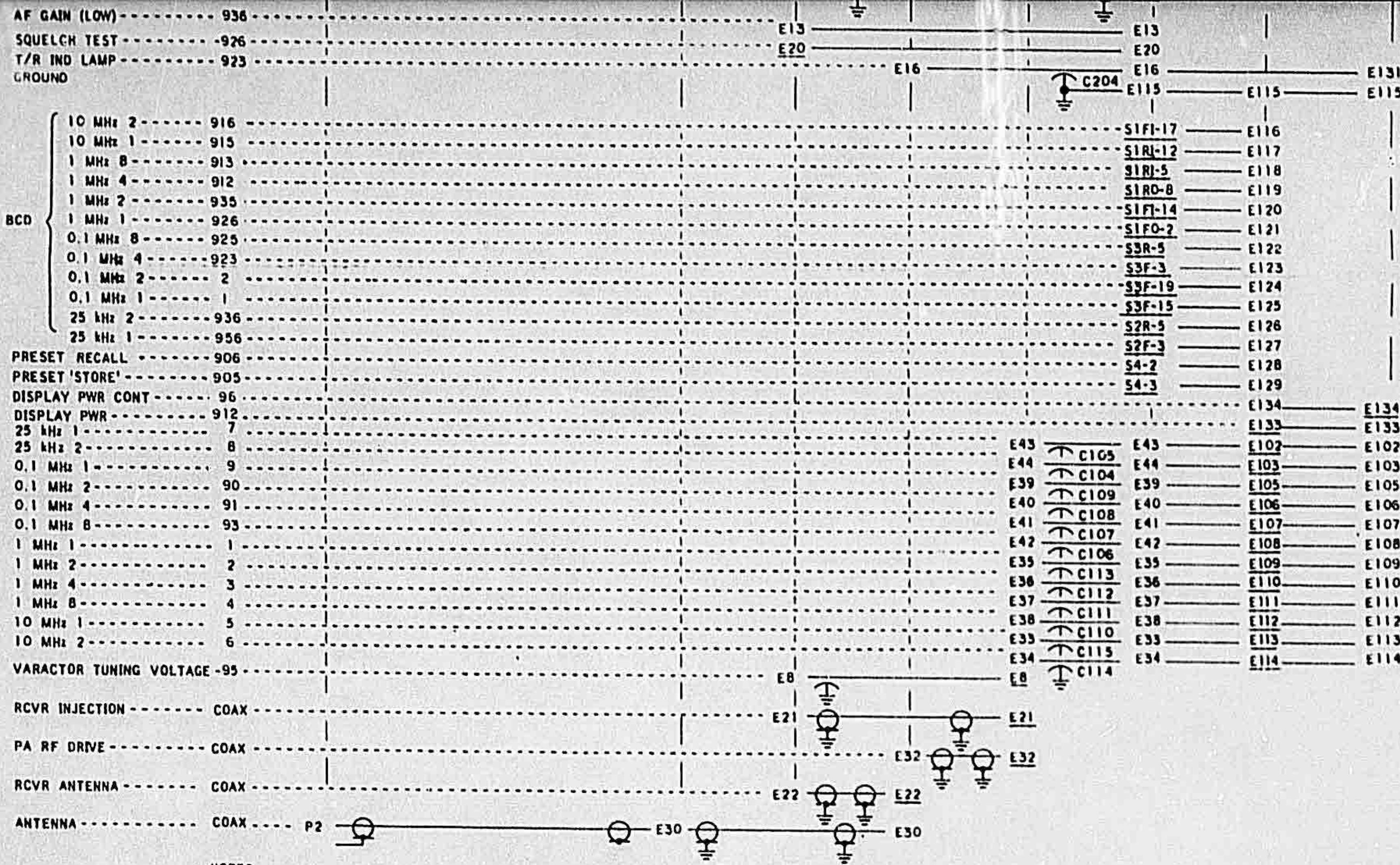
0.1 MHz 2 90
0.1 MHz 4 91
0.1 MHz 8 93
S1FI-17 E116
S1RJ-12 E117
S1RJ-5 E118
S1RO-8 E119
S1FI-14 E120
S1FO-2 E121
S3R-5 E122
S3F-3 E123
S3F-19 E124
S3F-13 E125
S2R-5 E126
S2F-3 E127
S4-2 E128
S4-3 E129
E134
E133
E43 C105 E43 E102
E44 C104 E44 E103
E39 C109 E39 E105
E40 C108 E40 E106
E41 C107 E41 E107

MIDDLE



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⑤ FEED-THRU CAPACITORS ARE 1000 pF, 50 V DC (COLLINS PART NUMBER 913-3303-010)

VHF-251E Chassis Wiring Schematic
Figure 6-34

LOWER

VHF-251/251S/251E Communications Transceiver

S-TEC Corporation
TEC LINE Avionics

appendix

Printed in USA

table of contents

FCC Application for Aircraft Radio Station License, Form 404

List of Effective Pages

*The asterisk indicates pages changed, added, or deleted by the current change.

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List of Effective Pages	4 Nov 81
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Record of Revisions

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REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	4 Nov 81		None				

FCC Form 404
February 1977

United States of America
Federal Communications Commission

Form Approved
GAO No. B-180227 (RO208)

APPLICATION FOR AIRCRAFT RADIO STATION LICENSE

INSTRUCTIONS—General

A. CORRECT FORM

Use FCC Form 404 to apply for:

- A *New Station License* when the station aboard an aircraft is first licensed or the ownership of the aircraft is changed and the previous owner is not to continue as the licensee of the station.
- A *Modified Station License* when the licensee remains the same, but the operation is to be different from that provided in the license. If the licensee's name or address changes, do not use FCC Form 404, but notify the Commission by letter. Type accepted transmitters may be added or substituted for those specified on the license without notifying the Commission if they perform the same functions and use the same frequencies.

Do not use FCC Form 404 for renewals *without* modification. Use FCC Form 405-B which is normally sent to you before the license expires.

Do not use FCC Form 404 when applying for transmitters or radio frequencies in radio services other than aviation services (e.g., Amateur, Citizens, Industrial) even though these facilities may be placed aboard the aircraft.

B. NUMBER OF APPLICATIONS

Submit a separate form for each aircraft unless the application is for a fleet license. See Section 87.29(a)(2) of the FCC Rules for those eligible for fleet licenses.

C. FCC RULES AND REGULATIONS

Before preparing this application, applicant should refer to Part 87, "Aviation Services" which is contained in Volume V of the Commission's Rules. This volume may be obtained from the Superintendent of Documents, Government Printing Office. See attached order form.

D. FEES

All fees have been suspended effective January 1, 1977. DO NOT SEND FEES UNTIL FURTHER NOTICE.

E. MAILING APPLICATION

Mail your application and fee to Federal Communications Commission, P.O. Box 1030, Gettysburg, PA 17325.

INSTRUCTIONS—Filling Out the Form

ITEM 1. The FAA registration number must be entered on all applications except those for fleet license. When a fleet license is involved, a control number will be assigned by the Commission. When applying for a modification or renewal of an existing aircraft radio station license, the FAA registration number or the control number appearing on the license must be entered.

ITEM 2. Check "No" if you are applying for a license for only one aircraft. Check "Yes" if you are applying for a fleet license (see Section 87.29(a)(2) of the FCC Rules for those eligible for fleet licenses) and give the number of aircraft in the fleet plus 10% to allow for future expansion.

ITEM 3. Check the type of applicant you are.

ITEM 4A. Only for individuals or individuals with a business name. Individuals enter your last name, first name, middle initial. If you are an individual doing business under a firm or company name, a license may be issued to either the individual or the company. If the latter is desired, enter your personal name in ITEM 4A and your company name in ITEM 4B.

ITEM 4B. Only for organizations or individuals with a business name who want the license in the name of the business.

- *Individuals with a business name*—Enter the firm or company name.
- *Corporation*—Insert the corporate name only as it appears in the Articles of Incorporation. Do not apply in the name of a Division of the Corporation.
- *Unincorporated Association*—Insert the name of the Association as it appears in the Articles of Association or By-laws.
- *Governmental Entities*—Insert the name of the Governmental Entity having jurisdiction of the station, e.g., city of New York; State of Maine. Do not apply in the name of a department, commission or other arm of the governmental entity.
- *Partnership*—Insert business name, if any. Also answer ITEM 4c.

ITEM 4C. Partnership only. Enter all the names of the partners. Use Item 11 or the back of the form if more space is necessary.

INSTRUCTIONS—*Continued on reverse side*

ORDER FORM

Please enter ______________ subscription(s) to Volume V, containing parts 87, 89, 91 and 93 of the Federal Communications Commission Rules and Regulations ($18.20 per domestic subscription (which includes U.S. Territories) and $22.75 per foreign subscription).

NOTE: Prices subject to change without notice. Prices were current as of February 1977.

NAME—FIRST, LAST

COMPANY NAME OR ADDITIONAL ADDRESS LINE

STREET ADDRESS

CITY | STATE | ZIP CODE

PLEASE PRINT OR TYPE

☐ Remittance Enclosed (Make checks payable to Superintendent of Documents)

☐ Charge to my Deposit Account No. ....

MAIL ORDER FORM TO:
Superintendent of Documents
Government Printing Office
Washington, D.C. 20402

APPENDIX

ITEM 5. Insert a permanent mailing address in the United States. If the license is to be mailed to a different address, attach a special request for mailing.

ITEMS 9A-9C. Check the desired frequencies based on the following information. When modifying an existing license, check those frequencies presently authorized and which will continue to be used after modification.

- *Private Aircraft:* These frequencies include those normally available for air traffic control, aeronautical advisory, aeronautical multicom, ground traffic control, altimeter, weather radar, Doppler radar, transponder beacon and DME. Refer to Part 87 of the Commission's Rules for the specific frequencies available. Private aircraft frequencies are available to any aircraft except those weighing more than 12,500 pounds which are used in carrying passengers or cargo for hire. Do not apply for private aircraft frequencies if the aircraft falls within the latter category.
- *Air Carrier:* Frequencies include all of those available for private aircraft except within the frequency range 122.0 MHz through 123.05 MHz.

DO NOT CHECK BOTH PRIVATE AND AIR CARRIER FREQUENCIES.

- *Public Service:* The public service frequencies available for assignment to aircraft stations are the medium and high frequencies available to ship telegraph and telephone stations for communication with coast stations. Transmitters used for public service operation must be type accepted by the Commission for use in ship stations (Part 83).
- *121.5 and 243 MHz only:* These frequencies are included when private aircraft or air carrier aircraft frequencies are authorized. Check if only an emergency locator transmitter is to be used, and the aircraft is not equipped for communications.
- *Aeronautical Enroute:* Aeronautical Enroute frequencies are available for communication with non-government aeronautical enroute stations. Indicate the section of the Commission's Rules (Part 87, sections 87.295 to 87.309) which makes available the group of frequencies desired. If Aeronautical Enroute frequencies are requested, answer ITEM 9B2.
- *Instructional:* These are the frequencies 123.3, 123.5, and 121.95 MHz available for communications with aviation instructional land stations. These frequencies are used for the instruction of student pilots or for the coordination of glider operations. If instructional frequencies are requested, submit a statement showing that the applicant:
  - (a) Operates a flying school, or
  - (b) Engages in soaring activities, or
  - (c) Takes flying instructions in his own aircraft.

In all cases specify the aviation instructional land station with which you will communicate. If you are taking flying instructions in your own aircraft, the instructional frequencies may be assigned on a temporary basis.

- *Flight Test HF or VHF or both:* Submit a statement showing that the applicant is a manufacturer of aircraft or major components.
- *Other:* Specify under "Other" any frequencies you require and which are not regularly available for use in accordance with the provisions of Part 87 of the Commission's Rules (Government frequencies or marine frequencies for fish spotting operations). Each request for "Other" frequencies must be accompanied by a statement showing the need for assignment, including reference to any governmental contracts which may be involved and a description of the proposed use. The emissions, power, points of communication, and area of proposed operation should be included in the statement.

ITEM 10. Check the categories of transmitters which you intend to use in the aircraft station. When modifying an existing license, include the transmitters already authorized and which will continue to be used after modification. Transmitters to be used on public service and other marine frequencies must be type accepted for use in ship stations (Part 83). Except as provided in Section 87.77, all other transmitters must be type accepted for use in aircraft. A list of type accepted equipment is available for inspection at the Commission's offices. Do not include receivers or transmitters which are licensed and used exclusively in other services, such as, common carrier, industrial, police, etc.

Radio Altimeters operating in the band 1600-1660 MHz may be authorized only if the transmitters were authorized before July 1, 1971.

Check "Other" when transmitters other than those of the indicated categories are to be used. Show in ITEM 11 or on the back of the form, the transmitter manufacturer and type number, frequencies, emission, power and purpose of the transmitter.

ITEM 13. Signature: Applications must be signed as indicated:

Individual:	By individual himself or his attorney in case of applicant's physical disability or his absence from the United States. (See Section 87.25.)
Partnership:	By an individual partner or by an officer of a corporation or association which is a member of the applicant partnership.
Corporation:	By an officer of the Corporation.
Unincorporated Assn.:	By an officer of the Association.
Governmental Entity:	By an official of the Governmental Entity.

DO NOT RETURN INSTRUCTION SHEET WITH COMPLETED FORM.

FCC Form 404
February 1977

UNITED STATES OF AMERICA
FEDERAL COMMUNICATIONS COMMISSION

Form Approved
GAO No. B-80227 (RO 208)

APPLICATION FOR AIRCRAFT RADIO STATION LICENSE

A. Read instructions before completing.
B. Use typewriter or print clearly in ink.
C. Sign and date application.
D. Mail this form to Federal Communications Commission, P.O. Box 1030, Gettysburg, PA. 17325.

DO NOT WRITE IN THIS BLOCK

1. FAA Registration or FCC Control Number *(If known)*
N

2. Is application for a fleet license? *If yes, give number of aircraft in fleet.*
No ☐ Yes ☐ No. of aircraft

3. Type of Applicant *(Check one)*
☐ (I) Individual ☐ (P) Partnership ☐ (A) Association ☐ (C) Corporation
☐ (D) Individual with Business Name ☐ (G) Governmental Entity

4A. Name of Individual *(Last, First, Middle Initial)*

4B. Name *(If other than individual)*

4C. Names of Partners *(Last, First, Middle Initial)* *(Answer only if you checked partnership in item 3)*

5. Mailing Address of Applicant *(Number and Street, City, State, ZIP Code)*

6. Will the applicant own the radio equipment? *If no, give name of owner.* Yes No
Name

7. Does the applicant own the aircraft on which the radio equipment is to be installed? *If no, give name of owner.* Yes No
Name

8. If not the owner of the radio equipment, is applicant a party to a lease or other agreement under which control will be exercised in the same manner as if the applicant owned the equipment? Yes No

9. Frequencies requested *(Check all you will use under this license)*

A. Do not check both private aircraft and air carrier
☐ (A) Private Aircraft ☐ (C) Air Carrier ☐ (S) Public Service ☐ 121.5 & 243 MHz only *(For emergency locator transmitter)*

B1. Specify frequencies by rule number(s) if you check here.
☐ (E) Aeronautical Enroute → Rule Number(s)

B2. Answer only if you checked item 9B1, aeronautical enroute frequencies. Yes No
Will a valid agreement with licensees of aeronautical enroute stations be in effect as required by the rules?

C. You must submit additional information, if you check here. *(See instructions)*
☐ (A) Instructional ☐ (T) Flight Test HF ☐ (V) Flight Test VF ☐ (O) Other *(specify)*

10 Categories of transmitters *(Check all transmitters to be used)*

	A	Emergency Locator *(121.5 & 243 MHz)*		H	Radar *(9300 to 9500 MHz)*
	B	VHF Communications *(118 to 136 MHz)*		I	Radar *(15,400 to 15,700 MHz)*
	C	Distance Measuring Equipment (DME) *(960 to 1215 MHz)*		J	Doppler Radar *(8750 to 8850 MHz)*
	D	Transponder *(1090 MHz)*		K	Doppler Radar *(13,250 to 13,400 MHz)*
	E	Radio Altimeter *(1600 to 1660 MHz)* *(See instruction)*		L	High Frequency Communication *(2–25 MHz)*
	F	Radio Altimeter *(4200 to 4400 MHz)*		M	Marine Transmitter for Public Service
	G	Radar *(5350 to 5470 MHz)*		N	Other

11. Answer space for any required statements *(Use reverse side if more space is needed)*

READ CAREFULLY BEFORE SIGNING

Certification: 1) The applicant waives any claim to the use of any particular frequency or of the ether because of previous use of same, whether by license or otherwise. 2) The applicant accepts full responsibility for the operation and control of the requested station license in accordance with applicable law and rules of the FCC. 3) The applicant will have unlimited access to the radio equipment and will take effective measures to prevent its use by unauthorized persons. 4) Neither applicant nor any member thereof is a foreign government or representative thereof.

WILLFUL FALSE STATEMENTS MADE ON THIS FORM OR ATTACHMENTS ARE PUNISHABLE BY FINE AND IMPRISONMENT, U.S. CODE: TITLE 18, SECTION 1001.

SIGNATURE of individual, partner, or authorized person on behalf of a governmental entity, or an officer of a corporation or association.

DATE

APPENDIX

RETURN ADDRESS

Sometimes it becomes necessary to return an application. Please print your name and mailing address in the box provided below. By putting your name and address in this area, you will enable us to return quickly any application which needs correction or clarification.

ADDITIONAL ANSWER SPACE

NOTICE TO INDIVIDUALS REQUIRED BY PRIVACY ACT OF 1974

Sections 301, 303, and 308 of the Communications Act of 1934, as amended (licensing powers), authorized the FCC to request the information on this application. The purpose of the information is to determine your eligibility for a license. The information will be used by FCC staff to evaluate the application, to determine station location, to provide information for enforcement and rulemaking proceedings and to maintain a current inventory of licensees. No license can be granted unless all information requested is provided.

U.S. GOVERNMENT PRINTING OFFICE : 198[illegible] - 330-834

PWC-150

POWER CONVERTER

01

PWC-150 Power Converter

S-TEC Corporation
TEC LINE Avionics

description

Printed in USA

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Record of Revisions

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REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	14 Feb 75						
2nd Ed	15 Jul 75						
3rd Ed	27 Feb 81		SB 1, 2				
1	20 Apr 83						

section I
description

1.1 INTRODUCTION

This instruction book contains all the specifications, installation instructions, equipment operating procedures, principles of operation, and information necessary for proper maintenance of the PWC-150 Power Converter, S-TEC part number 622-2093-001.

1.2 PURPOSE OF THE EQUIPMENT

The PWC-150 Power Converter is a remotely mounted unit consisting of two independent dc voltage-reducing regulators which provide 13.75 V dc to the VIR-351 Navigation Receiver and/or VHF-251 Communications Transceiver from a 27.5-V dc source voltage. Each voltage-reducing regulator has a separate 27.5-V dc input that may be switched externally.

1.3 DESIGN FEATURES

- Two independent dc reducing regulators contained in a single lightweight unit.
- Independently switchable inputs.
- Remote mounting in any position.
- High maintainability with quick access to all circuits.

1.4 EQUIPMENT SPECIFICATIONS

Table 1-1 lists the equipment specifications for the PWC-150 Power Converter.

Table 1-1. PWC-150 Power Converter Equipment Specifications.

CHARACTERISTICS	SPECIFICATIONS
Related documents	
FAA TSO	-C71; category CANAAAEXXXXX.
Physical	
Dimensions	
Width	98.42 mm (3.875 in).
Height	68.83 mm (2.71 in).
Length	171.45 mm (6.75 in).
Mounting	Secured to airframe, no mounting tray required.
Weight	0.68 kg (1.5 lb).
Environmental	
Temperature range	
Continuous	-40 to +55 °C (-40 to +131 °F).
Intermittent	To +71 °C (+159.8 °F) for 30 minutes.
Storage	-40 to +85 °C (-40 to +185 °F).
Altitude	9144 m (30 000 ft).
Cooling	Convection.
Relative humidity	95 percent at +50 °C (+122 °F).

Table 1-1. PWC-150 Power Converter Equipment Specifications (Cont).

CHARACTERISTICS	SPECIFICATIONS
Shock	
Operational	15 g.
Crash safety	30 g (10 ms duration).
Electrical	
Power requirements	COMM converter: 27.5 V dc +10 -20 percent at 5 A max. NAV converter: 27.5 V dc +10 -20 percent at 2 A max.
Input power consumption	Equals output current plus 20 mA max for each converter.
Output voltage (each converter)	13.75 V dc ±5 percent.
Rated output current	
NAV converter	2 A continuous.
COMM converter	Continuous duty: 5 A, 15 seconds; 1 A, 45 seconds.
	Intermittent duty: 5 A, 1 minute, not to exceed once per 10-minute interval.
Rated output power	27.5 watts average for each converter.
Voltage regulation	2 percent max.

1.5 EQUIPMENT SUPPLIED

The PWC-150 Power Converter (CPN 622-2093-001) does not require a special installation kit for mounting.

1.6 EQUIPMENT REQUIRED BUT NOT SUPPLIED

Four #6-32 screws are required to secure the PWC-150 Power Converter in place.

02

PWC-150 Power Converter

S-TEC Corporation
TEC LINE Avionics

installation

Printed in USA

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section II
installation

2.1 GENERAL

Installation data contained in this section consists of unpacking and inspection checks, special instructions, installation procedures, and postinstallation testing.

2.2 UNPACKING AND INSPECTING EQUIPMENT

Unpack the equipment carefully and make a careful visual inspection of each unit for possible shipping damage. All claims for damage should be filed with the transportation company involved. If claims for damage are to be filed, save the original packing carton and materials. If no defects can be detected, replace packing materials in the shipping container and save for future uses such as storage or reshipment.

2.3 SPECIAL INSTRUCTIONS

The PWC-150 Power Converter radiates heat. To ensure proper installation of the PWC-150 Power Converter, when mounting, ensure that adequate air circulation is provided for cooling.

2.4 INSTALLATION PROCEDURES

The following installation procedures must be performed as described to ensure proper operation and performance. Any deviation from these instructions may result in reduced performance and/or damage to the equipment.

a. Avoid mounting the PWC-150 close to temperature-sensitive equipment. If unavoidable, use blower or ram air cooling.
b. Rigidly mount the PWC-150 to the airframe. Mounting may be in any convenient location or position where adequate air circulation is available.
c. Refer to figure 2-1 for outline and mounting dimensions of the PWC-150.

2.5 CABLING

All connections to the PWC-150 are made through the terminal blocks located at either end of the chassis. Crimp type terminals are included with the PWC-150 for ease of installation. Refer to figure 2-2 for terminal board lug assignments.

During preparation of the interconnect wiring cables, observe the following precautions:

a. Bond and shield all parts of the aircraft electrical system, such as generator and ignition systems.
b. Leave slack in cables to allow for movement due to vibration.
c. After installation of the cables in the aircraft and before installation of the equipment, a check should be made to ensure the aircraft power is applied only to the pins specified.

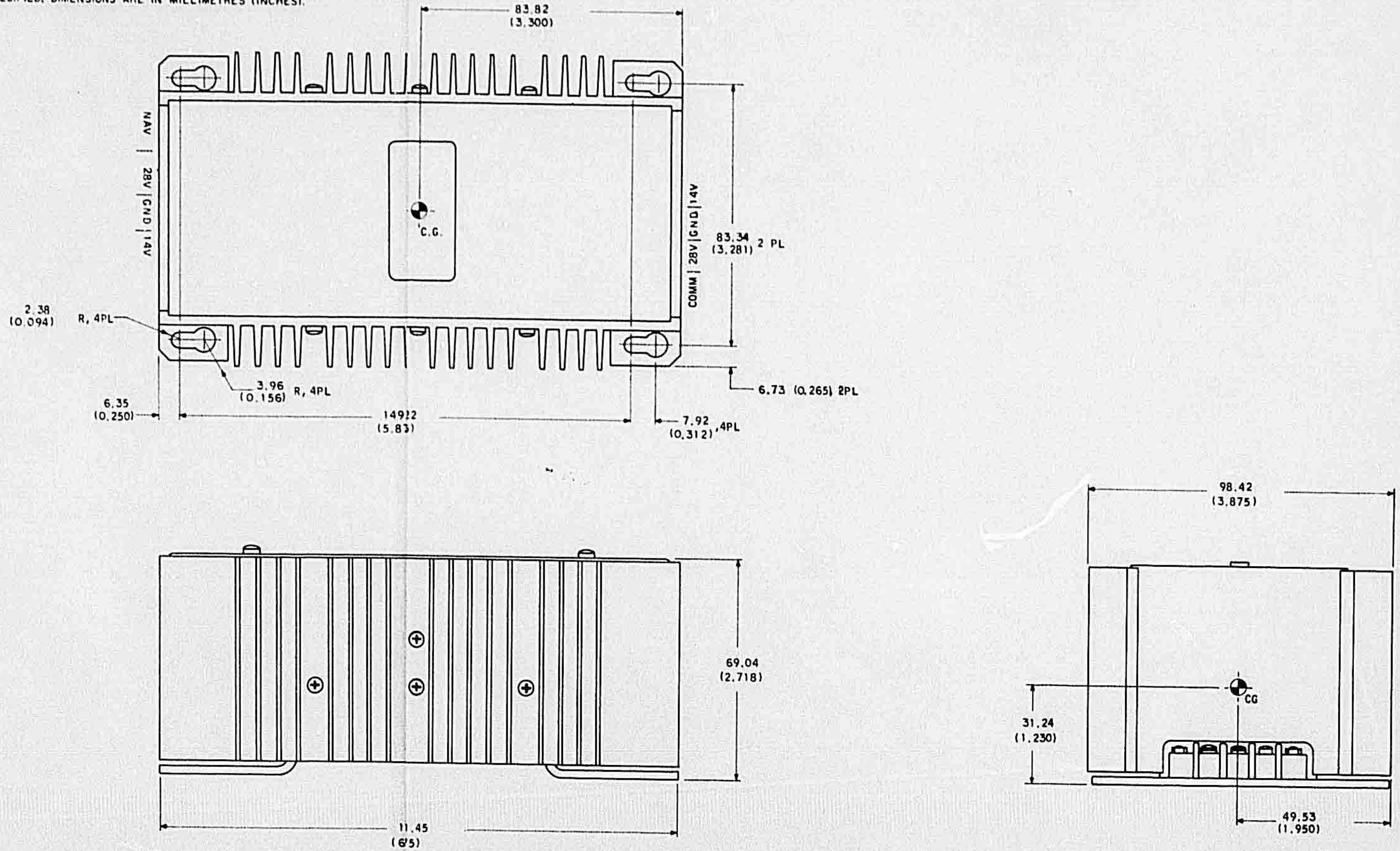
2.6 POSTINSTALLATION CHECKS

The following postinstallation checks are to be performed with the PWC-150 and its associated equipment installed in the aircraft. Checks should be made using the aircraft power supply and with the engine running.

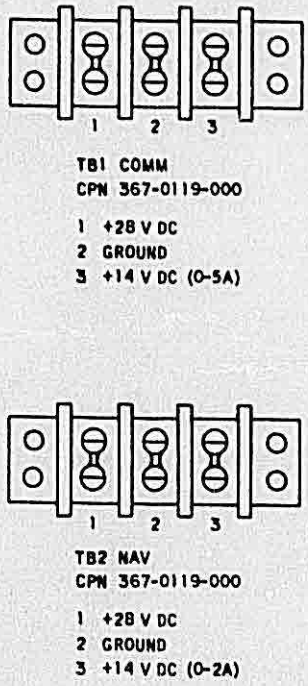
a. Before applying power to the units that are to be supplied power by the PWC-150, ensure the +13.75-V dc voltage is present on the correct (mating connector) pins.
b. Apply power to the VIR-351 Navigation Receiver and perform postinstallation checks on that unit.
c. Apply power to the VHF-251 Communications Transceiver and perform postinstallation checks on that unit.

NOTES:

1. WEIGHT OF UNIT: 0.68 kg's (1.50 LBS).
2. SOLDERLESS TERMINALS PROVIDED WILL ACCOMMODATE NO. 18-22 AWG WIRE.
3. WARNING: DO NOT MOUNT UNIT NEAR A HIGH HEAT SOURCE.
4. UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MILLIMETRES (INCHES).



PWC-150 Power Converter, Outline and Mounting Dimensions
Figure 2-1



PWC-150 Terminal Board Lug Assignments
Figure 2-2

04

PWC-150
Power Converter

S-TEC Corporation
TEC LINE Avionics

theory

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4.2 PWC-150 Principles of Operation	4-1

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section IV
theory

4.1 GENERAL

The theory section includes a discussion of basic circuit concepts needed for servicing and understanding the PWC-150 Power Converter.

4.2 PWC-150 PRINCIPLES OF OPERATION (Refer to figure 6-1.)

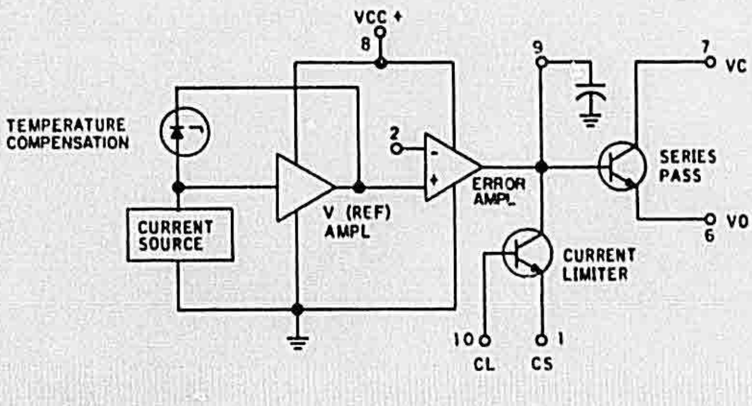
The PWC-150 consists of two independent dc voltage-reducing regulators that provide +13.75 V dc to the VIR-351 Navigation Receiver and/or VHF-251 Communications Transceiver from a +27.5-V dc source voltage.

Since the circuitry of both regulators is basically the same, the NAV portion will be used for discussion purposes.

The +27.5-volt input is applied to transistors Q3 and Q4 and pin 8 of voltage regulator U2. U2 is a precision voltage regulator that controls the base current of transistor Q4. Transistor Q4 controls the conduction of transistor Q3.

The precision voltage regulator (figure 4-1) consists of a temperature-compensated reference voltage amplifier, an error amplifier, a series pass output transistor, and an output current limiter. Basically, within regulator U2, a reference voltage is compared to the sampled output voltage. If a difference exists between the two voltages, an error voltage is generated that controls the output of the series pass transistor.

Regulator U2 also provides current limiting. Current sensing is monitored via a direct line to the regulated output. The current limiting transistor contained within U2 provides the monitoring function.



Precision Voltage Regulator, Functional Block Diagram
Figure 4-1

05

PWC-150
Power Converter

S-TEC Corporation
TEC LINE Avionics

maintenance

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section V
maintenance

5.1 GENERAL

This section provides the information necessary to maintain, repair, and test the PWC-150 Power Converter.

The PWC-150 requires no routine maintenance other than periodic inspections to ensure the unit has not sustained any physical damage.

5.2 TEST EQUIPMENT AND POWER REQUIREMENTS

5.2.1 Test Equipment

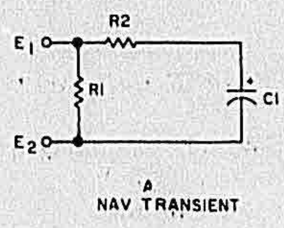
Table 5-1 lists the test equipment required to test, troubleshoot, and repair the PWC-150. Characteristics of the test equipment are listed, and a representative type of each piece of standard equipment is given. Special equipment includes that specifically designed for testing the PWC-150.

5.2.2 Power Requirements

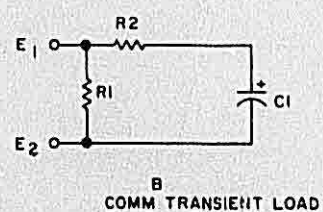
The PWC-150 operating power requirements are +22.00 to +30.25 V dc (+27.5 V dc nominal) at 5 amperes maximum.

Table 5-1. Test Equipment Required.

EQUIPMENT	CHARACTERISTIC DESIRED	REPRESENTATIVE TYPE
Dc power supply	0 to +35 V dc, 10 A	Any
Ac vtvm	20,000 ohms/volt sensitivity; 2% accuracy	HP 400H
Digital voltmeter	Input impedance: 1 megohm	Fairchild 7000
	Range: 0 to ±10 to 100 V	
Oscilloscope	Capable of 0.2 s/cm	Any
Ammeter	Capable of measuring 0 to 7 A	Any
Power rheostat	0 to 15 ohms, 100 watts	Any
COMM transient load		Fabricate according to figure 5-1, view A.
NAV transient load		Fabricate according to figure 5-1, view B.



	COMPONENT VALUE	CPN
R1	6.8 Ω,30 W	747-2201-410
R2	6.8 Ω,2 W	747-5317-000
C1	1000 μF, 30 V	184-5102-720



	COMPONENT VALUE	CPN
R1	3.9 Ω,30 W	747-2201-300
R2	3.3 Ω,2 W	747-5366-000
C1	2200 μF, 30 V	184-5102-740

PWC-150 Transient Loads
Figure 5-1

5.3 PERFORMANCE TEST

Test procedures are performed using the test setup shown in figure 5-2. The load placed on the PWC-150 will vary for different tests. These loads are noted in the appropriate test.

Caution

During operation, the PWC-150 dissipates large quantities of heat and becomes too hot to touch. Be careful to avoid burns.

5.3.1 COMM Converter Section

Caution

Do not apply a load greater than 3 A for more than a 1-minute interval. After load removal, a 3-minute no-load condition must be observed before reapplication.

5.3.1.1 Line Regulation

a. Connect the test equipment to the COMM section of the PWC-150 as shown in figure 5-2. Connect the power rheostat to terminals E_1 and E_2 (load).

b. Adjust rheostat to provide maximum resistance. Open switch S1 and close switch S2. Adjust power supply to provide 33.0 V dc.

c. Close switch S1 and adjust rheostat until 4.5 A is observed on ammeter. Read output voltage displayed by dvm. Result: +13.1 to +14.4 V dc. Open switch S1 after results have been recorded.

d. Adjust the power supply to provide +23.0 V dc. Close switch S1, and observe indication on dvm. Result: 13.1 to 14.4 V dc. Open switch S1 after results are recorded.

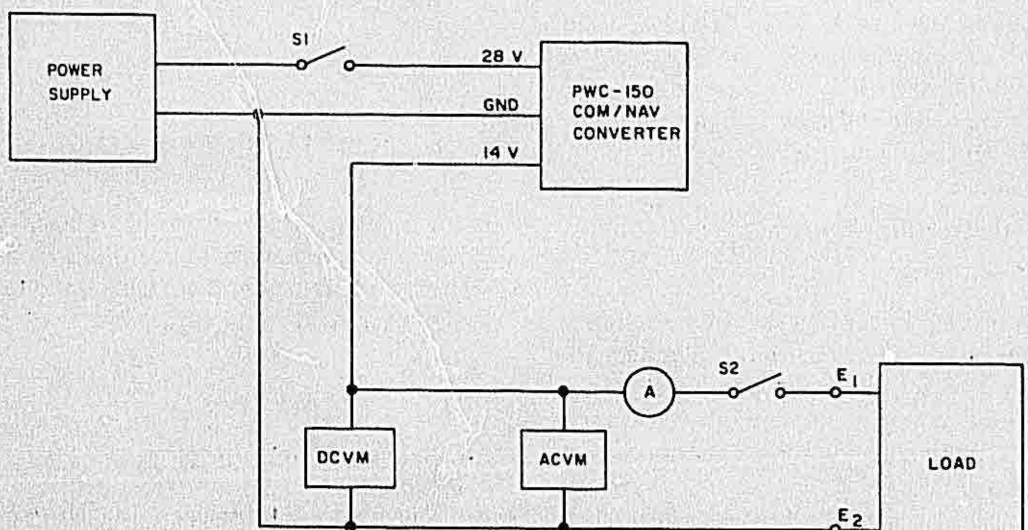
e. Calculate the line regulation using data recorded in steps c and d by applying the following formula:

$$\text{Line regulation} = 1 - \frac{V_0 \text{ at } 23\text{ V}}{V_0 \text{ at } 33\text{ V}}$$

Result: Less than 0.02.

5.3.1.2 Load Regulation

a. Adjust the power supply to provide +27.5 V dc output. Close switch S1, open switch S2, and



Bench Test Setup
Figure 5-2

observe indication on dvm. Result: 13.1 to 14.4 V dc. Record result.

b. Close switch S2, and adjust rheostat to provide a 5.0-A indication on ammeter. Observe dvm indication and record result. Result: 13.1 to 14.4 V dc.

c. Calculate the load regulation by using data recorded in steps a and b by applying the following formula:

$$\text{Load regulation} = 1 - \frac{V_O \text{ at } 5 \text{ A}}{V_O \text{ at } 0 \text{ A}}$$

Result: Less than 0.02.

5.3.1.3 Current Limit

a. Adjust power supply to provide +27.5-V dc output. Close switch S1.

b. Close switch S2, and increase load current by decreasing rheostat resistance until output current stops increasing (current will begin decreasing after max point has been reached). Observe output current at this point. Result: 6.0 to 8.0 A.

5.3.1.4 Short Circuit Current

Adjust power supply to provide a +27.5-V dc output. Connect a shorting bar to terminals E_1 and E_2. Close switches S1 and S2 and observe ammeter indication. Result: 1.5 A maximum.

5.3.1.5 Transient Check

a. Connect COMM transient load (figure 5-1, view B) to terminals E_1 and E_2. Open switch S2.

b. Connect oscilloscope to PWC-150 14-volt output terminal and ground. Set oscilloscope for 5 V/cm vertical, 0.2 s/cm horizontal. Monitor scope, and close switch S2. Note voltage transient if any. Result: 12.5 volts minimum level.

5.3.2 NAV Converter Section

5.3.2.1 Line Regulation

a. Connect the test equipment to the NAV section of the PWC-150 as shown in figure 5-2. Connect the power rheostat to terminals E_1 and E_2 (load).

b. Adjust rheostat to provide maximum resistance. Open switch S1 and close switch S2. Adjust power supply to provide 33.0 V dc.

c. Close switch S1, and adjust rheostat to provide a 2.0-ampere indication on ammeter. Observe dvm and record indication. Result: 13.1 to 14.4 V dc. Open switch S1 after result has been recorded.

d. Adjust power supply to provide 23.0 V dc. Observe dvm and record indication. Result 13.1 to 14.4 V dc.

e. Calculate line regulation using data recorded in steps c and d by applying the following formula:

$$\text{Line regulation} = 1 \cdot \frac{V_O \text{ at } 23 \text{ V}}{V_O \text{ at } 33 \text{ V}}$$

Result: Less than 0.02.

5.3.2.2 Load Regulation

a. Adjust power supply to provide a +27.5-V dc output. Close switch S1, open switch S2, and observe indication on dvm. Result 13.1 to 14.4 V dc. Record result.

b. Close switch S2, and adjust rheostat to provide a 2.0-A indication on ammeter. Observe dvm indication, and record result. Result: 13.1 to 14.4 V dc.

c. Calculate the load regulation using data recorded in steps a and b by applying the following formula:

$$\text{Load regulation} = 1 - \frac{V_O \text{ at } 2 \text{ A}}{V_O \text{ at } 0 \text{ A}}$$

Result: Less than 0.02.

5.3.2.3 Current Limit

a. Adjust power supply to provide a +27.5-V dc output. Close switch S1.

b. Close switch S2, and increase load current by decreasing rheostat resistance until output current stops increasing (current will begin decreasing after max point has been reached). Observe output current at this point. Result: 2 to 3 A

5.3.2.4 Short Circuit Current

Adjust power supply to provide a +27.5-V dc output. Connect a shorting bar to terminals E_1 and E_2. Close switches S1 and S2 and observe ammeter indication. Result: 1.2 A maximum.

5.3.2.5 Transient Check

a. Connect NAV transient load (figure 5-1, view A) to terminals E_1 and E_2. Open switch S2.

b. Connect oscilloscope to PWC-150 14 volt output terminal and ground. Set scope for 5 V/cm vertical, 0.2 s/cm horizontal. Monitor scope, and close switch S2. Note voltage transient if any. Result: 12.5 volts minimum level.

5.4 DISASSEMBLY/ASSEMBLY

Warning

This electronic equipment may have components that contain sealed materials (such as beryllium oxide, acids, lithium, radioactive material, mercury, etc) that can be hazardous to your health. If the component enclosure seal is broken, precautions must be taken against personal contact or inhalation, in accordance with OSHA requirements 29CFR1910.1000, during equipment maintenance, disassembly, or repair.

There are no special instructions necessary to disassemble or assemble the PWC-150 Power Converter. If disassembly is desired, refer to the exploded view illustrated by figure 5-3.

5.5 REPAIR

5.5.1 Replacement of Integrated Circuits

Integrated circuits (IC's) are delicate items and should not be replaced until all other defects are eliminated and it is determined that the IC is definitely defective.

Before removal of the fault IC, note its orientation on the board to ensure correct placement of the new component. Remove the old IC using a solder sucker and needle-nosed pliers to lift each lead. After the old IC has been removed, reheat each mounting hole and remove excess solder.

When soldering the new IC into place, avoid excessive heating. An excessive amount of heat may cause internal damage to the IC, making it inoperable. After soldering, use a toothpick to remove any heavy rosin deposits. Solder joints should be smooth, bright, and clean.

5.5.2 PC Board Postcoating

All PWC-150 Power Converters above serial number 4408 or those with Service Bulletin No 2 marked off the modification plate contain postcoated boards. After component replacement or scraping off coating during troubleshooting, the board must be touched-up to provide the required moisture barrier. Table 5-2 is a list of materials that are required to clean and recoat the circuit board.

5.5.2.1 Postcoating Removal

At times it may be necessary to remove postcoating to aid in component replacement or repair a damaged area of the circuit board. The following procedures describe postcoat removal.

Table 5-2. Postcoating Materials.

MATERIAL	S-TEC part number OR TYPE
Freon (TMC)	005-1314-010
Toluene	005-1497-010
Acrylic coating	821-0650-010
or	
HumiSeal 1B12	Aerosol
or	
HumiSeal 1B15	Aerosol
Acid brush	Any
Pipe cleaners	Any
Cotton tipped swabs	Any
Gloves	Chemical resistant

a. For best results, entire circuit board should be removed from its enclosure. If this is not possible or a very small area is to be cleaned, extreme care must be taken to avoid solvent movement/damage to other areas.
b. Using Freon TMC and a cotton swab, lightly rub the area where postcoating removal is desired. Use a pipe cleaner to loosen the more restricted areas around and beneath components.
c. After postcoating has been removed, blow or blot dry any excess solvent.

5.5.2.2 Postcoat Application

Warning

HumiSeal 1B31 has a low flash point and is highly flammable when in a liquid state (until dry). Therefore, HumiSeal 1B31 should be used only in areas approved for use with flammable materials. Do not expose HumiSeal 1B31 to excessive heat or to open flame. Keep container closed when not in use. Use HumiSeal 1B31 only with adequate ventilation. Avoid prolonged breathing of vapors and repeated contact with skin.

Caution

The entire cleaning and postcoating process should be done in an area that provides adequate ventilation. Rubber or plastic film gloves should be used at all times.

a. Adequate cleaning of the circuit board is essential for good coating adhesion. After the new component has been soldered in place or repairs have been completed, thoroughly clean the affected area with toluene to remove rosin flux and any other contaminants that may be present.

Caution

Do not touch area to be treated with bare hands. Always wear clean gloves when handling a clean board.

b. Scrub the printed circuit board using a clean acid brush and Freon. Take extra care around components and junctions to ensure all contaminants are removed. After cleaning, allow the board to air dry. If streaking is noted after board is dry, repeat cleaning procedure with Freon.

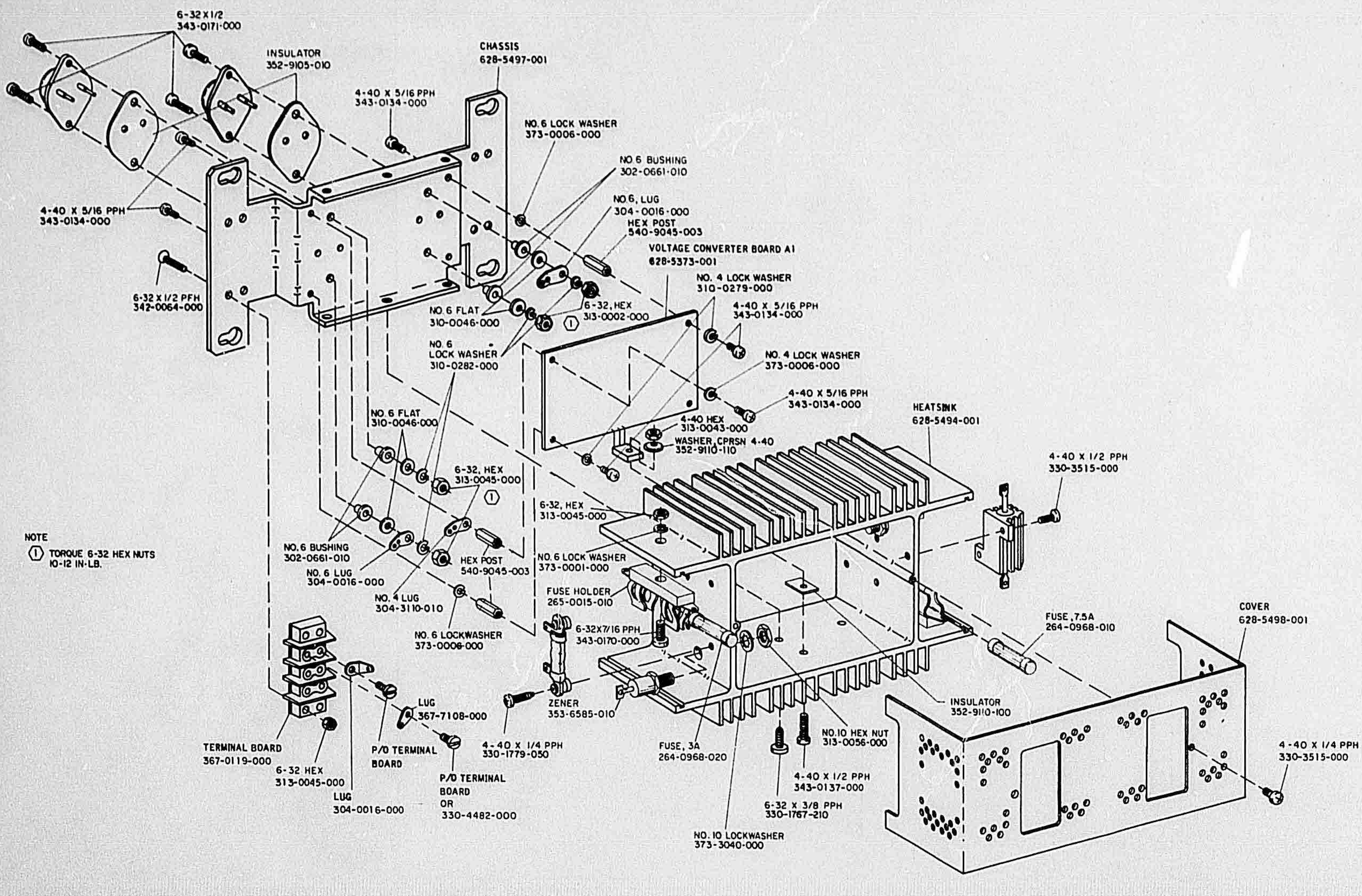
c. Place the printed circuit board in a well ventilated area and evenly spray the postcoating over the board to provide a uniform coating. Allow 15 minutes for drying, then spray the opposite side of the board if required. Apply a second coat to each side allowing at least 15 minutes between coats. After the second coat has been made, set the board aside and allow 30 minutes at room temperature for drying. Board will be completely cured after 24 hours at room temperature.

d. After coating, inspect board surface. Coating should be relatively smooth and uniform without bare spots or thick globules/runs. When fully cured, coating should be hard, free of stickiness, and exhibit a smooth glossy appearance.

EXPLODED VIEW CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
None	Transistors Q2 and Q4 are no longer supplied with mounting hardware. Compression washer 352-9110-110 and insulator 352-9110-100 are required.	NA	REV W

PWC-150 Power Converter, Exploded View
Figure 5-3 (Sheet A)



PWC-150 Power Converter, Exploded View
Figure 5-3

06

PWC-150 Power Converter

S-TEC Corporation
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diagrams

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list of illustrations

Figure	*Page*
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6-2 PWC-150 Power Converter, Schematic Diagram	6-3

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section VI
diagrams

6.1 CONFIGURATION STATUS CONTROL

S-TEC Corporation used the following method for identifying the configuration status of a unit or subassembly.

A 2-character maximum alphabetic identifier will be preceded by the letters REV (revision) and will start with — if no changes have been processed. The first change will be identified as A, the second as B, and continuing through Z to AA, AB, and ultimately to ZZ. Incorporation of design changes in a unit or subassembly that has been returned to Collins for repair by a customer or that has been removed from the company's finished goods inventory is defined as rework. At the time of rework, the unit or subassembly will be marked again to reflect the design level to which it is being upgraded. This is done by leaving the original marking on the unit or subassembly and adding the letters RWK (rework) followed by the alphabetic identifier of the latest change incorporated in the rework. For example, unit one is marked REV B — RWK F and unit two is marked REV F. This indicates that both units are at the design level of revision F, but unit one is reworked and they may not look exactly the same.

Note

A reworked unit may not contain all design changes made to the reworked identifier, but does contain all changes required to make unit operation identical to a newly manufactured unit with the same identifier. Therefore, a unit reworked to a specific identifier may physically appear different from a newly manufactured unit with the same alphabetic identifier.

Only alphabetic identifiers that result in schematic changes are covered in this section. If a unit or subassembly has an identifier that alphabetically falls between identifiers on the schematic changes pages, or after the last identifier on the schematic changes page up to and including the latest effectivity listed below, the electrical configuration is represented by the earlier identifier listed on the schematic changes page.

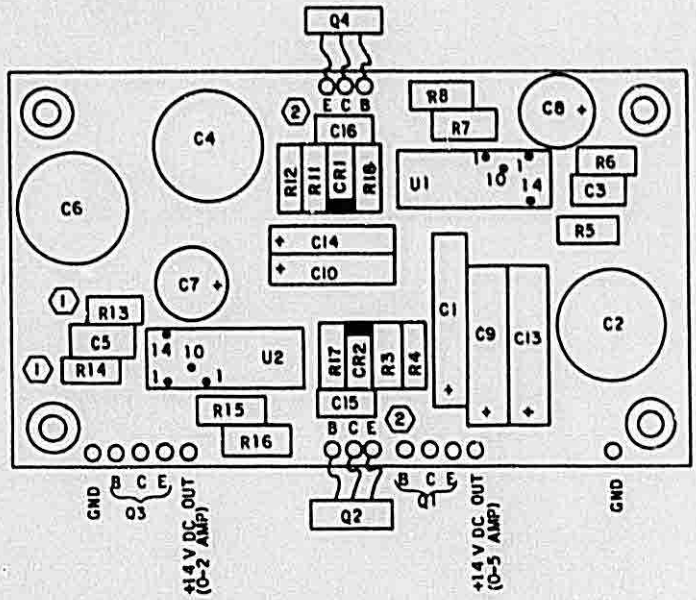
6.2 SCHEMATIC DIAGRAMS

Figure 6-1 is the PWC-150 component location diagram.

The PWC-150 Power Converter schematic diagram is provided in figure 6-2.

A schematic change sheet precedes the figure. The change sheet provides a description of schematic changes, a reason for the changes, the service bulletin number (if applicable) that modifies the unit, and the production cut-in effectivity for the change.

NOTE:
1. CAPACITORS C13 AND C14 INCORPORATED BY REVISION K.
2. CAPACITORS C15 AND C16 INCORPORATED BY REVISION N.



PWC-150 Power Converter, Component Location Diagram
Figure 6-1

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
1	Added C7, C8, C9, C10; R13 was 1 kilohm, R14 was 6800 ohms, C1 was 0.1 μF. Changes made to prevent parasitic oscillation.	NA	REV E
2	Added R17, R18; R3 and R11 were 470 ohms, C9 and C10 moved from chassis to PCB. Connected U2 pin 10 to U2 pin 3. Changes made to reduce loop gain and improve ripple performance.	NA	REV H
3	Corrected connection of capacitor C10.	NA	NA
4	Added C11 and C12; C6 was 0.1 μF and C10 was 10 μF. Changes made to prevent supply oscillation.	NA	REV J
5	Changed values and locations of capacitors C11 and C12 to prevent supply oscillation. C11 and C12 were both 10 μF.	NA	REV H
6	Changed value of C9 and C10 from 22 to 10 μF, and added C13 and C14 to reduce oscillation tendencies.	NA	REV K
7	Changed value of R5 from 1200 to 1210 ohms, R6 from 3300 to 3400 ohms, R13 from 680 to 590 ohms, and R14 from 3.9 kΩ to 4320 ohms, to stabilize current limiting threshold.	NA	REV L
	Added F1, F2, VR1, and VR2 to provide overload/short-out protection.	1	REV L
H	Add C15, C16 and changed value of C3, C5 to improve PWC-150 stability.	NA	REV N

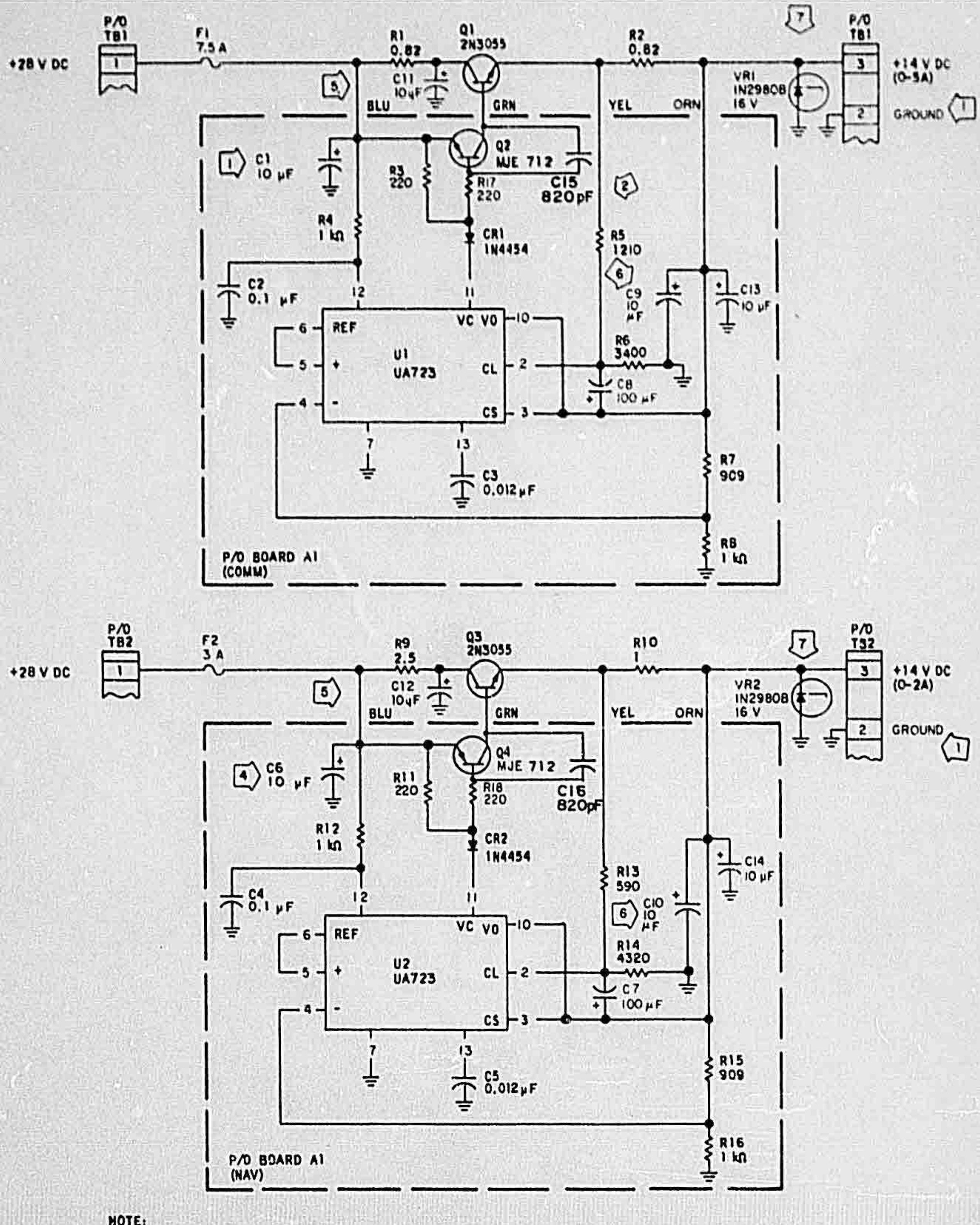
PWC-150 Power Converter, Schematic Diagram
Figure 6-2 (Sheet A)

PARTS LIST
PWC-150 POWER CONVERTER
ASSEMBLY PART NUMBER 628-5373-001

SYMBOL	DESCRIPTION	PART NUMBER
C1	CAPACITOR, FIXED, TANTALUM, 10 UF, ±20%, 50 V (EFF REV F)	184-0460-100
C1	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.1 UF, +80-20%, 50 V	913-3298-140
C2	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.1 UF, +80-20%, 50 V	913-3298-140
C3	CAP, CER, 0.012 UF, 10%, 100 V (EFF REV N)	913-5019-330
C3	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01 UF, +80-20%, 50 V (EFF THRU REV M)	913-3298-130
C4	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.1 UF, +80-20%, 50 V	913-3298-140
C5	CAP, CER, 0.012 UF, 10%, 100 V (EFF REV N)	913-5019-330
C5	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.01 UF, +80-20%, 50 V (EFF THRU REV M)	913-3298-130
C6	CAPACITOR, FIXED, TANTALUM, 10 UF, ±20%, 50 V (EFF REV J)	184-0460-100
C6	CAPACITOR, FIXED, CERAMIC, DIELECTRIC, 0.1 UF, +80-20%, 50 V	913-3298-140
C7	CAPACITOR, FIXED, TANTALUM, 100 UF, ±20%, 10 V	184-9113-140
C8	CAPACITOR, FIXED, TANTALUM, 100 UF, ±20%, 10 V	184-9113-140
C9	CAPACITOR, FIXED, TANTALUM, 10 UF ±20%, 20 V (EFF REV K)	184-0460-090
C9	CAPACITOR, FIXED, TANTALUM, 22 UF, ±20%, 20 V (EFF REV E)	184-0460-110
C10	CAPACITOR, FIXED, TANTALUM, 10 UF, ±20%, 20 V (EFF REV K)	184-0460-090
C10	CAPACITOR, FIXED, TANTALUM, 22 UF, ±20%, 20 V (EFF REV J)	184-0460-110
C10	CAPACITOR, FIXED, TANTALUM, 10 UF, ±20%, 20 V (EFF REV E)	184-0460-090
C11	CAPACITOR, FIXED, TANTALUM, 10 UF, 20%, 50 V (EFF REV T)	184-0460-100
C11	CAPACITOR, FIXED, TANTALUM, 22 UF, 20%, 20 V (EFF REV G)	184-0460-110
C12	CAPACITOR, FIXED, TANTALUM, 10 UF, 20%, 50 V (EFF REV T)	184-0460-100
C12	CAPACITOR, FIXED, TANTALUM, 22 UF, 20%, 20 V (EFF REV G)	184-0460-110
C13	CAPACITOR, FIXED, TANTALUM, 10 UF, ±20%, 20 V (EFF REV K)	184-0460-090
C14	CAPACITOR, FIXED, TANTALUM, 10 UF, ±20%, 20 V (EFF REV K)	184-0460-090
C15	CAP, CER, 820 PF, 10%, 200 V (EFF REV N)	913-4017-000
C16	CAP, CER, 820 PF, 10%, 200 V (EFF REV N)	913-4017-000
CR1	DIODE, 1N4454	353-3741-010
CR2	DIODE, 1N4454	353-3741-010

PARTS LIST
PWC-150 POWER CONVERTER
ASSEMBLY PART NUMBER 628-5373-001

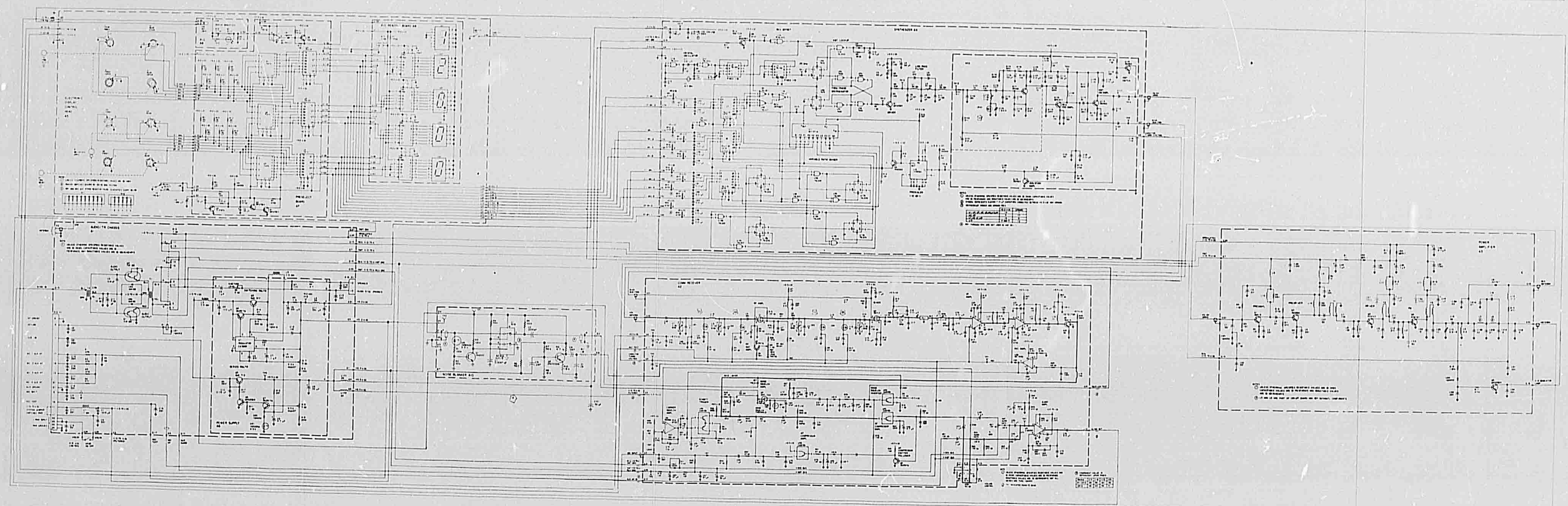
SYMBOL	DESCRIPTION	PART NUMBER
F1	FUSE, 7A (EFF REV L; SB 1)	264-0968-010
F2	FUSE, 3A (EFF REV L; SB 1)	264-0968-020
Q1	TRANSISTOR, 2N3055	352-1026-010
Q2	TRANSISTOR, MJE712	352-5000-010
Q3	TRANSISTOR, 2N3055	352-1026-010
Q4	TRANSISTOR, MJE712	352-5000-010
R1	RESISTOR, FIXED, WIREWOUND, 0.82 OHM, ±10%, 20 W	747-2186-020
R2	RESISTOR, FIXED, WIREWOUND, 0.82 OHM, ±10%, 20 W	747-2186-020
R3	RESISTOR, FIXED, COMPOSITION, 220 OHMS, 10%, 1/4 W (EFF REV H)	745-7950-170
R3	RESISTOR, FIXED, COMPOSITION, 470 OHMS, 10%, 1/4 W	745-7950-210
R4	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4 W	745-7950-250
R5	RESISTOR, FXD, FILM, 1210 OHMS, 1%, 1/8 W (EFF REV L)	745-7956-340
R5	RESISTOR, FIXED, COMPOSITION, 1200 OHMS, 10%, 1/4 W	745-7950-260
R6	RESISTOR, FXD, FILM, 3400 OHMS, 1%, 1/8 W (EFF REV L)	745-7956-770
R6	RESISTOR, FIXED, COMPOSITION, 3300 OHMS, 10%, 1/4 W	745-7950-310
R7	RESISTOR, FIXED, FILM, 909 OHMS, ±1%, 1/8 W	745-7956-220
R8	RESISTOR, FIXED, FILM, 1K, ±1%, 1/8 W	745-7956-260
R9	RESISTOR, FIXED, WIREWOUND, 2.5 OHMS, ±10%, 15 W	747-2172-020
R10	RESISTOR, FIXED, WIREWOUND, 1 OHM, ±10%, 10 W	747-2172-010
R11	RESISTOR, FIXED, COMPOSITION, 220 OHMS, 10%, 1/4 W (EFF REV H)	745-7950-170
R11	RESISTOR, FIXED, COMPOSITION, 470 OHMS, 10%, 1/4 W	745-7950-210
R12	RESISTOR, FIXED, COMPOSITION, 1K, 10%, 1/4 W	745-7950-250
R13	RESISTOR, FXD, FILM, 590 OHMS, 1%, 1/8 W (EFF REV L)	745-7956-040
R13	RESISTOR, FIXED, COMPOSITION, 680 OHMS, 10%, 1/4 W	745-7950-230
R14	RESISTOR, FXD, FILM, 4320 OHMS, 1%, 1/8 W (EFF REV L)	745-7956-870
R14	RESISTOR, FIXED, COMPOSITION, 3.9K, 10%, 1/4 W	745-7950-320
R15	RESISTOR, FIXED, FILM, 909 OHMS, ±1%, 1/8 W	745-7956-220
R16	RESISTOR, FIXED, FILM, 1K, ±1%, 1/8 W	745-7956-260
R17	RESISTOR, FIXED, COMPOSITION, 220 OHMS, 10%, 1/4 W (EFF REV H)	745-7950-170
R18	RESISTOR, FIXED, COMPOSITION, 220 OHMS, 10%, 1/4 W (EFF REV H)	745-7950-170
TB1	TERMINAL BOARD	367-0119-000
TB2	TERMINAL BOARD	367-0119-000
U1	INTEGRATED CIRCUIT, 723C	351-1177-010
U2	INTEGRATED CIRCUIT, 723C	351-1177-010
VR1	ZENER DIODE, 16 V, 1N2980B (EFF REV L; SB 1)	353-6585-010
VR2	ZENER DIODE, 16 V, 1N2980B (EFF REV L; SB 1)	353-6585-010



NOTE:
UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, AND CAPACITANCE VALUES ARE IN PICOFARADS.

PWC-150 Power Converter, Schematic Diagram
Figure 6-2

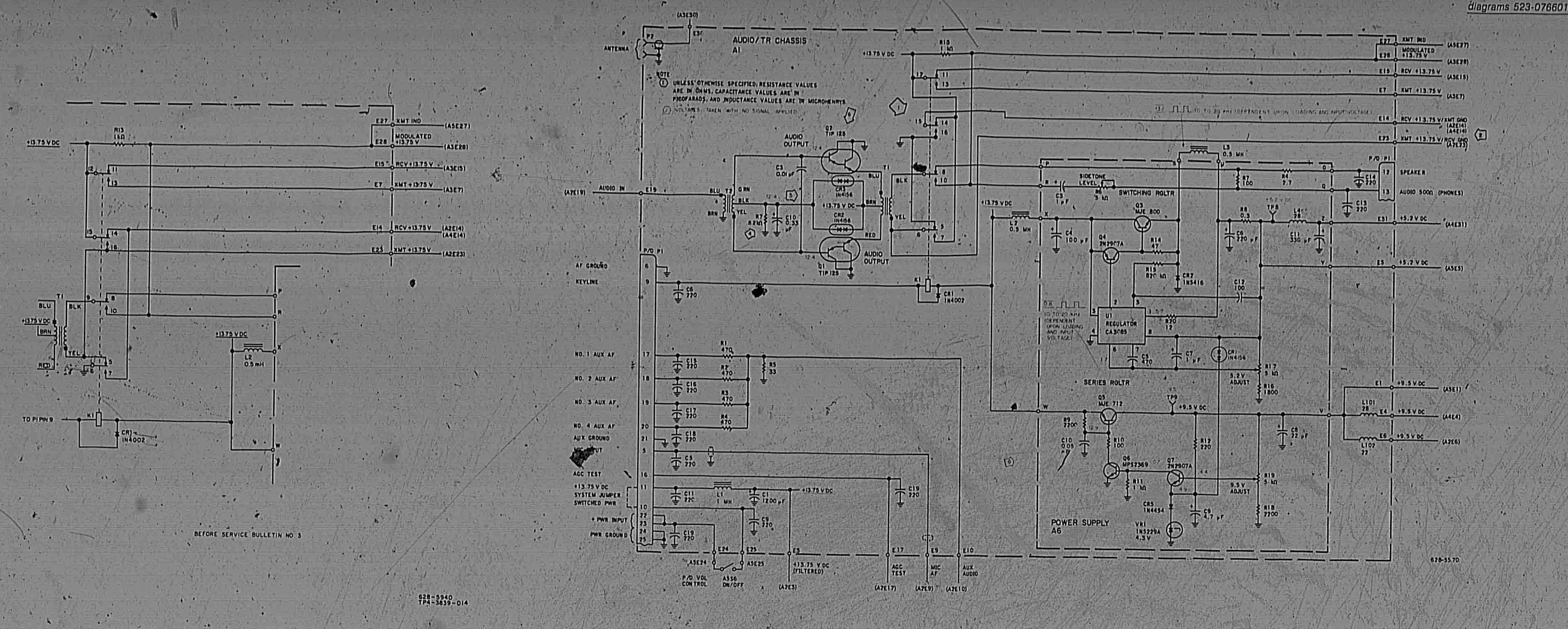
A



VHF-251 Communications Transceiver, Unit Schematic
Figure 6-1

A

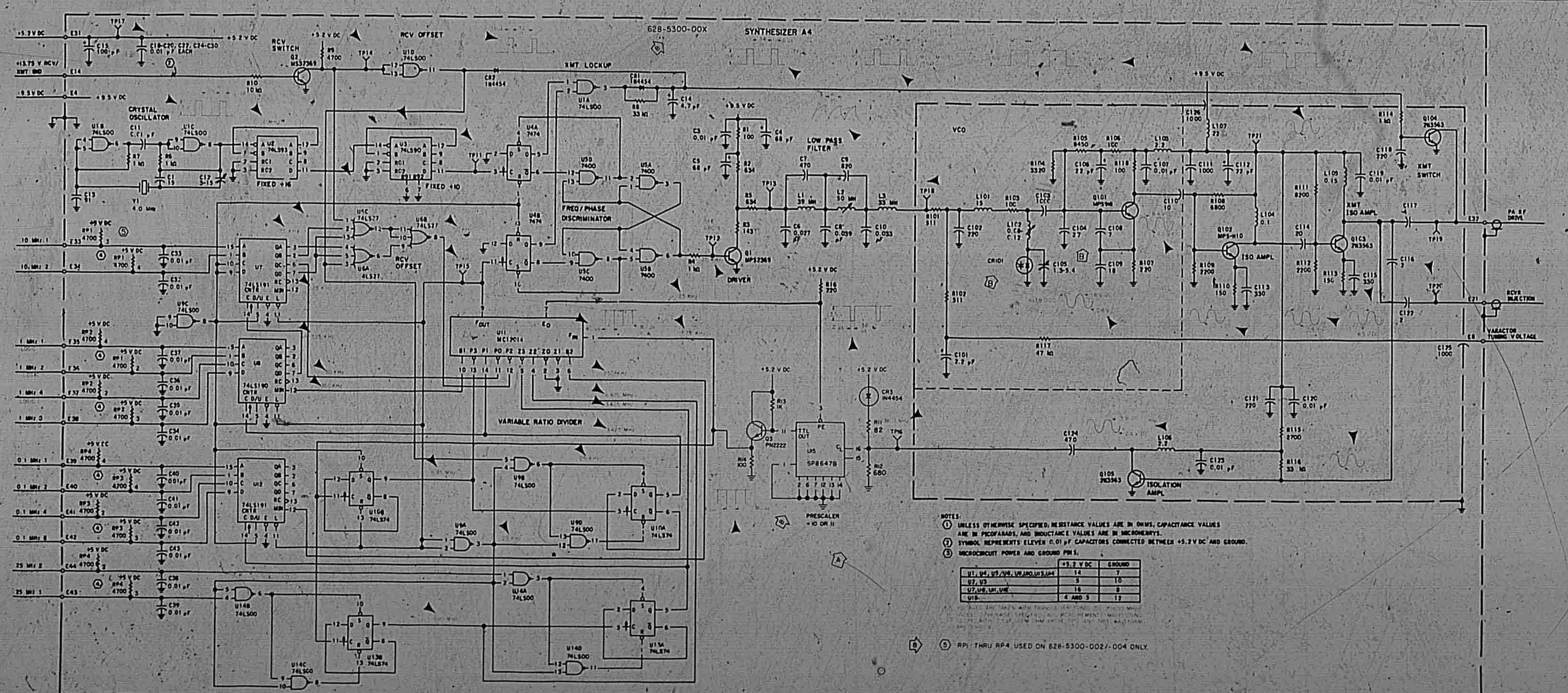
diagrams 523-0766013



Audio/TR Chassis A1 and Power Supply A6 Schematic
Figure 6-13

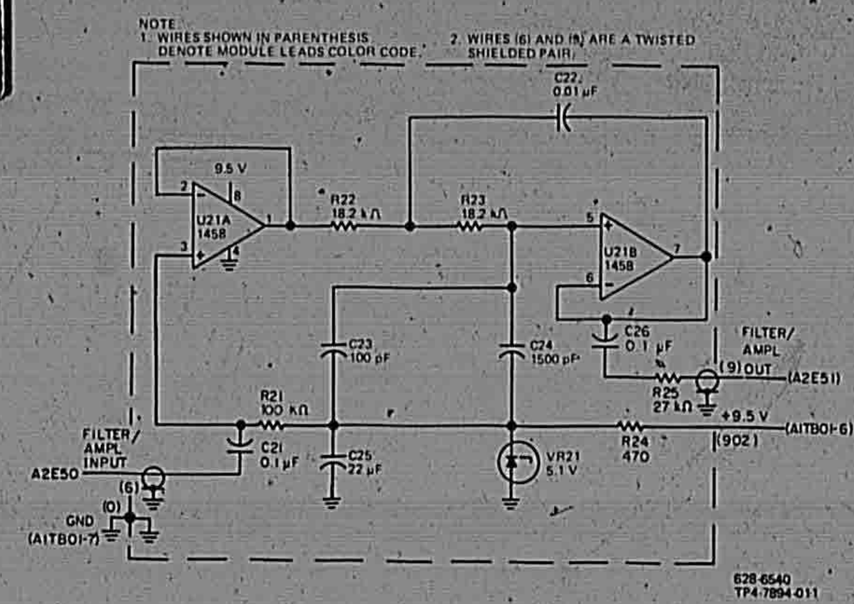
C

diagrams 523-0766013



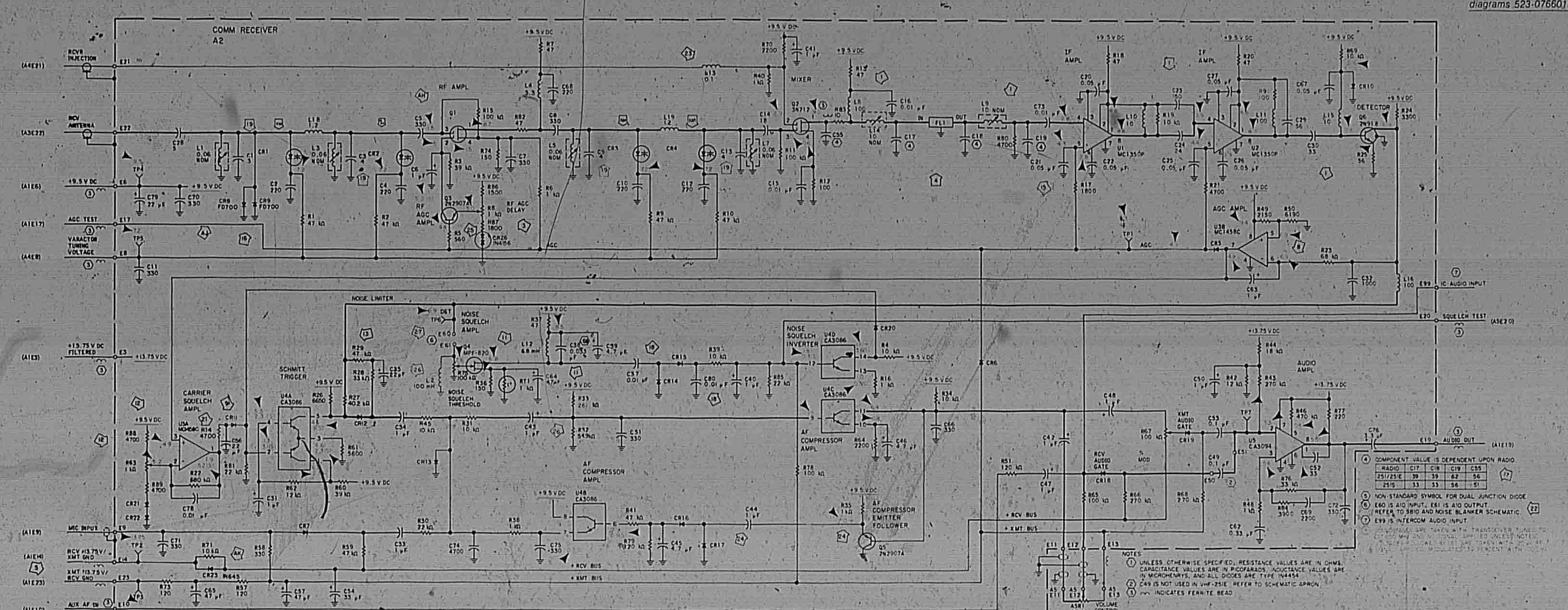
Synthesizer A4, Schematic Diagram, Board No. [illegible]
Figure 6-27

G



628-6640
TP4-7984-011

VHF-251E Filter Amplifier, Collins Part Number [illegible]

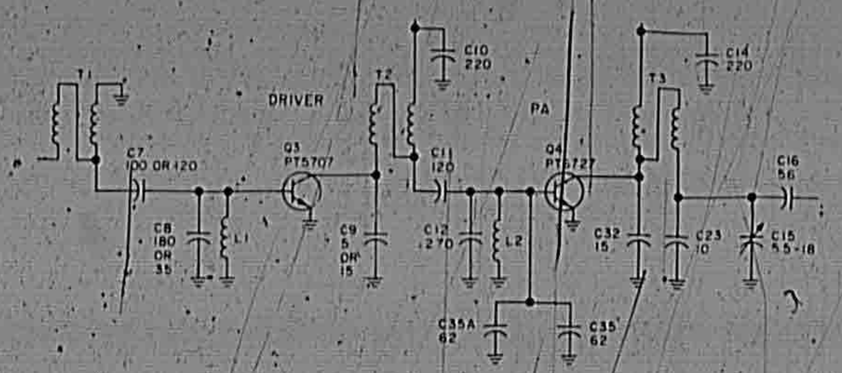


628-5567

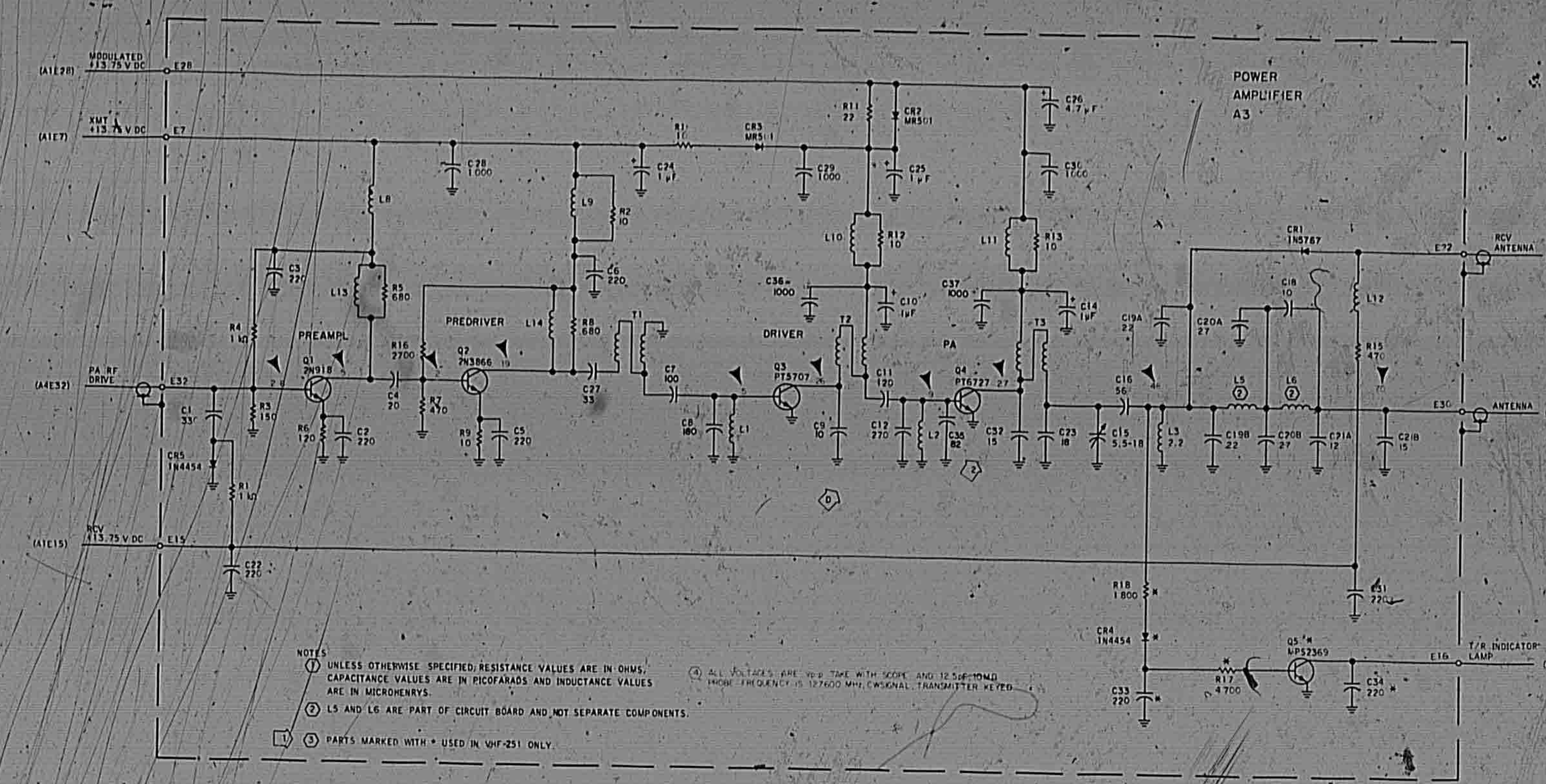
Comm Receiver A2 Schematic
Figure 6-17

I

diagrams 523-0766013



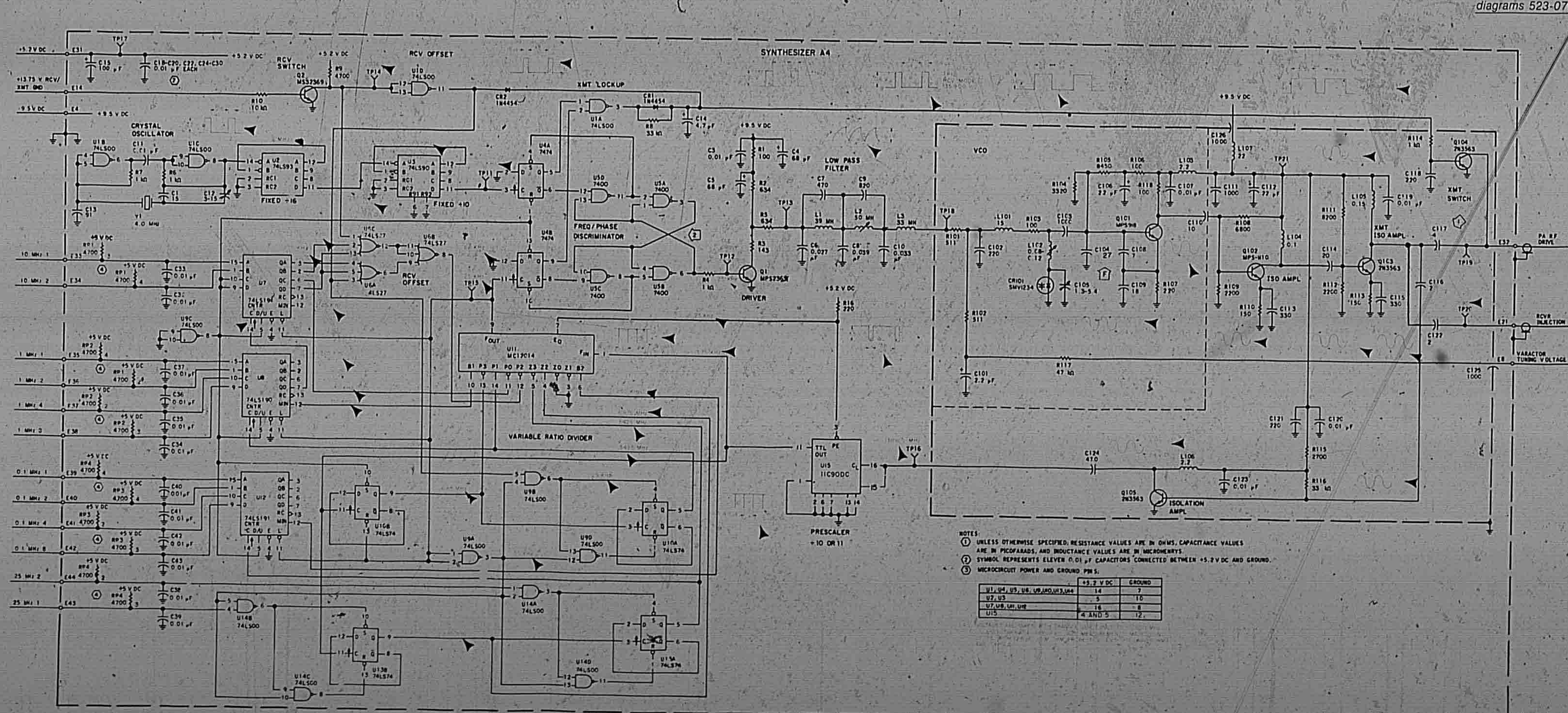
Before Revision Letter T, VHF-251 SB 13, VHF-251S SB 6, VHF-251E SB 2



Power Amplifier A3 Schematic
Figure 6-25

K

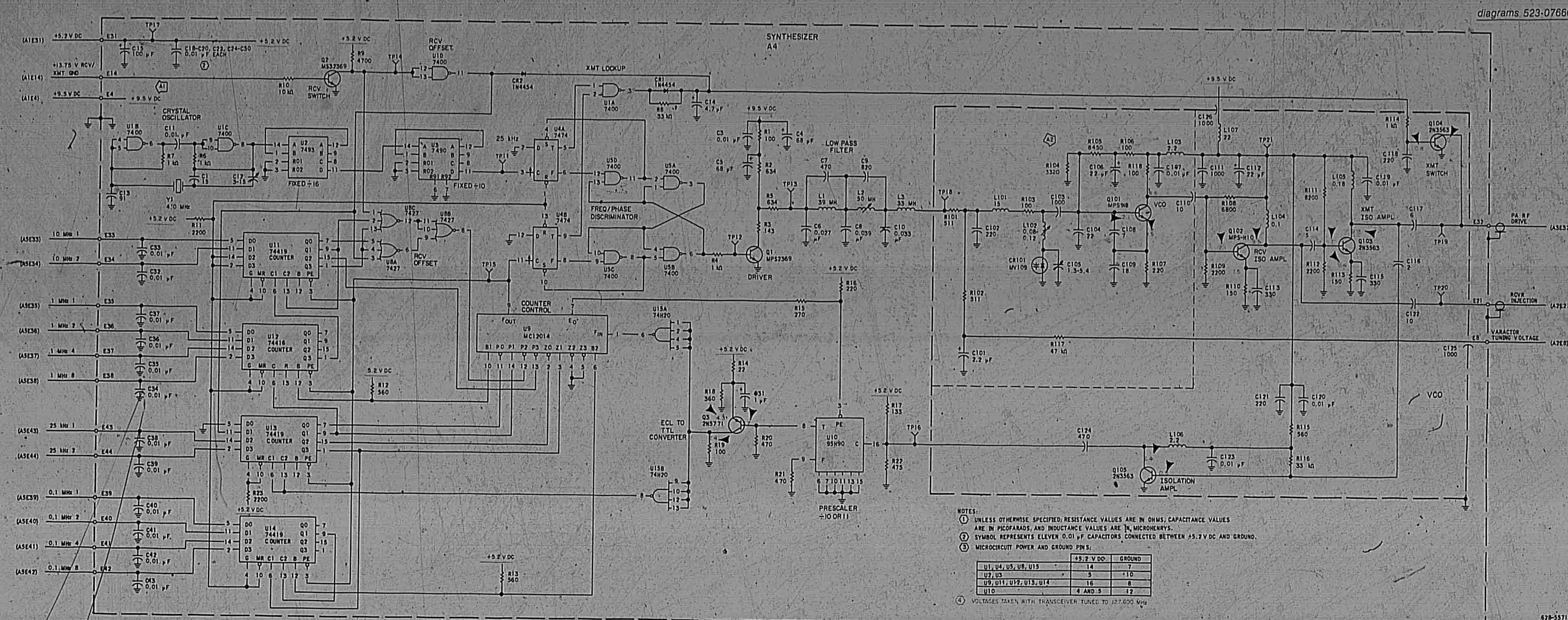
diagrams 523-0766013



Synthesizer A4 Schematic Diagram, Board No [illegible]
Figure 6-29

M

diagrams 523-0766013



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.
2. SYMBOL REPRESENTS ELEVEN 0.01 μF CAPACITORS CONNECTED BETWEEN +5.2 V DC AND GROUND.
3. MICROCIRCUIT POWER AND GROUND PINS:

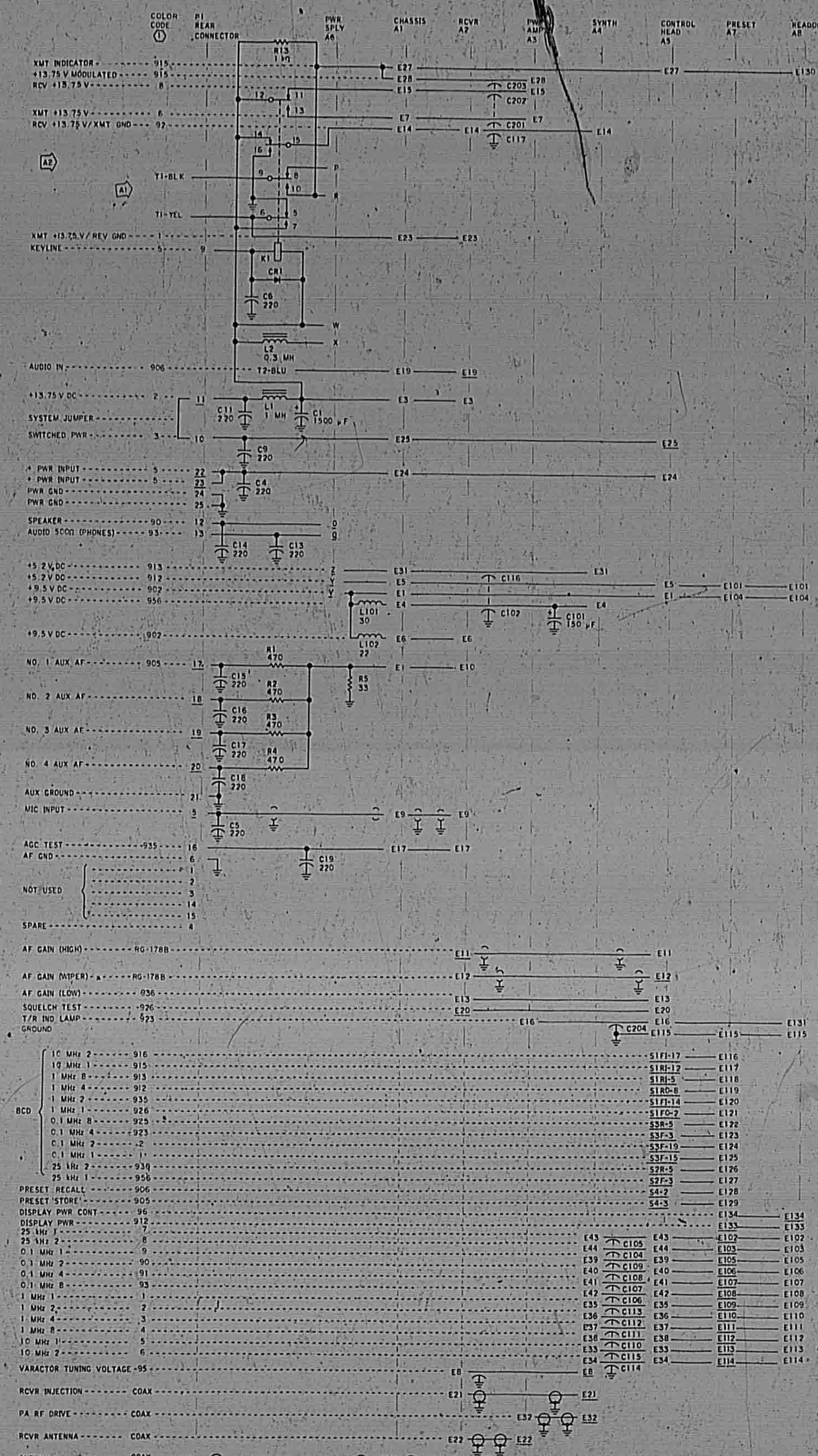
	+5.2 V DC	GROUND
U1, U4, U5, U8, U15	14	7
U2, U3	5	10
U9, U11, U12, U13, U14	16	8
U10	4 AND 5	12

4. VOLTAGES TAKEN WITH TRANSCEIVER TUNED TO 127.000 MHz

628-5571
TP4-0515-026

Synthesizer A4, Schematic Diagram, Board No 628-5030-002
Figure 6-31

Q



NOTES

1. NUMBERS IN THIS COLUMN INDICATE WIRE COLOR CODE.

0 = BLACK	5 = GREEN
1 = BROWN	6 = BLUE
2 = RED	7 = VIOLET
3 = ORANGE	8 = GRAY
4 = YELLOW	9 = WHITE

EXAMPLE: 913 = WHITE WIRE WITH BROWN AND ORANGE TRACERS.

2. UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.
3. UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.
4. UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.
5. FEED-THRU CAPACITORS ARE 1000 pF, 50 V DC (COLLINS PART NUMBER 913-3303-010)

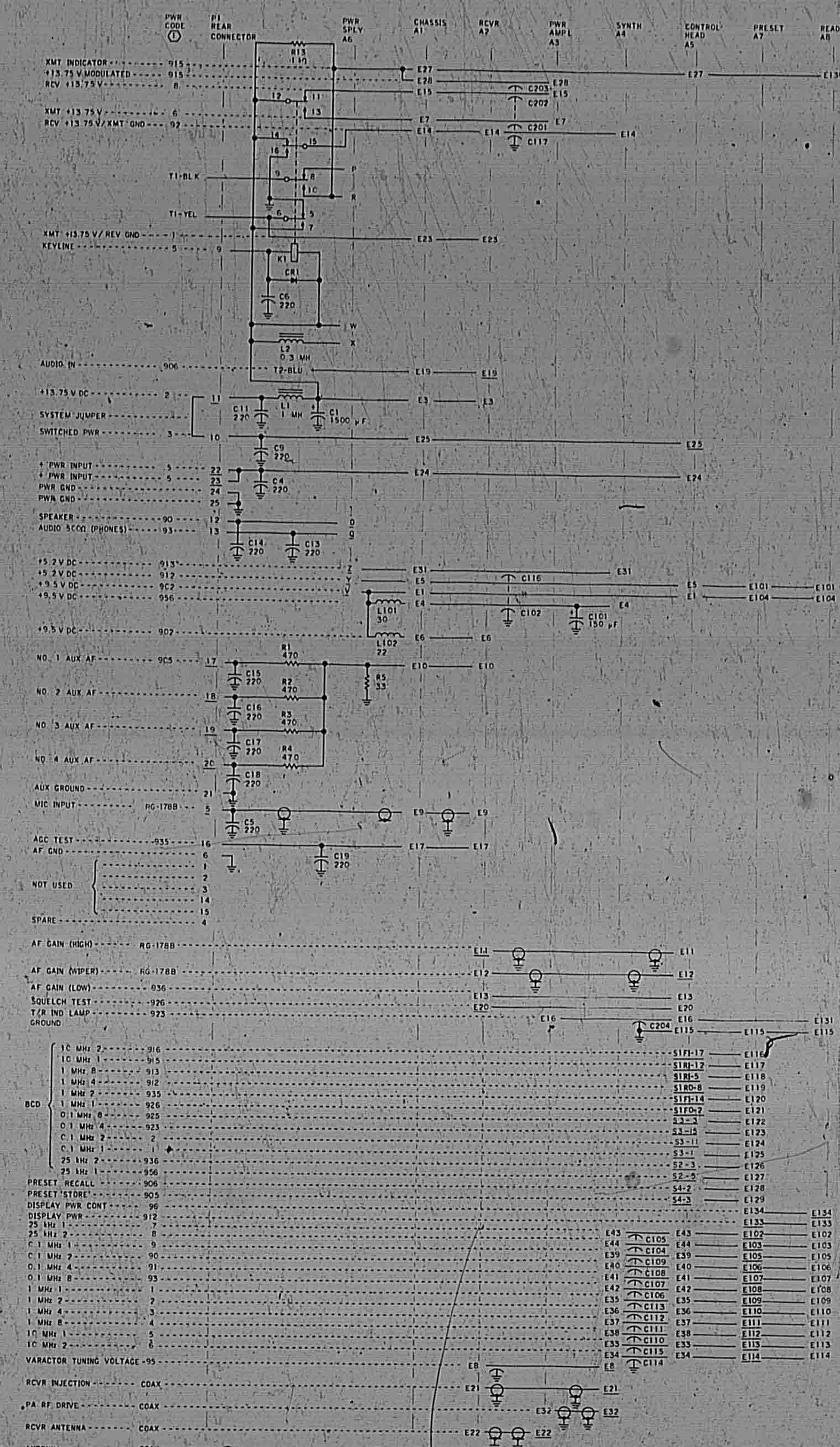
VHF-251 Chassis Wiring Schematic
Figure 6-32

628-5574
TP4-0518-015

Revised 27 February 1981

diagrams 523-0766013

R



NOTES

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3. UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.
4. UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.
5. FEED-THRU CAPACITORS ARE 1000 pF, 50 V DC (COLLINS PART NUMBER 913-3303-010)

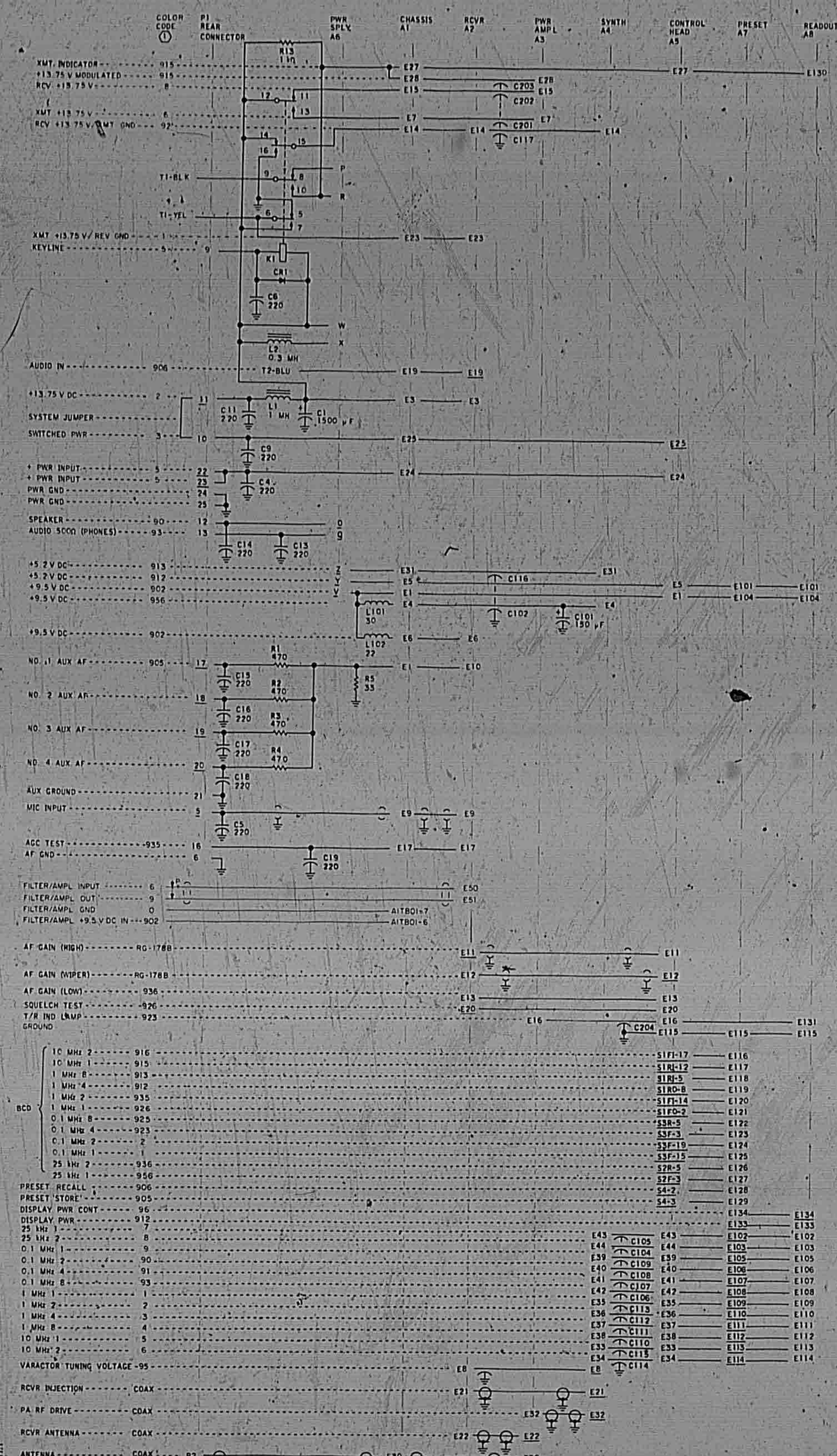
VHF-251S Chassis Wiring Schematic
Figure 6-33

628-6271
TP4-6656-015

Revised 27 February 1981

diagrams 523-0766013

U



NOTES

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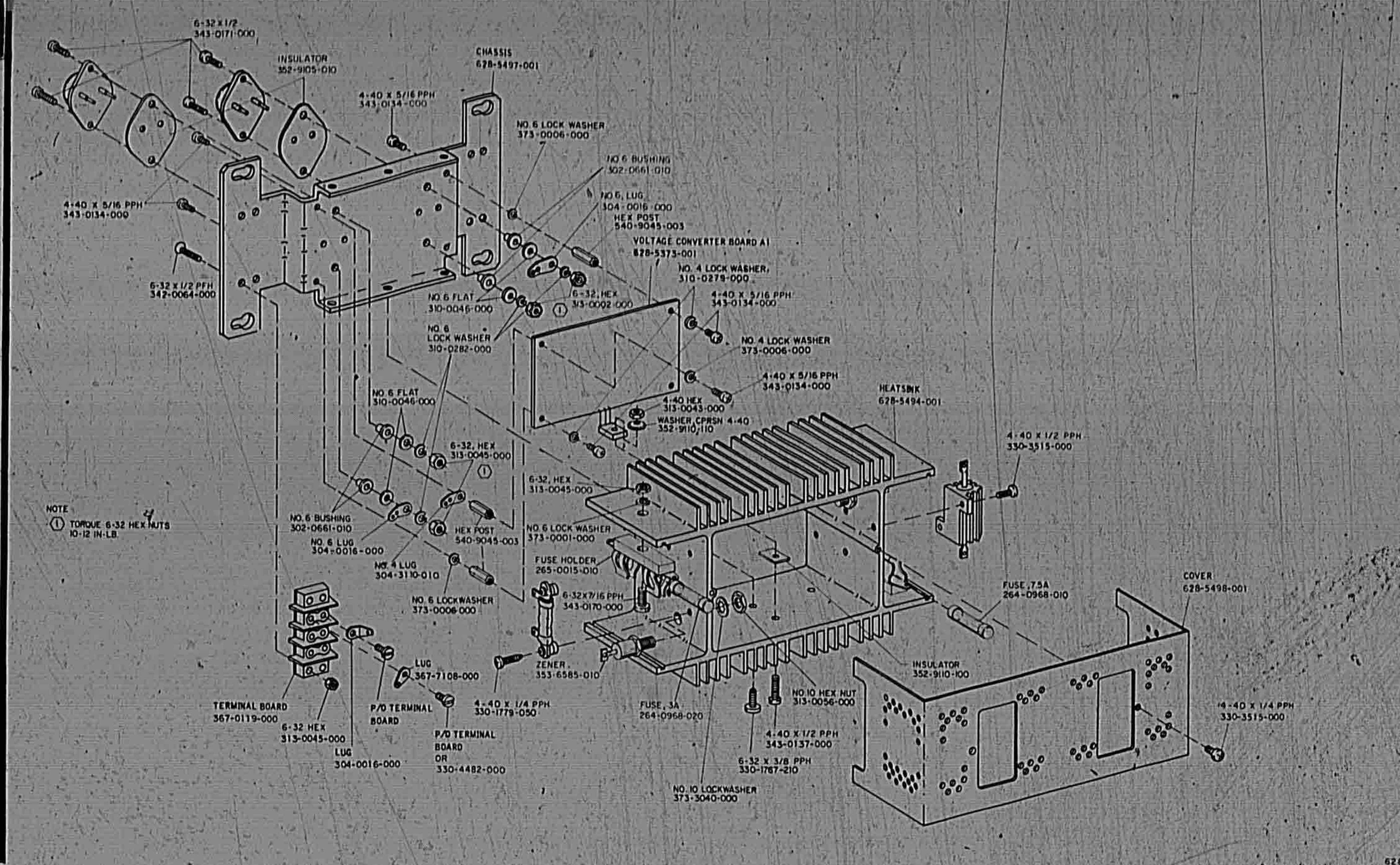
3. UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ON THIS INTERCONNECT ARE PART OF CHASSIS A1.
4. UNDERLINED NUMBERS INDICATE POINT OF SIGNAL ORIGIN.
5. FEED-THRU CAPACITORS ARE 1000 pF, 50 V DC (COLLINS PART NUMBER 913-3303-010).

628-6637

VHF-251E Chassis Wiring Schematic
Figure 6-45

V



PWC-150 Power Converter, Exploded View
Figure 5-3

AIRCRAFT TECHNICAL PUBLISHERS

MANUFACTURER: ROCKWELL INTERNATIONAL

MODEL: COMMUNICATIONS TRANSCEIVER
VHF - 253/253S

TYPE OF PUBLICATION: INSTRUCTION BOOK

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RECORD OF REVISIONS	See each Sec.
RECORD OF TEMPORARY REVISIONS	NIC
HIGHLIGHTS PAGE	NIC
LIST OF EFFECTIVE PAGES	See each Sec.
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NUMERICAL INDEX	NIC

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II	INSTALLATION	1C06
III	OPERATION	1E06
IV	THEORY	1F06
V	MAINTENANCE	1G06
VI	DIAGRAMS	1J06
	BULLETINS	2B02
	APPENDIX	2B08

523-0771196-00211A

Rockwell International

instruction book

Collins VHF-253/253S Communications Transceiver

This instruction book includes:
VHF-253/253S Communications Transceiver

Description	*523-0771197*
Installation	*523-0771198*
Operation	*523-0771199*
Theory	*523-0771200*
Maintenance	*523-0771201*
Diagrams	*523-0771202*
Bulletins	*523-0771203*
Appendix	*523-0771204*

Collins General Aviation Division
Avionics Group
Rockwell International
Cedar Rapids, Iowa 52498

Printed in the United States of America

Caution

The material in this manual is subject to change. Before attempting any maintenance operation on the equipment covered in this manual, verify that you have complete and up-to-date publications by referring to the applicable Publications and Service Bulletin Indexes.

We welcome your comments concerning this instruction book. Although every effort has been made to keep it free of errors, some may occur. When reporting a specific problem, please describe it briefly and include the instruction book part number, the paragraph or figure number, and the page number.

Send your comments to: Publications Department
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Rockwell International
Cedar Rapids, Iowa 52498

Collins VHF-253/253S Communications Transceiver

Rockwell International

description

Collins General Aviation Division

Printed in USA

●523-0771197-002118
2nd Edition, 1 November 1983

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1.2	Equipment Supplied	1-1	
1.3	Purpose of Equipment	1-1	
1.4	Equipment Specifications	1-2	1B03
1.5	Associated Equipment	1-5	1B06
1.6	License Requirements	1-5	

NOTICE: This section replaces first edition dated 1 September 1981.

List of Effective Pages

*The asterisk indicates pages changed, added, or deleted by the current change.

Page No	Issue
*Title	1 Nov 83
*List of Effective Pages	1 Nov 83
*1-1 thru 1-4	1 Nov 83
1-5	1 Sep 81
1-6 Blank	1 Sep 81

Record of Revisions

RETAIN THIS RECORD IN THE FRONT OF MANUAL.
ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS.

REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	1 Sep 81		1, 2				
2nd Ed	1 Nov 83		1, 2, 3				

section I
description

1.1 INTRODUCTION

This instruction book contains all the specifications, installation instructions, equipment operating procedures, principles of operation, and information necessary for proper maintenance of the VHF-253/253S Communications Transceivers.

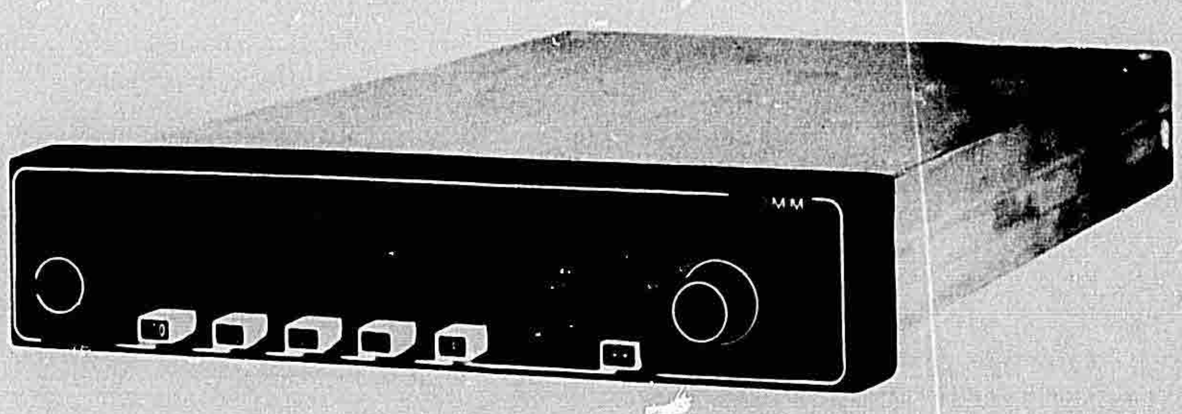
1.2 EQUIPMENT SUPPLIED

Table 1-1 lists the various statuses of the VHF-253/253S covered by this instruction book. The VHF-253/253S is shown in figure 1-1. The installation kit provides all materials necessary for installation except for the vhf communications antenna, interconnecting wires and coaxial cables, microphone, headphones or speaker, and any custom made support brackets that may be required. Figure 2-1 in the installation section of this instruction book provides an exploded view of the kit and lists the materials it contains.

The optional speaker amplifier is factory installed in transceivers with part numbers ending in -003 (-004). The speaker amplifier can be installed in the other transceivers by installing Service Bulletin No 1 and modification kit CPN 653-9011-001.

1.3 PURPOSE OF EQUIPMENT

The VHF-253/253S transceivers are panel-mounted, 720-channel vhf voice transceivers providing AM voice communication in the frequency range from 118.00 through 135.975 MHz in 25-kHz increments. The only difference between the VHF-253 and VHF-253S is the bandwidth of the receiver circuits. The VHF-253 has a narrow bandwidth and is intended for operation in areas using 25-kHz channel spacing with or without offset carriers. The VHF-253S has a wide bandwidth and will operate satisfactorily in areas where the received carrier frequency varies as much as 13 kHz from nominal.



TP6-1630-017

VHF-253/253S Communications Transceiver
Figure 1-1

Table 1-1. Equipment Covered.

UNIT	COLLINS PART NUMBER	DESCRIPTION
VHF-253	622-5640-001	720-channel vhf voice transceiver; 118.000 through 135.975 MHz in 25-kHz increments, intercom (without installation kit)
VHF-253	622-5640-002	Same transceiver as above, supplied with installation kit CPN 653-9000-001
VHF-253	622-5640-003	720-channel vhf voice transceiver; 118.000 through 135.975 MHz in 25-kHz increments, intercom, speaker amplifier (without installation kit)
VHF-253	622-5640-004	Same transceiver as above supplied with installation kit CPN 653-9000-001
VHF-253S	622-5641-001	720-channel vhf voice transceiver; 118.000 through 135.975 MHz in 25-kHz increments, intercom, wide-band receiver (without installation kit)
VHF-253S	622-5641-002	Same transceiver as above, supplied with installation kit CPN 653-9000-001
VHF-253S	622-5641-003	720-channel vhf voice transceiver; 118.000 through 135.975 MHz in 25-kHz increments, intercom, wide-band receiver, speaker amplifier (without installation kit)
VHF-253S	622-5641-004	Same transceiver as above, supplied with installation kit CPN 653-9000-001

Both the VHF-253 and VHF-253S have the following design features:

- Large liquid crystal display for exceptional readability in sunlight
- Visible active and preset frequencies, and four stored preset frequencies
- Remote sequencing through all stored preset frequencies and remote swap of preset and active frequencies for "hands off" communications
- Stuck mike protection
- Single crystal, LSI digital frequency synthesizer
- Mike level control and indicator, and audio tone control accessible through front panel
- Optional internal speaker amplifier
- +11 to +32 V dc operation with the same unit
- Lower weight and significantly less power required (less heat generated) than for other TSOd communications systems.

1.4 EQUIPMENT SPECIFICATIONS

Table 1-2 lists the equipment specifications of the VHF-253/253S Communications Transceiver.

Table 1-2. VHF-253/253S Communications Transceiver, Equipment Specifications.

CHARACTERISTICS	SPECIFICATIONS
Related documents	
FAA TSO	-C37b class II, -C38b, DO-160A environmental categories /A1C1/B/KPS/EXXXXXZBBBA
Physical	
Dimensions (mounted in tray)	
Width	160 mm (6.3 in)
Height	33 mm (1.3 in)
Length	307 mm (12.1 in)
Rear extension, including tray	267 mm (10.5 in) max
Mounting	Panel mounted
Kit	CPN 653-9000-001
Weight	1.23 kg (2.7 lb) max, with tray and connectors (Weight marked on nameplate includes tray and connectors.)
Environmental	
Temperature range	
Continuous	-20 to +55 °C (-4 to +131 °F)
Intermittent	To +70 °C (+158 °F) for 30 minutes
Storage	-55 to +85 °C (-67 to +185 °F)
Altitude	10 700 m (35 000 ft) max
Cooling	Ram air or fan to move air around transceiver
Relative humidity	95% at +65 °C (149 °F) for 10 days
Shock	
Operational	6 g
Crash safety	15 g (10 ms duration)
Vibration	Certified for panel mount in piston or turbine, fixed or rotary wing aircraft

Table 1-2. VHF-253/253S Communications Transceiver, Equipment Specifications (Cont).

CHARACTERISTICS	SPECIFICATIONS
Electrical	
General	
Channels	720
Frequency range	118.000 to 135.975 MHz in 25-kHz increments
Frequency stability	+0.0015%
Power requirements	Receive: +11 to +32 V dc, 8 watts Transmit: +11 to +32 V dc, 60 watts
Transmitter	
Vhf power output	10 watts, minimum
Modulation	85% modulation capability; 95% limiting, less than 15% distortion at 85% modulation.
Audio input impedance	150 ohms unbalanced with excitation current for a 50- to 600-ohm carbon or transistorized dynamic or electret microphone
Duty cycle	1 minute on, 4 minutes off
Receiver	
Sensitivity	Not more than 3.0 μV will provide a 10-dB minimum signal-plus-noise to noise ratio.
Selectivity	
VHF-253	Typical 6 dB at ±10.0 kHz, 60 dB at ±22.0 kHz
VHF-253S	Typical 6 dB at ±17.0 kHz, 60 dB at ±38.0 kHz
Spurious response	10 mV spurious signal produces no more output than a desired signal producing 6 dB s +n/n.
Squelch	Automatic squelch (phase noise reduction) with carrier override
AGC characteristics	From 10 μV to 20 000 μV, audio output will not vary more than 3 dB.
Audio	
Headphone output	50 mW into a 500-ohm load
Frequency range	Within 6 dB from 350 to 2500 Hz Down 18 dB minimum at 4000 Hz
Speaker ampl option	
Auxiliary audio inputs	Six 500-ohm inputs isolated from each other by 30 dB
Speaker output	5 watts into a 3.2-ohm speaker load

1.5 ASSOCIATED EQUIPMENT

The equipment listed in table 1-3 is required for proper operation of the VHF-253/253S, but is not supplied with the unit.

Table 1-3. Equipment Required But Not Supplied.

EQUIPMENT	TYPE
VHF communications antenna	
Interconnecting cables	Per interconnect wiring diagrams in installation section
Headphones or speaker	Any
Microphone	Shure 488 T or equivalent hand microphone or Telex 5x5 Pro II or equivalent headset

1.6 LICENSE REQUIREMENTS

An aircraft radio station license is required to operate the VHF-253/253S Communications Transceiver. A Federal Communications Commission (FCC) Application for Aircraft Radio Station License, Form 404, specifying each equipment by type number and manufacturer must be submitted to obtain the license. The FCC requires that the operator of the system hold a Restricted Radiotelephone Operator's Permit or a higher class license. To obtain this permit, apply at the nearest FCC field office. The applicant must be a citizen of the United States. No examination is required to obtain the restricted license.

Application for Aircraft Radio Station License, Form 404, is available by writing to the FCC, Gettysburg, PA 17325. For convenience, the document is reprinted in the appendix of this instruction book.

Collins VHF-253/253S Communications Transceiver

Rockwell International

installation

Collins General Aviation Division

Printed in USA

523-0771198-003118
3rd Edition, 1 November 1983

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NOTICE: This section replaces second edition dated 1 September 1981.

List of Effective Pages

*The asterisk indicates pages changed, added, or deleted by the current change.

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*Title	1 Nov 83
*List of Effective Pages	1 Nov 83
2-1	1 Jun 81
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2-10	1 Jun 81
*2-11 thru 2-16	1 Nov 83
*2-17 thru 2-18 Deleted	1 Nov 83

Record of Revisions

RETAIN THIS RECORD IN THE FRONT OF MANUAL.
ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS.

REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	1 Jun 81		1				
2nd Ed	1 Sep 81		1, 2				
3rd Ed	1 Nov 83		1, 2, 3				

2.1 GENERAL

This section provides the information required to properly plan and install a single or dual VHF-253/253S Communications Transceiver system. Postinstallation procedures are also provided to ensure proper operation after installation.

2.2 UNPACKING AND INSPECTING EQUIPMENT

Unpack equipment carefully and make a visual inspection of the unit for possible shipping damage. All claims for damage should be filed with the transportation company involved. If claims for damage are to be filed, save the original shipping container and materials. If no defects can be detected, replace packing materials in the shipping container and save for future use (such as storage or reshipment).

2.3 SPECIAL INSTRUCTIONS

The following special instructions must be followed to ensure proper installation of the VHF-253/253S. Damage to the equipment can occur if these instructions are not followed.

Caution

The locking pawl on the bottom of the unit must be in the retracted position prior to inserting the unit into the mounting tray.

a. Install the transceiver so that the pilot and copilot view it head-on or from above its long axis. The frequency displays may be difficult to read if they are viewed from below the long axis.
b. Ensure that the lower lip of the mounting tray is flush with the front of the instrument panel. This ensures proper engagement of the rear connectors when the transceiver is installed in the tray.
c. When inserting the transceiver into the mounting tray, do not push on the liquid crystal display area. To insert, place thumbs on bottom corners and gently apply pressure until the tab on the locking pawl touches the tray. Use a 5/64-inch Allen wrench to tighten the locking pawl.
d. When removing the transceiver from its mount, loosen the locking pawl fully to loosen the rear connectors, then grasp the unit by the control knobs and carefully pull the unit from the mount.
e. The minimum wire size for all power lines is #18 AWG. (#20 AWG wire can be used for the speaker amplifier power.)
f. Read all notes on drawings and interconnects and the paragraphs on planning before installing any units or cabling.

2.4 PLANNING

Proper planning of the communications system prior to installation will result in a more reliable and usable system. The following is a partial list of items to consider during planning:

a. Single or dual transceivers
b. Optional speaker amplifier (SB 1) or audio panel
c. Remote transfer switch
d. Remote select switch
e. Equipment location on instrument panel
f. Antenna selection and location
g. Microphone selection

If a particular installation differs from any of the typical interconnects provided in this section, then prepare a list of the differences so that they can be readily incorporated into the interconnect cabling.

The following paragraphs provide some insight into the more important items that must be considered when planning the communications system.

2.4.1 Application Information

The VHF-253/253S is intended for two-way air traffic control and advisory communications in piston- or turbine-powered airplanes or helicopters.

These transceivers are not intended for:

a. Military or other applications involving two-way communications between aircraft in close formation flight.

b. Use in which one crew member is transmitting with one transceiver while another crew member simultaneously monitors a different channel with a second transceiver.

The VHF-253 is recommended for operations in the United States of America and other regions where the vhf communications system employs 25-kHz channel spacing with or without offset carriers. The VHF-253S is intended for use in regions where the frequency tolerance of ground transmitters is not controlled accurately enough to support the 25-kHz channel spacing.

The only difference between the two transceiver types is the receiver bandwidth. The wider band receiver in the VHF-253S will pass signals with frequency errors up to 13 kHz from the nominal channel frequency. This greater bandwidth, however, limits the ability of the receiver to reject undesired signals on an adjacent 25-kHz channel. Therefore, the VHF-253 should be selected for use in regions employing the 25-kHz channel spacing.

2.4.2 Transceiver Options

The VHF-253/253S has several optional operational features that can be incorporated by adding a few switches to the aircraft. None of these options require any changes to the transceiver except the optional speaker amplifier which requires the installation of Service Bulletin No 1.

2.4.2.1 Remote Transfer Switch

The addition of a remote transfer switch on the yoke or cyclic stick allows the pilot to exchange the active and preset frequencies without having to remove his hands from the aircraft controls. This switch duplicates the function of the transfer switch on the front panel of the transceiver. This option is incorporated by installing a momentary-action, normally-open pushbutton or toggle switch as shown in the interconnect diagrams, figures 2-5 through 2-8.

Each time the remote transfer switch is pushed, the transceiver exchanges the two displayed frequencies and briefly sounds a tone to annunciate the transfer. (To guard against possible interruption of service, the transceiver ignores the transfer switch during transmissions.) In some installations, it may be desirable to install a guard ring around the switch to minimize the possibility of inadvertently pushing the switch.

2.4.2.2 Remote Frequency Selection Switch

The addition of a remote selection switch on the yoke or cyclic stick allows the pilot to step through the stored preset frequencies, one at a time, to find the one he wants without removing his hands from the aircraft controls. This option is incorporated by installing a momentary-action, normally-open pushbutton or toggle switch as shown in the interconnect diagrams, figures 2-5 through 2-8.

The transceiver maintains an internal counter to know which of the stored frequencies was last called up with the remote selection switch. The next time the pilot pushes the switch, the next stored frequency appears in the preset window. The pilot can repeatedly cycle through the four stored frequencies.

2.4.2.3 Combined Remote Frequency Selection and Transfer Switch

Both of the remote tuning functions can be combined in a double-throw, momentary-action toggle switch with a center-off position. The switch is connected so that the common terminal is grounded: one momentary contact is connected to the transfer function (pin 31), and the other momentary contact is connected to the select function (pin 12). The switch is usually mounted so that the pilot pushes the switch to step through the stored frequencies and pulls the switch to transfer frequencies.

2.4.2.4 Speaker Amplifier Option

The optional speaker amplifier provides a 5-watt audio output for a 3.2-ohm speaker. Also provided are six auxiliary audio inputs, a speaker sidetone input, and a speaker mute input. This option requires the installation of Service Bulletin No 1. Figure 2-6 is an interconnect diagram for the VHF-253/253S with the optional speaker amplifier.

Observe the following when planning an installation using the speaker amplifier:

a. Each auxiliary audio input requires 50 milliwatts to produce rated audio output.
b. Some equipment from manufacturers other than Collins may require a 4-ohm load on its speaker output to avoid distortion when it is loaded only with the 500-ohm auxiliary audio input of the VHF-253/253S.
c. If two speakers are required, use two 8-ohm speakers, connected in parallel. Phase the speakers so that both cones move in the same direction simultaneously. This speaker amplifier will not

produce full-rated output into two 3.2-ohm speakers connected either in series or in parallel.

d. The intercom feature of the VHF-253/253S cannot be used when the VHF-253/253S headphone output is connected to an active speaker amplifier. Acoustic feedback results if the speaker and intercom microphone are active simultaneously.
e. Connect the speaker amplifier MUTE input directly to the microphone push-to-talk switch line. A diode or resistor between the switch and the mute input can prevent proper speaker muting during transmissions.
f. If speaker sidetone is desired, install a 1000-ohm potentiometer as a sidetone level adjustment, as shown in figure 2-6. Mount this control so it is not readily accessible to the pilot (misadjustment can result in acoustic feedback during transmissions). After installation, adjust the control for the minimum acceptable sidetone level, and check to ensure that acoustic feedback does not occur during transmissions.

2.4.3 Antenna Selection

Both selection and placement of the vhf comm antenna are important for good performance of the transceiver. Refer to paragraph 2.5.2 for information on placement of the antenna.

Generally, radiating efficiency is more important than vswr for getting the most range from a transceiver. Some antennas with low vswr (very little reflected power) dissipate most of the transmitter power as heat (most of the received signal is converted to heat, too). The signal that heats the antenna doesn't contribute to communications. With an inefficient antenna, communications may be limited to short distances.

For lower-speed aircraft, a simple rod antenna directly wired to the connector, with no matching network, often provides the best possible performance.

Blade antennas can be more rigid than simple rods, so they are usually required on higher-speed aircraft. As a class, however, they tend to be less efficient than simple rod antennas.

Communication antennas that are raked aft horizontally should not be used on top of the fuselage. These antennas, although stylish, are less efficient than vertical elements, and they tend to cause worse comm-to-nav interference problems when they are in a direct line with the nav antenna.

2.4.4 Microphone Selection

The VHF-253/253S offers excellent modulation fidelity; however, transmissions sound only as good as the microphone used. Choose a microphone for good-quality voice output and good cancellation of background noise.

The transceiver provides bias current for carbon, amplified dynamic or amplified electret microphones. Satisfactory performance is obtained with microphone output levels between 50 millivolts and 1.5 volts. Do not use unamplified ceramic, electret or dynamic microphones.

Use of a good amplified dynamic microphone such as the Shure 488T hand microphone, or an amplified electret microphone such as the Telex 5X5 Pro II boom microphone, will provide excellent transmission fidelity. Carbon microphones, in general, are unsatisfactory.

2.5 CABLING

The transceiver interconnect cables should be prepared in accordance with the interconnect diagrams, figures 2-5 through 2-8. These interconnect diagrams illustrate a single comm system with and without the optional speaker amplifier and a dual comm system with an external audio panel. Since these interconnects are typical, variations or modifications to meet customer requirements are inevitable. Refer to paragraph 2.4, planning, for information on some of the options that can affect the interconnect cabling.

The mating connectors and crimp contacts for the transceiver are provided in the installation kit (CPN 653-9000-001) which is provided with the unit. The mating connectors can be ordered separately. The Collins part numbers are shown on the installation kit diagram, figure 2-1. Figure 2-2 lists the transceiver mating connector pin assignments.

Warning

Ensure that the aircraft battery master switch is turned off before installing any of the interconnect cabling.

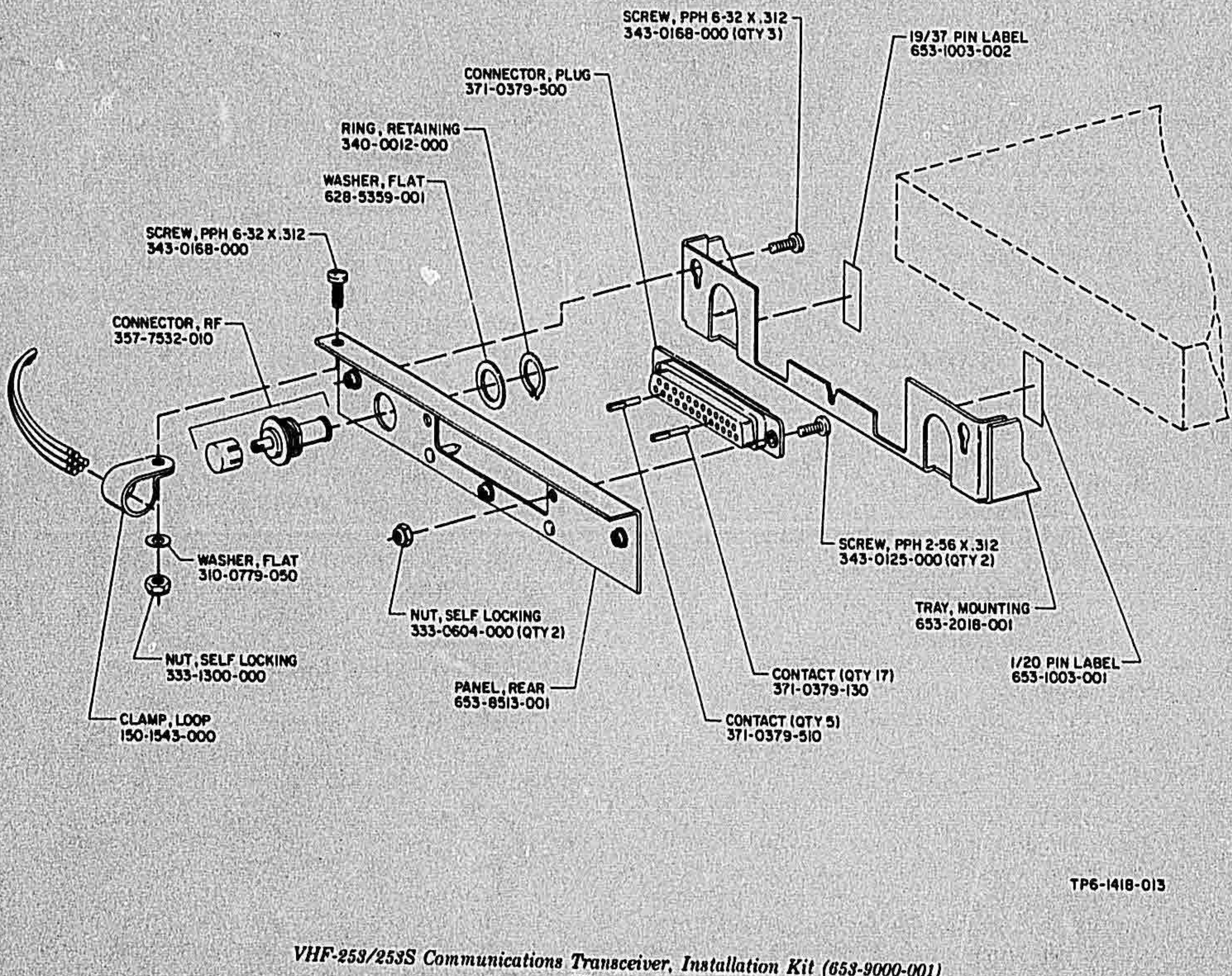
During preparation of the interconnect cables, observe the following precautions:

a. Keep the interconnect cables away from circuits carrying heavy current, pulse-transmitting equipment, and other sources of interference.

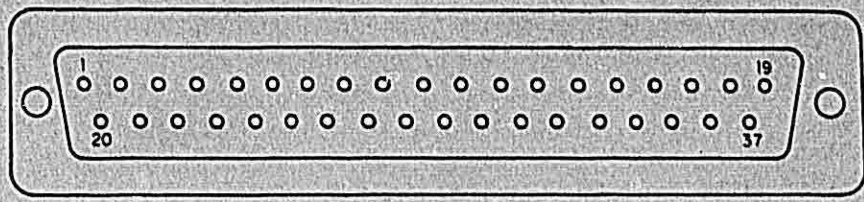
b. Avoid excessive cable lengths but allow sufficient slack for movement due to vibration.

c. After installation of the cables in the aircraft, and before installation of the equipment, check to ensure that aircraft power is applied only to the pins specified on the interconnect diagrams.

d. Remove and install connector contacts in accordance with steps e and f. Table 2-1 lists the special tools required to perform the following steps.



VHF-253/253S Communications Transceiver, Installation Kit (653-9000-001)
Figure 2-1



MATING CONNECTOR
(VIEWED FROM WIRING SIDE)

1	COMM POWER IN	20	COMM POWER IN
2	SPARE	21	POWER IN – SPKR AMPL*
3	POWER GROUND	22	POWER GROUND
4	XMIT MICROPHONE	23	AUX AUDIO IN 3*
5	AUX AUDIO IN 1 *	24	AUX AUDIO IN 4*
6	SPEAKER AMPL MUTE*	25	AUX AUDIO IN 5*
7	AUX AUDIO IN 2*	26	AUX AUDIO IN 6*
8	SPEAKER SIDETONE IN*	27	RESERVED
9	ICS MICROPHONE	28	RESERVED
10	SPARE	29	RESERVED
11	RESERVED	30	RESERVED
12	REMOTE SELECT	31	REMOTE TRANSFER
13	AGC TEST	32	PHONES AUDIO HI
14	COMPRESSOR DISABLE TEST	33	AUDIO GROUND
15	KEYLINE	34	SPEAKER AUDIO OUT*
16	SPARE	35	DIMMER GROUND
17	SPARE	36	DIMMER GROUND
18	DIMMER COMMON	37	14 VDC DIMMER
19	28 VDC DIMMER		

*APPLICABLE ONLY WHEN OPTIONAL SPEAKER AMPLIFIER IS INSTALLED
(REFER TO SERVICE BULLETIN NO. 1).

TP6-1419-011

VHF-253/253S Communications Transceiver, Mating Connector Pin Assignments
Figure 2-2

Table 2-1. Special Tools.

DESCRIPTION	MANUFACTURER & TYPE	COLLINS PART NUMBER
Crimping tool	Cannon, CCT-D*C-1	371-0382-010
Insertion/extraction tool - plastic	Cannon CIET-20HDB	371-8445-010
or		
Insertion/extraction tool - metal	Cannon CIET-22	371-8445-020

e. During installation of the mating connector, the connecting wires must be crimped in the contacts so that the crimped portion of the contact can enter the connector shell and provide a positive lock of the contact in the shell. Use the specified crimping tool or equivalent and crimp each interconnect wire in a contact. Use insertion/extraction tool and insert each wired contact into the proper connector hole from the rear and press until locked. Refer to figure 2-9.

f. To remove a contact, use the insertion/extraction tool to unlock the contact and pull it out of the connector from the rear.

g. Refer to figure 2-10 for instructions on installing the antenna cable connectors. Use RG-58 type coaxial cable.

2.6 INSTALLATION PROCEDURES

The following paragraphs provide instructions for installing the VHF-253/253S and associated vhf antenna. If an audio panel or other associated equipment is to be installed, refer to the applicable equipment instruction book for installation procedures.

Warning

Ensure that the aircraft battery master switch is turned off before installing any equipment, mounting trays, or interconnect cables.

2.6.1 Transceiver Installation

Installation kit, CPN 653-9000-001, normally supplied with the transceiver is required for installation. See figure 2-1. In most aircraft, mechanical installation involves only securing the mounting tray to the instrument panel mounting rails. Use four 6-32 panhead screws, and captive nuts. The rear of the mounting tray must also be supported; in most installations, however, this support is provided by mounting the transceiver above another radio. If other equipment does not rigidly support the rear of the mounting tray, drop hangers from the aircraft structure or other trays above the unit and bolt to the rear sides of the tray with 6-32 panhead screws, and captive nuts.

The mounting tray is the same height as the transceiver front panel to help in positioning the unit in the instrument panel or pedestal. The front panels of other adjacent equipment may extend above or below their mounting trays. Check for this possibility before installing the transceiver mounting tray to be certain that the unit will fit properly. The transceiver front panel and mounting tray are designed so that the front panel covers the sides of the mounting tray for a professional appearing installation.

If it is necessary to cut a hole in the instrument panel, use one of the panel cutout diagrams shown on the outline and mounting diagram, figure 2-4. It is easier to achieve an attractive installation when the mounting tray can be installed from the rear of the instrument panel.

Install the transceiver so that the pilot and copilot view it head-on or from above its long axis. The frequency displays may be difficult to read if they are viewed from below the long axis.

Plan the installation so that air will circulate around the transceiver. The transceiver has been designed to minimize internal heating; however, when several radios are mounted in a stack, they heat each other. Within limits, radios last longer at lower operating temperatures. Tests conducted on some large fleet operations have shown that reducing the operating temperature by ten degrees Celsius doubles the mean time between failures.

In unpressurized aircraft, ram air can be directed over the radio stack. In pressurized aircraft, a blower should be installed to move the air. The VHF-253/253S and its mounting tray are designed for horizontal airflow across the top and bottom covers. Directing the cooling air so that it moves across the covers minimizes heating from other equipment and extends the life of the transceiver.

The connector plate at the rear of the mounting tray can be removed to make installation easier. This permits installation of the cable connectors onto the connector plate prior to sliding the connector plate into position on the back of the tray. Secure the connector plate by tightening the three screws after the plate is in position.

If the transceiver is mounted at the bottom of a stack of radios, the locking pawl may occasionally bow the mounting tray downward and fail to properly extract the unit from the tray during removal. This can be prevented by installing a piece of aluminum angle or bar stock stiffener below the front edge of the mounting tray.

After the mounting tray has been installed, check to ensure that the locking pawl on the bottom of the transceiver is retracted and slide the transceiver into the mounting tray.

Caution

Do not push on the liquid crystal display area during installation of the transceiver.

To insert the transceiver, place thumbs on bottom corners and gently apply pressure until the tab on the locking pawl touches the mounting tray. Use a 5/64-inch Allen wrench through the front panel access hole to tighten the locking pawl and secure the transceiver in its mount.

2.6.2 Antenna Installation

Proper installation of a high-quality comm antenna is essential for optimum transceiver performance. Refer to paragraph 2.4.3 for information on antenna selection.

Mount comm antennas as far as possible away from other antennas and from the vertical stabilizer. Ideally, vhf communication antennas should be at least eight feet from other similar antennas and from the vertical tail. In most small aircraft, this is impossible. Closer spacings, though, produce ragged radiation patterns with weak zones at some bearings. Mounting the comm antenna as far as possible from the navigation antenna helps reduce comm-to-nav interference. Comm antennas should also be well separated from the emergency locator transmitter (ELT) antenna. With close spacing, the ELT antenna perturbs the comm radiation pattern. Additionally, many ELT's radiate broadband noise when excited by a comm transmission: this is a frequent cause of comm-to-nav interference. Keeping the antennas well apart minimizes the problem.

If a dual-transceiver installation is being made, vhf comm antennas should be no closer than 1.2 metres (4 feet) apart to minimize antenna interaction; preferably, one antenna is mounted on top of the fuselage and the other on the bottom. The top antenna should be mounted at the highest point above the cabin to ensure a good radiation pattern. Typically, the top-mounted antenna should be connected to Comm 2, and the belly antenna to Comm 1. This arrangement provides optimum communications while on the ground via Comm 2, and when airborne via Comm 1.

If it's absolutely necessary to mount both antennas on the same side of the aircraft, keep in mind that the antennas can interact with each other and produce large directional "dead spots". For this reason, the minimum allowable separation must be maintained.

The antenna base should be well bonded to metal aircraft skin. Remove paint from around the mounting holes and use external-tooth lockwashers between the antenna base and the skin, or under the screw heads, to assure a good connection between antenna and skin. Inadequate bonding often results in poor range and in interference to other receivers.

Communication antennas should be mounted on skin that is, as nearly as possible, horizontal in cruising flight. The skin should extend at least twenty-four inches from the base of the antenna in every direction. Any less will probably reduce the usable communication distance at some bearings around the aircraft.

Aircraft with fabric, fiberglass, or composite skins require special antenna mounting techniques. In many cases, a metal doubler plate must be installed inside the skin to structurally support the antenna. The doubler plate should, then, extend at least twenty-four inches, in every direction, from the antenna base. If this is impractical, it may be possible to cement metal foil inside the skin to extend the electrical ground plane to the minimum twenty-four inches. A foil extension must be well bonded to the doubler plate to be effective.

Comm transceiver performance depends heavily on the integrity of electrical bonding of the aircraft structure. If the electrical resistance between adjacent skin panels changes intermittently, noisy communications often result. Control surfaces not bonded to the wing or empennage may cause the same problem. Radio-frequency currents flow in the airframe while transmitting and while receiving. If the airframe characteristics change, the currents change, and the result is noise.

Connect the antenna to the VHF-253/253S with 50-ohm coaxial cable. Avoid sharp bends in the cable. Keep the comm antenna cables well away from other antenna cables: don't bundle several cables together. Typical coaxial cables leak signals through the shield. If cables for different types of equipment are close together, considerable interference may occur.

Connector corrosion is an easily prevented problem that is all too often encountered with antenna installations. An excellent means of retarding, and in many cases eliminating, corrosion is a liberal application of Dow-Corning DC-4 silicon grease (Collins part number 005-0201-000) both inside and outside of the connector and its mate. DC-4 will not adversely affect performance in any way; its sole purpose here is to provide an effective barrier against moisture.

2.7 POSTINSTALLATION TEST AND ADJUSTMENTS

2.7.1 Transceiver Tests

After all cabling has been installed and the equipment has been mounted in the aircraft, make the operational check given below to ensure proper operation of the equipment in the aircraft. These tests can be made using the aircraft power supply with the engine running or with an auxiliary power source.

a. Apply power to the VHF-253/253S by turning the VOL/TST control clockwise.
b. Check the squelch disable circuit by pulling the VOL/TST control. Noise from the receiver should be heard on the aircraft audio system.
c. Select the operating frequency of an active station within the immediate area and verify that frequency appears as selected in the preset (right) display window.
d. Push the transfer pushbutton and verify that the active and preset frequencies are exchanged.
e. Press the push-to-talk button and obtain a radio check with the active station.
f. Repeat steps c through e with other active stations on different frequencies if possible.
g. Verify proper operation of the frequency storage/recall feature by storing a different frequency in each of the numbered storage locations, and then recalling each frequency.

Note

When storing frequencies, the numbered preset button must be pushed within 5 seconds after the STO button is pushed. If a numbered button is pushed more than 5 seconds after pushing the STO button, the transceiver will recall the previously stored frequency instead of storing the new frequency.

2.7.2 Additional Dual Transceiver Tests

Warning

Severe distortion or total cancellation of the audio output of two communications transceivers can occur if their audio outputs are oppositely phased and they are used simultaneously while tuned to the same frequency or to different frequencies that are transmitting the same message. This situation can result in complete loss of an important message.

The design of the VHF-253/253S ensures that all units have the same audio phasing. It is possible however, that another unit in the audio system could invert the phase of the audio from one transceiver with respect to the other transceiver.

Perform the following test to check for audio cancellation:

a. Tune both transceivers to the same frequency (tune to an automated terminal information service (ATIS) if available). Set the audio selector switches so that both transceivers can be heard simultaneously.
b. Turn down the volume control on one of the transceivers and adjust the other transceiver for a comfortable audio level.

Note

Perform the following step while a signal is being received.

c. Slowly turn up the volume control on the transceiver that was turned down. Audio cancellation is occurring if any position of this volume control results in less audio volume than was produced by the other receiver alone.

Note

If the aircraft has more than two vhf communications transceivers, the above test should be repeated with each combination of two.

If cancellation occurs, perform one of the following:

a. If one of the transceivers has a floating audio output, invert its audio phase by reversing the audio high and audio low wires to the aircraft installation. Repeat the test to ensure that cancellation no longer occurs.
b. If neither transceiver has a floating audio output, install an audio isolation transformer with inverting connections between the audio output of one transceiver and the audio system. A 500- to 500-ohm or 600- to 600-ohm, line-to-line transformer rated for 100 milliwatts or more may be used. Repeat the test to ensure that cancellation no longer occurs.
c. If neither of the above solutions is feasible, apply a placard to the aircraft instrument panel with the following warning:

Warning

Do not monitor both vhf comm receivers simultaneously if both are tuned to the same frequency or to different frequencies that may carry the same message.

2.7.3 Transmit Microphone Gain Adjustment

The microphone level control is factory adjusted for satisfactory performance with most microphones. Readjustment may, however, be necessary if the VHF-253/253S is used with microphones with abnormally high or low output levels, or when the VHF-253/253S is used in extremely noisy aircraft.

This adjustment, if required, can be performed with the transceiver mounted in the aircraft. The microphone level control, shown in figure 2-3, is accessible through a hole in the transceiver front panel, below the frequency selector knobs. The LED microphone level indicator can be observed by sighting slightly upward through a hole in the transceiver front panel, under the volume control knob. This indicator is intentionally located so it will not be visible to the pilot, to avoid distraction.

To make the adjustment, rotate the level control fully counterclockwise with a small screwdriver. Tune the transceiver to a frequency that will not interfere with locally used channels. Key the transmitter with the push-to-talk switch. While speaking into the microphone with normal loudness, rotate the microphone level control clockwise until the microphone level indicator just begins to glow. This indicates optimum operation with audio compression just beginning to occur.

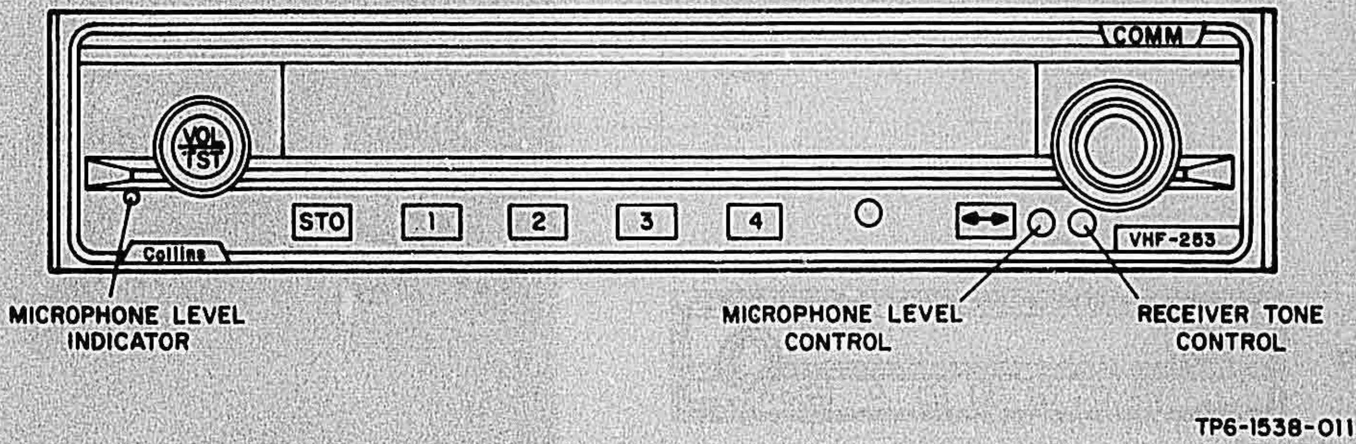
2.7.4 Receiver Tone Control Adjustment

The receiver tone control is accessible through a hole in the transceiver front panel (see figure 2-3) and provides a limited amount of receiver tone adjustment. Rotating the tone control clockwise emphasizes the higher frequencies and counterclockwise rotation reduces the higher frequencies.

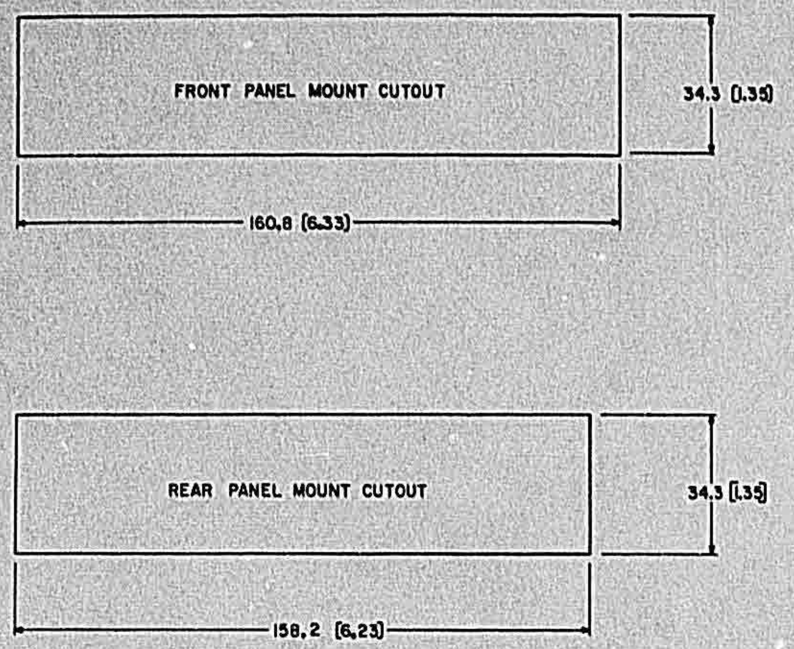
2.7.5 Intercom Level Adjustment

The trânsceiver intercom level can be made adjustable by adding a 2-kΩ variable resistor between each boom microphone and the ICS mic input to the VHF-253/253S as shown in figure 2-6.

To adjust the ICS audio level, one person should speak into the boom microphone while another person listens with headphones and adjusts the variable resistor. Repeat the procedure for each boom microphone installed.



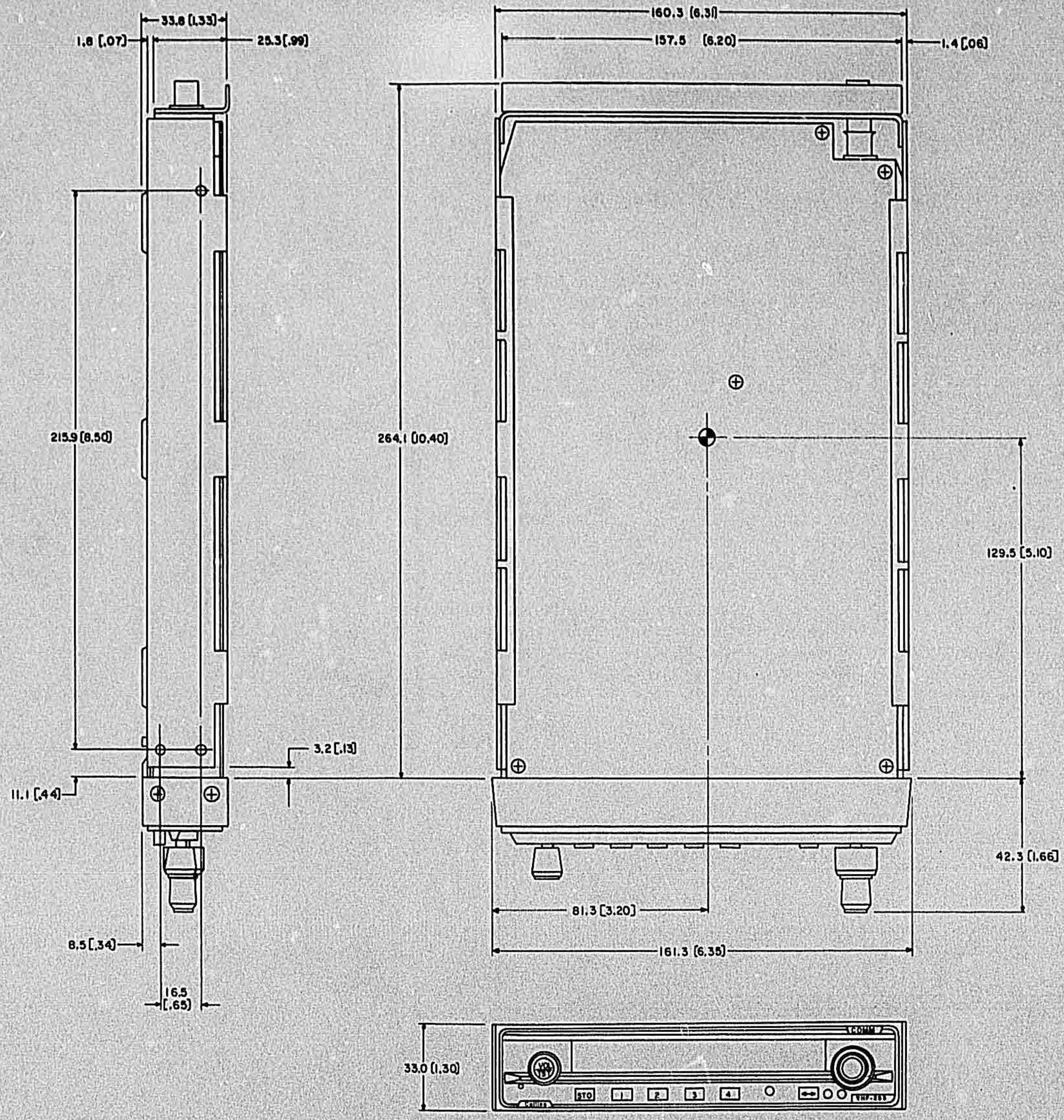
VHF-253/253S Communications Transceiver, Installation Adjustment Controls
Figure 2-3



NOTES:
1. DIMENSIONS ARE IN MM [INCHES].
2. CG IS WITH UNIT IN TRAY.
3. 1.2 kg [2.7 LB] INCLUDING MOUNTING TRAY.

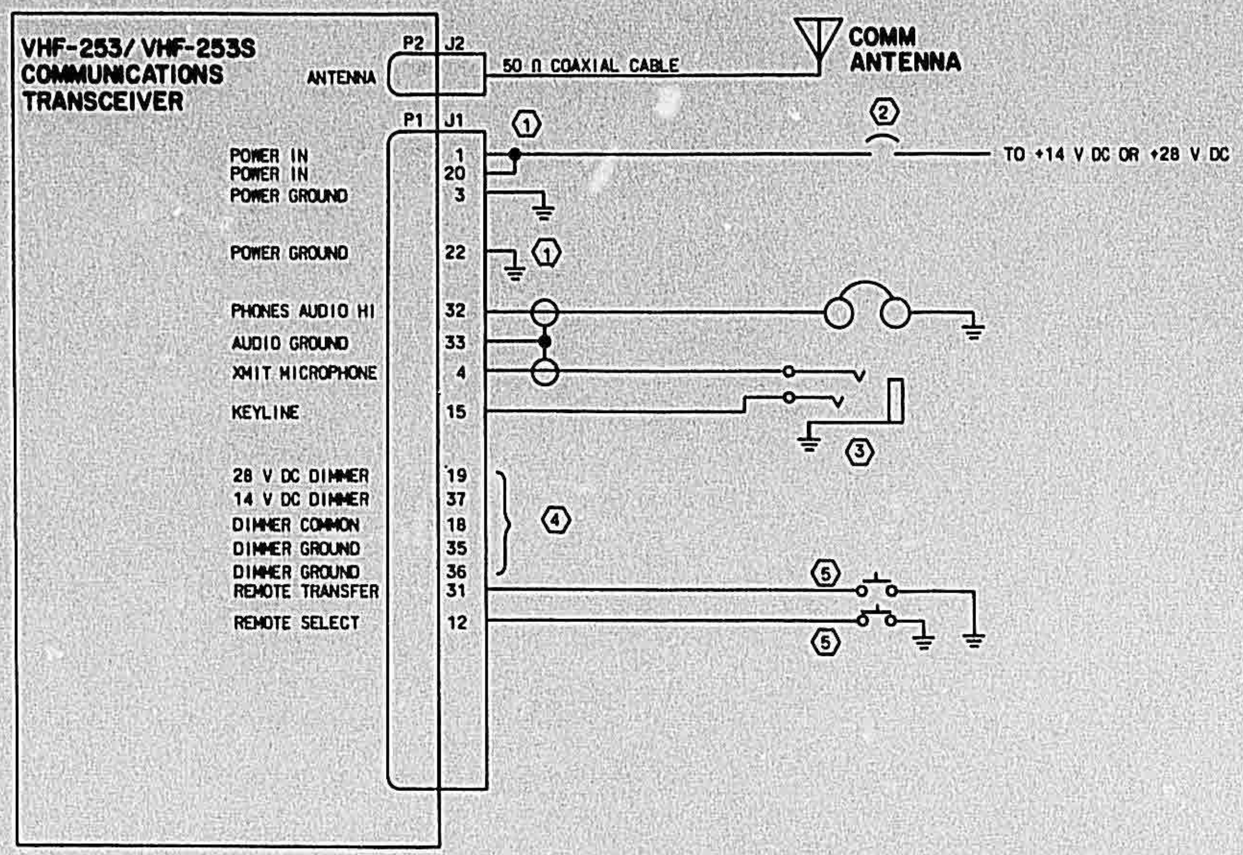
MATING CONNECTOR		
TYPE	COLLINS PART NO	VENDOR P/N
RF	357-7532-010	RFK-03508B
CONTACTS (QTY 17)	371-0379-130	DI10238-35
CONTACTS (QTY 5)*	371-0379-510	DI10238-166
CONNECTOR	371-0379-500	DC4R-37S-FO

* POWER AND GROUND CONTACTS



TP6-1420-014

VHF-253/253S Communications Transceiver, Outline and Mounting Diagram
Figure 2-4



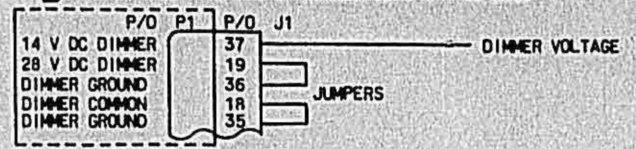
NOTES:

(1) POWER WIRES SHOULD BE NO. 18 AWG. USE CONTACTS WITH COLLINS PART NUMBER 371-0379-510 FOR THESE WIRES.

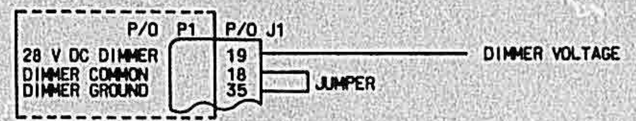
(2) USE 7 OR 7.5 AMP FUSE OR BREAKER IN 14 V AIRCRAFT. USE 5 AMP FUSE OR BREAKER IN 28 V AIRCRAFT.

(3) IN SOME AIRCRAFT, IT MAY BE NECESSARY TO INSULATE MICROPHONE JACK FROM AIRFRAME TO REDUCE NOISE PICKUP. IN THIS CASE, RETURN MIC JACK FRAME TO AUDIO GROUND (PIN 33). MIC AUDIO SHIELD MAY BE USED FOR THIS CONNECTION.

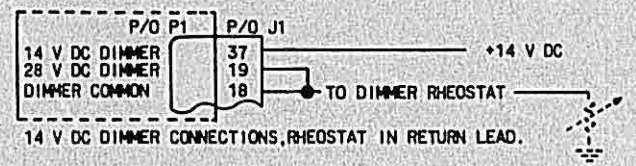
(4) THE FOLLOWING DIMMER CONNECTIONS CAN BE USED:



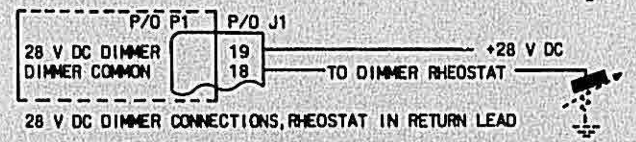
STANDARD 14 V DC DIMMER CONNECTIONS



STANDARD 28 V DC DIMMER CONNECTIONS



14 V DC DIMMER CONNECTIONS, RHEOSTAT IN RETURN LEAD.



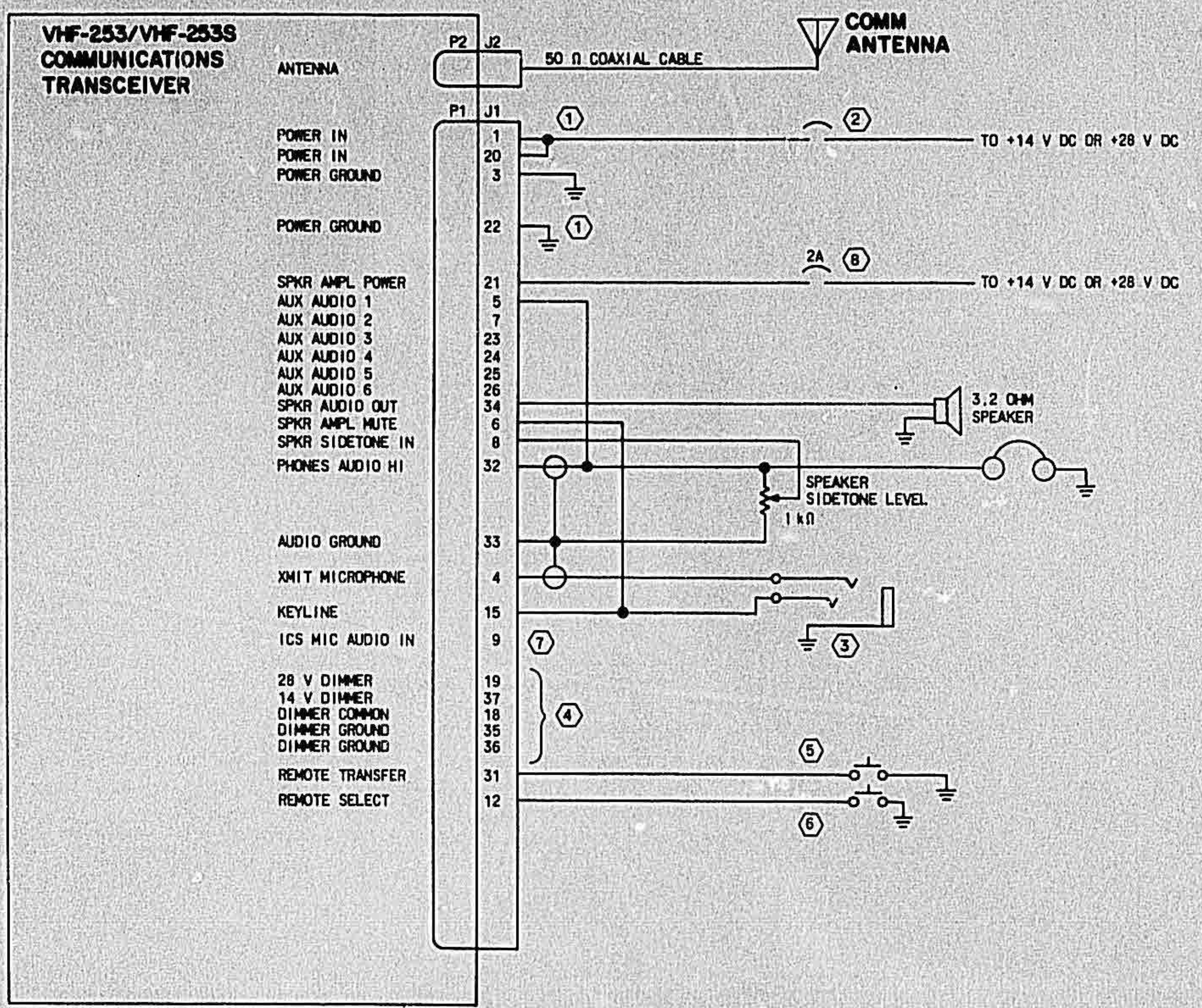
28 V DC DIMMER CONNECTIONS, RHEOSTAT IN RETURN LEAD

(5) OPTIONAL NORMALLY-OPEN, REMOTE TRANSFER SWITCH. MOMENTARILY GROUNDING PIN 31 INTERCHANGES THE ACTIVE AND PRESET FREQUENCY.
THE REMOTE TRANSFER AND SELECT FUNCTIONS CAN BE IMPLEMENTED WITH A SINGLE 3-POSITION, CENTER-OFF TOGGLE SWITCH WITH MOMENTARY CONTACTS.

(6) OPTIONAL NORMALLY-OPEN, REMOTE SELECT SWITCH. MOMENTARILY GROUNDING PIN 12 TRANSFERS THE NEXT STORED FREQUENCY TO THE PRESET DISPLAY.

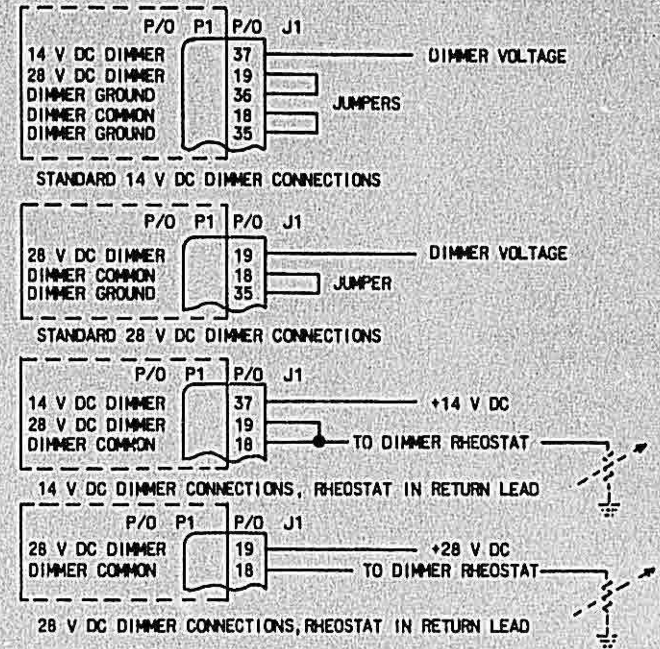
TP6-1426-064

VHF-253/253S Communications Transceiver, Basic Interconnect Diagram
Figure 2-5

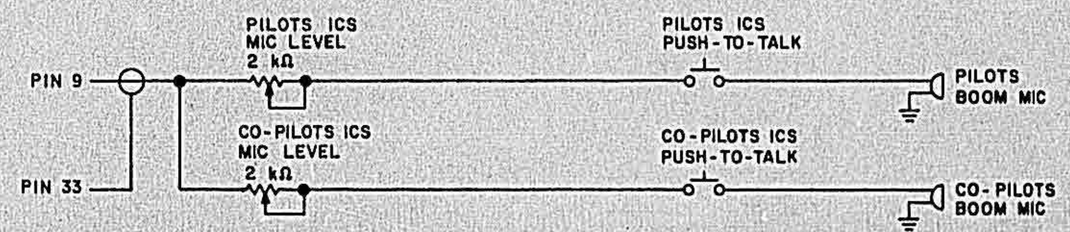


NOTES:

1. POWER WIRES SHOULD BE NO. 18 AWG. USE CONTACTS WITH COLLINS PART NUMBER 371-0379-510 FOR THESE WIRES.
2. USE 7 OR 7.5 AMP FUSE OR BREAKER IN 14 V AIRCRAFT. USE 5 AMP FUSE OR BREAKER IN 28 V AIRCRAFT
3. IN SOME AIRCRAFT, IT MAY BE NECESSARY TO INSULATE MICROPHONE JACK FROM AIRFRAME TO REDUCE NOISE PICKUP. IN THIS CASE, RETURN MIC JACK FRAME TO AUDIO GROUND (PIN 33). MIC AUDIO SHIELD MAY BE USED FOR THIS CONNECTION.
4. THE FOLLOWING DIMMER CONNECTIONS CAN BE USED:



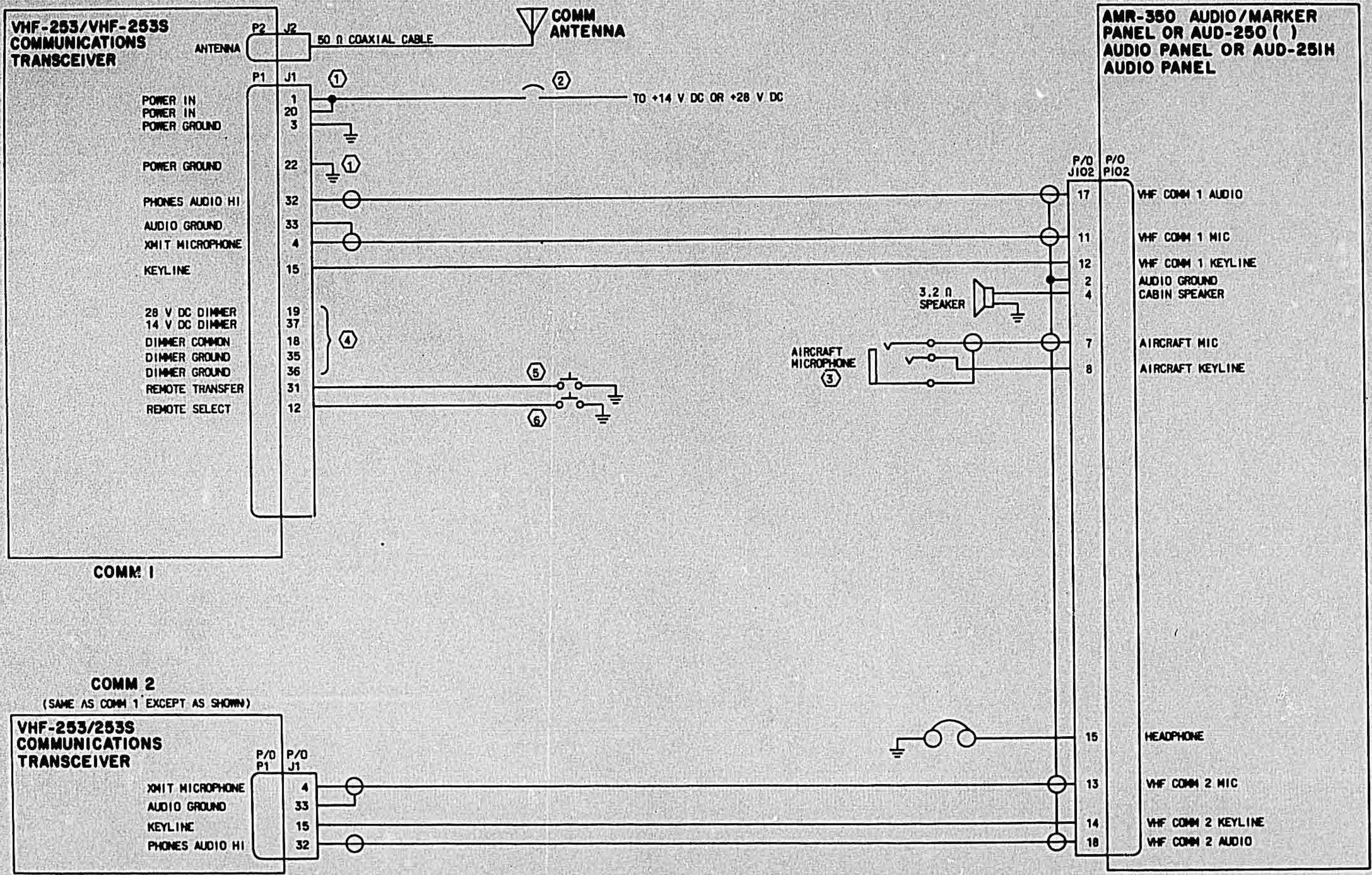
5. OPTIONAL NORMALLY-OPEN, REMOTE TRANSFER SWITCH. MOMENTARILY GROUNDING PIN 31 INTERCHANGES THE ACTIVE AND PRESET FREQUENCY.
THE REMOTE TRANSFER AND SELECT FUNCTIONS CAN BE IMPLEMENTED WITH A SINGLE 3-POSITION, CENTER-OFF TOGGLE SWITCH WITH MOMENTARY CONTACTS.
6. OPTIONAL NORMALLY-OPEN, REMOTE SELECT SWITCH. MOMENTARILY GROUNDING PIN 12 TRANSFERS THE NEXT STORED FREQUENCY TO THE PRESET DISPLAY.
7. USE THE FOLLOWING CIRCUIT IF ICS MICROPHONES ARE REQUIRED:



8. SPEAKER AMPLIFIER CIRCUIT BREAKER CAN BE ELIMINATED, IF DESIRED, BY CONNECTING SPEAKER AMPLIFIER POWER (PIN 21) TO MAIN POWER CIRCUIT BREAKER.

TP6-1426-064

VHF-253/253S Communications Transceiver With Optional Speaker Amplifier, Interconnect Diagram
Figure 2-6



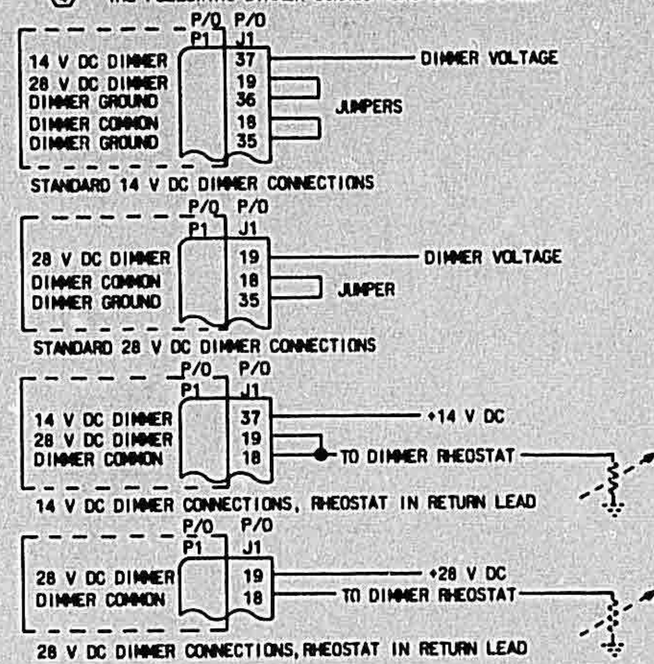
NOTES:

① POWER WIRES SHOULD BE NO. 18 AWG. USE CONTACTS WITH COLLINS PART NUMBER 371-0379-510 FOR THESE WIRES.

② USE 7 OR 7.5 AMP FUSE OR BREAKER IN 14 V AIRCRAFT. USE 5 AMP FUSE OR BREAKER IN 28 V AIRCRAFT.

③ IN SOME AIRCRAFT, IT MAY BE NECESSARY TO INSULATE MICROPHONE JACK FROM AIRFRAME TO REDUCE NOISE PICKUP. IN THIS CASE, RETURN MIC JACK FRAME TO AUDIO GROUND (PIN 33). MIC AUDIO SHIELD MAY BE USED FOR THIS CONNECTION.

④ THE FOLLOWING DIMMER CONNECTIONS CAN BE USED:

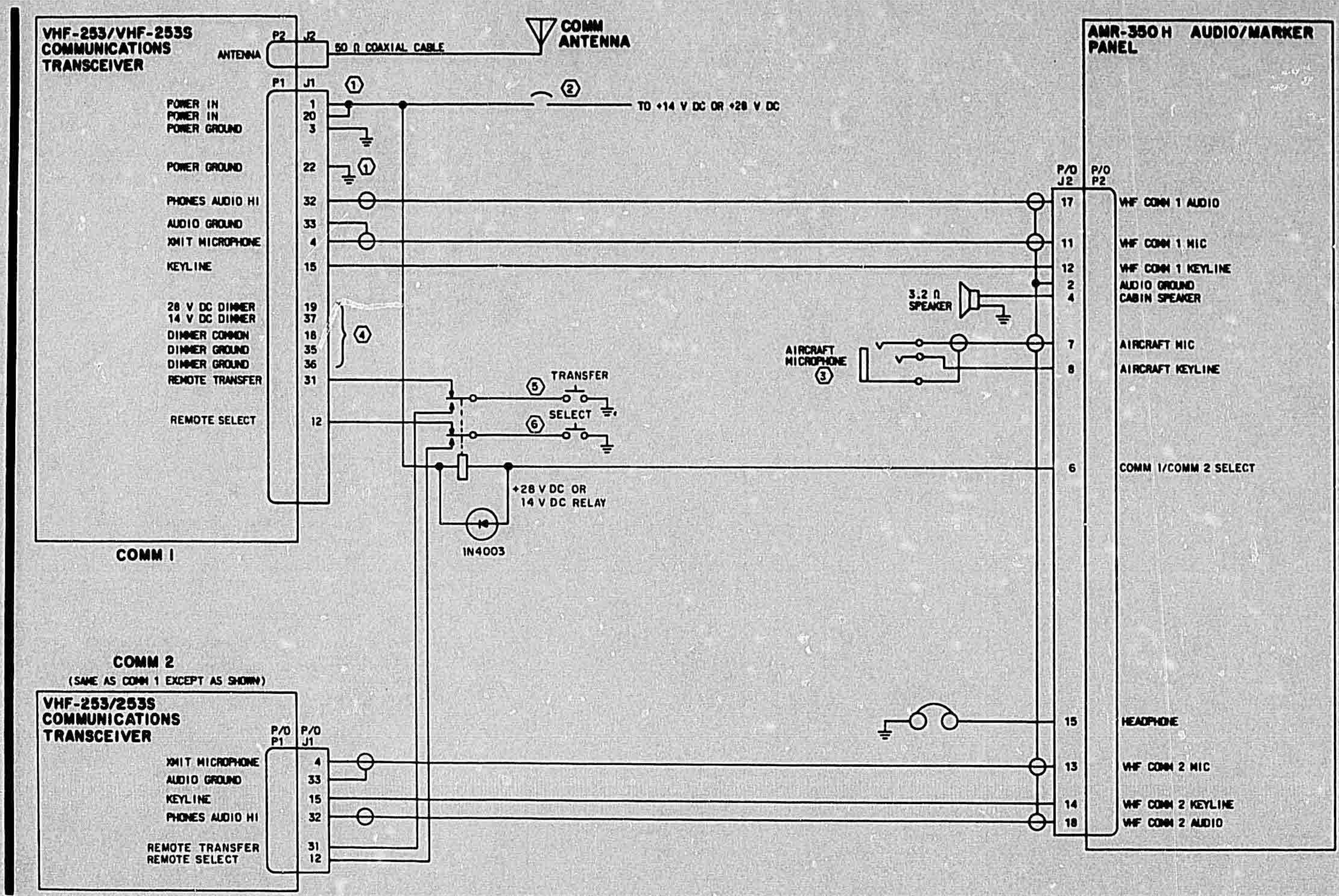


⑤ OPTIONAL NORMALLY-OPEN, REMOTE TRANSFER SWITCH. MOMENTARILY GROUNDING PIN 31 INTERCHANGES THE ACTIVE AND PRESET FREQUENCY. THE REMOTE TRANSFER AND SELECT FUNCTIONS CAN BE IMPLEMENTED WITH A SINGLE 3-POSITION, CENTER-OFF TOGGLE SWITCH WITH MOMENTARY CONTACTS.

⑥ OPTIONAL NORMALLY-OPEN, REMOTE SELECT SWITCH. MOMENTARILY GROUNDING PIN 12 TRANSFERS THE NEXT STORED FREQUENCY TO THE PRESET DISPLAY.

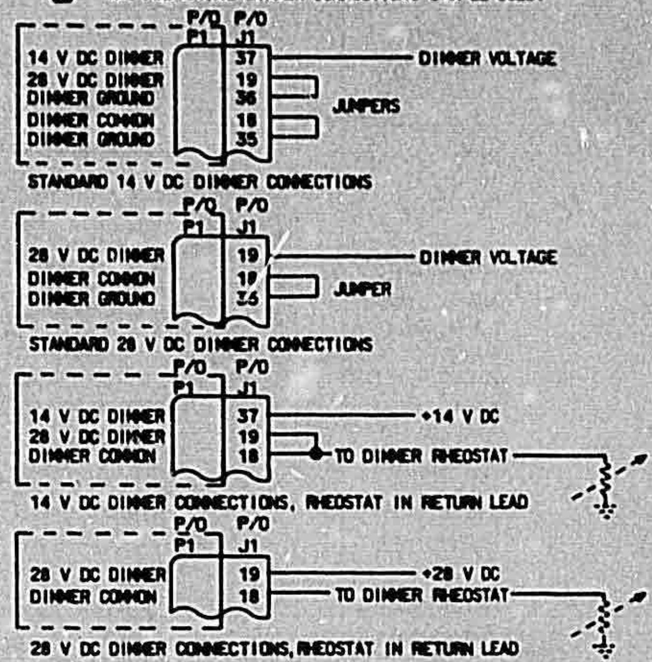
TP6-1426-064

VHF-253/253S Communications Transceiver With Audio Panel, Basic Interconnect Diagram
Figure 2-7



NOTES:

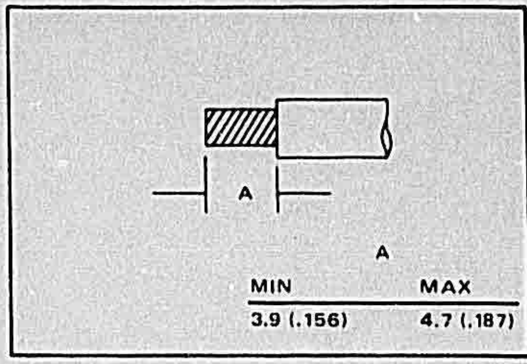
1. POWER WIRES SHOULD BE NO. 18 AWG. USE CONTACTS WITH COLLINS PART NUMBER 371-0379-510 FOR THESE WIRES.
2. USE 7 OR 7.5 AMP FUSE OR BREAKER IN 14 V AIRCRAFT. USE 5 AMP FUSE OR BREAKER IN 28 V AIRCRAFT.
3. IN SOME AIRCRAFT, IT MAY BE NECESSARY TO INSULATE MICROPHONE JACK FROM AIRFRAME TO REDUCE NOISE PICKUP. IN THIS CASE, RETURN MIC JACK FRAME TO AUDIO GROUND (PIN 33). MIC AUDIO SHIELD MAY BE USED FOR THIS CONNECTION.
4. THE FOLLOWING DIMMER CONNECTIONS CAN BE USED:



5. OPTIONAL NORMALLY-OPEN, REMOTE TRANSFER SWITCH. MOMENTARILY GROUNDING PIN 31 INTERCHANGES THE ACTIVE AND PRESET FREQUENCY. THE REMOTE TRANSFER AND SELECT FUNCTIONS CAN BE IMPLEMENTED WITH A SINGLE 3-POSITION, CENTER-OFF TOGGLE SWITCH WITH MOMENTARY CONTACTS.
6. OPTIONAL NORMALLY-OPEN, REMOTE SELECT SWITCH. MOMENTARILY GROUNDING PIN 12 TRANSFERS THE NEXT STORED FREQUENCY TO THE PRESET DISPLAY.

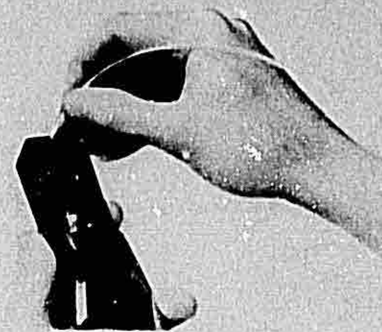
TP6-2865-014

VHF-253/253S Communications Transceiver With AMR-350H Audio/Marker Panel, Interconnect Diagram
Figure 2-8



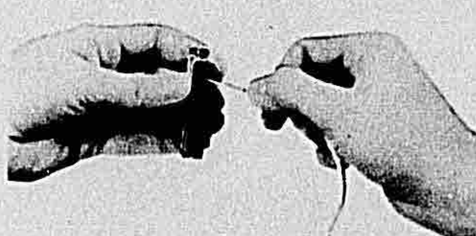
WIRE STRIPPING
1. CUT WIRES TO LENGTH. STRIP INSULATION PER ABOVE ILLUSTRATION. CHECK FOR BROKEN OR FRAYED WIRES.

NOTE: DIMENSIONS ARE IN MM (IN.).

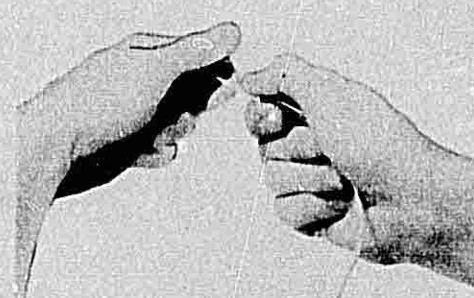


CONTACT CRIMPING
2. INSERT CONTACT AND WIRE INTO PROPER CRIMPING TOOL (AND LOCATOR, IF REQUIRED) CRIMP CONTACT TO WIRE. INSPECT CRIMP.

CONTACT INSERTION
3. CENTER WIRED CONTACT IN GROOVE OF INSERTION TOOL,WITH TOOL TIP BUTTING CONTACT SHOULDER. INSERT CONTACT INTO CAVITY UNTIL A POSITIVE STOP IS FELT INSPECT INSERTION.



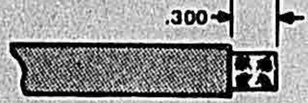
4. TO BE SURE CONTACT IS LOCKED SECURELY, PULL BACK LIGHTLY ON WIRE. REPEAT FOR BALANCE OF CONTACTS, WORKING ROW BY ROW ACROSS THE INSULATOR.



CONTACT EXTRACTION
5. PLACE WIRE INTO EXTRACTION TOOL TIP. INSERT TOOL TIP INTO CONTACT CAVITY UNTIL TIP BOTTOMS AGAINST CONTACT SHOULDER, RELEASING TINES. HOLD WIRE AGAINST TOOL WITH FINGER AND REMOVE TOOL AND CONTACT. REPEAT FOR BALANCE OF CONTACTS.

628-5699-001

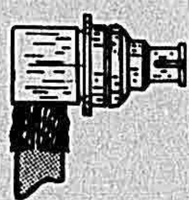
Use of Crimping and Insertion/ Extraction Tools
Figure 2-9



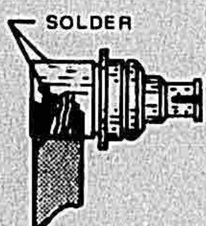
TRIM COAX CABLE OUTER INSULATION AS SHOWN.

FOLD BRAID BACK OVER OUTER INSULATION OF COAX. DO NOT CROSS STRANDS.

SOLDER CENTER CONDUCTOR TO CENTER PIN OF CONNECTOR. ENSURE FRONT END OF BRAID IS EVEN WITH BOTTOM OF CONNECTOR. (SHOWN BY ARROW).



SLIDE CONNECTOR CAP, WITH CLEARANCE HOLE IN POSITION TO CLEAR DIELECTRIC, ON TO CONNECTOR UNTIL IT SNAPS INTO PLACE.



PUSH BRAID FORWARD AND FLATTEN AGAINST CONNECTOR CAP AND SOLDER 360° AROUND. SOLDER CONNECTOR CAP TO CONNECTOR IN AT LEAST THHEE PLACES TO INSURE GOOD ELECTRICAL CONTACT.

357-7532-010 RF CONNECTOR

NOTE: CLOSE ADHERANCE TO THIS PROCEDURE IS NECESSARY FOR AN INTERFERENCE FREE INSTALLATION.

628-5656

Antenna Connector Preparation
Figure 2-10

Collins VHF-253/253S Communications Transceiver

Rockwell International

operation

Collins General Aviation Division

Printed in USA

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2nd Edition, 1 November 1983

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NOTICE: This section replaces first edition dated 1 September 1981.

List of Effective Pages

*The asterisk indicates pages changed, added, or deleted by the current change.

Page No	Issue
*Title	1 Nov 83
*List of Effective Pages	1 Nov 83
3-1 thru 3-5	1 Sep 81
3-6 Blank	1 Sep 81

Record of Revisions

RETAIN THIS RECORD IN THE FRONT OF MANUAL.
ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS.

REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	1 Sep 81		1,2				
2nd Ed	1 Nov 83		1, 2, 3				

section III

operation

3.1 GENERAL

The purpose of this section is to acquaint you with the operation of the VHF-253/253S Communications Transceiver. A description of the displays and control functions is presented. Figure 3-1 illustrates the controls and indicators discussed in this section. Table 3-1 briefly discusses the function of each control and display.

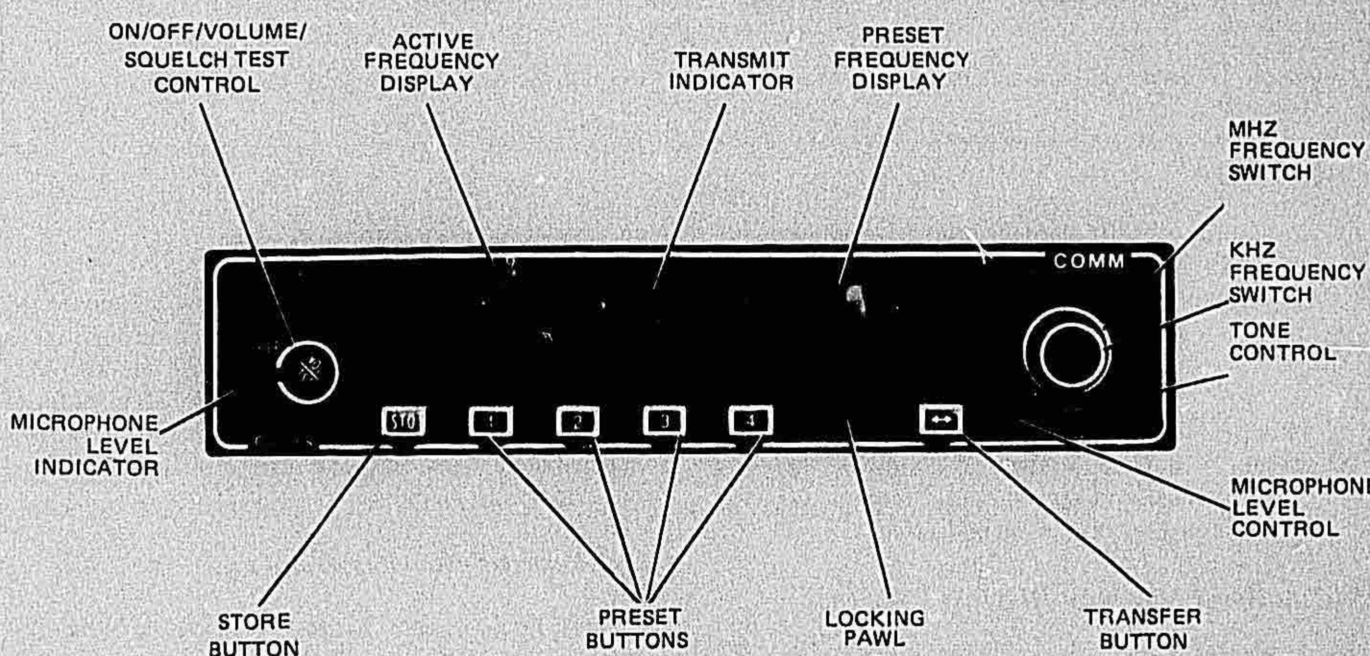
3.2 DISPLAYS AND CONTROLS

3.2.1 On/Off/Volume/Squelch Test Control

The VOL/TST control is the VHF-253/253S on/off, volume, and squelch test control. In the full counterclockwise position, no power is applied to the unit (except for the optional speaker amplifier, if installed, which may be connected to the radio master or a separate switch). Rotating the control to the right turns the unit on, and continued rotation increases the volume level.

To test squelch operation, pull the control. In this position, noise that is normally squelched out will be heard over the audio system. In addition to testing squelch operation, the TST position can be selected and used to set the volume control to the desired audio output level on frequencies that are not active. After the squelch test is complete, push the control back in to activate the automatic squelch.

The VHF-253/253S contains a microprocessor that controls much of its operation. Since the microprocessor is so important, it checks itself in a fraction of a second each time the transceiver is turned on. If it's



VHF-253/253S Communications Transceiver, Controls and Indicators
Figure 3-1

Table 3-1. VHF-253/253S Communications Transceiver, Controls and Indicators.

CONTROL OR INDICATOR	FUNCTION
On/off/volume/squelch test control	Controls the application of power to the unit, varies the audio gain, and tests squelch circuitry.
Active frequency display	Provides a digital readout of the operating frequency.
Transmit indicator	Indicates when transceiver is in transmit mode.
Preset frequency display	Provides a digital readout of the preset frequency.
kHz frequency switch	Changes the preset frequency in 50-kHz steps (or 25-kHz steps when pulled out).
MHz frequency switch	Changes the preset frequency in 1-MHz steps.
Microphone level indicator	Glows dimly when microphone level control is adjusted properly.
Store button	Used with preset buttons to store up to four preset frequencies.
Preset buttons	Used to store and recall preset frequencies.
Transfer button	Use to exchange active and displayed preset frequencies.
Locking Pawl	Used to secure the unit in its mounting tray.
Microphone level control	Used to adjust the signal level of the microphone input applied to the audio circuits.
Tone control	Provides some tone adjustment of the received audio to compensate for speaker variations.
Remote frequency transfer button (optional)	Provides same function as frequency transfer button on front panel except that it is remotely mounted.
Remote frequency selection button (optional)	Used to remotely recall, in sequence, the four stored preset frequencies.

operating properly, it displays two frequencies and the legend PRE (for preset). If it finds a problem, it leaves the display blank to indicate that a failure has occurred.

Note

The VHF-253/253S has a nonvolatile memory that remembers the active, displayed preset and stored preset frequencies even when the unit is turned off.

3.2.2 Active Frequency Display

The active frequency display provides a 5-digit, 7-segment display of the operating frequency that the transceiver is tuned to. The sixth digit of the frequency is not displayed since it is either a zero (if the fifth digit is a 0 or 5) or a 5 (if the fifth digit is 2 or 7).

3.2.3 Transmit (XMT) Indicator

The transmit indicator comes into view whenever the push-to-talk (ptt) switch on the microphone is pushed. The indicator goes out of view when the ptt switch is released or after approximately 2 minutes of continuous transmitting. (The 2-minute time limit is incorporated to prevent long term interference caused by a stuck ptt switch.)

3.2.4 Preset Frequency Display

The preset frequency display provides a 5-digit, 7-segment digital display of preselected nonactive frequencies. A selected frequency must occupy this display prior to being transferred to the active frequency display or being stored in memory. A frequency is placed in this display by using the frequency selector controls or by recalling a stored frequency from memory. The sixth digit of the preset frequency is not displayed.

3.2.5 Frequency Selector Switches

The large, outer frequency selector switch changes the displayed preset frequency in 1-MHz increments. The small frequency selector switch changes the preset frequency in 50-kHz increments when pushed and 25-kHz increments when pulled.

3.2.6 Transfer Button

Pushing the transfer button on the front panel or the optional remote frequency transfer button causes the active and displayed preset frequencies to be exchanged. (The preset frequency is transferred to the active display and the active frequency is transferred to the preset display.) Each transfer is annunciated by a short 800-Hz audio tone applied to the audio system to indicate that the active comm frequency has changed. Transfers are prohibited during transmissions (mic is keyed).

3.2.7 Preset Buttons

The four numbered preset buttons are used to recall previously stored preset frequencies from memory and display them in the preset frequency display. Stored frequencies must be recalled to the preset display before they can be transferred to the active display. Frequency recall does not alter the frequency stored in memory.

An optional remote frequency selection button can also be connected to the transceiver to recall stored frequencies in numerical sequence. (The next sequential stored frequency is transferred to the preset display each time the remote button is pushed.)

3.2.8 Store (STO) Button

The store (STO) button is used with the numbered preset buttons to store the frequency in the preset display in any one of the four preset memory locations. A frequency is stored by first selecting the desired frequency in the preset frequency display with the frequency selector switches. Then push the STO button and the numbered preset button corresponding to the desired memory location.

Note

To store a frequency, the numbered preset button must be pushed within 5 seconds after the STO button is pushed. If more than 5 seconds elapse, the store command is ignored and a frequency recall takes place.

Once a frequency is stored it remains in memory until changed by use of the STO button. The transceiver has a nonvolatile memory so that all stored frequencies, including the active and displayed preset frequencies, are retained even when power is turned off.

3.3 OPERATING PROCEDURES

The VHF-253/253S provides 2-way communications in the vhf range of 118.00 to 135.975 MHz with 25-kHz channel spacing. This allows operation on 720 different frequencies. The VHF-253S has wider receive bandwidth for improved operation in regions using 50-kHz channel spacing.

The frequency displays in the VHF-253/253S show only five of the six digits. The sixth digit is always a zero (when the fifth digit is 0 or 5) or a 5 (when the fifth digit is 2 or 7). Therefore, the sixth digit is redundant and does not need to be displayed.

Warning

If two communications transceivers in an aircraft are tuned to stations carrying the same voice message, attempting to listen to the received signals from both simultaneously could result in a great reduction in the actual audio volume.

All users of communication transceivers should be aware of this possibility, and should avoid simultaneously tuning two transceivers to the same frequency or two frequencies carrying the same voice message.

3.3.1 Equipment Turn On

The transceiver is turned on by rotating the VOL/TST control clockwise. When power is on, the transceiver displays the same active and preset frequencies that were present when the unit was turned off. If the displays are blank, a fault has been detected by the internal self-test that is executed whenever the unit is turned on.

Adjust the volume level and perform a quick squelch test by pulling the VOL/TST control and adjusting the volume level with background noise. After a comfortable listening level has been established, push the control back in; all background noise should disappear unless a station or aircraft is transmitting on the active frequency.

3.3.2 Frequency Selection

Frequency selection is made using either the frequency selector switches or the preset buttons.

Rotation of either frequency selector switch increases or decreases the frequency in the preset frequency display. The large, outer knob changes the preset frequency in 1-MHz increments (number to left of decimal point). The small inner knob changes the preset frequencies in 50-kHz increments when pushed or 25-kHz increments when pulled.

After the desired frequency is set in the preset frequency display, it can be transferred to the active frequency display by pushing the transfer button once. At the same time that the preset frequency is transferred to the active display, the previously active frequency is transferred to the preset display. Also, a short audio tone is applied to the audio system to indicate that the active frequency has been changed.

The VHF-253/253S has a nonvolatile memory that permits storing up to four preset frequencies. Once stored, the frequencies can be recalled to the preset display by pushing the associated preset button (1 through 4) whenever desired. After the stored frequency is recalled to the preset display, it can be visually verified and then transferred to the active display by pushing the transfer button.

During normal operation, all frequency selections and revisions are done in the preset frequency display. The frequency is activated only when the transfer button is pushed and desired frequency appears in the active frequency display.

3.3.3 Frequency Storage

Up to four preset frequencies can be stored in the VHF-253/253S nonvolatile memory for future recall. To program the memory, select the frequency in the preset frequency display using the frequency selector switches, push the store (STO) button and then push one of the numbered preset buttons. The preset display will blink briefly to indicate that the frequency was stored. A different frequency can be stored with each of the four numbered preset buttons.

Note

> When storing a frequency, the numbered preset button must be pushed within 5 seconds after the STO button is pushed. If more than 5 seconds elapse, the store command is ignored and the previously stored frequency is recalled instead of storing the new frequency.

After a frequency has been stored in each memory location, pushing one of the preset buttons recalls the associated frequency for display in the preset frequency display. After a frequency has been stored in memory, it will remain there until changed by using the STO button. Memory is retained even when the unit is turned off for an extended length of time.

3.3.4 Transmit and Receive Operation

The receiver in the VHF-253/253S is automatically tuned to the active frequency. Operation of the ptt button causes the transceiver to switch to the transmit mode and display the XMT indicator adjacent to the active frequency display.

To transmit, merely push the ptt button and speak directly into the microphone with a normal voice. When using a hand microphone, hold it so that it nearly touches your lips. Most high-quality noise-canceling microphones have a ridge at the top that should touch your face just above the upper lip. Holding the microphone away from your lips, even an inch, results in unnecessary background noise in your transmission. A noise-canceling microphone held an inch or so from your lips may even cancel your voice along with engine noise. Most boom microphones should be positioned within one quarter of an inch of your lips for clear transmission. If you use earphones, you should hear a side tone of your voice while transmitting.

The transceiver limits transmissions to about two minutes. This allows for normal air traffic control transmissions, which rarely exceed 15 seconds, but prevents long term interference with traffic control if the ptt button sticks. If longer transmissions are required, release the ptt button briefly every minute or so to reset the transmission timer. The frequency transfer button is inhibited during the transmit mode to prevent changing the active frequency in the middle of a transmission.

3.3.5 Direct Active Frequency Selection

As a safety feature, the transceiver automatically switches to direct control of the active frequency when a frequency selector switch is operated while the transfer line is grounded (jammed transfer switch or inadvertent ground on remote transfer line). During this mode of operation, the frequency selector switches control the active frequency of the transceiver rather than the displayed preset frequency.

This operating mode can be manually selected by pushing the transfer button while pushing and holding the STO button. When this mode is selected, frequency recall from memory to the preset display and frequency transfers between the active and preset displays can still be made. The only changes are that the selector switches control the active frequency and that the selector switches, as well as the transfer button, have no effect during transmissions. To restore normal operation, repeat the procedure given above or turn the transceiver off and then on.

3.3.6 Remote Selection of Stored Frequencies

Your aircraft may be equipped with either a pushbutton or a momentary-action toggle switch, usually mounted on the yoke or control stick, to permit remote selection of the stored preset frequencies. Each time you push this switch, the next sequential stored frequency is placed in the preset frequency displayed for viewing. After you have viewed all four stored frequencies, the next push of the switch places the first frequency in the preset display again, so that you can repeatedly step through all four stored frequencies to locate the one you want without removing your hands from the controls.

3.3.7 Remote Transfer of Frequencies

Your aircraft may be equipped with either a pushbutton or momentary-action toggle switch, usually mounted on the yoke or control stick, for remote transfer of the active and preset frequencies. A short tone or beep is heard each time a transfer is made to help make you aware of any inadvertent transfers that can occur if the button is accidentally pushed.

The remote transfer and remote selection functions can be incorporated in a single momentary action double-throw, center-off, toggle switch. If your aircraft is equipped with this type of switch, pushing it one way (usually away from you) steps through the stored frequencies, while pushing it the other way (toward you) transfers the active and preset frequencies.

Caution

The VHF-253/253S Communications Transceiver has been designed to exhibit a very high degree of functional integrity. Nevertheless, the user must recognize that it is not practical to provide monitoring for all conceivable system failures and that, however unlikely, it is possible that erroneous operation could occur without a fault indication. It is the responsibility of the pilot to detect such an occurrence by means of cross-checks with redundant or correlated information available in the cockpit.

Collins VHF-253/253S Communications Transceiver

Rockwell International

theory

Collins General Aviation Division

Printed in USA

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2nd Edition, 1 November 1983

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NOTICE: This section replaces first edition dated 1 September 1981.

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Record of Revisions

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4.1 GENERAL

The theory of operation is divided into two parts: a functional block diagram description and a detailed theory description. This section provides the information required to understand circuit operation in the transceiver with emphasis placed on new and unique circuits.

4.2 FUNCTIONAL THEORY OF OPERATION (Refer to figure 4-1)

4.2.1 Control/Display Circuits

The control/display circuits consist of the microprocessor, liquid crystal display (LCD), electrically alterable read only memory (EAROM), and the front panel switches and controls. All control operations and frequencies are synchronized with the 3.2-MHz synthesizer clock so that harmonics of the control signals will not cause receiver noise.

The front panel switches provide manual control of unit power, receiver volume, squelch test (override), frequency selection and transfer, and frequency store and recall.

The microprocessor monitors the front panel frequency switches and remote switch lines for input commands. All input commands are processed along with previously stored data to generate display data for the LCD, frequency data for the synthesizer, and mode data for the transmit/receive switch and modulator.

The liquid crystal display provides continual display of the 5-digit active frequency, a 5-digit preset frequency, and the PRE indicator, which identifies the preset frequency display. A transmit mode (XMT) indicator is also displayed whenever the transmit mode is selected by grounding the key line.

The EAROM provides the power-off storage capability to store the displayed active and preset frequencies, and four stored preset frequencies. The EAROM can retain data without power just like a ROM. However, when power is applied, the EAROM can be reprogrammed by the microprocessor to change the stored data.

4.2.2 Synthesizer

The synthesizer is a large scale integrated (LSI) circuit, digital frequency synthesizer that phase locks a voltage controlled oscillator (vco) to a single 3.2-MHz crystal oscillator. The crystal oscillator determines the overall frequency stability of the synthesizer. The synthesizer provides a 118.000- to 135.975-MHz excitation to the transmitter rf amplifiers and a 138.025- to 156.000-MHz injection signal to the first mixer circuit in the receiver in 25-kHz increments. The vco tune voltage within the synthesizer is also used to tune the varactors in the two 2-pole rf filters in the receiver.

4.2.3 Receiver

The receiver is a dual-conversion superheterodyne type with if frequencies of 20.025 MHz and 455 kHz. Frequency conversion is performed by two mixer circuits. The first is a diode mixer with injection from the synthesizer, and the second is a dual-gate MOSFET with injection from a 19.57-MHz local oscillator.

Rf selectivity is determined by a pair of varactor-tuned filters. The if selectivity is determined by two 20.025-MHz crystal filters and one 455-kHz ceramic filter. The if filters used in the VHF-253 have a narrower bandwidth than those used in the VHF-253S, thus permitting operation in systems using 25-kHz channel spacing without adjacent channel interference.

A 455-kHz if amplifier IC provides approximately 80 dB of amplification of the 455-kHz signal prior to application to the detector circuit. The output of the detector is applied to the audio circuits, the receiver AGC circuit, and the automatic squelch circuit.

AGC is used throughout the receiver to prevent overloading the amplifiers, which would result in a distorted audio output.

4.2.4 Automatic Squelch

Two automatic squelch circuits are used in the transceiver: carrier squelch and noise squelch. The carrier squelch is derived from the receiver AGC voltage and is used to open the squelch when multiple carriers are received. The noise squelch circuit uses a multifunction FM if IC to detect phase noise rather than amplitude noise. This feature provides reliable automatic squelch operation with no degradation due to ignition noise or receiver gain variations.

4.2.5 Audio

The audio circuits in the transceiver are common to both the receive and transmit modes. An audio compressor eliminates loudness variations when receiving signals from different transmitters and ensures proper modulation depth with different microphone signal levels. Limited tone control is provided in the receive mode. The final audio amplifier can also be used with an intercom microphone.

4.2.6 Transmitter

The transmitter is a broadband solid state circuit excited by the synthesizer output. Minimum unmodulated output power is 10 W over the frequency range of 118.000 to 135.975 MHz. Amplification is provided by two class A stages and two class C stages. The output of the modulator is applied to both class C amplifiers to provide 85- to 95-percent modulation. The output of the final rf amplifier is filtered to remove harmonics of the carrier.

4.2.7 Modulator

The modulator is a class D amplifier similar to a power supply switching regulator. Input to the modulator is from the audio compressor. The audio input is compared with a 106-kHz sawtooth signal to provide a pulse-width modulated signal which is used to drive the switch transistors. The output of the switch is filtered to obtain the modulated dc for the rf power amplifiers in the transmitter.

4.2.8 Power Supplies

The power supply is a switching regulator with an input voltage range from +11 to +32 V dc. The primary switching regulator provides +30-V dc and -20-V dc outputs. A secondary switching regulator provides +14 V dc from the +30-V dc power and a series pass regulator provides +5 V dc from the +14-V dc output.

The switching regulators are synchronized with other frequencies in the transceiver by a sync signal from the control circuit.

4.2.9 Optional Speaker Amplifier

The speaker amplifier accommodates up to six audio inputs plus a transmit sidetone input and provides 5 W of audio power into a 3.2-Ω speaker. Primary power for the speaker amplifier is independent of the transceiver power to permit operation when the transceiver is turned off.

A speaker amplifier mute input is provided to prevent acoustic feedback during transmissions.

4.3 DETAILED THEORY OF OPERATION

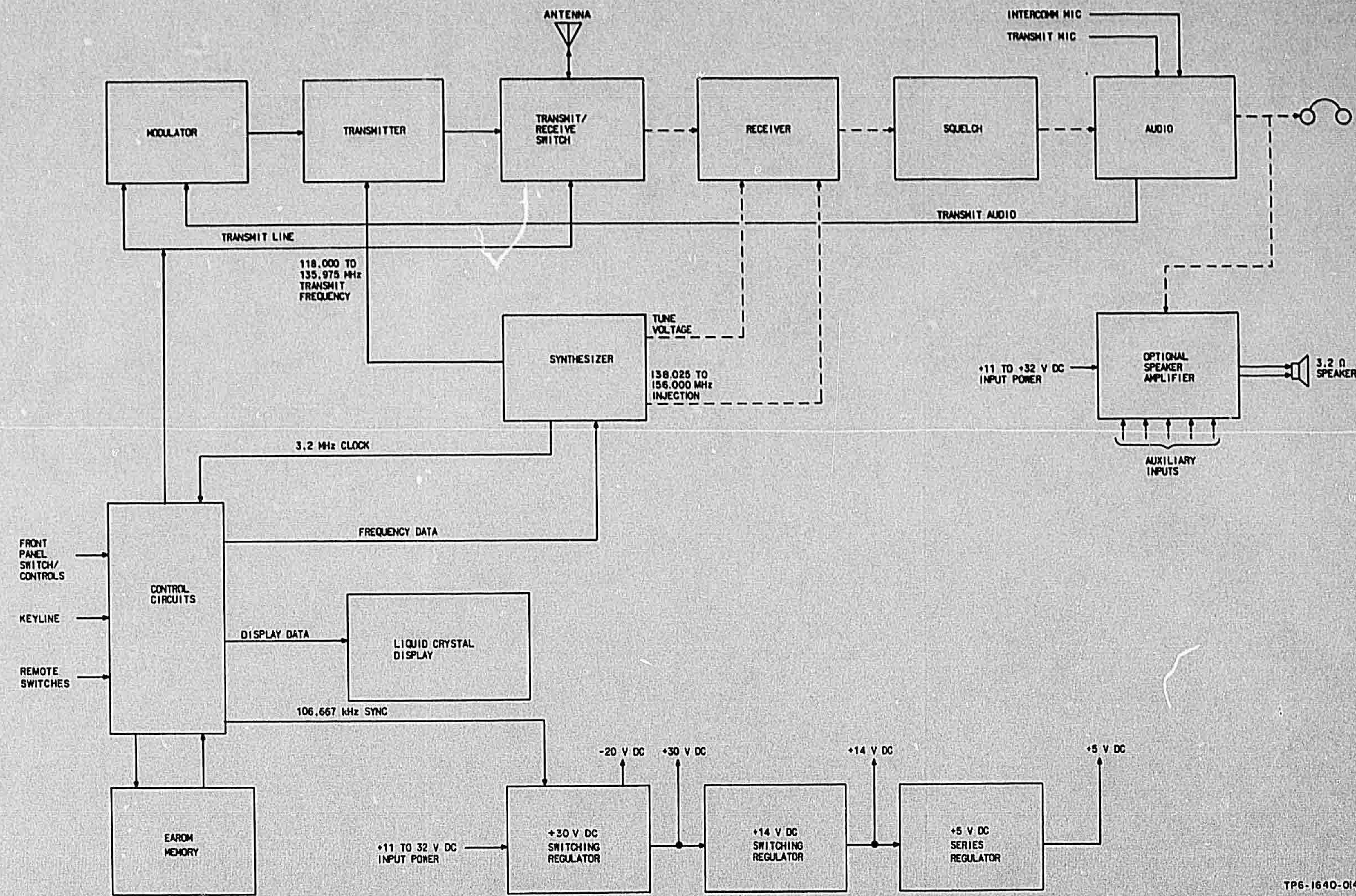
4.3.1 Control Circuit (Refer to figure 6-6)

The heart of the control circuit is microprocessor U601. The microprocessor (μP) is an 8-bit parallel processor with 1024 words of program memory and 64 words of data memory all on one MOS chip. The μP monitors the control switches for input commands, generates control signals and data for the LCD and synthesizer, and updates the EAROM for power-off memory ability.

The 3.2-MHz clock input to the μP is provided by the synthesizer clock to ensure that all clock and divided down control frequencies are controlled to avoid generating receiver interference.

The μP monitors the control switches by applying a logic 0 strobe pulse to the common terminal of each switch and checking the data bus to determine the position of each switch. The μP scans each switch once every 5 ms. Since all of the front panel control switches, except the transfer switch, operate in the same manner, only the megahertz frequency selector switch S601A is described in detail.

The megahertz frequency selector switch S601A is a 12-position switch that has been wired to function as a 3-position switch. The common terminal of the switch is connected to port P10 of the μP, while the other three terminals are connected to data bus bits 0, 1, and 2. Once during each 5-ms scan cycle, the μP applies a logic 0 pulse to the switch common and simultaneously monitors data bits 0, 1, and 2 to determine the switch position. The μP remembers the switch position from the previous scan cycle so that it can determine which direction the switch was



VHF-253/253S Communications Transceiver, Functional Block Diagram
Figure 4-1

turned if the switch position changes. The μP uses the switch position information to either increment or decrement the megahertz counter for the preset display.

The transfer pushbutton is the only front panel control switch that is not strobed. Data bus bit 3 is dedicated to monitoring the position of the transfer pushbutton which provides a ground when pushed. The remote transfer switch is connected in parallel with the front panel transfer switch through an RC noise filter.

The other front panel control switches are strobed so that more than one switch can be monitored by each data bit position.

Data bus bit 4 is dedicated to monitoring the remote frequency select pushbutton. This pushbutton is normally open and provides a ground when pushed.

The transmit key line is connected to the interrupt input of the μP through buffer U606A. A ground on the transmit key line selects the interrupt mode. During the transmit (interrupt) mode, the μP sends the transmit frequency to the synthesizer through port P16. After the transmit frequency has been sent to the synthesizer, the μP applies a logic 0 to port P23 to activate the modulator, apply +14 V dc to the transmitter and turn off tr switch Q505.

The 213.333-kHz ALE (address load enable) output of the μP is applied to frequency divider U605 to generate the 104-Hz LCD toggle, 13.3-kHz EAROM clock, and the 106-kHz power supply sync signal. The power supply sync signal is processed by C604 and CR608 to provide very short positive pulses to the power supply, which runs at half of the sync frequency or 53 kHz.

The LCD toggle is buffered by U604 and applied along with the buffered display data, load, and clock signals from the μP to the display circuits.

The EAROM clock signal from U605 and the EAROM data and control signals are applied to EAROM U603 through level shifter U602. The EAROM clock is also applied to the T0 port of the μP to synchronize EAROM read/write operations. Data read from EAROM is applied to the T1 port of the μP.

The EAROM clock signal is also rectified and filtered by CR605 and C603 to provide the +4-V dc display power. The EAROM clock is used to generate the display power so that the display power will go to zero in the absence of the ALE signal. This prevents destruction of the LCD by dc plating which would result if the ALE signal was lost and dc power was still applied.

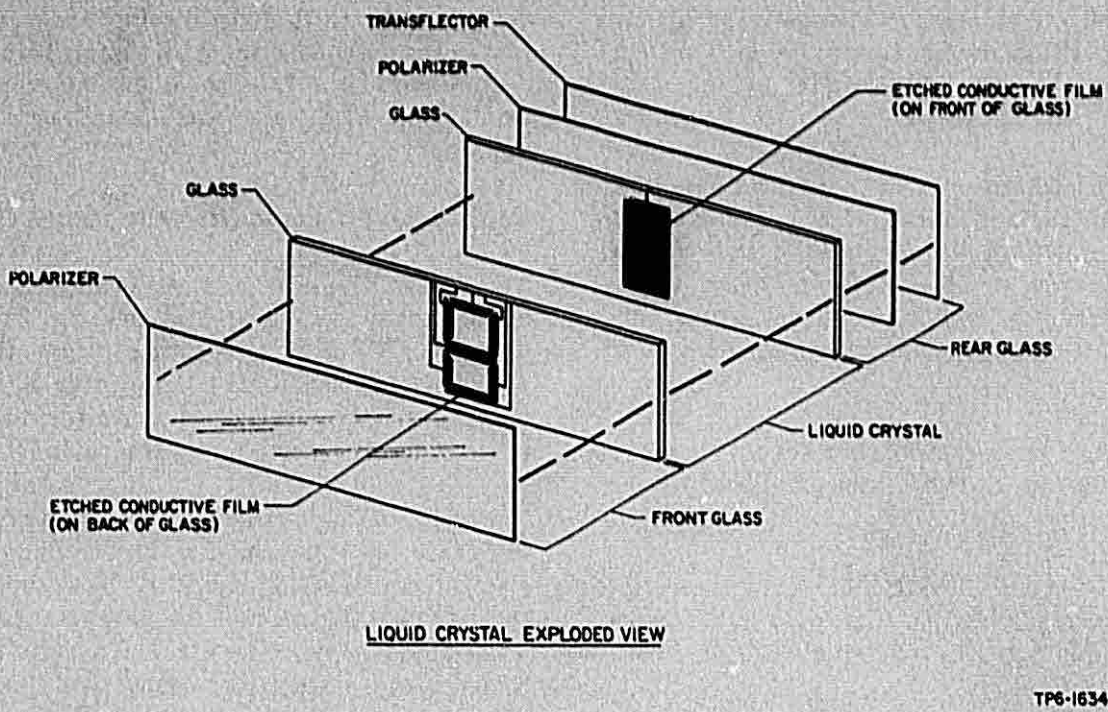
4.3.2 Display Circuit (Refer to figure 6-9)

The display circuit in the transceiver consists of the liquid crystal display (LCD) and two 32-bit LCD driver IC's, U1 and U2, that are permanently bonded to the display circuit card. All display data, control signals, and the display power are provided by the control circuit described in paragraph 4.3.1.

The LCD is a single cell display providing two 5-digit frequency displays, active and preset, and two special indicators, XMT and PRE. Basically, an LCD consists of a thin film of liquid crystal fluid sandwiched between two clear glass plates that have been coated with a transparent conductive film. Refer to figure 4-2 for a view of a simple LCD that has been exploded to show its major parts. The conductive film on the front glass is etched to form the characters or segments to be displayed. The front glass is also covered by a polarizer that orients the light entering the display.

The rear glass on the display is similar to the front glass except that the polarizer is rotated 90 degrees with respect to the front polarizer and a transflector is added to the back of the polarizer. The conductive film on the rear glass is electrically common and needs to be etched only in those areas that are directly behind the leads on the front glass. This is required so that the leads do not show when the segments are activated. The transflector reflects any light striking it from the front and transmits light from the rear (back lighting which is required when ambient light levels are low).

The liquid crystal used is a twisted nematic fluid in which the rod-shaped molecules lie parallel to each other and, when unactivated, also lie parallel to the front and rear glass. The molecules are also forced to lie parallel to the plane of the front polarizer and to the plane of the rear polarizer so that they undergo a 90-degree twist as they progress from front to rear of the thin film of liquid crystal fluid as shown in the top diagram of figure 4-3. This 90-degree twist causes the light striking the front of the LCD to be rotated 90 degrees, allowing it to pass through the rear polarizer, reflect off the transflector, and pass back through the rear polarizer again. The light is



Liquid Crystal Display, Exploded View Diagram
Figure 4-2

then rotated back 90 degrees so that it passes through the front polarizer and gives the unactivated display a light background.

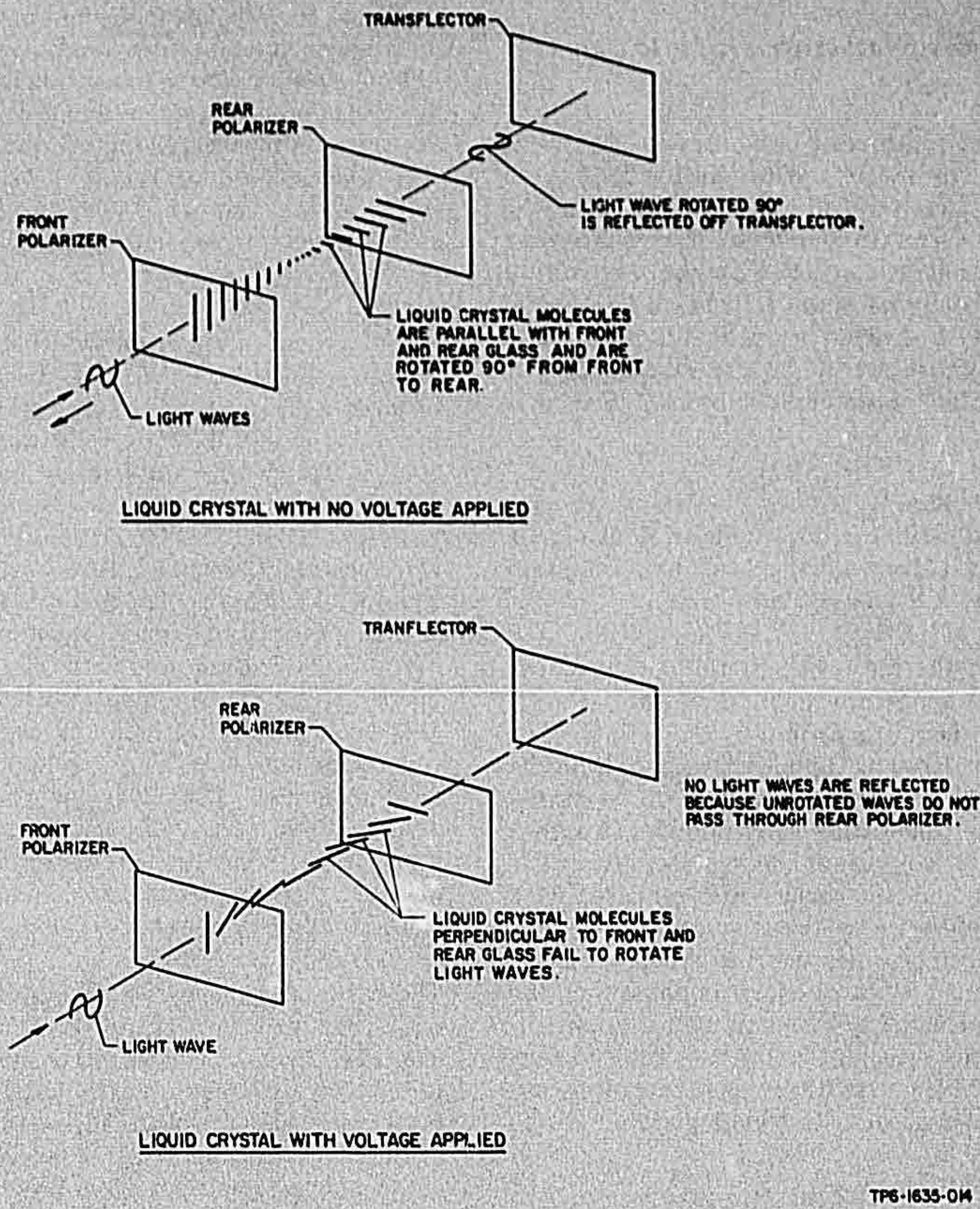
When a voltage is applied between the conductive films on the front and rear glass, the rod-shaped crystal molecules tend to turn so that they are perpendicular to the glass, thus destroying the symmetrical 90-degree twist required to align the light waves with the front and rear polarizers, as shown in the bottom diagram in figure 4-3. Since the light waves are no longer rotated, they will not pass through the rear polarizer and cannot reflect off the transflector. The unrotated light waves are absorbed by the polarizer and cause the activated area to appear dark.

Operation with low ambient light and back lighting is similar to front lighting except that the light enters the back of the LCD and passes through the liquid crystal only once.

The voltage required to activate the LCD must be a symmetrical ac voltage to prevent dc electroplating which eventually darkens the glass. This symmetrical ac voltage is obtained by dividing down the high frequency ALE signal from the μP to obtain the 104-Hz LCD toggle signal with a precise 50-percent duty cycle. This 4-V square wave is applied through U1 and U2 to the backplane of the LCD (conductive film on rear glass of LCD). When a segment on the display is unactivated (blank), the same square-wave signal is applied to the segment on the front glass. This results in zero voltage between the segment and the backplane and allows light to pass through the liquid crystal and be reflected back out the front. To activate a segment, U1 or U2 inverts the square wave. This results in an alternating 4-V potential between the segment and the backplane, which causes the liquid crystal molecules to turn perpendicular to the glass and block the light passing through the crystal. Thus, the activated segment appears dark.

The processing of the display data for the LCD is performed by LCD driver IC's U1 and U2. 64 bits of buffered display data are received from the μP once during each μP scan cycle. This data is clocked into two 32-bit shift registers (one in each LCD driver IC) that are connected in series. After the data has been transferred to the shift registers, it is transferred to 64 data latches (32 in each driver) where the data remains unchanged until the next μP scan cycle.

The latched data is applied to one input of each of the 64 LCD segment drivers (32 in each of the LCD driver IC's). The other input to the LCD segment drivers is the same square-wave signal that is applied to the



Liquid Crystal Display, Operational Diagram
Figure 4-3

LCD backplane. The LCD segment drivers are exclusive OR gates that provide an inverted square wave to the display segments when the data is a logic 1 and an uninverted square wave when the data is logic 0.

4.3.3 Frequency Synthesizer (Refer to figure 6-5)

The frequency synthesizer provides the 118.000- to 135.975-MHz transmitter excitation, the 138.025- to 156.000-MHz receiver injection signal, and the receiver preselector tune voltage. The synthesizer consists of a voltage controlled oscillator (vco) in a phase-locked loop that is controlled by a LSI digital synthesizer IC. Frequency select data is provided to the digital synthesizer IC by the microprocessor. Frequency stability is determined by a 3.2-MHz crystal oscillator.

Basically, the phase-locked loop consists of the voltage controlled oscillator, a variable-ratio divider, a frequency/phase discriminator, a 25-kHz reference frequency, and a low-pass filter.

The output of the vco, which is the output of the synthesizer, is applied to the input of the variable-ratio divider where it is divided by the ratio R. (The ratio R is determined by the microprocessor from the operating mode and active frequency of the transceiver.) The variable-ratio divider provides an output pulse for every R cycles of the vco frequency. The output pulses from the divider are compared with the 25-kHz reference by the frequency/phase discriminator which provides an error signal whenever the divider output is not 25 kHz or in phase with the reference frequency. The error output of the discriminator is applied through the low-pass filter to control the vco. The low-pass filter sums the error pulses from the discriminator to provide a dc tune voltage for the vco.

The ratio R required by the variable-ratio divider can be calculated by dividing the desired operating frequency by 25 kHz. The ratio R varies from 4720 at 118 MHz (lowest transmit frequency) to 6240 at 156 MHz (highest receiver injection frequency). The variable-ratio divider in the synthesizer does not use the ratio R directly but arrives at the same result by using a prescaler that first divides the vco frequency into 41-cycle or 40-cycle increments. The required number of 41-cycle increments plus the number of 40-cycle increments are then added together to obtain the ratio R. For example, if the desired vco frequency is 118.025 MHz, it takes one 41-cycle increment plus 117 40-cycle increments to equal 4721 which is also equal to 118.025 MHz divided by 25 kHz.

The number of 41-cycle increments can vary from 0 to 39 and corresponds to the number of 25-kHz increments selectable in each 1-MHz segment to which the synthesizer can be tuned. This number is stored by the microprocessor into one of two count-down counters (A counter) in digital synthesizer IC U403. The other count-down counter (N counter) is loaded with the total number of 40-cycle and 41-cycle increments which corresponds to the megahertz portion of the selected frequency (118 through 156).

The divide operation begins when the A and N counters in U403 are loaded. If the contents of the A counter is greater than zero, a logic 0 is sent to pin 1 of dual modulus prescaler U402 causing it to divide the vco frequency into 41-cycle increments. After each 41-cycle increment, the prescaler sends a logic 1 pulse to pin 10 of U403 to decrement both the A and the N counters. When the A counter is decremented to zero, a logic 1 is applied to pin 1 of U402 causing it to divide the vco frequency into 40-cycle increments. The process continues until the N counter is decremented to zero. A logic 1 pulse is then applied to the frequency/phase discriminator in U403 and both counters are reset to their original values, starting a new divide cycle. The divide operation is continuous and results in a series of pulses being applied to one input of the frequency/phase discriminator. The 25-kHz reference frequency is applied to the other input of the frequency/phase detector.

The frequency/phase discriminator is an exclusive OR circuit driving a charge pump with a tri-state output. If the divided down vco frequency is not equal to the reference frequency, the output of the discriminator goes high or low to adjust the vco until they are equal. When the two frequencies are equal but out of phase, the output of the discriminator pulses high or low depending upon the phase difference. When the two frequencies are equal and in phase, the output of the discriminator goes to a high impedance state with 25-kHz positive spikes. The positive spikes are required to replace the charge leaking off the integrator capacitor C418 in the low-pass filter.

The 25-kHz reference frequency is derived within the digital synthesizer IC by dividing the 3.2-MHz crystal oscillator output by 128. The reference frequency also establishes the minimum frequency spacing (or channel spacing) between selectable frequencies (or channels).

The output of the frequency/phase discriminator is applied to the first half of the low-pass filter, U401A, which is an integrator that sums the pulses from the discriminator. The second half of the low-pass filter, U401B, further attenuates any 25-kHz pulses so that they do not produce sidebands on the vco output. The output of the low-pass filter is the dc tune voltage applied to the vco and to the preselect circuits in the receiver. The normal range of the dc tune voltage is from approximately +2 V dc at 118 MHz to +6.5 V dc at 136 MHz in the transmit mode, and from approximately +6.75 V dc at 138 MHz to +11.5 V dc at 156 MHz in the receive mode.

The vco is a series tuned Colpitts oscillator (Q405) with two buffer stages (Q401 and Q402). The output frequency of the vco is determined by the dc tune voltage applied to varicap CR401 by the low-pass filter. The output of the vco is applied to the first mixer stage in the receiver, the transmitter power amplifier, and through buffer Q404 to the input of dual-modulus prescaler U402, which is the first stage of the variable-ratio divider.

Transistor switch Q403 is controlled by a phase-lock detector in U403 that turns Q403 on whenever the vco output frequency is not phase locked to the 25-kHz reference frequency. When Q403 is turned on, the vco output applied to the receiver and transmitter is shorted to ground to prevent any spurious transmissions while the vco is being tuned.

4.3.4 Receiver (Refer to figure 6-4)

The antenna signal is applied to the receiver preselector through forward biased tr diode CR504. The preselector is a 2-pole varactor (voltage variable capacitance diode) tuned rf filter consisting of CR203, CR204, L202, L203, and associated components. Tuning voltage for the varactors is provided by the synthesizer and varies from +6.75 V dc at 118 MHz to +11.5 V dc at 135.975 MHz. The preselector attenuates undesired signal components to control spurious responses.

Rf amplifier Q201 is a dual-gate MOSFET that provides approximately 20 dB of gain to the rf signal. The second gate on Q201 is controlled by the AGC signal derived from the detected signal. The application of AGC signal lowers the gain of the rf amplifier in the presence of strong rf signals so that the following stages in the receiver are not driven into saturation which would result in distortion of the audio output.

The output of the rf amplifier is applied to a 2-pole varactor-tuned interstage filter similar to the preselector. The interstage filter further attenuates any off-channel signals to minimize spurious responses.

The output of the interstage filter is applied along with the injection signal from the synthesizer to diode mixer M201 to obtain the first if signal. The injection frequency varies from 138.025 MHz at receiver frequency 118 MHz to 156.000 MHz at receiver frequency 135.975 MHz to obtain a first if frequency of 20.025 MHz.

The output of the first mixer is applied to the first of two monolithic 2-pole crystal filters FL201 tuned to 20.025 MHz. The filtered if is applied to the first if amplifier Q206. The AGC voltage is also applied to Q206 for further gain reduction in the presence of strong antenna signals. The output of Q206 is applied to a second 20.025-MHz crystal filter before being applied to the second if amplifier Q207. The combined voltage gain of Q206 and Q207 is approximately 20.

The output of second if amplifier Q207 is applied to the second mixer Q203 along with a 1.5-V, 19.57-MHz injection signal to obtain the 455-kHz second if signal. The 19.57-MHz, low-side injection signal is provided by crystal-controlled local oscillator Q205. The power gain of mixer Q203 is approximately 12 dB. The resultant 455-kHz output of the mixer is filtered by ceramic filter FL203.

Filters FL201, FL202, and FL203 determine the overall selectivity of the receiver and are the only electrical components that differ between the VHF-253 and the VHF-253S.

The filtered 455-kHz if signal is amplified by the 2-stage, linear if amplifier IC, U202. U202 provides approximately 80 dB of power gain with AGC applied to both stages.

The output of if amplifier U202 is applied to a class B transistor detector, Q204. Since Q204 is biased on the verge of conduction, it provides both half-wave rectification (detection) and amplification of the audio signal. The output of the detector is applied to the inverting input of AGC amplifier U203B where it is compared with a +8.6-V dc reference. The average dc output of the detector must be less than this reference before the AGC amplifier begins to reduce receiver gain. During normal operation, the amplified rf noise with no input signal is enough to lower the average output voltage of the detector and cause AGC gain reduction to occur. This ample-gain concept ensures that receiver performance remains satisfactory as components age. The output of the detector is also applied to squelch switch U701B in the audio circuit.

4.3.5 Automatic Squelch Circuits

Two automatic squelch circuits are used in the receiver. The noise squelch circuit is sensitive to the phase noise normally received when no signal is present and opens the squelch switch when the noise exceeds the noise threshold. The carrier squelch override circuit is sensitive to the output of the AGC amplifier and closes the squelch switch when the received carrier exceeds 20 μV (10 μV with SB 2).

4.3.5.1 Noise Squelch Circuit (Refer to figure 6-4)

The noise squelch circuit consists of a high-gain limiting amplifier U201A, a discriminator (quadrature detector) U201B, high-pass filter U201C, noise detector CR212, and comparator U203A. U201A, B, and C are contained in a single multifunction FM if IC. The noise squelch circuit receives its input from the first 455-kHz if amplifier U202A. This signal is amplified and limited by the high-gain FM if amplifier U201A and then applied the tuned quadrature detector circuit consisting of U201B, C251, and L218. The output of discriminator U201B is an audio frequency noise signal. The audio noise signal is filtered by high-pass filter U201C to remove any low frequency voice components resulting from the residual FM present in many communication transmitters. The filtered noise signal is detected by CR212 and filtered by C244 and C246 to obtain a dc voltage proportional to the phase noise level. The dc noise signal is applied to comparator U203A along with the noise threshold established by potentiometer R240. The output of the comparator is approximately +12 V dc when the dc noise signal is less than the noise threshold and approximately 0 V dc when greater than the threshold. The positive output from the comparator turns on squelch switch U701B in the audio circuit (figure 6-7) and applies the detected receiver audio signal to the audio amplifier circuits. The noise squelch threshold is normally adjusted so that a 3-μV carrier signal will cause the squelch switch to close.

4.3.5.2 Carrier Squelch Override Circuit (Refer to figure 6-4)

The carrier squelch override circuit, consisting of U203C and U203D, closes squelch switch U701B (figure 6-7) whenever the received carrier signal exceeds a preset level, normally 20 μV (10 μV with SB 2). The carrier squelch circuit receives its input signal directly from AGC amplifier U203B. The AGC signal is applied to comparator U203C along with the carrier threshold established by R242. Amplifier U203C provides a positive output when the AGC signal is more positive than the threshold. The output of U203C is amplified by U203D and applied through CR210 to the squelch switch. Diodes CR210 and CR213, and resistor R248 form a 3-input OR gate so that either the noise squelch, carrier squelch, or squelch override switch S201 can close the squelch switch U701B. The squelch override switch S201 provides +14 V dc through R248 to the squelch switch when in the pulled position.

4.3.6 Audio Circuits (Refer to figure 6-7)

The audio circuits in the transceiver provide speech processing and audio amplification in both receive and transmit modes. Speech processing is provided by the compressor circuit consisting of U701D, U702, U703A, and Q701. Additional audio amplification is provided by U704 to provide 50 mW into 500-Ω headphones.

During the receive mode the detected receiver audio is applied through tone control R1 to squelch analog switch U701B. When U701B is closed by either squelch circuit or squelch override switch S201, the received audio is applied to U702B in the audio compressor. U702B is an active low-pass filter that amplifies the speech frequency components and attenuates any higher frequency audio components. The output of U702B is applied through compressor analog switch U701D to the second low-pass filter, U702A. If the output of U702A is less than 4 V p-p, the compressor is biased off, analog switch U701D remains closed, and the compressor circuit performs as a low-pass filter and amplifier.

Biasing for the compressor circuit is provided by 7.5-V zener diode VR701 which establishes a +7.5-V dc bias at the output of U702A. This bias voltage is greater than the +5 V dc applied to the emitter of Q701 and keeps Q701 turned off until the audio signal at U702A exceeds approximately 4 V p-p. When the audio signal exceeds 4 V p-p, Q701 is turned on for a portion of the negative half cycles. The positive pulses at the collector of Q701 are averaged by capacitor C713 and applied to one input of comparator U703A. The other input of U703A is driven by a 3-V p-p, 106-kHz sawtooth signal from the power supply. The output of U703A is a pulse-width modulated signal with a duty cycle that decreases as the audio signal at the output of U702A increases above 4 V p-p. The output of U703A is applied to compressor switch U701D so that it chops the audio signal applied to U702A. This limits the output of U702A to a value less than that which would overdrive audio amplifier U704.

The output of the compressor is applied to the modulator, which is inoperable during the receive mode, and to volume control R721. The output from the volume control is summed with ICS microphone input and applied to audio headphone amplifier U704.

During the transmit mode, squelch switch U701B is held open by Q108, and the transmit mic switch U701C is closed by the +14-V dc transmit bus voltage. This enables the transmit microphone input to be applied through mic gain control R2 and mic switch U701C to the compressor circuit. The compressor circuit operates the same during the transmit mode as it does during the receive mode described previously. The compressed microphone audio is applied to the modulator, described in paragraph 4.3.7, and to audio amplifier U704 to provide the transmitter sidetone. Bias current for the transmit microphone is provided by the +14 V dc transmit bus voltage applied through CR703, R705, and R719.

4.3.7 Modulator Circuit (Refer to figure 6-7)

The modulator circuit, consisting of U703B, Q702, Q703, and L701, is a pulse-width modulated, switching amplifier with low-pass filtering of the output. The modulator provides the modulated dc for the rf power amplifiers in the transmitter. During the transmit mode, 0 V dc is applied to the transmit line by the control circuit. This 0-V transmit signal reverse biases diode CR701 and allows transmit power control R727 to establish a less positive (approximately +2.5 V dc) bias voltage on the noninverting input to U703B. This bias voltage is compared with a +1- to +4-V, 106-kHz sawtooth signal applied to the inverting input of U703B so that the output of U703B is switched on and off at a 106-kHz rate. The output of U703B is applied to the base of compound transistor switch Q702/Q703 so that it is also turned on and off at a 106-kHz rate. Each time Q702/Q703 is turned on, it applies a +30-V power pulse to the input of the low-pass modulation filter consisting of L101 and associated capacitors. The modulation filter averages the +30-V pulses to provide the dc required by the rf power amplifiers in the transmitter.

The microphone audio signal from the audio compressor is applied through modulation depth control R275 to the noninverting input of U703B where it is superimposed on the dc bias voltage provided by R727. The audio signal superimposed on the bias voltage causes the pulse width of the +30-V pulses, at the input of L101, to vary according to the amplitude of the audio signal. This pulse-width modulation results in a modulated dc output from the modulator filter.

The average dc output of the modulator determines the average rf output of the transmitter and is controlled by the bias voltage established by transmit power control R727.

The depth of modulation is proportional to the amplitude of the audio signal superimposed on the bias voltage. The audio amplitude is adjusted by modulation depth control R725.

The modulator is turned off during the receive mode by the +5-V dc signal applied through CR701 to comparator/modulator U703B. This turns U703B off (high impedance output) and prevents the modulator switching transistor Q702/Q703 from turning on. This causes the output of the modulator to be 0 V and prevents operation of the rf power amplifiers in the transmitter.

4.3.8 Transmit/Receive Switching (Refer to figures 6-7 and 6-8)

Transmit/receive switching is performed by transistor switches Q107, Q108, and Q505 and controlled by the microprocessor. During the receive mode, the microprocessor applies a +5-V dc signal to the transmit line, U601-24. This signal is applied through zener diode VR103 to turn off transistor Q107 which turns off the +14 V dc applied to the +14-V dc transmit bus. This removes the +14-V dc power applied to the transmitter and the bias voltage applied to the transmit microphone. The low voltage on the +14-V dc transmit bus also turns off Q108, which enables squelch switch U701B, turns off mic switch U701C, and turns on tr switch Q505. Tr switch Q505 forward biases diodes CR504 and CR506 so that received rf from the antenna is conducted through CR504 to the receiver circuits. The +5 V dc on the transmit line is also applied through CR701 to the modulator and prevents the modulator from turning on.

The transmit mode is selected when the push-to-talk (ptt) switch on the transmit microphone is pushed. Actuation of the ptt switch causes the microprocessor to apply 0 V dc to the transmit line to turn on Q107, which applies +14 V dc to the +14-V dc transmit bus. The 0-V dc signal on the transmit line also reverse biases CR701, causing the modulator to operate. The +14-V dc transmit bus voltage and positive modulator output causes the transmitter to become operational.

The +14-V dc transmit bus voltage turns on transistor Q108 which grounds the output from the squelch circuits and prevents squelch switch U701B from closing. The +14-V dc transmit bus voltage also turns on mic switch U701C and applies a bias voltage to the transmit microphone input. Tr switch Q505 is also turned off and reverse biases tr diodes CR504 and CR506. This prevents the application of transmitter rf to the receiver circuits.

4.3.9 Transmitter (Refer to figure 6-8)

The transmitter is a 4-stage broadband solid state circuit that amplifies the +7 dB mW synthesizer output to a rf output of 10 W. The first two stages, Q501 and Q502, are class A amplifiers that are powered directly from the +14-V dc transmit bus. The final two stages, Q503 and Q504, are class C amplifiers. Driver Q503 is powered by the +14-V dc transmit bus with limited collector modulation while power amplifier Q504 receives all of its power from the modulator. Output tuning is provided by variable capacitor C515 which is normally adjusted for maximum rf output power at 135.975 MHz. The rf output is low-pass filtered to reject harmonics of the carrier.

Modulation limiting is provided by the circuit consisting of R511, CR502, CR503, and R513 to prevent overmodulation of the rf output. This circuit applies collector modulation to driver Q503 through CR503 except when the modulation voltage drops below the +14-V dc transmit bus. When the modulation voltage drops below +14 V dc, CR503 is reverse biased and CR502 is forward biased so that part of the +14-V dc transmit bus voltage is applied to the collector of Q503. This permits Q503 to conduct, even through Q504 may be cut off by low modulation voltage. Normal leakage through Q504 ensures that some rf is applied to the antenna to prevent overmodulation.

4.3.10 Power Supply Circuits (Refer to figure 6-3)

Primary dc power for the transceiver is provided by a +30-V dc switching regulator that is capable of operating from a +11- to +32-V dc input power bus. The output of the +30-V dc regulator is applied to the modulator circuit, audio output amplifier, and the +14-V dc switching regulator. The +14-V dc regulator provides power to most of the analog circuits and to two +5-V dc series regulator IC's. One of the +5-V dc regulators (U404) provides power only to the digital synthesizer IC, U403. The other +5-V dc regulator, U102, provides power to most of the other digital circuits in the transceiver.

The +30-V dc regulator, consisting of U101, Q103 through Q105, T101, and U103B, is a variable pulse-width switching regulator. Regulator control is provided by U101, which compares the +30-V dc output voltage with an internally generated +5-V dc reference voltage. The resulting error voltage is compared with an internally generated sawtooth signal to obtain a controlled pulse-width signal. The controlled pulse-width signal is gated along with the output from an internal flip-flop to the output drive transistors in the IC. The output drive transistors control switch transistor pair Q103 and Q104. The switch transistors are connected in push-pull to the primary of switching transformer T101. The output of T101 is full-wave rectified by CR103 and CR106, and filtered by L102 and C104 to provide the +30-V dc regulated output. A -20-V dc output is also provided by the secondary of T101.

The +5-V dc reference voltage from U101 is also applied through CR101 to the collectors of the drive transistors in U101 to provide start-up current for the drive transistors until +5-V dc regulator U101 becomes operational.

Comparator U103B compares the current sense voltage from R111 and R112 with the +5-V dc reference from U101 to generate a shutdown signal if the current through the switch transistors becomes excessive. The primary input voltage is summed with the current sense voltage to compensate for the increased current required when the primary input voltage is low.

The operating frequency of the +30-V dc switching regulator is synchronized with the 3.2-MHz synthesizer clock by a 106.667-kHz signal from the control circuit.

The +14-V dc switching regulator consists of comparator U103A and transistor switch Q106. A sample of the +14-V dc output voltage is summed with the sawtooth signal from U101 and then compared with the +5-V dc reference by U103A to generate the pulse-width signal required to drive switch transistor Q106. The output of the switch transistor, which is a chopped +30-V dc signal, is filtered by L104 and C109 to provide the +14-V dc output.

The +5-V dc regulated power is provided from the +14-V dc output by 3-terminal series regulator IC, U102.

4.3.11 Optional Speaker Amplifier (Refer to figure 6-10)

The optional speaker amplifier, circuit card A4, consists of a 5-W audio amplifier IC and a voltage limiting power supply. The speaker amplifier has six parallel 510-Ω audio inputs and a 150-kΩ sidetone input.

During normal operation, double diode CR801 is forward biased and the six audio inputs are applied in parallel to the input of audio amplifier IC, U801. The output of U801 is applied through dc blocking capacitor C806 to the speaker terminal. A mute input, which is normally connected to the transmit key line, is provided to turn off the six audio inputs. The audio inputs are turned off by applying a ground to the mute input which reverse biases CR801 to prevent current flow from the inputs to the amplifier IC.

The sidetone input, which is normally connected to the transceiver audio output, is not turned off by the mute signal and allows the transmitted audio to be heard through the speaker amplifier at a reduced level.

The power supply circuit, consisting of Q801, VR801, and U802, limits the voltage applied to the audio amplifier IC to approximately +17 V dc. When the speaker amplifier is operated with a primary input voltage less than +17 V dc, series pass transistor Q801 is turned on by the current flow through U802, which maintains a +5-V dc drop across R808. With Q801 turned on, the voltage applied to U801 follows the primary input voltage. If the primary input voltage is greater than +17 V dc, the collector voltage of Q801 begins to rise above +17 V dc and zener diode VR801 begins to conduct. The current flow through VR801 also flows through R808 and causes an equal decrease in the current flow through U802 as U802 tries to hold the voltage across R808 at +5 V dc. Since the current through U802 is the base current for Q801, the reduced current begins to turn Q801 off to limit its collector voltage at approximately +17 V dc.

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VHF-253/253S

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Record of Revisions

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section V maintenance

5.1 GENERAL

This section provides the testing, troubleshooting, alignment, and repair procedures required for the VHF-253/253S Communications Transceiver.

The performance tests should be used as the first step in fault isolation to determine which troubleshooting or alignment procedures may be required for repair. After repair, the performance test should be repeated to verify proper operation of the repair or realigned circuits.

The troubleshooting procedures provide additional tests and checks to help isolate a fault once the functional area has been determined.

The functional area schematic diagrams in the diagrams section and the test point and adjustment location diagram in this section are arranged to allow viewing, while using the testing, troubleshooting, and alignment procedures.

5.2 TEST EQUIPMENT REQUIRED

5.2.1 Special Test Equipment

A simple breakout harness or box, similar to that shown in figure 5-1, must be fabricated so that the standard test equipment listed in paragraph 5.2.2 can be safely and conveniently connected to the transceiver.

Caution

Failure to use a breakout harness can result in incorrect power and test equipment connections that can damage the transceiver or the test equipment.

5.2.2 Standard Test Equipment

Table 5-1 lists the test equipment required for performance testing. Table 5-2 lists the tools required for disassembly, assembly, and alignment of the transceiver.

5.3 TESTING/TROUBLESHOOTING/ ALIGNMENT

5.3.1 Test Setup

Refer to figure 5-1 and connect the transceiver to be tested to the test setup. Use mating connector CPN 371-0379-500 and contacts CPN 371-0379-130 (Qty 17) and 371-0379-510 (Qty 5, power and ground) for rear connector. Use mating connector CPN 357-7532-010 or a standard BNC connector with the locking ring removed for the rf connector.

A breakout box with tip jacks for connecting the test equipment and loads is recommended.

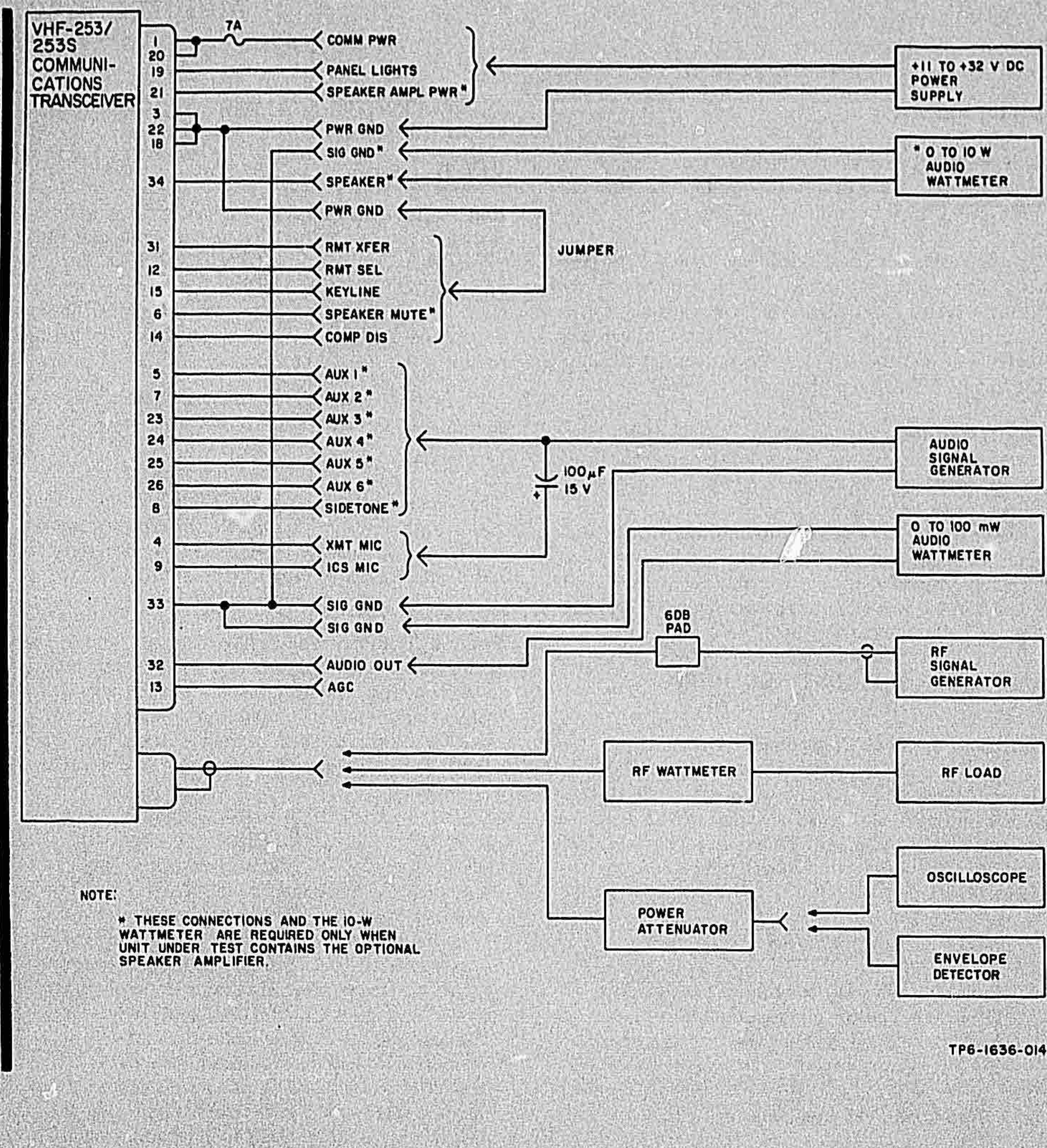
5.3.2 Performance Tests

The performance tests given below provide a relatively high degree of assurance that the transceiver is operating properly. They can be performed without removing the covers from the unit.

These tests can be performed as a preinstallation test or after minor repairs have been performed. The performance tests can also be used to isolate a fault to a function of area, thus determining which troubleshooting or adjustment procedures are applicable. Some of the performance criteria have been adjusted to allow for the tolerances of typical test equipment.

Note

All specified rf signal generator output levels are hard microvolts. These are the levels marked on the attenuators of most signal generators, provided that a 6-dB pad is connected between the signal generator and the transceiver antenna connector. If a Collins 479S-6A VOR/ILS Signal Generator is used, set it up to indicate signal levels in microvolts and do not use an external 6-dB pad. If a 6-dB pad is not available to use with most other generators, divide all rf levels by two. Use of a pad is recommended, both to provide consistent and repeatable results, and to provide some protection for the generator if the transmitter is accidentally keyed.



VHF-253/253S Communications Transceiver, Test Setup
Figure 5-1

Table 5-1. Test Equipment Required.

EQUIPMENT	CHARACTERISTIC DESIRED
Rf generator	Frequency range: 118 to 136 MHz
	RF output range: 1 to 200 000 μV
	Modulation: 0 to 95% with 350 to 8000 Hz
	Output level accuracy: ±2 dB
Audio generator	Range: 250 to 5000 Hz
	Distortion: 3% maximum
	Capable of providing 5 V across 500 Ω
Rf wattmeter	Power dissipation: not less than 20 W (short term)
	Impedance: 50 Ω ±10%
	Accuracy: ±0.5 W
Audio power meter (Refer to note 1.)	Power dissipation: 10 W maximum
	Impedance: 3.2 to 500 Ω
	Accuracy: ±1.5 dB
Frequency counter	Range: 118 to 136 MHz
	Accuracy: 0.0005% of displayed frequency
Power attenuator (Refer to note 2.)	50 Ω, 40 dB, 20 W
Attenuator pads	50 Ω, 6 ±0.25 dB
Power supply	+11 to 32 V dc at 6 A
Digital voltmeter	Resolution: 3-1/2 digit
	Input impedance: 1 MΩ, minimum, shunted by 200 pF maximum
Oscilloscope	Any dc coupled scope usable to 140 MHz (used for waveform observation only)

Note 1. If an audio power meter is not available, use 1% load resistors and measure voltage across resistor to determine power. The test procedures give the correct voltage in addition to the correct power indication where applicable.

Note 2. Power attenuator is required only if the modulation envelope is to be observed.

Table 5-2. Tools Required.

DESCRIPTION	CHARACTERISTIC	FUNCTION
20-W soldering iron	Any	Remove/replace IC's and components
Solder sucker	Any	Remove solder
Needle-nose pliers	Any	Bend component leads
Cutting tools	Various, small diagonal cutter, end nippers, etc (sharp tools that will not leave burrs)	Cut IC and component leads
Adjustment tool	JFD 5284 or equivalent	Adjust variable resistors and capacitors
	Plastic hex	Adjust variable coils
Screwdrivers	Various Phillips	Disassembly
Allen wrenches	0.05-inch	Remove knobs
Tweezers	Any	Remove/replace elastomeric connectors and pushbutton switch contacts

5.3.2.1 Frequency Selection Test

a. Apply power to transceiver and verify that valid frequencies (between 118.00 and 135.97) are displayed.
b. Push in the kilohertz (small) frequency selector knob if it is pulled out. Verify that clockwise rotation of the knob increments and counterclockwise rotation decrements the PRE display in 0.05-MHz steps. Verify proper sequencing from 1XX.00 to 1XX.95 with rollover to 1XX.00 (the kilohertz frequency selector does not roll over to the megahertz display (1XX.).
c. Pull the kHz frequency selector knob and verify that clockwise rotation of the knob increments and counterclockwise rotation decrements the PRE display in 0.025-MHz steps (the third digit is not displayed). Also verify proper sequencing from 1XX.00 through 1XX.97 with rollover to 1XX.00.
d. Verify that clockwise rotation of the megahertz (large) frequency selector knob increments and that counterclockwise rotation decrements the PRE display in 1-MHz steps. Also verify proper sequencing from 118 through 135 with rollover from 135 to 118, and rollover from 118 to 135 when decrementing.
e. Push and hold the STO button while momentarily pushing the transfer button. Release the STO button. Repeat steps b through d and verify that the frequency selector switches control the active frequency.
f. Repeat step e and verify that frequency control is returned to the PRE display.

5.3.2.2 Frequency Transfer Test

a. Select a different frequency in the preset frequency display than the one that is displayed in the active frequency display. Push the transfer button and verify that the active and preset frequencies change places.
b. Momentarily ground rear connector pin 31 (remote transfer) and verify that the active and preset frequencies change places.
c. Connect a 500-Ω headphone between connector pins 32 and 33. Set volume control at three-fourths of maximum. Verify that a short beep is heard each time the transfer button is pushed.

5.3.2.3 Memory Test

a. Select 121.10 in the preset frequency display. Push STO button and then, within 5 seconds, push 1 button. Verify that preset display and PRE indicator blanks momentarily when 1 button is pushed.

b. Select 122.20 in the preset frequency display. Push STO button and within 5 seconds push 2 button.
c. Select 123.30 in the preset frequency display. Push STO button and within 5 seconds push 3 button.
d. Select 124.40 in the preset frequency display. Push STO button and within 5 seconds push 4 button.
e. Select 125.50 in the preset frequency display. Push STO button and wait 8 seconds. Push 1 button and verify that 121.10 is displayed in preset frequency display.
f. Push each of the numbered buttons and verify that the appropriate stored frequency is displayed in the preset frequency display as follows:

NUMBERED BUTTON	PRESET FREQUENCY
1	121.10
2	122.20
3	123.30
4	124.40

g. Select 118.00 in the preset frequency display. Push the transfer button and verify that 118.00 is displayed in the active frequency display. Select 135.97 in the preset frequency display. Delay 5 seconds minimum and then turn off the transceiver.

Note

Nonvolatile memory U603 may exhibit reduced retention capability after 100 000 erase/write operations. To avoid unnecessary use of this life, the transceiver waits 5 seconds after a frequency selector knob is turned before storing the new frequency. If the transceiver is turned off within 5 seconds after selecting a new frequency, the new frequency will not have been entered in the nonvolatile memory.

h. Delay 5 seconds minimum and then turn on the transceiver. Verify that the active frequency is 118.00 and the preset frequency is 135.97.
i. Push each of the numbered buttons and verify that the appropriate stored frequency is displayed in the preset frequency display as follows:

NUMBERED BUTTON	PRESET FREQUENCY
1	121.10
2	122.20
3	123.30
4	124.40

j. Momentarily ground connector pin 12 at least five times and verify that the following preset frequencies are repeatedly displayed in sequence. The sequence can start at any point in the list.

121.10
122.20
123.30
124.40

5.3.2.4 Receiver Sensitivity

Note

The top cover, adjacent to the printed circuit board, must be in place and all screws securely fastened during the following test.

a. Ground connector pin 14 to disable audio compressor.
b. Connect rf generator through a 6-dB pad to the unit antenna connector.
c. Adjust rf generator for a 3-μV, 118.00-MHz signal modulated 30 percent by 1000 Hz.
d. Connect audio power meter (or a 500-Ω, 1-percent load resistor) between connector pins 32 and 33. Tune transceiver to 118.00 MHz. Pull volume control knob to disable squelch and adjust volume control for 5 mW (1.58 V rms) into a 500-Ω load.
e. Remove modulation from rf signal and verify that audio output is not more than 0.5 mW (0.5 V rms).
f. Repeat steps c through e with transceiver and rf generator tuned to 127.60 MHz and then 139.975 MHz.
g. Remove ground connection from pin 14.

5.3.2.5 Receiver Residual Output and Quieting Test

Note

The top cover, adjacent to the printed circuit board, must be in place and all screws securely fastened during the following test.

a. Connect rf generator through a 6-dB pad to the unit antenna connector.
b. Adjust rf generator for a 100-μV, 127.60-MHz signal modulated 30 percent by 1000 Hz.
c. Connect audio power meter (or 500-Ω, 1-percent load resistor) between connector pins 32 and 33. Tune transceiver to 127.60 MHz and adjust volume control fully counterclockwise, but not off.
d. Verify that audio output into a 500-Ω load does not exceed 0.05 μW (5 mV rms).
e. Adjust volume control for 5 mW (1.58 V rms) into a 500-Ω load.
f. Remove modulation from rf signal and verify that audio output power does not exceed 16 μW (89 mV rms).

5.3.2.6 Receiver AGC Test

a. Ground connector pin 14 to disable audio compressor.
b. Connect rf generator through a 6-dB pad to the unit antenna connector.
c. Adjust rf generator for a 1000-μV, 127.60-MHz signal modulated 30 percent by 1000 Hz.
d. Connect audio power meter (or 500-Ω, 1-percent load resistor) between connector pins 32 and 33. Tune transceiver to 127.60 MHz and adjust volume control for 2 mW (1 V rms) into a 500-Ω load.
e. Verify that the ratio between the minimum and maximum audio power does not exceed 6 dB (0.5 to 2.0 V rms) when the rf signal is slowly varied from 10 μV to 100 000 μV.
f. Remove ground connection from pin 14.

5.3.2.7 Audio Power

a. Connect rf generator through a 6-dB pad to unit antenna connector.
b. Adjust rf generator for a 100-μV, 127.60-MHz signal modulated 30 percent by 1000 Hz.
c. Connect an oscilloscope across a 500-Ω, 1-percent load connected between pins 32 and 33 (scope ground).
d. Tune transceiver to 127.60 MHz and adjust volume control clockwise until clipping becomes visible. Verify that audio output at the start of clipping is at least 14 V p-p (50 mW into 500 Ω).

5.3.2.8 Receiver Audio Frequency Response

a. Connect rf generator through a 6-dB pad to the unit antenna connector.
b. Adjust rf generator for a 100-μV, 127.60-MHz signal modulated 30 percent by 1000 Hz.
c. Connect audio power meter (or 500-Ω, 1-percent load resistor) between connector pins 32 and 33. Tune transceiver to 127.60 MHz and adjust volume control for 5 mW (1.58 V rms) into a 500-Ω load.
d. Change modulation frequency to 350 Hz and verify that the audio output power is at least 1.25 mW (0.79 V rms).
e. Change modulation frequency to 2500 Hz and verify that the audio output power is at least 1.25 mW (0.79 V rms).
f. Adjust rf generator for a 100-μV, 127.60-MHz signal modulated 10 percent by 1000 Hz.
g. Change modulation frequency to 4000 Hz and verify that the audio output power does not exceed 75 μW (0.19 V rms).

5.3.2.9 Receiver Selectivity

Note

The top cover, adjacent to the printed circuit board, must be in place and all screws securely fastened during the following test.

a. Connect the frequency counter through a 40-dB, 20-W power attenuator to the unit antenna connector.

Caution

Observe 1-minute transmit, 4-minute receive duty cycle to prevent transmitter overheating.

b. Tune transceiver to 127.600 MHz and ground unit connector pin 15 (key line). Record the transmitter frequency, f_t, with 100-Hz resolution. Remove ground from pin 15.
c. Remove power attenuator from antenna connector and connect rf generator through a 6-dB pad to the unit antenna connector.
d. Adjust rf generator for a 10-μV, 127.60-MHz unmodulated signal and record the AGC voltage at unit connector pin 13.

e. Increase the rf signal level to 20 μV and then vary the rf signal frequency to find the upper and lower -6-dB frequencies that produce the same AGC voltage that was measured in step d. The lower -6-dB frequency should be less than f_t -9 kHz for the VHF-253 and less than f_t - 17 kHz for the VHF-253S. The upper -6-dB frequency should be greater than f_t + 9 kHz for the VHF-253 and greater than f_t + 17 kHz for the VHF-253S.

f. Increase the rf signal level to 10 000 μV and then vary the rf signal frequency to find the upper and lower -60-dB frequencies that produce the same AGC voltage that was measured in step d. The lower -60-dB frequency should be greater than f_t -22 kHz for the VHF-253 and greater than f_t- 38 kHz for the VHF-253S. The upper -60-dB frequency should be less than f_t + 22 kHz for the VHF-253 and less than f_t+ 38 kHz for the VHF-253S.

5.3.2.10 Squelch Test

Note

The top cover, adjacent to the printed circuit board, must be in place and all screws securely fastened, and the volume control must be pushed in during this test.

a. Connect rf generator through a 6-dB pad to the unit antenna connector.

b. Adjust rf generator for a 4-μV, 118.00-MHz signal modulated 30 percent by 1000 Hz.

c. Connect audio power meter (or a 500-Ω, 1-percent load resistor) between connector pins 32 and 33. Tune transceiver to 118.00 MHz and adjust volume control for 50 mW (5 V rms) into a 500-Ω load.

d. Slowly reduce the rf signal level and verify that the audio output drops to 1 μW (22 mV rms) or less below the squelch threshold (typically between 1 and 2 μV rf signal).

e. Repeat steps b through d with the transceiver and rf generator tuned to 135.975 MHz and then 127.60 MHz.

5.3.2.11 Transmitter Output Test

Note

The top cover, adjacent to the printed circuit board, must be in place and all screws securely fastened during the following test.

a. Connect a 50-Ω, 20-W rf load and rf wattmeter to the unit antenna connector.

Note

Power output measurement must be measured with a length of coax no longer than 15 cm (6 in) between transceiver and wattmeter.

b. Tune the transceiver to 118.00 MHz.

Caution

Observe 1-minute transmit, 4-minute receive duty cycle to prevent transmitter overheating.

c. Ground unit connector pin 15 (key line) for less than one minute at a time and verify that the unmodulated rf output power is between 10 and 13 W.

d. Verify that dc input power is not more than 65 W.

e. Repeat steps b through d with the transceiver tuned to 127.60 and then 135.975 MHz.

f. Ground unit connector pin 15 for less than one minute and verify that XMT indicator on unit display is visible.

Note

Key line contact bounce exceeding 100 ms may fail to activate the transmitter.

5.3.2.12 Transmitter Modulation Test

Note

The top cover, adjacent to the printed circuit board, must be in place and all screws securely fastened during the following test.

a. Connect a 50-Ω, 20-W rf load and either an rf modulation analyzer or an oscilloscope to the unit antenna connector. The oscilloscope must be usable at 136 MHz.

Note

If an oscilloscope is used, attenuators must be used between the transceiver and scope input. These attenuators must provide a 50 Ω load for the transceiver and reduce rf output to a level that is an acceptable input level to the scope (rf output at the antenna connector may be as much as 155 V p-p). If excessive envelope distortion or low modulation depth is observed, the test should be repeated with additional attenuation added. This ensures that scope input nonlinearity is not introducing error.

b. Connect an audio signal generator to connector pin 4 (xmit microphone) and pin 33 through a 100-μF, 15-V blocking capacitor with the positive lead of the capacitor connected to pin 4 (see figure 5-1).
c. Adjust audio generator for a 250-mV, 1000-Hz signal at connector pin 4.

Note

A resistor may be required in series with the audio generator output to prevent loading down the generator.

d. Tune the transceiver to 118.00 MHz.

Caution

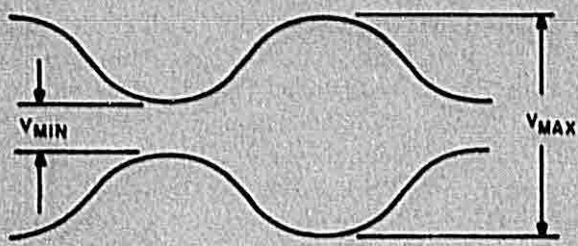
Observe 1-minute transmit, 4-minute receive duty cycle to prevent transmitter overheating.

e. Key transmitter by grounding connector pin 15 and verify that the modulation depth is 85 percent or greater. If an oscilloscope is used, refer to figure 5-2 to determine depth of modulation.
f. Adjust audio generator for a 500-mV, 1000-Hz signal at connector pin 4.
g. Key transmitter by grounding connector pin 15 and verify that the modulation depth is 95 percent or less.

5.3.2.13 Transmitter Frequency Accuracy Test

Note

The top cover, adjacent to the printed circuit board, must be in place and all screws securely fastened during the following test.



$$\text{MODULATION DEPTH (\%)} = \frac{V_{MAX} - V_{MIN}}{V_{MAX} + V_{MIN}} \times 100$$

TP6-1629-011

Modulation Depth Calculation
Figure 5-2

a. Connect frequency counter through at least 40 dB of power attenuators to the unit antenna connector.
b. Tune the transceiver to 135.00 MHz.
c. Key the transceiver by grounding connector pin 15 and verify that the actual frequency is between 134.997 and 135.003 MHz.

5.3.2.14 Microphone Bias Test

a. Connect a 150-Ω, 1-percent resistor between connector pins 4 and 33.

Caution

Observe 1-minute transmit, 4-minute receive duty cycle to prevent transmitter overheating.

b. Key transmitter by grounding connector pin 15 and verify that voltage across 150-Ω resistor is between 2.50 and 3.65 V dc. Remove ground from pin 15.
c. Remove 150-Ω resistor from connector pins 4 and 33 and connect to pins 9 and 33.
d. Verify that voltage across 150-Ω resistor is between 2.85 and 3.90 V dc.

5.3.2.15 Intercom Test

a. Connect an audio signal generator to connector pin 9 (ICS microphone) and pin 33 through a 100-μF, 15-V blocking capacitor with positive lead of the capacitor connected to pin 9.
b. Adjust audio generator for 100-mV, 1000-Hz signal at connector pin 9.

Note

A resistor may be required in series with the audio generator ouput to prevent loading down the generator.

c. Rotate transceiver volume control as far counterclockwise as possible without turning off the transceiver.
d. Connect audio power meter (or a 500-Ω, 1-percent load resistor) between connector pins 32 and 33, and verify that audio output power is between 1.9 and 5.2 mW (0.97 and 1.61 V rms) into a 500-Ω load.

5.3.2.16 Panel Light Test

a. Apply +28.0 V dc between connector pins 19(+) and 18(-).
b. Verify that all four panel lights are lit.

5.3.2.17 Speaker Amplifier Test

Note

This test should be performed only on units containing optional speaker amplifier.

a. Connect an audio power meter set at 3.2 Ω (or a 3.2-Ω, 1-percent, 10-W load resistor) between unit connector pins 34 and 33.
b. Connect a 15.0-V dc, 2-A power supply between unit connector pins 21(+) and 22(-). (The transceiver does not have to be turned on. Speaker amplifier power is not controlled by the transceiver on/off switch.)
c. Connect an audio signal generator between unit connector pins 5 (AUX 1) and 33. Adjust the generator for a 5-V rms, 1000-Hz signal at pin 5.
d. Verify that the speaker amplifier produces at least 5 W (4 V rms) into the 3.2-Ω load.
e. Repeat steps c and d with the audio generator connected in sequence to unit connector pins 7, 23, 24, 25 and 26 with pin 33 as common.
f. Reconnect the audio generator to unit connector pins 5 and 33. Adjust the generator for 5-V rms, 1000-Hz signal at pin 5.
g. Ground unit connector pin 6 (mute) and verify that output power into 3.2-Ω load does not exceed 5 mW (126 mV rms).
h. Adjust amplitude of audio input at pin 5 for 5.0 W (4 V rms) output power. Record amplitude of audio input signal.
i. Change the frequency of the audio generator to 250 Hz while maintaining the amplitude recorded in step h. Verify that the output power is at least 3 W (3.1 V rms) into the 3.2-Ω load.
j. Repeat step i with the audio generator set at 2500 Hz.
k. Disconnect the audio generator from pin 5 and reconnect to pin 8 (speaker sidetone input). Adjust the audio generator for a 1000-Hz signal at pin 8 with the amplitude equal to that recorded in step h.
l. Ground unit connector pin 6 (mute) and verify that the output power into the 3.2-Ω load is between 0.5 and 1.5 W (1.26 and 2.19 V rms).

5.3.3 Troubleshooting Tests and Procedures

The following tests and procedures are provided to help isolate and correct any faults detected by the performance tests provided in paragraph 5.3.2.

Note

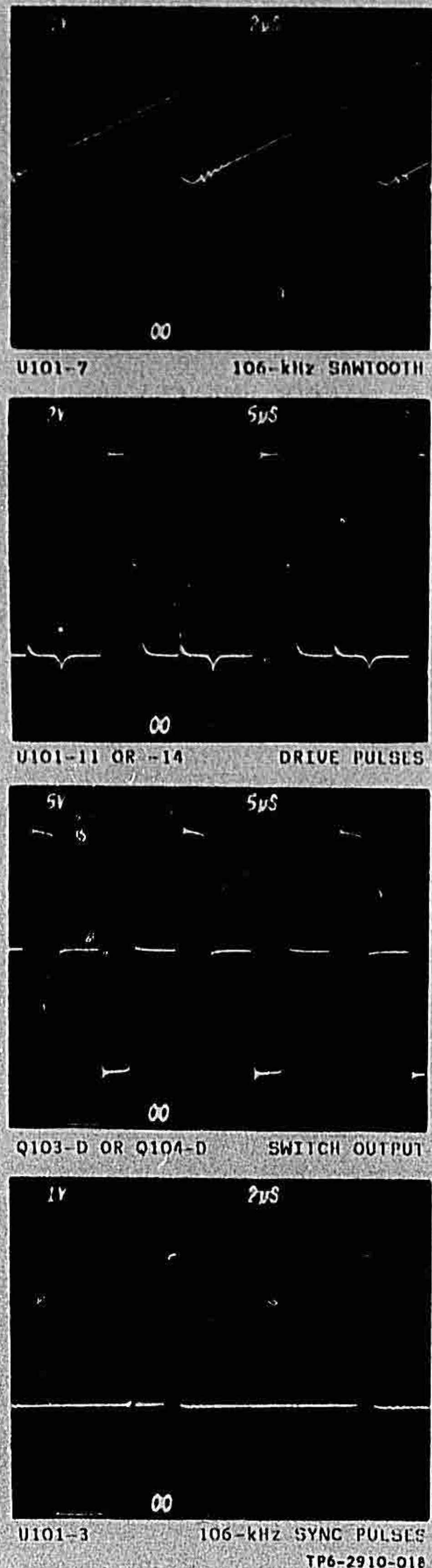
Always verify proper power supply operation and adjustment as given in paragraph 5.3.4.1 before performing any other adjustment or troubleshooting procedures.

Refer to figure 5-10 for the location of test points referenced in the following paragraphs.

5.3.3.1 Power Supply

Refer to figure 5-3, Power Supply Waveforms.

a. Check for input power at pin 15 of U101 and at center tap of T101 (pin 2).
b. Check pin 7 of U101 for a 106-kHz sawtooth waveform (peaks approximately +3.0 V dc and valleys approximately +0.8 V dc).
c. Check pins 11 and 14 of U101 for drive pulses (period approximately 19 μs, amplitude approximately 10 V, width ranges from approximately 8 μs with 12-V dc input to 1 μs with 28-V dc input). Absence of drive voltage may indicate that U103B has sensed excessive current and shut down the supply (U103 pin 7 at approximately +1.0 V dc), that the reference and feedback voltages at U101 pins 1 and 2 are incorrect (should be equal at approximately +2.25 V dc), that U101 is defective, or that CR101 is open.
d. Check drains of switching transistors Q103 and Q104 for switching waveform.
e. Check output windings of transformer T101 for the stepped up version of the waveform seen in step d.
f. Check cathodes of diodes CR103 and CR106 for proper rectification.
g. Check anodes of diodes CR104 and CR105 for proper rectification.
h. Check collector of Q106 for a chopped +30 volt signal.
i. Check pin 3 of U101 for synchronization pulses (period 9.4 μs, amplitude 3 to 5 volts, width 0.6 to 0.8 μs at +2.0-V dc level, baseline at -0.2 to -0.6 volts). Absence of synchronization pulses may result in a free-running power supply, which will normally produce receiver interference.



Power Supply Waveforms
Figure 5-3

5.3.3.2 Control/Display

Refer to figure 5-4, Control/Display Waveforms.

a. Check pin 11 of U601, the microprocessor, for address latch enable (ALE) pulses (5-V p-p, 4.7-μs period, 1.4-μs pulse width). If there is no ALE output, check pin 20 for ground, pins 26 and 40 for +5 V dc, and TP1 for 3.2 MHz. If these are satisfactory and there are no ALE pulses, the microprocessor is probably defective.

b. Check pin 4 of U601, processor reset. It should be high (approximately +5 V dc) whenever power is applied. The interrupt, pin 6 of U601, should also be high unless the microphone is keyed

c. Check U601 pins 30, 22, and 23 for display data, load, and clock outputs. Pin 30 should be high with a burst of pulses approximately every 5 ms. Pin 22 should be low with a single pulse every 5 ms. Pin 23 should be low with a burst of pulses every 5 ms.

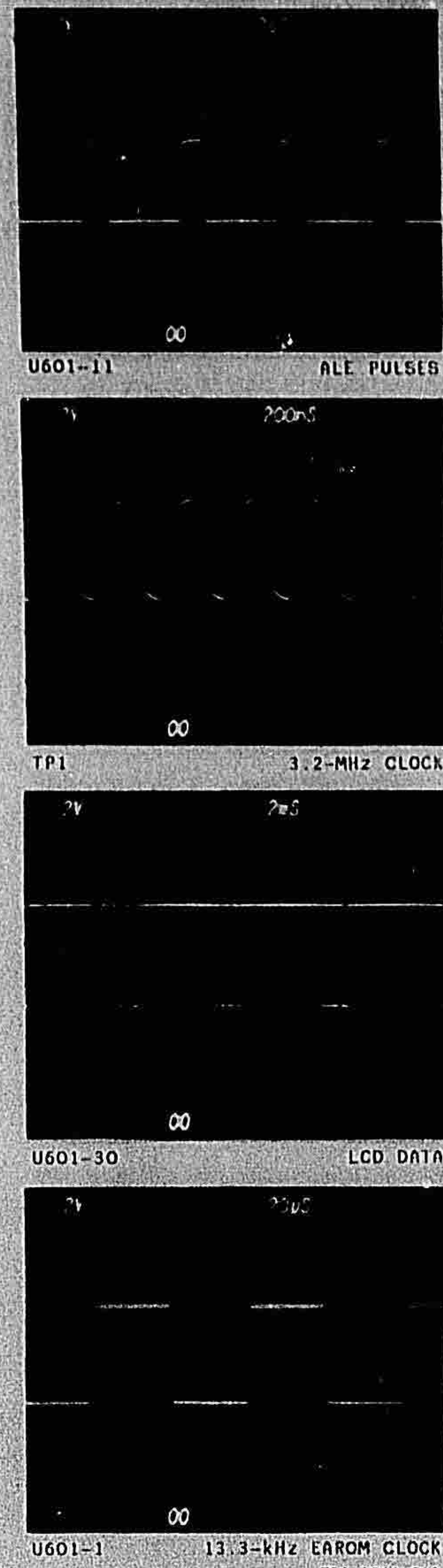
d. Check pins 27, 28, and 29 for push button/switch scan. These should be low pulses, once per scan cycle, with the remaining time high.

e. Failure of the above may be due to a "lost" processor. Try momentarily grounding pin 4 of U601, the reset pin. Upon release, proper operation should resume.

f. Check the LCD toggle, data, and load at U604-3, 11, and 9. These should be replications of the processor outputs. If none are observed, check for +4 V dc on the pullup resistors.

g. Failure of the +4 V dc can be due to loss of ALE, U605 failure, or failure of the LCD protection circuit, U604A, CR604, CR605. Check U605-10 for ALE (213 kHz). The EAROM clock should appear at U601-1 (13.3 kHz, 5 V p-p) and at U604-1 (13.3 kHz, 10 V p-p minimum). It should be rectified and filtered to +4 V dc at the cathode of CR605.

h. Verify the EAROM, U603, by loading known frequencies into memory and the display. Wait at least 5 seconds and remove power. Upon power up these values should reappear if the EAROM is working properly. EAROM inputs C1, C2, and C3 (U603-7,8,9) should be high (+14 V dc) except during EAROM read and update.

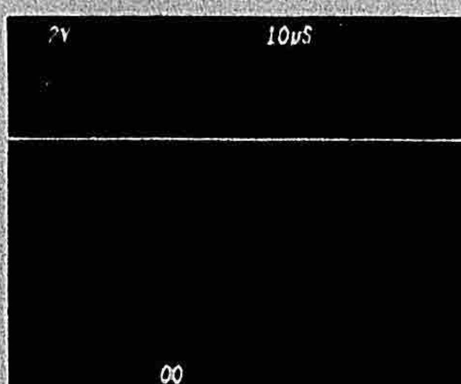


Control/Display Waveforms
Figure 5-4

5.3.3.3 Synthesizer

Refer to figure 5-5, Synthesizer Waveforms.

a. Check TP3 for +5.00 ±0.25 V dc.
b. Check TP1 for 3.2-MHz reference signal (5 V p-p).
c. Check Q402-C (output of vco) for signal. If there is a signal, it should be of a frequency consistent with the tuning voltage (156 MHz at 11.5 V dc and 138 MHz at 6.7 V dc).
d. Check voltage at TP5 (input to the prescaler). It should be in the range of 0.6 to 1.1 V p-p and a clean waveform. Any voltage outside these limits may cause the prescaler to miscount.
e. Check U402-3 (output of the prescaler). With transceiver set at 1XX.000, waveform should exhibit no FM. As frequency is increased to 1XX.975, an increasing amount of FM should be observed.
f. When the synthesizer is locked, there should be 25-kHz pulses at U403-6 (phase detector output).
g. The waveforms appearing on the modulus control input to the prescaler, U402-1, vary as the fractional MHz portion of the active frequency is varied.



U402-1 PRESCALER CONTROL AT 129.000 MHz

U402-1 PRESCALER CONTROL AT 129.975 MHz

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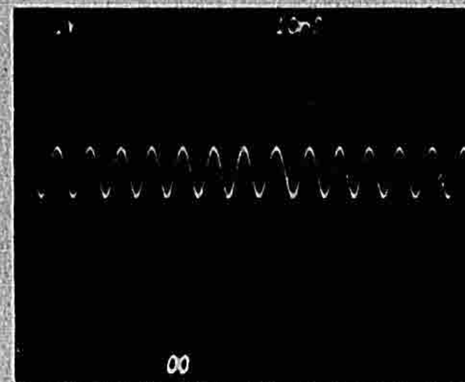
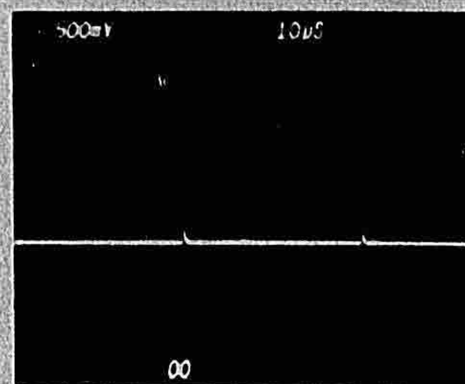
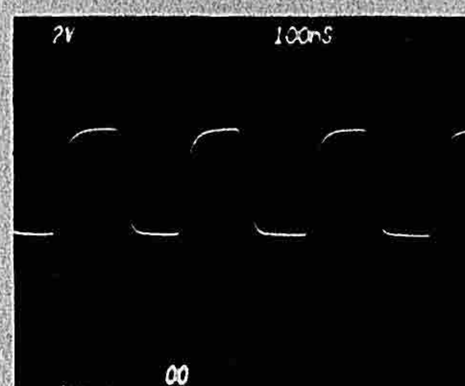


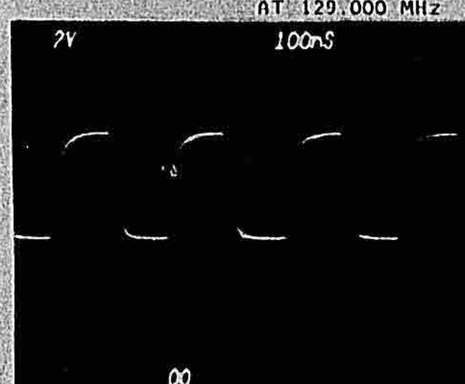
TP5 PRESCALER INPUT



U403-6 PHASE DETECTOR OUTPUT



U402-3 PRESCALER OUTPUT AT 129.000 MHz



U402-3 PRESCALER OUTPUT AT 129.975 MHz

TP6-2912-028

Synthesizer Waveforms
Figure 5-5

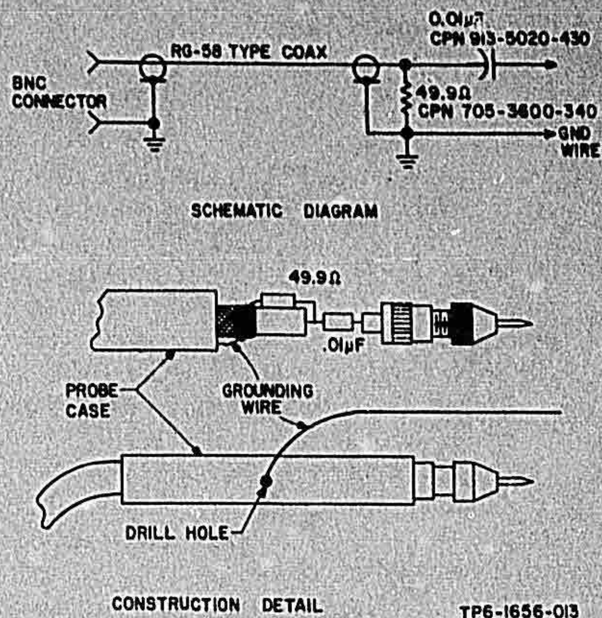
5.3.3.4 Receiver

Refer to figure 5-7, Receiver Waveforms.

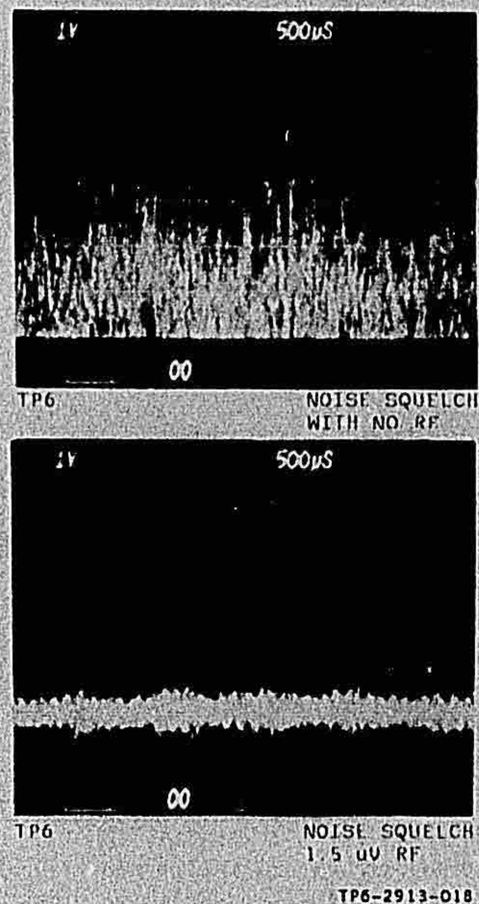
a. Check for the proper tuning voltage at the cathode of the preselector and interstage varactors, CR203, CR204, CR205, and CR206. Tuning voltage should be +11.5 V dc at 135.975 MHz decreasing to +6.75 V dc at 118.000 MHz.
b. Check for minimum of 0.5 V rms injection at pin 8 of M201.
c. Verify that oscillator Q205 is providing at least 1 V rms of injection at Q203-2.
d. A properly tuned receiver should be into AGC on noise. To verify this, remove the rf input and record the AGC voltage. Then, short the base of Q204 to ground and verify that the AGC voltage changes at least 0.5 V dc. If the receiver is not into AGC on noise, it is necessary to determine which stage is not functioning properly. The gain distribution chart given below can be used to help locate the problem. Figure 5-6 shows the test probe used.

INJECTION VOLTAGE REQUIRED TO CAUSE AGC VOLTAGE TO START TO RISE	INJECTION VOLTAGE TEST POINT
700 μV, 455 kHz	Detector Q204-B
1060 μV, 455 kHz	2nd if U202-10
140 μV, 455 kHz	2nd if U202-1
100 μV, 20.025 MHz	Mixer Q203-3
15 μV, 20.025 MHz	1st if Q207-S
5 μV, 20.025 MHz	Rf mixer Q206-3
0.3 μV, Receiver frequency	Rf ampl Q201-3

e. Low receiver sensitivity can also be caused by the following:
   1. Transmit/receive switch Q108 failure. Verify +13.0 ±1.0 V dc at Q108-C during receive mode.
   2. Transmit/receive diode, CR504 or CR506, failure. Verify +1.0 ±0.2 V dc at diode anodes during receive mode and negative dc voltage during transmit mode.



Signal Injection Probe
Figure 5-6



Receiver Waveforms
Figure 5-7

5.3.3.5 Modulator/Audio

Refer to figure 5-8, Modulator/Compressor Waveforms.

a. Turn power output (R727) and modulation depth (R725) controls fully counterclockwise. Adjust microphone level control R2 on front of unit fully clockwise. Apply a 500-mV rms, 1000-Hz signal to pin 4 (transmit mic) on the unit connector and ground pin 15 to key the transceiver. Verify that the dc bias voltage at pins 3, 4, and 9 of U701 and pins 1 and 7 of U702 is approximately +7.5 V dc.

b. Check for 100 mV rms at U701B-4.

c. Check the output of the compressor at TP7. The ac signal should be about 4 V p-p and biased around +7.5 V dc. If audio is not present or the output is clipped, check inputs of comparator U703A. The voltage at pin 3 should be a sawtooth wave rising from +1 V to +4 V. The voltage at pin 2 is the gain control voltage generated by Q701. With no signal into the compressor, this voltage should be at 0 volt, which corresponds to maximum gain. As the input signal level increases, this voltage should remain at 0 volt until the output of the compressor (TP7) reaches 4 V p-p. The control voltage should then increase to reduce the gain and maintain a constant output at TP7.

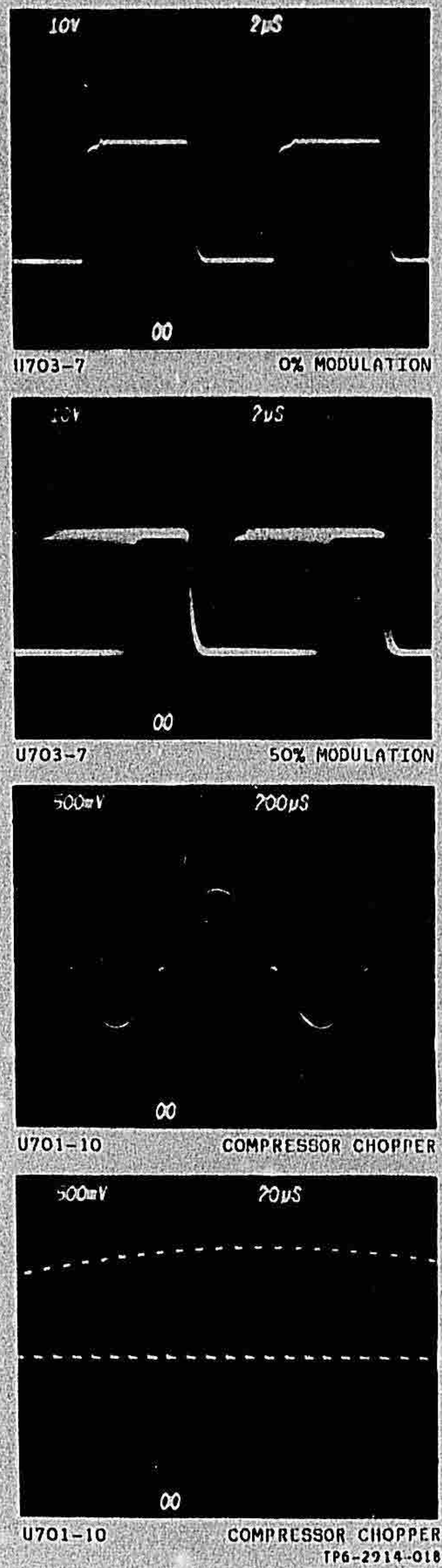
d. If the output is clipping, and the gain control voltage is at +5 V, short pin 1 of U703A to ground. The ac signal at TP7 should go to zero. If it remains the same, analog switch U701 is defective. If the ac signal at TP7 goes to zero, check for 0 V dc at U703A-2. If U703A-2 is at 0 V dc, U703 is probably defective. If U703A-2 is not 0 V dc, Q701 is probably defective.

e. Check for +5 V dc at U703B-5. This voltage should decrease to +2 V dc as R727 (rf power output) is turned clockwise. Return R727 to maximum counterclockwise position.

f. Verify that clockwise rotation of R725 (modulation depth) superimposes the ac signal at TP7 upon the dc bias at U703B-5.

g. Check for a pulse-width modulated signal at U703B-7.

h. Check for a pulse-width modulated signal at TP8. If voltage at TP8 is a constant +30 V dc, either L701 is defective or the transmitter is not drawing current. If voltage at TP8 is zero, Q703 and/or Q702 is open. If Q703 is shorted, the transmitter will draw excessive current and emit high levels of rf power.



Modulator/Compressor Waveforms
Figure 5-8

5.3.3.6 Transmitter

a. Check dc bias voltage at pin 1 of J501. Dc voltage should be 0.0 ±1.0 V dc during receive mode and +7.0 ±1.0 V dc during transmit mode. If abnormal, check synthesizer.
b. Check pin 1 of J501 for low rf excitation voltage from synthesizer. Rf voltage should be greater than 0.5 V rms during transmit mode.
c. Check collector of Q501 and Q502 for +13.5 ±0.5 V dc during transmit mode.
d. Check collector of Q503 for +12.0 ±1.0 V dc during transmit mode with no modulation.
e. Check collector of Q504 for +13.0 ±1.0 V dc during transmit mode with no modulation.
f. Check rf input and rf output voltage of Q501 through Q504.
g. Check dc bias voltage on Q501 and Q502. Emitter voltage should be +1.0 ±0.3 V dc and base voltage should be +1.3 ±0.3 V dc.
h. Check for a negative voltage on the cathode of CR504 and CR506.
i. Check coupling capacitors by holding a capacitor of appropriate value across the leads of the suspect capacitor. If capacitor is open, a large increase in rf output power will be observed.
j. Check pin 1 of J501 for a +14-V modulated signal during transmit mode with 85 percent modulation. If abnormal, check the modulator circuit, paragraph 5.3.3.5.
k. If transmitted audio is distorted when the transceiver is operated in the aircraft, but appears normal during bench testing, check the rf connectors, coax cables, and antenna in the aircraft. Refer to the installation section for information on proper antenna installation.

5.3.4 Adjustment/Alignment Procedures

The following procedures should be used to adjust and realign the circuits in the transceiver whenever required as indicated by the testing and troubleshooting procedures.

Note

Always verify proper power supply operation, paragraph 5.3.4.1, before performing any adjustment or alignment procedures.

Refer to figure 5-10 for the location of test points and adjustment controls referenced in the following paragraphs.

5.3.4.1 Power Supply Check and Adjustment

a. Remove input power to the unit, if applied, and remove the top and bottom covers to gain access to both sides of circuit card A1.
b. Connect a +11 to 32 V dc variable power source to unit connector pins 1, 20(+) and 3, 22(-).
c. Verify that the voltage at TP10(+) with respect to pin 3 remains at +30.0 ±0.5 V dc while the voltage of the power source is varied from +11 to +32 V dc. If necessary, adjust R104 for the correct voltage.
d. Set the voltage of the power source at +22.5 ±0.5 V dc and verify the following voltages:

TEST POINT	DESIRED VOLTAGE
C109 plus terminal	+14.0 ±1.0 V dc
C111 plus terminal	+5.00 ±0.25 V dc
C107 minus terminal	-22.0 ±3.0 V dc

5.3.4.2 Synthesizer Alignment

a. Connect a frequency counter to TP1 and adjust C426 for 3 200 000 ±10 Hz.
b. Tune transceiver to 135.975 MHz. Adjust C414 for +11.50 ±0.10 V dc at TP2 with respect to chassis ground.
c. Tune transceiver to 118.00 MHz. Adjust L405 for +6.75 ±0.10 V dc at TP2.
d. Repeat steps b and c until both are within limits.
e. Connect a 50-Ω, 20-W rf load to the unit antenna connector.
f. Tune transceiver to 118.000 MHz. Ground unit connector pin 15 (key line) and verify that voltage at TP2 drops to no less than +1.5 V dc. Remove ground from pin 15.

5.3.4.3 Receiver Filter Alignment

a. Connect rf generator through a 6-dB pad to the unit antenna connector.
b. Adjust rf generator for minimum voltage, 127.60-MHz signal modulated 30 percent by 1000 Hz. Tune transceiver to 127.60 MHz.
c. Connect a digital voltmeter, with at least 3-1/2-digit resolution, between unit connector pin 13 (AGC) and ground.
d. Slowly increase rf generator output level until the AGC voltage begins to increase.
e. Adjust L201, L203, L205, L207, C220, L209, L210, and C226 in sequence for maximum AGC voltage.
f. Repeat the adjustment sequence in step e until no further voltage increase can be obtained.

5.3.4.4 Receiver Squelch Adjustment

a. Connect rf generator through a 6-dB pad to the unit antenna connector.
b. Adjust rf generator for minimum voltage, 118.000-MHz signal modulated 30 percent by 1000 Hz.
c. Tune transceiver to 118.000 MHz and set volume control at midrange. (Volume control must be pushed in to enable automatic squelch circuit.)
d. Set R240 (noise squelch threshold) fully clockwise.
e. Monitor the audio output at unit connector pin 32 and adjust R242 (carrier squelch threshold) so that, as the rf signal is increased from minimum, the 1000-Hz audio signal appears when the rf signal equals 20 μV.
f. Remove rf signal from unit antenna connector.
g. Adjust L218 (squelch quadrature) for a maximum dc voltage at U203, pin 2, with respect to chassis ground.
h. Repeat steps a, b, and c.
i. Monitor audio output of unit connector pin 32 and adjust R240 (noise squelch threshold) so that, as the rf signal is slowly increased from minimum, the 1000-Hz audio signal appears when the rf signal equals 3 μV.

5.3.4.5 Tone Control Adjustment

Note

This adjustment is not essential for returning the unit to service because the tone control may be readjusted in the aircraft.

a. Ground connector pin 14 to disable audio compressor.
b. Connect rf generator through a 6-dB pad to the unit antenna connector.
c. Adjust rf generator for a 1000-μV, 118.00-MHz signal modulated 30 percent by 1000 Hz.
d. Connect an audio power meter, set for a 500-Ω load, between unit connector pins 32 and 33.
e. Adjust transceiver volume control for 10 mW into the 500-Ω load.
f. Change modulation frequency to 2500 Hz at 30 percent. Refer to figure 5-9 and adjust R4 (tone control) for 8.0 mW into the 500-Ω load.
g. Remove ground connection from pin 14.

5.3.4.6 Transmitter Microphone Gain Adjustment

Note

This adjustment is not essential for returning the unit to service because the mic gain control may be readjusted in the aircraft.

a. Connect a 50-Ω, 20-W load to the unit antenna connector.
b. Connect audio signal generator to unit connector pin 4 (xmt microphone) and pin 33. Connect a 100-μF, 15-V blocking capacitor between the audio generator and pin 4 with the positive lead connected to pin 4.

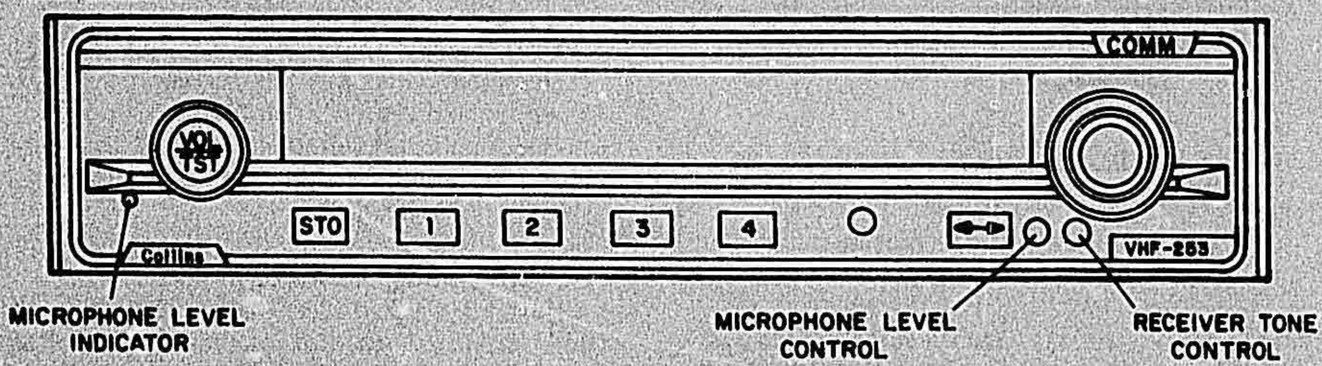
Note

A resistor may be required in series with the audio generator output to prevent overloading the generator.

c. Adjust audio generator for 1000-Hz signal.
d. Refer to figure 5-9 and set microphone level control R2 at maximum counterclockwise position.

Caution

Observe 1-minute transmit, 4-minute receive duty cycle to prevent transmitter overheating during tuning steps e, and f.



TP6-1538-011

VHF-253/253S Communications Transceiver, Front Panel Adjustment Controls and Indicator
Figure 5-9

e. Key transmitter by grounding unit connector pin 15 and adjust audio generator output level for 75 mV rms between connector pins 4 and 33.
f. Adjust microphone level control clockwise until microphone level indicator DS701 just begins to glow. Remove ground from connector pin 15.

5.3.4.7 Transmitter RF Output Adjustment

a. Connect a 50-Ω, 20-W rf load and wattmeter to the unit antenna connector.
b. Remove audio generator if connected to unit connector pins 4 and 33.
c. Tune transceiver to 135.975 MHz.

Caution

Observe 1-minute transmit, 4-minute receive duty cycle to prevent transmitter overheating during tuning steps d, e, and f.

d. Key transmitter by grounding unit connector pin 15 and adjust R727 (rf output power) for 10 W of rf power.
e. Adjust C515 for maximum rf output power.
f. Readjust R727 for 11 W of rf power and verify that voltage at J502 pin 1 does not exceed +14.0 V dc. Remove ground from connector pin 15.

Caution

Do not adjust for more than 11-W output. Higher power levels will reduce transmitter life.

5.3.4.8 Transmitter Modulation Depth Adjustment

Perform adjustment procedures given in paragraphs 5.3.4.6 and 5.3.4.7 before proceeding with this adjustment procedure.

a. Connect audio signal generator to unit connector pins 4 and 33 with a 100-µF, 15-V blocking capacitor between pin 4 and the generator output with positive capacitor lead connected to pin 4.

Note

A resistor may be required in series with the generator output to prevent overloading the generator.

b. Tune transceiver to 118.000 MHz.
c. Connect oscilloscope through a 50-Ω, 20-W, 40-dB power attenuator to the unit antenna connector. The oscilloscope must have a useful frequency response of 120 MHz.

Caution

Observe 1-minute transmit, 4-minute receive duty cycle to prevent transmitter overheating during steps d and e.

d. Key transmitter by grounding unit connector pin 15 and adjust audio generator for a 500-mV rms, 1000-Hz signal between unit connector pins 4 and 33.
e. Monitor the rf output envelope on the oscilloscope and adjust R725 (modulation level) until peak clipping just begins to occur in the valleys of the modulation envelope. Remove ground from connector pin 15.

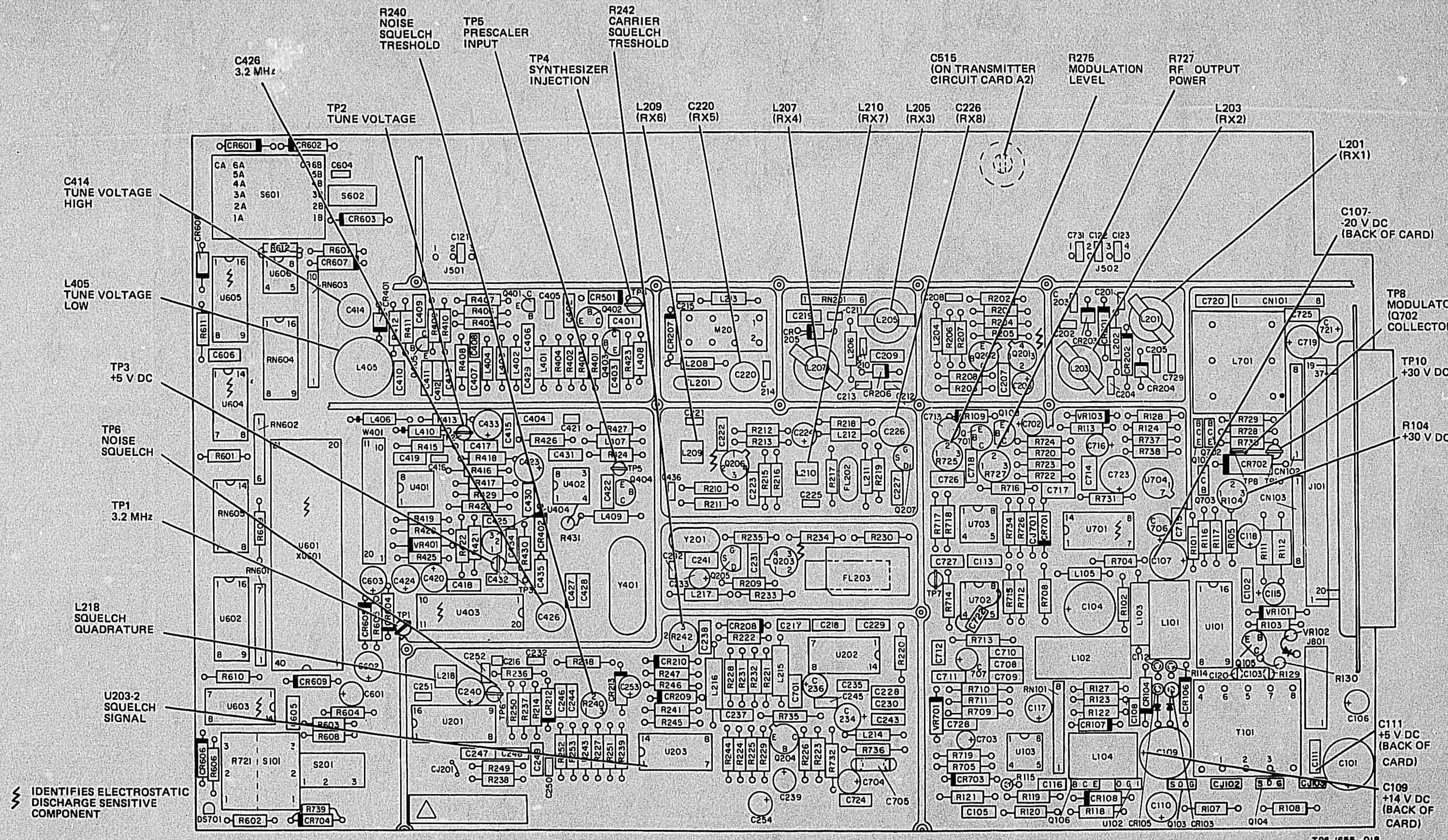
5.4 HANDLING OF UNITS CONTAINING ESDS COMPONENTS

The VHF-253/253S contains electrostatic discharge sensitive (ESDS) components that can be damaged by static voltages present in most repair facilities. Although most ESDS components contain internal gate protection circuits, good practice dictates careful handling of all ESDS components.

The following precautions should be observed when handling all ESDS components and units containing ESDS components.

a. Deenergize or disconnect all power and signal sources and loads used with unit.
b. Place the unit on grounded conductive work surface.
c. Ground the repair operator through a conductive wrist strap or other device using a 1-MΩ series resistor to protect the operator.
d. Ground any tools (including soldering equipment) that will contact the unit. Contact with the operator's hand provides a sufficient ground for tools that are otherwise electrically isolated.
e. All ESDS replacement components are shipped in conductive foam or tubes and must be stored in the original shipping container until installed.
f. When ESDS devices and assemblies are removed from the unit, they should be placed on the conductive work surface or in conductive containers.
g. When not being worked on, wrap disconnected circuit boards in aluminum foil or in plastic bags that have been coated or impregnated with a conductive material.
h. Do not handle ESDS devices unnecessarily or remove them from their packages until actually used or tested.

Failure to observe all of these precautions can cause permanent damage to the ESDS device. This damage



VHF-253/253S Communications Transceiver, Test Points and Adjustment Controls
Figure 5-10

Caution

Be very careful while disassembling the front panel to avoid damaging the LCD.

a. Remove front panel A3 from the chassis using the procedure given in paragraph 5.5.1.2.

Caution

Position the front panel with the front surface down to avoid dropping the LCD out of the rear of the panel after the display circuit card has been removed.

b. Remove the five 2-56 and two 4-40 panhead screws securing the display circuit card to the front panel.
c. Carefully grasp the plastic switch bodies on the display card and lift the display card from the rear of the panel. Avoid touching the edge connector portion of the display card.

If the LCD must be removed from the front panel, proceed as follows:

a. Use tweezers to remove the three elastomeric connectors and two spacers from the front panel.
b. Carefully lift the light diffuser from the front panel.
c. Carefully lift the LCD from the front panel by pushing from the front. Do not handle the edge connector along the top of the LCD.

5.5.2 Repair

5.5.2.1 Replacement of Integrated Circuits

Integrated circuits (IC's) are often difficult items to replace and therefore should not be replaced simply on a guess that the existing IC is defective. Do not replace an integrated circuit until all other defects are eliminated and it is determined that the IC is definitely defective.

Before removal of the faulty IC, note its orientation on the board to ensure correct placement of the new component. Remove the old IC, using a solder sucker and needle-nose pliers to lift each lead. After old IC has been removed, reheat each mounting hole and remove excess solder.

When soldering the new IC into place, avoid applying excessive heat which may cause internal damage to the IC, making it inoperable. After soldering, use a toothpick to remove any heavy rosin deposits; solder joints should be smooth, bright, and clean. Touch up postcoating with acrylic coating solution listed in table 5-3.

5.5.2.2 Replacement of Power Transistors

Apply thermal compound (see table 5-3) to both sides of transistor insulators and back of power transistors whenever replacement is required. Also, torque mounting screws to 3.0 ±0.5 lb·in for Q101, Q102, Q106, and Q702, and 6.0 ±0.5 lb·in for Q103, Q104, Q703, Q503, Q504, and U102 to ensure adequate thermal contact.

5.5.3 Assembly

Reassembly of the VHF-253/253S is essentially the reverse of the disassembly procedures given in paragraph 5.5.1. However, special handling is required when reassembling front panel assembly A3 or when replacing any defective integrated circuits or power transistors.

5.5.3.1 Reassembling Front Panel Assembly A3

Note

The electrical connections between the liquid crystal display (LCD) and the display circuit card are susceptible to failure caused by surface contaminants, such as dust, dirt, lint, oils, fluxes, etc. The cleaning procedures provided in the following assembly procedures must be performed to ensure proper operation of the LCD.

a. Prior to assembly, clean the following items with isopropyl alcohol. Do not handle the cleaned areas on the items with bare hands. Use tweezers to handle the elastomeric connectors and switch contacts.
   1. Elastomeric connectors.
   2. Edge connector area of LCD and display circuit card.
   3. Areas of front panel that contact the elastomeric connectors.
   4. Switch contacts and contact areas on display circuit card.

b. Place the front panel face down on a clean work surface and carefully insert the LCD into the panel with the edge connector toward the top of the panel.
c. Insert the plastic light diffuser and replace the two pressure pads.

d. Use tweezers and replace the three elastomeric connectors.

Caution

Screw lengths other than those specified can damage the display.

e. Insert the display circuit card and secure with five 2-56 x 0.19-in and two 4-40 x 0.25-in panhead screws.

Table 5-3. Repair Materials.

DESCRIPTION	SUPPLIER	USE
Rosin-core solder (60% Sn/40% Pb)		General soldering
Silver-bearing, rosin-core solder (62% Sn/2% Ag/36% Pb)	Federal type Sn62WRMAP2	Use to solder all chip capacitors.
Thermal compound	Dow Corning Corp. DC340-50Z (CPN 005-1234-020) 5 oz	Use to increase heat transfer between power components and chassis.
Adhesive	Dow-Corning Corp. RTV 732 (CPN 005-1180-020) 3 oz	One drop used between: Y401 and casting, C104 and L102, C109 and L104.
Isopropyl alcohol		Use to clean LCD, elastomeric connectors, edge connector and switch contacts on display circuit card, and area of front panel that comes in contact with elastomeric connectors.
Warning HumiSeal 1B31 has a low flashpoint and is highly flammable when in a liquid state. Therefore HumiSeal 1B31 should be used only in areas approved for applying flammable materials. Do not expose HumiSeal 1B31 to excessive heat or to open flame. Keep container closed when not in use. Use HumiSeal 1B31 only with adequate ventilation. Avoid prolonged breathing of vapors and repeated contact of HumiSeal 1B31 with skin.		
Coating solution (acrylic)	Columbia Technical Corp. HumiSeal 1B31 (CPN 821-0650-020) 1 gallon	Coat and seal repaired areas and components on A1 through A4.
Solvent	Du Pont de Nemours Inc. Freon TMC (CPN 005-1314-010) 1 gallon	Remove HumiSeal 1B31 before repair

Collins VHF-253/253S Communications Transceiver

Rockwell International

diagrams

Collins General Aviation Division

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NOTICE: This section replaces first edition dated 1 September 1981.

List of Effective Pages

*The asterisk indicates pages changed, added, or deleted by the current change.

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*Title	1 Nov 83
*List of Effective Pages	1 Nov 83
*6-1	1 Nov 83
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*6-25 thru 6-29	1 Nov 83
*6-30 Blank	1 Nov 83
*6-31 thru 6-33	1 Nov 83
*6-34 Blank	1 Nov 83
*6-35 thru 6-37	1 Nov 83
*6-38 Blank	1 Nov 83
*6-39 thru 6-40	1 Nov 83
*6-41 Added	1 Nov 83
*6-42 Blank Added	1 Nov 83

Record of Revisions

RETAIN THIS RECORD IN THE FRONT OF MANUAL.
ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS.

REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	1 Sep 81		1, 2				
2nd Ed	1 Nov 83		1, 2, 3				

section VI
diagrams

6.1 CONFIGURATION CONTROL

Collins General Aviation Division of Rockwell International uses the following method for identifying the configuration status of a unit or subassembly.

A 2-character maximum alphabetic identifier will be preceded by the letters REV (revision) and will start with — (dash) if no changes have been processed. The first change will be identified as A, the second as B, continuing through Z to AA, AB, and ultimately to ZZ.

Incorporation of design changes in a unit or subassembly that has been returned to Rockwell-Collins for repair by a customer or that has been removed from the company's finished goods inventory is defined as rework. At the time of rework, the unit or subassembly will be marked again to reflect the design level to which it is being upgraded. This is done by leaving the original marking on the unit or subassembly and adding the letters RWK (rework) followed by the alphabetic identifier of the latest change incorporated in the rework. For example, unit one is marked REV B — RWK F, and unit two is marked REV F. This indicates that both units are at the design level of revision F, but unit one is reworked and they may not look exactly the same.

Note

A reworked unit may not contain all design changes made to the reworked identifier but does contain all changes required to make unit operation identical to a newly manufactured unit with the same identifier. Therefore, a unit reworked to a specific identifier may physically appear different from a newly manufactured unit with the same alphabetic identifier.

Only alphabetic identifiers that result in schematic changes are covered in this section. If a unit or subassembly has an identifier that alphabetically falls between identifiers on the schematic changes page, or after the last identifier on the schematic changes page up to and including the latest effectivity listed in paragraph 6.3, the electrical configuration is represented by the earlier identifier listed on the schematic changes page.

6.2 DIAGRAMS

An exploded view diagram and a reduced composite schematic diagram for the VHF-253/253S are shown in figures 6-1 and 6-2. Functional area schematic diagrams are provided in figures 6-3 through 6-10.

A parts list and a component location diagram for each functional area are provided as part of each functional area schematic diagram. Parts that are not associated with a functional area (dust covers, attaching hardware, etc) are identified on the exploded view diagram, figure 6-1.

A schematic changes sheet precedes each schematic diagram. The schematic changes sheet provides a description of each change, a reason for the change, the service bulletin number (if applicable) that modifies the unit, and the production cut-in effectivity for the change.

6.3 CONFIGURATION EFFECTIVITY

Listed below are the units or subassemblies with the latest identifier (change) covered by this section.

UNIT/SUBASSEMBLY	COLLINS PART NUMBER	LATEST EFFECTIVITY
VHF-253 W/O SB 1	622-5640-001	REV R
VHF-253 With SB 1	622-5640-003	REV R
VHF-253S W/O SB 1	622-5641-001	REV R
VHF-253S With SB 1	622-5641-003	REV R
Circuit Card A1	653-3010-001	REV AD
Circuit Card A1	653-3010-002	REV AD
Circuit Card A1	653-3010-003	REV AD
Circuit Card A1	653-3010-004	REV AD
Circuit Card A2	653-3020-001	REV P
Front Panel Assy A3	653-8500-001	REV F
Front Panel Assy A3	653-8500-003	REV F
Circuit Card A4	653-3030-001	REV E
Display Circuit Card	653-3000-001	REV K

6.4 USED ON CODES

6.4.1 Top Level Configuration

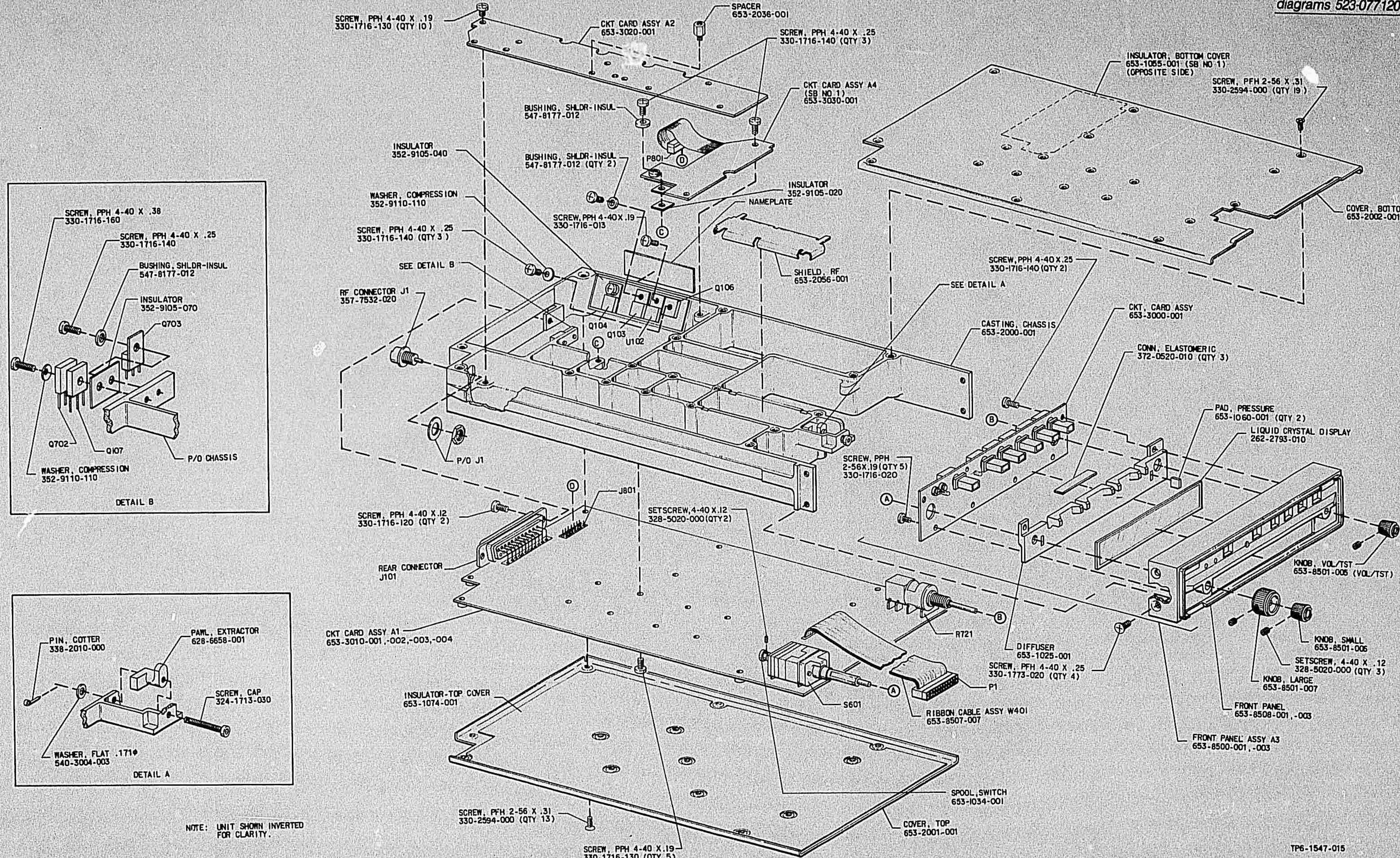
A used on code (A, B, C, etc) is provided in the table below to identify subassembly variations within the VHF-253/253S. A code letter is assigned to each top level part number. Any subassembly unique to that top level part number is assigned the same code letter. Absence of a code indicates that the subassembly applies to all units.

UNIT/SUBASSEMBLY	COLLINS PART NUMBER	USED ON CODE
VHF-253 W/O SB 1	622-5640-001	A
VHF-253 With SB 1	622-5640-003	B
VHF-253S W/O SB 1	622-5641-001	C
VHF-253S With SB 1	622-5641-003	D
Circuit Card A1	653-3010-001	A
Circuit Card A1	653-3010-002	B
Circuit Card A1	653-3010-003	C
Circuit Card A1	653-3010-004	D

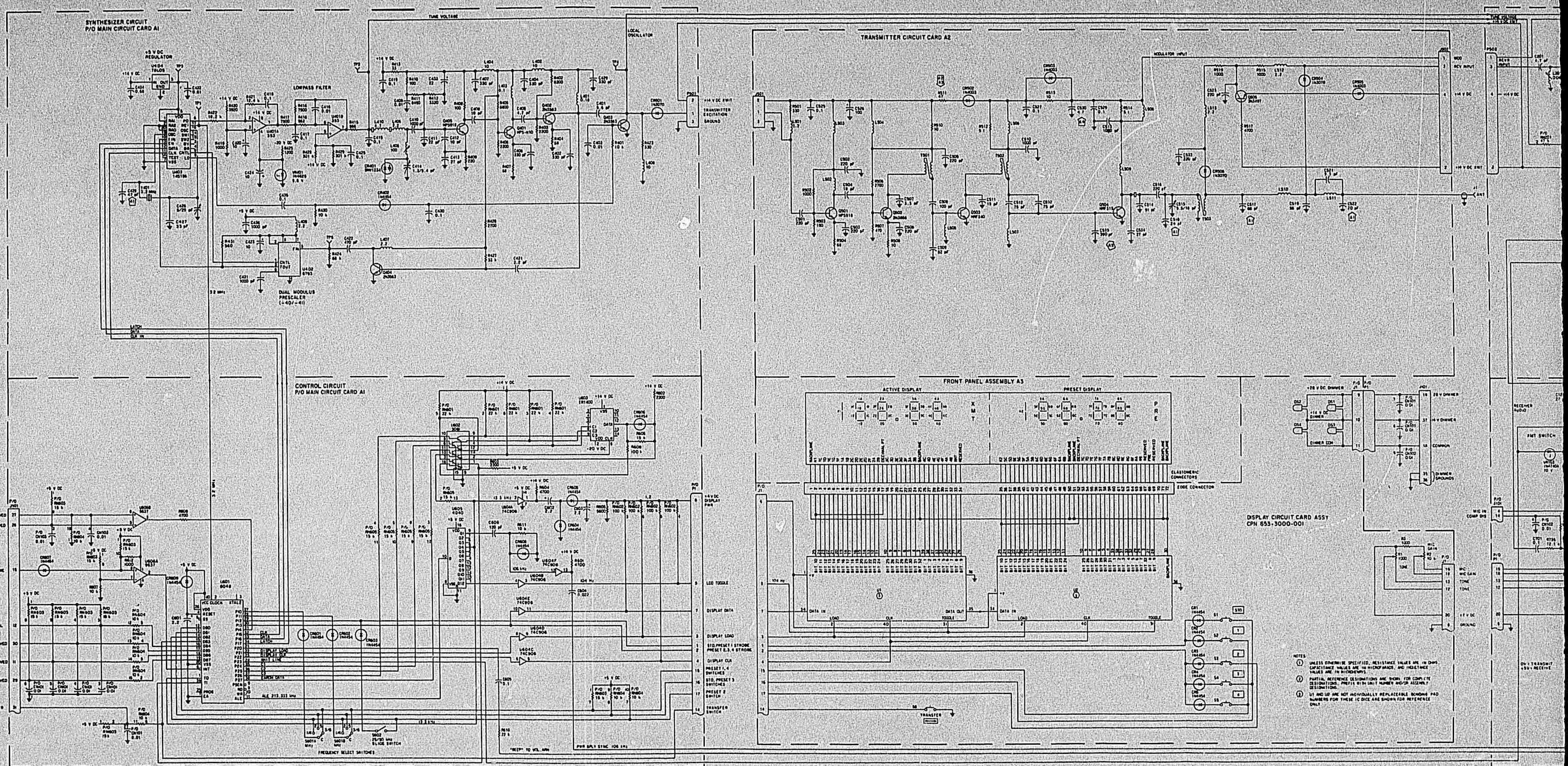
UNIT/SUBASSEMBLY	COLLINS PART NUMBER	LATEST EFFECTIVITY
Circuit Card A2	653-3020-001	
Front Panel Assy A3	653-8500-001	A,B
Front Panel Assy A3	653-8500-003	C,D
Circuit Card A4	653-3030-001	B,D
Display Circuit Card	653-3000-001	

6.4.2 Subassembly Configuration

The parts list for each circuit card or subassembly contains a USED ON CODE column. This column is used when a parts list covers more than one part number of a circuit card or subassembly. Then a used on code letter (A, B, C, etc) is assigned to each subassembly part number. A component not common to every subassembly is coded with the same letter as the subassembly it is used on. Absence of a code letter indicates that the part applies to all subassemblies.

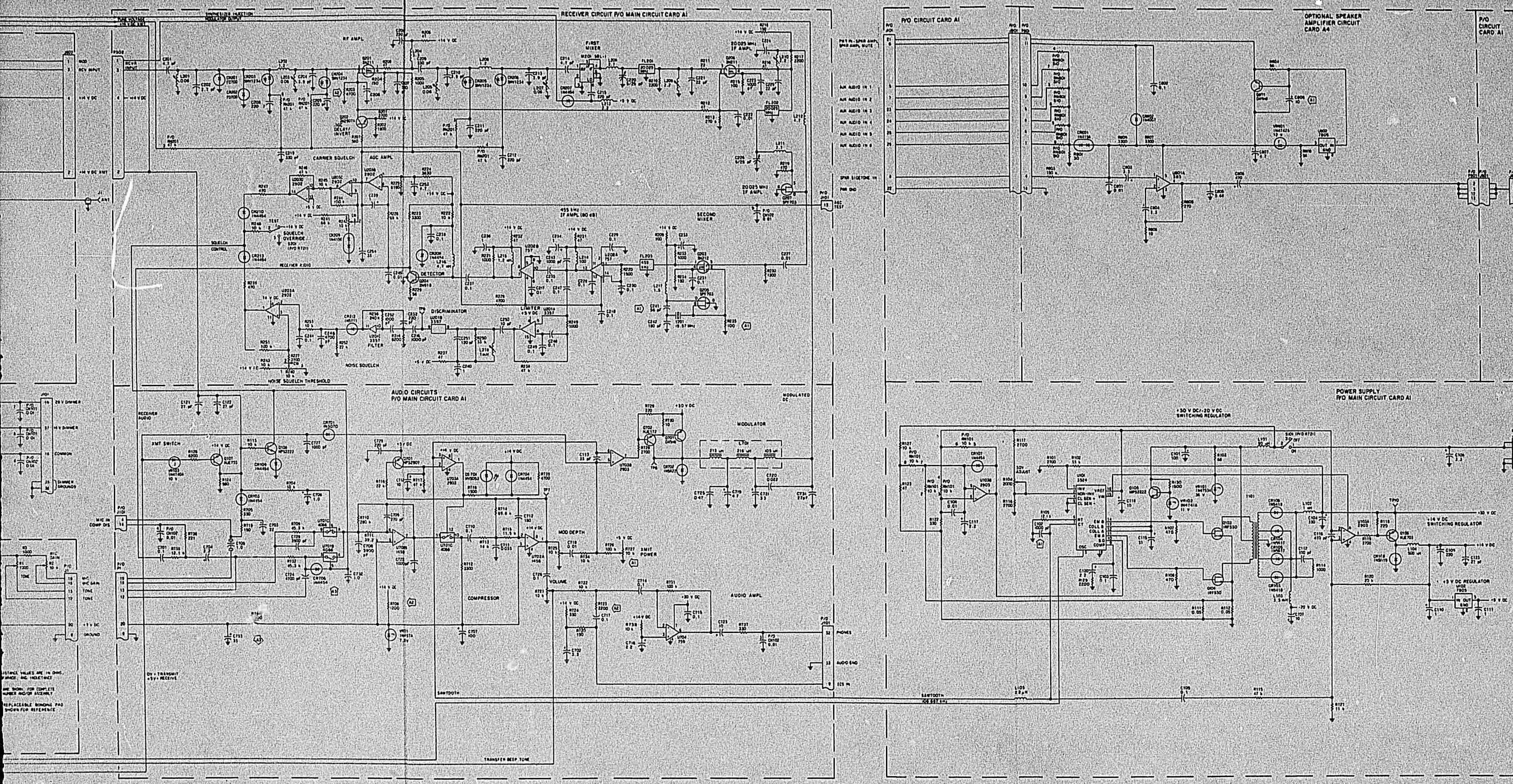


VHF-253/253S Communications Transceiver,
Exploded View Diagram
Figure 6-1



SEE BLOW-UP FICHE NO. CLQ503 - ITEM A

SEE BLOW-UP FICHE NO. CLQ503 - ITEM A

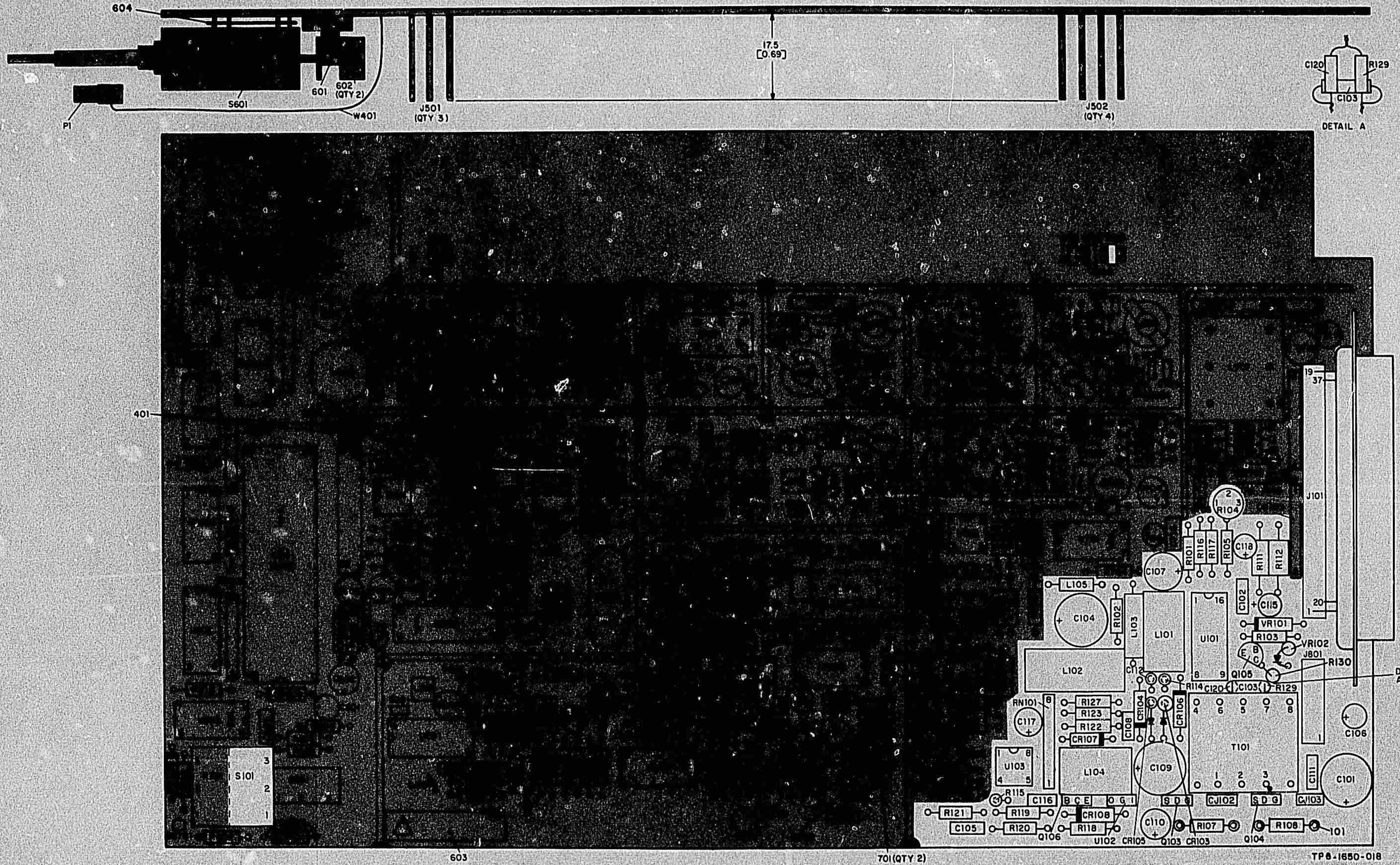


VHF-253/253S Communications Transceiver,
Overall Schematic Diagram
Figure 6-2

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	Changed R105 from 2.7 to 12.1 kΩ and C102 from 4700 to 1000 pF to improve low-voltage operation.		REV V

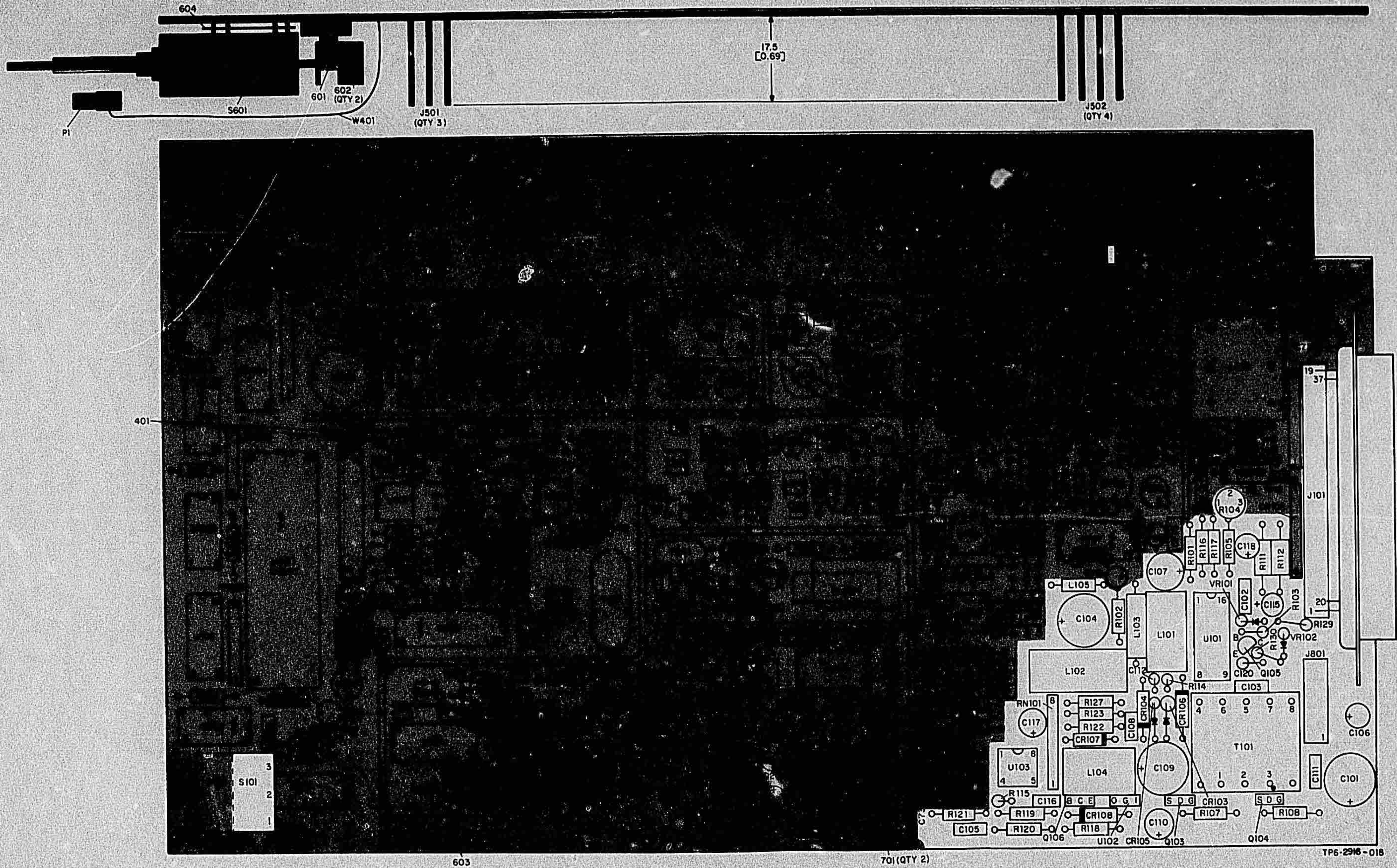
Circuit Card A1 Power Supply, Schematic and Component Location Diagrams
Figure 6-3 (Sheet A)



Circuit Card A1 (Through REV AA) Power Supply,
Component Location Diagram
Figure 6-8 (Sheet 1 of 3)

PARTS LIST
CIRCUIT CARD A1 POWER SUPPLY (PART NUMBER 653-3010-00X, REV AD)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A1	Circuit card A1	A	653-3010-001
A1	Circuit card A1	B	653-3010-002
A1	Circuit card A1	C	653-3010-003
A1	Circuit card A1	D	653-3010-004
C101	Capacitor, Al, 100μF, +100%-20%, 50V		183-1471-420
C102	Capacitor, cer, 4700pF, 10%, 100V (eff to rev V)		913-5019-160
C102	Capacitor, cer, 1000pF, 5%, 100V (eff rev V)		913-3281-270
C103	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C104	Capacitor, Al, 330μF, +100%-20%, 35V		183-1471-470
C105	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C106	Capacitor, Al, 3.3μF, 20%, 50V		183-1523-030
C107	Capacitor, Al, 10μF, +100%-20%, 35V		183-1471-080
C108	Capacitor, cer, 0.01μF, 20%, 50V		913-3279-110
C109	Capacitor, Al, 220μF, +100%-20%, 25V		183-1471-410
C110	Capacitor, Ta, 1μF, 20%, 35V		184-9102-790
C111	Capacitor, cer, 1μF, 20%, 50V		913-3279-270
C112	Capacitor, cer, 100pF, 10%, 100V		913-5020-150
C113	Used in audio circuit		
C114	Not used		
C115	Capacitor, Ta, 33μF, 20%, 10V (eff to rev AD)		184-9102-530
C115	Capacitor, Ta, 33μF, 20%, 35V (eff rev AD)		184-9102-880
C116	Capacitor, cer, 470pF, 5%, 100V		913-3117-080
C117	Capacitor, Al, 2.2μF, +100%-20%, 63V		183-1471-290
C118	Capacitor, Al, 10μF, +100%-20%, 16V (eff to rev W)		183-1471-140
C118	Capacitor, Ta, 10μF, 20%, 20V (eff rev W)		184-9102-610
C119	Not used		
C120	Capacitor, Ta, 2.2μF, 10%,20V		184-9086-430
C121	Used in audio circuit		
C122	Used in audio circuit		
C123	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
CJ101	Not used		
CJ102	Jumper wire (eff to rev AB)		428-0289-010
CJ103	Jumper wire (eff to rev AB)		428-0289-010
CN101-103	Capacitor, array, 0.01μF		913-3663-010
CR101	Not used		
CR102	Not used		
CR103	Diode, 1N5418		353-6558-040
CR104	Diode, 1N5617		353-6496-040
CR105	Diode, 1N5617		353-6496-040
CR106	Diode, 1N5418		353-6558-040
CR107	Diode, 1N4454		353-3644-010
CR108	Diode, 1N5819		353-6614-020
CR109	Used in audio circuit		
J101	Connector, 37-pin		371-0605-010
J801	Connector, 14-pin SB1	B,D	220-0071-100
L101	Inductor, 50μH		668-0337-060
L102	Inductor, 1mH		668-0337-050
L103	Coil, shielded, 3.3mH		240-2715-550
L104	Inductor, 500μH		668-0337-040
L105	Coil, 2.2μH		240-2027-000
Q101	Not used		
Q102	Not used		
Q103	Transistor, IRF530		352-7904-030
Q104	Transistor, IFR530		352-7904-030
Q105	Transistor, MPS2222		352-5021-010
Q106	Transistor, MJE703		352-1062-030
Q107	Used in audio circuit		
Q108	Used in audio circuit		
R101	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R102	Resistor, cmpsn, 33kΩ, 10%, 1/4W		745-0803-000
R103	Resistor, cmpsn, 68Ω, 10%, 1/4W		745-0707-000
R104	Resistor, var, 2kΩ, 10%, 1/2W		382-0027-080
R105	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W (eff to rev V)		745-0764-000
R105	Resistor, cmpsn, 12.1kΩ, 1%, 1/8W (eff rev V)		705-1048-000
R106	Not used		
R107	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R108	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R109	Not used		
R110	Not used		
R111	Resistor, ww, 0.05Ω, 1%, 1W		747-1499-110
R112	Resistor, ww, 0.05Ω, 1%, 1W		747-1499-110
R113	Used in audio circuit		
R114	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R115	Resistor, cmpsn, 47kΩ, 10%, 1/4W		745-0809-000
R116	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R117	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R118	Resistor, cmpsn, 220Ω, 10%, 1/4W		745-0725-000
R119	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R120	Resistor, film, 20kΩ, 1%, 1/8W		705-3605-620
R121	Resistor, film, 11kΩ, 1%, 1/8W		705-1046-000
R122	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R123	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R124	Used in audio circuit		
R125	Not used		
R126	Not used		
R127	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R128	Used in audio circuit		
R129	Resistor, cmpsn, 2200Ω, 10%, 1/4W		745-0761-000
R130	Resistor, cmpsn, 1.5kΩ, 10%, 1/4W		745-0755-000
RN101	Resistor, array, 10kΩ		350-4046-750
S101	Switch, SPDT p/o R721		376-0282-010
T101	Transformer, pwr		662-0929-010
TP10	Terminal, test		306-2721-010
U101	IC, 3524		351-1285-020
U102	IC, 7805		351-1198-010
U103	IC, 2903		351-1278-010
VR101	Diode, zener, 1N4753A		353-6481-510
VR102	Diode, zener, 1N4741A		353-6481-270
VR103	Used in audio circuit		
101	Bead, glass (qty 8)(eff rev T)		192-1042-010



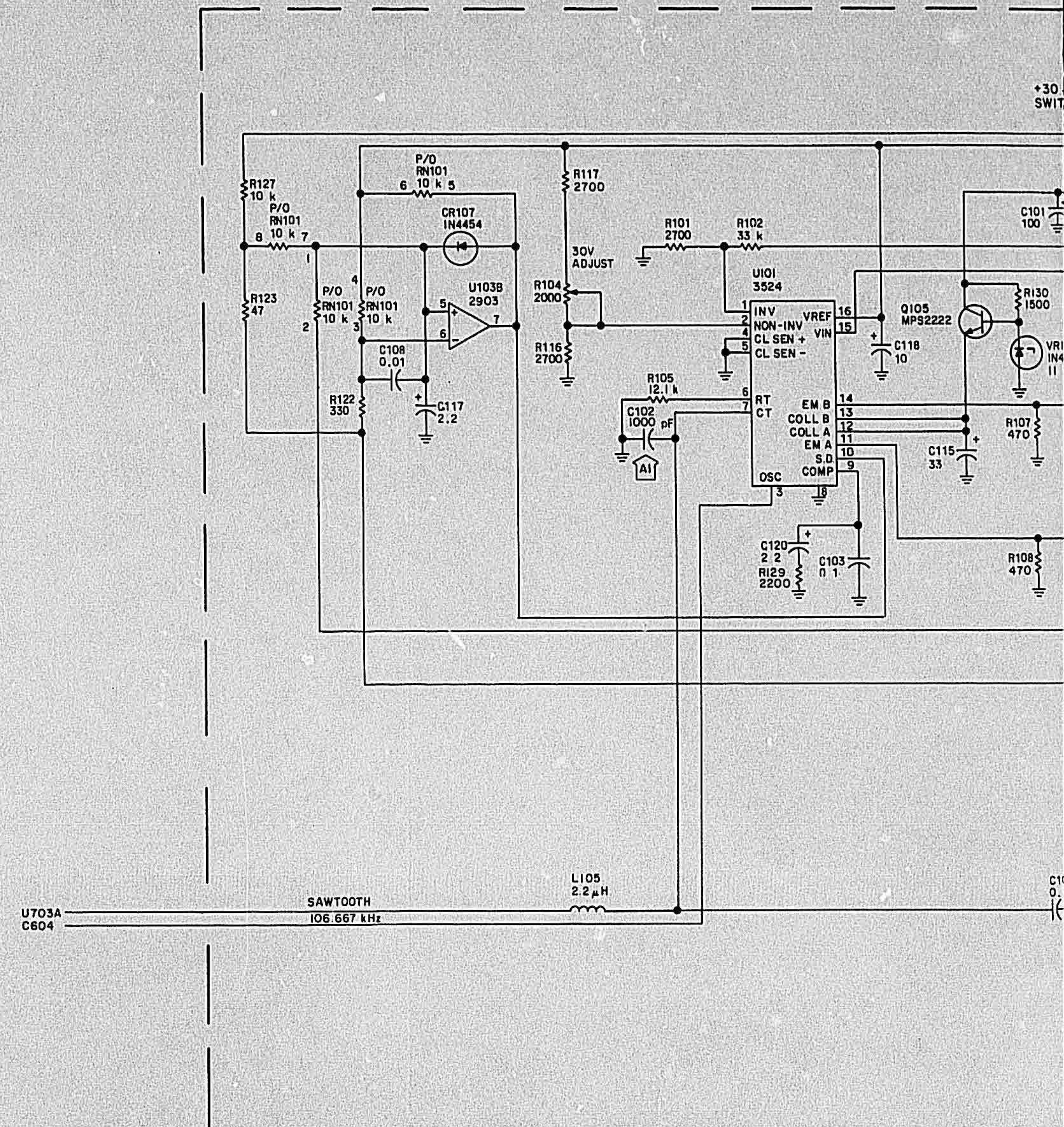
Circuit Card A1 (REV AB to AD) Power Supply, Component Location Diagram
Figure 6-3 (Sheet 2)

PARTS LIST

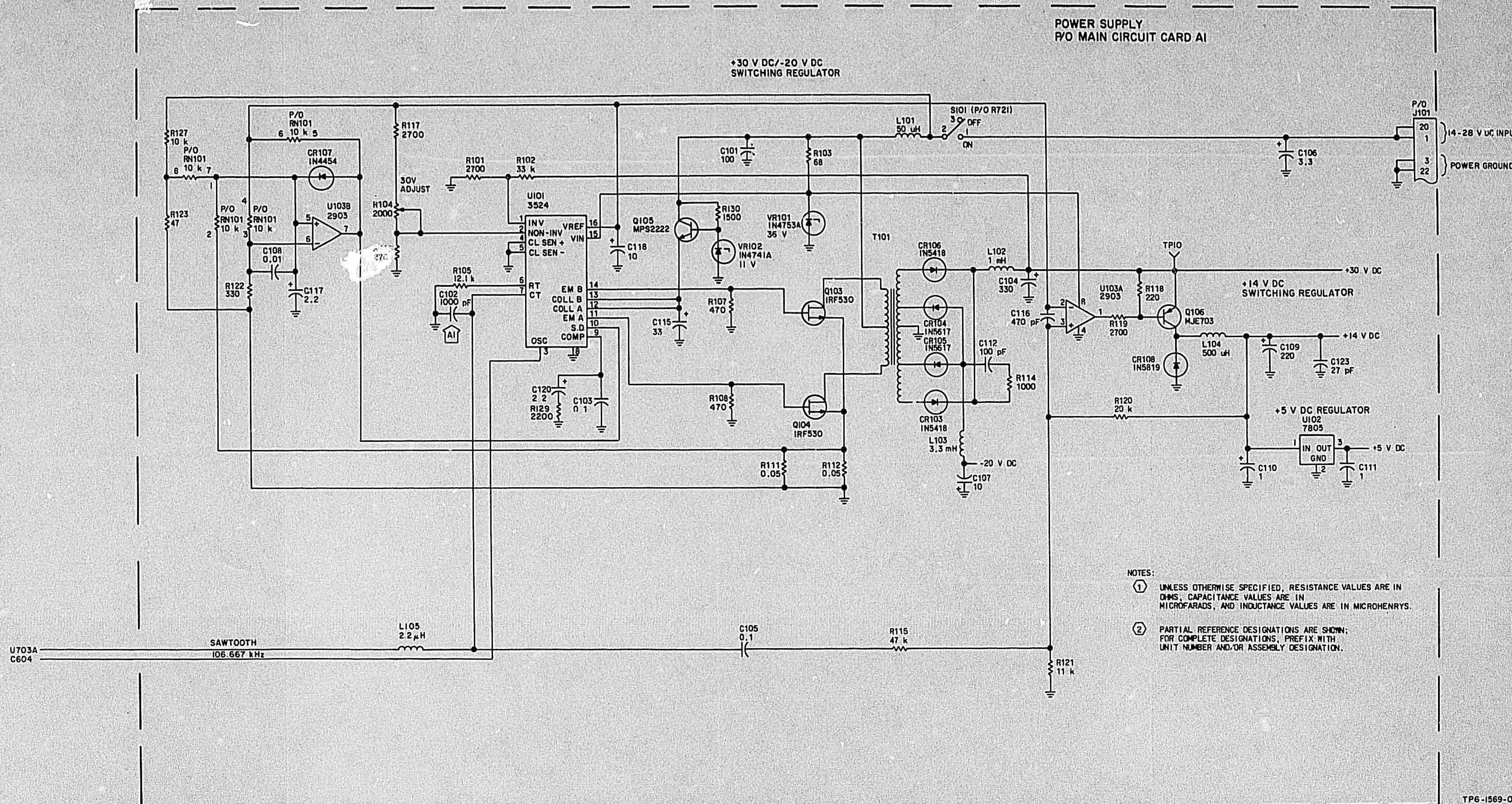
CIRCUIT CARD A1 POWER SUPPLY (PART NUMBER 653-3010-00X, REV AD)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A1	Circuit card A1	A	653-3010-001
A1	Circuit card A1	B	653-3010-002
A1	Circuit card A1	C	653-3010-003
A1	Circuit card A1	D	653-3010-004
C101	Capacitor, Al, 100μF, +100%-20%, 50V		183-1471-420
C102	Capacitor, cer, 4700pF, 10%, 100V (eff to rev V)		913-5019-160
C102	Capacitor, cer, 1000pF, 5%, 100V (eff rev V)		913-3281-270
C103	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C104	Capacitor, Al, 330μF, +100%-20%, 35V		183-1471-470
C105	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C106	Capacitor, Al, 3.3μF, 20%, 50V		183-1523-030
C107	Capacitor, Al, 10μF, +100%-20%, 35V		183-1471-080
C108	Capacitor, cer, 0.01μF, 20%, 50V		913-3279-110
C109	Capacitor, Al, 220μF, +100%-20%, 25V		183-1471-410
C110	Capacitor, Ta, 1μF, 20%, 35V		184-9102-790
C111	Capacitor, cer, 1μF, 20%, 50V		913-3279-270
C112	Capacitor, cer, 100pF, 10%, 100V		913-5020-150
C113	Used in audio circuit		
C114	Not used		
C115	Capacitor, Ta, 33μF, 20%, 10V (eff to rev AD)		184-9102-530
C115	Capacitor, Ta, 33μF, 20%, 35V (eff rev AD)		184-9102-880
C116	Capacitor, cer, 470pF, 5%, 100V		913-3117-080
C117	Capacitor, Al, 2.2μF, +100%-20%, 63V		183-1471-290
C118	Capacitor, Al, 10μF, +100%-20%, 16V (eff to rev W)		183-1471-140
C118	Capacitor, Ta, 10μF, 20%, 20V (eff rev W)		184-9102-610
C119	Not used		
C120	Capacitor, Ta, 2.2μF, 10%,20V		184-9086-430
C121	Used in audio circuit		
C122	Used in audio circuit		
C123	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
CJ101	Not used		
CJ102	Jumper wire (eff to rev AB)		428-0289-010
CJ103	Jumper wire (eff to rev AB)		428-0289-010
CN101-103	Capacitor, array, 0.01μF		913-3863-010
CR101	Not used		
CR102	Not used		
CR103	Diode, 1N5418		353-6558-040
CR104	Diode, 1N5617		353-6496-040
CR105	Diode, 1N5617		353-6496-040
CR106	Diode, 1N5418		353-6558-040
CR107	Diode, 1N4454		353-3644-010
CR108	Diode, 1N5819		353-6614-020
CR109	Used in audio circuit		
J101	Connector, 37-pin		371-0605-010
J801	Connector, 14-pin SB1	B,D	220-0071-100
L101	Inductor, 50μH		668-0337-060
L102	Inductor, 1mH		668-0337-050
L103	Coil, shielded, 3.3mH		240-2715-550
L104	Inductor, 500μH		668-0337-040
L105	Coil, 2.2μH		240-2027-000
Q101	Not used		
Q102	Not used		
Q103	Transistor, IRF530		352-7904-030
Q104	Transistor, IFR530		352-7904-030
Q105	Transistor, MPS2222		352-5021-010
Q106	Transistor, MJE703		352-1082-030
Q107	Used in audio circuit		
Q108	Used in audio circuit		
R101	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R102	Resistor, cmpsn, 33kΩ, 10%, 1/4W		745-0803-000
R103	Resistor, cmpsn, 68Ω, 10%, 1/4W		745-0707-000
R104	Resistor, var, 2kΩ, 10%, 1/2W		382-0027-080
R105	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W (eff to rev V)		745-0764-000
R105	Resistor, cmpsn, 12.1kΩ, 1%, 1/8W (eff rev V)		705-1048-000
R106	Not used		
R107	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R108	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R109	Not used		
R110	Not used		
R111	Resistor, ww, 0.05Ω, 1%, 1W		747-1499-110
R112	Resistor, ww, 0.05Ω, 1%, 1W		747-1499-110
R113	Used in audio circuit		
R114	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R115	Resistor, cmpsn, 47kΩ, 10%, 1/4W		745-0809-000
R116	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R117	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R118	Resistor, cmpsn, 220Ω, 10%, 1/4W		745-0725-000
R119	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R120	Resistor, film, 20kΩ, 1%, 1/8W		705-3805-620
R121	Resistor, film, 11kΩ, 1%, 1/8W		705-1046-000
R122	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R123	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R124	Used in audio circuit		
R125	Not used		
R126	Not used		
R127	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R128	Used in audio circuit		
R129	Resistor, cmpsn, 2200Ω, 10%, 1/4W		745-0761-000
R130	Resistor, cmpsn, 1.5kΩ, 10%, 1/4W		745-0755-000
RN101	Resistor, array, 10kΩ		350-4046-750
S101	Switch, SPDT p/o R721		376-0282-010
T101	Transformer, pwr		662-0929-010
TP10	Terminal, test		306-2721-010
U101	IC, 3524		351-1285-020
U102	IC, 7805		351-1198-010
U103	IC, 2903		351-1278-010
VR101	Diode, zener, 1N4753A		353-6481-510
VR102	Diode, zener, 1N4741A		353-6481-270
VR103	Used in audio circuit		
101	Bead, glass (qty 8)(eff rev T)		192-1042-010

SEE BLOW-UP FICHE NO. CLQ503 - ITEM E



SEE BLOW-UP FICHE NO. CLQ503 - ITEM E



Circuit Card A1 Power Supply, Schematic Diagram
Figure 6-3 (Sheet 3)

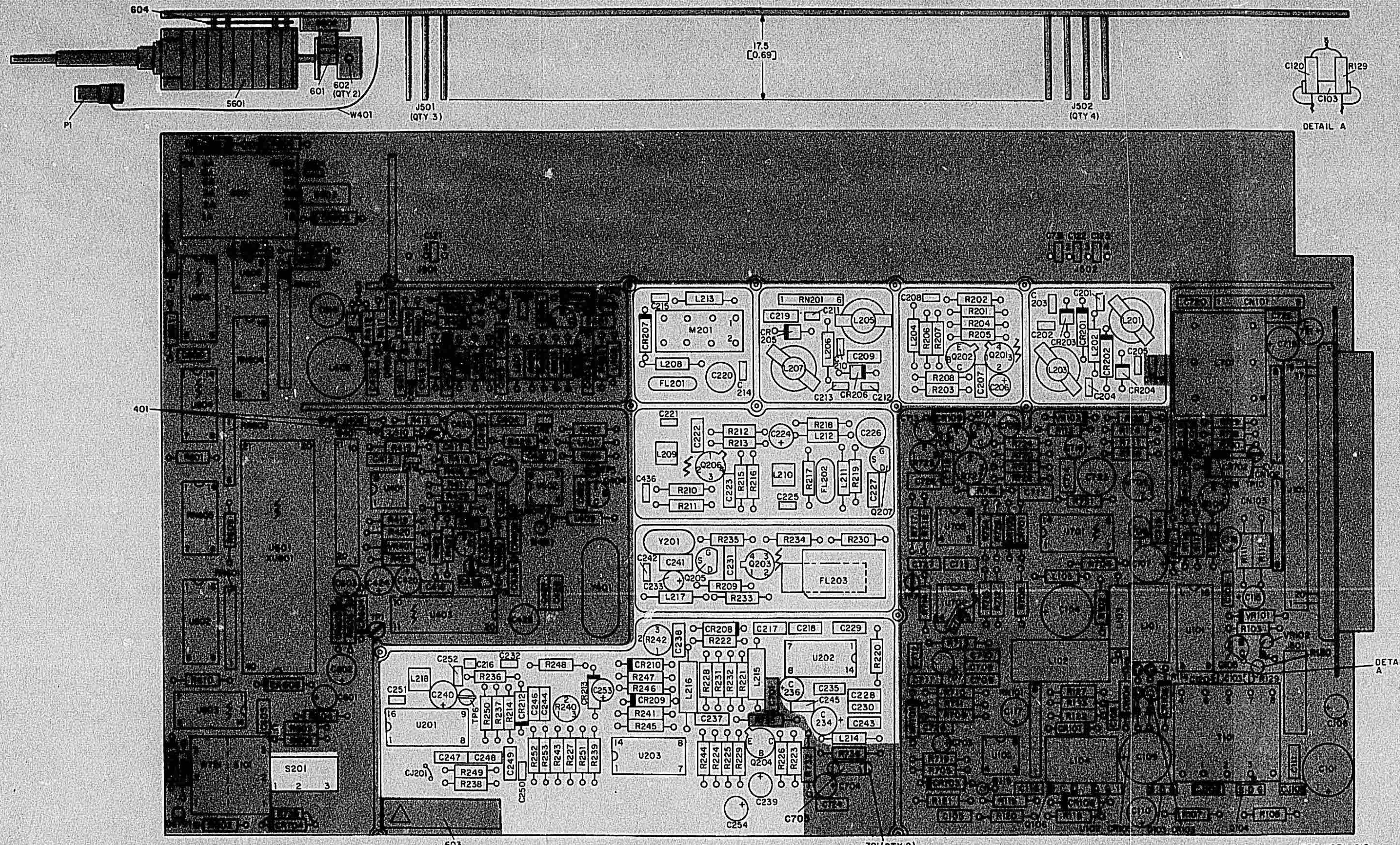
SEE BLOW-UP FICHE NO. CLQ503 - ITEM E

SEE BLOW-UP FICHE NO. CLQ503 - ITEM E

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	Changed C241 from 62 to 56 pF and R235 from 470 to 100 Ω to improve operation of Q205.		REV P
A2	Changed R203 from 39 to 4.7 kΩ to improve AGC stability.		REV AA

Circuit Card A1 Receiver, Schematic and Component Location Diagrams
Figure 6-4 (Sheet A)



Circuit Card A1 Receiver, Component Location Diagram
Figure 6-4 (Sheet 1 of 2)

PARTS
CIRCU

SYMBO
A1
A1
A1
A1
C201
C202
C203
C204
C205
C206
C207
C208
C209
C210
C211
C212
C213
C214
C215
C216
C217
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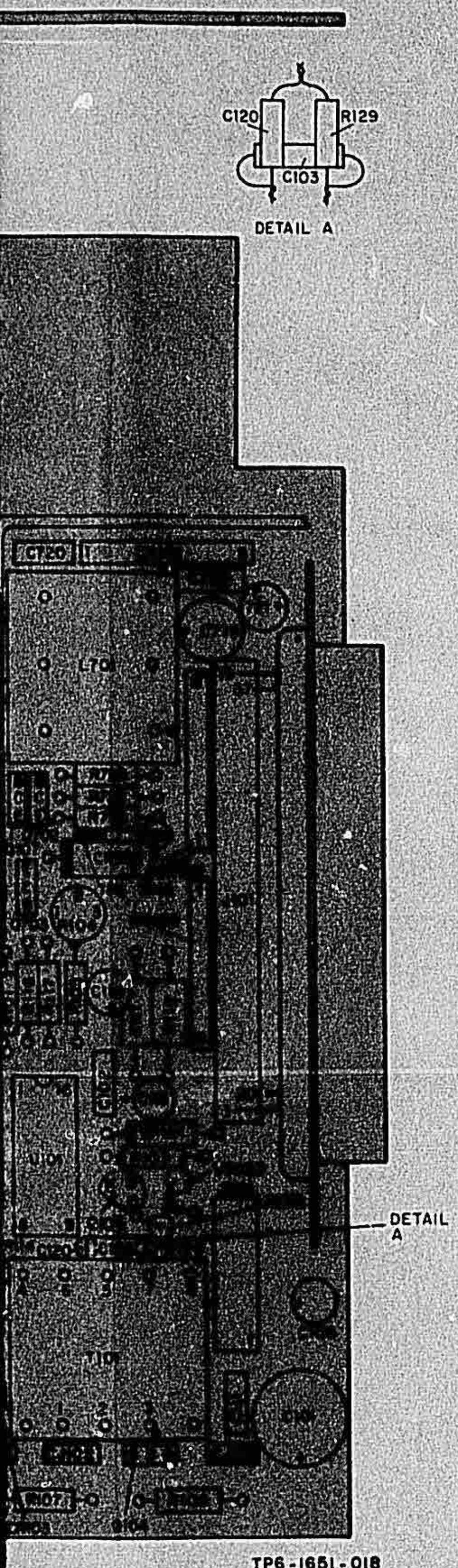
C247
C248
C249
C250
C251
C252
C253
C254
CJ201
CR201
CR202
CR203
CR204
CR205
CR206
CR207
CR208
CR209
CR210
CR211
CR212
CR213
FL201
FL201
FL202
FL202
FL203
FL203
J502
L201
L202
L203
L204
L205

SEE BLOW-UP FICHE NO. CLQ503 - ITEM 1

SEE BLOW-UP FICHE NO. CLQ503 - ITEM 1

SEE



PARTS LIST
CIRCUIT CARD A1 RECEIVER (PART NUMBER 653-3010-00X, REV AD)

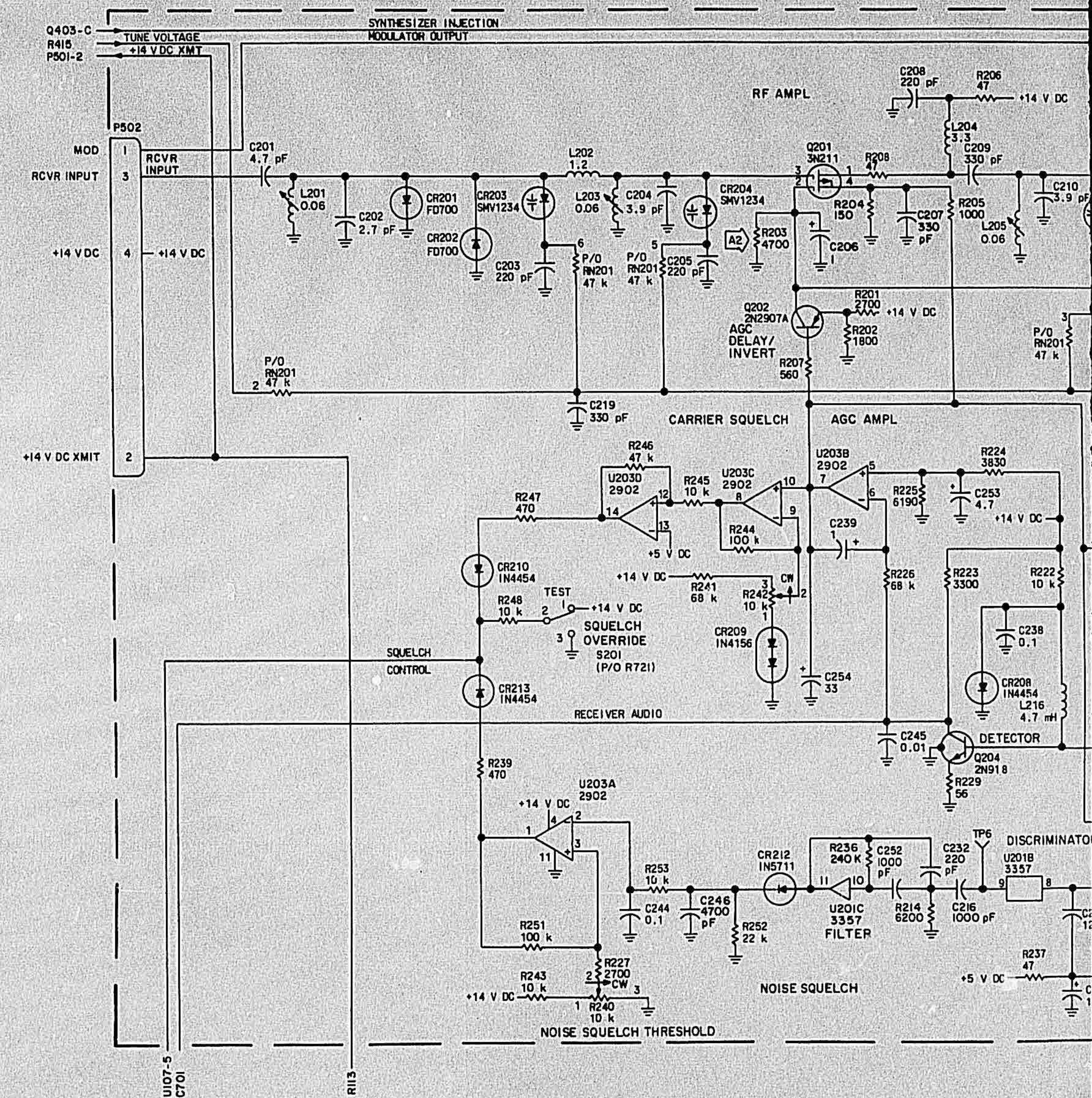
SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A1	Circuit card A1	A	653-3010-001
A1	Circuit card A1	B	653-3010-002
A1	Circuit card A1	C	653-3010-003
A1	Circuit card A1	D	653-3010-004
C201	Capacitor, cer, 4.7 ;0.25pF, 75V		913-1098-210
C202	Capacitor, cer, 2.7 ;0.25pF, 75V		913-1098-240
C203	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C204	Capacitor, cer, 3.9 ;0.25pF, 75V		913-1098-220
C205	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C206	Capacitor, Ta, 1μF, 20%, 35V		184-9102-790
C207	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C208	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C209	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C210	Capacitor, cer, 3.9;0.25pF, 75V		913-1098-220
C211	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C212	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C213	Capacitor, cer, 3.9;0.25pF, 75V		913-1098-220
C214	Capacitor, cer, 4.7;0.25pF, 75V		913-1098-210
C215	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C216	Capacitor, cer, 1000pF, 5%, 100V		913-3281-270
C217	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C218	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C219	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C220	Capacitor, var, 5-25pF, 50V		917-1256-030
C221	Capacitor, cer, 22pF, 5%, 100V		913-3401-100
C222	Capacitor, cer, 0.01μF, 10%, 100V		913-5019-200
C223	Capacitor, cer, 1000pF, 10%, 200V		913-4018-000
C224	Capacitor, Ta, 1μF, 20%, 35V		184-9102-790
C225	Capacitor, cer, 22pF, 5%, 100V		913-3401-100
C226	Capacitor, var, 5-25pF, 50V		917-1256-030
C227	Capacitor, cer, 0.01μF, 10%, 100V		913-5019-200
C228	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C229	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C230	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C231	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C232	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C233	Capacitor, Ta, 1μF, 20%, 35V		184-9102-790
C234	Capacitor, Ta, 1μF, 20%, 35V		184-9102-790
C235	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C236	Capacitor, Ta, 1μF, 20%, 35V		184-9102-790
C237	Capacitor, cer, 0.1μF, 10%, 50V		913-5010-320
C238	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C239	Capacitor, Ta, 1μF, 20%, 35V		184-9102-790
C240	Capacitor, Ta, 1μF, 20%, 35V		184-9102-790
C241	Capacitor, mica, 62pF (eff to rev P)		912-2099-240
C241	Capacitor, cer, 56pF, 5%, 100V (eff rev P)		913-3401-070
C242	Capacitor, cer, 180pF, 5%, 100V		913-1098-510
C243	Capacitor, cer, 1000pF, 10%, 200V		913-4018-000
C244	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C245	Capacitor, cer, 0.01μF, 10%, 100V		913-5019-200
C246	Capacitor, cer, 4700pF, 10%, 100V		913-5019-160
C247	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C248	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C249	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C250	Capacitor, cer, 10pF, 5%, 75V		913-1098-010
C251	Capacitor, cer, 120pF, 5%, 100V		913-3117-220
C252	Capacitor, cer, 1000pF, 5%, 100V		913-3281-270
C253	Capacitor, Ta, 4.7μF, 20%, 10V		184-9102-510
C254	Capacitor, Ta, 33μF, 20%, 10V		184-9102-530
CJ201	Jumper		428-0289-010
CR201	Diode, FD700		353-3586-010
CR202	Diode, FD700		353-3586-010
CR203	Diode, SMV1234		353-3264-020
CR204	Diode, SMV1234		353-3264-020
CR205	Diode, SMV1234		353-3264-020
CR206	Diode, SMV1234		353-3264-020
CR207	Diode, 1N4454		353-3644-010
CR208	Diode, 1N4454		353-3644-010
CR209	Diode, 1N4156		353-3610-010
CR210	Diode, 1N4454		353-3644-010
CR211	Not used		
CR212	Diode, 1N5711		353-3691-010
CR213	Diode, 1N4454		353-3644-010
FL201	Filter, 20.025 MHz, wide band	C,D	293-1345-020
FL201	Filter, 20.025 MHz, narrow band	A,B	293-1345-010
FL202	Filter, 20.025 MHz, wide band	C,D	293-1345-020
FL202	Filter, 20.025 MHz, narrow band	A,B	293-1345-010
FL203	Filter, 455 kHz, wide band	C,D	241-0752-010
FL203	Filter, 455 kHz, narrow band	A,B	241-0752-030
J502	Pin, connector (qty 4)		372-7518-030
L201	Coil, var, 0.06μH		278-0415-010
L202	Coil, 1.2μH		240-2024-000
L203	Coil, var, 0.06μH		278-0415-010
L204	Coil, 3.3μH		240-2029-000
L205	Coil, var, 0.06μH		278-0415-010

Q503 - ITEM I

SEE BLOW-UP FICHE NO. CLQ503 - ITEM I

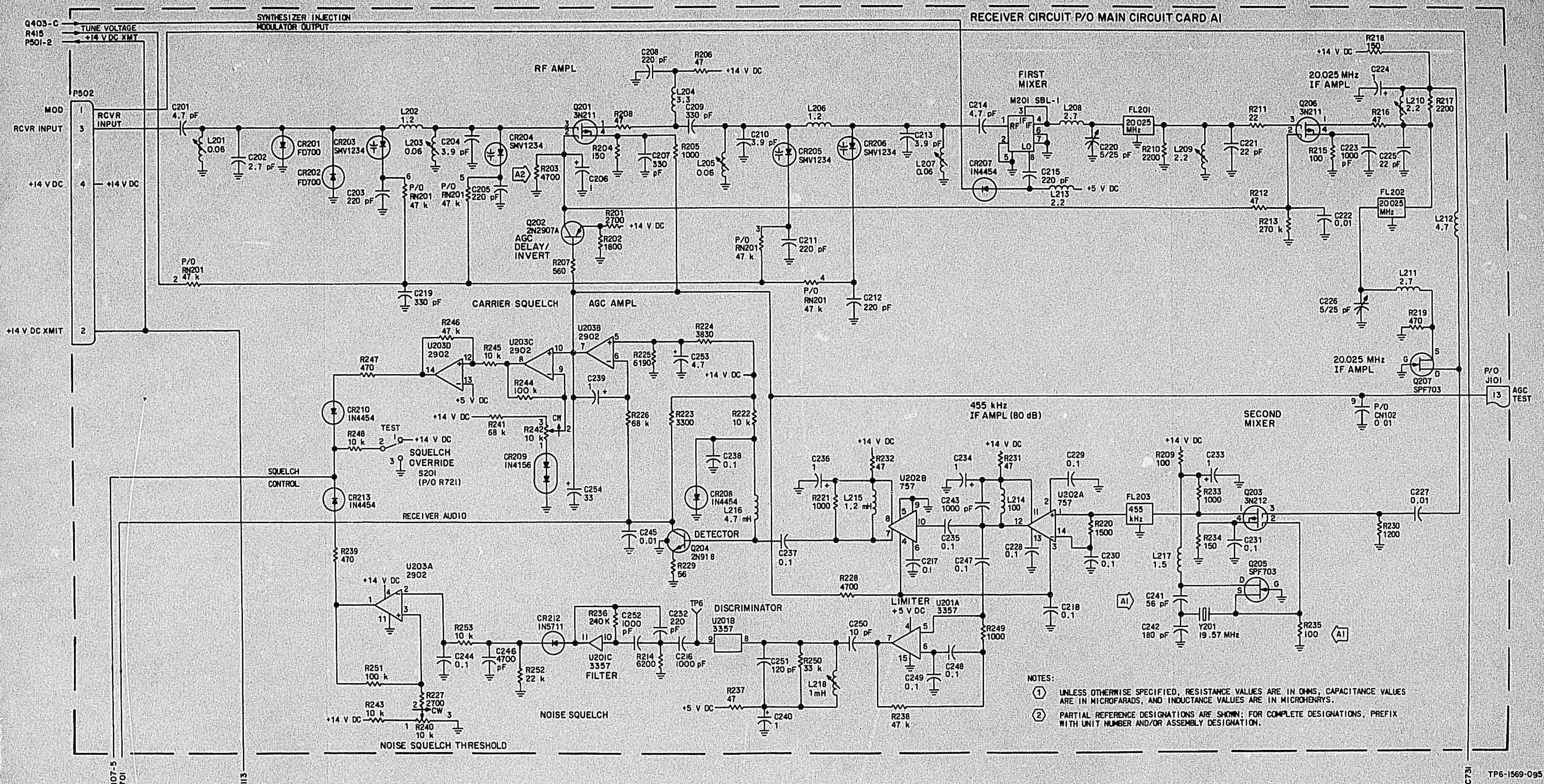
SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
L206	Coil, 1.2μH		240-2024-000
L207	Coil, var, 0.06μH		278-0415-010
L208	Coil, 2.7μH		240-2028-000
L209	Coil, var, 2.2μH		278-0500-010
L210	Coil, var, 2.2μH		278-0500-010
L211	Coil, 2.7μH		240-2028-000
L212	Coil, 4.7μH		240-2031-000
L213	Coil, 2.2μH		240-2027-000
L214	Coil, 100μH		240-2047-000
L215	Coil, shielded, 1.2mH		240-2715-500
L216	Coil, shielded, 4.7mH		240-2715-570
L217	Coil, 1.5μH		240-2025-000
L218	Coil, var, 1mH		278-0500-020
M201	Mixer, SBL-1		277-0496-010
Q201	Transistor, 3N211		352-1045-010
Q202	Transistor, 2N2907A		352-0551-010
Q203	Transistor, 3N212		352-1045-030
Q204	Transistor, 2N918		352-0440-000
Q205	Transistor, SPF703		352-5013-030
Q206	Transistor, 3N211		352-1045-010
Q207	Transistor, SPF703		352-5013-030
R201	Resistor, 2700Ω, 5%, 1/4W		745-0763-000
R202	Resistor, cmpsn, 1800Ω, 10%, 1/4W		745-0757-000
R203	Resistor, cmpsn, 39kΩ, 10%, 1/4W (eff to rev AA)		745-0806-000
R203	Resistor, cmpsn, 4700Ω, 10%, 1/4W (eff rev AA)		745-0773-000
R204	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R205	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R206	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R207	Resistor, cmpsn, 560Ω, 10%, 1/4W		745-0740-000
R208	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R209	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R210	Resistor, cmpsn, 2200Ω, 5%, 1/4W		745-0760-000
R211	Resistor, cmpsn, 22Ω, 10%, 1/4W		745-0689-000
R212	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R213	Resistor, cmpsn, 270kΩ, 10%, 1/4W		745-0838-000
R214	Resistor, cmpsn, 6200Ω, 10%, 1/4W		745-0777-000
R215	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R216	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R217	Resistor, cmpsn, 2200Ω, 5%, 1/4W		745-0760-000
R218	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R219	Resistor, cmpsn, 470Ω, 10%, 1/4W		745-0737-000
R220	Resistor, cmpsn, 1500Ω, 10%, 1/4W		745-0755-000
R221	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R222	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R223	Resistor, cmpsn, 3300Ω, 10%, 1/4W		745-0767-000
R224	Resistor, film, 3830Ω, 1%, 1/8W		705-1024-000
R225	Resistor, film, 6190Ω, 1%, 1/8W		705-1034-000
R226	Resistor, cmpsn, 68kΩ, 10%, 1/4W		745-0815-000
R227	Resistor, cmpsn, 2700Ω, 10%, 1/4W		745-0764-000
R228	Resistor, cmpsn, 4700Ω, 10%, 1/4W		745-0773-000
R229	Resistor, cmpsn, 56Ω, 10%, 1/4W		745-0704-000
R230	Resistor, cmpsn, 1200Ω, 5%, 1/4W		745-0751-000
R231	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R232	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R233	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R234	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R235	Resistor, cmpsn, 470Ω, 10%, 1/4W (eff to rev P)		745-0737-000
R235	Resistor, cmpsn, 100Ω, 10%, 1/4W (eff rev P)		745-0737-000
R236	Resistor, cmpsn, 240kΩ, 5%, 1/4W		745-0834-000
R237	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R238	Resistor, cmpsn, 47kΩ, 10%, 1/4W		745-0809-000
R239	Resistor, cmpsn, 470Ω, 10%, 1/4W		745-0737-000
R240	Resistor, var, 10kΩ, 20%, 1/2W (eff to rev AD)		382-0027-100
R240	Resistor, var, 10kΩ, 10%, 1/2W (eff rev AD)		382-0050-010
R241	Resistor, cmpsn, 68kΩ, 10%, 1/4W		745-0815-000
R242	Resistor, var, 10kΩ, 20%, 1/2W (eff to rev AD)		382-0027-100
R242	Resistor, var, 10kΩ, 10%, 1/2W (eff rev AD)(SB 3)		382-0050-010
R243	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R244	Resistor, cmpsn, 100kΩ, 10%, 1/4W		745-0821-000
R245	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R246	Resistor, cmpsn, 47kΩ, 10%, 1/4W		745-0809-000
R247	Resistor, cmpsn, 470Ω, 10%, 1/4W		745-0737-000
R248	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R249	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R250	Resistor, cmpsn, 33kΩ, 10%, 1/4W		745-0803-000
R251	Resistor, cmpsn, 100kΩ, 10%, 1/4W		745-0821-000
R252	Resistor, cmpsn, 22kΩ, 10%, 1/4W		745-0797-000
R253	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
RN201	Resistor, array, 47kΩ		350-4000-060
S201	Switch, DPDT p/o R721		376-0282-010

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
TP6	Terminal, test		306-2721-010
U201	IC, 3357		351-1346-010
U202	IC, 757		351-1091-010
U203	IC, 2902		351-1141-040
Y201	Crystal, 19.57 MHz		289-7351-010
201	Spacer (eff rev AC)		150-0853-060
202	Spacer (qty 2) (eff rev AC)		352-9552-580



SEE BLOW-UP FICHE NO. CLQ503 - ITEM C

SEE BLOW-UP FICHE

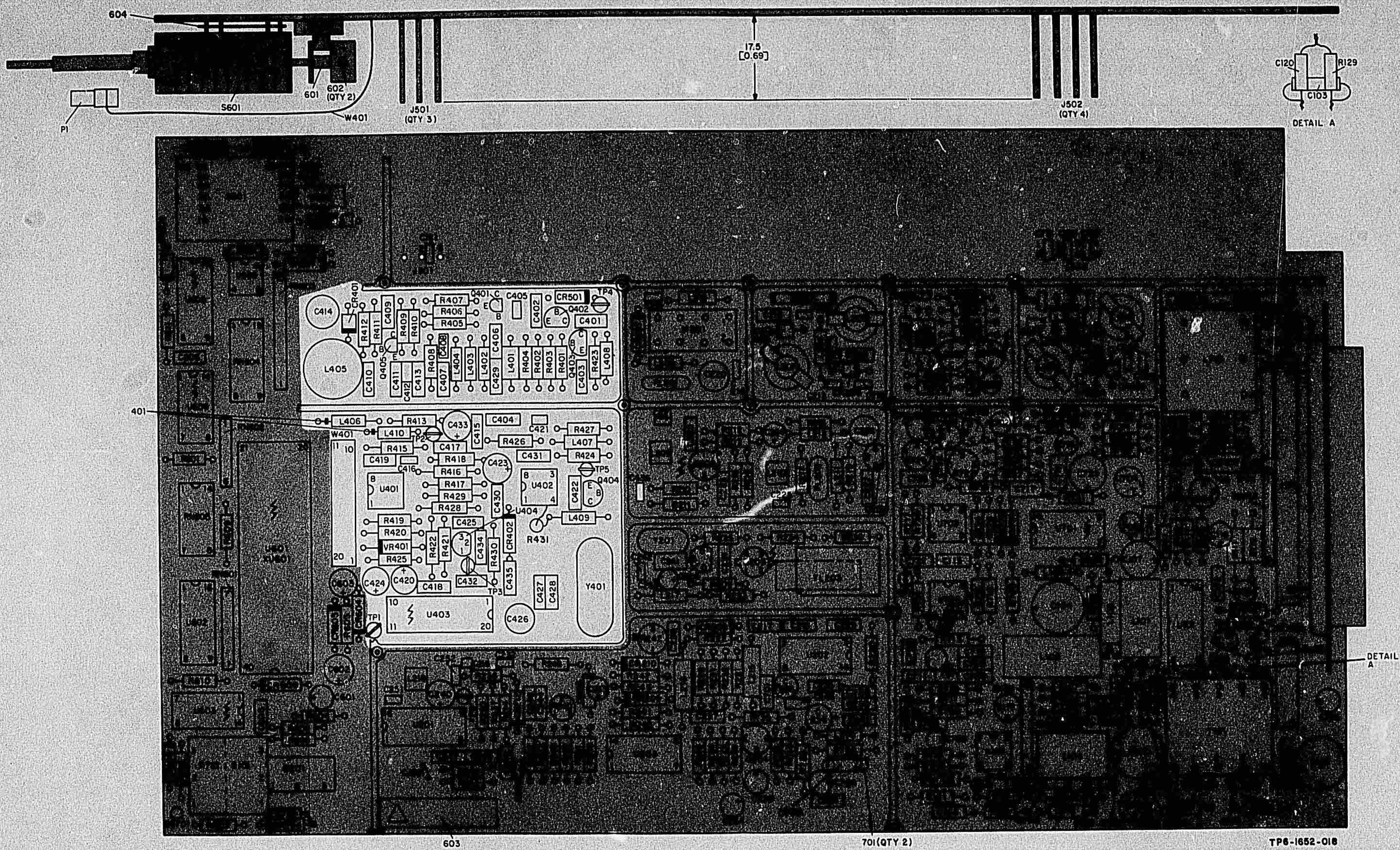


Circuit Card A1 Receiver, Schematic Diagram
Figure 6-4 (Sheet 2)

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	Changed C428 from 56 to 47 pF to center adjustment range of C426.		REV P

Circuit Card A1 Synthesizer, Schematic and Component Location Diagrams
Figure 6-5 (Sheet A)



Circuit Card A1 Synthesizer, Component Location Diagram
Figure 6-5 (Sheet 1 of 2)

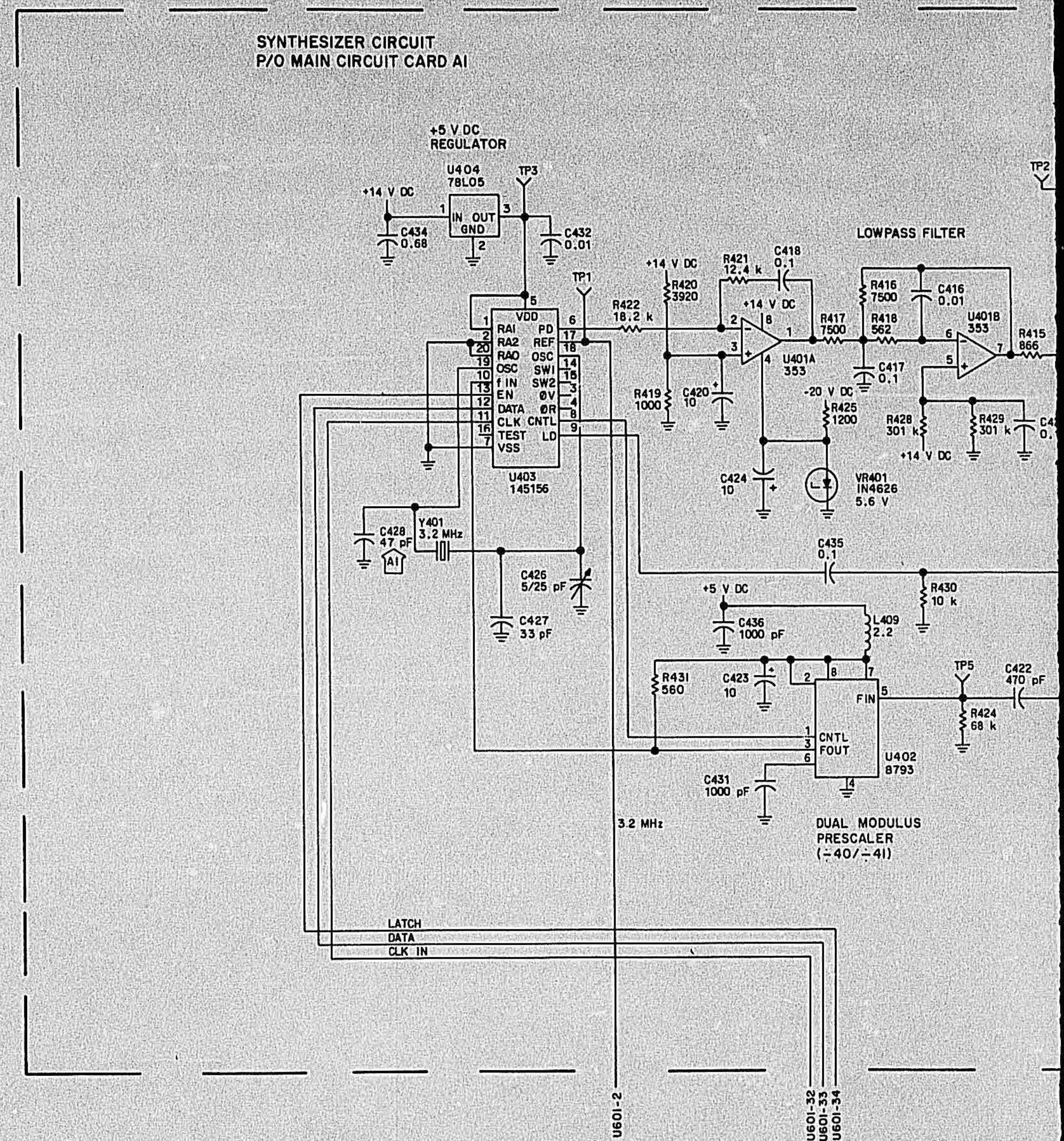
 Revised 1 November 1983

PARTS LIST

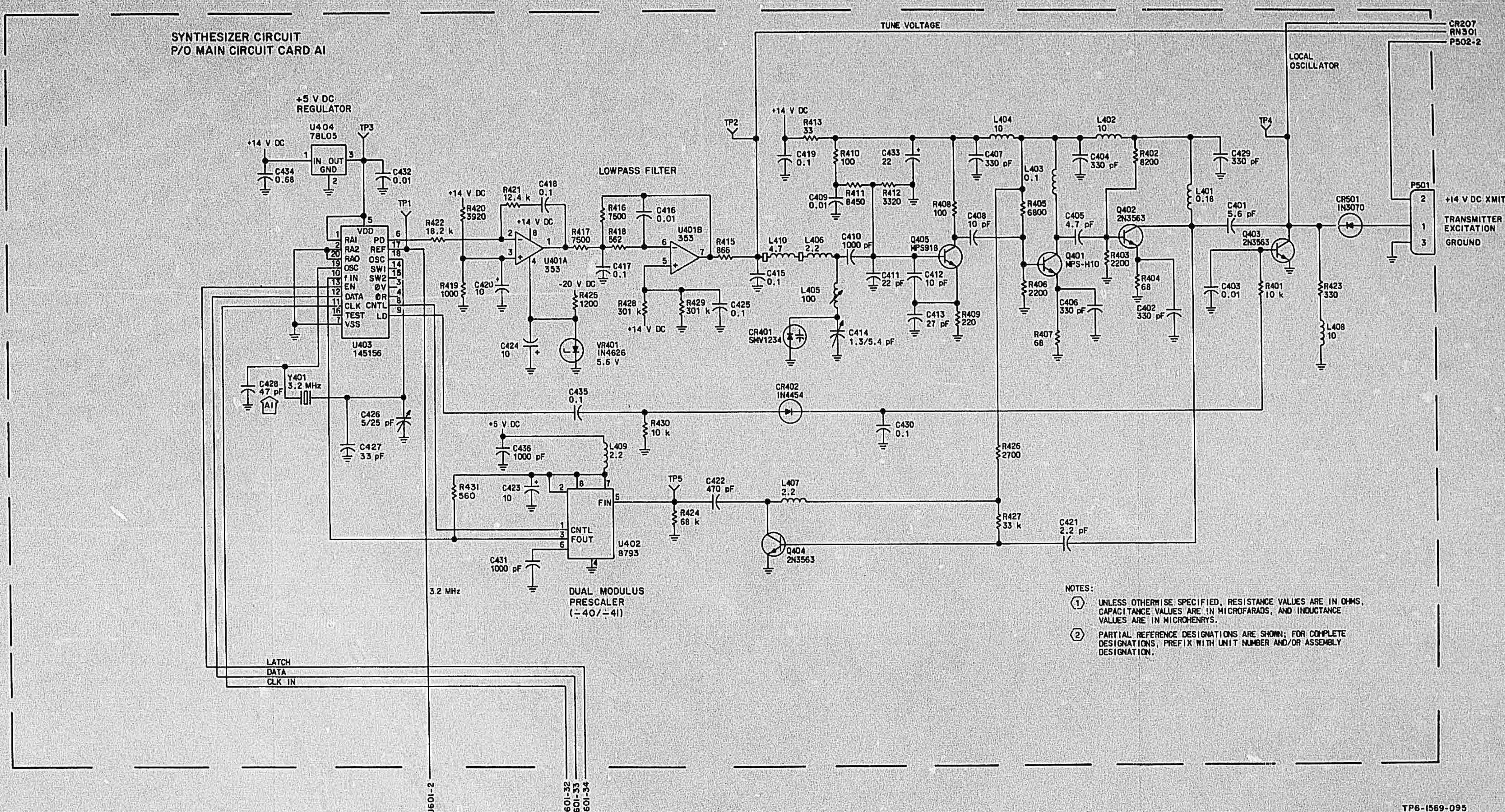
CIRCUIT CARD A1 SYNTHESIZER (PART NUMBER 653-3010-00X, REV AD)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A1	Circuit card A1	A	653-3010-001
A1	Circuit card A1	B	653-3010-002
A1	Circuit card A1	C	653-3010-003
A1	Circuit card A1	D	653-3010-004
C401	Capacitor, cer, 5.6 ;0.5pF, 75V		913-1098-130
C402	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C403	Capacitor, cer, 0.01μF, 10%, 100V		913-5019-200
C404	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C405	Capacitor, cer, 4.7 ;0.25pF, 75V		913-1098-210
C406	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C407	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C408	Capacitor, cer, 10pF, 5%, 75V		913-1098-010
C409	Capacitor, cer, 0.01μF, 10%, 100V		913-5019-200
C410	Capacitor, cer, 1000pF, 10%, 200V		913-4018-000
C411	Capacitor, cer, 22pF, 10%, 200V		913-5019-050
C412	Capacitor, cer, 10pF, 5%, 75V		913-1098-010
C413	Capacitor, cer, 27pF, 10%, 200V		913-5019-060
C414	Capacitor, var, 1.3-5.4pF, 200V		922-1032-020
C415	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C416	Capacitor, cer, 0.01μF, 20%, 50V		913-3279-110
C417	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C418	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C419	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C420	Capacitor, Al, 10μF, +100%-20%, 16V		183-1471-140
C421	Capacitor, cer, 2.2 ;0.25pF, 75V		913-1098-250
C422	Capacitor, cer, 470pF, 10%, 200V		913-4014-000
C423	Capacitor, Al, 10μF, +100%-20%, 16V		183-1471-140
C424	Capacitor, Al, 10μF, +100%-20%, 16V		183-1471-140
C425	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C426	Capacitor, var, 5-25pF, 50V		917-1256-030
C427	Capacitor, cer, 33pF, 10%, 200V		913-5019-070
C428	Capacitor, cer, 56pF, 10%, 200V (eff to rev P)		913-4003-000
C428	Capacitor, cer, 47pF, 10%, 200V (eff rev P)		913-4002-000
C429	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C430	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C431	Capacitor, cer, 1000pF, 10%, 200V		913-4018-000
C432	Capacitor, cer, 0.01μF, 10%, 100V		913-5019-200
C433	Capacitor, Ta, 22μF, 20%, 15V (eff to rev W)		184-9102-580
C433	Capacitor, Ta, 22μF, 20%, 15V (eff rev W)		184-9102-140
C434	Capacitor, cer, 0.68μF, 10%, 50V		913-5019-540
C435	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C436	Capacitor, cer, 1000pF, 5%, 100V		913-3281-270
CR401	Diode, SMV1234		353-3264-020
CR402	Diode, 1N4454		353-3644-010
CR501	Diode, 1N3070		353-3083-000
J501	Pin, connector (qty 3)		372-7518-030
L401	Coil, 0.18μH		240-2014-000
L402	Coil, 10μH		240-2035-000
L403	Coil, 0.1μH		240-2742-090
L404	Coil, 10μH		240-2035-000
L405	Coil, var, 0.1μH		278-0418-010
L406	Coil, 2.2μH		240-2027-000
L407	Coil, 2.2μH		240-2027-000
L408	Coil, 10μH		240-2035-000
L409	Coil, 2.2μH		240-2027-000
L410	Coil, 4.7μH		240-2031-000
Q401	Transistor, MPS-H10		352-5031-010
Q402	Transistor, 2N3563		352-5020-010
Q403	Transistor, 2N3563		352-5020-010
Q404	Transistor, 2N3563		352-5020-010
Q405	Transistor, MPS-918		352-5027-010
R401	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R402	Resistor, cmpsn, 8200Ω, 10%, 1/4W		745-0782-000
R403	Resistor, cmpsn, 2200Ω, 10%, 1/4W		745-0761-000
R404	Resistor, cmpsn, 68Ω, 10%, 1/4W		745-0707-000
R405	Resistor, cmpsn, 6800Ω, 10%, 1/4W		745-0779-000
R406	Resistor, cmpsn, 2200Ω, 10%, 1/4W		745-0761-000
R407	Resistor, cmps.ı, 68Ω, 10%, 1/4W		745-0707-000
R408	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R409	Resistor, cmpsn, 220Ω, 10%, 1/4W		745-0725-000
R410	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R411	Resistor, film, 8450Ω, 1%, 1/8W		705-3605-440
R412	Resistor, film, 3320Ω, 1%, 1/8W		705-1021-000
R413	Resistor, cmpsn, 33Ω, 10%, 1/4W		745-0695-000
R414	Not used		
R415	Resistor, film, 866Ω, 1%, 1/8W		705-0993-000
R416	Resistor, film, 7.5kΩ, 1%, 1/8W		705-1038-000
R417	Resistor, film, 7.5kΩ, 1%, 1/8W		705-1038-000
R418	Resistor, film, 562Ω, 1%, 1/8W		705-0984-000
R419	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R420	Resistor, film, 3920Ω, 1%, 1/8W		705-3605-280
R421	Resistor, film, 12.4kΩ, 1%, 1/8W		705-3605-520
R422	Resistor, film, 18.2kΩ, 1%, 1/8W		705-3605-600
R423	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R424	Resistor, cmpsn, 68kΩ, 10%, 1/4W		745-0815-000
R425	Resistor, cmpsn, 1200Ω, 10%, 1/4W		745-0752-000
R426	Resistor, cmpsn, 2700Ω, 10%, 1/4W		745-0764-000
R427	Resistor, cmpsn, 33kΩ, 10%, 1/4W		745-0803-000
R428	Resistor, film, 301kΩ, 1%, 1/8W		705-1115-000
R429	Resistor, film, 301kΩ, 1%, 1/8W		705-1115-000
R430	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R431	Resistor, cmpsn, 560Ω, 10%, 1/4W		745-0740-000
TP1-TP5	Terminal, test (qty 5)		306-2721-010
U401	IC,353		351-1370-040
U402	IC, 8793		351-1981-010
U403	IC, 145156		351-8736-010
U404	IC, 78L05		351-1353-030
VR401	Diode, zener, 1N4626		353-3591-500
W401	Cable, ribbon		653-8507-007
Y401	Crystal, 3.2 MHz, 0.001%		289-7503-010
401	Bead, ferrite (qty 2)		288-2154-000
402	Shield, rf (eff to rev AB)		653-2065-001
402	Shield, rf (eff rev AB)		653-2065-002
403	Insulator, shield (eff to rev AB)		628-6848-005
403	Insulator, shield (eff rev AB)		628-6848-006

SEE BLOW-UP FICHE NO. CLQ503 - ITEM G



SEE BLOW-UP FICHE NO. CLQ503 - ITEM G



Circuit Card A1 Synthesizer, Schematic Diagram
Figure 6-5 (Sheet 2)

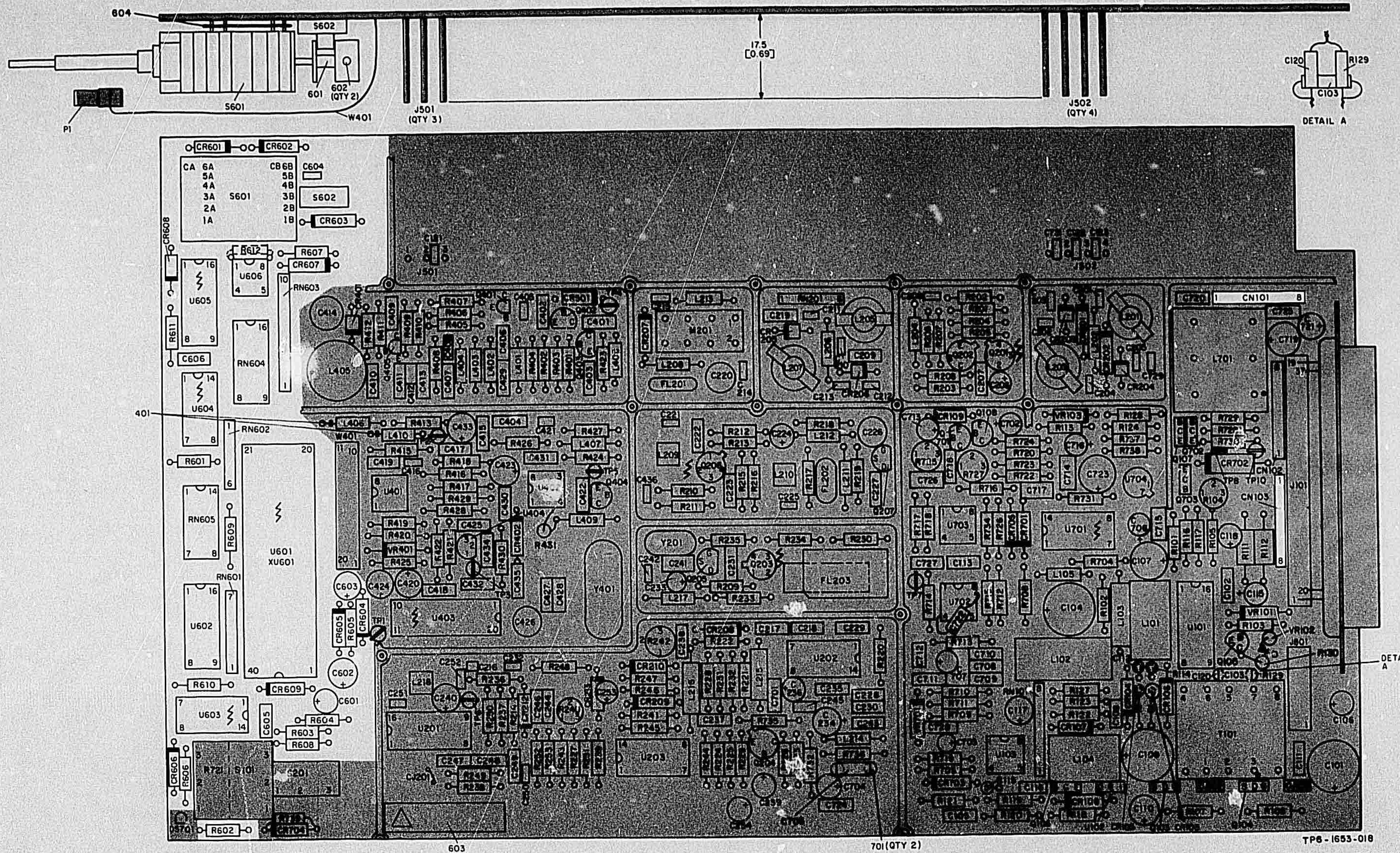
SEE BLOW-UP FICHE NO. CLQ503 - ITEM G

SEE BLOW-UP FICHE NO. CLQ503 - ITEM G

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
	(This page will contain schematic revision information.)		

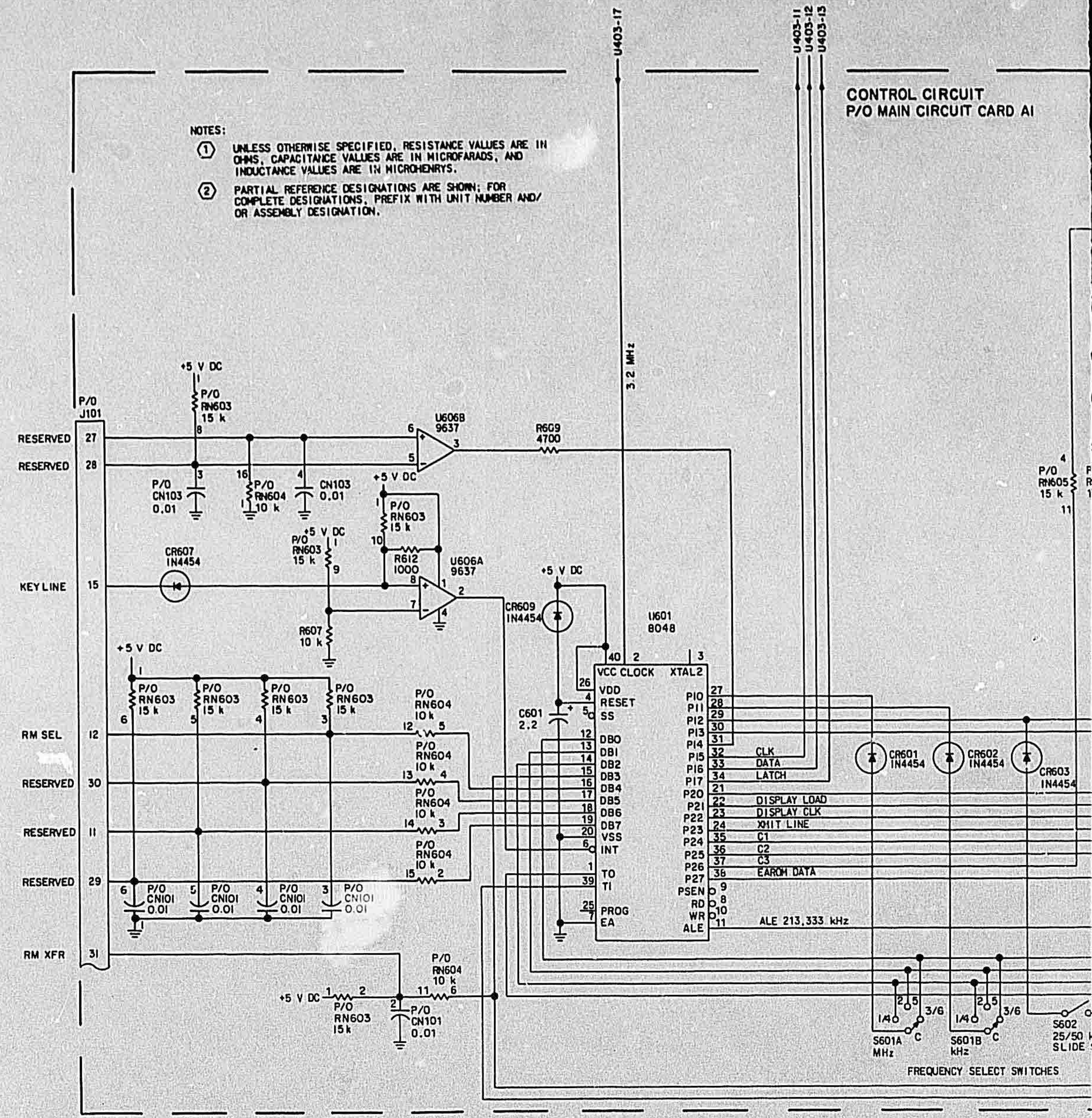
Circuit Card A1 Control Circuit, Schematic and Component Location Diagrams
Figure 6-6 (Sheet A)



Circuit Card A1 Control Circuit, Component Location Diagram
Figure 6-6 (Sheet 1 of 2)

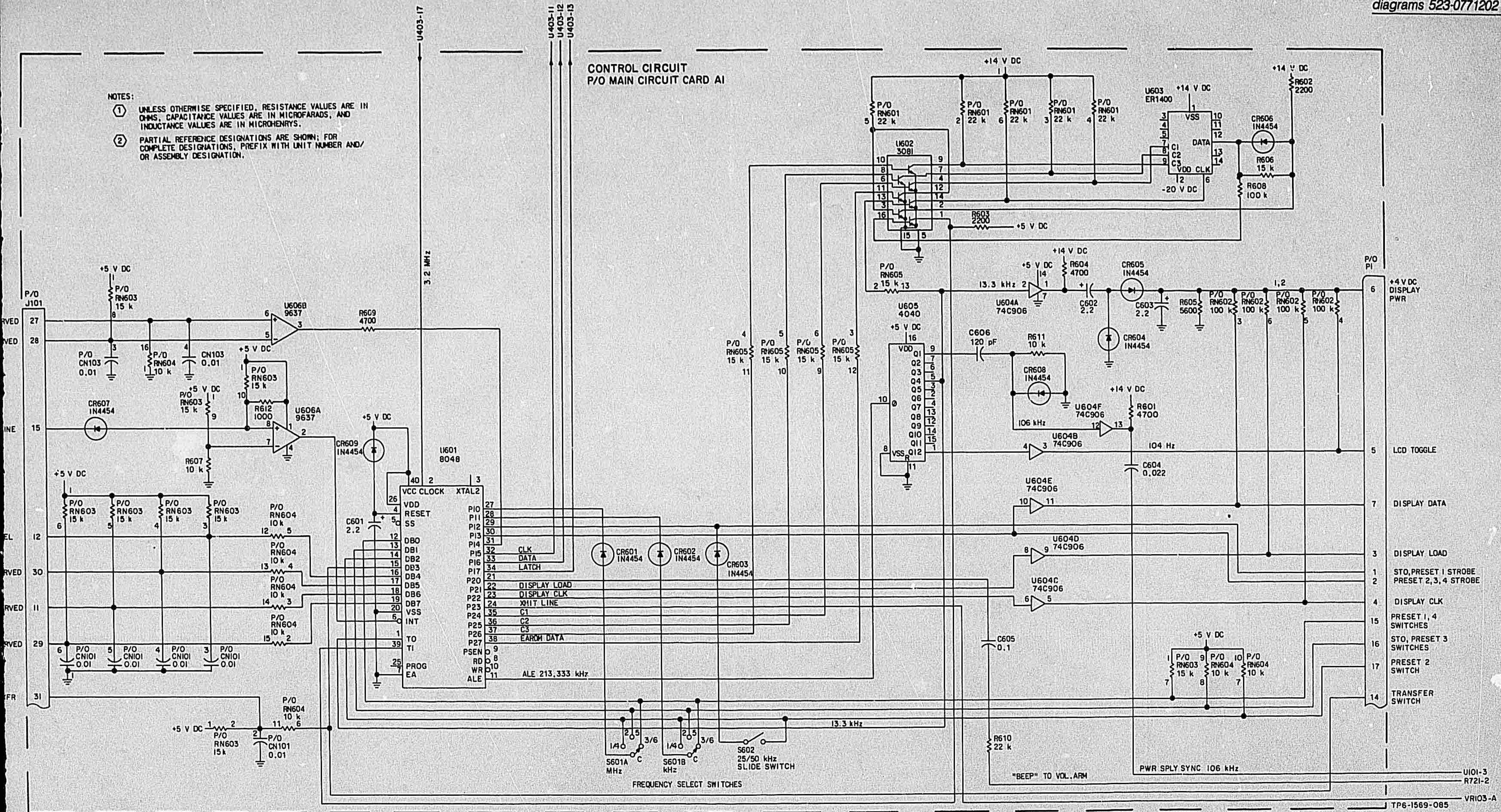
PARTS LIST
CIRCUIT CARD A1 CONTROL CIRCUITS (PART NUMBER 652-3010-00X, REV AD)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A1	Circuit card A1	A	653-3010-001
A1	Circuit card A1	B	653-3010-002
A1	Circuit card A1	C	653-3010-003
A1	Circuit card A1	D	653-3010-004
C601	Capacitor, Al, 2.2μF, +100%-20%, 63V		183-1471-290
C602	Capacitor, Al, 2.2μF, +100%-20%, 63V		183-1471-290
C603	Capacitor, Al, 2.2μF, +100%-20%, 63V		183-1471-290
C604	Capacitor, cer, 0.022μF, 20%, 50V		913-3279-130
C605	Capacitor, cer, 0.1μF, 10%, 50V		913-5019-320
C606	Capacitor, cer, 120pF, 5%, 100V		913-3117-220
CN101	Capacitor, array, 0.01μF		913-3663-010
CN103	Capacitor, array, 0.01μF		913-3663-010
CR601	Diode, 1N4454		353-3644-010
CR602	Diode, 1N4454		353-3644-010
CR603	Diode, 1N4454		353-3644-010
CR604	Diode, 1N4454		353-3644-010
CR605	Diode, 1N4454		353-3644-010
CR606	Diode, 1N4454		353-3644-010
CR607	Diode, 1N4454		353-3644-010
CR608	Diode, 1N4454		353-3644-010
CR609	Diode, 1N4454		353-3644-010
R601	Resistor, cmpsn, 4700Ω, 10%, 1/4W		745-0773-000
R602	Resistor, cmpsn, 2200Ω, 10%, 1/4W		745-0761-000
R603	Resistor, cmpsn, 2200Ω, 10%, 1/4W		745-0761-000
R604	Resistor, cmpsn, 4700Ω, 10%, 1/4W		745-0773-000
R605	Resistor, cmpsn, 5600Ω, 10%, 1/4W		745-0776-000
R606	Resistor, cmpsn, 15k0m, 10%, 1/4W		745-0791-000
R607	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R608	Resistor, cmpsn, 100kΩ, 10%, 1/4W		745-0821-000
R609	Resistor, cmpsn, 4700Ω, 10%, 1/4W		745-0773-000
R610	Resistor, cmpsn, 22kΩ, 10%, 1/4W		745-0797-000
R611	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R612	Resistor, cmpsn, 1kΩ, 10%, 1/8W		745-2341-000
RN601	Resistor, array, 22kΩ		350-4001-360
RN602	Resistor, 100kΩ		350-4001-130
RN603	Resistor, 15kΩ		350-4001-350
RN604	Resistor, 10kΩ		350-4030-250
RN605	Resistor, 15kΩ		350-4027-490
S601	Switch, rotary		259-2937-040
S602	Switch, slide		266-0253-050
U601	IC, 8048		351-8567-080
U602	IC, 3081		351-7802-020
U603	IC, ER1400		351-8733-010
U604	IC, 74C906		351-8901-010
U605	IC, 14040		351-8159-240
U606	IC, 9637		351-1302-010
XU601	Socket, IC, 40-pin		220-0067-300
601	Spool, switch		653-1034-001
602	Setscrew, 4-40 x .125 (qty 2)		328-5020-000
603	Label, ESD		280-2745-010
604	Insulator, switch (eff rev R to AB)		653-1075-001



SEE BLOW-UP FICHE NO. CLQ503 - ITEM K

SEE BLOW-UP FICHE NO. CLQ503 - ITEM K



Circuit Card A1 Control Circuit, Schematic Diagram
Figure 6-6 (Sheet 2)

Revised 1 November 1983

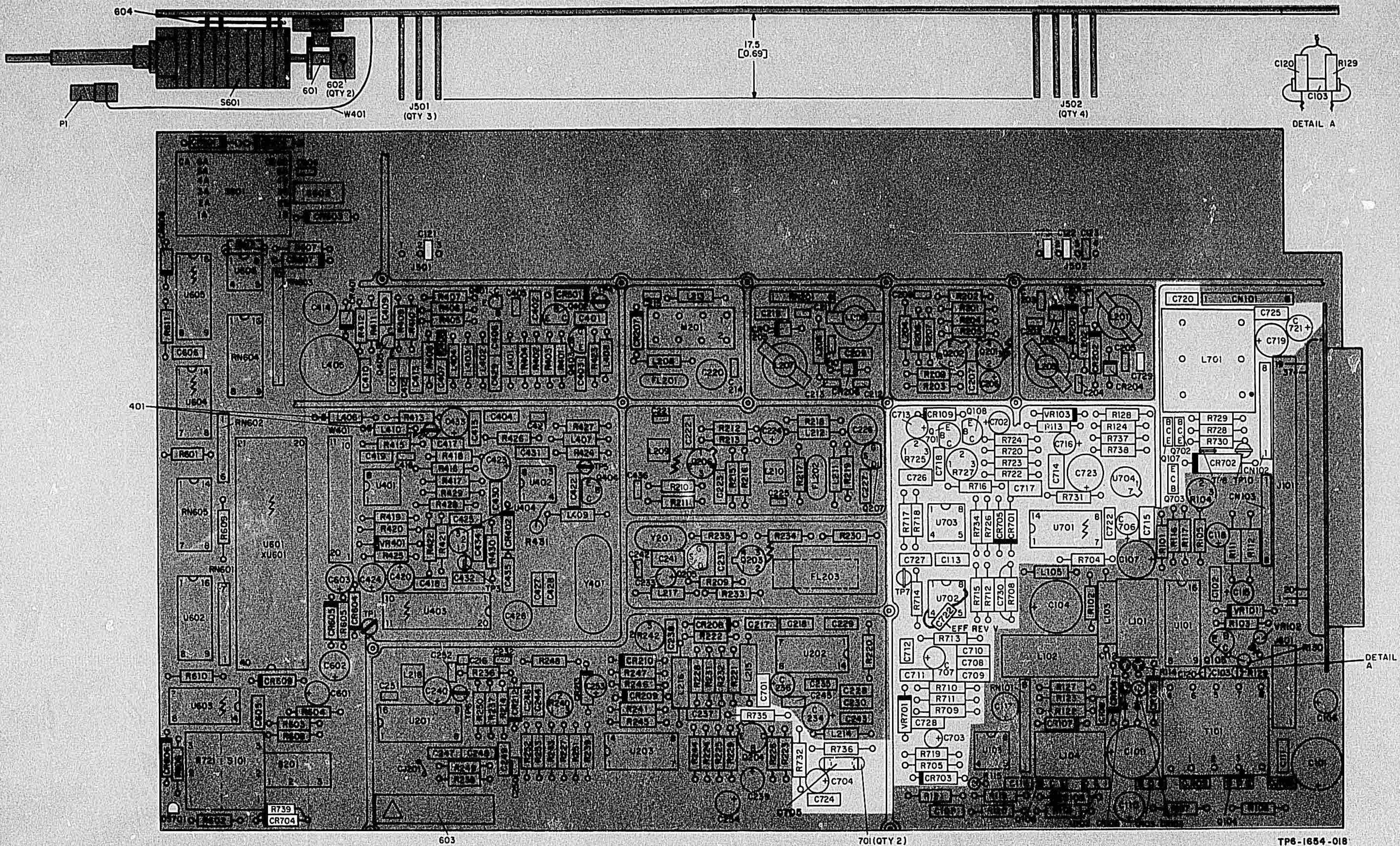
SEE BLOW-UP FICHE NO. CLQ503 - ITEM K

SEE BLOW-UP FICHE NO. CLQ503 - ITEM K

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	Replaced CR705 with jumper CJ701 to improve reliability of power supply.		REV T
A2	Deleted C730 (220 pF) which was across R708, and changed R723 from 10 to 2.2 kΩ to improve modulator performance.		REV V
A3	Added C732, C733, CR706, and R740 to reduce no-signal noise level.	SB 3	REV AD

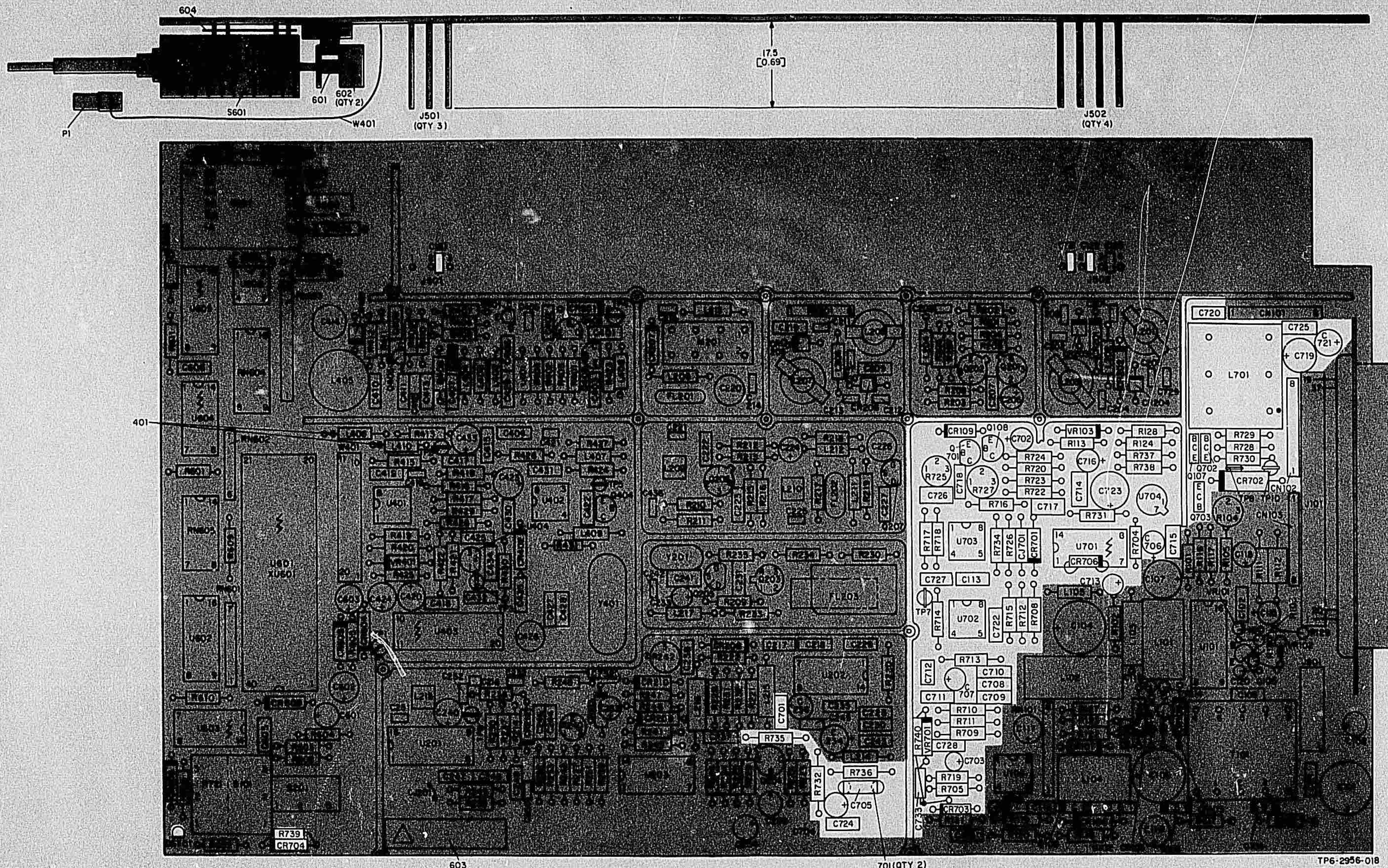
Circuit Card A1 Audio Circuits, Schematic and Component Location Diagrams
Figure 6-7 (Sheet A)



Circuit Card A1 (Through REV AA) Audio Circuits, Component Location Diagram
Figure 6-7 (Sheet 1 of 3)

PARTS LIST
CIRCUIT CARD A1 AUDIO CIRCUITS (PART NUMBER 653-3010-00X, REV AD)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A1	Circuit card A1	A	653-3010-001
A1	Circuit card A1	B	653-3010-002
A1	Circuit card A1	C	653-3010-003
A1	Circuit card A1	D	653-3010-004
C113	Capacitor, cer, 33pF, 10%, 200V		913-5019-070
C121	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
C122	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
C701	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C702	Capacitor, Ta, 3.3μF, 20%, 15V		184-9102-560
C703	Capacitor, Ta, 22μF, 20%, 15V		184-9102-580
C704	Capacitor, Al, 2.2μF, +100%-20%, 63V		183-1471-290
C705	Capacitor, cer, 1μF, 20%, 50V		913-3279-270
C706	Capacitor, Ta, 1μF, 20%, 35V		184-9102-790
C707	Capacitor, Ta, 100μF, 20%, 10V		184-9102-540
C708	Capacitor, cer, 3900pF, 10%, 100V		913-5019-150
C709	Capacitor, cer, 270pF, 10%, 200V		913-4011-000
C710	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C711	Capacitor, cer, 0.033μF, 10%, 100V		913-5019-380
C712	Capacitor, cer, 150pF, 5%, 100V		913-3117-050
C713	Capacitor, Ta, 10μF, 20%, 20V		184-9102-610
C714	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C715	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C716	Capacitor, Ta, 2.2μF, 20%, 25V		184-9102-220
C717	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C718	Capacitor, cer, 0.01μF, 10%, 100V		913-5019-200
C719	Capacitor, Al, 4.7μF, 20%, 50V		183-1523-050
C720	Capacitor, cer, 0.022, 10%, 50V		913-5019-240
C721	Capacitor, Al, 3.3μF, 20%, 50V		183-1523-030
C722	Capacitor, cer, 1000pF, 10%, 200V (eff to rev V)		913-4018-000
C722	Capacitor, cer, 1000pF, 5%, 100V (eff rev V)		913-3281-270
C723	Capacitor, Al, 10μF, +100%-20%, 35V		183-1471-080
C724	Capacitor, cer, 4700pF, 10%, 100V		913-5019-160
C725	Capacitor, cer, 0.47μF, 10%, 50V		913-5019-520
C726	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C727	Capacitor, cer, 1000pF, 10%, 200V		913-4018-000
C728	Capacitor, cer, 3900pF, 10%, 100V		913-5019-150
C729	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C730	Capacitor, cer, 220pF, 10%, 100V (eff to rev V)		913-5020-200
C731	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
C732	Capacitor, Ta, 1μF, 20%, 35V (eff rev AD)(SB 3)		184-9102-790
C733	Capacitor, Ta, 33μF, 20%, 10V (eff rev AD)(SB 3)		184-9102-530
CJ701	Jumper (eff rev T)		428-0289-010
CN102	Capacitor, array, 0.01μF		913-3663-010
CR109	Diode, 1N4454		353-3694-010
CR701	Diode, 1N3070		353-3083-000
CR702	Diode, 1N5822		353-6614-030
CR703	Diode, 1N4454		353-3644-010
CR704	Diode, 1N4454		353-3644-010
CR705	Diode, 1N4454 (eff to rev T)		353-3644-010
CR706	Diode, 1N4454 (eff rev AD)(SB 3)		353-3644-010
DS701	Diode, light emitting, MV5053		353-0293-040
L701	Inductor, modulator		668-0530-010
Q107	Transistor, MJE-703		352-1082-030
Q108	Transistor, MPS-2222		352-5021-010
Q701	Transistor, MPS-2907		352-5019-030
Q702	Transistor, MJE-172		352-1030-010
Q703	Transistor, D45H8		352-5508-010
R113	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R124	Resistor, cmpsn, 560Ω, 10%, 1/4W		745-0740-000
R128	Resistor, cmpsn, 8.2kΩ, 10%, 1/4W		745-0782-000
R701-R703	Not used		
R704	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R705	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R706-R707	Not used		
R708	Resistor, cmpsn, 1200Ω, 10%, 1/4W		745-0752-000
R709	Resistor, film, 45.3kΩ, 1%, 1/8W		705-3605-790
R710	Resistor, film, 280kΩ, 1%, 1/8W		705-3604-220
R711	Resistor, film, 39.2kΩ, 1%, 1/8W		705-3605-760
R712	Resistor, cmpsn, 3300Ω, 10%, 1/4W		745-0767-000
R713	Resistor, film, 14kΩ, 1%, 1/8W		705-1051-000
R714	Resistor, film, 69.8kΩ, 1%, 1/8W		705-3605-880
R715	Resistor, film, 11.5kΩ, 1%, 1/8W		705-1047-000
R716	Resistor, cmpsn, 22kΩ, 10%, 1/4W		745-0797-000
R717	Resistor, cmpsn, 47kΩ, 10%, 1/4W		745-0809-000
R718	Resistor, cmpsn, 1500Ω, 10%, 1/4W		745-0755-000
R719	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R720	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R721	Resistor, var, with switch, 10kΩ, 20%		376-0282-010
R722	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R723	Resistor, cmpsn, 10kΩ, 10%, 1/4W (eff to rev V)		745-0785-000
R723	Resistor, cmpsn, 2200Ω, 10%, 1/4W (eff rev V)		745-0761-000
R724	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R725	Resistor, var, 10kΩ, 20%, 1/2W		382-0027-100
R726	Resistor, cmpsn, 100kΩ, 10%, 1/4W		745-0821-000
R727	Resistor, var, 10kΩ, 20%, 1/2W		382-0027-100
R728	Resistor, cmpsn, 2700Ω, 10%, 1/4W		745-0764-000
R729	Resistor, cmpsn, 220Ω, 10%, 1/4W		745-0725-000
R730	Resistor, cmpsn, 10Ω, 10%, 1/4W		745-0677-000
R731	Resistor, cmpsn, 100kΩ, 10%, 1/4W		745-0821-000
R732	Resistor, film, 45.3kΩ, 1%, 1/8W		705-3605-790
R733	Not used		
R734	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R735	Resistor, film, 12.1kΩ, 1%, 1/8W		705-1048-000
R736	Resistor, film, 221Ω, 1%, 1/8W		705-3600-650
R737	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R738	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R739	Resistor, cmpsn, 4700Ω, 10%, 1/4W		745-0773-000
R740	Resistor, cmpsn, 1kΩ, 10%, 1/4W (eff rev AD)(SB 3)		745-0749-000
TP7,TP8	Terminal, test (qty 2)		306-2721-010
U701	IC, 4066		351-8252-010
U702	IC, 1458		351-1071-070
U703	IC, 2903		351-1278-010
U704	IC, 759		351-1985-010
VR103	Diode, zener, 1N4740A		353-6481-250
VR701	Diode, zener, 1N4737A		353-6481-190
701	Bead, ferrite (qty 2)		288-2154-000



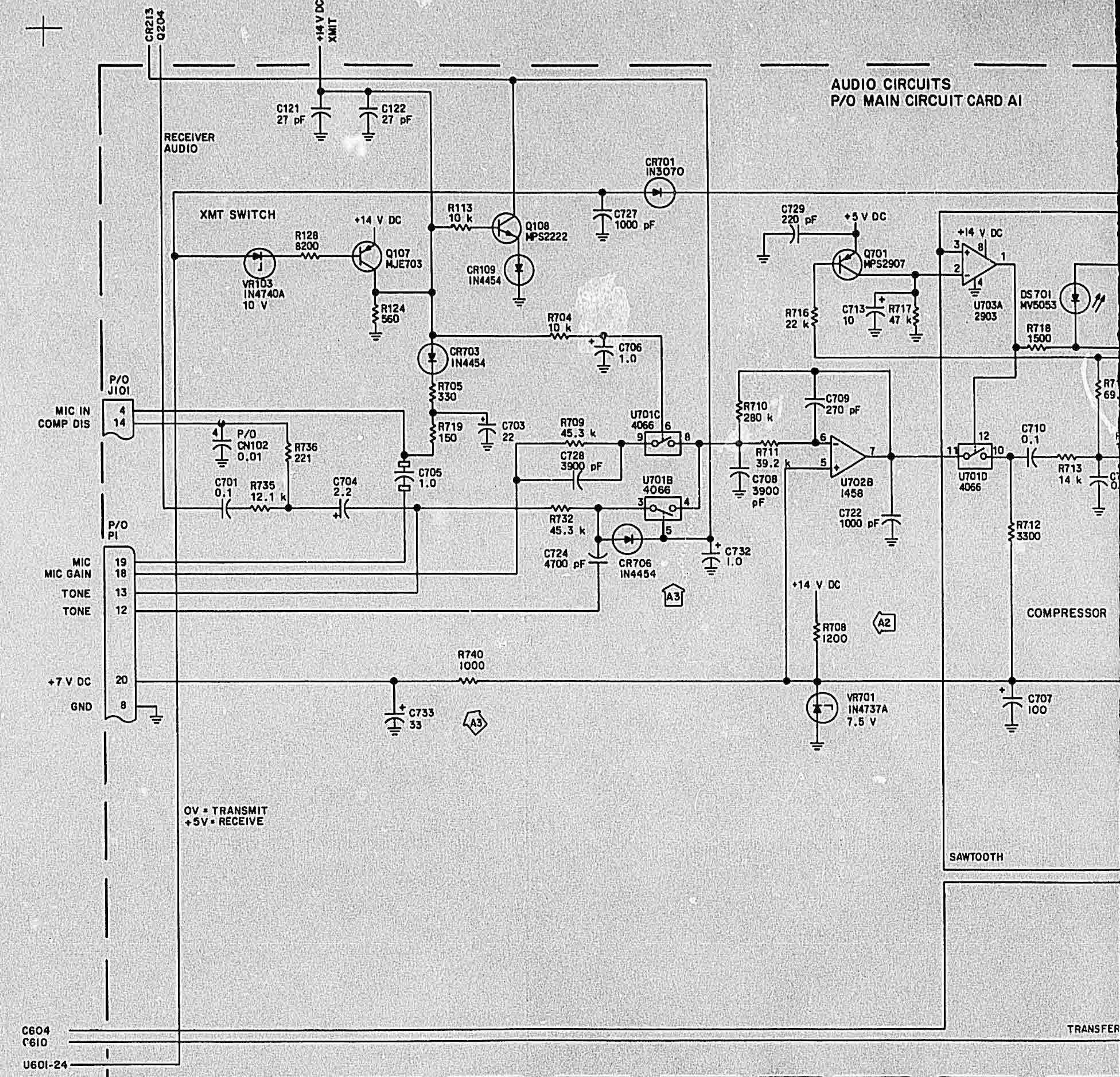
Circuit Card A1 (REV AB to AD) Audio Circuits, Component Location Diagrams
Figure 6-7 (Sheet 2)

Revised 1 November 1983

PARTS LIST
CIRCUIT CARD A1 AUDIO CIRCUITS (PART NUMBER 653-3010-00X, REV AD)

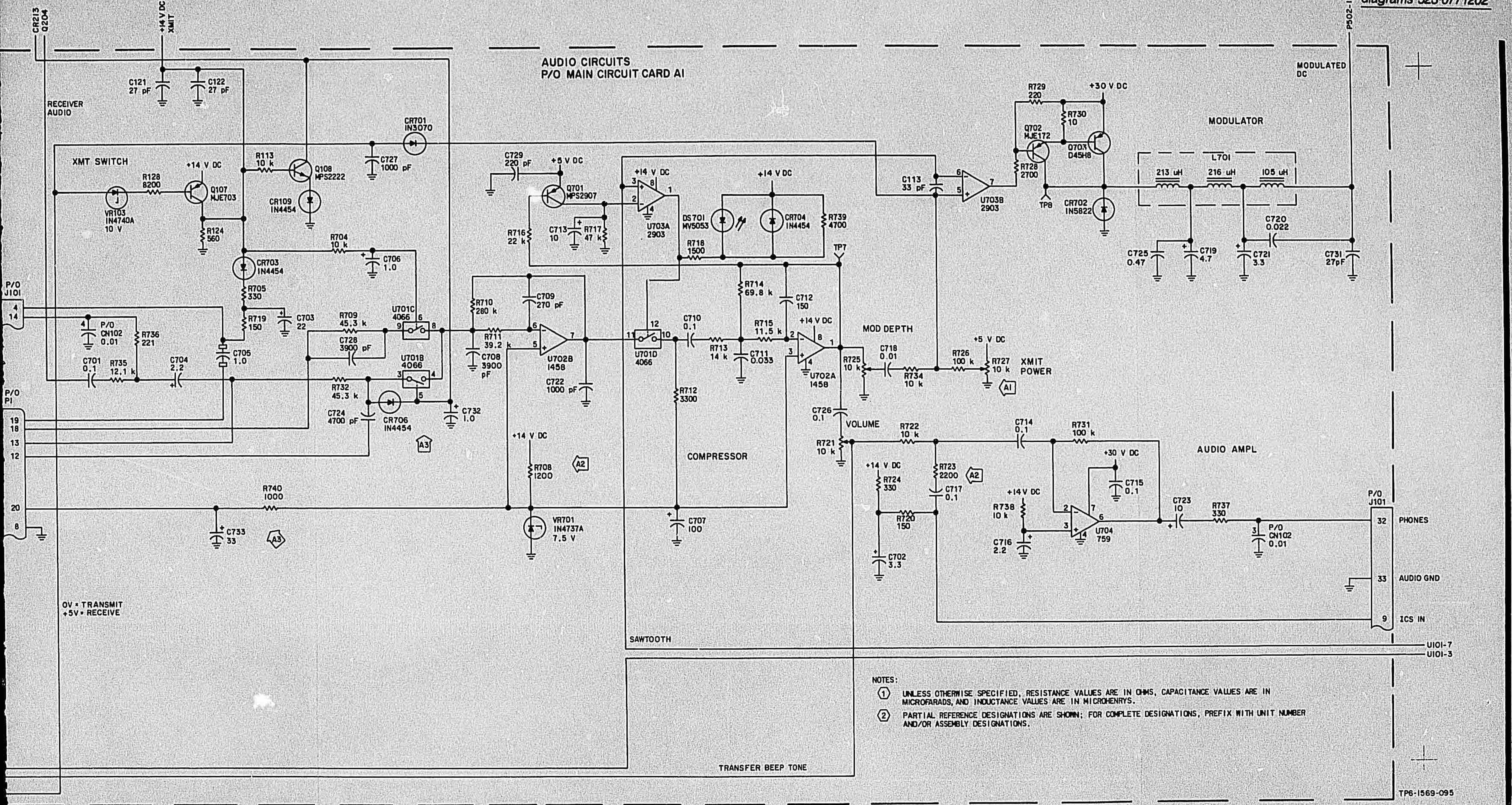
SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A1	Circuit card A1	A	653-3010-001
A1	Circuit card A1	B	653-3010-002
A1	Circuit card A1	C	653-3010-003
A1	Circuit card A1	D	653-3010-004
C113	Capacitor, cer, 33pF, 10%, 200V		913-5019-070
C121	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
C122	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
C701	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C702	Capacitor, Ta, 3.3μF, 20%, 15V		184-9102-560
C703	Capacitor, Ta, 22μF, 20%, 15V		184-9102-580
C704	Capacitor, Al, 2.2μF, +100%-20%, 63V		183-1471-290
C705	Capacitor, cer, 1μF, 20%, 50V		913-3279-270
C706	Capacitor, Ta, 1μF, 20%, 35V		184-9102-790
C707	Capacitor, Ta, 100μF, 20%, 10V		184-9102-540
C708	Capacitor, cer, 3900pF, 10%, 100V		913-5019-150
C709	Capacitor, cer, 270pF, 10%, 200V		913-4011-000
C710	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C711	Capacitor, cer, 0.033μF, 10%, 100V		913-5019-380
C712	Capacitor, cer, 150pF, 5%, 100V		913-3117-050
C713	Capacitor, Ta, 10μF, 20%, 20V		184-9102-610
C714	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C715	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C716	Capacitor, Ta, 2.2μF, 20%, 25V		184-9102-220
C717	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C718	Capacitor, cer, 0.01μF, 10%, 100V		913-5019-200
C719	Capacitor, Al, 4.7μF, 20%, 50V		183-1523-050
C720	Capacitor, cer, 0.022, 10%, 50V		913-5019-240
C721	Capacitor, Al, 3.3μF, 20%, 50V		183-1523-030
C722	Capacitor, cer, 1000pF, 10%, 200V (eff to rev V)		913-4018-000
C722	Capacitor, cer, 1000pF, 5%, 100V (eff rev V)		913-3281-270
C723	Capacitor, Al, 10μF, +100%-20%, 35V		183-1471-080
C724	Capacitor, cer, 4700pF, 10%, 100V		913-5019-160
C725	Capacitor, cer, 0.47μF, 10%, 50V		913-5019-520
C726	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C727	Capacitor, cer, 1000pF, 10%, 200V		913-4018-000
C728	Capacitor, cer, 3900pF, 10%, 100V		913-5019-150
C729	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C730	Capacitor, cer, 220pF, 10%, 100V (eff to rev V)		913-5020-200
C731	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
C732	Capacitor, Ta, 1μF, 20%, 35V (eff rev AD)(SB 3)		184-9102-790
C733	Capacitor, Ta, 33μF, 20%, 10V (eff rev AD)(SB 3)		184-9102-530
CJ701	Jumper (eff rev T)		428-0289-010
CN102	Capacitor, array, 0.01μF		913-3663-010
CR109	Diode, 1N4454		353-3694-010
CR701	Diode, 1N3070		353-3083-000
CR702	Diode, 1N5822		353-6614-030
CR703	Diode, 1N4454		353-3644-010
CR704	Diode, 1N4454		353-3644-010
CR705	Diode, 1N4454 (eff to rev T)		353-3644-010
CR706	Diode, 1N4454 (eff rev AD)(SB 3)		353-3644-010
DS701	Diode, light emitting, MV5053		353-0293-040
L701	Inductor, modulator		668-0530-010
Q107	Transistor, MJE-703		352-1082-030
Q108	Transistor, MPS-2222		352-5021-010

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
Q701	Transistor, MPS-2907		352-5019-030
Q702	Transistor, MJE-172		352-1030-010
Q703	Transistor, D45H8		352-5508-010
R113	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R124	Resistor, cmpsn, 560Ω, 10%, 1/4W		745-0740-000
R128	Resistor, cmpsn, 8.2kΩ, 10%, 1/4W		745-0782-000
R701-R703	Not used		
R704	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R705	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R706-R707	Not used		
R708	Resistor, cmpsn, 1200Ω, 10%, 1/4W		745-0752-000
R709	Resistor, film, 45.3kΩ, 1%, 1/8W		705-3605-790
R710	Resistor, film, 280kΩ, 1%, 1/8W		705-3604-220
R711	Resistor, film, 39.2kΩ, 1%, 1/8W		705-3605-760
R712	Resistor, cmpsn, 3300Ω, 10%, 1/4W		745-0767-000
R713	Resistor, film, 14kΩ, 1%, 1/8W		705-1051-000
R714	Resistor, film, 69.8kΩ, 1%, 1/8W		705-3605-880
R715	Resistor, film, 11.5kΩ, 1%, 1/8W		705-1047-000
R716	Resistor, cmpsn, 22kΩ, 10%, 1/4W		745-0797-000
R717	Resistor, cmpsn, 47kΩ, 10%, 1/4W		745-0809-000
R718	Resistor, cmpsn, 1500Ω, 10%, 1/4W		745-0755-000
R719	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R720	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R721	Resistor, var, with switch, 10kΩ, 20%		376-0282-010
R722	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R723	Resistor, cmpsn, 10kΩ, 10%, 1/4W (eff to rev V)		745-0785-000
R723	Resistor, cmpsn, 2200Ω, 10%, 1/4W (eff rev V)		745-0761-000
R724	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R725	Resistor, var, 10kΩ, 20%, 1/2W		382-0027-100
R726	Resistor, cmpsn, 100kΩ, 10%, 1/4W		745-0821-000
R727	Resistor, var, 10kΩ, 20%, 1/2W		382-0027-100
R728	Resistor, cmpsn, 2700Ω, 10%, 1/4W		745-0764-000
R729	Resistor, cmpsn, 220Ω, 10%, 1/4W		745-0725-000
R730	Resistor, cmpsn, 10Ω, 10%, 1/4W		745-0677-000
R731	Resistor, cmpsn, 100kΩ, 10%, 1/4W		745-0821-000
R732	Resistor, film, 45.3kΩ, 1%, 1/8W		705-3605-790
R733	Not used		
R734	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R735	Resistor, film, 12.1kΩ, 1%, 1/8W		705-1048-000
R736	Resistor, film, 221Ω, 1%, 1/8W		705-3600-650
R737	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R738	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R739	Resistor, cmpsn, 4700Ω, 10%, 1/4W		745-0773-000
R740	Resistor, cmpsn, 1kΩ, 10%, 1/4W (eff rev AD)(SB 3)		745-0749-000
TP7,TP8	Terminal, test (qty 2)		306-2721-010
U701	IC, 4066		351-8252-010
U702	IC, 1458		351-1071-070
U703	IC, 2903		351-1278-010
U704	IC, 759		351-1985-010
VR103	Diode, zener, 1N4740A		353-6481-250
VR701	Diode, zener, 1N4737A		353-6481-190
701	Bead, ferrite (qty 2)		288-2154-000



SEE BLOW-UP FICHE NO. CLQ503 - ITEM M

SEE BLOW-UP FICHE NO. CLQ503 - ITEM M



Circuit Card A1 Audio Circuits, Schematic Diagram
Figure 6-7 (Sheet 3)

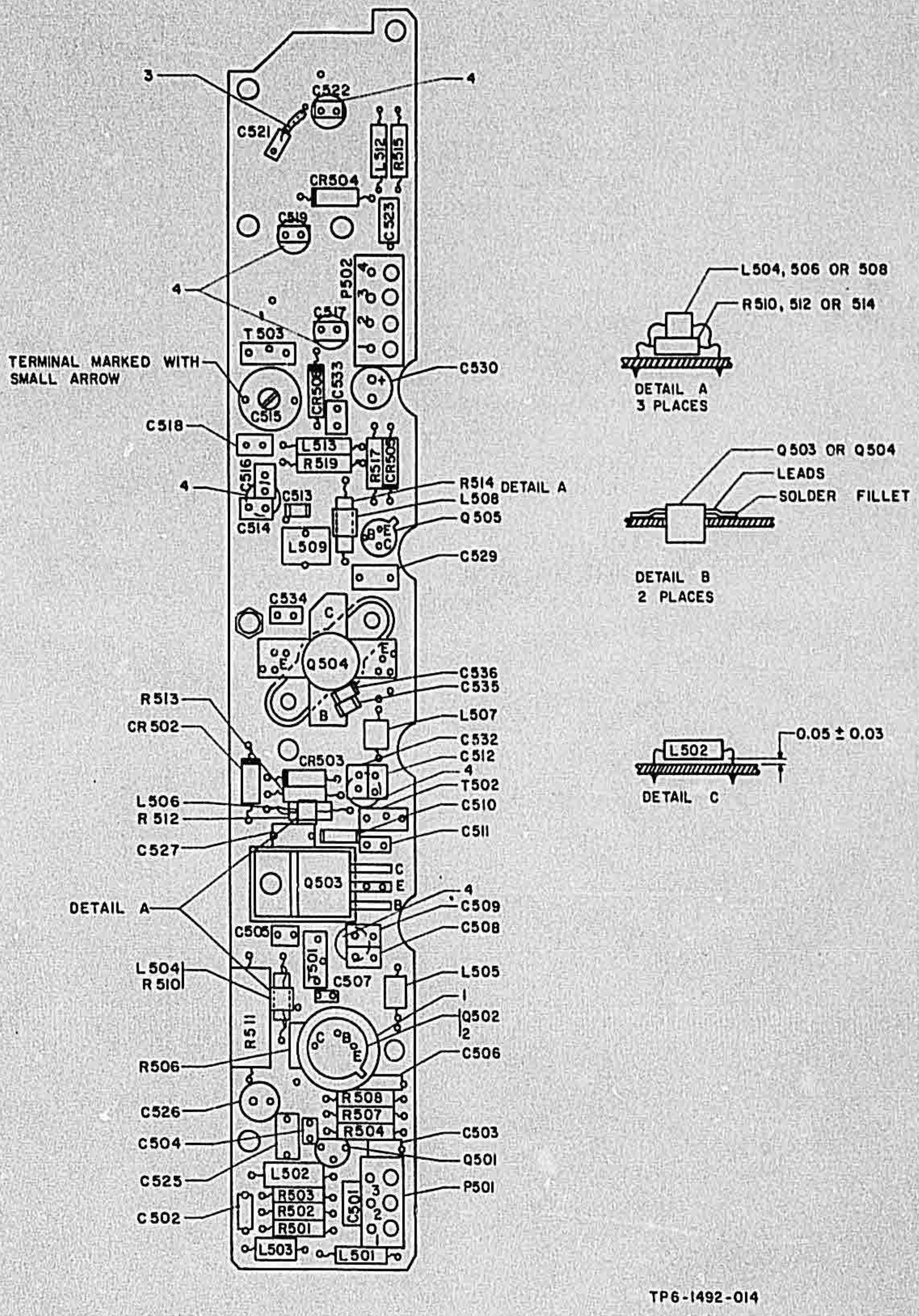
SEE BLOW-UP FICHE NO. CLQ503 - ITEM M

SEE BLOW-UP FICHE NO. CLQ503 - ITEM M

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	Changed C517 from 75 to 68 pF, C522 from 24 to 20 pF, and added C518 (24 pF) to decrease vswr susceptibility.		REV J
A2	Changed R511 from 33 to 100 Ω to improve modulation.		REV K
A3	Changed R511 from 100 to 47 Ω to prevent overmodulation.		REV L
A4	Changed C530 from 1 to 4.7 μF to reduce modulation distortion.		REV M
A5	Deleted C536 (220 pF) and changed C535 from 180 to 390 pF to improve reliability.		REV P

Transmitter Circuit Card A2, Schematic and Component Location Diagrams
Figure 6-8 (Sheet A)

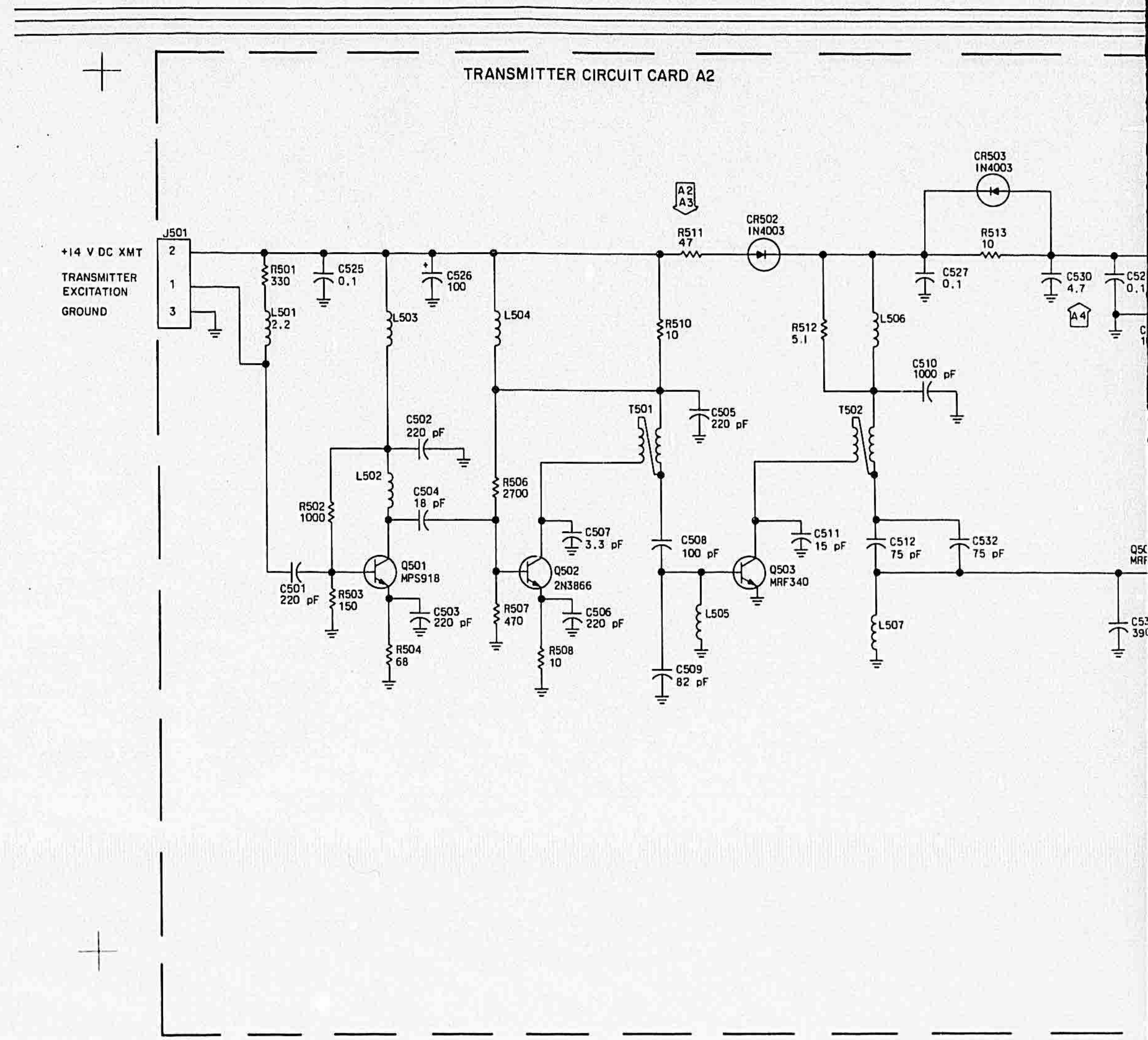


Transmitter Circuit Card A2, Component Location Diagram
Figure 6-8 (Sheet 1 of 2)

PARTS LIST
TRANSMITTER CIRCUIT CARD A2 (PART NUMBER 653-3020-001, REV P)

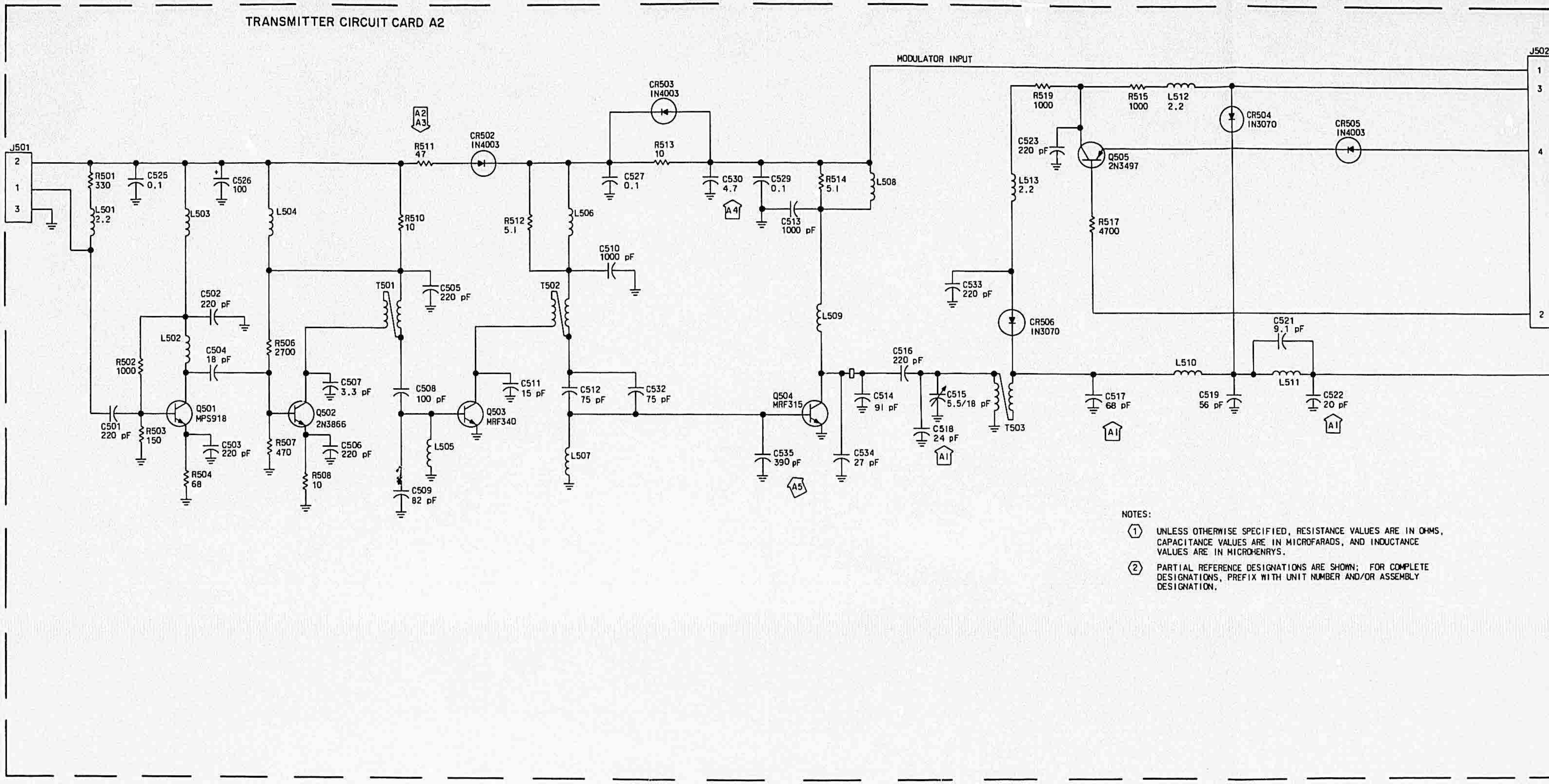
SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A2	Circuit card assy		653-3020-001
C501	Capacitor, cer, 220pF, 10%, 200V		913-4010-000
C502	Capacitor, cer, 220pF, 10%, 200V		913-4010-000
C503	Capacitor, cer, 220pF, 10%, 200V		913-4010-000
C504	Capacitor, cer, 18pF, 5%, 100V		913-3401-010
C505	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C506	Capacitor, cer, 220pF, 10%, 200V		913-4010-000
C507	Capacitor, cer, 3.3;0.25pF, 75V		913-1098-230
C508	Capacitor, cer, 100pF, 5%, 100V		913-3281-280
C509	Capacitor, cer, 82pF, 10%, 100V		913-3281-410
C510	Capacitor, cer, 1000pF, 5%, 100V		914-3506-350
C511	Capacitor, cer, 15pF, 5%, 75V		913-1098-180
C512	Capacitor, cer, 75pF, 5%, 100V		913-3401-080
C513	Capacitor, cer, 1000pF, 5%, 100V		914-3506-350
C514	Capacitor, cer, 91pF, 1%, 100V		913-1098-530
C515	Capacitor, var, cer, 5.5-18pF, 200V		917-1222-000
C516	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C517	Capacitor, cer, 75pF, 5%, 100V (eff to rev J)		913-3401-080
C517	Capacitor, cer, 68pF, 5%, 100V (eff rev J)		913-3401-090
C518	Capacitor, cer, 24pF, 5%, 100V (eff rev J)		913-3401-030
C519	Capacitor, cer, 56pF, 5%, 100V		913-3401-070
C520	Not used		
C521	Capacitor, cer, 9.1;0.5pF, 75V		913-1098-170
C522	Capacitor, cer, 24pF, 5%, 100V (eff to rev J)		913-3401-030
C522	Capacitor, cer, 20pF, 5%, 100V (eff rev J)		913-3401-020
C523	Capacitor, cer, 220pF, 10%, 200V		913-4010-000
C524	Not used		
C525	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C526	Capacitor, Al, 100μF, +100%-20%, 25V		183-1471-480
C527	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C528	Not used		
C529	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C530	Capacitor, Al, 1μF, 20%, 50V (eff to rev M)		183-1523-020
C530	Capacitor, Al, 4.7μF, 20%, 50V (eff rev M)		183-1523-050
C531	Not used		
C532	Capacitor, cer, 75pF, 5%, 100V		913-3401-080
C533	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C534	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
C535	Capacitor, cer, 180pF, 5%, 100V (eff to rev P)		914-3506-200
C535	Capacitor, cer, 390pF, 5%, 100V (eff rev P)		914-1502-280
C536	Capacitor, cer, 220pF, 5%, 100V (eff to rev P)		914-3506-220
CR501	Used in synthesizer on A1		
CR502	Diode, 1N4003		353-6442-030
CR503	Diode, 1N4003		353-6442-030
CR504	Diode, 1N3070		353-3083-000
CR505	Diode, 1N4003		353-6442-030
CR506	Diode, 1N3070		353-3083-000

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
L501	Inductor, 2.2μH		240-2027-000
L502	Inductor		628-5351-001
L503	Inductor		628-5632-001
L504	Inductor		628-5632-001
L505	Inductor		628-5632-001
L506	Inductor		628-5632-001
L507	Inductor		628-5632-001
L508	Inductor		628-5632-001
L509	Inductor		240-2759-010
L510	Inductor, (etched on circuit card)		
L511	Inductor, (etched on circuit card)		
L512	Inductor, 2.2μH		240-2027-000
L513	Inductor, 2.2μH		240-2027-000
P501	Connector, 3 pin		372-7518-010
P502	Connector, 4 pin		372-7518-020
Q501	Transistor, MPS918		352-5027-010
Q502	Transistor, 2N3866		352-0671-010
Q503	Transistor, MRF340		352-1532-010
Q504	Transistor, MRF315		352-1531-010
Q505	Transistor, 2N3497		352-0744-040
R501	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R502	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R503	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R504	Resistor, cmpsn, 68Ω, 10%, 1/4W		745-0707-000
R505	Not used		
R506	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R507	Resistor, cmpsn, 470Ω, 10%, 1/4W		745-0737-000
R508	Resistor, cmpsn, 10Ω, 10%, 1/4W		745-0677-000
R509	Not used		
R510	Resistor, cmpsn, 10Ω, 10%, 1/4W		745-0677-000
R511	Resistor, ww, 33Ω, 5%, 3W (eff to rev K)		747-5376-000
R511	Resistor, ww, 100Ω, 5%, 3W (eff rev K to L)		747-5340-000
R511	Resistor, ww, 47Ω, 5%, 3W (eff rev L)		747-5379-000
R512	Resistor, cmpsn, 5.1Ω, 5%, 1/4W		745-4375-000
R513	Resistor, cmpsn, 10Ω, 10%, 1/4W		745-0677-000
R514	Resistor, cmpsn, 5.1Ω, 5%, 1/4W		745-4375-000
R515	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R516	Not used		
R517	Resistor, cmpsn, 4.7kΩ, 10%, 1/4W		745-0773-000
R518	Not used		
R519	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
T501	Transformer, 4:1		608-6569-001
T502	Transformer, 4:1		608-6569-001
T503	Transformer, 4:1		608-6569-001
1	Heatsink		352-9644-010
2	Pad, transistor		352-9552-180
3	Sleeving, #26		152-2463-000
4	Spacer (qty 6) (eff rev N)		352-9552-580



SEE BLOW-UP FICHE NO. CLQ503 - ITEM Q

SEE BLOW-UP FICHE NO. CLQ503 - ITEM Q



TP6-1569-095

Transmitter Circuit Card A2, Schematic Diagram
Figure 6-8 (Sheet 2)

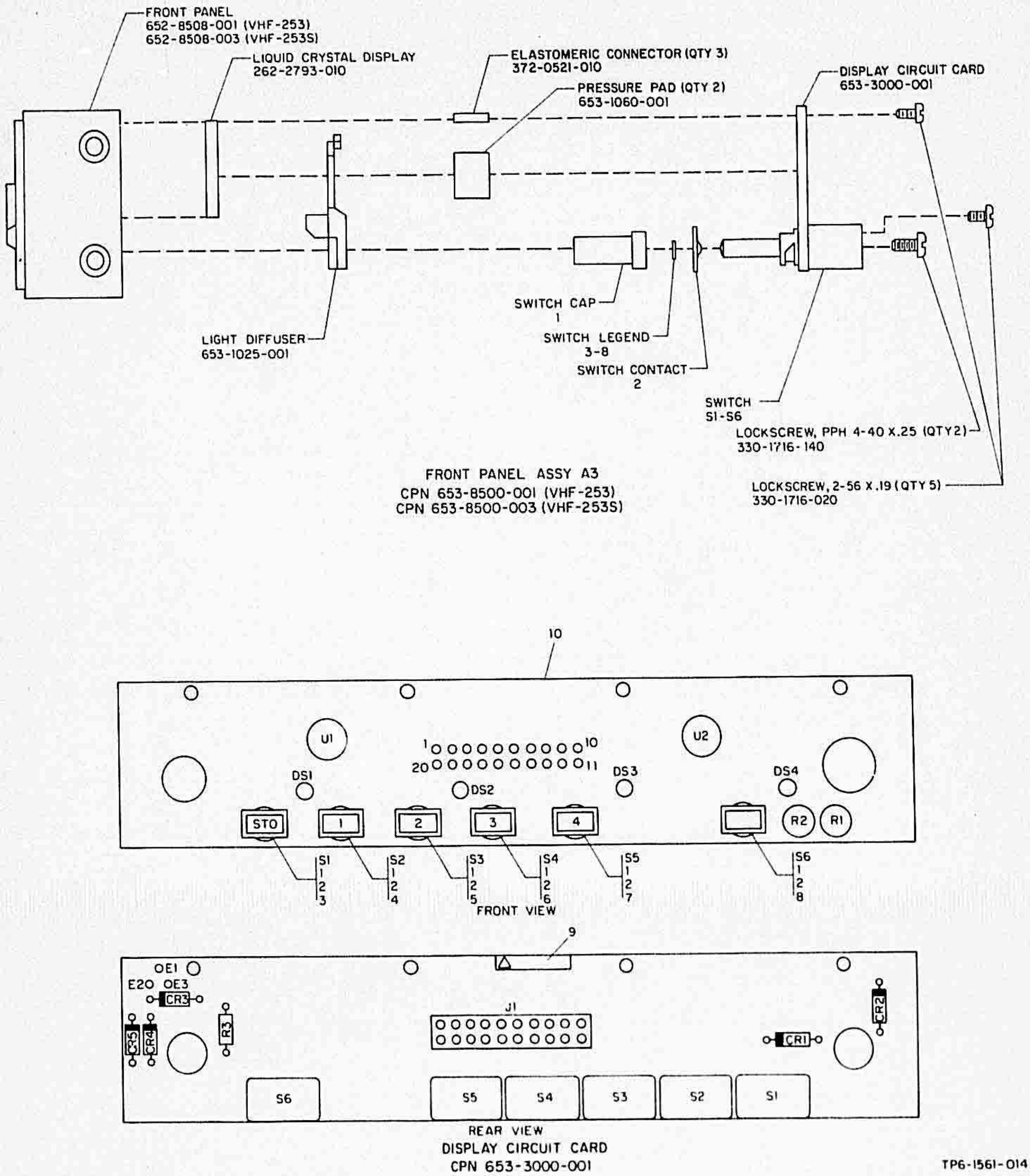
SEE BLOW-UP FICHE NO. CLQ503 - ITEM Q

SEE BLOW-UP FICHE NO. CLQ503 - ITEM Q

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
	(This page will contain schematic revision information.)		

Front Panel Assembly A3, Schematic and Component Location Diagrams
Figure 6-9 (Sheet A)

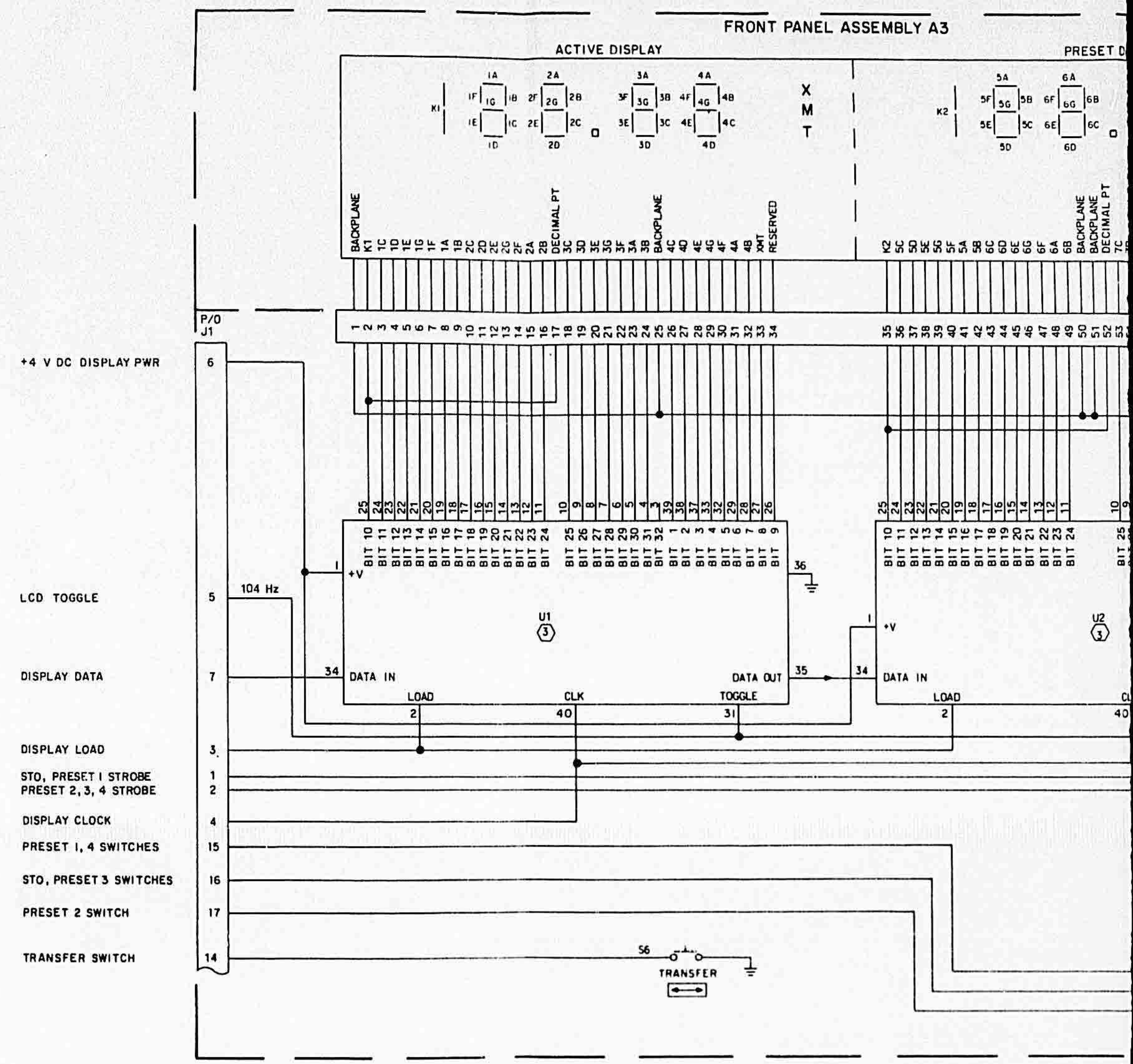


Front Panel Assembly A3, Component Location Diagram
Figure 6-9 (Sheet 1 of 2)

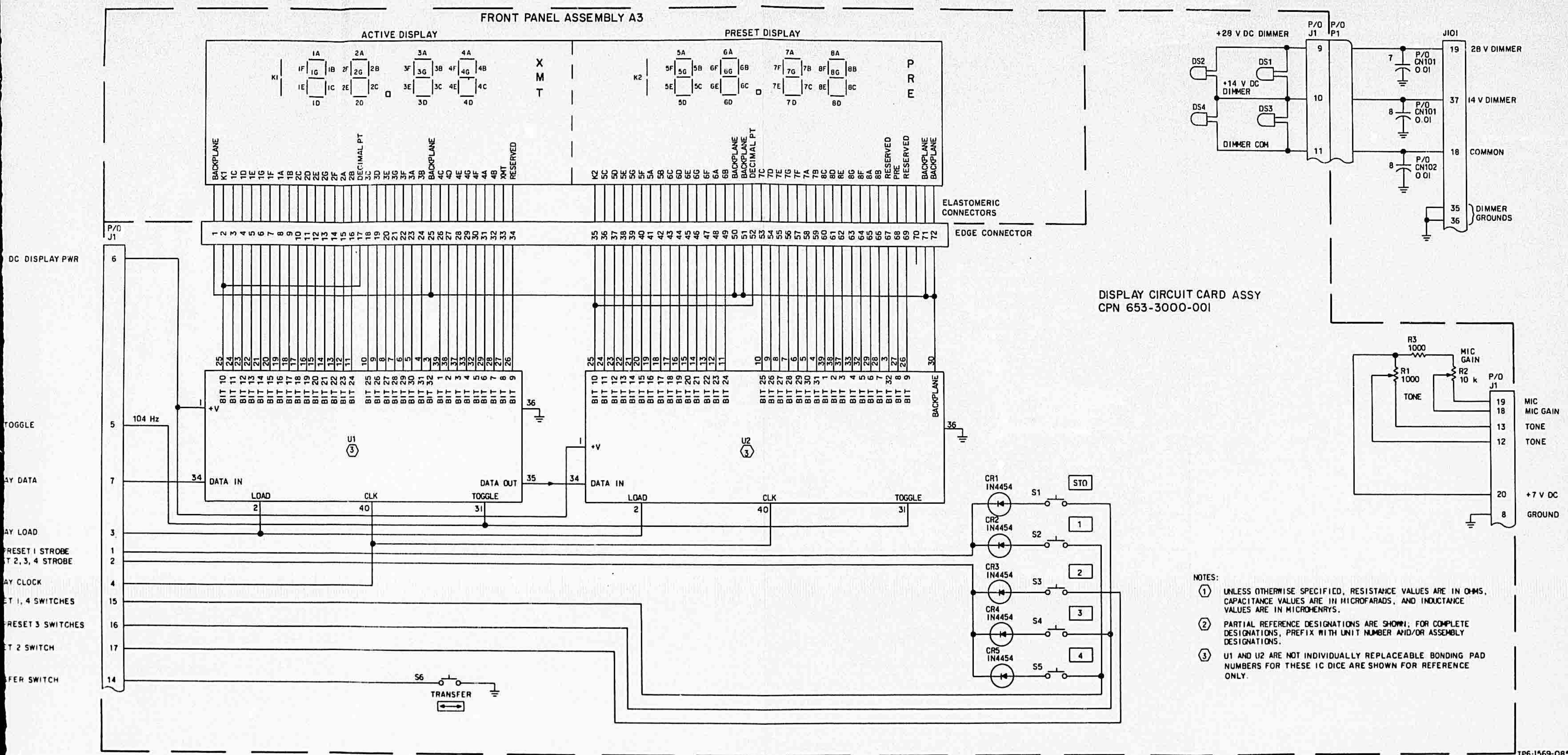
PARTS LIST
DISPLAY CIRCUIT CARD (PART NUMBER 653-3000-001, REV K)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
	Display Circuit Card		653-3000-001
CR1	Diode, 1N4454		353-3644-010
CR2	Diode, 1N4454		353-3644-010
CR3	Diode, 1N4454		353-3644-010
CR4	Diode, 1N4454		353-3644-010
CR5	Diode, 1N4454		353-3644-010
DS1	Lamp, incand, 14V		262-1398-120
DS2	Lamp, incand, 14V		262-1398-120
DS3	Lamp, incand, 14V		262-1398-120
DS4	Lamp, incand, 14V		262-1398-120
J1	Connector, 20-pin		220-0071-110
R1	Resistor, var, 1kΩ, 10%, 1/2W		382-0027-070
R2	Resistor, var, 10kΩ, 10%, 1/2W		382-0027-100
R3	Resistor, cmpsn, 1kΩ, 10%, 1/8W		745-2341-000
S1	Switch base		653-8517-001
S2	Switch base		653-8517-001
S3	Switch base		653-8517-001
S4	Switch base		653-8517-001
S5	Switch base		653-8517-001
S6	Switch base		653-8517-001
U1	IC, display driver (not replaceable)		
U2	IC, display driver (not replaceable)		
1	Switch cap (qty 6)		653-1030-001
2	Switch contact (qty 6)		653-2027-001
3	Legend, STO		653-1029-005
4	Legend, 1		653-1029-001
5	Legend, 2		653-1029-002
6	Legend, 3		653-1029-003
7	Legend, 4		653-1029-004
8	Legend, transfer		653-1029-008
9	Label, ESD		280-2745-010
10	Circuit card with U1 and U2		653-3000-005

SEE BLOW-UP FICHE NO. CLQ503 - ITEM U



SEE BLOW-UP FICHE NO. CLQ503 - ITEM U



Front Panel Assembly A3, Schematic Diagram
Figure 6-9 (Sheet 2)

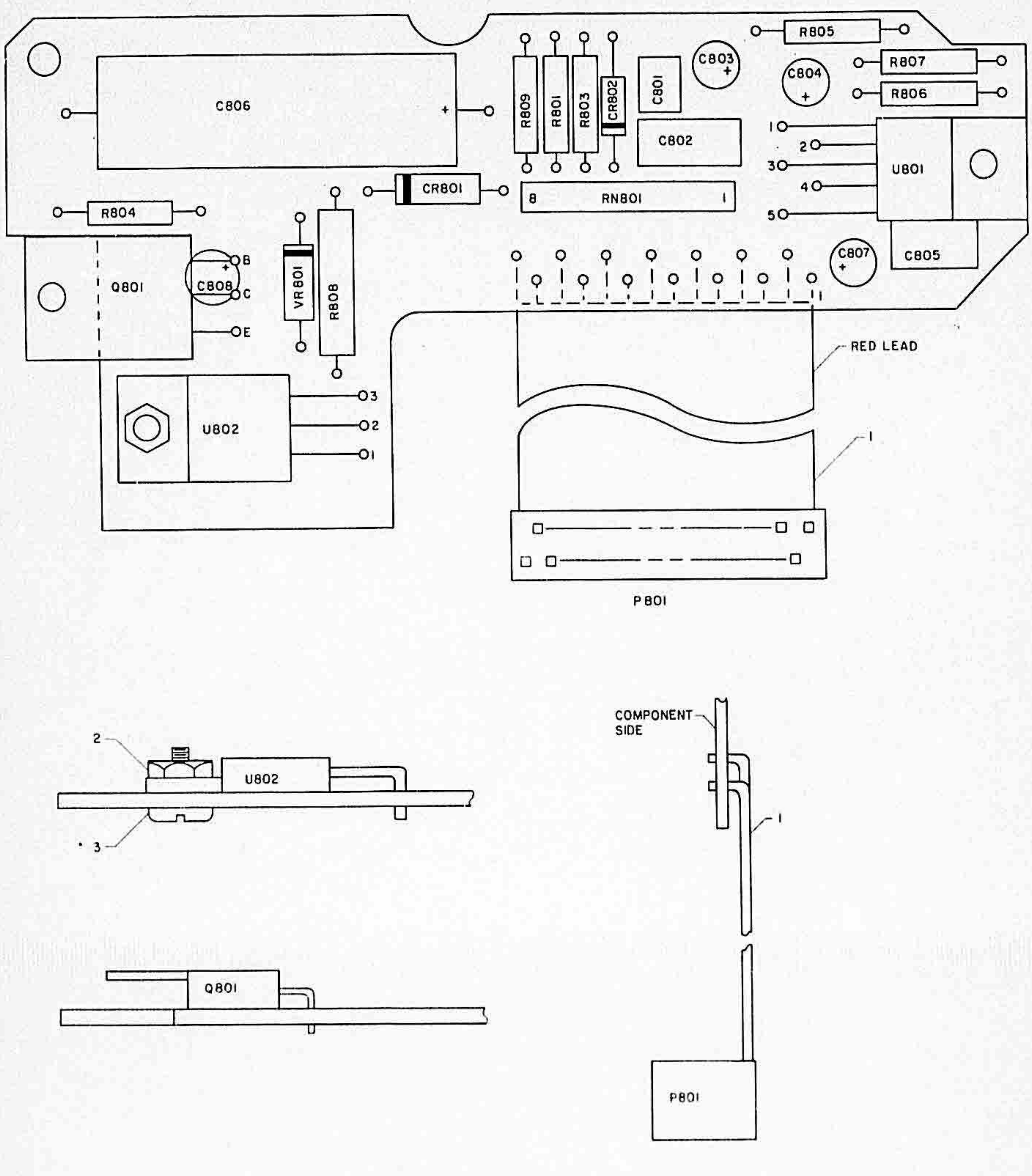
SEE BLOW-UP FICHE NO. CLQ503 - ITEM U

SEE BLOW-UP FICHE NO. CLQ503 - ITEM U

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	Added C808 (1.0 μF) to improve +28-V dc operation.		REV E

Speaker Amplifier Circuit Card A4, Schematic and Component Location Diagrams
Figure 6-10 (Sheet A)



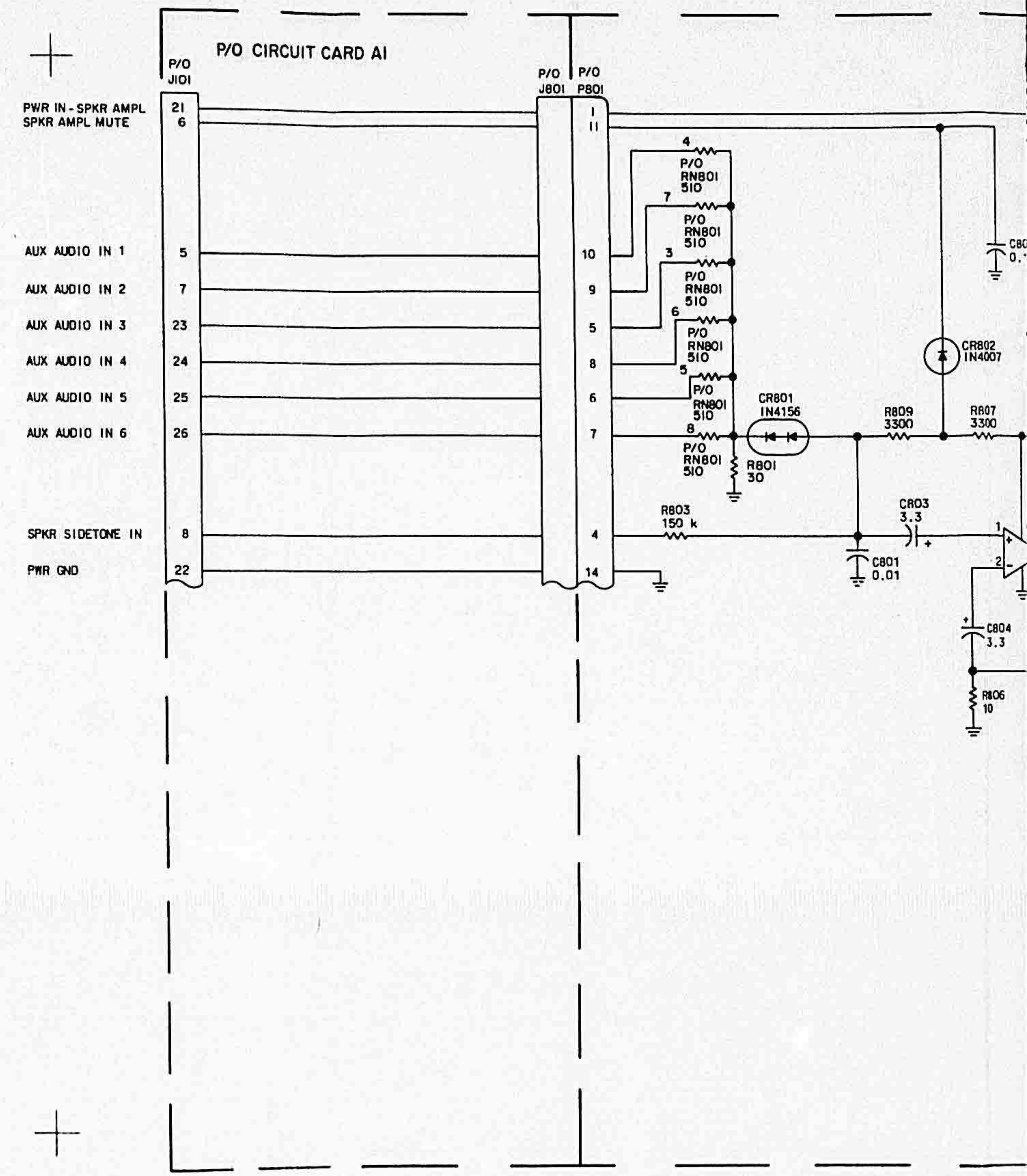
TP6-1552-014

Speaker Amplifier Circuit Card A4, Component Location Diagram Figure 6-10 (Sheet 1 of 2)

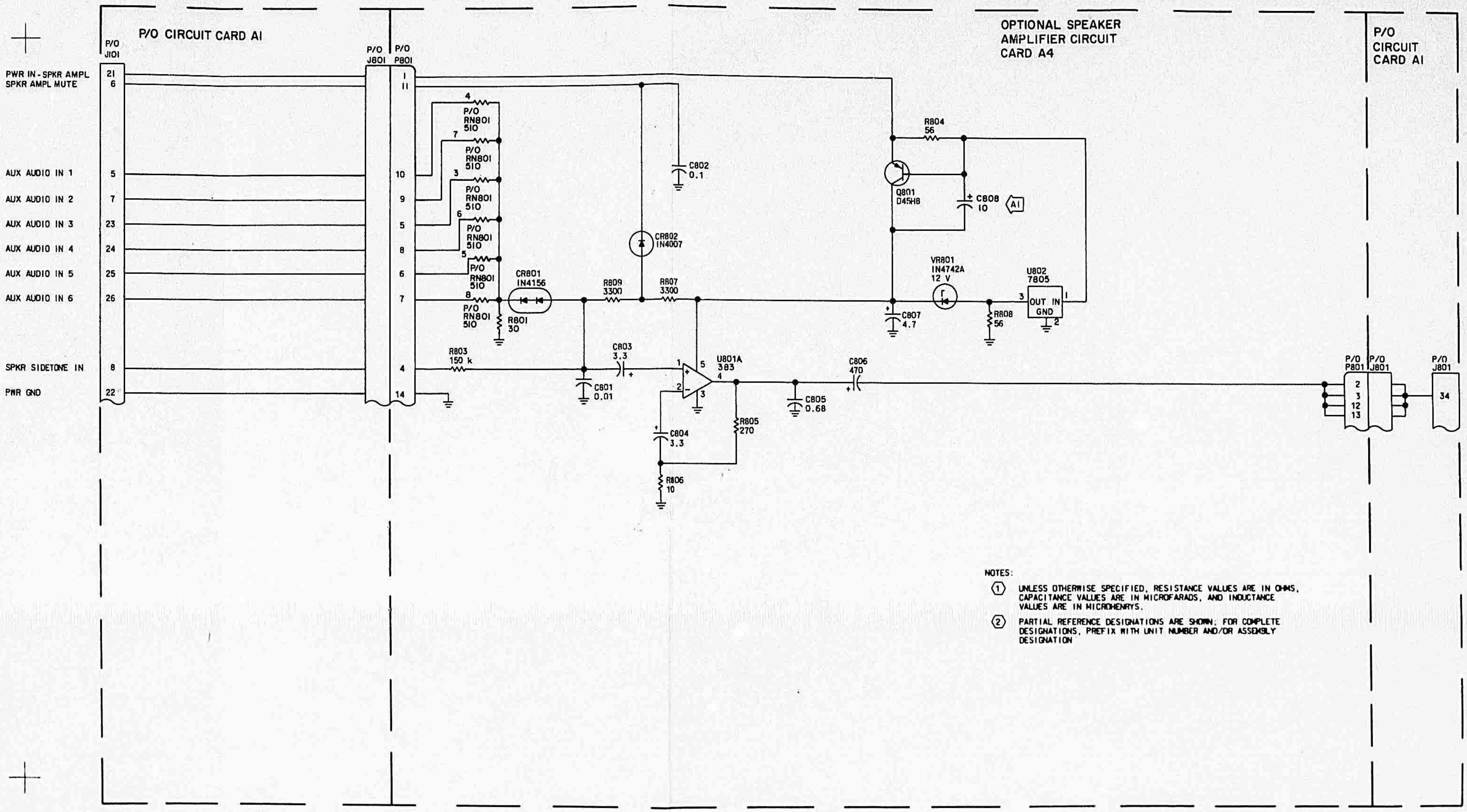
PARTS LIST
SPEAKER AMPLIFIER A4 (PART NUMBER 653-3030-001, REV E)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A4	Circuit card A4		653-3030-001
C801	Capacitor, cer, 0.01μF, 20%, 50V		913-3279-110
C802	Capacitor, cer, 0.1μF, 20%, 50V		913-3279-200
C803	Capacitor, Ta, 3.3μF, 20%, 15V		184-9102-120
C804	Capacitor, Ta, 3.3μF, 20%, 15V		184-9102-120
C805	Capacitor, cer, 0.68μF, 20%, 50V		913-3279-260
C806	Capacitor, Al, 470μF, +75-10%, 16V		183-1510-040
C807	Capacitor, Ta, 4.7μF, 20%, 35V		184-9102-830
C808	Capacitor, Ta, 1μF, 20%, 35V (eff rev E)		184-9102-790
CR801	Diode, 1N4156		353-3743-010
CR802	Diode, 1N4007		353-6442-070
P801	Connector, 14-pin		372-2648-010
Q801	Transistor, D45H8		352-5508-010
R801	Resistor, cmpsn, 30Ω, 5%, 1/4W		745-1863-120
R802	Not used		
R803	Resistor, cmpsn, 150kΩ, 10%, 1/4W		745-0827-000
R804	Resistor, cmpsn, 56Ω, 10%, 1/4W		745-0704-000
R805	Resistor, cmpsn, 270Ω, 10%, 1/4W		745-0728-000
R806	Resistor, cmpsn, 10Ω, 10%, 1/4W		745-0677-000
R807	Resistor, cmpsn, 3300Ω, 10%, 1/4W		745-0767-000
R808	Resistor, cmpsn, 56Ω, 10%, 1/2W		745-1300-000
R809	Resistor, cmpsn, 3300Ω, 10%, 1/4W		745-0767-000
RN801	Resistor network, 510Ω, 2%, 1W		350-4001-220
U801	IC, 383A		351-0533-010
U802	IC, 7805		351-1198-010
VR801	Diode, zener, 1N4742A		353-6481-290
1	Ribbon cable assy with P801		653-8507-002
2	Nut, lock, 4-40		333-1299-000
3	Screw, pph, 4-40 x .31		343-0134-000

SEE BLOW-UP FICHE NO. CLQ503 - ITEM O



SEE BLOW-UP FICHE NO. CLQ503 - ITEM O



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.
2. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATIONS, PREFIX WITH UNIT NUMBER AND/OR ASSEMBLY DESIGNATION

Speaker Amplifier Circuit Card A4, Schematic Diagram
Figure 6-10 (Sheet 2)

SEE BLOW-UP FICHE NO. CLQ503 - ITEM O

SEE BLOW-UP FICHE NO. CLQ503 - ITEM O

Collins VHF-253/253S Communications Transceiver

Rockwell International

bulletins

Collins General Aviation Division
Printed in USA
523-0771203-002118
2nd Edition, 1 November 1983

Bulletins

VHF-253/253S

523-0771203-002118

Service Bulletins and Service Information Letters Issued to Date

SB/SIL Number	*Unit*	*Title*	*Date*
1	VHF-253/253S	Optional Speaker Amplifier	Sep 1/81
1	VHF-253/253S	Carrier Squelch Adjustment for Use With Offset Carrier Signals	Sep 1/81
3	VHF-253/253S	No-Signal Audio Noise	May 15/83

NOTICE: This title page replaces first edition title page dated 1 September 1981.

Collins VHF-253/253S Communications Transceiver

Rockwell International

appendix

Collins General Aviation Division
•523-0771204-001118
1 September 1981

Printed in USA

table of contents

FCC Application for Aircraft Radio Station License, Form 404 2B08

List of Effective Pages

*The asterisk indicates pages changed, added, or deleted by the current change.

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List of Effective Pages	1 Sep 81
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Record of Revisions

RETAIN THIS RECORD IN THE FRONT OF MANUAL.
ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS.

REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED	REV NO	REVISION DATE	INSERTION DATE/BY	SB NUMBER INCLUDED
1st Ed	1 Sept 81		1, 2				

FCC Form 404
February 1977

United States of America
Federal Communications Commission

Form Approved
GAO No. B-180227 (RO208)

APPLICATION FOR AIRCRAFT RADIO STATION LICENSE

INSTRUCTIONS—General

A. CORRECT FORM

Use FCC Form 404 to apply for:

- A *New Station License* when the station aboard an aircraft is first licensed or the ownership of the aircraft is changed and the previous owner is not to continue as the licensee of the station.
- A *Modified Station License* when the licensee remains the same, but the operation is to be different from that provided in the license. If the licensee's name or address changes, do not use FCC Form 404, but notify the Commission by letter. Type accepted transmitters may be added or substituted for those specified on the license without notifying the Commission if they perform the same functions and use the same frequencies.

Do not use FCC Form 404 for renewals *without* modification. Use FCC Form 405-B which is normally sent to you before the license expires.

Do not use FCC Form 404 when applying for transmitters or radio frequencies in radio services other than aviation services (e.g., Amateur, Citizens, Industrial) even though these facilities may be placed aboard the aircraft.

B. NUMBER OF APPLICATIONS

Submit a separate form for each aircraft unless the application is for a fleet license. See Section 87.29(a)(2) of the FCC Rules for those eligible for fleet licenses.

C. FCC RULES AND REGULATIONS

Before preparing this application, applicant should refer to Part 87, "Aviation Services" which is contained in Volume V of the Commission's Rules. This volume may be obtained from the Superintendent of Documents, Government Printing Office. See attached order form.

D. FEES

All fees have been suspended effective January 1, 1977. DO NOT SEND FEES UNTIL FURTHER NOTICE.

E. MAILING APPLICATION

Mail your application and fee to Federal Communications Commission, P.O. Box 1030, Gettysburg, PA 17325.

INSTRUCTIONS—Filling Out the Form

ITEM 1. The FAA registration number must be entered on all applications except those for fleet license. When a fleet license is involved, a control number will be assigned by the Commission. When applying for a modification or renewal of an existing aircraft radio station license, the FAA registration number or the control number appearing on the license must be entered.

ITEM 2. Check "No" if you are applying for a license for only one aircraft. Check "Yes" if you are applying for a fleet license (see Section 87.29(a)(2) of the FCC Rules for those eligible for fleet licenses) and give the number of aircraft in the fleet plus 10% to allow for future expansion.

ITEM 3. Check the type of applicant you are.

ITEM 4A. Only for individuals or individuals with a business name. Individuals enter your last name, first name, middle initial. If you are an individual doing business under a firm or company name, a license may be issued to either the individual or the company. If the latter is desired, enter your personal name in ITEM 4A and your company name in ITEM 4B.

ITEM 4B. Only for organizations or individuals with a business name who want the license in the name of the business.

- *Individuals with a business name*—Enter the firm or company name.
- *Corporation*—Insert the corporate name only as it appears in the Articles of Incorporation. Do not apply in the name of a Division of the Corporation.
- *Unincorporated Association*—Insert the name of the Association as it appears in the Articles of Association or By-laws.
- *Governmental Entities*—Insert the name of the Governmental Entity having jurisdiction of the station, e.g., city of New York; State of Maine. Do not apply in the name of a department, commission or other arm of the governmental entity.
- *Partnership*—Insert business name, if any. Also answer ITEM 4c.

ITEM 4C. Partnership only. Enter all the names of the partners. Use Item 11 or the back of the form if more space is necessary.

INSTRUCTIONS—*Continued on reverse side*

ORDER FORM

Please enter ______________ subscription(s) to Volume V, containing parts 87, 89, 91 and 93 of the Federal Communications Commission Rules and Regulations ($18.20 per domestic subscription (which includes U.S. Territories) and $22.75 per foreign subscription).

NOTE: Prices subject to change without notice. Prices were current as of February 1977.

NAME—FIRST, LAST

COMPANY NAME OR ADDITIONAL ADDRESS LINE

STREET ADDRESS

CITY | STATE | ZIP CODE

PLEASE PRINT OR TYPE

☐ Remittance Enclosed (Make checks payable to Superintendent of Documents)

☐ Charge to my Deposit Account No. ....

MAIL ORDER FORM TO:
Superintendent of Documents
Government Printing Office
Washington, D.C. 20402

ITEM 5. Insert a permanent mailing address in the United States. If the license is to be mailed to a different address, attach a special request for mailing.

ITEMS 9A–9C. Check the desired frequencies based on the following information. When modifying an existing license, check those frequencies presently authorized and which will continue to be used after modification.

- *Private Aircraft:* These frequencies include those normally available for air traffic control, aeronautical advisory, aeronautical multicom, ground traffic control, altimeter, weather radar, Doppler radar, transponder beacon and DME. Refer to Part 87 of the Commission's Rules for the specific frequencies available. Private aircraft frequencies are available to any aircraft except those weighing more than 12,500 pounds which are used in carrying passengers or cargo for hire. Do not apply for private aircraft frequencies if the aircraft falls within the latter category.
- *Air Carrier:* Frequencies include all of those available for private aircraft except within the frequency range 122.0 MHz through 123.05 MHz.

DO NOT CHECK BOTH PRIVATE AND AIR CARRIER FREQUENCIES.

- *Public Service:* The public service frequencies available for assignment to aircraft stations are the medium and high frequencies available to ship telegraph and telephone stations for communication with coast stations. Transmitters used for public service operation must be type accepted by the Commission for use in ship stations (Part 83).
- *121.5 and 243 MHz only:* These frequencies are included when private aircraft or air carrier aircraft frequencies are authorized. Check if only an emergency locator transmitter is to be used, and the aircraft is not equipped for communications.
- *Aeronautical Enroute:* Aeronautical Enroute frequencies are available for communication with non-government aeronautical enroute stations. Indicate the section of the Commission's Rules (Part 87, sections 87.295 to 87.309) which makes available the group of frequencies desired. If Aeronautical Enroute frequencies are requested, answer ITEM 9B2.
- *Instructional:* These are the frequencies 123.3, 123.5, and 121.95 MHz available for communications with aviation instructional land stations. These frequencies are used for the instruction of student pilots or for the coordination of glider operations. If instructional frequencies are requested, submit a statement showing that the applicant:
  - (a) Operates a flying school, or
  - (b) Engages in soaring activities, or
  - (c) Takes flying instructions in his own aircraft.

In all cases specify the aviation instructional land station with which you will communicate. If you are taking flying instructions in your own aircraft, the instructional frequencies may be assigned on a temporary basis.

- *Flight Test HF or VHF or both:* Submit a statement showing that the applicant is a manufacturer of aircraft or major components.
- *Other:* Specify under "Other" any frequencies you require and which are not regularly available for use in accordance with the provisions of Part 87 of the Commission's Rules (Government frequencies or marine frequencies for fish spotting operations). Each request for "Other" frequencies must be accompanied by a statement showing the need for assignment, including reference to any governmental contracts which may be involved and a description of the proposed use. The emissions, power, points of communication, and area of proposed operation should be included in the statement.

ITEM 10. Check the categories of transmitters which you intend to use in the aircraft station. When modifying an existing license, include the transmitters already authorized and which will continue to be used after modification. Transmitters to be used on public service and other marine frequencies must be type accepted for use in ship stations (Part 83). Except as provided in Section 87.77, all other transmitters must be type accepted for use in aircraft. A list of type accepted equipment is available for inspection at the Commission's offices. Do not include receivers or transmitters which are licensed and used exclusively in other services, such as, common carrier, industrial, police, etc.

Radio Altimeters operating in the band 1600–1660 MHz may be authorized only if the transmitters were authorized before July 1, 1971.

Check "Other" when transmitters other than those of the indicated categories are to be used. Show in ITEM 11 or on the back of the form, the transmitter manufacturer and type number, frequencies, emission, power and purpose of the transmitter.

ITEM 13. Signature: Applications must be signed as indicated:

Individual: By individual himself or his attorney in case of applicant's physical disability or his absence from the United States. (See Section 87.25.)

Partnership: By an individual partner or by an officer of a corporation or association which is a member of the applicant partnership.

Corporation: By an officer of the Corporation.

Unincorporated Assn.: By an officer of the Association.

Governmental Entity: By an official of the Governmental Entity.

DO NOT RETURN INSTRUCTION SHEET WITH COMPLETED FORM.

FCC Form 404
February 1977

UNITED STATES OF AMERICA
FEDERAL COMMUNICATIONS COMMISSION

APPLICATION FOR AIRCRAFT RADIO STATION LICENSE

Form Approved
GAO No. B–80227 (RO 208)

A. Read instructions before completing.
B. Use typewriter or print clearly in ink.
C. Sign and date application.
D. Mail this form to Federal Communications Commission, P.O. Box 1030, Gettysburg, PA. 17325.

DO NOT WRITE IN THIS BLOCK

1. FAA Registration or FCC Control Number *(If known)*
N

2. Is application for a fleet license? *If yes, give number of aircraft in fleet.*
No ☐ Yes ☐ No. of aircraft

3. Type of Applicant *(Check one)*
☐ (I) Individual ☐ (P) Partnership ☐ (A) Association ☐ (C) Corporation
☐ (D) Individual with Business Name ☐ (G) Governmental Entity

4A. Name of Individual *(Last, First, Middle Initial)*

4B. Name *(If other than individual)*

4C. Names of Partners *(Last, First, Middle Initial)* *(Answer only if you checked partnership in item 3)*

5. Mailing Address of Applicant *(Number and Street, City, State, ZIP Code)*

6. Will the applicant own the radio equipment? *If no, give name of owner.* Yes No
Name

7. Does the applicant own the aircraft on which the radio equipment is to be installed? *If no, give name of owner.* Yes No
Name

8. If not the owner of the radio equipment, is applicant a party to a lease or other agreement under which control will be exercised in the same manner as if the applicant owned the equipment? Yes No

9. Frequencies requested *(Check all you will use under this license)*

A. Do not check both private aircraft and air carrier
☐ (A) Private Aircraft ☐ (C) Air Carrier ☐ (S) Public Service ☐ 121.5 & 243 MHz only *(For emergency locator transmitter)*

B1. Specify frequencies by rule number(s) if you check here.
☐ (E) Aeronautical Enroute → Rule Number(s)

B2. Answer only if you checked item 9B1, aeronautical enroute frequencies.
Will a valid agreement with licensees of aeronautical enroute stations be in effect as required by the rules? Yes No

C. You must submit additional information, if you check here. *(See instructions)*
☐ (A) Instructional ☐ (T) Flight Test HF ☐ (V) Flight Test VF ☐ (O) Other *(specify)*

10 Categories of transmitters *(Check all transmitters to be used)*

	A	Emergency Locator *(121.5 & 243 MHz)*		H	Radar *(9300 to 9500 MHz)*
	B	VHF Communications *(118 to 136 MHz)*		I	Radar *(15,400 to 15,700 MHz)*
	C	Distance Measuring Equipment (DME) *(960 to 1215 MHz)*		J	Doppler Radar *(8750 to 8850 MHz)*
	D	Transponder *(1090 MHz)*		K	Doppler Radar *(13,250 to 13,400 MHz)*
	E	Radio Altimeter *(1600 to 1660 MHz)* *(See instruction)*		L	High Frequency Communication *(2–25 MHz)*
	F	Radio Altimeter *(4200 to 4400 MHz)*		M	Marine Transmitter for Public Service
	G	Radar *(5350 to 5470 MHz)*		N	Other

11. Answer space for any required statements *(Use reverse side if more space is needed)*

READ CAREFULLY BEFORE SIGNING

Certification: 1) The applicant waives any claim to the use of any particular frequency or of the ether because of previous use of same, whether by license or otherwise. 2) The applicant accepts full responsibility for the operation and control of the requested station license in accordance with applicable law and rules of the FCC. 3) The applicant will have unlimited access to the radio equipment and will take effective measures to prevent its use by unauthorized persons. 4) Neither applicant nor any member thereof is a foreign government or representative thereof.

WILLFUL FALSE STATEMENTS MADE ON THIS FORM OR ATTACHMENTS ARE PUNISHABLE BY FINE AND IMPRISONMENT, U.S. CODE: TITLE 18, SECTION 1001.

SIGNATURE of individual, partner, or authorized person on behalf of a governmental entity, or an officer of a corporation or association.

DATE

RETURN ADDRESS

Sometimes it becomes necessary to return an application. Please print your name and mailing address in the box provided below. By putting your name and address in this area, you will enable us to return quickly any application which needs correction or clarification.

ADDITIONAL ANSWER SPACE

NOTICE TO INDIVIDUALS REQUIRED BY PRIVACY ACT OF 1974

Sections 301, 303, and 308 of the Communications Act of 1934, as amended (licensing powers), authorized the FCC to request the information on this application. The purpose of the information is to determine your eligibility for a license. The information will be used by FCC staff to evaluate the application, to determine station location, to provide information for enforcement and rulemaking proceedings and to maintain a current inventory of licensees. No license can be granted unless all information requested is provided.

U.S. GOVERNMENT PRINTING OFFICE : 1982 O - 330-834

A

diagrams 523-0771202

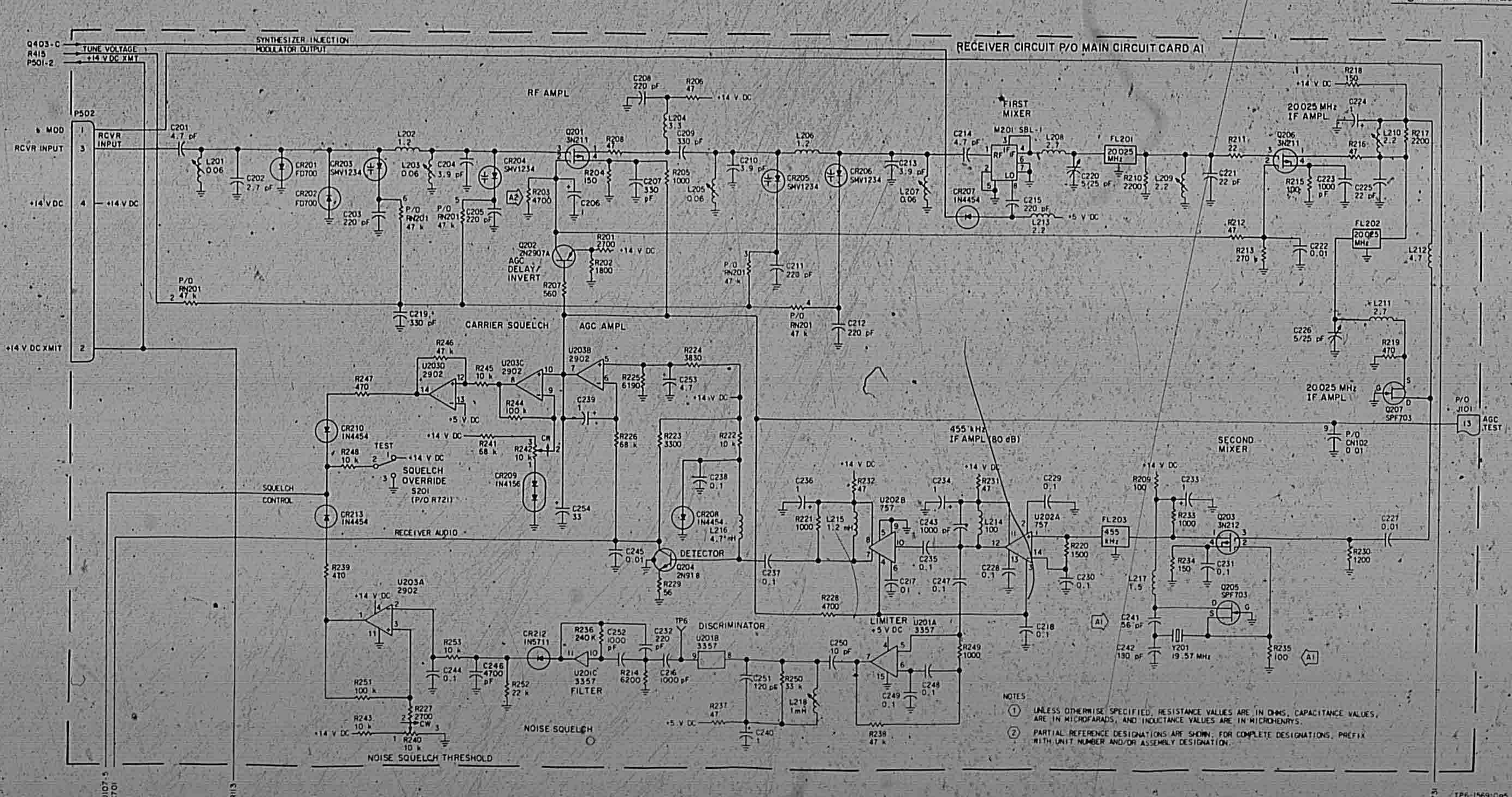
VHF-253/253S Communications Transceiver,
Overall Schematic Diagram
Figure 6-2

C

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
L206	Coil, 1.2µH		240-2024-000
L207	Coil, var, 0.06µH		278-0415-010
L208	Coil, 2.7µH		240-2028-000
L209	Coil, var, 2.2µH		278-0500-010
L210	Coil, var, 2.2µH		278-0500-010
L211	Coil, 2.7µH		240-2028-000
L212	Coil, 4.7µH		240-2031-000
L213	Coil, 2.2µH		240-2027-000
L214	Coil, 100µH		240-2047-000
L215	Coil, shielded, 1.2mH		240-2715-500
L216	Coil, shielded, 4.7mH		240-2715-570
L217	Coil, 1.5µH		240-2025-000
L218	Coil, var, 1mH		278-0500-020
M201	Mixer, SBL-1		277-0496-010
Q201	Transistor, 3N211		352-1045-010
Q202	Transistor, 2N2907A		352-0551-010
Q203	Transistor, 3N212		352-1045-030
Q204	Transistor, 2N918		352-0440-000
Q205	Transistor, SPF703		352-5013-030
Q206	Transistor, 3N211		352-1045-010
Q207	Transistor, SPF703		352-5013-030
R201	Resistor, 2700Ω, 5%, 1/4W		745-0763-000
R202	Resistor, cmpsn, 1800Ω, 10%, 1/4W		745-0757-000
R203	Resistor, cmpsn, 39kΩ, 10%, 1/4W (eff to rev AA)		745-0806-000
R203	Resistor, cmpsn, 4700Ω, 10%, 1/4W (eff rev AA)		745-0773-000
R204	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R205	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R206	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R207	Resistor, cmpsn, 560Ω, 10%, 1/4W		745-0740-000
R208	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R209	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R210	Resistor, cmpsn, 2200Ω, 5%, 1/4W		745-0760-000
R211	Resistor, cmpsn, 22Ω, 10%, 1/4W		745-0689-000
R212	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R213	Resistor, cmpsn, 270kΩ, 10%, 1/4W		745-0836-000
R214	Resistor, cmpsn, 6200Ω, 10%, 1/4W		745-0777-000
R215	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R216	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R217	Resistor, cmpsn, 2200Ω, 5%, 1/4W		745-0760-000
R218	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R219	Resistor, cmpsn, 470Ω, 10%, 1/4W		745-0737-000
R220	Resistor, cmpsn, 1500Ω, 10%, 1/4W		745-0755-000
R221	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R222	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R223	Resistor, cmpsn, 3300Ω, 10%, 1/4W		745-0767-000
R224	Resistor, film, 3830Ω, 1%, 1/8W		705-1024-000
R225	Resistor, film, 6190Ω, 1%, 1/8W		705-1034-000
R226	Resistor, cmpsn, 68kΩ, 10%, 1/4W		745-0815-000
R227	Resistor, cmpsn, 2700Ω, 10%, 1/4W		745-0764-000
R228	Resistor, cmpsn, 4700Ω, 10%, 1/4W		745-0773-000
R229	Resistor, cmpsn, 56Ω, 10%, 1/4W		745-0704-000
R230	Resistor, cmpsn, 1200Ω, 5%, 1/4W		745-0751-000
R231	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R232	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R233	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R234	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R235	Resistor, cmpsn, 470Ω, 10%, 1/4W (eff to rev P)		745-0737-000
R235	Resistor, cmpsn, 100Ω, 10%, 1/4W (eff rev P)		745-0737-000
R236	Resistor, cmpsn, 240kΩ, 5%, 1/4W		745-0834-000
R237	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R238	Resistor, cmpsn, 47kΩ, 10%, 1/4W		745-0809-000
R239	Resistor, cmpsn, 470Ω, 10%, 1/4W		745-0737-000
R240	Resistor, var, 10kΩ, 20%, 1/2W (eff to rev AD)		382-0027-100
R240	Resistor, var, 10kΩ, 10%, 1/2W (eff rev AD)		382-0050-010
R241	Resistor, cmpsn, 68kΩ, 10%, 1/4W		745-0815-000
R242	Resistor, var, 10kΩ, 20%, 1/2W (eff to rev AD)		382-0027-100
R242	Resistor, var, 10kΩ, 10%, 1/2W (eff rev AD)(SB 3)		382-0050-010
R243	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R244	Resistor, cmpsn, 100kΩ, 10%, 1/4W		745-0821-000
R245	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R246	Resistor, cmpsn, 47kΩ, 10%, 1/4W		745-0809-000
R247	Resistor, cmpsn, 470Ω, 10%, 1/4W		745-0737-000
R248	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R249	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R250	Resistor, cmpsn, 33kΩ, 10%, 1/4W		745-0803-000
R251	Resistor, cmpsn, 100kΩ, 10%, 1/4W		745-0821-000
R252	Resistor, cmpsn, 22kΩ, 10%, 1/4W		745-0797-000
R253	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
RN201	Resistor, array, 47kΩ		350-4000-060
S201	Switch, DPDT p/o R721		376-0282-010

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
TP6	Terminal, test		306-2721-010
U201	IC, 3357		351-1346-010
U202	IC, 757		351-1091-010
U203	IC, 2902		351-1141-040
Y201	Crystal, 19.57 MHz		289-7351-010
201	Spacer (eff rev AC)		150-0853-060
202	Spacer (qty 2) (eff rev AC)		352-9552-580

diagrams 523-0771202



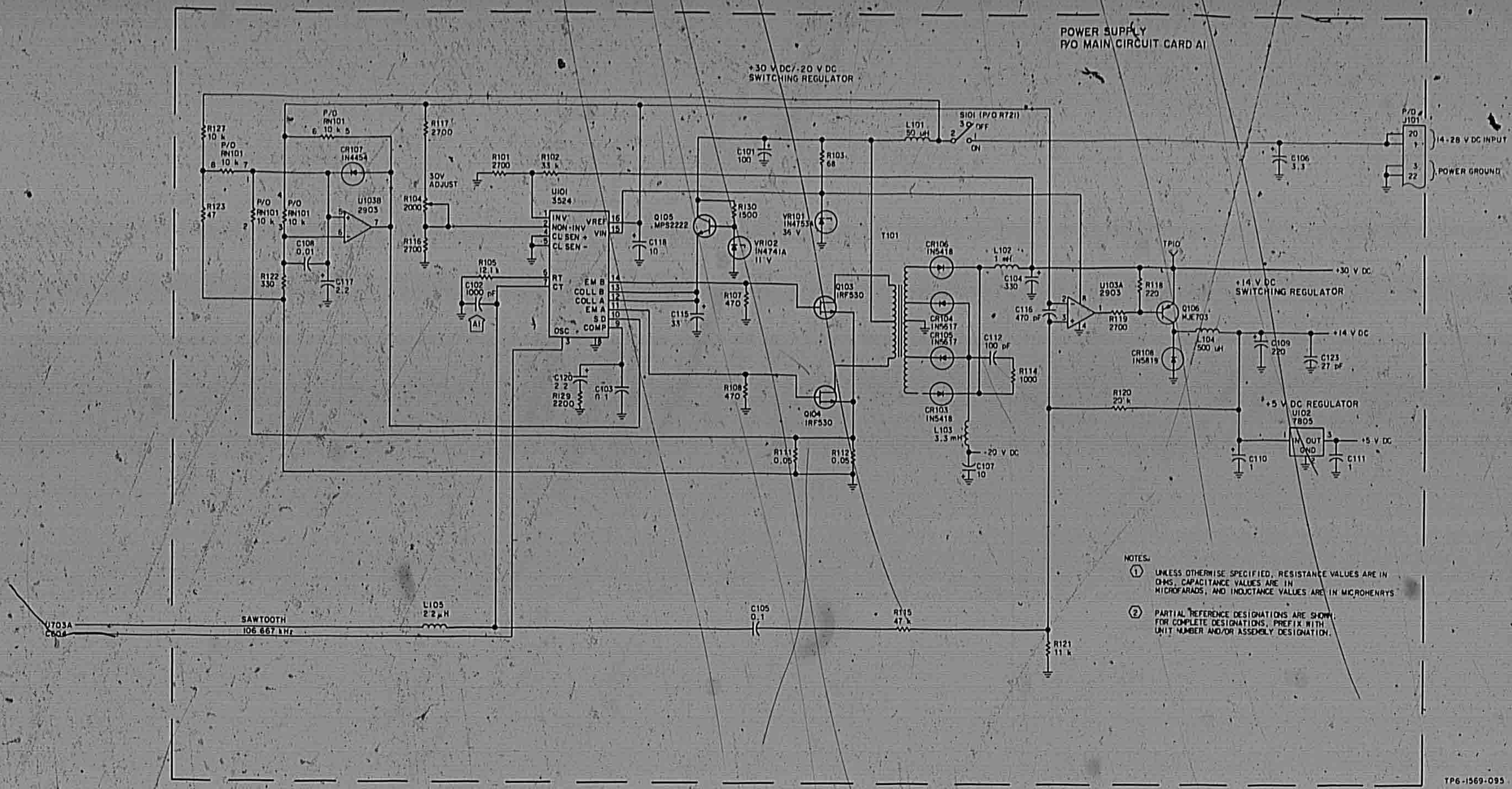
Circuit Card A1 Receiver, Schematic Diagram
Figure 6-[illegible] (Sheet 2)

E

PARTS LIST
CIRCUIT CARD A1 POWER SUPPLY (PART NUMBER 653-3010-00X, REV AD)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A1	Circuit card A1	A	653-3010-001
A1	Circuit card A1	B	653-3010-002
A1	Circuit card A1	C	653-3010-003
A1	Circuit card A1	D	653-3010-004
C101	Capacitor, Al, 100µF, +100%-20%, 50V		183-1471-420
C102	Capacitor, cer, 4700pF, 10%, 100V (eff to rev V)		913-5019-150
C102	Capacitor, cer, 1000pF, 5%, 100V (eff rev V)		913-3281-270
C103	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C104	Capacitor, Al, 330µF, +100%-20%, 35V		183-1471-470
C105	Capacitor, cer, 0.1µF, 20%, 50V		913-3279-200
C106	Capacitor, Al, 3.3µF, 20%, 50V		183-1523-030
C107	Capacitor, Al, 10µF, +100%-20%, 35V		183-1471-080
C108	Capacitor, cer, 0.01µF, 20%, 50V		913-3279-110
C109	Capacitor, Al, 220µF, +100%-20%, 25V		183-1471-410
C110	Capacitor, Ta, 1µF, 20%, 35V		184-9102-790
C111	Capacitor, cer, 1µF, 20%, 50V		913-3279-270
C112	Capacitor, cer, 100pF, 10%, 100V		913-5030-150
C113	Used in audio circuit		
C114	Not used		
C115	Capacitor, Ta, 33µF, 20%, 10V (eff to rev AD)		184-9102-530
C115	Capacitor, Ta, 33µF, 20%, 35V (eff rev AD)		184-9102-880
C116	Capacitor, cer, 470pF, 5%, 100V		913-3117-080
C117	Capacitor, Al, 2.2µF, +100%-20%, 63V		183-1471-290
C118	Capacitor, Al, 10µF, +100%-20%, 16V (eff to rev W)		183-1471-140
C118	Capacitor, Ta, 10µF, 20%, 20V (eff rev W)		184-9102-610
C119	Not used		
C120	Capacitor, Ta, 2.2µF, 10%, 20V		184-9086-430
C121	Used in audio circuit		
C122	Used in audio circuit		
C123	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
CJ101	Not used		
CJ102	Jumper wire (eff to rev AB)		428-0289-010
CJ103	Jumper wire (eff to rev AB)		428-0289-010
CN101-103	Capacitor, array, 0.01µF		913-3663-010
CR101	Not used		
CR102	Not used		
CR103	Diode, 1N5418		353-6558-040
CR104	Diode, 1N5617		353-6496-040
CR105	Diode, 1N5617		353-6496-040
CR106	Diode, 1N5418		353-6558-040
CR107	Diode, 1N4454		353-3644-010
CR108	Diode, 1N5819		353-6614-020
CR109	Used in audio circuit		
J101	Connector, 37-pin		371-0605-010
J801	Connector, 14-pin SB1	B,D	220-0071-100
L101	Inductor, 50µH		668-0337-060
L102	Inductor, 1mH		668-0337-050
L103	Coil, shielded, 3.3mH		240-2715-550
L104	Inductor, 500µH		668-0337-040

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
L105	Coil, 2.2µH		240-2027-000
Q101	Not used		
Q102	Not used		
Q103	Transistor, IRF530		352-7904-030
Q104	Transistor, IFR530		352-7904-030
Q105	Transistor, MPS2222		352-5021-010
Q106	Transistor, MJE703		352-1062-030
Q107	Used in audio circuit		
Q108	Used in audio circuit		
R101	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R102	Resistor, cmpsn, 33kΩ, 10%, 1/4W		745-0803-000
R103	Resistor, cmpsn, 68Ω, 10%, 1/4W		745-0707-000
R104	Resistor, var, 2kΩ, 10%, 1/2W		382-0027-080
R105	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W (eff to rev V)		745-0764-000
R105	Resistor, cmpsn, 12.1kΩ, 1%, 1/8W (eff rev V)		705-1048-000
R106	Not used		
R107	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R108	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R109	Not used		
R110	Not used		
R111	Resistor, ww, 0.05Ω, 1%, 1W		747-1499-110
R112	Resistor, ww, 0.05Ω, 1%, 1W		747-1499-110
R113	Used in audio circuit		
R114	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R115	Resistor, cmpsn, 47kΩ, 10%, 1/4W		745-0809-000
R116	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R117	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R118	Resistor, cmpsn, 220Ω, 10%, 1/4W		745-0725-000
R119	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R120	Resistor, film, 20kΩ, 1%, 1/8W		705-3605-620
R121	Resistor, film, 11kΩ, 1%, 1/8W		705-1046-000
R122	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R123	Resistor, cmpsn, 47Ω, 10%, 1/4W		745-0701-000
R124	Used in audio circuit		
R125	Not used		
R126	Not used		
R127	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R128	Used in audio circuit		
R129	Resistor, cmpsn, 2200Ω, 10%, 1/4W		745-0761-000
R130	Resistor, cmpsn, 1.5kΩ, 10%, 1/4W		745-0755-000
RN101	Resistor, array, 10kΩ		350-4046-750
S101	Switch, SPDT p/o R721		376-0282-010
T101	Transformer, pwr		662-0929-010
TP10	Terminal, test		306-2721-010
U101	IC, 3524		351-1285-020
U102	IC, 7805		351-1198-010
U103	IC, 2903		351-1278-010
VR101	Diode, zener, 1N4753A		353-6481-510
VR102	Diode, zener, 1N4741A		353-6481-270
VR103	Used in audio circuit		
101	Bead, glass (qty 8)(eff rev T)		192-1042-010



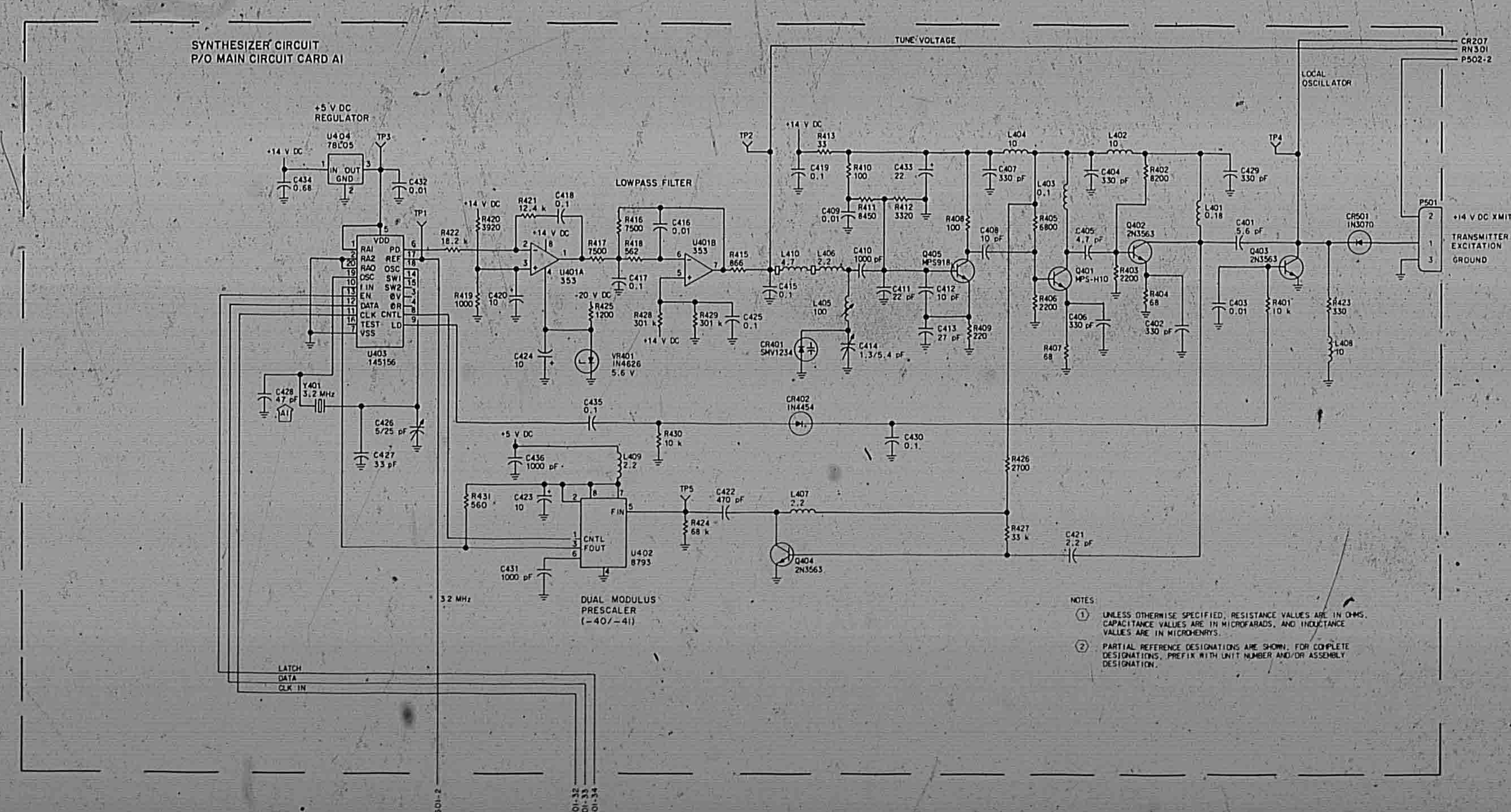
Circuit Card A1 Power Supply, Schematic Diagram
Figure 6-8 (Sheet 3)

G

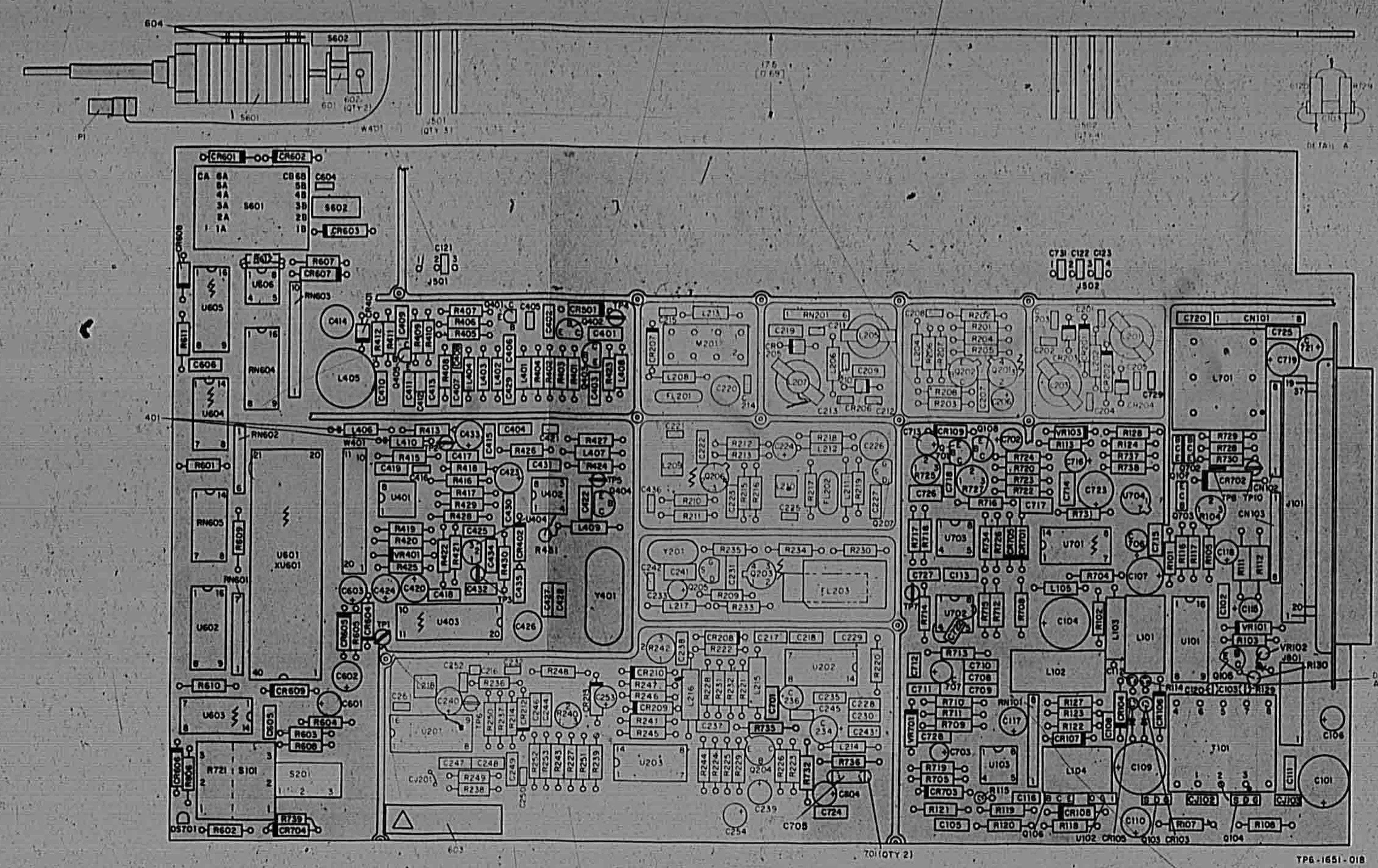
PARTS LIST
CIRCUIT CARD A1 SYNTHESIZER (PART NUMBER 653-3010-00X, REV AD)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A1	Circuit card A1	A	653-3010-001
A1	Circuit card A1	B	653-3010-002
A1	Circuit card A1	C	653-3010-003
A1	Circuit card A1	D	653-3010-004
C401	Capacitor, cer, 5.6, 0.5pF, 75V		913-1098-130
C402	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C403	Capacitor, cer, 0.01µF, 10%, 100V		913-5019-200
C404	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C405	Capacitor, cer, 4.7, 0.25pF, 75V		913-1098-210
C406	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C407	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C408	Capacitor, cer, 10pF, 5%, 75V		913-1098-010
C409	Capacitor, cer, 0.01µF, 10%, 100V		913-5019-200
C410	Capacitor, cer, 1000pF, 10%, 200V		913-4018-000
C411	Capacitor, cer, 22pF, 10%, 200V		913-5019-050
C412	Capacitor, cer, 10pF, 5%, 75V		913-1098-010
C413	Capacitor, cer, 27pF, 10%, 200V		913-5019-060
C414	Capacitor, var, 1.3-5.4pF, 200V		922-1032-020
C415	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C416	Capacitor, cer, 0.01µF, 10%, 50V		913-3279-110
C417	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C418	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C419	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C420	Capacitor, Al, 10µF, +100%-20%, 16V		183-1471-140
C421	Capacitor, cer, 2.2, 0.25pF, 75V		913-1098-250
C422	Capacitor, cer, 470pF, 10%, 200V		913-4014-000
C423	Capacitor, Al, 10µF, +100%-20%, 16V		183-1471-140
C424	Capacitor, Al, 10µF, +100%-20%, 16V		183-1471-140
C425	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C426	Capacitor, var, 5-25pF, 50V		917-1256-030
C427	Capacitor, cer, 33pF, 10%, 200V		913-5019-070
C428	Capacitor, cer, 56pF, 10%, 200V (eff to rev P)		913-4003-000
C428	Capacitor, cer, 47pF, 10%, 200V (eff rev P)		913-4002-000
C429	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C430	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C431	Capacitor, cer, 1000pF, 10%, 200V		913-4018-000
C432	Capacitor, cer, 0.01µF, 10%, 100V		913-5019-200
C433	Capacitor, Ta, 22µF, 20%, 15V (eff to rev W)		184-9102-580
C433	Capacitor, Ta, 22µF, 20%, 15V (eff rev W)		184-9102-140
C434	Capacitor, cer, 0.68µF, 10%, 50V		913-5019-540
C435	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C436	Capacitor, cer, 1000pF, 5%, 100V		913-3281-270
CR401	Diode, SMV1254		353-3264-020
CR402	Diode, 1N4454		353-3644-010
CR501	Diode, 1N3070		353-3083-000
J501	Pin, connector (qty 3)		372-7518-030
L401	Coil, 0.18µH		240-2014-000
L402	Coil, 10µH		240-2035-000
L403	Coil, 0.9µH		240-2742-090
L404	Coil, 10µH		240-2035-000
L405	Coil, var, 0.1µH		278-0418-010
L406	Coil, 2.2µH		240-2027-000

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
L407	Coil, 2.2µH		240-2027-000
L408	Coil, 10µH		240-2035-000
L409	Coil, 2.2µH		240-2027-000
L410	Coil, 4.7µH		240-2031-000
Q401	Transistor, MPS-H10		352-5031-010
Q402	Transistor, 2N3563		352-5020-010
Q403	Transistor, 2N3563		352-5020-010
Q404	Transistor, 2N3563		352-5020-010
Q405	Transistor, MPS-918		352-5027-010
R401	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R402	Resistor, cmpsn, 8200Ω, 10%, 1/4W		745-0782-000
R403	Resistor, cmpsn, 2200Ω, 10%, 1/4W		745-0761-000
R404	Resistor, cmpsn, 68Ω, 10%, 1/4W		745-0707-000
R405	Resistor, cmpsn, 6800Ω, 10%, 1/4W		745-0779-000
R406	Resistor, cmpsn, 2200Ω, 10%, 1/4W		745-0761-000
R407	Resistor, cmpsn, 68Ω, 10%, 1/4W		745-0707-000
R408	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R409	Resistor, cmpsn, 220Ω, 10%, 1/4W		745-0725-000
R410	Resistor, cmpsn, 100Ω, 10%, 1/4W		745-0713-000
R411	Resistor, film, 8450Ω, 1%, 1/8W		705-3605-440
R412	Resistor, film, 3320Ω, 1%, 1/8W		705-1021-000
R413	Resistor, cmpsn, 33Ω, 10%, 1/4W		745-0695-000
R414	Not used		
R415	Resistor, film, 866Ω, 1%, 1/8W		705-0993-000
R416	Resistor, film, 7.5kΩ, 1%, 1/8W		705-1038-000
R417	Resistor, film, 7.5kΩ, 1%, 1/8W		705-1038-000
R418	Resistor, film, 562Ω, 1%, 1/8W		705-0984-000
R419	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R420	Resistor, film, 3920Ω, 1%, 1/8W		705-3605-280
R421	Resistor, film, 12.4kΩ, 1%, 1/8W		705-3605-520
R422	Resistor, film, 18.2kΩ, 1%, 1/8W		705-3605-600
R423	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R424	Resistor, cmpsn, 68kΩ, 10%, 1/4W		745-0815-000
R425	Resistor, cmpsn, 1200Ω, 10%, 1/4W		745-0752-000
R426	Resistor, cmpsn, 2700Ω, 10%, 1/4W		745-0764-000
R427	Resistor, cmpsn, 33kΩ, 10%, 1/4W		745-0803-000
R428	Resistor, film, 301kΩ, 1%, 1/8W		705-1115-000
R429	Resistor, film, 301kΩ, 1%, 1/8W		705-1115-000
R430	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R431	Resistor, cmpsn, 560Ω, 10%, 1/4W		745-0740-000
TP1-TP5	Terminal, test (qty 5)		306-2721-010
U401	IC, 353		351-1370-040
U402	IC, 8793		351-1981-010
U403	IC, 145156		351-8736-010
U404	IC, 78L05		351-1353-030
VR401	Diode, zener, 1N4626		353-3591-500
W401	Cable, ribbon		653-8507-007
Y401	Crystal, 3.2 MHz, 0.001%		289-7503-010
401	Bead, ferrite (qty 2)		288-2154-000
402	Shield, rf (eff to rev AB)		653-2065-001
402	Shield, rf (eff rev AB)		653-2065-002
403	Insulator, shield (eff to rev AB)		628-6848-005
403	Insulator, shield (eff rev AB)		628-6848-006



Circuit Card A1 Synthesizer, Schematic Diagram
Figure 6-5 (Sheet 2)



Circuit Card A1 Receiver, Component Location Diagram
Figure 6-4 (Sheet 1 of 2)

PARTS LIST
CIRCUIT CARD A1 RECEIVER (PART NUMBER 653-3010-00X, REV AD)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A1	Circuit card A1	A	653-3010-001
A1	Circuit card A1	B	653-3010-002
A1	Circuit card A1	C	653-3010-003
A1	Circuit card A1	D	653-3010-004
C201	Capacitor, cer, 4.7, 0.25pF, 75V		913-1098-210
C202	Capacitor, cer, 2.7, 0.25pF, 75V		913-1098-240
C203	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C204	Capacitor, cer, 3.9, 0.25pF, 75V		913-1098-220
C205	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C206	Capacitor, Ta, 1µF, 20%, 35V		184-9102-790
C207	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C208	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C209	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C210	Capacitor, cer, 3.9, 0.25pF, 75V		913-1098-220
C211	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C212	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C213	Capacitor, cer, 3.9, 0.25pF, 75V		913-1098-220
C214	Capacitor, cer, 4.7, 0.25pF, 75V		913-1098-210
C215	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C216	Capacitor, cer, 1000pF, 5%, 100V		913-3281-270
C217	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C218	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C219	Capacitor, cer, 330pF, 10%, 200V		913-4012-000
C220	Capacitor, var, 5-25pF, 50V		917-1256-030
C221	Capacitor, cer, 22pF, 5%, 100V		913-3401-100
C222	Capacitor, cer, 0.01µF, 10%, 100V		913-5019-200
C223	Capacitor, cer, 1000pF, 10%, 200V		913-4018-000
C224	Capacitor, Ta, 1µF, 20%, 35V		184-9102-790
C225	Capacitor, cer, 22pF, 5%, 100V		913-3401-100
C226	Capacitor, var, 5-25pF, 50V		917-1256-030
C227	Capacitor, cer, 0.01µF, 10%, 100V		913-5019-200
C228	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C229	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C230	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C231	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C232	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C233	Capacitor, Ta, 1µF, 20%, 35V		184-9102-790
C234	Capacitor, Ta, 1µF, 20%, 35V		184-9102-790
C235	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C236	Capacitor, Ta, 1µF, 20%, 35V		184-9102-790
C237	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C238	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C239	Capacitor, Ta, 1µF, 20%, 35V		184-9102-790
C240	Capacitor, Ta, 1µF, 20%, 35V		184-9102-790
C241	Capacitor, mica, 62pF (eff to rev P)		912-2099-240
C241	Capacitor, cer, 56pF, 5%, 100V (eff rev P)		913-3401-070
C242	Capacitor, cer, 180pF, 5%, 100V		913-1098-510
C243	Capacitor, cer, 1000pF, 10%, 200V		913-4018-000
C244	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C245	Capacitor, cer, 0.01µF, 10%, 100V		913-5019-200
C246	Capacitor, cer, 4700pF, 10%, 100V		913-5019-160
C247	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C248	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C249	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C250	Capacitor, cer, 10pF, 5%, 75V		913-1098-010
C251	Capacitor, cer, 120pF, 5%, 100V		913-3117-220
C252	Capacitor, cer, 1000pF, 5%, 100V		913-3281-270
C253	Capacitor, Ta, 4.7µF, 20%, 10V		184-9102-510
C254	Capacitor, Ta, 33µF, 20%, 10V		184-9102-530
CJ201	Jumper		428-0289-010
CR201	Diode, FD700		353-3586-010
CR202	Diode, FD700		353-3586-010
CR203	Diode, SMV1234		353-3264-020
CR204	Diode, SMV1234		353-3264-020
CR205	Diode, SMV1234		353-3264-020
CR206	Diode, SMV1234		353-3264-020
CR207	Diode, 1N4454		353-3644-010
CR208	Diode, 1N4454		353-3644-010
CR209	Diode, 1N4156		353-3610-010
CR210	Diode, 1N4454		353-3644-010
CR211	Not used		
CR212	Diode, 1N5711		353-3691-010
CR213	Diode, 1N4454		353-3644-010
FL201	Filter, 20.025 MHz, wide band	C,D	293-1345-020
FL201	Filter, 20.025 MHz, narrow band	A,B	293-1345-010
FL202	Filter, 20.025 MHz, wide band	C,D	293-1345-020
FL202	Filter, 20.025 MHz, narrow band	A,B	293-1345-010
FL203	Filter, 455 kHz, wide band	C,D	241-0752-010
FL203	Filter, 455 kHz, narrow band	A,B	241-0752-030
J502	Pin, connector (qty 4)		372-7518-030
L201	Coil, var, 0.06µH		278-0415-010
L202	Coil, 1.2µH		240-2024-000
L203	Coil, var, 0.06µH		278-0415-010
L204	Coil, 3.3µH		240-2029-000
L205	Coil, var, 0.06µH		278-0415-010

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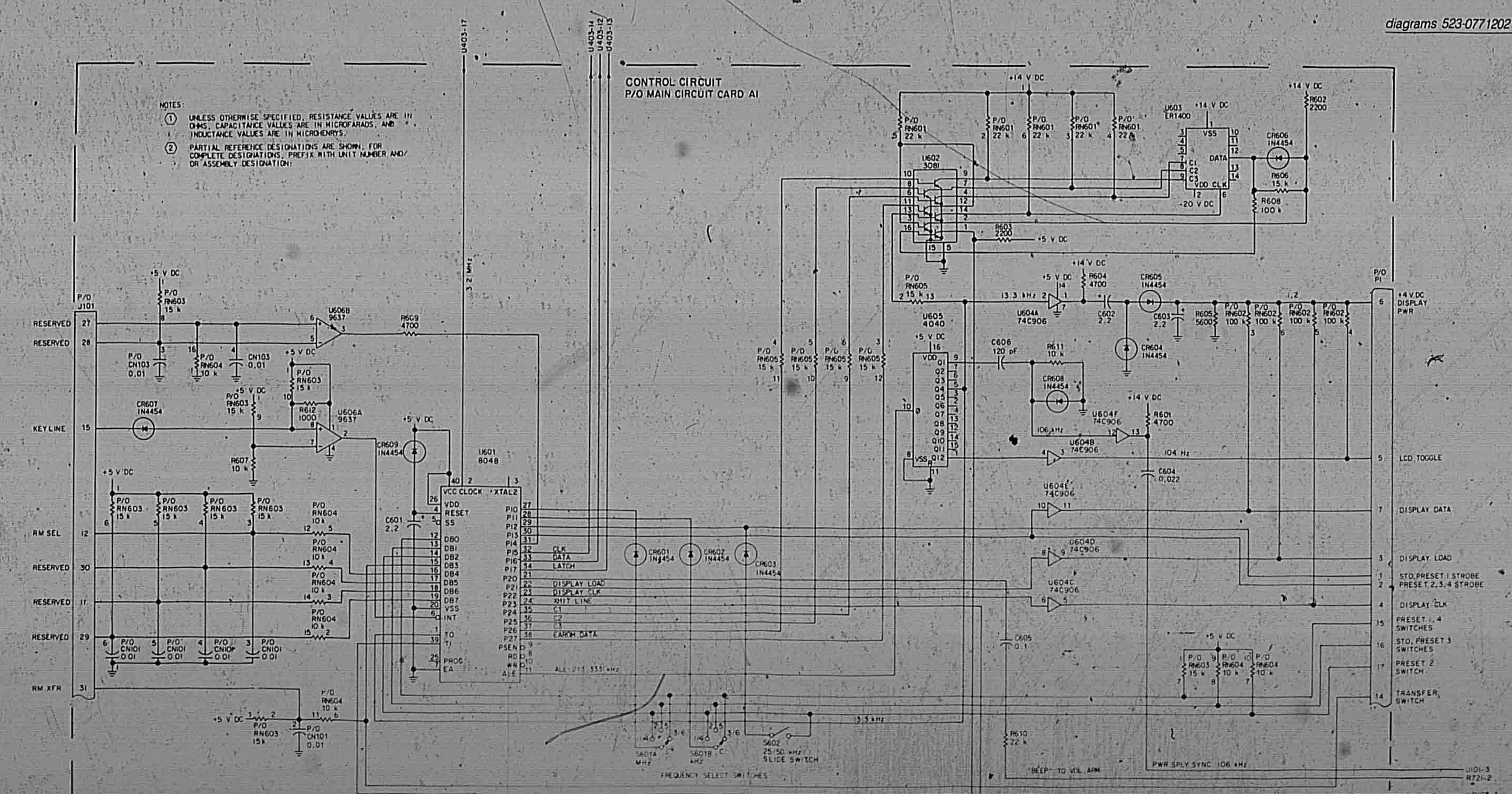
PARTS LIST
CIRCUIT CARD A1 CONTROL CIRCUITS (PART NUMBER 653-3010-00X, REV AD)

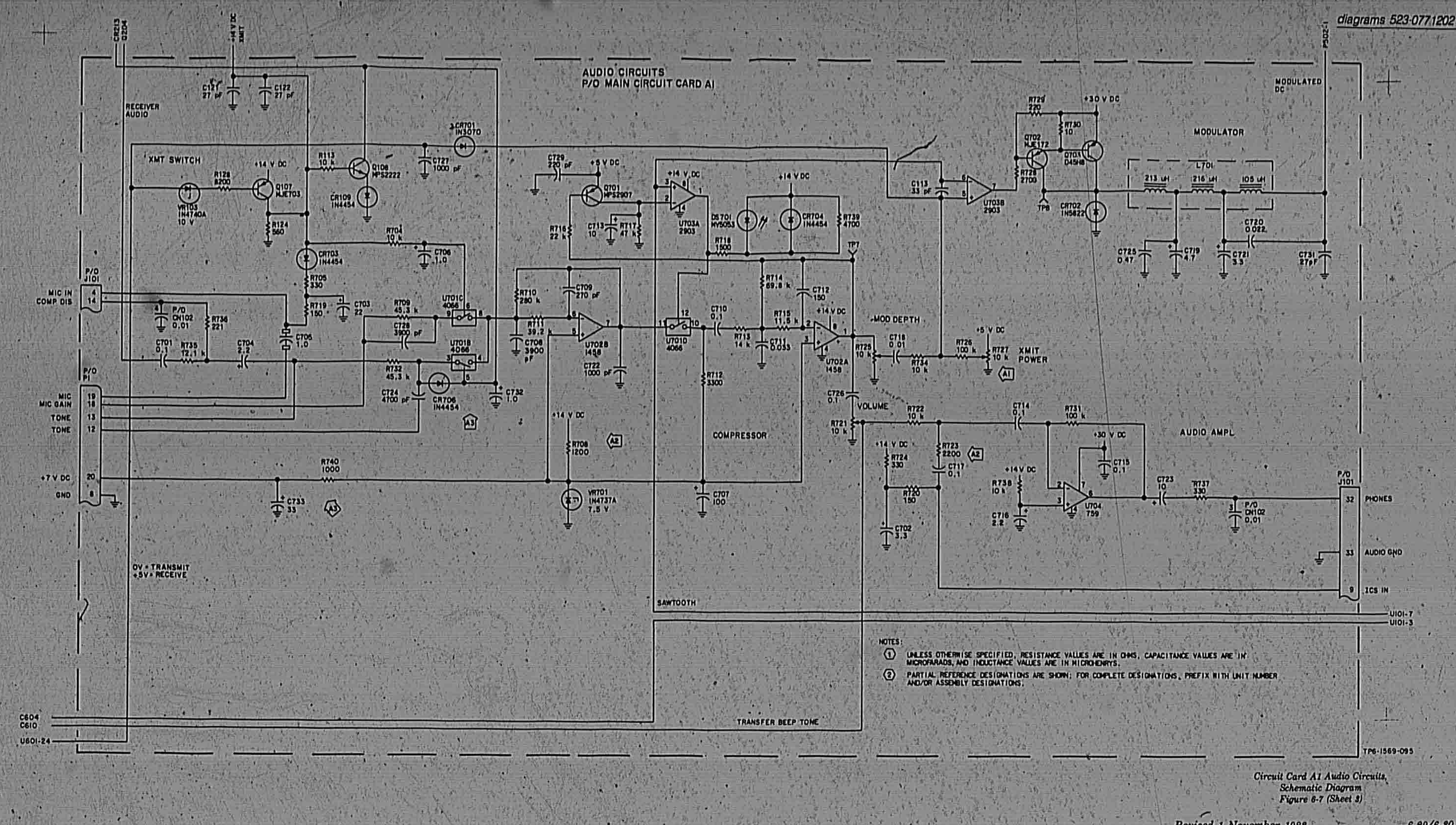
SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A1	Circuit card A1	A	653-3010-001
A1	Circuit card A1	B	653-3010-002
A1	Circuit card A1	C	653-3010-003
A1	Circuit card A1	D	653-3010-004
C601	Capacitor, Al, 2.2µF, +100%-20%, 63V		183-1471-290
C602	Capacitor, Al, 2.2µF, +100%-20%, 63V		183-1471-290
C603	Capacitor, Al, 2.2µF, +100%-20%, 63V		183-1471-290
C604	Capacitor, cer, 0.022µF, 20%, 50V		913-3279-130
C605	Capacitor, cer, 0.1µF, 10%, 50V		913-5019-320
C606	Capacitor, cer, 120pF, 5%, 100V		913-3117-220
CN101	Capacitor array, 0.01µF		913-3663-010
CN103	Capacitor array, 0.01µF		913-3663-010
CR601	Diode, 1N4454		353-3644-010
CR602	Diode, 1N4454		353-3644-010
CR603	Diode, 1N4454		353-3644-010
CR604	Diode, 1N4454		353-3644-010
CR605	Diode, 1N4454		353-3644-010
CR606	Diode, 1N4454		353-3644-010
CR607	Diode, 1N4454		353-3644-010
CR608	Diode, 1N4454		353-3644-010
CR609	Diode, 1N4454		353-3644-010
R601	Resistor, cmpsn, 4700Ω, 10%, 1/4W		745-0773-000
R602	Resistor, cmpsn, 2200Ω, 10%, 1/4W		745-0761-000
R603	Resistor, cmpsn, 2200Ω, 10%, 1/4W		745-0761-000
R604	Resistor, cmpsn, 4700Ω, 10%, 1/4W		745-0773-000
R605	Resistor, cmpsn, 5600Ω, 10%, 1/4W		745-0776-000
R606	Resistor, cmpsn, 15kΩ, 10%, 1/4W		745-0791-000
R607	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R608	Resistor, cmpsn, 100kΩ, 10%, 1/4W		745-0821-000
R609	Resistor, cmpsn, 4700Ω, 10%, 1/4W		745-0773-000
R610	Resistor, cmpsn, 22kΩ, 10%, 1/4W		745-0797-000
R611	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R612	Resistor, cmpsn, 1kΩ, 10%, 1/8W		[illegible]
RN601	Resistor, array, 22kΩ		[illegible]
RN602	Resistor, 100kΩ		[illegible]
RN603	Resistor, 15kΩ		[illegible]
RN604	Resistor, 10kΩ		[illegible]
RN605	Resistor, 15kΩ		[illegible]
S601	Switch, rotary		[illegible]
S602	Switch, slide		[illegible]
U601	IC, 8048		[illegible]
U602	IC, 3081		[illegible]
U603	IC, ER1400		[illegible]
U604	IC, 74C906		[illegible]
U605	IC, 14040		[illegible]
U606	IC, 9637		[illegible]
XU601	Socket, IC, 40-pin		[illegible]
601	Spool, switch		[illegible]
602	Setscrew, 4-40 x .125 (qty 2)		[illegible]
603	Label, ESD		[illegible]
604	Insulator, switch (eff rev R to AB)		653-1075-001



Circuit Card A1 Control Circuit, Schematic Diagram
Figure 6-6 (Sheet 2)

PARTS LIST
CIRCUIT CARD A1 AUDIO CIRCUITS (PART NUMBER 653-3010-00X, REV AD)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A1	Circuit card A1	A	653-3010-001
A1	Circuit card A1	B	653-3010-002
A1	Circuit card A1	C	653-3010-003
A1	Circuit card A1	D	653-3010-004
C113	Capacitor, cer, 33pF, 10%, 200V		913-5019-070
C121	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
C122	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
C701	Capacitor, cer, 0.1µF, 20%, 50V		913-3279-200
C702	Capacitor, Ta, 3.3µF, 20%, 15V		184-9102-560
C703	Capacitor, Ta, 22µF, 20%, 15V		184-9102-580
C704	Capacitor, Al, 2.2µF, +100%-20%, 63V		183-1471-290
C705	Capacitor, cer, 1µF, 20%, 50V		913-3279-270
C706	Capacitor, Ta, 1µF, 20%, 35V		184-9102-790
C707	Capacitor, Ta, 100µF, 20%, 10V		184-9102-540
C708	Capacitor, cer, 3900pF, 10%, 100V		913-5019-150
C709	Capacitor, cer, 270pF, 10%, 200V		913-4011-000
C710	Capacitor, cer, 0.1µF, 20%, 50V		913-3279-200
C711	Capacitor, cer, 0.033µF, 10%, 100V		913-5019-380
C712	Capacitor, cer, 150pF, 5%, 100V		913-3117-050
C713	Capacitor, Ta, 10µF, 20%, 20V		184-9102-610
C714	Capacitor, cer, 0.1µF, 20%, 50V		913-3279-200
C715	Capacitor, cer, 0.1µF, 20%, 50V		913-3279-200
C716	Capacitor, Ta, 2.2µF, 20%, 25V		184-9102-220
C717	Capacitor, cer, 0.1µF, 20%, 50V		913-3279-200
C718	Capacitor, cer, 0.01µF, 10%, 100V		913-5019-200
C719	Capacitor, Al, 4.7µF, 20%, 50V		183-1523-050
C720	Capacitor, cer, 0.022, 10%, 50V		913-5019-240
C721	Capacitor, Al, 3.3µF, 20%, 50V		183-1523-030
C722	Capacitor, cer, 1000pF, 10%, 200V (eff to rev V)		913-4018-000
C722	Capacitor, cer, 1000pF, 5%, 100V (eff rev V)		913-3281-270
C723	Capacitor, Al, 10µF, +100%-20%, 35V		183-1471-080
C724	Capacitor, cer, 4700pF, 10%, 100V		913-5019-160
C725	Capacitor, cer, 0.47µF, 10%, 50V		913-5019-520
C726	Capacitor, cer, 0.1µF, 20%, 50V		913-3279-200
C727	Capacitor, cer, 1000pF, 10%, 200V		913-4018-000
C728	Capacitor, cer, 3900pF, 10%, 100V		913-5019-150
C729	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C730	Capacitor, cer, 220pF, 10%, 100V (eff to rev V)		913-5020-200
C731	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
C732	Capacitor, Ta, 1µF, 20%, 35V (eff rev AD)(SB 3)		184-9102-790
C733	Capacitor, Ta, 33µF, 20%, 10V (eff rev AD)(SB 3)		184-9102-530
CJ701	Jumper (eff rev T)		426-0289-010
CN102	Capacitor, array, 0.01µF		913-3663-010
CR109	Diode, 1N4454		353-3694-010
CR701	Diode, 1N3070		353-3063-000
CR702	Diode, 1N5822		353-6614-030
CR703	Diode, 1N4454		353-3644-010
CR704	Diode, 1N4454		353-3644-010
CR705	Diode, 1N4454 (eff to rev T)		353-3644-010
CR706	Diode, 1N4454 (eff rev AD)(SB 3)		353-3644-010
DS701	Diode, light emitting, MV5053		353-0293-040
L701	Inductor, modulator		668-0530-010
Q107	Transistor, MJE-703		352-1082-030
Q108	Transistor, MPS-2222		352-5021-010
Q701	Transistor, MPS-2907		352-5019-030
Q702	Transistor, MJE-172		352-1030-010
Q703	Transistor, D45H8		352-5508-010
R113	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R124	Resistor, cmpsn, 560Ω, 10%, 1/4W		745-0740-000
R128	Resistor, cmpsn, 8.2kΩ, 10%, 1/4W		745-0782-000
R701-R703	Not used		
R704	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R705	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R706-R707	Not used		
R708	Resistor, cmpsn, 1200Ω, 10%, 1/4W		745-0752-000
R709	Resistor, film, 45.3kΩ, 1%, 1/8W		705-3605-790
R710	Resistor, film, 280kΩ, 1%, 1/8W		705-3604-220
R711	Resistor, film, 39.2kΩ, 1%, 1/8W		705-3605-760
R712	Resistor, cmpsn, 3300Ω, 10%, 1/4W		745-0767-000
R713	Resistor, film, 14kΩ, 1%, 1/8W		705-1051-000
R714	Resistor, film, 69.8kΩ, 1%, 1/8W		705-3605-880
R715	Resistor, film, 11.5kΩ, 1%, 1/8W		705-1047-000
R716	Resistor, cmpsn, 22kΩ, 10%, 1/4W		745-0797-000
R717	Resistor, cmpsn, 47kΩ, 10%, 1/4W		745-0809-000
R718	Resistor, cmpsn, 1500Ω, 10%, 1/4W		745-0755-000
R719	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R720	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R721	Resistor, var, with switch, 10kΩ, 20%		376-0282-010
R722	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R723	Resistor, cmpsn, 10kΩ, 10%, 1/4W (eff to rev V)		745-0785-000
R723	Resistor, cmpsn, 2200Ω, 10%, 1/4W (eff rev V)		745-0761-000
R724	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R725	Resistor, var, 10kΩ, 20%, 1/2W		382-0027-100
R726	Resistor, cmpsn, 100kΩ, 10%, 1/4W		745-0821-000
R727	Resistor, var, 10kΩ, 20%, 1/2W		382-0027-100
R728	Resistor, cmpsn, 2700Ω, 10%, 1/4W		745-0764-000
R729	Resistor, cmpsn, 220Ω, 10%, 1/4W		745-0725-000
R730	Resistor, cmpsn, 10Ω, 10%, 1/4W		745-0677-000
R731	Resistor, cmpsn, 100kΩ, 10%, 1/4W		745-0821-000
R732	Resistor, film, 45.3kΩ, 1%, 1/8W		705-3605-790
R733	Not used		
R734	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R735	Resistor, film, 12.1kΩ, 1%, 1/8W		705-1048-000
R736	Resistor, film, 221Ω, 1%, 1/8W		705-3600-850
R737	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R738	Resistor, cmpsn, 10kΩ, 10%, 1/4W		745-0785-000
R739	Resistor, cmpsn, 4700Ω, 10%, 1/4W		745-0773-000
R740	Resistor, cmpsn, 1kΩ, 10%, 1/4W (eff rev AD)(SB 3)		745-0749-000
TP7,TP8	Terminal, test (qty 2)		306-2721-010
U701	IC, 4066		351-8252-010
U702	IC, 1458		351-1071-070
U703	IC, 2903		351-1278-010
U704	IC, 759		351-1965-010
VR103	Diode, zener, 1N4740A		353-6481-250
VR701	Diode, zener, 1N4737A		353-6481-190
701	Bead, ferrite (qty 2)		288-2154-000

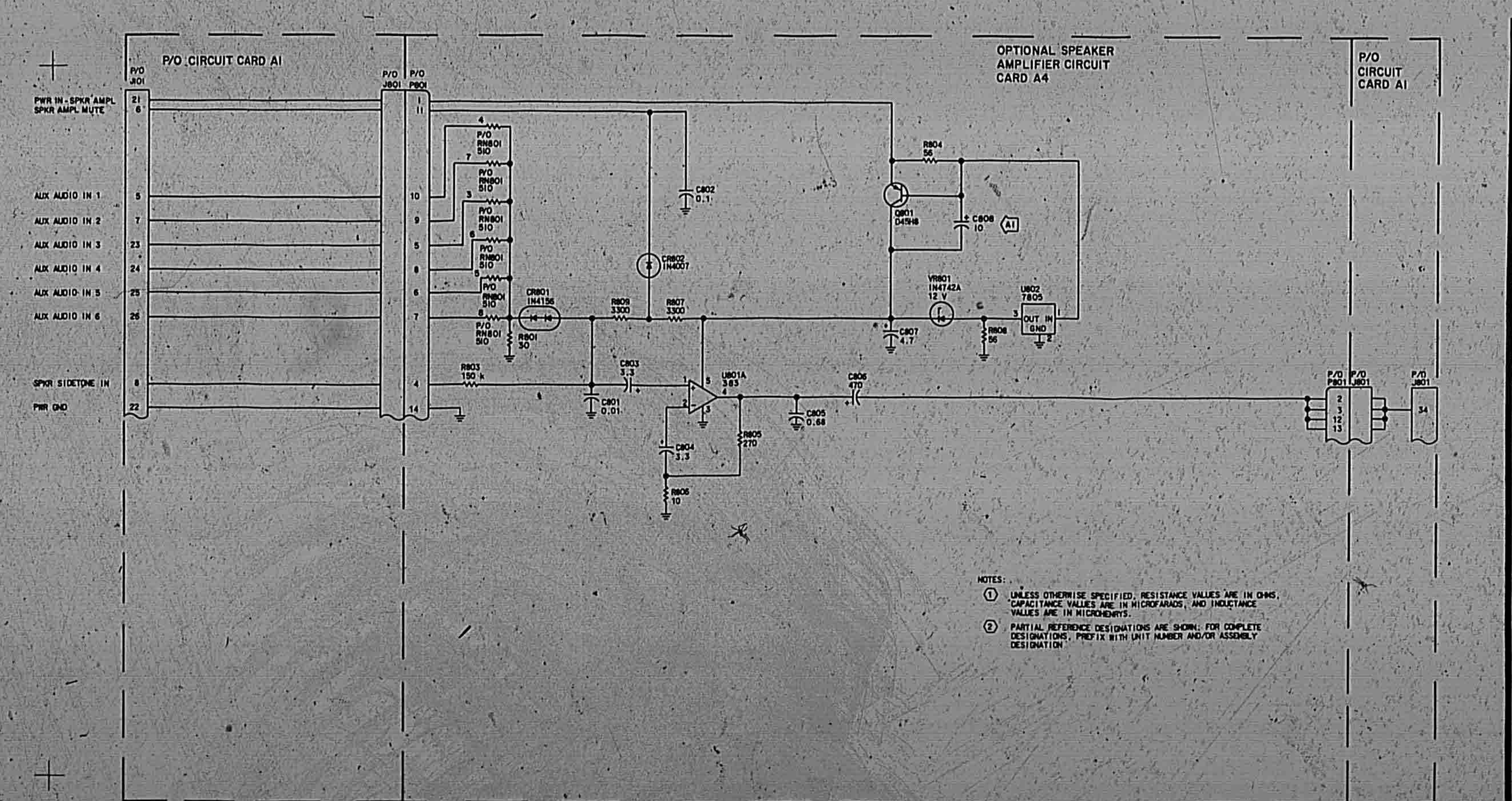


Circuit Card A1 Audio Circuits, Schematic Diagram
Figure 6-7 (Sheet 3)

diagrams 523-0771202

PARTS LIST
SPEAKER AMPLIFIER A4 (PART NUMBER 653-3030-001, REV E)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A4	Circuit card A4		653-3030-001
C801	Capacitor, cer, 0.01µF, 20%, 50V		913-3279-110
C802	Capacitor, cer, 0.1µF, 20%, 50V		913-3279-200
C803	Capacitor, Ta, 3.3µF, 20%, 15V		184-9102-120
C804	Capacitor, Ta, 3.3µF, 20%, 15V		184-9102-120
C805	Capacitor, cer, 0.68µF, 20%, 50V		913-3279-390
C806	Capacitor, Al, 470µF, +75-10%, 16V		183-1519-040
C807	Capacitor, Ta, 4.7µF, 20%, 35V		184-9102-820
C808	Capacitor, Ta, 10µF, 20%, 35V (eff rev E)		184-9100-750
CR801	Diode, 1N4156		353-3743-010
CR802	Diode, 1N4007		353-6442-070
P801	Connector, 14-pin		372-2648-010
Q801	Transistor, D45H8		352-5506-010
R801	Resistor, cmpsn, 30Ω, 5%, 1/4W		745-1863-120
R802	Not used		
R803	Resistor, cmpsn, 150kΩ, 10%, 1/4W		745-0827-000
R804	Resistor, cmpsn, 56Ω, 10%, 1/4W		745-0704-000
R805	Resistor, cmpsn, 270Ω, 10%, 1/4W		745-0728-000
R806	Resistor, cmpsn, 10Ω, 10%, 1/4W		745-0677-000
R807	Resistor, cmpsn, 3300Ω, 10%, 1/4W		745-0767-000
R808	Resistor, cmpsn, 56Ω, 10%, 1/4W		745-1300-000
R809	Resistor, cmpsn, 3300Ω, 10%, 1/4W		745-0767-000
RN801	Resistor network, 510Ω, 2%, 1W		350-4001-220
U801	IC, 383A		351-0833-010
U802	IC, 7805		351-1196-010
VR801	Diode, zener, 1N4742A		353-6481-290
1	Ribbon cable assy with P801		653-3007-002
2	Nut, lock, 4-40		353-1296-000
3	Screw, ppf, 4-40 x .31		343-0134-000

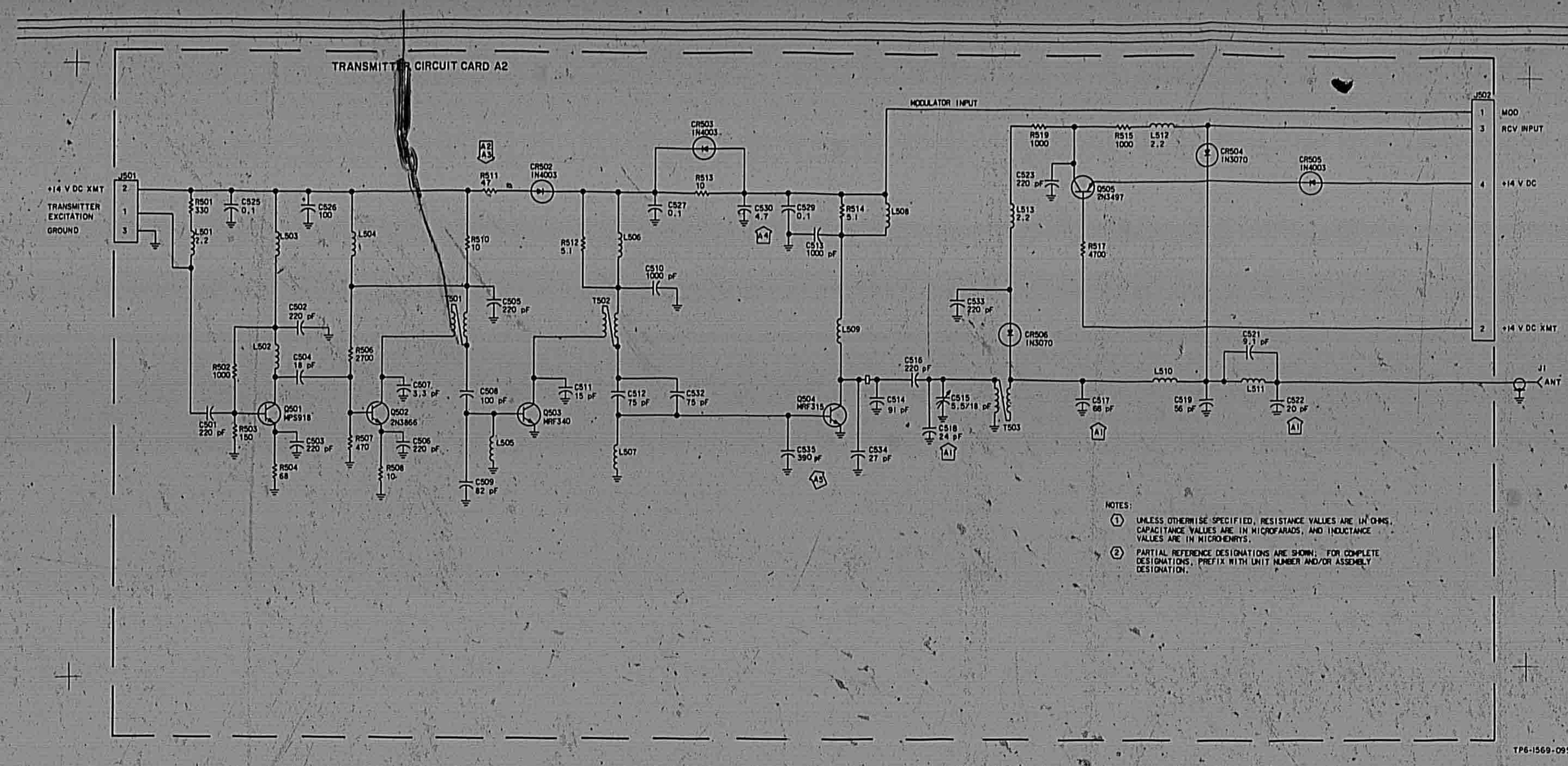


Speaker Amplifier Circuit Card A4, Schematic Diagram
Figure 6-10 (Sheet 2)

PARTS LIST
TRANSMITTER CIRCUIT CARD A2 (PART NUMBER 653-3020-001, REV P)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
A2	Circuit card assy		653-3020-001
C501	Capacitor, cer, 220pF, 10%, 200V		913-4010-000
C502	Capacitor, cer, 220pF, 10%, 200V		913-4010-000
C503	Capacitor, cer, 220pF, 10%, 200V		913-4010-000
C504	Capacitor, cer, 18pF, 5%, 100V		913-3401-010
C505	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C506	Capacitor, cer, 220pF, 10%, 200V		913-4010-000
C507	Capacitor, cer, 3.3;0.25pF, 75V		913-1098-230
C508	Capacitor, cer, 100pF, 5%, 100V		913-3281-280
C509	Capacitor, cer, 82pF, 10%, 100V		913-3281-410
C510	Capacitor, cer, 1000pF, 5%, 100V		914-3506-350
C511	Capacitor, cer, 15pF, 5%, 75V		913-1098-180
C512	Capacitor, cer, 75pF, 5%, 100V		913-3401-080
C513	Capacitor, cer, 1000pF, 5%, 100V		914-3506-350
C514	Capacitor, cer, 91pF, 1%, 100V		913-1098-530
C515	Capacitor, var, cer, 5.5-18pF, 200V		917-1222-000
C516	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C517	Capacitor, cer, 75pF, 5%, 100V (eff to rev J)		913-3401-080
C517	Capacitor, cer, 68pF, 5%, 100V (eff rev J)		913-3401-090
C518	Capacitor, cer, 24pF, 5%, 100V (eff rev J)		913-3401-030
C519	Capacitor, cer, 56pF, 5%, 100V		913-3401-070
C520	Not used		
C521	Capacitor, cer, 9.1;0.5pF, 75V		913-1098-170
C522	Capacitor, cer, 24pF, 5%, 100V (eff to rev J)		913-3401-030
C522	Capacitor, cer, 20pF, 5%, 100V (eff rev J)		913-3401-020
C523	Capacitor, cer, 220pF, 10%, 200V		913-4010-000
C524	Not used		
C525	Capacitor, cer, 0.1µF, 20%, 50V		913-3279-200
C526	Capacitor, Al, 100µF, +100%-20%, 25V		183-1471-480
C527	Capacitor, cer, 0.1µF, 20%, 50V		913-3279-200
C528	Not used		
C529	Capacitor, cer, 0.1µF, 20%, 50V		913-3279-200
C530	Capacitor, Al, 1µF, 20%, 50V (eff to rev M)		183-1523-020
C530	Capacitor, Al, 4.7µF, 20%, 50V (eff rev M)		183-1523-050
C531	Not used		
C532	Capacitor, cer, 75pF, 5%, 100V		913-3401-080
C533	Capacitor, cer, 220pF, 5%, 100V		913-3117-060
C534	Capacitor, cer, 27pF, 5%, 100V		913-3401-040
C535	Capacitor, cer, 180pF, 5%, 100V (eff to rev P)		914-3506-200
C535	Capacitor, cer, 390pF, 5%, 100V (eff rev P)		914-1502-280
C536	Capacitor, cer, 220pF, 5%, 100V (eff to rev P)		914-3506-220
CR501	Used in synthesizer on A1		
CR502	Diode, 1N4003		353-6442-030
CR503	Diode, 1N4003		353-6442-030
CR504	Diode, 1N3070		353-3083-000
CR505	Diode, 1N4003		353-6442-030
CR506	Diode, 1N3070		353-3083-000

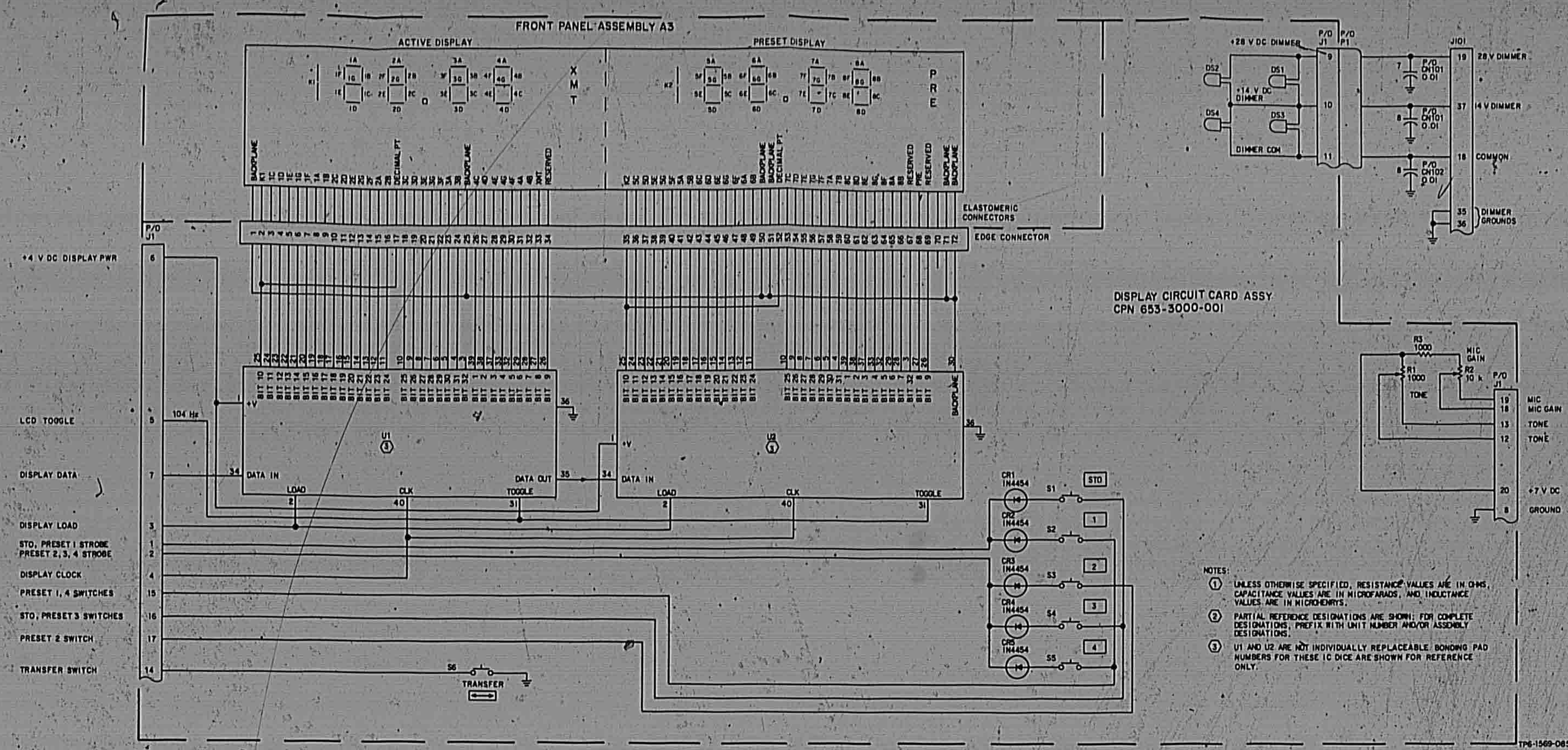
SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
L501	Inductor, 2.2µH		240-2027-000
L502	Inductor		628-5351-001
L503	Inductor		628-5632-001
L504	Inductor		628-5632-001
L505	Inductor		628-5632-001
L506	Inductor		628-5632-001
L507	Inductor		628-5632-001
L508	Inductor		628-5632-001
L509	Inductor		240-2759-010
L510	Inductor, (etched on circuit card)		
L511	Inductor, (etched on circuit card)		
L512	Inductor, 2.2µH		240-2027-000
L513	Inductor, 2.2µH		240-2027-000
P501	Connector, 3 pin		372-7518-010
P502	Connector, 4 pin		372-7518-020
Q501	Transistor, MPS918		352-5027-010
Q502	Transistor, 2N3866		352-0671-010
Q503	Transistor, MRF340		352-1532-010
Q504	Transistor, MRF315		352-1531-010
Q505	Transistor, 2N3497		352-0744-040
R501	Resistor, cmpsn, 330Ω, 10%, 1/4W		745-0731-000
R502	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R503	Resistor, cmpsn, 150Ω, 10%, 1/4W		745-0719-000
R504	Resistor, cmpsn, 68Ω, 10%, 1/4W		745-0707-000
R505	Not used		
R506	Resistor, cmpsn, 2.7kΩ, 10%, 1/4W		745-0764-000
R507	Resistor, cmpsn, 470Ω, 10%, 1/4W		745-0737-000
R508	Resistor, cmpsn, 10Ω, 10%, 1/4W		745-0677-000
R509	Not used		
R510	Resistor, cmpsn, 10Ω, 10%, 1/4W		745-0677-000
R511	Resistor, ww, 33Ω, 5%, 3W (eff to rev K)		747-5376-000
R511	Resistor, ww, 100Ω, 5%, 3W (eff rev K to L)		747-5340-000
R511	Resistor, ww, 47Ω, 5%, 3W (eff rev L)		747-5379-000
R512	Resistor, cmpsn, 5.1Ω, 5%, 1/4W		745-4375-000
R513	Resistor, cmpsn, 10Ω, 10%, 1/4W		745-0677-000
R514	Resistor, cmpsn, 5.1Ω, 5%, 1/4W		745-4375-000
R515	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
R516	Not used		
R517	Resistor, cmpsn, 4.7kΩ, 10%, 1/4W		745-0773-000
R518	Not used		
R519	Resistor, cmpsn, 1kΩ, 10%, 1/4W		745-0749-000
T501	Transformer, 4:1		608-6569-001
T502	Transformer, 4:1		608-6569-001
T503	Transformer, 4:1		608-6569-001
1	Heatsink		352-9644-010
2	Pad, transistor		352-9552-180
3	Sleeving, #26		152-2463-000
4	Spacer (qty 6) (eff rev N)		352-9552-580



Transmitter Circuit Card A2, Schematic Diagram
Figure 6-8 (Sheet 2)

PARTS LIST
DISPLAY CIRCUIT CARD (PART NUMBER 653-3000-001, REV K)

SYMBOL	DESCRIPTION	USED ON CODE	COLLINS PART NUMBER
	Display Circuit Card		653-3000-001
CR1	Diode, 1N4454		353-3644-010
CR2	Diode, 1N4454		353-3644-010
CR3	Diode, 1N4454		353-3644-010
CR4	Diode, 1N4454		353-3644-010
CR5	Diode, 1N4454		353-3644-010
DS1	Lamp, incand, 14V		262-1398-120
DS2	Lamp, incand, 14V		262-1398-120
DS3	Lamp, incand, 14V		262-1398-120
DS4	Lamp, incand, 14V		262-1398-120
J1	Connector, 20-pin		220-0071-110
R1	Resistor, var, 1kΩ, 10%, 1/2W		382-0027-079
R2	Resistor, var, 10kΩ, 10%, 1/2W		382-0027-100
R3	Resistor, cmpsn, 1kΩ, 10%, 1/8W		745-2341-000
S1	Switch base		653-8517-001
S2	Switch base		653-8517-001
S3	Switch base		653-8517-001
S4	Switch base		653-8517-001
S5	Switch base		653-8517-001
S6	Switch base		653-8517-001
U1	IC, display driver (not replaceable)		
U2	IC, display driver (not replaceable)		
1	Switch cap (qty 6)		653-1030-001
2	Switch contact (qty 6)		653-2027-001
3	Legend, STO		653-1029-005
4	Legend, 1		653-1029-001
5	Legend, 2		653-1029-002
6	Legend, 3		653-1029-003
7	Legend, 4		653-1029-004
8	Legend, transfer		653-1029-006
9	Label, ESD		280-2745-010
10	Circuit card with U1 and U2		653-3000-005



Front Panel Assembly A3, Schematic Diagram
Figure 6-9 (Sheet 2)