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AFC AMPLIFIER
303212

INSTRUCTION BOOKLET

The afc amplifier is a plug-in subassembly designed for use in Defense Electronics telemetry receivers. Although the basic purpose of the subassembly is to provide an automatic frequency control signal to the second local oscillator of the receiver in which it is installed, it also serves a number of other functions not directly involved with the afc system.

The afc amplifier accepts as its primary input a video signal, and uses this signal to produce an automatic frequency control signal, a signal to operate the receiver deviation meter, and a signal to operate the receiver tuning meter. The subassembly also provides signals for application to a center frequency monitor connector on the receiver rear panel, and to an indicator lamp to indicate when the receiver is in a search mode of operation.

The afc amplifier also provides an afc search function, which supplies a sweeping control voltage to the receiver's second local oscillator. The sweep width, or more specifically the afc search zone, is controlled by adjustment of a potentiometer located on the fm demodulator used with the receiver. Initiation of the afc search function is controlled by certain conditions and control settings, external to the afc amplifier, which are impressed upon the sweep control circuits of the subassembly.

Operation of the afc amplifier, for example, selection of the afc time constant, and selection of average or means-of-peak afc, is controlled through the application of logic control voltages to logic circuits of the subassembly. Application of the control voltages is in turn controlled by front-panel switches on the receiver in which the subassembly is used.

The afc amplifier circuitry is contained on a single plug-in printed circuit board, equipped with a handle and an edgeboard connector, which may be removed from or installed in the receiver in a few seconds after the top cover has been removed.

INSTALLATION

No special procedures are necessary to install or remove the afc amplifier. The proper location for the subassembly will be found in the subassembly module location drawing given in Section V, Maintenance, of the applicable receiver instruction manual.

All electrical connections between the main chassis and the subassembly are made automatically upon installation; there are no additional wires or cables to connect or disconnect.

PRINCIPLES OF OPERATION

The afc amplifier subassembly comprises six main sections of circuitry, which are as follows (see figure 1, page 7):

a. The control and delay section: this section includes the search decision gate, the search delay circuit, the search lamp driver, and two inverters. The primary function of this section is to control a number of field effect transistors (fet's) which are used in the subassembly as switches; the state of these switches determines the operating mode of the subassembly, and consequently determines to an extent the afc mode of the receiver in which the assembly is used. The control and delay section has ten inputs, which are also inputs to the subassembly, and eleven outputs, of which two are subassembly outputs.

   With the exception of one, all of the inputs are supplied with +15 volts or -15 volts; the exception is the search on/off input, which is supplied with +15 volts or open circuit. Switching is implemented with switches on the receiver front panel.

   Nine of the outputs are connected to the gates of fet switches, and the remaining two are connected through receiver main chassis wiring to the front panel search indicator lamp and afc time constant switch (this is the "time constant override" output, which switches out the normal time constant during search operation).

   An example of the functioning of the control and delay section would occur when the last of four necessary conditions for the afc search mode to commence is satisfied; specifically, the search function is turned on (with the demodulator search range control), an fm demodulator is installed in the receiver, the receiver is in the afc mode, and the carrier-operated relay is on (carrier level below threshold). After a one second delay the search lamp would be turned on (P1-U), the sweep and retrace circuitry would be connected to the integrator, the normal afc time constant would be removed and replaced by the search time constant (P1-12), and had the receiver been in the means-of-peak (m-o-p) afc mode, this would be switched to the average (avg) mode for the duration of the search (P1-N).

b. The sweep/retrace section: this section causes a symmetrical sawtooth waveform to appear at the integrator output when the afc amplifier subassembly is in the search mode. The amplitude of the waveform, hence the search range of the receiver, is controlled by the search range control on the fm demodulator. The sweep slope is controlled (normalized) by a resistive voltage divider located in the second i-f bandwidth filter used in the associated receiver; the retrace slope is fixed.

c. The integrator section: this section contains circuits which provide three selectable time constants for normal afc operation, and a fourth time constant for signal acquisition during search. The integrator has two possible dc feedback paths. The first is a low impedance path that ensures that the gain of the integrator is less than -40 dB; this is used to force the integrator output to approximately zero when the receiver is in a non-afc mode of operation. The second is a high impedance path which permits a dc gain of greater than 250 so that the integrator amplifier can be offset, by observing the receiver tuning meter, when the receiver is in a calibrate mode. The offset control is a potentiometer voltage divider located on the receiver front panel.

d. The peak detector section: this section has one input and three outputs. The input is a video signal of zero to three volts peak amplitude at frequencies of dc to 3 MHz. The peak detectors are essentially linear between peak levels of 20 mV and 3000 mV. As in the case of the integrator, the detectors have three selectable time constants, which are switched simultaneously with the integrator time constants. The positive and negative outputs of the peak detectors are applied directly to the deviation meter amplifier and the remaining output is applied to the buffer amplifier (see paragraph f), except during the search mode and the a-m receiver mode.

e. The deviation meter amplifier section: the inputs to the deviation meter amplifier are the positive and negative outputs of the peak detectors. The gain of the deviation meter amplifier is selectable, and is controlled by switching into the circuit different value resistors; this provides a means of selecting the desired range for the receiver deviation meter. The selectable resistor and the means of switching are both a part of the receiver's demodulator.

f. The buffer amplifier section: the input to this section is the sum of the outputs of the peak detectors, when the receiver is in the fm mode and is not searching. In the a-m mode and during search, the input is obtained directly from the discriminator, bypassing the peak detector, and the video filters of the receiver. The output of the buffer amplifier section is used for the following:

1) To provide a receiver rear panel output for center frequency indication, in the non-afc mode.
2) To drive the tuning meter in the non-afc mode.
3) To drive the integrator directly during search operation.
4) To drive a discriminator slope normalization network, located in the demodulator, during afc operation.

The afc amplifier subassembly also contains two clamping circuits for the receiver tuning meter, each consisting of an input and an output with the appropriate clamping network in between. In the afc/apc mode, the clamping circuit connected to pin C is utilized; the input is the second local oscillator control voltage, obtained from the integrator of the afc amplifier in afc operation and from the phase demodulator in pm operation. During non-afc/apc operation, the meter clamping circuit includes CR28, CR29, and the associated resistors.

Characteristic of the afc amplifier subassembly is the fact that many of the input and output connections interface with other receiver functions and subassemblies. In view of this, and to assist in assimilating the several functions of the subassembly, the following table of connector functions is provided (see also figure 4).

Table 1. Connector Functions

Pin Designation	Description
10 - Sweep Current Input	Connected through a resistor to +15V (in the second i-f filter module) during search; provides a source of sweep current.
15 - Search Disable	One of search decision gate inputs; +15V when demodulator search control is on, open circuit when this search control is off.
V - PM Disable	Search decision gate input; +15V present to disable search function (phase demodulator), -15V present to enable search function (fm demodulator); from demodulator.
14 - COR Disable	Search decision gate input; +15V when cor is off (carrier above threshold); -15V when cor is on, enabling search; from agc amplifier.
12 - Time Constant Override . . .	+15V during non-search, -15V during search to remove normal afc time constant; to receiver front-panel switch.
13 - AFC Control	+15V to disable search when in non-afc mode; -15V enables search in afc mode; from receiver front-panel switch.
18 - Cal, Non-AFC Override . . .	-15V when receiver is in calibrate mode; +15V when not in calibrate mode; in calibrate mode integrator functions as high gain amplifier for afc loop optimization; from receiver front-panel switch.

continued

Table 1, continued

Pin Designation	Description
U - Search Lamp Drive	Provides +12V during search to operate receiver front-panel search indicator lamp.
N - AVG/MOP Control	+15V in fm/pm mode, -15V in a-m mode; connects output of peak detectors to buffer in fm/pm mode, connects buffer with video directly from demodulator in a-m mode.
R - Time Constant I	+15V to provide 0.01 sec time constant when selected by front-panel switch; -15V for other time constants.
3 - Cal Gain Override	+15V when receiver is in calibrate mode to switch known impedance (resistor) into integrator circuit to permit optimizing afc loop.
L - Time Constant II	+15V to provide 0.1 sec time constant when selected by front-panel switch; -15V for other time constants.
M - Time Constant III	+15V to provide 1 sec time constant when selected by front-panel switch; -15V for other time constants.
16 - +15VDC Input	+15V dc operating voltage for subassembly circuits; from power supply regulator subassembly.
1 - Ground	Connects subassembly ground to receiver main chassis ground.
T - Video Input	Video input signal to afc subassembly; from receiver front-panel switch.
17 - -15VDC Input	-15V dc operating voltage for subassembly circuits; from power supply regulator subassembly.
E - Search Range Control	Input to search range control network located in demodulator.
D - VCO Control	Control voltage to cause deviation of receiver second local oscillator from center frequency.

continued

Table 1, continued

Pin Designation	Description
B - Cal Adjust	Accepts an integrator offset voltage whose level is determined by the receiver front-panel tuning meter zero control.
A - Normalized Input	Interconnects with network in fm demodulator; accepts normalized video input.
4 - Center Frequency Monitor . .	Provides a non-afc center frequency indication to appropriate receiver rear panel connector.
K - Output to Normalizer	Interconnects with demodulator afc normalizing network for return through pin A.
11 - Meter Filter	Connects with external capacitor to filter undesired components from tuning meter signal.
P - Tuning Meter Drive	Provides a clamped drive signal to the tuning meter in non-afc operation.
S - AM, AFC Input	Accepts a video signal directly from the fm demodulator; utilized during a-m and search operation.
C - Loop Stress Input	Input of divide and clamp network for tuning meter in afc/apc mode.
2 - Tuning Meter Drive	Provides a clamped drive signal to the tuning meter in the afc and apc modes.
H, 5 - Deviation Meter Range . . .	The resistance across these pins determines the gain of the deviation meter amplifier, hence the deviation meter range; resistance is located in the demodulator.
F - Deviation Meter Drive	Provides linear drive signal for the receiver deviation meter.

The following paragraphs discuss, in greater detail, the major areas of the afc amplifier subassembly mentioned in paragraphs a through f, and are based on the schematic diagram (figure 4) and the block diagram (figure 1).

Control and Delay Section

The control and delay section consists of the search decision gate, the search delay circuit, the search lamp driver, and two inverters. This section controls a number of field effect transistors (fet's) which determine the operating mode of the subassembly.

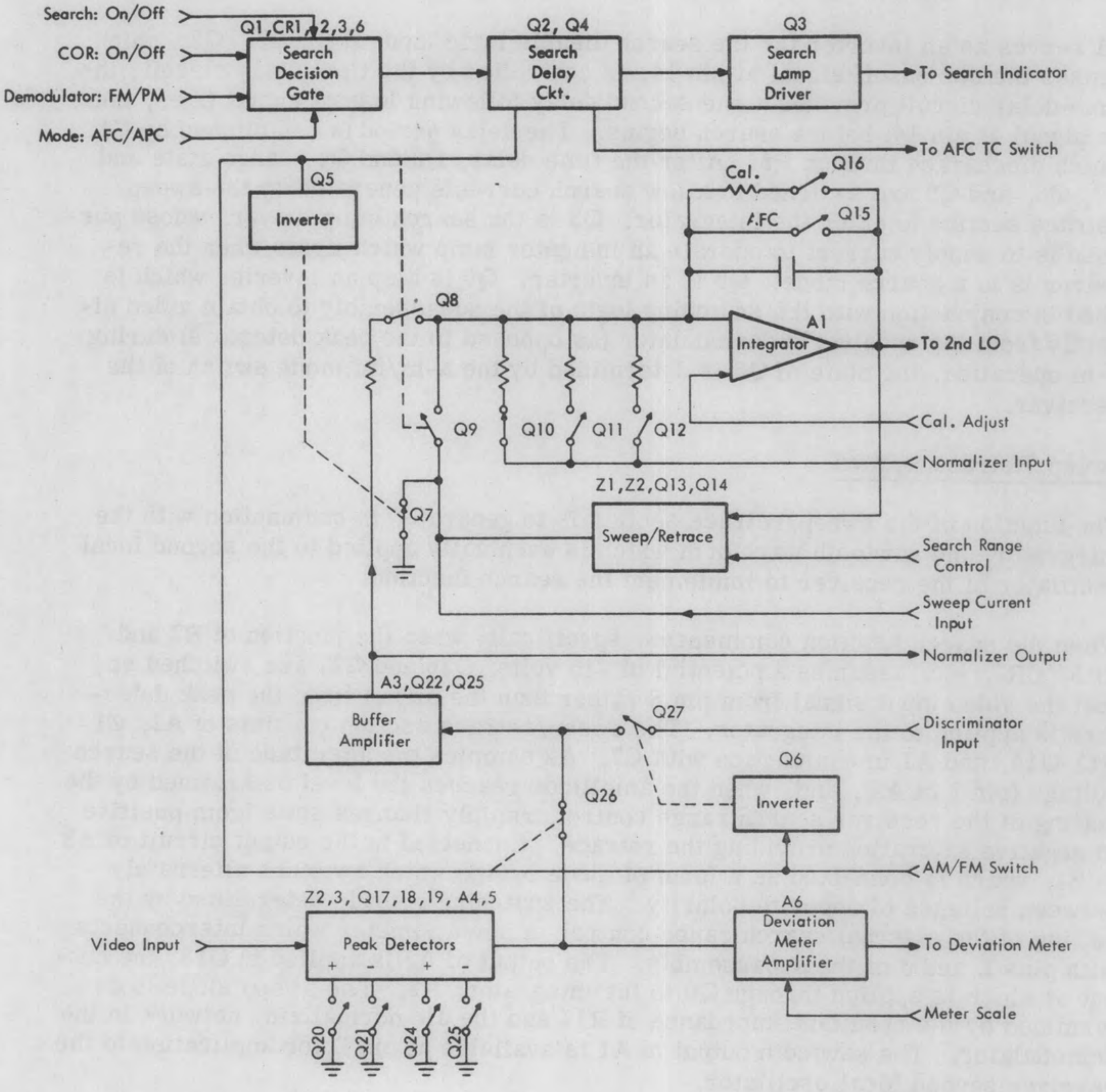


Figure 1. Functional Block Diagram

To initiate search, and thus sweep the second local oscillator of the receiver, four conditions must exist at the search decision gate inputs. First, the search range control on the fm demodulator must be turned on; second, an fm demodulator must be installed in the receiver (as opposed to a phase demodulator); third, the carrier operated relay must be on (signal below threshold); fourth, the receiver must be in the afc mode of operation. (Refer to table 1.)

Q1 serves as an inverter for the search disable logic input at pin 15. Q2, which senses the cor on/off signal at pin 14, is controlled by the time delay circuit; the time delay circuit provides a one second delay following loss of signal (i.e., cor on signal at pin 14) before search begins. The delay period is established by C1, which discharges through R5. After the time delay, Q2 and Q4 change state and Q7, Q8, and Q9 are switched to allow search currents generated by the sweep/retrace section to enter the integrator. Q3 is the search lamp driver, whose purpose is to supply current to operate an indicator lamp which lights when the receiver is in a search mode. Q5 is an inverter. Q6 is also an inverter which is used in conjunction with the switching logic of the subassembly to obtain video directly from the receiver's demodulator (as opposed to the peak detectors) during a-m operation; the state of Q6 is determined by the a-m/fm mode switch of the receiver.

Sweep/Retrace Section

The function of the sweep/retrace section is to generate, in conjunction with the integrator, the sawtooth waveform which is eventually applied to the second local oscillator of the receiver to implement the search function.

When the search function commences, specifically when the junction of R2 and CR3, CR2, etc. assumes a potential of -15 volts, Q26 and Q27 are switched so that the video input signal from pin S rather than the signal from the peak detectors is applied to the integrator. The sweep/retrace section consists of A2, Z1, Q13-Q14, and A1 in conjunction with C7. A2 samples the amplitude of the search voltage (pin 2 of A2), and, when the amplitude reaches the level determined by the setting of the receiver search range control, rapidly changes state from positive to negative saturation providing the retrace. Connected in the output circuit of A2 is Z1, which is connected as a form of diode bridge which switches alternately between voltages of opposite polarity. The switching point is determined by the setting of the external search range control, a potentiometer which interconnects with pins E and J of the subassembly. The output of A2 is applied to Q13, the output of which is applied through Q9 to the integrator, A1. The sweep slope is determined by the resultant impedance of R17 and the afc normalizing network in the demodulator. The sawtooth output of A1 is available at pin D for application to the receiver second local oscillator.

Integrator Section

The integrator contains the circuits which determine the afc time constants for the receiver. The desired time constant is obtained by switching in one of four different impedances by applying +15 volts to pin R (0.01 sec), pin L (0.1 sec), or pin M (1 sec), or by the application of -15 volts to pin 12 during search.

The application of +15 volts to pin R, L, or M switches on Q10, Q11, or Q12, respectively, together with the associated resistor, resulting in one of three progressively higher impedances. During search, when the junction of R2 and the various diodes (CR1, CR2, CR3, etc.) assume a potential of -15 volts, the impedance is determined by Q8, Q9, R17, and the external normalizing network.

The search function continues until a voltage of equal and opposite amplitude (an output of the discriminator) appears as the output of the buffer at Q8. This "holds" the second local oscillator momentarily so that the cor will open; when the cor opens (cor "off"), +15 volts will appear at pin 14, disabling the search function, and the receiver will revert to normal afc operation, and the afc time constant will be as determined by the receiver afc time constant switch with Q10, Q11, or Q12 and the associated resistor (R22, R25, or R28).

The integrator has two possible dc feedback paths, through Q15 or Q16. Q15 is essentially a shorting switch which is turned on by the application of -15 volts at pin 18, and reduces the gain of the integrator to less than -40 dB so that the output of the integrator is approximately zero during non-afc modes of operation. Q16 places a high impedance (R35) in the feedback circuit, producing an amplifier gain of greater than 250, so that the afc loop of the receiver can be optimized in the calibrate mode; Q16 is controlled by the application of +15 volts at pin 3 during the calibrate mode. The offset, or calibrate control, is a potentiometer which is part of a voltage divider located on the receiver front panel, and is interconnected with the integrator through pin B.

Peak Detector Section

The peak detector section is actually a very sensitive and linear full-wave rectifier consisting of two separate peak detectors. The input to each peak detector is through pin T.

The positive peak detector consists of Z2, Q18, CR22, Q20, Q24, and A4. The negative peak detector consists of Z3, Q19, CR23, Q21, Q25, and A5. The functioning of the peak detectors is similar, hence only the positive peak detector is discussed in detail. Z2 operates as a differential amplifier, driving Q18; Q17 is a six-volt source for Z2. Q18 supplies the signal which is detected by CR22.

Q20 and Q24 switch simultaneously with Q11 and Q12 to provide time constants for the peak detector which correspond to the time constants of the integrator. Time constant I (0.01 sec) is provided by C16 and R55. A4 functions as a unity gain amplifier and provides feedback to the differential amplifier, Z2; it is this feedback and use of the differential amplifier that provide the sensitivity and linearity that are characteristic of the peak detectors. As mentioned, the functioning of the negative peak detector is similar to that of the positive peak detector.

The positive and negative outputs of the peak detectors are summed by R68 and R69 and applied to the buffer amplifier section during the non-search mode. The positive and negative outputs are also applied to A6, the deviation meter amplifier.

Deviation Meter Amplifier

The deviation meter amplifier, A6, supplies the signal that drives the receiver's deviation meter, providing an indication in terms of frequency for fm, percent for a-m, and degrees for pm, of the amount of deviation or modulation of the received signal.

The gain of the amplifier is selectable, and is determined by the particular value of a resistance which is switched in (across pins H and 5) by the deviation meter range switch; both the switch and the resistor are located externally to the afc amplifier subassembly. The output signal of the deviation meter amplifier is available at pin F.

Buffer Amplifier Section

The buffer amplifier section includes Q26, Q27, A3, Q22, and Q23. Q26 and Q27 are switches that connect the appropriate input to the operational amplifier, A3. During normal afc operation, Q26 is on and the signal from the peak detectors is applied to A3; during search and a-m operation, the video signal from pin S is applied to A3 through Q27. A3, Q22, Q23, and diodes CR24 and CR25 form a buffer amplifier, the output of which is applied to Q8. Q22 and Q23, specifically, form a complementary pair and act as current drivers to produce the required output level from the buffer amplifier.

The output of the buffer amplifier also performs the following functions: provides a center frequency indication output for connection to a rear panel connector on the receiver in the non-afc mode; drives the receiver tuning meter in the non-afc mode; drives a discriminator slope normalization network, which is located in the demodulator.

Tuning Meter Clamping Circuits

There are two separate clamping circuits in the afc amplifier subassembly. One is used when the receiver is in the afc/apc mode of operation, and the other during non-afc modes. During afc/apc operation the clamping circuit consists of CR26, CR27, R80, and R81; the input is the afc or apc control voltage which is applied to the second local oscillator of the receiver. During non-afc operation, the clamping circuit comprises CR28, CR29, R78, and R79; the input in this case, is from the buffer (A3, etc.). A capacitive filter circuit, external to the subassembly, interconnects with pin 11.

MAINTENANCE

The design of the afc amplifier subassembly limits the need for maintenance. During normal operation, no periodic adjustment is necessary or desirable. Unnecessary adjustments may degrade the performance of the receiver, and therefore should be avoided.

Straightforward troubleshooting methods should be used if a malfunction occurs. The schematic diagram and circuit description given herein should provide the data necessary for qualified maintenance technicians to isolate the malfunction, using effect-to-cause reasoning.

The first check should be of the power supply voltages. Incorrect power supply voltages can have varying effects on the operation of the subassembly. The next most likely causes of trouble are the transistors and the diodes. A Simpson 260 multimeter, set up for continuity measurements, is recommended for checking the transistors. The following procedure may be used:

a. Place the test probes between emitter and base; then reverse the position of the probes. One of these positions should indicate forward bias on the meter.

b. Continue checking between base-collector, base-emitter, and emitter-collector.

c. If the meter does not deflect, the junction is probably open.

d. If both positions cause the meter to indicate the same resistance, the junction is probably shorted.

e. If indication is ambiguous, compare the component with the same component in a spare unit, keeping the multimeter set to the same resistance range.

Table 2. Transistor Complement

Reference Designation	Type	Function
A1	830	Integrator
A2	LM 301A	Sweep/Retrace Switch
A3	μA 741	Amplifier
A4	LM 302	Amplifier
A5	LM 302	Amplifier
A6	μA 741	Amplifier
Q1	2N3906	Inverter
Q2	2N3906	Amplifier
Q3	2N3906	Lamp Driver
Q4	2N3904	Switch
Q5	2N3904	Inverter
Q6	2N3904	Inverter
Q7 through Q12	2N5555	Switch
Q13	2N3904	Amplifier
Q14	2N3906	Voltage Source
Q15	U201	Switch
Q16	U201	Switch
Q17	2N3906	Voltage Source
Q18	2N3906	Amplifier
Q19	2N3906	Amplifier
Q20	2N5555	Switch
Q21	2N5555	Switch
Q22	2N3904	Amplifier
Q23 through Q27	2N5555	Switch
Z1	CA3018A	Diode Bridge
Z2	CA3028B	Amplifier
Z3	CA3028B	Amplifier

Repair and Replacement

All components used in the afc amplifier are considered non-repairable, and should be replaced when found to be defective. A complete electrical parts list is given in this booklet, and a component location drawing is provided.

Care should be exercised when replacing components on the printed circuit board. The following is a suggested procedure for removing components from the board; the procedure requires the following equipment:

Liquid soldering flux	1/8 inch, #18 AWG, flat braid
Flux remover	Medium wattage soldering iron

Apply a thin coat of liquid flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the joint for long periods of time as excessive heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and carefully pry loose the defective component. Clean the affected area using the flux remover. Trim the replacement component leads to the same length as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover.

Following replacement of any circuit component, realignment may be necessary; in this case, the following procedure is recommended.

Calibration

Recommended Equipment:

Test Oscillator	HP 651A
DC VTVM	HP 412A
Test Set	Defense Electronics 105958
Power Supply (2 required)	HP 721A

a. Connect the power supplies to the test set. Adjust the supplies for +15V and -15V, and set the short circuit current to 100 mA.

b. Set the test set MTR switch to B, the MODE switch to MOP, and the DET switch to ON.

c. Using the dc vtvm, set to the 0.1V full-scale position, measure the dc voltage at TP3 of the subassembly, and note this voltage as a reference. (The level should be approximately -98 mV.)

d. Measure the voltage at TP6, and adjust R53 for an indication as close as possible to that obtained in step c.

e. Set the CAL switch to ON, and measure the level at TP3 for a reference (it should be about +98 mV), connect the probe to TP5 and adjust R52 for an indication as close as possible to the reference.

f. Connect the 50 ohm output of the test oscillator to J1. Adjust for a frequency of 10 kHz and an input level of +10 dBm (0.707V rms). Set the DEV RANGE switch to 10.

g. Adjust R82 for a full-scale indication on the Deviation meter.

This completes calibration of the afc amplifier subassembly.

ELECTRICAL PARTS LIST - (See figure 2.)

Reference Designation	Description
A1	Integrated circuit, Defense Electronics 105911
A2	Integrated circuit, National Semiconductor LM 301A
A3	Integrated circuit, μA 741, Fairchild U5B7741393
A4	Integrated circuit, National Semiconductor LM 302
A5	Integrated circuit, National Semiconductor LM 302
A6	Integrated circuit, μA 741, Fairchild U5B7741393
C1	Capacitor, metalized mylar, 1.0 μF ±2%, 100V, Electrocube 210B1B105G
C2	Not assigned
C3	Not assigned
C4	Capacitor, dur-mica, 62 pF, Elmenco DM15F620J
C5	Not assigned
C6	Capacitor, ceramic, disc, 0.01 μF ±20%, Erie 805-Z5V
C7	Capacitor, metalized mylar, 0.033 μF ±5%, 100V, Electrocube 210B1A333J
C8 through C11	Capacitor, ceramic, disc, 0.01 μF ±20%, Erie 805-Z5V
C12	Capacitor, dur-mica, 56 pF, Elmenco DM15F560J
C13	Capacitor, dur-mica, 56 pF, Elmenco DM15F560J
C14	Capacitor, ceramic, disc, 0.01 μF ±20%, Erie 805-Z5V
C15	Capacitor, ceramic, disc, 0.01 μF ±20%, Erie 805-Z5V
C16	Capacitor, metalized mylar, 0.01 μF ±2%, 100V, Electrocube 210B1A103G
C17	Capacitor, metalized mylar, 0.01 μF ±2%, 100V, Electrocube 210B1A103G
C18	Capacitor, metalized mylar, 0.0909 μF ±2%, 100V, Electrocube 210B1A9092G
C19	Capacitor, metalized mylar, 0.0909 μF ±2%, 100V, Electrocube 210B1A9092G

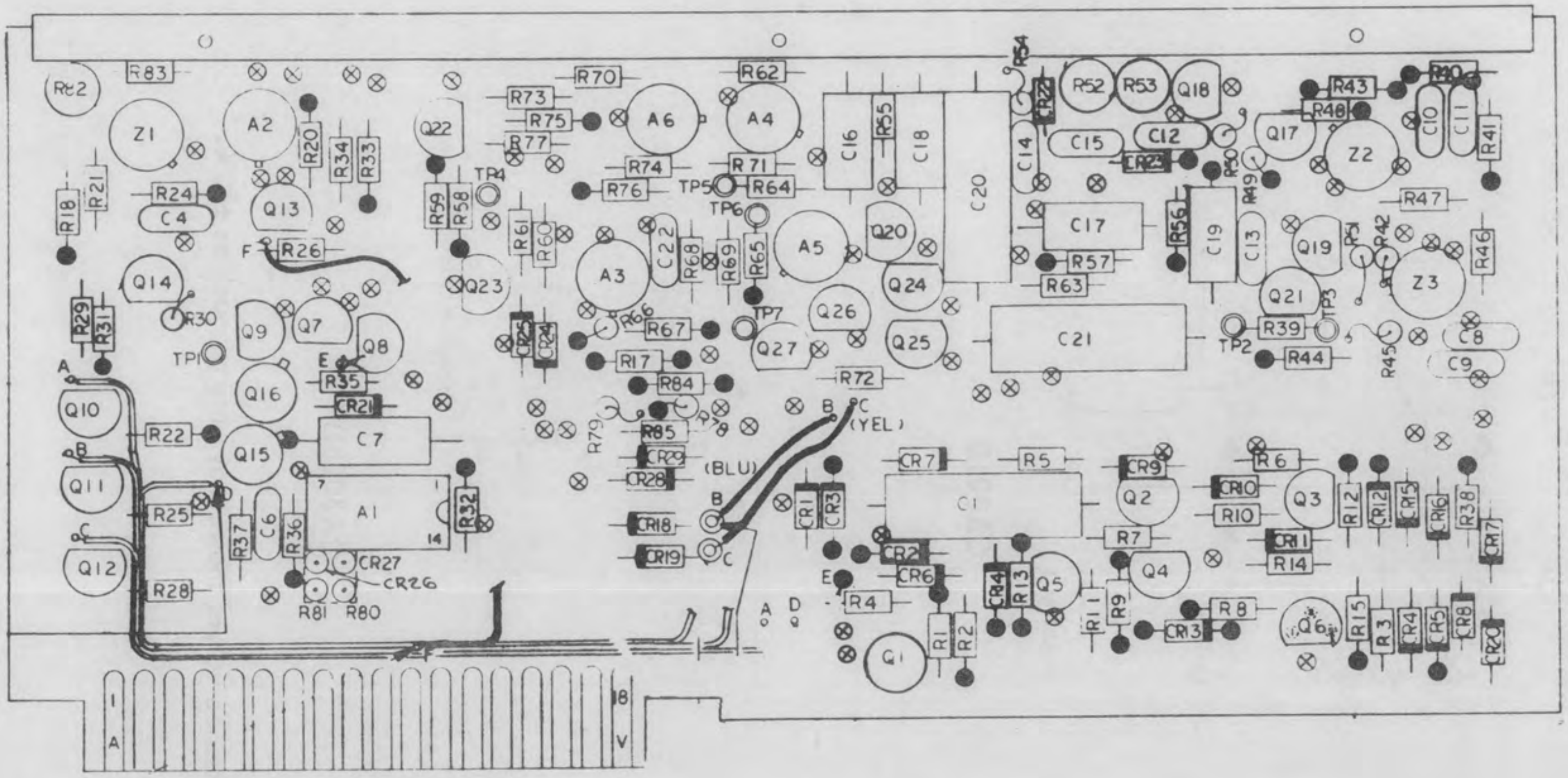
Reference Designation	Description
C20	Capacitor, metalized mylar, 1.0 μF ±2%, 100V, Electrocube 210B1B105G
C21	Capacitor, metalized mylar, 1.0 μF ±2%, 100V, Electrocube 210B1B105G
C22	Capacitor, ceramic, disc, 0.01 μF ±20%, Erie 805-Z5V
CR1 through CR14	Diode, 1N457
CR15	Diode, 1N276
CR16	Diode, 1N276
CR17 through CR19	Diode 1N457
CR20	Diode, 1N276
CR21	Diode, 1N457
CR22	Diode, HP 5082-2800
CR23	Diode, HP 5082-2800
CR24	Diode, 1N457
CR25	Diode, 1N457
CR26	Diode, 1N4305
CR27	Diode, 1N4305
CR28	Diode, 1N276
CR29	Diode, 1N276
Q1	Transistor 2N4249
Q2	Transistor, 2N3906
Q3	Transistor, 2N3906
Q4 through Q6	Transistor, 2N3904
Q7 through Q12	Transistor, 2N5555
Q13	Transistor, 2N3904
Q14	Transistor, 2N3906
Q15	Transistor, Siliconix U201
Q16	Transistor, Siliconix U201
Q17	Transistor, 2N3906

Reference Designation	Description
Q18	Transistor, 2N3906
Q19	Transistor, 2N3906
Q20	Transistor, 2N5555
Q21	Transistor, 2N5555
Q22	Transistor, 2N3904
Q23	Transistor, 2N3906
Q24 through Q27	Transistor, 2N5555
R1	Resistor, fixed composition, 510k ±5%, 1/4W, Allen Bradley CB5145
R2 through R4	Resistor, fixed composition, 30k ±5%, 1/4W, Allen Bradley CB3035
R5	Resistor, fixed composition, 1.3 meg ±5%, 1/4W, Allen Bradley CB1355
R6	Resistor, fixed composition, 150Ω ±5%, 1/4W, Allen Bradley CB1515
R7	Resistor, fixed composition, 7.5k ±5%, 1/4W, Allen Bradley CB7525
R8	Resistor, fixed composition, 7.5k ±5%, 1/4W, Allen Bradley CB7525
R9	Resistor, fixed composition, 30k ±5%, 1/4W, Allen Bradley CB3035
R10	Resistor, fixed composition, 30k ±5%, 1/4W, Allen Bradley CB3035
R11	Resistor, fixed composition, 1 meg ±5%, 1/4W, Allen Bradley CB1055
R12	Resistor, fixed composition, 30k ±5%, 1/4W, Allen Bradley CB3035
R13	Resistor, fixed composition, 30k ±5%, 1/4W, Allen Bradley CB3035
R14	Resistor, fixed composition, 1 meg ±5%, 1/4W, Allen Bradley CB1055
R15	Resistor, fixed composition, 30k ±5%, 1/4W, Allen Bradley CB3035
R16	Not assigned
R17	Resistor, fixed composition, 36k ±5%, 1/4W, Allen Bradley CB3635
R18	Resistor, fixed composition, 68k ±5%, 1/4W, Allen Bradley CB6835
R19	Not assigned

Reference Designation	Description
R20	Resistor, fixed film, 36.5k ±1%, 1/8W, RN55D3652F
R21	Resistor, fixed film, 36.5k ±1%, 1/8W, RN55D3652F
R22	Resistor, fixed composition, 7.5k ±5%, 1/4W, Allen Bradley CB7525
R23	Not assigned
R24	Resistor, fixed composition, 470k ±5%, 1/4W, Allen Bradley CB4745
R25	Resistor, fixed composition, 75k ±5%, 1/4W, Allen Bradley CB7535
R26	Resistor, fixed composition, 27k ±5%, 1/4W, Allen Bradley CB2735
R27	Not assigned
R28	Resistor, fixed composition, 750k ±5%, 1/4W, Allen Bradley CB7545
R29	Resistor, fixed composition, 4.7k ±5%, 1/4W, Allen Bradley CB4725
R30	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R31	Resistor, fixed composition, 2.2k ±5%, 1/4W, Allen Bradley CB2225
R32	Resistor, fixed composition, 2.4k ±5%, 1/4W, Allen Bradley CB2425
R33	Resistor, fixed composition, 13k ±5%, 1/4W, Allen Bradley CB1335
R34	Resistor, fixed composition, 30k ±5%, 1/4W, Allen Bradley CB3035
R35	Resistor, fixed composition, 10 meg ±5%, 1/4W, Allen Bradley CB1065
R36	Resistor, fixed composition, 910Ω ±5%, 1/4W, Allen Bradley CB9115
R37	Resistor, fixed composition, 220k ±5%, 1/4W, Allen Bradley CB2245
R38	Resistor, fixed composition, 30k ±5%, 1/4W, Allen Bradley CB3035
R39	Resistor, fixed film, 2.00k ±1%, 1/8W, RN55D2001F
R40	Resistor, fixed composition, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R41	Resistor, fixed composition, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R42	Resistor, fixed composition, 7.5k ±5%, 1/4W, Allen Bradley CB7525
R43	Resistor, fixed composition, 7.5k ±5%, 1/4W, Allen Bradley CB7525
R44	Resistor, fixed composition, 1k ±5%, 1/4W, Allen Bradley CB1025
R45	Resistor, fixed composition, 1k ±5%, 1/4W, Allen Bradley CB1025
R46	Resistor, fixed composition, 4.3k ±5%, 1/4W, Allen Bradley CB4325
R47	Resistor, fixed composition, 4.3k ±5%, 1/4W, Allen Bradley CB4325

Reference Designation	Description
R48	Resistor, fixed composition, 2.2k ±5%, 1/4W, Allen Bradley CB2225
R49	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R50	Resistor, fixed composition, 2k ±5%, 1/4W, Allen Bradley CB2025
R51	Resistor, fixed composition, 2k ±5%, 1/4W, Allen Bradley CB2025
R52	Potentiometer, variable, 10k, helitrim, Beckman 62PR10K
R53	Potentiometer, variable, 10k, helitrim, Beckman 62PR10K
R54	Resistor, fixed composition, 2k ±5%, 1/4W, Allen Bradley CB2025
R55	Resistor, fixed film, 1 meg ±1%, 1/4W, RN60D1004F
R56	Resistor, fixed composition, 2k ±5%, 1/4W, Allen Bradley CB2025
R57	Resistor, fixed film, 1 meg ±1%, 1/4W, RN60D1004F
R58	Resistor, fixed composition, 20Ω ±5%, 1/4W, Allen Bradley CB2005
R59	Resistor, fixed composition, 20Ω ±5%, 1/4W, Allen Bradley CB2005
R60	Resistor, fixed composition, 20k ±5%, 1/4W, Allen Bradley CB2035
R61	Resistor, fixed composition, 20k ±5%, 1/4W, Allen Bradley CB2035
R62	Resistor, fixed composition, 10k ±5%, 1/4W, Allen Bradley CB1035
R63	Resistor, fixed composition, 10k ±5%, 1/4W, Allen Bradley CB1035
R64	Resistor, fixed composition, 1k ±5%, 1/4W, Allen Bradley CB1025
R65	Resistor, fixed composition, 1k ±5%, 1/4W, Allen Bradley CB1025
R66	Resistor, fixed film, 3.65k ±1%, 1/8W, RN55D3651F
R67	Resistor, fixed film, 7.50k ±1%, 1/8W, RN55D7501F
R68 through R71	Resistor, fixed film, 4.99k ±1%, 1/8W, RN55D4991F
R72	Resistor, fixed film, 3.74k ±1%, 1/8W, RN55D3741F
R73 through R77	Resistor, fixed film, 2.49k ±1%, 1/8W, RN55D2491F
R78	Resistor, fixed composition, 5.1k ±5%, 1/4W, Allen Bradley CB5125
R79	Resistor, fixed composition, 5.1k ±5%, 1/4W, Allen Bradley CB5125
R80	Resistor, fixed composition, 200k ±5%, 1/4W, Allen Bradley CB2045
R81	Resistor, fixed composition, 5.1k ±5%, 1/4W, Allen Bradley CB5125

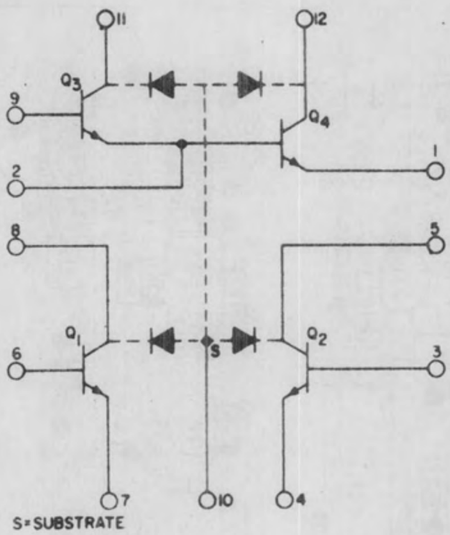
Reference Designation	Description
R82	Potentiometer, variable, 50k, helitrim, Beckman 62PR50K
R83	Resistor, fixed composition, 220k ±5%, 1/4W, Allen Bradley CB2245
R84	Resistor, fixed composition, 10k ±5%, 1/4W, Allen Bradley CB1035
R85	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
Z1	Integrated circuit, RCA CA3018
Z2	Integrated circuit, RCA CA3028B
Z3	Integrated circuit, RCA CA3028B



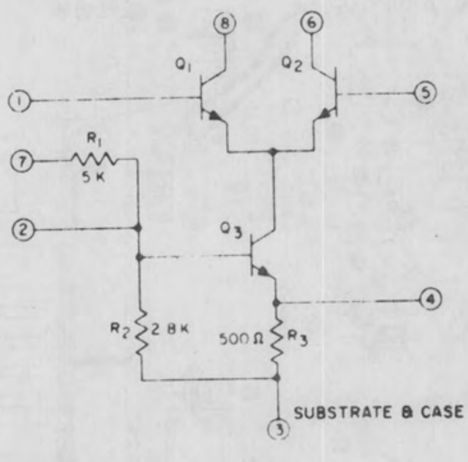
PIN 1 THRU 18 COMPONENT SIDE
PIN A THRU V CIRCUIT SIDE

Figure 2. Component Locations
303212

303212



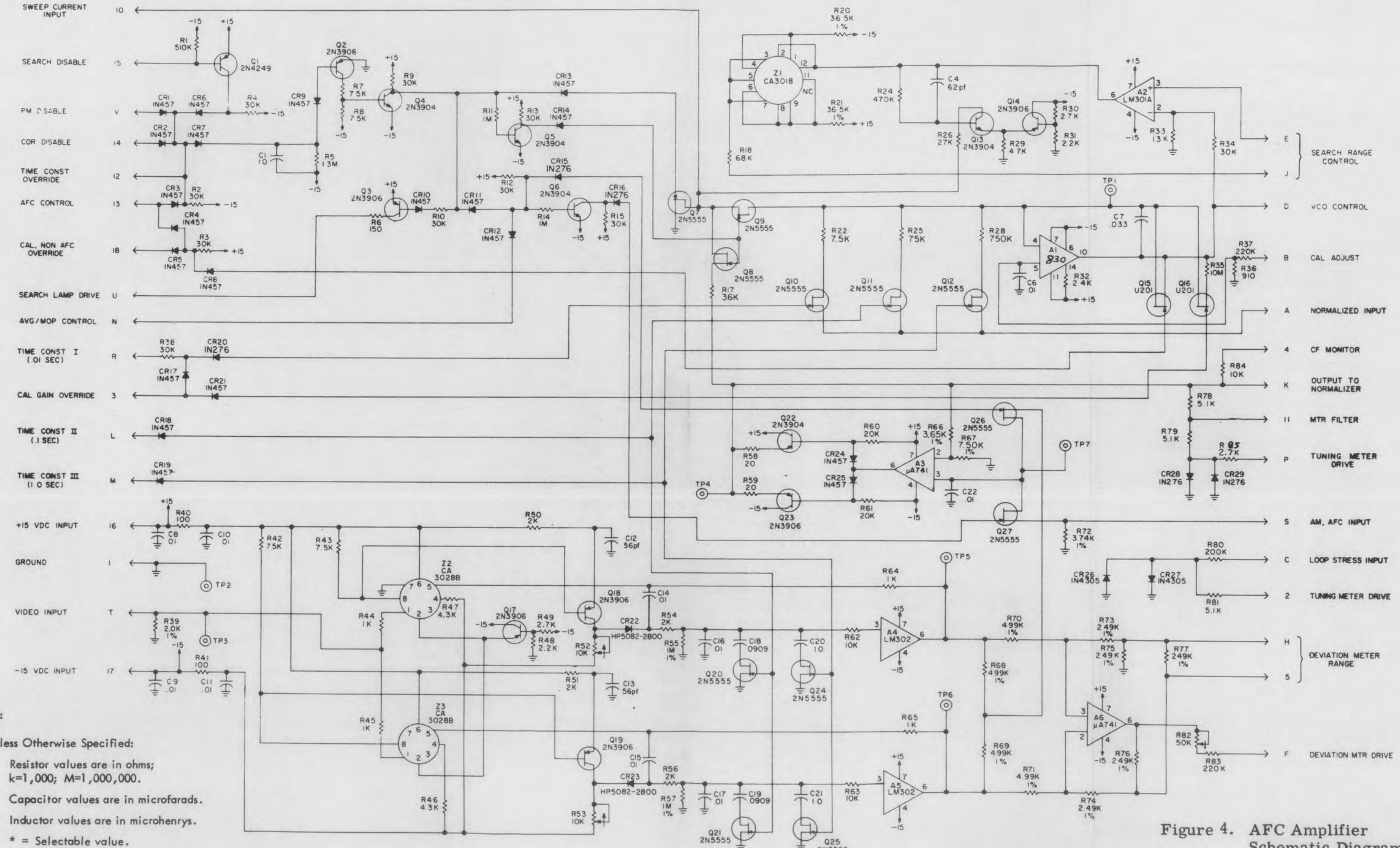
CA3018



CA3028B*

* Resistance values shown may vary as much as ±30%.

Figure 3. CA3018 and CA3028B Integrated Circuits Schematic Diagram



NOTES:

Unless Otherwise Specified:

- Resistor values are in ohms; k=1,000; M=1,000,000.
- Capacitor values are in microfarads.
- Inductor values are in microhenrys.
- * = Selectable value.
- Indicates clockwise rotation.

Figure 4. AFC Amplifier Schematic Diagram 401633

INSTRUCTION BOOKLET

The video/audio amplifier is a plug-in subassembly designed for use with Defense Electronics telemetry receivers. The subassembly accepts am, video and audio signals as its inputs, and supplies as its outputs an amplified am signal, a video signal, and an amplified audio signal. In the design of the video/audio amplifier, emphasis has been placed on low distortion, high linearity with respect to frequency and amplitude, and extreme stability.

The video/audio amplifier circuitry is contained on a single plug-in printed circuit board, equipped with a handle and an edgeboard connector, which may be removed from or installed in the receiver in a few seconds after the top cover has been removed.

INSTALLATION

No special procedures are necessary to install or remove the video/audio amplifier subassembly. The proper location for the subassembly will be found in the subassembly/module location drawing given in Section II, of the applicable receiver instruction manual. All electrical connections between the main chassis and the subassembly are made automatically upon installation; there are no additional wires or cables to connect or disconnect.

PRINCIPLES OF OPERATION

Functionally, the video/audio amplifier consists of three separate amplifier circuits, the video and am amplifiers and the audio amplifier. The video amplifier comprises Q1 through Q9; the am amplifier consists of Q10, Q11, Q12, Q15, and Q16; the audio amplifier comprises operational amplifier Z1, and Q13-Q14.

The input to the video amplifier is applied, through pin 4 of the edgeboard connector, to a feedback amplifier consisting of Q1, Q2, and Q3. TP1 is provided for monitoring of the video input signal. The signal is applied to one base of differential amplifier Q1, amplified, and applied to the base of Q3. The input to the other base of Q1 is negative feedback obtained from the collector of Q3 at the junction of CR2 and CR3. The purpose of Q2 is to provide a current source for Q1; R4 allows balancing of the input amplifier to assure that the video output signal is referenced to zero volts dc. CR1 and CR4 provide temperature compensation for increased gain linearity.

The second stage of the video amplifier receives its input from Q3 and consists of Q4-Q5, Q6-Q7, and Q8-Q9. Q4 and Q5 form a push-pull amplifier whose outputs are applied to a second push-pull amplifier, Q6-Q7. Negative feedback is applied to the emitters of Q4 and Q5. The resistances of R20 and R25 (82 ohms) are chosen to provide short-circuit protection for the video amplifier, by biasing Q8 and Q9 in such a way as to limit current through these stages in the event that the output is shorted or otherwise excessively loaded. The output of Q6-Q7 is applied to complementary emitter-followers Q8 and Q9, which provide isolation thus ensuring that the video amplifier will not be affected by external factors such as capacitance of the interconnecting cable. The output of the video amplifier is obtained at the junction of R21 and R22 and is available at pin 7 of the edgeboard connector.

The a-m amplifier receives its input from pin 10 of the connector. The input is applied to the base of Q10, one-half of differential pair Q10-Q11. The a-m amplifier functions similarly to the feedback amplifier portion of the video amplifier, except that the input to Q12 is obtained from the collector of Q11. Applied to the base of Q11 is negative feedback from the emitters of complementary amplifiers Q15 and Q16. The output of the a-m amplifier is obtained at the junction of R32 and R45 and is available at pin 11 of the edgeboard connector.

Input to the audio amplifier is applied through pin 14 of the edgeboard connector to pin 2 of Z1, an integrated-circuit operational amplifier. Z1, Q13, and Q14 form a complementary push-pull amplifier. The output of Z1 is obtained at pin 6 and applied to the junction of CR12 and CR13, and then to the bases of Q13 and Q14. The audio output signal is obtained from the emitters of Q13 and Q14 and coupled through C19 and C20 to pin 12 of the edgeboard connector.

MAINTENANCE

The design of the video/audio amplifier limits the need for maintenance. During normal operation, no periodic adjustment is necessary or desirable. Unnecessary adjustments may degrade the performance of the receiver, and therefore should be avoided.

Straightforward troubleshooting methods should be used if a malfunction occurs. The schematic diagram and circuit description given herein should provide the data necessary for qualified maintenance technicians to isolate the malfunction, using effect-to-cause reasoning.

The first check should be of the power supply voltages. Incorrect power supply voltages can have varying effects on the operation of the subassembly. The next most likely causes of trouble are the transistors and the diodes. A Simpson 260 multimeter, set up for continuity measurements, is recommended for checking the transistors. The following procedure may be used:

a. Place the test probes between emitter and base; then reverse the position of the probes. One of these positions should indicate forward bias on the meter.

b. Continue checking between base-collector, base-emitter, and emitter-collector.

c. If the meter does not deflect, the junction is probably open.

d. If both positions cause the meter to indicate the same resistance, the junction is probably shorted.

e. If indication is ambiguous, compare the component with the same component in a spare unit, keeping the multimeter set to the same resistance range.

Table 1. Transistor Complement

Reference Designation	Type	Function
Q1	2N2916	Differential Amplifier
Q2	2N3565	Current Source
Q3	2N4249	Amplifier
Q4 Q5	2N3565 2N4249	Complementary Pair
Q6 Q7	2N3906 2N3904	Complementary Pair
Q8 Q9	2N2219 2N2904	Complementary Emitter Followers
Q10 Q11	2N3565 2N3565	Differential Amplifier
Q12	2N3565	Amplifier
Q13 Q14	2N2219 2N2904	Complementary Emitter Followers
Q15 Q16	2N3565 2N4249	Complementary Emitter Followers
Z1	MC1439G	Operational Amplifier

Repair and Replacement

All components used in the video/audio amplifier are considered non-repairable, and should be replaced when found to be defective. A complete electrical parts list is given in this booklet, and a component location drawing is provided.

Care should be exercised when replacing components on the printed circuit board. The following is a suggested procedure for removing components from the board; the procedure requires the following equipment:

Liquid soldering flux	1/8 inch, #18 AWG, flat braid
Flux remover	Medium wattage solder iron

Apply a thin coat of liquid flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the joint for long periods of time as excessive heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and carefully pry loose the defective component. Clean the affected area using the flux remover. Trim the replacement component leads to the same length as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover.

If a component is replaced, readjustment of R4 may be necessary; in this case, the following procedure is recommended.

Calibration

Recommended Equipment:

DC VTVM	HP 412A
Power Supplies	HP 721A
Test Set	HSD 105959

a. Connect the test set to the power supplies. Adjust the supplies for +15V and -15V, and set the short circuit current to 100 mA. Set the 75 Ohm Load switch of the test set to OUT, and set S1 to OFF. Insert the subassembly into the test set.

b. Connect the dc vtvm to J3 of the test set, set to the 1V scale. Adjust R4 for 0(±0.025)V dc, as indicated by the vtvm. Repeat for final adjustment of R4, using the 0.1V range of the vtvm.

This completes the calibration procedure for the video/audio amplifier subassembly.

ELECTRICAL PARTS LIST - (See figure 1.)

Reference Designation	Description
C1	Capacitor, ceramic, monolythic, 1.0 uF ±20%, 25V, Sprague 5C023105X0250B3
C2	Not assigned
C3	Capacitor, ceramic, monolythic, 1.0 uF ±20%, 25V, Sprague 5C023105X0250B3
C4	Not assigned
C5	Capacitor, dipped, mica, 47 pF ±5%, Elmenco DM15E470J
C6	Capacitor, dipped, mica, 1000 pF ±5%, Elmenco DM20F102J
C7	Capacitor, tantalum, 22 uF, 15V, Sprague 150D226X9015B2
C8	Capacitor, dipped, mica, 1000 pF ±5%, Elmenco DM20F102J
C9	Capacitor, tantalum, 22 uF, 15V, Sprague 150D226X9015B2
C10	Not assigned
C11 through C13	Not assigned
C14	Capacitor, tantalum, 3.3 uF, 15V, Sprague 150D335X9015A2
C15	Capacitor, dipped, mica, 22 pF ±5%, Elmenco DM15E220J
C16	Capacitor, dipped, mica, 2200 pF ±5%, Elmenco DM20F222J
C17	Capacitor, tantalum, 6.8 uF, 35V, Sprague 150D685X9035B2
C18	Capacitor, tantalum, 6.8 uF, 35V, Sprague 150D685X9035B2
C19	Capacitor, tantalum, 22 uF, 15V, Sprague 150D226X9015B2
C20	Capacitor, tantalum, 22 uF, 15V, Sprague 150D226X9015B2
C21	Capacitor, tantalum, 3.3 uF, 15V, Sprague 150D335X9015A2
CR1 through CR6	Diode, silicon, 1N914
CR7	Diode, zener, 1N755
CR8 through CR11	Not assigned
CR12 through CR15	Diode, silicon, 1N914

Reference Designation	Description
Q1	Transistor, 2N2916
Q2	Transistor, 2N3565
Q3	Transistor, 2N4249
Q4	Transistor, 2N3565
Q5	Transistor, 2N4249
Q6	Transistor, 2N3906
Q7	Transistor, 2N3904
Q8	Transistor, 2N2219
Q9	Transistor, 2N2904
Q10 through Q12	Transistor, 2N3565
Q13	Transistor, 2N2219
Q14	Transistor, 2N2904
Q15	Transistor, 2N3565
Q16	Transistor, 2N4249
R1	Resistor, composition, fixed, 10Ω ±5%, 1/4W, Allen Bradley CB1005
R2	Resistor, composition, fixed, 6.8k ±5%, 1/4W, Allen Bradley CB6825
R3	Resistor, composition, fixed, 10k ±5%, 1/4W, Allen Bradley CB1035
R4	Resistor, variable, trimpot, 500Ω, Bourns 3009P-1-501
R5	Resistor, composition, fixed, 20k ±5%, 1/4W, Allen Bradley CB2035
R6	Resistor, composition, fixed, 8.2k ±5%, 1/4W, Allen Bradley CB8225
R7	Resistor, composition, fixed, 330Ω ±5%, 1/4W, Allen Bradley CB3315
R8	Resistor, composition, fixed, 1.5k ±5%, 1/4W, Allen Bradley CB1525

Reference Designation	Description
R9	Resistor, composition, fixed, 10k ±5%, 1/4W, Allen Bradley CB1035
R10	Resistor, composition, fixed, 5.1k ±5%, 1/4W, Allen Bradley CB5125
R11	Resistor, composition, fixed, 180Ω ±5%, 1/4W, Allen Bradley CB1815
R12	Resistor, composition, fixed, 2k ±5%, 1/4W, Allen Bradley CB2025
R13	Resistor, composition, fixed, 5.6k ±5%, 1/4W, Allen Bradley CB5625
R14 and R15	Resistor, composition, fixed, 270Ω ±5%, 1/4W, Allen Bradley CB2715
R16	Resistor, composition, fixed, 5.6k ±5%, 1/4W, Allen Bradley CB5625
R17	Resistor, composition, fixed, 180Ω ±5%, 1/4W, Allen Bradley CB1815
R18	Resistor, composition, fixed, 620Ω ±5%, 1/4W, Allen Bradley CB6215
R19	Resistor, composition, fixed, 470Ω ±5%, 1/4W, Allen Bradley CB4715
R20	Resistor, composition, fixed, 82Ω ±5%, 1/4W, Allen Bradley CB8205
R21 and R22	Resistor, composition, fixed, 15Ω ±5%, 1/4W, Allen Bradley CB1505
R23	Resistor, composition, fixed, 1k ±5%, 1/4W, Allen Bradley CB1025
R24	Resistor, composition, fixed, 470Ω ±5%, 1/4W, Allen Bradley CB4715
R25	Resistor, composition, fixed, 82Ω ±5%, 1/4W, Allen Bradley CB8205
R26	Resistor, composition, fixed, 10Ω ±5%, 1/4W, Allen Bradley CB1005
R27	Resistor, fixed, film, 162K ±1%, 1/8W, RN55B/D1623F
R28	Resistor, fixed, film, 1.02K ±1%, 1/8W, RN55B/D1021F

Reference Designation	Description
R29	Resistor, composition, fixed, 8.2k ±5%, 1/4W, Allen Bradley CB8225
R30	Resistor, fixed, film, 750Ω ±1%, 1/8W, RN55B/D7500F
R31	Resistor, fixed, film, 1.02K ±1%, 1/8W, RN55B/D1021F
R32	Resistor, composition, fixed, 15Ω ±5%, 1/4W, Allen Bradley CB1505
R33	Resistor, composition, fixed, 7.5k ±5%, 1/4W, Allen Bradley CB7525
R34	Resistor, composition, fixed, 3k ±5%, 1/4W, Allen Bradley CB3025
R35	Resistor, composition, fixed, 27k ±5%, 1/4W, Allen Bradley CB2735
R36	Resistor, composition, fixed, 180k ±5%, 1/4W, Allen Bradley CB1845
R37	Resistor, composition, fixed, 390Ω ±5%, 1/4W, Allen Bradley CB3915
R38	Resistor, composition, fixed, 10k ±5%, 1/4W, Allen Bradley CB1035
R39	Resistor, composition, fixed, 3.9k ±5%, 1/4W, Allen Bradley CB3925
R40	Resistor, composition, fixed, 22Ω ±5%, 1/4W, Allen Bradley CB2205
R41 and R42	Resistor, composition, fixed, 30Ω ±5%, 1/4W, Allen Bradley CB3005
R43	Resistor, composition, fixed, 3.9k ±5%, 1/4W, Allen Bradley CB3925
R44	Resistor, composition, fixed, 22Ω ±5%, 1/4W, Allen Bradley CB2205
R45	Resistor, composition, fixed, 15Ω ±5%, 1/4W, Allen Bradley CB1505
R46	Resistor, composition, fixed, 82Ω ±5%, 1/4W, Allen Bradley CB8205
R47	Resistor, composition, fixed, 82Ω ±5%, 1/4W, Allen Bradley CB8205

Reference Designation	Description
R48	Resistor, composition, fixed, 470Ω ±5%, 1/4W, Allen Bradley CB4715
R49	Resistor, composition, fixed, 43Ω ±5%, 1/4W, Allen Bradley CB4305
R50	Resistor, value selected (300 to 3K)
TP1	Test Point, white, AMP 3-582118-9
XQ2 through XQ14	Transipads, HSD B18214
Z1	Amplifier, operational, Motorola MC-1439G

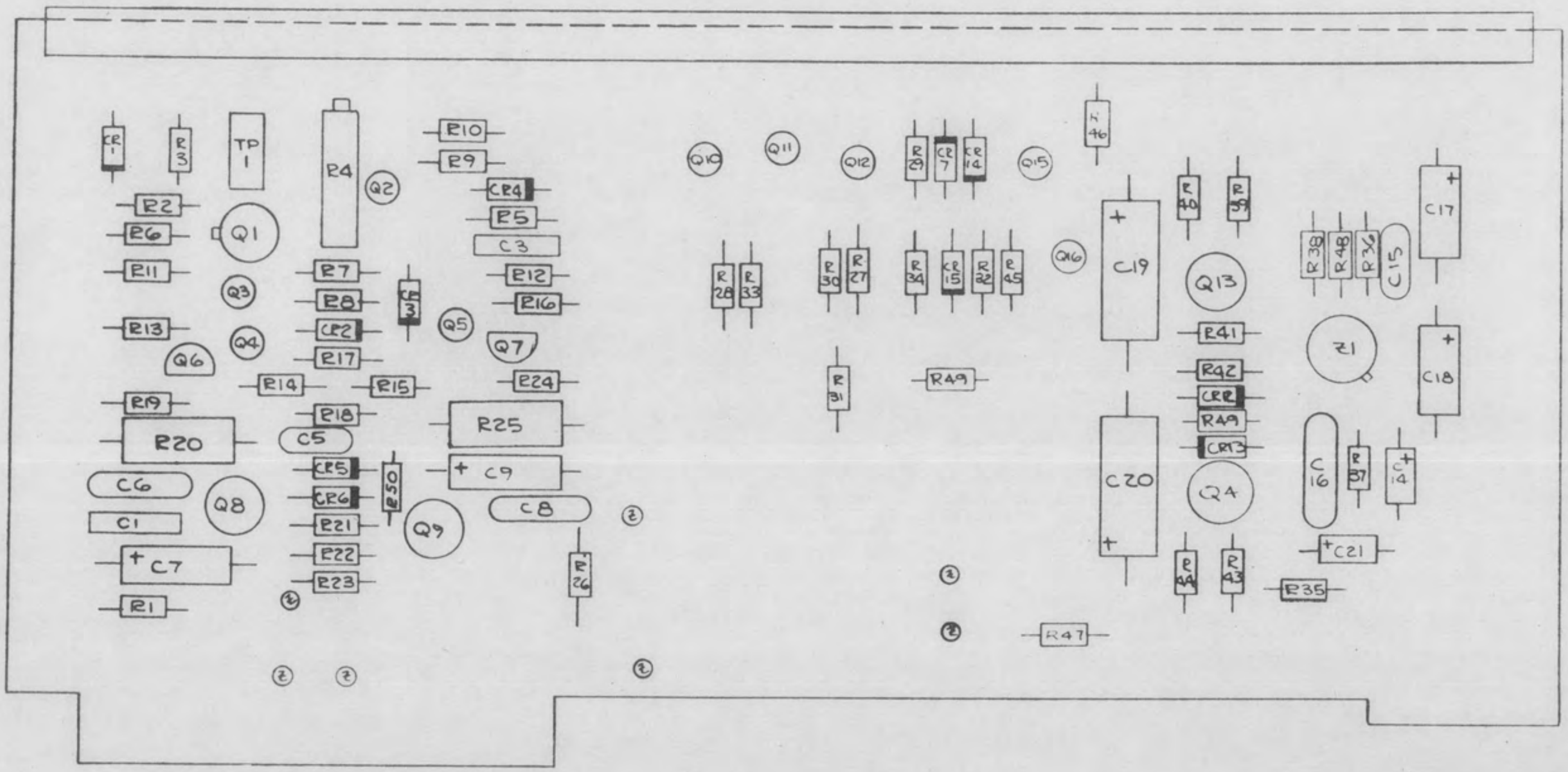
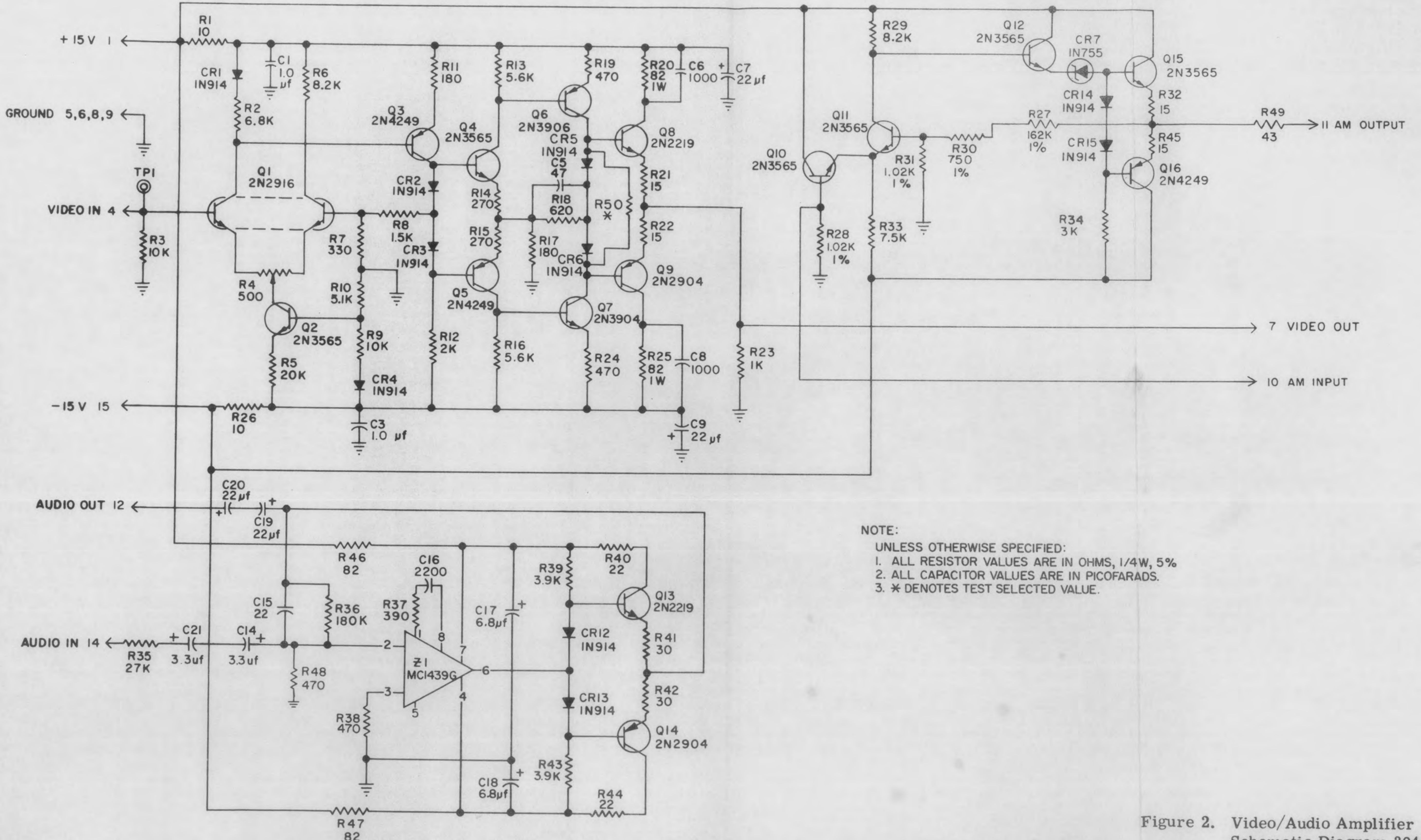


Figure 1. Component Locations
303213



NOTE:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.
3. * DENOTES TEST SELECTED VALUE.

Figure 2. Video/Audio Amplifier Schematic Diagram 304125

Revised: June 1975
January 1970

MODEL V-74-Gxxx
VIDEO BANDWIDTH FILTERS

The V-74-G series of video filters are compact modular subassemblies, each contructed on a single printed circuit board, used to establish the desired video high frequency cutoff point in the Model TMR-74 Telemetry Receiver.

Each filter accepts as its input an unfiltered video signal, and provides as its output a filtered video signal with a high frequency rolloff of 24 dB per octave. The cutoff frequency depends upon the specific filter selected by the appropriate switch on the receiver, which will accept a complement of ten filters.

The following 24 dB/octave video bandwidth filters are available as options (the basic model number is followed by the bandwidth in kHz):

- V-74-G1R5 (1.5 kHz)
- V-74-G3R125 (3.125 kHz)
- V-74-G6R25 (6.25 kHz)
- V-74-G12R5 (12.5 kHz)
- V-74-G25
- V-74-G50
- V-74-G100
- V-74-G200
- V-74-G250
- V-74-G300
- V-74-G400
- V-74-G500
- V-74-G750
- V-74-G1000
- V-74-G1500
- V-74-G3000
- V-74-DIR (unfiltered)

No special procedures are necessary to install or remove the video filters. The proper locations for the modules will be found in the subassembly/module location drawing given in Section V, Maintenance, of the TMR-74 instruction manual.

All components used in the video filters are considered non-repairable, and should be replaced when found to be defective. An electrical parts list is given in this booklet, and a component location drawing is provided.

Care should be exercised when replacing components on the printed circuit board. The following is a suggested procedure for removing components from the board; the procedure requires the following equipment:

Liquid soldereing flux
Flux remover
1/8 inch, #18 AWG, flat braid
Medium wattage soldereing iron.

Apply a thin coat of liquid flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the joint for long periods of time as excessive heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and carefully pry loose the defective component. Clean the affected area using the flux remover. Trim the replacement component leads to the same length as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover.

ELECTRICAL PARTS LIST

The circuit of each of the V-74-G series of video filters is identical; only the electrical part values have been changed to produce the required high-frequency cutoff point. A listing of parts used is given here, followed by table 1, which lists electrical values and Defense Electronics part numbers. Part locations are shown in figure 1.

Reference Designation	Description
C1	Capacitor, tubular
C2	Capacitor, tubular
L1	Inductor, fixed
L2	Inductor, fixed

Table 1. Electrical Part Values

Filter Cutoff Frequency (kHz)	Value* - Part Number ** C1	C2	L1	L2
1.5	0.226 1085	0.681 1107	7.15 mH 11-7R15	33.2 mH 11-33R2
3.125	0.110 1070	0.316 1092	3.48 mH 11-3R48	16.2 mH 11-16R2
6.25	0.0562 1056	0.162 1078	1.69 mH 11-1R69	7.87 mH 11-7R87
12.5	0.0274 1041	0.0787 1063	866 uH 09-866	4.02 mH 11-4R02
25	0.0140 1027	0.0402 1049	422 uH 09-422	1.96 mH 11-1R96
50	6810 1012	0.0196 1034	215 uH 09-215	1.00 mH 11-1R100
100	3480 0107	0.0100 1020	105 uH 09-105	487 uH 09-487
200	1690 0092	4870 1005	53.6 uH 09-53R6	249 uH 09-249
250	1400 0088	4020 1001	42.2 uH 09-42R2	196 uH 09-196
300	1150 0084	3320 0106	35.7 uH 09-35R7	158 uH 09-158
400	866 0078	2490 0100	26.7 uH 09-26R7	124 uH 09-124
500	681 0073	1960 0095	21.5 uH 09-21R5	100 uH 09-100
750	464 0065	1330 0087	14.0 uH 09-14R0	64.9 uH 09-64R9
1000	348 0059	953 0080	10.5 uH 09-10R5	48.7 uH 09-48R7

Table 1. (Cont.)

Filter Cutoff Frequency (kHz)	Value* - Part Number ** C1	C2	L1	L2
1500	205 0048	562 0069	6.49 uH 09-6R49	30.1 uH 09-30R1
2000	140 0041	365 0060	4.22 uH 09-4R22	19.6 uH 09-19R6
3000	115 0037	332 0058	3.48 uH 09-3R48	16.2 uH 09-16R2
DIR	-	-	4.7 uH Nytronics WEE-4.7	-

* Numbers less than one indicate value in microfarads, numbers greater than one indicate value in picofarads.

** For complete Defense Electronics part numbers, prefix C1 and C2 part numbers 9096-, prefix L1 and L2 part numbers 3033-.

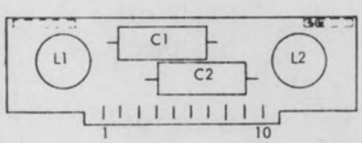


Figure 1. Component Locations

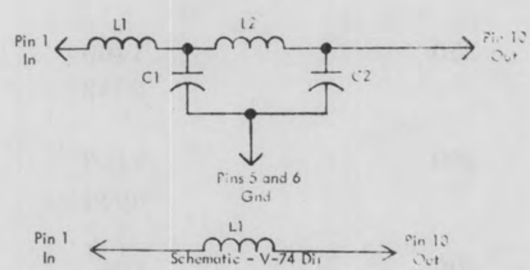


Figure 2. Video Filters
Schematic Diagram 105725

15 February 1971

MODEL I-74-G30(1)
SECOND IF FILTER

INSTRUCTION BOOKLET

The I-74-G30(1) Second IF Filter is a modified version of the I-74-G30 filter described in the attached booklet. The modification consists of a different type of crystal filter (Defense Electronics 106156). The new filter provides an improvement in the selectivity ratio (3:1). The phase linearity of the I-74-G30(1) is within ±8° over 80% of the 3 dB bandwidth.

CHANGE SHEET

ELECTRICAL PARTS LIST, revise as follows:

Page	Reference Designation	Description
9	C20*	Capacitor, ceramic, tubular, 5.1 pF ±0.25 pF, Erie NPO-301-000
11	R8	Resistor, variable, 100k, Bourns 3339P-1-104(100k)
	R17	Resistor, variable, 100k, Bourns 3339P-1-104(100k)

MAINTENANCE DIAGRAMS, revise as follows:

Page	
17/18	Figure 3, Schematic Diagram, change value of C20 from 6.2 to 5.1.

*NOTE: This change applies only to C20 of I-74-G30 and modifications thereof; C20 of I-74-G50 and I-74-G100 are not affected by this revision, and should be added to the parts lists on pages 13 and 14 as
C20 Capacitor, ceramic, tubular, 6.2 ±0.25 pF, Erie NPO-301-000

Model: I-74-G30, 50, 100	Date: 2-1-71

The I-74-G30, 50, 100 Second IF Filter is a plug-in modular subassembly designed for use in Defense Electronics telemetry receivers. Its purpose is to establish the second i-f bandwidth of the receiver. This instruction booklet describes the following second i-f filters:

I-74-G30 (30 kHz bandwidth)
I-74-G50 (50 kHz bandwidth)
I-74-G100 (100 kHz bandwidth)

The second i-f filter is constructed as a plug-in printed circuit board, with edge-board connector, mounted on spacers to a metal shield. The metal shield, which covers the foil side of the board but not the connector, is L-shaped to provide a flange at the top for ease in removing or installing the filter.

Table 1. Specifications

Center Frequency	10.000 MHz.
Symmetry	10% maximum where: the absolute value of $\left\|\frac{F_1 - F_2}{F_1 + F_2}\right\| \times 100 = \%$ of symmetry; F_1 = upper 3 dB frequency minus 10.000 MHz; F_2 = 10.000 MHz minus lower 3 dB frequency
Bandwidth Tolerance	±10%.
Phase Linearity	within ±3° over the 3 dB bandwidth.
Selectivity	4.5:1 60 dB/6 dB.

INSTALLATION

No special procedures are necessary to install or remove the second i-f filter. The proper location for the subassembly will be found in the subassembly/module location drawing in Section V, Maintenance, of the applicable receiver instruction manual. All electrical connections between the main chassis and the subassembly are made automatically upon installation; there are no additional wires or cables to connect or disconnect.

The physical proximity of the i-f filters to each other and to other subassemblies of the receiver may necessitate the use of a flat-bladed screwdriver or similar instrument to lift the subassembly from the main chassis thus allowing removal. The subassembly is equipped with a flange, at the top, for this purpose.

PRINCIPLES OF OPERATION

The second i-f filter comprises a crystal filter assembly, and a three-stage gain controlled amplifier. The assembly is turned on by the application of +15V at pin 7, forward-biasing a network of diodes (CR1-CR5), and is turned off by the application of -15V at pin 7, reverse-biasing those same diodes.

The second i-f signal is applied through pin 1 of the edgeboard connector, to input diode, CR1. When CR1 is forward biased (+15V at pin 7), the input signal is coupled to the input of the crystal filter, which is designed to pass a bandwidth of 100 kHz (I-74-G100), 50 kHz (I-74-G50), or 30 kHz (I-74-G30).

The filter output is applied to T1, the signal input to the three-stage amplifier. Q1, Q2, and Q3 are dual-gate metal oxide silicon (mos) field effect transistors (fet's). These dual-gate fet's are utilized to provide logarithmic gain control of the amplification. These filters provide the constant gain-bandwidth characteristic of the receiver. With zero agc volts applied, the gain of the filter depends on the bandwidth (i.e., I-74-G30 = 36 dB, I-74-G50 = 34 dB, I-74-G100 = 31 dB) and with -8 volts agc applied, all filters are set for -10 dB of gain.

The 10 MHz signal across T1 is applied to gate 1 of double-tuned amplifier Q1. Agc voltage is applied through pin 11 of the edgeboard connector to gate 2 of Q1. Potentiometer R8 is the agc slope adjustment.

The varying agc voltage at gate 2 of Q1 serves to control the gain of the amplifier, and thus controls the amplification of the signal applied to gate 1. The output of Q1 is amplified by Q2 and Q3, which function similarly to Q1; agc voltage is again applied to gate 2. Potentiometer R17 is the gain adjustment for the second i-f filter assembly.

In the output circuits of Q1 and Q2 are double-tuned filters (L3/L4, L5/L6, etc.) while in the output of Q3, a single-tuned filter (L7, etc.)

is utilized. The component values are chosen to provide the proper 3 dB bandwidth for the filter. This combination of double-tuned/single-tuned networks provides optimum phase linearity in the amplifier.

The 10 MHz output of Q3 is coupled through forward-biased diode CR5 (+15V at pin 7) and T2 to pin 15 of the edgeboard connector. T2 provides a balanced 50-ohm ferrite-loaded transmission line.

Diode CR3 applies +15V operating voltage to pin 8 for application to the narrowband first i-f filter in the receiver.

Diode CR4 applies operating voltage to the amplifier, Q1-Q2-Q3, when forward-biased (+15V at pin 7). Diode CR2 and resistor R1 provide the appropriate voltage level, through pin 6, to the receiver search sweep circuitry to provide the proper sweep rate corresponding to the second i-f filter bandwidth.

MAINTENANCE

The design of the second i-f filter limits the need for maintenance. During normal operation, no periodic adjustment is necessary or desirable. Unnecessary adjustments may degrade the performance of the receiver, and therefore should be avoided.

Straightforward troubleshooting methods should be used if a malfunction occurs. The schematic diagram and circuit description given herein should provide the data necessary for qualified maintenance technicians to isolate the malfunction, using effect-to-cause reasoning.

Table 2. Transistor Complement

Reference Designation	Type	Function
Q1	3N140	Amplifier
Q2	3N140	Amplifier
Q3	3N140	Amplifier

Repair and Replacement

All components used in the subassembly are considered non-repairable, and should be replaced when found to be defective. A complete electrical parts list is given in this booklet, and a component location drawing is provided. If it becomes necessary to replace components on the printed circuit board, the board must be removed from the metal shield. This is accomplished by simply removing the four screws securing the board and the four screws securing the crystal filter and lifting the board free.

Care should be exercised when replacing components on the printed circuit board. If a component is replaced, recalibration may be necessary; in this case, the following procedures are recommended:

Alignment

Recommended Equipment:

Sweep Signal Generator	HP 675A
Phase/Amplitude Tracking Detector	HP 676A
Electronic Counter	HP 5245L
Signal Generator	HP 606A
Test Oscillator	HP 651A
Power Supplies (3)	Power Designs 4005
Oscilloscope	HP 130C
Digital Voltmeter	Dymec 2401A
Oscilloscope	HP 561A
Differential Amplifier	HP Type 63
Time Base	HP Type 67
Mixer	HP 10514A
Attenuator	HP 355C
Attenuator	HP 355B
Voltmeter	HP 412A
RF Millivolt Meter	HP 411A
Test Fixture	Defense Electronics 203756 (Slope and offset Compensator)
Test Set	Defense Electronics 105957
Assorted 50 ohm cables	
Assorted BNC Connectors	
Test Cable*	
3 dB Pad	Applied Research
10 dB Pad	Weinschel

Equipment Setup:

a. Connect test equipment as shown in figure 1.

b. Set power supply no. 1 to +2V ungrounded. Set power supply no. 2 to +15V, power supply no. 3 to -15V and calibrate digital voltmeter.

c. Set oscilloscope no. 1 (Amplitude Response) vertical control to 50 mV/cm and horizontal control to external, both dc coupled.

* 8" RG-174 cable with Amphenol 31-369 connector and 3 dB pad (Applied Research HFA 5C) at one end, ground clip and 3/8" projecting center conductor at other end.

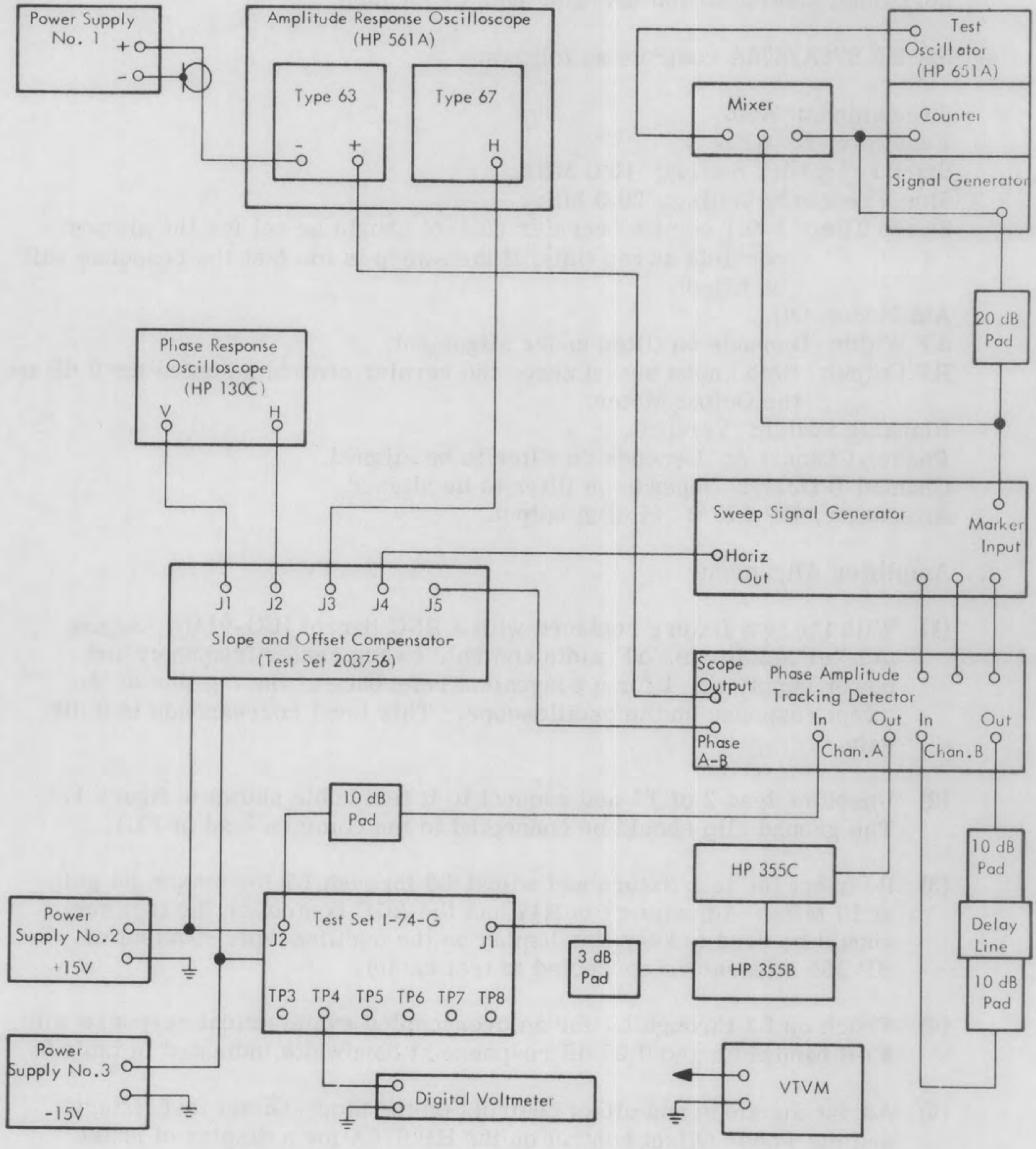


Figure 1. Test Equipment Setup

d. Set oscilloscope no. 2 (Phase Response) vertical control to 100 mV/cm and horizontal control to 100 mV/cm, both dc coupled.

e. Set HP 675A/676A controls as follows:

Sweep mode: Auto.
Function: Fo/ΔF.
Start Frequency Setting: 10.0 MHz.
Stop Frequency Setting: 20.0 MHz.
Sweep Time: 1-0.1 sec (the vernier control should be set for the slowest possible sweep time; if the sweep is too fast the response will be tilted).
AM Mode: Off.
ΔF Width: Depends on filter under alignment.
RF Output: Both knobs set on zero, the vernier control adjusted for 0 dB on the Output Meter.
Blanking Switch: Vertical.
Phase, Channel A: Depends on filter to be aligned.
Channel B Delay: Depends on filter to be aligned.
Attenuator, HP 675A: +4 dBm output.

f. Amplifier Alignment.

(1) With the test fixture replaced with a BNC barrel (UG-914U), adjust marker amplitude, ΔF width control, sweep center frequency and power supply no. 1 for a convenient reference at the top line of the swept response on the oscilloscope. This level corresponds to 0 dB gain.

(2) Unsolder lead 2 of T1 and connect to it test cable shown in figure 1. The ground clip should be connected to the common lead of FL1.

(3) Reinsert the test fixture and adjust L3 through L7 for maximum gain at 10 MHz. Adjustment of R17 and the AGC control on the test set should be used to keep the display on the oscilloscope. (Output of HP 355 attenuators connected to test cable).

(4) Touch up L3 through L7 for an overcoupled symmetrical response with 3 dB bandwidth and 0.25 dB response at bandwidth indicated in table 3.

(5) Adjust the slope and offset controls on the Slope-Offset test fixture and the Phase Offset control on the HP 676A for a display of phase across the 0.25 dB bandwidth. The phase should be within $\pm 0.5^\circ$ of the best straight line.

(6) Remove the test cable and reconnect lead 2 of T1.

Table 3. Amplifier Bandwidth vs. Gain

Model Number	Amplifier Bandwidth		Gain Settings	
	3 dB	0.25 dB	0 Volts AGC	-8 Volts AGC
I-74-G30	200 kHz	75 kHz	36.25 dB	-10 dB
I-74-G50	200 kHz	75 kHz	34 dB	-10 dB
I-74-G100	260 kHz	100 kHz	+31 dB	-10 dB

g. Gain Control Range.

(1) With agc voltage at TP4 at zero volts, and the HP 355 attenuator at 51 dB, adjust R17 for reference level set in step f(1).

(2) With agc voltage of TP4 at -8.00 volts and the HP 355 attenuator at 10 dB, adjust R8 for reference level set in step f(1).

(3) Repeat above steps until the correct gain settings are achieved. The final adjustment should be accurate within ±0.5 dB.

CHANGE SHEET

ELECTRICAL PARTS LIST, revise as follows:

Page	Reference Designation	Description
9	C20*	Capacitor, ceramic, tubular, 5.1 pF ±0.25 pF, Erie NPO-301-000
11	R8	Resistor, variable, 100k, Bourns 3339P-1-104(100k)
	R17	Resistor, variable, 100k, Bourns 3339P-1-104(100k)

MAINTENANCE DIAGRAMS, revise as follows:

Page	
17/18	Figure 3, Schematic Diagram, change value of C20 from 6.2 to 5.1.

*NOTE: This change applies only to C20 of I-74-G30 and modifications thereof; C20 of I-74-G50 and I-74-G100 are not affected by this revision, and should be added to the parts lists on pages 13 and 14 as
C20 Capacitor, ceramic, tubular, 6.2 ±0.25 pF, Erie NPO-301-000

Model: I-74-G30, 50, 100	Date: 2-1-71

ELECTRICAL PARTS LIST - (See Figures 1 and 2)

A complete electrical parts list is given herein for the I-74-G30 second i-f filter. For the remaining two filters, only those components that differ from the I-74-G30 are listed.

I-74-G30

Reference Designation	Description
C1 through C3	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5U
C4	Capacitor, ceramic, disc, 0.001 μF ±10%, Erie HR 809-X5T
C5	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5U
C6	Capacitor, ceramic, disc, 220 pF ±10%, Erie HR 839-X5F
C7	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5U
C8	Capacitor, ceramic, "red cap" 0.01 μF ±20%, Erie 8121-100-W5R-103M
C9	Capacitor, dipped mica, 91 pF ±5%, 500V, Elmenco DM15F910J
C10	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5U
C11	Capacitor, ceramic, tubular, 5.6 pF ±0.25 pF, Erie NPO-301-000
C12	Capacitor, dipped mica, 390 pF ±5%, 500V, Elmenco DM15F391J
C13	Capacitor, ceramic, disc, 0.001 μF ±10%, Erie HR809-X5T
C14	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5U
C15	Capacitor, ceramic, disc, 220 pF ±10%, Erie HR 839-X5F
C16	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5U
C17	Capacitor, ceramic "red cap" 0.01 μF ±20%, Erie 8121-100-W5R-103M
C18	Capacitor, dipped mica, 91 pF ±5%, 500V, Elmenco DM15F910J
C19	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5U
C20	Capacitor, ceramic, tubular, 6.2 pF ±0.25 pF, Erie NPO-301-000
C21	Capacitor, dipped mica, 390 pF ±5%, 500V, Elmenco DM15F391J
C22	Capacitor, ceramic, disc, 0.001 μF ±10%, Erie HR 809-X5T
C23	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5U

I-74-G30, continued

Reference Designation	Description
C24	Capacitor, ceramic, disc, 220 pF ±10%, Erie HR 839-X5F
C25	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5U
C26	Capacitor, dipped mica, 100 pF ±5%, 500V, Elmenco DM15F101J
C27	Capacitor, ceramic, "red cap" 0.01 μF ±20%, Erie 8121-100-W5R-103M
C28	Capacitor, dipped mica, 910 pF ±5%, 500V, Elmenco DM15F911J
C29	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5U
C30	Capacitor, ceramic, disc, 0.01 μF ±20%, 100V, Erie 805-Z5U
CR1	Diode, 1N4305
CR2 through CR4	Diode, 1N457
CR5	Diode, 1N4305
FL1	Crystal Filter, 30 kHz, Defense Electronics 203195
L1	Inductor, fixed, 270 μH ±5%, Nytronics WEE-270
L2	Inductor, fixed, 270 μH ±5%, Nytronics WEE-270
L3	Inductor assembly, Defense Electronics 203667-09
L4	Inductor assembly, Defense Electronics 203667-10
L5	Inductor assembly, Defense Electronics 203667-09
L6	Inductor assembly, Defense Electronics 203667-10
L7	Inductor assembly, Defense Electronics 203667-09
L8	Inductor, fixed, 120 μH ±5%, Nytronics WEE-120
L9	Inductor, fixed, 270 μH ±5%, Nytronics WEE-270
L10	Inductor, fixed, 270 μH ±5%, Nytronics WEE-270
Q1	Transistor, RCA 3N140

I-74-G30, continued

Reference Designation	Description
Q2	Transistor, RCA 3N140
Q3	Transistor, RCA 3N140
R1	Resistor, fixed composition, 1 meg ±5%, 1/4W, Allen Bradley CB1055
R2	Resistor, fixed composition, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R3	Resistor, fixed composition, 560Ω ±5%, 1/4W, Allen Bradley CB5615
R4	Resistor, fixed composition, 20k ±5%, 1/4W, Allen Bradley CB2035
R5	Resistor, fixed composition, 20k ±5%, 1/4W, Allen Bradley CB2035
R6	Resistor, fixed composition, 240k ±5%, 1/4W, Allen Bradley CB2445
R7	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R8	Resistor, variable, 100k, helitrim, Beckman 62PR100k
R9	Resistor, fixed composition, 300Ω ±5%, 1/4W, Allen Bradley CB3015
R10	Resistor, fixed composition, 8.2k ±5%, 1/4W, Allen Bradley CB8225
R11	Resistor, fixed composition, 330Ω ±5%, 1/4W, Allen Bradley CB3315
R12	Not assigned
R13	Resistor, fixed composition, 20k ±5%, 1/4W, Allen Bradley CB2035
R14	Resistor, fixed composition, 20k ±5%, 1/4W, Allen Bradley CB2035
R15	Resistor, fixed composition, 240k ±5%, 1/4W, Allen Bradley CB2445
R16	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R17	Resistor, variable, 100k, helitrim, Beckman 62PR100K
R18	Resistor, fixed composition, 300Ω ±5%, 1/4W, Allen Bradley CB3015
R19	Resistor, fixed composition, 8.2k ±5%, 1/4W, Allen Bradley CB8225
R20	Resistor, fixed composition, 330Ω ±5%, 1/4W, Allen Bradley CB3315
R21	Resistor, fixed composition, 20k ±5%, 1/4W, Allen Bradley CB2035
R22	Resistor, fixed composition, 20k ±5%, 1/4W, Allen Bradley CB2035
R23	Resistor, fixed composition, 240k ±5%, 1/4W, Allen Bradley CB2445
R24	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R25	Resistor, fixed composition, 300Ω ±5%, 1/4W, Allen Bradley CB3015

I-74-G30, continued

Reference Designation	Description
R26	Resistor, fixed composition, 100k ±5%, 1/4W, Allen Bradley CB1045
R27	Not assigned
R28	Resistor, fixed composition, 330Ω ±5%, 1/4W, Allen Bradley CB3315
R29	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R30	Resistor, fixed composition, 51k ±5%, 1/4W, Allen Bradley CB5135
R31	Not assigned
R32	Resistor, fixed composition, 27k ±5%, 1/4W, Allen Bradley CB2735
R33	Resistor, fixed composition, 10k ±5%, 1/4W, Allen Bradley CB1035
R34	Resistor, fixed film, 16.9k ±1%, 1/8W, RN55D1872F
T1	Transformer assembly, Defense Electronics 203576
T2	Transformer assembly, Defense Electronics 106031

Miscellaneous:

Button, engraved, 30, Defense Electronics 105898-02

I-74-G50

Reference Designation	Description
C26	Capacitor, dipped mica, 130 pF ±5%, 500V, Elmenco DM15F131J
R34	Resistor, fixed film, 18.7k ±1%, 1/8W, RN55D1872F
FL1	Crystal filter, 50 kHz, Defense Electronics 203196

Miscellaneous:

Button, engraved, 50, Defense Electronics 105898-03

I-74-G100

Reference Designation	Description
C26	Capacitor, dipped mica, 130 pF ±5%, 500V, Elmenco DM15F131J
R1	Resistor, fixed composition, 3 meg ±5%, 1/4W, Allen Bradley CB3055
R26	Resistor, fixed composition, 3.3k ±5%, 1/4W, Allen Bradley CB3325
R34	Resistor, fixed film, 21.5k ±1%, 1/8W, RN55D2152F
FL1	Crystal filter, 100 kHz, Defense Electronics 203197

Miscellaneous:

Button, engraved, 100, Defense Electronics 105898-04

MAINTENANCE DRAWINGS

This section contains a typical component location drawing and a schematic diagram of the I-74-G30 filter. The component location drawing shown in figure 1 applies to filters I-74-G30, 50, and 100. The schematic diagrams for the I-74-G50 and 100 are identical to that given in figure 2 except for the component descriptions given on pages 13 and 14.

Unless otherwise specified, the following information applies to the schematic diagram:

a. Capacitor values less than one are in microfarads.

b. Capacitor values greater than one are in micromicrofarads (picofarads).

c. Inductance values are in microhenrys.

d. Resistance values are in ohms; k = 1,000; m = 1,000,000.

e. Arrow denotes clockwise adjustment.

f. * Denotes factory selected value.

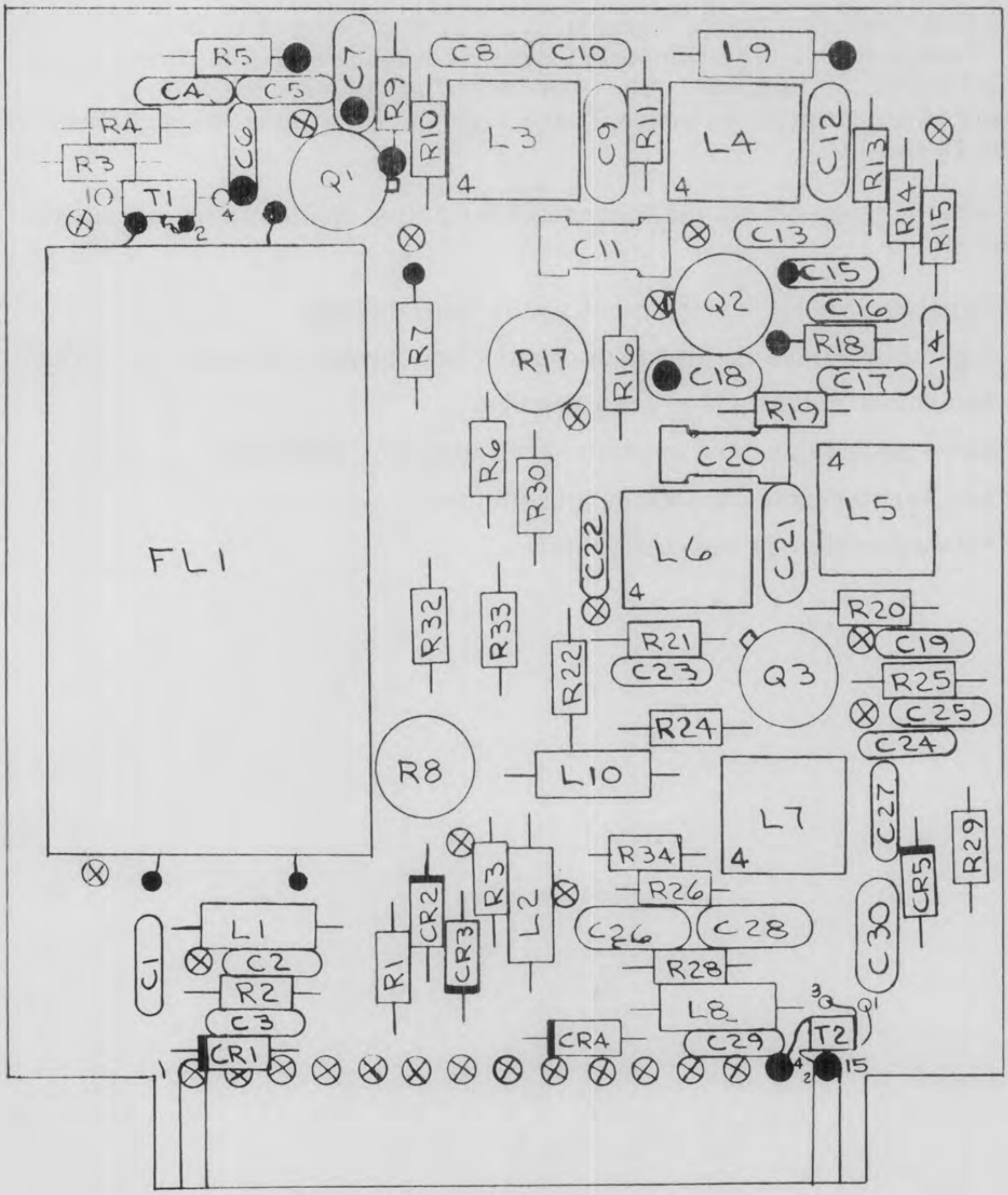


Figure 2. Component Location Drawing C203656 (I-74-G30, 50, 100)

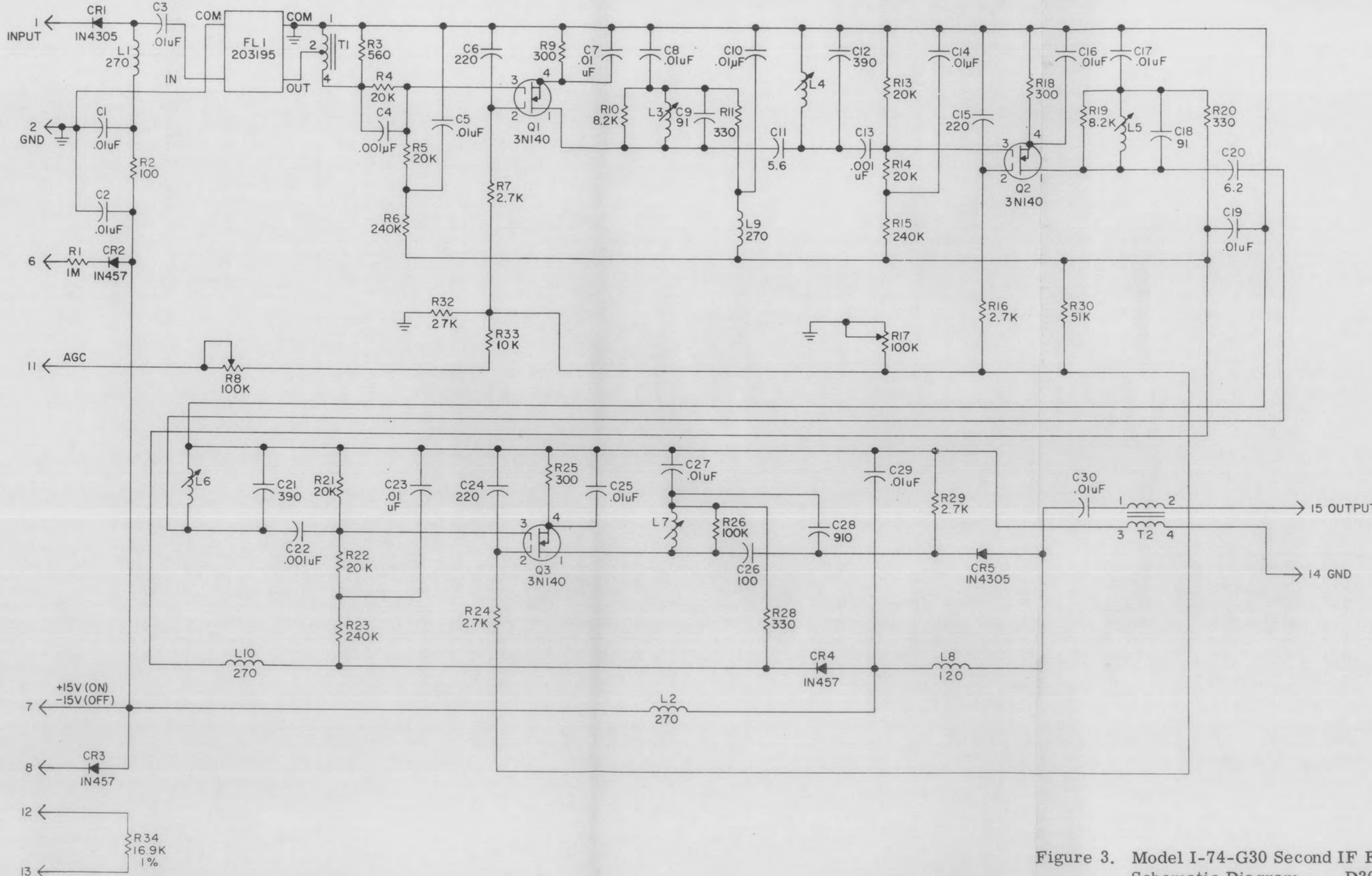


Figure 3. Model I-74-G30 Second IF Filter Schematic Diagram D303475

MODEL TU-74-PB
215-320 MHz RF TUNER

March 1970
Revised: July 1979

EFFECTIVE PAGES

March 1970:
Revised: July 1979

i through v

1-0 through 1-2

2-1 through 2-2

3-1 through 3-2

4-1 through 4-5/4-6

5-1 through 5-8

6-1 through 6-12

7-1 through 7-5/7-6

TABLE OF CONTENTS

Section		Title	Page
I	GENERAL DESCRIPTION		1-1
II	PREPARATION FOR USE		
	2.1	General	2-1
	2.2	Unpacking and Inspection	2-1
	2.3	Installation	2-1
	2.4	Performance Check	2-2
III	OPERATION		3-1
IV	PRINCIPLES OF OPERATION		
	4.1	General	4-1
	4.2	Circuit Description	4-1
	4.2.1	AGC Circuitry	4-2
	4.2.2	Crystal Oven Temperature Regulator	4-3
V	MAINTENANCE		
	5.1	General	5-1
	5.2	Preventive Maintenance	5-1
	5.3	Corrective Maintenance	5-2
	5.3.1	Troubleshooting	5-2
	5.3.2	Repair and Replacement	5-2
	5.3.3	Alignment	5-4
VI	ELECTRICAL PARTS LIST		
	Main Chassis		6-1
	AGC Shaping Amplifier, A1		6-10
	Crystal Oven Temperature Regulator, A2		6-11
	AGC Shaping Network, A3		6-12
VII	MAINTENANCE DIAGRAMS		7-1

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1	Model TU-74-PB RF Tuner	1-0
4-1	Model TU-74-PB RF Tuner, Block Diagram	4-5
7-1	Model TU-74-PB RF Tuner, Schematic Diagram	7-2
7-2	Component Location Drawings A1 and A2	7-4
7-3	Component Location Drawings Filter Box Assembly and A3	7-5

LIST OF TABLES

Number	Title	Page
1-1	Specifications	1-1
1-2	Transistor Complement	1-2

Figure 1-1. Model TU-74-PB RF Tuner

SECTION I
GENERAL DESCRIPTION

The Model TU-74-PB RF Tuner is designed for use with the Model TMR-74 Telemetry Receiver. It is a front-panel plug-in module that provides reception of signals in the 215-320 MHz frequency range.

Front-panel pushbutton switches allow selection of three modes of operation; variable frequency oscillator, crystal oscillator, or external oscillator. A front panel tuning control and frequency dial allow precise tuning over the entire frequency range.

A model CO-65 proportional oven containing an X-75 crystal plugs into the front panel of the rf tuner for crystal oscillator operation. Also available is a CA-74 crystal adapter which utilizes an X-54 crystal without oven.

The rf tuner provides a 55 MHz first i-f output, a spectrum display unit output, and a first l-o monitor output.

The electrical and mechanical specifications for the rf tuner are given in table 1-1 and the transistor complement is given in table 1-2. A functional block diagram is shown in figure 4-1.

Table 1-1. Specifications

Input Impedance	50 ohms, nominal.
Noise Figure	7 dB maximum.
Dynamic Range	noise threshold to -7 dBm.
Bandwidth	4 MHz.
IF Output Frequency	55 MHz.
Rejection and Emission:	
Image Rejection	80 dB minimum.
IF Rejection	90 dB minimum.
EMC	certified compliant to MIL-STD-461.
LO Conducted to Antenna	-73 dBm maximum.
First Local Oscillator:	
Modes	crystal, VFO, external.

continued

Table 1-1, continued

First Local Oscillator, continued	
Stability - VFO	±0.001%/°C.
- Crystal	±0.005% without oven; ±0.0005% with oven (proportional type).
First LO Output	-7 dBm into 50 ohms at submultiple of mixer injection frequency.
First LO Input	-13 dBm into 50 ohms at submultiple of mixer injection frequency (see page 3-1).
Mixer Injection Frequency	55 MHz above rf input.
Size	4-29/32" high by 4-5/8" wide by 16-21/32" deep overall.

Table 1-2. Transistor Complement

Chassis	Reference Designation	Type	Function
Main Chassis	Q1	TA-7153	RF Amplifier
	Q2	2N5032	
	Q3	3N143	Mixer
	Q4	3N159	IF Amplifier
	Q5	A492	
	Q6	2N3933	Frequency Doubler
	Q7	2N3933	Frequency Doubler
	Q8	2N3933	Combiner
	Q9	2N3933	
	Q10	2N3933	
	Q11	2N3933	VFO/XTAL Oscillator
AGC Shaping Amplifier, A1	A1A1	LM301A	AGC Shaper
	A1Q1	2N2218	
Crystal Oven Temperature Regulator, A2	A2Z1	CA-3028A	Differential Amplifier
	A2Q1	2N3251	Amplifier
	A2Q2	2N2270	Series Current Regulator
	A2Q3	2N4919	

SECTION II
PREPARATION FOR USE

2.1 GENERAL

The Model TU-74-PB RF Tuner is shipped fully assembled, with all internal subassemblies installed, and in operating condition. Consequently, preparation for use procedures are reduced essentially to checks of the physical condition of the equipment, and a referenced performance check. Also discussed in this section are mechanical installation data and crystal oven installation.

2.2 UNPACKING AND INSPECTION

The following checks should be made upon unpacking the rf tuner:

a. Check for any mechanical damage to the chassis.

b. Check the connectors on the rear of the chassis, examining them for loose or damaged pins.

c. Check the front panel of the tuner for damage to knobs, pushbuttons, and the tuning dial.

d. Operate the controls examining them for looseness.

2.3 INSTALLATION

The rf tuner is a plug-in module to the TMR-74 telemetry receiver. All electrical connections are made through a type N coaxial connector and a multipin (with coaxial inserts) connector on the rear of the module. There are no cables to connect during installation or to disconnect during removal.

To install the rf tuner, insert it through the opening on the right side of the receiver until the front panel is flush against the front panel of the receiver. Tighten the two adjustable fasteners on the front panel of the tuner. To remove the module, unscrew the two fasteners and slide the unit out of the receiver.

To install either the crystal oven assembly (CO-65), or the crystal adapter assembly (CA-74), insert the assembly into the opening on the front panel of the tuner until the front panel is flush against the front panel of the tuner. Tighten the adjustable fastener on the front panel of the assembly. To remove the assembly, unscrew the fastener and slide the unit out of the tuner.

An X-75 crystal plugs into the CO-65 crystal oven assembly and an X-54 crystal plugs into the CA-74 crystal adapter assembly. The received frequency may be written on the strip provided on the front panel of the assembly with any pen or magic marker. (Refer to Section III, Operation, for crystal frequency/signal frequency formula.)

2.4 PERFORMANCE CHECK

When installation is completed, it is suggested that the performance of the rf tuner be checked using the procedures given in Section V of the Receiver Instruction Manual.

SECTION III
OPERATION

The complete and meaningful operating procedure for the rf tuner, including all controls and indicators thereon, is an integral part of the operating procedure for a functioning receiver given in Section III of the receiver instruction manual. For this reason, only general operating information is given in this instruction manual.

The operating controls and indicators of the rf tuner are all located on the front panel. These controls and indicators, and their functions are given below.

FIRST LO MODE	Pushbutton switches select the mode of operation for the first local oscillator; XTAL, VFO, or EXT.
TUNING	Control used to tune the rf preselector in all modes and the variable frequency oscillator in the VFO mode.
Frequency Dial	Tape dial indicates tuned frequency.

The crystal oven socket on the front panel is provided for a model CO-65 proportional oven containing an X-75 crystal. If desired, a CA-74 crystal adapter, which holds an X-54 crystal without oven, may be used.

For crystal-controlled operation, depress the XTAL switch and adjust the TUNING control for the desired frequency as viewed on the Frequency Dial. Then insert the crystal oven, containing a crystal of the proper type and frequency, into the crystal oven socket. Crystal frequency is determined by the following formula:

$$f_c = \frac{f_r + 55}{4}$$

where: f_c = crystal frequency

f_r = signal frequency

For vfo operation, depress the VFO switch and adjust the TUNING control for the proper frequency, as viewed on the frequency dial. The TUNING meter of the receiver is utilized for precise tuning and indication of the received signal.

For external oscillator operation, depress the EXT switch and connect the external oscillator source to the proper rear apron connector of the receiver. (Refer to table 1-1, Specifications, for proper signal level and frequency.) Then tune the receiver as in the vfo mode.

SECTION IV
PRINCIPLES OF OPERATION

4.1 GENERAL

The TU-74-PB rf tuner accepts an rf input signal in the 215-320 MHz frequency range, and provides a 55 MHz first i-f output signal for the receiver. It also provides a 55 MHz output for application to a spectrum display unit and an l-o output at one-fourth the local oscillator injection frequency for monitoring purposes. The output amplifier circuitry of the tuner is gain controlled by receiver agc. Three modes of operation are featured; crystal oscillator, vfo, or external oscillator. An eight-section inductuner, gear driven from a front-panel tuning knob, is employed to simultaneously tune the rf amplifier, first local oscillator, and multiplier chain circuitry.

A block diagram of the rf tuner is shown in figure 4-1 and the main chassis schematic diagram is shown in figure 7-2.

4.2 CIRCUIT DESCRIPTION

The rf input signal is applied from J1 through J2 to the cascode rf amplifier Q1 and Q2. The cascode configuration is employed because of its inherent low noise characteristics and the ease at which it can be gain controlled for increased signal handling capability.

The input circuit of Q1 is double-tuned, utilizing two sections (L1-A and L1-B) of an eight-section inductuner as the tuning elements to obtain the required selectivity prior to amplification. The primary (L1-A) and associated circuitry provides the required 50 ohm input impedance, and, in conjunction with L1-B, transforms the 50 ohm source impedance up to the higher impedance required by Q1 for noise figure considerations. Capacitive top coupling is used between L1-A and L1-B to provide a bandwidth of approximately 5 MHz at any selected center frequency.

Q1 is a dual-gate MOS-FET with the rf signal applied to gate 1 and a preshaped agc signal applied to gate 2. Agc is derived from agc shaping amplifier, A1, which preshapes the linear receiver agc (P1-7) to provide a logarithmic agc signal to gate 2 for low-noise gain control of Q1.

The output of Q1 is applied to amplifier Q2, a bipolar transistor connected in a grounded base configuration. Q2 features high overload capabilities as well as high gain. The 215-320 MHz output of Q2 is applied through a second double-tuned circuit (L1-C and L1-D) to the input of mixer Q3. The other input to Q3 is the 270-375 MHz l-o injection signal.

The output of Q3 is applied through a double-tuned capacitive-coupled circuit to the i-f preamplifier, Q4-Q5. Q4 is a dual-gate MOS-FET with a 55 MHz signal applied to gate 1 and a pre-shaped agc signal applied to gate 2. Agc is derived from agc shaping network, A3, which pre-shapes the linear receiver to provide low noise gain control of Q4. The output of Q4 is applied through a double-tuned inductive-coupled circuit to Q5, a bi-polar transistor connected in a grounded base configuration. These two double-tuned circuits (between Q4-Q4 and Q4-Q5) establish the 4 MHz transfer bandwidth of the rf tuner.

The 55 MHz output of Q5, taken from the center tap of autotransformer T1, is applied to P1-A1 as the i-f output signal of the rf tuner. A sample of the output is applied to P1-A2 as the SDU output signal.

The front panel first l-o mode switch, S1, determines which of the three possible 67.5-93.75 MHz oscillator signals will be applied to the multiplier chain and hence to the first mixer. Q11 functions as the variable frequency oscillator in one mode, and as the crystal oscillator in the second mode. In the third mode (external) it is inoperative.

When S1-B (VFO) is depressed, -15V is applied through FL3 to the emitter circuit of Q11, forward biasing CR1, turning on Q11. At the same time, diodes CR2 and CR3 are reverse biased, keeping the crystal connected to J3-1/J3-5 switched out of the circuit. One section of the eight-section inductuner (L1-H) is the tuning element of the oscillator. When S1-A (XTAL) is depressed, -15V is applied through FL1 to the emitter circuit of Q11, this time forward biasing CR2 and CR3 to allow the plug-in crystal (J3-1/J3-5) to be switched into the circuit. Q11 now functions as the crystal oscillator. In the xtal mode CR1 is reverse biased.

The output of Q11 is coupled to Q10, the vfo/xtal amplifier of combiner circuit Q8-Q9-Q10. When either S1-A or S1-B are depressed, -15V is also applied to Q10 turning it on and coupling the vfo or xtal l-o signal to combiner output amplifier Q8. When S1-C is depressed, the -15V is removed from Q11 and Q10, preventing them from operating; -15V is applied to amplifier Q9, turning it on. The external l-o input signal is then coupled in through P1-A4, amplified by Q9, and applied to combiner output amplifier Q8.

The 67.5-93.75 MHz output of the combiner, at the collector of Q8, is applied through a double-tuned circuit to the input of the first of two doublers, Q7 and Q6. Common-emitter amplifier, Q7, employs two sections of the inductuner (L1-G and L1-F) in its double-tuned output circuit which is tuned to twice the frequency of the input signal. This signal is then doubled again by Q6 which utilizes one section of the inductuner (L1-E) in its single-tuned output circuit. The 270-375 MHz signal at the output of Q6 is coupled through C22 to the input of the mixer, Q3.

4.2.1 AGC CIRCUITRY

The receiver agc signal input at P1-7 is coupled to E1 of subassembly A1 where it is applied to operational amplifier A1A1. Potentiometer A1R2, in conjunction with

A1CR1, sets the break point of the agc input signal to effect the proper slope change at the input of A1A1. The output of A1A1 is applied to buffer amplifier A1Q1 whose output is applied through A1E3 to gate 2 of Q1, the rf amplifier. Potentiometer A1R6 is the feedback loop adjustment used to set the agc slope. Potentiometer A2R4 operates as the agc threshold adjustment by controlling the current injection to the feedback loop.

The receiver agc applied to A1E2 is also applied to the agc shaping network, A3, which is essentially a resistive voltage divider network. A3R2 is the i-f agc slope adjustment and A3R5 is the gain set adjustment. The pre-shaped agc signal output of A3 is supplied to gate 2 of i-f preamplifier, Q4.

4.2.2 CRYSTAL OVEN TEMPERATURE REGULATOR, A3

The crystal oven temperature regulator board, A2, provides proportional control of the crystal oven heater in the front-panel crystal oven assembly. It accomplishes this function by controlling a current amplifier in series with the oven heater connected across the +20V and -20V lines. The control signal is derived from a negative temperature coefficient resistor (thermistor) in the front-panel oven assembly.

The thermistor is connected through J3-8 to the control input of integrated-circuit differential amplifier, A2Z1. As the instantaneous temperature of the oven varies, the resistance of the thermistor varies, and A2Z1, configured as a balanced bridge, provides an output signal proportional to the change in the resistance of the thermistor. This signal is amplified by A2Q1 which drives the current amplifier A2Q2-A2Q3 which, in turn, controls the current flow through the oven heater connected across J3-6 and J3-7. For example, as the temperature rises, the resistance of the negative temperature coefficient resistor (thermistor) decreases and the current through the oven heater decreases, lowering the oven temperature. In this manner, true proportional control of the oven temperature is achieved.

At the desired operating temperature of the oven, which is 75°C, the resistance of the thermistor will be approximately 4500 ohms. Zener diode, A2CR1, functions to prevent latch-up of A2Z1 if/when the thermistor is removed from the circuit; e.g., front panel crystal oven assembly unplugged.

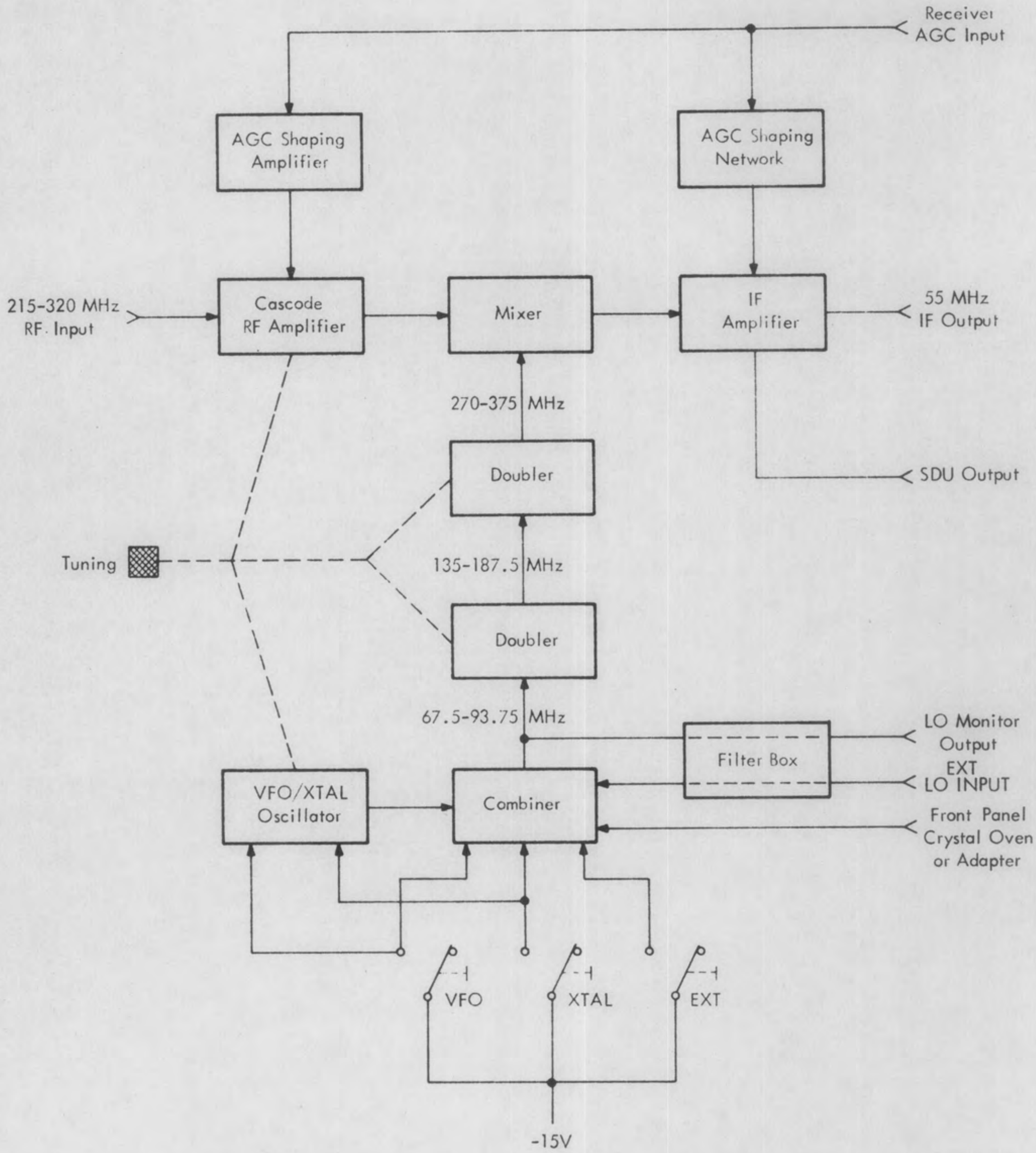


Figure 4-1. Model TU-74-PB RF Tuner, Block Diagram

SECTION V
MAINTENANCE

5.1 GENERAL

The Model TU-74-PB RF Tuner is designed to give long and troublefree performance with a minimum of maintenance. During normal operation, no periodic adjustments are required; unnecessary adjustments should be avoided as they may degrade the performance of the unit. The TU-74-PB should be kept clean, relatively dustfree, and in good mechanical condition. Lubrication is not required and should be avoided as damage to the unit could result.

5.2 PREVENTIVE MAINTENANCE

Preventive maintenance consists of both physical and electrical checks, which are designed to detect and prevent physical and performance deterioration. These checks are usually conducted at regular intervals.

Physical Checks

The regularly scheduled physical checks (weekly, monthly, or quarterly, as dictated by environmental conditions and the station preventive maintenance program) consist of blowing out the dust from the interior of the unit using low pressure air and making a visual inspection checking:

a. Resistors for blistering, discoloration, and other evidence of overheating.

b. Wiring for cut, cracked, or frayed insulation.

c. Machine screws and nuts for looseness.

d. Rear apron connectors for corrosion and loose connections.

e. Finish for scratches and bare spots.

Burned or discolored resistors and defective wiring should be replaced. When plugs or wiring have been replaced, refer to the schematic diagrams to ensure that the proper connections have been made. Bare spots and scratches should be covered using an available touch-up paint.

Performance Checks

It is recommended that the performance checks be conducted: 1) when the unit is installed; 2) prior to any major operational run; 3) as a semiannual preventive maintenance check; 4) after any major repair, realignment, or replacement of the subassemblies or components.

Since any valid performance checks must be performed in an operating TMR-74 receiver, the performance checks for the TU-74-PB are included as an integral part of the performance checks for the overall receiver. Refer to Section V, Maintenance, of the TMR-74 receiver instruction manual for details.

5.3 CORRECTIVE MAINTENANCE

The corrective maintenance for the TU-74-PB consists of troubleshooting, repair and replacement, and alignment. These are given in paragraphs 5.3.1, 5.3.2, and 5.3.3.

5.3.1 TROUBLESHOOTING

Troubleshooting should be based upon the performance of the equipment. The principles of operation, block diagram, and schematic diagrams given in this instruction manual should provide the data necessary for a trained maintenance technician to isolate the malfunction. If troubleshooting procedures for the reciever (as listed in Section V of the appropriate instruction manual) indicate that the rf tuner is inoperative or operating improperly, the cause should be isolated within the rf tuner by applying logical effect-to-cause reasoning.

For example, the input to the tuner is normal, the voltages applied to J2 are normal, however there is no i-f or sdu output at J2-A1 and J2-A2. Check the 55 MHz output to the preamplifier, Q4; if no signal is available at that point, the l-o drive can be checked at E2. If none, the l-o monitor output can be checked at J2A5 to determine if the oscillators and combiner are operating. If they are, the fault must be in the multiplier chain, Q7 and Q6. Checking each doubler will then quickly isolate the fault.

5.3.2 REPAIR AND REPLACEMENT

The rf tuner has been designed with a goal toward achieving ease and speed of maintenance. The disassembly and assembly of the unit should pose no problem to servicing personnel. All components are considered nonrepairable and should be replaced when defective. The replaceable components are listed in Section VI.

Access to the tuner circuitry is gained by removing the two side dust covers and then the top dust cover. Each side cover is held in place by nine Phillips head machine screws while the top cover is held in place by four of the same type screws. The major portion of the circuitry is contained in the rf subchassis which is assembled using point-to-point wiring. Four printed circuit boards are used, A1, A2, A3, which are mounted on spacers with Phillips head machine screws. The filter box assembly contains point-to-point wiring.

The main chassis switches, wiring, controls, and other mechanical components are removed and replaced in a straightforward manner, readily evident to a technician when viewing the tuner; thus their replacement is not detailed in this manual.

The plastic caps on the front panel pushbutton switches are friction fit type, i.e., they can be removed by grasping the cap firmly and sliding off.

The suggested procedure for removing components located on the printed circuit boards found in the receiver is given below; the procedure requires the use of the following material and equipment:

Liquid soldering flux	1/8 inch, #18 AWG flat braid
Liquid flux remover	Medium wattage soldering iron

Apply a thin coat of soldering flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the solder joint for long periods of time as excess heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and pry the component loose. Clean the affected area using the flux remover. Trim the replacement component leads to the same as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover. After repairs have been made, the affected unit should be realigned following the procedure referenced in paragraph 5.3.3.

5.3.3 ALIGNMENT

Recommended Equipment:

Power Supplies (two)	HP 721A
Test Set	Defense Electronics (TP 3994)
Sweep Generator (VHF)	Telonic SM-2000
Counter	HP 5245L, with 5253B converter
50 ohm Detector	Telonic XD-3A
DC VTVM	HP 412A
RF Millivoltmeter	HP 411A
Signal Generator	HP 608E

a. Equipment Setup.

(1) Interconnect power supplies, test set, and rf tuner.

(2) Turn on power supplies and adjust for +15V and -15V.

(3) Set short circuit current on both power supplies to 100 mA.

(4) Set AGC control on test set to zero.

b. LO Combiner Filter Alignment.

(1) Connect sweep generator output to Ext LO Input; connect 50 ohm detector to LO Output. Adjust sweep generator output for 40 MHz sweep centered about 80 MHz. Set rf tuner first l-o mode to EXT.

(2) Adjust C47 and C54 to produce a symmetrical response centered about 79 MHz. The 1 dB bandwidth referenced to center frequency should be a minimum of 30 MHz with a 1.5 to 2 dB dip in overall response.

c. VCO Alignment.

(1) Connect counter to LO Output. Place first l-o mode switch on tuner in VFO position.

(2) Adjust TUNING control for indicated frequency of 260 MHz.

(3) Adjust C71 on tuner assembly for a frequency indication on counter of 78.750 MHz ±100 kHz.

(4) Adjust tuner to 215 MHz. Adjust shunt indicator L25 for frequency indication of 67.50 MHz ±100 kHz.

(5) Rotate tuner dial to 320 MHz position. Adjust end inductor L24 for frequency indication of 93.75 MHz ±100 kHz.

(6) Repeat steps (2) through (5) until correct vfo frequencies are obtained for the corresponding dial frequency. Table 5-1 is provided as a guide for ascertaining vfo frequency versus dial frequencies.

Table 5-1. Dial Indication vs. VFO Frequency

Dial Indication	VFO Frequency
215.00	67.500000
220.00	68.750000
225.00	70.000000
230.00	71.250000
235.00	72.500000
240.00	73.750000
245.00	75.000000
250.00	76.250000
255.00	77.500000
260.00	78.750000
265.00	80.000000
270.00	81.250000
275.00	82.500000
280.00	83.750000
285.00	85.000000
290.00	86.250000
295.00	87.500000
300.00	88.750000
305.00	90.000000
310.00	91.250000
315.00	92.500000
320.00	93.750000

d. First Doubler Alignment.

(1) Set l-o mode switch to EXT. Connect sweep generator output to LO Output jack. Connect 50 ohm detector between ground and E3, at output of second doubler.

(2) Set tuner dial to 215 MHz and adjust C45 and C49 for a symmetrical response centered about 135 MHz.

(3) Set tuner dial to 320 MHz and adjust L20 and L22 end inductors for a symmetrical response centered about 187.5 MHz.

(4) Repeat steps (2) and (3) until second doubler filter is aligned and tracks properly throughout tuning range.

NOTE

If the mode switch is set to VFO, a "birdy" marker will be seen on the second doubler filter response. This marker will travel with transfer response during tuning, thereby enabling detection of vfo oscillator-to-doubler tracking performance.

e. Second Doubler Alignment.

(1) Set tuner dial to 215 MHz. Connect dc vtvm between ground and TP1 (+3.0V range). Select VFO first l-o mode.

(2) Adjust C41 for a maximum voltage indication on the dc vtvm.

(3) Reset tuner dial to 320 MHz and adjust L18 for maximum voltage indication.

(4) Alternately release and engage VFO mode switch while observing the dc vtvm. There should be typically 0.5 volt change in the voltage indication, with maximum voltage present when VFO is "on".

f. IF Alignment.

(1) Place lo mode switch in EXT position. Connect 50 ohm detector to IF Output jack.

(2) Connect sweep generator output to pin 3 of Q4, in i-f amplifier stage. Connect dc vtvm between ground and C30. Adjust A3R5 for +3.0V indication on voltmeter.

(3) Adjust C32 and C35 for a symmetrical response centered about 55 MHz. Detune C24 and C27, if necessary.

(4) Remove sweep generator connection from Q4, pin 3, and connect to E2, adjacent to Q3.

(5) Adjust C24 and C27 for symmetrical response centered about 55 MHz. (This should not require any retuning of C32 and C35 to obtain proper alignment.) Overall 1 dB bandwidth should be 4.0 MHz minimum.

g. RF Preselector Alignment.

(1) Set lo mode switch to EXT. Connect sweep generator output to RF Input jack, J1.

(2) Connect 50 ohm detector between ground and Q2 collector. Detung C12 and C20 to low-frequency side. Connect dc vtvm between ground and C10. Adjust A1R4 for +3.0V indication on voltmeter.

(3) Set tuner dial to 215 MHz and adjust C3 and C7 for symmetrical response centered about 215 MHz. Adjust C5 for 1.0 dB bandwidth of 12 MHz.

(4) Reset tuner dial to 320 MHz and adjust L3 and L5 for symmetrical response centered about 320 MHz.

(5) Repeat steps (3) and (4) as necessary to provide proper response throughout tuning range.

NOTE

Bandwidth of preselector will increase with increasing frequency. Therefore, adjustment of C5 should be made at 215 MHz only.

h. RF Interstage Filter Alignment.

(1) Connect sweep generator output to RF Input jack, J1. Connect marker adder input of sweep generator to TP1 on tuner. Set lo mode switch to EXT.

(2) Set tuner dial to 215 MHz and adjust C12 and C20 for symmetrical response centered about 215 MHz. Adjust C18 for a 1.0 dB bandwidth of 8 MHz.

(3) Reset tuner dial to 320 MHz and adjust L8 and L10 for symmetrical response centered about 320 MHz.

(4) Repeat steps (2) and (3) as necessary to provide proper response throughout tuning range.

i. Gain Adjustment.

(1) Connect signal generator output to RF input jack, J1. Set frequency to 260 MHz and output level to -30 dBm. Connect rf voltmeter with

50 ohm load to IF Output port, A1. Set mode switch to VFO.

(2) Set tuner dial to 260 MHz and adjust A3R5 for output indication of -10 dBm on rf voltmeter.

j. Agc Slope Adjustment.

(1) Connect signal generator to RF Input jack, J1. Set frequency to 260 MHz and output level to -30 dBm. Connect rf voltmeter to IF Output port, A1.

(2) Remove connection to terminal E1 on agc assembly, A3.

(3) Connect dc vtvm between ground and agc test point on tuner test set. Select +10V range.

(4) Set tuner dial to 260 MHz. Output indication on rf voltmeter should be -10 dBm.

(5) Set agc control on test set for a -2.0V indication on dc vtvm. Adjust A1R6 for a -14 dBm indication on the rf voltmeter.

(6) Set agc control on test set for -6V indication on the dc vtvm.

This completes the alignment of the TU-74-PB.

SECTION VI
ELECTRICAL PARTS LIST

This section of the manual contains the electrical parts list for the TU-74-PB including subassemblies A1 through A3. The electrical parts for subassemblies A1, A2, and A3 are listed separately in this section.

MAIN CHASSIS (See figures 7-1 and 7-3)

Reference Designation	Description
A1	AGC Shaping Amplifier, Defense Electronics 203277-91
A2	Temperature Regulator, Defense Electronics 105727-91
A3	AGC Shaping Network, Defense Electronics 106061-90
C1	Capacitor, ceramic, tubular, 10 pF ±0.1 pF, 500V, Erie NPO-301-000
C2	Capacitor, ceramic, tubular, 3.6 pF ±0.1 pF, 500V, Erie NPO-301-000
C3	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C4	Capacitor, ceramic, tubular, 2 pF ±0.1 pF, 500V, Erie NPO-301-000
C5	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C6	Capacitor, ceramic, tubular, 2 pF ±0.1 pF, 500V, Erie NPO-301-000
C7	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C8	Capacitor, ceramic, tubular, 6.8 pF ±.25 pF, 500V, Erie NPO-301-000
C9	Capacitor, ceramic, standoff, 470 pF ±20%, Allen Bradley SS5A-471W
C10	Capacitor, ceramic, feedthru, 470 pF, Allen Bradley FA5C-471W
C11	Capacitor, ceramic, 22 pF ±5%, 500V, JFD UY02-220J
C12	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C13	Capacitor, ceramic, 100 pF ±5%, 500V, JFD UY02-101J
C14	Capacitor, ceramic, 100 pF ±5%, 500V, JFD UY02-101J
C15	Capacitor, ceramic, standoff, 470 pF ±20%, Allen Bradley SS5A-471W
C16	Capacitor, ceramic, tubular, 1.5 pF ±.1 pF, 500V, Erie NPO-301-000
C17	Capacitor, ceramic, feedthru, 470 pF, Allen Bradley FA5C-471W

Main Chassis, continued

Reference Designation	Description
C18	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C19	Capacitor, ceramic, tubular, 1.5 pF ±.1 pF, 500V, Erie NPO-301-000
C20	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C21	Capacitor, ceramic, tubular, 5.1 pF ±.25 pF, 500V, Erie NPO-301-000
C22	Capacitor, ceramic, tubular, 1.5 pF ±.1 pF, 500V, Erie NPO-301-000
C23	Capacitor, ceramic, standoff, 470 pF ±20%, Allen Bradley SS5A-471W
C24	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C25	Capacitor, ceramic, standoff, 470 pF ±20%, Allen Bradley SS5A-471W
C26	Capacitor, ceramic, tubular, 0.8 pF ±.1 pF, Qual. Comp. Type QC
C27	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20GYCE
C28	Capacitor, dipped, mica, 62 pF ±5%, 500V, Elmenco DM15F620J
C29	Capacitor, ceramic, disc, 470 pF ±10%, Erie HR-839-X5F
C30	Capacitor, ceramic, feedthru, 470 pF, Allen Bradley FA5C-471W
C31	Capacitor, ceramic, disc, 470 pF ±10%, Erie HR-839-X5F
C32	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C33	Capacitor, ceramic, standoff, 470 pF ±20%, Allen Bradley SS5A-471W
C34	Capacitor, ceramic, standoff, 470 pF ±20%, Allen Bradley SS5A-471W
C35	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYF
C36	Capacitor, ceramic, tubular, 6.8 pF ±.25 pF, 500V, Erie NPO-301-000
C37	Capacitor, ceramic, feedthru, 470 pF, GMV, Allen Bradley FA5C-471W
C38	Capacitor, ceramic, standoff, 470 pF ±20%, Allen Bradley SS5A-471W
C39	Capacitor, ceramic, disc, 470 pF ±10%, Erie HR-839-X5F
C40	Capacitor, ceramic, feedthru, 470 pF, GMV, Allen Bradley FA5C-471W
C41	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C42	Capacitor, ceramic, feedthru, 470 pF, GMV, Allen Bradley FA5C-471W
C43	Capacitor, ceramic, feedthru, 470 pF, GMV, Allen Bradley FA5C-471W
C44	Capacitor, ceramic, tubular, 10 pF ±.1 pF, 500V, Erie NPO-301-000
C45	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C46	Capacitor, ceramic, tubular, 9.1 pF±.5pF,500V, Erie NPO-301-000

Main Chassis, continued

Reference Designation	Description
C47	Capacitor, ceramic, tubular, 2.7 pF ±.1 pF, 500V, Erie NPO-301-000
C48	Capacitor, ceramic, tubular, 13 pF ±5%, 500V, Erie NPO-301-000
C49	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C50 through C52	Capacitor, ceramic, feedthru, 470 pF, GMV Allen Bradley FA5C-471W
C53	Capacitor, ceramic, tubular, 15 pF ±5%, 500V, Erie NPO-301-000
C54	Capacitor, ceramic, tubular, 47 pF ±5%, 500V, Erie NPO-308-000
C55	Capacitor, ceramic, tubular, 15 pF ±5%, 500V, Erie NPO-301-000
C56	Capacitor, ceramic, tubular, 15 pF ±5%, 500V, Erie NPO-301-000
C57	Capacitor, ceramic, tubular, 47 pF ±5%, 500V, Erie NPO-308-000
C58	Capacitor, ceramic, tubular, 15 pF ±5%, 500V, Erie NPO-301-000
C59	Capacitor, ceramic, tubular, 4.7 pF ±0.25 pF, 500V, Erie NPO-301-000
C60	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYF
C61	Capacitor, ceramic, tubular, 13 pF ± 5%, 500V, Erie NPO-301-000
C62	Capacitor, ceramic, standoff, 470 pF, ±20%, Allen Bradley SS5A-471W
C63	Capacitor, ceramic, feedthru, 470 pF, GMV, Allen Bradley FA5C-471W
C64	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C65	Capacitor, ceramic, feedthru, 470 pF, GMV, Allen Bradley FA5C-471W
C66 through C68	Capacitor, ceramic, disc, 270 pF ±10%, Erie HR-839-X5F
C69	Capacitor, ceramic, feedthru, 470 pF, GMV, Allen Bradley FA5C-471W
C70	Capacitor, ceramic, tubular, 2.2 pF ±.25 pF, 500V, Erie NPO-301-000
C71	Capacitor, variable, glass, 0.8-8.5 pF, JFD VC-20-GYCE
C72	Capacitor, ceramic, tubular, 12 pF ±5%, 500V, Erie N150-301-000
C73	Capacitor, ceramic, tubular, 27 pF ±5%, 500V, Erie NPO-308-000
C74	Capacitor, ceramic, tubular, 24 pF ±5%, 500V, Erie NPO-308-000

Main Chassis, continued

Reference Designation	Description
C75	Capacitor, ceramic, tubular, 20 pF ±5%, 500V, Erie NPO-301-000
C76	Capacitor, ceramic, tubular, 47 pF ±5%, 500V, Erie NPO-308-000
C77	Capacitor, ceramic, tubular, 47 pF ±5%, 500V, Erie NPO-308-000
C78	Capacitor, ceramic, feedthru, 470 pF, GMV, Allen Bradley FA5C-471W
C79	Capacitor, ceramic, disc, 100 pF ±10%, Erie HR-839-X5F
C80 through C84	Capacitor, ceramic, feedthru, 470 pF, GMV, Allen Bradley FA5C-471W
C85	Capacitor, ceramic, standoff, 470 pF ±20%, Allen Bradley SS5A-471W
C86	Capacitor, ceramic, disc, 0.005 μF, -40 +60%, 150V, Centralab DDM-502
CR1 through CR3	Diode, 1N914A
E1 through E7	Terminal, feedthru, Sealectro FT-SM-1
E8	Terminal, standoff, Sealectro ST-SM-1
E9	Terminal, standoff, Sealectro ST-SM-1
E10	Terminal, feedthru, Sealectro FT-SM-1
E11	Terminal, feedthru, Sealectro FT-SM-1
E12 through E17	Terminal, standoff, Sealectro ST-SM-1
E18 through E20	Terminal, standoff, Sealectro TF-300
FL1 through FL12	Filtercon, feedthru, 1500 pF, 200V, Erie 1201-052
J1	Connector, type N, Americon 3004-7141, integral part of W1

Main Chassis, continued

Reference Designation	Description
J1	Connector, type N, Americon 3004-7141, integral part of W1
J2	Connector, tnc, Fxr. 79775, Alternate Fxr. 31-2301
J3	Connector, Cannon DEMF-9S
L1	Inductuner, Defense Electronics 303424
L2	Inductor, Defense Electronics 500031
L3	Inductor, Defense Electronics 106017
L4	Inductor, Defense Electronics 106018-3
L5	Inductor, Defense Electronics 106017
L6	Inductor, Defense Electronics 106018-3
L7	Inductor, Defense Electronics 106125
L8	Inductor, Defence Electronics 106017
L9	Inductor, Defense Electronics 106018-3
L10	Inductor, Defense Electronics 106017
L11	Inductor, Defense Electronics 106018-3
L12	Inductor, fixed, rf, 0.33 uH ±10%, Nytronics WEE-.33
L13 through L15	Inductor, fixed, rf, 1.0 uH ±10%, Nytronics WEE-1.0
L16	Inductor, fixed, rf, 0.18 uH ±10%, Nytronics WEE-.18
L17	Inductor, fixed, rf, 0.56 uH ±10%, Nytronics WEE-.56
L18	Inductor, Defense Electronics 106017
L19	Inductor, Defense Electronics 106018-1
L20	Inductor, Defense Electronics 106017
L21	Inductor, Defense Electronics 106018-2
L22	Inductor, Defense Electronics 106017
L23	Inductor, Defense Electronics 106018-2
L24	Inductor, fixed, 0.1 uH ±10%, Nytronics WEE-.1
L25	Inductor, fixed, 0.1 uH ±10%, Nytronics WEE-.1
L26	Inductor, fixed, 0.1 uH ±10%, Nytronics WEE-.1

Main Chassis, continued

Reference Designation	Description
L27	Inductor, fixed, 0.1 uH ±10%, Nytronics WEE-.1
L28	Inductor, fixed, rf, 0.18 uH ±10%, Nytronics WEE-.18
L29	Inductor, fixed, rf, 0.18 uH ±10%, Nytronics WEE-.18
L30	Inductor, fixed, rf, 0.33 uH ±10%, Nytronics WEE-.33
L31	Inductor, Defense Electronics 106017
L32	Inductor, Defense Electronics 106018-4
L33	Inductor, fixed, rf, 0.56 uH ±10%, Nytronics WEE-.56
L34	Inductor, fixed, rf, 0.27 μH ± 10%, Nytronics WEE-.27
P1	Connector, Cannon DCM-17W5P
P1A1	Coaxial Insert, Cannon DM53740-1, integral part of W2
P1A2	Coaxial Insert, Cannon DM53740-1, integral part of W3
P1A3	Not assigned
P1A4	Coaxial Insert, Cannon DM53740-1, integral part of W5
P1A5	Coaxial Insert, Cannon DM53740-1, integral part of W4
Q1	Transistor, MOS-FET, RCA TA-7153
Q2	Transistor, Bi-Polar, Motorola 2N5032
Q3	Transistor, MOS-FET, RCA 3N143
Q4	Transistor, MOS-FET, RCA 3N159
Q5	Transistor, Bi-Polar, Amperex A-492
Q6 through Q11	Transistor, Bi-Polar, RCA 2N3933
R1	Resistor, fixed composition, 100k ±5%, 1/4W, Allen Bradley CB1045
R2	Resistor, fixed composition, 10k ±5%, 1/4W, Allen Bradley CB1035
R3	Resistor, fixed composition, 10Ω ±5%, 1/4W, Allen Bradley CB1005
R4	Resistor, fixed composition, 62Ω ±5%, 1/4W, Allen Bradley CB6205
R5	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R6	Resistor, fixed composition, 4.3k ±5%, 1/4W, Allen Bradley CB4325

Main Chassis, continued

Reference Designation	Description
R7	Resistor, fixed composition, 2k ±5%, 1/4W, Allen Bradley CB2025
R8	Resistor, fixed composition, 10K ±5%, 1/4W, Allen Bradley CB1035
R9	Resistor, fixed composition, 22Ω ±5%, 1/4W, Allen Bradley CB2205
R10	Resistor, fixed composition, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R11	Resistor, fixed composition, 2k ±5%, 1/4W, Allen Bradley CB2025
R12	Resistor, fixed composition, 10k ±5%, 1/4W, Allen Bradley CB1035
R13 through R15	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R16	Resistor, fixed composition, 4.7Ω ±5%, 1/4W, Allen Bradley CB4725
R17	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R18	Resistor, fixed composition, 62Ω ±5%, 1/4W, Allen Bradley CB6205
R19	Resistor, fixed composition, 3.3k ±5%, 1/4W, Allen Bradley CB3325
R20	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R21	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R22	Resistor, fixed composition, 910Ω ±5%, 1/4W, Allen Bradley CB
R23	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R24	Resistor, fixed composition, 220Ω ±5%, 1/4W, Allen Bradley CB2215
R25	Resistor, fixed composition, 330Ω ±5%, 1/4W, Allen Bradley CB3315
R26	Resistor, fixed composition, 220Ω ±5%, 1/4W, Allen Bradley CB2215
R27	Resistor, fixed composition, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R28	Resistor, fixed composition, 22Ω ±5%, 1/4W, Allen Bradley CB2205
R29	Resistor, fixed composition, 1.6k ±5%, 1/4W, Allen Bradley CB1625
R30	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R31	Resistor, fixed composition, 4.3k ±5%, 1/4W, Allen Bradley CB4325
R32	Resistor, fixed composition, 22Ω ±5%, 1/4W, Allen Bradley CB2205
R33	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R34	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R35	Resistor, fixed composition, 1.6k ±5%, 1/4W, Allen Bradley CB1625
R36	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725

Main Chassis, continued

Reference Designation	Description
R37	Resistor, fixed composition, 4.3k ±5%, 1/4W, Allen Bradley CB4325
R38	Resistor, fixed composition, 24Ω ±5%, 1/4W, Allen Bradley CB2405
R39	Resistor, fixed composition, 24Ω ±5%, 1/4W, Allen Bradley CB2405
R40	Resistor, fixed composition, 36Ω ±5%, 1/4W, Allen Bradley CB3605
R41	Resistor, fixed composition, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R42	Resistor, fixed composition, 22Ω ±5%, 1/4W, Allen Bradley CB2205
R43	Resistor, fixed composition, 4.3k ±5%, 1/4W, Allen Bradley CB4325
R44	Resistor, fixed composition, 4.3k ±5%, 1/4W, Allen Bradley CB4325
R45	Resistor, fixed composition, 10Ω ±5%, 1/4W, Allen Bradley CB1005
R46	Resistor, fixed composition, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R47	Resistor, fixed composition, 3.3k ±5%, 1/4W, Allen Bradley CB3325
R48	Resistor, fixed composition, 3.3k ±5%, 1/4W, Allen Bradley CB3325
R49	Resistor, fixed composition, 51Ω ±5%, 1/4W, Allen Bradley CB5105
R50	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R51	Resistor, fixed composition, 1.8k ±5%, 1/4W, Allen Bradley CB1825
R52	Resistor, fixed composition, 1.2k ±5%, 1/4W, Allen Bradley CB1225
R53	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R54	Resistor, fixed composition, 4.3k ±5%, 1/4W, Allen Bradley CB4325
R55	Resistor, fixed composition, 22Ω ±5%, 1/4W, Allen Bradley CB2205
R56	Resistor, fixed composition, 3.9k ± 5%, 1/4W, Allen Bradley CB3925
R57	Resistor, fixed composition, 47 Ω± 5%, 1/4W, Allen Bradley CB4705
R58	Resistor, fixed composition, 47 Ω± 5%, 1/4W, Allen Bradley CB4705
S1	Switch, pushbutton assembly, 1st l-o mode, Defense Electronics 203239
T1	Transformer Assembly, Defense Electronics 203533
TP1	Test Point Jack, Sealectro SKT-5BC
W1	Cable Assembly, Defense Electronics 203751-1
W2	Cable Assembly, Defense Electronics 203751-3

Main Chassis, continued

Reference Designation	Description
W3	Cable Assembly, Defense Electronics 203751-3
W4	Cable Assembly, Defense Electronics 203751-2
W5	Cable Assembly, Defense Electronics 203751-2
W6	Cable Assembly, Defense Electronics 203751-4
Z1 through Z7	Bead, ferrite, Ferroxcube K.5001.0013B

Miscellaneous:

Pushbutton, engraved (VFO), Defense Electronics 105842-1

Pushbutton, engraved (XTAL), Defense Electronics 105842-2

Pushbutton, engraved (EXT), Defense Electronics 105842-3

AGC SHAPING AMPLIFIER, A1, (See figure 7-2)

Reference Designation	Description
A1	Integrated circuit, LM-301A
C1	Capacitor, ceramic, 30 pF ±5%, Erie NPO-308
C2	Capacitor, ceramic, monolithic, 0.01 µF ±20%, 25V, Sprague 3C023103X025A3
CR1	Diode, silicon, 1N914A
Q1	Transistor, silicon, 2N2218
R1	Resistor, fixed composition, 6.2k ±5%, 1/4W, Allen Bradley CB6225
R2	Resistor, variable, 1.0k ±10%, Bourns 3009P-1-1K
R3	Resistor, fixed composition, 68k ±5%, 1/4W, Allen Bradley CB6835
R4	Resistor, variable, 100k ±10%, Bourns 3009P-1-100K
R5	Resistor, fixed composition, 3.9k ±5%, 1/4W, Allen Bradley CB3925
R6	Resistor, variable, 10k ±10%, Bourns 3009P-1-10K
R7	Resistor, fixed composition, 20k ±5%, 1/4W, Allen Bradley CB2035
R8	Resistor, fixed composition, 10Ω ±5%, 1/4W, Allen Bradley CB1005

CRYSTAL OVEN TEMPERATURE REGULATOR, A2 (See figure 7-2)

Reference Designation	Description
C1	Capacitor, ceramic, monolythic, 0.01 μF ±20%, 25V, Sprague 3C023103X025A3
C2	Capacitor, ceramic, disc, 0.005 μF, -20%+80%, 50V, Centralab CK 502
CR1	Diode, zener, 6.2V ±5%, Motorola 1N753A
Q1	Transistor, silicon, pnp, Motorola 2N3251
Q2	Transistor, silicon, npn, RCA 2N2270
Q3	Transistor, silicon, npn, power, Motorola 2N4919
R1	Resistor, fixed film, 22.6k ±1%, 1/8W, RN55D2262F
R2	Resistor, fixed film, 4.12k ±1%, 1/8W, RN55D4121F
R3	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R4	Resistor, fixed composition, 18k ±5%, 1/4W, Allen Bradley CB1835
R5	Resistor, fixed composition, 2.7k ±5%, 1/4W, Allen Bradley CB2725
R6	Resistor, fixed film, 22.6k ±1%, 1/8W, RN55D2262F
R7	Resistor, fixed composition, 1k ±5%, 1/4W, Allen Bradley CB1025
R8	Resistor, fixed composition, 12k ±5%, 1/4W, Allen Bradley CB1235
Z1	Integrated circuit, differential amplifier, RCA CA3028A

AGC SHAPING NETWORK, A3 (See figure 7-3)

Reference Designation	Description
R1	Resistor, fixed composition, 6.8k ±5%, 1/4W, Allen Bradley CB6825
R2	Resistor, variable, 2k, Bourns 3009P-202
R3	Resistor, fixed composition, 33k ±5%, 1/4W, Allen Bradley CB3335
R4	Resistor, fixed composition, 110k ±5%, 1/4W, Allen Bradley CB1145
R5	Resistor, variable, 10k, Bourns 3009P-103

SECTION VII
MAINTENANCE DIAGRAMS

This section contains the component location drawings and the schematic diagrams for the TU-74-PB. Unless otherwise specified, the following information applies to the schematic diagrams:

a. Capacitor values less than one are in microfarads.

b. Capacitor values greater than one are in micromicrofarads (picofarads).

c. Inductance values are in microhenries.

d. Resistance values are in ohms; k=1,000; M=1,000,000.

e. Arrow denotes clockwise adjustment.

f. * Typical value shown, factory selected.

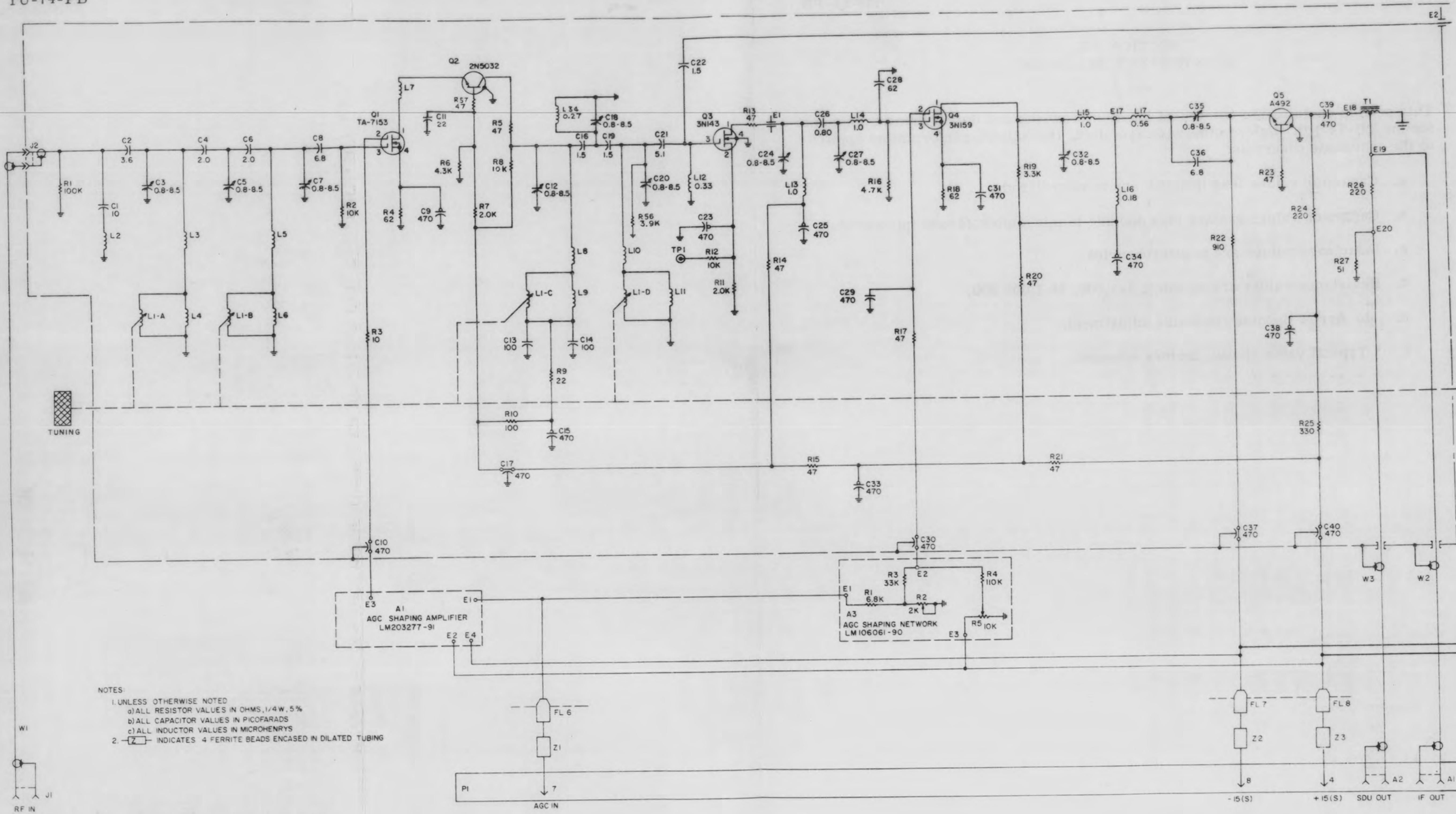


Figure 7-1. Model TU-74-PB RF Tuner, Schematic Diagram (Sheet 1 of 3)

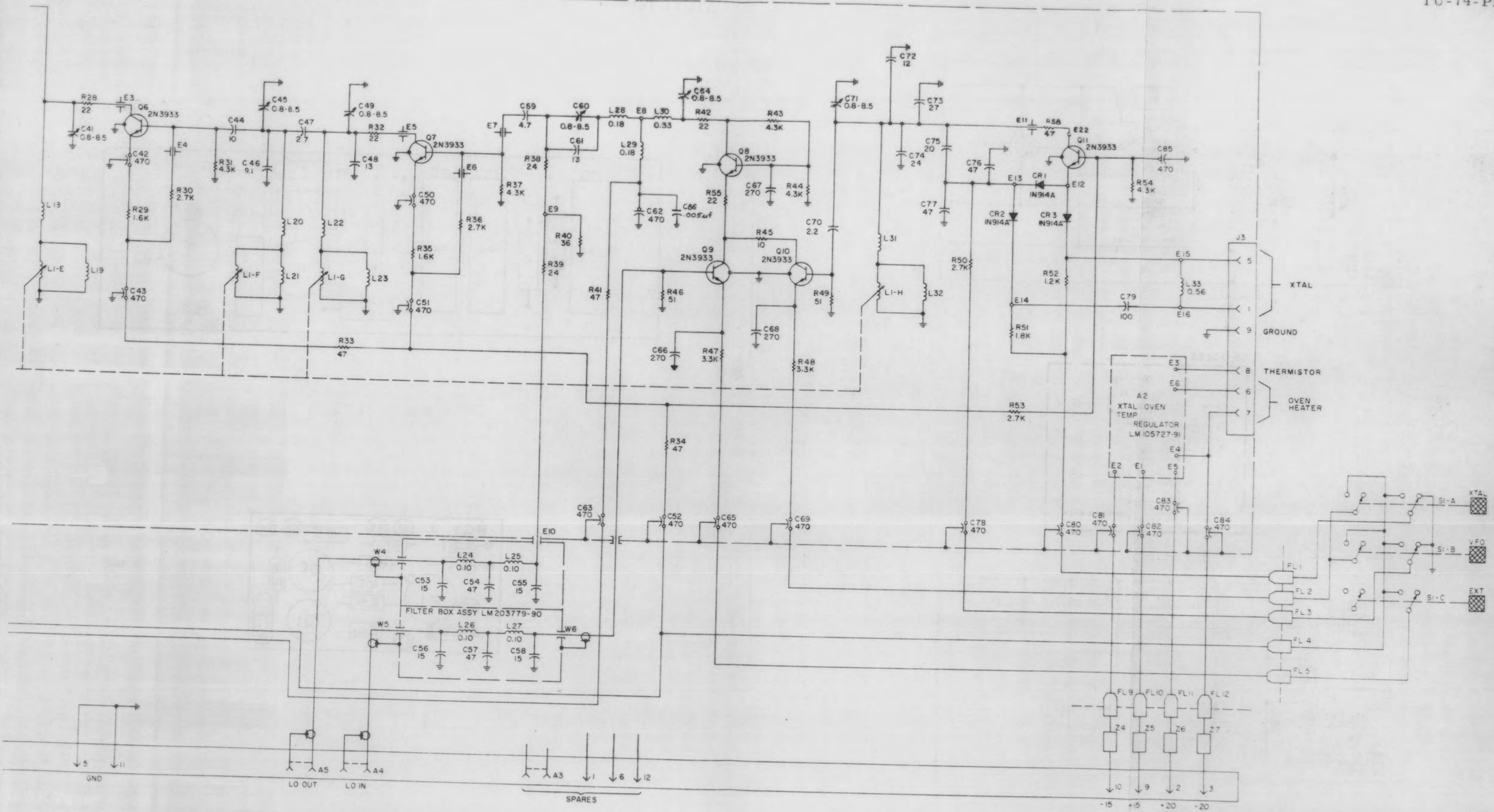


Figure 7-1. Model TU-74-PB RF Tuner Schematic Diagram (Sheet 2 of 3)

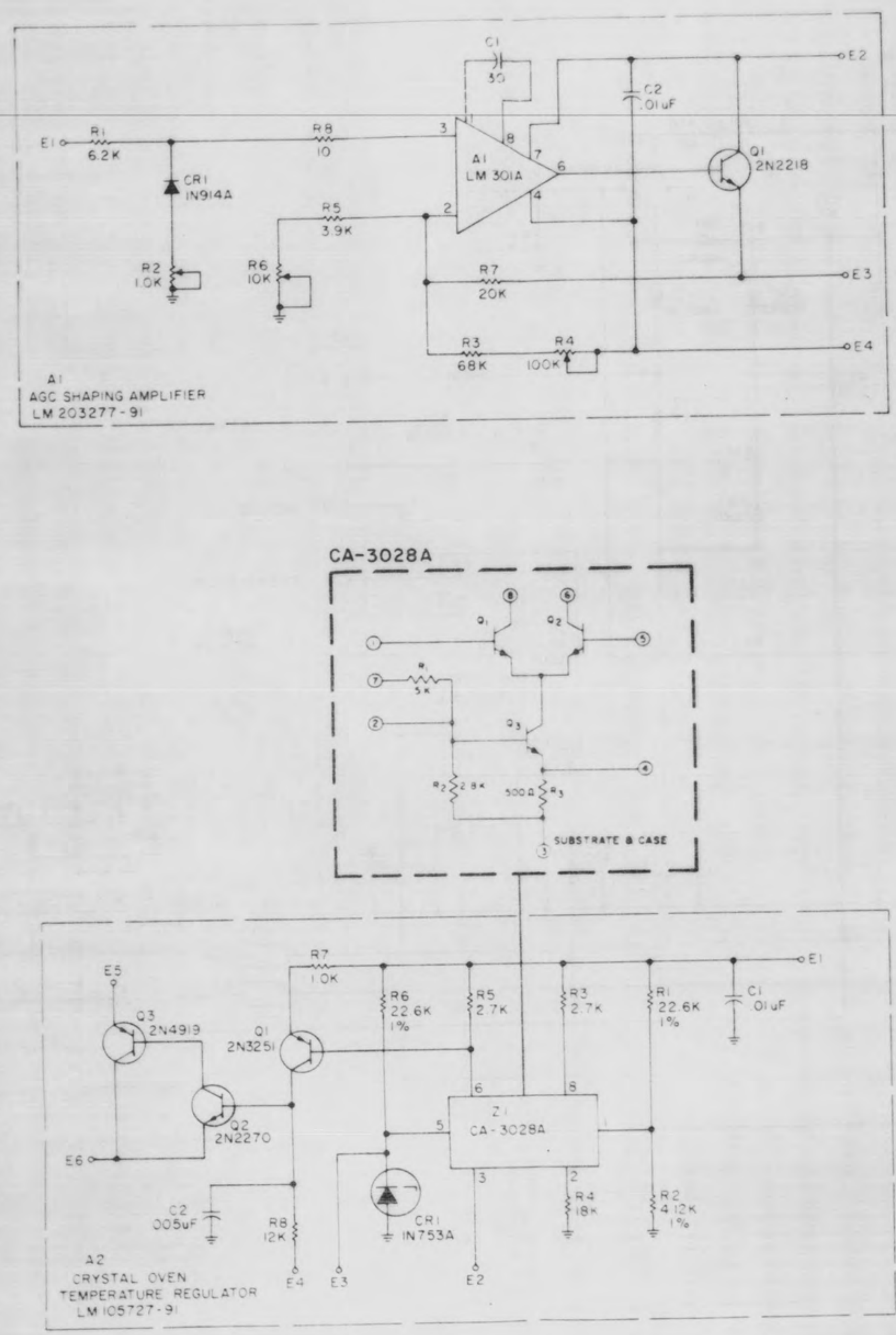


Figure 7-1. Model TU-74-PB RF Tuner, Schematic Diagram (Sheet 3 of 3)

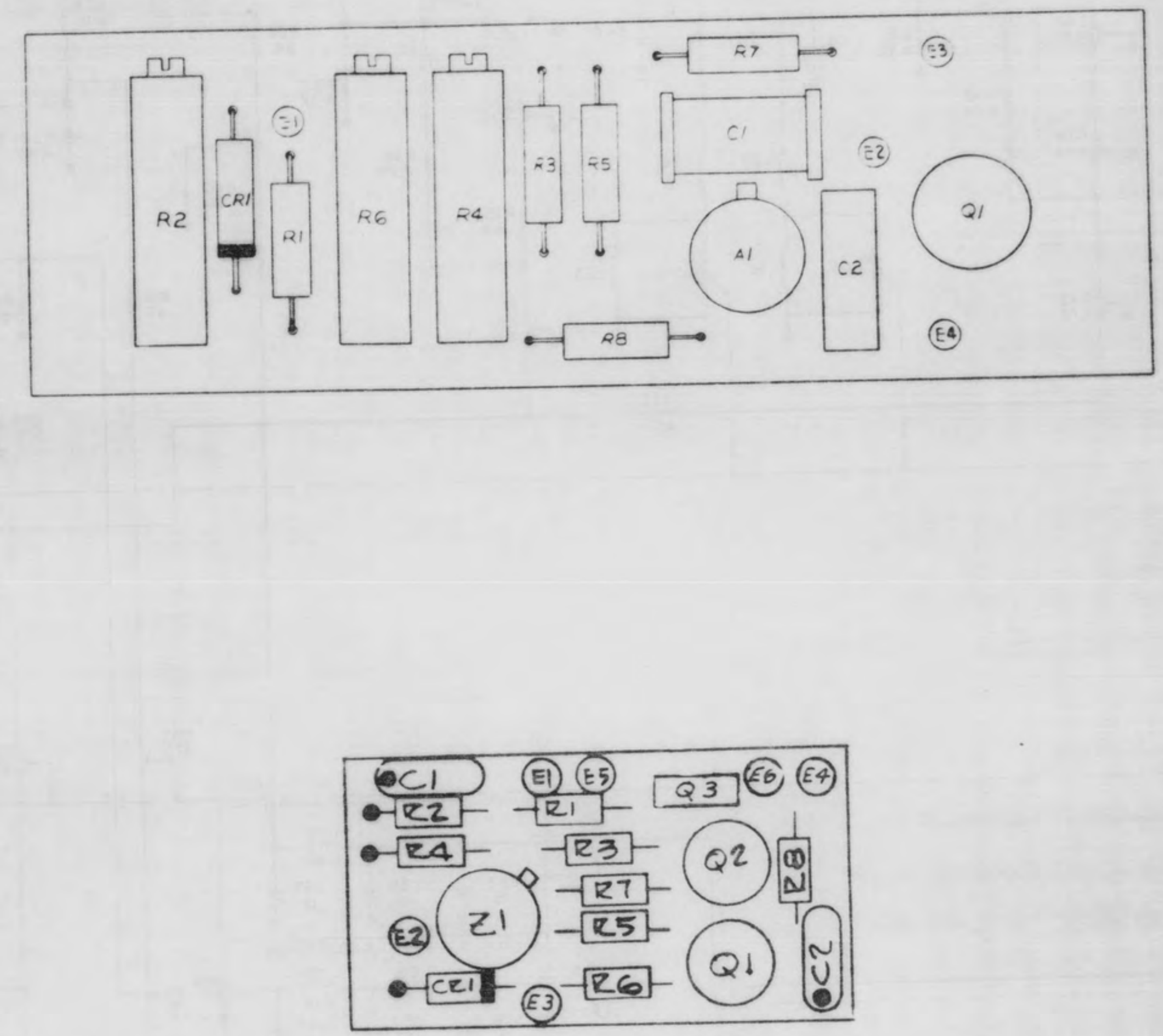
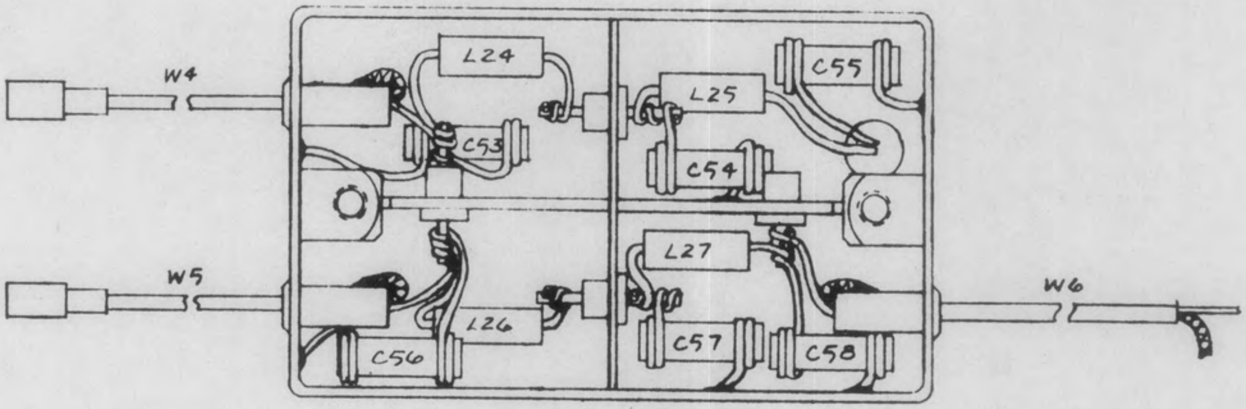


Figure 7-2. Component Location Drawings
AGC Shaping Amplifier, A1 (Top)
Crystal Oven Temperature Regulator, A2 (Bottom)



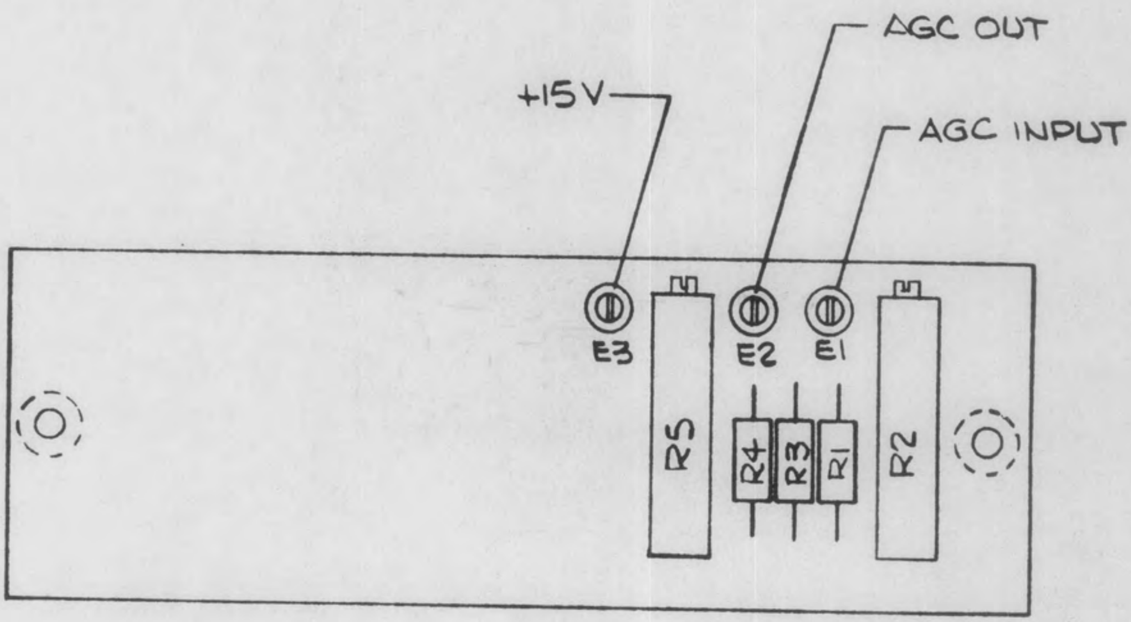


Figure 7-3. Component Location Drawings
Filter Box Assembly (Top)
AGC Shaping Network, A3 (Bottom)

February 1970

MODEL D-74-N
NARROW BANDWIDTH FM DEMODULATOR

INSTRUCTION BOOKLET

The Model D-74-N Narrow Bandwidth FM Demodulator is an internal plug-in module of the Model DF-74-H FM Demodulator Housing. The D-74-N is designed for use in conjunction with second i-f bandwidths of 10 kHz through 50 kHz.

The primary function of the D-74-N is to detect frequency modulation from receiver second i-f signals. In addition, the demodulator provides a limited 10 MHz output signal for predetection recording. The demodulator circuitry is completely solid state, providing compactness and a high degree of reliability.

The D-74-N is a plug-in printed circuit board that may be installed in or removed from the demodulator housing in a matter of minutes. To effect installation or removal, the housing must be removed from the receiver and the top cover, which is held in place by six Phillips head screws, removed.

Specifications for the D-74-N are given in table 1, a transistor complement is given in table 2, and a block diagram of the unit is shown in figure 1.

Table 1. Specifications

Center Frequency	10 MHz.
IF Bandwidths	for use with 10 kHz to 50 kHz i-f filter.
FM Frequency Response	dc to 15 kHz (3 dB).
Deviation Sensitivity	1.5 kHz deviation will produce rated video output.
Linearity	less than 2% distortion with 15 kHz deviation at 1 kHz modulation frequency.
Center Frequency Stability	±1.0 kHz over temperature range.
Capture Ratio	0.8.
Limited IF Output	50 mV into 50 ohm load (-13 dBm).
Deviation Meter Ranges	3, 10, 30 kHz full scale.

Table 2. Transistor Complement

Reference Designation	Type	Function
Q1	2N708	10 MHz Amplifier
Q2	2N708	Limiter
Q3	2N708	
Q4	2N708	Limiter
Q5	2N708	
Q6	2N708	Q Multiplier
Q7	2N708	Limiter
Q8	2N708	
Q9	2N708	Q Multiplier
Q10	2N708	Buffer Amplifier
Q11	2N708	Limiter
Q12	2N708	

PRINCIPLES OF OPERATION

The D-74-N consists of an input 10 MHz amplifier, from two-stage limiters, two Q multipliers, a 10 MHz buffer amplifier, and a crystal discriminator. Refer to the block diagram, figure 1, and the schematic diagram, figure 2.

The 10 MHz input signal is applied through A1 to the 10 MHz input amplifier, Q1. Q1 ensures proper operation of the first limiter, Q2-Q3. The output of Q1 is capacitively coupled to the base of Q2, the first stage of the first limiter, by C2.

The limiters (Q2-Q3, Q4-Q5, Q7-Q8, and Q11-Q12) are non-saturating emitter-coupled pairs which provide full-wave limiting of the signal.

The Q multipliers, Q6 and Q9, effectively increase the Q of their associated tuned circuits to achieve the narrow bandwidth required.

A 10 MHz limited output signal is obtained from the collector of buffer amplifier Q10, and made available at A3.

The limited 10 MHz signal from the final limiter, Q11-Q12, is applied to the crystal discriminator.

In the discriminator, the inductive reactance of quartz crystal Y1 operating between series and parallel resonance is used to form a series resonant circuit at 10 MHz with C31. The inductive reactance of the crystal is trimmed by C35, C36 and L11 to a value which causes equal voltages to be developed across the inductive and capacitive portions of the circuit at exactly 10 MHz. The voltages across these portions are detected and subtracted by the diodes CR1 and CR2.

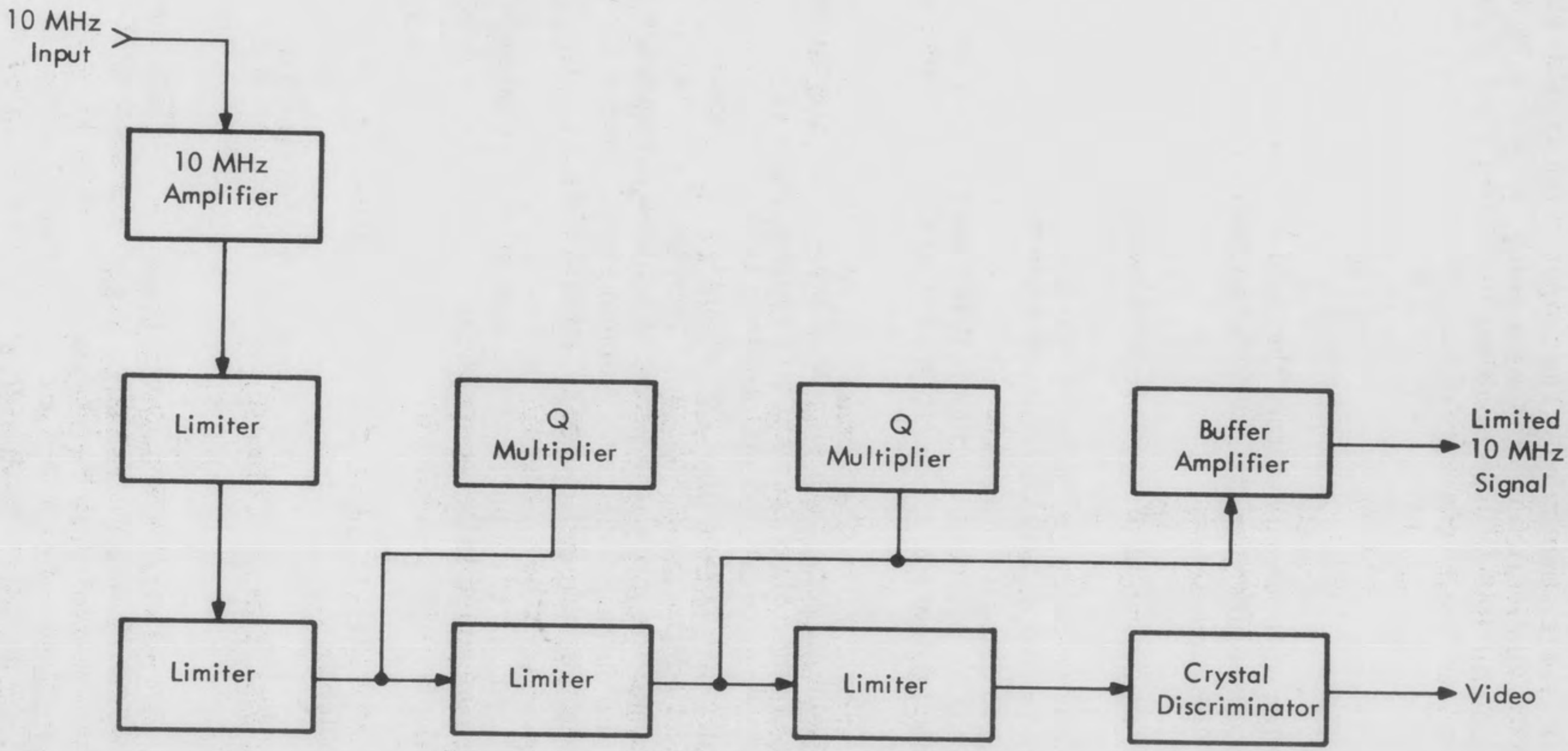


Figure 1. Model D-74-N FM Demodulator
Functional Block Diagram

For frequencies other than 10 MHz the voltages detected by the diodes are unequal, causing an output that is greater than zero. The output of the crystal discriminator is then applied to pin 9 for application to the output buffer amplifier in the demodulator housing. Potentiometer R45 is used to adjust the output level of the demodulator.

MAINTENANCE

Due to the efficient design of the demodulator, the need for maintenance is limited. It is assembled and disassembled in a straightforward manner and should pose no problem to servicing personnel.

All circuitry is located on a plug-in printed circuit board.

All components, including transistors, are soldering in place. All components are considered non-repairable and should be replaced when defective.

During normal operation, no periodic realignment is necessary or desirable. Unnecessary adjustments may degrade the performance of the equipment and therefore should be avoided.

Straightforward troubleshooting methods should be used if a malfunction occurs. The block diagram, schematic diagram, and circuit description given herein should provide the data necessary for qualified maintenance technicians to isolate the malfunction using effect-to-cause reasoning. For example, if the input to the demodulator is normal and the 10-MHz limited output is present at A3, but no output is obtained from output connector pin 9, the defect is located between the input to limiters Q11-Q12 and the output connector. Normal signal tracing techniques should be used to isolate the malfunction to the defective stage.

If a component is replaced, a realignment of the assembly may be necessary. In this case the following procedure is recommended:

Alignment

Recommended Equipment:

Test Set	Defense Electronics 105960
Power Supplies (two req'd)	HP 721A
Sweep Generator	HP 675A
Oscilloscope	HP 120A
FM Generator	Boonton 202J
Univerter	Boonton 207H
Counter	HP 5245L
RF Millivoltmeter, with 50 ohm termination	HP 411A

continued

Recommended Equipment, continued

VTVM	HP 412A
Signal Generator	HP 606A
Test Oscillator	HP 651
Balanced Mixer	HP 10514A
Distortion Analyzer	HP 331A
Filter	Krohn-Hite 315A

a. Connect the power supplies to the test set, and adjust them for +15V and -15V; set the short circuit current to 100 mA.

b. Limiter Alignment.

(1) Connect test equipment as shown in figure A.

(2) Set HP 675 sweep generator for $F_O/\Delta F$, with F_O equal to 10.0 MHz, ΔF equal to 200 kHz initially. Set the sweep generator for horizontal markers.

(3) Apply power to the demodulator. Connect the test probe of the test set to TP2 of the demodulator. Set the HP 606A to 10.000 MHz and the HP 651 to approximately 80 kHz. Adjust L2 and L3 for a symmetrical (no tilt) double-tuned response with the markers equally down the skirts of the response (do not change the frequency of the HP 606A).

(4) Connect the test probe of the test set to TP3 of the demodulator. Set the HP 606A to 10.000 MHz and the HP 651 to approximately 35 kHz. Adjust L4 and L5 for a symmetrical response as above.

(5) Connect the test probe of the test set to TP4 on the demodulator. Set the HP 606A to 10.000 MHz and the HP 651 to approximately 25 kHz. Adjust L7 and L8 for a symmetrical response as above.

c. Detector Alignment.

(1) Connect equipment as shown in figure A with the oscilloscope vertical input connected to the video output on the test set. Set the HP 606A to 10.000 MHz and set the HP 651 to approximately 35 kHz. Set the sweep time for about 0.1 sec.

(2) Adjust L11 for an S curve with its negative (low-frequency) peak at the frequency of the lower marker (9.965 MHz). Adjust L10 for best linearity of the central portion of the S curve.

(3) Connect test equipment as shown in figure B. Set the Boonton 202J for 1 kHz (or 1700 Hz) internal fm, 15 kHz deviation. Set its center frequency so the Univerter output is at 10.000 MHz ±0.5 kHz as indicated by the counter.

(4) With the Krohn-Hite filter set as a highpass with a cutoff frequency of 350 Hz, read the distortion of the demodulator output. Adjust L10 for minimum distortion.

(5) Recheck step (2) using the setup of figure B for zero output at 10.000 MHz. If readjustment of L11 appears necessary, also repeat step (4).

d. Deviation Sensitivity Adjustment.

(1) Connect test equipment as shown in figure C.

(2) Starting with the Boonton 202J set for a univerter cw output of 10.000 MHz, tune the 202J higher in frequency to produce an output of +1.00V on the 1V scale of the HP 412A. Note this frequency.

(3) Tune the 202J lower in frequency to produce an output of -1.00V on the 1V scale of the HP 412A. Note this frequency.

(4) The frequency difference between steps (2) and (3) should be 26.7(±0.5) kHz. If it is less, rotate R45 counterclockwise, if it is more, rotate R45 clockwise. Repeat steps (2) and (3).

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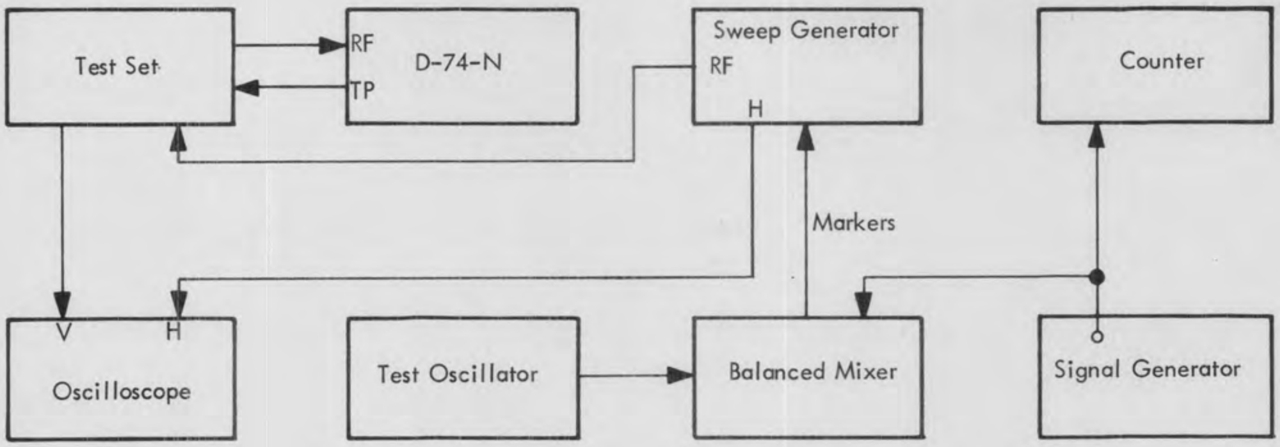


Figure A. Test Equipment Setup No. 1

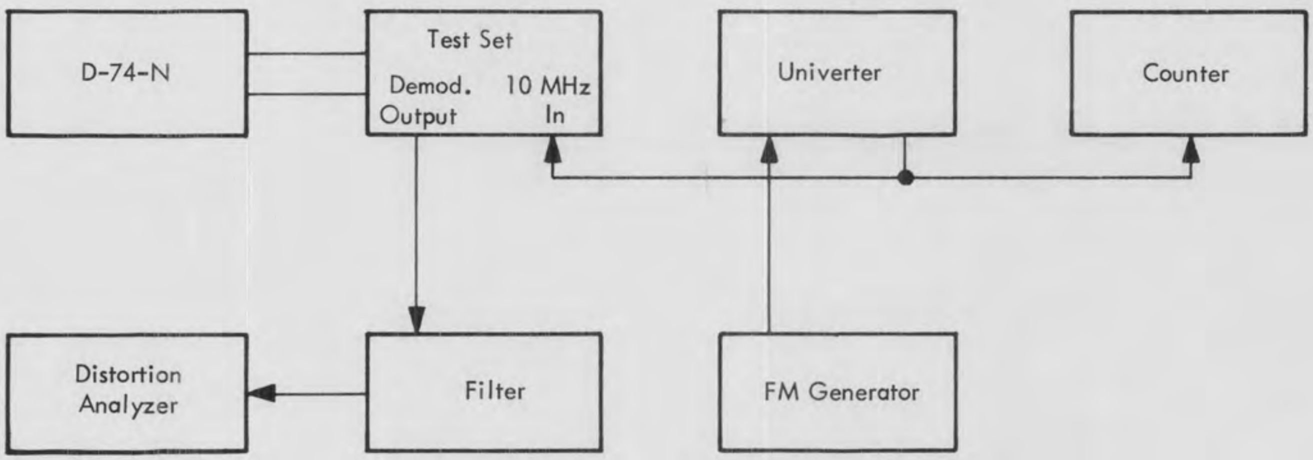


Figure B. Test Equipment Setup No. 2

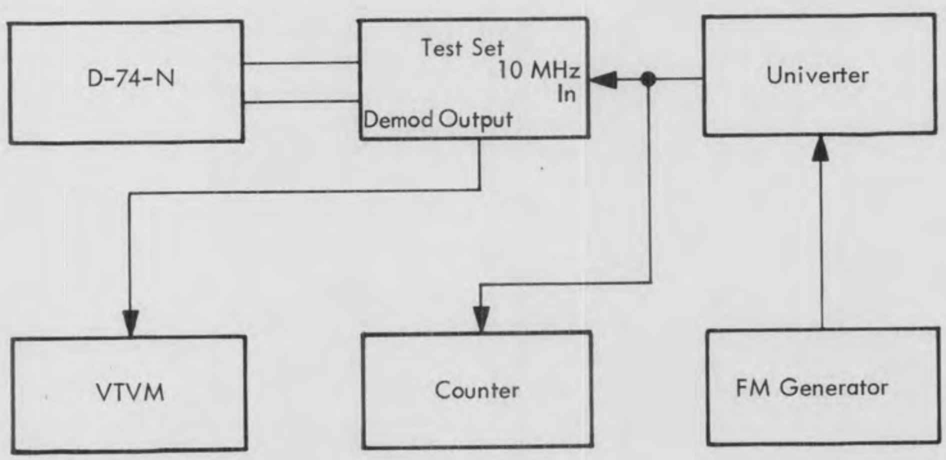


Figure C. Test Equipment Setup No. 3

CHANGE SHEET

ELECTRICAL PARTS LIST, revise as follows:

Page 11, R45 Resistor, variable, 25k, change Beckman part number from 63XR25K to 66XR25K.

Model:	Date:
D-74-N	1-26-72

ELECTRICAL PARTS LIST

Reference Designation	Description
C1 through C3	Capacitor, ceramic, disc, 0.005 uF -40+60%, 150V, Centralab DDM-502
C4	Capacitor, ceramic, disc, 0.01 uF ±20%, Erie 805-Z5V
C5	Capacitor, mica, dipped, 360 pF ±5%, Elmenco DM15F361J
C6	Capacitor, ceramic, tubular, 3.0 pF ±0.1 pF, Erie NPO-301-000
C7	Capacitor, mica, dipped, 360 pF ±5%, Elmenco DM15F361J
C8 and C9	Capacitor, mica, dipped, 680 pF ±5%, Elmenco DM15F681J
C10	Capacitor, ceramic, disc, 0.01 uF ±20%, Erie 805-Z5V
C11	Capacitor, ceramic, tubular, 9.1 pF ±0.5 pF, Erie NPO-301-000
C12 and C13	Capacitor, mica, dipped, 680 pF ±5%, Elmenco DM15F681J
C14	Capacitor, ceramic, disc, 0.005 uF -40+60%, 150V, Centralab DDM-502
C15 and C16	Capacitor, mica, dipped, 680 pF ±5%, Elmenco DM15F681J
C17	Capacitor, ceramic, disc, 0.01 uF ±20%, Erie 805-Z5V
C18	Capacitor, ceramic, tubular, 6.2 pF ±0.25%, Erie NPO-301-000
C19	Capacitor, mica, dipped, 680 pF ±5%, Elmenco DM15F681J
C20	Capacitor, mica, dipped, 910 pF ±5%, Elmenco DM15F911J
C21	Capacitor, mica, dipped, 2700 pF ±5%, Elmenco DM19F272J
C22 through C25	Capacitor, ceramic, disc, 0.005 uF -40+60%, 150V, Centralab DDM-502
C26	Capacitor, mica, dipped, 8200 pF ±5%, Elmenco DM19F822J
C27	Capacitor, mica, dipped, 2400 pF, ±5%, Elmenco DM19F242J
C28	Capacitor, mica, dipped, 1500 pF ±5%, Elmenco DM19F152J
C29	Capacitor, 2.4 pF ±0.1 pF, NPO-301-000, factory selected

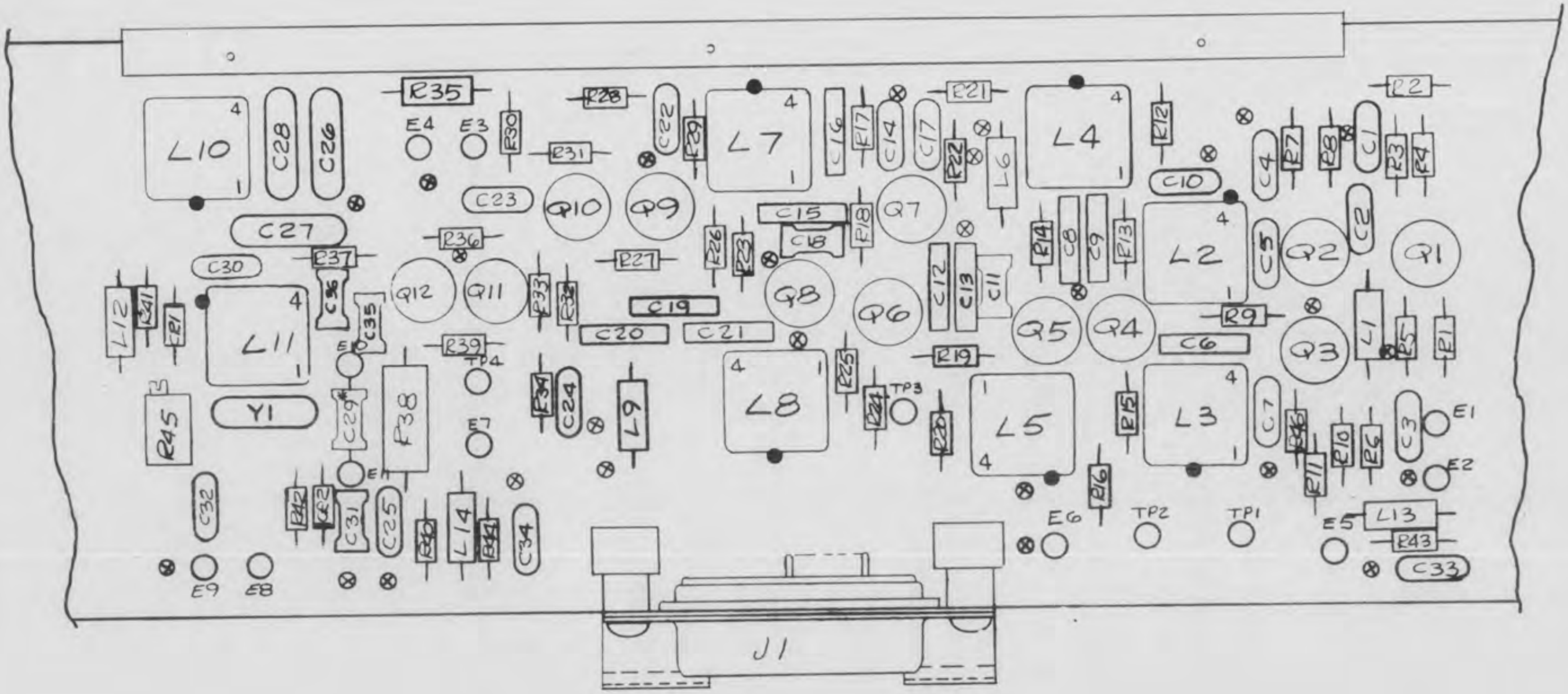
Reference Designation	Description
C30	Capacitor, mica, dipped, 200 pF ±5%, Arco DM15F201J
C31	Capacitor, ceramic, tubular, 30 pF ±5%, Erie NPO-308-000
C32	Capacitor, ceramic, tubular, 47 pF ±5%, Erie NPO-308-000
C33 and C34	Capacitor, ceramic, disc, 0.005 uF -40+60%, 150V, Centralab DDM-502
C35	Capacitor, ceramic, tubular, 10 pF ±5%, Erie NPO-301-000
C36	Capacitor, ceramic, tubular, 10 pF ±5%, Erie N330-301-000
CR1	Diode, 1N914
CR2	Diode, 1N914
L1	Inductor, 47 uH ±5%, Essex WEE-47
L2 through L5	Inductor Assembly,Defense Electronics 203482
L6	Inductor, 220 uH ±10%, Essex WEE-220
L7	Inductor Assembly, Defense Electronics 203482
L8	Inductor Assembly, Defense Electronics 203482
L9	Inductor, 220 uH ±10%, Essex WEE-220
L10	Inductor Assembly, Defense Electronics 203326
L11	Inductor Assembly, Defense Electronics 203325
L12	Inductor, 220 uH ±10%, Essex WEE-220
L13	Inductor, 38 uH, Wilco 3038-15
L14	Inductor, 38 uH, Wilco 3038-15
P1	Connector, Cannon DBM-13W3P
P1A1	Connector, insert, Cannon DM53741-1
P1A3	Connector, insert, Cannon DM53740-1
Q1 through Q12	Transistor, 2N708

Reference Designation	Description
R1	Resistor, composition, fixed, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R2	Resistor, composition, fixed, 1k ±5%, 1/4W, Allen Bradley CB1025
R3	Resistor, composition, fixed, 1k ±5%, 1/4W, Allen Bradley CB1025
R4	Resistor, composition, fixed, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R5	Resistor, composition, fixed, 27Ω ±5%, 1/4W, Allen Bradley CB2705
R6	Resistor, composition, fixed, 4.7k ±5%, 1/4W, Allen Bradley CB4725
R7	Resistor, composition, fixed, 4.7k ±5%, 1/4W, Allen Bradley CB4725
R8	Resistor, composition, fixed, 300Ω ±5%, 1/4W, Allen Bradley CB3015
R9	Resistor, composition, fixed, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R10	Resistor, composition, fixed, 10k ±5%, 1/4W, Allen Bradley CB1035
R11	Resistor, composition, fixed, 18k ±5%, 1/4W, Allen Bradley CB1835
R12	Resistor, composition, fixed, 4.7k ±5%, 1/4W, Allen Bradley CB4725
R13	Resistor, composition, fixed, 300Ω ±5%, 1/4W, Allen Bradley CB3015
R14	Resistor, composition, fixed, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R15	Resistor, composition, fixed, 10k ±5%, 1/4W, Allen Bradley CB1035
R16	Resistor, composition, fixed, 18k ±5%, 1/4W, Allen Bradley CB1835
R17	Resistor, composition, fixed, 1.6k ±5%, 1/4W, Allen Bradley CB1625
R18	Resistor, composition, fixed, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R19	Resistor, composition, fixed, 1.5k ±5%, 1/4W, Allen Bradley CB1525

Reference Designation	Description
R20	Resistor, composition, fixed, 3.3k ±5%, 1/4W, Allen Bradley CB3325
R21	Resistor, composition, fixed, 2.4k ±5%, 1/4W, Allen Bradley CB2425
R22	Resistor, composition, fixed, 300Ω ±5%, 1/4W, Allen Bradley CB3015
R23	Resistor, composition, fixed, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R24	Resistor, composition, fixed, 5.6k ±5%, 1/4W, Allen Bradley CB5625
R25	Resistor, composition, fixed, 18k ±5%, 1/4W, Allen Bradley CB1835
R26	Resistor, composition, fixed, 47Ω ±5%, 1/4W, Allen Bradley CB4705
R27	Resistor, composition, fixed, 1.6k ±5%, 1/4W, Allen Bradley CB1625
R28	Resistor, composition, fixed, 820Ω ±5%, 1/4W, Allen Bradley CB8215
R29	Resistor, composition, fixed, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R30	Resistor, composition, fixed, 1.3k ±5%, 1/4W, Allen Bradley CB1325
R31	Resistor, composition, fixed, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R32	Resistor, composition, fixed, 1.8k ±5%, 1/4W, Allen Bradley CB1825
R33	Resistor, composition, fixed, 1.2k ±5%, 1/4W, Allen Bradley CB1225
R34	Resistor, composition, fixed, 1k ±5%, 1/4W, Allen Bradley CB1025
R35	Resistor, composition, fixed, 270Ω ±5%, 1/2W, Allen Bradley EB2715
R36	Resistor, composition, fixed, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R37	Resistor, composition, fixed, 100Ω ±5%, 1/4W, Allen Bradley CB1015

Reference Designation	Description
R38	Resistor, composition, fixed, 510Ω ±5%, 1W, Allen Bradley GB5115
R39	Resistor, composition, fixed, 18k ±5%, 1/4W, Allen Bradley CB1835
R40	Resistor, composition, fixed, 39Ω ±5%, 1/4W, Allen Bradley CB3905
R41	Resistor, composition, fixed, 4.3k ±5%, 1/4W, Allen Bradley CB4325
R42	Resistor, composition, fixed, 4.3k ±5%, 1/4W, Allen Bradley CB4325
R43	Resistor, composition, fixed, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R44	Resistor, composition, fixed, 100Ω ±5%, 1/4W, Allen Bradley CB1015
R45	Resistor, variable, 25k, Beckman 63XR25K
Y1	Crystal, 10.0356 MHz, Defense Electronics A11568
XQ1 through XQ12	Transipad, Defense Electronics B18214

Pushbutton, NAR bandwidth, Defense Electronics 104740-01



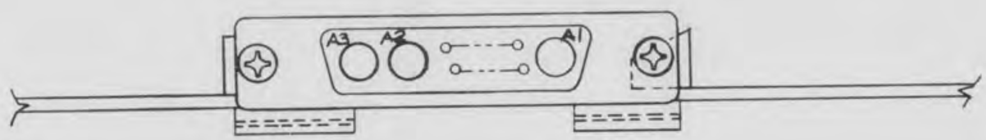
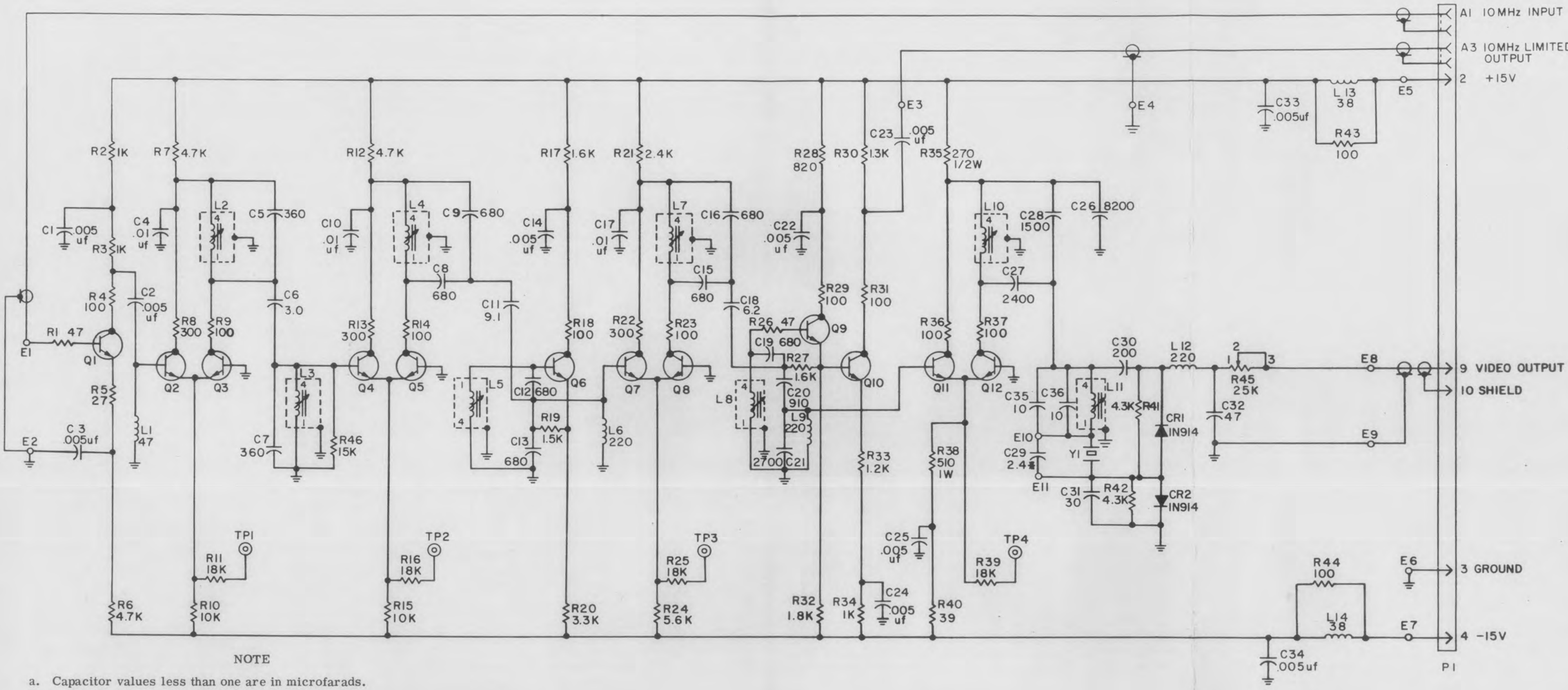


Figure 2. Model D-74-N Narrow Bandwidth Demodulator
Component Location Drawing D303143



NOTE

a. Capacitor values less than one are in microfarads.

b. Capacitor values greater than one are in micromicrofarads (picofarads).

c. Inductance values are in microhenries.

d. Resistance values are in ohms; k=1,000; M=1,000,000.

e. Arrow denotes clockwise adjustment.

f. * Typical value shown, factory selected.

g. All transistors are 2N708.

Figure 3. Model D-74-N Narrow Bandwidth Demodulator Schematic Diagram D303160

INSTRUCTION MANUAL

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MODEL DF-74-H
FM DEMODULATOR HOUSING

Revised: September 1970
February 1970

EFFECTIVE PAGES

February 1970:

i through v
1-0 through 1-4
2-1 through 2-2
3-1 and 3-2
4-1 through 4-4
5-1 through 5-4
6-1 through 6-6
7-1 through 7-4

September 1970:

i and ii
6-1 and 6-2
6-4 and 6-5
7-3/7-4

TABLE OF CONTENTS

Section	Title		Page
I	GENERAL DESCRIPTION		1-1
II	PREPARATION FOR USE		
	2.1	General	2-1
	2.2	Unpacking and Inspection	2-1
	2.3	Installation	2-1
	2.3.1	Demodulator Housing	2-1
	2.3.2	Demodulators	2-1
	2.4	Performance Check	2-2
III	OPERATION		3-1
IV	PRINCIPLES OF OPERATION		
	4.1	General	4-1
	4.2	Circuit Description	4-1
	4.3	Interface and Control Circuits	4-2
V	MAINTENANCE		
	5.1	General	5-1
	5.2	Preventive Maintenance	5-1
	5.3	Corrective Maintenance	5-2
	5.3.1	Troubleshooting	5-2
	5.3.2	Repair and Replacement	5-2
	5.3.3	Alignment	5-3
VI	ELECTRICAL PARTS LIST		6-1
VII	MAINTENANCE DIAGRAMS		7-1

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1	Model DF-74-H FM Demodulator Housing	1-0
2-1	Top View of Housing, Showing Location of Demodulators	2-2
4-1	Model DF-74-H FM Demodulator Housing, Simplified Block Diagram	4-1
5-1	Model DF-74-H FM Demodulator Housing, Internal Views	5-4
7-1	Component Location Drawings, A4 and A5	7-2
7-2	Model DF-74-H FM Demodulator Housing, Schematic Diagram	7-3

LIST OF TABLES

Table	Title	Page
1-1	Specifications	1-1
1-2	Transistor and Submodule Complement	1-3

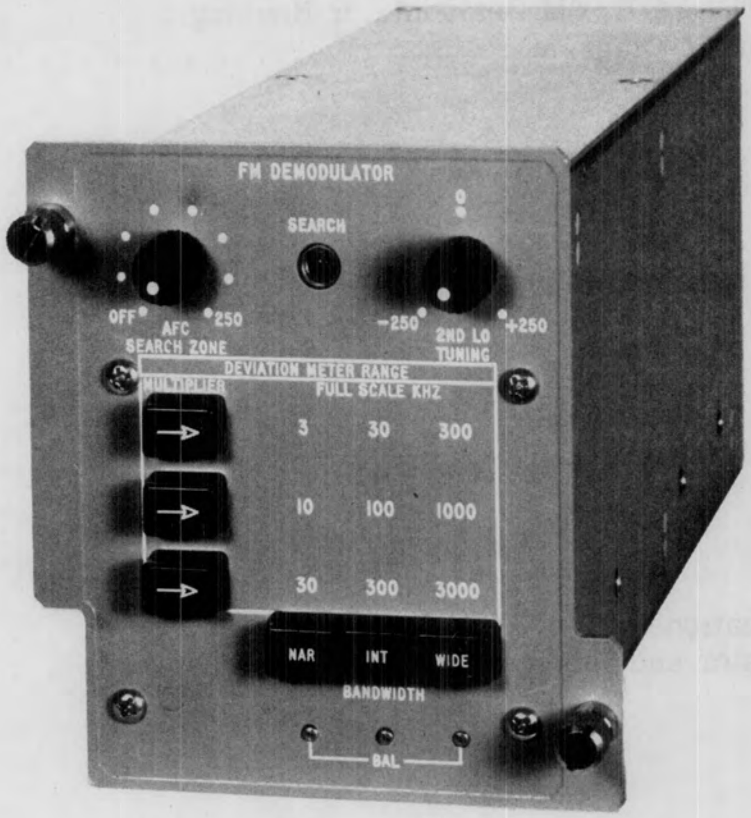

Figure 1-1. Model DF-74-H FM Demodulator Housing

SECTION I
GENERAL DESCRIPTION

The Model DF-74-H FM Demodulator Housing is designed for use with the Model TMR-74 Telemetry Receiver. It is a demodulator housing plug-in module in which up to three fm demodulator submodules may be simultaneously housed.

The fm demodulator submodules that are normally supplied with the DF-74-H are: D-74-N (narrow bandwidth), D-74-I (intermediate bandwidth), and D-74-W (wide bandwidth).

The primary function of the DF-74-H, complete with demodulators, is to detect frequency modulation from receiver second i-f signals. In addition to fm detected video outputs, the DF-74-H provides a limited 10 MHz output for predetection recording and performs a host of interface, interlock and control functions within the receiver; for details refer to schematic diagram, figure 7-2.

Selection of deviation meter range and demodulator bandwidth is accomplished by front-panel pushbutton controls. Separate front panel discriminator (dc) balance controls are provided for each of the three demodulators. Other controls and indicators on the DF-74-H are; second l-o vernier tuning and afc search range controls and an amber lamp which indicates when the afc is in a search mode.

The electrical and mechanical specifications for the DF-74-H are given in table 1-1 and the transistor and submodule complement is given in table 1-2. A functional block diagram is shown in figure 4-1.

Table 1-1. Specifications

DF-74-H:	
Center Frequency	10.000 MHz.
Indicator	amber lamp glows to indicate afc is in a search mode.
Controls	a. Discriminator (dc) balance control. b. Second l-o tuning. c. Afc search range control. d. Deviation meter range pushbutton switch. e. Narrow-Intermediate-Wideband fm demodulator pushbutton switch.
Size	5" high by 4-1/4" wide by 10-5/8" deep behind front panel.

continued

Table 1-1, continued

D-74-N:	
IF Bandwidths	for use with 10 kHz to 50 kHz i-f filter.
FM Frequency Response	dc to 15 kHz (3 dB).
Deviation Sensitivity	1.5 kHz deviation will produce rated video output.
Linearity	less than 2% distortion with 15 kHz deviation at 1 kHz modulation frequency.
Center Frequency Stability	±1.0 kHz over temperature range.
Capture Ratio	0.8.
Limited IF Output	50 mV into 50 ohm load (-13 dBm).
Deviation Meter Ranges	3 kHz, 10 kHz, 30 kHz, full scale.
DF-74-I:	
IF Bandwidths	recommended for use with 50 kHz to 750 kHz i-f filter.
FM Frequency Response	dc to 150 kHz (3 dB at approximately 250 kHz).
Deviation Sensitivity	15 kHz deviation will produce rated video output.
Linearity	1% over ±200 kHz.
Center Frequency Stability	±10 kHz over temperature range.
Capture Ratio	0.8.
Limited IF Output	50 mV into 50 ohm load (-13 dBm).
Deviation Meter Ranges	30 kHz, 100 kHz, 300 kHz, full scale.
DF-74-W:	
IF Bandwidths	recommended for use with 750 kHz to 4.0 MHz i-f filter. *
FM Frequency Response	dc to 2.0 MHz (3 dB).
Deviation Sensitivity	150 kHz deviation will produce rated video output.
Linearity	1% over ±500 kHz, 2% over ±750 kHz, 5% over ±2000 kHz.
Center Frequency Stability	±50 kHz over temperature range.
Capture Ratio	0.8.
Limited IF Output	50 mV into 50 ohm load (-13 dBm).
Deviation Meter Ranges	300 kHz, 1000 kHz, 3000 kHz, full scale.

* An extra-wide bandwidth fm demodulator is available on special order.

Table 1-2. Transistor and Submodule Complement

Reference Designation	Type	Function
Q1	2N4220	Switch
Q2	2N4220	Switch
Q3	2N4220	Switch
Q4	2N4259	Video Driver
Q5	2N4259	Video Driver
Q6	2N3251	Video Driver
Q7	2N2218	Video Driver
Q8	2N3133	Video Driver
A1*	D-74-N	Narrow Bandwidth FM Demodulator
A2*	D-74-I	Intermediate Bandwidth FM Demodulator
A3*	D-74-W	Wide Bandwidth FM Demodulator

* As required by user.

SECTION II
PREPARATION FOR USE

2.1 GENERAL

The Model DF-74-H FM Demodulator Housing is shipped fully assembled, with all internal subassemblies installed, and in operating condition. Consequently, preparation for use procedures are reduced essentially to checks of the physical condition of the equipment, and a referenced performance check. Also discussed in this section are mechanical installation data and internal demodulator installation.

2.2 UNPACKING AND INSPECTION

The following checks should be made upon unpacking the demodulator housing:

a. Check the front panel of the demodulator for damage to knobs, push-buttons, and the search indicator light.

b. Operate the controls, examining them for looseness.

c. Remove the top and bottom covers of the demodulator housing chassis; inspect for security of subassemblies and loose or disconnected wiring.

d. Replace the covers on the housing.

2.3 INSTALLATION

2.3.1 DEMODULATOR HOUSING

The Model DF-74-H FM Demodulator Housing is a plug-in module to the TMR-74 telemetry receiver. All electrical connections are made through a multipin (with coaxial inserts) connector on the rear of the module. There are no cables to connect during installation or to disconnect during removal.

To install the demodulator housing, insert it through the opening on the left side of the receiver until the front panel is flush against the front panel of the receiver. Tighten the two adjustable fasteners on the front panel of the demodulator.

To remove the module, unscrew the two fasteners and slide the unit out of the receiver.

2.3.2 DEMODULATORS

The DF-74-H provides facilities for mounting three plug-in demodulator boards. To gain access to the boards, the housing module must be removed from the receiver and the top cover (held in place by six machine screws) removed from the housing. The boards are then visible as shown in figure 2-1.

The demodulators are standard pc boards with all electrical connections made through a single multipin (with coaxial inserts) connector on the bottom (as viewed in figure 2-1). Birtcher clips at each end provide the mechanical mounting facilities for the boards. Handles are provided for ease of removal.

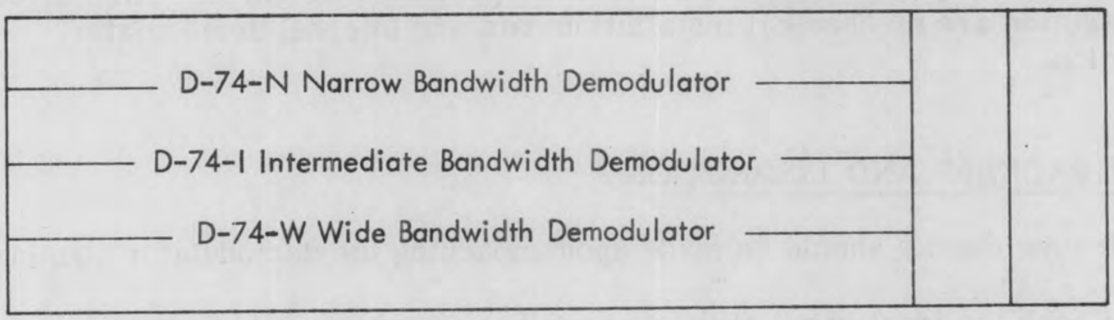

Figure 2-1. Top View of Housing, Showing location of demodulators

2.4 PERFORMANCE CHECK

When installation is completed, it is suggested that the performance of the DF-74-H be checked using the procedures given in Section V of the TMR-74 Instruction Manual.

SECTION III
OPERATION

The complete and meaningful operating procedure for the DF-74-H, including all controls and indicators thereon, is an integral part of the operating procedure for a functioning receiver given in Section III of the receiver instruction manual. For this reason, only general operating information is given in this instruction manual.

The operating controls and indicators of the demodulator housing are all located on the front panel. These controls and indicators, and their functions are given below.

BANDWIDTH	Pushbutton switch selects one of three internal demodulators for operation; narrow, intermediate, or wideband. *
MULTIPLIER	Pushbutton switch selects the multiplying factor to provide the optimum deviation meter range.
BAL	Screwdriver controls, when used in conjunction with receiver calibrate oscillator, set the dc output of each discriminator to zero.
AFC SEARCH ZONE	Controls the zone of afc search up to ±250 kHz; off position provided.
SEARCH (light)	Indicates when receiver is in afc search mode.
SECOND LO TUNE	Provides vernier tuning of ±250 kHz when second l-o is in vfo mode. Controls center of afc search zone. May also be used to minimize loop stress when in afc mode.

Selecting the desired demodulator consists simply of pushing the correct bandwidth pushbutton — NAR, INT, or WIDE. *

To select the desired deviation meter range, depress the correct multiplier pushbutton corresponding to the selected demodulator and the expected carrier deviation. The deviation meter full scale ranges are engraved, in kHz, in a map grid arrangement with the pushbuttons on the front panel of the demodulator housing.

The demodulators are balanced by placing the receiver in the calibrate mode and adjusting the appropriate screwdriver control for 0V dc at the video output terminal.

The afc search zone and the 2nd l-o tune controls and the search indicator have been placed on the demodulator for convenience and are not part of the demodulator operation but are utilized in the operation of the overall receiver. Refer to Section III of the receiver instruction manual for operating details.

---

* A blank pushbutton denotes no internal demodulator utilized in that position.

SECTION IV
PRINCIPLES OF OPERATION

4.1 GENERAL

The Model DF-74-H FM Demodulator Housing provides, primarily, the fm demodulation function in the TMR-74 receiver. The housing comprises three plug-in fm demodulator submodules, demodulator switching facilities, a video driver and other miscellaneous receiver interface and control circuitry. A simplified block diagram of the DF-74-H is shown in figure 4-1.

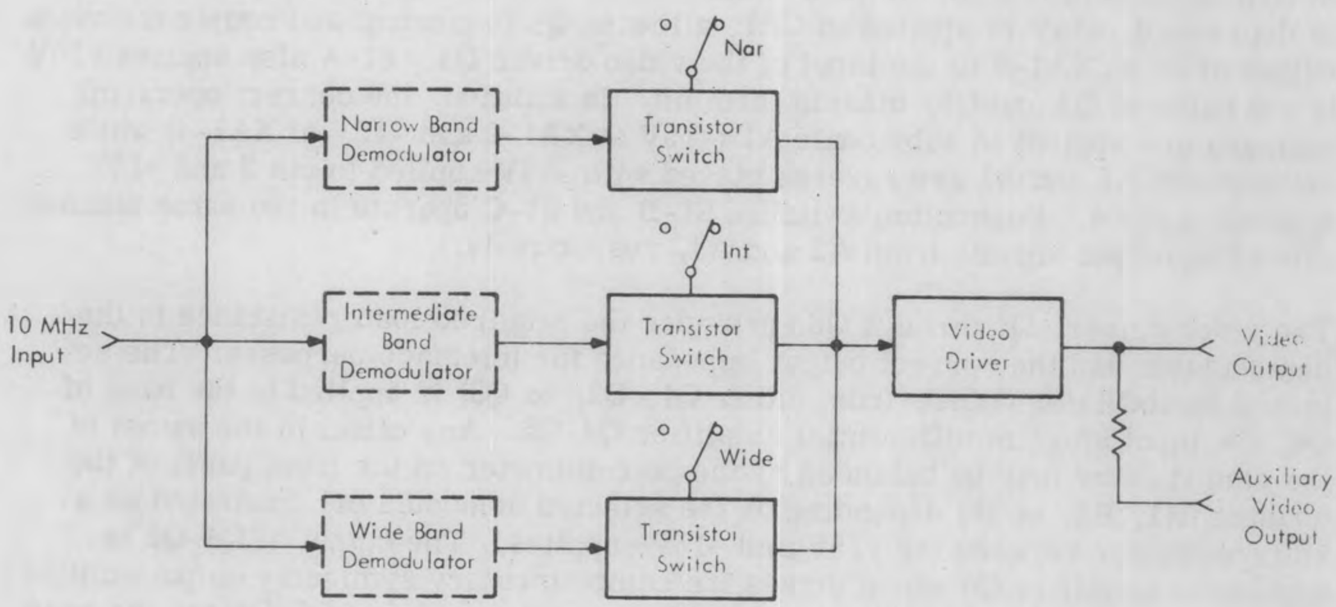

Figure 4-1. Model DF-74-H FM Demodulator Housing, Simplified Block Diagram

4.2 CIRCUIT DESCRIPTION (Refer to figure 7-1)

The 10 MHz input signal at P1-A1 is applied to junction board A5, and then simultaneously to all three fm demodulator submodules through XA1-A1, XA2-A1, and XA3-A1. The standard configuration of demodulators is:

A1 - Narrow Bandwidth Demodulator
A2 - Intermediate Bandwidth Demodulator
A3 - Wide Bandwidth Demodulator

Each demodulator comprises 10 MHz amplifier(s), limiters, and an fm demodulator and provides two outputs, a demodulated video signal and a 10 MHz limited signal for pre-D recording.

The 10 MHz limited output is taken from A3 of each demodulator connector and applied through junction board A5 to P1A4 as the 10 MHz limited output of the housing. Only one demodulator is functioning at a time as will be explained in a later paragraph.

The video output of A1 is applied through XA1-9 to the signal input of switching transistor Q1. The video output of A2 is applied through XA2-9 to the signal input of switching transistor Q2. The video output of A3 is applied through XA3-9 to the signal input of switch transistor Q3.

The pushbutton switch assembly, S1, controls the operation of the demodulator and transistor switches by applying either the correct bias, or reverse bias to the switching transistors and to the demodulators. For example, when S1-A (NAR) is depressed, +15V is applied to CR1, allowing Q1 to conduct and couple the video output of A1 at XA1-9 to the input of the video driver Q4. S1-A also applies -15V to the gates of Q2 and Q3, biasing them off. In addition, the correct operating voltages are applied to submodule A1 (+15V at XA1-2 and -15V at XA1-4) while submodules A2 and A3 are reverse biased with -15V applied to pin 2 and +15V applied to pin 4. Pushbutton switches S1-B and S1-C operate in the same manner providing output signals from A2 and A3, respectively.

The video driver, Q4 through Q8, provides the required load resistance to the demodulator and the correct output impedance for interface purposes. The selected demodulator output (from either Q1, Q2, or Q3) is applied to the base of Q4, the input stage of differential amplifier Q4-Q5. Any offset in the output of the demodulator may be balanced by the potentiometer on the front panel of the housing (R1, R2, or R3 depending on the selected demodulator) connected as a voltage divider between the -15V and +15V supplies. The output of Q4-Q5 is applied to amplifier Q6 which drives the complementary symmetry output emitter-follower Q7-Q8. Feedback is employed between the output of Q7-Q8 and the base of Q5 through R16, R9 and C1.

The output of Q7-Q8 is applied through a low pass filter to P1-18 as the video output of the demodulator housing. A portion of that signal is also applied through a voltage divider network to P1-24 as the auxiliary video output.

Switch assembly S1 also switches voltage divider networks R4-R5, R6-R7, or R8 into the circuit between pins P1-8 and P1-9 to provide afc normalization in the receiver when switching between demodulators.

4.3 INTERFACE AND CONTROL CIRCUITS

Switch assembly S2 (front panel multiplier pushbuttons) provides three different full scale ranges of the deviation meter circuitry corresponding to the demodulator in use by selecting the proper resistance for circuits located in the receiver base unit.

The DF-74-H also contains a number of other interface and control circuits which form functional parts of the receiver circuitry when the demodulator housing is installed in an operational receiver. The primary purpose of many of these circuits is to establish proper interface levels between the characteristics of the particular demodulator in use, and associated circuitry which is located in other receiver subassemblies or modules.

These circuits perform functions in the afc, a-m, tuning meter, and afc search circuits. The interface and control circuits are grouped and identified functionally, in the vicinity of P1, in the DF-74-H schematic diagram (figure 7-2).

SECTION V
MAINTENANCE

5.1 GENERAL

The Model DF-74-H FM Demodulator Housing is designed to give long and trouble-free performance with a minimum of maintenance. During normal operation, no periodic adjustments are required; unnecessary adjustments should be avoided as they may degrade the performance of the unit. The DF-74-H should be kept clean, relatively dustfree, and in good mechanical condition. Lubrication is not required and should be avoided as damage to the unit could result.

5.2 PREVENTIVE MAINTENANCE

Preventive maintenance consists of both physical and electrical checks, which are designed to detect and prevent physical and performance deterioration. These checks are usually conducted at regular intervals.

Physical Checks

The regularly scheduled physical checks (weekly, monthly, or quarterly, as dictated by environmental conditions and the station preventive maintenance program) consist of blowing out the dust from the interior of the unit using low pressure air and making a visual inspection checking:

a. Resistors for blistering, discoloration, and other evidence of overheating.
b. Wiring for cut, cracked, or frayed insulation.
c. Machine screws and nuts for looseness.
d. Rear apron connectors for corrosion and loose connections.
e. Finish for scratches and bare spots.

Burned or discolored resistors and defective wiring should be replaced. When plugs or wiring have been replaced, refer to the schematic diagrams to ensure that the proper connections have been made. Bare spots and scratches should be covered using an available touch-up paint.

Performance Checks

It is recommended that the performance checks be conducted: 1) when the unit is installed; 2) prior to any major operational run; 3) as a semiannual preventive maintenance check; 4) after any major repair, realignment, or replacement of the subassemblies or components.

Since any valid performance checks must be performed in an operating TMR-74 receiver, the performance checks for the DF-74-H are included as an integral part of the performance checks for the overall receiver. Refer to paragraph 5.2.2 of the TMR-74 receiver instruction manual for details.

5.3 CORRECTIVE MAINTENANCE

The corrective maintenance for the DF-74-H consists of troubleshooting, repair and replacement. These are given in paragraphs 5.3.1, 5.3.2, and 5.3.3.

5.3.1 TROUBLESHOOTING

Troubleshooting should be based upon the performance of the equipment. The principles of operation, block diagram, and schematic diagram given in this instruction manual should provide the data necessary for a trained maintenance technician to isolate the malfunction. If troubleshooting procedures for the receiver (as listed in Section V of the appropriate instruction manual) indicate that the demodulator is inoperative or operating improperly, the cause should be isolated within the demodulator by applying logical effect-to-cause reasoning.

For example (refer to figure 4-1) if the input to the demodulator housing is normal, but no video output is present, select another demodulator and note any change. If an output is then obtained, the plug-in internal demodulator pc board is defective and should be replaced with a spare while repairs are effected. Normal signal tracing techniques should be used to isolate the malfunction to the defective stage.

5.3.2 REPAIR AND REPLACEMENT

The DF-74-H has been designed with a goal toward achieving ease and speed of maintenance. The disassembly and assembly of the unit should pose no problem to servicing personnel. All components are considered nonrepairable and should be replaced when defective. The replaceable components are listed in Section VI.

Access to the demodulator circuitry is gained by removing the metal screws (six for the top cover and six for the bottom cover) securing each cover, and removing the covers. The major portion of the circuitry is contained on five printed circuit boards, three of which are plug-in type (A1, A2 and A3) while the other two (A4 and A5) are mounted on spacers and hard wired. (Refer to figure 5-1).

Switches, wiring, controls, and other mechanical components are removed and replaced in a straightforward manner, readily evident to a technician when viewing the housing; thus their replacement is not detailed in this manual. Access to the front panel components is gained by removing the four Phillips head machine screws and two control knobs on the front panel. These components are actually mounted on the keyplate directly behind the front panel. If access to the feedthru filters or other components in that area is necessary, the keyplate can be unbolted and tilted away from the chassis. The keyplate is held in place by four machine screws on the sides of the chassis.

The plastic caps on the pushbutton switches are friction fit type, i.e., they can be removed by grasping the cap firmly and sliding off. If a DF-74-H is supplied less any internal demodulators, a blank pushbutton cap is factory installed. These blank pushbutton caps contain stoppers to prevent that position of the ganged switch assembly from being engaged. If a demodulator is subsequently ordered for the housing, an engraved pushbutton cap is shipped with the board. It is then a simple matter to remove the blank cap containing stoppers and install the engraved cap that will allow that position of the ganged switch assembly to operate.

The suggested procedure for removing components located on the printed circuit boards found in the receiver is given below; the procedure requires the use of the following material and equipment:

Liquid soldering flux	1/8 inch, #18 AWG flat braid
Liquid flux remover	Medium wattage soldering iron.

Apply a thin coat of soldering flux to the flat braid. Place and hold the braid over the solder joint. Apply heat to the braid directly over the solder joint; the braid will absorb most of the solder.

CAUTION

Do not heat the solder joint for long periods of time as excess heat may damage the circuit board.

After the major portion of the solder has been absorbed by the braid, apply heat directly to the solder joint and pry the component loose. Clean the affected area using the flux remover. Trim the replacement component leads to the same length as the original component leads. Position the replacement component on the circuit board and solder it in place. Clean the affected area with flux remover. After repairs have been made, the affected unit should be realigned following the procedure referenced in paragraph 5.3.3.

5.3.3 ALIGNMENT

The adjustable components in the DF-74-H fall into two categories: operational and corrective maintenance. The operational adjustable components are located on the front panel and are covered in Section III. The corrective maintenance adjustable components are located on the demodulator boards. The alignment procedures for these boards are given in the applicable demodulator instruction booklet.

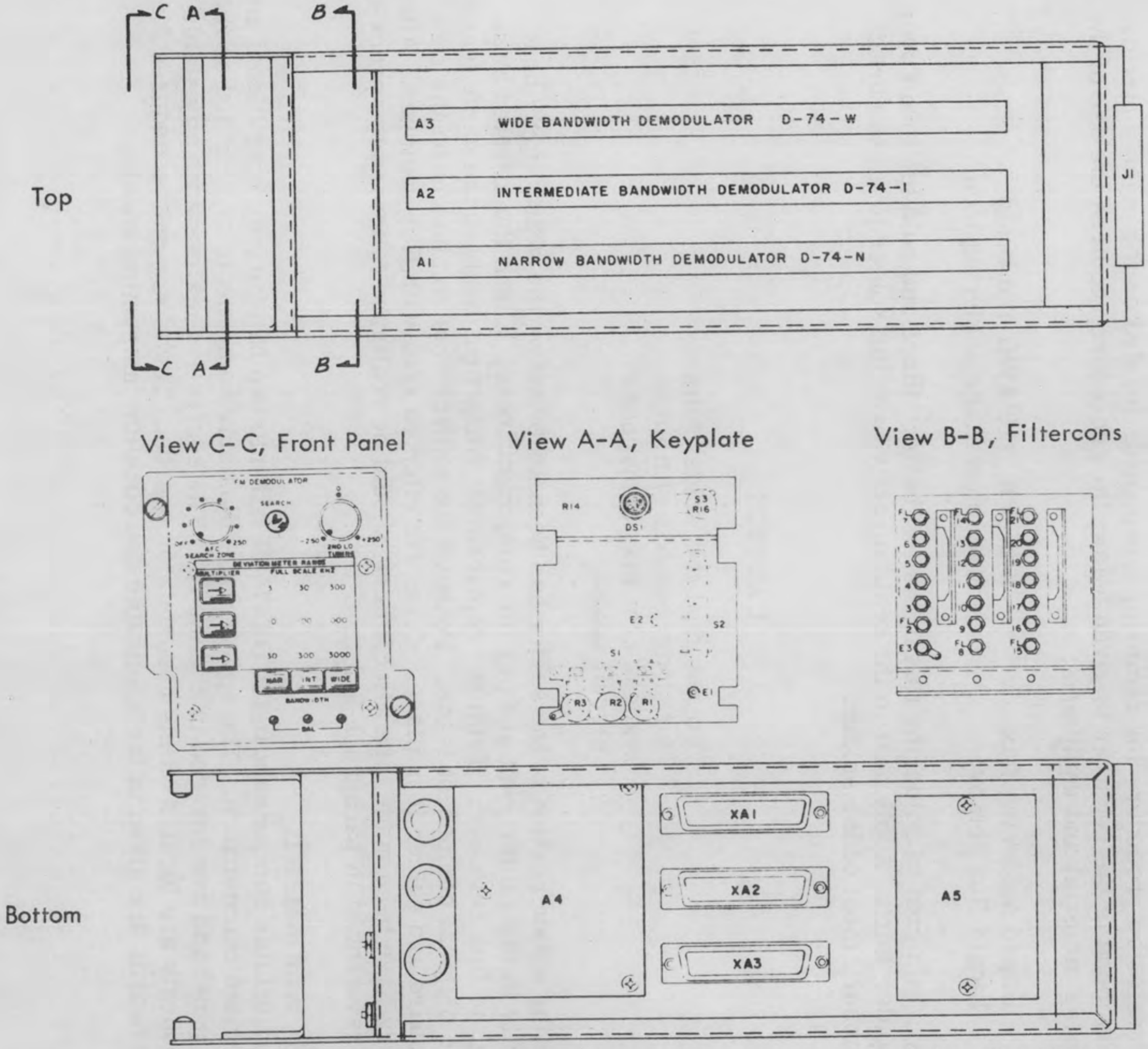

Figure 5-1. Model DF-74-H FM Demodulator Housing, Internal Views

SECTION VI
ELECTRICAL PARTS LIST

This section of the manual contains the electrical parts list for the overall fm demodulator housing and includes a list of the subassemblies and modules (A1 through A5). The electrical parts for the subassemblies, A4 and A5, are listed separately in this section. The electrical parts for the modules (A1, A2, and A3) are listed in the instruction booklets provided for those units.

MAIN CHASSIS

Reference Designation	Description
A1	Demodulator board, narrow bandwidth, Defense Electronics D-74-N
A2	Demodulator board, intermediate bandwidth, Defense Electronics D-74-I
A3	Demodulator board, wide bandwidth, Defense Electronics D-74-W
A4	Video driver board, Defense Electronics LM203260
A5	Junction board, Defense Electronics LM105572
DS1	Indicator, lamp assembly, Dialco 507-3912-0333-600
FL2 through FL21	Filtercon, Erie 1221-001
P1	Connector, Cannon DDM-36W4P
P1A1	Connector Insert, Cannon DM53743-3
P1A4	Connector Insert, Cannon DM53743-3
R1 through R3	Potentiometer, 1 meg, Allen Bradley GS1G048P253UA
R4	Resistor, fixed film, 205Ω ±1%, 1/8W, RN55D2050F
R5	Resistor, fixed film, 20.5k ±1%, 1/8W, RN55D2052F
R6	Resistor, fixed film, 221Ω ±1%, 1/8W, RN55D2210F

Main Chassis, continued

Reference Designation	Description
R7	Resistor, fixed film, 2.00k ±1%, 1/8W, RN55D2001F
R8	Resistor, fixed film, 200Ω ±1%, 1/8W, RN55D2000F
R9	Resistor, fixed film, 137Ω ±1%, 1/8W, RN55D1370F
R10	Not assigned
R11	Resistor, fixed film, 619Ω ±1%, 1/8W, RN55D6190F
R12	Not assigned
R13	Not assigned
R14	Potentiometer, 10k, Allen Bradley GA1G044P103UA
R15	Resistor, fixed composition, 15k ±5%, 1/4W, Allen Bradley CB1535
R16	Potentiometer, 25k, integral part of S3
R17	Resistor, fixed film, 3.9k ±5%, 1/4W, Allen Bradley CB3925
S1	Switch assembly, BANDWIDTH, Defense Electronics 203238 (Refer to Miscellaneous for knobs)
S2	Switch assembly, MULTIPLIER, Defense Electronics 203239 (with three Defense Electronics 105740-04 black buttons)
S3	Switch/potentiometer control, 25k (R16), Allen Bradley GS1G048P253UA
XA1	Connector, Cannon DBMF-13W3S
XA1A1	Connector insert, Cannon DM53743-3
XA1A3	Connector insert, Cannon DM53743-3
XA2	Connector, Cannon DBMF-13W3S
XA2A1	Connector insert, Cannon DM53743-3
XA2A3	Connector insert, Cannon DM53743-3
XA3	Connector, Cannon DBMF-13W3S
XA3A1	Connector insert, Cannon DM53743-3
XA3A1	Connector insert, Cannon DM53743-3

Main Chassis, continued

Miscellaneous:

Knob, control, Raytheon 50-1WD-1G (Quantity 2)
Pushbutton, Multiplier, Defense Electronics 105-734-01 (Quantity 3)
Pushbutton, bandwidth, Defense Electronics 105-749-XX *
Pushbutton, blank, color black, Centralab 52312 (Quantity - as required)

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* supplied with demodulator board - for replacement number refer to applicable demodulator instruction booklet.

A4, VIDEO DRIVER BOARD 203260

Reference Designation	Description
C1	Capacitor, dipped mica, 160 pF ±5%, Elmenco DM15F161J
C2	Capacitor, ceramic, tubular, 39 pF ±5%, Erie NPO 308-000
C3	Capacitor, tantulum, 0.47 μF ±25%, 35V, Sprague 150D474X0035A2
C4	Capacitor, tantulum, 0.47 μF ±25%, 35V, Sprague 150D474X0035A2
C5	Capacitor, ceramic, tubular, 6.8 pF ±0.25 pF, Erie NPO 301-000
C6	Capacitor, tantulum, 0.47 μF ±25%, 35V, Sprague 150D474X0035A2
C7	Capacitor, tantulum, 0.47 μF ±25%, 35V, Sprague 150D474X0035A2
C8	Capacitor, ceramic, tubular, 430 pF ±5%, Elmenco DM15F431J
C9	Capacitor, dipped mica, 1100 pF ±5%, Elmenco DM15E112J
CR1 through CR4	Diode, 1N914
L1	Inductor, 1.8 μH, Essex WEE-1.8
L2	Inductor, 8.2 μH, Essex WEE-8.2
L3	Inductor, 38 μH, Wilco 3038-15
L4	Inductor, 38 μH, Wilco 3038-15
Q1 through Q3	Transistor, 2N4220
Q4	Transistor, 2N4259
Q5	Transistor, 2N4259
Q6	Transistor, 2N3251
Q7	Transistor, 2N2218
Q8	Transistor, 2N3133

A4, Video Driver Board, continued

Reference Designation	Description
R1	Resistor, fixed film, 22.1k ±1%, 1/8W, RN55D2212F
R2	Resistor, fixed, composition, 3.6k ±5%, 1/4W, RC07GF362J
R3	Resistor, fixed, composition, 100Ω ±5%, 1/4W, RC07GF101J
R4	Resistor, fixed, composition, 470Ω ±5%, 1/4W, RC07GF471J
R5	Resistor, fixed, composition, 470Ω ±5%, 1/4W, RC07GF471J
R6	Resistor, fixed, composition, 10k ±5%, 1/4W, RC07GF103J
R7	Resistor, fixed, composition, 100Ω ±5%, 1/4W, RC07GF101J
R8	Resistor, fixed, composition, 220k ±5%, 1/4W, RC07GF224J
R9	Resistor, fixed, composition, 4.3k ±5%, 1/4W, RC07GF432J
R10	Resistor, fixed, composition, 560Ω ±5%, 1/4W, RC07GF561J
R11	Resistor, fixed, composition, 330Ω ±5%, 1/4W, RC07GF331J
R12	Resistor, fixed, composition, 3.3k ±5%, 1/4W, RC07GF332J
R13	Resistor, fixed, composition, 68Ω ±5%, 1/2W, RC20GF680J
R14	Resistor, fixed, composition, 36Ω ±5%, 1/4W, RC07GF360J
R15	Resistor, fixed, composition, 30Ω ±5%, 1/4W, RC07GF300J
R16	Resistor, fixed film, 3.32k ±1%, 1/8W, RN55D3321F
R17	Resistor, fixed, composition, 1.3k ±5%, 1/4W, RC07GF132J
R18	Resistor, fixed, composition, 68Ω ±5%, 1/2W, RC20GF680J
R19	Resistor, fixed, composition, 100Ω ±5%, 1/4W, RC07GF101J
R20	Resistor, fixed, composition, 100Ω ±5%, 1/4W, RC07GF101J
R21	Resistor, fixed, composition, 7.5k ±5%, 1/4W, RC07GF752J
R22	Resistor, fixed, composition, 180Ω ±5%, 1/4W, RC07GF181J
R23	Resistor, fixed, composition, 68Ω ±5%, 1/4W, RC07GF680J
XQ1 through XQ8	Transipad, Defense Electronics B18214

A5, JUNCTION BOARDS 105572

Reference Designation	Description
L1	Inductor, 3.9 μH, Essex WEE-3.9
L2	Inductor, 3.9 μH, Essex WEE-3.9
R1	Resistor, fixed, composition, 51Ω ±5%, 1/4W, RC07GF510J
R2	Resistor, fixed, composition, 51Ω ±5%, 1/4W, RC07GF510J

SECTION VII
MAINTENANCE DIAGRAMS

This section contains the component location drawings and the schematic diagram for the DF-74-H. Unless otherwise specified, the following information applies to the schematic diagram:

a. Capacitor values less than one are in microfarads.

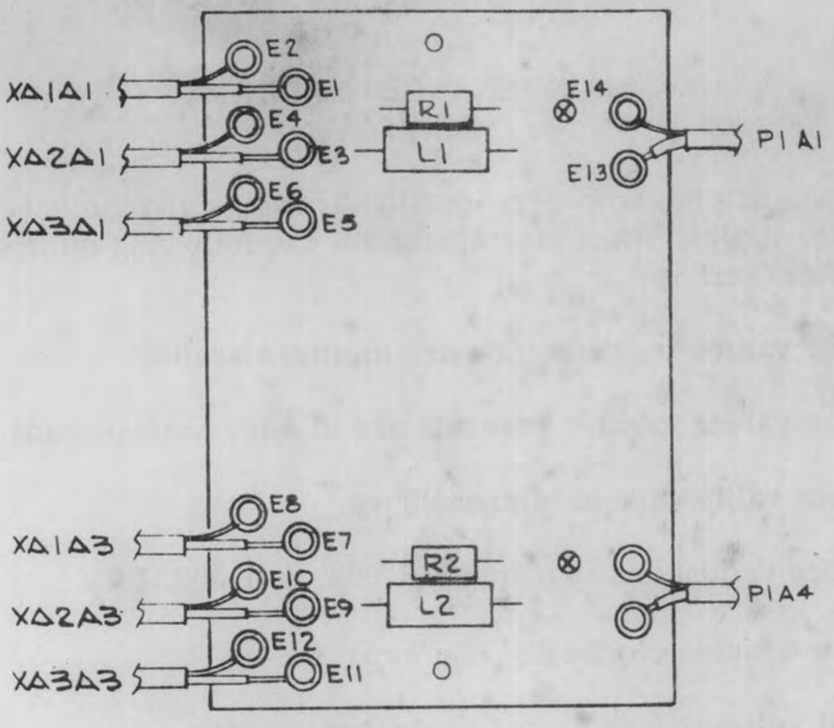
b. Capacitor values greater than one are in micromicrofarads (picofarads).

c. Inductance values are in microhenries.

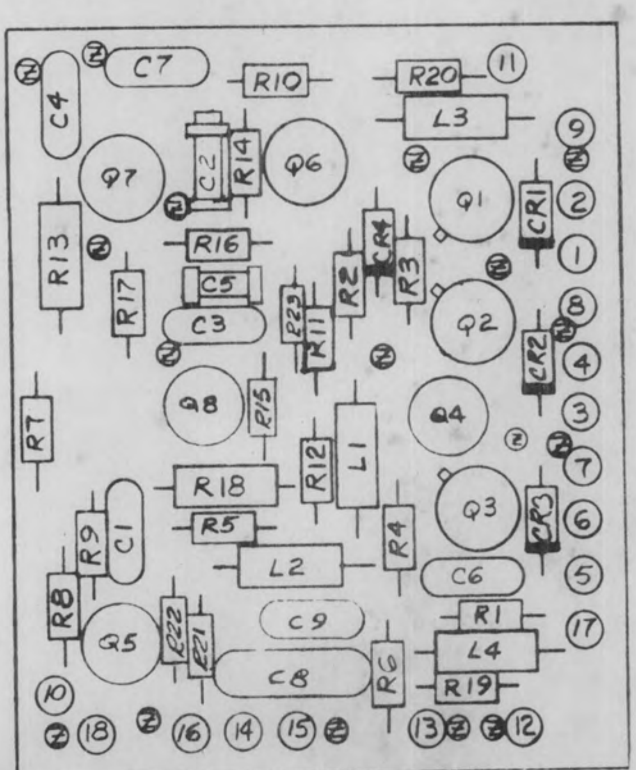
d. Resistance values are in ohms; k=1,000; m=1,000,000.

e.  Arrow denotes clockwise adjustment.

f. * Typical value shown, factory selected.



A5, Junction Board
Component Location Drawing B105572



A4, Video Driver Board
Component Location Drawing C203260

Figure 7-1. Component Location Drawings, A4 and A5