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HARRIS
RF COMMUNICATIONS

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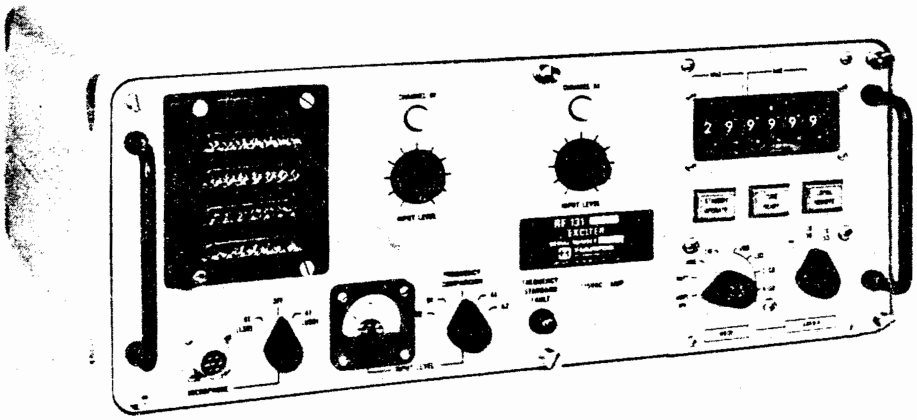
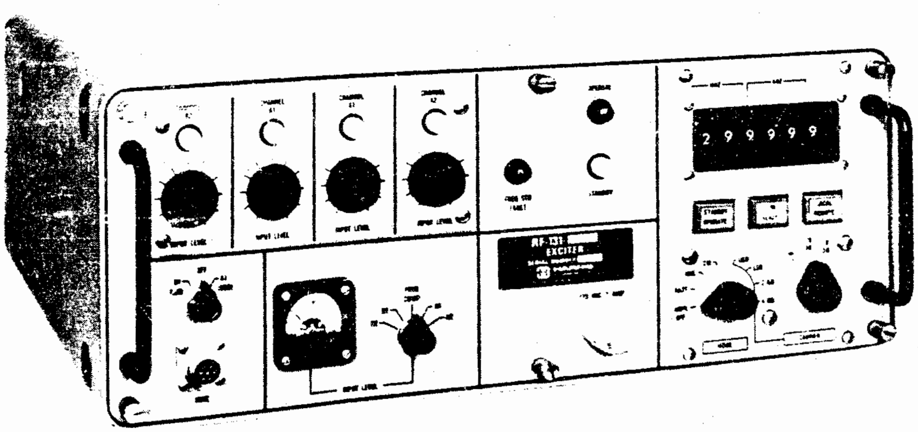
RF-131 EXCITER

INSTRUCTION MANUAL



RF-131 TWO CHANNEL EXCITER MODEL



RF-131 FOUR CHANNEL EXCITER MODEL

HARRIS

LIMITED ONE YEAR WARRANTY
HARRIS CORPORATION (RF COMMUNICATIONS GROUP)

FROM HARRIS TO YOU – This warranty is extended to the original buyer and applies to all Harris Corporation, RF Communications Group equipment purchased and employed for the service normally intended, except those products specifically excluded.

WHAT WE WILL DO – If your Harris Corporation, RF Communications Group equipment purchased from us for use outside the United States fails in normal use because of a defect in workmanship or materials within one year from the date of shipment, we will repair or replace (at our option) the equipment or part without charge to you, at our factory. If the product was purchased for use in the United States, we will repair or replace (at our option) the equipment or part without charge to you at our Authorized Repair Center or factory.

WHAT YOU MUST DO – You must notify us promptly of a defect within one year from date of shipment. Assuming that Harris concurs that the complaint is valid, and is unable to correct the problem without having the equipment shipped to Harris:

- Customers with equipment purchased for use outside the United States will be supplied with information for the return of the defective equipment or part to our factory in Rochester, NY, U.S.A., for repair or replacement. You must prepay all transportation, insurance, duty and customs charges. We will pay for return to you of the repaired/replaced equipment or part, C.I.F. destination; you must pay any duty, taxes or customs charges.
- Customers with equipment purchased for use in the United States must obtain a Return Authorization Number, properly pack, insure, prepay the shipping charges and ship the defective equipment or part to our factory or to the Authorized Warranty Repair Center indicated by us.

Harris Corporation
RF Communications Group
Customer Service
1680 University Avenue
Rochester, NY 14610, U.S.A.

Telephone: (716) 244-5830
Telex: 978464
Cable: RFCOM

Harris will repair or replace the defective equipment or part and pay for its return to you, provided the repair or replacement is due to a cause covered by this warranty.

WHAT IS NOT COVERED – We regret that we cannot be responsible for:

- Defects or failures caused by buyer or user abuse or misuse.
- Defects or failures caused by unauthorized attempts to repair or alter the equipment in any way.
- Consequential damages incurred by a buyer or user from any cause whatsoever, including, but not limited to transportation, non-Harris repair or service costs, downtime costs, costs for substituting equipment or loss of anticipated profits or revenue.
- The performance of the equipment when used in combination with equipment not purchased from Harris.
- HARRIS MAKES NO OTHER WARRANTIES BEYOND THE EXPRESS WARRANTY AS CONTAINED HEREIN. ALL EXPRESS OR IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY ARE EXCLUDED.

SERVICE WARRANTY – Any repair service performed by Harris under this limited warranty is warranted to be free from defects in material or workmanship for sixty days from date of repair. All terms and exclusions of this limited warranty apply to the service warranty.

IMPORTANT – Customers who purchased equipment for use in the United States must obtain a Return Authorization Number before shipping the defective equipment to us. Failure to obtain a Return Authorization Number before shipment may result in a delay in the repair/replacement and return of your equipment.

IF YOU HAVE ANY QUESTIONS – Concerning this warranty or equipment sales or services, please contact our Customer Service Department.

GENERAL INFORMATION

RF-130 SYSTEM
RF-131-122
RF-131-123
RF-131-126

RF-745 SYSTEM
RF-131-172
RF-131-173
RF-131-176

HF ISB SYNTHESIZED EXCITER

TECHNICAL MANUAL

PUBLICATION NUMBER: 0759-9001G/9002G
APRIL 1983

RF-131 EXCITER

INSTRUCTION MANUAL

HARRIS

HARRIS CORPORATION RF COMMUNICATIONS DIVISION
1680 University Avenue Rochester, New York 14610 U.S.A.
Tel.: 716-244-5830 Cable: RFCOM; Rochester, N.Y. TELEX: 978464

Equipment manufactured by Harris Corporation, RF Communications Division meets stringent quality and safety standards. However, high voltages are present in many radio products, and only a skilled technician should attempt to remove outer covers and make adjustments or repairs. All personnel who operate and maintain the equipment should be familiar with this page as a safety preparedness measure. Although this procedure is reproduced as a service to the personnel involved with this equipment, Harris Corporation assumes no liability regarding any injuries incurred during the operation and repair of such equipment, or the administration of this suggested procedure.

ELECTRICAL SHOCK: EMERGENCY PROCEDURE

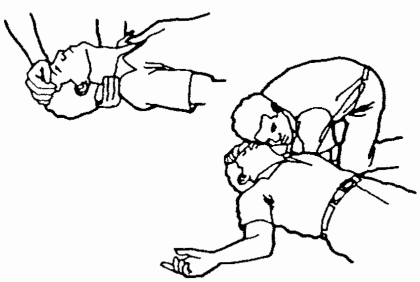
The victim will appear unconscious and may not be breathing. If the victim is still in contact with the voltage source, disconnect the power source in a manner safe to you, or remove the victim from the source with an insulated aid (wooden pole or rope). Next, determine if the victim is breathing and has a pulse. If there is a pulse but no breathing, administer artificial respiration. If there is no pulse and no breathing, perform CPR (if you have been trained to do so). If you have not been trained to perform CPR, administer artificial respiration anyway. Never give fluids to an unconscious person.

WHEN BREATHING STOPS

FIRST, send someone to get a **DOCTOR**.
THEN, administer first aid to restore breathing (artificial respiration):

1 IF A VICTIM APPEARS TO BE UNCONSCIOUS

TAP VICTIM ON THE SHOULDER AND SHOUT, "ARE YOU OKAY?"

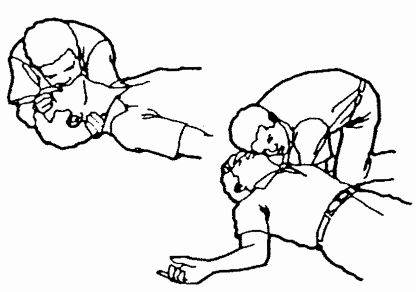


2 IF THERE IS NO RESPONSE

TILT THE VICTIM'S HEAD, CHIN POINTING UP. Place one hand under the victim's neck and gently lift. At the same time, push with the other hand on the victim's forehead. This will move the tongue away from the back of the throat to open the airway.

IMMEDIATELY LOOK, LISTEN, AND FEEL FOR AIR.

While maintaining the backward head tilt position, place your cheek and ear close to the victim's mouth and nose. Look for the chest to rise and fall while you listen and feel for the return of air. Check for about five seconds.



3 IF THE VICTIM IS NOT BREATHING

GIVE FOUR QUICK BREATHS.

Maintain the backward head tilt, pinch the victim's nose with the hand that is on the victim's forehead to prevent leakage of air, open your mouth wide, take a deep breath, seal your mouth around the victim's mouth, and blow into the victim's mouth with four quick but full breaths just as fast as you can. When blowing, use only enough time between breaths to lift your head slightly for better inhalation.

If you do not get an air exchange when you blow, it may help to reposition the head and try again.

AGAIN, LOOK, LISTEN, AND FEEL FOR AIR EXCHANGE.

4 IF THERE IS STILL NO BREATHING

CHANGE RATE TO ONE BREATH EVERY FIVE SECONDS.

For more information about these and other life-saving techniques, contact your Red Cross chapter for training.
"When Breathing Stops" reproduced with permission from an American Red Cross Poster.

MODEL RF-131 HF ISB SYNTHESIZED EXCITERS CONFIGURATION MATRIX AND IDENTIFICATION DATA

The Model RF-131 Exciter Configuration Identification Table presented below is intended to allow the technician to identify the exciter configuration in his posession, - it lists the major data pertinent to the configuration. Reading left to right in the table: model number, exciter type, associated transmitting system, exciter control head used, specific assemblies used, and the identifying number of the applicable instruction manual are given. If the exciter in your posession contains items that vary from the data given in the table, write to: HARRIS CORPORATION, RF Communications Division, 1680 University Avenue, Rochester, New York 14610 U.S.A.; or, telephone 716-244-5830 for assistance.

MODEL RF-131 EXCITERS – CONFIGURATION IDENTIFICATION TABLE

Model No.	Type	Used with Transmitter System Model No.	Control Head Part No.	Lower Lower Sideband Generator Module A2A1		Lower Sideband Generator Module A2A2			Upper Sideband Generator Module A2A3			Upper Upper Sideband Generator Module A2A4		Up-Converter Module A2A5 Part No.	RF Output Module A2A7 Part No.	Combiner Module A2A12 Part No.	Subcarrier Generator Assembly A2A13 Part No.	Instruction Manual Identification No.
				Module Part No.	Data Filter Part No.	Module Part No.	Data Filter Part No.	Voice Filter Part No.	Module Part No.	Data Filter Part No.	Voice Filter Part No.	Module Part No.	Data Filter Part No.					
RF-131-112	Two Channel Voice Configuration	RF-130	0759-6100			0759-3260		0759-3363	0759-3360		0759-3263			0759-3500	0759-3700	0759-4200		0759-9000D
RF-131-113	Two Channel Data Configuration	RF-130	0759-6100			0759-3200	0759-3213		0759-3300	0759-3313				0759-3500	0759-3700	0759-4200		0759-9000D
RF-131-122	Two Channel Voice Configuration	RF-130	0759-6600			0759-3260		0759-3363	0759-3360		0759-3263			0759-3500	0759-3700	0759-4200		0759-9001E
RF-131-123	Two Channel Data Configuration	RF-130	0759-6600			0759-3200	0759-3213		0759-3300	0759-3313				0759-3500	0759-3700	0759-4200		0759-9001E
RF-131-126	Four Channel Data Configuration	RF-130	0759-6600	0759-3100	0759-3113	0759-3200	0759-3213		0759-3300	0759-3313		0759-3400	0759-3413	0759-3500	0759-3700	0759-4200	0759-4300	0759-9001E
RF-131-172	Two Channel Voice Configuration	RF-745	0759-6500			0759-3260		0759-3363	0759-3360		0759-3263			0759-3570	0759-3750	0759-4200		0759-9002E
RF-131-173	Two Channel Data Configuration	RF-745	0759-6500			0759-3200	0759-3213		0759-3300	0759-3313				0759-3570	0759-3750	0759-4200		0759-9002E
RF-131-176	Four Channel Data Configuration	RF-745	0759-6500	0759-3100	0759-3113	0759-3200	0759-3213		0759-3300	0759-3313		0759-3400	0759-3413	0759-3570	0759-3750	0759-4200	0759-4300	0759-9002E

OPTIONAL EQUIPMENT AND SPARE PARTS

Listed below are optional accessories and spare parts kits available from Harris Corporation for use with the equipment described in this manual. To order any of these items, or to obtain more information concerning them write to:

HARRIS CORPORATION
RF Communications Division
1680 University Ave.
Rochester, New York
14610 U.S.A.

Attn: MARKETING DEPARTMENT

OR CALL: (716) 244-5830, and ask for Marketing Department.

When placing an order, please specify the model number and transmitting system used, (i.e. RF-130 or RF-745)
We will be happy to answer any questions you may have regarding these or any other items we manufacture. We also welcome your evaluation of our equipments and suggestions for other accessory items or spare parts.

HARRIS CORPORATION
RF Communications Division

Optional Equipment for the RF-131 Exciters
(Used with the RF-130 or RF-745 Series Transmitting Systems)

Model or Part No.	Name	Description	Use
RF-784	Full Frequency Remote Control Unit	Provides complete frequency, mode, carrier level, and keying remote control of the transmitting systems at distances up to 300 feet (92 meters); requires RF-785 Multiconductor cable.	Used to duplicate the functions of the RF-131 Exciter control head module.
RF-785	Multiconductor Cable	48 wire cable available in various lengths	Interconnects RF-784 Full Frequency Remote Control Unit with the Transmitting System.
RF-790	Channelized Remote Control Unit **Availability** **Model RF-790** – **Number of Preset Channels** -122 – 20 -132 – 30 -142 – 40 152 – 50 162 – 60 172 – 70 182 – 80 192 – 90 102 – 99	Provides preset frequency, mode, carrier level, and keying remote control of the transmitting systems at unlimited (depending on line characteristics) distances: Control is by two wire voice grade telephone line. Interconnecting cables and FSK modems are included.	Used to duplicate the functions of the RF-131 Exciter control head module.

Optional Equipment for the RF-131 Exciters (continued)

Model or Part No.	Name	Description	Use
RF-794	Full Frequency Remote Control Unit	Provides complete frequency, mode, carrier level, and keying remote control of the transmitting system at unlimited (depending on line characteristics) distances: Control is by two wire voice grade telephone line. Interconnecting cables and FSK modems are included.	Used to duplicate the functions of the RF-131 Exciter control head module.

Spares Kits for the RF-131 Exciters.

Kit Model Number	Name	Kit Description/Content
RF-131/RSK	RF-131 Running Spares Kit	This kit contains items readily replaced in field operation including those parts that may be consumed during equipment installation and setup. Typical parts include fuses, lamps, etc. This kit will normally support a single exciter for two to four years.
RF-131-122/123/172/173 SSK and RF-131-126/176 SSK	RF-131 Site Spares Kits	These kits contain those items that will allow the exciter to be repaired at the highest practical level of assembly (thus minimizing "down" or "off the air" time). These kits include a complete set assemblies and subassemblies; piece parts for items impractical to repair by assembly or subassembly replacement (such as case and chassis assembly parts), and a common hardware kit. These kits will generally support up to five exciters for two to four years.
RF-131/ARK	RF-131 Assembly Repair Kit	This kit contains all parts necessary to repair defective exciter assemblies and subassemblies. This kit supplements the RF-131-122/123/172/173 SSK and RF-131-126/176 Site Spares Kits, as it allows repair of replaced assemblies as time permits, either at the exciter site or special depot facility. Each exciter Assembly Repair Kit (ARK) will generally support a Site Spares Kit (SSK) for two to four years.
RF-131/MRK	RF-131 Maintenance Repair Kit	This kit contains maintenance items unique to the RF-131 Exciter. These items include extender boards, extender cables, tuning tools, and other special items required to maintain the exciter.

NOTE: An Operational Spares Kit is also available for support of the RF-131 Exciter when used in an RF-130 or RF-745 Transmitting System. Though primarily intended for support of the transmitting systems, this kit will allow isolation of the system troubles to the RF-131 Exciter, where the procedures of the instruction manual interface with those of the RF-130 system manual (PN 825-3005) or the RF-745 system manual (PN 6049-9100). Order the appropriate operational spares kit for your transmitting system:

RF-130/OSK — For RF-130 (1KW) systems
RF-745/OSK — For RF-745 (10KW) systems

Individual Accessories for the RF-131 Exciters (All models).

Item No.	Name	Part No.	Remarks
1	Male Adapter Cable	1001-0050 (RF)	Allows connection of test equipment directly to exciter chassis; also part of Maintinance Repair Kit RF-131/MRK.
2	Female Adapter Cable	1001-0051 (RF)	Used to allow convenient troubleshooting of the RF-131 Exciter modules; also part of Maintinance Repair Kit RF-131/MRK (items 2–12)
3	Sideband Generator Module Extender Cable	1001-0079 (RF)	
4	Up-Converter Module Extender Cable	0759-9115 (RF)	
5	RF Output Module Extender Cable	0759-9120 (RF)	
6	High Band PLL Module Extender Cable	1001-0078 (RF)	
7	Frequency Standard Module Extender Cable	1001-0081 (RF)	
8	Special Frequencies Module Extender Cable	1001-0076 (RF)	
9	Power Supply Module Extender Cable	1001-0082 (RF)	
10	Combiner Module Extender Cable	1001-0075 (RF)	
11	Subcarrier Generator Module Extender Cable	1001-0080 (RF)	
12	Low Band PLL Module Extender Cable	1001-0077 (RF)	
13	Instruction Manual	0759/9001/9002 (Current Issue) (RF)	Contains complete data on the RF-131 Exciters, All models.
14	Microphone	162-0020 (RF)	Normally supplied; dynamic microphone with Push-to-Talk (PTT) switch.
15	Connector	MS3106E-16-5S (Mil type)	Mates with case 115 VAC AUX AC POWER IN connector A1J3; Not required if RF-131 primary power is supplied from system power amplifier (for example, the RF-110A Radio Frequency Amplifier in the RF-130 system, or the RF-110B in the RF-745 system).

Individual Accessories for the RF-131 Exciters (All Models).

Item No.	Name	Part No.	Remarks
16	Connector	MS3106E-10SL-4S (Mil type)	Two required (Model RF-131-122 and -123, 172, 173) or four required (Model RF-131-126, 176); Mates with case audio input connectors A1J1 (Channel B2), A1J2 (Channel A2), A1J5 (Channel A1) and/or A1J6 (Channel B1).
17	Connector	MS3116J-22-55S (Mil type)	Mates with case Interface Connector A1J4.
18	Connector	MS3116J-22-55SW (Mil type)	Mates with Remote Control Connector A1J7; Already assembled onto interconnecting cable assembly if Remote Control Unit RF-784 have been purchased.
19	BNC Connector	UG-88E/U	Mates with INT 1 mHZ OUT connector A1J17, EXT 1 mHZ IN connector A1J18, and RF Output Connector A1J23.

TABLE OF CONTENTS – SECTION 1

NOTE

The Table of Contents which begins on this page is for Section 1 only. The Tables of Contents for Sections A2A1 through A2A17 are given at the beginning of the Sections following the Title pages. A list of Tables and a list of illustrations are also included for each Section in the same location.

LIST OF TABLES — SECTION 1

LIST OF ILLUSTRATIONS — SECTION 1

PART 1

INTRODUCTION

1.1 GENERAL DESCRIPTION

The RF-131 is an high-frequency, single-sideband exciter providing nominally 100 milli watts PEP and average on any one of 280,000 channels spaced 0.1 kHz apart in the 2 to 30 MHz range. Modes of operation include Upper Sideband, Lower Sideband, Independent Sideband (2 or 4 channels), Reduced Carrier Sideband, AM (compatible) and CW. FSK (F1) and FAX (F4) operation is possible with an external modem.

The RF-131 can be used to drive several different types of linear power amplifiers. This is accomplished by using a control head which permits the packaging of all the interface circuitry peculiar to a given system in an easily interchangeable module. With the appropriate control head installed, the RF-131 is readily interfaced with a variety of transmitting systems.

With the 0759-6600 Control Head Module Assembly installed, the basic exciter becomes the RF-131-122 or RF-131-123, (2 channel) or RF-131-126 (4 channel). The RF-131-122, -123 or -126 exciters are intended to be used with the RF-130 sieres transmitters.

With the 0759-6500 Control Head Module installed, the exciter becomes the RF-131-172 or -173, (2 channel) or the RF-131-176 (4 channel). The RF-131-172, -173, or -176 exciters are intended to be used with the RF-745 series transmitters.

Complete remote control capability is afforded by many varied types of remote controls manufactured by RF Communications. Hard wired remotes for distances up to 300 ft. or remotes for operation from a distance of hundreds or thousands of miles using a single voice-grade telephone circuit are available.

Low spurious signal production and simplicity of mechanical structure is made possible with a method of frequency synthesis involving voltage controlled oscillators, phase locked loops, and intermediate frequencies in the VHF range. Most spurious products which are generated by this method of frequency synthesis lie far above the HF range and are relatively easily filtered out. The variable counters used also provide for simple external programming or remote selection of the operating frequency.

Frequency control is digital in increments of 100 Hz from 2.0000 to 29.9999 MHz, selectable with a bank of thumb-actuated digit switches. Any selected output frequency within the range of the exciter is phase locked to a very stable internal reference oscillator maintained in a constant temperature environment. Stability of the selected output frequency is better than 1 part in 10^8 per day. The exciter may also be used with an external frequency standard. The RF-131 allows for automatic switching over from the internal standard to a secondary (external) standard, if the internal standard fails. This feature also permits frequency standards from two or more RF-131 exciters to act as standby units for each other. Automatic fault detection and switchover of the frequency source allows for continuous operation of the equipment, eliminating a transmitter shutdown due to frequency standard failure.

The RF-131 features high stability, simplicity of operation, rapid tuning, and easy of maintenance in an extremely small package. Low input power and high reliability result from solid-state construction. Maintenance of the RF-131 is simplified with total modular construction and an extendable chassis on tilt-lock slides. The construction meets MIL M-23313A (maintainability) requirements of 30 minutes or less for Mean Time to Repair (MTTR). Maintenance at the module level is aided by a standard input/output impedance of 50 ohms for all RF signal paths, simplifying test bench evaluation.

1.2 SPECIFICATIONS

Specifications for the RF-131 Exciter are listed in Table 1-1.

1.3 MODULES SUPPLIED AND OPTIONS INCLUDED

Table 1-2 lists the modules and assemblies which make up the RF-131 Exciter.

Certain modules vary slightly when used in various versions of the RF-131. The RF-131-122, -123 and -126 for use in the RF-130 System require the following:

- Up-Converter Module A2A5, PN 0759-3500 which uses a PN 0759-3510 comparator PWB Board for TGC.

- RF Output Module A2A7, PN 0759-3700 with the following internal connections:

  A7A1E6 to A7A1E14,
  A7A1E9 to A7A1E18

  These provide a fixed TGC clock speed of about 200 Hz, and couple a reset pulse into the TGC counter whenever the PPC inhibit line is activated. This reset pulse is required when tune cycles are initiated outside of the exciter, for example by pushing the RETUNE button on an antenna coupler.

The RF-131-172, -173 and -176 used in an RF-745 System require the following:

- Up-Converter Module A2A5 PN 0759-3570 which uses a PN 0759 3580 Comparator PWB for TGC.

- RF Output Module A2A7 PN 0759-3750 with the following internal connections.

  A2A7A1 E6 to A2A7A1TP2
  A2A7A1 E9 is not connected

This provides a TGC clock speed of 200Hz for increasing power and a clock speed of 1000Hz for decreasing power.

The difference between the RF-131 Exciter Models lie in the sideband selection filters supplied. The -122/172 uses Voice Filters, (PN 0759-3263 and PN 0759-3363) suitable for voice and low speed data (FSK). The -123/-173 uses Data Filters (PN 0759-3213 and PN 0759-3313). The -126/-176 uses the same filters as the -123/-172 plus Data Filters, PN 0759-3123 and PN 0759-3413. The data filters have less amplitude variation within the passband, and have controlled differential delay distortion characteristics, making them suitable for high-speed data and secure voice signals. These filters can be supplied factory installed or can be provided as a field change kit.

TABLE 1-1. RF-131 Exciters Specifications

Frequency Range	2.0000 MHz - 29.9999 MHz, digitally selected, 100 Hz increments
Stability	1 part in 10^8 /day using internal standard
Jitter	3^{o}_{RMS} in 10 ms
Frequency Standard	1 MHz, monitor output provided. Connector provided for connection of external standard. Automatic switchover to external standard if internal standard fails.
Modes of Operation	USB LSB AME CW (reinserted carrier) RATT (external RATT converter required) 2ISB 4ISB (RF-131-126 and -176 only)
Carrier Suppression	USB, LSB, 2ISB, 4ISB: Switch selectable: -10 dB; -20 dB; - ∞ (-60 dB from rated PEP). AME: -6 dB from rated PEP RATT: - ∞(-60 dB from rated PEP)
Sideband Filters:	
RF-131-122	Within 3 dB, 300 to 3500 Hz from carrier
RF-131-123, -126	Within 0.5 dB, 250 to 3040 Hz from carrier; less than 500 us differential delay distortion between 350 and 3040 Hz from carrier.
Audio Inputs	600 ohms, balanced, -25 to +10 dBm nominal.
Local Mike Input	-50 dBm, 200 ohms (dynamic)
Temperature	0^{o} C to 54^{o} C Operating Temperature
Humidity	0 to 95% Relative Humidity
Power	115 Vac ± 10%, Single Phase, 50-60 Hz, 70W
Dimensions	H x W x D: 7 in. x 17.5 in. x 17 in. (17.8 cm x 44.5 cm x 43.2 cm)
Weight	60 lbs.

TABLE 1-2. LIST OF MODULES AND ASSEMBLIES

Reference Designator	Functional Name	Coverage Included In Book Section
A1	Case Assembly	General Information
A2	Chassis-Panel Assembly	General Information
A2A1*	Lower Lower Sideband Generator Module	A2A1/A2A2/A2A3/A2A4
A2A2	Lower Sideband Generator Module	A2A1/A2A2/A2A3/A2A4
A2A3	Upper Sideband Generator Module	A2A1/A2A2/A2A3/A2A4
A2A4*	Upper Upper Sideband Generator Module	A2A1/A2A2/A2A3/A2A4
A2A5	Up-Converter Module	A2A5
A2A6	Control Head Module	A2A6
A2A7	RF Output Module	A2A7
A2A8	High Band PLL Module	A2A8
A2A9	Frequency Standard Module	A2A9
A2A10	Special Frequencies Module	A2A10
A2A11	Power Supply Module	A2A11
A2A12	Combiner Module	A2A12
A2A13*	Subcarrier Generator	A2A13
A2A14	Low Band PLL Module	A2A14
A2A15	Meter Amplifier	A2A15
A2A16	Oven/Light Regulator	A2A16
A2A17	Microphone Amplifier	A2A17
A2A18	Power Distribution Board	General Information

*Supplied in four-channel models only. (RF-131-126 and -176)

TABLE 1-3. RECOMMENDED TEST EQUIPMENT

Name	Specifications	Mfr and Model No.
RF Voltmeter	1mV to 3V, 200MHz	Boonton Model 91H with 50 ohm BNC Adapter
AF Voltmeter	0.1mV to 300V	H.P. Model 400F
Voltmeter, Multi-Function	0.5Vac to 300Vac 1.5uA to 150uA	H.P. Model 410C
Spectrum Analyzer	0 to 100MHz, 50 ohms 0 to 1000MHz, 50 ohms	H.P. 8553/8552 H.P. 8554/8552
Oscilloscope	(100mV/cm to 50V/cm, 5s/cm to 0.1us/cm)	Model 453 Tektronix (Model 454 required for High Band PLL A2A8)
DC Volt ohm Milliameter	0 to 5 MEG ohms, 0 to 1000 Vdc, 0 to 1000Vac	Simpson Model 260
DC Power Supply	0 to 25Vdc, 400mA	H.P. Model 6215A
Audio Generator, Two-tone	20Hz to 20kHz, 600 ohms	Marconi Model TF 2005
RF Attenuator	50 ohm, 0 to 100dB	Kay Electric Co. Model 30-0
RF Signal Generator	50kHz to 65MHz 0.1uV to 3V, 50 ohms	H.P. Model 606A
RF Signal Generator	10 to 455MHz 0.1uV to 1V, 50 ohms	H.P. Model 608E
Frequency Counter	0 to 50MHz	H.P. Model 5245L

PART 2

INSTALLATION AND INTERFACE DATA

2.1 POWER REQUIREMENTS

The exciter requires 115 Vac nominal, 50-60 Hz, single phase, approximately 70 Watts. When the RF-131 is a part of an RF-745 transmitting system, the exciter power will be furnished by RF-110 Radio Frequency Power Amplifier.

2.2 SITE SELECTIONS

In selecting an installation site, adequate consideration must be given to the space required. This consideration should include space for servicing the slide mounted equipment when extended from the case, cable bends, and considerations of proximity to associated equipment. See Figure 2-1 for dimensions.

2.3 INSTALLATION REQUIREMENTS

The following factors should be considered when determining the proper locations of the exciter.

a. Ease of operation.

b. Ease of maintenance, adjustment of equipment and replacement and repair of defective parts or complete units.

c. Possibility of interaction between units and other electronic equipment in the vicinity.

d. Critical and minimum cable length requirements.

e. Adequate heat dissipation.

f. Availability of adequate ground.

2.4 INTERCONNECTION/INTERFACE DATA

The RF-131 interface connectors are shown in Figure 2.2, and their functions described in Table 2-1. Detailed pin function/identification data is given in Tables 2-2 through 2-6.

2.5 INITIAL PPC AND TGC ADJUSTMENTS

At the time of installation, the power control circuits of the exciter (TGC, PPC) must be adjusted in conjunction with the associated power amplifier. Therefore the adjustment procedure is given in detail in the systems technical manuals for such systems ,as the RF-745 (Publication No. 6049-9100) which employs an RF-131 exciter.

The basic procedure is repeated here for installations not using a complete RF Communications system. A requirement is that the power amplifier provides an accurate detected envelope analog from the output of the power amplifier, to be used in the exciter for power control. The level of this envelope analog must be adjustable from +7.2V to +8.8V at the rated PEP output of the power amplifier. The procedure, in condensed form, is:

a. Key the system in CW mode, and check that the voltage at A2A5A1TP6 measures exqctly +8.0 Vdc (±0.1 Vdc). (Adjust A2A5A1R4 if necessary.)

b. The exciter TGC loop will drive the power amplifier to whatever level satisfies the comparator. Adjustment of the level of detected envelope analog at the power amplifier will be followed by a change in power output. Therefore, adjust the envelope analog until desired power output is established.

c. In USB mode, with a single tone of audio applied to A1 channel (USB) and the level set for a mid-scale indication on the front panel meter (A1 position), adjust A2A7A1R53 to the point where it just barely begins to affect the power output level.

d. The value of A2A5A1R63 may have to be changed to provide the desired system power output in tune mode.

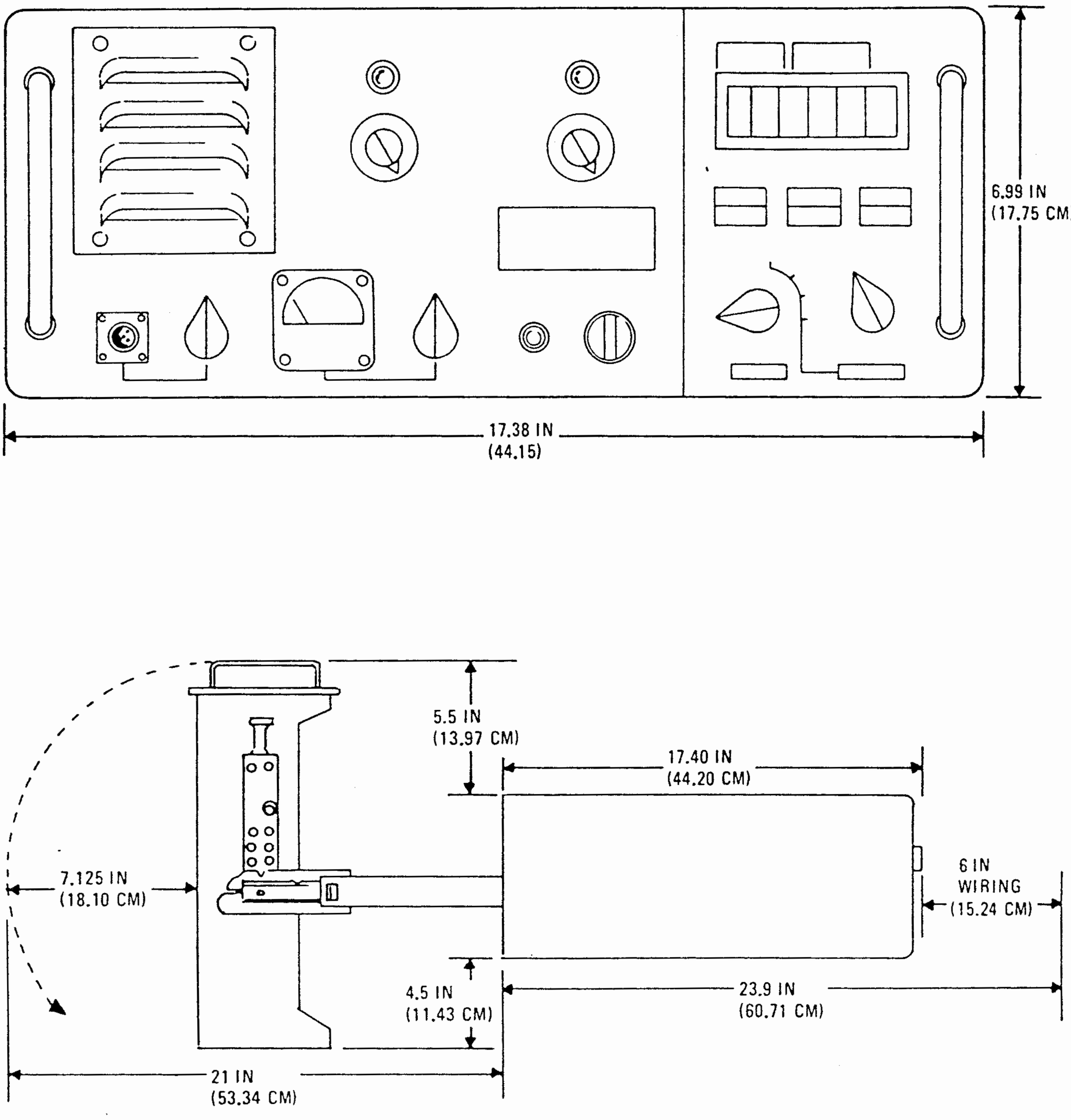


Figure 2.1 Outline and Mounting Dimensions

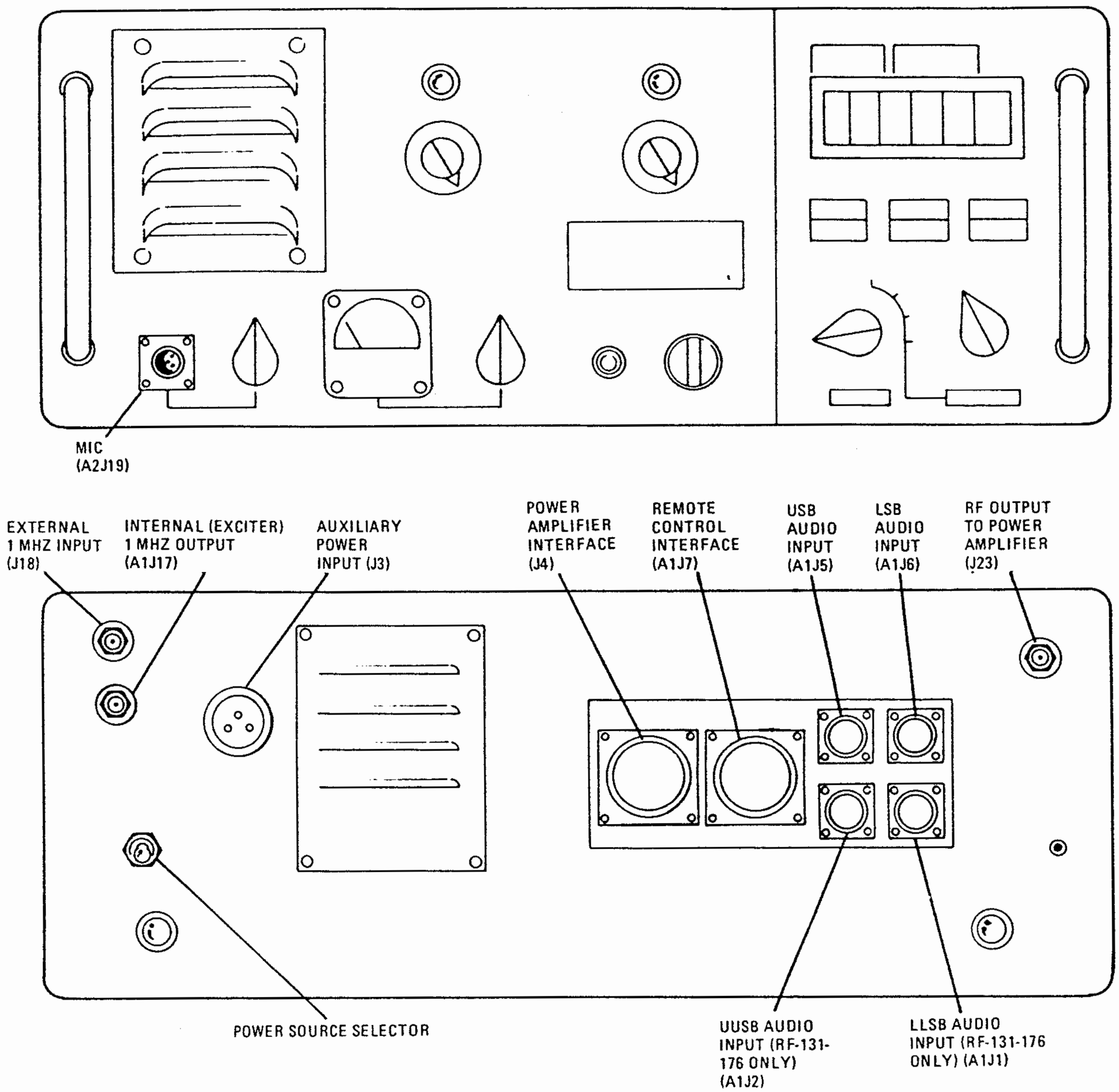


Figure 2.2 RF-131 Interface Connectors, Front and Rear Views

Table 2-1. RF-131 Exciter Connector Functions

Connector Reference Designator	Function	Identification	Typical Mating Connector
A1J1	LLSB (B2) Audio Input; Used on RF-131-126/-176 only.	MS3102A10SL4P	MS3106E-10SL-4S
J2	UUSB (A2) Audio Input; Used on RF-131-126/-176 only.	MS3102A10AL4P	MS3106E-10SL-4S
J3	115Vac Aux Ac power; Used if primary power is not provided via A1J4 from associated power amplifier. Aux AC switch A1S1 on rear of exciter must be in proper position.	PN 8001-16S-5P-FP (Sealtron; integral part of input power filter A1FL2)	MS3106E-16S-5S
J4	Interfaces with associated power amplifier and antenna coupler; amplifier band selection, keying, inhibits, PA mode control, and power control; Primary power may be applied from power amplifier. USB and LSB inputs may also be connected through this connector.	PN PT02A-22-55P (Bendix)	MS3116J-22-55S
J5	USB (A1) Audio Input; connected in parrallel with USB line in A1J4.	MS3102A10SL4P	MS3106E-10SL-4S
J6	LSB (B1) Audio Input; connected in parallel with LSB line in A1J4.	MS3102A10SL4P	MS3106E-10SL-4S
J7	Remote Control Connector. Interface with Model RF-784, RF-790, or RF-794 Remote Control Units	PN PT02A-22-55PW (Bendix)	MS3116J-22-55SW
J17	INT 1MHZ OUT; allows for external monitoring of exciter internal 1MHz frequency standard of Frequency Standard Module A2A9	PN 225398-8 (Amp, Inc.)	UG-88E/U
J18	EXT 1MHz IN; allows exciter to be referenced to an external 1MHz frequency standard.	PN 225398-8 (Amp, Inc.)	UG-88E/U
J23	RF output to power amplifier	PN 225398-8 (Amp, Inc.)	UG-88E/U
A2J19	Local Microphone Input	PN DM9606-7S (Deutsch)	PN DM9728-7P (Deutsch)

Table 2-2. A1J1, A1J2, A1J5, and A1J6 SSB Audio Connector Pin Functions.

Pin	Function
A, B	600 ohm audio connection, balanced, floating, – 25 to + 10dBm

Table 2-3. A1J4 Case Interface Connector Functional Data

Pin	Function	Signal Originates at (or is Via)	Remarks
2-A	Codeline 1	Exciter	Normal load is a 100ma/28Vdc relay coil, connected through a 19 position decoder switch.
B	Codeline 2	Exciter	
C	Codeline 3	Exciter	
D	Codeline 4	Exciter	
E	Codeline 5	Exciter	
F	Spare		
G	CW/FSK GND	Exciter	Puts PA in Class B when grounded.
H	12V return	PA	Negative side of exciter 12V PTT relay.
J	+28V interlock	PA	+28V must be present for exciter to be keyable.
K	Keyline	either	Ground equals a request for RF transmission; transmission results if there are no inhibits.
L	Spare		
M	Standby command	Exciter	Energizes Standby relay in associated PA
N	Operate command	Exciter	Energizes Operate relay in associated PA
P	Ground pulse output	Exciter	Frequency change pulse to associated PA
R	115Vac hot	PA	Primary power input
S	115Vac common	PA	Primary power input
T	+20V carrier insert	PA	Indication from associated antenna coupler that tune carrier is required.
U	115Vac remote output	Exciter	For 115V indication at remote site.
V	Spare		
W	Spare		
X	Spare		
Y	Spare		
Z	Spare		
a	Spare		
b	Spare		
c	CW/FSK Keyline	PA	Keyline for CW FSK. Ground to transmit.
d	APC	PA	Envelope analog of PA output for PPC, TGC
e	Spare		
f	LSB Audio input	PA	Wired in parallel with J6
g	LSB Audio input	PA	Wired in parallel with J6
h	Spare		
i	GND		
j	Spare		
k	+12V PTT Key	PA	Positive side of exciter 12V PTT relay.
m	Spare		
n	Spare		
p	Spare		
q	USB Audio Input	PA	Wired in parallel with J5
r	USB Audio Input	PA	Wired in parallel with J5

Note: Remaining connector pins to t through z and AA thru HH are spare, and are not used at this time.

TABLE 2-4. A1J7 Remote Control Interface Connector Pin Identification/Function.

Pin	Identification/Function
A	10M-1
B	10M-2
C	1M-1
D	1M-2
E	1M-4
F	1M-8
G	100K-1
H	100K-2
J	100K-4
K	100K-8
L	10K-1
M	10K-2
N	10K-4
P	10K-8
R	1K-1
S	1K-2
T	1K-4
U	1K-8
V	100-1
W	100-2
X	100-4
Y	100-8
Z	Spare
a	Spare
b	Remote Amplifier Off
c	Remote Operate
d	Remote Standby
e	Remote Tune Pulse

Pin	Identification/Function
f	Remote Frequency Change Pulse
g	Local/Remote Indicate
h	Remote Carrier D
i	Spare
j	Remote Fault
k	Remote Ready
m	Spare
n	Remote GND Pulse
p	Remote Operate Indicate
q	Remote Standby Indicate
r	Remote Sideband Keyline
s	GND
t	Remote Tune
u	Remote Mode A
v	Remote Mode B
w	Remote Mode C
x	Remote CW/FSK Keyline
y	Remote Carrier E
z	Spare
AA	Spare
BB	Spare
CC	Spare
DD	Spare
EE	Spare
FF	Spare
GG	Spare
HH	Spare

TABLE 2-5. A1J3 115VAC AUX AC POWER in Connector Pin Functions

Pin	Function
A	Hot
B	Common
C	Chassis GND

TABLE 2-6. A2J19 MICROPHONE Connector Pin Functions

Pin	Function
1	Spare
2	Spare
3	Spare
4	Audio to exciter
5	Audio to exciter
6	GND
7	Microphone Push-to-talk ground

PART 3

OPERATION

3.1 INTRODUCTION

The RF-131 Radio Frequency Exciter is intended for use in a complete transmitting system with control and frequency selection interfacing to a companion RF amplifier. Consequently, the operator should refer to an appropriate systems manual for overall operation. The following paragraphs describe the various controls only in so far as their effect on the exciter is concerned. A separate paragraph is devoted to each of the three steps of preparing the RF-131 for operation; selecting the mode of operation, selecting the frequency, and setting the audio input level. Tables 3-1 and 3-2 list and describe the function of each control and indicator on the front panel and control head module, respectively, the controls and indicators are shown in figures 3.1. and 3.2.

3.2 SELECTING THE MODE OF OPERATION

3.2.1 Turn-on Procedure

Set the exciter's MODE Selector to any position except AMPL OFF. The STANDBY portion of the STANDBY/OPERATE Pushbutton will illuminate.

After the STANDBY portion of the pushbutton switch is illuminated the STANDBY/OPERATE Pushbutton can be depressed. The STANDBY portion of the pushbutton will extinguish and the OPERATE portion will illuminate.

When primary power is first applied to the exciter, some time will be required for the frequency standard to warm sufficiently to provide the proper frequency output. Under most conditions, the internal frequency standard will be stabalized sufficiently to permit normal operation in about 10 minutes. After a maximum of 15 minutes, it will be sufficiently stabilized to meet most transmitting requirements, regardless of ambient temperature prior to turn-on. The frequency standard will reach stabilization a maximum of 4 hours after turn-on.

NOTE

To avoid frequency standard warmup periods when the system is to be shut down for brief periods, do not interrupt primary power to the exciter. The frequency standard will remain on even when the MODE Selector is set to AMPL OFF. (If primary power is present, either the LOCAL or REMOTE lamp will remain on.)

The operator can check frequency difference between the Internal Standard and an External 1MHz Standard (applied to EXT 1MHz in connector A1J18) by placing the INPUT LEVEL FREQUENCY COMPARISON Selector to FREQUENCY COMPARISON position. The frequency difference between the two standards will be indicated by fluctuations up and down scale at a rate equivalent to the cycles-per-second (CPS) difference. (It will not indicate whether the internal frequency is higher or lower than the external standard.) The damping action of the meter will limit the indication to a maximum of approximately 10 CPS. Therefore, meter indication may not be accurate until the internal frequency standard has had a minimum of 10 minutes warmup after initial turn-on. See Section A2A9 for instructions on adjusting the frequency of the internal standard.

The FREQUENCY STANDARD FAULT indicator will illuminate if a failure occurs in the internal oscillator output. However, if the set is receiving an external Standard input, the exciter will automatically switch to the external standard and continue to function.

NOTE

To take advantage of this automatic switchover feature the frequency standard of one exciter can also function as external standard for another by connecting the INT. 1MHz OUT connector (A1J17) output of the first exciter to the EXT 1MHz in input connector (A1J18) of the second.

3.2.2 Mode Selection

With exciter MODE selector set at any position except AMPL OFF, the STANDBY portion of the STANDBY/OPERATE pushbutton will go On, and the STANDBY/OPERATE pushbutton can be depressed.

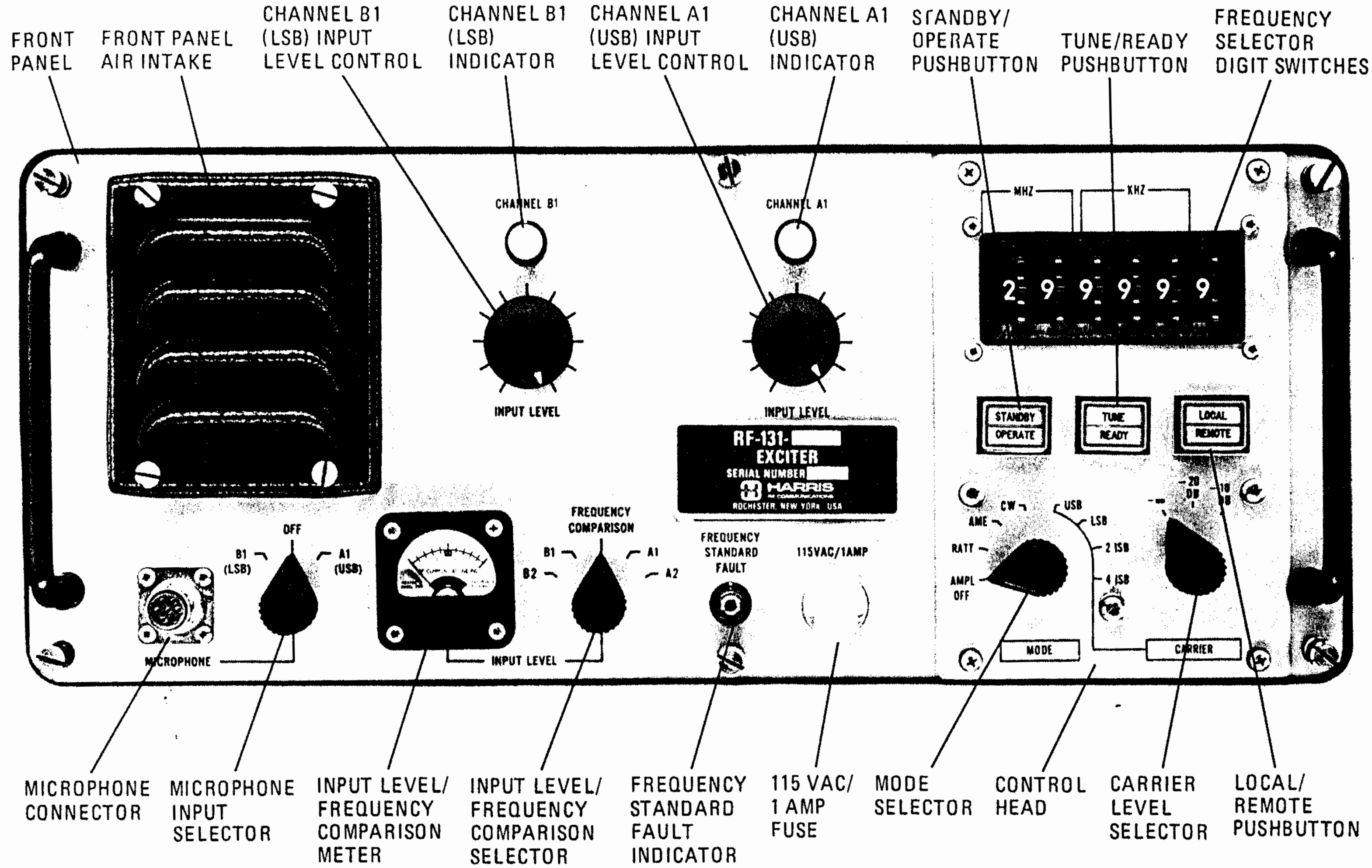


Figure 3.1 Front Panel/Control Head Controls and Indicators RF-131-122 and -172.

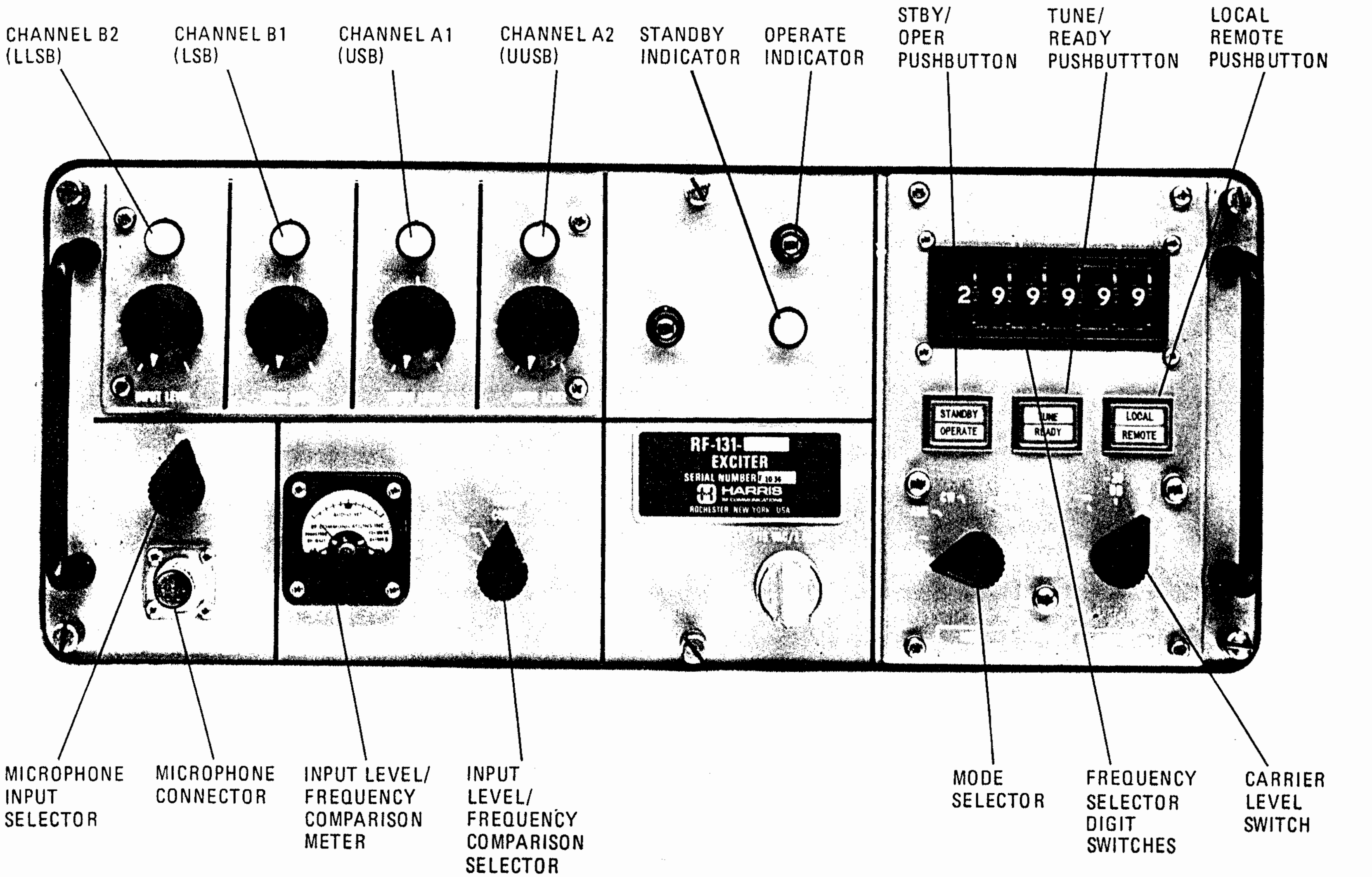


Figure 3.2 Front Panel/Control Head Controls and Indicators RF-131-126 and -176.

NOTE

Always place MICROPHONE switch in OFF when not using the microphone.

3.2.2.1 Single Sideband Operation (LSB or USB)

Two single sideband channels are available in the RF-131 Exciters, USB and LSB. There are no provisions for switching the remote inputs to the RF-131 from one channel to another. Therefore, USB must be used when the remote input is through the upper sideband inputs A1J4-q and -r (or A1 Channel input A1J5). LSB must be used when the remote input is through A1J4-f and -g (or B1 Channel input A1J6). For local inputs through the front panel MICROPHONE connector, setting the MICROPHONE input selector at USB or LSB will connect the microphone audio to the indicated channel, while interrupting any remote signal input (through the connectors on the rear of the case) to that channel. The CHANNEL indicator for the selected sideband will illuminate when the MODE selector is set to that position. Refer to paragraph 3.3 before keying.

3.2.2.2 Independent Sideband Operation (2 or 4 ISB)

Setting the MODE selector to 2ISB will cause the CHANNEL A1 and B1 indicators to illumunate. See Figure 3.1. Setting the MODE selector to 4ISB will cause CHANNEL A1, A2, B1 and B2 to illuminate. See Figure 3.2. Set the audio level for each channel according to the instructions of paragraph 3.3 before keying. As explained under single sideband operation, there are no provisions for switching the remote inputs to the RF-131 from one channel to another. Therefore, the connectors specified in paragraph 3.2.2.1 must be used for USB and LSB inputs. Setting the front panel MICROPHONE input selector to USB or LSB will connect the microphone audio input from the front panel MICROPHONE input selector to the indicated channel, while interrupting any remote signal input through that channel.

3.2.2.3 Teletype (FSK) Operation RATT

For FSK operation, an appropriate converter or modem will be required. Apply the audio tones from the modem to the USB or AUX USB input (paragraph 3.2.2.1). Set the MODE selector to RATT. The A1 (USB Channel indicator will illuminate indicating that the upper sideband channel is active). Set the audio level according to instructions of paragraph 3.3.

3.2.2.4 Amplitude Modulation Equivalent (AME) Operation

For AME operation, set the MODE selector to AME. The CHANNEL A1 Indicator will go on, indicating that the upper sideband channel is active. Audio may be applied through the connectors on the rear of the case for USB (paragraph 3.2.2.1) or through the front panel MICROPHONE Connector. (If the front panel MICROPHONE connector is used, the MICROPHONE Input Selector must be set at USB.) The audio from the USB channel will be combined with the carrier to provide a compatible AM signal. Set the audio level according to instructions of paragraph 3.3.

3.2.2.5 Telegraph (CW) Operation

When the MODE selector is set at CW (for CW transmission), all sideband channels are disabled. The CW key is remotely connected through the CW/FSK keyline, connector pin A1J4-c on the rear of the case.

3.2.3 Carrier Reinsertion Procedure

The carrier can be reinserted at -10 or -20dB below PEP, or fully suppressed ($-\infty$CARR), by the CARRIER LEVEL selector on the Control Head. This selects functions only in USB, LSB and ISB Modes. The level of carrier insertion in all other modes is predetermined and not adjustable. This feature is generally used with receivers having Automatic Frequency Control or Coherent Automatic Gain Control.

3.3 SETTING INPUT SIGNAL LEVEL

The levels of the input signals (audio of FSK) are set by using the INPUT LEVEL meter, and the channel INPUT LEVEL control for the channel to be adjusted; A1 for USB, B1 for LSB. Adjust the channel INPUT LEVEL control for the selected channel to provide a center scale reading on the INPUT LEVEL meter, with the FREQUENCY COMPARISON selector set to that channel. (For voice signals, set the Channel INPUT LEVEL control to provide an average center scale reading.) When using two-channel ISB, both channels are still set for a center scale indication on the INPUT LEVEL FREQUENCY COMPARISON meter -the exciter automatically compensates to divide total RF output power properly between the channels used.

3.4 FREQUENCY SELECTION

Select the desired operating frequency with the frequency selector switches on the Control Head front panel. The switches control the output frequency in steps of 100Hz from 02.0000MHz to 29.9999MHz. The frequency indicated at the switches represents the carrier frequency in any of the possible modes of emmission including CW.

3.5 KEYING

Provisions exist for remote keying the RF-131 in each mode. For voice transmission, single or multiple sideband, the RF-131 is keyed through A1J4-K or through the remote 12V PTT circuit A1J4-k and H. For RATT (FSK) or CW modes, the CW/FSK keyline is grounded through A1J4-c. When using a microphone connected to the front panel MICROPHONE connector, the system is keyed through A2J19-7 and the MICROPHONE input selector (the MICROPHONE input selector must be set at USB or LSB in order to key the exciter through the MICROPHONE connector).

When transmitting 2ISB, and using the front panel microphone for one channel, either of the remote keylines or the MICROPHONE connector keyline connection will key the RF-131. The PTT switch on the microphone switches MIC audio as well as grounding the keyline, to prevent inadvertent transmission of local sounds while the RF-131 is remotely keyed.

TABLE 3-1. FRONT PANEL CONTROLS AND INDICATORS (Excluding Control Head)

Control or Indicator	Function	
CHANNEL A1/B1,A2/B2 Indicators	Illuminate to indicate the channel that is active; selected by the MODE Selector	
INPUT LEVEL Control	One for each channel; Used to adjust audio input level.	
MICROPHONE Connector	Connector for local microphone.	
MICROPHONE Input Selector	Switches the microphone audio to the indicated channel and provides keyline from microphone PTT switch	
	POSITION	**OPERATION**
	OFF	Microphone input and microphone PTT keyline disconnected.
	B1 (LSB)	Microphone input is connected to LSB channel. Microphone PTT keyline is connected to permit keying from microphone PTT switch.
	A1 (USB)	Microphone input is connected to USB channel. microphone PTT keyline is connected to permit keying from Microphone PTT Switch.
INPUT LEVEL FREQUENCY COMPARISON Meter	Indicates level of signal selected by INPUT LEVEL FREQUENCY COMPARISON Selector	
INPUT LEVEL FREQUENCY COMPARISION Selector	Connects meter to audio input for audio monitoring, or to Frequency Standard's frequency comparison circuit, for adjustment of exciter's frequency standard.	
115VAC/1AMP (Fuseholder)	Holder for fuse in power input line; illuminate when fuse is blown or absent.	
FREQUENCY STANDARD FAULT Indicator	Illuminate when Internal Frequency Standard has failed.	

TABLE 3-2. CONTROL HEAD CONTROLS AND INDICATORS

Control	Function
FREQUENCY Selector Digit Switches	These switches are used to set the exciter's transmitting frequency. These switches control the carrier (output) frequency in incremental steps to a resolution of 100Hz, from 02.0000MHz to 29.9999MHz. The indicated frequency represents the carrier frequency position in any of the modes of emission, including CW.
STANDBY/OPERATE Pushbutton Switch	Changes the system/transmitter status from Standby to Operate, or vice-versa; pushbutton segments illuminate to indicate system/transmitter status.
TUNE/READY Pushbutton Switch	Allows commencement of system Tune Cycle when depressed; TUNE segment illuminates when Tune Cycle is in progress; READY segment illuminates when Tune Cycle has been completed.
LOCAL/REMOTE Pushbutton Switch	Allows system to be controlled from a Local (front panel) or Remote source; pushbutton segments illuminate to indicate control source.
MODE Selector	Allows selection of system operating mode; also energizes system power amplifier.

Selector Position	Operational Mode Description
AMPL OFF	Removes power from amplifier units but exciter frequency standard oven remains on to maintain long-term frequency stability.
RATT	Exciter is placed in RATT mode. A1(USB) CHANNEL indicator will illuminate. FSK audio tones (applied through an appropriate converter) are transmitted as upper sideband when exciter is keyed by grounding CW/FSK keyline through pin A1J4-c. Changes PA operating parameters.
AME	Exciter is placed in AME mode. A1 (USB) CHANNEL indicator will illuminate. Signals applied to one of the USB inputs will be transmitted as compatible AM (carrier plus upper sideband) Exciter is keyed through A1J4-K or remote 12V PTT.
CW	Exciter is placed in CW mode with audio circuits disabled. Carrier is keyed through CW/FSK keyline on A1J4-c. Changes PA operating parameters.
USB	Exciter is placed in USB mode with USB channel active. A1 (USB) CHANNEL indicator will illuminate. Signals applied to the USB Channel will be transmitted as upper sideband. Exciter is keyed through A1J4-K or remote 12V PTT.
LSB	Exciter is placed in LSB mode with LSB channel active. B1 (LSB) CHANNEL indicator will illuminate. Signals applied to the LSB channel will be transmitted as lower sideband. Exciter is keyed from pin A1J4-K or remote 12V PTT.

TABLE 3-2. CONTROL HEAD CONTROLS AND INDICATORS (Cont.)

Control	Function	
MODE Selector (Cont.)	**Selector Position**	**Operational Mode Description**
	2ISB	Exciter is placed in 2ISB mode. A1 (USB) and B1 (LSB) CHANNEL indicators will illuminate. Separate signals applied to USB and LSB inputs will be transmitted as separate upper and lower sidebands simultaneoulsy. Exciter is keyed through A1J4-K or remote 12V PTT.
	4ISB	Exciter is placed in 4ISB mode with A2(UUSB), A1(USB), B2(LLSB) and B1(LSB) channel active. All four CHANNEL indicators will illuminate separate signals applied to inputs will be transmitted simultaneously. Exciter is keyed through A1J4-K or 12V PTT (Only on RF 131-126)
		NOTE Setting the MICROPHONE input selector to USB or LSB will interrupt remote audio signals on that channel, and connect the output of the microphone amplifier to the channel input. Set the selector to USB or LSB allows the Microphone PTT to key the exciter if the MODE Selector is at LSB, USB, 2ISB, or 4ISB positions. At the same time the Remote 12V PTT keying path is disabled of the MODE Selector is at LSB, USB or AME positions.
CARRIER Level Selector	Allows the insertion of a selectable amount of carrier signal when the system is in any sideband mode; reinsertion levels available (measured from full PEP) are -20dB and -10dB.	

PART 4

BLOCK DIAGRAM DISCUSSION

4.1 GENERAL

Figure 4-1 is a simplified block diagram of the RF-131 Exciter. The blocks on the Figure indicate functional rather than actual names (see Table 4-1). This is done to provide a better understanding of the more complex circuits shown on the system block diagrams (Figures 4-2 and 4-3). In addition, many of the circuits shown on the system diagram are not shown on the simplified block diagram. This is done to avoid confusing overall operational discussion with specific details.

4.2 SIMPLIFIED BLOCK DIAGRAM DISCUSSION

As shown on Figure 4-1, there are two audio inputs and a 1.75MHz carrier applied to the Balanced Modulators. The outputs of the Balanced Modulators are independent upper and lower sidebands of a greatly reduced 1.75 MHz carrier. The upper sideband contains audio 1 information and the lower sideband contains audio 2. The lower sideband is removed from the upper sideband channel by the Upper Sideband (USB) Filter and the upper sideband is removed from the lower sideband channel by the Lower Sideband (LSB) Filter. The output of the USB Filter is therefore the upper sideband modulated by audio 1 and the output of the LSB Filter is the lower sideband modulated by audio 2. These outputs are combined and applied to Mixer 1.

NOTE

Switching circuits, not described here, are used to select the MODE to be transmitted. That is, sideband,CW, AME. In addition, up to two more balanced modulators and sideband filters are used in the RF 131-126 and -176 to produce an upper upper sideband and a lower lower sideband signals. These are covered on the system block diagram discussion which follows, but are not included here for simplicity.

Mixer 1 mixes the 1.75MHz sidebands with the frequency produced by the 100Hz Frequency Synthesizer. This synthesizer generates one of a possible 999 frequencies in the 18,250 to 18,350KHz range. Each one of these frequencies is separated from the next by 100Hz. This creates 999 x 100Hz or 99,900Hz which is the frequency spread between 18,250 and 18,350KHz. The Figure illustrates a frequency of 18,312KHz being generated by the 100Hz Frequency Synthesizer in response to 620 set into the thumb switches.

The output of Mixer 1 is 20,000 to 20,100KHz (20,062 shown on the Figure) which is the sum of the frequencies mixed in Mixer 1. The difference frequency is filtered out by the 20MHz bandpass filter. The output of this filter is applied to Mixer 2 where it is subtracted from a fixed frequency of 180MHz. The output of Mixer 2 is applied to a 160MHz Bandpass Filter which removes all frequencies except the 159 to 160MHz range. This frequency (159.938MHz shown) is applied to Mixer 3 where it is mixed with the frequencies generated by the 100KHz Frequency Synthesizer. This synthesizer produces 279 frequencies 100KHz apart, controlled by the first three digits of the selector thumb switch. These frequencies cover a range of 27,900KHz and are placed in the 162 to 189.9MHz range. (174.200MHz Bandpass Filter is subtracted from the output of the 100KHz Frequency Synthesizer and the operating frequency is developed. The Figure shows 159,938 being subtracted from 174,800 producing the output frequency of 14.262 which is the frequency set into the switches.

TABLE 4-1. SIMPLIFIED BLOCKS vs. EQUIPMENT

Figure 4-1 Names	Figures 4-2 and 4-3 Names
Bal Mod and USB Filter	USB Generator Module A2A3
Bal Mod and LSB Filter	LSB Generator Module A2A2
Combiner	Combiner Module A2A12
Mixer 1, 20MHz Bandpass Filter and Mixer 2	Up-Converter Module A2A5
160MHz Bandpass Filter	160MHz Bandpass Filter
Mixer 3 and Low Pass Filter	RF Output Module A2A7
100Hz Frequency Synthesizer	Special Frequency Module A2A10 and Low Band PLL Module A2A14
100KHz Frequency Synthesizer	High Band PLL Module A2A8

4.3 SYSTEM BLOCK DIAGRAM DISCUSSION

The following description will give a general understanding of the relationship between modules. Detailed descriptions of the functions of the individual modules will be found in the first few paragraphs of the respective Unit Instructions.

Refer to Figure 4-2 and 4 3. Audio signals enter the RF-131 Exciter through the two audio inputs on the rear of the case-J5 and J6 in the two channel exciters. In the four channel exciters the audio enters at J5, J6, J2 and J1. The audio signals are applied via the case and chassis cable harnesses to their respective Sideband Generator modules where a balanced 600 ohm impedance is established by a coupling transformer.

All Sideband Generator modules are alike, with the exception of the sideband channel selection filters. Each sideband generator translates its audio input signal to an intermediate frequency SSB signal. The two channels receive a 1.75MHz carrier injection frequency from Special Frequencies module A2A10. The four channel injection frequencies are 1.756290 for the UUSB and 1.74310 for the LLSB. This is produced by Subcarrier Generator Module A2A13 (Figure 4-3). The intermediate frequency SSB signals from the Sideband Generator module are applied to Combiner module A2A12.

The Combiner module produces a composite signal and gates on or off the separate SSB signals (from the Sideband Generator modules) and the 1.75MHz carrier (from the Special Frequencies module), according to instructions received from the Control Head. Adjustment of signal level before insertion of carrier is provided by the PPC (Peak Power Control) attenuator in response to signals related to output power from an associated power amplifier.

Following the Combiner module, the 1.75MHz 1st IF is translated to 160MHz (nominal) by a two step mixing process in the Up-Converter module A2A5. The first mixer mixes the incoming 1st IF to 20.05 ± .05MHz, using an injection frequency of 18.30 ± .05MHz, the exact frequency depending on the setting of the last 3 digits of the Control Head frequency selector switch. This injection frequency is derived from the Low Band PLL (Phase Locked Loop) via the Special Frequencies module.

The second mixing step in the Up-Converter Module involves a fixed frequency injection of 180MHz from the Special Frequencies module and results in a difference 160MHz (159.95 ± .05MHz). A 160MHz bandpass filter between the Up-Converter module and the RF Output module A2A7 eliminates the sum generated by the 2nd mixer (200.05 ± .05MHz).

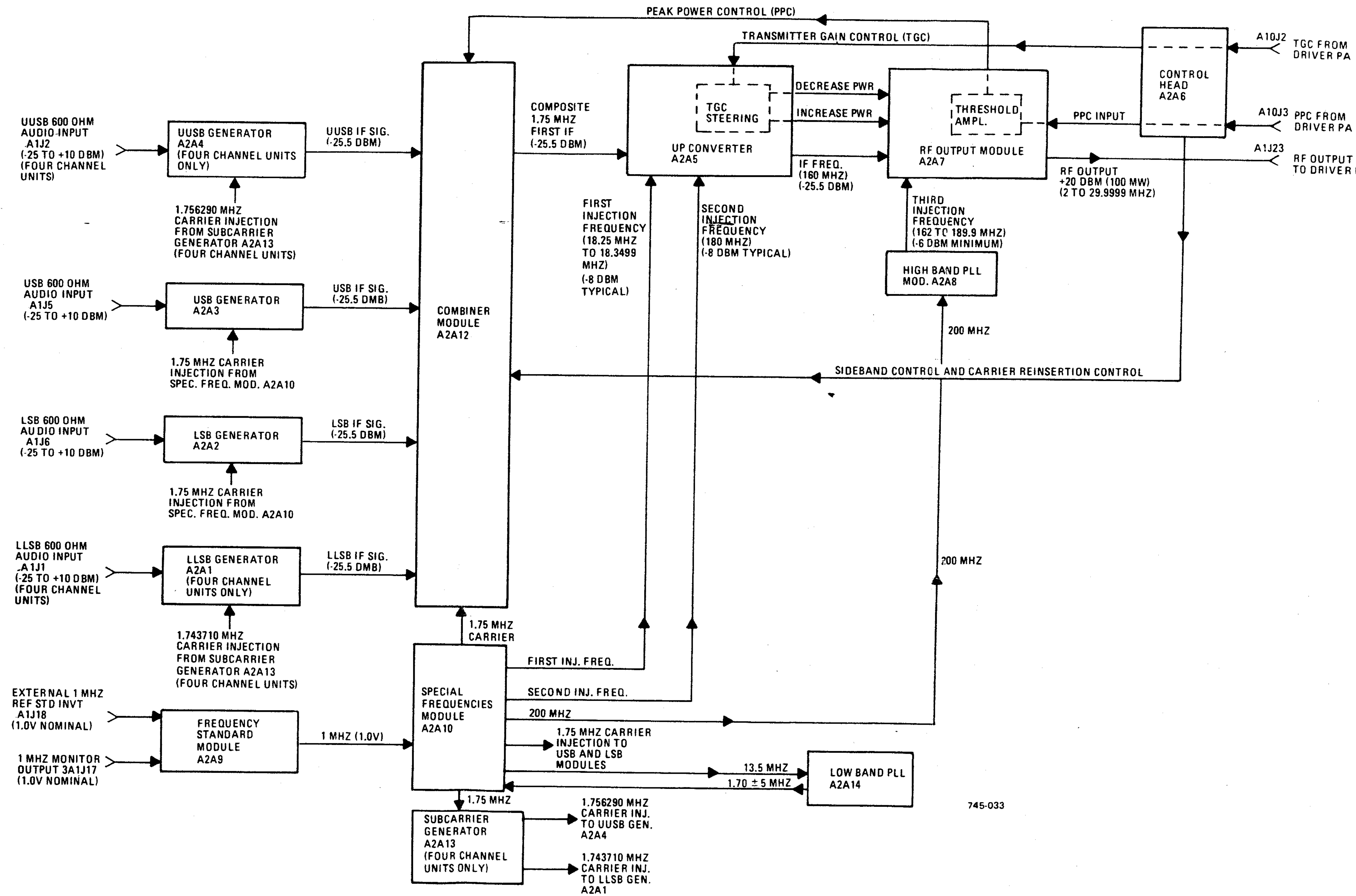


Figure 4-1. **RF-131 Exciter Simplified Block Diagram**

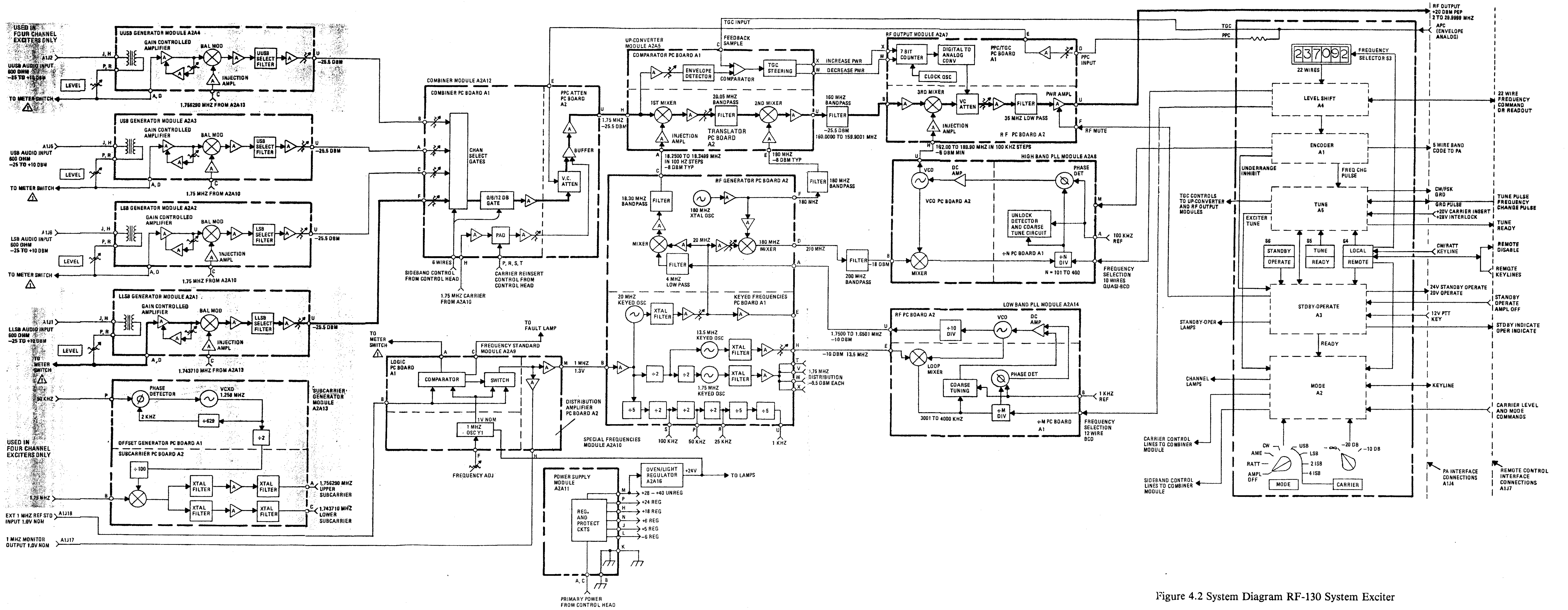


Figure 4.2 System Diagram RF-130 System Exciter

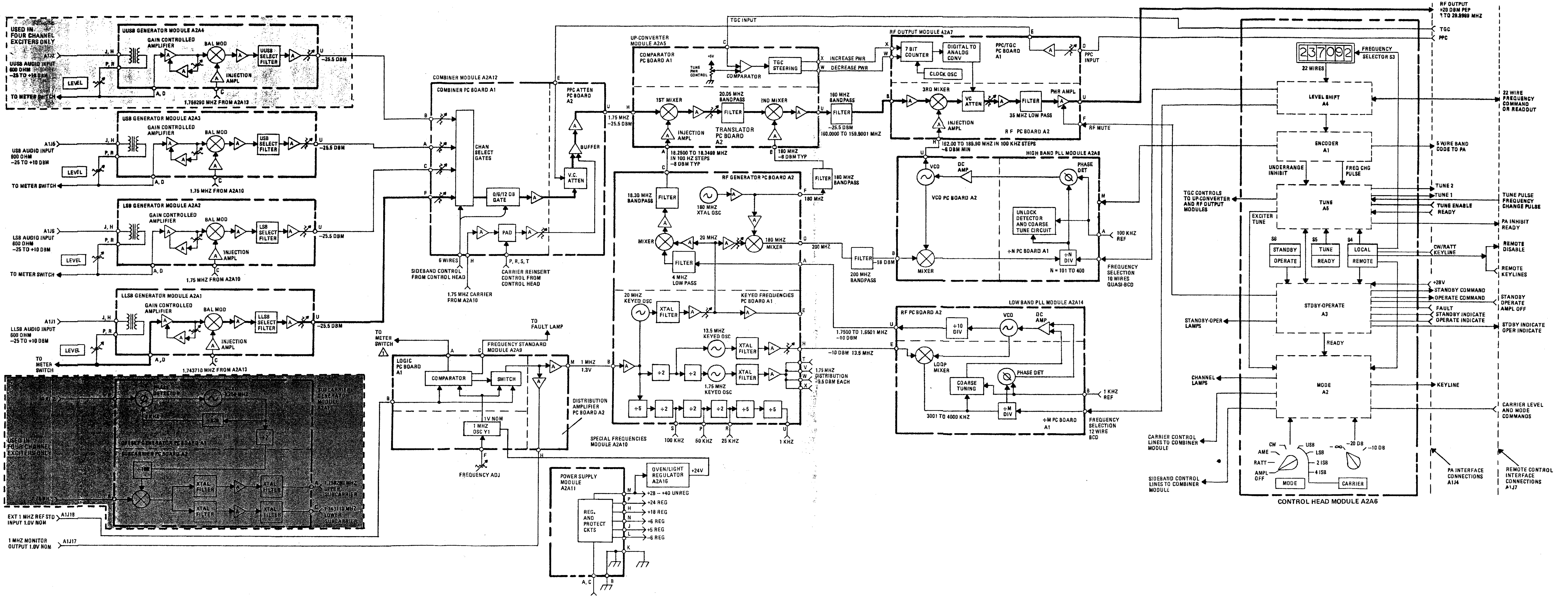


Figure 4.3 System Diagram RF-745 System Exciter

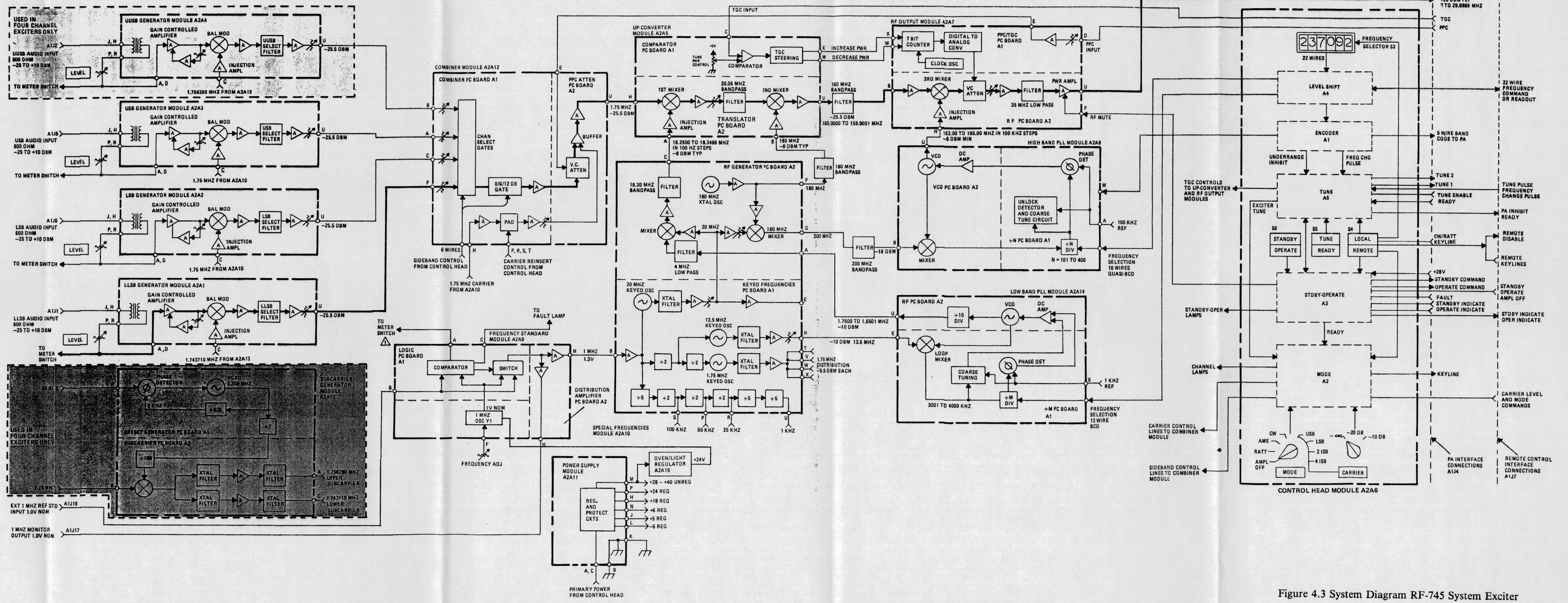


Figure 4.3 System Diagram RF-745 System Exciter

The final output frequency is generated on the RF Output module by mixing the 160MHz IF from the Up-Converter with a 162.0-189.9MHz injection from the Hi Band PLL module. The frequency of the injection is determined (in 100kHz increments) by the first three digits of the Control Head frequency selector switch.

As a result of the two variable-frequency injections (18.30±.05MHz into the Up-Converter and 162.0-189.9MHz into the RF Output module), the full range of 2.0000 to 29.9999MHz (carrier frequency) is available, in 100Hz steps. The signal is raised to a level of +20dBm (100mw) PEP by several amplifier stages. The TGC (Transmitter Gain Control) attenuator may reduce the power in response to signals from an associated power amplifier.

Two variable attenuators are present in the signal path to automatically maintain correct power output from the transmitting system Both respond to control signal feed back from the associated power amplifier. The PPC (Peak Power Control) attenuator, located in the Combiner module and driven through an amplifier in the RF Output module, is used to provide attenuation based on the peak output level at the power amplifier output, so that the PEP rating of the PA is not exceeded. The TGC attenuator is adjusted to compensate for changes in system gain due to changes in selected frequency temperature, etc. The TGC attenuator is adjusted by a digital counter (memory) and D/A converter in response to signals from a comparator circuit. The comparator is located in the Up-Converter module, while the counter D/A converter and TGC attenuator are in RF Output module.

4.4 SYNTHESIZER

The Frequency Standard, Low Band and High Band PLL, and Special Frequencies modules comprise the synthesizer. Its function is to provide accurate, stable frequencies.

All reference frequencies in the exciter are derived from the 1MHz output of the Frequency Standard Module A2A9. The 1MHz is generated by a very stable oscillator maintained in an oven with proportional temperature control. Power for the 1MHz Frequency Standard oven is supplied by a ±24VDC supply on the Oven/Light Regulator PWB A2A16. The frequency stability of the standard (and therefore of the overall exciter) is 1 part in 10^8 per day after a 4 hour warmup. Failure in the 1MHz output from the Frequency Standard is indicated by the front panel FREQ STD FAULT lamp. The frequency of the standard can be monitored at J17 on the rear of the exciter cabinet. Alternatively, the exciter can be referenced to an external 1MHz standard input ($1V_{RMS}$) applied at J18 on the exciter case. The external standard is then selected with a small toggle switch inside the Frequency Stãndard module. In the event the internal frequency standard fails during normal operation (exciter referenced to the internal standard), the exciter switches to the exteranl standard input automatically.

The Special Frequencies module contains a number of dividers and keyed oscillators to produce certain fixed frequencies required elsewhere in the exciter, all locked to the frequency standard to maintain accuracy and stability.

The 18.30±.05MHz injection frequency for the first mixing step in the signal path is developed in the Special Frequencies module where a 1.70±.05MHz input from the Low Band PLL A2A14 is translated to 18.30±.05MHz by difference mixing with a fixed 20 MHz. The Low Band PLL output frequency is selectable by the equipment operator in 100Hz increments from 1.6501MHz to 1.7500MHz by the last 3 digits of the Control Head frequency selector. Frequency selection information is transferred from the Control Head to the Low Band PLL in BCD (binary-coded-decimal). Any of the selected output frequencies from the Low Band PLL module is compared and phase locked to a 1kHz reference frequency derived from the very stable 1MHz output from the Frequency Standard module A2A9.

The 180MHz injection for the second mixing step in the signal path is derived from a crystal oscillator in the Special Frequencies module.

The High Band PLL module (A2A8) is the source of injection frequencies for the final mixing step in the signal path. The output frequency of the High Band PLL is selectable by the equipment operator in increments of 100kHz from 162.00 to 189.90MHz with the first 3 digit switches on the Control Head frequency selector. As in the Low Band PLL, frequency information is transferred from the Control Head to the Hi Band PLL in BCD. Any selected output frequency is phase locked to the 100kHz Reference jnput derived from the 1MHz Standard.

4.5 FREQUENCY SELECTION

This paragraph illustrates how to determine the frequencies which result at various places in the synthesizer and signal path in response to settings of the frequency selector switch.

The frequency generated by the Hi Band PLL is equal to 160MHz plus 100kHz times the first 3 digits on the frequency selector switch. Example: Switch Setting: 12.3657MHz Hi Band Frequency = 160MHz + (100kHz x 123) = 160MHz + 12.3MHz = 172.3MHz.

The frequency generated by the Low Band PLL's oscillator equals 17.5MHz minus 1kHz times the last three digits on the frequency selector switch. Example: Switch Setting: 12.367MHz.

Lo Band Osc. Frequency = 17.5MHz − (1kHz x 657) or

17.500MHz − 0.657MHz = 16.843MHz.

The output of the Low Band PLL module is one tenth of that frequency (1.6843MHz in the example).

The frequency delivered to the Up-Converter for the first mixing step equals 18.250MHz plus 100Hz times the last three digits of the frequency selector switch. In the example, 18.250MHz + (100Hz x 657) = 18.3175MHz.

The frequency of the carrier in the 2nd IF will be 20MHz plus 100Hz times the last three digits of the frequency selector switch.

The frequency of the carrier in the 3rd (last) IF will be 160MHz minus 100Hz times the last three digits of the frequency selector switch.

Note that because the mixing step to 160MHz is a difference mixing, the positions of the sidebands will be reversed in the 3rd IF. That is, USB will be below the carrier at this point. However, the final mixer re-inverts the signal so correct sideband positions appear at the output of the exciter.

It may be noted that the 180MHz injection to the second mixer comes from a crystal oscillator not referenced to the Frequency Standard. Therefore any frequency error in 180MHz oscillator will appear in the last IF. However an equal error will appear in the Hi Band PLL frequency, in such a polarity that the error is subtracted out in the final mixing step, and no error appears at the exciter output. The required error to accomplish this cancellation appears in the Hi Band PLL output because the 180MHz oscillator is used to construct the 200MHz reference needed by the Hi Band PLL.

4.6 OTHER CIRCUITS

The Control Head module A2A6 is the control center for the entire exciter. It develops binary-coded-decimal information from an operator-controlled digit switch for frequency control of the high and low band phase locked loops as well as mode and carrier reinsert information for the combiner module. In addition, it provides the interfacing between the exciter and the rest of the system. Further information concerning the Control Head Module is found in Section A2A6 of this technical manual.

Power Supply module A2A11 provides all DC voltages required throughout the exciter, some regulated, others merely rectified and filtered.

Meter Amplifier A2A15 amplifies and detects audio levels applied to the Sideband Generator modules, so that audio level can be indicated by the INPUT LEVEL meter.

Mike Amplifier A2A17 amplifies signals from the microphone to an adequate level for application to the Sideband Generator module.

Power Distribution Board A2A18 provides interconnection points for distrubution of power from the Power Supply module.

PART 5

MAINTENANCE

5.1 SCOPE

This part gives overall maintenance instructions for the Exciter. Detailed adjustment and maintenance procedures are given in the appropriate tabbed sections of this manual.

5.2 FAULT ISOLATION

The first step in the troubleshooting procedure is symptom recognition based upon a complete knowledge and understanding of the equipment characteristics. Not all equipment troubles are the direct result of component failure. For example, a trouble may cause only a condition of less than peak performance. It is important that these degradations be recognized, as well as complete failures.

The next step in logic troubleshooting is to formulate a number of logical choices as to the cause and likely location of the trouble. Does the equipment work in some modes but not in others? How about other frequencies? Table 5-1 is a list of possible fault conditions and probable causes.

The modular construction of the RF-131 lends itself to a logical and straight forward troubleshooting procedure. With reference to the overall Functional Block Diagram (figure 4.1), with its level and frequency information for all inter-module signal and injection paths, a trouble can be quickly localized to a particular module.

The quickest and most convenient method of confirming the correct input levels to a suspected module is to temporarily remove the module from the chassis and connect a Boonton type 91H or equivalent RF voltmeter (with a 50 ohm probe adaptor) to the indicated chassis connector pin(s) with a short BNC-to-Winchester adapter cable, (see paragraph 5.7). The 50 ohm probe adaptor simulates correct loading on the signal source.

NOTE

Do not connect the 50 ohm load to any digital input, since this is too heavy a load for the digital integrated circuits. For these circuits, use an oscilloscope with a high impedance probe.

Obviously the lack of a key input signal indicates the trouble to be in an earlier module. Similarly, output signal levels can be measured conveniently by temporarily removing the following module.

After establishing the existence of a trouble in a particular module, the servicing information for that module should be referred to. This instruction manual is divided into a series of Unit Instruction booklets, one for each module. Each Unit Instruction booklet contains the theory of operation, key signal levels and adjustment procedure(s) for the module described. Again, a logical procedure guided by a knowledge of circuit function will isolate the problem. Occasionally, however, a quick check of the more obvious possibilities first will save a lenghty troubleshooting procedure (i.e., are all the pins secure in the module and chassis connectors? Are all DC input voltages present? Has the module POSITIVELY been isolated as the cause of the malfunction?) Access to the module PW boards (while the exciter is operating) can be obtained by extending the module off the chassis by means of one of the module extender cables. (These extender cables may be ordered from RF Communications, Inc. See table 1-3.)

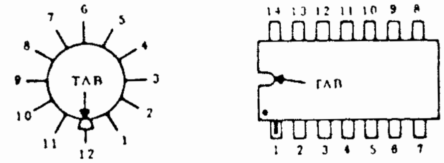
5.3 PW BOARDS REPAIRS

The following general rules and techniques have proven useful in servicing the PWB's of the RF-131 exciter.

TABLE 5-1. TROUBLESHOOTING CHART

This chart is intended to serve as a guide to indicate those areas which should be checked first in the event of improper operation.

Condition	Possible Cause	Check
No Exciter Output	1. No AC Power to Exciter	Exciter STANDBY or OPERATE indicator should be illumunated. If not, the exciter may lack AC power. Refer to systems manual.
	2. Exciter not connected	Check RF cabling from exciter.
	3. No Audio input	Set INPUT LEVEL meter switch to desired channel. Some indication should be noted.
	4. Exciter RF output Module Muted	To provide RF output power the exciter must be in an OPERATE mode, be keyed, have +28V Interlock present, be set for a frequency of 2.0000MHz or greater, and if in USB, LSB ISB, or RATT, there must be audio applied.
	5. Exciter power supply voltages incorrect	Check voltages at A2A18 Power Distribution Board, on underside of chassis.
	6. Defective Signal Path Levels	With the exciter output disconnected from the power amplifier, place in CW mode or in USB with normal level of audio from an audio generator, and check the levels against the values shown on the functional block diagram, figure 4.2.
	7. TGC attenuator at maximum attenuation	Refer to the Unit Instruction covering the RF Output module (A2A7). Make sure the exciter is operating as shown in the previous paragraph in this column. The voltage to the TGC attenuator should be equal to or greater than +0.2 volts. If it is less than +0.2 volts, the TGC circuit may be defective.
Exciter RF power output low	8. Defective signal path	See checks for conditions 6 and 7 above.



Integrated Circuit Orientation, (Top View)

- When replacing components on printed wiring boards, clip the mounting leads first with a suitable pair of diagonal cutters and remove the component. This is especially helpful on multilead components such as the dual in-line and circular type integrated circuits. The individual leads are then removed from the PW board with a low wattage iron.

- Before removing an integrated circuit from a PW board, note orientation of the pin locating tab and insure the replacement component is reinstalled in exactly the same way.
- Because of the double sided construction used on many of the PW boards in the RF-131, a component lead may be soldered to printed circuit areas on the top as well as the bottom of the PW board. Consequently, when a component lead is removed, resolder the replacement component top and bottom where applicable.
- Overheating a printed circuit conductor may cause it to pull loose from the board material. Apply only the minimum amount of heat necessary for component removal or replacement.
- The use of soldering iron in the 25-35 watt range is recommended.
- A desoldering tool (solder-sucker) similar to the Unline Mark VII, 40 watt type and the No. 7342 Unline tip is a great convenience (it also minimizes board damage) when removing multilead components which cannot be cut loose with diagonal ctters. Components of this type include the special RF Communications Inc. minimodules and the double balanced mixers which are both extensively used in the various module assemblies. The Unline Mark VII is available form: Vanguard Electronic Tools Inc., P.O. Box Newton, Kansas 67114.
- A very convenient device to use in place of a solder-sucket is a roll of Solder-Wick, manufactured by Solder Removal Co. of Covina, California. Many of our personnel prefer this flux-saturated copper braid over a solder -sucker for removing solder from PW boards.
- The RF-131 uses metal oxide field effect transistors (MOS-FETS) in some circuit applications. For example, in the sample and hold phase detectors of the Low Band PLL module. Type 3N153 MOS-FETs require special care during handling to prevent burn-out of their insulated gate from static charges. Use the following procedure when replacing a MOS-FET transistor. (Common junction FETs do not require this procedure.)

a. Remove new MOS-FET from package, notice that the 4 leads are connected together with a small ferrule or wire. This prevents static charge differences between the gate and substrate terminals.

b. If the ferrule is present, warap several turns of solder or small gauge wire around the leads and then remove the ferrule.

c. Preposition the four leads and install the MOS-FET on the PW board.

d. Remove the jumper only after the leads are soldered.

5.4 POWER, DEFINITIONS OF

The terms average power ($_{AVG}$), peak envelope power (PEP) and peak power (P_{PK}) are all used in this technical manual. Each term has a particular meaning is more convenient to use in certain situations than the other two. Their differences are as follows.

For simplicity, assume that an RF transmitter develops an output voltage which is steady in frequency and amplitude, across a pure resistive load R. The instantaneous power (Pi) dissipated by R is the product of instantaneous values for voltage (Ei) and current (Ii).

$$Pi = Ei \times Ii \text{ thus,}$$

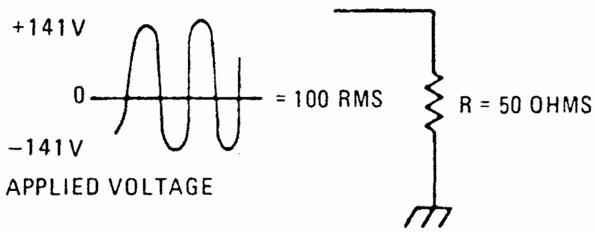
$$Pi = \frac{(Ei)^2}{R}$$

Thus the peak power occurs at the crest of the output voltage waveform. The average power (P_{AVG}) (sometimes mistakenly called RMS power) is, of course, the product of RMS voltage and RMS current.

$$P_{AVG} = E_{RMS} \times I_{RMS} \text{ thus}$$

$$P_{AVG} = \frac{(E_{RMS})^2}{R}$$

To illustrate, average power and peak power are computed for this simple circuit:



APPLIED VOLTAGE

$$P_{PK} = \frac{(141V)^2}{50} = 400W$$

$$P_{AVG} = \frac{(100)^2}{50} = 200W$$

Note that for a continuous sine wave, peak power is exactly twice the average power.

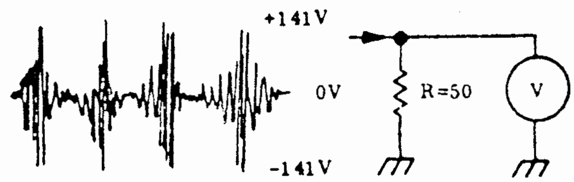
The third term, peak envelope power, (PEP) has become the traditional way of rating SSB transmitters, in spite of its being more difficult to work with. It can be defined two different (but equally correct) ways:

- PEP equals one-half of P_{PK}, for any modulating envelope.
- PEP equals the average power during one RF cycle at that point on the modulating envelope where the one-RF-cycle average power is greates.

Why is PEP used? In the first place, any type of transmitter must have some maximum power rating beyond which either the transmitter will be damaged or unacceptable distortion of the signal results. Conventional AM transmitters are normaly rated in terms at maximum unmodulated carrier power since there is a fixed relationship between this and peak power at 100% modulation. In addition unmodulated carrier power is easy to measure, since a carrier is a steady sine wave. In a SSB transmitter however, there is no such carrier. The maximum allowable power will be determined by either distortion requirements or, sometimes peak voltage breakdown limits. Therefore, some measure of peak power is needed and in fact a SSB transmitter could be rated in terms of P_{PK} rather than PEP. But P_{PK} is difficult to measure accurately; in fact the only direct way involves an oscilloscope, an instrument not well known for its accuracy in HF measurements.

A different approach has been used. A type of AC voltmeter which responds to the peak value of the waveform but is calibrated to display 0.707 of that value. (For example, the Hewlett Packard 410B.) The reading of a sine wave will be RMS volts even through the instrument is actually sensing the peaks. From this reading one could easily obtain average power of the sine wave by figuring $(E_{RMS})^2/R$.

But what happens when we apply such a meter to the complex output of a SSB transmitter? Assume the following situration with recurring peak voltages of 141 volts.



The meter will sense the 141V peaks and display 0.707 x 141V = 100V. This is of course, the RMS value of only the RF cycle at the peak of the modulation envelope. The voltage is called peak envelope voltage (PEV). And now

$$PEP = \frac{(PEV)^2}{R} = \frac{(100)^2}{50} = 200W.$$

a simple calculation made direct from the meter reading. Note that, as stated previously, this is just half of the actual P_{PK} and conveys the same amount of information, PEP is easier to measure accurately, and requires only the equipment normally found at communications installations. Module signal inputs and outputs in the RF-131 often have PEV or PEP ratings which are referenced in various test procedures.

If you understandind PEP, P_{PK} and P_{AVG} you should be able to confirm all the values shown below for the classic "two-tone envelope", two equal tones of slightly different frequency.

From this prove:

1. V_{PK} = 141V
2. PEV = 100V
3. V_{RMS} = difficult to measure or calculate
4. V_{RMS} of each tone (by itself) = 50V
5. P_{PK} = 400W
6. PEP = 200W
7. P_{AVG} = 100W
8. P_{AVG} of each tone (by itself) = 50W

5.5 CONVERSION BETWEEN dBm AND VOLTS$_{RMS}$

Throughout the communications industry, power levels are often measured in dBm. This means decibels with respect to 1 milliwatt. Thus, for example, +6 dBm more than a milliwatt; and -6 dBm means 6 dBm less than 1 mW, or 0.25 mW (250 uW).

Notice that every value of dBm corresponds to a particular amount of power. If you know the impedance in which this power is dissipated, you can determine the corresponding voltage and current.

Table 5-2 lists 50 ohm voltage equivalents for many dBm power levels. Note that for negative values of dBm, read voltages in either of the two left-hand columns. For positive values of dBm, read voltages in the right-hand column. For instance, -6 dBm is 0.112V (112 mV) across 50 ohms while a +6 dBm is 0.446V. Similarly, -20 dBm equals 22.4 mV while +20 dBm equals 2.24 volts (both across 50 ohms).

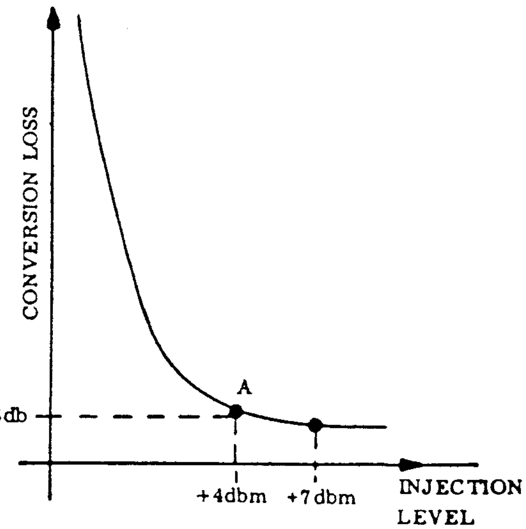
TABLE 5-2. CONVERSION OF dBm VOLTS $_{RMS}$ ACROSS 50 OHMS.
(Based on 0 dBm = 1 milliwatt)

(NEGATIVE dBm)		dBm	(POSITIVE dBm)
VOLTS	MILLIVOLTS		VOLTS
.224	224	0	.224
.199	199	1	.251
.178	178	2	.282
.158	158	3	.316
.141	141	4	.354
.126	126	5	.398
.112	112	6	.446
	99.9	7	.501
	89.0	8	.562
	79.3	9	.630
	70.7	10	.707
	63.0	11	.793
	56.2	12	.890
	50.1	13	.999
	44.6	14	1.12
	39.8	15	1.26
	35.4	16	1.41
	31.6	17	1.58
	28.2	18	1.78
	25.1	19	1.99
	22.4	20	2.24
	19.9	21	2.51
	17.8	22	2.82
	15.8	23	3.16
	14.1	24	3.54
	12.6	25	3.98
	12.0	25.41	--
	11.2	26	4.46
	10.0	27	5.01
	8.90	28	5.62
	7.93	29	6.30
	7.07	30	7.07
	3.98	35	12.6
	2.24	40	22.4
	1.26	45	39.8
	0.707	50	70.7

(NEGATIVE dBm)		dBm	(POSITIVE dBm)
VOLTS	MILLIVOLTS		VOLTS
.224	224	0	.224
.199	199	1	.251
.178	178	2	.282
.158	158	3	.316
.141	141	4	.354
.126	126	5	.398
.112	112	6	.446
	99.9	7	.501
	89.0	8	.562
	79.3	9	.630
	70.7	10	.707
	63.0	11	.793
	56.2	12	.890
	50.1	13	.999
	44.6	14	1.12
	39.8	15	1.26
	35.4	16	1.41
	31.6	17	1.58
	28.2	18	1.78
	25.1	19	1.99
	22.4	20	2.24
	19.9	21	2.51
	17.8	22	2.82
	15.8	23	3.16
	14.1	24	3.54
	12.6	25	3.98
	12.0	25.41	--
	11.2	26	4.46
	10.0	27	5.01
	8.90	28	5.62
	7.93	29	6.30
	7.07	30	7.07
	3.98	35	12.6
	2.24	40	22.4
	1.26	45	39.8
	0.707	50	70.7

5.6 MIXERS/INJECTION LEVEL.

Balanced diode mixers are used throughout the RF-131 wherever frequency translation is required. The signal path conversion loss for the type of mixers used is typically 6dB, provided that the local oscillator injection level is sufficiently high. For proper operation, the local oscillator injection source must be capable of developing at least +4 dBm (350 mv rms) into 50 ohms. The design level is +7dBm (500mv rms). Below +4dBm the conversion loss of the mixer increases rapidly (point A in the figure below).



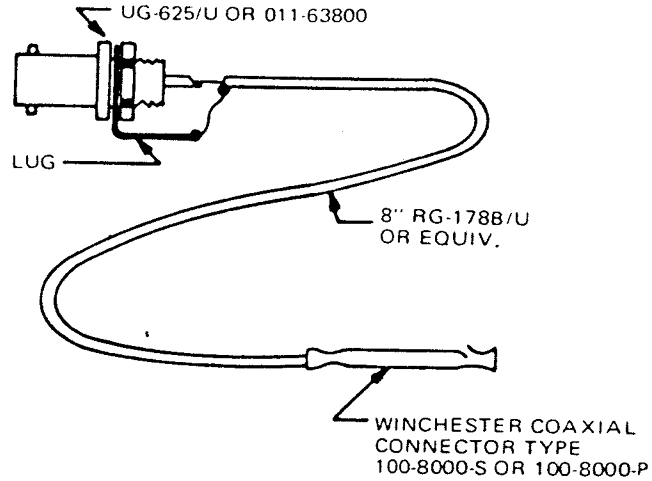
Because of the varying load which a mixer presents to the local oscillator source during a single RF cycle, a problem arises in measuring the injection level with a RF voltmeter. The injection voltage indicated by a peak detecting RF voltmeter (like the Boonton type 91H at this level) will be less than expected because of peak flattening. Consequently, a normal voltmeter indication will be approximately 250mv on a 91H. Point A in the above figure corresponds to a 91H reading of approximately 250mv.

5.7 TEST ADAPTERS.

The following adapter cables will be found useful in signal tracing the exciter. The adapters permit connection of test equipment directly to the chassis connectors. Adapter cables are included in the RF-131 Assembly Repair Kit, RF Communications part number 1001-0010. The cables themselves are available as part numbers 1001-0050 and 1001-0051.

5.8 REMOVAL OF FILTER A2FL3.

The 200 MHz filter A2FL3 is located on the



main chassis in a channel directly beneath 160MHz filter A2FL1 (between modules A2A10 and A2A5 see figure 6.1). To remove the filter, proceed as follows:

a. Remove the coaxial cable connectors from both ends of both A2FL1 and A2FL3. Be sure to distinguish between the cables for the two filters, so as to not confuse them at reassembly.

b. Remove A2FL1 by inserting a screwdriver through the holes in the underside of the chassis and removing the two machine screws which secure each end.

c. Remove the two machine screws which secure each end of A2FL3 to the channel on the top of the chassis.

d. Slide the filter out through the hole located in the side of the chassis.

5.9 LOGIC INTERPRETATION

Many counting and control functions in the RF-131 use digital integrated circuits. The basic circuit elements (gates, flip-flops, etc) are binary in nature, that is, the output voltage of each is either high or low.

The two possible states of each element are called a logical "1" and logical "0". The assignment of voltage levels to these logic states is arbitrary, however in this technical manual positive logic is standardized, which means we define the states as:

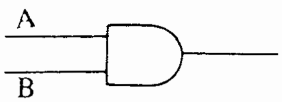
Logical "1": More positive (less negative) voltage

Logical "0": Less positive (more negative) voltage

GENERAL INFORMATION

A gate is a circuit element whose output level depends on the levels at all of its inputs in a particular pattern.

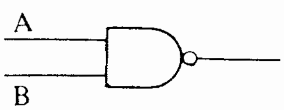
AND Gate



INPUTS A	INPUTS B	OUTPUT
0	0	0
1	0	0
0	1	0
1	1	1

For an AND gate: Output is "1" if and only if all inputs are "1." Output is "0" if any or all inputs are "0." A table which shows all possibilities, for a two input AND gate is shown above.

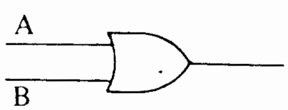
NAND Gate



INPUTS A	INPUTS B	OUTPUT
0	0	1
1	0	1
0	1	1
1	1	0

The outputs of the NAND Gate are the opposite of the AND Gate.

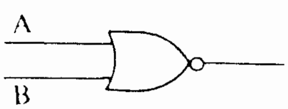
OR Gate



INPUTS A	INPUTS B	OUTPUT
0	0	0
1	0	1
0	1	1
1	1	1

The output of the OR Gate is "1" if any (or all) inputs at "1".

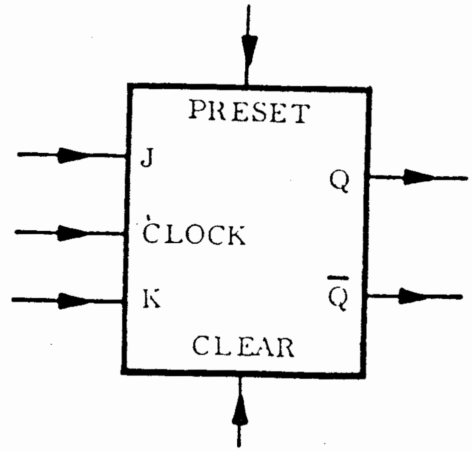
NOR Gate



INPUTS A	INPUTS B	OUTPUT
0	0	1
1	0	0
0	1	0
1	1	0

The outputs of the NOR Gate are the opposite of the OR Gate.

A flip-flop is a different element. Its outputs depend on previous sequences of inputs, and thus can serve as a memory element.



The above is a JK flip-flop (FF). We refer to the state of the FF as the condition of the Q output. For example, if the Q output is high, we say the FF contains a "1" or, the FF has a "1" output.

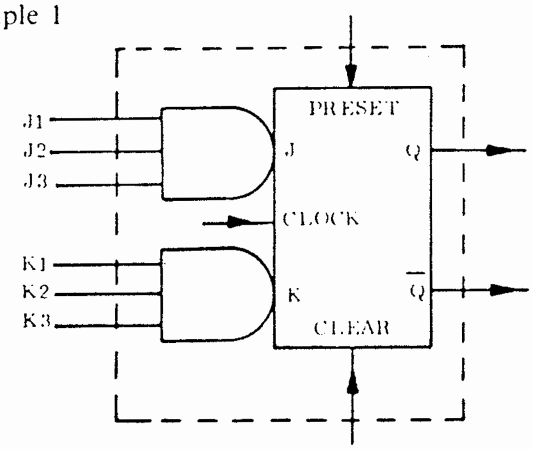
The $\overline{Q}$ output is always at the opposite level of the Q output (that is the meaning of the line over the Q).

The state of the FF can be changed in two different ways. One way is by means of the CLOCK input, the other is by means of PRESET and CLEAR. The effect of an applied clock pulse on the state of a FF depends upon the J and K inputs. The J input must be high for an applied clock pulse to cause a "1" output, likewise, the K input must be high and a clock pulse applied to cause a "0" output. If both J and K are kept high, the FF toggles (changes state) on each applied clock pulse.

The PRESET and CLEAR inputs operate independently of the clock. A high level input to PRESET drives the FF to "1" (if it is not already at "1") while a high level input to CLEAR drives the FF to "0" (if it is not already at "0").

There are many variations of the basic JK flip-flop. For example, a circuit may have several J and K inputs.

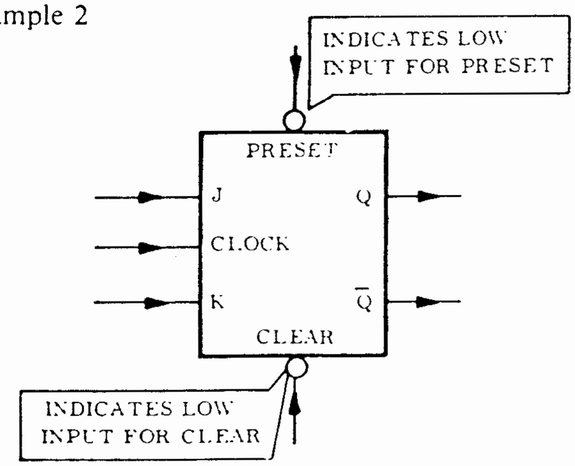
Example 1



Because of the AND Gates, all J's or K's must be high in order to toggle with an applied clock pulse.

Some circuits PRESET or CLEAR with a low level input instead of a high level. This is indicated by a "circle" at the appropriate input terminal.

Example 2



There are three classes of logic used in the RF-131, DTL (diode-transistor logic), TTL (transistor-transistor logic) and ECL (emitter coupled logic). DTL and TTL are characterized by logic levels of roughly +0.5 VDC and +3.5 VDC for "0" and "1" respectively; and ECL by levels of approximately −1.6 VDC and −0.6 for "0" and "1". Also, our TTL flip-flops generally use the master-slave principle and toggle on the trailing edge of the clock pulse, while our ECL flip-flops are capacitively coupled and toggle only on positive going transitions. Use of ECL logic in the RF-131 is limited to the ÷N circuits of the Hi Band PLL module; DTL is used in the Control Head; practically all other logic elements are TTL.

5.10 INTEGRATED CIRCUITS AND MINI-MODULES

The following pages contain logic and schematic diagrams of the integrated circuit and mini-module types used in the exciter. Table 5-2 is a quick cross-reference list. These diagrams are presented to assist in troubleshooting, and understanding of the functional operation of the equipment. The components themselves are not field repairable, and must be replaced if a malfunction is isolated to one of them.

When replacement parts listed in Maintenance Parts List are different from actual components used on chassis, the replacement part is either the equivalent or better than the original component.

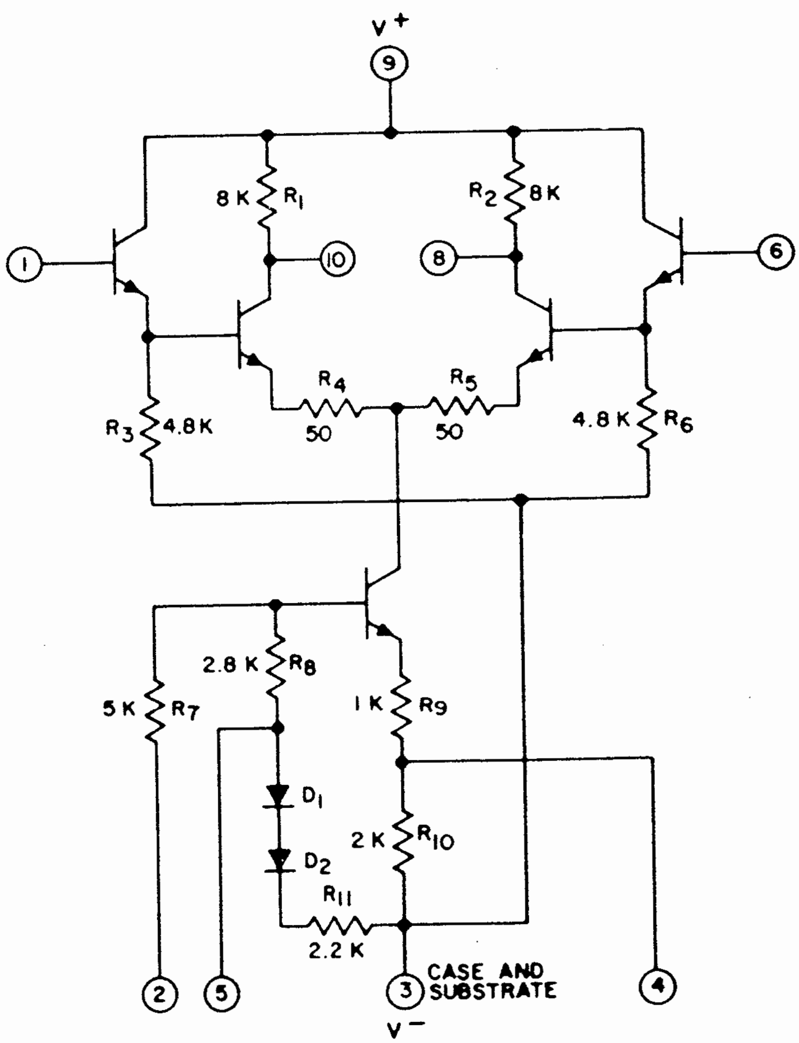
Logic Type	Levels (approx.)	Comments
DTL, TTL	"0": 0 to +0.8VDC "1": +2.0 to +5.0VDC	TTL Flip-Flops toggle on trailing edge of clock pulses.
ECL	"0": approx −1.55VDC "1": approx −0.55VDC	Flip-Flops toggle on positive going transitions; clock input formed by tying together one J and one K.

TABLE 5-3. LIST OF INTEGRATED CIRCUITS AND MINIMODULE TYPES USED IN THE RF-131 EXCITER

Type	Functional Name	Page
CA3000	Dc Amplifier	5-11
CA3004	RF Amplifier	5-12
CS3028A	Differential/Cascode Amplifiers	5-13
CA3028B	Differential/Cascode Amplifiers	5-13
CA3053	Differential/Cascode Amplifiers	5-13
DM8280N	High Speed Decade Frequency Divider/Counter	5-14
130-0001-003	Operational Amplifier	5-15
LM324N	Operational Amplifiers	5-16
MC672P	Quadruple 2-Input NAND Gates	5-16
MC840P	Hex Inverters	5-16
MIC-945-5N	Clocked Flip-Flop	5-17
N8280A	High Speed Decade Frequency Divider/Counter	5-18
SN72741P	Operational Amplifier	5-19
SN74H00N	Quadruple 2-Input NAND Gates	5-20
SN74H21N	Dual 4-Input Positive-AND Gates	5-21
SN74H72N	AND-Gated J-K Master-Slave Flip-Flop	5-22
SN74LS00N	Quadruple 2-Input NAND Gates	5-20
SN74LS04N	Hex Inverters	5-23
SN74LS11N	Triple 3-Input Positive-AND Gates	5-24
SN74LS75N	4-Bit Bistable Latch	5-25
SN74LS112N	Dual J-K Negative-Edge-Triggered Flip-Flop	5-26
SN74LS136N	2-Input Exclusive-OR Gate	5-27
SN74LS196N	Presettable Decade Counter	5-28
SN74S00N	Quadruple 2-Input NAND Gates	5-20
SN74S11N	Triple 3-Input Positive-AND Gates	5-24
SN74S112AN	Dual J-K Negative-Edge-Triggered Flip-Flop	5-26
SN7406N	Hex Inverter Buffers/Drivers	5-29
SN7410N	Triple 3-Input Positive-NAND Gates	5-30
SN7430N	8-Input Positive-NAND Gates	5-31
SN7472N	AND-Gates J-K Master-Slave Flip-Flop	5-22
SN7473N	Dual TTL J-K Flip-Flop	5-32
SN7476N	Dual TTL J-K Flip Flops (With Preset and Clear)	5-33
SN7490N	Decade Counter	5-34
SN7493N	4-Bit Binary Counter	5-35
SN7412N	TTL Monostable Multivibrators	5-36
SN74122N	Retriggerable Monostable Multivibrators	5-37
SN74160N	Synchronous 4-Bit Counter	5-38
uA723HC	Voltage Regulator	5-40
uA7812KC	12V Voltage Regulator	5-41
uA7818KC	18V Voltage Regulator	5-41
8007C	FET Operational Amplifier	5-42
0759-3725	173 MHz Filter	5-43
0759-4015	Vhf Crystal Oscillator	5-44
0759-5000	Attenuator	5-45
0759-5010	Vhf Amplifier	5-46
0759-5020	Hf Amplifier (No. 1)	5-47
0759-5030	Hf Amplifier (No. 2)	5-48
0759-5040	Hf Power Amplifier Assembly	5-49
0759-5150	Doubly-Balanced Modulator	5-50
6722-6118	1024x8-Bit Read-Only Memory	5-51
6722-6130	UV Erasable PROM	5-52

CA3000 (RCA)
DC AMPLIFIER

- Voltage Gain: 30 dB Typical
- Push-Pull Input and Output
- Frequency Capability: DC to 30 MHz



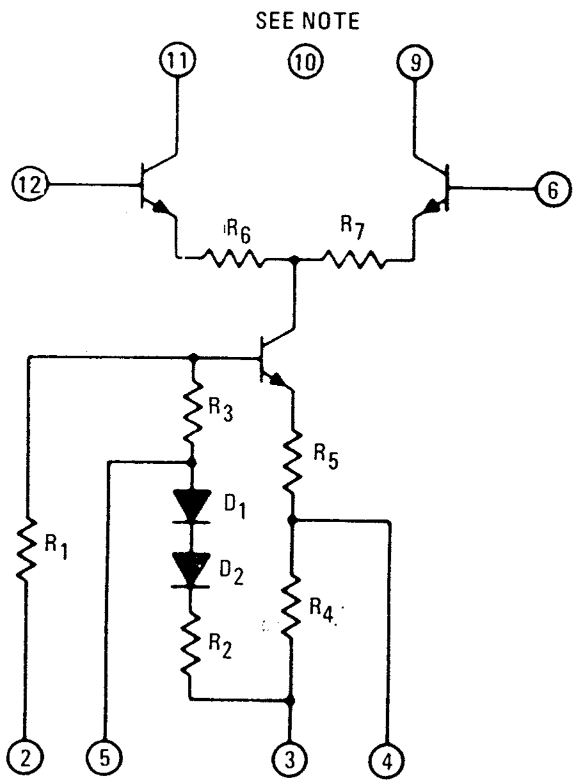
Resistance values are in ohms

CA3004 (RCA)
RF AMPLIFIER

The CA3004 is a balanced Differential-Amplifier configuration with controlled constant-current source.

- Push-Pull Input and Output
- Frequency Range: DC to 100 MHz

SCHEMATIC DIAGRAM FOR CA3004



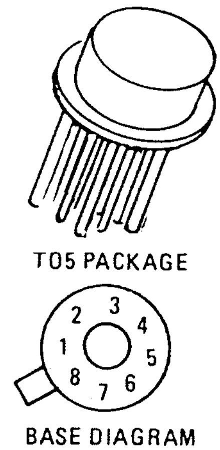
NOTE: CONNECT TERMINAL NO. 10 TO MOST POSITIVE DC SUPPLY VOLTAGE USED FOR CIRCUIT.

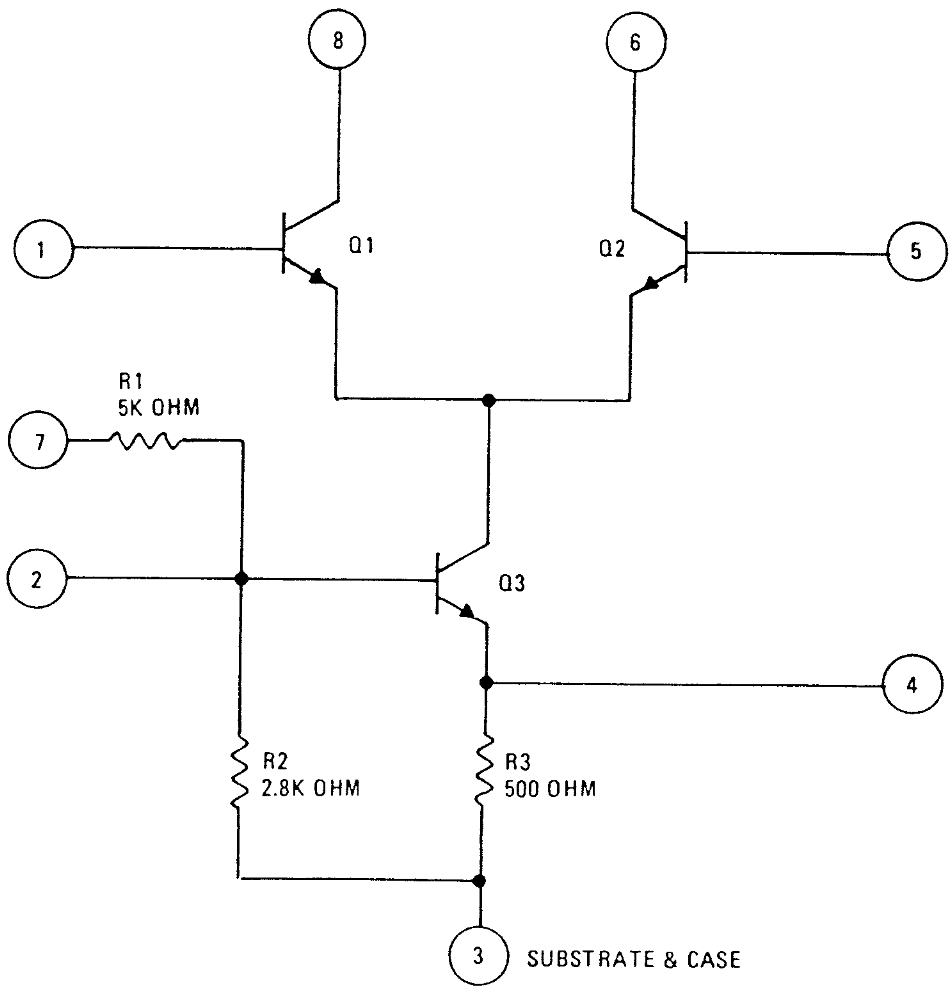
CA3028 (RCA)
CA3053 (RCA)

DIFFERENTIAL/CASCODE AMPLIFIER BIPOLAR LINEAR

The CA 3028 is controlled for input offset voltage, input offset current, and input bias current. The device has a controlled constant current source for balanced differential amplifier operation.

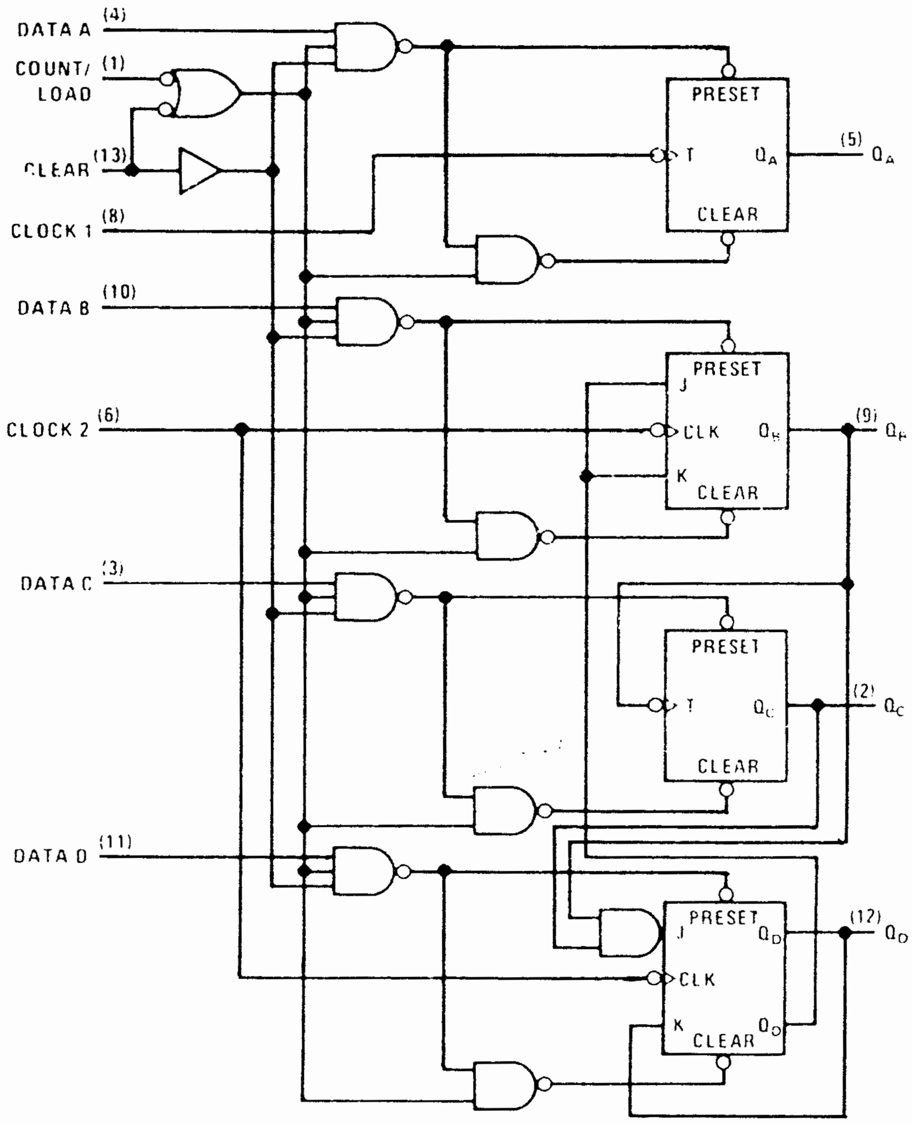
The CA3053 is identical to the CA3028 except for the maximum operational frequency.





DM8280N (NATIONAL SEMICONDUCTOR)
N8280N (SIGNETICS)
HIGH SPEED DECADE FREQUENCY COUNTER/DIVIDER

The DM8280N and N8280N are high speed counters consisting of four de-coupled master-slave flip-flops. The counters feature a direct clear which, when placed at a low logic level sets all outputs low regardless of the conditions on the clocks.



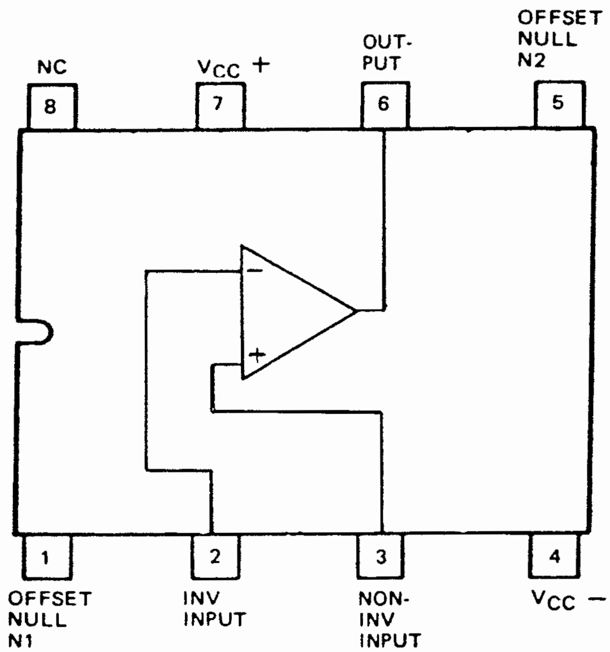
DECADE (BCD)

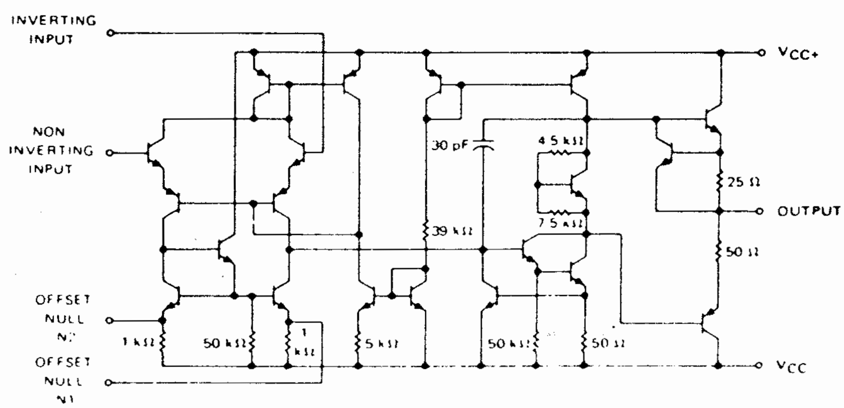
COUNT	OUTPUT			
	Q_D	Q_C	Q_B	Q_A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H

H = High Level, L = Low Level

130-0001-003 (R.F.COMMUNICATIONS)
SN72741P (TEXAS INSTRUMENTS)
OPERATIONAL AMPLIFIER

The SN72741P is a high performance operational amplifier, featuring off-set voltage null capability.

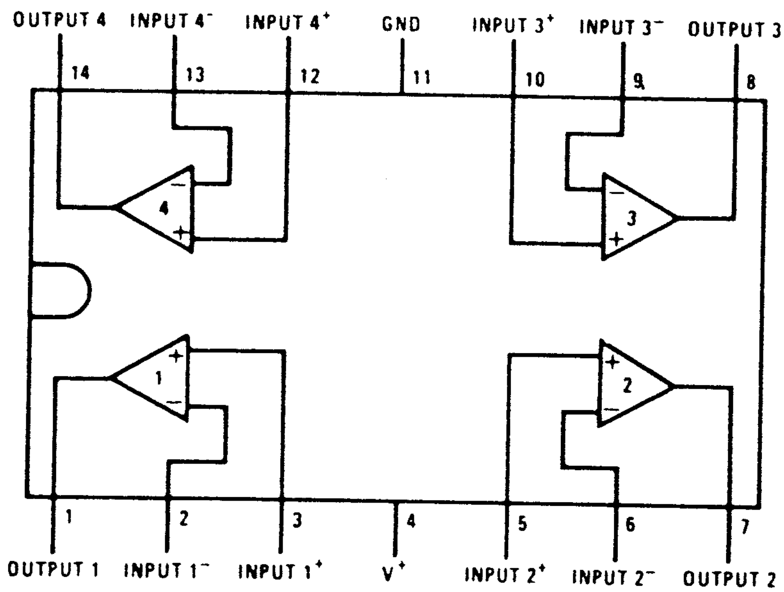




COMPONENT VALUES SHOWN ARE NOMINAL

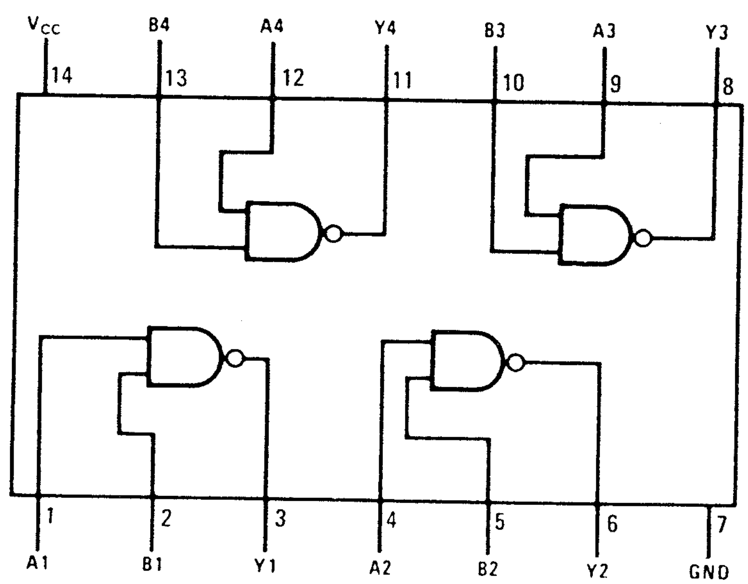
LM324N
OPERATIONAL AMPLIFIERS

- Four internally compensated Op Amps in one package.
- Large dc voltage gain: 100 dB
- Unify gain cross frequency is temperature compensated.



MC672P (MOTOROLA)
MC846P (MOTOROLA)

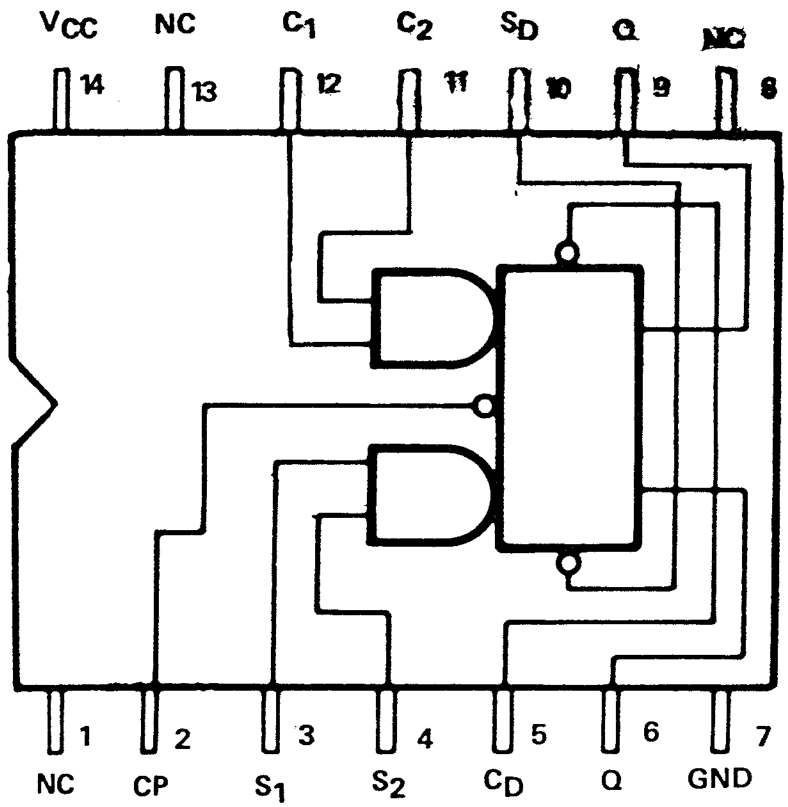
The MC672P consists of four 2-input NAND gates with active output pull-up. The MC846P is a higher speed.



$$Y = \overline{AB}$$

MIC-945-5N (ITT)

CLOCKED FLIP-FLOP



SYNCHRONOUS ENTRY

Inputs t_n				Output t_{n+1}
3	4	11	12	6
0	Φ	0	Φ	NC
0	Φ	Φ	0	NC
Φ	0	0	Φ	NC
Φ	0	Φ	0	NC
0	Φ	1	1	0
Φ	0	1	1	0
1	1	0	Φ	1
1	1	Φ	0	1
1	1	1	1	Undetermined

For J-K Mode Operation:
Connect 4 to 9 and 11 to 6

ASYNCHRONOUS ENTRY

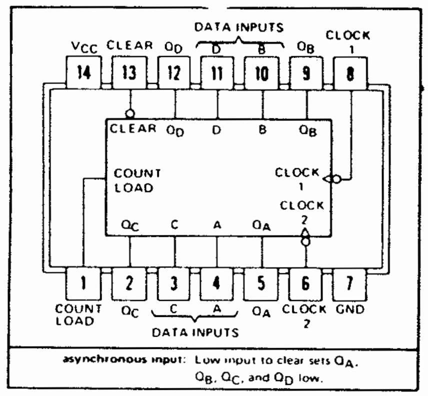
Inputs		Outputs	
5	10	6	9
1	1	NC	NC
1	0	1	0
0	1	0	1
0	0	1	1

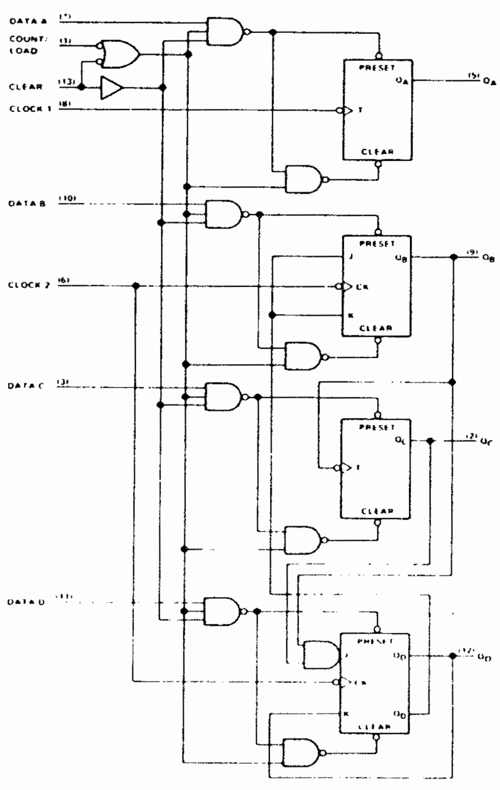
Asynchronous entry is independent of all other inputs and overrides synchronous entry.

NOTES:

2. Abbreviations used in the body of tables:
NC = no change, the trigger-pulse has equal effect.
0 = low, the more negative voltage level.
1 = high, the more positive voltage level
(In all cases, unused pins have the same effect as high.)
Φ = immaterial, either 1 or 0 has no effect on outputs.

N8280A (NATIONAL) DECADE COUNTER

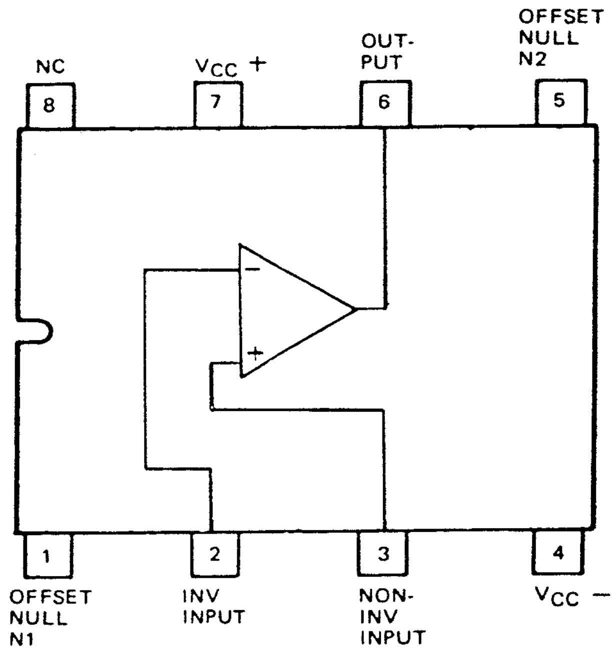


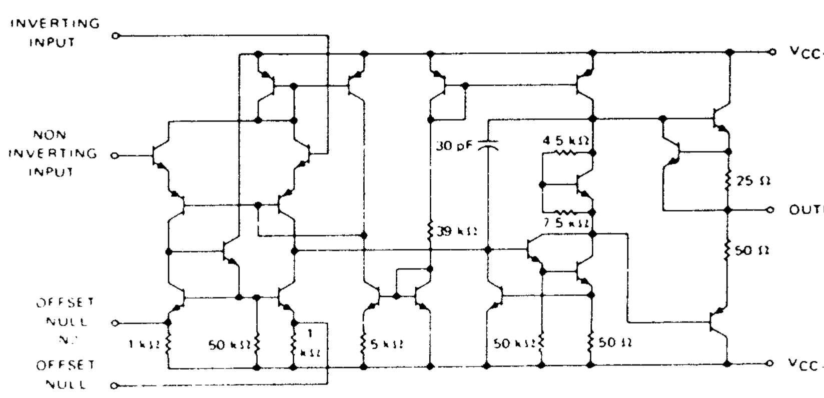


dynamic input activated by transition from a high level to a low level

SN72741P (TEXAS INSTRUMENTS) OPERATIONAL AMPLIFIER

The SN72741P is a high performance operational amplifier, featuring off-set voltage null capability.

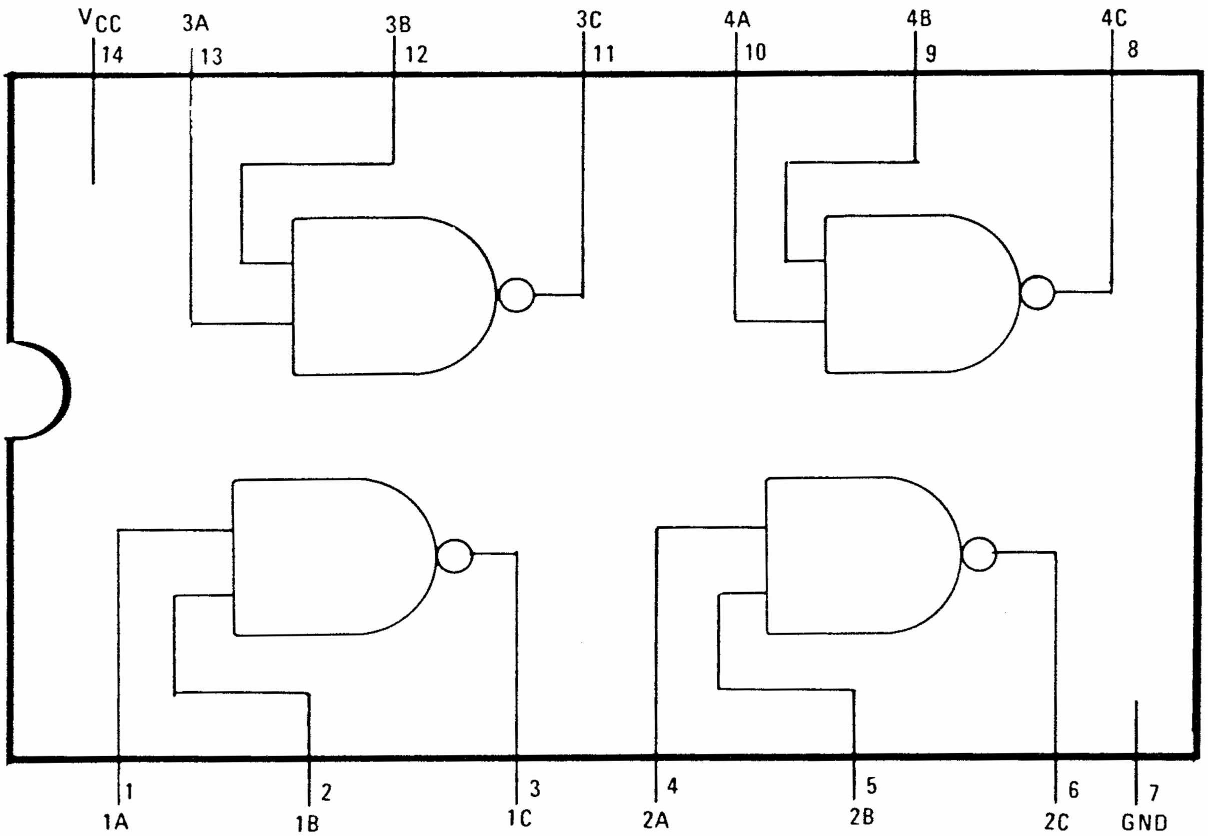




COMPONENT VALUES SHOWN ARE NOMINAL

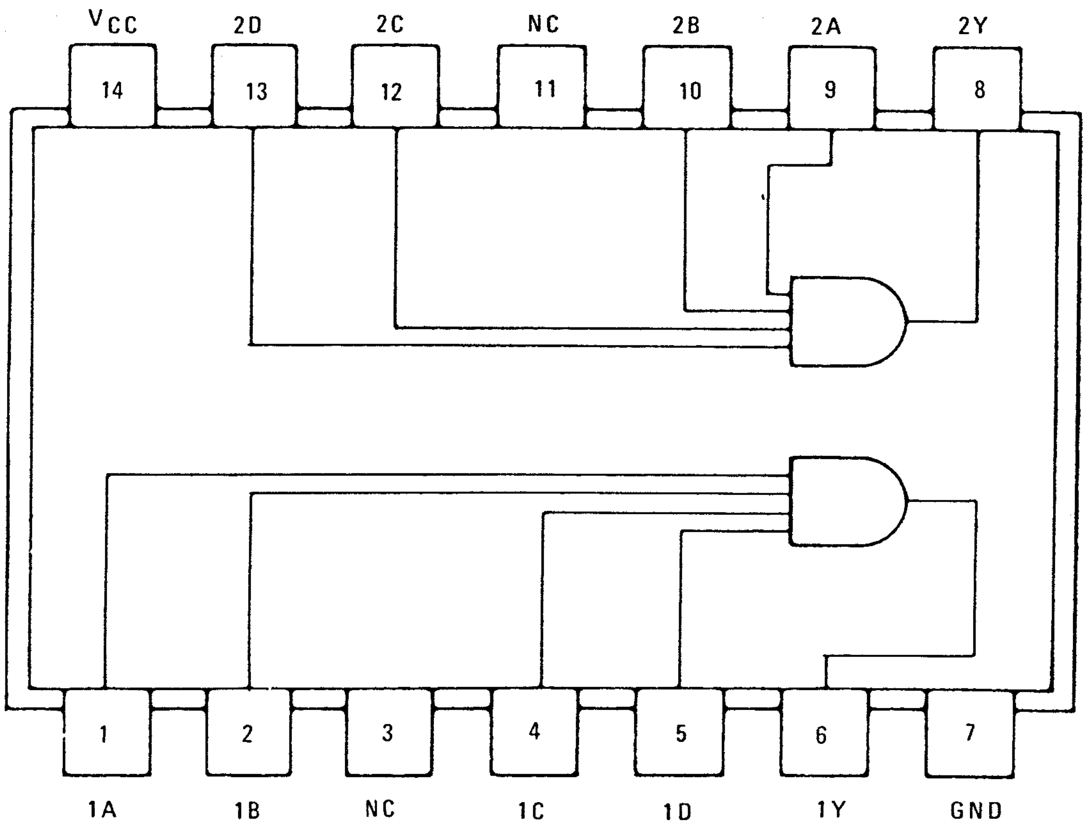
SN74H00N (TEXAS INSTRUMENTS)
SN74S00N (TEXAS INSTRUMENTS)
QUADRUPLE 2-INPUT NAND GATE

Differ only in maximum operating frequency.



A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

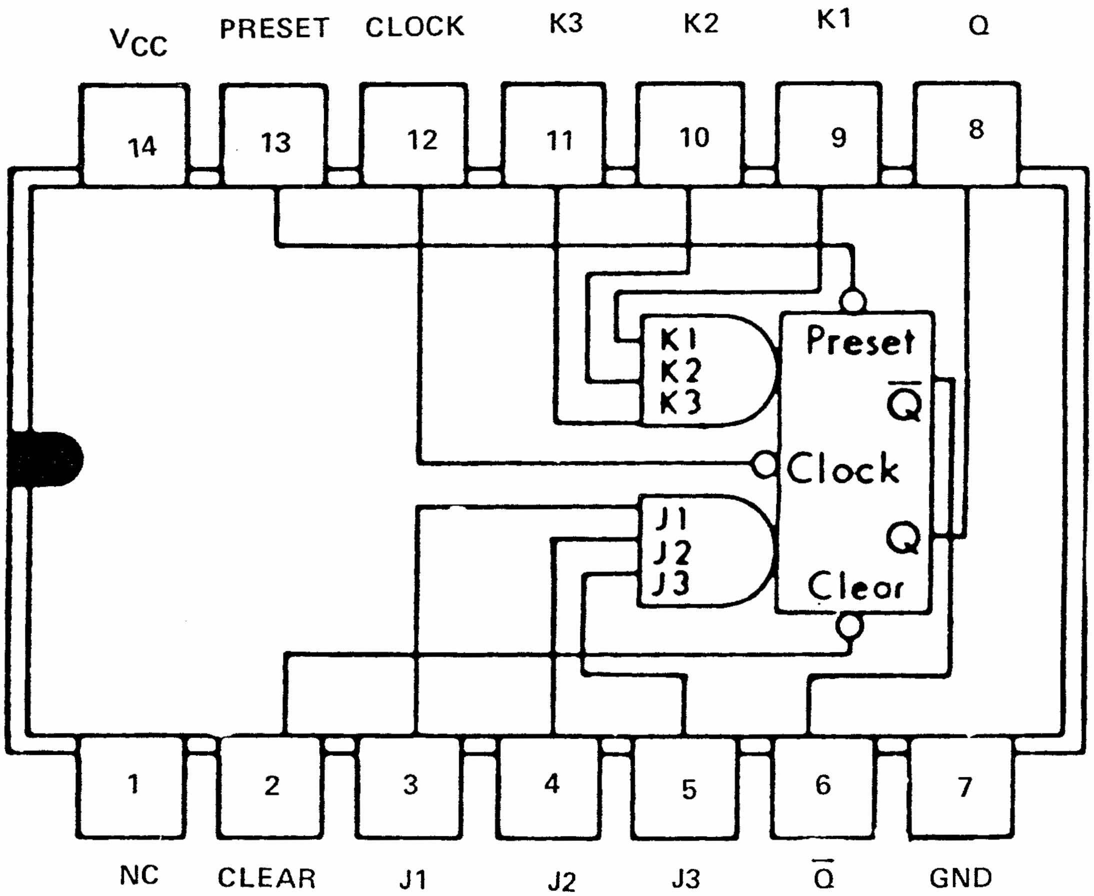
SN74H21N (TEXAS INSTRUMENTS)
DUAL 4-INPUT POSITIVE - AND GATES



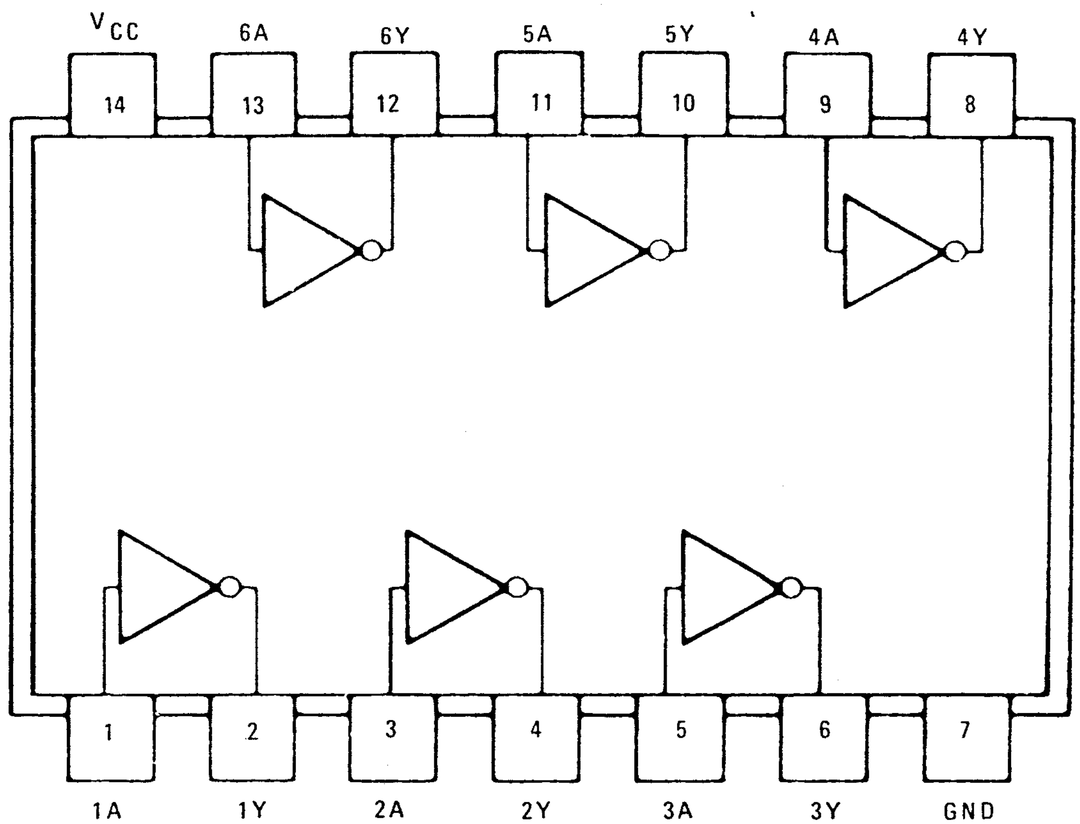
LOGIC Y = ABCD

SN74H72N (TEXAS INSTRUMENTS)
SN7472N (TEXAS INSTRUMENTS)
AND-GATED J-K MASTER-SLAVE FLIP-FLOP

The SN7472N is a TTL flip-flop with multiple J and K inputs. All inputs must be high to enable this circuit.



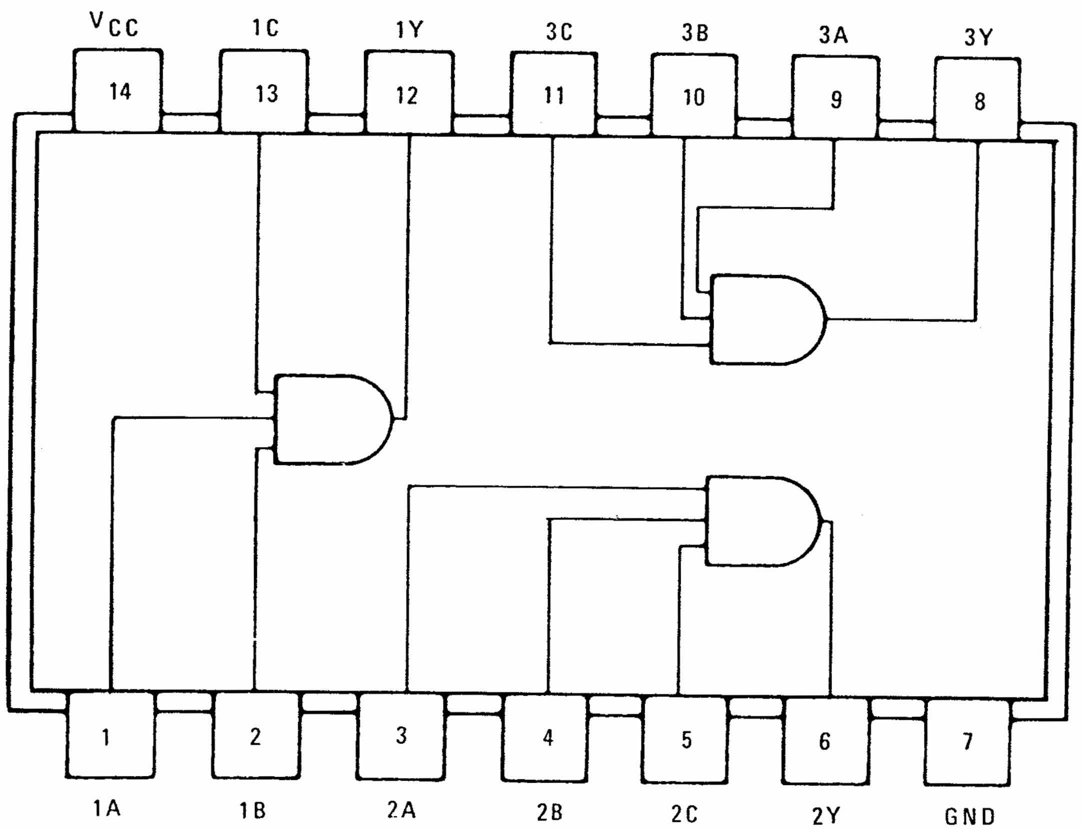
SN74LS04N (TEXAS INSTRUMENTS)
HEX INVERTERS



POSITIVE LOGIC: $Y = \overline{A}$

SN74S11N (TEXAS INSTRUMENTS)
TRIPLE 3-INPUT POSITIVE - AND GATE

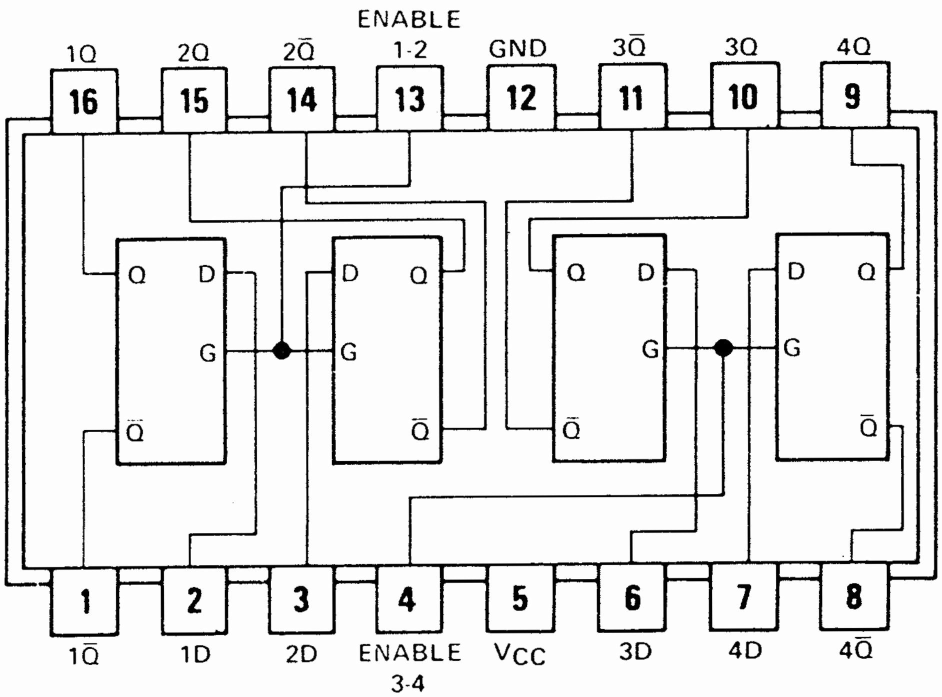
(The SN74LS11N differs from the SN74S11N in maximum operating speed only.)



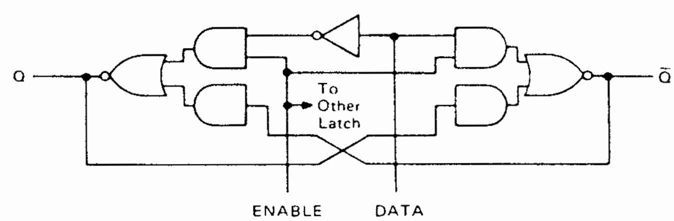
LOGIC Y = ABC

SN74LS75N (TEXAS INSTRUMENTS)
4-BIT BISTABLE LATCH

The SN74LS75N features complementary Q and $\overline{Q}$ outputs from a 4-bit latch, and is contained in a 16-pin N-type (dual in-line plastic) package. This latch is used as a temporary storage device for binary information between processing units and input/output or indicator units.



functional block diagram (each latch)



FUNCTION TABLE
(Each Latch)

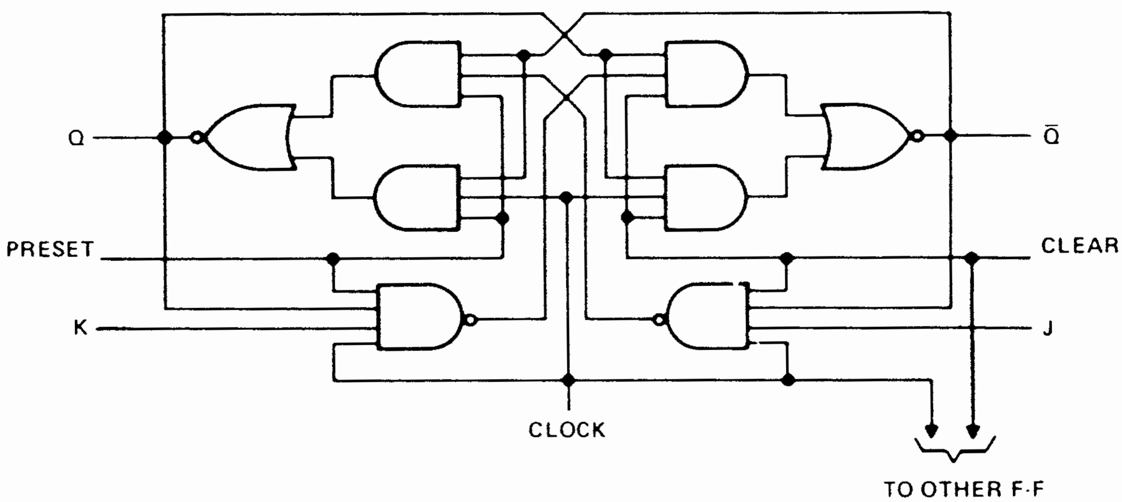
INPUTS		OUTPUTS	
D	G	Q	$\overline{Q}$
L	H	L	H
H	H	H	L
X	L	Q_0	$\overline{Q}_0$

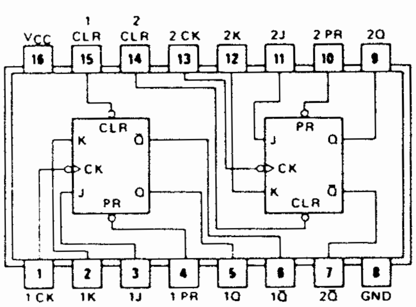
H = high level, L = low level, X = irrelevant

Q_0 = the level of Q before the high-to-low transition of G

SN74LS112AN (TEXAS INSTRUMENTS)
SN74S112N (TEXAS INSTRUMENTS)
DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOP

The SN74LS112AN differs from the SN74S112N in maximum operating frequency only.)





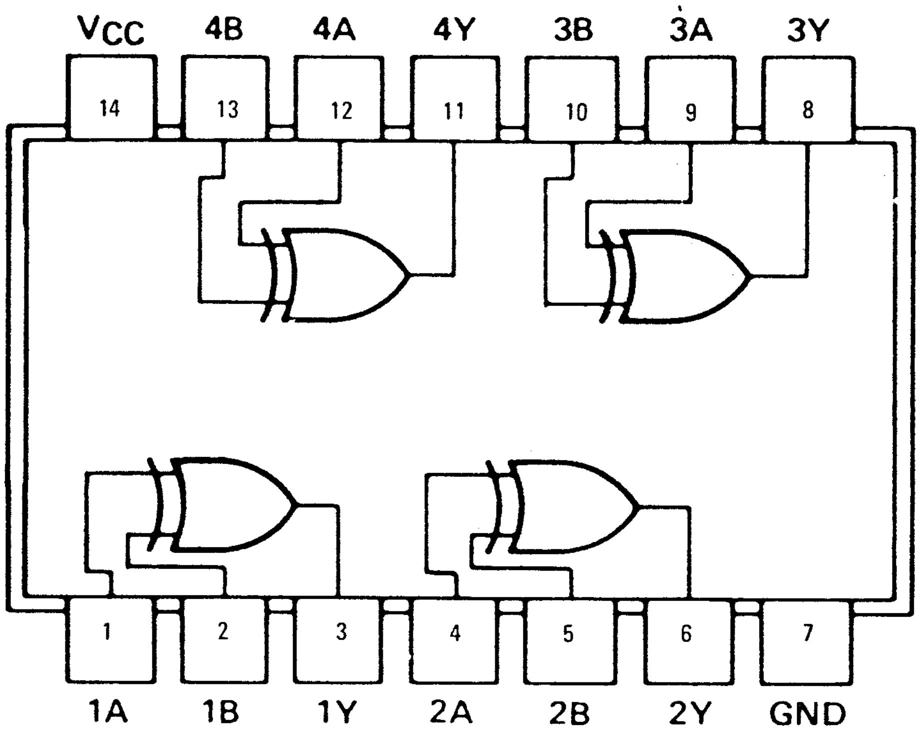
FUNCTION TABLE

INPUTS					OUTPUTS	
PRESET	CLEAR	CLOCK	J	K	Q	Q̄
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L*	L	X	X	X	H*	H*
H	H	↓	L	L	Q_0	$\bar{Q}_0$
H	H	↓	H	L	H	L
H	H	↓	L	H	L	H
H	H	↓	H	H	TOGGLE	
H	H	H	X	X	Q_0	$\bar{Q}_0$

SN74LS136N (TEXAS INSTRUMENTS)
QUAD 2-INPUT EXCLUSIVE - OR GATE

The SN74LS146N 2-Input Exclusive-OR Gate contains four standard gates in an N-type (dual in-line plastic), 16 pin package.

As is the case with all exclusive-OR gates, each gate compares two input levels. If they are the same, a 0 output is produced. If they are different, a 1 output is produced.



POSITIVE LOGIC: $Y = A \oplus B = \overline{A}B + A\overline{B}$

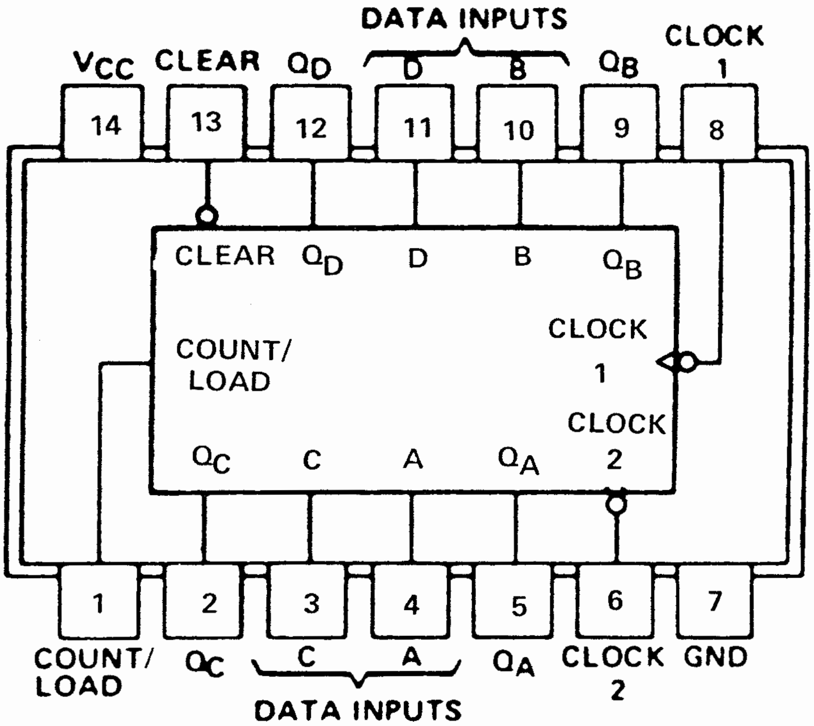
FUNCTION TABLE

INPUTS		OUTPUT
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	L

H = high level, L = low level

SN74LS196N (TEXAS INSTRUMENTS) DECADE COUNTER

The SN74LS196N is a high speed counter that consists of four Dc coupled master-slave flip-flops which are interconnected to provide either a divide-by-two or a divide-by-five counter.



FUNCTION TABLE
(See Note A)

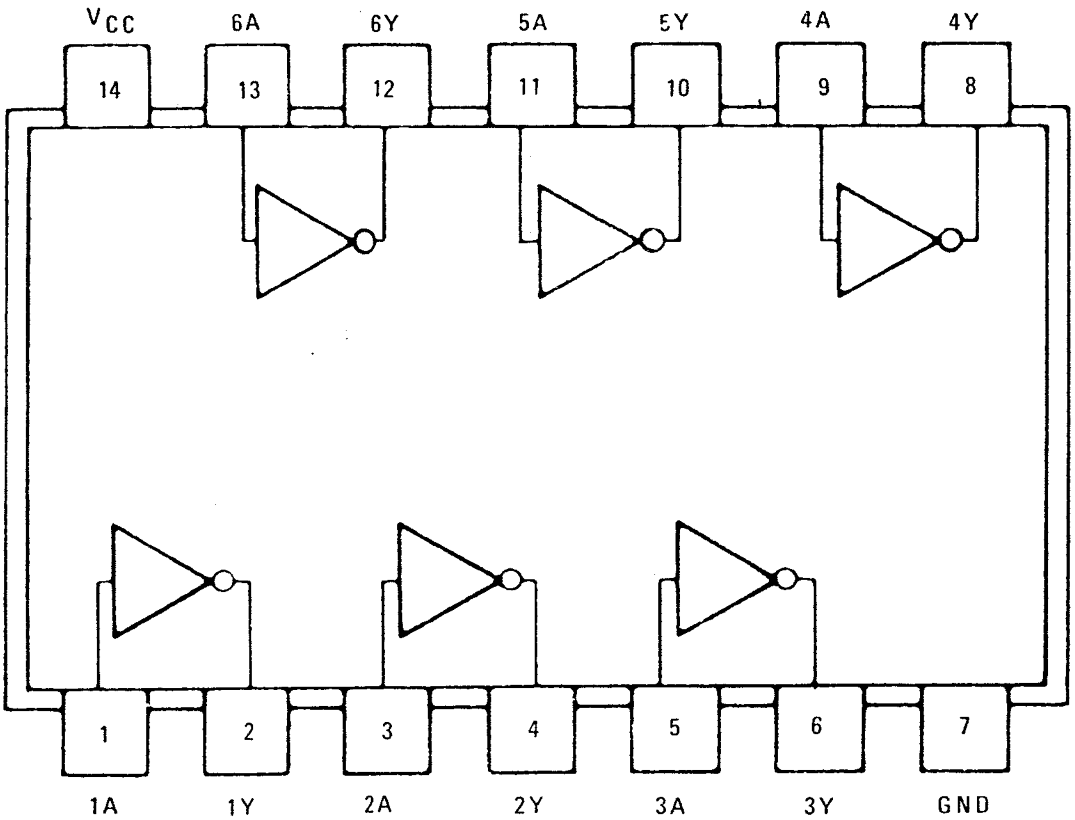
COUNT	OUTPUT			
	Q_D	Q_C	Q_B	Q_A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
10	H	L	H	L
11	H	L	H	H
12	H	H	L	L
13	H	H	L	H
14	H	H	H	L
15	H	H	H	H

H = high level, L = low level

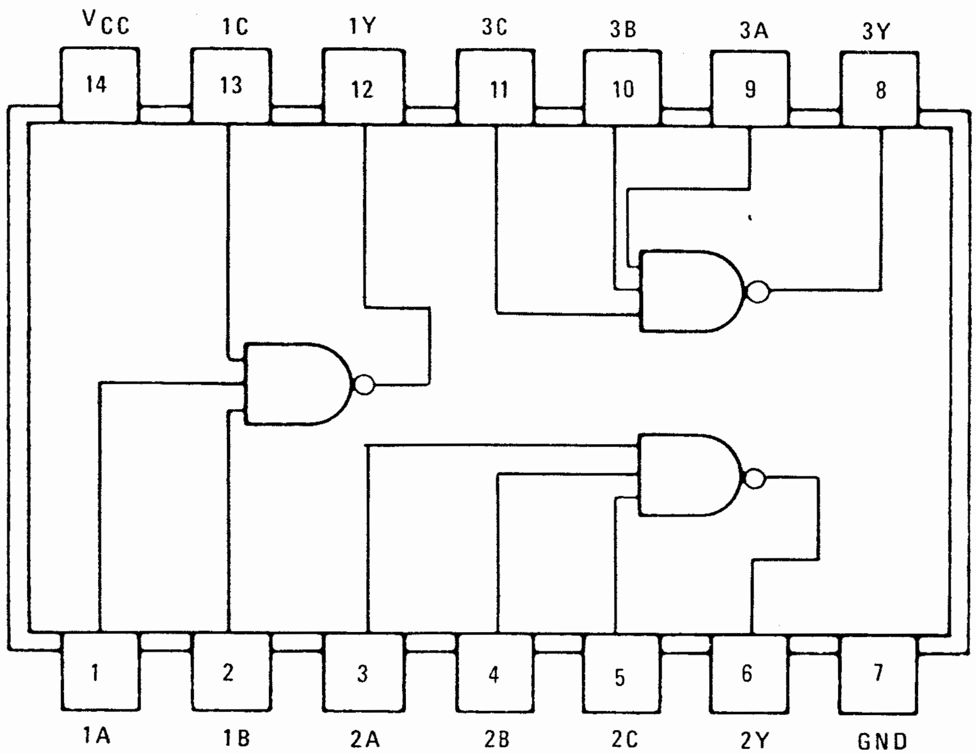
NOTE A: Output Q_A connected to clock-2 input.

SN7406N (TEXAS INSTRUMENTS)
MC840P (MOTOROLA)
HEX INVERTER BUFFERS/DRIVERS

The SN7406N is a high voltage hex inverter without resistors, and the MC840P is a hex inverter without input diodes.

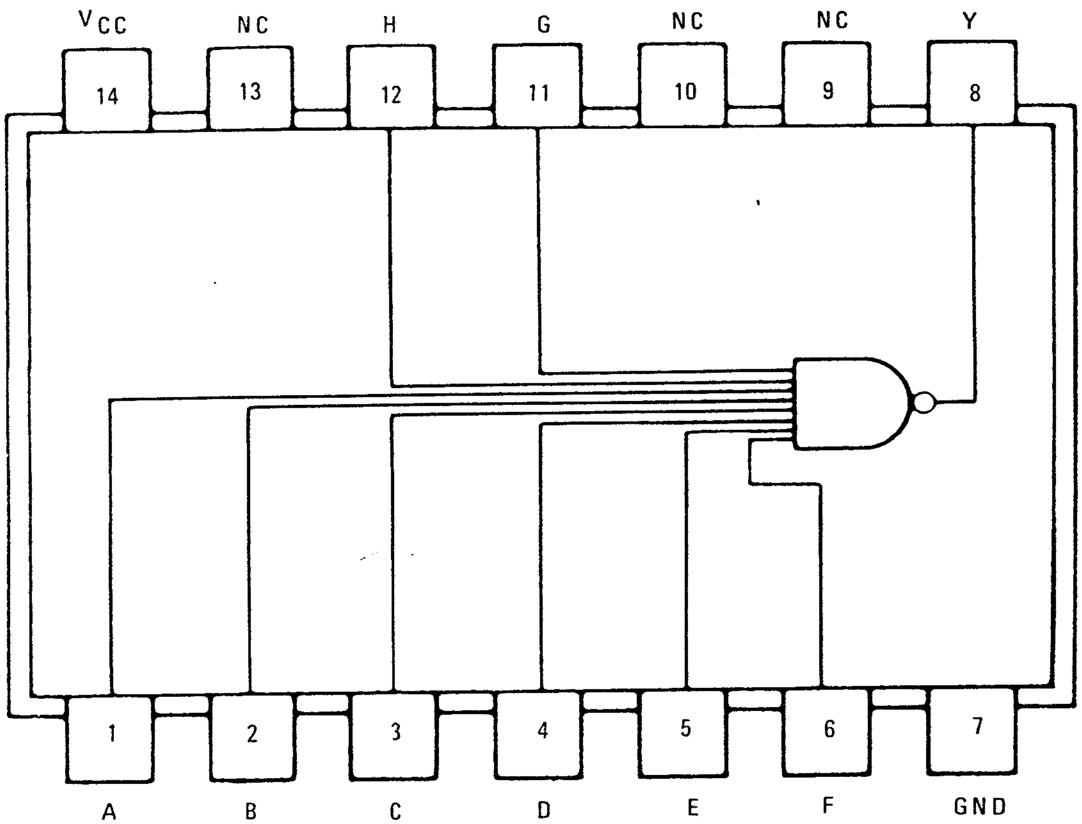


SN7410 (TEXAS INSTRUMENTS)
TRIPLE 3-INPUT POSITIVE NAND GATE



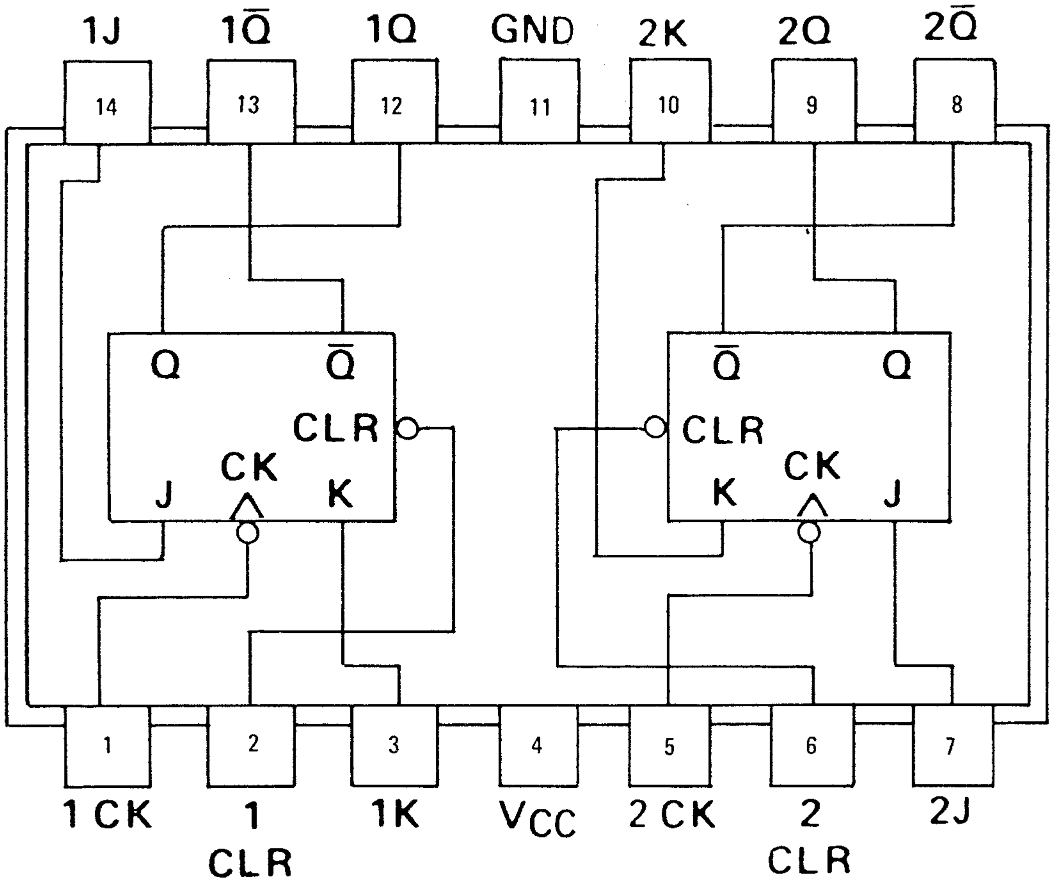
A	B	C	D
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

SN7430N (TEXAS INSTRUMENTS)
8-INPUT POSITIVE - NAND GATE



POSITIVE LOGIC
Y = ABCDEFGH

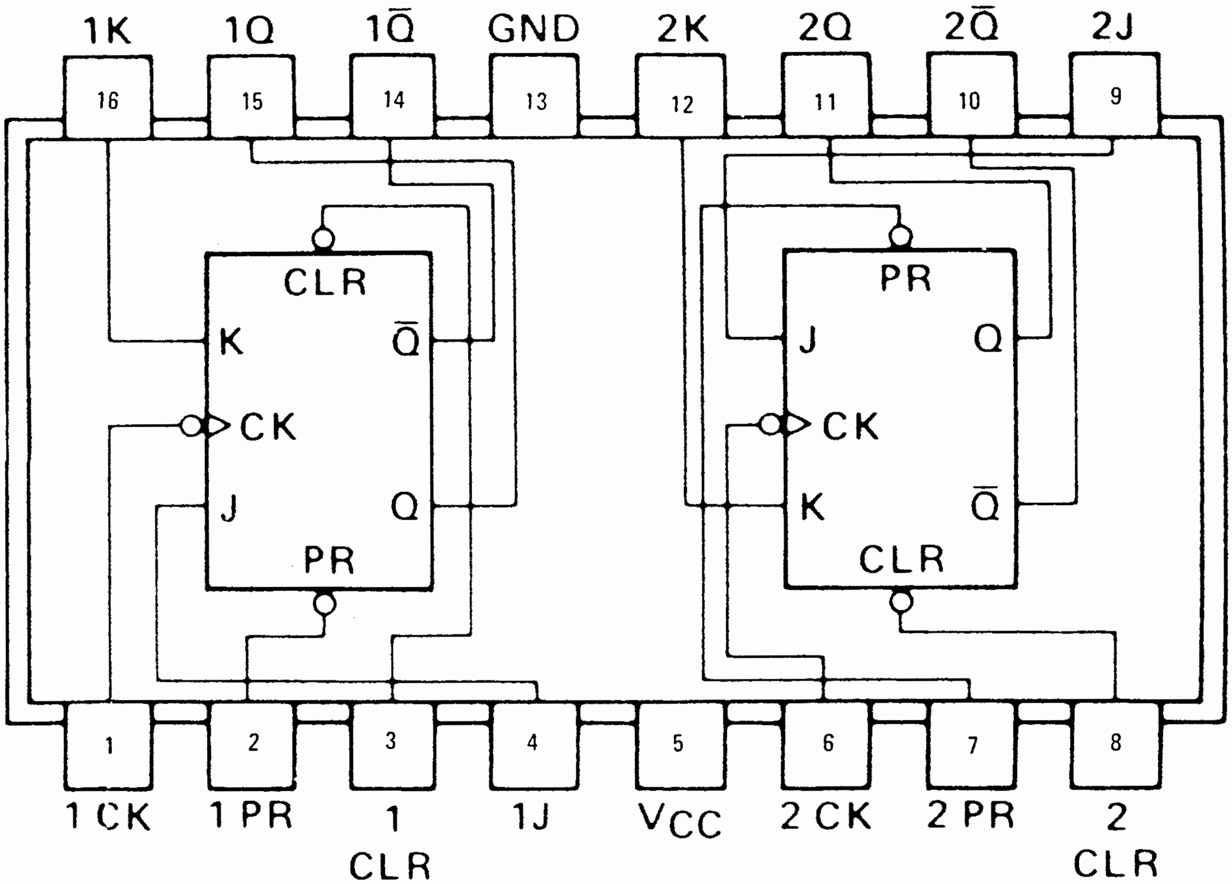
SN7473N (TEXAS INSTRUMENTS)
DUAL TTL J-K FLIP-FLOP



FUNCTION TABLE

INPUTS				OUTPUTS	
CLEAR	CLOCK	J	K	Q	$\bar{Q}$
L	X	X	X	L	H
H	⎍	L	L	Q_0	$\bar{Q}_0$
H	⎍	H	L	H	L
H	⎍	L	H	L	H
H	⎍	H	H	TOGGLE	

SN7476N (TEXAS INSTRUMENTS)
DUAL TTL J-K FLIP-FLOP (WITH PRESET AND CLEAR)

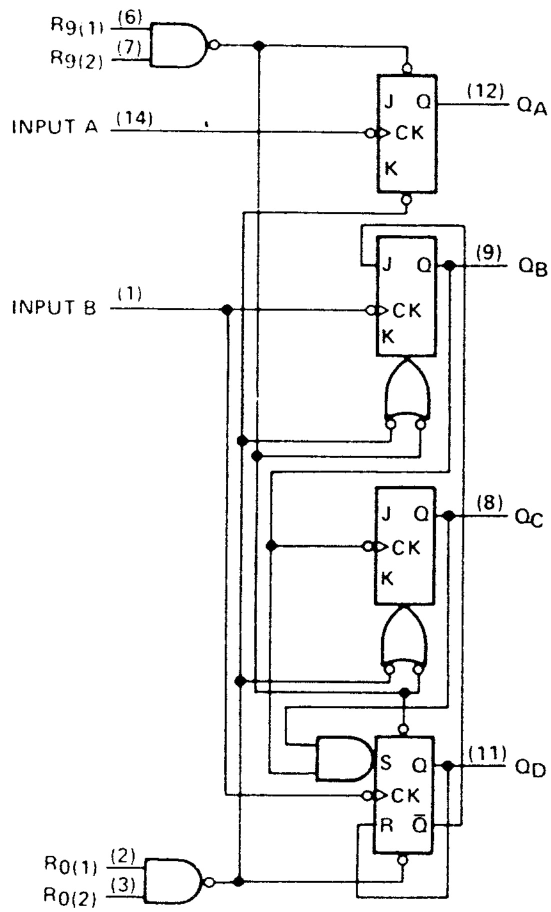


FUNCTION TABLE

INPUTS					OUTPUTS	
PRESET	CLEAR	CLOCK	J	K	Q	$\bar{Q}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H*	H*
H	H	⎍	L	L	Q_0	$\bar{Q}_0$
H	H	⎍	H	L	H	L
H	H	⎍	L	H	L	H
H	H	⎍	H	H	TOGGLE	

SN7490N (TEXAS INSTRUMENTS) DECADE COUNTER

The SN7490N is a TTL decade counter consisting of four flip-flops internally connected to provide a divide-by-two and a divide-by-five counter.



BCD COUNT SEQUENCE

COUNT	OUTPUT			
	Q_D	Q_C	Q_B	Q_A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H

RESET/COUNT FUNCTION TABLE

RESET INPUTS				OUTPUT			
$R_{0(1)}$	$R_{0(2)}$	$R_{9(1)}$	$R_{9(2)}$	Q_D	Q_C	Q_B	Q_A
H	H	L	X	L	L	L	L
H	H	X	L	L	L	L	L
X	X	H	H	H	L	L	H
X	L	X	L	COUNT			
L	X	L	X	COUNT			
L	X	X	L	COUNT			
X	L	L	X	COUNT			

SN7493N (TEXAS INSTRUMENTS)
4-BIT BINARY COUNTER

The SN7493N is a high speed, monolithic 4-bit binary counter consisting of four master-slave flip-flops which are interconnected to provide a divide-by-eight counter.

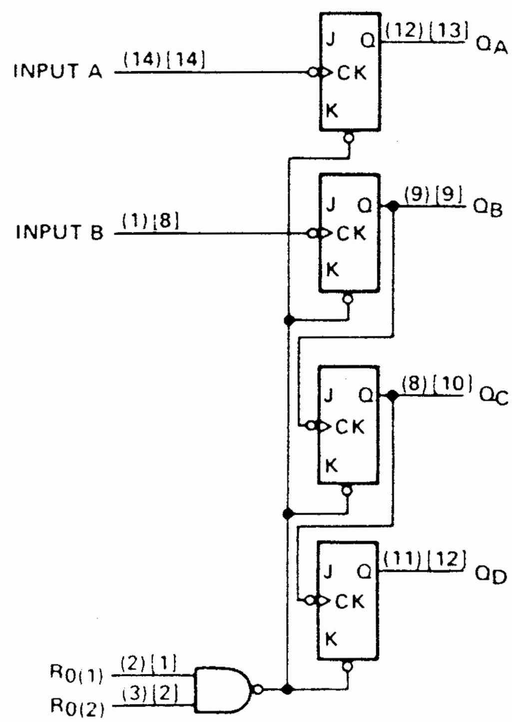
RESET/COUNT FUNCTION TABLE

RESET INPUTS		OUTPUT			
$R_{0(1)}$	$R_{0(2)}$	Q_D	Q_C	Q_B	Q_A
H	H	L	L	L	L
L	X	COUNT			
X	L	COUNT			

A. Output Q_A is connected to input B for BCD count.
B. Output Q_D is connected to input A for bi-quinary count.
C. Output Q_A is connected to input B.
D. H = high level, L = low level, X = irrelevant

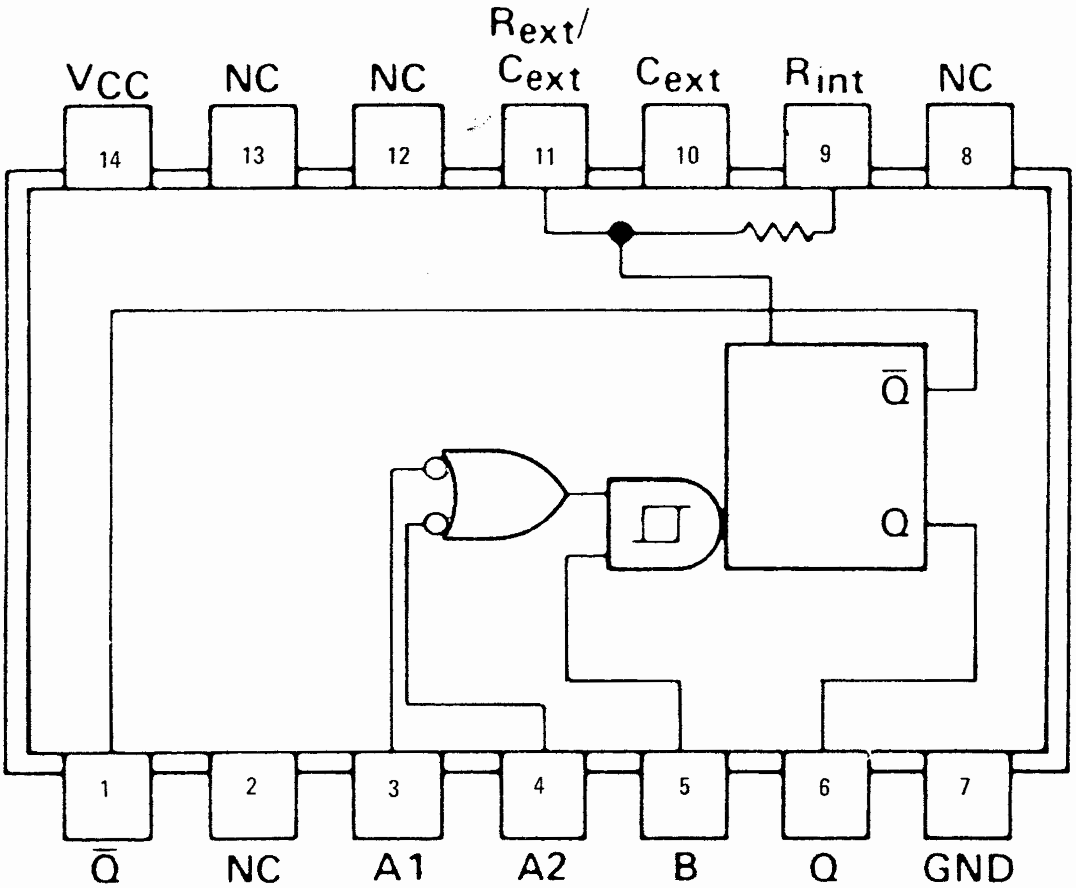
COUNT SEQUENCE
(See Note C)

COUNT	OUTPUT			
	Q_D	Q_C	Q_B	Q_A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
10	H	L	H	L
11	H	L	H	H
12	H	H	L	L
13	H	H	L	H
14	H	H	H	L
15	H	H	H	H



SN74121 (TEXAS INSTRUMENTS)
TTL MONOSTABLE MULTIVIBRATOR

The SN74121 features dual negative-transistion-triggered inputs and a single positive-transistion-triggered input which can be used as an inhibit input.

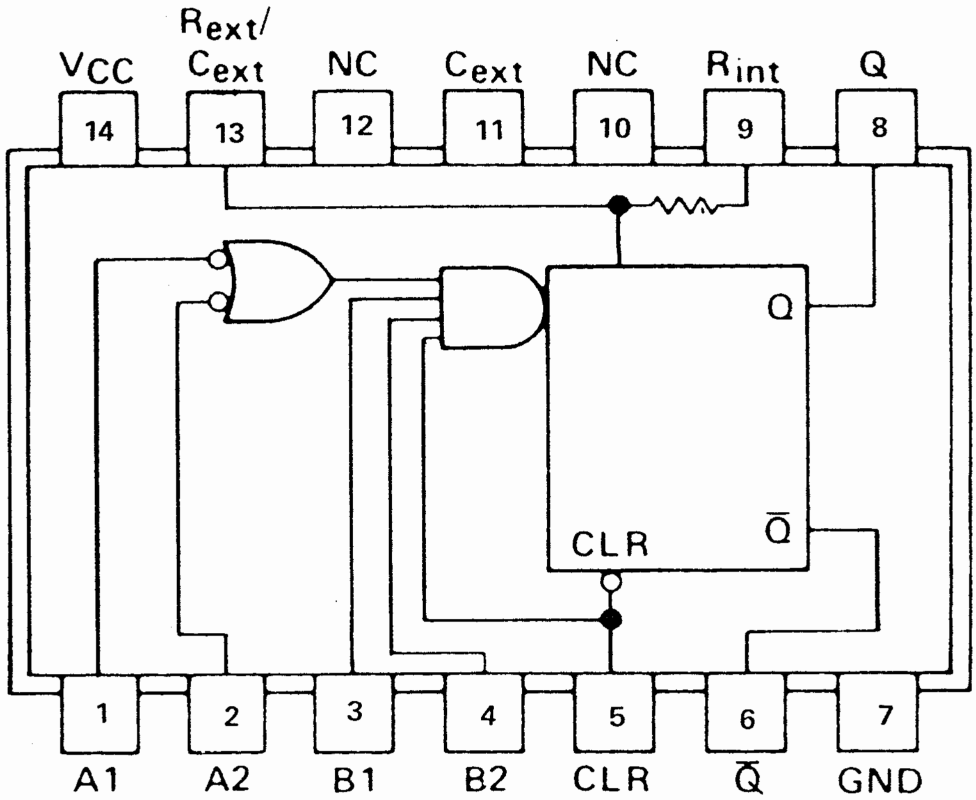


FUNCTION TABLE

INPUTS			OUTPUTS	
A1	A2	B	Q	Q̄
L	X	H	L	H
X	L	H	L	H
X	X	L	L	H
H	H	X	L	H
H	↓	H	⊓	⊔
↓	H	H	⊓	⊔
↓	↓	H	⊓	⊔
L	X	↑	⊓	⊔
X	L	↑	⊓	⊔

SN74122N (TEXAS INSTRUMENTS)

RETRIGGERABLE MONOSTABLE MULTIVIBRATOR



FUNCTION TABLE

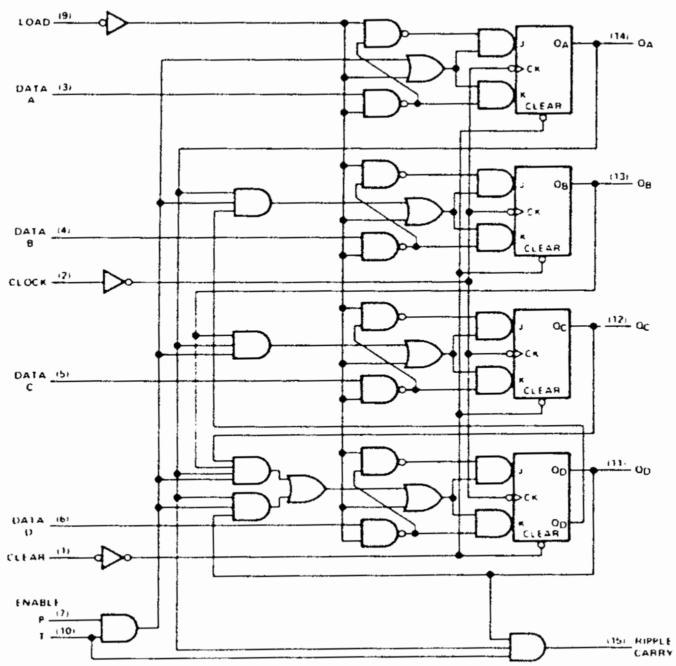
INPUTS					OUTPUTS	
CLEAR	A1	A2	B1	B2	Q	Q̄
L	X	X	X	X	L	H
X	H	H	X	X	L	H
X	X	X	L	X	L	H
X	X	X	X	L	L	H
X	L	X	H	H	L	H
H	L	X	↑	H	⊓	⊔
H	L	X	H	↑	⊓	⊔
H	X	L	H	H	L	H
H	X	L	↑	H	⊓	⊔
H	X	L	H	↑	⊓	⊔
H	H	↓	H	H	⊓	⊔
H	↓	↓	H	H	⊓	⊔
H	↓	H	H	H	⊓	⊔
↑	L	X	H	H	⊓	⊔
↑	X	L	H	H	⊓	⊔

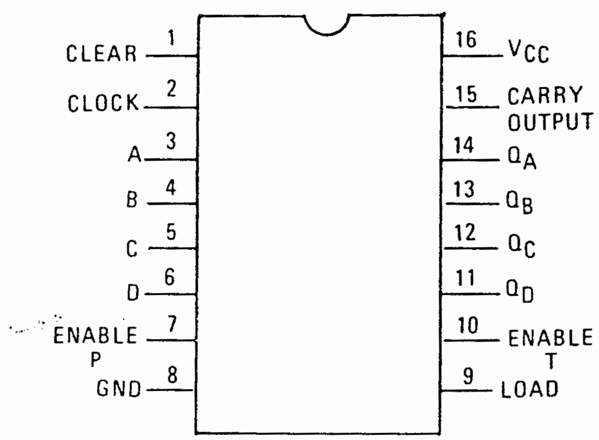
SN74160N (TEXAS INSTRUMENTS)

SYNCHRONOUS DECADE COUNTER TTL BIPOLAR DIGITAL

All flip-flops are clocked simultaneously to provide synchronous operation. Outputs change coincident with each other when so instructed by the count-enable inputs and internal gating. The buffered clock input triggers the four J-K master-slave flip-flops on the positive going edge of the input waveform. A low level at the load input disables the counter and causes the outputs to agree with setup data after the next clock pulse regardless of enable input levels. The clear function is synchronous and a low level at the clear input sets all four flip-flops outputs low after the next clock input regardless of enable levels.

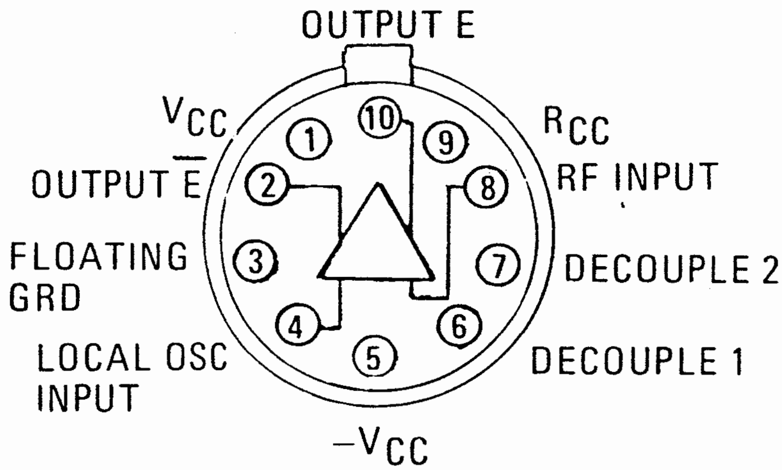
Carry look-ahead circuitry provides for cascading counters for n-bit synchronous applications. The two count enable inputs (P & T) must be high to count, and, input T is fed forward to enable the carry output. The carry output thus enabled will produce a positive output pulse with a duration approximately equal to the positive portion of Q_A. This positive overflow carry pulse can be used to enable successive stages.





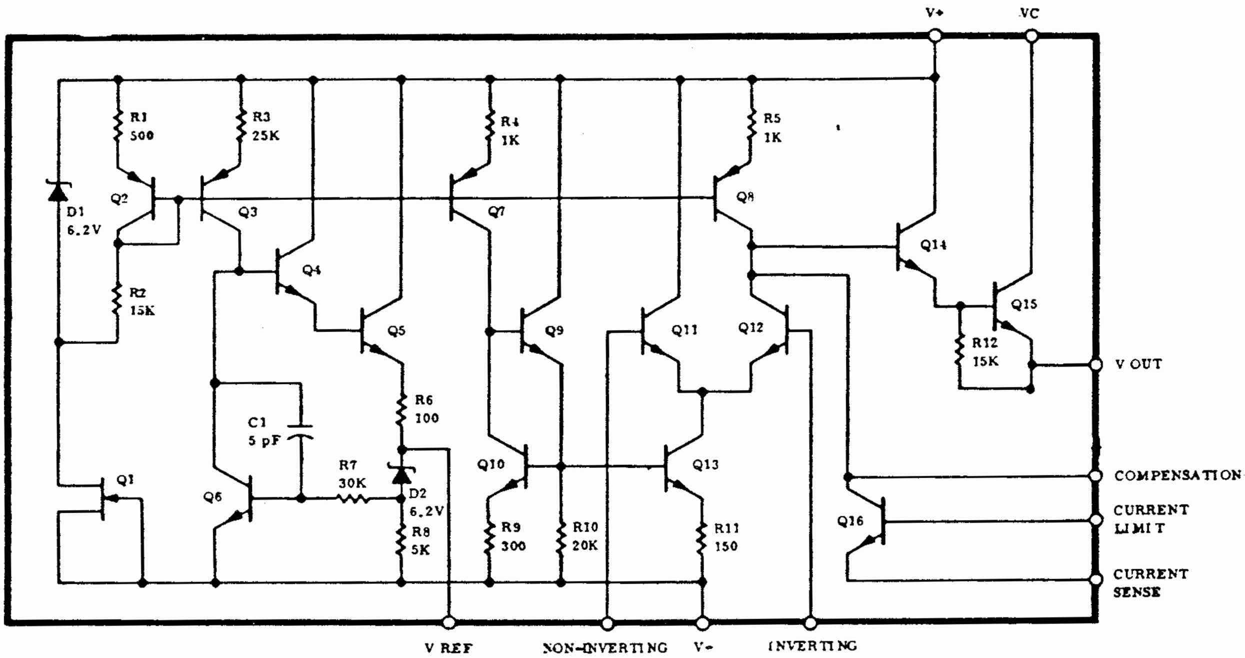
SN76514L (TEXAS INSTRUMENTS)

DOUBLY-BALANCED MIXER

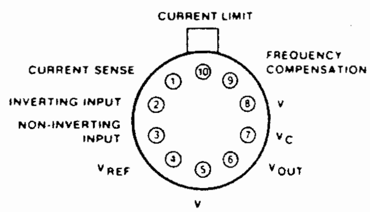


uA723HC (FAIRCHILD) VOLTAGE REGULATOR

The uA723HC is a monolithic voltage regulator consisting of a temperature compensated reference amplifier, power series pass transistor and current limit circuitry.



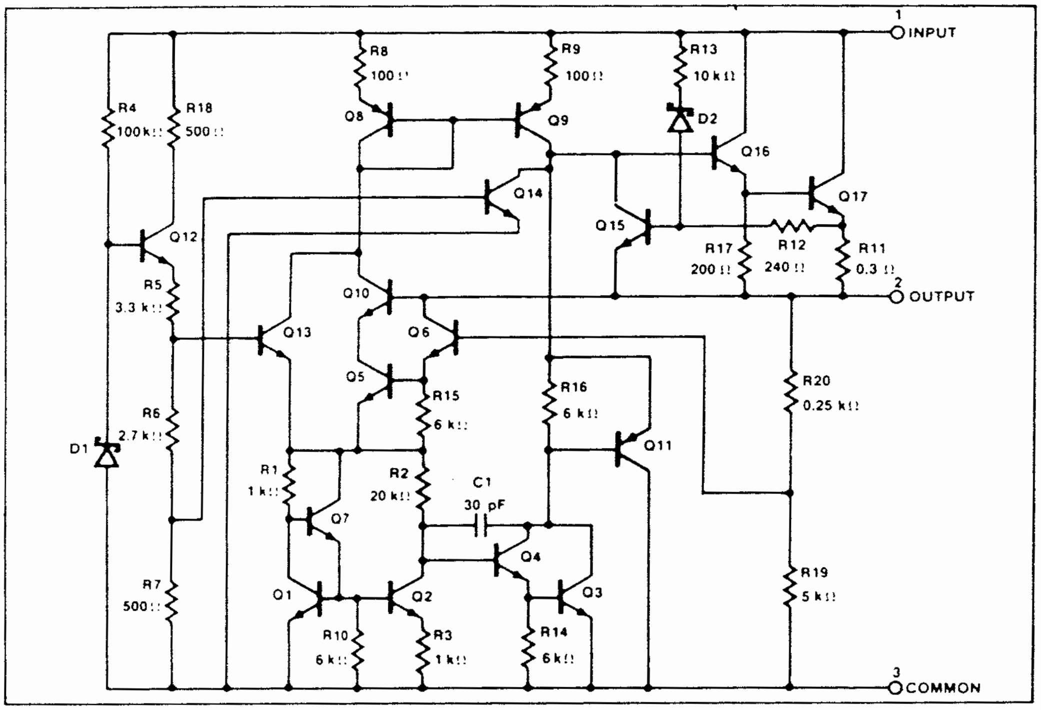
ALL RESISTOR VALUES ARE IN OHMS.

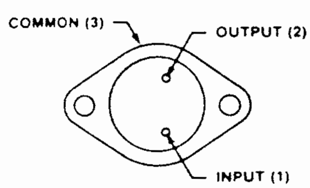


uA7812KC (FAIRCHILD)
uA7818KC (FAIRCHILD)
THREE TERMINAL VOLTAGE REGULATOR

The uA7812KC and uA7818KC are monolithic voltage regulator which employ internal current limiting, thermal shut-down and can handle over/amp output current. The uA7812KC is rated at 12 Vdc output and the uA7818KC is rated at 18 Vdc output.

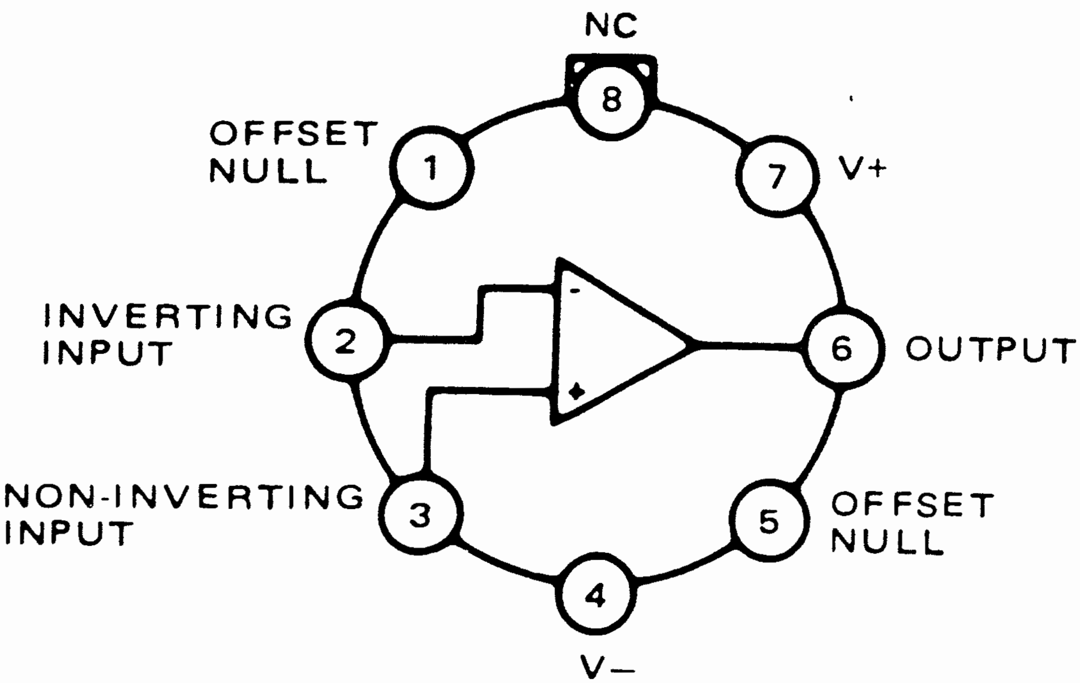
SCHEMATIC DIAGRAM





8007C (INTERSIL)
FET INPUT OPERATIONAL AMPLIFIERS

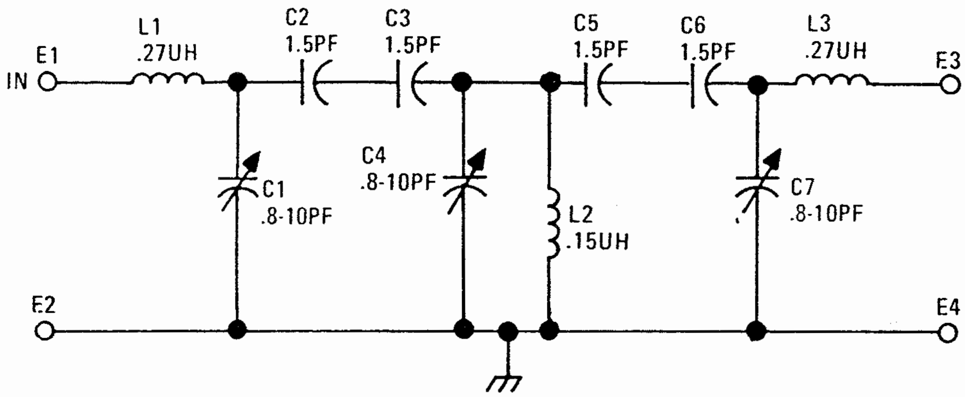
The 8007C FET Input Operational Amplifier provides a unique bootstrap circuit to insure good common mode rejection and to prevent excessive gate currents seen at high common mode voltages.



TOP VIEW

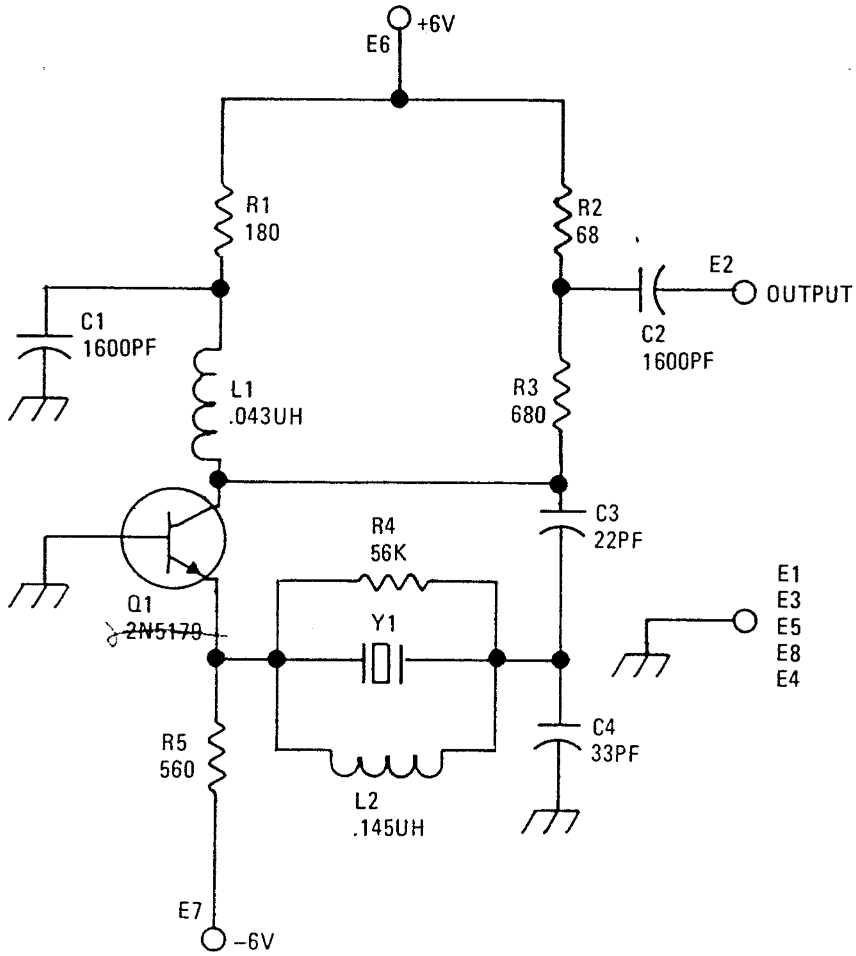
NOTE: PIN 4 CONNECTED TO CASE

0759-3725 (RF COMMUNICATIONS)
173 MHZ FILTER



0759-3725 - 173 MHZ FILTER

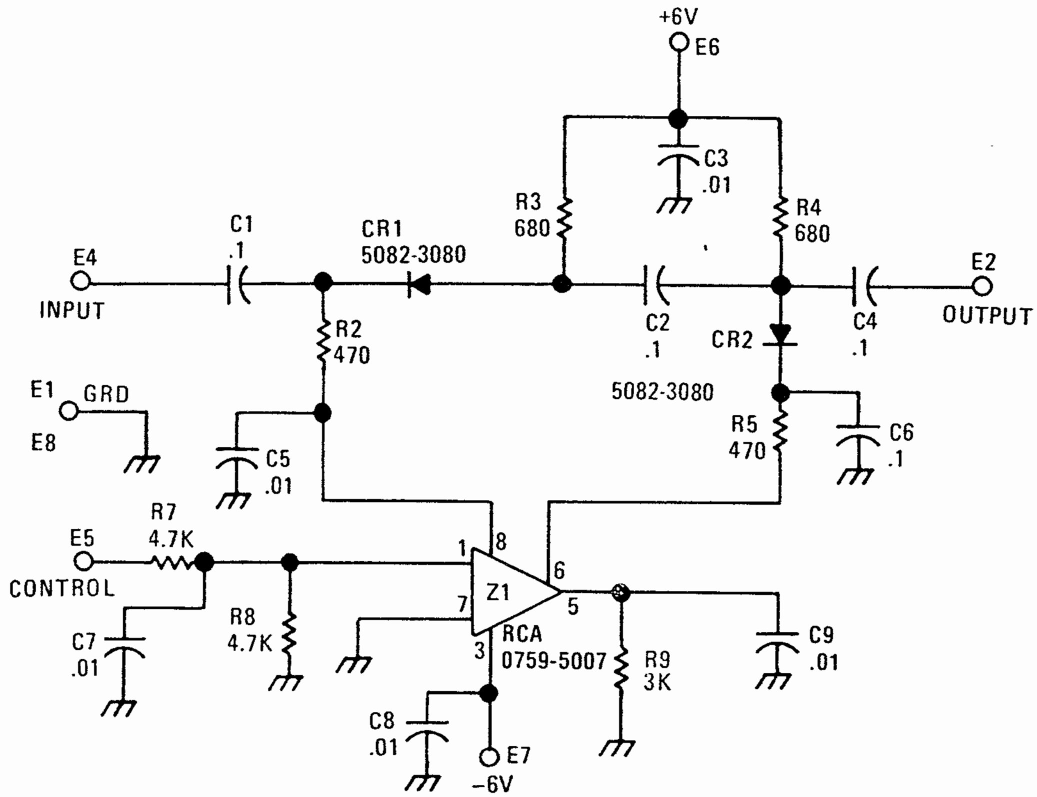
0759-4015 (RF COMMUNICATIONS)
180 MHZ CRYSTAL OSCILLATOR VHF

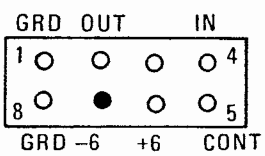


NOTE:

UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/8W, 10%.

0759-5000 (RF COMMUNICATIONS) ATTENUATOR



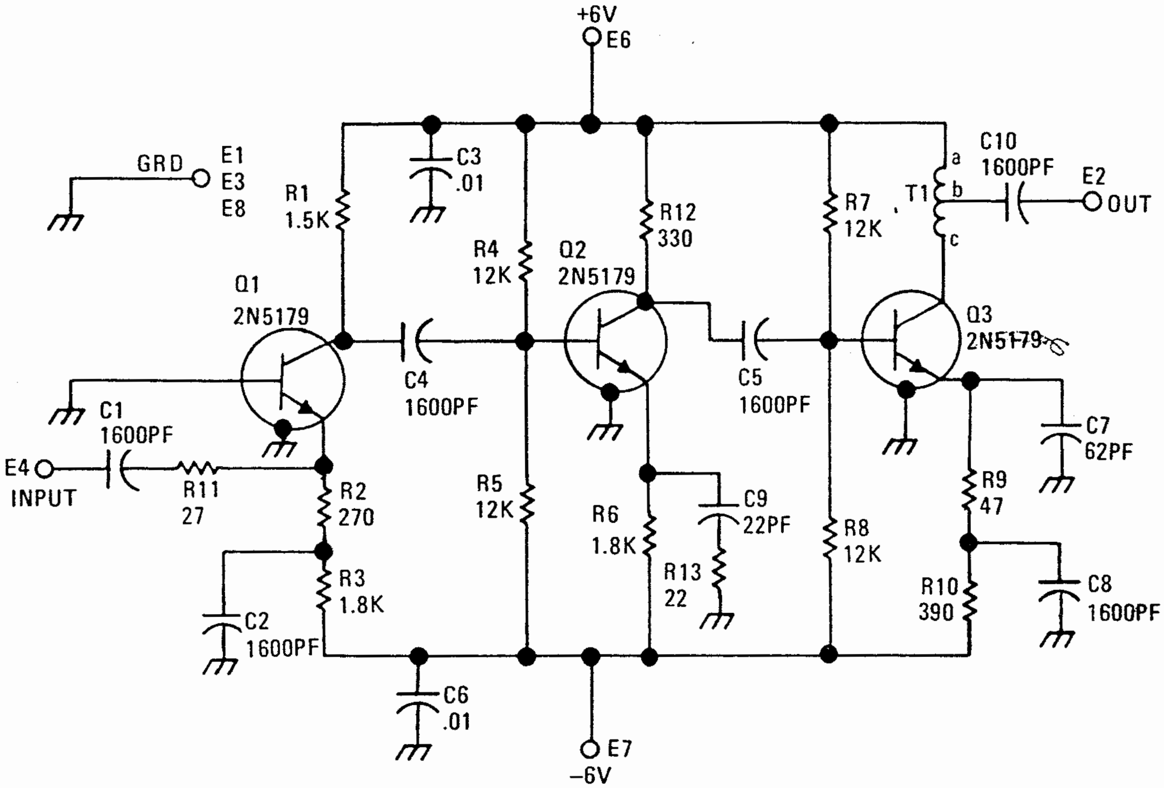


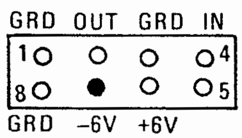
BOTTOM VIEW

NOTE:

UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS; 1/8W, 10%.

0759-5010 (RF COMMUNICATIONS) VHF AMPLIFIER



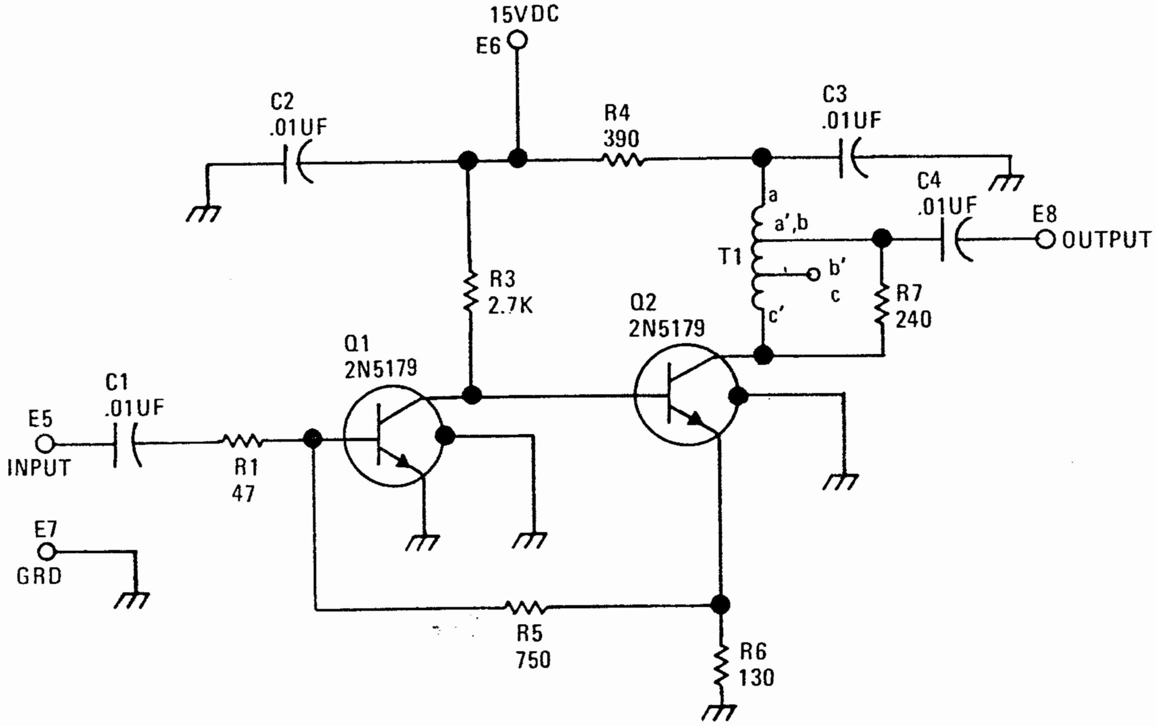


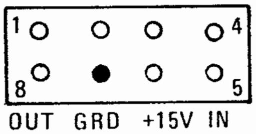
NOTE:

UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS 1/8W, 10%

0759-5010 - VHF AMPLIFIER

0759-5020 (RF COMMUNICATIONS)
HF AMPLIFIER (NO. 1)



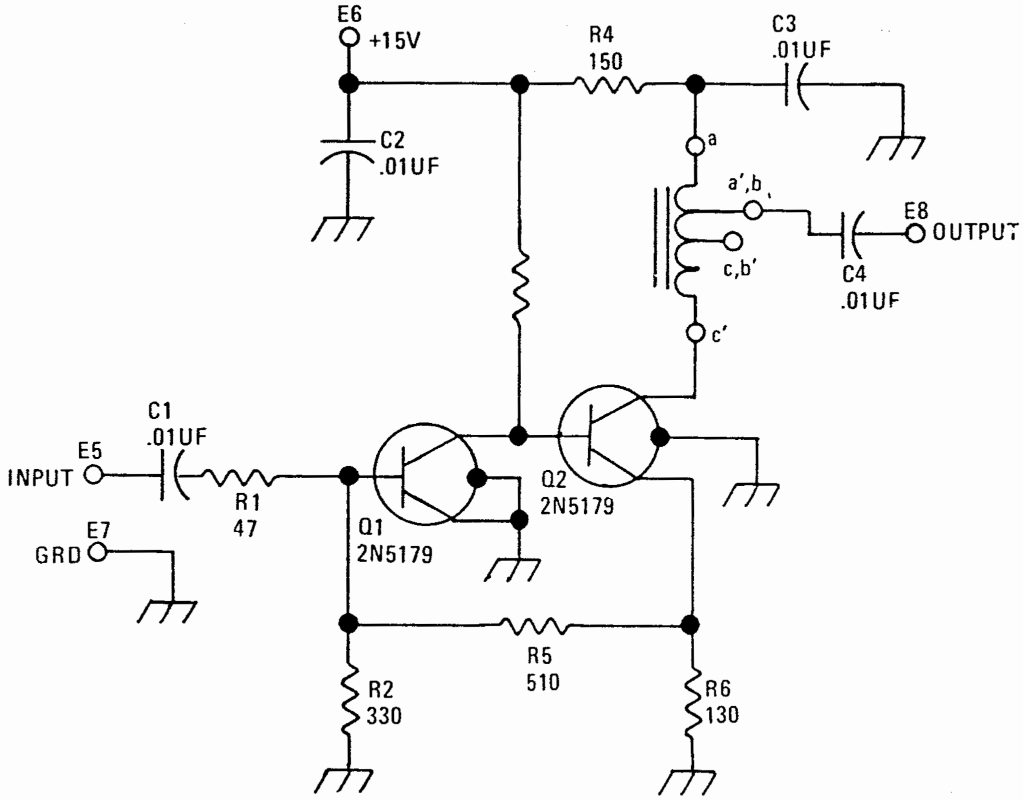


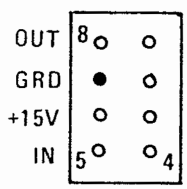
BOTTOM VIEW

NOTES:

ALL RESISTORS ARE IN OHMS, 1/8W, 5%

0759-5030 (RF COMMUNICATIONS)
HF AMPLIFIER (NO. 2)



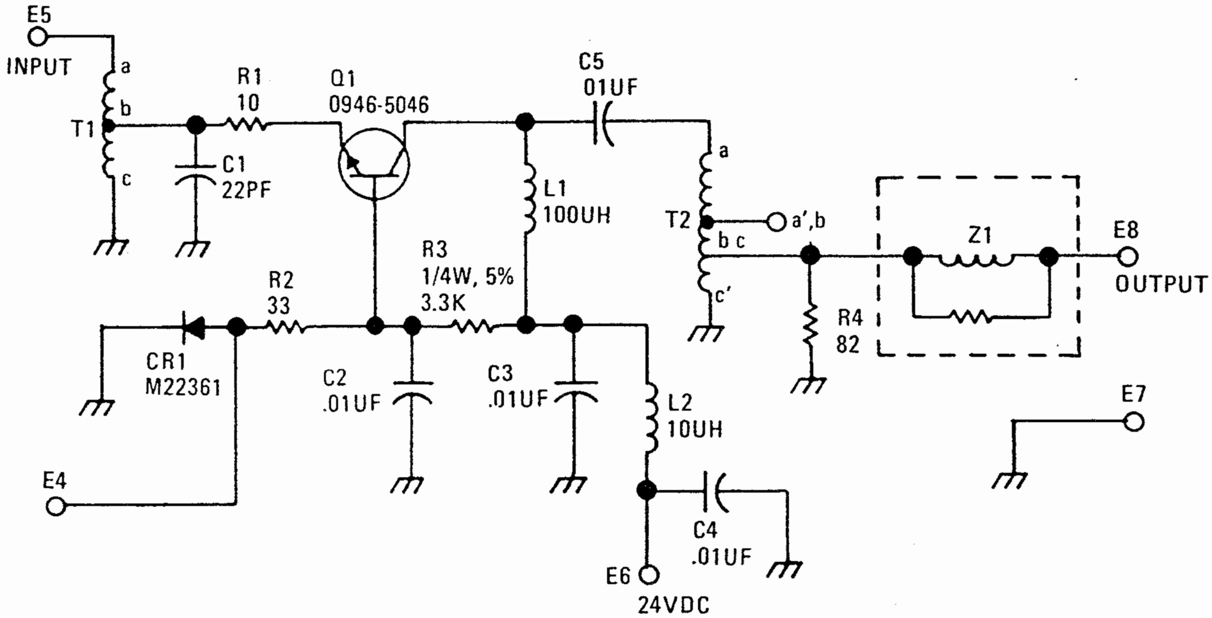


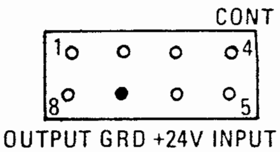
BOTTOM VIEW

NOTE:

UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS 1/8W, 10%.

0759-5040 (RF COMMUNICATIONS)
POWER AMPLIFIER - HF ASSEMBLY



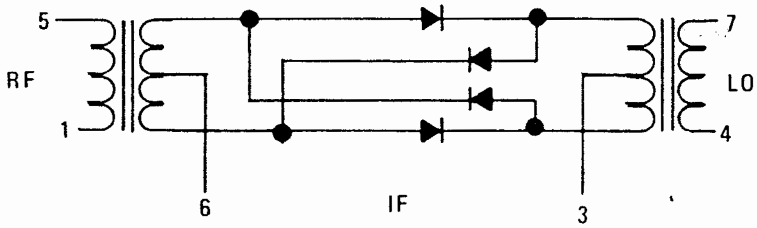


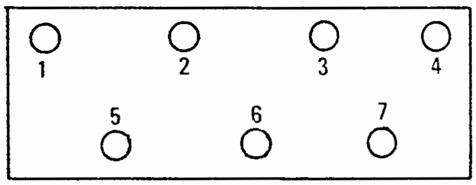
BOTTOM VIEW

NOTE:
ALL RESISTORS ARE IN OHMS, 1/8W, 5%

0759-5040 - POWER AMPLIFIER - HF ASSY

0759-5150 (RF COMMUNICATIONS)
BALANCED MODULATOR



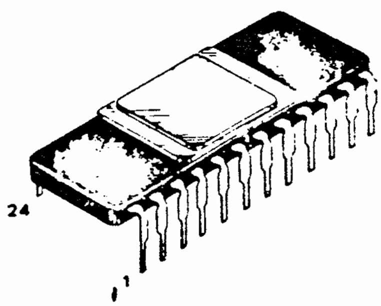


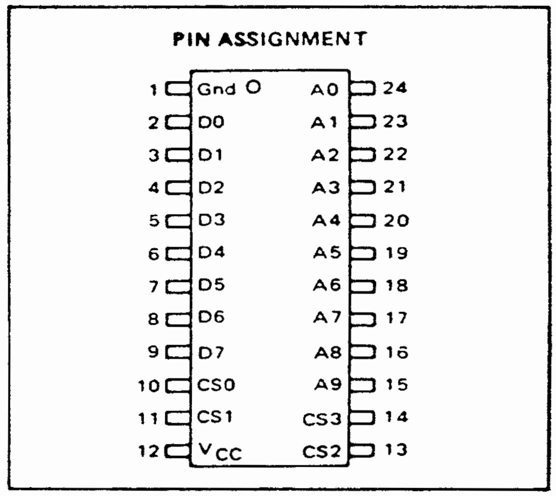
(BOTTOM VIEW)

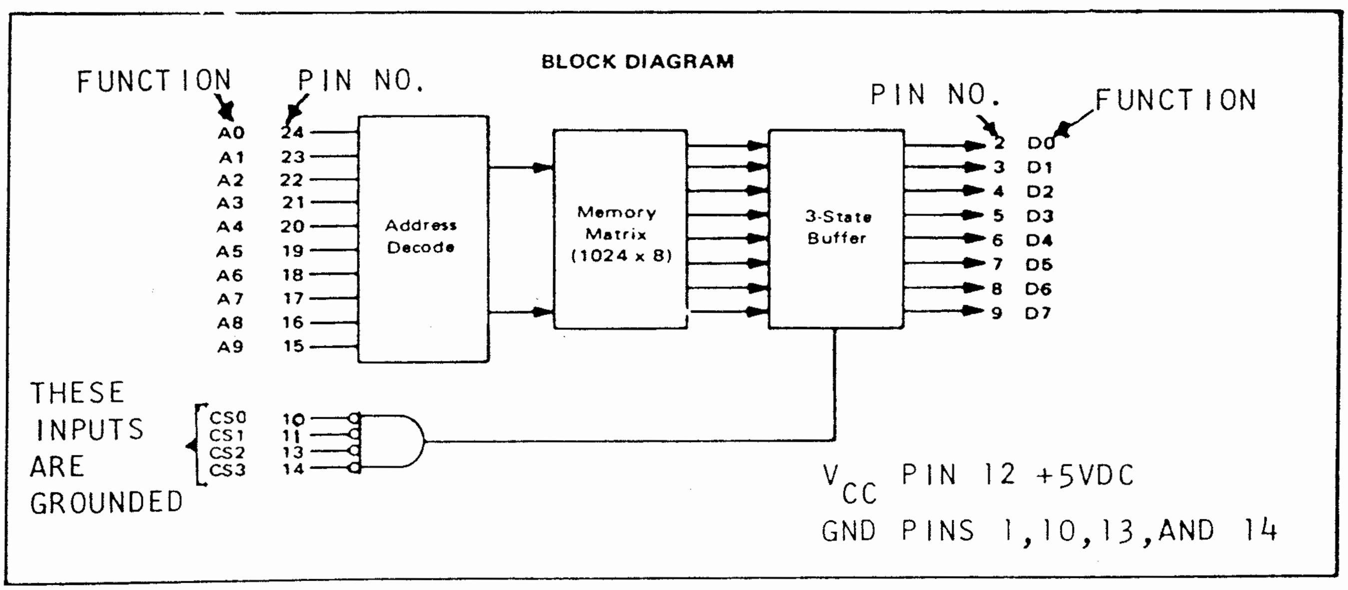
6722-6118 MOS (N-CHANNEL, SILICON GATE) 1024 x 8-BIT READ ONLY MEMORY (RF COMMUNICATIONS)

The RF Communications Part No. 6722-6118 Read Only Memory (ROM) is a mask-programmable byte-organized memory integrated circuit. It is fabricated with N-channel silicon-gate technology. This device operates from a +5 Vdc power supply, is compatible with DTL and TTL, and requires no clocks or refreshing because of static operation.

The memory provides READ-ONLY storage in byte increments. The memory expansion feature, provided through Chip Select inputs, is not used in this application of the device. Refer to Pin Assignment and Block Diagram data on this page.





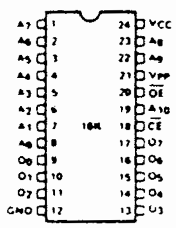


RF COMMUNICATIONS PART NO. 6722-6130 UV ERASABLE PROM

- Single +5V Power Supply
- Low Power Dissipation
  - 525 mW Max. Active Power
  - 132 mW Max. Standby Power
- Simple Programming Requirements
  - Single Location Programming
  - Programs with One 50 ms Pulse
- Inputs and Outputs TTL Compatible during Read and Program
- Completely Static

The RF Communications 6722-6130 is an ultraviolet erasable and electrically programmable read-only memory (EPROM), that operates from a single 5-volt power supply, has a static standby mode, and features fast single address location programming.

PIN CONFIGURATION



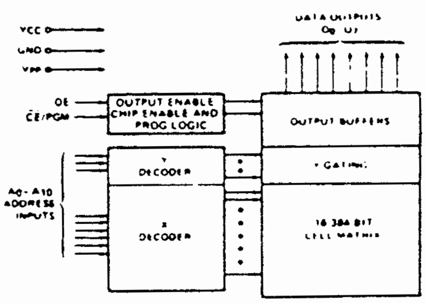
PIN NAMES

A_0 - A_{10}	ADDRESSES
$\overline{CE}$/PGM	CHIP ENABLE/PROGRAM
$\overline{OE}$	OUTPUT ENABLE
O_0-O_7	OUTPUTS

MODE SELECTION

PINS / MODE	$\overline{CE}$/PGM (18)	$\overline{OE}$ (20)	V_{PP} (21)	V_{CC} (24)	OUTPUTS (9-11, 13-17)
Read	V_{IL}	V_{IL}	+5	+5	D_{OUT}
Standby	V_{IH}	Don't Care	+5	+5	High Z
Program	Pulsed V_{IL} to V_{IH}	V_{IH}	+25	+5	D_{IN}
Program Verify	V_{IL}	V_{IL}	+25	+5	D_{OUT}
Program Inhibit	V_{IL}	V_{IH}	+25	+5	High Z

BLOCK DIAGRAM



Change page 5-51/5-52

PART 6

CASE ASSEMBLY A1 AND PANEL AND CHASSIS ASSEMBLY A2

6.1 INTRODUCTION

This part contains data applicable to Case Assembly A1, Panel and Chassis Assembly A2, and the parts mounted on these assemblies.

The flexible Case Cable Assembly W1 shown in figure 6.1, connects Control Head A2A6 Assembly to Filter Box Assembly A1FL1 at the inside back of the case, and is considered part of the Case Assembly A1, as indicated in the Maintenance Parts List.

The relationship of various components to the applicable subassemblies and cable assemblies of both Case Assembly A1 and Panel and Chassis Assembly A2 is clearly noted in both parts lists (tables 6-1 and 6-2). This provides for ease of identification when reordering parts.

Figure 6.2 shows the reference designators for the top view and Figure 6.3 shows the reference designator for the bottom of Panel and Chassis Assembly A2 parts. These reference designators can also be found in the applicable parts list.

Figure 6.4 shows the interconnecting wiring of the Panel and Chassis Assembly A2. Reference should also be made to the wiring diagram for Control Head Module A2A6 contained in the Unit Description for assembly A2A6.

As previously stated, tables 6-1 and 6-2 are the applicable parts lists for Case Assembly A1 and Panel and Chassis Assembly A2, respectively. Table 6-3, the List of Manufacturers, correlates the 5-digit MFR (Manufacturer) codes, used in all the parts lists of this book, with the name and address of the applicable manufacturer.

TABLE 6-1. MAINTENANCE PARTS LIST - CASE ASSEMBLY A1, PART NO. 0759-1000.

Reference Designation	Name and Description
A1	Case Assembly: MFR 14304, PN 0759-1000
FL1	Filter Box Assembly: MFR 14304, PN 0759-1015
FL1C1-C84	Capacitor, Feedthru, 1500pF, Mil type CK70AW152M
FL2	Filter, Power: MFR 14304, PN 0759-1010
J1, J2	Connector, Multiconductor Receptacle: Mil type MS3102R10SL4P
J3	Part of A1FL2
J4	Connector, Multiconductor Receptacle: MFR 77820, PN PT02A-22-55P
J5, J6	Connector, Multiconductor Receptacle: Mil type MS3102R10SL4P
J7	Connector, Multiconductor Receptacle: MFR 77820, PN PT02A-22-55PW
J8 - J16	Not used
J17, J18	Connector, Coaxial, BNC: MFR 00779, PN 225398-8
J19-J22	Not used
J23	Connector, Coaxial, BNC: MFR 00779, PN 225398-8
P1 - P5	Not used
P6	Connector, Multiconductor Jack: MFR 81312, PN MRAC75S-JTX (See note)
P7 - P16	Not used
P17, P18	Mini-connector, Coaxial Plug, Right Angle: MFR 94375, PN G4602-045-901
P19-P22	Not used
P23	Mini-connector, Coaxial Plug, Right Angle: MFR 94375, PN G4602-045-901
S1	Switch, Toggle, DPST, AUX AC IN/REMOTE AC IN: Mil type MS35059-233
W1	Cable Assembly, Case: MFR 14304, PN 0759-1002.

Note: Connector pins used are Mil type MS17804-16-20

TABLE 6-2. MAINTENANCE PARTS LIST - PANEL AND CHASSIS ASSEMBLY A2, PART NO. 0759-5500.

Reference Designation	Name and Description
A2	Panel and Chassis Assembly: MFR 14304, PN 0759-5500
	Front Panel Assembly: MFR 14304, PN 6722-5600
	Chassis Assembly: MFR 14304, PN 0759-5700
B1	Fan, 115V, 50/60Hz, Single Phase: MFR 14304, PN B22-0004-002
C1	Capacitor, Fixed, Ceramic, 0.1uF, 50WVDC: MFR 14304, PN C11-0005-104
DS1 - DS3	Not used
DS4, DS5	Lens, White: Mil type LC12WT
DS6	Not used
DS7	Lens, Red: Mil type LC12RT Lamp (for DS4, DS5 and DS7), 28V: Mil type MS25237-387
F1	Fuse, Std Blo, 1 Ampere, 250V: Mil type F02A250V1A
FL1	BP Filter, 160MHz: MFR 14304, PN 0759-5708
FL2	BP Filter, 180MHz: MFR 14304, PN 0759-5710
FL3	BP Filter, 200MHz: MFR 14304, PN 0759-5709
J1	Not used
J2, J3	Connector Block, Multiconductor: MFR 81312, PN MRAC-20S-N (See note)
J4	Not used
J5	Connector Block, Multiconductor: MFR 81312, PN MRAC-20S-N (See note)
J6	Not used
J7, J8	Same as A2J2 (See note)
J9	Connector Block, Multiconductor: MFR 81312, PN MRAC-14S-N (See note)
J10	Same as A2J2 (See note)
J11	Same as A2J9 (See note)
J12	Same as A2J2 (See note)
J13	Not used
J14	Same as A2J2 (See note)
J15, J16	Not used
J17, J18	Connector, Coaxial, Right Angle, Bulkhead: MFR 94375, PN G4615-400-901
J19	Connector, Female: MFR 17419, PN DM9606-7S
J20-J22	Not used
J23	Same as A2J17
M1	Meter, INPUT LEVEL/FREQUENCY COMPARISON: MFR 14304, PN 0759-5611
MP1, MP2	Knob, Pointer (for MICROPHONE Input Selector and INPUT LEVEL/FREQUENCY COMPARISON Selector): Mil type MS91528-1K2B
MP3, MP4	Knob, Skirted (for INPUT LEVEL Controls): Mil type MS91528-1F2B
P1 - P15	Not used
P16	Connector, Multiconductor Plug: MFR 81312, PN MRAC-75P-JTX (See note)
Q1	Transistor: MFR 04713, PN 2N6261
R1	Not used

TABLE 6-2. MAINTENANCE PARTS LIST - PANEL AND CHASSIS ASSEMBLY A2, PART NO. 0759-5500. (continued)

Reference Designation	Name and Description
R10	Resistor, Variable (FREQ. STD. ADJ.), 5K: MFR 80294, PN 3070S-1-502
R11	Resistor, Fixed Composition, 10K, ±10%, ¼W: Mil type RC07GF103K
S1	Switch, Rotary (MICROPHONE Input Selector): MFR 7159, PN PSA-221
S2	Switch, Rotary (INPUT LEVEL/ FREQUENCY COMPARISON Selector) : MFR 7159, PN PSA-207
XDS1 - XDS3	Not used
XDS4, XDS5	Lampholder (For DS4 and DS5): Mil type LH73/1
XDS6	Not used
XDS7	Same as XDS4 and XDS5
XF1	Fuseholder (For F1): Mil type FHL17G2
A2A15	Meter Amplifier PWB Assembly: MFR 14304, PN 6722-4500
A2A16	Oven/Light Regulator PWB Assembly: MFR 14304, PN 0759-5725
A2A17	Microphone PWB Assembly: MFR 14304, PN 0759-5715
A2A18	Power Distribution Board: MFR 14304, PN 0759-5720
R2, R3	Resistor, Variable (INPUT LEVEL Controls), 1K: Mil type RV4NAYSD102C
R4, R5	Not used
R6, R7	Resistor, Fixed Composition, 1.5K, ±10%, ¼W: Mil type RC07GF152K
R8, R9	Not used

Note: The following is a list of the various connector pins used on the connector blocks of Panel and Chassis Assembly A2:
Connector Pin, Male: Mil type MS17803-16-20
Connector Pin, Female: Mil type MS17804-16-20
Connector Pin, Coaxial, Female: MFR 81312, PN 100-8000P
Connector Pin, Coaxial, Male: MFR 81312, PN 100-8000S

TABLE 6-3. LIST OF MANUFACTURERS

MFR Code	Name and Address
05820	Wakefield Engineering Inc. Audobon Rd. Wakefield, Ma 01880
00656	Aerovox Corporation 740 Belleville Avenue New Bedford, Ma 02741
00779	AMP Inc. P.O. Box 3608 Harrisburg, Pa 17105
00853	Sangamo Electric Company South Carolina Division P.O. Box 128 Pickens, SC 29671
01295	Texas Instruments Inc. Semiconductor Group P.O. Box 5012 13500 North Central Expressway Dallas, Tx 75222
02660	Bunker Ramo Corporation Connector Division 2801 South 25th Avenue Broadview, Il 60153
02735	RCA Corp. Solid State Division Route 202 Somerville, NJ 08876
04713	Motorola Inc. Semiconductor Products Division 5005 East McDowell Road Phoenix, Az 85036
05820	Wakefield Engineering Inc. Audubon Road Wakefield, Ma 01880
06486	TRW Electronic Components Capacitor Division/Solid State Division West Lynn, Ma 01905
07263	Fairchild Semiconductor A Division of Fairchild Camera and Instrument Corporation 464 Ellis Street Mountain View, Ca 94042

MFR Code	Name and Address
12040	National Semiconductor Corporation P.O. Box 443 Commerce Drive Danbury, Ct 06810
12954	Dickson Electronics Corporation 8700 East Thomas Road P.O. Box 1390 Scottsdale, Az 85252
14304	Harris Corporation RF Communications Division 1680 University Avenue Rochester, NY 14610
	ITT Semiconductor Division 3301 Electronics Way P.O. Box 3049 West Palm Beach, Fl 33402
14655	Cornell-Dubilier Electronics Division of Federal Pacific Government Contracts Department 150 Avenue L Newark, NJ 07101
15801	Fenwall Electronics Division Walter Kidde and Company Inc. 63 Fountain Street Framingham, Ma 01701
16170	Teledyne Systems Company Microelectronics Division 12964 Panama Street Los Angeles, Ca 90066
16733	Cablewave Systems 60 Dodge Avenue New Haven, Ct 06743
17419	The Deutsch Company 7001 West Imperial Highway Los Angeles, Ca 90045
17540	Alpha Industries 20 Sylvan Road Woburn, Ma 01801
18324	Signetics Corporation 811 East Arques Sunnyvale, Ca 94086

TABLE 6-3. LIST OF MANUFACTURERS

MFR Code	Name and Address
21845	Solitron Devices Inc. Transistor Division 1177 Blue Herron Blvd. Riviera Beach, Fl 33404
21921	RCA Corporation Parts and Accessories 2000 Clements Bridge Road Deptford, NJ 08096
26742	Methode Electronics Inc. 7447 West Wilson Avenue Chicago, Il 60656
31433	Union Carbide Company Materials Systems Division Highway 276 SE Greenville, SC 29606
32293	Intersil Inc. 10900 North Tantau Avenue Cupertino, Ca 95014
32997	Bourns, Inc. Trimpot Products Division 1260 Columbia Aenue Riverside, Ca 92507
35009	IRC Division of Renfrew Electric Co. Ltd. 349 Carlaw Avenue Toronto, Ontario, Canada M4M 2T2
50444	Hewlett-Packard Co. HP Laboratories 1501 Page Mill Road Palo Alto, Ca 94304
56289	Sprague Electric Co. North Adams, Ma 01247
71590	Centralab Electronics Division Globe-Union Inc. 5757 North Green Bay Avenue Milwaukee, Wi 53201
72982	Erie Technological Products Inc. 644 West 12th Street Erie, Pa 16512
73168	Fenwal Inc. Division of Walter Kidde and Co. Inc. 400 Main Street Ashland, Ma 01721

MFR Code	Name and Address
73899	JFD Electronics Corp. 15th at 62nd Street Brooklyn, NY 11219
74970	E. F. Johnson Co. 299 10th Avenue S.W. Waseca, Mn 56093
77820	The Bendix Corp. Electrical Components Division Sherman Avenue Sidney, NY 13838
78488	Stackpole Carbon Co. St. Mary's, Pa 15857
80294	Bourns Inc. Instrument Division 6135 Magnolia Avenue Riverside, Ca 92506
80483	Aladdin Industries Inc. 703 Murfreesboro Road Nashville, Tn 37210
81312	Winchester Electronics Division Litton Industries Inc. Main Street and Hillside Avenue Oakville, Ct 06779
81640	Control Switch Inc. A Subsidiary of Cutler-Hammer Inc. Folcroft, Pa 19032
83125	Nytronics/Darlington Inc. Capacitor Division Orange Street Darlington, SC 29532
84411	TRW Electronic Components TRW Capacitors 112 West First Street Ogallala, Ne 69155
91293	Johnson Mfg. Co. P.O. Box 329 Booton, NJ 07005
91506	Augat, Inc. 33 Perry Avenue Attleboro, Ma 02703

MFR Code	Name and Address
93125	General Electric Company Industry Control Department of Switchgear and Control Division of Apparatus Group Schenectady, NY
94375	Plessey Connector Division Inc. 400 Moreland Road Commack, NY 11725
96182	Master Specialties Co. 1640 Monrovia Costa Mesa, Ca. 92627
98291	Sealectro Corp. 225 Hoyt Mamaraneck, NY 10544
99800	American Precision Industries Inc. Delevan Division 270 Quaker Road East Aurora, NY 14052

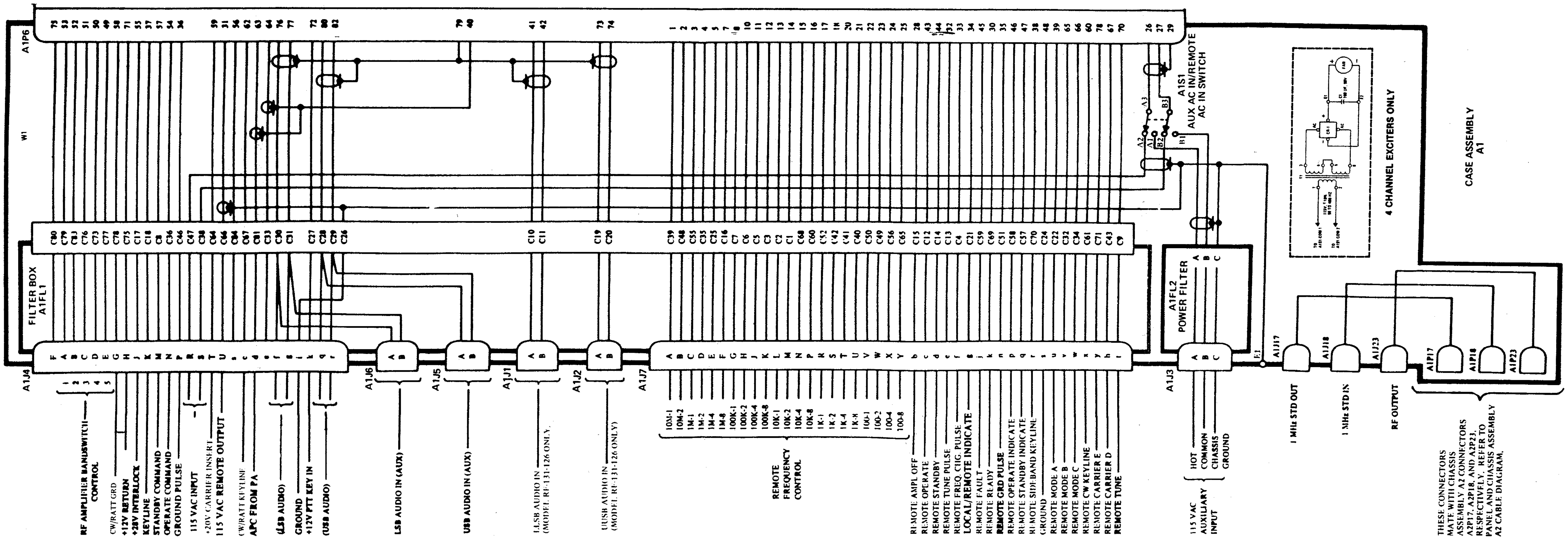


Figure 6-1. Flexible Case Cable Assembly W1
RF-130 SYSTEM EXCITERS

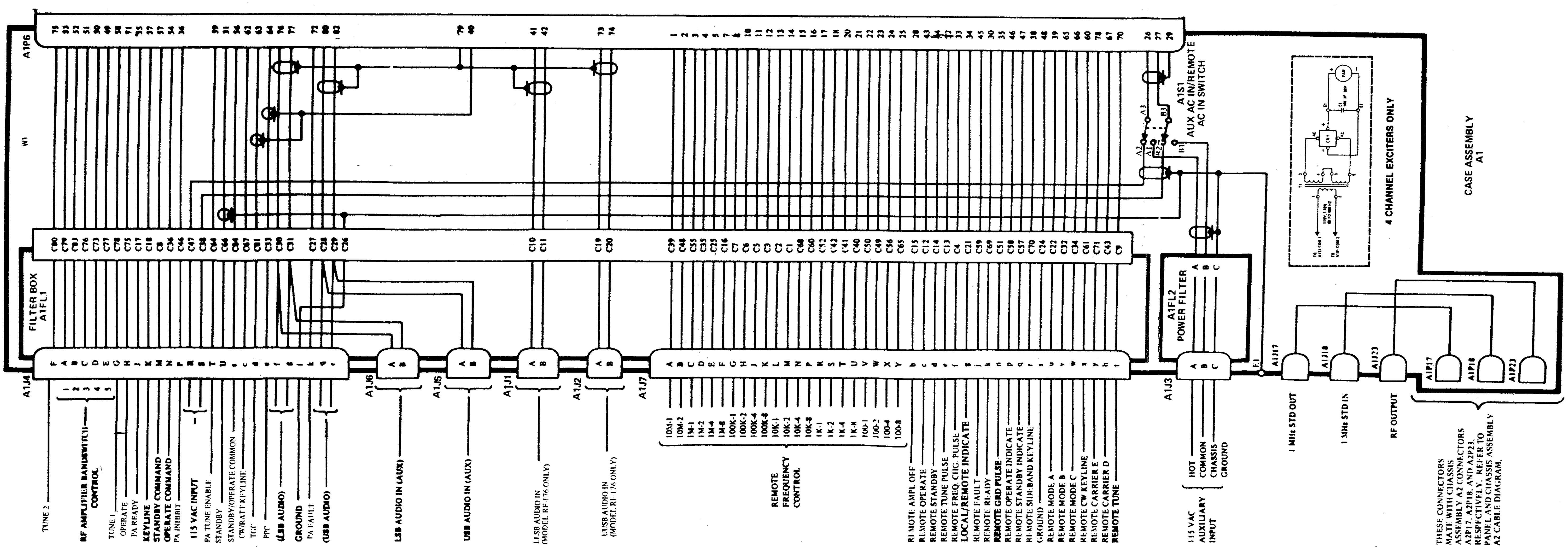


Figure 6.1A Flexible Case Cable Assembly W1
RF-745 System Exciters

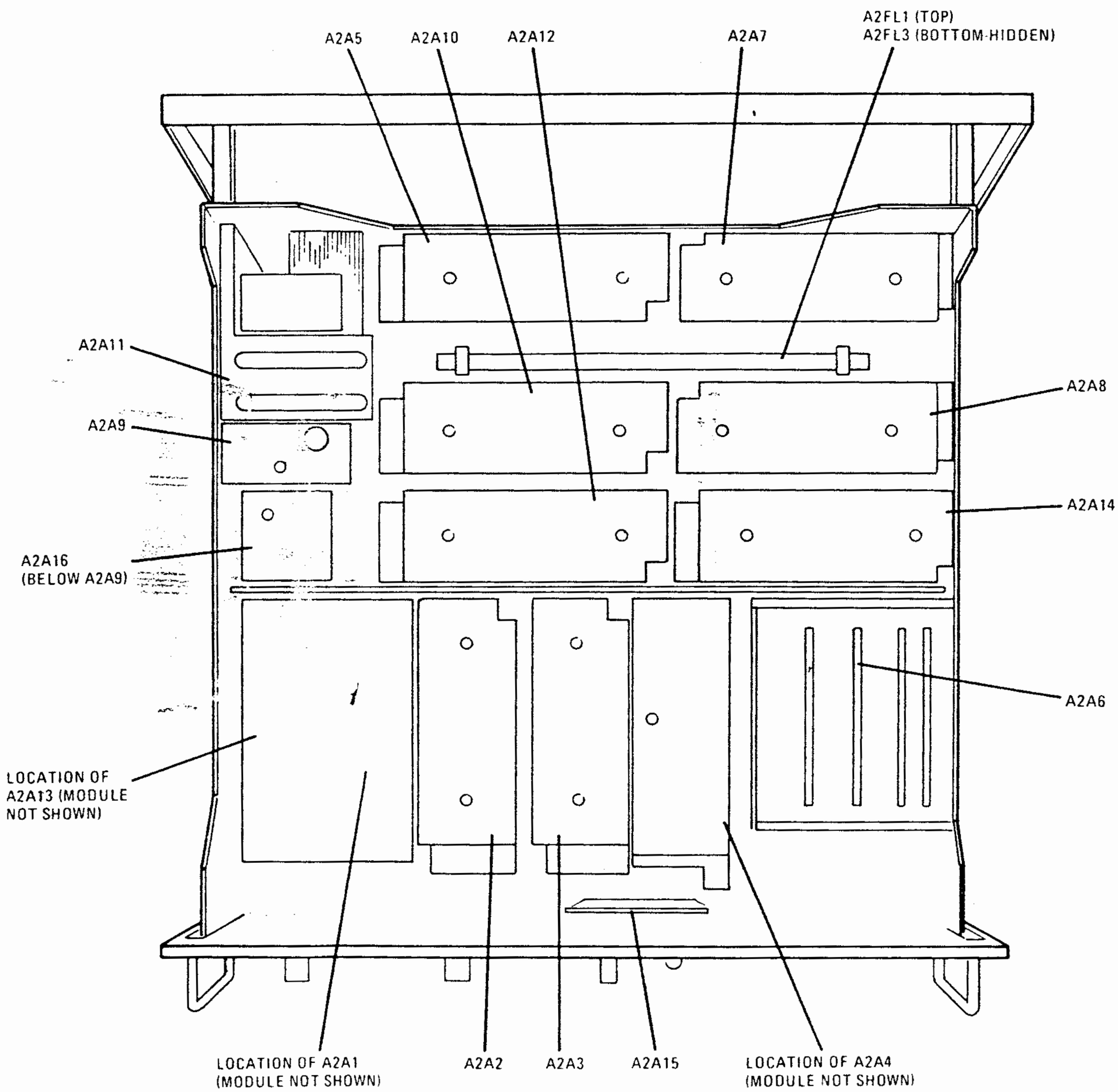


Figure 6.2 Panel and Chassis Assembly A2 Component Locations Top View

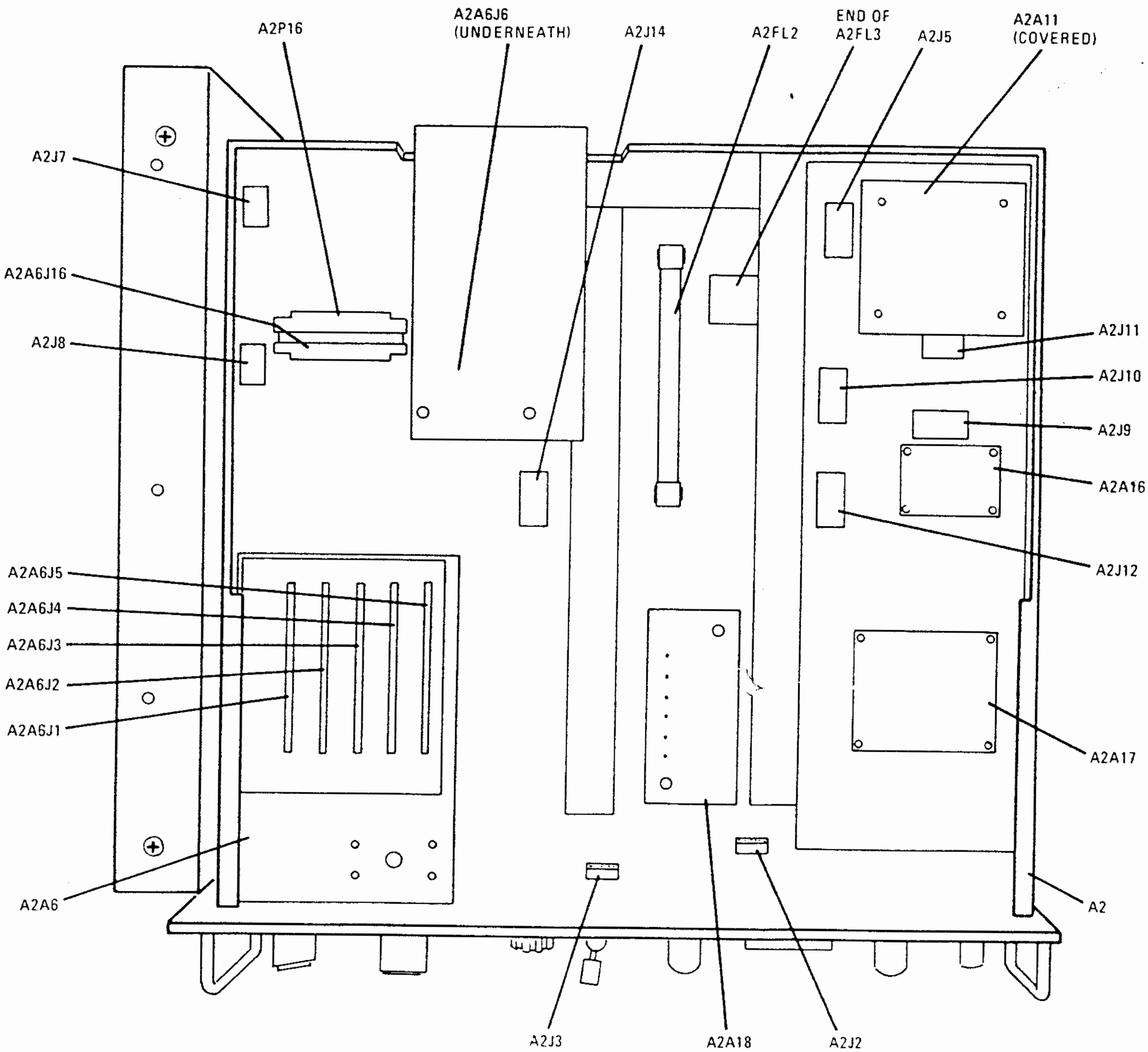


Figure 6.3 Panel and Chassis Assembly A2 Component Locations Bottom View

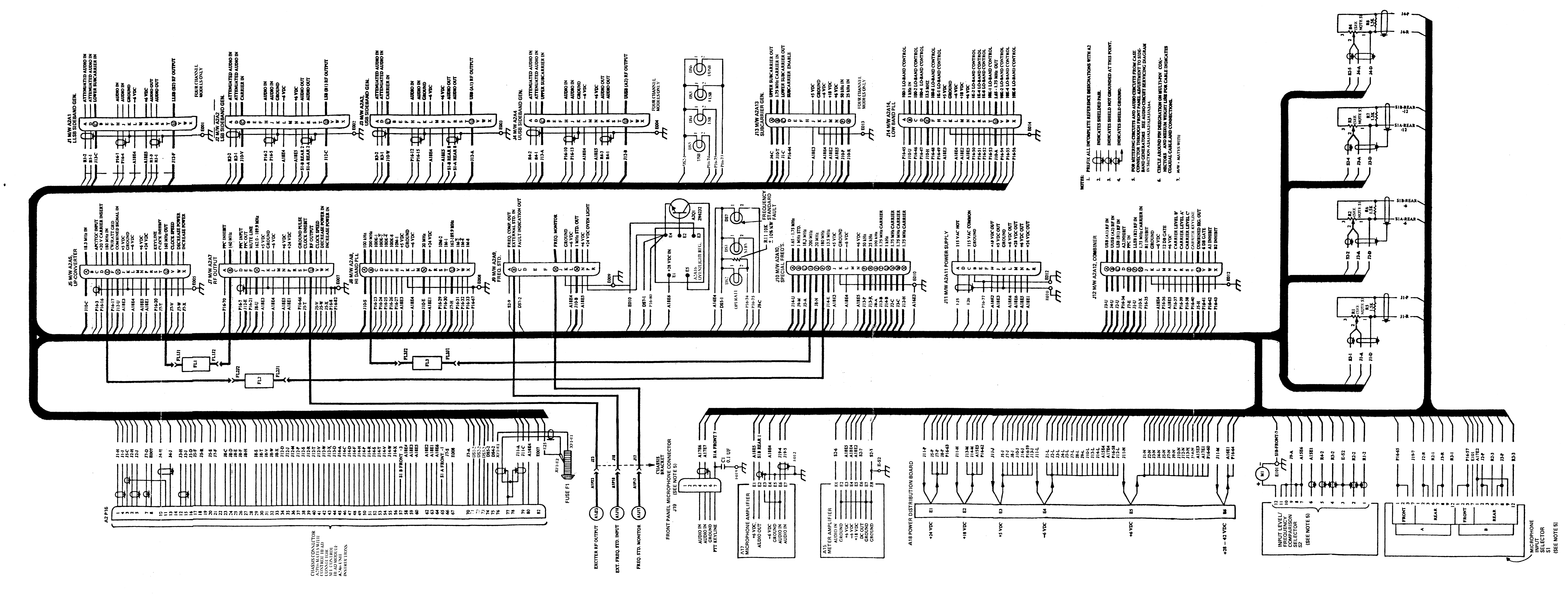


Figure 6.4 Panel and Chassis Assembly A2 Interconnect Wiring Diagram (RF-130 System)

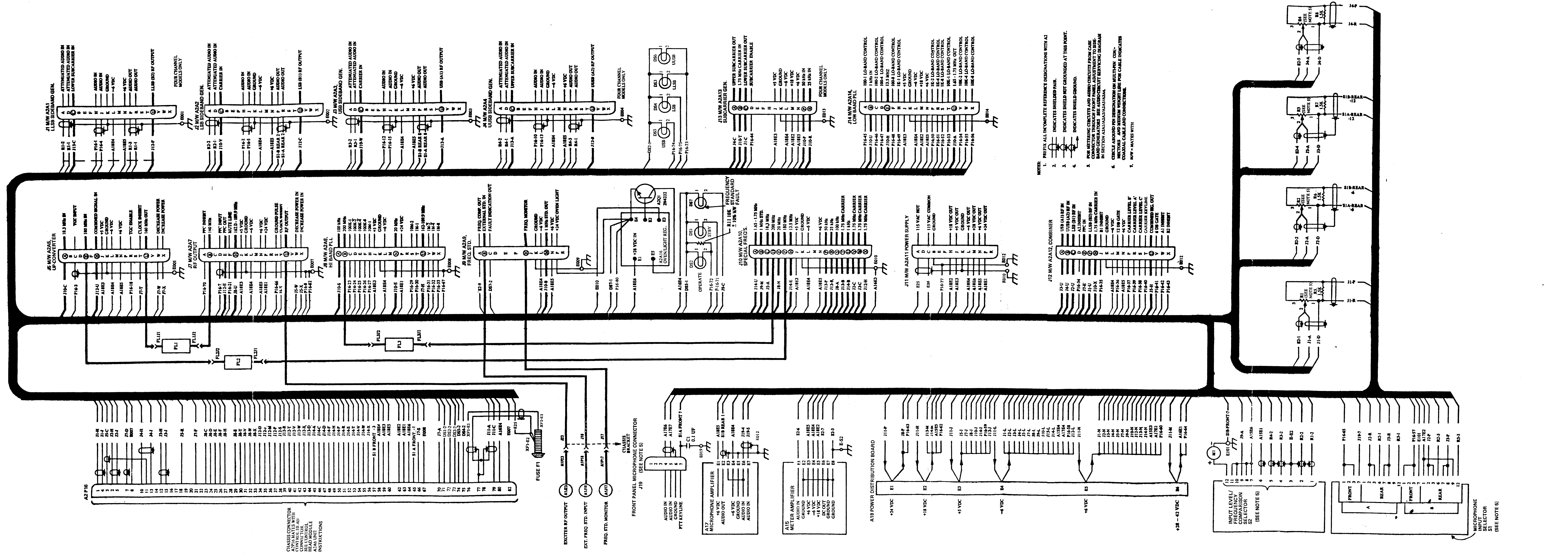


Figure 6.5 Panel and Chassis Assembly A2 Interconnect
Wiring Diagram (RF-745 System)

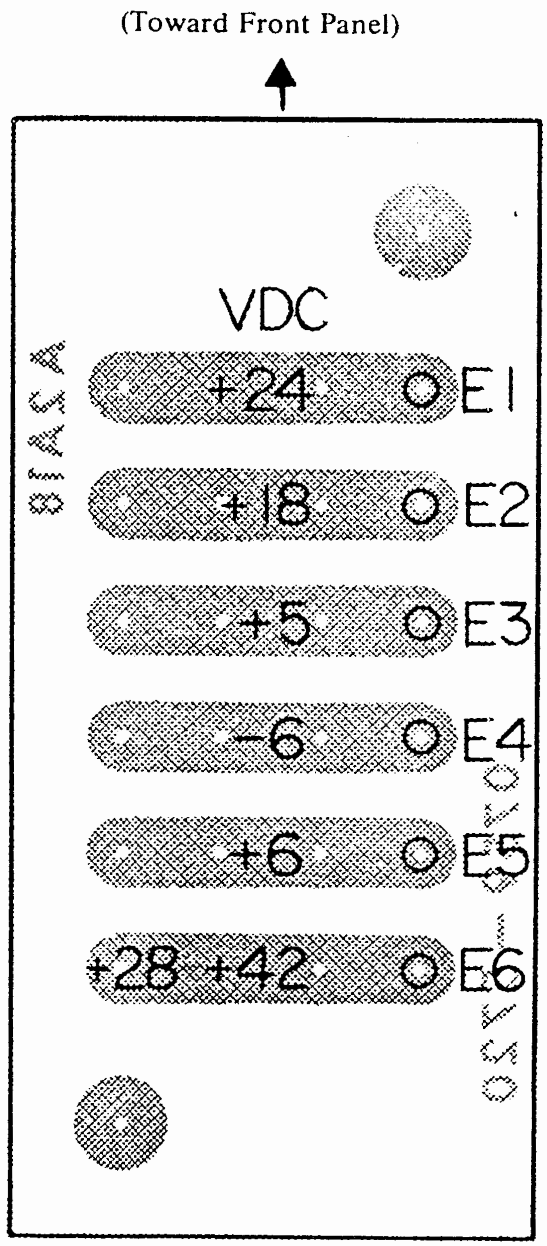
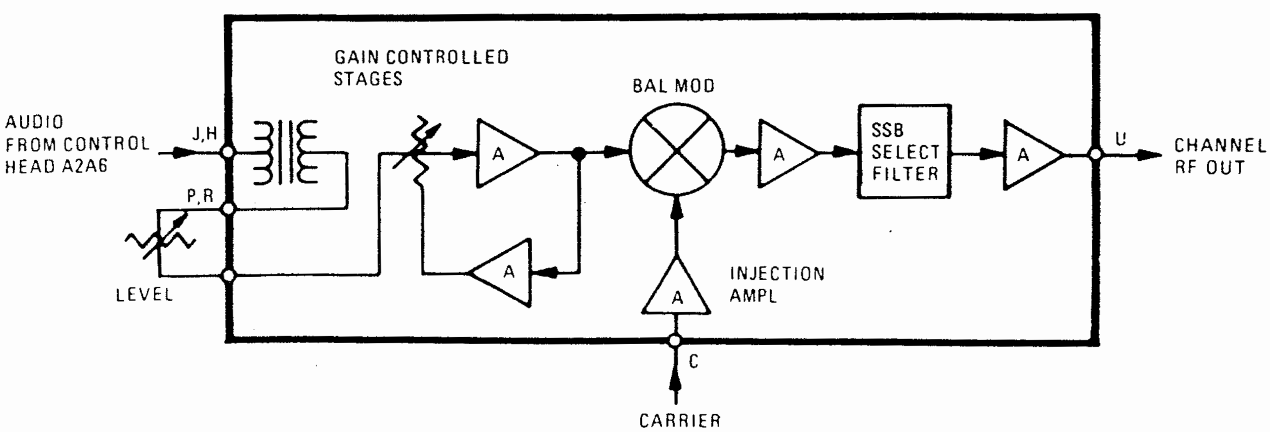


Figure 6.6 Power Distribution Board, A2A18

UNIT INSTRUCTIONS

SIDEBAND GENERATOR MODULES

A2A1
A2A2
A2A3
A2A4



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1. GENERAL DESCRIPTION

The Sideband Generator modules translate input signals in the audio range to one of four possible channel positions in the vicinity of 1.75 MHz. Modules A2A1, A2A2, A2A3 and A2A4 translate to the Lower Lower Sideband, Lower Sideband, Upper Sideband and Upper Upper Sideband positions respectively, relative to 1.75 MHz. Except for differences in the passband frequencies of the sideband selection filters, all modules are identical and this instruction pertains equally to all four.

NOTE

Two channel Exciters are not supplied with Sideband Generator Modules A2A1 and A2A4.

The A2A2 and A2A3 modules can be supplied with two filter quality options; a standard voice quality filter, or a filter specially compensated for tight amplitude and delay specifications for data transmission. The filter types are easily changed in the field to suit specific requirements. The various module and filter part numbers are indicated in Table 1. Note that the A2A1 and A2A4 modules are supplied with data filters only. Table 2 lists the frequency characteristics of each module.

In normal operation, correct audio input level is established by setting INPUT LEVEL FREQUENCY COMPARISON Selector A1S2 to the appropriate position and adjusting the applicable control for average deflection at midscale.

2. TECHNICAL CHARACTERISTICS

Weight: 1.82 Pounds (825.5 grams)

Dimensions:
4-1/8 in. (H) x 2-1/8 in.(W) x 5-7/8 in.(D)
10.5 cm(H) x 5.4 cm(W) x 14.9 cm (D),

Power Requirements:
+6 Vdc at 80 mA
-6 Vdc at 24 mA

Signal Inputs:
Carrier (see Table 1), 75 mv_{RMS}.
Audio. 44 mV_{RMS} (minimum value for full output)

Signal Output:
12 mV PEV(-25 DBM), SSB

Carrier Suppression:
65 dB from full output

Input Impedance:
Carrier: 50 ohms
Audio: 600 ohms

Output Impedance: 50 ohms

Frequency Response:
Voice Filters, 3 dB maximum ripple
300 to 3500 Hz
Data Filters, 0.5 dB maximum ripple
250 to 3040 Hz

Differential Phase Delay:
Voice Filters: not specified
Data Filters: 500 usec maximum
350 to 3040 Hz.

3. SEMICONDUCTOR COMPLEMENT

Table 3 lists all semiconductors used in a typical sideband generator module. (See Part 5 of the General Information Section for integrated circuit details.)

4. CIRCUIT DESCRIPTIONS

The carrier injection enters the Sideband Generator Module (figure 5) on P1-C and is applied to voltage amplifier Q1. Q1 provides a nominal voltage gain of 4 (determined by the value of R5). Emitter follower Q2 provides the power gain necessary for driving balanced modulator Z4.

Balanced audio from the rear panel connectors enters the module on P1-J and H and is transformer coupled to the INPUT LEVEL adjust potentiometer on the exciter front panel via P1-P and R. The attentuated audio signal re-enters the Sideband Generator Module on P1-A and is applied to the audio gain controlled stages, Q5 and Q6. Emitter follower Q7 provides audio power gain and couples the audio into the balanced modulator via C29. Capacitor C31 bypasses any carrier appearing at Z4-6.

The double sideband suppressed carrier signal developed at Z4-1 is amplified by IC amplifier Z1. Z1 is stabilized at a voltage gain of 3 by feedback from pin 9 to pin 6. Unity gain amplifier Q3 lowers the impedance level for driving the sideband selection filter FL2. The sideband selection filter rejects the undesired image sideband (and adds more carrier suppression) before further voltage amplifica-

TABLE 1. RF-131 EXCITER MODEL/SIDEBAND GENERATOR MODULE CORRELATION

Model No.	Type	Used With Transmitter System Model No.	Sideband Generator Module A2A1		Lower Sideband Generator Module A2A2			Upper Sideband Generator Module A2A3			Sideband Generator Module A2A4	
			Module Part No.	Data Filter Part No.	Module Part No.	Data Filter Part No.	Voice Filter Part No.	Module Part No.	Data Filter Part No.	Voice Filter Part No.	Module Part No.	Data Filter Part No.
RF-131-122 -172	Two Channel Voice Configuration	RF-130 RF745			0759-3260		0759-3363	0759-3360		0759-3263		
RF-131-123 -173	Two Channel Data Configuration	RF-130 RF-745			0759-3200	0759-3213		0759-3300	0759-3313			
RF-131-126 -176	Four Channel Data Configuration	RF-130 RF-745	0759-3100	0759-3113	0759-3200	0759-3213		0759-3300	0759-3313		0759-3400	0759-3413

TABLE 2. SIDEBAND GENERATOR MODULE CHARACTERISTICS

Characteristic	Lower Lower Sideband Generator Module A2A1	Lower Sideband Generator Module A2A2	Upper Sideband Generator Module A2A3	Upper Upper Sideband Generator Module A2A4
Carrier Injection Frequency (MHz)	1.743710	1.750000	1.750000	1.756290
Sideband Position Relative to Carrier or Subcarrier	LSB	LSB	USB	USB
Approximate Output Frequency Range (MHz)	1.7440 to 1.7467	1.7470 to 1.7497	1.7503 to 1.7530	1.7532 to 1.7559

tion by Z2. Emitter follower Q4 provides a low source impedance for driving a 50 ohm output load. An adjustable output level is provided by screwdriver adjustment R34.

The gain controlled stages Q5 and Q6 are conventional cascaded audio amplifiers in which field effect transistors Q8 and Q9 are allowed to provide a variable amount of emitter degeneration. Each stage can provide −8dB to +10dB of gain depending upon the bias condition of its associated FET. Resistor divider networks (R61, R62 and R63, R64) couple one-half of each FET's drain voltage to its gate to cancel the second-harmonic generation which the FET's would otherwise cause. With −4Vdc on the FET gates, the drain-source impedance is very high, however a 0 Vdc gate voltage reduces the impedance to typically 350 ohms. The compression potentiometer (R53) supplies a sample of the audio modulating voltage to an AGC amplifier circuit consisting of Z3 and Q11. Q11 linearly amplifies the signal to a level sufficient for peak detection in detectors CR1-CR3. R55 is set to bias Q11 so it will remain linear even with large output voltage swings. The detected voltage from CR3 is fed to AGC storage capacitor C35. This voltage developed at the FET gates is a negative Dc level which increases in absolute value as the audio level increases at the balanced modulator. With the compression adjustment properly set, the audio input to the balanced modulator is prevented from significantly exceeding 20 mV_{RMS}.

CR2, Q10, R59 and C34 form a discharge circuit for the AGC storage capacitor C35. Without these components C35 would charge to a voltage peak and hold because of the very high gate impedance of the FET's (It is important that the discharge time constant of C35 be long in order to minimize IM distortion). The circuit works as follows: both C34 and C35 charge simultaneously (negative with respect to ground) to an applied voltage peak through CR2 and CR3 respectively. The charge on C35 holds, but the charge on C34 leaks off through R59. When the voltage at the base of Q10 decreases sufficiently (approximately 0.7V from peak) Q10 begins to conduct and thereafter discharges C35 at the same rate that C34 discharges.

5. TEST DATA

Voltage measurements for a typical Sideband Generator Module are given in Table 4. Measurements are taken with a Tektronix Model 453 (or equivalent) oscilloscope using a X10 probe for reduced circuit loading. Measurements are made while the module is receiving normal Dc voltages and signal inputs. The input at P1-A is a 1600Hz single tone audio signal at 11MV rms. This can be obtained by connecting a 44 mV signal to the appropriate audio input connector on the rear of the exciter, and turning the audio input level control fully clockwise.

6. ADJUSTMENTS

There are three adjustment controls in the Sideband Generator Module, COMPRESSION (R53) output LEVEL (R34), and DC OFFSET (R55). All controls are relatively long term and need only be checked after a component replacement in the module. The adjustment procedure is as follows:

Table 3. Semiconductor Complement

Reference Designation	Type	Function
A1CR1	1N3064	Volt Doubler Det.
A1CR2	1N3064	Volt Doubler Det.
A1CR3	1N3064	Volt Doubler Det.
A1Q1	2N5179	Voltage Amplifier
A1Q2	2N4123	Power Amplifier
A1Q3	2N4125	Impedance Match.
A1Q4	2N5179	Power Ampl. and Isolation
A1Q5	2N4123	Gain Controlled Amplifier
A1Q6	2N4123	Gain Controlled Amplifier
A1Q7	2N3053	Power Ampl. and Isolation
A1Q8	0759-5083	Gain Control Element
A1Q9	0759-5083	Gain Control Element
A1Q10	2N4123	AGC Release
A1Q11	2N4125	Voltage Amplifier
A1Z1	CA3004	Voltage Amplifier
A1Z2	CA3004	Voltage Amplifier
A1Z3	CA3028	Voltage Amplifier
A1Z4	0759-5150	Balanced Mod.

These reference designators are applicable to A2A1, A2A2, A2A3 and A2A4 modules.

a. Apply a 1.0kHz steady tone to the appropriate audio input connection on the rear of the exciter from a Hewlett-Packard Model 200CD (or equivalent) Audio Oscillator.

b. Obtain a 6 foot length of small gauge shielded wire with short clip leads on one end and connect a Hewlett-Packard Model 400D (or equivalent) high impedance audio voltmeter to terminals E8 and E9 on the Sideband Generator PWB.

c. Adjust the INPUT LEVEL control on the exciter front panel for a 11mV indication on the meter.

d. Transfer the meter to TPI and adjust the COMPRESSION control for a 20mV indication. If the above adjustment cannot be made, center R55

e. Connect a Tektronix Model 453 oscilloscope to TP2, with vertical sensitivity of 2V/div. Turn the DC OFFSET control (R55) back and forth, and watch the signal move up and down on the CRT. Observe the points where positive clipping and negative clipping occur. Set R55 so the signal lies midway between the two clipping points.

f. Repeat the adjustments of steps d and e until both are satisfactory.

g. Connect a Boonton Model 91H high impedance RF voltmeter to terminals E3 and E4 and adjust the output LEVEL control (R34) for a 12 mV indication. Insure that Combiner Model A2A12 is plugged into the chassis during this adjustment so the Sideband Generator and Special Frequencies module are properly loaded.

h. Remove all test equipment.

7. MAINTENANCE PARTS LIST

Table 5 is a maintenance parts list for the Sideband Generator Modules. Unique components for upper and lower sideband generator modules are contained in Table 2. Code numbers used for manufacturers are listed in Table 6-3, part 6 of the General Information Section.

TABLE 4. SIDEBAND GENERATOR MODULE TRANSISTOR AND INTEGRATED CIRCUIT VOLTAGE MEASUREMENTS.

Transistor	Emitter	Base	Collector
Q1	155 mV P-P	230 mV P-P	1.4 V P-P
Q2	1.1 V P-P	1.4 V P-P	+4.5 VDC
Q3	**65 mV P-P	**80 mV P-P	**50 mV P-P
Q4	70 mV P-P	70 mV P-P	130 mV P-P
Q5	30 mV P-P	35 mV P-P	*55 mV P-P
Q6	*55 mV P-P	*55 mV P-P	70 mV P-P
Q7	65 mV P-P	70 mV P-P	20 mV P-P
Q10	* − 1.9 Vdc	* − 1.7 Vdc	0
Q11	140 mV P-P	160 mV P-P	2.5 V P-P

FET's	Gate	Source	Drain
Q8	* − 1.9 Vdc	0	30 mV P-P
Q9	* − 1.9 Vdc	0	*55 mV P-P

Integrated Circuits	Pins					
	1	2	3	4	5	6
Z1	0	0	− 5.8 Vdc	− 3.8 Vdc	− 3.4 Vdc	0
Z2	0	0	− 5.5 Vdc	− 3.7 Vdc	− 3.2 Vdc	0
Z3	20 mV P-P	60 mV P-P / − 3.6 Vdc	− 5.6 Vdc	70 mV P-P / − 4.3 Vdc	0	160 mV P-P / + 3.7 Vdc
Z4	**50 mV P-P	0	0	1.1 V P-P	0	65 mV P-P

	7	8	9	10	11	12
Z1	0	0	**80 mV P-P / + 4.5 Vdc	+ 5.8 Vdc	260 mV P-P / + 4.5 Vdc	**50 mV P - P / 0 Vdc
Z2	0	0	70 mV P-P / + 4.6 Vdc	+ 5.8 Vdc	100 mV P-P / + 5 Vdc	20 mV P-P / 0
Z3	0	+ 5.5 V	— —	— —	— —	— —
Z4	0	— —	— —	— —	— —	— —

*These voltages may vary considerable, depending on the characteristics of the individual FET's used (Q8, Q9).
**Double sideband signal.

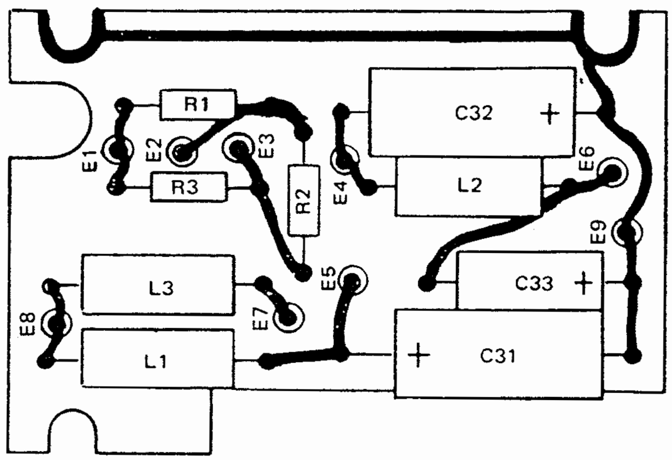


Figure 1. Plate Assembly A3 Component Locations

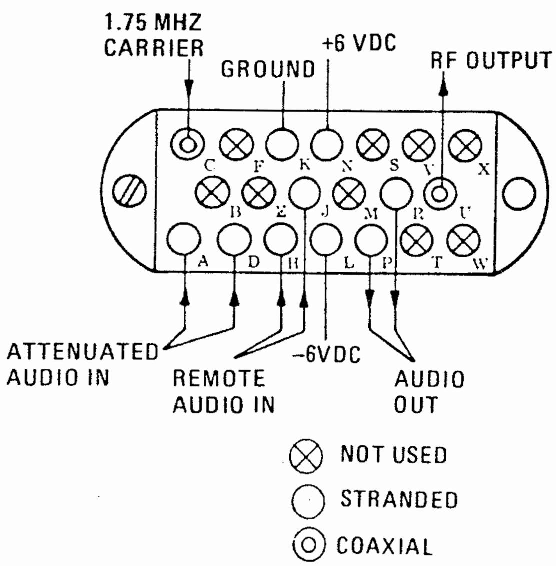


Figure 2. Module Chassis Connector Top View

NOTES:
1. ONLY AUDIO CONNECTIONS SHOWN. FOR OTHER MODULE CONNECTIONS REFER TO CABLE DIAGRAM IN GENERAL INFORMATION SECTION.
2. TWO CHANNEL VERSIONS DO NOT HAVE A2A1, A2A4, A2R1, A2R4.

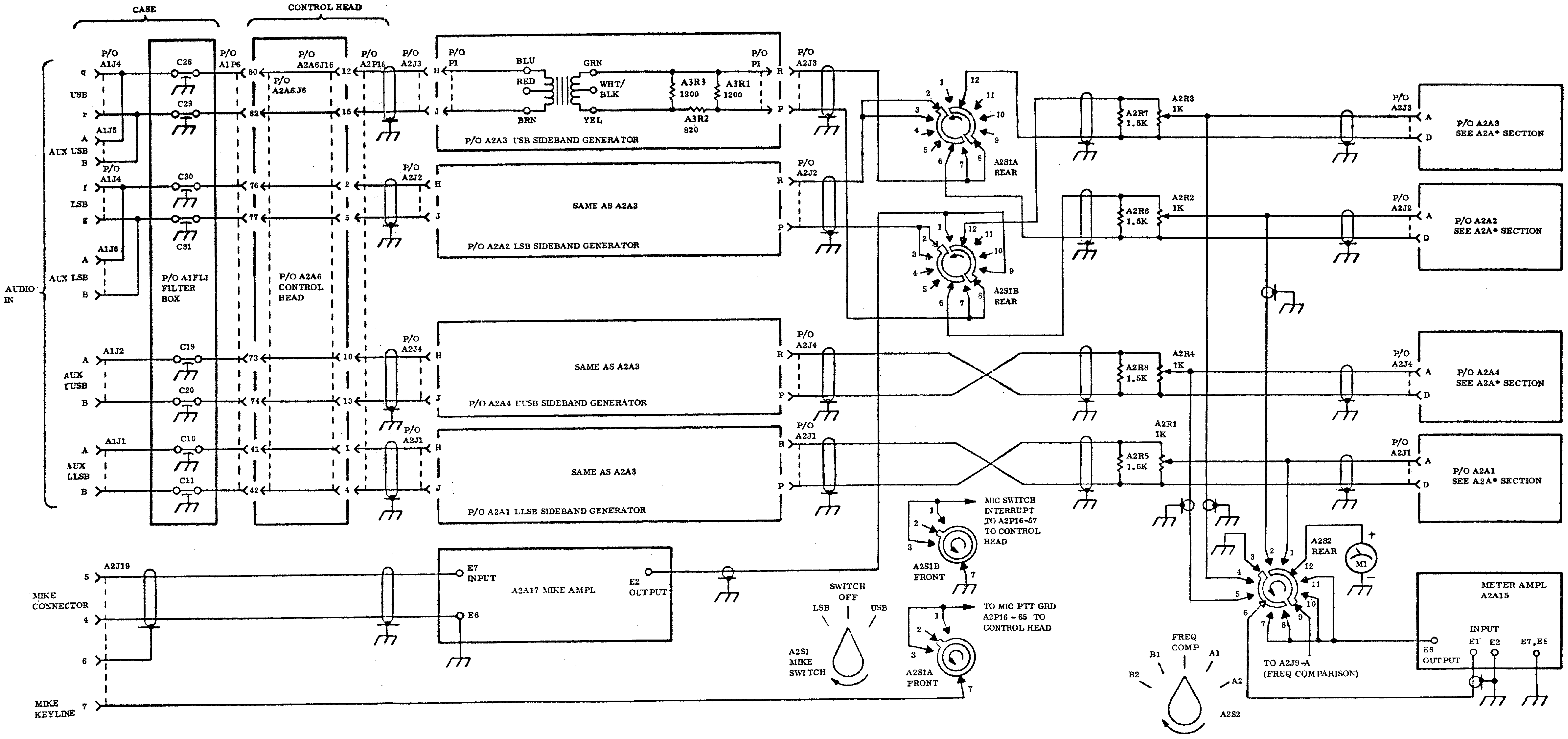


Figure 3. Audio Circuits Servicing Diagram

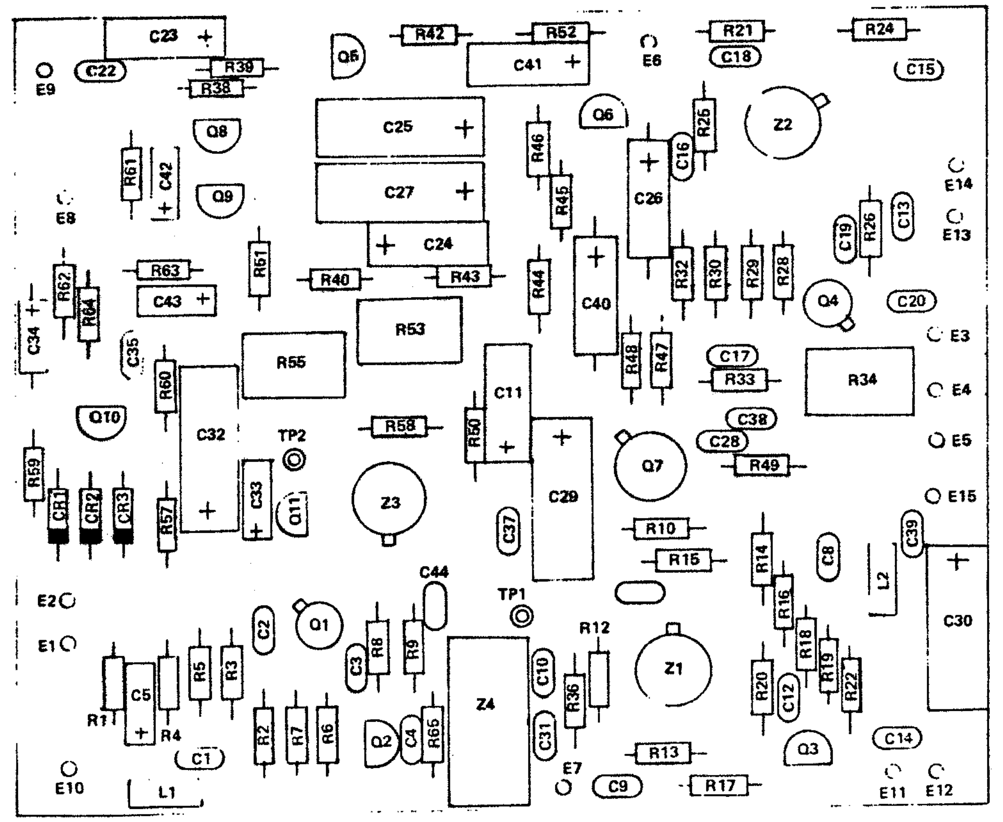
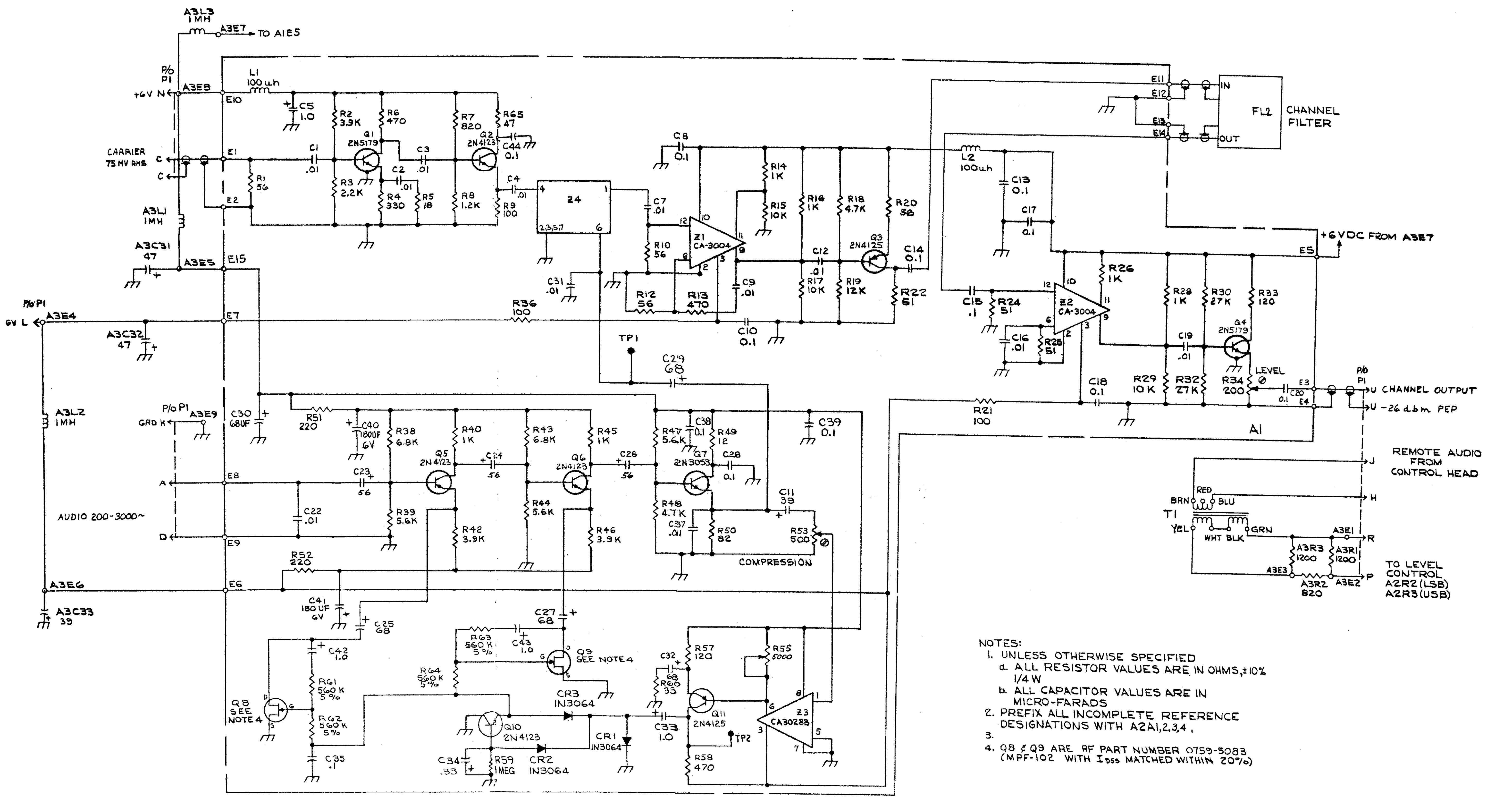


Figure 4. Sideband Generator PWB Assembly Component Location

0759-5061



NOTES:
1. UNLESS OTHERWISE SPECIFIED
   a. ALL RESISTOR VALUES ARE IN OHMS, ±10% 1/4 W
   b. ALL CAPACITOR VALUES ARE IN MICRO-FARADS
2. PREFIX ALL INCOMPLETE REFERENCE DESIGNATIONS WITH A2A1,2,3,4.
3.
4. Q8 & Q9 ARE RF PART NUMBER 0759-5083 (MPF-102 WITH I_{DSS} MATCHED WITHIN 20%)

Figure 5. Sideband Generator PWB Schematic Drawing

TABLE 5. MAINTENANCE PARTS LIST-Sideband Generator

Reference Designation	Name and Description
A2A1	Lower Lower Sideband Generator Module: MFR 14304, PN 0759-3100 (Note 1)
A2A2	Lower Sideband Generator Module: MFR 14304, PN 0759-3200 (Note 2) or PN 0759-3260
A2A3	Upper Sideband Generator Module: MFR 14304, PN 0759-3300 (Note 3) or PN 0759-3360
A2A4	Upper Upper Sideband Generator Module: MFR 14304, PN 0759-3400 (Note 4)
FL2	Data Filter: MFR 14304, PN 0759-3113
FL2	Data Filter: MFR 14304, PN 0759-3213
FL2	Voice Filter: MFR 14304, PN 0759-3363
FL2	Data Filter: MFR 14304, PN 0759-3313
FL2	Voice Filter: MFR 14304, PN 0759-3263
FL2	Data Filter: MFR 14304, PN 0759-3413
A2A1A1, A2A2A1, A2A3A1 A2A4A1	Sideband Generator PWB Assembly: MFR 14304, PN 0759-5060
C1	Capacitor, Fixed Ceramic, .01 uF: MFR 72982, PN 8121-050-651-103M
C2 - C4	Same as C1
C5	Capacitor, Tantalum, 1.0 uF: 50Vdcw Mil type CSR13G105ML
C6	Not used
C7	Same as C1
C8	Capacitor, Fixed Ceramic, .1 uF: MFR 14304, PN C11-0005-104
C9	Same as C1
C10	Same as C8
C11	Capacitor, Tantalum, 39 uF: 10VdcwMil type CSR13C396KL
C12	Same as C1
C13 - C15	Same as C8
C16	Same as C1
C17, C18	Same as C8
C19	Same as C1
C20	Same as C8
C21	Not used
C22	Same as C1
C23, C24	Capacitor, Tantalum, 56 uF: 6Vdcw Mil type CSR13B566KL
C25	Capacitor, Tantalum, 68 uF: 15VdcwMil type CSR13D686ML
C26	Same as C23
C27	Same as C25
C28	Same as C8
C29, C30	Same as C25
C31	Same as C1
C32	Same as C25
C33	Same as C5
C34	Capacitor, Tantalum, 0.33 uF Mil type CSR13G334ML
C35	Same as C8
C36	Not used
C37	Same as Cl
C38, C39	Same as C8
C40, C41	Capacitor, Tantalum, 180 uF: 6Vdcw Mil type CSR13B187KL
C42, C43	Same as C5
C44	Same as C8
CR1-CR3	Diode: Mil type 1N3064
L1, L2	Inductor, 100 uH: MFR 99800, PN 1537-76
MP1	PC Board: MFR 14303, PN 0759-5062
Q1	Transistor, NPN: MFR 21921, PN 2N5179
Q2	Transistor, NPN: MFR 04713, PN 2N4123
Q3	Transistor, PNP: MFR 04713, PN 2N4125
Q4	Same as Q1
Q5, Q6	Same as Q2
Q7	Transistor, NPN: MFR 21921, PN 2N3053
Q8, Q9	Transistor, FET Matched Pair: MFR 14304, PN 0759-5083
Q10	Same as Q2
Q11	Same as Q3

TABLE 5. MAINTENANCE PARTS LIST-Sideband Generator (Continued)

Reference Designation	Name and Description
R1	Resistor, Fixed Composition, 56 Ω, ± 10%, ¼ W: Mil type RC07GF560K
R2	Resistor, Fixed Composition, 3.9 Ω, ± 10%, ¼ W: Mil type RC07GF392K
R3	Resistor, Fixed Composition, 2.2 Ω, ±, 10%, ¼ W: Mil type RC07GF222K
R4	Resistor, Fixed Composition, 330 Ω, ±,10%, ¼ W: Mil type RC07GF331K
R5	Resistor, Fixed Composition, 18 Ω, ±,10%, ¼ W: Mil type RC07GF180K
R6	Resistor, Fixed Composition, 470 Ω, ±,10%, ¼ W: Mil type RC07GF471K
R7	Resistor, Fixed Composition, 820 Ω, ± 10%, ¼ W: Mil type RC07GF821K
R8	Resistor, Fixed Composition, 1.2 Ω, ± 10%, ¼ W: Mil type RC07GF122K
R9	Resistor, Fixed Composition, 100 Ω, ± 10%, ½ W: Mil type RC07GF101K
R10	Same as R1
R11	Not used
R12	Same as R1
R13	Same as R6
R14	Resistor, Fixed Composition, 1 Ω, ± 10%, ¼ W: Mil type RC07GF102K
R15	Resistor, Fixed Composition, 10 Ω, ± 10%, ¼ W: Mil type RC07GF103K
R16	Same as R14
R17	Same as R15

Reference Designation	Name and Description
R18	Resistor, Fixed Composition, 4.7 Ω, ± 10%, ¼ W: Mil type RC07GF472K
R19	Resistor, Fixed Composition, 12K, ± 10%, ¼ W: Mil type RC07GF123K
R20	Same as R1
R21	Same as R9
R22	Resistor, Fixed Composition, 51 Ω, ± 10 %, ¼ W: Mil type RC07GF510K
R23	Not used
R24, R25	Same as R22
R26	Same as R14
R27	Not used
R28	Same as R14
R29	Same as R15
R30	Resistor, Fixed Composition, 27 Ω, ± 10%, ¼ W: Mil type RC07GF273K
R31	Not used
R32	Same as R30
R33	Resistor, Fixed Composition, 120 Ω, ± 10%, ¼ W: Mil type RC07GF121K
R34	Resistor, Variable, 200 Ω: MFR 35009 PN 156-4-200 ohms
R35	Not used
R36	Same as R9
R37	Not used
R38	Resistor, Fixed Composition, 6.8 Ω, ± 10%, ¼ W: Mil type RC07GF682K
R39	Resistor, Fixed Compostion, 5.6 Ω, ± 10%, ¼ W: Mil type RC07GF562K
R40	Same as R14
R41	Not used
R42	Same as R2
R43	Same as R38
R44	Same as R39
R45	Same as R14
R46	Same as R2
R47	Same as R39
R48	Same as R18

TABLE 5. MAINTENANCE PARTS LIST-Sideband Generator (Continued)

Reference Designation	Name and Description
R49	Resistor, Fixed Composition, 12 Ω, ±10%, ¼W: Mil type RC07GF120K
R50	Resistor, Fixed Composition, 82 Ω, ±10%, ¼W: Mil type RC07GF820K
R51, R52	Resistor, Fixed Composition, 220 Ω, ±10%, ¼W: Mil type RC07GF221K
R53	Resistor, Variable, 500 Ω: MFR 35009, PN 156-4-500 Ω
R54	Not used
R55	Resistor, Variable, 5 Ω: MFR 35009 PN 156-4-5000Ω
R56	Not used
R57	Same as R33
R58	Same as R6
R59	Resistor, Fixed Composition, 1 Meg Ω, ±10%, ¼W: Mil type RC07GF105K
R60	Resistor, Fixed Composition, 33 Ω, ±10%, ¼W: Mil type RC07GF330K
R61 -R64	Resistor, Fixed Composition, 560 Ω, ±5%, ¼W: Mil type RC07GF564J

Reference Designation	Name and Description
R65	Resistor, Fixed Composition 47 Ω, ±10%, ¼W: Mil type RC07GF470K
Z1, Z2	Integrated Circuit: MFR 21921, PN CA3004
Z3	Integrated Circuit: MFR 21921, PN CA3028B
Z4	Mixer: MFR 14304, PN 0759-5150
A2A1A3, A2A2A3, A2A3A3, A2A4A3	Plate Assembly, MFR 14304, PN 1928-5065
A3C1 - C30	Not used
A3C31-32	Capacitor, Fixed Tantalum 47uF Mil type CSR13E476ML
A1C33	Capacitor, Fixed Tant. 39uF Mil type CSR13C396KL
A3L1 - L3	Inductor, Choke, 1MH: MFR 99800, PN 2500-28
A3R1	Same as A2A1 A1R8
A3R2	Same as A2A1 A1R7
A3R3	Same as A2A1 A1R8
MP1	Shield, Transformer: MFR 14304, PN 0946-5069

Note 1. Supplied with A2A1FL2 Data Filter PN 0759-3113 only.

Note 2. A2A2 PN 0759-3200 is supplied with A2A2FL2 Data Filter PN 0759-3213.
A2A2 PN 0759-3260 is supplied with A2A2FL2 Voice Filter PN 0759-3363.

Note 3. A2A3 PN 0759-3300 is supplied with A2A3FL2 Data Filter PN 0759-3313.
A2A3 PN 0759-3360 is supplied with A2A3FL2 Voice Filter PN 0759-3263.

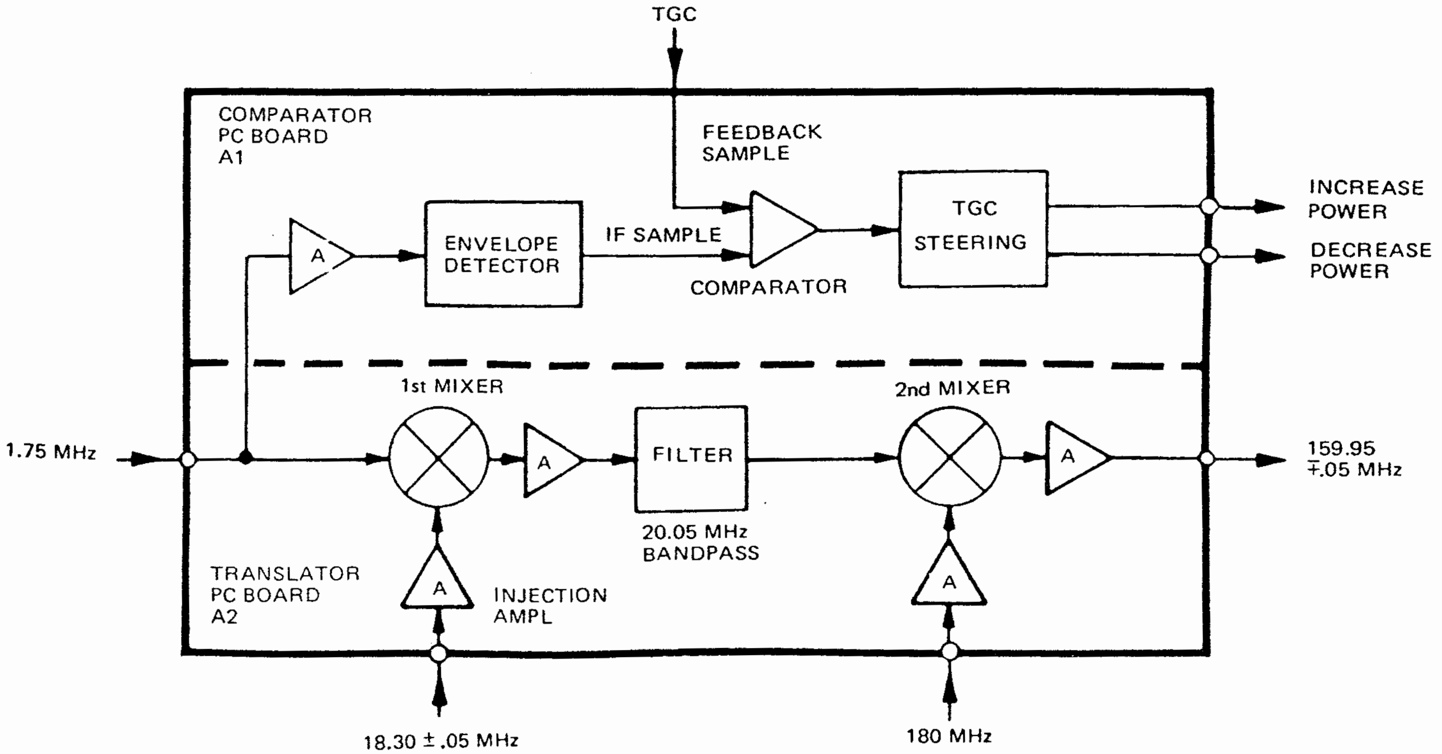
Note 4. Supplied with A2A4FL2 Data Filter PN 0759-3413 only.

UNIT INSTRUCTIONS

RF-130 SYSTEM

UP-CONVERTER MODULE

A2A5



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A2A5

1. GENERAL DESCRIPTION.

The Up-Converter module translates a 1.75 MHz signal input to 160 MHz in a two step mixing process. Two externally generated injection frequencies are required, 18.30 MHz (nominal) and 180 MHz, both of which are received from the Special Frequencies module (Unit Instruction A2A10). In addition, the Up-Converter module develops "steering" voltages for the TGC control circuitry in the RF output module. TGC is a power output control loop which establishes tune power level and maintains correct system power output despite any slow changes of gain in the exciter or associated PA due to frequency or temperature changes.

The Up-Converter module contains two PC board assemblies, the Comparator PC Board (A1) and the Translator PC Board (A2).

2. TECHNICAL CHARACTERISTICS.

Weight: 1.22 lbs

Dimensions (HWD):
4 1/8 x 2 1/8 x 5 7/8 inches.

Power Requirements:
+24 VDC @ 23 ma.
+ 6 VDC @ 52 ma.
+ 5 VDC @ 5.8 ma.
– 6 VDC @ 39 ma.

Signal Inputs:
1.75 MHz fixed, 12 mv PEV
18.25 - 18.35 MHz variable, 90 mv rms
180.0 MHz fixed, 90 mv rms

Signal Output:
159.90 - 160.00 MHz, 12 mv PEV,
at output of associated 160 MHz filter.

Logic Outputs:
Count Up Command
Count Down Command
Oscillator Inhibit

Input Impedance:
1.75 MHz, 50 ohms
18.25 - 18.35 MHz, 50 ohms
180.0 MHz, 50 ohms
TGC, Approx. 90K ohms

Output Load: 50 ohms, (Signal Output)

3. SEMICONDUCTOR COMPLEMENT.

Table 1 list all semiconductors used in the Up-Converter module.

TABLE 1. SEMICONDUCTOR COMPLEMENT

SYMBOL	TYPE	FUNCTION
A1CR1	1N3064	Peak Detector
CR2, 3	1N3064	Temp. Compensation
CR4	1N3064	Isolation
CR6 – 15	1N3064	Isolation
A1Q1 – Q5	2N4123	IF Ampl.
Q6	2N4123	DC Ampl.
Q7	2N4125	DC Ampl.
Q8	2N4123	IF Sensor
Q9, Q10	2N4123	Emitter Follower
Q11	2N4123	IF Sensor
Q12, Q13	2N4123	Isolation
Q14	2N4125	Cross Coupled Ampl.
Q15, Q16	2N4123	Schmitt Trigger
Q17	2N4125	Cross Coupled Ampl.
Q18, Q19	2N4123	Schmitt Trigger
Q20, Q21	2N4125	Balance Sensor
Q22	2N4123	Clock Inhibit
Q23	2N4123	Fast Inhibit Enable
Q24	2N4123	Reduce Power Enable
A1Z1	CA3028B	Comparator
A2AR1	0759-5010	Injection Ampl.*
AR2	0759-5010	Injection Ampl.*
AR3	0759-5010	Signal Ampl.*
A2Q1	2N4123	Amplifier
Q2	2N4123	Amplifier
A2Z1	0759-5150	1st Mixer
Z2	0759-5150	2nd Mixer

*RF Communications Inc. Mini-Module

4. CIRCUIT DESCRIPTION, UP-CONVERTER PC BOARD.

The 1.75 MHz signal path enters the Translator PC Board (figure 6) on terminal E2 and is applied to the first balanced mixer. The 18.30 ± .05 MHz first injection signal enters on terminal E5 at a level of 90 millivolts and is amplified by AR1 before driving the first balanced mixer. AR1 is a sealed miniature 14 dB amplifier. Resistors

R12 and R11, with their associated bypass capacitors, decouple AR1 from the DC supplies while R8, R9 and R10 provide resistive buffering at the amplifier input. The injection voltage level can be measured at E5 with an RF Voltmeter having a high impedance probe (Boonton 91H or equivalent).

Following the first balanced mixer, amplifier stage Q1 and Q2 amplifies the signal voltage for driving the 20.05 MHz bandpass filter. Gain for the stage (and for the PC Board) is controlled by feedback through potentiometer R4. The output of the amplifier stage is applied to the bandpass filter through impedance matching transformer T1. The filter passes only the sum component of the mixing process. The output of the filter is applied through impedance matching transformer T2 and 10 DB pad R24 to the input of the second balanced mixer, Z2.

Translation of the 20.05 ± .05 MHz 2nd IF to 159.95 ∓ .05 MHz is accomplished by the 2nd balanced mixer and injection amplifier which are practically identical to the first. The 180 MHz 2nd injection frequency enters on terminal E11 at a level of 90 mv and is applied to the 2nd mixer after amplification by AR2.

AR3 is another sealed amplifier, providing a module output impedance of 50 ohms. Following the Up-Converter module a 160 MHz bandpass filter (A2FL1) passes only the difference frequency component to the RF Output module.

Even though Z2 is a balanced type mixer, a certain amount of the 180 MHz injection appears at the mixer output, (roughly equal to the signal PEV.). As a result, attempts to measure the signal path level at the module output with a broadband RF voltmeter can be misleading. Measurement of the signal path level should be made on the output side of the 160 MHz bandpass filter where the injection frequency and sum components have been removed.

5. TEST DATA, TRANSLATOR PC BOARD.

Typical voltage measurements for all transistors, IC's and mini-modules used on the Translator PC Board are given in table 2. Measurements were taken with a Tektronix 453 or equivalent oscilloscope while the module was receiving normal DC input voltages.

If RF voltages are measured at the chassis connector (i.e., with the module removed) then a 50 ohm probe adapter should be used to simulate proper loading. A short BNC-Winchester adapter cable (Section 5) facilitates mating the probe adapter to the chassis connector pin. A steady 1.75 MHz input can be obtained at P1-H with the exciter keyed and in the "CW" mode.

6. CIRCUIT DESCRIPTION, COMPARATOR PC BOARD.

The TGC (Transmitter Gain Control) circuit is a feedback loop enclosing the RF circuits of the Up-Converter module, the RF Output module and the external amplifier(s) with which the exciter is used. The purpose of the loop is to minimize variations in RF power output (from the system) resulting from frequency and temperature changes.

Basically the circuit functions by sensing the amplitude of the 1.75 MHz 1st IF and comparing it with the amplitude of the APC signal from the external power amplifier. The loop automatically corrects the RF power output from the system to make the (detected) IF and feedback signals equal. The advantage of this method of TGC (comparison method) over the more conventional and simpler method of "threshold detection" is the ability to hold constant gain with a varying signal level. For example, with threshold detection, the system gain must continuously follow the modulation envelope, becoming minimum on voice peaks and maximum as the voice level drops With the comparison method however, an instantaneous ratio of input and output signals is monitored and the circuit responds only to actual gain changes.

Referring to figure 8, the 1.75 MHz IF sample enters the TGC board on terminal E1 and is applied to a two stage feedback amplifier consisting of Q1 and Q2. The feedback stabilizes the AC gain of the two stages as well as the DC operating points. The gain is adjusted by R4. Additional gain is provided by feedback amplifier Q3, Q4, Q5 to provide ample voltage swing for driving

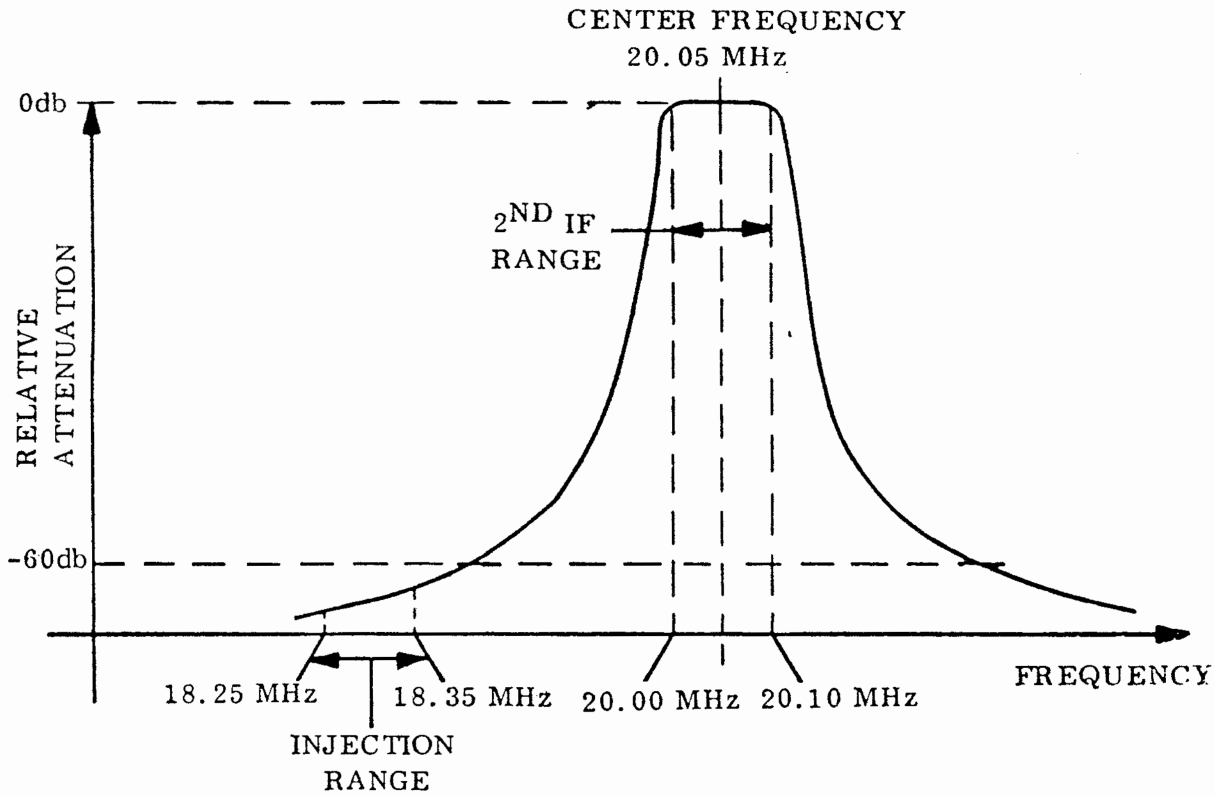


Figure 1. 20.05 MHz Bandpass Filter, Attenuation Characteristics

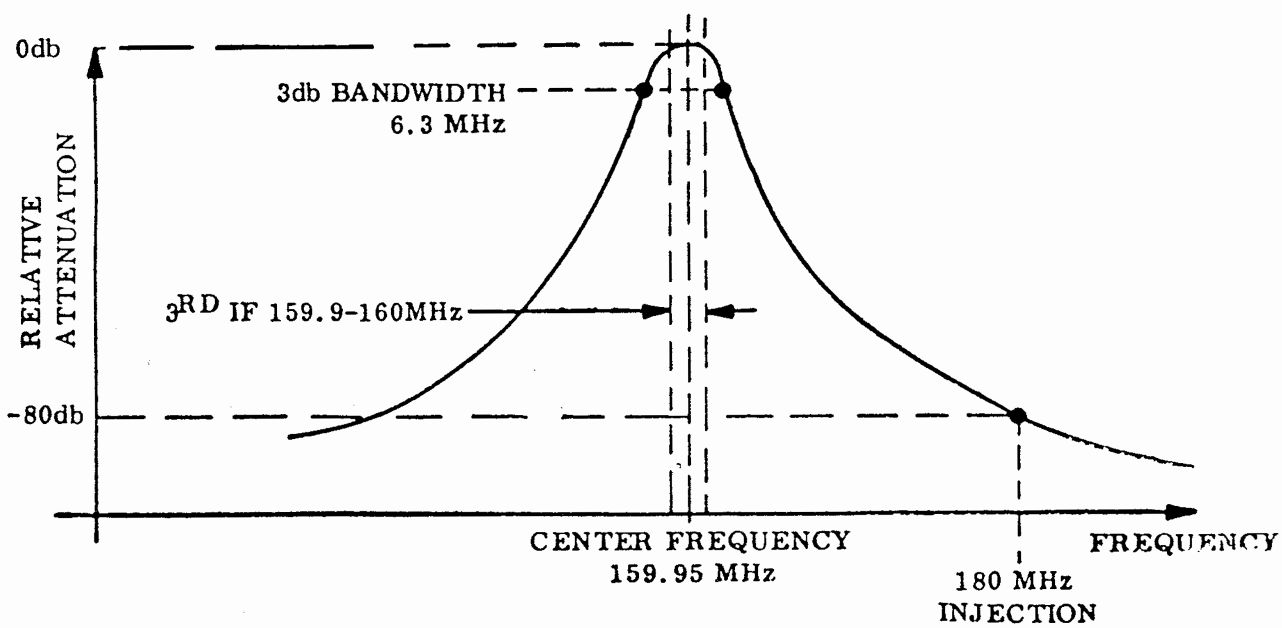


Figure 2. 160 MHz Bandpass Filter, Attenuation Characteristic

TABLE 2. TRANSLATOR, PC BOARD VOLTAGE MEASUREMENTS

	PINS							
	1	2	3	4	5	6	7	8
AR1	GRD	900 MV P-P	GRD	70 RMS	GRD	+4.2 VDC	−4.2 VDC	GRD
AR2	GRD	330 MV RMS	GRD	53 MV RMS	GRD	+4.2 VDC	−4.2 VDC	GRD
AR3	GRD	*	GRD	*	GRD	+4.2 VDC	−4.2 VDC	GRD

	1	2	3	4	5	6	7
Z1	25 MV P-P / 0 VDC	GRD	GRD	GRD	GRD	35 MV P-P / 0 VDC	900 MV P-P / 0 VDC
Z2	* / 0	GRD	GRD	GRD	GRD	* / 0 VDC	330 MV RMS / 0

*Voltage either too low to measure accurately, or variable due to unpredictable leakage through mixer.

	Q1	Q2
EMITTER	GRD	100 MV P-P / +.7 VDC
BASE	+.7 VDC	110 MV P-P / +1.4 VDC
COLLECTOR	110 MV P-P / +1.4 VDC	245 MV P-P / +5.3 VDC

the peak detector consisting of CR1 and C5. The time constant of C5 and load resistors R13 and R14 is small for audio frequencies, allowing the voltage at the base of Q6 to follow the modulation envelope of the 1.75 MHz IF. Transistors Q6 and Q7 provide an approximate voltage gain of 10 for the detected envelope. Emitter followers Q9 and Q10 provide isolation and reduce the impedance.

The detected IF envelope drives the comparator via emitter follower Q12 where it is compared in amplitude with the TGC feedback signal via Q13. TGC feedback enters the Up-Converter module on P1-C and is applied to the base of Q13 after being scaled down by the voltage divider consisting of R28 and R29.

Note

The values shown for R28 (82K) and R29 (12K) are in an RF-130 Transmitter System. Use of the RF-131 in systems with other amplifiers may require different scaling factors for R28, and R29.

The comparator consists of a differential amplifier followed by cross coupled transistors Q14 and Q17. When the differential inputs (pins 1 and 5) are equal, there is a 0 volt differential between the output terminals (pins 6 and 8) and neither Q14 or Q17 can conduct. Consequently, Schmitt Trigger input transistors Q15 and Q18 are cut off while Q16 and Q19 are in saturation, so each of the output steering voltages is at approximately +0.5 VDC. However, assume that the instantaneous voltage at pin 1 becomes negative with respect to pin 5 (indicating that the system RF power output has fallen off). This makes pin 6 go more negative and pin 8 more positive, turning on Q17, supplying base current to DC amplifier Q18. The conduction of Q18 lowers the available bias for Q19, cutting Q19 off. The positive collector swing is coupled out P1-X where it prepares the TGC counter in the RF Output module to increment and increase the RF power level until the voltage at pin 1 of the differential amplifier again equals the voltage at pin 5. (As described below, the TGC counter also requires a clock oscillator enabling signal before the RF level begins to change.) A similar sequence occurs with transistors Q14, Q15 and Q16 for an opposite polarity input at the comparator.

To prevent the loop from making continuous minor adjustments in the system gain, advantage is taken of the inherent junction stand-off voltage of transistors Q14 and Q17. The stand-off voltages create a dead zone in the development of output steering voltages. As a result, the RF output from the system can drift by approximately ± 6 percent before correction is initiated. Decreasing R33 will increase the width of the dead zone, but R33 is normally left at maximum resistance (full counter clockwise).

In addition to unbalance in the comparator circuit, an enabling signal is required by the clock oscillator in the RF Output module before power level correction begins. (See Unit Instruction A2A7.) The clock oscillator is normally inhibited by a ground reaching the RF Output module from switching transistor Q22 via P1-T. Q22 is held saturated by base current from four sources, all of which must be removed before the oscillator can become enabled. The four sources are:

1) through CR9, Q21, and Q20 to the +5 VDC supply. Q20 and Q21 are normally conducting because of base return voltages of approximately 0.5 VDC. However, unbalanced in the comparator will drive either Q20 or Q21 to cut-off with a base voltage of +5 VDC. Thus the clock oscillator can enable only when an actual unbalance exists.

2) through CR11 and R56 to the +6 VDC supply. This source is removed when the exciter is keyed because of a ground input on P1-S from the Control Head module (Keyline).

3) through CR6 and R23 to the +6 VDC supply. A ground from Q11 removes this source when an IF signal is present.

4) through CR4 and R20 to +6 VDC (CW/FSK only). This source is also removed when an IF signal is present, due to Q8. The action of Q23 prevents this path from affecting clock oscillator operation in MODE positions other than CW or RATT. Q23, which normally conducts with base current through R57, is turned off in the CW or RATT modes when a CW/RATT ground is received on P1-F from the Control Head module. This back biases CR14 and allows Q8 to inhibit the clock oscillator between keying characters.

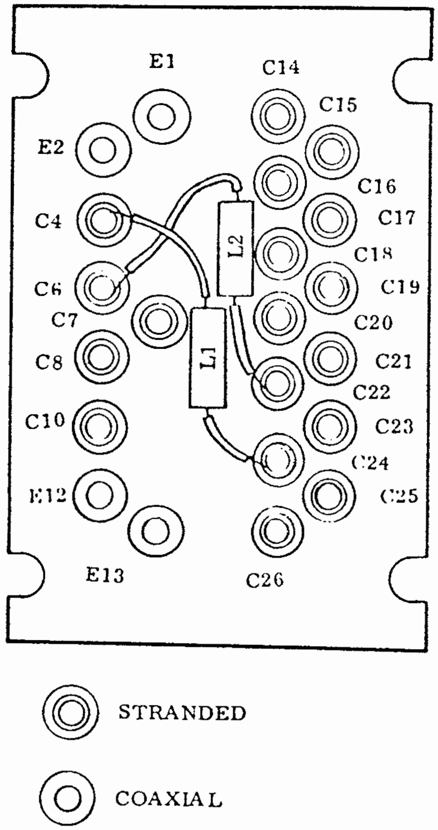


Figure 3. Filter Plate Assembly, Component Location

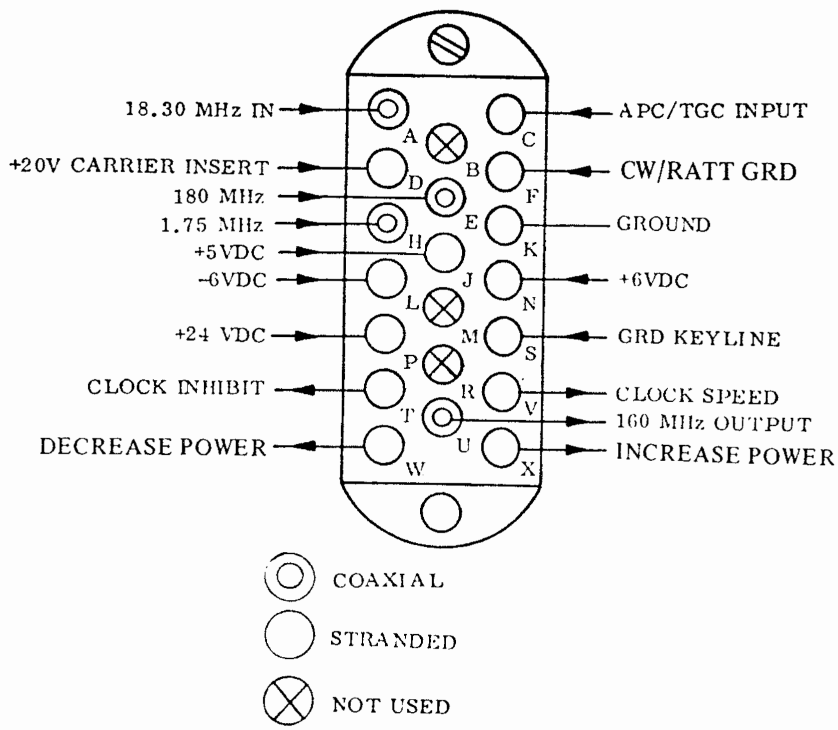


Figure 4. Chassis Connector A2J5, (Top View)

At one time, Q11 functioned quite slowly, and Q8 was added to provide more rapid response in CW. Now, however, Q8 and Q11 have essentially equal response speed, and so Q8 and Q23 could have been omitted.

Application of +20V Carrier Insert at P1-D turns on Q24 and connects a parallel resistance across R19. This decreases the IF sample level at the comparator yielding a reduced RF power output when the +20V Carrier Insert signal is present. See Unit Instruction A2A6 for function of +20V Carrier Insert.

7. TEST DATA, TGC PC BOARD.

DC voltage measurements for all transistors and integrated circuits on a typical comparator PC board are given in table 3. Measurements were made with a Hewlett-Packard model 410C or equivalent VTVM while the module was receiving normal DC voltages and signal inputs. The exciter was keyed, the MODE selector was at CW, and the system was delivering 1000 watts into a dummy load. TGC has been adjusted according to paragraph 8.

8. MODULE ADJUSTMENT.

RF Level

The level adjustment (R4) is the only adjustment on the Translator PC board and is used to establish the overall gain of the Up-Converter. Its adjustment is as follows:

a. Remove the Up-Converter module. Set the MODE selector at CW and key the exciter. Confirm the presence of 12 mv ± 1 mv at the input to the Up-Converter module (Pin A2J5-H) with a Boonton 91H or equivalent RF voltmeter with 50 ohm termination. Replace the Up-Converter and remove the RF Output module.

b. Now connect the RF voltmeter (using 50 ohm probe adapter) to the output of the 160 MHz bandpass filter at A2J7-B via a short BNC to WINCHESTER adapter cable.

c. Adjust A2R4 for a 12 mv ± 1 mv indication.

TGC Adjustment

a. First ascertain that the Combiner Module and Translator PC Board have had their RF gains properly set.

b. Place the exciter MODE switch in CW and key with a CW key.

c. Connect the DC probe of an HP 410C vacuum tube voltmeter (or equivalent) to TP6, and adjust A1R4 for a reading of +8.0V, ±0.1V.

d. Unkey the exciter, remove the voltmeter, place the exciter in STANDBY and replace the module cover.

9. PARTS LIST.

Table 4 is a list of Maintenance parts for the Up-Converter module. Manufacturers are referenced by a five-digit code. For a list of manufacturers' names and addresses refer to table 6-3 in the General Information Section.

TABLE 3. COMPARATOR PC BOARD, DC MEASUREMENTS

	EMITTER	BASE	COLLECTOR
Q1	0	.6	1.3
Q2	.65	1.3	3.5
Q3	2.7	3.3	14.2
Q4	13.6	14.2	24
Q5	12.9	13.6	24
Q6	2.4	3.1	17.7
Q7	18.3	17.7	9.2
Q8	0	0.74	.02
Q9	8.6	9.2	22.8
Q10	8.0	8.6	23.8
Q11	0	.66	.04
Q12	.15	.81	6
Q13	.15	.8	6
Q14	4.8	4.75	0
Q15	.24	0	3.9
Q16	.46	1.18	.64
Q17	4.75	4.8	0
Q18	.3	0	4
Q19	.58	1.28	.73
Q20	4.75	4.05	4.7
Q21	4.7	4	4.7
Q22	0	.73	0.1
Q23	0	.16	6
Q24	0	0	9.2

	PINS			
	1	2	3	4
Z1	.15	−3.5	−5.8	−4.3
	5	6	7	8
Z1	.15	4.8	−3.5	4.75

UP-CONVERTER

NOTES:

1. **UNLESS OTHERWISE SPECIFIED:**

   A. ALL RESISTORS ARE IN OHMS, ¼ WATT.
   B. ALL CAPACITORS ARE IN MICROFARADS.

2. **PREFIX INCOMPLETE REFERENCE DESIGNATORS WITH A2A5 PLUS SUB-ASSEMBLY DESIGNATOR IF ANY.**

3. **REFER TO TABLE 1. FOR LISTING OF SEMICONDUCTOR TYPES.**

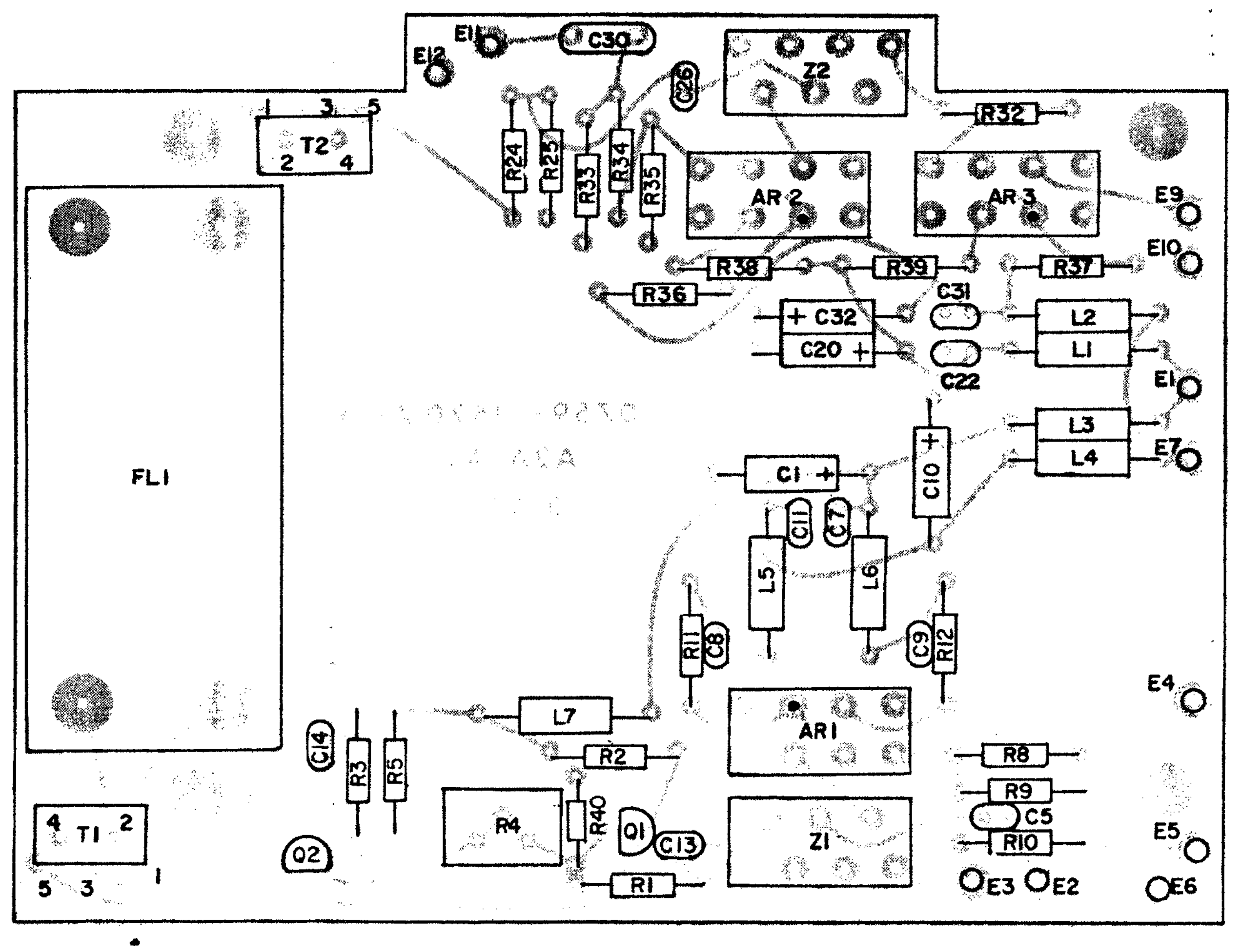


Figure 5. Translator Board A2A5A2 Component Locations

0759-3522

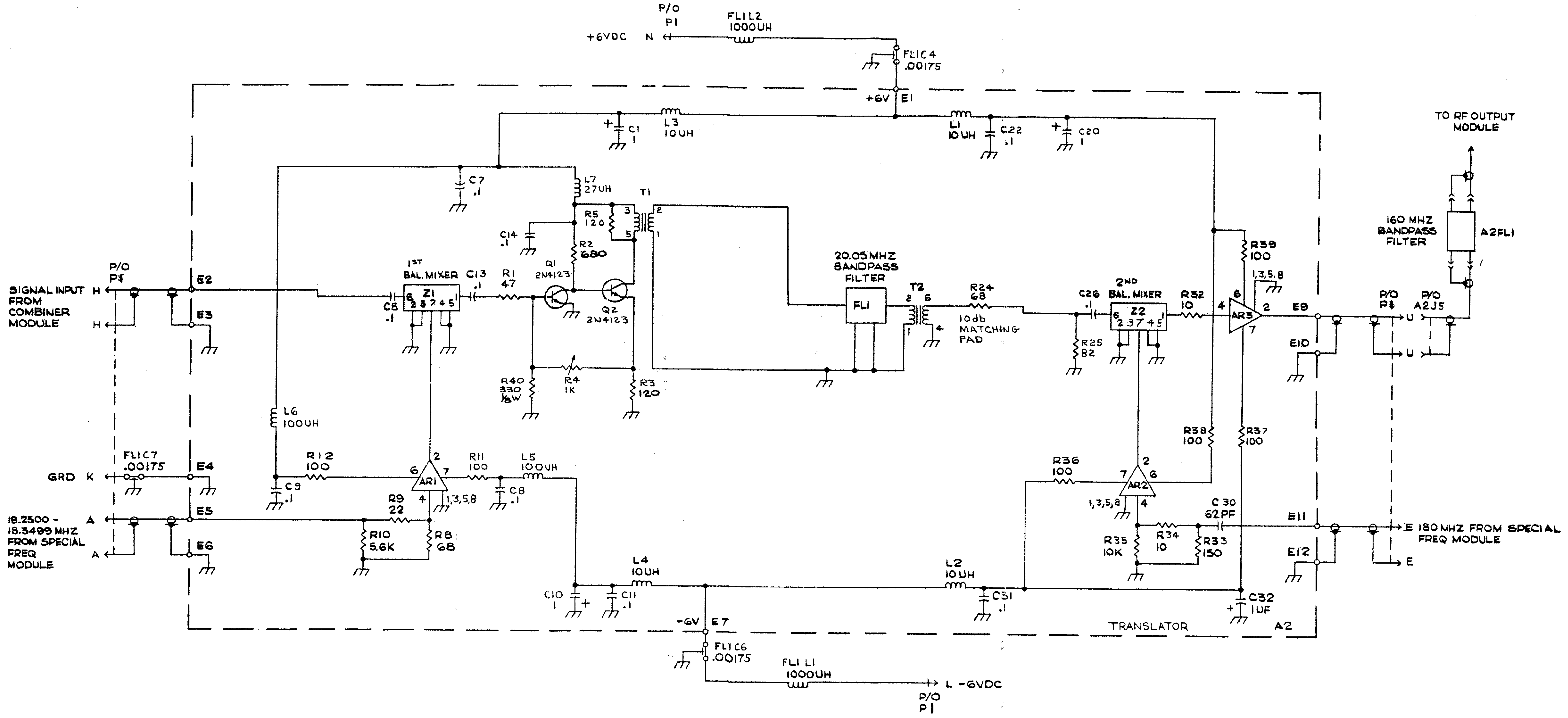


Figure 6. Translator Board A2A5A2 Schematic Diagram

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTORS ARE IN OHMS, 1/4 WATT.
   B. ALL CAPACITORS ARE IN MICROFARADS.
2. PREFIX INCOMPLETE REFERENCE DESIGNATORS WITH A2A5 PLUS SUB-ASSEMBLY DESIGNATOR IF ANY.
3. REFER TO TABLE 1. FOR LISTING OF SEMICONDUCTOR TYPES.

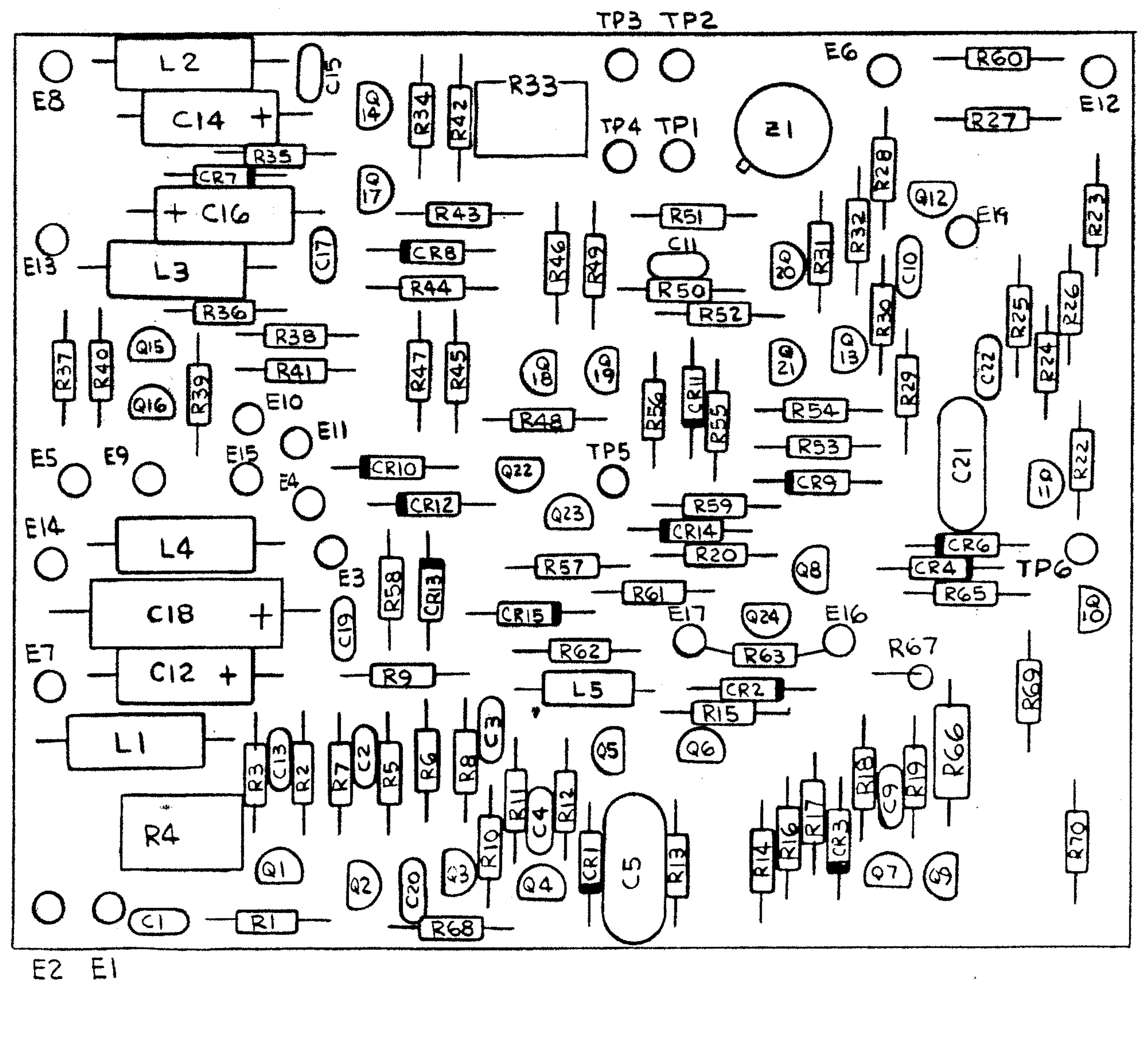


Figure 7. Comparator Board A2A5A1 Component Locations

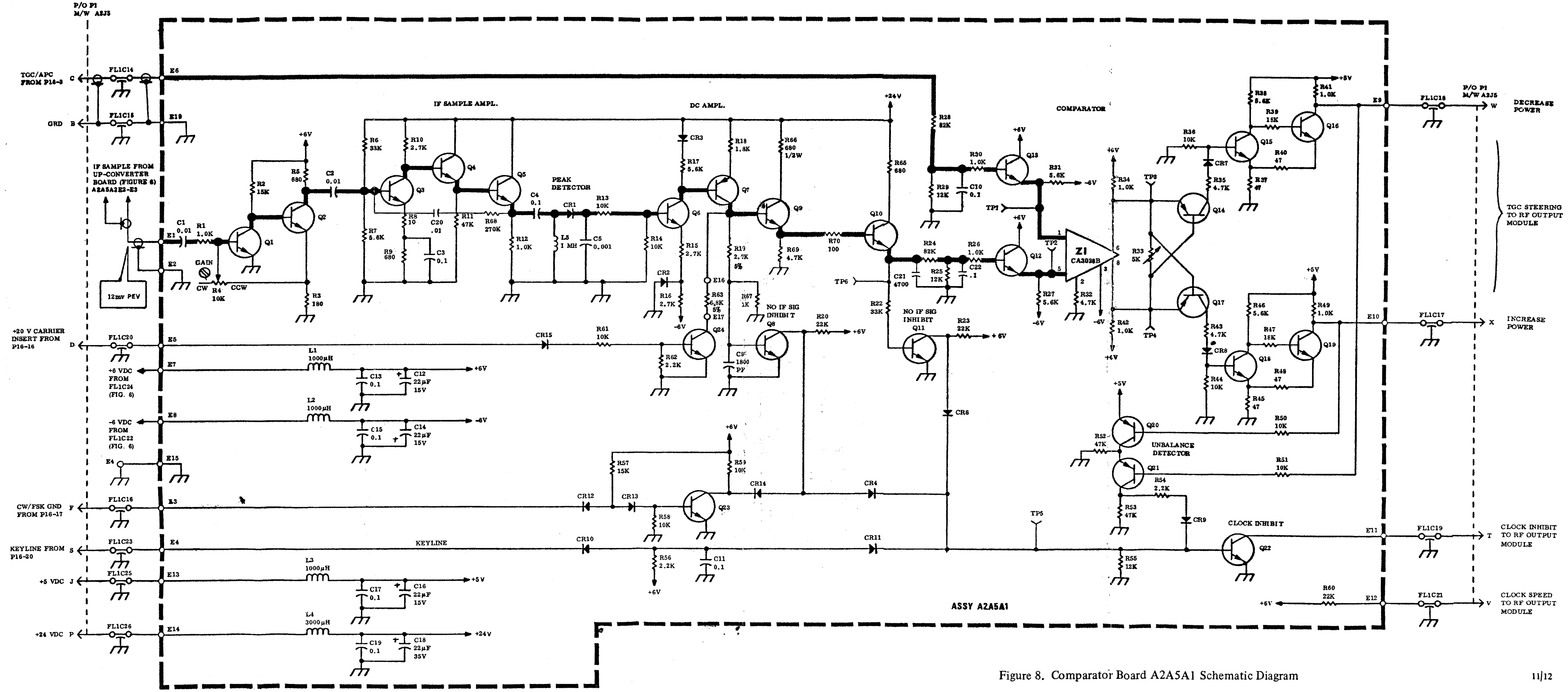


Figure 8. Comparator Board A2A5A1 Schematic Diagram

TABLE 4. MAINTENANCE PARTS LIST-UP-CONVERTER MODULE A2A5

Reference Designation	Name and Description
A2A5	Up-Converter Module Assembly: MFR 14304, PN 0759-3500
FL1	Filter Plate Assembly: MFR 14304, PN 0759-3504
C1 - C3	Not used
C4	Capacitor, Fixed Ceramic, 1750pF: MFR 72982, PN 1214-001
C5	Not used
C6 - C8	Same as FL1C4
C9	Not used
C10	Same as FL1C4
C11 - C13	Not used
C14 - C26	Same as FL1C4
L1,L2	Same as A1L1
MP1 - MP4	Pin, Coaxial, Connector: MFR 81312, PN 100-8000S
MP5-MP16	Pin, Connector: Mil type MS17803-16-20
P1	Connector, Plug: MFR 81312, PN MRAC20PN
A2A5A1	Comparator Board, Up-Converter Module: MFR 14304, PN 0759-3510
C1	Capacitor, Fixed Ceramic, .01uF, MFR 72982, PN 8121-050-651-103M
C2	Same as A1C1
C3	Capacitor, Fixed Ceramic, .1uF: MFR 14304, PN C11-0005-104
C4	Same as A1C3
C5	Capacitor, Fixed Mica, 1000pF: Mil type CM06FD102J03
C6 - C8	Not used
C9	Capacitor, Fixed Ceramic: 1600pF, MFR 72982, PN 8101-050-651-162M
C10, C11	Same as A1C3
C12	Capacitor, Fixed Tantalum, 22uF, 15V: Mil type CSR13D226ML
C13	Same as A1C3

Reference Designation	Name and Description
C14	Same as A1C12
C15	Same as A1C3
C16	Same as A1C12
C17	Same as A1C3
C18	Capacitor, Fixed Tantalum, 22uF, 35WVDC: Mil type CSR13F226ML
C19	Same as A1C3
C20	Same as A1C1
C21	Capacitor, Fixed Mica, 4700pF: Mil type CM06DD472J03
C22	Same as A1C3
CR1	Diode: Mil type 1N3064
CR2 - CR4	Same as A1CR1
CR5	Not used
CR6 - CR9	Same as A1CR1
CR10	Diode: Mil type 1N277
CR11-CR15	Same as A1CR1
L1	Inductor: 1000uH: MFR 99800, PN 2500-28
L2, L3	Same as A1L1
L4	Inductor, 3000uH: MFR 99800, PN 2500-50
L5	Same as A1L1
MP1	Pc Board: MFR 14304, PN 0759-3511
Q1 - Q6	Transistor, NPN: MFR 04713, PN 2N4123
Q7	Transistor, PNP: MFR 04713, PN 2N4125
Q8 - Q13	Same as A1Q1
Q14	Same as A1Q7
Q15, Q16	Same as A1Q1
Q17	Same as A1Q7
Q18, Q19	Same as A1Q1
Q20, Q21	Same as A1Q7
Q22 - Q24	Same as A1Q1
R1	Resistor, Fixed Composition, 1K, 10%, ¼W: Mil type RC07GF102K

TABLE 4. MAINTENANCE PARTS LIST - UP-CONVERTER MODULE A2A5 (Continued)

Reference Designation	Name and Description
R2	Resistor, Fixed Composition, 15K, 10%, ¼W: Mil type RC07GF153K
R3	Resistor, Fixed Composition, 180 Ω, 10%, ¼W: Mil type RC07GF181K
R4	Resistor, Variable, 0 to 10K: MFR 35009, PN 156-4-10K
R5	Resistor, Fixed Composition, 680 Ω, 10%, ¼W: Mil type RC07GF681K
R6	Resistor, Fixed Composition, 33K, 10%, ¼W: Mil type RC07GF333K
R7	Resistor, Fixed Composition, 5.6K, 10%, ¼W: Mil type RC07GF562K
R8	Resistor, Fixed Composition, 10 Ω, 10%, ¼W: Mil type RC07GF100K
R9	Same as A1R5
R10	Resistor, Fixed Composition, 2.7K, 10%, ¼W: Mil type RC07GF272K
R11	Resistor, Fixed Composition, 47K, 10%, ¼W: Mil type RC07GF473K
R12	Same as A1R1
R13	Resistor, Fixed Composition, 10K, 10%, ¼W: Mil type RC07GF103K
R14	Same as A1R13
R15	Same as A1R10
R16	Same as A1R10
R17	Same as A1R7
R18	Resistor, Fixed Composition, 1.8K, 10%, ¼W: Mil type RC07GF182K
R19	Resistor, Fixed Composition, 2.7K, 5%, ¼W: Mil type RC07GF272J
R20	Resistor, Fixed Composition, 22K, 10%, ¼W: Mil type RC07GF223K
R21	Not used
R22	Same as A1R6
R23	Same as A1R20
R24	Resistor, Fixed Composition, 82K, 10%, ¼W: Mil type RC07GF823K
R25	Resistor, Fixed Composition, 12K, 10%, ¼W: Mil type RC07GF123K
R26	Same as A1R1
R27	Same as A1R7
R28	Same as A1R24
R29	Same as A1R25
R30	Same as A1R1
R31	Same as A1R7
R32	Resistor, FixedComposition, 4.7K, 10%, ¼W: Mil type RC07GF472K
R33	Resistor, Film, Variable 5K: MFR 35009, PN 156-4-5K
R34	Same as A1R1
R35	Same as A1R32
R36	Same as A1R13
R37	Resistor, Fixed Composition, 47 Ω, 10%, ¼W: Mil type RC07GF470K
R38	Same as A1R7
R39	Resistor, Fixed Composition, 18K, 10%, ¼W: Mil type RC07GF183K
R40	Same as A1R37
R41, R42	Same as A1R1
R43	Same as A1R32
R44	Same as A1R13
R45	Same as A1R37
R46	Same as A1R7
R47	Same as A1R39
R48	Same as A1R37
R49	Same as A1R1
R50, R51	Same as A1R13
R52, R53	Same as A1R11
R54	Resistor, Fixed Composition, 2.2K, 10%, ¼W: Mil type RC07GF222K

TABLE 4. MAINTENANCE PARTS LIST - UP-CONVERTER MODULE A2A5 (Continued)

Reference Designation	Name and Description
R55	Same as A1R25
R56	Same as A1R54
R57	Same as A1R2
R58, R59	Same as A1R13
R60	Same as A1R20
R61	Same as A1R13
R62	Same as A1R54
R63	Resistor, Fixed Composition, 10K, 5%, ¼W: Mil type RC07G103J
R64	Not used
R65	Same as A1R5
R66	Resistor, Fixed Composition, 680, 10%, ½W: Mil type RC20GF681K
R67	Same as A1R1
R68	Resistor, Fixed Composition, 270K, 10%, ¼W: Mil type RC07GF274K
R69	Same as A1R32
R70	Resistor, Fixed Composition, 100 Ω, 10%, ¼W: Mil type RC07GF101K
Z1	Integrated Circuit: MFR 21921, PN CA3028B
A2A5A2	Translator, PWB Assembly: MFR 14304, PN 0759-3520
AR1	Amplifier, VHF: MFR 14304, PN 0759-5010
AR2, AR3	Same as A2AR1
C1	Capacitor, Fixed Tantalum, 1uF, 50WVDC: Mil type CSR13G105ML
C2, C3, C4	Not used
C5	Same as A1C3
C6	Not used
C7 - C9	Same as A1C3
C10	Same as A2C1
C11	Same as A1C3
C12	Not used
C13, C14	Same as A1C3
C15 - C19	Not used
C20	Same as A2C1
C21	Not used
C22	Same as A1C3
C23 - C25	Not used
C26	Same as A1C3
C27 - C29	Not used
C30	Capacitor, Fixed Mica, 62pF, 150WVDC: Mil type CM05ED620J03
C31	Same as A1C3
C32	Same as A2C1
FL1	Filter, Bandpass: MFR 14304, PN 0759-4012B
L1	Inductor, 10uH: MFR 99800, PN 1537-36
L2 - L4	Same as A2L1
L5	Inductor, 100uH: MFR 99800, PN 1537-76
L6	Same as A2L5
L7	Inductor, 27uH: MFR 99800, PN 1840-38
MP1	Pc Board: MFR 14304, PN 0759-3521
Q1	Transistor NPN: MFR 21921 PN 2N4123
Q2	Same as A2Q1
R1	Same as A1R37
R2	Same as A1R5
R3	Resistor, Fixed Composition, 120 Ω ±10%, ¼W: Mil type RC07GF121K
R4	Resistor, Variable 1K: MFR 35009, PN 156-4-1K
R5	Resistor, Fixed Composition, 220 Ω ±5%, ¼W: Mil type RCR07G220J
R6 - R7	Not used
R8	Resistor, Fixed Composition, 68 Ω ±10% ¼W: Mil type RC07GF680K

TABLE 4. MAINTENANCE PARTS LIST - UP-CONVERTER MODULE A2A5 (Continued)

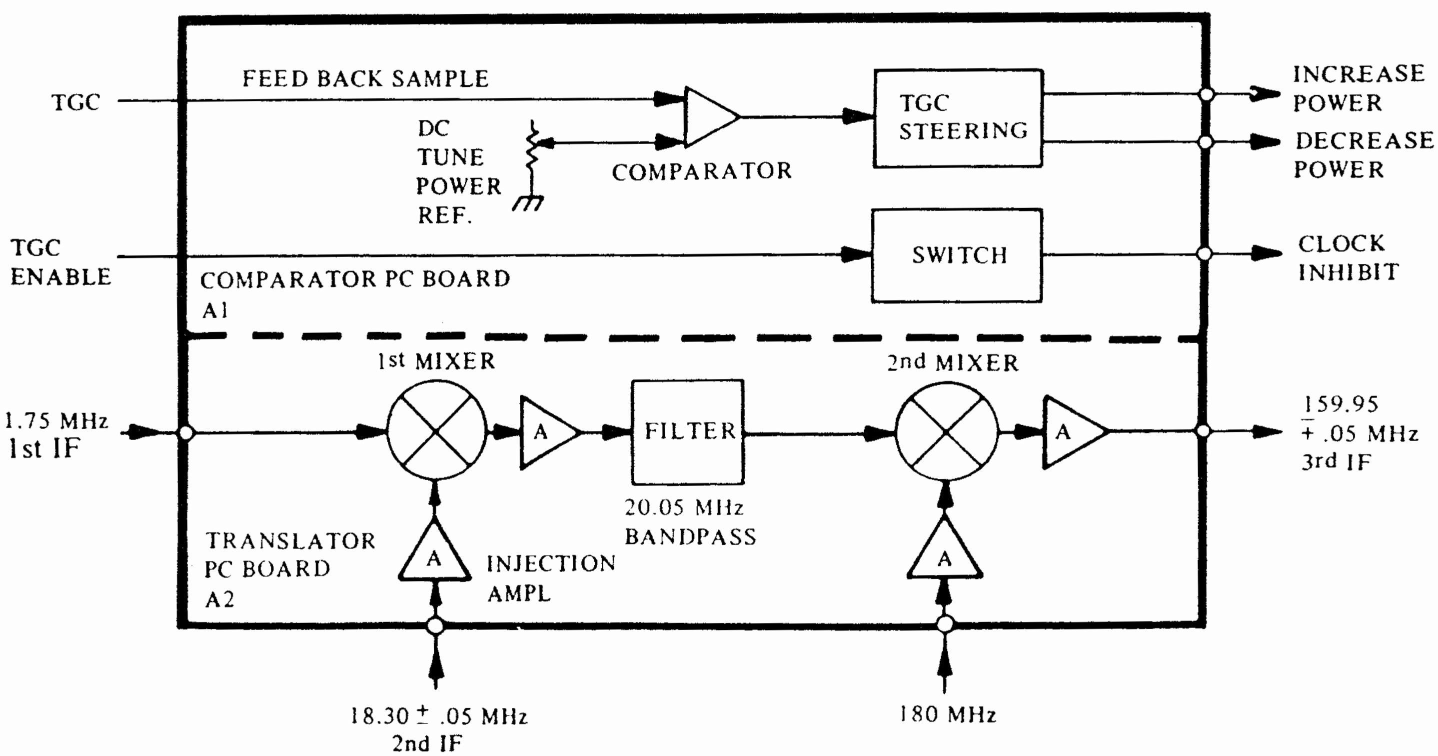
Reference Designation	Name and Description
A2A5A2	(Continued)
R9	Resistor, Fixed Composition, 22 Ω ±10%, ¼W: Mil type RC07GF220K
R10	Same as A1R7
R11, R12	Same as A1R70
R13 - R23	Not used
R24	Same as A2R8
R25	Resistor, Fixed Composition, 82 Ω ±10%, ¼W: Mil type RC07GF820K
R26 - R31	Not used
R32	Same as A1R8
R33	Resistor, Fixed Composition, 150 Ω ±10%, ¼W: Mil type RC07GF151K
R34	Same as A1R8
R35	Same as A1R13
R36 - 39	Same as A1R70
R40	Resistor, Fixed Composition, 330 Ω ±10%, 1/8W: Mil type RC05GF331K
T1	Transformer: MFR 14304, PN 0759-5110-2
T2	Same as A2T1
Z1, Z2	Mixer: MFR 14304, PN 0759-5150

UNIT INSTRUCTIONS

RF-745 SYSTEM

UP-CONVERTER MODULE

A2A5



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A2A5

1. GENERAL DESCRIPTION.

The Up-Converter module translates a 1.75 MHz signal input to 160 MHz in a two step mixing process. Two externally generated injection frequencies are required, 18.30 MHz (nominal) and 180 MHz, both of which are received from the Special Frequencies module (Unit Instruction A2A10). In addition, the Up-Converter module develops "steering" voltages for the TGC control circuitry in the RF Output module. The steering voltages establish and maintain a constant RF power output from the overall transmitting system by automatically correcting for changes in system gain with temperature, frequency, ageing, etc., each time a system tune cycle is completed.

The Up-Converter module contains two PC board assemblies, the comparator PC Board (A1) and the Translator PC Board (A2).

2. TECHNICAL CHARACTERISTICS.

Weight: 1.22 lbs

Dimensions (HWD):
4 1/8 x 2 1/8 x 5 7/8 inches

Power Requirements:
+6 VDC @ 61 MA.
-6 VDC @ 42 MA.

Signal Inputs:
1.75 MHz fixed, 12 MV PEV
18.25 - 18.35 MHz variable, 110 MV RMS
180.0 MHz fixed, 110 MV RMS

Signal Output:
159.90 - 160.00 MHz, 12 MV PEV, at output of associated 160 MHz filter.

Logic Outputs:
Count Up Command
Count Down Command
Oscillator Inhibit

Input Impedance:
1.75 MHz, 50 ohms
18.25 - 18.35 MHz, 50 ohms
180.0 MHz, 50 ohms
TGC, Approx. 90K ohms

Output Load: 50 ohms (Signal Output)

3. SEMICONDUCTOR COMPLEMENT.

Table 1 list all semiconductors used in the Up-Converter module.

TABLE 1. SEMICONDUCTOR COMPLEMENT.

SYMBOL	TYPE	FUNCTION
A1CR1	1N3064	Isolation
A1CR2	1N3064	Isolation
A1CR3		(Not used)
A1CR4	1N277	Isolation
A1CR5	1N3064	Isolation
A1Q1	2N4125	Cross Coupled Ampl.
A1Q2	2N4123	Schmitt Trigger
A1Q3	2N4123	Schmitt Trigger
A1Q4	2N4125	Cross Coupled Ampl.
A1Q5	2N4123	Schmitt Trigger
A1Q6	2N4123	Schmitt Trigger
A1Q7		(Not used)
A1Q8		(Not used)
A1Q9	2N4123	Clock Inhibit
A1Z1	CA3028B	Comparator
A2AR1	0759-5010	Injection Ampl.*
A2AR2	0759-5010	Injection Ampl.*
A2AR3	0759-5010	Signal Ampl.*
A2Q1	2N4123	Amplifier
A2Q2	2N4123	Amplifier
A2Z1	0759-5150	1st Mixer
A2Z2	0759-5150	2nd Mixer

*RF Communications Inc., Mini-Module

4. CIRCUIT DESCRIPTION, TRANSLATOR PC BOARD.

The 1.75 MHz signal path enters the Translator PC Board (figure 6) on terminal E2 and is applied to the first balanced mixer. The 18.30 ± .05 MHz first injection signal enters on terminal E5 at a level of 110 millivolts and is amplified by AR1 before driving the first balanced mixer. AR1 is a sealed miniature 14 dB amplifier. Resistors R12 and R11, with their associated bypass capacitors, decouple AR1 from the DC supplies while R8, R9 and R10 provide resistive buffering at the amplifier input. The injection voltage level can be measured at E5 with an RF Voltmeter having a high impedance probe (Boonton 91H or equivalent).

Following the first balanced mixer, amplifier stage Q1 and Q2 amplifies the signal voltage for driving the 20.05 MHz bandpass filter. Gain for the stage (and for the PC Board) is controlled by feedback through potentiometer R4. The output of the amplifier stage is applied to the bandpass filter through impedance matching transformer T1. The filter passes only the sum component of the mixing process. The output of the filter is a applied through impedance matching transformer T2 and 10 dB pad R24 to the input of the second balanced mixer, Z2.

Translation of the 20.05 ± .05 MHz 2nd IF to 159.95 + .05 MHz is accomplished by the 2nd balanced mixer and injection amplifier which are practically identical to the first. The 180 MHz 2nd injection frequency enters on terminal E11 at a level of 110 mv and is applied to the 2nd mixer after amplification by AR2.

AR3 is another sealed amplifier, providing a module output impedance of 50 ohms. Following the Up-Converter module a 160 MHz bandpass filter (A2FL1) passes only the difference frequency component to the RF Output module.

Even though Z2 is a balanced type mixer, a certain amount of the 180 MHz injection appears at the mixer output, (roughly equal to the signal PEV). As a result, attempts to measure the signal path level at the module output with a broadband RF voltmeter can be misleading. Measurement of the signal path level should be made on the output side of the 160 MHz bandpass filter where the injection frequency and sum components have been removed.

5. TEST DATA, TRANSLATOR PC BOARD.

Typical voltage measurements for all transistors, IC's and mini-modules used on the PC Board are given in table 2. Measurements were taken with a Tektronix 453 or equivalent oscilloscope while the module was receiving normal DC input voltages.

The indicated rms measurements are taken with a Boonton type 91H or equivalent RF voltmeter using the high impedance probe. If RF voltages are measured at the chassis connector (i.e., with the module removed) then a 50 ohm probe adapter should be used to simulate proper loading. A short BNC-Winchester adapter cable (Section 5) facilitates mating the probe adapter to the chassis connector pin. A steady 1.75 MHz input can be obtained at P1-H with the exciter keyed and in the "CW" mode.

6. CIRCUIT DESCRIPTION, COMPARATOR PC BOARD.

The Comparator PC Board forms part of the closed TGC loop which monitors system output power. The purpose of the loop is to minimize variations in RF output from the system resulting from frequency and temperature caused gain changes, by varying the RF output drive from exciter.

Basically the circuit functions by comparing the amplitude of a feedback signal from the external power amplifier with an internal DC voltage. The loop automatically corrects the RF power output from the system to make the two signals equal.

Referring to figure 6, the TGC signal enters the Comparator PC Board at terminal E1 and is applied to one side of the comparator. Potentiometer R1 on the other input of the comparator provides an adjustable reference voltage against which the incoming TGC signal is compared. Zener diode VR2 limits the maximum TGC voltage presented to pin 1 of comparator Z1 to 4.7 volts. The comparator consists of differential amplifier Z1 followed by cross coupled switch transistors Q1 and Q4. When the TGC voltage is equal to the reference voltage (the inputs to the differential amplifier are equal), there is 0 volt differential between the output terminals (pins 6 and 8 of Z1), and neither Q1 nor Q4 will conduct. Consequently Schmitt Trigger transistors Q2 and Q5 are cut off, while Q3 and Q6 are in saturation, and the two steering voltages, present at E7 and E8 of the Comparator PC Board, are at approximately 0 VDC.

During a TUNE cycle, assume that the instantaneous voltage at pin 1 is less than the reference voltage at pin 5 (including that the system RF output is below the normal rated TUNE level). This will unbalance the differential amplifier, resulting in Q1 being driven further into cutoff, and Q4 turning on. Conducting Q4 will supply base current to Schmitt trigger Q5. The conduction of Q5 will lower the available bias of Q6, allowing Q6 to come out of saturation. The collector of Q6 will then swing more positive (to approximately 5 VDC), providing an increase power signal from the Up-Converter module to the RF Output module.

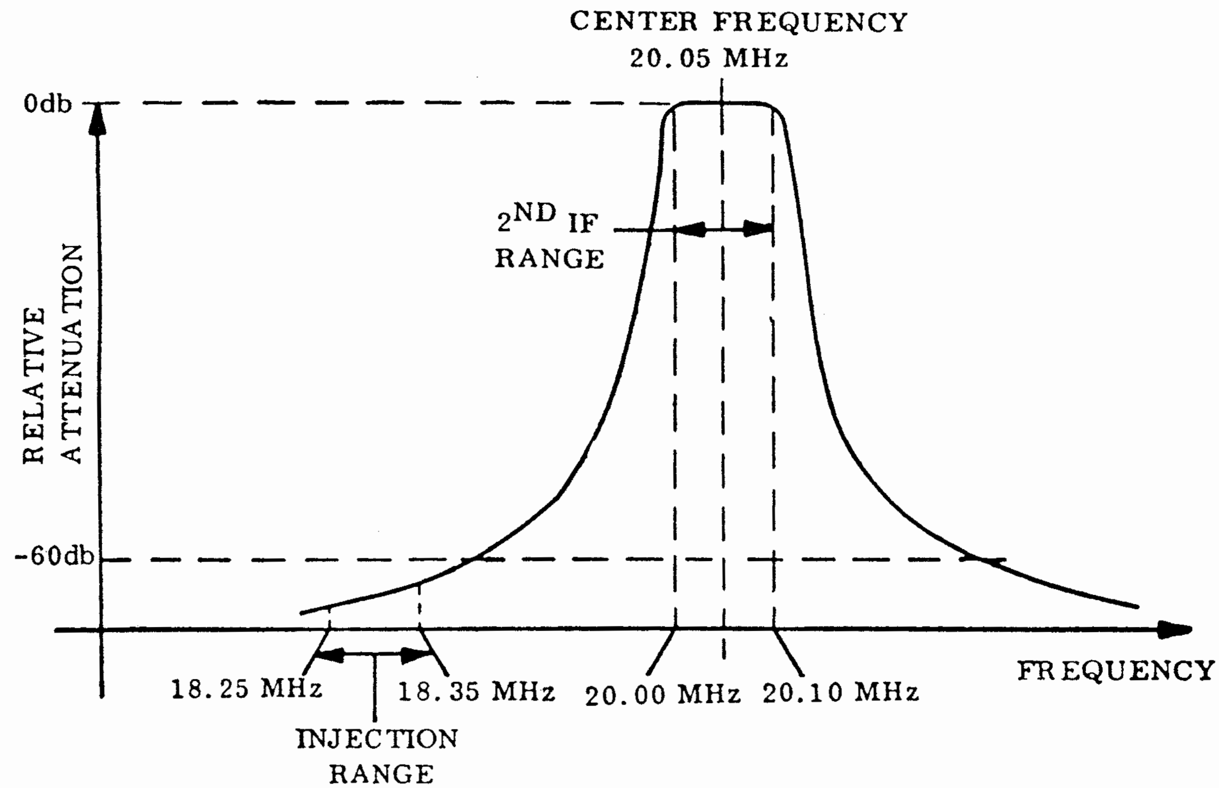


Figure 1. 20.05 MHz Bandpass Filter, Attenuation Characteristics

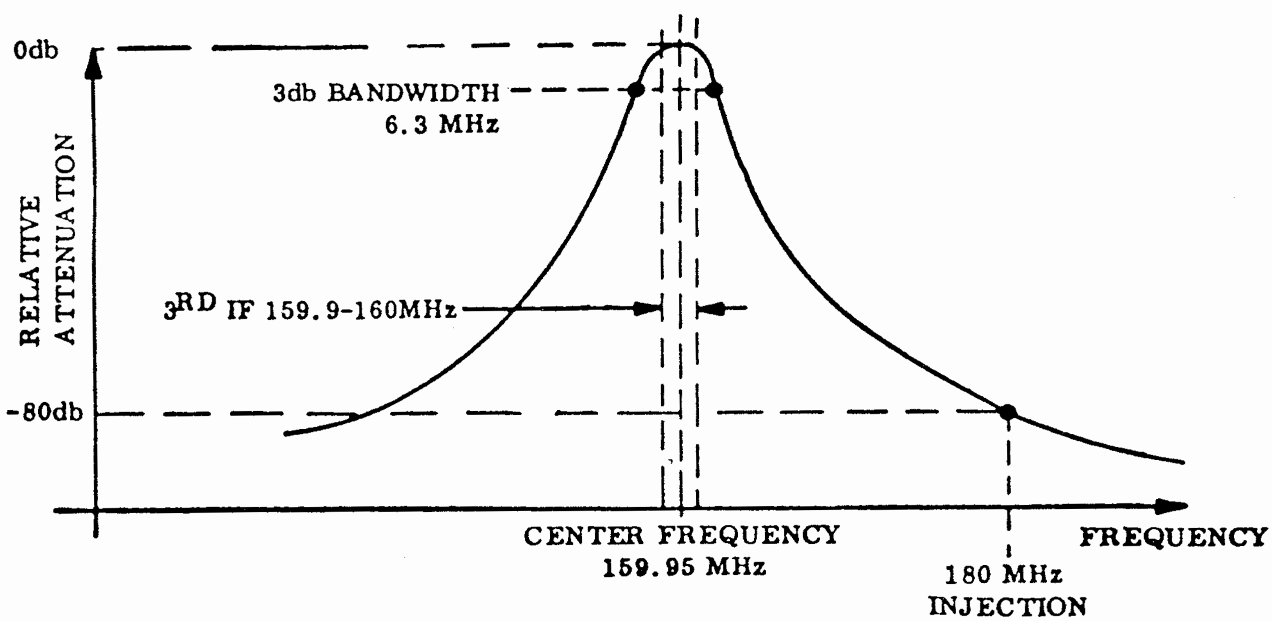


Figure 2. 160 MHz Bandpass Filter, Attenuation Characteristic

TABLE 2. TRANSLATOR, PC BOARD VOLTAGE MEASUREMENTS

	PINS							
	1	2	3	4	5	6	7	8
AR1	GRD	900 MV P-P	GRD	70 RMS	GRD	+4.2 VDC	−4.2 VDC	GRD
AR2	GRD	330 MV RMS	GRD	53 MV RMS	GRD	+4.2 VDC	−4.2 VDC	GRD
AR3	GRD	*	GRD	*	GRD	+4.2 VDC	−4.2 VDC	GRD

	1	2	3	4	5	6	7
Z1	25 MV P-P / 0 VDC	GRD	GRD	GRD	GRD	35 MV P-P / 0 VDC	900 MV P-P / 0 VDC
Z2	* / 0	GRD	GRD	GRD	GRD	* / 0 VDC	330 MV RMS / 0

*Voltage either too low to measure accurately, or variable due to unpredictable leakage through mixer.

	Q1	Q2
EMITTER	GRD	100 MV P-P / +.7 VDC
BASE	+.7 VDC	110 MV P-P / +1.4 VDC
COLLECTOR	110 MV P-P / +1.4 VDC	245 MV P-P / +5.3 VDC

In addition to unbalance in the comparator circuit, an enabling signal is required by the clock oscillator amplifier in the RF Output module before power level correction begins (see Unit Instruction A2A7). The clock oscillator amplifier is normally inhibited by a ground reaching the RF Output module from switching transistor Q9 on the Comparator PC Board. Q9 is held saturated by base current through CR5. When a system tuning cycle is initiated (TGC/enable line grounded), Q9 will be turned off, removing the ground from the Oscillator Inhibit line, and permitting the TGC circuitry in the RF Output module to count up or down in power level until the correct TUNE power level is reached.

7. TEST DATA, COMPARATOR PC BOARD.

Typical DC voltage measurements for all transistor and integrated circuits on the Comparator PC Board are given in the following procedure. Measurements are taken with a Simpson 260 or equivalent Voltmeter.

a. Disconnect TGC input at exciter interface box or by unsoldering shielded wire from E1 on A2A5A1.

b. Measure the voltage at TP1. If TP1 does not measure between 0 and +4 VDC adjust R1 for a reading less than 4 VDC.

NOTE

If it is necessary to adjust R1, you must go through the TGC adjustment procedure (see system manual) following completion of tests on this module.

c. Jumper E1 to E5.

The following are typical voltages under the above conditions:

Pin	1	2	3	4
Z1	+4	4.5	6	Not
	VDC	VDC	VDC	Used
Pin	5	6	7	8
Z1	+2.8	+5.85	Not	+5.15
	VDC	VDC	Used	VDC

	Base	Emitter	Collector
Q1	+5.15 VDC	+5.85 VDC	+2.3 VDC
Q2	+.7 VDC	+.1 VDC	+.1 VDC
Q3	+.1 VDC	+.1 VDC	+5.0 VDC
Q4	+5.85 VDC	+5.15 VDC	0 VDC
Q5	0 VDC	+.2 VDC	+4.0 VDC
Q6	+1.2 VDC	+.5 VDC	+.6 VDC

d. Remove jumper from E1 to E5 and jumper E1 to E6 or E2 (ground).

The following are typical voltages under the above conditions:

Pin	1	2	3	4
Z1	0	−4.5	−6	Not
	VDC	VDC	VDC	Used
Pin	5	6	7	8
Z1	+2.8	+5.15	Not	+5.85
	VDC	VDC	Used	VDC

	Base	Emitter	Collector
Q1	+5.85 VDC	+5.15 VDC	0 VDC
Q2	0 VDC	+.2 VDC	+4 VDC
Q3	+1.2 VDC	+.5 VDC	+.6 VDC
Q4	+5.15 VDC	+5.85 VDC	+2.3 VDC
Q5	+.7 VDC	+.1 VDC	+.1 VDC
Q6	+.1 VDC	+.1 VDC	+5 VDC

e. Remove the RF Output module; connect an ohmmeter with the positive lead to J7-T and the negative lead to chassis ground (X1 scale)

1. Jumper E3 to E6.

	Base	Emitter	Collector
Q9	0 VDC	GRD	∞ ohms

2. Remove jumper applied in step 1 and disconnect TGC Enable wire from E3.

	Base	Emitter	Collector
Q9	+.7 VDC	GRD	4 ohms

f. Reconnect the TGC input to E1 and the TGC Enable input to E3. Perform adjustment procedure (see your system manual) if the setting of R1 was disturbed in step b.

8. MODULE ADJUSTMENT.

RF Level

The level adjustment (R4) is the only adjustment on the Translator PC board and is used to establish the overall gain of the Up-Converter. Its adjustment is as follows:

a. Remove the Up-Converter module. Set the MODE selector at CW and key the exciter. Confirm the presence of 12 mv ± 1 mv at the input to the Up-Converter module (Pin A2J5-H) with a Boonton 91H or equivalent RF voltmeter with 50 ohms termination. Replace the Up-Converter and remove the RF Output module.

b. Now connect the RF voltmeter (using 50 ohm probe adapter) to the output of the 160 MHz bandpass filter at A2J7-B via a short BNC to WINCHESTER adapter cable.

c. Adjust A2R4 for a 12 mv ± 1 mv indication.

TGC Adjustment

Disconnect the TGC input at exciter interface box or by unsoldering shielded wire. Measure the voltage at TP1 on the Comparator PC Board. If TP1 does not measure between 0 and +4 VDC adjust R1 for a reading less than +4 VDC. If it is necessary to adjust R1 you must perform the TGC adjustment procedure in the systems manual.

9. PARTS LIST.

Table 3 is a list of Maintenance parts for the Up-Converter module. Manufacturers are referenced by a five-digit code. For a list of manufacturers' names and addresses refer to part six of the General Information Section.

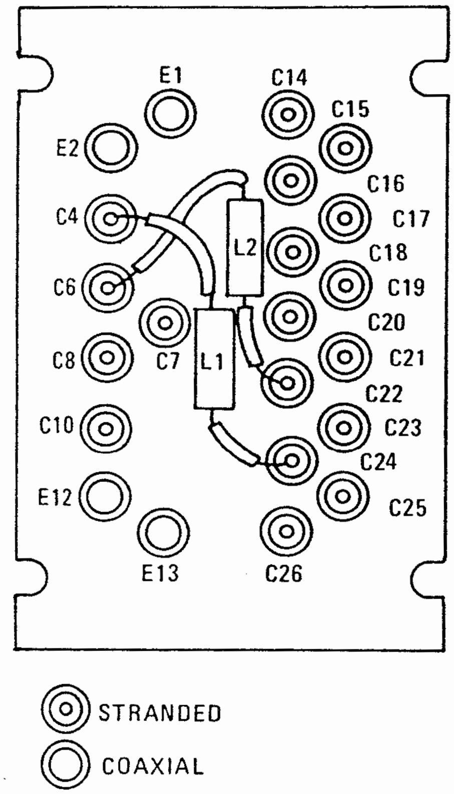


Figure 3. Filter Plate Assembly A2A5FL2 Component Locations

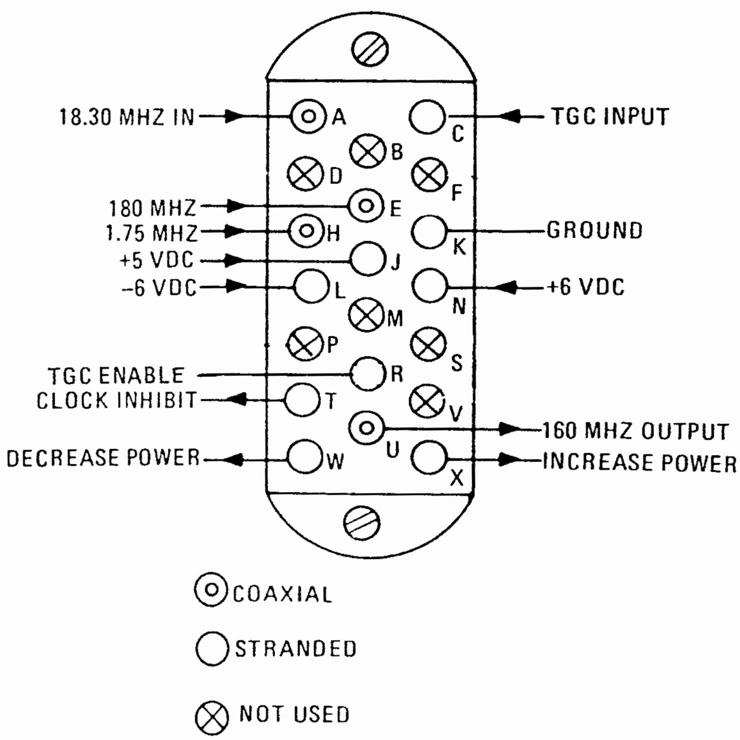


Figure 4. Module Chassis Connector A2J5, Top View

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTORS ARE IN OHMS, ¼ WATT.
   B. ALL CAPACITORS ARE IN MICROFARADS.
2. PREFIX INCOMPLETE REFERENCE DESIGNATORS WITH A2A5 PLUS SUB-ASSEMBLY DESIGNATOR IF ANY.
3. REFER TO TABLE 1. FOR LISTING OF SEMICONDUCTOR TYPES.

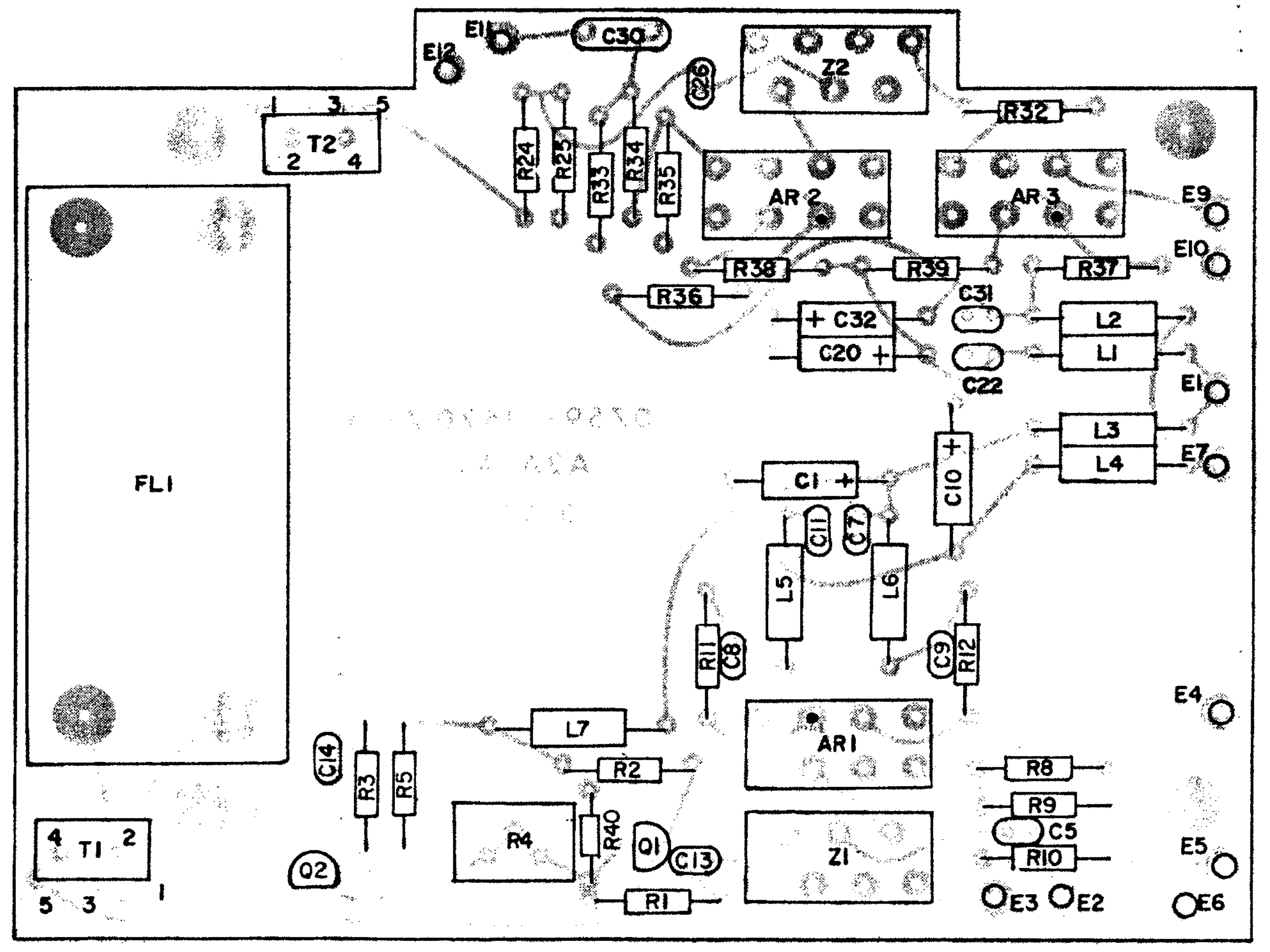


Figure 5. Translator Board A2A5A2 Component Locations

0759-3522

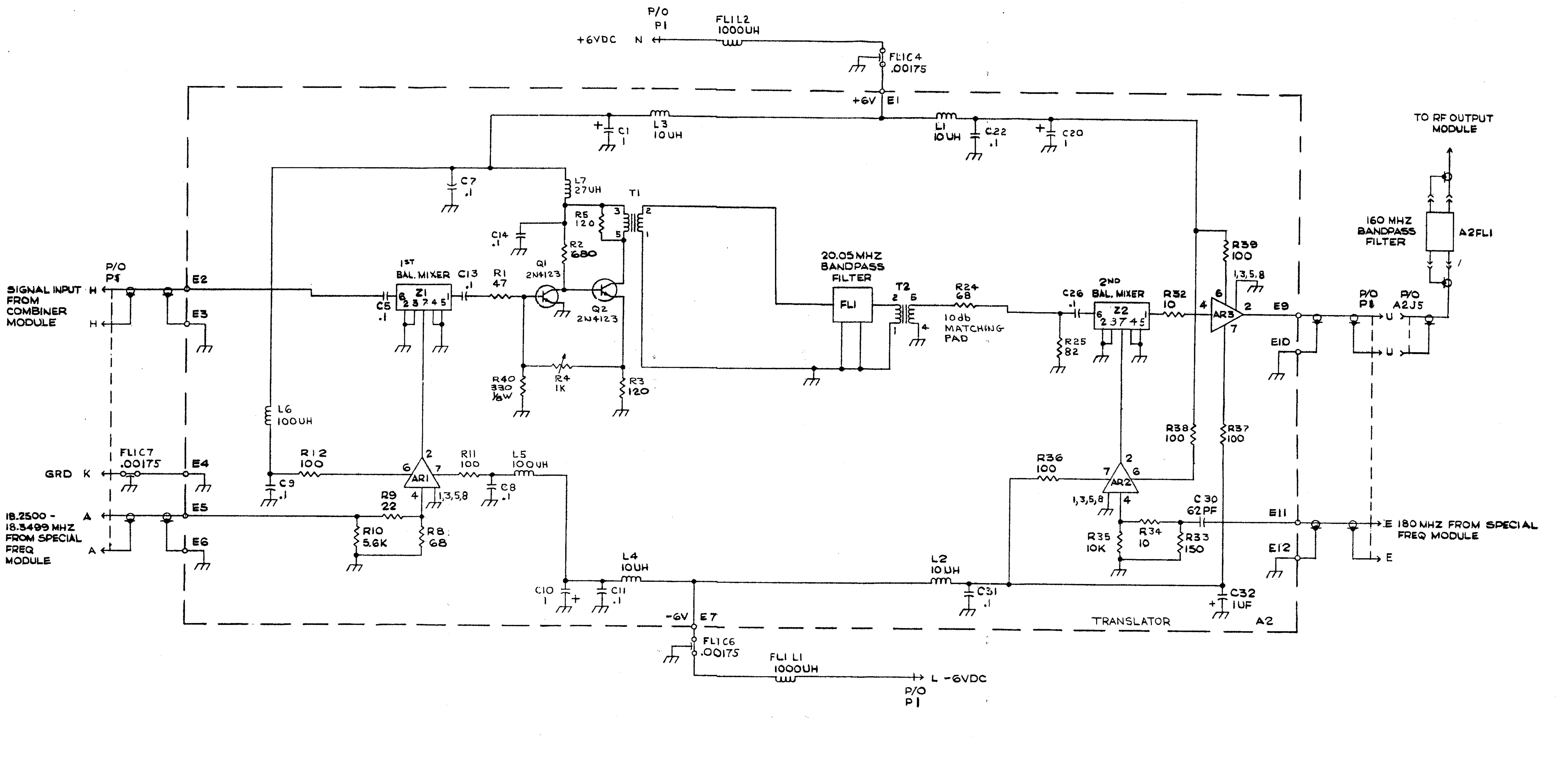


Figure 6. Translator Board A2A5A2 Schematic Diagram

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTORS ARE IN OHMS, 1/4 WATT, 10%.
   B. ALL CAPACITORS ARE IN MICROFARADS.
   C. ALL FL1 CAPACITORS ARE .00175 MFD.
   D. ALL DIODES ARE 1N3064.
2. PREFIX ALL INCOMPLETE REF. DESIG. WITH A2A5.

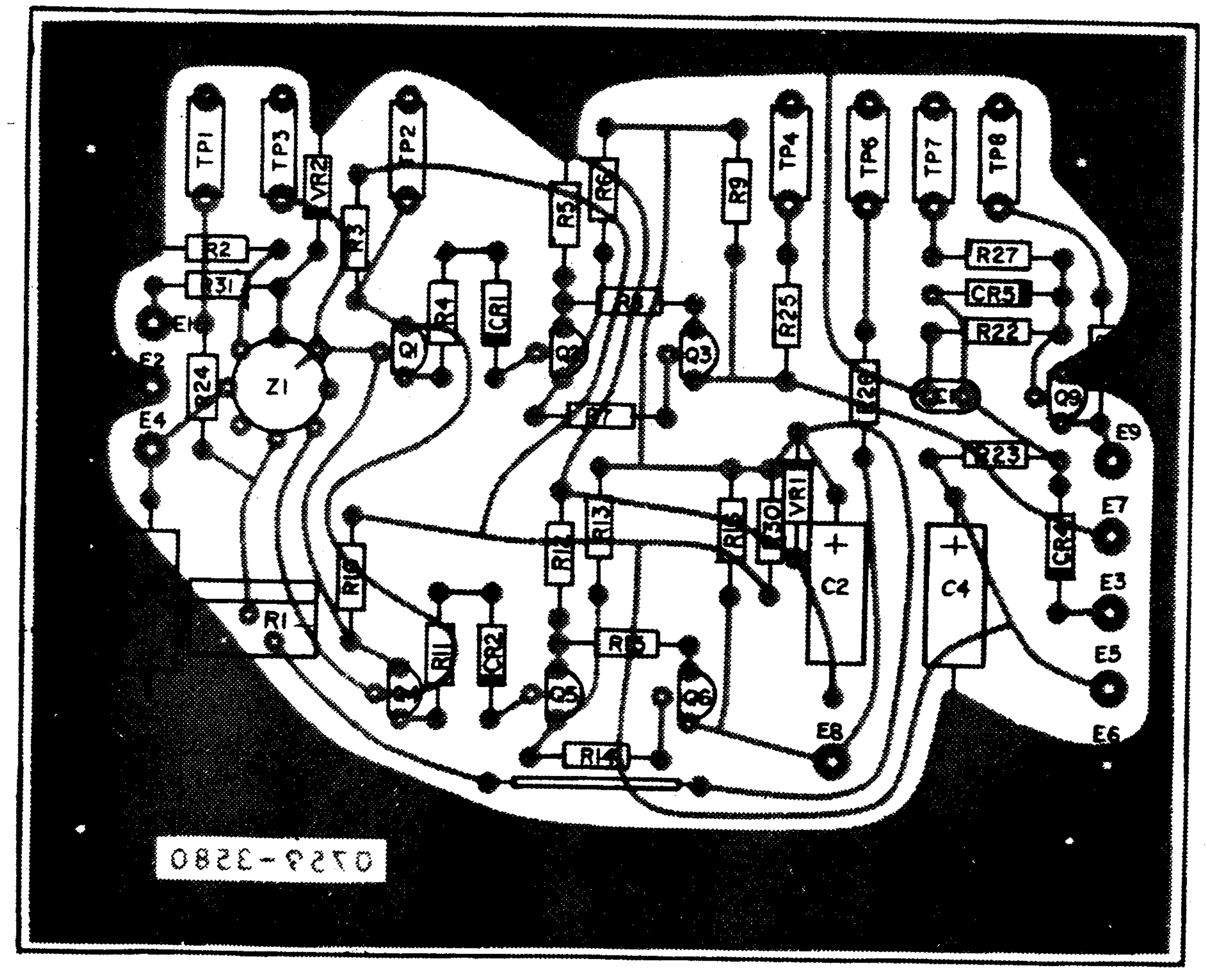


Figure 7. Comparator Board A2A5A1 Component Locations

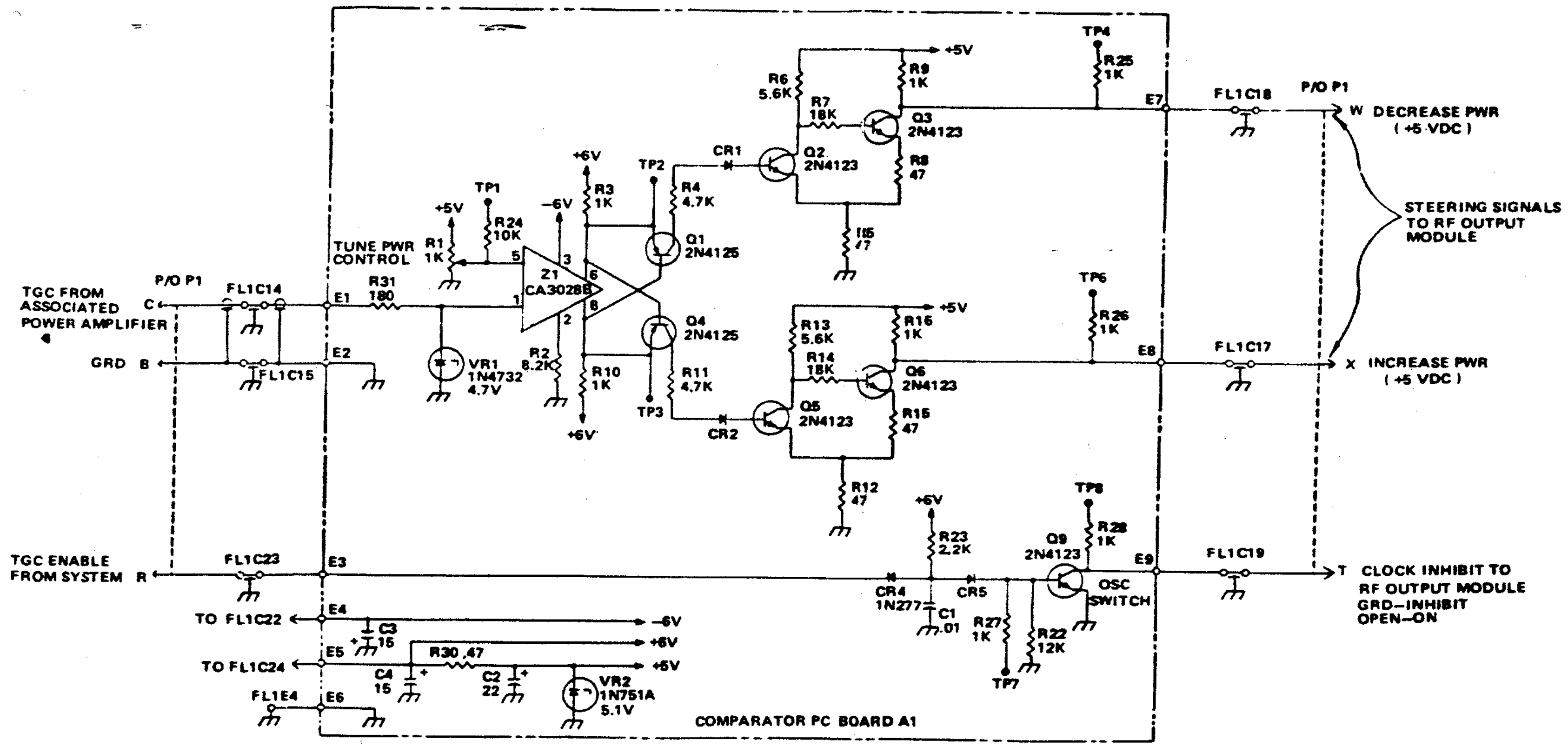


Figure 8. Comparator Board A2A5A1 Schematic Diagram

TABLE 3. MAINTENANCE PARTS LIST-UP-CONVERTER MODULE A2A5

Reference Designation	Name and Description
A2A5	Up-Converter Module Assembly: MFR 14304, PN 0759-3570
FL1	Filter Plate Assembly: MFR 14304, PN 0759-3504
C1 - C3	Not used
C4	Capacitor, Fixed Ceramic, 1750pF: MFR 72982, PN 1214-001
C5	Not used
C6 - C8	Same as FL1C4
C9	Not used
C10	Same as FL1C4
C11 - C13	Not used
C14 - C26	Same as FL1C4
L1,L2	Same as A1L1
MP1 - MP4	Pin, Coaxial, Connector: MFR 81312, PN 100-8000S
MP5-MP16	Pin, Connector: Mil type MS17803-16-20
P1	Connector, Plug: MFR 81312, PN MRAC20PN
A2A5A1	Comparator Board, Up-Converter Module: MFR 14304, PN 0759-3580
C1	Capacitor, Fixed Ceramic, .01uF, MFR 72982, PN 8121-050-651-103M
C2	Capacitor, Fixed Tantalum 22uF, 15V Mil type CSR13D226ML
C3, C4	Capacitor, fixed Tantalum 15uF, 20V Mil type CSR13E156ML
CR1, CR2	Diode: Mil type 1N3064
CR3	Not used
CR4	Diode: Mil type 1N277
CR5	Same as A1CR1
Q1	Transistor, PNP MFR 04713 PN 2N4125
Q2, Q3	Transistor, NPN : MFR 04713, PN 2N4123
Q4	Transistor, PNP: MFR 04713, PN 2N4125
Q5, Q6	Same as A1Q2
Q7, Q8	Not used
Q9	Same as A1Q2

Reference Designation	Name and Description
R1	Potentiometer, 1K ohms MFR 35009 PN 156-4-1K
R2	Resistor, Fixed Composition, 8.2K, 10%, ¼W: Mil type RC07GF822K
R3	Resistor, Fixed Composition, 1K, 10%, ¼W: Mil type RC07GF102K
R4	Resistor, Fixed Composition 4.7K ohms, 10%, ¼W Mil type RC07GF472K
R5	Resistor, Fixed Composition, 47Ω, 10%, ¼W: Mil type RC07GF470K
R6	Resistor, Fixed Composition, 5.6K, 10%, ¼W: Mil type RC07GF562K
R7	Resistor, Fixed Composition, 18K, 10%, ¼W: Mil type RC07GF183K
R8	Resistor, Fixed Composition, 47Ω, 10%, ¼W: Mil type RC07GF470K
R9, R10	Same as A1R3
R11	Resistor, Fixed Composition, 4.7K, 10%, ¼W: Mil type RC07GF472K
R12	Same as A1R5
R13	Same as A1R6
R14	Same as A1R7
R15	Same as A1R5
R16	Same as A1R3
R17 to R21	Not used
R22	Resistor, Fixed Composition 12K, 10%, ¼W Mil type RC07GF123K
R23	Resistor, Fixed Composition, 2.2K, 10%, ¼W: Mil type RC07GF222K
R24	Resistor, Fixed Composition, 10K, 10%, ¼W: Mil type RC07GF103K
R25-R28	Same as A1R3
R29	Not used
R30	Same as A1R5
R31	Resistor, Fixed Composition, 180Ω, 10%, ¼W: Mil type RC07GF181K

TABLE 3. MAINTENANCE PARTS LIST - UP-CONVERTER MODULE A2A5 (Continued)

Reference Designation	Name and Description
TP1	Test Point, BRN MFR 14304 PN J60-0001-008
TP2	Test Point, Red MFR 14304, PN J60-0001-002
R59	
TP3	Test Point, ORN MFR 14304, PN J60-0001-006
TP4	Test Point, Yel, MFR 14304 PN J60-0001-007
TP5	Not used
TP6	Test Point, Blu, MFR 14304 PN J60-0001-010
TP7	Test Point, Grn, MFR 14304 PN J60-0001-004
TP8	Test Point, Gray, MFR 14304, PN J60-0001-013
VR1	Diode, Zener, 5.1 VDC MFR 04713, PN 1N751A
VR2	Diode, Zener, 4.7 VDC MFR 04713 PN 1N4732
Z1	Integrated Circuit: MFR 21921, PN CA3028B
A2A5A2	Translator, PWB Assembly: MFR 14304, PN 0759-3520
AR1	Amplifier, VHF: MFR 14304, PN 0759-5010
AR2, AR3	Same as A2AR1
C1	Capacitor, Fixed Tantalum, 1uF, 50WVDC: Mil type CSR13G105ML
C2, C3, C4	Not used
C5	Same as A1C3
C6	Not used
C7 - C9	Same as A1C3
C10	Same as A2C1
C11	Same as A1C3
C12	Not used
C13, C14	Same as A1C3
C15 - C19	Not used
C20	Same as A2C1
C21	Not used
C22	Same as A1C3
C23 - C25	Not used
C26	Same as A1C3
C27 - C29	Not used
C30	Capacitor, Fixed Mica, 62pF, 150WVDC: Mil type CM05ED620J03
C31	Same as A1C3
C32	Same as A2C1
FL1	Filter, Bandpass: MFR 14304, PN 0759-4012B
L1	Inductor, 10uH: MFR 99800, PN 1537-36
L2 - L4	Same as A2L1
L5	Inductor, 100uH: MFR 99800, PN 1537-76
L6	Same as A2L5
L7	Inductor, 27uH: MFR 99800, PN 1840-38
MP1	Pc Board: MFR 14304, PN 0759-3521
Q1	Transistor NPN: MFR 21921 PN 2N4123
Q2	Same as A2Q1
R1	Same as A1R37
R2	Same as A1R5
R3	Resistor, Fixed Composition, 120 Ω ± 10%, ¼W: Mil type RC07GF121K
R4	Resistor, Variable 1K: MFR 35009, PN 156-4-1K
R5	Resistor, Fixed Composition, 220 Ω ± 5%, ¼W: Mil type RCR07G220J
R6 - R7	Not used
R8	Resistor, Fixed Composition, 68 Ω ± 10% ¼W: Mil type RC07GF680K

TABLE 3. MAINTENANCE PARTS LIST - UP-CONVERTER MODULE A2A5 (Continued)

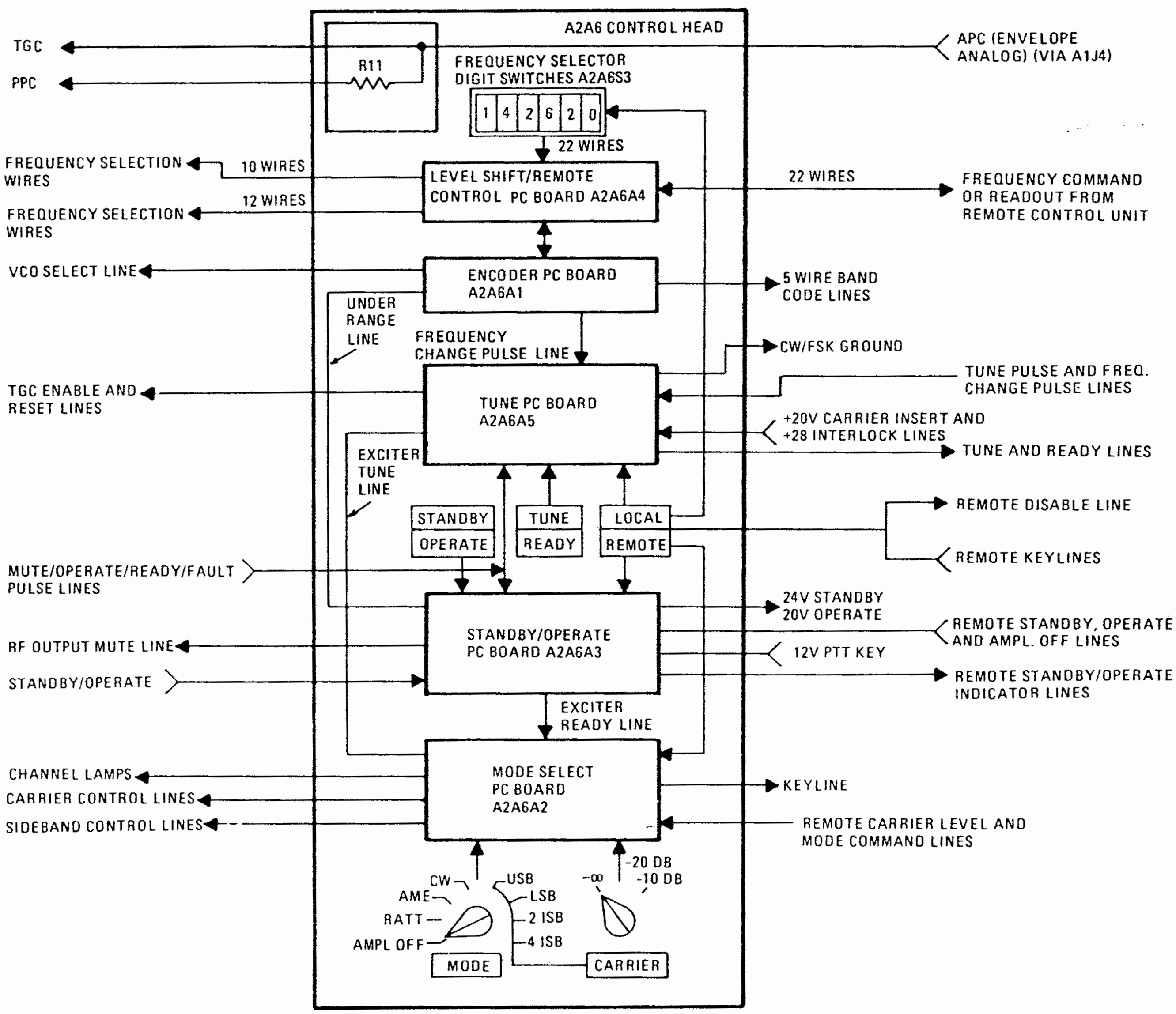
Reference Designation	Name and Description
A2A5A2	(Continued)
R9	Resistor, Fixed Composition, 22 Ω ±10%, ¼W: Mil type RC07GF220K
R10	Same as A1R7
R11, R12	Same as A1R70
R13 - R23	Not used
R24	Same as A2R8
R25	Resistor, Fixed Composition, 82 Ω ±10%, ¼W: Mil type RC07GF820K
R26 - R31	Not used
R32	Same as A1R8
R33	Resistor, Fixed Composition, 150 Ω ±10%, ¼W: Mil type RC07GF151K
R34	Same as A1R8
R35	Same as A1R13
R36 - 39	Same as A1R70
R40	Resistor, Fixed Composition, 330 Ω ±10%, 1/8W: Mil type RC05GF331K
T1	Transformer: MFR 14304, PN 0759-5110-2
T2	Same as A2T1
Z1, Z2	Mixer: MFR 14304, PN 0759-5150

CONTROL HEAD MODULE

A2A6

NOTE

THIS CONTROL HEAD MODULE P/N 0759-6600 IS FOR USE WITH THE RF-130 1 KW TRANSMITTING SYSTEM



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CONTROL HEAD MODULE A2A6

1. INTRODUCTION

Control Head Module A2A6 provides a central location for the control of all other exciter modules, provides a flexible and convenient means of interfacing the exciter with external equipments and provides for remote control of the whole system.

Control voltages for sideband selection, carrier reinsertion level, and output frequency are all developed in the Control Head, in response to the position of local selector switches or logic signals received from an external remote control system.

Control Head Module A2A6, Part No. 0759-6600 is used in the Model RF-131-122, -123 and -126 Exciters covered in this instruction book. These units meet the interface requirements of the RF-130 1kW Transmitter, and will accept full remote control.

All of the control functions between the RF-131 Exciter and a transmitting system are implemented in the Control Head. For example, for the RF-130 Transmitting System, the Control Head supplies the Power Amplifier with standby and operate commands, a 5-wire code that automatically tunes the Power Amplifier to the selected frequency, and a ground pulse that signals a frequency change of 1kHz or greater. The RF-131 Exciter also accepts readback lines from the system, ensuring that the prescribed system cycles have been executed.

Control Head Module A2A6, Part No. 0759-6600 contains five plug-in logic subassemblies for the control of system emission mode and carrier reinsertion. These logic subassemblies are as follows:

A2A6A1	Encoder PWB Assembly
A2A6A2	Mode Select PWB Assembly
A2A6A3	Standby/Operate PWB Assembly
A2A6A4	Level Shift/Remote Control PWB Assembly
A2A6A5	Tune PWB Assembly

Figure 1 shows subassembly, control and connector locations.

2. FREQUENCY CONTROL AND FREQUENCY CHANGE (GROUND) PULSE GENERATION.

Frequency control originates at either the frequency selector digit switch (A2A6S3) on the Control Head front panel or at a remote control should the exciter LOCAL/REMOTE Switch (A2A6S4) be in the REMOTE position.

Switch assembly A2A6S3 contains a group of six, thumb-actuated switches that control the exciter's output in 10MHz, 1MHz, 100KHz, 10KHz and 1KHz and 100Hz increments. With the exception of the 10MHz switch, each switch has ten possible positions from 0 to 9, and a four-wire output that yields a 4-bit BCD indication of the selected digit. The 10MHz switch has only three positions 0, 1 and 2, and a two-wire binary output. Thus the entire six digit number is carried on 22 wires. Refer to Table 1 for BCD format.

The wiring from both local and remote frequency determining inputs comes to the Level Shift/Remote Control PWB A2A6A4 with the local wiring at A2A6A4P5. (Refer to Figure 2) Each frequency determining input line produces a ground for its logic "0" and an open for its logic "1". When the system is in REMOTE the local portion of the LOCAL/REMOTE switch has its ground return opened. Thus the only source of grounds in the Level Shift/Remote Control PWB A2A6A4 during remote operation is from the Remote Control Unit. Ungrounded lines are pulled high (towards +5V) by pull-up resistors R1 through R22 (Figure 10). Diodes CR4 through CR25 provide isolation so that the local switches cannot affect remote frequency control. Similar isolation is provided by the remote control when local operation is selected.

The wiring on the right side of Figure 10 routes the selected (LOCAL or REMOTE) frequency information to the rest of the system.

Refer to Figure 2. The 12 wires from the three least-significant frequency selector digit switches (that is, 10kHz, 1kHz, and 100Hz) are routed to the A2A14 Low Band PLL Module via connectors A2A6P5, A2A6J4, A2A6J16, and A2J14. The logic levels present on these 12 wires control the digital dividers of the divide-by-M circuit in the module, thereby establishing the module's output frequency.

TABLE 1. BCD CODES

Switch Indication	Switch Output			
	8 Bit	4 Bit	2 Bit	1 Bit
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

The 10 wires from the three most-significant frequency selector digit switches (that is, 10MHz, 1MHz and 100kHz) control the digital dividers of the A2A8 High Band PLL Module, establishing its output frequency. However, before the logic levels on the 10 wires are applied to the module, their levels are shifted from approximately 0 and +5Vdc to approximately −1.6 and −0.6Vdc for logic "0" and "1" representation, respectively. This is necessary because of the ECL logic elements of PN 1976-3800-2 High Band PLL Module. In addition, the logic levels of the 2-bit and 4-bit wires of the 100kHz and 1MHz frequency selector digit switches must be inverted. (Refer to the High Band PLL Module A2A8 Section in this book for further discussion.) This inversion is accomplished in Encoder PWB A2A6A1 by inverters U8, U9 and U10 (see Figure 4) and then returned to Level Shift/Remote Control PWB A2A6A4 for level shifting. Thus, the full level-shifted output to the A2A8 High Band PLL Module is 10 wires of quasi-BCD (refer to Table 2). The 10 wire output is routed to the board via connectors A2A6J4, A2A6J16, A2AP16 and A2J8. The logic input/level-shifted output of the level shift circuitry of A2A6A4 are illustrated as follows:

LOGIC LEVEL INPUT
TO LEVEL SHIFT "1" +5V
CIRCUITRY OF A2A6A1 "0" 0V

TYPICAL LEVEL-SHIFTED
OUTPUT OF LEVEL SHIFT "1" −0.2V
CIRCUITRY OF A2A6A1 "0" −2V

TABLE 2. QUASI-BCD CODES.

Switch Indication	Quasi-BCD Output			
	8 Bit	4 Bit	2 Bit	1 Bit
0	0	1	1	0
1	0	1	1	1
2	0	1	1	1
3	0	1	0	1
4	0	0	1	0
5	0	0	1	1
6	0	0	0	0
7	0	0	0	1
8	1	1	1	0
9	1	1	1	1

The 5-wire code generator of Encoder PWB A2A6A1 (Read-Only Memory U1) receives 10MHz, 1MHz and 100kHz frequency selector digit switch inputs (routed to A2A6A1 via Level Shift/Remote Control PWB A2A6A4) and develops the 5-wire primary band selection code used to accomplish automatic band switching in the companion system RF Amplifier. The 5-wire primary band selection code frequency, code line identification, and RF Power Amplifier band number data is shown in Table 3.

Encoder PWB A2A6A1 provides several other important functions through its frequency-change, band-change, high level interface and code image generation and ROM U1 circuitry. These functions are described in detail in subsequent paragraphs.

ROM U1 generates frequency underrange information. Depending on whether the frequency selected is underrange or inrange, the output at U1-2 will be low and the output at U1-3 will be high (respectively), inhibiting (or not affecting) keyline operation. Also, should an invalid input be applied at U1 (such as all logic "0's" occurring when the frequency selector digit switches are changed), U1 will generate an output of logic "1's." When this occurs, the frequency change and band change circuitry of Encoder PWB A2A6A1 will not change from its previous state. Thus, preventing a power amplifier frequency/band change during exciter frequency change.

The frequency and band change functions are interrelated.

The high level interface and code image generation circuitry provides the system RF Power Amplifier with a ground on those code lines with a primary code bit of "0" and connects together those code lines with a primary code bit of "1". The ungrounded code lines must be tied together in order for the RF Power Amplifier band-switching mechanism to operate.

Table 3. Frequency/Primary Band Selection Code/Power Amplifier Band Data.

FREQUENCY Selector Digit Switch Selected Frequency (MHz)	Primary Band Selection Code					System RF Power Amplifier Band Number
	Code Line A	Code Line B	Code Line C	Code Line D	Code Line E	
02.0 to 02.4	1	1	1	1	0	1
02.5 to 02.9	1	1	1	0	0	2
03.0 to 03.4	1	1	0	0	0	3
03.5 to 04.0	1	0	0	0	0	4
04.0 to 04.9	0	0	0	0	1	5
05.0 to 05.9	0	0	0	1	0	6
06.0 to 06.9	0	0	1	0	0	7
07.0 to 07.9	0	1	0	0	0	8
08.0 to 09.9	1	0	0	0	1	9
10.0 to 11.9	0	0	0	1	1	10
12.0 to 13.9	0	0	1	1	0	11
14.0 to 15.9	0	1	1	0	1	12
16.0 to 17.9	1	1	0	1	1	13
18.0 to 19.9	1	0	1	1	0	14
20.0 to 21.9	0	1	1	0	0	15
22.0 to 23.9	1	1	0	0	1	16
24.0 to 25.9	1	0	0	1	1	17
26.0 to 27.9	0	0	1	1	1	18
28.0 to 29.9	0	1	1	1	1	19

NOTE

Although this table refers to logic levels on the primary band selection code lines at the input to the high level interface and code image generation circuitry, the information applies to the output lines (code lines A thru E) if it is assumed that "0" represents a ground condition and "1" represents lines connected together by the code image generator circuitry. Note that the lines connected together (the "1" condition) will not have exactly equal voltages on them. This is due to diode and transistor voltage drops in the circuit, and because the relative voltages will vary and will be within a few volts of ground while the RF Power Amplifier is tuning. These voltages will go about +24V when the tuning operation is complete.

3. ENCODER PWB ASSEMBLY A2A6A1 CIRCUIT DESCRIPTIONS

Encoder PWB A2A6A1 contains four major functional circuit groups. These are the 5-wire primary code generation circuitry, frequency change circuitry, band change circuitry, and the high level interface and code image generation circuitry. These circuits are described in detail in the following paragraphs.

3.1 Five-Wire Code Generation Circuitry

Refer to Figures 4 and 6. 10MHz, 1 MHz, and 100kHz frequency selector digit switch data from the Level Shift/Remote Control PWB A2A6A4 is applied to Encoder PWB A2A6A1 at A2A6A1P1-C and 2 (10MHz), -H,-B, -F,-K (1MHz), and -M,-8,-6,-7 (100kHz). These data inputs are inverted (by U8,U9, and U10) and applied to the inputs of read-only memory (ROM) U1. ROM U1 generates a 5-wire primary code output (present at pins 5,6,7,8, and 9 of U1). These codes, codes A, B, C, D, and E, are present at board output pins A2A6-A1P1-V,-17,-U,-16, and -T, respectively, and are used to drive the band switch of the associated power amplifier. These codes correlate with the primary band selection code data given in Table 3. Refer to Table 4 and consider the development of primary code line A. A logic "0" output occurs on line A for all frequency selector digit switch settings between 04.0 and 07.9 MHz, 10.0 and 15.9 MHz, 20.0 and 21.9 MHz, and between 26.0 and 29.9 MHz. At all other switch settings, the output is logic "1". This is generated by ROM U1. That is, a logic "0" output is generated by ROM U1 for any of the frequency selector digit switch ranges (previously stated) that require a Logic 0. The development of primary code lines B, C, D, and E can be traced in a similar manner.

3.2 Other Functions Provided by ROM U1

ROM U1 generates a high at U1-3 should the input frequency be less than 2 MHz, and a low at U1-2 should the input frequency be less than 1.5 MHz.

These outputs, routed through gates U12 (U12-1 and -3; U12-13 and -11), appear at A2A6A1P1-11, and impart frequency underrange information. If the frequency is underrange, the output at A2A6A1P1-11 is high, and keyline operation will be inhibited. If the frequency is inrange, the output at A2A6A1P1-11 is low, and keyline operation will not be affected.

Another property of ROM U1 is that should an invalid BCD input (all "0's") be applied, the ROM will generate an output of "1's". This feature prevents meaningless codes, such as those generated by the frequency selector digit switches between their detented positions, from causing incorrect tuning. The power amplifier band selector will not rotate when this condition exists.

3.3 Frequency Change Circuitry

The frequency change circuitry consists of Latch U2, part of Latch U3 (pins 1, 2, and 13), part of exclusive-OR gate U5 (pins 1 thru 6), and exclusive-OR gate U7.

Refer to Figures 4 and 6. The frequency change circuitry monitors one BCD bit from the 10MHz, 1MHz, 100kHz, and 1kHz frequency selector digit switches. (The 100Hz switch is not monitored.) Note that the bits applied to the input of latch U2 (U2-2,-3,-6,-7) are inverted from those of the frequency selector digit switches (by inverters U8-3,-4; U9-5,-6; U10-1,-2; and U10-9,-8). Because of this condition, and the inverted outputs of Latch U2, each exclusive-OR gate contained in U7, and U5-1-2 will have a "0" on one input and a "1" on the other input. This results in a high output at U7-3,-6,-8, and -11. This condition exists during normal (frequency selected-circuit operating) condition.

When a new frequency is selected, the inputs to one of the gates of U7 will become equal, resulting in a low output from U7. During the transition of U7's output from high (normal) to low the following events occur:

- Monostable multivibrator U11 is triggered (U11-1) and generates a frequency change pulse of 500 millisecond duration (U11-8). (The time constant of components C4 and R10 is of sufficient length to ensure that U11 is triggered.)
- The frequency change pulse is routed, via components R27,Q13, and pin 14 of A2A6A1P1, to Tune PWB A2A6A5, where it initiates the first part of a tune cycle.
- The high-to-low transition is also detected at gate U5 (U5-4), causing its output (U5-6), and therefore latch enables (U2-13-4 U3-13) to go high. This allows the new frequency information, reflecting the new position of the frequency selector digit switches, present at the input of latches U2 and U3-2 to be transferred to the outputs of the latches.

3.4 Band Change Circuitry

The band change circuitry consists of part of latches U3 and U4, part of exclusive-OR gate U5, and exclusive-OR gate U7. Circuit operation is similar to that of the frequency change circuitry described in paragraph 3.3. Refer to Figures 4 and 6. When the 5-wire primary code is changed (reflecting the selection of a new band), the output of gate U6 (U6-3,-6,-8,-11) will go low. (At the same time, a frequency change pulse is generated) C3 couples the negative going pulse from the output U6 to pin 2 of monostable multivibrater U11 causing U11 to generate a frequency change pulse of 360 Msec (U11-8). The time constant of capacitor C5 and the internal impedances of inverter U10-6 and NAND gate U12-4 is sufficient duration to prevent the voltage at U12-4 and U10-6 from becoming a "1" until the generation of a frequency change pulse. This prevents new frequency information from being latched until completion of the frequency change pulse.

3.5 High Level Interface and Code Image Generation Circuitry

The high level interface and code generation circuitry provides the image generation required for operation of the band switch in the associated power amplifier. Image generation requires that all ungrounded lines be connected (or shorted) together in a manner that allows current to flow in either direction. Figure 7, a simplified system tuning diagram, shows the associated power amplifier in the process of tuning from 2.0 to 2.5 MHz, and indicates two-direction current flow.

Note that the Code Image Generator Circuits will not reflect band change information until after the latches of U4 have been reset (that is, there will be no change in the Q outputs at U4-1,-14,-11, and -8) as described in paragraph 3.4.

4 STANDBY/OPERATE PWB ASSEMBLY A2A6A3 CIRCUIT DESCRIPTIONS

Standby/Operate PWB A2A6A3 transmits control signals for the system Power Amplifier, off, standby, operate and RF output mute functions; selects the active keyline and lights the STANDBY and OPERATE lamps (in A2A6S6 pushbutton assembly - see Figure 1). Refer to Figure 11 during the following descriptions.

4.1 AMPL OFF Function

When AMPL OFF is selected on the MODE selector (A2A6S1), pin 22 of Standby/Operate PWB A2A6A3 is grounded, turning off Z5-4. This action leaves relay K1 deactivated and +24Vdc is not switched to the standby command line (at Pin T). When the standby Command Line is open, the system Power Amplifier will remain off.

4.2 Standby/Operate Memory Flip-Flop Z4 Function

Memory flip-flop Z4 clocks between standby and operate states. Z4 is a J-K is type flip-flop with overriding preset and clear functions.

A low signal at clear input Z4-5 will set Z4-9 high, Z5-4 low and in turn, Z5-6 high. These operations leave relay K2 deactivated and the operate command line (pin 14) open The presence of +24 Vdc on the standby command line (pin T) and an open operate command line places the system Power Amplifier in standby mode.

A low signal at preset input Z4-10 will set Z4-9 low. This operation will activate relay K2 and place +24Vdc, reduced to +20Vdc through resistor R8 on the operate command line.

Flip-flop Z4 is clocked by a pulse from the local

STANDBY/OPERATE pushbutton A2A6S6 through gate Z7-3 and (if in local control) to Z4-2. The pulse causes Z4 to change states, unless its clear or preset inputs are activated by a low signal. Changing the state of Z4 causes the system Power Amplifier to change modes; that is, either from standby to operate or operate to standby mode.

When the exciter is switched to remote control mode (LOCAL/REMOTE pushbutton A2A6S4 is depressed), the status of the local STANDBY OPERATE pushbutton (A2A6S6) is ignored (gate Z7-3 is inhibited), and direct signals on the remote standby and operate lines control Z4's clear and preset inputs. A high level on the remote standby line will be inverted by gate Z6-3, disabling remote operate gate Z3-6 and clearning Z4 (and the system) to standby mode. A high level on the remote operate line will be gated through Z3-6 if the remote standby line is low, as a low at the preset input of Z4 will place the system in operate mode.

4.3 Automatic Off Condition

If power to the exciter is lost, the +24Vdc power source will discharge, relay K1 will be deactivated, and the standby command line will open, turning off the system Power Amplifier.

4.4 Automatic Standby Conditions

Standby/Operate Memory Flip-Flop Z4 will be set to standby state (as will the system Power Amplifier be set to standby mode, if previously turned on) when:

- MODE Selector A2A6S1 is placed at AMPL OFF position. This action places the system Power Amplifier in standby mode for the next initial turn-on.
- Control is changed from local to remote (depressing LOCAL/REMOTE pushbutton A2A6S6)
- The voltage on the exciter +5Vdc line drops below 3.6Vdc. This will ensure that the system will be in standby mode when it is turned on, or in standby mode after a power transient that could endanger the memory function of Z4.

The system Power Amplifier is turned off locally when pin 22 of Standby/Operate PWB A2A6A3 is grounded. The operation through Z6-8 and Z5-10 grounds the clear input of Z4, setting it to standby state. Thus, when the system is next turned on, it is in standby mode.

When the system is in remote mode, pin A of Standby/Operate PWB A2A6A3 is grounded, and the system Power Amplifier is turned off. Z6-11 goes high, and since Z6-6 is enabled in remote mode (at pin 4), Z6-6 goes low, Z6-8 goes high, and Z5-4 goes low. The Z5-4 low, reflected at Z4's Clear input, places it in standby state.

Switching LOCAL/REMOTE pushbutton A2A6S6 between LOCAL and REMOTE positions grounds a charged capacitor (C3 or C4, depending on switch position), causing a low-going spike at Z6C. This places a low-going spike at Z4's clear input, placing it in standby state.

When the voltage supplying Z4 goes too low, Z4's flip-flop state will be indeterminate. This condition may place the system in an undesired (operate) mode, particulary when power is to be restored. To prevent this condition, a voltage sensing circuit consisting of components R12, R13, and Q6 turns transistor Q7 on when the supply voltage is approximately 3.6 Vdc. The action through Q7 sets Z4 to Standby state via Z6-8 and Z5-10.

4.5 Output Mute Function

The exciter's RF Output is keyed or unkeyed by the RF output mute line to the final amplifier in the signal path. (The RF output mute line is at pin 5 of A2A6A3P1.) The line is muted (unkeyed) when:

- The system is in standby mode
- The carrier frequency has been set to less than 2.0000 MHz
- The +28V interlock from the system Power Amplifier is absent, indicating that either the system Power Amplifier or Antenna Coupler is not ready to tune or transmit.

When flip-flop Z4 is in standby state, Z4-9 is high setting Z2-2 low and setting RF mute gate Z3-8 high. The high at Z3-8 turns on 6.8V zener diode VR1 and transistor Q2, saturating Q2. The resulting low voltage (approximately -5.5V) at Q2's collector mutes the exciter RF output.

The resulting low voltage (approximately −5.5V) at Q2's collector mutes the exciter RF output.

When the system is in operate mode, has +28V interlock, and it's frequency is not set below 2.0000MHz, all inputs to Z3-8 are high, making its output low. The low state voltage is insufficient to turn On zener diode VR1. Consequently, transistor Q2 will not conduct and the RF output mute line voltage will be pulled a few volts positive by the combined loads of resistor R5 and RF Output Module A2A7. Thus, the exciter's RF output will be keyed on.

When a frequency below 2.0000MHz has been detected by Encoder PWB A2A6A1, the board places a high at pin 10 of Standby/Operate PWB A2A6A3. In A2A6A3, this high is inverted by Z2-4, inhibiting Z3-8 and thereby turning On transistor Q2. Thus, the exciter's RF output is muted, as previously described.

When Tune PWB A2A6A5 detects the presence of system +28V interlock or the system Power Amplifier is keyed, it applies a high at pin H of Standby/Operate PWB A2A6A3. When the +28V Interlock is absent or the system Power Amplifier is unkeyed, a low is applied at pin H. This condition also mutes the exciter's RF output, as previously described.

4.6 STANDBY and OPERATE Lamp Function

The STANDBY and OPERATE lamps of STANDBY/OPERATE pushbutton A2A6S6 display the status of Standby/Operate Memory Flip-Flop Z4, when MODE Selector A2A6S1 is at AMPL OFF position. When Z4 is in standby state; Z4-9 is high, Z2-2 low Z2-12 high, and transistor Q1 is saturated. This condition causes the STANDBY lamp to go on. Similarly, when Z4 is in operate state; Z4-9 is low, Z1-4 high, and transistor Q3 is saturated. This condition causes the OPERATE lamp to go on.

4.7 Remote Standby and Operate Indicate Functions

Gates Z2-10 and Z7-8 provide standby and operate indicate outputs, for use with the optional Remote Control Units. These outputs are routed to the Remote Control Units via A1J7-p and -q. Refer to Figure 2.

4.8 Exciter Ready Function

When the system is in operate mode, Tune PWB A2A6A5 recognizes that the system is ready and that the frequency is not set below 2.0000MHz. The appropriate channels and keylines are activated by the mode select PWB A2A6A2 in response to a ground condition (Exciter Ready Line) from Standby/Operate PWB A2A6A3.

There are three conditions required for the generation of the exciter ready ground. These are:

- Standby/Operate Memory Flip-Flop Z4 must be in operate state
- Tune PWB A2A6A5's memory of the most recent grounding of the keyline has caused the +28V interlock, which, in turn, has caused a high on the ready interconnect line of Standby/Operate PWB A2A6A3
- The frequency is not underrange

4.9 Keyline Selection Circuit Function

The keyline Selection Circuit causes the CW/RATT keyline from the system Power Amplifier (A1J4-c, Figure 2) to control the system Keyline (A1J4-J) when the system is in either CW or RATT Mode. The circuit also causes the +12V Press-To-Talk Key Input (+12V PTT KEY IN, A1J4-k, Figure 2) from the system Power Amplifier or the exciter front panel microphone (from panel connector A2J19), when switched into a channel, to control the system Keyline when MODE Selector A2A6S1 is at AME, USB, 2 ISB, or 4 ISB positions (that is, the system is in a sideband mode).

When the system is in CW or RATT mode, Mode Select PWB A2A6A2 causes a ground to be applied to pin 18 of Standby/Operate PWB A2A6A3. The ground at pin 18 causes Z1-10 to go high. This condition allows the CW hold input at pin X to control the input of Z2-6. When the CW/RATT Keyline is grounded, the CW hold input goes high, causing Z2-6 and the auxiliary keyline (at A2A6A3P1-20) to go low. This condition, in turn, causes Tune PWB A2A6A5 to key the system. The CW/RATT mode ground at pin 18 (A2A6A3) also disables gate Z2-8 through diode CR5, causing Z2-8 to go high (no effect will be reflected on the auxiliary keyline at pin 20).

When the system is in sideband mode, the CW/RATT mode ground is high, causing Z1-10 to go low and disabling the CW hold input (pin X) control. The high CW/RATT mode ground enables gate Z2-8, allowing the auxiliary keyline to be activated by a ground from either the +12V PTT key input from the front panel microphone connector A2J19 (when microphone is switched into a channel) or the PTT relay A2A6A3K3.

5 TUNE PWB ASSEMBLY A2A6A5 CIRCUIT DESCRIPTIONS

Tune PWB A2A6A5 monitors frequency changes, TUNE pushbutton (TUNE portion of TUNE/READY pushbutton A2A6S5) closures, local/remote control changes, and other situations that require the retuning of the system transmitter. Refer to Figure 13 during the following descriptions.

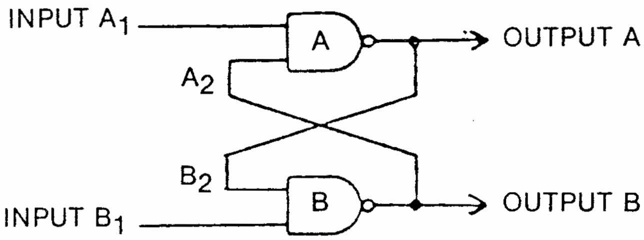
5.1 System Tune Cycle

The tune cycle is initiated by the operator, who gives the tune command by either keying the system when the Antenna Coupler is at home position (systems without an antenna coupler bypass the tune cycle), or by depressing TUNE/READY pushbutton A2A6S5. When the Antenna Coupler is at home position, keying the system will send the Antenna Coupler through the active and end portion of the tune cycle. When the TUNE/READY pushbutton is depressed, the TGC Attenuator will be at maximum attenuation, the Antenna Coupler will be sent to home position, and the system will be keyed. These conditions cause the system to go through a complete and active tune cycle.

The active portion of the tune cycle starts with the Antenna Coupler sending a +20V carrier insert signal, and the system Power Amplifier sending a +28V Interlock signal, to Tune PWB A2A6A5. These conditions cause unmuting of RF Output Module A2A7, lighting of the TUNE lamp in TUNE/READY pushbutton A2A6S5, and the grounding of the exciter tune line to Mode Select PWB A2A6A2 (at A2A6A2P1-20). Grounding the exciter tune line causes the appropriate carrier level, for the system to tune with, to be gated to the exciter. At the end of the tune cycle, the sytem will be evaluated to determine if it is ready to transmit.

If the system is ready, the READY lamp of TUNE/READY pushbutton A2A6S5 will go on.

Tune PWB has two latches that act as memories, that is, retaining a previously set state. Referring to Figure 13, these latches are identified as a tune latch consisting of Z5-6 and Z2-11, and a ready latch, consisting of Z1-11 and Z4-8. Z5-6, Z2-11, Z1-11, and Z4-8 are NAND gates.



When two NAND gate outputs are connected together, as shown above, a latch or memory circuit is formed.

A low at INPUT A will cause Gate A's output to be high. (A low on either A_1 or A_2 will also cause OUTPUT A to be high.) This high is routed to input B_2. If INPUT B_1 is not being held low, Gate B will recognize all high inputs and OUTPUT B will be low. The low OUTPUT B will hold input A_2 low. If the low at INPUT A_1 disappears, nothing happens (that is, no change in state occurs), as input A_2 is still being held low. When a low at INPUT B_1 occurs, the latch will be changed in some manner. If both INPUT A_1 AND INPUT B_1 are held low, both OUTPUT A and OUTPUT B will be high. The input that goes high last will set the latch.

5.2 Ready Latch Function

The ready latch circuit (Figure 13) causes the READY lamp of TUNE/READY pushbutton A2A6S5 to go on, and exciter ready information to be sent to Mode Select PWB A2A6A2, thus enabling the appropriate channels and setting the correct carrier level (when the latch is set to ready state and the system is not tuning, as evidenced by the absence of the +20V carrier insert signal).

The ready latch is a memory used to retain intermittently available information about the system's ability to transmit. The system Power Amplifier (and Antenna Coupler, when attached) indicate the capability to transmit by returning a +28V interlock signal. Since the system is not necessarily keyed all the time, the memory is needed to retain information about the +28V interlock status when the system was last keyed.

Refer to Figure 13. When the output of the ready latch is set to ready state, Z1-11 is high, and if the delayed carrier insert line from Q2 is also high, Z1-8 will be low. This condition sets Z6-11 high, turns on Q7 and the READY lamp, and places a high on the ready interconnection line (pin 11 of A2A6A5P1) to Standby/Operate Board A2A6A3.

As previously mentioned, the ready latch consists of Z1-11 and Z-48. The latch is set to Ready state by the simultaneous occurances of the +28V interlock, system in keyed condition, and no +20V carrier insert signal. These conditions are signaled by a low from Z5-8. Gate Z5-8 monitors system keying through Z7-6; the +20V carrier insert through Q3, and the +28V Interlock through Z7-10 and Q1. A grounded Power Amplifier keyline (indicating system is keyed) at pin 18 of Tune PWB A2A6A5 causes Z7-6 to be high. The lack of +20V carrier insert causes Q3 to remain off, resulting in a high input to Z5-11. All the inputs into Z5 (-11, -12, -13) cause its output to be low. This sets the ready latch to ready state. If any input into Z5 (-11, -12, -13) is low, its output will be high and, consequently, have no effect on the ready latch.

The ready latch is reset to the not ready state by a low being applied to any input of Z4 (-9 to -13). Specifically, these low(s) occur when:

- The +20V carrier insert is present (system is tuning)
- System is switched between local and remote control
- MODE Selector A2A6S1 is set to AMPL OFF position
- TUNE portion of TUNE/READY pushbutton A2A6S5 is depressed
- The voltage on the exciter +5V line drops below 3.6 Volts
- System frequency changes
- The occurance (for more than 0.3 second) of Standby/Operate Memory Flip-Flop Z4 (on Standby/Operate PWB A2A6A3) being set to operate state; with the system keyed and no +28V Interlock

Presence of the +20V carrier insert causes Q3 to conduct, placing a low at the input of Z4-10. Switching between local and remote control or placing the MODE selector to AMPL OFF position causes Standby/Operate PWB A2A6A3 to place a low on the fault interconnection line to Tune PWB A2A6A5 (at A2A6A5P1-B), causing a low at the input of Z4-13. A TUNE pushbutton closure (depressing TUNE/READY pushbutton A2A6S5) is reflected at (that is, gated through) Z1-3 (local) or Z2-3 (remote) gates as a high pulse to gate Z2-4. (Local or remote control modes have already been established by the condition of LOCAL/REMOTE pushbutton A2A6S6.) Gate Z2-6 will gate through the high pulse only if Standby/Operate Memory Flip-Flop Z4 has been set to operate state. (The condition of Z4 will be verified by a high on the operate interconnection line from Standby/Operate PWB A2A6A5.) The output of Z2-6 will be a low pulse that will set the tune latch and be applied to gate Z4-4 and monostable multivibrator Z6-8. Z6-8 has a feedback circuit consisting of capacitor C11 and the time constant resistance of R29 and the input dc resistance of gate Z4-6 (low state). The negative-going output pulse from Z6-8 into Z4-9 resets the ready latch to not ready state. A frequency change pulse (applied at A2A6A5P1-1) or a remote frequency change pulse (applied at A2A6A1P1-5, when gated through) also places a negative pulse at the input of Z4-1.

Transistor Q5 monitors condition of the system being keyed, Standby/Operate Memory Flip-Flop Z4 in operate state, and no +28V interlock. A time delay circuit, consisting of components C3 and R13, is used to compensate for delays that occur between the time the system is keyed and the time that the system Power Amplifier returns the +28V interlock (if the system is ready to transmit). The time delay circuit can be disabled by a ground through diodes CR6, CR7, or CR8 through R12. This action cuts Off Q5 and Q6, as the voltage at the base of Q5 is less than that of the three silicon junction voltage drops. This condition leaves Q6 turned Off and its collector pulled high by R16. Therefore, the ready latch is not affected. If the system is not keyed, the output of inverter Z7-6 is low, and the circuit is disabled through CR6. If Standby/Operate Memory Flip-Flop Z4 is in Standby state, the circuit is disabled through CR8. If the +28V interlock is present, the circuit is disabled through CR7 by Q1. The circuit is enabled when the system is keyed, Z4 is in Operate state, and no +28V interlock is present. When these conditions occur, Q5 is turned On after 0.3 second (the time constant of C3 and R13) and Q6 is saturated (its collector is low), resetting the latch to not ready state.

5.3 Tune Latch Function

The Tune Latch circuit (Figure 13) causes the system to be keyed when:

- The TUNE portion of TUNE/READY pushbutton A2A6S5 is depressed, and to remain keyed until the system is in ready mode
- The system frequency is changed
- MODE Selector A2A6S1 is set to AMPL OFF position
- The system is switched between local and remote control

When the TUNE pushbutton is depressed (on the local or Remote Control units), the output of gate Z2-6 has a negative-going pulse which places the tune latch in key state. The output of Z5-6 is low, causing Z7-2 output to be high and thereby saturating Q8. This action grounds the Power Amplifier keyline (system keyline A2-A6A5P1-18). The tune latch is reset when:

- The ready latch is set to ready state as indicated by a low output from Z4-8 being applied to Z5-3, thereby resetting the tune latch
- The system frequency is changed, as indicated by a ground pulse (local frequency change pulse) being applied through A2A6A5P1-1 to gate Z4A (pulse originates at Encoder PWB A2A6A1)
- The system frequency is changed as indicated by a ground pulse (remote frequency change pulse) being applied through A2A6A5P1-15 gated through Z3-3 and Z3-6, and being applied to Z5-5
- Control is changed between local and remote, or whenever MODE selector A2A5S1 is set to AMPL OFF position. This is indicated by a ground (or a ground pulse a low) being applied at A2A6A5P1-B (this pulse originates in Standby/Operate PWB A2A6A3, and is routed to A2A6A5P1-B via the fault interconnection line)
- The voltage on the exciter +5V line drops below 3.6 Vdc.

5.4 Delayed Carrier Insert Function

The delayed carrier insert circuit extends the system tune cycle approximately 1 second, to determine if the system is ready to transmit. By extending the tune cycle 1 second, the system is maintained in keyed mode by the Mode Select Board A2A6A2. However, the ready latch is allowed to monitor the +28V interlock. If the +28V interlock is present, the READY lamp (in TUNE/READY pushbutton A2A6S5) goes On and the exciter ready signal is sent to Mode Select PWB A2A6A2.

Capacitor C2 and resistor R4 form a time constant network that charges quickly through diodes CR2 and VR1, but discharges slowly. Transistor Q2 is kept saturated during the discharge. This causes a low to be held momentarily on Q2's col ector, which, in turn holds Z8-3 high. This high turns on Q4 and the TUNE lamp If the +28V interlock is present, Q1 is saturated, setting Z7-10 high Since Z8-3 is temporarily held high, Z8-8 is held low, sending an exciter tune signal to Mode Select PWB A2A6A2 (via A2A6A5P1-9). Mode Select PWB A2A6A2 then maintains the system in tune and keyed modes.

The ready latch is connected to the faster response of carrier insert circuit transistor Q3. Consequently, the ready latch is monitoring for an acceptable ready situation, if it exists, when the

+20V carrier insert disappears. If the system is ready, the ready latch is set to ready state. If the system is not ready, the READY lamp (in TUNE/READY pushbutton A2A6S5) remains off and the Mode Select PWB A2A6A2 does not maintain the system in keyed mode.

5.5 +28V Interlock Function

When the exciter is in operate mode, the presence of the +28V interlock causes:

- RF Output Module A2A7 to be unmuted
- The TGC attenuation to be adjusted by a low on the TGC enable line (A2A6A5P1-10)
- Mode Select Board A2A6A2 to place the exciter in transmit mode
- The setting of the ready latch, if the system is not tuning (no +20V Carrier Insert)

The presence of +28V interlock (at A2A6A5P1-F) saturates Q1, causing its collector to be low and the output of Z7-10 to be high. This high on the mute interconnection line corresponds to an unmuted condition. This condition also causes Z5-8 output to be low (if the system is keyed and not tuning), setting the ready latch to ready state.

5.6 TGC Attenuator Reset Function

The TGC attenuator is reset to maximum attenuation by a ground pulse, and is allowed to change this setting only when the +28V interlock is present and the system is keyed. The TGC attenu ator is reset when the +20V carrier insert is present and applied through a differentiation circuit consisting of capacitor C4 and the resistances of R20 and Z6-1's dc input impedance (low state), generating a ground pulse. The ground pulse is inverted by Z6-3, re-inverted to normal by at Z3-11, and applied to the TGC reset line (A2A6A5P1-13) as a ground pulse. Diode CR10 prevents Z6-1's input from being damaged by positive pulses greater than the supply voltage. The TGC Attenuator is also reset when monostable multivibrator Z4-6 and Z6-8 produce a ground pulse. This pulse is routed through Z6-3 and Z3-11 to the TGC reset line (A2A6A5P1-13).

5.7 Ground Pulse Function

Monostable multivibrator Z4-6 and Z6-8 will produce a negative pulse at its output when:

- The system frequency is changed
- The TUNE portion of TUNE/READY pushbutton A2A6S5 is depressed (TUNE pushbutton closure)
- The system is switched between local and remote control
- MODE Selector A2A6S1 is set to AMPL OFF position

The negative pulse is inverted by Z8-11 and re-inverted to a ground pulse at the collector of Q9. The ground pulse output (at A2A6A5P1-Z) is routed to the system Antenna Coupler, sending it to home position. An LC network, consisting of C12 and L1, keeps transient voltages from the system Antenna Coupler from damaging the collector of Q9.

5.8 Auxiliary Key Function

Refer to Figure 13. A low at the auxiliary key input (A2A6A5P1-3; low originates at Standby Operate PWB A2A6A3) keys the system through diode CR13, making the output of Z7A high, turning on Q8, and keying the system through a point common with the Power Amplifier keyline input A2A6A5P1-18.

5.9 CW/FSK Ground Function

The CW/RATT ground is used to change the of operation of the power output tubes of the system Power Amplifier. An amplifier, consisting of Z3-8 and Q12, is used to increase the current-carrying capability when the CW/RATT ground line (A2A6A5P1-21) is grounded. The CW/RATT Ground input from Mode Select PWB A2A6A2, applied at A2A6A5P1-14, makes Z3-8 output high. This saturates Q12, placing a ground on the CW/RATT ground line to the system Power Amplifier.

5.10 CW Hold Function

The CW Hold circuit delays releasing the system keyline when the system is in CW or RATT Modes.

This is done so that the system will remain keyed between CW Key closures.

The CW key, when operating, intermittantly grounds A2A6A5P1-W, discharging C7 to ground through CR11 and R21. Resistors R22 and R23 determine the amount of time required to charge C7 to a high enough voltage to turn on Q10 and Q11. If the time between CW key closures is less than this time, Q10 and Q11 will remain at cutoff, Q11's collector will be pulled high by R26, and the Mode Select PWB A2A6A2 will keep the system in Keyed Mode. (CW hold output is at A2A6A5P1-X)

6. MODE SELECT PWB ASSEMBLY A2A6A2 CIRCUIT DESCRIPTIONS

Mode Select PWB A2A6A2 decodes and switches local and remote control inputs, keys the system Power Amplifier, enables the sideband channels, sets the sideband channel attenuation, and sets the carrier level. Refer to Figure 9 during the following descriptions.

6.1 Level Shifting Function

The logic levels used in the Control Head are standard DTL/TTL levels; 0.8V or less is recognized as a low level and 2.0V or more is recognized as a high level. However, Combiner Module A2A12 is controlled by signals whose high is recognized as +2.0V or more, and whose low is recognized as −4V or less. Mode Select PWB A2A6A2 employs high-threshold logic to translate from standard DTL/TTL levels to those required by the module.

Refer to Figure 9. High-threshold integrated circuits Z10, Z15, and Z16 recognize 6.5V or less above the common terminal as a low, and 8.5V or more above the common terminal as a high. By connecting the common terminal to −6V instead of ground, the low level input becomes +0.5V or less, because +6.5V above −6V equals +0.5V. For the same reason, the high level input is ±2.5V or more, because 8.5V above −6V equals +2.5V. These voltages/limits are sufficiently close to the DTL/TTL levels to allow the circuits to operate properly. The high-threshold logic output is −5V for a low level, and +5V (through a 1.5K pull-up resistor) for a high level. These levels are compatible with the requirements of Combiner Module A2A12.

6.2 Mode Control Function

The mode control input consists of three local and three remote lines. From Figure 9, these lines are shown as local A mode, local B mode, and local C mode lines A2A6A2P1-B, C, and D, respectively), and remote A mode, remote B mode, and remote C mode lines (A2A6A2P1-H, K, and J, respectively).

The three local mode control lines are selected through gates Z1-3, -6, and -11 the three remote mode control lines through gates Z5-3, -6, and -11. The selection process is accomplished through the local/remote switching input at A2A6A2P1-L and inverter Z5-8.

TABLE 5. BINARY CODING OF LOCAL/REMOTE CONTROL LINES A, B AND C.

Mode	Mode Control Line		
	A	B	C
OFF	1	1	1
RATT	1	0	0
AME	0	1	0
CW	0	0	0
USB	1	1	0
LSB	0	0	1
2ISB	1	0	1
4ISB	0	1	1

The outputs of each corresponding local and remote mode gate (for example, local A mode gate Z1-11 and remote mode gate Z5-11) are "wired-AND", that is, connected together. Consequently, if either gate produces a "0", the output will go low. For example, if the switching input at A2A6A2P1-L is local, one input of the three remote gates is grounded by Z5-8, forcing the remote gate outputs to go high. However, these outputs can be pulled down by the local gates, in response to the inputs on the local mode lines. These outputs, shown as A, B, C in Figure 9, are the invert of the mode code. They are subsequently re-inverted to provide normal mode levels A, B and C by inverters Z1-8, Z2-11 and Z2-8, respectively. The inverted and non-inverted mode control levels are routed to logic circuitry that converts them to the desired output signals.

Level shifters provide output levels compatible with the requirements of Combiner Module A2A12.

6.3 Carrier Level Control Function

The carrier level control input consists of two local and two remote lines, coded as shown in Table 6. From Figure 9, these lines are shown as local D carrier and local E carrier lines (A2A6A2P-E and A, respecitvely), and remote D carrier and remote E carrier lines (A2A6A2P1-F and M, respectively).

The two local carrier level control lines are selected through gates Z2-3 and -6; the two remote carrier level control lines through gates Z6-3 and -6. The selection process is accomplished through the Local/Remote switching input at A2A6A2P1-L and inverter Z5-8.

The input carrier level codes are allowed to control the carrier if the exciter is in ready mode and a switchable carrier mode is selected. The output carrier level is determined by the mode logic for non-switchable carrier modes (specifically, RATT, AME and CW modes). The output carrier Level Signals are level-shifted for Combiner Module A2A12 control. The significant levels in the carrier logic are shown in Table 6.

TABLE 6. CODING OF LOCAL/REMOTE CARRIER LEVEL CONTROL LINES D AND E.

System Carrier Level	Carrier Level Control Line Binary Coding	
	D	E
'œ dB	1	1
−20dB	0	1
−10dB	0	0

6.4 System Keying Function

Mode Select PWB A2A6A2 keys the system and system Power Amplifier through relay K1 (and Keyline connection A2A6A2P1-1) when the exciter is in tune cycle, or is ready and keyed by one of the four appropriate keys as shown in Table 7. Keying relay K1 is driven by a lamp-driver type of integrated circuit that has a 30V output rating (sufficient to withstand the +24Vdc applied to the relay).

TABLE 7. KEYING THAT CONTROLS THE SYSTEM POWER AMPLIFIER BIAS KEY

System Control Mode	CW and RATT Operation Modes Controlled By	AME, USB, LSB, 2 ISB, and 4ISB (RF-131-126 Only) Controlled By
Local	Local CW/RATT Key	Local PTT Switch Keylines
Remote	Remote CW/RATT Key	Remote Sideband Keyline

6.5 Lamp Driver Function

The lamp driver circuit consists of either 30V DTL logic or a grounded-emitter transistor Q1, whose collector is connected to the lamps. When the logic driving Q1 is high, the current through R1 and Q1's base-emitter turns on Q1, driving it into saturation. This condition grounds one side of the lamps, turning them on. When the logic input to Q1 is low, it grounds the base of Q1 through the collector of a saturated transistor inside, turning Q1 Off and extinguishing the lamps.

7 MAINTENANCE PARTS LIST

Table 8 is a list of maintenance parts for the A2A6 Control Head Module. Manufacturers therein are referenced by a five-number code. The correlation of these codes to the appropriate manufacturers, and the manufacturer's names and addresses is contained in Part 6 of the General Information.

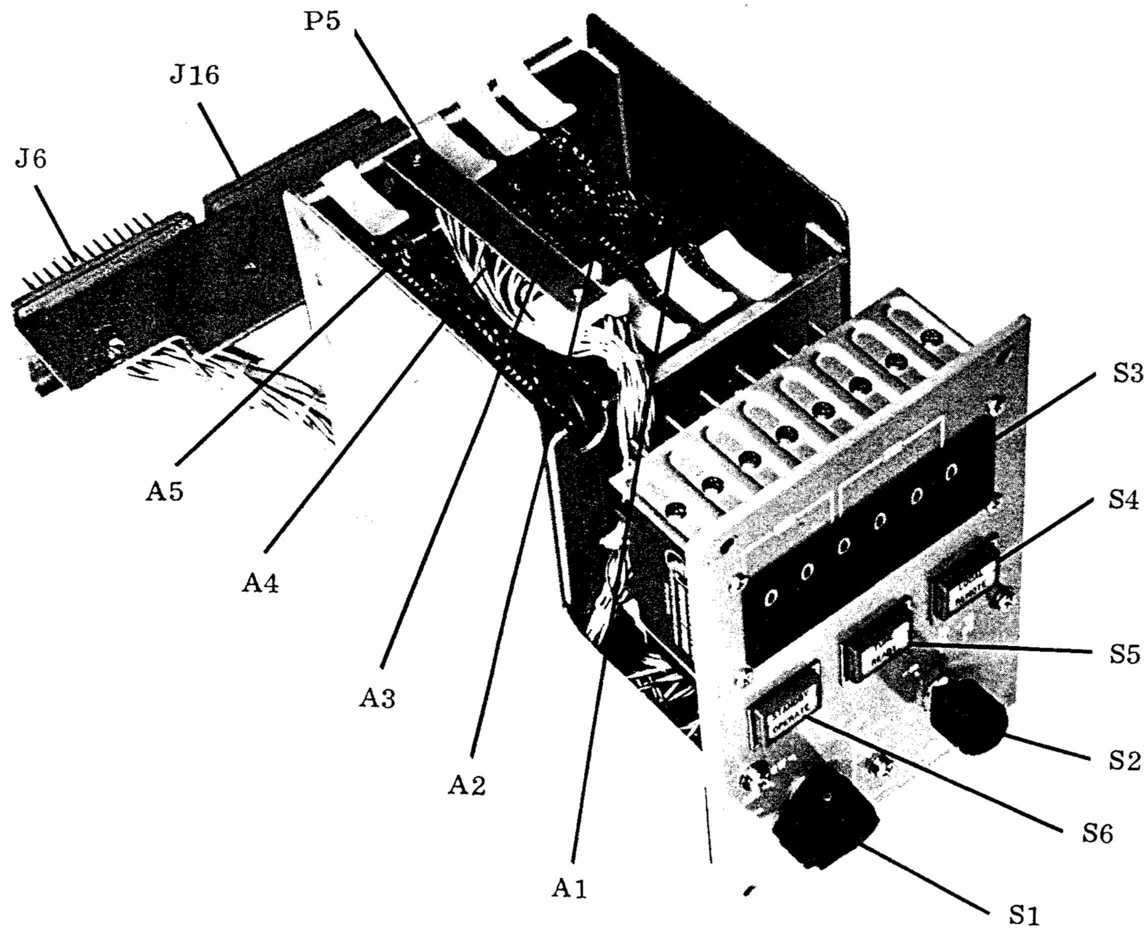


Figure 1. Control Head Component Locations

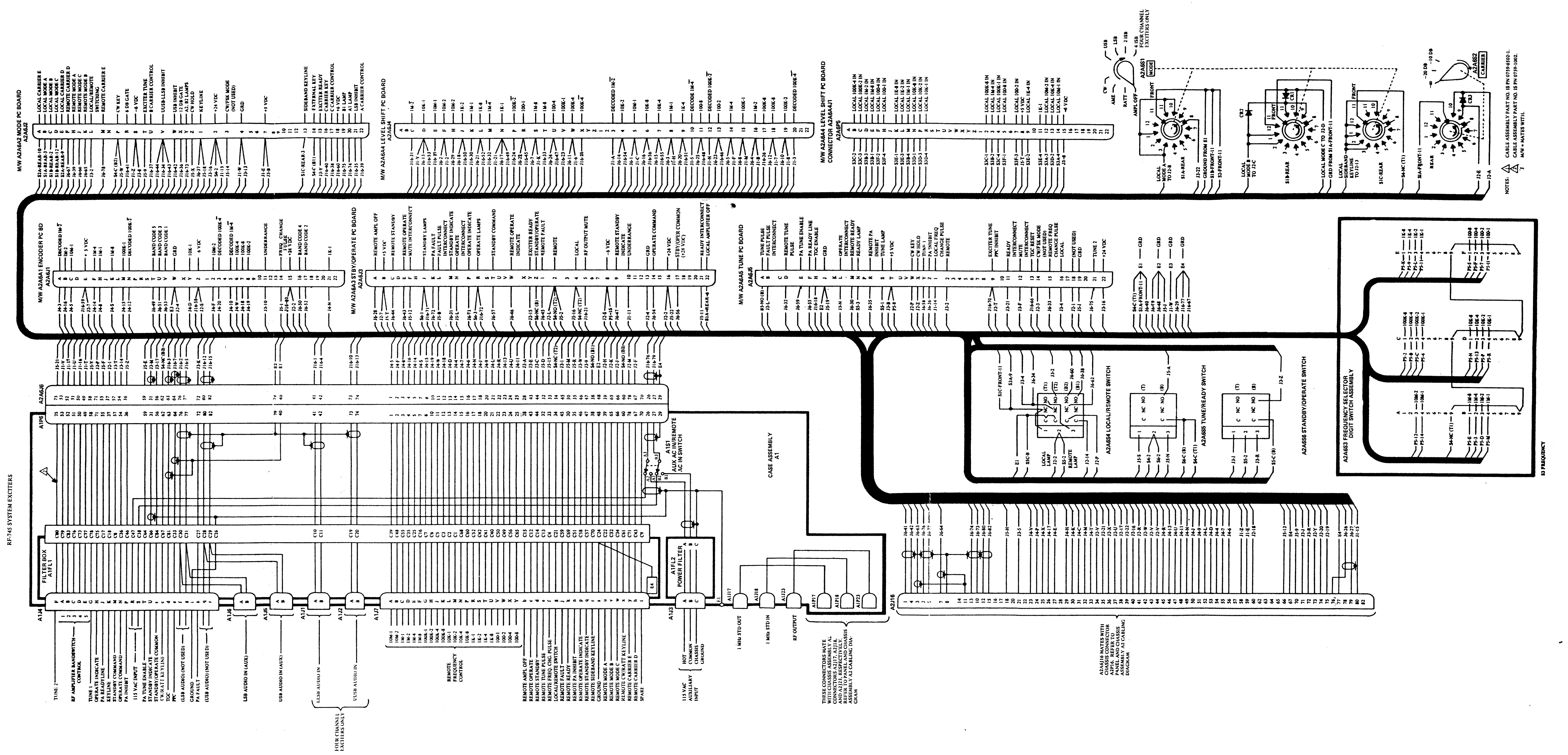


Figure 2. Control Head Wiring Diagram

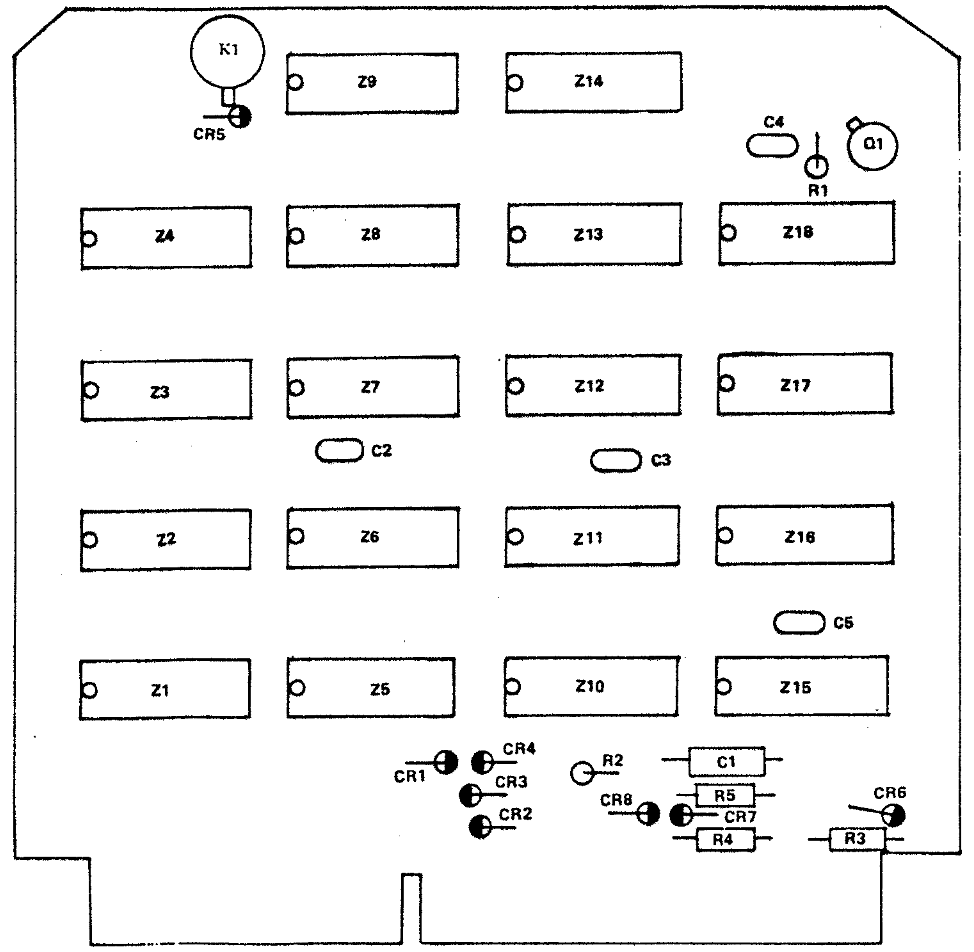
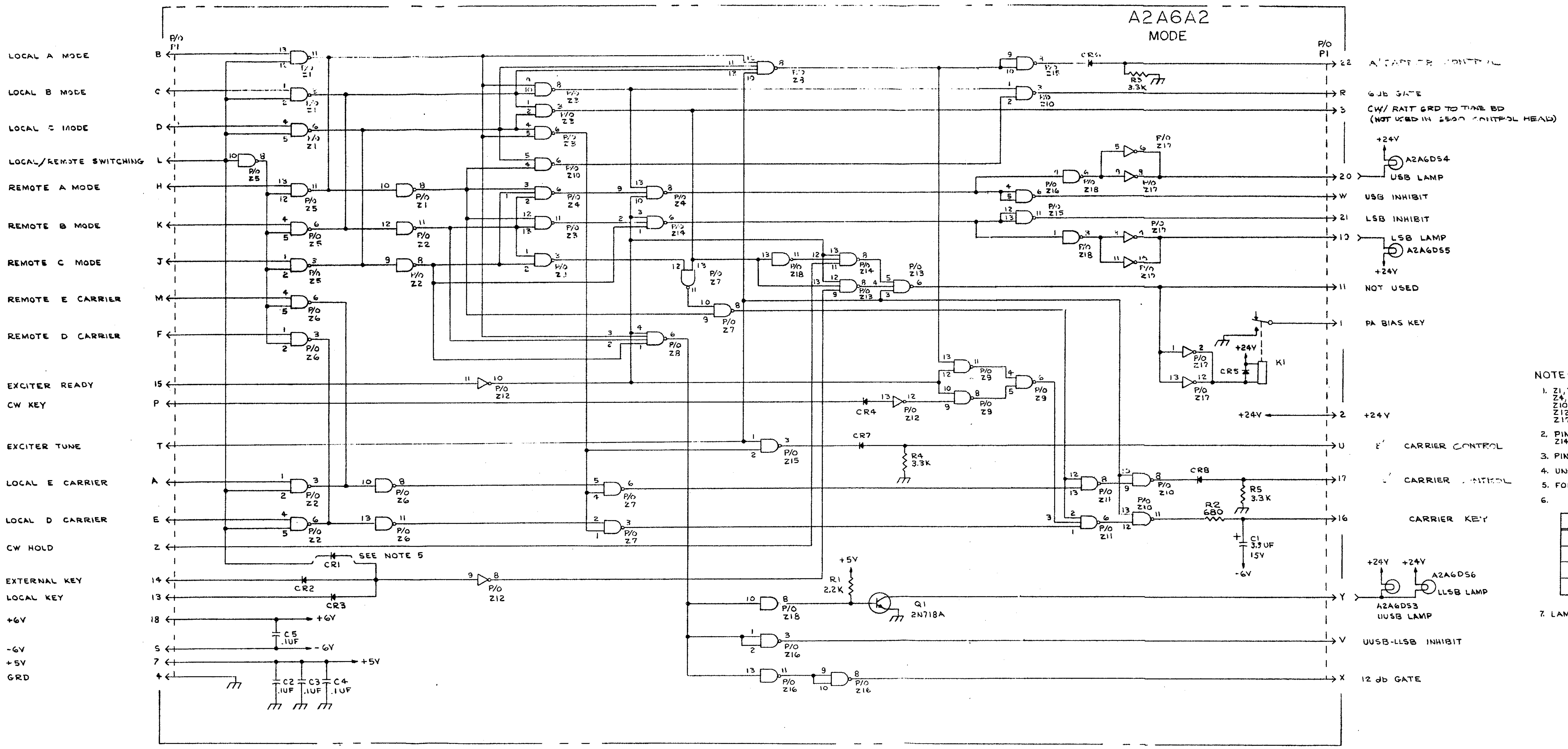


Figure 8. Mode Select PWB Component Location Drawing



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NOTES:

1. Z1, Z2, Z3, Z5, Z6, Z7, Z9 AND Z18 ARE MC846P
   Z4, Z8, Z11, Z13 AND Z14 ARE MC1800P
   Z10, Z15 AND Z16 ARE MC672P
   Z12 IS MC840P
   Z17 IS SN7406N
2. PIN 7 IS GRD AND PIN 14 IS +5V ON Z1 THRU Z9, Z11, Z12, Z13 Z14, Z17 AND Z18.
3. PIN 7 IS -6V AND PIN 14 IS +6V ON Z10, Z15 AND Z16
4. UNLESS OTHERWISE SPECIFIED ALL DIODES ARE IN3064., ALL RES. ARE 1/4W, 10%
5. FOR CONSTANT REMOTE KEYING INSERT CR1, IN3064. (OPTION)
6. MODE TABLE

MODE	A	B	C
OFF	1	1	1
RATT	1	0	0
AME	0	1	0
CW	0	0	0
USB	1	1	0
LSB	0	0	1
2 ISB	1	0	1
4 ISB	0	1	1

CARRIER LEVEL TABLE

CARRIER	D	E
-∞ db	1	1
-20 db	0	1
-10 db	0	0

7. LAMPS ARE SHOWN FOR REF ONLY.

Figure 9. Mode Select PWB A2A6A2 Schematic Diagram

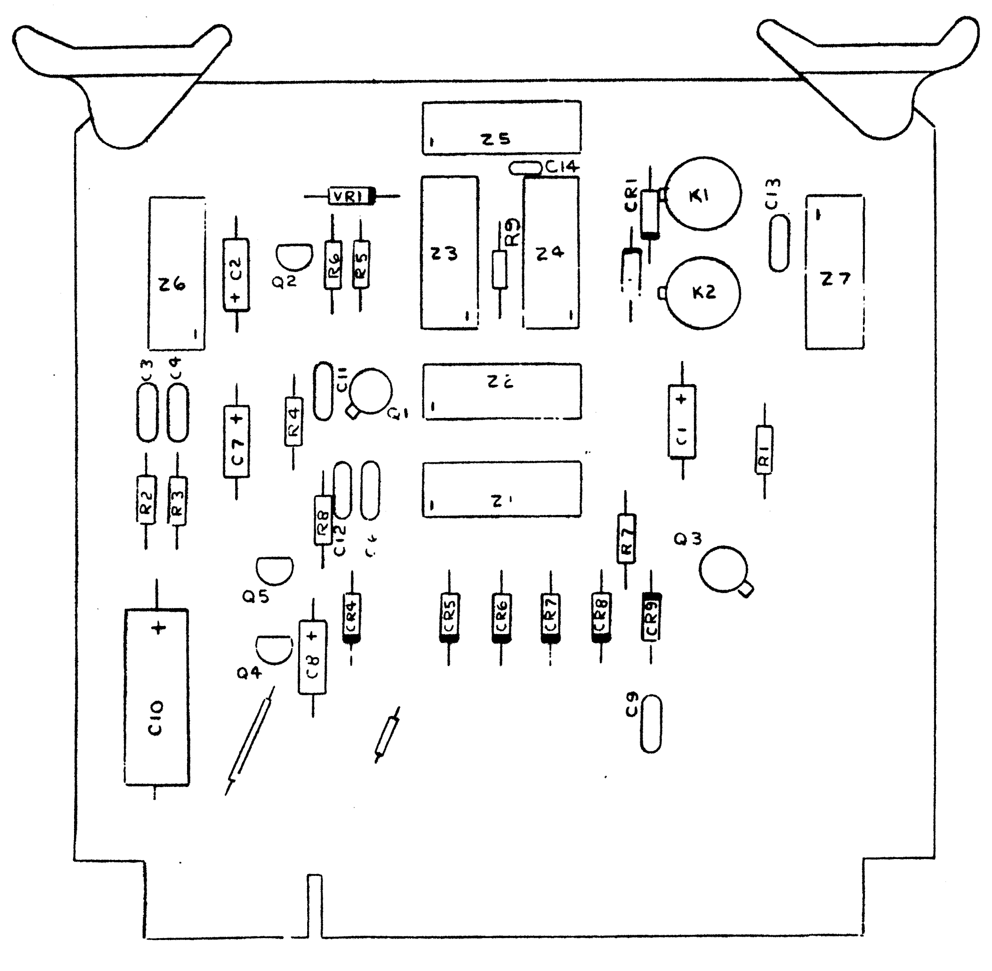

Figure 10. Standby/Operate PWB Component Location Drawing

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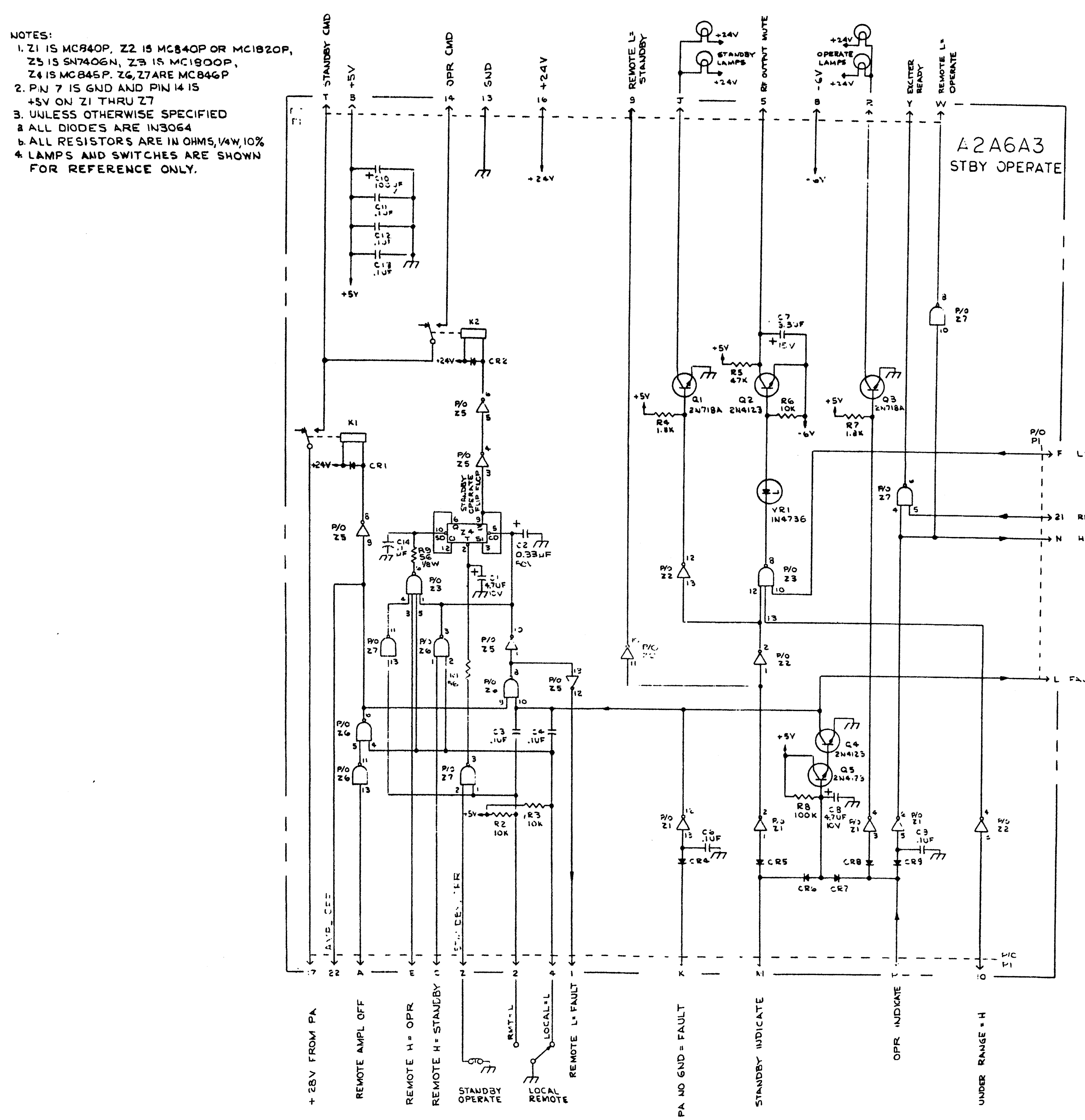


Figure 11. Standby/Operate PWB A2A6A3 Schematic Diagram

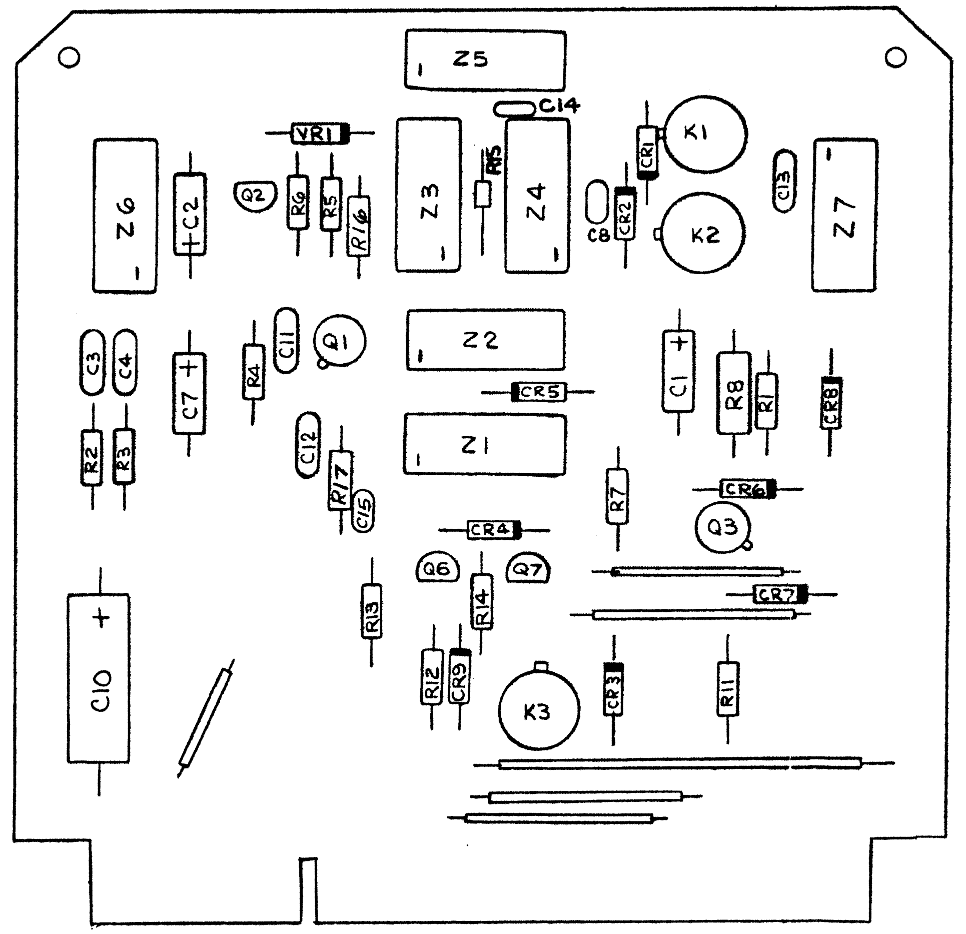


Figure 10. Standby/Operate PWB Component Location Drawing

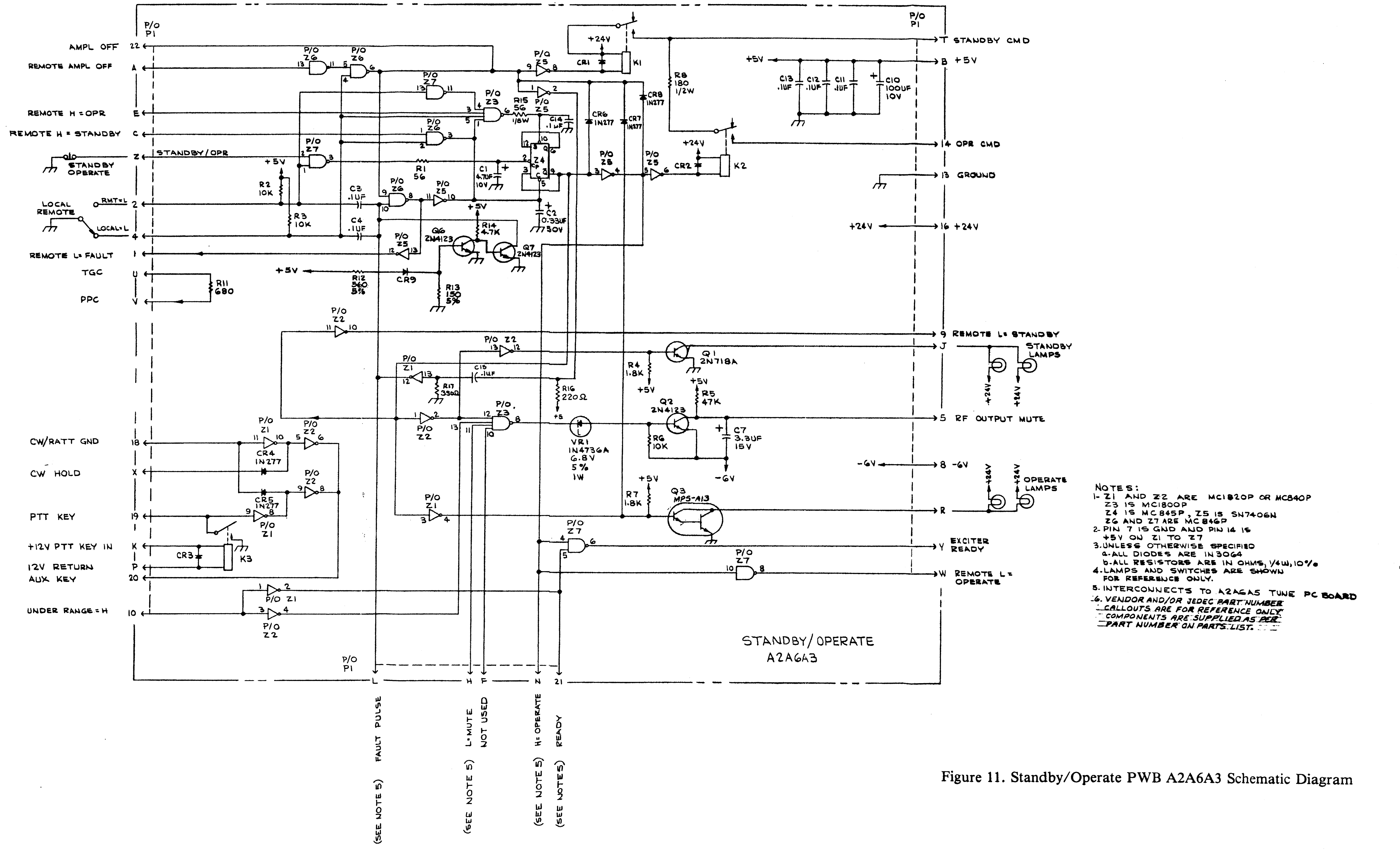


Figure 11. Standby/Operate PWB A2A6A3 Schematic Diagram

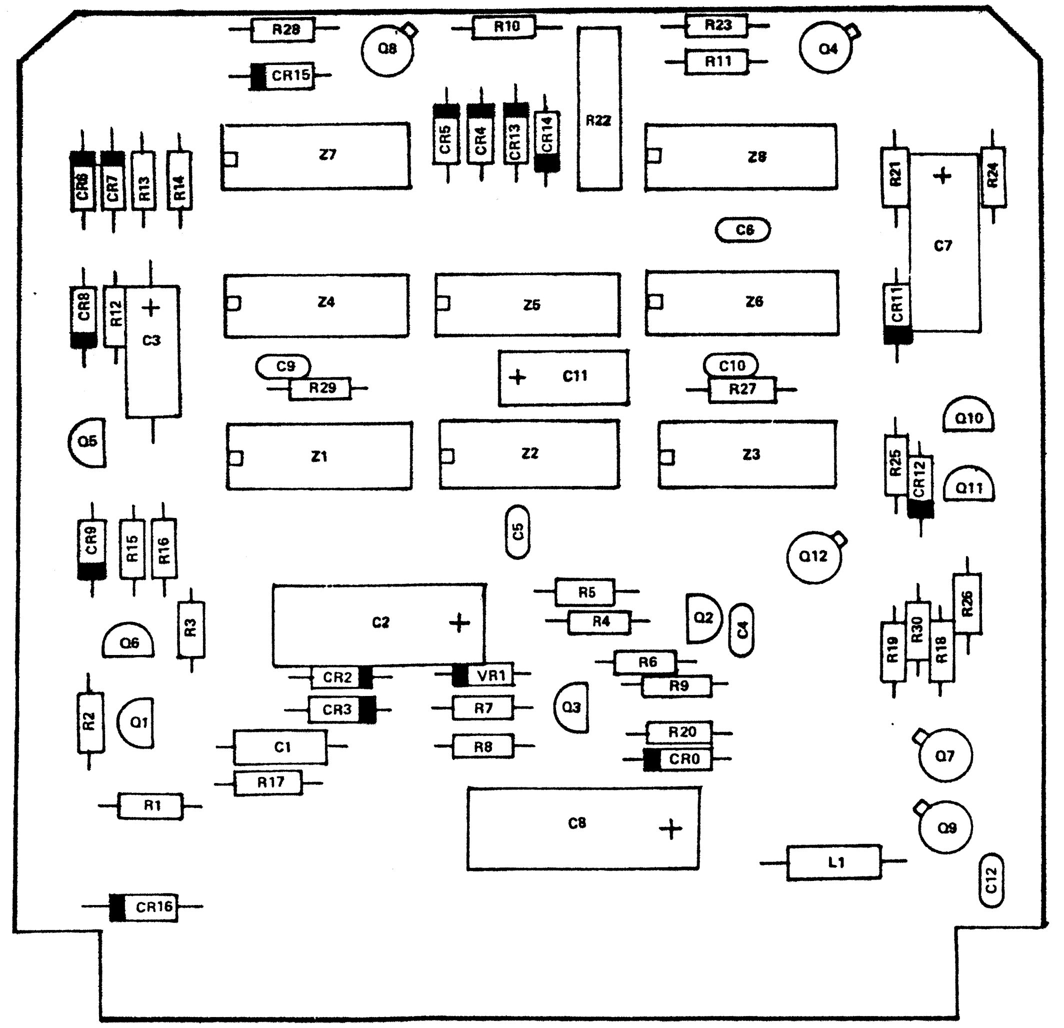


Figure 12. Tune PWB Component Location Drawing

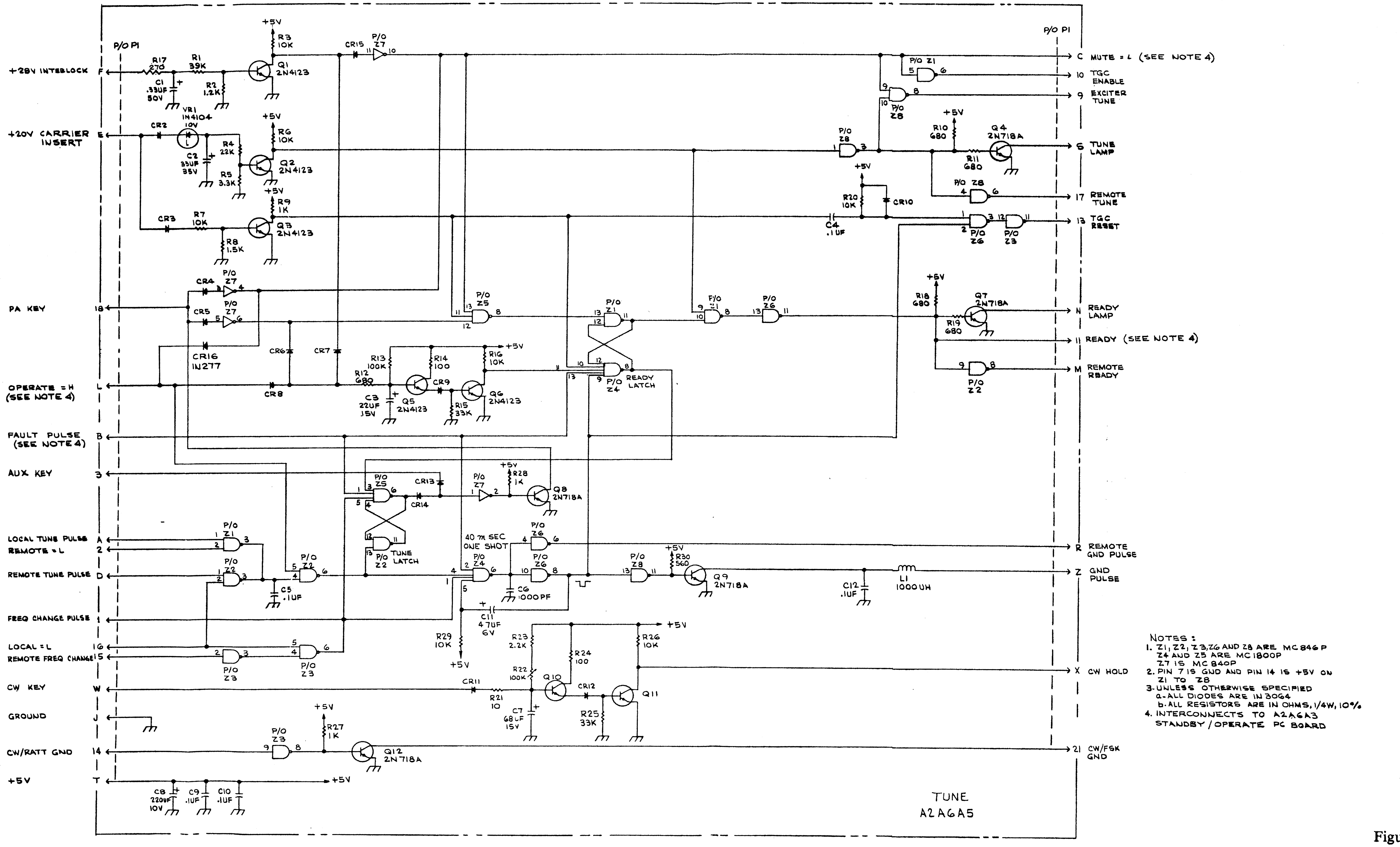


Figure 13. Tune PWB A2A6A5 Schematic Diagram

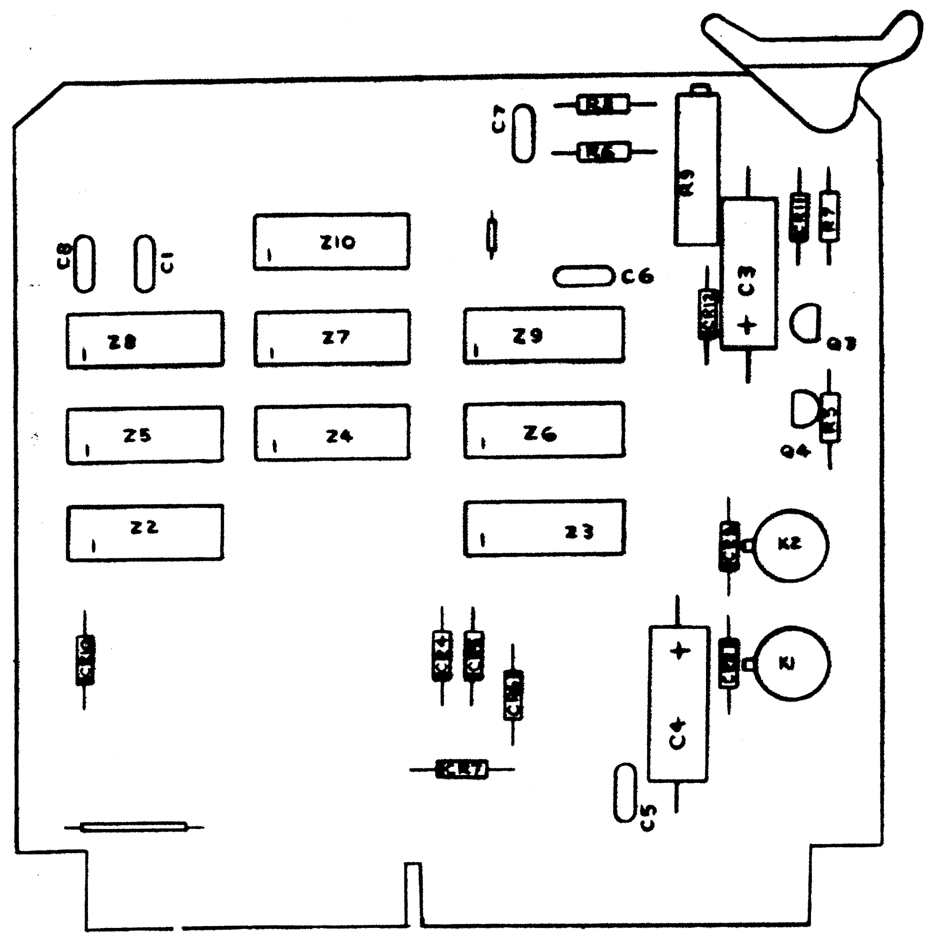
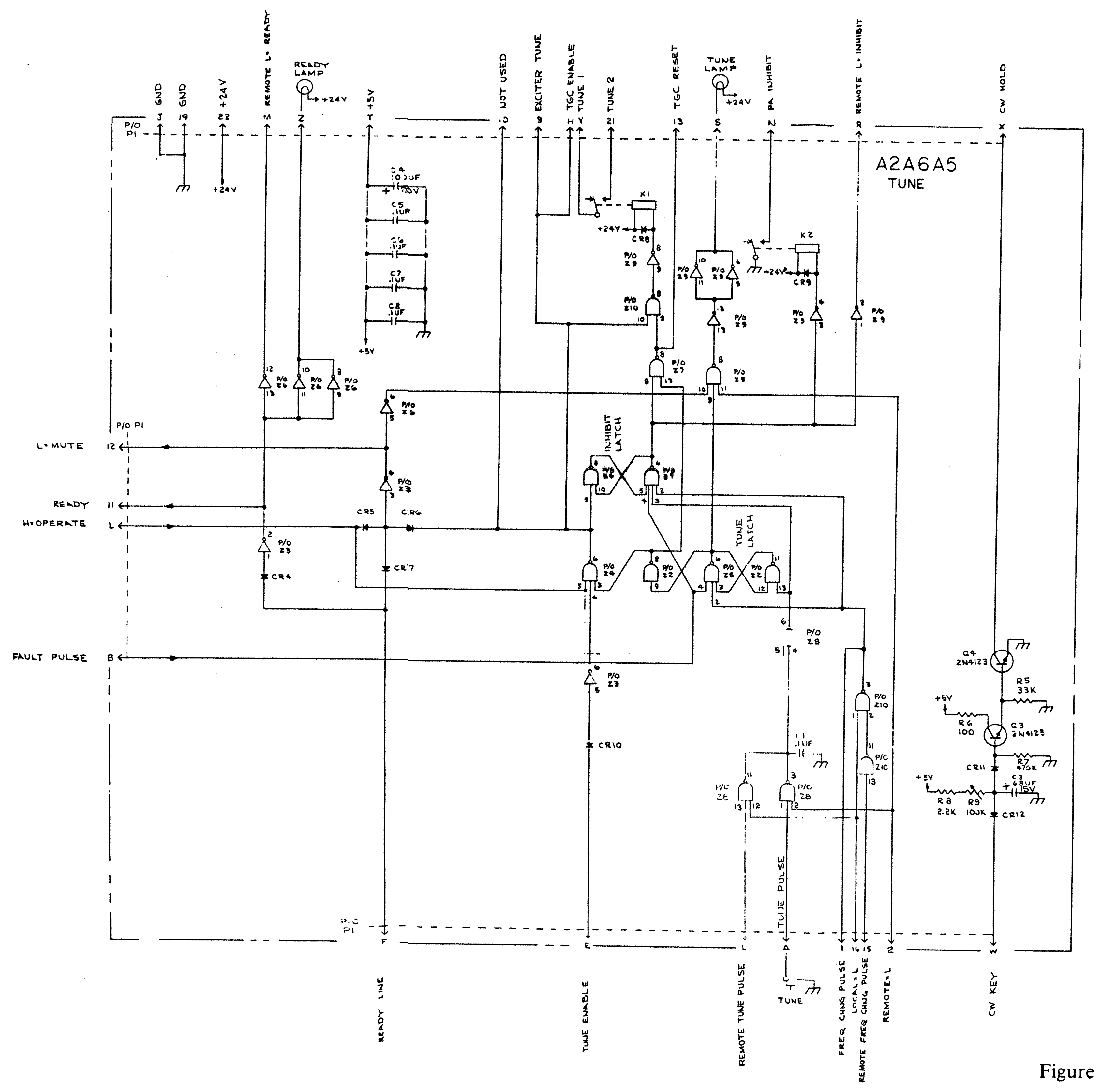


Figure 12. Tune PWB Component Location Drawing



NOTES:
1. Z2, Z8 AND Z10 ARE MC846P
   Z3 IS MC840P
   Z4, Z5 AND Z7 ARE MC1800P
   Z6 AND Z9 ARE MC1820P
2. PIN 7 IS GND AND PIN 14 IS +5V ON Z2 THRU Z10
3. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, 1/4W, 10%
   b. ALL DIODES ARE IN3064.
4. LAMPS AND SWITCHES ARE SHOWN FOR REFERENCE ONLY.

Figure 13. Tune PWB A2A6A5 Schematic Diagram

Binary Input Data A9 A4 A3 A2 A1 A0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=1;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=1;A5=1 D7–D0
000000	△1	11111110	△1	11111110	△1	11111110	△1	11111110	△1	11111110	△1	11111110	△1	11111110	△1	11111110
000001		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
000010		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
000011		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
000100		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
000101		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
000110		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
000111		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
001000		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
001001		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
001010		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
001011		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
001100		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
001101		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
001110		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
001111		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010000		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010001		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010010		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010011		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010100		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010101		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010110		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010111		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
011000		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
011001		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
011010		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
011011		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
011100		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
011101		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
011110		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
011111	△1	11111110	△1	11111110	△1	11111110	△1	11111110	△1	11111110	△1	11111110	△1	11111110	△1	11111110

Binary Input Data A9 A4 A3 A2 A1 A0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=1;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=1;A5=1 D7–D0
000000	△1	11111110	△1	11111110	△1	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110
000001		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
000010		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
000011		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
000100		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
000101		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
000110		11111110		11111110		11111110	29.9	01111001	27.9	00111001	25.9	10011001	23.9	11001001	21.9	01100001
000111		11111110		11111110		11111110	29.8	01111001	27.8	00111001	25.8	10011001	23.8	11001001	21.8	01100001
001000		11111110		11111110		11111110	29.7	01111001	27.7	00111001	25.7	10011001	23.7	11001001	21.7	01100001
001001		11111110		11111110		11111110	29.6	01111001	27.6	00111001	25.6	10011001	23.6	11001001	21.6	01100001
001010		11111110		11111110		11111110	29.5	01111001	27.5	00111001	25.5	10011001	23.5	11001001	21.5	01100001
001011		11111110		11111110		11111110	29.4	01111001	27.4	00111001	25.4	10011001	23.4	11001001	21.4	01100001
001100		11111110		11111110		11111110	29.3	01111001	27.3	00111001	25.3	10011001	23.3	11001001	21.3	01100001
001101		11111110		11111110		11111110	29.2	01111001	27.2	00111001	25.2	10011001	23.2	11001001	21.2	01100001
001110		11111110		11111110		11111110	29.1	01111001	27.1	00111001	25.1	10011001	23.1	11001001	21.1	01100001
001111		11111110		11111110		11111110	29.0	01111001	27.0	00111001	25.0	10011001	23.0	11001001	21.0	01100001
010000		11111110		11111110		11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110
010001		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010010		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010011		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010100		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010101		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
010110		11111110		11111110		11111110	28.9	01111001	26.9	00111001	24.9	10011001	22.9	11001001	20.9	01100001
010111		11111110		11111110		11111110	28.8	01111001	26.8	00111001	24.8	10011001	22.8	11001001	20.8	01100001
011000		11111110		11111110		11111110	28.7	01111001	26.7	00111001	24.7	10011001	22.7	11001001	20.7	01100001
011001		11111110		11111110		11111110	28.6	01111001	26.6	00111001	24.6	10011001	22.6	11001001	20.6	01100001
011010		11111110		11111110		11111110	28.5	01111001	26.5	00111001	24.5	10011001	22.5	11001001	20.5	01100001
011011		11111110		11111110		11111110	28.4	01111001	26.4	00111001	24.4	10011001	22.4	11001001	20.4	01100001
011100		11111110		11111110		11111110	28.3	01111001	26.3	00111001	24.3	10011001	22.3	11001001	20.3	01100001
011101		11111110		11111110		11111110	28.2	01111001	26.2	00111001	24.2	10011001	22.2	11001001	20.2	01100001
011110		11111110		11111110		11111110	28.1	01111001	26.1	00111001	24.1	10011001	22.1	11001001	20.1	01100001
011111	△1	11111110	△1	11111110	△1	11111110	28.0	01111001	26.0	00111001	24.0	10011001	22.0	11001001	20.0	01100001

Binary Input Data A9 A4 A3 A2 A1 A0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=1;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=1;A5=1 D7–D0
100000	△3	11111110	△3	11111110	△3	11111110	△3	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110
100001		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
100010		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
100011		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
100100		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
100101		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
100110		11111110		11111110		11111110	19.9	10110001	17.9	11011001	15.9	01101101	13.9	00110101	11.9	00011101
100111		11111110		11111110		11111110	19.8	10110001	17.8	11011001	15.8	01101101	13.8	00110101	11.8	00011101
101000		11111110		11111110		11111110	19.7	10110001	17.7	11011001	15.7	01101101	13.7	00110101	11.7	00011101
101001		11111110		11111110		11111110	19.6	10110001	17.6	11011001	15.6	01101101	13.6	00110101	11.6	00011101
101010		11111110		11111110		11111110	19.5	10110001	17.5	11011001	15.5	01101101	13.5	00110101	11.5	00011101
101011		11111110		11111110		11111110	19.4	10110001	17.4	11011001	15.4	01101101	13.4	00110101	11.4	00011101
101100		11111110		11111110		11111110	19.3	10110001	17.3	11011001	15.3	01101101	13.3	00110101	11.3	00011101
101101		11111110		11111110		11111110	19.2	10110001	17.2	11011001	15.2	01101101	13.2	00110101	11.2	00011101
101110		11111110		11111110		11111110	19.1	10110001	17.1	11011001	15.1	01101101	13.1	00110101	11.1	00011101
101111		11111110		11111110		11111110	19.0	10110001	17.0	11011001	15.0	01101101	13.0	00110101	11.0	00011101
110000		11111110		11111110		11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110
110001		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
110010		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
110011		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
110100		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
110101		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
110110		11111110		11111110		11111110	18.9	10110001	16.9	11011001	14.9	01101101	12.9	00110101	10.9	00011101
110111		11111110		11111110		11111110	18.8	10110001	16.8	11011001	14.8	01101101	12.8	00110101	10.8	00011101
111000		11111110		11111110		11111110	18.7	10110001	16.7	11011001	14.7	01101101	12.7	00110101	10.7	00011101
111001		11111110		11111110		11111110	18.6	10110001	16.6	11011001	14.6	01101101	12.6	00110101	10.6	00011101
111010		11111110		11111110		11111110	18.5	10110001	16.5	11011001	14.5	01101101	12.5	00110101	10.5	00011101
111011		11111110		11111110		11111110	18.4	10110001	16.4	11011001	14.4	01101101	12.4	00110101	10.4	00011101
111100		11111110		11111110		11111110	18.3	10110001	16.3	11011001	14.3	01101101	12.3	00110101	10.3	00011101
111101		11111110		11111110		11111110	18.2	10110001	16.2	11011001	14.2	01101101	12.2	00110101	10.2	00011101
111110		11111110		11111110		11111110	18.1	10110001	16.1	11011001	14.1	01101101	12.1	00110101	10.1	00011101
111111	△3	11111110	△3	11111110	△3	11111110	18.0	10110001	16.0	11011001	14.0	01101101	12.0	00110101	10.0	00011101

Binary Input Data A9 A4 A3 A2 A1 A0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=1;A5=1 D7–D0
100000	△3	11111110	△3	11111110	△3	11111110	△3	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110
100001		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
100010		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
100011		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
100100		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
100101		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
100110		11111110		11111110		11111110	9.9	10001101	7.9	01000101	5.9	00010101	3.9	10000101	1.9	11111111
100111		11111110		11111110		11111110	9.8	10001101	7.8	01000101	5.8	00010101	3.8	10000101	1.8	11111111
101000		11111110		11111110		11111110	9.7	10001101	7.7	01000101	5.7	00010101	3.7	10000101	1.7	11111111
101001		11111110		11111110		11111110	9.6	10001101	7.6	01000101	5.6	00010101	3.6	10000101	1.6	11111111
101010		11111110		11111110		11111110	9.5	10001101	7.5	01000101	5.5	00010101	3.5	10000101	1.5	11111111
101011		11111110		11111110		11111110	9.4	10001101	7.4	01000101	5.4	00010101	3.4	11000101	1.4	11111110
101100		11111110		11111110		11111110	9.3	10001101	7.3	01000101	5.3	00010101	3.3	11000101	1.3	11111110
101101		11111110		11111110		11111110	9.2	10001101	7.2	01000101	5.2	00010101	3.2	11000101	1.2	11111110
101110		11111110		11111110		11111110	9.1	10001101	7.1	01000101	5.1	00010101	3.1	11000101	1.1	11111110
101111		11111110		11111110		11111110	9.0	10001101	7.0	01000101	5.0	00010101	3.0	11000101	1.0	11111110
110000		11111110		11111110		11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110
110001		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
110010		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
110011		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
110100		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
110101		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
110110		11111110		11111110		11111110	8.9	10001101	6.9	00100101	4.9	00001101	2.9	11100101	0.9	11111110
110111		11111110		11111110		11111110	8.8	10001101	6.8	00100101	4.8	00001101	2.8	11100101	0.8	11111110
111000		11111110		11111110		11111110	8.7	10001101	6.7	00100101	4.7	00001101	2.7	11100101	0.7	11111110
111001		11111110		11111110		11111110	8.6	10001101	6.6	00100101	4.6	00001101	2.6	11100101	0.6	11111110
111010		11111110		11111110		11111110	8.5	10001101	6.5	00100101	4.5	00001101	2.5	11100101	0.5	11111110
111011		11111110		11111110		11111110	8.4	10001101	6.4	00100101	4.4	00001101	2.4	11110101	0.4	11111110
111100		11111110		11111110		11111110	8.3	10001101	6.3	00100101	4.3	00001101	2.3	11110101	0.3	11111110
111101		11111110		11111110		11111110	8.2	10001101	6.2	00100101	4.2	00001101	2.2	11110101	0.2	11111110
111110		11111110		11111110		11111110	8.1	10001101	6.1	00100101	4.1	00001101	2.1	11110101	0.1	11111110
111111	△3	11111110	△3	11111110	△3	11111110	8.0	10001101	6.0	00100101	4.0	00001101	2.0	11110101	0.0	11111110

NOTES

△1 BINARY INPUT DATA FROM 0000000000 THRU 0101100101 ARE NOT WITHIN THE OPERATING RANGE OF THE EQUIPMENT. THE OUTPUT CODE FOR ALL BINARY NUMBERS WITHIN THIS RANGE IS 11111110.

△2 THIS GROUP OF BINARY DATA IS NOT WITHIN THE OPERATING RANGE OF THE EQUIPMENT, AND IS REPRESENTATIVE OF BETWEEN-FREQUENCY POSITIONING OF THE FREQUENCY SELECTOR DIGIT SWITCHES.

△3 THIS DATA IS NOT WITHIN THE OPERATING RANGE OF THE EQUIPMENT. IT MERELY DEFINES THE OUTPUT CODE FOR ALL POSSIBLE BINARY NUMBERS OF MEMORY LOCATION.

TABLE 4. ROM PROGRAM BINARY FREQUENCY TABLE

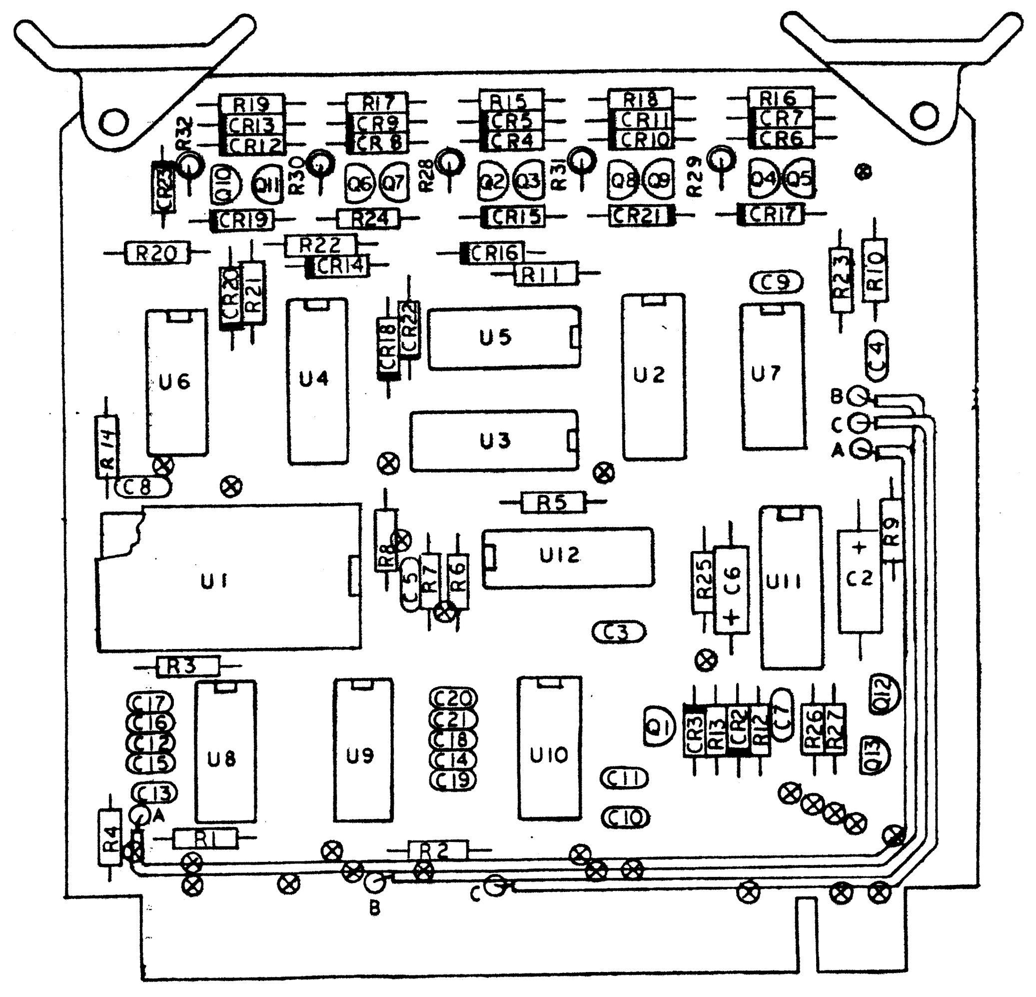


Figure 3. Encoder PWB Component Location Drawing

NOTES:

1. UNLESS OTHERWISE SPECIFIED
   A. ALL RESISTORS ARE IN OHMS, 1/4W, ±10%.
   B. ALL CAPACITORS ARE IN MICROFARADS.
   C. ALL TRANSISTORS ARE MPS-A05.
   D. ALL DIODES ARE 1N4148.
2. U2,3,4 PIN 5 (+), PIN 12 (GRD).
   U5,6,7 PIN 14 (+), PIN 7 (GRD).
   U8,9,10 IS A SN74LS04N, PIN 14 (+), PIN 7 (GRD).
   U12 IS A SN74LS00N, PIN 14 (+), PIN 7 (GRD).

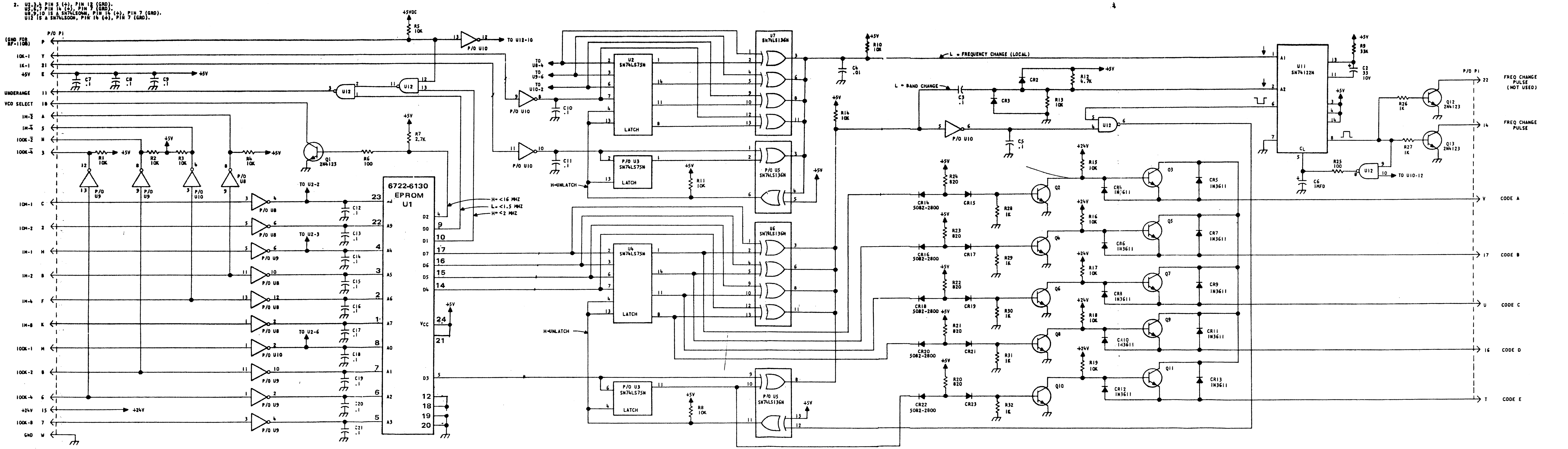


Figure 4. Encoder PWB A2A6A1 Schematic Diagram

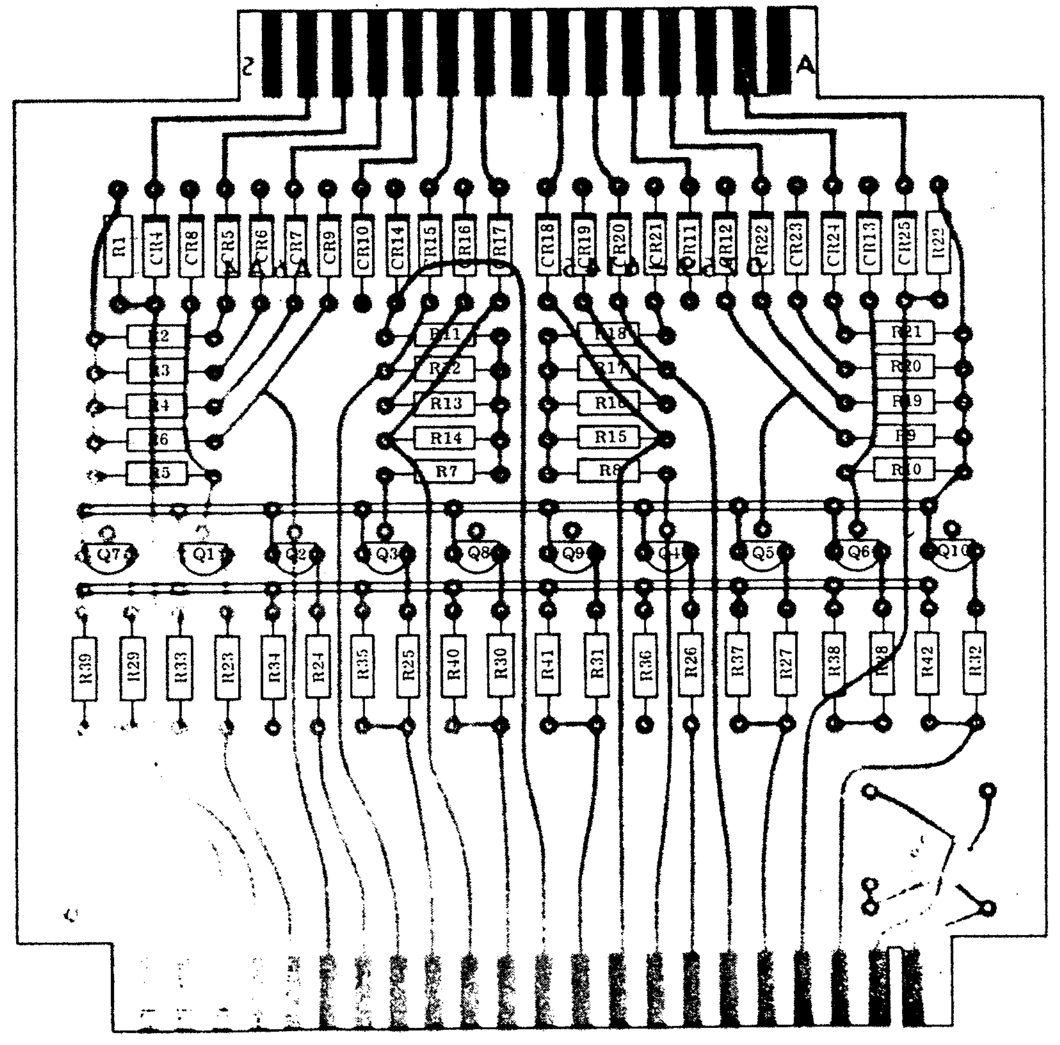


Figure 5. Level Shift/Remote Control PWB Component Location Drawing

NOTES:
1. PARTIAL REF DESIGNATIONS ARE SHOWN. PREFIX WITH A2A6A4
2. UNLESS OTHERWISE SPECIFIED:
   a. ALL DIODES ARE 1N277
   b. ALL RESISTORS ARE IN OHMS, ±10%, 1/4W
   c. ALL TRANSISTORS ARE 2N4123

0759-6147

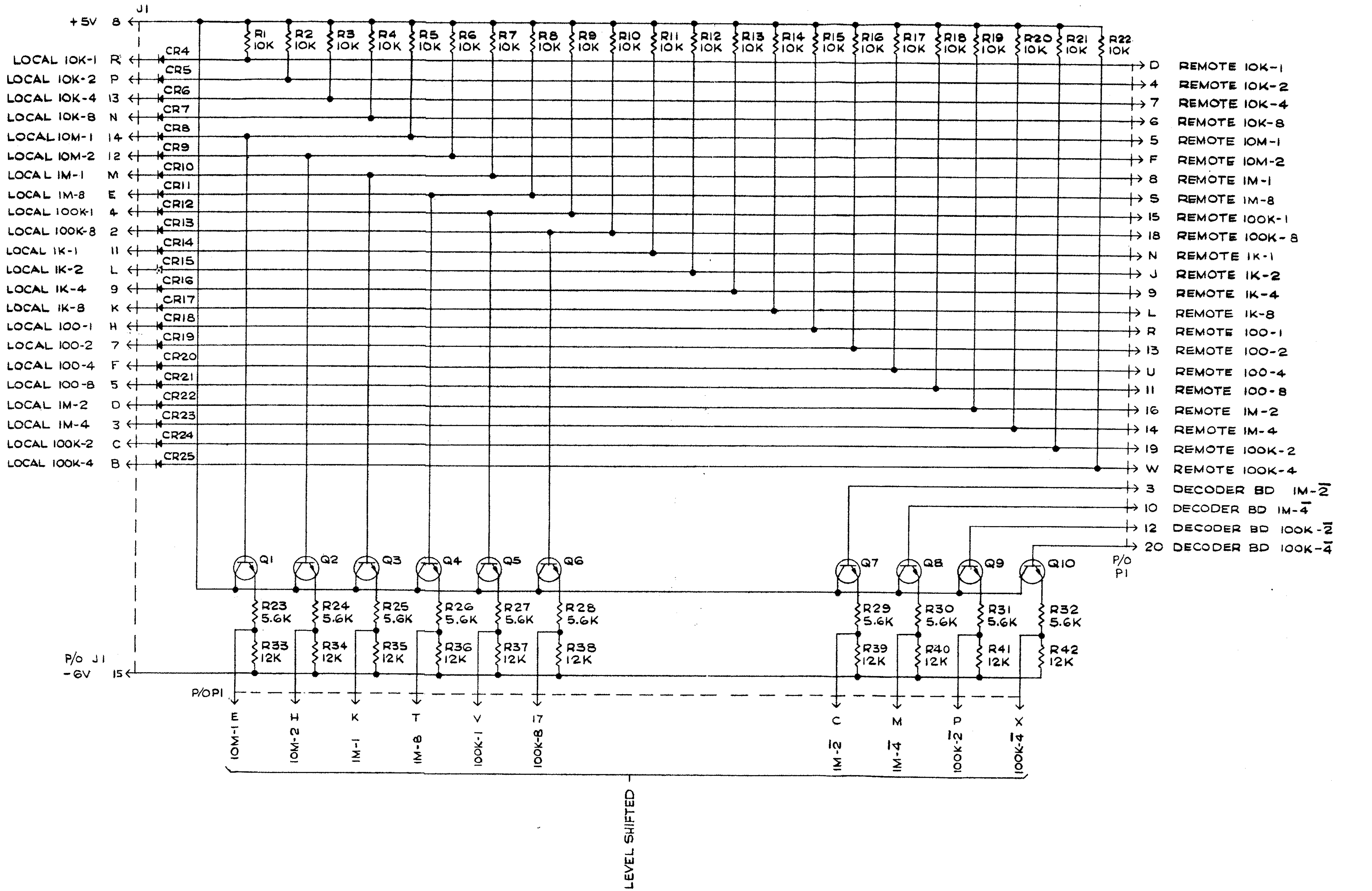


Figure 6. Level Shift/Remote Control PWB A2A6A4 Schematic Diagram

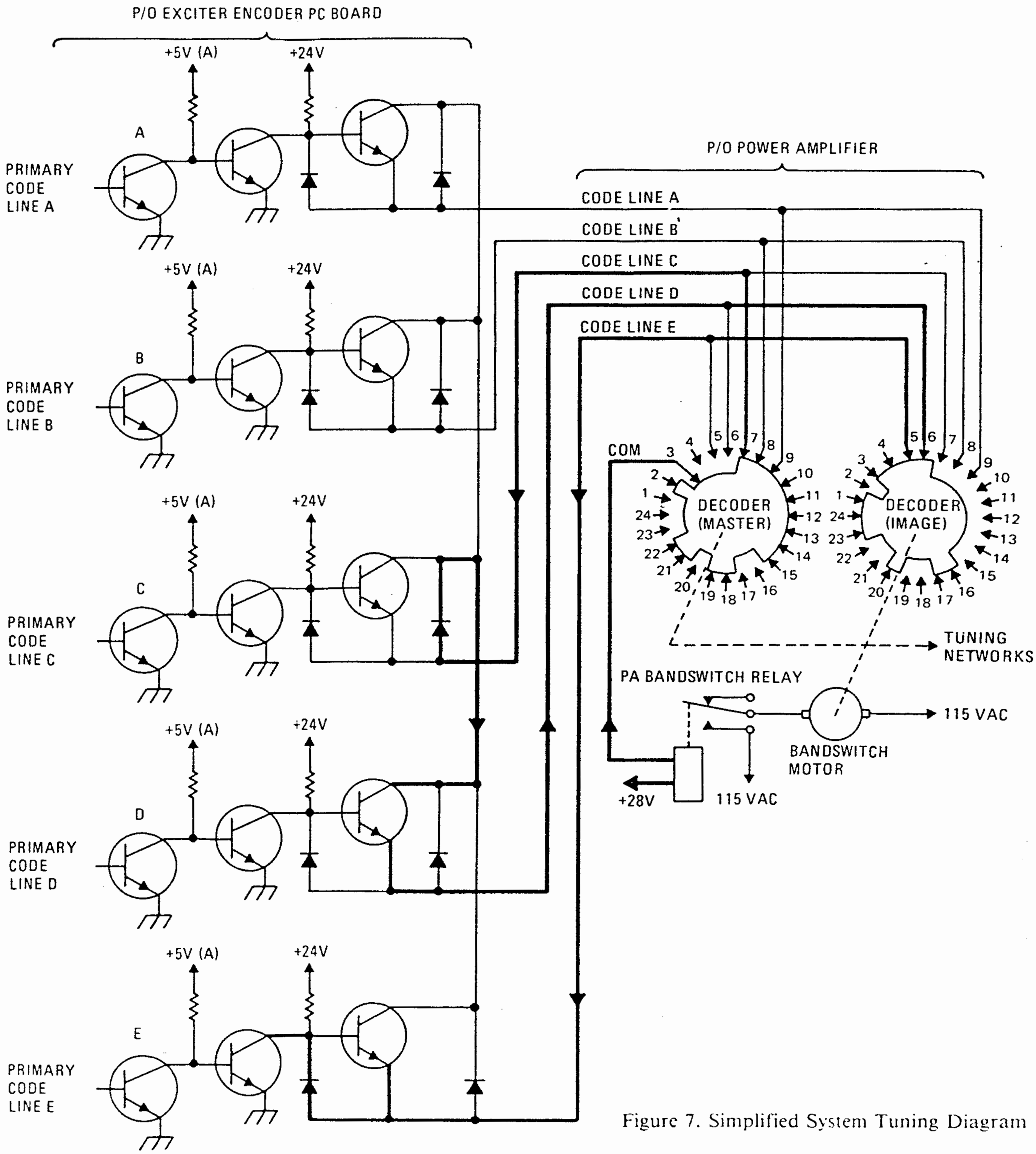


Figure 7. Simplified System Tuning Diagram

Figure 7. Simplified System Tuning Diagram

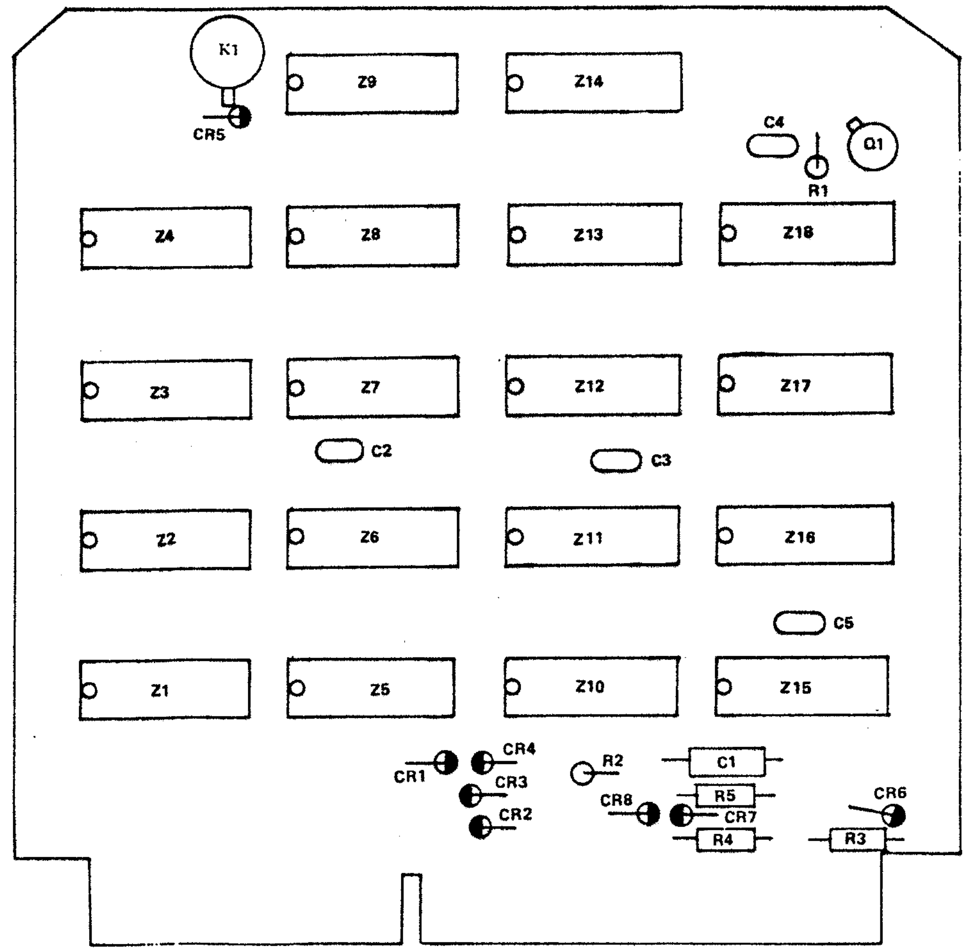
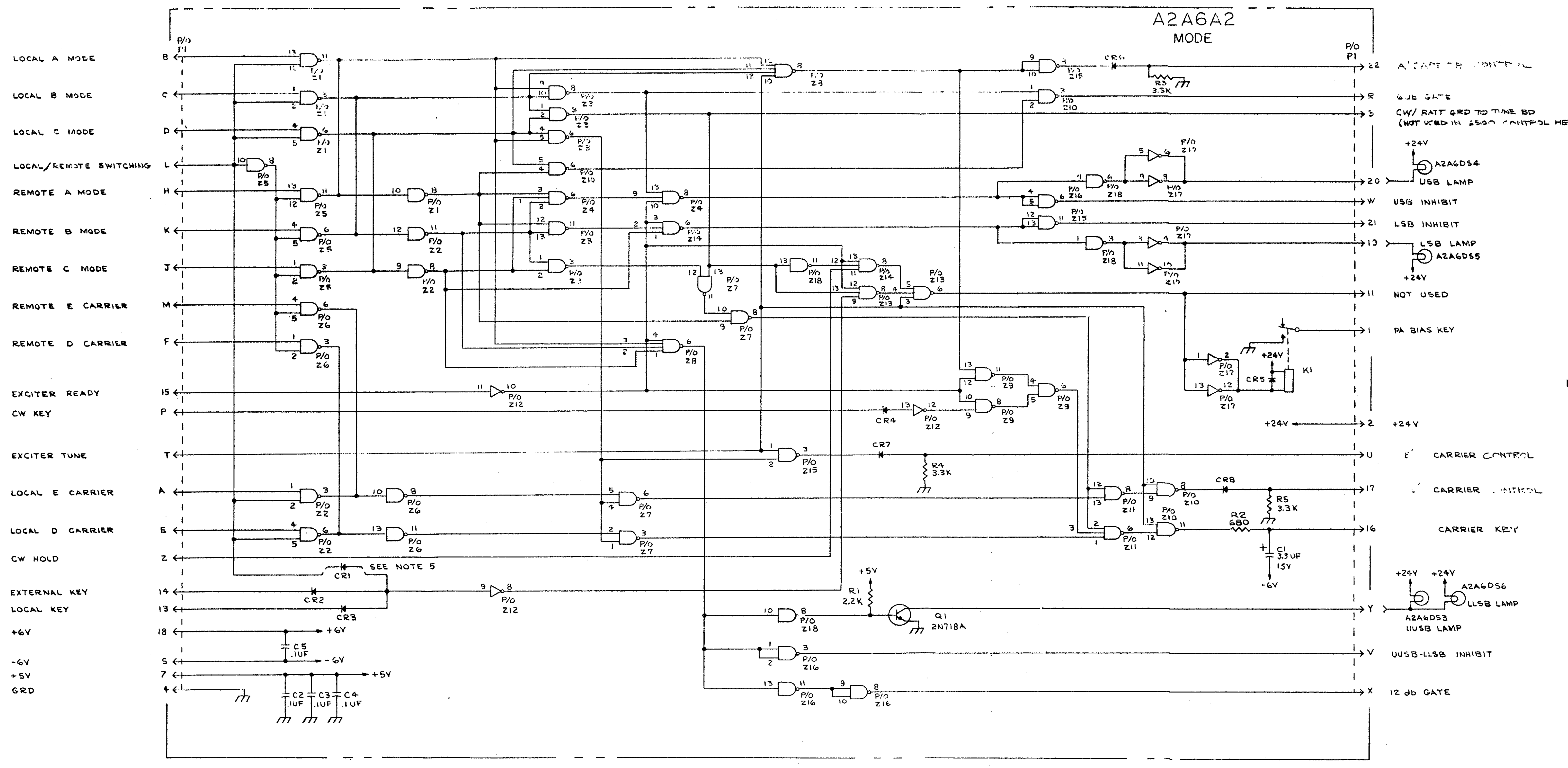


Figure 8. Mode Select PWB Component Location Drawing



0759-6522

NOTES:

1. Z1, Z2, Z3, Z5, Z6, Z7, Z9 AND Z18 ARE MC846P
   Z4, Z8, Z11, Z13 AND Z14 ARE MC1800P
   Z10, Z15 AND Z16 ARE MC672P
   Z12 IS MC840P
   Z17 IS SN7406N
2. PIN 7 IS GRD AND PIN 14 IS +5V ON Z1 THRU Z9, Z11, Z12, Z13 Z14, Z17 AND Z18.
3. PIN 7 IS -6V AND PIN 14 IS +6V ON Z10, Z15 AND Z16
4. UNLESS OTHERWISE SPECIFIED ALL DIODES ARE IN3064., ALL RES. ARE 1/4W, 10%
5. FOR CONSTANT REMOTE KEYING INSERT CR1, IN3064. (OPTION)
6. MODE TABLE

MODE	A	B	C
OFF	1	1	1
RATT	1	0	0
AME	0	1	0
CW	0	0	0
USB	1	1	0
LSB	0	0	1
2 ISB	1	0	1
4 ISB	0	1	1

CARRIER LEVEL TABLE

CARRIER	D	E
-∞ db	1	1
-20 db	0	1
-10 db	0	0

7. LAMPS ARE SHOWN FOR REF ONLY.

Figure 9. Mode Select PWB A2A6A2 Schematic Diagram

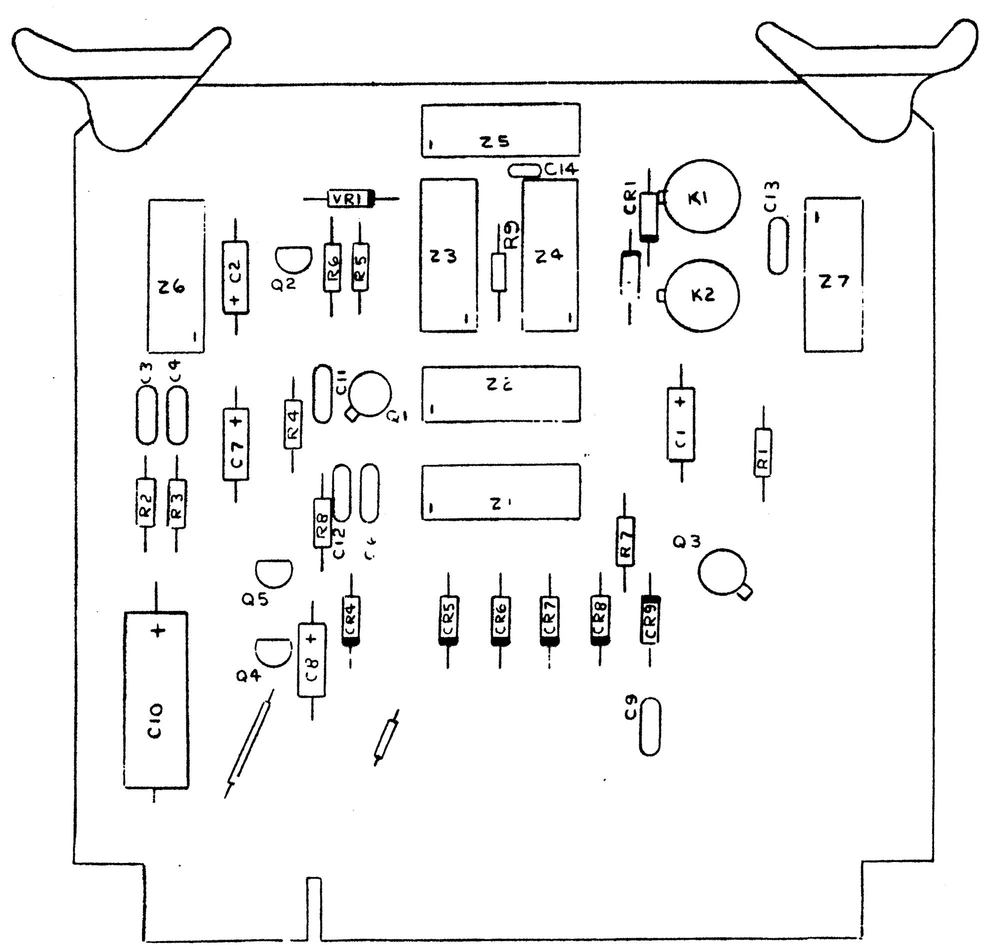


Figure 10. Standby/Operate PWB Component Location Drawing

0759-6527

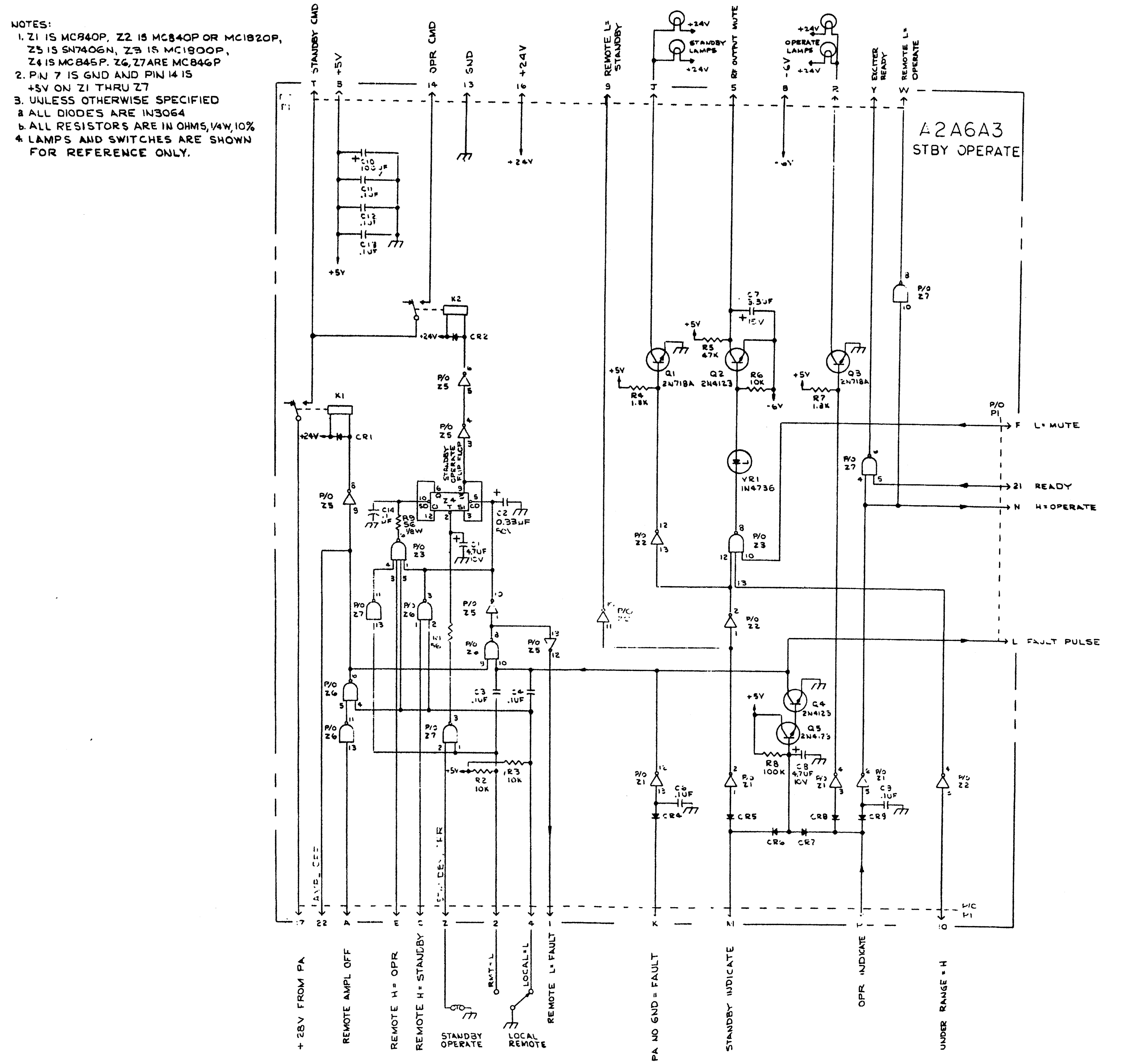


Figure 11. Standby/Operate PWB A2A6A3 Schematic Diagram

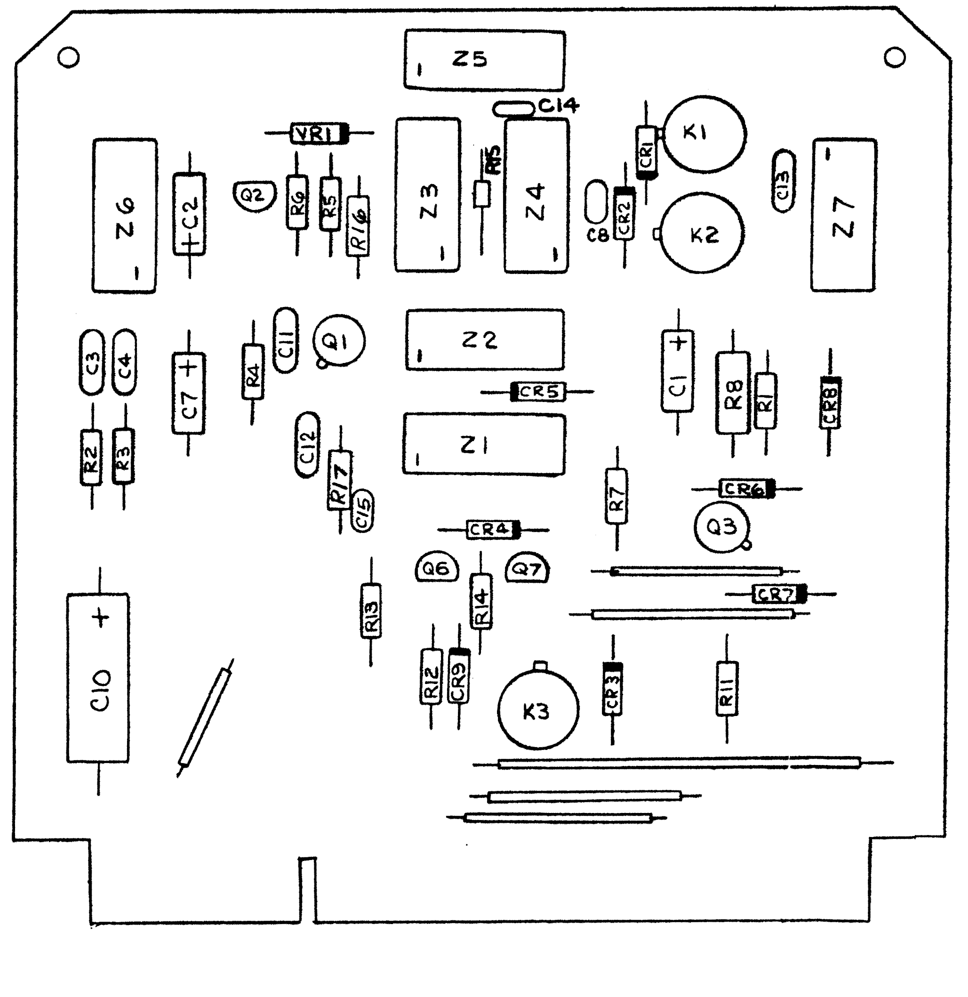
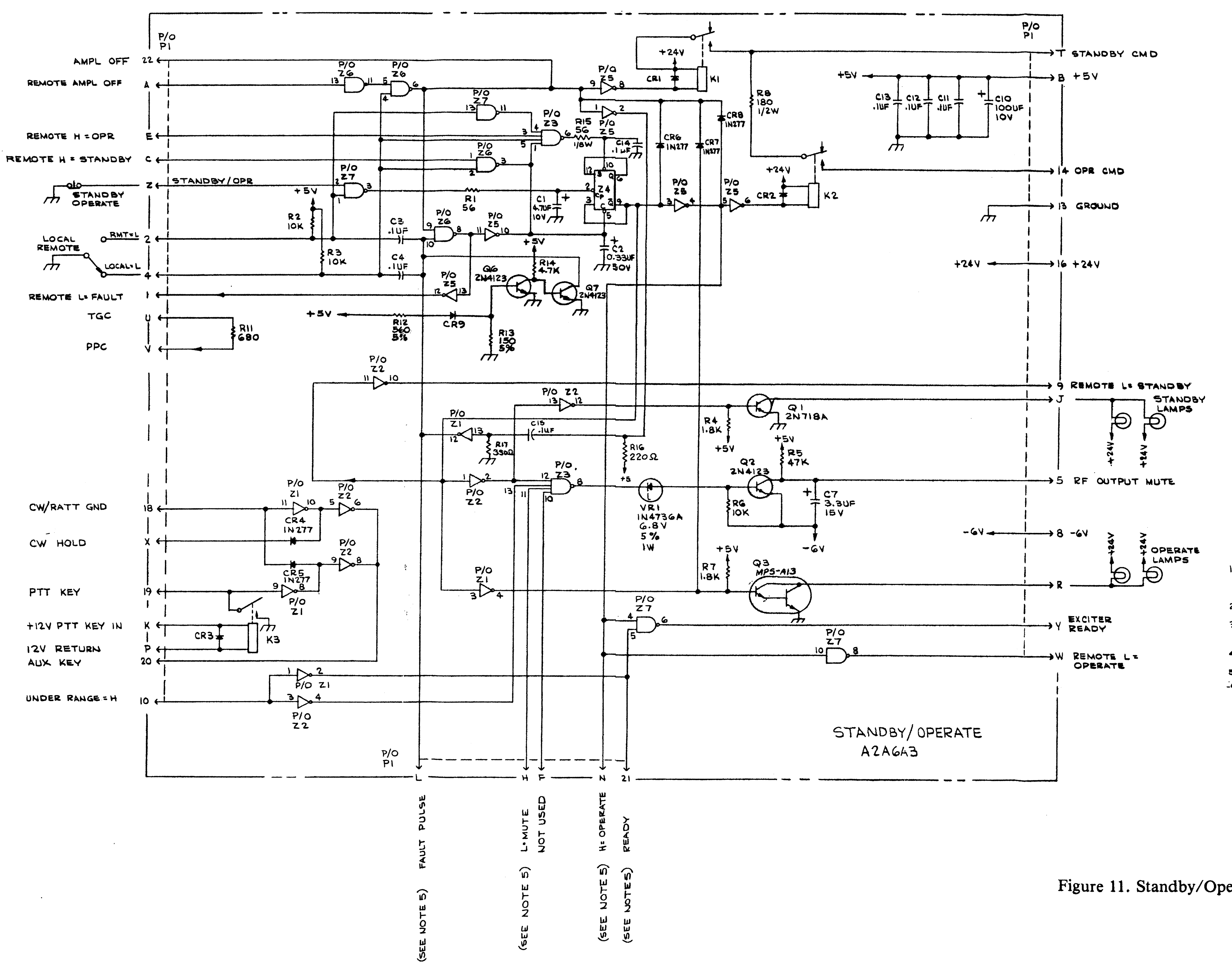


Figure 10. Standby/Operate PWB Component Location Drawing



NOTES:
1- Z1 AND Z2 ARE MC1820P OR MC840P
Z3 IS MC1800P
Z4 IS MC845P, Z5 IS SN7406N
Z6 AND Z7 ARE MC846P
2- PIN 7 IS GND AND PIN 14 IS +5V ON Z1 TO Z7
3. UNLESS OTHERWISE SPECIFIED
a- ALL DIODES ARE IN3064
b- ALL RESISTORS ARE IN OHMS, 1/4W, 10%
4. LAMPS AND SWITCHES ARE SHOWN FOR REFERENCE ONLY.
5. INTERCONNECTS TO A2A6A5 TUNE PC BOARD
6. VENDOR AND/OR JEDEC PART NUMBER CALLOUTS ARE FOR REFERENCE ONLY. COMPONENTS ARE SUPPLIED AS PER PART NUMBER ON PARTS LIST.

Figure 11. Standby/Operate PWB A2A6A3 Schematic Diagram

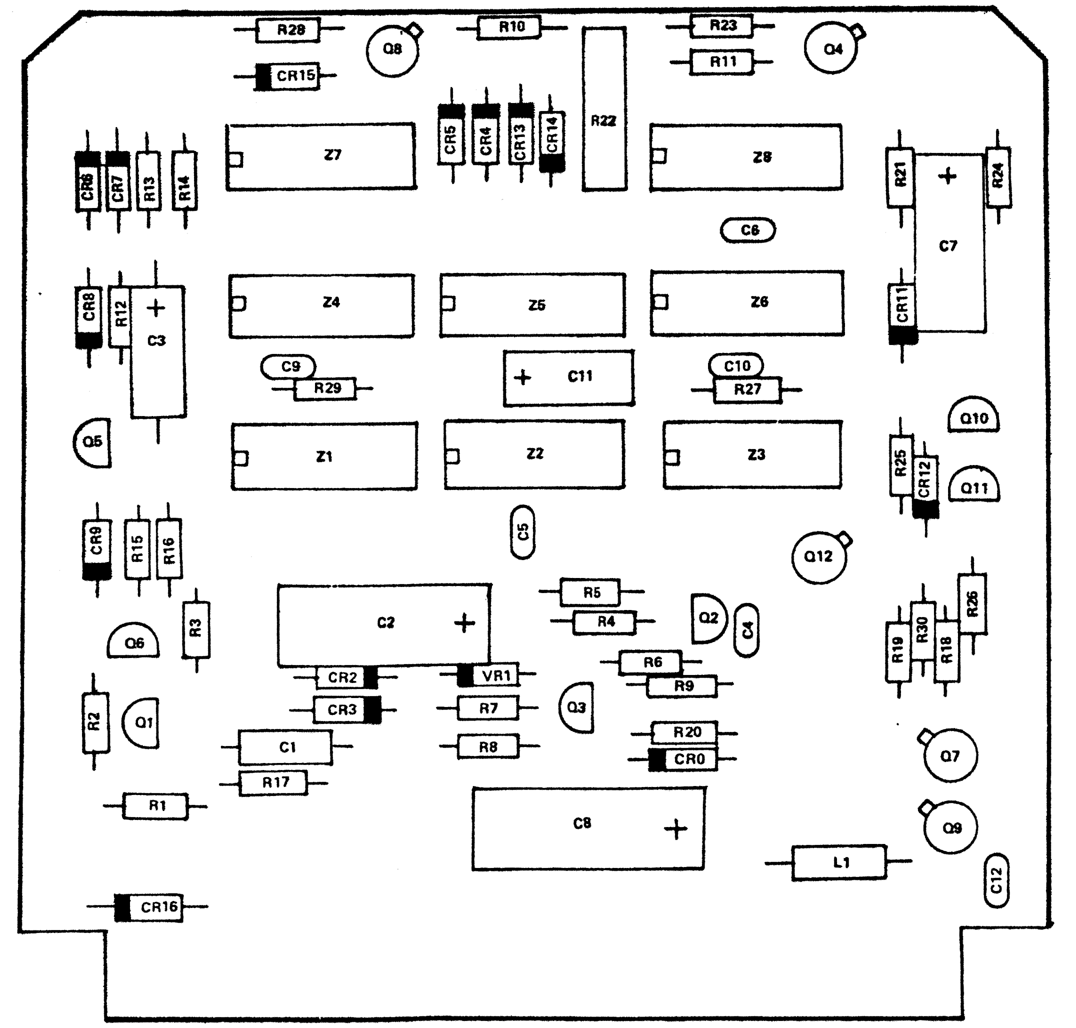
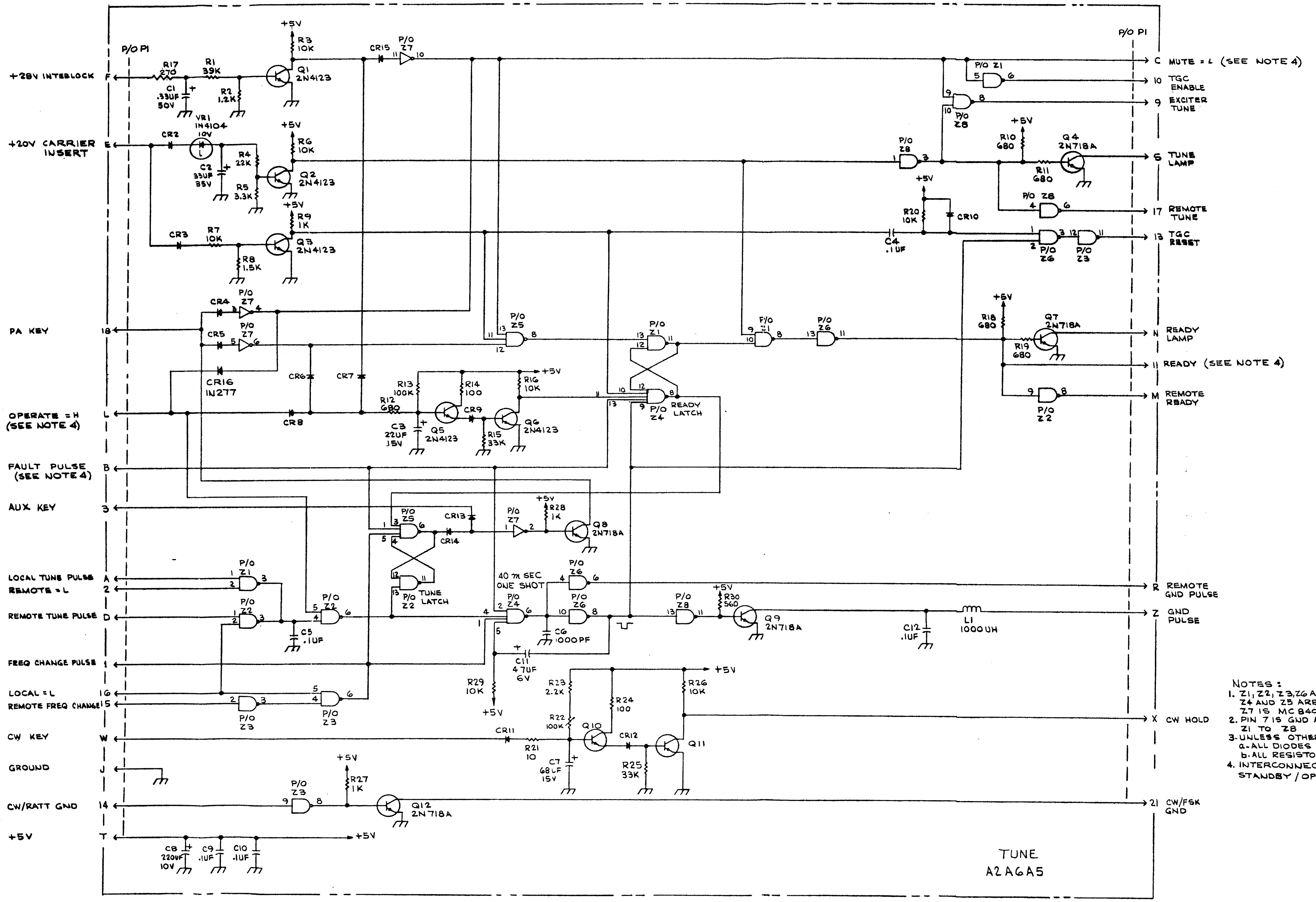


Figure 12. Tune PWB Component Location Drawing



NOTES:
1. Z1, Z2, Z3, Z6 AND Z8 ARE MC846P
Z4 AND Z5 ARE MC1800P
Z7 IS MC840P
2. PIN 7 IS GND AND PIN 14 IS +5V ON Z1 TO Z8
3- UNLESS OTHERWISE SPECIFIED
a- ALL DIODES ARE IN3064
b- ALL RESISTORS ARE IN OHMS, 1/4W, 10%
4. INTERCONNECTS TO A2A6A3 STANDBY / OPERATE PC BOARD

Figure 13. Tune PWB A2A6A5 Schematic Diagram

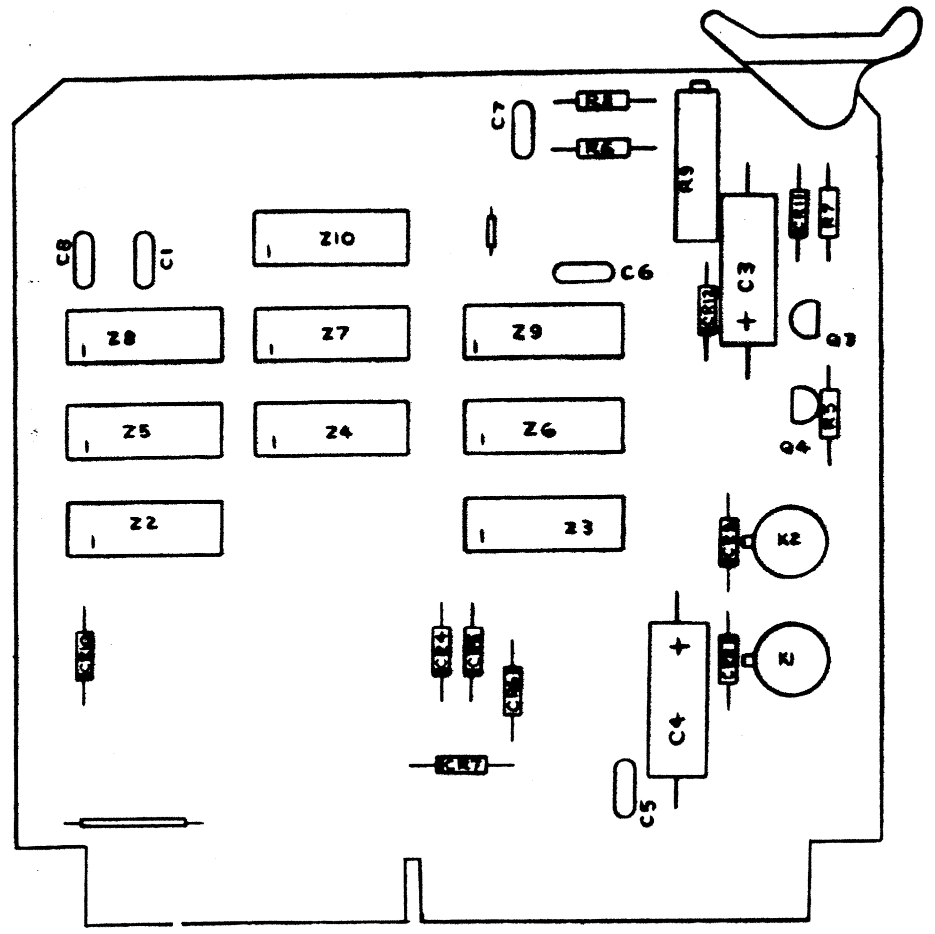
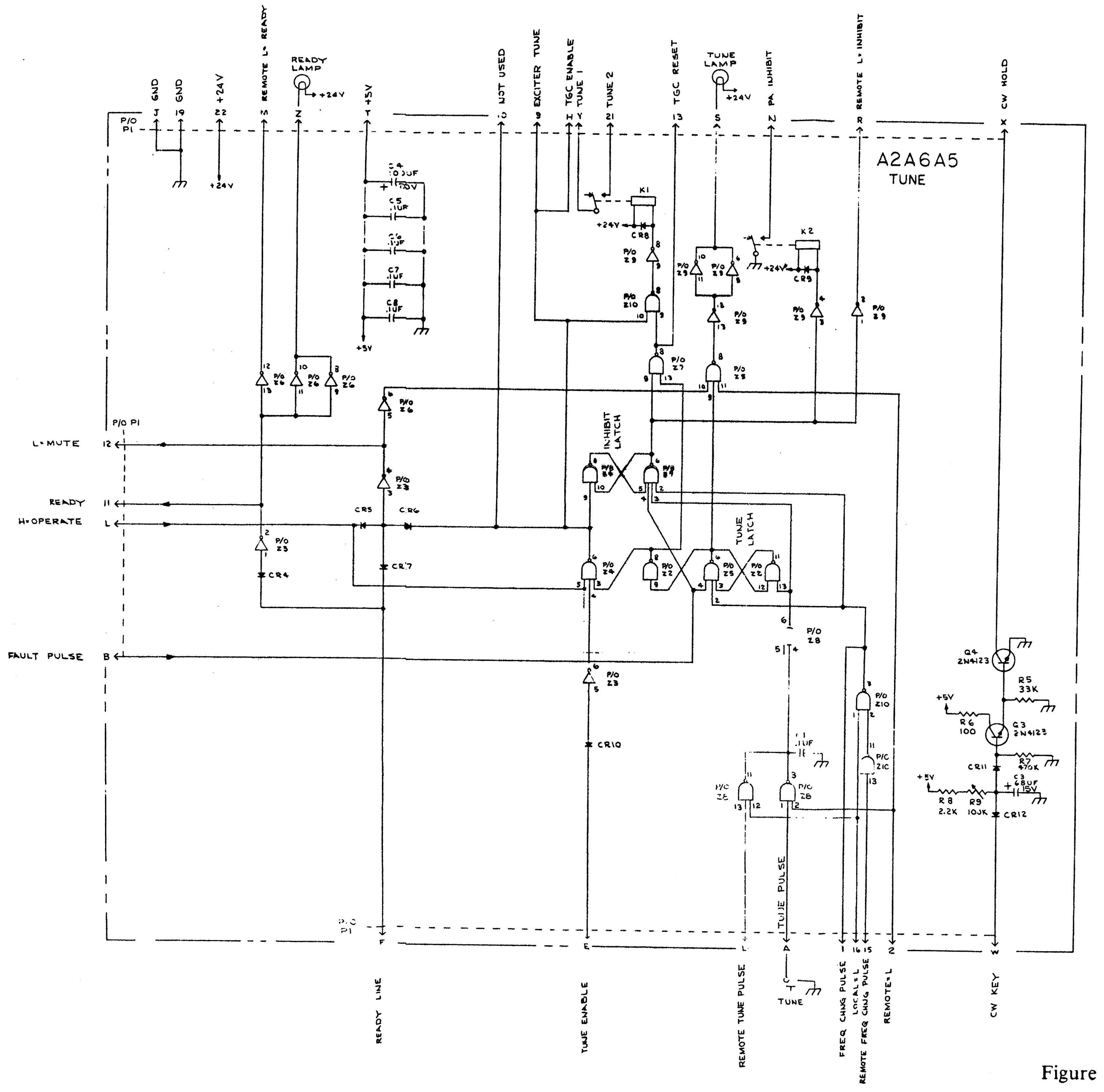


Figure 12. Tune PWB Component Location Drawing



NOTES:
1. Z2, Z8 AND Z10 ARE MC846P
Z3 IS MC840P
Z4, Z5 AND Z7 ARE MC1800P
Z6 AND Z9 ARE MC1820P
2. PIN 7 IS GND AND PIN 14 IS +5V ON Z2 THRU Z10
3. UNLESS OTHERWISE SPECIFIED:
a. ALL RESISTORS ARE IN OHMS, 1/4W, 10%
b. ALL DIODES ARE IN3064.
4. LAMPS AND SWITCHES ARE SHOWN FOR REFERENCE ONLY.

Figure 13. Tune PWB A2A6A5 Schematic Diagram

TABLE 8. MAINTENANCE PARTS LIST-Control Head A2A6

Reference Designation	Name and Description
A2A6	Control Head Module Assembly: MFR 14304, PN 0759-6600
CR1 - CR3	Diode: Mil type 1N3064
J1 - J5	Connector, PWB: MFR 26742, PN 81-6044-1107
J6	Connector, Multipin, Block Thin: MFR 81312, PN MRAC75PJ
J5MP1	Pin, Connector, Straight, Male: Mil type MS17803-16-20
J7 - J15	Not used
J16	Connector, Multipin, Thick: MFR: 81312, PN MRAC75SJ
J16MP1	Pin, Connector, Straight, Female: Mil type MS17804-16-20
P5	Connector, PWB: MFR 02660, PN 225-21521-101
	Panel Assembly, Control Head MFR 14304, PN 0759-8530
MP1-MP6	Knob: Mil type MS91528-1K2B
S1	Switch, Mode Select, Rotary: MFR 71590, PN PSA-209
S2	Switch, Carrier Insert Rotary: MFR 71590, PN PSA-200
S3	Switch, Frequency Select, Thumbwheel Rotary: MFR 14304, PN 0759-6104
S4	Switch Pushbutton: MFR 96182, PN 90EA1C5J2 (WB) L2N1R16 Local/Remote. Lamps, 28V: Mil type MS2537-387
S5	Switch, Pushbutton: MFR 96182, PN 90EA1C2J2 (YG) L2N1R16 Tune/Ready. Lamps, 28V: Mil type MS2537-387
S6	Switch, Pushbutton: MFR 96182, PN 90EA1C2J2 (YG) L2N1R16 Standby/Operate. Lamps, 28V, No. 387, Mil type MS2537-387
A2A6A1	Encoder PWB Assembly; MFR 14034, PN 6722-6115
C1	Not used
C2	Capacitor, Fixed, 33uF, 10 WVDC: Mil type M39003/01-2258
C3	Capacitor, Fixex, 0.1uF, 50 WVDC: MFR 14304, PN C11-0005-104
C4	Capacitor, Fixed 0.01uF, 50 WVDC: MFR 14304, PN C11-0005-103
C5	Same as C3
C6	Capacitor, Fixed, 1uF, 50 WVDC: Mil type M39003/01-2357
C7-C21	Same as C3
CR1	Not used
CR2, CR3	Diode, Silicon; Mil type 1N4148
CR4-CR13	Diode, Silicon; Mil type 1N3611
CR14	Diode, Silicon: MFR 50444, PN 5082-2800
CR15	Same as CR2
CR16	Same as CR14
CR17	Same as CR2
CR18	Same as CR14
CR19	Same as CR2
CR20	Same as CR14
CR21	Same as CR2
CR22	Same as CR14
CR23	Same as CR2
Q1	Transistor, NPN: MFR 04713, PN 2N4123
Q2-Q11	Transistor, NPN: MFR 04713, PN MPS-A05
Q12, Q13	Same as Q1
R1-R5	Resistor, Fixed, Composition, 10K, ±5%, ¼W: Mil type RC07GF103J
R6	Resistor, Fixed, Composition, 100 Ω, ±5%, ¼W: Mil type RC07GF101J
R7	Resistor, Fixed, Composition, 2.7K, ±5%, ¼W: Mil type RC07GF272J
R8	Same as R1
R9	Resistor, Fixed Composition, 33K, ÷5%, ¼W: Mil type RC07GF333J
R10, R11	Same as R1
R12	Resistor, Fixed Composition, 4.7K, ÷5%, ¼W: Mil type RC07GF472J
R13-R19	Same as R1
R20-R24	Resistor, Fixed Composition, 820Ω, ±5%, ¼W: Mil type RC07GF821J
R25	Same as R6
R26-R32	Resistor, Fixed Composition, 1K, ±5%, ¼W: Mil type RC07GF102J
U1	Read-Only Memory (ROM), 1024 x 8-Bit, MOS: MFR 14304, PN 6722-6130
U2-U4	Integrated Circuit, 4-Bit Bistable Latch: MFR 01295, PN SN 74LS75N

TABLE 8. MAINTENANCE PARTS LIST-Control Head A2A6 (Continued)

Reference Designation	Name and Description
U5-U7	Integrated Circuit, Quadruple 2-Input Exclusive-OR Gate: MFR 01295m PN SN74LS136N
U8-U10	Integrated Circuit, Hex Inverter: MFR 01295, PN SN74LS04N
U11	Integrated Circuit, Retriggerable Monostable Multivibrator: MFR 01295, PN SN 74LS122N
U12	Integrated Circuit, Quadruple 2-Input Positive NAND Gate: MFR 14304, PN I01-0048-000
A2A6A2	Mode Select PWB Assembly: MFR 14304, PN 0759-6520
C1	Capacitor, Fixed Tantalum, 3.3uF, 15WVDC Mil type C39003/01-2268
C2-C5	Capacitor, Fixed Ceramic, 0.1uF, 50 WVDC: MFR 14304 PN C11-0005-104
CR1	Not used
CR2-CR8	Diode, Silicon: Mil type 1N3064
K1	Relay, DPDT: MFR 16170, PN 712-26
MP1	Mode Select PWB: MFR 14304, PN 0759-6521
Q1	Transistor, NPN: Mil type 2N718A
R1	Resistor, Fixed Composition, 2.2K, ±10%, ¼W: Mil type RC07GF222K
R2	Resistor, Fixed Composition, 680 Ω, ±10%, ¼W: Mil type RC07GF681K
R3-R5	Resistor, Fixed Composition, 3.3K, ±10%, ¼W: Mil type RC07GF332K
Z1 - Z3	Integrated Circuit: MFR 04713, PN MC1846P
Z4	Integrated Circuit: MFR 04713, PN MC1800P
Z5 - Z7	Integrated Circuit: MFR 04713, PN MC846P
Z8	Integrated Circuit: MFR 04713, PN MC 1800P
Z9	Integrated Circuit: MFR 04713, PN MC846P
Z10	Integrated Circuit: MFR 04713, PN MC672P
Z11	Integrated Circuit: MFR 04713, PN MC1800P
Z12	Integrated Circuit: MFR 04713, PN MC840P

Reference Designation	Name and Description
Z13, Z14	Integrated Circuit: MFR 04713, PN MC1800P
Z15, Z16	Integrated Circuit: MFR 04713, PN MC672P
Z17	Integrated Circuit: MFR 01295, PN SN7406N
Z18	Integrated Circuit: MFR 04713, PN MC846P
A2A6A3	Standby/Operate PWB Asasembly: MFR 14304, PN 0759-6625
C1	Capacitor, Fixed Tantalum, 4.7uF, 10 WVDC: Mil type CSR13C475ML
C2	Capacitor, Fixed Tantalum, 0.33uF, 50 WVDC: Mil type CSR13G334ML
C3, C4	Capacitor, Fixed Ceramic 0.1uF, 50 WVDC: MFR 14304 PN C11-0005-104
C5, C6	Not used
C7	Capacitor, Fixed Tantalum, 3.3uF, 50 WVDC: Mil type M39003/01-2366
C8	Capacitor, Ceramic, .01uF MFR 14304, PN C11-0005-103
C9	Not used
C10	Capacitor, Fixed Tantalum, 100uF, 10 WVDC: Mil type CSR13C107ML
C11 - C15	Capacitor, Fixed Ceramic, 0.1uF, 50 WVDC: MFR 14304 PN C11-0005-104
CR1 - CR3	Diode, Silicon: Mil type 1N3064
CR4 - CR8	Diode, Germanium: Mil type 1N277
CR9	Diode, Silicon: Mil type 1N3064
K1, K2	Relay, DPDT: MFR 16170, PN 712-26
K3	Relay, DPDT, 12VDC: MFR 16170, PN 712-12
Q1	Transistor, NPN: Mil type 2N718A
Q2	Transistor, NPN: MFR 04713, PN 2N4123
Q3	Transistor, Darlington: MFR 14304 PN Q50-0001-000
Q4, Q5	Not used
Q6, Q7	Transistor, NPN: MFR 04713, PN 2N4123
R1	Resistor, Fixed composition, 56Ω, ±10%, ¼W: Mil type RC07GF560K
R2, R3	Resistor, Fixed Composition, 10K, ±10%, ¼W: Mil type RC07GF103K
R4	Resistor, Fixed Composition, 47K, ±10%, ¼W: Mil type RC07GF182K

TABLE 8. MAINTENANCE PARTS LIST-Control Head A2A6 (Continued)

Reference Designation	Name and Description
R5	Resistor, Fixed composition, 47K, ±10%, ¼W: Mil type RC07GF473K
R6	Resistor, Fixed Composition, 10K, ±10%, ¼W: Mil type RC07GF103K
R7	Resistor, Fixed Composition, 1.8K, ±10%, ¼W: Mil type RC07GF182K
R8	Resistor, Fixed Composition, 180Ω, ±10%, ½W: Mil type RC20GF181K
R9, R10	Not used
R11	Resistor, Fixed Composition, 680Ω, ±10%, ¼W: Mil type RC07GF681K
R12	Resistor, Fixed Composition, 560 Ω, ±5%, ¼W: Mil type RC07GF561J
R13	Resistor, Fixed Composition, 150Ω, ±5%, ¼W: Mil type RC07GF151J
R14	Resistor, Fixed Composition, 4.7K, ±10%, ¼W: Mil type RC07GF472K
R15	Resistor, Fixed Composition, 56Ω, ±10%, 1/8W: Mil type RC07GF560K
R16	Resistor, Fixed Composition, 220Ω, ±5%, ¼W: Mil type RC07GF221J
R17	Resistor, Fixed Composition, 330Ω, ±5%, ¼W: Mil type RC07GF331J
VR1	Diode, Zener, 6.8V, 1W: Mil type 1N4736A
Z1, Z2	Integrated Circuit: MFR 04713, PN MC840P
Z3	Integrated Circuit: MFR 04713, PN MC1800P
Z4	Integrated Circuit: MFR 04713, PN MC845P
Z5	Integrated Circuit: MFR 01295, PN SN7406N
Z6, Z7	Integrated Circuit: MFR 04713, PN MC846P
A2A6A4	Level Shift/Remote Control PWB Assembly: MFR 14304, PN 0759-6145
CR1 - CR3	Not used
CR4-CR25	Diode, Germanium Mil type 1N277
MP1	Level Shift/Remote Control PWB: MFR 14304, PN 0759-6146
Q1 - Q10	Transistor, NPN: MFR 04713, PN 2N4123
R1 - R22	Resistor, Fixed Composition, 5.6K, ±10%, ¼W: Mil type RC07GF103K
R23 - R32	Resistor, Fixed Composition, 5.6K, ±10%, ¼W: Mil type RC07GF562K

Reference Designation	Name and Description
R33 - R42	Resistor, Fixed Composition, 12K, ±10%, ¼W: Mil type RC07GF123K
A2A6A5	Tune PWB Assembly: MFR 14304, PN 0759-6635
C1	Capacitor, Fixed Tantalum, 0.33uF, 50 WVDC: Mil type CSR13G334ML
C2	Capacitor, Fixed Tantlaum, 33.0uF, 35 WVDC: Mil type CSR13F336ML
C3	Capacitor, Fixed Tantalum, 22uF, 15 WVDC: Mil type CSR13D226ML
C4, C5	Capacitor, Fixed Ceramic, 0.1uF: MFR 72982, PN 8131-100-6511-104M
C6	Capacitor, Fixed Ceramic, 1000uF: MFR 72982, PN 8121-100-X7R-102K
C7	Capacitor, Fixed Tantlaum, 68uF: 15 WVDC: Mil type CSR13D686ML
C8	Capacitor, Fixed Tantalum, 220uF, 10WVDC: Mil type CSR13C227ML
C9, C10	Capacitor, Fixed Ceramic, 0.1uF: MFR 72982, PN 8131-100-651-104M
C11	Capactor, Fixed Tantalum, 47uF: 6 WVDC: Mil type CSR13B476ML
C12	Capacitor, Fixed Ceramic, 0.1uF: MFR 72982, PN 8131-050-651-104M
CR1	Not used
CR2-CR15	Diode, Silicon: Mil type 1N3064
CR16	Diode, Germanium: Mil type 1N277
L1	Inductor,1000uH: MFR 99800, PN 2500-28
Q1 - Q3	Transistor, NPN: MFR 04713, PN 2N4123
Q4	Tranisitor, NPN: Mil type 2N718A
Q5, Q6	Transistor, NPN: MFR 04713, PN 2N4123
Q7 - Q9	Transistor, NPN: Mil type 2N718A
Q10, Q11	Transistor, NPN: MFR 04713, PN 2N4123
Q12	Tranisitor, NPN: Mil type 2N718A
R1	Resistor, Fixed Composition, 39K, ±10%, ¼W: Mil type RC07GF393K
R2	Resistor, Fixed Composition, 1.2K, ±10%, ¼W: Mil type RC07GF122K
R3	Resistor, Fixed Composition, 10K, ±10%, ¼W: Mil type RC07GF103K
R4	Resistor, Fixed Composition, 22K, ±10%, ¼W: Mil type RC07GF223K

TABLE 8. MAINTENANCE PARTS LIST-Control Head A2A6 (Continued)

Reference Designation	Name and Description
R5	Resistor, Fixed Composition, 3.3K, ±10%, ¼W: Mil type RC07GF332K
R6, R7	Resistor, Fixed compsition, 10K, ±10%, ¼W: Mil type RC07GF103K
R8	Resistor, Fixed Composition, 1.5K, ±10%, ¼W: Mil type RC07GF152K
R9	Resistor, Fixed Composition, 1K, ±10%, ¼W: Mil type RC07GF102K
R10-R12	Resistor, Fixed Composition, 680Ω, ±10%, ¼W: Mil type RC07GF681K
R13	Resistor, Fixed Composition, 100K, ±10%, ¼W: Mil type RC07GF104K
R14	Resistor, Fixed Composition, 100Ω, ±10%, ¼W: Mil type RC07GF101K
R15	Resistor, Fixed Composition, 33K, ±10%, ¼W: Mil type RC07GF333K
R16	Resistor, Fixed Composition, 10K, ±10%, ¼W: Mil type RC07GF103K
R17	Resistor, Fixed Composition, 270Ω, ±10%, ¼W: Mil type RC07GF271K
R18, R19	Resistor, Fixed Composition, 680Ω, ±10%, ¼W: Mil type RC07GF681K
R20	Resistor, Fixed Composition, 10K, ±10%, ¼W: Mil type RC07GF103K
R21	Resistor, Fixed Composition, 10Ω, ±10%, ¼W: Mil type RC07GF100K

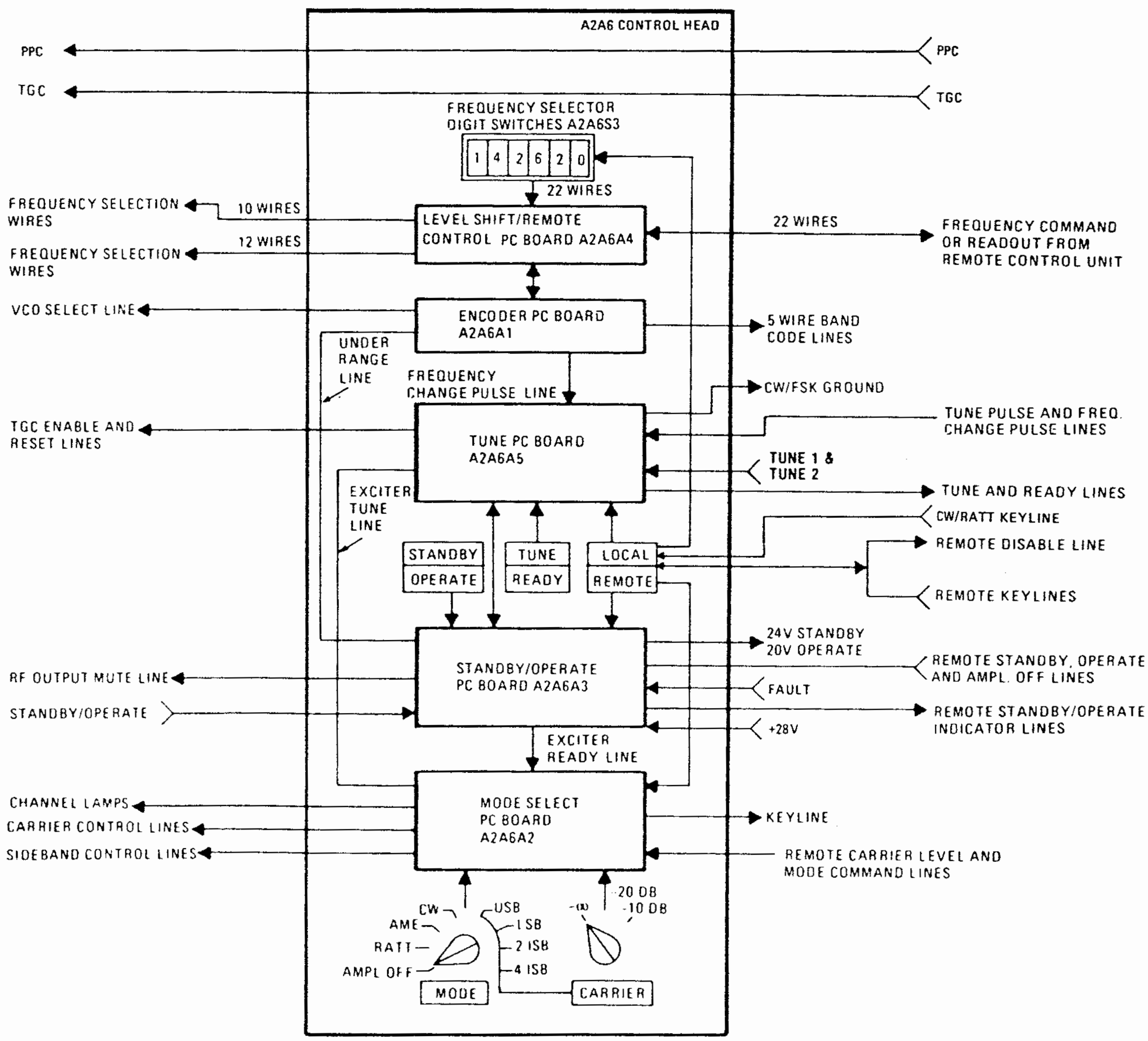
Reference Designation	Name and Description
R22	Resistor, Variable, 100K: MFR 80294, PN 3009Y-1-104
R23	Resistor, Fixed Composition, 2.2K, ±10%, ¼W: Mil type RC07GF222K
R24	Resistor, Fixed Composition, 100Ω, ±10%, ¼W: Mil type RC07GF101K
R25	Resistor, Fixed Composition, 33Ω, ±10%, ¼W: Mil type RC07GF333K
R26	Resistor, Fixed Composition, 10K, ±10%, ¼W: Mil type RC07GF103K
R27, R28	Resistor, Fixed Composition, 1K, ±10%, ¼W: Mil type RC07GF102K
R29	Resistor, Fixed Composition, 10K, ±10%, ¼W: Mil type RC07GF103K
R30	Resistor, Fixed Composition, 560Ω, ±5%, ¼W: Mil type RC07GF561J
VR1	Diode, Zener, 10V: Mil type 1N4104
Z1 - Z3	Integrated Circuit: MFR 04713, PN MC846P
Z4, Z5	Integrated Circuit: MFR 04713, PN MC1800P
Z6	Integrated Circuit: MFR 04713, PN MC1800P
Z7	Integrated Circuit: MFR 04713, PN MC840P
Z8	Integrated Circuit: MFR 04713, PN MC846P

UNIT INSTRUCTIONS

CONTROL HEAD MODULE A2A6

NOTE

THIS CONTROL HEAD MODULE P/N 0759-6500 IS FOR USE WITH THE RF-745 10 KW TRANSMITTING SYSTEM



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CONTROL HEAD MODULE A2A6

1. INTRODUCTION

Control Head Module A2A6 provides a central location for the control of all other exciter modules, provides a flexible and convenient means of interfacing the exciter with external equipments and provides for remote control of the whole system.

Control voltages for sideband selection, carrier reinsertion level, and output frequency are all developed in the Control Head, in response to the position of local selector switches or logic signals received from an external remote control system.

Control Head Module A2A6, Part No. 0759-6500 is used in the Model RF-131-172, -173 and -176 Exciters covered in this instruction book. These units meet the interface requirements of the RF-745 10KW Transmitter, and will accept full remote control.

All of the control functions between the RF-131 Exciter and a transmitting system are implemented in the Control Head. For example, for the RF-745 Transmitting System, the Control Head supplies the Power Amplifier with standby and operate commands, a 5-wire code that automatically tunes the Power Amplifier to the selected frequency, and a ground pulse that signals a frequency change of 1kHz or greater. The RF-131 Exciter also accepts readback lines from the system, ensuring that the prescribed system cycles have been executed.

Control Head Module A2A6, Part No. 0759-6500 contains five plug-in logic subassemblies for the control of system emission mode and carrier reinsertion. These logic subassemblies are as follows:

A2A6A1	Encoder PWB Assembly
A2A6A2	Mode Select PWB Assembly
A2A6A3	Standby/Operate PWB Assembly
A2A6A4	Level Shift/Remote Control PWB Assembly
A2A6A5	Tune PWB Assembly

Figure 1 shows subassembly, control and connector locations.

2. FREQUENCY CONTROL AND FREQUENCY CHANGE (GROUND) PULSE GENERATION.

Frequency control originates at either the frequency selector digit switch (A2A6S3) on the Control Head front panel or at a remote control should the exciter LOCAL/REMOTE Switch (A2A6S4) be in the REMOTE position.

Switch assembly A2A6S3 contains a group of six, thumb-actuated switches that control the exciter's output in 10MHz, 1MHz, 100KHz, 10KHz and 1KHz and 100Hz increments. With the exception of the 10MHz switch, each switch has ten possible positions from 0 to 9, and a four-wire output that yields a 4-bit BCD indication of the selected digit. The 10MHz switch has only three positions 0, 1 and 2, and a two-wire binary output. Thus the entire six digit number is carried on 22 wires. Refer to Table 1 for BCD format.

The wiring from both local and remote frequency determining inputs comes to the Level Shift/ Remote Control PWB A2A6A4 with the local wiring at A2A6A4P5. (Refer to Figure 2) Each frequency determining input line produces a ground for its logic "0" and an open for its logic "1". When the system is in REMOTE the local portion of the LOCAL/REMOTE switch has its ground return opened. Thus the only source of grounds in the Level Shift/Remote Control PWB A2A6A4 during remote operation is from the Remote Control Unit. Ungrounded lines are pulled high (towards +5V) by pull-up resistors R1 through R22 (Figure 10). Diodes CR4 through CR25 provide isolation so that the local switches cannot affect remote frequency control. Similar isolation is provided by the remote control when local operation is selected.

The wiring on the right side of Figure 10 routes the selected (LOCAL or REMOTE) frequency information to the rest of the system.

Refer to Figure 2. The 12 wires from the three least-significant frequency selector digit switches (that is, 10kHz, 1kHz, and 100Hz) are routed to the A2A14 Low Band PLL Module via connectors A2A6P5, A2A6J4, A2A6J16, and A2J14. The logic levels present on these 12 wires control the digital dividers of the divide-by-M circuit in the module, thereby establishing the module's output frequency.

TABLE 1. BCD CODES

Switch Indication	Switch Output			
	8 Bit	4 Bit	2 Bit	1 Bit
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

The 10 wires from the three most-significant frequency selector digit switches (that is, 10MHz, 1MHz and 100kHz) control the digital dividers of the A2A8 High Band PLL Module, establishing its output frequency. However, before the logic levels on the 10 wires are applied to the module, their levels are shifted from approximately 0 and +5Vdc to approximately −1.6 and −0.6Vdc for logic "0" and "1" representation, respectively. This is necessary because of the ECL logic elements of PN 1976-3800-2 High Band PLL Module. In addition, the logic levels of the 2-bit and 4-bit wires of the 100kHz and 1MHz frequency selector digit switches must be inverted. (Refer to the High Band PLL Module A2A8 Section in this book for further discussion.) This inversion is accomplished in Encoder PWB A2A6A1 by inverters U8, U9 and U10 (see Figure 4) and then returned to Level Shift/Remote Control PWB A2A6A4 for level shifting. Thus, the full level-shifted output to the A2A8 High Band PLL Module is 10 wires of quasi-BCD (refer to Table 2). The 10 wire output is routed to the board via connectors A2A6J4, A2A6J16, A2AP16 and A2J8. The logic input/level-shifted output of the level shift circuitry of A2A6A4 are illustrated as follows:

LOGIC LEVEL INPUT TO LEVEL SHIFT CIRCUITRY OF A2A6A1 — "1" +5V, "0" 0V

TYPICAL LEVEL-SHIFTED OUTPUT OF LEVEL SHIFT CIRCUITRY OF A2A6A1 — "1" −0.2V, "0" −2V

TABLE 2. QUASI-BCD CODES.

Switch Indication	Quasi-BCD Output			
	8 Bit	4 Bit	2 Bit	1 Bit
0	0	1	1	0
1	0	1	1	1
2	0	1	1	1
3	0	1	0	1
4	0	0	1	0
5	0	0	1	1
6	0	0	0	0
7	0	0	0	1
8	1	1	1	0
9	1	1	1	1

The 5-wire code generator of Encoder PWB A2A6A1 (Read-Only Memory U1) receives 10MHz, 1MHz and 100kHz frequency selector digit switch inputs (routed to A2A6A1 via Level Shift/Remote Control PWB A2A6A4) and develops the 5-wire primary band selection code used to accomplish automatic band switching in the companion system RF Amplifier. The 5-wire primary band selection code frequency, code line identification, and RF Power Amplifier band number data is shown in Table 3.

Encoder PWB A2A6A1 provides several other important functions through its frequency-change, band-change, high level interface and code image generation and ROM U1 circuitry. These functions are described in detail in subsequent paragraphs.

ROM U1 generates frequency underrange information. Depending on whether the frequency selected is underrange or inrange, the output at U1-2 will be low and the output at U1-3 will be high (respectively), inhibiting (or not affecting) keyline operation. Also, should an invalid input be applied at U1 (such as all logic "0's" occurring when the frequency selector digit switches are changed), U1 will generate an output of logic "1's." When this occurs, the frequency change and band change circuitry of Encoder PWB A2A6A1 will not change from its previous state. Thus, preventing a power amplifier frequency/band change during exciter frequency change.

The frequency and band change functions are interrelated.

The high level interface and code image generation circuitry provides the system RF Power Amplifier with a ground on those code lines with a primary code bit of "0" and connects together those code lines with a primary code bit of "1". The ungrounded code lines must be tied together in order for the RF Power Amplifier band-switching mechanism to operate.

Table 3. Frequency/Primary Band Selection Code/Power Amplifier Band Data.

FREQUENCY Selector Digit Switch Selected Frequency (MHz)	Primary Band Selection Code					System RF Power Amplifier Band Number
	Code Line A	Code Line B	Code Line C	Code Line D	Code Line E	
02.0 to 02.4	1	1	1	1	0	1
02.5 to 02.9	1	1	1	0	0	2
03.0 to 03.4	1	1	0	0	0	3
03.5 to 04.0	1	0	0	0	0	4
04.0 to 04.9	0	0	0	0	1	5
05.0 to 05.9	0	0	0	1	0	6
06.0 to 06.9	0	0	1	0	0	7
07.0 to 07.9	0	1	0	0	0	8
08.0 to 09.9	1	0	0	0	1	9
10.0 to 11.9	0	0	0	1	1	10
12.0 to 13.9	0	0	1	1	0	11
14.0 to 15.9	0	1	1	0	1	12
16.0 to 17.9	1	1	0	1	1	13
18.0 to 19.9	1	0	1	1	0	14
20.0 to 21.9	0	1	1	0	0	15
22.0 to 23.9	1	1	0	0	1	16
24.0 to 25.9	1	0	0	1	1	17
26.0 to 27.9	0	0	1	1	1	18
28.0 to 29.9	0	1	1	1	1	19

NOTE

Although this table refers to logic levels on the primary band selection code lines at the input to the high level interface and code image generation circuitry, the information applies to the output lines (code lines A thru E) if it is assumed that "0" represents a ground condition and "1" represents lines connected together by the code image generator circuitry. Note that the lines connected together (the "1" condition) will not have exactly equal voltages on them. This is due to diode and transistor voltage drops in the circuit, and because the relative voltages will vary and will be within a few volts of ground while the RF Power Amplifier is tuning. These voltages will go about +24V when the tuning operation is complete.

3. ENCODER PWB ASSEMBLY A2A6A1 CIRCUIT DESCRIPTIONS

Encoder PWB A2A6A1 contains four major functional circuit groups. These are the 5-wire primary code generation circuitry, frequency change circuitry, band change circuitry, and the high level interface and code image generation circuitry. These circuits are described in detail in the following paragraphs.

3.1 Five-Wire Code Generation Circuitry

Refer to Figures 4 and 6. 10MHz, 1 MHz, and 100kHz frequency selector digit switch data from the Level Shift/Remote Control PWB A2A6A4 is applied to Encoder PWB A2A6A1 at A2A6A1P1-C and 2 (10MHz), -H,-B, -F,-K (1MHz), and -M,-8,-6,-7 (100kHz). These data inputs are inverted (by U8,U9, and U10) and applied to the inputs of read-only memory (ROM) U1. ROM U1 generates a 5-wire primary code output (present at pins 5,6,7,8, and 9 of U1). These codes, codes A, B, C, D, and E, are present at board output pins A2A6-A1P1-V,-17,-U,-16, and -T, respectively, and are used to drive the band switch of the associated power amplifier. These codes correlate with the primary band selection code data given in Table 3. Refer to Table 4 and consider the development of primary code line A. A logic "0" output occurs on line A for all frequency selector digit switch settings between 04.0 and 07.9 MHz, 10.0 and 15.9 MHz, 20.0 and 21.9 MHz, and between 26.0 and 29.9 MHz. At all other switch settings, the output is logic "1". This is generated by ROM U1. That is, a logic "0" output is generated by ROM U1 for any of the frequency selector digit switch ranges (previously stated) that require a Logic 0. The development of primary code lines B, C, D, and E can be traced in a similar manner.

3.2 Other Functions Provided by ROM U1

ROM U1 generates a high at U1-3 should the input frequency be less than 2 MHz, and a low at U1-2 should the input frequency be less than 1.5 MHz.

These outputs, routed through gates U12 (U12-1 and -3; U12-13 and -11), appear at A2A6A1P1-11, and impart frequency underrange information. If the frequency is underrange, the output at A2A6A1P1-11 is high, and keyline operation will be inhibited. If the frequency is inrange, the output at A2A6A1P1-11 is low, and keyline operation will not be affected.

Another property of ROM U1 is that should an invalid BCD input (all "0's") be applied, the ROM will generate an output of "1's". This feature prevents meaningless codes, such as those generated by the frequency selector digit switches between their detented positions, from causing incorrect tuning. The power amplifier band selector will not rotate when this condition exists.

3.3 Frequency Change Circuitry

The frequency change circuitry consists of Latch U2, part of Latch U3 (pins 1, 2, and 13), part of exclusive-OR gate U5 (pins 1 thru 6), and exclusive-OR gate U7.

Refer to Figures 4 and 6. The frequency change circuitry monitors one BCD bit from the 10MHz, 1MHz, 100kHz, and 1kHz frequency selector digit switches. (The 100Hz switch is not monitored.) Note that the bits applied to the input of latch U2 (U2-2,-3,-6,-7) are inverted from those of the frequency selector digit switches (by inverters U8-3,-4; U9-5,-6; U10-1,-2; and U10-9,-8). Because of this condition, and the inverted outputs of Latch U2, each exclusive-OR gate contained in U7, and U5-1-2 will have a "0" on one input and a "1" on the other input. This results in a high output at U7-3,-6,-8, and -11. This condition exists during normal (frequency selected-circuit operating) condition.

When a new frequency is selected, the inputs to one of the gates of U7 will become equal, resulting in a low output from U7. During the transition of U7's output from high (normal) to low the following events occur:

- Monostable multivibrator U11 is triggered (U11-1) and generates a frequency change pulse of 500 millisecond duration (U11-8). (The time constant of components C4 and R10 is of sufficient length to ensure that U11 is triggered.)

- The frequency change pulse is routed, via components R27,Q13, and pin 14 of A2A6A1P1, to Tune PWB A2A6A5, where it initiates the first part of a tune cycle.

- The high-to-low transition is also detected at gate U5 (U5-4), causing its output (U5-6), and therefore latch enables (U2-13-4 U3-13) to go high. This allows the new frequency information, reflecting the new position of the frequency selector digit switches, present at the input of latches U2 and U3-2 to be transferred to the outputs of the latches.

3.4 Band Change Circuitry

The band change circuitry consists of part of latches U3 and U4, part of exclusive-OR gate U5, and exclusive-OR gate U7. Circuit operation is similar to that of the frequency change circuitry described in paragraph 3.3. Refer to Figures 4 and 6. When the 5-wire primary code is changed (reflecting the selection of a new band), the output of gate U6 (U6-3,-6,-8,-11) will go low. (At the same time, a frequency change pulse is generated) C3 couples the negative going pulse from the output U6 to pin 2 of monostable multivibrater U11 causing U11 to generate a frequency change pulse of 360 Msec (U11-8). The time constant of capacitor C5 and the internal impedances of inverter U10-6 and NAND gate U12-4 is sufficient duration to prevent the voltage at U12-4 and U10-6 from becoming a "1" until the generation of a frequency change pulse. This prevents new frequency information from being latched until completion of the frequency change pulse.

3.5 High Level Interface and Code Image Generation Circuitry

The high level interface and code generation circuitry provides the image generation required for operation of the band switch in the associated power amplifier. Image generation requires that all ungrounded lines be connected (or shorted) together in a manner that allows current to flow in either direction. Figure 7, a simplified system tuning diagram, shows the associated power amplifier in the process of tuning from 2.0 to 2.5 MHz, and indicates two-direction current flow.

Note that the Code Image Generator Circuits will not reflect band change information until after the latches of U4 have been reset (that is, there will be no change in the Q outputs at U4-1,-14,-11, and -8) as described in paragraph 3.4.

4 STANDBY/OPERATE PWB ASSEMBLY A2A6A3 CIRCUIT DESCRIPTIONS

Standby/Operate PWB A2A6A3 transmits control signals for the system Power Amplifier, off, standby, operate and RF output mute functions; selects the active keyline and lights the STANDBY and OPERATE lamps (in A2A6S6 pushbutton assembly - see Figure 1). Refer to Figure 11 during the following descriptions.

4.1 AMPL OFF Function

When AMPL OFF is selected on the MODE selector (A2A6S1), pin 22 of Standby/Operate PWB A2A6A3 is grounded, causing a high output at Z5-8. This action leaves relay K1 deactivated and +24Vdc is not switched to the standby command line (at Pin T). When the standby Commad Line is open, the system Power Amplifier will remain off.

4.2 Standby/Operate Memory Flip-Flop Z4 Function

Memory flip-flop Z4 clocks between standby and operate states. Z4 is a J-K is type flip-flop with overriding preset and clear functions.

A low signal at clear input Z4-5 will set Z4-9 high, Z5-4 low and in turn, Z5-6 high. These operations leave relay K2 deactivated and the operate command line (pin 14) open. The presence of +24 Vdc on the standby command line (pin T) and an open operate command line places the system Power Amplifier in standby mode.

A low signal at preset input Z4-10 will set Z4-9 low. This operation will activate relay K2 and place +24Vdc on the operate command line.

Flip-flop Z4 is clocked by a pulse from the local

STANDBY/OPERATE pushbutton A2A6S6 through gate Z7-3 and (if in local control) to Z4-2. The pulse causes Z4 to change states, unless its clear or preset inputs are activated by a low signal. Changing the state of Z4 causes the system Power Amplifier to change modes; that is, either from standby to operate or operate to standby mode.

When the exciter is switched to remote control mode (LOCAL/REMOTE pushbutton A2A6S4 is depressed), the status of the local STANDBY OPERATE pushbutton (A2A6S6) is ignored (gate Z7-3 is inhibited), and direct signals on the remote standby and operate lines control Z4's clear and preset inputs. A high level on the remote standby line will be inverted by gate Z6-3, disabling remote operate gate Z3-6 and clearing Z4 (and the system) to standby mode. A high level on the remote operate line will be gated through Z3-6 if the remote standby line is low, as a low at the preset input of Z4 will place the system in operate mode.

4.3 Automatic Off Condition

If power to the exciter is lost, the +24Vdc power source will discharge, relay K1 will be deactivated, and the standby command line will open, turning off the system Power Amplifier.

4.4 Automatic Standby Conditions

Standby/Operate Memory Flip-Flop Z4 will be set to standby state (as will the system Power Amplifier be set to standby mode, if previously turned on) when:

- A system power amplifier fault occurs.
- MODE Selector A2A6S1 is placed at AMPL OFF position. This action places the system Power Amplifier in standby mode for the next initial turn-on.
- Control is changed from local to remote (depressing LOCAL/REMOTE pushbutton A2A6S6)
- The voltage on the exciter -5Vdc line drops below 3.6Vdc. This will ensure that the system will be in standby mode when it is turned on, or in standby mode after a power transient that could endanger the memory function of Z4.

The system Power Amplifier is turned off locally when pin 22 of Standby/Operate PWB A2A6A3 is grounded. The operation through Z6-8 and Z5-10 grounds the clear input of Z4, setting it to standby state. Thus, when the system is next turned on, it is in standby mode.

When the system is in remote mode, pin A of Stand-by/Operate PWB A2A6A3 is grounded, and the system Power Amplifier is turned off. Z6-11 goes high, and since Z6-6 is enabled in remote mode (at pin 4), Z6-6 goes low, Z6-8 goes high, and Z5-4 goes low. The Z5-4 low, reflected at Z4's Clear input, places it in standby state.

Switching LOCAL/REMOTE pushbutton A2A6S6 between LOCAL and REMOTE positions grounds a charged capacitor (C3 or C4, depending on switch position), causing a low-going spike at Z6-8. This places a low-going spike at Z4's clear input, placing it in standby state.

When the system power amplifier is in either standby or operate mode, the Standby Indicate or Operate Indicate Line (at P1-M or P1-P respectively) is grounded. This condition turns off Q5 and Q4 via diode CR6 or CR7. When the system power amplifier is in its warm-up cycle, both indicate lines are ungrounded, biasing on Q5 and Q4 via R8. This condition causes Q4 to saturate, causing Z6-8 to go high and Z5-10 low. Thus, flip-flop Z4 is set to standby. A time delay circuit is formed by C8 and R8, which causes a switching delay in the indicate lines while the system is changing between Standby and Operate Modes.

4.5 Output Mute Function

The exciter RF Output is keyed or unkeyed by the RF output mute line to the final amplifier in the signal path. (The RF output mute line is at pin 5 of A2A6A3P1.) The line is muted (unkeyed) when:

- The carrier frequency has been set to less than 2.0000 MHz
- The +28V interlock from the system Power Amplifier is absent, indicating that the system is not ready to tune or transmit.

A ground on P1-M from the system power amplifier sets Z1-2 high, Z2-2 low, and RF Mute gate Z3-8 high. This high at Z3-8 biases on VR1 and saturates Q2. The resulting low voltage (approximately -5.5V) at Q2 collector mutes the exciter RF output.

When the system is in operate mode, has +28V interlock, and it's frequency is not set below 2.0000MHz, all inputs to Z3 (-10, -12, -13) are high, making its output low. The low state voltage is insufficient to turn On zener diode VR1. Consequently, transistor Q2 will not conduct and the RF output mute line voltage will be pulled a few volts positive by the combined loads of resistor R5 and RF Output Module A2A7. Thus, the exciter's RF output will be keyed on.

When a frequency below 2.0000MHz has been detected by Encoder PWB A2A6A1, the board places a high at pin 10 of Standby/Operate PWB A2A6A3. In A2A6A3, this high is inverted by Z2-4, inhibiting Z3-8 and thereby turning On transistor Q2. Thus, the exciter's RF output is muted, as previously described.

When Tune PWB A2A6A5 detects that the system is either tuning or in Ready Mode, it applies a high at pin F of Standby/Operate PWB A2A6A3. This condition also mutes the exciter's RF output, as previously described.

4.6 STANDBY and OPERATE Lamp Function

The STANDBY and OPERATE Lamps of STANDBY/OPERATE pushbutton A2A6S6 display the system status. When the system PA is in standby, a ground is applied at P1-M. This ground is inverted three times (via Z1-2, Z2-2 and Z2-12 respectively). When the output of Z2-12 is high, Q1 is saturated. This causes the STANDBY lamp to illuminate. Similarly, when the system PA is in Operate Mode P1-P is grounded, illuminating the OPERATE lamp.

4.7 Remote Standby and Operate Indicate Functions

Gates Z2-10 and Z7-6 provide standby and operate indicate outputs, for use with the optional Remote Control Units. These outputs are routed to the Remote Control Units via A1J7-p and -q. Refer to Figure 2.

4.8 Exciter Ready Function

When the system is in Operate Mode, Tune PWB A2A6A5 recognizes that the system is ready and that the frequency is not set below 2.0000MHz. The appropriate channels and keylines are activated by the Mode Select PWB A2A6A2 in response to a ground condition (Exciter Ready Line) from Standby/Operate PWB A2A6A3..

There are three conditions required for the generation of the exciter ready ground. These are:

- Standby/Operate Memory Flip-Flop Z4 must be in operate state
- Tune PWB A2A6A5's memory of the most recent grounding of the keyline has caused the +28V interlock, which, in turn, has caused a high on the ready interconnect line of Standby/Operate PWB A2A6A3
- The frequency is not underrange

5 TUNE PWB ASSEMBLY A2A6A5 CIRCUIT DESCRIPTIONS

Tune PWB A2A6A5 monitors frequency changes, TUNE pushbutton (TUNE portion of TUNE/READY pushbutton A2A6S5) closures, local/remote control changes, and other situations that require the retuning of the system transmitter. Refer to Figure 13 during the following descriptions.

5.1 System Tune Cycle

The tune cycle is initiated by the operator, who gives the tune command by depressing TUNE/READY pushbutton A2A6S5. (The tune command will be ignored unless the Operate Lamp is illuminated).

When the TUNE/READY pushbutton is depressed, the TGC Attenuator circuit of the RF Output Module A2A7 will be at maximum attenuation and Tune 1 from the PA will be connected, via K1, to Tune 2. After the TUNE/READY pushbutton is depressed, the TUNE PWB will wait for a Tune Enable ground (from the PA) to be applied to P1-E. The Tune Enable will;

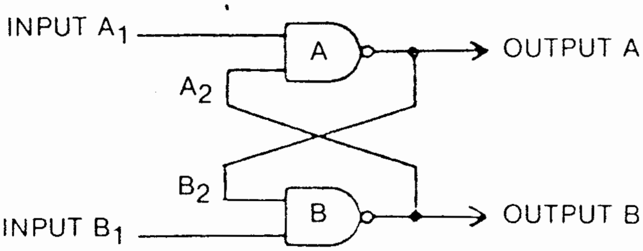
- Unmute the RF Output Module A2A7
- Remove the TGC Reset
- Enable the TGC Counter and the TGC Attenuator.
- Allow the transfer of the Exciter Tune signal to the Mode Select PWB.
- Remove the PA inhibit.

The Mode Select PWB will use the Exciter Tune signal to key the system, and allow the Combiner Module to supply a Tune Level Carrier.

When the tune cycle has been completed, the Tune Enable ground from the PA will disappear, as will the Exciter Tune signal. The TGC Attenuator setting will be held at that level, Tune 1 and Tune 2 lines will be opened, and the RF Output Module will be muted.

The Tune PWB will now await a ground on the PA Ready Line (P1-F). This ground on P1-F will unmute the RF Output Module, send a ready signal (via P1-11) to Standby/Operate PWB, and cause the READY Lamp to illuminate.

Tune PWB has two latches that act as memories, that is, retaining a previously set state. Referring to Figure 13, these latches are identified as a tune latch, consisting of Z5-6 and Z2-11 and an inhibit latch consisting of Z4-8 and Z7-6. Z5-6, Z2-11, Z4-8 and Z7-6 are NAND gates.



When two NAND gate outputs are connected together, as shown above, a latch or memory circuit is formed.

A low at INPUT A will cause Gate A's output to be high. (A low on either A_1 or A_2 will also cause OUTPUT A to be high.) This high is routed to input B_2. If INPUT B_1 is not being held low, Gate B will recognize all high inputs and OUTPUT B will be low. The low OUTPUT B will hold input A_2 low. If the low at INPUT A_1 disappears, nothing happens (that is, no change in state occurs), as input A_2 is still being held low. When a low at INPUT B_1 occurs, the latch will be changed in some manner. If both INPUT A_1 AND INPUT B_1 are held low, both OUTPUT A and OUTPUT B will be high. The input that goes high last will set the latch.

5.2 Inhibit Latch Function

When a frequency change occurs, a ground pulse will be applied, via P1-1, to Z7-2. Depressing the TUNE/READY pushbutton A2A6S5 will cause a ground pulse to be applied (via P1-A, Z8-3 and Z8-6), to Z7-3. A Fault pulse is applied, via P1-B, to Z7-4. (This Fault pulse is caused by: switching from remote to local or vice-versa, a fault condition, or the absence of any Standby or Operate Indicate signals). A ground on any Z7-2, Z7-3 or Z7-4 input, will latch Z7-6 high. This high forces Z9-4 low, energizing relay K2, grounding the PA Inhibit Line (P1-Z), inhibiting the power amplifier.

When the TUNE/READY pushbutton is depressed, the Tune Latch (Z5-6 and Z2-11) is reset. These conditions, along with the high at Z7-9, cause the output of Z7-8 to go low. When this occurs:

- The TGC Attenuator is reset to maximum by the low at P1-13.

- The output of Z9-8 is Low, energizing relay K1 connecting Tune 1 to Tune 2.

After the Tune 1 and Tune 2 Lines are connected, the system PA will apply a ground to the Tune Enable Line at P1-E. This causes the output at Z3-6 to go high and the output at Z4-6 to go Low. Resetting the Inhibit Latches cause the output at Z4-8 to go high. If no fault condition exists, no frequency change indicated and no TUNE/READY closure has occurred, the Inhibit Latch output at Z7-6 will go Low.

When the output of Z4-6 is Low, the transmitter tune cycle starts, and the following events occur:

- The Low at Z4-9 resets the Inhibit Latch. Consequently, relay K2 is de-energized, opening the PA Inhibit Line at P1-Z.

- The Low at Z4-6 is reflected at P1-9, where it is routed (as an Exciter Tune Command) to the Mode Select PWB for keying and setting the Tune Carrier Level of the Combiner Module A2A12.

- The Low at Z4-6 is also reflected at P1-11, where it is routed (as a TGC Enable signal) to Up-Converter Module A2A5, enabling its TGC clock oscillator and activating the TGC Loop.

- The Tune 1/Tune 2 Line connection is maintained by relay K1.

- The RF Output Module A2A7 is unmuted, as the Low at Z4-6 causes Z3-4 to go high, removing the mute signal (via P1-12) from the Standby/Operate PWB A2A6A3, and turning on the system RF amplifier.

When the system Tune cycle has been completed, the ground on the Tune Enable Line is removed, causing the output at Z4-6 to go high. The high output at Z4-6 will cause the following:

- The Inhibit Latch remains unlatched

- The Exciter Tune Command (at P1-9) to the Mode Select PWB A2A6A2 is removed

- The connection between Tune 1/Tune 2 Lines is broken.

- The RF Output Module A2A7 is muted

When the system is in the Ready mode, the system PA will ground the PA Ready Line at P1-F. This condition unmutes the exciter, and illuminates the READY Lamp.

5.3 Tune Latch Function

The Tune Latch circuit prevents a Tune Enable ground (at P1-E) from resetting the Inhibit Latch (to its uninhibit state) until the TUNE/READY pushbutton is depressed. This prevents the system from going through a Tune cycle until commanded to do so by the radio operator, even if the Tune Enable ground is present.

When the Inhibit Latch circuit is set to the Inhibit state by a fault condition, the Tune Latch circuit is also set (by the conditions at Z5-4 and Z5-2) causing a high output at Z5-6. When the TUNE/READY pushbutton has not been depressed (no Tune Closure), the high at Z5-6 is inverted at Z2-8, and is applied to Z4-3. Thus, the Tune Enable Line condition cannot reset the Inhibit Latch.

When the TUNE/READY pushbutton is depressed (Tune Closure), the Tune Latch circuit is reset by a low at Z2-13. Thus, the inhibit at Z4-3 is removed.

5.4 Tune Pulse Function

The Local TUNE/READY pushbutton input at P1-A or the Remote Tune Pulse at P1-D is selected at Z8-3 and Z8-11 in response to the status of the Local or Remote Lines P1-16 and P1-2 respectively. The Tune Pulse is routed, via Z8-6 to the Tune and Inhibit Latches only if the system is in the Operate Mode (a high on the Operate Line P1-L).

5.5 Tune Lamp Function

The Tune Lamp in the TUNE/READY pushbutton A2A6S5 illuminates when the Tune Latch circuit is set (the circuit is awaiting a reset by a tune closure — depresing the TUNE/READY pushbutton). Thus, if the TUNE Lamp is illuminated, the TUNE/READY pushbutton must be depressed in order to execute a system Tune Cycle.

NOTE

The Local TUNE/READY pushbutton and its Lamps are inoperative when a remote control unit is used.

5.6 CW Hold Function

The CW Hold circuit provides an adjustable delay to hold the system keyed for a small period after the CW Key has been removed. When the CW key is open, current flows from the +5 volt supply through R8 and R9 and CR11 to turn on Q3 and Q4, unkeying the Mode PWB.

When the CW Key is closed, C3 is quickly discharges through CR12 and Tune PWB pin W to ground so no current flows through the base-emitter junctions of Q3 and Q4. The collector of Q4 draws no current from Mode PWB and the system is keyed. When the key is lifted, capacitor C3 starts to charge from 0.7 volts through resistor R8 and R9 toward the +5 volt supply. Since C3 is charging through a resistance it takes a period of time to charge to the 2 volt level required to turn on all three silicon junctions (CR11, Q3 base-emitter, Q4 base-emitter). While Q4 is off, the system key is held closed by the Mode PWB. This charging time is the basis of the CW Hold circuit.

6. MODE SELECT PWB ASSEMBLY A2A6A2 CIRCUIT DESCRIPTIONS

Mode Select PWB A2A6A2 decodes and switches local and remote control inputs, keys the system Power Amplifier, enables the sideband channels, sets the sideband channel attenuation, and sets the carrier level. Refer to Figure 9 during the following descriptions.

6.1 Level Shifting Function

The logic levels used in the Control Head are standard DTL/TTL levels; 0.8V or less is recognized as a low level and 2.0V or more is recognized as a high level. However, Combiner Module A2A12 is controlled by signals whose high is recognized as +2.0V or more, and whose low is recognized as −4V or less. Mode Select PWB A2A6A2 employs high-threshold logic to translate from standard DTL/TTL levels to those required by the module.

Refer to Figure 9. High-threshold integrated circuits Z10, Z15, and Z16 recognize 6.5V or less above the common terminal as a low, and 8.5V or more above the common terminal as a high. By connecting the common terminal to −6V instead of ground, the low level input becomes +0.5V or less, because +6.5V above −6V equals +0.5V. For the same reason, the high level input is ±2.5V or more, because 8.5V above −6V equals +2.5V. These voltages/limits are sufficiently close to the DTL/TTL levels to allow the circuits to operate properly. The high-threshold logic output is −5V for a low level, and +5V (through a 1.5K pull-up resistor) for a high level. These levels are compatible with the requirements of Combiner Module A2A12.

6.2 Mode Control Function

The mode control input consists of three local and three remote lines. From Figure 9, these lines are shown as local A mode, local B mode, and local C mode lines A2A6A2P1-B, C, and D, respectively), and remote A mode, remote B mode, and remote C mode lines (A2A6A2P1-H, K, and J, respectively).

The three local mode control lines are selected through gates Z1-3, -6, and -11; the three remote mode control lines through gates Z5-3, -6, and -11. The selection process is accomplished through the local/remote switching input at A2A6A2P1-L and inverter Z5-8.

TABLE 5. BINARY CODING OF LOCAL/REMOTE CONTROL LINES A, B AND C.

Mode	Mode Control Line		
	A	B	C
OFF	1	1	1
RATT	1	0	0
AME	0	1	0
CW	0	0	0
USB	1	1	0
LSB	0	0	1
2ISB	1	0	1
4ISB	0	1	1

The outputs of each corresponding local and remote mode gate (for example, local A mode gate Z1-11 and remote mode gate Z5-11) are "wired-AND," that is, connected together. Consequently, if either gate produces a "0," the output will go low. For example, if the switching input at A2A6A2P1-L is local, one input of the three remote gates is grounded by Z5-8, forcing the remote gate outputs to go high. However, these outputs can be pulled down by the local gates, in response to the inputs on the local mode lines. These outputs, are the inverse of the mode code. They are subsequently re-inverted to provide normal mode levels by inverters Z1-8, Z2-11 and Z2-8, respectively. The inverted and noninverted mode control levels are routed to logic circuitry that converts them to the desired output signals. Level shifters provide output levels compatible with the requirements of Combiner Module A2A12.

6.3 Carrier Level Control Function

The carrier level control input consists of two local and two remote lines, coded as shown in Table 6. From Figure 9, these lines are shown as local D carrier and local E carrier lines (A2A6A2P-E and A, respectively), and remote D carrier and remote E carrier lines (A2A6A2P1-F and M, respectively).

The two local carrier level control lines are selected through gates Z2-3 and -6; the two remote carrier level control lines through gates Z6-3 and -6. The selection process is accomplished through the Local/Remote switching input at A2A6A2P1-L and inverter Z5-8.

The input carrier level codes are allowed to control the carrier if the exciter is in ready mode and a switchable carrier mode is selected. The output carrier level is determined by the mode logic for non-switchable carrier modes (specifically, RATT, AME and CW modes). The output carrier Level Signals are level-shifted for Combiner Module A2A12 control. The significant levels in the carrier logic are shown in Table 6.

TABLE 6. CODING OF LOCAL/REMOTE CARRIER LEVEL CONTROL LINES D AND E.

System Carrier Level	Carrier Level Control Line Binary Coding	
	D	E
∞ dB	1	1
−20dB	0	1
−10dB	0	0

6.4 System Keying Function

Mode Select PWB A2A6A2 keys the system and system Power Amplifier through relay K1 (and Keyline connection A2A6A2P1-1) when the exciter is in tune cycle, or is ready and keyed by one of the four appropritate keys as shown in Table 7. Keying relay K1 is driven by a lamp-driver type of integrated circuit that has a 30V output rating (sufficient to withstand the +24Vdc applied to the relay).

TABLE 7. KEYING THAT CONTROLS THE SYSTEM POWER AMPLIFIER BIAS KEY

System Control Mode	CW and RATT Operation Modes Controlled By	AME, USB, LSB, 2 ISB, and 4ISB Controlled By
Local	Local CW/RATT Key	Local PTT Switch Keylines
Remote	Remote CW/RATT Key	Remote Sideband Keyline

6.5 Lamp Driver Function

The lamp driver circuit consists of either 30V DTL logic or a grounded-emitter transistor Q1, whose collector is connected to the lamps. When the logic driving Q1 is high, the current through R1 and Q1's base-emitter turns on Q1, driving it into saturation. This condition grounds one side of the lamps, turning them on. When the logic input to Q1 is low, it grounds the base of Q1 through the collector of a saturated transistor inside, turning Q1 Off and extinguishing the lamps.

7 MAINTENANCE PARTS LIST

Table 8 is a list of maintenance parts for the A2A6 Control Head Module. Manufacturers therein are referenced by a five-number code. The correlation of these codes to the appropriate manufacturers, and the manufacturer's names and addresses is contained in Part 6 of this manual.

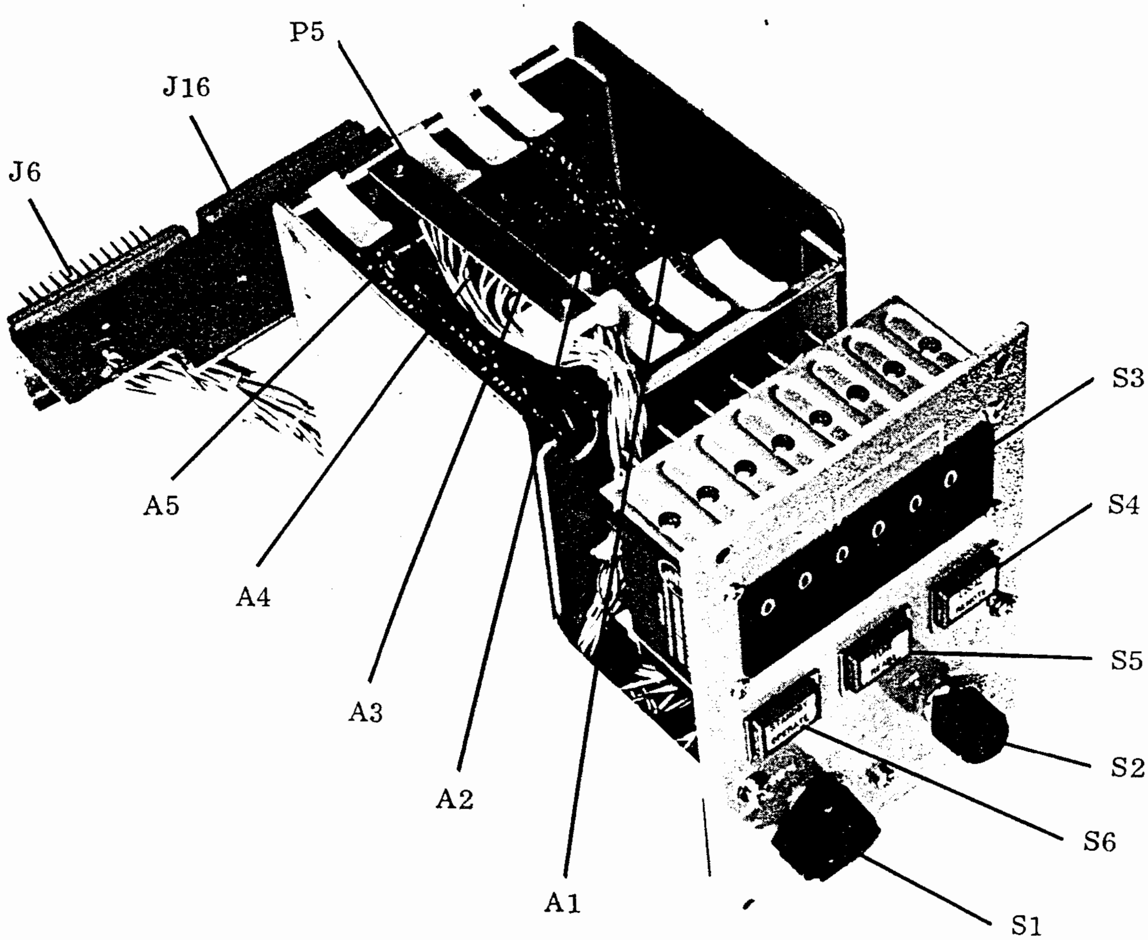


Figure 1. Control Head Component Locations

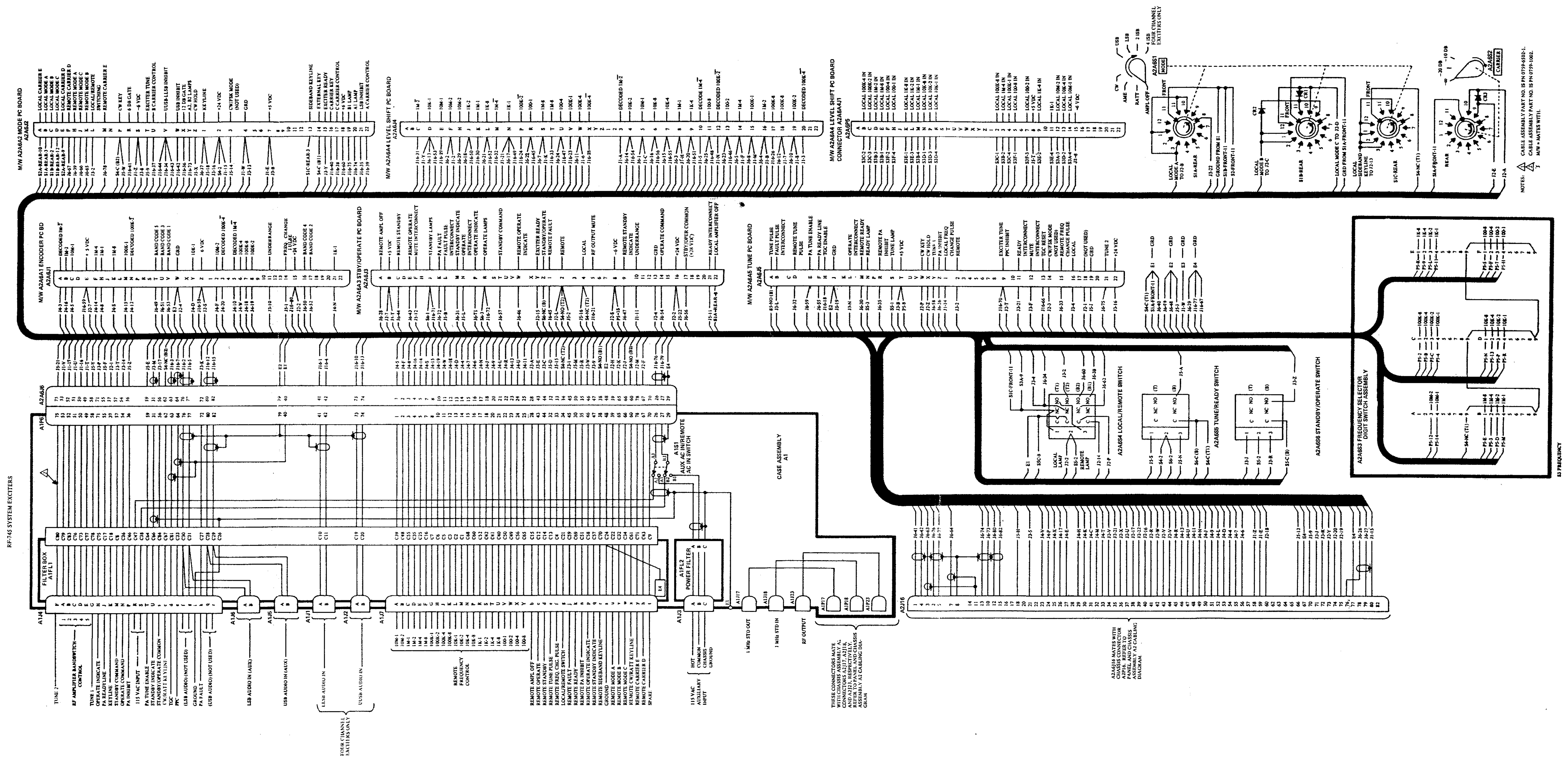


Figure 2. Control Head Wiring Diagram

Binary Input Data A9 A4 A3 A2 A1 A0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=1;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=1;A5=1 D7–D0
0 0 0 0 0 0	△1	11111110	△1	11111110	△1	11111110	△1	11111110	△1	11111110	△1	11111110	△1	11111110	△1	11111110
0 0 0 0 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 0 0 1 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 0 0 1 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 0 1 0 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 0 1 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 0 1 1 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 0 1 1 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 1 0 0 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 1 0 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
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0 0 1 0 1 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
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0 0 1 1 1 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 1 1 1 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
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0 1 0 0 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 1 0 0 1 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
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0 1 0 1 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 1 0 1 1 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 1 0 1 1 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 1 1 0 0 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 1 1 0 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 1 1 0 1 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 1 1 0 1 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 1 1 1 0 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 1 1 1 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 1 1 1 1 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 1 1 1 1 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110

Binary Input Data A9 A4 A3 A2 A1 A0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=1;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=1;A5=1 D7–D0
0 0 0 0 0 0	△1	11111110	△1	11111110	△1	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110
0 0 0 0 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 0 0 1 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 0 0 1 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 0 1 0 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 0 1 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
0 0 0 1 1 0		11111110		11111110		11111110	29.9	01111001	27.9	00111001	25.9	10011001	23.9	11001001	21.9	01100001
0 0 0 1 1 1		11111110		11111110		11111110	29.8	01111001	27.8	00111001	25.8	10011001	23.8	11001001	21.8	01100001
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0 0 1 0 0 1		11111110		11111110		11111110	29.6	01111001	27.6	00111001	25.6	10011001	23.6	11001001	21.6	01100001
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0 1 0 1 1 0		11111110		11111110		11111110	28.9	01111001	26.9	00111001	24.9	10011001	22.9	11001001	20.9	01100001
0 1 0 1 1 1		11111110		11111110		11111110	28.8	01111001	26.8	00111001	24.8	10011001	22.8	11001001	20.8	01100001
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0 1 1 0 1 0		11111110		11111110		11111110	28.5	01111001	26.5	00111001	24.5	10011001	22.5	11001001	20.5	01100001
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0 1 1 1 0 1		11111110		11111110		11111110	28.2	01111001	26.2	00111001	24.2	10011001	22.2	11001001	20.2	01100001
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0 1 1 1 1 1		11111110		11111110		11111110	28.0	01111001	26.0	00111001	24.0	10011001	22.0	11001001	20.0	01100001

NOTES

1. BINARY INPUT DATA FROM 0000000000 THRU 0101100101 ARE NOT WITHIN THE OPERATING RANGE OF THE EQUIPMENT. THE OUTPUT CODE FOR ALL BINARY NUMBERS WITHIN THIS RANGE IS 11111110.
2. THIS GROUP OF BINARY DATA IS NOT WITHIN THE OPERATING RANGE OF THE EQUIPMENT, AND IS REPRESENTATIVE OF BETWEEN-FREQUENCY POSITIONING OF THE FREQUENCY SELECTOR DIGIT SWITCHES.
3. THIS DATA IS NOT WITHIN THE OPERATING RANGE OF THE EQUIPMENT. IT MERELY DEFINES THE OUTPUT CODE FOR ALL POSSIBLE BINARY NUMBERS OF MEMORY LOCATION.

Binary Input Data A9 A4 A3 A2 A1 A0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=0 A6=1;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=0;A7=1 A6=1;A5=1 D7–D0
1 0 0 0 0 0	△1	11111110	△1	11111110	△1	11111110	△3	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110
1 0 0 0 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 0 0 0 1 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
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1 0 0 1 1 0		11111110		11111110		11111110	19.9	10110001	17.9	11011001	15.9	01101101	13.9	00110101	11.9	00011101
1 0 0 1 1 1		11111110		11111110		11111110	19.8	10110001	17.8	11011001	15.8	01101101	13.8	00110101	11.8	00011101
1 0 1 0 0 0		11111110		11111110		11111110	19.7	10110001	17.7	11011001	15.7	01101101	13.7	00110101	11.7	00011101
1 0 1 0 0 1		11111110		11111110		11111110	19.6	10110001	17.6	11011001	15.6	01101101	13.6	00110101	11.6	00011101
1 0 1 0 1 0		11111110		11111110		11111110	19.5	10110001	17.5	11011001	15.5	01101101	13.5	00110101	11.5	00011101
1 0 1 0 1 1		11111110		11111110		11111110	19.4	10110001	17.4	11011001	15.4	01101101	13.4	00110101	11.4	00011101
1 0 1 1 0 0		11111110		11111110		11111110	19.3	10110001	17.3	11011001	15.3	01101101	13.3	00110101	11.3	00011101
1 0 1 1 0 1		11111110		11111110		11111110	19.2	10110001	17.2	11011001	15.2	01101101	13.2	00110101	11.2	00011101
1 0 1 1 1 0		11111110		11111110		11111110	19.1	10110001	17.1	11011001	15.1	01101101	13.1	00110101	11.1	00011101
1 0 1 1 1 1		11111110		11111110		11111110	19.0	10110001	17.0	11011001	15.0	01101101	13.0	00110101	11.0	00011101
1 1 0 0 0 0		11111110		11111110		11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110
1 1 0 0 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 1 0 0 1 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 1 0 0 1 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 1 0 1 0 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 1 0 1 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 1 0 1 1 0		11111110		11111110		11111110	18.9	10110001	16.9	11011001	14.9	01101101	12.9	00110101	10.9	00011101
1 1 0 1 1 1		11111110		11111110		11111110	18.8	10110001	16.8	11011001	14.8	01101101	12.8	00110101	10.8	00011101
1 1 1 0 0 0		11111110		11111110		11111110	18.7	10110001	16.7	11011001	14.7	01101101	12.7	00110101	10.7	00011101
1 1 1 0 0 1		11111110		11111110		11111110	18.6	10110001	16.6	11011001	14.6	01101101	12.6	00110101	10.6	00011101
1 1 1 0 1 0		11111110		11111110		11111110	18.5	10110001	16.5	11011001	14.5	01101101	12.5	00110101	10.5	00011101
1 1 1 0 1 1		11111110		11111110		11111110	18.4	10110001	16.4	11011001	14.4	01101101	12.4	00110101	10.4	00011101
1 1 1 1 0 0		11111110		11111110		11111110	18.3	10110001	16.3	11011001	14.3	01101101	12.3	00110101	10.3	00011101
1 1 1 1 0 1		11111110		11111110		11111110	18.2	10110001	16.2	11011001	14.2	01101101	12.2	00110101	10.2	00011101
1 1 1 1 1 0		11111110		11111110		11111110	18.1	10110001	16.1	11011001	14.1	01101101	12.1	00110101	10.1	00011101
1 1 1 1 1 1		11111110		11111110		11111110	18.0	10110001	16.0	11011001	14.0	01101101	12.0	00110101	10.0	00011101

Binary Input Data A9 A4 A3 A2 A1 A0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=0 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=0;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=0;A5=1 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=1;A5=0 D7–D0	Sel. Freq. (MHz)	Output Data A8=1;A7=1 A6=1;A5=1 D7–D0
1 0 0 0 0 0	△3	11111110	△3	11111110	△3	11111110	△3	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110
1 0 0 0 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 0 0 0 1 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 0 0 0 1 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 0 0 1 0 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 0 0 1 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 0 0 1 1 0		11111110		11111110		11111110	9.9	10001101	7.9	01000101	5.9	00010101	3.9	10000101	1.9	11111111
1 0 0 1 1 1		11111110		11111110		11111110	9.8	10001101	7.8	01000101	5.8	00010101	3.8	10000101	1.8	11111111
1 0 1 0 0 0		11111110		11111110		11111110	9.7	10001101	7.7	01000101	5.7	00010101	3.7	10000101	1.7	11111111
1 0 1 0 0 1		11111110		11111110		11111110	9.6	10001101	7.6	01000101	5.6	00010101	3.6	10000101	1.6	11111111
1 0 1 0 1 0		11111110		11111110		11111110	9.5	10001101	7.5	01000101	5.5	00010101	3.5	10000101	1.5	11111111
1 0 1 0 1 1		11111110		11111110		11111110	9.4	10001101	7.4	01000101	5.4	00010101	3.4	11000101	1.4	11111110
1 0 1 1 0 0		11111110		11111110		11111110	9.3	10001101	7.3	01000101	5.3	00010101	3.3	11000101	1.3	11111110
1 0 1 1 0 1		11111110		11111110		11111110	9.2	10001101	7.2	01000101	5.2	00010101	3.2	11000101	1.2	11111110
1 0 1 1 1 0		11111110		11111110		11111110	9.1	10001101	7.1	01000101	5.1	00010101	3.1	11000101	1.1	11111110
1 0 1 1 1 1		11111110		11111110		11111110	9.0	10001101	7.0	01000101	5.0	00010101	3.0	11000101	1.0	11111110
1 1 0 0 0 0		11111110		11111110		11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110	△2	11111110
1 1 0 0 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 1 0 0 1 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 1 0 0 1 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 1 0 1 0 0		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 1 0 1 0 1		11111110		11111110		11111110		11111110		11111110		11111110		11111110		11111110
1 1 0 1 1 0		11111110		11111110		11111110	8.9	10001101	6.9	00100101	4.9	00001101	2.9	11100101	0.9	11111110
1 1 0 1 1 1		11111110		11111110		11111110	8.8	10001101	6.8	00100101	4.8	00001101	2.8	11100101	0.8	11111110
1 1 1 0 0 0		11111110		11111110		11111110	8.7	10001101	6.7	00100101	4.7	00001101	2.7	11100101	0.7	11111110
1 1 1 0 0 1		11111110		11111110		11111110	8.6	10001101	6.6	00100101	4.6	00001101	2.6	11100101	0.6	11111110
1 1 1 0 1 0		11111110		11111110		11111110	8.5	10001101	6.5	00100101	4.5	00001101	2.5	11100101	0.5	11111110
1 1 1 0 1 1		11111110		11111110		11111110	8.4	10001101	6.4	00100101	4.4	00001101	2.4	11110101	0.4	11111110
1 1 1 1 0 0		11111110		11111110		11111110	8.3	10001101	6.3	00100101	4.3	00001101	2.3	11110101	0.3	11111110
1 1 1 1 0 1		11111110		11111110		11111110	8.2	10001101	6.2	00100101	4.2	00001101	2.2	11110101	0.2	11111110
1 1 1 1 1 0		11111110		11111110		11111110	8.1	10001101	6.1	00100101	4.1	00001101	2.1	11110101	0.1	11111110
1 1 1 1 1 1		11111110		11111110		11111110	8.0	10001101	6.0	00100101	4.0	00001101	2.0	11110101	0.0	11111110

TABLE 4. ROM PROGRAM BINARY FREQUENCY TABLE

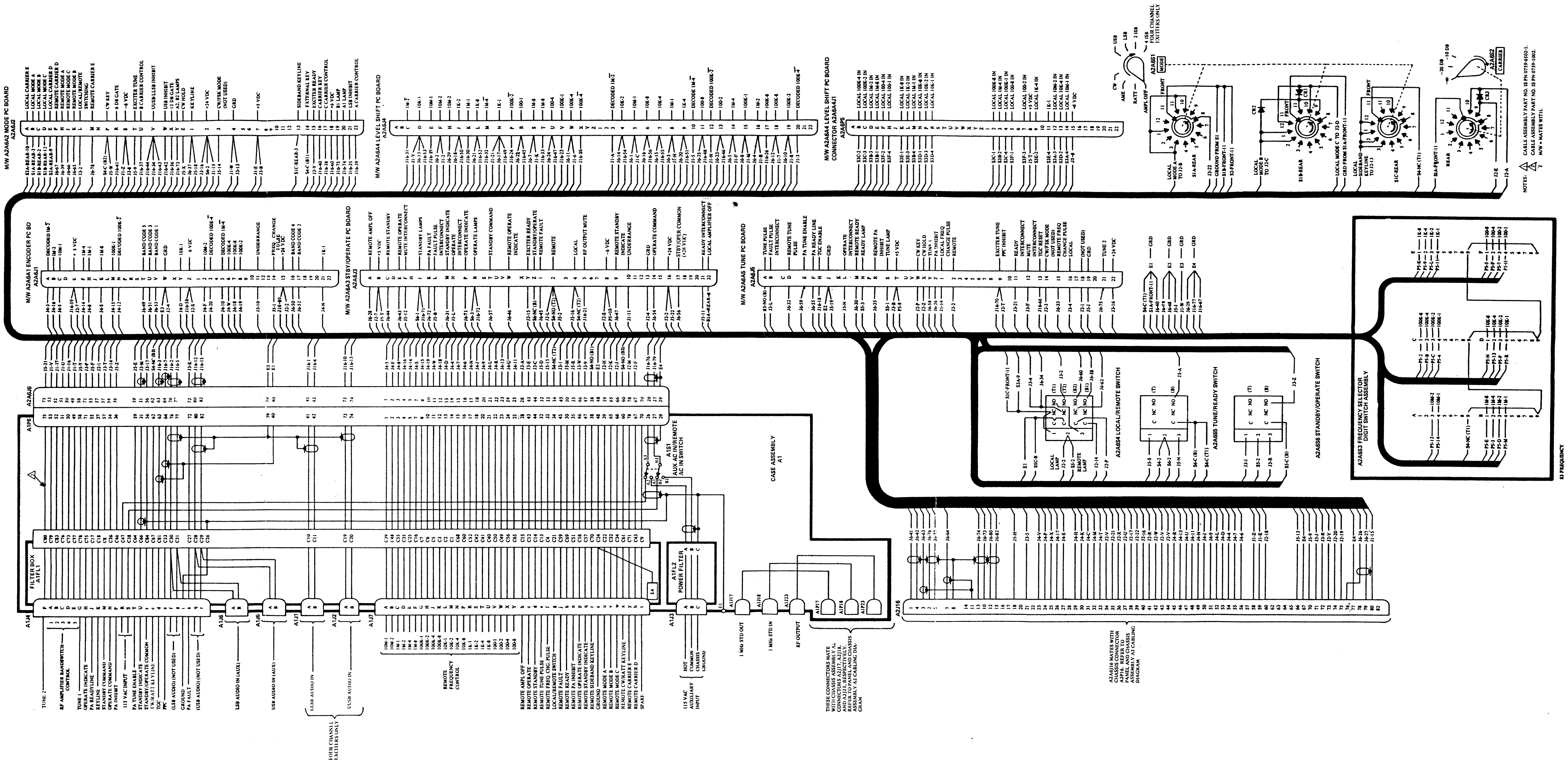


Figure 2. Control Head Wiring Diagram

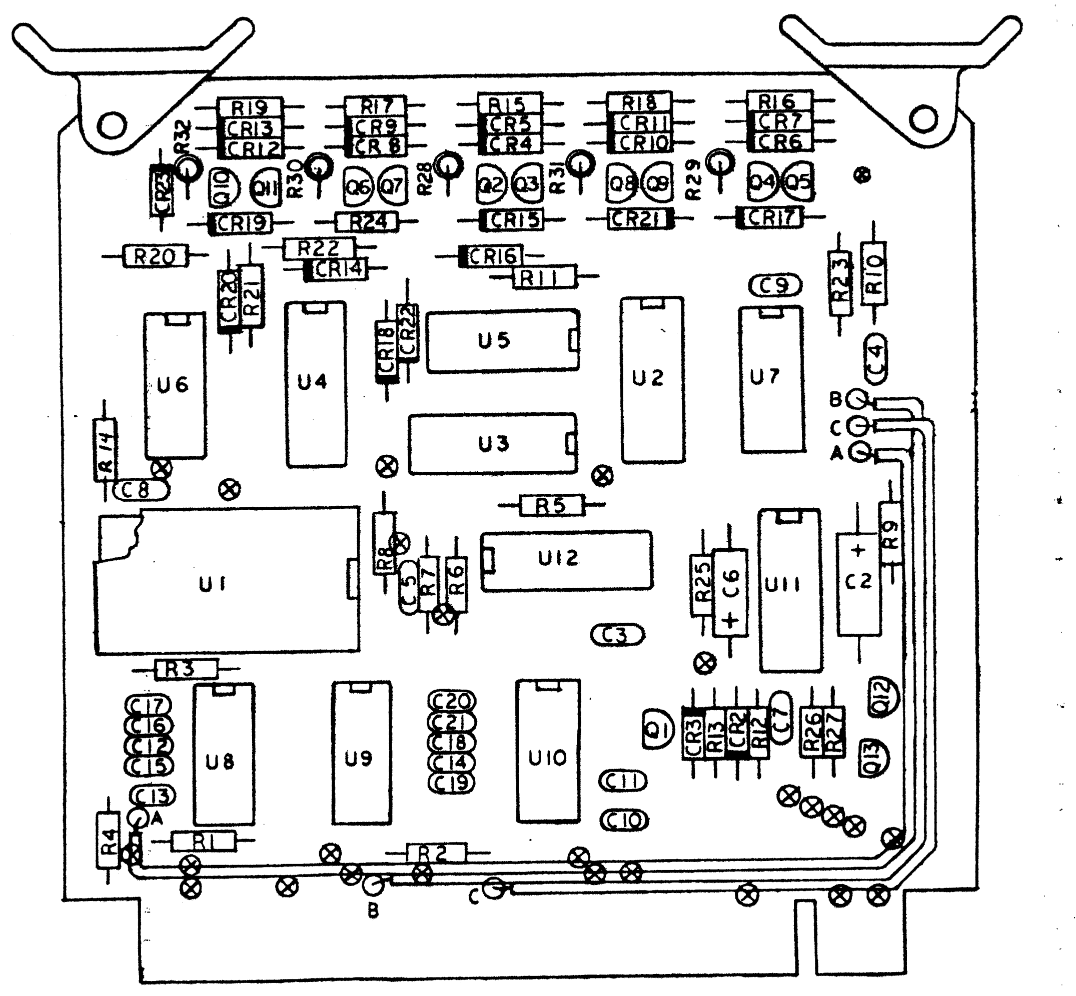


Figure 3. Encoder PWB Component Location Drawing

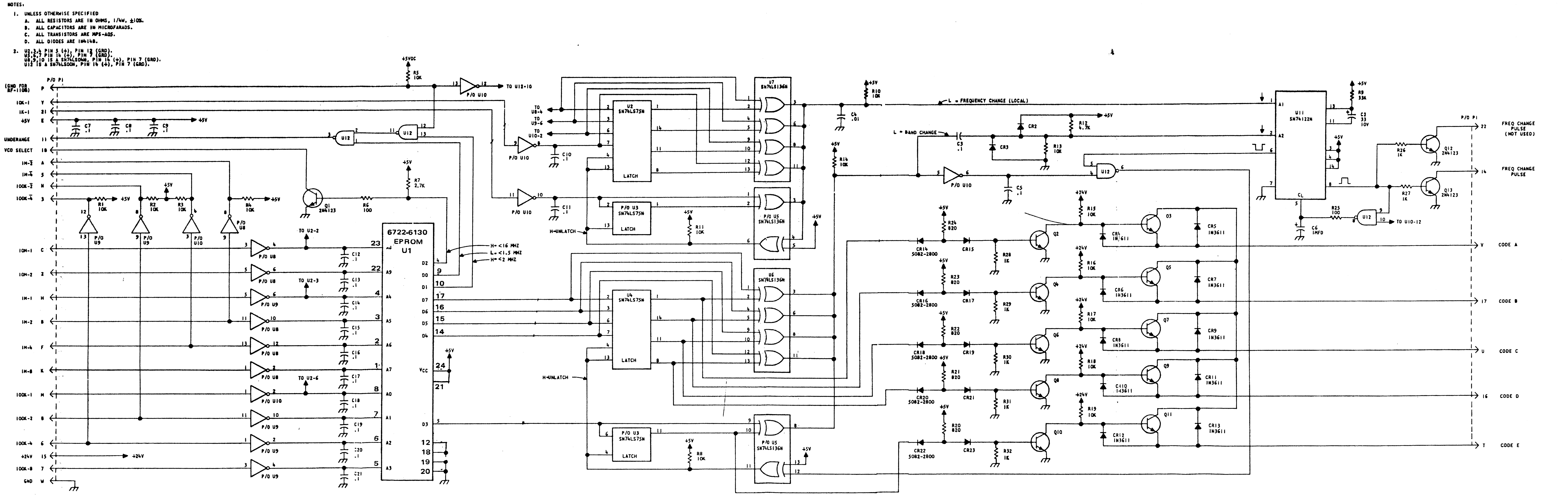


Figure 4. Encoder PWB A2A6A1 Schematic Diagram

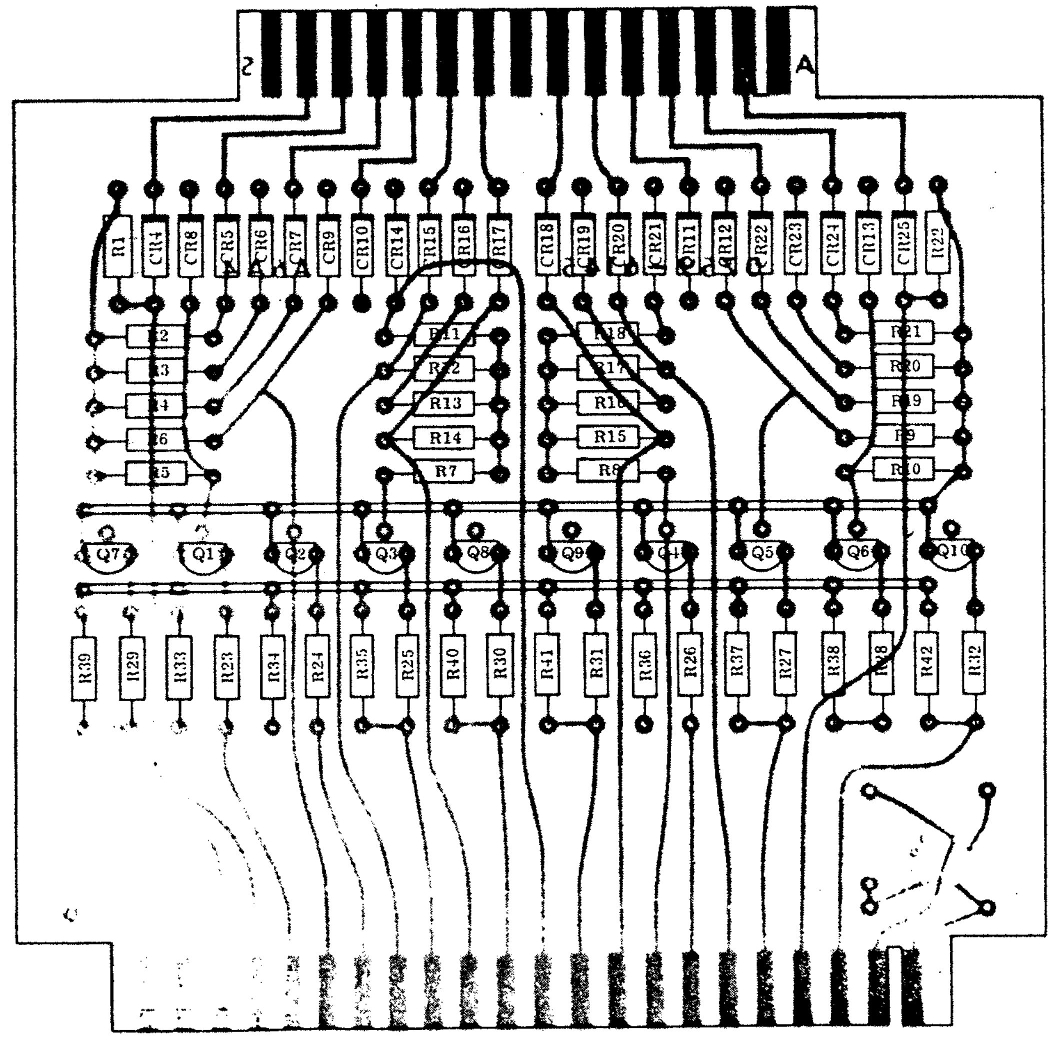


Figure 5. Level Shift/Remote Control PWB Component Location Drawing

0759-6147

NOTES:
1. PARTIAL REF DESIGNATIONS ARE SHOWN. PREFIX WITH A2A6A4
2. UNLESS OTHERWISE SPECIFIED:
   a. ALL DIODES ARE IN277
   b. ALL RESISTORS ARE IN OHMS, ±10%, 1/4W
   c. ALL TRANSISTORS ARE 2N4123

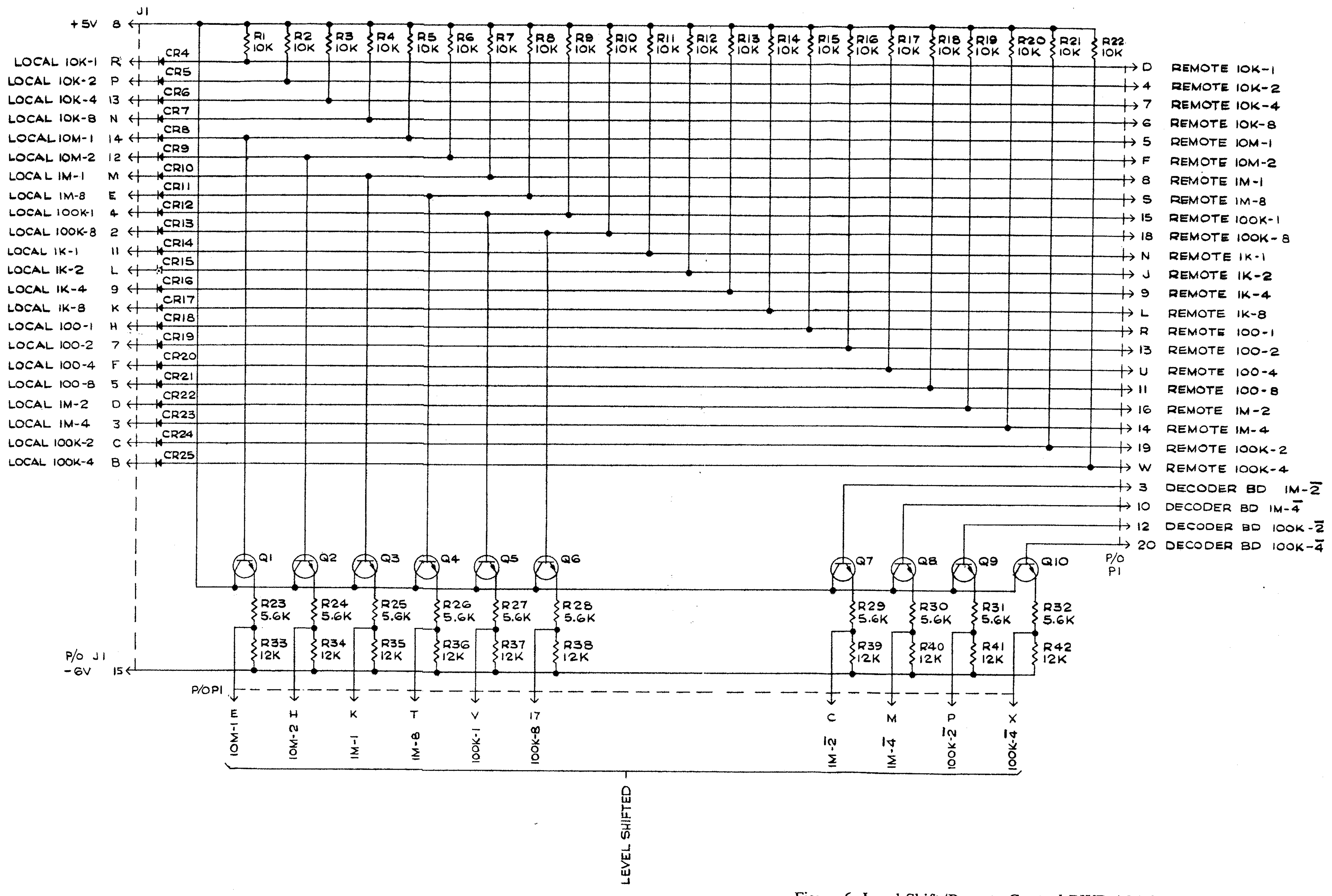


Figure 6. Level Shift/Remote Control PWB A2A6A4 Schematic Diagram

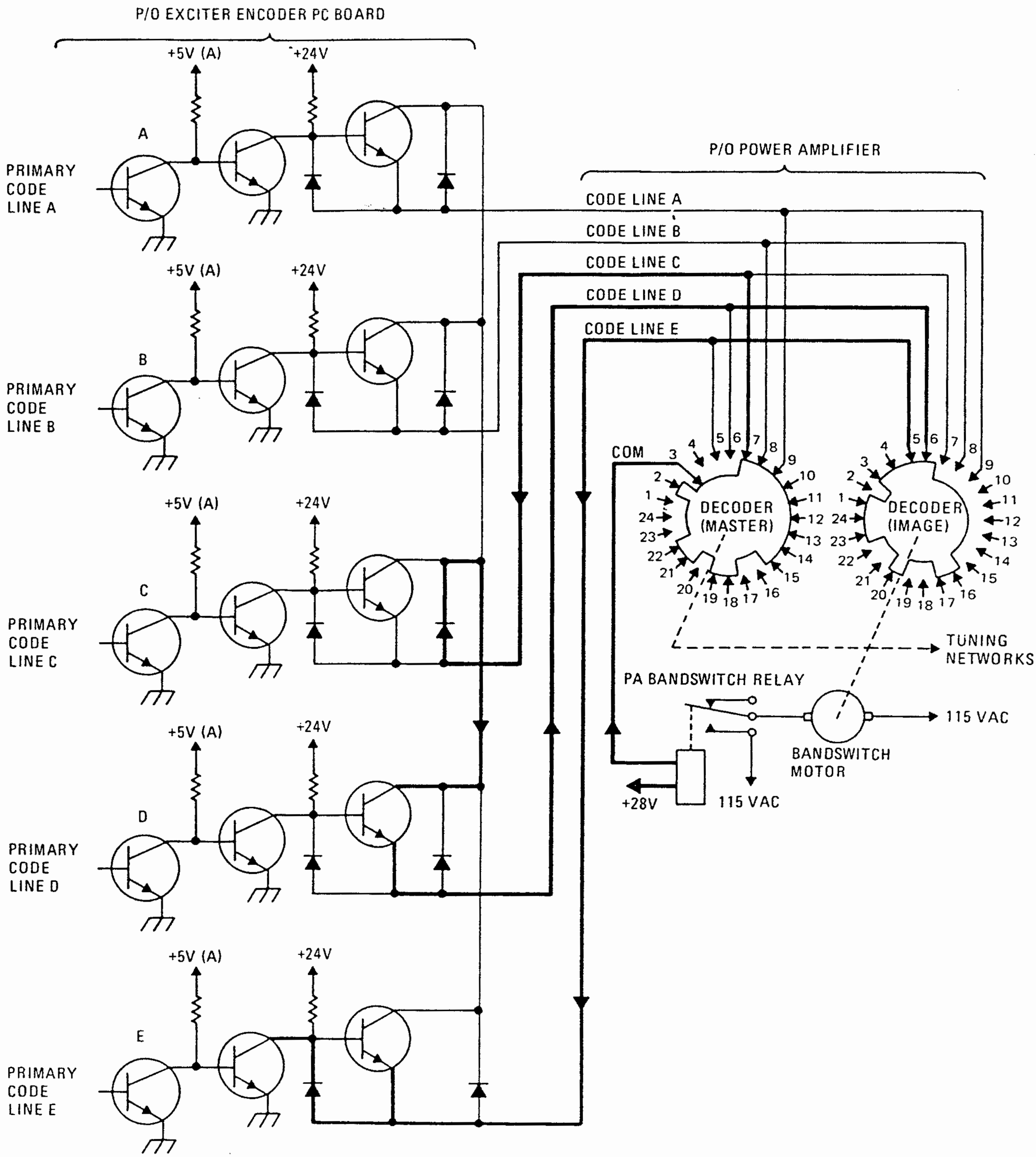


Figure 7. Simplified System Tuning Diagram

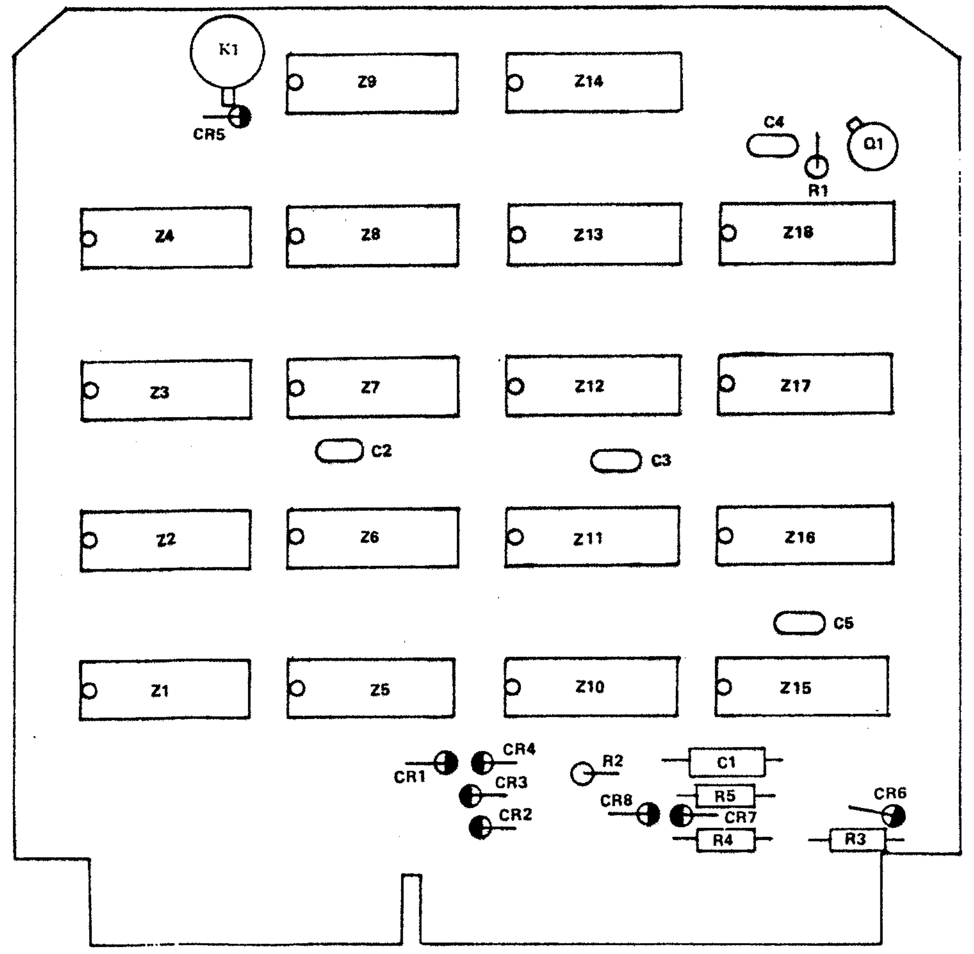
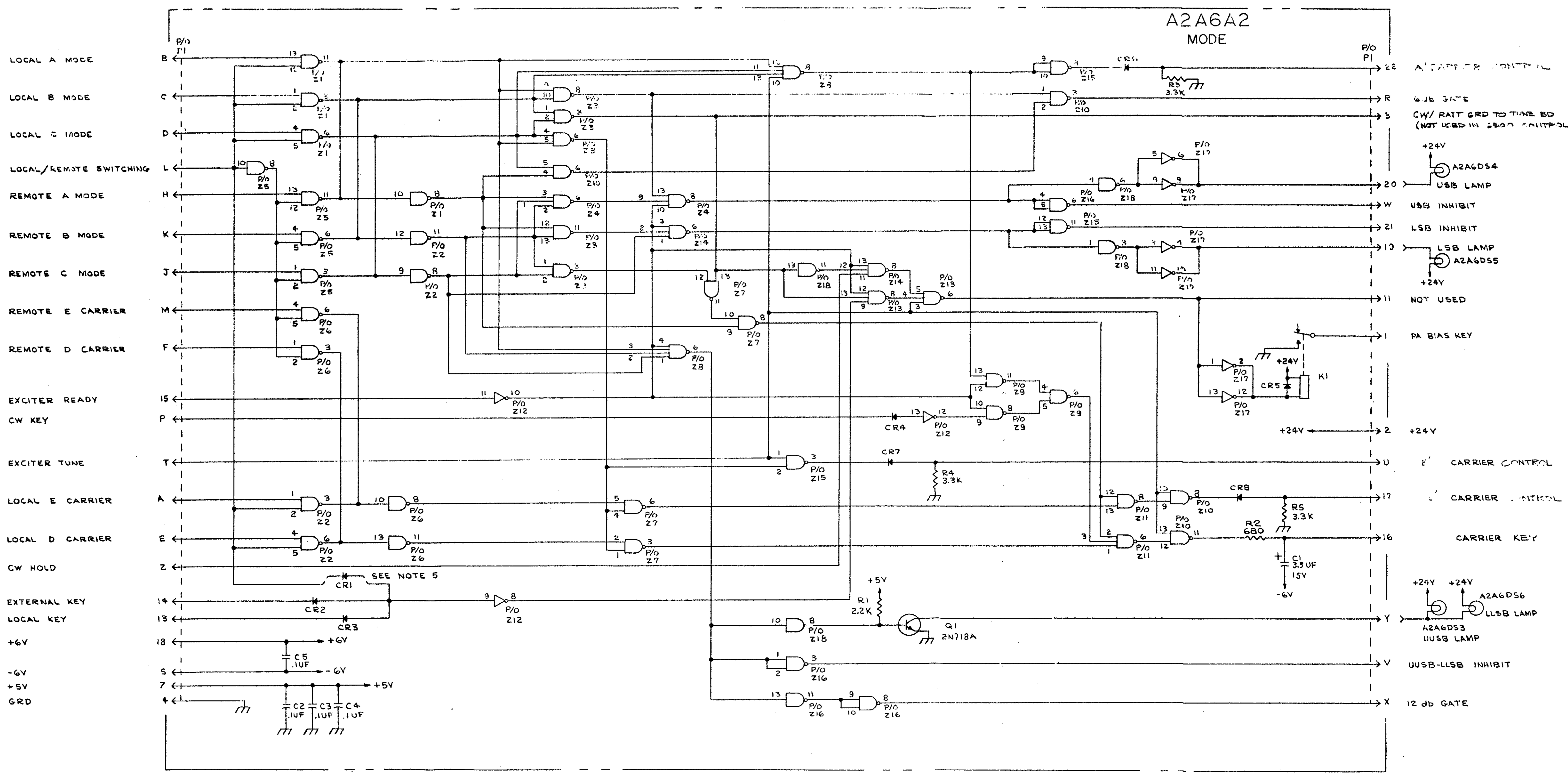


Figure 8. Mode Select PWB Component Location Drawing



0759-6522

NOTES:

1. Z1, Z2, Z3, Z5, Z6, Z7, Z9 AND Z18 ARE MC846P
Z4, Z8, Z11, Z13 AND Z14 ARE MC1800P
Z10, Z15 AND Z16 ARE MC672P
Z12 IS MC840P
Z17 IS SN7406N
2. PIN 7 IS GRD AND PIN 14 IS +5V ON Z1 THRU Z9, Z11, Z12, Z13 Z14, Z17 AND Z18.
3. PIN 7 IS -6V AND PIN 14 IS +6V ON Z10, Z15 AND Z16
4. UNLESS OTHERWISE SPECIFIED ALL DIODES ARE IN3064., ALL RES. ARE 1/4W, 10%.
5. FOR CONSTANT REMOTE KEYING INSERT CR1, IN3064. (OPTION)
6. MODE TABLE

MODE	A	B	C
OFF	1	1	1
RATT	1	0	0
AME	0	1	0
CW	0	0	0
USB	1	1	0
LSB	0	0	1
2 ISB	1	0	1
4 ISB	0	1	1

CARRIER LEVEL TABLE

CARRIER	D	E
-∞ db	1	1
-20 db	0	1
-10 db	0	0

7. LAMPS ARE SHOWN FOR REF ONLY.

Figure 9. Mode Select PWB A2A6A2 Schematic Diagram

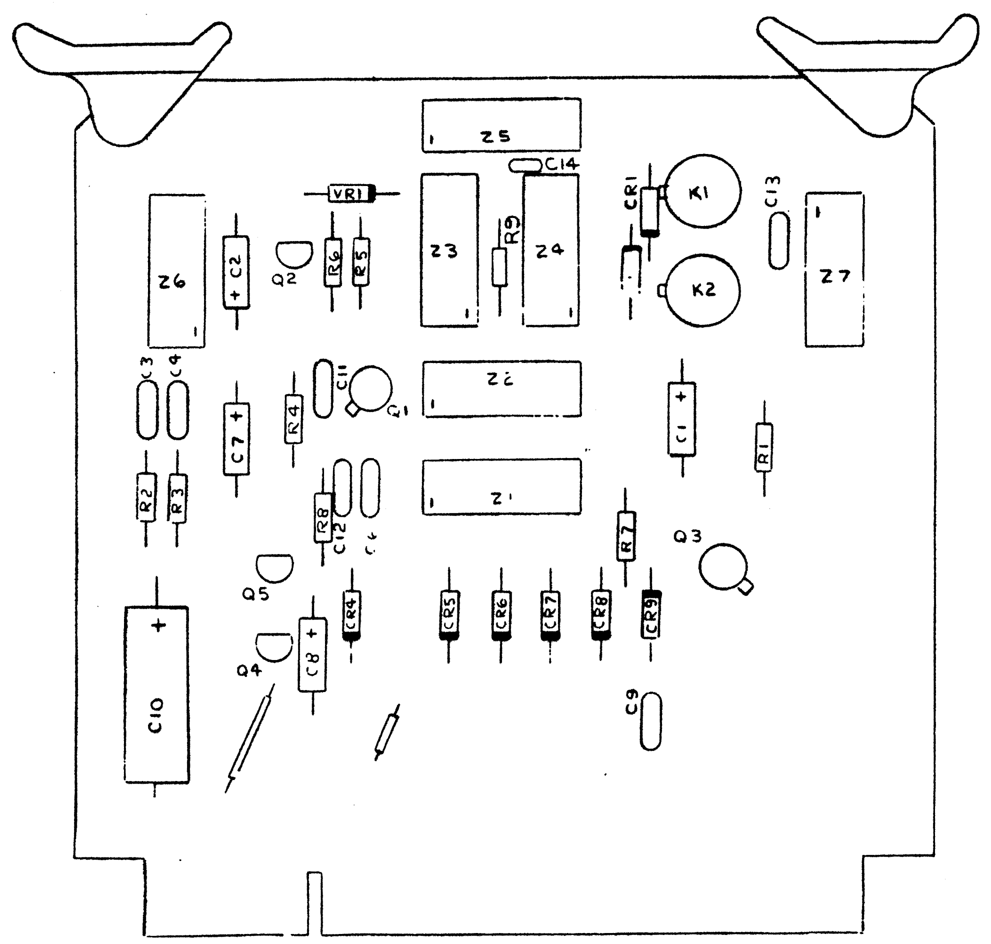


Figure 10. Standby/Operate PWB Component Location Drawing

0759-6527

NOTES:
1. Z1 IS MC840P, Z2 IS MC840P OR MC1820P, Z5 IS SN7406N, Z3 IS MC1800P, Z4 IS MC845P. Z6, Z7 ARE MC846P
2. PIN 7 IS GND AND PIN 14 IS +5V ON Z1 THRU Z7
3. UNLESS OTHERWISE SPECIFIED
a ALL DIODES ARE IN3064
b. ALL RESISTORS ARE IN OHMS, 1/4W, 10%
4. LAMPS AND SWITCHES ARE SHOWN FOR REFERENCE ONLY.

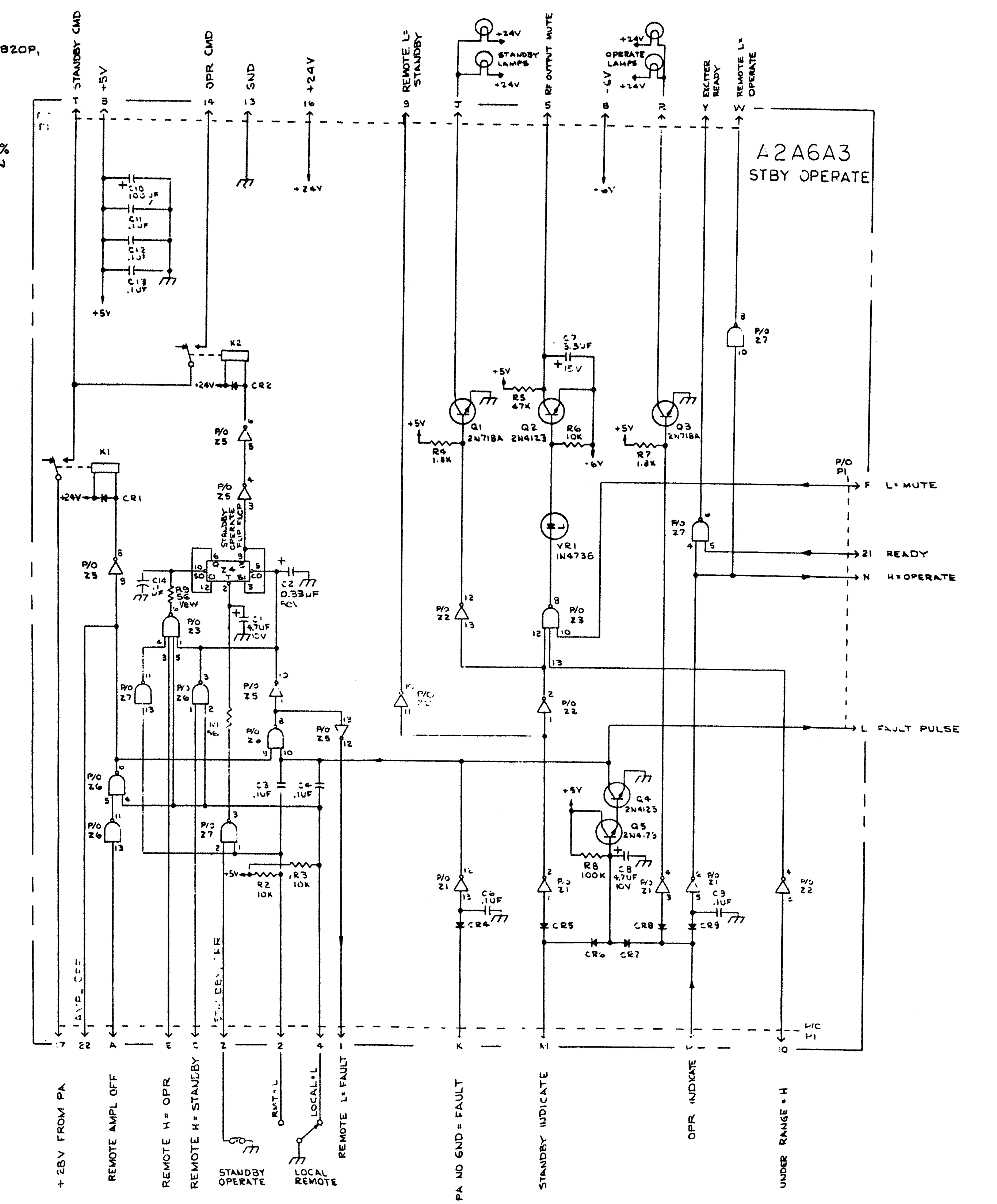


Figure 11. Standby/Operate PWB A2A6A3 Schematic Diagram

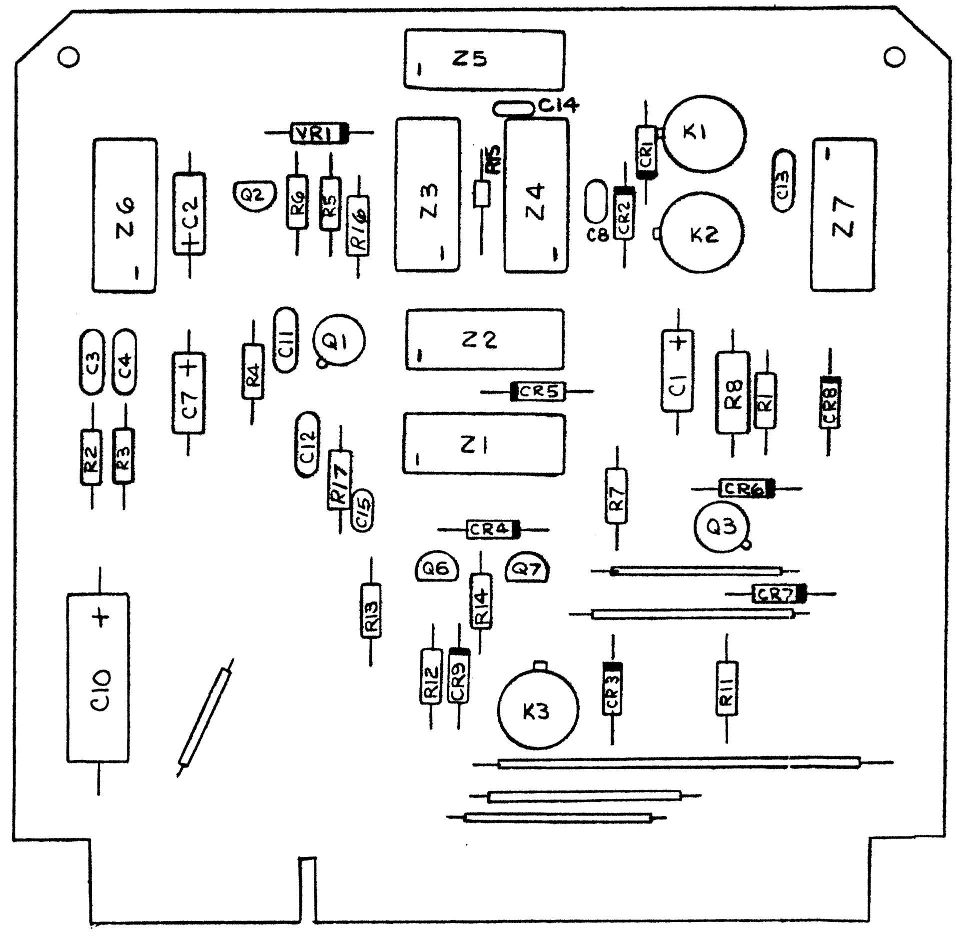


Figure 10. Standby/Operate PWB Component Location Drawing

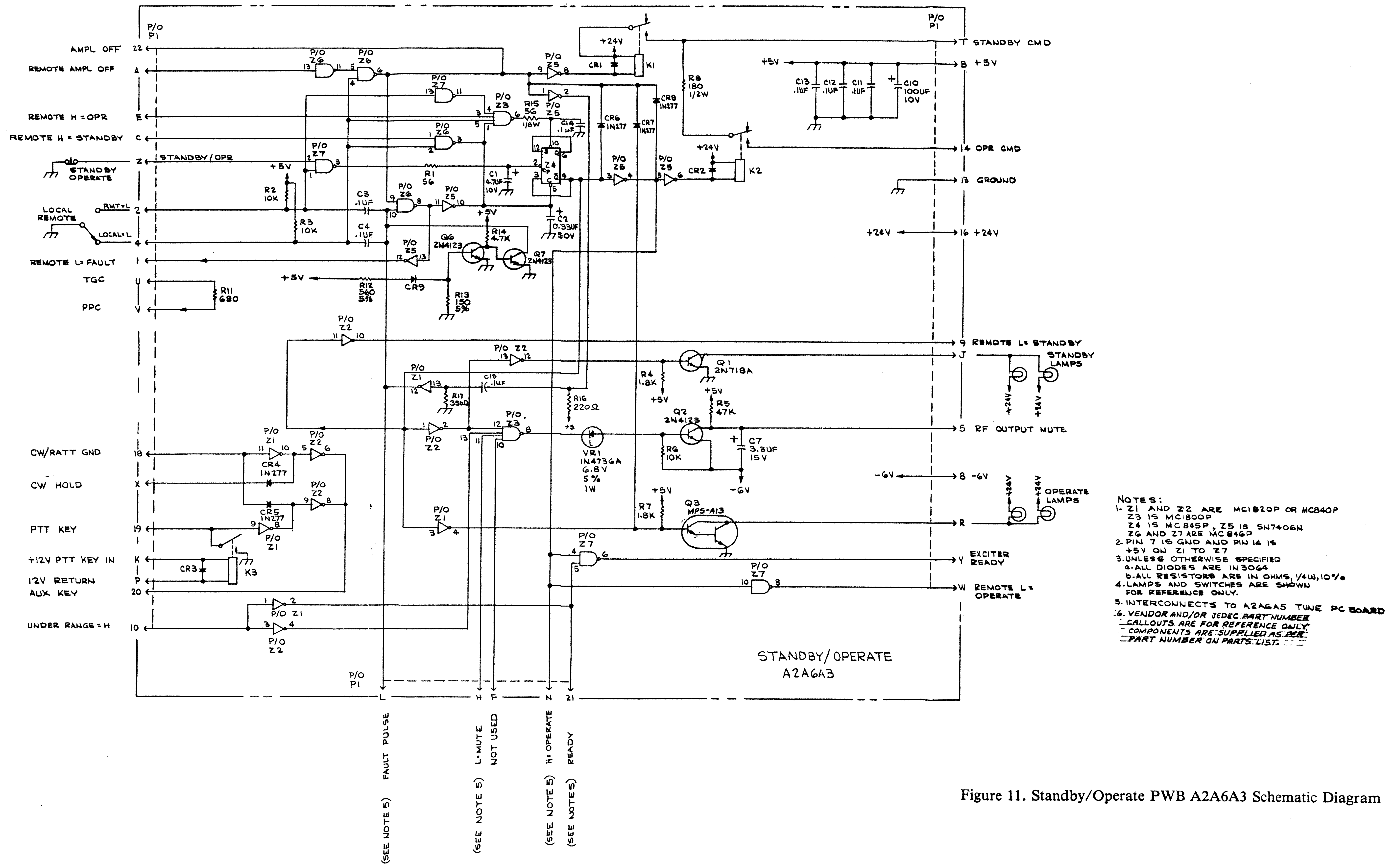


Figure 11. Standby/Operate PWB A2A6A3 Schematic Diagram

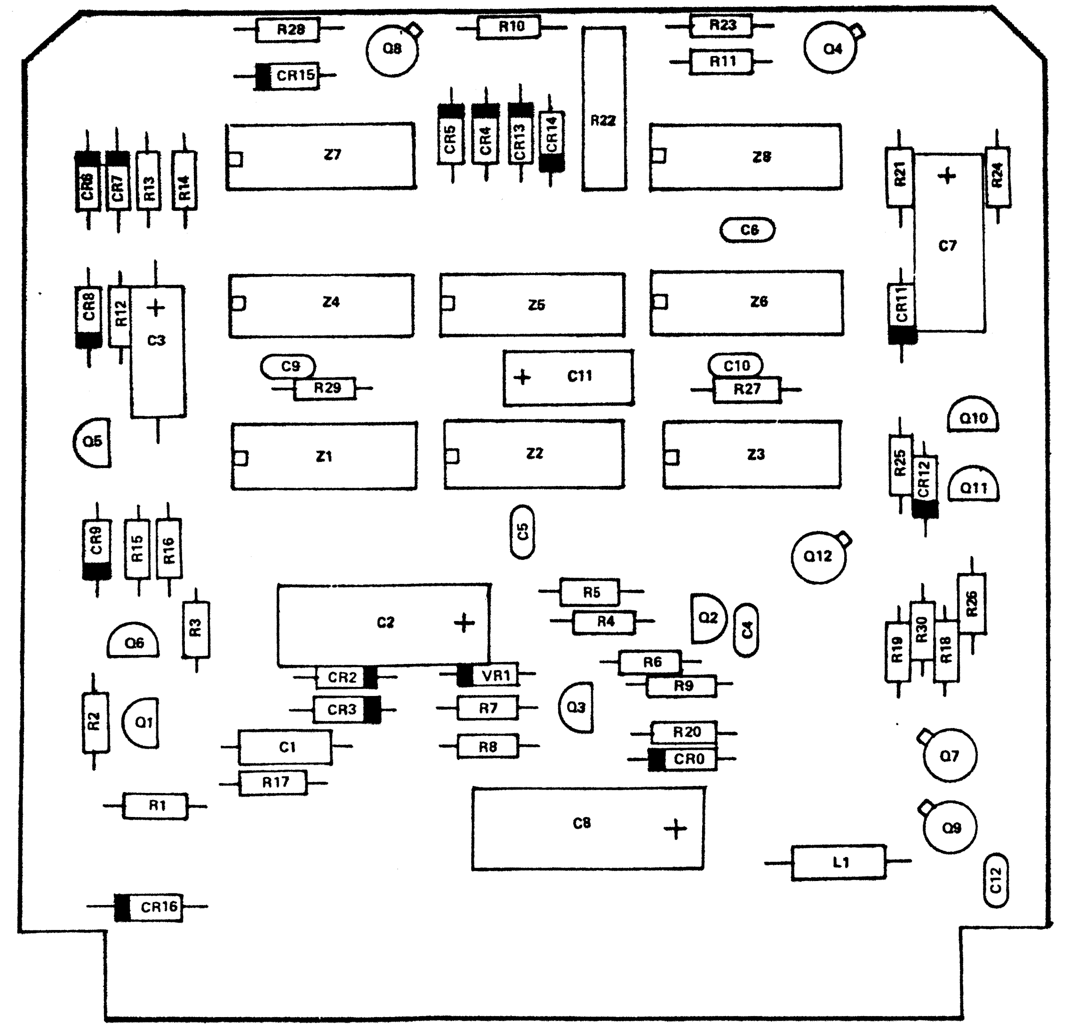


Figure 12. Tune PWB Component Location Drawing

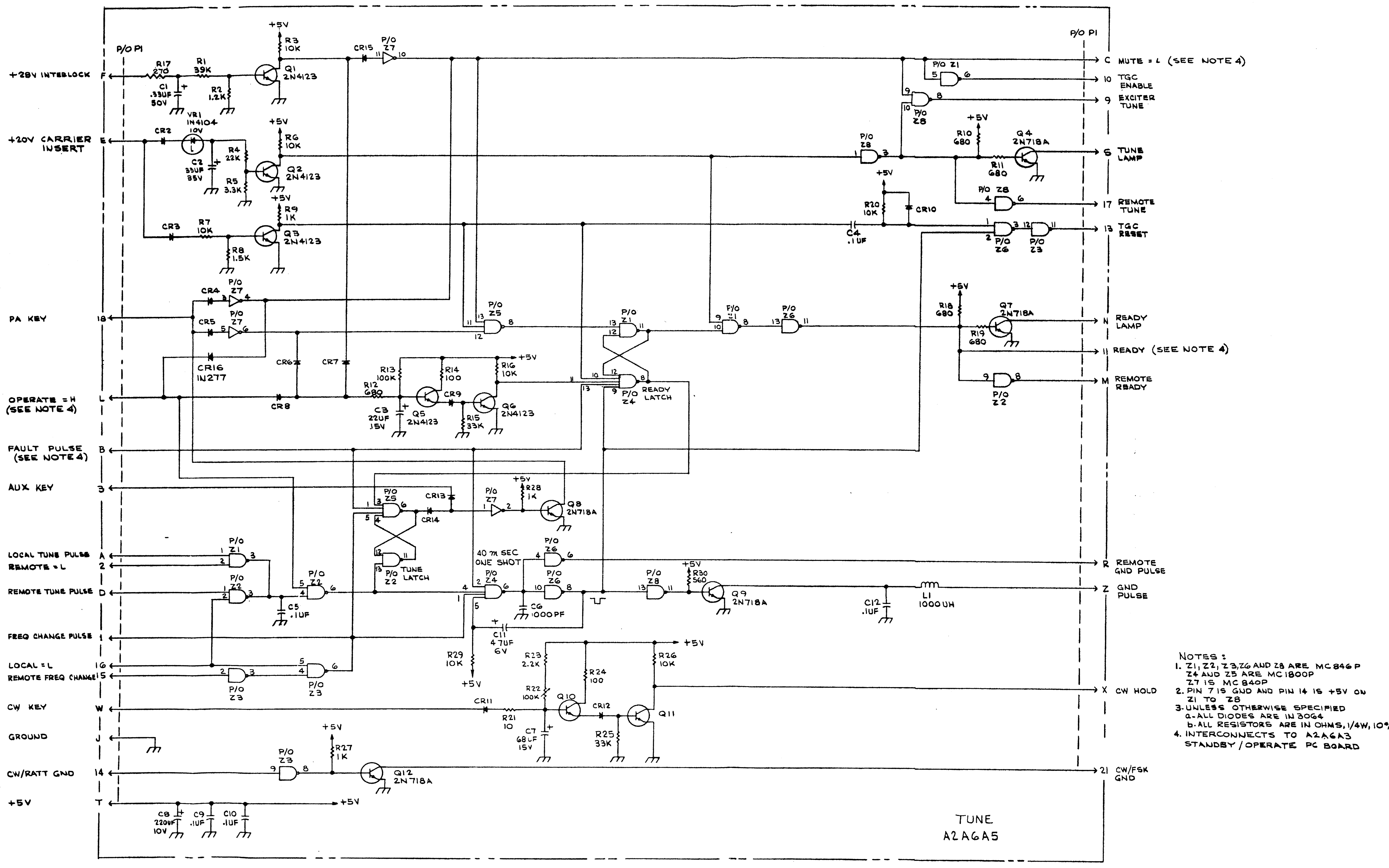


Figure 13. Tune PWB A2A6A5 Schematic Diagram

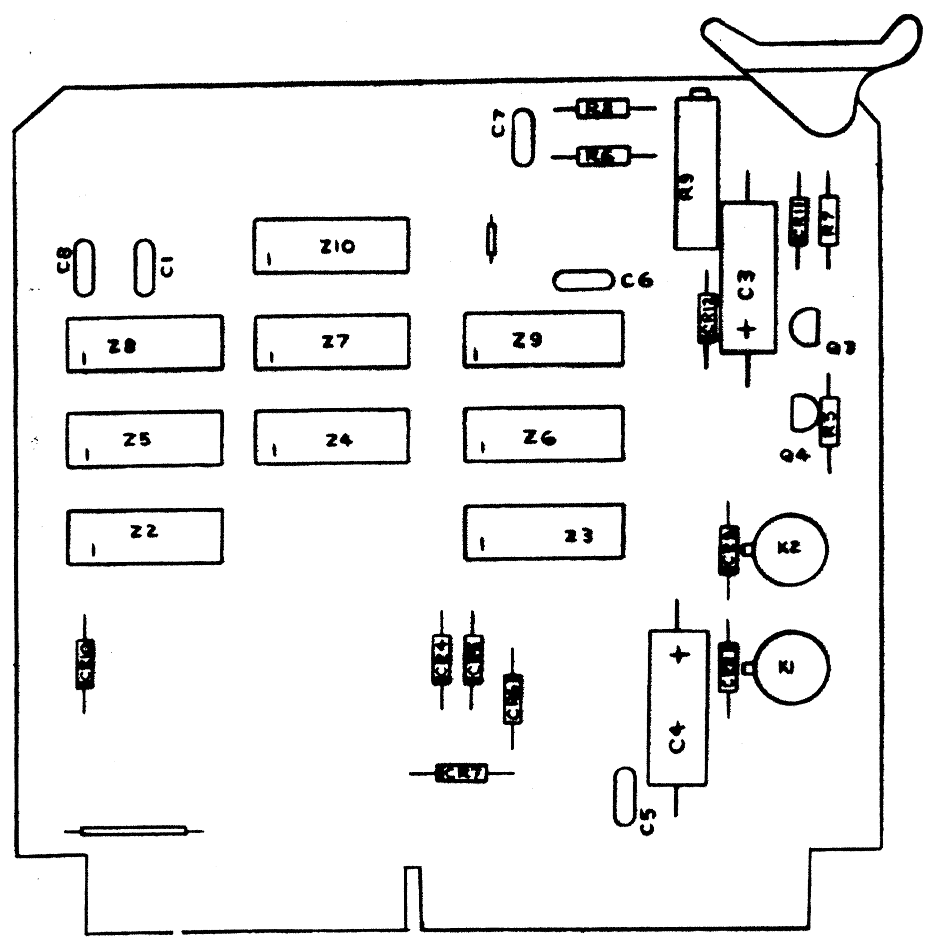
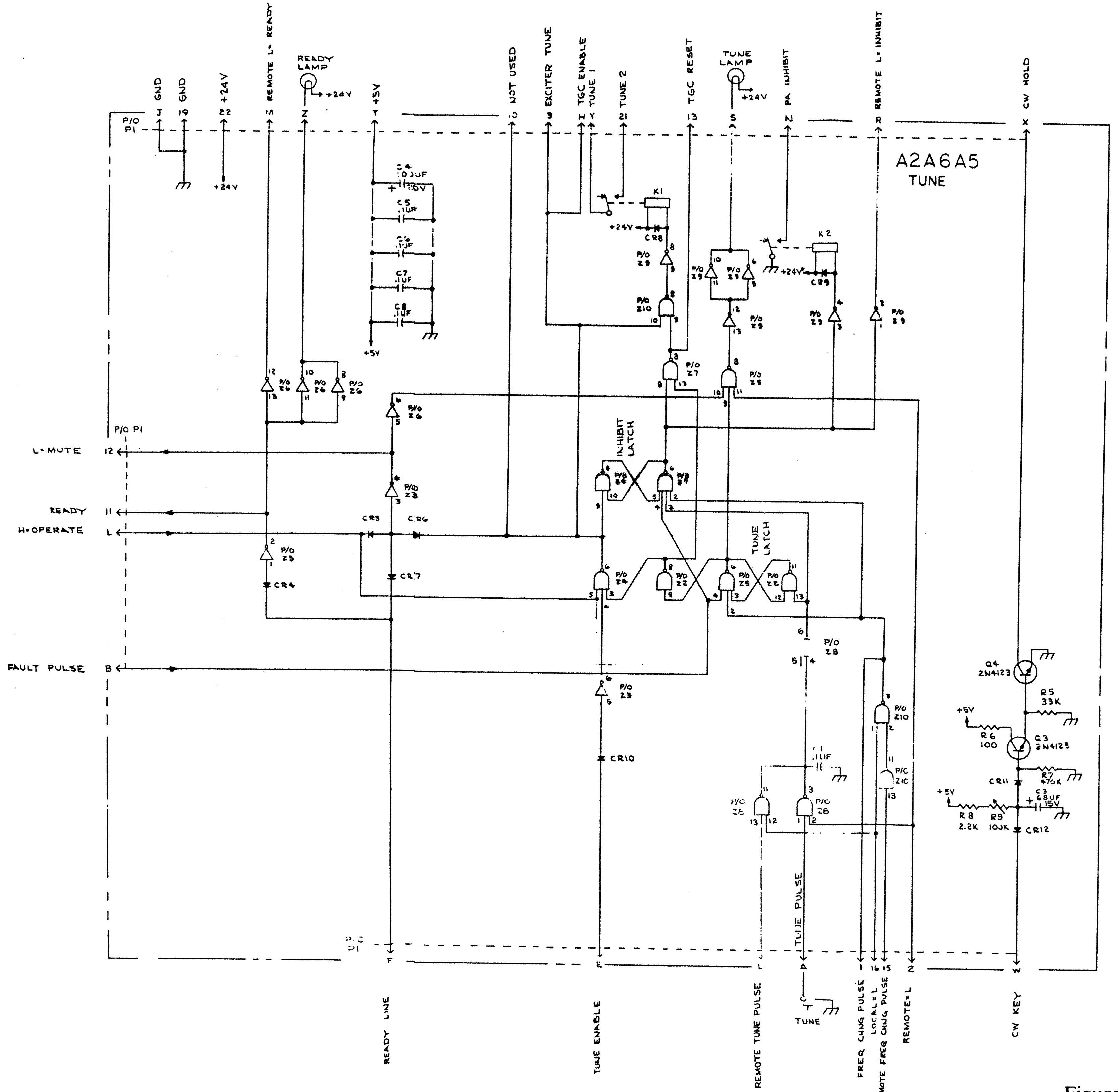


Figure 12. Tune PWB Component Location Drawing



NOTES:
1. Z2, Z8 AND Z10 ARE MC846P
   Z3 IS MC840P
   Z4, Z5 AND Z7 ARE MC1800P
   Z6 AND Z9 ARE MC1820P
2. PIN 7 IS GND AND PIN 14 IS +5V ON Z2 THRU Z10
3. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, 1/4W, 10%
   b. ALL DIODES ARE 1N3064.
4. LAMPS AND SWITCHES ARE SHOWN FOR REFERENCE ONLY.

Figure 13. Tune PWB A2A6A5 Schematic Diagram

TABLE 8. MAINTENANCE PARTS LIST-Control Head A2A6

Reference Designation	Name and Description
A2A6	Control Head Module Assembly: MFR 14304, PN 0759-6500
CR1 - CR3	Diode: Mil type 1N3064
J1 - J5	Connector, PWB: MFR 26742, PN 81-6044-1107
J6	Connector, Multipin, Block Thin: MFR 81312, PN MRAC75PJ
J5MP1	Pin, Connector, Straight, Male: Mil type MS17803-16-20
J7 - J15	Not used
J16	Connector, Multipin, Thick: MFR: 81312, PN MRAC75SJ
J16MP1	Pin, Connector, Straight, Female: Mil type MS17804-16-20
P5	Connector, PWB: MFR 02660, PN 225-21521-101
	Panel Assembly, Control Head MFR 14304, PN 0759-8530
MP1-MP6	Knob: Mil type MS91528-1K2B
S1	Switch, Mode Select, Rotary: MFR 71590, PN PSA-209
S2	Switch, Carrier Insert Rotary: MFR 71590, PN PSA-200
S3	Switch, Frequency Select, Thumbwheel Rotary: MFR 14304, PN 0759-6104
S4	Switch Pushbutton: MFR 96182, PN 90EA1C5J2 (WB) L2N1R16 Local/Remote. Lamps, 28V: Mil type MS2537-387
S5	Switch, Pushbutton: MFR 96182, PN 90EA1C2J2 (YG) L2N1R16 Tune/Ready. Lamps, 28V: Mil type MS2537-387
S6	Switch, Pushbutton: MFR 96182, PN 90EA1C2J2 (YG) L2N1R16 Standby/Operate. Lamps, 28V, No. 387, Mil type MS2537-387
A2A6A1	Encoder PWB Assembly; MFR 14034, PN 6722-6115
C1	Not used
C2	Capacitor, Fixed, 33uF, 10 WVDC: Mil type M39003/01-2258
C3	Capacitor, Fixex, 0.1uF, 50 WVDC: MFR 14304, PN C11-0005-104
C4	Capacitor, Fixed 0.01uF, 50 WVDC: MFR 14304, PN C11-0005-103
C5	Same as C3
C6	Capacitor, Fixed, 1uF, 50 WVDC: Mil type M39003/01-2357
C7-C21	Same as C3
CR1	Not used
CR2, CR3	Diqde, Silicon; Mil type 1N4148
CR4-CR13	Diode, Silicon; Mil type 1N3611
CR14	Diode, Silicon: MFR 50444, PN 5082-2800
CR15	Same as CR2
CR16	Same as CR14
CR17	Same as CR2
CR18	Same as CR14
CR19	Same as CR2
CR20	Same as CR14
CR21	Same as CR2
CR22	Same as CR14
CR23	Same as CR2
Q1	Transistor, NPN: MFR 04713, PN 2N4123
Q2-Q11	Transistor, NPN: MFR 04713, PN MPS-A05
Q12, Q13	Same as Q1
R1-R5	Resistor, Fixed, Composition, 10K, ±5%, ¼W: Mil type RC07GF103J
R6	Resistor, Fixed, Composition, 100 Ω, ±5%, ¼W: Mil type RC07GF101J
R7	Resistor, Fixed, Composition, 2.7K, ±5%, ¼W: Mil type RC07GF272J
R8	Same as R1
R9	Resistor, Fixed Composition, 33K, ÷5%, ¼W: Mil type RC07GF333J
R10, R11	Same as R1
R12	Resistor, Fixed Composition, 4.7K, ÷5%, ¼W: Mil type RC07GF472J
R13-R19	Same as R1
R20-R24	Resistor, Fixed Composition, 820Ω, ±5%, ¼W: Mil type RC07GF821J
R25	Same as R6
R26-R32	Resistor, Fixed Composition, 1K, ±5%, ¼W: Mil type RC07GF102J
U1	Read-Only Memory (ROM), 1024 x 8-Bit, MOS: MFR 14304, PN 6722-6130
U2-U4	Integrated Circuit, 4-Bit Bistable Latch: MFR 01295, PN SN 74LS75N

TABLE 8. MAINTENANCE PARTS LIST-Control Head A2A6 (Continued)

Reference Designation	Name and Description
U5-U7	Integrated Circuit, Quadruple 2-Input Exclusive-OR Gate: MFR 01295m PN SN74LS136N
U8-U10	Integrated Circuit, Hex Inverter: MFR 01295, PN SN74LS04N
U11	Integrated Circuit, Retriggerable Monostable Multivibrator: MFR 01295, PN SN 74LS122N
U12	Integrated Circuit, Quadruple 2-Input Positive NAND Gate: MFR 14304, PN I01-0048-000
A2A6A2	Mode Select PWB Assembly: MFR 14304, PN 0759-6520
C1	Capacitor, Fixed Tantalum, 3.3uF, 15WVDC Mil type C39003/01-2268
C2-C5	Capacitor, Fixed Ceramic, 0.1uF, 50 WVDC: MFR 14304 PN C11-0005-104
CR1	Not used
CR2-CR8	Diode, Silicon: Mil type 1N3064
K1	Relay, DPDT: MFR 16170, PN 712-26
MP1	Mode Select PWB: MFR 14304, PN 0759-6521
Q1	Transistor, NPN: Mil type 2N718A
R1	Resistor, Fixed Composition, 2.2K, ±10%, ¼W: Mil type RC07GF222K
R2	Resistor, Fixed Composition, 680 Ω, ±10%, ¼W: Mil type RC07GF681K
R3-R5	Resistor, Fixed Composition, 3.3K, ±10%, ¼W: Mil type RC07GF332K
Z1 - Z3	Integrated Circuit: MFR 04713, PN MC1846P
Z4	Integrated Circuit: MFR 04713, PN MC1800P
Z5 - Z7	Integrated Circuit: MFR 04713, PN MC846P
Z8	Integrated Circuit: MFR 04713, PN MC 1800P
Z9	Integrated Circuit: MFR 04713, PN MC846P
Z10	Integrated Circuit: MFR 04713, PN MC672P
Z11	Integrated Circuit: MFR 04713, PN MC1800P
Z12	Integrated Circuit: MFR 04713, PN MC840P

Reference Designation	Name and Description
Z13, Z14	Integrated Circuit: MFR 04713, PN MC1800P
Z15, Z16	Integrated Circuit: MFR 04713, PN MC672P
Z17	Integrated Circuit: MFR 01295, PN SN7406N
Z18	Integrated Circuit: MFR 04713, PN MC846P
A2A6A3	Standby/Operate PWB Assembly: MFR 14304, PN 0759-6525
C1	Capacitor, Fixed Tantalum, 4.7uF, 10 WVDC: Mil type CSR13C475ML
C2	Capacitor, Fixed Tantalum, 0.33uF, 50 WVDC: Mil type CSR13G334ML
C3, C4	Capacitor, Fixed Ceramic 0.1uF, 50 WVDC: MFR 14304 PN C11-0005-104
C5	Not used
C6	Same as A3C3
C7	Capacitor, Fixed Tantalum, 3.3uF, 50 WVDC: Mil type M39003/01-2366
C8	Same as A3C1
C9	Same as A3C3
C10	Capacitor, Fixed Tantalum, 100uF, 10 WVDC: Mil type CSR13C107ML
C11 - C14	Capacitor, Fixed Ceramic, 0.1uF, 50 WVDC: MFR 14304 PN C11-0005-104
CR1 - CR2	Diode, Silicon: Mil type 1N3064
CR3	Not used
CR4 - CR9	Diode, Silicon: Mil type 1N3064
K1, K2	Relay, DPDT: MFR 16170, PN 712-26
Q1	Transistor, NPN: Mil type 2N718A
Q2	Transistor, NPN: MFR 04713, PN 2N4123
Q3	Same as A3Q1
Q4, Q5	Same as A3Q2
R1	Resistor, Fixed composition, 56Ω, ±10%, ¼W: Mil type RC07GF560K
R2, R3	Resistor, Fixed Composition, 10K, ±10%, ¼W: Mil type RC07GF103K
R4	Resistor, Fixed Composition 1.8K, +10%, ¼W: Mil type RC07GF182K

TABLE 8. MAINTENANCE PARTS LIST-Control Head A2A6 (Continued)

Reference Designation	Name and Description
R5	Resistor, Fixed composition, 47K, ± 10%, ¼W: Mil type RC07GF473K
R6	Resistor, Fixed Composition, 10K, ± 10%, ¼W: Mil type RC07GF103K
R7	Resistor, Fixed Composition, 1.8K, ± 10%, ¼W: Mil type RC07GF182K
R8	Resistor, Fixed Composition, 100K ± 10%, ¼W: Mil type RC07GF104K
R9	Resistor, Fixed Composition, 56Ω, ± 10%, ⅛W: Mil type RC05GF560K
VR1	Diode, Zener, 6.8V, 1W: Mil type 1N4736A
Z1, Z2	Integrated Circuit: MFR 04713, PN MC840P
Z3	Integrated Circuit: MFR 04713, PN MC1800P
Z4	Integrated Circuit: MFR 04713, PN MC845P
Z5	Integrated Circuit: MFR 01295, PN SN7406N
Z6, Z7	Integrated Circuit: MFR 04713, PN MC846P
A2A6A4	Level Shift/Remote Control PWB Assembly: MFR 14304, PN 0759-6145
CR1 - CR3	Not used
CR4-CR25	Diode, Germanium Mil type 1N277
MP1	Level Shift/Remote Control PWB: MFR 14304, PN 0759-6146
Q1 - Q10	Transistor, NPN: MFR 04713, PN 2N4123
R1 - R22	Resistor, Fixed Composition, 5.6K, ± 10%, ¼W: Mil type RC07GF103K
R23 - R32	Resistor, Fixed Composition, 5.6K, ± 10%, ¼W: Mil type RC07GF562K

Reference Designation	Name and Description
R33 - R42	Resistor, Fixed Composition, 12K, ± 10%, ¼W: Mil type RC07GF123K
A2A6A5	Tune PWB Assembly: MFR 14304, PN 0759-6535
C1	Capacitor, Fixed Ceramic, 0.1uF: MFR 72982, PN 8131-100-6511-104M
C2	Not used
C3	Capacitor, Fixed Tantalum, 68uF, 15WVDC: Mil type CSR13D686ML
C4	Capacitor, Fixed Tantalum, 100uF: 10 WVDC: Mil type CSR13C107ML
C5-C8	Capacitor, Fixed Ceramic, 0.1uF: MFR 72982, PN 8131-050-651-104M
CR1-CR3	Not used
CR4-CR12	Diode, Silicon: Mil type 1N3064
K1, K2	Relay, DPDT, MFR 16170, PN 712-26
Q1, Q2	Not used
Q3, Q4	Transistor, NPN: MFR 04713, PN 2N4123
R1-R4	Not used

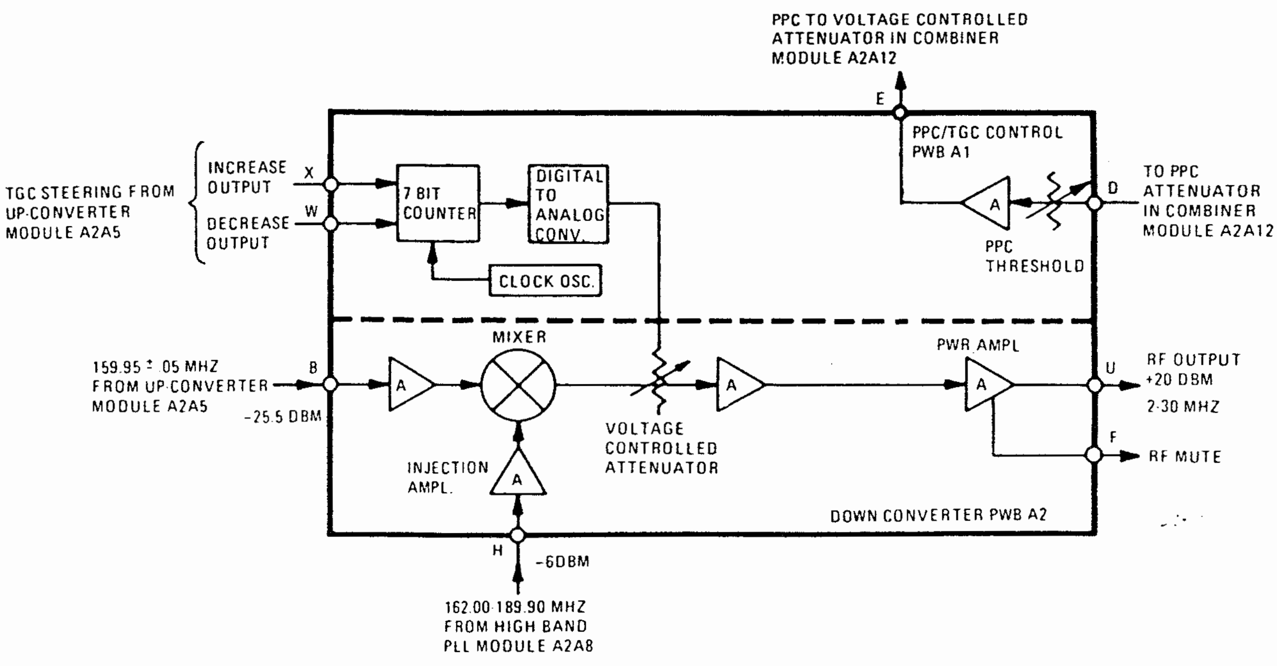
TABLE 8. MAINTENANCE PARTS LIST-Control Head A2A6 (Continued)

Reference Designation	Name and Description
R5	Resistor, Fixed Composition, 33K, ±10%, ¼W: Mil type RC07GF333K
R6	Resistor, Fixed Composition, 100Ω, ±10%, ¼W: Mil type RC07GF101K
R7	Resistor, Fixed Composition, 470K, ±10%, ¼W: Mil type RC07GF474K
R8	Resistor, Fixed Composition, 2.2K, ±10%, ¼W: Mil type RC07GF222K
R9	Resistor, Variable, 100K: MFR 80294, PN 3009Y-1-104
Z2	Integrated Circuit: MFR 04713, PN MC846P
Z3	Integrated Circuit: MFR 04713, PN MC840P
Z4, Z5	Integrated Circuit: MFR 04713, PN MC1800P
Z6	Integrated Circuit: MFR 04713, PN MC1820P
Z7	Integrated Circuit: MFR 04713, PN MC1800P
Z8	Integrated Circuit: MFR 04713, PN MC846P
Z9	Integrated Circuit: MFR 04713, PN MC1820P
Z10	Integrated Circuit: MFR 04713, PN MC846P

UNIT INSTRUCTIONS

RF OUTPUT MODULE

A2A7



RF OUTPUT MODULE A2A7

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1. GENERAL DESCRIPTION

RF Output Module A2A7 converts the 160 MHz (nominal) 3rd intermediate frequency to the final desired output frequency (in the HF range), increases the signal power level to +20dBm (2.24V_{RMS} into 50 ohms) and with appropriate inputs provides control of both peak and average power outputs of the entire transmitting system. The module contains two PWB assemblies; PPC/TGC Control PWB A2A7A1. and Down-Converter PWB A2A7A2.

2. TECHNICAL CHARACTERISTICS

Weight: 1.19 pounds (540 grams)

Dimensions:
4-1/8 in. (H)x2-1/8 in. (W)x5-7/8 in. (D)
10.5 cm (H)x5.4 cm (W)x14.9 cm (D)

Power Requirements (typical):
+24 Vdc at 125 mA
+ 6 Vdc at 50 mA
+ 5 Vdc at 160 mA
− 6 Vdc at 36 mA

Signal Inputs:
159.9 to 160.0 MHz Variable: −25.4 dBm PEP, 12 mV PEV.
162.0 to 189.9 MHz Variable: −6 dBm, 110 mV_{RMS}, or greater.
Peak Power Control (PPC), 0 to +5 Vdc Variable
TGC Control Lines, 0 to +5 Vdc Binary

Signal Outputs:
2.0000 to 29.9999 MHz, 2.24 V PEV (+20 dBm PEP)

Input Impedance:
159.9 to 160.0 MHz: 50 ohms
162.0 to 189.9 MHz: 50 ohms
PPC: 560 ohms

Output Load: 50 ohms

3. SEMICONDUCTOR COMPLEMENT

Table 1 lists all semiconductors used in RF Output Module A2A7. (See Part 5 of the General Information Section for Integrated Circuit Details.)

Table 1. SEMICONDUCTOR COMPLEMENT

Reference Designation	Type	Function
A2A7A1		
CR3	1N3064	Counter Stop (max. count)
CR4	1N3064	Counter Stop (min. count)
CR9	1N3064	Offset Temp. Comp.
CR10	1N3064	Limiting
CR11	1N3064	Limiting
CR13	1N3064	Blocking
CR14	1N3064	Clamping
CR15	1N3064	Temp. Comp.
CR16	1N3064	Blocking
CR17	1N3064	Limiting
Q2	2N4853	Clock Oscillator
Q3	2N4125	Switch
Q5	2N4123	Switch
Q6	2N4123	Amplifier
Q7	2N4123	Inverter
Q8	2N4125	P/O D/A Conv. 1-bit
Q9	2N4125	P/O D/A Conv. 2-bit
Q10	2N4125	P/O D/A Conv. 4-bit
Q11	2N4125	P/O D/A Conv. 8-bit
Q12	2N4125	P/O D/A Conv. 16-bit
Q13	2N4125	P/O D/A Conv. 32-bit
Q14	2N4125	P/O D/A Conv. 64-bit
Q15	2N4125	PPC Inverter
Q16	2N4123	PPC Amplifier
Q17	2N4125	PPC Amplifier
Q18	2N4125	PPC Inhibit
Q19	2N4123	Switch
VR1	1N5223B	Zener, +2.7V Regulator
VR2	1N751A	Zener, −5.1V Regulator
Z1	SN7473N	P/O Digital Counter, 1-bit and control
Z2	SN7473N	P/O Digital Counter, 2-bit and 4-bit
Z3	SN7473N	P/O Digital Counter, 8-bit and 16-bit
Z4	SN7473N	P/O Digital Counter, 32-bit and 64-bit
Z5-Z11	SN7410N	P/O Digital Counter, 3 input NAND gates
A2A7A2		
AR1	0759-5020	Power Amplification, 19dB
AR2	0759-5010	Power Amplification, 14dB
AR3	0759-5020	Power Amplification, 19dB
AR4	0759-5030	Power Amplification, 22dB
AR5	0759-5040	Power Amplification 11.5dB
CR1	1N4002	Blocking
Q1	2N5179	Signal Path Isolation
Z1	0759-5150	Mixer, down conversion
Z2	0759-5000	TGC Attenuator
Z4	0759-3725	173 MHz Bandpass Filter

4. OVERALL CIRCUIT DESCRIPTION

The signal enters the RF Output Module A2A7 at a level of approximately −25.5dBm, and at a center frequency (carrier) of between 159.00MHz and 160.00MHz, in 100Hz increments. The exact center frequency depends on the setting of the last three digits of the FREQUENCY Selector digit switches. This signal is mixed with a variable injection frequency from the High Band PLL Module A2A8, to produce the final output frequency from the RF-131 Exciter. The High Band PLL Module A2A8 injection frequency is adjustable, in 100KHz increments, from 162.0MHz to 189.9MHz with the first three digits of the FREQUENCY Selector digit switches. Consequently, the range of difference frequencies produced is from 2.0MHz to 29.999MHz.

Following the mixer, the signal passes through the TGC, Voltage-Controlled Attenuator (VCA). The VCA, is a sealed unit (mini-module), that changes its insertion loss in response to changes in the Dc control input. The VCA has an attenuation versus control characteristic similar to that shown in Figure 1.

The VCA is the control element of the Transmitter Gain Control (TGC) loop, and is driven by the TGC counter and its digital-to-analog converter. The TGC counter is a 7 bit up-down counter; that is, applied clock pulses can be made to increment or decrement any stored number. The digital-to-analog converter senses the number contained in the counter and provides a proportionate Dc output voltage to the VCA. The higher the stored number, the higher (more positive) will be the VCA control voltage and consequently, the higher the RF power output from the module. Since the counter capability is 7 bits, 128 steps (2^7) of RF power output is available.

Instructions to increase or decrease the number in the counter, the numerical value in the counter, are received on the two TGC steering wires from Comparator PWB A2A5A1 in the Up-Converter Module A2A5. (See A2A5 Up-Converter Module Section.)

A second VCA (refer to A2A12 Combiner Module Section) is the control element in the Peak Power Control (PPC) loop. The PPC is a fast time constant threshold type of circuit that detects the audio modulation peaks at the output of the external amplifier and if necessary, attenuates the signal level to prevent overdriving the system. The threshold power level for the development of the PPC voltage is adjustable by potentiometer R53 on PPC/TGC Control PWB A2A7A1

Following the TGC VCA, four untuned broadband amplifiers raise the signal level to a nominal output value of +20dBm (100mW).

5. PPC/TGC CONTROL PWB A2A7A1 CIRCUIT DESCRIPTION

NOTE

The purpose and theory of operation of the overall TGC loop is covered in paragraph 4 of section A2A5 (Up-Converter Module).

Refer to Figure 5. The TGC (Transmitter Gain Control) instructions for automatic adjustment of the exciter RF power output are received, from the Up-Converter Module A2A5, at A2A7 P1-W and A2A7 P1-X. These instructions are binary logic levels which direct clock pulses generated by a gated clock oscillator (Q2, Q6, and Q7) to either increment or decrement the 7-bit counter.

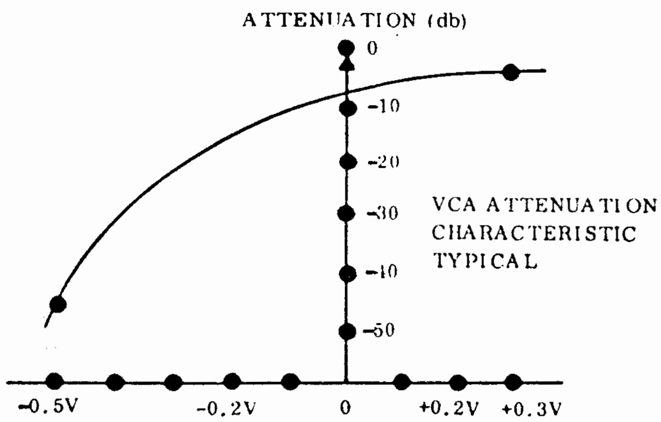


Figure 1. VCA: Attenuation Versus Control Voltage

For example, if the RF power output is low, a logic 1 input (+3.5V nominal) at pin X presets control flip-flop Z1A for toggling to zero on the next pulse from the clock oscillator, thus enabling the count-up gates of the 7-bit counter (Z5A, Z6A, Z7A, ect). The counter then increments on each successive clock pulse untill the proper RF level is reached, at which time they deliver a ground input to A2A7P1-T that inhibits further operation of the clock oscillator. Conversely, if the RF output power is too high, a logic 1 input on pin W will cause Z1A to toggle to 1, enabling the count-down gates (Z5B, Z6B, Z7B etc).

The clock oscillator is a unijuction RC discharge circuit consisting of R4, C3, and Q2. The frequency of oscillation is determined primarily by C3, R4, and the firing voltage of the unijunction transistor. It is approximately 200Hz with the values used.

An increase in clock frequency to 1000Hz is effected in some systems by grounding terminal A2A7A1 E6. This results in R6 being switched in parallel with R4 by transistor Q3. See paragraph 1.3, part 1 of the General Information Section to determine what options are used in your particular system and to determine what wiring is applied to A2A7A1 E6.

The pulses from Q6 are delivered to the clock terminal of control flip-flop Z1A and also to C18. As the collector of Q6 goes negative, charging current for C18 flows through CR17 to ground. Q19 is cut off, so Q7 is saturated, holding the counter clock line down. When the collector of Q6 goes back to positive at the conclusion of the clock pulse, capacitor C18 is discharged through the base-emitter junction of Q19 allowing base current to flow for about 5 microseconds. This pulse of base current saturates Q19, cutting off Q7 unless the counter is at zero and the control flip-flop is set to decrease the count, or when the counter is at maximum and the control flip-flop is set to increase the count.

The output of Q6 consists of short, negative going pulses of about 5 microseconds in length. The output of Q7 is a train of short positive pulses beginning when the Q6 pulses end. In either case, the logic will trigger on the negative going edge. Hence, logic on Q6 triggers on the leading edge of the negative going pulse, and logic on Q7 triggers on the trailing edge of the positive going pulse.

Thus, the delay is equal to the sum of the two pulses or about 10 microseconds. The output from Q7 is the clock pulse for all flip-flops of the counter (Z1B thru Z4B).

The number stored in the counter is read in standard binary form with Z1B holding the most significant. During count-up, a flip-flop can toggle to logic 1 only when all of its preceeding stages contain a 1. Similarly, during count-down, a flip-flop can toggle to 0 only when all of its preceeding stages contàin 0. Diodes CR3 and CR4 at the end of the counter chain detect a maximum or minimum count condition and turn OFF the clocking pulses by grounding the input of Q5. The counter is then prevented from being clocked again until the steering voltages are reversed on control flip-flop Z1A. This action prevents erratic system operation that could result from the TGC attenuator changing from minimum to maximum attenuation (or vice-versa) with a single clock pulse.

The digital/analog converter consist of transistors Q8 thru Q14; one for each counter bit. The transistors (all PNP) are connected so as to saturate whenever the associated counter flip-flop $\overline{Q}$ is at 0. In saturation, collector current is determined by the collector load resistance and the source voltage (+2.7Vdc). The collector load resistance for the least significant bit (R23) is the highest value (least current) and decreases by approximately one half for each successive bit. All of the collector currents add across the output load resistor R43. Thus, the voltage level developed across R43 is proportional to the number in the counter. A low counter number produces a relatively low attenuator control voltage and consequently, a low RF power output. Resistors R43 and R44 (and the attenuator input-resistance) establish the minimum Dc output voltage at approximately −0.55Vdc when the counter is cleared (i.e., all 0's). This corresponds to full attenuation, (see Figure 1).

Whenever a frequency change of 1KHz or greater is initiated by the equipment operator, a momentary ground pulse received at A2A7P1-S (from Control Head Module A2A6) clears all of the counter flip-flops, sending the TGC attenuator to maximum. Maximum attenuation is maintained until the exciter's Tune Cycle is initiated. (Refer to Control Head Module A2A6 for system sequencing.)

The positive going PPC input is received from the external power amplifier at A2A7 P1-D and applied to PPC inverter Q15. Q15 is normally held in an On condition with a negative base return through R14 to −6V and a positive emitter return (0 to +4.5Vdc) to PPC ADJUST potentiometer R53.

However, PPC voltages approaching the no-load voltage at the wiper of A2A7A1R53 will tend to drive Q15 to cut off, producing a negative swing at the base of Q16. This is coupled to the PPC attenuator in Combiner Module A2A12, via emitter followers Q16 and Q17. The positive voltage excursion at the base of Q16 is clamped to +1.2Vdc by diodes A2A7A1 CR10 and A2A7A1 CR11.

The emitter follower circuits shape the PPC characteristics as follows: During attack, capacitor C8 is discharged quickly through R60 and the low resistance of Q17, providing rapid attack. During PPC recovery however, C8 has a relatively high resistance charging path through R49 (Q17 cuts off); the time constant of R49 and C8 establishs the circuit recovery time at approximately 500 milliseconds.

During the Tune Cycle, the exciter disables the PPC control line to prevent erroneous PPC information from affecting system operation. Disabling results from a ground input at A2A7 P1-A from Control Head Module A2A6. The ground turns on switching transistor Q18, pulling the PPC control line positive and yielding minimum attenuation from the PPC attenuator.

6. DOWN CONVERTER PWB A2A7A2 CIRCUIT DESCRIPTION

Refer to Figure 7. The 160MHz signals enters RF Module at A2A7P1-B at a level of 12mV PEV, and is applied to mixer Z1 via emitter follower Q1. The injection frequency from the High Band PLL Module A2A8 enters at A2A7P1-H and is amplified to a level sufficient for driving the mixer, by power amplifier stage AR2. AR2 is a sealed mini-module providing approximately 14dB of gain across the range of injection frequencies. Bandpass filter Z4 minimizes the generation of spurious frequencies in the mixer by attenuating the harmonics of the injection frequency.

Following the mixer, TGC attenuator Z2 provides a controllable amount of attenuation of the 2 to 30MHz difference frequency. The control input to Z2 enters at terminal E10, from the digital-to-analog converter on the PPC/TGC PWB A2A7A1. Z2 is a sealed mini-module as are the remaining stages AR1, AR3, AR4, AR5, etc.

The remaining untuned broadband amplifiers (AR1, AR3 through AR5) raise the signal level to +20dBm (100mW) at the module output A2A7P1-U. When the exciter is unkeyed, a negative muting voltage (-6Vdc) generated in the Control Head Module A2A6 is applied to A2A7 P1-F which turns off output stage AR5. When the exciter is keyed, the muting input becomes slightly positive. Thermistor RT1, between AR1 and AR3, compensates for changes in the gain of modules A2A5 and A2A7 caused by temperature variations.

7. PPC/TGC CONTROL PWB A2A7A1 TEST DATA

Voltage measurements for a typical PPC inverter circuit are given in Table 2. Values were measured with a Simpson Model 260 VOM, with the system unkeyed. (PPC voltage input = 0)

Typical wave forms are discussed in the following paragraphs. They were taken with a Tektronix Model 453 Oscilloscope (or equivalent) equipped with a X10 probe for minimal loading effects.

a. Isolate the TGC circuit by temporarily removing the Up-Converter Module A2A5 from the chassis.

b. Temporarily discounnect the jumper between terminals A2A7A1E12 and A2A7A1E13. This will allow the oscillator and counter to continually cycle.

c. Place a jumper between terminals A2A7A1E4 and A2A7A1E15.

d. Connect the oscilloscope (equipped with the X10 probe) to the collector of Q7. The display should indicate a train of pulses having an amplitude of approximately 3.5V peak-to-peak with a repetition frequency of approximately 200 Hz. (1000Hz when used in the RF-745 system).

e. Connect the oscilloscope to Z1B-Q or Z1B-Q. The display should indicate a 50 percent duty cycle square wave, having an amplitude of approximately 3.5V peak-to-peak with a repetition frequency equal to one-half that of the clock.

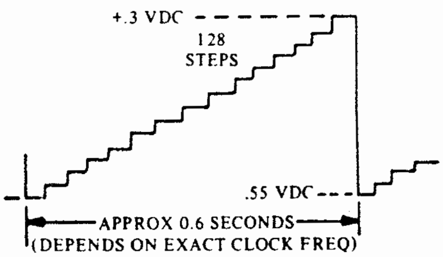
NOTE

Each succeeding flip-flop should have a square wave output at the Q and Q terminals whose repetition frequency is one-half that of the previous flip-flop.

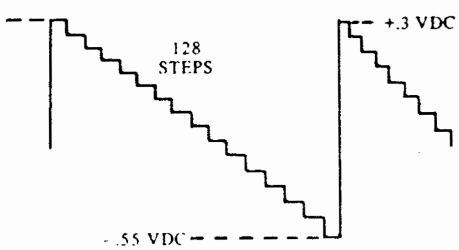
TABLE 2. PPC/TGC INVERTER CIRCUIT TEST VOLTAGES

Transistor	Emitter	Base	Collector
Q15	+2.75	+2	+2.7
Q16	+0.64	+1.2	+6
Q17	+1.2	+0.64	−6
Q18	+6	+6	+1.2

f. Connect the oscilloscope to terminal A2A7A1E10 (TGC attenuator control voltage). Display should appear as shown:



g. Shift the ground jumper from A2A7A1E4 to A2A7A1E5. The oscilloscope display of terminal A2A7A1E10 should appear as shown:



h. Place a 560 ohm resistor from Q3 base to ground. The period of the staircase wave forms should decrease to approximately 60 milliseconds. A ground placed on A2A7A1E3 (counter clear) should hold the attenuator control voltage at the bottom of the staircase until the ground is removed.

i. Test clock inhibit function by grounding terminal A2A7A1E7. Output staircase should hold a constant Dc voltage somewhere between a −.55Vdc and +.3Vdc.

j. Reconnect the jumper between terminals A2A7A1E12 and E13. Reinsert the Up-Converter Module in A2A5 chassis.

8. DOWN-CONVERTER PWB A2A7A2 TEST DATA

The RMS measurements of Down-Converter PWB should be taken with a Boonton Type 91H RF Voltmeter equipped with a high impedance probe. A steady input on A2A7P1-B is obtained by holding the exciter keyed with the MODE Selector set at CW. If the signal voltages are measured at the chassis connector (ie.; with the module removed) a 50 ohm adapter should be used to simulate proper loading. A short adapter cable (see Figure 5.1 in the General Information Section) facilitates mating the probe to the proper chassis connector pin. The measurements are for the VCA introduced minimum attenuation which is approximately 4dB. If necessary for troubleshooting purposes, minimum attenuation can be obtained by connecting the control input to +6Vdc at terminal A2A7A2E5 after disconnecting the TGC input at terminal A2A7A2E10.

9. PEAK POWER CONTROL (PPC) ADJUSTMENT

The exciter PPC circuit derives it's control voltage from the APC (Average Power Control) signal, and controls the peak levels of sideband signals (but not the carrier) within the exciter. The exciter PPC amplifier has a fast attack, slow decay time constant, to hold the peak output level at the power amplifier output within the PEP rating of the amplifier. Potentiometer A2A7A1R53 sets the threshold at which the PPC begins to attack. The threshold of the PPC amplifier can be adjusted, using A2A7A1R53, to accept input voltages in the range of 0 V to +4.6 V at A2A7A1E8. The easiest way to adjust the PPC is to do so in a mode where the carrier is fully suppressed (ie.; LSB Mode -00 carrier). Since the PPC adjustment of the exciter must be made within the feedback loop of the associated power amplifier, refer to the system manual for a more detailed description of this adjustment.

10. RF GAIN ADJUSTMENT

a. Connect the exciter RF output to a dummy load.

b. Unplug RF Output Module A2A7.

c. Set exciter MODE Selector to CW mode, keydown, and frequency to 7MHz.

d. Verify that 12 mV (−25.5 dBm) of 160 MHz is present at A1J7-B, using a Boonton 91H RF Voltmeter or an HP-8554/8552 Spectrum Analyzer.

e. Replace the A2A7 Module.

f. Adjust the RF Output Module gain potentiometer A2A7A2R11 for an exciter output of +20 dBm (2.24 V_{RMS}) into 50 ohms.

g. Remove test setup, and reconnect the exciter RF output to the system.

11. MAINTENANCE PARTS LIST

Table 3 lists the maintenance parts for the RF output Module A2A7. For a complete listing of manufacturer's codes, refer to Table 6-3, part of the General Information Section.

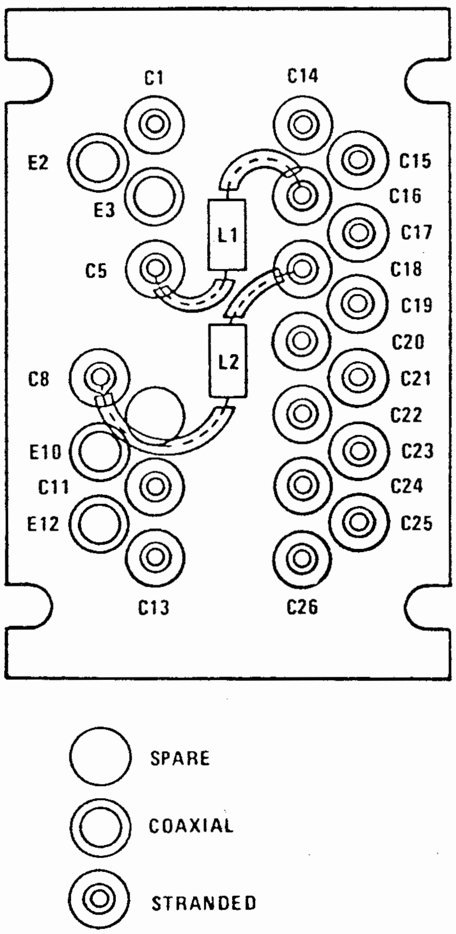


Figure 2. Filter Plate Assembly, A2A7FL1 Component Location

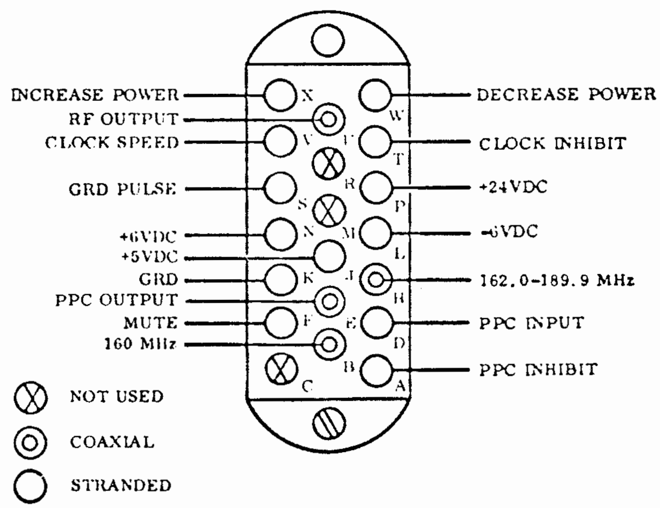


Figure 3. Chassis Connector, A2J7 (Top View)

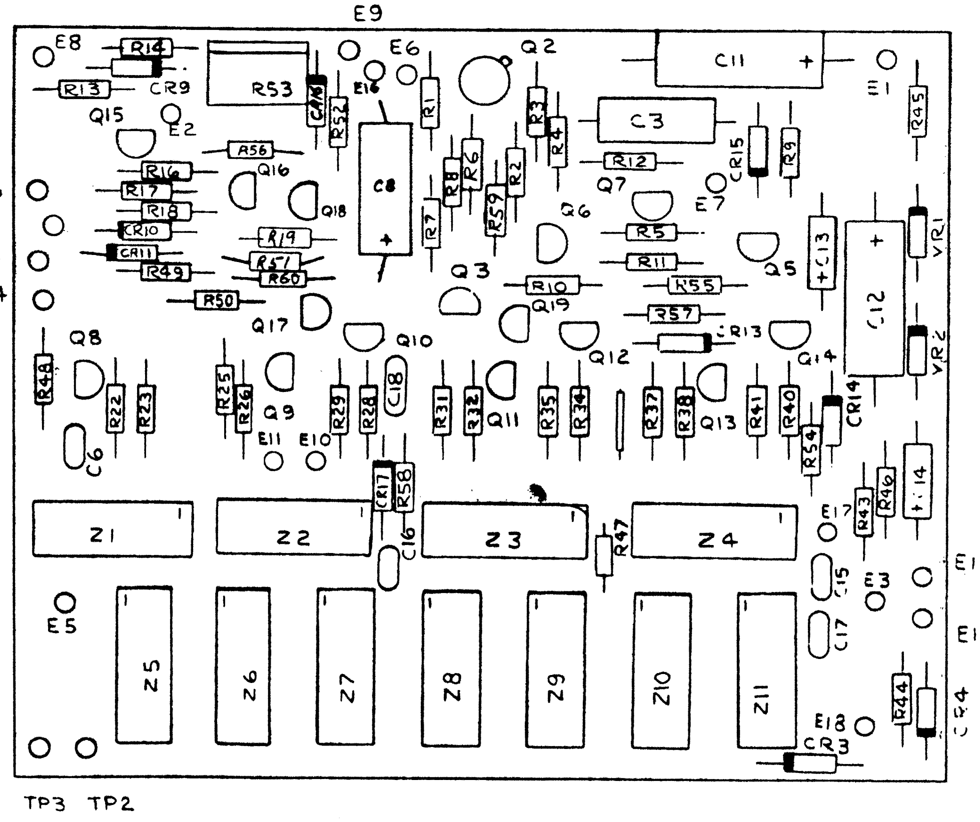
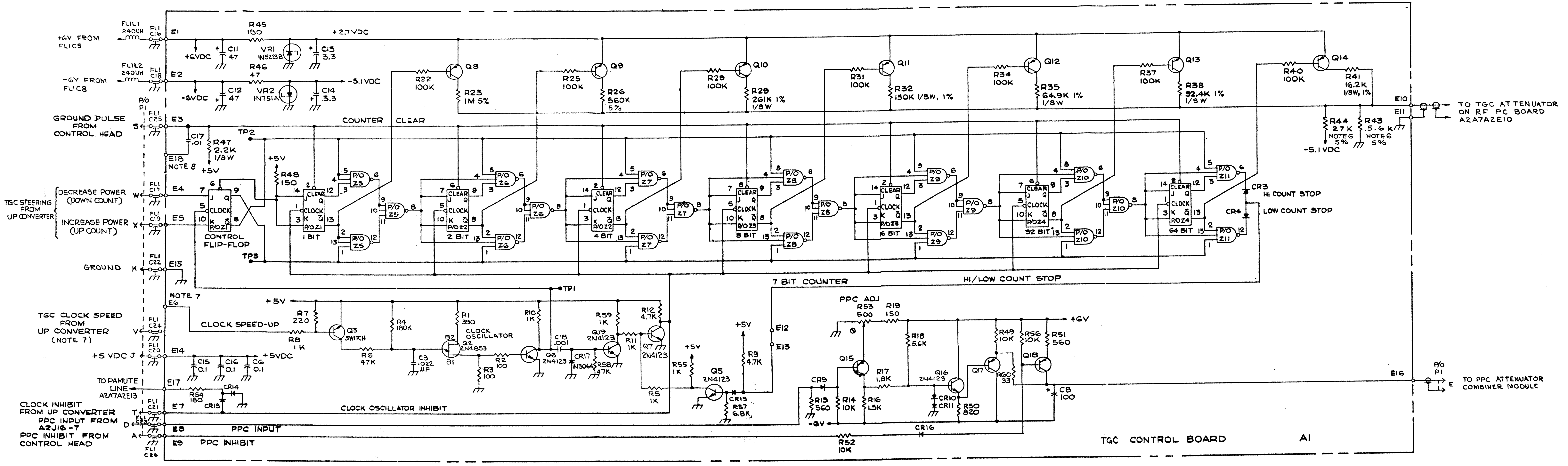


Figure 4. PPC/TGC Control PWB Component Locations

0759-3712



NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN PREFIX WITH A2A7
2. UNLESS OTHERWISE SPECIFIED:
   a. ALL CAPACITORS ARE IN MICROFARADS
   b. ALL DIODES ARE IN3064
   c. ALL RESISTORS ARE IN OHMS, 1/4W, 10%
   d. ALL TRANSISTORS ARE 2N4125
3. INTEGRATED CIRCUITS Z1, Z2, Z3, AND Z4 ARE SN7473N.
   PIN 11 IS CONNECTED TO GROUND
   PIN 4 IS CONNECTED TO +5VC
4. INTEGRATED CIRCUITS Z5, Z6, Z7, Z8, Z9 Z10, AND Z11 ARE SN7410N
   PIN 7 IS CONNECTED TO GROUND
   PIN 14 IS CONNECTED TO +5VDC
5. FL1C16 THRU FL1C26 ARE .00175UF.
6. ON S/N 11-100 R43 IS 3.9K, 5% & R44 IS 39K, 5%. S/N 1-10 & 101 UP ARE AS SHOWN.
7. SPEED CONTROL TERMINAL A1E6 IS CONNECTED EITHER TO A1TP2 OR A1E14 DEPENDING ON THE REQUIREMENTS OF THE SYSTEM OF WHICH THE EXCITER IS A PART.
8. TERMINAL A1E18 IS EITHER LEFT UNCONNECTED, OR IS CONNECTED TO A1E9 (PPC INHIBIT) DEPENDING ON THE REQUIREMENTS OF THE SYSTEM OF WHICH THE EXCITER IS A PART.

Figure 5. PPC/TGC Control PWB A2A7A1 Schematic Diagram

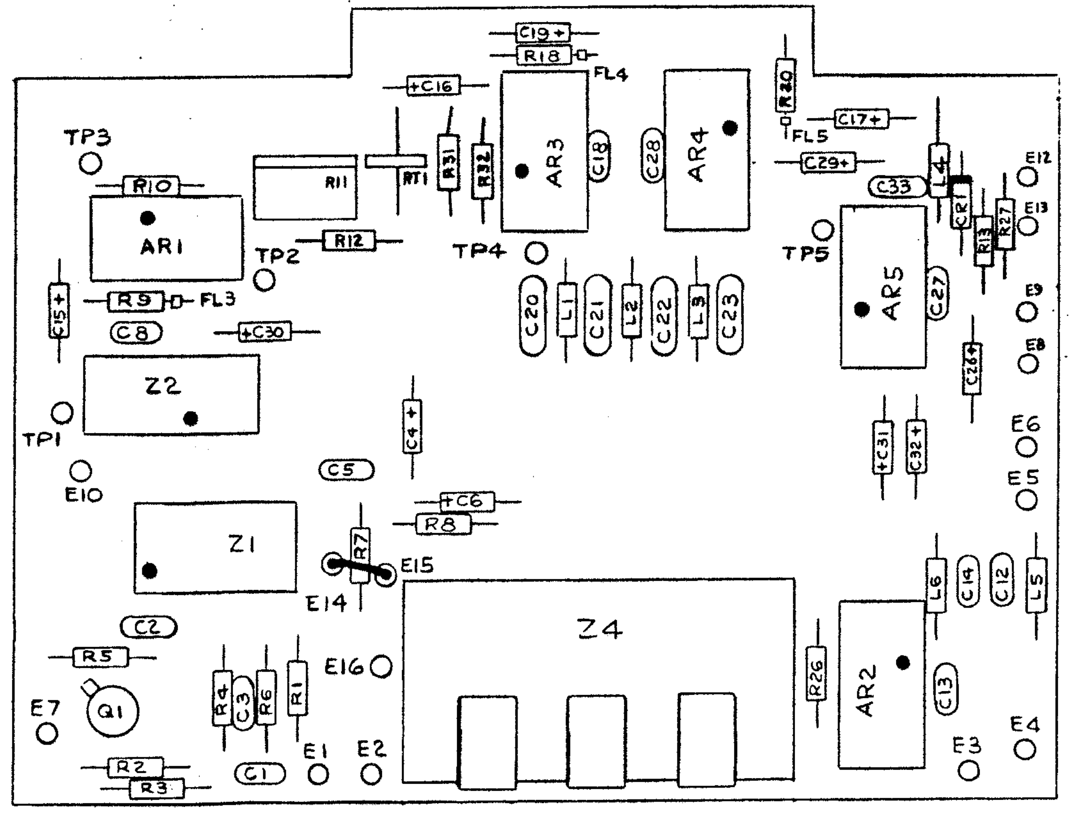


Figure 6. Down Converter PWB A2A7A2 Component Locations

0759-3701

NOTES:
1. PARTIAL REF DESIGNATIONS ARE SHOWN. PREFIX WITH A2A7
2. UNLESS OTHERWISE SPECIFIED:
a. ALL CAPACITORS ARE IN MICROFARADS
b. ALL RESISTORS ARE IN OHMS, 1/4 W, ±10%
c. ALL FEED-THROUGH CAPACITORS ARE .00175UF

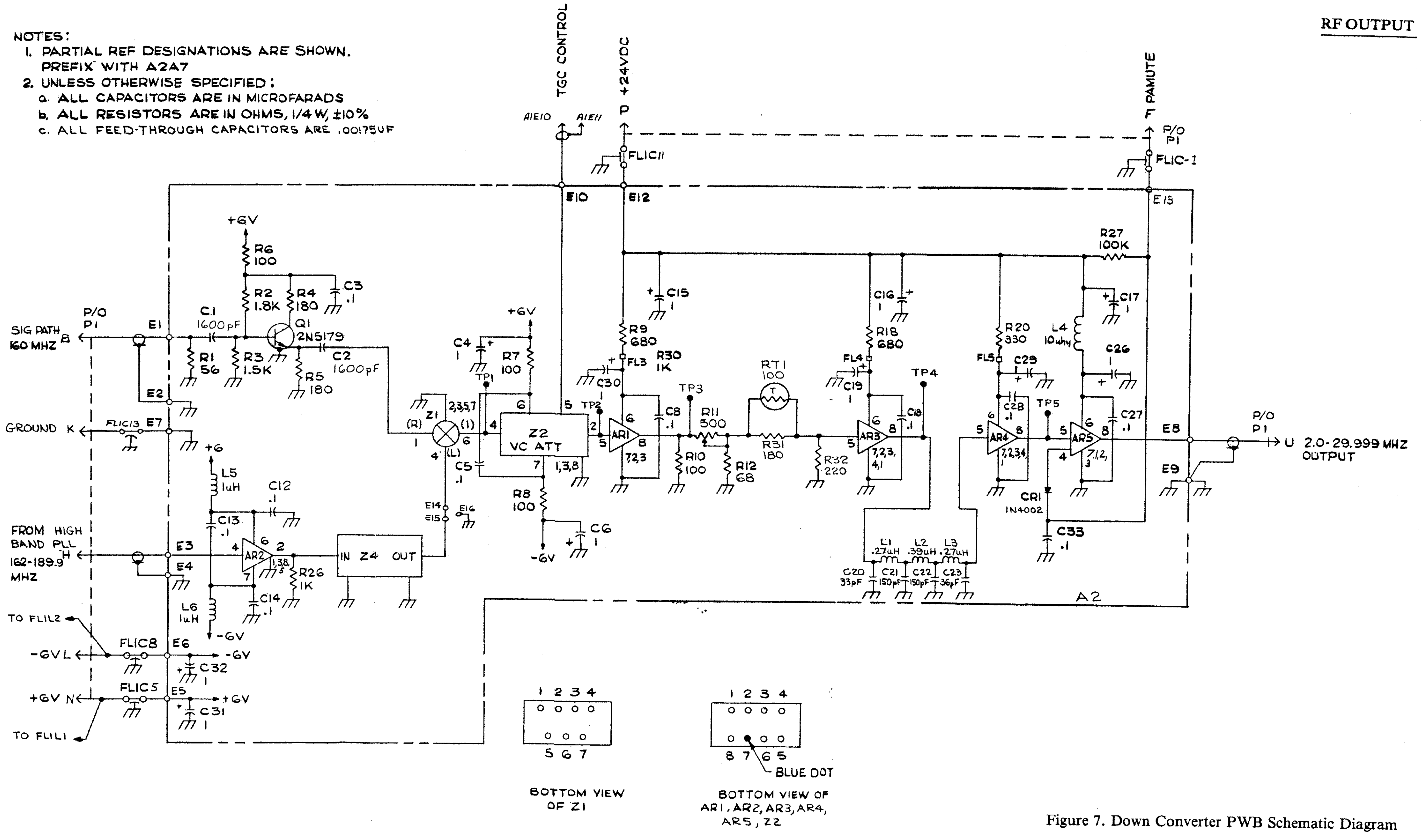


Figure 7. Down Converter PWB Schematic Diagram

TABLE 3. MAINTENANCE PARTS LIST - RF OUTPUT MODULE A2A7

Reference Designation	Name and Description
A2A7	RF Output Module: MFR 14304 PN 0759-3700 (used in RF-130 System exciters only) see note
A2A7	RF Output Module: MFR 14304 PN 0759-3750 (used in RF-745 System exciters only) see note
FL1	Filter Plate Assembly: MFR 14304, PN 0759-3704
C2-C4	Not used
C5	Same as FL1C1
C6, C7	Not used
C8	Same as FL1C1
C9, C10	Not used
C11	Same as FL1C1
C12	Not used
C13-C26	Same as FL1C1
L1	Inductor, 240uH: MFR 99800, PB 1537-94
L2	Same as FL1L1
MP1	Pin, Connector: MFR 81312, PN 100-8000S
MP2, MP3	Same as MP1
MP4	Pin, Connector: Mil type MS17803-16-20
MP5-MP16	Same as MP4
P1	Connector, Plug: MFR 81312, PN MRAC20PN
A2A7A1	PPC/TGC Control PWB Assembly: MFR 14304, PN 0759-3710
C1, C2	Not used
C3	Capacitor, Fixed Mylar .022uF: MFR 14655, PN WMF-2S22
C4, C5	Not used
C6	Capacitor, Fixed Ceramic: 0.1uF: MFR 72982, PN 8121-050-651-104M
C7	Not used
C8	Capacitor, Fixed Tantalum, 100uF ± 10%, 10 WVdc: Mil type CSR13C107ML
C9, C10	Not used
C11, C12	Capacitor, Fixed Tantalum, 47uF ± 10%, 20WVdc: Mil type CSR13E476ML
C13, C14	Capacitor, Fixed Tantalum, 3.3uF ± 10%, 15WVdc: Mil type CSR13D335ML
C15, C16	Same as A1C6
C17	Capacitor, Fixed Ceramic, .01uF: MFR 72982, PN 8121-050-651-103M
C18	Capacitor, Fixed Ceramic, .001uF: MFR 00656, PN 3419-050C-102M
CR1, CR2	Not used
CR3, CR4	Diode: Mil type 1N3064
CR5-CR11	Same as A1CR3
CR12	Not used
CR13-CR17	Same as A1CR3
MP1	PC Board: MFR 14304, PN 0759-3711
Q1	Not used
A1Q2	Transistor, UJT: MFR 04713, PN 2N4853
Q3	Transistor, PNP: MFR 04713, PN 2N4125
Q4	Not used
Q5-Q7	Transistor, NPN: MFR 04713, PN 2N4123
Q8-Q15	Same as A1Q3
Q16	Same as A1Q5
Q17	Same as A1Q3
Q18	Same as A1Q3
Q19	Same as A1Q5
R1	Resistor, Fixed Composition, 390 Ω, ± 10%, ¼W: Mil type RC07GF391K
R2, R3	Resistor, Fixed Composition, 100 Ω, ± 10%, ¼W: Mil type RC07GF101K
R4	Resistor, Fixed Composition, 180K Ω, ± 10%, ¼W: Mil type RC07GF184K
R5	Resistor, Fixed Composition, 1K Ω, ± 10%, ¼W: Mil type RC07GF102K
R6	Resistor, Fixed Composition, 47K Ω, ± 10%, ¼W: Mil type RC07GF473K
R7	Resistor, Fixed Composition, 220 Ω, ± 10%, ¼W: Mil type RC07GF221K
R8	Same as A1R5
R9	Resistor, Fixed Composition, 4.7K Ω, ± 10%, ¼W: Mil type RC07GF472K
R10, R11	Same as A1R5
R12	Same as A1R9
R13	Resistor, Fixed Composition, 560 Ω, ± 10%, ¼W: Mil type RC07GF561K
R14	Resistor, Fixed Composition, 10K Ω, ± 10%, ¼W: Mil type RC07GF103K

NOTE: The 0759-3700 and 0759-3750 RF Output Modules are identical in form and function. The difference being factory supplied jumper wiring on the PPC/TGC Control PWB A2A7A1. This jumpering changes the TGC clock speed (200Hz or 1000Hz) dependent upon the transmitting system in use.
JUMPER: A7A1E6 to A7A1E14; A7A1E9 to A7A1 E18; in RF-130 Systems
JUMPER: A7A1E6 to A7A1TP2; A7A1E9 — No connection; in RF-745 Systems

TABLE 3. MAINTENANCE PARTS LIST - RF OUTPUT MODULE A2A7 (Continued)

Reference Designation	Name and Description
R15	Not used
R16	Resistor, Fixed Composition, 1.5K Ω, ± 10%, ¼W: Mil type RC07GG152K
R17	Resistor, Fixed Composition, 1.8K Ω, ± 10%, ¼W: Mil type RC07GF182K
R18	Resistor, Fixed Composition, 5.6K Ω, ± 10%, ¼W: Mil type RC07GF562K
R19	Resistor, Fixed Composition, 150 Ω, ± 10%, ¼W: Mil type RC07GF151K
R20, R21	Not used
R22	Resistor, Fixed composition, 100K Ω, ± 10%, ¼W: Mil type RC07GF104K
A1R23	Resistor, Fixed Composition, 1MEG Ω ± 5%, ¼W: Mil type RC07GF105J
R24	Not used
R25	Same as A1R22
R26	Resistor, Fixed composition, 560K Ω ± 5%, ¼W: Mil type RC07GF564J
R27	Not used
R28	Same as A1R22
R29	Resistor, Fixed Film, 261K Ω ± 1%, 1/8W: Mil type RN55D2613F
R30	Not used
R31	Same as A1R22
R32	Resistor, Fixed Film, 130K Ω ± 1%, 1/8W: Mil type RN55D1303F
R33	Not used
R34	Same as A1R22
R35	Resistor, Fixed Film 64.9K Ω ± 1%, 1/8W: Mil type RN55D6492F
R36	Not used
R37	Same as A1R22
R38	Resistor, Fixed Film, 32.4K Ω ± 1%, 1/8W: Mil type RN55D3242F
R39	Not used
R40	Same as A1R22
R41	Resistor, Fixed Film, 16.2K Ω ± 1%, 1/8W: Mil type RN55D1622F
R42	Not used
R43	Resistor, Fixed Composition, 5.6K Ω ± 5%, ¼W: Mil type RC07GF562J
R44	Resistor, Fixed Composition, 27K Ω ± 5%, ¼W: Mil type RC07GF273J

Reference Designation	Name and Description
R45	Resistor, Fixed Composition, 180 Ω ± 5%, ¼W: Mil type RC07GF181J
R46	Resistor, Fixed Composition, 47 Ω ± 10%, ¼W: Mil type RC07GF470K
R47	Resistor, Fixed Composition, 2.2K Ω ± 10%, 1/8W: Mil type RC05GF222K
R48	Resistor, Fixed Composition, 150 Ω ± 10%, ¼W: Mil type RC07GF151K
R49	Resistor, Fixed Composition, 10K Ω ± 10%, ¼W: Mil type RC07GF103K
R50	Resistor, Fixed Composition, 820 Ω ± 10%, ¼W: Mil type RC07GF821K
R51	Same as A1R13
R52	Same as A1R14
A1R53	Resistor, Variable, 0-500 Ω: MFR 35009, PN 156-4-500 ohm
R54	Resistor, Fixed Composition, 180 Ω ± 10%, ¼W: Mil type RC07GF181K
R55	Same as A1R5
R56	Same as A1R14
R57	Resistor, Fixed Composition, 6.8K Ω ± 10%, ¼W: Mil type RC07GF682K
R58	Same as A1R6
R59	Same as A1R5
R60	Resistor, Fixed Composition, 33 Ω ± 10%, ¼W: Mil type RC07GF330K
VR1	Diode: Mil type 1N5223B
VR2	Diode: Mil type 1N751A
Z1-Z4	Integrated Circuit: MFR 01295, PN SN7473N Dual J-K Flip-Flop
Z5-Z11	Integrated Circuit: MFR 01295, PN SN7410N Triple NAND Gates
A2A7A2	Down-Converter PWB Assembly: MFR 14304, PN 0759-3720
AR1	Driver, HF: MFR 14304, PN 0759-5020
AR2	VHF Amplifier: MFR 14304, PN 0759-5010
AR3	Same as A2AR1
AR4	Driver, HF: MFR 14304, PN 0759-5030
AR5	Power Amplifier, HF: MFR 14304, PN 0759-5040

TABLE 3. MAINTENANCE PARTS LIST - RF OUTPUT MODULE A2A7 (Continued)

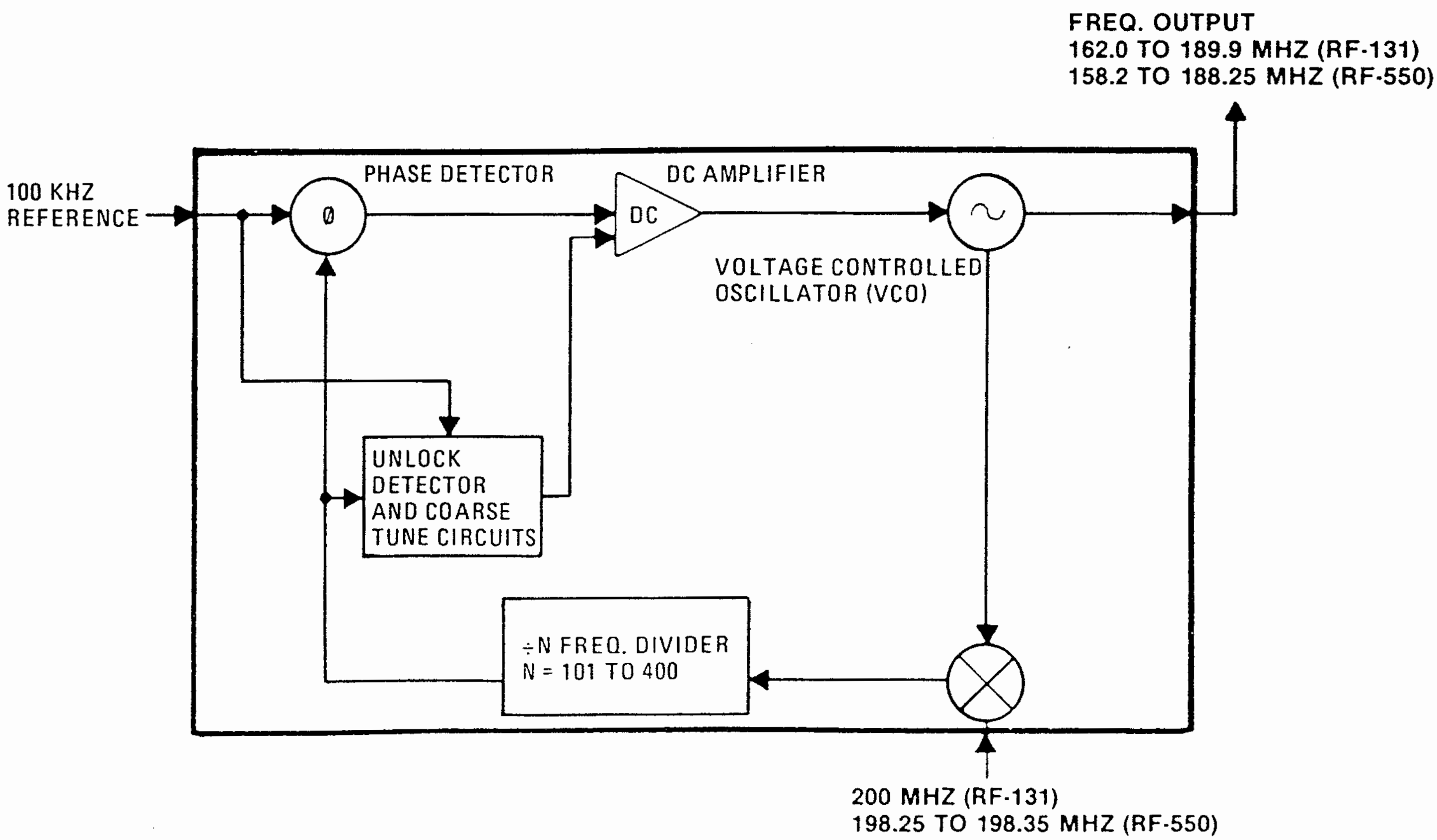
Reference Designation	Name and Description
A2A7A2	Continued
C1, C2	Capacitor, Fixed Ceramic, 0.0018uF 50WVdc: MFR 72982, PN 8101-050-651-182M
C3	Same as A1C6
C4	Capacitor, Fixed Tantalum, 1.0uF, ±10%, 50WVdc: Mil type CSR13G105ML
C5	Same as A1C6
C6	Same as A2C4
C7	Not used
C8	Same as A1C6
C9-C11	Not used
C12-C14	Same as A1C6
C15-C17	Same as A2C4
C18	Same as A1C6
C19	Same as A2C4
C20	Capacitor, Fixed Mica, 33 pF: Mil type CM05ED330J03
C21,C22	Capacitor, Fixed Mica, 150 pF: Mil type CM05FD151J03
C23	Capacitor, Fixed Mica, 36 pF: Mil type CM05ED360L03
C24,C25	Not used
C26	Same as A2C4
C27,C28	Same as A1C6
C29-C32	Same as A2C4
C33	Same as A1C6
CR1	Diode: MFR 04713, PN 1N4002
FL1,FL2	Not used
FL3-FL5	Ferrite Bead: MFR 78488, PN 57-0180
L1	Coil, Fixed RF, .27uH: MFR 99800, PN 1025-06
L2	Coil, Fixed RF, .39uH: MFR 99800, PN 1025-10
L3	Same as A2L1
L4	Coil, Fixed RF, 10uH: MFR 99800, PN 1537-36
L5, L6	Coil, Fixed RF, 1uH: MFR 99800, PN 1025-20
MP1	PC Board: MFR 14304, PN 0759-3721
Q1	Transistor: MFR 21921, PN 2N5179

Reference Designation	Name and Description
R1	Resistor, Fixed Composition, 56 Ω ± 10%, ¼W: Mil type RC07GF560K
R2	Resistor, Fixed Composition, 1.8K Ω ± 10%, ¼W: Mil type RC07GF182K
R3	Same as A1R16
R4, R5	Same as A1R54
R6-R8	Same as A1R2
R9	Resistor, Fixed Composition, 680 Ω ± 10%, ¼W: Mil type RC07GF681K
R10	Same as A1R2
R11	Same as A1R53
R12	Resistor, Fixed Composition, 68 Ω ± 10%, ¼W: Mil type RC07GF680K
R13	Resistor, Fixed Composition, 330 Ω ±5%, ¼W: Mil type RC07GF331J
R14-R17	Not used
R18	Same as A2R9
A2R19	Not used
R20	Resistor, Fixed Composition, 330 Ω ± 10%, ¼W: Mil type RC07GF331K
R21-R25	Not used
R26	Same as A1R5
R27	Same as A1R22
R28-R30	Not used
R31	Same as A1R54
R32	Same as A1R7
RT1	Thermistor, 100 Ω ± 10% at 25 °C, MFR 15801, PN CB21L1
Z1	Doubly Balanced Mixer: MFR 14304, PN 0759-5150
Z2	Voltage-Controlled Attenuator: MFR 14304, PN 0759-5000
Z3	Not used
Z4	Filter, VHF Bandpass, 173MHz: MFR 14304, PN 0759-3725

UNIT INSTRUCTIONS

HIGH BAND PLL MODULE

A2A8



HIGH BAND PLL MODULE A2A8

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1. GENERAL DESCRIPTION

High Band Phase Lock Loop (PLL) Module A2A8 is an electrically-tuned frequency synthesizer which can be used interchangeably in both the RF-131 Exciter, and the RF-550 Receiver. For use in the RF-550, Jumper E28 to E29 on the ÷N PWB, omit the Jumper when used in the RF-131.

High Band PLL Module A2A8 contains two major PWB assemblies: ÷N PWB A2A8A1 and RF PWB A2A8A2.

NOTE

In some instances, the integrated circuit part numbers listed may differ from those of the equipment supplied. In all instances these parts are equivalent, and may be replaced with like part numbers of those listed in Table 1.

2. TECHNICAL CHARACTERISTICS

Weight:
1.2 Pounds (544 grams)

Dimensions:
4-1/8in (H) x 2-1/8in (W) x 5-7/8in (D)
10.5cm (H) x 5.4cm (W) x 14.9cm (D)

Power Requirements:
5Vdc at 255mA_{AVG}
-6Vdc at 12mA_{AVG}
15Vdc at 80.5mA_{AVG}
24Vdc at 144mA_{AVG}

Signal Inputs:
200MHz at 28mV_{RMS} (RF-131)
198.25 to 198.35 MHz at 39mV_{RMS} (RF-550)
100kHz at 3V P-P (TTL levels)
10 Control Wires using quasi-binary code (ECL Levels in the RF-131; TTL Levels in the RF-550)

Signal Outputs:
162.00 to 189.9MHz (RF-131)
158.25 to 188.25MHz (RF-550)
Both in 100Hz increments at 110mV_{RMS} level.
(100K increments for any single mixer injection frequency in the RF-550)

Impedance:
198/200MHz: 50Ω
100kHz: approximately 1K Ω

Output Load:
50 Ω

3. SEMICONDUCTOR COMPLEMENT

Table 1 lists all semiconductors used in the High Band PLL Module A2A8.

Table 1. SEMICONDUCTOR COMPLEMENT

Reference Designation	Type	Function
A1CR4	1N3064	OR Gate
CR5	1N3064	OR Gate
Q1	2N5179	Ramp Control Switch
Q2	2N2907	Ramp Generator
Q3	2N2222	Ramp Discharge
Q4	3N171	Sampling FET
Q5	2N5179	Sample Driver
Q6	2N4221A	Source Follower
U1	SN74S11N	Triple AND Gate
U2	SN74S00N	Preload Gate
U3	SN74S112AN	Dual JK Flip-Flop
U4	SN74S112AN	Dual JK Flip-Flop
U5	SN74LS196N	Decade Divider
U6	SN74S11N	Triple AND Gate
U7	SN74S112AN	Dual JK Flip-Flop
U8	SN74S112AN	Dual JK Flip-Flop
U9	SN74S00N	Quad NAND Gate
U10	SN74LS112AN	Dual JK Flip-Flop
U11	SN74LS00N	Quad NAND Gate
U12	SN74LS112AN	Dual JK Flip-Flop
U13	LM324N	Comparator
U14	LM324N	Comparator
U15	LM324N	Comparator
U16	SN74S00N	Preload Gate
U17	SN74LS112AN	Dual JK Flip-Flop
A2AR1	130-0001-003	Operational Amplifier
AR3	8007C	Operational Amplifier
CR2	1N3064	Isolation
CR3	1N3064	Reverse Polarity Protection
Q1	2N2222	Unlock Switch
Q2	3N171	Unlock Switch
Q3	SRF-552	Amplifier
Q4	2N5179	Amplifier
Q5	2N5179	Amplifier
Q6	2N5179	Amplifier
Q9	2N2222	VCO Steering Buffer
Q10	2N5179	Buffer Amplifier
U1	0759-5150	Mixer
U2	UA7818KC	18V Regulator
VR3	1N753A	Voltage Regulator
A2A1Q1	2N5397	Oscillator
CR1	KV2001	Voltage Variable Capacitor
CR2	KV2001	Voltage Variable Capacitor

4. OVERALL CIRCUIT DESCRIPTION

High Band PLL Module A2A8 consists basically of a voltage-controlled oscillator (VCO), a loop mixer, a programmable frequency divider (÷N), a frequency discriminator and a phase detector. The circuit forms a phase-locked loop which locks the selected output frequency to a very stable 100kHz reference input.

NOTE

Operation of a simple phase-locked loop system is described in Circuit Description paragraph 4, in the Low Band PLL Module A2A14 section of this manual.

5. DETAILED DESCRIPTION OF ÷N PWB A2A8A1 CIRCUITS

Refer to figure 7. ÷N PWB A2A8A1 contains the programmable ÷N Frequency Counter, Sample and Hold Phase Detector, Unlock Detector and the VCO Steering Detector.

In order to understand the operation of the ÷N counter, some background information is in order. A decade divider circuit counts in binary from zero through nine in one cycle. This is shown in table 2, where the Clock function is some input frequency; QA, QB, QC, and QD are the outputs from the individual flip-flops in the counter. High and low states are defined as standard TTL levels.

The first divide-by-ten digital counter comprises U3 and U4 and will achieve one output pulse after ten input pulses (if not preloaded with a number other than zero). The first divide-by-ten output (U4B-9) is used to clock the second divide-by-ten counter U5 and it too will produce one output pulse for every ten input pulses (if not preloaded with a number other than zero). This will produce one output pulse from the second counter after 100 input pulses to the first counter. In a similar fashion, U17 forms a divide-by-four counter, the net result being two divide-by-tens and a divide-by-four counter, for a total division ratio of 400.

Electrically, this is accomplished by dual high speed JK flip-flop packages U3, U4 and U17 and a high speed divide-by-ten integrated circuit, U5. Gate U1A produces a TTL level signal for the first decade counter while the output from U4-9 clocks the second decade counter U5. Although U4-9 is high (1) for both the eight and nine count, only one negative-going transition occurs to clock U5 (pin 8). Similarly, the QD output from U5-12 is used to clock the divide-by-four counter at U17-1 and U17-13.

TABLE 2. DECADE DIVIDER CIRCUIT INPUT-OUTPUT DATA

Clock Input Pulses	Counter State	QA	QB	QC	QD
0	0	0	0	0	0
1	1	1	0	0	0
2	2	0	1	0	0
3	3	1	1	0	0
4	4	0	0	1	0
5	5	1	0	1	0
6	6	0	1	1	0
7	7	1	1	1	0
8	8	0	0	0	1
9	9	1	0	0	1
10	0	0	0	0	0
11	1	1	0	0	0
12	2	0	1	0	0
13	3	1	1	0	0

Preloading is a technique whereby a counter may be loaded to a given state instead of being reset to zero, so that fewer input pulses are needed to achieve the full state. For example, if a decade counter is preloaded to the decimal six and then clocked with input pulses, it will count seven, eight and nine and recycle to zero in only four clock pulses. If the counter is immediately reset to decimal six after each zero state by the use of preloading, the device becomes a divide-by-four instead of a divide-by-ten. The count ratio in High Band PLL Module A2A8 varies from 101 to 400 depending upon the Frequency Selector switch setting on the front panel and may be determined by: 400 minus the 1st Three Digit Switch Settings. For example, if the ratio is set for 15.0000MHz, the division is 400 - 150 = 250.

In order to have sufficient time for preloading, the counter is inhibited after the 395th count and the final four counts are assumed by shift register U7, U8. AND gate U1-C detects the 395 state and clears shift register U7, U8 on the next clock pulse. This provides the necessary high from U8-6 for AND gates U2 and U16 and the required low for decade counter U5 to allow preloading to take place. The preloading is ended on the 399 state when U8A toggles and the following clock pulse sets U8B, enabling the counter. The ÷N divider output occurs as a negative transition at U8-9 at the 396th count and is coupled to the Sample and Hold Phase Detector.

Control inputs are quasi-binary in that the two and four bit data lines for both the 100kHz and 1MHz digits are inverted. This system is used both for generic compatibility and to accommodate the fact that a flip-flop cannot be toggled from the preset terminal if it already contains a Logic 1. The first decade counter, consisting of U3A, U3B, U4A and U4B will always hold the binary number 0110 at the start of preloading and as a consequence, the inverted two and four digit inputs are required to toggle flip-flops U3B and U4A out of the 1 state.

In the RF-131 the quasi-binary 1MHz control inputs are accommodated by introducing the inverted two and four bit data lines at the inverting inputs of U14B and U14C respectively. All control inputs are compared against a -1 Vdc reference voltage by comparators U13, U14 and U15. This -1Vdc reference voltage is developed across R23, R24 and R28. (The jumper at E28 and E29 is not installed in RF-131 systems.)

The quasi-binary 1MHz control inputs are accommodated by introducing the inverted two and four bit data lines at the inverting inputs of U14B and U14C respectively. All control inputs are compared against a – 1 Vdc reference voltage by comparators U13, U14 and U15. This – 1Vdc reference voltage is developed across R23, R24 and R28. (The jumper at E28 and E29 is not installed in RF-131 systems.)

In the RF-550, comparators U13, U14, and U15 on the. ÷N PWB are biased at approximately +2.0Vdc by jumpering R28. The comparators once again provide TTL Levels to the divider circuits, and the re-inversion of two and four bit data inputs are handled in the same manner as in the RF-131.

The sample and hold phase detector is composed of ramp generator Q2-R12-C22, sampling FET Q4 and hold capacitor C23. NAND gates U9C, U9D form a one-shot which provides a very narrow reference pulse at the rate of 100kHz. This reference pulse sets U10A-5, causing switch Q1 to conduct, charging C22 through Q2 and R12. The ramp at C22 is terminated by a sample pulse from the ÷N output at U8-9, clearing flip-flop U10. This also momentarily cuts off switch Q5 which turns on sampling FET Q4. When Q4 is on, the voltage on C23 will increase or decrease to attain equilibrium with ramp capacitor C22. See Figure 1.

Source follower FET Q6 provides a high impedance load for C23 so that it will not discharge between sample pulses. The phase error voltage is then coupled to RF PWB A2A8A2 through A1E1. The cycle is completed at the onset of the next reference pulse, which momentarily discharges C22 and again sets flip-flop U10A.

When the loop is locked, the phase error voltage output tunes the VCO to maintain the correct output frequency. If the loop becomes unlocked, however, a greater voltage swing (in the correct direction to regain lock) to the VCO is required. This is handled by the Unlock Detector circuits subsequently described.

The Unlock Detector is composed of frequency discriminator flip-flops U10A and U10B, AND gate U6C and NAND gates U11A, B and C. The principle of operation is: Should the divider output become unlocked from the reference (whether the ÷N output should be higher or lower than the reference), the unlock Detector Output at A1E4 will go high to enable the coarse steering circuits on the RF PWB A2A8A2 while flip-flop U12A will assume the correct state to tune the VCO in the correct direction to regain the locked state. This operation can be illustrated by two examples.

If the loop is locked, both reference and sample pulses to the phase detector will be at a 100kHz rate, and should occur in a alternating sequence as shown in Figures 1 and 2. The time difference between the pulses represents the phase error voltage from the phase detector output.

In the locked state, flip-flop U10A will always receive a clear pulse after every set pulse. This insures that the output from NAND gate U11A will always be high, since U10-5 will never be high when U10-1 goes high. For the same reason, NAND gate U11B will also always be high, thus insuring a low output from NAND gate U11C. AND gate U6C detects any sample and reference pulses occuring at the same time. Since this cannot happen in the locked state (the input pulses alternate with each other) its output will also be low. The net result is that NAND gate U11C and AND gate U6C are always low, keeping the VCO steering switch on the RF PWB A2A8A2 Off.

If, however, the divider output frequency should shift high for example, sample pulses will occur faster than reference pulses and sooner or later two (or more) sample pulses will arrive between two successive reference pulses (see Figure 3). It now becomes possible for NAND gate U11B to see a sample pulse while U10B is in the set (high output)

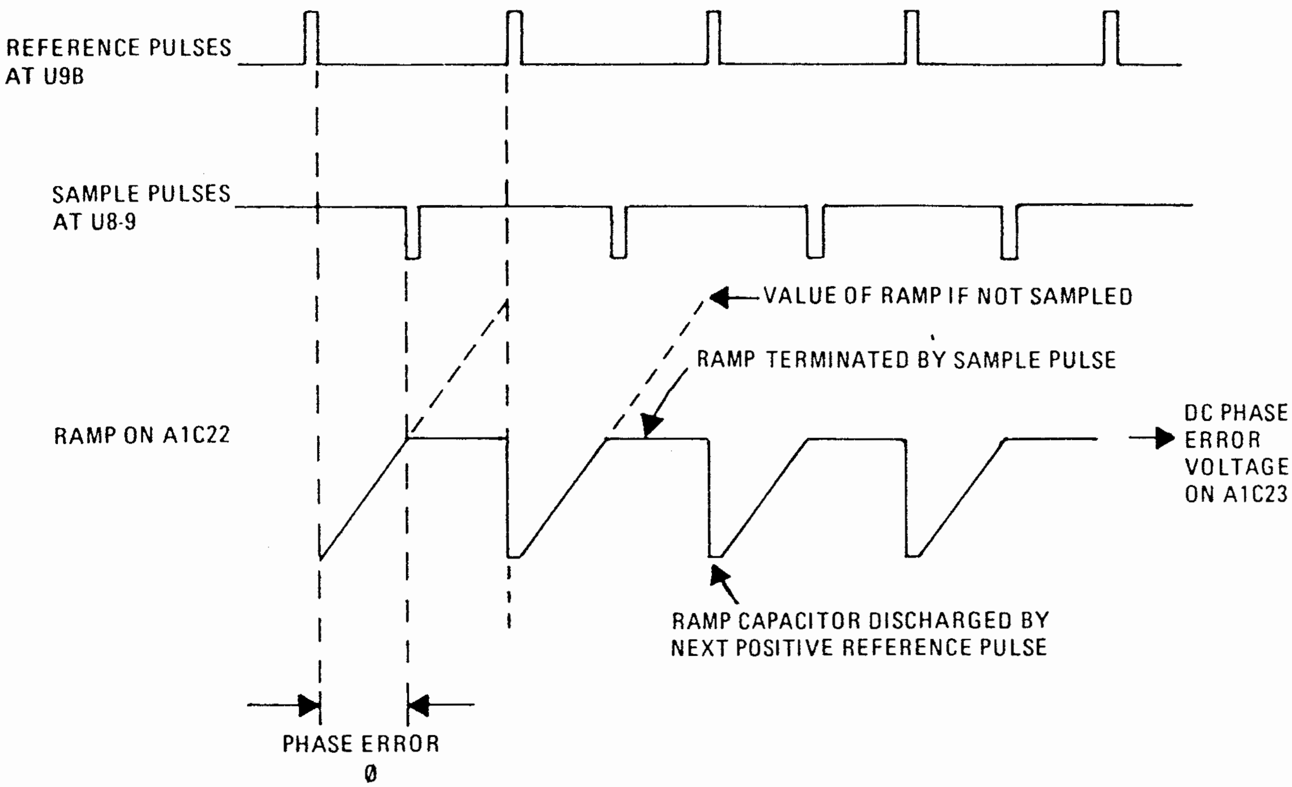


Figure 1. Phase Detector Operation

state allowing negative going pulses at U11B-11. At the same time, flip-flop U10A will be cleared more often than it will be set, and the output from NAND gate U11A remains always high (just as when the loop is locked). Also AND gate U6C will catch any sample and reference pulse occuring at the same time, so it too may have positive pulses appearing at U6C-6. VCO steering flip-flop U12A is clocked by NAND gate U11A and cleared by NAND gate U11B. Based on the previous discussion, it is being cleared and never clocked so its output will be low. The final result will be positive pulses at A1E4, to turn on the VCO steering circuits and a low voltage to help tune the VCO from A1E9.

The same type of operation occurs when the divider output is low in frequency, causing negative going pulses at U11A-3 and an ensured high at U11B-11 (just as when the loop is locked). Flip-flop U12A is now being clocked and never cleared, thus achieving set state. The net result becomes positive pulses at A1R4 and a high state from U12A-5. In summary then, NAND gates U11A and U11B are low and high frequency detectors, while AND gate U6C is high only when a sample and reference pulse occur at the same time. When enabled by these gates, flip-flop U12A will help tune the VCO in a correct direction to regain the locked state.

6. DETAILED DESCRIPTION OF RF PWB A2A8A2 CIRCUITS

Refer to Figure 10. RF PWB A2A8A2 contains the VCO, Loop Mixer U1, Loop Filter and Dc Amplifier AR3, Unlock Switching and VCO Steering Control circuits, and an 18Vdc regulator.

Referring to the VCO Assembly A2A8A2A1, the VCO is an electrically tuneable oscillator in the range of 158.25 to 189.9MHz (combined range for the RF-550 and RF-131). Using FET Q1 in grounded gate configuration, the output frequency is détermined principally by C9, L2, C10 and CR1, CR2. Positive feedback and output coupling is provided by capacitive voltage divider C6 and C7. Frequency range adjustment is obtained with C9 and C10 while electrical tuning is through voltage variable capacitors CR1 and CR2.

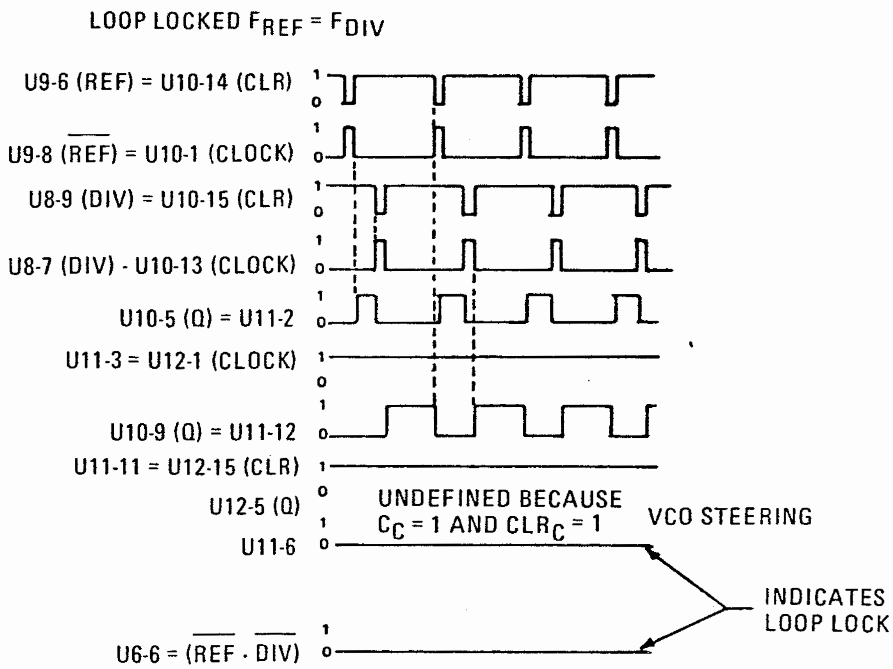


Figure 2. High Band PLL Module Coarse Tune Timing Diagram (Locked)

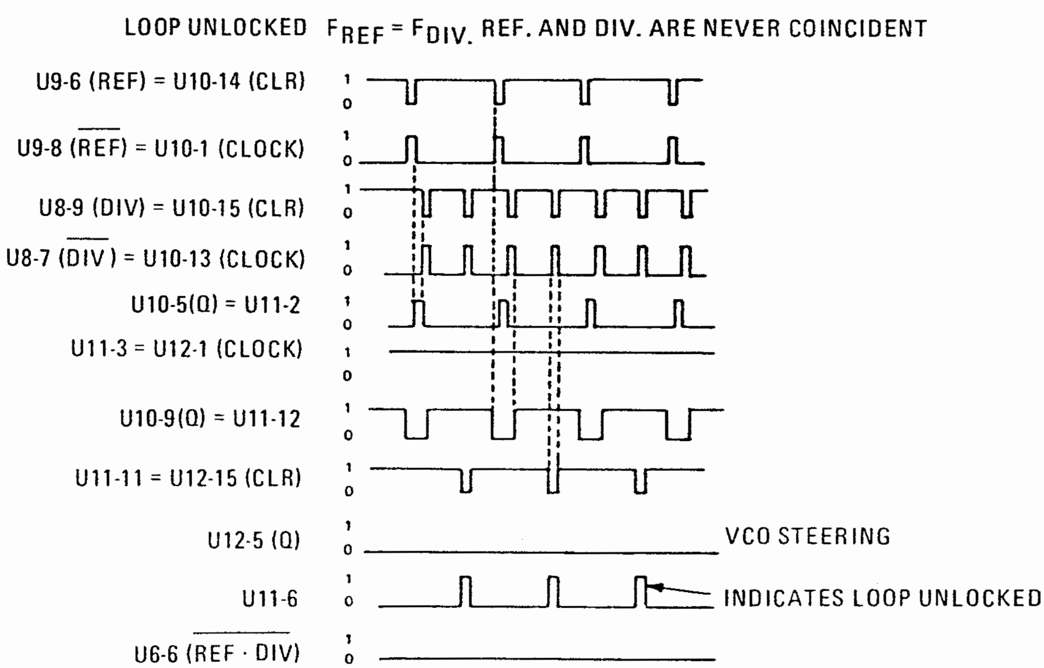


Figure 3. High Band PLL Module Coarse Tune Timing Diagram (Unlocked)

Output from the VCO is fed to two circuit points. One output becomes the module output at A2A8 P1-U via A2A8A2A1J1. The second output is fed to loop mixer U1 through buffer amplifiers Q10 and Q3.

Loop mixer U1 translates the high VCO output frequency to the 10-40MHz range by mixing it with 200MHz. The 10-40MHz signal is then fed through a low pass filter and amplifier Q4-Q5-Q6 to the frequency divider circuits on the ÷N PWB A2A8A1. The phase error voltage input is fed to high gain Dc amplifier AR3. R13, R14, and C5 shape AR3 frequency response to stabilize the loop.

When the loop is unlocked, the unlock detector voltage from the ÷N PWB A2A8A1 is fed through switch Q1, and amplifier AR1, and turns on FET switch Q2. This allows the VCO steering voltage to be transferred through Q9 and Q2 to Dc amplifier AR3 while the loop is unlocked. Again, an example will clarify the operation. If the loop unlocks when the VCO shifts too high in frequency (and so the output of the ÷N is lower than the 100kHz reference), positive pulses will occur at the base of Q1, causing negative pulses at the inverting terminal of AR1, hence positive pulses at the gate of Q2. A high VCO steering voltage at E2, discharging C3, turns on Q9 and grounds the voltage at voltage divider R10 and R43 through switch Q2 and R2. This produces a negative voltage swing at AR3-6. A negative going voltage to the varicaps A2A1CR1 and A2A1CR2 will increase their capacitance, decreasing the VCO frequency. Should the loop unlock with a lower VCO frequency, the VCO steering voltage goes low, and a more positive voltage is transferred to the varicaps and the VCO frequency is increased. When the loop is locked, however, the coarse tune circuits are inhibited by the unlock detector on the ÷N PWB A2A8A1, which turns Off FET Q2. This allows R1 to maintain a preset bias on AR3-3, while the phase error voltage tunes the VCO to maintain the correct frequency output.

In the RF-131 the VCO is driven from 162.0 to 189.9 MHz to tune the exciter from 2.0 to 29.9 MHz, and uses a fixed mixer injection frequency of 200 MHz for a frequency range at the input of the ÷N PWB of 38.0 to 10.1 MHz and division ratios if 380 to 101. The frequency of the module output will be 160MHz plus the first three digits of the frequency selector.

The normal operating range of the VCO in the RF-550 Receiver is from 158.35 to 188.25MHz. (The VCO can generate 158.25MHz with 00.0000 selected at the Frequency Switches). A loop mixer injection frequency from 198.25 to 198.35MHz results in a frequency range at the ÷N PWB input of 10.1 to 40.0 MHz and division ratios of 101 to 400.

The 18 volt Dc voltage supply for the module is obtained by regulator U2 from a +24Vdc input.

7. ALIGNMENT DATA

Adjustment of the High Band PLL Module A2A8 will be required if the VCO does not lock frequency within one-half second from resetting one of the first three digit switches on the front panel, or if the module jumps in and out of lock. By viewing and measuring output at A2TP2 on RF PWB A2A8A2, a Dc voltage (which will decrease in incremental steps from approximately 13Vdc at 299 switch setting, to approximately 1.5Vdc at 000 setting) can be noted in a properly adjusted module. Lock is also indicated by a steady frequency at the module output, and ramps at A1TP1 which truncate at the same dc level, as shown in Figure 1.

Test equipment required is as follows: Tektronix Model 453 Oscilloscope (or equivalent) with 10X probe for reduced circuit loading; Alignment Tool(JFD No. 5284, or equivalent); Hewlett-Packard Spectrum Analyzer 8554B/8552A, (or equivalent) and a small screwdriver.

7.1 ALIGNMENT PROCEDURE

a. Set potentiometer A2A8A2R1 approximately at the center of its range. Note that A2A8 A2R1 is a 20-turn potentiometer.

b. See Figure 9. Carefully adjust the VCO trimmer capacitors A2A8A2A1C9 and A2A8A2A1C10 all the way CW to their end stops and then CCW four turns.

c. Set the front panel frequency selector switches to 15.0 MHz.

d. Set oscilloscope for horizontal sweep of 10us per division and calibrated to read 1 Volt per division vertical. Connect the oscilloscope to A2A8A1TP1. Adjust A2A8A2R1 until the ramp amplitude equals 2.5 Volts peak-to-peak and all ramps truncate at the same level as shown in Figure 1.

NOTE

A locked condition is defined as each successive ramp truncating at the same Dc level.

e. If the loop fails to lock adjust trimmer capacitors A2A8A2A1C9 and/or A2A8A2A1C10 one turn in either direction and repeat step d.

f. Connect oscilloscope to A2A8A2TP2. Decrease the frequency selector switch settings such that lock is maintained while adjusting A2A8A2A1C9 until a +1.5 Vdc (locked loop) level is achieved at a switch setting of 00.0 MHz.

g. Reset the frequency to 15.0MHz. Increase the frequency selector switch settings such that lock is maintained while adjusting A2A8A2A1C10 until a +13 Vdc (locked loop) level is achieved at a switch setting of 29.9 MHz.

h. Repeat steps f and g until A2A8A2TP2 has +13Vdc at 29.9MHz setting and +1.5Vdc at 00.0MHz setting.

i. Recheck A2A8A1TP1 and adjust A2A8-A2R1 for a ramp amplitude of 2.5 volts peak-to-peak.

j. Connect module output (A2A8P1-U) to spectrum analyzer. Adjust the analyzer for 50kHz/division and a 3kHz bandwidth. Adjust A2A8A1C24 so that any 100KHz sidebands are suppressed at least 70dB.

8. MAINTENANCE PARTS LIST

Table 3 is the Maintenance Parts List for the High Band PLL Module A2A8. Manufacturers are referenced by a five-digit code. For a complete list of manufacturer's names and addresses refer to the General Information Section.

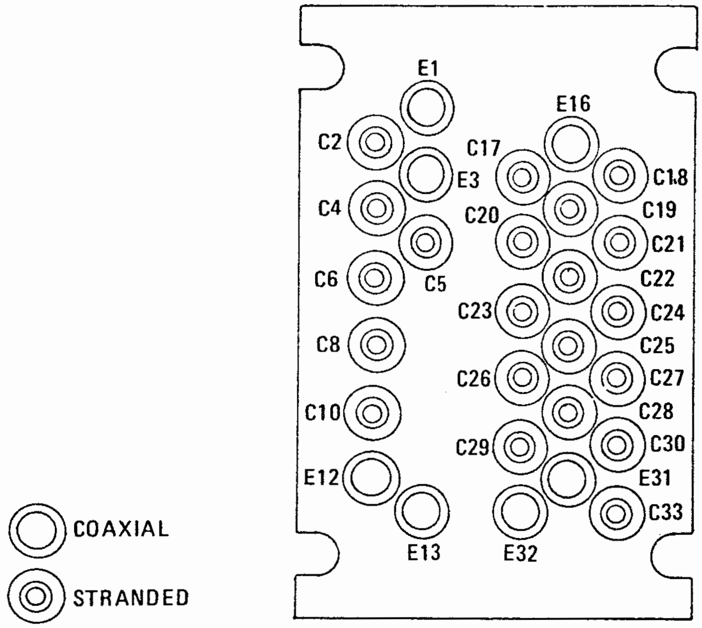


Figure 4. Filter Plate Assembly A2A8FL1 Component Locations

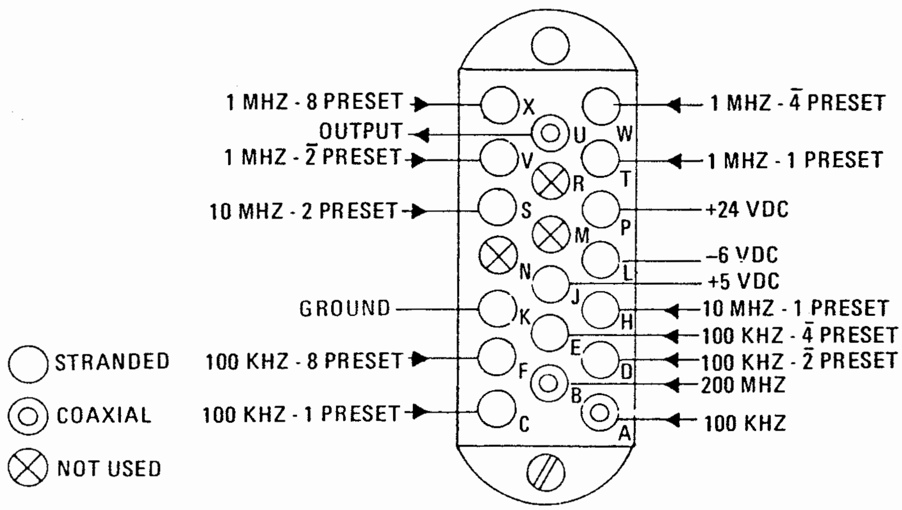


Figure 5. Module Chassis Connector A2J8 Top View

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTORS ARE IN OHMS, 1/4W, ±5%
   B. ALL CAPACITORS ARE IN MICROFARADS
   C. ALL INDUCTORS ARE IN MICROHENRIES
2. PREFIX ALL REFERENCE DESIGNATORS WITH A2A8 AND ANY APPLICABLE SUBASSEMBLY DESIGNATOR
3. FOR RF-550, JUMPER A1E28 AND A1E29 TOGETHER. FOR RF-131, OMIT THE JUMPER
4. A1U3, 4, 7, 8, 10, 12, AND 17 HAVE +5VDC ON PIN 16 AND GND ON PIN 8
5. A1U1, 2, 5, 6, 9, 11 AND 16 HAVE +5VDC ON PIN 14 AND GND ON PIN 7
6. A1U13, 14, AND 15 HAVE +5VDC ON PIN 4.
7. ON A1, U1 AND U6 ARE SN74S11N; U3, U4, U7 AND U8 ARE SN74S112N; U2, U9, AND U16 ARE SN74S00N; U11 IS SN74LS00N; U10, U12, AND U17 ARE SN74LS112N; U13, U14, AND U15 ARE LM324N

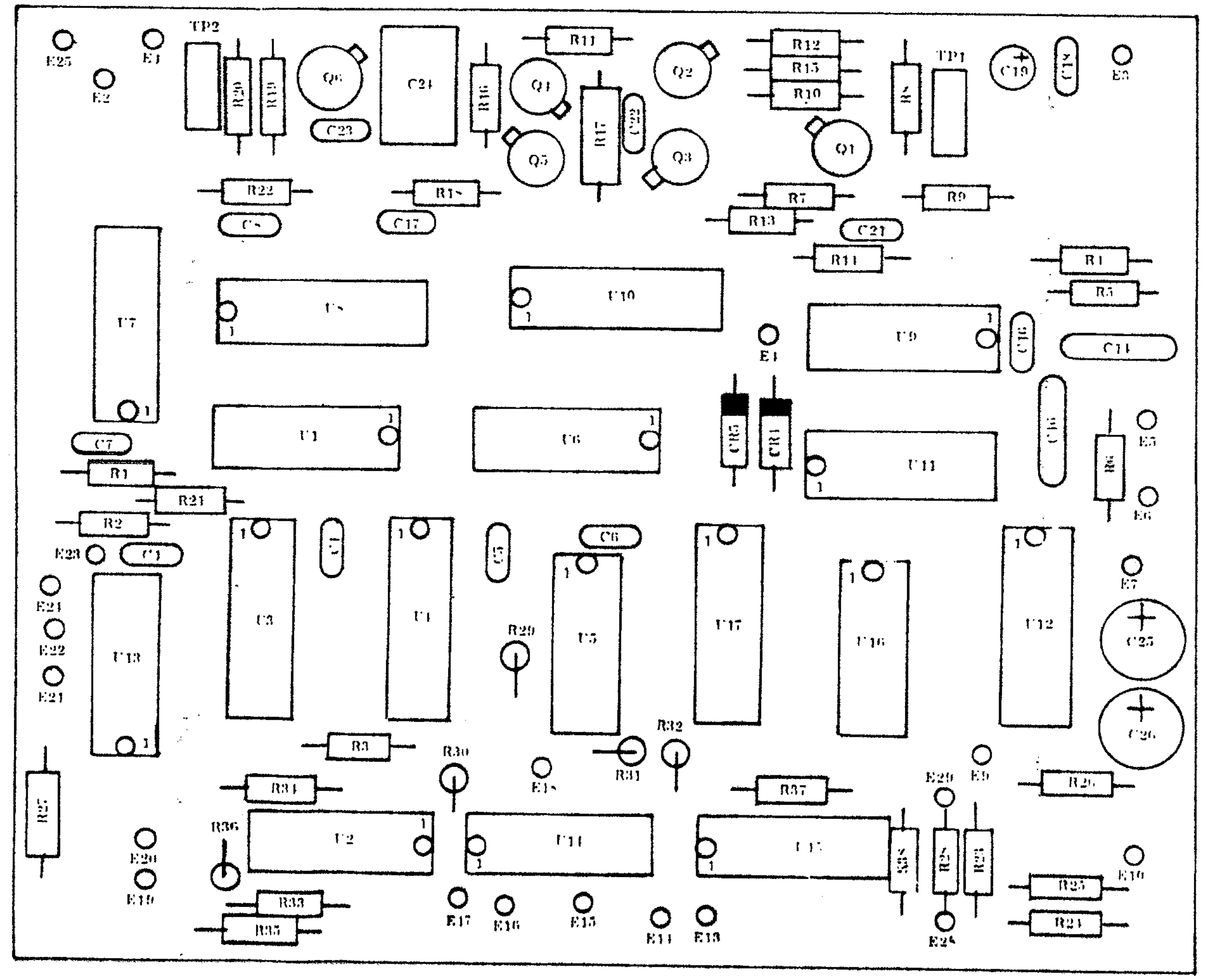


Figure 6. ÷N PWB Component Locations

1976-3801

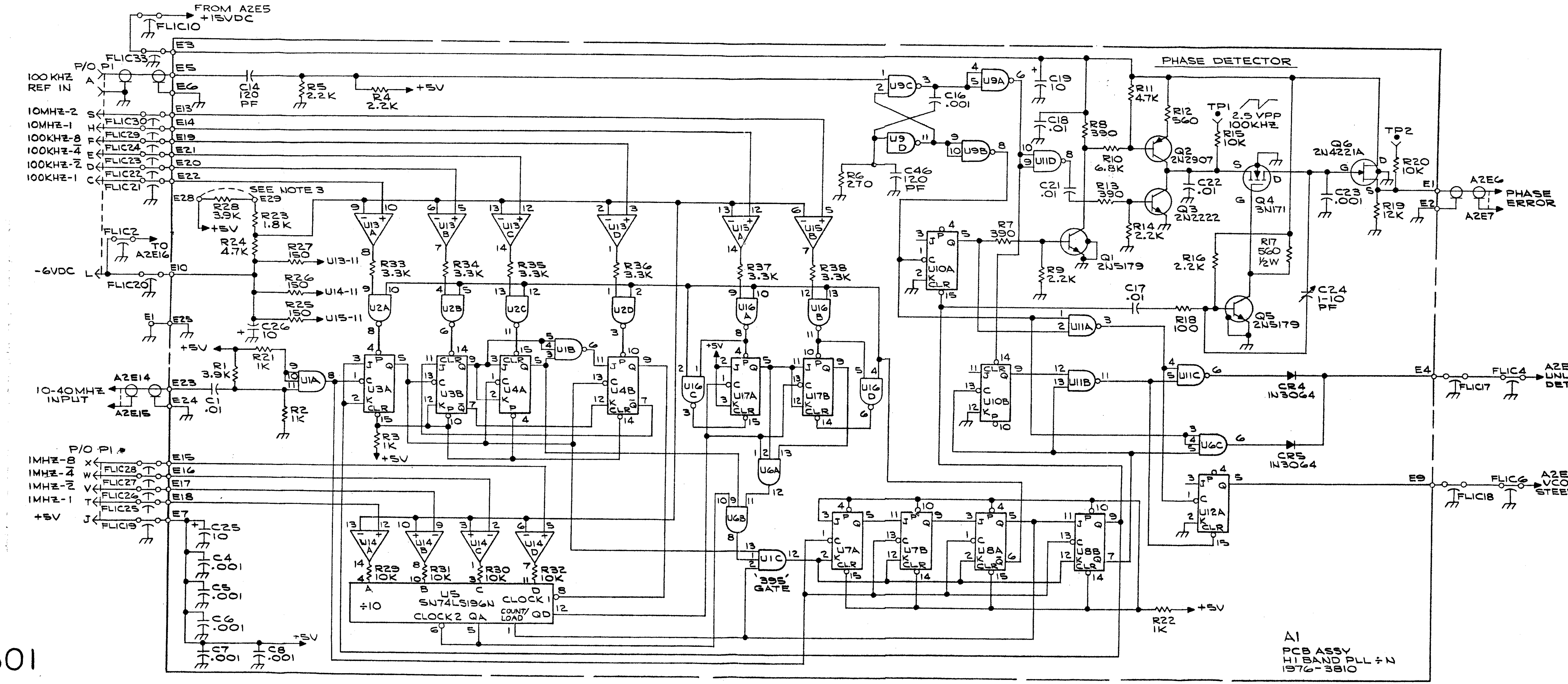


Figure 7. ÷ N PWB A2A8A1 Schematic Diagram

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTORS ARE IN OHMS, ¼ WATT.
   B. ALL CAPACITORS ARE IN MICROFARADS.
2. PREFIX INCOMPLETE REFERENCE DESIGNATORS WITH A2A8 PLUS SUB-ASSEMBLY DESIGNATOR IF ANY.
3. REFER TO TABLE 1. FOR LISTING OF SEMICONDUCTOR TYPES.

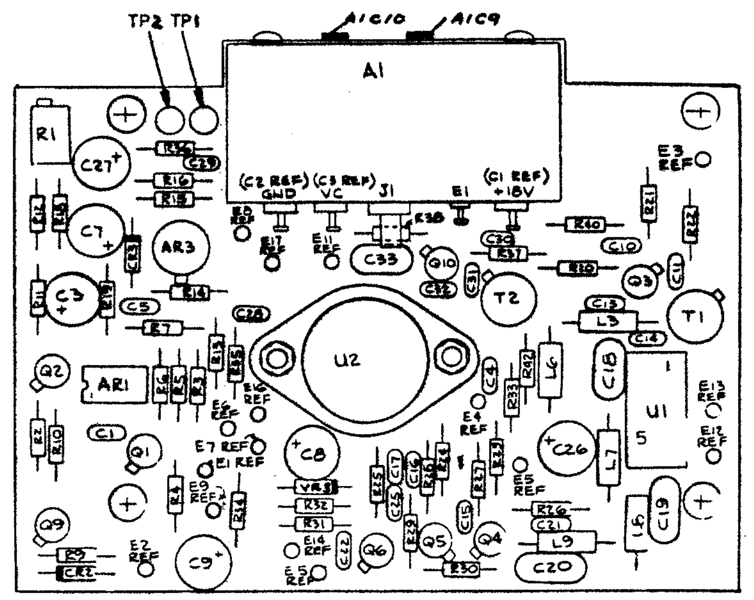
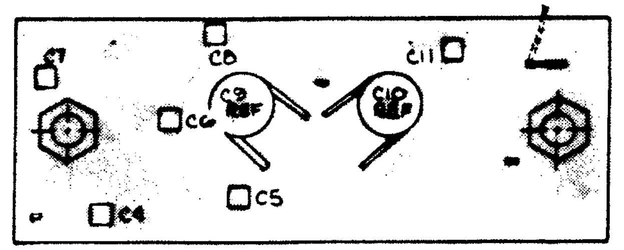
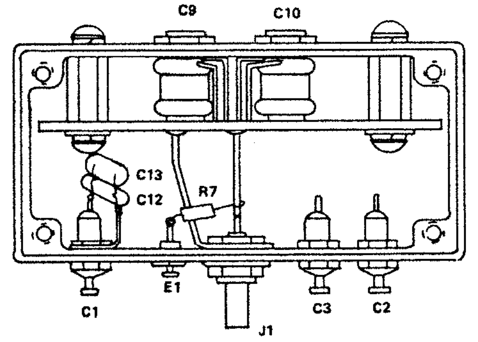
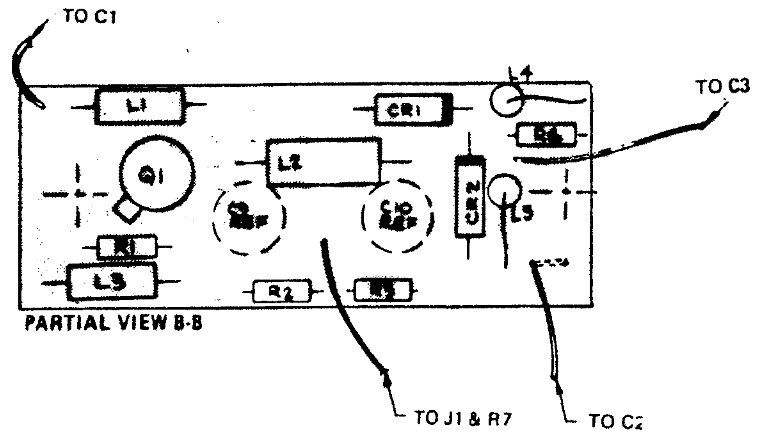


Figure 8. RF PWB Component Locations



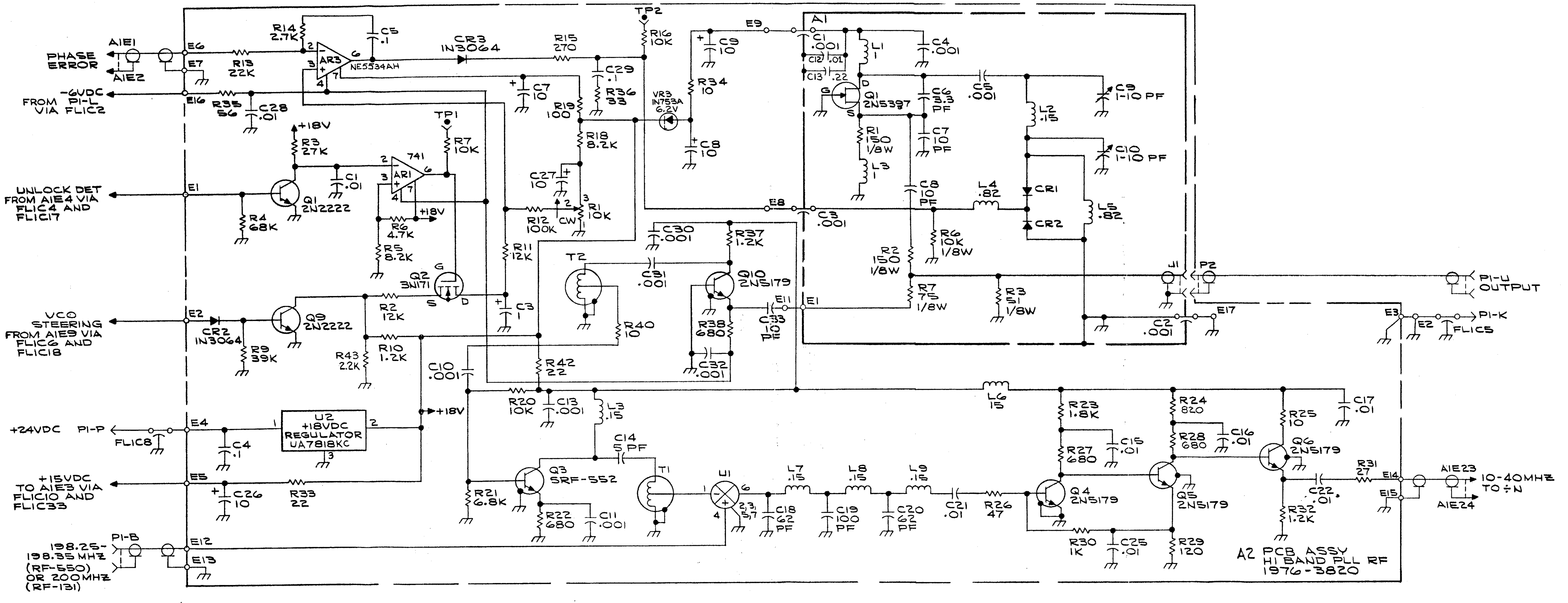
PARTIAL VIEW A-A





PARTIAL VIEW B-B

Figure 9. VCO Assembly A2A8A2A1 Component Locations



1976-3801

Figure 10. RF PWB A2A8A2 Schematic Diagram

TABLE 3. MAINTENANCE PARTS LIST - High Band PLL Module A2A8, (continued)

Reference Designation	Name and Description
A2A8	High Band PLL Module: MFR 14304, PN 1976-3800-2 (RF-131) PN 1976-3800-1 (RF-550)
FL1	Filter Plate Assembly: MFR 14304, PN 1976-3804
C1	Not used
C2	Capacitor, Feedthru, 1750pF: MFR 72982, PN 1214-001
C3	Not used
C4-C6	Capacitor, Feedthru, 1750pF: MFR 72982, PN 1214-001
C7	Not used
C8	Capacitor, Feedthru, 1750pF: MFR 72982, PN 1214-001
C9	Not used
C10	Capacitor, Feedthru, 1750pF: MFR 72982, PN 1214-001
C11-C16	Not used
C17-C30	Capacitor, Feedthru, 1750pF: MFR 72982, PN 1214-001
C31,C32	Not used
C33	Capacitor, Feedthru, 1750pF: MFR 72982, PN 1214-001
W1	Cable Assembly: MFR 14304, PN 1976-3802
P1	Connector, Module: MFR 81312, PN MRAC20PN
	Pins (Coax Male for P1): MFR 81312, PN 100-8001S95
	Pins (Straight Male for P1): Mil type MS17803-16-20
P2	Plug, Coax: MFR 16733, PN 7000426
A2A8A1	÷N PWB Assembly MFR 14304, PN 1976-3810
C1	Capacitor, Fixed, Ceramic 0.01uF: MFR 14304, PN C11-0005-103
C2, C3	Not used
C4-C8	Capacitor, Fixed, Ceramic 0.001uF: MFR 14304, PN C11-0005-102
C9-C13	Not used
C14	Capacitor, Fixed, Mica 120pF: Mil type CM05FD121J03
C15	Not used

Reference Designation	Name and Description
C16	Capacitor, Fixed, Ceramic, 1000pF: MFR 72982, PN 8121-050-X7R-102K
C17, C18	Capacitor, Fixed, Ceramic 0.01uF: MFR 14304, PN C11-0005-103
C19	Capacitor, Fixed, Tantalum 10uF: MFR 31433, PN T362C106M035AS
C20	Not used
C21	Capacitor, Fixed, Ceramic, 0.01uF: MFR 14304, PN C11-0005-103
C22	Capacitor, Fixed, Ceramic, 0.01uF: MFR 72982, PN 8121-100-X7R-103K
C23	Capacitor, Fixed, Ceramic, 0.001uF: MFR 72982, PN 8121-100-X7R-102K
C24	Capacitor, Variable, 1 to 10pF: MFR 91293, PN 5201
C25, C26	Capacitor, Fixed, Tantalum, 10uF: MFR 31433, PN T362C106M035AS
C27-C45	Not used
C46	Capacitor, Fixed, Ceramic, 120pF: Mil type CM05FD121J03
CR1-CR3	Not used
CR4, CR5	Diode, Silicon, Type 1N3064
Q1	Transistor, NPN, Type 2N5179
Q2	Transistor, PNP, Type 2N2907
Q3	Transistor, NPN, Type 2N2222
Q4	Transistor, FET, Type 3N171
Q5	Transistor, NPN, Type 2N5179
Q6	Transistor, FET, Type 2N4221A
R1	Resistor, Fixed Composition 3.9K, ±5%, ¼W: Mil type RC07GF392J
R2, R3	Resistor, Fixed Composition, 1K, ±5%, ¼W: Mil type RC07GF102J
R4	Resistor, Fixed Composition 2.2K, ±5%, ¼W: Mil type RC07GF222J
R5	Resistor, Fixed Composition 2.2K, ±5%, ¼W: Mil type RC07GF222J
R6	Resistor, Fixed Composition 270 Ω, ±5%, ¼W: Mil type RC07GF271J
R7, R8	Resistor, Fixed Composition 390 Ω, ±5%, ¼W: Mil type RC07GF391J
R9	Resistor, Fixed Composition 2.2K, ±5%, ¼W: Mil type RC07GF222J
R10	Resistor, Fixed Composition 6.8K, ±5%, ¼W: Mil type RC07GF682J

TABLE 3. MAINTENANCE PARTS LIST - High Band PLL Module A2A8, (continued)

Reference Designation	Name and Description
A2A8A1	
R11	Resistor, Fixed Composition 4.7K, ±5%, ¼W: Mil type RC07GF472J
R12	Resistor, Fixed Composition 560 Ω, ±5%, ¼W: Mil type RC07GF561J
R13	Resistor, Fixed Composition 390 Ω, ±5%, ¼W: Mil type RC07GF391J
R14	Resistor, Fixed Composition 2.2K, ±5%, ¼W: Mil type RC07GF222J
R15	Resistor, Fixed Composition 10K, ±5%, ¼W: Mil type RC07GF103J
R16	Resistor, Fixed Composition 2.2K, ±5%, ¼W: Mil type RC07GF222J
R17	Resistor, Fixed Composition 560 Ω, ±5%, ½W: Mil type RC20GF561J
R18	Resistor, Fixed Composition 100 Ω, ±5%, ¼W: Mil type RC07GF101J
R19	Resistor Fixed Composition 12K, ±5%. ¼W: Mil type RC07GF123J
R20	Resistor, Fixed composition, 10K, ±5%, ¼W: Mil type RC07GF103J
R21, R22	Resistor, Fixed Composition 1K, ±5%, ¼W: Mil type RC07GF102J
R23	Resistor, Fixed Composition 1.8K, ±5%, ¼W: Mil type RC07GF182J
R24	Resistor, Fixed Composition 4.7K, ±5%, ¼W: Mil type RC07GF472J
R25-R27	Resistor, Fixed Composition 150 Ω, ±5%, ¼W: Mil type RC07GF151J
R28	Resistor, Fixed Composition 3.9K, ±5%, ¼W: Mil type RC07GF392J
R29-R32	Resistor, Fixed Composition 10K, ±5%, ¼W: Mil type RC07GF103J
R33-R38	Resistor, Fixed Composition 3.3K, ±5%, ¼W: Mil type RC07GF332J
TP1	Jack, Test, PC Board: MFR 14304, PN J60-0001-008
TP2	Jack, Test, PC Board: MFR 14304, PN J60-0001-002
U1	Integrated Circuit AND Gate: MFR 01295, PN SN74S11N
U2	Integrated Circuit, NAND Gate: MFR 01295, PN SN74S00N
U3, U4	Integrated Circuit, Flip-Flop: MFR 01295, PN SN74S112AN

Reference Designation	Name and Description
U5	Integrated Circuit, ÷10: MFR 01295, PN SN74LS196N
U6	Integrated Circuit AND Gate: MFR 01295, PN SN74S11N
U7, U8	Integrated Circuit, Flip-Flop: MFR 01295, PN SN74S112AN
U9	Integrated Circuit, NAND Gate: MFR 01295, PN SN74S00N
U10	Integrated Circuit, Flip-Flop: MFR 01295, PN SN74S112AN
U11	Integrated Circuit, NAND Gate: MFR 01295, PN SN74LS00N
U12	Integrated Circuit, Flip-Flop: MFR 01295, PN SN74S112AN
U13-U15	Integrated Circuit, Quad Amplifier: MFR 12040, PN LM324N
U16	Integrated Circuit, NAND Gate: MFR 01295, PN SN74S00N
U17	Integrated Circuit, Flip-Flop: MFR 01295, PN SN74S112AN
A2A8A2	RF PWB Assembly: MFR 14304, PN 1976-3820
AR1	Integrated Circuit, OP Amp., Type 741 MFR 14304, PN 130-0001-003
AR3	Integrated Circuit, Op Amp: MFR 18324, PN NE5534AFE
C1	Capacitor, Fixed, Ceramic 0.01uF: MFR 14304, PN C11-0005-103
C2	Not used
C3	Capacitor, Fixed, Tantalum, .47uF MFR 14304, PN C11-0005-474
C4	Capacitor, Fixed, Ceramic 0.1uF: MFR 14304, PN C11-0005-104
C5	Capacitor, Fixed Ceramic 0.1uF: MFR 72982, PN 8131-100-X7R-104K
C6	Not used
C7-C9	Capacitor, Fixed, Tantalum 10uF: MFR 31433, PN T362C106M035AS
C10, C11	Capacitor, Fixed, Ceramic 0.001uF: MFR 14304, PN C11-0005-102
C12	Not used
C13	Capacitor, Fixed, Ceramic 0.001uF: MFR 14304, PN C11-0005-102
C14	Capacitor, Fixed, 5pF: Mil type DM5CC050A

TABLE 3. MAINTENANCE PARTS LIST - High Band PLL Module A2A8, (continued)

Reference Designation	Name and Description
A2A8A2	Continued
C15-C17	Capacitor, Fixed, Ceramic 0.01uF: MFR 14304, PN C11-0005-103
C18	Capacitor, Fixed, Mica 62pF: Mil type CM05ED620J03
C19	Capacitor, Fixed, Mica 100pF: Mil type CM05FD101J03
C20	Capacitor, Fixed, Mica 62pF: Mil type CM 05ED620J03
C21, C22	Capacitor, Fixed, Mica 0.01uF: MFR 14304, PN C11-0005-103
C23, C24	Not used
C25	Capacitor, Fixed, Ceramic 0.01uF: MFR 14304, PN C11-0005-103
C26, C27	Capacitor, Fixed, Tantalum, 10uF: MFR 31433, T362C106M035AS
C28	Capacitor, Fixed, Ceramic 0.01uF: MFR 14304, PN C11-0005-103
C29	Capacitor, Fixed, Ceramic, 0.1uF: MFR 72982, PN 8131-100-X7R-104K
C30-C32	Capacitor, Fixed, Ceramic 0.001uF: MFR 14304, PN C11-0005-102
C33	Capacitor, Fixed, Mica, 10 pF: Mil type CM05CD100D03
CR1	Not Used
CR2, CR3	Diode, PN 1N3064
L1, L2	Not Used
L3	Inductor, Fixed, RF, 0.15 uH: MFR 99800, PN 1537-00
L4, L5	Not Used
L6	Inductor, Fixed, RF, 15 uH: MFR 99800, PN 1537-40
L7 - L9	Inductor, Fixed, RF 0.15 uH: MFR 99800, PN 1537-00
Q1	Transistor, Type 2N2222
Q2	Transistor, Type 3N171
Q3	Transistor, Type SRF-552, MFR 04713
Q4 - Q6	Transistor, Type 2N5179
Q7, Q8	Not Used
Q9	Transistor, Type 2N2222
Q10	Transistor, Type 2N5179
R1	Resistor, Variable, 10K: MFR 32997, PN 3299X-1-103

Reference Designation	Name and Description
R2	Resistor, Fixed, Composition, 12K, ±5%, ¼W: Mil type RC07GF123J
R3	Resistor, Fixed, Composition, 27K, ±5%, ¼W: Mil type RC07GF273J
R4	Resistor, Fixed, Composition, 68K, ±5%, ¼W: Mil type RC07GF683J
R5	Resistor, Fixed, Composition, 8.2K, ±5%, ¼W: Mil type RC07GF822J
R6	Resistor, Fixed, Composition, 4.7K, ±5%, ¼W: Mil type RC07GF472J
R7	Resistor, Fixed, Composition, 10K, ±5%, ¼W: Mil type RC07GF103J
R8	Not Used
R9	Resistor, Fixed, Composition, 39K, ±5%, ¼W: Mil type RC07GF393J
R10	Resistor, Fixed, Composition, 1.2K, ±5%, ¼W: Mil type RC07GF122J
R11	Resistor, Fixed, Composition, 12K, ±5%, ¼W: Mil type RC07GF123J
R12	Resistor, Fixed, Composition, 100K, ±5%, ¼W: Mil type RC07GF104J
R13	Resistor, Fixed, Composition, 22K, ±5%, ¼W: Mil type RC07GF223J
R14	Resistor, Fixed, Composition, 2.7K, ±5%, ¼W: Mil type RC07GF272J
R15	Resistor, Fixed, Composition, 270 Ω, ±5%, ¼W: Mil type RC07GF271J
R16	Resistor, Fixed, Composition, 10K, ±5%, ¼W: Mil type RC07GF103J
R17	Not Used
R18	Resistor, Fixed, Composition, 8.2K, ±5%, ¼W: Mil type RC07GF822J
R19	Resistor, Fixed, Composition, 100 Ω, ±5%, ¼W: Mil type RC07GF101J
R20	Resistor, Fixed, Composition, 10K, ±5%, ¼W: Mil type RC07GF103J
R21	Resistor, Fixed, Composition, 6.8K, ±5%, ¼W: Mil type RC07GF682J
R22	Resistor, Fixed, Composition, 680 Ω, ±5%, ¼W: Mil type RC07GF681J
R23	Resistor, Fixed, Composition, 1.8K, ±5%, ¼W: Mil type RC07GF182J
R24	Resistor, Fixed, Composition, 820 Ω, ±5%, ¼W: Mil type RC07GF821J
R25	Resistor, Fixed, Composition, 10 Ω, ±5%, ¼W: Mil type RC07GF100J

TABLE 3. MAINTENANCE PARTS LIST - High Band PLL Module A2A8.

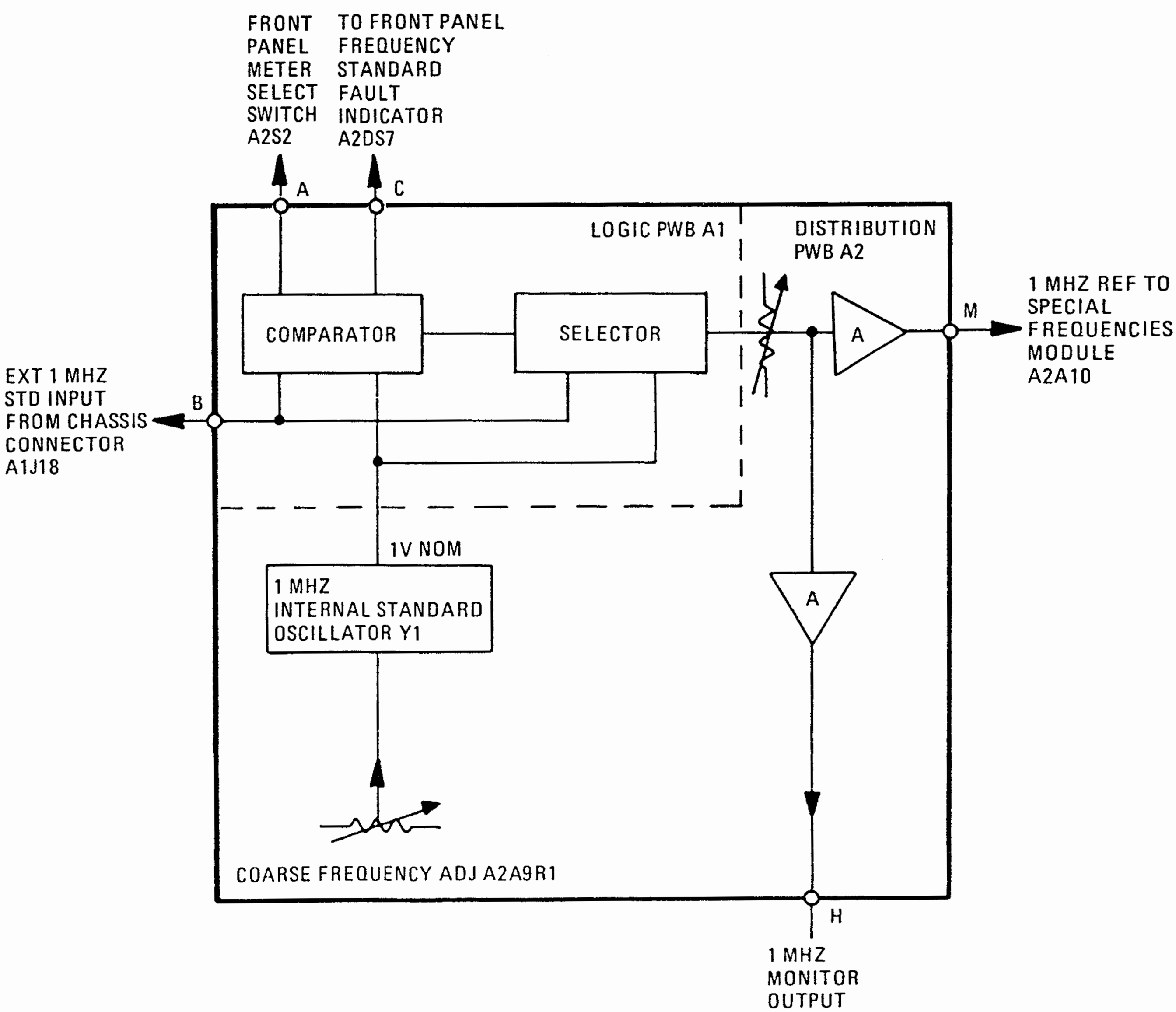
Reference Designation	Name and Description
A2A8A2	(Continued)
R26	Resistor, Fixed, Composition, 47 Ω, ±5%, ¼W: Mil type RC07GF470J
R27	Resistor, Fixed, Composition, 680 Ω, ±5%, ¼W: Mil type RC07GF681J
R28	Resistor, Fixed, Composition, 680 Ω, ±5%, ¼W: Mil type RC07GF681J
R29	Resistor, Fixed, Composition, 120 Ω, ±5%, ¼W: Mil type RC07GF121J
R30	Resistor, Fixed, Composition, 1K, ±5%, ¼W: Mil type RC07GF102J
R31	Resistor, Fixed, Composition, 27 Ω, ±5%, ¼W: Mil type RC07GF270J
R32	Resistor, Fixed, Composition, 1.2K, ±5%, ¼W: Mil type RC07GF122J
R33	Resistor, Fixed, Composition, 22 Ω, ±5%, ¼W: Mil type RC07GF220J
R34	Resistor, Fixed, Composition, 10 Ω, ±5%, ¼W: Mil type RC07GF100J
R35	Resistor, Fixed, Composition, 56 Ω, ±5%, ¼W: Mil type RC07GF560J
R36	Resistor, Fixed, Composition, 33Ω, ±5%, ¼W: Mil type RC07GF330J
R37	Resistor, Fixed, Composition, 1.2K, ±5%, ¼W: Mil type RC07GF122J
R38	Resistor, Fixed, Composition, 680 Ω, ±5%, ¼W: Mil type RC07GF681J
R39	Not Used
R40	Resistor, Fixed, Composition, 10 Ω, ±5%, ¼W: Mil type RC07GF100J
R41	Not Used
R42	Resistor, Fixed, Composition, 22 Ω, ±5%, ¼W: Mil type RC07GF220J
R43	Resistor, Fixed, Composition, 2.2K, ±5%, ¼W: Mil type RC07GF222J
T1, T2	Transformer Assembly: MFR 14304, PN 1976-3824
TP1	Jack, Test, MFR 74970, PN 105-0851-001
TP2	Jack, Test, MFR 74970, PN 105-0852-001
U1	Mini-module, Mixer: MFR 14304, PN 0759-5150
U2	Integrated Circuit, Regulator: MFR 07263, Type UA7818KC

Reference Designation	Name and Description
VR1, VR2	Not Used
VR3	Diode, Zener, 6.2V: Type 1N753A
A2A8A2A1	VCO Assembly: MFR 10403, PN 1976-3850
C1 - C3	Capacitor, Fixed, Feedthru, 1000 pF: MFR 72982, PN 2425-003-W5U0-102AA
C4, C5	Capacitor, Fixed, Chip, 1000 pF: MFR 14304, 50V: PN C11-0006-102
C6	Capacitor, Fixed, Chip, 3.3 pF: MFR 14304, PN C11-0006-3R3
C7 - C8	Capacitor, Fixed, Chip, 10 pF: 50V: MFR 14304, PN C11-0006-100
C9 - C10	Capacitor, Variable: 1 to 10 pF: MFR 73899, PN VAJ605 w/nut
C11	Capacitor, Fixed, Ceramic, 1000 pF: 50V: MFR 14304, PN C11-0006-102
C12	Capacitor, Fixed, Ceramic, 0.01 uF: MFR 14304, PN C11-0005-103
C13	Capacitor, Fixed, Ceramic, 0.22 uF: MFR 14304, PN C11-0005-224
CR1, CR2	Diode, Varicap: MFR 17540 PN DKV 6520B
E1	Terminal, Feedthru: MFR KEV Electronics, PN E35-0001-903
J1	Receptacle, Coax: MFR 98291 PN 51-043-0000
L1	Inductor,Fixed, 1.0 uH: MFR 99800, PN 1025-20
L2	Inductor,Fixed, 0.15 uH: MFR 99800, PN 1537-00
L3	Inductor,Fixed, 1.0 uH: MFR 99800, PN 1025-20
L4, L5	Inductor,Fixed, 0.82 uH: MFR 99800, PN 1025-18
Q1	Transistor, J-FET, N Channel: Type 2N5397
R1, R2	Resistor, Fixed, Composition, 150 Ω, ±5%, 1/8W: Mil type RC05GF151J
R3	Resistor, Fixed, Composition, 51 Ω, ±5%, 1/8W: Mil type RC05GF510J
R4, R5	Not Used
R6	Resistor, Fixed, Composition, 10K, ±5%, 1/8W: Mil type RC05GF103J
R7	Resistor, Fixed, Composition, 75 Ω, ±5%, 1/8W: Mil type RC05GF750J

UNIT INSTRUCTIONS

FREQUENCY STANDARD MODULE

A2A9



FREQUENCY STANDARD MODULE A2A9

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1. GENERAL DESCRIPTION

Frequency Standard Module A2A9 supplies a very stable 1 MHz signal that is used as the master frequency reference for the RF-131 Exciter. The MHz signal is generated either internally, by a fundamental frequency crystal oscillator maintained in a constant-temperature, proportionally-controlled oven,or externally, by a remote source. Selection between internal and external sources may be accomplished manually by a switch on the module. The RF-131 Exciter has a failure detection circuit that senses a failure of the internal frequency standard, and automatically switches over to the external source. This failure detection circuit also lights the frequency standard fault indicator on the Exciter front panel. Frequency Standard Module A2A9 contains two PWB assemblies; Logic PWB A2A9A1 and Distribution PWB A2A9A2, and a hermetically sealed 1MHz internal standard oscillator assembly.

2. TECHNICAL CHARACTERISTICS

Weight: (453.6 grams)

Power Requirements:
+24 Vdc at 110 mA
+ 6 Vdc at 69 mA
− 6 Vdc at 63 mA

Signal Inputs:
1 MHz External Standard,
1.0 to 2.0 $Volts_{RMS}$

Internal Standard Stability: (Aging Rate)
Less than 1 part in 10^8/day
(i.e. .01Hz/day)

Short Term Stability: (Phase Jitter)
Less than $.03_{RMS}$ in 10 ms

Retrace Error:
(4 hours after turn-on)
1.0 MHz ±(.1Hz + .01Hz/day x N)
N = number of days since last adjustment

Coarse Frequency Adjustment Range:
Sufficient for 10 years of crystal aging.

Output Level: 1 MHz at 1.0 V_{RMS} into 50 ohms

3. SEMICONDUCTOR COMPLIMENT

Table 1 lists all semiconductors used in the Frequency Standard Module A2A9.

TABLE 1. SEMICONDUCTOR COMPLEMENT

Reference Designation	Type	Function
A2A9A1-CR1	1N3064	Isolation
CR2	1N3064	Isolation
CR3	1N3064	RF Detector
CR4	1N4001	Temp. Comp.
CR5	1N3064	Protection
Q1	2N5179	Voltage Amplifier
Q2	2N4123	Amplifier
Q3	2N5179	Voltage Amplifier
Q4	2N5179	Power Gain
Q5	2N4125	Dc Amplifier
Q6	2N5179	Inverter
Q7	2N5179	Inverter
Q8	2N718A	Lamp Driver
Q9	2N5179	Gated Amplifier
Q10	2N5179	Switch
Q11	2N5179	Gated Amplifier
Q12	2N5179	Switch
Q13	2N5179	Power Gain
Z1	CA-3000	Level Detector
A2A9A2-Q1	2N5109	Power Gain
Q2	2N5109	Power Gain

4. LOGIC PWB A2A9A1 CIRCUIT DESCRIPTION

Refer to Figure 3. The 1MHz Internal Standard Signal enters Logic PWB A2A9A1 at terminal E1 and is applied, via C16 to Internal Amplifier Q11, via C5 to the RF Level Detectors, and via C4 to the Frequency Comparator circuit. The main signal path is through Q11 to output emitter follower Q13. A high resistance, R4 1, in series with the emitter of Q11, prevents this stage from developing a significant output signal unless switching transistor Q12 is forward biased. Likewise, switching transistor Q10 associated with External Amplifier Q9 gates the External Standard ON or OFF. The External Standard signal enters the Logic PWB at Terminal E3, from the External 1MHz IN connector A1J18 located on the rear panel of the exciter. In normal operation, Q12 is ON while Q10 is held OFF by a negative base voltage from Q7.

Automatic switchover from the Internal to the External Standard is accomplished by monitoring the level of the Internal Standard with Level Detector Z1. Integrated circuit Z1 is a differential amplifier connected as a Schmitt Trigger circuit, with collector to base coupling via R29. The Schmitt Trigger is normally held in its high state (+6Vdc at Z1-8) by a detected Dc voltage at Z1-1 from the RF Detector circuit comprised of T2 and CR3. However, a decrease in voltage at Z1-1 allows the Schmitt Trigger to revert to its low state, yielding a relatively low level output at Z1-8 (approximately 0.1Vdc). TRIP Control (R22) is adjusted to produce a Dc voltage at Z1-1 that is slightly higher than the switching threshold. In the tripped condition, the low level at Z1-8 turns on Dc amplifier Q5, Lamp Driver Q8, and inverter transistor Q6. Lamp Driver Q8 supplies a ground to the Frequency Standard FAULT indicator on the Exciter front panel, via A2A9 P1-C. Inverter Q6 turns OFF the Internal Standard signal with a negative voltage to the base of Q12 via R44, while Q7 turns ON closing the External Standard signal path.

REFERENCE SOURCE toggle switch S1, provides manual switching to the External Standard when desired. In the External position, S1-B forces the level detector to its Tripped Condition by applying -6Vdc to R27. S1-A disconnects the Frequency Standard FAULT indicator.

Transistors Q1 and Q3 constitute a frequency comparator that detects frequency differences between the Internal and External Standards. The difference or beat frequency modulates the collector current of Q2, and is indicated by a vibrating motion of the Exciter panel Input Level/Frequency Meter, when the INPUT LEVEL/FREQUENCY COMPARISON switch is in the FREQUENCY COMPARISON position.

5. DISTRIBUTION PWB A2A9A2 CIRCUIT DESCRIPTION

Refer to Figure 5. Distribution PWB A2A9A2 provides power gain for driving two separate 50 ohm output loads; Special Frequencies Module A2A10, and the Internal 1 MHz Out Monitor jack A1J17 on the rear panel of the exciter. The 1 MHz Reference Standard signal enters at Terminal E3 and is applied to power amplifier stages Q1 and Q2 via LEVEL Control R12. Amplifier Q1 drives Special Frequencies Module A2A10 via T1, while Q2 supplies the monitor output to A1J17.

6. LOGIC PWB A2A9A1 TEST DATA

Typical Dc voltage measurements for all transistors and integrated circuits on the Logic PWB are given in Table 2. Measurements were taken with a Hewlett-Packard Model 410C (or equivalent) VTVM while the module was receiving normal Dc voltages and signal inputs. REFERENCE SOURCE toggle switch S1 was set on EXTERNAL position with no external signal applied.

TABLE 2. LOGIC PWB A2A9A1 Dc VOLTAGE MEASUREMENTS

Transistor	Emitter (Vdc)	Base (Vdc)	Collector (Vdc)
Q1	−5.2	−5.5	+ .6
Q2	−2.6	−2.2	+1.1
Q3	−5.2	−5.5	−3.9
Q4	−2.7	−2	+4
Q5	+5.4	+4.7	+5.3
Q6	−5.2	−4.4	−5.1
Q7	−5.2	−4.8	−4.5
Q8	Gnd	+ .7	+0.
Q9	−3.4	−2.7	+ .7
Q10	−5.2	−4.5	−5.1
Q11	− .15	−2.5	+5.3
Q12	−5.2	−5.0	− .4
Q13	+1.7	+2.5	+5.3

Integrated Circuit	A2A9A1S1 At EXTERNAL Position	A2A9A1S1 At INTERNAL Position
Z1- 1	−4.9	−1.2
2	Gnd	Gnd
3	−5.7	−5.7
4	−4.8	−4.8
5	−5.7	−5.7
6	−1.8	−3.1
7	NC	NC
8	+2.4	+5.8
9	+5.7	+5.7
10	+3.9	+1.0

7. DISTRIBUTION PWB A2A9A2 TEST DATA

Dc measurements should be made with a Hewlett-Packard Model 410C (or equivalent) VTVM. Signal measurements should be made with a Boonton 91H equipped with a high impedance probe, to prevent loading of circuitry under test.

8. FREQUENCY STANDARD MODULE A2A9 ADJUSTMENTS

8.1 Frequency Stability Adjustments

It is a characteristic of all crystal oscillators to drift slowly and predictably with age. The rate of drift is directly related to the quality of the crystalline quartz used in the oscillator. Crystal Oscillator Y2 in Frequency Standard Module A2A9 is specified as having an aging rate of less than 1 part in 10^8 per day after 21 days of continuous operation. To compensate for aging, the oscillator has a mechanical coarse adjustment. Adjustment procedures are described in a subsequent paragraph.

Another cause of frequency drift in a crystal oscillator is changes in ambient temperature. This type of frequency drift is controlled by enclosing the crystal oscillator in a precision temperature-controlled oven. The oven used in the RF-131 reaches operating temperature approximately 10 minutes after turn-on, and maintains a contant temperature for optimum oscillator stability.

Because the resonant frequency of a crystal oscillator is related to temperature, and due to the inherent tendency of the crystalline quartz used in the oscillator to become stabilized to a particular condition, an oscillator which is OFF (cold) most of the time will have a slightly different frequency than one that is ON most of the time. It should be noted that the time required for a crystal oscillator to stabilize completely to the operating frequency is related to its most recent operating history, that is, it is a function of the total previous OFF time as well as the frequency and duration of duty cycles. For example, a unit that is not in use for a month may require a week of continuous operation to stabilize completely. The frequency drift during this period can be many times the specified aging rate. For non-critical applications and where a few Hertz of error can be tolerated, the equipment can be turned OFF after use. However, when maximum stability is required, the RF-131 (when not in use) should be placed in the AMPL OFF on the 6600 control head.

NOTE

The RF-131 uses solid state circuitry throughout. Continuous operation will have no detrimental effect upon life expectancy of the unit.

A frequency standard that is in continuous operation may approach a frequency error drift of 1 part in 10^6 over a three month period. Therefore, adjustment of the frequency standard internal oscillator should be made on a periodic basis that is determined by exciter application and accuracy requirements. Adjustment of the frequency standard internal oscillator should be made as follows:

a. Set the front panel FREQUENCY Selector digit switches to 29.9999 MHz. Connect a frequency counter which is referenced to an accurate standard, to RF OUTPUT connector J23, located on the rear panel of the exciter.

b. Adjust the coarse frequency adjustment (located on top of the crystal oscillator of module A2A9), for an output of 29.9999 MHz ± .2Hz.

8.2 Trip Control Adjustments

Trip Control A2A9A1R22 on the Logic PWB is adjusted for automatic switchover from the internal to the external standard with a level reduction in the internal standard to approximately 70 percent of normal. For adjustment purposes, a reduction of 70 percent can be realized by temporarily connecting a 220 ohm resistor from Terminal E1 to ground.

9. MAINTENANCE PARTS LIST

Table 3 is a Maintenance Parts List for the Frequency Standard Module A2A9. Refer to Table 6-3 in the General Information Section for a complete listing of manufacturer's codes.

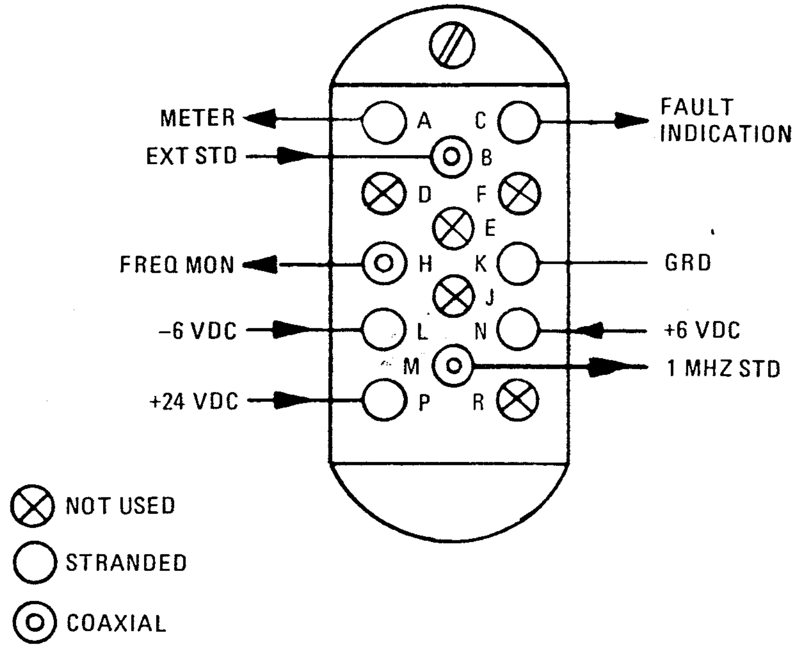


FIGURE 1. MODULE CHASSIS CONNECTOR A2J9 (TOP VIEW)

NOTES:

1-1. UNLESS OTHERWISE SPECIFIED
  a) ALL RESISTORS ARE IN OHMS, 1/4W, 10%.
  b) ALL CAPACITORS ARE IN UF
  c) ALL TRANSISTORS ARE 2N5179.

1-2. PREFIX INCOMPLETE DESIGNATION WITH A2A9

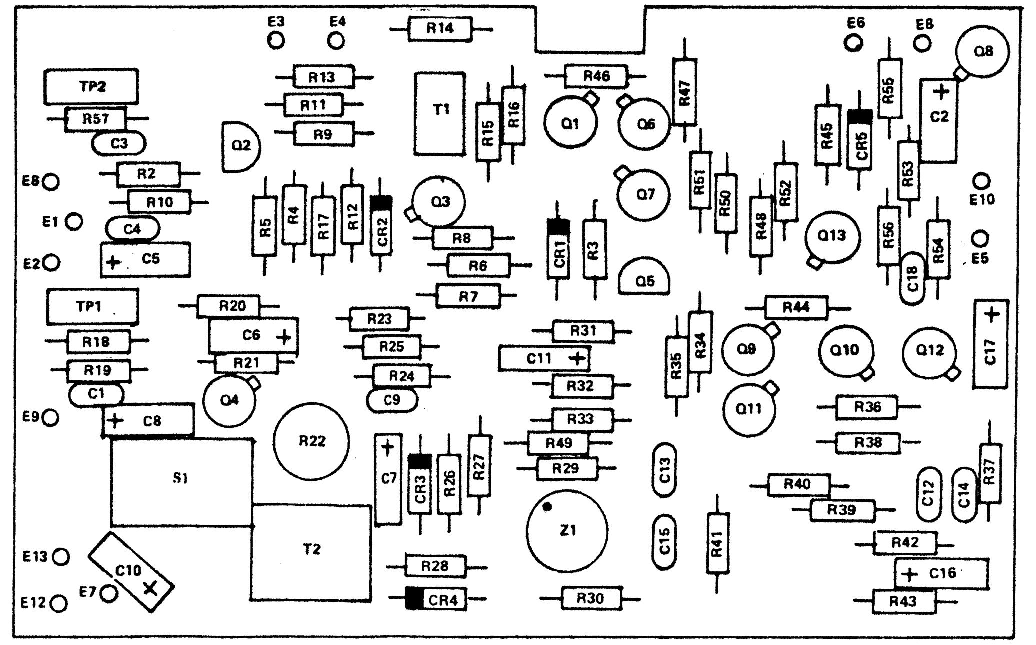


Figure 2. Logic PWB Component Location Drawing

0759-3901

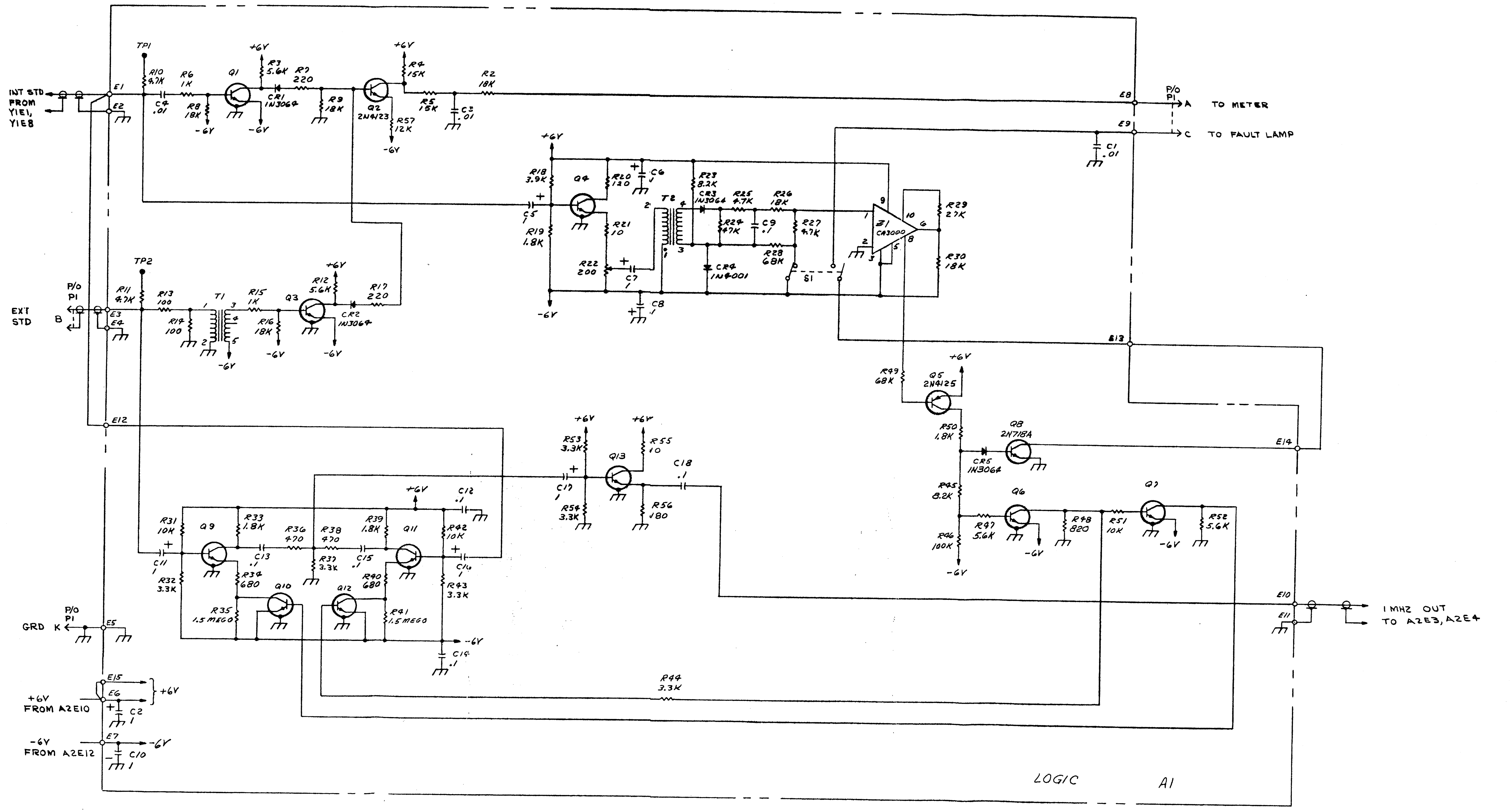


Figure 3. Logic PWB A2A9A1 Schematic Diagram

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTORS ARE IN OHMS, ¼ WATT.
   B. ALL CAPACITORS ARE IN MICROFARADS.
2. PREFIX INCOMPLETE REFERENCE DESIGNATORS WITH A2A9 PLUS SUB-ASSEMBLY DESIGNATOR IF ANY.
3. REFER TO TABLE 1. FOR LISTING OF SEMICONDUCTOR TYPES.

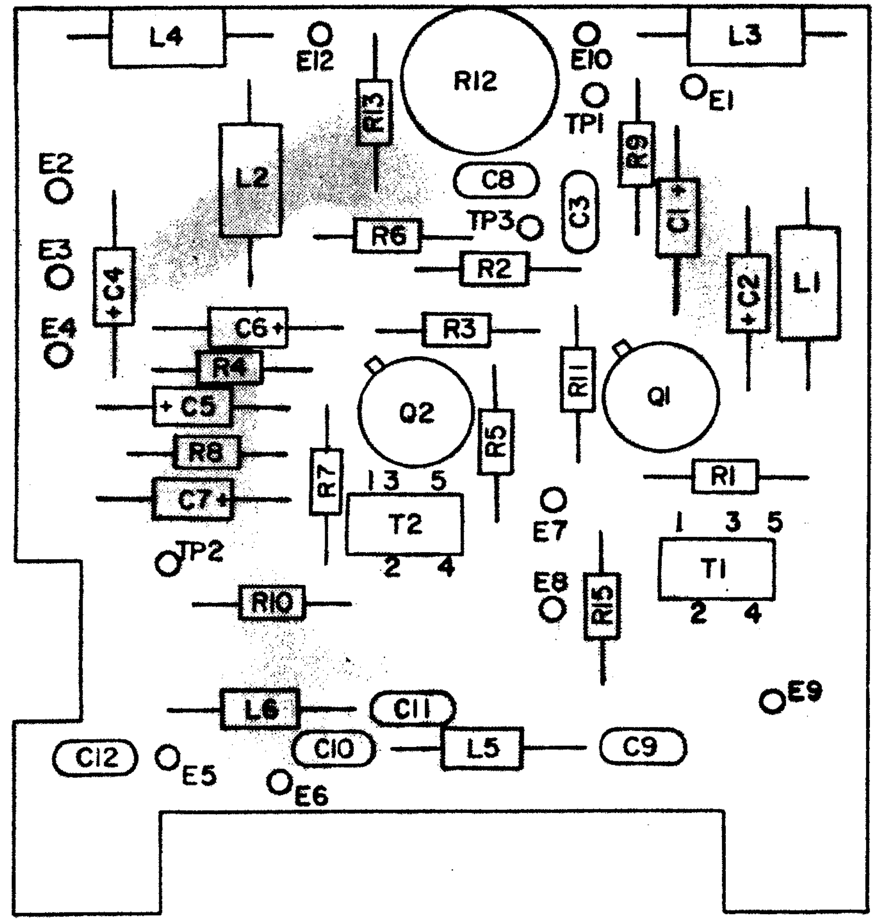
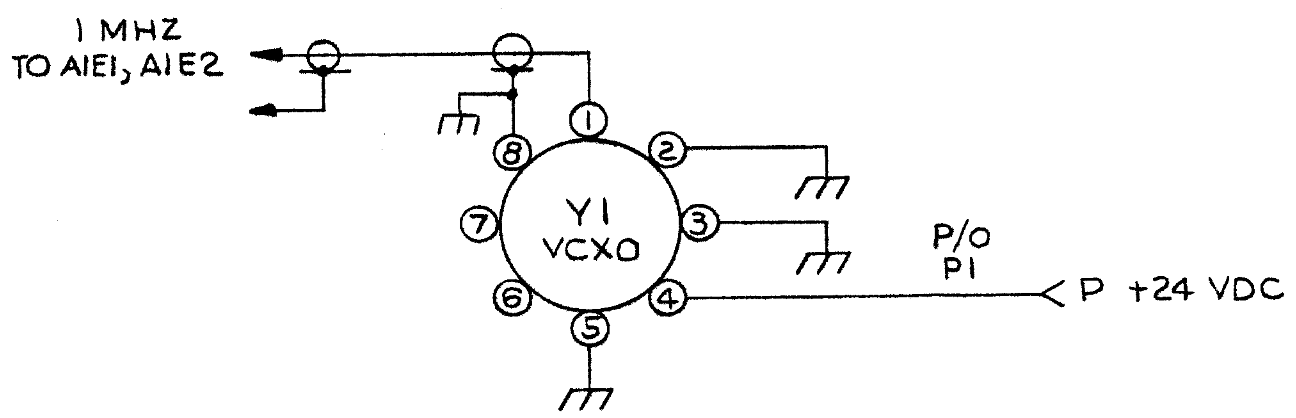


Figure 4. Distribution PWB Component Location Drawing



0759 -3901

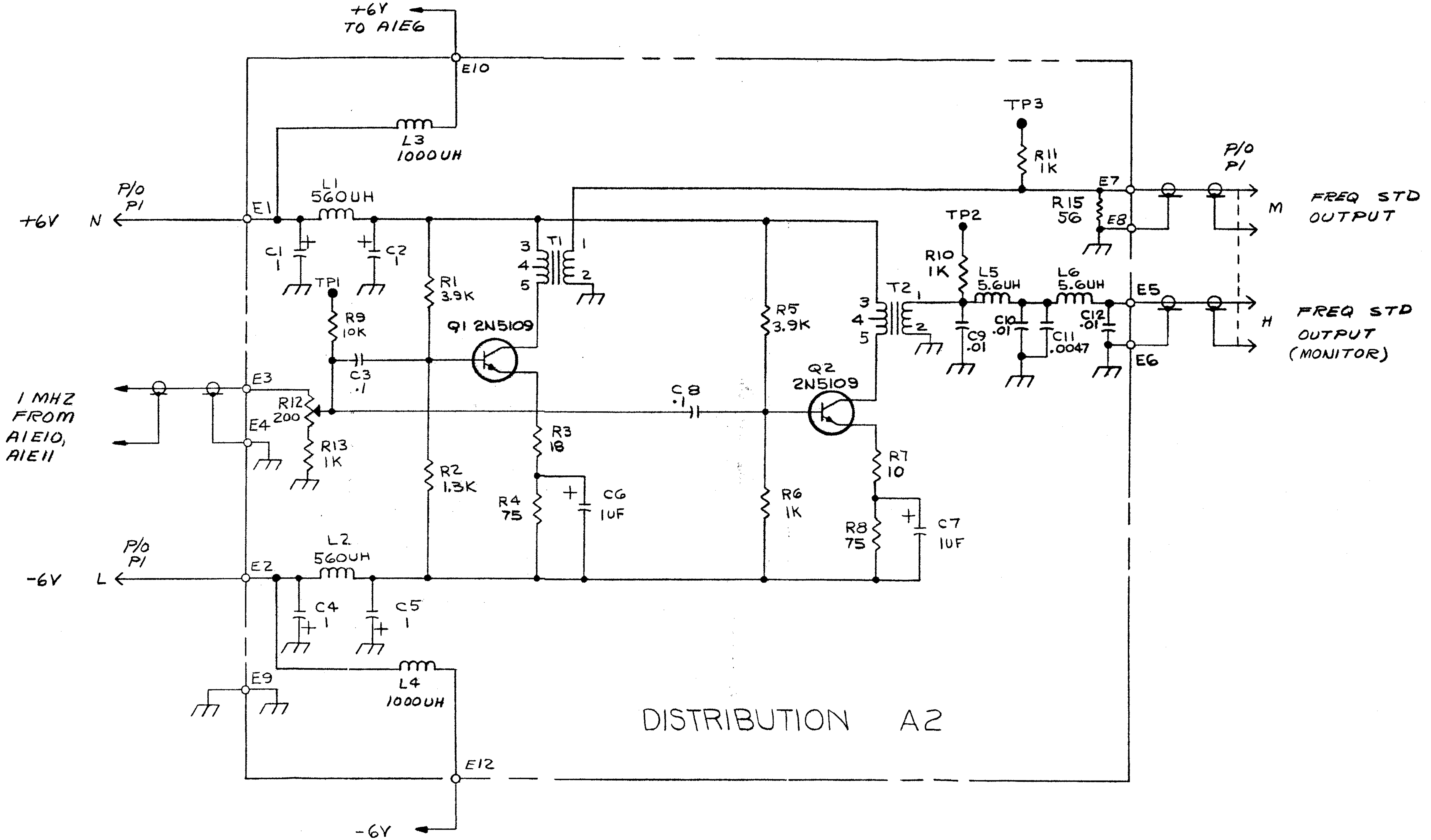


Figure 5. Distribution PWB A2A9A2 Schematic Diagram

TABLE 3. MAINTENANCE PARTS LIST - FREQUENCY STANDARD MODULE

Reference Designation	Name and Description
A2A9	Frequency Standard Module Assembly: MFR 14304 PN 0759-3900
MP1-MP3	Pin, Connector: MFR 81312 PN 100-80005
MP4	Pin, Connector: Mil Type MS 17803-16-20
MP5-MP9	Pin, Connector: MFR 81312 PN 100-80005
P1	Plug Connector: MFR 81312 PN MRAC 14P-N
Y1	Oscillator, Crystal, 1 MHz: MFR 14304 PN 0759-3906
A2A9A1	Logic PWB Assembly: MFR 14304, PN 0759-3910
C1	Capacitor, Ceramic, .01uF: MFR 72982, PN 8121-050-651-103M
C2	Capacitor, Tantalum, 1uF, 50VDCW: Mil Type CSR13G105ML
C3, C4	Same as A2A9A1C1
C5-C8	Same as A2A9A1C2
C9	Capacitor, Ceramic, .1uF: MFR 14304 PN C11-0005-104
C10, C11	Same as A2A9A1C2
C12-C15	Same as A2A9A1C9
C16-C17	Same as A2A9A1C2
C18	Same as A2A9A1C9
CR1-CR3	Diode: Mil Type 1N3064
CR4	Diode: Mil type 1N4001
CR5	Diode: Mil type 1N3064
Q1	Transistor: MFR 21921 PN 2N5179
Q2	Transistor: MFR 04713 PN 2N4123
Q3, Q4	Same as A2A9A1 Q1
Q5	Transistor: MFR 04713 PN 2N4125
Q6, Q7	Same as A2A9A1Q1
Q8	Transistor: Mil type PN 2N718A
Q9-Q13	Same as A2A9A1Q1
R1	Not used
R2	Resistor, Fixed Composition, 18K Ω ±10% ¼W: Mil type RCR07G183K
R3	Resistor, Fixed Composition, 5.6K Ω ±10% ¼W: Mil type RCR07G562K
R4, R5	Resistor, Fixed Composition, 15K Ω ±10% ¼W: Mil type RCR07G153K
R6	Resistor, Fixed Composition, 1K Ω ±10% ¼W: Mil type RCR07G102K
R7	Resistor, Fixed Composition, 220 Ω ±10% ¼W: Mil type RCR07G221K
R8, R9	Same as A2A9A1R2
R10, R11	Resistor, Fixed Composition, 4.7K Ω ±10% ¼W: Mil type RCR07G472K
R12	Same as A2A9A1R3
R13, R14	Resistor, Fixed Composition, 100 Ω ±10% ¼W: Mil type RCR07G182K
R15	Same as A2A9A1R6
R16	Same as A2A9A1R2
R17	Same as A2A9A1R7
R18	Resistor, Fixed Composition, 3.9K Ω ±10% ¼W: Mil typeRCR07G392K
R19	Resistor, Fixed Composition, 1.8K Ω ±10% ¼W: Mil type RCR07G182K
R20	Resistor, Fixed Composition, 120 Ω ±10% ¼W: Mil type RCR07G121K
R21	Resistor, Fixed Composition, 10 Ω ±10% ¼W: Mil type RCR07G100K
R22	Resistor, Variable 200 Ω MFR 14304 PN R40-0012-201
R23	Resistor, Fixed Composition,8.2K Ω ±10% ¼W: Mil type RCR07G822K
R24	Resistor, Fixed Composition, 47K Ω ±10% ¼W: Mil type RCR07G473K
R25	Same as A2A9A1R11
R26	Same as A2A9A1R2
R27	Same as A2A9A1R11
R28	Resistor, Fixed Composition,68K Ω ± 10% ¼W: Mil Type RCR07G683K
R29	Resistor, Fixed Composition, 27K Ω ± 10% ¼W: Mil Type RCR07G273K
R30	Same as A2A9A1R2
R31	Resistor, Fixed Composition, 10K Ω ± 10% ¼W: Mil Type RCR07G103K
R32	Resistor, Fixed Composition, 3.3K Ω ± 10% ¼W: Mil Type RCR07G332K
R33	Same as A2A9A1R19
R34	Resistor, Fixed Composition, 680 Ω ± 10% ¼W: Mil Type RCR07G681K
R35	Resistor, Fixed Composition, 1.5 M Ω ±10% ¼W: Mil Type RCR07G155K
R36	Resistor, Fixed Composition, 470 Ω ± 10% ¼W: Mil Type RCR07G471K
R37	Same as A2A9A1R32

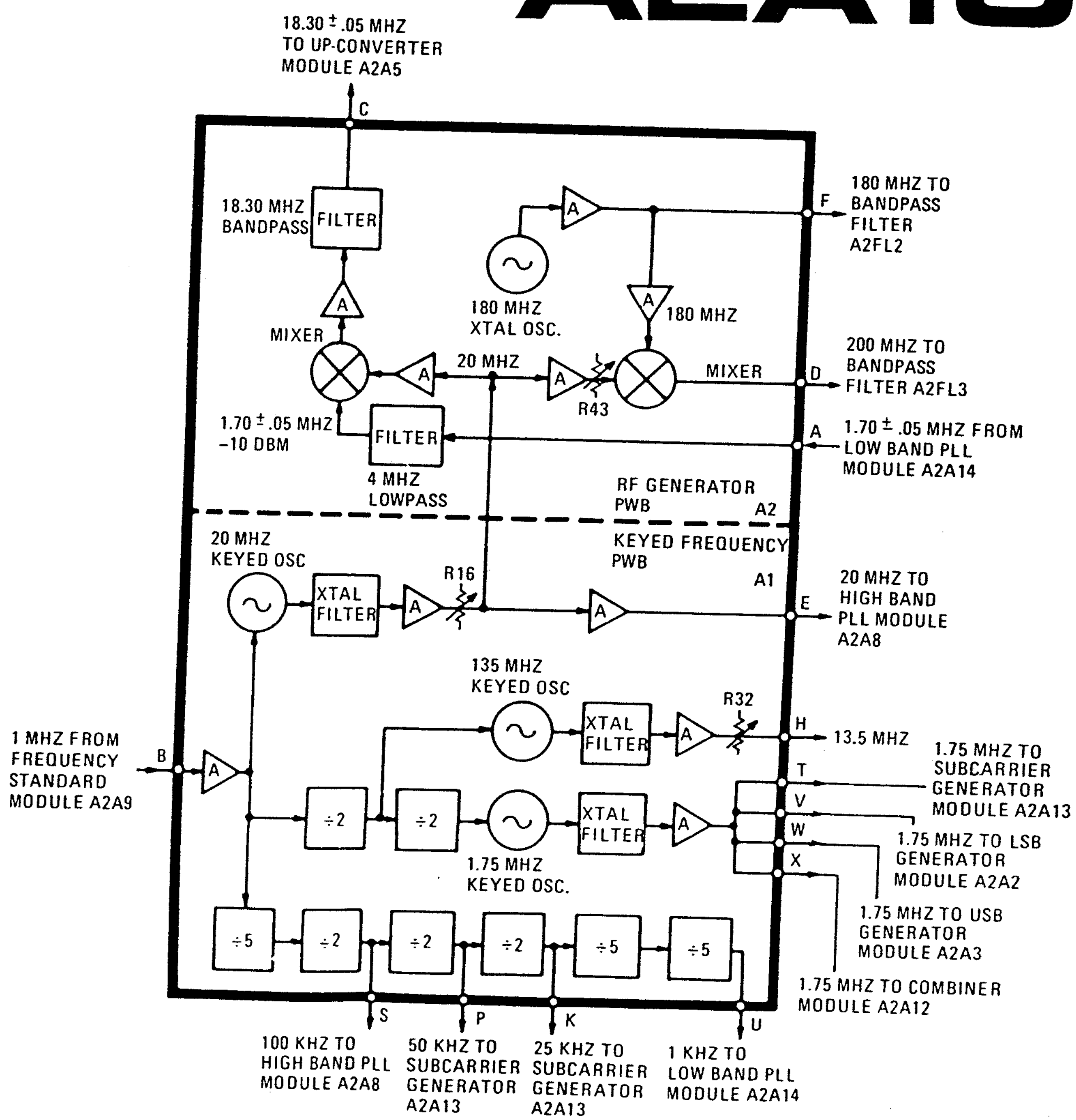
TABLE 3. MAINTENANCE PARTS LIST - FREQUENCY STANDARD MODULE (Continued)

Reference Designation	Name and Description
R38	Same as A2A9A1R36
R39	Same as A2A9A1R19
R40	Same as A2A9A1R34
R41	Same as A2A9A1R35
R42	Same as A2A9A1R31
R43, R44	Same as A2A9A1R32
R45	Same as A2A9A1R23
R46	Resistor, Fixed Composition, 100K Ω ± 10% ¼W: Mil Type RCR07G104K
R47	Same as A2A9A1R3
R48	Resistor, Fixed Composition, 820 Ω ± 10% ¼W: Mil Type RCR07G821K
R49	Resistor, Fixed Composition, 68K Ω ± 10% ¼W:Mil Type RCR07G683K
R50	Same as A2A9A1R19
R51	Same as A2A9A1R31
R52	Same as A2A9A1R3
R53, R54	Same as A2A9A1R32
R55	Same as A2A9A1R21
R56	Resistor, Fixed Composition, 180 Ω ± 10% ¼W: Mil Type RCR07G181K
R57	Resistor, Fixed Composition, 12K Ω ± 10% ¼W: Mil Type RCR07G123K
S1	Switch, Toggle: MFR 81640 PN T8001
T1	Transformer, broadband: MFR 14304 PN 0759-5110-2
T2	Transformer: MFR 80403 PN 70-0154
TP1	Test Point: MFR 14304 PN J60-0001-008
TP2	Test Point: MFR 14304 PN J60-0001-002
Z1	Integrated Circuit: MFR 21921 PN CA-3000
A2A9A2	Distribution PWB Assembly: MFR 14304 PN 0759-3920
C1, C2	Capacitor, Tantalum 1uF: Mil Type CSR13G105ML
C3	Capacitor, Ceramic .1uF: MFR 72982 PN 8121-050-651-104M
C4 To C7	Same as A2A9A2C1
C8	Same as A2A9A2C3
C9, C10	Capacitor, Ceramic .01uF: MFR 14304 PN C11-0008-103
C11	Capacitor Ceramic 4700 pF: MFR 72982 PN 8121-100-X7R-472K
C12	Same as A2A9A2C3

Reference Designation	Name and Description
L1, L2	Choke 560 uH: MFR 99800 PN 2500-16
L3, L4	Choke 1000 uH: MFR 99800 PN 2500-28
L5, L6	Choke 5.6 uH: MFR 99800 PN 1537-30
Q1, Q2	Transistor: Mil Type 2N5109
R1	Same as A2A9A1R18
R2	Resistor, Fixed Composition, 1.3K Ω ± 5% ¼W: Mil Type RCR07G132J
R3	Resistor, Fixed Composition, 18 Ω ±5% ¼W: Mil Type RCR07G180J
R4	Resistor, Fixed Composition, 75 Ω ±5% ¼W: Mil Type RCR07G750J
R5	Same as A2A9A1R18
R6	Resistor, Fixed Composition, 1K Ω ±5% ¼W: Mil Type RCR07G102J
R7	Same as A2A9A1R21
R8	Same as A2A9A2R4
R9	Resistor, Fixed Composition, 10K ± 5% ¼W: Mil Type RCR07G103J
R10, R11	Same as A2A9A2R6
R12	Resistor Variable 200: MFR 14304 PN R40-0012-201
R13	Same as A2A9A2R6
R14	Not used
R15	Resistor, Fixed Composition, 56 Ω ± 5% ¼W: Mil Type RCR07G560J
T1, T2	Transformer, broadband: MFR 14304 PN 0759-5110-2

SPECIAL FREQUENCIES MODULE

A2A10



SPECIAL FREQUENCIES MODULE A2A10

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1. GENERAL DESCRIPTION

Special Frequencies Module A2A10 accepts a 1 MHz Reference Standard input and synthesizes most of the injection and lower reference frequencies required by the other modules of the RF-131 Exciter. In addition, the Special Frequencies Module A2A10 translates a 1.70 ±.05 MHz input to 18.30±.05MHz for use in Up-Converter Module A2A5. The Special Frequencies Module contains two PWB assemblies; the Keyed Frequency Generator PWB A2A10A1, and RF Generator PWB A2A10A2.

2. TECHNICAL CHARACTERISTICS

Weight: 1.38 Pounds (629.5 grams)

Dimensions:
4-1/8 in.(H) x 2-1/8 in.(W) x 5-7/8 in.(D)
10.5 cm (H) x 5.4 cm(W) x 14.9 cm(D)

Power Requirements:
+6 Vdc at 230 mA
+5 Vdc at 36 mA
−6 Vdc at 68 mA

Signal Inputs:
1 MHz fixed, 1.0 V_{RMS}
1.65 - 1.75 MHz variable, 70 mV_{RMS}

Signal Outputs:
1 kHz fixed,3.6V peak-peak typical, 2.4V peak-peak min.
25 kHz fixed,3.6V peak-peak typical, 2.4V peak-peak min.
50 kHz fixed,3.6V peak-peak typical, 2.4V peak-peak min.
100 kHz fixed,3.6V peak-peak typical, 2.4V peak-peak min.
1.75 MHz fixed (4 outputs), 75 mV_{RMS}
13.5 MHz fixed, 70 mV_{RMS}
18.25 to 18.35 MHz variable, 120 mV_{RMS}
20 MHz fixed,70 mV_{RMS}
180 MHz fixed, 120 mV_{RMS}
200 MHz fixed, 80 mV_{RMS}

Input Impedance:
1 MHz: 2.2K ohms (approximately)
1.65 to 1.75 MHz: 50 ohms

Output Load:
1,25,50 and 100 kHz: 1K ohm; all other, 50 ohms

3. SEMICONDUCTOR COMPLEMENT

Table 1 lists all semiconductors used in the Special Frequencies Module A2A10. (See Section 5 for Integrated Circuit Data.)

TABLE 1. SEMICONDUCTOR COMPLEMENT

Reference Designation	Type	Function
A1CR1	1N3064	Temperature Stabilization
CR2	1N3064	Temperature Stabilization
CR3	1N3064	Temperature Stabilization
CR4	1N3064	Emitter Load
Q1	2N4264	Temperature Compensation
Q2	2N4264	Keying Transistor
Q3	2N5179	20 MHz Oscillator
Q4	2N4123	Isolation
Q5	2N4123	Power Gain
Q6	2N5179	Isolation
Q7	2N4123	Keying Transistor
Q8	2N5179	13.5 MHz Oscillator
Q9	2N4123	Isolation
Q10	2N4123	Power Gain
Q11	2N4125	Keying Transistor
Q12	2N4125	1.75 MHz Oscillator
Q13	2N4123	Power Amplifier (Pull-Up)
Q14	2N4123	Power Amplifier (Pull-Down)
Q15	2N4264	Driving Amplifier
VR1	1N4733	Voltage Regulation
Z1	SN7476N	Digital Frequency Divider
Z2	SN7490N	Digital Frequency Divider
Z3	SN7490N	Digital Frequency Divider
Z4	SN7490N	Digital Frequency Divider
A2AR1	0759-5010	Power Amplifier 14 dB
AR2	0759-5010	Power Amplifier 14 dB
CR1	1N3064	Temperature Stabilization
Q1	2N5179	Driver
Q2	2N5179	Tuned Power Amplifier
Q3	2N4123	Driver
Q4	2N4123	Tuned Power Amplifier
Q5	2N5179	Tuned Power Amplifier
Z1	0759-5150	Mixer
Z2	0759-5150	Mixer
Y1	0759-4015	180 MHz XTAL Oscillator

4. KEYED FREQUENCIES GENERATOR PWB A2A10A1 CIRCUIT DESCRIPTION

Refer to Figure 5. The 1MHz Reference Standard frequency enters at terminal E1, and is applied to a driver amplifier consisting of transistors Q1 and Q15. The transistors Q1 and Q15 are driven from cut-off to saturation over the input cycle, developing a 50 percent duty cycle, semi-square wave at the collector of Q15. This semi-square wave is formed when Q15 turns On causing the wave to fall. The fall time is very fast due to the small RC time constant of the circuit. The rise occurs when Q15 is turned Off and resistor R3 and the internal resistors of Z1 and Z2 pull up the collector of Q15 to about +4V.

The RC time constant of the pull up resistors, and transistors Q2 and Q15 is significant enough to produce a somewhat longer risetime at the collector of Q15. Integrated circuits Z1, Z2, Z3 and Z4 are triggered, or clocked, by the falling edge of the sawtooth wave. Therefore, the faster the fall, the less effect noise has on advancing or retarding clock time, as the wave falls through the threshold zone of the integrated circuit. The 1MHz semi-square wave is applied to keying transistor Q2 and to frequency dividers Z1 and Z2.

Transistors Q2 and Q3, with their associated components, constitute a 20 MHz keyed oscillator. Q3 is a common base Colpitts circuit with collector to emitter feedback via capacitive voltage divider C9 and C10. Oscillations are keyed On and Off at the 1 MHz rate by keying transistor Q2. During the interval when the 1 MHz wave is high, Q2 is saturated and resistively loads the 20 MHz tuned circuit, preventing oscillations. When Q2 comes out of saturation, the oscillator is shocked into operation by energy stored in the field of inductor L2. Oscillations always begin with a negative going swing at the collector of Q3. The result of repeating the same wave train at a 1 MHz rate is the production of a 1 MHz spectrum centered at the resonant frequency of L2, C8, C9 and C10, with spectrum point frequencies determined only by the keying frequency. Changing the resonant frequency of the oscillator tuned circuit with trimmer adjustment C8 does not change the frequency of the spectrum points, only their relative amplitudes. (See Figure 1)

The oscillator is temperature compensated by diode CR1. Increasing the temperature tends to increase the base current (and hence the collector current) of Q3 by lowering its emitter base junction resistance. However, the junction resistance of CR1 is also lowered, causing a decrease in the available bias voltage at the base of Q3. Consequently, the collector current and the 20 MHz output amplitude tend to be more constant with temperature variations.

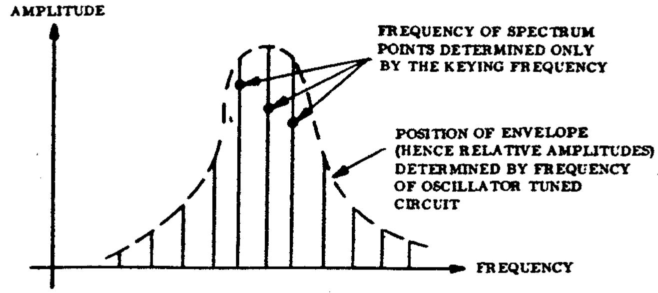


Figure 1. Spectrum, Keyed Oscillator

A narrow passband crystal filter, FL1, follows the keyed oscillator and passes only the 20MHz component of the spectrum to the module output. Emitter follower Q4 and Q5 provide power gain for driving the 50 ohm output load impedance presented at terminal E14. In addition, the 20MHz signal is routed to the High Band PLL Module A2A8, via isolation amplifier Q6 and A2A10, P1-E, for use as the digital discriminator reference frequency.

The 1MHz output from the driver amplifier is also applied to frequency dividers Z1 and Z2. Z1 is a type SN7476N dual J-K flip-flop integrated circuit (see Part 5 of the General Information Section for integrated circuit details). The 500 KHz square wave output at Z1-14 is the keying signal for the 13.5 MHz keyed oscillator, which is similar to the 20MHz keyed oscillator previously described. The 13.5 MHz output is routed to the Low Band PLL Module A2A14, via A2A10P1-4.

The second flip-flop in Z1 is driven by the first via Z1-15 and Z1-6. A 250 kHz square wave, developed at Z1-11, is the keying signal for the 1.75 MHz keyed oscillator consisting of Q11 and Q12. Q12 is a Hartley type oscillator with collector-to-base feedback via T1 and C25. In the absence of a keying signal, Q12 is prevented from oscillating by heavy loading from keying transistor Q11. The primary winding of T1 and capacitor C27 are the main frequency determining elements. The 250 kHz spectrum developed at the collector of Q12, is coupled through C28 (output amplitude adjust) to a compensated crystal filter consisting of Y1, C29, C33 and T2.

Capacitor C29 matches the leakage of undesired spectrum components through the holder capacitance of the crystal unit. When C29 is properly adjusted, its capacitance will be nearly equal to the holder capacitance, and only 1.75 MHz coupled through the crystal will produce a net signal current in the primary of T2. A power amplifier consisting of Q13 and Q14 provides both pull-up and pull-down of load voltage and yields a very low output impedance for driving the four 50 ohm output loads at A2A10P1-T, -V, -W, and -X.

Integrated circuits Z2, Z3, and Z4 are type SN7490N dual counters and provide a divide-by-two function and a divide-by-five function in the same package. The 1 MHz entering at Z2-1 is progressively counted down to 200 kHz, 100 kHz, 50 kHz, 25 kHz, 5 kHz and 1 kHz. The 100 kHz and 1 kHz outputs are used as reference frequencies by the High Band and Low Band PLL Modules A2A8 and A2A14 respectively. The 50 kHz and 25 kHz outputs are used by the Subcarrier Generator Module A2A13 (in four channel models only).

5. RF GENERATOR PWB A2A10A2 CIRCUIT DESCRIPTION

Refer to Figure 7. RF Generator PWB A210A2 develops three injection frequencies, two of which are used by Up-Converter Module A2A5 (18.3 ±.05 MHz and 180 MHz) and one by the High Band PLL Module A2A8 (200 MHz).

Development of the 18.3±.05 MHz signal originates in the Low Band PLL Module A2A14, where a 1.6501 to 1.7500 MHz variable frequency output (adjustable with the last three digits of the Frequency Selector digit switch) is generated. This signal is applied to balanced mixer Z1 on RF Generator PWB A2A10A2 via a low pass filter comprised of C28, C29 and L7. The filter attenuates harmonic frequencies generated by digital frequency division in the Low Band PLL Module A2A14. Z1 translates the Low Band PLL Module output to the range of 18.3499 to 18.2500 MHz by difference mixing it with a 20 MHz fixed frequency signal from the Keyed Frequency PWB A2A10A1.

TABLE 2. KEYED FREQUENCY PWB A2A10A1 Voltage Measurements

Transistor	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Emitter	2.8V P-P	700mV P-P	850mV P-P	460mV P-P	430mV P-P	170mV P-P	2.6V P-P	1.1V P-P
Base	1.35V P-P	1.6V P-P	2.2 Vdc	460mV P-P	460mV P-P	180mV P-P	2.4V P-P	2.2 Vdc
Collector	4.8V P-P	3.8V P-P	3.8V P-P	6Vdc	6Vdc	1.3V P-P	5.6V P-P	5.2V P-P

Transistor	Q9	Q10	Q11	Q12	Q13	Q14	Q15	
Emitter	1.2V P-P	1.0V P-P	8.8V P-P	1.3V P-P	370mV P-P	1.0V P-P	0	
Base	950mV P-P	1.2mV P-P	5.5 Vdc	1.4V P-P	400mV P-P	1.3V P-P	1.35V P-P	
Collector	6Vdc	6Vdc	3.7V P-P	3.7V P-P	1.3V P-P	370mV P-P	3.6V P-P	

The 20 MHz is amplified to a level sufficient to drive Z1, by a two-stage tuned power amplifier consisting of Q1, Q2 and their associated circuitry. Feedback from the emitter of Q2 to the base of Q1, via R5, establishes the overall current gain of Q1 and Q2 and stabilizes the quiesent operating point of the transistors through temperature variations. The low input impedance of Z1 is transformed up to the proper collector load for Q2 by a network consisting of C6 through C10 and L2.

A second feedback amplifier and an 18.3 MHz bandpass filter follow the balanced mixer. The filter eliminates undesired mixer products, and passes only the difference frequency to the module output. T1 transforms the 100 ohm filter terminating resistance of R16 to the collector load for Q4.

The 180 MHz signal originates at Y1, a self contained 180 MHz crystal oscillator unit. Networks C15 and R22, C16 and R23 decouple the oscillator from the Dc lines. Broadband amplifier unit AR1 follows Y1, and drives two paralleled loads via resistive dividers R26 and R27, R30 and R31. The dividers provide resistive buffering between the two signal paths. One of the paths delivers the 180 MHz through a high-pass filter, consisting of C21, C22 and L4, to A2A10P1-F. A narrow, 180 MHz bandpass filter located on the main chassis (external to the module) passes only the 180 MHz to Up-Converter Module A2A5 where it serves as the second injection frequency. The other feeds balanced mixer Z2 via amplifier AR2.

The 200 MHz injection frequency for the High Band PLL Module A2A8 is developed at the output of Z2 by additive mixing 180 MHz from AR2 with the 200 MHz from the Keyed Frequencies PWB A2A10A1, via terminal E3 and amplifier stage Q5. Transistor Q5 is a temperature compensated, tuned amplifier providing an approximate voltage gain of 3. A narrow 200 MHz bandpass filter (A2FL3, located on the chassis external to the Module) passes only the 200 MHz component of the mixing process to the High Band PLL Module A2A8.

With reference to the overall block diagram of the RF-131 Exciter (see Part 4 of the General Information Section) it should be noted that frequency error in the 180 MHz crystal oscillator is cancelled after final mixing in the RF Output Module A2A7.

6. KEYED FREQUENCIES PWB A2A10A1 TEST DATA

Typical voltage measurement for all transistors on the Keyed Frequencies PWB are given in Table 2. Measurements were taken with a Tektronix Model 453 (or equivalent) oscilloscope while the module was receiving normal Dc voltages and signal inputs.

7. RF GENERATOR PWB A2A10A2 TEST DATA

Typical voltage measurements for all transistors of the RF Generator PWB A2A10A2 are given in Table 3. The conditions of measurement and the type of measuring instruments for both Dc and RF signals are identical to those in paragraph 6.

TABLE 3. RF GENERATOR PWB A2A10A2
Voltage Measurements

Transistor	Q1	Q2	Q3	Q4	Q5
Emitter	150mV P-P	640mV P-P	0	290mV P-P	160mV P-P
Base	150mV P-P	800mV P-P	46mV P-P	300mV P-P	170mV P-P
Collector	800mV P-P	2.4mV P-P	300mV P-P	4.4V P-P	400mV P-P

The 200 MHz level should be measured at the output of A2FL3 (that is, at the input to the High Band PLL Module A2A8) where the 160 MHz difference frequency and the 180 MHz leakage have been filtered out. Remove the High Band PLL Module from the chassis and measure 28 mV rms at A2J8-B using a Boonton 91H (or equivalent) RF voltmeter with a 50 ohm adapter added to the probe.

8. A2A10 MODULE ADJUSTMENTS

NOTE

The following adjustments require the use of a non-metalic blade type tuning tool.

TABLE 4. KEYED FREQUENCY PWB A2A10A1 FREQUENCY DIVIDER VOLTAGE MEASUREMENTS

Meas. Point	Frequency	Volts Peak-Peak
Z1-1	1 MHz	2.4V min., 3.6V typical
Z2-1	1 MHz	2.4V min., 3.6V typical
Z1-14	500kHz	2.4V min., 3.6V typical
Z1-11	250kHz	2.4V min., 3.6V typical
A1E6	100kHz	2.4V min., 3.6V typical
A1E8	50kHz	2.4V min., 3.6V typical
A1E10	25kHz	2.4V min., 3.6V typical
A1E12	1 kHz	2.4V min., 3.6V typical

8.1 PRELIMINARY ADJUSTMENT

Before making adjustments to Special Frequencies Module A2A10, verify that frequency dividers Z1 through Z4 on the Keyed Frequencies PWB A2A10A1 are working properly by measuring the peak-to-peak voltages at the points indicated in Table 4. These measurements should be made using a Tektronix Model 453 (or equivalent) oscilloscope with a X10 probe.

8.2 KEYED FREQUENCIES PWB A2A10A1 ADJUSTMENTS

The following adjustments apply to the Keyed Frequencies PWB A2A10A1. They should be performed in the order shown.

NOTE

Adjustments in paragraph 8.2.1 through 8.2.3 require a spectrum analyzer that has been calibrated in the linear display mode. To calibrate the Hewlett Packard 8553L Spectrum Analyzer, refer to its instruction manual. If a spectrum analyzer with an accurate linear display is unavailable, a Boonton 91H RF Voltmeter with a 50 ohm probe may be substituted where the analyzer with linear display is required.

8.2.1 1.75 MHz Adjustment

Remove either sideband generator from its chassis connector, and connect a Hewlett Packard 8553L (or equivalent) Spectrum Analyzer with 50 ohm input impedance to pin C of J2 or J3. With the spectrum analyzer in the 10dB log display mode, adjust transformers T1 and T2 for a peak indication of 1.75 MHz.

Set the spectrum analyzer to linear display (10mV/DIV,X1) and adjust capacitor A2A10-A1C28 for a display of 75 mV (7.5 divisions) of the 1.75MHz signal. Set the spectrum analyzer to log display and adjust A2A10A1C29 for minimum balanced 250 KHz sidebands on both sides of the desired 1.75MHz signal. Set the spectrum analyzer to linear display and check for a 75mV level of the 1.75MHz output. Readjust capacitor C28, if necessary.

8.2.2 13.5 MHz Adjustment

Remove Low Band PLL Module A2A14 from its chassis connector, and connect the spectrum analyzer (set to 10dB log display mode) to A2J14 pin E to monitor the 13.5 MHz level. Adjust potentiometer A2A10A1R32 for a −10dBm of the 13.5 MHz signal. Next, adjust capacitor A2A10A1C17 for minimum, balanced 500 KHz sidebands on both sides of the desired 13.5 MHz signal. Set the spectrum analyzer to linear display (10mV/DIV X1) and check for a 71mV level of the 13.5 MHz signal. Adjust A2A10A1R32, if required.

8.3 RF GENERATOR PWB A2A10A2 ADJUSTMENTS

8.3.1 18.3 MHz Adjustment

Remove Up-Converter Module A2A5 and High Band PLL Module A2A8. Connect an RF voltmeter (with a 50 ohm probe) to A2J8-N. Temporarily adjust A2A10A1R16 to obtain a level of approximately −25 dBm (12.6 V). This temporary adjustment of the 20 MHz potentiometer allows amplifier A2A10A2 transistors Q1 and Q2 to come out of saturation.

Connect the voltmeter to A2J5-A. Adjust A2A10A2C9 for a peak indication on the voltmeter.

Reconnect the voltmeter to A2J8-N and readjust A2A10A1R16 to obtain a −10dBm amplitude (70 mV). Connect the voltmeter to A2J5-A and adjust A2A14A2R2 to obtain a −8dBm (90 mV) indication.

8.3.2 200 MHz Adjustment

Connect a Boonton 91H (or equivalent) voltmeter equipped with a 50 ohm adapter to A2J8-B (with High Band PLL Module A2A8 removed). Adjust A2A10A2R43 for an indication of 28mV.

Recheck adjustment procedures of paragraph 8.3.1 and readjust if required.

9. MAINTENANCE PARTS LIST

Table 5 is a Maintenance Parts List for the Special Frequencies Module A2A10. Manufacturers are referenced by a five digit code. For a complete listing of manufacturer codes refer to Table 6-3 in the General Information Section.

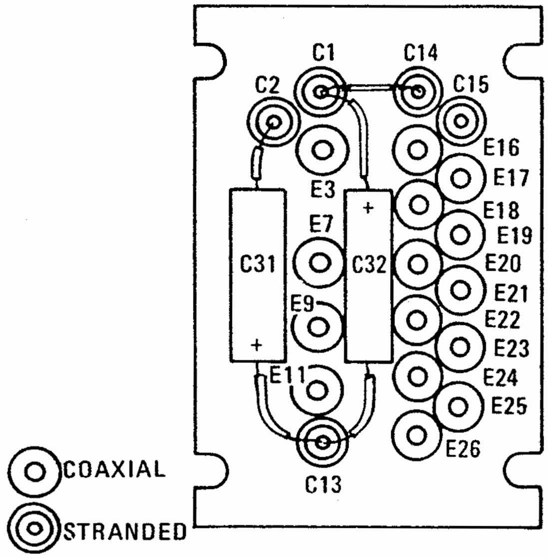


Figure 2. Filter Plate Assembly, A2A10FL1 Component Location

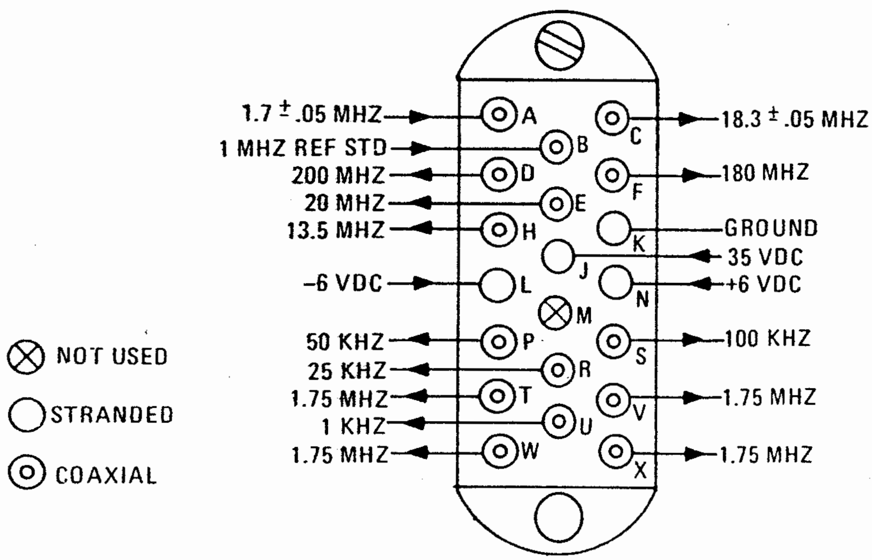


Figure 3. Module Chassis Connector A2J10 Top View

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   - A. ALL RESISTORS ARE IN OHMS, ¼ WATT.
   - B. ALL CAPACITORS ARE IN MICROFARADS.
2. PREFIX INCOMPLETE REFERENCE DESIGNATORS WITH A2A10 PLUS SUB-ASSEMBLY DESIGNATOR IF ANY.
3. REFER TO TABLE 1. FOR LISTING OF SEMICONDUCTOR TYPES.

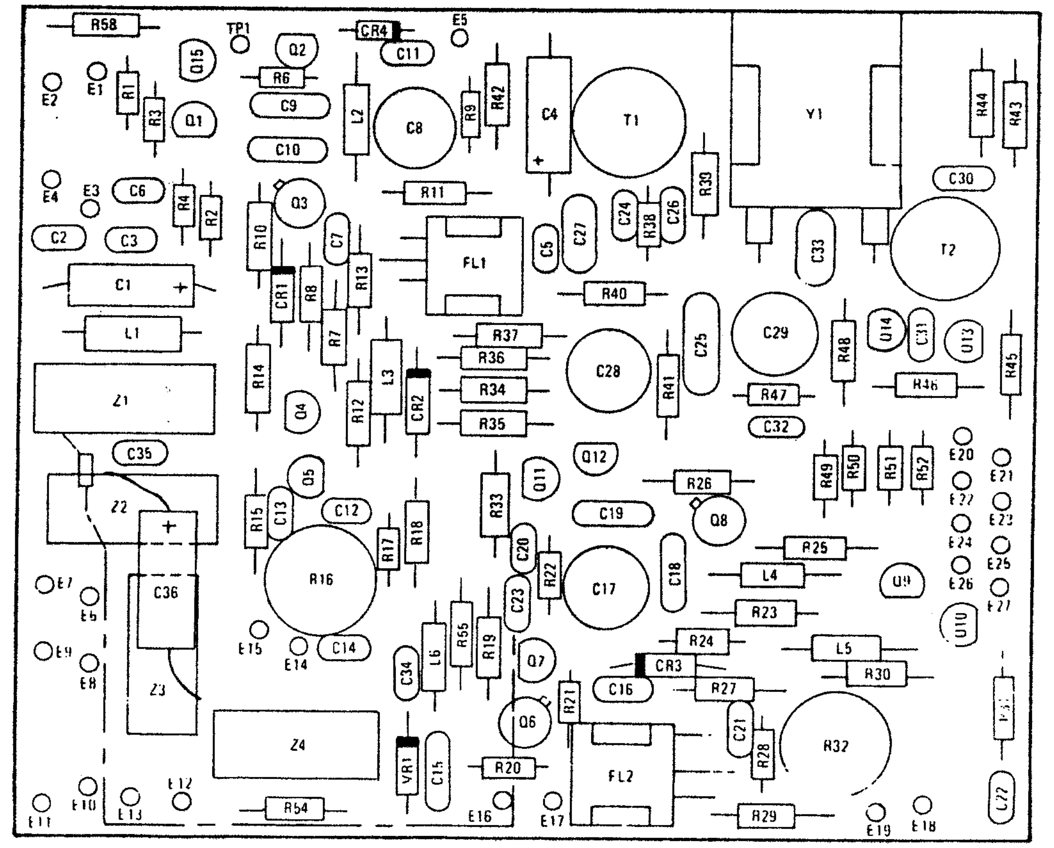


Figure 4. Keyed Frequency Generator, Component Locations

0759-4001

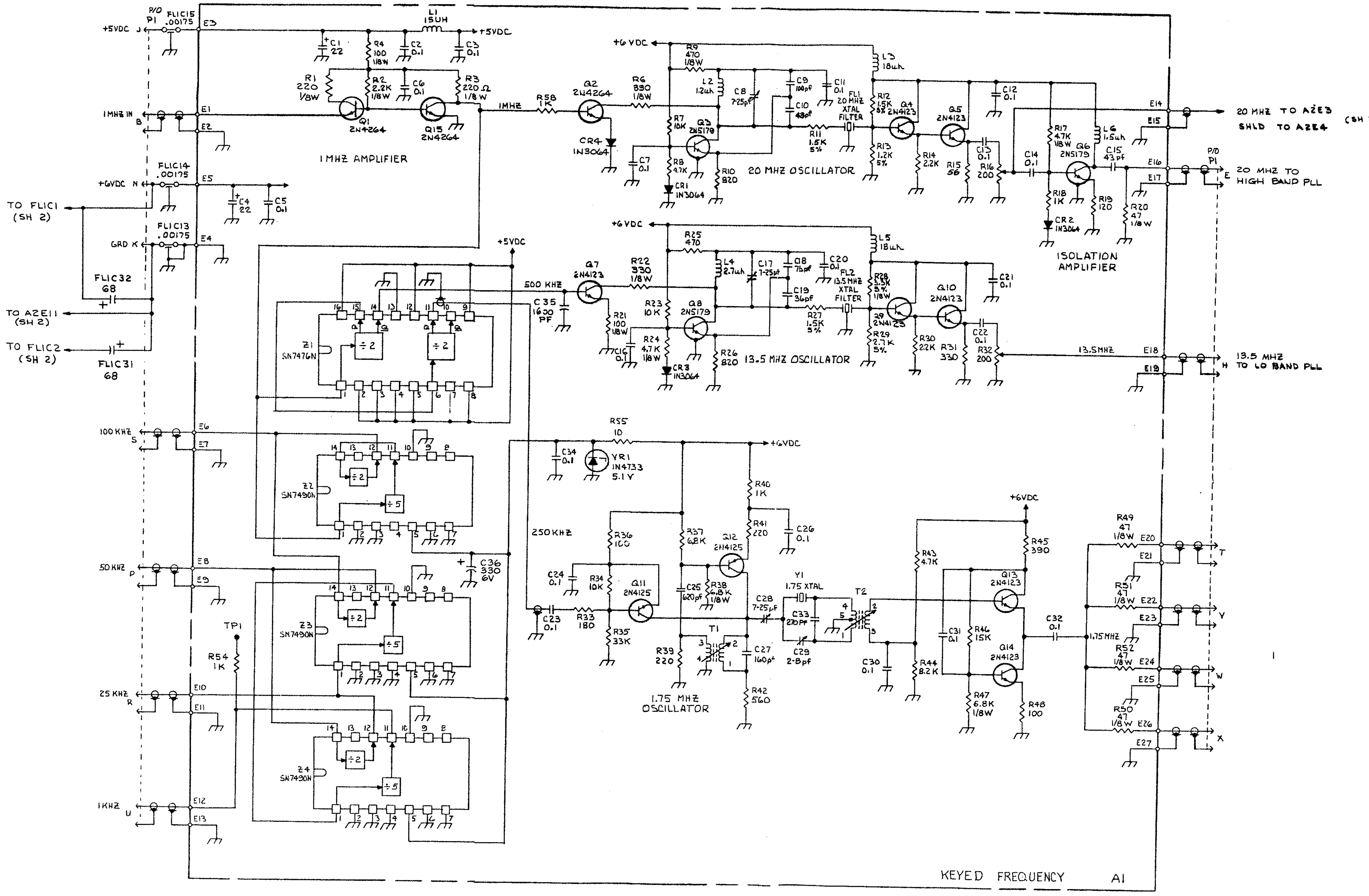


Figure 5. Keyed Frequency Generator PWB A2A10A1 Schematic Diagram

NOTES:

1. **UNLESS OTHERWISE SPECIFIED:**

   A. ALL RESISTORS ARE IN OHMS, ¼ WATT.
   B. ALL CAPACITORS ARE IN MICROFARADS.

2. **PREFIX INCOMPLETE REFERENCE DESIGNATORS WITH A2A10 PLUS SUB-ASSEMBLY DESIGNATOR IF ANY.**

3. **REFER TO TABLE 1. FOR LISTING OF SEMICONDUCTOR TYPES.**

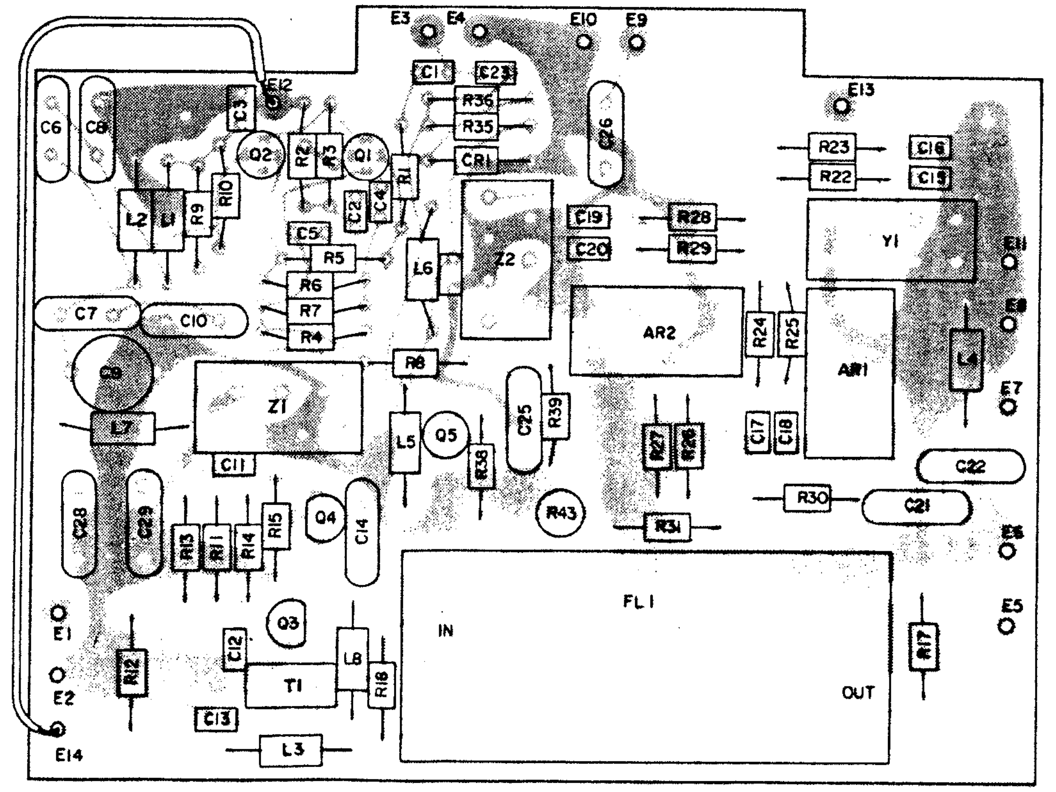


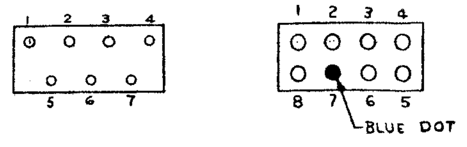
Figure 6. RF Generator PWB Component Locations

0759-4001

NOTES:

2.1. UNLESS OTHERWISE SPECIFIED:
a) ALL RESISTORS ARE IN OHMS, ¼W, 10%
b) ALL CAPACITORS ARE IN UF.

2.2 PREFIX INCOMPLETE REF DESIGNATIONS WITH A2A10



BOTTOM VIEW OF Z1 & Z2

BOTTOM VIEW OF Y1, AR1 & AR2

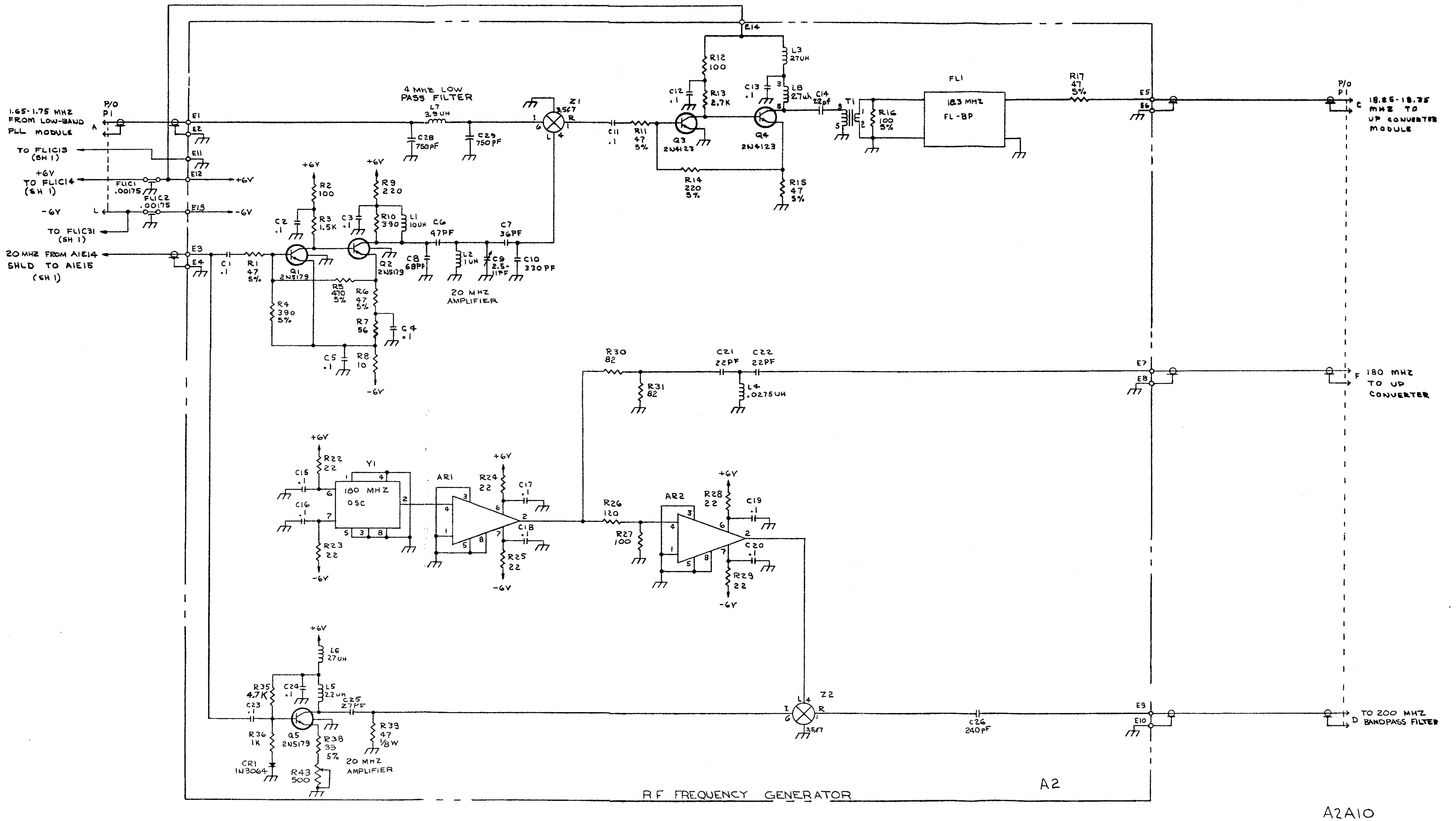


Figure 7. RF Generator PWB A2A10A2 Schematic Diagram

TABLE 6. MAINTENANCE PARTS LIST - POWER SUPPLY MODULE A2A11

Reference Designation	Name and Description
A2A11	Power Supply Module: MFR 14304, PN 0759-4100
C1, C2	Capacitor, Fixed Electrolytic, 6500 uF, 15 Vdc: MFR 00853, PN 500-1927-01
C3	Capacitor, Fixed Electrolytic, 2600 uF, 50 Vdc: MFR 56289, PN 3GD262G050AB2A
C4 - C8	Capacitor, Fixed, 0.1 uF, 50V: MFR 14304, PN C11-0005-104
CR1, CR2	Diode: MFR 14304, PN 0946-4157
FL1 - FL11	Bead Ferrite: MFR 78488, PN 57-0180
Q1 - Q4	Transistor: MFR 04713, PN 2N6261
Q5	Not Used
Q6	Transistor: MFR 04713, PN2N6261
T1	Transformer, Power: MFR 14304, PN 0759-4106
A2A11A1	Rectifier Board Assembly: MFR 14304, PN 0946-4155
CR1, CR2	Not Used
CR3 - CR8	Diode: MFR 14304, PN 0946-4157
MP1	PC Board: MFR 14304, PN 0946-4156
A2A11A2	Low Voltage PWB Assembly: MFR 14304, PN 0759-4115
C1	Capacitor, Fixed Ceramic, 560 pF: Mil type CK05BX561K
C2	Capacitor, Fixed Ceramic, 5600 pF: Mil type CK06BX562K
CR1, CR2	Diode: Mil type 1N3064
MP1	PC Board: MFR 14304, PN 0759-4116
P1	Connector, Plug, 14 Pin: MFR 81312, PN MRAC14P
Q1	Transistor: MFR 04713, PN 2N6261
R1	Resistor, Fixed Wirewound, 0.47 Ω ±5%, 2W: MFR 35009, PN BWH-0.47
R2	Resistor, Fixed Composition, 390 Ω ±5%, ¼W: Mil type RCR07GF391J
R3	Resistor, Fixed Composition, 470 Ω ±5%, ¼W: Mil type RCR07GF471J
R4	Not Used
R5	Resistor, Fixed Composition, 82 Ω ±5%, 2W: Mil type RC42GF820J
R6	Resistor, Fixed Film: MFR 14304, PN 0759-4126 (Note 1)
R7	Resistor, Fixed Film, 115KΩ ±1%, ¼W: Mil type RN60D1151F
R8, R9	Resistor, Fixed Composition, 2.2KΩ ±5%, ¼W: Mil type RC07GF222J
R10	Resistor, Fixed Composition, 470 Ω ±5%, ¼W: Mil type RC07GF471J
R11	Not Used
R12	Resistor, Fixed Composition, 390 Ω ±5%, ¼W: Mil type RC07GF391J
R13 - R16	Not Used
R17	Resistor, Fixed Composition, 470 Ω ±5%, ¼W: Mil type RC07GF471J
R18 - R25	Not Used
R26	Resistor, Fixed Film: MFR14304, PN 0759-4125 (Note 1)
R27	Resistor, Fixed Film, 2.15K Ω ±1%, ¼W: Mil type RN60D2151F
R28 - R31	Not Used
R32	Resistor, Fixed Wirewound, 0.39 Ω ±5%, 2W: MFR 35009, PN BWH-0.39
R33, R34	Resistor, Fixed Composition, 10K Ω ±5%, ¼W: Mil type RC07GF103J
RT1, RT2	Thermistor, 1K: MFR 73168, PN KA31J1
VR1	Diode: Mil type 1N751 A
VR2	Diode: Mil type PN 1N5374 A
Z1	Voltage Regulator Type UA723C: MFR 07263, PN UA723HC
Z2	Not Used
Z3	Voltage Regulator Type UA723C: MFR 07263, PN UA723HC
A2A11A3	High Voltage PWB Assembly: MFR 14304, PN 0759-4120
C1, C2	Capacitor, Fixed Mica, 100 pF: Mil type CM05FD101J03
C3	Capacitor, Ceramic, 4700 pF: MFR 31433, PN C312C472M5U1EA
C4	Capacitor, Fixed Mica, 300 pF: Mil type CM05FD301J03
C5	Capacitor, Fixed, 0.1 uF 50V: MFR 14304. PN C11-0005-104
C6	Capacitor, Tantalum, 1 uF: Mil type M3900-01-2357
CR1	Diode: Mil type 1N3064
MP1	Pc Board: MFR 14304, PN 0759-4121
Q1	Transistor: MFR 04713, PN 2N6261

TABLE 6. MAINTENANCE PARTS LIST - POWER SUPPLY MODULE A2A11 (Continued)

Reference Designation	Name and Description
A2A11A3	
R1	Resistor, Fixed Wirewound, 2.7 Ω ±5%, 2W: MFR 35009, PN BWH-2.7 Ω
R2	Resistor, Fixed Film, 22.6KΩ ±5%, ¼W: Mil type RN60D2262F
R3	Resistor, Fixed Film: MFR 14304, PN 0759-4129 (Note 1)
R4	Resistor, Fixed Composition, 1.8K Ω ±5%, ¼W: Mil type RCR07G182J
R5	Resistor, Fixed Composition, 12K Ω ±5%, ¼W: Mil type RC07GF123J
R6	Resistor, Fixed Composition, 47K Ω ±5%, ¼W: Mil type RC07GF473J
R7	Resistor, Fixed Wirewound, 5.6 Ω ±5%, 2W: MFR 35009, PN BWH-5.6 Ω
R8, R9	Not Used
R10	Resistor, Fixed Film, 22.6K Ω ±5%, 1W: Mil type RN60D2262F
R11	Resistor, Fixed Film: MFR 14304, PN 0759-4128 (Note 1)
R12	Resistor, Fixed Composition, 1K Ω ±5%, ¼W: Mil type RC07GF102J
R13	Resistor, Fixed Composition, 33KΩ ±5%, ¼W: Mil type RC07GF333J
R14	Resistor, Fixed Composition, 8.2K Ω ±5%, ¼W: Mil type RC07GF822J
R15	Resistor, Fixed Composition, 220 Ω ±5%, ½W: Mil type RC20GF221J
R16	Resistor, Fixed Composition, 2.2K Ω ±5%, ¼W: Mil type RC07GF222J
R17, R18	Resistor, Fixed Composition, 390 Ω ±5%, ¼W: Mil type RC07GF391J
R19	Resistor, Fixed Film, 4.02K Ω ±5%, ¼W: Mil type RN60D4021F
R20	Resistor, Fixed Film: MFR 14304, PN 0759-4127 (Note 1)
R21, R22	Resistor, Fixed Composition, 3.32K Ω ±5%, 1/8W: Mil type RN55D3321F
R23	Resistor, Fixed Composition, 68 Ω ±5%, ¼W: Mil type RC07GF680J
R24	Not Used
R25	Resistor, Fixed Composition, 560 Ω ±5%, 2W: Mil type RC42GF561J
R26	Resistor, Fixed Composition, 68 Ω ±5%, ¼W: Mil type RC07GF680J
R27	Resistor, Fixed Composition, 22 Ω ±5%, ¼W: Mil type RC07GF220J
R28	Resistor, Fixed Wirewound, 0.47 Ω ±5%, 2W: MFR 35009, PN BWH-0.47 Ω
RT1	Thermisistor, 1K: MFR 73168, PN KA31J1
VR1	Diode: Mil type 1N751A
VR2	Diode, Zener: MFR 04713, PN MZ4625
Z1	Voltage Regulator, Type UA723C: MFR 07263, PN UA723HC
Z2	Not Used
Z3, Z4	Voltage Regulator, Type UA723C: MFR 07263, PN UA723HC

Note 1: Selected Value, see Table 4.

TABLE 5. MAINTENANCE PARTS LIST-Special Frequencies Module A2A10

Reference Designation	Name and Description
A2A10	Special Frequencies Module: MFR 14304, PN 0759-4000
FL1	Filter Plate Assembly: MFR 14304, PN 0759-4004
C1, C2	Capacitor, Feed Thru, .00175 uF: MFR 72982, PN 1214-001
C3-C12	Not Used
C13-C15	Same as FL1C1
C16-C30	Not Used
C31,C32	Capacitor, Tantalum, 68uF 15VDCW: Mil type CSR13D686ML
MP1-MP15	Pin, Connector: MFR 81312, PN 100-8000S
MP16-MP19	Pin Connector: Mil type MS 17803-16-20
P1	Connector: MFR 81312, PN MRAC20PN
A2A10A1	Keyed Frequency Generator PWB Assembly: MFR 14304, PN 0759-4010
C1	Capacitor, Tantalum, 22uF 15 VDCW: Mil type CSR13D226ML
C2, C3	Capacitor, Ceramic, .1 uF: MFR 14304, PN C11-0005-104
C4	Same as A10A1C1
C5-C7	Same as A10A1C2
C8	Capacitor, Variable, 7 to 25 pF: MFR 72982, PN 538-014-7-25pF
C9	Capacitor, Mica, 100pF: Mil type CM05FD101J03
C10	Capacitor, Mica, 43 pF: Mil type CM05ED430J03
C11-C14	Same as A10A1C2
C15	Same as A10A1C10
C16	Same as A10A1C2
C17	Same as A10A1C8
C18	Capacitor, Mica, 75 pF: Mil type CM05ED750J03
C19	Capacitor, Mica, 36 pF: Mil type CM05ED360J03
C20-C24	Same as A10A1C2
C25	Capacitor, Mica, 620 pF: Mil type CM06FD621J03
C26	Same as A10A1C2
C27	Capacitor, Mica, 160 pF: Mil type CM05FD161J03
C28	Same as A10A1C8
C29	Capacitor, Variable, 2 to 8 pF: MFR 72982, PN 538-014, 2-8 pF A
C30-C32	Same as A10A1C2
C33	Capacitor, Mica, 270 pF: Mil type CM05FD271J03
C34	Same as A10A1C2
C35	Capacitor, Ceramic, 1800 pF: MFR 72982, PN 8101-050-651-182M
C36	Capacitor, Tantalum, 330uF: Mil type CSR13B337ML
CR1-CR4	Diode: Mil type 1N3064
FL1	Filter, 20 MHz: MFR 14304, PN 0759-4023
FL2	Filter, 13.5 MHz: MFR 14304, PN 0759-4022
L1	Inductor, 15 uH: MFR 99800, PN 1537-40
L2	Inductor, 1.2 uH: MFR 99800, PN 1537-14
L3	Inductor, 18 uH: MFR 99800, PN 1537-42
L4	Inductor, 2.7 uH: MFR 99800, PN 1537-22
L5	Same as A10A1L3
L6	Inductor, 1.5 uH: MFR 99800, PN 1537-16
Q1, Q2	Transistor: MFR 04713, PN 2N4264
Q3	Transistor: MFR 21921, PN 2N5179
Q4, Q5	Transistor: Mil type 2N4123
Q6	Same as A10A1Q3
Q7	Same as A10A1Q4
Q8	Same as A10A1Q3
Q9, Q10	Same as A10A1Q4
Q11, Q12	Transistor: MFR 04713, PN 2N4125
Q13, Q14	Same as A10A1Q4
Q15	Same as A10A1Q1
R1	Resistor, Fixed Composition, 220 Ω ±5%, 1/8W: Mil type RCR05G221J

TABLE 5. MAINTENANCE PARTS LIST-Special Frequencies Module A2A10

Reference Designation	Name and Description
R2	Resistor, FixedComposition, 2.2K ±5%, 1/8W: Mil type RCR05G222J
R3	Same as A10A1R1
R4	Resistor, Fixed Composition, 100 Ω ±5%, 1/8W: Mil type RCR05G101J
R5	Not Used
R6	Resistor, Fixed Composition, 330 Ω ±5%, 1/8W: Mil type RCR05G331J
R7	Resistor, Fixed Composition, 10K ±5%, ¼W: Mil type RCR07G103J
R8	Resistor, Fixed Composition, 4.7K ±5%, ¼W: Mil type RCR07G472J
R9	Resistor, Fixed Composition, 470 Ω ±5%, 1/8W: Mil type RCR05G471J
R10	Resistor, Fixed Composition, 820 Ω ±5%, ¼W: Mil type RCR07G821J
R11, R12	Resistor, Fixed Composition, 1.5K ±5%, ¼W: Mil type RCR07G152J
R13	Resistor, Fixed Composition, 1.2K ±5%, ¼W: Mil type RCR07G122J
R14	Resistor, Fixed Composition, 2.2K ±5%, ¼W: Mil type RCR07G222J
R15	Resistor, Fixed Composition, 56 Ω ±5%, ¼W: Mil type RCR07G560J
R16	Resistor, Variable, 200 Ω MFR 14304, PN R40-0012-201
R17	Resistor, Fixed Composition, 4.7K ±5%, 1/8W: Mil type RCR05G472J
R18	Resistor, Fixed Composition, 1K ±5%, ¼W: Mil type RCR07G102J
R19	Resistor, Fixed Composition, 120 Ω ±5%, ¼W: Mil type RCR07G121J
R20	Resistor, Fixed Composition, 47 Ω ±5%, 1/8W: Mil type RCR05G470J
R21	Same as A10A1R4
R22	Same as A10A1R6
R23	Same as A10A1R7
R24	Same as A10A1R17
R25	Resistor, Fixed Composition, 470 Ω ±5%, ¼W: Mil type RCR07G471J

Reference Designation	Name and Description
R26	Same as A10A1R10
R27	Same as A10A1R11
R28	Resistor, Fixed Composition, 3.3K ±5%, 1/8W: Mil type RCR05G332J
R29	Resistor, Fixed Composition, 2.7K ±5%, ¼W: Mil type RCR07G272J
R30	Same as A10A1R14
R31	Resistor, Fixed Composition, 330 Ω ±5%, ¼W: Mil type RCR07G331J
R32	Same as A10A1R16
R33	Resistor, Fixed Composition, 180 Ω ±5%, ¼W: Mil type RCR07G181J
R34	Same as A10A1R7
R35	Resistor, Fixed Composition, 33K ±5%, ¼W: Mil type RCR07G333J
R36	Resistor, Fixed Composition, 100 Ω ±5%, ¼W: Mil type RCR07G101J
R37	Resistor, Fixed Composition, 6.8K ±5%, ¼W: Mil type RCR07G682J
R38	Resistor, Fixed Composition, 6.8K ±5%, 1/8W: Mil type RCR05G682J
R39	Resistor, Fixed Composition, 220 Ω ±5%, ¼W: Mil type RCR07G221J
R40	Same as A10A1R18
R41	Same as A10A1R39
R42	Resistor, Fixed Composition, 560 Ω ±5%, ¼W: Mil type RCR05G561J
R43	Same as A10A1R8
R44	Resistor, Fixed Composition, 8.2K ±5%, ¼W: Mil type RCR07G822J
R45	Resistor, Fixed Composition, 390 Ω ±5%, ¼W: Mil type RCR07G391J
R46	Resistor, Fixed Composition, 15K ±5%, ¼W: Mil type RCR07G153J
R47	Same as A10A1R38
R48	Same as A10A1R36
R49 - R52	Same as A10A1R20
R53	Not Used

TABEL 5. MAINTENANCE PARTS LIST-Special Frequencies Module A2A10

Reference Designation	Name and Description
R54	Same as A10A1R18
R55	Resistor, Fixed Composition, 10 Ω, ±5%, ¼W: Mil type RCR07G100J
R56, R57	Not Used
R58	Same as A10A1R18
T1	Transformer, RF: MFR 14304, PN 0759-4014
T2	Transformer, RF: MFR 14304, PN 0759-4013
VR1	Diode, Zener, 5.1 Vdc: MFR 04713, PN 1N4733
XY1	Socket, Crystal: MFR 91506 PN 8000-AG9
Y1	Crystal, 1.75 MHz: Mil type MFR 14304, PN 0759-4019
Z1	Integrated Circuit: MFR 01295, PN SN7476N
Z2 - Z4	Integrated Circuit: MFR 01295, PN SN7490N
A2A10A2	RF Generator PWB Assembly: MFR 14304, PN 0759-4020
AR1, AR2	VHF Amplifier: MFR 14304, PN 0759-5010
C1 - C5	Capacitor, Ceramic, .1 uF: MFR 14304, PN C11-0005-104
C6	Capacitor, Mica, 47 pF: Mil type CM05ED470J03
C7	Capacitor, Mica, 36 pF: Mil type CM05ED360J03
C8	Capacitor, Mica, 68 pF: Mil type CM05ED680J03
C9	Capacitor, Variable, 2.5-11 pF: MFR72982, PN 538-014, 2.5-11 pF
C10	Capacitor, Mica, 330 pF: Mil type CM05FD331J03
C11-C13	Same as A10A2C1
C14	Capacitor, Mica, 22 pF: Mil type CM05ED220J03
C15-C20	Same as A10A2C14
C21, C22	Same as A10A2C14
C23, C24	Same as A10A2C1
C25	Capacitor, Mica, 27 pF: Mil type CM05ED270J03

Reference Designation	Name and Description
C26	Capacitor, Mica, 240 pF: Mil type CM05FD241J03
C27	Not Used
C28, C29	Capacitor, Mica, 750 pF: Mil type CM06FD751J03
CR1	Diode: Mil type 1N3064
FL1	Filter, 18.3 MHZ: MFR 14304, PN 0759-3523
L1	Inductor, 10 uH: MFR 99800, PN 1537-36
L2	Inductor,1 uH: MFR 99800, PN 1537-12
L3	Inductor,27 uH: MFR 99800, PN 1537-47
L4	Inductor, .0275 uH: MFR 14304, PN 0759-4024
L5	Inductor, 2.2 uH: MFR 99800, PN 1537-20
L6	Same as A10A2L3
L7	Inductor, 3.9 uH: MFR 99800, PN 1537-26
L8	Inductor, 2.7 uH: MFR 99800, PN 1537-22
Q1, Q2	Transistor: MFR 21921, PN 2N5179
Q3, Q4	Transistor: Mil type 2N4123
Q5	Same as A10A2Q1
R1	Resistor, Fixed Composition, 47 Ω ±5%, ¼W: Mil type RCR07G470J
R2	Resistor, Fixed Composition, 100 Ω ±5%, ¼W: Mil type RCR07G101J
R3	Resistor, Fixed Composition, 1.5K ±5%, ¼W: Mil type RCR07G152J
R4	Resistor, Fixed Composition, 390 Ω ±5%, ¼W: Mil type RCR07G471J
R5	Resistor, Fixed Composition, 470 Ω ±5%, ¼W: Mil type RCR07G471J
R6	Same as A10A2R1
R7	Resistor, Fixed Composition, 56 Ω ±10%, ¼W: Mil type RCR07G560K
R8	Resistor, Fixed Composition, 10 Ω ±10%, ¼W: Mil type RCR07G100K
R9	Resistor, Fixed Composition, 220 Ω ±10%, ¼W: Mil type RCR07G221K

TABLE 5. MAINTENANCE PARTS LIST-Special Frequencies Module A2A10

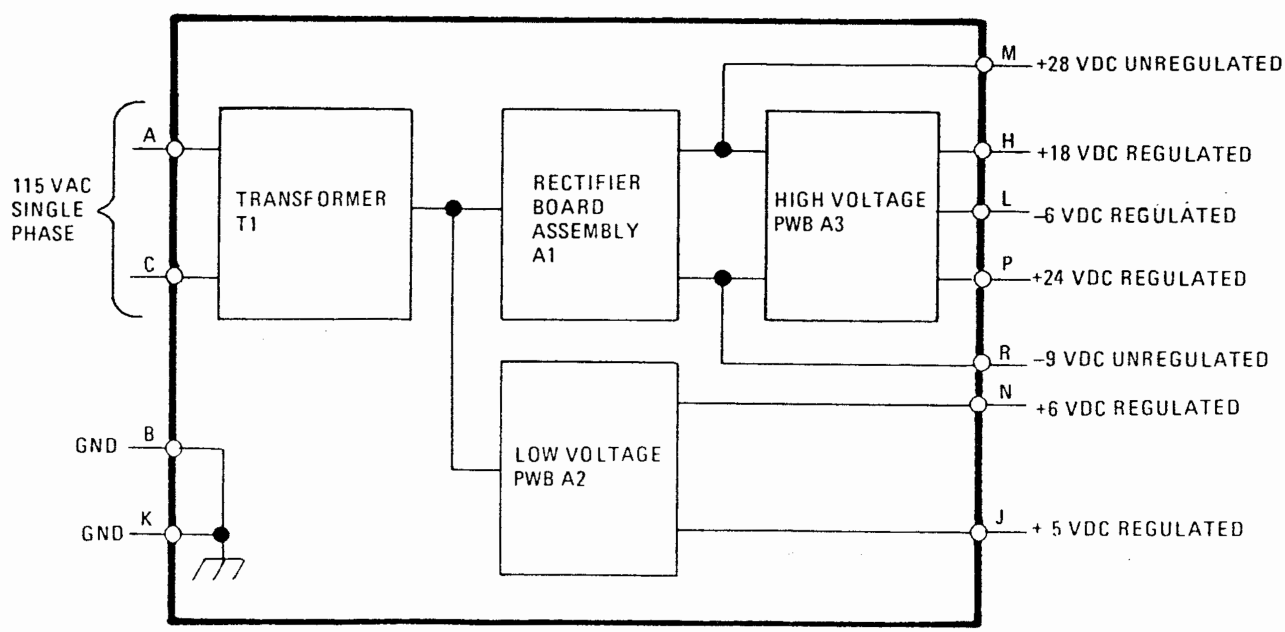
Reference Designation	Name and Description
R10	Same as A10A2R4
R11	Same as A10A2R1
R12	Same as A10A2R2
R13	Resistor, Fixed Composition, 2.7K ±10%, ¼W: Mil type RCR07G272K
R14	Same as A10A2R9
R15	Same as A10A2R1
R16	Same as A10A2R2
R17	Same as A10A2R1
R18 - R21	Not Used
R22 - R25	Resistor, Fixed Composition, 22 Ω ±5%, ¼W: Mil type RCR07G220J
R26	Resistor, Fixed Composition, 120 Ω ±5%, ¼W: Mil type RCR07G121J
R27	Same as A10A2R2
R28, R29	Same as A10A2R22
R30 - R31	Resistor, Fixed Composition, 82 Ω ±5%, ¼W: Mil type RCR07G820J

Reference Designation	Name and Description
R32 - R34	Not Used
R35	Resistor, Fixed Composition, 4.7K ±5%, ¼W: Mil type RCR07G472J
R36	Resistor, Fixed Composition, 1K ±5%, ¼W: Mil type RCR07G102J
R37	Not Used
R38	Resistor, Fixed Composition, 33 Ω ±5%, ¼W: Mil type RCR07G330J
R39	Resistor, Fixed Composition, 47Ω ±5%, ¼W: Mil type RCR07G470J
R40 - R42	Not Used
R43	Resistor, Variable, 500 Ω MFR 80294, PN 3329P-1-501
T1	Transformer, 2:1 MFR 14304, PN 0759-5110-2
Y1	Oscillator, 180 MHz: MFR 14304, PN 0759-4015
Z1, Z2	Mixer, Balanced: MFR 14304, PN 0759-5150

UNIT INSTRUCTIONS

POWER SUPPLY MODULE

A2A11



POWER SUPPLY MODULE A2A11

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1. GENERAL DESCRIPTION

Power Supply Module A2A11 produces five regulated and two unregulated voltages for use by all other modules in the exciter. The regulated voltage sources deliver a relatively low value of short circuit current (relative to their maximum possible load current) by means of current fold-back techniques. Current fold-back reduces the possibility of accidentally short circuiting the power supply, while connecting test equipment to the various PWB assemblies of the exciter. The module contains three PWB assemblies: Rectifier PWB Assembly A2A11A1, Low Voltage PWB A2A11A2, High Voltage PWB A2A11A3, and a dual secondary power transformer.

2. TECHNICAL CHARACTERISTICS

Weight: 3.95 Pounds (1769 grams)

Dimensions:
4-3/8 in.(H) x 3-5/10 in.(W) x 4-1/4 in.(D)
11.11 cm (H) x 8.41 cm (W) x 10.79 cm(D)

Primary Power:
115 Vac ± 15%, 48-420 Hz

Dc Outputs: (max.)
+28 Vdc unregulated at 600 ma
+24 Vdc regulated at 250 ma
+18 Vdc regulated at 120 ma
+ 6 Vdc regulated 1300 ma
+ 5 Vdc regulated at 1400 ma
− 6 Vdc regulated at 1000 ma
− 9 Vdc unregulated at 100 ma

Load Regulation:
0.03% (typical) E out

Operating Temperature Range:
−20°C to +70°C

3. SEMICONDUCTOR COMPLEMENT

Table 1 lists all semiconductors used in Power Supply Module A2A11.

TABLE 1. SEMICONDUCTOR COMPLEMENT

Reference Designation	Type	Function
A2A11Q1	2N6261	+18 Vdc series regulating element
Q2	2N6261	+24 Vdc series regulating element
Q3	2N6261	+ 5 Vdc series regulating element
Q4	2N6261	+ 6 Vdc series regulating element
Q6	2N6261	− 6 Vdc series regulating element
CR1	0946-4157	+ 9 Vdc Rectifier
CR2	0946-4157	+ 9 Vdc Rectifier
A2A11A1CR3	0946-4157	− 9 Vdc Rectifier
CR4	0946-4157	− 9 Vdc Rectifier
CR5	0946-4157	+28 Vdc Rectifier
CR6	0946-4157	+28 Vdc Rectifier
CR7	0946-4157	+28 Vdc Rectifier
CR8	0946-4157	+28 Vdc Rectifier
A2A11A2CR1	1N3064	Blocking
CR2	1N3064	Blocking
VR1	1N751A	+ 5 V, +6 V regulators, foldback reference
VR2	1N5347A	Z1, Z2 source voltage regulation
Q1	2N6261	+ 5 Vdc series pass driver
Z1	uA723HC	+ 6 Vdc regulation sensor
Z3	uA723HC	+ 5 Vdc regulation sensor
A2A11A3CR1	1N3064	Blocking
VR1	1N751A	− 6 V regulator foldback reference
VR2	MZ4265	+24 Vdc regulator offset
Q1	2N6261	− 6 V series pass driver
Z1	uA723HC	+24 Vdc regulation sensor
Z3	uA723HC	+18 Vdc regulation sensor
Z4	uA723HC	− 6 Vdc regulation sensor

4. CIRCUIT DESCRIPTIONS

All of the regulator circuits in the Power Supply Module are of the conventional series - pass type, in which a differential amplifier compares the output voltage of the supply against a very stable reference and corrects the equivalent resistance of the series pass element accordingly. The load current is sensed by measuring the voltage drop across a small fixed resistance in series with the regulator.

Consider the +6 Vdc regulator circuit (Figure 7). The collector of the series - pass transistor Q4 is returned to the unregulated +9 volts (developed across filter capacitor C1, via a full wave rectifier consisting of A1CR1 and A1CR2). Load current to P1-N passes through Q4 via current sensing resistor R1 on the Low Voltage PWB A2A11A2. The current passed by Q4 is controlled by integrated circuit Z1.

Refer to Figure 1. Load voltage is sensed on Z1-2, the reference voltage on Z1-3. The reference input is from a voltage divider consisting of A2R6, and A2R7 (Figure 7) connected to the +7.2 Vdc (typical) reference output at Z1-4. The ratio of A2R6 and A2R7 determines the Dc output voltage from the supply, as the differential amplifier forces the collector current in the output transistor (and consequently the collector current of pass transistor Q4) to whatever value is necessary to raise or lower the Dc voltage at Z1-2 to the same voltage that appears at Z1-3. Capacitor C1 provides frequency compensation for the circuit, preventing oscillations.

The current limiting and fold-back operations are as follows: The base of current limiting transistor (Z1-10) is connected to the junction of A2R2 and thermistor A2RT1 (Figure 7). Since CR1 is back biased with +5.1 Vdc at its anode, the voltage appearing at Z1-10 (before limiting begins) is virtually the same as the voltage appearing at the emitter of A2A11Q4. The emitter of current limiting transistor (Z1-1) is connected to the load side of A2R1. Output current limiting begins when the voltage drop across R1 forward biases the emitter-base junction of the current limiting transistor.

The current passed by the limiting transistor lowers the voltage output from the differential amplifier, thus decreasing the voltage present at Z1-6. If not for CR1, the output voltage versus current curve would be similar to the current limiting curve as shown in Figure 2 (dashed line).

However, as the voltage at Z1-10 falls below approximately +5.1 Vdc, CR1 will conduct, providing an alternate current path to the base of the current limiting transistor, via A2CR1 and A2R8. The presence of an alternate current path modifies the curve to follow the solid line in Figure 2. Once fold-back begins, any further decrease in load resistance produces a decreasing load current. The negative temperature coefficient of the thermistor A2RT1 maintains a relatively constant value of short circuit current from the supply, over the operating temperature range.

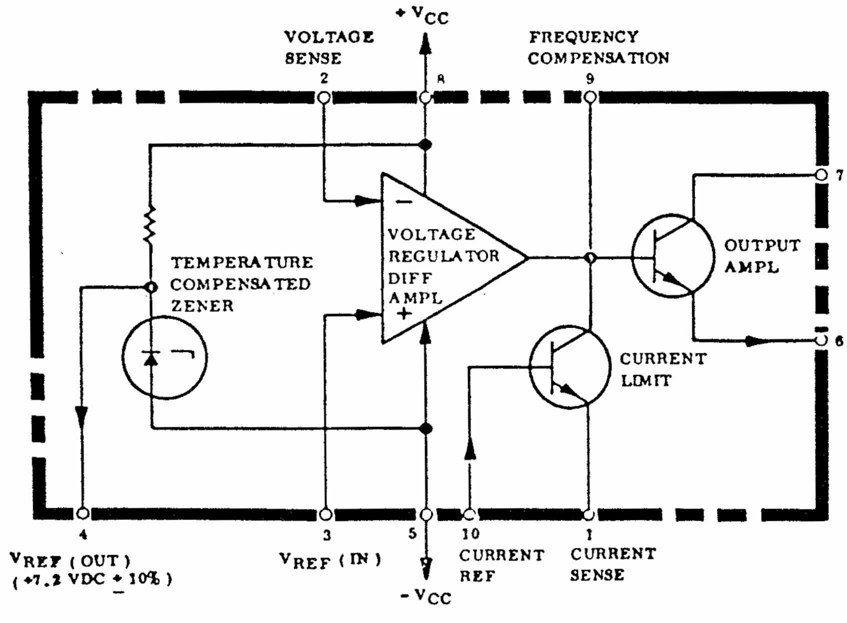


Figure 1. Regulation Sensor, Equivalent Circuit A2Z1, A2Z3, A3Z1, A3Z3, A3Z4

In principle, the remaining regulated supplies operate in the same manner as the +6 Vdc circuit. However, only the +6Vdc and +5 Vdc power supplies, with their higher load currents, have an alternate path provided, via an external diode, causing greater current fold-back.

The +24 Vdc and +18 Vdc regulators use a slightly different fold-back design. In order to start current limiting (using the +24 Vdc regulator as an example) about +0.7 Vdc must be developed between Z1-10 and Z1-1 to turn on the internal transistor. To do this, the voltage drop across current sensing resistor A3R1 must exceed 0.7 Vdc by an amount equal to the drop across A3R4 in the voltage divider network A3R4 and A3R6. Since this excess voltage required is greatest at normal output voltage (.6Vdc at 24 Vdc) and least under short circuit conditions (V out = 0), it is apparent that the current at the threshold of current limiting exceeds the current allowed for an open circuit.

Also, the higher load currents supplied by the +5Vdc and −6Vdc supplies, require the use of a driver transistor (A2Q1, A3Q1) between the regulator sensor and the series pass element.

In addition, the voltage sensing polarity of the −6Vdc supply is opposite that of the positive voltage supplies. In other words, a positive going output error causes Z3-3 to become positive with respect to Z3-2 instead of vice-versa. This inversion is compensated for by the action of series pass transistor Q6, which is used in a common emitter configuration rather than a common collector as in the positive supplies.

Pin 5 of A3Z1 is returned to +5.1Vdc through VR2 rather than ground, to maintain the total voltage across Z1 within the manufacturer's rating.

The −9Vdc unregulated output is no longer used in the RF-131 Exciter. Typical load requirements for the regulators are listed in Table 2. Table 3 shows fold-back limits.

5. TEST DATA

Voltages at the transistor and IC terminals were measured in a typical power supply.

NOTE

For troubleshooting purposes, greater access to the High Voltage PWB is obtained by removing the four mounting screws and swinging the board aside. Likewise, removal of the four metal hexagonal stand offs facilitates swinging the Low Voltage PWB aside for access. Operation of the module off the chassis is facilitated with the use of the power supply extender cable, supplied as part of the RF-131 Maintenance Repair Kit (See Table 1-4 in the General Information Section of this Manual).

6. ADJUSTMENTS

There are no simple adjustments in Power Supply Module A2A11, however, the output voltage from each regulator is factory adjusted to within 3 percent of its nominal value (5Vdc supply, −0 percent to +5 percent) by the choice of a resistor value in its voltage sensing circuit. This is necessary to compensate for the manufacturing variations in the Reference Voltage output from the regulator units. Although this voltage is very stable, it can very ±10 percent from unit to unit. The selected resistor and its possible values for the various supplies are given in Table 4. The supply voltage should be checked following replacement of a regulator unit, and, if necessary, a different resistor value (from Table 4) should be substituted to bring the supply voltage to within 3 percent of the nominal value (+5 percent to −0 percent for the 5Vdc supply).

Table 5 lists the Power Supply Module A2A11 cable connections for use during voltage measurement and trouble shooting operations.

TABLE 2. TYPICAL DC LOAD CURRENTS MEASURED AT A2J11

(Note: Values were measured on a two channel RF-131 Exciter)

Supply	+28Vdc	+24Vdc	+18Vdc	+6Vdc	+5Vdc	−6Vdc
Current	350mA	222mA	20mA	700mA	800mA	700mA
Measured at	P1-M	P1-P	P1-H	P1-N	P1-J	P1-L

7. MAINTENANCE PARTS LIST

Refer to Table 6 for the Power Supply Module A2A11 parts list. For a complete list of manufacturer's codes, refer to Table 6-3 in the General Information Section.

TABLE 3. POWER SUPPLY FOLDBACK CHARACTERISTICS

Power Supply	Starts Foldback At	Short Circuit Current After Foldback Reduce To
+ 5 Vdc	1690 mA	300 + 100 mA − 150 mA
− 6 Vdc	1400 mA	
+ 6 Vdc	1400 mA	
+ 18 Vdc	225 mA	130 + 20 mA − 50 mA
+ 24 Vdc	500 mA	250 + 50 mA − 100 mA

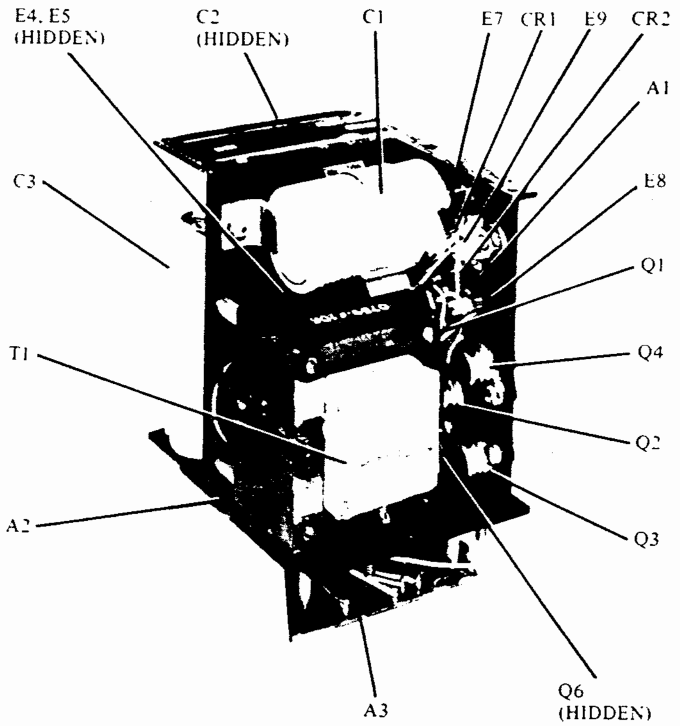


Figure 3. Power Supply A2A11 Component Locations - Transformer Side of Chassis

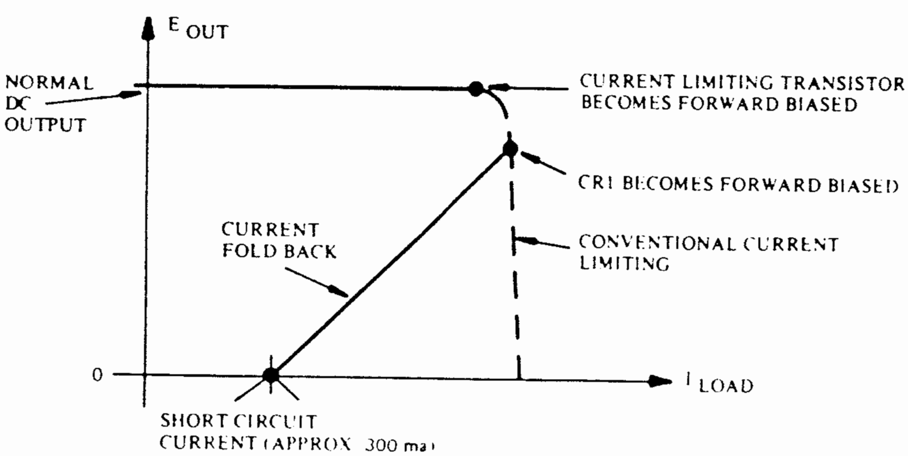


Figure 2. Supply Voltage Vs. Load Current, +6V Supply (Other Supplies are Similar)

TABLE 4. SUPPLY VOLTAGE REGULATION
-Selected Resistors

(Note: Refer to paragraph 6.)

Power Supply	Resistor Reference	Values (Ohms)	Mil Part Number
+ 5 Vdc	A2R26	4.42K	RN60D4421F
		4.87K	RN60D4871F
		5.36K	RN60D5361F
		5.90K	RN60D5901F
+ 6 Vdc	A2R6	4.99K	RN60D4991F
		5.76K	RN60D5761F
		6.65K	RN60D6651F
		7.68K	RN60D7681F
− 6 Vdc	A3R20	2.49K	RN60D2491F
		2.67K	RN60D2671F
		2.87K	RN60D2871F
		3.01K	RN60D3011F
+18 Vdc	A3R11	14.0 K	RN60D1402F
		14.7 K	RN60D1472F
		15.4 K	RN60D1542F
		16.2 K	RN60D1622F
+24 Vdc	A3R3	21.5 K	RN60D2152F
		23.7 K	RN60D2372F
		25.5 K	RN60D2552F
		27.4 K	RN60D2742F
		29.4 K	RN60D2942F

TABLE 5. POWER SUPPLY MODULE A2A11
Cable Assembly PN 0759-4102
Wire Number / Routing Data

Wire Number	From	To
1	A2A11A1E8	A2A11C3 NEG
2	C3 NEG	E1
3	T1-6	C1 Neg
4	C1 NEG	C2 POS
5	C2 POS	E1
6	A1E4	C2 NEG
7	C2 NEG	Q6-e
8	Q6-e	A3E4
9	A3E4	P1-R
10	--	--
11	C1 POS	Q3-c
12	Q3-c	Q4-c
13	Q4-c	A2E1
14	C3 POS	Q2-c
15	A1E3	C3 POS
16	Q2-c	A3E7
17	A3E7	P1-M
18	Q6-b	A3E3
19	Q6-c	A3E2
20	Q3-b	A2E8
21	Q3-e	A2E9
22	Q2-b	A3E6
23	Q2-e	A3E9
24	Q1-c	A3E8
25	A3E8	P1-P
26	Q1-b	A3E12
27	Q1-e	A3E11
28	Q4-b	A2E4
29	Q4-e	A2E3
30	A2E5	P1-N
31	A2E7	P1-J
32	--	--
33	A2E2	A3E10
34	A2E2	P1-H
35	A2E10	P1-K
36	A2E13	P1-B
37	A2E6	E1
38	A2E6	A3E13
39	A3E1	P1-L
40	E4	P1-A
41	E5	P1-C
42	T1-1	E5
43	T1-3	E5
44	T1-2	E4
45	T1-4	E4
46	T1-5	A1E3
47	T1-7	A1E2
48	T1-8	A1E7
49	T1-9	A1E6
50	A1E2	E8(CR2-A)
51	A1E3	E7(CR1-A)
52	A2A11E9(CR1-C,CR2-C)	A2A11C1 POS

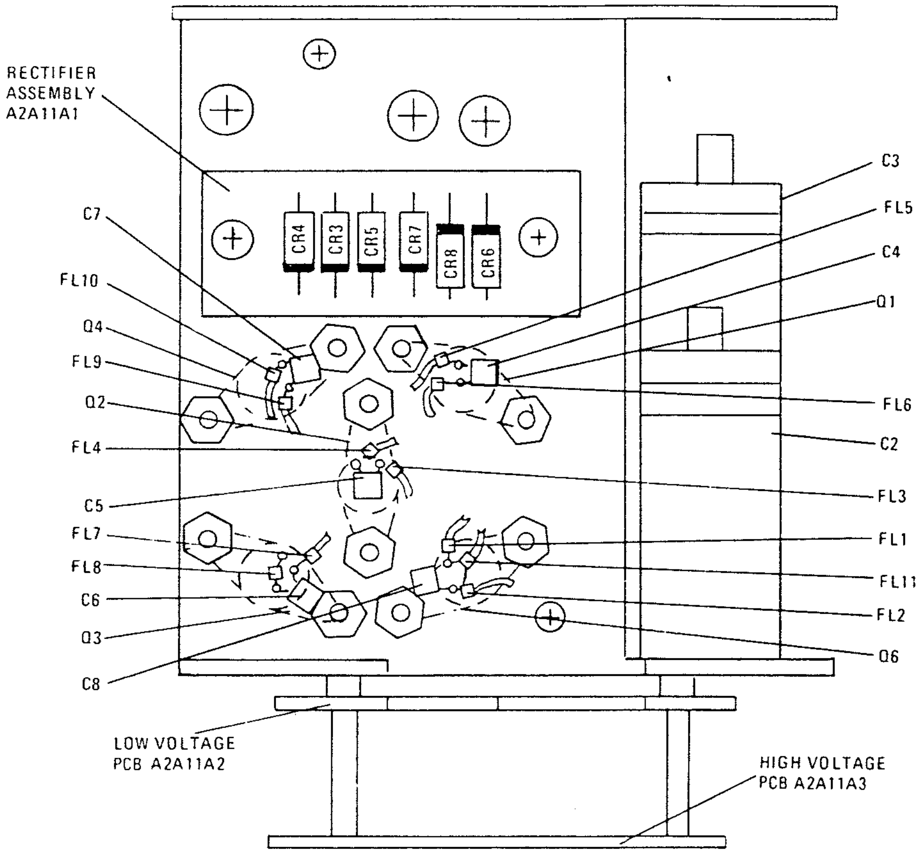
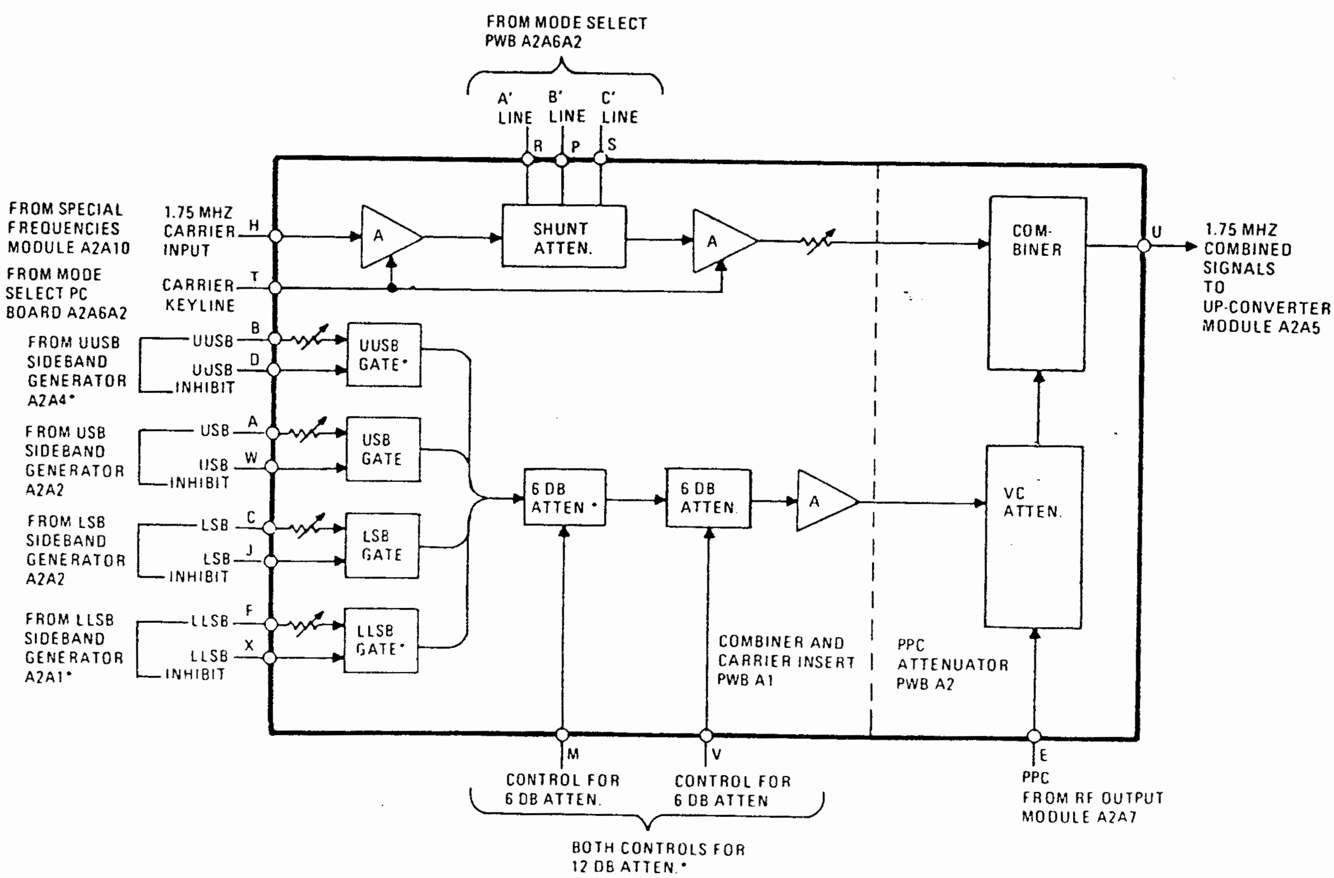


Figure 4. Power Supply A2A11 Component Locations - Rectifier Assembly Side of Chassis

UNIT INSTRUCTIONS

COMBINER MODULE

A2A12



* MODEL RF 131 126 ONLY

COMBINER MODULE A2A12

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1. GENERAL DESCRIPTION

Combiner Module A2A12 linearly adds the carrier and sideband input signals, and adjusts the levels of the output according to commands from the Control Head Module A2A6 to provide an output of 12 mV pev to the Up-Converter Module A2A5. The four channel version has provisions for upper-upper sideband (UUSB), upper sideband (USB), lower sideband (LSB) and lower-lower sideband (LLSB) inputs. The Combiner Module A2A12 output for the Model RF-131-126/-176 may be either sideband alone, carrier only (CW), USB and carrier (compatible AM) or a combination of two or four of the sidebands (2 or 4 channel Independent Sideband). Carrier suppression in some modes can be selected for 6, 10, 20 or infinity, according to the inputs received from Control Head A2A6. (In the two channel exciter models, the UUSB and LLSB channels are not used) Combiner Module A2A21 consists of two PWB assemblies: Combiner and Carrier Insert PWB Assembly A2A12A1, and PPC Attenuator PWB Assembly A2A12A2.

2. TECHNICAL CHARACTERISTICS

Weight: 1.19 Pounds (539.77 grams)

Dimensions:
4-1/8 in.(H) x 2-1/8 in.(W) x 5-78 in.(D)
10.5 cm(H) x 5.4 cm(W) x 14.9 cm(D)

Power Requirements:
+6 Vdc at 40 mA
−6 Vdc at 14 mA

Signal Inputs: (-25dBm PEP (12mVPEV) each.)
UUSB
USB
LSB
LLSB
1.75 MHz fixed, 75 mV_{RMS}

Control Inputs: (Closure to −6Vdc or open circuit)
UUSB Inhibit
USB Inhibit
LSB Inhibit
LLSB Inhibit
6 dB Gate
12 dB Gate
Carrier Keyline
Carrier Level Control

Signal Output:
One, two or four of the above sideband signals with or without reinserted carrier; USB plus carrier (compatible AM); or carrier alone; 12 mV PEV (−25 dBm PEP)

Input Impedance:
All signal inputs: 50 ohms
All control inputs: greater than 1 K ohm

Output Load: 50 ohms

3. SEMICONDUCTOR COMPLEMENT

Table 1 lists all semiconductors used in the Combiner module.

TABLE 1. SEMICONDUCTOR COMPLEMENT

Reference Designation	Type	Function
A1A12A1		
CR1, CR2	HP -5082-2800	Clipper
CR3	1N3064	Clamp
CR4, CR5	1N3064	P/O UUSB Inhibit Ckt.
CR6, CR7	1N3064	P/O USB Inhibit Ckt.
CR8, CR9	1N3064	P/O LSB Inhibit Ckt.
CR10,CR11	1N3064	P/O LLSB Inhibit Ckt.
Q1	2N4123	RF Amplifier
Q2	2N4125	6 dB Shunt Attenuator Switch
Q3	2N4125	10 dB Shunt Attenuator Switch
Q4	2N4125	20 dB Shunt Attenuator Switch
Q5	2N4123	Tuned Amplifier
Q7	2N4123	SSB Amplifier
Q8	2N4123	SSB Amplifier
Q9	2N4123	SSB Amplifier
Q10	2N4123	SSB Amplifier
Q11	2N4125	6 dB Attenuator Switch
Q12	2N4125	12 dB Attenuator Switch
Q13	2N4125	Amplifier
Q14	2N4123	Emitter Follower
A1A12A2		
Q1	2N4125	Amplifier
Q2	2N4125	Amplifier
Q3	2N4123	Emitter Follower
Z1	0759-5000	VC Attenuator

4. FUNCTIONAL DESCRIPTION

For reference purposes full power output from the Combiner Module A2A12 is defined as −25 dBm continuous or PEP. This is equivalent to 12 mV PEV developed across a restive 50 ohm output load (0dBm = 1 milliwatt). That is, 12 mV PEV is considered a "ceiling" for RF output whether it be an SSB voice peak, an instantaneous ISB peak, or a continuous carrier signal (CW). For example, in the CW mode of emission, the module develops a carrier frequency output of 12 mV_{RMS} (when keyed). In any of the sideband modes, a voice signal (or combination of signals on one or more sidebands) drives the module output to 12 mV PEV. When the selected mode uses more than one sideband channel (as in ISB, for instance), the combined sideband inputs are attenuated 6dB (for 2 channel) or 12 dB (for 4 channel) so that the total Combiner Module A2A12 output is still only 12 mV PEV. Since the sideband signal is attenuated after the SSB inputs are combined, or summed, the SSB input levels can be adjusted at the Combiner and Carrier Insert PWB A2A12A1 to change the ratio of signal supplied by each. For example, the USB input level can be increased and the LSB input level decreased at the time the system is installed, so that when it is in ISB mode, the USB signal will be stronger than the LSB signal.

NOTE

In SSB and ISB modes, the level of the carrier frequency appearing at the module output can be electrically switched by inputs from Control Head Module A2A6 to −10 dB, −20 dB, or −65 dB (−∞) relative to −25 dBm.

5. CIRCUIT DESCRIPTION

The two or four SSB signals enter Combiner and Carrier Insert PWB A2A12A1 through A2A12 P1 B-A-C and F (for UUSB, USB, LSB and LLSB respectively) and are applied to separate electronically-controlled gates.

NOTE

Since the four gates for the SSB inputs are identical (the input frequencies are different) only the USB gate will be discussed. Two channel versions of the RF-131 (Models RF-131-122 and RF-131-123) use only the USB and LSB inputs.

Refer to Figure 4 for the following discussion: The USB input from Upper Sideband Generator Module A2A3 is applied via A2A12 P1-A and E3, to potentiometer R27 which sets the input impedance of 50 ohms and allows sideband level adjustment of that particular channel input to the Combiner. The signal is then applied, via C14 and R33, to the base of amplifier Q8, which is now forward biased through R30 and R33. Capacitor C16 provides filtering to remove the SSB (RF) signal from the +6 Vdc supply. The USB Inhibit signal is used to gate amplifier Q8. This input (USB Inhibit) from the Control Head A2A6 will be absent when a mode using USB is selected. Conversely, when the Mode Selector in Control Head A2A6 selects a mode not utilizing USB, a −6 Vdc is present on the USB inhibit line. The −6 Vdc is applied via A2A12 P1-W, to forward bias CR6 and CR7, resulting in approximately −0.7 Vdc on the base of Q8, turning Q8 Off. CR7, being forward biased, conducts the USB to ground, reducing the chance of leakage through Q8. Capacitor C15 provides filtering to remove the USB signal from the USB Inhibit Line.

The collectors of Q7, Q8, Q9 and Q10 (the four sideband gates) are tied to the input of Q13. A potentiometer on the input of each gate is normally adjusted to equalize the gain so that the output from any sideband gate (if operated alone and no attenuators being on) would provide a Combiner output of 12 mV PEV to Up-Converter Module A2A5. To maintain the 12 mV PEV Combiner output, when multiple sideband signals are summed at the base of Q13 (as in two-channel or four-channel ISB), or when in AME (USB and Carrier), shunt attenuators Q11 and Q12 are used. Q11 and Q12 are controlled by the 6 dB gate and 12 dB gate inputs from the Mode Selector on Control Head A2A6. In any one sideband mode, both gate inputs (6 dB and 12 dB) will be open. Q11 and Q12 will be biased to cutoff by the positive 6 Vdc applied, via R54 and R56 respectively. When the Control Head Mode Selector is set at ISB, −6 Vdc is applied to the 6 dB gate input of the Combiner via A2A12 P1-V and R55 to the base of Q11. This drives Q11 into saturation, connecting R52 (511 ohms) in parallel with the 511 ohm effective input resistance of stage Q13 (R51, R58, R59 and Q13). This 6 dB shunt is also applied in the AME Mode (USB plus carrier).

When the Control Head Mode Selector is set at four-channel ISB (not applicable to RF-131-122 and RF-131-123 Models), −6 Vdc is also applied to the 12 dB gate input, driving Q12 into saturation and shunting the 280 ohm resistor R53 across the combined (280 ohm) load resistance of R51, R52 and Q13. Emitter follower Q14 lowers the output impedance and drives the input of the PPC Attenuator PWB A2A12A2.

The 1.75 MHz carrier input from Special Frequencies Module A2A10 is applied, via A2A12 P1-H and Capacitor C1, to the base of Q1.

Resistor R1 establishes the input impedance of approximately 50 ohms. The carrier signal is amplified by Q1, clipped by diodes CR1, and CR2 and applied to voltage divider R6 and R7. Hot carrier diodes CR1 and CR2 clip the output of Q1 to provide a constant reference level of approximately 0.3 V across the voltage divider R6 and R7. The three shunt attenuators (Q2, Q3 and Q4) that are connected in parallel across R7 are controlled by the A, B and C Lines from Control Head A2A6. Q2 is biased On, for a −6 dB carrier suppression; Q2 and Q3 for −10 dB and Q2, Q3 and Q4 for −20 dB suppression. Q3 and Q4 shunt attenuators operate in the same manner as Q2.

Q2 is normally cutoff since the A line from Control Head A2A6 Mode Selector is normally open. Control Head A2A6 commands 6 dB of carrier suppression by applying −6 Vdc to the A Line. This −6 Vdc, via R63, will forward bias transistor Q2, driving Q2 into saturation and connecting R8 to ground (via Q2) in parallel with R7.

For 65 dB (∞) carrier suppression, −6 Vdc (from Control Head A2A6) is also applied, via the Carrier Keyline, through A2A12P1-T. The signal is routed through R3 to the base of Q1, and R12 to the base of Q5, turning Off Q1 and Q5.

The carrier signal is applied from voltage divider R6/R7 and shunt attenuators Q2, Q3 and Q4 to the base of tuned amplifier Q5. The tuned circuit consisting of L1 and C8 in the collector circuit of Q5, will restore the wave peaks clipped by CR1 and CR2, converting the signal waveshape to essentially a sine wave. The output of Q5 is developed across the Carrier Adjust potentiometer R15. From R15, the carrier signal is applied via terminal E25 to E1 and E2 of the PPC Attenuator PWB A2A12A2.

The combined sideband signals enter the PPC Attenuator PWB at E3 and E4, where the combined sideband signal is applied to Voltage Controlled Attenuator Z1. The amount of attenuation is controlled by the PPC output from the PPC/TGC Control PWB A2A7A1 in the RF Output Module A2A7. By controlling the gain in this manner, the PPC will prevent any modulation peaks on the sideband signals from exceeding the PEP rating of the system, without distorting the relative amplitudes of the combined sideband signals. The carrier sideband signals (up to four) are combined by Q1 and Q2. Emitter Follower Q3 lowers the output impedance level of the combined signals to drive the input impedance of Up-Converter Module A2A5 at connector A2J5-H.

6. TEST DATA

Voltages for all transistors on Combiner and Carrier Insert PWB A2A12A1 and PPC Attenuator PWB A2A12A2 are given in Tables 2 and 3 respectively. Measurements were taken with a Tektronix Model 453 Oscilloscope while the Module was receiving normal Dc inputs. The selected mode was USB (that is, A2A12 P1-W was open circuited and −6 Vdc was present on A2A12 P1-R, P, S, D, T, J and X) and the Carrier Level Selector was set at −∞.

TABLE 2. TRANSISTOR VOLTAGE DATA FOR COMBINER AND CARRIER INSERT PWB A2A12A1

Transistor Ref.-Desig.	Base	Emitter	Collector
A1Q1	230mV P-P −3 Vdc	0	+6 Vdc
A1Q2	−0.7 Vdc	GND	0
A1Q3	−0.7 Vdc	GND	0
A1Q4	−0.7 Vdc	GND	0
A1Q5	0	0	+6 Vdc
A1Q7	−0.6 Vdc	0	+3.3 Vdc
A1Q8	30mV P-P +2.2 Vdc	30mV P-P +1.3 Vdc	30mV P-P +3.3 Vdc
A1Q9	−0.6 Vdc	0	+3.3 Vdc
A1Q10	−0.6 Vdc	0	+3.3 Vdc
A1Q11	+6 Vdc	+6 Vdc	+3.3 Vdc
A1Q12	+6 Vdc	+6 Vdc	+3.3 Vdc
A1Q13	+4.4 Vdc	+5 Vdc	+1.5 Vdc
A1Q14	+1.5 Vdc	+0.8 Vdc	+6 Vdc

TABLE 3. TRANSISTOR/INTEGRATED CIRCUIT VOLTAGE DATA FOR PPC ATTENUATOR PWB A2A12A2

Transistor Ref.Desig	Base	Emitter	Collector
A2Q1	+3.9 Vdc	+4.5 Vdc	+3.7 Vdc
A2Q2	+4 Vdc	+4.6 Vdc	+3.7 Vdc
A2Q3	+3.7 Vdc	+2.9 Vdc	+5.7 Vdc

Integrated Circuit	Integrated circuit Pin Number 1	2	3	4	5	6	7	8
A2Z1	Gnd	7.5 mV RMS	Gnd	12 mV RMS	+.5 Vdc	+6 Vdc	−6 Vdc	Gnd

7. COMBINER MODULE A2A12 ADJUSTMENTS

The procedures of subsequent paragraphs 7.1 through 7.2.4 allow adjustment of the Combiner Module A2A12 output to $12mV_{RMS}$ (−25 dBm) for the Upper Sideband (USB) and Lower Sideband LSB) inputs, and $3mV_{RMS}$ for the Upper Upper Sideband (UUSB) and Lower Lower Sideband (LLSB) inputs. (UUSB and LLSB are present in the Model RF-131-126 Exciter only.) The −25dBm level will be correct for system installations that use a 6 dB level difference between tune power and full rated power output.

Refer to the installation procedures in Part 2 of the General Information Section of this book for instructions applicable to systems that use a tune power output that is more or less than −6dB from full rated power output.

NOTE

Table 4 shows both a Spectrum Analyzer and Oscilloscope representation of the Combiner Module A2A12 outputs for the various exciter modes (as selected by the MODE Selector on Control Head A2A6).

7.1 CARRIER LEVEL ADJUSTMENT

The Carrier Level can be adjusted by setting potentiometer A2A12A1R15 (Figure 4) to provide a module output of $12mV_{RMS}$ (−25dBm...at A2A12P1-U) into a 50 ohm load, with no sideband (audio) inputs or carrier attenuators switched in.

To adjust the carrier level, with the module installed in the exciter, proceed as follows:

a. Place exciter MODE Selector (on Control Head A2A6) in CW position.

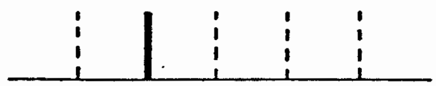
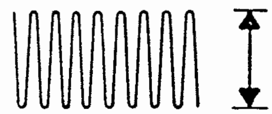
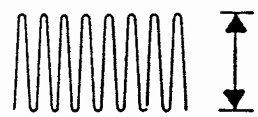
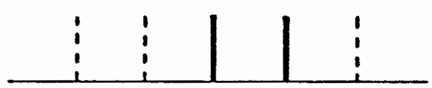
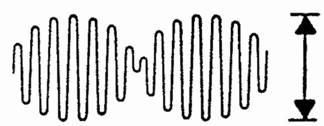
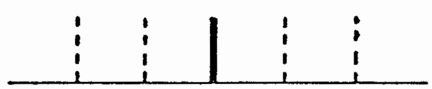
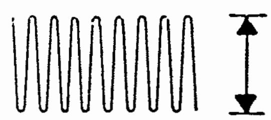
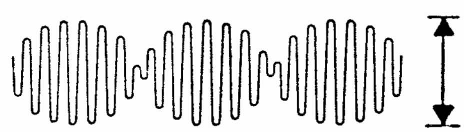
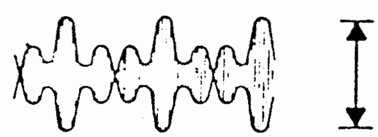
b. Monitor the 1.75MHz Carrier Input Level (from Special Frequencies Module A2A10) at Pin H of module connector A2A12P1 or terminal E9 of Combiner and Carrier Insert PWB A2A12A1. Input level indicated should be approximately 75 mV_{RMS} into 50 ohm load.

c. Connect an RF voltmeter with a high impedance probe to Pin U of module connector A2A12P1 or terminal E7 of PPC Attenuator PWB A2A12A2.

d. Adjust potentiometer A2A12A1R15 to obtain a $12mV_{RMS}$ indication on the voltmeter.

COMBINER MODULE

TABLE 4. COMBINER MODULE A2A12 OUTPUTS - FULL RATED PEP FOR VARIOUS MODES OF EXCITER OPERATION

EXCITER	ANALYZER DISPLAY	OSCILLOSCOPE DISPLAY
LSB	–25.4 DBM  CARRIER	 34 MV P-P (12 MV RMS)
USB	–25.4 DBM  CARRIER	 34 MV P-P (12 MV RMS)
AM	–31.4 DBM  CARRIER	 34 MV P-P
CW	–25.4 DBM  CARRIER	 34 MV P-P (12 MV RMS)
2 CHANNEL ISB	–31.4 DBM  CARRIER	 34 MV P-P
4 CHANNEL ISB (MODEL RF-131-126 ONLY)	–37.4 DBM  CARRIER	 34 MV P-P

7.2 SIDEBAND LEVEL ADJUSTMENTS

Each of the sideband output levels can be adjusted by setting the appropriate input level potentiometer to obtain a $12mV_{RMS}$ output level (USB and LSB Channels) or $3mV_{RMS}$ (UUSB and LLSB Channels - Model RF-131-126 only) when the sideband input level to each channel is $12mV_{RMS}$.

7.2.1 USB SIDEBAND LEVEL ADJUSTMENT

Adjust the USB Channel Sideband Level with the module installed in the exciter. Proceed as follows:

NOTE

For this adjustment, no Carrier Input should be present, and the 6 dB and 12 dB gates (routed from Pins V and M of module connector A2A12P1, respectively) should be open.

a. Place exciter MODE Selector (on Control Head A2A6) in USB position (Carrier fully suppressed).

b. Refer to the A2A7 RF Output Module Section in this book. Adjust PPC ADJ potentiometer A2A7A1R53 to its most positive direction.

NOTE

This adjustment effectively disables the PPC Attenuator PWB A2A12A2, so that it will not affect the output at Pin U of A2A12P1 during the USB sideband level adjustment.

c. Connect an audio oscillator to Case Assembly connector A1J5.

d. Adjust the audio oscillator to provide a 1 kHz at $44mV_{RMS}$ (into a 600 ohm impedance) input at A1J5.

e. Using an RF voltmeter with a high impedance probe, measure the input level at Pin A of module connector A2A12P1. The input level should be $12mV_{RMS}$.

NOTE

1. If input level measured in step e is not $12mV_{RMS}$, the audio generator in Upper Sideband Generator Module A2A3 is not working properly. Refer to A2A1/A2A2/A2A3/A2A4 Section of this book.

2. The input frequency at A2A12P1-A will be approximately 1.75MHz.

f. Connect the RF voltmeter to Pin U of module connector A2A12P1 (module output) or terminal E7 of PPC Attenuator PWB A2A12A2.

g. Adjust USB Input Level potentiometer A2A12A1R27 to obtain a $12mV_{RMS}$ output level indication at RF voltmeter.

7.2.2 LSB Sideband Level Adjustment

Adjust the LSB Channel Sideband Level with the module installed in the exciter. Proceed as follows:

NOTE

For this adjustment, no Carrier Input should be present, and the 6dB and 12dB gates (routed from Pins V and M of module connector A2A12P1, respectively) should be open.

a. Place exciter MODE Selector (on Control Head A2A6) in LSB position (Carrier fully suppressed).

b. Connect an audio oscillator to Case Assembly connector A1J6.

c. Adjust the audio oscillator to provide a 1kHz at $44mV_{RMS}$ (into 600 ohm impedance) input at A1J6.

d. Using an RF voltmeter with a high impedance probe, measure the input level at Pin C of module connector A2A12P1. The input level should be $12mV_{RMS}$.

NOTE

1. If input level measured in step d is not $12mV_{RMS}$, the audio generator in Lower Sideband Generator Module A2A2 is not working properly. Refer to A2A1/A2A2/A2A3 A2A4 Section of this book.

2. The input frequency at A2A12P1-C will be approximately 1.75MHz.

e. Connect the RF voltmeter to Pin U of module connector A2A12P1 (module output) or terminal E7 of PPC Attenuator PWB A2A12A2.

f. Adjust LSB Input Level potentiometer A2A12A1R35 to obtain a 12mV$_{RMS}$ output level indication at RF voltmeter.

g. If only the USB (paragraph 7.2.1) and LSB Sideband Levels have been adjusted (Models RF-131-122 and -123), refer to paragraph 9 of the A2A7 RF Output Module Section and readjust PPC ADJ potentiometer A2A7A1R53 as specified therein. Otherwise, proceed to the UUSB and LLSB adjustments of paragraphs 7.2.3 and 7.2.4 (Model RF-131-126 only).

7.2.3 UUSB Sideband Level Adjustment (Model RF-131-126 Exciter Only)

Adjust the UUSB Channel Sideband Level with the module installed in the exciter. Proceed as follows:

NOTE

For this adjustment, all the front panel audio controls (INPUT LEVEL Controls A2R1, A2R2, A2R3 and A2R4) should be rotated maximum counterclockwise.

a. Place exciter MODE Selector (on Control Head A2A6) in 4ISB position (Carrier fully suppressed).

b. Connect an audio oscillator to Case Assembly connector A1J2.

c. Adjust the audio oscillator to provide a 1 kHz at 44mV$_{RMS}$ (into a 600 ohm impedance) input at A1J2.

d. Using an RF voltmeter with a high impedance probe, measure the input level at Pin B of module connector A2A12P1. The input level should be 12mV$_{RMS}$.

NOTE

1. If input level measured in step d is not 12mV$_{RMS}$, the audio generator in Upper Sideband Generator Module A2A4 is not working properly. Refer to A2A1/A2A2/ A2A3-A2A4 Section of this book.

2. The input frequency at A2A12P1-B will be approximately 1.75MHz.

e. Connect a spectrum analyzer to Pin U of module connector A2A12P1 (module output) or terminal E7 of PPC Attenuator PWB A2A12A2.

f. Adjust UUSB Input Level potentiometer A2A12A1R19 to obtain a 3mV$_{RMS}$ output level indication on the spectrum analyzer.

NOTE

The 12mV$_{RMS}$ input level is attenuated 12dB by the combined operation of the two 6dB attenuators in the module. These are automatically switched in when the MODE Selector is placed in 4ISB position. Consequently, the attenuated output is 3mV$_{RMS}$.

7.2.4 LLSB Sideband Level Adjustent (Model RF-131-126 Exciter Only)

Adjust the LLSB Channel Sideband Level with the module installed in the exciter. Proceed as follows:

NOTE

For this adjustment, all the front panel audio controls (INPUT LEVEL Controls A2R1, A2R2, A2R3 and A2R4) should be rotated maximum counterclockwise.

a. Place exciter MODE Selector (on Control Head A2A6) in 4ISB position (Carrier fully suppressed).

b. Connect an audio oscillator to Case Assembly connector A1J1.

c. Adjust the audio oscillator to provide a 1 kHz at 44mV$_{RMS}$ (into a 600 ohm impedance) input at A1J1.

d. Using an RF voltmeter with high impedance probe, measure the input level at Pin F of module connector A2A12P1. The input level should be 12mV$_{RMS}$.

NOTE

1. If input level measured in step d is not 12mV_{RMS}, the audio generator in Lower Lower Sideband Generator Module A2A1 is not working properly. Refer to A2A1/A2A2/ A2A3/A2A4 Section of this book.

2. The input frequency at A2A12P1-F will be approximately 1.75MHz.

e. Connect a spectrum analyzer to Pin U of module connector A2A12P1 (module output) or terminal E7 of PPC Attenuator PWB A2A12A2.

f. Adjust LLSB Input Level potentiometer A2A12A1R43 to obtain a 3mV_{RMS} output level indication on the spectrum analyzer.

NOTE

The 12mV_{RMS} input level is attenuated 12dB by the combined operation of the two 6dB attenuators in the module. These are automatically switched in when the MODE Selector is placed in 4ISB position Consequently, the attenuated output is 3mV_{RMS}.

g. Refer to paragraph 9 of the A2A7 RF Output Module Section of this book and readjust PPC ADJ. potentiometer A2A7A1R53 as specified therein.

8. MAINTENANCE PARTS LIST

Table 5 lists the electronic components of Combiner Module, A2A12. For a complete list of manufacturer's names and addresses, refer to Table 6-3 in the General Information Section of this book.

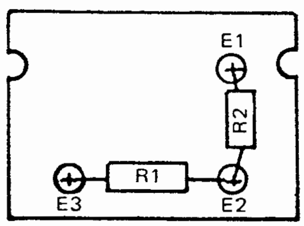


FIGURE 1. PLATE ASSEMBLY A2A12A3 P/N 1928-4245

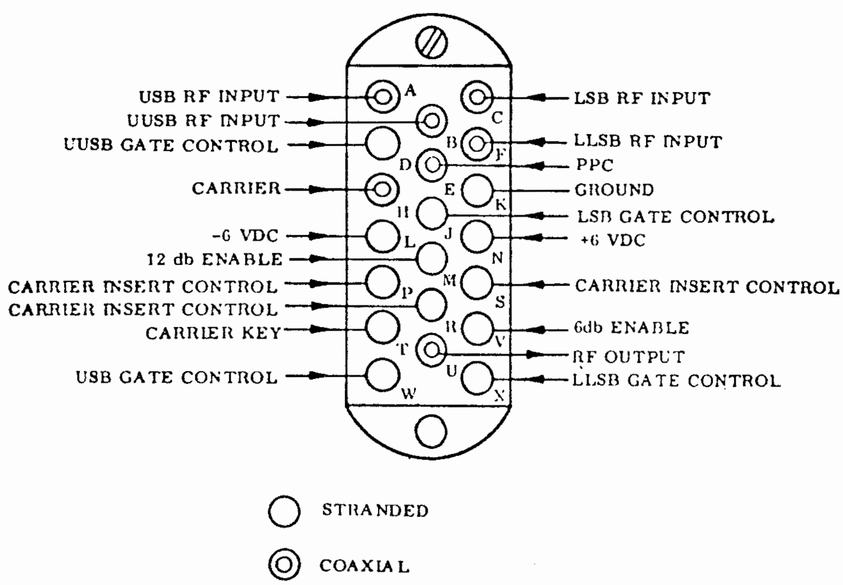


FIGURE 2. MODULE CHASSIS CONNECTOR A2J12

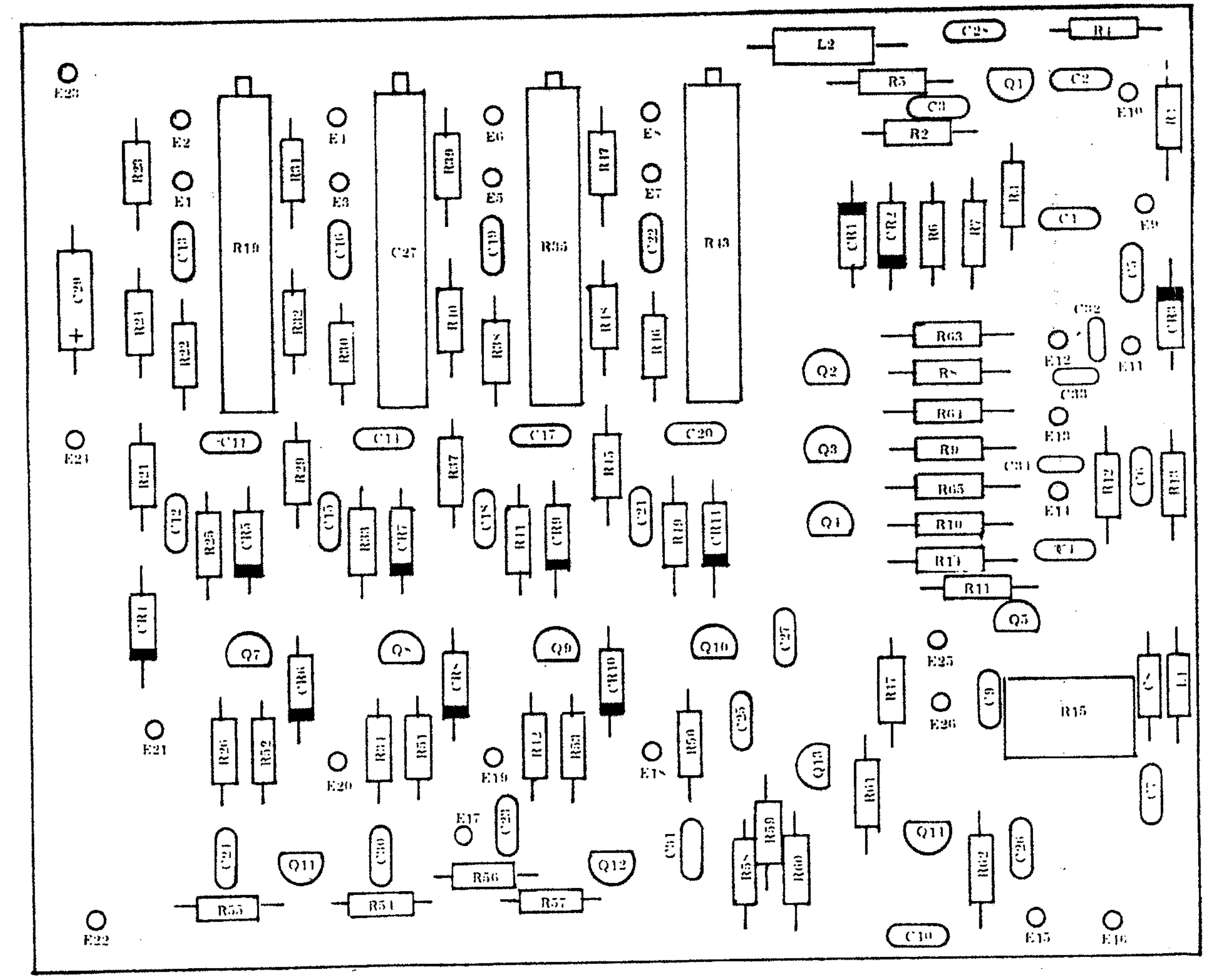


Figure 3. Combiner and Carrier Insert PWB A2A12A1 Component Locations

0759-4242

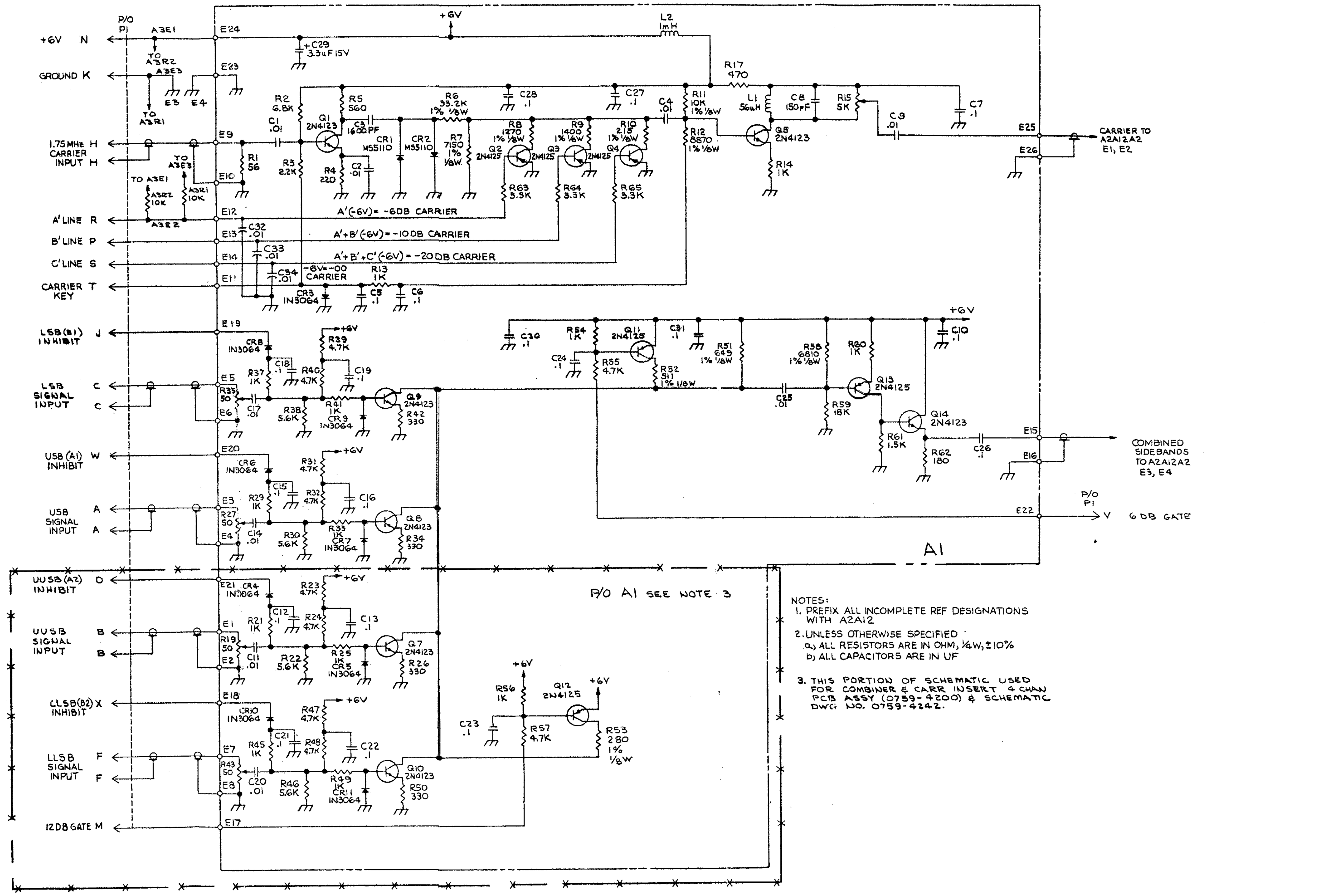


Figure 4. Combiner and Carrier Insert PWB A2A12A1 Schematic Diagram

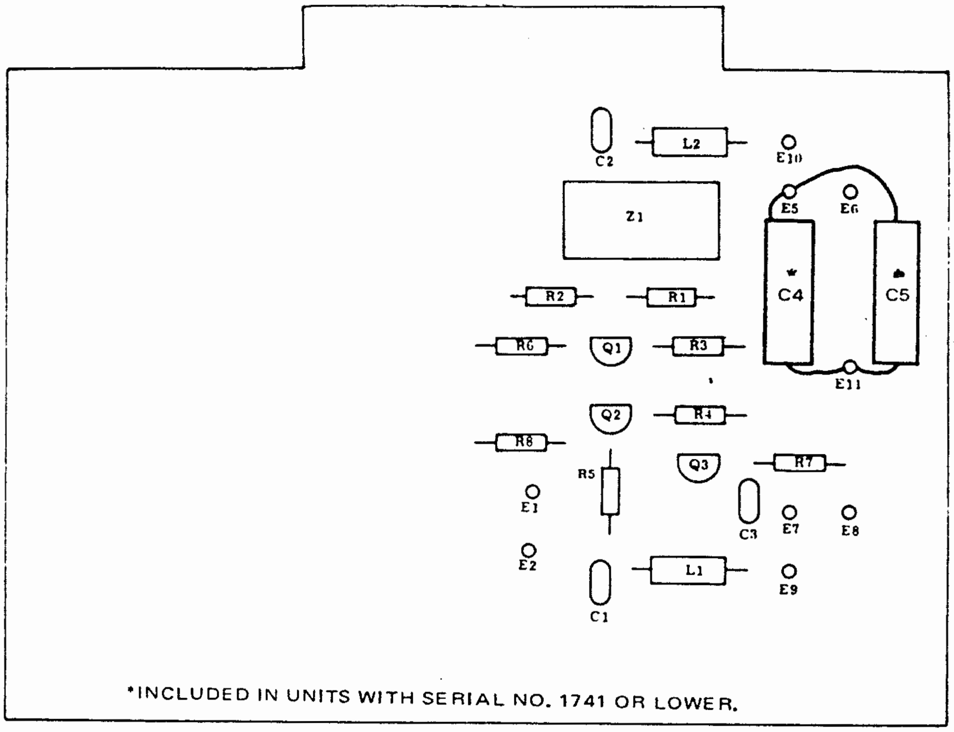


Figure 5. PPC Attenuator PWB A2A12A2 Component Locations

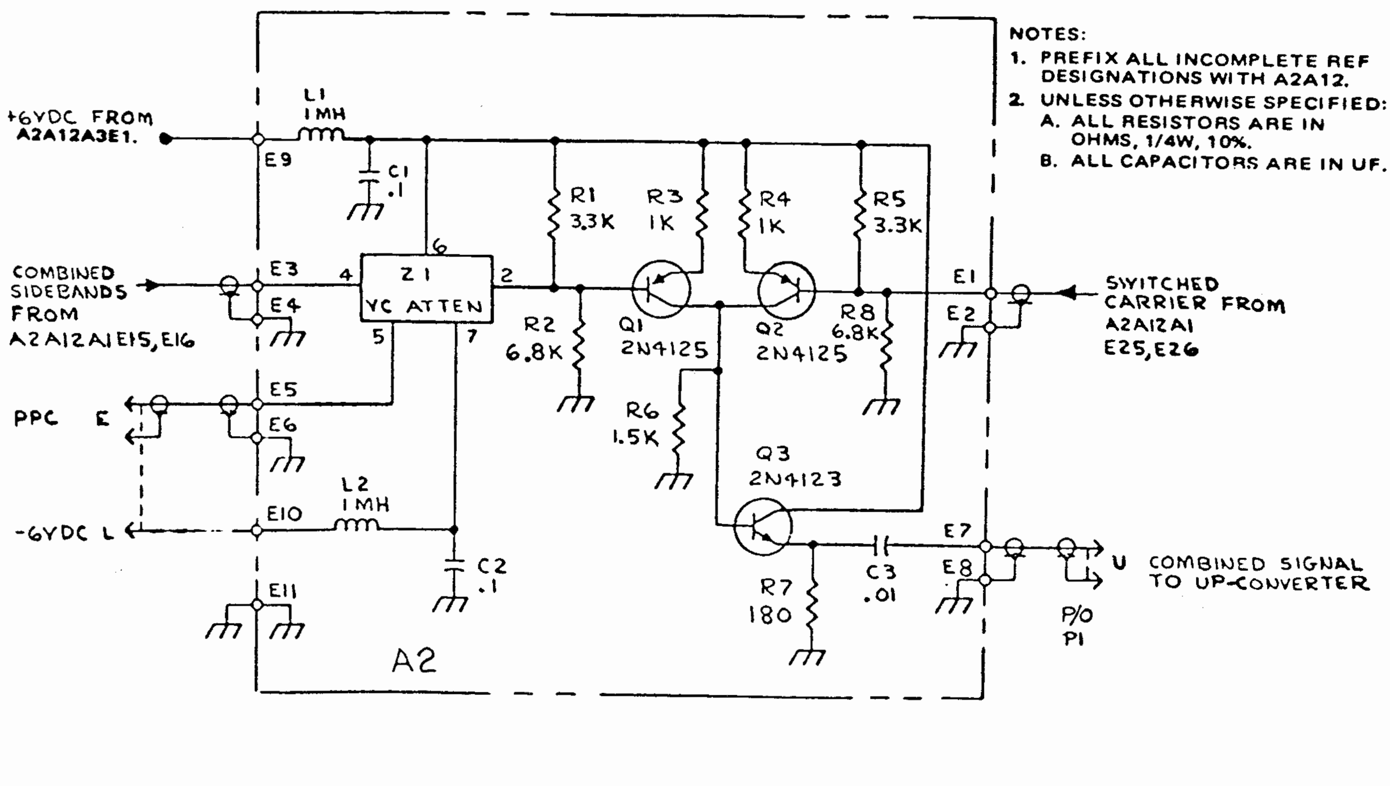


Figure 6. PPC Attenuator PWB A2A12A2 Schematic Diagram

TABLE 5. MAINTENANCE PARTS LIST-Combiner Module A2A12

Reference Designation	Name and Description
A2A12	Two Channel Combiner Module Assembly:MFR 14304, PN 0759-4200-1 (Note 1)
MP1	Pin, Connector: MFR 81312, PN 100-8000S
MP2	Pin, Connector: Mil type MS17803-16-20
P1	Connector, Plug: MFR 81312, PN MRAC20PN7
A2A12A1	Two Channel Combiner and Carrier Insert PWB Assembly: MFR 14304, PN 0759-4240-1 (Note 2)
C1, C2	Capacitor, Fixed Ceramic, .01 uF: MFR 72982, PN 8121-050-651-103M
C3	Capacitor, Fixed Ceramic, 1800 pF: MFR 72982, PN 8101-050-651-182M
C4	Same as A1C1
C5 - C7	Capacitor, Fixed Ceramic, .1 uF: MFR 14304, PN C11-0005-104
C8	Capacitor, Fixed Ceramic, 150 pF ± 10%, 100 WVDC: MFR 83125, PN DC-151K
C9	Same as A1C1
C10	Same as A1C5
C11	Same as A1C1 (Note 3)
C12, C13	Same as A1C5 (Note 3)
C14	Same as A1C1
C15, C16	Same as A1C5
C17	Same as A1C1
C18,C19	Same as A1C5
C20	Same as A1C1 (Note 3)
C21 - C24	Same as A1C5 (Note 3)
C25	Same as A1C1
C26 - C28	Same as A1C5
C29	Capacitor, Fixed Tantalum, 3.3 uF, 15 WVDC: Mil type CSR13D335ML
C30,C31	Same as A1C5
C32-C34	Same as A1C1
CR1, CR2	Hot Carier Diode: MFR 50444, PN 5082-2800
CR3-CR11	Diode, Silicon: Mil type 1N3064 (Note 3)
L1	Inductor, 56 uH: MFR 99800, PN 1025-62
L2	Inductor, 1000 uH: MFR 99800, PN 2500-28
Q1	Transistor, NPN: MFR 01295, PN 2N4123
Q2 - Q4	Transistor, PNP: MFR 01295, PN 2N4125
Q5	Same as A1Q1
Q6	Not Used
Q7 - Q10	Same as A1Q1 (Note 3)
Q11 - Q13	Same as A1Q2 (Note 3)
Q14	Same as A1Q1
R1	Resistor, Fixed Composition, 56 Ω ± 10%, ¼W: Mil type RC07GF560K
R2	Resistor, Fixed Composition, 6.8K ± 10%, ¼W: Mil type RC07GF682K
R3	Resistor, Fixed Composition, 2.2K ± 10%, ¼W: Mil type RC07GF222K
R4	Resistor, Fixed Composition, 220 Ω ± 10%, ¼W: Mil type RC07GF221K
R5	Resistor, Fixed Composition, 560 Ω ± 10%, ¼W: Mil type RC07GF561K
R6	Resistor, Fixed Film, 33.2K ± 1%, 1/8W: Mil type RN55D3322F
R7	Resistor, Fixed Film, 7150 Ω ± 1%, 1/8W: Mil type RN55D7151F
R8	Resistor, Fixed Film, 1270 Ω ± 1%, 1/8W: Mil type RN55D1271F
R9	Resistor, Fixed Film, 1400 Ω ± 1%, 1/8W: Mil type RN55D1401F
R10	Resistor, Fixed Film, 215 Ω ± 1%, 1/8W: Mil type RN55D2150F
R11	Resistor, Fixed Film, 10K ± 1%, 1/8W: Mil type RN55D1002F
R12	Resistor, Fixed Film, 8870 Ω ± 1%, 1/8W: Mil type RN55D8871F
R13, R14	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102K
R15	Resistor, Variable Film, 5K: MFR 35009, PN 156-4-5K
R16	Not Used
R17	Resistor, Fixed Composition, 470 Ω ± 10%, ¼W: Mil type RC07GF471K

TABLE 5. MAINTENANCE PARTS LIST-Combiner Module A2A12 (Continued)

Reference Designation	Name and Description
A2A12A1	Continued
R18	Not Used
R19	Resistor, Variable WW, 50 Ω; MFR 80294, PN 3059P-50Ω (Note 5)
R20	Not Used
R21	Same as A1R13 (Note 5)
R22	Resistor, Fixed Composition, 5.6K ±10%, ¼W: Mil type RC07GF562K (Note 5)
R23, R24	Resistor, Fixed Composition, 4.7K ±10%, ¼W: Mil type RC07GF472K (Note 5)
R25	Same as A1R13 (Note 5)
R26	Resistor, Fixed Composition, 330 Ω ±10%, ¼W: Mil type RC07GF331K (Note 5)
R27	Same as A1R19
R28	Not Used
R29	Same as A1R13
R30	Same as A1R22
R31, R32	Same as A1R23
R33	Same as A1R13
R34	Same as A1R26
R35	Same as A1R19
R36	Not Used
R37	Same as A1R13
R38	Same as A1R22
R39, R40	Same as A1R23
R41	Same as A1R13
R42	Same as A1R26
R43	Same as A1R19 (Note 5)
R44	Not Used
R45	Same as A1R13 (Note 5)
R46	Same as A1R22 (Note 5)
R47, R48	Same as A1R23 (Note 5)
R49	Same as A1R13 (Note 5)
R50	Same as A1R26 (Note 5)
R51	Resistor, Fixed Film, 649 Ω ±1%, 1/8W: Mil type RN55D6490F
R52	Resistor, Fixed Film, 511 Ω ±1%, 1/8W: Mil type RN55D5110F
R53	Resistor, Fixed Film, 280 Ω ±1%, 1/8W: Mil type RN55D2800F (Note 6)
R54	Same as A1R13
R55	Same as A1R23
R56	Same as A1R13 (Note 6)
R57	Same as A1R23 (Note 6)
R58	Resistor, Fixed Film, 6810 Ω ±1%, 1/8W: Mil type RN55D6811F
R59	Resistor, Fixed Composition, 18K ±10%, ¼W: Mil type RC07GF183K
R60	Same as A1R13
R61	Resistor, Fixed Composition, 1.5K ±10%, ¼W: Mil type RC07GF152K
R62	Resistor, Fixed Composition, 180 Ω ±10%, ¼W: Mil type RC07GF181K
R63 - R65	Resistor, Fixed Composition, 3.3K ±10%, ¼W: Mil type RC07GF332K
A2A12A2	PPC Attenuator PWB Assembly: MFR 14304, PN 0759-4270 (Note 7)
C1, C2	Capacitor, Fixed Ceramic, .1 uF; MFR 14304, PN C11-0005-104
C3	Capacitor, Fixed Ceramic, .01 uF; MFR 72982, PN 8121-050-651-103M
C4, C5	Capacitor, Fixed, 47 uF, 35V; Mil type MS39003/1-2313*
L1, L2	Choke, 1 mH; MFR 99800, PN 2500-28
Q1, Q2	Transistor, PNP: MFR 01295, PN 2N4125
Q3	Transistor, NPN: MFR 01295, PN 2N4123
R1	Same as A1R63
R2	Same as A1R2
R3, R4	Same as A1R13
R5	Same as A1R63
R6	Same as A1R61
R7	Same as A1R62
R8	Same as A1R2
Z1	Attenuator: MFR 14304, PN 0759-5000
A2A12A3	Plate Assembly: MFR 14304, PN 1928-4245
R1, R2	Resistor, Fixed Composition, 10K ±10%, ¼W: Mil type RC07GF103K (Note 9)

*Applies to units with Serial No. lower than SN1741

NOTES:

1. FOUR CHANNEL COMBINER MODULE A2A12 PART NUMBER IS 0759-4200 (APPLIES TO RF-131 MODELS -126/-176 ONLY)

2. FOUR CHANNEL COMBINER AND CARRIER INSERT PWB A2A12A1 PART NUMBER IS 0759-4240 (APPLIES TO RF-131 MODELS -126/-176 ONLY)

3. COMPONENTS C11, C12, C13, C21, C22, C23, CR4, CR5, CR10, CR11, Q7, Q10 AND Q12 ARE USED IN THE FOUR CHANNEL COMBINER AND CARRIER INSERT PWB ONLY.

4. NOT USED

5. COMPONENTS R19, R21, R22, R23, R24, R25, R26, R43, R45, R46, R47, R48, R49 AND R50 ARE USED IN THE FOUR CHANNEL COMBINER AND CARRIER INSERT PWB ONLY.

6. THESE COMPONENTS ARE USED ONLY IN THE FOUR CHANNEL COMBINER AND CARRIER INSERT PWB.

7. THE PPC ATTENUATOR PWB IS THE SAME IN BOTH TWO AND FOUR CHANNEL EXCITERS.

8. NOT USED

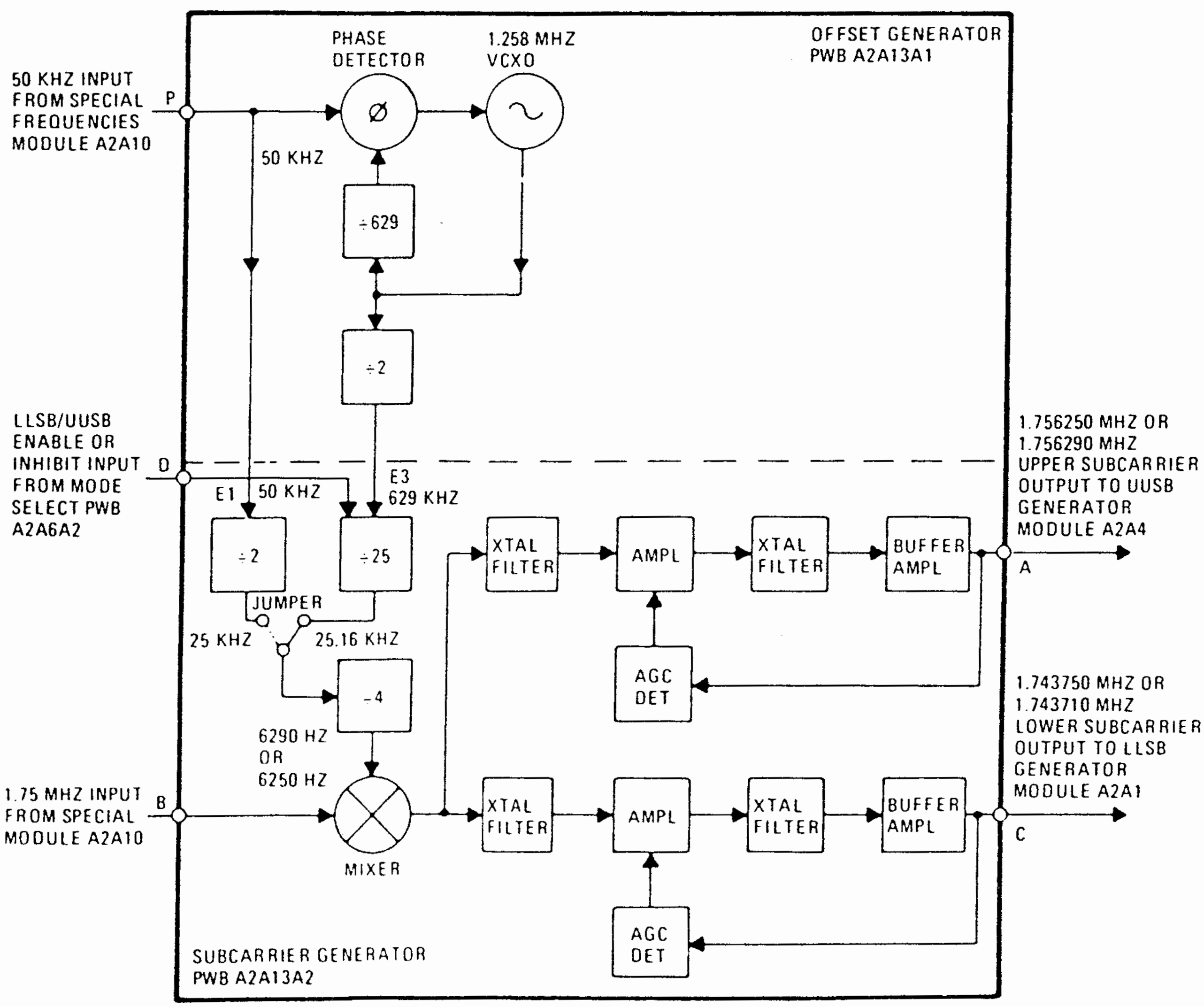
9. R1 AND R2 ARE PART OF THE 0759-4202 CABLE ASSEMBLY

UNIT INSTRUCTIONS

SUBCARRIER GENERATOR ASSEMBLY

A2A13

(RF-131 MODELS -126/-176 ONLY)



SUBCARRIER GENERATOR ASSEMBLY

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1. GENERAL DESCRIPTION

Subcarrier Generator Assembly A2A13 generates the two frequencies required to produce the two outboard sideband channels (Upper Upper Sideband - UUSB and Lower Lower Sideband-LLSB). The assembly comprises Offset Generator PWB A2A13A1 and Subcarrier Generator PWB A2A13A2, as shown in the block diagram on the cover sheet of this section.

Depending on assembly strapping and trimming adjustments, Subcarrier Generator PWB A2A13A2 can generate the following frequencies:

1.743710 MHz LLSB and 1.756290 MHz UUSB for 6290 Hz Offset Channels

1.743750 MHz LLSB and 1.756250 MHz UUSB for 6250 Hz Offset Channels

When frequencies of 1.743710 MHz and 1.756290 MHz are required, a phase locked crystal oscillator in Offset Generator Board A2A13A1 generates a 6290 Hz frequency. This frequency is divided by 100 in Subcarrier Generator PWB A2A13A2 and mixed with a 1.75MHz Carrier Signal from Special Frequencies Module A2A10. The sum and difference products of this mixing are the required subcarrier output frequencies.

When frequencies of 1.743750 MHz and 1.756250 MHz are required, the output of Offset Generator PWB A2A13A1 is not used. The Offset Frequency is obtained by dividing a 50kHz input frequency (from Special Frequencies Module A2A10) by 8 in the Subcarrier Generator PWB A2A13A2. The resultant 6250Hz Offset Frequency is mixed with the 1.75MHz Carrier Signal to provide the required subcarrier output frequencies.

The selection of just which sets of output frequencies are to be generated is determined by the way in which Subcarrier Generator Assembly A2A13A2 is strapped. In both instances, the output frequencies are gain-controlled and adjustable, to provide output levels of $75mV_{RMS}$ to the UUSB and LLSB Generator Modules (A2A4 and A2A1, respectively).

2. TECHNICAL CHARACTERISITCS

Dimensions:
4-1/8 in. (H) x 2-1/8 in. (W) x 5-7/8 in. (D)
10.5 cm (H) x 5.4 cm (W) x 14.9 cm (D)

Power Requirements:
+ 5Vdc at 150 mA
+ 6Vdc at 44 mA
− 6Vdc at 32 mA
+ 18Vdc at 7 mA

Signal Inputs:
50kHz at 2.4V p-p minimum
1.75MHz at 75 mV_{RMS}.

Subcarrier Enable (Logic):
>1.0 Vdc = ON condition
0 Vdc (approximately) = OFF condition

Signal Outputs:
1.743710 MHz and 1.756290 MHz at $75mV_{RMS}$ for a 6290 Hz Offset Input Frequency
1.743750 MHz and 1.756250 MHz at $75mV_{RMS}$ for a 6250 Hz Offset Input Frequency

Impedance (Rf inputs and outputs):
50 ohms

3. SEMICONDUCTOR COMPLEMENT

Table 1 lists all the semiconductors used in the Subcarrier Generator Assembly A2A13.

TABLE 1. SEMICONDUCTOR COMPLEMENT

Reference Designation	Type	Function
A2A13A1		
CR1	1N3064	Diode
CR2	MV1638	Diode (Voltage Variable-Capacitance)
CR3	1N3064	Diode
Q1	2N4123	Transistor
Q2	2N4125	Transistor
Q3	3N153	Transistor
Q4	2N4264	Transistor
Q5	3N153	Transistor
Q6	2N5089	Transistor
Q7	2N5179	Transistor
Q8, Q9	2N4123	Transistor
Z1	SN7472N	J-K-Flip-Flop

Table 1. Semiconductor Complement

Reference Designation	Type	Function
Z2	SN74H00N	Quad 2-Input NAND
Z3	SN7430N	8-Input NAND
Z4	SN7493N	4-Bit Binary Counter
Z5	SN7476N	Dual J-K Flip-Flop
Z6	SN7490N	Decade Counter
A2A13A2		
Q1, Q2	Not used	
Q3 - Q5	2N4123	Transistor
Q6 - Q9	2N4125	Transistor
Z1, Z2	SN74L90	Decade Counter
Z3	1976-4330	Double Balanced Mixer
Z4, Z5	CA3028A	Differential/Cascade Amplifier
Z6	SN7472N	J-K Flip-Flop

4. CIRCUIT DESCRIPTIONS

4.1 Offset Generator PWB A2A13A1

The 6290 Hz offset frequency is generated by phase-locking a 1.258 MHz VCXO at a reference frequency derived from the 1 MHz standard. This frequency is divided by 2 on Offset Generator PWB A2A13A1 and then by 100 on Subcarrier Generator PWB A2A13A2.

Referring to Figure 4, the 1.258 MHz VCXO (Q7, crystal Y1, and variable capacitance diode CR2) is followed by amplifiers Q8 and Q9. The output of Q9 is TTL compatible; that is, it will drive TTL dividers Z1 and Z6. The output of Z1 (÷2) is 629 kHz and is applied to Subcarrier Generator PWB A2A13A2, where it is divided by 100 to become the 6290 Hz Offset Frequency. Z6 is the first stage of a ÷629 counter. Z6 through Z4 form a basic divide-by-640 circuit: division by 629 is accomplished by Z3, which detects the count of 629 and resets the divider to zero via Z2. The output at Z2-3 is a negative going pulse which resets Z5, and the output at Z2-6 is a positive-going pulse which resets Z4 and Z6. The 2.0 kHz divider output is applied through amplifier Q4 to sampling FET Q3 in the sample-and-hold phase detector.

A 50 kHz square-wave from the Special Frequencies Module A2A10 is applied via A2A13 P1-P to Z2-9. The output of Z2-8 is applied through amplifier Q1 to ramp discharge transistor Q2. A ramp waveform is established by charging C24 through R9 and then quickly discharging C24 through Q2 at the 50 kHz reference rate. Each pulse from the ÷629 counter turns on Q3 momentarily, sampling the ramp at that time. The sampled voltage is stored on memory capacitor C11, where it is held between samples. Q5 is a MOSFET connected as a source follower to minimize loading on the memory capacitor. Q6 amplifies the output of the phase detector and, by adjusting the bias voltage of CR2, controls the oscillator frequency, completing the loop. R12 can be adjusted to compensate for differences in offset voltages on individual MOSFET's. For further information on phase locked loops, see the Low Band PLL Module A2A14 section of this manual.

4.2 Subcarrier Generator PWB A2A13A2

4.2.1 6290Hz Offset Frequency

The 629 kHz signal from the Offset Generator PWB A2A13A1 is applied to frequency dividers Z1 and Z2. Z1 and Z2 are digital counters with ÷2, ÷5 or ÷10 capabilities. When a 6290 Hz offset frequency is desired, terminal E16 is strapped to terminal E17. With this strapping, the 629 kHz input is divided by five on Z2, by 10 on Z1 and then by 2 on Z2 again to provide a total division of 100, with a 50 percent duty cycle. This output is then applied to the input of mixer Z3.

4.2.2 6250Hz Offset Frequency

When a 6250Hz offset frequency is desired, terminal E16 is strapped to terminal E18. With this strapping, the 50 kHz input from the Special Frequencies Module A2A10 is divided by eight to obtain 6250Hz. The ÷8 is accomplished by using the ÷2 portions of Z1 and Z2 successively. As in the case of the 6290Hz offset frequency, the output of Z2 is applied to mixer Z3.

4.2.3 Selection of Either Offset Frequency

Whichever offset frequency is used, the output from the Subcarrier Generator is desired only when 4 ISB has been selected. To accomplish this, a positive voltage from the Mode Select PWB A2A6A2 of the Control Head, is applied to A2A13 P1-D. This positive voltage is applied to the base of Q3, via R23, biasing On Q3 which grounds pin 2 of

Z2. Pin 2 of Z2 must be at ground for Z2 to provide an output. Since either the 6250Hz or the 6290Hz offset frequency signal appears at the output of Z2, this circuit effectively controls the output of the Subcarrier Generator. Thus, when Q3 is biased On, the proper frequency appears at the input to mixer Z3.

The mixer also receives a 1.75 MHz carrier frequency input in addition to the offset frequency signal. This signal is applied to Z3, pin 4. The resulting outputs from the mixer are thus 1.75 MHz plus the Offset Frequency and 1.75 MHz minus the Offset Frequency. These outputs are applied to the inputs of two filter stages.

Since the two filters are identical except for frequency, only one filter will be described.

The mixer output is capacitively coupled through C22 to the first crystal filter consisting of Y1, C7, and T1. Crystal Y1 is cut midway between the two possible UUSB Offset Frequencies at 1.756270 MHz. (The other filter is cut for 1.743730 MHz for the opposite (LLSB) sideband channel.) Capacitor C7 cancels capacitive coupling through the crystal to T1. The output of T1 is applied with a maximum voltage gain of about 10. The output signal from amplifier Z4 is coupled through C24 to the second filter consisting of Y2, C25, and T2. Y2 is cut to the same frequency as Y1. Trimmer C25 provides fine adjustment to null undesired mixing products. Buffer amplifier Q4 provides a fixed load for the second crystal filter, and additional voltage gain. The output of Q4 will then be either 1.756290MHz or 1.756250 MHz. Resistor R32, in the attenuator network comprising R31, R32, and R33, is adjusted for an output of 75 mV_{RMS}(−9.5 dBm) into a 50 ohm load.

5. ADJUSTMENT AND ALIGNMENT PROCEDURES

5.1 Offset Generator PWB A2A13A1

Upon replacement of any component in the Offset Generator PWB A2A13A1, the following adjustment procedure should be performed.

a. Connect Channel 1 of a Tektronix 453 (or eqivalent) Oscilloscope to A2A13A1TP4. Use a high impedance probe, and adjust the oscilloscope to trigger on this waveform.

b. Connect Channel 2 of the oscilloscope to A2A13A1TP3. Adjust the oscilloscope vertical display for Chopped Mode.

c. Insure that the oscilloscope is triggering on the waveform at A2A13A1TP4

d. Adjust A2A13A1R12 until the waveform at TP3 rèmains fixed with respect to the waveform at TP4, instead of slowly drifting.

e. Further adjust R12 so that each TP4 pulse is centered between the two TP3 pulses occurring immediately before and after it.

5.2 Subcarrier Generator PWB A2A13A2 Alignment Procedure

a. Connect a HP 8553B/8552B (or equivalent) Spectrum Analyzer to A2A13P1-A.

b. Adjust C25 for a spur content of greater than −50dB at ±50KHz of subcarrier A2 center frequency.

c. Adjust R32 for a −9.5 dBm output level.

d. Connect a HP 8553B/8552B (or equivalent) Spectrum Analyzer to A2A13 P1-C.

e. Adjust C29 for a spur content of greater than −50dB, at ±50KHz of subcarrier B2 center frequency.

f. Adjust R41 for a −9.5dBm output level.

6. MAINTENANCE PARTS LIST

Refer to Table 2 for the Maintenance Parts List for Subcarrier Generator Assembly A2A13, Part Number 1976-4300. For a listing of Manufacturer's Codes refer to Table 6-3 in the General Information Section.

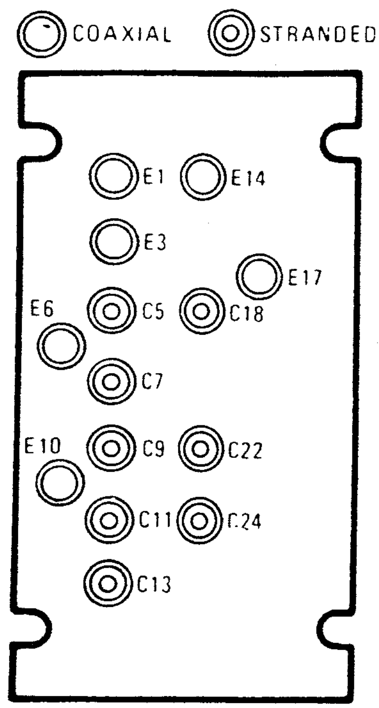


Figure 1. Filter Plate Assembly A2A13FL1 Component Locations

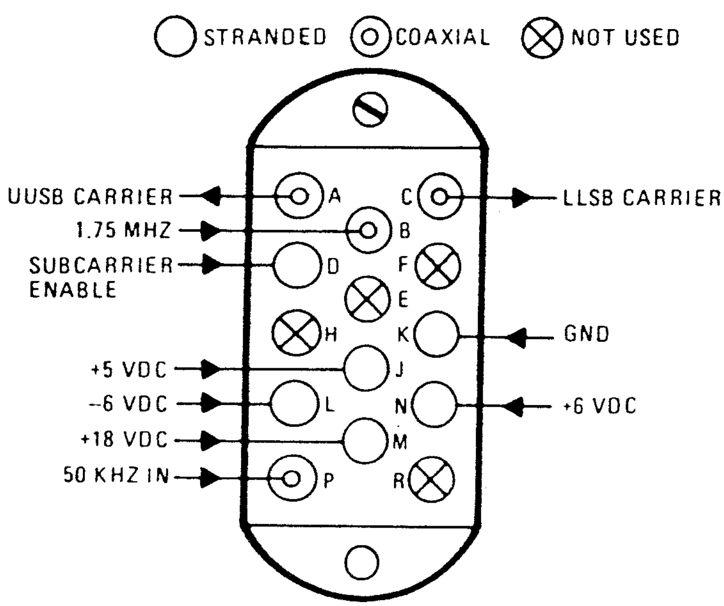


Figure 2. Module Chassis Connector A2J13 Top View

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTORS ARE IN OHMS, ¼ WATT.
   B. ALL CAPACITORS ARE IN MICROFARADS.
2. PREFIX INCOMPLETE REFERENCE DESIGNATORS WITH A2A13 PLUS SUB-ASSEMBLY DESIGNATOR IF ANY.
3. REFER TO TABLE 1. FOR LISTING OF SEMICONDUCTOR TYPES.

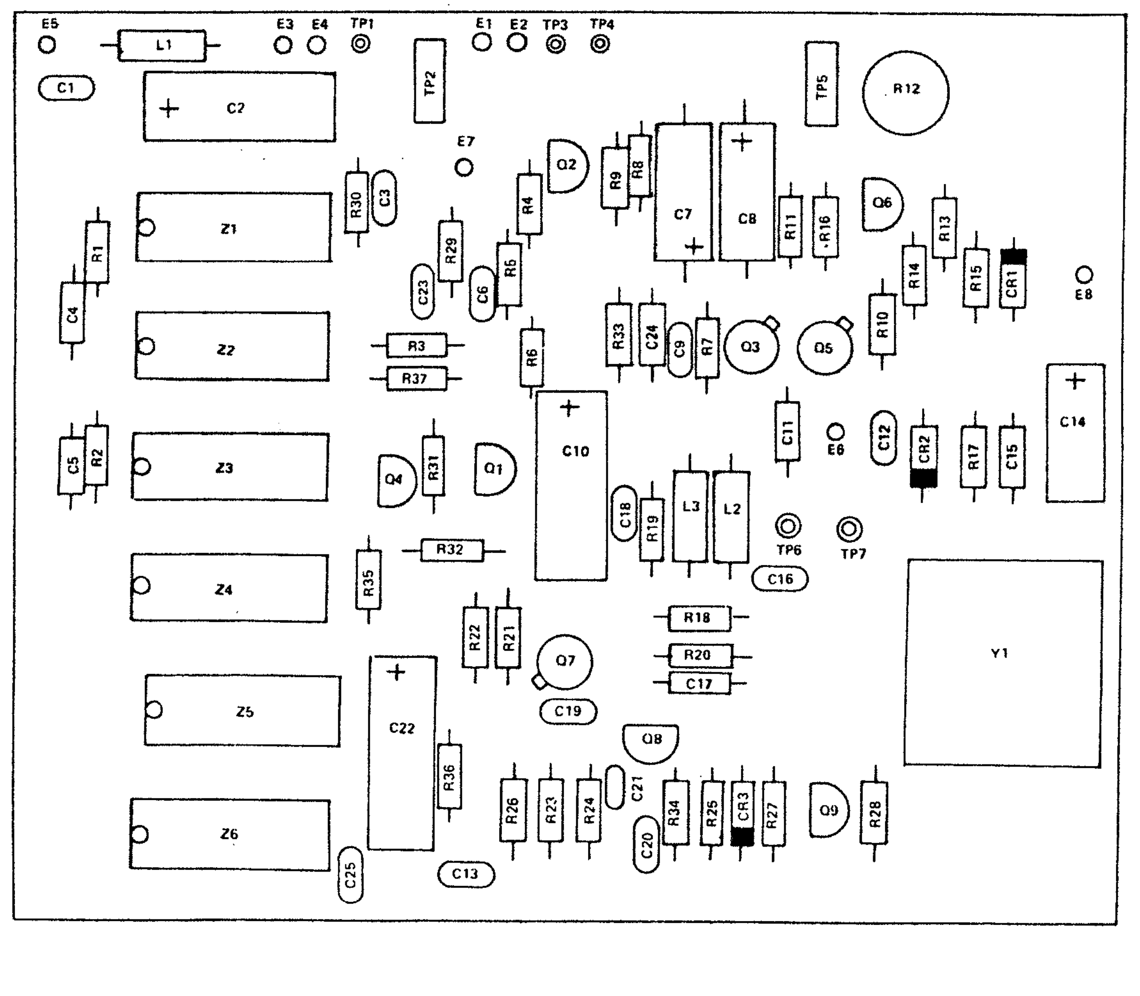


Figure 3. Offset Generator PWB Component Locations

1976-4301

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTORS ARE IN OHMS, 1/4W, ±10%.
   B. ALL CAPACITORS ARE IN MICROFARADS.
   C. ALL INDUCTORS ARE IN MICROHENRIES.
2. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; PREFIX WITH A2A13 AND SUBASSEMBLY PREFIX IF ANY.
3. FOR 6250HZ OFFSET FREQUENCY, JUMPER A2E16 AND A2E18 TOGETHER. FOR 6290HZ OFFSET FREQUENCY, JUMPER A2E16 AND A2E17 TOGETHER.
4. VOLTAGES SHOWN WERE MEASURED IN A TYPICAL MODULE.
5. SUBCARRIER ENABLE VOLTAGE: ON ≥1.0VDC, OFF ≤0VDC.

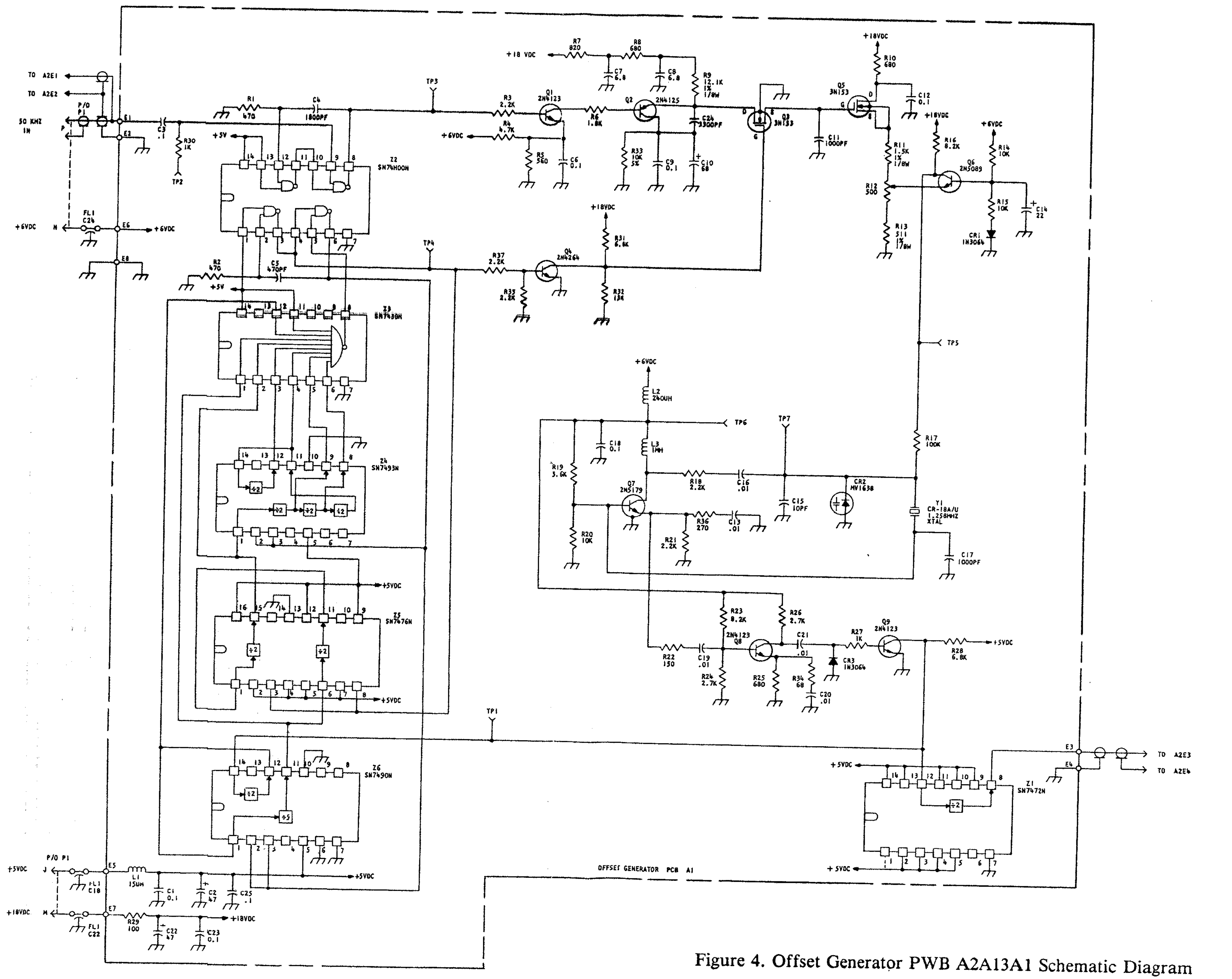


Figure 4. Offset Generator PWB A2A13A1 Schematic Diagram

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTORS ARE IN OHMS, ¼ WATT.
   B. ALL CAPACITORS ARE IN MICROFARADS.
2. PREFIX INCOMPLETE REFERENCE DESIGNATORS WITH A2A13 PLUS SUB-ASSEMBLY DESIGNATOR IF ANY.
3. REFER TO TABLE 1. FOR LISTING OF SEMICONDUCTOR TYPES.

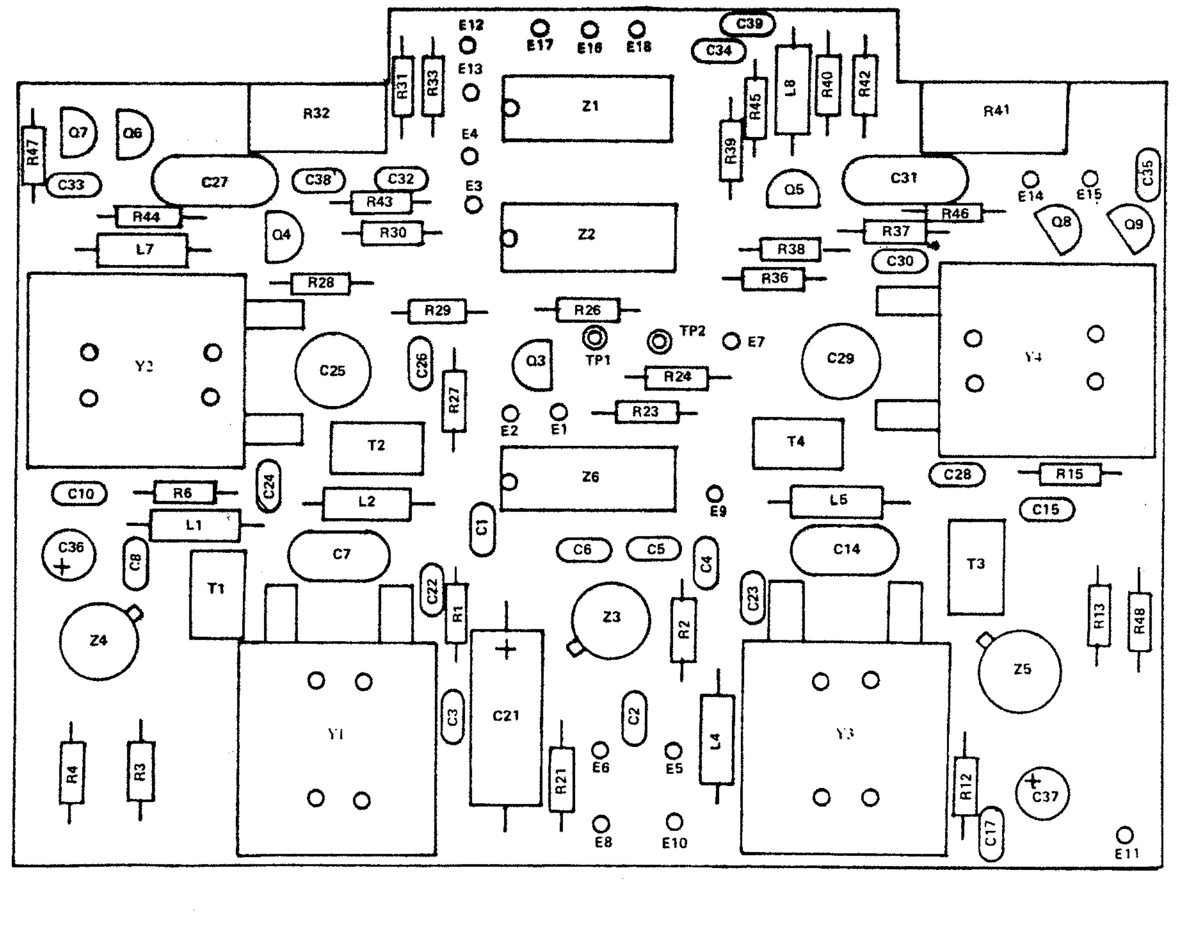


Figure 5. Subcarrier Generator PWB Component Locations

1976-4301

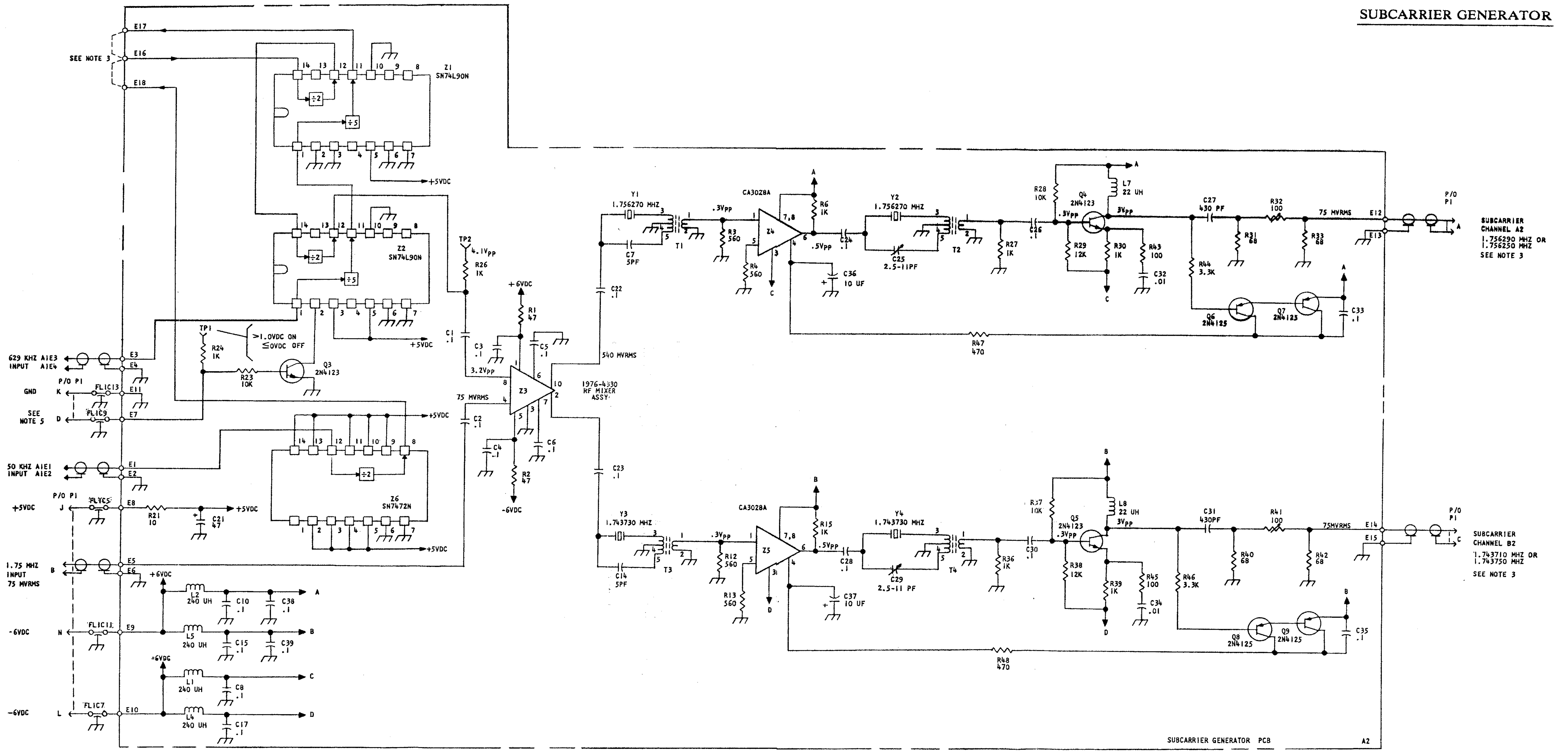


Figure 6. Subcarrier Generator PWB A2A13A2 Schematic Diagram

TABLE 2. MAINTENANCE PARTS LIST-Subcarrier Generator Assembly A2A13, PN 1976-4300

Reference Designation	Name and Description
A2A13	Subcarrier Generator Assembly: MFR 14304, PN 1976-4300
FL1	Filter Plate Assembly: MFR 14304, PN 0759-4304
FL1C1-C4	Not Used
FL1C5	Capacitor, Feed-thru, Ceramic, 1800 pF, 250V: MFR 72982, PN 1214-001
FL1C6	Not Used
FL1C7	Capacitor, Feed-thru, Ceramic, 1800 pF, 250V: MFR 72982, PN 1214-001
FL1C8	Not Used
FL1C9	Capacitor, Feed-thru, Ceramic, 1800 pF, 250V: MFR 72982, PN 1214-001
FL1C10	Not Used
FL1C11	Capacitor, Feed-thru, Ceramic, 1800 pF, 250V: MFR 72982, PN 1214-001
FL1C12	Not Used
FL1C13	Capacitor, Feed-thru, Ceramic, 1800 pF, 250V: MFR 72982, PN 1214-001
FL1C14-17	Not Used
FL1C18	Capacitor, Feed-thru, Ceramic, 1800 pF, 250V: MFR 72982, PN 1214-001
FL1C19-21	Not Used
FL1C22	Capacitor, Feed-thru, Ceramic, 1800 pF, 250V: MFR 72982, PN 1214-001
FL1C23	Not Used
FL1C24	Capacitor, Feed-thru, Ceramic, 1800 pF, 250V: MFR 72982, PN 1214-001
MP1-MP4	Connector Pin, Coaxial, Male: MFR 81312, PN 100-8000S
MP5-10	Connector Pin, Male: Mil type MS17803-16-20
P1	Connector, Rectangular, 14 Pin: MFR 81312, PN MRAC14PN7
A2A13A1	Offset Generator PWB Assembly: MFR 14304, PN 0759-4310

Reference Designation	Name and Description
C1	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C2	Capacitor, Fixed Tantalum, 47 uF, ± 20%, 20V: Mil type CSR13E476ML
C3	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C4	Capacitor, Fixed Ceramic, 1800 pF, ± 10%, 100V: MFR 83125, PN DC-182K
C5	Capacitor, Fixed Ceramic, 470 pF, ± 10%, 200V: MFR 83125, PN DC-471K
C6	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C7, C8	Capacitor, Fixed Tantalum, 6.8 uF, ± 20%, 35V: Mil type CSR13F685ML
C9	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C10	Capacitor, Fixed Tantalum, 68 uF, ± 20%, 15V: Mil type CSR13D686ML
C11	Capacitor, Fixed Ceramic, 1000 pF, ± 10%, 100V: MFR 83125, PN DC-102K
C12	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C13	Capacitor, Fixed Ceramic, 0.01 uF, ± 20%, 50V: MFR 14304, PN C11-0005-103
C14	Capacitor, Fixed Tantalum, 22 uF, ± 20%, 15V: Mil type CSR13D226ML
C15	Capacitor, Fixed Ceramic, 10 pF, ± 10%, 200V: MFR 83125, PN DC-100K
C16	Capacitor, Fixed Ceramic, 0.01 uF, ± 20%, 10V: MFR 14304, PN C11-0005-103

TABLE 2. MAINTENANCE PARTS LIST-Subcarrier Generator Assembly A2A13, PN 1976-4300 (Continued)

Reference Designation	Name and Description
C17	Capacitor, Fixed Ceramic, 1000 pF, ± 10%, 100V: MFR 83125, PN DC-102K
C18	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C19 - C21	Capacitor, Fixed Ceramic, 0.01 uF, ± 20%, 50V: MFR 14304, PN C11-0005-103
C22	Capacitor, Fixed Tantalum, 47 uF, ± 20%, 35V: Mil type CSR13F476ML
C23	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C24	Capacitor, Fixed Ceramic, 3300 pF, ± 10%, 100V: MFR 83125, PN DC-332K
C25	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
CR1	Diode: Type 1N3064
CR2	Diode: MFR 04713, PN MV1638
CR3	Diode: Type 1N3064
L1	Inductor, Fixed, RF, 15 uH: MFR 99800, PN 1537-40
L2	Inductor, Fixed, RF, 240 uH: MFR 99800, PN 1537-94
L3	Inductor, Fixed, RF, 1 mH: MFR 99800, PN 2500-28
Q1	Transistor, NPN: Type 2N4123
Q2	Transistor, PNP: Type 2N4125
Q3	Transistor, FET: Type 3N153
Q4	Transistor, NPN: Type 2N4264
Q5	Transistor, FET: Type 3N153
Q6	Transistor, NPN: Type 2N5089
Q7	Transistor, NPN: Type 2N5179
Q8, Q9	Transistor, NPN: Type 2N4123
R1, R2	Resistor, Fixed Composition, 470 Ω ± 10%, ¼W: Mil type RC07GF471K
R3	Resistor, Fixed Composition, 2.2K ± 10%, ¼W: Mil type RC07GF222K
R4	Resistor, Fixed Composition, 4.7K ± 10%, ¼W: Mil type RC07GF472K

Reference Designation	Name and Description
R5	Resistor, Fixed Composition, 560 Ω ± 10%, ¼W: Mil type RC07GF561K
R6	Resistor, Fixed Composition, 1.8K ± 10%, ¼W: Mil type RC07GF182K
R7	Resistor, Fixed Composition, 820 Ω ± 10%, ¼W: Mil type RC07GF821K
R8	Resistor, Fixed Composition, 680 Ω ± 10%, ¼W: Mil type RC07GF681K
R9	Resistor, Fixed Film, 12.1K ± 1%, 1/8W: Mil type RN55D1212F
R10	Resistor, Fixed Composition, 680 Ω ± 10%, ¼W: Mil type RC07GF681K
R11	Resistor, Fixed Film, 1.5K ± 1%, 1/8W: Mil type RN55D1501F
R12	Resistor, Variable, 500Ω: MFR 35009, PN 150-1-500Ω
R13	Resistor, Fixed Film, 511 Ω ± 1%, 1/8W: Mil type RN55D5110F
R14, R15	Resistor, Fixed Composition, 10K ± 10%, ¼W: Mil type RC07GF103K
R16	Resistor, Fixed Composition, 8.2 Ω ± 10%, ¼W: Mil type RC07GF822K
R17	Resistor, Fixed Composition, 100K ± 10%, ¼W: Mil type RC07GF104K
R18	Resistor, Fixed Composition, 2.2K ± 10%, ¼W: Mil type RC07GF222K
R19	Resistor, Fixed Composition, 5.6K ± 10%, ¼W: Mil type RC07GF562K
R20	Resistor, Fixed Composition, 10K ± 10%, ¼W: Mil type RC07GF103K
R21	Resistor, Fixed Composition, 2.2K ± 10%, ¼W: Mil type RC07GF222K
R22	Resistor, Fixed Composition, 150 Ω ± 10%, ¼W: Mil type RC07GF151K
R23	Resistor, Fixed Composition, 8.2K ± 10%, ¼W: Mil type RC07GF822K
R24	Resistor, Fixed Composition, 2.7K ± 10%, ¼W: Mil type RC07GF272K
R25	Resistor, Fixed Composition, 680 Ω ± 10%, ¼W: Mil type RC07GF681K
R26	Resistor, Fixed Composition, 2.7K ± 10%, ¼W: Mil type RC07GF272K
R27	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102K

TABLE 2. MAINTENANCE PARTS LIST-Subcarrier Generator Assembly A2A13, PN 1976-4300 (Continued)

Reference Designation	Name and Description
R28	Resistor, Fixed Composition, 6.8K ± 10%, ¼W: Mil type RC07GF682K
R29	Resistor, Fixed Composition, 100 Ω ± 10%, ¼W: Mil type RC07GF101K
R30	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102K
R31	Resistor, Fixed Composition, 6.8K ± 10%, ¼W: Mil type RC07GF682K
R32	Resistor, Fixed Composition, 15K ± 10%, ¼W: Mil type RC07GF153K
R33	Resistor, Fixed Composition, 10K ± 5%, ¼W: Mil type RC07GF103J
R34	Resistor, Fixed Composition, 68 Ω ± 10%, ¼W: Mil type RC07GF680K
R35	Resistor, Fixed Composition, 2.2K ± 10%, ¼W: Mil type RC07GF222K
R36	Resistor, Fixed Composition, 270 Ω ± 10%, ¼W: Mil type RC07GF271K
R37	Resistor, Fixed Composition, 2.2K ± 10%, ¼W: Mil type RC07GF222K
TP1	Not Used
TP2	Jack, Test Point, PWB, Red: MFR 14304, PN J60-0001-002
TP3, TP4	Not Used
TP5	Jack, Test Point, PWB, Green: MFR 14304, PN J60-0001-004
XY1	Socket, Crystal: MFR 91506, PN 8000-AG10-1
Y1	Crystal, 1.258 MHz: Mil type CR-18A/U1.258 MHz
Z1	Integrated Circuit: MFR 01295, PN SN7472N
Z2	Integrated Circuit: MFR 01295, PN SN74H00N
Z3	Integrated Circuit: MFR 01295, PN SN7430N
R36	Resistor, Fixed Composition, 270 Ω ± 10%, ¼W: Mil type RC07GF271K
R37	Resistor, Fixed Composition, 2.2K Ω ± 10%, ¼W: Mil type RC07GF222K
TP1	Not Used
TP2	Jack, Test Point, Pc Board, Red: MFR 14304, PN J60-0001-002
TP3, TP4	Not Used

Reference Designation	Name and Description
TP5	Jack, Test Point, Pc Board, Green: MFR 14304, PN J60-0001-004
XY1	Socket, Crystal: MFR 91506, PN 8000-AG10-1
Y1	Crystal, 1.258 MHz: Mil type CR-18A/U 1.258 MHz
Z1	Integrated Circuit: MFR 01295, PN SN7472N
Z2	Integrated Circuit: MFR 01295, PN SN74H00N
Z3	Integrated Circuit: MFR 01295, PN SN7430N
Z4	Integrated Circuit: MFR 01295, PN SN7493N
Z5	Integrated Circuit: MFR 01295, PN SN7476N
Z6	Integrated Circuit: MFR 01295, PN SN7490N
A2A13A2	Subcarrier Generator PWB Assembly: MFR 14304, PN 1976-4320
C1 - C6	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C7	Capacitor, Fixed Mica, 5 pF, 500V: Mil type CM05CD050D03
C8	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C9	Not Used
C10	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C11 - C13	Not Used
C14	Capacitor, Fixed Mica, 5 pF, 500V: Mil type CM05CD050D03
C15	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C16	Not Used

TABLE 2. MAINTENANCE PARTS LIST-Subcarrier Generator Assembly A2A13, PN 1976-4300 (Continued)

Reference Designation	Name and Description
C17	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C18 - C20	Not Used
C21	Capacitor, Fixed Tantalum, 47 uF, ± 20%, 20V: Mil type CSR13E476ML
C22 - C24	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C25	Capacitor, Variable, 2.5-11 pF: MFR 72982, PN 538-014,B,2.5-11 pF
C26	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C27	Capacitor, Fixed, Mica, 430 pF, ± 5%, 500V: Mil type CM06FD431J03
C28	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C29	Capacitor, Variable, 2.5-11 pF, ± 10%,: MFR 72982, PN 538-014,B,2.5-11 pF
C30	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C31	Capacitor, Fixed, Mica, 430 pF, ± 5%, 500V: Mil type CM06FD431J03
C32 - C35	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
C36, C37	Capacitor, Fixed Tantalum, 10 uF, ± 20%, 35V: MFR 12954, PN D10GSC35M
C38, C39	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%, 50V: MFR 14304, PN C11-0005-104
L1, L2	Inductor, Fixed, RF 240 uH: MFR 99800, PN1537-94
L3	Not Used
L4, L5	Inductor, Fixed, RF 240 uH: MFR 99800,PN 1537-94
L6	Not Used
L7, L8	Inductor, Fixed, RF 22 uH: MFR 99800, PN 1537-44

Reference Designation	Name and Description
Q1, Q2	Not Used
Q3 - Q5	Transistor, NPN: Type 2N4123
Q6 - Q9	Transistor, PNP: Type 2N4125
R1, R2	Resistor, Fixed Composition, 47 Ω ± 10%, ¼W: Mil type RC07GF470K
R3, R4	Resistor, Fixed Composition, 560 Ω ± 10%, ¼W: Mil type RC07GF561K
R5	Not Used
R6	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102K
R7 - R11	Not Used
R12, R13	Resistor, Fixed Composition, 560 Ω ± 10%, ¼W: Mil type RC07GF561K
R14	Not Used
R15	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102K
R16 - R20	Not Used
R21	Resistor, Fixed Composition, 10 Ω ± 10%, ¼W: Mil type RC07GF100K
R22	Not Used
R23	Resistor, Fixed Composition, 10K ± 10%, ¼W: Mil type RC07GF103K
R24	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102K
R25	Not Used
R26, R27	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102K
R28	Resistor, Fixed Composition, 10K ± 10%, ¼W: Mil type RC07GF103K
R29	Resistor, Fixed Composition, 12K ± 10%, ¼W: Mil type RC07GF123K
R30	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102K
R31	Resistor, Fixed Composition, 68 Ω ± 10%, ¼W: Mil type RC07GF680K
R32	Resistor, Variable, 100 Ω MFR 35009, PN 156-4-100
R33	Resistor, Fixed Composition, 68 Ω ± 10%, ¼W: Mil type RC07GF680K
R34, R35	Not Used
R36	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102K
R37	Resistor, Fixed Composition, 10K ± 10%, ¼W: Mil type RC07GF103K

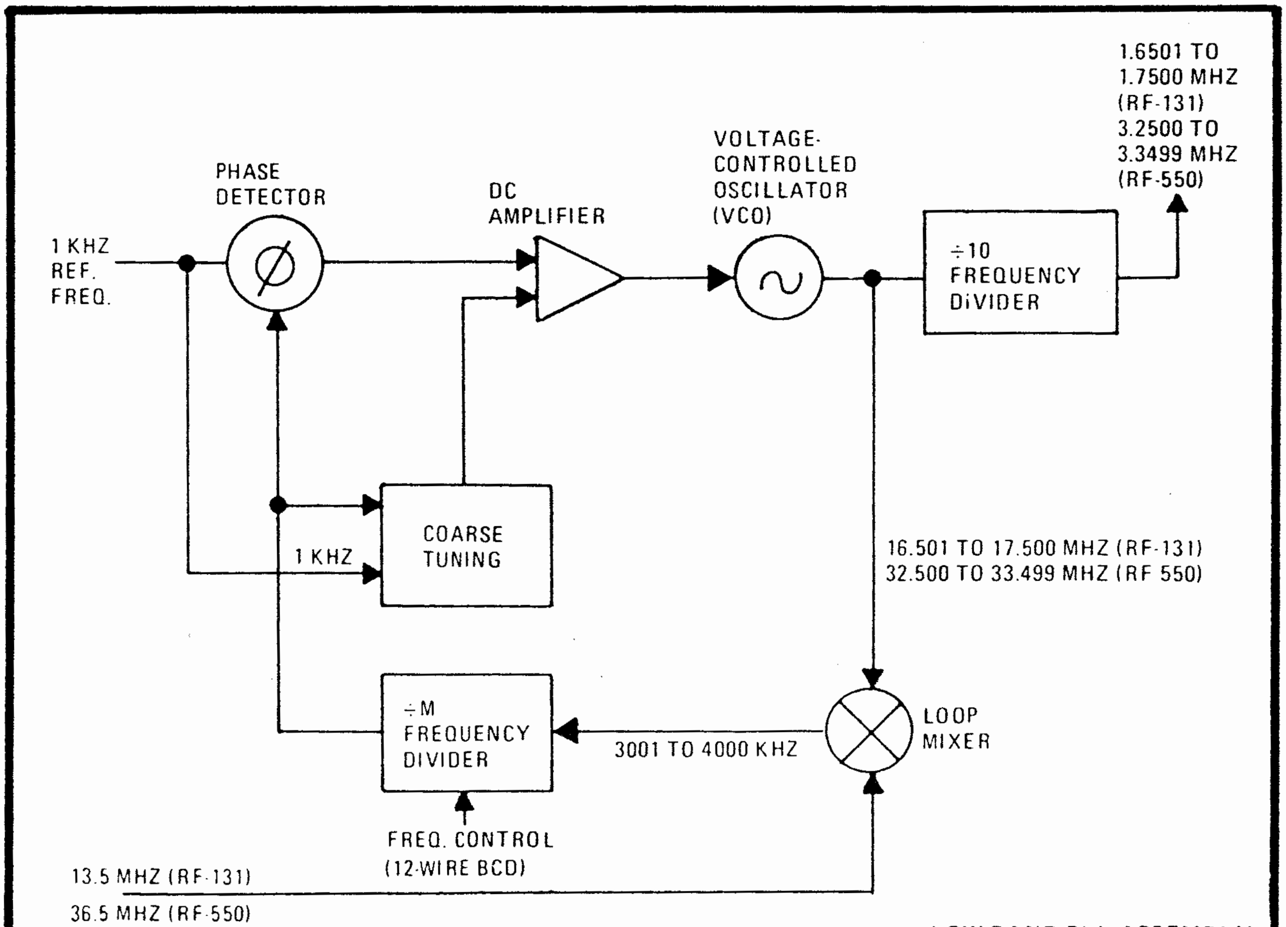
TABLE 2. MAINTENANCE PARTS LIST-Subcarrier Generator Assembly A2A13, PN 1976-4300 (Continued)

Reference Designation	Name and Description
R38	Resistor, Fixed Composition, 12K ±10%, ¼W: Mil type RC07GF123K
R39	Resistor, Fixed Composition, 1K ±10%, ¼W: Mil type RC07GF102K
R40	Resistor, Fixed Composition, 68 Ω ±10%, ¼W: Mil type RC07GF680K
R41	Resistor, Variable, 100 Ω: MFR 35009, PN 156-4-100
R42	Resistor, Fixed Composition, 68 Ω ±10%, ¼W: Mil type RC07GF680K
R43	Resistor, Fixed Composition, 100 Ω ±10%, ¼W: Mil type RC07GF101K
R44	Resistor, Fixed Composition, 3.3K ±10%, ¼W: Mil type RC07GF332K
R45	Resistor, Fixed Composition, 100 Ω ±10%, ¼W: Mil type RC07GF101K
R46	Resistor, Fixed Composition, 3.3K ±10%, ¼W: Mil type RC07GF332K
R47, R48	Resistor, Fixed Composition, 470 Ω ±10%, ¼W: Mil type RC07GF471K
T1 - T4	Transformer, Balanced: MFR 14304, PN 0759-5110-2
XY1-XY4	Socket, Crystal: MFR 91506, PN 8000-AG10-1
Y1, Y2	Crystal, 1.756270 MHz: Mil type CR19A/U 1756.27 kHz
Y3, Y4	Crystal 1.743730 MHz: Mil type CR19A/U 1743.73 kHz
Z1, Z2	Integrated Circuit: MFR 01295, PN SN74L90
Z3	Integrated Circuit: MFR 14304, PN 1976-4330
Z4, Z5	Integrated Circuit: MFR 02735, PN CA3028A
Z6	Integrated Circuit: MFR 01295, PN SN7472N

UNIT INSTRUCTIONS

LOW BAND PLL MODULE

A2A14



LOW BAND PLL ASSEMBLY
A2A14

LOW BAND PLL MODULE A2A14

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1. GENERAL DESCRIPTION

The Low Band Phase Lock Loop (PLL) Module A2A14 is an electrically-tuned frequency synthesizer compatible with both the RF-550 Receiver and the RF-131 Exciter. Refer to the RF PWB Schematic diagram for the strapping changes required to effect interchangeability. The Low Band PLL A2A14, responds to BCD information from the control group to provide 100Hz, 1KHz, and 10KHz control capability. When the module is used with the RF-550, the output Frequency is adjustable in 100Hz steps from 3.25 to 3.3499 MHz. When used in the RF-131, the output is also adjustable in 100Hz steps, however, due to the strapping changes the output range is 1.6501 to 1.7500 MHz. The selected output frequency is phase locked to a reference frequency standard. Low Band PLL module A2A14 contains two major PWB assemblies; ÷M PWB A2A14A1 and RF PWB A2A14A2.

NOTE

In some instances, the integrated circuit part numbers listed herin may differ from those of the equipment supplied. In all instances these parts are the equivalent or better and may be used interchangeably.

2. TECHNICAL CHARACTERIATICS

Weight
1.0 Pound (450 grams)

Dimensions:
4-1/8 in. (H) x 2-1/8 in. (W) x 5-7/8 in. (D)
10.5 cm (H) x 5.4 cm (W) x 14.9 cm (D)

Power Requirements:
+18Vdc at 45mA (RF-131)
+15Vdc at 45mA (RF-550)
+ 5Vdc at 95mA
+ 5Vdc at 306mA (RF-550)
+ 6Vdc at 211mA
− 6Vdc at 4.5mA

Signal Inputs:
13.5MHz fixed at 70mV$_{RMS}$ (RF-131)
36.5MHz at 70mV$_{RMS}$ (±1KHz with VFO) (RF-550)
1kHz fixed at 2V P-P Min. (4V P-P Typical)
12 wires, Binary-Coded-Decimal (BCD) Frequency Control

Signal Outputs:
1.6501 to 1.7500MHz (RF-131)
3.25 to 3.349MHz (RF 550)

Input Impedance:
13.5MHz: 50 ohms
1kHz: 1K ohm

Output Load:
50 ohms

3. SEMICONDUCTOR COMPLEMENT

Table 1 lists all semiconductors used in the Low Band PLL Module, A2A14.

Table 1. SEMICONDUCTOR COMPLEMENT

Reference Designation	Type	Function
A1CR1	1N3064	Bias Diode
Q1	2N2222	Amplifier
Q2	2N5179	Switch
Q3	2N2907	Ramp Generator
Q4	2N2222	Ramp Discharge Switch
Q5	2N2222	Sample Pulse Switch
Q6	3N171	Sampling FET
Q7	1976-4424	Source Follower
Q8	2N2222	Amplifier
U1	0759-5150	Mixer
U2	SN74LS160AN	÷10 Integrated Circuit
U3	SN74LS160AN	÷10 Integrated Circuit
U4	SN74LS160AN	÷10 Integrated Circuit
U5	SN74LS160AN	÷10 Integrated Circuit
U6	SN74LS11N	Triple three-input AND Gate
U7	SN74LS00N	Quad two-input NAND Gate
U9	SN74S112N	Freq. Discriminator Flip-Flop
U10	SN74LS112N	Coarse Tune Flip-Flop
U11	SN74121N	One shot
AR1	8007C	Op Amp
A2CR1	DKV6520B	Voltage Variable Capacitor
Q1	2N5179	Amplifier
Q3	2N5397	FET Oscillator
Q4	2N5179	Buffer Amplifier
U2	SN74S11N	Triple three-input AND Gate
U3	SN74S112AN	÷10 Counter
U4	SN74S112AN	÷10 Counter
U5	UA7812KC	12 Volt Regulator

4. OVERALL CIRCUIT DESCRIPTION

The two basic elements of an elementary phase locked loop frequency synthesizer are a voltage controlled oscillator (VCO) and a phase detector.

The phase detector is a device which yields a Dc output voltage proportional to the phase difference between two input signals. If the inputs to the phase detector are a reference frequency and the VCO Output Frequency and if the phase detector output controls the VCO, then a phase-locked loop is formed in which the phase detector will drive the VCO frequency to equal the Reference Frequency. This is due to the fact that the only stable condition of the loop is when the output of the phase detector is pure Dc, with no Ac component present. This can occur only when the two inputs to the phase detector have the same frequency.

In addition, a phase-locked loop may include a frequency divider in the feedback loop to obtain multiples of the reference frequency from the VCO. Figure 1 shows a simple phase-locked loop with a frequency divider. One input frequency to the phase detector is a stable reference, the other is the divider output. The loop works by forcing the two frequencies to be exactly equal. It does this by electrically tuning the VCO. When the VCO is tuned to the frequency at which $f_o \div M = F_R$, the loop is said to be locked. For example, in the RF-131, assume that the VCO is electrically tunable in the vicinity of 1.7000kHz, that the reference frequency is 1kHz, and that the ÷M ratio is 17000. The feedback of the loop will force the VCO frequency to exactly $f_o = (M)$ (1kHz) = 17000kHz. Other frequencies are synthesized simply by changing the division ration of the ÷M. For example:

X

÷M	Output Frequency*
17002	17002 kHz
17001	17001 kHz
17000	17000 kHz
16999	16999 kHz
16998	16998 kHz

*These numbers apply only to the simplified circuit of Figure 1, not the actual module.

The loop actually used in the Low Band PLL Module A2A14 is similar to the example just given. The addition of a loop mixer (Figure 2) however, reduces the speed requirements of the frequency divider without affecting the principle of operation. A fixed divide-by-ten circuit, following the VCO, scales the VCO frequency down to the desired output range.

In the RF-131 for example, the VCO output frequency to the divider is then 16.501 to 17.500MHz which becomes 3001 to 4000kHz at the output of the loop mixer. This is accomplished by mixing the VCO output with 13.5MHz. It then becomes 1kHz when divided by the frequency divider (÷M) by a ratio between 3001 to 4000.

When used in the RF-550, the VCO output frequency to the divider is 32.5 MHz to 33.49 MHz which becomes 3001 to 4000KHz at the mixer output. This is accomplished by mixing the VCO output with 36.5 MHz. It then becomes 1KHz when divided by the Frequency divider (÷MPWB) by a ratio between 3001 to 4000.

5. DETAILED DESCRIPTION OF ÷M PWB A2A14A1 CIRCUITS

÷M PWB A2A14A1 contains five basic elements of Low Band PLL Module A2A14. These are the loop mixer, ÷M digital counter, sample and hold phase detector, unlock detector, and coarse tune generator.

5.1 Mixer Operation

The loop mixer translates a high frequency from the VCO to a more suitable frequency for the ÷M counter, as described in paragraph 4. The frequencies are 16.501 to 17.50MHz and a reference of 13.5MHz in the RF-131 (32.500 to 33.499 MHz and a reference of 36.5 MHz in the RF-550). The difference of these frequencies lies in 3.00MHz to 4.00MHz region. A low pass filter (C12, L5 and C13) is used after the mixer and amplifier Q1 to provide the necessary drive level to the ÷M frequency divider.

mable decade counters and a fixed ÷4 counter, and has the capability of dividing an applied input signal by any whole number between 3001 and 4000. The status of the counter after a number of clock pulses is shown in Table 2.

Refering to Table 2. The Carry Output column is simply a flag to indicate when the counter has reached a nine (or full) state. It therefore requires ten clock pulses to the input of the counter to achieve one carry output pulse. If the carry line is used as a switch to allow a second counter to operate, the second counter will count only one pulse for every ten pulses into the first counter. Thus, with two decade counters, a divide-by-one hundred frequency division is achieved.

Preloading advances the counter to a given state so that fewer input pulses are needed to achieve the full, or carry state. For example: If the counter is preloaded to the decimal six and then clocked with input pulses, it will count seven, eight, nine, zero and thus achieve a carry in only four input pulses. If the counter is reset to decimal six instead of zero on the next clock pulse after the carry, the device becomes a divide-by-four instead of a divide-by-ten counter. In U2, U3, U4, U5 decade dividers, a load command (low on pin 9) causes preloading to occur on the next clock pulse rather than normal counting. Thus the operation described above (using the divider as a divide-by-four) can be achieved by permanently wiring the data input terminals for a binary six (0110), and connecting the carry output to the load input.

U2, U3, U4 and U5 comprise the ÷M counter (See Figure 6). U2, U3, U4 and U5 are preloaded by 12 data input frequency control lines carrying binary-coded-decimal information. The final counter, U5 is permanently wired with decimal six at U5-3 and U5-6, and functions as a divide-by-four counter. If

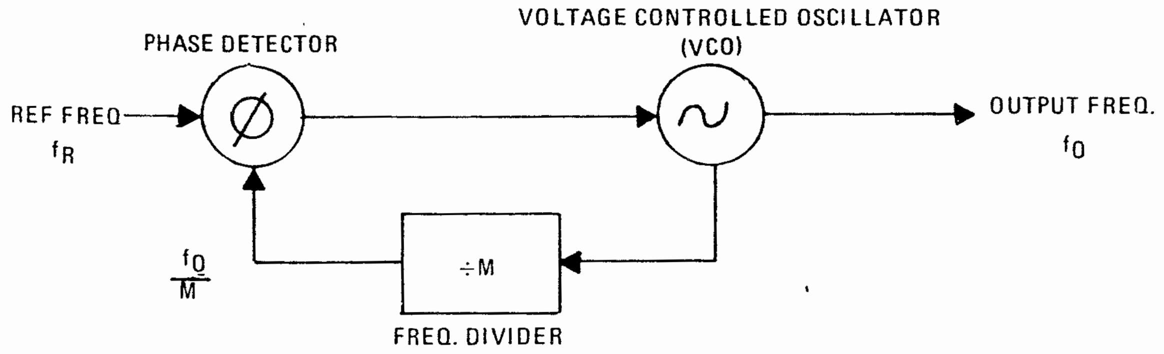


Figure 1. Simple Phase Locked Loop

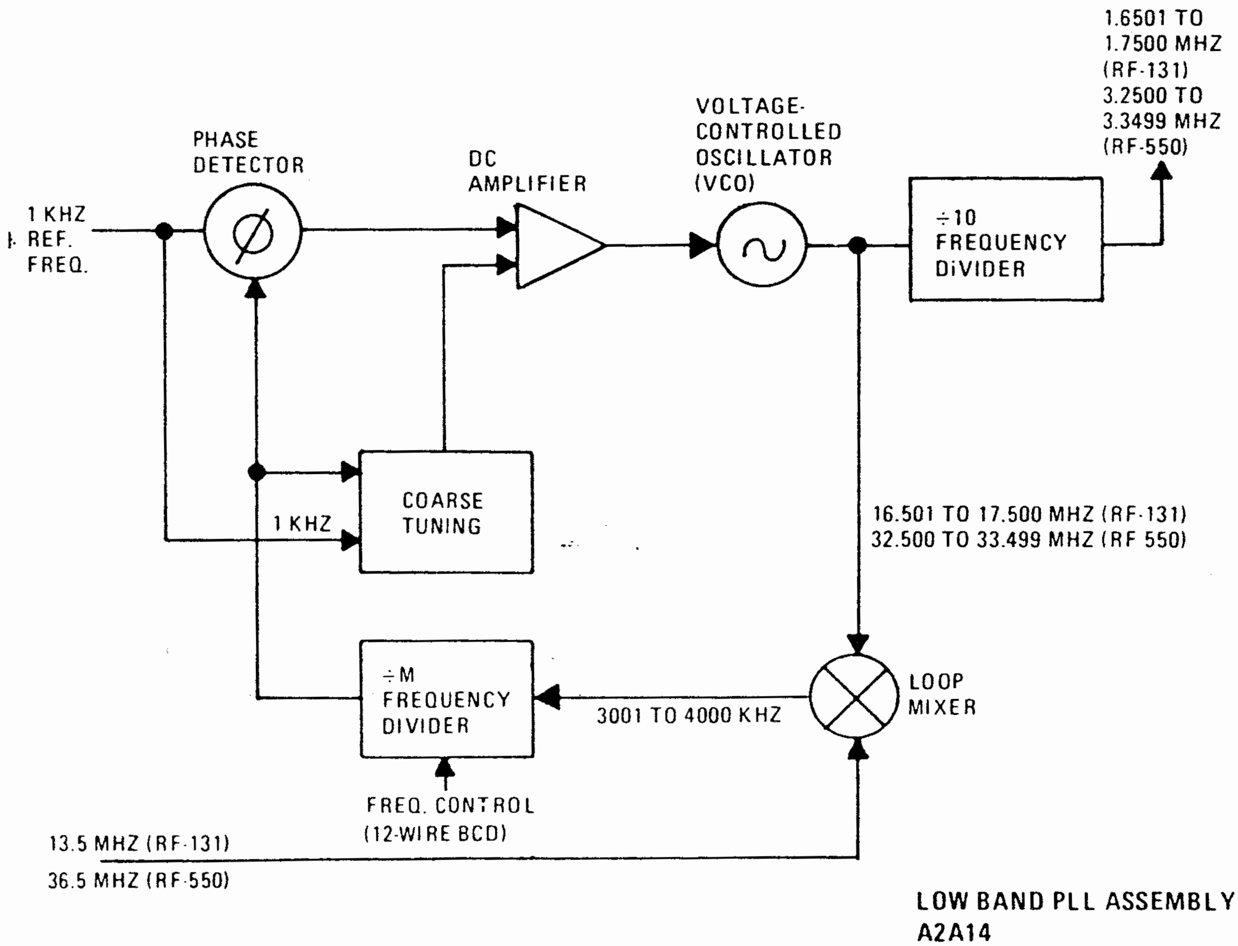


Figure 2. Block Diagram, Low Band PLL

the counter is started at 6000, it counts three divide-by-tens and the fixed divide-by-four yielding a total of 4000. If however, the counter is loaded with 6999, it counts from 6999 to 10.000 for a total count (division ratio) of 3001.

TABLE 2. DECADE DIVIDER CIRCUIT INPUT/OUTPUT DATA

Clock Input Pulses	Counter State	Q_A	Q_B	Q_C	Q_D	Carry Output
0	0	0	0	0	0	0
1	1	1	0	0	0	0
2	2	0	1	0	0	0
3	3	1	1	0	0	0
4	4	0	0	1	0	0
5	5	1	0	1	0	0
6	6	0	1	1	0	0
7	7	1	1	1	0	0
8	8	0	0	0	1	0
9	9	1	0	0	1	1
10	0	0	0	0	0	0
11	1	1	0	0	0	0
12	2	0	1	0	0	0
13	3	1	1	0	0	0

The counters are cascaded at the enable inputs of the U2 through U5. The counters are synchronously clocked and require a "1" level at pin ten (enable input). The carry output from the previous counter provides the high "1" necessary to count. Therefore U2 counts continuously, while U3 counts when it receives a carry input from U2, and likewise with U4 and U5. AND gates U6A, U6B and NAND gate U7A, detect a full condition of each of the counters and drives the load inputs low. A low level on a load input forces the counter to the state defined by the levels on the ABCD inputs (pins 3-6), at the next clock pulse regardless of the counter's present state.

5.3 Phase Detector Operation

The phase detector consists of ramp generator Q3, R13, and C22, sampling FET Q6 and hold capacitor C23. The phase detector receives two inputs; a reference signal consisting of narrow pulses at a rate of 1kHz, and a sample signal consisting of short pulses at a rate determined by the VCO frequency and the divider ratio. By referring to the timing diagram (Figure 3), the operation of the phase detector can be understood.

If the loop is locked, both reference and sample pulses to the phase detector will be 1kHz, and should occur in alternating sequence as shown.

The difference between the pulses represents the phase error from the phase detector output.

Flip-flop U9A (Figure 6) is set on the negative edge of the 1kHz reference pulse causing switch Q2 to enable a ramp to be generated by charging C22 through Q3. When a sample pulse arrives from the ÷M output (U7B), flip-flop U9A is cleared, causing switch Q2 to stop the ramp at whatever voltage is on C22 at that time. At the same instant, the sample pulse enables switch Q5 and Q6 which transfer the voltage on C22 to C23. Since C22 is twice the value of C23 the voltage on C22 will change only slightly while C23 will increase or decrease to achieve the same level as C22.

Ramp capacitor C22 is discharged by switch Q4 on the next positive reference pulse and the cycle is complete. Source follower Q7 provides a high impedance load to storage capacitor C23, so that it won't discharge between sample pulses. When the loop is locked, the voltage on capacitor C23 remains almost constant, changing only by the amount necessary to correct for VCO frequency changes. The loop thus constantly compensates to maintain the correct output frequency phase locked to the reference standard.

5.4 Unlock Detector Course Tune Generator Operation

The unlock detector utilizes a frequency discriminator comprising flip-flops U9 and U10, and NAND gates U7C and U7D. Flip-flop U9A is clocked by reference pulses from U11-6 and cleared by sample pulses from the divider output at U7B-6. Flip-flop U9B is clocked by sample pulses from the divider output at U6B-6 and cleared by reference pulses from U11D-1. When the loop is locked, the flip-flops are cleared after each set (clock) pulse. This ensures the output of NAND gates U7C and U7D always are high since each input goes low before the other goes high.

If, however, the divider output frequency is higher, for example, sample pulses will occur faster than reference pulses. It now becomes possible for NAND gate U7D to "see" sample pulses while flip-flop U9B is in the set (high "1") state. This causes negative going pulses at U7D-3 which clock Flip-Flop U10-A. When flip-flop U10-A is set, its

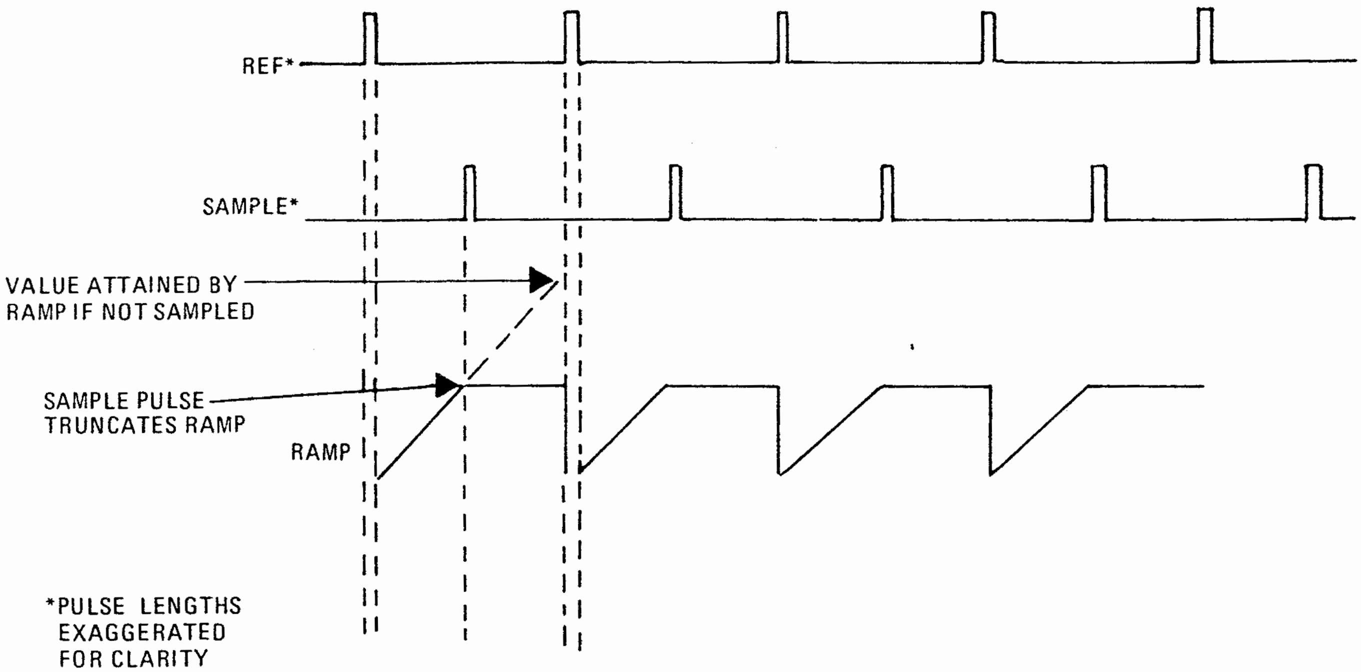


Figure 3. Phase Detector Timing Diagram

high output signal becomes the coarse tune output at A1E19 and is fed to the VCO as coarse tune information. Flip-flop U9A will receive more clear pulses than clock pulses and ensure a high state at NAND gate U7C-11.

If, the divider output should shift lower in frequency, it becomes possible for NAND gate U7C to "see" reference pulses while flip-flop U9A is in the set state. This causes negative pulses at U7C-11 which clear flip-flop U10A. NAND gate U7D is high, since flip-flop U9B is cleared more than clocked and thus will not receive a clock pulse while in the set state. The low output from flip-flop U10A becomes the coarse tune output at A2A14 A1E19.

6. DETAILED DESCRIPTION OF RF PWB A2A14A2 CIRCUITS

RF PWB A2A14A2 contains the voltage controlled oscillator loop amplifier, final output scaling divide-by-ten counter, and a 12 Volt Dc supply for the module.

6.1 VCO Operation

See Figure 8. The Dc output from the phase detector of the ÷M PWB A2A14A1 is fed through Dc amplifier AR1. The coarse tune signal is also fed to Dc amplifier AR1 and causes either a positive or negative swing from AR1-6 when the coarse tune signal changes state during an unlocked condition. A change in state of the coarse tune circuitry of ÷M PWB causes a voltage swing at AR1-3. In the locked state, the coarse tune signal remains constant and the output from AR1-6 is controlled by the phase error voltage input. R3, R4 and C5 shape AR1's frequency response to stabilize the loop.

The oscillator itself uses Q3 in common gate configuration. The oscillator frequency is determined principally by a combination of C18, L7, C37 and CR1. Positive feedback and output coupling for the oscillator is provided by capacitive voltage divider C25 and C20. Nominal frequency range is determined by L7 and its associated capacitors, while C18 provides a mechanical frequency adjustment. Electrical tuning is by means of voltage variable capacitor CR1.

VCO output is amplified by Q1 and fed back to the loop mixer of ÷M PWB where it is processed to produce a Dc phase detector output to control the oscillator frequency. The VCO output is also fed through buffer amplifier Q4, which feeds a fixed divide-by-ten counter, scaling the VCO output frequency of 1.6501 and 1.75000MHz in the RF-131 (32.500 to 33.499 in the RF-550).

6.2 Output Scaling Counter Operation

The final divide-by-ten circuitry (U2, U3 and U4) receives the frequencies (16.501 to 17.500MHz for the RF-131, 32.500 to 33.499 MHz for the RF-550) in 1KHz steps, which appear as 100Hz steps at the module output. For example, in the RF-131 if the final divide-by-ten circuitry receives 16.600 MHz, the output will be (16.600 MHz ÷ 10), or 1.6600MHz. If the VCO now shifts 1KHz in the positive direction, the divide-by-ten circuitry will receive 16.601MHz, and the module output becomes 1.6601 MHz (16.601MHz ÷ 10), for an increment of 100Hz. In the RF-550 for example, assume the final divide-by-ten circuitry receives 33.300 MHz, the output will be 33,300 ÷ 10 for a frequency of 3.3300. With a VCO shift of 1KHz in the positive direction, the divide-by-ten circuitry receives 33.301 MHz which is seen as 3.3301 MHz (33.301 MHz ÷ 10) at the module output, again an increment of 100Hz. Potentiometer R2 allows for output level adjustment, and a Lowpass Filter is used to convert the divider TTL output to a sinusoidal form at A2A14A2E9.

Terminals A2E13 and A2E14 are connected together. The cathode end of CR1 is tied to 12Vdc through R35 and R18, and its anode voltage is controlled through amplifier AR1. The loop operation can best be explained through an example. If the VCO tries to shift higher in frequency, the output of the loop mixer will also shift higher because the VCO input to the mixer is higher than the reference input. This increases the sample rate to the phase detector, lowering the phase error voltage. The phase error voltage is fed to the inverting terminal of AR1. A decreasing phase error voltage raises the output level of AR1 and the voltage level of the anode of CR1. This decreases the voltage across CR1, increasing its capacitance and lowering the VCO frequency, thus completing a negative feedback loop. Should the ÷ M ratio change, the exact same sequence occurs except the VCO is forced to a new frequency. Thus the phase detector output once again has no Ac component.

The module uses its own + 12Vdc supply obtained by 12V regulator U5 from the + 18Vdc input at A2A14P1-M.

7. LOW BAND PLL MODULE A2A14 FREQUENCY OUTPUT

The frequency of the module output will be:

f_o = 1750.0kHz − 0.1kHz x last 3 digit switches. (RF-131)

f_o = 3250.0kHz + 0.1kHz x last 3 digit switches. (RF-550)

For example: The Frequency Selector Digit switches read:

0 2 1 5 6 3

Therefore f_o = 1750.0kHz − 0.1kHz x 563
= 1750.0kHz − 56.3kHz
= 1693.7kHz (RF-131)

f_o = 3250.0kHz − 0.1KHz x 563
= 3250.0KHz − 56.3KHz
= 3306.3KHz (RF-550)

8. ADJUSTMENT/ALIGNMENT DATA

Adjustment of Low Band PLL Module A2A14 will be required if the VCO does not lock on frequency within one-half second, from resetting one of the last three frequency selector digit switches, or if the module jumps in and out of lock. By measuring the voltage at A2A14A2TP1, the Dc voltage will decrease in incremental steps from approximately 6.6 Vdc in the RF-131 (8.2Vdc in the RF550), at the XXX999 switch setting, to approximately 1.0Vdc in the RF-131 (4.0Vdc RF-550) at XXX000 setting. Lock is indicated by a steady frequency at the module output, and ramps which truncate at the same Dc level at A2A14A1TP1, as shown in figure 4.

Test equipment required is Tektronix Model 453 Oscilloscope, or equivalent, with a 10X probe for reduced circuit loading, an RF Milivoltmeter, alignment tool (JFD No. 5284, or equivalent); and a small screwdriver.

8.1 Alignment Procedure

a. Set frequency selector digit switches at "000" and connect an oscilloscope to A2A14A1TP1. Adjust the oscilloscope to read approximately 1ms per division - horizontal and 1 Volt per division - vertical.

b. Adjust A2A14A2R1 and/or A2A14A2C18 so that all successive ramps at A2A14A1TP1 truncate at the same Dc level. This indicates that the loop is locked.

c. Disconnect the oscilloscope at A2A14A1TP1 and connect it to A2A14A2TP1.

d. Adjust A2A14A2C18 so that the voltage at A2A14A2TP1 equals + 1 Volt (RF-131) or 4 Volts (RF-550) and the loop remains locked.

e. Disconnect the oscilloscope at A2A14A2TP1 and connect it to A2A14A1TP1.

NOTE

When the loop is locked, all ramps truncate at the same level. However, the loop must be able to lock at two different levels, high and low, as shown in Figure 4.

f. Adjust A2A14A2R1 so that high state lock conforms to that shown in Detail A of Figure 4 and low state lock conforms to that shown in Detail B.

NOTE

High or low state lock can be obained by switching the 10kHz switch back and forth between 9 and 0. It does not matter whether high or low state lock occurs at any particular frequency, in fact, a frequency may lock high one time and low another.

g. In the RF-131 adjust A2A14A2R2 to yield 89mV_{RMS} at the 18.3±0.05MHz output of the Special Frequencies Module A2A10A2E5. For the RF-550 measure the level at A2A14A2-E9 and adjust A2A14A2R2 for 70mV.

9. MAINTENANCE PARTS LIST

Table 3 lists the electronic parts for Low Band PLL Module A2A14, PN 1976-4400. Manufacturers are referenced by a five-digit code. For a complete list of manufacturers' codes and addresses, refer to the General Information Section.

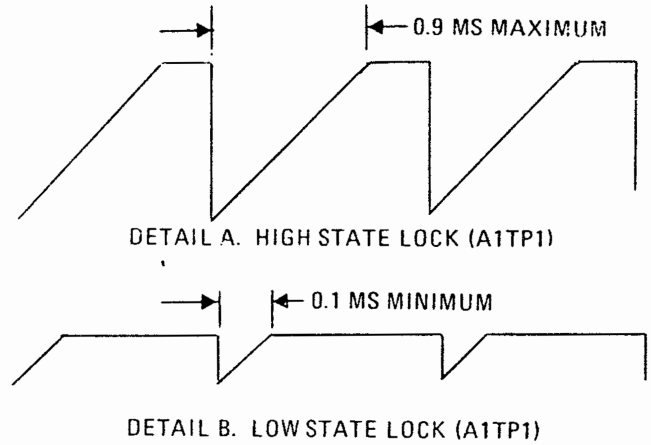
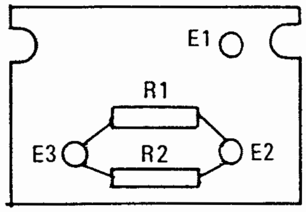


Figure 4. Ramp Waveshapes at A2A14A1TP1-Properly Adjusted Module



NOTE: RESISTORS A2A14R1 AND A2A14R2 ARE ASSEMBLED TO PLATE ASSEMBLY A2A14A3.

Figure 5. Plate Assembly A2A14A3, PN 1928-4245 Component Locations

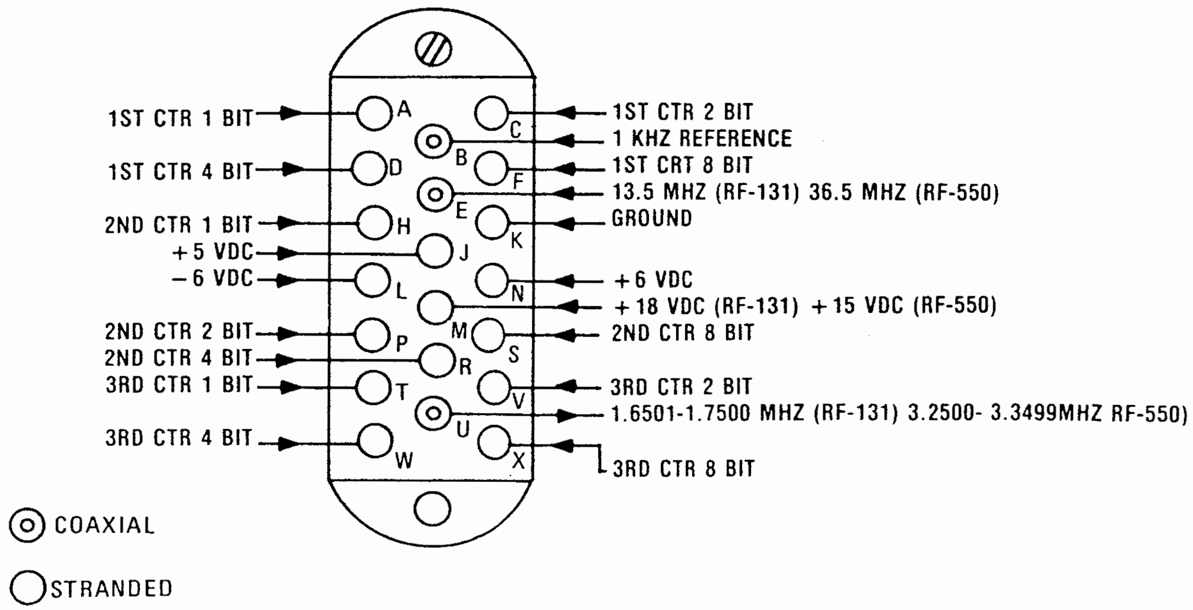


Figure 6. Module Chassis Connector A2J14 Top View

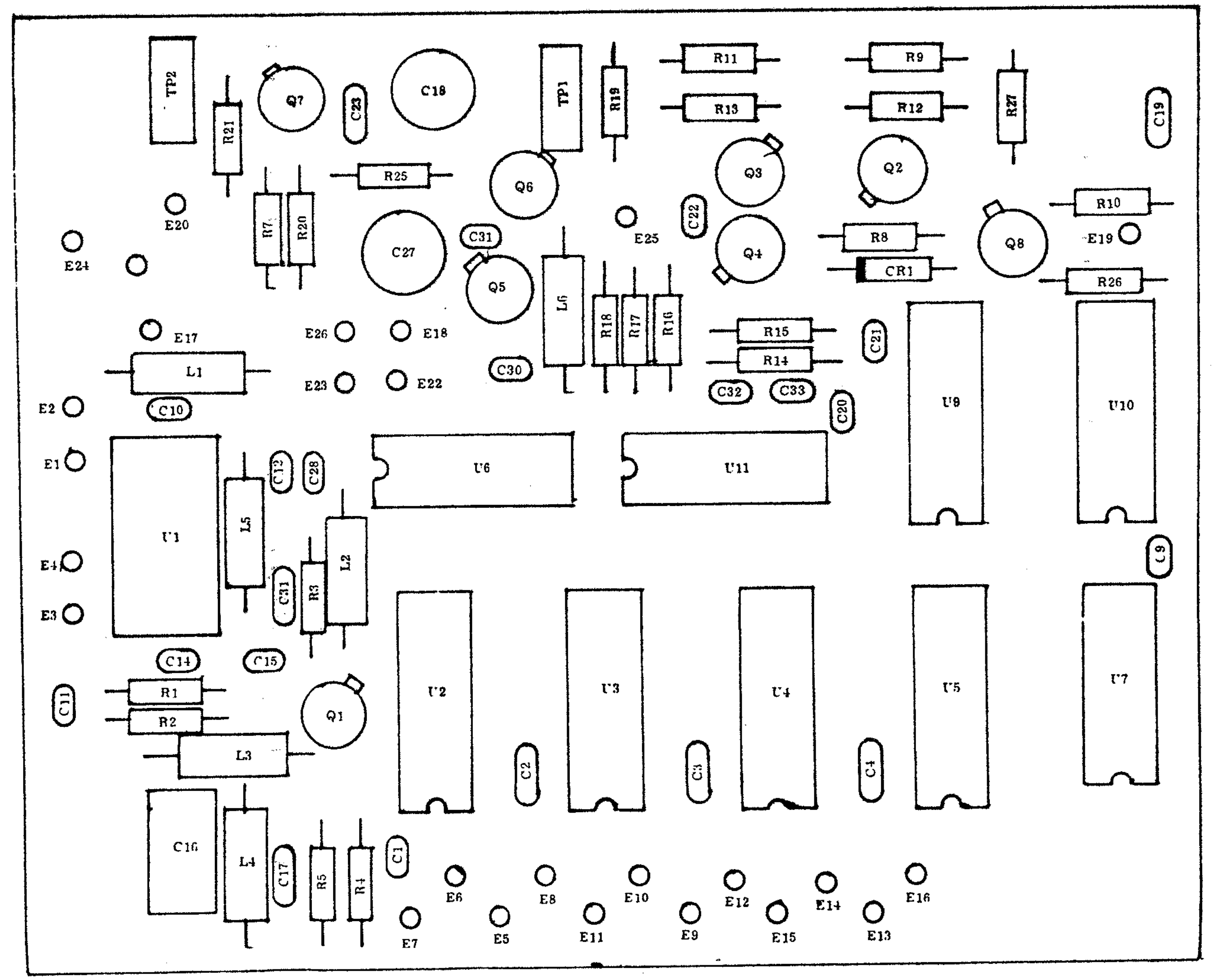
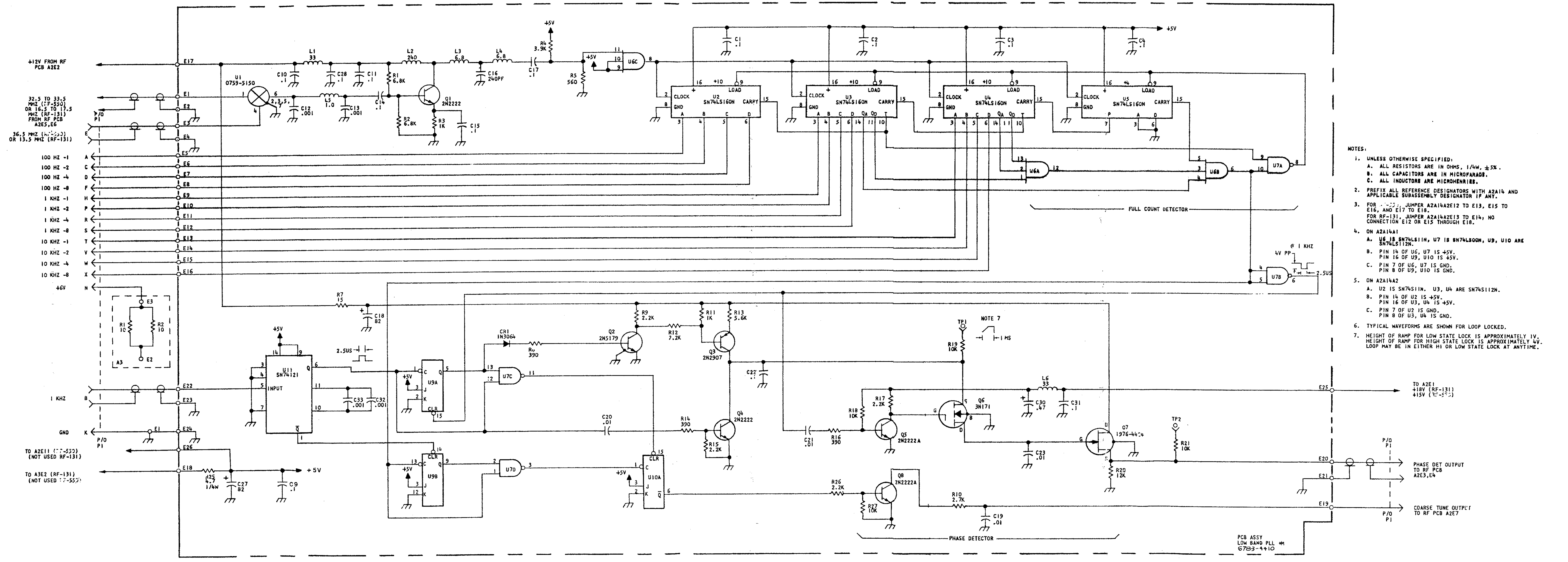


Figure 7. Low Band PLL Module ÷M PWB Component Location



6783-4401

Figure 8. Low Band PLL Module ÷M PWB Schematic Diagram

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   - A. ALL RESISTORS ARE IN OHMS, ¼ WATT.
   - B. ALL CAPACITORS ARE IN MICROFARADS.
2. PREFIX INCOMPLETE REFERENCE DESIGNATORS WITH A2A14 PLUS SUB-ASSEMBLY DESIGNATOR IF ANY.
3. FOR RF-550, JUMPER A2A14A2E12 TO E13, E15 TO E16, AND E17 TO E18.
4. FOR RF-131, JUMPER A2A14A2E13 TO E14, NO CONNECTION AT E12, OR E15 THROUGH E18.
5. REFER TO TABLE 1 FOR LISTING OF SEMICONDUCTOR TYPES
6. WAVE FORMS ARE SHOWN FOR LOCKED LOOP.
7. HEIGHT OF RAMP FOR LOW LOCK STATE IS APPROXIMATELY 1V. HEIGHT OF RAMP FOR HIGH LOCK STATE IS APPROXIMATELY 4V. LOOP MAY BE IN HIGH OR LOW LOCK STATE AT ANY TIME.

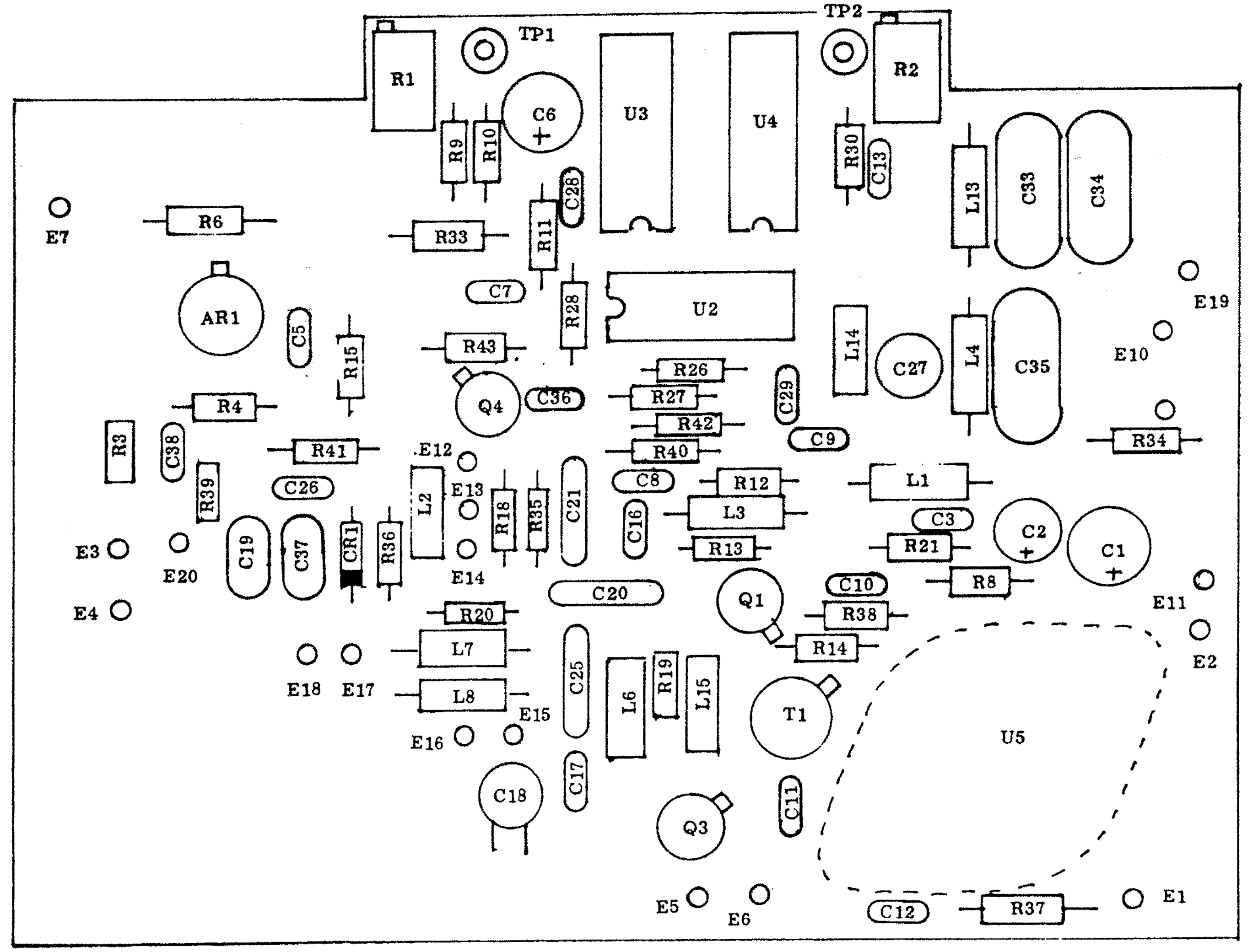
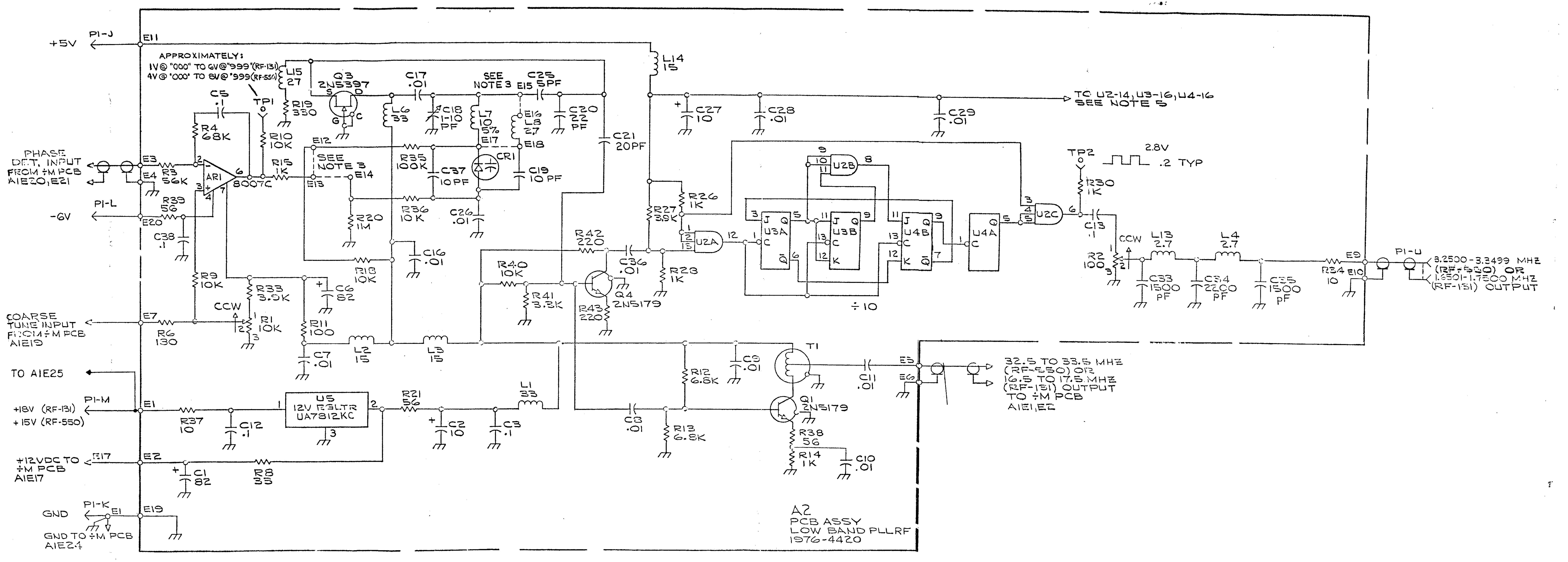


Figure 9. Low Band PLL Module-RF PWB Component Location



6783-4401

Figure 10. Low Band PLL Module-RF PWB Schematic Diagram

MAINTENANCE PARTS LIST-A2A14 Low Band PLL

Reference Designation	Name and Description
A2A14	Low Band Phase-Locked Loop Module: MFR 14304, PN 1976-4400
P1	Connector, Module: MFR 81312, PN MRAC20PN
	Pins, Connector, Coaxial, Male: MFR 81312, PN 100-80005
	Pins, Connector, Straight, Male: Mil type MS17803-16-20
R1, R2	Resistor, Fixed Composition, 10 Ω ± 10%, ¼W: Mil type RC07GF100J
A2A14A1	÷M: PWB Assembly, Low Band PLL MFR 14304, PN 6783-4410
C1-C4	Capacitor, Fixed Ceramic, 0.1 uF: MFR 14304, PN C11-0005-104
C9-C11	Same as A1C1
C12, C13	Capacitor, Fixed Ceramic, 0.001 uF: MFR 14304, PN C11-0005-102
C14, C15	Capacitor, Fixed Ceramic, 0.1 uF: MFR 14304, PN C11-0005-104
C16	Capacitor, Fixed Ceramic, 240 pF: Mil type CM05FD241J03
C17	Capacitor, Fixed Ceramic, 0.1 uF: MFR 14304, PN C11-0005-104
C18	Capacitor, Fixed Ceramic, 82 uF: MFR 31433, PN T368C826M015AS
C19-C21	Capacitor, Fixed Ceramic, 0.01 uF: MFR 14304, PN C11-0005-103
C22	Capacitor, Fixed Ceramic, 0.1 uF: MFR 14304, PN C11-0005-104
C23	Capacitor, Fixed Ceramic, 0.01 uF: MFR 14304, PN C11-0005-103
C24-C26	Not Used
C27	Capacitor, Fixed Ceramic, 82 uF: MFR 31433,PN T368C826M015AS
C28	Capacitor, Fixed Ceramic, 0.1 uF: MFR 14304, PN C11-0005-104
C29	Not Used
C30	Capacitor, Fixed Ceramic, .47 uF: MFR 14304, PN C-6419
C31	Capacitor, Fixed Ceramic, 0.1 uF: MFR 14304, PN C11-0005-104
C32, C33	Capacitor, Fixed Ceramic, .001 uF: MFR 14304, PN C11-0005-102
CR1	Diode, Mil type 1N3064

Reference Designation	Name and Description
L1, L6	Inductor, 33 uH: MFR 99800, PN1537-51
L2	Inductor, 240 uH: MFR 99800, PN 1537-94
L3, L4	Inductor, 6.8 uH: MFR 99800, PN 1537-32
L5	Inductor, 1.0 uH: MFR 99800, PN 1537-12
Q1	Transistor, NPN: Type 2N2222
Q2	Transistor, NPN: Type 2N5179
Q3	Transistor, PNP: Type 2N2907
Q4, Q5	Transistor, NPN: Type 2N2222
Q6	Transistor, FET: Type 3N171
Q7	Transistor, FET: MFR 14304, PN 1976-4424
Q8	Transistor, NPN: Type 2N2222
R1, R2	Resistor, Fixed Composition, 6.8K ± 10%, ¼W: Mil type RC07GF682J
R3	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102J
R4	Resistor, Fixed Composition, 3.9K ± 10%, ¼W: Mil type RC07GF392J
R5	Resistor, Fixed Composition, 560 Ω ± 10%, ¼W: Mil type RC07GF561J
R6	Not Used
R7	Resistor, Fixed Composition, 15 Ω ± 10%, ¼W: Mil type RC07GF150J
R8	Resistor, Fixed Composition, 390 Ω ± 10%, ¼W: Mil type RC07GF391J
R9	Resistor, Fixed Composition, 2.2K ± 10%, ¼W: Mil type RC07GF222J
R10	Resistor, Fixed Composition, 2.7K ± 10%, ¼W: Mil type RC07GF272J
R11	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102J
R12	Resistor, Fixed Composition, 2.2K ± 10%, ¼W: Mil type RC07GF222J
R13	Resistor, Fixed Composition, 5.6K ± 10%, ¼W: Mil type RC07GF562J
R14	Resistor, Fixed Composition, 390 Ω ± 10%, ¼W: Mil type RC07GF391J
R15	Resistor, Fixed Composition, 2.2K ± 10%, ¼W: Mil type RC07GF222J
R16	Resistor, Fixed Composition, 390 Ω ± 10%, ¼W: Mil type RC07GF391J

MAINTENANCE PARTS LIST-A2A14 Low Band PLL (Continued)

Reference Designation	Name and Description
R17	Resistor, Fixed Composition, 2.2K ±10%, ¼W: Mil type RC07GF222J
R18, R19	Resistor, Fixed Composition, 10K ±10%, ¼W: Mil type RC07GF103J
R20	Resistor, Fixed Composition, 12K ±10%, ¼W: Mil type RC07GF123J
R21	Resistor, Fixed Composition, 10K ±10%, ¼W: Mil type RC07GF103J
R22-R24	Not Used
R25	Resistor, Fixed Composition, 4.7 Ω ±5%, ¼W: Mil type RC07G4R7J
R26	Resistor, Fixed Composition, 2.2K ±5%, ¼W: Mil type RC07G222J
R27	Resistor, Fixed Composition, 10K ±5%, ¼W: Mil type RC07GF103J
TP1	Jack, Test Point: MFR 14304, J60-0001-008
TP2	Jack, Test Point: MFR 14304, J60-0001-002
U1	Mixer: MFR 14304, PN 0759-5150
U2-U5	Integrated Circuit Counter: MFR 01295, PN SN74LS160AN
U6	Integrated Circuit, AND Gate: MFR 01295, PN SN74LS11N
U7	Integrated Circuit, NAND Gate: MFR 14304, PN I01-0048-000
U9, U10	Integrated Circuit, Flip-Flop: MFR 01295, PN SN74S112N
U11	Integrated Circuit, Multivibrator: MFR 01295, PN SN74121N
A2A14A2	RF: PWB Assembly, Low Band PLL, MFR 14304, PN 1976-4420
AR1	Integrated Circuit, Op Amp: MFR 32293,PN 8007C
C1	Capacitor, Fixed, 82 uF, ± 20%, MFR 12954, PN D82GS1D15M
C2	Capacitor, Fixed, 10 uF: MFR 12954, PN T362C106M035AS
C3	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%: MFR 14304, PN C11-0005-104
C4	Not Used

Reference Designation	Name and Description
C5	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%: MFR 72982, PN 8121-100-X7R-104K
C6	Capacitor, Fixed, 82 uF: MFR 31433, PN T368C826M015AS
C7-C11	Capacitor, Fixed Ceramic, 0.01 uF, ± 20%: MFR 14304, PN C11-0005-103
C12, C13	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%: MFR 14304, PN C11-0005-104
C14, C15	Not Used
C16, C17	Capacitor, Fixed Ceramic, 0.01 uF, ± 20%: MFR 14304, PN C11-0005-103
C18	Capacitor, Variable, 1-10 pF, ± 10%: MFR 73899, PN VAJ605
C19	Capacitor, Fixed Ceramic, 10 pF, ± 10%: Mil type CM05CD100J03
C20	Capacitor, Fixed Ceramic, 22 pF, ± 10%: Mil type CM05ED220J03
C21	Capacitor, Fixed Ceramic, 20 pF, ± 10%: Mil type CM05CD200J03
C22-C24	Not Used
C25	Capacitor, Fixed Ceramic, 5 pF, ± 10%: Mil type CM05CD050D03
C26	Capacitor, Fixed Ceramic, 0.01 uF, ± 20%: MFR 14304, PN C11-0005-103
C27	Capacitor, Fixed Ceramic, 10 uF, ± 20%: MFR 12954, PN T362C106M035AS
C28, C29	Capacitor, Fixed Ceramic, 0.01 uF, ± 20%: MFR 14304, PN C11-0005-103
C30-C32	Not Used
C33	Capacitor, Fixed Ceramic, 1500 pF, ± 10%: Mil type CM06FD152J03
C34	Capacitor, Fixed Ceramic, 2200 pF, ± 10%: Mil type CM06FD222J03

MAINTENANCEPARTS LIST-A2A14 Low Band PLL (Continued)

Reference Designation	Name and Description
C35	Capacitor, Fixed Ceramic, 1500 pF, ± 10%: Mil type CM05Fd152J03
C36	Capacitor, Fixed Ceramic, 0.01 uF, ± 20%: MFR 14304, PN C11-0005-103
C37	Capacitor, Fixed Ceramic, 10 pF, ± 10%: Mil type CM05CD100J03
C38	Capacitor, Fixed Ceramic, 0.1 uF, ± 20%: MFR 14304, PN C11-0005-104
CR1	Diode: MFR 17540, PN DKV6520B
L1	Inductor, 33 uH: MFR 99800, PN 1537-51
L2, L3	Inductor, 15 uH: MFR 99800, PN 1537-40
L4	Inductor, 2.7 uH: MFR 99800, PN 1537-22
L5	Not Used
L6	Inductor, 33 uH: MFR 99800, PN 1537-51
L7	Inductor, 10 uH: MFR 99800, PN 1537-36-5%
L8	Inductor, 2.7 uH: MFR 99800, PN 1537-22
L9-L12	Not Used
L13	Inductor, 2.7 uH: MFR 99800, PN 1537-22
L14	Inductor, 15 uH: MFR 99800, PN 1537-40
L15	Inductor, 27 uH: MFR 99800, PN 1537-47
Q1	Transistor, NPN: Type 2N5179
Q2	Not Used
Q3	Transistor, FET: Type 2N5397
Q4	Transistor, NPN: Type 2N5179
R1	Resistor, Variable Potentiometer, 10K: MFR 32997, PN 3299X-1-103
R2	Resistor, Variable Potentiometer, 100 Ω: MFR 32997, PN 3299X1-101
R3	Resistor, Fixed Composition, 56K ± 10%, ¼W: Mil type RC07GF563J
R4	Resistor, Fixed Composition, 68K ± 10%, ¼W: Mil type RC07GF683J

Reference Designation	Name and Description
R5	Not Used
R6	Resistor, Fixed Composition, 180 Ω ± 10%, ¼W: Mil type RC07GF181J
R7	Not Used
R8	Resistor, Fixed Composition, 33 Ω ± 10%, ¼W: Mil type RC07GF330J
R9, R10	Resistor, Fixed Composition, 10K ± 10%, ¼W: Mil type RC07GF103J
R11	Resistor, Fixed Composition, 100 Ω ± 10%, ¼W: Mil type RC07GF101J
R12, R13	Resistor, Fixed Composition, 6.8K ± 10%, ¼W: Mil type RC07GF682J
R14, R15	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102J
R16, R17	Not Used
R18	Resistor, Fixed Composition, 10K ± 10%, ¼W: Mil type RC07GF103J
R19	Resistor, Fixed Composition, 330 Ω ± 10%, ¼W: Mil type RC07GF331J
R20	Resistor, Fixed Composition, 1M Ω ± 10%, ¼W: Mil type RC07GF105J
R21	Resistor, Fixed Composition, 56 Ω ± 10%, ¼W: Mil type RC07GF560J
R21-R25	Not Used
R26	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102J
R27	Resistor, Fixed Composition, 3.9K ± 10%, ¼W: Mil type RC07GF392J
R28	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102J
R29	Not Used
R30	Resistor, Fixed Composition, 1K ± 10%, ¼W: Mil type RC07GF102J
R31, R32	Not Used
R33	Resistor, Fixed Composition, 3.9K ± 10%, ¼W: Mil type RC07GF392J
R34	Resistor, Fixed Composition, 10 Ω ± 10%, ¼W: Mil type RC07GF100J
R35	Resistor, Fixed Composition, 100K ± 10%, ¼W: Mil type RC07GF104J
R36	Resistor, Fixed Composition, 10K ± 10%, ¼W: Mil type RC07GF103J
R37	Resistor, Fixed Composition, 10 Ω ± 10%, ¼W: Mil type RC07GF100J

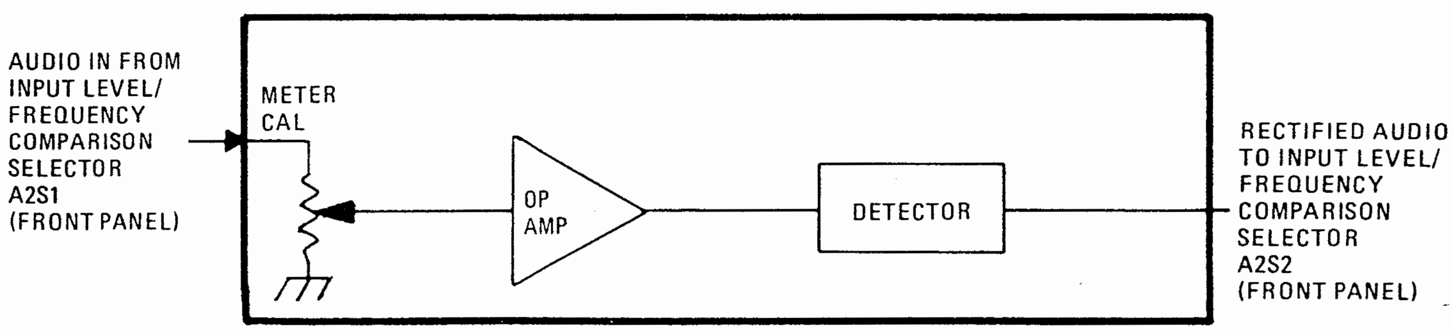
MAINTENANCE PARTS LIST-A2A14 Low Band PLL

Reference Designation	Name and Description
R38, R39	Resistor, Fixed, Composition, 56 ohms, ±5%, ¼W: MIL Type RC07GF560J
R40	Resistor, Fixed, Composition, 10K, ±5%, ¼W: MIL Type RC07GF103J
R41	Resistor, Fixed, Composition, 3.3K, ±5%, ¼W: MIL Type RC07GF332J
R42, R43	Resistor, Fixed, Composition, 220 ohms, ±5%, ¼W: MIL Type RC07GF221J
TP1	Test Point PWB: MFR 74970, PN 105-0851-001
TP2	Test Point PWB: MFR 74970, PN 105-0852-001

UNIT INSTRUCTIONS

METER AMPLIFIER

A2A15



METER AMPLIFIER A2A15

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1. GENERAL DESCRIPTION

Meter Amplifier A2A15 amplifies and rectifies an audio input signal from the selected Sideband Generator Module (A2A1, A2A2, A2A3, or A2A4) to provide a Dc signal input to the front panel INPUT LEVEL/FREQUENCY COMPARISON Meter A2M1. Thus, the Dc-operated meter provides an indication of the audio (Ac) signal output of the selected Sideband Generator Module.

Audio output from the selected Sideband Generator Module is routed through the applicable front panel INPUT LEVEL Control (A2R2 or A2R3 for Model RF-131-122 and -123 Exciters; A2R1, A2R2, A2R3, or A2R4 for Model RF-131-126 Exciter) and the front panel INPUT LEVEL/FREQUENCY COMPARISON Selector A2S2 to the input of Meter Amplifier A2A15. The output of Meter Amplifier A2A15 is routed back through A2S2 to the front panel INPUT LEVEL/FREQUENCY Meter A2M1.

NOTE

Refer to Figure 1 of the A2A1/A2A2/A2A3/A2A4 Sideband Generator Section audio circuit routing.

All functional components of Meter Amplifier A2A15 are mounted to its PWB, which is in turn mounted on the back of the front panel.

2. TECHNICAL CHARACTERISTICS

Dimensions: 2.0 in. x 3.0 in. (5.08 cm x 7.62 cm)

Power Requirements: 18Vdc at 10mA

Input Signal Level: 44mV_{RMS} for center scale deflection of INPUT LEVEL/FREQUENCY COMPARISON Meter A2M1 Output Signal Level: 100μa for full-scale meter deflection

3. SEMICONDUCTOR COMPLEMENT

Table 1 lists all the semiconductors used in Meter Amplifier A2A15.

TABLE 1. SEMICONDUCTOR COMPLIMENT

Reference Designation	Type	Function
A2A15AR1	130-001-003	Operational Amplifier
A2A15CR1	1N914	Part of Detector/Voltage Doubler rectifying circuit
A2A15CR2	1N914	Part of Detector/Voltage Doubler rectifying circuit
A2A15CR3	1N914	Reduces gain variations (along with resistor R7)
A2A15CR4	HP5082-2800	Meter protector

4. CIRCUIT DESCRIPTIONS

Refer to Figure 2. The input audio signal is applied at Terminal E1 and routed through capacitor C1 and meter calibration potentiometer and resistor R2 to operational amplifier AR2. The audio signal is amplified by AR1 and routed, via C2, to detector/voltage-doubling diodes CR1 and CR2. Components R7 and CR3 reduce gain variations due to temperature fluctuations. Components C4 and R8 filter the audio signal. Hot carrier diode CR4 protects the front panel meter from excessive drive levels.

5. METER AMPLIFIER A2A15 ADJUSTMENT

Adjustment of the meter calibration potentiometer A2A15R1 should be accomplished when the board is either repaired or replaced. Proceed as follows:

a. Connect an audio signal generator to any one of the audio connectors at the rear of the exciter (A1J1, A1J2, A1J3, or A1J4, depending on the Sideband Generator Module(s) being used in the exciter).

b. Set front panel INPUT LEVEL/FREQUENCY COMPARISON Selector A2S2 to the position of the sideband channel being used (A1, B1, A2, or B2).

c. Rotate INPUT LEVEL Control for the channel being used, fully clockwise (A1R1, A1R2, A1R3, or A1R4).

d. Adjust audio signal generator to provide a 1000Hz at 44mV_{RMS} input.

e. Adjust meter calibration potentiometer A2A15R1 to obtain center scale deflection on front panel INPUT LEVEL/FREQUENCY COMPARISON Meter A2M1.

f. Disconnect audio signal generator.

6. MAINTENANCE PARTS LIST

Table 2 lists the electronic components of Meter Amplifier A2A15, PN 6722-4500. Manufacturers are referenced by a five-digit code. For a complete listing of manufacturer's names and addresses, refer to Table 6-3 in Part 6 of the General Information Section of this manual.

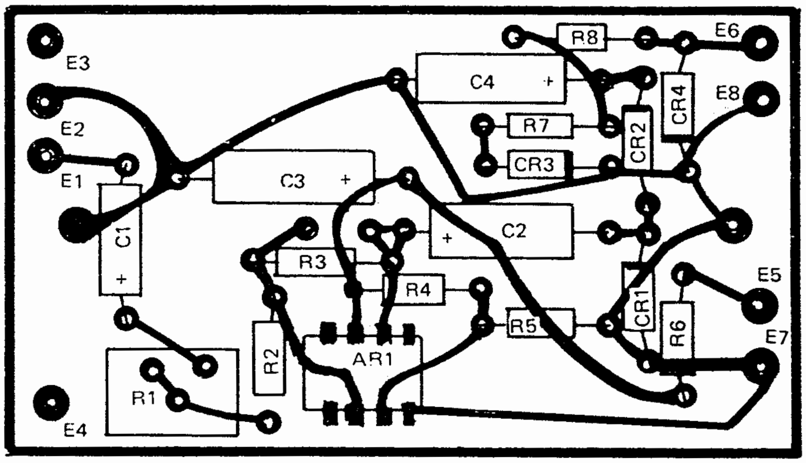
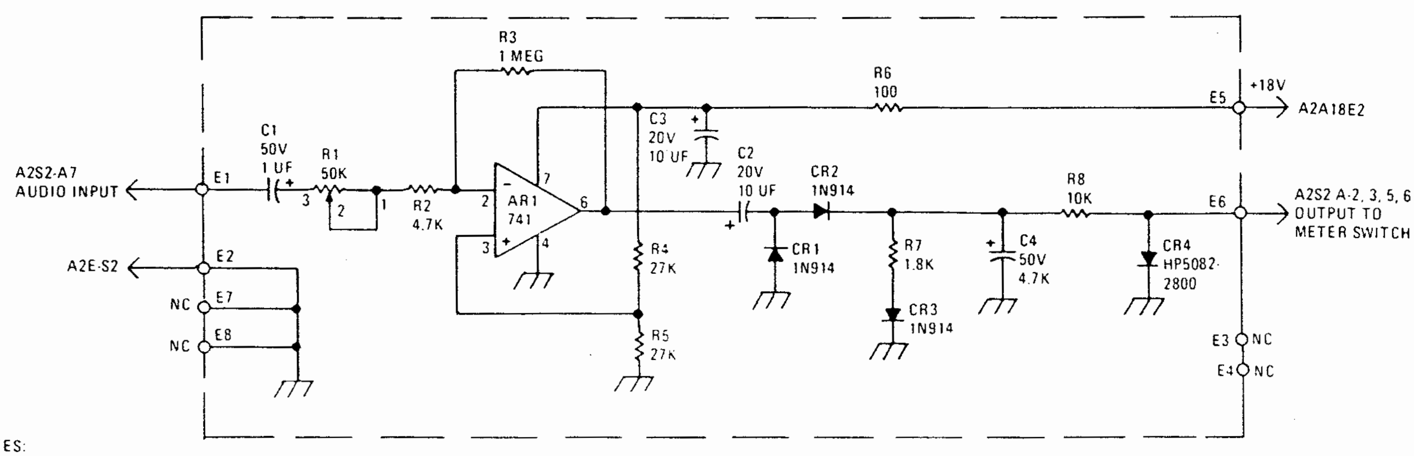


Figure 1. Meter Amplifier PWB, Component Location



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/4W, 10%
2. PREFIX ALL INCOMPLETE REF DESIGNATIONS WITH A2A15

Figure 2. Meter Amplifier, Schematic Diagram

MAINTENANCE PARTS LIST-A2A15 Meter Amplifier

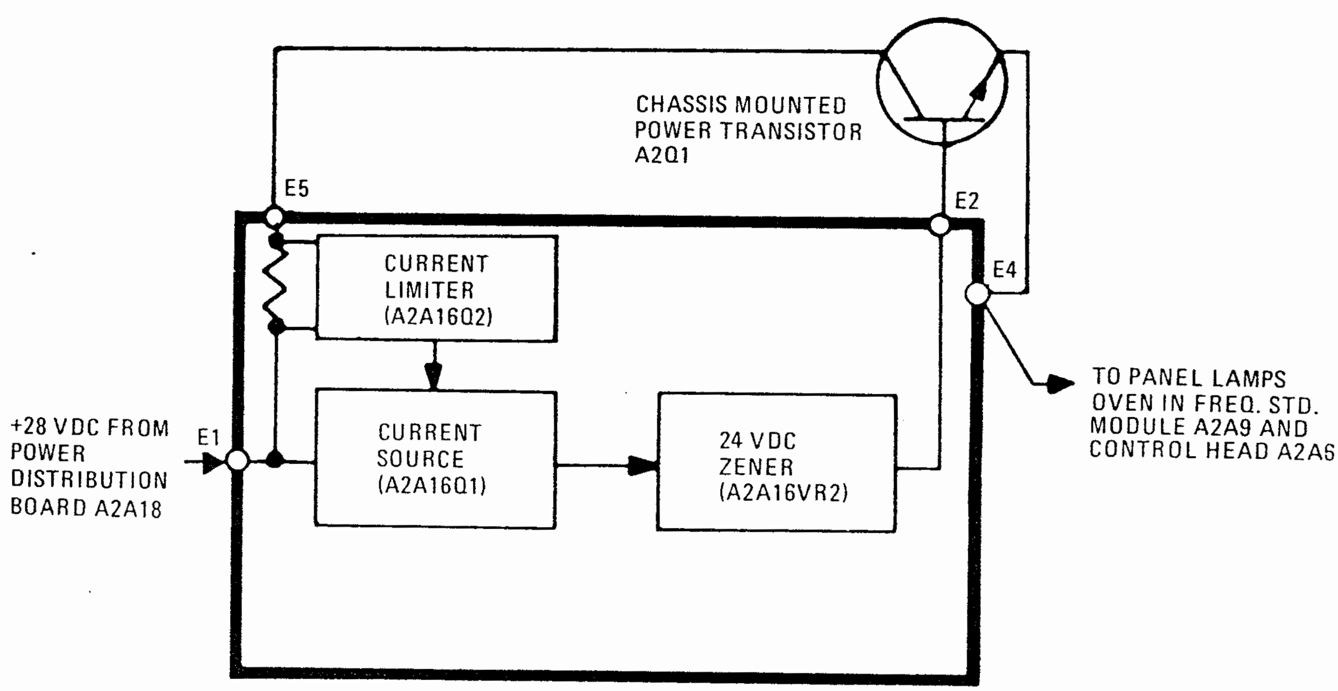
Reference Designation	Name and Description
A2A15	Meter Amplifier PWB Assembly: MFR 14304, PN 6722-4500
AR1	Op Amplifier: MFR 14304, PN 130-0001-003
C1	Capacitor, Fixed Tantalum, 1 uF, 50 V: Mil type M39003/01-2357
C2, C3	Capacitor, Fixed Tantalum, 10 uF, 20 V: Mil type M39003/01-2287
C4	Capacitor, Fixed Tantalum, 4.7 uF, 50 V: Mil type M39003/01-2369
CR1-CR3	Diode: Mil type 1N914
CR4	Diode, Hot Carrier: MFR 50444, PN HP5082-2800

Reference Designation	Name and Description
R1	Resistor, Variable, Right Angle, 50K ±10%, ¼W: MFR 06486, PN 156-4-50K
R2	Resistor, Fixed Composition, 4.7K ±5%, ¼W: Mil type RC07GF472J
R3	Resistor, Fixed Composition, 1M Ω ±5%, ¼W: Mil type RC07GF105J
R4, R5	Resistor, Fixed Composition, 27K ±5%, ¼W: Mil type RC07GF273J
R6	Resistor, Fixed Composition, 100 Ω ±5%, ¼W: Mil type RC07GF101J
R7	Resistor, Fixed Composition, 1.8K ±5%, ¼W: Mil type RC07GF182J
R8	Resistor, Fixed Composition, 10K ±5%, ¼W: Mil type RC07GF103J

UNIT INSTRUCTIONS

OVEN/LIGHT REGULATOR

A2A16



OVEN/LIGHT REGULATOR A2A16

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1. GENERAL DESCRIPTION

Over/Light Regulator A2A16 provides a zener regulated voltage to the heater of the temperature-regulated oven of the 1MHz oscillator of Frequency Standard Module A2A9. The zener +24Vdc output is also used to light the front panel lamps, and for various applications in Control Head A2A6.

The Oven/Light Regulator circuit components are mounted on a small PWB attached to the underside of the main chassis. The circuit also includes power transistor A2Q1, which is also mounted on the main chassis beneath Frequency Standard Module A2A9.

2. TECHNICAL CHARACTERISTICS

Power Requirements (including Power Transistor A2Q1): +28Vdc unregulated input at 800mA

Output Voltage: +24Vdc ± 2Vdc zenered

3. CIRCUIT DESCRIPTION

Refer to Figure 2. Unregulated +28Vdc from Power Supply Module A2A11 (via Power Distribution Board A2A18) is applied to Terminal El of the regulator. A 2.7Vdc Zener Diode, VR1, provides a fixed bias for current source transistor A2A16Q1, compensating for variations in input voltage.Transister A2A16Q1 provides a constant current to Zener Diode VR2, resistor R3, and the base of Power Transistor A2Q1. Zener Diode VR2 provides a fixed +24Vdc bias to A2Q1. Current Limiter transistor Q2 allows the power supply to continue operating at a limited current without damage should any overload, including a short circuit, occur. The emitter of A2Q1 is connected to Terminal E4 of the regulator. This terminal is the +24Vdc output point of the regulator, and supplies voltage for the applications described in paragraph 1.

TABLE 1. OVEN/LIGHT REGULATOR A2A16 TRANSISTOR VOLTAGE DATA

Transistor Reference Designator	Base Voltage	Emitter Voltage	Collector Voltage
A2A16Q1	35 Vdc	36 Vdc	24 Vdc
A2A16Q2	38 Vdc	38 Vdc	35 Vdc

4. OVER/LIGHT REGULATOR A2A16 TRANSISTOR VOLTAGE DATA

Typical voltages for the transistors of the regulator are given in Table 1. Measurements were taken with a Simpson Type 260 Multimeter.

5. ADJUSTMENTS

There are no adjustments in Oven/Light Regulator A2A16. If the Internal Frequency Standard of Frequency Standard Module A2A9 requires adjustment, refer to the applicable section in this manual.

6. MAINTENANCE PARTS LIST

Table 2 lists the electronic components of Oven/Light Regulator A2A16. Manufacturers are referenced by a five-digit code. For a complete listing of manufacturer's names and addresses, refer to table 6-3 in Part 6 of the General Information Section of this manual.

TABLE 2. MAINTENANCE PARTS LIST-OVEN/LIGHT REGULATOR A2A16

Reference Designation	Name and Description
A2A16	Ovenlight Regulator PWB Assembly: MFR 14304, Pn 0759-5725
C1	Capacitor, Fixed Ceramic,.1 uF: MFR 14304, PN C11-0005-104
C2	Not Used
C3	Capacitor, Fixed Tantalum, 6.8 uF, 35V: Mil type CSR13F685ML
MP1	Oven/Light Regulator,PWB:: MFR 14304, PN 0759-5726
MP2	Heat Sink, for Transistor Q1: MFR 05820, PN 2606SH5E
Q1, Q2	Transistor, PNP: Mil type 2N4235
R1	Resistor, Fixed Composition, 47 Ω ± 10%, ¼W: Mil type RC07GF470K
R2	Resistor, Fixed Composition, 2.7K ± 10%, 1W: Mil type RC32GF272K
R3	Resistor, Fixed Composition, 27K ± 10%, ¼W: Mil type RC07GF273K
R4	Resistor, Wirewound, 0.68 Ω ± 10%, 2W: MFR 35009, PN BWH-2W-0.68 Ω ± 10 %
VR1	Diode, Zener, 2.7V: Mil type 1N4371A
VR2	Diode, Zener, 5W, 24V: Mil type 1N5359B

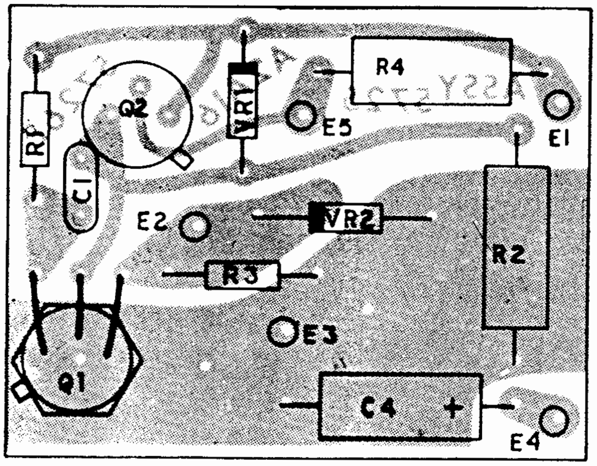


Figure 1. Oven/Light Regulator PWB A2A16 Component Location

NOTES:
1. TRANSISTOR A2Q1 IS LOCATED ON THE MAIN CHASSIS, BENEATH MODULE A2A9.
2. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTANCE VALUES ARE IN OHMS ± 10%, 1/4W.
   B. ALL CAPACITANCE VALUES ARE IN MICROFARADS.

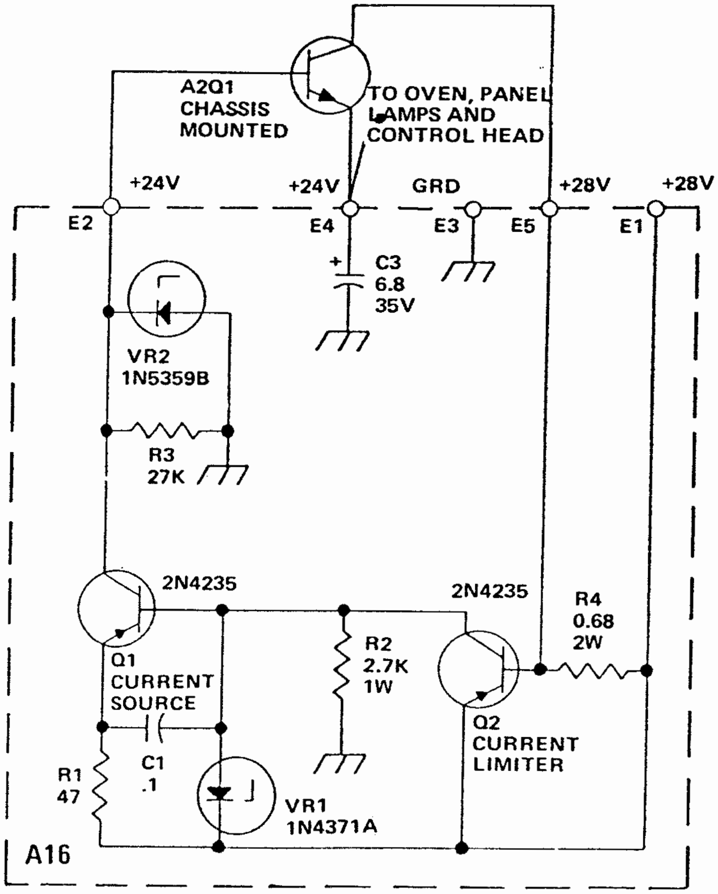
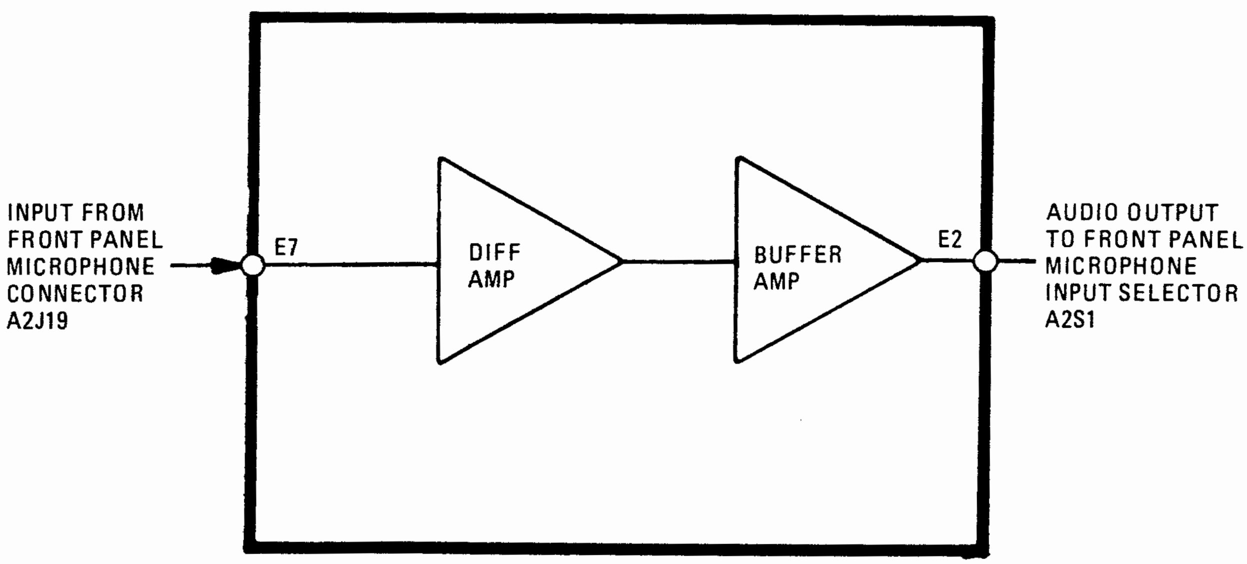


Figure 2. Oven/Light Regulator PWB A2A16 Schematic Diagram

UNIT INSTRUCTIONS

MICROPHONE AMPLIFIER

A2A17



MICROPHONE AMPLIFIER A2A17

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1. GENERAL DESCRIPTION

Microphone Amplifier A2A17 amplifies the incoming audio signal originating at the system microphone. The amplifier components are mounted on a single-sided board attached to the underside of the main chassis.

2. TECHNICAL CHARACTERISTICS

Input Power Requirements:

−6Vdc at 3.2mA
+6Vdc at 5.9mA

3. CIRCUIT DESCRIPTION

The audio input signal enters Microphone Amplifier A2A16 at Terminal E7 and is applied to the input of differential amplifier Z1 at Z1-6. Ac feedback between Z1-9 and Z1-6 stabilizes the amplifier. Bypass capacitor C7 prevents oscillations. The amplified audio output at Z1-11 is applied to the base of emitter follower transistor Q1. The output of Q1 (and its associated components...a buffer amplifier) is routed to output Terminal E2. (The output of Microphone Amplifier A2A17 is routed to the front panel MICROPHONE Input Selector A2S1, where it can be routed to the desired operational mode.)

4. SEMICONDUCTOR VOLTAGE DATA

Semiconductor voltage data for a typical Microphone Amplifier A2A17 is given in Table 1. Measurements were taken with a Simpson Model 260 VOM, while normal Dc voltages were being applied.

5. MAINTENANCE PARTS LIST

Table 2 lists the electronic components of Microphone Amplifier A2A17. Manufacturers are referenced by a five-digit code. For a complete listing of manufacturer's names and addresses, refer to Table 6-3 in Part 6 of the General Information Section of this manual.

TABLE 2. MAINTENANCE PARTS LIST-MICROPHONE AMPLIFIER A2A17

Reference Designation	Name and Description
A2A17	Microphone Amplifier PWB Assembly: MFR 14304, PN 0759-5715
C1	Capacitor, Fixed Tantalum, 10 uF, 20V: Mil type CSR13E106ML
C2	Capacitor, Fixed Tantalum, 100 uF, 20V: Mil type CSR13E107ML
C3	Same as C1
C4	Same as C2
C5, C6	Same as C1
C7	Capacitor, Fixed Mica, 100 pF: Mil type CM05FD101J03
C8	Capacitor, Fixed Ceramic, .01 uF: MFR 72982, PN 8121-050-651-103M
MP1	PWB: MFR 14304, PN 0759-5716
Q1	Transistor, NPN: MFR 21921, PN 2N4123
R1, R2	Resistor, Fixed Composition, 560 Ω ±10%, ¼W: Mil type RC07GF561K
R3, R4	Resistor, Fixed Composition, 1K ±10%, ¼W: Mil type RC07GF102K
R5	Resistor, Fixed Composition, 56K ±10%, ¼W: Mil type RC07GF563K
R6	Resistor, Fixed Composition, 100 Ω ±10%, ¼W: Mil type RC07GF101K
R7	Resistor, Fixed Composition, 4.7K ±10%, ¼W: Mil type RC07GF472K
R8	Resistor, Fixed Composition, 6.8K ±10%, ¼W: Mil type RC07GF682K
R9	Same as R3
R10	Same as R6
Z1	Integrated Circuit: MFR 21921, PN CA3004

TABLE 1. MICROPHONE AMPLIFIER A2A16 SEMICONDUCTOR VOLTAGE DATA

Transistor A2A17Q1	Emitter +2.65 Vdc				Base +3.35 Vdc				Collector +6 Vdc			
Differential Amplifier A2A17Z1	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9	Pin 10	Pin 11	Pin 12
	0 Vdc	Gnd	−5.6Vdc	−5.6Vdc	−5.6Vdc	0 Vdc	0 Vdc	0 Vdc	+4.8Vdc	+6.0Vdc	+4.8Vdc	0Vdc

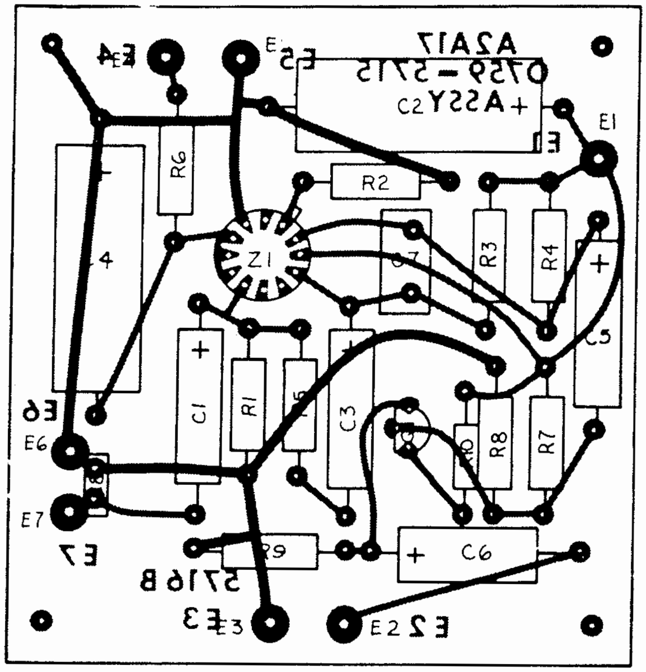
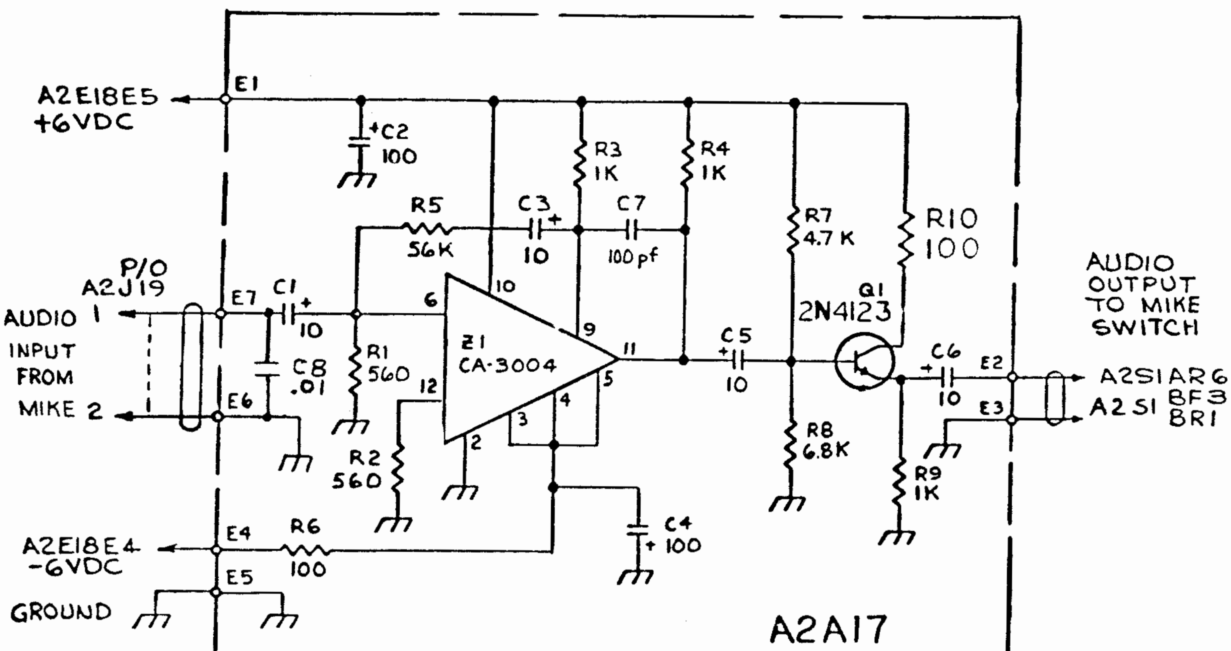


Figure 1. Microphone Amplifier PWB A2A17 Component Locations



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   - A. ALL RESISTORS ARE IN OHMS, 1/4 W, 10%.
   - B. ALL CAPACITORS ARE IN MICROFARADS.
2. PREFIX ALL INCOMPLETE REF. DESIGNATIONS WITH A2A17.

Figure 2. Microphone Amplifier PWB A2A17 Schematic Diagram

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