INSTRUCTION MANUAL

FOR

ELECTROMAGNETIC INTERFERENCE/ FIELD INTENSITY METER MODEL NM-17/27

Manual No. 1-500783-255 (Rev. A)

(For use with serial numbers 101 and above)
Serial No. ___________

This manual refers directly to serial numbers 151 and above. Appendix A, Manual Backdating Information adapts this manual to serial numbers 101 thru 150.

Notice – Sections of this instrument are protected by U.S. patent No. 3710249 (Jan 9, 1973)

1st Print 4/73
Revision A 6/74
Reprint 6/78 Lib

THE SINGER COMPANY
LOS ANGELES OPERATION
5340 Alla Road, Los Angeles, California, 90066

WARRANTY

THE SINGER COMPANY, LOS ANGELES OPERATION, (SELLER) warrants each new instrument to be free from defects in material and workmanship, effective after delivery to the original purchaser as follows:

TCXO Oscillator .... 2 Years
Electrical and Electronic Measuring Instruments....... 1 Year

Repair or replacement (at our option) without charge (F.O B. factory) will be effected when our examination satisfactorily indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuses, lamps, thermoelements, and RatioTran potentiometers are excluded from warranty coverage. Warranty returns must first be authorized by the factory.

If the instrument or any portion thereof, has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, the warranty is void.

This warranty is in lieu of all other warranties, express or implied INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY, or fitness for a particular purpose. In no event shall the SELLER be liable for INCIDENTAL OR CONSEQUENTIAL damages. The SELLER neither assumes, nor authorizes any person to assume for it, any other liability in connection with sales of instruments manufactured by SELLER.

With respect to repairs, the foregoing warranty shall apply for a period of ninety days to the repaired portion.

THE SINGER COMPANY, LOS ANGELES OPERATION
5340 Alla Road, Los Angeles, California 90066

REPAIR AND MAINTENANCE

Instruments should be returned only on prior authorization from the Singer Representative or the factory. You will be advised of detailed shipping instructions at that time. Return the instrument to the factory Prepaid. Validity of warranty will be determined by the factory.

Chargeable repairs: If requested, an estimate of charges will be made prior to repairs. Please provide us with the following information in order to expedite the processing of your instrument:

1. Model or Type
2. Serial Number
3. Description of trouble(1)
4. Approximate date instrument was placed in operation.
5. Approximate number of hours in use.
6. Has maintenance action been previously requested.
7. Other comments.

(1) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken and any other relevant data.

CONTENTS

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

APPENDIX

TABLES

ILLUSTRATIONS

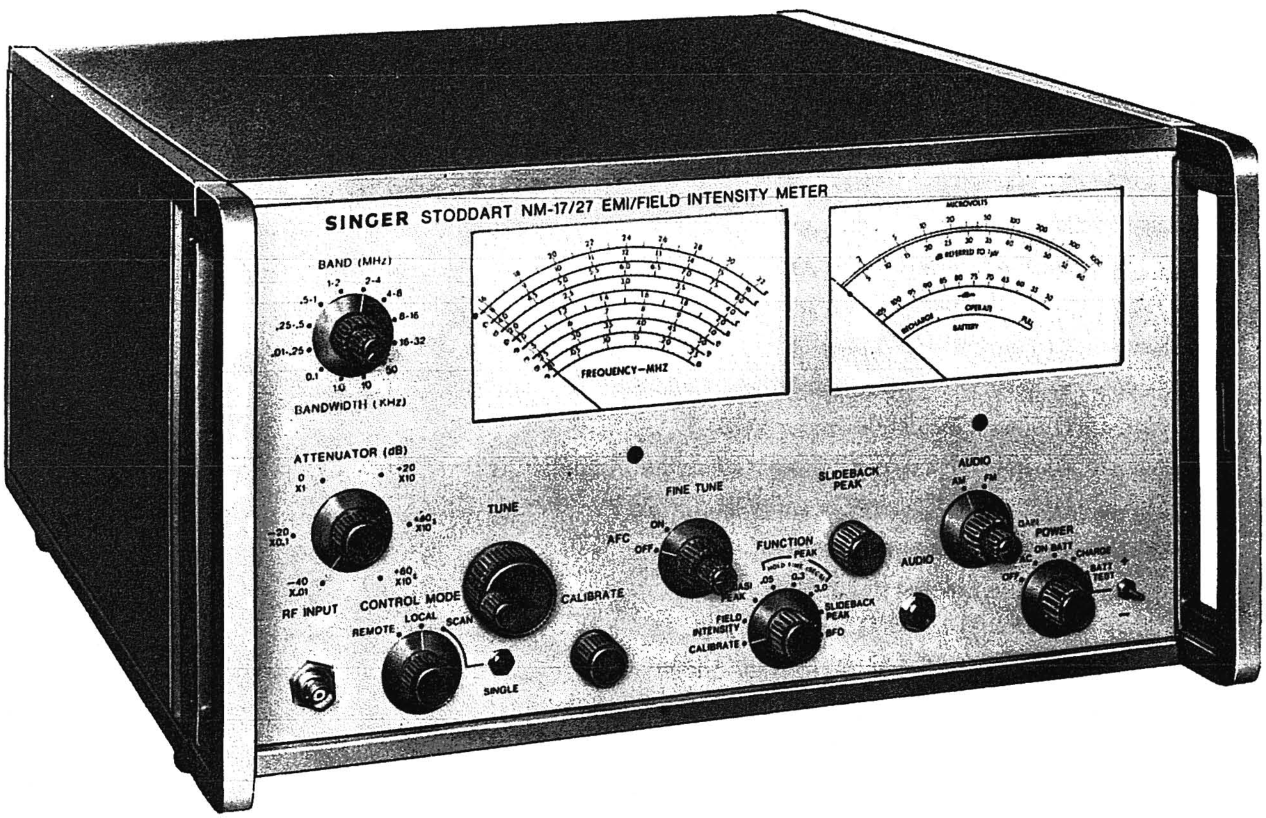


Figure 1—1. Electromagnetic Interference/Field Intensity Meter Model NM-17/27

Section I
INTRODUCTION

1.1 SCOPE OF MANUAL

This manual provides operation and maintenance information for the Model NM-17/27 Electro-magnetic Interference/Field Intensity (EMI/FI) Meter (Figure 1-1). The manual is divided into eight sections containing a general description of the equipment and accessories, specifications, installation information, operating instructions, operating theory, maintenance information, schematic diagrams and a parts list.

1.2 PURPOSE AND USE OF EQUIPMENT

The Model NM-17/27 is a programmable, precision electromagnetic interference/field intensity (EMI/FI) meter for the measurement of conducted or radiated RF interference, within the frequency range of 10 kHz to 32 MHz in accordance with standard military and commerical EMI test specifications. The instrument performs automatic and semiautomatic testing when supplied with appropriate command signals and provides outputs of signal amplitude and frequency that are suitable for input to a digital data processing system. Some typical applications of the Model NM-17/27 are:

a. Determining the presence, level, frequency, and characteristics of conducted or radiated RF signals within the frequency range of 10 kHz to 32 MHz.

b. Automatic and semiautomatic EMI testing in accordance with military specifications, such as; MIL-STD-461A amd MIL-STD-826A, FCC rules and regulations, and other related specifications.

c. Spectrum signature recording when connected to an X-Y plotter.

d. Measurement of radiation from a component, system, or vehicle.

e. General laboratory applications as a tunable, programmable, two-terminal microvoltmeter.

f. RF current measurement in a conductor.

g. Antenna propagation studies, radiation pattern and field strength measurements.

h. Measurement of the susceptibility of electronic equipment to an electromagnetic environment.

i. Analyzing bandpass, band rejection, and discriminating characteristics of electronic components, circuitry, and systems.

j. Determination of shielding effectiveness.

1.3 GENERAL DESCRIPTION

The instrument is rugged and portable, and operates from internal, rechargeable batteries. It is an ideal unit for use in conjunction with a simple, lightweight computer and recorder, to form a high-speed, high-volume, mobile test station.

The instrument may be used to analyze narrowband or broadband signals within its frequency range. Field intensity or direct peak detector functions may be used for measurements in addition to quasi-peak, slideback peak and BFO detection modes. AM, FM and PM signals may be detected and are available at the video output receptacle for oscilloscope display. When used in conjunction with an oscilloscope, the Model NM-17/27 becomes an improved spectrum analyzer with integral pre-selection.

Exceptional gain flatness is inherent in the design of the Model NM-17/27. This feature permits X-Y plotting of signal amplitude and frequency information without extreme deviations from the calibration curve.

Electronic tuning permits remote and local tuning without mechanical drive. The internal electronic scan may be activated by a front-panel pushbutton. Four IF bandwidths are provided, permitting quick identification of broadband or narrowband signals:

a. The 50 kHz bandwidth provides greatest sensitivity for broadband signals.

b. The 10 kHz bandwidth can be used for broadband or narrowband signals.

c. The 1 kHz and 100 Hz bandwidths provide greatest sensitivity for narrowband signals and permit improved frequency resolution for closely spaced channels. (A fine-tuning control is provided for ease in tuning CW signals when these bandwidths are used.)

The frequency dial indicates operating frequency in all modes of operation: manual tuning, automatic scan, remote scan and AFC. Adjustments to the fine-tuning control are also indicated on the frequency dial. The primary detection circuitry of the Model NM-17/27 uses a logarithmic amplifier which provides 60 dB of dynamic display range on the panel meter. In conjunction with the five 20 dB RF attenuator steps (total of 100 dB attenuation) the overall measurement range is 160 dB (from 0.01 microvolt to one volt.

1.4 PROGRAMMABLE FUNCTIONS

In order to facilitate automated testing methods, the following critical control functions of the Model NM-17/27 are programmable by the application of voltage from a remote source:

a. Frequency band selection.

b. Bandwidth selection.

c. Frequency tuning.

d. Receiver gain (calibration).

e. Detector function selection.

1.5 SUPPLIED ACCESSORIES

The items listed in Table 1–1 are furnished with the Model NM-17/27 EMI/FI meter.

Table 1-1. Supplied Accessories

Quantity	Device	Singer Part No.
1	AC Power Cable, 7½ ft.	1-910166-001
1	Module Extender Cable, 16 inches, 9 pin connectors	2-004543-001
1	41 Pin Connector (mates with PROGRAMMER input receptacle)	1-910101-005
1	Instruction Manual	1-500783-255
2	Rack Mounting Brackets	3-103317-001
4	Flat-head Screws, 10-32 x ½ (for Rack Mounting Brackets)	1-964064-265
1	Calibration Charts	1-403550-001

1.6 OPTIONAL ACCESSORIES

Accessories available for use with the Model NM-17/27 are listed below.

a. *Meter Transit Case**, Model 95207-2. Used to transport or store the Model NM-17/27 and supplied accessories.

b. *Programmable Rod Antenna Coupler**, Model 94592-1, (10 kHz to 32 MHz). Used with Rod Antenna (f) for measuring electric field strength.

c. *Programmable Loop Antenna/Coupler**, Model 94593-1. Used for measuring magnetic field strength.

d. *Antenna Control Cable*, Model 94594-1. Connects the Rod Antenna Coupler (b) or the Loop Antenna (c) to the Model NM-17/27 for automatic remote band switching of the antennas at a distance of up to 20 ft.

e. *Collapsible Tripod**, Model 91933-2. Used for mounting either antenna, or for mounting the Ground Plane (n) with either antenna.

f. *Rod Antenna**, 41 inches, Model 92197-3. Used with Rod Antenna Coupler (b) for measuring electric field strength.

g. *Remote Meter Cable*, Model 92191-1. Used with Remote Meter (u) to allow signal level indication of Model NM-17/27 within a distance of 20 ft.

h. *Headphones**, Model 10796. Used for audio reception of signal outputs. (Z = 600 ohms)

i. *RF Current Probe**, Model 91197-1. Used for measuring RF currents. Has a maximum transfer impedance of 0.33 ohms that is substantially constant from 5 kHz to 2MHz.

j. *RF Current Probe**, Model 91550-1. Used for measuring RF currents. Has a maximum transfer impedance of 5.5 ohms that provides the best sensitivity from 50 kHz to 100 MHz.

k. *RF Current Probe**, Model 91550-2. Used for measuring RF currents. Same as Current Probe, Model 91550-1 (j) except internally loaded and compensated to provide a substantially constant transfer impedance of one ohm from 150 kHz to 150 MHz.

l. *Loop Probe**, Model 90799-3. Used for localizing source of electromagnetic leakage, especially in areas of limited accessability.

m. *Tripod Bag*, Model 92049-1. Used in storing or transporting the Collapsible Tripod (e).

n. *Ground Plane**, Model 92199-3. Used with Rod Antenna Coupler (b) and Rod Antenna (f) as directed by measurement specifications to provide a true signal ground.

o. *Video Output Cable, X-Output Cable,* or *Y-Output Cable*, Model 90071-1. Used for connecting the signal output (video), or data outputs (X-axis or Y-axis), to the appropriate readout device.

p. *RF Transmission Line**, Model 92191-1. Used for connecting the Model NM-17/27 to a signal source within a distance of 20 feet.

q. *Headphone Extension Cable*, Model 90074-1. Used for connecting Headphones (h) to the Model NM-17/27 within a distance of 20 feet.

r. *Cable Bag*, Model 91981-2. Used for the storage or the transportation of the cables necessary for operation of the Model NM-17/27 system.

s. *Accessory Case*, Model 92220-6. Used for the storage or transportation of optional accessories.

t. *BNC to Type N Adapter**, Model 11663. Adapts the Current Probe type N connector to a BNC connector.

u. *Remote Meter*, Model 95175. Used with Remote Meter Cable (g) to allow signal level indication of Model NM-17/27 within a distance of 20 feet.

* Indicates items displayed in Figure 1–2.

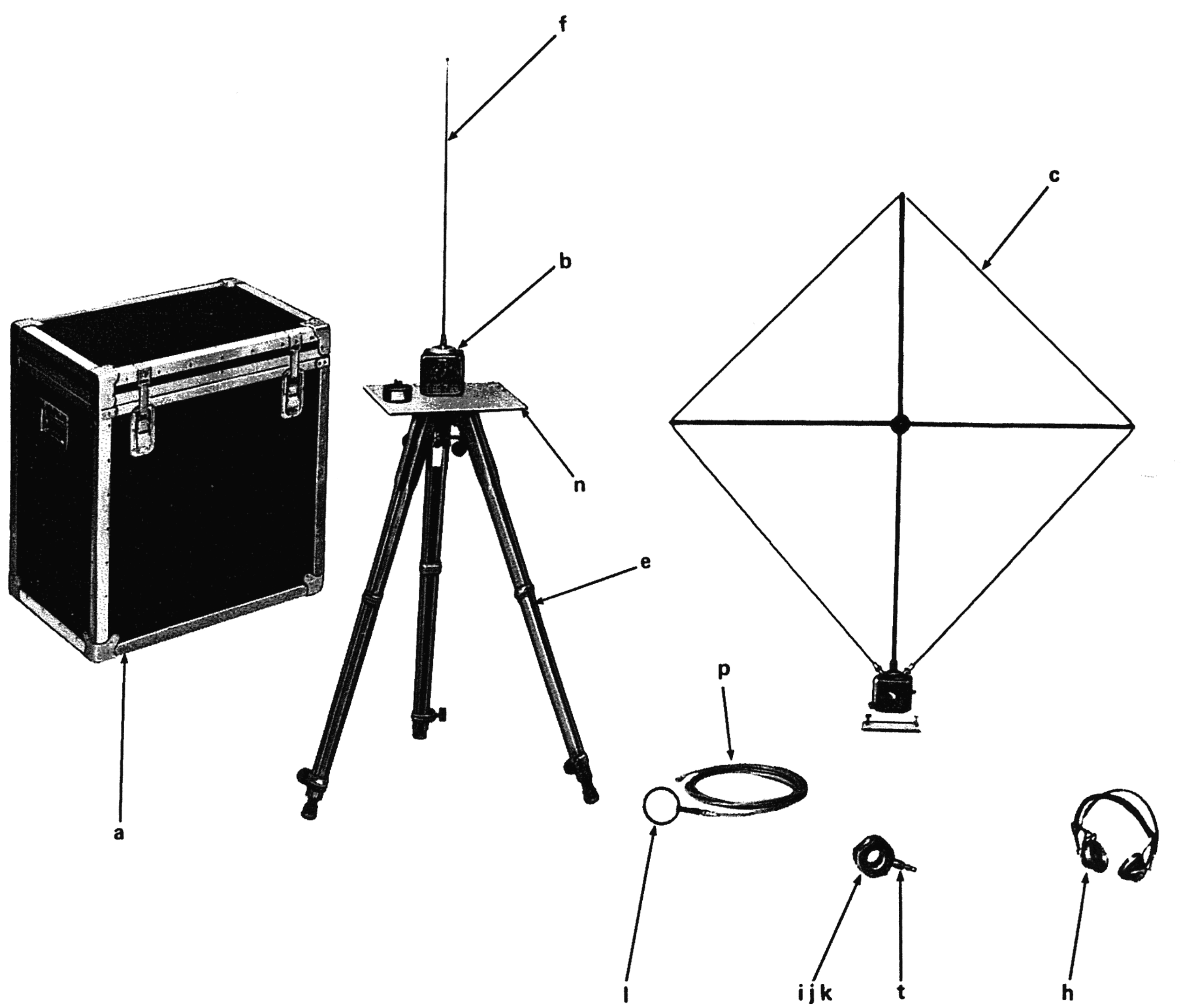


Figure 1—2. Optional Accessories

Section II

SPECIFICATIONS

2.1 INTRODUCTION

This section contains specification information for the Model NM-17/27.

2.2 SPECIFICATIONS

Table 2–1 contains specification data for the Model NM-17/27.

Table 2–1. Specifications

Characteristic	Specifications
Receiver type	Superheterodyne, single conversion on Bands 1 and 4: dual conversion on Bands 2, 3, 5, 6, 7 and 8.
Intermediate frequencies:	Bands 1 and 4: 0.455 MHz Bands 2, 3, 5 and 6: 1.6 MHz/0.455 MHz Bands 7 and 8: 5.0 MHz/0.455 MHz
Frequency	
Range:	0.01 MHz to 32 MHz in 8 bands. A sufficient overlap in frequency range is provided between each band to prevent hiatus in overall frequency coverage. Band 1: 0.01 to 0.25 MHz Band 2: 0.25 to 0.5 MHz Band 3: 0.5 to 1.0 MHz Band 4: 1 to 2 MHz Band 5: 2 to 4 MHz Band 6: 4 to 8 MHz Band 7: 8 to 16 MHz Band 8: 16 to 32 MHz
Accuracy:	True frequency is within ±2% of indicated frequency, or within ±5 kHz, whichever is greater.
Voltage measurement	
Range:	0.01 uV to 1.0 V (160 dB); 60 dB on meter scale and 100 dB of attenuator range.
Accuracy:	±2 dB for CW signals ±3 dB for impulse signals
Gain flatness:	Maximum ±2 dB (25°) (typically ± 1dB) (Maximum ±3 dB, −15°C to +50°C)
Sensitivity (as a two-terminal RF voltmeter):	To produce a 3 dB meter indication above noise:
Narrowband, CW signal:	Field intensity function, Bands 1 thru 8: (uV / dBuV / dBm) 100 Hz bandwidth (0.01 – 32 MHz): 0.016 / −36 / −143 1 kHz bandwidth (0.01 – 32 MHz): 0.05 / −26 / −133 10 kHz bandwidth (0.02 – 32 MHz): 0.16 / −16 / −123
Broadband, impulse signal:	Direct peak function, Bands 1 thru 8: (uV/MHz / dBuV/MHz) 10 kHz bandwidth (0.01 – 0.014 MHz): 140 / +43 10 kHz bandwidth (0.014 – 0.02 MHz): 70 / +37 10 kHz bandwidth (0.02 – 32 MHz): 45 / +33 50 kHz bandwidth (0.07 – 32 MHz): 20 / +26
Calibrator:	Internal solid-state impulse generator, fixed amplitude, approximately 500 Hz repetition rate.

Table 2–1., Specifications (Cont.)

Characteristic	Specifications
RF input	
Impedance:	Approximately 50 ohms (Type BNC coaxial connector).
VSWR:	Maximum 1.5:1 (typically 1.2:1).
Undesired response rejection (referenced to 3 dB S + N/N in 1 kHz bandwidth):	Intermediate frequency rejection: 70 dB minimum Image frequency rejection: 70 dB minimum Spurious rejection: 70 dB minimum
Local oscillator emission:	Less than 50 picowatts
Shielding effectiveness:	Minimum 80 dB (typically greater than 100 dB)
Automatic frequency control holding range:	Greater than ±7 kHz in 100 Hz and 1 kHz bandwidths. Greater than ±20 kHz in 10 kHz bandwidth. Greater than ±70 kHz in 50 kHz bandwidth.
Selectable 6 dB IF bandwidth	0.1 kHz ±10% 1 kHz ±10% 10 kHz ±10% 50 kHz ±10% (tolerance does not apply to band 1).
Internal frequency scan:	Electronically scans any band in one minute, providing outputs to X-Y recorder. Pen lift provided (isolated contact closure).
Detector functions:	
Field intensity:	Average value of output of the 60 dB logarithmic detector.
Quasi-peak:	Weighted average of output of the 60 dB logarithmic detector. Charge time is 1 millisecond; discharge time is 600 milliseconds.
Peak function:	Responds to true peak value. Calibrated in rms of an equivalent sine wave. Selectable hold times of 0.05, 0.3, and 3 seconds.
Slideback peak:	Manual slideback detector with aural null indication.
BFO:	Beat frequency oscillator. Nominal tone is 1 kHz.
Programmable functions requirements:	
Frequency band selection:	–12 V, 30 mA maximum.
Frequency tuning:	0 V to +10 V minimum sawtooth (input resistance of 2 kilohms).
Bandwidth selection:	+12 V, 12 mA maximum.
Detector function selection:	+12 V, 60 mA maximum. Selects functions: calibrate, FI, QP, direct peak and hold time and CAL control.
Receiver gain (calibrate control):	0 V to approximately –6 V (input resistance of 100 kilohms).
Data outputs (simultaneously available):	
X-axis output:	0 V to +1 V ±5% across 1,000 ohms, 0 V to +2 V open circuit, for any frequency band. BNC connector on rear panel.
Frequency readout:	10 mV per kHz, bands 1, 2 and 3; other bands: 100 mV per MHz. Accuracy ±2%. From PROGRAMMER receptacle on rear panel.
Y-axis output:	0 V to +1 V ±5% across 1,000 ohms, 0 V to +2 V open circuit, for 0 dB to full-scale meter deflection. BNC connector on rear panel.
dB readout:	10 mV per dB, –0.40 volts to +1.20 volts ±10 mV for full-voltage measurement range. From PROGRAMMER receptacle on rear panel.
LO outputs (8) (optional):	–20 dBm minimum.

Table 2–1., Specifications (Cont.)

Characteristic	Specifications
Signal outputs (simultaneously available):	For a full-scale CW signal:
IF (455 kHz):	80 mV rms minimum across 50 ohms. BNC connector on rear panel.
Log video:	300 mV ±10% peak across 50 ohms, dc to 10 kHz. BNC connector on rear panel.
Linear video:	100 mV minimum peak-to-peak across 50 ohms, 20 Hz to 15 kHz, for 30% amplitude modulation. BNC connector on rear panel.
Audio (AM or FM):	30 mW minimum across 600 ohms. The 3 dB bandwidth is 20 Hz to 4 kHz, for 30% amplitude modulation. Phone jack on front panel.
FM video:	100 mV minimum peak-to-peak across 50 ohms. Output is typically 25 mV/5 kHz deviation. Video bandwidth is dc to 5 kHz minimum. BNC connector on rear panel.
Power requirements:	
Ac power:	105 V to 130 V or 210 V to 260 V, 50 Hz to 400 Hz, approximately 30 watts.
Battery:	Rechargeable nickle-cadmium cells provided in removeable battery pack. Approximately eight hours continuous operation. Internal charging circuits charge battery in approximately 15 hours. Battery test indication is provided on front panel meter.
Mechanical	
Dimensions (including handles):	Approximate height: 22.2 cm (8.7 inches) Approximate width: 42.4 cm (16.7 inches) Approximate depth: 47 cm (18.5 inches)
Weight (including battery pack) pack):	Approximately 27.3 kg (60 pounds)
Environmental:	
Temperature:	Operational: −15°C to +50°C (+5°F to +123°F) Non-operational −50°C to +75°C (−58°F to +167°F)
Vibration:	Meets MIL-T-21200, Class 3 non-operating.
Altitude:	Operational to at least 4,570 m. (15,000 ft.) (mean sea level).

Section III
INSTALLATION

3.1 INTRODUCTION

This section contains information on bench operation vs rack mounting, 115 V vs 230 V operation, and operation from a battery and battery care information.

3.2 BENCH OPERATION

The Model NM-17/27 is shipped ready for use as a bench-operated instrument. A folding support that is attached to the feet under the front of the instrument may be pulled down to elevate the front of the instrument for ease of operation.

3.3 RACK MOUNTING

A set of adapter brackets and attaching screws are provided to permit mounting of the Model NM-17/27 into a standard 19-inch rack. To prepare the instrument for rack mounting, proceed as follows:

a. Remove the six screws that attach the four feet and folding support to the bottom of the instrument. Retain the screws, feet, and support for future use.

b. Attach one rack mounting bracket (Part No. 3-103317-001) to each side of the instrument using two 10-32 x ½ screws (Part No. 1-964064-265) in each bracket.

3.4 OPERATION FROM AN AC POWER SOURCE

The Model NM-17/27 requires ac power of 105 to 130 volts, or 210 to 260 volts, 50 to 400 Hz, approximately 30 watts.

a. Set the 115/230 V slide switch on the rear panel to the position corresponding to the ac power line voltage. For 115 V operation, use two 0.5 A fuses, for 230 V operation, use two 0.25 A fuses.

> **WARNING**
>
> The Model NM-17/27 is designed for operation from a polarized, three-terminal power receptacle having one terminal connected to earth ground. When only a two-terminal power receptacle is available, to eliminate shock hazard, use a three-prong to two-prong adapter and connect the adapter pigtail lead to the power receptacle ground.

b. Connect the female end of the 7½-foot power cable to the ac power receptacle on the rear panel of the instrument. Connect the male end of the cable to the ac power source.

c. Set the POWER switch on the front panel to the ON AC position. The Frequency meter scale lamps should illuminate.

3.5 OPERATION FROM INTERNAL BATTERIES

The Model NM-17/27 may be operated from the internal rechargeable batteries for a period of 8 hours when the batteries are fully charged.

a. To operate from the internal batteries, set the POWER switch to the ON BATT position.

b. To check the condition of the internal batteries, set the POWER switch to BATT TEST. Set the BATT TEST toggle switch to + and thereafter to –. In both positions the Output meter should indicate above the RECHARGE zone of the BATTERY scale.

c. If either the + or – battery test causes the Output meter to indicate in the RECHARGE zone of the BATTERY scale, the equipment should be switched off, operated from an ac power source, or the batteries charged. (Refer to Paragraph 3.6 for recharging of batteries.)

> **NOTE**
>
> The Model NM-17/27 is fully capable of normal operation from an ac power source when internal batteries are completely discharged or if the battery pack is removed from the instrument. When operated from an ac power source (POWER switch at ON AC position), the battery trickle charger will require approximately 40 hours to recharge fully discharged batteries. With the power switch in the CHARGE position, the batteries will be fully charged in approximately 15 hours.

d. If there is no indication on Output meter for either positive or negative battery test in Step b, press the appropriate reset button on rear panel.

3.6 BATTERY CHARGING

To charge the fully or partially discharged internal batteries, set the POWER switch to CHARGE position. With fully discharged batteries, the batteries will be fully charged in approximately 15 hours. Overcharging the batteries for any length of time will not damage the battery cells. The fully charged batteries should operate the instrument continuously for eight hours without recharging. If the operating time is considerably shorter, then the battery pack is defective and should be replaced.

> **NOTE**
>
> When a number of cells are operated in series, charge imbalance occurs. To reduce the possibility of one or more cells going into reverse charge towards the end of the discharge cycle, charge balancing is recommended. The recommended method of charge balancing is to deliberately charge for a longer period of time than is necessary to reach maximum ampere – hour rating. Balancing is recommended once a month or every 15 charge/discharge cycles by charging for about 50% longer than the normally recommended time.

Section IV

OPERATING INSTRUCTIONS

4.1 INTRODUCTION

Instructions and information for preparing the Model NM-17/27 for use, functional descriptions of controls and receptacles, instructions for using signal input devices available as accessories, operating instructions, and calibration instructions are presented in this section of the manual.

4.2 OPERATING CONTROLS, INDICATORS, AND RECEPTACLES

All external operating controls, indicators, and receptacles of the Model NM-17/27 are located on the front panel and on the rear panel (See Figure 4-1). Functional descriptions of the panel features are contained in Table 4-1.

4.3 BASIC OPERATION

Specific operational procedures for detecting and measuring RF signals with the Model NM-17/27 will vary, depending upon the purpose of measurement, the signal pickup device used, and the type of signal being measured. Military and commercial EMI test specifications generally include detailed requirements and instructions for performing measurements of conducted or radiated interference. However, the following basic operating procedure will generally apply for all measurement conditions:

a. Select the appropriate signal pickup device.

b. Determine type of signal to be measured (narrowband or broadband).

c. Calibrate the instrument (Adjust the instrument for standard gain).

d. Measure signal.

e. Calculate the measured signal level in the required units of measurement.

4.4 SIGNAL PICKUP DEVICES

Various accessories are available for use with the Model NM-17/27 as signal pickup devices. Typical among these are the two antennas and the three RF current probes described in the paragraphs that follow. The antennas consist of a rod antenna and a loop antenna and are used for radiated signal measurements. The RF current probes are used for measuring RF currents appearing on cables or conductors, such as: power lines, and signal and control lines.

4.4.1 Loop Antenna, Model 94593-1

The Model 94593-1 Loop Antenna/Coupler is a collapsible assembly consisting of the antenna coupler, mast section, three arms, and a length of modified coaxial cable that forms the loop. The antenna coupler matches the impedance of the loop to the 50-ohm input impedance of the Model NM-17/27 in each of the eight bands.

The loop should be assembled as follows:

a. Insert the mast section of the antenna in the receptacle on the top of the coupler.

b. Install the three supporting arms into the holes in the mast section, aligning the slots at the ends of the arms in the plane of the loop.

c. Insert the modified coaxial cable (used to form the loop) in the slots in the arms and connect the cable ends to the BNC receptacles on the top of the coupler.

The Loop Antenna/Coupler can be mounted directly on the Model 91933-2 Tripod by turning the tripod center screw into the mating tapped hole in the base of the coupler. The loop may be rotated to any azimuth setting around the vertical axis of the tripod. The maximum signal intensity pickup for vertically polarized signals (in the far field) is obtained when the plane of the loop is vertical and in line with the signal source.

Connect the Loop Antenna/Coupler RF OUTPUT receptacle to the Model NM-17/27 RF INPUT receptacle using the Model 92191-1 RF Transmission Line. For automatic switching of the eight bands by the Model NM-17/27, connect the Model 94594-1 Antenna Control Cable between the Loop Antenna/Coupler and the PROGRAMMER receptacle on the rear panel of the Model NM-17/27, and rotate the Loop Antenna/Coupler BAND (MHz) switch to the AUTO position. Manual band switching may be accomplished by providing 12 V across the two banana plug terminals mounted on the side of the antenna coupler case and rotating the BAND (MHz) switch on the Loop Antenna/Coupler to the desired frequency range.

> **CAUTION**
>
> Do not use the Model 94594-1 Antenna Control Cable during manual band switch operation because the 12 V across the banana plugs may interfere with the Model NM-17/27 circuitry.

Each Loop Antenna/Coupler is individually calibrated and antenna correction factors (ACF) versus frequency curves are provided in the Calibration Charts (P/N 1-403550-001) supplied with Model NM-17/27 equipment. The ACF's are in dB values which are added to Model NM-17/27 meter indications when calculating RF field strength in terms of dB referred to 1 uV/meter.

4.4.2 Antenna Coupler, Model 94592-1, and Rod Antenna, Model 92197-3

The Model 92197-3 41-inch telescopic Rod Antenna must be attached to the insulated TNC receptacle on top of the Model 94592-1 Antenna Coupler and extended to its maximum length during use. The Rod Antenna and Antenna Coupler may be attached to the Model 92199-3 Ground Plane by two 8-32 screws through the Ground Plane, into the base of the Antenna Coupler.

The Ground Plane may be mounted on the Model 91933-2 Tripod or placed on the ground. For screen room use, mount on the Tripod and connect the Ground Plane to the screen room ground or as directed by the measurement specification. For RF field strength measurements the

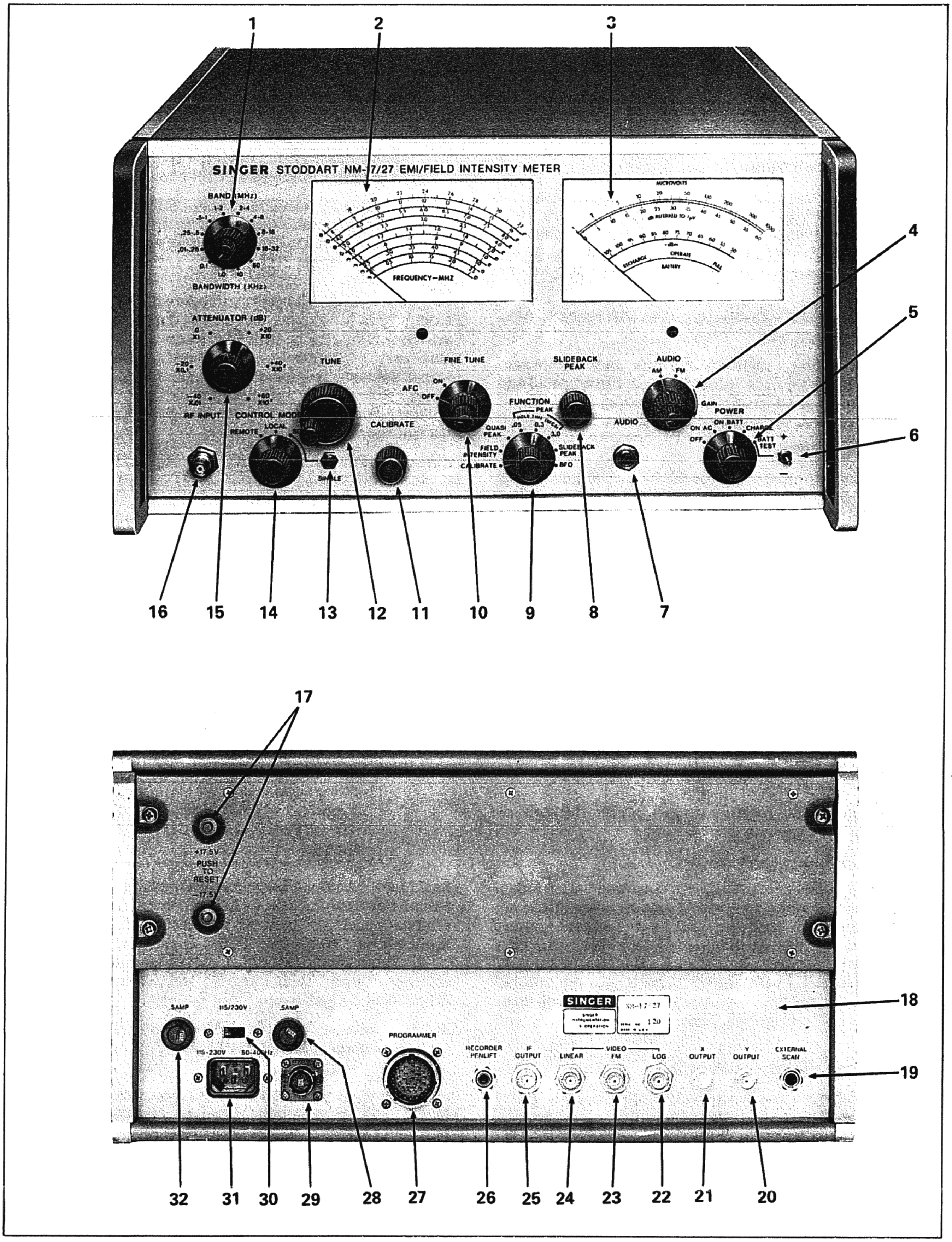


Figure 4-1. Operating Controls, Indicators, and Receptacles, Model NM-17/27

Table 4-1. Controls, Indicators and Receptacles

(Keyed to Figure 4-1)

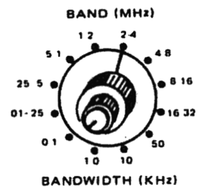
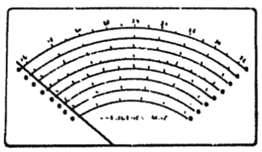
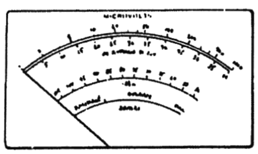
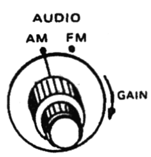
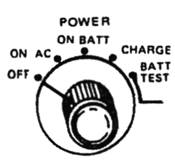
Item	Panel Marking	Description	Function
1		4-position rotary switch (inner knob) (S3)	Provides selection of four calibrated bandwidths of 0.1 kHz, 1.0 kHz, 10 kHz and 50 kHz.
		8-position rotary switch (outer knob) (S2)	Provides selection of appropriate RF tuner and IF circuit for the frequency band desired. Also causes the red indicators on the selected band scale of the Frequency meter to illuminate.
2		Frequency meter (A47)	Provides eight scales to indicate frequency from 10 kHz to 32 MHz. A pair of red indicators are illuminated on the frequency scale in use.
3		Output meter (A46)	Provides display of logarithmic microvolt scale from 1 to 1000 uV, a linear dB scale from 0 to 60 dB referred to 1 uV, and a linear dBm scale from –107 to –47 dB referred to 1 milliwatt. An additional scale displays the charge condition of the batteries when the POWER switch is set at CHARGE or BATT TEST position and the BATT TEST switch is set at + or – position. Although this meter has no panel designation, it will be referred to as the Output meter throughout this manual.
4		Variable resistor (inner knob) (R4)	Provides adjustment of the audio output level.
		2-position rotary switch (outer knob) (S7)	Provides selection of AM or FM audio for output at AUDIO receptacle.
5		5-position rotary switch (S9)	Provides selection of the following power-related functions: <u>OFF</u> – Disconnects power source. <u>ON AC</u> – Operates equipment from ac line power and connects trickle charger to batteries. <u>ON BATT</u> – Operates equipment from internal batteries. <u>CHARGE</u> – Connects full output of battery charger to batteries and removes power from remainder of instrument. <u>BATT TEST</u> – Connects test circuit for checking charge condition of batteries.
6		2-position toggle switch (S11)	Provides selection of + or – batteries for test and display of condition on battery scale of Output meter when POWER switch is set to either CHARGE or BATT TEST.
7		Phone jack (J12)	Provides headphone audio output.
8		Variable resistor (R3)	Provides adjustment of the voltage to the slideback peak detector for an aural null indication.

Table 4-1. Controls, Indicators and Receptacles (Cont.)

(Keyed to Figure 4-1)

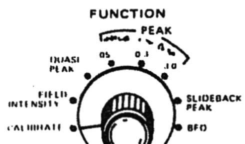
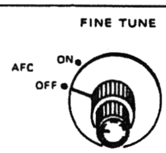
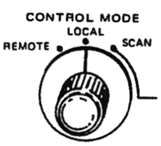
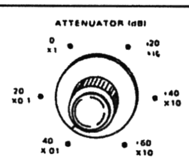
Item	Panel Marking	Description	Function
9		8-position rotary switch (S5)	Provides selection of the measurement functions as follows: CALIBRATE – Disconnects RF input and energizes impulse generator to standardize receiver gain. FIELD INTENSITY – Weights signal to permit measurement of average carrier values. QUASI-PEAK – Weights signal to permit measurement near the peak value of input signals. PEAK – Responds to peak value of signal. Three positions provide selectable hold time of 0.05, 0.3, and 3.0 seconds. SLIDEBACK PEAK – Applies manually controlled reverse bias to detector for slideback peak signal measurements with aural null indication. BFO – Activates beat frequency oscillator to permit audible reception of CW signals.
10		Variable resistor (inner knob) (R2)	Provides control of fine tuning of the EMI/FI Meter when the AFC switch is at OFF position.
		2-position rotary switch (outer knob) (S6)	Provides selection of automatic frequency control.
11		Variable resistor (R6)	Provides adjustment of the IF gain of EMI/FI Meter.
12		Variable resistor (R1)	Provides tuning of EMI/FI Meter in the selected band.
13		Momentary pushbutton switch (S8)	Provides initiation of a single 60-second scan of the frequency band in use when the CONTROL MODE switch is in the SCAN position.
14		3-position rotary switch (S1)	Provides selection of local or remote control of band selection, frequency tuning, bandwidth selection, detector function, and receiver gain. In the SCAN position the internal frequency scanning circuits are enabled.
15		6-position rotary switch (S4)	Provides selection of 100 dB attenuation to be inserted in 20 dB steps.
16		BNC receptacle (J1)	Provides RF signal input.
17	+17.5 V PUSH TO RESET –17.5 V	Circuit breakers (A44CB1) (A44CB2)	Provides protection of internal batteries from overload. Press to reset.
18		BNC receptacles (8)	Provide LO option outputs.

Table 4-1. Controls, Indicators and Receptacles (Cont.)

(Keyed to Figure 4-1)

Item	Panel Marking	Description	Function
19	EXTERNAL SCAN	Phone jack (J8)	Provides frequency scan voltage input from external source when CONTROL MODE switch is at SCAN position.
20	Y OUTPUT	BNC receptacle (J11)	Provides a dc voltage representing signal level.
21	X OUTPUT	BNC receptacle (J6)	Provides a dc voltage representing frequency in each band.
22	VIDEO – LOG	BNC receptacle (J3)	Provides detected video output of log IF amplifier.
23	VIDEO – FM	BNC receptacle (J2)	Provides detected video output of FM discriminator.
24	VIDEO – LINEAR	BNC receptacle (J10)	Provides detected video output of linear IF amplifier.
25	IF OUTPUT	BNC receptacle (J4)	Provides 455 kHz IF output for application to auxiliary signal processing equipment.
26	RECORDER PENLIFT	Phone jack (J7)	Provides output for X–Y recorder pen lift control; used in conjunction with electronic scanning.
27	PROGRAMMER	41 pin receptacle (J9)	Provides remote control input for programmable functions. See table 5-1 for details.
28	.5 AMP .25 AMP	Fuse (F1)	Provides ac line fuse. Use 0.5 ampere fuse for 115 V operation and 0.25 ampere fuse for 230 V operation.
29	AUX PWR	6 pin receptacle (J14)	Provides power output for Model SCU-7.
30	115V 230V	Slide switch (S10)	Provides selection of power line voltage available – 115 V or 230 V.
31	115–230V 50–400 Hz	3-pin receptacle (J5)	Provides ac power input.
32	.5 AMP .25 AMP	Fuse (F2)	Provides ac line fuse. Use 0.5 ampere fuse for 115 V operation and 0.25 ampere fuse for 230 V operation.

Ground Plane is not large enough to constitute a true signal ground. The ground plane may be enlarged by attaching a network of radial wires or equivalent conductors. Up to 24 radial wires may be attached to the ground plane and the length of each wire must equal, or exceed, the physical height of the antenna. The Rod Antenna correction factors are more accurate when a true signal ground is used.

Connect the Antenna Coupler RF OUTPUT receptacle to the Model NM-17/27 RF INPUT receptacle using the Model 92191-1 RF Transmission Line. For automatic switching of the eight bands by the Model NM-17/27, connect the Model 94594-1 Antenna Control Cable between the Antenna Coupler and the PROGRAMMER receptacle on the rear panel of the Model NM-17/27, and rotate the Antenna Coupler BAND (MHz) switch to the AUTO position. Manual band switch operation may be accomplished by providing 12 V across the two banana plug terminals mounted on the side of the Antenna Coupler case and rotating the BAND (MHz) switch to the desired frequency range.

CAUTION

Do not use the Model 94594-1 Antenna Control Cable during manual band switch operation because the 12 V may interfere with the Model NM-17/27 circuitry.

Each Rod Antenna and Antenna/Coupler is individually calibrated and antenna correction factor (ACF) versus frequency curves are provided in the Calibration Charts (P/N 1-403550-001) supplied with the Model NM-17/27 equipment. The ACF's are in dB values which are to be added to the Model NM-17/27 Output meter indications when calculating RF field strength in terms of dB referred to 1 uV/meter.

4.4.3 Antenna Coupler, Model 94592-1 (for High Impedance Measurements)

The Model 94592-1 Antenna Coupler may be used for performing two-terminal high impedance measurements. Connect the Model 94592-1 Antenna Coupler RF OUTPUT receptacle to the Model NM-17/27 RF INPUT receptacle using the Model 92191-1 RF Transmission Line. Add the Banana to BNC Adapter (P/N 1-910210-001) to the banana jack receptacles on the top of the Antenna Coupler. Connect signal sources to be measured to the BNC jack on the Adapter. The Model 94592-1 Antenna Coupler must be switched to frequency of measurement either automatically or manually as detailed in Paragraph 4.4.2.

CAUTION

The peak input voltage applied to the Antenna Coupler high impedance terminals must not exceed 500 volts dc.

Signal levels in dB referred to 1 uV may be calculated by adding a dB correction factor to the sum of the Output meter indication in dB and the ATTENUATOR setting in dB. The correction factor is provided in the Calibration Charts (P/N 1-403550-001) supplied with Model NM-17/27 equipment. Refer to the vertical scale on the left side of ACF chart for the Model 94592-1 Antenna Coupler.

4.4.4 Loop Probe, Model 90799-3

The Loop Probe is used primarily in localizing electromagnetic leakage and may be used over the full frequency range of the Model NM-17/27. Its main advantage is that it can be used in areas where limited accessibility prevents the use of other signal pickup devices. Since the loop probe housing is insulated, it may be safely used as a hand-held probe in close proximity to the signal source. The maximum signal intensity pickup for vertically polarized signals is obtained when the plane of the loop is vertical and in line with the signal source. The loop probe is coupled to the Model NM-17/27 RF INPUT RECEPTACLE using the Model 92191-1 RF Transmission Line.

Antenna correction factors are not provided for the loop probe because it is intended for relative indications, rather than absolute signal level measurement.

4.4.5 RF Current Probes, Models 91550-1, 91550-2 and 91197-1

These Current Probes are clamp-on types of RF current transformers useable in the frequency range of the Model NM-17/27. These probes may be clamped around a conductor (or group of conductors) having a maximum diameter of 1-¼ inches. The Current Probe is coupled to the Model NM-17/27 RF INPUT receptacle using the Model 92191-1 RF Transmission Line. Instruction Manuals containing individual calibrated transfer impedance curves and full instructions for use are provided with each RF Current Probe.

The individual current probe features are:

Model 91550-1 – Has a maximum transfer impedance of 5.5 ohms that provides best sensitivity from 50 kHz to 100 MHz. Can tolerate up to 350 amperes dc or 350 amperes, 50 Hz to 1500 Hz, ac current before core saturation affects RF measurements.

Model 91550-2 – Same as Model 91550-1 except internally loaded and compensated to provide a substantially constant transfer impedance of one ohm from 150 kHz to 150 MHz. (0 dB above one ohm) Can tolerate up to 350 amperes dc or 50 Hz to 400 Hz ac current before internal load reaches thermal limit.

Model 91197-1 – Has a maximum transfer impedance of 0.33 ohms that is substantially constant from 5 kHz to 2 MHz. Can tolerate up to 350 amperes dc or 350 amperes, 50 Hz to 1500 Hz, ac current before core saturation affects RF measurements.

4.5 MAXIMUM SAFE INPUT LEVELS

To avoid possible damage to the input circuits of the Model NM-17/27, the input signal level measured at the RF INPUT receptacle must not exceed the limits set forth in Table 4-2.

Table 4-2. Maximum Safe Input Levels

Signal Type	ATTENUATOR Switch Position	Limit at RF INPUT Receptacle
Dc or peak	Any	±400V
Ac (to 70 Hz)	Any	230 V rms
Ac (to 400 Hz)	Any	115 V rms
Impulsive	Any	1.0V/MHz (+120 dBuV/MHz)
CW	+20,+40,+60dB	0.25 watt (+27 dBm)
	–40, –20, 0 dB	0.02 watt (+13 dBm)

4.6 GAIN CALIBRATION (GAIN STANDARDIZATION)

The Model NM-17/27 may be calibrated (gain standardized) at the desired measurement frequency as follows:

a. Set the FUNCTION switch to the CALIBRATE position and the CONTROL MODE switch to the LOCAL position.

NOTE

When the FUNCTION switch is in the CALIBRATE position, the ATTENUATOR (dB) switch and the BANDWIDTH (kHz) switch are automatically disabled and may be left in any position.

b. Obtain the proper calibration figure for the specific frequency band in use from the Calibration Charts (P/N 1-403550-001) supplied with the Model NM-17/27 equipment.

c. Adjust the CALIBRATE control so the Output meter indicates the correct calibration figure on the dB REFERRED TO 1 uV scale.

d. Return the FUNCTION switch to its original position.

4.7 NARROWBAND SIGNAL MEASUREMENTS

A narrowband (NB) signal is defined as a signal having a spectral power distribution that is narrow compared to the 6 dB bandwidth of the Model NM-17/27. The following signals are classified as NB:

a. Continuous wave (CW) or unmodulated carrier.

NOTE

This equipment is calibrated in terms of rms of a sine wave (0.707 of true peak of a sine wave) for any detector function selected by the FUNCTION switch. Therefore, for unmodulated RF carriers the FIELD INTENSITY (FI), QUASI-PEAK (QP), DIRECT PEAK (DP), and SLIDEBACK PEAK (SP) detector functions will provide identical Output meter readings. This is in accordance with the instrument design criteria set forth in EMI measurement specifications.

b. Amplitude modulated (AM) or single sideband (SSB) modulated carrier.

c. Frequency modulated (FM) carrier, depending upon the bandwidth of the Model NM-17/27.

NOTE

Theoretically, an FM signal produces an infinite number of sidebands and would not qualify as an NB signal. The bandwidth of the significant sidebands, however, is approximately $2(\Delta f+f_m)$, where Δf = peak frequency deviation and f_m = modulation frequency. If $2(\Delta f+f_m)$ is less than the 6 dB bandwidth of the receiver in use, for measurement purposes the FM signal may be considered as NB.

4.7.1 Selection of Bandwidth

In the examples for narrowband signal measurement outlined in the following paragraphs, a 10 kHz bandwidth is recommended for ease of tuning. However, any of the four bandwidths may be used for narrowband signal measurement at the discretion of the operator. Use of a narrower bandwidth provides greater CW signal sensitivity. For example, using the 100 Hz bandwidth, the Model NM-17/27 CW signal sensitivity is approximately 20 dB better than with the 10 kHz bandwidth, and approximately 27 dB better than with the 50 kHz bandwidth.

NOTE

The 50 kHz bandwidth is specified only for frequencies above 250 kHz; however, it may be used at lower frequencies with reduced measurement accuracy. Below a signal frequency of approximately 70 kHz for the 50 kHz bandwidth and 20 kHz for the 10 kHz bandwidth, RF tuner local oscillator leakage causes a signal-like indication on the Output meter.

4.7.2 Field Intensity Measurements

Conducted or radiated NB signals may be measured in terms of the rms value of the average carrier levels. Perform the measurements as in the following steps:

a. Connect the appropriate pickup device to the RF INPUT receptacle of the Model NM-17/27.

b. Set the FUNCTION switch to the FIELD INTENSITY position, the BANDWIDTH (kHz) switch to the 10 kHz position, and the AFC switch to the OFF position.

c. Tune the Model NM-17/27 for maximum response to the signal as indicated by the maximum indication of the Output meter, adjusting the ATTENUATOR (dB) switch as necessary to maintain the meter indication in the upper portion of the scale. Rotate the TUNE control back and forth; also use the FINE TUNE control to maximize the meter indication. Set the AFC switch to the ON position, if desired, to lock the instrument to the signal. Note the signal frequency.

NOTE

When a sine wave signal is being measured in the FIELD INTENSITY function in the presence of internal receiver noise or ambient interference of random nature, it is possible to determine the actual value of the signal with Chart 3 of the supplied Calibration Charts (P/N 1-403550-001).

d. Calibrate the instrument as described in Paragraph 4.6.

e. Note the Output meter indication on the scale of the units of measurement desired (microvolts, dB referred to 1 uV, or dBm).

f. Multiply the meter indication noted in Step e in microvolts by the ATTENUATOR factor (X 0.01 to X 1000) for a measurement in terms of microvolts across 50 ohms. Algebraically add the ATTENUATOR setting in dB (−40 to +60 dB) to the meter indication in dB to obtain the input signal level in terms of dB referred to 1 uV across 50 ohms. Algebraically add the ATTENUATOR setting in dB to the meter indication in dBm to obtain the input signal level in terms of dBm.

g. No further calculations are necessary for two-terminal RF voltage measurements across 50 ohms.

h. Refer to Paragraph 4.10 for calculation of signal levels when using pickup devices.

4.7.3 Quasi-Peak Measurements

Conducted or radiated NB signals having a relatively fast repetition frequency may be measured in terms of weighted rms values as in the following:

a. Connect the appropriate pickup device to the RF INPUT receptacle of the Model NM-17/27.

b. Set the FUNCTION switch to the QUASI-PEAK position, the BANDWIDTH (kHz) switch to the 10 kHz position, and the AFC switch to the OFF position.

c. Tune the Model NM-17/27 for maximum response to the signal as indicated by maximum indication of the Output meter, adjusting the ATTENU ATOR (dB) switch as necessary to maintain the meter indication in the upper portion of the scale. Rotate the TUNE control back and forth; also use the FINE TUNE control to maximize the meter indication. Set the AFC switch to the ON position, if desired, to lock the instrument to the signal. Note the signal frequency.

d. Calibrate the instrument as described in Paragraph 4.6.

e. Note the Output meter indication on the scale of the units of measurement desired (microvolts, dB referred to 1 uV, or dBm).

f. Multiply the meter indication noted in Step e in microvolts by the ATTENUATOR factor (X 0.01 to X 1000) for a measurement in terms of microvolts across 50 ohms. Algebraically add the ATTENUATOR switch setting in dB (−40 to +60 dB) to the meter indication in dB to obtain the input signal level in terms of dB referred to 1 uV across 50 ohms. Algebraically add the ATTENUATOR switch setting in dB to the meter indication in dBm to obtain the input signal level in terms of dBm.

g. No further calculations are necessary for two-terminal RF voltage measurements across 50 ohms.

h. Refer to Paragraph 4.10 for calculation of signal levels when using pickup devices.

4.7.4 Peak Measurements

Conducted or radiated NB signals may be measured in rms values as in the following:

NOTE

The peak function is the best detector to use in the search for presence of signals because of its extremely fast response time. In the absence of signals, the Output meter will smoothly fluctuate with the rotation of the TUNE control. Interception of a signal, however, will cause the Output meter to rise sharply.

a. Connect the appropriate pickup device to the RF INPUT receptacle of Model NM-17/27.

b. Set the FUNCTION switch to the PEAK/0.05 SEC HOLD TIME position, the BANDWIDTH (kHz) switch to the 10 kHz position, and the AFC switch to the OFF position.

c. Tune the Model NM-17/27 for maximum response to the signal as indicated by maximum indication of the Output meter. Set the ATTENUATOR (dB) switch as necessary to maintain the meter indication in the upper portion of the scale. Rotate the TUNE control back and forth; also use FINE TUNE control to maximize the meter indication. Set the AFC switch to the ON position, if desired, to lock the instrument to the signal. Note the signal frequency.

d. Calibrate the instrument as described in Paragraph 4.6.

e. Note the Output meter indication on the scale of the units of measurement desired (microvolts, dB referred to 1 uV, or dBm).

f. Multiply the meter indication noted in Step e in microvolts by the ATTENUATOR factor (X 0.01 to X 1000) for a measurement in terms of microvolts across 50 ohms. Algebraically add the ATTENUATOR setting in dB (−40 to +60 dB) to the meter indication in dB to obtain the input signal level in terms of dB referred to 1 uV across 50 ohms. Algebraically add the ATTENUATOR setting in dB to meter indication in dBm to obtain the input signal level in terms of dBm.

g. No further calculations are necessary for two-terminal RF voltage measurements across 50 ohms.

h. Refer to Paragraph 4.10 for calculation of signal levels when using pickup devices.

4.7.5 Slideback Peak Measurement

Conducted or radiated NB signals may be measured in rms values using the aural null indication as in the following:

a. Connect the appropriate pickup device to the RF INPUT receptacle of the Model NM-17/27.

b. Set the FUNCTION switch to the PEAK/0.3 SEC HOLD TIME position, the BANDWIDTH (kHz) switch to the 10 kHz position, and the AFC switch to the OFF position.

c. Tune the Model NM-17/27 for maximum response to the signal in the FIELD INTENSITY mode as indicated by maximum indication of the Output meter, setting ATTENUATOR switch as necessary to maintain the meter deflection in the upper portion of the scale. Rotate the TUNE control back and forth; also use the Fine Tune control to maximize meter indication. Set switch back to the PEAK/0.3 SEC HOLD TIME mode. Set the AFC switch to the ON position, if desired, to lock the instrument to the signal. Note the signal frequency.

d. Calibrate the instrument as described in Paragraph 4.6.

e. Set the FUNCTION switch to the SLIDEBACK PEAK position and rotate SLIDEBACK PEAK control fully counterclockwise.

f. Connect a set of headphones to the AUDIO receptacle. Set the AUDIO switch to the AM position, and adjust the AUDIO GAIN control to the desired sound level.

g. Rotate the SLIDEBACK PEAK control slowly clockwise until the signal in the headphones is cut off. Note the Output meter indication at this threshold level.

h. Multiply the meter indication noted in Step e in microvolts by the ATTENUATOR factor (X 0.01 to X 1000) for a measurement in terms of microvolts across 50 ohms. Algebraically add the ATTENUATOR setting in dB (−40 to +60 dB) to the meter indication in dB to obtain the input signal level in terms of dB referred to 1 uV across 50 ohms. Algebraically add the ATTENUATOR setting in dB to the meter indication in dBm to obtain the input signal level in terms of dBm.

i. No further calculations are necessary for two-terminal RF voltage measurements across 50 ohms.

j. Refer to Paragraph 4.10 for calculation of signal levels when using pickup devices.

4.8 BROADBAND SIGNAL MEASUREMENTS

Broadband (BB) signals are defined as those having a spectral power distribution that is broad compared to the impulse bandwidth of the Model NM-17/27. Broadband interference may be considered as being composed of short pulses, the pulse repetition frequency determining the character of the interference.

If the pulses are clearly separated, the interference is termed impulsive. Such interference is generated by motor brush sparking and by internal combustion engine ignition circuits. If the pulses are not clearly distinguishable and overlap, the interference is termed random. A good example of this is thermal noise.

Following is a list of signals, classified as broadband:

a. Pulse modulated CW (depending on receiver bandwidth)

b. Random noise

c. Impulsive noise from motor brushes

d. Impulsive noise from internal combustion engine ignition circuits

e. Corona discharge

4.8.1 Selection of Bandwidth

For a given broadband impulse signal level at the RF INPUT receptacle of the Model NM-17/27 the peak detected output varies directly with impulse bandwidth. Therefore, the wider bandwidths of 50 kHz and 10 kHz are preferred because of their greater response and better sensitivity to weak broadband signals. Because of the large range of bandwidths provided, from 50,000 Hz to 100 Hz (corresponding to a 500 to 1 response ratio), RF tuner overload occurs when using the 100 Hz and 1 kHz bandwidths for some combinations of ATTENUATOR settings and Output meter indications. See Figure 4-2 which displays the point of overload for various combinations of bandwidths, ATTENUATOR settings and Output meter indications available on the Model NM-17/27. Note that with the 50 kHz bandwidth and PEAK detection there is no possibility of overload for an on-scale Output meter indication for any combination of parameters. The 10 kHz bandwidth is also typically free from overload problems, although close to marginal under conditions of the worst combination. The 100 Hz and 1 kHz bandwidths may be used at Output meter indication levels, generally, less than full-scale, as dictated by Figure 4-2.

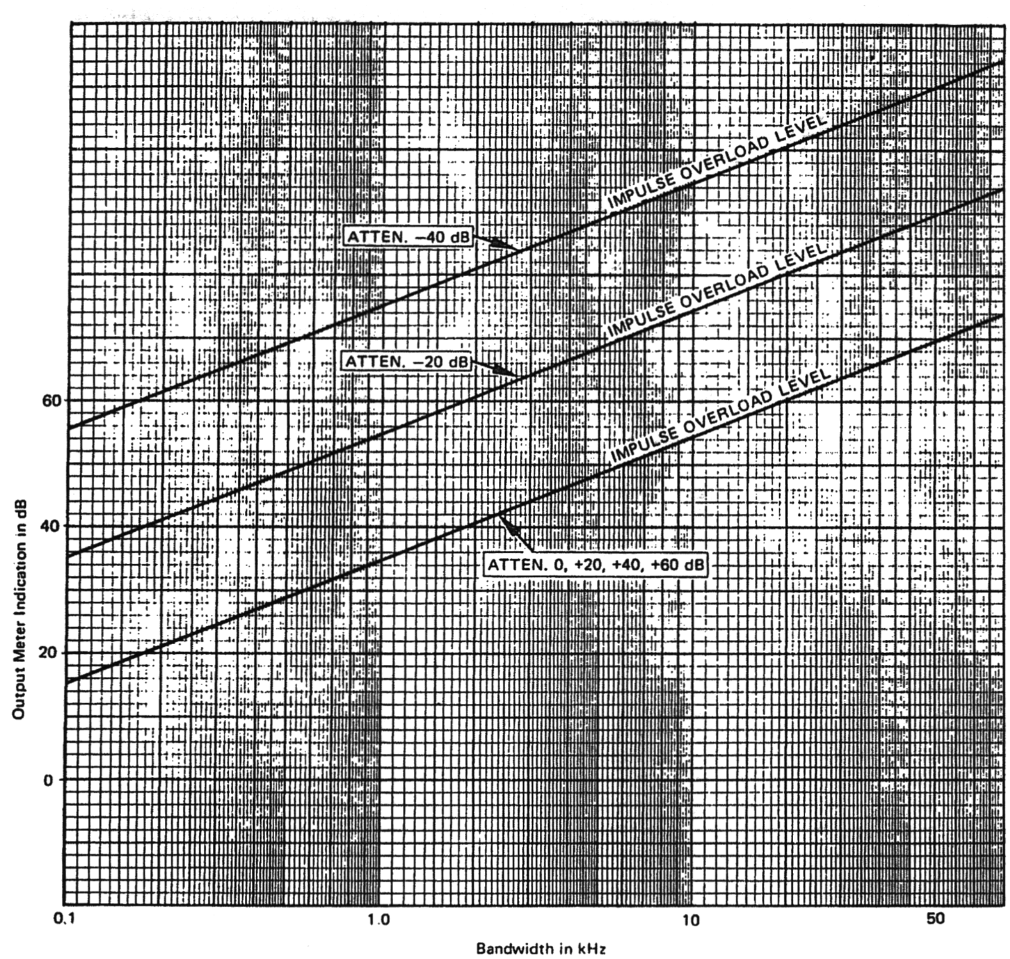


Figure 4-2. Selection of Broadband Bandwidths Chart

NOTE

The 50 kHz bandwidth is not specified at frequencies in Band 1 because of RF bandwidth constriction effects and reduction in sensitivity due to local oscillator feedthrough.

4.8.2 Peak Measurements

Measure the peak value of conducted or radiated BB signals in terms of rms as in the following steps:

a. Connect the appropriate input device to the RF INPUT receptacle of the Model NM-17/27.

b. Set the FUNCTION switch to the PEAK/0.3 SEC HOLD TIME position, the BANDWIDTH (kHz) switch to the 10 kHz position, and the AFC switch to the OFF position.

c. Tune the Model NM-17/27 to the broadband signal, as indicated by maximum deflection of the Output meter. Set the ATTENUATOR (dB) switch for an indication in the upper position of the scale. Precise tuning is not possible for random or impulsive signals, but the interference level may be measured at any frequency within the spectral range of the signal. Note the frequency of measurement.

d. Calibrate the instrument as described in Paragraph 4.6.

e. Multiply the meter indication in microvolts by the ATTENUATOR switch factor (X 0.01 to X 1000) and by 100 (bandwidth ratio, 1 MHz/10 kHz) to obtain the signal level in microvolts per MHz (uV/MHz). Add the ATTENUATOR switch setting in dB to the meter indication in dB and add 40 dB to obtain the signal level in dB referred to 1 uV/MHz (dBuV/MHz).

NOTE

If the 1.0 kHz bandwidth is used, bandwidth ratio becomes 1000:1 or 60 dB. If the 50 kHz bandwidth is used, the bandwidth ratio becomes 20:1 or 26 dB.

f. Refer to Paragraph 4.10 for calculation of signal levels.

4.8.3 Quasi-Peak Measurements

Measure the weighted value of conducted or radiated BB signals in terms of rms as follows:

a. Connect the appropriate input device to the RF INPUT receptacle of the Model NM–17/27.

b. the Set FUNCTION switch to the QUASI-PEAK position, the BANDWIDTH switch to 10 kHZ position, and the AFC switch to the OFF position.

c. Tune the Model NM-17/27 to the broadband signal, indicated by maximum deflection of the Output meter. Set the ATTENUATOR switch for an indication in the upper portion of the scale. Precise tuning is not possible for random or impulsive signals, but the interference level may be measured at any frequency within the spectral range of the signal. Note the frequency of measurement.

d. Calibrate the instrument as described in Paragraph 4.6.

e. Multiply the meter indication in microvolts by the ATTENUATOR switch factor (X 0.01 to X 1000) and by 100 (bandwidth ratio, 1 MHz/10 kHz) to obtain the signal level in microvolts per MHz (uV/MHz). Add the ATTENUATOR switch setting in dB to the meter indication in dB and add 40 dB to obtain the signal level in dB referred to 1 uV/MHz (dBuV/MHz).

NOTE

If the 1.0 kHz bandwidth is used, the bandwidth ratio becomes 1000:1 or 60 dB. If the 50 kHz bandwidth is used, the bandwidth ratio becomes 20:1 or 16 dB.

f. Refer to Paragraph 4.10 for calculation of signal levels.

4.8.4 Slideback Peak Measurements

Measure the peak value of conducted or radiated BB signals in terms of rms using the aural null indication as follows:

a. Connect the appropriate pickup device to the RF INPUT receptacle of the equipment.

b. Set the FUNCTION switch to the PEAK/0.3 SEC HOLD TIME position, the BANDWIDTH switch to the 1.0 MHz position, and the AFC switch to OFF position.

c. Tune the Model NM-17/27 to the broadband signal, indicated by maximum deflection of the Output meter. Set the ATTENUATOR switch for an indication in the upper portion of the scale. Precise tuning is not possible for random or impulsive signals, but the interference level may be measured at any frequency within the spectral range of the signal. Note the frequency of measurement.

d. Calibrate the instrument as described in Paragraph 4.6.

e. Set the FUNCTION switch to the SLIDEBACK PEAK position and rotate the SLIDEBACK control fully counterclockwise.

f. Connect a set of headphones to the AUDIO receptacle. Set the AUDIO switch to the AM position, and rotate the AUDIO GAIN control to the desired sound level.

g. Rotate the SLIDEBACK PEAK control slowly clockwise until the signal in the headphones is cut off. Note the Output meter indication at this threshold level.

h. Multiply the meter indication in microvolts by the ATTENUATOR switch factor (X 0.01 to X 1000) and by 100 (bandwidth ratio, 1 MHz/10 kHz) to obtain the signal level in microvolts per MHz (uV/MHz). Add the meter indication in dB to the ATTENUATOR switch setting in dB and add 40 dB to obtain the signal level in dB referred to 1 uV/MHz (dBuV/MHz).

NOTE

If the 1.0 kHz bandwidth is used, the bandwidth ratio becomes 1000:1 or 60 dB. If the 50 kHz bandwidth is used, the bandwidth ratio becomes 10:1 or 26 dB.

i. Refer to Paragraph 4.10 for calculation of signal levels.

4.9 DETERMINATION OF SIGNAL TYPES

To determine if the signal is narrowband, random noise or impulsive interference, when the Model NM-17/27 is accurately tuned to the signal frequency, change the BANDWIDTH switch from 10 kHz to 1.0 kHz. If the signal is narrowband, the meter deflection remains unchanged. If the signal is random noise, the meter deflection will decrease by approximately 10 dB. If the signal is impulsive, the meter deflection will decrease by approximately 20 dB.

A signal type of special interest is pulsed CW. Although classified as a broadband signal in military interference specifications, a pulsed CW signal has some characteristics that resemble narrowband signals. For example, a CW pulse may be thought of as having a distinct carrier frequency much as an AM signal has. The spectral power distribution of a carrier modulated with a rectangular pulse in principle extends from the carrier frequency to infinity and to zero. The frequencies of the components are given by $f = f_c + nf_r$, where f_c = carrier frequency, f_r = pulse repetition frequency and n = 0, 1, 2, 3. . . The relative amplitude of the components is given by:

$$\frac{\sin 2\pi fT}{2\pi fT}$$

where T = pulse width.

Since the detector of the usual receiver ignores phase information, the actual spectral information available will show the absolute amplitude of the various components. A CW pulse train will have a wide spectral distribution with the first zero at 1/T on each side of the carrier frequency and zero recurring at 1/T intervals as far on each side of the carrier as the power is detectable. Actual pulses are never rectangular and the spectral distribution is somewhat different from the ideal case, the exact spectral envelope being determined by the nature of the pulse shape. An oscilloscope may also be used to determine if the signal is random or impulsive by connecting the LINEAR VIDEO receptacle to the oscilloscope. In the case of random noise, "grass" will be displayed on the oscilloscope. In the case of an impulsive signal, individual pulses will be displayed on the oscilloscope. The audio output available in the headphones also helps to determine the nature of the interference. Random noise yields a hissing sound, and impulsive interference results in a popping sound.

4.10 SIGNAL LEVEL CALCULATIONS

Typical methods for calculating signal levels of radiated and conducted RF interference in various units of measurement are described in the following paragraphs.

NOTE

If a coaxial cable of such length that insertion losses are significant is used to connect a signal pickup device to Model NM-17/27 during measurements, the loss factor of the cable should be determined at the test frequency and included in the following calculations.

4.10.1 Calculation of Conducted NB Interference (50-ohm Direct Connection)

When the Model NM-17/27 is used as a two-terminal RF microvoltmeter and connected across a 50-ohm signal source; the measurement procedures given in Paragraph 4.7.2 thru 4.7.5 yield signal levels in microvolts or in dB referred to 1 uV and no further calculations are necessary.

4.10.2 Calculation of Conducted NB Interference (High Impedance Connection)

When the Model NM-17/27 is used as a high impedance two-terminal RF microvoltmeter with Model 94592-1 Antenna Coupler as described in Paragraph 4.4.3, use the measurement procedures given in Paragraphs 4.7.2 thru 4.7.5 for conducted measurements, then correct the measurement as follows:

a. Refer to Chart 1 of the Calibration Charts (P/N 1-403550-001) supplied with the Model NM-17/27.

b. Determine the Antenna Coupler two-terminal high impedance factor in dB at the frequency of measurement using the vertical scale on the left side of the chart.

c. Add the factor in dB of Step b to the RF signal imput level in dB referred to 1 uV as described in Paragraphs 4.7.2 thru 4.7.5.

d. To convert the signal level in dB referred to 1 uV to microvolts or millivolts, refer to Table 4-4 or Chart 4 of the Calibration Charts.

4.10.3 Calculation of Radiated NB Interference

To obtain the RF field strength in dB referred to one microvolt per meter (dBuV/m), the antenna correction factor (ACF) in dB for the particular antenna used in achieving the measurement must be *added* to the input signal level in dB obtained in Paragraphs 4.7.2 thru 4.7.5. Perform the calculation as follows:

a. Determine the RF signal input level in dB referred to 1 uV as described in Paragraphs 4.7.2 thru 4.7.5.

b. Determine the ACF in dB from the calibration chart for the antenna used at test frequency (refer to P/N #1-403550-001 Calibration Charts).

c. Algebraically add the results of Steps a and b to obtain the RF field strength of the radiated NB interference in dB referred to 1 uV/m.

d. To convert the signal level in dB referred to 1 uV/m to microvolts or millivolts per meter, refer to Table 4-4 or to Chart 4 of the Calibration Charts (P/N 1-403550-001).

4.10.4 Calculation of Conducted NB Interference Measured with the RF Current Probe

Signal levels of conducted NB interference may be computed in terms of dB referred to one microampere (dBuA) when the RF Current Probe is employed as a signal pickup device. The transfer impedance in dB referred to one ohm must be *subtracted* from the input signal level in dB obtained in Paragraphs 4.7.2 thru 4.7.5. Perform the calculation as follows:

a. Determine the RF signal input level in dB referred to 1 uV as described in Paragraphs 4.7.2 thru 4.7.5.

b. Determine the transfer impedance of the current probe in dB at the test frequency from the chart furnished with the Current Probe.

c. Algebraically *subtract* the transfer impedance figure obtained in Step b from the measured signal level in dB determined in Step a to obtain a value of the conducted NB interference in terms of dB referred to 1 uA in the test conductor.

NOTE

The transfer impedance in dB may have a positive or negative sign, depending upon whether it is above (positive) or below (negative) the one ohm reference. *Observe the sign* when subtracting in Step c.

d. To convert the signal level in dB referred to 1 uA into microamperes or milliamperes, refer to Table 4-3 or to Chart 4 of the Calibration Charts (P/N 1-403550-001) and substitute "A" for "V" in units provided in the table headings.

Table 4-3. Conversion of Units (Continued)

dB Referred to 1 μV	μV
−20	0.100
−19	0.112
−18	0.126
−17	0.141
−16	0.159
−15	0.178
−14	0.200
−13	0.224
−12	0.251
−11	0.282
−10	0.316
− 9	0.355
− 8	0.398
− 7	0.447
− 6	0.501
− 5	0.562
− 4	0.631
− 3	0.708
− 2	0.794
− 1	0.891
0	1.00
1	1.12
2	1.26
3	1.41
4	1.59
5	1.78
6	2.00
7	2.24
8	2.51
9	2.82
10	3.16
11	3.55
12	3.98
13	4.47
14	5.01
15	5.62

dB Referred to 1 μV	μV
16	6.31
17	7.08
18	7.94
19	8.91
20	10.00
21	11.20
22	12.60
23	14.30
24	15.90
25	17.80
26	20.00
27	22.40
28	25.10
29	28.20
30	31.60
31	35.50
32	39.80
33	44.70
34	50.10
35	56.20
36	63.10
37	70.80
38	79.40
39	89.10
40	100.00
dB Referred to 1 μV	**mV**
41	0.112
42	0.126
43	0.141
44	0.159
45	0.178
46	0.200
47	0.224
48	0.251
49	0.282
50	0.316
51	0.355
52	0.398
53	0.447
54	0.501
55	0.562
56	0.631
57	0.708
58	0.794
59	0.891
60	1.00
61	1.12
62	1.26
63	1.41
64	1.59
65	1.78
66	2.00
67	2.24
68	2.51
69	2.82
70	3.16

Table 4-3. Conversion of Units (Continued)

dB Referred to 1 μV	mV
71	3.55
72	3.98
73	4.47
74	5.01
75	5.82
76	6.31
77	7.08
78	7.94
79	8.91
80	10.00
81	11.20
82	12.60
83	14.10
84	15.90
85	17.80
86	20.00
87	22.40
88	25.10
89	28.20
90	31.60
91	35.50
92	39.80
93	44.70
94	50.10
95	56.20
96	63.10
97	70.80
98	79.80
99	89.10
100	100.00
dB Referred to 1 μV	**Volts**
101	0.112
102	0.126
103	0.141
104	0.159
105	0.178
106	0.200
107	0.224
108	0.251
109	0.282
110	0.316
111	0.355
112	0.398
113	0.447
114	0.501
115	0.562
116	0.631
117	0.708
118	0.794
119	0.811
120	1.000

4.10.5 Calculation of Conducted BB Interference (50-ohm Direct Connection)

When the Model NM-17/27 is used as a two-terminal RF microvoltmeter and connected across a 50-ohm signal source, the procedures given in Paragraphs 4.8.2 thru 4.8.4 provide signal levels in uV/MHz or in dB referred to 1 uV/MHz and no further calculations are necessary.

4.10.6 Calculation of Conducted BB Interference (High Impedance Connection)

When the Model NM-17/27 is used as a high impedance two-terminal RF microvoltmeter with Model 94592-1 Antenna Coupler as described in Paragraph 4.4.3, use the measurement procedures given in Paragraphs 4.8.2 thru 4.8.4 for conducted measurements, then correct the measurement as follows:

a. Refer to Chart 1 of the Calibration Charts (P/N 1-403550-001) supplied with the Model NM-17/27.

b. Determine the Antenna Coupler two-terminal high impedance factor in dB at the frequency of measurement using the vertical scale on the left side of the chart.

c. *Add* the factor of dB of Step b to the RF signal input level in dB referred to 1 uV/MHz as described in Paragraphs 4.8.2 thru 4.8.4.

d. To convert the signal level in dB referred to 1 uV/MHz to uV/MHz or mV/MHz, refer to Table 4-3 or to Chart 4 of the Calibration Charts.

4.10.7 Calculation of Radiated BB Interference

To obtain the RF field strength in dB referred to 1 uV/m/MHz, the ACF in dB for the antenna used must be added to the input signal level in dB obtained in Paragraphs 4.8.2 thru 4.8.4. Perform the calculation as follows:

a. Determine the RF signal input level in dB referred to 1 uV/MHz as described in Paragraphs 4.8.2 thru 4.8.4.

b. Determine the ACF in dB from Calibration Chart for antenna used at the test frequency (refer to Calibration Charts (P/N 1-403550-001).

c. Add the results of Steps a and b to obtain the RF field strength of the radiated BB interference in dB referred to 1 uV/m/MHz.

d. To convert the signal level in dB referred to 1 uV/m/MHz directly into uV/m/MHz or mV/m/MHz, refer to Table 4-3 or to Chart 4 of the Calibration Charts (P/N 1-403550-001).

4.10.8 Calculation of Conducted BB Interference Measured with the RF Current Probe

Signal levels of conducted BB interference as measured with the RF Current Probe may be computed in terms of dB referred to 1 microampere per MHz (dBuA/MHz). The transfer impedance in dB above or below one ohm must be *subtracted* from the input signal level in dB obtained in Paragraph 4.8.2 thru 4.8.4. Perform the calculation as follows:

a. Determine the RF signal input level in dB referred to 1 uV/MHz as described in Paragraphs 4.8.2 thru 4.8.4.

b. Determine the transfer impedance of the Current Probe in dB at the test frequency from the chart furnished with the Current Probe.

c. Algebraically *subtract* the transfer inpedance figure obtained in Step b from the measured signal level in dB determined in Step a to obtain the value of the conducted BB interference in terms of dB referred to 1 uA/MHz in the test sample conductor.

NOTE

The transfer impedance in dB may have a positive or negative sign, depending upon whether it is above (positive) or below (negative) the one ohm reference. *Observe the sign* when subtracting in Step c.

d. To convert the signal level in dB referred to 1 uA/MHz into uA/MHz or mA/MHz, refer to Table 4-3 or to Chart 4 of Calibration Charts (P/N 1-403550-001) and substitute "A" for "V" in the units provided in the table headings.

4.10.9 Calculation of Conducted Signal Levels in Picowatts

The methods described in Paragraphs 4.7.2 thru 4.7.5 are used to measure conducted NB signals in terms of uV or dB referred to 1 uV. Signal levels may also be expressed in picowatts, considering the 50 ohm input impedance of Model NM-17/27. If E is the RF signal level in uV, then the input power P in picowatts is: $P = \frac{E^2}{50}$.

Figure 4-3 is a graphical presentation of this equation providing the input signal in picowatts for any signal voltage from 1 uV to 1 V. Conducted NB signal levels may be also expressed in terms of dBm, (dB referred to 1 milliwatt). The RF signal level for 1 mW across 50 ohms is $(10^{-3} \times 50)^{1/2} = 0.223$ V = 107 dB above 1 uV. To obtain the dBm value of a signal, subtract 107 dB from the signal measured in dB above 1 uV. This may be read directly from the dBm scale on the Output meter of the Model NM-17/27.

4.11 OPERATION WITH X–Y RECORDER

Signal amplitude may be plotted with respect to frequency, as in spectrum signature studies, by connecting an X–Y recorder to the Model NM-17/27. Any suitable X–Y recorder may be used that is compatible with the X–Y output characteristics of the Model NM-17/27 (refer to the specifications in Table 2-l). The X-output voltage of the Model NM-17/27 is proportional to the indicated frequency throughout each band, and the Y-output voltage is proportional to the signal level as indicated on the Output meter.

The internal scan feature of the Model NM-17/27 provides semiautomatic frequency tuning over each band in one minute, and also provides a contact closure during the scan period for use as a recorder pen lift control.

The instructions that follow are general and are intended as a guide for the particular test setup and X–Y recorder used. Proceed as follows:

a. Connect the X–Y cables (Model 90071-1) to the X–Y OUTPUT receptacles on the rear panel of the Model NM-17/27 and the corresponding input receptacles of the recorder.

b. Connect a suitable cable between the RECORDER PENLIFT phone jack on rear panel of the Model NM-17/27 and the appropriate receptacle on the recorder. A three-conductor phone plug (military type PJ-068 or equivalent) is required for the RECORDER PENLIFT connection.

c. Turn on the Model NM-17/27 and set the BAND (MHz) switch to the desired frequency range. Set the CONTROL MODE switch to the LOCAL position, the AFC switch to the OFF position, the BANDWIDTH switch to the 10 kHz position and the FUNCTION switch to the SLIDEBACK PEAK position.

d. Turn on and prepare the X–Y recorder for operation.

e. Rotate the TUNE control on the Model NM-17/27 to the low frequency end of the band in use and zero the recorder pen on the X-axis.

f. Temporarily disconnect the Y-axis to the recorder, and zero the recorder pen on the Y-axis. Reconnect the cable.

g. Rotate the TUNE control on the Model NM-17/27 to the high frequency end of the band in use. Adjust the recorder pen for full-scale deflection on the X-axis, then turn the TUNE control back to the low frequency end of the band.

h. Adjust the SLIDEBACK PEAK control on the Model NM-17/27 to obtain full-scale deflection of the Output meter. Adjust the recorder pen for full-scale deflection on the Y-axis, then turn the SLIDEBACK PEAK control back to the fully counterclockwise position.

i. Calibrate the Model NM-17/27 as described in Paragraph 4.6.

j. Connect the proper signal pickup device to the RF INPUT receptacle of the Model NM-17/27. Set the FUNCTION switch to the PEAK/0.3 SEC HOLD TIME position.

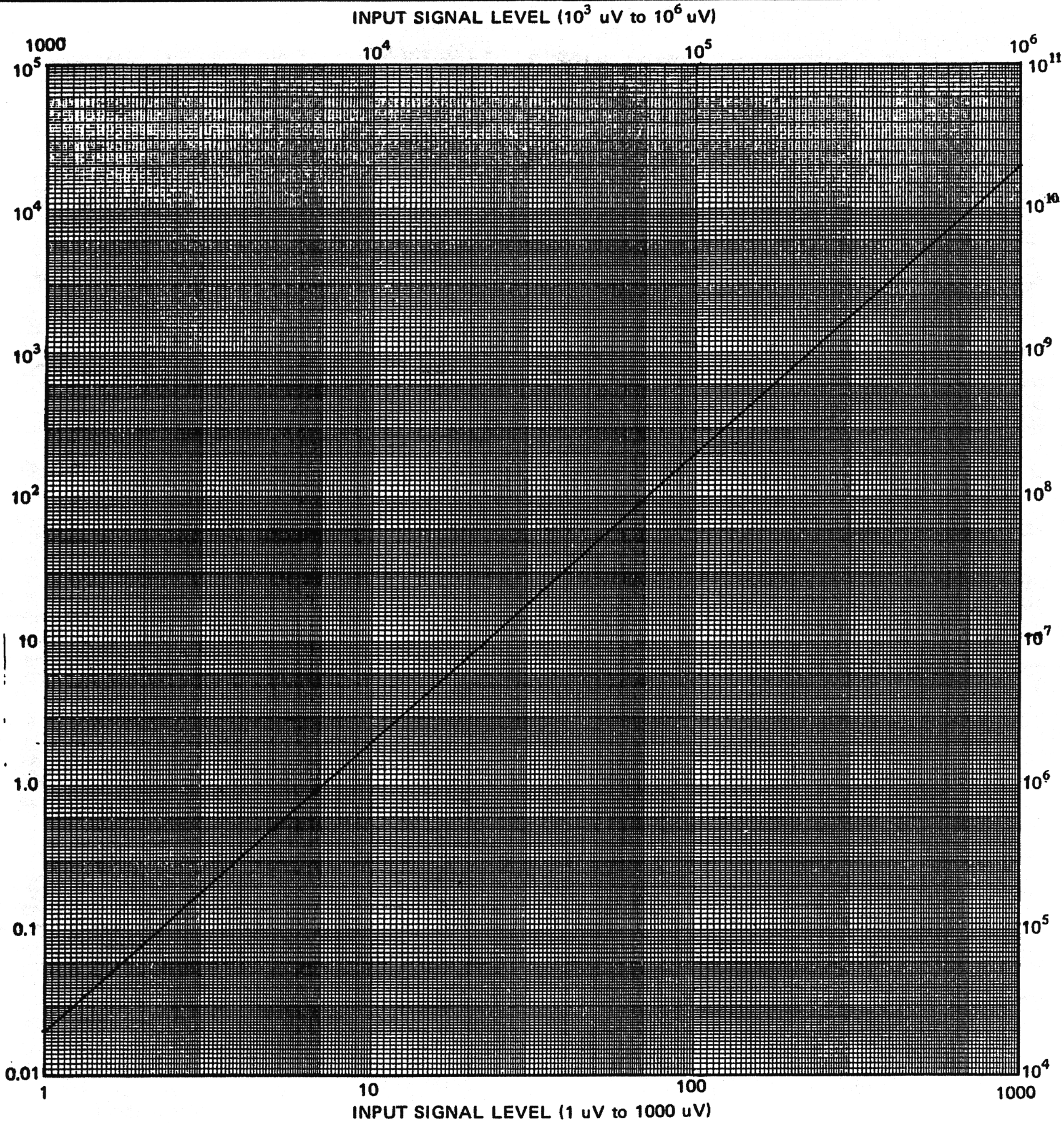
k. Tune the Model NM-17/27 slowly across the band in use and observe the Output meter deflection. Set the ATTENUATOR switch to maintain an on-scale deflection for the strongest signal encountered. Rotate the TUNE control back to the low frequency end of the band.

l. To record a spectral signature of the band, set the CONTROL MODE switch on the Model NM-17/27 to the SCAN position and press the SINGLE switch. The Model NM-17/27 will automatically sweep the full frequency range of the band in use in one minute, and will then return to the low frequency end of the band.

m. Repeat Steps i, k and l to record a spectrum signature of each band selected.

4.12 OPERATION WITH EXTERNAL SCAN INPUT

The frequency tuning of the Model NM-17/27 may be remotely controlled independently from remote programming of other functions by using the EXTERNAL SCAN input. This feature should be employed when the application requires a scan time other than one minute for X–Y recording, or when a spectral display is desired. For example, the Model SCU-7 Scan Control Unit or a low frequency function generator may be used as a tuning voltage source. To produce a finely detailed X–Y plot, the function generator may be adjusted to develop a 0 volt to +10 volt ramp function with a scan time of 1000 seconds.



NOTE: For input signal levels from 1 uV to 1000 uV, use the bottom and left-hand scales. For input signal levels from 1000 uV to 1,000,000 uV, use top and right-hand scales.

EXAMPLES: 10 uV = 2 pW
100,000 uV = 2 x 10^8 pW (or 0.1 V = 200 uW)

Figure 4-3. Signal Power Conversion Chart (Picowatts – Microvolts)

For spectral display on an oscilloscope, scan times as fast as 30 milliseconds may be employed. For X–Y recording with external scan, the following general procedure is recommended:

a. Connect and calibrate the equipment as directed in Paragraph 4.11.

b. Provide a tuning voltage source capable of delivering 0 volt to +10 volts across 2000 ohms with a scan time suitable for the application.

> **CAUTION**
>
> Do not exceed ±15 volts at the EXTERNAL SCAN receptacle of the Model NM-17/27 as the voltage comparator, A33U2, may be damaged.

c. Connect the tuning voltage source to the EXTERNAL SCAN receptacle on the Model

NM-17/27 rear panel. Use a standard phone plug (military type PJ-055 or equivalent) and shielded cable.

d. Set the CONTROL MODE switch to the SCAN position.

NOTE

Insertion of the phone plug into the EXTERNAL SCAN receptacle automatically disables the internal sweep circuit.

e. Proceed with the X–Y recording as in Paragraph 4.11.

4.13 REMOTE CONTROL

The interconnection requirements for remote controls via the PROGRAMMER receptacle on the rear panel of the Model NM-17/27 are described in the following paragraphs. Wiring diagrams (Figures 4-5 thru 4-9) that illustrate typical remote controls and a PROGRAMMER receptacle pin data list (table 5-1) are included.

4.13.1 Frequency Band Selection

A total of eight mutually exclusive contact closures are required for remote selection of the eight frequency bands covered by the Model NM-17/27. Switching potential is –12 V at 30 mA maximum current. See Figure 4-4.

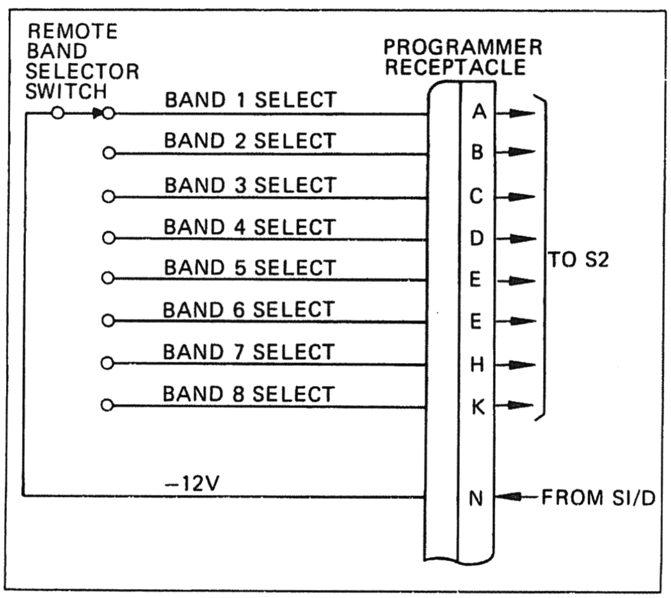


Figure 4-4. Remote Frequency Band Selection, Wiring Diagram

4.13.2 Bandwidth Selection

Remote selection of any of four bandwidths requires four mutually exclusive contact closures. Switching potential is +12 V at 12 mA maximum current. See Figure 4-5.

4.13.3 Frequency Tuning

Remote tuning of the Model NM-17/27 is accomplished by the application of a linear ramp voltage to the tuning circuit of the Model NM-17/27 as displayed in Figure 4-6. Scan

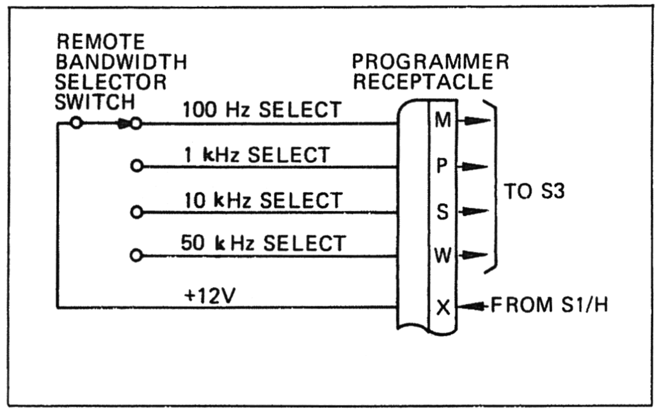


Figure 4-5. Remote Bandwidth Selection, Wiring Diagram

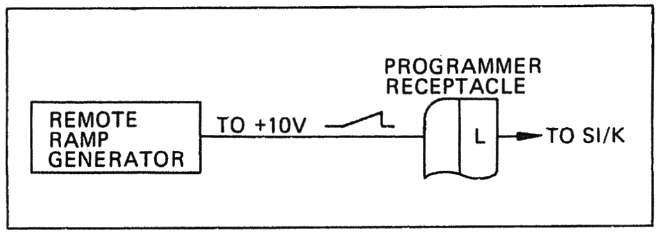


Figure 4-6. Remote Frequency Tuning, Wiring Diagram

time over the frequency band in use is determined by remote programming requirements. The remote ramp generator circuits must provide a sawtooth waveform from 0 volt to +10 volts to an input resistance of approximately 2 kilohms.

4.13.4 Gain (Calibrate)

Remote adjustment of the Model NM-17/27 IF gain for calibration purposes requires a device capable of supplying a continuously variable dc voltage ranging from 0 V to –6 V to an input resistance of 100 kilohms. See Figure 4-7.

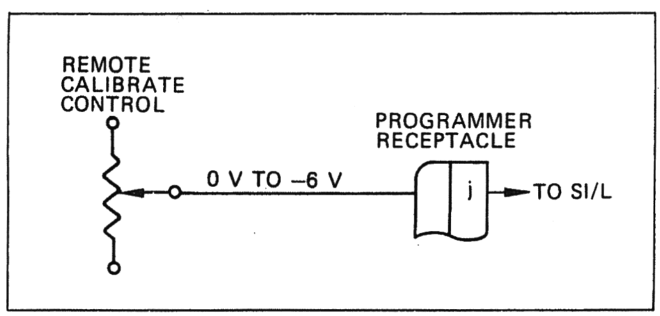


Figure 4-7. Remote Function Selection, Wiring Diagram

4.13.5 Detector Function Selection

Remote selection of detector functions requires six mutually exclusive contact closures. Refer to Figure 4-8. Switching potential is +12 V at 60 mA maximum current.

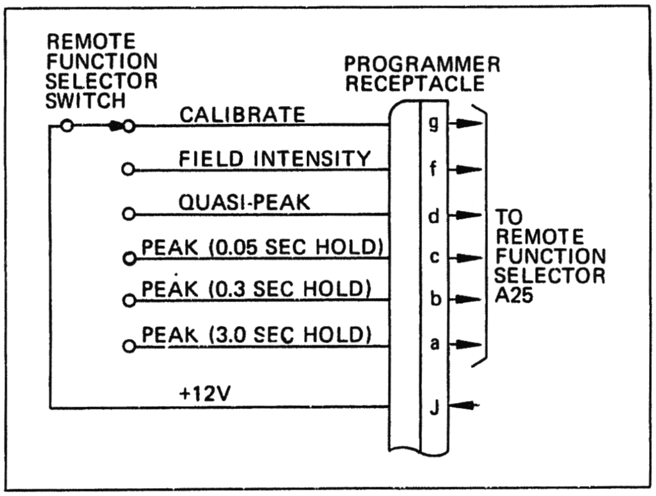


Figure 4-8. Remote Function Selection, Wiring Diagram

Section V
THEORY OF OPERATION

5.1 INTRODUCTION

This section contains the theory of operation of the Model NM-17/27 Electromagnetic Interference Field Intensity (EMI/FI) meter. The information is presented in two forms; a basic discussion of the simplified Block Diagram, Figure 5-4 and the Detailed Block Diagram, Figure 8-30; and a detailed circuit analysis oriented to the schematic diagrams, Figures 8-1 thru 8-29. The Block Diagram discussion will aid the user in understanding the various controls of the instrument to obtain accurate measurements. The circuit analysis information is primarily for the benefit of the technician to troubleshoot, and repair the equipment.

5.2 BASIC PRINCIPLES OF OPERATION

The Model NM-17/27 (See Figure 5-4) is basically a dual-conversion superheterodyne receiver, operating within the frequency range of 10 kHz to 32 MHz in eight bands. However, to perform the required measurement functions and to provide automated features, several additional functions have been incorporated into the instrument. These functions are as follows: an adjustable RF Attenuator, an internal Impulse Calibrator, and internal frequency sweep, a frequency readout, a Log IF Amplifier, a Metering Circuit, and several special-purpose detector functions.

5.2.1 RF Circuitry

The RF input signal is applied to the Input Filter, A41, and through the RF Attenuator, A45, to an RF tuner selector switch part of A9, and then to the RF Tuner selected by the BAND (MHz) switch.

The Input Filter, A41, is a combination high-pass and low-pass filter that rejects signals below and above the frequency range of the instrument.

The RF Attenuator, A45, controls the level of the input signal for the +60 dB, +40 dB and +20 dB steps (The 0 dB, –20 dB and –40 dB steps are accomplished by the IF Preamplifier Assembly, A11) to maintain signal level within the range of the Output meter.

The BAND (MHz) switch controls the Tuning Control Assembly, A29, the Band Selector Assembly, A30, and the RF Switch and Impulse Calibrator Assembly, A9. These in turn apply the tuning voltage to the Tuners, supply +12 volts and –12 volts to operate the Tuner selected, and pass the RF signal to the selected Tuner respectively. The Band Selector Assembly, A30, also selects the appropriate frequency band lamps, A47, and selects appropriate circuitry in the Frequency Readout Assembly, A34, so that its output is a scaled voltage representative of the tuned frequency of the Model NM-17/27. The output is applied to the PROGRAMMER receptacle, J9-T. The Band Selector Assembly, A30, also passes the proper tuner IF signal to the IF Converter Assembly, A10, by energizing the proper diode switches in the IF Converter Assembly via the tuner IF cable from the energized Tuner.

The Impulse Calibrator Assembly, A9, contains an impulse generator. The output of the inpulse generator is applied to the selected Tuner when the CALIBRATE position is selected by the FUNCTION switch, S5E, or by the Remote Function Selector Assembly, A25. The impulse calibrator is an all solid-state circuit that generates a short pulse with a spectral output that is constant over the frequency range of the Model NM-17/27. Simultaneously, the 10 kHz bandwidth, 0 dB RF attenuator setting, and quasi-peak function are selected when the FUNCTION switch is set at the CALIBRATE position.

Separate RF Tuners are used for each frequency band. Each Tuner consists of an RF amplifier, a mixer, a local oscillator and one stage of IF amplification. Varactor diodes are used in the Tuners as the capacitive tuning elements for some of the RF input, mixer and local oscillator tuned circuits. The varactor diodes are voltage tuned. Tuning may be performed remotely via the PROGRAMMER connector, J9-L, or the EXTERNAL SCAN receptacle, J8, at the rear panel or internally from a variable voltage derived from the TUNE and FINE TUNE controls or from the Internal Sweep Assembly, A33.

The Internal Sweep Assembly, A33, generates a sawtooth voltage that rises from 0 to 10 volts in 60 seconds. A single sweep of a selected RF Tuner occurs when the CONTROL MODE switch is set to the SCAN position and the SINGLE switch is depressed.

The Tune Control Assembly, A29, contains a summing amplifier, which adds the outputs of the TUNE control, FINE TUNE control, and the AFC voltage and applies the sum to the CONTROL MODE switch, SIG. The tuning voltages from all sources are first processed by the Shaper Assembly, A26, before applying to the RF Tuner via the Tuning Control Assembly, A29. This provides a nearly linear output frequency change for a linear input voltage change.

Three different first intermediate frequencies are employed: Bands 1 and 4 are 455 kHz; Bands 2, 3, 5 and 6 are 1.6 MHz, and Bands 7 and 9 are 5.0 MHz.

The IF Converter Assembly, A10, converts the RF Tuner 1.6 MHz and 5 MHz IF's to 455 kHz (Controlled by the Band Selector Assembly, A30). The bandpass filters minimize spurious responses caused by second local oscillator signal leakage back to the RF Tuners. To further reduce the possibility of spurious responses, the converter second local oscillators are selectively energized by the BAND (MHz) switch.

5.2.2 IF Circuitry

The 455 kHz IF signal from the converter is further amplified by the IF Preamplifier and Calibration Amplifier Assembly, A11, Amplification is provided by three stages in cascade. Each of the first two stages provides exactly 20 dB of voltage gain. The –40 dB, –20 dB and 0 dB steps of the ATTENUATOR (dB) switch are provided by routing the signal through stages 1 and 2; through stage 1 and bypassing stage 2; and by bypassing both stages 1 and 2, respectively. The IF signal routing is accomplished by three reed relays controlled by the ATTENUATOR (dB) switch. The gain of the third section is controlled by the CALIBRATE control.

The 455 kHz IF signal from the IF preamplifier is applied to the Bandwidth Selector Assembly, A12, which contains four bandpass filters. The filters consist of passive elements separated and isolated by active amplifiers. The filters largely determine the overall Model NM-17/27 impulse bandwidths of 100 Hz, 1 kHz, 10 kHz and 50 kHz. The filters are energized one at a time by diode switches as selected by the BANDWIDTH (kHz) switch. Bandwidth selection may also be performed remotely via the PROGRAMMER receptacle, J9-M, P, S and W. The IF signal output is routed to the IF OUTPUT receptacle, J4, and to the Linear IF Amplifier and BFO Assembly, A15,

The Linear IF Amplifier and BFO Assembly, A15, amplifies the 455 kHz IF signal by means of an amplifier circuit that includes a fast AGC loop to limit the output signal level range. A 456 kHz BFO signal (offset by 1 kHz from the 455 kHz IF signal) is injected beyond the AGC loop and controlled by the FUNCTION switch. The IF signal is again amplified and detected. The resulting modulation components are amplified by a 20 Hz to 25 kHz video amplifier.

The IF signal from the Bandwidth Selector Assembly, A14, is also routed to the Log IF Amplifier Assembly, A12. In the Log IF Amplifier Assembly, A12, the 455 kHz IF signal is again amplified, then applied to a log amplifier which provides a range of approximately 80 dB, 10 dB below to 10 dB above the range of the 60 dB Output meter scale. The linearity of the logarithmic action is accurate to within ±0.5 dB. A partially limited IF signal from this section of the module is routed to the FM Discriminator Module, A18. The output of the log amplifier is applied to an active detector and then to a video amplifier buffer stage.

The IF signal output of the IF Preamplifier Assembly, A11, is also applied to the AFC and FM Detector Assembly, A18. The AFC and FM Detector Assembly, A18, contains both narrowband AFC (100 Hz and 1 kHz) and broadband AFC (10 kHz and 50 kHz). These are selected automatically by the BANDWIDTH (kHz) switch. A programmed attenuator inserts 6 dB for band 1 thru band 4, 12 dB for bands 5 and 6, and 15 dB for bands 7 and 8 to provide optimum phase-lock loop stability. The output of the AFC and FM Detector Assembly, A18, is routed to the Tune Control Assembly, A29, when the AFC switch is at the ON position. This voltage is added to the tune voltage and corrects any frequency drift.

5.2.3 Video and Metering Circuitry

The linear video signal from the Linear IF and BFO Assembly, A15, is available at the LINEAR VIDEO receptacle, J5, and is also available at the Audio Assembly, A24, when the AUDIO switch is in the AM position. The Audio Assembly amplifies the video output signal and presents the video information to the AUDIO receptacle, J12. When the FUNCTION switch is in the SLIDEBACK PEAK position, the output from the tone generator is substituted for the normal AM source. When the AUDIO switch is in the FM position, the amplified output of the FM discriminator is applied to the AUDIO receptacle.

The log IF video signal from the Log IF Assembly, A12, is routed to the LOG VIDEO receptacle, J3, and also to the Weighting Circuits and Meter Amplifier Assembly, A21, the Direct Peak Assembly, A22, and the Slideback Peak Assembly, A23, depending upon the position of the FUNCTION switch, S5B, and the CONTROL MODE switch, S1B.

The Slideback Peak Assembly, A23, contains a comparator circuit that compares the video input signal voltage level to a manually controlled dc voltage from the SLIDEBACK PEAK panel control. If the signal voltage exceeds the slideback peak voltage, the output of a tone generator is amplified by the audio amplifier and appears at the AUDIO receptacle. At the point of voltage equality, the comparator output switches and the tone discontinues. The voltage, which is a measure of the peak video signal level at this threshold point, is routed through the FUNCTION switch to the metering circuit and displayed on the Output meter and at the Y-OUTPUT receptacle, J11.

The Direct Peak Assembly, A22, contains a fast reacting pulse-stretching circuit which responds to the peak of the video modulation. Other circuits hold the maximum signal modulation level for the time selected by the FUNCTION switch, S5E, (.05, 0.3 and 3.0 seconds), then the signal is momentarily grounded (dumped) and a new signal level may be measured. The appearance of a higher level signal during the hold period will override the level indication and restart the hold period.

The output from the direct peak module returns to the FUNCTION switch, S5C, then to the meter amplifier in the Weighting Circuits and Meter Amplifier assembly, A21, and to the Output meter and the Y-OUTPUT receptacle, J11.

The Weighting Circuits and Meter Amplifier Assembly, A21, performs the functions of FI weighting (average of the log IF amplifier), QP weighting (1 ms charge time, 600 ms discharge time), and meter amplification. The FI amplifier is employed in FIELD INTENSITY and BFO modes of the FUNCTION switch. The QP amplifier is employed in the QUASI PEAK and CALIBRATE modes of the FUNCTION switch. The meter amplifier operates in all modes and drives the Output Meter, A46, and the Y OUTPUT receptacle, J11. Outputs from the FI and QP amplifiers are returned to the FUNCTION switch, then to the meter amplifier and to the Output meter.

The dB readout function is accomplished by the dB Readout and Audio assembly, A24, by adding a voltage which is proportional to the RF ATTENUATOR (dB) position in dB to a voltage which is proportional to the Output meter indication. The addition is performed by a summing network controlled by relays. The output voltage is available at the PROGRAMMER receptacle, J9-V.

The Remote Function Selector, A25, enables control of the EMI/FI meter functions from an external programmer. The remote function selector operates only when the CONTROL MODE switch is set at the REMOTE position. With the remote control mode selected, all inputs to the FUNCTION switch are removed and the output of the Logarithmic IF Amplifier, A12, is applied to the remote function selector. The field intensity, quasi-peak, peak, or calibrate functions may then be selected by a remote programmer. Also the remote programmer may perform simultaneous direct peak and FI measurements.

5.2.4 Power Supply Circuitry

The power supply circuitry contains the dc/dc Converter Assembly, A16; Voltage Regulator Assembly, A31, Rectifier Charge Regulator Assembly, A32; Power Transformer, A42; and Battery, A44. The power supply provides ±12 Vdc and +100 Vdc. The power supply accepts 115 V or 230 V, 50 to 400 Hz input power. The rechargeable battery package permits up to 8 hours of operation without external power.

5.3 DETAILED CIRCUIT ANALYSIS

5.3.1 Band 1 Tuner Assembly (A1)

The Band 1 RF Tuner Assembly consists of an input bandpass filter, RF amplifier, low-pass filter, balanced mixer, local oscillator and tuned 455 kHz IF preamplifier. (See Figure 8-1)

The input bandpass filter consists of both low-pass and high-pass filters. The low-pass filter has input and output impedances of 50 ohms. The filter consists of two M-derived end half-sections, A1L1, A1C1, A1C2 and A1L4, A1C5, and two constant-K center half-sections. The cut-off frequency is 350 kHz, thus providing good VSWR over the bandpass of the tuner. From the output of the low-pass filter the signal is applied to a 50 to 800 ohm transformer which is also part of a two-element high-pass filter consisting of A1T1 and A1C6. The signal is then applied to the RF amplifier, A1Q1 and A1Q2.

The first stage of the amplifier, A1Q1, operates in the common-emitter configuration. The required gain and input impedance are achieved by use of emitter degeneration and collector-to-base feedback. An emitter follower, A1Q2, completes the RF amplifier. The RF amplifier with its input and output filters provides a net voltage gain of approximately 30 dB to the mixer input.

A low-pass filter, A1L5, A1L6, A1C12, A1C13, A1C14, and A1C15, is placed between the RF amplifier and mixer to reject image noise and spurious responses. This filter has a response null at the 455 kHz IF frequency.

The RF tuner employs a double-balanced mixer, A1U1, which provides signal frequency conversion to the 455 kHz I.F. This mixer also rejects the I.F. response and features a wide dynamic range at the RF input port. The local oscillator feedthrough is nulled by adjustment of a dc bias potentiometer. A1R9.

The RF tuner employs a two-transistor version of the Vacar oscillator. This circuit is similar to the basic Clapp oscillator circuit but has flatter output power level over a wide frequency range. High output isolation is achieved by extracting the output power from the collector of the second transistor, A1Q5, whereas feedback is extracted from the emitter. Output power to the mixer is approximately 10 mW. The local oscillator is voltage-tuned by varactor diode A1CR1. The local oscillator is 455 kHz. above the incoming signal and tracking between the frequency dial and the local oscillator is accomplished by adjusting A1L9 and A1C28.

The 455 kHz IF preamplifier contains a tuned input and tuned output stage. Impedance matching from mixer A1U1 to transistor A1Q3 is accomplished by transformer A1T2. Collector bias for A1Q3 is applied through switching diodes located in the second converter module, A10; in this manner the second converter input switching is controlled directly by the RF tuner through its IF output cable. Overall RF tuner gain is set by adjustment of potentiometer A1R21 in the emitter circuit of A1Q3.

5.3.2 Band Tuner Assembly (A2)

The Band 2 RF Tuner consists of an input filter, RF amplifier, low-pass filter, balanced mixer, local oscillator and tuned 1.6 MHz I.F. preamplifier. (See Figure 8-2) The input filter consists of both low-pass and high-pass filters. A half-section, low-pass filter, A2L1 and A2C1, at the input reduces magnetic coupling at the intermediate frequency (1.6 MHz). The high-pass filter, A2T1, A2C2 and A2L2, has an input impedance of 50 ohms, an output impedance of 200 ohms, and a cutoff frequency of approximately 200 kHz. The high-pass filter is followed by another low-pass filter consisting of two M-derived end half-sections, A2L3, A2C3, A2C4 and A2L6, A2C6 and A2C7, and two constant-K center half-sections. This filter has a cutoff frequency of 600 kHz and a response null at 800 kHz (1/2 IF). The signal is then applied to the RF amplifier, A2Q1 and A2Q2. The first stage of the RF amplifier, A2Q1, is operated in the common-emitter configuration. The required gain and input impedance are achieved by use of emitter degeneration and collector-to-base feedback. An emitter follower, A2Q2, completes the RF amplifier. The RF amplifier with its input and output filters provides a net power gain of approximately 10 dB to the mixer input.

A low-pass filter, A2L7, A2C14, A2C15 and A2C16 is placed between the RF amplifier and mixer to reject image noise and spurious responses. This filter has a response null at 1.6 MHz, the IF frequency.

The RF tuner employs a double-balanced mixer, A2Z1, which provides signal frequency conversion to the 1.6 MHz IF. This mixer also rejects the IF response and features a wide dynamic range, at the RF input port.

The RF tuner employs a two-transistor version of the Vacar oscillator. This circuit is similar to the basic Clapp oscillator circuit but has flatter output power level over a wide frequency range. High output isolation is achieved by extracting the output power from the collector of the second transistor, A2Q5, whereas feedback is extracted from the emitter. Capacitive voltage dividers are employed at both ends of the tuned circuit. Output power to the mixer is approximately 10 mW. The local oscillator is voltage-tuned by varactor diode A2CR1. The local oscillator is 1.6 MHz above the incoming signal and tracking between the frequency dial and the local oscillator is accomplished by adjusting A2L9 and A2C28.

The 1.6 MHz IF preamplifier contains a tuned input and tuned output stage. Impedance matching from the mixer, A2Z1 to transistor A2Q3 is accomplished by an L-network containing a tapped capacitor, A2L8, A2C20 and A2C21. Collector bias for A2Q3 is applied through switching diodes located in the second converter module, A10; in this manner the converter input switching is controlled directly by the RF tuner through its IF output cable. Overall RF tuner gain is set by adjustment of potentiometer A2R9 in the emitter circuit of A2Q3.

5.3.3 Band 3 Tuner Assembly (A3)

The Band 3 RF Tuner consists of a double-tuned preselector, RF amplifier, low-pass filter, balanced mixer, local oscillator and tuned 1.6 MHz IF preamplifier. (See Figure 8-3).

This RF tuner employs a two-pole, voltage-tuned preselector for rejection of undesired signals. Impedance matching from the 50 ohm input to the high-impedance point on the first resonator (junction of A3L1 and A3CR1) is accomplished by means of an L-matching network, A3L1 and A3C1. Coupling between the two resonators is through an inductor and capacitor network, A3L2 and A3C3, the values being chosen to provide a fixed coupling coefficient across the tuning range. The coupling is adjusted by varying the inductor, A3L2, and capacitor, A3C3, of this network. Impedance matching from the tap point on the second resonator to A3Q1 transistor base is by means of a series inductor A3L3. Adjustment of this inductor also affects the input VSWR and frequency response of the preselector. Tuning of the preselector resonators is accomplished by varactor diodes A3CR1 and A3CR2. The varactor tuning voltage is supplied from the tuning control module, A29. A3C2 and A3C4 are bypass capacitors.

The first stage of the RF amplifier, A3Q1, operates in the common-emitter configuration. The required gain and input impedance are achieved by use of emitter degeneration and collector-to-base feedback. An isolation stage consisting of an emitter follower, A3Q2, completes the RF amplifier. The RF amplifier with its preselector and low-pass filter provides a net power gain of approximately 10 dB to the mixer input.

A low-pass filter, A3L4, A3L5, A3C12, A3C13 and A3C14, is placed between the RF amplifier and mixer to reject image noise and spurious responses. This filter has response nulls at the 1.6 MHz IF and the image frequency.

The RF tuner employs a double-balanced mixer, A3Z1, which provides signal frequency conversion to the 1.6 MHz IF. This mixer also rejects the IF response and features a wide dynamic range, at the RF input port.

The RF tuner employs a two-transistor version of the Vacar oscillator. This circuit is similar to the basic Clapp oscillator circuit but has flatter output power level over a wide frequency range. High output isolation is achieved by extracting the output power from the collector of the second transistor, A3Q5, whereas feedback is extracted from the emitter. Capacitive voltage dividers are employed at both ends of the tuned circuit. Output power to the mixer is approximately 10 mW. The local oscillator is voltage-tuned by varactor diode A3CR3. The local oscillator is 1.6 MHz above the incoming signal and tracking between the frequency dial and the local oscillator is accomplished by adjusting A3L7 and A3C27.

The 1.6 MHz IF preamplifier contains a tuned input and tuned output stage. Impedance matching from the mixer, A3Z1, to transistor A3Q3 is accomplished by an L-network containing a tapped capacitor, A3L6, A3C15 and A3C16. Collector bias for A3Q3 is applied through switching diodes located in the second converter module, A10; in this manner the converter input switching is controlled directly by the RF tuner through its IF output cable. Overall RF tuner gain is set by adjustment of potentiometer A3R13 in the emitter circuit of A3Q3.

5.3.4 Band 4 Tuner Assembly (A4)

Band 4 RF Tuner consists of a double-tuned first preselector, RF amplifier, single-tuned second preselector, balanced mixer, local oscillator and tuned 455 kHz IF preamplifier. (See Figure 8-4).

This RF tuner employs a two-pole, voltage-tuned first preselector, for rejection of undesired signals, Impedance matching from the 50 ohm input to the high-impedance point on the first resonator (junction of A4L1 and A4L2) is accomplished by means of a series inductor, A4L1. Coupling between the two resonators, is through an inductor and capacitor network, A4L3 and A4C3; the values being chosen to provide a fixed coupling coefficient across the tuning range. The coupling is adjusted by varying the inductor A4L3 and capacitor A4C3 of this network. Impedance matching from the high-impedance point on the second resonator (junction of A4L4 and A4L3) to A4Q1 transistor base is by means of a series inductor, A4L5. Adjustment of this inductor also affects the input VSWR and frequency response of the first preselector. Tuning of the preselector resonators is accomplished by varactor diodes, A4CR1 and A4CR2. The varactor tuning voltage is supplied from the Tuning Control Module, A29. A4C1 and A4C5 are bypass capacitors.

The first stage of the RF amplifier, A4Q1, operates in the common-emitter configuration. The required gain and input impedance are achieved by use of emitter degeneration and collector-to-base feedback. An IF trap, A4L6 and A4C9, and an emitter follower, A4Q2, complete the RF amplifier. A single-pole resonator configuration, is used in the second preselector. Impedance matching is accomplished by a combination of series inductors, A4L7, A4L8 and A4L9, and the tapped transformer, A4T1; the relative values are chosen for maximum loss at the image frequency. Tuning of the second preselector is accomplished by varactor diode, A4CR3. The varactor tuning voltage is supplied from the Tuning Control Module, A29. A4C14 is a bypass capacitor. The RF amplifier with its first and second preselectors provide a net power gain of approximately 10 dB to the mixer input. The RF tuner employes a double-balanced mixer, A4Z1, which provides signal frequency conversion to the 455 kHz IF. This mixer also rejects the IF response and features a wide dynamic range at the RF input port.

The RF tuner employs a two-transistor version of the Vacar oscillator. This circuit is somewhat similar to the basic Clapp oscillator but has flatter output power level over a wide frequency range. High output isolation is achieved by extracting the output power from the collector of the second transistor, A4Q5, whereas feedback is extracted from the emitter. Capacitive voltage dividers are employed at both ends of the tuned circuit. Output power to the mixer is approximately 10 mW. The local oscillator is voltage-tuned by varactor diode, A4CR4. The local oscillator is 455 kHz above the incoming signal and tracking between the frequency dial and the local oscillator is accomplished by adjustment of A4L11 and A4C25. The 455 kHz IF preamplifier contains a tuned input and tuned output stage. Impedance matching from the mixer, A4Z1, to the transistor, A4Q3, is accomplished by a tapped transformer, A4T2. Collector bias for A4Q3 is applied through switching diodes located in the Second Converter Module, A10; in this manner the converter input switching is controlled directly by the RF tuner through its IF output cable. Overall RF tuner gain is set by adjustment potentiometer, A4R13 in the emitter circuit of A4Q3.

5.3.5 Bands 5 thru 8 Tuner Assemblies (A5-A8)

RF tuners, bands 5 thru 8, are identical in operation with band 4. Component values generally become smaller with increasing frequency and the IF amplifier frequency increases to 1.6 MHz for bands 5 and 6 and to 5 MHz for bands 7 and 8. (See Figures 8-5 thru 8-8).

5.3.6 RF Switch and Impulse Calibrator Assembly (A9)

This module consists of the impulse calibrator, calibrator output switch, low-pass filter, and RF input switch (See Figure 8-9).

The impulse generator is the standard calibrating signal source in the Model NM-17/27. The generator consists of a free-running blocking oscillator, switching amplifier and a section of coaxial cable used as a pulse-forming delay line.

When the FUNCTION switch is placed in the CAL position

+12 volts is applied to energize the circuit, and the delay line, A9DL1, charges. The blocking oscillator, A9Q1, operates at approximately 500 Hz, producting an output across the tertiary winding (pins 3 and 4) of transformer, A9T1. This signal is coupled through A9C9 to the base of the switching amplifier, A9Q2. On the positive portion of the input wave A9Q2 conducts and the collector becomes negative with respect to the charge on A9DL1. This causes the delay line to discharge and produce a negative going output across the attenuator resistors, A9R8 thru A9R11. This continues until the input cycle reverses; the base of A9Q2 becomes negative and the transistor becomes cut off. At this time A9DL1 again charges towards +12 volts until the next positive cycle arrives at the base of A9Q2.

The output pulses from the attenuator have a flat spectral output throughout the frequency range of the Model NM-17/27. The output level is adjustable by potentiometer A9R12.

The low-pass filter has input and output impedance of 50 ohms. The filter consists of two M-derived end half-sections, A9L1, A9C1, A9C2 and A9L4, A9C4, A9C5, and two constant-K center half-sections. The cut-off frequency is 39 MHz, thus providing a flat response to the frequency range of the Model NM-17/27. The purpose of the low-pass filter is to reject spurious signals containing frequencies beyond the normal range of the equipment.

When the impulse calibrator is energized, activation of two reed relays occurs. One relay, A9K9, connects the impulse generator to RF input switch and disconnects the low-pass filter. The 2nd reed relay, A9K10, disconnects the RF input, A9J9, from the low-pass filter and grounds the filter. In this manner a strong signal applied to the RF input will not interfere with proper calibration.

The signal from the low-pass filter or impulse generator is applied to eight parallel reed relays, A9K1 thru A9K8. The outputs of these relays are connected to connectors A11J1 thru A11J8.

5.3.7 Second Converter Assembly (A10)

The Second Converter consists of input switching diodes, input filters, a mixer, local oscillators and a tuned 455 kHz IF amplifier. (See Figure 8-10)

Input switching diodes, A10CR1 thru A10CR8, become conductive by a dc bias supplied from the RF tuners by way of the IF input cables, the current being supplied from the IF preamplifier collector circuit of the RF tuner in use. In the double conversion bands (1.6 and 4 MHz IF inputs) this same current also switches the output of the 1.6 and 5 MHz bandpass filters via diodes A10CR9 and A10CR10 respectively.

The 1.6 MHz input has a parallel tuned trap, A10L1, A10C1 and A10C36, for the 1835 kHz spurious response (1145 x 2 – 455), and a three-pole bandpass filter. The 5 MHz input has a parallel tuned trap, A10L4 and A10C9, for the 4090 kHz image, and a three pole bandpass filter. The bandpass filters minimize spurious responses caused by second local oscillator signal leakage back to the RF tuners.

The 1.6 and 5 MHz IF signals are applied to the mixer, A10Z1, input via switching diodes A10CR9 and A10CR10. The mixer is double-balanced and rejects the L.O. signal.

Two independent FET crystal oscillators, A10Q2, A10Y1 and A10Q3, A10Y2, are employed; the 1.145 MHz crystal oscillator for the 1.6 MHz/0.455 MHz conversion, and the 4.545 MHz crystal oscillator for the 5 MHz/0.455 MHz conversion. The oscillator output circuits are added by the output transformer secondaries, A10T8 and A10T9; the unenergized transformer becomes a low impedance in series with the oscillator output. The two oscillators are selectively energized by the BAND (MHz) switch, S2, via Band Selector Assembly, A30, when required. Both second local oscillators are de-energized when the converter input frequency is 455 kHz.

A low noise 455 kHz FET amplifier, A10Q1, with tuned input, A10T5, and double-tuned output, A10T6 and A10T7, complete the IF converter. This stage operates as a source follower amplifier, most of the 10 to 12 dB of gain being achieved by the turns ratio of the input transformer, A10T5.

5.3.8 IF Preamplifier and Calibrator Amplifier Assembly (A11)

The IF Preamplifier and Calibrator Amplifier contains two 20 dB amplifier stages, A11Q1, A11Q2, A11Q3 and A11Q4, A11Q5, A11Q6; relays to insert these stages in the IF signal path or bypass them; and a variable gain amplifier, A11U1 and A11Q7, having a voltage gain control range of +10 dB to –10 dB. (See Figure 8-11) The relays, A11K1, A11K2 and A11K3, are operated by the ATTENUATOR (dB) switch, S4D, on the front panel of the Model NM-17/27.

When the ATTENUATOR (dB) switch, S4, is in the –40 dB position both 20 dB amplifier stages are inserted into the IF signal path yielding 40 dB of gain. When the ATTENUATOR (dB) switch is in the –20 dB position, the first amplifier is inserted into the IF signal path and the second amplifier is bypassed, increasing the IF signal levels by 20 dB. In the 0 dB to +60 dB positions of the ATTENUATOR (dB) switch, both 20 dB amplifier stages are bypassed and the IF signal is directly applied from the IF converter to the variable gain amplifier (calibration amplifier). Instead of wasting power by IF attenuation, this unique approach increases the IF gain by 20 dB or 40 dB and preserves the dynamic range for all attenuator steps. The two identical 20 dB amplifier stages contain three, dc coupled, heavily fed back transistor voltage amplifiers in CE, CE and EF configurations, providing a very stable gain, high input impedance (1 kilohm) and low output impedance (50 ohms).

The calibration amplifier is designed around the wideband operational amplifier, A11U1, in the non-inverting configuration. The gain control is achieved by variable feedback, using an FET, A11Q7, as a voltage controlled resistor. In this manner the receiver gain may be varied without reduction in dynamic range. The resistance of the FET, A11Q7, is approximately a log function of the gate-to-source voltage applied. Using a logarithmic potentiometer for gain control, the gain is approximately linear in dB with the rotation of the potentiometer. Potentiometer, A11R26, in series with the panel mounted CALIBRATE control, adjusts the gain change range. Transformer A11T1 matches the output impedance of the amplifier A11U1 to a 50 ohm load.

5.3.9 Log Amplifier and Detector Assembly (A12)

The 455 kHz Log Amplifier contains an integrated circuit log amplifier, A12U1. (See Figure 8-12) This monolithic amplifier contains four 30 dB sections (see A12U1 Functional Block Diagram, Figure 5-1). The output of each section is proportional to the logarithm of the input voltage throughout a 30 dB input voltage range. The outputs of two of these 30 dB sections are summed in a differential

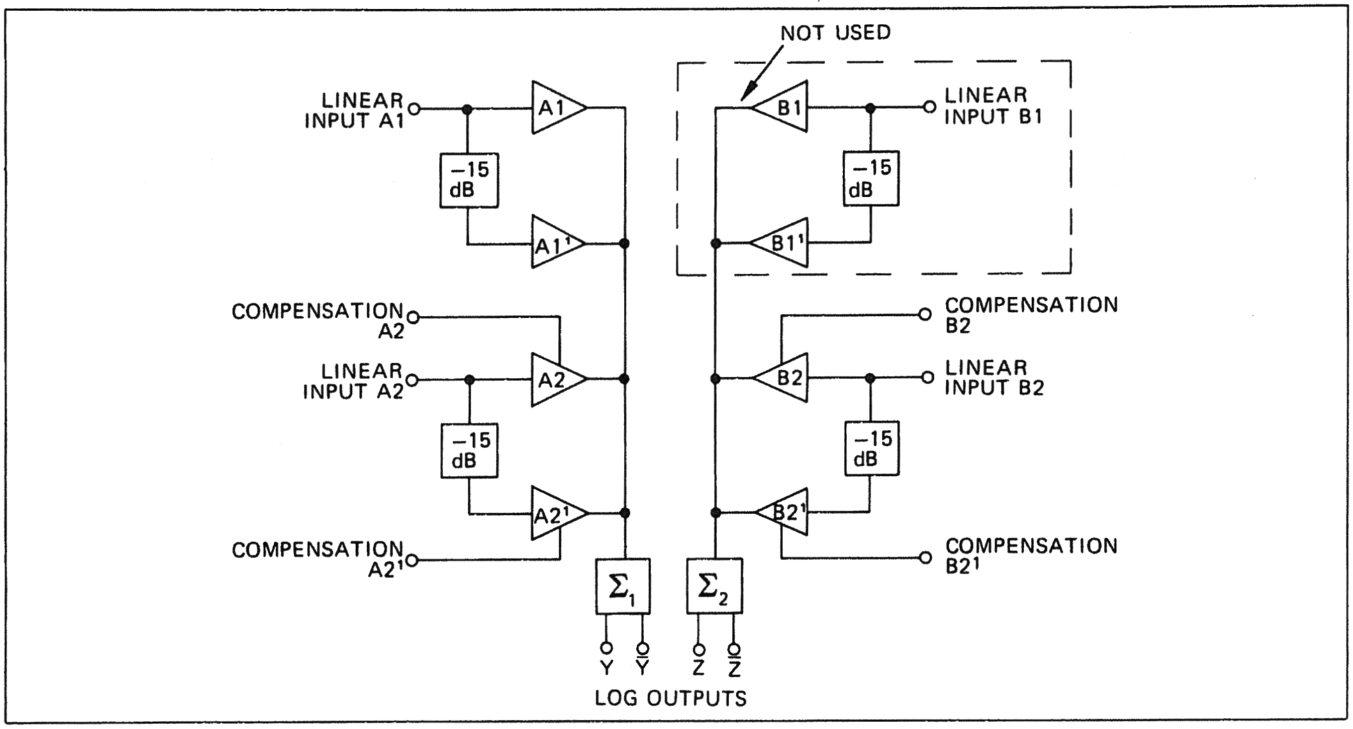


Figure 5-1. Simplified Block Diagram A12U1

output stage, Σ, which yields an output that is proportional to the sum of the log of the input voltages of the two stages.

As displayed in the A12U1 functional block diagram, inputs A1 and A2 are summed to become output $Y\bar{Y}$; inputs B1 and B2 are summed to become output $Z\bar{Z}$. Each section contains two 15 dB stages, e.g. B2 and $B2^1$, with a 15 dB attenuator in series with $B2^1$. In this section, B2 is operational until it saturates at +15 dB, the $B2^1$ becomes operational until it saturates 15 dB higher, or a total of 30 dB.

Four compensation points are available to allow slight variation in the log transfer characteristics of stages A2, $A2^1$, B2 and $B2^1$.

To cover the 60 dB instantaneous dynamic range of the Model NM-17/27 with some overlap at both ends, five stages are employed: B2, $B2^1$, A2, $A2^1$, and A1, by connecting a nominal 30 dB amplifier between the 20 dB driver and input B2 and inserting a nominal 30 dB attenuator between the 20 dB driver and input A1 (See Figure 5-2)

The lowest 30 dB input signal level range is amplified by the 30 dB amplifier and is applied to input B2. Above that level, section B2 saturates and the next 30 dB signal range is directly applied to input A2. In the highest signal range A2 also saturates and the signal is applied to input A1 via the 30 dB attenuator. The 30 dB input voltage range of each section is 18 mV to 560 mV. Considering that the input voltage range of the 455 kHz log IF amplifier is 100 uV to 100 mV, a driver of 20 dB gain is applied ahead of A12U2.

The outputs $Y\bar{Y}$ and $Z\bar{Z}$ of the two summing amplifiers are parallel connected, yielding a logarithmic transfer slope of 4 mV to 6 mV/dB and maximum output levels of 240 mV to 360 mV. An amplifier stage, A12U2, is connected to the output of A12U1, to increase the log transfer slope and the signal levels applied to the active detector. The gain of this amplifier, is adjustable with potentiometer A12B31 to obtain an exact 50 mV/dB transfer slope at the output of the 455 kHz log IF amplifier.

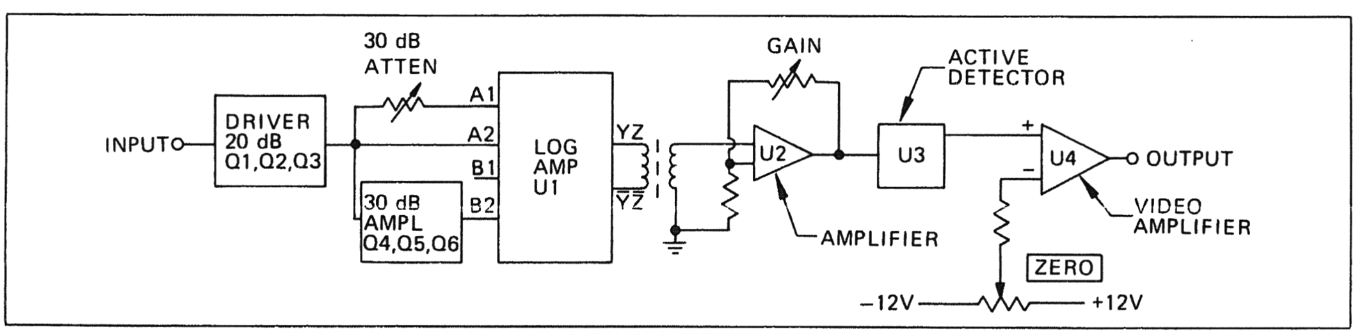


Figure 5-2. Simplified Block Diagram 455 kHz Log IF Amp., A12

The active detector, A12U3, contains an operational amplifier and hot carrier diodes A12CR5 and A12CR6. The detector is followed by a fixed gain video amplifier, A12U4, designed with an operational amplifier. A variable bias is applied to the video amplifier with potentiometer A12R36 to align the output levels to 0.6 V to 3.6 V for the input range of 100 uV to 100 mV (−67 dBm to -7 dBm). The video amplifier serves as an output buffer and contains a low-pass filter, A12L10 and A12C27, to suppress 455 kHz IF. The video amplifier has two outputs: (1) video output A12J2 producing 3.6 volts across 1000 ohms with full-scale Output meter deflection and (2) buffered video output at A12J3 connected to the LOG VIDEO back panel receptacle producing 300 millivolts across 50 ohms with full-scale Output meter deflection.

The 20 dB driver (A12Q1, A12Q2 and A12Q3) and the 30 dB amplifier (A12Q4, A12Q5 and A12Q6) to input B2 are two-stage transistor amplifiers CE and EF. The third transistor, A12Q3 and A12Q6 respectively, is used as a constant current source for the EF stage. To avoid distortion in these amplifiers, which would cause nonlinearities in the log transfer line, the output of the 20 dB driver is limited to ±4 V and the output of the nominal 30 dB amplifier is limited to ±2.5 V. The limited IF output at A12J4 connected to the 30 dB amplifier, at juncture of A12R20 and A12R21, delivers a partially limited 100 mV 455 kHz signal across 1000 ohms, utilized in the FM discriminator.

The log linearity of a correctly aligned 455 kHz log IF amplifier is ±0.5 dB. To obtain this linearity, the four variable compensating resistors, A12R23 thru A12R26, the gain adjustment of the 30 dB amplifier, A12R15, and the variable 30 dB attenuator, A12R22, must be adjusted.

5.3.10 Bandwidth Selector Assembly (A14)

The purpose of the BANDWIDTH (kHz) switch is to establish the overall selectivity of the Model NM-17/27. Bandwidths of 50, 10, 1, and 0.1 kHz may be selected by application of a +12 volt enable command to the appropriate connector terminal. The circuitry consists of two LC filters (50 and 10 kHz bandwidths), two crystal filters (1 and 0.1 kHz bandwidths), output buffers, and switching circuits. (See Figure 8-13.) The 50 kHz LC filter circuit is enabled by application of +12 volts to A14P1-5. This turns on A14Q3, a transistor switch which supplies current from the −12 volt supply to turn on diodes switches A14CR1 and A14CR2, and to operate amplifiers A14Q1 and A14Q2. The 455 kHz signal applied to A14J1 is coupled through A14CR1 to a single-tuned circuit consisting of A14C1, A14L1, and A14C3. A field-effect transistor, A14Q1, is used as a source follower to isolate the first tuned circuit from a double-tuned circuit consisting of A14C5, A14C6, A14L3, A14L2, A14C8 and A14L4. Isolation of the tuned circuits in this manner, and low coupling coefficient in the double-tuned circuits, provide a nearly Gaussian frequency response which minimizes distortion of impulsive signals. Potentiometer, A14R9, adjusts the gain of the filter. Source follower, A14Q2, isolates the double-tuned circuit from the output diode switch, A14CR2. The output signal is routed to output buffers, A14Q8 and A14Q9. The 10 kHz LC filter circuit is enabled by application of +12 volts to A14P1-4. Switching action of A14Q7 is identical to that of the 50 kHz filter circuit. The 455 kHz input signal is coupled through diode switch, A14CR3, to the filter circuitry. A total of three double-tuned circuits and FET isolation stages are used to establish the 10 kHz bandwidth. The output is routed through diode switch A14CR5 to the output buffers.

The 1 kHz and 0.1 kHz crystal filter circuits are identical except for the crystal filter component. The 1 kHz bandwidth is enabled by application of +12 volts to A14P1-3, and the 0.1 kHz bandwidth requires application of +12 volts to A14P1-2. The 455 kHz input signal is coupled through diode switch, A14CR6, or A14CR8, and applied to an RC amplifier stage, A14Q10, or, A14Q13, then to the crystal filter. Potentiometers A14R43 and A14R65 permit gain adjustment of the filter circuits. A second RC amplifier stage, A14Q11 or A14Q14, isolates the filter from the output diode switch, A24CR7, or, A14CR9, which routes the signal to the output buffers, A14Q8 and A14Q9. When either of the crystal filter circuits is enabled, a +12 volt logic level is applied through A14CR10 or A14CR11 to A14P1-7. This logic level enables the narrowband discriminator circuit in the AFC-FM Detector Assembly, A18.

Transistor emitter followers, A14Q8 and A14Q9, provide three separate isolated outputs. A14Q8 supplies the 455 kHz signal to the logarithmic amplifier, A12, and A14Q9 feeds the signal to the linear IF amplifier, A15, and to the IF OUTPUT receptacle, J4.

5.3.11 Linear IF Amplifier and BFO Assembly (A15)

The purpose of the Linear IF and BFO Assembly is to provide audio and video outputs from amplitude modulated signals, CW telegraphy, and single sideband signals. Automatic gain control is included to maintain reasonably constant output from widely varying input signals. The circuitry consists of a variable gain IF amplifier, AM detector, video amplifier, and beat frequency oscillator. (See Figure 8-14.)

A 455 kHz signal applied to A15J1 is fed to an integrated circuit variable gain IF amplifier, A15U1, which provides a maximum gain of approximately 70 dB. The output of A15U1 is developed across an inductor, A15L1, and is applied to the detector driver amplifier stage, A15Q2. The output of A15U1 is also coupled to the AGC detector, A15CR1, which features a fast charge - slow discharge characteristic determined by the RC network A15R5, A15R6 and A15C10. This type of AGC action is well suited for AM, CW, and SSB reception. The AGC voltage is amplified by a field-effect transistor, A15Q1, and applied to the gain control terminal of A15U1. Potentiometer A15R8 is used to adjust the signal level at which the AGC loop operates.

The output of the detector driver, A15Q2, is applied across a tuned circuit, A15L5 and A15C18, to a diode AM detector, A15CR2. The network, consisting of A15R17, A15C19, A15C20, A15R18, A15L6, and A15C21, form the detector load and a low-pass filter which attenuates the 455 kHz ripple component in the output.

An integrated circuit operational amplifier, A15U2, functions as a video amplifier with a voltage gain of two. It also serves to isolate the AM detector circuit and provides outputs to the linear video output receptacle and to the audio amplifier circuitry.

A crystal-controlled BFO, A15Q3, is included to permit proper reception of CW and single sideband signals. The BFO is enabled by the FUNCTION switch which applies +12 volts to A15P1-4 when in the BFO position. The output of the BFO, which operates at 456 kHz, is coupled through A15C13 and A15R13 to the detector driver, A15Q2. A nominal 455 kHz IF signal will produce a beat frequency tone of 1000 Hz.

5.3.12 DC to DC Converter Assembly (A16)

The dc-to-dc converter employs an electronic chopper, A16Q4 and A16Q5, and bridge rectifier, A16CR2, to convert the input from the rectifier and charge regulator assembly, A32 or batteries to +100 Vdc. (See Figure9-15.) To maintain the 100-volt output constant at varying battery levels, a pre-regulator, A16Q1 thru A16Q3, is applied before the chopper circuit.

5.3.13 AFC and FM Detector Assembly (A18)

The AFC and FM detector circuit consists of a crystal-controlled phase-locked loop for narrowband automatic frequency control (AFC), a monolithic phase-locked loop broadband AFC and FM detector, a relay operated by the BANDWIDTH (kHz) switch to select the appropriate AFC circuit and a programmed attenuator operated by the BAND (MHz) switch to establish the optimized loop gain for each band; (See Figure 5-3 and 8-16.) The narrow band (NB) AFC circuit is a phase-locked loop using a double balanced mixer, A18Z1, as a phase detector. The reference signal source is a crystal controlled FET oscillator, A18Q1, buffered by an emitter-follower stage, A18Q2, which provides a 50 ohm source impedance to the L port of the balanced mixer, A18Z1. An integrated circuit, A18U1, is used as a limiting IF amplifier for the NB input signal. This is followed by an emitter-follower buffer stage and the signal is then applied to the R port of the balanced mixer, A18Z1. The balanced mixer output is applied to an active filter, A18U2, with cutoff frequencies selected to yield the best loop stability with maximum lock and capture ranges.

When the received signal is tuned exactly to the incoming signal with the AFC switch in the OFF position, the IF signal is exactly 455 kHz, the dc output from the balanced mixer, A18Z1, is 0 V. Now, closing the phase-locked loop by setting the AFC switch to the ON position, the IF signal locks to the 455 kHz crystal controlled reference frequency and the phase shift between the two signals in the mixer, A18Z1, is 90° and the mixer output remains at 0 V. When the Model NM-17/27 is tuned slightly above the incoming signal, the phase shift between reference and IF signal is between 0° and 90° and the output of the balanced mixer is a plus error signal voltage. When the Model NM-17/27 is tuned slightly below the incoming signal, the phase shift is between 90° and 180° and the output is a minus error signal voltage. This error signal shifts the frequency of the Model NM-17/27 in both cases toward the incoming signal, maintaining the IF signal exactly at 455 kHz. The relay, A18K1, is interlocked with the BANDWIDTH (kHz) switch via the bandwidth selector module, A14, to apply the output of the NB AFC circuit, in the 100 Hz and 1000 Hz BANDWIDTH (kHz) switch positions, to the programmed attenuator A18U3. The output of A18U3 passes through the AFC switch to the Tuning Control Module, A29, where it is added to the varactor tuning voltage.

For broadband AFC and for FM detection, a frequency discriminator A18U4, containing a voltage controlled oscillator (VCO), a phase comparator and a low-pass filter is employed.

The center frequency of the phase-locked loop is determined by the free running frequency of the VCO and is adjusted to 455 kHz. When the AFC switch is ON the dc output of the phase comparator is proportional to the IF

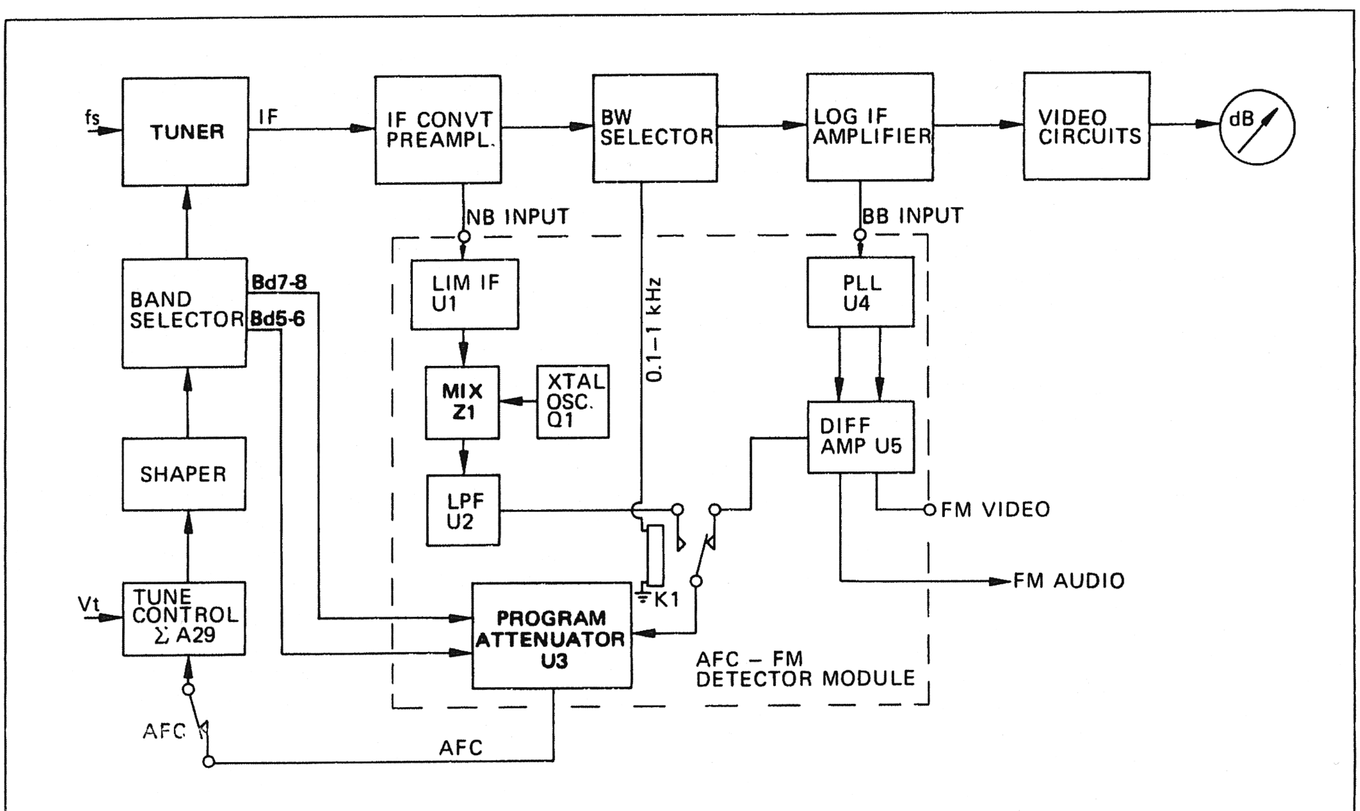


Figure 5-3. Simplified Block Diagram of AFC-FM Detector Circuit

frequency applied to the input to A18U4. This dc output shifts the VCO frequency to match that of the input signal. A18U4 is followed by a differential amplifier, A18U5, to obtain 0 V error voltage when the IF frequency is equal to the free-running VCO frequency of 455 kHz.

The dc component of the error signal is used for AFC when connected in the AFC loop. In this circuit, the VCO frequency during lock is not fixed, but changes with the IF frequency. Therefore, the IF frequency is not locked to 455 kHz, as it is in the NB AFC circuit, but it is shifting with the Model NM-17/27 tuning. Within the lock range, however, the IF frequency deviation from the nominal 455 kHz is smaller than the difference between signal frequency and Model NM-17/27 tuning, so the AFC loop is pulling the Model NM-17/27 toward the signal. (The AFC of this circuit is much less tight than that of the NB AFC circuit; therefore it is not capable of holding the signal in the narrow bandwidth of 100 Hz and 1 kHz.) The lock and capture range of the BB AFC circuit is considerably wider than that of the NB AFC circuit.

The programmed attenuator is an operational amplifier, A18U3, connected in a noninverting configuration with various resistors connected to the inverting input. The resistors are shorted by FET switches, energized by the BAND (MHz) switch via logic diodes. For bands 1 thru 4 a gain of 6 dB is provided, in bands 5 and 6 an attenuation of 12 dB is introduced, and in bands 7 and 9 the attenuation is increased to 15 dB. This gain variation is used to provide optimum loop stability in both NB and BB AFC circuits. A SPDT reed relay, A18K1, connects either the NB or the BB AFC voltage to the programmed attenuator. The relay is operated by the BANDWIDTH (kHz) switch via the Bandwidth Selector Assembly, A14.

5.3.14 Weighting Circuits and Meter Amplifier Assembly (A21)

The weighting circuits and meter amplifier perform both signal weighting and meter scaling of the signal to be displayed on the Output meter. The weighting and meter amplifier contains a field intensity (FI) weighting amplifier, a quasi-peak (QP) weighting amplifier, and the meter amplifier. (See Figure 8-17.) The FI amplifier operates in the field intensity and BFO modes. The QP amplifier is operational in the quasi-peak and calibrate modes. The meter amplifier operates in all modes. The FI amplifier, A21U1, provides an output voltage that is the average of the input voltage. The input circuit of the FI amplifier contains a resistor and capacitor network, A21R2 and A21C1, with a charge time and a discharge time of approximately 0.6 second. The voltage across the capacitor at any given time is the average of the input voltage. This voltage is applied to the amplifier, which has unity gain. The output of the FI amplifier is routed through the FUNCTION switch and back to the input of the meter amplifier, A21U3.

The QP amplifier, A21U2, provides an output that is the quasi-peak value of the input signal. The input circuit of this amplifier contains a diode, A21CR1, and a resistor-capacitor network, A21R7 and A21C2. When an input signal is applied, the capacitor is charged through the diode to the positive value of the input signal. Each time the input voltage rises above the charge level of the capacitor, the diode conducts and charges the capacitor to the new peak value. The charge time is relatively short, approximately one millisecond. The discharge time of the capacitor is relatively long, approximately 600 milliseconds, and therefore the voltage charge on the capacitor at any time is the quasi-peak value of the input signal. This voltage is applied to the amplifier, A21U2, which has unity gain. The output of the QP amplifier is routed through the FUNCTION switch and back to the meter amplifier, A21U3. The output voltage swing of the detector circuits is from 0.6 to 3.6 volts. The meter amplifier, A21U3, shifts this voltage swing to 0 to 3.0 volts and provides current amplification to drive the succeeding circuitry. The 0 to 3 volt output is applied to two resistive divider networks, A21R16, A21R17 and A21R18 thru A21R20, and to dB readout and audio amplifier, A24. The two divider networks produce 0 to 1 volt outputs: one is applied to Output meter, A46, and the other is routed to the Y OUTPUT receptacle, J11, on the rear panel during all functions except slideback peak.

5.3.15 Direct Peak Circuity Assembly (A22)

The direct peak circuit enables measurement of the peak value of signals. The direct peak circuit detects and holds the peak value of the input signal. The amount of time that the peak value is held is selectable. The direct peak circuit contains two pulse stretchers and a dump circuit. (See Figure 8-18.)

The first pulse stretcher is very sensitive and fast-reacting, and performs a small amount of stretching. It consists of a comparator, A22Q1 and A22Q2; a switching transistor, A22Q3; and RC network, A22R8, A22R9 and A22C2; and a source follower, A22Q4. The comparator compares the peak amplitude of a Model NM-17/27 pulse to the peak value stored in the pulse stretcher. When the input amplitude is greater than the stored amplitude, the comparator is unbalanced and produces an output that causes the switching transistor, A22Q3, to turn on. The biasing of the switching transistor is such that the transistor reacts very rapidly to a small input level change. Thus, a short duration pulse with an amplitude slighty greater the stored amplitude will turn on the switching transistor. The switching transistor provides a rapid charge path for the capacitor, A22C2, in the RC network. The charge on the capacitor is transferred via the source follower, A22Q4, to the comparator A22Q1 and A22Q2. When the capacitor charge equals the input peak value, the comparator is balanced and the switching transistor turns off. The capacitor begins to discharge. The discharge time of the capacitor is long so that the input pulse is stretched. As long as no input occurs with a peak value greater than the present charge, the capacitor will continue to discharge. If an input occurs with an amplitude greater than the capacitor charge, the capacitor is charged to this new value. The output of the source follower is also applied to the second pulse stretcher.

The second pulse stretcher has a slower response than the first pulse stretcher and holds the peak amplitude until dumped by the dump circuit (up to 3 seconds hold time). This pulse stretcher consists of a comparator, A22U1; a switching diode, A22CR1; an RC network, A22R11 and A22C4; and a source follower, A22Q6. Operation of the second pulse stretcher is similar to the operation of the first in that the comparator, A22U1, causes the capacitor, A22C4, to be charged when the input is greater than the stored amplitude. Response time of the second pulse stretcher is slower than the first because a larger storage capacitor is used. The requirement for fast response time is reduced because of the pulse streteching accomplished in the first pulse stretcher. The most significant difference between the first and second pulse stretcher is that no discharge is provided for the capacitor in the second pulse stretcher. Therefore, the capacitor maintains its charge, holding the peak amplitude. The capacitor charge is applied to the source follower, A22Q6, whose output is applied to the comparator, A22U1, and is also the peak amplitude output of the direct peak circuit. The time that the peak amplitude is held in the second pulse stretcher is selectable at 0.05, 0.3 or 3 seconds. Discharging of the capacitor, A22C4, in the second pulse stretcher after the selected time interval is accomplished by the dump circuit.

The dump circuit consists of a comparator, A22U2; two switching transistors, A22Q5 and A22Q7; an RC network, A22C5, A22R20 and A22R21; and two relays, A22K1 and A22K2. The comparator monitors the voltage levels stored in the two pulse stretchers. When the input signal remains constant or is increasing in amplitude, the voltage level in the first pulse stretcher is equal to or greater than the voltage level in the second pulse stretcher. With this condition, the dump circuit comparator produces an output that turns on switching transistor, A22Q7. This prevents charging of capacitor A22C5 in the RC network. When the input signal decreases in peak amplitude, the voltage in the first pulse stretcher decreases. With this condition the dump circuit comparator causes the switching transistor, A22Q7, to turn off and permits the capacitor, A22C5, to charge. The charge on the capacitor is coupled via a unijunction transistor, A22Q8, to the second switching transistor, A22Q5. When the capacitor charge reaches approximately +8 volts, the unijunction transistor, A22Q8, causes the second switching transistor, A22Q5, to turn on. When turned on, the second switching transistor provides a very rapid discharge path for the capacitor, A22C4, in the second pulse stretcher. Discharge of this capacitor reduces the voltage level stored in the second pulse stretcher. When the voltage level in the second pulse stretcher is reduced to a point that is equal to the voltage level in the first pulse stretcher, the dump circuit comparator turns on the first switching transistor, A22Q7. This switching transistor discharges the capacitor, A22C5, in the dump circuit causing the second switching transister, A22Q5, to turn off. Discharge of the second pulse stretcher capacitor, A22C4, is stopped and the voltage stored is equal to the input peak value. The time interval between the reduction of the input peak value and dumping of the second pulse stretcher is determined by the charge time of the capacitor, A22C5, in the dump circuit. The two relays in the dump circuit select the resistance in the capacitor charge path to control charge time. When the selected hold time is 3 seconds, both relays are de-energized, and A22R21 becomes the charge resistor. In the 0.05 and 0.3 second positions, a relay is energized to select a smaller value of resistance in parallel with the charge resistor to decrease capacitor charge times from 3 seconds to either 0.05 or 0.3 seconds.

During the time the dump circuit capacitor is charging, an input with a peak amplitude equal to or greater than the level stored in the second pulse stretcher will stop operation of the dump circuit.

5.3.16 Slideback Peak Circuit Assembly (A23)

The slideback peak circuit provides a means of determining the peak value of a signal detected by the logarithmic IF amplifier, A12. When a CW signal is applied to the input of the Model NM-17/27, the detected signal is dc. When an AM signal is applied to the input of the Model NM-17/27, the detected signal contains the modulation superimposed upon the dc level. When an AM signal is applied to the input of the Model NM-17/27, the detected signal contains the modulation superimposed upon the dc level. When a short pulse is applied to the input of the Model NM-17/27, the detected signal is a pulse with a width that is inversely proportional to the bandwidth. Such short pulses may be indicated by substituting an equivalent dc voltage which may be measured by the meter amplifier and displayed on the Output meter.

The Slideback Peak Circuit, A23, contains a comparator, a pulse stretcher, a gate, and an astable multivibrator. (See Figure 8-19.) The comparator, A23Q2 and A23Q3 compares the detected signal with a manually-controlled slideback peak voltage. When the peak of the detected signal exceeds the slideback voltage, the comparator, A23Q2 and A23Q3, opens the gate, A23Q5 and A23Q6, which starts the free running multivibrator, A23Q7 and A23Q8. The constant frequency of the multivibrator is connected via the FUNCTION switch, the AUDIO switch, and the AUDIO GAIN control to the audio amplifier circuit on A24. When the manually-controlled slideback voltage equals or exceeds the peak of the detected signal, the comparator closes the gate and stops the multivibrator. By slowly increasing the slideback voltage until the tone in the headphone just stops, a precise aural monitor of the detected peak level is obtained. The slideback voltage is connected via the FUNCTION switch to the meter amplifier and is displayed on the Output meter. The pulse stretcher, A23Q4 and A23C2, between the comparator and gate serves to stretch short pulses to match the rise time of the gate. Capacitor, A23C3, stretches the fall time of the gate to extend the operation period of the multivibrator on short pulse signals.

In addition to the components described above, Slideback Peak Circuit, A23, contains a rectifier A23CR3 and adder, A23U1, which are connected via the FUNCTION switch to the Y OUTPUT receptacle, J11. An output of the meter amplifier, A21, is also applied to the input of the adder, A23U1. When the detected signal exceeds the slideback voltage, the Y output is the sum of the slideback voltage displayed on the Output meter (0 to 1 V) and the rectified multivibrator output (approximately 100 mV). When the slideback voltage equals or exceeds the detected signal level, the Y output equals the slideback peak voltage displayed on the Output meter. The circuit enables the Model 17/27 to indicate and plot any signal above a selected threshold level.

5.3.17 dB Readout and Audio Amplifier Assembly (A24)

The dB Readout and Audio Amplifier Assembly, A24, provides an electrical analog of measured signal strength in dB and amplification of audio signals to drive a headset.

The dB readout is accomplished by adding a voltage which is proportional to the RF ATTENUATOR (dB) switch position to a voltage which is proportional to the Output meter indication. The addition is performed by a summing network controlled by relays. (See Figure 8-20.) The relays, A24K1 thru A24K5, are energized by the ATTENUATOR (dB) switch and add a fixed voltage corresponding to the ATTENUATOR (dB) switch position. The 0 to 3 volt output of Weighting and Meter Amplifier Circuit, A21, is also supplied to the summing network which scales both inputs to a 10 mV/dB output. The output of the summing network is routed to the PROGRAMMER connector, J9-V, on the rear panel to enable readout of measured signal strength to external equipment. The dB readout and audio assembly also contains a diode logic circuit that controls the gains of the IF Preamplifier Assembly, A11. When the ATTENUATOR (dB) switch is set to any position other than −20 dB or −40 dB, the diode ligic, A23CR9 thru A23CR12, routes +12 V to relay A11K1 of the IF Preamplifier Assembly, A11, causing the two 20 dB preamplifier stages to be bypassed and the IF signal from the IF converter to be directly applied to the calibration amplifier in A11. Diode, A24CR8, performs the same logic function when the FUNCTION switch is in the CALIBRATE position.

The audio amplifier consists of an audio driver, integrated circuit A24U3.

5.3.18 Remote Function Selector Assembly (A25)

The Remote Function Selector Assembly, A25, enables control of the EMI/FI meter functions from an external programmer. The remote function selector operates only when the CONTROL MODE switch is set at the REMOTE position. With the remote control mode selected, all inputs to the FUNCTION switch are removed and the output of Logarithmic IF Amplifier, A12, is applied to the remote function selector (See Figure 8-21.) The field intensity (FI), quasi-peak (QP), direct peak, or calibrate functions may then be selected by a remote programmer. To select a function, the remote programmer applies +12 volts to the appropriate A25 remote function selector input via the PROGRAMMER connector. Selection of the FI, QP, or direct peak mode energizes an appropriate relay, A25K1 thru A25K3, in A25. The energized relay routes the output of the logarithmic IF amplifier to the FI or QP weighting circuit in A21 or to Direct Peak Circuit, A22. The output of the selected FI, QP, or direct peak circuit is routed through the energized relay to the meter amplifier in A21. The direct peak is selected by the remote programmer by applying +12 volts to one of three lines. Voltage on any of the three causes direct peak relay, A25K3, to energize, and the hold time (0.05, 0.3 or 3 seconds) of the direct peak circuit is determined by the line to which the +12 volts is applied.

When selected by the remote programmer, the calibrate function operates in the same manner as when selected by the FUNCTION switch. Usually the calibrate function is selected at the remote programmer to permit calibration of the device that is recording or displaying the dB output from the dB Readout and Audio Amplifier, A24. If the Model NM-17/27 requires calibration it is accomplished in the same manner as in the LOCAL mode (operation of CALIBRATE control at the programmer). The remote function selector enables the remote programmer to perform simultaneous direct peak and FI measurement. The remote function selector contains an FI amplifier, A25U1, that operates in the same manner as the FI amplifier in A21. When the direct peak mode is selected, the logarithmic IF amplifier output is applied to this FI amplifier and to Direct Peak Circuit Board, A22. The Model NM-17/27 performs a normal direct peak measurement and the FI amplifier in the A25 provides a simultaneous FI measurement output to the remote programmer.

5.3.19 Shaper Assembly (A26)

Shaper, A26, modifies the input tuning voltages which are then applied to the RF tuner selected by the BAND (MHz), switch S2. Tuning is accomplished in the RF tuners by varactor diodes. The capacitance of a varactor diode is controlled by the voltage applied to it and the capacitance is a nonlinear function of the varactor voltage. Maximum varactor capacitance occurs at the minimum applied voltage (approximately 2V) and minimum varactor capacitance at maximum applied voltage (approximately 60 V). The requency of the RF tuner is proportional to 1/VC. To obtain a linear relationship between the input tuning voltage and tuned frequency, the shaper produces an appropriate nonlinear varactor voltage.

The Tuning Control Circuit, A23, provides a linear 0 to 10 V tuning voltage to the shaper input. The shaper modifies this voltage into a nonlinear output voltage of approximately 2 V to 60 V which is routed via the Tuning Control Board, A19, to the selected RF tuner. The nonlinear varactor voltage curve is synthesized from six linear sections, each produced by a slope generator. The six slope generators consist of IC operational amplifiers, A26U1 thru A26U6; (See Figure 8-22.) A seventh operational amplifier, A26U7, is used as an adder stage. A three-stage booster amplifier, A26Q1 thru A26Q4, follows the adder stage to provide the maximum varactor tuning voltage of approximately 60 volts.

5.3.20 Tuning Control Assembly (A29)

The Tuning Control Board, A29, contains a summing amplifier, A29U1 and A29U2, which adds the output of the manual TUNE and FINE TUNE panel controls and applies it via the CONTROL MODE switch, to the input of the Shaper, A26, and to the Frequency Readout Circuit, A34. (See Figure 8-23.) The resultant 0 to 10 V tuning voltage is also routed via the Tune Control Assembly, A29, to the Frequency meter, A47, and to the X OUTPUT receptacle, J6, on the rear panel.

The output of the shaper is connected to the Tuning Control Assembly, A29, which applies this voltage to the RF tuner of the selected band. To accomplish this, the tuning control board contains 8 relays, energized by the BAND (MHz) switch, S2. When the AFC switch, S6, is in the ON position, the tuning control board receives an AFC error voltage from AFC-FM detector assembly, A18, that is applied to summing amplifier, A29U2. If the AF input frequency deviates from the tuned frequency of the Model NM-17/27 within the lock range of the AFC circuit, the AFC voltage shifts the selected RF tuner tuning toward the RF input frequency. The tuning control board applies logic signals to the AFC-FM detector module to control the discriminator slope of the AFC circuit for each of the tuners.

When the CONTROL MODE switch, SIG, is set to the SCAN position, the output of the Internal Sweep Assembly, A33, is applied to the Tuning Control Assembly, A29, the Shaper Assembly, A26, and the Frequency Readout Assembly, A34. When the CONTROL MODE switch is set to the REMOTE position, SIG applies a tuning control voltage from an external source to the same circuits. Tuning controls on the front panel are disabled in this mode of operation.

5.3.21 Band Selector Assembly (A30)

Band Selector Assembly, A30, consists of eight DPST relays, A30K1 thru A30K8, one for each RF tuner, and diodes A30CR1 thru A30CR14. (See Figure 8-24.) Each relay, when energized, supplies +12 volts and −12 volts to an RF tuner. The relays are controlled manually by BAND (MHz) switch, S2, when the CONTROL MODE switch, SID, is in the LOCAL or SCAN position, and controlled remotely via the PROGRAMMER receptacle when the CONTROL MODE switch, SID, is in the REMOTE position. Diodes A30CR1 thru A30CR6 selectively supply voltage to A10 IF converter oscillators, No. 1 or No. 2 or no oscillator, depending on the relay and corresponding RF tuner that is energized.

Diodes A20CR7 thru A30CR14 absorb the back emf voltage generated by the coil when it is de-energized, thus eliminating contact sparking and associated EMI.

5.3.22 Voltage Regulator Assembly (A31)

Voltage Regulator, A31, receives the output of the rectifiers or batteries and produces outputs of ±12 Vdc. The voltage regulator contains an overload protection circuit which limits the output current to 600 mA. (See Figure 8-25.)

5.3.23 Rectifier and Charge Regulator Assembly (A32)

The Rectifier-Charge Regulator, A32, contains two bridge rectifiers, A32CR1 and A32CR2, and two battery charge regulators, A32Q1 and A32Q2. (See Figure 8-26.) The two bridge rectifiers produce outputs of approximately ±27 volts. This is applied to the battery charge regulators and the output of this assembly is applied via the ON AC position of the POWER switch to the voltage regulator assembly, A31, and the dc-to-dc converter assembly, A16. The battery charge regulators monitor battery voltage levels and supply charging current to the batteries. With the POWER switch set to the ON AC position, trickle charge current (105 mA) is applied to the batteries. With the POWER switch set at the CHARGE position, full charging current (300 mA) is applied.

5.3.24 Internal Sweep Assembly (A33)

When the CONTROL MODE switch is set at the SCAN position and the SINGLE pushbutton is depressed, the Internal Sweep Assembly, A33, generates a sawtooth voltage that rises from 0 to 10 volts in 60 seconds. This sawtooth voltage is applied to Shaper Assembly, A26, and via Tuning Control Assembly, A29, causes the selected tuner to sweep the band from the low end to the high end in 60 seconds. (See Figure 8-27.)

To generate the sawtooth voltage, A33 contains a ramp generator, A33U1, a comparator, A33U2, a relay driver, A33U3, and a relay, A33K1. When the SINGLE pushbutton is depressed, the relay driver causes the relay to energize and initiate operation of the ramp generator. The ramp generator produces the sawtooth voltage that rises from 0 to +10 volts in 60 seconds. The comparator monitors the output of the sweep generator and applies a pulse to the relay driver when the output reaches +10 volts. This pulse causes the relay driver to de-energize the relay, stopping operation of the ramp generator. A second set of contacts on the relay provide an isolated closure across the RECORDER PEN LIFT receptacle, J7, on the rear panel.

5.3.25 Frequency Readout Assembly (A34)

The frequency readout circuit provides a scaled output voltage of 10 mV/kHz in bands 1 thru 3 and 100 mV/MHz in bands 4 thru 9 that is representative of the tuned frequency of the Model NM-17/27. This output is available at the PROGRAMMER receptacle, J9-T, and may be applied to a digital voltmeter to obtain a digital readout of received frequency. (See Figure 8-28.)

The scaling is accomplished by combining the tuning control voltage from A29 with a bandswitched voltage which is proportional to the minimum frequency of the selected band. The voltage combining circuitry employs operational amplifiers, A34U1 and A34U2, and resistive scaling networks A34R4 thru A34R19, selected by reed relays.

The voltage output of A34 is an electrical analog of the tuned frequency as follows:

Band 1:	0.1 V to 2.50 V
Band 2:	2.50 V to 5.00 V
Band 3:	5.00 V to 10.00 V
Band 4:	100 mV to 200 mV
Band 5:	200 mV to 400 mV
Band 6:	400 mV to 800 mV
Band 7:	800 mV to 1.6 V
Band 8:	1.6 V to 3.2 V

5.3.26 Input Filter Assembly (A41)

The Input Filter Assembly, A41, is a combination high-pass filter and low-pass filter that rejects signals below and above the frequency range of the equipment. (See Figure 8-29.) The high-pass filter portion consists of A41C1, A41C3, and A41L2; and A41L1, A41L3, and A41C2 constitute the low-pass filter. A41C1, with a 400 V rating, also serves as a dc blocking capacitor. The filter is shielded to prevent stray RF pickup and the type BNC input receptacle to the filter mounts on the Model NM-17/27 front panel and serves as the RF INPUT receptacle, J1.

5.3.27 Power Transformer Assembly (A42)

The Power Transformer Assembly, A42, has two primary windings. With the 115 V/230 V switch on the rear panel at the 115 position, the two primaries are connected in parallel. With the switch at the 230 V position, the primaries are connected in series. Both secondaries produce an output of approximately 23 volts rms. The secondary outputs are applied to rectifier-charge regulator, A32.

5.3.28 Battery Pack Assembly (A44)

The Battery Pack Assembly, A44, contains 2 groups of nickle-cadmium batteries rated at 17.5 volts.

5.3.29 RF Attenuator Assembly (A45)

The RF Attenuator Assembly, A45, is assembled on a six-position, rotary switch. The switch and attenuator components are enclosed in an RF shield. The attenuator is used to insert up to 60 dB attenuation into the RF line (See Figure 8-29.) and selects another 40 dB of gain change in the IF Preamplifier/Calibration Amplifier, A11, as follows:

Attenuator Position (dB)	Attenuation Factor (dB) RF	IF
−40, X .01	0	−40
−20, X 0.1	0	−20
0, X 1	0	0
+20, X 10	+20	0
+40, X 10^2	+40	0
+60, X 10^3	+60	0

In the −40, −20, and 0 dB positions the signal passes through the attenuator without attenuation. However, a fourth switching deck on the attenuator switch (See detailed block diagram, Figure 5-30) controls the gain of the IF Amplifer, A11, in 20 dB increments. In the +20, +40 and +60 positions, resistive networks are switched into the RF input circuit. The +20 attenuator network is a single π section, and the +40 and +60 attenuators are each double π sections. The precision resistors in the attenuators having a maximum power dissipation rating of 0.25 watt, and therefore the total signal input power should not be allowed to exceed this rating.

5.3.30 Output Meter Assembly (A46)

The Output Meter Assembly, A46, displays measured signal strength or battery condition. When the POWER switch is at the ON AC position or the ON BAT position, the Output meter displays signal strength. With the switch at the

CHARGE or BATT TEST position, the Output meter indicates battery condition. The meter deflects full-scale with a 1 Vdc input. The meter has four scales: (1) microvolt, (2) dB referred to 1 microvolt, (3) –dBm, and (4) battery condition.

5.3.31 Frequency Meter Assembly (A47)

The Frequency Meter Assembly, A47, monitors the tuning control voltage output from, the Tuning Control Assembly, A29, and indicates the frequency to which the Model NM-17/27 is tuned. Frequency is displayed on eight linearly-graduated scales which correspond to the eight tuning bands of the Model NM-17/27. Light emitting diodes (LEDS) are employed to indicate the selected frequency band.

5.4 PROGRAMMER RECEPTACLE PIN DATA

Signals at the PROGRAMMER receptacle on the rear panel are listed in Table 5-1.

Table 5-1. PROGRAMMER Receptacle Pin Data (J9)

Pin	Function
A	Relay contact closure in the Model P-7 applies –12 V from the Model NM-17/27 via pin N of this connector back to the model NM-17/27 to select band 1 of the Model NM-17/27.
B	Relay contact closure in the Model P-7 applies –12 V from the Model NM-17/27 via pin N of this connector back to the Model NM-17/27 to select band 2 of the Model NM-17/27.
C	Relay contact closure in the Model P-7 applies –12 V from the Model NM-17/27 via pin N of this connector back to the model NM-17/27 to select band 3 of the Model NM-17/27.
D	Relay contact closure in the Model P-7 applies –12 V from the Model NM-17/27 via pin N of this connector back to the Model NM-17/27 to select band 4 of the Model NM-17/27.
E	Relay contact closure in the Model P-7 applies –12 V from the Model NM-17/27 via pin N of this connector back to the Model NM-17/27 to select band 5 of the Model NM-17/27.
F	Relay contact closure in the Model P-7 applies –12 V from the Model NM-17/27 via pin N of this connector back to the Model NM-17/27 to select band 6 of the Model NM-17/27.
G	Not used.
H	Relay contact closure in the Model P-7 applies –12 V from the Model NM-17/27 via pin N of this connector back to the Model NM-17/27 to select band 7 of the Model NM-17/27.
J	Relay contact closure in the Model P-7 applies +12 V from the Model NM-17/27 via pin J of this connector to select the detector function in the Model NM-17/27.
K	Relay contact closure in the Model P-7 applies –12 V from the Model NM-17/27 via pin N of this connector back to the Model NM-17/27 to select band 8 of the Model NM-17/27.
L	0 V to +10 V from the Model P-7 to tune the Model NM-17/27.
M	Relay contact closure in the Model P-7 applies +12 V from the Model NM-17/27 via pin X of this connector to select the 100 Hz bandwidth in the Model NM-17/27.
N	–12 V from the Model NM-17/27 when the Model NM-17/27 is in REMOTE control mode to provide the voltage switched at pins A, B, C, D, E, F, H and K of this connector.
P	Relay contact closure in the Model P-7 applies +12 V from the Modd NM-17/27 via pin X of this connector to the select 1 kHz bandwidth in the Model NM-17/27.
R	This pin is connected to the RC integrator in Internal Sweep Assembly, A33. Connecting an external capacitor from pin R to ground will increase the duration of the internal sweep at a rate of one minute per 100 microfarads. A low-leakage tantalum capacitor should be used, positive terminal to pin R.
S	Relay contact closure in the Model P-7 applies +12 V from the Model NM-17/27 via pin X of this connector to select the 10 kHz bandwidth in the Model NM-17/27.
T	0.1 V to +10 V from the Model NM-17/27 representing the frequency. Bands 1-3: 10 mV/kHz (0.1 V to 10.0 V). Bands 4-8: 100 mV/kHz (0.1 V to 3.20 V)
U	Provides dc ground between the Model NM-17/27 and the Model P-7.
V	–40 mV to +120 mV from the Model NM-17/27 representing the weighted dB readout. (1 mV/dB)

Table 5-1. PROGRAMMER Receptacle Pin Data (Cont.)

Pin	Function
W	Relay contact closure in the Model P-7 applies +12 V from the Model NM-17/27 via pin X of this connector to select the 50 kHz bandwidth in the Model NM-17/27.
X	+12 V from the Model NM-17/27 when the Model NM-17/27 is in REMOTE control mode to provide the voltage to the Model P-7 that is switched at pins M, P, S and W of this connector.
Y	0 V to +2 V from the Model NM-17/27 representing the Y-data.
Z	Not used.
a	Relay closure in the Model P-7 applies +12 V from the Model NM-17/27 via pin J of this connector to select PEAK 3.0 SEC detector function in the Model NM-17/27.
b	Relay closure in the Model P-7 applies +12 V from the Model NM-17/27 via pin J of this connector to select PEAK 0.3 SEC detector function in the Model NM-17/27.
c	Relay closure in the Model P-7 applies +12 V from the Model NM-17/27 via pin J of this connector to select PEAK 0.05 SEC detector function in the Model NM-17/27.
d	Relay closure in the Model P-7 applies +12 V from the Model NM-17/27 via pin J of this connector to select QP detector function in the Model NM-17/27.
e	Not used.
f	Relay closure in the Model P-7 applies +12 V from the Model NM-17/27 via pin J of this connector to select FI detector function in the Model NM-17/27.
g	Relay closure in the Model P-7 applies +12 V from the Model NM-17/27 via pin J of this connector to select CAL detector function in the Model NM-17/27.
h	Not used.
i	Not used.
j	0 V to –6 V to the Model NM-17/27 for remote calibration of the Model NM-17/27 by the Model P-7 CAL controls.
k	0 V to +2 V FI information from the Model NM-17/27. This is selected in the Model P-7 and appears at the SIMULTANEOUS FI receptacle of the Model P-7. (When the DETECTOR FUNCTION switch of the Model P-7 is in the PEAK mode).
m	0 V to +10 V tuning voltage monitor output. (Test point only)
n	0 V to +2 V X-axis output. (Test point only)
p	Not used.
q	Not used.
r	Not used.
s	–12V regulated power supply output for accessory items.
t	+12V regulated power supply output for accessory items.

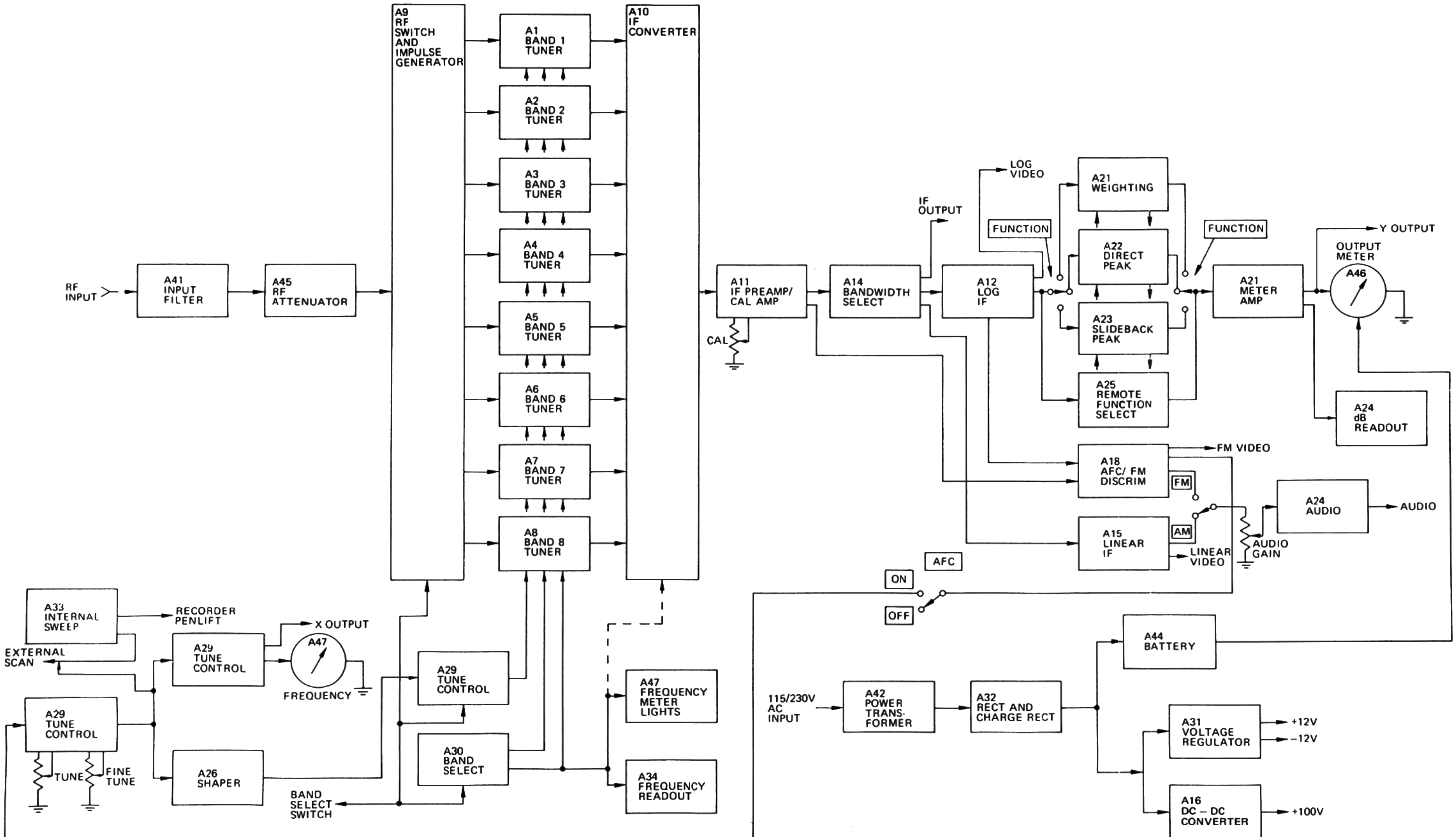


Figure 5-4. Simplified Block Diagram, Model NM-17/27

Section VI

MAINTENANCE

6.1 INTRODUCTION

This section of the manual contains minimum performance procedures, disassembly procedures, alignment procedures, and fault isolation procedures for the Model NM-17/27. The minimum performance test procedures are intended to verify that the Model NM-17/27 is functioning in accordance with the specification requirements listed in Section II. Disassembly procedures are presented as necessary for ordinary maintenance requirements. Disassembly of the Model NM-17/27 beyond the extent provided in this section is not recommended.

The alignment and fault isolation procedures are intended for use only by skilled personnel, well-qualified and experienced in the calibration and maintenance of laboratory test equipment. Alignment of the Model NM-17/27 should not be attempted unless proper test equipment is available and unless the instructions given in this manual are clearly understood and realignment is definitely required. The alignment procedures progress from the output circuits back through the instrument to the RF input section.

No scheduled, periodic maintenance of the Model NM-17/27 is required. The minimum performance test procedures should be used to establish the operational performance capability of the instrument, and the fault isolation procedure should be used to assist in isolating a possible malfunction to a specific section. Use normal troubleshooting techniques to further isolate the fault to the component level. Replace the faulty component, then test and realign the unit as necessary.

6.2 MINIMUM PERFORMANCE TEST PROCEDURES

The test procedures contained in this section may be used to establish the performance of the Model NM-17/27 within acceptable limits. The tests follow the order of the specifications (Table 2-1); however, they may be performed in any desired order.

6.2.1 Test Equipment Required for Minimum Performance Tests

Table 6-1 lists the test equipment minimum parameters and recommended models that are required for conducting the minimum performance test of the Model NM-17/27.

Table 6-1. Test Equipment Requirements for Minimum Performance Tests

Instrument	Minimum Parameters	Recommended Model
Audio oscillator	Frequency range: 50 Hz to 4 kHz Internal impedance: 600 ohms Power output: 160 mW	Hewlett-Packard 200 CD
Signal generator	Frequency range: 10 kHz to 32 MHz Output level: −103 dBm to 0 dBm Impedance: 50 ohms Internal AM capabilities:	50 kHz to 32 MHz Hewlett-Packard 606A with Hewlett-Packard 355 C and Hewlett-Packard 355D (see below)
Impulse generator	Frequency range: 10 kHz to 32 MHz Output level: 0 to 106 dBuV/MHz Repetition rate: 60 pps	Singer 93453-1
Oscilloscope	Frequency response: 1 kHz Level: 100 mV p-p	Tektronix 535A
Dc digital voltmeter and ohmmeter	Measurement range: 0 V to 3.2 V Accuracy: ±1 mV	Hewlett-Packard 3440A
RF voltmeter	Frequency response: 455 kHz Measurement range: 80 mV rms Input impedance: 10 Megohms Accuracy: ±2 mV	Hewlett-Packard 410C
RFI meter	Frequency response: 10 kHz to 32 MHz Input impedance: 50 ohms Measurement range: 80 mV rms	10 kHz to 32 MHz Singer Model NM-17/27 32 MHz to 37 MHz Singer Model NM-37/57

Table 6-1. Test Equipment Requirements for Minimum Performance Tests (Cont.)

Instrument	Minimum Parameters	Recommended Model
Power meter	Frequency response: 300 Hz to 4 kHz Input impedance: 600 ohms Range: 0 to 100 milliwatts	General Radio 583-A
Frequency counter	Frequency response: 10 kHz to 32 MHz Accuracy: ±10 Hz	Hewlett-Packard 5326C
VSWR bridge	Frequency response: 10 kHz to 32 MHz	Anzac RB-1 and Hewlett-Packard 4800A
Audio amplifier	Frequency response: 50 Hz to 400 Hz Output voltage: 115 V rms Output power: 40 Watts	Bogen-Presto MO-100
Programmer and cable	Required for remote control testing only.	Singer P-7
Step attenuator	Frequency response: 10 kHz to 32 MHz Attenuation: 0 dB to 10 dB Impedance: 50 ohms VSWR: less than 1.2:1	Hewlett-Packard 355C
Step attenuator 10 dB steps	Frequency response: 10 kHz to 32 MHz Attenuation: 0 dB to 60 dB Accuracy: ±0.2 dB Impedance: 50 ohms VSWR: less than 1.20:1	Hewlett-Packard 355D
Variable transformer	Voltage range: 0 V to 250 V Output power: 30 V	General Radio 100 R
Adapter	BNC, T	Tektronix 103-0030-00
Headphones	Impedance: 600 ohms	Singer 10796
Resistor	Resistance: 1 kilohm Power: ¼ W	

6 2.2 Evaluation of Operating Readiness

Battery Test

Set the POWER switch to the BATT TEST position. Note the Output meter deflection on the BATTERY scale. The deflection should be in the OPERATE or FULL region for both positions of the +, – switch. If the meter pointer deflects in the RECHARGE region, set the POWER switch to the CHARGE position and allow the battery to charge for approximately two hours, then recheck.

6.2.3 Evaluation of Frequency Range and Accuracy

Set the Model NM-17/27 ATTENUATOR switch to the +20 dB position, CONTROL MODE switch to the LOCAL position, AFC switch to the OFF position, FINE TUNE control to mid position, and POWER switch to the ON AC position. Connect the signal generator to the RF INPUT receptacle and monitor the frequency with the frequency counter. Set the signal output level to approximately –47 dBm. Set the frequency to 10 kHz as indicated by the frequency counter. Carefully vary the Model NM-17/27 TUNE control for maximum response to the test signal. Note the Model NM-17/27 Frequency meter indication. The indication shall be within ±2% or within ±5 kHz (whichever is greater) of the test frequency. Repeat the above for all frequencies listed in Table 6-2.

Table 6-2. Test Frequencies for Frequency Range and Accuracy Evaluation

Band MHz	Bandwidth kHz	Test Frequencies, MHz (suggested)
.01 – .25	1.0	0.01, 0.05, 0.10, 0.15, 0.20 and 0.25
.25 – .5	1.0	0.25, 0.30, 0.35, 0.40, 0.45 and 0.50
.5 – 1	1.0	0.5, 0.6, 0.7, 0.8, 0.9 and 1.0
·1 – 2	1.0	1.0, 1.2, 1.4, 1.6, 1.8 and 2.0
2 – 4	10	2.0, 2.5, 3.0, 3.5 and 4.0
4 – 8	10	4.0, 5.0, 6.0, 7.0 and 8.0
8 – 16	10	8, 10, 12, 14 and 16
16 – 32	10	16, 20, 24, 28 and 32

6.2.4 Evaluation of Voltage Measurement Accuracy

Connect the signal generator via the 10 dB step attenuator to the RF INPUT receptacle of the Model NM-17/27. Set the step attenuator to 0 dB. Set the signal generator for a CW signal at 300 kHz and an output level of −67 dBm. Set the Model NM-17/27 BAND switch to the .25–.5 position, BANDWIDTH switch to the 20 kHz position, ATTENUATOR switch to the 0 dB position, AFC switch to the OFF position, FUNCTION switch to the FIELD INTENSITY position and CONTROL MODE switch to the LOCAL position.

a. *Narrowband (CW) Function Tracking Accuracy*

Tune the Model NM-17/27 for maximum signal indication on the Output meter. Adjust the CALIBRATE control for a reference indication of 40 dB on the dB REFERRED TO 1 uV scale of the Output meter. Set the FUNCTION switch to the QUASI-PEAK position, then to each of the three PEAK positions, and record the Output meter indication at each position. Set the FUNCTION switch to the SLIDEBACK PEAK position. Rotate the SLIDEBACK PEAK control fully counterclockwise. Connect headphones to AUDIO receptacle, set AUDIO switch to the AM position, and adjust the AUDIO control for a desired sound level. Rotate the SLIDEBACK PEAK control slowly clockwise until the signal cuts off. Record the Output meter indication at this threshold level. The Output meter is required to indicate 40 dB ±0.5 dB on the dB REFERRED TO 1 uV scale at each position of the FUNCTION switch.

b. *Bandwidth Tracking Accuracy*

Set the Model NM-17/27 FUNCTION switch to the FIELD INTENSITY position and the BANDWIDTH switch to the 0.1 kHz position. Tune the Model NM-17/27 for maximum deflection on the Output meter using the FINE TUNE control. Note the Output meter deflection. Set the BANDWIDTH switch sequentially to 1.0 kHz, 10 kHz and 50 kHz, noting the Output meter deflections. The deflections are required to be within ±0.5 dB of each other.

c. *Narrowband Attenuator Tracking Accuracy*

Set the FUNCTION switch to the FIELD INTENSITY position, the BANDWIDTH switch to the 10 kHz position, and the ATTENUATOR switch to the +60 dB position. Adjust the signal generator output level to −7 dBm. Adjust the CALIBRATE control as necessary to provide an Output meter indication of exactly 40 dB. Set the Model NM-17/27 ATTENUATOR switch for each input signal level and step attenuator position as listed in Table 6-3. Record the Output meter indication for each Model NM-17/27 ATTENUATOR position. The required Output meter indication is 40 dB ±0.5 on the dB REFERRED TO 1 uV scale for each position of the ATTENUATOR switch.

d. *Narrowband Log IF Amplifier Tracking Accuracy*

Set the Model NM-17/27 BANDWIDTH switch to the 10 kHz position and ATTENUATOR switch to the +40 dB position. Adjust the signal generator output level to −7 dBm and set the step attenuator to the 0 dB position. Adjust the Model NM-17/27 CALIBRATE control to obtain full-scale deflection (60 dB) on the Output meter. Decrease the RF input level in 10 dB steps using the step attenuator to obtain input signal levels indicated in Table 6-4. Record the Output meter indication at each signal level.

Table 6-4. Input Signal Level vs Output Meter Indication for Narrowband Log IF Accuracy

RF Input Signal Level (dBm)	Output meter indication required
−7	60 dB
−17	50 dB ± 1 dB
−27	40 dB ± 1 dB
−37	30 dB ± 1 dB
−47	20 dB ± 1 dB
−57	10 dB ± 1 dB
−67	0 dB ± 1 dB

e. *Broadband (Impulse) Function Tracking Accuracy*

Connect the output of the impulse generator via the 10 dB step attenuator to the RF INPUT receptacle of the Model NM-17/27. Set the step attenuator to the 20 dB position. Set the Model NM-17/27 BAND switch to the .25–.50 position, BANDWIDTH switch to the 50 kHz position, AFC switch to the OFF position ATTENUATOR switch to the 0 dB position, and CONTROL MODE switch to the LOCAL position. Tune the Model NM-17/27 to near the center of the frequency band. Adjust the output level of the impulse generator to 106 dBuV/MHz and the pulse repetition rate to 60 pps. Set the Model NM-17/27 FUNCTION switch to the PEAK/0.3 SEC HOLD TIME position. Adjust the CALIBRATE control

Table 6-3. Signal Generator vs Attenuator Settings for Narrowband Attenuator Accuracy

ATTENUATOR Switch Position (dB)	Signal Generator Output Level	Step Attenuator Position (dB)
+60	−7 dBm	0
+40	−27 dBm	0
+20	−47 dBm	0
0	−67 dBm	+20
−20	−67 dBm	+20
−40	−67 dBm	+40

for an Output meter indication of 60 dB. Decrease the impulse generator output in 10 dB steps. Record the Output meter indication for the PEAK and the SLIDEBACK PEAK detector functions at each impulse signal level. Table 6-5 indicates the Output meter indication required.

Table 6-5. Impulse Generator Output Level vs Output Meter Indication for Broadband Tracking Accuracy

Impulse Generator Output dBuV/MHz	PEAK and SLIDEBACK PEAK Output Meter Indication Required
106	60 dB
96	50 dB ±2 dB
86	40 dB ±2 dB
76	30 dB ±2 dB
66	20 dB ±2 dB
56	10 dB ±2 dB
46	0 dB ±2 dB

f. *Broadband Bandwidth Tracking Accuracy*

Return the output level of the impulse generator to 106 dBuV/MHz (and to an Output meter indication of 60 dB) with the FUNCTION switch in the PEAK/0.3 SEC HOLD TIME position. Set the BANDWIDTH switch to the 50 kHz, 10 kHz, and 1.0 kHz positions. Record the Output meter indication for the bandwidths displayed in Figure 6-6.

Table 6-6. Bandwidth vs Output Meter Indication for Broadband Tracking Accuracy Test

Bandwidth	Output Meter Indication Required
50 kHz	60 dB
10 kHz	46 dB ±1 dB
1.0 kHz	26 dB ±1 dB

6.2.5 Evaluation of Narrowband (CW) Sensitivity

Connect the output of the signal generator via the 10 dB step attenuator to the RF INPUT receptacle of the Model NM-17/27. Set the step attenuator to the 40 dB position. Set the Model NM-17/27 ATTENUATOR switch to the −40 dB position, BANDWIDTH switch to the 0.1 kHz position, AFC switch to the OFF position, FUNCTION switch to the FIELD INTENSITY position, CONTROL MODE switch to the LOCAL position, and CALIBRATE control to the maximum clockwise position.

Band 1

Adjust the signal generator for a 10 kHz signal at an output level of −90 dBm, yielding an RF input level of −130 dBm to the Model NM-17/27 RF INPUT receptacle. Set the BAND switch to the .01−.25 position and carefully tune the Model NM-17/27 for maximum deflection of the Output meter. Reduce the signal generator output level to zero and record the noise level indicated on the Output meter on dB REFERRED TO 1 uV scale. Increase the output level of the signal generator to obtain an indication on the Output meter of 3 dB above the Model NM-17/27 noise level. Record the signal level at the RF INPUT receptacle (signal generator output level less step attenuator position, subtracted algebraically) as the CW sensitivity in dBm. Example:

Signal generator output level	103 dBm
Step attenuator position	+ 40 dB
Signal level (CW sensitivity)	143 dBm

Repeat the procedure for frequencies at the center and the high end of the band. The required signal level is 143 dBm maximum.

Bands 2 thru 8

Set the Model NM-17/27 BANDWIDTH switch to the 10 kHz position. Follow the procedure given for Band 1, selecting test frequencies at the low, center and high frequencies of each band. The required signal level is 123 dBm maximum.

6.2.6 Evaluation of Broadband (Impulse) Sensitivity

Connect the output of the impulse generator via the 10 dB step attenuator to the RF INPUT receptacle of the Model NM-17/27. Set the step attenuator to the 20 dB position. Set the Model NM-17/27 ATTENUATOR switch to the --40 dB position, BANDWIDTH switch to the 10 kHz position, AFC switch to the OFF position, CONTROL MODE switch to the LOCAL position, FUNCTION switch to the PEAK/0.3 SEC HOLD TIME position and CALIBRATE control to the maximum clockwise position.

Set the BAND switch to the .01−.25 position and tune the Model NM-17/27 to 100 kHz. With the impulse generator not energized, record the Output meter indication as the Model NM-17/27 noise level. Energize the impulse generator and adjust for minimum output level, then increase the output level to obtain an indication on the Output meter that is 3 dB above the Model NM-17/27 noise level. Record the impulse signal amplitude at the RF INPUT receptacle (impulse generator output level less the step attenuator position, subtracted algebraically) as the impluse sensitivity in dBuV/MHz. Example:

Impulse Generator output level	+53 dBuV/MHz
Step attenuator position	+20 dB
Impulse signal amplitude	+33 dBuV/MHz

Repeat this procedure for a test frequency of 250 kHz in Band 1 and at 2 or 3 frequencies across each band. The required impulse signal amplitude is +33 dBuV/MHz maximum.

6.2.7 Evaluation of Gain Flatness

Connect the output of the signal generator directly to the RF INPUT receptacle of the Model NM-17/27. Adjust the signal generator for a 10 kHz CW signal at an output level of −50 dBm. Set the Model NM-17/27 ATTENUATOR switch to the +20 dB position, AFC switch to the OFF position, CONTROL MODE switch the to LOCAL position, and FUNCTION switch to the FIELD INTENSITY position. Rotate the CALIBRATE control to the fully clockwise position.

Band 1

Set the Model NM-17/27 BAND switch to the .01−.25 position. Set the BANDWIDTH (kHz) switch to the 1.0 kHz position. Tune the Model NM-17/27 to the signal generator frequency and obtain maximum deflection of the Output meter. Record the Output meter indication on the dB REFERRED TO 1 uV scale. Adjust the signal generator to a frequency near the center of the band (maintain –50 dBm signal level) and repeat the procedure. Set the signal generator to a frequency near the high end of the band and again repeat the procedure, recording the levels indicated on the Output meter.

Bands 2 thru 8

Set the BANDWIDTH (kHz) switch to the 50 kHz position and repeat the procedure given for Band 1 and check Bands 2 thru 8, selecting test frequencies near the low end, center, and high end of each band. Record the Output meter indication at each test frequency. The requirement of this test is that the maximum difference between the highest and lowest Output meter indication for all eight bands is 4 dB (±2 dB).

6.2.8 Evaluation of Calibration Accuracy

a. Perform gain calibration of the Model NM-17/27 at 10 kHz on Band 1 using the procedure and calibration figures presented in the serialized Model NM-17/27 Calibration Charts (P/N 1-403550-001).

b. Set the Model NM-17/27 ATTENUATOR switch to the 0 dB position, BANDWIDTH switch to the 10 kHz position, AFC switch to the OFF position, and FUNCTION switch to the FIELD INTENSITY position.

c. Connect the output of the signal generator to the Model NM-17/27 RF INPUT receptacle using a short length of 50 ohm coaxial cable and tune to the test frequency. Set the signal generator for a CW signal at an output level of exactly –67 dBm. Adjust the signal generator frequency for maximum indication on the Model NM-17/27 Output meter; an indication of +40 dB ±1 dB is acceptable.

d. Repeat Steps a thru c for three test frequencies across each band.

6.2.9 Evaluation of RF Input Impedance and VSWR

This test defines the accuracy of the Model NM-17/27 input impedance referenced to 50 ohms.

Set the Model NM-17/27 ATTENUATOR switch to the 0 dB position, CONTROL MODE switch to the LOCAL position, FUNCTION switch to the FIELD INTENSITY position, and POWER switch to the ON AC position.

0.5 MHz to 32 MHz Range

a. Apply a –20 dBm signal at the test frequencies listed in Table 6-7 from the RF signal generator, to the VWSR bridge RF input receptacle. Connect the RFI meter (used as a return loss meter) to the detector output of the VSWR bridge. Connect one of the remaining receptacles to the RF Input receptacle of the Model NM-17/27. Connect the 50 ohm termination to to remaining VSWR bridge receptacle.

Table 6-7. Frequencies for VSWR Test (0.5 MHz to 32 MHz Range)

Band (MHz)	Test Frequencies, MHz (suggested)
.5 – 1	0.5, 0.75 and 1
1 – 2	1, 1.5 and 2
2 – 4	2, 3 and 4

b. Tune the Model NM-17/27 for maximum response to the test signal, setting the ATTENUATOR switch as necessary, then returning the ATTENUATOR switch to the 0 dB position.

c. Disconnect the VSWR bridge from Model NM-17/27 RF INPUT receptacle and tune the return loss meter for maximum response to the test signal and adjust its gain and attenuator to obtain a reference full-scale meter indication.

NOTE

This calibrates the test system for infinite VSWR and 0 dB return loss.

d. Reconnect the VSWR bridge to the Model NM-17/27 RF INPUT receptacle (using shortest possible length of transmission line, preferably a single coaxial adapter). Note the reduction, in dB, of the indication on return loss meter. This reduction is the return loss as a result of the termination of the SWR bridge by the Model NM-17/27 input impedance.

e. Using Table 6-9, determine the VSWR corresponding to the return loss measured in Step d. A VSWR less than 1.50:1 is acceptable.

10 kHz to 500 kHz Range

If a VSWR bridge is available in the 10 kHz to 500 kHz frequency range, use the preceding procedure at the test frequencies listed in Table 6-8. In lieu of this, use the vector impedance meter and manufacturer's instructions. This provides a measurement of vector impedance and phase angle which may be converted to VSWR using a Smith chart.

Table 6-8. Frequencies for VSWR Test (10 kHz to 500 kHz Range)

Band (MHz)	Test Frequencies, MHz
.01 – .25	0.01, 0.05, 0.1, 0.2 and 0.25
.25 – .5	0.25, 0.38 and 0.5

Table 6-9. Return Loss vs VSWR

Return Loss (dB)	VSWR
9.5	2.01
10	1.92
11	1.79
12	1.67
13	1.58
14	1.50
15	1.43
16	1.37
17	1.33
18	1.29
19	1.24
20	1.22
21	1.194
22	1.170
23	1.153

Table 6-9. Return Loss vs VSWR (Cont.)

Return Loss (dB)	VSWR
24	1.136
25	1.120
26	1.105
27	1.093
28	1.083
29	1.074
30	1.066
31	1.058
32	1.051
33	1.046
34	1.041
35	1.036
36	1.032
37	1.029
38	1.027
39	1.023
40	1.020

6.2.10 Evaluation of Undersired Response Rejection

a. Connect the output of the signal generator via the 10 dB step attenuator to RF INPUT receptacle of Model NM-17/27. Set the signal generator output level to −23 dBm. Set the step attenuator to the 0 dB position. Set the Model NM-17/27 ATTENUATOR switch to the −40 dB position, BANDWIDTH switch to the 10 kHz position, AFC switch to the OFF position, FUNCTION switch to the PEAK 0.3 SEC position, CONTROL MODE switch to the LOCAL position, BAND switch to the .01−.25 position and CALIBRATE control to the maximum clockwise position.

b. Set the Model NM-17/27 to a test frequency of 10 kHz.

c. Slowly tune the signal generator from 10 kHz to three times the maximum frequency of the band (750 kHz) and observe the Model NM-17/27 Output meter for indications of spurious responses. Ignore responses that are due to harmonic outputs from the signal generator.

d. If a spurious response occurs, set the BANDWIDTH switch to 1.0 kHz and tune the signal generator frequency for maximum response. Reduce the input signal level to 3 dB above the noise level and note the output level of the signal generator.

Retune the signal generator to the test frequency and reduce the input signal level to 3 dB above the noise level and note output level of signal generator. The difference in signal generator levels must be 70 dB minimum.

e. Repeat Steps a thru d for the test frequencies listed in Table 6-10. (The IF and image frequencies are listed for identification purposes.)

Table 6-10. Frequencies for Undesired Response Rejection Test

Test Frequency (MHz)	Band No.	Image Frequency (MHz)	IF Frequency (MHz)
0.01	1	0.920	0.455
0.05	1	0.960	0.455
0.12	1	1.030	0.455
0.25	1	1.160	0.455
0.25	2	3.450	1.6
0.38	2	3.580	1.6
0.5	2	3.700	1.6
0.5	3	3.700	1.6
0.75	3	3.950	1.6
1.0	3	4.200	1.6
1.0	4	1.910	0.455
1.5	4	2.410	0.455
2.0	4	2.910	0.455
2.0	5	5.200	1.6
3.0	5	6.200	1.6
4.0	5	7.200	1.6
4.0	6	7.200	1.6
6.0	6	9.200	1.6
8.0	6	11.200	1.6
8.0	7	18.000	5.0
12.0	7	22.000	5.0
16.0	7	26.000	5.0
16.0	8	26.000	5.0
24.0	8	34.000	5.0
32.0	8	42.000	5.0

6.2.11 Evaluation of Local Oscillator Emission

a. Connect the RFI meter to the RF INPUT receptacle of the Model NM-17/27. Set the Model NM-17/27 ATTENUATOR switch to the −40 dB position.

b. Set the Model NM-17/27 frequency to 10 kHz. Tune the RFI meter for maximum response to the Model NM-17/27 local oscillator frequency. See list in Table 6-11.

c. Note the local oscillator emission in terms of microvolts. Convert measurement to power in picowatts (pW) as follows:

$$P = \frac{E^2}{R}$$

where P = power in pW

E = voltage in uV

R = 50 ohms

Maximum acceptable local oscillator emission is 50 picowatts.

NOTE: 50 pW = 50 uV across 50 ohms

d. Repeat Steps b and c at the test frequencies listed in Table 6-11.

Table 6-11. Frequencies for Local Oscillator Emission Test

Test Frequency (MHz)	Band No.	L. O. Frequency (MHz)
0.01	1	0.465
0.05	1	0.505
0.12	1	0.575
0.25	1	0.705

Table 6-11. Frequencies for Local Oscillator Emission Test (Cont.)

Test Frequency (MHz)	Band No.	L. O. Frequency (MHz)
0.25	2	1.85
0.38	2	1.98
0.50	2	2.10
0.5	3	2.10
0.75	3	2.35
1.0	3	2.60
1	4	1.455
1.5	4	1.955
2	4	2.455
2	5	3.60
3	5	4.60
4	5	5.60
4	6	5.60
6	6	7.60
8	6	9.60
8	7	13.0
12	7	17.0
16	7	21.0
16	8	21.0
24	8	29.0
32	8	37.0

6.2.12 Evaluation of AFC Holding Range

Connect the output of the signal generator to the RF INPUT receptacle of the Model NM-17/27. Tune the signal generator to 300 kHz and adjust the output level to −67 dBm CW. Set the Model NM-17/27 ATTENUATOR switch to the 0 dB position, BANDWIDTH switch to the 0.1 kHz position, AFC switch to the OFF position, FUNCTION switch to the FIELD INTENSITY position, and the CONTROL MODE switch to the LOCAL position.

a. Tune the Model NM-17/27 for maximum response to the signal at 300 kHz. Vary the CALIBRATE control for an indication of 40 dB on the Output meter.

b. Set the Model NM-17/27 AFC switch to the ON position. Tune the signal generator slowly above and below 300 kHz, noting the frequencies at which the Model NM-17/27 Output meter indication suddenly drops in value when the AFC lock loses control. The required minimum control is ±7 kHz (of center frequency).

c. Repeat Steps a and b with the Model NM-17/27 BANDWIDTH switch set at 1.0 kHz.

d. Repeat Steps a and b with the Model NM-17/27 BANDWIDTH switch set at 10 kHz. It may be easier to observe the Model NM-17/27 Frequency meter for the point of AFC lock control loss. The Frequency meter indication will snap back to its initial setting as the lock is lost. The required minimum control for the 10 kHz bandwidth is ±20 kHz (of center frequency).

e. Repeat Steps a and b with the Model NM-17/27 BANDWIDTH switch set to 50 kHz. The required minimum control for the 50 kHz bandwidth is ±70 kHz (of center frequency).

6.2.13 Evaluation of Selectable IF Bandwidths

Connect the output of the signal generator via the BNC T-adapter to the RF INPUT receptacle of the Model NM-17/27. Connect the remaining port of the T-adapter to the input of the frequency counter.

Set the signal generator to 300 kHz and set the signal output level to 0 dBm, unmodulated. Set the Model NM-17/27 ATTENUATOR switch to the +60 dB position, AFC switch to the OFF position, FUNCTION switch to the QUASI PEAK position, CONTROL MODE switch to the LOCAL position, BAND switch to the .25–.5 position and BANDWIDTH switch to the 0.1 kHz position.

a. Tune the Model NM-17/27 to the 300 kHz signal and for maximum indication on the Output meter. Vary the CALIBRATE control for a convenient reference level; e.g. 50 dB.

b. Increase the signal generator output level by exactly 6 dB.

c. Tune the signal generator frequency above and below 300 kHz and note the two frequencies on the frequency counter at which the Output meter indication returns to the reference level of Step a. The difference between the two frequencies noted is the 6 dB bandwidth.

d. Repeat Steps a thru c with the Model NM-17/27 BANDWIDTH switch in the 1.0 kHz position.

e. Repeat Steps a thru c with the Model NM-17/27 BANDWIDTH switch in the 10 kHz position.

f. Repeat Steps a thru c with the Model NM-17/27 BANDWIDTH switch in the 50 kHz position.

The bandwidths measured are required to be within ±10% of the values indicated on the front panel.

6.2.14 Evaluation of Automatic Scan Operation

Set the Model NM-17/27 CONTROL MODE switch to the SCAN position. Momentarily press the SINGLE switch and observe the indication on the Frequency meter. The Frequency meter should indicate a smooth scan from the low-frequency end of the scale to the high-frequency end of the scale in approximately one minute, then return to the low frequency end of the scale to rest there, completing a one-cycle function.

Connect an ohmmeter across the RECORDER PENLIFT receptacle on the rear panel of the Model NM-17/27. Momentarily press the SINGLE switch and observe the ohmmeter indication. Initially the ohmmeter should indicate an open circuit, then it should indicate a short circuit during the one-minute scan period, then again indicate an open circuit.

6.2.15 Evaluation of BFO Operation

Connect the signal generator to the RF INPUT receptacle of the Model NM-17/27 and set the frequency to 300 kHz. Set the output level to −50 dBm, amplitude modulated 30% with a 1 kHz sine wave. Set the Model NM-17/27 BANDWIDTH switch to the 10 kHz position, ATTENU ATOR switch to the 0 dB position, BAND switch to the 2-4 position, AFC switch to the OFF position, and FUNCTION switch to the QUASI PEAK position. Tune the Model NM-17/27 for maximum Output meter indication of the signal.

Connect the headphones to the AUDIO receptacle of the Model NM-17/27 and vary the AUDIO control for a comfortable 1 kHz modulation sound level. Remove the signal generator 1 kHz amplitude modulation and set the FUNCTION switch to the BFO position and note that a tone (approximately 1 kHz) is audible in the headphones. Rotate the FINE TUNE control and note change in audio tone. Decrease the signal generator output level to –90 dBm and note that the BFO tone remains.

6.2.16 Evaluation of Remote Control Operation

Connect the programmer to the PROGRAMMER receptacle on the rear panel of the Model NM-17/27 and set the CONTROL MODE switch to the REMOTE position. Check operation of remote band selection, bandwidth selection, receiver tuning, function selection, and adjustment of receiver gain (calibration). Performance should be the same as for local operation.

6.2.17 Evaluation of Data Outputs

a. *X Output*

Connect the one kilohm resistor to the X OUTPUT receptacle on Model NM-17/27 rear panel. Rotate the TUNE control fully clockwise to obtain full-scale indication on the Frequency meter. Connect the digital voltmeter across the one kilohm load and measure the dc amplitude of the X output level. The required output is +1 volt ±5% (+0.95 V to +1.05 V).

b. *Frequency Readout*

Connect the digital voltmeter between pin T of the PROGRAMMER receptacle, on the Model NM-17/27 rear panel, and chassis ground. Set the CONTROL MODE switch to the LOCAL position. Set the BAND switch to each band and adjust the TUNE control for the Frequency meter scale frequencies listed in Table 6-12. Note the dc digital voltmeter indication. The voltages are required to be within ±2% of the values listed in Table 6-12.

c. *Y Output*

Connect the signal generator RF output receptacle to the RF INPUT receptacle of the Model NM-17/27. Set the signal generator to a test frequency of 300 kHz CW and set the output level to –47 dBm. Set the Model NM-17/27 CONTROL MODE switch to the LOCAL position, the AFC switch to the OFF position, the ATTENUATOR switch to the 0 dB position, the BAND switch to the .25-5 position, the BANDWIDTH SWITCH to the 10 kHz position, and the FUNCTION switch to the QUASI PEAK position. Tune the Model NM-17/27 for maximum response on the Output meter to the test signal. Vary the CALIBRATE control so that the Output meter indicates 60 dB. Connect the one kilohm resistor to the Y OUTPUT receptacle on the rear panel of the Model NM-17/27. Connect the dc digital volmeter across the one kilohm load and measure the dc amplitude of the Y output. The required output level is +1 volt ±5% (+0.95 V to +1.05 V).

d. *dB Readout*

Connect the dc Digital voltmeter between pin V of the PROGRAMMER receptacle, on the Model NM-17/27 rear panel, and chassis ground. Set the FUNCTION switch to the SLIDEBACK PEAK position, CONTROL MODE switch to the LOCAL position, BANDWIDTH switch to the 0.1 position, and the BAND switch to the .25–.5 position. Vary the SLIDEBACK PEAK control for an Output meter indication of exactly 60 dB. Set the ATTENUATOR switch to each position and note the dc digital voltmeter indication. The voltages are required to be within ±1.0 mV of the values listed in Table 6-13.

Return the ATTENUATOR switch to the 0 dB poisition. Vary the SLIDEBACK PEAK control to provide the following exact Output meter indications and note the dc digital voltmeter indications. The voltages are required to be within ±1.0 mV of the values listed in Table 6-14.

6.2.18 Evaluation of Signal Outputs

Connect the signal generator RF output receptacle to the RF INPUT receptacle of the Model NM-17/27. Tune the signal generator to a test frequency of 300 kHz CW and set

Table 6-12. Frequency Meter vs Frequency Readout Voltage

Band:	1	2	3	4	5	6	7	8
Frequency, MHz:	0.25	0.50	1.0	2.0	4.0	8.0	16	32
Voltage, Volts:	2.5	5.0	10.0	0.200	0.400	0.800	1.60	3.20

Table 6-13. Attenuator Position vs Output Voltage for dB Readout Test

Attenuator:	–40	–20	0	+20	+40	+60
Voltage (volts):	–0.040	–0.020	+0.000	+0.020	+0.040	+0.060

Table 6-14. Output Meter Indication vs Output Voltage for dB Readout Test

Output Meter Indication	60 dB	50 dB	40 dB	30 dB	20 dB
Voltage (volts):	+0.060	+0.050	+0.040	+0.030	+0.020

the output level to –47 dBm. Set the Model NM-17/27 CONTROL MODE switch to the LOCAL position, the AFC switch to the OFF position, the ATTENUATOR switch to the 0 dB position, BAND switch to the .25–.50 position, the BANDWIDTH switch to the 50 kHz position, and the FUNCTION switch to the FIELD INTENSITY position. Tune the Model NM-17/27 for maximum response on the Output meter to the test signal.

a. *IF Output*

Vary the CALIBRATE control as necessary to produce an Output meter indication of 60 dB. Connect the 50 ohm load to the IF OUTPUT receptacle on the rear panel. Connect the RF voltmeter across the 50 ohm load and measure the amplitude of IF output signal. The required output level is 90 millivolts rms minimum.

b. *Log Video Output*

Remove the 50 ohm load from the IF OUTPUT receptacle and connect it to the LOG VIDEO receptacle on the Model NM-17/27 rear panel. Connect the digital voltmeter across the 50 ohm load and measure the dc amplitude. The required output level is +300 millivolts ±10% (+270 mV to +300 mV).

c. *Linear Video Output*

Amplitude modulate the signal generator output with a 1 kHz sine wave at 30%. Remove the 50 ohm termination from the LOG VIDEO receptacle and connect it to the LINEAR VIDEO receptacle. Connect the oscilloscope across the 50 ohm load. Note the amplitude of the demodulated 1 kHz sine wave displayed on the oscilloscope; the required output level is 100 mV peak to peak minimum.

d. *Audio Output*

Connect the power meter to the AUDIO OUTPUT receptacle. Set power meter impedance to 600 ohms. Monitor audio input to the power meter with the oscilloscope. Set the signal generator output level to –47 dBm with 30% amplitude modulation, 1 kHz sine wave. Rotate the AUDIO control cw until the 1 kHz modulation displayed by the oscilloscope begins to distort. Note the power meter indication in milliwatts. The required audio output power is 30 milliwatts minimum. Decrease the signal generator output level to –87 dBm and note the change in audio output power. The difference in audio power level must not exceed 6 dB.

Externally modulate the signal generator with the audio oscillator. Vary the modulation frequency from 20 Hz to 4 kHz, maintaining the modulation at 30%. Note the audio output variation on the power meter. This variation must not exceed 3 dB.

e. *FM Video Output*

Connect the 50 ohm load to the FM VIDEO receptacle. Connect the dc digital voltmeter across the 50 ohm load. Set the signal generator to CW operation and set the output level to –47 dBm.

The dc digital voltmeter should indicate 0 V. Set the input frequency to 290 kHz and then to 310 kHz. The dc digital voltmeter should indicate +50 mV minimum and –50 mV minimum respectively.

6.2.19 Evaluation of Power Supply Operation

a. *115 Volt Operation (50 Hz to 400 Hz)*

Connect the output of the audio oscillator to the input of the audio amplifier. Connect the 115 V output of the audio amplifier to the variable transformer input. Connect the ac line cord of the Model NM-17/27 to the variable transformer output. Adjust the audio oscillator and variable transformer for 60 Hz at 115 volts. Set the Model NM-17/27 POWER switch to the ON AC position. Vary the TUNE control for a Frequency meter indication in the upper-frequency range of any band. Set the variable transformer for 105 volts and vary the audio oscillator from 50 Hz to 400 Hz, noting the Frequency meter indication. Increase the input voltage to 130 volts and vary the input frequency from 50 Hz to 400 Hz, noting the Frequency meter indication. The Frequency meter indication should not vary for any of the above tests.

b. *230 Volt Operation (50 Hz to 400 Hz)*

Set the Model NM-17/27 POWER switch to the OFF position. Set the 115 V/230 V switch on the rear panel to the 230 V position. Set the variable transformer output to 230 volts and set the frequency to 60 Hz. Set the Model NM-17/27 POWER switch to the ON AC position. Repeat as in the 115 volt operation test, Step a, for 210 volts to 260 volts and 50 Hz to 400 Hz. Set the POWER switch to the OFF position and set the 115 V/ 230 V switch to the 115 V position.

6.3 ALIGNMENT AND ADJUSTMENT PROCEDURES

6.3.1 Disassembly Procedures

The removal of the four cover panels from the Model NM-17/27 provides access to the subassemblies for alignment and maintenance. The battery pack, located at the rear of the instrument, may be removed without removing the cover panels. Refer to Figures 6-1 and 6-2 for the identification and location of the subassemblies.

a. *Removal of Cover Panels*

Remove the four 4-40 x 3/8 flat-head screws that secure each side cover panel. Remove the side cover panels, exposing the side frames. The socket-head cap screws holding the top and bottom cover panels are now accessible. Remove the twenty 10-32 x 3/4 socket-head cap screws that secure the top and bottom cover panels to the side frames. Remove the top and bottom cover panels from the Model NM-17/27. Be careful not to damage the RF gaskets mounted in recesses on the interior surface of the top and bottom cover panels.

b. *Removal of Battery Pack*

The battery pack is mounted above the rear connector panel and may be removed as follows: Remove the four 8-32 x 1/4 pan-head screws and lock-washers that secure the battery pack to the side frames. Support the battery pack while removing it from the rear far enough to gain access to the battery pack cable connector. Disconnect the battery pack connection and remove the battery pack from the instrument.

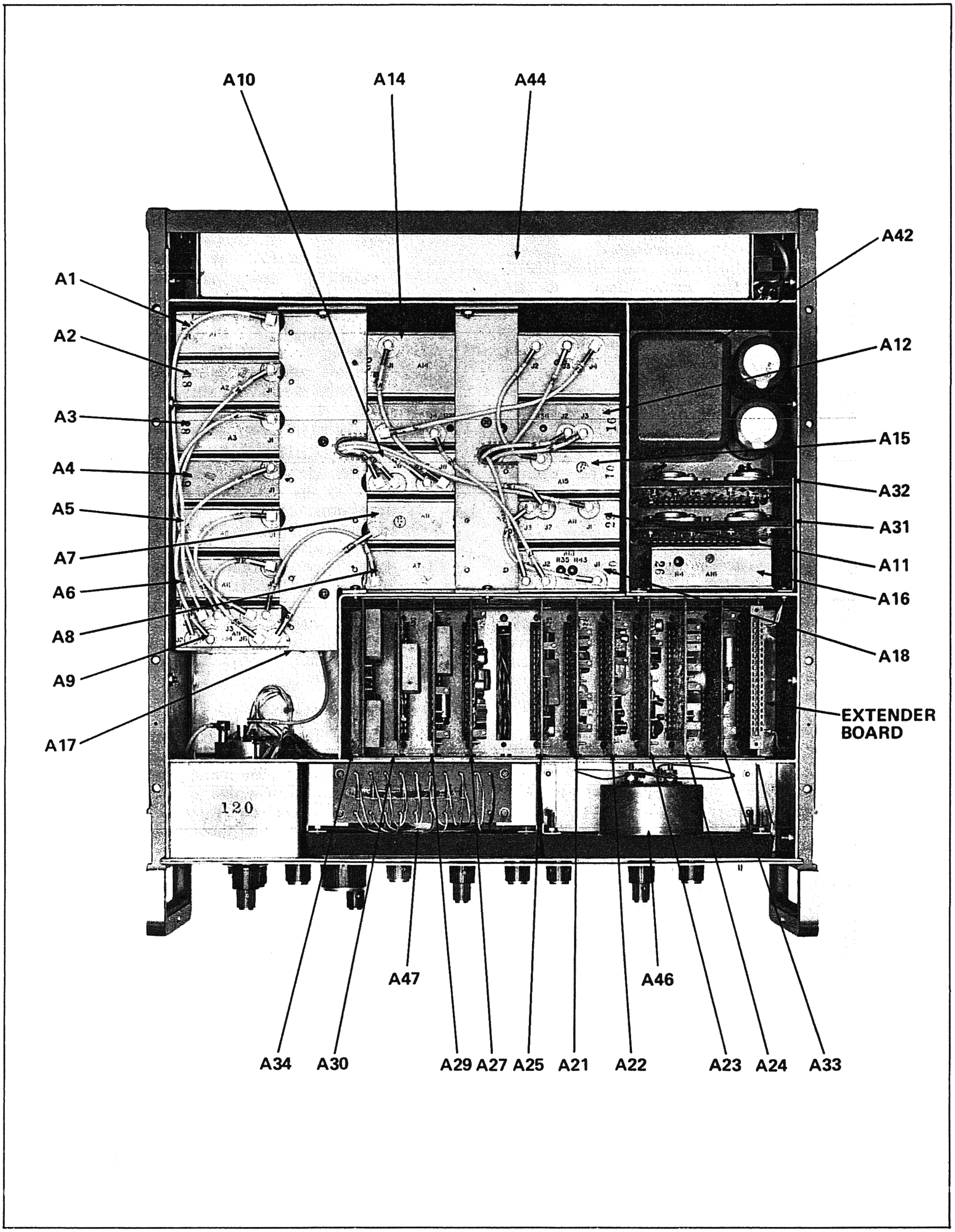


Figure 6-1. Location of Main Assemblies (Top View)

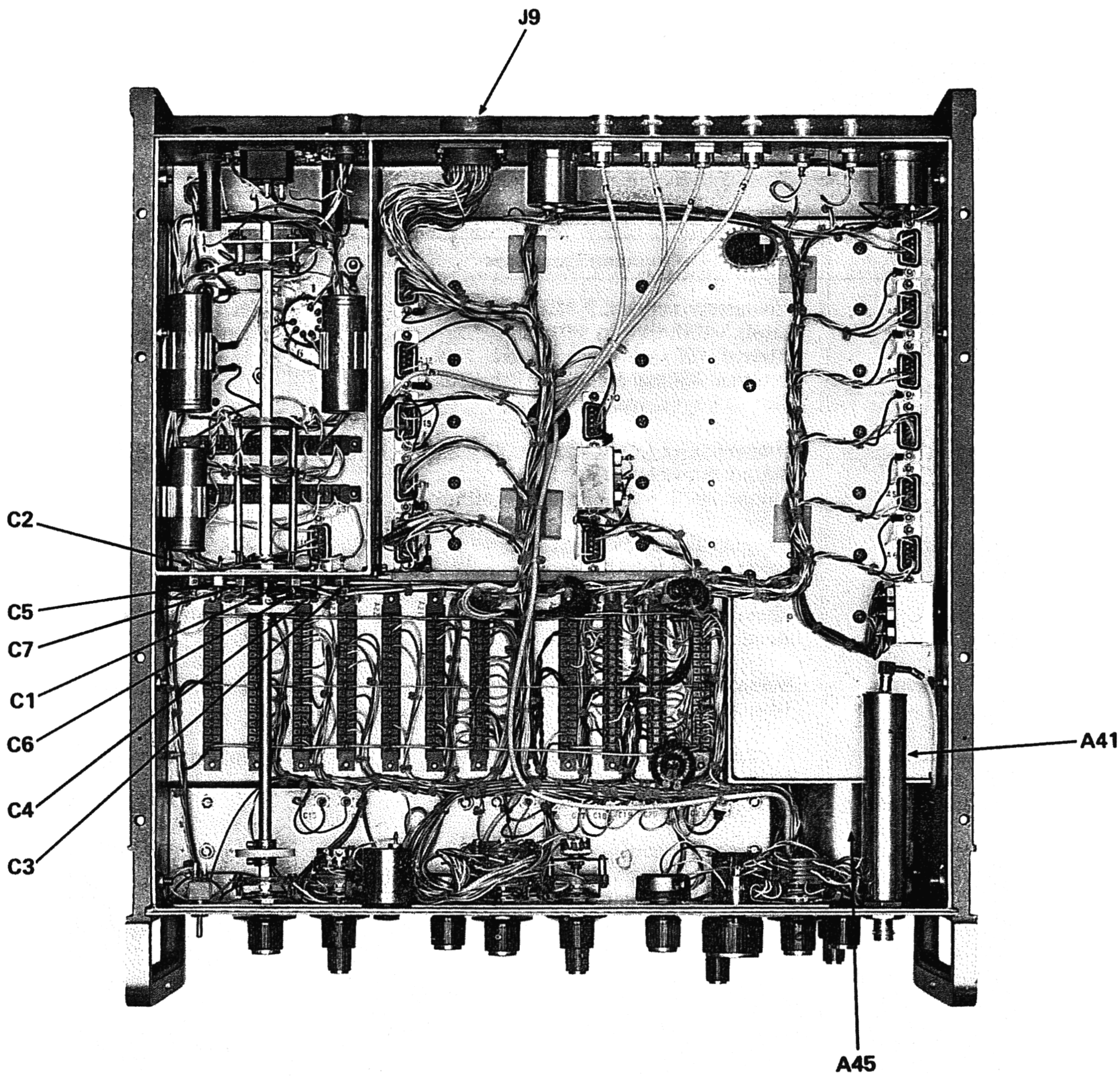


Figure 6-2. Location of Main Assemblies (Bottom View)

c. *Removal of Subassemblies*

The plug-in, shielded modules are held in place by two retaining brackets mounted across the top of the modules. Remove the five screws and two nuts that secure the brackets. The modules may be disengaged from the chassis connectors, and the coaxial cables disconnected. The remainder of the subassemblies are accessible from the top or bottom of the instrument and require no special instructions for removal.

NOTE

An extender cable and an extender board are provided for access to a few shielded module and circuit board adjustments that are otherwise inaccessable.

Table 6-15 lists the test equipment requirements for the alignment and adjustment of the Model NM-17/27.

Figure 6-15. Test Equipment Required for Alignment and Fault Isolation of Model NM-17/27

Instrument	Minimum Parameters	Recommended Model
Signal generator	Frequency range: 455 kHz to 32.3 MHz Level: −130 dBm to +10 dBm Internal AM capabilities: 1 kHz, 11% External AM capabilities: 1 kHz, 30% Output impedance: 50 ohms	Hewlett-Packard 606 (with external step attenuator)
Sweep generator	Frequency range: 50 kHz to 32.1 MHz Output impedance: 50 ohms Output level: −15 dBm to −7 dBm	Texscan VS-20
Oscilloscope with 10X probe	Frequency response: 455 kHz Level: 316 mV to 8V p-p	Tektronix 535A
Dc clip-on milliammeter	Measurement range: 12 mA to 300 mA Accuracy: ±10%	Hewlett-Packard 428B
Dc digital voltmeter (2 required)	Measurement range: 0 V to 105 V Accuracy: ±1 mV	Hewlett-Packard 3440A
Ac voltmeter with amplifier output and high impedance probe	Frequency response: 1 kHz to 5 MHz Measurement range: 3 mV rms to 24 V rms Accuracy: ±2%	Ballantine 314A
RFI meter with QP function	Frequency response: 455 kHz to 32 MHz Measurement level: −73 dBm to −60 dBm	Singer NM-25T
Frequency counter	Frequency response: 455 kHz to 37.3 MHz Accuracy: ±10 Hz	Hewlett-Packard 5246L
Programmer and cable	Required for remote control testing only	Singer P-7 and 94595-1
X–Y plotter	X input level: 2 V Y input level: 2 V	Moseley 135
VSWR bridge with mismatches	Frequency response: 50 kHz to 32 MHz	Telonic TRK-2
Step attenuator 10 dB steps	Frequency response: 455 kHz Range: 0 dB to 60 dB	Hewlett-Packard 355D
Step attenuator 1 dB steps	Frequency response: 455 kHz Range: 0 dB to 10 dB	Hewlett-Packard 355C
Variable attenuator	Frequency response: 455 kHz Range: 80 dB continuous	Texscan CA-50/50-1
Balanced mixer	Frequency response: 50 kHz to 32 MHz	Hewlett-Packard 10514A
Low pass filter	Frequency cutoff: 10 kHz	See Figure 6-5
RF detector	Frequency response: 350 kHz to 32.1 MHz Imput impedance: 50 ohms	See Figure 6-7

Figure 6-15. Test Equipment Required for Alignment and Fault Isolation of Model NM-17/27 (Cont.)

Instrument	Minimum Parameters	Recommended Model
Variable transformer	Output voltage range: 115 V ±2 V Output power: 30 W	General Radio 100-R
Power supply	Output level: +0.6 Vdc to +3 Vdc, −12 Vdc Output current: 300 mA	Hewlett Packard 6116A
Termination	Impedance: 50 ohms Connector: BNC	
Headphone	Impedance: 600 ohms	Singer 10796
Resistor	Resistance: 1 kilohm ±1% Power: ¼ Watt	
Adapter	Subminiature snap-on male to female BNC	
20 dB attenuator	Impedance: 50 ohms Connector: BNC	Singer RFA-20

6.3.2 Rectifier and Charge Regulator, A32 (See Figure 6-33)

a. Set the 115 V/230 V switch on the rear panel of the Model NM-17/27 to the 115 V position.

b. Connect the Model NM-17/27 to the variable transformer and set to 115 ±2 V (113 V to 117 V).

c. Connect the clip-on milliameter over the red wire connected to A32-1.

d. Set the POWER switch to the CHARGE position.

e. Adjust A32R9 for an indication of 300 mA ± 30 mA (270 mA to 330 mA) on the clip-on milliameter.

f. Connect the clip-on millimeter over the white wire connected to A32-18.

g. Adjust A32R10 for an indication of 300 mA ± 30 mA (270 mA to 330 mA) on the clip-on milliameter.

h. Set BATT TEST switch to the + position. Connect the dc digital voltmeter to A32-1 and measure the positive charge voltage. With fully charged batteries, the voltmeter should indicate +19.85 V ± 0.35 V (+19.5 V to +20.2 V) and the Output meter should indicate in the FULL zone of the BATTERY scale.

NOTE

The range of the FULL zone is +19.85 V ±0.35 V (+19.5 V to +20.2 V). Estimate the position that the meter pointer should indicate and adjust A32R14 accordingly.

6.3.3 Voltage Regulator, A31 (See Figure 6-32)

a. Set the POWER switch to the ON AC position.

b. Measure the positive regulated voltage output at A31-1 with the dc digital voltmeter and adjust A31R18 to obtain +12 V ±10 mV (+11.990 V to +12.010 V).

c. Measure the negative regulated voltage output at A31-18 and adjust A31R19 to obtain −12 V ±10 mV (−11.990 V to −12.010 V).

d. Since there is an interaction between the adjustments of A31R18 and A31R19, repeat Steps b and c as necessary to obtain correct values without further adjustment.

6.3.4 DC to DC Converter, A16 (See Figure 6-23)

a. Measure the output voltage of the dc to dc converter at feedthrough capacitor, C1 accessible from the bottom of the power supply section, with the dc digital voltmeter.

b. Adjust A16R4 to obtain +100 V ±5 V (+95 V to +105 V), on the dc digital voltmeter.

6.3.5 Tuning Control, A29 (See Figure 6-31)

a. Set the AFC switch to the OFF position.

b. Rotate the FINE TUNE control to its mid position.

c. Connect the dc digital voltmeter to A29TP2.

d. Set the TUNE control to the fully cw position.

e. Adjust A29R10 for +10 V ±10 mV (+9.99 V to +10.01 V) on the dc digital voltmeter.

f. Rotate the TUNE control fully ccw.

g. Vary the FINE TUNE control to obtain 0 V ± 1 mV on the dc digital voltmeter.

h. Adjust the Frequency meter mechanical zero screw for 0.01 MHz on the .01 to .25 MHz scale.

i. Vary the TUNE control to obtain +9.836 V ±1 mV (+9.835 V to +9.837 V) on the dc digital voltmeter.

j. Adjust A29R15 for 0.25 MHz on the .01 to .25 MHz scale.

6.3.6 Internal Sweep, A33 (See Figure 6-34)

a. Set the CONTROL MODE switch to the SCAN position.

b. Connect the dc digital voltmeter to A33TP1.

c. Adjust A33R1 for 0 V ± 5 mV.

d. Depress the SINGLE switch.

e. Adjust A33R5 for +10 V ±10 mV (+9.99 V to +10.01 V) when the voltage reaches its maximum value (after one minute.)

6.3.7 Shaper, A26 (See Figure 6-30)

Set the TUNE control fully ccw, and vary the FINE TUNE control to obtain 0 V at A29TP2. Measure the voltage at A26TP1. Adjust A26R31 for 1.4 V ±20 mV (+1.38 V to +1.42 V).

Rotate the TUNE control fully cw and vary the FINE TUNE control to obtain +10.0 V at A29TP2. Measure the voltage at A26TP1. Adjust A26R40 for +62 V ±1 V (+61 V to +63 V).

6.3.8 Frequency Readout, A34 (See Figure 6-35)

Connect one dc digital voltmeter to A29TP2 and the other dc digital voltmeter to A34TP3.

Set the CONTROL MODE switch to the LOCAL position.

Set the TUNE control fully ccw.

Vary the FINE TUNE control for an indication of exactly 0.01 MHz on the .01–.25 MHz scale.

Adjust A34R22 for +100 mV on the dc digital voltmeter connected to A34TP2.

6.3.9 Log IF Amplifier, A12 (See Figure 6-20)

a. Remove the cable from A12J1 and connect the signal generator to A12J1, shunted by 100 ohms, and connect the ac voltmeter with high impedance probe to A12TP1. Set the signal generator output to 455 kHz at –7 dBm and align the 20 dB driver gain by adjusting A12R6 for 1.0 V at A12TP1. Check the waveform at A12TP1 with the oscilloscope; it should be an undistorted sine wave. Increase the input level by 6 dB. The waveform should remain undistorted. Increase the input level farther. The output should be symmetrically limited at approximately 8 V p-p.

b. Decrease the input level to –47 dBm and connect the ac voltmeter, with the high impedance probe, to A12TP2. Adjust A12R15 to obtain +316 mV ±5% (+300 mV to +332 mV) at A12TP2. Check the waveform at A12TP2 with the oscilloscope; it should be an undistorted sine wave. increase the input level in 10 dB steps to –7 dBm. The output at A12TP2 should rise to approximately 1.7 V rms, limited, and be slightly distorted.

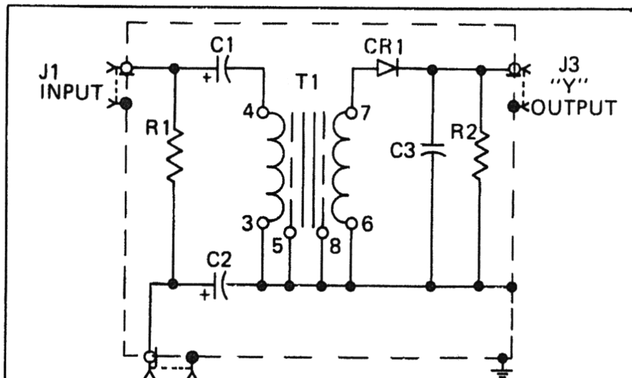
c. Increase the input level to –7 dBm and adjust A12R22 to obtain 32 mV at A12TP3.

d. Connect the ac voltmeter to A12TP4. The level should be between 210 mV and 350 mV. Connect the oscilloscope. with the 10X probe, to A12TP4. The waveform should be a 455 kHz logarithmically compressed sine wave. Decrease the input level in 10 dB steps to –67 dBm. The level at A12TP4 should decrease and the waveform should not change.

e. Connect ac voltmeter to A12TP5. Adjust A12R31 to obtain 2.2 V rms.

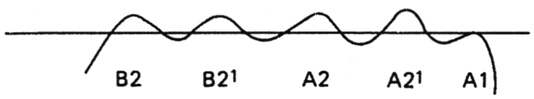
f. Connect the dc digital voltmeter to A12TP7. Set the FUNCTION switch to the FIELD INTENSITY position. Decrease the input level to –67 dBm. Adjust A12R36 (zero) for an output level of 0.60 V ±10 mV (0.59 V to 0.61 V). Increase the input level to –7 dBm. Adjust A12R31 (gain) for an output level of 3.60 V ±10 mV (3.59 V to 3.61 V). Since there is interaction between the gain and zero adjustments, repeat both adjustments until the voltmeter indications are correct. If the gain is too high, shunt A12R30 with 68 kilohms or 22 kilohms (R45) as necessary.

g. Connect the X–Y plotter via the 1 kHz log derivative test fixture (see Figure 6-3) to A12J2. Connect the variable 80 dB attenuator between the signal generator and A12J1. Amplitude modulate the signal generation 11% at 1 kHz. Monitor A12J2 with the dc digital voltmeter and the ac voltmeter. Set the signal generator output level to +3 dBm and plot the derivative curve of the logarithmic transfer line on the X–Y plotter by varying the variable attenuator. The derivative curve has five peaks corresponding the subsections B2, B2[1], A2, A2[1], and A1. In a correctly aligned log IF amplifier, peaks B2, B2[1], A2, A2[1] and the valleys between them are at approximately equal levels. Peak A1 may be slightly lower. Note the peak and valley levels on the ac voltmeter. The maximum deviation should be less than 2 dB. Determine the X scale on the plot by setting the variable attenuator to 0 dB and operating the signal generator output level control. Remove the 1 kHz modulation and note the dc output levels on the dc digital voltmeter while varying the signal generator output level from –7 dBm to –67 dBm in 10 dB steps. The correct output levels are: +3.60 V, +3.10 V, +2.60 V, +2.10 V, +1.60 V, +1.10 V and +0.60 V, ±50 mV respectively. Determine the deviation between actual and correct output levels as tracking errors in dB (1 dB = 50 mV). The limit of the tracking error is ±1 dB.

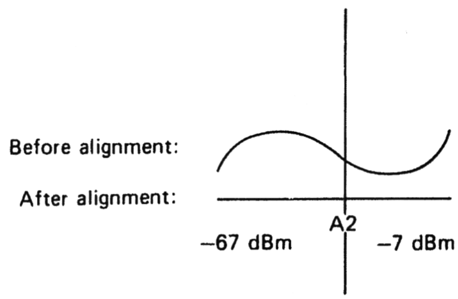


QTY	REF. DESIG.	DESCRIPTION	
1	C1	10 uF, 20 Vdc	
1	C2	0.01 uF	
1	C3	0.1 uF	
1	CR1	IN4154	
3	J1,J2,J3	VG 1464/U	
1	R1	68 kilohm, ¼ W	
1	R2	1 megohm, ¼ W	
1	T1	UTC 0–11 (50 ohm to 50 kilohm) or equiv.	

Figure 6-3. 1 kHz Log Derivative Test Fixture

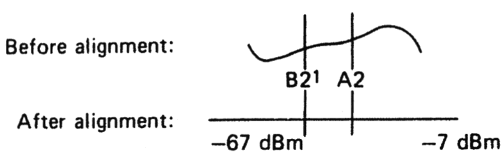


If one of the peaks on the derivative plot is lower than the others, this indicates that the slope of the corresponding subsection is low and should be increased by reducing the compensating resistor of that subsection (rotating it cw). No compensation is available for A1. For instance, if peak A2 is low, decrease A12R23 until A2 rises on the derivative plot to the correct level. Observe that the valleys on both sides of A2 will also rise. The slope increase of A2 has an effect on the tracking. The dc output levels above the adjusted section increase; below the adjusted section decrease.



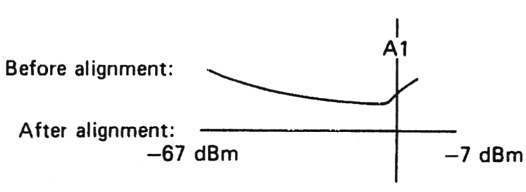
If any peak is higher than the others, the slope of the corresponding subsection should be decreased by adjusting the compensating trimmer of that subsection in a ccw direction.

Increasing the gain of the 30 dB limiting amplifier, connected to input B2, from 30 dB to 32 dB causes the valley between B2[1] and A2 on the derivative plot to be deeper, shifts peaks B2 and B2[1] to lower input levels and slightly lowers the peaks of B2[1] and A2. In addition, the dc output decreases above A2 and increases below B2.



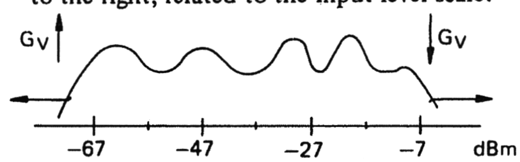
Decreasing the gain of the 30 dB limiting amplifier to 28 dB has the opposite effect on the derivative curve and the tracking.

Increasing the attenuation connected to input A1 from 30 dB to 32 dB shifts peak A1 to a higher input level, causes the valley between A2[1] and A1 to be deeper and lowers the peak of A2[1] slightly. In addition, it increases the dc output levels below A1.



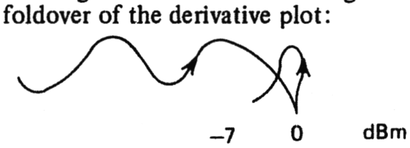
Decreasing the attenuation to input A1 from 30 dB to 28 dB has the opposite effect on the derivative curve and the tracking.

The utilized 60 dB dynamic range of the log transfer curve can be shifted by adjusting the driver gain. Decreasing the driver gain from the nominal 20 dB to 18 dB shifts the derivative curve to the right, related to the input level scale.



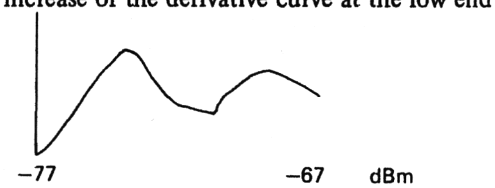
Increasing the driver gain from 20 dB to 22 dB shifts the derivative curve to the left related to the input level scale. The driver gain adjustment has no effect on the average transfer slope, but has an effect on the position of the transfer line, which can be compensated by the adjustment, A12R36.

The driver gain alignment can be used to improve tracking. The maximum driver gain is limited by a foldover of the derivative plot:



at the high end which should not occur below 0 dBm.

The minimum driver gain is limited by a sharp increase of the derivative curve at the low end



which should not occur above –77 dBm. Generally, a high slope log amplifier requires low gain in the postamplifier and also low driver gain; a low slope log amplifier requires high postamplifier gain and also higher driver gain.

Remove the 1kHz modulation from the signal generator, connected to A12J1. Vary the input level from –7 dBm to –67 dBm and measure the noise output level with the ac voltmeter. The noise level should be less than 3 mV rms.

Connect the dc digital voltmeter to A12J3. With the input level set to –7 dBm, the buffered video output level should be 300 mV ±5% (285 mV to 315 mV) across 50 ohms. Remove the 50 ohm load. The buffered video output should rise to 600 mV.

Connect the ac voltmeter to A12J4 and vary the input level from –7 dBm to –67 dBm. Above –27 dBm input level, the IF output at A12J4 is limited to 200 mV rms, unloaded. Loaded with 1 kilohm, it drops to about 100 mV.

6.3.10 Weighting Circuits and Meter Amplifier, A21 (See Figure 6-25)

a. Connect the signal generator to A12J1 via the 10 dB step attenuator. Set the signal generator frequency to 455 kHz and the output level to –7 dBm. Set the FUNCTION switch to the FIELD INTENSITY position and connect the dc digital volmeter to A21TP1. Set the step attenuator to the 60 dB position. Adjust A21R21 for an indication of +0.6 V ±10 mV (+0.59 V to +0.61V) on the dc digital voltmeter. Set the step attenuator to the 0 dB position. The dc digital voltmeter should indicate +3.60 V ±10 mV (+3.59 V to +3.61 V).

b. Set the FUNCTION switch to the QUASI PEAK position and connect the dc digital voltmeter to A21TP2. Set the step attenuator to the 60 dB position. Adjust A21R22 for an indication of +0.6 V ±10 mV (+0.59 V to +0.61 V) on the dc digital voltmeter. Set the step attenuator to the 0 dB position. The dc digital voltmeter should indicate +3.6 V ±10 mV (+3.59 V to +3.61 V).

c. Connect the dc digital voltmeter to A21TP3. Set the FUNCTION switch to the FIELD INTENSITY position and the step attenuator to the 0 dB position. Adjust A21R13 on the dc digital voltmeter for an indication of +3.00 V ±10 mV (+2.99 V to +3.01 V). Set the 10 dB step attenuator to the 60 dB position. Adjust A21R11 for an indication of 0.00 V ±10 mV on the dc digital voltmeter. There is interaction between the two adjustments; therefore, repeat the adjustments until both values are correct. Set the FUNCTION switch to the QUASI PEAK, PEAK, and SLIDEBACK PEAK positions. The dc digital voltmeter should indicate +3.00 V ±10 mV (+2.99 V to +3.01 V) and 0.00 V ±10 mV for the 10 dB position and the 60 dB position of the step attenuator respectively.

d. Set the FUNCTION switch to the FIELD INTENSITY position and the step attenuator to the 0 dB position. Set the POWER switch to the OFF position and adjust the Output meter mechanical zero screw for an indication of +0 dB referred to 1 uV. Set the POWER switch to the ON AC position and observe the Output meter deflection. Adjust A21R17 for an output meter deflection of exactly 60 dB referred to 1 uV. Set the step attenuator to the 60 dB position. Adjust A21R11 for an Output meter indication of 0 dB referred to 1 uV.

e. Set the step attenuator to the 0 dB position and check the voltage at the Y OUTPUT connector, loaded with 1 kilohm with the dc digital voltmeter. Adjust A21R19 for an indication of +1 V ±5 mV (+0.995 V to +1.005 V). Remove the 1 kilohm load. The dc digital voltmeter should indicate +2 V ±10 mV (+1.99 V to +2.01 V).

6.3.11 Direct Peak Circuit, A22 (See Figure 6-26)

a. Connect the dc digital voltmeter to A22Q6-G. Adjust A22R15 for an indication of +150 mV on the dc digital voltmeter.

b. Connect the signal generator via the 10 dB step attenuator and 1 dB step attenuator to A12J1.

c. Set the signal generator frequency to 20.5 MHz at level of –13 dBm.

d. Set the FUNCTION switch to the PEAK .05 position.

e. Set both step attenuators to the 0 dB positions. The Output meter should indicate full-scale deflection. Set the FUNCTION switch, sequentially, to the PEAK .05, PEAK 0.3, and PEAK 3.0 positions. Decreasing the input level by 1 dB should drop the signal by 1 dB after the selected peak hold time. Operate the 10 dB step attenuator to obtain 50 dB, 40 dB, 30 dB, 20 dB, and 10 dB meter deflection and check the dumping sensitivity at all levels. It should be $\leq$ 1 dB. Adjust A22R16 if necessary.

6.3.12 Remote Function Selector, A25 (See Figure 6-29)

Set the FUNCTION switch to the PEAK 0.05 SEC position and connect the dc digital voltmeter to J9-K. Set the 10 dB step attenuator to the 0 dB position. The dc digital voltmeter should indicate 2.00 V ±0.05 V. Set the 10 dB step attenuator to the 60 dB position. Adjust A25R5 for a dc digital voltmeter indication of 0.00 V ±0.05 V. Load J9-K with 1 kilohm. Set the 10 dB step attenuator to the 0 dB position. The simultaneous FI output should indicate 1.00 V ±0.02 V (+0.08 V to +1.02 V).

6.3.13 dB Readout, A24 (See Figure 6-28)

a. Set the FUNCTION switch to the FIELD INTENSITY position.

b. Connect A24-3 to ground and connect the dc digitial voltmeter to A24TP1. Adjust A24R4 to obtain 0 mV ±1 mV at A24TP1.

c. Connect the dc digital voltmeter to A24TP2 and adjust A24R14 to obtain –400 mV ±3 mV on A24TP2.

6.3.14 Slideback Peak Circuit, A23 (See Figure 6-27)

Set the FUNCTION switch to the SLIDEBACK PEAK position and the AUDIO switch to the AM position. Connect the headphones to the AUDIO receptacle and set the SLIDEBACK PEAK control fully ccw. An 800 Hz tone should be present in the headphones. Vary the AUDIO control for a convenient sound level. Connect the dc digital voltmeter to A23TP1. Set the 10 dB step attenuator to the 0 dB position and rotate the SLIDEBACK PEAK control slowly cw until the tone in the headphones ceases. Note the slideback peak level on the dc digital voltmeter. It should indicate 3.60 V ±0.01 V. Set the 10 dB step attenuator to the 0 dB position and connect the digital voltmeter to the Y OUTPUT receptacle. Adjust A23R26 for an indication of 2 V ±10 mV. Load the Y OUTPUT receptacle with 1 kilohm. The voltage should drop to 1V ±5 mV.

6.3.15 Bandwidth Selector, A14 (See Figure 6-21)

a. Connect the signal generator via the 10 dB step attenuator to A14J1.

b. Set the signal generator to 455 kHz at a level of +13 dBm and set the 10 dB step attenuator to the 40 dB position.

c. Set the FUNCTION switch to the FIELD INTENSITY position.

d. Set potentiometers A14R9, A14R28, A14R43, and A14R65 fully clockwise.

e. Set the BANDWIDTH (kHz) switch to the 0.1 position. Connect the ac voltmeter with 100 ohm termination to A14J4. Carefully tune the signal frequency for maximum indication on the ac voltmeter. Adjust A14R65 to obtain 56 mV ±2 mV (54 mV to 58 mV) on the ac voltmeter.

f. Measure the center frequency and the 6 dB bandwidth of the filter. The center frequency should be 455 kHz and the 6 dB bandwidth should be 100 Hz ±10Hz.

g. Switch to the 1 kHz filter position. Carefully tune the signal frequency for maximum indication on the ac voltmeter. Adjust A14R43 to obtain 56 mV ±2 mV (54 mV to 58 mV) on the ac voltmeter.

h. Measure the center frequency and the 6 dB bandwidth of the filter. The center frequency should be 455 kHz ±100 Hz and the 6 dB bandwidth should be 1 kHz ±100 Hz.

i. Switch to the 10 kHz filter position. Tune the signal frequency to 455 kHz ±100 Hz. Adjust A14L5, A14L6, A14L7, A14L8, A14L9, and A14L10 for maximum indication on the ac voltmeter. Adjust A14R28 to obtain 56 mV ±2 mV (54 mV to 56 mV) output level on the ac voltmeter. The adjustment of A14L10 may interact slightly with the adjustment of A14R28. Readjust as necessary.

j. Measure the center frequency and 6 dB bandwidth of the filter. The center frequency should be 455 kHz ±500 Hz and the bandwidth should be 9.7 kHz ±500 Hz. Readjust A14L5 thru A14L10 if necessary, and readjust A14R28 for 56 mV ±2 mV (54 mV to 58 mV) at the filter peak frequency.

k. Set the BANDWIDTH kHz switch to the 50 kHz position. Tune the signal frequency to 455 kHz ±100 Hz. Adjust A14L1, A14L3, and A14L4 for maximum indication on the ac voltmeter. Adjust A14R9 to obtain 56 mV ±2 mV (54 mV to 58 mV) output level on the ac voltmeter. The adjustment of A14L4 may interact slightly with the adjustment of A14R9. Readjust as necessary.

l. Measure the center frequency and 4 dB bandwidth of the filter. The center frequency should be 455 kHz ±2 kHz and the bandwidth should be 50 kHz ±5 kHz.

NOTE

4 dB bandwidth is used to allow for the selectivity of tuner and converter circuits.

Readjust A14L1, A14L3, and A14L4 if necessary to meet these specifications, and readjust A14R9 for 56 mV ±2 mV (54 mV to 58 mV) on the ac voltmeter at the filter peak frequency.

m. Apply a 455 kHz signal to obtain a 56 mV ±2 mV (54 mV to 58 mV) output level from A14J4. Move the ac voltmeter to A14J2 maintaining the 100 ohm termination. The output level from A14J2 should be 44 mV ±10 mV (34 mV to 54 mV). Move the ac voltmeter to A14J3. The output level from A14J3 should be 78 mV ±18 mV (60 mV to 96 mV).

n. Reconnect the cable from A13J4 to A12J1. Set the signal generator output level to –21 dBm and the 10 dB step attenuator to the 0 dB position.

o. Set the BANDWIDTH (kHz) switch sequentially to 0.1, 1.0, 10, and 50. The signal level indicated on the Output meter should be 60 dB ±0.2 dB for all four bandwidths. Adjust A14R65, A14R43, A15R28, and A14R9, respectively, if necessary.

p. Remove the input signal and terminate A14J1 with 50 ohms.

q. Check the internal noise indication in all four positions of the BANDWIDTH (kHz) switch with the FUNCTION switch set sequentially to the FIELD INTENSITY, QUASI PEAK, PEAK 0.5 SEC, and SLIDEBACK PEAK position.

r. The noise indication on the Output meter should be < 0dB, < 0dB, 2 dB, and 2 dB respectively, in the 0.1 kHz, 1.0 kHz and 10 kHz positions; and < 0dB, < 0dB, 5 dB, and 5 dB respectively in the 50 kHz position.

6.3.16 Linear IF and BFO, A15 (See Figure 6-22)

a. Connect the signal generator to A15J1. Set the signal generator to 455 kHz at –7 dBm.

b. Set the FUNCTION switch to the FIELD INTENSITY position. Connect the high impedance probe of the ac voltmeter to A12TPI.

c. Adjust A15R8 to obtain 710 mV ±10 mV (700 mV to 720 mV) rms on the ac voltmeter.

d. Move the ac voltmeter to A15P1-6. Apply 30% modulation at 1 kHz to the signal generator. Align A15L5 to obtain maximum audio output indication on the ac voltmeter. The audio output level should be at least 140 mV rms. Connect the oscilloscope with the 50 ohm termination to A15J2. The oscilloscope should display an undistorted 1 kHz sine wave with an amplitude of at least 200 mV p-p.

e. Decrease the signal generator output level to –67 dBm. The audio output level should be at least 70 mV rms.

f. Remove the modulation from the signal generator. The audio output residual noise should be less the 20 mV rms.

g. Increase signal generator output level to –7 dBm. The residual noise should be less than 3 mV rms.

h. Set the FUNCTION switch to the BFO position. The audio output level should be at least 0.5 volts rms. The video output as observed on the oscilloscope should be at least 700 mV p-p at a frequency of 1 kHz ±100 Hz (900 Hz to 1100 Hz).

i. Decrease signal generator frequency to 431 kHz. The audio output level should not decrease more than 3 dB. The beat frequency should be 25 kHz.

j. The BFO amplitude at A15TP2 should be approximately 18 V p-p as measured on the oscilloscope with the high impedance probe.

6.3.17 AFC and FM Detector, A18 (See Figure 6-24)

a. Connect the dc digital voltmeter to A18TP5.

b. Set the BANDWIDTH switch to the .1 kHz position. Adjust A18R43 for 0 V on the dc digital voltmeter.

c. Connect the oscilloscope to A18TP1.

d. Adjust A18R5 for a 1 V p-p symmetrically-clamped waveform.

e. Connect the ac voltmeter to A18TP1.

f. Connect the frequency counter to the amplifier output of the ac voltmeter.

g. Adjust A18C5 for 455 kHz ±10 Hz (454.09 kHz to 455.01 kHz) on the frequency counter.

h. Connect the signal generator to A18J1.

i. Set the signal generator for 455 kHz at −47 dBm.

j. Short circuit A18TP1 to ground and connect the ac voltmeter to A18TP2.

k. Adjust A18R7 for 200 mV rms on the ac voltmeter.

l. Remove the signal generator and terminate A18J1 with 50 ohms.

m. Remove the short-circuit from A18TP1.

n. Connect the dc digital voltmeter to A18TP6 and adjust A18R20 for 0 V on the dc digital voltmeter.

o. Set the BANDWIDTH switch to the 10 kHz position.

p. Terminate A18J2 with 1 kilohm and adjust A18R43 for 0 V on the dc digital voltmeter.

q. Connect the signal generator to A18J2 and set the signal generator for 455 kHz at 0 dBm.

r. Adjust A18R35 for 0 V on the dc digital voltmeter.

s. Repeat Steps p thru r because there is interaction between the two adjustments.

6.3.18 IF Preamplifier and Calibration Amplifier, A11 (See Figure 6-19)

a. Set the ATTENUATOR (dB) switch to the 0 dB position.

b. Set the CALIBRATE control fully cw.

c. Connect the signal generator to A11J1. Set the signal generator frequency to 455 kHz and the output level to −27 dBm.

d. Connect the ac voltmeter, without high impedance probe to A11J2.

e. Adjust A11R24 for 31.6 mV ±2% (31.0 mV to 32.2 mV) on the RF voltmeter.

f. Set the CALIBRATE control to the fully ccw position.

g. Adjust A11R26 for 3.16 mV ±2% (3.10 mV to 3.22 mV) on the ac voltmeter.

h. Vary the CALIBRATE control for an indication of 10 mV on the RF voltmeter.

i. Set the ATTENUATOR (dB) switch to the −20 dB position.

j. Adjust A11R5 for 100 mV ±2% (98 mV to 102 mV) on the ac voltmeter.

k. Decrease the signal generator output level to −47 dBm.

l. Set the ATTENUATOR (dB) switch to the −40 dB position.

m. Adjust A11R14 for 100 mV ±2% (98 mV to 102 mV) on the ac voltmeter.

6.3.19 IF Converter, A10 (See Figure 6-18)

a. Connect the sweep generation RF output to A10J1 via the bias injection fixture (See Figure 6-4).

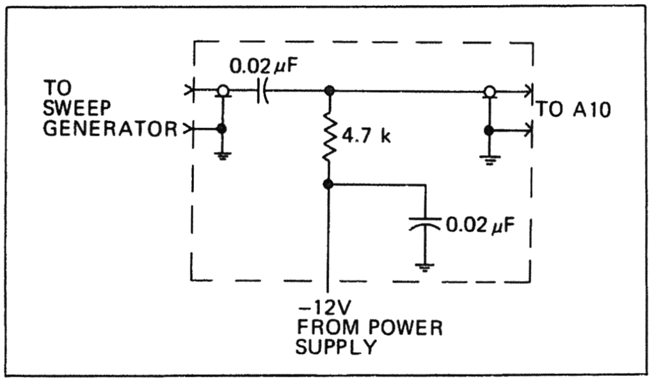


Figure 6-4. Bias Injection Fixture

b. Connect the signal generator to the marker input of the sweep generator. Set signal generator to exactly 455 kHz.

c. Connect the RF detector RF input terminal to A10J9 and the dc output terminal to the sweep generator video input receptacle.

d. Set the sweep generator to sweep approximately 350 kHz to 550 kHz and set its output level to −15 dBm.

e. Connect the oscilloscope vertical and horizontal receptacles to the oscilloscope terminals of the sweep generator.

f. Adjust A10T5, A10T6, and A10T7 for a symmetrical display at each side of the 455 kHz marker.

g. Remove the bias injection fixture from A10J1 and connect it to A10J2.

h. Set the BAND (MHz) switch to the .25–.5 position.

i. Set the signal generator to exactly 1.6 MHz.

j. Set the sweep generator to sweep approximately 1.5 MHz to 1.7 MHz.

k. Adjust A10T1, A10L2, and A10T2 for a symmetrical display at each side of the 1.6 MHz marker.

l. Remove the bias injection fixture from A10J2 and connect it to A10J7.

m. Set the BAND (MHz) switch to the 8-16 position.

n. Set the signal generator to exactly 5.0 MHz.

o. Set the sweep generator to sweep approximately 4.9 MHz to 5.1 MHz.

p. Adjust A10C12, A10C14, and A10C17 for a symmetrical display each side of the 5 MHz marker.

q. Remove the bias injection filter from A10J7 and connect it to A10J2.

r. Set the BAND(MHz) switch to the .25–.5 position.

s. Connect the RFI meter to A10J9.

t. Tune the RFI meter to exactly 455 kHz.

u. Remove the sweep generator and reconnect the signal generator to the bias injection fixture input.

v. Set the signal generator for 1.835 MHz and adjust the output level for 21 dB above the noise as noted on the RFI meter.

w. Adjust A10L1 for minimum indication on the RFI meter.

x. Remove the bias injection fixture from A10J2 and reconnect it to A10J7.

y. Set the BAND(MHz) switch to the 8-16 position.

z. Set the signal generator to 4.09 MHz.

aa. Adjust A10L4 for minimum indication on the RFI meter.

6.3.20 RF Switch and Impulse Calibrator, A9 (See Figure 6-17)

a. Set the RFI meter to the quasi-peak mode and "calibrate" it to a −65 dBm signal from the signal generator at a frequency between 10 kHz and 32 MHz.

b. Connect the RFI meter to A9J8.

c. Set the BAND(MHz) switch to the 16-32 position.

d. Set the FUNCTION switch to the CALIBRATE position.

e. Adjust A9R12 for the same level as noted on the RFI meter in Step a.

6.3.21 Band 1 Tuner, A1 (See Figure 6-9)

a. Set the BAND(MHz) switch to the .01−.25 position.

b. Connect the frequency counter to A1J3.

c. Set the TUNE control fully ccw and FINE TUNE control to mid-position.

e. Adjust A1L9 for 465 kHz ±100 Hz on the frequency counter.

f. Rotate the TUNE control to the fully cw position.

g. Adjust A1C28 for 709 kHz ±200 Hz on the frequency counter.

h. Repeat Steps d thru g as there is interaction between the two adjustments.

i. Remove the frequency counter from A1J3 and connect it to A1J2. Connect the ac voltmeter to A1J2.

j. Connect the signal generator A1J1 and set to approximately 254 kHz at −24 dBm.

k. Set the TUNE control to the fully cw position.

l. Adjust A1T2 for maximum on the ac voltmeter.

m. Vary the signal generator frequency to produce 455 kHz on the frequency counter.

n. Readjust A1T2 for maximum indication on the RF voltmeter.

o. Adjust A1R21 for 14 dB of gain (difference between signal generator level and ac voltmeter indication).

p. Set the TUNE control to the fully ccw position.

q. Connect the RFI meter to A1J2.

r. Tune the RFI meter to 465 kHz.

s. Adjust A1R9 and move or remove the wire turns on the body of A1C36 for minimum indication on the RFI meter.

6.3.22 Band 2 Tuner, A2 (See Figure 6-10)

a. Set the BAND(MHz) switch to the .25−5 position.

b. Connect the frequency counter to A2J3.

c. Set the FINE TUNE control to the mid-position.

d. Set the TUNE control to the fully ccw position.

e. Adjust A2L9 for 1.846 MHz ±500 Hz on the frequency counter.

f. Rotate the TUNE control to the fully cw position.

g. Adjust A2C28 for 2.108 MHz ±500 Hz on the frequency counter.

h. Repeat Steps d thru g as there is interaction between the two adjustments.

i. Remove the frequency counter from A2J3 and connect it to A2J2. Also connect the ac voltmeter to A2J2.

j. Connect the signal generator to A2J1 and set to approximately 508 kHz at −22 dBm.

k. Set the TUNE control to the fully cw position.

l. Adjust A2L8 for maximum indication on the ac voltmeter.

m. Vary the signal generator frequency to produce 1.6 MHz on the frequency counter.

n. Readjust A2L8 for maximum indication on the ac voltmeter.

o. Adjust A2R9 for a gain of 22 dB (difference between signal generator level and ac voltmeter indication).

6.3.23 Band 3 Tuner, A3 (See Figure 6-11).

a. Set the BAND(MHz) switch to the .5−1 position.

b. Connect the frequency counter to A3J3.

c. Set the FINE TUNE control to the mid-position.

d. Set the TUNE control to the fully ccw position.

e. Adjust A3L7 for 2.092 MHz ±500 Hz on the frequency counter.

f. Rotate the TUNE control to the fully cw position.

g. Adjust A3C27 for 2.615 MHz ±500 Hz on the frequency counter.

h. Repeat Steps d thru g as there is interaction between the two adjustments.

i. Interconnect the equipment as in Figure 6-6. (The 10 kHz low pass filter and detector may be assembled as in Figure 6-5 and Figure 6-7.)

j. Set the sweep generator to sweep approximately from 450 kHz to 1.1 MHz and set the output level to −8 dBm.

k. Set the signal generator to exactly 1.6 MHz at a level of +10 dBm.

l. Vary the sweep generator marker gain to obtain the IF marker on the response curve (See Figure 6-8, Trace 1).

m. Set the TUNE control to the fully cw position.

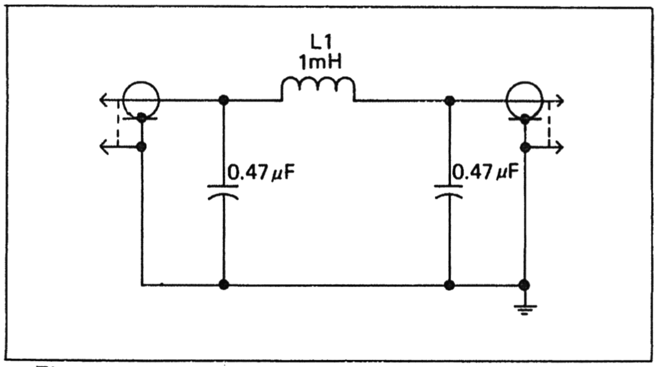


Figure 6-5. 10 kHz Low Pass Filter Schematic Diagram

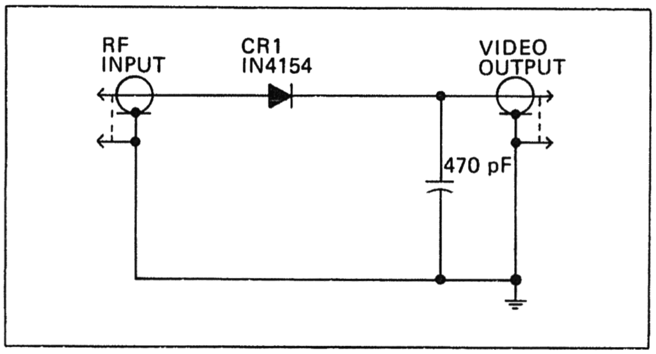


Figure 6-7. RF Detector Schematic Diagram

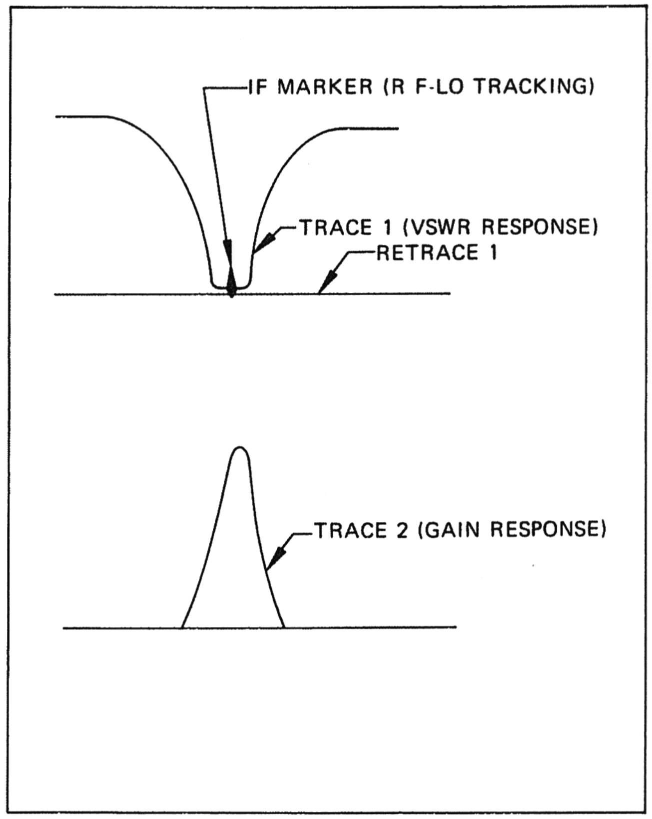


Figure 6-8. Oscilloscope Display for Tuner Test

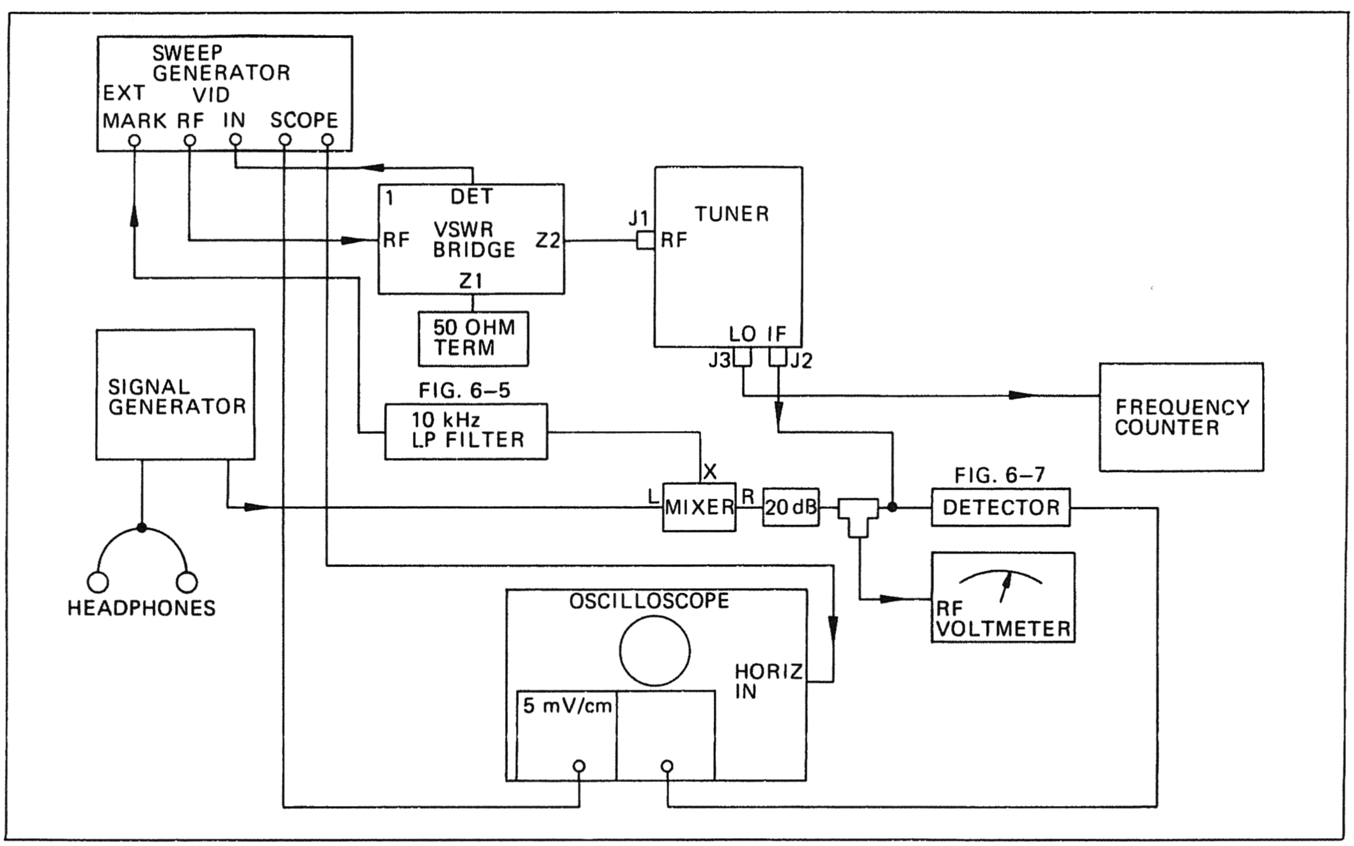


Figure 6-6. Tuner Test Equipment Interconnections

n. Adjust A3C1 and A3C4 for the best VSWR at the IF marker frequency.

o. Set the TUNE control to the fully ccw position.

p. Adjust A3L1 and A3T1 for the best VSWR at the IF marker frequency.

q. Adjust A3L2 for the best VSWR response at the IF marker frequency.

r. Set the TUNE control to the fully cw position.

s. Adjust A3C3 for the best VSWR response at the IF marker frequency.

t. Adjust A3L6 for the best gain response (See Figure 6-8, Trace 2) at the IF marker frequency.

u. Repeat Steps n thru t as there is interaction between the two adjustments.

v. Connect the signal generator to A3J1.

w. Connect the frequency counter to A3J2.

x. Set the signal generator to approximately 1 MHz at a level of –22 dBm.

y. Vary the signal generator frequency for 1.6 MHz on the frequency counter.

z. Connect the ac voltmeter to A3J2.

aa. Readjust A3L6 for minimum indication on the ac voltmeter.

ab. Adjust A3R13 for a gain of 22 dB (difference between RF input level and ac voltmeter indication).

ac. Set the signal generator to exactly 1.0 MHz.

ad. Adjust A3R17 for exactly 1.0 MHz on the Model NM-17/27 Frequency meter while varying the TUNE control for maximum indication on the ac voltmeter.

ae. Set the signal generator to exactly 500 kHz.

af. Adjust A3R18 for exactly 500 kHz on the Model NM-17/27 Frequency meter while varying the TUNE control for maximum indication on the ac voltmeter.

6.3.24 Band 4 Tuner, A4 (See Figure 6-12)

a. Set the BAND(MHz) switch to the 1-2 position.

b. Connect the frequency counter to A4J3.

c. Set the FINE TUNE control to the mid-position.

d. Set the TUNE control to the fully ccw position.

e. Adjust A4L11 for an indication of 1.44 MHz ±1 kHz on the frequency counter.

f. Rotate the TUNE control to the fully cw position.

g. Adjust A4C25 for an indication of 2.485 MHz ±1 kHz on the frequency counter.

h. Repeat Steps d thru g as there is interaction between the two adjustments.

i. Interconnect the equipment as in Figure 6-6. (The 10 kHz low pass filter and detector may be assembled as in Figure 6-5 and Figure 6-7).

j. Set the sweep generator to sweep approximately from 900 kHz to 2.1 MHz and set the output level to –8 dBm.

k. Set the signal generator to exactly 455 kHz at a level of +10 dBm.

l. Vary the sweep generator marker gain to obtain the IF marker on the response curve. (See Figure 6-8, Trace 1)

m. Set the TUNE control to the fully cw position.

n. Adjust A4C2 and A4C4 for the best VSWR at the IF marker frequency.

o. Set the TUNE control to the fully ccw position.

p. Adjust A4L2 and A4L4 for the best VSWR at the IF marker frequency.

q. Adjust A4L3 for the best VSWR response at the IF marker frequency.

r. Set the TUNE control to the fully cw position.

s. Adjust A4C3 for the best VSWR response at the IF marker frequency.

t. Adjust A4C15 for the best gain response (see Figure 6-8, Trace 2) at the IF marker frequency.

u. Set the TUNE control to the fully ccw position.

v. Adjust A4T1 for the best gain response at the IF marker frequency.

w. Adjust A4T2 for best gain response at the IF marker frequency.

x. Repeat Steps n thru w as there is interaction between the adjustments.

y. Connect the signal generator to A4J1.

z. Connect the frequency counter to A4J2.

aa. Set the TUNE control fully cw.

ab. Set the signal generator to approximately 2 MHz at a level of –20 dBm.

ac. Vary the signal generator frequency for 455 kHz on the frequency counter.

ad. Connect the ac voltmeter to A4J2.

ae. Adjust A4R13 for a gain of 14 dB (difference between RF input level and ac voltmeter indication).

af. Connect the RFI meter to A4J2 and tune to maximum response at 455 kHz.

ag. Adjust A4L6 for minimum response on the RFI meter.

ah. Set the signal generator to exactly 2.0 MHz.

ai. Adjust A4R20 for exactly 2.0 MHz on the Model NM-17/27 Frequency meter while varying the TUNE control for maximum indication on the RFI meter.

aj. Set the signal generator to exactly 1 MHz.

ak. Adjust A4R18 for exactly 1 MHz on the Model NM-17/27 Frequency meter while varying the TUNE control for maximum indication on the RFI meter.

6.3.25 Band 5 Tuner, A5 (See Figure 6-13)

a. Set the BAND(MHz) switch to the 2-4 position.

b. Connect the frequency counter to A5J3.

c. Set the FINE TUNE control to the mid-position.

d. Set the TUNE control to the fully ccw position.

e. Adjust A5L10 for 3.57 MHz ±1 kHz on the frequency counter.

f. Rotate the TUNE control to the fully cw position.

g. Adjust A5C29 for 5.66 MHz ±1 kHz on the frequency counter.

h. Repeat Steps d thru g as there is interaction between the two adjustments.

i. Interconnect the equipment as in Figure 6-6. (The 10 kHz low pass filter and detector may be assembled as in Figure 6-5 and Figure 6-7.)

j. Set the sweep generator to sweep approximately from 1.9 MHz to 4.1 MHz and set the output level to −8 dBm.

k. Set the signal generator to exactly 1.6 MHz at a level of +10 dBm.

l. Vary the sweep generator marker gain to obtain the IF marker on the response curve. (See Figure 6-8, Trace 1.)

m. Set the TUNE control to the fully cw position.

n. Adjust A5C1 and A5C6 for the best VSWR at the IF marker frequency.

o. Set the TUNE control to the fully ccw position.

p. Adjust A5L2 and A5L4 for the best VSWR at the IF marker frequency.

q. Adjust A5L3 for the best VSWR response at the IF marker frequency.

r. Set the TUNE control to the fully cw position.

s. Adjust A5C3 for the best VSWR response at the IF marker frequency.

t. Adjust A5C14 for the best gain response (see Figure 6-8, trace 2) at the IF marker frequency.

u. Set the TUNE control to the fully ccw position.

v. Adjust A5T1 for the best gain response at the IF marker frequency.

w. Adjust A5L9 for the best gain response at the IF marker frequency.

x. Connect the RFI meter to A5J2 and tune to maximum response at 1.6 MHz.

y. Adjust A5L7 and A5L8 for minimum response on the RFI meter.

z. Repeat Steps n thru w as there is interaction between the adjustments.

aa. Connect the signal generator to A5J1. Connect the frequency counter to A5J2.

ab. Set the TUNE control to the fully cw position.

ac. Set the signal generator to approximately 1.6 MHz at a level of −22 dBm.

ad. Vary the signal generator frequency for 1.6 MHz on the frequency counter.

ae. Connect the ac voltmeter to A5J2.

af. Adjust A5R13 for a gain of 22 dB (difference between RF input level and ac voltmeter indication).

ag. Set the signal generator to exactly 4.0 MHz.

ah. Adjust A5R18 for exactly 4.0 MHz on the Model NM-17/27 Frequency meter while varying the TUNE control for a maximum indication on the RFI meter.

aj. Adjust A5R17 for exactly 2.0 MHz on the Model NM-17/27 Frequency meter while varying the TUNE control for maximum on the RFI meter.

6.3.26 Band 6 Tuner, A6 (See Figure 6-14)

a. Set the BAND(MHz) switch to the 4-8 position.

b. Connect the frequency counter to A6J3.

c. Set the FINE TUNE control to the mid-position.

d. Set the TUNE control to the fully ccw position.

e. Adjust A6L10 for 5.54 MHz ±2 kHz on the frequency counter.

f. Rotate the TUNE control to the fully cw position.

g. Adjust A6C29 for an indication of 9.72 MHz ±5 kHz on the frequency counter.

h. Repeat Steps d thru g as there is interaction between the two adjustments.

i. Interconnect the equipment as in Figure 6-6. (The 10 kHz low pass filter and detector may be assembled as in Figure 6-5 and Figure 6-7.)

j. Set the sweep generator to sweep approximately from 3.9 MHz to 8.1 MHz and set the output level to −8 dBm.

k. Set the signal generator to exactly 1.6 MHz at a level of +10 dBm.

l. Vary the sweep generator marker gain to obtain the IF marker on the response curve (see Figure 6-8, Trace 1).

m. Set the TUNE control to the fully cw position.

n. Adjust A6C2 and A6C3 for the best VSWR at the IF marker frequency.

o. Set the TUNE control to the fully ccw position.

p. Adjust A6L2 and A6L4 for the best VSWR at the IF marker frequency.

q. Adjust A6L3 for the best VSWR response at the IF marker frequency.

r. Set the TUNE control to the fully cw position.

s. Adjust A6C4 for the best VSWR response at the IF marker frequency.

t. Adjust A6C16 for the best gain response (see Figure 6-8, Trace 2) at the IF marker frequency.

u. Set the TUNE control to the fully ccw position.

v. Adjust A6T1 for the best gain response at the IF marker frequency.

w. Adjust A6L9 for best gain response at the IF marker frequency.

x. Repeat Steps n thru w as there is interaction between the adjustments.

y. Connect the signal generator to A6J1.

z. Connect the frequency counter to A6J2.

aa. Set the TUNE control to the fully cw position.

ab. Set the signal generator to approximately 32.3 MHz at a level of –22 dBm.

ac. Vary the signal generator frequency for 1.6 MHz on the frequency counter.

ad. Connect the ac voltmeter to A6J2.

ae. Adjust A6R14 for a gain of 22 dB (difference between RF input level and ac voltmeter indication).

af. Connect the RFI meter to A6J2 and tune to maximum response at 1.6 MHz.

ag. Adjust A6L8 for minimum response on the RFI meter.

ah. Set the signal generator to exactly 8.0 MHz.

ai. Adjust A6R21 for exactly 8.0 MHz on the NM-17/27 Frequency meter while varying the TUNE control for maximum indication on the RFI meter.

aj. Set the signal generator to exactly 4.0 MHz.

ak. Adjust A6R20 for exactly 4.0 MHz on the Model NM-17/27 Frequency meter while varying the TUNE control for maximum indication on the RFI meter.

6.3.27 Band 7 Tuner, A7 (See Figure 6-15)

a. Set the BAND(MHz) switch to the 8-16 position.

b. Connect the frequency counter to A7J3.

c. Set the FINE TUNE control to the mid-position.

d. Set the TUNE control to the fully ccw position.

e. Adjust A7L10 for 12.88 MHz ±5 kHz on the frequency counter.

h. Repeat Steps d thru g as there is interaction between the two adjustments.

i. Interconnect the equipment as in Figure 6-6. (The 10 kHz low pass filter and detector may be assembled as in Figure 6-5 and Figure 6-7).

j. Set the sweep generator to sweep approximately from 7.9 MHz to 16.1 MHz and set the output level to –8 dBm.

k. Set the signal generator to exactly 5 MHz at a level of +10 dBm.

l. Vary the sweep generator marker gain to obtain the IF marker on the response curve (see Figure 6-8, Trace 1).

m. Set the TUNE control to the fully cw position.

n. Adjust A7C1 and A7C3 for the best VSWR at the IF marker frequency.

o. Set the TUNE control to the fully ccw position.

p. Adjust A7L2 and A7L4 for the best VSWR at the IF marker frequency.

q. Adjust A7L3 for the best VSWR response at the IF marker frequency.

r. Set the TUNE control to the fully cw position.

s. Adjust A7C2 for the best VSWR response at the IF marker frequency.

t. Adjust A7C16 for the best gain response (see Figure 6-8, Trace 2) at the IF marker frequency.

u. Set the TUNE control to the fully ccw position.

v. Adjust A7T1 for the best gain response at the IF marker frequency.

w. Adjust A7L9 for best gain response at the IF marker frequency.

x. Repeat Steps n thru w as there is interaction between the adjustments.

y. Connect the signal generator to A7J1.

z. Connect the frequency counter to A7J2.

aa. Set the TUNE CONTROL to the fully cw position.

ab. Set the signal generator to approximately 16.24 MHz at a level of –22 dBm.

ac. Vary the signal generator frequency for 4 MHz on the frequency counter.

ad. Connect the ac voltmeter to A7J2.

ae. Adjust A7R15 for a gain of dB (difference between RF input level and ac voltmeter indication.

af. Connect the RFI meter to A7J2 and tune to maximum response at 5.0 MHz.

ag. Adjust A7L6 for maximum response on the RFI meter.

ah. Set the signal generator to exactly 16.0 MHz.

ai. Adjust A7R20 for exactly 16.0 MHz on the Model NM-17/27 Frequency meter while varying the TUNE control for maximum indication on the RFI meter.

aj. Set the signal generator to exactly 8.0 MHz.

ak. Adjust A7R21 for exactly 8 MHz on the Model NM-17/27 Frequency meter while varying the TUNE control for maximum indication on the RFI meter.

6.3.28 Band 8 Tuner, A8 (See Figure 6-16)

a. Set the BAND (MHz) switch to the 16-32 position.

b. Connect the frequency counter to A8J3.

c. Set the FINE TUNE control to the mid-position.

d. Set the TUNE control to the fully ccw position.

e. Adjust A8L11 for 2.076 MHz ±10 kHz on the frequency counter.

f. Rotate the TUNE control to the fully cw position.

g. Adjust A8C26 for 37.3 MHz ±20 kHz on the frequency counter.

h. Repeat Steps d thru g as there is interaction between the two adjustments.

i. Interconnect the equipment as in Figure 6-6. (The 10 kHz low pass filter and detector may be assembled as in Figure 6-5 and Figure 6-7).

j. Set the sweep generator to sweep approximately from 15.9 MHz to 32.1 MHz and set the output level to −8 dBm.

k. Set the signal generator to exactly 5 MHz at a level of +10 dBm.

l. Vary the sweep generator marker gain to obtain the IF marker on the response curve (See Figure 6-8, Trace 1).

m. Set the TUNE control to the fully cw position.

n. Adjust A8C2 and A8C4 for the best VSWR at the IF marker frequency.

o. Set the TUNE control to the fully ccw position.

p. Adjust A8T1 and A8T2 for the best VSWR at the IF marker frequency.

q. Adjust A8L3 for the best VSWR response at the IF marker frequency.

r. Set the TUNE control to the fully cw position.

s. Adjust A8C3 for the best VSWR response at the IF marker frequency.

t. Adjust A8C15 for the best gain response (See Figure 6-8, trace 2) at the IF marker frequency.

u. Set the TUNE control to the fully ccw position.

v. Adjust A8T3 for the best gain response at the IF marker frequency.

w. Adjust A8L10 for best gain response at the IF marker frequency.

x. Repeat Steps n thru w as there is interaction between the adjustments.

y. Connect the signal generator to A8J1.

z. Connect the frequency counter to A8J2.

aa. Set the TUNE control to the fully cw position.

ab. Set the signal generator to approximately 32.3 MHz at a level of −22 dBm.

ac. Vary the signal generator frequency for 5 MHz on the frequency counter.

ad. Connect the ac voltmeter to A8J2.

ae. Adjust A8R17 for a gain of 22 dB (Difference between RF input level and ac voltmeter indication).

af. Connect the RFI meter to A8J2 and tune to maximum response at 5.0 MHz.

ag. Set the signal generator to exactly 32.0 MHz.

ah. Adjust A8R22 for exactly 32.0 MHz on the Model NM-17/27 Frequency meter while varying the TUNE control for maximum indication on the RFI meter.

ai. Set the signal generator to exactly 16.0 MHz.

aj. Adjust A8R21 for exactly 16.0 MHz on the Model NM-17/27 Frequency meter while varying the TUNE control for maximum indication on the RFI meter.

6.4 FAULT ISOLATION PROCEDURE

Fault isolation procedures are presented as a guide in troubleshooting the Model NM-17/27. The procedures are divided into 6 sections; dc current drains of assemblies, power supply circuitry, control circuitry, meter circuitry, IF circuitry, and RF circuitry.

6.4.1 DC Current Drains of Assemblies

Table 6-16 lists the dc current drains of each assembly.

Table 6-16. DC Current Drains of Assemblies

Assembly	Terminal	dc Voltage	dc Current
A1	5	+62 V	0.55 mA ±0.1 mA
	8	+12 V	30 mA ±2 mA
	9	−12 V	28 mA ±2 mA
A2	5	+62 V	2.0 mA ± 0.2 mA
	8	+12 V	28 mA ± 2 mA
	9	−12 V	23 mA ±2 mA
A3	5	+62 V	4 mA ±0.5 mA
	8	+12 V	28 mA ±2 mA
	9	−12 V	21 mA ±2 mA
A4	5	+62 V	4 mA ±0.5 mA
	8	+12 V	29 mA ±2 mA
	9	−12 V	24 mA ±2 mA
A5	5	+62 V	4 mA ±0.5 mA
	8	+12 V	27 mA ±2 mA
	9	−12 V	20 mA ±2 mA
A6	5	+62 V	4 mA ±0.5 mA
	8	+ 12 V	29 mA ±2 mA
	9	−12 V	24 mA ±2 mA
A7	5	+62 V	4 mA ±0.5 mA
	8	+12 V	32 mA ±2 mA
	9	−12 V	25 mA ±2 mA
A8	5	+62 V	4 mA ±0.5 mA
	8	+12 V	28 mA ±2 mA
	9	−12 V	25 mA ±2 mA
A9	9	+12 V	25 mA
A10	8	+12 V	6.9 mA ±1 mA
A11	8	+12 V	30 mA
	9	−12 V	15 mA
A12	8	+12 V	55 mA
	9	−12 V	45 mA
A14	8 (BW: 0.1 kHz)	+12 V	31 mA
	8 (BW: 1 kHz)	+12 V	31 mA
	8 (BW: 10 kHz)	+12 V	32 mA
	8 (BW: 50 kHz)	+12 V	28 mA
	9 (BW: 0.1 kHz)	−12 V	39 mA
	9 (BW: 1 kHz)	−12 V	39 mA
	9 (BW: 10 kHz)	−12 V	40 mA
	9 (BW: 50 kHz)	−12 V	36 mA
A15	4	+12 V	3 mA
	8	+12 V	20 mA
	9	−12 V	6 mA
A16	3	+17.5 V	28.5 mA ±3.5 mA
	7	−17.5 V	28.5 mA ±3.5 mA

Table 6-16. DC Current Drains of Assemblies (Cont.)

Assembly	Terminal	dc Voltage	dc Current
A18	8	+12 V	40 mA
	9	−12 V	40 mA
A21	1	+12 V	4 mA ±1 mA
	18	−12 V	4 mA ±1 mA
A22	1	+12 V	17 mA ±1 mA
	18	−12 V	11.5 mA ±1 mA
A23	1	+12 V	16 mA ±1 mA
	18	−12 V	6 mA ±1 mA
A24	1	+12 V	13 mA ±2 mA
	18	−12 V	≤1 mA
A25	1,A	+12 V	5 mA ± 1 mA
	18,V	−12 V	5 mA ± 1 mA
A26	2	+12 V	12 mA
	12	+100 V	3 mA
	17	−12 V	14 mA
A29	1,A	+12 V	18 mA
	18,V	−12 V	4 mA
A31	3	+20 V	320 mA ±32 mA
	16	−20 V	320 mA ±32 mA
A33	1	+12 V	4 mA ±1 mA
	17	−12 V	4 mA ±1 mA
A34	1	+12 V	3 mA
	18	−12 V	3 mA

6.4.2 Power Supply Troubleshooting Procedures

a. Measure the secondary voltage from the power transformer between A32-6 and A32-7, and between A32-12 and A32-13 with the ac voltmeter. The voltmeter should indicate 23.5 V ±0.5 V rms (23 V to 24 V) in each case.

b. Measure the positive rectifier output voltage from A32-5 to ground with the dc digital voltmeter. The voltmeter should indicate +27.5 V to ±0.5 V (+27 V to +28 V). Measure the negative rectifier output voltage from A32-14 to ground. The voltmeter should indicate −27.5 V ±0.5 V (−27 V to −28 V).

c. Measure the positive unregulated output voltage from A32-4 to ground with the dc digital voltmeter. The voltmeter should indicate +20 V ± 1 V (+19 V to +21 V). Measure the negative unregulated output voltage from A32-15 to ground. The voltmeter should indicate −20 V ± 1 V (−19 V to −21 V).

d. Connect the clip-on milliammeter over the red wire connected to A32-1. The milliammeter should indicate 120 mA ± 12 mA (108 mA to 132 mA).

e. Set the POWER switch to the CHARGE position.

f. Connect the clip-on milliammeter over the white wire connected to A32-18.

g. Set the POWER switch to the ON AC position and check that the trickle charge current to the negative terminal of the battery is 120 mA ± 12 mA (108 mA to 132 mA).

h. Set the BATT TEST switch to the − position.

i. Connect the dc digital voltmeter to A32-18 and measure the negative charge voltmeter. With fully charged batteries, the voltmeter should indicate −19.85 V ±0.35 V (−19.5 V to −20.2V) and the Output meter should indicate in the FULL zone of the BATTERY scale.

j. Using the dc digital voltmeter, check that the positive unregulated input voltage at A31-3 is +20 V ± 1 V (+19 V to +21 V) and that the negative unregulated input voltage at A31-16 is −20 V ± 1 V (−19 V to −21 V).

k. Observe the square wave at A16TP3 with the oscilloscope. The approximate peak-to-peak amplitude of the square wave should be 50 V, and the frequency should be approximately 5 kHz.

6.4.3 Control Circuitry Troubleshooting Procedure

a. *Bandswitching.*

Set the CONTROL MODE switch to the LOCAL position and the POWER switch to the ON AC position. Set the BAND (MHz) switch to the .01–.25 position. Check for approximately −12 Vdc at A1-9, A9-1, A29-8, A34-17, A47-1, and J9-A. Check for approximately +12 Vdc at A1-8. Check that the .01–.25 MHz band indicators on the Frequency meter are lit.

Set the BAND (MHz) switch to the .25–.5 position. Check for approximately −12 Vdc at A2-9, A9-2, A29-11, A34-16, A47-2 and J9-B. Check for approximately +12 Vdc at A2-8. Check that the .25–.5 MHz band indicators on the Frequency meter are lit.

Set the BAND (MHz) switch to the .5-1 position. Check for approximately −12 Vdc at A3-9, A9-3, A34-15, A47-3, and J9-C. Check for approximately −11.5 Vdc at A10-6 and A29-10.

Check for approximately +12 Vdc at A3-8. Check that the .5-1 MHz band indicators on the Frequency meter are lit.

Set the BAND (MHz) switch to the 1-2 position. Check for approximately −12 Vdc at A4-9, A9-4, A29-13, A34-14, and J9-D. Check for approximately +12 Vdc at A4-8. Check that the 1-2 MHz band indicators on the Frequency meter are lit.

Set the BAND (MHz) switch to the 2-4 position. Check for −12 Vdc, at A5-9, A9-5, A29.14, A34-5, A47-5, and J9-E. Check for approximately −11.5 Vdc at 10-6. Check for approximately +12 Vdc at A5-8. Check that the 2-4 MHz band indicators on the Frequency meter are lit.

Set the BAND (MHz) switch to the 4-8 position. Check for approximately −12 Vdc, at A6-9, A9-6, A29-15, A34-4, A47-6, and J9-F. Check for approximately −11.5 Vdc at A10-6. Check for approximately +12 Vdc at A6-8. Check that the 4-8 MHz Band indicators on the Frequency meter are lit.

Set the BAND (MHz) switch to the 8-16 position.

Check for approximately −12 Vdc at A7-9, A9-7, A29-16, A34-3, A47-7, and J9-H. Check for approximately −11.5 Vdc at A10-7. Check for approximately +12 Vdc at A7-8. Check that the 8-16 MHz band indicators on the Frequency meter are lit.

Set the BAND(MHz) switch to the 16-32 position. Check for approximately −12 Vdc at A8-9, A9-8, A29-17, A34-2, A47-8 and J9-K. Check for approximately −11.5 Vdc at A10-7. Check for approximately +12 Vdc at A8-8. Check that the 16-32 MHz band indicators on the Frequency meter are lit.

Set the CONTROL MODE switch to the SCAN position and repeat Step a above.

NOTE

The REMOTE testing can only be accomplished easily with the Model P-7 Programmer.

Connect the "NM-17/27 PROGRAM" receptacle of the programmer to the Model NM-17/27 PROGRAM receptacle with the 41-conductor cable. Set the Model NM-17/27 CONTROL MODE switch to the REMOTE position. Repeat Step a, selecting the frequency bands with the programmer.

b. *Bandwidth Switching.*

Set the CONTROL MODE switch to the LOCAL position and the FUNCTION switch to the FIELD INTENSITY position. Set the BANDWIDTH (kHz) switch to the 0.1 kHz position. Check for approximately +11.5 Vdc at A14-2 and set the BANDWIDTH (kHz) switch to the 1.0 kHz position. Check for approximately +11.5 Vdc at A14-3 and J9-P.

Set the BANDWIDTH (kHz) switch to the 10 kHz position. Check for approximately +11.5 Vdc at A14-5 and J9-W.

Set the CONTROL MODE switch to the SCAN position and repeat Step b above.

Set the CONTROL MODE switch to the REMOTE position and repeat Step b, selecting the bandwidth with the programmer BANDWIDTH switch (1, 2, 3, and 4 represents .1 kHz, 1.0 kHz, 10 kHz, and 50 kHz respectively).

c. *Function Switching.*

Set the FUNCTION switch to the CAL position. Check for approximately +12 Vdc, at A9-9.

Set the FUNCTION switch to the PEAK .05 position. Check for approximately +12 Vdc, at A22-15.

Set the FUNCTION switch to the PEAK 0.3 position. Check for approximately +12 Vdc, at A22-14.

Set the FUNCTION switch to the BFO position. Check for approximately +12 Vdc, at A15-4.

Set the CONTROL MODE switch to the SCAN position and repeat Step c.

Set the CONTROL MODE switch to the REMOTE position and repeat Step c, selecting the functions by the programmer DETECTOR FUNCTION switch.

d. *dB Readout*

Set the CONTROL MODE switch to the LOCAL position and FUNCTION switch to the FIELD INTENSITY POSITION.

Set the ATTENUATOR (dB) switch to the −40, X.01 position and check for approximately +11.5 Vdc at A11-7.

Set the ATTENUATOR (dB) switch to the −20, X.1 position and check for approximately +11.5 Vdc at A11-6.

Set the ATTENUATOR (dB) switch to the 0, X1 position and check for approximately +11.5 at A24-4 and approximately +11 Vdc at A11-5.

Set the ATTENUATOR (dB) switch to the +20, X1 position and check for approximately +11.5 Vdc at A24-5 and approximately +11 Vdc at A11-5.

Set the ATTENUATOR (dB) switch to the +40, X10 position and check for approximately +11.5 Vdc at A24-15 and approximately +11 Vdc at A11-5.

Set the ATTENUATOR (dB) switch to the +60, X100 position and check for approximately +11.5 Vdc at A24-16 and approximately +11 Vdc at A11-5.

e. *Tuning Control*

Connect the digital voltmeter to A29TP2.

Rotate the TUNE control to obtain an indication of +5 V ± 10 mV (+4.99 V to +5.01 V) on the dc digital voltmeter.

Rotate the FINE TUNE control to the fully cw position.

The dc digital voltmeter should indicate +4.8 V ±20 mV (+4.78 V to +4.82V). Rotate the TUNE control to the mid position, +5.0 V ± 10 mV (+4.99 V to +5.01 V). Vary the TUNE control and the FINE TUNE control to obtain 10 V on the dc digital voltmeter. Check for +2 V ± 20 mV (+1.98 V to +2.02V) at the X OUTPUT receptacle on the rear panel with the dc digital voltmeter.

Connect one dc digital voltmeter to A29TP2 and the other dc digital voltmeter to A26TP1. Vary the TUNE and FINE TUNE controls to obtain the following voltages at A29TP2: 0V, +2 V, +4 V, +6 V, +8 V, and +10 V. The voltages at A26TP1 should be +1.4V, +4.15 V, +9.4 V, +18.5 V, +34.2 V, and +62 V respectively (within ±2%).

Set the CONTROL MODE switch to the SCAN position. Depress the SINGLE switch. The dc digital voltmeter should indicate a voltage starting from zero and rising to approximately +62 V after one minute.

Set the CONTROL MODE switch to the REMOTE position. Vary the manual control of the programmer throughout its range, from fully ccw to fully cw. The dc digital voltmeter should indicate a voltage starting at zero and rising to approximately +62 V.

Set the BAND (MHz) switch to each position, in sequence, noting the voltage at A34TP2.

The dc digital voltmeter should indicate +2.46 V, +4.92 V, +98.5 mV, +137 mV, +394 mV, +788 mV, and +1.576 V respectively (within ±0.5%).

Rotate the TUNE control to be fully cw position and vary the FINE TUNE control for +10 V ± 10 mV (+9.09 V to +10.01 V) at A29TP2.

Set the BAND(MHz) switch to each position, in sequence, starting with the .01–.25 MHz position.

The dc digital voltmeter at A34TP2 should indicate +2.54 V, +5.08 V, +10.15, +203 mV, +406 mV, +812 mV, +1.624, and +3.23 V respectively (within ± 0.5%).

6.4.4 Meter Circuitry Troubleshooting

a. Connect the signal generator to A12J1 via the 10 dB step attenuator. Set the signal generator frequency to 455 kHz and the output level to –7 dBm.

b. Connect the dc digital voltmeter to A21TP3.

c. Set the 10 dB step attenuator, sequentially, to the 0 dB, 10 dB, 20 dB, 30 dB, 40 dB, 50 dB, and 60 dB positions. In each position measure the FIELD INTENSITY, QUASI PEAK, PEAK, and SLIDE-BACK PEAK signal levels at A21TP3 and note the front panel Output meter indications. The levels at A21TP3 should be: +3.0 V, +2.5 V, +2.0 V, +1.5 V, +1.0 V, +0.5 V, and 0 V. The tolerance is ±50 mV. The levels on the Output meter should be: 60 dB, 50 dB, 40 dB, 30 dB, 20 dB, 10 dB, and 0 dB. The tolerance is ±1 dB.

d. Remove the input signal.

e. The internal noise indication on the dc digital voltmeter should be negative and the indication on the Output meter should be below 0 dB at all functions.

f. Apply 30% 1 kHz modulation on the full-scale input signal. Connect the ac voltmeter and the oscilloscope across the AUDIO receptacle. Adjust the AUDIO control to obtain 7 V rms on the ac voltmeter. The oscilloscope should display a 1 kHz undistorted sine-wave.

g. Set the 10 dB step attenuator to the 40 dB position. The output change should be less than 4 dB.

h. Remove the modulation applied to the RF INPUT receptacle. Set the 10 dB step attenuator to the 0 dB position and the FUNCTION switch to the BFO position. A 1 kHz signal should appear at the AUDIO receptacle. The audio level across the AUDIO receptacle indicated by the ac voltmeter should be 3.5 V ± 0.5 V (3 V to 4 V rms). Set the 10 dB step attenuator to the 50 dB position. The output change should be less than 10 dB. (less than 0.28 times the above indication)

i. Apply a 455 kHz CW signal to A12J1. Set the 10 dB step attenuator to the 0 dB position.

j. The Output meter should indicate full-scale deflection.

k. Connect the digital voltmeter to the LOG VIDEO receptacle and load with 50 ohms.

l. The digital voltmeter should indicate 300 mV ±2%.

m. Remove the 50 ohm load.

n. The output should rise to 600 mV ± 1 dB (535 mV to 670 mV) and the Output meter deflection should not change.

o. Apply 30% external modulation to the signal generator.

p. Check the 3 dB video bandwidth of the log IF amplifier with –37 dB input level. The 3 dB bandwidth should be wider than 30 kHz.

q. Alternately apply 0.5 Vdc and 0.5 V 30 usec pulses to the X port of the balanced mixer while applying 455 kHz at 350 mV rms to the L port.

r. Connect the R port to A12J1 via the 10 dB step attenuator.

s. Connect A12J2 to the peak metering circuit and compare the CW indication with the pulse indication from full-scale deflection to zero deflection by varying the step attenuator.

t. The pulse indication error should be less than 1 dB.

u. Set the FUNCTION switch to the CALIBRATE position. Connect the power supply to A24-3 and apply sequentially +1 V, +2 V and +3 V. Note on A24TP2 sequentially +200 mV, +400 mV and +600 mV; tolerance is ±0.5%.

v. Set the FUNCTION switch to the FIELD INTENSITY position and repeat Step r. Note on A24TP2 sequentially –200 mV, 0 mV and +200 mV; tolerance is ±2 mV.

w. Set the ATTENUATOR switch to the +60 dB position and repeat Step r. Note A24TP2 sequentially +800 mV, +1.0 V, +1.2 V; tolerance ± 0.5%. Remove power supply from A24TP3.

6.4.5 IF Circuitry Troubleshooting

a. Connect the ac voltmeter to A18TP1.

b. Connect the frequency counter to the amplifier output of the ac voltmeter.

c. Check the pull range of the crystal oscillator. It should be approximately 455 kHz ±40 Hz.

d. Connect the oscilloscope to A18TP4 and observe the waveform. It should be a square wave with an amplitude of 7V p-p ± 1 V, with a duty cycle of 40% to 60%.

e. Connect the dc digital voltmeter to A18TP5 and increase the signal generator frequency until the dc digital voltmeter indicates +100 mV. Check the voltage at A18TP6. It should be +180 mV ±20 mV (+160 mV to +200 mV).

f. Set the BAND(MHz) switch to the 2-4 position. The voltage should drop to +23 mV ± 2 mV (+21 mV to +25 mV).

g. Set the BAND(MHz) switch to the 8-16 position. The voltage should drop to +16 mV ± 2 mV (+14 mV to +18 mV).

h. Set the BAND(MHz) switch to the .01–.25 position. The voltage should drop to 0V. Slowly increase the signal generator frequency and observe the voltage on the dc digital voltmeter. It should increase linearly with the frequency as long as the VCO is locked on to the input signal. When the lock is lost the voltage should drop suddenly to zero. Note the high frequency end of the lock range, the frequency should be 550 kHz ± 20 kHz. Note the maximum voltage. The voltage should be +2.2V ±0.44V (+1.76 V to +2.64 V). After the lock is lost, slowly decrease the input frequency, until the signal is captured (indicated by a sudden rise in voltage). Note the high frequency end of the capture range, the frequency should be 540 kHz ± 20 kHz (520 kHz to 560 kHz).

i. Set the signal generator frequency to 455 kHz. The voltage should return to zero. Decrease the input signal frequency and determine the lock range and maximum voltage on the low frequency side. Determine the capture range on the low frequency side. Lock and capture range should be symmetrical to 455 kHz ± 136 kHz (319 kHz to 591 kHz).

j. Connect the dc digital voltmeter to A18TP5 and set the signal generator frequency to 505 kHz. Note the voltage on the dc digital voltmeter (V_H). Then set the signal generator to 405 kHz and note the voltage on the digital voltmeter (V_L). Determine the discriminator slope:

$$S = \frac{V_H - V_L}{100},$$

the value should be +10.5 mV/kHz, ±1.05 mV/kHz (+9.45 mV/kHz to +11.55 mV/kHz).

k. Connect cable W8 to A18J1 and cable W7 to A18J2. Set the signal generator to 1.2 MHz at −67 dBm, monitored by the frequency counter. Set the ATTENUATOR (dB) switch to the 0 dB position, the BANDWIDTH (kHz) switch to the 1 kHz position, and the AFC switch to the OFF position. Tune the Model NM-17/27 for maximum signal indication on the Output meter (40 dB). Connect the oscilloscope to A18TP1 and A18TP2. Trigger the oscilloscope with the reference signal at A18TP1. Set the AFC switch to the ON position. The IF signal should lock onto the crystal oscillator frequency, indicated on the oscilloscope. Connect the dc digital voltmeter to A18TP6 and fine tune the Model NM-17/27 for 0 V. The phase shift between reference signal at A18TP1 and IF signal at A18TP2 should be exactly 90°.

l. Tune the signal generator slowly above 1.2 MHz. The dc digital voltmeter should indicate a negative voltage. Increase the signal frequency until the phase lock is lost, as noted on the oscilloscope. The dc digital voltmeter should indicate 0V and the signal indication on the Output meter should drop to zero. Note the maximum negative voltage on the dc digital voltmeter. It should be −400 mV, ±100 mV. Note the signal frequency (fs) when the signal is lost and calculate the high side of the lock range as f_s− 1.2 MHz. It should be 40 kHz. Repeat the same procedure decreasing the signal frequency below 1.2 MHz. The digital voltmeter should indicate a positive voltage. Determine the maximum voltage and the low side lock range. The lock ranges and voltage maximums should be symmetrical to 1.2 MHz. The assymetry should be 30% maximum.

m. When the signal is out of lock on the high side, slowly decrease the signal generator frequency until the signal is captured. Note the signal frequency at that point and determine the high side capture range as f_s−1.2 MHz. The value should be 4 kHz, ± 2 kHz. Repeat the procedure on the low side to determine the low side capture range. The capture range should be symmetrical to the center frequency. The assymmetry should be 30% maximum.

n. Set the BANDWIDTH (kHz) switch to the 10 kHz position. Connect the oscilloscope to A18TP5 and set the signal generator to 1.2 MHz. Check the IF frequency at A14J3. Retune the Model NM-17/27 if necessary to obtain exactly 455 kHz. The dc digital voltmeter should indicate zero with the AFC switch ON. Repeat Step l with 10 kHz bandwidth, and determine the maximum voltage and the lock range. The values should be: −400 mV ± 100 mV, +65 kHz ± 10 kHz, +400 mV ± 100 mV, and −65 kHz ±10 kHz respectively.

o. Repeat Step m with 10 kHz bandwidth and determine the capture range. The capture range should be 27 kHz ± 5 kHz at each side of the center frequency.

p. Set the BANDWIDTH (kHz) switch to the 50 kHz position and repeat Step 1. Determine the maximum voltage and the lock range. The values should be −1.3V ± 0.2V, +180 kHz ± 20 kHz, +1.3V ± 0.2V, and −180 kHz ± 20 kHz respectively.

q. Repeat Step m with 50 kHz bandwidth and determine the capture range. The capture range should be 75 kHz ± 10 kHz at each side of the center frequency.

r. Display the FM discriminator curve with 50 kHz bandwidth by connecting the oscilloscope to the FM VIDEO receptacle and the sweep generator to the RF INPUT receptacle of the Model NM-17/27. Set the sweep range to approximately 0.9 MHz to 1.5 MHz, sweep rate to 2 sweeps/sec and the output level of the sweep generator to −47 dBm. Set the ATTENUATOR(dB) switch of the Model NM-17/27 to +20 dB, the FUNCTION switch to the PEAK 3.0 SEC position, the AFC switch to the ON position. The Output meter should indicate approximately 40 dB. Set the horizontal resolution of the oscilloscope to 50 kHz/cm, monitored by the 100 kHz markers of the sweep generator. Set the vertical resolution to 0.2 V/cm. The discriminator curve should display the capture range on the low frequency (left) side, and the lock range, on the high frequency (right) side. The discriminator slope should be approximately 4 mV/kHz.

s. Set the bandwidth to 10 kHz. The amplitude of the discriminator curve should decrease, but the slope remain unchanged.

t. Connect the dc digital voltmeter to A11J2. Check the gain in dB versus rotation angle in degrees of the CALIBRATE control in 45° steps. It should be approximately linear. Check the sensitivity at A11J1 with the CALIBRATE control at mid-position and in the 10 kHz bandwidth. With the ATTENUATOR switch at the 0 dB position the S/N = 1/1 sensitivity should be less than 1 uV. With the ATTENUATOR switch at the –20 dB position the S/N = 1/1 sensitivity should be less than 0.2 uV, and with the ATTENUATOR switch at the –40 dB position the S/N = 1/1 sensitivity should be less than 0.15 uV. Check the dynamic range of A11 with the CALIBRATE control at mid-position. The maximum output voltage should be 300 mV rms maximum. Check the input VSWR in all 3 positions of the ATTENUATOR switch. The VSWR should be 1.1: 1 maximum. Check the output impedance. It should be 50 ohm ±10% (45 ohm to 55 ohm).

u. Connect the oscilloscope probe to A10Z1-5. Set the BAND(MHz) switch to the .25–.5 position. Observe 1.145 MHz oscillator waveform. The output level should be approximately 1.2 V p-p. Set the BAND(MHz) switch to the 8-16 position. Observe 4.545 MHz oscillator waveform. The output level should be 1.4 V p-p.

v. By use of the CW signal generator, measure rejection at the 50 kHz bandwidth points (430 kHz and 480 kHz frequency counter reading). The rejection should be 0.6 dB ±0.2 dB (0.4 dB to 0.8 dB). Measure the gain at 455 kHz. The gain should be 11 dB ±1 dB (10 dB to 12 dB). Set the BAND(MHz) switch to the .25–.5 position. Measure the rejection and gain as in Step v above. The 50 kHz rejection should be 1.3 dB ± 0.3 dB (1.0 dB to 1.6 dB), and the gain should be 3.5 dB ± 1 dB (2.5 dB to 4.5 dB). Set the BAND(MHz) switch to the 8-16 position. Measure the rejection and gain as in Step v above. The 50 kHz rejection should be 1 dB ± 0.3 dB (0.7 dB to 1.3 dB), and the gain should be 3.5 dB ± 1 dB (2.5 dB to 4.5 dB).

6.4.6 RF Circuitry Troubleshooting

a. Connect the signal generator to A9J9. Set the signal generator to 32.3 MHz at + 10 dBm. Connect the RFI meter to A9J1 thru A9J8 while switching the BAND(MHz) switch throughout its range. Check insertion loss through each output connector. Maximum loss will occur at 32 MHz but should be less than 0.8 dB.

b. Connect the ac voltmeter to A1J3. Observe the local oscillator output level as the TUNE control is rotated from fully ccw to fully cw. The output level should be –12 dBm minimum.

c. Connect the signal generator to A1J1 and set the frequency to 254 kHz at a level of –24 dBm. Connect the ac voltmeter to A1J2. Check the gain at 254 kHz, 130 kHz, and 10 kHz. The total gain variation should be ± 0.5 dB.

d. Connect the RFI meter to A1J2. Tune the RFI meter to 465 kHz and measure the level. The level should be –60 dBm maximum.

e. Set the signal generator to a level of –120 dBm at 254 kHz. Rotate the TUNE control to peak the RFI meter. Reduce the signal generator level to zero and note the noise level on the RFI meter. Increase the signal generator level so that the RFI meter indicates 3 dB above the noise level. The signal generator output level should be –130 dBm maximum.

f. Set the signal generator to the IF frequency (455 kHz) and rotate the TUNE control to the fully ccw position. Tune the RFI meter to 455 kHz. Reduce the signal generator output level to zero and note the noise level on the RFI meter. Increase the signal generator output level for an indication of 3 dB above the noise level on the RFI meter. Note the signal generator output level. The difference between this level and the sensitivity specification level should be greater than 70 dB. Repeat Step f with the TUNE control set the mid-frequency and the high frequency end of the tuner.

g. Set the signal generator to the image frequency (910 kHz above the tuner frequency) and repeat Step f.

h. Set the signal generator to one-half the IF frequency (277 kHz) and repeat Step f.

i. Connect the RFI meter to A1J1. Rotate the TUNE control throughout its range tuning the RFI meter to the same frequencies. The local oscillator emission should not exceed –73 dBm.

j. Interconnect the equipment as displayed in Figure 6-6. Adjust the sweep generator output level to –20 dBm CW. Vary the sweep generator frequency from 10 kHz to 254 kHz while observing the ac voltmeter. Set the sweep generator to the frequency that produces the highest ac voltmeter indication (highest VSWR). Disconnect the cable between the VSWR bridge and the tuner. Reduce the input level to the VSWR bridge by means of the 10 dB step attenuator until the ac voltmeter indication is the same as the highest VSWR indication, above. The dB difference in input level may be used to determine the VSWR from the return loss vs VSWR chart. (See Table 6-9). The VSWR should not exceed 1.4:1.

k. Refer to Table 6-16 for parameters of the 8 tuners. Repeat Steps b thru j for tuners 2 thru 8.

Table 6-17. Tuner Parameters

Band	Nominal Frequency Range (MHz)	Frequency Range, Inc. Overlap (MHz) 1.40 –62.0V	Local Oscillator Frequency (MHz)					Image Freq. (MHz)		I.F. (MHz)	Tuner Gain (dB)
			1.40V	13.30 V			62.0V	1.40V	62.0V		
				Min.	Nom.	Max.					
1	0.01 – 0.25	0.01 – 0.254	0.465	0.5855	0.587	0.5885	0.709	0.920	1.164	0.455	14
2	0.25 – 0.50	0.256 – 0.508	1.846	19.73	1.977	1.981	2.108	3.446	3.708	1.6	22
3	0.5 – 1.0	0.492 – 1.015	2.092	2.346	1.353	2.361	2.615	3.692	4.215	1.6	22
4	1.0 – 2.0	0.985 – 2.03	1.440	1.947	1.962	1.977	2.485	1.895	2.940	0.455	14
5	2.0 – 4.0	1.97 – 4.06	3.570	4.585	4.615	4.645	5.660	5.170	7.260	1.6	22
6	4.0 – 8.0	3.94 – 8.12	5.540	7.570	7.630	7.690	9.720	7.140	11.320	1.6	22
7	8.0 –16.0	7.88 –16.24	12.88	16.940	17.06	17.180	21.24	17.88	26.24	5.0	22
8	16.0 –32.0	15.76 –32.30	20.76	28.690	28.93	29.170	37.30	25.76	42.30	5.0	22

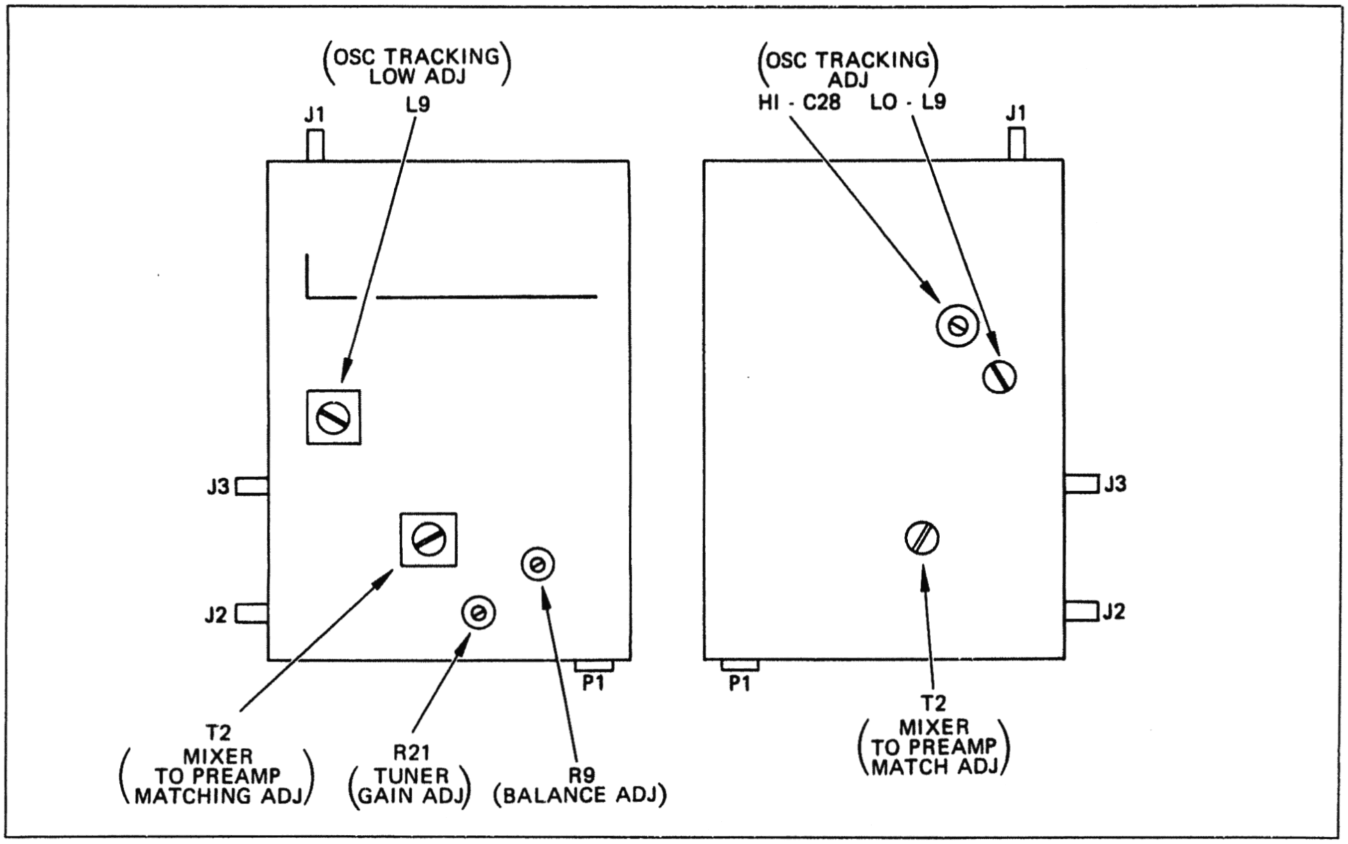


Figure 6-9. Trimmer Locations, Band 1 Tuner Assembly, A1

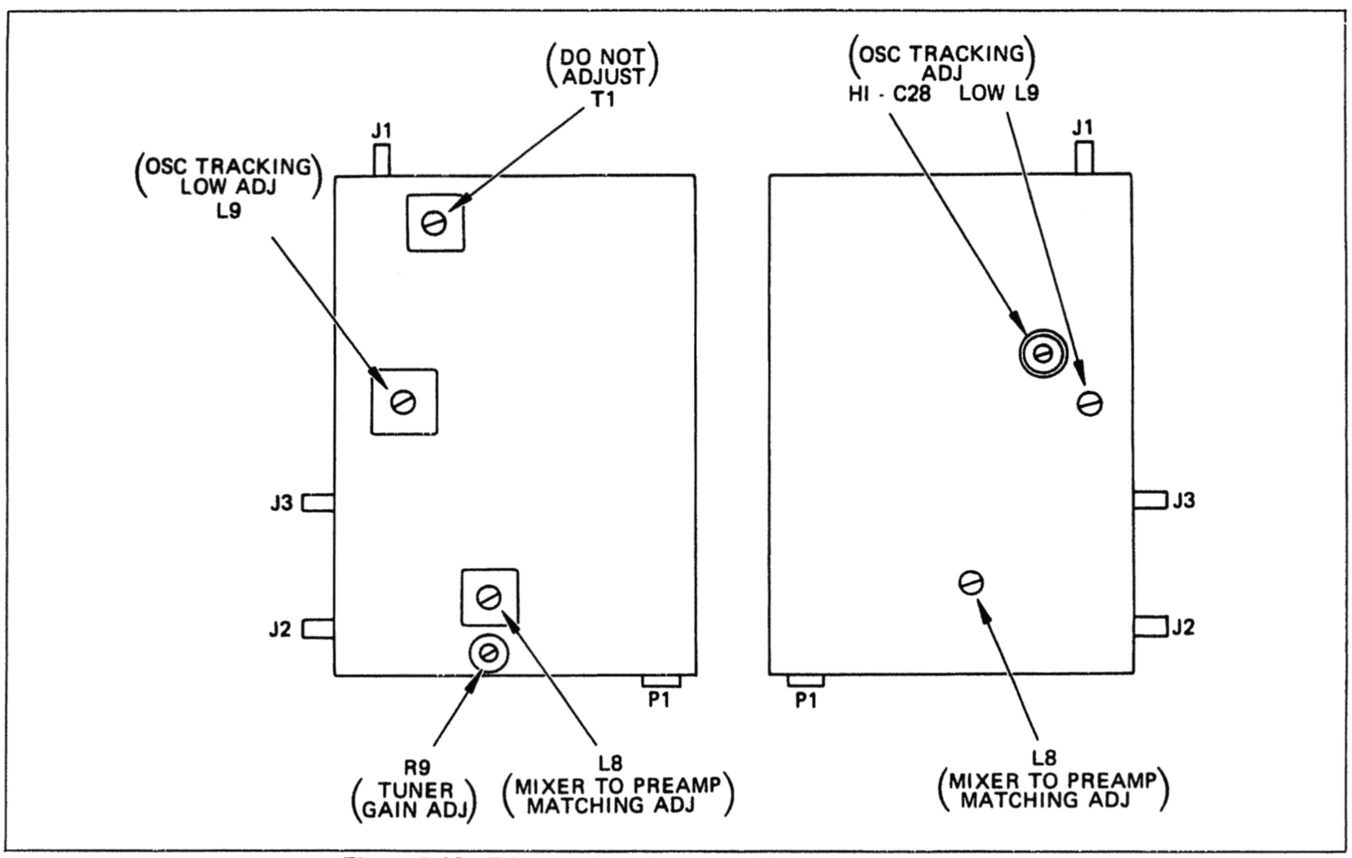


Figure 6-10. Trimmer Locations, Band 2 Tuner Assembly, A2

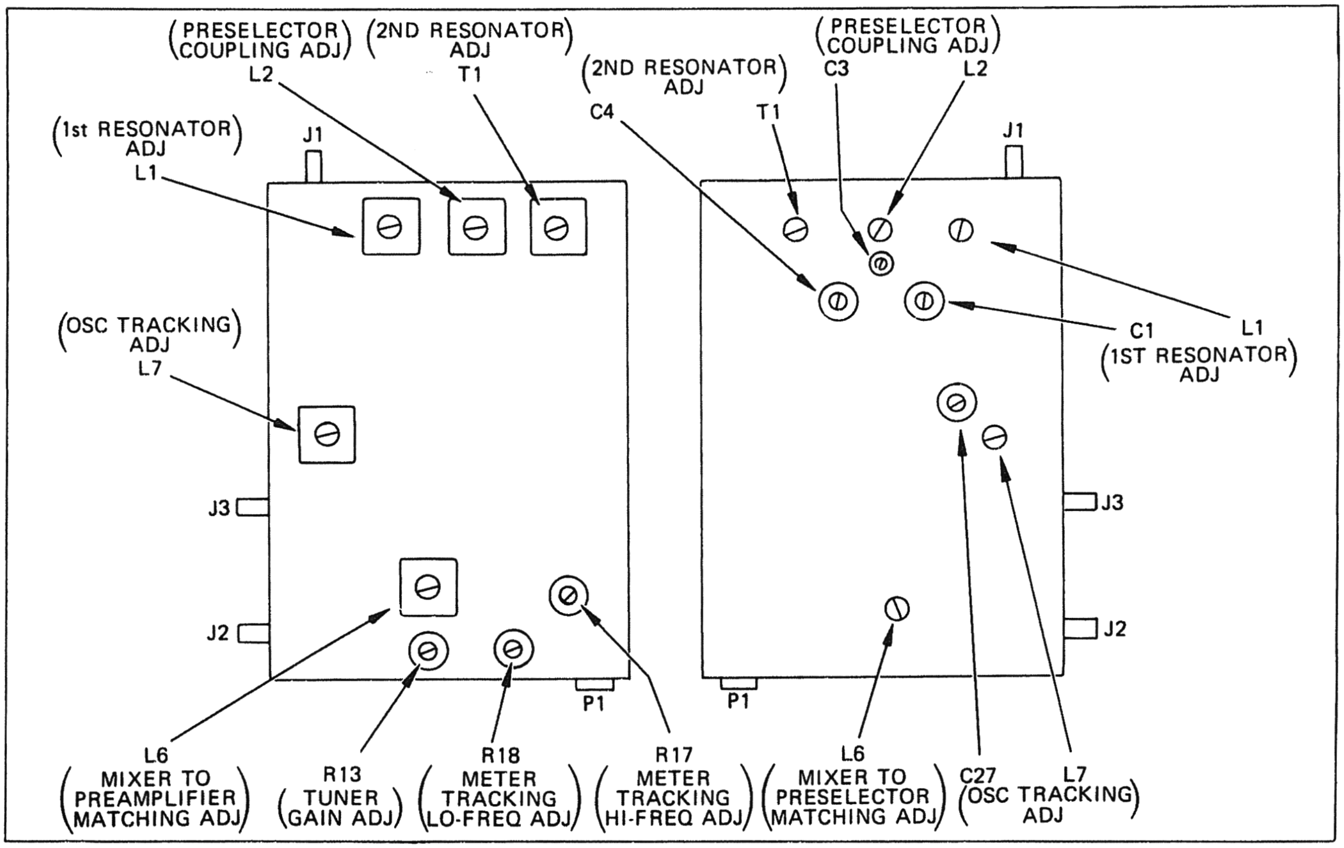


Figure 6-11. Trimmer Locations, Band 3 Tuner Assembly, A3

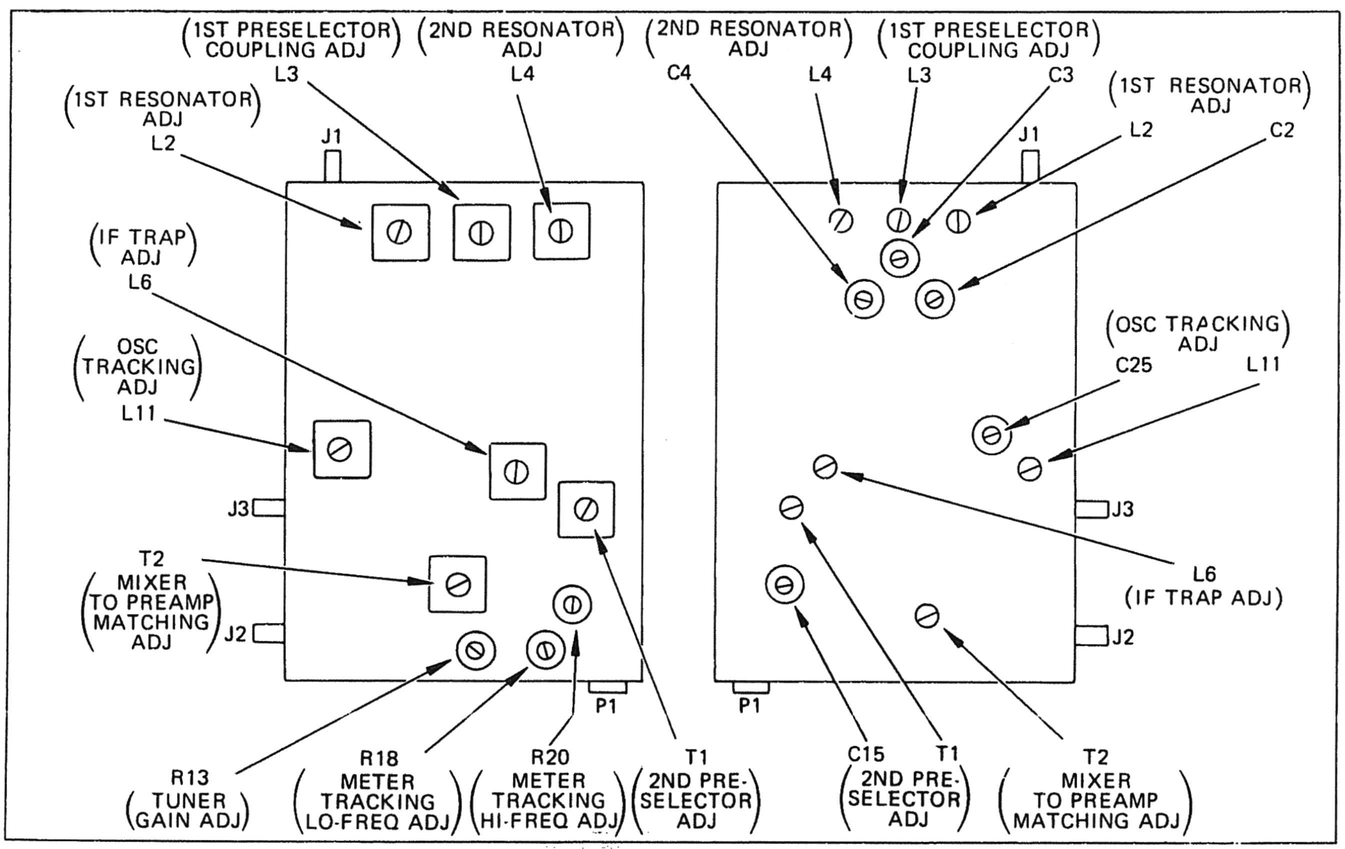


Figure 6-12. Trimmer Locations, Band 4 Tuner Assembly, A4

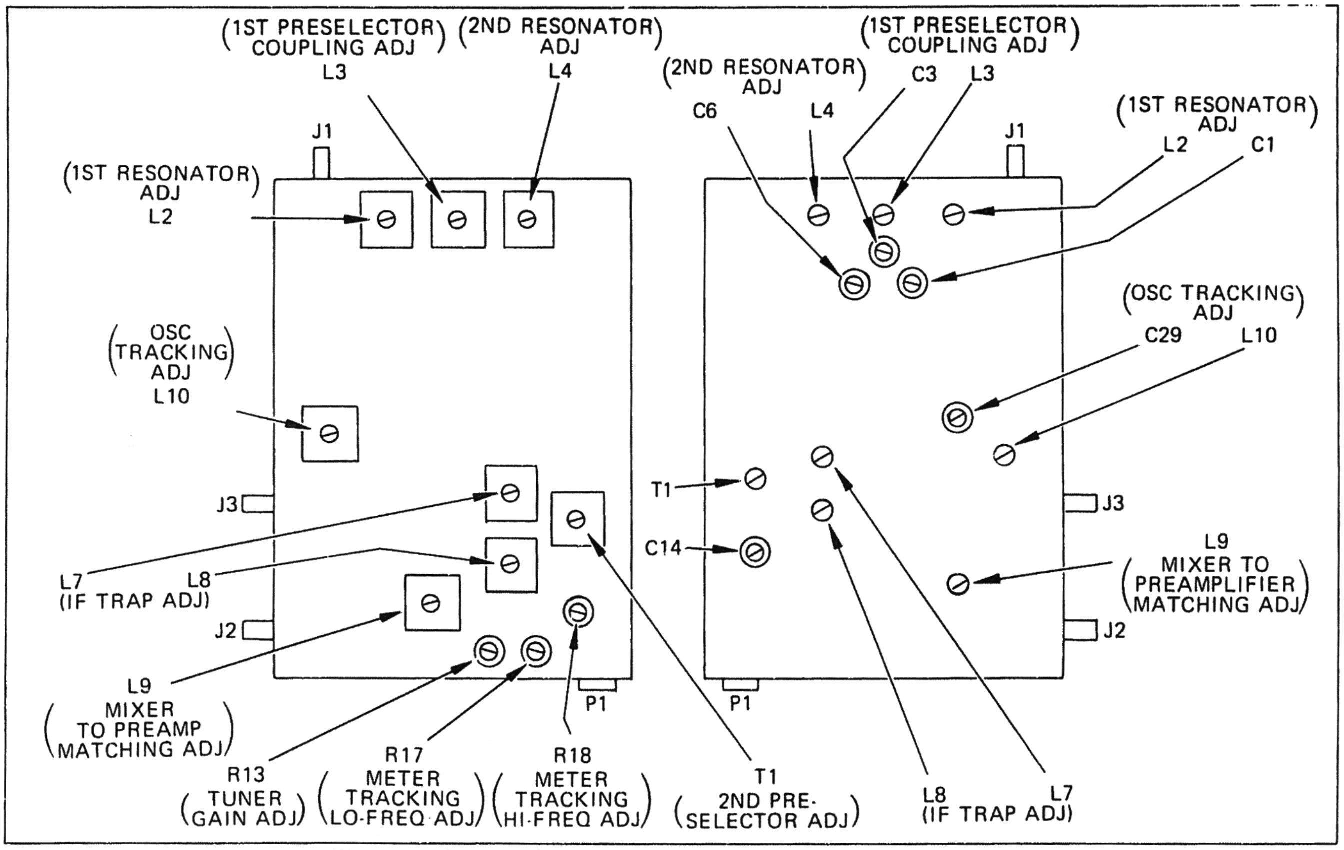


Figure 6-13. Trimmer Locations, Band 5 Tuner Assembly, A5

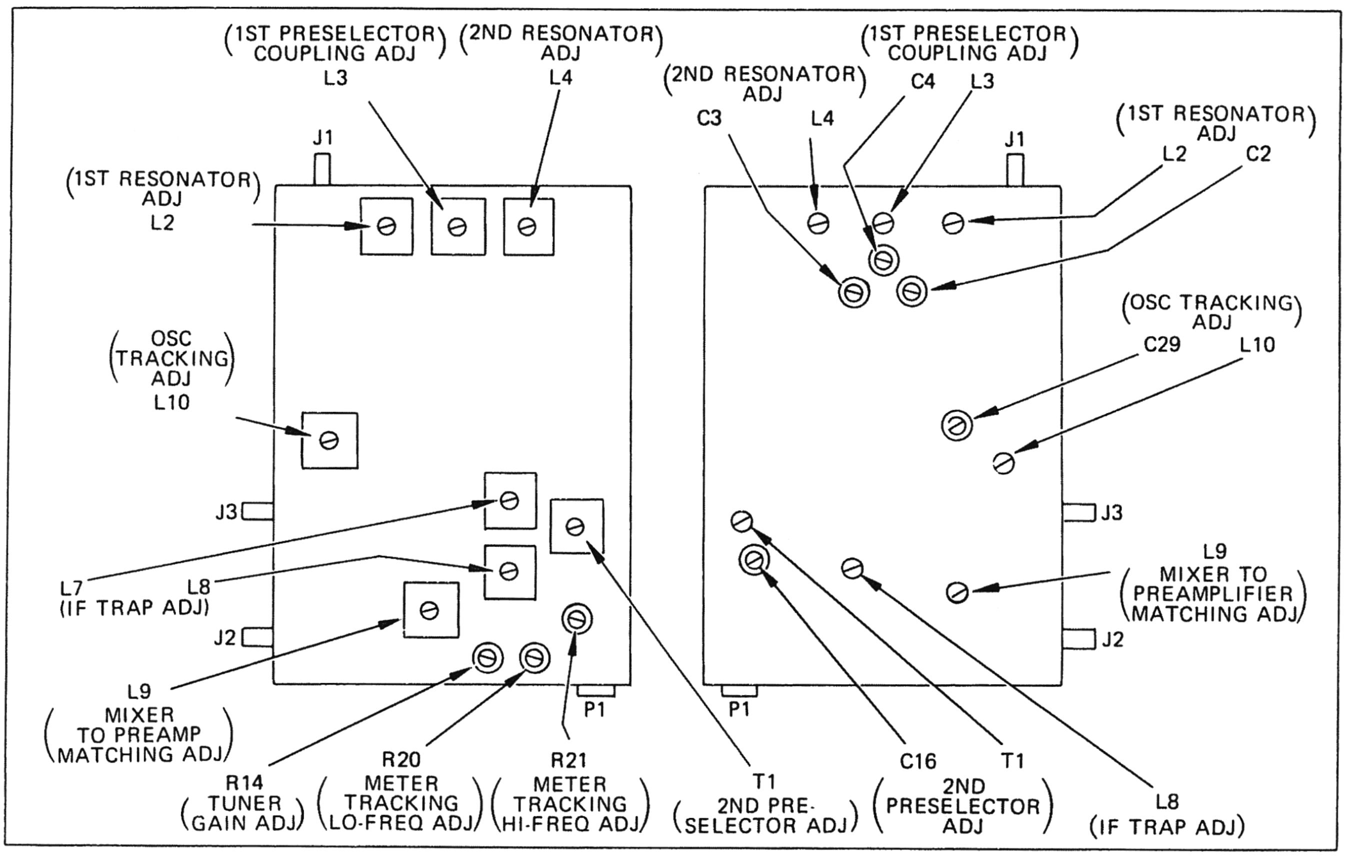


Figure 6-14. Trimmer Locations, Band 6 Tuner Assembly, A6

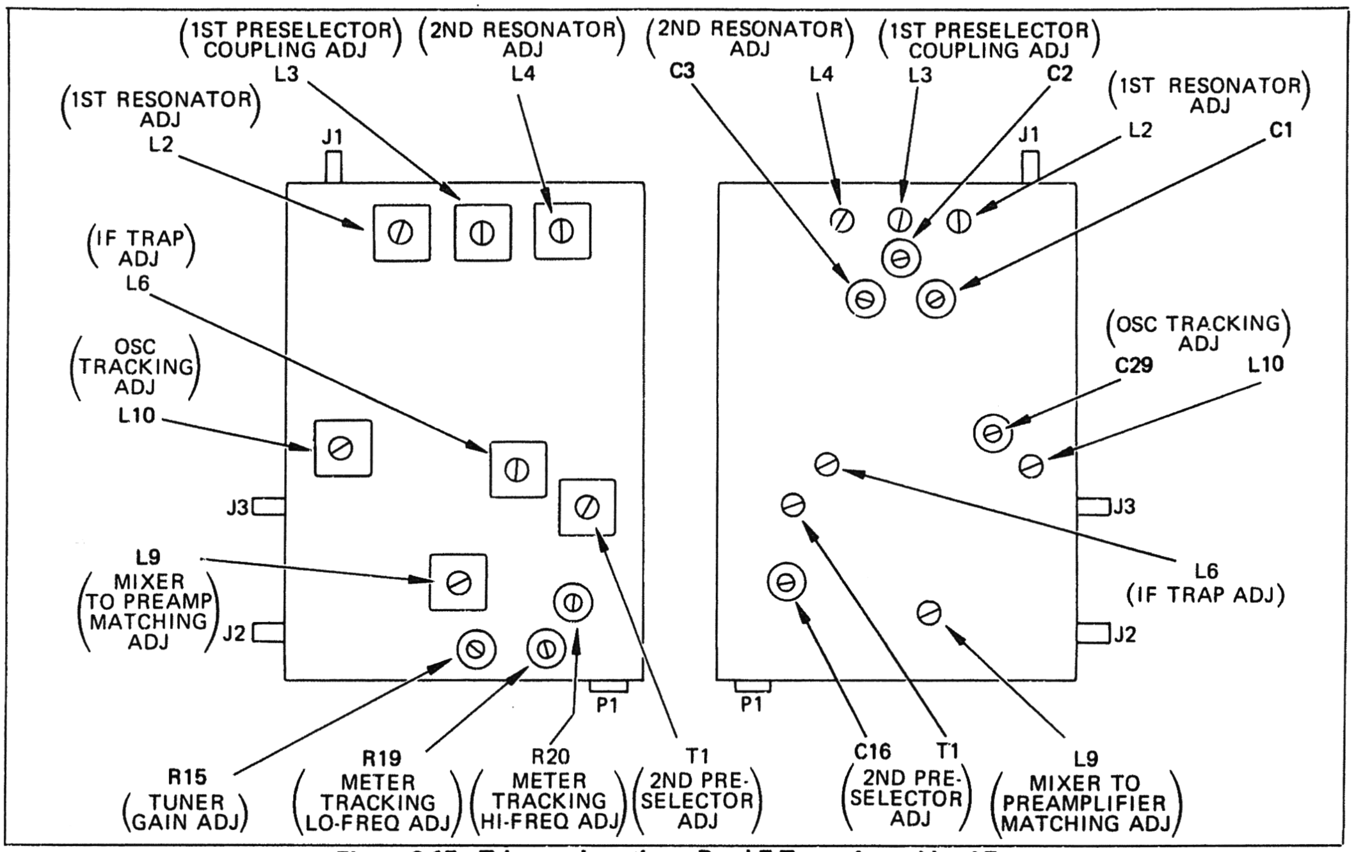


Figure 6-15. Trimmer Locations, Band 7 Tuner Assembly, A7

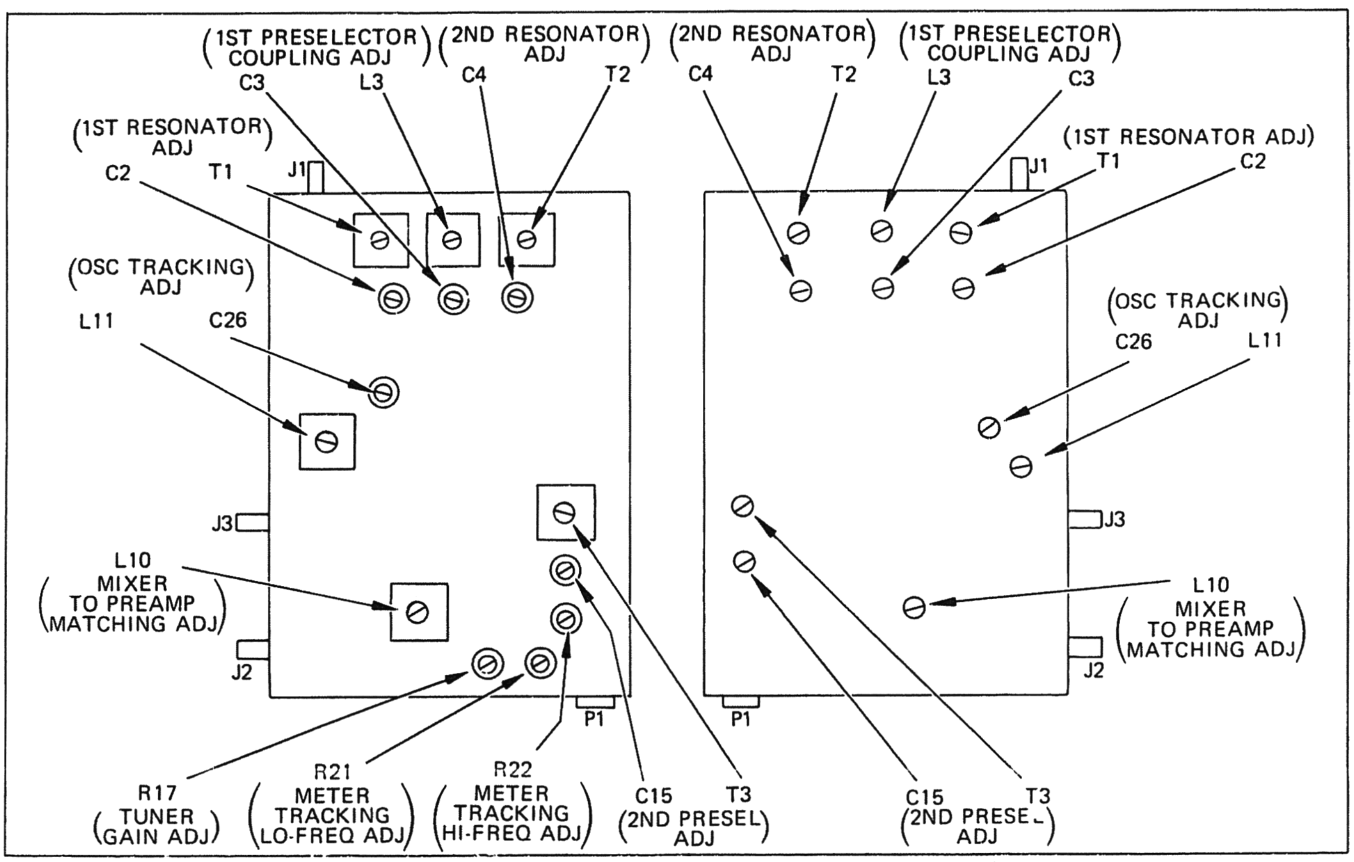


Figure 6-16. Trimmer Locations, Band 8 Tuner Assembly, A8

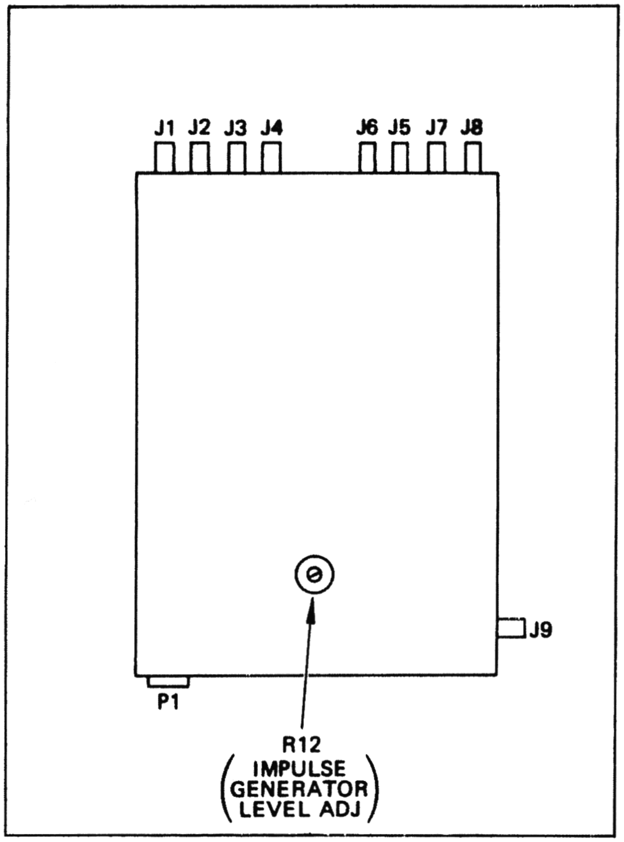


Figure 6-17. Trimmer Locations, RF Switch and Impulse Calibrator Assembly, A9

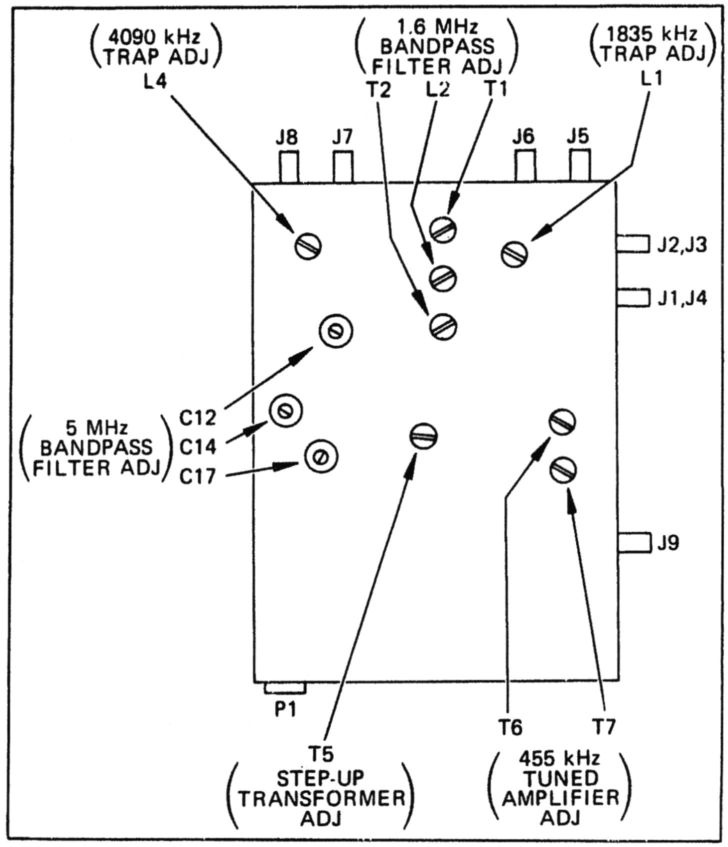


Figure 6-18. Trimmer Locations, Second Converter Assembly, A10

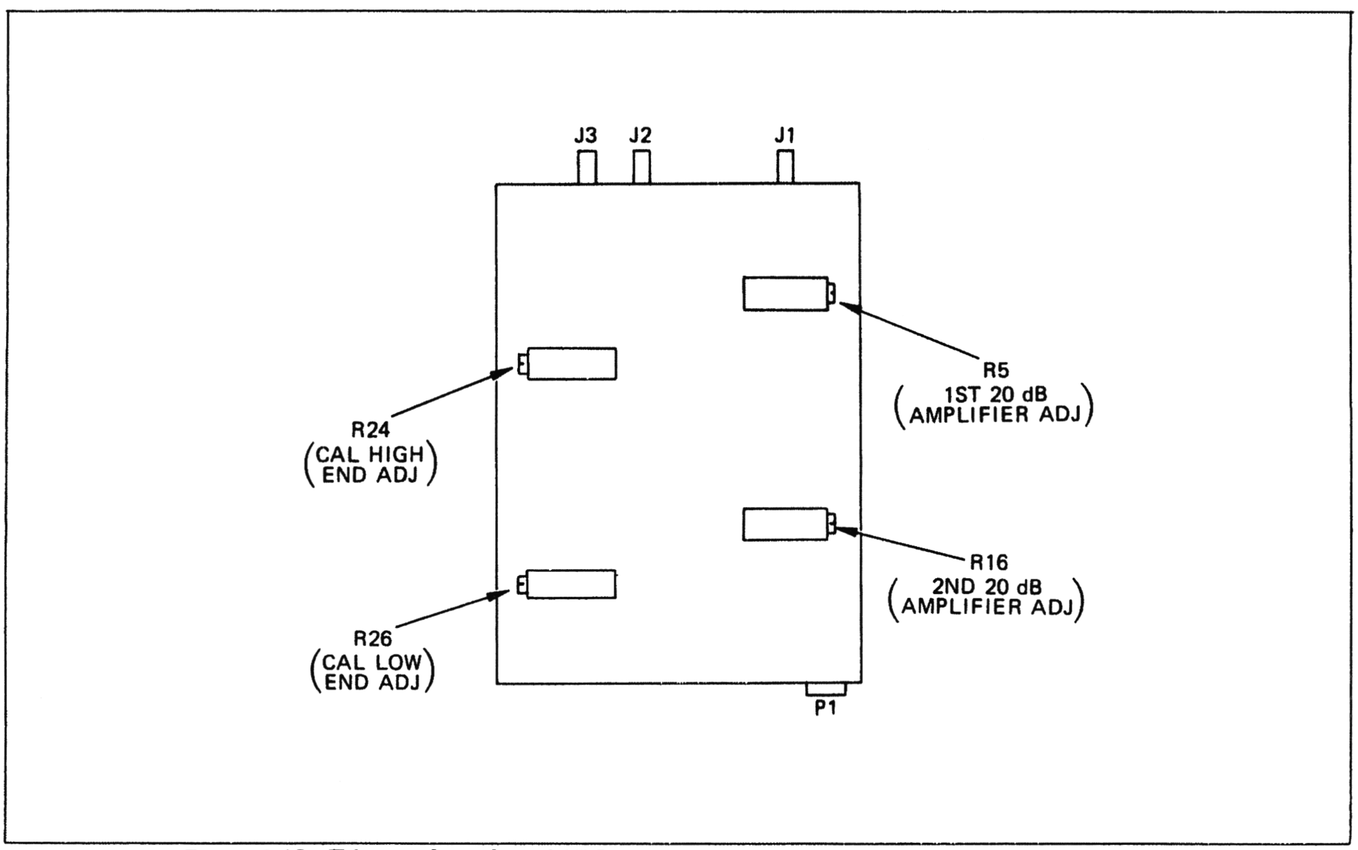


Figure 6-19. Trimmer Locations 1 IF Preamplifier and Calibration Amplifier Assembly, A11

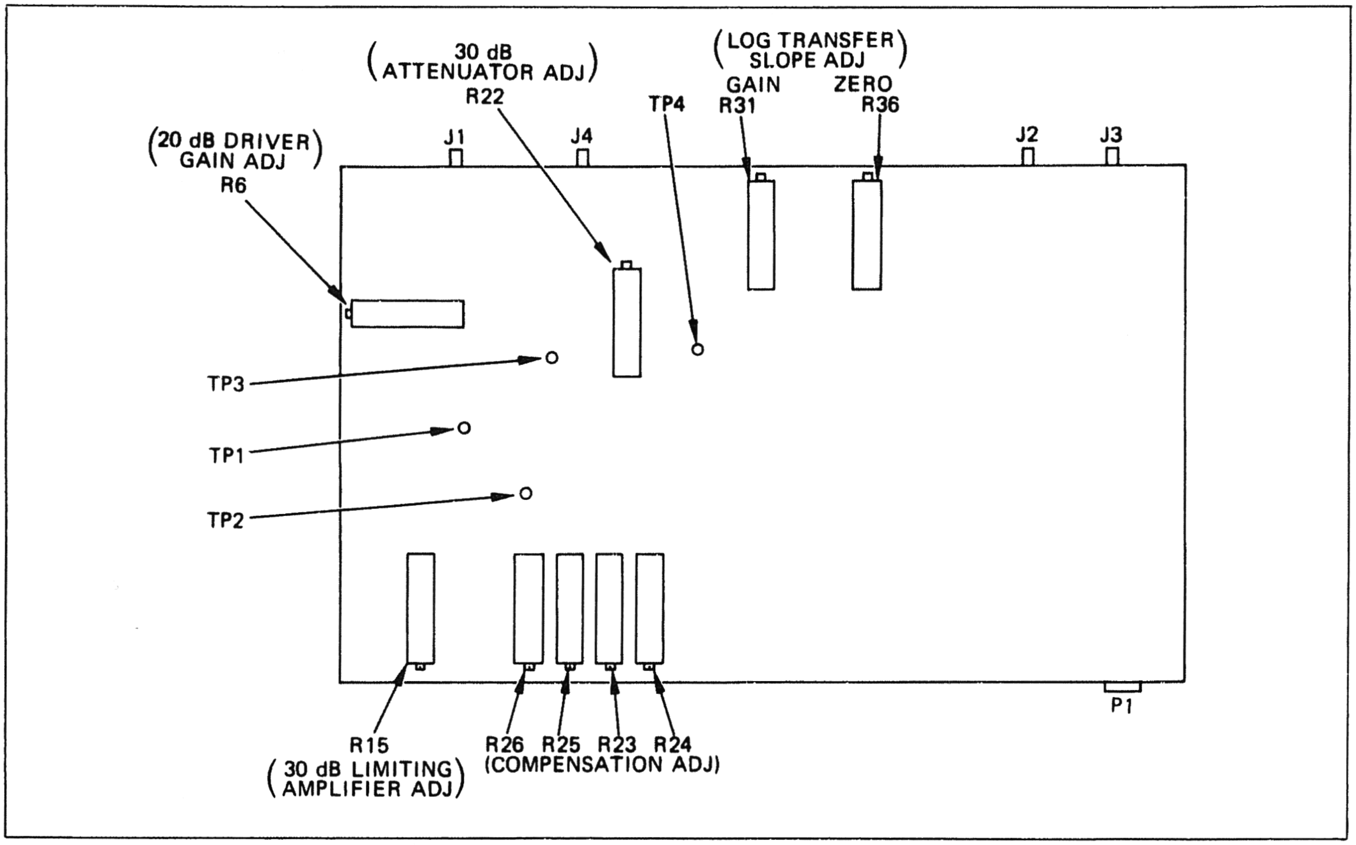


Figure 6-20. Trimmer Locations, Log Amplifier and Detector Assembly, A12

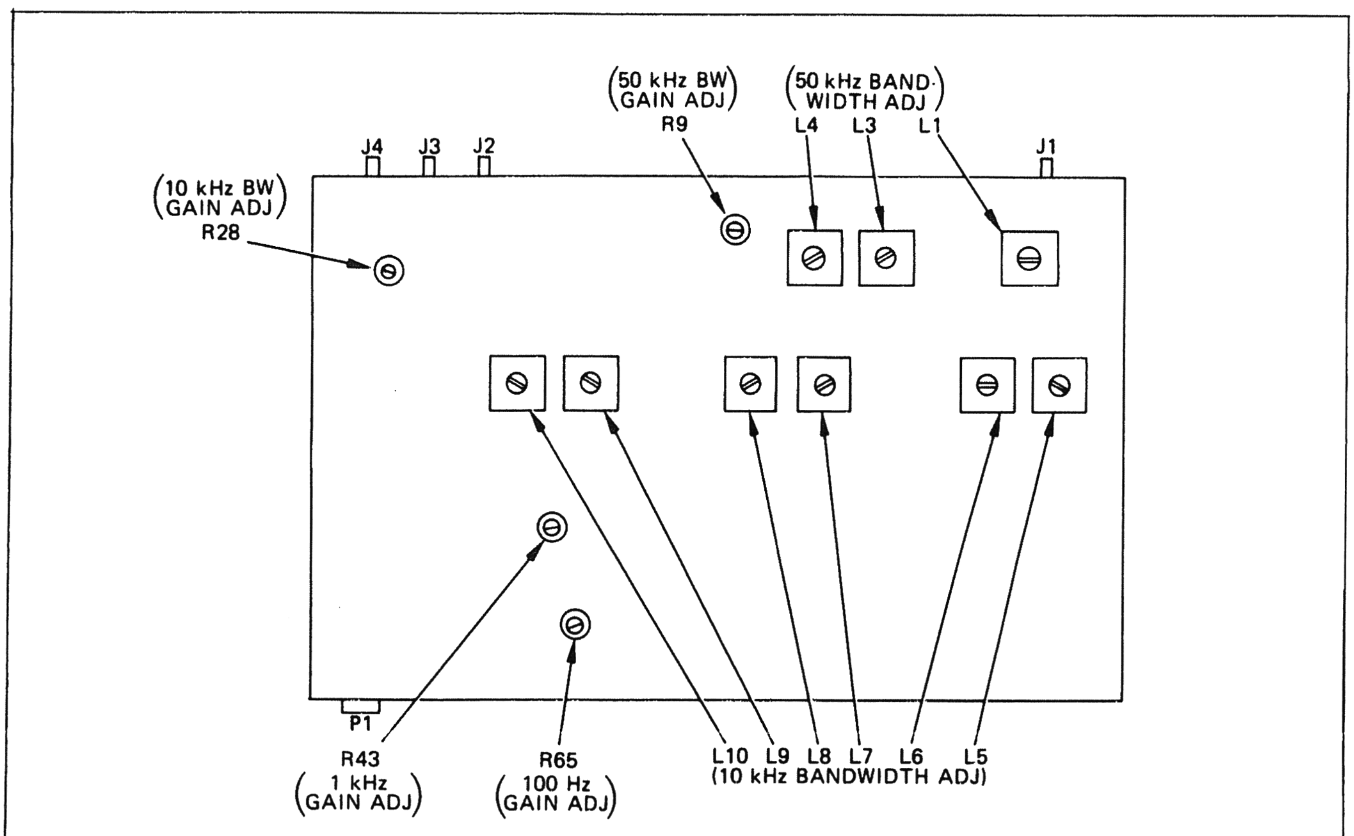


Figure 6-21. Trimmer Locations, Bandwidth Selector Assembly, A14

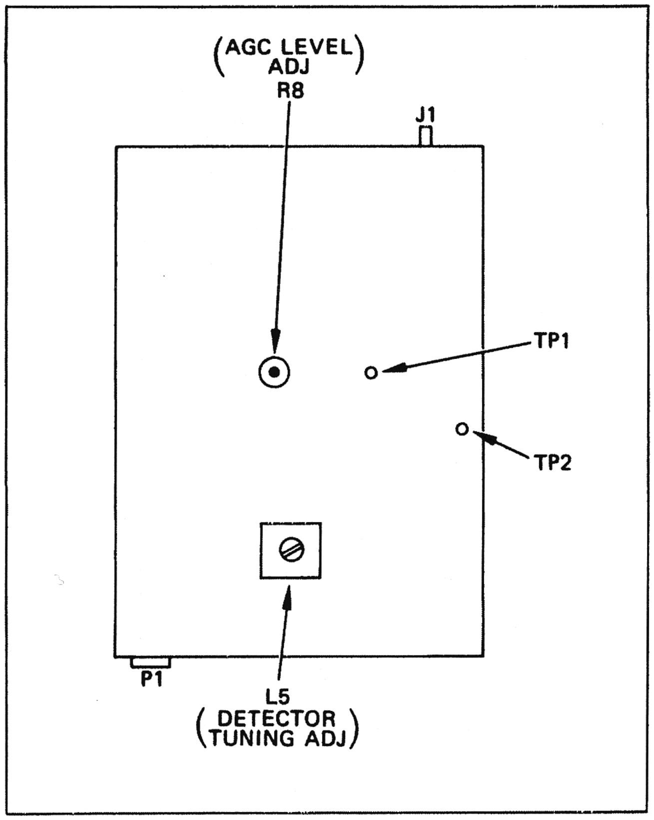


Figure 6-22. Trimmer Locations, Linear IF and BFO Assembly, A15

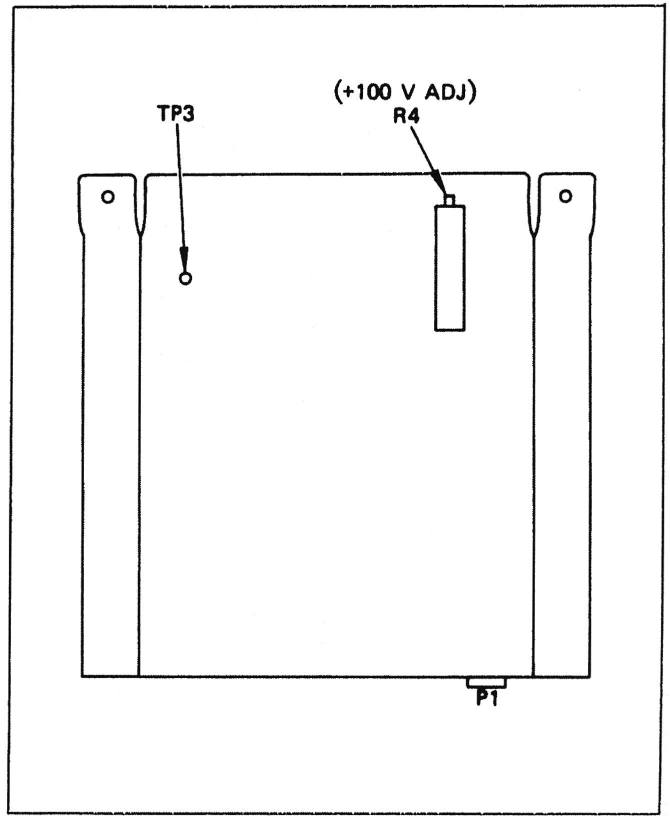


Figure 6-23. Trimmer Locations, DC to DC Converter Assembly, A16

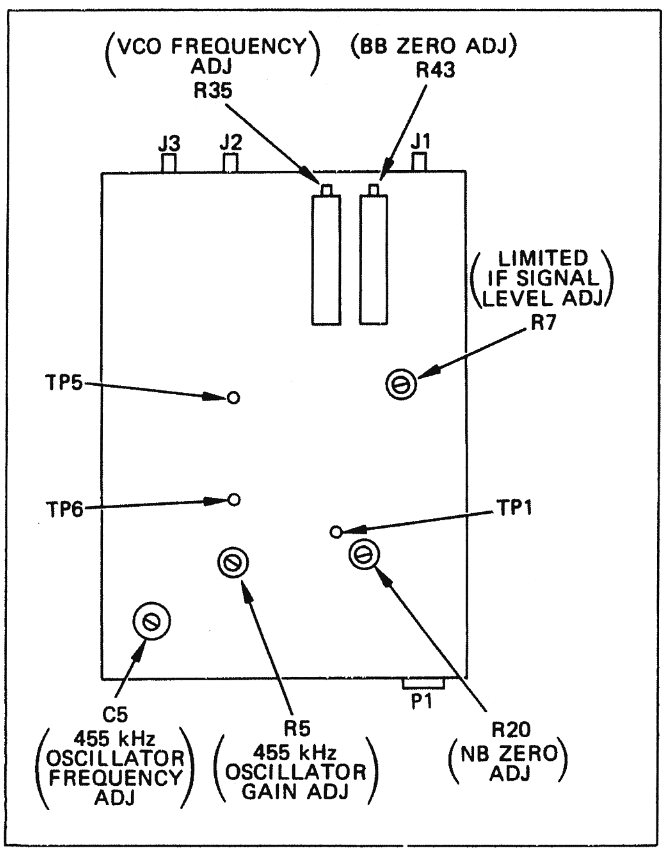


Figure 6-24. Trimmer Locations, AFC and FM Detector Assembly, A18

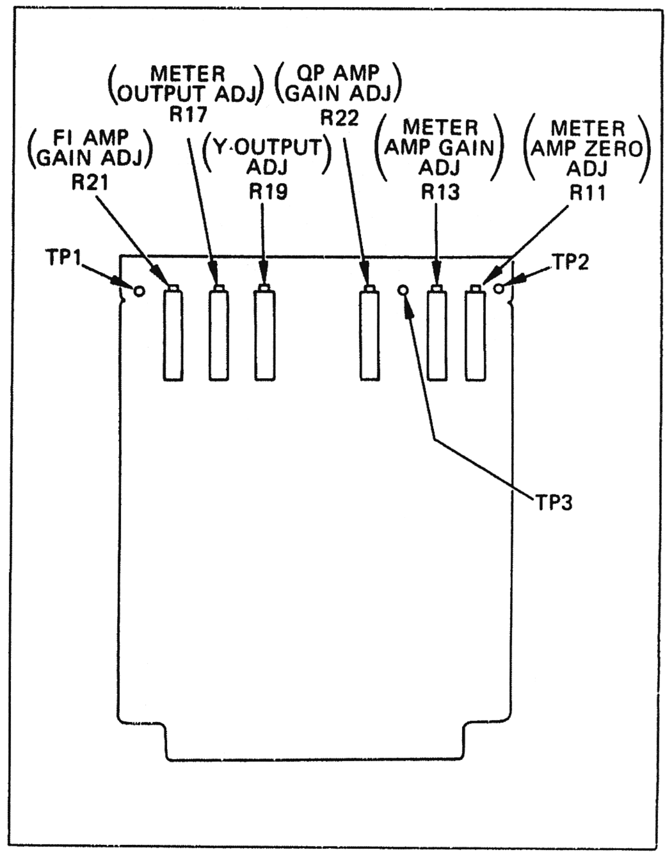


Figure 6-25. Trimmer Locations, Weighting Circuits and Meter Amplifier Assembly, A21

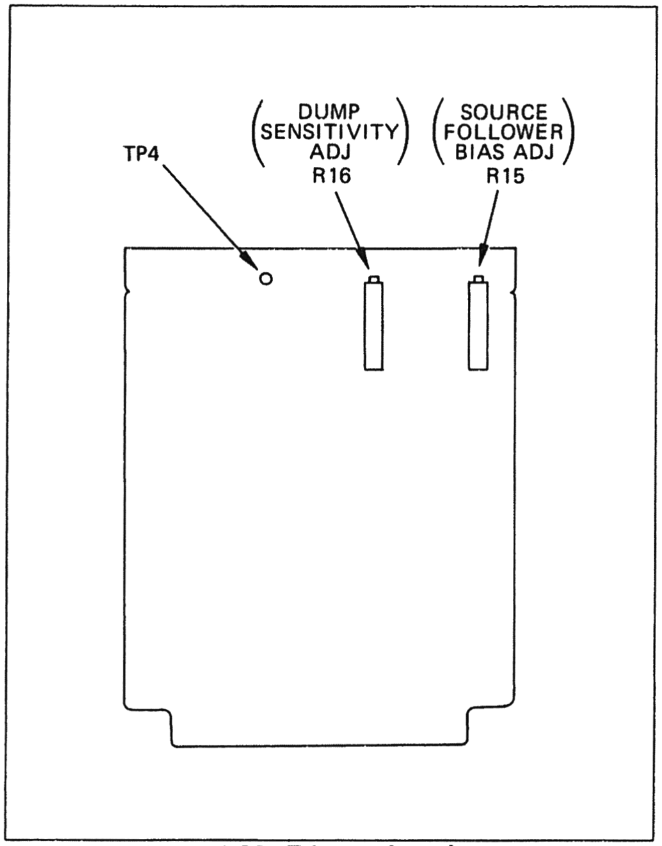


Figure 6-26. Trimmer Locations, Direct Peak Circuit Assembly, A22

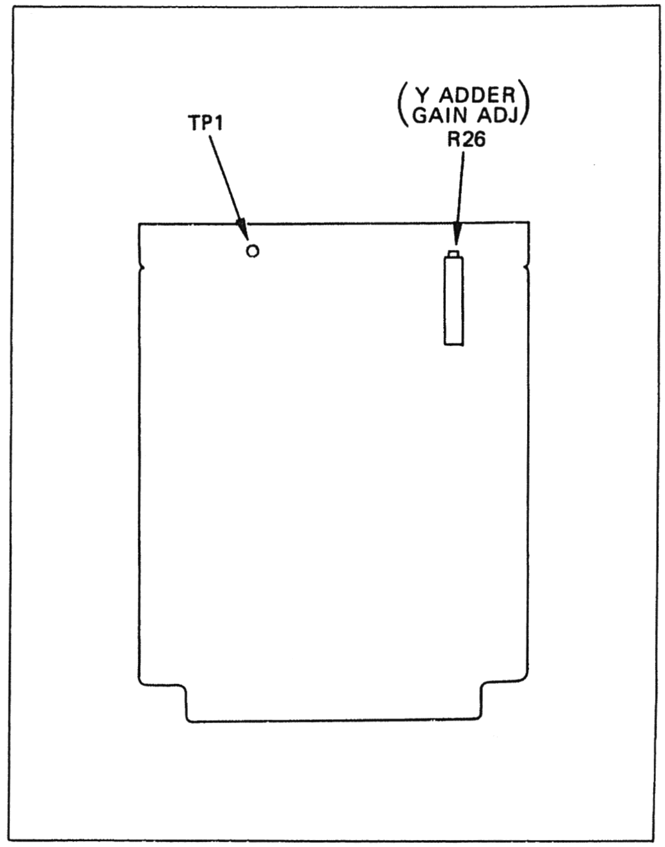


Figure 6-27. Trimmer Locations, Slideback Peak Circuit Assembly, A23

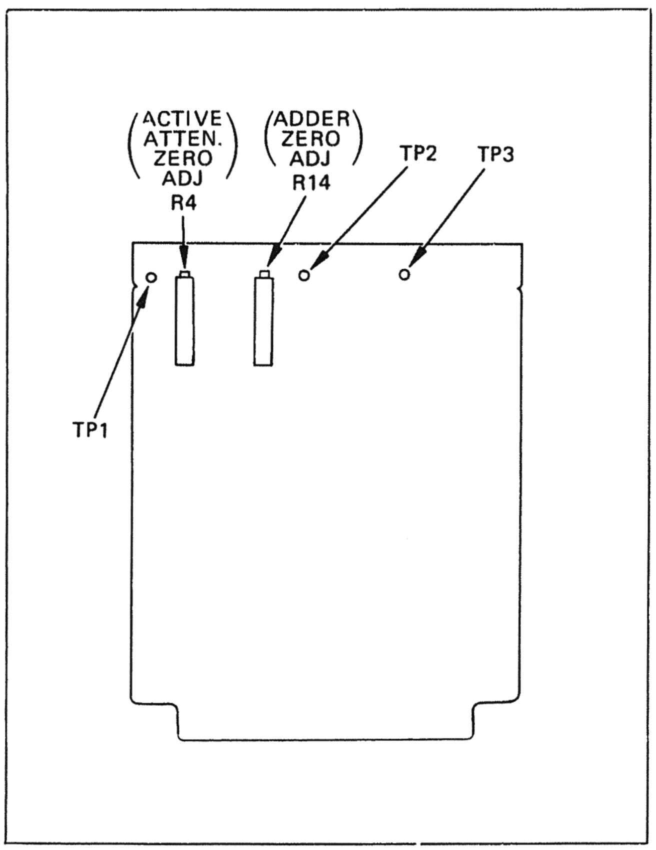


Figure 6-28. Trimmer Locations, dB Readout and Audio Amplifier Assembly, A24

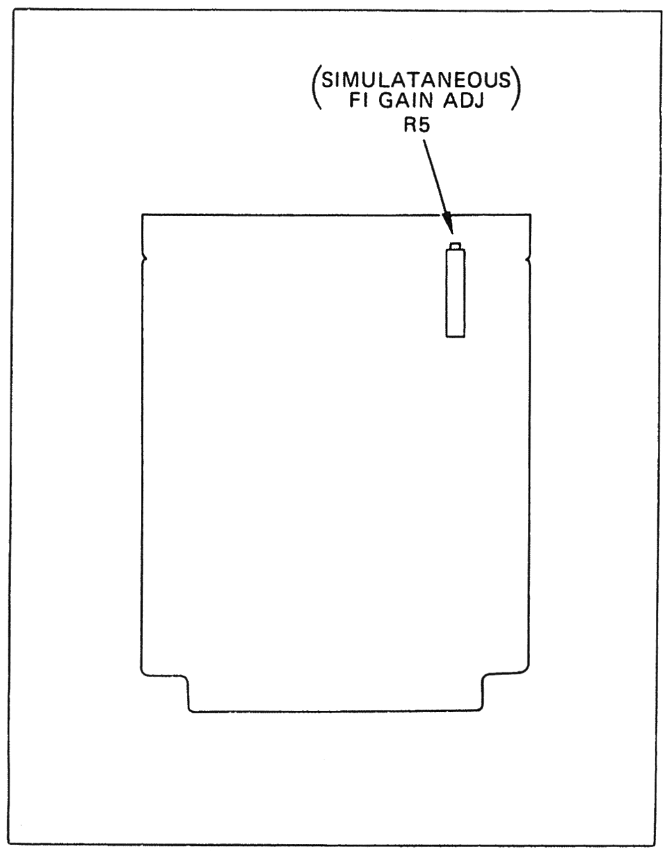


Figure 6-29. Trimmer Locations, Remote Function Selector Assembly, A25

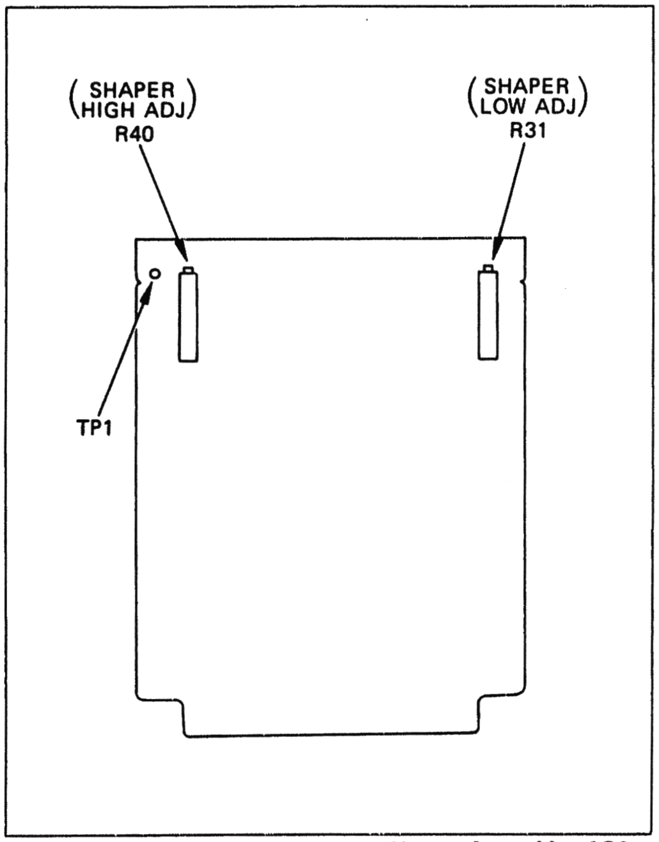


Figure 6-30. Trimmer Locations, Shaper Assembly, A26

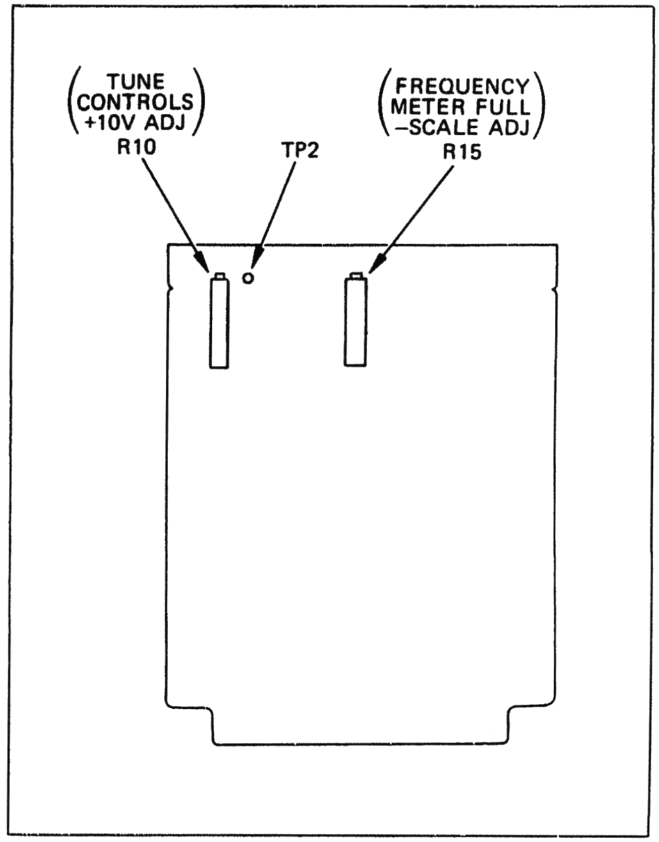


Figure 6-31. Trimmer Locations, Tuning Control Assembly, A29

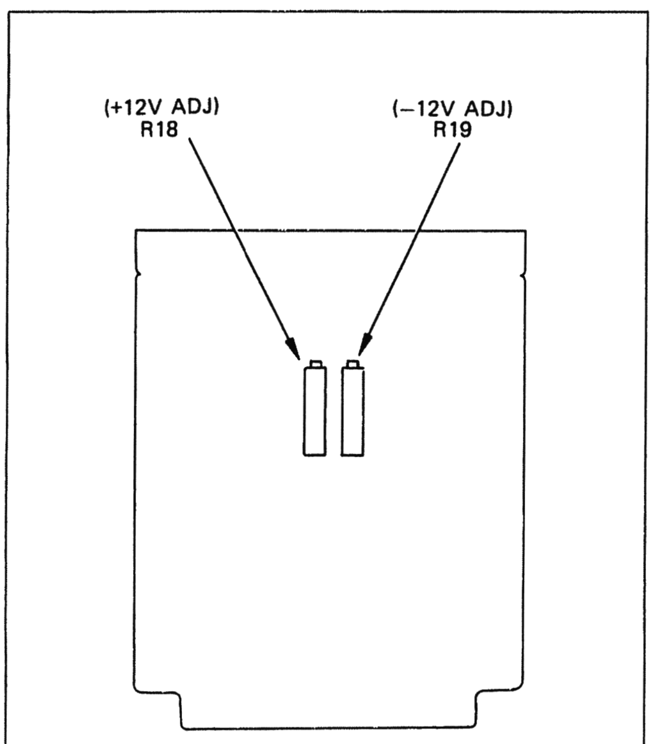


Figure 6-32. Trimmer Locations, Voltage Regulator Assembly, A31

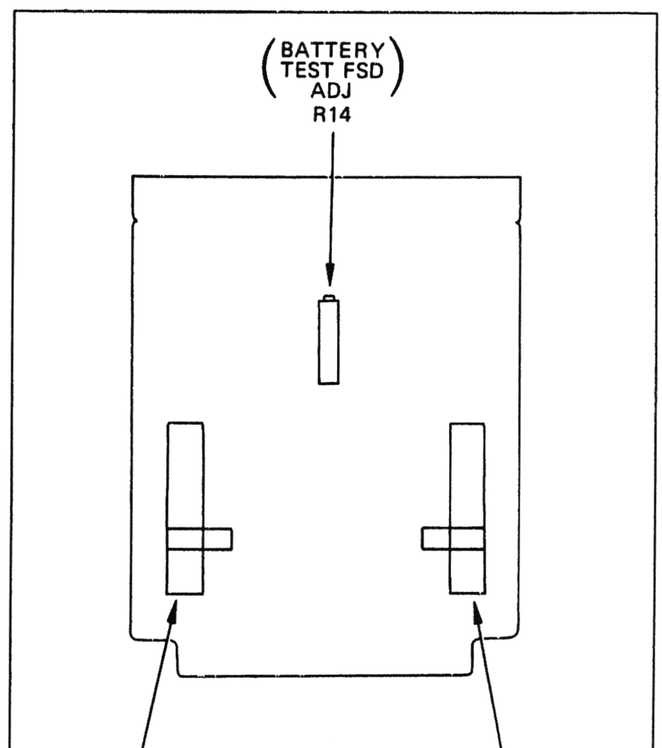


Figure 6-33. Trimmer Locations, Rectifier and Charge Regulator Assembly, A32

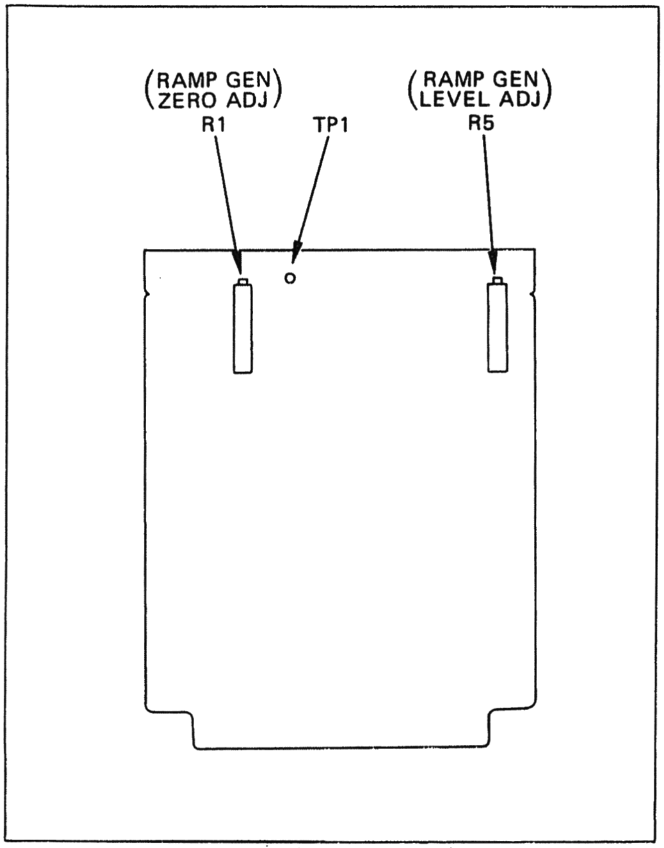


Figure 6-34. Trimmer Locations, Internal Sweep Assembly, A33

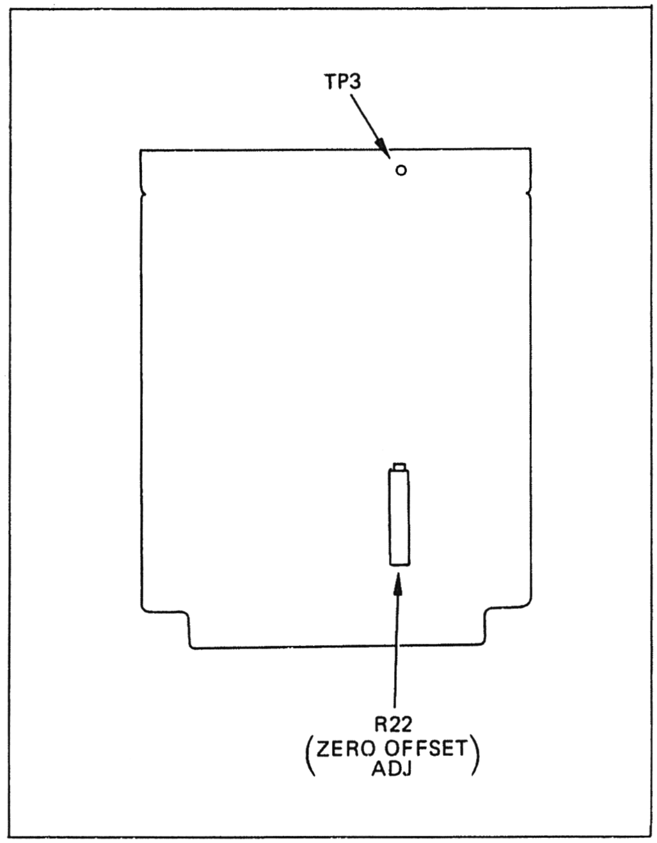


Figure 6-35. Trimmer Locations, Frequency Readout Assembly, A34

Section VII
REPLACEABLE PARTS

7.1 INTRODUCTION

This section contains information for ordering replacement parts. Tables 7-1 thru 7-34 list the parts according to their functional groupings. Parts are listed in alpha-numerical order of their reference designators and indicate the description, the Singer part number, typical manufacturer of the part in a five-digit code, and the manufacturer's part number. Table 7-35 lists the typical manufacturers in numerical code number order.

Table 7-1. Parts List for Main Assemblies and Chassis

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
A1	Tuner 1 assembly	1-004605-001	88869	
A2	Tuner 2 assembly	1-004606-001	88869	
A3	Tuner 3 assembly	1-004607-001	88869	
A4	Tuner 4 assembly	1-004608-001	88869	
A5	Tuner 5 assembly	1-004609-001	88869	
A6	Tuner 6 assembly	1-004610-001	88869	
A7	Tuner 7 assembly	1-004611-001	88869	
A8	Tuner 8 assembly	1-004612-001	88869	
A9	RF switch and impulse calibrator assembly	1-004673-001	88869	
A10	Second converter assembly	1-004645-001	88869	
A11	IF pre-amp and calibrator amp. assembly	1-004704-001	88869	
A12	Log amplifier and detector assembly	1-004692-001	88869	
A13	Not used			
A14	Bandwidth selector assembly	1-004693-001	88869	
A15	Linear IF and BFO assembly	1-004694-001	88869	
A16	Dc to dc converter assembly	1-004271-001	88869	
A17	Two position RF switch assembly	4-003962-001	88869	
A18	AFC and FM detector assembly	1-004695-001	88869	
A19	Not used			
A20	Not used			
A21	Weighting circuits and meter amplifier assembly	4-004114-005	88869	
A22	Direct peak circuit assembly	4-004136-005	88869	
A23	Slideback peak circuit assembly	4-004137-005	88869	
A24	dB readout and audio amplifier assembly	1-004870-001	88869	
A25	Remote function selector assembly	4-004139-005	88869	
A26	Shaper assembly	4-004140-008	88869	
A27	Not used			
A28	Not used			
A29	Tuning control assembly	3-004715-001	88869	
A30	Band selector assembly	4-004658-001	88869	
A31	Voltage regulator assembly	4-004727-001	88869	
A32	Rectifier and charge regulator assembly	4-004041-006	88869	
A33	Internal sweep assembly	4-004095-005	88869	
A34	Frequency readout assembly	4-004144-006	88869	
A35	Not used			
A36	Not used			
A37	Not used			
A38	Not used			

Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
A39	Not used			
A40	Not used			
A41	Input filter assembly	3-004686-001	88869	
A42	Power transformer assembly	2-403756-001	88869	
A43	Not used			
A44	Battery pack assembly	4-003771-001	88869	
A45	Turret attenuator assembly	4-004467-001	88869	
A46	Output meter assembly	4-403696-001	88869	
A47	Frequency meter assembly	4-403698-001	88869	
C1	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C2	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C3	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C4	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	001121	FB2B-102W
C5	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C6	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C7	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C8	Capacitor, fixed, electrolytic, 2600 uF, –10 +75%, 50 Vdc	1-900102-037	56289	36D262G050,AB2A
C9	Capacitor, fixed, electrolytic, 2600 uF, –10 +75%, 50 Vdc	1-900102-037	56289	36D262G050,AB2A
C10	Capacitor, fixed, electrolytic, 1500 uF, –10 +100%, 35 Vdc	1-900040-006	76433	977-207
C11	Capacitor, fixed, electrolytic, 1500 uF, –10 +100%, 35 Vdc	1-900040-006	76433	977-207
C12	Capacitor, fixed, electrolytic, 50 uF, –10 +100%, 250 Vdc	1-900040-005	76433	977-92
C13	Not used			
C14	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C15	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C16	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C17	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C18	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C19	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W

Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C20	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C21	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C22	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C23	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C24	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 25 Vdc	1-900076-001	72982	5835
C25	Not used			
C26	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C27	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 25 Vdc	1-900076-001	72982	5835
C28	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 25 Vdc	1-900076-001	72982	5835
C29	Not used			
C30	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C31	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C32	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C33	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C34	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C35	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C36	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB1B-102W
C37	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C38	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C39	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C40	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C41	Capacitor, fixed, feedthrough, 1000 pF, ±20%, 500 Vdc	1-900038-001	01121	FB2B-102W
C42	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835-000-Y5U0-203Z
C43	Capacitor, fixed, electrolytic, 10 uF, ±10%, 20 Vdc	1-900057-119	56289	150D106X9020B2
C44	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835-000-Y5U0-203Z

Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C45	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835-000-Y5U0-203Z
C46	Capacitor, fixed, electrolytic, 10 uF, ±10%, 20 Vdc	1-900057-119	56289	150D106X 9020B2
CR1	Diode, silicon	1-913058-002	04651	IN277
CR2	Diode, silicon	1-913058-002	04651	IN277
CR3	Diode, silicon	1-913058-002	04651	IN277
CR4	Diode, silicon	1-913058-002	04651	IN277
CR5	Diode, silicon	1-913058-002	04651	IN277
CR6	Diode, silicon	1-913058-002	04651	IN277
CR7	Diode, silicon	1-913058-002	04651	IN277
CR8	Diode, silicon	1-913058-002	04651	IN277
F1	Fuse, slo-blo, 0.5 A, 125 V	1-924000-014	03614	MDL
F2	Fuse, slo-blo, 0.5 A, 125 V	1-924000-014	03614	MDL
J1	Connector, jack, BNC (part of A41)			
J2	Connector, jack, BNC (part of W40)			
J3	Connector, jack, BNC (part of W20)			
J4	Connector, jack, BNC (part of W19)			
J5	Connector, jack, 3 pins	1-910165-001	82389	EAC-301
J6	Connector, jack, BNC	1-910132-001	11636	UG-1094A/U
J7	Connector, jack, phone, assembly	2-004364-001	88869	
J8	Connector, jack, phone, assembly	2-004477-001	88869	
J9	Connector, jack, 41 pins	1-910200-001	77068	PT02E-20-41P
J10	Connector, jack, BNC (part of W39)			
J11	Connector, jack, BNC	1-910132-001	11636	UG-1094A/U
J12	Connector, jack, phone, assembly	2-004363-001	88869	
J13	Connector, jack, 5 pins	1-910157-003	02660	126
J14	Connector, jack, 6 pins	1-910206-006	08718	KPSE02E10-6S
L1	Inductor, fixed, 1 mH	1-906003-049	16407	DD-1000
L2	Inductor, fixed, 470 uH, 192 mA	1-906016-045	0000I	DR-470
L3	Inductor, fixed, 470 uH, 192 mA	1-906016-045	0000I	DR-470
L4	Inductor, fixed, 470 uH, 192 mA	1-906016-045	0000I	DR-470
L5	Inductor, fixed, 470 uH, 192 mA	1-906016-045	0000I	DR-470
L6	Inductor, fixed, 470 uH, 192 mA	1-906016-045	0000I	DR-470
L7	Inductor, fixed, 470 uH, 192 mA	1-906016-045	0000I	DR-470
L8	Inductor, fixed, 470 uH, 192 mA	1-906016-045	0000I	DR-470
L9	Inductor, fixed, 470 uH, 192 mA	1-906016-045	0000I	DR-470
L10	Inductor, fixed, 470 uH, 192 mA	1-906016-045	0000I	DR-470
L11	Inductor, fixed, 100 uH, 325 mA	1-906016-037	0000I	DR-100

Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
L12	Inductor, fixed, 100 uH, 325 mA	1-906016-037	0000I	DR-100
L13	Inductor, fixed, 100 uH, 325 mA	1-906016-037	0000I	DR-100
L14	Inductor, fixed, 100 uH, 325 mA	1-906016-037	0000I	DR-100
L15	Inductor, fixed, toroid, 8 mH, ±2 mH	1-403588-001	88869	
L16	Inductor, fixed, toroid, 8 mH, ±2 mH	1-403588-001	88869	
L17	Inductor, fixed, 100 uH, 325 mA	1-906016-037	0000I	DR-100
R1	Resistor, variable, wirewound, 1 k ohm, ±3%, 2 W	1-945087-005	80294	3500S-1-102
R2	Resistor, variable, 250 ohm (part of S6/R2)			
R3	Resistor, variable, composition, 10 k ohm, ±10%, 2 W 10%, 2 W	1-945078-108	01121	JAIN 048P 103A
R4	Resistor, variable, 5 k ohm (part of S7/R4)			
R5	Resistor, fixed, film, 1 k ohm, ±1%, ⅛ W	1-945027-193	07117	RN55D1001F
R6	Resistor, variable, composition, 5 k ohm, ±10%, 2 W	1-945078-007	01121	JAIN 048P 502AA
R7	Resistor, fixed, composition, 1 k ohm, ±5%, ½ W	1-945001-162	01121	EB1025
R8	Resistor, fixed, composition, 330 ohm, ±5%, ½ W	1-945001-150	01121	EB3315
R9	Resistor, fixed, composition, 330 ohm, ±5%, ½ W	1-945001-150	01121	EB3315
S1	Switch, rotary, 9 poles, 3 positions	4-403214-001	88869	
S2/S3	Switch, rotary, assembly S2: Switch, rotary, 1 pole, 8 positions	4-403415-001	88869	
S3	Switch, rotary, 1 pole, 4 positions (part of S2/S3)			
S4	Not used			
S5	Switch, rotary, 5 poles, 8 positions	4-403213-001	88869	
S6/R2	Switch/variable resistor assembly S6: Switch, rotary, 1 pole, 2 positions	1-403215-002	88869	
S7/R4	Switch/variable resistor assembly S7: Switch, rotary, 1 pole, 2 positions	1-403215-001	88869	
S8	Switch, pushbutton, momentary, 1 pole, 2 positions	1-951035-001	82389	923
S9	Switch, rotary, 8 poles, 5 position	1-951034-001, 4-403244-001, 4-403217-001	88869	
S10	Switch, slide, 2 poles, 2 positions	1-951029-001	82389	46256LF
S11	Switch, toggle, 2 poles, 2 positions	1-951036-007	09353	7203
W1	Cable assembly, 7 in., with subminiature right angle snap-on connectors	3-004657-015	88869	
W2	Cable assembly, 5 in., with subminiature right angle snap-on connectors	3-004657-005	88869	
W3	Cable assembly, 12 in., with subminiature right angle snap-on connectors	3-004657-022	88869	

Table 7-1. Part List for Main Assemblies and Chassis (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
W4	Cable assembly, 7 in., with subminiature right angle snap-on connectors	3-004657-011	88869	
W5	Cable assembly, 6 in., with subminiature right angle snap-on connectors	3-004657-006	88869	
W6	Cable assembly, 4 in., with subminiature right angle snap-on connectors	3-004657-001	88869	
W7	Cable assembly, 5 in., with subminiature right angle snap-on connectors	3-004657-007	88869	
W8	Cable assembly, 4 in., with subminiature right angle snap-on connectors	3-004657-024	88869	
W9	Not used			
W10	Not used			
W11	Cable assembly, 10 in., with subminiature right angle snap-on connectors	3-004657-020	88869	
W12	Cable assembly, 8 in., with subminiature right angle snap-on connectors	3-004657-016	88869	
W13	Cable assembly, 7 in., with subminiature right angle snap-on connectors	3-004657-012	88869	
W14	Cable assembly, 6 in., with subminiature right angle snap-on connectors	3-004657-008	88869	
W15	Cable assembly, 5 in., with subminiature right angle snap-on connectors	3-004657-002	88869	
W16	Cable assembly, 4 in., with subminiature right angle snap-on connectors	3-004657-003	88869	
W17	Cable assembly, 5 in., with subminiature right angle snap-on connectors	3-004657-023	88869	
W18	Cable assembly, 4 in., with subminiature right angle snap-on connectors	3-004657-004	88869	
W19	Cable assembly, 16 in., BNC to subminiature right angle snap-on	3-004656-003	88869	
W20	Cable assembly, 18 in., BNC to subminiature right angle snap-on	3-004656-004	88869	
W21	Cable assembly, 6 in., with subminiature right angle snap-on connectors	3-004657-017	88869	
W22	Cable assembly, 6 in., with subminiature right angle snap-on connectors	3-004657-013	88869	
W23	Cable assembly, 6 in., with subminiature right angle snap-on connectors	3-004657-009	88869	
W24	Cable assembly, 5 in., with subminiature right angle snap-on connectors	3-004657-010	88869	
W25	Cable assembly, 7 in., with subminiature right angle snap-on connectors	3-004657-014	88869	
W26	Cable assembly, 9 in., with subminiature right angle snap-on connectors	3-004657-018	88869	
W27	Cable assembly, 9 in., with subminiature right angle snap-on connectors	3-004657-019	88869	

Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
W28	Cable assembly, 10 in., with subminiature right angle snap-on connectors	3-004657-021	88869	
W29	Cable assembly, 28 in., with subminiature right angle snap-on connector on one end	2-004730-001	88869	
W30	Not used			
W31	Not used			
W32	Not used			
W33	Not used			
W34	Not used			
W35	Not used			
W36	Not used			
W37	Not used			
W38	Not used			
W39	Cable assembly, 12 in., BNC to BNC	2-004729-001	88869	
W40	Cable assembly, 16 in., BNC to subminiature right angle snap-on	3-004656-002	88869	
XF1	Fuseholder	1-924007-001	75915	341001
XF2	Fuseholder	1-924007-001	75915	341001

Table 7-2. Parts List, Miscellaneous

QUANTITY	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
1	Bail	1-964118-005	0000H	MP40016-5
1	Board, meter assembly	1-004288-001	88869	
16	Connector, jack, 9 pins	1-910167-001	08718	DEM-9S
10	Connector, jack, PC board, 18 pins	1-910155-002	05574	VH18/1AB
3	Connector, jack, PC board, 18/36 pins	1-910155-001	05574	2VH18/1AN
1	Extender, circuit board, 18 pins	4-004224-005	88869	
1	Extractor, circuit board	2-103537-001	88869	
1	Foot, front left	1-964117-001	0000H	PP40012-1
1	Foot, front right	1-964117-002	0000H	PP40021-2
2	Foot, rear	1-964119-001	21604	
1	Knob, [ATTENUATOR (dB)]	1-935023-001	0000H	RSSN-70TSL-2BLK
1	Knob, [AUDIO/AM–FM]	1-935024-001	0000H	RSS-50L-1-RED-SHORT-70TSL-2BLK
1	Knob, [BAND (MHz)/BANDWIDTH (kHz)]	1-935024-001	0000H	RSS-50L-RED-SHORT-70TSL-2BLK
1	Knob, [CALIBRATE]	1-935025-001	0000H	RSSN-70-2-RED
1	Knob, [CONTROL MODE]	1-935023-001	0000H	RSSN-70TSL-2BLK
1	Knob, [FUNCTION]	1-935023-001	0000H	RSSN-70TSL-2BLK
1	Knob, [POWER]	1-935023-001	0000H	RSSN-70TSL-2BLK
1	Knob, [SLIDEBACK PEAK]	1-935002-002	0000H	RSSN-70-2
1	Knob, [FINE TUNE/AFC]	1-935024-001	0000H	RSS-50L-1-RED-SHORT-70TSL-2BLK
1	Knob, [TUNE]	1-935021-001	0000H	RSSN-125SP-2BLK
1	Wrench, Allen, 5/32 in.	1-964287-001	0000J	028
1	Wrench, Allen, 9/64 in.	1-964287-009	0000J	964

Table 7-3. Parts List, Supplied Accessories

QUANTITY	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
7½ ft.	Ac power cable	1-910166-001	70903	KH7375
16 in.	Module extender cable	2-004543-001	88869	
1	Connector (mates with programmer receptacle)	1-910191-005	77068	PT06E-20-41S (SR)
1	Instruction manual	1-500783-255	88869	
2	Rack mounting brackets	3-103317-001	88869	
4	Flathead screws 10-32x½	1-964064-265		
1	Calibration charts	1-403550-001	88869	

Table 7-4. Parts List for Tuner 1 Assembly, A1

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, plastic, 9380 pF, ±2%, 100 Vdc	1-900114-023	14752	410D1B9381G
C2	Capacitor, fixed, plastic, 0.014 uF, ±2%, 100 Vdc	1-900114-024	14752	410D1B143G
C3	Capacitor, fixed, plastic, 0.0176 uF, ±2%, 100 Vdc	1-900114-025	14752	410D1B1762G
C4	Capacitor, fixed, plastic, 0.014 uF, ±2%, 100 Vdc	1-900114-024	14752	410D1B143G
C5	Capacitor, fixed, plastic, 9380 pF, ±2%, 100 Vdc	1-900114-023	14752	410D1B9381G
C6	Capacitor, fixed, plastic, 0.056 uF, ±10%, 250 Vdc	1-900001-110	73445	C280AE.056 uF
C7	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C8	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	535000Y5U0203Z
C9	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C10	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C11	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C12	Capacitor, fixed, plastic, 9380 pF, ±2%, 100 Vdc	1-900114-023	14752	410D1B9381G
C13	Capacitor, fixed, plastic, 0.01 uF, ±10%, 250 Vdc	1-900001-101	73445	C280AE.01 uF
C14	Capacitor, fixed, mica, 68 pF, ±5%, 500 Vdc	1-900071-011	72136	DM10-680d
C15	Capacitor, fixed, mica, 680 pF, ±5%, 300 Vdc	1-900003-052	72136	DM15F681J
C16	Capacitor, fixed, electrolytic, 1.0 uF, ±20%, 35 Vdc	1-900057-146	56289	150D105X0035A2
C17	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C18	Capacitor, fixed, mica, 250 pF, ±5%, 500 Vdc	1-900071-018	72136	DM10-251J
C19	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C20	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C21	Capacitor, fixed, plastic, 2400 pF, ±5%, 63 Vdc	1-900116-012	73445	2222/424/22402
C22	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C23	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C24	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C25	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C26	Capacitor, fixed, plastic, 6800 pF, ±5%, 63 Vdc	1-900116-024	73445	2222/424/26802
C27	Capacitor, fixed, mica, 56 pF, ±5%, 500 Vdc	1-900071-105	72136	DM10-560J
C28	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C29	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C30	Capacitor, fixed, ceramic, 390 pF, N1500 ±250 ppm/°C	1-900119-001	72982	8131A100P3K 391J
C31	Capacitor, fixed, mica, 390 pF, ±5%, 500 Vdc	1-900072-031	72136	SCDM10-391J
C32	Capacitor, fixed, mica, 47 pF, ±5%, 500 Vdc	1-900071-009	72136	DM10-470J
C33	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 100 Vdc	1-900077-002	56289	TG-510

Table 7-4. Parts List for Tuner 1 Assembly, A1 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C34	Capacitor, fixed, plastic, 6800 pF, ±5%, 63 Vdc	1-900116-024	73445	2222/424/26802
C35	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C36	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-001	00656	3420050C104M
C37	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C38	Capacitor, fixed, mica, 150 pF, ±5%, 500 Vdc	1-900071-015	72136	DM10-151J
CR1	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
J1	Connector, jack, UG-1455/U	1-910139-002	98291	51 0450000
J2	Connector, jack, UG-1455/U	1-910139-002	98291	51 0450000
J3	Connector, jack, UG-1455/U	1-910139-002	98291	51 0450000
L1	Inductor, fixed, toroid, 13.4 uH nominal	4-403394-001	88869	
L2	Inductor, fixed, toroid, 44 uH nominal	4-403394-002	88869	
L3	Inductor, fixed, toroid, 44 uH nominal	4-403394-002	88869	
L4	Inductor, fixed, toroid, 13.4 uH nominal	4-403394-001	88869	
L5	Inductor, fixed, toroid, 35 uH nominal	4-403394-003	88869	
L6	Inductor, fixed, toroid, 420 uH nominal	4-403394-002	88869	
L7	Inductor, fixed, 10 mH, 50 mA	1-906016-061	0000I	DR-10,000
L8	Inductor, fixed, toroid, 46 uH nominal	4-403394-005	88869	
L9	Inductor, variable, 323 uH nominal	4-403395-001	88869	
L10	Inductor, fixed, 10 mH, 50 mA	1-906016-061	0000I	DR-10,000
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, silicon, PNP	1-958082-001	07263	2N4250
Q2	Transistor, silicon, PNP	1-958082-001	07263	2N4350
Q3	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q4	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q5	Transistor, silicon, NPN	1-958078-001	01295	2N4997
R1	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R2	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R3	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R4	Resistor, fixed, composition, 470 ohm, ±5%, ¼ W	1-945000-154	01121	CB4715
R5	Resistor, fixed, composition, 8.2 k ohm, ±5%, ¼ W	1-945000-184	01121	CB8225
R6	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
R7	Resistor, fixed, composition, 33 k ohm, ±5%, ⅛ W	1-945086-099	01121	BB3335
R8	Resistor, fixed, composition, 680 ohm, ±5%, ¼ W	1-945000-158	01121	CB6815
R9	Resistor, variable, cermet, 50 k ohm, ±20%, ½ W	1-945037-013	80740	G2PR50K
R10	Resistor, fixed, composition, 390 ohm, ±5%, ¼ W	1-945000-152	01121	CB3915
R11	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R12	Resistor, fixed, composition, 33 k ohm, ±5%, ⅛ W	1-945086-099	01121	BB3335
R13	Resistor, fixed, composition, 68 ohm, ±5%, ⅛ W	1-945086-035	01121	BB6805

Table 7-4. Parts List for Tuner 1 Assembly, A1 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R14	Resistor, fixed, composition, 6.8 k ohm, ±5%, ⅛ W	1-945086-083	01121	BB6825
R15	Resistor, fixed, composition, 1 k ohm, ±5%, ⅛ W	1-945086-063	01121	BB1025
R16	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R17	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R18	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R19	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535
R20	Resistor, fixed, composition, 5.6 k ohm, ±5%, ¼ W	1-945000-180	01121	CB5625
R21	Resistor, variable, cermet, 500 ohm, ±20%, ½ W	1-945037-006	80740	62PR500
R22	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R23	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R24	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R25	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R26	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R27	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R28	Resistor, fixed, composition, 100 k ohm, ±5%, ¼ W	1-945000-210	01121	CB1045
R29	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R30	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R31	Resistor, fixed, composition, 51 ohm, ±5%, ⅛ W	1-945086-032	01121	BB5105
R32	Resistor, fixed, composition, 51 ohm, ±5%, ⅛ W	1-945086-032	01121	BB5105
R33	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R34	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R35	Resistor, fixed, composition, 1.5 k ohm, ±5%, ¼ W	1-945000-166	01121	CB1525
R36	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
T1	Transformer, fixed, 36 mH nominal	1-403447-001	88869	
T2	Transformer, variable, 530 uH nominal	4-403396-001	88869	
T3	Transformer, fixed, toroid, 74 uH nominal	4-403394-006	88869	
U1	Integrated circuit, double balanced, modulator/demodulator	1-926058-001	07263	U5E7796393

Table 7-5. Parts List for Tuner 2 Assembly, A2

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, plastic, 2400 pF, ±5%, 63 Vdc	1-900116-012	73445	2222/424/22402
C2	Capacitor, fixed, plastic, 4700 pF, ±5%, 63 Vdc	1-900116-020	73445	2222/424/24702
C3	Capacitor, fixed, plastic, 1300 pF, ±5%, 63 Vdc	1-900116-006	73445	2222/424/21302
C4	Capacitor, fixed, plastic, 2000 pF, ±5%, 63 Vdc	1-900116-010	73445	2222/424/22002
C5	Capacitor, fixed, plastic, 2400 pF, ±5%, 63 Vdc	1-900116-012	73445	2222/424/22402
C6	Capacitor, fixed, plastic, 2000 pF, ±5%, 63 Vdc	1-900116-010	73445	2222/424/22002
C7	Capacitor, fixed, plastic, 1300 pF, ±5%, 63 Vdc	1-900116-006	73445	2222/424/21302
C8	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C9	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835/000/Y5U0/ 203Z
C10	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C11	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C12	Capacitor, fixed, electrolytic, 1.0 uF, ±10%, 15 Vdc	1-900057-146	56289	150D105X0035A2
C13	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C14	Capacitor, fixed, plastic, 5100 pF, ±5%, 63 Vdc	1-900116-021	73445	2222/424/25102
C15	Capacitor, fixed, mica, 820 pF, ±5%, 300 Vdc	1-900003-054	72136	DM15-821J
C16	Capacitor, fixed, electrolytic, 5100 pF, ±5%, 63 Vdc	1-900116-021	73445	2222/424/25102
C17	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C18	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C19	Capacitor, fixed, mica, 180 pF, ±5%, 500 Vdc	1-900071-106	72136	DM10-181J
C20	Capacitor, fixed, mica, 180 pF, ±5%, 500 Vdc	1-900071-106	72136	DM10-181J
C21	Capacitor, fixed, mica, 680 pF, ±5%, 300 Vdc	1-900003-052	72136	DM15F681J
C22	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C23	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C24	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C25	Capacitor, fixed, mica, 330 pF, ±5%, 500 Vdc	1-900071-022	72136	DM10-331J
C26	Capacitor, fixed, mica, 10 pF, ±5%, 500 Vdc	1-900071-003	72136	DM10-100J
C27	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 100 Vdc	1-900077-002	56289	TG-S10
C28	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ± 250 ppm/°C	1-900113-001	91293	9302
C29	Capacitor, fixed, ceramic, 82 pF, ±5%, N750, 1000 Vdc	1-900067-020	72982	851/000U2J0/ 820J
C30	Capacitor, fixed, mica, 180 pF, ±5%, 500 Vdc	1-900071-106	72136	DM10-181J
C31	Capacitor, fixed, mica, 220 pF, ±5%, 500 Vdc	1-900071-017	72136	DM10-221J
C32	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C33	Capacitor, fixed, mica, 330 pF, ±5%, 500 Vdc	1-900071-022	72136	DM10-331J

Table 7-5. Parts List for Tuner 2 Assembly, A2 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C34	Capacitor, fixed, mica, 330 pF, ±5%, 500 Vdc	1-900071-022	72136	DM10-331J
C35	Capacitor, fixed, plastic, 4700 pF, ±5%, 63 Vdc	1-900116-020	73445	2222/424/24702
C36	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 100 Vdc	1-900077-002	56289	TG-S10
C37	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 100 Vdc	1-900077-002	56289	TG-S10
C38	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835/000/Y5U0/ 203Z
C39	Capacitor, fixed, mica, 100 pF, ±5%, 500 Vdc	1-900071-017	72136	DM10-100J
CR1	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
FL1	Bead, ferrite	1-906013-001	02114	5659065/4B
J1	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J2	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J3	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
L1	Inductor, fixed, toroid, 7 uH nominal	4-403394-007	88869	
L2	Inductor, fixed, toroid, 380 uH nominal	4-403394-009	88869	
L3	Inductor, fixed, 30 uH, ±5%, 255 mA	1-906014-026	99800	1537.50
L4	Inductor, fixed, 100 uH, 325 mA	1-906016-037	0000I	DR-100
L5	Inductor, fixed, 100 uH, 325 mA	1-906016-037	0000I	DR-100
L6	Inductor, fixed, 30 uH, ±5%, 255 mA	1-906014-026	99800	1537.50
L7	Inductor, fixed, 12 uH, 300 mA	1-906003-026	16407	DD-12.0
L8	Inductor, variable, 70 uH nominal	4-403395-002	88869	
L9	Inductor, variable, 25 uH nominal	4-403395-003	88869	
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, silicon, PNP	1-958082-001	07263	2N4250
Q2	Transistor, silicon, PNP	1-958082-001	07263	2N4250
Q3	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q4	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q5	Transistor, silicon, NPN	1-958078-001	01295	2N4997
R1	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01211	CB1015
R2	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R3	Resistor, fixed, composition, 910 ohm, ±5%, ¼ W	1-945000-161	01121	CB9115
R4	Resistor, fixed, composition, 51 ohm, ±5%, ¼ W	1-945000-131	01121	CB5105
R5	Resistor, fixed, composition, 1.8 k ohm, ±5%, ¼ W	1-945000-168	01121	CB1825
R6	Resistor, fixed, composition, 1.8 k ohm, ±5%, ¼ W	1-945000-168	01121	CB1825
R7	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
R8	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535
R9	Resistor, variable, cermet, 100 ohm, ±20%, ½ W	1-945037-004	80740	G2PR100
R10	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535
R11	Resistor, fixed, composition, 5.6 k ohm, ±5%, ¼ W	1-945000-180	01121	CB5625
R12	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315

Table 7-5. Parts List for Tuner 2 Assembly, A2 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R13	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R14	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R15	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R16	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R17	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R18	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R19	Resistor, fixed, composition, 470 ohm, ±5%, ¼ W	1-945000-154	01121	CB4715
R20	Resistor, fixed, composition, 30 k ohm, ±5%, ¼ W	1-945000-197	01121	CB3035
R21	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
R22	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
T1	Transformer, fixed, toroid, 380 uH nominal	1-004710-001	88869	
T2	Transformer, toroid, 54 uH nominal	4-403394-010	88869	
T3	Transformer, toroid, 20 uH nominal	4-403394-011	88869	
Z1	Mixer, double balanced	1-403393-001	88869	

Table 7-6. Parts List for Tuner 3 Assembly, A3

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ± 250 ppm/°C	1-900113-001	91293	9302
C2	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C3	Capacitor, variable, 2.8 pF to 10 pF, −600 ±300 ppm/°C	1-900117-001	91293	9312
C4	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C5	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C6	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C7	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C8	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C9	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C10	Capacitor, fixed, electrolytic, 1 uF, ±20%, 35 Vdc	1-900057-146	56289	150D105X0035A2
C11	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C12	Capacitor, fixed, plastic, 2400 pF, ±5%, 63 Vdc	1-900116-012	73445	2222/424/22402
C13	Capacitor, fixed, plastic, 2000 pF, ±5%, 63 Vdc	1-900116-010	73445	2222/424/22002
C14	Capacitor, fixed, plastic, 2400 pF, ±5%, 63 Vdc	1-900116-012	73445	2222/424/22402
C15	Capacitor, fixed, mica, 180 pF, ±5%, 500 Vdc	1-900071-106	72136	DM10-181J
C16	Capacitor, fixed, mica, 680 pF, ±5%, 300 Vdc	1-900003-052	72136	DM15-681J
C17	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C18	Capacitor, fixed, mica, 180 uF, ±5%, 500 Vdc	1-900071-106	72136	DM10-181J
C19	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C20	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C21	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C22	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C23	Capacitor, fixed, mica, 75 pF, ±5%, 500 Vdc	1-900071-012	72136	DM10-750J
C24	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C25	Capacitor, fixed, ceramic, 0.005 uF, ±20%, 100 Vdc	1-900077-001	56289	TG-D50
C26	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C27	Capacitor, fixed, plastic, 2000 pF, ±5%, 63 Vdc	1-900116-010	73445	2222/424/22002
C28	Capacitor, fixed, mica, 20 pF, ±5%, 500 Vdc	1-900071-005	72136	DM10-200J
C29	Capacitor, fixed, mica, 220 pF, ±5%, 500 Vdc	1-900071-017	72136	DM10-221J
C30	Capacitor, fixed, mica, 39 pF, ±5%, 500 Vdc	1-900072-013	72136	DM10-390J
C31	Capacitor, fixed, mica, 300 pF, ±5%, 500 Vdc	1-900072-028	72136	SCDM10-301J
C32	Capacitor, fixed, plastic, 2400 pF, ±5%, 63 Vdc	1-900116-012	73445	2222/424/22402

Table 7-6. Parts List for Tuner 3 Assembly, A3 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C33	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 100 Vdc	1-900077-002	56289	TG-S10
CR1	Diode, varactor, 300 pF	1-913075-001	01282	PQ1300B
CR2	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR3	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
FL1	Bead, ferrite	1-906013-001	02114	5659065/4B
J1	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J2	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J3	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
L1	Inductor, variable, 172 mH nominal	4-403395-004	88869	
L2	Inductor, variable, 180 mH nominal	4-403395-005	88869	
L3	Inductor, fixed, toroid, 155 mH nominal	4-403394-012	88869	
L4	Inductor, fixed, toroid, 5 uH nominal	4-403394-013	88869	
L5	Inductor, fixed, 0.68 uH, 600 mA	1-906003-011	16407	DD-0.68
L6	Inductor, variable, 70 uH nominal	4-403395-002	88869	
L7	Inductor, variable, 25 uH nominal	4-403395-003	88869	
L8	Inductor, variable, 1 mH, 139 mA	1-906016-049	0000I	DR-1000
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, silicon, PNP	1-958082-001	07263	2N4250
Q2	Transistor, silicon, PNP	1-958082-001	07263	2N4250
Q3	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q4	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q5	Transistor, silicon, NPN	1-958078-001	01295	2N4997
R1	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R2	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R3	Resistor, fixed, composition, 910 ohm, ±5%, ¼ W	1-945000-161	01121	CB9115
R4	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R5	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R6	Resistor, fixed, composition, 51 ohm, ±5%, ¼ W	1-945000-131	00121	CB5105
R7	Resistor, fixed, composition, 1.8 k ohm, ±5%, ¼ W	1-945000-168	01121	CB1825
R8	Resistor, fixed, composition, 1.8 k ohm, ±5%, ¼ W	1-945000-168	01121	CB1825
R9	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
R10	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535
R11	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535
R12	Resistor, fixed, composition, 5.6 k ohm, ±5%, ¼ W	1-945000-180	01121	CB5625
R13	Resistor, variable, cermet, 100 ohm, ±20%, ½ W	1-945037-004	80740	62PR100
R14	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R15	Resistor, fixed, composition, 510 ohm, ±5%, ¼ W	1-945000-155	01121	CB5115
R16	Resistor, fixed, composition, 33 k ohm, ±5%, ¼ W	1-945000-198	01121	CB3335

Table 7-6. Parts List for Tuner 3 Assembly, A3 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R17	Resistor, variable, cermet, 2 k ohm, ±20%, ½ W	1-945037-008	80740	62PR2K
R18	Resistor, variable, cermet, 50 k ohm, ±20%, ½ W	1-945037-013	80740	62PR50K
R19	Resistor, fixed, composition, 20 k ohm, ±5%, ¼ W	1-945000-193	01121	CB2035
R20	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R21	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R22	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R23	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R24	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R25	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R26	Resistor, fixed, composition, 220 ohm, ±5%, ¼ W	1-945000-146	01121	CB2215
R27	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
T1	Transformer, variable, 240 uH nominal	4-403395-006	88869	
T2	Transformer, toroid, 54 uH nominal	4-403394-010	88869	
T3	Transformer, toroid, 20 uH nominal	4-403394-014	88869	
Z1	Mixer, double balanced	1-403393-001	88869	

Table 7-7. Parts List for Tuner 4 Assembly, A4

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C2	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91291	9302
C3	Capacitor, variable, ceramic, 1.7 pF to 10 pF, +100 ±250 ppm/°C	1-900113-002	91293	9301
C4	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C5	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C6	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C7	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C8	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C9	Capacitor, fixed, mica, 820 pF, ±5%, 300 Vdc	1-900003-054	72136	DMI5F821J
C10	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C11	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C12	Capacitor, fixed, ceramic, 0.02 pF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C13	Capacitor, fixed, mica, 390 pF, ±5%, 500 Vdc	1-900071-022	72136	DM10-391J
C14	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C15	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C16	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C17	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C18	Capacitor, fixed, plastic, 3000 pF, ±5%, 63 Vdc	1-900116-015	73445	2222/424/23002
C19	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900075-171	56289	150D335X9015A2
C20	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C21	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 100 Vdc	1-900077-002	56289	TG-S10
C22	Capacitor, fixed, mica, 100 pF, ±5%, 500 Vdc	1-900071-013	72136	DM10-101J
C23	Capacitor, fixed, mica, 33 pF, ±5%, 500 Vdc	1-900071-104	72136	DM10-330J
C24	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C25	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C26	Capacitor, fixed, ceramic, 0.005 uF, ±20%, 100 Vdc	1-900077-001	56289	TG-D50
C27	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C28	Capacitor, fixed, plastic, 1300 pF, ±5%, 63 Vdc	1-900116-006	73445	2222/424/21302
C29	Capacitor, fixed, mica, 220 pF, ±5%, 500 Vdc	1-900071-017	72136	DM10-221J
C30	Capacitor, fixed, mica, 270 pF, ±5%, 500 Vdc	1-900072-027	72136	SDCM10-271J

Table 7-7. Parts List for Tuner 4 Assembly, A4 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C31	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 100 Vdc	1-900077-002	56289	TG-S10
C32	Capacitor, fixed, plastic, 4700 pF, ±5%, 63 Vdc	1-900116-020	73445	2222/424/24702
C33	Capacitor, fixed, ceramic, 390 pF, N1500, ±250 ppm/°C	1-900119-001	72982	8131A100P3K391J
C34	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	10900003-056	72136	DM15F102J
CR1	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR2	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR3	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR4	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
J1	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J2	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J3	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
L1	Inductor, fixed, toroid, 58 uH nominal	4-403394-015	88869	
L2	Inductor, fixed, toroid, 172 uH nominal	4-403394-004	88869	
L3	Inductor, variable, 430 uH nominal	4-403395-007	88869	
L4	Inductor, variable, 69 uH nominal	4-403395-008	88869	
L5	Inductor, fixed, toroid, 110 uH nominal	4-403394-016	88869	
L6	Inductor, variable, 150 uH nominal	4-403395-011	88869	
L7	Inductor, fixed, toroid, 0.27 uH nominal	4-403394-017	88869	
L8	Inductor, fixed, 6.8 uH	1-906003-023	16407	DD-6.80
L9	Inductor, fixed, 15 uH, 275 mA	1-906003-027	16407	DD-15.0
L10	Inductor, fixed, toroid, 32 uH nominal	4-403394-018	88869	
L11	Inductor, variable, 25 uH nominal	4-403395-003	88869	
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, silicon, PNP type	1-958082-001	07263	2N4250
Q2	Transistor, silicon, PNP type	1-958082-001	07263	2N4250
Q3	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q4	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q5	Transistor, silicon, NPN	1-958078-001	01295	2N4997
R1	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R2	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R3	Resistor, fixed, composition, 1.3 k ohm, ±5%, ¼ W	1-945000-165	01121	CB1325
R4	Resistor, fixed, composition, 33 ohm, ±5%, ¼ W	1-945000-126	01121	CB3305
R5	Resistor, fixed, composition, 1.8 k ohm, ±5%, ¼ W	1-945000-168	01121	CB1825
R6	Resistor, fixed, composition, 1.8 k ohm, ±5%, ¼ W	1-945000-168	01121	CB1825
R7	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R8	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R9	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R10	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725

Table 7-7. Parts List for Tuner 4 Assembly, A4 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R11	Resistor, fixed, composition, 220 ohm, ±5%, ¼ W	1-945000-146	01121	CB2215
R12	Resistor, fixed, composition, 220 ohm, ±5%, ¼ W	1-945000-146	01121	CB2215
R13	Resistor, variable, cermet, 100 ohm, ±20%, ½ W	1-945037-004	80740	62PR100
R14	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535
R15	Resistor, fixed, composition, 5.6 k ohm, ±5%, ¼ W	1-945000-180	01121	CB5625
R16	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R17	Resistor, fixed, composition, 510 ohm, ±5%, ¼ W	1-945000-155	01121	CB5115
R18	Resistor, variable, cermet, 50 k ohm, ±20%, ½ W	1-945037-013	80740	62PR50K
R19	Resistor, fixed, composition, 33 k ohm, ±5%, ¼ W	1-945000-198	01121	CB3335
R20	Resistor, variable, cermet, 2 k ohm, ±20%, ½ W	1-945037-008	80740	62PR2K
R21	Resistor, fixed, composition, 20 k ohm, ±5%, ¼ W	1-945000-193	01121	CB2035
R22	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R23	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R24	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R25	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R26	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R27	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R28	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R29	Resistor, fixed, composition, 220 ohm, ±5%, ¼ W	1-945000-146	01121	CB2215
R30	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
T1	Transformer, variable, 40 uH nominal	4-403395-009	88869	
T2	Transformer, variable, 125 uH nominal	4-403395-010	88869	
T3	Transformer, fixed, toroid, 32 uH	4-403394-019	88869	
Z1	Mixer, double balanced	1-403393-001	88869	

Table 7-8. Parts List for Tuner 5 Assembly, A5

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250ppm/°C	1-900113-001	91293	9302
C2	Not used			
C3	Capacitor, variable, ceramic, 2.8 pF to 10 pF, –600 ±300 ppm/°C	1-900117-001	91293	9312
C4	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C5	Not used			
C6	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C7	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C8	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C9	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C10	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C11	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	79282	5835000Y5U 0203Z
C12	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C13	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C14	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ± 250ppm/°C	1-900113-001	91293	9302
C15	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C16	Capacitor, fixed, plastic, 6200 pF, ±5%, 63 Vdc	1-900116-023	73445	2222/424/26202
C17	Capacitor, fixed, mica, 820 pF, ±5%, 300 Vdc	1-900003-054	72136	DM15F821J
C18	Capacitor, fixed, mica, 250 pF, ±5%, 500 Vdc	1-900071-018	72136	DM10-251J
C19	Capacitor, fixed, mica, 180 pF, ±5%, 500 Vdc	1-900072-023	72136	SCDM10-181J
C20	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C21	Capacitor, fixed, mica, 200 pF, ±5%, 500 Vdc	1-900071-016	72136	DM10-201J
C22	Capacitor, fixed, mica, 620 pF, ±5%, 300 Vdc	1-900003-051	72136	DM15F621J
C23	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C24	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C25	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C26	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C27	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C28	Capacitor, fixed, mica, 24 pF, ±5%, 500 Vdc	1-900076-007	72136	DM10-240J
C29	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C30	Capacitor, fixed, plastic, 6200 pF, ±5%, 63 Vdc	1-900116-023	73445	2222/424/26202

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C31	Capacitor, fixed, mica, 430 pF, ±5%, 500 Vdc	1-900003-046	72136	DM15F431J
C32	Capacitor, fixed, ceramic, 390 pF, N1500 ±250 ppm/°C	1-900119-001	72982	8131A100P3K391J
C33	Capacitor, fixed, mica, 470 pF, ±5%, 500 Vdc	1-900003-047	72136	DM15F471J
C34	Capacitor, fixed, mica, 120 pF, ±5%, 500 Vdc	1-900071-014	72136	DM10-121J
C35	Capacitor, fixed, mica, 120 pF, ±5%, 500 Vdc	1-900071-014	72136	DM10-121J
C36	Capacitor, fixed, ceramic, 0.01 uF, ±10%, 100 Vdc	1-900077-002	56289	TG-S10
C37	Not used			
C38	Capacitor, fixed, mica, 10 pF, ±5%, 500 Vdc	1-900071-003	72136	DM10-100J
CR1	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR2	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR3	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR4	Diode, varactor, 300 pF	1-913075-001	01271	PQ1300B
FL1	Bead, ferrite	1-906013-001	02114	5659065/4B
J1	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J2	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J3	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
L1	Inductor, fixed, toroid, 22 uH	4-403394-020	88869	
L2	Inductor, variable, 29 uH nominal	4-403395-012	88869	
L3	Inductor, variable, 125 uH nominal	4-403395-013	88869	
L4	Inductor, variable, 15 uH nominal	4-403395-019	88869	
L5	Inductor, fixed, toroid, 56 uH	4-403394-021	88869	
L6	Inductor, fixed, 15 uH, 275 mA	1-906003-027	16407	DD-15.0
L7	Inductor, variable, 1.6 uH nominal	4-403395-015	88869	
L8	Inductor, variable, 14.5 uH nominal	4-403395-016	88869	
L9	Inductor, variable, 70 uH nominal	4-403395-002	88869	
L10	Inductor, variable, 7 uH nominal	4-403395-018	88869	
L11	Inductor, fixed, 12 uH, 300 mA	1-906003-026	16407	DD-12.0
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, silicon, PNP	1-958082-001	07263	2N4250
Q2	Transistor, silicon, PNP	1-958082-001	07263	2N4250
Q3	Transistor, silicon NPN	1-958078-001	01295	2N4997
Q4	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q5	Transistor, silicon, NPN	1-958078-001	01295	2N4997
R1	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R2	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R3	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R4	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R5	Resistor, fixed, composition, 180 ohm, ±5%, ¼ W	1-945000-144	01121	CB1815

Table 7-8. Parts List for Tuner 5 Assembly, A5 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R6	Resistor, fixed, composition, 2.7 k ohm, ±5%, ¼ W	1-945000-172	01121	CB2725
R7	Resistor, fixed, composition, 1.5 k ohm, ±5%, ¼ W	1-945000-166	01121	CB1525
R8	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
R9	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R10	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R11	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	02212	CB4725
R12	Resistor, fixed, composition, 5.6 k ohm, ±5%, ¼ W	1-945000-180	01121	CB5625
R13	Resistor, variable, cermet, 500 ohm, ±20%, ½ W	1-945037-006	80740	62PR500
R14	Resistor, fixed, composition, 22 ohm, ±5%, ¼ W	1-945000-122	01121	CB2205
R15	Resistor, fixed, composition, 510 ohm, ±5%, ¼ W	1-945000-155	01121	CB5115
R16	Resistor, fixed, composition, 33 k ohm, ±5%, ¼ W	1-945000-198	01121	CB3335
R17	Resistor, variable, cermet, 50 k ohm, ±20%, ½ W	1-945037-013	80740	62PR50K
R18	Resistor, variable, cermet, 2 k ohm, ±20%, ½ W	1-945037-008	80740	62PR2K
R19	Resistor, fixed, composition, 20 k ohm, ±5%, ¼ W	1-945000-203	01121	CB2035
R20	Resistor, fixed, composition, 68 k ohm, ±5%, ¼ W	1-945000-206	01121	CB6835
R21	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R22	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R23	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R24	Resistor, fixed, composition, 2.7 k ohm, ±5%, ¼ W	1-945000-172	01121	CB2725
R25	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R26	Resistor, fixed, composition, 470 ohm, ±5%, ¼ W	1-945000-154	01121	CB4715
R27	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
R28	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535
T1	Transformer, variable, 11.5 uH nominal	4-403395-014	88869	
T2	Transformer, toroid, 54 uH	4-403394-010	88869	
T3	Transformer, toroid, 32 uH	4-403394-019	88869	
Z1	Mixer, double balanced	1-403393-001	88869	

Table 7-9. Parts List for Tuner 6 Assembly, A6

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C2	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C3	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C4	Capacitor, variable, ceramic, 2.8 pF to 10 pF, −600 ±300 ppm/°C	1-900117-001	91293	9312
C5	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C6	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C7	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C8	Capacitor, fixed, mica, 330 pF, ±5%, 500 Vdc	1-900071-022	72136	DM10-331J
C9	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C10	Capacitor, fixed, electrolytic, 3.3 uF ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C11	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C12	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C13	Capacitor, fixed, mica, 100 pF, ±5%, 500 Vdc	1-900071-013	72136	DM10-101J
C14	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C15	Capacitor, fixed, mica, 15 pF, ±5%, 500 Vdc	1-900071-004	72136	DM10-150J
C16	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C17	Capacitor, fixed, plastic, 2000 pF, ±5%, 63 Vdc	1-900116-010	73445	2222/424/22402
C18	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C19	Capacitor, fixed, mica, 180 pF, ±5%, 500 Vdc	1-900071-106	72136	DM10-181J
C20	Capacitor, fixed, mica, 200 pF, ±5%, 500 Vdc	1-900071-016	72136	DM10-201J
C21	Capacitor, fixed, mica, 680 pF, ±5%, 300 Vdc	1-900003-052	72136	DM15F681J
C22	Capacitor, fixed, mica, 680 pF, ±5%, 300 Vdc	1-900003-052	72136	DM15F681J
C23	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C24	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C25	Capacitor, fixed, mica, 270 pF, ±5%, 500 Vdc	1-900071-020	72136	DM10-271J
C26	Capacitor, fixed, mica, 39 pF, ±5%, 500 Vdc	1-900071-110	72136	DM10-390J
C27	Capacitor, fixed, ceramic, 0.005 uF, ±20%, 100 Vdc	1-900077-001	56289	TG-D50
C28	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z
C29	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C30	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U 0203Z

Table 7-9. Parts List for Tuner 6 Assembly, A6 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C31	Capacitor, fixed, plastic, 1600 pF, ±5%, 63 Vdc	1-900116-008	73445	2222/424/21602
C32	Capacitor, fixed, mica, 220 pF, ±5%, 500 Vdc	1-900071-017	72136	DM10-221J
C33	Capacitor, fixed, mica, 680 pF, ±5%, 300 Vdc	1-900003-052	72136	DM15F681J
C34	Capacitor, fixed, mica, 43 pF, ±5%, 500 Vdc	1-900071-108	72136	DM10-430J
C35	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 100 Vdc	1-900077-002	56289	TG-S10
CR1	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR2	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR3	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR4	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
FL1	Bead, ferrite	1-906013-001	02114	5659065/4B
J1	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J2	Connector, jack UG-1455/U	1-910139-002	98291	510450000
J3	Connector, jack UG-1455/U	1-910139-002	98291	510450000
L1	Inductor, fixed, toroid, 7.1 uH	4-403394-022	88869	
L2	Inductor, variable, 4.3 uH nominal	4-403395-020	88869	
L3	Inductor, variable, 19 uH nominal	4-403395-021	88869	
L4	Inductor, variable, 3.3 uH nominal	4-403395-022	88869	
L5	Inductor, fixed, toroid, 11.7 uH	4-403394-023	88869	
L6	Inductor, fixed, 6.8 uH, 350 mA	1-906003-023	16407	DD-6.80
L7	Inductor, fixed, 3.3 uH, 575 mA	1-906003-019	16407	DD-3.30
L8	Inductor, variable, 5 uH nominal	4-403395-024	88869	
L9	Inductor, variable, 70 uH nominal	4-403395-002	88869	
L10	Inductor, variable, 1.67 uH nominal	4-403395-025	88869	
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, silicon, PNP	1-958082-001	07263	2N4250
Q2	Transistor, silicon, PNP	1-958082-001	07263	2N4250
Q3	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q4	Transistor, sliicon, NPN	1-958078-001	01295	2N4997
Q5	Transistor, silicon, NPN	1-958078-001	01295	2N4997
R1	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R2	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R3	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R4	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R5	Resistor, fixed, composition, 1.8 k ohm, ±5%, ¼ W	1-945000-168	01121	CB1825
R6	Resistor, fixed, composition, 22 ohm, ±5%, ¼ W	1-945000-122	01121	CB2205
R7	Resistor, fixed, composition, 1.8 k ohm, ±5%, ¼ W	1-945000-168	01121	CB1825
R8	Resistor, fixed, composition, 1.8 k ohm, ±5%, ¼ W	1-945000-168	01121	CB1825
R9	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015

Table 7-9. Parts List for Tuner 6 Assembly, A6 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R10	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R11	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535
R12	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
R13	Resistor, fixed, composition, 1.5 k ohm, ±5%, ¼ W	1-945000-166	01121	CB1525
R14	Resistor, variable, cermet, 100 ohm, ±20%, ½ W	1-945037-004	80740	62PR100
R15	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535
R16	Resistor, fixed, composition, 5.6 k ohm, ±5%, ¼ W	1-945000-180	01121	CB5625
R17	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R18	Resistor, fixed, composition, 510 ohm, ±5%, ¼ W	1-945000-155	01121	CB5115
R19	Resistor, fixed, composition, 33 k ohm, ±5%, ¼ W	1-945000-198	01121	CB3335
R20	Resistor, variable, cermet, 50 k ohm, ±20%, ½ W	1-945037-013	80740	62PR50K
R21	Resistor, variable, cermet, 2 k ohm, ±20%, ½ W	1-945037-008	80740	62PR2K
R22	Resistor, fixed, composition, 20 k ohm, ±5%, ¼ W	1-945000-193	01121	CB2035
R23	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R24	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R25	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R26	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R27	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R28	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R29	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R30	Resistor, fixed, composition, 220 ohm, ±5%, ¼ W	1-945000-146	01121	CB2215
R31	Resistor, fixed, composition, 27 ohm, ±5%, ¼ W	1-945000-124	01121	CB2705
R32	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
T1	Transformer, variable, 3 uH nominal	4-403395-023	88869	
T2	Transformer, fixed, toroid, 54 uH	4-403394-010	88869	
T3	Transformer, fixed, toroid, 12.5 uH	4-403394-024	88869	
Z1	Mixer, double balanced	1-403393-001	88869	

Table 7-10. Parts List for Tuner 7 Assembly, A7

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C2	Capacitor, variable, ceramic, 2.8 pF to 10 pF, -600 ±300 ppm/°C	1-900117-001	91293	9312
C3	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C4	Not used			
C5	Capacitor, fixed, mica, 10 pF, ±5%, 500 Vdc	1-900071-003	72136	DM10-100J
C6	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C7	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C8	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C9	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C10	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C11	Capacitor, fixed, mica, 39 pF, ±5%, 500 Vdc	1-900072-013	72136	SCDM10-390J
C12	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C13	Capacitor, fixed electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C14	Capacitor, fixed, ceramic, 0.005 uF, ±20%, 100 Vdc	1-900077-001	56289	TG-D50
C15	Capacitor, fixed, mica, 15 pF, ±5%, 500 Vdc	1-900071-004	72136	DM10-150J
C16	Capacitor, variable, ceramic, 2.8 pF to 10 pF, -600 ±300 ppm/°C	1-900117-001	91293	9312
C17	Capacitor, fixed, plastic, 2000 pF, ±5%, 63 Vdc	1-900116-010	73445	2222/424/22002
C18	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C19	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C20	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C21	Capacitor, fixed, mica, 56 pF, ±5%, 500 Vdc	1-900071-105	72136	DM10-560J
C22	Capacitor, fixed, ceramic, 0.02 uF, ±20% 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C23	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C24	Capacitor, fixed, ceramic, 0.022 uF, ±10%, 100 Vdc	1-900104-004	00656	3420/100C/223K
C25	Capacitor, fixed, mica, 470 pF, ±5%, 500 Vdc	1-900003-047	72136	DM15F471J
C26	Capacitor, fixed, mica, 47 pF, ±5%, 500 Vdc	1-900071-009	72136	DM10 470J
C27	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C28	Capacitor, fixed, ceramic, 0.005 uF, ±20% 100 Vdc	1-900077-001	56289	TG-D50
C29	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C30	Not used			
C31	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C32	Capacitor, fixed, mica, 220 pF, ±5%, 500 Vdc	1-900071-017	72136	DM10-221J
C33	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C34	Capacitor, fixed, mica, 470 pF, ±5%, 500 Vdc	1-900003-047	72136	DM15F471J
C35	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C36	Capacitor, fixed, mica, 22 pF, ±5%, 500 Vdc	1-900071-006	72982	DM10-220J
C37	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C38	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C39	Capacitor, fixed, ceramic, 0.005 uF, ±20%, 100 Vdc	1-900077-001	56289	TG-D50
C40	Capacitor, fixed, mica, 120 pF, ±5%, 500 Vdc	1-900071-014	72136	DM10-121J
C41	Capacitor, fixed, mica, 510 pF, ±5%, 500 Vdc	1-900003-049	72136	DM15
CR1	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR2	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR3	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
CR4	Diode, varactor, 300 pF	1-913075-001	01281	PQ1300B
FL1	Bead, ferrite	1-906013-001	02114	5659065/4B
FL2	Bead, ferrite	1-906013-001	02114	5659065/4B
FL3	Bead, ferrite	1-906013-001	02114	5659065/4B
J1	Connector, plug, UG-1455/U	1-910139-002	98291	510450000
J2	Connector, plug, UG-1455/U	1-910139-002	98291	510450000
J3	Connector, plug, UG-1455/U	1-910139-002	98291	510450000
L1	Inductor, fixed, toroid, 2.6 uH	4-403394-025	88869	
L2	Inductor, variable, 0.86 uH nominal	4-403395-026	88869	
L3	Inductor, variable, 8 uH nominal	4-403395-027	88869	
L4	Inductor, variable, 0.73 uH nominal	4-403395-028	88869	
L5	Inductor, variable, 3.8 uH nominal	4-403394-026	88869	
L6	Inductor, variable, 27 uH nominal	4-403395-029	88869	
L7	Inductor, fixed, 2.2 uH, 760 mA	1-906003-017	16407	DD-2.2
L8	Inductor, fixed, 1.0 uH, 475 mA	1-906003-013	16407	DD-1.0
L9	Inductor, variable, 1.5 uH nominal	4-403395-031	88869	
L10	Inductor, variable, 0.4 uH nominal	4-403395-032	88869	
L11	Not used			
L12	Inductor, fixed, 1.2 uH	1-906003-014	16407	DD-1.2
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q2	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q3	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q4	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q5	Transistor, silicon, NPN	1-958078-001	01295	2N4997
R1	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R2	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R3	Resistor, fixed, composition, 1.8 k ohm, ±5%, ¼ W	1-945000-168	01121	CB1825
R4	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R5	Resistor, fixed, composition, 22 ohm, ±5%, ¼ W	1-945000-122	01121	CB2205

Table 7-10. Parts List for Tuner 7 Assembly, A7 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R6	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R7	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R8	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R9	Resistor, fixed, composition, 1.5 k ohm, ±5% ¼ W	1-945000-166	01121	CB1525
R10	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R11	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R12	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R13	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535
R14	Resistor, fixed, composition, 5.6 k ohm, ±5%, ¼ W	1-945000-180	01121	CB5625
R15	Resistor, variable, cermet, 100 ohm, ±20%, ½ W	1-945037-004	80740	62PR100
R16	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R17	Resistor, fixed, composition, 510 ohm, ±5%, ¼ W	1-945000-155	01121	CB5115
R18	Resistor, fixed, composition, 33 k ohm, ±5%, ¼ W	1-945000-198	01121	CB3335
R19	Resistor, variable, cermet, 50 k ohm, ±20%, ½ W	1-945037-013	80740	62PR50K
R20	Resistor, variable, cermet, 2 k ohm, ±20%, ½ W	1-945037-008	80740	62PR2K
R21	Resistor, fixed, composition, 20 k ohm, ±5%, ¼ W	1-945000-193	01121	CB2035
R22	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R23	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R24	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R25	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R26	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R27	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R28	Resistor, fixed, composition, 680 ohm, ±5%, ¼ W	1-945000-158	01121	CB6815
R29	Resistor, fixed, composition, 220 ohm, ±5%, ¼ W	1-945000-146	01121	CB2215
R30	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
T1	Transformer, variable, 1.2 uH nominal	4-403395-030	88869	
T2	Transformer, fixed, toroid, 17 uH	4-403394-027	88869	
T3	Transformer, fixed, toroid, 5.4 uH	4-403394-028	88869	
Z1	Mixer, double balanced	1-403393-001	88869	

Table 7-11. Parts List for Tuner 8 Assembly, A8

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 100 Vdc	1-900077-002	56289	TG-S10
C2	Capacitor, variable, glass, 1 pF to 10 pF, 500 Vdc	1-900063-001	91293	7341A
C3	Capacitor, variable, glass, 1 pF to 10 pF, 500 Vdc	1-900063-001	91293	7341A
C4	Capacitor, variable, glass, 1 pF to 10 pF, 500 Vdc	1-900063-001	91293	7341A
C5	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 100 Vdc	1-900077-002	56289	TG-S10
C6	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C7	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C8	Capacitor, fixed, ceramic, 4.3 pF, ±10%, 600 Vdc	1-900066-037	95121	MC-4.3
C9	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C10	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C11	Capacitor, fixed, mica, 39 pF, ±5%, 500 Vdc	1-900071-110	72136	DM10-390J
C12	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C13	Capacitor, fixed, ceramic, 0.005 uF, ±20%, 100 Vdc	1-900077-001	56289	TG-D50
C14	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 100 Vdc	1-900077-002	56289	TG-S10
C15	Capacitor, variable, glass, 1 pF to 10 pF, 500 Vdc	1-900063-001	91293	7341A
C16	Capacitor, fixed, plastic, 2000 pF, ±5%, 63 Vdc	1-900116-010	73445	2222/424/22002
C17	Capacitor, fixed, plastic, 1200 pF, ±5%, 63 Vdc	1-900116-005	73445	2222/424/21202
C18	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C19	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C20	Capacitor, fixed, mica, 56 pF, ±5%, 500 Vdc	1-900071-105	72136	DM10-560J
C21	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C22	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C23	Capacitor, fixed, mica, 33 pF, ±5%, 500 Vdc	1-900071-104	72136	DM10-330J
C24	Capacitor, fixed, ceramic, 1.0 pF, ±10%, 600 Vdc	1-900066-023	95121	MC-1.0
C25	Capacitor, fixed, ceramic 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C26	Capacitor, variable, glass, 1 pF to 10 pF, 500 Vdc	1-900063-001	91293	7341A
C27	Capacitor, fixed, mica, 250 pF, ±5%, 500 Vdc	1-900071-018	72136	DM10-251J
C28	Capacitor, fixed, ceramic, 0.005 uF, ±20% 100 Vdc	1-900077-001	56289	TG-D50
C29	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C30	Capacitor, fixed, mica, 620 pF, ±5%, 300 Vdc	1-900003-051	72136	DM15F621J
C31	Capacitor, fixed, mica, 620 pF, ±5%, 300 Vdc	1-900003-051	72136	DM15F621J
C32	Capacitor, fixed, mica, 10 pF, ±5%, 500 Vdc	1-900071-003	72136	DM10-100J
C33	Capacitor, fixed, ceramic, 0.01 uF, ±20%, 100 Vdc	1-900077-002	56289	TG-S10
C34	Capacitor, fixed, ceramic, 0.005 uF, ±20%, 100 Vdc	1-900077-001	56289	TG-D50
CR1	Diode, varactor, 47 pF	1-913064-001	04713	1N5148A
CR2	Diode, varactor, 47 pF	1-913064-001	04713	1N5148A
CR3	Diode, varactor, 47 pF	1-913064-001	04713	1N148A

Table 7-11. Parts List for Tuner 8 Assembly, A8 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
CR4	Diode, varactor, 47 pF	1-913064-001	04713	1N5148A
FL1	Bead, ferrite	1-906013-001	02114	5659065/4B
FL2	Bead, ferrite	1-906013-001	02114	5659065/4B
J1	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J2	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J3	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
L1	Inductor, fixed, toroid, 3.5 uH	4-403394-029	88869	
L2	Inductor, fixed, 1.0 uH, 475 mA	1-906003-013	16407	DD-1.0
L3	Inductor, variable, 5 uH, nominal	4-403395-034	88869	
L4	Inductor, fixed, toroid, 6.7 uH	4-403394-030	88869	
L5	Inductor, fixed, 2.2 uH, 760 mA	1-906003-017	16407	DD-2.2
L6	Inductor, fixed, 4.7 uH, 475 mA	1-906003-021	16407	DD-4.7
L7	Inductor, fixed, 27 uH, 200 mA	1-906016-030	0000I	DR-27
L8	Inductor, fixed, 1.0 uH, 475 mA	1-906003-013	16407	DD-1.0
L9	Inductor, fixed, toroid 0.56 uH	4-403394-031	88869	
L10	Inductor, variable, 1.5 uH nominal	4-403395-031	88869	
L11	Inductor, variable, 1.14 uH nominal	4-403395-037	88869	
P1	Connector, plug 9 pin	2-103549-001	88869	
Q1	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q2	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q3	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q4	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q5	Transistor, silicon, NPN	1-958078-001	01295	2N4997
R1	Resistor, fixed, composition, 33 ohm, ±5%, ¼ W	1-945000-126	01121	CB3305
R2	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R3	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R4	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R5	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R6	Resistor, fixed, composition 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R7	Resistor, fixed, composition, 820 ohm, ±5%, ¼ W	1-945000-160	01121	CB8215
R8	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R9	Resistor, fixed, composition, 10 ohm, ±5%, ¼ W	1-945000-114	01121	CB1005
R10	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R11	Resistor, fixed, composition, 1.5 k ohm, ±5%, ¼ W	1-945000-166	01121	CB1525
R12	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R13	Resistor, fixed, composition, 10 k ohm, ±5%,,¼ W	1-945000-186	01121	CB1035
R14	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R15	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R16	Resistor, fixed, composition, 5.6 k ohm, ±5%, ¼ W	1-945000-180	01121	CB5625
R17	Resistor, variable, cermet, 100 ohm, ±20%, ½ W	1-945037-004	80740	62PR100
R18	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R19	Resistor, fixed, composition, 510 ohm, ±5%, ¼ W	1-945000-155	01121	CB5115
R20	Resistor, fixed, composition, 33 k ohm, ±5%, ¼ W	1-945000-198	01121	CB3335
R21	Resistor, variable, cermet, 50 k ohm, ±20%, ½ W	1-945037-013	80740	62PR50K
R22	Resistor, variable, cermet, 2 k ohm, ±20%, ½ W	1-945037-008	80740	62PR2K
R23	Resistor, fixed, composition, 20 k ohm, ±5%, ¼ W	1-945000-193	01121	CB2035
R24	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R25	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R26	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R27	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R28	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R29	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R30	Resistor, fixed, composition, 22 ohm, ±5%, ¼ W	1-945000-122	01121	CB2205
R31	Resistor, fixed, composition, 680 ohm, ±5%, ¼ W	1-945000-158	01121	CB6815
R32	Resistor, fixed, composition, 220 ohm, ±5%, ¼ W	1-945000-146	01121	CB2215
R33	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
T1	Transformer, variable, 3 uH nominal	4-403395-033	88869	
T2	Transformer, variable, 1.9 uH nominal	4-403395-036	88869	
T3	Transformer, variable, 1.6 uH nominal	4-403395-036	88869	
T4	Transformer, fixed, toroid, 17 uH	4-403394-027	88869	
T5	Transformer, fixed, toroid, 5.4 uH	4-403394-028	88869	
Z1	Mixer, double balanced	1-403393-001	88869	

Table 7-12. Parts List for RF Input Switch and Impulse Calibrator Assembly, A9

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, mica, 75 pF, ±5%, 500 Vdc	1-900071-012	72136	DM10-750J
C2	Capacitor, fixed, mica, 120 pF, ±5%, 500 Vdc	1-900071-014	72136	DM10-121J
C3	Capacitor, fixed, mica, 150 pF, ±5%, 500 Vdc	1-900071-015	72136	DM10-151J
C4	Capacitor, fixed, mica, 120 pF, ±5%, 500 Vdc	1-900071-014	72136	DM10-121J
C5	Capacitor, fixed, mica, 75 pF, ±5%, 500 Vdc	1-900071-012	72136	DM10-750J
C6	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C7	Capacitor, fixed, electrolytic, 22 uF, ±10%, 15 Vdc	1-900057-181	56289	150D22X0015B2
C8	Capacitor, fixed, plastic, 0.15 uF, ±10%, 200 Vdc	1-900015-056	56289	192P15492
C9	Capacitor, fixed, mica, 120 pF, ±5%, 500 Vdc	1-900071-014	72136	DM10-121J
C10	Capacitor, fixed, mica, 15 pF, ±5%, 500 Vdc	1-900071-004	72136	DM10-150J
C11	Capacitor, fixed, mica, 15 pF, ±5%, 500 Vdc	1-900071-004	72136	DM10-150J
C12	Capacitor, fixed, mica, 15 pF, ±5%, 500 Vdc	1-900071-004	72136	DM10-150J
C13	Capacitor, fixed, mica, 10 pF, ±5%, 500 Vdc	1-900071-003	72136	DM10-100J
C14	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C15	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U0203Z
C16	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U203Z
C17	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U203Z
C18	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U203Z
C19	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U203Z
C20	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U203Z
C21	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U203Z
C22	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835000Y5U203Z
DL1	Delay line	1-103665-001	88869	
J1	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J2	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J3	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J4	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J5	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J6	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J7	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J8	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J9	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
K1	Relay, reed, SPST	1-942014-004	0000G	1A12AH
K2	Relay, reed, SPST	1-942014-004	0000G	1A12AH
K3	Relay, reed, SPST	1-942014-004	0000G	1A12AH
K4	Relay, reed, SPST	1-942014-004	0000G	1A12AH
K5	Relay, reed, SPST	1-942014-004	0000G	1A12AH
K6	Relay, reed, SPST	1-942014-004	0000G	1A12AH

Table 7-12. Parts List for RF Input Switch and Impulse Calibrator Assembly, A9 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
K7	Relay, reed, SPST	1-942014-004	0000G	1A12AH
K8	Relay, reed, SPST	1-942014-004	0000G	1A12AH
K9	Relay, reed, SPDT	1-942014-101	0000G	1C12AH
K10	Relay, reed, SPDT	1-942014-101	0000G	1C12AH
L1	Inductor, fixed, toroid, 0.18 uH	4-403394-032	88869	
L2	Inductor, fixed, toroid, 0.47 uH	4-403394-033	88869	
L3	Inductor, fixed, toroid, 0.47 uH	4-403394-033	88869	
L4	Inductor, fixed, toroid, 0.18 uH	4-403394-032	88869	
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, silicon, NPN	1-958034-001	07263	2N3646
Q2	Transistor, silicon, NPN	1-958034-001	07263	2N3646
R1	Resistor, fixed, composition, selected, 1.3 k ohm nominal, ±5%, ¼ W	1-945000-165	01121	CB1325
R2	Resistor, fixed, composition, 5.6 k ohm, ±5%, ¼ W	1-945000-180	01121	CB5625
R3	Resistor, fixed, composition, 39 k ohm, ±5%, ¼ W	1-945000-200	01121	CB3935
R4	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R5	Resistor, fixed, composition, 33 k ohm, ±5%, ¼ W	1-945000-198	01121	CB3335
R6	Resistor, fixed, composition, 1 M ohm, ±5%, ¼ W	1-945000-234	01121	CB1055
R7	Resistor, fixed, composition, 5.6 k ohm, ±5%, ¼ W	1-945000-180	01121	CB5625
R8	Resistor, fixed, composition, 33 ohm, ±5%, ¼ W	1-945000-126	01121	CB3305
R9	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
R10	Resistor, fixed, composition, 15 ohm, ±5%, ¼ W	1-945000-118	01121	CB1505
R11	Resistor, fixed, composition, 15 ohm, ±5%, ¼ W	1-945000-118	01121	CB1505
R12	Resistor, variable, cermet, 10 k ohm, ±20%, ½ W	1-945037-010	80740	62PR10K
T1	Transformer, pulse, MIL-T-21038, grade 7	1-945018-001	01961	2671

Table 7-13. Parts List for IF Converter Assembly, A10

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, plastic, 5100 pF, ±5%, 63 Vdc	1-900116-021	73445	2222/424/25102
C2	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-001	00656	3420/050C/104M
C3	Capacitor, fixed, mica, 510 pF, ±5%, 500 Vdc	1-900003-049	72136	DM15F511J
C4	Capacitor, fixed, mica, 20 pF, ±5%, 500 Vdc	1-900071-005	72136	DM10-200J
C5	Capacitor, fixed, mica, 510 pF, ±5%, 500 Vdc	1-900003-049	72136	DM15F511J
C6	Capacitor, fixed, mica, 20 pF, ±5%, 500 Vdc	1-900071-005	72136	DM10-200J
C7	Capacitor, fixed, mica, 510 pF, ±5%, 500 Vdc	1-900003-049	72136	DM15F511J
C8	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-001	00656	3420/050C/104M
C9	Capacitor, fixed, plastic, 3000 pF, ±5%, 63 Vdc	1-900116-015	73445	2222/424/23002
C10	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-001	00656	3420/050C/104M
C11	Capacitor, fixed, mica, 82 pF, ±5%, 500 Vdc	1-900072-019	72136	SCDM10-820J
C12	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C13	Capacitor, fixed, ceramic, 3.0 pF, ±10%, 500 Vdc	1-900066-033	95121	MC-3.0PF
C14	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C15	Capacitor, fixed, mica, 82 pF, ±5%, 500 Vdc	1-900072-019	72136	SCDM10-820J
C16	Capacitor, fixed, ceramic, 3.0 pF, ±10%, 500 Vdc	1-900066-033	95121	MD-3.0PF
C17	Capacitor, variable, ceramic, 2.3 pF to 20 pF, N450 ±250 ppm/°C	1-900113-001	91293	9302
C18	Capacitor, fixed, mica, 82 pF, ±5%, 500 Vdc.	1-900072-019	72136	SCDM-820J
C19	Capacitor, fixed, mica, 82 pF, ±5%, 500 Vdc,	1-900072-019	72136	SCDM-820J
C20	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C21	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835/000/Y5U0/ 203Z
C22	Capacitor, fixed, mica, 560 pF, ±5%, 300 Vdc	1-900003-050	72136	DM15F561J
C23	Capacitor, fixed, mica, 110 pF, ±5%, 500 Vdc	1-900071-111	72136	DM10-111J
C24	Capacitor, fixed, mica, 560 pF, ±5%, 300 Vdc	1-900003-050	72136	DM15F561J
C25	Capacitor, fixed, plastic, 2000 pF, ±5%, 63 Vdc	1-900116-010	73445	2222/242/22002
C26	Capacitor, fixed, mica, 150 pF, ±5%, 500 Vdc	1-900071-015	72136	DM10-151J
C27	Capacitor, fixed, mica, 39 pF, ±5%, 500 Vdc	1-900072-013	72136	SCDM10-390J
C28	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835/000/Y5U0/ 203Z
C29	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835/000/Y5U0/ 203Z
C30	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C31	Capacitor, fixed, mica, 150 pF, ±5%, 500 Vdc	1-900071-015	72136	DM10-151J
C32	Capacitor, fixed, mica, 39 pF, ±5%, 500 Vdc	1-900072-013	72136	SCDM10-390J
C33	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835/000/Y5U0/ 203Z

Table 7-13. Parts List for IF Converter Assembly, A10 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C34	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc	1-900076-002	72982	5835/000/Y5U0/ 203Z
C35	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-001	00656	3420/050C/104M
C36	Capacitor, fixed, plastic, 5100 pF, ±5%, 63 Vdc	1-900116-021	73445	2222/424/25102
CR1	Diode, silicon, 50 V	1-913001-001	04713	1N4001
CR2	Diode, band switch	1-913074-001	80795	ITT244
CR3	Diode, band switch	1-913074-001	80795	ITT244
CR4	Diode, band switch	1-913074-001	80795	ITT244
CR5	Diode, silicon, 50 V	1-913001-001	80795	1N4001
CR6	Diode, band switch	1-913074-001	80795	ITT244
CR7	Diode, band switch	1-913074-001	80795	ITT244
CR8	Diode, band switch	1-913074-001	80795	ITT244
CR9	Diode, band switch	1-913074-001	80795	ITT244
CR10	Diode, band switch	1-913074-001	80795	ITT244
J1	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
Thru				
J9	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
L1	Inductor, variable, 0.76 uH nominal	4-403395-038	88869	
L2	Inductor, variable, 20 uH nominal	4-403395-041	88869	
L3	Inductor, fixed, 1 mH, 40 mA	1-906016-049	00001	DR1000
L4	Inductor, variable, 0.51 uH nominal	4-403395-039	88869	
L5	Inductor, fixed, toroid, 10 uH	4-403394-034	88869	
L6	Inductor, fixed, 1 mH, 40 mA	1-906016-049	00001	DR1000
L7	Inductor, fixed, 1 mH, 40 mA	1-906016-049	00001	DR1000
L8	Inductor, fixed, 1 mH, 40 mA	1-906016-049	00001	DR1000
L9	Inductor, fixed, 33 uH, 475 mA	1-906003-031	16407	DD-33.0
L10	Inductor, fixed, 33 uH, 475 mA	1-906003-031	16407	DD-33.0
L11	Inductor, fixed, 33 uH, 475 mA	1-906003-031	16407	DD-33.0
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, N-channel, J-FET	1-958084-001	04713	MPF820
Q2	Transistor, N-channel, J-FET	1-958085-001	04713	2N5486
Q3	Transistor, N-channel, J-FET	1-958085-001	04713	2N5486
R1	Resistor, fixed, composition, 62 ohm, ±5% ¼ W	1-945000-133	01121	CB6205
R2	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R3	Resistor, fixed, composition, 390 ohm, ±5%, ¼ W	1-945000-152	01121	CB3915
R4	Resistor, fixed, composition, 220 k ohm, ±5%, ¼ W	1-945000-218	01121	CB2245
R5	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R6	Resistor, fixed, composition, 220 k ohm, ±5%, ¼ W	1-945000-218	01121	CB2245

Table 7-13. Parts List for IF Converter Assembly, A10 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R7	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
T1	Transformer, variable, 20 uH nominal	4-403395-040	88869	
T2	Transformer, variable, 20 uH nominal	4-403395-042	88869	
T3	Transformer, fixed, toroid, 10 uH,	4-403394-035	88869	
T4	Transformer, fixed, toroid, 10 uH,	4-403394-035	88869	
T5	Transformer, variable, 1300 uH nominal	4-403395-043	88869	
T6	Transformer, variable, 200 uH nominal	4-403395-044	88869	
T7	Transformer, variable, 200 uH nominal	4-403395-045	88869	
T8	Transformer, fixed, toroid, 9.2 uH	4-403394-036	88869	
T9	Transformer, fixed, toroid, 1.2 uH	4-403394-037	88869	
Y1	Crystal, 1145 kHz	1-403504-001	88869	
Y2	Crystal, 4545 kHz	1-403504-002	88869	
Z1	Mixer, double balanced	1-403393-001	88869	

Table 7-14. Parts List for IF Preamplifier and Calibration Amplifier Assembly, A11

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, plastic, 0.022 uF, ±10%, 250 Vdc	1-900001-105	73445	C280AE-.022uF
C2	Capacitor, fixed, plastic, 0.1 uF, ±10%, 250 Vdc	1-900001-113	73445	C280AE-.1uF
C3	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C4	Capacitor, fixed, plastic, 0.022 uF, ±10%, 250 Vdc	1-900001-105	73445	C280AE-.022uF
C5	Capacitor, fixed, plastic, 0.022 uF, ±10%, 250 Vdc	1-900001-105	73445	C280AE-.022uF
C6	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C7	Capacitor, fixed, plastic, 0.022 uF, ±10%, 250 Vdc	1-900001-105	73445	C280AE-.022uF
C8	Capacitor, fixed, plastic, 0.1 uF, ±10%, 250 Vdc	1-900001-113	73445	C280AE-.1uF
C9	Capacitor, fixed, plastic, 0.022 uF, ±10%, 250 Vdc	1-900001-105	73445	C280AE-.022uF
C10	Capacitor, fixed, mica, 24 pF, ±5%, 500 Vdc	1-900071-007	72136	DM10-240J
C11	Capacitor, fixed, mica, 24 pF, ±5%, 500 Vdc	1-900071-007	72136	DM10-240J
C12	Capacitor, fixed, plastic, 0.1 uF, ±10%, 250 Vdc	1-900001-113	73445	C280AE-.1uF
C13	Capacitor, fixed, ceramic, 0.005 uF, ±20%, 100 Vdc	1-900077-001	56289	TG-D50
C14	Capacitor, fixed, electrolytic, 10 uF, ±10%, 20 Vdc	1-900057-119	56289	150D106X9020B2
C15	Capacitor, fixed, electrolytic, 10 uF, ±10%, 20 Vdc	1-900057-119	56289	150D106X9020B2
J1	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J2	Connector, jack, UG-1455/U	1-910139-002	98291	501450000
J3	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
K1	Relay, reed, SPST	1-942024-001	0000L	TP-12
K2	Relay, reed, SPST	1-942024-001	0000L	TP-12
K3	Relay, reed, SPST	1-942024-001	0000L	TP-12
L1	Inductor, fixed, 1 mH, 40 mA	1-906003-049	16407	DD-1000
L2	Inductor, fixed, 1 mH, 40 mA	1-906003-049	16407	DD-1000
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q2	Transistor, silicon, PNP	1-958049-001	01295	2N5447
Q3	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q4	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q5	Transistor, silicon, PNP	1-958049-001	01295	2N5447
Q6	Transistor, silicon, NPN	1-958078-001	01295	2N4997
Q7	Transistor, N-channel, VCR FET	1-958083-001	17856	VCR4N
R1	Resistor, fixed, composition, 51 ohm, ±5%, ¼ W	1-945000-131	01121	CB5105
R2	Resistor, fixed, composition, 33 k ohm, ±5%, ¼ W	1-945000-198	01121	CB3335
R3	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R4	Resistor, fixed, composition, 1.5 k ohm, ±5%, ¼ W	1-945000-166	01121	CB1525
R5	Resistor, variable, wirewound, 100 ohm, ±10%, ¾ W	1-945081-004	80294	3009P-1-101
R6	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R7	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225

Table 7-14. Parts List for IF Preamplifier and Calibration Amplifier Assembly, A11 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R8	Resistor, fixed, composition, 680 ohm, ±5%, ¼ W	1-945000-158	01121	CB6815
R9	Resistor, fixed, composition, 1.5 k ohm, ±5%, ¼ W	1-945000-166	01121	CB1525
R10	Resistor, fixed, composition, 33 k ohm, ±5%, ¼ W	1-945000-198	01121	CB3335
R11	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R12	Resistor, fixed, composition, 1.5 k ohm, ±5%, ¼ W	1-945000-166	01121	CB1525
R13	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R14	Resistor, variable, wirewound, 100 ohm, ±10%, ¾ W	1-945081-004	80294	3009P-1-101
R15	Resistor, fixed, composition, 680 ohm, ±5%, ¼ W	1-945000-158	01121	CB6815
R16	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R17	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R18	Resistor, fixed, composition, 560 ohm, ±5%, ¼ W	1-945000-156	01121	CB5615
R19	Resistor, fixed, composition, 560 ohm, ±5%, ¼ W	1-945000-156	01121	CB5615
R20	Resistor, fixed, composition, 680 ohm, ±5%, ¼ W	1-945000-158	01121	CB6815
R21	Resistor, fixed, composition, 680 ohm, ±5%, ¼ W	1-945000-158	01121	CB6815
R22	Resistor, fixed, composition, 1000 ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R23	Resistor, fixed, composition, 100 k ohm, ±5%, ¼ W	1-945000-210	01121	CB1045
R24	Resistor, variable, wirewound, 50 k ohm, ±10%, ¾ W	1-945081-012	80294	3009P-1-503
R25	Resistor, fixed, composition, 3.9 k ohm, ±5%, ¼ W	1-945000-176	01121	CB3925
R26	Resistor, variable, wirewound, 10 k ohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
R27	Resistor, fixed, composition, 56 ohm, ±5%, ¼ W	1-945000-132	01121	CB5605
T1	Transformer, variable, 1 mH nominal	1-403438-001	88869	
U1	Integrated circuit, operational amplifier	1-926035-001	03606	CA-3015

Table 7-15. Parts List for Log IF Amplifier Detector Assembly, A12

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, plastic, 0.022 uF, ±10%, 250 Vdc	1-900001-105	73445	C280AE.002uF
C2	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 25 Vdc	1-900076-004	72982	5835/000/Y5U0/ 104Z
C3	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C4	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 25 Vdc	1-900076-004	72982	5835/000/Y5U0/ 104Z
C5	Capacitor, fixed, plastic, 0.022 uF, ±10%, 250 Vdc	1-900001-105	73445	C280AE.002uF
C6	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 25 Vdc	1-900076-004	72982	5835/000/Y5U0/ 104Z
C7	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C8	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 25 Vdc	1-900076-004	72982	5835/000/Y5U0/ 104Z
C9	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 25 Vdc	1-900076-004	72982	5835/000/Y5U0/ 104Z
C10	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 25 Vdc	1-900076-004	72982	5835/000/Y5U0/ 104Z
C11	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C12	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 25 Vdc	1-900076-004	72982	5835/000/Y5U0/ 104Z
C13	Capacitor, fixed, plastic, 0.0047 uF, ±2%, 100 Vdc	1-900114-105	14752	410B1B472K
C14	Capacitor, fixed, plastic, 0.022 uF, ±10%, 250 Vdc	1-900001-105	73445	C280AE.022uF
C15	Capacitor, fixed, mica, 500 pF, ±5%, 500 Vdc	1-900003-048	72136	DM15F501J
C16	Capacitor, fixed, mica, 1000 pF, ±5%, 500 Vdc	1-900004-011	72136	DM19F102J
C17	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C18	Capacitor, fixed, plastic, 0.01 uF, ±10%, 250 Vdc	1-900001-101	73445	C280AE.01uF
C19	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C20	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 25 Vdc	1-900076-004	72982	5835/000/Y5U0/ 104Z
C21	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 25 Vdc	1-900076-004	72982	5835/000/Y5U0/ 104Z
C22	Capacitor, fixed, electrolytic, 10 uF, ±10%, 20 Vdc	1-900057-119	56289	150D106X9020B2
C23	Capacitor, fixed, electrolytic, 10 uF, ±10%, 20 Vdc	1-900057-119	56289	150D106X9020B2
C24	Capacitor, fixed, electrolytic, 50 uF, 10% +75%, 20 Vdc	1-900039-008	76433	984-1655
C25	Capacitor, fixed, electrolytic, 50 uF, -10% +75%, 20 Vdc	1-900039-008	76433	984-1655
C26	Capacitor, fixed, mica, 200 pF, ±5%, 500 Vdc	1-900003-037	72136	DM15F201J
C27	Capacitor, fixed, plastic, 0.0047 uF, ±2%, 100 Vdc	1-900114-105	14752	410B1B472K
CR1	Diode, germanium, 60 V	1-913058-002	04651	1N277
CR2	Diode, zener, 6.2 V, 1 W	1-913004-008	04713	1N4735A
CR3	Diode, zener, 6.2 V, 1 W	1-913004-008	04713	1N4735A
CR4	Diode, pin	1-913049-002	28480	5082-2900

Table 7-15. Parts List for Log IF Amplifier Detector Assembly, A12 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
CR5	Diode, pin	1-913049-002	28480	5802-2900
CR6	Diode, pin	1-913049-002	28480	5082-2900
J1	Connector, jack UG-1455/U	1-910139-002	89291	510450000
J2	Connector, jack UG-1455/U	1-910139-002	89291	510450000
J3	Connector, jack UG-1455/U	1-910139-002	89291	510450000
J4	Connector, jack UG-1455/U	1-910139-002	98291	510450000
L1	Inductor, fixed, 100 uH, 120 mA	1-906016-037	0000I	DR-100
L2	Inductor, fixed, 100 uH, 120 mA	1-906016-037	0000I	DR-100
L3	Inductor, fixed, 100 uH, 120 mA	1-906016-037	0000I	DR-100
L4	Inductor, fixed, 100 uH, 120 mA	1-906016-037	0000I	DR-100
L5	Inductor, fixed, 27 uH, 200 mA	1-906016-030	00001	DR-27
L6	Inductor, fixed, 100 uH, 120 mA	1-906016-037	0000I	DR-100
L7	Inductor, fixed, 100 uH, 120 mA	1-906016-037	0000I	DR-100
L8	Inductor, fixed, 1 mH, 40 mA	1-906016-049	0000I	DR-1000
L9	Inductor, fixed, 1 mH, 40 mA	1-906016-049	0000I	DR-1000
L10	Inductor, fixed, 1 mH, 40 mA	1-906016-049	0000I	DR-1000
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q2	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q3	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q4	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q5	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q6	Transistor, silicon, NPN	1-958056-001	01295	2N5449
R1	Resistor, fixed, compostion, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R2	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R3	Resistor, fixed, composition, 30 k ohm, ±5%, ¼ W	1-945000-197	01121	CB3035
R4	Resistor, fixed, composition, 2.7 k ohm, ±5%, ¼ W	1-945000-172	01121	CB2725
R5	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R6	Resistor, variable, wirewound, 500 ohm, ±10%, ¾ W	1-945081-006	80294	3009P-1-501
R7	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R8	Resistor, fixed, composition, 6.8 k ohm, ±5%, ¼ W	1-945000-182	01121	CB6825
R9	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R10	Resistor, fixed, composition, 470 ohm, ±5%, ¼ W	1-945000-154	01121	CB4715
R11	Resistor, fixed, composition, 5.1 k ohm, ±5%, ¼ W	1-945000-179	01121	CB5125
R12	Resistor, fixed, composition, 6.8 k ohm, ±5%, ¼ W	1-945000-182	01121	CB6825
R13	Resistor, fixed, composition, 2.7 k ohm, ±5%, ¼ W	1-945000-172	01121	CB2725
R14	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R15	Resistor, variable, wirewound, 100 ohm, ±10%, ¾ W	1-945081-004	80294	3009P-1-101
R16	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325

Table 7-15. Parts List for Log IF Amplifier Detector Assembly, A12 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R17	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R18	Resistor, fixed, composition, 270 ohm, ±5%, ¼ W	1-945000-148	01121	CB2715
R19	Resistor, fixed, composition, 180 ohm, ±5%, ¼ W	1-945000-144	01121	CB1815
R20	Resistor, fixed, composition, 1.1 k ohm, ±5%, ¼ W	1-945000-163	01121	CB1125
R21	Resistor, fixed, composition, 8.2 k ohm, ±5%, ¼ W	1-945000-184	01121	CB8225
R22	Resistor, variable, wirewound, 20 k ohm, ±10%, ¾ W	1-945081-011	80294	3009P-1-203
R23	Resistor, variable, wirewound, 10 k ohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
R24	Resistor, variable, wirewound, 10 k ohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
R25	Resistor, variable, wirewound, 10 k ohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
R26	Resistor, variable, wirewound, 10 k ohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
R27	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R28	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R29	Resistor, fixed, composition, 3.6 k ohm, ±5%, ¼ W	1-945000-175	01121	CB3625
R30	Resistor, fixed, composition, 47 k ohm, ±5%, ¼ W	1-945000-202	01121	CB4735
R31	Resistor, variable, wirewound, 10 k ohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
R32	Resistor, fixed, composition, 2 k ohm, ±5%, ¼ W	1-945000-169	01121	CB2025
R33	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R34	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R35	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R36	Resistor, variable, wirewound, 20 k ohm, ±10%, ¾ W	1-945081-011	80294	3009P-1-203
R37	Resistor, fixed, composition, 150 k ohm, ±5%, ¼ W	1-945000-214	01121	CB1545
R38	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R39	Resistor, fixed, composition, 5.1 k ohm, ±5%, ¼ W	1-945000-179	01121	CB5125
R40	Resistor, fixed, film, 60.4 ohm, ±1%, 1/8 W	1-945027-076	07115	RN55D60R4F
R41	Resistor, fixed, film, 301 ohm, ±1%, 1/8 W	1-945027-143	07115	RN55D3010F
R42	Resistor, fixed, composition, 150 ohm, ±5%, ½ W	1-945001-151	01121	EB1515
R43	Resistor, fixed, composition, 220 ohm, ±5%, ½ W	1-945001-146	01121	EB2215
R44	Thermistor, 1 k ohm, ±10%	1-945099-001	01295	TG-1/8
R45	Resistor, fixed, composition, [selected at test, may be omitted]			
T1	Transformer, variable, 1 mH nominal	1-403450-001	88869	
T2	Transformer, variable, 1 mH nominal	1-403451-001	88869	
U1	Integrated circuit, logarithmic amplifier	1-926007-017	01295	SN76502
U2	Integrated circuit, high speed operational amplifier	1-926057-001	07263	U5F7715393
U3	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U4	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393

Table 7-16. Parts List for Bandwidth Selector Assembly, A14

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, mica, 240 pF, ±5%, 500 Vdc	1-900003-039	72136	DM15F241J
C2	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C3	Capacitor, fixed, mica, 47 pF, ±5%, 500 Vdc	1-900003-021	72136	DM15F470J
C4	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C5	Capacator, fixed, mica, 300 pF, ±5%, 500 Vdc	1-900003-042	72136	DM15F301J
C6	Capacitor, fixed, mica, 1800 pF, ±5%, 500 Vdc	1-900004-017	72136	DM19F182J
C7	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C8	Capacitor, fixed, mica, 300 pF, ±5%, 500 Vdc	1-900003-042	72136	DM15F301J
C9	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C10	Capacitor, fixed, ceramic, 0.1 uF, ±20% 50 Vdc	1-900104-002	00656	3419-050E-104M
C11	Capacitor, fixed, ceramic, 0.1 uF, ±20%, ro Vdc	1-900104-002	00656	3419-050E-014M
C12	Capacitor, fixed, mica, 270 pF, ±5%, 500 Vdc	1-900003-041	72136	DM15F271J
C13	Capacitor, fixed, mica, 3900 pF, ±5%, 500 Vdc	1-900004-026	72136	DM19F392J
C14	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C15	Capacitor, fixed, ceramic, 3.9 pF, ±10%, 500 Vdc	1-900066-036	95121	MC-3.9pF
C16	Capacitor, fixed, mica, 240 pF, ±5%, 500 Vdc	1-900003-039	72136	DM15F241J
C17	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C18	Capacitor, fixed, mica, 330 pF, ±5%, 500 Vdc	1-900003-043	72136	DM15F331J
C19	Capacitor, fixed, mica, 1800 pF, ±5%, 500 Vdc	1-900004-017	72136	DM19F182J
C20	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C21	Capacitor, fixed, ceramic, 3.9 pF, ±10%, 500 Vdc	1-900066-036	95121	MC-3.9pF
C22	Capacitor, fixed, mica, 240 pF, ±5%, 500 Vdc	1-900003-039	72136	DM15F241J
C23	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C24	Capacitor, fixed, mica, 330 pF, ±5%, 500 Vdc	1-900003-043	72136	DM15F331J
C25	Capacitor, fixed, mica, 1800 pF, ±5%, 500 Vdc	1-900004-017	72136	DM19F182J
C26	Capacitor, fixed, ceramic, 3.9 pF, ±10%, 500 Vdc	1-900066-036	95121	MC-3.9pF
C27	Capacitor, fixed, mica, 240 pF, ±5%, 500 Vdc	1-900003-039	72136	DM15F241J
C28	Capacitor, fixed, ceramic, 0.1 uF, ±20%,500 Vdc	1-900104-002	00656	3419-050E-104M
Thru				
C52	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 500 Vdc	1-900104-002	00656	3419-050E-104M
CR1	Diode, silicon	1-913045-001	03508	1N4154
Thru				
CR11	Diode, silicon	1-913045-001	03508	1N4154
FL1	Filter, bandpass, 455 kHz ±1kHz	2-403359-001	88869	
FL2	Filter, bandpass, 455 kHz ±100 Hz	2-403360-001	88869	
J1	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J2	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J3	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J4	Connector, jack, UG-1455/U	1-910139-002	98291	510450000

Table 7-16. Parts List for Bandwidth Selector Assembly, A14 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
L1	Inductor, variable, 0.5 mH nominal	4-403395-046	88869	
L2	Inductor, fixed, 4.7 mH, 19 mA	1-906016-057	0000I	DR-4.7
L3	Inductor, variable, 0.5 mH nominal	4-403395-046	88869	
Thru				
L10	Inductor, variable, 0.5 mH nominal	4-403395-046	88869	
L11	Inductor, fixed, 4.7 mH, 19 mA	1-906016-057	0000I	DR-4.7
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, N-channel, J-FET	1-958084-001	04713	MPF820
Q2	Transistor, N-channel, J-FET	1-958084-001	04713	MPF820
Q3	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q4	Transistor, N-channel, J-FET	1-958084-001	04713	MPF820
Q5	Transistor, N-channel, J-FET	1-958084-001	04713	MPF820
Q6	Transistor, N-channel, J-FET	1-958084-001	04713	MPF820
Q7	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q8	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q9	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q10	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q11	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q12	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q13	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q14	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q15	Transistor, silicon, NPN	1-958000-001	04713	2N3904
R1	Resistor, fixed, composition, 82 ohm, ±5%, ¼ W	1-945000-136	01121	CB8205
R2	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R3	Resistor, fixed, composition, 180 ohm, ±5%, ¼ W	1-945000-144	01121	CB1815
R4	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R5	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R6	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R7	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R8	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R9	Resistor, variable, cermet, 5 k ohm, ±.05%, ½ W	1-945037-009	80740	62PR5K
R10	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R11	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R12	Resistor, fixed, composition, 100 ohm, ±5% ¼ W	1-945000-138	01121	CB1015
R13	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R14	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R15	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235

Table 7-16. Parts List for Bandwidth Selector Assembly, A14 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R16	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R17	Resistor, fixed, composition, 180 ohm, ±5%, ¼ W	1-945000-144	01121	CB1815
R18	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R19	Resistor, fixed, composition, 68 k ohm, ±5%, ¼ W	1-945000-206	01121	CB6835
R20	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R21	Resistor, fixed, composition, 680 ohm, ±5%, ¼ W	1-945000-158	01121	CB6815
R22	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R23	Resistor, fixed, composition, 68 k ohm, ±5%, ¼ W	1-945000-206	01121	CB6835
R24	Resistor, fixed, composition, 680 ohm, ±5%, ¼ W	1-945000-158	01121	CB6815
R25	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R26	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R27	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R28	Resistor, variable, cermet, 25 k ohm, ±.05%, ½ W	1-945037-012	80740	62PR25K
R29	Resistor, fixed, composition, 33 k ohm, ±5%, ¼ W	1-945000-198	01121	CB3335
R30	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R31	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R32	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R33	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R34	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R35	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R36	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R37	Resistor, fixed, composition, 510 ohm, ±5%, ¼ W	1-945000-155	01121	CB5115
R38	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
R39	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R40	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R41	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R42	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R43	Resistor, variable, cermet, 500 ohm, ±.05%, ½ W	1-945037-006	80740	62PR500
R44	Resistor, fixed, composition, 510 ohm, ±5%, ¼ W	1-945000-155	01121	CB5115
R45	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R46	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R47	Resistor, fixed, composition, 68 ohm, ±5%, ¼ W	1-945000-134	01121	CB6805
R48	Resistor, fixed, composition, 2.7 k ohm, ±5%, ¼ W	1-945000-172	01121	CB2725
R49	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R50	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R51	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R52	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R53	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025

Table 7-16. Parts List for Bandwidth Selector Assembly, A14 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R54	Resistor, fixed, composition, 39 ohm, ±5%, ¼ W	1-945000-128	01121	CB3905
R55	Resistor, fixed, composition, 150 ohm, ±5%, ¼ W	1-945000-142	01121	CB1515
R56	Resistor, fixed, composition, 91 ohm, ±5%, ¼ W	1-945000-137	01121	CB9105
R57	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R58	Resistor, fixed, composition, 330 ohm, ±5%, ¼ W	1-945000-150	01121	CB3315
R59	Resistor, fixed, composition, 510 ohm, ±5%, ¼ W	1-945000-155	01121	CB5115
R60	Resistor, fixed, composition, 47 ohm, ±5%, ¼ W	1-945000-130	01121	CB4705
R61	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R62	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R63	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R64	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R65	Resistor, variable, cermet, 500 ohm, ±.05%, ½ W	1-945037-006	80740	62PR500
R66	Resistor, fixed, composition, 510 ohm, ±5%, ¼ W	1-945000-155	01121	CB5115
R67	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R68	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R69	Resistor, fixed, composition, 68 ohm, ±5%, ¼ W	1-945000-134	01121	CB6805
R70	Resistor, fixed, composition, 2.7 k ohm, ±5%, ¼ W	1-945000-172	01121	CB2725
R71	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R72	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R73	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R74	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R75	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235

Table 7-17. Parts List for Linear IF and BFO Assembly, A15

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 Vdc	1-900001-013	73445	C280AE.1uF
Thru				
C8	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 Vdc	1-900001-013	73445	C280AE.1uF
C9	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C10	Capacitor, fixed, electrolytic, 1.0 uF, ±20%, 35 Vdc	1-900057-146	56289	150D105X0035A2
C11	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 Vdc	1-900001-013	73445	C280AE.1uF
C12	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 Vdc	1-900001-013	73445	C280AE.1uF
C13	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 Vdc	1-900001-013	73445	C280AE.1uF
C14	Capacitor, fixed, mica, 680 pF, ±5%, 300 Vdc	1-900003-052	72136	DM15F681J
C15	Capacitor, fixed, mica, 680 pF, ±5%, 300 Vdc	1-900003-052	72136	DM15F681J
C16	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 Vdc	1-900001-013	73445	C280AE.1uF
C17	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 Vdc	1-900001-013	73445	C280AE.1uF
C18	Capacitor, fixed, mica, 270 pF, ±5%, 500 Vdc	1-900003-041	72136	DM15F271J
C19	Capacitor, fixed, mica, 470 pF, ±5%, 500 Vdc	1-900003-047	72136	DM15F471J
C20	Capacitor, fixed, mica, 470 pF, ±5%, 500 Vdc	1-900003-047	72136	DM15F471J
C21	Capacitor, fixed, mica, 1500 pF, ±5%, 500 Vdc	1-900004-015	72136	DM19F152J
C22	Capacitor, fixed, plastic, 0.1 uF, ±20%, 250 Vdc	1-900001-013	73445	C280AE.1uF
C23	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
C24	Capacitor, fixed, electrolytic, 3.3 uF, ±10%, 15 Vdc	1-900057-171	56289	150D335X9015A2
CR1	Diode, silicon	1-913045-001	03508	1N4154
CR2	Diode, silicon	1-913045-001	03508	1N4154
J1	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
L1	Inductor, fixed, 4.7 mH, 19 mA	1-906016-057	0000I	DR-4.7
L2	Inductor, fixed, 4.7 mH, 19 mA	1-906016-057	0000I	DR-4.7
L3	Inductor, fixed, .33 mH, 195 mA	1-906000-003	99800	2500-04
L4	Inductor, fixed, 4.7 mH, 19 mA	1-906016-057	0000I	DR-4.7
L5	Inductor, variable, 0.5 mH nominal	4-403395-046	88869	
L6	Inductor, fixed 4.7 mH, 19 mA	1-906016-057	0000I	DR-4.7
P1	Connector, plug, 9 pin	2-103549-001	88869	
Q1	Transistor, N-channel, J-FET	1-958002-002	04713	2N5458
Q2	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q3	Transistor, silicon, NPN	1-958000-001	04713	2N3904
R1	Resistor, fixed, composition, 51 ohm, ±5%, ¼ W	1-945000-131	01121	CB5105
R2	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R3	Resistor, fixed, composition, 51 ohm, ±5%, ¼ W	1-945000-131	01121	CB5105
R4	Resistor, fixed, composition, 6.8 k ohm, ±5%, ¼ W	1-945000-182	01121	CB6825
R5	Resistor, fixed, composition, 100 k ohm, ±5%, ¼ W	1-945000-210	01121	CB1045
R6	Resistor, fixed, composition, 10 M ohm, ±5%, ¼ W	1-945000-258	01121	CB1065

Table 7-17. Parts List for Linear IF and BFO Assembly, A15 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R7	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R8	Resistor, variable, cermet, 5 k ohm, ±.05%, ½ W	1-945037-009	80740	62PR5K
R9	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R10	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R11	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R12	Resistor, fixed, composition, 2.7 k ohm, ±5%, ¼ W	1-945000-172	01121	CB2725
R13	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R14	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R15	Resistor, fixed, composition, 330 k ohm, ±5%, ¼ W	1-945000-222	01121	CB3345
R16	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R17	Resistor, fixed, composition, 6.8 k ohm, ±5%, ¼ W	1-945000-182	01121	CB6825
R18	Resistor, fixed, composition, 3.3 k ohm, ±5%, ¼ W	1-945000-174	01121	CB3325
R19	Resistor, fixed, composition, 100 k ohm, ±5%, ¼ W	1-945000-210	01121	CB1045
R20	Resistor, fixed, composition, 220 k ohm, ±5%, ¼ W	1-945000-218	01121	CB2245
R21	Resistor, fixed, composition, 220 k ohm, ±5%, ¼ W	1-945000-218	01121	CB2245
R22	Resistor, fixed, composition, 51 ohm, ±5%, ¼ W	1-945000-131	01121	CB5105
R23	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R24	Resistor, fixed, composition, 330 k ohm, ±5%, ¼ W	1-945000-222	01121	CB3345
U1	Integrated circuit, gain controlled IF amplifier	1-926061-001	07263	U6A7757393
U2	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
Y1	Crystal, 456 kHz	1-912007-001	88869	

Table 7-18. Parts List for DC to DC Converter Assembly, A16

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, electrolytic, 10 uF, ±20%, 35 Vdc	1-900057-152	56289	150D106X0035B2
C2	Capacitor, fixed, electrolytic, 10 uF, ±20%, 35 Vdc	1-900057-152	56289	150D106X0035B2
C3	Capacitor, fixed, electrolytic, 4.7 uF, ±20%, 35 Vdc	1-900057-150	56289	150D475X0035B2
C4	Capacitor, fixed, electrolytic, 4.7 uF, ±20%, 35 Vdc	1-900057-150	56289	150D475X0035B2
C5	Capacitor, fixed, electrolytic, 10 uF, ±10%, 20 Vdc	1-900057-119	56289	150D106X9020B2
C6	Capacitor, fixed; electrolytic, 1 uF, ±20%, 35 Vdc	1-900057-146	56289	150D105X0035A2
C7	Capacitor, fixed, electrolytic, 1 uF, ±20%, 35 Vdc	1-900057-146	56289	150D105X0035A2
C8	Capacitor, fixed, ceramic, 0.002 uF, ±10%, 500 Vdc	1-900012-013	72982	871000X5F0202K
C9	Capacitor, fixed, ceramic, 0.002 uF, ±10%, 500 Vdc	1-900012-013	72982	871000X5F0202K
C10	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C11	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C12	Capacitor, fixed, plastic, 1 uF, ±10%, 250 Vdc	1-900001-125	73445	C280AE1.0uF
C13	Capacitor, fixed, plastic, 1 uF, ±10%, 250 Vdc	1-900001-125	72445	C280AE1.0uF
C14	Capacitor, fixed, electrolytic, 4.7 uF, ±20%, 35 Vdc	1-900057-150	56289	150D475X0035B2
C15	Capacitor, fixed, feed-thru, 0.001 uF, ±20%	1-900045-002	01121	FA5C-102W
C16	Capacitor, fixed, feed-thru, 0.001 uF, ±20%	1-900045-002	01121	FA5C-102W
C17	Capacitor, fixed, feed-thru, 0.001 uF, ±20%	1-900045-002	01121	FA5C-102W
C18	Capacitor, fixed, ceramic, 0.005 uF, –20% +80%, 500 Vdc	1-900012-004	72982	801Z5U502Z
CR1	Diode, zener, 6.2 V, 400 mW	1-913054-111	04713	1N753A
CR2	Diode, bridge rectifier	1-913046-001	04713	MDA920A-4
L1	Inductor, fixed, 1 mH, 40 mA	1-906016-049	0000I	DR-1000
L2	Inductor, fixed, 1 mH, 40 mA	1-906016-049	0000I	DR-1000
L3	Inductor, fixed, 10 mH, 14 mA	1-906016-061	0000I	DR-10000
P1	Connector plug, 9 pin	2-103549-001	88869	
Q1	Transistor, silicon, NPN	1-958040-001	04713	2N3053
Q2	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q3	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q4	Transistor, silicon, NPN	1-958065-001	04713	MJ420B
Q5	Transistor, silicon, NPN	1-958065-001	04713	MJ420B
R1	Resistor, fixed, composition, 2.2 k ohm, ±5%, ½ W	1-945001-170	01121	EB2225
R2	Resistor, fixed, composition, 8.2 k ohm, ±5%, ¼ W	1-945000-184	01121	CB8225
R3	Resistor, fixed, composition, 8.2 k ohm, ±5%, ¼ W	1-945000-184	01121	CB8225
R4	Resistor, variable, wirewound, 500 ohm, ±10% ¾ W	1-945081-006	80294	3009P-1-501
R5	Resistor, fixed, composition, 2.7 k ohm, ±5%, ¼ W	1-945000-172	01121	CB2725
R6	Resistor, fixed, composition, 10 ohm, ±5%, ¼ W	1-945000-114	01121	CB1005
R7	Resistor, fixed, composition, 10 ohm, ±5%, ¼ W	1-945000-114	01121	CB1005
R8	Resistor, fixed, composition, 8.2 k ohm, ±5%, ¼ W	1-945000-184	01121	CB8225

Table 7-18. Parts List for DC to DC Converter Assembly, A16 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R9	Not used			
R10	Resistor, fixed, composition, 390 ohm, ±5%, ¼ W	1-945000-152	01121	CB3915
R11	Resistor, fixed, composition, 390 ohm, ±5%, ¼ W	1-945000-152	01121	CB3915
R12	Resistor, fixed, composition, 390 ohm, ±5%, ¼ W	1-945000-152	01121	CB3915
R13	Resistor, fixed, composition, 100 k ohm, ±5%, ¼ W	1-945000-210	01121	CB1045
T1	Transformer, fixed, toroid	3-004210-001	88869	

Table 7-19. Parts List for AFC to FM Detector Assembly, A18

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C2	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C3	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C4	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C5	Capacitor, variable, ceramic, 25 pF, 100 Vdc	1-900120-001	72982	538-011-5-25
C6	Not used			
C7	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C8	Capacitor, fixed, ceramic, 0.005 uF, –20% +80%, 500 Vdc	1-900012-004	72982	801Z5U502Z
C9	Capacitor, fixed, mica, 910 pF, ±5%, 500 Vdc	1-900003-055	72136	DM15F911J
C10	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C11	Capacitor, fixed, mica, 160 pF, ±5%, 500 Vdc	1-900071-112	72136	DM10-161J
C12	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C13	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419 050E-104M
C14	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C15	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C16	Capacitor, fixed, ceramic, 0.1 uF, ±20%, 50 Vdc	1-900104-002	00656	3419-050E-104M
C17	Capacitor, fixed, ceramic, 0.47 uF, ±20%, 50 Vdc	1-900104-006	00656	3420-050E-474M
C18	Capacitor, fixed, mica, 250 pF, ±5%, 500 Vdc	1-900071-018	72136	DM10-251J
C19	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C20	Capacitor, fixed, mica, 1000 pF, ±5%, 100 Vdc	1-900003-056	72136	DM15F102J
C21	Capacitor, fixed, plastic, 0.033 uF, ±20%, 250 Vdc	1-900001-007	73445	C280AE-.003uF
C22	Capacitor, fixed, plastic, 0.01 uF, ±20%, 250 Vdc	1-9000001-001	73445	C280AE-.01uF
C23	Capacitor, fixed, ceramic, 0.47 uF, ±20%, 50 Vdc	1-900104-006	00656	3420 050E-474M
C24	Capacitor, fixed, electrolytic, 10 uF, ±20%, 20 Vdc	1-900115-007	12954	D10GSB20M
C25	Capacitor, fixed, electrolytic, 10 uF, ±20%, 20 Vdc	1-900115-007	12954	D10GSB20M
CR1	Diode, germanium	1-913058-002	04651	1N277
CR2	Diode, zener, 6.2 V, 400 mW	1-913054-111	04713	1N753A
CR3	Diode, zener, 6.2 V, 400 mW	1-913054-111	04713	1N753A
J1	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J2	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
J3	Connector, jack, UG-1455/U	1-910139-002	98291	510450000
K1	Relay, SPDT	1-942019-001	0000K	206-00052
L1	Inductor, fixed, 120 uH, 95 mA	1-906016-038	0000I	DR-120
L2	Inductor, fixed, 100 uH, 120 mA	1-906016-037	0000I	DR-100
L3	Inductor, fixed, 100 uH, 120 mA	1-906016-037	0000I	DR-100
P1	Connector, plug, 9 pins	2-103549-002	88869	
Q1	Transistor, N-channel, J-FET	1-958069-001	01295	2N5248

Table 7-19. Parts List for AFC to FM Detector Assembly, A18 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
Q2	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q3	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q4	Transistor, silicon, FET	1-958031-008	0000A	E111
Q5	Transistor, silicon, FET	1-958031-008	0000A	E111
R1	Resistor, fixed, composition, 10 M ohm, ±5%, ¼ W	1-945000-258	01121	CB-1065
R2	Resistor, fixed, composition, 3.3 k ohm, ±5%, ⅛ W	1-945086-075	01121	BB3325
R3	Resistor, fixed, composition, 560 ohm, ±5%, ⅛ W	1-945086-057	01121	BB5615
R4	Resistor, fixed, composition, 2.2 k ohm, ±5%, ⅛ W	1-945086-071	01121	BB2225
R5	Resistor, variable, cermet, 1 k ohm, ±20%, ½ W	1-945100-007	80294	3329H-1-102
R6	Resistor, fixed, composition, 2.7 k ohm, ±5%, ⅛ W	1-945086-073	01121	BB2725
R7	Resistor, variable, cermet, 5 k ohm, ±20%, ½ W	1-945100-009	80294	3329H-1-502
R8	Resistor, fixed, composition, 1 k ohm, ±5%, ⅛ W	1-945086-063	01121	BB1025
R9	Resistor, fixed, composition, 330 ohm, ±5%, ⅛ W	1-945086-051	01121	BB3315
R10	Resistor, fixed, composition, 2.7 k ohm, ±5%, ⅛ W	1-945086-073	01121	BB2725
R11	Resistor, fixed, composition, 2.7 k ohm, ±5%, ⅛ W	1-945086-073	01121	BB2725
R12	Resistor, fixed, composition, 220 ohm, ±5%, ⅛ W	1-945086-047	01121	BB2215
R13	Resistor, fixed, composition, 560 ohm, ±5%, ⅛ W	1-945086-057	01121	BB5615
R14	Resistor, fixed, composition, 47 ohm, ±5%, ⅛ W	1-945086-031	01121	BB4705
R15	Resistor, fixed, composition, 47 ohm, ±5%, ⅛ W	1-945086-031	01121	BB4705
R16	Resistor, fixed, composition, 30 k ohm, ±5%, ⅛ W	1-945086-098	01121	BB3035
R17	Resistor, fixed, composition, 15 k ohm, ±5%, ⅛ W	1-945086-091	01121	BB1535
R18	Resistor, fixed, composition, 30 k ohm, ±5%, ⅛ W	1-945086-098	01121	BB3035
R19	Resistor, fixed, composition, 2 k ohm, ±5%, ⅛ W	1-945086-070	01121	BB2025
R20	Resistor, variable, cermet, 10 k ohm, ±20%, ¼ W	1-945100-010	80294	3329H-1-103
R21	Resistor, fixed, composition, 20 k ohm, ±5%, ⅛ W	1-945086-094	01121	BB2035
R22	Resistor, fixed, composition, 3.9 k ohm, ±5%, ⅛ W	1-945086-077	01121	BB3925
R23	Resistor, fixed, composition, 100 k ohm, ±5%, ⅛ W	1-945086-111	01121	BB1045
R24	Resistor, fixed, composition, 100 k ohm, ±5%, ⅛ W	1-945086-111	01121	BB1045
R25	Resistor, fixed, composition, 820 ohm, ±5%, ⅛ W	1-945086-061	01121	BB8215
R26	Resistor, fixed, composition 18 k ohm, ±5%, ⅛ W	1-945086-093	01121	BB1835
R27	Resistor, fixed, composition, 100 k ohm, ±5%, ⅛ W	1-945086-111	01121	BB1045
R28	Resistor, fixed, composition, 10 k ohm, ±5%, ⅛ W	1-945086-087	01121	BB1035
R29	Resistor, fixed, composition, 100 k ohm, ±5%, ⅛ W	1-945086-111	01121	BB1045
R30	Resistor, fixed, composition, 100 k ohm, ±5%, ⅛ W	1-945086-111	01121	BB1045
R31	Resistor, fixed, composition, 1 k ohm, ±5%, ⅛ W	1-945086-063	01121	BB1025
R32	Thermistor, disc, 1 k ohm at 25°C, ±10%	1-945101-001	24446	1D203
R33	Resistor, fixed, composition, 2.7 k ohm, ±5%, ⅛ W	1-945086-073	01121	BB2725
R34	Resistor, fixed, composition, 390 ohm, ±5%, ⅛ W	1-945086-053	01121	BB3915

Table 7-19. Parts List for AFC to FM Detector Assembly, A18 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R35	Resistor, variable, wirewound, 500 ohm, ±10%, ¾ W	1-945081-006	80294	3009P-1-501
R36	Resistor, fixed, composition, 2 k ohm, ±5%, 1/8 W	1-945086-070	01121	BB2025
R37	Resistor, fixed, composition, 22 k ohm, ±5%, 1/8 W	1-945086-095	01121	BB2235
R38	Resistor, fixed, composition, 220 k ohm,±5%, 1/8 W	1-945086-119	01121	BB2245
R39	Resistor, fixed, composition, 390 ohm, ±5%, ¼ W	1-945000-152	01121	CB3915
R40	Resistor, fixed, composition, 22 k ohm, ±5%, 1/8 W	1-945086-095	01121	BB2235
R41	Resistor, fixed, composition, 100 k ohm, ±5%, 1/8 W	1-945086-111	01121	BB1045
R42	Resistor, fixed, composition, 390 ohm, ±5%, ¼ W	1-945000-152	01121	CB3915
R43	Resistor, variable, wirewound, 20 k ohm, ±10%, ¾ W	1-945081-011	80294	3009P-1-203
R44	Resistor, fixed, composition, 100 k ohm, ±5%, 1/8 W	1-945086-111	01121	BB1045
R45	Resistor, fixed, composition, 47 ohm, ±5%. 1/8 W	1-945086-031	01121	BB4705
R46	Resistor, fixed, composition, 1 k ohm, ±5%, 1/8 W	1-945086-063	01121	BB1025
R47	Resistor, fixed, composition, 2.2 k ohm, ±5%, 1/8 W	1-945086-071	01121	BB2225
T1	Transformer, fixed	1-403502-001	88869	
U1	Integrated circuit, 4-stage limiting FM amplifier	1-926046-001	04713	MC-1355P
U2	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741-393
U3	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741-393
U3	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741-393
U4	Integrated circuit, phase-locked loop	1-926060-001	0000D	NE565A
Y1	Crystal, 455 kHz	1-912008-001	88869	
Z1	Balanced mixer	1-403393-001	88869	

Table 7-20. Parts List for Weighting and Meter Amplifier Circuits Assembly, A21

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, plastic, 3 uF, ±10%, 100 Vdc	1-900091-107	14752	625B1A305
C2	Capacitor, fixed, plastic, 0.47 uF, ±10%, 250 Vdc	1-900001-121	73445	C280AE-.47uF
C3	Capacitor, fixed, electrolytic, 100 uF, ±20%, 25 Vdc	1-900039-004	76433	984-1653
C4	Capacitor, fixed, electrolytic, 100 uF, ±20%, 25 Vdc	1-900039-004	76433	984-1653
CR1/CR2	Diodes, matched pair assembly	1-403547-001	88869	
CR2	Diode [part of CR1/CR2]			
R1	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R2	Resistor, fixed, composition, 62 k ohm, ±5%, ¼ W	1-945000-205	01121	CB6235
R3	Resistor, fixed, composition, 62 k ohm, ±5%, ¼ W	1-945000-205	01121	CB6235
R4	Resistor, fixed, film, 12.1 k ohm, ±0.5%, 1/8 W	1-945088-297	07115	RN55D
R5	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R6	Resistor, fixed, composition, 120 ohm, ±5%, ¼ W	1-945000-140	01121	CB1215
R7	Resistor, fixed, composition, 1.2 M ohm, ±5%, ¼ W	1-945000-236	01121	CB1265
R8	Resistor, fixed, composition, 1.2 M ohm, ±5%, ¼ W	1-945000-236	01121	CB1265
R9	Resistor, fixed, film, 12.1 k ohm, ±0.5%, 1/8 W	1-945088-297	07115	RN55D
R10	Resistor, fixed, film, 12.1 k ohm, ±1%, 1/8W	1-945027-297	07115	RN55D1212F
R11	Resistor, variable, wirewound, 100 k ohm, ±10%, ¾ W	1-945081-013	80294	3009P-1-104
R12	Resistor, fixed, composition, 220 k ohm, ±5%, ¼ W	1-945000-218	01121	CB2245
R13	Resistor, variable, wirewound, 2 k ohm, ±10%, ¾ W	1-945081-008	80294	3009P-1-202
R14	Resistor, fixed, film, 10.5 k ohm, ±1%, 1/8 W	1-945027-291	07115	RN55D1052F
R15	Resistor, fixed, film, 12.1 k ohm, ±1%, 1/8 W	1-945027-297	07115	RN55D1212F
R16	Resistor, fixed, composition, 1.8 k ohm, ±5%, ¼ W	1-945000-168	01121	CB1825
R17	Resistor, variable, wirewound, 500 ohm, ±10%, ¾ W	1-945081-006	80294	3009P-1-501
R18	Resistor, fixed, composition, 1.2 k ohm, ±5%, ¼ W	1-945000-164	01121	CB1225
R19	Resistor, variable, wirewound, 500 ohm, ±10%, ¾ W	1-945081-006	80294	3009P-1-501
R20	Resistor, fixed, composition, 3 k ohm, ±5%, ¼ W	1-945000-173	01121	CB3025
R21	Resistor, variable, wirewound, 10 k ohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
R22	Resistor, variable, wirewound, 10 k ohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
U1	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U2	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U3	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393

Table 7-21. Parts List for Direct Peak Circuit Assembly, A22

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, ceramic, 0.002 uF, ±10%, 500 Vdc	1-900012-013	72982	871000X5F0-202K
C2	Capacitor, fixed, mica, selected, 500 pF nominal, ±5%, 500 Vdc	1-900003-048	72136	DM15F501J
C3	Not used			
C4	Capacitor, fixed, plastic, 1.0 uF, ±5%, 500 Vdc	1-900091-001	14752	625B1A105J
C5	Capacitor, fixed, plastic, 5.0 uF, ±5%, 500 Vdc	1-900091-011	14752	625B1A505J
C6	Capacitor, fixed, ceramic, 0.02 uF, ±20%, 100 Vdc	1-900077-003	56289	TG-S20
C7	Capacitor, fixed, electrolytic, 100 uF, ±20%, 25 Vdc	1-900039-004	76433	984-1653
C8	Capacitor, fixed, electrolytic, 100 uF, ±20%, 25 Vdc	1-900039-004	76433	984-1653
CR1	Diode, silicon	1-913045-001	24446	1N4154
CR2	Diode, silicon	1-913045-001	24446	1N4154
CR3	Diode, silicon	1-913045-001	24446	1N4154
CR4	Diode, silicon	1-914056-001	04713	1N456A
CR5	Diode, silicon	1-913056-001	04713	1N456A
K1	Relay, reed, SPST, 12 Vdc	1-942017-001	0000K	206-00049
K2	Relay, reed, SPST, 12 Vdc	1-942017-001	0000K	206-00049
Q1/Q2	Transistor, matched pair assembly	1-403190-001	88869	
Q2	Transistor, [part of Q1/Q2]			
Q3	Transistor, silicon, PNP	1-958053-001	07263	2N4258
Q4	Transistor, N-channel, J-FET, selected	1-403329-001	88869	
Q5	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q6	Transistor, N-channel, J-FET, selected	1-403329-001	88869	
Q7	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q8	Transistor, UJT	1-958050-001	03508	2N2646
Q9	Transistor, N-channel, J-FET	1-958052-001	04713	2N4221
R1	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R2	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R3	Resistor, fixed, composition, 220 ohm, ±5%, ¼ W	1-945000-146	01121	CB2215
R4	Resistor, fixed, composition, 3.9 k ohm, ±5%, ¼ W	1-945000-176	01121	CB3925
R5	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R6	Resistor, fixed, composition, 3.9 k ohm, ±5%, ¼ W	1-945000-176	01121	CB3925
R7	Resistor, fixed, composition, 1.2 k ohm, ±5%, ¼ W	1-945000-164	01121	CB1225
R8	Resistor, fixed, composition, 10 ohm, ±5%, ¼ W	1-945000-114	01121	CB1005
R9	Resistor, fixed, composition, 47 M ohm, ±5%, ¼ W	1-945000-268	01121	CB4765
R10	Resistor, fixed, composition, 220 ohm, ±5%, ¼ W	1-945000-146	01121	CB2215
R11	Resistor, fixed, composition, 33 ohm, ±5%, ¼ W	1-945000-126	01121	CB3305
R12	Resistor, fixed, composition, 220 ohm, ±5%, ¼ W	1-945000-146	01121	CB2215
R13	Resistor, fixed, film, 12.1 k ohm, ±0.5%, ⅛ W	1-945088-297	07115	RN55D

Table 7-21. Parts List for Direct Peak Circuit Assembly, A22 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R14	Resistor, fixed, composition, selected, 22 ohm nominal, ±5%, ¼ W	1-945000-122	01121	CB2205
R15	Resistor, variable, wirewound, 500 ohm, ±10%, ¾ W	1-945081-006	80294	3009P-1-501
R16	Resistor, variable, wirewound, 50 ohm, ±10%, ¾ W	1-045081-003	80294	3009P-1-500
R17	Resistor, fixed, composition, 56 k ohm, ±5%, ¼ W	1-945000-204	01121	CB5635
R18	Resistor, fixed, composition, 39 ohm, ±5%, ¼ W	1-945000-128	01121	CB3905
R19	Resistor, fixed, composition, selected, 6.8 k ohm nominal, ±5%, ¼ W	1-945000-182	01121	CB6825
R20	Resistor, fixed, composition, 51 k ohm, ±5%, ¼ W	1-945000-203	01121	CB5135
R21	Resistor, fixed, composition, selected, 430 k ohm nominal, ±5%, ¼ W	1-945000-225	01121	CB4345
R22	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R23	Resistor, fixed, composition, 56 k ohm, ±5%, ¼ W	1-945000-204	01121	CB5635

Table 7-22. Parts List for Slide Back Peak Circuit Assembly, A23

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, ceramic 0.002, ±10%, 500 Vdc	1-900012-013	72982	871000X5F0-202K
C2	Capacitor, fixed, mica, 500 pF, ±5%, 500 Vdc	1-900003-048	72136	DM15F501J
C3	Capacitor, fixed, electrolytic, 2.2 uF, ±10%, 20 Vdc	1-900057-111	56289	150D225X9020A2
C4	Capacitor, fixed, plastic, 0.015 uF, ±10%, 250 Vdc	1-900001-103	73445	C280AE-0.015uF
C5	Capacitor, fixed, plastic, 0.015 uF, ±10%, 250 Vdc	1-900001-103	73445	C280AE-0.015uF
C6	Capacitor, fixed, plastic, 0.1 uF, ±10%, 250 Vdc	1-900001-113	73445	C280AE-0.1uF
C7	Capacitor, fixed, plastic, 0.47 uF, ±10%, 250 Vdc	1-900001-121	73445	C280AE-0.47uF
C8	Capacitor, fixed, electrolytic, 100 uF, −10% +75%, 25 Vdc	1-900039-004	76433	984-1653
C9	Capacitor, fixed, electrolytic, 100 uF, −10% +75%, 25 Vdc	1-900039-004	76433	984-1653
CR1	Diode, zener, 9.1 V, 400 mW	1-913054-115	04713	1N757A
CR2	Diode, stabistor	1-913057-001	01295	G129
CR3	Diode, silicon	1-913056-001	04713	1N456A
FL1	Bead, ferrite	1-906013-001	02114	5659065/4B
FL2	Bead, ferrite	1-906013-001	02114	5659065/4B
FL3	Bead, ferrite	1-906013-001	02114	5659065/4B
Q1	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q2/Q3	Transistor, matched pair assembly	1-403190-001	88869	
Q3	Transistor, [part of Q2/Q3]			
Q4	Transistor, silicon, PNP	1-958053-001	07263	2N4258
Q5	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q6	Transistor, silicon, NPN	1-958056-001	01295	2N5449
Q7	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q8	Transistor, silicon, NPN	1-958000-001	04713	2N3904
R1	Resistor, fixed, composition, 12 k ohm, ±5%, ¼ W	1-945000-188	01121	CB1235
R2	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R3	Resistor, fixed, composition, 100 k ohm, ±5%, ¼ W	1-945000-210	01121	CB1045
R4	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R5	Resistor, fixed, film, 12.1 k ohm, ±0.5%, ⅛ W	1-945088-297	07115	RN55D
R6	Resistor, fixed, composition, 220 ohm, ±5%, ¼ W	1-945000-146	01121	CB2215
R7	Resistor, fixed, composition, 2.2 k ohm, ±5%, ¼ W	1-945000-170	01121	CB2225
R8	Resistor, fixed, composition, 3.9 k ohm, ±5%, ¼ W	1-945000-176	01121	CB3925
R9	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R10	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R11	Resistor, fixed, composition, 1 M ohm, ±5%, ¼ W	1-945000-234	01121	CB1055
R12	Resistor, fixed, composition, 2.2 M ohm, ±5%, ¼ W	1-945000-242	01121	CB2255
R13	Resistor, fixed, composition, 12 k ohm, ±5%, ¼ W	1-945000-188	01121	CB1235
R14	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725

Table 7-22. Parts List for Slide Back Peak Circuit Assembly, A23 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R15	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R16	Resistor, fixed, composition, 68 k ohm, ±5%, ¼ W	1-945000-206	01121	CB6835
R17	Resistor, fixed, composition, 68 k ohm, ±5%, ¼ W	1-945000-206	01121	CB6835
R18	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R19	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R20	Resistor, fixed, composition, 1 k ohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R21	Resistor, fixed, composition, 220 k ohm, ±5%, ¼ W	1-945000-218	01121	CB2245
R22	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R23	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R24	Resistor, fixed, composition, 22 k ohm, ±5%, ¼ W	1-945000-194	01121	CB2235
R25	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R26	Resistor, variable, wirewound, 50 k ohm, ±10%, ¾ W	1-945081-012	80294	3009P-1-503
U1	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393

Table 7-23. Parts List for dB Readout and Audio Circuit Assembly, A24

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, electrolytic, 100 uF, −10% +75%, 25 Vdc	1-900039-004	76433	984-1653
C2	Capacitor, fixed, electrolytic, 100 uF, −10% +75%, 25 Vdc	1-900039-004	76433	984-1653
C3	Capacitor, fixed, plastic, 0.22 uF, ±10%, 250 Vdc	1-900001-117	73445	C280AE,0.22uF
CR1	Diode, silicon, Vr=75 V, If=10 mA	1-913007-001	03508	1N4148
CR2	Diode, silicon, Vr=75 V, If=10 mA	1-913007-001	03508	1N4148
CR3	Diode, silicon, Vr=75 V, If=10 mA	1-913007-001	03508	1N4148
CR4	Diode, silicon, Vr=75 V, If=10 mA	1-913007-001	03508	1N4148
CR5	Diode, silicon, Vr=75 V, If=10 mA	1-913007-001	03508	1N4148
CR6	Diode, germanium, Vr=100 V, If=270 mA	1-913058-002	04651	1N277
CR7	Diode, germanium, Vr=100 V, If=270 mA	1-913058-002	04651	1N277
CR8	Diode, germanium, Vr=100 V, If=270 mA	1-913058-002	04651	1N277
CR9	Diode, germanium, Vr=100 V, If=270 mA	1-913058-002	04651	1N277
CR10	Diode, germanium, Vr=100 V, If=270 mA	1-913058-002	04651	1N277
K1	Relay, 1 pole, 1 position, coil: 12 Vdc, 4 mA, 3050 ohm	1-942017-001	0000K	206-00049
K2	Relay, 1 pole, 1 position, coil: 12 Vdc, 4 mA, 3050 ohm	1-942017-001	0000K	206-00049
K3	Relay, 1 pole, 1 position, coil: 12 Vdc, 4 mA, 3050 ohm	1-942017-001	0000K	206-00049
K4	Relay, 1 pole, 1 position, coil: 12 Vdc, 4 mA, 3050 ohm	1-942017-001	0000K	206-00049
K5	Relay, 1 pole, 1 position, coil: 12 Vdc, 4 mA, 3050 ohm	1-942017-001	0000K	206-00049
R1	Resistor, fixed, wirewound, 50 kilohm, ±0.1%, ¼ W	1-945084-041	01681	4060
R2	Resistor, fixed, composition, 8.2 kilohm, ±5%, ¼ W	1-945000-184	01121	CB8225
R3	Resistor, fixed, wirewound, 10 kilohm, ±0.1%, ¼ W	1-945084-018	01681	4060
R4	Resistor, variable, cermet, 10 kilohm, ±10%, ¾ W	1-945081-010	80294	3009
R5	Resistor, fixed, wirewound, 2 kilohm, ±0.1%, ¼ W	1-945084-044	01681	4060
R6	Resistor, fixed, wirewound, 120 kilohm, ±0.1%, ¼ W	1-945084-039	01681	4060
R7	Resistor, fixed, wirewound, 60 kilohm, ±0.1%, ¼ W	1-945084-040	01681	4060
R8	Resistor, fixed, wirewound, 60 kilohm, ±0.1%, ¼ W	1-945084-040	01681	4060
R9	Resistor, fixed, wirewound, 40 kilohm, ±0.1%, ¼ W	1-945084-010	01681	4060
R10	Resistor, fixed, wirewound, 30 kilohm, ±0.1%, ¼ W	1-945084-042	01681	4060
R11	Resistor, fixed, wirewound, 24 kilohm, ±0.1%, ¼ W	1-945084-043	01681	4060
R12	Resistor, fixed, composition, 1 kilohm, ±5%, ¼ W	1-945000-162	01121	CB1025
R13	Resistor, fixed, wirewound, 2 kilohm, ±0.1%, ¼ W	1-945084-044	01681	4060
R14	Resistor, variable, cermet, 10 kilohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
R15	Resistor, fixed, composition, 100 kilohm, ±5%, ¼ W	1-945000-210	01121	CB1045

Table 7-23. Parts List for dB Readout and Audio Circuit Assembly, A24 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R16	Resistor, fixed, composition, 91 kilohm, ±5%, ¼ W	1-945000-209	01121	CB9135
R17	Resistor, fixed, composition, 10 kilohm, ±5%, ¼ w	1-945000-186	01121	CB1035
R18	Resistor, fixed, composition, 680 kilohm, ±5%, ¼ W	1-945000-230	01121	CB6845
U1	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U2	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U3	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393

Table 7-24. Parts List for Remote Function Selector Assembly, A25

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, electrolytic, 1.0 uF, ±20%, 35 Vdc	1-900057-146	56289	150D105X0035A2
C2	Capacitor, fixed, electrolytic, 100 uF, 10% +75%, 25 Vdc	1-900039-004	76433	984-1653
C3	Capacitor, fixed, electrolytic, 100 uF, 10% +75%, 25 Vdc	1-900039-004	76433	984-1653
CR1	Diode, silicon	1-913058-002	04651	1N277
CR2	Diode, silicon	1-913058-002	04651	1N277
CR3	Diode, silicon	1-913058-002	04651	1N277
CR4	Diode, silicon	1-913058-002	04651	1N277
CR5	Diode, silicon	1-913058-002	04651	1N277
CR6	Diode, silicon	1-913058-002	04651	1N277
CR7	Diode, silicon	1-913058-002	04651	1N277
CR8	Diode, silicon	1-913058-002	04651	1N277
CR9	Diode, silicon	1-913056-001	04713	1N456A
CR10	Diode, silicon	1-913056-001	04713	1N456A
CR11	Diode, silicon	1-913056-001	04713	1N456A
CR12	Diode, silicon	1-913058-002	04651	1N277
CR13	Diode, silicon	1-913058-002	04651	1N277
CR14	Diode, silicon	1-913058-002	04651	1N277
CR15	Diode, silicon	1-913057-001	01295	G129
K1	Relay, reed, DPST	1-942018-001	0000K	206-00050
K2	Relay, reed, DPST	1-942018-001	0000K	206-00050
K3	Relay, reed, DPST	1-942018-001	0000K	206-00050
R1	Resistor, fixed, film, 178 k ohm, ±1%, 1/8 W	1-945027-409	07115	RN55D17835
R2	Resistor, fixed, film, 178 k ohm, ±1%, 1/8 W	1-945027-409	07115	RN55D17835
R3	Resistor, fixed, film, 178 k ohm, ±1%, 1/8 W	1-945027-409	07115	RN55D17835
R4	Resistor, fixed, composition, 2.7 k ohm, ±5%, 1/4 W	1-945000-172	01121	CB2725
R5	Resistor, variable, wirewound, 20 k ohm, ±10%, 3/4 W	1-945081-011	80294	3009P1-1-203
R6	Resistor, fixed, film, 178 k ohm, ±1%, 1/8 W	1-945027-409	07115	RN55D17835
R7	Resistor, fixed, film, 1.5 k ohm, ±1%, 1/8 W	1-945016-210	07115	RN60D1501F
R8	Resistor, fixed, film, 3.01 k ohm, ±1%, 1/8 W	1-945016-239	07115	RN60D3011F
U1	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393

Table 7-25. Parts List for Shaper Circuit Assembly, A26

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, electrolytic, 50 uF, -10% +75%, 15 Vdc	1-900039-008	76433	984-1655
C2	Capacitor, fixed, electrolytic, 50 uF, -10% +75%, 15 Vdc	1-900039-008	76433	984-1655
C3	Capacitor, fixed, mica, 100 pF, ±5%, 500 Vdc	1-900003-030	72136	DM15F101J
C4	Capacitor, fixed, plastic, 0.22 uF, ±10%, 250 Vdc	1-900001-117	73445	C280AE0.22uF
C5	Capacitor, fixed, mica, 100 pF, ±5%, 500 Vdc	1-900003-030	72136	DM15F101J
C6	Capacitor, fixed, plastic, 0.022 uF, ±10%, 250 Vdc	1-900001-105	73445	C280AE0.022uF
CR1	Diode, silicon	1-913059-001	01295	1N626
CR2	Diode, silicon	1-913059-001	01295	1N626
CR3	Diode, silicon	1-913059-001	01295	1N626
CR4	Diode, silicon	1-913059-001	01295	1N626
CR5	Diode, silicon	1-913059-001	01295	1N626
CR6	Diode, silicon	1-913059-001	01295	1N626
CR7	Diode, silicon	1-913059-001	01295	1N626
CR8	Diode, silicon	1-913059-001	01295	1N626
CR9	Diode, silicon	1-913059-001	01295	1N626
CR10	Diode, silicon	1-913059-001	01295	1N626
CR11	Diode, silicon	1-913059-001	01295	1N626
CR12	Diode, silicon	1-913059-001	01295	1N626
CR13	Diode, zener, 7.5 V, 400 mW	1-913045-001	04713	1N755A
Q1	Transistor, silicon, NPN	1-958065-001	04713	MJ420B
Q2	Transistor, silicon, NPN	1-958065-001	04713	MJ420B
Q3	Transistor, silicon, NPN	1-958065-001	04713	MJ420B
Q4	Transistor, silicon, NPN	1-958065-001	04713	MJ420B
R1	Resistor, fixed, film, 15 k ohm, ±1%, ⅛ W	1-945027-306	07115	RN55D1502F
R2	Resistor, fixed, film, 15 k ohm, ±1%, ⅛ W	1-945027-306	07115	RN55D1502F
R3	Resistor, fixed, film, 15 k ohm, ±1%, ⅛ W	1-945027-306	07115	RN55D1502F
R4	Resistor, fixed, film, 15 k ohm, ±1%, ⅛ W	1-945027-306	07115	RN55D1502F
R5	Resistor, fixed, film, 15 k ohm, ±1%, ⅛ W	1-945027-306	07115	RN55D1502F
R6	Resistor, fixed, film, 15 k ohm, ±1%, ⅛ W	1-945027-306	07115	RN55D1502F
R7	Resistor, fixed, film, 13.3 k ohm, ±1%, ⅛ W	1-945027-301	07115	RN55D1332F
R8	Resistor, fixed, film, 16.2 k ohm, ±1%, ⅛ W	1-945027-309	07115	RN55D1622F
R9	Resistor, fixed, film, 20 k ohm, ±1%, ⅛ W	1-945027-318	07115	RN55D2002F
R10	Resistor, fixed, film, 26.1 k ohm, ±1%, ⅛ W	1-945027-329	07115	RN55D2612F
R11	Resistor, fixed, film, 39.2 k ohm, ±1%, ⅛ W	1-945027-346	07115	RN55D3922F
R12	Resistor, fixed, film, 80.6 k ohm, ±1%, ⅛ W	1-945027-376	07115	RN55D8062F
R13	Resistor, fixed, film, 59 k ohm, ±1%, ⅛ W	1-945027-363	07115	RN55D5902F
R14	Resistor, fixed, film, 76.8 k ohm, ±1%, ⅛ W	1-945027-374	07115	RN55D7682F

Table 7-25. Parts List for Shaper Circuit Assembly, A26 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R15	Resistor, fixed, film, 78.7 k ohm, ±1%, ⅛ W	1-945027-375	07115	RN55D7872F
R16	Resistor, fixed, film, 60.4 k ohm, ±1%, ⅛ W	1-945027-364	07115	RN55D6042F
R17	Resistor, fixed, film, 71.5 k ohm, ±1%, ⅛ W	1-945027-371	07115	RN55D7152F
R18	Resistor, fixed, film, 60.4 k ohm, ±1%, ⅛ W	1-945027-364	07115	RN55D6042F
R19	Resistor, fixed, film, 113 k ohm, ±1%, ⅛ W	1-945027-390	07115	RN55D1133F
R20	Resistor, fixed, film, 56.2 k ohm, ±1%, ⅛ W	1-945027-361	07115	RN55D5622F
R21	Resistor, fixed, film, 36.5 k ohm, ±1%, ⅛ W	1-945027-343	07115	RN55D3652F
R22	Resistor, fixed, film, 27.4 k ohm, ±1%, ⅛ W	1-945027-331	07115	RN55D2742F
R23	Resistor, fixed, film, 21.5 k ohm, ±1%, ⅛ W	1-945027-321	07115	RN55D2152F
R24	Resistor, fixed, film, 590 k ohm, ±1¼, ⅛ W	1-945027-459	07115	RN55D5903F
R25	Resistor, fixed, composition, 6.8 k ohm, ±5%, ¼ W	1-945000-182	01121	CB6825
R26	Resistor, fixed, composition, 7.5 k ohm, ±5%, ¼ W	1-945000-183	01121	CB7525
R27	Resistor, fixed, composition, 8.2 k ohm, ±5%, ¼ W	1-945000-184	01121	CB8225
R28	Resistor, fixed, composition, 9.1 k ohm, ±5%, ¼ W	1-945000-185	01121	CB9125
R29	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R30	Resistor, fixed, composition, 12 k ohm, ±5%, ¼ W	1-945000-188	01121	CB1235
R31	Resistor, variable, wirewound, 100 k ohm,±10%, ¾ W	1-945081-013	80294	3009P-1-104
R32	Resistor, fixed, composition, 11 k ohm, ±5%, ¼ W	1-945000-187	01121	CB1135
R33	Resistor, fixed, composition, 7.5 k ohm, ±5%, ¼ W	1-945000-183	01121	CB7525
R34	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R35	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R36	Resistor, fixed, composition, 330 k ohm, ±5%, ¼ W	1-945000-222	01121	CB3345
R37	Resistor, fixed, composition, 6.8 k ohm, ±5%, ¼ W	1-945000-182	01121	CB6825
R38	Resistor, fixed, composition, 330 k ohm, ±5%, ¼ W	1-945000-222	01121	CB3345
R39	Resistor, fixed, film, 73.2 k ohm, ±1%, ⅛ W	1-945027-372	07115	RN55D7322F
R40	Resistor, variable, wirewound, 5 k ohm, ±10%, ¾ W	1-945081-009	80294	3009P-1-502
R41	Resistor, fixed, composition, 150 ohm, ±5%, ¼ W	1-945000-142	01121	CB1515
U1	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U2	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U3	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U4	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U5	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U6	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U7	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393

Table 7-26. Parts List for Tuning Control Board Assembly, A29

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, electrolytic, 50 uF, 10% +75%, 15 Vdc	1-900039-008	76433	984-1655
C2	Capacitor, fixed, electrolytic, 50 uF, 10% +75%, 15 Vdc	1-900039-008	76433	984-1655
C3	Capacitor, fixed, electrolytic, 150 uF, ±10%, 150 Vdc	1-900057-191	56289	150D157X9015S2
C4	Capacitor, fixed, ceramic, 0.005 uF, ±20%, 100 Vdc	1-900077-001	56289	TG-D50
C5	Capacitor, fixed, ceramic, 0.005 uF, ±20%, 100 Vdc	1-900077-001	56289	TG-D50
CR1	Diode, silicon	1-913056-001	04713	1N456A
CR2	Diode, silicon	1-913056-001	04713	1N456A
CR3	Diode, silicon	1-913056-001	04713	1N456A
CR4	Diode, silicon	1-913056-001	04713	1N456A
CR5	Diode, silicon	1-913058-001	04651	1N498
CR6	Diode, silicon	1-913056-001	04713	1N456A
CR7	Diode, silicon	1-913058-001	04651	1N498
CR8	Diode, silicon	1-913056-001	04713	1N456A
CR9	Diode, silicon	1-913058-001	04651	1N498
CR10	Diode, silicon	1-913056-001	04713	1N456A
CR11	Diode, silicon	1-913058-001	04651	1N498
CR12	Diode, silicon	1-913056-001	04713	1N456A
K1	Relay, reed, SPST	1-942017-001	0000K	206-00049
K2	Relay, reed, SPST	1-942017-001	0000K	206-00049
K3	Relay, reed, SPST	1-942017-001	0000K	206-00049
K4	Relay, reed, SPST	1-942017-001	0000K	206-00049
K5	Relay, reed, SPST	1-942017-001	0000K	206-00049
K6	Relay, reed, SPST	1-942017-001	0000K	206-00049
K7	Relay, reed, SPST	1-942017-001	0000K	206-00049
K8	Relay, reed, SPST	1-942017-001	0000K	206-00049
R1	Resistor, fixed, film, 15 k ohm, ±1%, ⅛ W	1-945027-306	07115	RN55D1502F
R2	Resistor, fixed, film, 15 k ohm, ±1%, ⅛ W	1-945027-306	07115	RN55D1502F
R3	Resistor, fixed, composition, 3.3 M ohm, ±5%, ¼ W	1-945000-246	01121	CB3355
R4	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R5	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535
R6	Resistor, fixed, film, 13.3 k ohm, ±1%, ⅛ W	1-945027-301	07115	RN55D1332F
R7	Resistor, fixed, film, 13.3 k ohm, ±1%, ⅛ W	1-945027-301	07115	RN55D1332F
R8	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R9	Resistor, fixed, film, 15 k ohm, ±1%, ⅛ W	1-945027-306	07115	RN55D1502F
R10	Resistor, variable, wirewound, 500 ohm, ±10%, ¾ W	1-945081-006	80294	3009P-1-501
R11	Resistor, fixed, composition, 24 k ohm, ±5%, ¼ W	1-945000-195	01121	CB2435

Table 7-26. Parts List for Tuning Control Board Assembly, A29 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R12	Resistor, fixed, film, 4.75 k ohm, ±1%, 1/8 W	1-945027-258	07115	RN55D4751F
R13	Resistor, fixed, film, 1.24 k ohm, ±1%, 1/8 W	1-945027-202	07115	RN55D1241
R14	Resistor, fixed, film, 15 k ohm, ±1%, 1/8 W	1-945027-306	07115	RN55D1502
R15	Resistor, variable, wirewound, 10 k ohm, ±10%, 3/4 W	1-945081-010	80294	3009P-1-103
U1	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U2	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393

Table 7-27. Parts List for Band Selector Assembly, A30

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
CR1	Diode, silicon	1-913058-002	04651	1N277
CR2	Diode, silicon	1-913058-002	04651	1N277
CR3	Diode, silicon	1-913058-002	04651	1N277
CR4	Diode, silicon	1-913058-002	04651	1N277
CR5	Diode, silicon	1-913058-002	04651	1N277
CR6	Diode, silicon	1-913058-002	04651	1N277
CR7	Diode, silicon	1-913056-001	04713	1N456A
CR8	Diode, silicon	1-913056-001	04713	1N456A
CR9	Diode, silicon	1-913056-001	04713	1N456A
CR10	Diode, silicon	1-913056-001	04713	1N456A
CR11	Diode, silicon	1-913056-001	04713	1N456A
CR12	Diode, silicon	1-913056-001	04713	1N456A
CR13	Diode, silicon	1-913056-001	04713	1N456A
CR14	Diode, silicon	1-913056-001	04713	1N456A
K1	Relay, reed, DPST	1-942018-001	0000K	206-00050
K2	Relay, reed, DPST	1-942018-001	0000K	206-00050
K3	Relay, reed, DPST	1-942018-001	0000K	206-00050
K4	Relay, reed, DPST	1-942018-001	0000K	206-00050
K5	Relay, reed, DPST	1-942018-001	0000K	206-00050
K6	Relay, reed, DPST	1-942018-001	0000K	206-00050
K7	Relay, reed, DPST	1-942018-001	0000K	206-00050
K8	Relay, reed, DPST	1-942018-001	0000K	206-00050

Table 7-28. Parts List for Voltage Regulator Assembly, A31

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, electrolytic, 22 uF, ±20%, 35 Vdc	1-900057-154	56289	150D226X9035R2
C2	Capacitor, fixed, electrolytic, 22 uF, ±20%, 35 Vdc	1-900057-154	56289	150D226X9035R2
C3	Capacitor, fixed, electrolytic, 150 uF, ±10%, 15 Vdc	1-900057-191	56289	150D157X9015S2
C4	Capacitor, fixed, electrolytic, 150 uF, ±10%, 15 Vdc	1-900057-191	56289	150D157X9015S2
C5	Capacitor, fixed, mica, 150 pF, ±5%, 500 Vdc	1-900071-015	72136	DM10-151J
C6	Capacitor, fixed, mica, 150 pF, ±5%, 500 Vdc	1-900071-015	72136	DM10-151J
C7	Not used			
C8	Capacitor, fixed, electrolytic, 1 uF, ±20%, 35 Vdc	1-900057-146	56289	150D105X0035A2
CR1	Diode, zener, 4.7 V, 400 mW	1-913054-018	04713	1N750A
CR2	Diode, zener, 5.6 V, 400 mW	1-913054-110	04713	1N752A
CR3	Diode, reference, 6.2 V	1-913060-001	04713	1N827A
Q1	Transistor, silicon, NPN	1-958039-001	04713	2N3055
Q2	Transistor, silicon, PNP	1-958012-009	04713	2N4901
Q3	Transistor, silicon, NPN	1-958040-001	02735	2N3053
Q4	Transistor, silicon, PNP	1-958023-001	02735	2N4037
Q5	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q6	Transistor, silicon, NPN	1-958000-001	04713	2N3904
Q7	Transistor, silicon, NPN	1-958040-001	02735	2N3053
Q8	Transistor, silicon, PNP	1-958023-002	02735	2N4037
R1	Resistor, fixed, composition, 2.2 k ohm, ±5%, ½ W	1-945001-170	01121	EB2225
R2	Resistor, fixed, composition, 2.2 k ohm, ±5%, ½ W	1-945001-170	01121	EB2225
R3	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R4	Resistor, fixed, composition, 100 ohm, ±5%, ¼ W	1-945000-138	01121	CB1015
R5	Resistor, fixed, wirewound, 1.0 ohm, ±3%, 4.75 W	1-945079-001	91637	RS-2A
R6	Resistor, fixed, wirewound, 1.0 ohm, ±3%, 4.75 W	1-945079-001	91637	RS-2A
R7	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R8	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R9	Resistor, fixed, composition, 2.7 k ohm, ±5%, ¼ W	1-945000-172	01121	CB2725
R10	Not used			
R11	Resistor, fixed, film, 768 ohm, ±1%, ¼ W	1-945016-182	07115	RN60D7680F
R12	Resistor, fixed, film, 2.67 k ohm, ±1%, ¼ W	1-945016-234	07115	RN60D2672F
R13	Resistor, fixed, film, 2.67 k ohm, ±1%, ¼ W	1-945016-234	07115	RN60D2762F
R14	Resistor, fixed, film, 2.67 k ohm, ±1%, ¼ W	1-945016-234	07115	RN60D2672F
R15	Resistor, fixed, film, 2.67 k ohm, ±1%, ¼ W	1-945016-234	07115	RN60D2672F
R16	Resistor, fixed, film, 2.87 k ohm, ±1%, ¼ W	1-945016-237	07115	RN60D2872F
R17	Resistor, fixed, film, 8.06 k ohm, ±1%, ¼ W	1-945016-280	07115	RN60D8062F
R18	Resistor, variable, wirewound, 500 ohm, ±10%, ¾ W	1-945081-006	80294	3009P1-501

Table 7-28. Parts List for Voltage Regulator Assembly, A31 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R19	Resistor, variable, wirewound, 100 ohm, ±10%, ¾ W	1-945081-004	80294	3009P1-101
U1	Integrated circuit, operational amplifier	1-926040-001	06650	20-007C
U2	Integrated circuit, operational amplifier	1-926040-001	06650	20-007C

Table 7-29. Parts List for Rectifier and Charge Regulator Assembly, A32

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
CR1	Diode, bridge rectifier	1-913061-001	04713	MDA942-1
CR2	Diode, bridge rectifier	1-913061-001	04713	MDA942-1
CR3	Diode, zener, 4.7 V, 400 mW	1-913054-108	04713	1N750A
CR4	Diode, zener, 4.7 V, 400 mW	1-913054-108	04713	1N750A
CR5	Diode, silicon	1-913001-004	04713	1N4004
CR6	Diode, silicon	1-913001-004	04713	1N4004
CR7	Diode, zener, 12 V, 400 mW	1-913054-117	04713	1N759A
CR8	Diode, silicon	1-913056-001	04713	1N456A
CR9	Diode, silicon	1-913056-001	04713	1N456A
CR10	Diode, silicon	1-913056-001	04713	1N456A
CR11	Diode, silicon	1-913056-001	04713	1N456A
Q1	Transistor, silicon, NPN	1-958039-009	04713	2N3055
Q2	Transistor, silicon, PNP	1-958012-009	04713	2N4901
R1	Resistor, fixed, wirewound, 1.0 ohm, ±3%, 4.75 W	1-945079-001	91637	RS-2A
R2	Resistor, fixed, wirewound, 1.0 ohm, ±3%, 4.75 W	1-945079-001	91637	RS-2A
R3	Resistor, fixed, composition, 2.2 k ohm, ±5%, 1 W	1-945002-170	01121	GB2225
R4	Resistor, fixed, composition, 2.2 k ohm, ±5%, 1 W	1-945002-170	01121	GB2225
R5	Resistor, fixed, composition, 220 ohm, ±5%, ½ W	1-945001-146	01121	EB2215
R6	Resistor, fixed, composition, 220 ohm, ±5%, ½ W	1-945001-146	01121	EB2215
R7	Resistor, fixed, wirewound, 20 ohm, ±1%, 12.5 W	1-945080-102	91637	RH10
R8	Resistor, fixed, wirewound, 20 ohm, ±1%, 12.5 W	1-945080-102	91637	RH10
R9	Resistor, adjustable, wirewound, 25 ohm, ±10%, 12 W	1-945074-002	44655	1009
R10	Resistor, adjustable, wirewound, 25 ohm, ±10%, 12 W	1-945074-002	44566	1009
R11	Resistor, fixed, composition, 39 ohm, ±5%, 1 W	1-945002-128	01121	GB3905
R12	Resistor, fixed, composition, 39 ohm, ±5%, 1 W	1-945002-128	01121	GB3905
R13	Resistor, fixed, composition, 4.3 k ohm, ±5%, ¼ W	1-945000-177	01121	CB4325
R14	Resistor, variable, wirewound, 2 k ohm, ±10%, ¾ W	1-945081-008	80294	3009P1-202

Table 7-30. Parts List for Internal Sweep Assembly, A33

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, electrolytic, 100 uF, ±10%, 20 Vdc	1-900057-131	56289	150D107X9010R2
C2	Capacitor, fixed, ceramic, 0.001 uF, ±10%, 250 Vdc	1-900001-130	73445	C280AE0.001uF
C3	Capacitor, fixed, ceramic, 0.0022 uF, ±10%, 250 Vdc	1-900001-134	73445	C280AE0.0022uF
C4	Capacitor, fixed, electrolytic, 1.0 uF, ±20%, 35 Vdc	1-900057-146	56289	150D105X0035A2
C5	Capacitor, fixed, electrolytic, 1.0 uF, ±20%, 35 Vdc	1-900057-146	56289	150D105X0035A2
CR1	Diode, silicon	1-913056-001	04713	1N456A
CR2	Diode, silicon	1-913058-002	04651	1N277
CR3	Diode, silicon	1-913056-001	04713	1N456A
K1	Relay, reed, SPST	1-942020-001	0000K	206-00070
R1	Resistor, variable, wirewound, 10 k ohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
R2	Resistor, fixed, composition, 1.8 M ohm, ±5%, ¼ W	1-945000-240	01121	CB1855
R3	Resistor, fixed, composition, 100 k ohm, ±5%, ¼ W	1-945000-210	01121	CB1045
R4	Resistor, fixed, composition, 39 k ohm, ±5%, ¼ W	1-945000-200	01121	CB3935
R5	Resistor, variable, wirewound, 10 k ohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
R6	Resistor, fixed, composition, 100 k ohm, ±5%, ¼ W	1-945000-210	01121	CB1045
R7	Resistor, fixed, composition, 33 k ohm, ±5%, ¼ W	1-945000-198	01121	CB3335
R8	Resistor, fixed, composition, 47 k ohm, ±5%, ¼ W	1-945000-202	01121	CB4735
R9	Resistor, fixed, composition, 47 k ohm, ±5%, ¼ W	1-945000-202	01121	CB4735
R10	Resistor, fixed, composition, 470 k ohm, ±5%, ¼ W	1-945000-226	01121	CB4745
R11	Resistor, fixed, composition, 47 k ohm, ±5%, ¼ W	1-945000-202	01121	CB4735
R12	Resistor, fixed, composition, 390 k ohm, ±5%, ¼ W	1-945000-224	01121	CB3945
R13	Resistor, fixed, composition, 270 k ohm, ±5%, ¼ W	1-945000-220	01121	CB2745
R14	Resistor, fixed, composition, 220 ohm, ±5%, ¼ W	1-945000-146	01121	CB2215
U1	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U2	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741383
U3	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393

Table 7-31. Parts List for Frequency Readout Assembly, A34

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, electrolytic, 50 uF, ±20%, 15 Vdc	1-900039-008	76433	984-1655
C2	Capacitor, fixed, electrolytic, 50 uF, ±20%, 15 Vdc	1-900039-008	76433	984-1655
CR1	Diode, silicon	1-913059-001	01295	1N626
CR2	Diode, silicon	1-913059-001	01295	1N626
CR2	Diode, silicon	1-913059-001	01295	1N626
CR4	Diode, silicon	1-913059-001	01295	1N626
CR5	Diode, silicon	1-913059-001	01295	1N626
CR6	Diode, silicon	1-913059-001	01295	1N626
CR7	Diode, silicon	1-913059-001	01295	1N626
CR8	Diode, silicon	1-913059-001	01295	1N626
K1	Relay, reed, SPST	1-942017-001	0000K	206-00049
K2	Relay, reed, SPST	1-942017-001	0000K	206-00049
K3	Relay, reed, SPST	1-942017-001	0000K	206-00049
K4	Relay, reed, SPST	1-942017-001	0000K	206-00049
K5	Relay, reed, SPST	1-942017-001	0000K	206-00049
K6	Relay, reed, SPST	1-942017-001	0000K	206-00049
K7	Relay, reed, SPST	1-942017-001	0000K	206-00049
K8	Relay, reed, SPST	1-942017-001	0000K	206-00049
R1	Resistor, fixed, wirewound, 15 k ohm, ±0.1%, ¼ W	1-945084-016	01686	4060-15K
R2	Resistor, fixed, wirewound, 13.5 k ohm, ±0.1% ¼ W	1-945084-017	01686	4060-13.5K
R3	Resistor, fixed, film, 7.15 k ohm, ±1%, 1/8 W	1-945027-275	07115	RN55D7152F
R4	Resistor, fixed, wirewound, 360 k ohm, ±0.1%, ¼ W	1-945084-033	01686	4060-360K
R5	Resistor, fixed, wirewound, 11.08 k ohm, ±0.1%, ¼ W	1-945084-036	01686	4060-11.08K
R6	Resistor, fixed, wirewound, 14.64 k ohm, ±0.1%, ¼ W	1-945084-031	01686	4060-14.64K
R7	Resistor, fixed, wirewound, 10.32 k ohm, ±0.1%, ¼ W	1-945084-030	01686	4060-10.32K
R8	Resistor, fixed, wirewound, 7.32 k ohm, ±0.1%, ¼ W	1-945084-029	01686	4060-7.32K
R9	Resistor, fixed, wirewound, 5.6 k ohm, ±0.1%, ¼ W	1-945084-037	01686	4060-5.16K
R10	Resistor, fixed, wirewound, 366 k ohm, ±0.1%, ¼W	1-945084-026	01686	4060-366K
R11	Resistor, fixed, wirewound, 258.2 k, ±,0.1%, ¼ W	1-945084-038	01686	4060-258.2K
R12	Resistor, fixed, wirewound, 183 k ohm, ±0.1%, ¼ W	1-945084-022	01686	4060-183K
R13	Resistor, fixed, wirewound, 129.1 k ohm, ±0.1%, ¼ W	1-945084-025	01686	4060-129.1K
R14	Resistor, fixed, wirewound, 91.5 k ohm, ±0.1%, ¼ W	1-945084-020	01686	4060-91.5K
R15	Resistor, fixed, wirewound, 64.6 k ohm, ±0.1%, ¼ W	1-945084-021	01686	4060-64.6K

Table 7-31. Parts List for Frequency Readout Assembly, A34 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R16	Resistor, fixed, wirewound, 45.7 k ohm, ±0.1%, ¼ W	1-945084-019	01686	4060-45.7K
R17	Resistor, fixed, wirewound, 32.3 k ohm, ±0.1%, ¼ W	1-945084-024	01686	4060-32.3K
R18	Resistor, fixed, wirewound, 22.85 k ohm, ±0.1%, ¼ W	1-945084-034	01686	4060-22.85
R19	Resistor, fixed, wirewound, 16.3 k ohm, ±0.1%, ¼ W	1-945084-023	01686	4060-16.3K
R20	Resistor, fixed, wirewound, 3.0 k ohm, ±0.1%, ¼ W	1-945084-035	01686	4060-3.0K
R21	Resistor, fixed, film, 1.74 k ohm, ±1%, ⅛ W	1-945027-216	07115	RN55D1742F
R22	Resistor, variable, wirewound, 10 k ohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
U1	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393
U2	Integrated circuit, operational amplifier	1-926036-002	07263	U5B7741393

Table 7-32. Parts List for Input Filter Assembly, A41

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, mylar, 1.2 uF, ±5%, 400 Vdc	1-900118-132	14752	230D1E125-J
C2	Capacitor, fixed, mica, 33 pF, ±5%, 500 Vdc	1-900003-017	72136	DM15
C3	Capacitor, fixed, mylar, 1.2 uF, ±5%, 100 Vdc	1-900118-002	14752	230D1B125-J
J1	Connector, jack, BNC UG-911/U	1-910005-001	02660	31-237
J2	Connector, jack, UG-1455/U	1-910139-002	98291	51-045-0000
L1	Inductor, fixed, toroid, 1.5 mH	3-004685-001	88869	

Table 7-33. Parts List for Battery Pack, A44

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
BT1	Battery, 17.5 V	2-403172-001	88869	
BT2	Battery, 17.5 V	2-403172-001	88869	
CB1	Circuit breaker, 2 amp.	1-924008-007	75915	815002
CB2	Circuit breaker, 2 amp.	1-924008-007	75915	815002

Table 7-34. Parts List for RF Attenuator, A45

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, mica, 5 pF, ±0.5pF, 500 Vdc	1-900071-002	72136	DM10-050D
J1	Connector, jack, UG-1455/U	1-910139-002	98291	51-045-0000
J2	Cable assembly	1-004811-001	88869	
R1	Resistor, fixed, film, 61.9 ohm, ±1%, ¼ W	1-945016-077	07115	RN60D6192F
R2	Resistor, fixed, film, 249 ohm, ±1%, ¼ W	1-945016-135	07115	RN60D2490F
R3	Resistor, fixed, film, 61.9 ohm, ±1%, ¼ W	1-945016-077	07115	RN60D6192F
R4	Resistor, fixed, film, 61.9 ohm, ±1%, ¼ W	1-945016-077	07115	RN60D6192F
R5	Resistor, fixed, film, 249 ohm, ±1%, ¼ W	1-945016-135	07115	RN60D2490F
R6	Resistor, fixed, film, 61.9 ohm, ±1%, ¼ W	1-945016-077	07115	RN60D6192F
R7	Resistor, fixed, film, 61.9 ohm, ±1%, ¼ W	1-945016-077	07115	RN60D6192F
R8	Resistor, fixed, film, 249 ohm, ±1%, ¼ W	1-945016-135	07115	RN60D2490F
R9	Resistor, fixed, film, 61.9 ohm, ±1%, ¼ W	1-945016-077	07115	RN60D6192F
R10	Resistor, fixed, film, 53.6 ohm, ±1%, ¼ W	1-945016-071	07115	RN60D5362F
R11	Resistor, fixed, film, 787 ohm, ±1%, ¼ W	1-945016-183	07115	RN60D7870F
R12	Resistor, fixed, film, 53.6 ohm, ±1%, ¼ W	1-945016-071	07115	RN60D5362F
R13	Resistor, fixed, film, 53.6 ohm, ±1%, ¼ W	1-945016-071	07115	RN60D5362F
R14	Resistor, fixed, film, 787 ohm, ±1%, ¼ W	1-945016-183	07115	RN60D7870F
R15	Resistor, fixed, film, 53.6 ohm, ±1%, ¼ W	1-945016-071	07115	RN60D5362F
S1	Switch, rotary, 5 poles, 6 positions	2-403406-001	88869	

Table 7-35. Code List of Manufacturers

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbook H4-2.

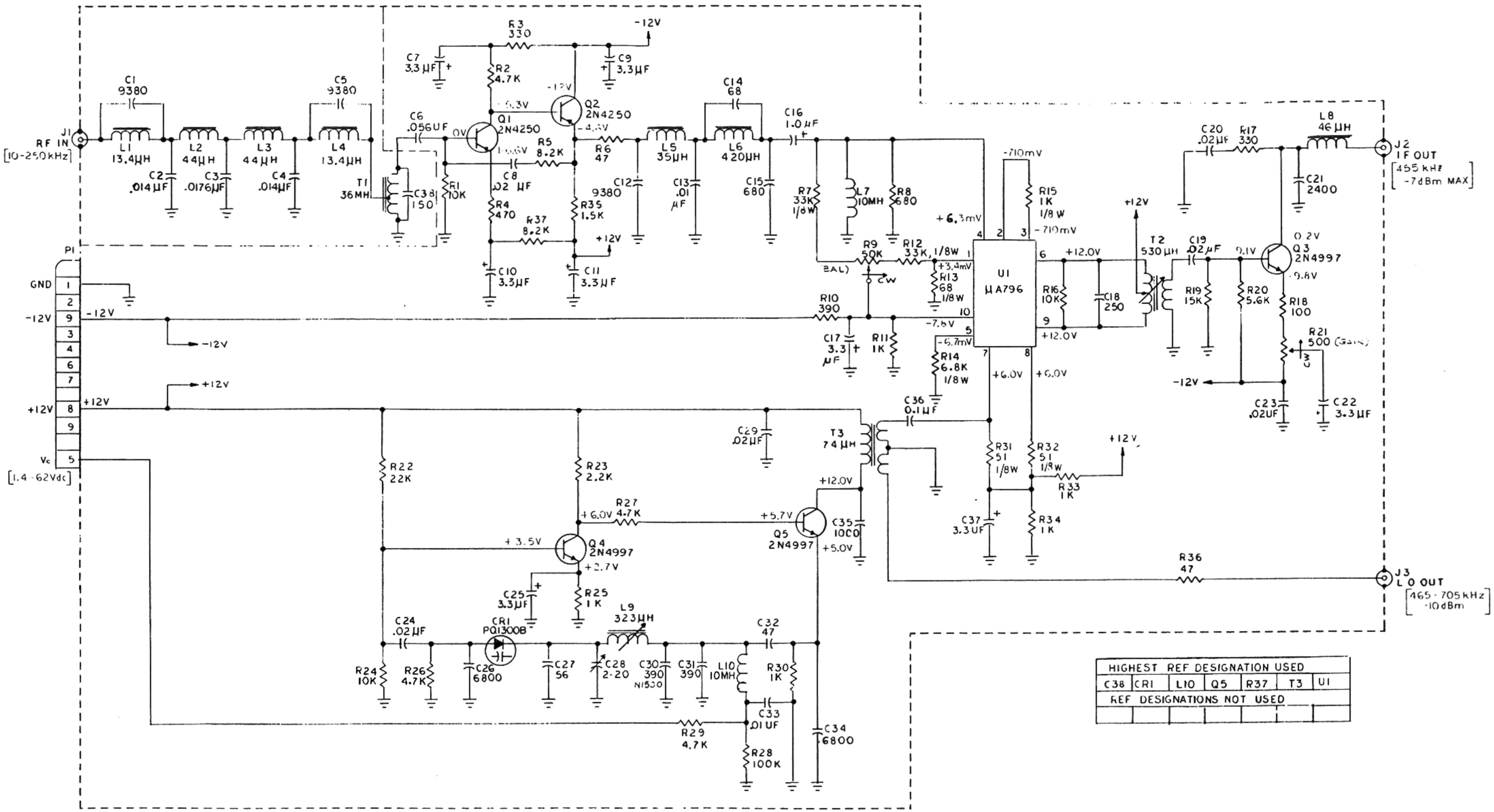
Code No.	Manufacturer	Address
00348	Microtran Co. Inc.	Valley Stream, N. Y.
00656	Aerovox Corp.	New Bedford, Mass.
00853	Sangamo Electric, Co.	Marion, Ill.
01121	Allen-Bradley Co.	Milwaukee, Wis.
01281	TRW Semiconductors Inc.	Lawndale, Calif.
01295	Texas Instrument, Inc., Transistors Products Div.	Dallas, Texas
01351	Dynamic Gear Co., Inc.	Amityville, N.Y.
01681	RCL Mfg. Co.	Riverside, N.J.
01961	Pulse Engineering	Santa Clara, Calif.
02114	Ferrox Cube Corp. of America	Saugerties, N.Y.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	RCA Semiconductors and Materials Div.	Sommerville, N.J.
03508	GE Semiconductor Prod. Div.	Syracruse, N.Y.
03606	RCA Electronic Prod. Div.	Camden, N.J.
03614	Bussman Mfg.	Los Angeles, Calif.
03877	Transitron Electronic Corp.	Wakefield, Mass.
04062	Elmenco Products Co.	New York, N.Y.
04651	Sylvania Elect. Prod., Inc.	Mountain View, Calif.
04713	Motorola Inc.	Phoenix, Ariz.
05574	Viking Industries, Inc.	Chatsworth, Calif.
06650	Bell and Howell Co.	Chicago, Ill.
07109	Oaktron Industries	Monroe, Wis.
07115	Corning Glass Works, Electronic Components Dept.	Bradford, Pa.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.
08514	Centralab	Milwaukee, Wis.
08718	ITT Cannon Elect. Co	Phoenix, Ariz.
09353	C & K Components Inc.	Newton, Mass.
11636	Kings Electronics Co.	So. Pasadena, Calif.
11783	NY-Glass, Inc.	Paramount, Calif.
12954	Dickson Electronics Corp.	Scottsdale, Ariz.
14655	Cornell-Dubilier Elec. Corp.	Plainfield, N.J.
14752	Electro Cube	So. Pasadena, Calif.
15636	Elec-trol, Inc.	Northridge, Calif.
15801	Fenwal Electronics	Farmingham, Mass.
15849	USECO, Inc.	Mt. Vernon, N.Y.
16407	Nytronics Inc.	Lexington, Ky.
17856	Siliconix, Inc.	Santa Clara, Calif.
21604	IWI/Cortland	Chicago, Ill.
24152	SEI Mfg.	Northridge, Calif.
24446	GE Corp.	Schenectady, N.Y.
24972	Telefunken Sales Corp.	Long Island, N.Y.
27014	National Semiconductor Corp.	Santa Clara, Calif.
28480	Hewlett Packard	Palo Alto, Calif.
44655	Ohmite Mfg. Co.	Skokie, Ill.

Table 7-35. Code List of Manufacturers (Cont.)

Code No.	Manufacturer	Address
56289	Sprague Electric Co.	North Adams. Mass.
70903	Belden Mfg. Co.	Chicago, Ill.
71279	Cambridge Thermionic Corp.	Cambridge Mass.
71450	CTS Corp.	Elkhart. Ind.
71785	Cinch Mfg., Div. of United Carr	Chicago, Ill.
72136	Electro Motive Mfg. Co.	Willimantic, Conn.
72982	Erie Resistor Corp.	Erie Pa.
73445	Amperex Electronics Co.	Hicksville N.Y.
75042	International Resistance Co.	Philadelphia, Pa.
75915	Littelfuse Inc.	Desplaines, Ill.
76433	General Instrument Co.	Newark N.J.
76493	Miller, J.W.	Los Angeles, Calif.
77068	Bendix Corp.	No. Hollywood, Calif.
80294	Bourns Laboratories Inc.	Riverside, Calif.
80740	Helipot Div. of Beckman Industries	Fullerton, Calif.
80795	ITT Semiconductors	New York, N.Y.
81095	Triad Transformer Corp.	Huntington, Ind.
81564	Artted Co. Inc.	Springfield, Mass.
82389	Switchcraft	Chicago, Ill.
83003	Varo Inc.	Garaland, Texas
88869	Singer Instrumentation	Los Angeles, Calif.
90201	Mallory P.R. and Co. Inc.	Detroit, Mich.
91293	Johanson Mfg. Co.	Boonton, N.J.
91637	Dale Electronics, Inc.	Columbus, Neb.
91737	Gremar Mfg. Co.	Wakefield, Mass.
95121	Quality Components Inc.	St. Marys, Pa.
95264	Lerco, Electronics Inc.	Burbank, Calif.
95712	Dage Electric Co., Inc.	Franklin, Ind.
98003	Nielsen Hardware Corp.	Hartford, Conn.
98291	Sealectro Corp.	New Rochelle, N.Y.
99800	Delevan Electronics, Corp.	East Aurora, N.Y.
0000A*	Siliconics	Sunnyvale, Calif.
0000B*	Mura Corp.	Jericko, N.Y.
0000C*	Modutec	Norwalk, Conn.
0000D*	Signetics	Sunnyvale, Calif.
0000E*	Power Components	Scottdale, Pa.
0000F*	Hytronics Corp.	Pinellas Park, Fla.
0000G*	Electronic Application	So. El Monte, Calif.
0000H*	Buckeye Stamping Co.	Columbus, Ohio
0000I*	Lenox-Fugle Electronics, Inc.	- - - - -
0000J*	Southwest Supply Co., Inc.	Los Angeles Calif.
0000K*	Triridge Corp.	Pittsburg, Pa.
0000L*	Electornics Instruments and Specialty Corp.	Winchester, Mass
0000M*	Bourns, Inc., Trimpot Div	- - - - -

*These vendors have no numbers assigned in the latest supplement to the Federal Supply Code for Manufacturers H4-2

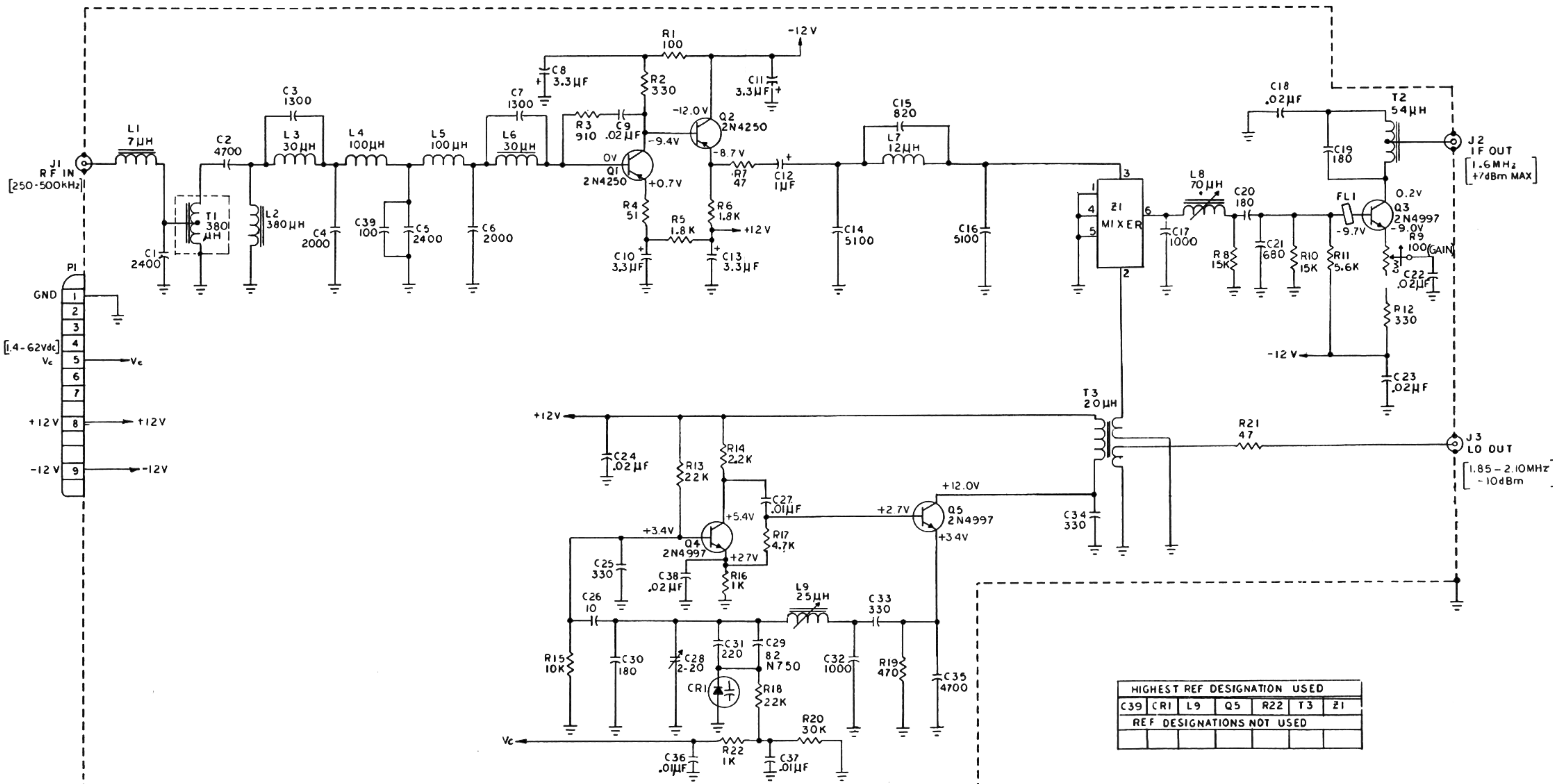
Section VIII
SCHEMATIC DIAGRAMS



HIGHEST REF DESIGNATION USED						
C38	CR1	L10	Q5	R37	T3	U1
REF DESIGNATIONS NOT USED						

3. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUB-ASSEMBLY DESIGNATION(S).
2. ALL CAPACITORS ARE IN PICOFARADS.
1. ALL RESISTORS ARE IN OHMS ±5%, 1/4 W.
NOTES: UNLESS OTHERWISE SPECIFIED

Figure 8-1. Schematic Diagram, Band 1 Tuner, A1
Dwg No. 4-501254-001 (B)

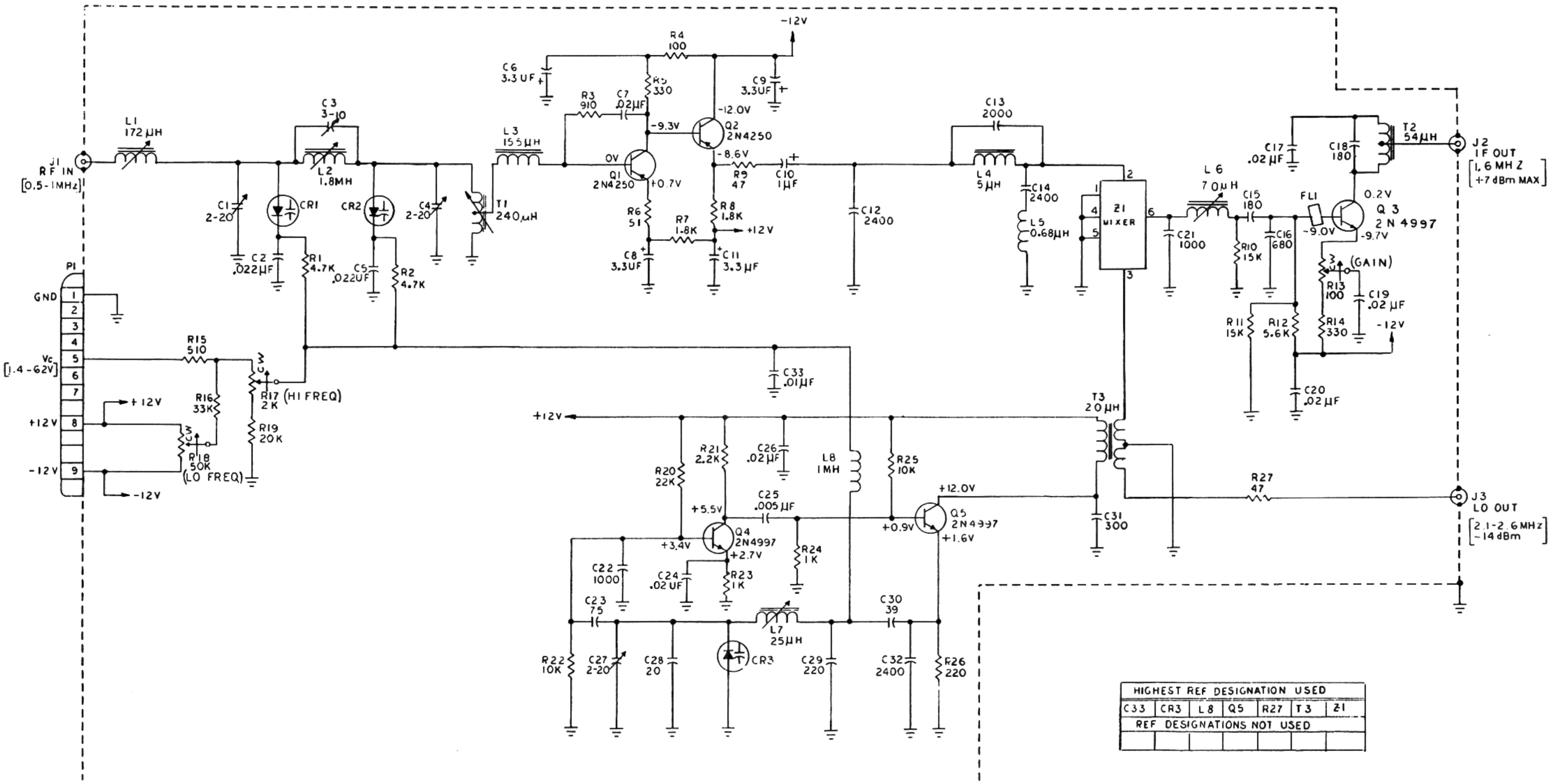


HIGHEST REF DESIGNATION USED						
C39	CR1	L9	Q5	R22	T3	Z1
REF DESIGNATIONS NOT USED						

4. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S).
3. CR1 IS A PO1300B
2. ALL CAPACITORS ARE IN PICOFARADS.
1. ALL RESISTORS ARE IN OHMS, ±5%, 1/4W.

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 8-2. Schematic Diagram, Band 2 Tuner, A2
Dwg No. 4-501255-001 (A)

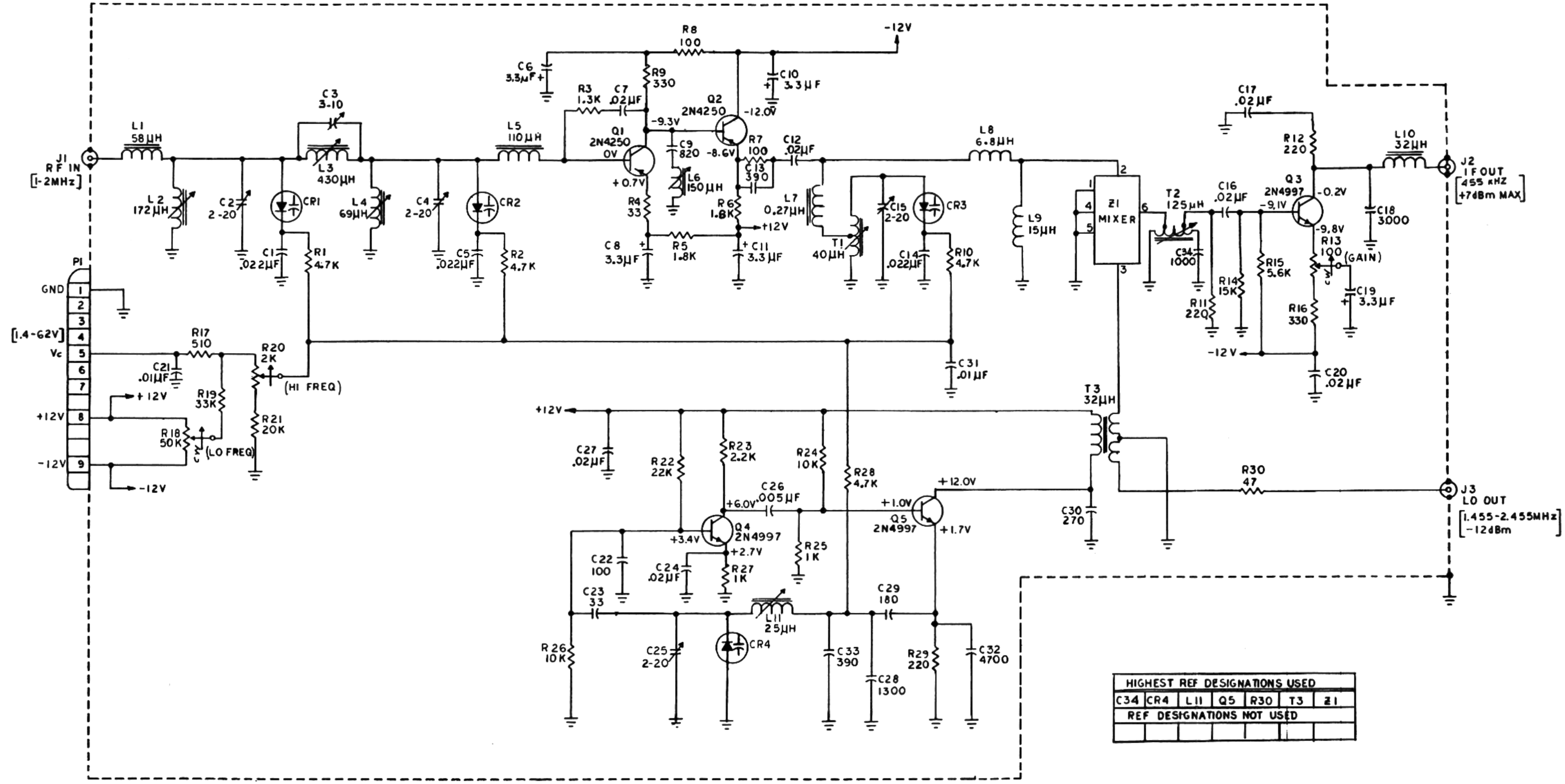


HIGHEST REF DESIGNATION USED						
C33	CR3	L8	Q5	R27	T3	Z1
REF DESIGNATIONS NOT USED						

4. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN, FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S).
3. CR1 THRU CR4 ARE PQ1300B.
2. ALL CAPACITORS ARE IN PICOFARADS.
1. ALL RESISTORS ARE IN OHMS, ±5%, 1/4W.

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 8-3. Schematic Diagram, Band 3 Tuner, A3
Dwg No. 4-501256-001 (A)

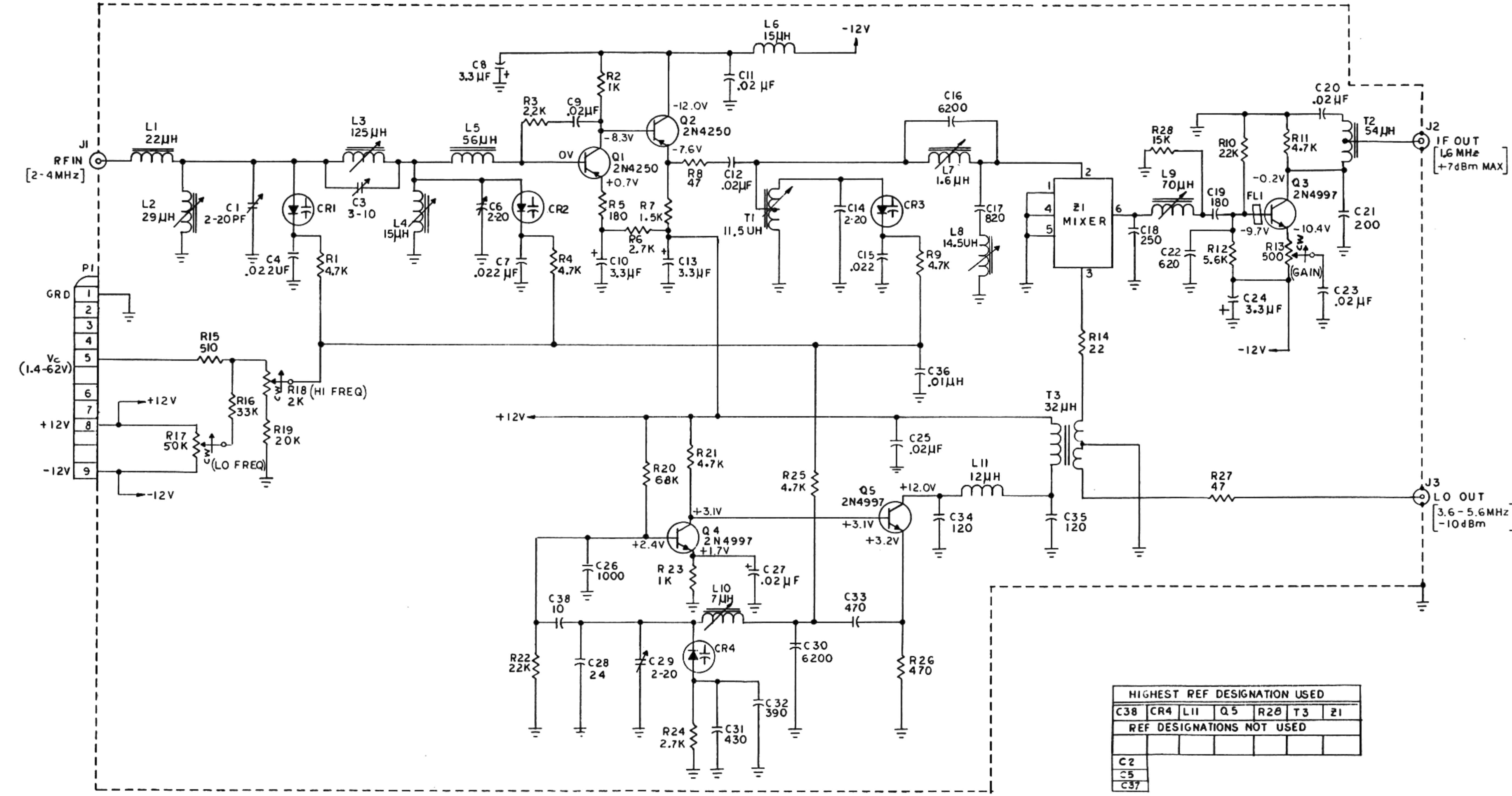


HIGHEST REF DESIGNATIONS USED						
C34	CR4	L11	Q5	R30	T3	Z1
REF DESIGNATIONS NOT USED						

4. PARTIAL REFERENCE DESIGNATIONS SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUB ASSEMBLY DESIGNATION(S).
3. CR1 THRU CR4 ARE PQ1300B.
2. ALL CAPACITORS ARE IN PICOFARADS.
1. ALL RESISTORS ARE IN OHMS, ±5%, 1/4W.

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 8-4. Schematic Diagram, Band 4 Tuner, A4
Dwg No. 4-501257-001 (A)



HIGHEST REF DESIGNATION USED						
C38	CR4	L11	Q5	R28	T3	Z1
REF DESIGNATIONS NOT USED						
C2						
C5						
C37						

4. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATIONS PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S)

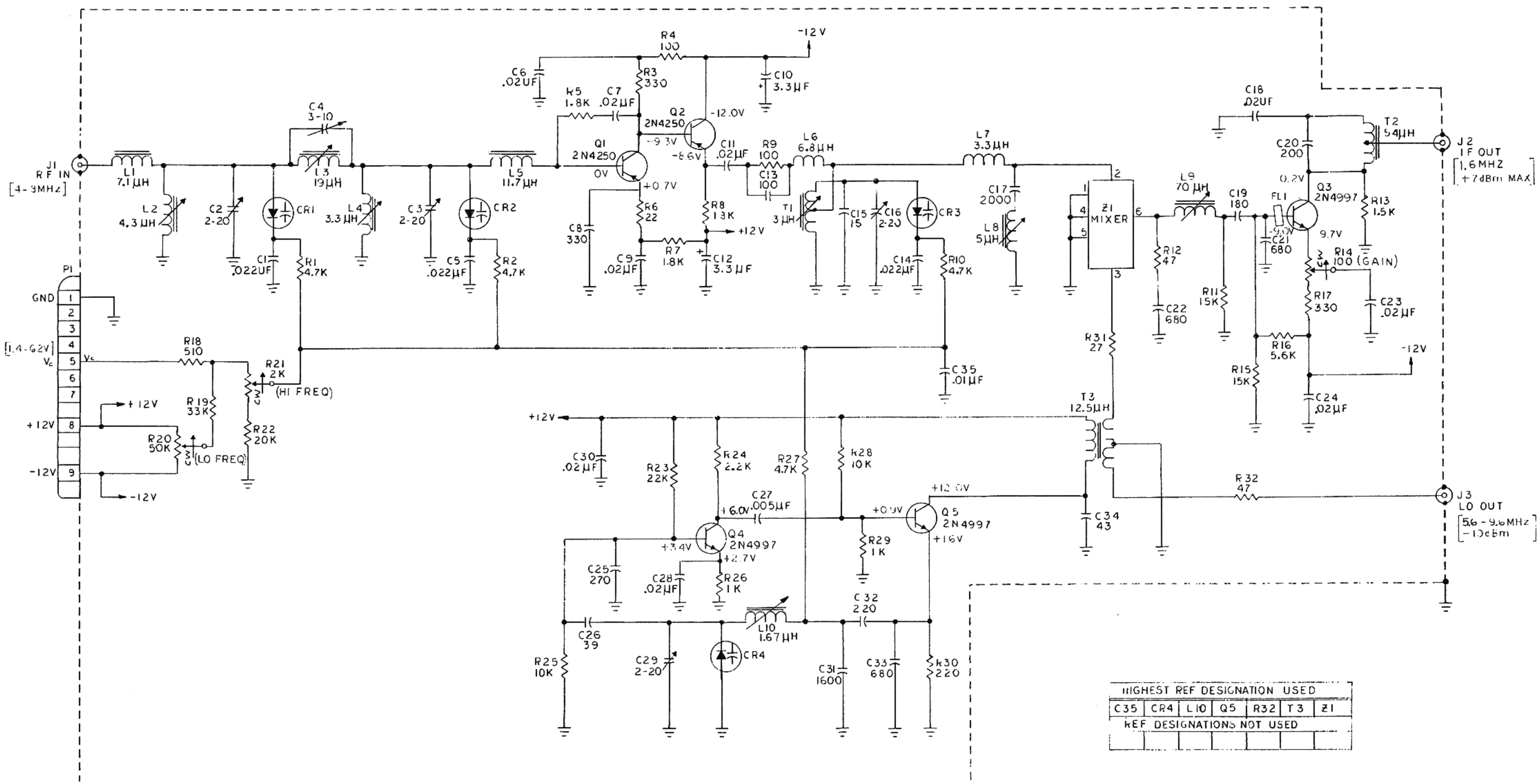
3. CR1 THRU CR4 IS PQ1300B.

2. ALL CAPACITORS ARE IN PICOFARADS.

1. ALL RESISTORS ARE IN OHMS ±5%, 1/4W.

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 8-5. Schematic Diagram, Band 5 Tuner, A5 Dwg No. 4-501258-001 (A)

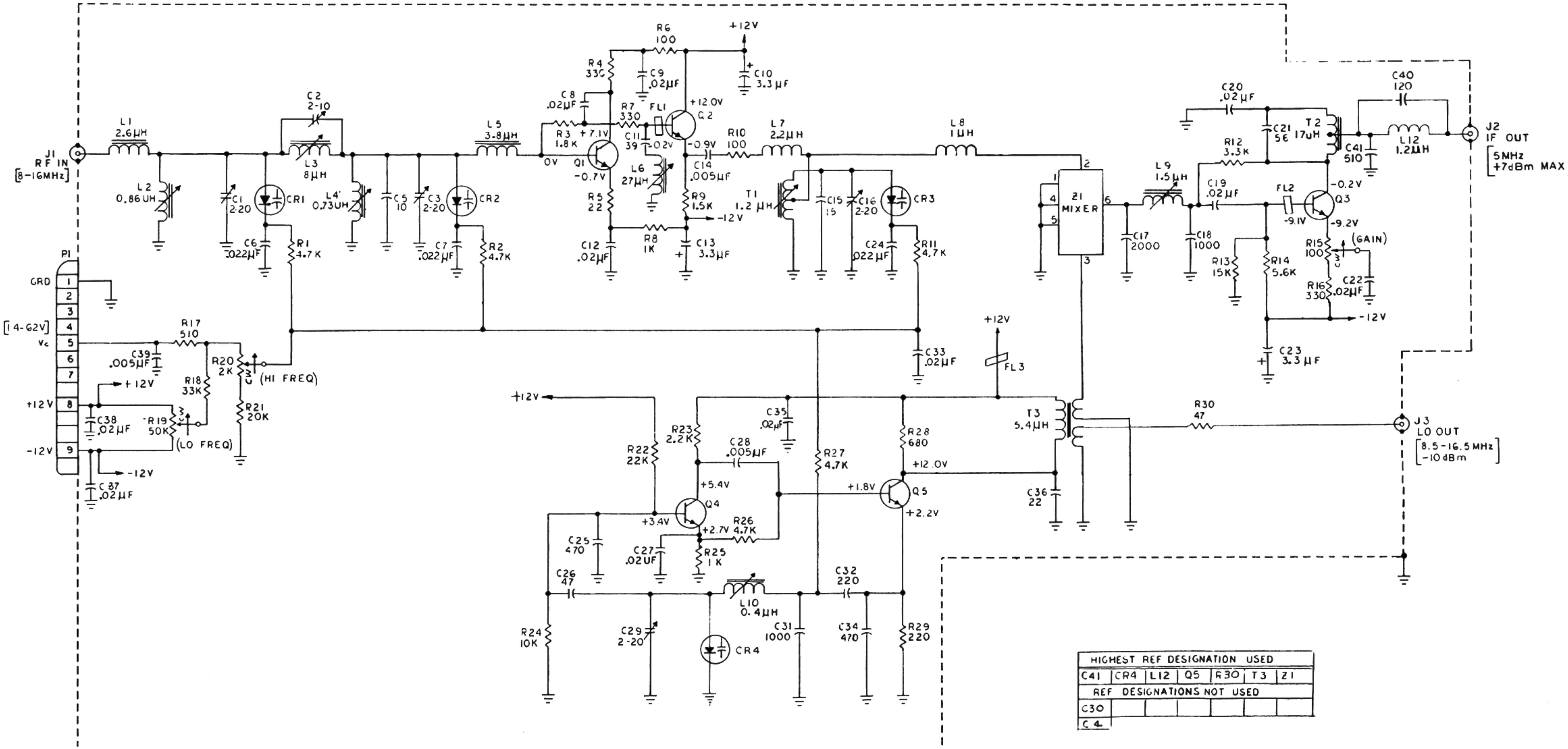


HIGHEST REF DESIGNATION USED						
C35	CR4	L10	Q5	R32	T3	Z1
REF DESIGNATIONS NOT USED						

4. PARTIAL REFERENCE DESIGNATIONS SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUB ASSEMBLY DESIGNATION(S).
3. CR1 THRU CR4 ARE PQ1300B.
2. ALL CAPACITORS ARE IN PICOFARADS.
1. ALL RESISTORS ARE IN OHMS, ±5%, 1/4W.

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 8-6. Schematic Diagram, Band 6 Tuner, A6
Dwg No. 4-501259-001 (B)

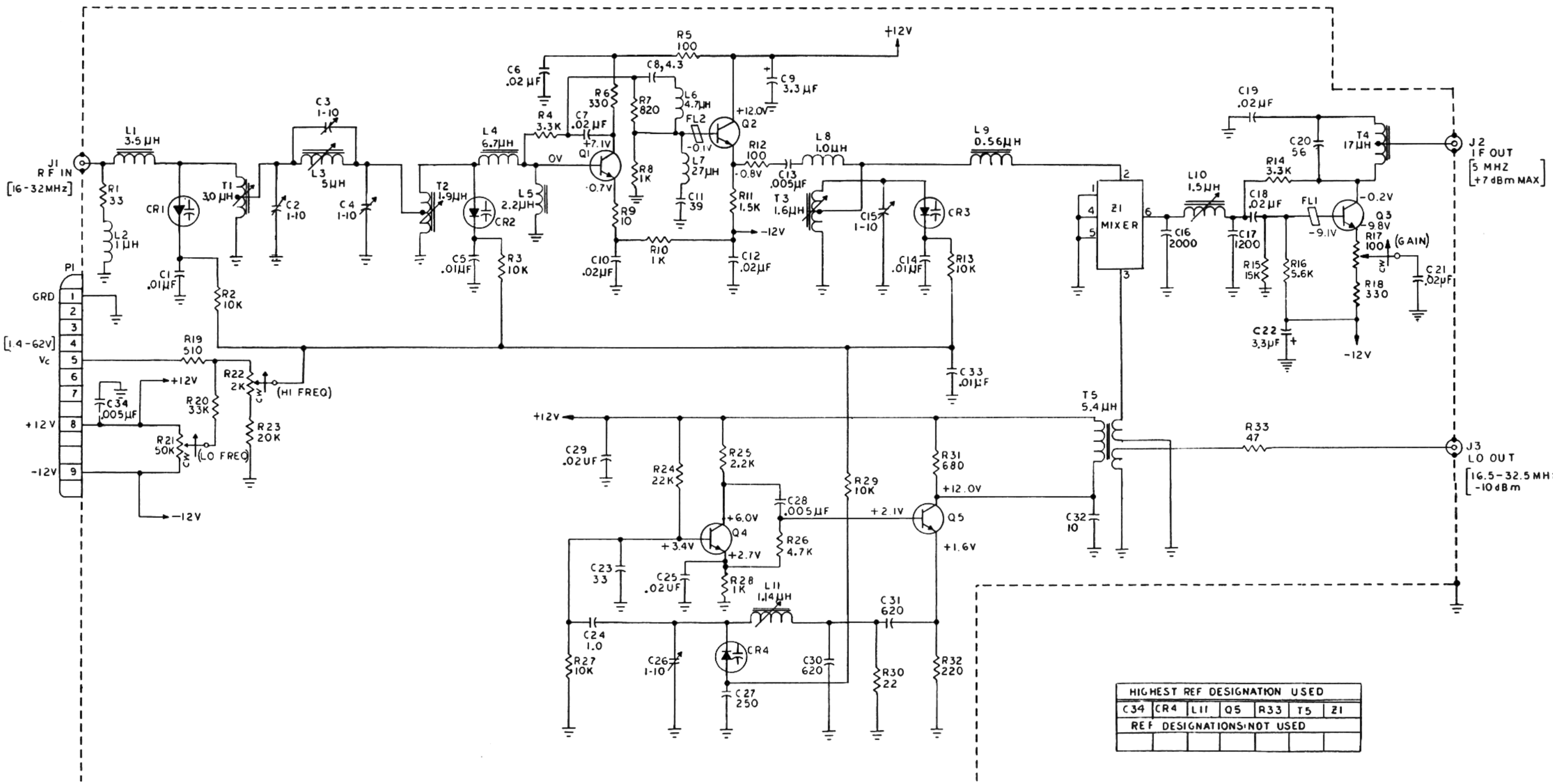


HIGHEST REF DESIGNATION USED						
C41	CR4	L12	Q5	R30	T3	Z1
REF DESIGNATIONS NOT USED						
C30						
C4						

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE IN OHMS, ±5%, 1/4W.
2. ALL CAPACITORS ARE IN PICOFARADS.
3. CR1 THRU CR4 ARE PQ1300B.
4. ALL TRANSISTORS ARE 2N4997
5. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATIONS)

Figure 8-7. Schematic Diagram, Band 7 Tuner, A7
Dwg No. 4-501260-001 (B)

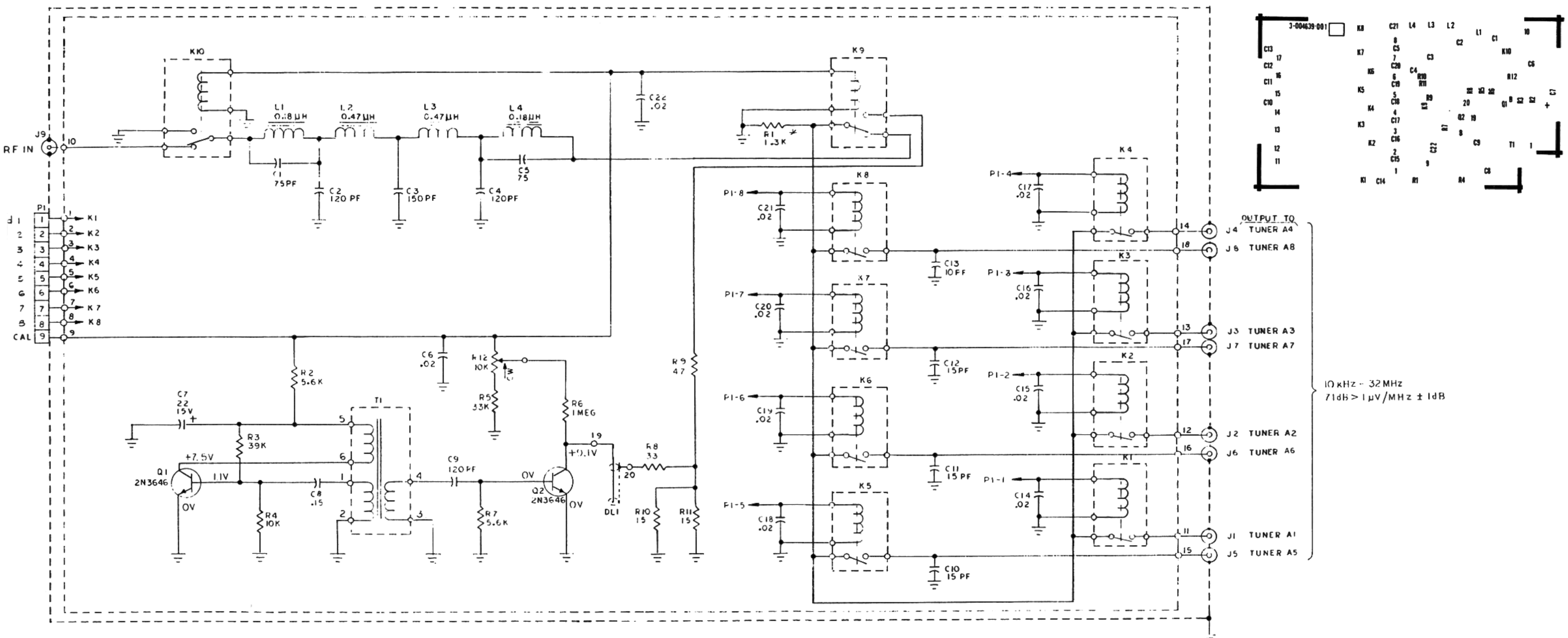


HIGHEST REF DESIGNATION USED						
C34	CR4	L11	Q5	R33	T5	Z1
REF DESIGNATIONS NOT USED						

5. PARTIAL REFERENCE DESIGNATIONS SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUB ASSEMBLY DESIGNATION (S)
4. ALL TRANSISTORS ARE 2N4997.
3. CR1 THRU CR4 ARE IN5148A.
2. ALL CAPACITORS ARE IN PICOFARADS.
1. ALL RESISTORS ARE IN OHMS, ± 5%, 1/4W.

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 8-8. Schematic Diagram, Band 8 Tuner, A8
Dwg No. 4-501261-001 (A)



HIGHEST REF DESIGNATION						
C22	DL1	K10	L4	Q2	R12	T1
REF DESIGNATIONS NOT USED						

4. PARTIAL REFERENCE DESIGNATIONS SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUB ASSEMBLY DESIGNATION(S)

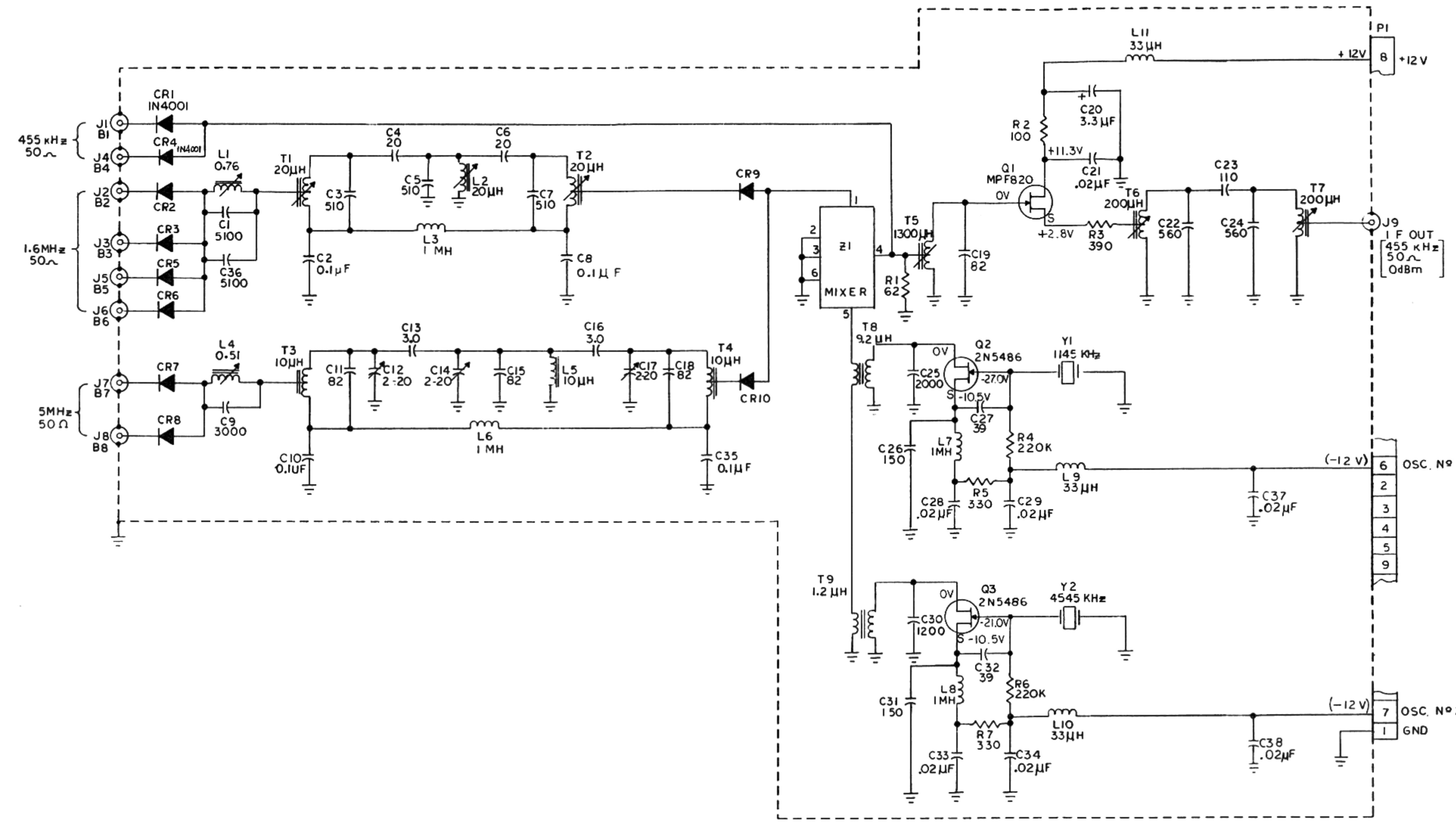
* OPTIONAL (SELECTED)

ALL CAPACITORS ARE IN MICROFARADS.

ALL RESISTORS ARE IN OHMS, ±5%, 1/4W.

OTES: UNLESS OTHERWISE SPECIFIED

Figure 8-9. Schematic Diagram, RF Switch and Impulse Calibrator, A9 Dwg No. 4-501263-001 (A)



4 PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S)

3 ALL CAPACITORS ARE IN PICOFARADS

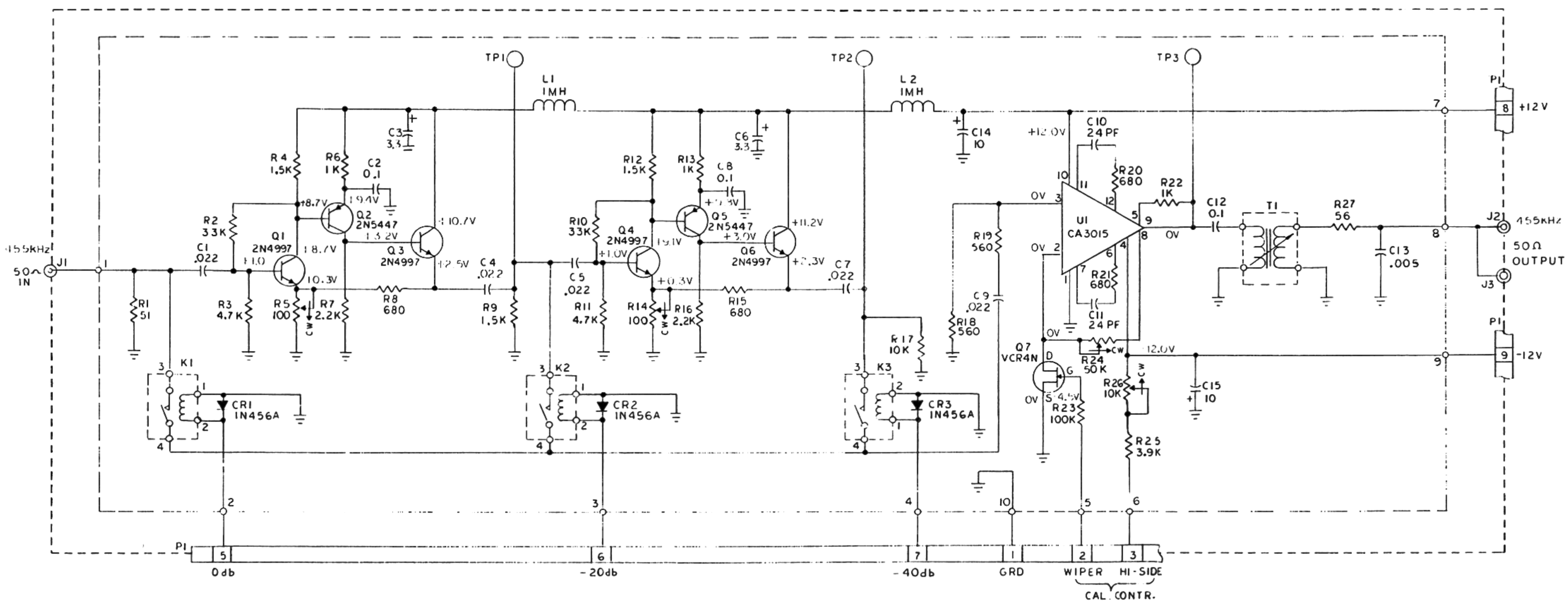
2. ALL DIODES ARE ITT244.

1. ALL RESISTORS ARE IN OHMS, ±5%, 1/4W

NOTES: UNLESS OTHERWISE SPECIFIED

HIGHEST REF DESIGNATION USED								
C 38	CR9	L11	Q3	R7	T 9	Y2	Z1	

Figure 8-10. Schematic Diagram, Second Converter, A10
Dwg No. 4-501265-001 (A)

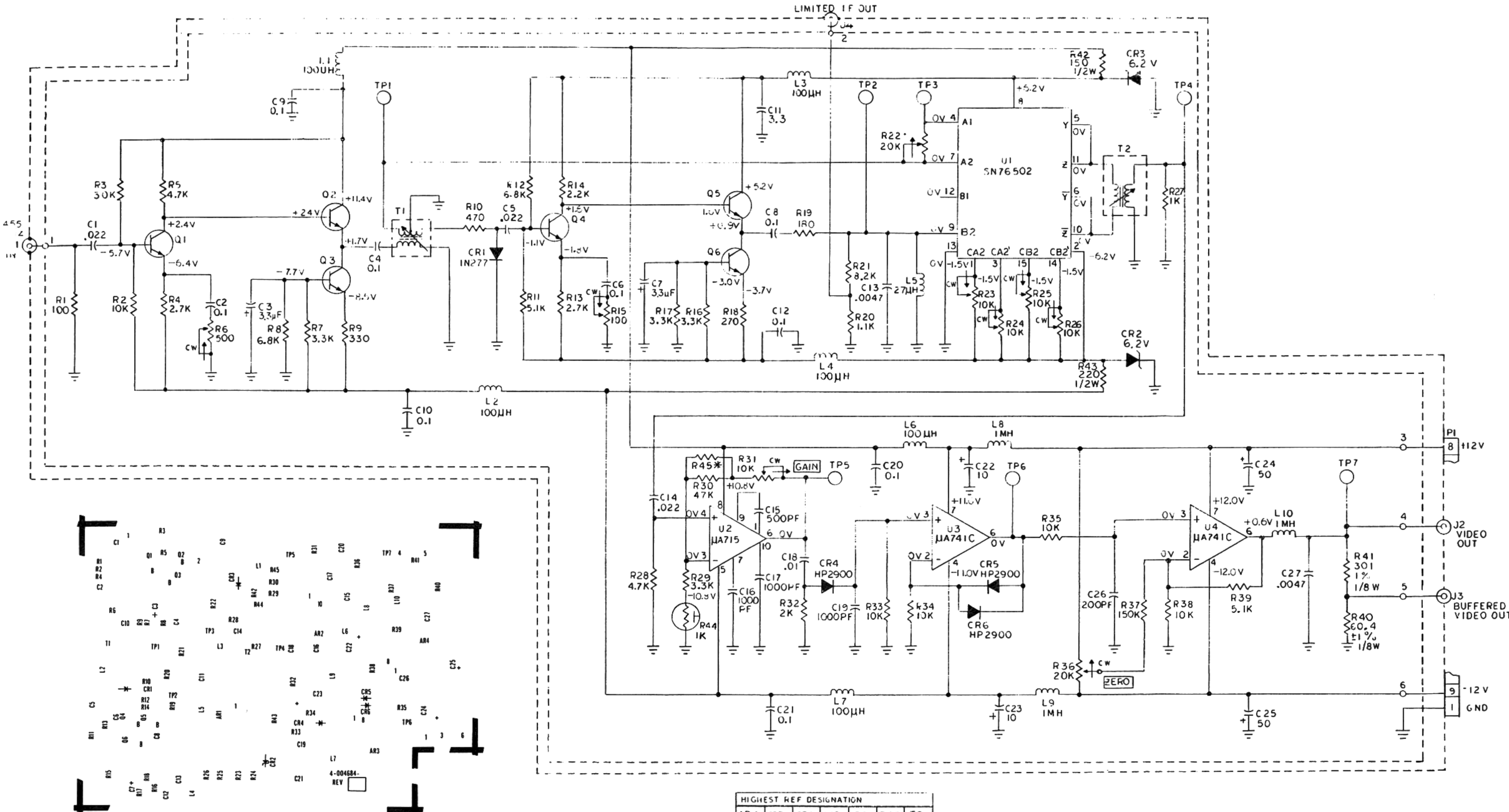


HIGHEST REF DESIGNATION USED							
C15	K3	L2	Q7	R27	T1	U1	CR3
REF DESIGNATIONS NOT USED							

3. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S)
2. ALL CAPACITORS ARE IN MICROFARADS
1. ALL RESISTORS ARE IN OHMS ±10%, 1/4 W

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 8-11. Schematic Diagram, IF Preamplifier and Calibration Amplifier, A11
Dwg No. 4-501266-001 (A)

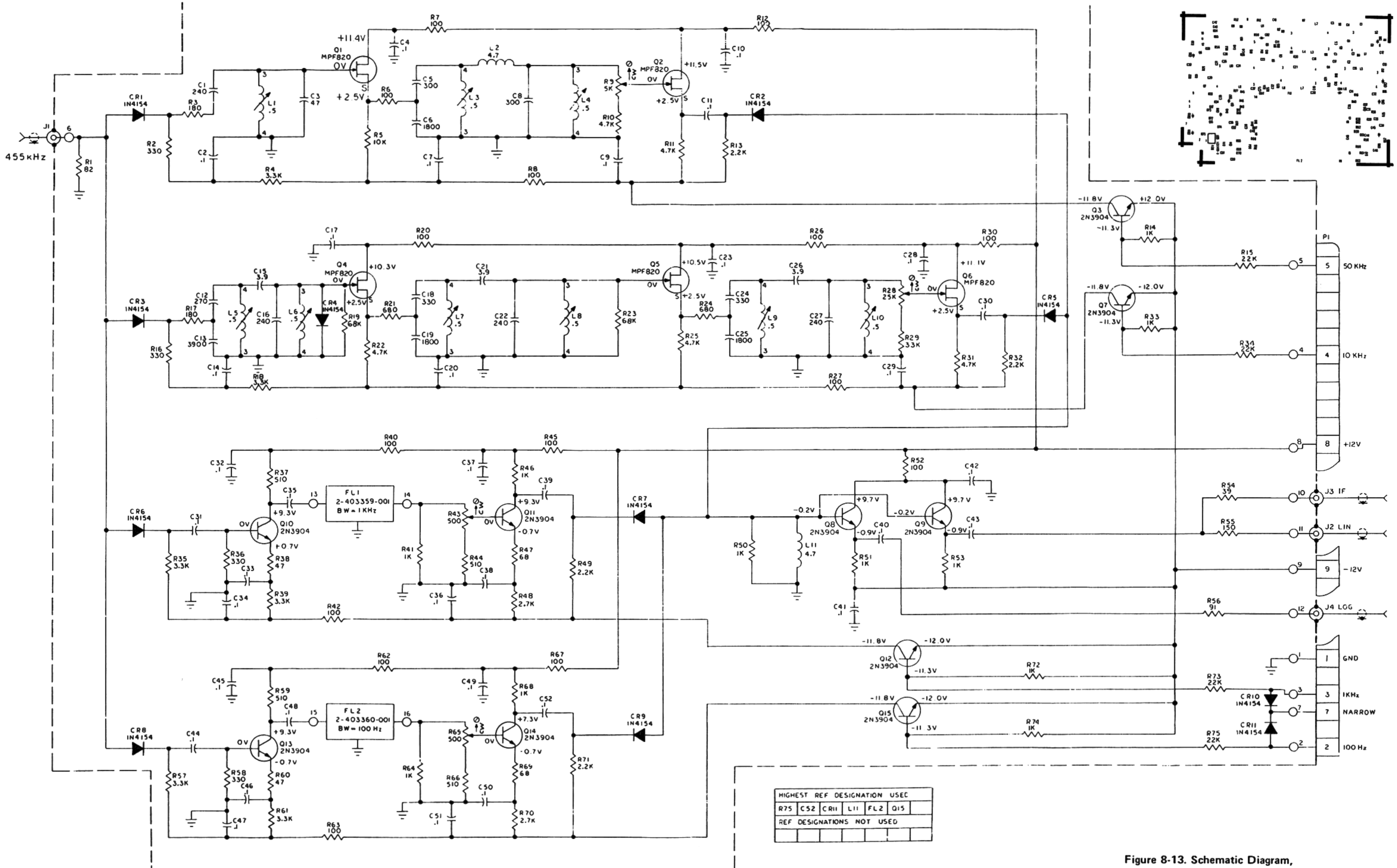


HIGHEST REF DESIGNATION						
AR4	C27	CR6	L10	Q6	R45	T2
REF DESIGNATION NOT USED						

5. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S).
4. ALL TRANSISTORS ARE 2N5449
3. ✱ DENOTES SELECT AT TEST (RESISTOR MAY BE OMITTED).
2. ALL CAPACITORS ARE IN MICROFARADS.
1. ALL RESISTORS ARE IN OHMS, ±5%, 1/4 W.

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 8-12. Schematic Diagram, Log Amplifier and Detector, A12
Dwg No. 4-501275-001 (D)

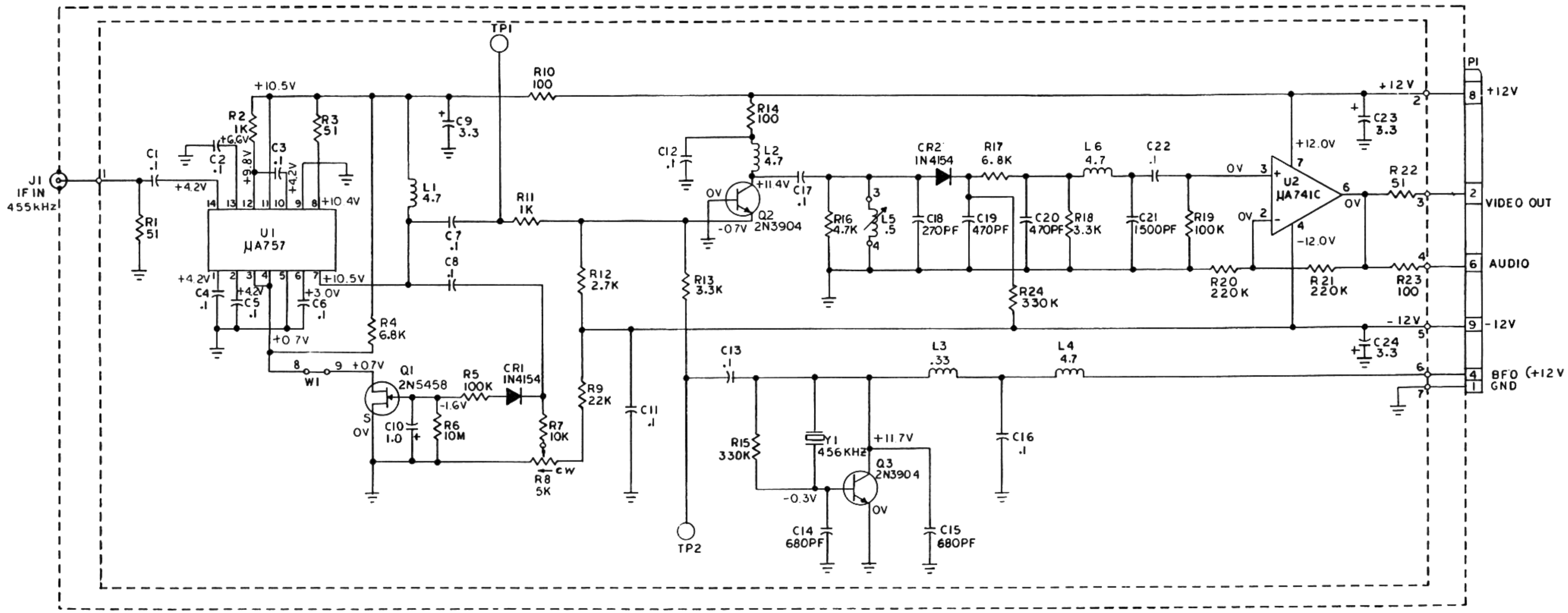


HIGHEST REF DESIGNATION USED					
R75	C52	CR11	L11	FL2	Q15
REF DESIGNATIONS NOT USED					

3. ALL INDUCTORS ARE IN MILLIHENRIES.
2. ALL CAPACITORS ARE IN PICOFARADS EXCEPT .1 μfd
1. ALL RESISTORS ARE IN OHMS ±5%, 1/4 W.

4. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S)

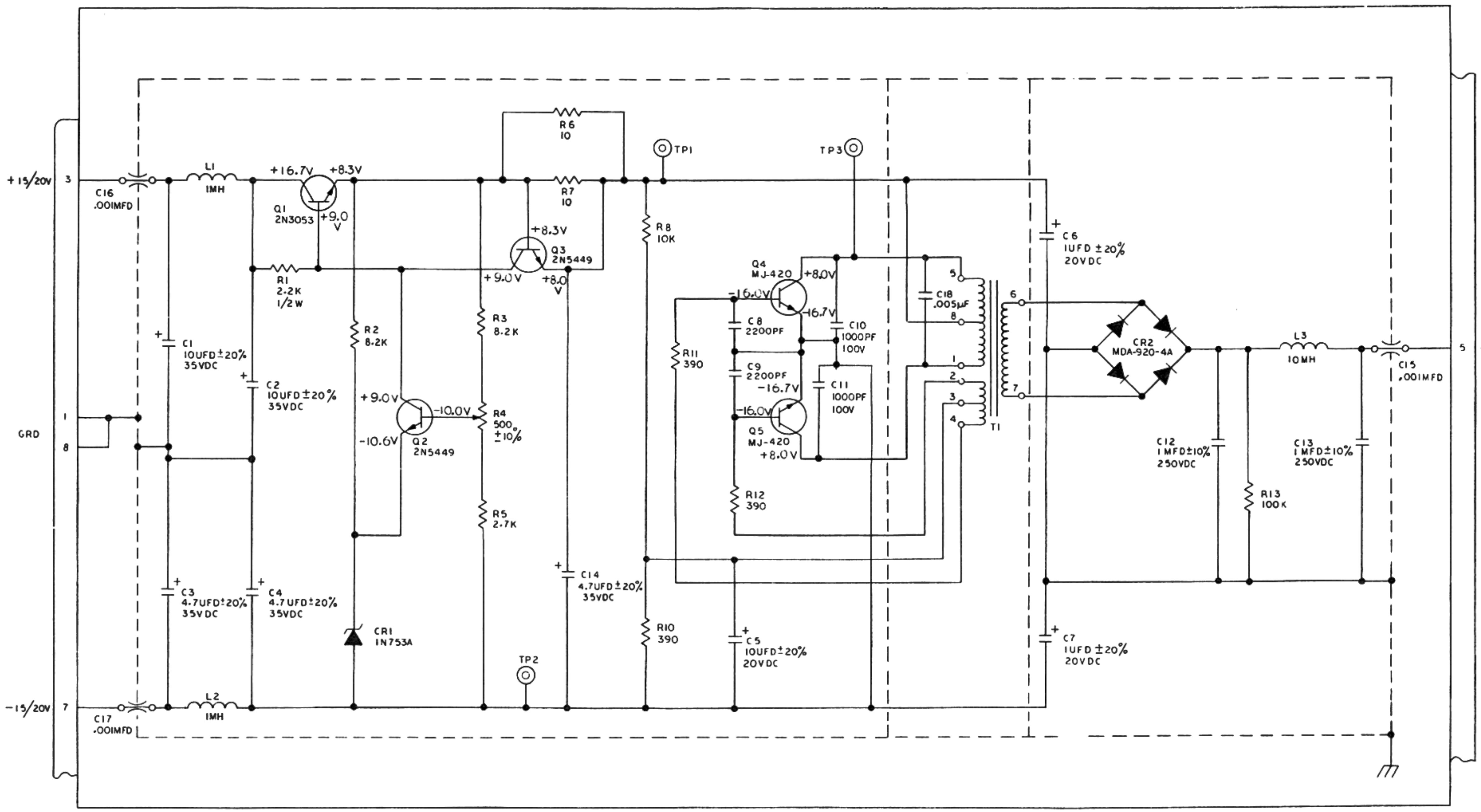
Figure 8-13. Schematic Diagram, Bandwidth Selector, A14
Dwg No. 4-501292-001 (A)



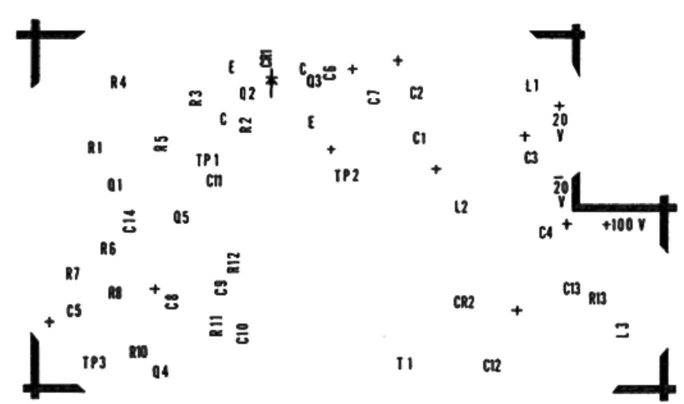
HIGHEST REF DESIGNATION USED						
C24	CR2	L6	Q3	R24	U2	Y1
REF DESIGNATIONS NOT USED						

4. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S)
3. ALL INDUCTORS ARE IN MILLIHENRYS.
2. ALL CAPACITORS ARE IN MICROFARADS.
1. ALL RESISTORS ARE IN OHMS, ±5%, 1/4 W.

Figure 8-14. Schematic Diagram, Linear IF and BFO, A15
Dwg No. 4-501284-001 (A)

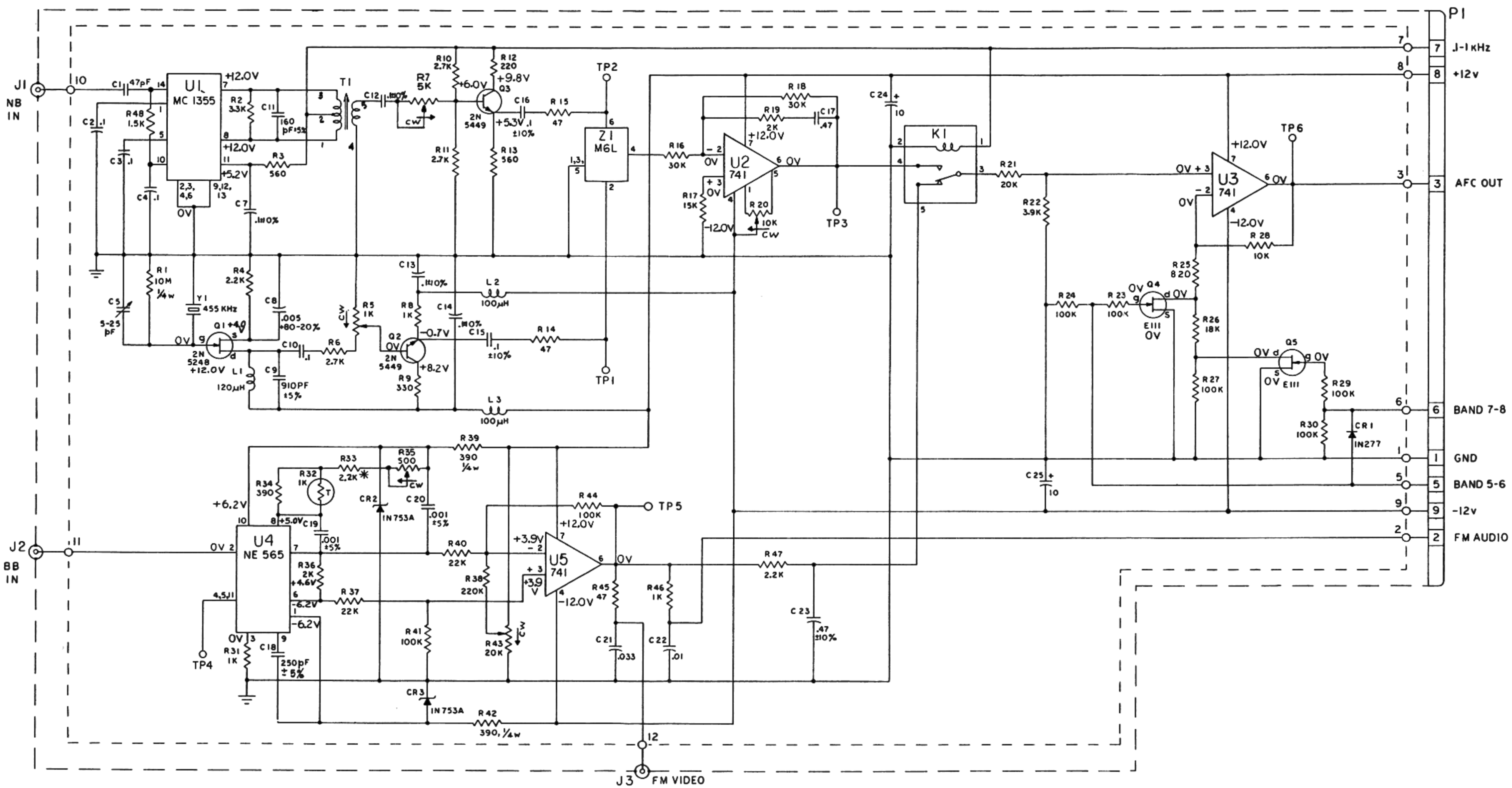


2. ALL INDUCTORS ARE 1 MH.
1. ALL RESISTORS ARE IN OHMS ± 5%, 1/4 WATT.



HIGHEST REF DESIGNATIONS USED					
C18	CR2	Q5	L3	T1	R13
REF DESIGNATIONS NOT USED					
R9					

Figure 8-15. Schematic Diagram, DC to DC Converter, A16
Dwg No. 4-501129-001 (D)



4. ✱ INDICATES FACTORY SELECTED VALUE.

3. PARTIAL REFERENCE DESIGNATIONS PREFIX SHOWN; FOR COMPLETE DESIGNATIONS PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATIONS).

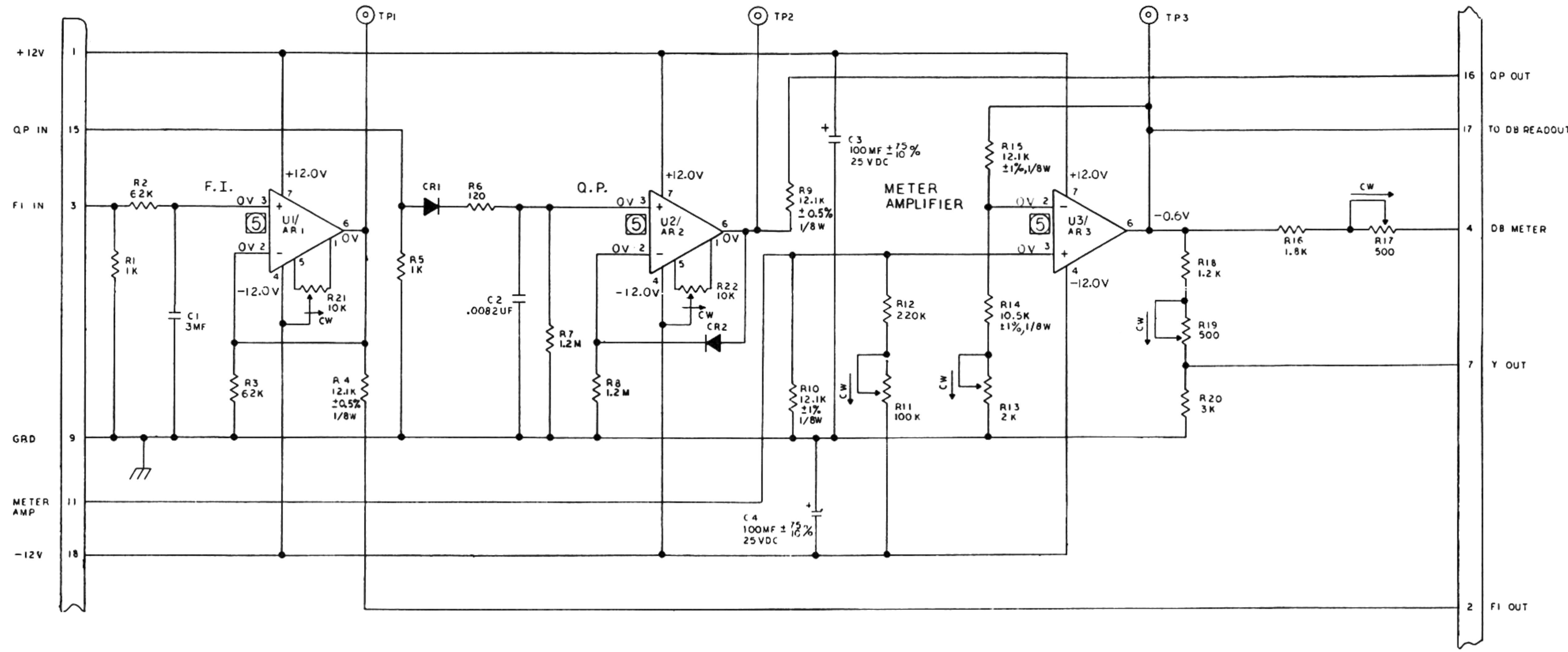
2. ALL CAPACITOR VALUES ARE IN MICROFARADS, ±20%

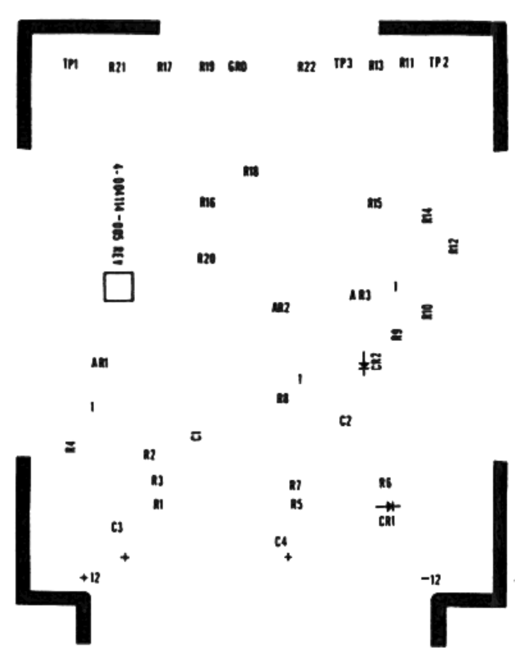
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, 1/8 w

NOTES: UNLESS OTHERWISE SPECIFIED

HIGHEST REF. DESIGNATIONS USED							
AR3	C25	CR3	Q5	R48	K1	Z1	U2
REF. DESIGNATIONS NOT USED							
	C6						

Figure 8-16. Schematic Diagram, AFC and FM Detector Circuit, A18 Dwg No. 4-501293-001 (B)





5 U1,U2 ETC REFERS TO NM 17/27
ARI,AR2 ETC REFERS TO NM 37/57

4 ALL DIODES ARE HP-2800.

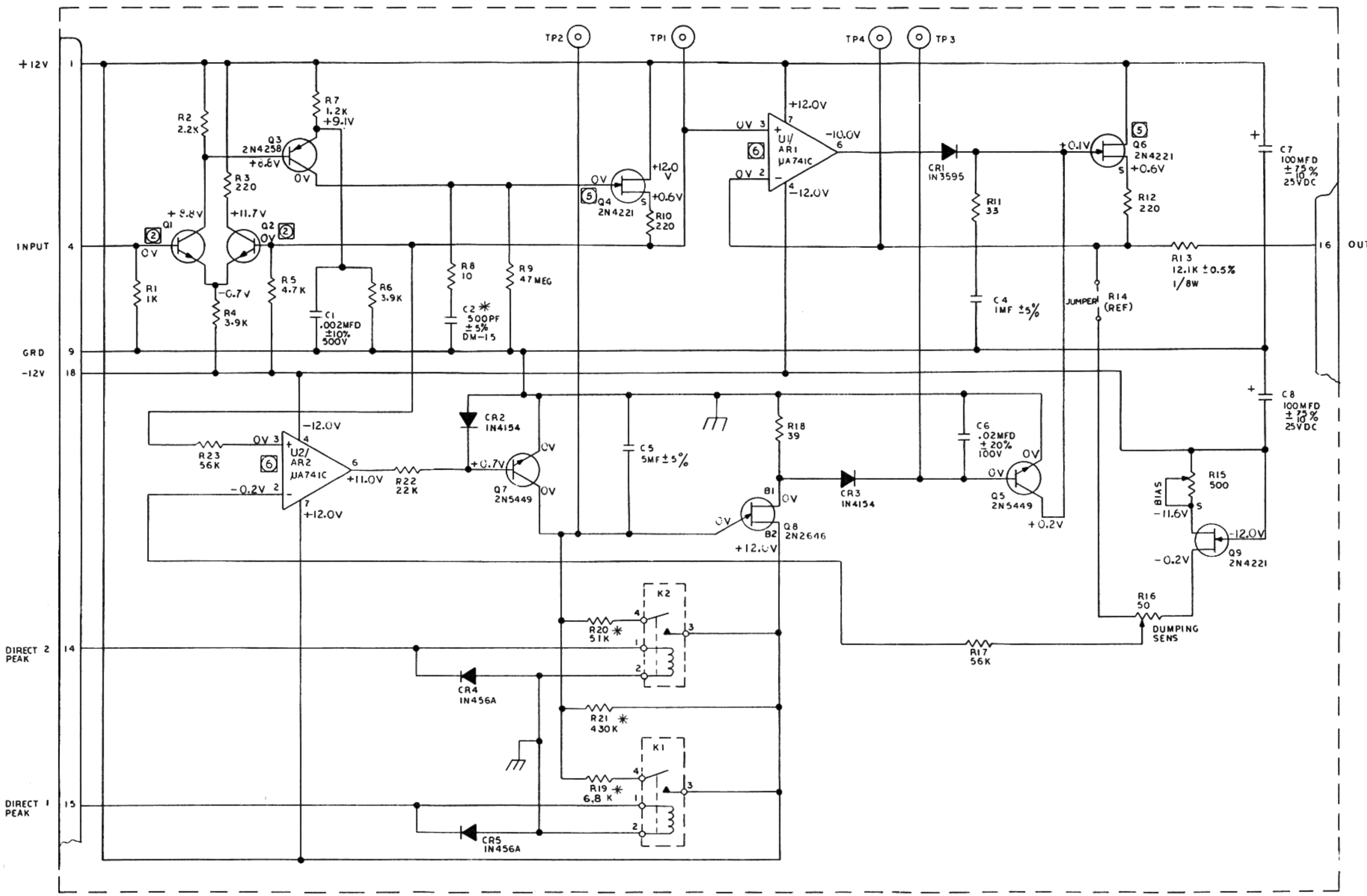
3 AR1, AR2, AR3, ARE FAIRCHILD UA741C.

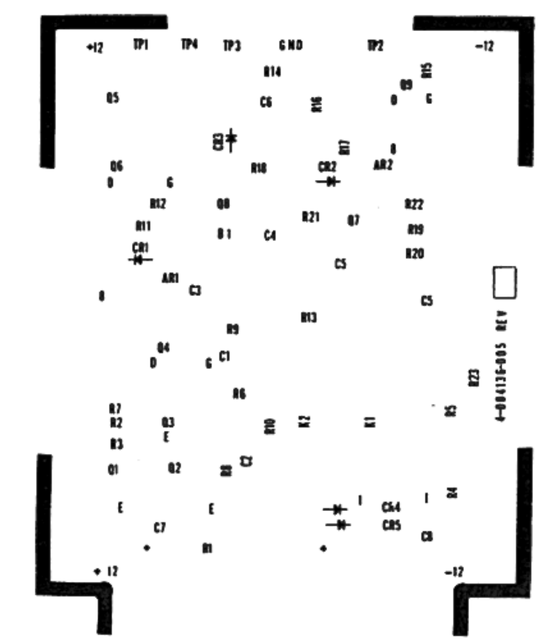
2 ALL CAPACITORS ARE ±10%, 250VDC.

1 ALL RESISTORS ARE IN OHMS, ±5%, 1/4 WATT.

HIGHEST REF DESIGNATIONS USED			
AR3	CR2	R22	C4
REF DESIGNATIONS NOT USED			

Figure 8-17. Schematic Diagram, Weighting Circuits and Meter Amplifier, A21 Dwg No. 4-501314-001 (A)





HIGHEST REF DESIGNATIONS USED						
R23	C8	CR5	Q9	AR2	K2	TP4
REF DESIGNATIONS NOT USED						
R14						

6. U1,U2 REFERS TO NM 17/27
AR1,AR2 REFERS TO NM 37/57

5. Q4, Q6 TO BE SELECTED FOR GATE SOURCE CUT-OFF, PER 1-403329-001

4. COMPONENTS MARKED WITH ✳ MAY BE CHANGED AT TEST.

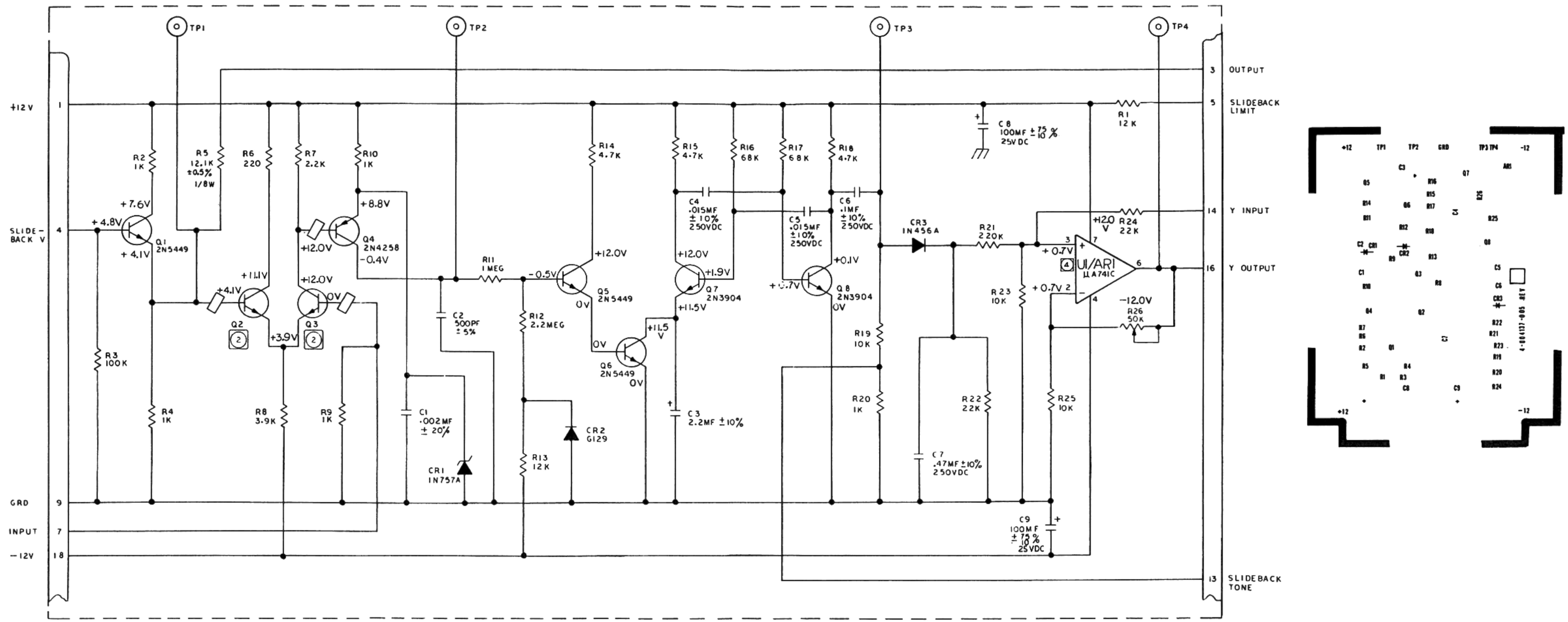
3. ALL RELAYS ARE SPST RA 30131121.

2. Q1 AND Q2 ARE A MATCHED PAIR OF 2N5179'S PER 1-403190-001.

1. ALL RESISTORS ARE IN OHMS ±5%, 1/4 WATTS.

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 8-18. Schematic Diagram, Direct Peak Circuit Board, A22 Dwg No. 4-501145-001 (D)



HIGHEST REF DESIGNATIONS USED					
R26	Q8	CR3	C9	AR1	TP4
REF DESIGNATIONS NOT USED					

④ U1 REFERS TO NM17/27; AR1 REFERS TO NM37/57.

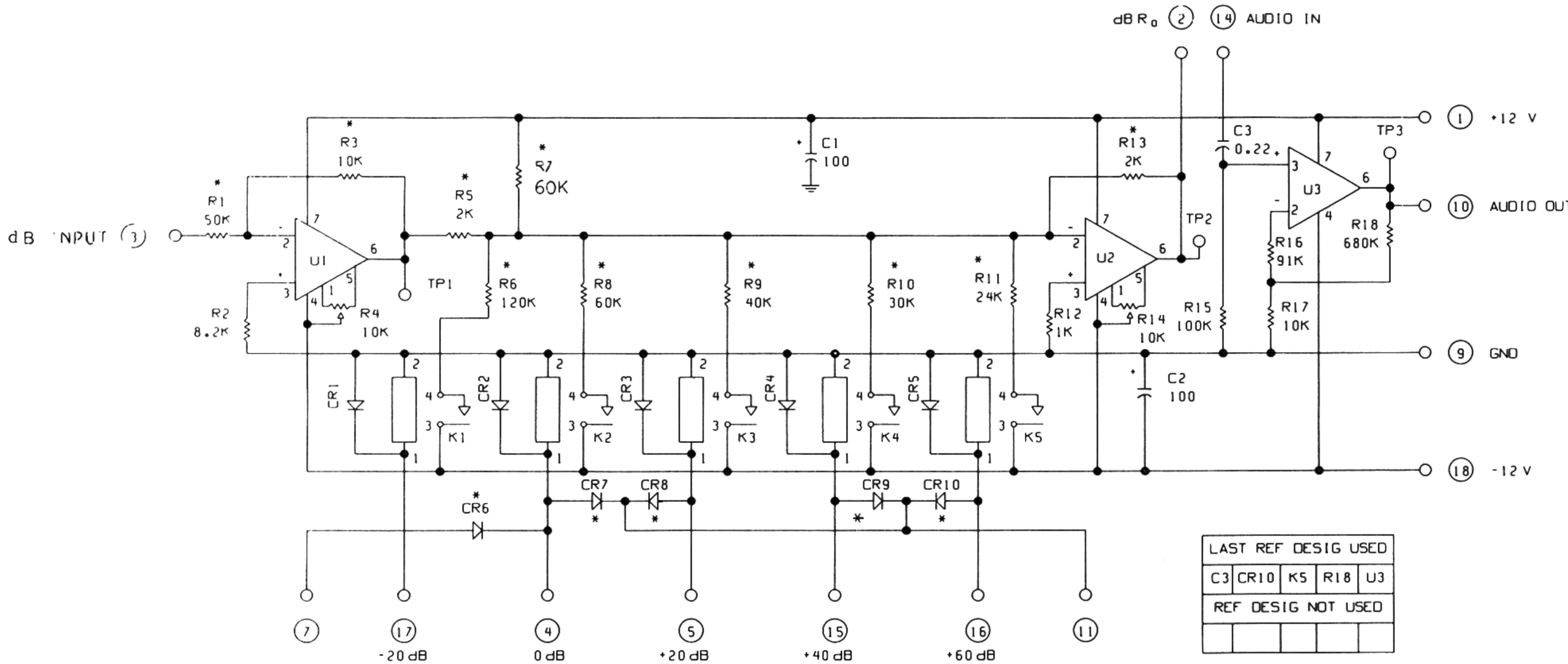
3. D.C. BIAS VOLTAGES MEASURED WITH FUNCTION SWITCH AT SF AND SP CONTROL FULLY CW.

② Q2 AND Q3 ARE A MATCHED PAIR OF 2N5179'S PER 1-403190-001.

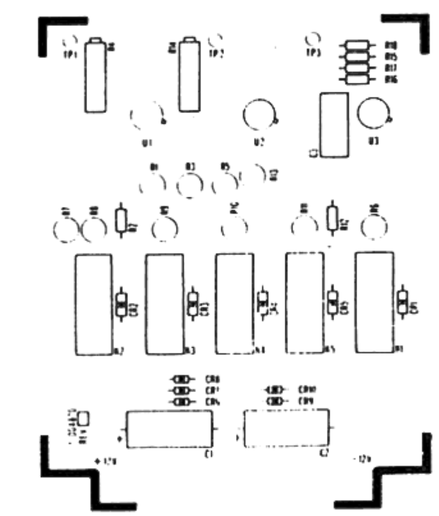
1. ALL RESISTORS ARE IN OHMS ±5%, 1/4W.

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 8-19. Schematic Diagram, Slideback Peak Circuit Board, A23 Dwg No. 4-501146-001 (C)

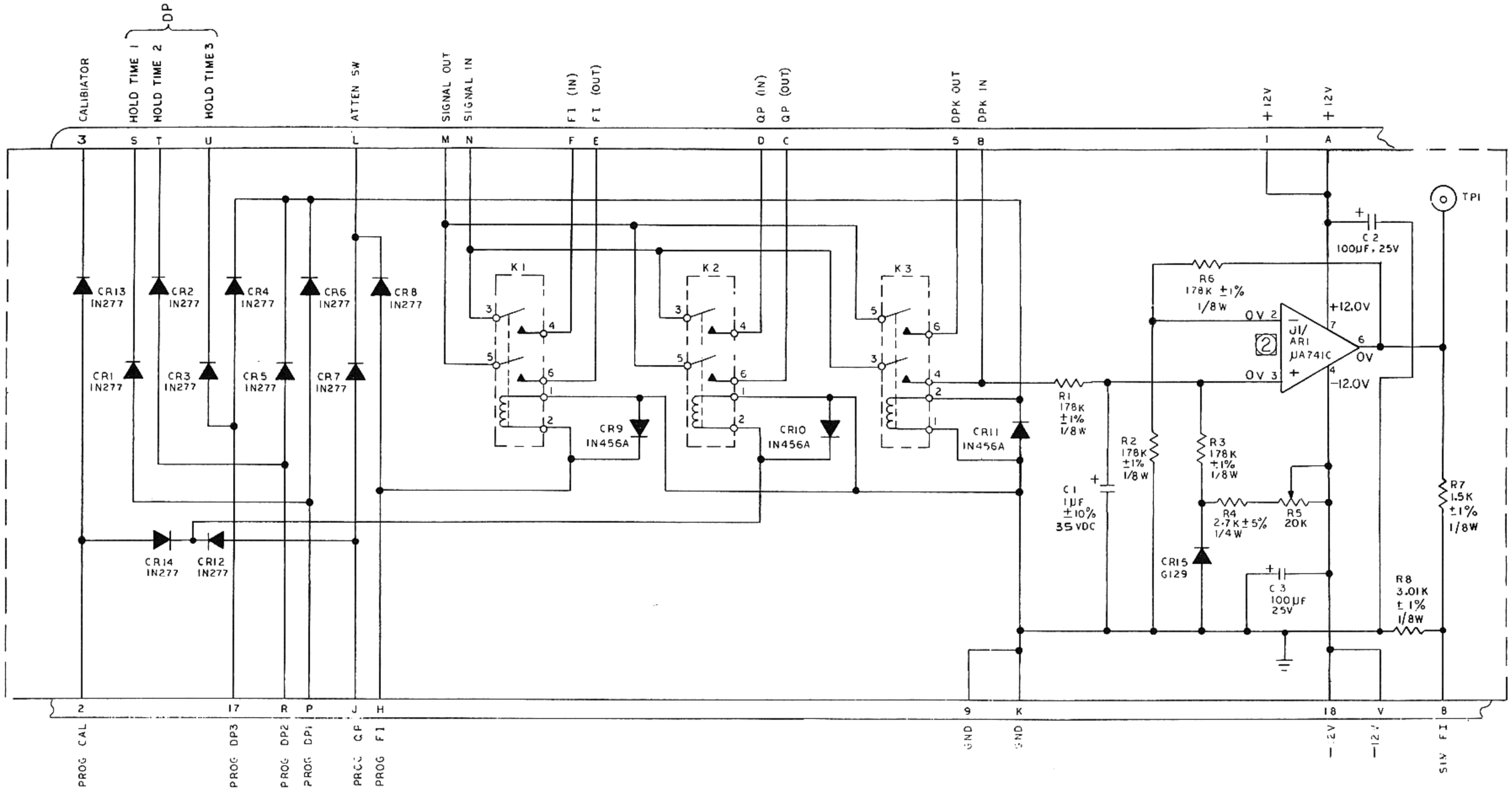


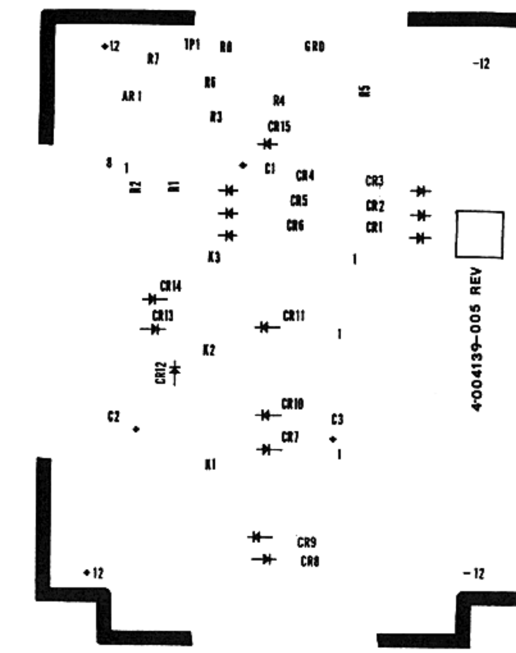
LAST REF DESIG USED				
C3	CR10	K5	R18	U3
REF DESIG NOT USED				



5. ALL RESISTORS MARKED WITH *: 0.1%, 1/4W, ±10 PPM/°C TC
   ALL OTHER RESISTORS: 5%, 1/4W
4. ALL INTEGRATED CIRCUITS: 741C
3. ALL DIODES MARKED WITH *: 1N277
   ALL OTHER DIODES: 1N4148
2. ALL RELAYS: ELECTROL RA30131121 OR EQUIVALENT
1. PARTIAL REF DESIGNATIONS ARE SHOWN.
   FOR COMPLETE DESIGNATION PREFIX
   WITH UNIT NO. OR SUBASSEMBLY DESIGNATION (S)

Figure 8-20. Schematic Diagram, dB Readout and Audio Board, A24
Dwg No. 2-501383





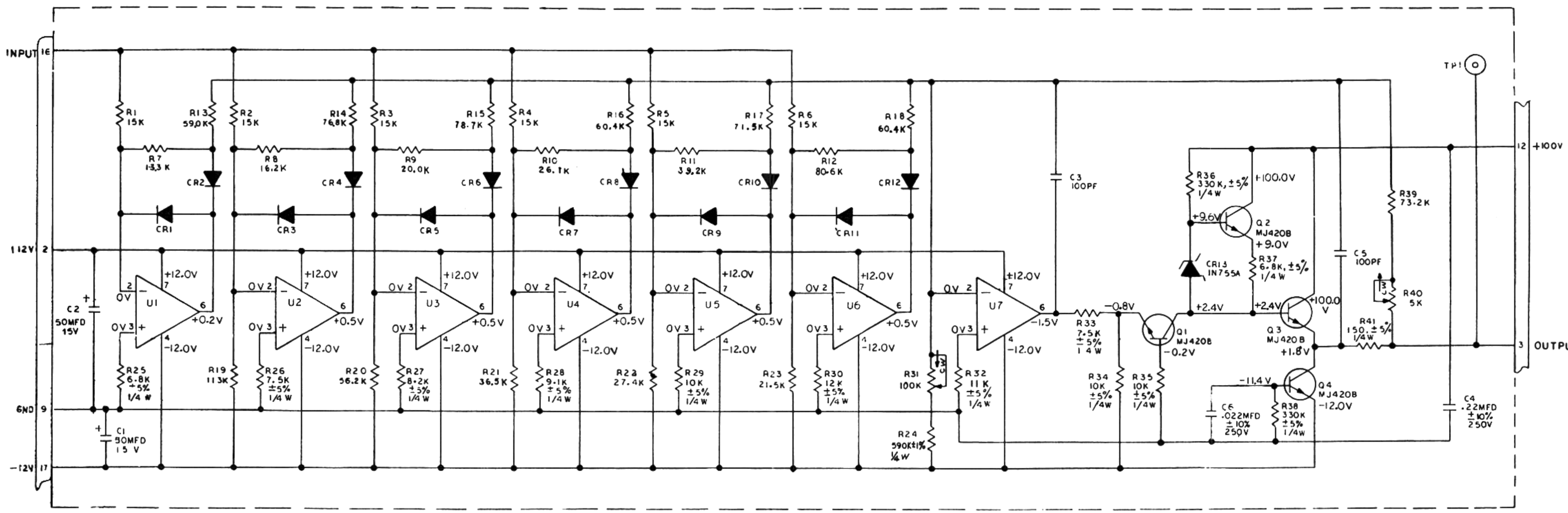
HIGHEST REF DESIGNATIONS USED				
AR1	C3	R8	CR15	TP1
REF DESIGNATIONS NOT USED				

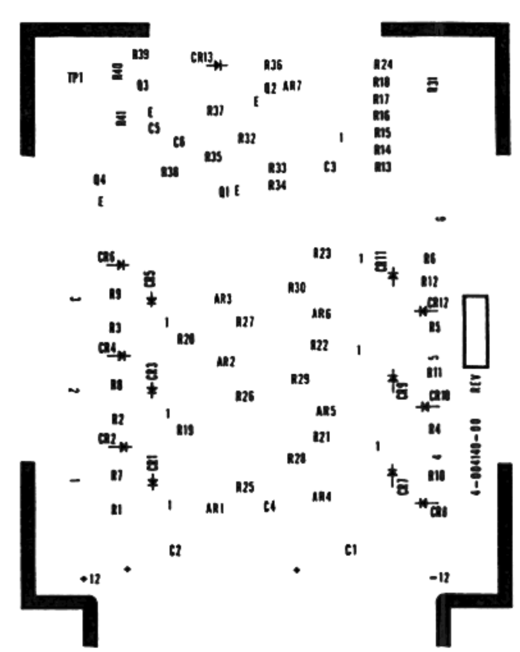
2. U1 REFERS TO NM 17/27
AR1 REFERS TO NM 37/57

1. ALL RELAYS ARE DPST RA30132121.

NOTES: UNLESS OTHERWISE SPECIFIED

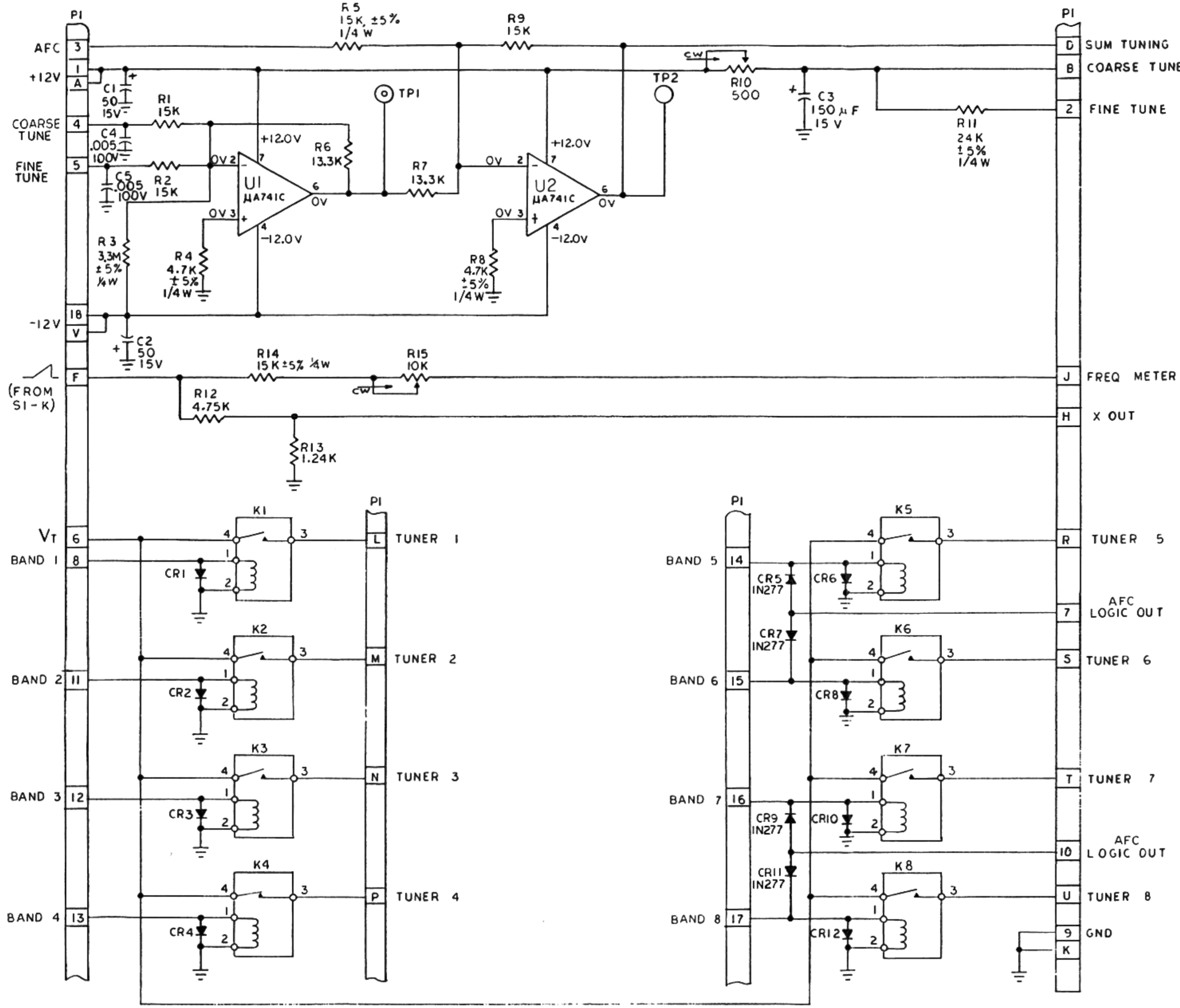
Figure 8-21. Schematic Diagram, Remote Function Selector Board, A25 Dwg No. 4-501148-001 (B)

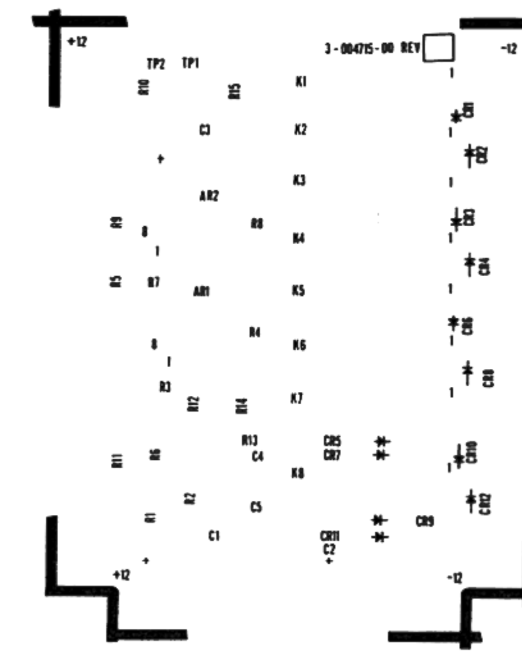




HIGHEST REF DESIGNATIONS USED					
AR7	R41	Q4	CR13	C6	TP1
REF DESIGNATIONS NOT USED					

Figure 8-22. Schematic Diagram, Shaper, A26
Dwg No. 4-501295-001 (A)

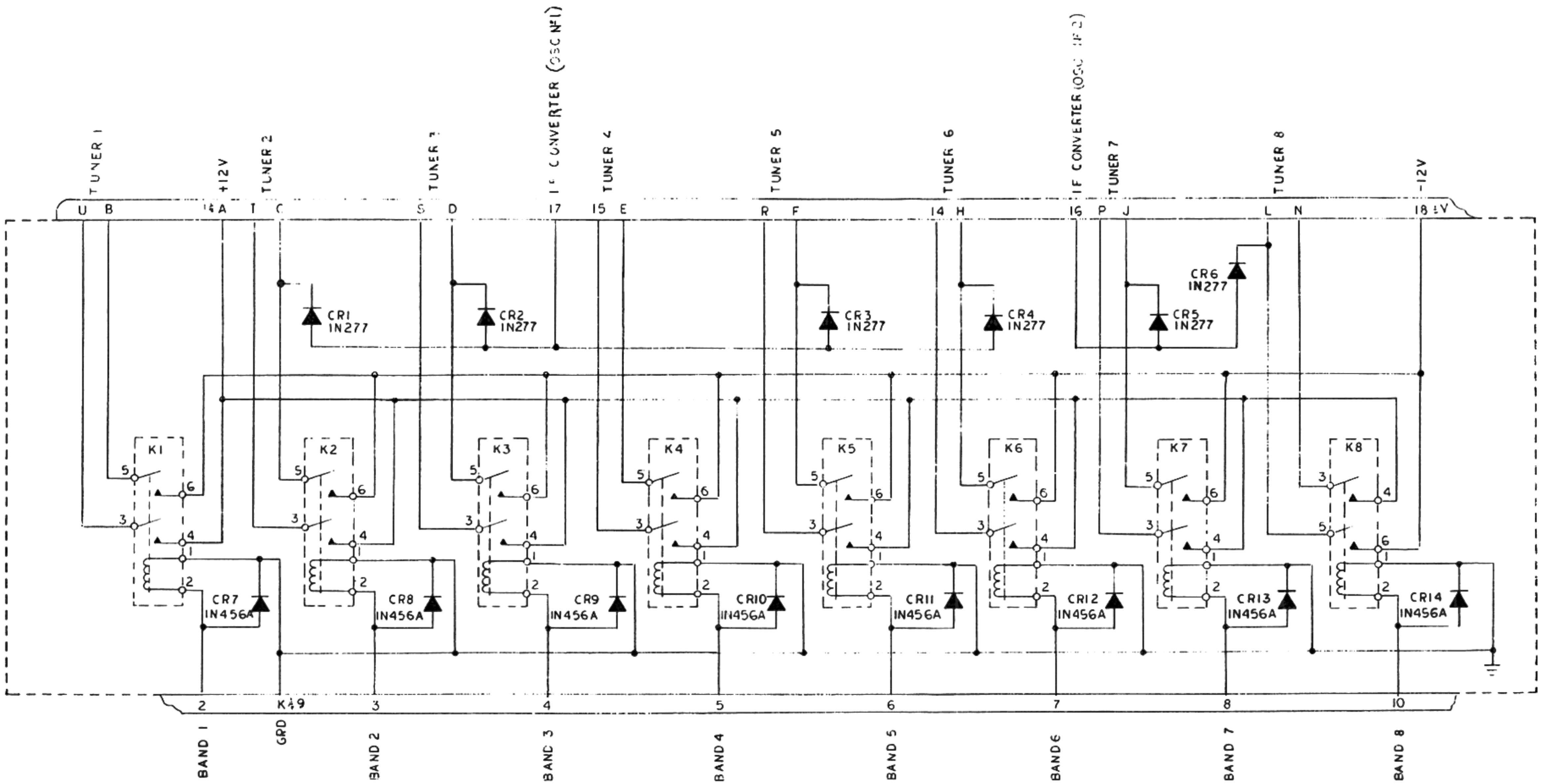


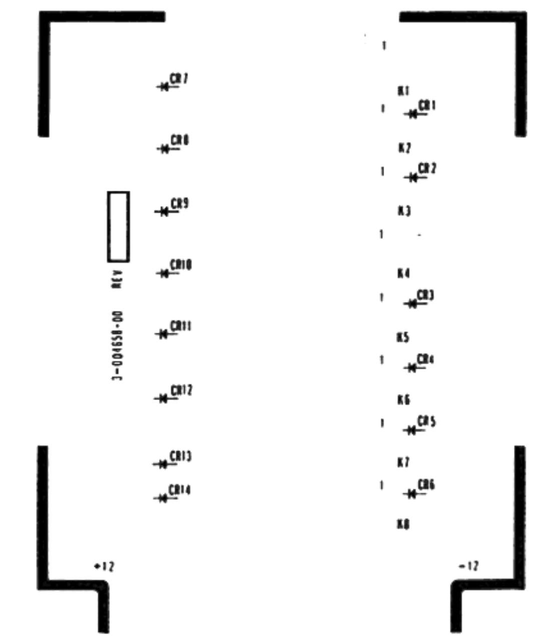


4. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATIONS.
3 ALL DIODES ARE IN456
2 ALL CAPACITORS ARE IN MICROFARADS
1 ALL RESISTORS ARE IN OHMS, ±1%, 1/8W

HIGHEST REF DESIGNATION USED						
AR2	C5	CR12	K8	R15	TP2	
REF DESIGNATIONS NOT USED						

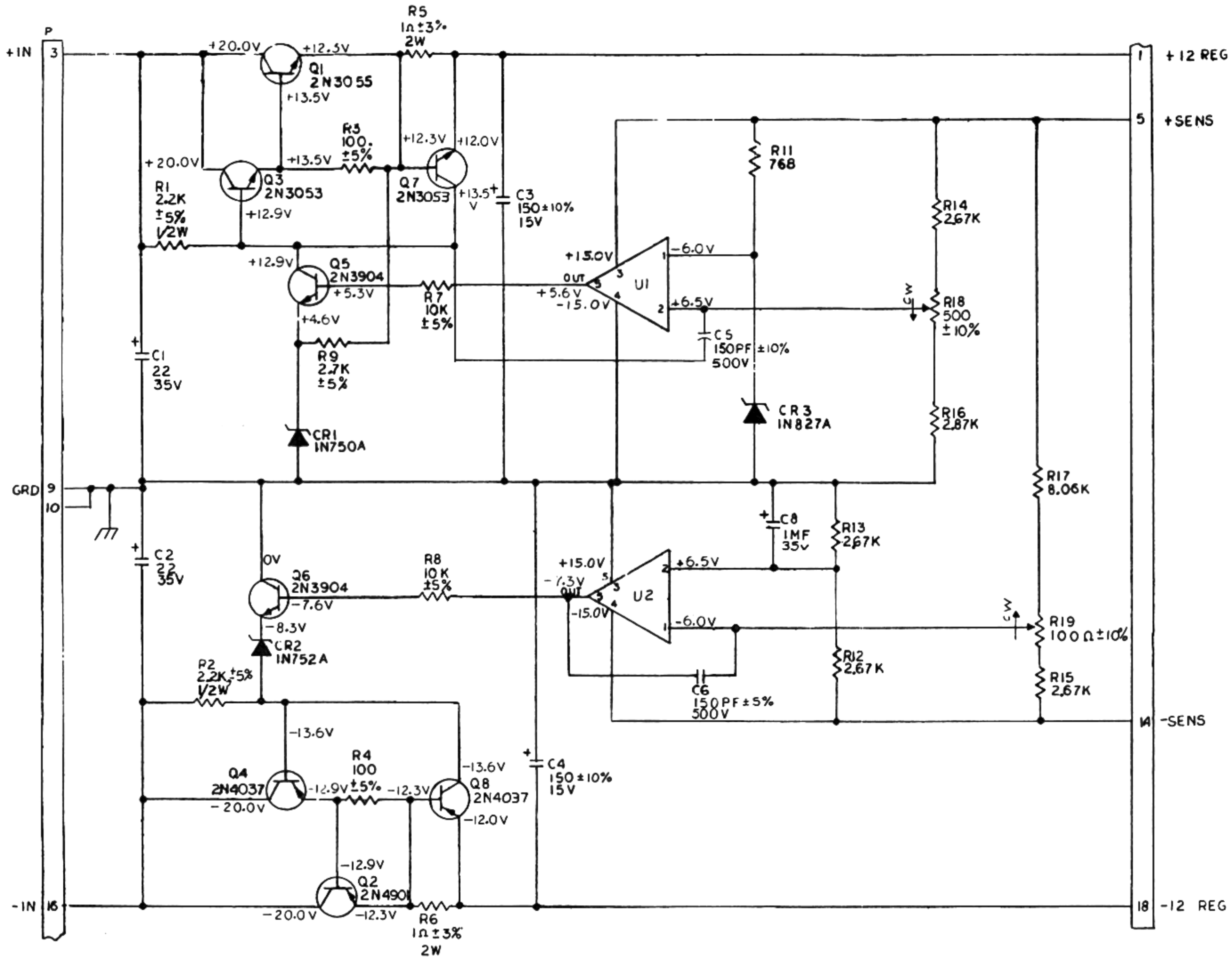
Figure 8-23. Schematic Diagram, Tuning Control Board, A29
Dwg No. 4-501285-001 (B)

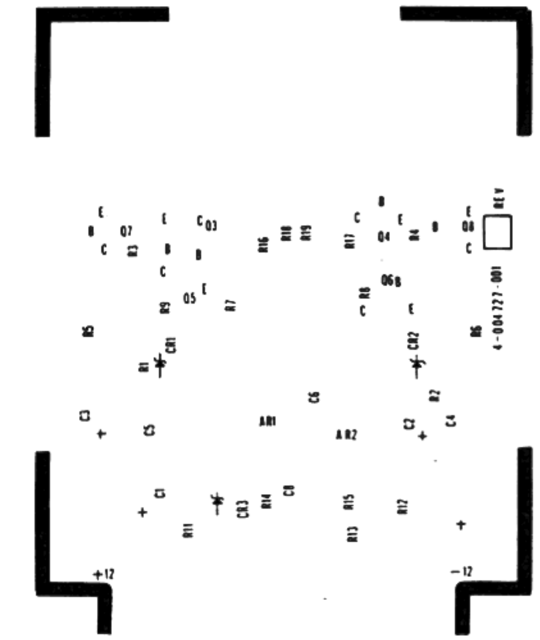




HIGHEST REF DESIGNATIONS USED	
CR14	K8
REF DESIGNATIONS NOT USED	

Figure 8-24. Schematic Diagram, Band Selector Board, A30
Dwg No. 4-501269-001 (A)

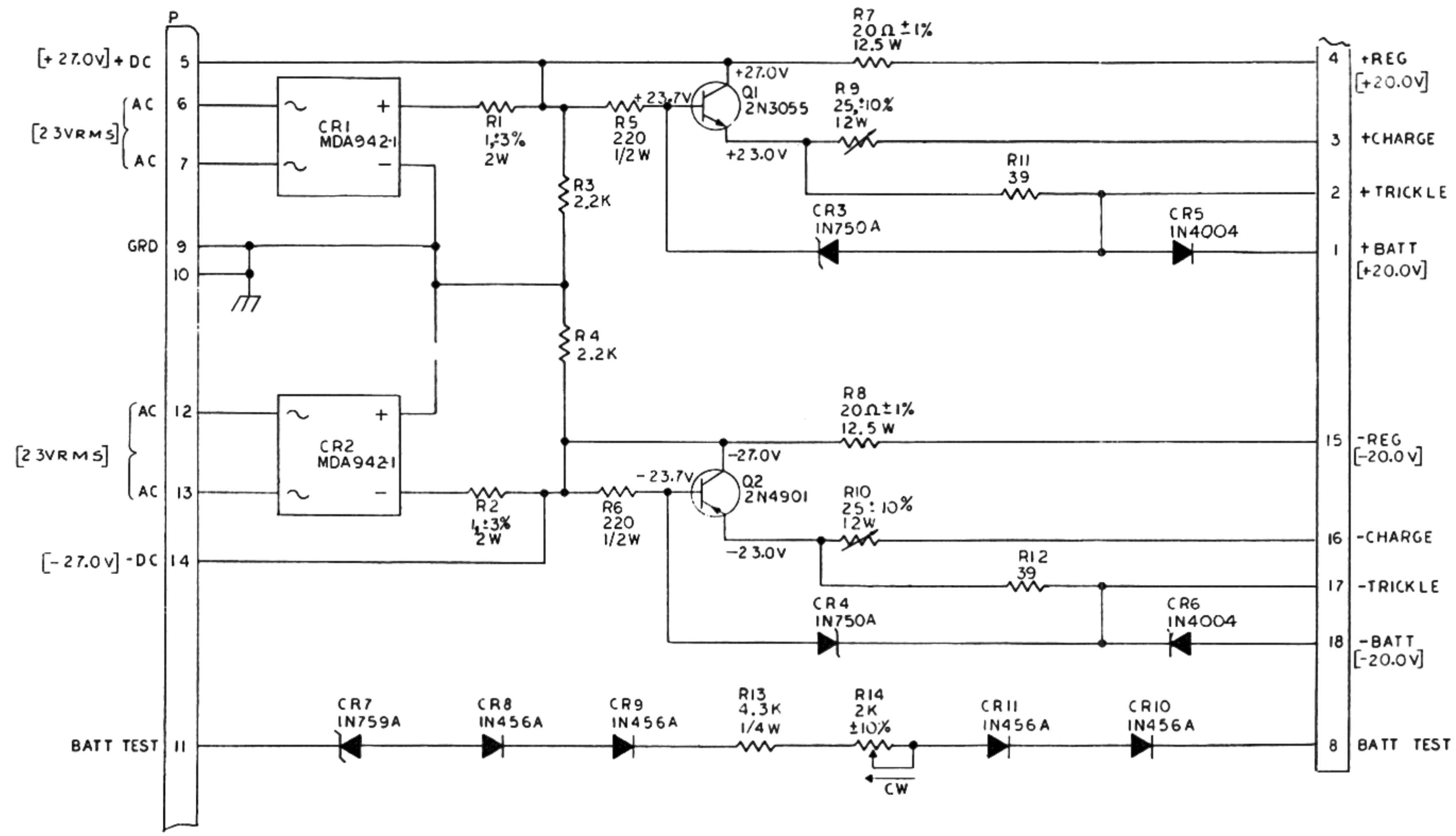




HIGHEST REF DESIGNATIONS USED				
AR2	C8	CR3	Q8	R19
REF DESIGNATIONS NOT USED				
C7				R10

4. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATIONS.
3. INTEGRATED CIRCUITS AR1 & AR2 ARE BELL-HOWELL 20-007C.
2. ALL RESISTORS ARE IN OHMS, ±1%, 1/4W.
1. ALL CAPACITORS ARE IN MICROFARADS ±20%.

Figure 8-25. Schematic Diagram,
Voltage Regulator, A31
Dwg No. 4-501294-001 (B)



HIGHEST REF DESIGNATORS USED			
CR11	Q2	R14	
REF DESIGNATORS NOT USED			

2. BIAS VOLTAGES TAKEN WITH BATTERIES FULLY CHARGED, RECEIVER ON, AND 115VRMS LINE VOLTAGE.

1. ALL RESISTORS ARE IN OHMS, ± 5%, 1 W.

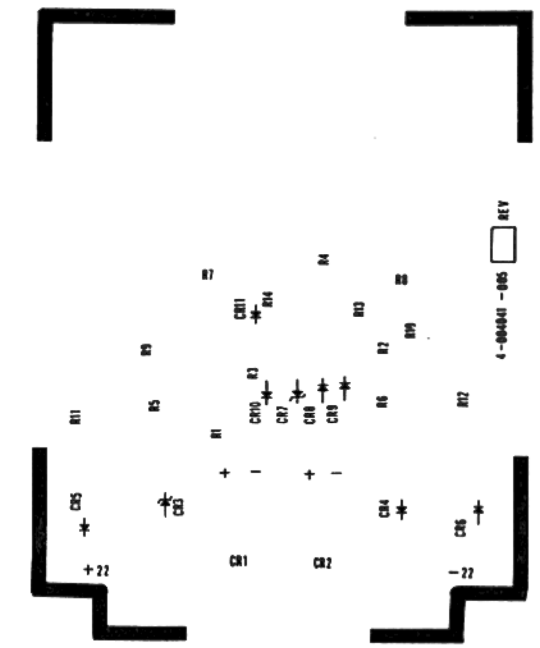
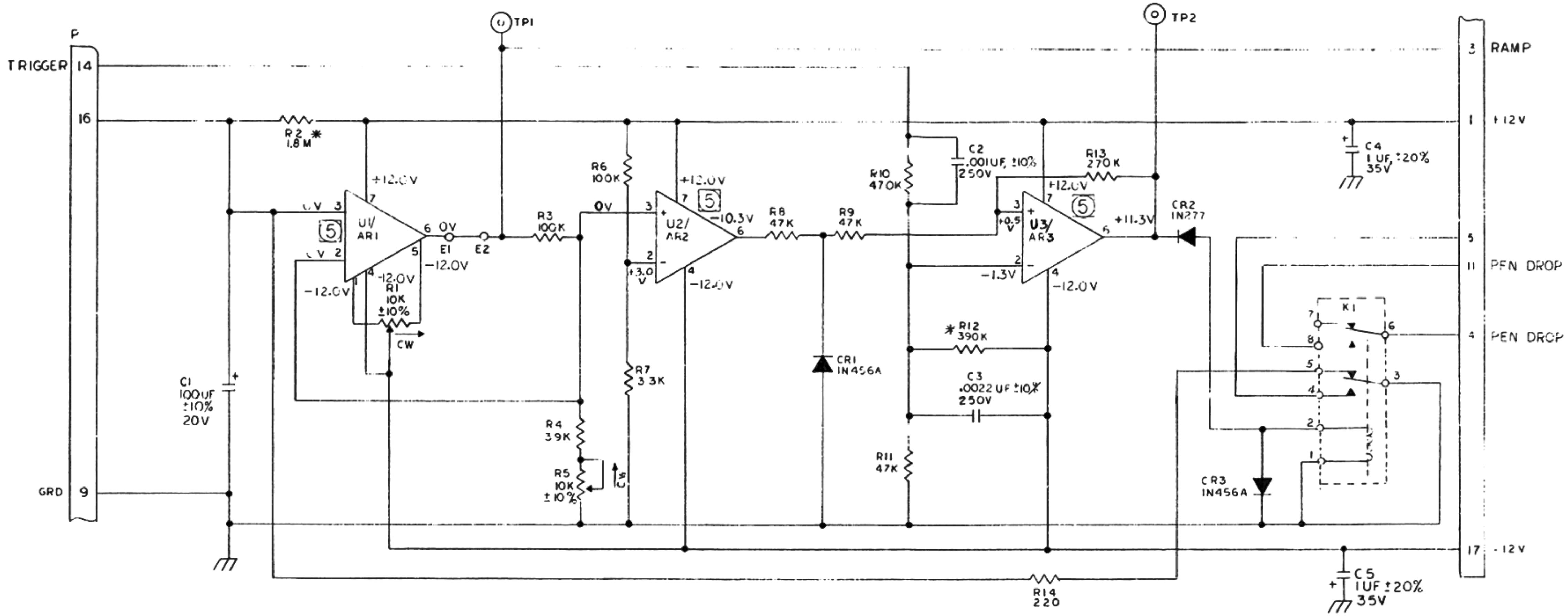
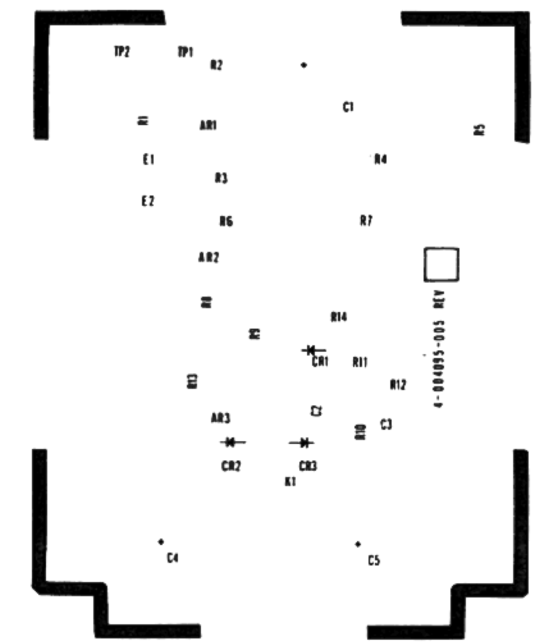


Figure 8-26. Schematic Diagram, Rectifier and Charge Regulator, A32
Dwg No. 4-501289-001 (A)



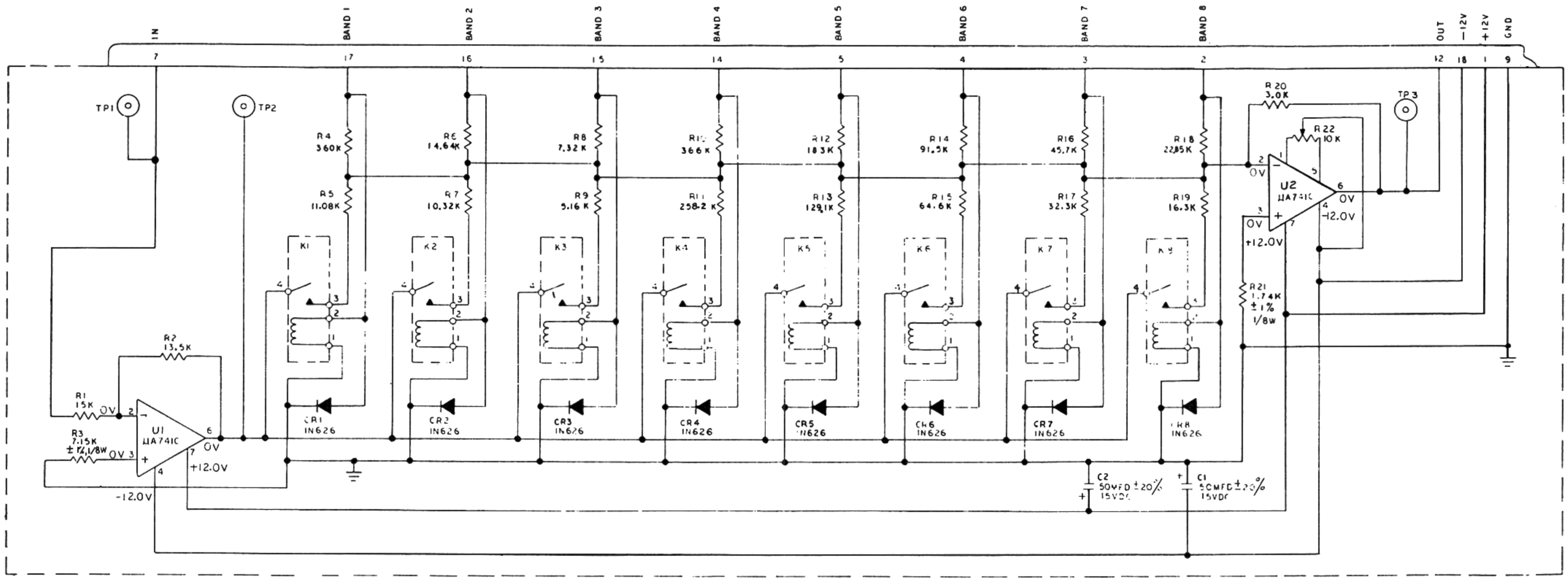


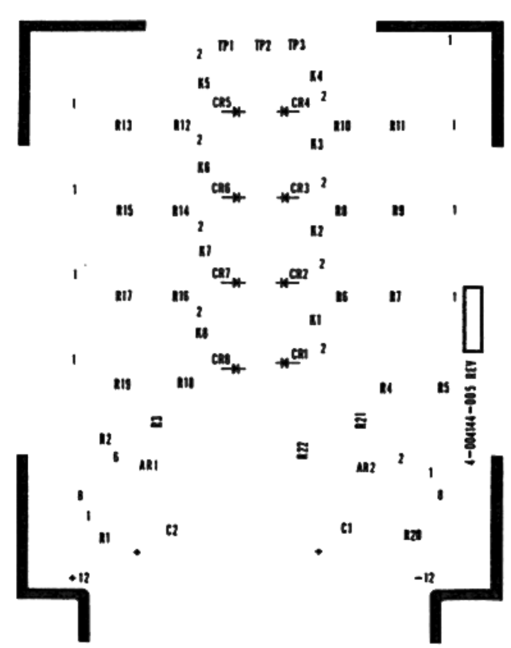
HIGHEST REF DESIGNATIONS USED				
AR3	C5	CR3	K1	R14
REF DESIGNATIONS NOT USED				

[5] U1,U2 ETC REFERS TO NM 17/27
AR1,AR2 ETC REFERS TO NM 37/57

4 COMPONENTS MARKED WITH A * MAY BE CHANGED DURING TEST
3 K1 IS ELECTROL RA30142121.
2. AR1, AR2, AR3, ARE FAIRCHILD µA741C.
1. ALL RESISTORS ARE IN OHMS, ±5%, 1/4W.

Figure 8-27. Schematic Diagram, Internal Sweep, A33 Dwg No. 4-501126-001 (C)

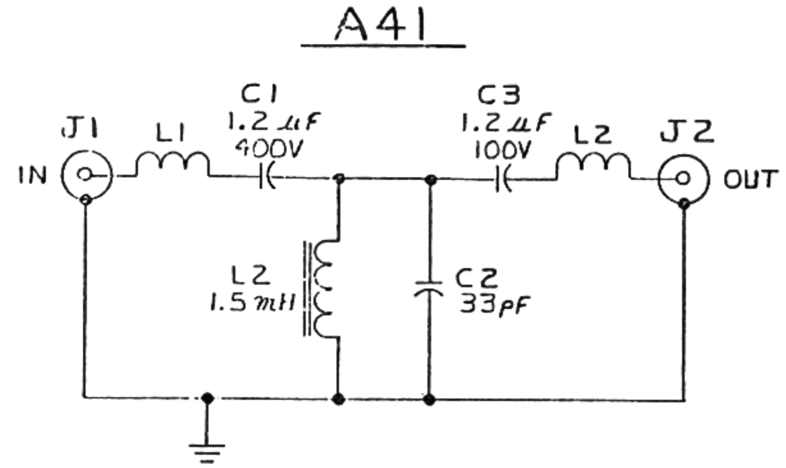


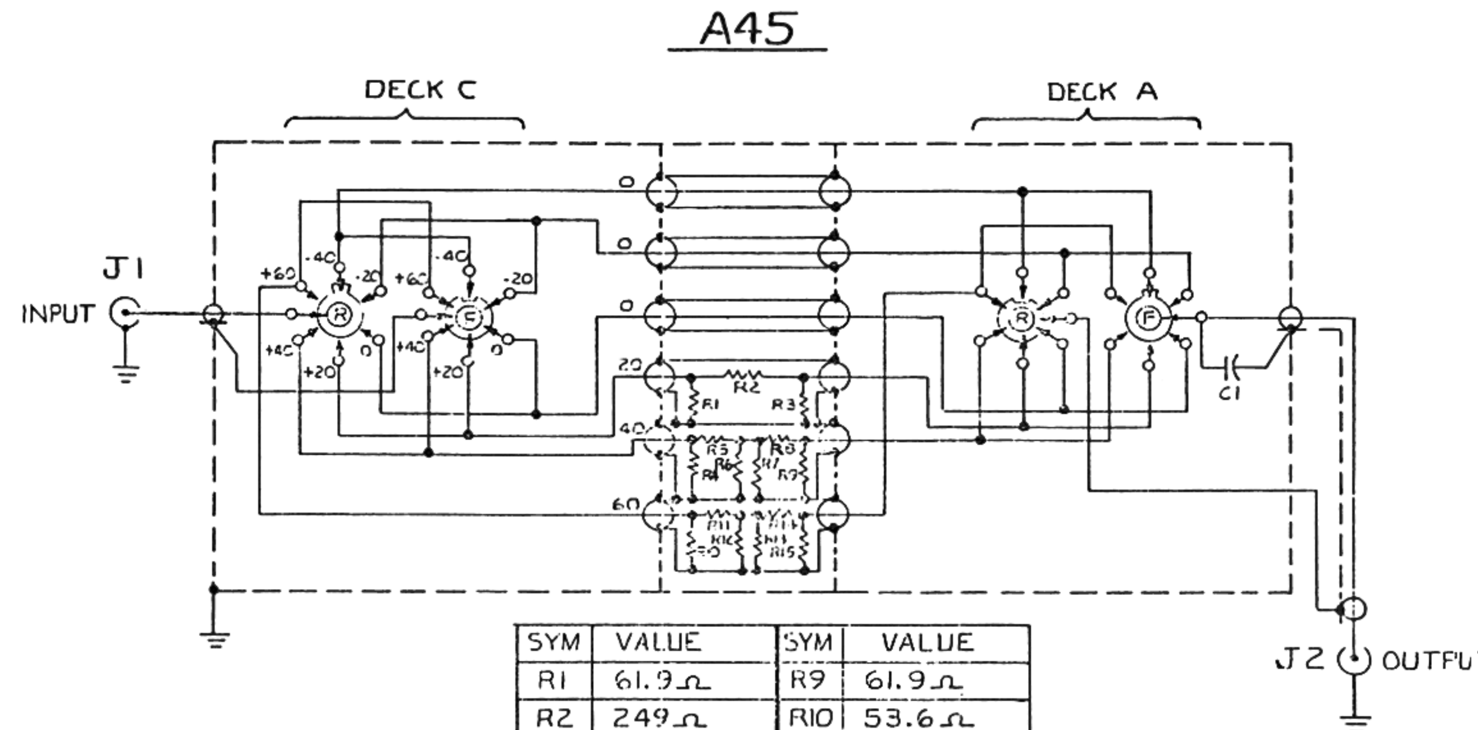


3. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S)
2. ALL RELAYS ARE SPST
1. ALL RESISTORS ARE IN OHMS ±0.1%, 1/4W.

HIGHEST REF DESIGNATION USED				
R22	C2	CR8	AR2	K8
REF DESIGNATIONS NOT USED				

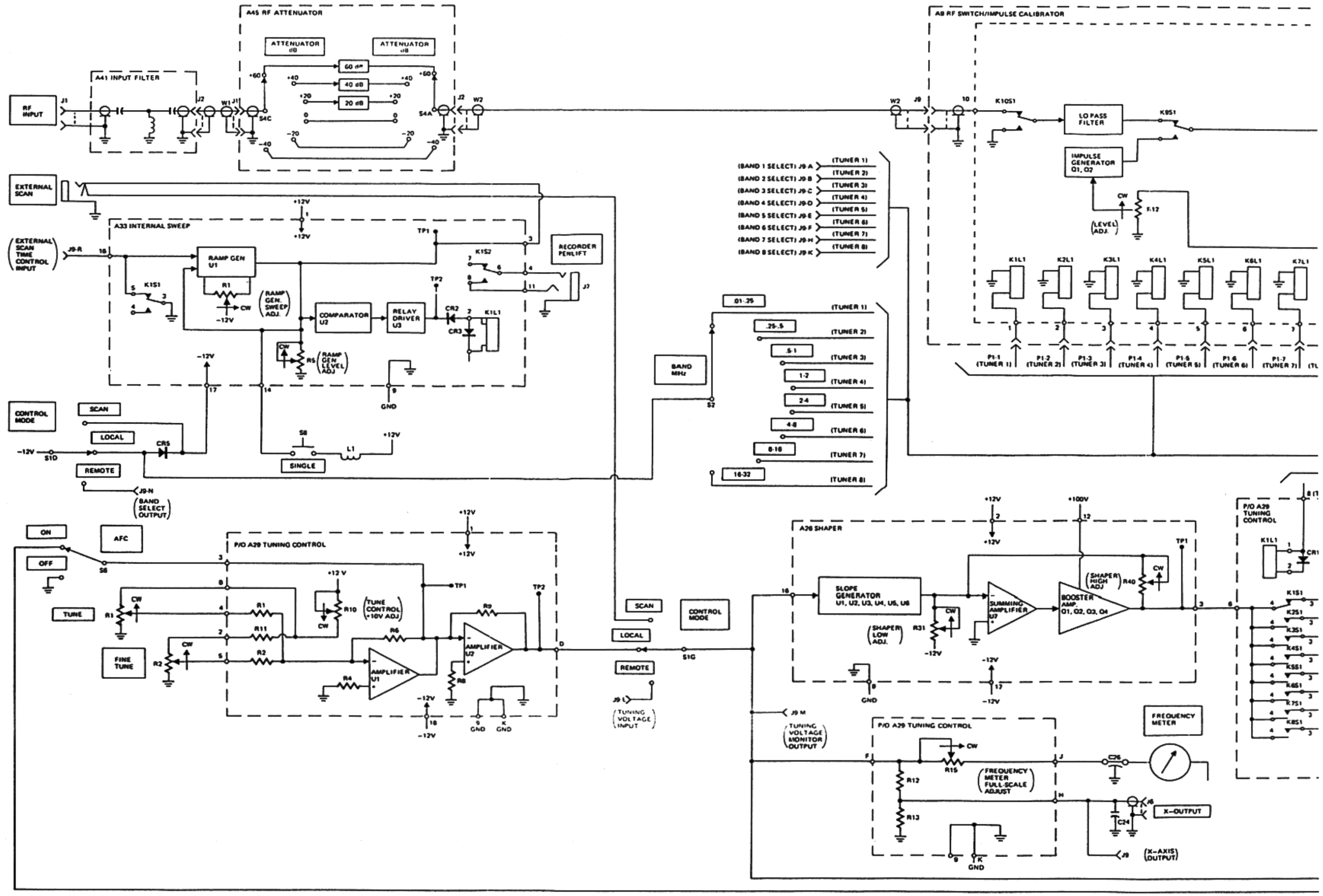
Figure 8-28. Schematic Diagram, Frequency Readout Board, A34 Dwg No. 4-501286 (A)

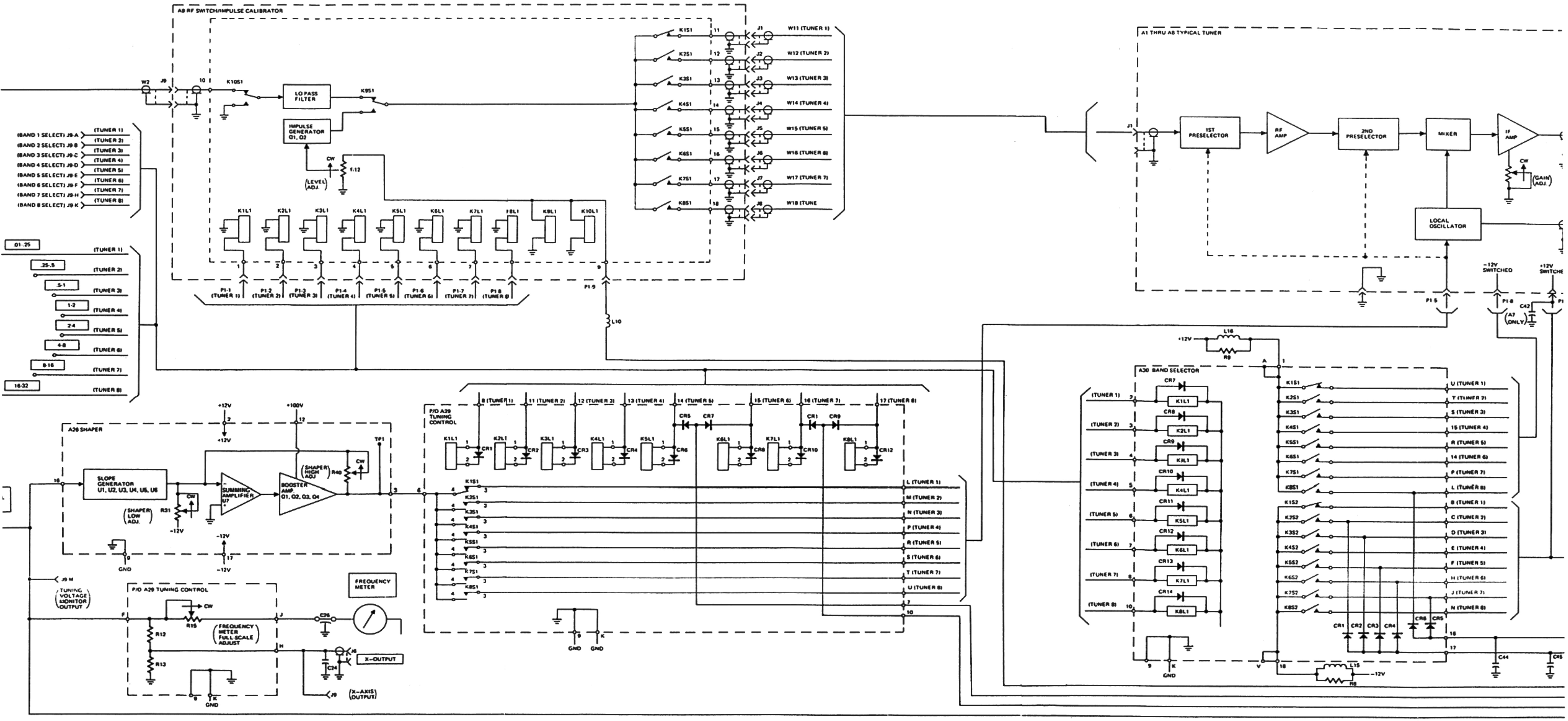




SYM	VALUE	SYM	VALUE
R1	61.9 Ω	R9	61.9 Ω
R2	249 Ω	R10	53.6 Ω
R3	61.9 Ω	R11	787 Ω
R4	61.9 Ω	R12	53.6 Ω
R5	249 Ω	R13	53.6 Ω
R6	61.9 Ω	R14	787 Ω
R7	61.9 Ω	R15	53.6 Ω
R8	249 Ω	C1	5pF DM10

Figure 8-29. Schematic Diagram, Input Filter, A41 and RF Attenuator, A45


A45 RF ATTENUATOR
A41 INPUT FILTER
A9 RF SWITCH/IMPULSE CALIBRATOR
A33 INTERNAL SWEEP
P/O A29 TUNING CONTROL
A26 SHAPER
RF INPUT
EXTERNAL SCAN
CONTROL MODE
RAMP GEN U1
COMPARATOR U2
RELAY DRIVER U3
RECORDER PENLIFT
LO PASS FILTER
IMPULSE GENERATOR Q1, Q2
BAND MHz
SLOPE GENERATOR
FREQUENCY METER
X-OUTPUT



A9 RF SWITCH/IMPULSE CALIBRATOR
LO PASS FILTER
IMPULSE GENERATOR Q1, Q2
(LEVEL ADJ.)
A1 THRU A8 TYPICAL TUNER
1ST PRESELECTOR
RF AMP
2ND PRESELECTOR
MIXER
IF AMP
LOCAL OSCILLATOR
(GAIN ADJ.)
-12V SWITCHED
A30 BAND SELECTOR
A26 SHAPER
SLOPE GENERATOR U1, U2, U3, U4, U5, U6
SUMMING AMPLIFIER U7
BOOSTER AMP Q1, Q2, Q3, Q4
(SHAPER LOW ADJ.)
(SHAPER HIGH ADJ)
P/O A29 TUNING CONTROL
FREQUENCY METER
(FREQUENCY METER FULL-SCALE ADJUST)
X-OUTPUT
(X-AXIS OUTPUT)
(TUNING VOLTAGE MONITOR OUTPUT)

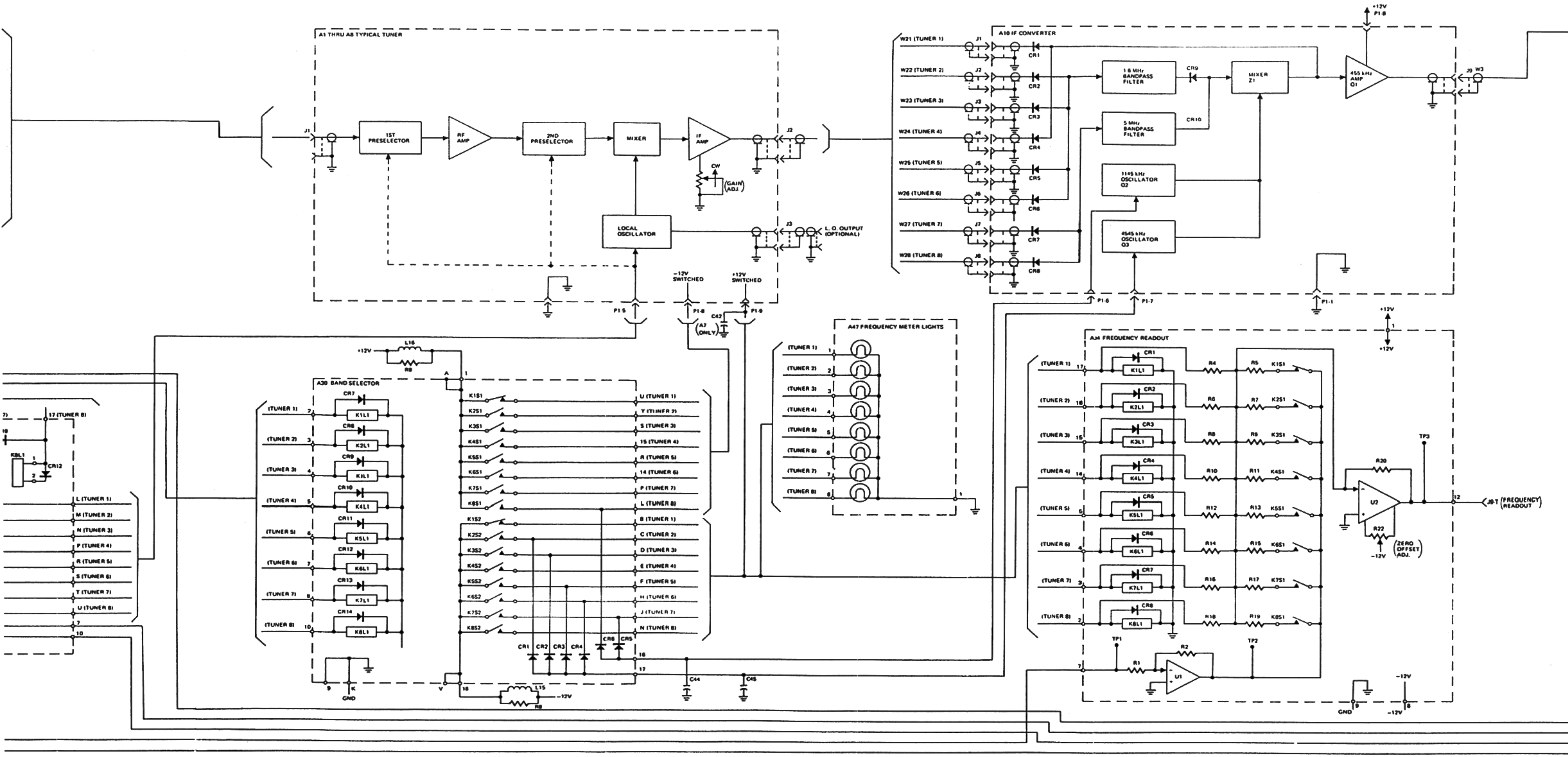
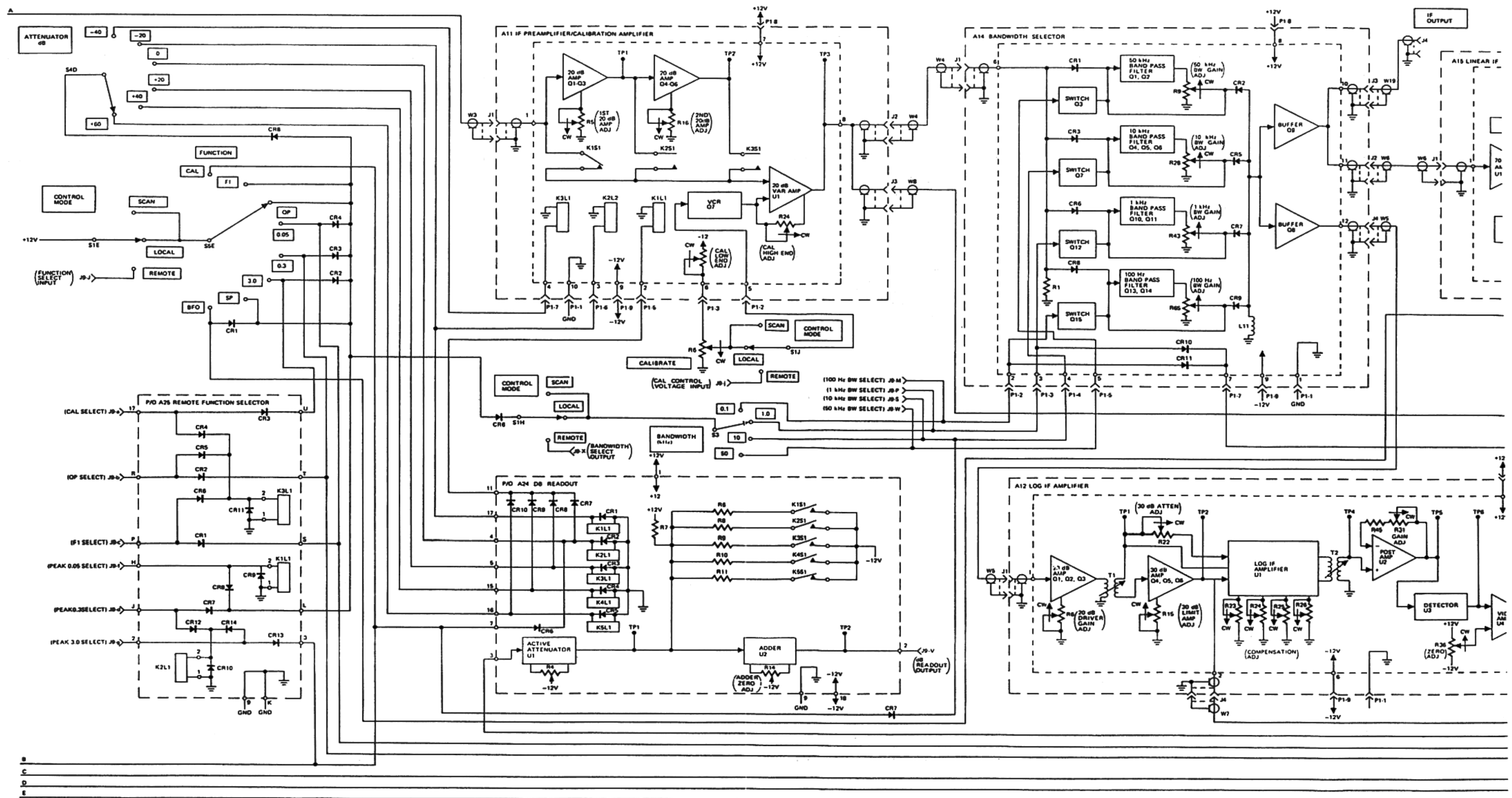
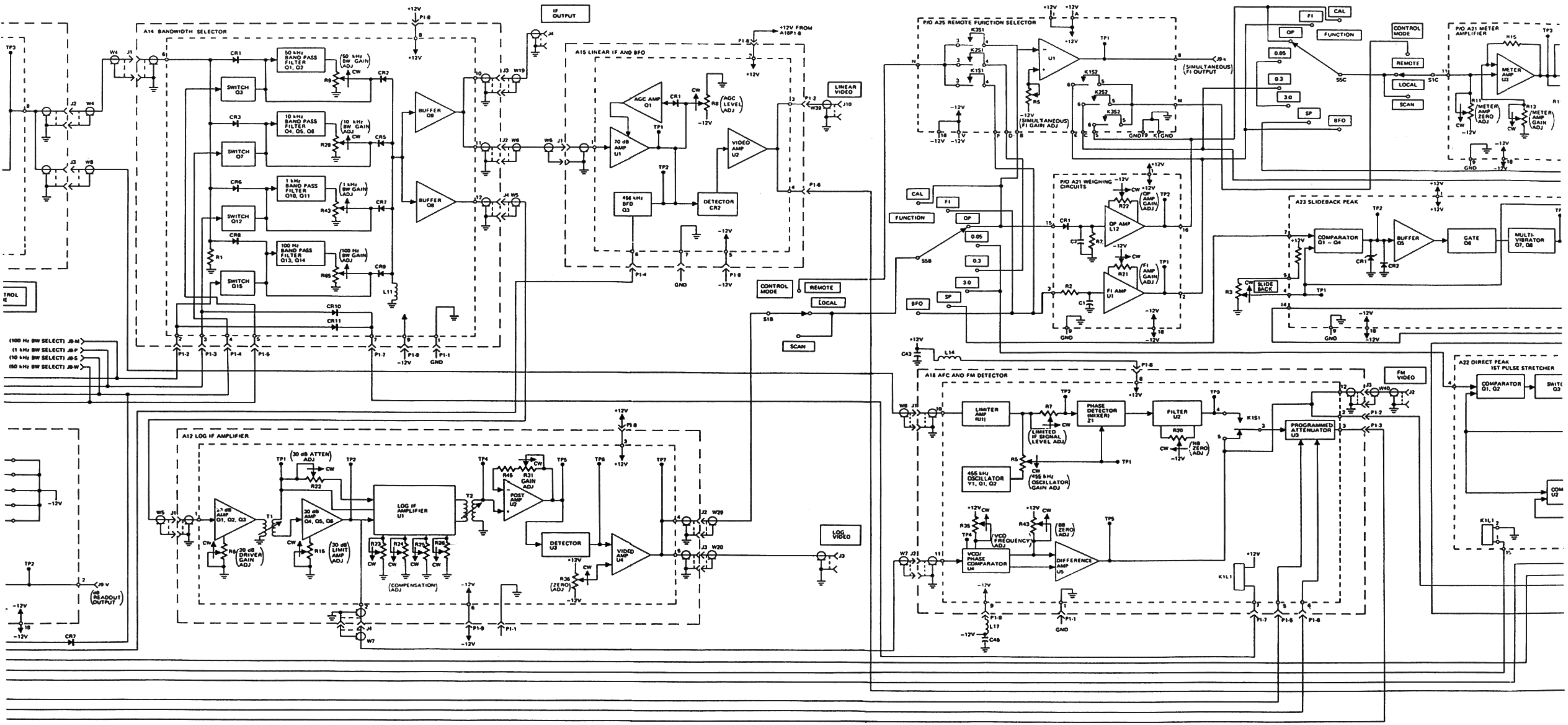


Figure 8-30. Detailed Block Diagram, Model NM-17/27 (Sheet 1)



ATTENUATOR dB
-40
-20
0
+20
+40
+60
S4D
FUNCTION
CAL
FI
CONTROL MODE
SCAN
LOCAL
REMOTE
OP
0.05
0.3
3.0
SP
BFO
A11 IF PREAMPLIFIER/CALIBRATION AMPLIFIER
20 dB AMP Q1-Q3
20 dB AMP Q4-Q6
20 dB VAR AMP U1
VCR Q7
(1ST 20 dB AMP ADJ)
(2ND 20 dB AMP ADJ)
(CAL LOW END ADJ)
(CAL HIGH END ADJ)
CALIBRATE
(CAL CONTROL VOLTAGE INPUT)
A14 BANDWIDTH SELECTOR
50 kHz BAND PASS FILTER Q1, Q2
10 kHz BAND PASS FILTER Q4, Q5, Q6
1 kHz BAND PASS FILTER Q10, Q11
100 Hz BAND PASS FILTER Q13, Q14
(50 kHz BW GAIN ADJ)
(10 kHz BW GAIN ADJ)
(1 kHz BW GAIN ADJ)
(100 Hz BW GAIN ADJ)
SWITCH Q3
SWITCH Q7
SWITCH Q12
SWITCH Q15
BUFFER Q8
BUFFER Q9
IF OUTPUT
A15 LINEAR IF
(100 Hz BW SELECT) J9-M
(1 kHz BW SELECT) J9-P
(10 kHz BW SELECT) J9-S
(50 kHz BW SELECT) J9-W
BANDWIDTH (kHz)
0.1
1.0
10
50
(BANDWIDTH SELECT OUTPUT)
P/O A25 REMOTE FUNCTION SELECTOR
(CAL SELECT) J9-a
(OP SELECT) J9-b
(FI SELECT) J9-c
(PEAK 0.05 SELECT) J9-f
(PEAK 0.3 SELECT) J9-d
(PEAK 3.0 SELECT) J9-g
(FUNCTION SELECT INPUT)
P/O A24 DB READOUT
ACTIVE ATTENUATOR U1
ADDER U2
(ADDER ZERO ADJ)
(dB READOUT OUTPUT)
A12 LOG IF AMPLIFIER
20 dB AMP Q1, Q2, Q3
30 dB AMP Q4, Q5, Q6
(30 dB ATTEN ADJ)
(20 dB DRIVER GAIN ADJ)
(30 dB LIMIT AMP ADJ)
LOG IF AMPLIFIER U1
(COMPENSATION ADJ)
POST AMP U2
R31 GAIN ADJ
DETECTOR U3
(ZERO ADJ)



A14 BANDWIDTH SELECTOR
50 kHz BAND PASS FILTER Q1, Q2
10 kHz BAND PASS FILTER Q4, Q5, Q6
1 kHz BAND PASS FILTER Q10, Q11
100 Hz BAND PASS FILTER Q13, Q14
SWITCH Q3
SWITCH Q7
SWITCH Q12
SWITCH Q15
BUFFER Q9
BUFFER Q8
IF OUTPUT
A15 LINEAR IF AND BFO
AGC AMP Q1
70 dB AMP U1
VIDEO AMP U2
456 kHz BFO Q3
DETECTOR CR2
LINEAR VIDEO
+12V FROM A18P1-8
(100 Hz BW SELECT) J9-M
(1 kHz BW SELECT) J9-P
(10 kHz BW SELECT) J9-S
(50 kHz BW SELECT) J9-W
A12 LOG IF AMPLIFIER
(30 dB ATTEN ADJ)
LOG IF AMPLIFIER U1
POST AMP U2
DETECTOR U3
VIDEO AMP U4
(COMPENSATION ADJ)
LOG VIDEO
(dB READOUT OUTPUT)
P/O A25 REMOTE FUNCTION SELECTOR
(SIMULTANEOUS FI GAIN ADJ)
(SIMULTANEOUS FI OUTPUT)
P/O A21 WEIGHING CIRCUITS
OP AMP U2
FI AMP U1
CAL
FI
FUNCTION
OP
0.05
0.3
3.0
SP
BFO
CONTROL MODE
REMOTE
LOCAL
SCAN
P/O A21 METER AMPLIFIER
METER AMP U3
A23 SLIDEBACK PEAK
COMPARATOR Q1 – Q4
BUFFER Q5
GATE Q6
MULTI-VIBRATOR Q7, Q8
SLIDE BACK
A18 AFC AND FM DETECTOR
LIMITER AMP (U1)
PHASE DETECTOR (MIXER) Z1
FILTER U2
PROGRAMMED ATTENUATOR U3
(LIMITED IF SIGNAL LEVEL ADJ)
455 kHz OSCILLATOR Y1, Q1, Q2
(455 kHz OSCILLATOR GAIN ADJ)
VCO/PHASE COMPARATOR U4
(VCO FREQUENCY ADJ)
DIFFERENCE AMP U5
FM VIDEO
A22 DIRECT PEAK 1ST PULSE STRETCHER
COMPARATOR Q1, Q2

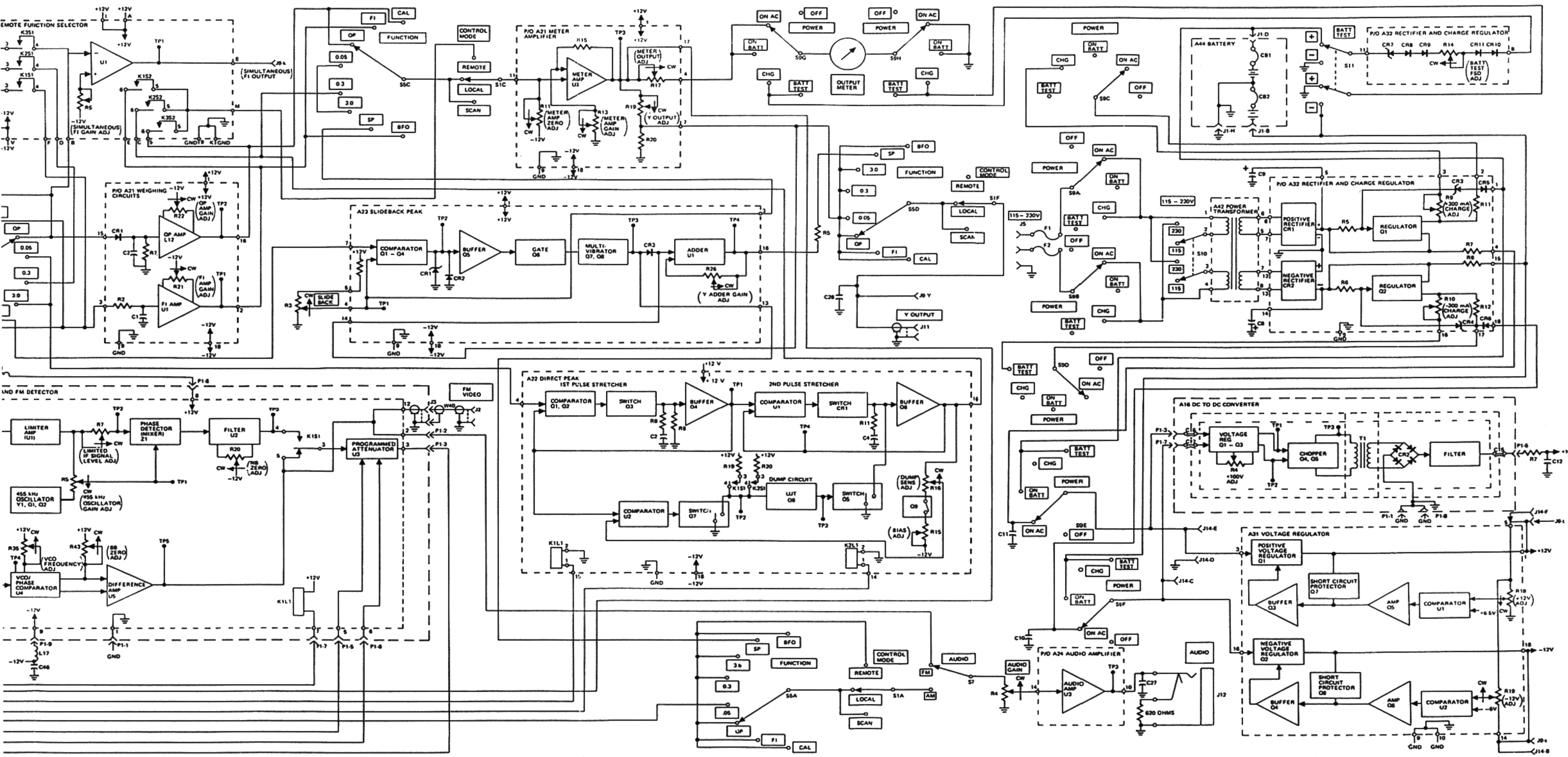


Figure 8-30. Detailed Block Diagram, Model NM-17/27 (Sheet 2)

APPENDIX A

BACKDATING INFORMATION

FOR MODEL NM-17/27 EMI/FI METERS

Serial Numbers 101 thru 150

This manual refers directly to serial numbers 151 and above. The following information is provided to adapt this manual for serial numbers 101 thru 150.

Perform the following changes to the manual, down to the effective serial number of your instrument.

Effective serial number: 101 thru 150

Page 2-1 Table 2-1. Specifications (Cont.)

Audio (AM or FM), should be: 50 mW minimum across 600 ohms, 300 to 4000 Hz for 30% amplitude modulation

Page 4-2 Figure 4-1. Operating Controls, Indicators and Receptacles, Model NM-17/27

Delete: Item 29 and the receptacle

Page 4-3 Table 4-1. Controls and receptacles (Cont.)

Delete: Item 29, AUX PWR, and all information

Page 5-11 Paragraph 5.3.18

The last paragraph before section 5.3.19, should be: The audio amplifier consists of an audio driver, integrated circuit, A24U1, and a push-pull power amplifier, A24Q1 and A24Q2. Impedence matching to the 600 ohm AUDIO receptacle, J12, is accomplished by transformer A24T1.

Page 6-8 Table 6-13. Attenuator Position vs Output Voltage for dB Readout Test

Voltage (volts), should be: +0.020, +0.040, +0.060, +0.080, +0.100, +0.120

Page 6-8 Paragraph 6.2.18-d. *Audio Output*

line 7 should be: is 50 milliwatts minimum
line 11 should be: . . .300 Hz to 4000 Hz. . .

Page 6-16 Paragraph 6.3.13 *dB Readout, A24*

Delete Steps b and c and replace with the following: Short circuit A24TP1 to ground and connect the dc digital voltmeter to A24TP2. Set the ATTENUATOR (dB) switch to the following positions: –40 dB, –20 dB, 0 dB, +20 dB, +40 dB, and +60 dB. Note the dc digital voltmeter indications and adjust A24R5, A24R22, A24R3, A24R7, A24R10 and A24R12 for –40 mV, –20 mV, 0 mV, +20 mV, +40 mV and +60 mV respectively. Set the 10 dB step altenuator to the 0 dB position and remove the short circuit from A24TP1. Apply –7 dBm input signal level. The Output meter should indicate 60 dBuV. The dc digital voltmeter should indicate +60 mV. If necessary, adjust A24R1.

Page 6-38 Figure 6-28.

Replace with Figure 6-28 below.

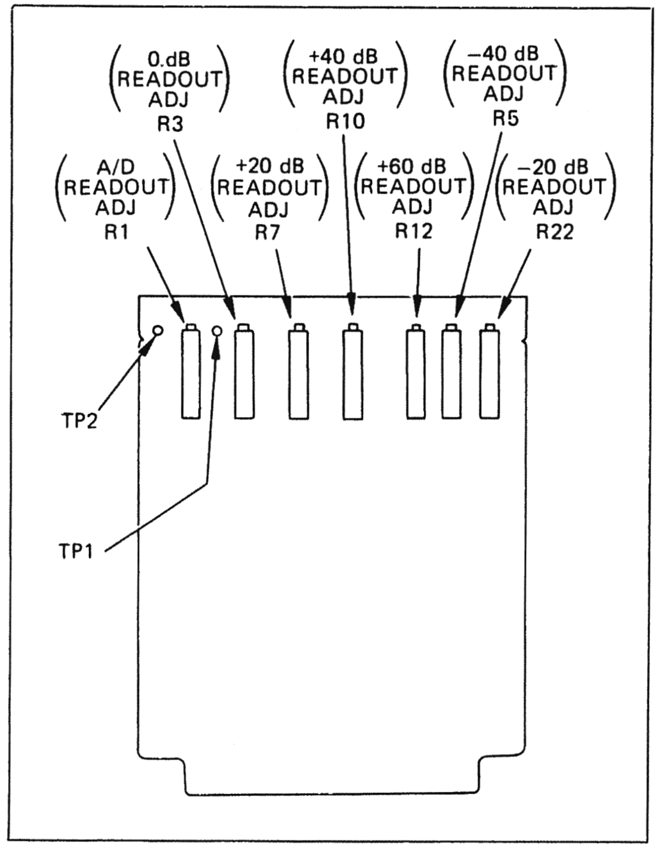


Figure 6-28. Trimmer Locations, dB Readout and Audio Amplifier Assembly, A24

Page 7-2 Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)

A24, change the Singer Part No. from 1-004870-001 to 3-004641-001

Page 7-5 Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)

Delete: J14 and all information

Page 7-57 Table 7-21. Parts List for Direct Peak Circuit Assembly, A22 CR1;

Change the Singer Part No. and Mfr. Part No. from 1-913050-001 and S334 to 1-913045-001 and 1N4154

Page 7-61 Table 7-23. Parts List for dB Readout and Audio Circuit Assembly, A24

Remove Table 7-23 from the manual and replace with the attached Table 7-23

Page 8-37 Figure 8-18. Schematic Diagram, Direct Peak Circuit, A22

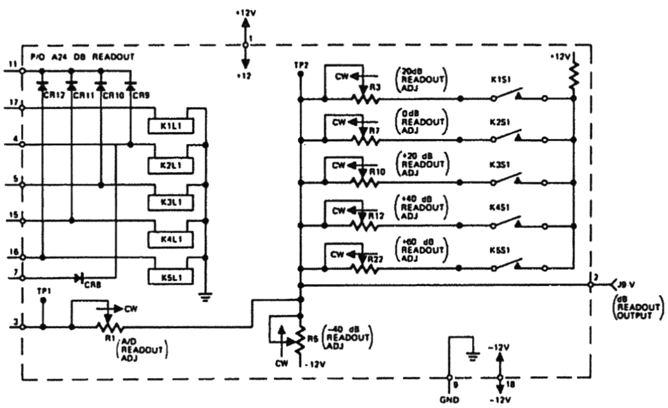
Change CR1 from 1N4154 to 5334

Page 8-41 Figure 8-20. Schematic Diagram, dB Readout and Audio Board, A24

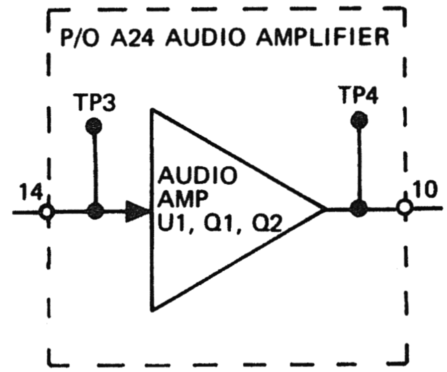
Remove Figure 8-20 from the manual and replace with the attached Figure 8-20

Page 8-63 Figure 8-30. Detailed Block Diagram Model NM-17/27

Delete: J14, AUX PWR, and all lines. Replace P/O A24 dB Readout assembly with the following:



Replace P/O A24 AUDIO amplifier assembly with the following:



Effective serial number: 101 thru 130

Page 6-19 Paragraph 6.3.21, Band 1 Tuner, Step s.

Delete: "and move or remove the wire turns on the body of A1C36."

Page 7-5 Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)

Delete: C46 and all information.

Page 7-6 Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)

Delete: L17 and all information.

Page 8-63 Figure 8-30. Detailed Block Diagram Model NM-17/27

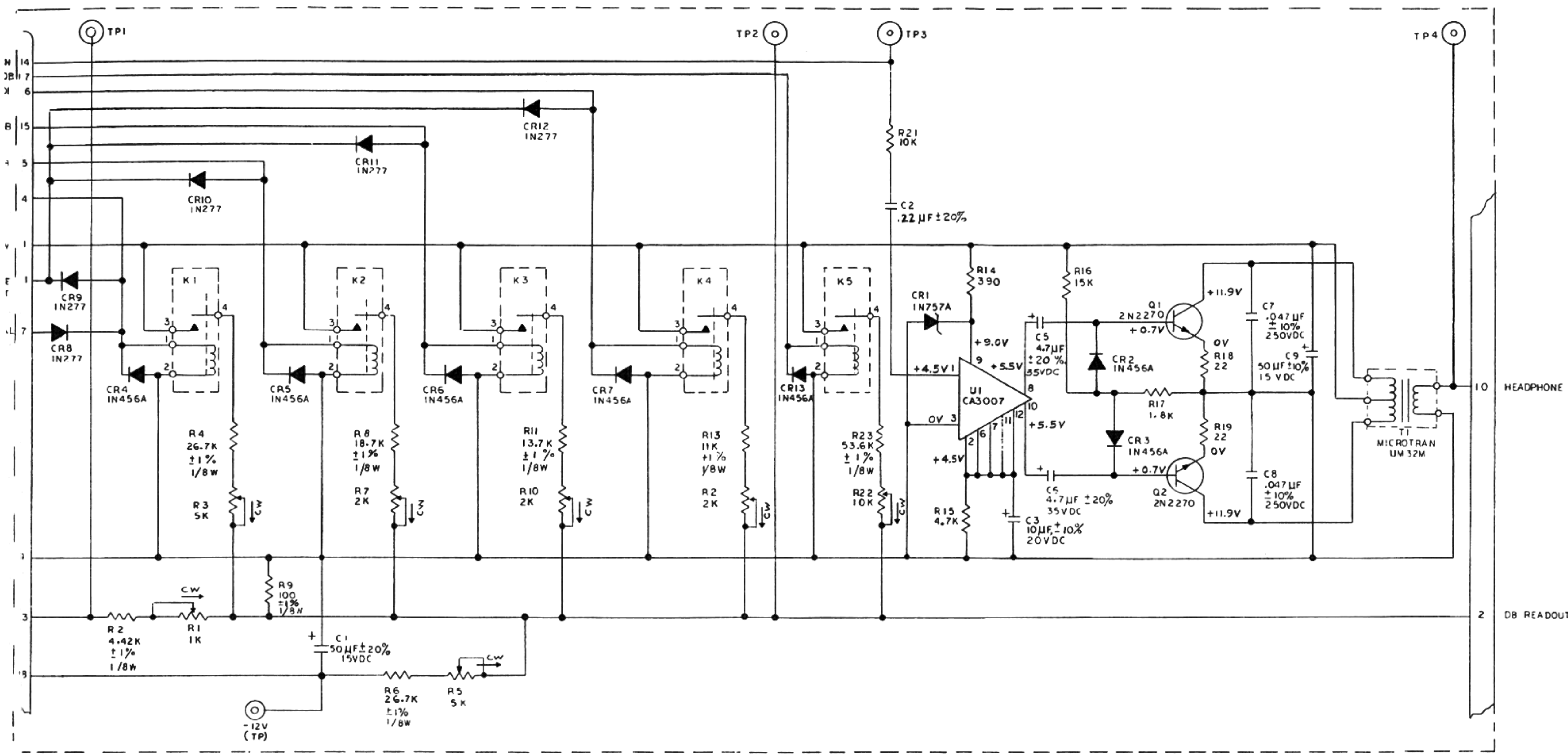
Delete: C46 and L17. Replace L17 with a straight line.

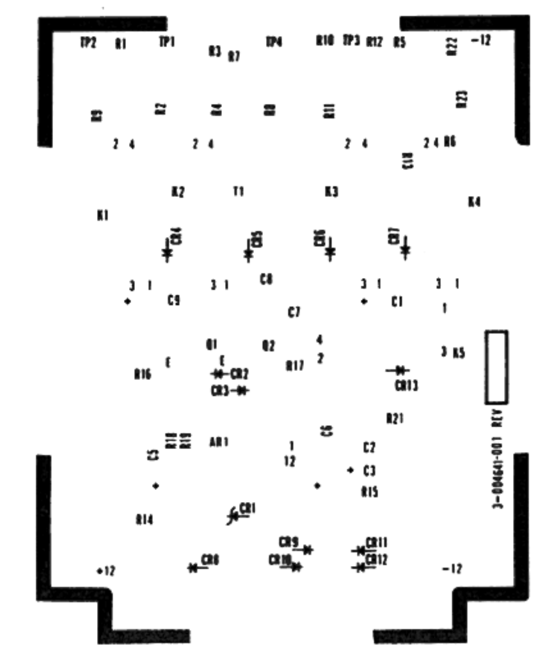
Table 7-23. Parts List for DB Readout and Audio Circuit Assembly, A24

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
C1	Capacitor, fixed, electrolytic, 50 uF, −10%,+75%, 15 Vdc	1-900039-008	76433	984-1655
C2	Capacitor, fixed, plastic, 0.22 uF, ±20%, 250 Vdc	1-900001-017	73445	C280AE-0.22uF
C3	Capacitor, fixed, electrolytic, 10 uF, ±10%, 20 Vdc	1-900057-119	56289	150D106X9020B2
C4	Not Used			
C5	Capacitor, fixed, electrolytic, 4.7 uF, ±20%, 35 Vdc	1-900057-150	56289	150D475X0035B2
C6	Capacitor, fixed, electrolytic, 4.7 uF, ±20%, 35 Vdc	1-900057-150	56289	150D475X0035B2
C7	Capacitor, fixed, plastic, 0.047 uF, ±10%, 250 Vdc	1-900001-109	73445	C280AE-0.047uF
C8	Capacitor, fixed, plastic, 0.047 uF, ±10%, 250 Vdc	1-900001-109	73445	C280AE-0.047uF
CR1	Diode, zener, 9.1 V, 400 mW	1-913054-115	04713	1N757A
CR2	Diode, silicon	1-913056-001	04713	1N456A
CR3	Diode, silicon	1-913056-001	04713	1N456A
CR4	Diode, silicon	1-913056-001	04713	1N456A
CR5	Diode, silicon	1-913056-001	04713	1N456A
CR6	Diode, silicon	1-913056-001	04713	1N456A
CR7	Diode, silicon	1-913056-001	04713	1N456A
CR8	Diode, silicon	1-913058-002	04651	1N277
CR9	Diode, silicon	1-913058-002	04651	1N277
CR10	Diode, silicon	1-913058-002	04651	1N277
CR11	Diode, silicon	1-913058-002	04651	1N277
CR12	Diode, silicon	1-913058-002	04651	1N277
CR13	Diode, silicon	1-913056-001	04713	1N456A
K1	Relay, reed, SPST	1-942017-001	0000K	206-00049
K2	Relay, reed, SPST	1-942017-001	0000K	206-00049
K3	Relay, reed, SPST	1-942017-001	0000K	206-00049
K4	Relay, reed, SPST	1-942017-001	0000K	206-00049
K5	Relay, reed, SPST	1-942017-001	0000K	206-00049
Q1	Transistor, silicon, NPN	1-958014-001	02735	2N2270
Q2	Transistor, silicon, NPN	1-958014-001	02735	2N2270
R1	Resistor, variable, wirewound, 1 k ohm, ±10%, ¼ W	1-945081-007	80294	3009P-1-102
R2	Resistor, fixed, film, 4.42 k ohm, ±1%, 1/8 W	1-945027-255	07115	RN55D4421F
R3	Resistor, variable, wirewound, 5 k ohm, ±10%, ¼ W	1-945081-009	80294	3009P-1-502
R4	Resistor, fixed, film, 26.7 k ohm, ±1%, 1/8 W	1-945027-330	07115	RN55D2672F
R5	Resistor, variable, wirewound, 5 k ohm, ±10%, ¼ W	1-945081-009	80294	3009P-1-502
R6	Resistor, fixed, film, 26.7 k ohm, ±1%, 1/8 W	1-945027-330	07115	RN55D2672F
R7	Resistor, variable, wirewound, 2 k ohm, ±10%, ¼ W	1-945081-008	80294	3009P-1-202
R8	Resistor, fixed, film, 18.7 k ohm, ±1%, 1/8 W	1-945027-315	07115	RN55D1872F
R9	Resistor, fixed, film, 100 ohm, ±1%, 1/8 W	1-945027-097	07115	RN55D1000F
R10	Resistor, variable, wirewound, 2 k ohm, ±10%, ¼ W	1-945081-008	80294	3009P-1-202

Table 7-23. Parts List for DB Readout and Audio Circuit Assembly, A24 (Cont.)

REF. DESIG.	DESCRIPTION	SINGER PART NO.	MFR. CODE	MFR. PART NO.
R11	Resistor, fixed, film, 13.7 k ohm, ±1%, 1/8 W	1-945027-302	07115	RN55D1372F
R12	Resistor, variable, wirewound, 2 k ohm, ±10%, ¾ W	1-945081-008	80294	3009P-1-202
R13	Resistor, fixed, film, 11 k ohm, ±1%, 1/8 W	1-945027-293	07115	RN55D1102F
R14	Resistor, fixed, composition, 390 ohm, ±5%, ¼ W	1-945000-152	01121	CB3915
R15	Resistor, fixed, composition, 4.7 k ohm, ±5%, ¼ W	1-945000-178	01121	CB4725
R16	Resistor, fixed, composition, 15 k ohm, ±5%, ¼ W	1-945000-190	01121	CB1535
R17	Resistor, fixed, composition, 1.8 k ohm, ±5%, ¼ W	1-945000-168	01121	CB1825
R18	Resistor, fixed, composition, 22 ohm, ±5%, ¼ W	1-945000-122	01121	CB2205
R19	Resistor, fixed, composition, 22 ohm, ±5%, ¼ W	1-945000-122	01121	CB2205
R20	Not Used			
R21	Resistor, fixed, composition, 10 k ohm, ±5%, ¼ W	1-945000-186	01121	CB1035
R22	Resistor, variable, wirewound, 10 k ohm, ±10%, ¾ W	1-945081-010	80294	3009P-1-103
R23	Resistor, fixed, film, 53.6 k ohm, ±1%, 1/8 W	1-945027-359	07115	RN55D5362F
T1	Transformer	1-954020-001	00348	UM32M
U1	Integrated circuit, audio amplifier	1-926039-001	03606	CA3007





HIGHEST REF DESIGNATIONS USED							
C9	CR13	Q2	T1	K5	AR1	R23	TP4
REF DESIGNATIONS NOT USED							
R20							

(For use with serial numbers 101 thru 150)

ARTIAL REFERENCE DESIGNATIONS ARE HOWN; FOR COMPLETE DESIGNATION PREFIX ITH UNIT NUMBER OR SUBASSEMBLY IGNATION(S).

AYS ARE SPST ELECTROL INC. Nº RA30131121.

RESISTORS ARE IN OHMS ±5%, 1/4W.

Figure 8-20. Schematic Diagram dB Readout and Audio Board, A24 Dwg. No. 501264-001 (B)

ADDENDUM
FOR
MANUAL NO. 1-500783-255 (Rev. A)
MODEL NM-17/27

ERRATA

Correct the following errors in the above manual:

Page 5-13: Table 5-1. PROGRAMMER Receptacle Pin Data (J9)
Pin T, Bands 4-8, Was: 100 mV/kHz Is: 100 mV/MHz
Page 8-35/8-36: Figure 8-17. Schematic Diagram, Weighing Circuits and Meter Amplifier, A21
Dwg. No., Was: 4-501314-001(A) Is: 4-501128-001(A)
C2, Was: .0082 uF Is: 0.47 uF
Page 8-61/8-62: Figure 8-30. Detailed Block Diagram, Model NM-17/27 (Sheet 1)
At the junction of K1L1 and K8L1, Add: A ground symbol
J8, Was: Connected to W18 (TUNE) Is: Connected to W18 (TUNER 8)
A29-H, Was: Connected to J9 (X-AXIS OUTPUT) Is: Connected to J9-M (X-AXIS OUTPUT)
At the output of the FREQUENCY METER, Add: A ground symbol
Remove one of the two lines connecting the upper end of A33 K1L1 to A33-2
Page 8-63/8-64: Figure 8-30. Detailed Block Diagram, Model NM-17/27 (Sheet 2)
Remove the contact symbol from the junction of J9-t and A31-5, A31-1 and replace with a straight line.
Remove the arrowhead from the junction of J14-F and A31-5
Add: An arrowhead to the input of A22K2S1
A12, P1-1, Add: The designation GND

Pages iv and v: CONTENT (Cont.)
Change Paragraph numbers 6.3.3 thru 6.3.28 to 6.3.4 thru 6.3.29 respectively
Add: 6.3.3 Battery Maintenance 6-13

Page vi: APPENDIX
Add: B Supplementary Battery Information B-1

Page 2-3: Table 2-1. Specifications (Cont.)
Power requirements, Add: NOTE
Refer to Appendix B for supplementary battery information

Page 3-1: Paragraph 3.6 BATTERY CHARGING
Add: NOTE
Refer to Appendix B for supplementary battery information

Page 5-2: Paragraph 5.2.4 Power Supply Circuitry
Add: NOTE
Refer to Appendix B for supplementary battery information

Revision	Approved	Initials	Date
Z			
Y			
X			
W			
V			
U			
T			
S			
R			
Q			
P			
O			
N			
M			
L			
K			
J			
I			
H			
G			
F			
E			
D			
C			
B			
A			

CLASS CODE

SINGER INSTRUMENTATION LOS ANGELES, CALIF.

TITLE ADDENDUM MODEL NM-17/27

DWG NO. 1-500783-255(A) SHEET 1.1

FORM NO. 160 1M 3-70 D-H

ERRATA (Continued)

Page 6-13: Change Paragraph numbers 6.3.3 thru 6.3.6 to 6.3.4 thru 6.3.7 respectively

Add: Paragraph 6.3.3 Battery Maintenance as follows:

6.3.3 Battery Maintenance

a. Set the POWER switch to BATT TEST. Set the BATT TEST toggle switch to + and -, observing the dB meter indication on the battery scale. The meter indicates the battery condition during discharge with a test load.

b. If there is no indication on the dB meter for either the positive or negative battery test in Step a, press the appropriate circuit breaker button on the rear panel to reset. If ther is still no indication, remove the battery pack as instructed in Paragraph 6.3.1-b and check the battery cable and connector.

c. If the batteries are discharged and the NM-17/27 is not required to operate, connect the instrument to an AC power source and set the POWER switch to CHARGE. Completely discharged batteries will be fully charged in approximately 12 hours.

d. If the batteries are discharged but the NM-17/27 is required for use, the trickle charge during AC operation will require approximately 30 hours to charge completely discharged batteries.

NOTE

Refer to Appendix B for supplementary battery information

Pages 6-14 thru 6-23: Change Paragraph numbers 6.3.7 thru 6.3.28 to 6.3.8 thru 6.3.29 respectively.

Following Page A-5/A-6, Add: The attached Appendix B

Page 6-8:

Table 6-13. Attenuator Position vs Output Voltage for dB Readout Test

Was:	Attenuator:	-40	-20	0	+20	+40	+60
	Voltage (volts):	-0.040	-0.020	+0.000	+0.020	+0.040	+0.060
Is:	Attenuator:	-40	-20	0	+20	+40	+60
	Voltage (volts):	+0.200	+0.400	+0.600	+0.800	+1.000	+1.200

Table 6-14. Output Meter Indication vs Output Voltage for dB Readout Test

Was:	Output Meter Indication	60 dB	50 dB	40 dB	30 dB	20 dB
	Voltage (volts):	+0.060	+0.050	+0.040	+0.030	+0.020
Is:	Output Meter Indication	60 dB	50 dB	40 dB	30 dB	20 dB
	Voltage (volts):	+0.600	+0.500	+0.400	+0.300	+0.200

CLASS CODE

REVISED

APPROVED

SINGER INSTRUMENTATION LOS ANGELES, CALIF.

TITLE ADDENDUM MODEL NM-17/27

DWG NO. I- 500783-255(A)

SHEET 1.2

FORM NO 160 1M 3-70 D-H

APPENDIX B
Battery Supplementary Information

A. 1 The Nickel-Cadmium (NiCd) Battery

The NiCd battery has the following qualities:

a. May be recharged hundreds of times.

b. Nearly constant discharge potential during its normal operating cycle.

c. Excellent charge retention.

d. Good low temperature characteristics.

e. Rugged, sealed construction; can take much abuse.

f. May stand for long periods of time in either charged or discharged state without any adverse effects.

A. 2 NiCd Battery Discharge Characteristics

The discharge voltage is quite flat and should remain within the range of 1.20 volts to 1.25 volts per cell for approximately 80% of its normal operating range (1.25 volts to 1.10 volts). Cells should not be discharged under load to extremely low voltage. Recharging should be started when cell voltage reaches 1.10 volts under load. The low end of the battery meter scale operating range is based on the 1.1 volt point. The cell voltage under normal load drops very rapidly with time when below the 1.1 volt output level.

A. 3 Normal Battery Cycle Life

The life of the cell or battery is based on the drain and nature of its discharge cycles. If the battery is only partially discharged (1/2 to 3/4 of its capacity) on each cycle, then the number of cycles possible before the battery's usefulness is ended is extended.

Where discharges completely exhaust a cell, the cycle life can be considerably less. Where the recommended cut-off of 1.1 volts is observed hundreds of cycles should be obtained. Also, when cells are operated according to recommended procedure, termination of cell life will not be sudden. Rather, a gradual decline in capacity will result, allowing replacement on an orderly schedule.

A.4 Battery Life

The battery is capable of operating the equipment for 8 hours from a fully charged condition to the point at which the battery meter indicates below the low end of the operating range. It has been found that if the battery has been operated throughout a large number of charge/discharge cycles (all within the 50% to 100% of full-charge range) the battery capacity apparently decreases by 10% or 15%. However, this loss is normally regained after 3 or 4 sequential cycles from full-charge to the lower operating range point on the battery meter scale.

A.5 Temperature Characteristics

NiCd batteries are not recommended for use beyond the range of -15°C to +50°C (+5°F to +122°F). The following tabulation indicates the effect of temperature on the service life of NiCd batteries discharged at a "10 Hour Rate.

Discharge Temperature	Approximate Percent of +21.1°C (+70°F) Capacity
+45.0°C (+113°F)	93
+21.1°C (+ 70°F)	100
+ 4.4°C (+ 40°F)	93
- 2.2°C (+ 28°F)	88
-20.0°C (- 4°F)	60

A.6 Retention of Charge

When a fully charged battery is allowed to stand idle it will gradually lose its charge. This loss is hastened considerably by high temperatures. The following table illustrates this.

Storage Period	+55°C (+131°F) and 100% R.H.	+51.8°C (+125°F) Dry	+45°C (+113°F) Dry	+21.1°C (+70°F)	+4.4°C (+40°F)
Initial	100%	100%	100%	100%	100%
1 mo.	20%	30%	60%	88%	95%
2 mo.	5%	25%	32%	82%	90%
3 mo.	0	0	18%	80%	89%
6 mo.	0	0	0	67%	89%
12 mo.	0	0	0	41%	79%

Cells which are allowed to stand idle are not harmed by the gradual self-discharge that occurs.

A.7 Cell Reversal

There is a phenomenon which may occur during discharge of battery packs containing series-connected NiCd cells. This is known as "cell reversal" and it may seriously affect the performance of the battery.

Reverse charging of a cell can occur during the discharge of a series string without outward indication. Individual cells do not have identical capacities. The cell in a series string that has the least capacity will dissipate all of its energy before the other cells.

Consider the case of a 25-volt battery consisting of 20 cells of 1.25 V each. The end of discharge would be 20.0 volts. We would normally assume any voltage between these two to be satisfactory. If one of the cells dissipates its energy and is down to 0 volts, it is possible that the other 19 cells will still have a total voltage of 22.8 volts, which would appear satisfactory.

However, this one cell will now be driven into reverse polarity and is being charged in a reverse direction. In the case of a 5-cell, 6.25 volt battery, the loss of one cell is immediately apparent, since the battery voltage will drop to 4.8 volts, which is below the normal 5.0 volt endpoint. Thus, it can be seen that the greater the number of cells in a series string, the more difficult it becomes to distinguish a difference in performance due to the loss of the contribution voltage of a single cell.

Reverse charging of a cell, if driven far enough, could cause permanent damage. However, a certain amount of protection against reversal is built into the cell and short reversals do not seem to have any deleterious effect. The effect of cell reversal during discharge of a series string depends upon the number of times it occurs, as well as the number of cells in series and the length of time on reverse charge. Another problem is that once the cell loses some of its capacity the effect will snowball; the cell will go into reverse charge sooner with each battery charge-discharge cycle.

Generally the cells are fairly well balanced in production batteries, and deep cell reversal is uncommon. However, for further protection, there are several equipment operational steps that can be used to minimize the possibility of cell reversal and to correct the condition if it occurs.

a. Operate the instrument on ac power whenever practical, especially when in use over extended periods of time.

b. When operating the instrument from the battery, check the condition of the battery periodically; more often when the battery is several hours into the discharge cycle.

c. Never operate the equipment on the battery when the battery voltage indicates below the operating range on the front panel meter.

d. Never forget to turn off the equipment when it is operating on the battery.

e. "Charge balancing" of the battery should be performed every month or every 15 charge/discharge cycles, whichever occurs first. Charge balancing is to deliberately charge the battery 50% longer than the normally-recommended time for fully charging the battery. Overcharging the batteries for any length of time will not damage the battery cells.

f. When cell reversal is suspected (as indicated by an abnormally low battery test voltage for a known battery charge condition), perform battery charge balancing immediately. If this does not correct the condition, then one or more cells may be permanently damaged and the battery should be replaced.

Page 7-11: Table 7-4. Parts List for Tuner 1 Assembly, A1
C31, Was: 500 Vdc — Is: 100 Vdc

Page 7-17: Table 7-6. Parts List for Tuner 3 Assembly, A3
C30, C31, Was: 500 Vdc — Is: 100 Vdc

Page 7-20: Table 7-7. Parts List for Tuner 4 Assembly, A4
C19, SINGER PART NO., Was: 1-900075-171 — Is: 1-900057-171
C30, Was: 500 Vdc — Is: 100 Vdc

Page 7-23: Table 7-8. Parts List for Tuner 5 Assembly, A5
C19, Was: 500 Vdc — Is: 100 Vdc

Page 7-29: Table 7-10. Parts List for Tuner 7 Assembly, A7
C11, Was: 500 Vdc — Is: 100 Vdc

Page 7-37: Table 7-13. Parts List for IF Converter Assembly, A10
C11, C15, C18, C19, C27, C32, Was: 500 Vdc — Is: 100 Vdc

Page 7-61: Table 7-23. Parts List for dB Readount and Audio Circuit Assembly, A24
R1, R3, R5 thru R11, R13, Was: 1/4W, MFR. PART NO. 4060
Is: 1/8W, MFR. PART NO. RB-71

Pages 7-73 and 7-74: Table 7-31. Parts List for Frequency Readout Assembly, A34
R1, R2, R4 thru R20, Was: 1/4W, MFR. PART NO. 4060
Is: 1/8W, MFR. PART NO. RB-71

REVISED | APPROVED

CLASS CODE

Page 6-3: Paragraph 6.2.4. Evaluation of Voltage Measurement Accuracy
line 6, Was: "BANDWIDTH switch to the 20 kHz position. ···"
Is: "BANDWIDTH switch to the 10 kHz position. ···"

Page 7-64: Table 7-25. Parts List for Shaper Circuit Assembly, A26
CR13, SINGER PART NO., Was: 1-913045-001 Is: 1-913054-113

Page 7-29: Table 7-10. Parts List for Tuner 7 Assembly, A7

C16, Was:	Capacitor, variable, ceramic, 2.8 pF to 10 pF, 600 ±300 ppm/°C	1-900117-001	91293	9312
Is:	Capacitor, variable, ceramic, 2.5 pF to 20 pF	1-900113-001	91293	9302

Page 5-11: Paragraph 5.3.17. dB Readout and Audio Amplifier Assembly (A24)
Continuation of paragraph at the top of the page, lines 1 and 2:
Was: ..., the diode ligic, A23CR9 thru A23CR12, routes...
Is: ..., the diode logic, A24CR7 thru A24CR10, routes...

Page 6-8: Table 6-13. Attenuator Position vs Output Voltage for dB Readout Test
Was: Voltage (volts): -0.040, -0.020, +0.000, +0.020, +0.040, +0.060
Is: Voltage (volts): +0.200, +0.400, +0.600, +0.800, +1,000, +1,200

Page 6-8: Table 6-14. Output Meter Indication vs Output Voltage for dB Readout Test
Was: Voltage (volts): +0.060, +0.050, +0.040, +0.030, +0.020
Is: Voltage (volts): +0.600, +0.500, +0.400, +0.300, +0.200

Page 6-27: MISSING SUB-TITLE and PARAGRAPHS:
At the left top of the page, add the following:

f. Frequency Readout
Set the CONTROL MODE switch to REMOTE to de-energize the band selector (A34) and to remove the tuning voltages from the input to A34. Connect a short from TP1 to ground.

Connect the digital voltmeter to TP3 of A34 and adjust R22 to obtain zero volts at TP3.

Remove the short from TP1 to ground and set the CONTROL MODE switch to LOCAL. Rotate the TUNE and FINE TUNE controls fully counterclockwise to obtain zero volts at TP1 as measured with the digital voltmeter.

Connect the digital voltmeter to TP3 and set the BAND switch to BAND 1, the digital voltmeter should indicate +0.10 volts.

ERRATA (Continued)

Page 6-27: The first paragraph (at left top), line 2,
Was: ... voltage at A34TP2.
Is: ... voltage at A34TP3.

Page 7-5: Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)
J13, Singer Part No.; Was: 1-910157-003
Is: 1-910157-103

Page 7-32: Table 7-11. Parts List for Tuner 8 Assembly, A8
CR3, Mfg. Part No.; Was: 1N148A
Is: 1N5148A

Page 7-69: Table 7-28. Parts List for Voltage Regulator Assembly, A31
Q4, Singer Part No.; Was: 1-958023-001
Is: 1-958023-002

R5, R6, incomplete Mfr. Part No.; Was: RS-2A
Is: RS-2A-1.0-3%

R18, R19, Description/Mfr. Part No.; Was: wirewound 3009P1-501
Is: cermet 3006P1-501

Page 8-61/8-62. Figure 8-30. Detailed Block Diagram, Model NM-17/27 (Sheet 1)
A30K8S1 connection; Was: L (TUNER 8) Is: N(TUNER 8)

A30K8S2 connection; Was: N(TUNER 8) Is: L (TUNER 8)

Show the connection from A30CR6 to L(TUNER 8) and K8S2.

Page 8-63/8-64: Figure 8-30 Detailed Block Diagram, Model NM-17/27 (Sheet 2)
Inputs to A25 (J9)

Was:	Is:
(CAL SELECT) J9-a	(DP3 SELECT) J9-a
(QP SELECT) J9-b	(DP2 SELECT) J9-b
(FI SELECT) J9-c	(DP1 SELECT) J9-c
(PEAK 0.05 SELECT) J9-f	(FI SELECT) J9-f
(PEAK 0.3 SELECT) J9-d	(QP SELECT) J9-d
(PEAK 3.0 SELECT) J9-g	(CAL SELECT) J9-g

RUNNING CHANGES

Perform the following changes to the manual up to the serial number effectivity of your instrument:

Effective Serial No.: Instrument serial numbers suffixed with 04109 and above

Page 7-53: Table 7-19. Parts List for AFC to FM Detector Assembly, A18
C1, Was: Capacitor, fixed, ceramic, 0.1µF, ± 20%, 50 Vdc — 1-900104-002 00656 3419-050E-104M
Is: Capacitor, fixed, mica, 47 pF, ± 5%, 300 Vdc — 1-900098-022 04062 DM5-EC470J

Page 7-55: Table 7-19. Parts List for AFC to FM Detector Assembly, A8 (Cont.)
Add: R48 Resistor, fixed, composition, 1.5 k ohm, ± 5%, 1/8 W — 1-945086-067 01121 BB1525

Page 8-33/8-34: Figure 8-16. Schematic Diagram, AFC and FM Detector Circuit, A18
C1, Was: .1 Is: 47 pF
Add: A resistor, R48, 1.5 k, from U1-14 to U1-10

Effective Serial No: Instrument serial numbers suffixed with 04121 and above

Page 7-5: Table 7-1 Parts List for Main Assemblies and Chassis (Cont.)
Add: C47 Capacitor, fixed, electrolytic 10µF, ± 10%, 20 Vdc — 1-900057-119 56289 150D106X9020B2

Page 7-6: Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)
Add: L18 Inductor, fixed, 100µH, 325 mA 1-906016-037 00001 DR-100

Page 7-40: Table 7-14. Parts List for IF Preamplifier and Calibration Amplifier Assembly, A
Add: L3 Inductor, fixed, 2.7 mH, 97 mA 1-906016-054 00001 DR-2700

Page 8-23/8-24: Figure 8-11. Schematic Diagram, IF Preamplifier and Calibration Amplifier, A11
Add: An inductor, L3, 2.7 mH, from J3 to J2

Page 8-63/8-64: Figure 8-30. Detailed Block Diagram, Model NM-17/27 (Sheet 2)
Add: A capacitor, C47, 10µF, from A18P1-7 to ground
Add: An inductor, L18, 100µH, from A18P1-7 to C47

CLASS CODE		REVISED / APPROVED
SINGER INSTRUMENTATION LOS ANGELES, CALIF.	TITLE ADDENDUM MODEL NM-17/27	DWG NO. 1-500783-255(A) SHEET 2.1

RUNNING CHANGES (Continued)

Effective serial number: Serial numbers suffixed with 04273 and above.

Page 7-57, Table 7-21. Parts List for Direct Peak Circuit Assembly, A22.

CR1 thru CR3, Was: Diode, silicon 1-913045-001 24446 1N4154

Is: Diode, silicon 1-913086-001 07263 1N3595

Page 8-37/8-38: Figure 8-18. Schematic Diagram, Direct Peak Circuit Board, A22.

CR1 thru CR3, Was: 1N4154 Is: 1N3595

Effective serial number: Serial numbers prefixed with 110 and above

Pages 7-4 and 7-5: Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)

C44, C45, Was: Capacitor, fixed, ceramic, 0.02 uF, ±20%, 25 Vdc 1-900076-002 72982 5835-000-Y5U0-203Z

Is: Not used

Page 7-38: Table 7-13. Parts List for IF Converter Assembly, A10 (Cont.)

Add: C37, C38 Capacitor, fixed, ceramic, 0.02 uF, ± 20%, 25 Vdc 1-900076-002 72982 5835-000-Y5U0-203Z

Page 8-21/8-22: Figure 8-10. Schematic Diagram, Second Converter, A10

Add: A capacitor, C37, 0.02 uF, from the junction of A10P1-6 and L9 to ground, with the curved side to ground.

Add: A capacitor, C38, 0.02 uF, from the junction of A10P1-7 and L10 to ground, with the curved side to ground.

Page 8-61/8-62: Figure 8-30. Detailed Block Diagram, Model NM-17/27 (Sheet 1)

Delete: C44 and C45

Effective serial number: Serial numbers suffixed with 05127 and above

Page 7-61: Table 7-23. Parts List for dB Readout and Audio Circuit Assembly, A24

R1, R3, R5-R11, R13, Description/Mfr. Part No., Was: 1/4W/4060 Is: 1/8W/RB-71

Page 7-73, 7-74: Table 7-31. Parts List for Frequency Readout Assembly, A34

R1, R2, R4-R20, Description/Mfr. Part No., Was: 1/4W/4060 Is: 1/8W/RB-71

Effective serial number: Serial numbers prefixed with 201 and above

Page 7-6: Table 7-1. Parts List for Main Assemblies and Chassis (Cont.)

R1, Was: Resistor, variable, wirewound, 1k ohm, ± 3%, .2W 1-945087-005 80294 3500S-1-102

Is: Resistor, variable, wirewound, 1k ohm, ± 3%, 1-1/2W 1-945102-004 80740 7216R1KL.25

Effective serial number: Serial numbers suffixed with 05230 and above

Page 7-69: Table 7-28. Parts List for Voltage Regulator Assembly, A31

Add: C9 Capacitor, fixed, ceramic, 0.01μF, ±20%, 100Vdc 1-900077-002 56289 TG-S10

C10 Capacitor, fixed, ceramic, 0.01μF, ±20%, 100Vdc 1-900077-002 56289 TG-S10

RUNNING CHANGES (Continued)

Page 8-51/8-52: Figure 8-25. Schematic Diagram, Voltage Regulator, A31

Add: A capacitor, C9, .01,100V, from the junction of R9 and R3 with the curved side to Q7-C.

Add: A capacitor, C10, .01, 100V, from the junction of Q4-B and Q8-C with the curved side to the junction of R4 and Q8-B.

Effective serial number: Serial numbers suffixed with 06040 and above

Page 7-37: Table 7-13. Parts List for IF Converter Assembly, A10

C30, Was:	Capacitor, fixed, mica, 1000 pF, ±5%, 100V	1-900003-056	72136	DM15F102J
Is:	Capacitor, fixed, mica, 1200 pF, ±5%, 100V	1-900003-057	72136	DM15F122J

Pages 7-47 and 7-48: Table 7-16. Parts List for Bandwidth Selector Assembly, A14 (Cont.)

R38, R60, Was:	Resistor, fixed, composition, 47 ohm, ±5%, 1/4W	1-945000-130	01121	CB4705
Is:	Resistor, fixed, composition, 56 ohm, ±5%, 1/4W	1-945000-132	01121	CB5605

Page 7-53: Table 7-19. Parts List for AFC to FM Detector Assembly, A18 (Cont.)

R33, Was:	Resistor, fixed composition, 2.7 k ohm, ±5%, 1/8W	1-945086-073	01121	BB2725
Is:	Resistor, fixed,composition, selected, 2.2 k ohm nominal, ±5%, 1/8W	1-945086-071	01121	BB2225

Page 8-21/8-22: Figure 8-10. Schematic Diagram, Second Converter, A10

C30, Was: 1000 Is: 1200

Page 8-27/8-28: Figure 8-13. Schematic Diagram, Bandwidth Selector, A14

R38, R60, Was: 47 Is: 56

Page 8-33/8-34: Figure 8-16. Schematic Diagram, AFC and FM Detector Circuit, A18

NOTE 4, Was: * indicates shunt during test if necessary

Is: * indicates factory selected values

R33, Was: 2.7 K* Is: 2.2 K*

REVISED

APPROVED

CLASS CODE		
THE SINGER COMPANY LOS ANGELES OPERATION LOS ANGELES, CALIF.	TITLE ADDENDUM MODEL NM-17/27	DWG. NO. 1- 500783-255(A) SHEET 2.3

Effective serial number: Instrument serial numbers suffixed with 312 and above

Page 5-11/5-12: Paragraph 5.3.21. Band Selector Assembly (A30)

Delete the first 5 lines of paragraph 1 and replace with the following:

Band Selector Assembly, A30, consists of eight sets of DPST switching transistors, A30Q1 thru A30Q32, one set for each RF tuner, and diode logic diodes A30CR1 thru A30CR6. Each switch, when energized, supplies +12 volts and -12 volts to an RF tuner. The switches are controlled manually by Band...

Line 12, Was: ... on the relay and ...
Is: ... on the switch and ...

Delete paragraph 2 (on the top of page 5-12).

Page 7-2: Table 7-1. Parts List for Main Assemblies and Chassis

Singer Part No.	A30;	Was:	4-004658-001
		Is:	4-005484-001
	A34;	Was:	4-004144-006
		Is:	4-004144-007

Page 7-68: Table 7-27. Parts List for Band Selector Assembly, A30.

Delete the entire table and replace with Table 7-27A.

Table 7-27A. Parts List for Band Selector Assembly, A30

REF. DESIG	SINGER PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NO.
CR1	1-913007-001	Diode, Silicon Vr=75 V, If=10 mA	03508	1N4148
CR2	1-913007-001	Diode, Silicon Vr=75 V, If=10 mA	03508	1N4148
CR3	1-913007-001	Diode, Silicon Vr=75 V, If=10 mA	03508	1N4148
CR4	1-913007-001	Diode, Silicon Vr=75 V, If=10 mA	03508	1N4148
CR5	1-913007-001	Diode, Silicon Vr=75 V, If=10 mA	03508	1N4148
CR6	1-913007-001	Diode, Silicon Vr=75 V, If=10 mA	03508	1N4148
Q1	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q2	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q3	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q4	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q5	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q6	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q7	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q8	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q9	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q10	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q11	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q12	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q13	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q14	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q15	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q16	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q17	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q18	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q19	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q20	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q21	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q22	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q23	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q24	1-958000-002	Transistor, Silicon, PNP	04713	2N3906

Table 7-27A. Parts List for Band Selector Assembly, A30 (Cont'd.)

REF DESIG.	SINGER PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NO.
Q25	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q26	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q27	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q28	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q29	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q30	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
Q31	1-958000-001	Transistor, Silicon, NPN	04713	2N3904
Q32	1-958000-002	Transistor, Silicon, PNP	04713	2N3906
R1	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R2	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R3	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R4	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R5	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R6	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R7	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R8	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R9	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R10	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R11	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R12	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R13	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R14	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R15	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325

Table 7-27A. Parts List for Band Selector Assembly, A30 (Cont'd.)

REF DESIG.	SINGER PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NO.
R16	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4W	01121	CB3325
R17	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R18	1-945000-186	Resistor, Composition 10 k ohms, ±5%, 1/4 W	01121	CB1035
R19	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R20	1-945000-186	Resistor, Composition 10 k ohms, ±5%, 1/4 W	01121	CB1035
R21	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R22	1-945000-186	Resistor, Composition 10 k ohms, ±5%, 1/4 W	01121	CB1035
R23	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R24	1-945000-186	Resistor, Composition 10 k ohms, ±5%, 1/4 W	01121	CB1035
R25	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R26	1-945000-186	Resistor, Composition 10 k ohms, ±5%, 1/4 W	01121	CB1035
R27	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R28	1-945000-186	Resistor, Composition 10 k ohms, ±5%, 1/4 W	01121	CB1035
R29	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R30	1-945000-186	Resistor, Composition 10 k ohms, ±5%, 1/4 W	01121	CB1035
R31	1-945000-174	Resistor, Composition 3.3 k ohms, ±5%, 1/4 W	01121	CB3325
R32	1-945000-186	Resistor, Composition 10 k ohms, ±5%, 1/4 W	01121	CB1035

Page 7-73: Table 7-31. Parts List for Frequency Readout Assembly, A34

R4; Was:	360 k ohm,	1-945084-033,	RB-71-360K
Is:	356.4 k ohm,	1-945084-051,	RB-71-356.4K
R6; Was:	14.64 k ohm,	1-945084-031,	RB-71-14.64K
Is:	14.49 k ohm,	1-945084-046,	RB-71-14.49K
R8; Was:	7.32 k ohm,	1-945084-029,	RB-71-7.32K
Is:	7.24 k ohm,	1-945084-045,	RB-71-7.24K
R10; Was:	366 k ohm,	1-945084-026,	RB-71-366K
Is:	361.8 k ohm,	1-945084-052,	RB-71-361.8K
R12; Was:	183 k ohm,	1-945084-022	RB-71-183K
Is:	180.9 k ohm,	1-945084-050	RB-71-180.9K
R14; Was:	91.5 k ohm,	1-945084-020	RB-71-91.5K
Is:	90.46 k ohm,	1-945084-049	RB-71-90.46K
R16; Was:	45.7 k ohm,	1-945084-019	RB-71-45.7K
Is:	45.23 k ohm,	1-945084-048	RB-71-45.23K
R18; Was:	22.85 k ohm,	1-945084-034	RB-71-22.85K
Is:	22.61 k ohm,	1-945084-047	RB-71-22.61K

Page 8-49/8-50: Figure 8-24. Schematic Diagram, Band Selector Board, A30
Dwg. No. 4-501269-001(A)

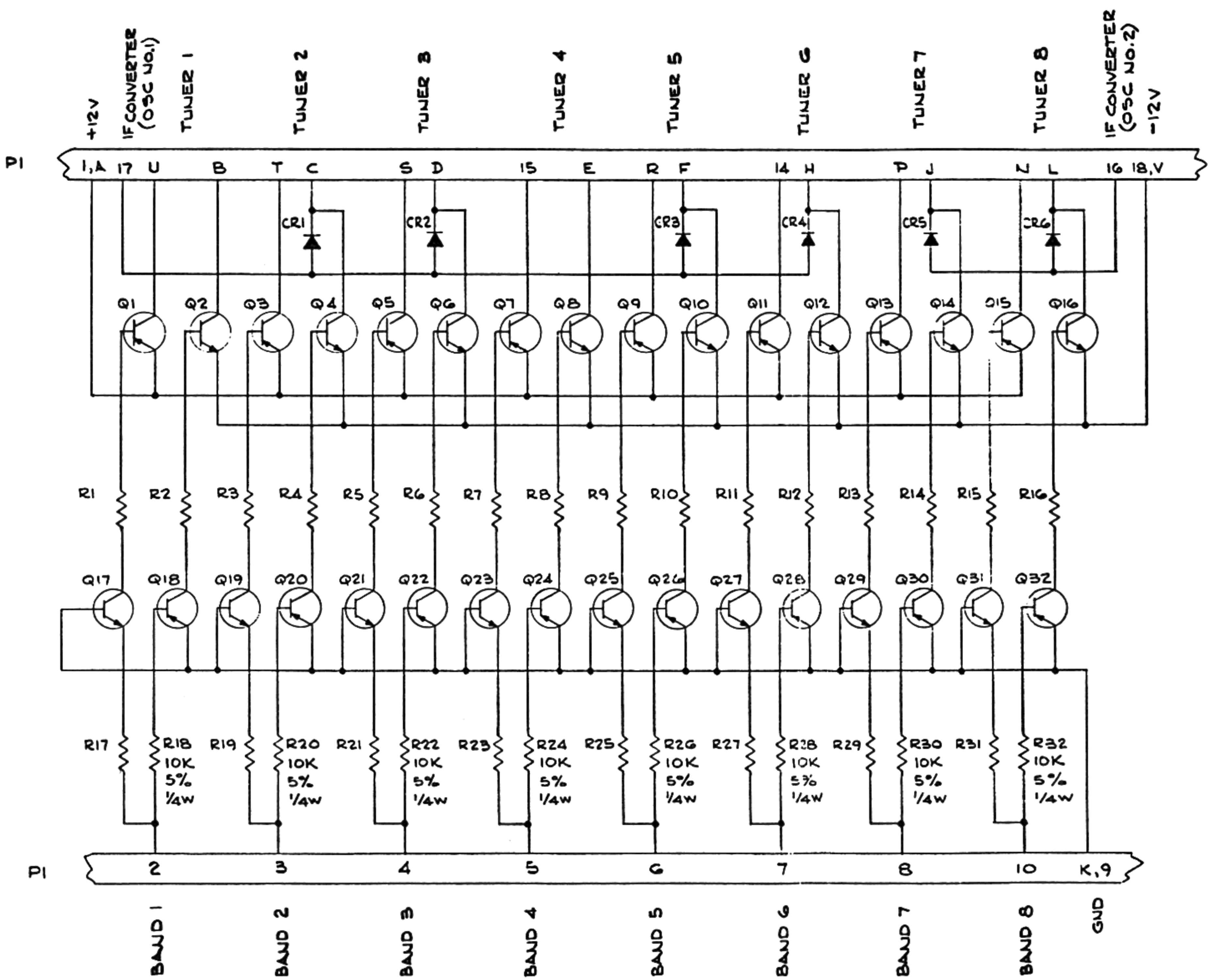
Delete the entire figure and replace with new Figure 8-24A, Dwg. No. 4-501640-001.

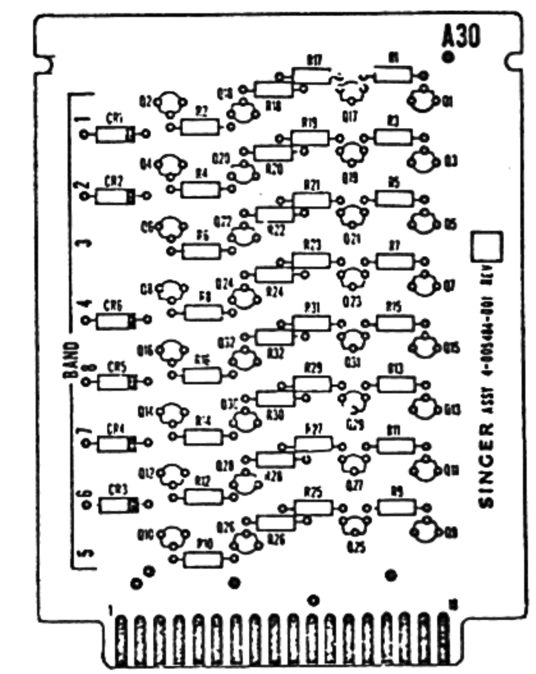
Page 8-57/8-58: Figure 8-28. Schematic Diagram, Frequency Readout Board, A34

Was:	R4 = 360K	Is:	356.4K
	R6 = 14.64K		14.49K
	R8 = 7.32K		7.24K
	R10 = 366K		361.8K
	R12 = 183K		180.9K
	R14 = 91.5K		90.46K
	R16 = 45.7K		45.23K
	R18 = 22.85K		22.61K

Page 8-61/8-62: Figure 8-30. Detailed Block Diagram, Model NM-17/27 (Sheet1)

A30 Band Selector; the simplified schematic is a representative functional diagram of the operation of the Band Selector. See Figure 8-24A, Band Selector, A30, schematic diagram for detailed information. Delete CR7 thru CR14 and reference callouts to K1 thru K8.





HIGHEST REF DES USED						
CR6	Q32	R32	P1			
REF DES NOT USED						

Figure 8-24A. Schematic Diagram, Band Selector Board, A30 Dwg. No. 4-501640-001