INSTRUCTION MANUAL

FOR

TYPE 340A VLF RECEIVER

Ser # 30

WATKINS-JOHNSON

INSTRUCTION MANUAL

FOR

TYPE 340A VLF RECEIVER

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GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

1.1.1 The Type 340A VLF Receiver is a double conversion, wideband, voltage-tuned unit which tunes the frequency range of 1 to 900 kHz. This range is covered in one band. The 340A can be manually tuned by using its front-panel tuning controls, or it can be automatically swept through its entire frequency range by applying a ramp waveform to a rear-apron connector. A front-panel digital display provides a direct readout of the receiver tuned frequency. Selectable IF bandwidths of 1, 6, 20 and 50 kHz are provided to facilitate detection of both wideband and narrowband signals.

1.1.2 The 340A detects AM, FM, and CW modulated signals. In the AM mode, either manual or automatic gain control may be selected. Any IF bandwidth may be used in the AM mode. In the FM mode AGC is utilized and the 20 or 50-kHz IF bandwidth may be selected. When selecting the logarithmic (LOG) mode, a varying dc output level is made available at a rear-apron connector. This output utilizes a special fast reaction AGC circuit which provides for recording or monitoring large dynamic changes in the incoming signal level. In the CW mode, one of two beat frequency oscillators can be selected. The CW ZERO mode provides a crystal-controlled frequency which is zero beat with the signal centered in the passband of the second IF amplifier. In the CW VAR mode a variable frequency oscillator or VFO develops a signal which can be varied 10 kHz on either side of the second IF center frequency.

1.1.3 The front-panel five-digit LED (Light Emitting Diode) display provides an extremely accurate readout of the receiver tuned frequency. The counter performs this function by counting the LO frequency which is equal to the 2-MHz IF frequency plus the tuned frequency of the receiver. Since the display can read a maximum frequency of 999.99 kHz, the 2-MHz IF frequency is not displayed. The LO signal is counted, stored, and displayed at a proper interval so that there is no noticeable blink of the display. This feature gives the operator an updated readout of the receiver tuned frequency, even when the tuned frequency is being changed rapidly. A digital automatic frequency control (DAFC) circuit in the 340A enables the operator to lock the receiver local oscillator to the internal electronic counter circuits. The DAFC capability minimizes drift of the local oscillator, thus increasing receiver stability.

1.1.4 Two antenna inputs provide for either a 50 ohm unbalanced or 600 ohm balanced RF input. The balanced line helps minimize low frequency interference which may be introduced on the antenna line. This input is useful in areas where high concentrations of man made noise are present. A step attenuator is provided to reduce the input signal level in 20 dB steps. The front-panel SIGNAL STRENGTH meter gives a relative indication of signal strength.

1.1.5 Audio outputs from the receiver are available at the front-panel PHONES jack or at rear-apron terminal board TB1. The dynamic level at both receptacles is controlled by the AUDIO level control.

1.2 MECHANICAL CHARACTERICS

1.2.1 The Type 340A VLF Receiver is designed for mounting in a standard 19-inch rack. All controls which are required for normal operation of the unit are mounted on the front panel. The front, rear, sides, and main deck of the receiver are constructed of aluminim. The aluminum front panel is painted with gray enamel and then overlaid with a black-anodized bezel. The bezel is etched with control markings. A counter display escutcheon with polarized window is located at the upper left of the front panel. The interior of the receiver chassis mounts assemblies A1 through A24. Counter assembly A1 and input transformer assembly A24 mount in brass enclosures which are plated with precious metals to prevent tarnishing. These enclosures also prevent undesired RFI radiation. Assemblies A2 through A23 consist of plug-in printed circuit cards. Some are mounted in a aluminum housing for shielding purposes.

1.2.2 The rear apron mounts a variety of input and output connectors. Input power selector switch S2 and line power fuses F1 and F2 are also mounted on the rear apron.

Figure 2-1. Type 340A VLF Receiver, Functional Block Diagram

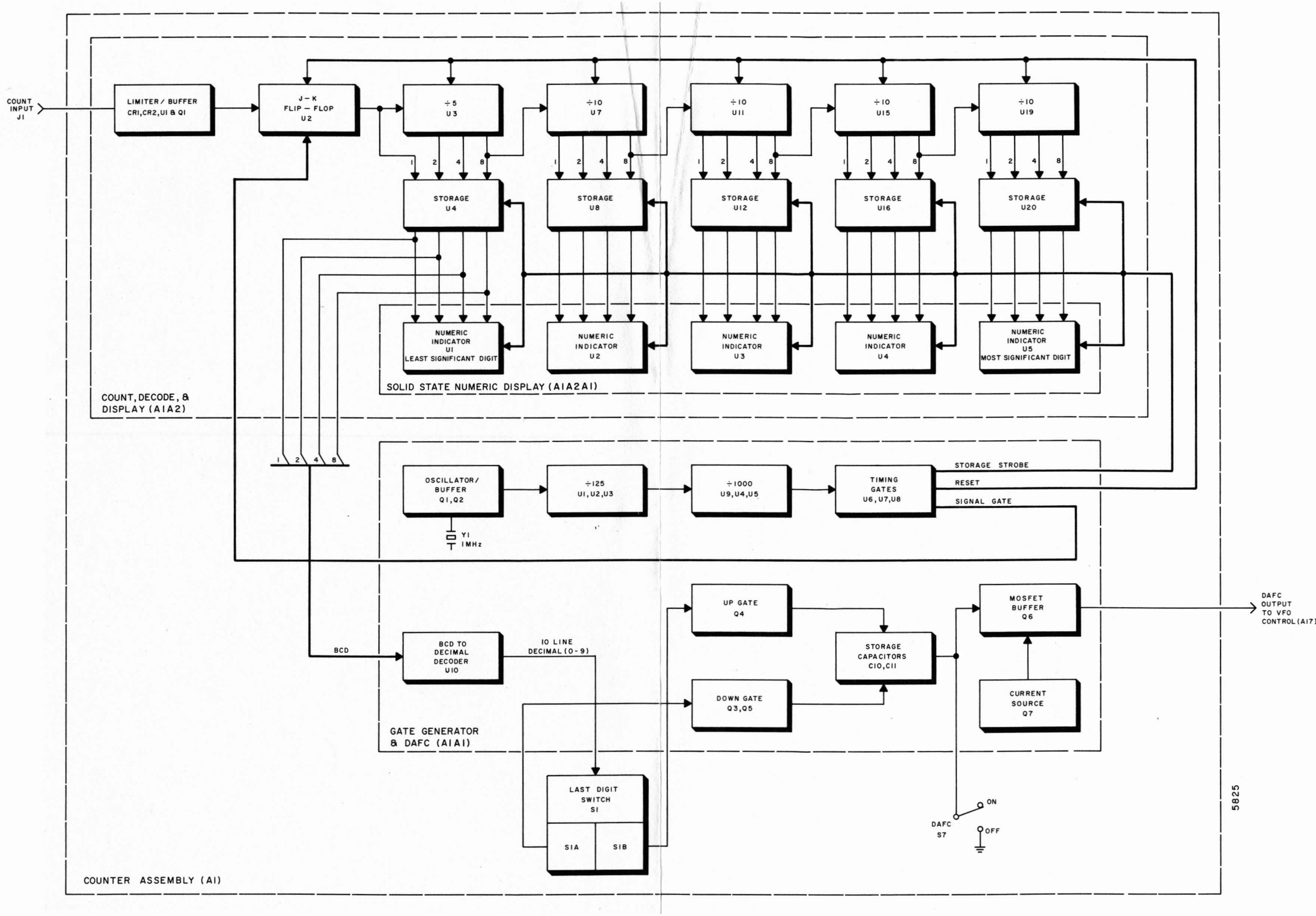


Figure 2-2. Type 79832-1 Frequency Counter, Functional Block Diagram

SECTION II

CIRCUIT DESCRIPTION

2.1 GENERAL

The various circuits in the Type 340A Receiver are described in the following paragraphs. Figures 2-1 and 2-2 are functional block diagrams for the receiver and frequency counter sections of the 340A. Figures 6-1 through 6-26 are schematic diagrams which are used in the detailed circuit descriptions. These illustrations can be found at the back of this manual. Note that the unit numbering method is used to identify components. This means that components, assemblies, subassemblies, or modules carry prefixes before the usual class letter and number of the item, such as A1C15 or A1A2U5. These prefixes are omitted on drawings and in the text except in those cases where confusion might result from their omission.

2.2 RECEIVER FUNCTIONAL DESCRIPTION

2.2.1 General. - The Type 340A Receiver is a double-conversion superheterodyne receiver which tunes the frequency range of 1 to 900 kHz in one band. The 340A operates in either the AM, FM or CW detection modes with selectable IF bandwidths of 50, 20, 6, or 1 kHz. A built-in frequency counter functions as a highly accurate tuning dial. The receiver local oscillator signal, which is equal to the tuned frequency plus the 2 MHz IF, is counted and displayed on a 5-digit LED readout. However, the readout eliminates the 2 MHz offset and only the tuned frequency is displayed. DAFC (digital automatic frequency control) circuits within the counter provide long term stability of the receiver tuned frequency to ±10 Hz.

2.2.2 Input Transformer/Filter (A24). - Input signals from an external antenna connect to the 50-ohm unbalanced or 600-ohm balanced RF input jacks on the rear apron of the receiver. Either input is applied to impedance matching transformer T1 in the input transformer/high pass filter assembly, A24. Transformer T1 provides a 50-ohm secondary impedance for either the 50-ohm or 600-ohm antenna inputs. From the transformer, the RF input is applied to a high pass filter network. This filter provides attenuation for inputs below the receiver 1-kHz low band limit.

2.2.3 Low-Pass Filter and Attenuator (A14). - The filtered output from A24 is applied to low-pass filter assembly A14. This nine-pole, low-pass network attenuates undesired inputs above the receiver 900-kHz high-band limit. An attenuator network, which is associated with the front panel ATTENUATOR (dB) switch, provides 60, 40, 20 or 0 dB of attenuation for the incoming RF signal. The attenuator can provide a direct connection to input converter assembly A16 for small signal inputs, or several steps of attenuation for large input signal levels.

2.2.4 Input Converter (A16). - The attenuator output is applied to input converter assembly A16. Input signals are filtered by a three-pole low-pass filter before application to RF amplifier Q1. This stage utilizes a grounded gate, junction field-effect transistor (JFET) to maintain RF circuit noise at a minimum level. Amplifier Q2, a JFET source follower, provides impedance transformation to drive balanced mixer U1. The amplified incoming signal is high beat heterodyned with the local oscillator signal from the variable frequency oscillator (VFO) assembly, A15. Mixing occurs in balanced mixer U1. The VFO input is coupled through balun transformer T1. The balanced characteristics of mixer U1 cancel the two original input frequencies providing only the sum and difference frequencies at its output. The mixer output is coupled to emitter follower Q3 and to IF driver module A7. The sum and difference signals applied to Q3 are buffered and applied to rear apron SM (signal monitor) jack J7. The undesired sum signal will be rejected in the IF stages of the signal monitor.

2.2.5 IF Driver Amplifier (A7). - The sum and difference output signals from assembly A16 are initially amplified by FET driver Q1. The output of Q1 is applied to a multipole bandpass filter where the sum output of the first mixer is rejected. The filter output is applied to the paralleled inputs of the 1, 6, 20, and 50 kHz IF amplifiers. Transistor Q2 functions as a current source for Q1.

2.2.6 VFO Control (A17). - The operating frequency of the VFO assembly (A15) is controlled by the front panel MAIN TUNING and FINE TUNING controls. These potentiometers control the function of VFO control assembly (A17). In remote operation, an external tuning voltage is applied to rear apron jack J1. A section of the LOCAL/REMOTE receiver control switch disables the front panel MAIN TUNING control during remote operation. The

2.2.11.2 In the automatic gain control (AGC) modes of receiver operation, AGC circuits in the gain control assembly supply a voltage in the 0 to -5 Vdc range. This voltage swings negative from the nominal zero volt level with increases in received signal strength. The AM detector dc output varies in accordance with the average of incoming signal levels, and it is used to develop the AGC voltage. Both the LOG AGC voltage and the AM/FM AGC voltages are developed in gain control module A18. The detector voltage is applied to emitter follower Q3. The output from Q3 is applied to AGC amplifier U3 and to Log AGC amplifier U1.

2.2.11.3 The buffered detector input is applied to pass diodes at the input of AGC amplifier U3. These diodes are non-conducting until the detector voltage exceeds 1.4V. In the off condition the AGC line is held at zero volts and the receiver maintains maximum gain. At levels above 1.4V the detector voltage turns on U3 which is connected as an inverting operational amplifier. When operating, U3 provides the 0 to -5 Vdc control voltage which sets the overall gain of the receiver. The AGC voltage is applied to rear-apron jack J8 and to the AM AGC and FM AGC section of MODE switch S5A-W. The arm of this switch section applies the AGC voltage to the gain-controlled stages in A8 through A11. In remote operation of the receiver, the AGC mode is disabled and only remote controlled manual gain is available.

2.2.11.4 When selecting the LOG mode of receiver operation, the output from the Log AGC circuits is connected to the gain-controlled stages through MODE switch S5A-W. The buffered AM detector voltage from Q3 is applied to Log AGC amplifier U1 and its associated shaping network. This circuit develops the 0 to -5V gain control voltage during the LOG mode of operation. The shaping circuit consists of a three-break-point feedback network which is controlled by the output of U1. The shaping network enables the LOG mode of operation to respond to large dynamic changes in the detector voltage which increase in amplitude with increases in the received signal strength. The output from U1 is applied to the gain control stages of the receiver and inverter U2. This stage inverts the negative-going gain control voltage from U1 and provides a 0.1 to 1.0V output over the dynamic range of the Log AGC voltage.

2.2.12 455-kHz IF Amplifier (A13). - The output signal from the second converter module, A12, is applied to the 455-kHz IF amplifier assembly, A13. This assembly consists of input amplifier Q1, gain-controlled MOSFET Q2, output emitter follower Q6, and band switching transistors Q3, Q4, and Q5. The normal bandpass of input amplifier Q1 is set at approximately 4 kHz by a resonant tank in its collector circuit. Band switch transistors Q3, Q4, and Q5 are controlled by the 50, 20, and 6 kHz enable lines from bandwidth control assembly A6. Selection of the 50, 20 or 6-kHz bandwidths activates the desired bandswitch transistor. In the on condition the conducting transistor effectively grounds a resistor in parallel with the tank circuit of the input amplifier. Different values of resistance are used for each of the three bandwidths. For decreasing values of switched-in parallel resistance the tank circuit Q decreases and the input amplifier bandpass becomes wider.

2.2.13 IF Buffer (A19). - The 455-kHz IF output from assembly A13 is applied to IF buffer assembly A19. This assembly consists of common emitter input amplifier Q1, and two output buffers, Q2 and Q3. The output from buffer stage Q2 connects to rear-apron 455-kHz IF OUT jack J4. The output from Q3 supplies the 455-kHz IF signal to the AM, FM, and CW demodulator assemblies.

2.2.14 AM Demodulator (A22). - The IF input signal to the AM demodulator is amplified by cascade, common emitter input amplifiers Q1 and Q2. The amplified signal is applied to a voltage detector network which consists of detector diode CR1 and capacitor C5. Amplitude variations of the AM envelope are rectified by the detector which develops the audio signal. The detected signal is applied to complementary emitter followers Q3 and Q4 which set the output impedance to the audio amplifier and rear-apron AM DET jack J5.

2.2.15 FM Demodulator (A21). - FM demodulator assembly A21 consists of the following: input amplifier/limiter U1; a Foster Seeley discriminator network; unity gain amplifier A21U2; bandwidth enable switches A21Q1, A21Q2; and output amplifier A21U3. Enable switches A21Q1 and A21Q2 are JFET switches which pass FM signals only when the 20-kHz or 50-kHz bandwidth is selected. The +18 Vdc enable voltage for the two switches originates in the bandwidth control module whose function is controlled by the front panel IF BANDWIDTH (kHz) switch. The activated enable switch provides a low impedance signal path for the FM audio signal. Amplifier U3 provides outputs to FM DET jack J6, and the audio amplifier module.

2.2.16 CW Demodulator (A20). - CW demodulator assembly A20 contains high and low voltage source transistors Q1 and Q2 plus the sealed CW demodulator module U1. The output from the two voltage source transistors connects to the ±10 kHz variable BFO potentiometer mounted on the front panel. Positioning of the BFO kHz sampled LO signal from R17 out-of-phase with the undesired LO feedthrough signal at the output of the balanced mixer. Potentiometer R17 and C11 are adjusted for minimum LO feedthrough. Sum and difference outputs from the balanced mixer are applied to module pin 4 and through C12 and R19 to the base of emitter follower Q3. Resistors R20, R21, and R24 are biasing resistors. The output from Q3 is coupled through C14 and R25 to module pin 1. This output connects to SM OUTPUT jack J7 on the rear apron. The mixer output from module pin 4 connects to IF driver amplifier assembly A7.

2.6 TYPE 79969 VFO CONTROL

Figure 6-18 is the schematic diagram for this assembly; its reference designation prefix is A17. Three separate circuits on the VFO control assembly provide the following: isolation of the remote tuning voltage input; development of a 0V to +10V analog voltage which can supply frequency data to ancillary equipment; and shaping of the main tuning, fine tuning, and DAFC input voltages for application to the VFO assembly. Each circuit will be discussed in a separate paragraph.

2.6.1 Remote Buffer. - Tuning voltage inputs from the remote station (when used) enter the receiver through REMOTE TUNING IN jack J1 on the rear apron. The LOW input or receiver ground is applied to the non-inverting input (pin 3) of IC U1 through module pin 1. Resistors R1, R2, R4, R9 and capacitor C2 form a noise cancelling network. A similar network is used with the HIGH input which connects to the inverting input of the IC. Feedback output from pin 6 to the inverting input of U1, through R10, BALANCE potentiometer R6, and the noise immunity circuit, sets the gain of U1 at one. The 1 to 1 ratio of 50K ohm resistors R3 and R10 determine the gain of the operational amplifier. Potentiometer R6, in the inverting input line, provides for setting the amount of noise passed through the amplifier. At its optimum setting, R6 allows minimum noise to be passed through U1. The remote tuning voltage is applied from pin 7 of the VFO control to LOCAL/REMOTE switch S6B-Z. During operation the remote tuning voltage is returned to the VFO control through switch S6B-Z and module pin 18.

2.6.2 Analog Voltage Source. - The local or remote tuning input is a dc voltage in the range of -10V to +10V. This voltage is applied to module pin 18 from either the local main tuning potentiometer or remote buffer IC U1 in the VFO control. LOCAL/REMOTE switch S6B-Z selects either of the two tuning voltages. The analog voltage level, which is available at rear apron jack J3, is developed by analog voltage source IC U2. Several inputs to U2 determine the output voltage level. These inputs consist of the local or remote tuning voltage, the fine tuning voltage, and the DAFC error voltage. The FINE TUNE input from potentiometer R3 on the main chassis is a voltage in the range of -10V to +10V. The fine tuning voltage is at the same level as the main tuning voltage and since only a small percentage of frequency change is desired, it is reduced through a voltage divider consisting of resistors R11 and R14. The DAFC voltage is also reduced for similar reasons through a voltage divider consisting of resistors R12 and R15. Gain is set by the ratio of resistor R27 in the feedback path to resistor R19 in the inverting input line, pin 2. The non-inverting input to the IC is returned to ground through R26 and balances the current flow through both the inverting and non-inverting inputs of the amplifier. The output voltage has a range of 0 to +10 Vdc. Any given voltage point in the analog voltage range represents a tuned frequency for the receiver. The +10V output represents the 900-kHz end, and the 0V level represents the 1-kHz end of the band.

2.6.3 Shaping Amplifier. - The main tuning, fine tuning, and DAFC error voltage is also applied to voltage shaper operational amplifier U3. This IC with its associated feedback network provides a shaped +2V to +10V output which complements the voltage-versus-capacitance characteristics of the varactor diodes used in the VFO assembly. The characteristics of the varactor diodes are such that for a given reverse bias voltage change the capacitance of the varactor diode changes. This action changes the operating frequency of the varactor-controlled oscillator. The shaped tuning voltage output from shaper amplifier U3 is applied to the varactors so that the non-linear diodes can exhibit linear tuning characteristics across the 1 to 900-kHz tuning range. Three separate inputs determine the output voltage from the shaper network. They are: the +10V to -10V main tuning voltage; the +10V to -10V fine tuning voltage; and the DAFC voltage output from the frequency counter which is centered at 0V and increases or decreases from -3.5V to +2.5V. The main tuning voltage from module pin 18 connects to the inverting input of U3 through R13, R16, and range potentiometer R24. The fine tuning input from module pin 14 is reduced through the voltage divider (R11, R14) and resistor R22 before application to the inverting input. The DAFC input from module pin 15 is also reduced through a voltage divider (R12, R15) and resistor R23 before connection to the inverting input of U3. Since both the fine tuning and DAFC voltage levels have a minimum effect on the output of U3, they will be disregarded in the description of circuit operation. Figure 2-3 is a simplified schematic diagram for the shaping network. Note that the DAFC and fine tuning input lines have been omitted in the simplified schematic. These levels would normally be summed with the main tuning voltage. The nonthe reverse bias applied. Therefore, with an increased reverse bias, the diode exhibits a decrease in capacitance. Capacitor C17 isolates the dc tuning voltage from L1 and the remaining oscillator circuitry. Protective diode CR2 with series resistor R3 limits the negative half-cycle of the oscillator signal. Limiting of the oscillator signal is necessary to prevent false biasing of the varactor. The oscillator output is taken from the junction of voltage divider capacitors C3 and C4 in the emitter-to-base feedback path. Transistor Q2, which provides a high impedance load for Q1, isolates the oscillator from the output circuits. An LO signal in the 50-100 mV range is coupled through R13 and C9 to output No. 1, pin 17. This signal is used to drive the frequency counter module, A1. The output of Q2 is also coupled through C8 to common emitter amplifier Q3. Potentiometer R24 sets the gain of the amplifier by increasing or decreasing emitter degeneration. The amplified output from Q3 is coupled to a complementary symmetry amplifier consisting of transistors Q4 and Q5. This amplifier increases the LO signal to approximately 1V rms. The LO signal is applied to the input converter module for heterodyning with the incoming RF signal through output No. 2, module pin 22.

2.8 TYPE 72370 IF DRIVER AMPLIFIER

Figure 6-9 is the schematic diagram for this assembly; its reference designation prefix is A7. Sum and difference inputs from the input converter, module A16, connect to module pin 22. FET amplifier Q1 is connected in a grounded-gate configuration. Transistor Q2 serves as a constant current source for biasing Q1. The signals from Q1 are applied through voltage divider capacitors C4 and C5 to a 5-pole band-pass filter. The center frequency of the filter is set at 2 MHz for selecting the difference output of the first mixer (A16U1). The bandwidth of the filter is 50 kHz so that detection of wideband input signals is possible through the 50-kHz IF amplifier. The filter output is taken at the junction of voltage divider capacitors C14-C15 and appears at module pin 1. The 2-MHz first IF signal is then applied to the 1, 6, 20, and 50-kHz IF amplifier modules.

2.9 TYPE 72407 IF AMPLIFIER (50-kHz BANDWIDTH)

Figure 6-10 is the schematic diagram for this assembly; its reference designation prefix is A8. The 2-MHz IF signal is applied to module pin 1. It is coupled through capacitor C1 and resistor R1 to the low impedance source of common-gate FET amplifier Q1. The common-gate configuration is used to provide voltage gain, isolation of the input, and to maintain minimum levels of circuit noise. The gate biasing network consists of resistors R6, R7, and R8. The biasing provides a positive voltage on the gate only when the IF BANDWIDTH switch is in the 50-kHz IF bandwidth position. When any other bandwidth is selected, the +18V is disconnected from the assembly and the gate of Q1 is held at a negative potential to prevent conduction. Drain potential for Q1 is supplied through CR2, R4, and L2. Inductor L1 and resistor R2 develop the input signal to the source of Q1. The output from Q1 is coupled through C4 to a two-pole bandpass filter network which, in conjunction with the bandpass filter contained in assembly A7, sets the 50-kHz bandwidth of the receiver. The filter output is applied to pin 3 of dual-gate IGFET Q3. A gain control voltage from module pin 20 is applied to pin 2 of the IGFET through R15 and R16. Diode CR1 provides a return path for the gain controlled gate when no AGC voltage is applied. With no AGC input, diode CR1 is forward biased by the +18V supply through R14 and R16. This action clamps the junction of R15 and R16 at +0.6V. When the incoming signal strength causes the AGC voltage to increase to a sufficiently negative level (approximately -0.6V), CR1 is reverse biased and the gain-controlled gate (pin 2 of Q3) follows the AGC voltage. Potentiometer R20 in series with R19 in the drain circuit of Q3 selects the desired amount of signal developed across RF choke L6. The IF signal from the wiper of R20 is applied through C17 to the base of emitter follower Q4. This stage, and its associated emitter network, sets the output impedance of the 50-kHz bandwidth IF amplifier.

2.10 TYPE 72408 IF AMPLIFIER (20-kHz BANDWIDTH)

Figure 6-11 is the schematic diagram for this assembly; its reference designation prefix is A9. The 2-MHz IF input signal is applied to module pin 1 and is connected through C1 and R2 to the low impedance source of common-gate FET amplifier Q1. The gate biasing network consists of resistors R17, R18, and R19. The biasing provides a positive voltage on the gate only when the IF BANDWIDTH switch is in the 20-kHz IF bandwidth position. When any other bandwidth is selected, the +18V supply is disconnected from the module and the gate of Q1 is held at a negative potential to prevent conduction. The drain potential for Q1 is supplied through R3 and L2. Inductor L1 and resistor R1 develop the input signal to the source of Q1. Inductor L2 is an RF choke. Capacitor C2 decouples RF from the supply line. The amplified output from Q1 is applied to the IN port of FL1 through C3. This filter sets the overall bandwidth of the amplifier strip at 20 kHz. The OUT port of FL1 conntects to pin 3 of gain controlled IGFET Q2. This stage receives the manual gain control or AGC voltage which is applied to pin 2 of the FET. Diode CR1 clamps the gain control line at the junction of R10 and R11 at 0.6V with no signal input to the receiver. When the incoming signal strength increases, the AGC voltage begins modulator U1. The sum output from U1 is rejected by the filter. Emitter follower Q4 provides a low impedance output from module pin 1 through C18 and R26.

2.14 TYPE 72362 455-kHz IF AMPLIFIER

Figure 6-14 is the schematic diagram for this assembly; its reference designation prefix is A13.

2.14.1 The 455-kHz IF input from the second converter connects to module pin 22. The IF input is coupled through C1 to the base of common emitter amplifier Q1. A parallel resonant tank in the collector circuit of Q1 tunes it to 455 kHz. The bandpass of the tank is approximately 4 kHz when the 1-kHz IF bandwidth is selected. When either the 6, 20, or 50-kHz IF bandwidths are selected, a switched +18V is applied to module pins 12, 14 or 16, respectively, from the bandwidth control module, assembly A6. The switched +18V is used to activate band-switching transistors Q3, Q4, or Q5 which are associated with the 50-kHz, 20-kHz, and 6-kHz IF bandwidths respectively. In a typical example of input circuit operation, assume that the 50-kHz IF bandwidth is selected and that the switched +18V is applied to module pin 16. This action causes Q3 to conduct to saturation. Resistor R7 in the collector circuit of Q3 is effectively grounded through the low collector-to-emitter resistance. With Q3 conducting, R7 is placed in parallel with the tank circuit. The "switched-in" value of R7 decreases the tank circuit Q and increases the 3 dB bandwidth from the nominal 4 kHz to 70 kHz. Increasing the bandwidth of the input amplifier also increases the amount of undesired noise passed by the stage. This increased noise output is compensated for by lowering the efficiency of the resonate tank by decreasing the tank circuit Q. Note that the value of "switched-in" parallel resistance increases when it is desired to decrease the bandpass of the input amplifier from 50 kHz to 20 kHz to 6 kHz. Resistors R16 and R21 are the "switched-in" parallel resistors for the 20-kHz and 6-kHz IF bandwidths respectively.

2.14.2 The output from Q1 is applied to pin 3 of amplifier Q2. Manual or automatic gain control inputs from module pin 6 connect to pin 2 of the amplifier. AGC delay and short circuit protection is provided by R13, R14, and CR1. These components function identically to the AGC input circuits of the 1, 6, 20, and 50-kHz bandwidth IF amplifiers (refer to paragraph 2.9). The output from Q2 is coupled through C10 to the base of emitter follower Q6. This stage provides the IF output at module pin 1 through C11 and R27.

2.15 TYPE 79983 GAIN CONTROL

Figure 6-19 is the schematic diagram for this assembly; its reference designation prefix is A18. Inputs consist of a 0V to -10V level from the MANUAL GAIN potentiometer and the AM detector voltage from the AM demodulator assembly.

2.15.1 The 0V to -10V manual gain input is applied to module pin 21 from either the MANUAL GAIN potentiometer or from the remote control input at rear-apron connector J2. The local or remote manual gain control voltage is selected by section S6B-X of the LOCAL/REMOTE switch. When the MANUAL GAIN control is set for maximum receiver gain (maximum clockwise position) zero volts is present at the base of Q1. This causes transistor Q1 to conduct slightly and the base of PNP transistor Q2 to be at a slightly positive level. In this condition Q2 is cut off and its emitter is at zero volts. The zero-volt level connects to module pin 15, the manual gain output. As the manual gain control is turned in a counterclockwise direction, transistor Q1 conducts less, the base of Q2 becomes negative enough for it to conduct, and the emitter of Q2 moves to a negative voltage level. Receiver gain decreases as the manual gain control voltage increases in a negative direction.

2.15.2 In the FM or AM AGC modes of operation the AGC voltage output from the gain control module is applied to the gain determining stages of the receiver. The AM detector voltage from pin 1 of assembly A22 is used to develop the AGC voltage. The detector input is applied to module pin 20 and is coupled through R14 to the base of driver Q3. The positive detector voltage forward biases Q3 and the emitter voltage follows the positive level applied to the base. The output from Q3 connects to the inverting input of AGC amplifier U3 through delay diodes CR4 and CR5. These diodes prevent AGC action until the detector voltage reaches a 1.2V level. This provides maximum receiver gain when incoming signals are at a low level. The dc input voltage to U3 varies in proportion to the average output from the detector. Amplifier U3 inverts the positive voltage input level to a 0 to -5V AGC output. The gain of U3 is set at approximately 10 by the ratio of feedback resistor R27 to input resistor R25. The output from U3 passes through R28 to module pin 2. The AGC output connects to MODE switch S5A-W and is applied to the gain-controlled stages when either the AM AGC or FM modes are selected.

2.15.3 In the LOG mode of receiver operation a special LOG AGC voltage developed in the gain control module

Capacitor C4 references the center-tapped secondary of T1 to the primary tuned circuit. As the FM input deviates above or below the 455-kHz IF center frequency, an ac signal is developed in the secondary of T1 which is proportional to the amount of deviation or frequency change from the initial 455-kHz IF frequency. Diodes CR1 and CR2 rectify or demodulate the transformer secondary voltages to produce an audio output. A low-pass filter at the discriminator output, C7, L4, and C8, passes the audio signal and removes the undesired IF components. Voltage follower U2 is a unity gain amplifier which provides a high impedance load for the discriminator. The output of U2 connects to JFET switches Q1 and Q2. These JFET elements are controlled by either the 50-kHz or 20-kHz enable lines from the bandwidth control module. As an example, with the 50-kHz BW selected, +18V is switched to module pin 8 while module pin 9 is floating above ground. In this condition diode CR3 is reverse biased and zero volts exists across R13 between the gate and source of switch Q1. Since Q1 is a depletion mode device the zero-volt potential between its source and gate provides a low impedance signal path between its drain-source junction. In the "on" condition, Q1 passes the FM audio signal from the discriminator to amplifier U3. When the 20-kHz BW is selected, Q2 conducts in a similar manner.

2.18.3 The gain of amplifier U3 is set by the value of input resistor R9 or R11 and potentiometer R27 in the feedback path. Resistors R9 or R11 are switched into the input circuit of the amplifier when either the 20-kHz or 50-kHz bandwidths are selected. It should be noted that the value of R9 is approximately twice the value of R11. The value of R9, which is associated with the 50-kHz bandwidth, decreases the gain of U3 and in turn decreases the output passed from the wide bandwidth discriminator. Potentiometer R27 adjusts the gain of U3 to set the slope of the discriminator. The output from U3 connects through a voltage divider network to module pins 7 and 3.

2.19 TYPE 79953 CW DEMODULATOR

Figure 6-21 is the schematic diagram for this assembly; its reference designation prefix is A20. A sealed assembly designated U1 mounts on assembly A20.

2.19.1 The CW demodulator assembly develops a signal which can be varied 10 kHz on either side of the 455-kHz second IF center frequency for use in the CW VAR mode of operation, or it can provide a 455-kHz signal in the CW ZERO mode of operation. In either mode the output from the "on" oscillator is mixed with the output of the 455-kHz IF amplifier in a detector to produce an audible beat note. Inputs to the module cosist of the 455-kHz IF signal, positive and negative operating potentials, two switched +18V enable lines from the mode switch, and the VARIABLE BFO voltage from the front panel BFO ± kHz control.

2.19.2 The variable BFO voltage for controlling the frequency of the varactor oscillator in module U1 is generated by transistors Q1 and Q2. Pins 1 and 3 of the BFO kHz control connect to module pins 9 and 13. The wiper of the potentiometer connects to module pin 22. Varying the BFO kHz control in either direction changes the amount of bias applied to the varactor oscillator, thus changing its operating frequency. When the BFO kHz control is in its maximum CW position, an increased reverse bias is applied to the varactor oscillator, the varactor exhibits a decrease in capacitance, the frequency of the BFO increases to 465 kHz. If the BFO kHz control is in its maximum CCW position the frequency decreases to 445 kHz. Potentiometers R2 and R4 in the base circuits of Q1 and Q2 provide for calibrating the high frequency (465 kHz) and low frequency (445 kHz) limits of the BFO range. The CW audio output connects from pin 7 of U1 to module pin 3.

2.20 TYPE 7448 AUDIO AMPLIFIER

Figure 6-24 is the schematic diagram for this module; its reference designation prefix is A23. Inputs to the audio amplifier module consist of the audio outputs from the AM, FM, or CW demodulator assemblies, and three +18V enable lines from the MODE switch. The audio inputs from their respective demodulators are applied to switch transistors Q1 through Q3. Each switch is activated only when its enable voltage from the MODE switch is applied. In the "ON" condition the audio input passes through its associated switch to module pin 2. This output connects to the front-panel AUDIO gain control. The wiper of the gain potentiometer returns the audio signal to module pin 21, through C5 to pin 2 of amplifier U1. The decoupling of pins 7 and 8 sets the gain of U1 at approximately 200. The values of C7 and R9 determine the 600-ohm output impedance. Capacitor C9 couples the output to pin 3 for frequency compensation. The output from the amplifier is used for driving the front-panel PHONE jack or the rear-apron speaker terminal TB1. The phone output is taken from the primary of impedance matching transformer T1 through R10 and module pin 15. The balanced audio output to TB1 is provided by transformer T1 and module pins 13 and 14.

the base of Q3 to the input side of the regulator so that voltage fluctuations at this point can be sensed and compensated for by the gain of the differential amplifier. A differential amplifier is used in the comparison circuit as variations in base-emitter voltage due to temperature changes in one transistor will tend to cancel similar changes in the other. This configuration also permits the reference diode CR2, to be placed in the base circuit rather than the emitter, as is the case with a one-stage error amplifier. Less current flows through the diode, resulting in a more stable reference voltage.

2.23 TYPE 76181 +18V REGULATED POWER SUPPLY

Figure 6-6 is the schematic diagram for this module; its reference designation prefix is A4.

2.23.1 Transistor Q2, which is mounted on the main chassis of the receiver functions as the +18V series regulator. The dynamic impedance of the regulator is controlled by the circuits on the regulator board. The AC input voltage from pins 5 and 7 of power transformer T1 is rectified by full-wave rectifier assembly U1. Electrolytic capacitor C1 on the main chassis filters the pulsating dc output from the rectifier. The voltage is then fed back into the regulator module through pin 8. Resistor R2 and diode CR1 form a starting circuit which supplies voltage to control transistors Q2 and Q3 until the series regulator turns on. When the unit is energized CR1 is forward biased resulting in voltage being applied to the collector of Q2 and the base of Q3. Diode CR2 is reverse baised since its cathode is more positive than its anode. At the same time Zener diode VR1 breaks down, clamping the anode of CR1 at +12V. Once the regulated output rises to +18V, CR2 becomes forward biased and CR1 becomes reverse biased since its anode is clamped to +12V and its cathode voltage is approximately +18V. The voltage for the collector of Q2 and the base of Q3 is now supplied from the regulated +18V output through CR2.

2.23.2 Transistors Q2 and Q4 form a differential amplifier. Zener diode VR2 establishes a fixed reference voltage on the base of Q4. The base of Q2 is connected to the regulated output voltage through a sampling network made up of fixed resistors R4 and R6, and potentiometer R5. When a difference in voltage exists at the bases of Q2 and Q4, this voltage is amplified by Q2, Q3, and Q1. It is the latter transistor which directly controls the conduction of series regulator Q2 mounted on the main chassis. Assuming that the regulated output voltage increases, Q2 conducts harder causing the base voltage of Q3 to decrease. As a result, the voltage drop across load resistor R3 decreases so that the base voltage on Q1 swings more positive. This positive-going voltage is inverted by Q1 so that the base voltage of the series regulator swings in the negative direction. The dynamic collector-emitter impedance of main chassis transistor Q2 now increases, resulting in the regulated output voltage dropping to its nominal value. A differential amplifier is used as the comparison circuit since variations in base-emitter voltage due to changes in temperature in one transistor will tend to cancel similar changes in the other. This configuration also permits the reference diode, VR2, to be placed in a base circuit rather than the emitter, as is the case with a one-stage error amplifier. This configuration maintains a more constant current flow through the diode, resulting in a more stable reference voltage. Silicon diode CR3 is included to provide temperature compensation for the Zener reference voltage. The negative temperature coefficient of the silicon diode counteracts the positive temperature coefficient of the Zener so that the reference voltage remains almost constant for large variations in ambient temperature.

2.24 TYPE 76195 ±10V PRECISION POWER SUPPLY

Figure 6-7 is the schematic diagram for this assembly; its reference designation prefix is A5. This assembly requires inputs from the +18V and -18V power supplies to develop the +10V and -10V precision power supply sources.

2.24.1 Operational amplifier U1 and transistor Q1 provide the -10V output at module pin 17. The +10V output is dependent upon the generation of the -10V output. The -18V input through R12 and R1 will develop a small voltage across Zener VR1. This small negative voltage on the non-inverting input of U1 will cause the output of U1 to also become negative. This action brings Q1 into conduction and the feedback path to the inverting input of U1 is completed through CR1, R2, and R3. This also enables the Zener to regulate pin 3 at -6.2V. Potentiometer R5 is adjusted to provide the proper offset voltage between the inverting and non-inverting inputs of U1. This provides a regulated output of -10V at the emitter of Q1.

2.24.2 Operational amplifier U2 in conjunction with transistor Q2 inverts the -10V potential developed in IC U1. This is accomplished by setting the gain of U2 at approximately unity and applying the -10 volt output from U1 through R8 and R9 to the inverting input of U2. The feedback path is from the emitter of Q2, through precision resistor R13, to pin 2 of U2. Potentiometer R8 is set to calibrate the +10V output by insuring the feedback is at

Nth NEG IN TRANSITION		1	2	3	4	5	6	7	8	9	10
COUNT VALUE	0	1	2	3	4	5	6	7	8	9	10
1 OUT	0	1	0	1	0	1	0	1	0	1	0
2 OUT	0	0	1	1	0	0	1	1	0	0	0
4 OUT	0	0	0	0	1	1	1	1	0	0	0
8 OUT	0	0	0	0	0	0	0	0	1	1	0

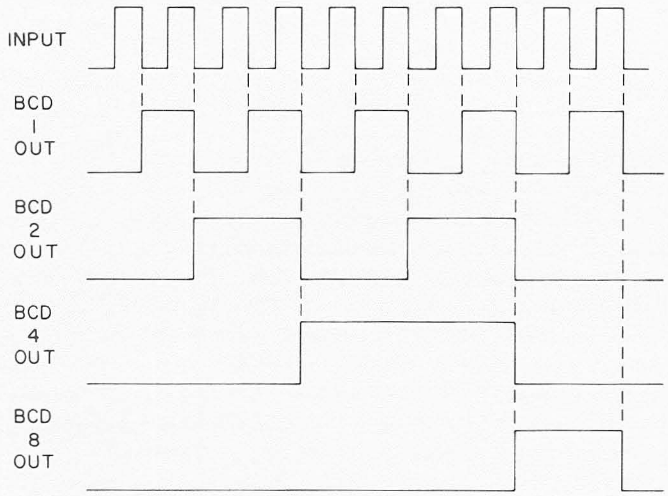
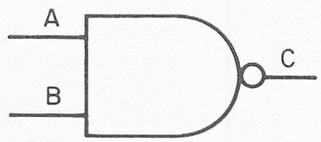
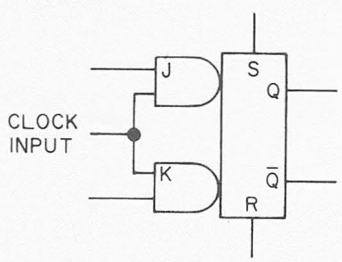


Figure 2-4. BCD Counting, Waveform and Truth Table



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

Figure 2-5. NAND Gate, Logic Symbol and Truth Table



SET - RESET TRUTH TABLE
(J & K MAY HAVE ANY STATE)

R	S	Q
0	0	NOT DEFINED
0	1	0
1	0	1
1	1	NO CHANGE

CLOCKED TRUTH TABLE
(R & S = 1)

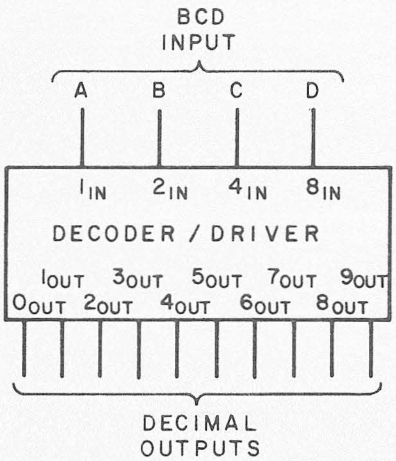
J	K	Q_{n+1}
0	0	Q_n
1	0	1
0	1	0
1	1	$\bar{Q}_n$

Q_n = INITIAL STATE OF Q OUTPUT

Q_{n+1} = STATE AFTER ONE CLOCK PULSE

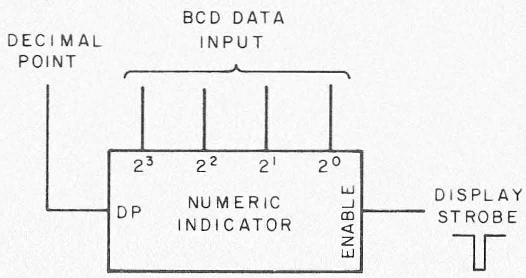
Figure 2-6. J-K Flip-Flop, Logic Symbol and Truth Tables

The flip-flop changes output state on the negative going edge of the clock pulse, depending on the state of the J and K inputs. During counting, the set and J-K inputs are held high. Pulses to be counted are applied to the clock input. When a positive input pulse goes high, then low, the Q output changes to the opposite state. This is shown by the last line of the clocked truth table. The negative transition of a second clock pulse will make the Q output revert to its original state. Therefore, the flip-flop divides the number of input pulses by two. When display. A low activates the decimal.



INPUT				OUTPUT ON
8	4	2	1	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9

Figure 2-8. Decoder, Logic Symbol and Truth Table



NUMERICAL CHARACTER TRUTH TABLE

BCD INPUTS				ENABLE	CHARACTER DISPLAYED
2^3	2^2	2^1	2^0		
0	0	0	0	0	0
THROUGH				0	THROUGH
1	0	0	1	0	9
ANY					NO CHANGE

DECIMAL POINT TRUTH TABLE

DP INPUT	ENABLE	DECIMAL POINT
0	0	ON
1	0	OFF
ANY	1	NO CHANGE

Figure 2-9. Numeric Indicator, Logic Symbol and Truth Table

2.26 FREQUENCY COUNTER BLOCK DIAGRAM DESCRIPTION

2.26.1 General. - Figure 2-2 is a functional block diagram of the Type 79832-1 Counter Assembly; its reference designation prefix is A1. The block diagram shows the functional interconnections between the gate generator and DAFC plug-in card A1A1, and the count, decode, and display plug-in card, A1A2.

2.26.2 Counter Operating Principle. - The function of the frequency counter is to provide a digital display of the tuned frequency of the receiver, and to provide DAFC (digital automatic frequency control). The receiver tunes the frequency range of 1 to 900 kHz and the intermediate frequency is 2 MHz providing a VFO (LO) frequency range from 2.001 MHz to 2.900 MHz. The counter eliminates the undesired 2-MHz readout by providing only enough digits to display 999.99 kHz. Therefore, the 2-MHz IF offset is counted but it is not displayed on the five digit readout. In a typical example of counter operation, assume that the receiver is tuned to 800 kHz. The 2.800-MHz LO signal is gated into five decade counters for a precise period of 100 ms. This sample time is controlled by the counter gate generator circuits. This action provides a count of 2,800,000 Hz x 0.1 second or a value of 280,000 in the five counting decades. Since there is not a decade scaler or readout to display the most significant digit, the displayed count is 80000. The display has a resolution of 10 Hz since the least significant displayed digit is the tens-of-Hz digit. A decimal point is placed in the display so that the final displayed count represents kilohertz, or 800.00 kHz.

2.26.3 Gate Generator and DAFC (A1A1). - The principle function of the gate generator circuits is to supply

2.27 TYPE 79893 GATE GENERATOR AND DAFC

Figure 6-2 is the schematic diagram for this assembly; its reference designation prefix is A1A1. This assembly generates timing signals to control the count, decode, and display assembly (A1A2). The gate generator also contains digital automatic frequency control (DAFC) circuitry.

2.27.1 Oscillator. - Transistor Q1 is operated as a modified Colpitts 1 MHz crystal controlled oscillator. Resistors R1 and R2 bias the base of Q1. Capacitors C1 and C2 provide additional circuit capacitance required by Y1, and capacitor C3 is used to adjust the frequency to exactly 1 MHz. Capacitors C4 and C5 form a voltage divider to provide the necessary impedance step-up and regenerative feedback. Resistor R4 sets the emitter current and capacitor C6 couples the output of Q1 to amplifier Q2. Resistors R5 and R6 bias the base of Q2. This transistor is normally conducting to saturation. Negative half-cycles of the oscillator output switch Q2 off providing positive pulses at the collector. The output of Q2 is coupled to the C_2 toggle input of counter U1.

2.27.2 Divide-By-Five IC's U1, U2, and U3. - Integrated circuits U1, U2, and U3 are decade counter IC's which are connected in a divide-by-five configuration. This is accomplished by applying the input to the C_2 input of each IC. The 1-MHz clock input from Q2 is divided by a factor of 125 through U1, U2, and U3 providing an 8-kHz pulse train at the D or BCD 8 output of U3. Note that an additional input is applied to the C_1 input of U1. This input signal is the output of quad NAND gate U6B which is divided by a factor of 8 through the unused divide-by-two sections of U1 through U3. This output (U3 pin 5) is inverted through Q8 and applied to module pin C as a display strobe output. However, this output is not used in the Type 79832-1 Frequency Counter. The display strobe for the numeric indictors in the count, decode, and display module is provided by the storage strobe pulse output from the gate generator.

2.27.3 Decade Dividers U9, U4, and U5. - The 8-kHz pulse train output from U3 is applied to the C_1 input of decade divider U9. This IC provides an 800-Hz pulse train at its BCD 8 output (pin D). Three NAND gates are associated with the input and output of U9; they allow either a 100 ms or 10 ms gate time to be used with the counter assembly. Since only the 100 ms gate time is used with the Type 79832-1 counter, the 10 ms gate is tied to ground and the 100 ms gate is left floating. This arrangement disables NAND gate U11A and allows the 800 Hz pulse train output from U9 to pass through NAND gates U8D and U8C. The input at pin 8 of U8C is held in a logic 1 state by U11A so that any pulses applied to pin 9 are inverted at the output of U8C. The output of gate U8C is applied to the C_1 input of decade divider U4. The BCD 8 output of U4 is an 80 Hz pulse train which is applied to the C_1 input of U5. This IC divides its input by 10 providing an 8 Hz pulse train at its BCD 8 output (pin 12). This output is inverted through NAND gate U8B and is designated the SIGNAL GATE. The SIGNAL GATE occurs 8 times per second providing a cycle time of 125 ms. The U5 BCD 8 is asymmetrical with a 80%-20% relationship between its logic one and logic zero states. Therefore, the output from U5 is high for 25 ms and low for 100 ms.

2.27.4 Control Signal Generation. - Refer to Figure 2-10 which shows the various BCD waveforms which are combined to produce the gate generator tuning pulses. The U5 BCD 8 is combined with two other waveforms to produce the reset pulse. The inverted U5 BCD 1 divides the 20% portion of the U5 BCD 8 into halves, and is high during the first half. The U4 BCD 8 is high for 2.5 ms of the time that the two previous waveforms are high. When these three waveforms are combined and inverted in NAND gate U7A, the reset pulse is the result. To provide the signal gate waveform, it is only necessary to invert the U5 BCD 8, and this is done by NAND gate U8B. To produce storage strobe pulses, the inverted U5 BCD 1 is again used, to locate the output pulse in the first half of the 20% portion of the U5 BCD 8. Otherwise the same BCD waveforms are used as were used to produce the preset. The waveforms are combined in U6B. All of these three output timing waveforms connect directly to module pins which route them to the count, decode, and display board to control its function.

2.27.5 DAFC Circuit. - Figure 2-11 is the block diagram for the DAFC loop. The DAFC circuit on the gate generator card consists of the BCD-to-decimal decoder U10 and transistors Q3 through Q7 which provide VFO drift correction voltage to the VFO control circuitry. Other DAFC circuitry consists of the front-panel DAFC ON/OFF control and the LAST DIGIT selector switch. The DAFC circuitry is activated when the DAFC switch is placed in the ON position.

2.27.5.1 In a typical example of DAFC operation, assume that the receiver has been properly locked onto a last digit, and the decimal information present at the output of decoder A1A1U10 agrees with the last digit selected by switch A1S1. This assumption is hypothetical since the receiver always has a small amount of frequency drift. In this condition both the UP GATE and DOWN GATE would be turned off and there would be no

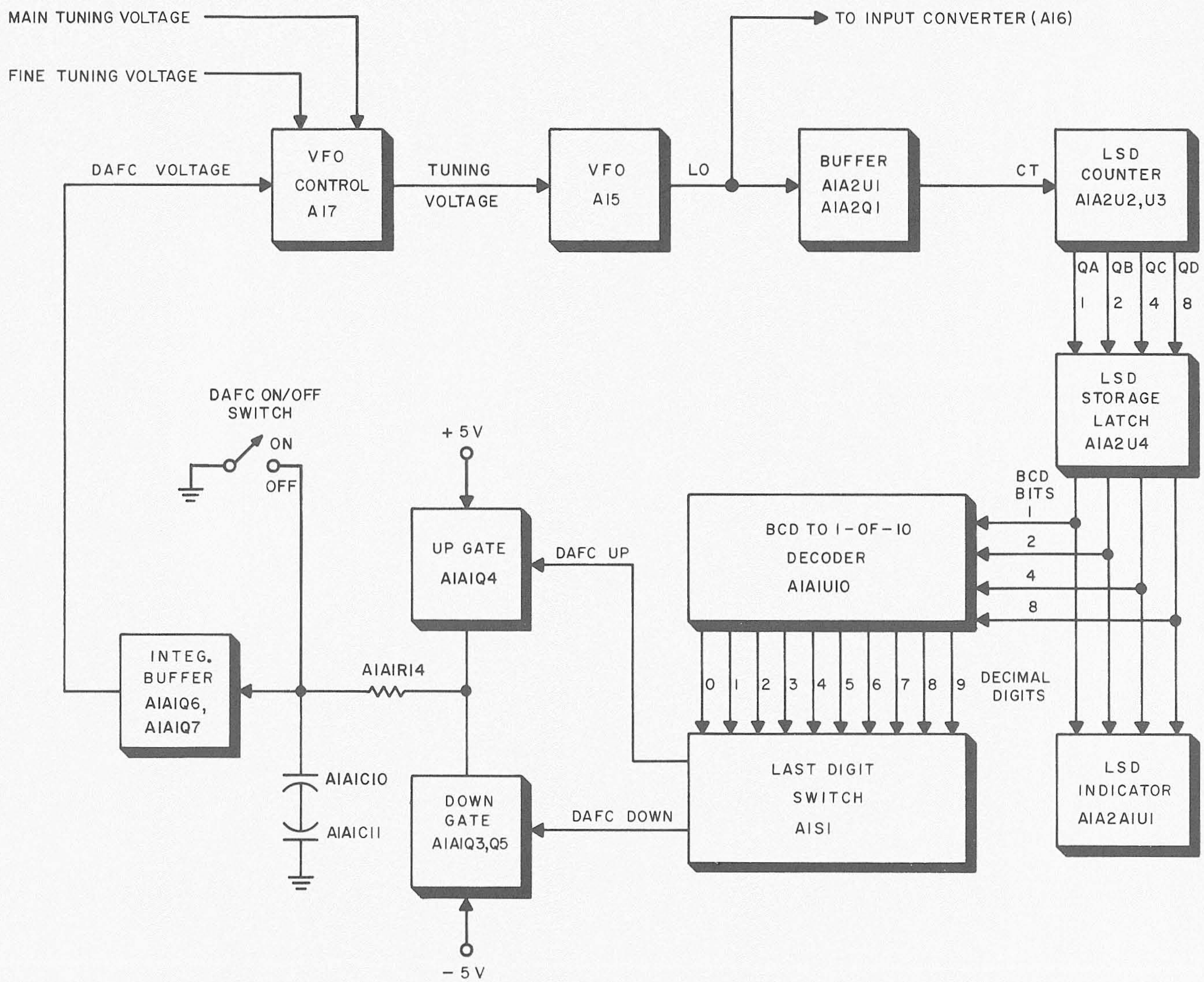


Figure 2-11. DAFC Loop, Functional Block Diagram

SECTION III

INSTALLATION AND OPERATION

3.1 UNPACKING AND INSPECTION

3.1.1 Examine the shipping carton for damage before the equipment is unpacked. If the carton has been damaged, try to have the carrier's agent present when the equipment is unpacked. If not, retain the shipping carton and padding material for the carrier's inspection if damage to the equipment is evident after it has been unpacked.

3.1.2 See that the equipment is complete as listed on the packing slip. Contact Watkins-Johnson Company, Rockville, or your Watkins-Johnson representative with details of any shortage.

3.1.3 The unit was thoroughly inspected and factory adjusted for optimum performance prior to shipment. It is, therefore, ready for use upon receipt. After uncrating and checking contents against the packing slip, visually inspect all exterior surfaces for dents and scratches. If external damage is visible, inspect the internal components for apparent damage.

3.2 INSTALLATION

3.2.1 Rack/Mounting Support. - Rack mount equipment, manufactured by WJ-Rockville, is designed for assembly in standard 19-inch racks in accordance with MIL-STD-189, or E. I. A. standard #RS-310. The unit may be supported solely by the front panel (3.5 inch and larger) for static installations, but it is recommended that chassis slides be added for ease of assembly, access to the unit, and to provide additional support for general installation. Mobile installations of the equipment should be evaluated on an individual basis. Additional information, such as recommended mounting methods, may be found in WJ-Rockville Application Note 1302.50.

3.2.2 Thermal Considerations. - WJ-Rockville equipment is designed for operational temperatures between 0°C and +50°C (32°F to 122°F). The operational temperature range is further qualified for free, unrestricted ambient air at sea level pressure. Equipment installation should provide for free flow of air around and through ventilated units. Multiple stacking, in particular, close adjacent stacking of electronic equipment in a standard console can produce an appreciable increase in the ambient air temperature for the units as versed to the ambient air in the vicinity of the console. Forced-air ventilation may be necessary to maintain the proper ambient air temperature in a console which accommodates equipment that contribute to a high thermal density. Additional information may be obtained from WJ-Rockville in Application Note 1303.50.

3.2.3 Power Connection. - Before energizing the equipment, it is necessary to set the unit to match the input power source voltage to be used. The equipment can operate from either a 115 or 220 Vac, 50-400 Hz source. The rear-panel switch, S2 must be set accordingly. Additionally, this unit has a tapped-primary main power transformer which can be set for 230 Vac operation where high line voltages are common. Consult the main chassis schematic diagram located in Section VI. After setting the unit for the proper input voltage, make sure that the POWER switch is off and plug in the unit. The third pin on the unit power plug supplies a safety ground connection. If the two-pin to three-pin adapter supplied with the unit must be used, be certain that the ground wire of the adapter is securely connected to a low impedance ground.

3.2.4 Remote Tuning Input Connections (Jack J1). - Connect the remote tuning voltage to rear apron jack J1. This input affects the receiver tuning only when the front panel LOCAL/REMOTE switch is in the REMOTE position.

3.2.5 Remote Control Input Connections (Multipin Jack J2). - Connect the remote bandwidth select lines (pins A, B, C, and D) and the remote manual gain control (pin E) voltage to REMOTE CONTROL INPUT Jack J2.

3.2.6 Analog Voltage Output (Jack J3). - Connect the ANALOG VOLTAGE, Jack J3, to the input of the associated monitoring equipment. The analog voltage output is in the range of 0 to +10V. Any given voltage in the 0 to +10V range corresponds to a particular frequency in the receiver tuning range.

3.3.11 DAFC Last Digit Switch. - The DAFC LAST DIGIT switch functions when the DAFC ON/OFF switch is in the ON position. The LAST DIGIT switch sets the least significant digit of the readout and locks the local oscillator to this digit. When locking the 340A to a frequency, first tune the receiver as closely as possible to the frequency with the DAFC off. Next, turn on the DAFC and select the desired least significant digit. If the receiver is to be retuned, turn off the DAFC and reset the DAFC as previously described.

3.4 PREPARATION FOR RESHIPMENT AND STORAGE

3.4.1 If the unit must be prepared for reshipment, the packaging methods should follow the pattern established in the original shipment. If retained, the original materials can be reused to a large extent or will at a minimum provide excellent guidance for the repackaging effort.

3.4.2 If time permits, contract packing and packaging firms can be found in many cities. Based on an examination of the equipment and the proposed method of shipment, these firms can usually perform a reliable repackaging service.

3.4.3 Conditions during storage and shipment should normally be limited as follows:

(a) Maximum humidity: 95% (no condensation)

(b) Temperature range: -30°C to +85°C.

SECTION IV
MAINTENANCE

4.1 GENERAL

The 340A Receiver has been designed to operate over extended periods of time with little or no routine maintenance. An occasional cleaning and inspection are the only preventive maintenance operations recommended. The cleaning interval should be based on the operating enviroment. If the receiver should become totally inoperative, or if one or more of the receiver functions should fail, repair time will be minimized if the repair technician is thoroughly familiar with the circuit description presented in Section II. Reference should also be made to the simplified block diagrams, Figures 2-1 and 2-2, and to the schematic diagrams found in Section VI. A complete parts list including part location illustrations can be found in Section V.

4.2 CLEANING

The unit should be kept free of dust, moisture, and other foreign matter to ensure trouble-free operation. If available, use low velocity compressed air to blow accumulated dust from the interior and exterior of the unit. A clean dry cloth, a soft bristled brush, or a cloth saturated with cleaning compound may also be used. Do not use abrasive metal cleaning materials.

4.3 INSPECTION FOR DAMAGE OR WEAR

Many potential or existing troubles can be detected by a visual inspection of the unit. For this reason, a complete visual inspection should be made for indications of mechanical and electrical defects on a periodic basis, or whenever the unit is inoperative. Electronic components that show signs of deterioration should be checked and a thorough investigation of the associated circuitry should be made to verify proper operation. Damage to parts due to heat is often the result of other less apparent troubles in the circuit. It is essential that the cause of overheating be determined and corrected before replacing the damaged parts. Mechanical parts and front panel controls and switches should be inspected for excessive wear, looseness, misalignment, corrosion, and other signs of deterioration.

4.4 TEST EQUIPMENT REQUIRED

The test equipment outlined in Table 4-1 or their equivalents are required for troubleshooting, performance checks, and alignment of the 340A Receiver.

Table 4-1. Test Equipment Required

ITEM	INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	USE	RECOMMENDED INSTRUMENT
1	Oscilloscope	X and Y Sensitivity	Troubleshooting; alignment	Tektronix Type 503
2	Oscilloscope	15 MHz vertical BW	Troubleshooting; alignment	Tektronix Type 516
3	Signal Generator	50 kHz to 3 MHz frequency range	Signal substitution; alignment	Hewlett Packard Type 606B
4	Sweep Generator	Sweep at 455 kHz and 2 MHz with variable sweep width	Alignment	Hewlett Packard Type 675A
5	FM Signal Generator	54-216 MHz range	FM sensitivity check	Hewlett Packard Type 202H
6	Converter	.1-55 MHz range	FM sensitivity check	Hewlett Packard Type 207H
7	Test Oscillator	1 kHz output	Alignment	Hewlett Packard Type 651B

if the inputs are proper and the output is low (0V). To check this type of problem, remove the IC(s) following the suspected IC while observing the output. If the output continues to be low when all of the IC's have been removed from its output, then it can be considered defective.

(3) A decade counter or logic gate can be considered defective if there is any gross distortion of its output. This type of malfunction is valid only when the inputs to the IC occur at the proper time and are at the correct level.

Table 4-2. Receiver Troubleshooting Chart

TROUBLE INDICATION	PROBABLE FAULT	DIAGNOSTIC PROCEDURE
POWER pushbutton and LED display do not illuminate.	Faulty POWER switch, defective power transformer T1, line fuses F1 or F2 blown, no primary input power, FL1 defective.	Check ac input circuits for defective component.
POWER pushbutton illuminates but receiver is totally inoperative.	Defective power supply assembly. a. The ±10V supply is dependent on both the +18V and -18V power supply modules. b. The ±5V power supply is used throughout the frequency counter module. Ensure that this module (A2) is operating before suspecting the circuits of the frequency counter.	Check the following: A2 pin 6 for -5V A2 pin 18 for +5V A3 pin 14 for -18V A4 pin 14 for +18V A5 pin 7 for +10V A5 pin 17 for -10V
Receiver operates normally but counter gives a random or unstable count. Local oscillator input to frequency counter module is at the proper level.	a. Faulty +5V power supply. b. Defective frequency counter circuits.	a. Check A2 pins 6 and 18 for proper output voltage. b. See counter troubleshooting chart (Table 4-3).
Receiver output improper in AM MAN and both CW modes of operation. Other modes of operation normal.	a. Defective MANUAL GAIN control circuits. b. Defective MODE switch. c. Defective LOCAL/REMOTE switch.	a. Check potentiometer R17, A18Q1, and A18Q2. b. Check S5A. c. Check section S6B-X.
AM AGC and FM modes of receiver operation malfunction. Manual gain modes operate normally.	Defective AGC circuits.	Check A18U3 and its associated circuitry.
LOG mode of operation malfunctions. Other modes operate normally.	Defect in LOG AGC or LOG amplifier circuits.	Check stages A18U1 and A18U2. See paragraph 4.6.5 for LOG mode operational check.
AM AGC, FM AGC, and LOG modes malfunction. Manual gain modes operate normally.	Defective AGC driver stage.	Check A18Q3.
No output in AM AGC or AM MAN modes; FM AGC mode malfunctions. Both CW modes OK.	a. Defective AM Demodulator card (A22). (FM AGC mode malfunctions due to loss of AGC voltage.)	a. Check stages A22Q1 through A22Q4 and associated circuitry.

Table 4-2. Receiver Troubleshooting Chart (Continued)

TROUBLE INDICATION	PROBABLE FAULT	DIAGNOSTIC PROCEDURE
MAIN TUNING control has no effect on front panel frequency counter display, the counter operates normally with an externally applied test signal, and the receiver has no output.	a. Defective main tuning potentiometer.	a. Check R2.
	b. Defective VFO control circuits.	b. Check A17U3 and associated circuitry.
	c. Defective VFO circuits.	c. Check A15U1, and A15Q1 through A15Q5.
	d. Defective LOCAL/REMOTE switch section.	d. Check S6B-Z.
Frequency counter operates normally as the receiver is tuned through its range, but the receiver has no output in all reception modes and bandwidths.	a. Defective amplifier on VFO board.	a. Check A15Q3 through A15Q5.
	b. Bandwidth Control assembly defective.	b. Check assembly A6.
	c. Defect in pre-IF amplifier circuit(s).	c. Check assemblies A24, A14, A16, A7 and the input attenuator.
	d. Defect in second converter and second IF amplifier circuits.	d. Check assemblies A12, A13, and A19.
	e. Defective ±10V power supply.	e. Check A5 pins 7 and 17.
Receiver malfunctions in REMOTE mode.	a. LOCAL/REMOTE switch defective.	a. Check switch S6.
	b. Remote circuits on the VFO control assembly malfunction.	b. Check A17U1 and its associated circuitry.

Table 4-3. Frequency Counter Troubleshooting Chart

TROUBLE INDICATION	PROBABLE FAULT	DIAGNOSTIC PROCEDURE
LED indicators do not light.	Faulty +5V power supply. Note: Loss of the +5V supply will also cause malfunction in the receiver bandwidth control assembly A6.	Check A2 pin 19 for +5 output.
One or more LED indicators show incomplete character.	Defective LED IC.	Replace LED IC.
LED indicators light but the frequency display is unstable or at the wrong frequency.	a. Oscillating +5V power supply.	a. Replace +5V power supply with one known to be operational and check counter operation.
	b. Defective logic IC.	b. Inject 1.5 MHz 100 mV test signal into jack A1J1. Signal trace through count, decode and display module A1A2 with a wideband oscilloscope (see paragraph 4.5.2).

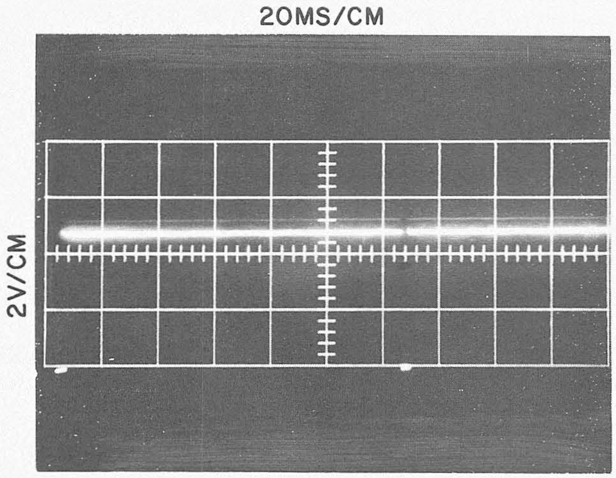


Figure 4-1. Reset Pulse at A1A1 pin 13

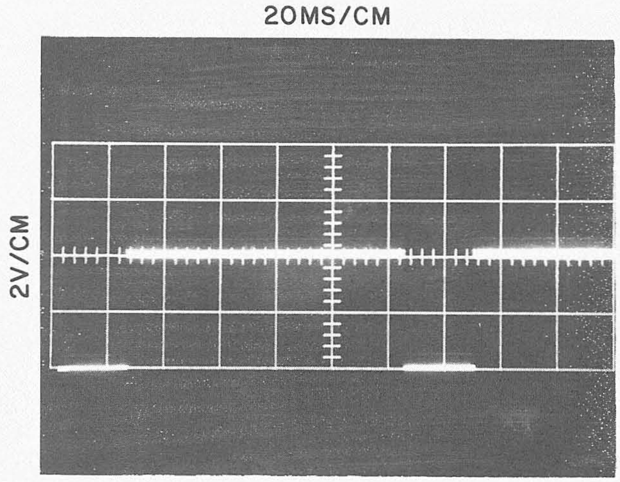


Figure 4-2. Signal Gate Waveform at A1A1 pin 11

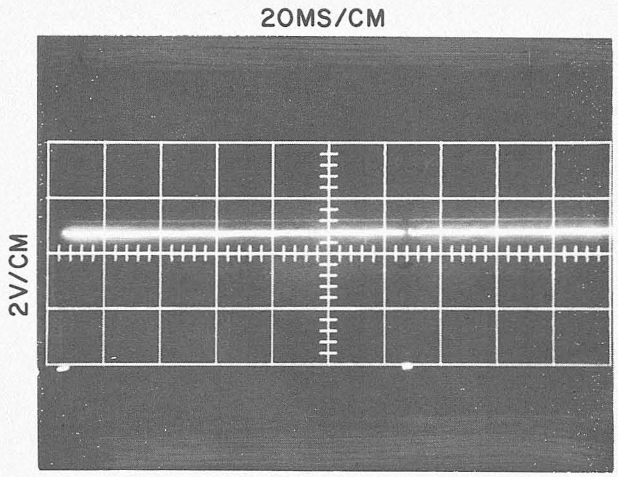


Figure 4-3. Storage Strobe at A1A1 pin 14

4.6 RECEIVER PERFORMANCE CHECKS

The following performance checks may assist in the troubleshooting effort or may be used to determine if the receiver is operating properly. The performance checks may also be used to determine if a repaired unit is operating at minimum standards.

4.6.1 Power Supply Regulator Tests. - Proceed as follows:

(1) Connect the power input to the Variac. Use the digital voltmeter to measure the output voltage of the power supply under test.

(2) Set the Variac control for a 115 Vac output. The output from each supply should be within the following limits.

BANDWIDTH	TEST FREQUENCY (kHz)	INPUT LEVEL (μV)	MODULATION FREQUENCY (kHz)
6 kHz	400	0.64	1.0
	50	0.64	1.0
20 kHz	900	1.20	1.0
	50	1.20	1.0
50 kHz	900	1.80	1.0
	100	1.80	1.0
	50	20.00	1.0

4.6.3 CW Sensitivity Checks. - Proceed as follows:

(1) Set up the equipment as shown in Figure 4-5.

(2) Select the 1 kHz IF bandwidth.

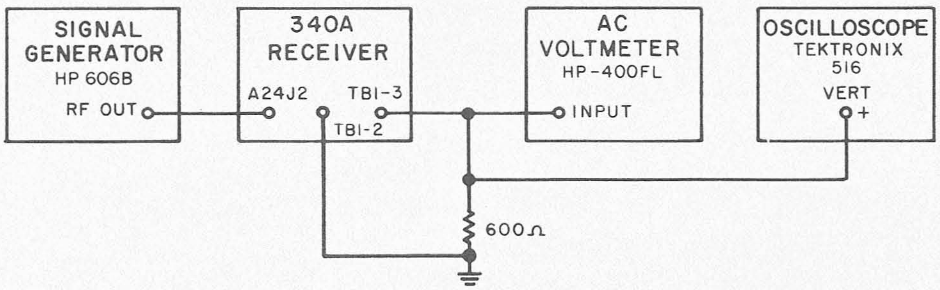


Figure 4-5. Test Setup, CW Sensitivity Checks

(3) Tune the receiver to 400 kHz. Set the mode switch to the CW ZERO position and the MANUAL GAIN control to the maximum clockwise position.

(4) Tune the signal generator in the vicinity of 400 kHz with a CW output of 0.13 μV to obtain an audio signal of approximately 400 Hz.

(5) Adjust the AUDIO gain for a maximum undistorted output on the oscilloscope.

(6) Observe the AC voltmeter for a 2.45 Vrms minimum output level.

(7) Remove the input signal and observe a 10-dB decrease in the output level.

(8) Select the 6-kHz IF bandwidth and repeat steps (3) through (7) with a 0.33 μV output from the signal generator.

(9) Select the 20-kHz IF bandwidth and repeat steps (3) through (7) with a 0.58 μV output from the signal generator.

(10) Select the 50-kHz IF bandwidth and repeat steps (3) through (7) with a 0.9 μV output from the signal generator.

4.6.4 BFO VAR Mode Checks. - Proceed as follows:

(1) Set up the equipment as shown in Figure 4-6.

(4) Set the output from the signal generator to 1.2 μV with a 7 kHz deviation rate.

(5) Adjust the AUDIO gain control to obtain a 2.45V rms minimum indication on the AC voltmeter.

(6) Remove the modulation from the FM generator and observe a decrease of 17 dB minimum on the AC voltmeter.

(7) Vary the receiver tuning control 10 kHz on either side of 400 kHz and note the reading at the FM DETECTOR output jack, J6.

(8) The voltage at J6 will vary from approximately +1.0 Vdc to -1.0 Vdc.

(9) Repeat steps (5) and (6) with the IF bandwidth set to 50 kHz and the output from the FM generator set at 1.8 μV with 17 kHz deviation.

(10) Vary the receiver tuning control 25 kHz on either side of 400 kHz and note the reading at the FM DETECTOR output jack J6.

(11) The voltage at J6 will vary from approximately +1.0 Vdc to -1.0 Vdc.

4.6.6 <u>LOG Mode Operation Checks.</u> - Proceed as follows:

(1) Set up equipment as shown in Figure 4-8.

(2) Adjust the signal generator for a 300 kHz CW signal at minimum output level.

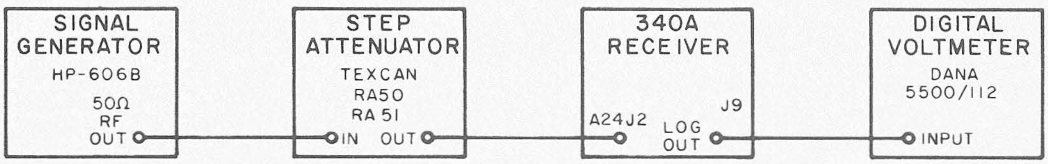


Figure 4-8. Test Setup, LOG Mode Operation Checks

(3) Set the receiver to the LOG mode and select the 6-kHz bandwidth.

(4) Adjust the output of the signal generator and attenuator until the voltmeter reads 0.1 Vdc. Observe the output level from the signal generator.

(5) Increase the output from the signal generator 60 dB above the level in step (3).

(6) Observe the reading on the voltmeter. It shall be a minimum of 0.9 Vdc.

(7) Repeat steps (4) through (6) for the 1, 20, and 50-kHz bandwidths.

4.6.7 <u>Remote Tuning Tests.</u> - Proceed as follows:

(1) Set up the equipment as shown in Figure 4-9.

(2) Set the RECEIVER CONTROL switch to the REMOTE position.

(3) Set the test power supply for -10 Vdc.

(4) Observe the frequency displayed on the receiver readout. It shall be a maximum of 2 kHz.

(5) Set the test power supply for +10 Vdc.

(6) Observe the frequency readout on the receiver display. It shall be a minimum of 900 kHz.

(7) Measure and record the gain from A24J1 to J7. It shall be between -3 dB and -7 dB.

4.6.10 DAFC Check.

(1) Set the receiver DAFC switch to the OFF position and the LAST DIGIT selector to 0.

(2) Tune the receiver to 20.000 kHz.

(3) Set the DAFC switch to the ON position.

(4) Slowly turn the LAST DIGIT selector clockwise through positions 0 through 9 for ten revolutions. Observe that the frequency display follows the selected frequency.

NOTE

When the DAFC is ON, the display may vary between the selected digit and the next highest or lowest digit.

(5) Repeat step (4) turning the selector in the counterclockwise direction.

4.6.11 Gain Distribution Checks.

The following procedure may be used to check the overall gain distribution, or the gain of a particular module or group of modules. Proceed as follows:

(1) Make the following initial control settings:

a. RECEIVER CONTROL - LOCAL

b. ATTENUATION - 0 dB

c. MANUAL GAIN - Maximum

d. MAIN TUNING - 400 kHz

e. FINE TUNING - Midrange

f. AUDIO - Maximum

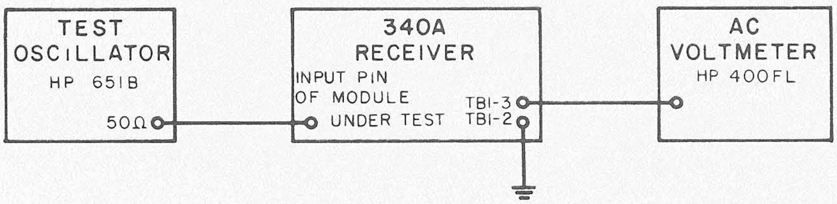
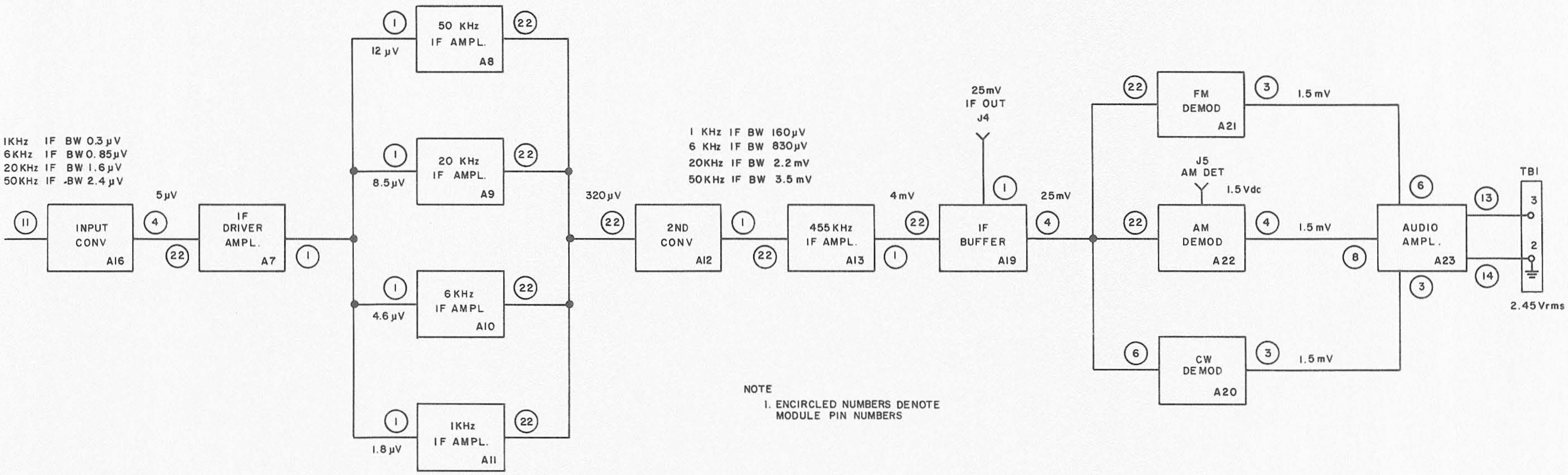


Figure 4-12. Test Setup, Audio Amplifier Gain Check

(2) Remove boards A20, A21, and A22.

(3) Connect the AC voltmeter as shown in Figure 4-12. Connect the test oscillator output to XA23 pin 8.

(4) Tune the test oscillator to 1 kHz. Adjust the output level of the test oscillator for a 2.45 Vrms reading on the AC voltmeter. A typical output level value of the test oscillator is shown in Figure 4-16.



NOTE
1. ENCIRCLED NUMBERS DENOTE MODULE PIN NUMBERS

Figure 4-16. Type 340A VLF Receiver, Gain Distribution

(17) Adjust the signal generator for 455 kHz output, no modulation. Further adjust the output to a level required for a 1.5 Vdc reading on the digital voltmeter. A typical signal generator output level value is shown in Figure 4-16.

(18) Connect the AC voltmeter to the IF output jack, J4. The voltmeter should read at least 20 mV. Replace board A13.

(19) Remove board A12 and select the 1 kHz IF bandwidth.

(20) Repeat step (16) connecting the signal generator to XA13 pin 22.

(21) Repeat step (20) for the 6, 20, and 50 kHz IF bandwidths. Replace board A12.

(22) Remove boards A8, A9, A10, and A11. Select the 50 kHz IF bandwidth.

(23) Adjust the HP-606B signal generator for 2 MHz output with no modulation.

(24) Connect the signal generator to XA12 pin 22 and adjust the output level to a value required for a 1.5 Vdc reading on the digital voltmeter. A typical signal generator output level value is shown in Figure 4-16.

(25) Replace boards A8, A9, A10, and A11. Remove A7 and select the 50 kHz IF bandwidth.

(26) Repeat steps (23) and (24) connecting the signal generator to XA8 pin 1.

(27) Select the 20 kHz IF bandwidth. Repeat steps (23) and (24) connecting the signal generator to XA9 pin 1.

(28) Select the 6 kHz IF bandwidth. Repeat steps (23) and (24) connecting the signal generator to XA10 pin 1.

(29) Select the 1 kHz IF bandwidth. Repeat steps (23) and (24) connecting the signal generator to XA11 pin 1.

(30) Replace board A7 and remove board A16.

(31) Repeat steps (23) and (24) connecting the signal generator to XA7 pin 22. Replace board A16 and select the 1 kHz IF bandwidth.

(32) Adjust the signal generator for 400 kHz, no modulation. Connect the signal generator to XA16 pin 11 and adjust the output level to a value required for a 1.5 Vdc reading on the digital voltmeter. A typical signal generator output level value is shown in Figure 4-16.

(33) Repeat step (32) for the 6, 20, and 50 kHz IF bandwidths.

4.7 RECEIVER ALIGNMENT AND ADJUSTMENT PROCEDURE

The following alignment procedures are suitable for making adjustments after replacing transistors or other components which could affect the alignment of a particular module or circuit. Only those controls referred to in each alignment step effect the alignment of that circuit. The remaining controls may be left in any position. The alignment of the receiver should be performed only with suitable test equipment by technicians thoroughly familiar with the unit. If the limits and tolerances specified in the following procedures cannot be obtained, then a factory alignment is necessary.

CAUTION

Ensure that the power supplies are within specification before performing alignment and adjustment procedures.

(5) Repeat step (3) for the FM and CW inputs to the audio amplifier A23. Select the FM AGC and CW VAR modes respectively.

(6) Replace boards A20, A21, and A22.

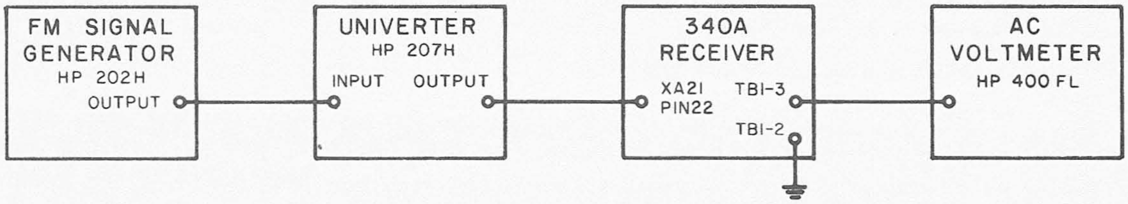


Figure 4-13. Test Setup, FM Demodulator Gain Check

(7) Remove board A19 and set up the equipment as shown in Figure 4-13. Select the FM AGC mode and the 50 kHz IF bandwidth.

(8) Adjust the FM signal generator and univerter to produce a 455 kHz output with 400 kHz modulation and 17 kHz deviation.

(9) Adjust the output of the signal generator to a level of 25 mV. Note that the AUDIO gain control can be adjusted for a minimum of 2.45V rms.

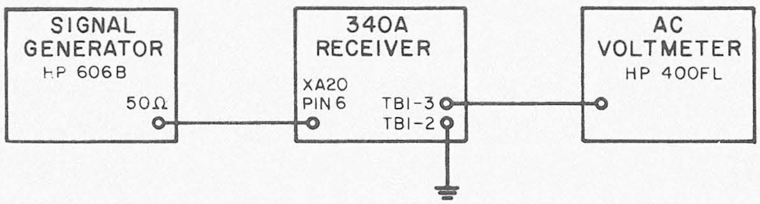


Figure 4-14. Test Setup, CW Demodulator Gain Check

(10) Set up the equipment as shown in Figure 4-14. Select the CW VAR mode.

(11) Adjust the signal generator for 455 kHz output, no modulation. Adjust the output level to 25 mV. Note that the AUDIO gain control can be adjusted for a minimum of 2.45V rms.

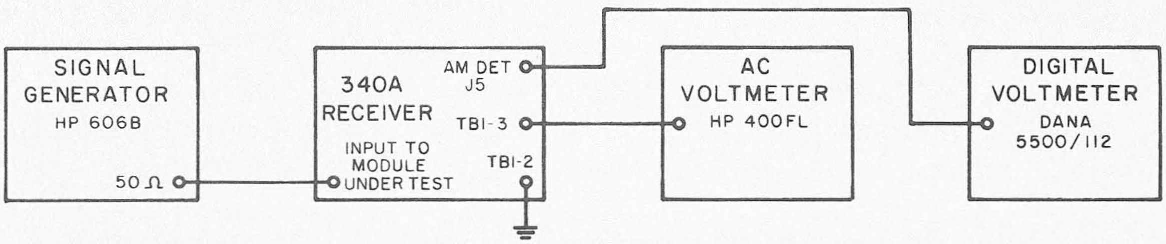


Figure 4-15. Test Setup, Gain Distribution Checks

(12) Set up the equipment as shown in Figure 4-15. Select the AM MAN mode.

(13) Adjust the signal generator for 455 kHz output with 50% modulation at 1 kHz.

(14) Connect the signal generator to XA22 pin 22. Adjust the output level to 25 mV. Note that the AUDIO gain control can be adjusted for a minimum of 2.45M rms. Test for approximately 1.5 Vdc at J5.

(15) Replace A19 and remove A13. Disconnect the AC voltmeter.

(16) Connect the signal generator to XA19 pin 22.

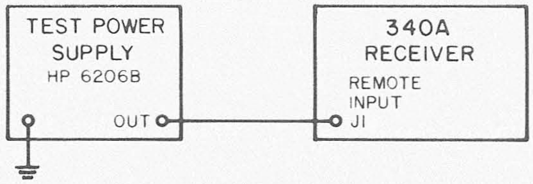


Figure 4-9. Test Setup, Remote Tuning Checks

4.6.8 Tuning and Analog Output Check. - Proceed as follows:

(1) Set up the equipment as shown in Figure 4-10.

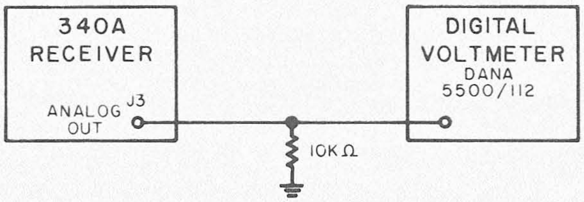


Figure 4-10. Test Setup, Tuning and Analog Output Check

(2) Tune the receiver from 1 kHz to 900 kHz. The voltage at J3 shall vary from 0 to +10 Vdc over the tuning range.

(3) Tune the receiver to 400 kHz.

(4) Vary the FINE TUNING control and verify its operation.

4.6.9 Signal Monitor Output Checks. - Proceed as follows:

(1) Set up the equipment as shown by the solid lines in Figure 4-11.

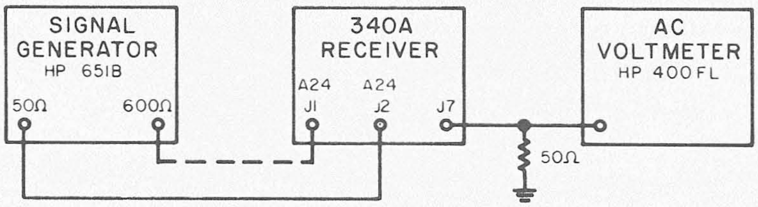


Figure 4-11. Test Setup, Signal Monitor Output Checks

(2) Set the receiver controls for AM MAN mode, MANUAL GAIN maximum counterclockwise and the FINE TUNING control to midrange.

(3) Tune the receiver to 400 kHz and select the 1-kHz bandwidth.

(4) Set the signal generator for 400 kHz.

(5) Measure and record the gain from A24J2 to J7. It shall be a minimum of 3 dB and a maximum of 10 dB.

(6) Set up the equipment as shown by the dotted lines in Figure 4-11.

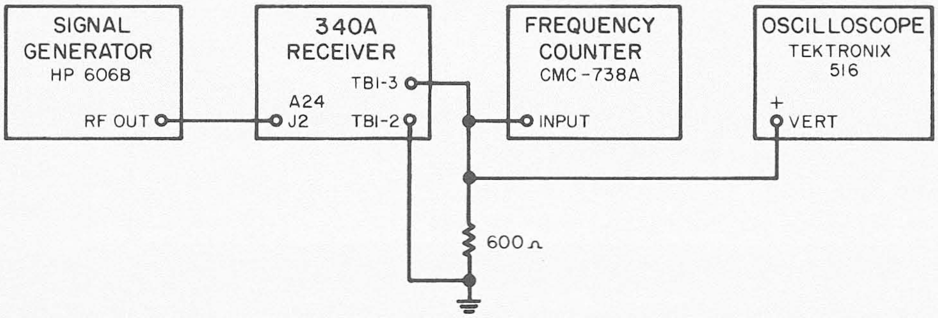


Figure 4-6. Test Setup, BFO VAR Mode Operation Checks

(2) Tune the receiver to 100 kHz, set the IF bandwidth at 50 kHz, and the MANUAL GAIN control fully clockwise.

(3) Tune the signal generator to 100 kHz CW with a 0.9 μV output level.

(4) In the CW ZERO mode, vary the input signal for a zero readout on the frequency counter or a zero beat on the oscilloscope.

(5) Set the receiver to the CW VAR mode.

(6) Turn the BFO ±10 kHz control to the maximum clockwise position and observe the frequency counter for a 10 kHz ±2 kHz readout.

4.6.5 FM Sensitivity Checks. - Proceed as follows:

(1) Set up the equipment as shown in Figure 4-7.

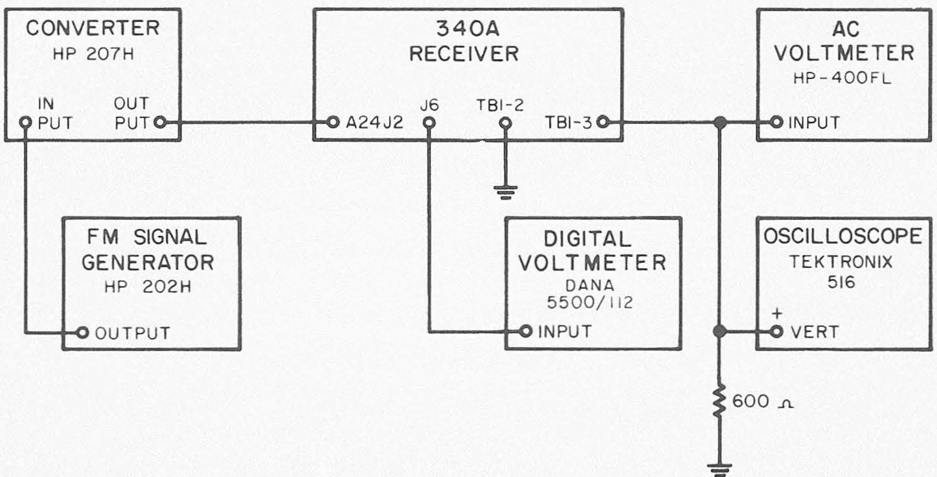


Figure 4-7. Test Setup, FM Sensitivity Checks

(2) Set the FM generator to 199.6 MHz (corresponds to 400 kHz input to 340A Receiver) with a 400 Hz modulation rate.

(3) Tune the receiver to 400 kHz, select the FM AGC mode and select the 20 kHz IF bandwidth position. Set the AUDIO gain control to midrange.

POWER SUPPLY	MEASURED AT	MINIMUM READING	MAXIMUM READING
+5V	XA2 pin 18	4.9V	5.1V
-5V	XA2 pin 6	-4.8V	-5.2V
-18V	XA3 pin 14	-17.5V	-18.5V
+18V	XA4 pin 14	+17.5V	+18.5V
+10V	XA5 pin 7	10.09V	10.11V
-10V	XA5 pin 17	-10.09V	-10.11V

(3) Set the Variac control for a 127 Vac output. Repeat the measurements listed in step (2).

(4) Set the Variac control for a 103 Vac output. Repeat the measurements listed in step (2).

4.6.2 AM Sensitivity Checks. - Proceed as follows:

(1) Set up the equipment as shown in Figure 4-4.

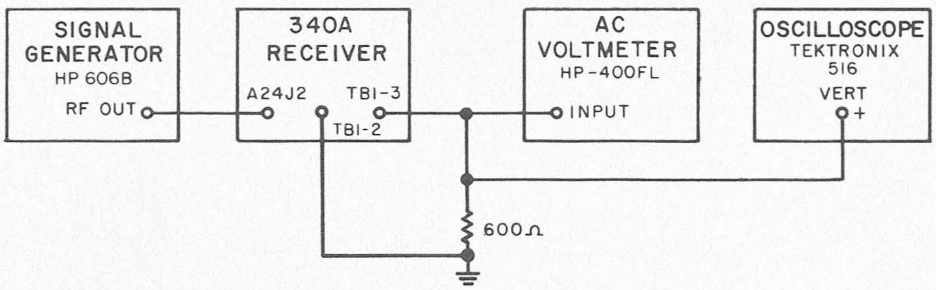


Figure 4-4. Test Setup, AM Sensitivity Checks

(2) Set the signal generator for 50% modulation.

(3) Set the receiver for the AM MAN mode and the MANUAL GAIN control to the level required for an undistorted response. Set the BANDWIDTH control to 1 kHz and tune the receiver to 900 kHz.

(4) Adjust the signal generator to 900 kHz with 400 Hz modulation and an output level of 0.25 μV.

(5) Adjust the receiver AUDIO gain for a maximum output without clipping. Observe the output level, it shall be a minimum of 2.45 Vrms.

(6) Remove the modulation from the input signal. Observe the decrease in the output, it shall be a minimum of 10 dB.

(7) Repeat the procedure for the following conditions:

BANDWIDTH	TEST FREQUENCY (kHz)	INPUT LEVEL (μV)	MODULATION FREQUENCY (kHz)
1 kHz	900	0.25	0.40
	400	0.25	0.40
	50	0.25	0.40

Table 4-3. Frequency Counter Troubleshooting Chart (Continued)

TROUBLE INDICATION	PROBABLE FAULT	DIAGNOSTIC PROCEDURE
One LED indicator displays a single steady count; indicators to the left readout a normal display.	a. Defective storage IC on assembly A1A2. b. Defective LED indicator on assembly A1A2A1.	a. Check storage IC and replace if defective. b. Check LED indicator and replace if defective.
One LED indicator fails and the LED indicators to the left also fail.	Failure of a decade counter IC on assembly A1A2.	Isolate the defective decade counter by signal tracing with wideband oscilloscope. Replace defective component.
Only readout is zero on LED indicators with or without input signal.	a. Reset pulse from A1A1 fails, stays low (active). b. Signal gate waveform from A1A1 fails, stays low (inactive).	a. Check for proper reset waveform (see Figure 4-1). b. Check for proper signal gate waveform (see Figure 4-2).
Only readout is a stable count with or without input.	Storage strobe pulse from A1A1 fails, stays high (inactive).	Check for proper storage strobe waveform (see Figure 4-3).
Readout displays a rapid free-running count.	Storage strobe pulse from A1A1 fails, stays low (active).	Check for proper storage strobe waveform (see Figure 4-3).
Stable readout with flashing background.	Signal gate pulse from A1A1 fails, stays high (active).	Check for proper signal gate waveform (see Figure 4-2).
Slow free-running count with normal input to J1.	Reset pulse from A1A1 fails, stays high (inactive).	Check for proper reset waveform (see Figure 4-1).
In the DAFC ON position, the DAFC will not lock on the digit (±1 digit) selected by the LAST DIGIT switch.	a. Defective decoder IC. b. Defective LAST DIGIT switch. c. Defective up command and down command circuits. d. Defective DAFC output circuits.	a. Check A1A1U10. b. Check A1S1. c. Check stages A1A1Q3 through A1A1Q5. d. Check stages A1A1Q6 and A1A1Q7.

Table 4-2. Receiver Troubleshooting Chart (Continued)

TROUBLE INDICATION	PROBABLE FAULT	DIAGNOSTIC PROCEDURE
	b. Defective AM audio enable circuitry.	b. Check A23Q1 and S5A-X.
No output in FM AGC mode when selecting the 20 kHz IF BW. Other reception modes operate normally in the 20 kHz IF BW.	Defective 20 kHz FM enable switch.	Check A21Q2.
No output in FM AGC mode when selecting the 50 kHz IF BW. Other reception modes operate normally in the 50 kHz IF BW.	Defective 50 kHz FM enable switch.	Check A21Q1.
No output in FM AGC mode when selecting the 20 kHz or 50 kHz IF BW. Other reception modes operate normally in the 50 kHz and 20 kHz IF BW.	a. Defective FM limiter/discriminator output amplifier circuits.	a. Check stages A21U1, A21U2, and A21U3.
	b. FM audio enable switch malfunctions.	b. Check stage A23Q2 and S5A-X.
No output in CW ZERO mode; all bandwidths affected. Other reception modes operates normally.	a. No CW ZERO enable voltage.	a. Check for +18 Vdc at pin 2 of the CW demodulator board.
	b. Demodulator assembly A20U1 defective.	b. Check for CW ZERO audio output at pin 3 of the CW demodulator card when the IF input and plus and minus operating voltages are known to be OK.
Receiver malfunctions in CW VAR mode; all bandwidths affected. Other reception modes operate normally.	a. No CW ZERO enable voltage.	a. Check for +18 Vdc at pin 3 of the CW demodulator board.
	b. Defective VAR BFO ±10 kHz control.	b. Check R14.
	c. Defective or misaligned CW VAR control circuitry.	c. Check stages A20Q1 and A20Q2. Check CW VAR operation by performing performance check outlined in paragraph 4.6.4.
	d. Demodulator assembly A20U1 defective.	d. Check for CW VAR audio output at pin 3 of the CW demodulator card when the IF input and plus and minus operating voltages are known to be OK.
No receiver output in both CW reception modes. Other reception modes are normal.	a. CW audio enable circuitry defective.	a. Check stage A23Q3, S5A-X, and diodes CR2, and CR3.
	b. Negative and positive voltage switches defective.	b. Check S5A, L1, C4, and S5B-W.

Table 4-1. Test Equipment Required (Continued)

ITEM	INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	USE	RECOMMENDED INSTRUMENT
8	Frequency Counter	1 MHz output	Alignment	Computer Measurement CMC-738A
9	AC voltmeter	Standard	Operational checks; alignment	Hewlett Packard Type 400FL
10	Digital voltmeter	1% accuracy	Operational checks; alignment	Dana Type 5500/112
11	Variac	0-125 Vac	Power supply checks	General Radio Type W5MT3A
12	Step Attenuator	1 and 10 dB steps	Operational checks	Tekscan Type RA50, RA51
13	Test Power Supply	-10 Vdc to +10 Vdc range	Remote mode tuning test	Hewlett Packard Type 6606B

4.5 TROUBLESHOOTING

4.5.1 Receiver Troubleshooting Procedure.

4.5.1.1 General. - Initial troubleshooting of the 340A Receiver should be directed towards localizing the malfunction to a particular plug-in card. To minimize down time, the receiver can be returned to operation by substituting the defective plug-in card with a replacement known to be operational. When time permits, the defective card can be repaired using the troubleshooting aids provided in this section.

4.5.1.2 Localizing Troubles. - The receiver troubleshooting chart, Table 4-2, is designed to show logical methods of troubleshooting the 340A Receiver. Since it is impossible to cover each problem which may occur in the receiver circuits, the troubleshooting chart is provided only to aid maintenance personnel in the troubleshooting effort. When trouble occurs, find the related TROUBLE INDICATION which is listed in the left column of the troubleshooting chart. After the trouble has been localized to a particular assembly or circuit group, make voltage and resistance checks to isolate the problem to a particular circuit element.

4.5.2 Frequency Counter Troubleshooting Procedure.

4.5.2.1 General. - Troubleshooting of the Type 79832-1 Frequency Counter module should be directed towards localizing the problem to the Gate Generator (A1A1) assembly or to the Count, Decode, and Display assembly (A1A2). To minimize down time, the defective assembly can be replaced with an assembly known to be operational. When time permits, the defective board can be repaired using the troubleshooting aids (Table 4-3) and waveform photographs (Figures 4-1, 4-2, and 4-3) provided in this section.

4.5.2.2 Visual Inspection. - Before troubleshooting the frequency counter module, check for proper mating of connectors and integrated circuits in their receptacles.

4.5.2.3 Typical Problems. - When troubleshooting logic circuits, malfunctions can occur which maintenance personnel should be aware of. Some of these are listed below:

(1) A decade counter or logic gate IC can be considered defective when its output is floating above ground (approximately 1-2V) and is not at its normal level (approximately 4-5V); the IC has no output but its input is normal.

(2) A decade counter or logic gate IC cannot be considered defective

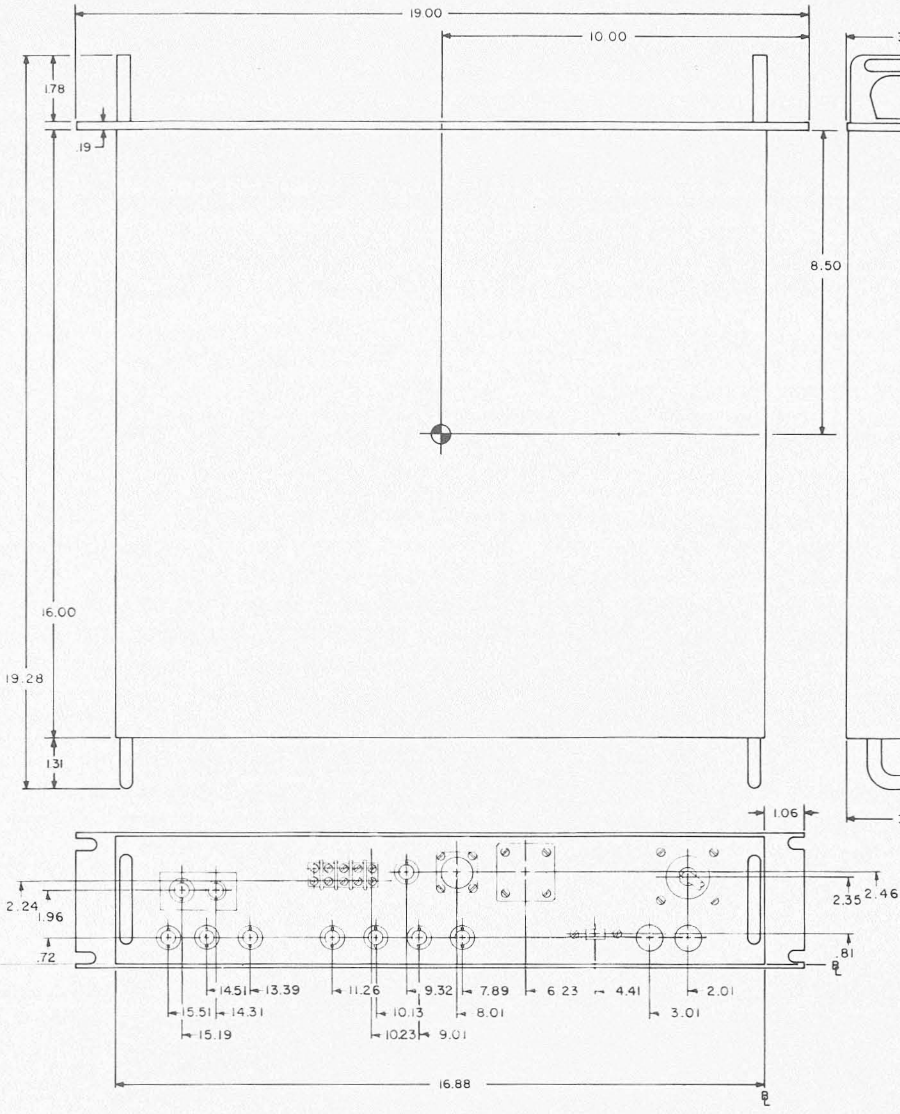


Figure 3-1. Type 340A VLF Receiver, Critical Dimensions

3.2.7 IF Output (Jack J4). - A 455-kHz IF signal, after bandwidth limiting, is available at IF OUTPUT Jack J4.

3.2.8 AM Detector Output (Jack J5). - The AM DET OUTPUT, Jack J5, provides a 0 to +5V output into a 10 k-ohm load.

3.2.9 FM Detector Output (Jack J6). - The FM DET OUTPUT, Jack J6, provides a ±1V output into a 10 k-ohm load.

3.2.10 Signal Monitor Output Connection (Jack J7). - A signal centered at 2 MHz for application to a signal monitor is available at rear apron jack J7.

3.2.11 AGC Output (Jack J8). - The AGC OUTPUT provides a 0 to -5V level into a 10 k-ohm load. The output increases in a negative direction with increased signal strength.

3.2.12 Log Video Output (Jack J9). - The LOG VIDEO OUTPUT makes available a video compensated signal which changes from 0.1V to 1.0V over a 60 dB RF input signal range.

3.2.13 Balanced Audio Output Connections. - A 10 mW, 600 ohm balanced audio signal is available at pins 2 and 3 of terminal board TB1. The audio level at the front panel PHONES jack and at TB1 is set by the front panel AUDIO control.

3.2.14 RF Input Connections. - Connect the VLF antenna input to the balanced 600 ohm input jack A24J1, or to the unbalanced 50 ohm input jack A24J2.

3.3 OPERATION

3.3.1 Push ON/OFF Power Switch. - Press this control to apply prime power to the receiver. The pushbutton will glow red when the unit is on.

3.3.2 Audio Level Control. - The AUDIO level control sets the audio level at rear apron terminal board TB1 and at the front panel PHONE jack.

3.3.3 Fine Tuning Control. - The FINE TUNE control is a vernier of the main tuning control. With this control set initially at midrange, it is possible to slightly increase or decrease the tuned frequency of the receiver.

3.3.4 Reception Mode Switch. - The six position mode switch selects either the FM, AM AGC, AM MAN, LOG, CW ZERO, or CW VAR modes of receiver operation.

3.3.5 IF Bandwidth (kHz) Switch. - The IF BANDWIDTH (kHz) switch is used to select either the 1, 6, 20 or 50 kHz IF bandwidth.

3.3.6 Manual Gain Control. - The MANUAL GAIN control sets the gain of the receiver in the AM MAN and two CW modes of operation. Turn the control to its maximum clockwise position for maximum gain.

3.3.7 Attenuator Switch. - The four position ATTENUATOR (dB) switch inserts 0, 20, 40, or 60 dB of attenuation prior to the input RF amplifier. Set this control to prevent overloading of the receiver for large incoming signals.

3.3.8 Receiver Control Switch. - In the LOCAL position, all receiver functions are controlled from the front panel. In the REMOTE position the four IF bandwidths, manual gain, and receiver tuning are controlled from a remote station.

3.3.9 Variable BFO Control. - The ±10 kHz variable BFO control is used in the CW VAR mode of operation. Setting of this control from its maximum clockwise to maximum counterclockwise position provides a 0 to 10 kHz signal on either side of the 455 kHz IF center frequency.

3.3.10 Signal Strength Meter. - The Signal Strength meter provides a relative indication of incoming signal strength.

2.28 TYPE 79944 COUNT, DECODE, AND DISPLAY

Figure 6-3 is the schematic diagram for this assembly; its reference designation prefix is A1A2. The Part 16537 Solid State Numeric Display mounts on assembly A1A2; its reference designation prefix is A1A2A1.

2.28.1 Input Limiter/Amplifier. - Input 2.001-3.900 MHz LO signals from the VFO (A15) are applied to module pin 17. Peak limiting diodes CR1 and CR2 limit the negative and positive input cycles to prevent overloading of wideband amplifier U1. The output from pin 7 of U1 is coupled through C4 to the base of common emitter amplifier Q1. Diode CR3 clips the negative excursion of the input cycle to provide reverse bias protection for the transistor.

2.28.2 J-K Flip-Flop. - The output from Q1 is applied to pin 3 (clock input) of J-K Flip-Flop U2. Pins 1, 14, 6 and 7 are held high by the positive supply. The SIGNAL GATE input from the gate generator is applied through module pin 20. During the 100 ms logic one condition of the SIGNAL GATE waveform pins 2 and 5 of the J and K inputs are also enabled, allowing the input signal to toggle U2. The Q output from U2 is one-half the input VFO frequency and is applied to the C_2 input of counter U3 and through R6 to the BCD 1 parallel data input of storage latch U4.

2.28.3 Least Significant Digit. - The least significant digit of the display or the tens-of-Hz digit is developed by applying the Q output from U2 to pin 4 of storage latch U4. This input is one-half the input VFO frequency and provides the BCD 1 input for the first decade of counting. The BCD 2, 4, and 8 outputs from count-by-five divider U3 are used to supply the remaining BCD inputs to storage latch U4. The storage strobe pulse is applied to pin 1 of U4. This pulse occures 10 ms after the signal gate goes to a logic zero level. The storage strobe transfers the BCD values present at the output of U2 and U3 into the storage latch. The storage strobe is also used to enable the input to numeric indicator A1U1. This pulse is applied to pin 5 of A1U1 through module pin 1 which is externally wired to module pin B. Each numeric indicator contains a 4 bit storage latch, a BCD to decimal dot matrix encoder, and 28 light emitting diodes. The RESET pulse, which occurs just before the SIGNAL GATE goes to a logic 1, sets U2 and U3 to zero before the new 100 ms counting period. This signal connects to pin 13 of each counter through module pin 13.

2.28.4 Remaining Decades. - Decade counters U7, U11, U15, and U19 with their associated storage latch and numeric indicator operate similarly to the least significant digit described in paragraph 2.28.3. As inputs, each decade of counting receives a "carry" pulse from the preceding counter. These input pulses are counted, stored, and displayed as a decimal number up to a count of nine. When the tenth pulse is received, they reset to zero and pass a carry pulse to the following decade of counting. The reset, storage, and display update functions are identical to the least significant decade of counting.

2.28.5 Preset Functions. - The preset module pairs associated with the four most significant decade of counting are nomally used to preset each of the data input lines (pins 3, 4, 10, and 11 of U7, U11, U15, and U19) to a predetermined number. Presetting is necessary when it is desired to start the counting functions at a number other than zero. However, the preset functions are not used in the 340A Receiver counter assembly since the VFO (LO) frequency is 2 MHz above the tuned frequency and there is no provision for a 10^6 digit on the readout. The preset strobe pulse line is inhibited by the +5V buss line through module pin C (See Figure 6-1). The inhibit voltage disables the data inputs to the decade counters, holding them in a logic zero state.

change in the voltage charge held by integrator capacitors C10 and C11. Capacitors C10 and C11 are connected in series "back-to-back" to reduce the leakage path to a minimum. The receiver tuned frequency would be a function of the main and fine tuning voltage levels only. Next, assume that the VFO drifts to a frequency which causes the BCD output of least significant digit storage latch A1A2U4 to change in value. The amount of frequency drift must be greater than 10 Hz since the least significant digit is the tens-of-Hz digit. The changing BCD output from A1A2U4 is applied to decoder A1A1U10 where it is translated to decimal information. Decoder A1A1U10 provides a logic zero on the active output line while the remaining lines are logic ones. The 10 decimal output lines from A1A1U10 connect to LAST DIGIT switch A1S1 sections A and B. Switch A1S1 is wired to provide an open circuit for the selected digit. The remaining switch contacts are held to a logic one by the other outputs of the decoder. When the VFO drifts and the logic zero output of the decoder switches to a digit which is not selected by A1S1, a logic zero is applied to either the UP GATE or the DOWN GATE. The UP GATE, which consists of transistor Q4, connects to the wiper of switch S1A. When the VFO frequency drifts below the selected last digit a logic zero turn-on voltage (DAFC UP) is applied to Q4. An example of this action would be if the selected last digit is XXX.XO (zero) and the VFO drifts down to XXX.X9. The DAFC UP signal turns on Q4, charging integrator capacitors C10 and C11 in a positive direction. The charge held on C10 and C11 is applied to the VFO control module through integrator buffer Q6. The DAFC input is summed with the main and fine tuning voltages producing the tuning voltage for the varactor oscillator in the VFO control. The oscillator frequency will shift upward until the display is XXX.XO, shutting off the DAFC UP signal from A1S1. When the VFO drifts to a higher frequency, switch S1B applies a logic zero (DAFC DOWN) to inverter Q3, turning on Q5. This stage charges capacitors C10 and C11 in a negative direction. The negative charge is buffered by Q6 and again summed with the main and fine tuning voltages in the VFO control.

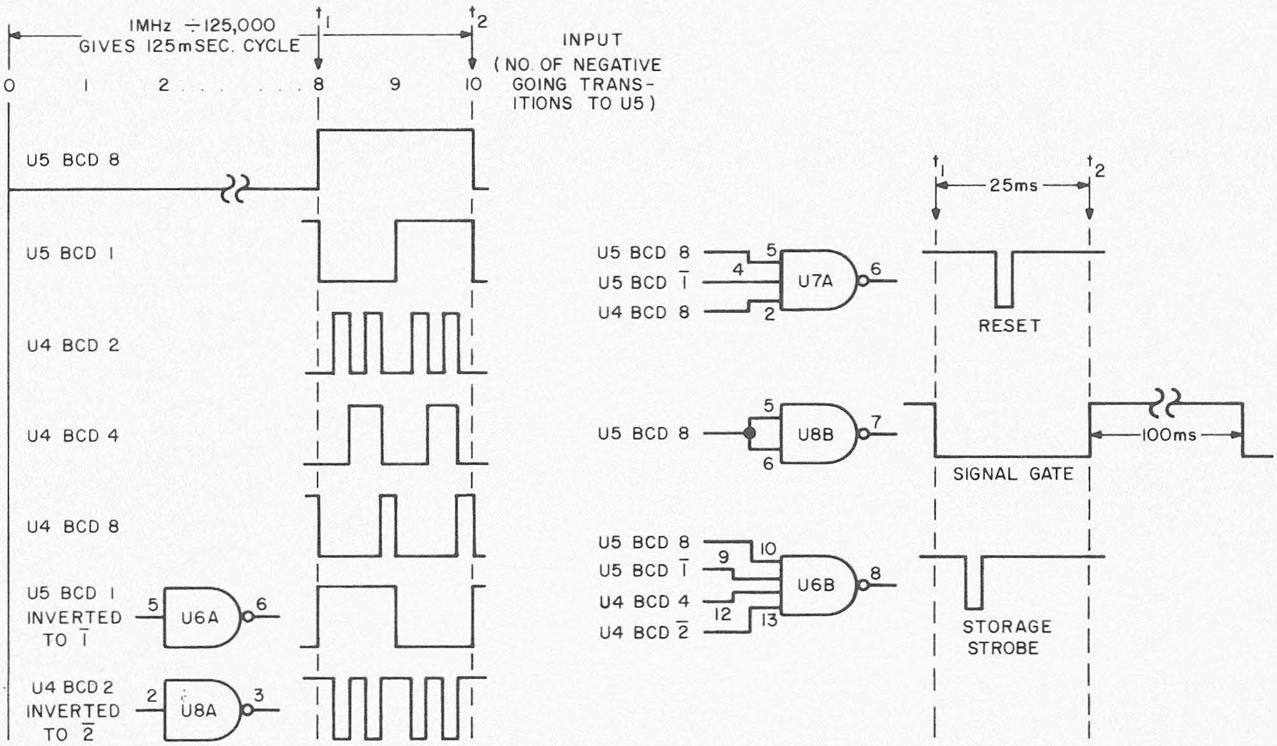


Figure 2-10. Gate Generator Timing Logic

2.27.5.2 Refer to Figure 6-2. The charge stored in C10 and C11 is buffered by the very high input impedance of MOSFET Q6. Current for Q6 is supplied by a constant current source consisting of Q7 and CR1 and CR2. The diodes are forward biased by the -5V supply through R18. The voltage drop across the two diodes is approximately 1.4 Vdc. Since the voltage drop across the base-emitter junction of Q7 is about 0.7 Vdc, approximately 0.7 Vdc is applied to potentiometer R17. The potentiometer is set to adjust the collector current of Q7. The collector supplies the source current for Q6. The current through Q6 is set so that there is zero offset voltage between the gate and source. This sets the DAFC output at module pin H to zero volts when the DAFC ON/OFF switch is set to OFF, grounding the gate of Q6 through module pin D. Capacitor C12 is a filter to remove noise from the DAFC line.

the various timing waveforms required by the count, decode, and display card. DAFC circuits also located on the board, are used to provide long term stabilization of the receiver variable frequency oscillator (VFO).

2.26.3.1 Gate Generator. - Oscillator/buffer stages Q1 and Q2 develop a stable 1-MHz clock input to a divide-by-125 network consisting of divide-by-five counters U1, U2, and U3. This output is further divided by 1000 through decade counter U9, U4, and U5. Various BCD outputs from U9, U4, and U5 are applied to timing gates U6, U7, and U8 which develop the SIGNAL GATE, RESET, and STORAGE STROBE timing pulses. The SIGNAL GATE waveform is formed by inverting the BCD 8 output of U5 through a portion of gate U8 (U8B). This signal has a cycle period of 125 ms with a 80% - 20% relationship between high and low states. After inversion, the signal gate is high (logic 1) for 100 ms and is low (logic 0) for 25 ms. During the 100 ms period the VFO signal is counted, and during the 25 ms period the RESET and STORAGE STROBE commands are developed by other gates contained in U6 and U7. The development of these waveforms will be discussed further in the gate generator detailed circuit description.

2.26.3.2 DAFC. - The DAFC circuits contained in the counter assembly provide an analog correction voltage to the receiver VFO circuits which prevents long term drift. This DAFC action is accomplished by sampling the BCD output of the least significant digit of the display, decoding the BCD information to decimal information, and encoding the decimal information in the DAFC LAST DIGIT switch to provide an up or down command. These commands are integrated with a long time constant integrator/buffer and applied as a control voltage to the VFO control circuits contained in assembly A17. The VFO control circuits apply a tuning voltage to a varactor (voltage variable capacitance) diode in the VFO assembly (A15) which varies the receiver VFO frequency. A voltage variable capacitance diode is a semiconductor device whose capacitance is inversely related to the reverse bias applied to it. Therefore, if the reverse bias increases, the capacitance decreases causing the LO frequency to increase. Since the tuning voltage developed in the VFO control (A17) is a composite voltage consisting of the main tuning, fine tuning, and DAFC voltage, any variation in these levels will change the frequency of the VFO. The DAFC circuits hold the LO frequency to ±10 Hz of the frequency indicated on the LED display since the BCD sample applied to the DAFC circuit is provided by the least significant (tens-of-Hz) digit of the display. The DAFC circuits on the gate generator and DAFC card, A1A1, are controlled by LAST DIGIT switch A1S1, and DAFC ON/OFF switch A1S7. Switch A1S1 selects the least significant digit of the display when the DAFC is activated. The BCD output from storage IC A1A2U4 is decoded by A1A1U10 and applied to A1S1 as decimal information. If the decimal output from A1A1U10 does not agree with the digit selected by A1S1, an up or down command pulse is applied to either down gate transistors A1A1Q3 and A1A1Q5 or up gate transistor A1A1Q4. These two circuits charge back-to-back storage capacitors A1A1C10 and A1A1C11 in either a positive or negative direction. The polarity of the charge is dependent on whether the drift error is above or below the selected digit on the LAST DIGIT switch. The charge is buffered by FET A1A1Q6. A current source consisting of A1A1Q7, A1A1CR1, and A1A1CR2 supplies source current for the FET. Switch A1S7 turns the DAFC function on or off.

2.26.4 <u>Count, Decode, and Display (A1A2).</u> - The LO signal from the receiver VFO card is applied to COUNT IN jack A1J1 and is cabled to the count, decode, and display card. The LO inputs are initially peak-limited by diodes CR1 and CR2 before application to wideband amplifier U1. The output from U1 is applied to buffer Q1 for additional amplification and pulse forming. This signal is used to toggle J-K Flip-Flop U2, which is gated by the signal gate waveform supplied by the gate generator timing circuits. The signal gate is a waveform which is high for 100 ms and is low for 25 ms. During the 100 ms period the LO signal is sampled by U2. J-K flip-flop U2 and count-by-five IC U3 form the first decade and least significant digit of the count. The output from U2 (BCD 1) and the BCD 2, 4, and 8 outputs from U3 are applied to the parallel data inputs of storage IC U4. The BCD inputs to U4 are held in storage and are updated each time a storage strobe pulse from the gate generator occurs. The BCD outputs from U4 connect to LED (light-emitting-diode) numeric indicator A1U1. This IC decodes the BCD inputs and displays the decimal equivalent. The numeric indicator is also controlled by the gate generator storage strobe pulse. For each ten pulses counted by U2 and U3 a carry pulse is applied to decade counter U7. This IC develops the second least significant digit of the display. The BCD outputs from U7 are stored in U8, and are then decoded and displayed in numeric indicator A1U2. Decade counter U7 also passes a carry pulse to the next decade of counting after it has counted 10 pulses. This count to ten and carry process is continued until the five decades of counting are developed. After the 100 ms count period is completed, the storage strobe updates the storage and indicator IC's. A reset pulse is then applied to each of the decade counters. This action sets each counter to zero prior to the new 100 ms signal gate.

stopping of the divide-by-two action is required, the J and K inputs are held low. As indicated by the first line of the clocked truth table, clock pulses can no longer change the Q output state. Before presenting a new train of clock pulses to be counted, it is necessary to set the Q output low so that the count starts from zero. The set-reset truth table shows that this is accomplished when the reset line goes low, for any state of the clocked inputs. The $\overline{Q}$ output is then high, because its state is always opposite to that of the Q output. The above discussion applies directly to the TTL flip-flop used in the counter assembly, the Type RF3202.

2.25.2.3 Decade Counters. - These modules serve a variety of functions in the counter assembly including scaling, counting, and data storage. A logic symbol is shown in Figure 2-7. These devices contain the usual four J-K flip-flops with feedback lines found in most decade counters. In addition, a group of NAND gates allows parallel entry of 4 lines of data, which program the R and S inputs of the flip-flops. Two clock inputs, C_1 and C_2, are provided. Input pulses may be applied directly to the first of four flip-flops at C_1, with the output of this flip-flop driving the other three via C_2. This connection is used whenever the device is used as a counter; that is, whenever its function is to provide a BCD output telling how many pulses have been presented to the input. A reset function is provided for counting application. When the R_D input is driven low, the outputs of all flip-flops will be set to zero in preparation for a new count. The connection to C_1 is also used when scaling by a factor of ten is needed. In scaling, the IC serves only as a frequency divider, with the input signal applied to a clock input and the output taken at the D_{OUT} pin. If the input is applied to C_2, the scaling factor is five. Entry of parallel data is effected when the S_T terminal is driven low. Under this condition the parallel data will be loaded into the flip-flops and the output terminals will be set accordingly. Use of the parallel input capability has two applications. One application is in presetting. It is desirable to have some of the decade counters begin their count from zero or numbers other than zero, and the parallel entry makes loading in of these preset numbers possible. In a second application, only parallel entry occurs; the IC does not count or scale. Instead, it serves only as a storage element. It holds the BCD data from a similar IC that is used as a counter while a new count is being made. Once the data is loaded in, it will be held until another storage strobe pulse applied to the S_T input commands updating of the stored data. Several types of decade counters are used. The 8292, a low power version, is used in greatest quantity. The 8280, a medium speed version, and the 8290, a high speed version, are also used. Except as noted all are identical.

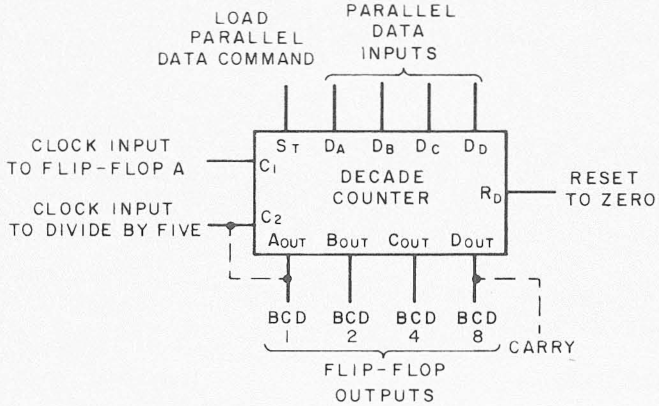


Figure 2-7. Decade Counter, Logic Symbol

2.25.2.4 BCD-to-Decimal Decoder. - The Type 7445 Decoder integrated circuit is used in the counter DAFC loop and operates in the negative logic configuration. Four lines of BCD data at the IC's input produce one line of decimal data at one of its ten outputs. The truth table and logic diagram shown in Figure 2-8 show that a low state exists on the active output line while all other output lines are high.

2.25.2.5 Numeric Indicator. - The LED (light-emitting-diode) IC's are used to visually display the count applied to the counter assembly. A total of five LED's are used; each LED displays one digit. The LED's provide a number character which is the decimal equivalent of the BCD input data applied to the IC. The LED's provide three basic functions in the counter. They are: (1) the BCD input is stored in latches to provide a steady readout until it is desired to update the display; the storage latches are controlled by an enable line which commands the latches to either store the inputs (enable line high) or to readout the BCD inputs which are present at the input to the LED (enable line low); (2) decoding of the BCD input into a 4 x 7 matrix dot pattern; (3) displaying a right hand decimal point which is placed between the kHz and hundreds-of-Hz position of the

the proper level.

2.25 TYPE 79832-1 FREQUENCY COUNTER

Figure 6-1 is the schematic diagram for the counter assembly; its reference designation prefix is A1. The counter is constructed in a self-contained shielded unit to prevent RFI radiation. Two plug-in printed circuit cards mount within the assembly. They are designated Gate Generator A1A1, and Count, Decode and Display. A1A2. Both subassemblies are mounted on hinged multipin plugs for easy access to components for trouble-shooting and maintenance. Inputs to the counter assembly consist of ±5V from power supply assembly A2, count inputs from the receiver local oscillator, and DAFC ON/OFF control from the front panel DAFC switch. An analog DAFC correction voltage output from the counter connects to the receiver LO circuits. The counter DAFC circuits stabilize the receiver LO to ±10 Hz throughout the 1 to 900 kHz tuning range when operating. Before the description of the operating principle of the counter assembly, a brief explanation of BCD (binary coded decimal) waveform development, counting principles, and logic IC's is presented. Understanding of these concenpts is essential for understanding counter operations.

2.25.1 <u>BCD Counting Description.</u> - Only two characters, 0 or 1, are used for each binary place. BCD representation of a digit in the base ten, or decimal system, requires four binary places. The first place, or bit, represents 2^0 or 1, the second bit 2^1 or 2, the third bit 2^2 or 4, and the fourth bit 2^3 or 8. Thus, 001 equals 1, 0010 equals 2, 001 equals 3 and so on. Four flip-flops, each representing the 0 or 1 state of each binary place, are required to count up to ten. However, a logic 1 output from each of the four flip-flops (1111) would represent 15 so a means must be provided to restrict the count to ten. A combination of four flip-flops plus an AND gate is used to count 0 through 9 and automatically reset to zero. Note that instead of the total count the value held in a decade is the least significant decimal digit. For example, the actual count of twelve results in a two in the counter. One-place decade counters, upon receipt of the tenth pulse, reset themselves to zero and pass a "ten" or "carry" pulse to the decade counter for the next, more significant digit. Figure 2-3 is included to show the binary equivalent waveforms of the digits 0 through 9. The symmetrical BCD 1 waveform is exactly one-half the basic frequency. The output waveforms of the other flip-flops are modified by the feedback connections and are not symmetrical. The BCD 8 is also the carry pulse to the next decade of counting.

2.25.2 <u>Digital Integrated Circuits.</u> - Most of the circuitry used in the counter assembly consists of logic gates and counters which are contained in solid state integrated circuits (IC's). Two logic families are used: TTL and DTL. For some slow speed functions, diode-transistor-logic (DTL) is employed. Where higher speed and greater driving power is required transistor-transistor-logic (TTL) is used. The DTL and TTL IC's include NAND gates, J-K flip-flops, and decade counters. These IC's operate from a +5V source and have a high state output level (logic 1). A high state is at least +3.6V and may approach the supply voltage potential under light loading. The low state (or logic 0) is +0.4V or less. Active components in these IC's operate in the saturated mode. All IC's in the counter assembly (with the exception of the decoder associated with the DAFC circuits), use positive logic (0 = low, 1 = high) configurations. Each of the IC's used in the counter are discussed in the following paragraphs.

2.25.2.1 NAND Gate. - The logic NAND or inverting AND gate is used in the timing circuits of the counter assembly. The NAND gate symbol and truth table are shown in Figure 2-5. A "1" or "0" in the table refer to the high and low states of positive logic. The function of a NAND gate is this: if any input is low, the output will go high; only when all inputs are high will the output go low. Two types of NAND gates are used, they are the 9961 and the 7523. The 9961 contains two gates, each of which has four inputs. The 7523 contains four gates, each of which has two inputs.

2.25.2.2 J-K Flip-Flop. - Figure 2-6 shows the logic symbol and truth tables for the J-K flip-flop. This device has the following important characteristics:

(1) When a pulse is presented to the clock input, the flip-flop switches its outputs to a state determined by the states of the J and K inputs.

(2) With J and K inputs held high, the flip-flop responds to pulses at its clock input by changing states of the Q output in a divide-by-two action. This occurs because there is internal feedback from the Q and $\overline{Q}$ outputs to the J and K inputs.

(3) When the set-reset (R and S) inputs are active, they dominate all clocked inputs (J, K, or clock).

2.21 TYPE 76211 +5V AND -5V POWER SUPPLY

Figure 6-4 is the schematic diagram for this module; its reference designation prefix is A2. Main chassis mounted transistor Q1 is the series regulator for the +5V supply (Refer to Figure 6-26). Electrolytic capacitor C3 provides filtering for the negative supply and electrolytic capacitor C2 is the positive supply filter. Both filters are located on the main chassis.

2.21.1 Transistor Q1 functions as a series regulator for the negative supply. Its conduction is controlled by Q3 which senses and responds to fluctuations of the negative output level from its nominal -5V level. Transistor Q2 is a constant current source for Zener diode VR1 which provides a reference voltage on the base of Q3. The constant output from Q2 maintains the base of Q3 at the 5.6V Zener level. This action improves the regulation of the negative supply. In a typical example of operation, assume that the output level begins to rise (become more positive). This causes the forward bias on the emitter of Q3 to increase since the base of the PNP transistor is held at 5.6V by the Zener diode. The forward bias increases the conduction of Q3 and in turn a larger voltage is dropped across load resistors R2 and R3. The base of Q1 (NPN) now becomes more positive and Q1 also increases conduction until the output level returns to its nominal -5V level. Should the -5V output increase in the negative direction, the opposite circuit action will occur to again return the -5V output to its correct value. Resistor R5 is overload protection for the negative supply. If output current should become excessive, the voltage drop across R5 will limit the emitter-base junction forward bias on Q3. This in turn reduces the conduction of Q1 limiting the output voltage.

2.21.2 Main chassis mounted transistor Q1 is the series regulator for the +5V supply (Refer to Figure 6-26). Conduction of the transistor is controlled by a feedback loop consisting of a differential amplifier, Q5 and Q6, which drives amplifier Q4, which, in turn, drives emitter follower, Q7. The output of the emitter follower is connected to the base of the series regulator transistor through module pin 16. The output of the negative supply is used as the reference voltage for the positive supply. It is connected to a sampling network made up of R11, R12, and R13. Potentiometer R12 is used to set the positive output at precisely +5 volts. When properly set the base voltage of both Q5 and Q6 will be 0 Vdc. If the output voltage deviates from the set value, the difference voltage is sensed by Q6 as an error signal, and the feedback circuit supplies the series regulator with a compensating voltage to return the output to its nominal value. Assuming that the output voltage drops below +5 Vdc, the base of Q6 will go negative. This causes Q6 to conduct less, so that the voltage drop across R7 increases in the negative direction. The forward bias on Q5 is thus increased so that it conducts harder, increasing the voltage drop across R6. Amplifier Q4, a PNP transistor, now conducts harder so that its collector voltage moves toward the more positive emitter voltage. This results in an increased forward bias on emitter follower Q7 so that it conducts harder, providing a more positive voltage across load resistor, R9. Since the base-emitter junction of the series regulator is connected across R9, its forward bias increases and it conducts harder, lowering its collector-emitter resistance. The output voltage now rises back to the nominal +5 Vdc value. Should the output voltage rise above +5 Vdc the feedback circuit will have the opposite effect, resulting in a decreased forward bias on the series regulator, so that the collector-emitter resistance of the transistor increases and the output voltage drops to the nominal value. Overload protection of the positive supply is provided by resistor R10 in conjunction with silicon diodes CR6, CR7, and CR8. If excessive current is drawn from the supply the voltage drop across R10 will forward bias the diodes and the base of Q7 will be pulled down to the voltage at the output terminal. This will result in the base of the series regulator being driven sufficiently negative to limit the current drawn from the transistor to a safe value. Diodes CR9, CR10, and CR11 are included for temperature compensation. The negative temperature coefficient of the germanium diodes counteracts a tendency of the positive voltage to increase at elevated temperatures.

2.22 TYPE 76160 -18V REGULATED POWER SUPPLY

Figure 6-5 is the schematic diagram for this module; its reference designation prefix is A3. Transistor Q1 functions as a series regulator whose conduction is controlled by Q2, a voltage amplifier. Transistors Q3 and Q4 are connected in a differential amplifier configuration. The base of Q4 is held at a fixed potential by Zener diode CR2. The base of Q3 is connected to the regulated output through a sampling network consisting of fixed resistors R5 and R7, and potentiometer R6. The signals at the bases of the two stages are summed in the common emitter circuit to produce a signal at the collector of Q3 that is the difference between the two inputs. Thus, any fluctuation in the output voltage is sensed by Q3, amplified and inverted and fed to the base of Q2. For example, if the output voltage rises (becomes more negative) Q3 will conduct harder, causing an increased voltage drop across R2 and R3. This lowers the forward bias voltage and the current flow through Q2. As a result, the current flow through Q1 is reduced, returning the output voltage to its nominal value. Resistor R4 connects is applied to the gain-controlled stages of the receiver. The LOG AGC circuit has a rapid response time enabling the receiver to provide a given output for changing input signals over a 60-dB dynamic range. The buffered detector voltage from driver Q3 is applied to the inverting input of LOG AGC amplifier U1. Offset resistor R16 balances the current flow through both the inverting and non-inverting inputs. The gain of U1 is set by the ratio of feedback resistor R18 to input resistors R10 through R13. Input resistors R10 through R12 are switched into the input circuit of U1 by the action of diodes CR1 through CR3. Voltage divider resistors R6 through R9 plus R29 and R30 set the anodes of diodes CR1 through CR3 at a fixed positive potential from the +18V supply. As the positive detector voltage input level increases and decreases diodes CR1 through CR3 are biased on and off, inserting different values of resistance into the input line of U1. The changing input resistance also changes the gain of U1 so that it provides a shaped output voltage. In a typical example of circuit operation, assume that the instantaneous dc detector level present at the emitter of buffer Q3 is approximately 1.8V. This level is applied to the inverting input of LOG AGC amplifier U1 through R13. The anodes of diodes CR1, CR2, and CR3 are held at approximately 2.1V, 1.4V, and 1.1V, respectively, by the +18V supply and the voltage divider associated with each diode. At detector levels below 1.7V the gain of U1 is set at approximately 2 by the ratio of feedback resistor R18 to the total parallel resistance of input resistors R10 through R13. At 1.8V detector levels, diode CR3 is biased off and the gain of U1 decreases to approximately 1 since the input resistance to U1 is increased by removing R12. If the detector voltage again increases to a level where CR2 is reverse biased (approximately 2.0V) the gain of U1 would again decrease due to the increased input resistance. The output from U1 is applied to module pin 5. It is then connected to MODE switch section S5A-W which applies it to the gain-controlled stages that are active during the LOG mode of operation. The output from U1 is also applied to the inverting input of U2 through R20. This stage inverts the negative-going output from U1 and provides a 0.1 to 1.0V output into a 10K ohm load. This signal is available at rear-apron jack J9, the LOG VIDEO output.

2.16 TYPE 72360 IF BUFFER

Figure 6-20 is the schematic diagram for this module; its reference designation prefix is A19. The output from 455-kHz IF amplifier (A13) is applied to module pin 22. This input is coupled through C1 and R1 to the base of common emitter amplifier Q1. Potentiometer R8 in the emitter by-pass circuit is provided to adjust the gain of the amplifier by varying the degeneration. The amplified output from Q1 is coupled through dc-blocking capacitors C4 and C6 and resistors R9 and R10 to the base of buffer stages Q2 and Q3. Transistor Q2 provides a 50-ohm output at module pin 1. This output connects to rear-apron, 455 kHz IF OUTPUT jack J4. Transistor Q3 connects to module pin 4 and supplies a 455-kHz IF signal to the AM, FM, and CW demodulator assemblies.

2.17 TYPE 72308 AM DEMODULATOR

Figure 6-23 is the schematic diagram for this module; its reference designation prefix is A22. The 455-kHz IF signal is applied through module pin 22 to the base of common emitter amplifier Q1. The output from amplifier Q1 is coupled through C9 to the base of the common emitter amplifier Q2. This stage, in conjunction with voltage step-up transformer T1, provides the signal level required by detector diode CR1. Transformer T1 is the collector load for Q2. The operating point of Q2 is set by biasing resistors R8 and R9. Detector diode CR1 rectifies amplitude variations of the modulation envelope. The average value of diode current provides the charge on capacitor C5. The instantaneous value of the charge is directly proportional to the amplitude of the modulation envelope. This charge or audio signal is developed across R12 and is applied to complementary emitter-followers Q3 and Q4. A low-pass filter, consisting of inductor L1 and capacitor C8, removes 455-kHz IF signal components from the detector output. The AM demodulator provides outputs to rear apron AM DET OUTPUT jack J5, the signal strength meter, the audio amplifier module, and to the AGC circuits of the gain control module.

2.18 TYPE 79933 FM DEMODULATOR

Figure 6-22 is the schematic diagram for this module; its reference designation prefix is A21.

2.18.1 The 455-kHz IF signal is applied to module pin 22. Two +18V enable lines from the bandwidth control module and FET switches allow the detected FM signal to be passed through the FM demodulator, only when the 50-kHz or 20-kHz IF bandwidths are selected. The FM demodulator provides outputs to rear-apron FM DET OUTPUT jack J6, and to audio amplifier assembly A23.

2.18.2 Amplifier/limiter U1 operates as a high gain amplifier for small signal inputs and as a limiter for larger input signals. The input is coupled through C1, R1 and C2 to input pin 14 of U1. Capacitor C3, variable inductor L2, and the primary of transformer T1 form a tuned circuit which resonates at the IF center frequency.

to increase in a negative direction. When the AGC voltage reaches approximately -0.6V diode CR3 becomes reverse biased and the gain controlled gate (pin 2 of Q2) follows the AGC voltage. The IF output from Q2 is developed across inductor L3, resistor R6, and potentiometer R5, which selects the desired amount of signal output from Q2. The signal at the wiper of R5 is coupled through dc blocking capacitor C7 to the base of emitter follower Q3. This stage sets the nominal low output impedance from the 20-kHz IF amplifier.

2.11 TYPE 72406-1, -2 IF AMPLIFIER (1 and 6-kHz BANDWIDTH)

Figure 6-12 is the schematic diagram for this assembly; its reference designation prefix is A10 (6-kHz BW) and A11 (1-kHz BW). Assemblies A10 and A11 are identical with the exception of bandpass filter FL1. The design of the IF strip is similar to the 20-kHz BW IF amplifier assembly A9. The circuit description in paragraph 2.10 is entirely applicable for assemblies A10 and A11.

2.12 TYPE 79952 BANDWIDTH CONTROL

Figure 6-8 is the schematic diagram for this assembly; its reference designation prefix is A6. Inputs to the bandwidth control assembly consist of four switched ground lines from the IF BANDWIDTH select switch, and the +5V and +18V supply potentials. The output from the bandwidth control is one of four +18V enable lines which is used as the supply potential for the selected IF amplifier and for controlling special circuit functions in assemblies A13 and A21. The switching circuit consisting of transistors Q1, Q2, and logic switch U1A, is used when selecting the 1-kHz BW IF amplifier. This switch section will be used as an example in the following description. The remaining switch sections operate identically. IF BANDWIDTH switch S4A-W is shown in the 1-kHz BW position (refer to Figure 6-26). The ground from the wiper of S4A-W is transferred through LOCAL/REMOTE switch S6A-Z to pin 10 of the bandwidth control module. The ground or low (0 logic level) connects to pin 2 of NAND (negative AND) gate U1A. Pin 1 of U1A is held in a high or logic 1 state from the +5V power supply input. The high and low inputs to the NAND gate cause its output to stand at the logic 1 level of approximately 1.3V. This positive level places a forward bias on diode CR1 and turns on NPN switch Q1. Since the emitter of Q1 is at chassis ground, Q1 saturates and the collector to emitter junction resistance is reduced. This action effectively grounds the +18V supply line through resistors R2 and R3. When Q1 conducts, the base of Q2 becomes less positive, its emitter-base junction is forward biased, and the +18V supply line is passed through its low resistance collector-to-emitter junction. Output 1 connects to and activates the circuits of the 1-kHz BW IF amplifier. When the ground is removed from pin 2 of U1A, pin 3 falls to zero volts, and transistor Q1 is biased off. This action causes the base of Q2 to become more positive and Q2 turns off, removing the 1-kHz BW enable voltage from output 1. The +18V enable lines for the 20-kHz and 50-kHz IF amplifiers (outputs 3 and 4) are also used to activate the FM demodulator assembly (A21). The FM demodulator is active only when the 50-kHz and 20-kHz IF bandwidths are selected.

2.13 TYPE 7766 SECOND CONVERTER

Figure 6-13 is the schematic diagram for this assembly; its reference designation prefix is A12.

2.13.1 The 2-MHz IF input signal, after bandwidth limiting, is applied to module pin 22. The input signal is initially amplified by common emitter amplifier Q1. Operation of the amplifier is controlled by biasing resistors R1 and R2, and the emitter network. Inductor L1 is the collector load. The amplified output from Q1 is coupled through C3 to the signal input port of mixer U1. Resistors R7 and R10 in conjunction with R6 and R9 form a voltage divider which allows pin 1 of U1 to be at the same dc potential as pin 4. Potentiometer R8 compensates for resistance variations between the two inputs and is used to set pins 1 and 4 at equal dc levels to balance the modulator. The negative operating potential for U1 is supplied by the -18V line through 10V Zener diode VR1.

2.13.2 Transistor Q2 functions as a modified Colpitts crystal-controlled oscillator. Crystal Y1 sets the frequency of oscillation at 1.545 MHz. The output from Q2 is taken from the junction of voltage divider capacitors C8 and C9 in the oscillator feedback path. The 1.545-MHz signal is applied to the carrier input port of balanced modulator U1. Inductor L2 allows pins 7 and 8 to be at the same dc level for optimum balance. The positive operating potential for U1 is supplied by the +18V line through 6.2V Zener diode VR2.

2.13.3 The output from balanced modulator U1 consists of the sum and difference frequencies which are generated when the 2-MHz IF center frequency is heterodyned with the 1.545-MHz oscillator frequency. The 3.545-MHz sum output and the 455-kHz difference output are directly coupled to the high impedance base input of emitter follower Q3. The low impedance emitter output from Q3 is coupled through C20 and R21 to a low-pass filter network. The filter rolls off at approximately 750 kHz to permit passage of the 455-kHz output from inverting input to U3 is returned to ground through offset resistor R28 which balances the current flow through both inputs of the amplifier. A centering voltage is also applied through potentiometer R25 to the inverting input. This voltage allows the -10V to +10V tuning voltage input to be translated to the +2 to +10V tuning voltage output. Also connecting to the inverting input is a dual, negative feedback loop through R30, CR2, CR1, and R29. A biasing network comprised of resistors R31 through R34 plus diode CR3 provides control bias for break diode CR2. In a typical example of circuit operation, assume that the 1 kHz low band edge tuning voltage (-10V) is applied to U3 through R13, R16, and range potentiometer R24. At this point the output from U3 will be 2 volts. In this condition CR3 is reverse biased by the anode potential applied through R31 and the cathode potential supplied by shaping potentiometer R33. The shaping potentiometer sets the "break" point for the output tuning voltage curve. With CR3 in the non-conducting state, diodes CR1 and CR2 are forward biased providing a dual feedback loop through R30, and through CR1, CR2, and R29. As the tuned frequency of the receiver is increased, the tuning voltage from the main tuning control likewise increases in a positive direction from its -10V low-band level. This action causes the output of U3 to increase from its initial 2V level. The output of U3 will increase linearly until it reaches the point where CR3 will become forward biased (break point). When CR3 conducts the voltage at the junction of CR1, CR2, and CR3 is clamped by the current flow through CR3, and break diode CR2 will be reverse biased for any given increase at the output of U3. With the break diode (CR2) reverse biased, the negative feedback loop through CR2, CR1, and R29 is broken, increasing the gain of U3. Since the setting of R33 can determine at what point the gain of U3 can increase or decrease (dependent on whether the tuned frequency is being increased or decreased) the slope of the +2V to +10V tuning voltage range can be set for matching the voltage-versus-capacitance characteristics of the varactor diode used in the VFO. The shaped tuning voltage allows linear tuning of the receiver across its tuning range. This characteristic is important when the receiver is being automatically swept across its 1-900-kHz tuning range by the application of a external (REMOTE MODE) -10V to +10V ramp tuning waveform to REMOTE jack J1. This mode of operation can be used when it is desired to produce a panoramic display of signal activity in the RF spectrum covered by the receiver. The externally generated ramp tuning waveform is used for both the horizontal input to the signal display and for the remote tuning input to the receiver. Since the ramp input is a linear waveform, it is also necessary for the receiver to tune in a linear fashion so that displayed signals can occur at their proper position on the signal display.

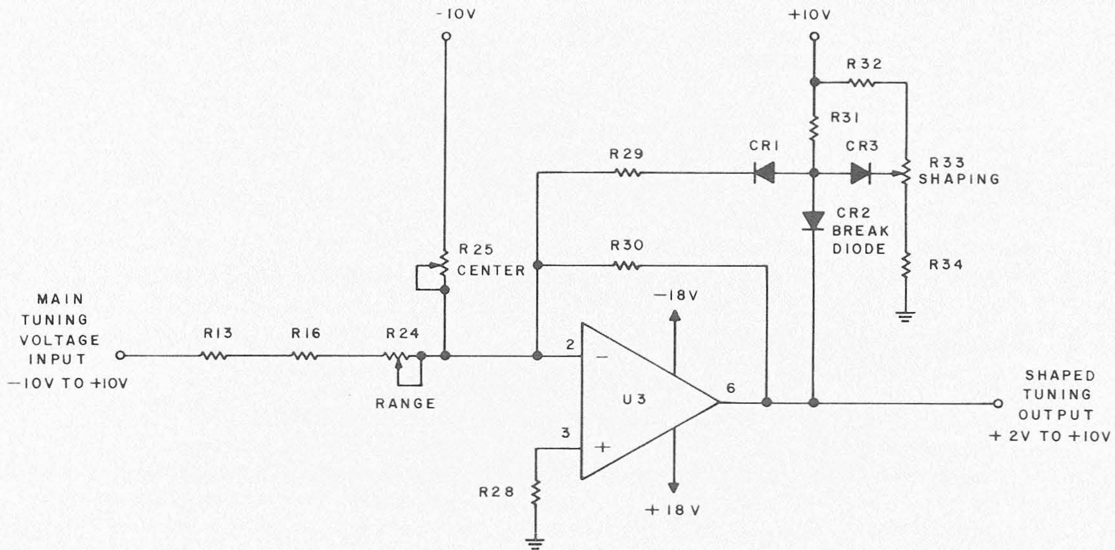


Figure 2-3. Shaping Amplifier Simplified Schematic Diagram

2.7 TYPE 7768 VARIABLE FREQUENCY OSCILLATOR

Figure 6-16 is the schematic diagram for this assembly; its reference designation prefix is A15. The VFO module develops the local oscillator signal which is 2 MHz above the incoming RF signal to the receiver. The LO signal is used for driving counter assembly A1 and for high-beat heterodyning in the input converter module A16. The tuning voltage input from the VFO control assembly is applied to module pin 1 and is coupled through R1, R2, and CR1 to varactor tuning diode U1. The varactor diode is used in the VFO as a voltage-tuned capacitive reactance element. Inductor L1 is the inductive element. Together they form the tank circuit for Colpitts oscillator Q1. The varactor diode is a semiconductor device whose capacitance is inversely related to control in the CW-VAR mode of receiver operation changes the voltage potential applied to a varactor oscillator in module U1. Positioning of the BFO control from its maximum clockwise position to its maximum counter-clockwise position shifts the oscillator frequency from 465 to 445 kHz. Module U1 also contains a fixed 455-kHz oscillator which is active when the CW ZERO mode of operation is selected. The signals generated in either the CW-variable oscillator or the CW-zero oscillator are mixed with the 455-kHz IF frequency input to module U1. The output of U1 is the audio difference signal generated when the IF frequency is mixed with the output of either oscillator. The selected CW output is applied to the audio amplifier assembly.

2.2.17 Audio Amplifier (A23). - Audio amplifier assembly A23 consists of: AM, FM and CW enable switches Q1, Q2, and Q3; audio amplifier U1; and impedance matching transformer T1. Inputs to assembly A23 consist of a +18V enable voltage from MODE switch S5A-X, and either the AM, FM, or CW audio signal. The +18V enable voltage activates the enable switch associated with the mode selected. The signal from the AM, FM, or CW demodulator is coupled through the active transistor switch to the front panel AUDIO level potentiometer. The potentiometer applies the desired signal level to audio amplifier U1. The output of U1 is applied to the front panel PHONES jack and Z-match transformer T1. The transformer secondary connects to the 600-ohm audio terminal board, TB1.

2.2.18 Power Supplies. - Assemblies A2 through A5 supply the ±5V, ±18V, and ±10V operating potentials for the receiver and frequency counter circuits. Primary power is applied through POWER switch S1, and 115/230 Vac transformer T1. The output of T1 is applied to ±5V power supply A2, -18V power supply A3, and +18V power supply A4. The ±18V regulated output from A3 and A4 is applied to the ±10V precision regulator assembly A5.

2.3 TYPE 79966 INPUT TRANSFORMER/HIGH-PASS FILTER

Figure 6-25 is the schematic diagram for this assembly; its reference designation prefix is A24. The Part 16334 component assembly mounts within assembly A24 and is designated A24A1. RF inputs are applied to either the 600-ohm balanced or 50-ohm unbalanced RF input jacks A24J1 or A24J2. The balanced input, which should be used when the antenna line is subject to excessive RF interference, is applied to terminals E1 and E2 of the component board, A24A1. The 600-ohm input impedance is stepped down through the turns ratio of T1 to match the 50-ohm secondary impedance. The unbalanced 50-ohm input connects to terminals E3 and E4 of the component assembly. The 50-ohm primary matches the 50-ohm secondary impedance. The secondary windings of T1 connect to a three-pole, high-pass filter network consisting of C1, C2, and inductor L1. The low frequency roll-off of the high-pass filter is set at 1 kHz. This provides for maximum attenuation to undesired inputs below the 1-kHz low band limit. The output from the filter connects to terminal E5 and output jack A24J3.

2.4 TYPE 79869 LOW-PASS FILTER

Figure 6-15 is the schematic diagram for this assembly; its reference designation prefix is A14. The circuitry on A14 comprises a nine-pole, low-pass filter. Input and output impedances are 50 ohms. The filter cut-off is approximately 1 MHz to attenuate undesired RF inputs above the 900-kHz high band limit.

2.5 TYPE 71372 INPUT CONVERTER

Figure 6-17 is the schematic diagram for this assembly; its reference designation prefix is A16. Inputs from low-pass filter A14 connect to module pin 22. The inputs are initially filtered by a three-pole, low-pass filter consisting of C1, L1, and C2. The filter rolls off at 900 kHz. The output signal from the filter is coupled through C3 to the base of common emitter amplifier Q1. The emitter-base bias voltage for Q1 is provided by the -18V supply from module pin 18 through R1, R3, R2, and R5. The emitter network consisting of R6, C4, C5, and C15 sets emitter degeneration and improves amplifier stability. The amplified output from Q1 is applied to common base amplifier Q2 which is connected in a cascode configuration with Q1. The output from Q2 is applied through R8 and C9 to impedance matching transformer T1. A negative feedback loop consisting of C6 and R4 improves the overall stability of the cascode amplifier. Transformer T1 provides impedance matching between the input amplifier circuits and balanced mixer U1. Resistors R11, R12, and R13 provide 3-dB attenuation between the transformer output and the signal input port (pin 3) of U1. The balanced mixer, U1, heterodynes the RF signal with the local oscillator signal developed in the VFO and its associated control circuitry. The unbalanced output of the VFO is applied through module pins 11 and 13 to balun transformer T2 which transforms the unbalanced VFO signal to the balanced input required by U1. Potentiometer R14, resistors R15 and R16, and potentiometer R17 form a LO sampling network. Potentiometer R17 sets the amplitude of the LO signal applied to a phase shift network consisting of C10, C11, L3, R22, and R26. Variable capacitor C11 is set to shift the remote tuning voltage input is applied to unity gain voltage follower U1 in the VFO control assembly. Voltage follower U1 buffers the +10V to -10V remote tuning voltage. The buffered output is applied to U2 and U3 during remote operation. Filter elements at the input of U1 remove undesired noise which may have been introduced on the remote lines. Additional fine tuning and DAFC correction voltage inputs are also applied to summing networks associated with the main tuning input to U2 and U3. Integrated circuit U2 functions as an analog voltage amplifier which translates the tuning voltage inputs into an output level in the range of 0 to +10V. Any given point in the 0 to +10V range corresponds to a particular frequency in the 1 to 900 kHz tuning range. The magnitude of the analog voltage output is dependent on the position of the MAIN TUNING control, FINE TUNING control and the amount of the DAFC correction voltage applied by the frequency counter (A1). The DAFC voltage changes only when the front panel DAFC switch is on and the DAFC circuits sense an error in the local oscillator frequency. Shaper amplifier U3 shapes the local or remote +10 to -10V tuning voltage to track nonlinear varactor diodes in the VFO in a linear fashion across the 1 to 900-kHz tuning range.

2.2.7 Variable Frequency Oscillator (A15). - The shaped tuning voltage output from the VFO control assembly is applied to varactor tuning diode U1 in VFO assembly A15. The tuning voltage changes the capacitance of U1 by varying the reverse bias on the varactor. The voltage variable capacitance of U1 sets the resonant frequency of a tank circuit associated with local oscillator Q1. The oscillator output is buffered by Q2, an emitter follower. The output from Q2 drives common emitter amplifier Q3 and also supplies the 50-mV input signal required by counter assembly A1. The amplified LO output from Q3 drives complementary emitter followers Q4 and Q5 providing a 1.2 Vrms LO signal for heterodyning with the RF input signal in the input converter (A16).

2.2.8 IF Amplifiers (A8, A9, A10, and A11). - The IF output signal from the IF driver assembly A7 is applied in parallel to the inputs of the 50, 20, 6, and 1-kHz bandwidth IF amplifiers. The 50-kHz BW IF assembly consists of the following: a FET IF amplifier; a band-pass filter composed of discrete components; a gain-controlled MOSFET amplifier, plus an output emitter follower. The 20, 6, and 1-kHz bandwidth IF amplifiers are similar modules which consist of: an IF amplifier; a crystal bandpass filter; a gain-controlled MOSFET amplifier; and an output emitter follower. In the 50-kHz IF amplifier the response of the bandpass filter is combined with the overall bandwidth of the input converter to set the 50-kHz IF bandwidth. The overall response of the 1, 6, and 20-kHz IF amplifier is set by the crystal filter, FL1, in each case.

2.2.9 Bandwidth Control (A6). - Operating voltages for the selected IF amplifier are supplied by bandwidth control module A6. This assembly is controlled by the LOCAL-REMOTE switch, S6, and by the front panel IF BANDWIDTH (kHz) select switch S4A-W. In local operation the IF BW selector switch provides a ground through sections W through Z of LOCAL/REMOTE switch S6A to logic switches U1A through U1D on the Bandwidth Control module. The switched ground activates the selected logic switch providing a turn-on voltage for two enable switches which are associated with each of the four IF bandwidths. The activated enable switch provides the operating potential required by the selected IF amplifier module. In remote operation, BW selection is provided by a ground which is supplied by a remote station. Sections W through Z of LOCAL/REMOTE switch S6A also disable the local bandwidth selector switch and provide the necessary connections from the rear-apron remote receiver control jack in remote operation.

2.2.10 Second Converter (A12). - The 2-MHz first IF output from the selected IF amplifier is applied to second converter module A12. This module converts the 2-MHz first IF input to the 455-kHz second intermediate frequency. Inputs are initially amplified by JFET input amplifier Q1. The amplified input is applied to the signal input port of U1, a balanced mixer. Crystal controlled oscillator Q2 injects a 1.545-MHz signal into the carrier input port of the mixer. The two inputs are heterodyned in U1 developing the difference 455-kHz second IF frequency. The mixer output is buffered by emitter follower Q3. A low-pass filter network passes the 455-kHz IF signal and rejects the sum output from U1. Emitter follower Q4 sets a low output impedance from the module.

2.2.11 Gain Control (A18). - Automatic or manual gain control voltages for the 1, 6, 20, and 50-kHz IF amplifiers, and the 455-kHz IF amplifier is supplied by gain control assembly A18.

2.2.11.1 Manual gain, which is utilized in the AM MAN and both CW modes of receiver operation, is controlled by the front panel MANUAL GAIN potentiometer. The manual gain potentiometer supplies a voltage in the range of 0V to -10V to gain control module A18. A voltage divider at the input to emitter follower Q1 splits the 0 to -10V input producing a 0V to -5V gain control range. This variable dc level is buffered by emitter followers Q1 and Q2 before application to the gain controlled modules. LOCAL/REMOTE switch S6B-X provides switching to REMOTE RECEIVER CONTROL jack J2 on the rear apron if remote control of the manual gain is desired.

1.3 EQUIPMENT SUPPLIED

The Type 340A Receiver is the only equipment supplied. Pertinent electrical specifications, dimensions, and weight are given in Table 1-1.

1.4 EQUIPMENT REQUIRED BUT NOT SUPPLIED

The Type 340A Receiver operates independently, requiring only a VLF antenna input and a speaker or headphone at its output. Additional ancillary equipment such as a signal monitor or voltage controlled recorder can be easily connected for operation with the receiver. The 340A can also be controlled from a remote location by a remote unit which can provide receiver tuning, selection of the four IF bandwidths, and remote manual gain control.

Figure 1-1. Type 340A VLF Receiver

Table 1-1. Type 340A VLF Receiver, Specifications

Tuning Range	1 kHz to 900 kHz in one band
Types of Reception	AM, FM, and CW
Input Impedance	50 ohms, unbalanced, or 600 ohms, balanced
IF Frequencies	2 MHz and 455 kHz
IF Bandwidths	1, 6, 20, or 50 kHz
Noise Figure	7 dB, maximum
Image Rejection	70 dB, minimum
IF Rejection	70 dB, minimum
Sensitivity (50-ohm input)	
1-kHz Bandwidth	AM: 0.25 μV input modulated 50% by 400-Hz tone produces 10 dB (s plus n)/n, minimum CW: 0.13 μV input produces 10 dB (s plus n)/n, minimum
6-kHz Bandwidth	AM: 0.64 μV input modulated 50% by 1-kHz tone produces 10 dB (s plus n)/n, minimum CW: 0.33 μV input produces 10 dB (s plus n)/n, minimum
20-kHz Bandwidth	AM: 1.2 μV input modulated 50% by 1-kHz tone produces 10 dB (s plus n)/n, minimum CW: 0.58 μV input produces 10 dB (s plus n)/n, minimum FM: 1.2 μV input modulated at 1-kHz rate with 7-kHz deviation produces 17 dB (s plus n)/n, minimum
50-kHz Bandwidth	AM: 1.8 μV input modulated 50% with 1-kHz tone produces 10 dB (s plus n)/n, minimum CW: 0.9 μV input produces 10 dB (s plus n)/n, minimum FM: 1.8 μV input modulated at 1-kHz rate with 17-kHz deviation produces 17 dB (s plus n)/n, minimum
Audio Output Level	10 mW minimum into 600-ohm load
455-kHz Predetection IF Output	20 mV, minimum, into 50-ohm load for input signal above AGC threshold
AM Detector Output	0 to +5V minimum, into 10 kΩ load
FM Detector Output	±1V into 10 kΩ load, typical
Analog Voltage Output	0 to +10V into 10 kΩ load, typical
Logarithmic Output	60 dB range, minimum. Output changes from 0.1V to 1V typical over range.
Signal Monitor Output	Centered at 2 MHz
AGC Output	0 to -5V into 10 kΩ load, typical
Conducted LO Radiation	10 μV, maximum
Digital AFC	Holds receiver within ±10 Hz of indicated frequency over operating temperature range
Incidental FM (DAFC off)	5 Hz peak, maximum
Beat Frequency Oscillators	Two: One crystal controlled to zero beat with IF and one variable ±10 kHz around IF
Remote Tuning Input	-10V to +10V into 10 kΩ load tunes receiver from lowest frequency to highest frequency
Operating Temperature Range	0° to 50°C
Input Power	115/230 Vac ±10%, 48-420 Hz
Power Consumption	15 watts, approximately
Dimensions	3.5 inches high, 19 inches wide, and 16 inches deep
Weight	18 pounds, approximately

LIST OF ILLUSTRATIONS (Cont)

Illustration Page

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WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted. Extreme caution should be exercised in working with the equipment with any of the protective covers removed.

4.7.1 Variable Frequency Oscillator Alignment. - Proceed as follows:

(1) Set up the equipment as shown in Figure 4-17.

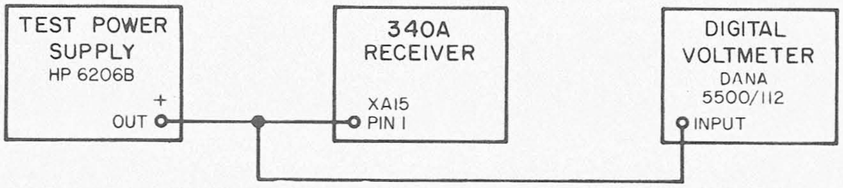


Figure 4-17. Test Setup, Variable Frequency Oscillator Alignment

(2) Remove the ±10V precision power supply board A5.

(3) Remove the variable frequency oscillator board A15, and insert it in the extender card. Place the combination in XA15.

(4) Set the output of the test power supply for a +5 Vdc reading on the digital voltmeter.

(5) Adjust A15L1 for a 435.00 kHz readout on the receiver front panel display.

(6) Remove the extender card and replace A15 in its receptacle.

4.7.2 VFO Control Remote Buffer Adjustment. - Proceed as follows:

(1) Unsolder the ground connection from XA17 pin 1.

(2) Set up the equipment as shown in Figure 4-18.

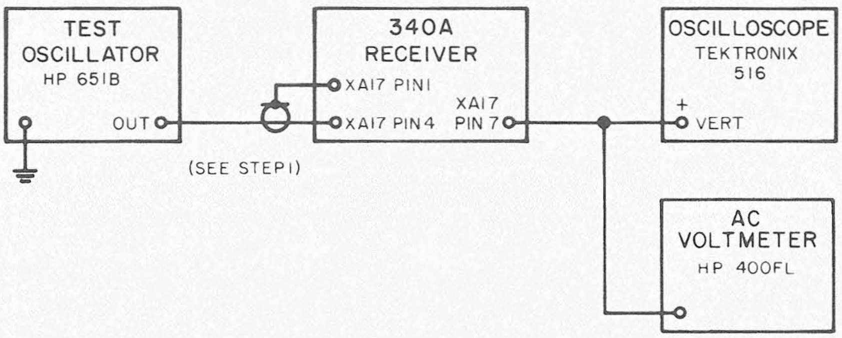


Figure 4-18. Test Setup, VFO Control Remote Buffer Adjustment

(3) Set the test oscillator for a CW output at 1 kHz; set the output level at approximately 1V p-p.

(4) Adjust A17R6 for a minimum reading on the AC voltmeter.

(5) Disconnect the equipment and resolder the ground to pin 1.

4.7.3 VFO Shaping Amplifier Alignment. - Proceed as follows:

(1) Set up the equipment as shown in Figure 4-19.

(2) Set the RECEIVER CONTROL to the REMOTE position, the FINE TUNING control midrange, and the DAFC switch to the OFF position.

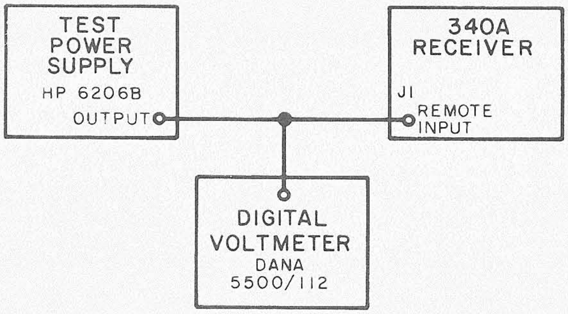


Figure 4-19. Test Setup, VFO Shaping Amplifier Alignment

(3) On linear graph paper, plot frequency (1 kHz to 900 kHz) versus voltage (-10V to +10V) varying the power supply in 1 Vdc increments.

(4) Draw a straight line from the point (-10V, 1 kHz) to the point (+10V, 900 kHz).

(5) Adjust A17R33 for best linearity about the straight line by making an adjustment and repeating step (3) as necessary.

4.7.4 455-kHz IF Amplifier Alignment. - Proceed as follows:

(1) Press the POWER pushbutton to OFF.

(2) Remove the second converter board, A12. Install the extender card between the 455 kHz IF amplifier board, A13 and its receptical.

(3) Set up the equipment as shown in Figure 4-20.

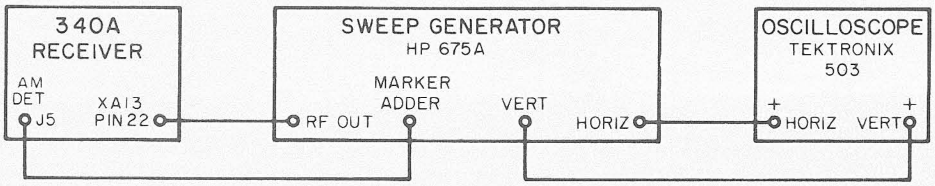


Figure 4-20. Test Setup, 455-kHz IF Amplifier Alignment

(4) Press the POWER pushbutton to ON. Select the 1-kHz IF bandwidth.

(5) Select the AM MAN reception mode and set the MANUAL GAIN control to the maximum clockwise position.

(6) Set the output level of the sweep generator to -65 dBm. Adjust the output frequency to obtain a response centered at 455 kHz using the external or internal 455-kHz marker.

(7) Adjust A13L1 to center the response at 455 kHz. A typical response is shown in Figure 4-21.

(8) Replace A12 and A13 in their respective receptacles.

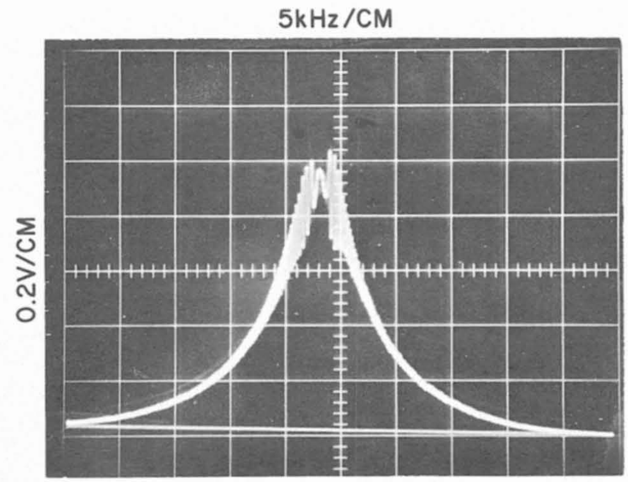


Figure 4-21. Typical Response, 455-kHz IF Amplifier

4.7.5 <u>50-kHz Bandwidth IF Amplifier Alignment and 20, 6, and 1-kHz Bandwidth IF Amplifier Operational Checks.</u> - Proceed as follows:

(1) Press the POWER pushbutton to OFF.

(2) Remove the IF driver amplifier card, A7.

(3) Install the extender card between the 50-kHz IF amplifier (A8) and its receptical.

(4) Set up the equipment as shown in Figure 4-20 except connect the output of the sweep generator to XA8 pin 1.

(5) Press the POWER pushbutton to ON and select the 50-kHz IF bandwidth.

(6) Select the AM MAN reception mode; set the MANUAL GAIN control to the maximum clockwise position.

(7) Set gain potentiometer A8R20 to its maximum clockwise position.

(8) Adjust the output center frequency of the sweep generator to 2 MHz. Use the 1 MHz marker output of the sweep generator to identify the 2 MHz IF center frequency.

(9) Adjust the sweep time and $\triangle$F width controls on the sweep generator to obtain a response curve on the oscilloscope. Adjust the output level of the sweep generator to obtain a 2V peak response.

(10) Adjust A8L3 and A8L4 for a maximum amplitude symmetrical response centered on the marker. A typical response is shown in Figure 4-22.

NOTE

The response of the 20 kHz, 6 kHz, and 1 kHz IF bandwidths is set by a sealed crystal filter (FL1) in each IF amplifier assembly. To verify the operation of each filter perform steps (11), (12), and (13).

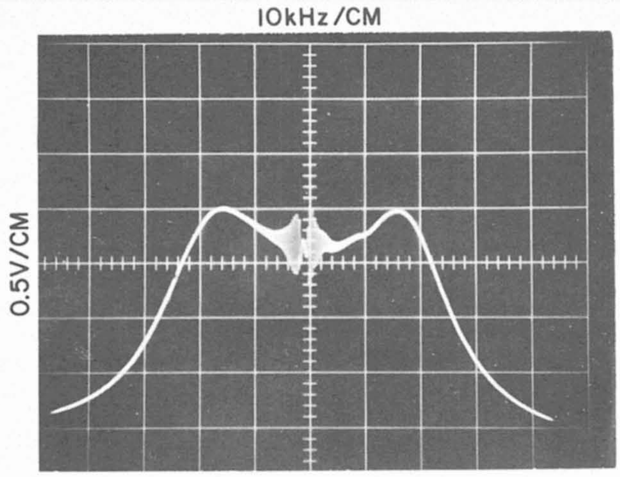


Figure 4-22. Typical Response, 50-kHz IF Bandwidth

(11) Select the 20-kHz IF bandwidth. Adjust the sweep time, △F width control, and the RF output level of the sweep generator to display a 2V peak response curve. A typical response is shown in Figure 4-23.

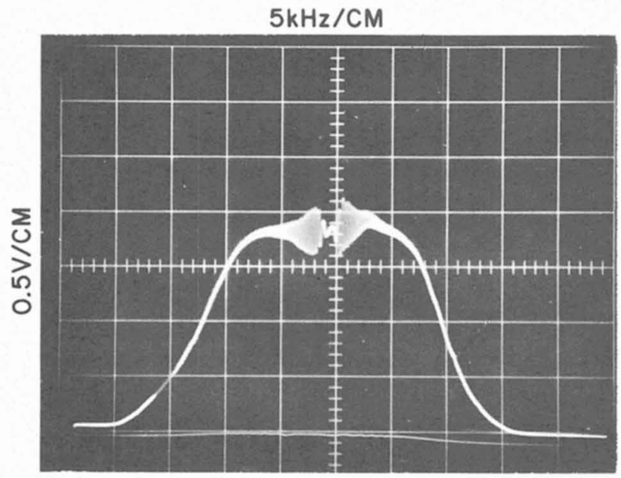


Figure 4-23. Typical Response, 20-kHz IF Bandwidth

(12) Select the 6 kHz IF bandwidth. Adjust the sweep time, △F width controls and RF output level of the sweep generator to display a 2V peak response curve. A typical response is shown in Figure 4-24.

(13) Select the 1-kHz IF bandwidth. Adjust the sweep time, △F width control, and the RF output level of the sweep generator to display a 2V peak response curve. A typical response is shown in Figure 4-25.

(14) Press the POWER pushbutton to OFF and return assemblies A7 and A8 to their receptacles.

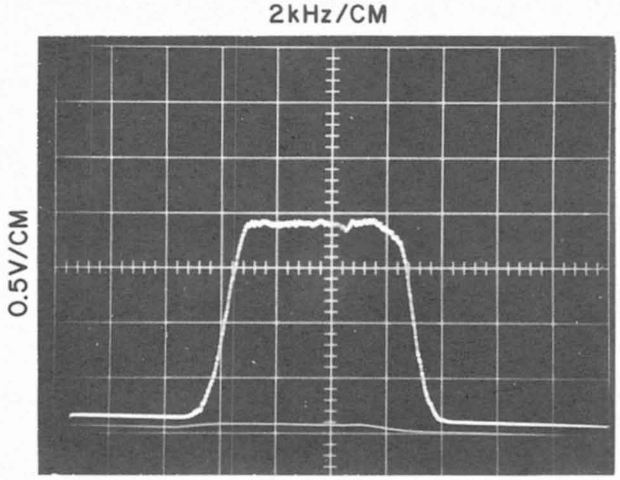


Figure 4-24. Typical Response, 6 kHz IF Bandwidth

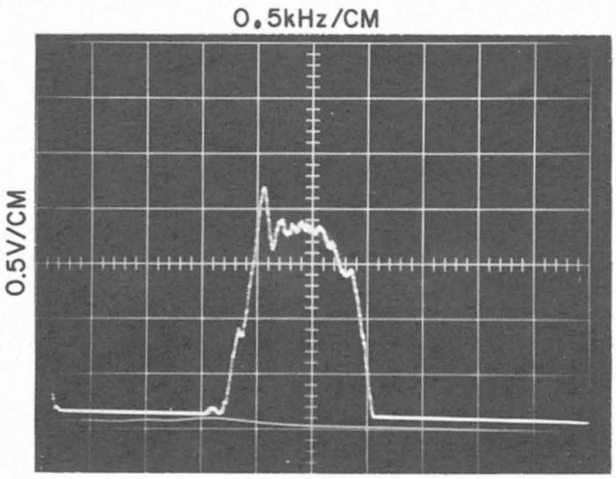


Figure 4-25. Typical Response, 1 kHz IF Bandwidth

4.7.6 IF Driver Amplifier Alignment. - The following alignment procedure should be performed only after alignment procedure 4.7.5 has been completed. Proceed as follows:

(1) Press the POWER pushbutton to OFF.

(2) Set up the equipment as shown in Figure 4-26.

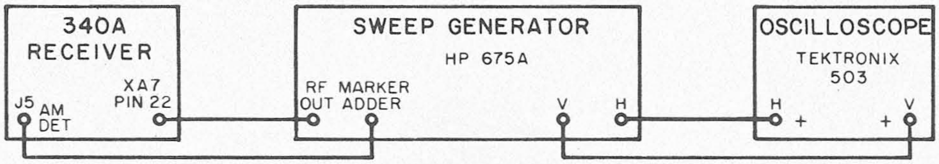


Figure 4-26. Test Setup, IF Driver Amplifier Alignment

(3) Remove the IF amplifier driver board (A7) and insert it in the extender card and place the combination in receptacle XA7.

(4) Press the POWER pushbutton to ON and select the 50-kHz IF bandwidth.

(5) Select the AM MAN reception mode and turn the MANUAL GAIN control to the maximum clockwise position.

(6) Adjust the sweep generator output to -89 dBm.

(7) Use the 1-MHz marker output of the sweep generator to center the response at 2 MHz.

(8) Adjust inductors A7L3 through A7L7 to obtain a maximum symmetrical response with a 3-dB bandwidth of 50 kHz. A typical response is shown in Figure 4-27.

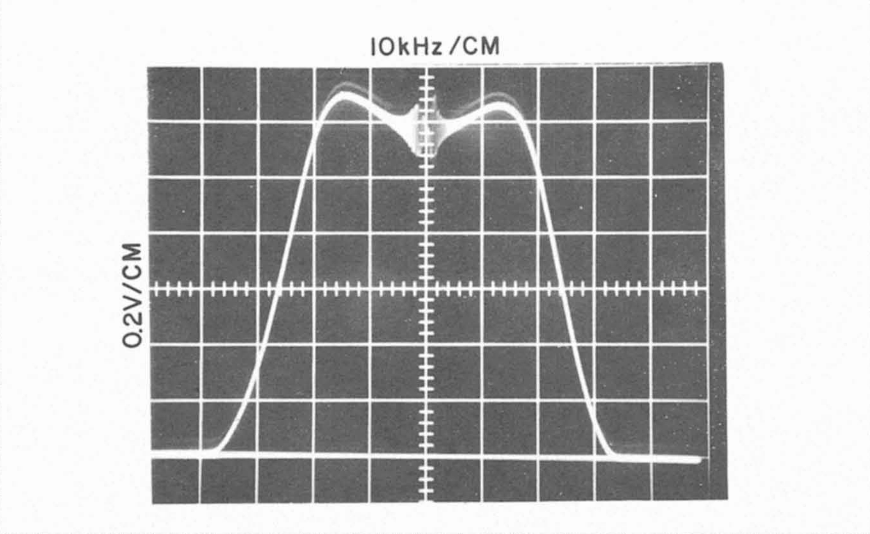


Figure 4-27. Typical Response, IF Driver Amplifier

4.7.7 IF Amplifier Gain Adjustments. - Proceed as follows:

(1) Set up the equipment as shown in Figure 4-28.

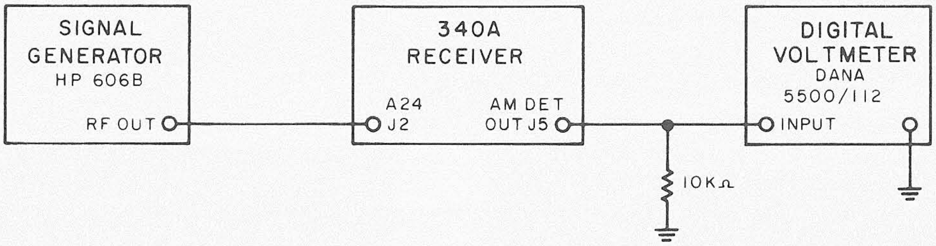


Figure 4-28. Test Setup, IF Amplifier Gain Adjustments

(2) Select the 50-kHz IF bandwidth, turn the MANUAL GAIN control to the maximum clockwise position.

(3) Tune the receiver and signal generator to 400 kHz. Set the output level of the signal generator at 2.4 μV.

(4) Set the 50-kHz IF bandwidth gain potentiometer A8R20 to the maximum clockwise position and adjust A19R8 for a 1.8 Vdc reading on the digital voltmeter. Readjust A8R20 for a 1.5 Vdc reading on the digital voltmeter.

(5) Select the 20-kHz IF bandwidth. Change the output level of the signal generator to 1.6 μV. Adjust A9R5 for a 1.5 Vdc reading on the digital voltmeter.

(6) Select the 6-kHz IF bandwidth. Change the output level of the signal generator to 0.85 μV. Adjust A10R14 for a 1.5 Vdc reading on the digital voltmeter.

(7) Select the 1-kHz IF bandwidth. Change the output level of the signal generator to 0.3 μV. Adjust A11R14 for a 1.5 Vdc reading on the digital voltmeter.

4.7.8 FM Demodulator Alignment. - The following alignment procedure should be performed only after alignment procedures 4.7.4 through 4.7.7 have been completed. Proceed as follows:

(1) Press the POWER pushbutton to OFF.

(2) Connect the equipment as shown in Figure 4-29. Install the extender card between A21 and its receptical. Remove A13.

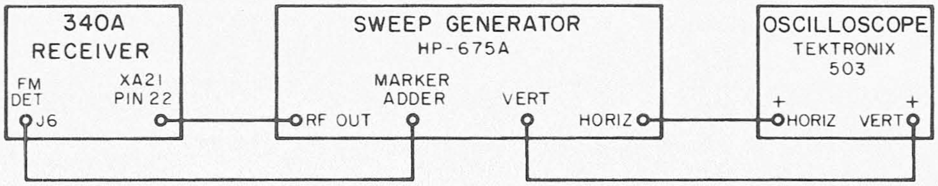


Figure 4-29. Test Setup, FM Demodulator Alignment

(3) Press the POWER pushbutton to ON.

(4) Select the 50-kHz IF bandwidth and the FM AGC reception mode.

(5) Set the sweep generator to sweep around 2.0 MHz at -50 dBm.

(6) Adjust A21T1 for zero-crossing at 2 MHz. Adjust A21L2 for response symmetry. A typical response is shown in Figure 4-30.

(7) Select the 20-kHz IF bandwidth. Adjust the sweep generator and oscilloscope control to obtain a response. A typical response is shown in Figure 4-31.

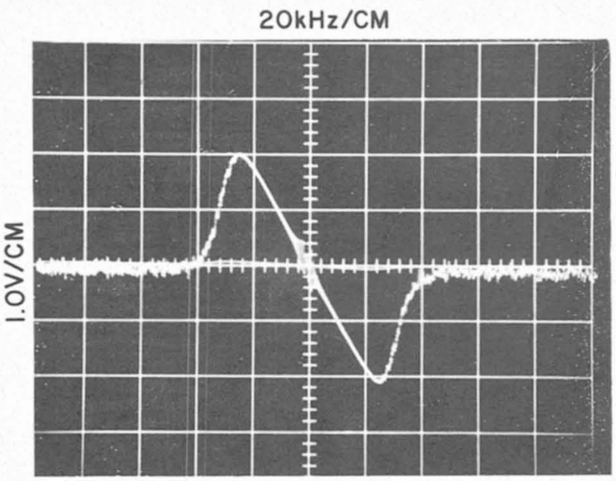


Figure 4-30. Typical Response, 50-kHz Discriminator

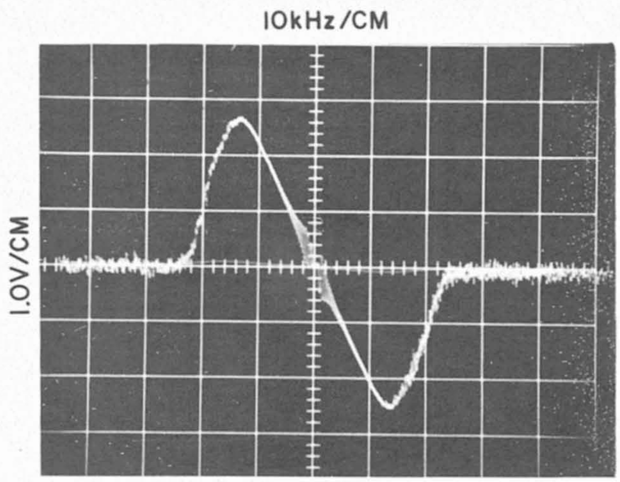


Figure 4-31. Typical Response, 20-kHz Discriminator

(8) Press the POWER pushbutton to OFF and return A13 and A21 to their recepticals.

4.7.9 FM Discriminator Slope Adjustment. - Proceed as follows:

(1) Connect the equipment as shown in Figure 4-32.

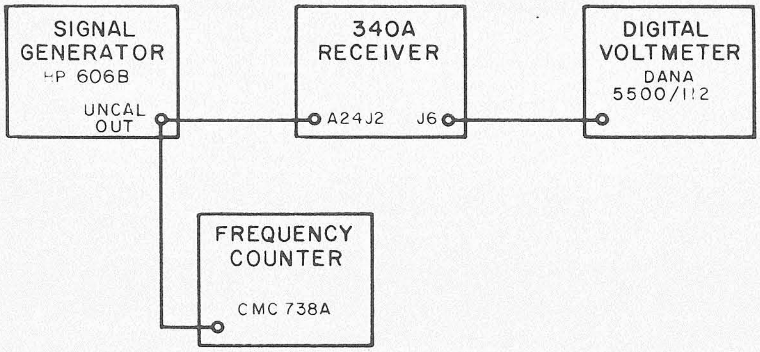


Figure 4-32. Test Setup, FM Discriminator Slope Adjustment

(2) Select the FM AGC mode, and the 20 kHz IF bandwidth.

(3) Tune the receiver and signal generator to 400 kHz. Adjust the output level of the signal generator to 0.3 mV. The digital voltmeter should read 0.0 volts.

(4) Tune the signal generator to 410 kHz. Adjust A21R27 for a 1.0 Vdc reading on the voltmeter.

(5) Tune the signal generator to 390 kHz. The digital voltmeter should read -1.0 Vdc ±0.25 volts.

(6) Select the 50 kHz IF bandwidth.

(7) Tune the signal generator to 425 kHz. The digital voltmeter should read 1.0 Vdc ±0.25 volts.

(8) Tune the signal generator to 375 kHz. The digital voltmeter should read -1.0 Vdc ±0.25 volts.

4.7.10 CW Demodulator Alignment. - Proceed as follows:

(1) Press the POWER pushbutton to OFF. Install the extender card between A20 and its receptacle. Remove A13.

(2) Connect the equipment as shown in Figure 4-33. Connect the frequency counter to the uncalibrated output of the signal generator.

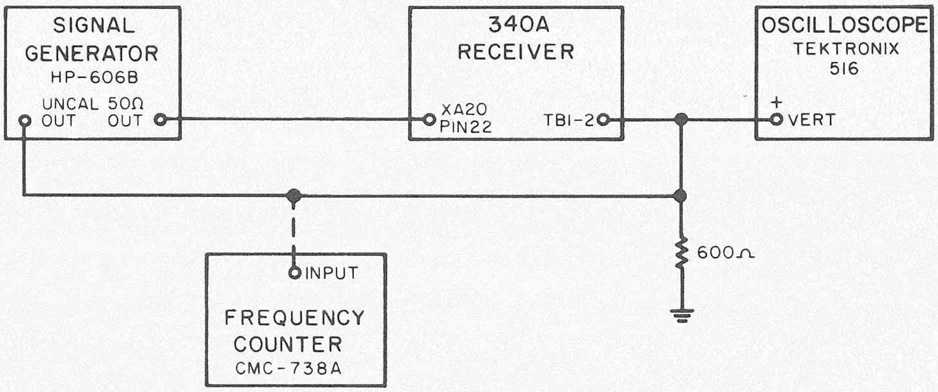


Figure 4-33. Test Setup, CW Demodulator Alignment

(3) Press the POWER pushbutton to ON. Select the CW VAR mode, tune the receiver to 100 kHz ±1 Hz, select the 50 kHz IF bandwidth, turn the MANUAL GAIN control fully clockwise, and set the BFO (kHz) control to the 0 position.

(4) Adjust the signal generator for 100 kHz ±1 Hz CW output at 1.0 μV.

(5) Adjust A20L1 for a zero beat on the oscilloscope.

(6) Connect the frequency counter to the input of the oscilloscope.

(7) Turn the BFO (kHz) control to its maximum counterclockwise position. Adjust A20R2 for a 10 kHz ±2 kHz readout on the frequency counter.

(8) Turn the BFO (kHz) control to its maximum clockwise position. Adjust A20R4 for a 10 kHz ±2 kHz readout on the frequency counter.

(9) Repeat steps 7 and 8 until the proper BFO range is obtained.

(10) Press the POWER pushbutton to OFF. Remove the extender card and replace assembly A20 in its receptacle.

4.7.11 Power Supply Adjustments. - Adjust power supply boards A2, A3, A4, and A5 in the following sequence:

(1) Connect the digital voltmeter to A2TP1.

(2) Adjust A2R12 for a +5.00 Vdc reading.

(3) Connect the digital voltmeter to XA3 pin 14.

(4) Adjust A3R6 for a -18.00 Vdc reading.

(5) Connect the digital voltmeter to XA4 pin 14.

(6) Adjust A4R5 for a +18.00 Vdc reading.

(7) Connect the digital voltmeter to A5TP1.

(8) Adjust A5R5 for a -10.10 Vdc reading.

(9) Connect the digital voltmeter to A5TP2.

(10) Adjust A5R8 for a +10.10 Vdc reading.

4.7.12 Frequency Counter Adjustments.

4.7.12.1 1-MHz Oscillator Adjustment. - Proceed as follows:

(1) Set up the equipment as shown in Figure 4-34.

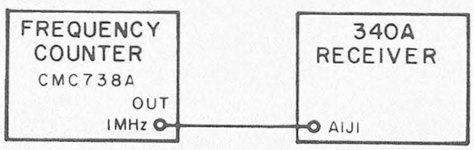


Figure 4-34. Test Setup, 1-MHz Oscillator Adjustment

(2) Set the DAFC switch to the OFF position.

(3) Adjust A1A1C3 for a readout of 000.00 kHz on the receiver counter display.

4.7.12.2 DAFC Adjustment. - Proceed as follows:

(1) Connect the digital voltmeter to jack A1J2 or XA17 pin 15.

(2) Set the DAFC switch to the OFF position.

(3) Adjust A1A1R17 for a 0.00V reading on the digital voltmeter.

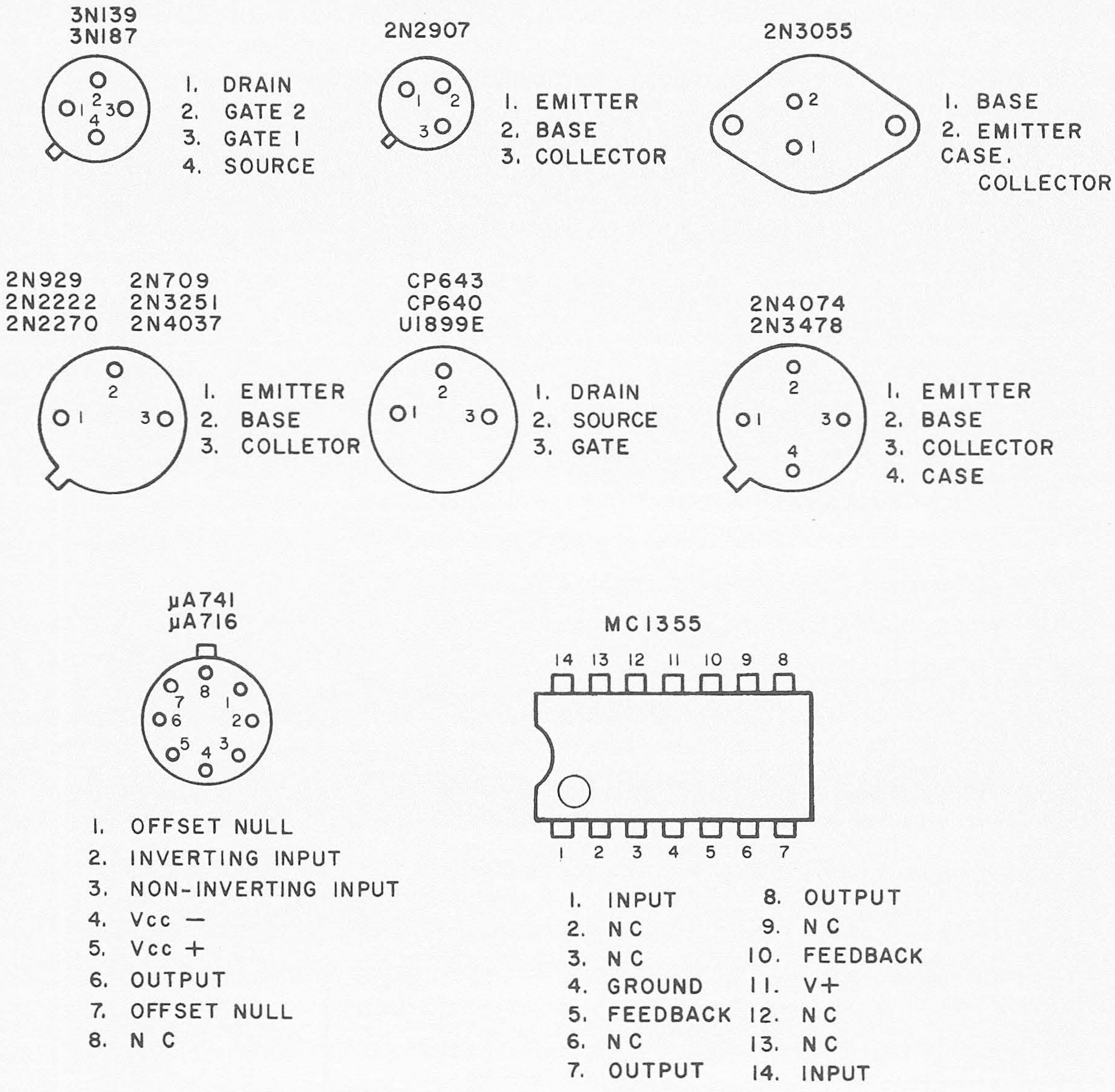


Figure 4-35. Transistor and Integrated Circuit Pin Configurations

Table 4-4. Typical Transistor Element Voltages

REF DESIG	TYPE	FIELD EFFECT TRANSISTOR ELEMENTS				STANDARD TRANSISTOR ELEMENTS			
		Drain	Gate 2	Gate 1	Source	Emitter	Base	Collector	Notes
Q1	2N3055					5.30	5.98	9.55	
Q2	2N3055					18.00	18.62	24.6	
A2Q1	2N2270					-11.37	-10.72	- 5.22	
A2Q2	2N2270					-10.68	-10.06	- 5.53	
A2Q3	2N4037					- 4.95	- 5.53	-10.44	
A2Q4	2N3251					9.36	8.71	6.64	
A2Q5	2N929					- 0.54	0.0	8.71	
A2Q6	2N929					- 0.54	0.0	9.36	
A2Q7	2N2270					6.00	6.64	9.36	
A3Q1	2N3055					-27.78	-27.20	-18.00	
A3Q2	2N4037					-18.00	-18.61	-27.20	
A3Q3	2N4037					- 7.0	- 7.5	-18.61	
A3Q4	2N4037					- 7.0	- 7.6	-17.50	
A4Q1	2N4037					24.6	23.9	18.61	
A4Q2	2N929					6.9	7.5	13.63	
A4Q3	2N929					13.04	13.63	24.0	
A4Q4	2N929					6.9	7.5	13.04	
A5Q1	2N2907					-10.00	-10.74	-16.34	
A5Q2	2N4074					10.00	10.74	17.20	
A6Q1	2N2222A					0.0	0.65	0.02	1
A6Q2	2N4037					18.00	17.28	17.98	1
A6Q3	2N2222A					0.0	0.65	0.02	2
A6Q4	2N4037					18.00	17.29	17.98	2
A6Q5	2N2222A					0.0	0.65	0.02	3
A6Q6	2N4037					18.00	17.28	17.98	3
A6Q7	2N2222A					0.0	0.65	0.02	4
A6Q8	2N4037					18.00	17.28	17.98	4
A7Q1	CP640	14.4	-	0.0	2.5				
A7Q2	2N2222A					0.6	1.3	2.4	
A8Q1	CP643	3.4	-	0.0	15.0				4
A8Q3	3N187	15.15	3.36	1.53	1.62				4, 5
A8Q4	2N2222A					7.58	8.22	16.41	4
A9Q1	CP643	13.63	-	2.73	5.94				3
A9Q2	3N187	14.62	2.84	1.71	1.7				3, 5
A9Q3	2N2222A					7.7	8.3	17.1	3
A10Q1	CP643	14.8	-	2.79	3.9				2
A10Q2	3N187	14.9	3.3	1.5	2.1				2, 5
A10Q3	2N2222A					7.6	8.2	17.1	2
A11Q1	CP643	14.8	-	2.79	3.9				1
A11Q2	3N187	14.9	3.3	1.5	2.1				1, 5
A11Q3	2N2222A					7.6	8.2	17.1	1
A12Q1	2N3478					2.26	3.02	17.00	
A12Q2	2N2222A					3.6	3.8	7.07	
A12Q3	2N2222A					7.8	8.4	17.52	
A12Q4	2N2222A					7.5	8.2	17.5	
A13Q1	2N3478					1.42	2.18	8.14	
A13Q2	3N187	14.8	3.30	1.55	2.1				5
A13Q3	2N2222A					0	0.68	.08	4
A13Q4	2N2222A					0	0.68	0.08	3
A13Q5	2N2222A					0	0.68	.06	2
A13Q6	2N2222A					7.75	8.35	17.0	
A15Q1	2N2222A					1.77	1.97	6.76	

Table 4-4. Typical Transistor Element Voltages (Continued)

REF DESIG	TYPE	FIELD EFFECT TRANSISTOR ELEMENTS				STANDARD TRANSISTOR ELEMENTS			
		Drain	Gate 2	Gate 1	Source	Emitter	Base	Collector	Notes
A15Q2	2N2222A					7.58	8.03	16.23	
A15Q3	2N2222A					4.78	5.68	16.78	
A15Q4	2N2222A					8.7	9.2	16.3	
A15Q5	2N3251					7.5	7.4	0	
A16Q1	2N5109					- 9.6	- 8.9	- 2.1	
A16Q2	2N5109					- 0.7	0	5.8	
A16Q3	2N2222A					5.8	6.5	16.4	
A18Q1	2N929					- 0.6	- 0.02	18.00	5
A18Q2	2N3251					0.02	- 0.60	-18.00	5
A18Q3	2N2222A					- 0.5	0.03	18.00	
A19Q1	2N2222A					2.78	3.38	15.1	
A19Q2	2N2222A					7.46	8.07	16.35	
A19Q3	2N2222A					8.00	8.62	17.64	
A20Q1	2N929					5.1	5.8	17.25	8
A20Q2	2N3251					3.6	2.98	0.0	8
A21Q1	U1899E	0.0	-	0.0	0.0				4, 10
A21Q2	U1899E	0.0	-	0.0	0.0				3, 10
A22Q1	2N2222A					3.92	4.55	10.69	
A22Q2	2N2222A					6.82	7.43	17.11	
A22Q3	2N3251					0.7	0.08	-17.5	
A22Q4	2N929					0.04	0.68	16.00	
A23Q1	2N929					7.9	8.4	18.00	9
A23Q2	2N929					8.0	8.7	18.00	10
A23Q3	2N929					7.6	8.21	17.2	11

See notes and test conditions in Table 4-5.

Table 4-5. Typical Integrated Circuit Pin Voltages

REF DESIG	TYPE	PIN NUMBERS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Notes
A5U1	μA741C	-	-6.29	-6.29	-16.50	-	-10.74	0.0	-							
A5U2	μA741C	-	0.0	0.0	-16.50	-	10.74	17.00	-							
A12U1	μA796C	-0.16	-0.85	-0.85	- 0.16	-7.04	8.43	7.11	7.11	8.42	-8.29					
A17U1	μA741C	-	0.0	0.0	-18.00	-	-	18.00								12
A17U2	μA741C	-	0.0	0.0	-18.00	-	9.91	18.00								6
A17U3	μA741C	-	0.0	0.0	-18.00	-	10.88	18.00								6
A18U1	μA741C	-	0.0	0.0	-18.00	-	- 0.13	18.00								7
A18U2	μA741C	-	0.0	0.0	-18.00	-	0.05	18.00								7
A18U3	μA741C	-	0.0	0.0	-18.00	-	0.0	18.00								7
A21U1	μA719C	2.7	0.0	0.0	0.0	2.8	0.0	15.3	15.4	0.0	2.8	5.3	0.0	0.0	2.7	10
A21U2	μA741C	-	1.1	1.1	-17.59	0.0	1.1	17.90								10
A21U3	μA741C	-	0.0	0.0	-17.59	-	-0.15	17.90								10
A23U1	μA716C	-	9.05	14.27	0.0	8.99	17.9	9.10	9.10							

TEST CONDITIONS:

Voltage readings are positive dc with respect to ground. Readings taken with Dana 1500/112 digital voltmeter. 115 Vac, 60 Hz applied to receiver, no signal input. RECEIVER CONTROL in LOCAL position; remaining controls, unless otherwise noted, may be left in any position.

NOTES:

1. IF BANDWIDTH (kHz) switch in 1 kHz position.
2. IF BANDWIDTH (kHz) switch in 6 kHz position.
3. IF BANDWIDTH (kHz) switch in 20 kHz position.
4. IF BANDWIDTH (kHz) switch in 50 kHz position.
5. Reception mode switch in the AM MAN position, MANUAL GAIN control in its maximum clockwise position.
6. The voltage readings at pin 6 of A17U1 and A17U2 are approximate and are measured with main tuning control set for a 900 kHz readout.
7. Reception mode switch in the AM AGC position.
8. Reception mode switch in CW VAR position and the BFO ±kHz control in the center or zero position.
9. Reception mode switch in the AM MAN or AM AGC positions.
10. Reception mode switch in the FM AGC position.
11. Reception mode switch in the CW ZERO or CW VAR position.
12. Output voltage at pin 6 of A17U1 is equal to the voltage applied to REMOTE TUNING input jack J1.

SECTION V

REPLACEMENT PARTS LIST

5.1 UNIT NUMBERING METHOD

The unit numbering method of assigning reference designations (electrical symbol numbers) has been used to identify assemblies, subassemblies (and modules), and parts. An example of the unit method follows:

A1R1

Subassembly Designation — A1 | R1 — Class and No. of Item

Read from right to left as: First (1) resistor (R) of first (1) subassembly (A)

As shown on the main chassis schematic, components which are an integral part of the main chassis have no subassembly designation.

5.2 REFERENCE DESIGNATION PREFIX

Partial reference designations have been used on the equipment and on the illustrations in this manual. The partial reference designations consists of the class letter(s) and identifying item number. The complete reference designations may be obtained by placing the proper prefix before the partial reference designations. Reference Designation Prefixes are provided on drawings and illustrations in parenthesis within the figure titles.

5.3 LIST OF MANUFACTURERS

Mfr. Code	Name and Address
00779	AMP, Incorporated P. O. Box 3608 Harrisburg, Pennsylvania 17105
01121	Allen-Bradley Company 1201 South 2nd Street Milwaukee, Wisconsin 53204
01735	Connector Corporation of America 12959 Sherman Way North Hollywood, California 91605
02735	RCA Corporation Solid State Division Route 202 Somerville, New Jersey 08876
04713	Motorola Semiconductor Products, Inc. 5005 East McDowell Road Phoenix, Arizona 85008
05820	Wakefield Engineering, Inc. Audubon Road Wakefield, Massachusetts 01880
06001	General Electric Company Capacitor Department P. O. Box 158 Irmo, South Carolina 29063
06540	Amatom Electronic Hardware Division of Mite Corporation 81 Rockdale Avenue New Rochelle, New York 10802
06978	Aladdin Electronics, Division of Aladdin Industries, Inc. 703 Murfreesboro Road Nashville, Tennessee 37210
07263	Fairchild Semiconductor A Division of Fairchild Camera and Instrument Corporation 464 Ellis Street Mountain View, California 94040

Mfr. Code	Name and Address
07387	The Birtcher Corporation 4371 Valley Boulevard Los Angeles, California 90032
12498	Teledyne Crystalonics 147 Sherman Street Cambridge, Massachusetts 02140
13103	Thermalloy Company 8717 Diplomacy Row Dallas, Texas 75247
14193	CAL & R Inc. 1601 Olympic Boulevard Santa Monica, California 90404
14482	Watkins-Johnson Company 3333 Hillview Avenue Palo Alto, California 94304
14632	Watkins-Johnson Co., CEI Division 6006 Executive Boulevard Rockville, Maryland 20852
14949	Trompeter Electronics, Inc. 8936 Comanche Avenue Chatsworth, California 91311
15818	Teledyne Semiconductor 1300 Terra Bella Avenue Mountain View, California 94040
18324	Signetics Corporation 811 East Argues Avenue Sunnyvale, California 94086
21604	The Buckeye Stamping Company 555 Marion Road Columbus, Ohio 43207
25088	Siemens America, Inc. 350 5th Avenue New York, New York 10001
27193	Cutler-Hammer, Inc. Special Products Division 4201 North 27th Street Milwaukee, Wisconsin 53216

Mfr. Code	Name and Address
28480	Hewlett Packard Company 1501 Page Mill Road Palo Alto, California 94304
44655	Ohmite Manufacturing Company 3601 West Howard Street Skokie, Illinois 60076
49956	Raytheon Company 141 Spring Street Lexington, Massachusetts 02173
56289	Sprague Electric Company Marshall Street North Adams, Masschusetts 01247
70417	Chrysler Corporation Amplex Division 6501 Harper Avenue Detroit, Michigan 48211
70674	A.D.C. Products, Division of Magnetics Controls Company 4900 West 78th Street Minneapolis, Minnesota 55435
71279	Cambridge Thermionic Corporation 445 Concord Avenue Cambridge, Massachusetts 02138
71400	Bussman Manufacturing Division of McGraw-Edison Company 2536 West University Street St. Louis, Missouri 63107
71590	Globe-Union Inc. Centralab Division Milwaukee, Wisconsin
71785	Cinch Manufacturing Company Howard B. Jones Division 1026 South Homan Avenue Chicago, Illinois 60624
71787	Curtis Marine Company Norfolk, Virginia
72136	Electro Motive Manufacturing Co., Inc. South Part & John Streets Willimantic, Connecticut 06226

Mfr. Code	Name and Address
72982	Erie Technological Products, Inc. 644 West 12th Street Erie, Pennsylvania 16512
73138	Beckman Instruments, Inc. Helipot Division 2500 Harbor Boulevard Fullerton, California 92634
73899	JFD Electronics Company Division of Stratford Retreat House 15th at 62nd Street Brooklyn, New York 11219
74306	Piezo Crystal Company 100 K Street Carlisle, Pennsylvania 17013
74868	Bunker-Ramo Corporation The Amphenol RF Division 33 East Franklin Street Danbury, Connecticut 06810
75042	IRC Division of TRW Incorporated 401 North Broad Street Philadelphia, Pennsylvania 19108
75915	Littelfuse, Incorporated 800 East Northwest Highway Des Plaines, Illinois 60016
76854	Oak Manufacturing Company Division of Oak Electro/Netics Corporation South Main Street Crystal Lake, Illinois 60014
78189	Illinois Tool Works, Inc. Shakeproof Division St. Charles Road Elgin, Illinois 60126
79136	Waldes Kohinoor Inc. 47-16 Austel Place Long Island City, New York 11101
80058	Joint Electronic Type Designation System
80131	Electronic Industries Association 2001 Eye Street, N.W. Washington, D.C. 20006
80223	Unit Transformer Company 150 Varick Street New York, New York 10013
81312	Winchester Electronics Division Litton Industries, Incorporated Main Street & Hillside Avenue Oakville, Connecticut 06779
81349	Military Specifications
82094	Globe Rubber Works 11 Newbury North Quincy, Massachusetts 02171
82389	Switchcraft, Incorporated 5555 North Elston Avenue Chicago, Illinois 60630
83086	New Hampshire Ball Bearings, Inc. Peterborough, New Hampshire 03458
87034	Marco-Oak Industries, Div. of Oak Electro/Netics Corporation 207 South Helena Street Anaheim, California 92803
91293	Johanson Manufacturing Company P.O. Box 329 Boonton, New Jersey 07005
91418	Radio Materials Company 4242 West Bryn Mawr Avenue Chicago, Illinois 60646
91506	Augat, Incorporated 33 Perry Avenue Attleboro, Massachusetts 02703
93332	Sylvania Electric Products, Inc. Semiconductor Products 100 Sylvan Road Woburn, Massachusetts 01801
93958	Republic Electronics Corporation 176 East 7th Street Paterson, New Jersey 07524

Mfr. Code	Name and Address
94144	Raytheon Company Components Division Industrial Components Operation Quincy, Massachusetts
95121	Quality Components, Inc. P. O. Box 113 St. Mary's, Pennsylvania 15857
96906	Military Standards
98291	Sealectro Corporation 225 Hoyt Mamaroneck, New York 10544
99800	American Precision Industries Delevan Electronics Division 270 Quaker Road East Aurora, New York 14052

5.4 PARTS LIST

The parts list which follows contains all electrical parts used in the equipment and certain mechanical parts which are subject to unusual wear or damage. When ordering replacement parts from the Watkins-Johnson Co., specify the type and serial number of the equipment and the reference designation and description of each part ordered. The list of manufacturers provided in paragraph 5.3 and the manufacturer's part numbers for components are included as a guide to the user of the equipment in the field. These parts may not necessarily agree with the parts installed in the equipment, however the parts specified in this list will provide satisfactory operation of the equipment. Replacement parts may be obtained from any manufacturer as long as the physical and electrical parameters of the part selected agree with the original indicated part. In the case of components defined by a military or industrial specification, a vendor which can provide the necessary component is suggested as a convenience to the user.

NOTE

As improved semiconductors become available it is the policy of CEI Division to incorporate them in proprietary products. For this reason some transistors, diodes, and integrated circuits installed in the equipment may not agree with those specified in the parts lists and schematic diagrams of this manual. However, the semiconductors designated in the manual may be substituted in every case with satisfactory results.

5.4.1 340A Receiver, Main Chassis

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	HIGH FREQUENCY COUNTER ASSEMBLY	1	79832-1	14632	
A2	+5V, -5V POWER SUPPLY	1	76211	14632	
A3	-18V REGULATED POWER SUPPLY	1	76160	14632	
A4	+18V REGULATED POWER SUPPLY	1	76181	14632	
A5	±10V PRECISION POWER SUPPLY	1	76195	14632	
A6	BANDWIDTH CONTROL	1	79952	14632	
A7	IF DRIVER AMPLIFIER	1	72370	14632	
A8	IF AMPLIFIER (50 kHz)	1	72407	14632	
A9	IF AMPLIFIER (20 kHz)	1	72408	14632	
A10	IF AMPLIFIER (6 kHz)	1	72406-2	14632	
A11	IF AMPLIFIER (1 kHz)	1	72406-1	14632	
A12	2ND CONVERTER	1	7766	14632	
A13	IF AMPLIFIER (455 kHz)	1	72362	14632	
A14	LOW-PASS FILTER	1	79869	14632	
A15	VARIABLE FREQUENCY OSCILLATOR	1	7768	14632	
A16	INPUT CONVERTER	1	71372	14632	
A17	VFO CONTROL	1	79969	14632	
A18	GAIN CONTROL	1	79983	14632	
A19	IF BUFFER	1	72360	14632	
A20	CW DEMODULATOR	1	79953	14632	
A21	FM DEMODULATOR	1	79933	14632	
A22	AM DEMODULATOR	1	72308	14632	
A23	AUDIO AMPLIFIER	1	7448	14632	
A24	INPUT TRANSFORMER, HIGH PASS FILTER ASSEMBLY	1	79966	14632	
C1	CAPACITOR, ELECTROLYTIC, ALUMINUM: 770 μF, -10 +150%, 50V	1	43F3006CA4	06001	
C2	CAPACITOR, ELECTROLYTIC, ALUMINUM: 2500 μF, -10 +150%, 15V	1	43F3003CA4	06001	
C3	CAPACITOR, ELECTROLYTIC, ALUMINUM: 200 μF, -10 +75%, 25V	1	39D207G025EJ4	56289	
C4	NOT USED				
C5	CAPACITOR, ELECTROLYTIC, TANTALUM: 4.7 μF, 10%, 35V	1	CS13BF475K	81349	56289
C6	CAPACITOR, ELECTROLYTIC, TANTALUM: 6.8 μF, 10%, 35V	4	CS13BF685K	81349	56289
C7	Same as C6				
C8	Same as C6				
C9	Same as C6				

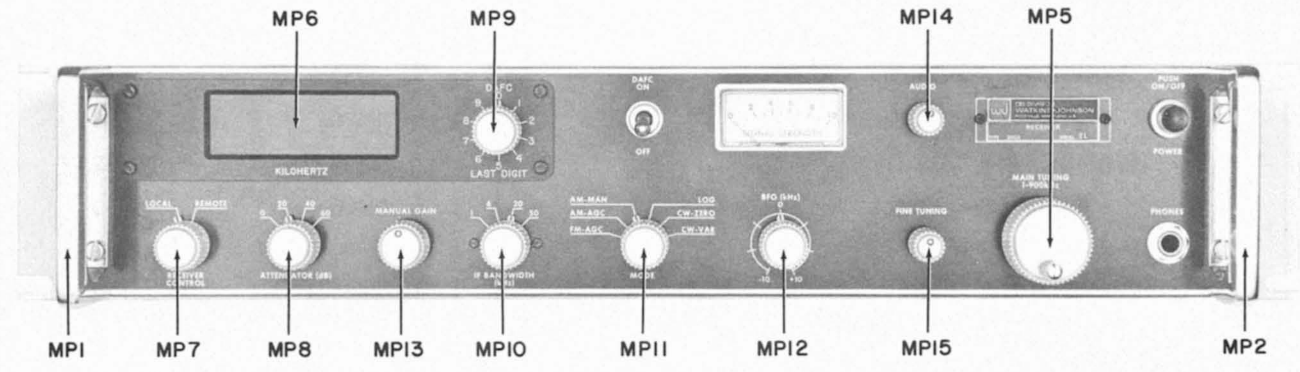


Figure 5-1. Type 340A VLF Receiver, Front View, Component Locations

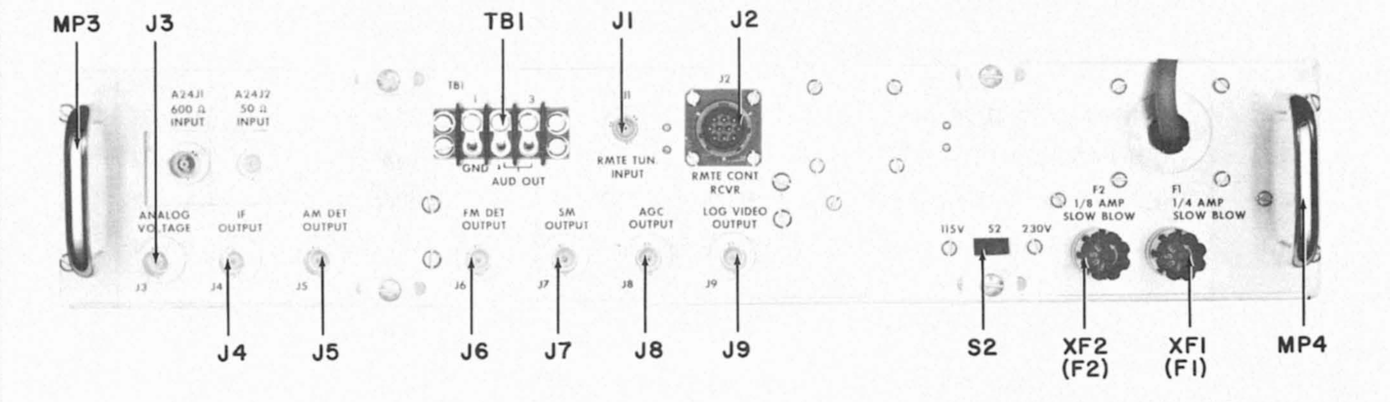


Figure 5-2. Type 340A VLF Receiver, Rear View, Component Locations

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C10	CAPACITOR, ELECTROLYTIC, TANTALUM: 15 μF, 10%, 20V	2	CS13BE156K	81349	56289
C11	Same as C10				
C12	CAPACITOR, ELECTROLYTIC, TANTALUM: 1.0 μF, 10%, 20V	1	CS13BF105K	81349	56289
C13	CAPACITOR, ELECTROLYTIC, ALUMINUM: 200 μF, -10+75%, 25V	1	39D207G025EJ4	56289	
CR1	DIODE	1	1N270	80131	93332
CR2	DIODE	2	1N462A	80131	93332
CR3	Same as CR2				
DS1	LAMP, NEON Part of S1	-	A1H	87034	
E1	HEADER BOARD ASSEMBLY	2	22625-1	14632	
E2	Same as E1				
F1	FUSE, CARTRIDGE, 1/4 AMP, 3 AG	1	MDL1/4	71400	
F2	FUSE, CARTRIDGE, 1/8 AMP, 3 AG	1	MDL1/8	71400	
FL1	FILTER	1	JN33-694B	56289	
J1	CONNECTOR, RECEPTACLE	1	BJ-77	14949	
J2	CONNECTOR, RECEPTACLE	1	MS3122E12-10P	96906	74868
J3	CONNECTOR, RECEPTACLE	7	17825-1002	74868	
J4	Same as J3				
J5	Same as J3				
J6	Same as J3				
J7	Same as J3				
J8	Same as J3				
J9	Same as J3				
J10	JACK, TELEPHONE	1	L11	82389	
J11	CONNECTOR, RECEPTACLE	1	M4SLRN	81312	
L1	COIL, FIXED	1	2500-28	99800	
M1	METER, SIGNAL STRENGTH	1	14524-1	14632	
MP1	HANDLE	2	32306-2	14632	
MP2	Same as MP1				
MP3	HANDLE	2	415-1250-02-00	71279	
MP4	Same as MP3				
MP5	CRANK ASSEMBLY	1	11755-5	14632	
MP6	FILTER GLASS	1	12584-17	14632	
MP7	KNOB	6	PS70PL1 (GREY)	21604	
MP8	Same as MP7				

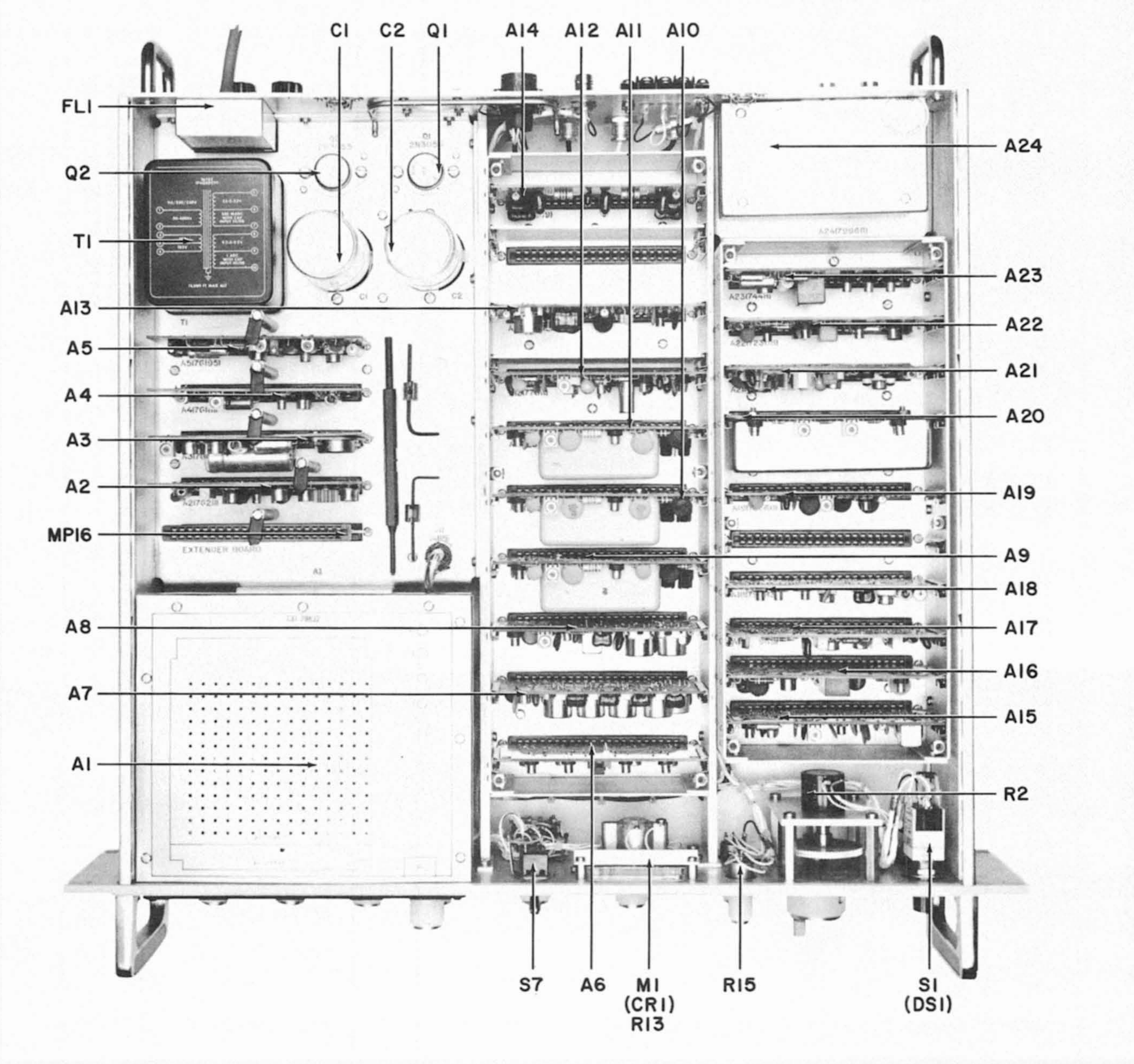


Figure 5-3. Type 340A VLF Receiver, Top View, Component Locations

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
MP9	Same as MP7				
MP10	Same as MP7				
MP11	Same as MP7				
MP12	Same as MP7				
MP13	KNOB	1	PS70D2 (GREY)	21604	
MP14	KNOB	2	PS50D1 (GREY)	21604	
MP15	Same as MP14				
MP16	EXTENDER CARD	1	79878	14632	
P1	CONNECTOR, PLUG	1	45775	74868	
P2	CONNECTOR, PLUG	2	44950	74868	
P3	Same as P2				
Q1	TRANSISTOR	2	2N3055	80131	04713
Q2	Same as Q1				
R1	RESISTOR, FIXED, COMPOSITION: 27 kΩ, 5%, 1/2W	1	RCR20G273JS	81349	01121
R2	RESISTOR, VARIABLE, WIRE WOUND: 10 kΩ, 3%, 2W	1	8106R10K-L.25	73138	
R3	RESISTOR, VARIABLE, COMPOSITION: 10 kΩ, 10%, 1/2W	2	RV6NAYSD103A	81349	44655
R4	RESISTOR, FIXED, COMPOSITION: 51 Ω, 5%, 1/4W	4	RCR07G510JS	81349	01121
R5	Same as R4				
R6	RESISTOR, FIXED, COMPOSITION: 62 Ω, 5%, 1/4W	2	RCR07G620JS	81349	01121
R7	RESISTOR, FIXED, COMPOSITION: 24 kΩ, 5%, 1/4W	1	RCR07G243JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 2.4 kΩ, 5%, 1/4W	1	RCR07G242JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 240 Ω, 5%, 1/4W	1	RCR07G241JS	81349	01121
R10	Same as R4				
R11	Same as R4				
R12	Same as R6				
R13	RESISTOR, FIXED, COMPOSITION: 47 kΩ, 5%, 1/4W	1	RCR07G473JS	81349	01121
R14	RESISTOR, VARIABLE, COMPOSITION: 1 kΩ, 10%, 2W	1	RV4NAYSD102A	81349	44655
R15	Same as R3				
R16	RESISTOR, FIXED, COMPOSITION: 39 kΩ, 5%, 1/4W	1	RCR07G393JS	81349	01121
R17	RESISTOR, VARIABLE, COMPOSITION: 10 kΩ, 10%, 2W	1	RV4NAYSD103A	81349	44655
R18	RESISTOR, FIXED, COMPOSITION: 10 Ω, 5%, 1/4W	1	RCR07G100JS	81349	01121
S1	SWITCH, PUSH	1	671-6A1H	87034	
S2	SWITCH, SLIDE	1	11A1211	82389	
S3	SWITCH, ROTARY	2	1128-43	14632	

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
S4	Same as S3				
S5	SWITCH, ROTARY	1	1128-03	14632	
S6	SWITCH, ROTARY	1	1128-45	14632	
S7	SWITCH, TOGGLE	1	8282K14	27193	
T1	TRANSFORMER, POWER	1	16703	14632	
TB1	TERMINAL BOARD	1	353-18-03-001	71785	
XA2	CONNECTOR, PRINTED CIRCUIT BOARD	22	250-22-30-170	71785	
XA3	Same as XA2				
XA4	Same as XA2				
XA5	Same as XA2				
XA6	Same as XA2				
XA7	Same as XA2				
XA8	Same as XA2				
XA9	Same as XA2				
XA10	Same as XA2				
XA11	Same as XA2				
XA12	Same as XA2				
XA13	Same as XA2				
XA14	Same as XA2				
XA15	Same as XA2				
XA16	Same as XA2				
XA17	Same as XA2				
XA18	Same as XA2				
XA19	Same as XA2				
XA20	Same as XA2				
XA21	Same as XA2				
XA22	Same as XA2				
XA23	Same as XA2				
XF1	FUSEHOLDER	2	342004	75915	
XF2	Same as XF1				
XQ1	SOCKET, TRANSISTOR	2	8038-1G1	91506	
XQ2	Same as XQ1				
ACCESSORY PARTS, NOT SHOWN ON SCHEMATIC, BUT FURNISHED WITH EQUIPMENT:					
	CONNECTOR, PLUG	2	PL76	14949	
	CONNECTOR, PLUG	1	MS3126F12-10S	96906	74868

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
REF	TUNING DRIVE ASSEMBLY	1	22783-1	14632	

For exploded view and parts list refer to Figure 5-32.

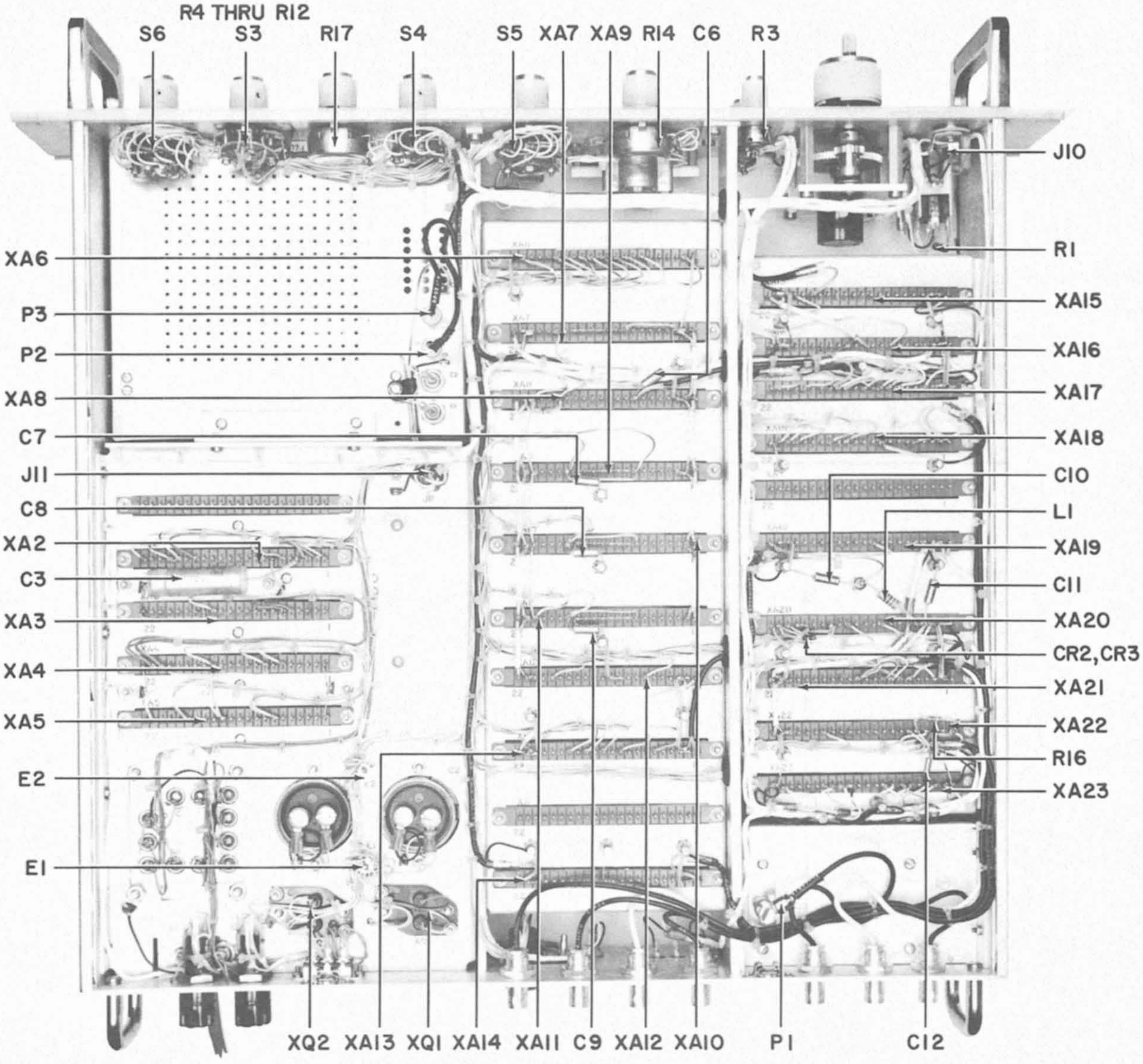


Figure 5-4. Type 340A VLF Receiver, Bottom View, Component Locations

5.4.2 Type 79832-1 High Frequency Counter Assembly REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	GATE GENERATOR	1	79893	14632	
A2	COUNT, DECODE AND DISPLAY	1	79944	14632	
C1	CAPACITOR, FIXED, PAPER: 0.01 μF, 20%, 600V	2	102P515	56289	
C2	Same as C1				
C3	CAPACITOR, CERAMIC, FEEDTHRU: 0.05 μF, GMV, 300V	1	MS001DA503P	01121	
C4 thru C23	NOT USED				
C24	CAPACITOR, CERAMIC, DISC: 0.33 μF, 20%, 50V	1	8131-M050-651-334M	72982	
J1	CONNECTOR, RECEPTACLE	2	46025	74868	
J2	Same as J1				
MP1	COVER	1	22934-1	14632	
P1	CONNECTOR, PLUG	1	M4PLSH10C	81312	
R1	RESISTOR, FIXED, COMPOSITION: 22 MΩ, 5%, 1/4W	1	RCR07G226JS	81349	01121
S1	SWITCH, ROTARY	1	263283BA2	76854	
XA1	CONNECTOR, PRINTED CIRCUIT BOARD	2	251-22-30-160	71787	
XA2	Same as XA1				

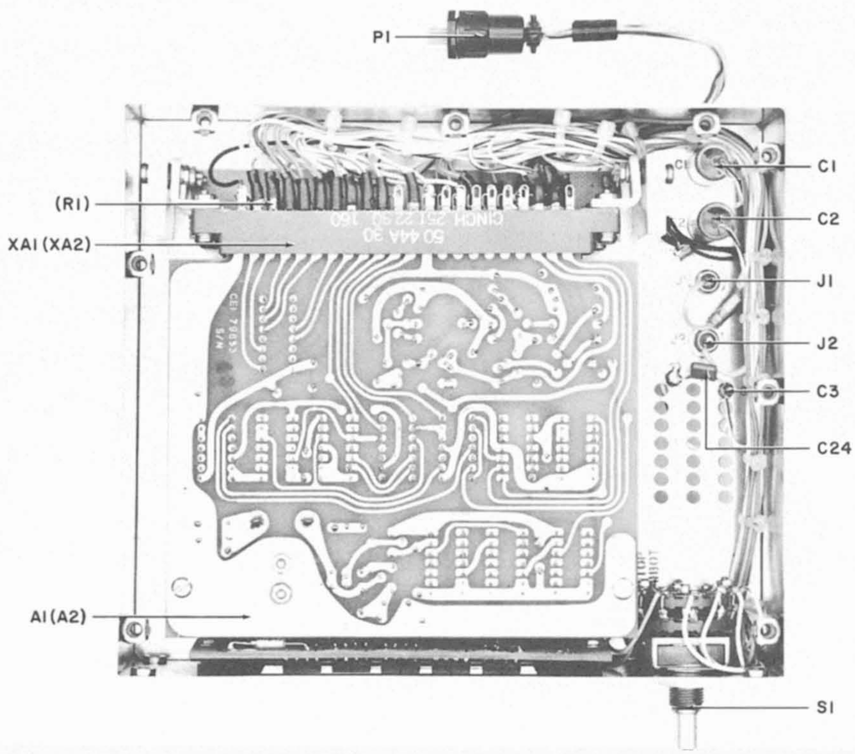


Figure 5-5. Type 79832-1 High Frequency Counter Assembly (A1), Component Locations

5.4.2.1 Type 79893 Gate Generator REF DESIG PREFIX A1A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, TUBULAR: 10 pF, ±0.5 pF, 500V	1	301-000C0H0-100D	72982	
C2	CAPACITOR, MICA, DIPPED: 15 pF, 5%, 500V	1	CM05CD150J03	81349	72136
C3	CAPACITOR, VARIABLE, AIR: 0.8-10 pF, 250V	1	2954	91293	
C4	CAPACITOR, MICA, DIPPED: 750 pF, 5%, 300V	2	DM15-751J	72136	
C5	Same as C4				
C6	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 200V	1	8131A200Z5U0-103M	72982	
C7	CAPACITOR, ELECTROLYTIC, TANTALUM: 10 μF, 10%, 20V	3	CS13BE106K	81349	56289
C8	CAPACITOR, CERAMIC, DISC: 5000 pF, 20%, 100V	1	C023B101E502M	56289	
C9	CAPACITOR, ELECTROLYTIC, TANTALUM: 4.7 μF, 10%, 35V	1	CS13BF475K	81349	56289
C10	Same as C7				
C11	Same as C7				
C12	CAPACITOR, CERAMIC, DISC, 0.1 μF, -20+80%, 25V	5	DFJ3	73899	
C13	Same as C12				
C14	Same as C12				
C15	NOT USED				
C16	Same as C12				
C17	Same as C12				
CR1	DIODE	2	1N462A	80131	93332
CR2	Same as CR1				
Q1	TRANSISTOR	2	2N929	80131	04713
Q2	TRANSISTOR	3	2N2222A	80131	04713
Q3	TRANSISTOR	2	2N3251	80131	04713
Q4	Same as Q3				
Q5	Same as Q1				
Q6	TRANSISTOR	1	3N139	80131	02735
Q7	Same as Q2				
Q8	Same as Q2				
R1	RESISTOR, FIXED, COMPOSITION: 100 kΩ, 5%, 1/4W	1	RCR07G104JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 150 kΩ, 5%, 1/4W	1	RCR07G154JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 1.0 kΩ, 5%, 1/4W	5	RCR07G102JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 3.0 kΩ, 5%, 1/4W	1	RCR07G302JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 51 kΩ, 5%, 1/4W	1	RCR07G513JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	1	RCR07G103JS	81349	01121
R7	Same as R3				

REF DESIG PREFIX A1A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R8	RESISTOR, FIXED, COMPOSITION: 5.6 kΩ, 5%, 1/4W	2	RCR07G562JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 4.7 kΩ, 5%, 1/4W	3	RCR07G472JS	81349	01121
R10	Same as R8				
R11	Same as R9				
R12	Same as R9				
R13	RESISTOR, FIXED, COMPOSITION: 22 Ω, 5%, 1/4W	1	RCR07G220JS	81349	01121
R14	RESISTOR, FIXED, COMPOSITION: 5.1 MΩ, 5%, 1/4W	1	RCR07G515JS	81349	01121
R15	RESISTOR, FIXED, COMPOSITION: 10 Ω, 5%, 1/4W	1	RCR07G100JS	81349	01121
R16	Same as R3				
R17	RESISTOR, VARIABLE, FILM: 500 Ω, 30%, 1/2W	1	62PR500	73138	
R18	Same as R3				
R19	Same as R3				
U1	INTEGRATED CIRCUIT	6	868292	14632	
U2	Same as U1				
U3	Same as U1				
U4	Same as U1				
U5	Same as U1				
U6	INTEGRATED CIRCUIT	2	86961	14632	
U7	Same as U6				
U8	INTEGRATED CIRCUIT	2	86143	14632	
U9	Same as U1				
U10	INTEGRATED CIRCUIT	1	867445	14632	
U11	Same as U8				
XY1	SOCKET, CRYSTAL	1	8000-AG2	91506	
Y1	CRYSTAL, QUARTZ	1	91804-11	14632	

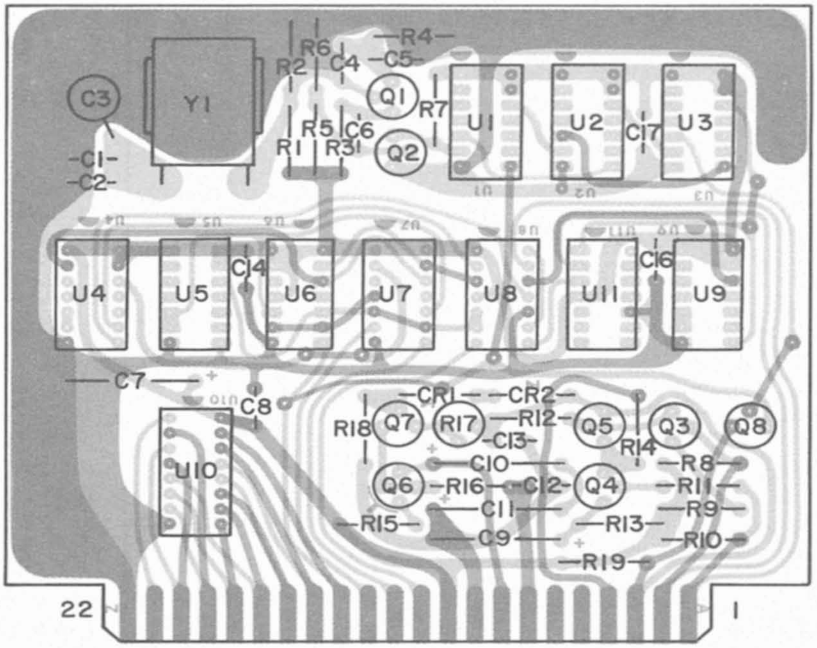


Figure 5-6. Type 79893 Gate Generator (A1A1), Component Locations

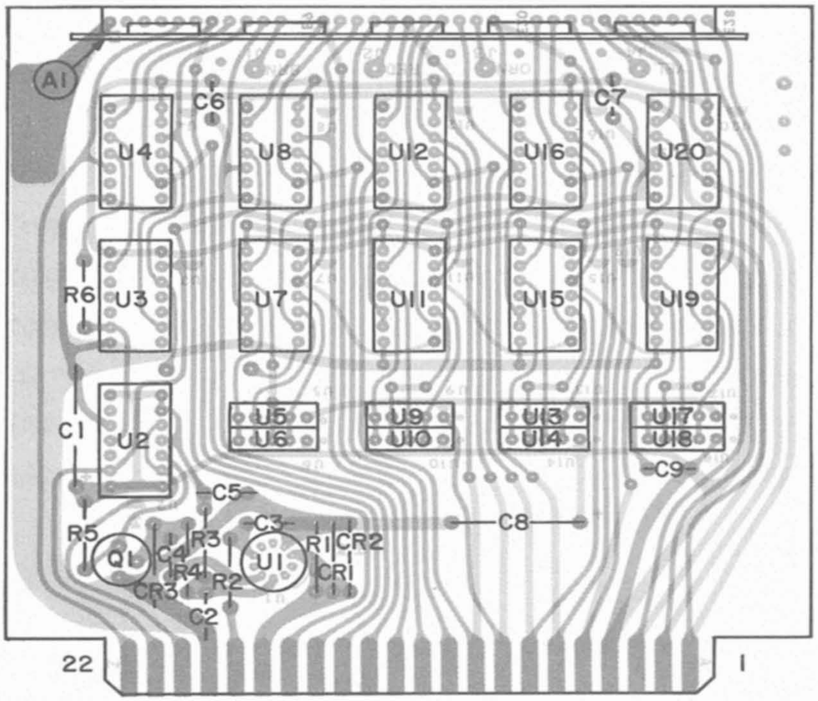


Figure 5-7. Type 79944 Count, Decode, and Display (A1A2), Component Locations

5.4.2.2 Type 79944 Count, Decode and Display REF DESIG PREFIX A1A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	SOLID STATE NUMERIC DISPLAY	1	16537	14632	
C1	CAPACITOR, ELECTROLYTIC, TANTALUM: 10 μF, 10%, 20V	2	CS13BE106K	81349	56289
C2	CAPACITOR, CERAMIC: 0.1 μF, -20 +80%, 25V	7	DFJ3	73899	
C3	Same as C2				
C4	Same as C2				
C5	Same as C2				
C6	Same as C2				
C7	Same as C2				
C8	Same as C1				
C9	Same as C2				
CR1	DIODE	3	5082-2900	28480	
CR2	Same as CR1				
CR3	Same as CR1				
J1	CONNECTOR, RECEPTACLE	4	60599-3	00779	
J2	Same as J1				
J3	Same as J1				
J4	Same as J1				
Q1	TRANSISTOR	1	2N709A	80131	02735
R1	RESISTOR, FIXED, COMPOSITION: 620 Ω, 5%, 1/4W	1	RCR07G621JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 47 Ω, 5%, 1/4W	2	RCR07G470JS	81349	01121
R3	Same as R2				
R4	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	1	RCR07G103JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 1.0 kΩ, 5%, 1/4W	1	RCR07G102JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 100 Ω, 5%, 1/4W	1	RCR07G101JS	81349	01121
R7	RESISTOR, FIXED, COMPOSITION: 200 Ω, 5%, 1/4W	1	RCR07G201JS	81349	01121
U1	INTEGRATED CIRCUIT	1	N5733K	18324	
U2	INTEGRATED CIRCUIT	1	RF3202DC	49956	
U3	INTEGRATED CIRCUIT	9	868292	14632	
U4	Same as U3				
U5*	PRESET MODULE	1	31689-10	14632	
U6	PRESET MODULE	4	31689-20	14632	
U7	INTEGRATED CIRCUIT	1	868280	14632	
U8	Same as J3				
U9*	PRESET MODULE	1	31689-10	14632	
U10	Same as U6				
U11	Same as U3				

* Choice is customer's option. Not always furnished.

REF DESIG PREFIX A1A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
U12	Same as U3				
U13*	PRESET MODULE	1	31689-10	14632	
U15	Same as U3				
U16	Same as U3				
U17*	PRESET MODULE	1	31689-18	14632	
U18	Same as U6				
U19	Same as U3				
U20	Same as U3				
XU1	SOCKET, INTEGRATED CIRCUIT	1	8058-1G91	91506	

* Choice is customer's option. Not always furnished.

5.4.2.2.1 Part 16537 Solid State Numeric Display REF DESIG PREFIX A1A2A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, ELECTROLYTIC, TANTALUM: 4.7 μF, 10%, 10V	1	CS13BC475K	81349	56289
C2	CAPACITOR, CERAMIC, DISC: 0.1 μF, -20 +80%, 25V	1	DFJ3	73899	
U1	INTEGRATED CIRCUIT	5	5082-7300	28480	
U2	Same as U1				
U3	Same as U1				
U4	Same as U1				
U5	Same as U1				

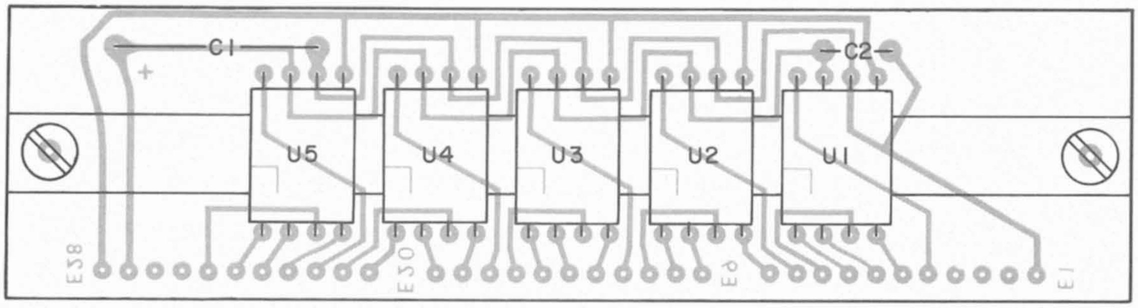


Figure 5-8. Part 16537 Solid State Numeric Display (A1A2A1), Component Locations

5.4.3 Type 76211 +5V and -5V Power Supply REF DESIG PREFIX A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 0.05 μF, +80 -20% 25V	2	DFJ1	73899	
C2	Same as C1				
CR1	DIODE	2	1N4998	80131	04713
CR2	Same as CR1				
CR3	DIODE	1	MDA950A3	04713	
CR4	DIODE	5	1N462A	80131	93332
CR5	Same as CR4				
CR6	Same as CR4				
CR7	Same as CR4				
CR8	Same as CR4				
CR9	DIODE	3	1N198A	80131	93332
CR10	Same as CR9				
CR11	Same as CR9				
Q1	TRANSISTOR	3	2N2270	80131	02735
Q2	Same as Q1				
Q3	TRANSISTOR	1	2N4037	80131	02735
Q4	TRANSISTOR	1	2N3251	80131	02735
Q5	TRANSISTOR	2	2N929	80131	02735
Q6	Same as Q5				
Q7	Same as Q1				
R1	RESISTOR, FIXED, COMPOSITION: 75 Ω, 5%, 1/4W	1	RCR07G750JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 6.2 kΩ, 5%, 1/4W	1	RCR07G622JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 620 Ω, 5%, 1/4W	1	RCR07G621JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 10kΩ, 5%, 1/4W	1	RCR07G103JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 10 Ω, 5%, 1/4W	1	RCR07G100JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 39 kΩ, 5%, 1/4W	1	RCR07G393JS	81349	01121
R7	RESISTOR, FIXED, COMPOSITION: 120 kΩ, 5%, 1/4W	1	RCR07G124JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 2 kΩ, 5%, 1/4W	2	RCR07G202JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 1 kΩ, 5%, 1/4W	1	RCR07G102JS	81349	01121
R10	RESISTOR, FIXED, WIRE WOUND: 0.33 Ω, 5%, 2W	1	BWH 0.33J	75042	
R11	Same as R8				
R12	RESISTOR, VARIABLE, WIRE WOUND: 500 Ω, 10%, 3/4W	1	89PR500	73138	
R13	RESISTOR, FIXED, COMPOSITION: 2.4 kΩ, 5%, 1/4W	1	RCR07G242JS	81349	01121
RA1	HEATSINK	2	3AL635-2R	07387	
RA2	Same as RA1				
TP1	JACK, TIP	1	TJ203R	94144	

REF DESIG PREFIX A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
VR1	DIODE	1	IN752A	80131	04713

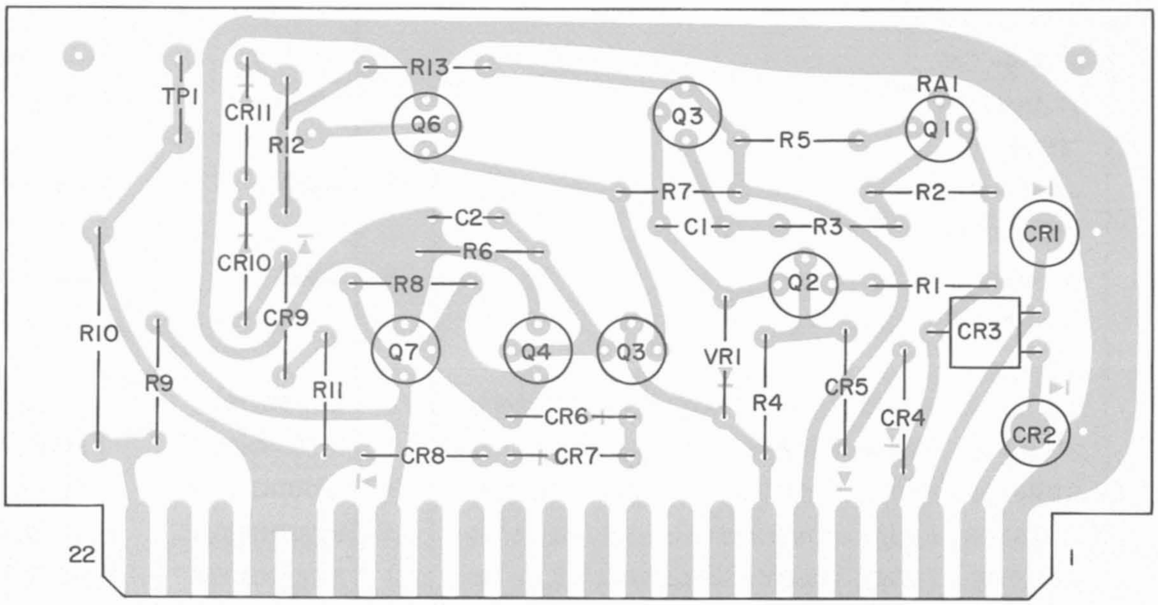


Figure 5-9. Type 76211 +5V and -5V Power Supply (A2), Component Locations

5.4.4 Type 76160 -18V Regulated Power Supply REF DESIG PREFIX A3

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, ELECTROLYTIC, ALUMINUM: 200 μF, -10 + 75%, 50V	1	39D207G050FJ4	56289	
C2	CAPACITOR, ELECTROLYTIC, ALUMINUM: 10 μF, -10 + 75%, 50V	1	30D106G050CB2	56289	
C3	CAPACITOR, ELECTROLYTIC, ALUMINUM: 10 μF, -10 + 75%, 25V	1	30D106G025BB2	56289	
C4	CAPACITOR, MICA, DIPPED: 200 pF, 5%, 500V	1	CM05FD201J03	81349	72136
C5	CAPACITOR, ELECTROLYTIC, TANTALUM: 47 μF, 10%, 20V	1	CS13BE476K	81349	56289
CR1	DIODE	1	MDA950A3	04713	
CR2	DIODE	1	1N754A	80131	04713
CR3	DIODE	1	1N462A	80131	93332
Q1	TRANSISTOR	1	2N3055	80131	04713
Q2	TRANSISTOR	3	2N4037	80131	02735
Q3	Same as Q2				
Q4	Same as Q2				
R1	RESISTOR, FIXED, COMPOSITION: 470 Ω, 5%, 1/4W	1	RCR07G471JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 6.8 kΩ, 5%, 1/4W	2	RCR07G682JS	81349	01121
R3	Same as R2				
R4	RESISTOR, FIXED, COMPOSITION: 150 kΩ, 5%, 1/4W	1	RCR07G154JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 5.6 kΩ, 5%, 1/4W	1	RCR07G562JS	81349	01121
R6	RESISTOR, VARIABLE, FILM: 1 kΩ, 30%, 1/2W	1	62PAR1K	73138	
R7	RESISTOR, FIXED, COMPOSITION: 3.9 kΩ, 5%, 1/4W	1	RCR07G392JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 2.2 kΩ, 5%, 1/4W	2	RCR07G222JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 220 Ω, 5%, 1/4W	1	RCR07G221JS	81349	01121
R10	Same as R8				

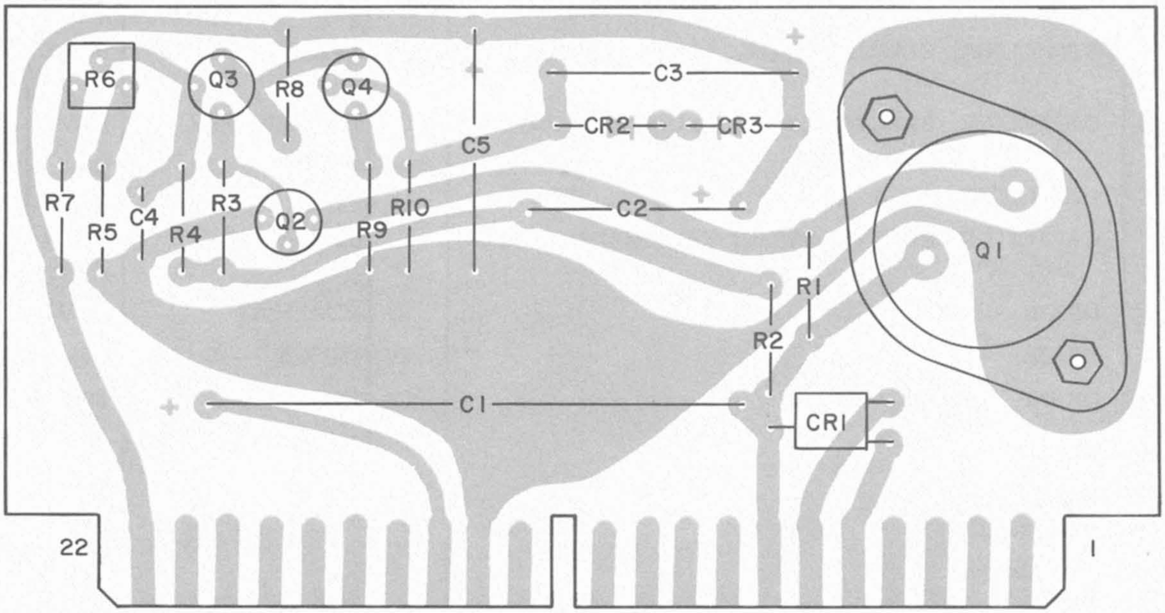


Figure 5-10. Type 76160 -18V Regulated Power Supply (A3), Component Locations

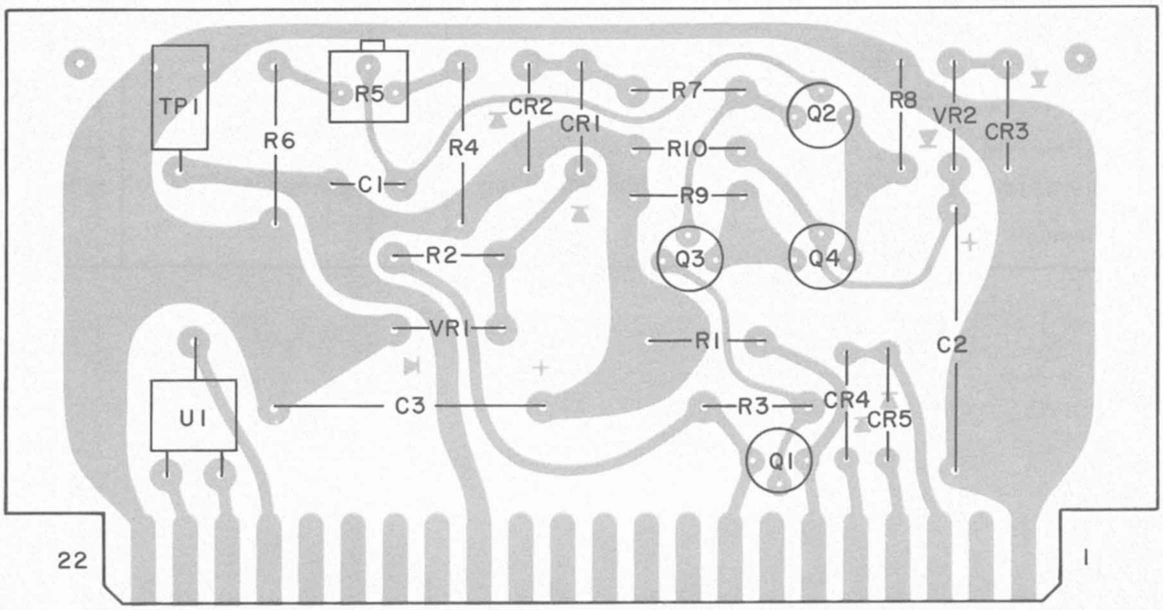


Figure 5-11. Type 76181 +18V Regulated Power Supply (A4), Component Locations

5.4.5 Type 76181 +18V Regulated Power Supply REF DESIG PREFIX A4

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, MICA, DIPPED: 47 pF, 5%, 500V	1	CM05ED470J03	81349	72136
C2	CAPACITOR, ELECTROLYTIC, TANTALUM: 10 μF, 10%, 35V	1	CS13BF106K	81349	56289
C3	CAPACITOR, ELECTROLYTIC, TANTALUM: 47 μF, 10%, 35V	1	CS13BF476K	81349	56289
CR1	DIODE	3	1N462A	80131	93332
CR2	Same as CR1				
CR3	Same as CR1				
CR4	DIODE	2	1N4003	80131	04713
CR5	Same as CR4				
Q1	TRANSISTOR	1	2N4037	80131	02735
Q2	TRANSISTOR	3	2N929	80131	04713
Q3	Same as Q2				
Q4	Same as Q2				
R1	RESISTOR, FIXED, COMPOSITION: 300 Ω, 5%, 1/4W	1	RCR07G301JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 8.2 kΩ, 5%, 1/4W	1	RCR07G822JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	1	RCR07G103JS	81349	01121
R4	RESISTOR, FIXED, FILM: 5.11 kΩ, 1%, 1/4W	1	RN60D5111F	81349	75042
R5	RESISTOR, VARIABLE, FILM: 1 kΩ, 30%, 1/2W	1	62PAR1K	73138	
R6	RESISTOR, FIXED, FILM: 3.16 kΩ, 1%, 1/4W	1	RN60D3161F	81349	75042
R7	RESISTOR, FIXED, COMPOSITION: 4.7 kΩ, 5%, 1/4W	3	RCR07G472JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 3.3 kΩ, 5%, 1/4W	1	RCR07G332JS	81349	01121
R9	Same as R7				
R10	Same as R7				
TP1	JACK, TIP	1	SKT103PCRED	98291	
U1	DIODE	1	MDA940A3	04713	
VR1	DIODE	1	1N759A	80131	04713
VR2	DIODE	1	1N754A	80131	04713

5.4.6 Type 76195 ±10V Precision Power Supply REF DESIG PREFIX A5

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, ELECTROLYTIC, TANTALUM: 100 μF, 20%, 25V	3	109D107X0025F2	56289	
C2	CAPACITOR, ELECTROLYTIC, TANTALUM: 2.2 μF, 10%, 35V	2	CS13BF225K	81349	56289
C3	CAPACITOR, ELECTROLYTIC, TANTALUM: 22 μF, 20%, 25V	2	109D226X0025C2	56289	
C4	Same as C1				
C5	Same as C3				
C6	Same as C1				
C7	Same as C2				
C8	CAPACITOR, CERAMIC, DISC, 5000 pF, 20%, 100V	1	C023B101E502M	56289	
CR1	DIODE	1	1N4446	80131	93332
Q1	TRANSISTOR	1	JAN2N2907	81349	04713
Q2	TRANSISTOR	1	2N2222A	80131	02735
R1	RESISTOR, FIXED, COMPOSITION: 180 kΩ, 5%, 1/4W	1	RCR07G184JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 1.1 kΩ, 5%, 1/4W	1	RCR07G112JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 430 Ω, 5%, 1/4W	1	RCR07G431JS	81349	01121
R4	RESISTOR, FIXED, WIRE WOUND: 1.82 kΩ, 1%, 1/4W	1	A2537-1.82KF	14193	
R5	RESISTOR, VARIABLE, WIRE WOUND: 500 Ω, 10%, 1W	1	3005P1-501	82094	
R6	RESISTOR, FIXED, WIRE WOUND: 2.8 kΩ, 1%, 1/4W	1	A2537-2.8KF	14193	
R7	RESISTOR, FIXED, COMPOSITION: 100 Ω, 5%, 1/4W	2	RCR07G101JS	81349	01121
R8	RESISTOR, VARIABLE, WIRE WOUND: 200 Ω, 10%, 1W	1	3005P1-201	82094	
R9	RESISTOR, FIXED, WIRE WOUND: 4.54 kΩ, 1%, 1/4W	1	A2537-4.54KF	14193	
R10	RESISTOR, FIXED, COMPOSITION: 2.2 kΩ, 5%, 1/4W	1	RCR07G222JS	81349	01121
R11	RESISTOR, FIXED, COMPOSITION: 470 Ω, 5%, 1/4W	2	RCR07G471JS	81349	01121
R12	Same as R11				
R13	RESISTOR, FIXED, WIRE WOUND: 4.64 kΩ, 1%, 1/4W	1	A2537-4.64KF	14193	
R14	Same as R7				
TP1	JACK, TIP	2	SKT103PCRED	98291	
TP2	Same as TP1				
U1	INTEGRATED CIRCUIT	2	U5B7741393	07263	
U2	Same as U1				
VR1	DIODE	1	1N827	80131	04713
XU1	SOCKET, INTEGRATED CIRCUIT	2	8058-1G49	91506	
XU2	Same as XU1				

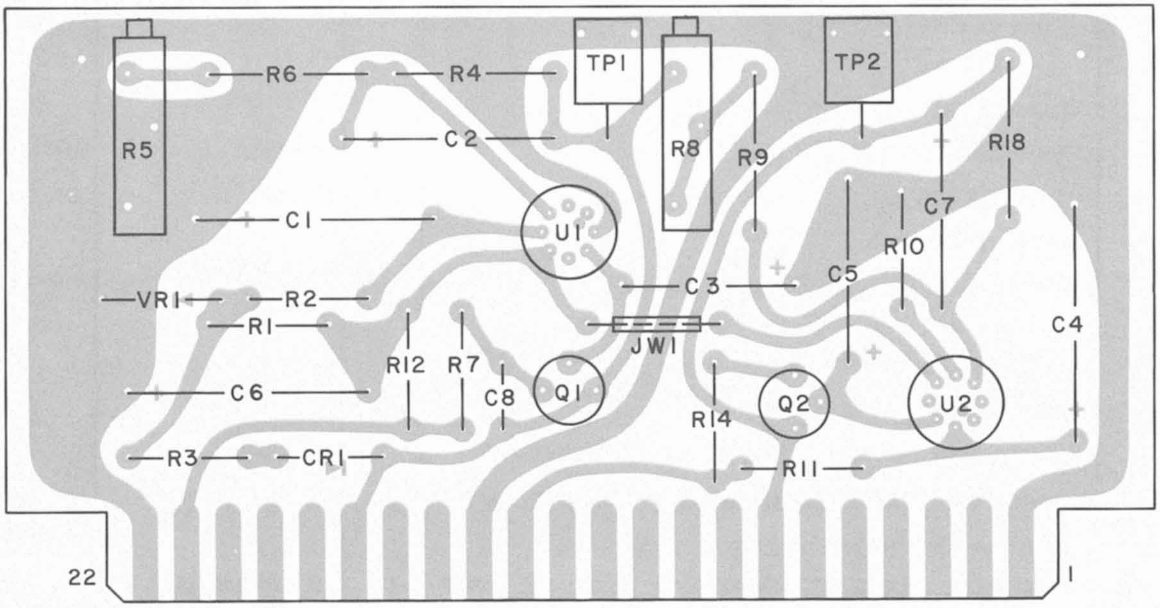


Figure 5-12. Type 76195 ±10V Precision Power Supply (A5), Component Locations

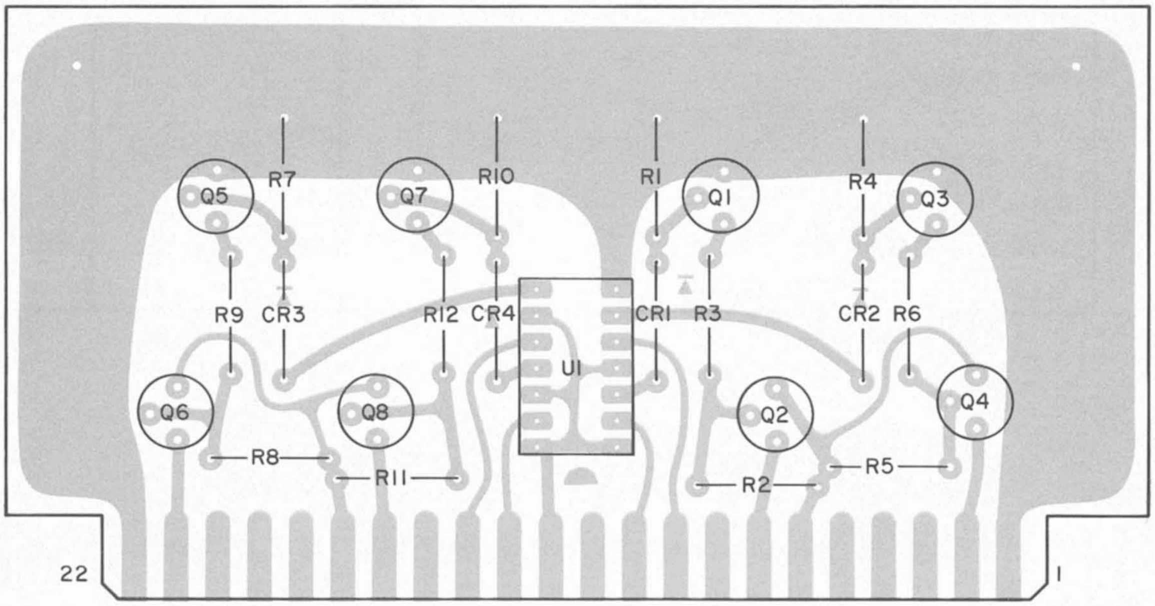


Figure 5-13. Type 79952 Bandwidth Control (A6), Component Locations

5.4.7 Type 79952 Bandwidth Control REF DESIG PREFIX A6

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
CR1	DIODE	4	1N462A	80131	93332
CR2	Same as CR1				
CR3	Same as CR1				
CR4	Same as CR1				
Q1	TRANSISTOR	4	2N2222A	80131	04713
Q2	TRANSISTOR	4	2N4037	80131	02735
Q3	Same as Q1				
Q4	Same as Q2				
Q5	Same as Q1				
Q6	Same as Q2				
Q7	Same as Q1				
Q8	Same as Q2				
R1	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	8	RCR07G103JS	81349	01121
R2	Same as R1				
R3	RESISTOR, FIXED, COMPOSITION: 15 kΩ, 5%, 1/4W	4	RCR07G153JS	81349	01121
R4	Same as R1				
R5	Same as R1				
R6	Same as R3				
R7	Same as R1				
R8	Same as R1				
R9	Same as R3				
R10	Same as R1				
R11	Same as R1				
R12	Same as R3				
U1	INTEGRATED CIRCUIT	1	86946	14632	
XU1	SOCKET, INTEGRATED CIRCUIT	1	314AG5DR	91506	

5.4.8 Type 72370 IF Driver Amplifier REF DESIG PREFIX A7

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 0.1 μF, -20+80%, 25V	2	DFJ3	73899	
C2	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 100V	1	C023B101F103M	56289	
C3	SAME AS C1				
C4	CAPACITOR, CERAMIC, DISC: 0.02 μF, 20%, 100V	1	C023B101H203M	56289	
C5	CAPACITOR, MICA, DIPPED: 1000 pF, 5%, 100V	3	DM15-102J	72136	
C6	CAPACITOR, MICA, DIPPED: 22 pF, 5%, 500V	2	CM05ED220J03	81349	72136
C7	SAME AS C5				
C8	CAPACITOR, MICA, DIPPED: 18 pF, 5%, 500V	2	CM05CD180J03	81349	72136
C9	CAPACITOR, MICA, DIPPED: 910 pF, 5%, 100V	1	DM15-911J	72136	
C10	CAPACITOR, MICA, DIPPED: 100 pF, 5%, 500V	1	CM05FD101J03	81349	72136
C11	SAME AS C8				
C12	SAME AS C5				
C13	SAME AS C6				
C14	CAPACITOR, MICA, DIPPED: 1200 pF, 5%, 500V	1	CM06FD122J03	81349	72136
C15	CAPACITOR, MICA, DIPPED: 8200 pF, 5%, 100V	1	DM19-822J	72136	
L1	COIL, FIXED: 100 μH, 5%	1	1537-76	99800	
L2	COIL, FIXED: 1000 μH, 5%	1	2500-28	99800	
L3	COIL, VARIABLE	5	30312-127	14632	
L4	SAME AS L3				
L5	SAME AS L3				
L6	SAME AS L3				
L7	SAME AS L3				
Q1	TRANSISTOR	1	CP640	12498	
Q2	TRANSISTOR	1	2N2222A	80131	04713
R1	RESISTOR, FIXED, COMPOSITION: 15 Ω, 5%, 1/4W	1	RCR07G150JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 22 Ω, 5%, 1/4W	1	RCR07G220JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 4.7 kΩ, 5%, 1/4W	1	RCR07G472JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 100 Ω, 5%, 1/2W	1	RCR20G101JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	1	RCR07G103JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 1.1 kΩ, 5%, 1/4W	1	RCR07G112JS	81349	01121
RA1	HEATSINK	1	3AL635-2R	07387	

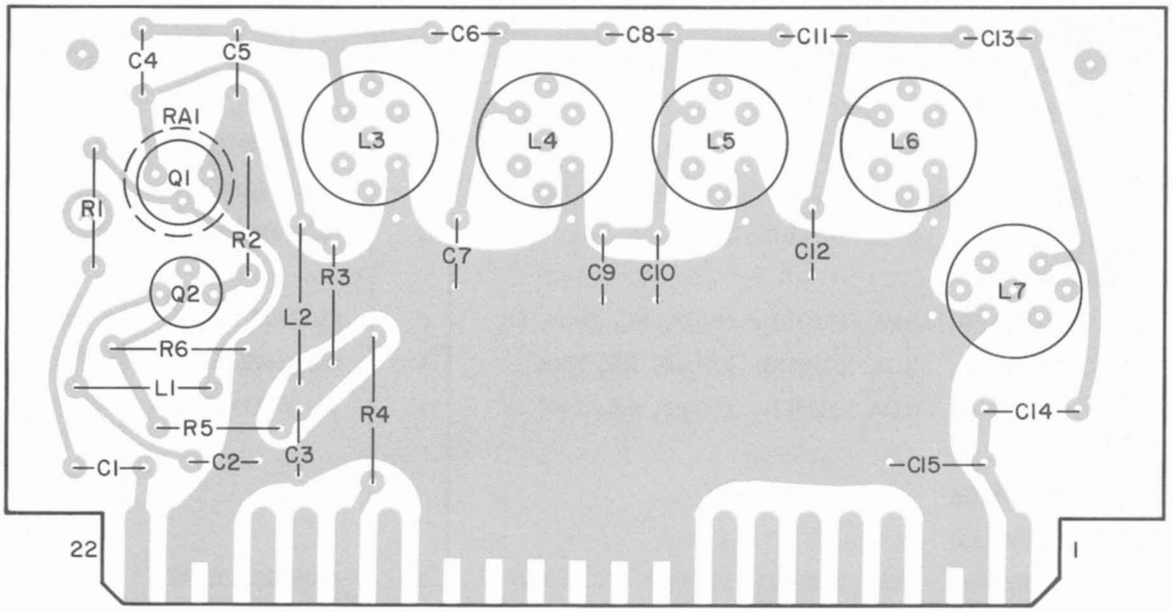


Figure 5-14. Type 72370 IF Driver Amplifier (A7), Component Locations

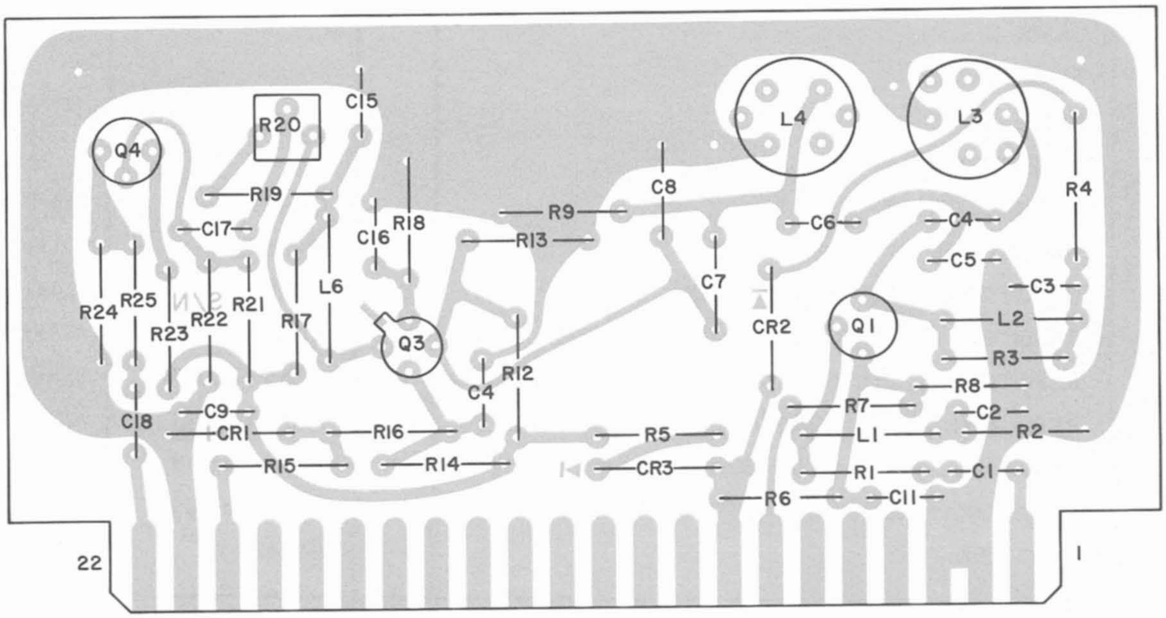


Figure 5-15. Type 72407 IF Amplifier (50 kHz) (A8), Component Locations

5.4.9 Type 72407 IF Amplifier (50 kHz)

REF DESIG PREFIX A8

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 0.1 μF, -20+80%, 25V	7	DFJ3	73899	
C2	Same as C1				
C3	Same as C1				
C4	CAPACITOR, CERAMIC, TUBULAR: 6.2 pF, ±0.5 pF, 500V	1	301-000C0H0-629D	72982	
C5	CAPACITOR, MICA, DIPPED: 1000 pF, 5%, 100V	1	DM15-102J	72136	
C6	CAPACITOR, MICA, DIPPED: 22 pF, 5%, 500V	1	CM05ED220J03	81349	72136
C7	CAPACITOR, MICA, DIPPED: 2000 pF, 5%, 500V	2	CM06FD202J03	81349	72136
C8	Same as C7				
C9	Same as C1				
C10	NOT USED				
C11	Same as C1				
C12	NOT USED				
C13	NOT USED				
C14	CAPACITOR, CERAMIC, DISC: 1000 pF, GMV, 500V	1	SM1000PFGMV	91418	
C15	Same as C1				
C16	Same as C1				
C17	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 100V	2	C023B101F103M	56289	
C18	Same as C17				
CR1	DIODE	3	1N462A	80131	93332
CR2	Same as CR1				
CR3	Same as CR1				
L1	COIL, FIXED: 100 μH, 5%	1	1537-76	99800	
L2	COIL, FIXED: 220 μH, 5%	2	1537-92	99800	
L3	COIL, VARIABLE	2	30312-127	14632	
L4	Same as L3				
L5	NOT USED				
L6	Same as L2				
Q1	TRANSISTOR	1	CP643	12498	
Q2	NOT USED				
Q3	TRANSISTOR	1	3N187	80131	02735
Q4	TRANSISTOR	1	2N2222A	80131	04713
R1	RESISTOR, FIXED, COMPOSITION: 2.7 Ω, 5%, 1/4W	1	RCR07G2R7JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 150 Ω, 5%, 1/4W	1	RCR07G151JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 2.7 kΩ, 5%, 1/4W	2	RCR07G272JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 82 Ω, 5%, 1/4W	1	RCR07G820JS	81349	01121

REF DESIG PREFIX A8

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R5	RESISTOR, FIXED, COMPOSITION: 47 Ω, 5%, 1/4W	1	RCR07G470JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 6.2 kΩ, 5%, 1/4W	2	RCR07G622JS	81349	01121
R7	RESISTOR, FIXED, COMPOSITION: 8.2 kΩ, 5%, 1/4W	1	RCR07G822JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	1	RCR07G103JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 15 kΩ, 5%, 1/4W	2	RCR07G153JS	81349	01121
R10	NOT USED				
R11	NOT USED				
R12	RESISTOR, FIXED, COMPOSITION: 150 kΩ, 5%, 1/4W	1	RCR07G154JS	81349	01121
R13	Same as R9				
R14	RESISTOR, FIXED, COMPOSITION: 30 kΩ, 5%, 1/4W	1	RCR07G303JS	81349	01121
R15	RESISTOR, FIXED, COMPOSITION: 1.0 kΩ, 5%, 1/4W	1	RCR07G102JS	81349	01121
R16	Same as R6				
R17	RESISTOR, FIXED, COMPOSITION: 330 Ω, 5%, 1/4W	2	RCR07G331JS	81349	01121
R18	Same as R17				
R19	RESISTOR, FIXED, COMPOSITION: 1.2 kΩ, 5%, 1/4W	1	RCR07G122JS	81349	01121
R20	RESISTOR, VARIABLE, FILM: 2 kΩ, 10%, 1/2W	1	62PAR 2K	73138	
R21	RESISTOR, FIXED, COMPOSITION: 22 kΩ, 5%, 1/4W	2	RCR07G223JS	81349	01121
R22	Same as R21				
R23	RESISTOR, FIXED, COMPOSITION: 100 Ω, 5%, 1/4W	2	RCR07G101JS	81349	01121
R24	Same as R3				
R25	Same as R23				
RA1	HEATSINK	1	2220B	13103	

5.4.10 Type 72408 IF Amplifier (20 kHz) REF DESIG PREFIX A9

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 0.1 μF, -20+80%, 25V	2	DFJ3	73899	
C2	Same as C1				
C3	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 200V	1	8131A200Z5U0-103M	72982	
C4	CAPACITOR, CERAMIC, DISC: 470 pF, 20%, 1000V	1	B470PFM	91418	
C5	CAPACITOR, CERAMIC, DISC: 0.02 μF, 20%, 100V	1	C023B101H203M	56289	
C6	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 100V	3	C023B101F103M	56289	
C7	Same as C6				
C8	Same as C6				
C9	CAPACITOR, CERAMIC, DISC: 0.1 μF, 20%, 100V	1	8131M100-651-104M	72982	
CR1	DIODE	3	1N462A	80131	93332
CR2	Same as CR1				
CR3	Same as CR1				
FL1	CRYSTAL FILTER	1	9700226	74306	
L1	COIL, FIXED: 100 μH, 5%	1	1537-76	99800	
L2	COIL, FIXED: 220 μH, 5%	1	1537-92	99800	
L3	COIL, FIXED: 220 μH, 10%	1	1025-76	99800	
Q1	TRANSISTOR	1	CP643	12498	
Q2	TRANSISTOR	1	3N187	80131	02735
Q3	TRANSISTOR	1	2N2222A	80131	04713
R1	RESISTOR, FIXED, COMPOSITION: 150 Ω, 5%, 1/4W	1	RCR07G151JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 2.7 Ω, 5%, 1/8W	1	RCR05G2R7JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 82 Ω, 5%, 1/4W	1	RCR07G820JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 1.5 kΩ, 5%, 1/8W	1	RCR05G152JS	81349	01121
R5	RESISTOR, VARIABLE, FILM: 1 kΩ, 10%, 1/2W	1	62PR1K	73138	
R6	RESISTOR, FIXED, COMPOSITION: 820 Ω, 5%, 1/8W	1	RCR05G821JS	81349	01121
R7	RESISTOR, FIXED, COMPOSITION: 12 kΩ, 5%, 1/8W	1	RCR05G123JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 1.2 kΩ, 5%, 1/8W	1	RCR05G122JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 100 kΩ, 5%, 1/8W	1	RCR05G104JS	81349	01121
R10	RESISTOR, FIXED, COMPOSITION: 4.7 kΩ, 5%, 1/8W	1	RCR05G472JS	81349	01121
R11	RESISTOR, FIXED, COMPOSITION: 16 kΩ, 5%, 1/8W	1	RCR05G163JS	81349	01121
R12	RESISTOR, FIXED, COMPOSITION: 330 Ω, 5%, 1/8W	1	RCR05G331JS	81349	01121
R13	RESISTOR, FIXED, COMPOSITION: 470 Ω, 5%, 1/8W	1	RCR05G471JS	81349	01121
R14	RESISTOR, FIXED, COMPOSITION: 24 kΩ, 5%, 1/8W	2	RCR05G243JS	81349	01121
R15	Same as R14				
R16	RESISTOR, FIXED, COMPOSITION: 2.7 kΩ, 5%, 1/8W	1	RCR05G272JS	81349	01121
R17	RESISTOR, FIXED, COMPOSITION: 8.2 kΩ, 5%, 1/8W	1	RCR05G822JS	81349	01121

REF DESIG PREFIX A9

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R18	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/8W	1	RCR05G103JS	81349	01121
R19	RESISTOR, FIXED, COMPOSITION: 6.2 kΩ, 5%, 1/8W	1	RCR05G622JS	81349	01121
RA1	HEATSINK	1	2220B	13103	

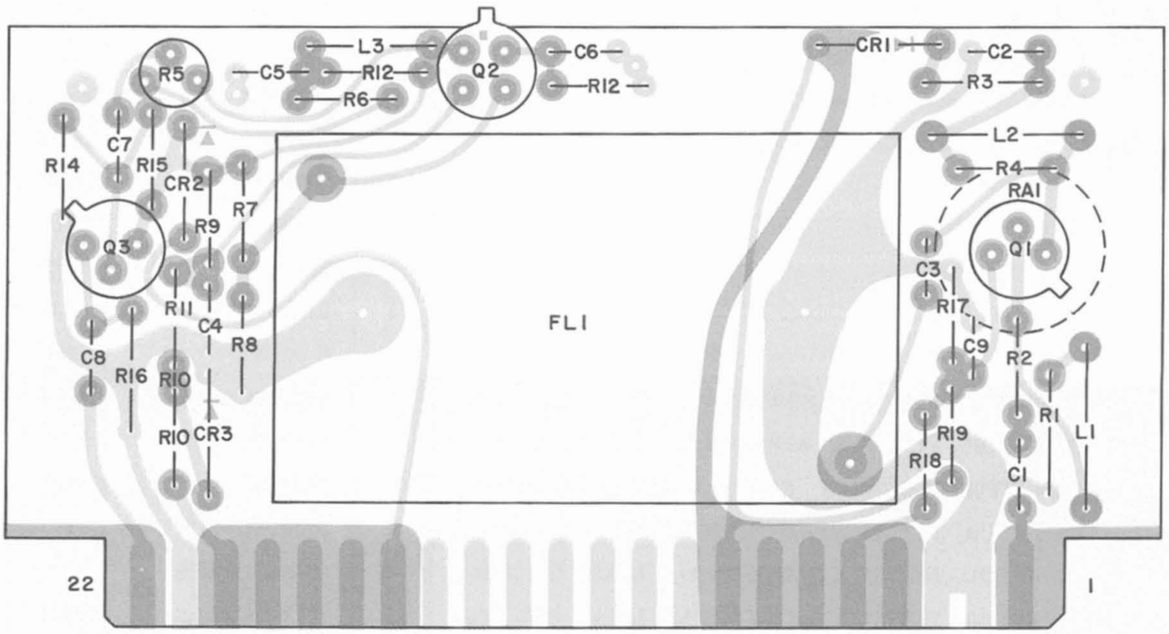


Figure 5-16. Type 72408 IF Amplifier (20-kHz) (A9), Component Locations

5.4.11 Type 72406-2 IF Amplifier (6 kHz) REF DESIG PREFIX A10

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 0.1 μF, -20+80%, 25V	2	DFJ3	73899	
C2	NOT USED				
C3	Same as C1				
C4	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 200V	1	8131A200Z5U0-103M	72982	
C5	NOT USED				
C6	NOT USED				
C7	CAPACITOR, CERAMIC, DISC: 470 pF, 20%, 500V	1	B470PFM	91418	
C8	CAPACITOR, CERAMIC, DISC: 0.02 μF, 20%, 100V	2	C023B101H203M	56289	
C9	Same as C8				
C10	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 100V	2	C023B101F103M	56289	
C11	Same as C10				
C12	CAPACITOR, CERAMIC, DISC: 0.1 μF, 20%, 100V	1	8131M100-651-104M	72982	
CR1	DIODE	3	1N462A	80131	
CR2	Same as CR1				
CR3	Same as CR1				
FL1	CRYSTAL FILTER	1	9710320	74306	
L1	COIL, FIXED: 100 μH, 5%	1	1537-76	99800	
L2	COIL, FIXED: 220 μH, 5%	1	1537-92	99800	
L3	COIL, FIXED: 220 μH, 10%	1	1025-76	99800	
Q1	TRANSISTOR	1	CP643	12498	
Q2	TRANSISTOR	1	3N187	80131	02735
Q3	TRANSISTOR	1	2N2222A	80131	04713
R1	RESISTOR, FIXED, COMPOSITION: 2.7 Ω, 5%, 1/8W	1	RCR05G2R7JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 150 Ω, 5%, 1/4W	1	RCR07G151JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 1.5 kΩ, 5%, 1/8W	1	RCR05G152JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 82 Ω, 5%, 1/4W	1	RCR07G829JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 6.2 kΩ, 5%, 1/8W	1	RCR05G622JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 12 kΩ, 5%, 1/8W	1	RCR05G123JS	81349	01121
R7	RESISTOR, FIXED, COMPOSITION: 1.2 kΩ, 5%, 1/8W	1	RCR05G122JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 100 kΩ, 5%, 1/8W	1	RCR05G104JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 4.7 kΩ, 5%, 1/8W	1	RCR05G472JS	81349	01121
R10	RESISTOR, FIXED, COMPOSITION: 22 kΩ, 5%, 1/8W	3	RCR05G223JS	81349	01121
R11	RESISTOR, FIXED, COMPOSITION: 330 Ω, 5%, 1/8W	2	RCR05G331JS	81349	01121
R12	Same as R11				
R13	RESISTOR, FIXED, COMPOSITION: 220 Ω, 5%, 1/8W	1	RCR05G221JS	81349	01121
R14	RESISTOR, VARIABLE, FILM: 500 Ω, 10%, 1/2W	1	62PAR500	73138	

REF DESIG PREFIX A10

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R15	Same as R10				
R16	Same as R10				
R17	RESISTOR, FIXED, COMPOSITION: 2.7 kΩ, 5%, 1/8W	1	RCR05G272JS	81349	01121
R18	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/8W	1	RCR05G103JS	81349	01121
R19	RESISTOR, FIXED, COMPOSITION: 8.2 kΩ, 5%, 1/8W	1	RCR05G822JS	81349	01121
RA1	HEATSINK	1	2220B	13103	

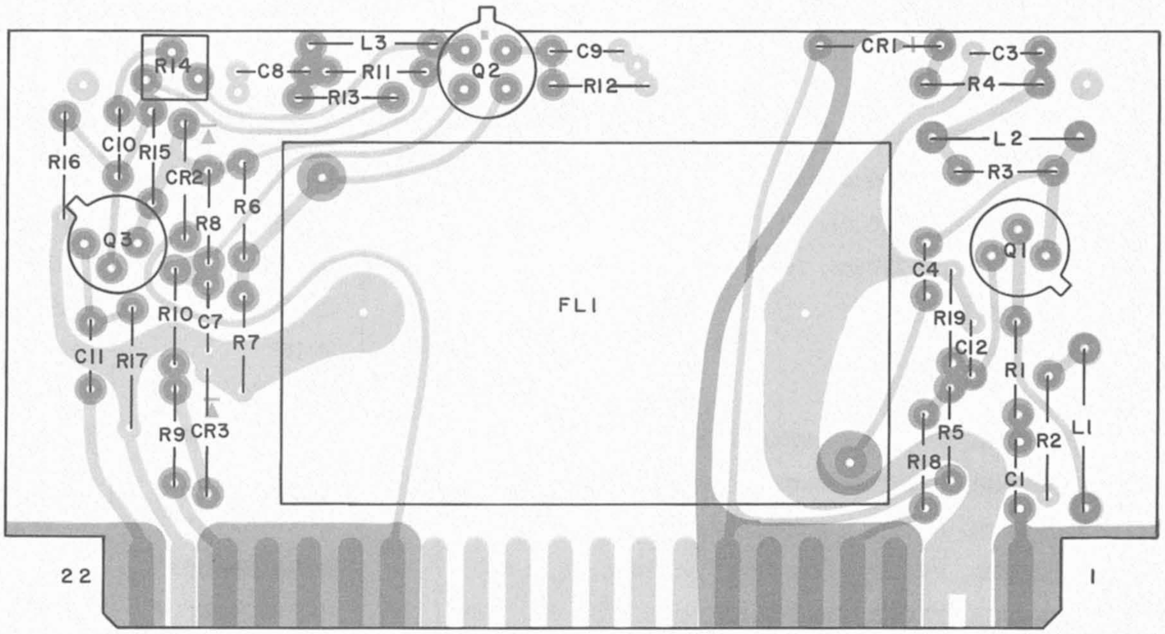


Figure 5-17. Type 72406 IF Amplifier (6 kHz, 1 kHz) (A10, A11), Component Locations

5.4.12 Type 72406-1 IF Amplifier (1 kHz) REF DESIG PREFIX A11

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 0.1 μF, -20+80%, 25V	2	DFJ3	73899	
C2	NOT USED				
C3	Same as C1				
C4	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 200V	1	8131A200Z5U0-103M	72982	
C5	NOT USED				
C6	NOT USED				
C7	CAPACITOR, CERAMIC, DISC: 470 pF, 20%, 500V	2	B470PFM	91418	
C8	CAPACITOR, CERAMIC, DISC: 0.02 μF, 20%, 100V	1	C023B101H203M	56289	
C9	Same as C7				
C10	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 100V	2	C023B101F103M	56289	
C11	Same as C10				
C12	CAPACITOR, CERAMIC, DISC: 0.1 μF, 20%, 100V	1	8131M100-651-104M	72982	
CR1	DIODE	3	1N462A	80131	93332
CR2	Same as CR1				
CR3	Same as CR1				
FL1	CRYSTAL, FILTER	1	9710319	74306	
L1	COIL, FIXED: 100 μH, 5%	1	1537-76	99800	
L2	COIL, FIXED: 220 μH, 5%	1	1537-92	99800	
L3	COIL, FIXED: 220 μH, 10%	1	1025-76	99800	
Q1	TRANSISTOR	1	CP643	12498	
Q2	TRANSISTOR	1	3N187	80131	02735
Q3	TRANSISTOR	1	2N2222A	80131	04713
R1	RESISTOR, FIXED, COMPOSITION: 2.7 Ω, 5%, 1/8W	1	RCR05G2R7JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 150 Ω, 5%, 1/4W	1	RCR07G151JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 1.5 kΩ, 5%, 1/8W	1	RCR05G152JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 82 Ω, 5%, 1/4W	1	RCR07G820JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 6.2 kΩ, 5%, 1/8W	1	RCR05G622JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 12 kΩ, 5%, 1/8W	1	RCR05G123JS	81349	01121
R7	RESISTOR, FIXED, COMPOSITION: 1.2 kΩ, 5%, 1/8W	1	RCR05G122JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 100 kΩ, 5%, 1/8W	1	RCR05G104JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 4.7 kΩ, 5%, 1/8W	1	RCR05G472JS	81349	01121
R10	RESISTOR, FIXED, COMPOSITION: 22 kΩ, 5%, 1/8W	3	RCR05G223JS	81349	01121
R11	RESISTOR, FIXED, COMPOSITION: 330 Ω, 5%, 1/8W	2	RCR05G331JS	81349	01121
R12	Same as R11				
R13	RESISTOR, FIXED, COMPOSITION: 220 Ω, 5%, 1/8W	1	RCR05G221JS	81349	01121
R14	RESISTOR, VARIABLE, FILM: 500 Ω, 10%, 1/2W	1	62PAR500	73138	

REF DESIG PREFIX A11

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R15	Same as R10				
R16	Same as R10				
R17	RESISTOR, FIXED, COMPOSITION: 2.7 kΩ, 5%, 1/8W	1	RCR05G272JS	81349	01121
R18	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/8W	1	RCR05G103JS	81349	01121
R19	RESISTOR, FIXED, COMPOSITION: 8.2 kΩ, 5%, 1/8W	1	RCR05G822JS	81349	01121
RA1	HEATSINK	1	2220B	13103	

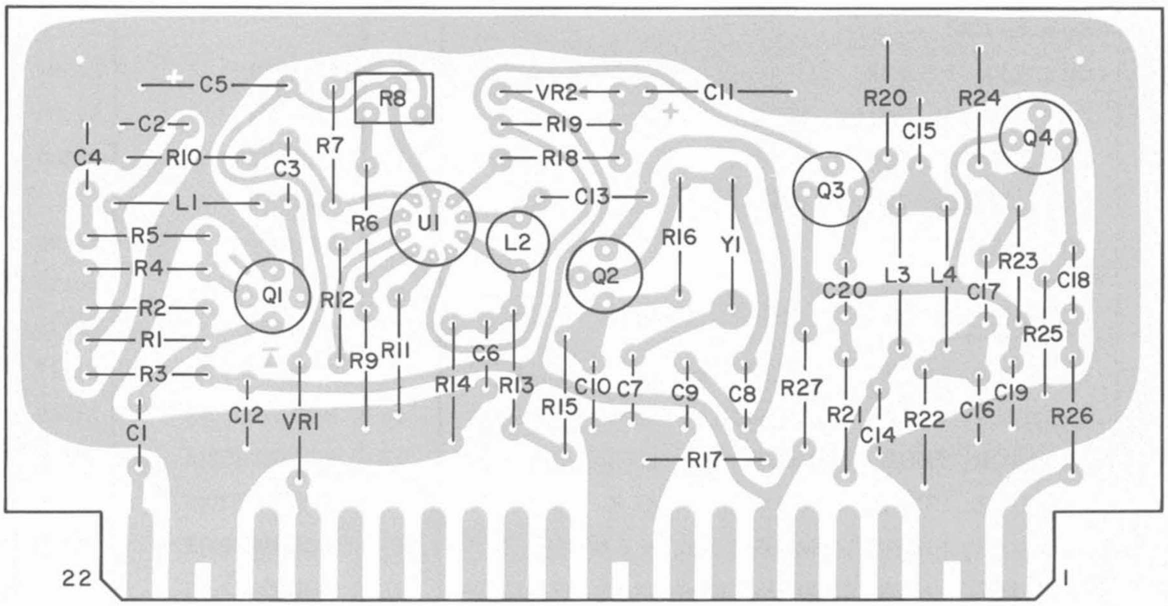


Figure 5-18. Type 7766 2nd Converter (A12), Component Locations

5.4.13 Type 7766 2nd Converter REF DESIG PREFIX A12

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 100V	5	C023B101F103M	56289	
C2	Same as C1				
C3	Same as C1				
C4	CAPACITOR, CERAMIC, DISC: 0.1 μF, -20+80%, 25V	2	DFJ3	73899	
C5	CAPACITOR, ELECTROLYTIC, TANTALUM: 1.0 μF, 10%, 20V	2	CS13BF105K	81349	56289
C6	CAPACITOR, CERAMIC, DISC: 0.02 μF, 20%, 100V	2	C023B101H203M	56289	
C7	CAPACITOR, MICA, DIPPED: 39 pF, 5%, 500V	1	CM05ED390J03	81349	72136
C8	CAPACITOR, MICA, DIPPED: 220 pF, 5%, 500V	2	CM05FD221J03	81349	72136
C9	Same as C8				
C10	Same as C6				
C11	Same as C5				
C12	Same as C4				
C13	CAPACITOR, COMPOSITION, TUBULAR: 0.47 pF, 10% 500V	1	QC0.47PFK	95121	
C14	CAPACITOR, MICA, DIPPED: 430 pF, 5%, 500V	2	DM15-431J	72136	
C15	CAPACITOR, MICA, DIPPED: 750 pF, 5%, 300V	1	DM15-751J	72136	
C16	Same as C14				
C17	Same as C1				
C18	Same as C1				
C19	CAPACITOR, CERAMIC, DISC: 0.05 μF, -20+80%, 25V	2	DFJ1	73899	
C20	Same as C19				
L1	COIL, FIXED: 220 μH, 5%	1	1537-92	99800	
L2	COIL, FIXED, MOLD: 1.2 mH, 10%	1	3635-2	71279	
L3	COIL, FIXED: 160 μH, 5%	2	1537-87	99800	
L4	Same as L3				
Q1	TRANSISTOR	1	2N3478	80131	02735
Q2	TRANSISTOR	3	2N2222A	80131	04713
Q3	Same as Q2				
Q4	Same as Q2				
R1	RESISTOR, FIXED, COMPOSITION: 20 kΩ, 5%, 1/4W	1	RCR07G203JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 4.7 kΩ, 5%, 1/4W	2	RCR07G472JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 330 Ω, 5%, 1/4W	1	RCR07G331JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 1.0 kΩ, 5%, 1/4W	4	RCR07G102JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 27 Ω, 5%, 1/4W	1	RCR07G270JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 47 kΩ, 5%, 1/4W	2	RCR07G473JS	81349	01121
R7	Same as R6				

REF DESIG PREFIX A12

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R8	RESISTOR, VARIABLE, FILM: 10 kΩ, 30%, 1/2W	1	62PAR10K	73138	
R9	Same as R4				
R10	Same as R4				
R11	RESISTOR, FIXED, COMPOSITION: 6.8 kΩ, 5%, 1/4W	2	RCR07G682JS	81349	01121
R12	Same as R4				
R13	RESISTOR, FIXED, COMPOSITION: 15 kΩ, 5%, 1/4W	1	RCR07G153JS	81349	01121
R14	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	1	RCR07G103JS	81349	01121
R15	Same as R11				
R16	RESISTOR, FIXED, COMPOSITION: 270 kΩ, 5%, 1/4W	1	RCR07G274JS	81349	01121
R17	RESISTOR, FIXED, COMPOSITION: 2.2 kΩ, 5%, 1/4W	1	RCR07G222JS	81349	01121
R18	RESISTOR, FIXED, COMPOSITION: 3.9 kΩ, 5%, 1/4W	2	RCR07G392JS	81349	01121
R19	Same as R18				
R20	Same as R2				
R21	RESISTOR, FIXED, COMPOSITION: 560 Ω, 5%, 1/4W	2	RCR07G561JS	81349	01121
R22	Same as R21				
R23	RESISTOR, FIXED, COMPOSITION: 33 kΩ, 5%, 1/4W	2	RCR07G333JS	81349	01121
R24	Same as R23				
R25	RESISTOR, FIXED, COMPOSITION: 2.7 kΩ, 5%, 1/4W	1	RCR07G272JS	81349	01121
R26	RESISTOR, FIXED, COMPOSITION: 47 Ω, 5%, 1/4W	1	RCR07G470JS	81349	01121
R27	RESISTOR, FIXED, COMPOSITION: 100 Ω, 5%, 1/4W	1	RCR07G101JS	81349	01121
U1	INTEGRATED CIRCUIT	1	U5E7796393	07263	
VR1	DIODE	1	1N758A	80131	04713
VR2	DIODE	1	1N753A	80131	04713
XU1	SOCKET, INTEGRATED CIRCUIT	1	8058-1G91	91506	
Y1	CRYSTAL, QUARTZ	1	CR18AU(1.545MHZ)	81349	74306

5.4.14 Type 72362 455 kHz IF Amplifier REF DESIG PREFIX A13

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 100V	2	C023B101F103M	56289	
C2	CAPACITOR, ELECTROLYTIC, TANTALUM: 6.8 μF, 10%, 35V	2	CS13BF685K	81349	56289
C3	CAPACITOR, CERAMIC, DISC: 0.1 μF, -20 + 80%, 25V	4	DFJ3	73899	
C4	CAPACITOR, CERAMIC, DISC: 0.01 μF, 10%, 200V	2	CK06BX103K	81349	56289
C5	CAPACITOR, MICA, DIPPED: 4700 pF, 5%, 500V	1	CM05FD472J03	81349	72136
C6	Same as C4				
C7	Same as C2				
C8	CAPACITOR, CERAMIC, DISC: 1000 pF, GMV, 500V	1	SM1000PFGMV	91418	
C9	Same as C3				
C10	Same as C1				
C11	Same as C3				
C12	Same as C3				
CR1	DIODE	1	1N462A	80131	93332
L1	COIL, VARIABLE	1	30312-128	14632	
L2	COIL, FIXED: 1000 μH, 5%	1	2500-28	99800	
Q1	TRANSISTOR	1	2N3478	80131	02735
Q2	TRANSISTOR	1	3N187	80131	02735
Q3	TRANSISTOR	4	2N2222A	80131	04713
Q4	Same as Q3				
Q5	Same as Q3				
Q6	Same as Q3				
R1	RESISTOR, FIXED, COMPOSITION: 12 kΩ, 5%, 1/4W	1	RCR07G123JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 4.7 kΩ, 5%, 1/4W	1	RCR07G472JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 1.0 kΩ, 5%, 1/4W	3	RCR07G102JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 100 Ω, 5%, 1/4W	2	RCR07G101JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 91 Ω, 5%, 1/4W	1	RCR07G910JS	81349	01121
R6	Same as R4				
R7	RESISTOR, FIXED, COMPOSITION: 680 Ω, 5%, 1/4W	1	RCR07G681JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	1	RCR07G103JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 68 kΩ, 5%, 1/4W	1	RCR07G683JS	81349	01121
R10	RESISTOR, FIXED, COMPOSITION: 150 kΩ, 5%, 1/4W	1	RCR07G154JS	81349	01121
R11	RESISTOR, FIXED, COMPOSITION: 15 kΩ, 5%, 1/4W	1	RCR07G153JS	81349	01121
R12	RESISTOR, FIXED, COMPOSITION: 30 kΩ, 5%, 1/4W	1	RCR07G303JS	81349	01121
R13	Same as R3				
R14	RESISTOR, FIXED, COMPOSITION: 6.2 kΩ, 5%, 1/4W	1	RCR07G622JS	81349	01121

REF DESIG PREFIX A13

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R15	RESISTOR, FIXED, COMPOSITION: 330 Ω, 5%, 1/4W	2	RCR07G331JS	81349	01121
R16	RESISTOR, FIXED, COMPOSITION: 1.2 kΩ, 5%, 1/4W	1	RCR07G122JS	81349	01121
R17	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	2	RCR07G103JS	81349	01121
R18	RESISTOR, FIXED, COMPOSITION: 100 kΩ, 5%, 1/4W	2	RCR07G104JS	81349	01121
R19	Same as R15				
R20	Same as R3				
R21	RESISTOR, FIXED, COMPOSITION: 2.7 kΩ, 5%, 1/4W	1	RCR07G272JS	81349	01121
R22	Same as R17				
R23	Same as R18				
R24	RESISTOR, FIXED, COMPOSITION: 33 kΩ, 5%, 1/4W	2	RCR07G333JS	81349	01121
R25	Same as R24				
R26	RESISTOR, FIXED, COMPOSITION: 3.3 kΩ, 5%, 1/4W	1	RCR07G332JS	81349	01121
R27	RESISTOR, FIXED, COMPOSITION: 33 Ω, 5%, 1/4W	1	RCR07G330JS	81349	01121
VR1	DIODE	1	1N758A	80131	04713

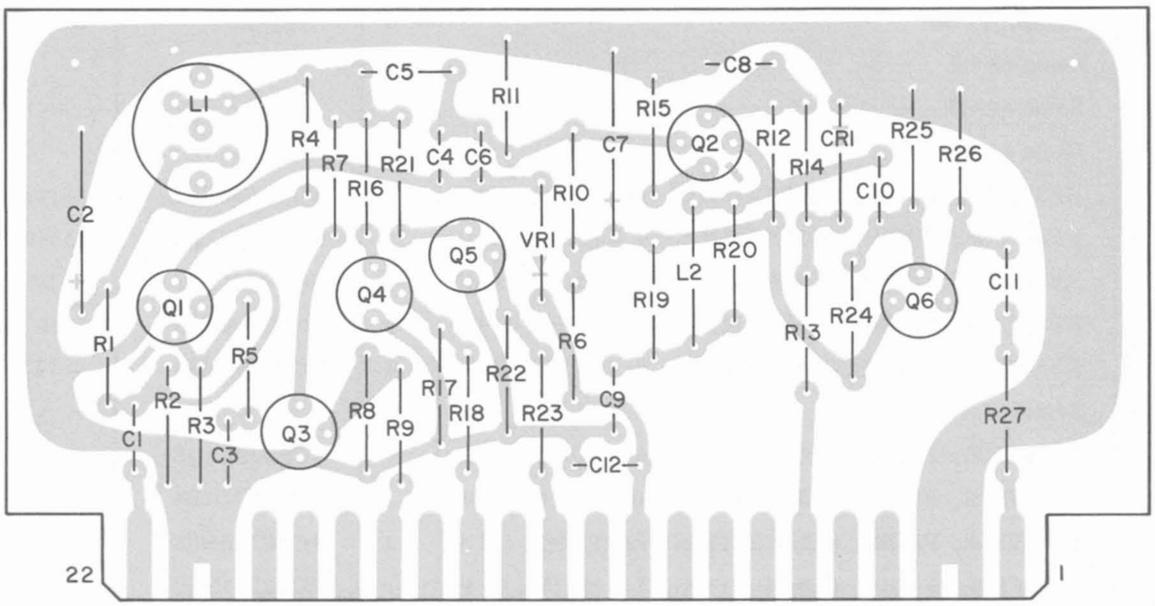


Figure 5-19. Type 72362 455 kHz IF Amplifier (A13), Component Locations

5.4.15 Type 79869 Low Pass Filter REF DESIG PREFIX A14

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, MICA, DIPPED: 3300 pF, 2%, 500V	2	CM06FD332G03	81349	72136
C2	CAPACITOR, MICA, DIPPED: 430 pF, 5%, 500V	2	DM15-431J	72136	
C3	CAPACITOR, MICA, DIPPED: 6800 pF, 2%, 100V	3	DM19-682G	72136	
C4	Same as C3				
C5	CAPACITOR, MICA, DIPPED: 220 pF, 5%, 500V	1	CM05FD221J03	81349	72136
C6	Same as C3				
C7	Same as C2				
C8	Same as C1				
L1	COIL, FIXED: 12 μH, 10%	4	1537-38	99800	
L2	Same as L1				
L3	Same as L1				
L4	Same as L1				

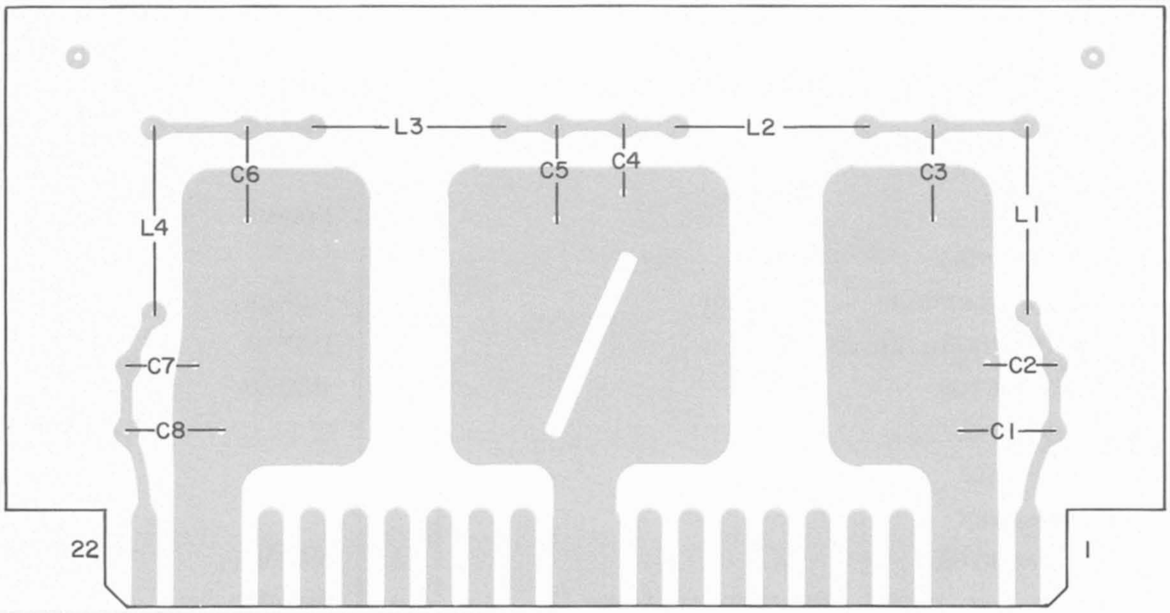


Figure 5-20. Type 79869 Low Pass Filter (A14), Component Locations

5.4.16 Type 7768 Variable Frequency Oscillator REF DESIG PREFIX A15

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 0.1 μF, +80 -20%, 25V	6	DFJ3	73899	
C2	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 100V	3	C023B101F103M	56289	
C3	CAPACITOR, CERAMIC, DISC: 180 pF, 5%, 50V	2	1T180RJ	93958	
C4	Same as C3				
C5	CAPACITOR, ELECTROLYTIC, TANTALUM: 6.8 μF, 10%, 35V	1	CS13BF685K	81349	56289
C6	Same as C2				
C7	Same as C2				
C8	CAPACITOR, CERAMIC, DISC: 0.02 μF, 20%, 100V	3	C023B101H203M	56289	
C9	Same as C1				
C10	Same as C1				
C11	Same as C1				
C12	Same as C8				
C13	Same as C8				
C14	Same as C1				
C15	Same as C1				
C16	CAPACITOR, ELECTROLYTIC, TANTALUM: 4.7 μF, 10%, 35V	1	CS13BF475K	81349	56289
C17	CAPACITOR, MICA, DIPPED: 3300 pF, 5%, 500V	1	CM06FD332J03	81349	72136
CR1	DIODE	2	1N462A	80131	93332
CR2	Same as CR1				
CR3	DIODE	2	1N4446	80131	93332
CR4	Same as CR3				
L1	COIL, VARIABLE: 10.8-13.2 μH	1	7107-26	71279	
L2	COIL, FIXED: 240 μH, 5%	1	1537-94	99800	
Q1	TRANSISTOR	4	2N2222A	80131	04713
Q2	Same as Q1				
Q3	Same as Q1				
Q4	Same as Q1				
Q5	TRANSISTOR	1	2N3251	80131	04713
R1	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	3	RCR07G103JS	81349	01121
R2	Same as R1				
R3	RESISTOR, FIXED, COMPOSITION: 1.3 kΩ, 5%, 1/4W	1	RCR07G132JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 47 kΩ, 5%, 1/4W	1	RCR07G473JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 22 kΩ, 5%, 1/4W	1	RCR07G223JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 2.2 kΩ, 5%, 1/4W	1	RCR07G222JS	81349	01121
R7	RESISTOR, FIXED, COMPOSITION: 1 kΩ, 5%, 1/4W	2	RCR07G102JS	81349	01121

REF DESIG PREFIX A15

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R8	RESISTOR, FIXED, COMPOSITION: 180 Ω, 5%, 1/4W	1	RCR07G181JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 33 kΩ, 5%, 1/4W	2	RCR07G333JS	81349	01121
R10	Same as R9				
R11	RESISTOR, FIXED, COMPOSITION: 100 Ω, 5%, 1/4W	1	RCR07G101JS	81349	01121
R12	RESISTOR, FIXED, COMPOSITION: 3.3 kΩ, 5%, 1/4W	1	RCR07G332JS	81349	01121
R13	RESISTOR, FIXED, COMPOSITION: 560 Ω, 5%, 1/4W	1	RCR07G561JS	81349	01121
R14	RESISTOR, FIXED, COMPOSITION: 18 kΩ, 5%, 1/4W	1	RCR07G183JS	81349	01121
R15	Same as R1				
R16	Same as R7				
R17	RESISTOR, FIXED, COMPOSITION: 47 Ω, 5%, 1/4W	4	RCR07G470JS	81349	01121
R18	Same as R17				
R19	RESISTOR, FIXED, COMPOSITION: 4.7 kΩ, 5%, 1/4W	2	RCR07G472JS	81349	01121
R20	RESISTOR, FIXED, COMPOSITION: 330 Ω, 5%, 1/4W	1	RCR07G331JS	81349	01121
R21	Same as R19				
R22	Same as R17				
R23	Same as R17				
R24	RESISTOR, VARIABLE, FILM: 500 Ω, 30%, 1/2W	1	62PAR500	73138	
R25	RESISTOR, FIXED, COMPOSITION: 470 kΩ, 5%, 1/4W	1	RCR07G474JS	81349	01121
U1	DIODE	1	BB113	25088	
VR1	DIODE	1	1N754A	80131	04713

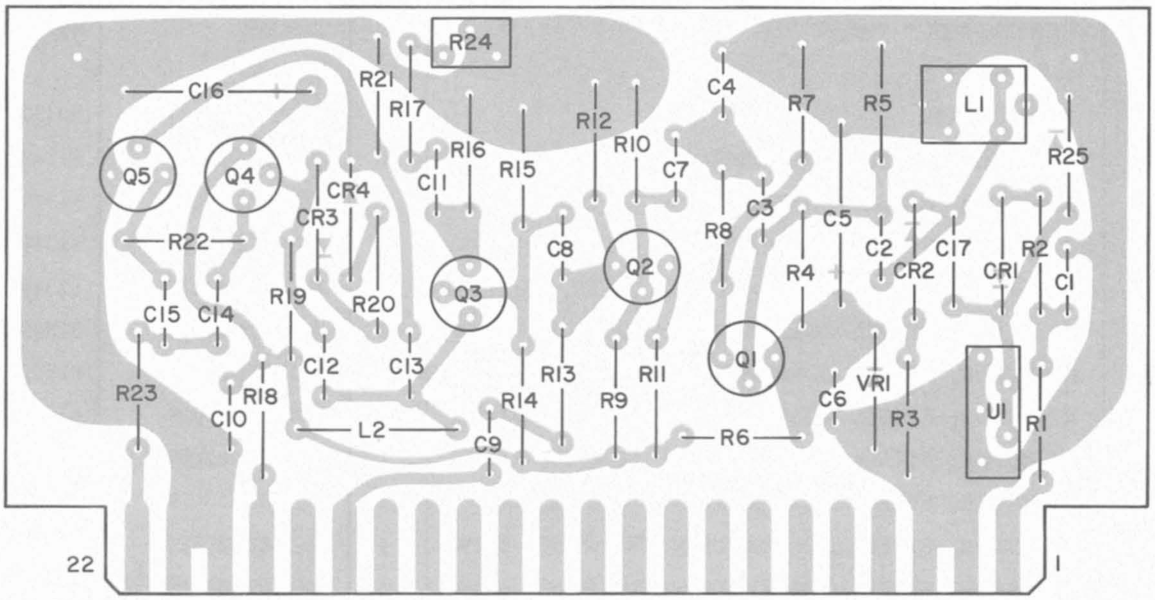


Figure 5-21. Type 7768 Variable Frequency Oscillator (A15), Component Locations

5.4.17 Type 71372 Input Converter REF DESIG PREFIX A16

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, MICA, DIPPED: 3000 pF, 5%, 500V	2	CM06FD302J03	81349	
C2	Same as C1				
C3	CAPACITOR, ELECTROLYTIC, TANTALUM: 47 μF, 20%, 25V	1	196D476X0025MA3	56289	
C4	CAPACITOR, ELECTROLYTIC, TANTALUM: 100 μF, 20%, 20V	1	196D107X0020MA3	56289	
C5	CAPACITOR, CERAMIC, DISC: 0.1 μF, 20%, 100V	2	8131M100-651-104M	72982	
C6	CAPACITOR, ELECTROLYTIC, TANTALUM: 4.7 μF, 20%, 35V	1	196D475X0035JA1	56289	
C7	CAPACITOR, ELECTROLYTIC, TANTALUM: 27 μF, 10%, 35V	3	196D276X9035MA3	56289	
C8	Same as C7				
C9	Same as C7				
C10	CAPACITOR, MICA, DIPPED: 36 pF, 5%, 500V	1	CM05ED360J03	81349	72136
C11	CAPACITOR, VARIABLE, AIR: 0.8-10 pF, 250V	1	2951	91293	
C12	CAPACITOR, CERAMIC, DISC: 5000 pF, 20%, 500V	1	SM5000PFM	91418	
C13	Same as C5				
C14	CAPACITOR, CERAMIC, DISC: 0.02 μF, 20%, 100V	1	C023B101H203M	56289	
C15	CAPACITOR, CERAMIC, DISC: .033 μF, 10%, 100V	1	CK06BX333K	81349	56289
L1	COIL, FIXED: 8.2 μH, 10%	1	1537-34	99800	
L2	COIL, FIXED: 1.2 mH, 10%	1	3635-38	71279	
L3	COIL, FIXED: 150 μH, 5%	1	1537-84	99800	
Q1	TRANSISTOR	2	2N5109	80131	
Q2	Same as Q1				
Q3	TRANSISTOR	1	2N2222A	80131	02735
R1	RESISTOR, FIXED, COMPOSITION: 2.2 kΩ, 5%, 1/4W	1	RCR07G222JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 1.0 kΩ, 5%, 1/4W	3	RCR07G102JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 150 Ω, 5%, 1/4W	1	RCR07G151JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 1.2 kΩ, 5%, 1/4W	1	RCR07G122JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 100 Ω, 5%, 1/4W	2	RCR07G101JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 6.8 Ω, 5%, 1/4W	1	RCR07G6R8JS	81349	01121
R7	RESISTOR, FIXED, COMPOSITION: 47 Ω, 5%, 1/4W	2	RCR07G470JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 22 Ω, 5%, 1/4W	1	RCR07G220JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 33 Ω, 5%, 1/4W	1	RCR07G330JS	81349	01121
R10	RESISTOR, FIXED, COMPOSITION: 330 Ω, 5%, 1/2W	1	RCR20G331JS	81349	01121
R11	RESISTOR, FIXED, COMPOSITION: 360 Ω, 5%, 1/4W	2	RCR07G361JS	81349	01121
R12	RESISTOR, FIXED, COMPOSITION: 20 Ω, 5%, 1/4W	1	RCR07G200JS	81349	01121

REF DESIG PREFIX A16

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R13	Same as R11				
R14	RESISTOR, VARIABLE, FILM: 100 Ω, 10%, 1/2W	2	62PAR100	73138	
R15	Same as R2				
R16	Same as R2				
R17	Same as R14				
R18	Same as R7				
R19	RESISTOR, FIXED, COMPOSITION: 470 Ω, 5%, 1/4W	1	RCR07G471JS	81349	01121
R20	RESISTOR, FIXED, COMPOSITION: 22 kΩ, 5%, 1/4W	1	RCR07G223JS	81349	01121
R21	RESISTOR, FIXED, COMPOSITION: 15 kΩ, 5%, 1/4W	1	RCR07G153JS	81349	01121
R22	RESISTOR, FIXED, COMPOSITION: 220 Ω, 5%, 1/4W	1	RCR07G221JS	81349	01121
R23	Same as R5				
R24	RESISTOR, FIXED, COMPOSITION: 680 Ω, 5%, 1/4W	1	RCR07G681JS	81349	01121
R25	RESISTOR, FIXED, COMPOSITION: 10 Ω, 5%, 1/4W	1	RCR07G100JS	81349	01121
R26	RESISTOR, FIXED, COMPOSITION: 20 Ω, 5%, 1/4W	1	RCR07G220JS	81349	01121
RA1	HEATSINK	2	2225B	13103	
RA2	Same as RA1				
T1	TRANSFORMER	1	33009-2	14632	
T2	TRANSFORMER	1	22294-21	14632	
U1	MIXER, BALANCED	1	M9A	14482	

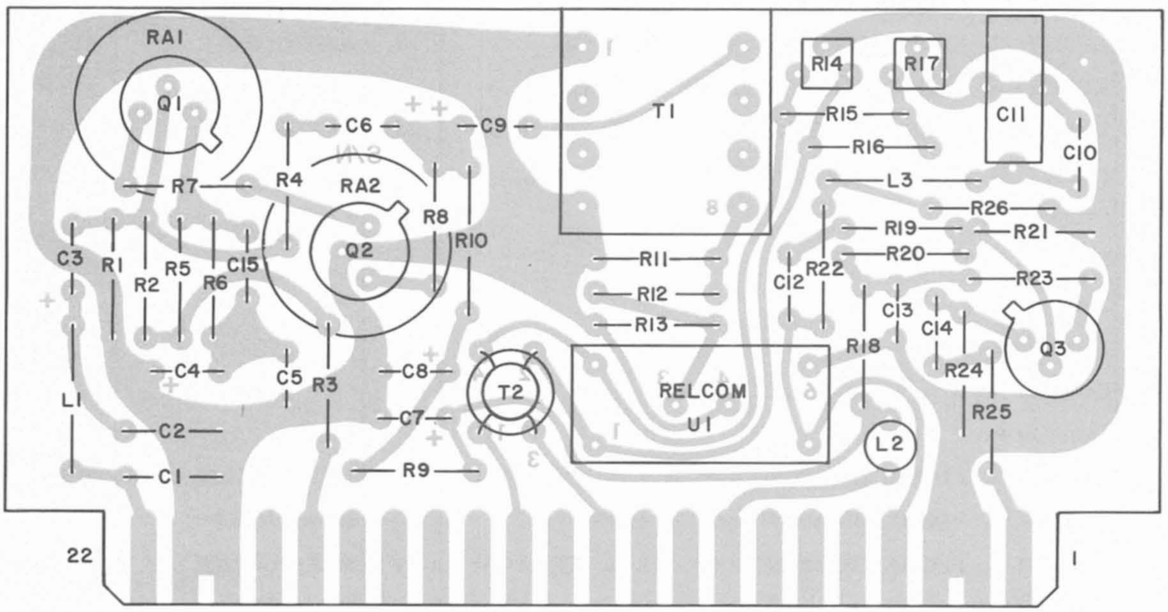


Figure 5-22. Type 71372 Input Converter (A16), Component Locations

5.4.18 Type 79969 VFO Control REF DESIG PREFIX A17

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, MICA, DIPPED: 100 pF, 5%, 500V	2	CM05FD101J03	81349	72136
C2	Same as C1				
C3	CAPACITOR, MICA, DIPPED: 1000 pF, 5%, 500V	1	CM06FD102J03	81349	72136
CR1	DIODE	3	1N458A	80131	93332
CR2	Same as CR1				
CR3	Same as CR1				
R1	RESISTOR, FIXED, WIRE WOUND: 50 kΩ, 1/10%, 1/4W	4	A2525	14193	
R2	Same as R1				
R3	Same as R1				
R4	RESISTOR, FIXED, FILM: 51.1 kΩ, 1%, 1/4W	2	RN60D5112F	81349	75042
R5	RESISTOR, FIXED, FILM: 24.3 kΩ, 1%, 1/4W	2	RN60D2432F	81349	75042
R6	RESISTOR, TRIM, FILM: 5 kΩ, 10%, 3/4W	3	89PR5K	73138	
R7	Same as R5				
R8	RESISTOR, FIXED, FILM: 8.25 kΩ, 1%, 1/4W	2	RN60D8251F	81349	75042
R9	Same as R8				
R10	Same as R1				
R11	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	1	RCR07G103JS	81349	01121
R12	RESISTOR, FIXED, COMPOSITION: 6.8 kΩ, 5%, 1/4W	1	RCR07G682JS	81349	01121
R13	RESISTOR, FIXED, FILM: 16.2 kΩ, 1%, 1/4W	1	RN60D1622F	81349	75042
R14	RESISTOR, FIXED, COMPOSITION: 1.0 kΩ, 5%, 1/4W	1	RCR07G102JS	81349	01121
R15	RESISTOR, FIXED, COMPOSITION: 3.3 kΩ, 5%, 1/4W	1	RCR07G332JS	81349	01121
R16	RESISTOR, FIXED, FILM: 17.8 kΩ, 1%, 1/4W	1	RN60D1782F	81349	75042
R17	RESISTOR, FIXED, FILM: 26.1 kΩ, 1%, 1/4W	1	RN60D2612F	81349	75042
R18	RESISTOR, FIXED, COMPOSITION: 470 kΩ, 5%, 1/4W	4	RCR07G474JS	81349	01121
R19	RESISTOR, FIXED, WIRE WOUND: 20 kΩ, 1/10%, 1/10W	2	M40-20K	14193	
R20	Same as R19				
R21	Same as R18				
R22	Same as R18				
R23	Same as R18				
R24	Same as R6				
R25	Same as R6				
R26	RESISTOR, FIXED, COMPOSITION: 4.7 kΩ, 5%, 1/4W	1	RCR07G472JS	81349	01121
R27	RESISTOR, FIXED, FILM: 10 kΩ, 1%, 1/4W	1	RN60D1002F	81349	75042
R28	RESISTOR, FIXED, COMPOSITION: 8.2 kΩ, 5%, 1/4W	1	RCR07G822JS	81349	01121
R29	Same as R4				
R30	RESISTOR, FIXED, FILM: 21.5 kΩ, 1%, 1/4W	1	RN60D2152F	81349	75042

REF DESIG PREFIX A17

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R31	RESISTOR, FIXED, COMPOSITION: 18 kΩ, 5%, 1/4W	1	RCR07G183JS	81349	01121
R32	RESISTOR, FIXED, FILM: 4.75 kΩ, 1%, 1/4W	1	RN60D4751F	81349	75042
R33	RESISTOR, VARIABLE, FILM: 2 kΩ, 10%, 3/4W	1	89PR2K	73138	
R34	RESISTOR, FIXED, FILM: 4.12 kΩ, 1%, 1/4W	1	RN60D4121F	81349	75042
U1	INTEGRATED CIRCUIT	3	U5B7741393	07263	
U2	Same as U1				
U3	Same as U1				
XU1	SOCKET, INTEGRATED CIRCUIT	3	8058-1G49	91506	
XU2	Same as XU1				
XU3	Same as XU1				

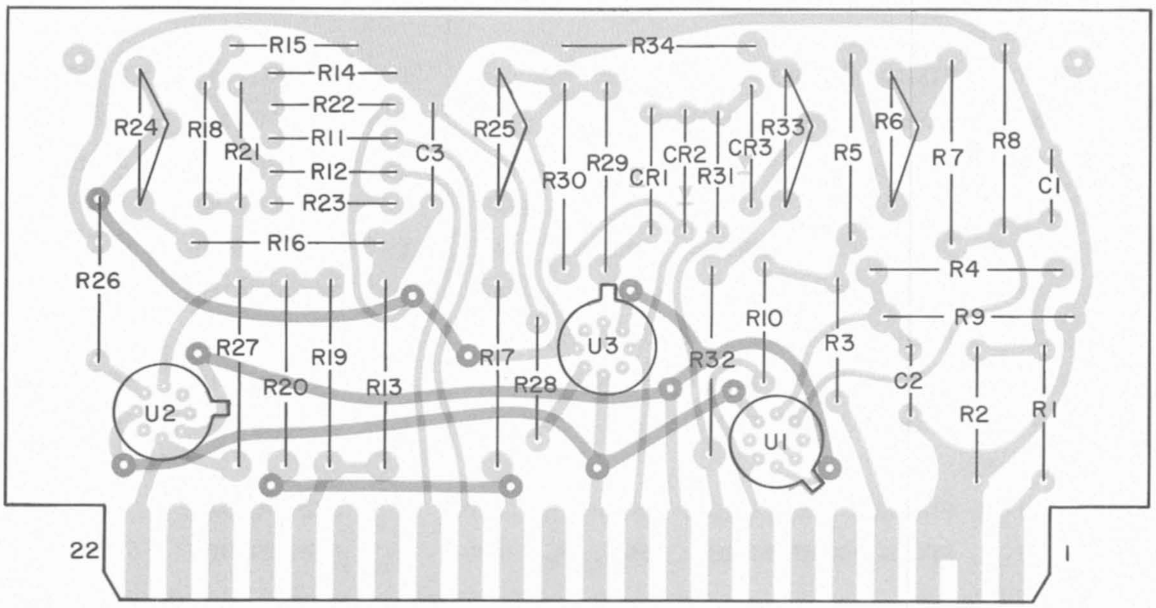


Figure 5-23. Type 79969 VFO Control (A17), Component Locations

5.4.19 Type 79983 Gain Control REF DESIG PREFIX A18

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 1500 pF, 10%, 1000V	1	DD152	71590	
C2	CAPACITOR, MICA, DIPPED: 470 pF, 5%, 500V	1	DM15-471J	72136	
C3	CAPACITOR, ELECTROLYTIC, TANTALUM: 1 μF, 10%, 35V	1	CS13BF105K	81349	56289
C4	CAPACITOR, ELECTROLYTIC, TANTALUM: 22 μF, 10%, 35V	2	CS13BF226K	81349	56289
C5	Same as C4				
CR1	DIODE	5	1N462A	80131	93332
CR2	Same as CR1				
CR3	Same as CR1				
CR4	Same as CR1				
CR5	Same as CR1				
Q1	TRANSISTOR	1	2N929	80131	04713
Q2	TRANSISTOR	1	2N3251	80131	04713
Q3	TRANSISTOR	1	2N2222A	80131	04713
R1	RESISTOR, FIXED, COMPOSITION: 39 kΩ, 5%, 1/4W	5	RCR07G393JS	81349	01121
R2	Same as R1				
R3	RESISTOR, FIXED, COMPOSITION: 100 kΩ, 5%, 1/4W	1	RCR07G104JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	2	RCR07G103JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 4.7 kΩ, 5%, 1/4W	1	RCR07G472JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 15 kΩ, 5%, 1/4W	1	RCR07G153JS	81349	01121
R7	RESISTOR, FIXED, COMPOSITION: 560 Ω, 5%, 1/4W	1	RCR07G561JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 470 Ω, 5%, 1/4W	1	RCR07G471JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 910 Ω, 5%, 1/4W	1	RCR07G911JS	81349	01121
R10	RESISTOR, FIXED, COMPOSITION: 160 kΩ, 5%, 1/4W	1	RCR07G164JS	81349	01121
R11	RESISTOR, FIXED, COMPOSITION: 75 kΩ, 5%, 1/4W	1	RCR07G753JS	81349	01121
R12	Same as R1				
R13	RESISTOR, FIXED, COMPOSITION: 200 kΩ, 5%, 1/4W	1	RCR07G204JS	81349	01121
R14	RESISTOR, FIXED, COMPOSITION: 330 Ω, 5%, 1/4W	1	RCR07G331JS	81349	01121
R15	NOT USED				
R16	RESISTOR, FIXED, COMPOSITION: 20 kΩ, 5%, 1/4W	2	RCR07G203JS	81349	01121
R17	RESISTOR, FIXED, COMPOSITION: 5.6 kΩ, 5%, 1/4W	1	RCR07G562JS	81349	01121
R18	Same as R1				
R19	RESISTOR, FIXED, COMPOSITION: 47 kΩ, 5%, 1/4W	1	RCR07G473JS	81349	01121
R20	RESISTOR, FIXED, COMPOSITION: 82 kΩ, 5%, 1/4W	1	RCR07G823JS	81349	01121
R21	RESISTOR, FIXED, COMPOSITION: 22 kΩ, 5%, 1/4W	2	RCR07G223JS	81349	01121
R22	RESISTOR, FIXED, COMPOSITION: 33 kΩ, 5%, 1/4W	1	RCR07G333JS	81349	01121

REF DESIG PREFIX A18

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R23	Same as R4				
R24	Same as R1				
R25	Same as R21				
R26	Same as R16				
R27	RESISTOR, FIXED, COMPOSITION: 220 kΩ, 5%, 1/4W	1	RCR07G224JS	81349	01121
R28	RESISTOR, FIXED, COMPOSITION: 22 Ω, 5%, 1/4W	1	RCR07G220JS	81349	01121
U1	INTEGRATED CIRCUIT	3	U5B7741393	07263	
U2	Same as U1				
U3	Same as U1				
XU1	SOCKET, INTEGRATED CIRCUIT	3	8058-1G49	91506	
XU2	Same as XU1				
XU3	Same as XU1				

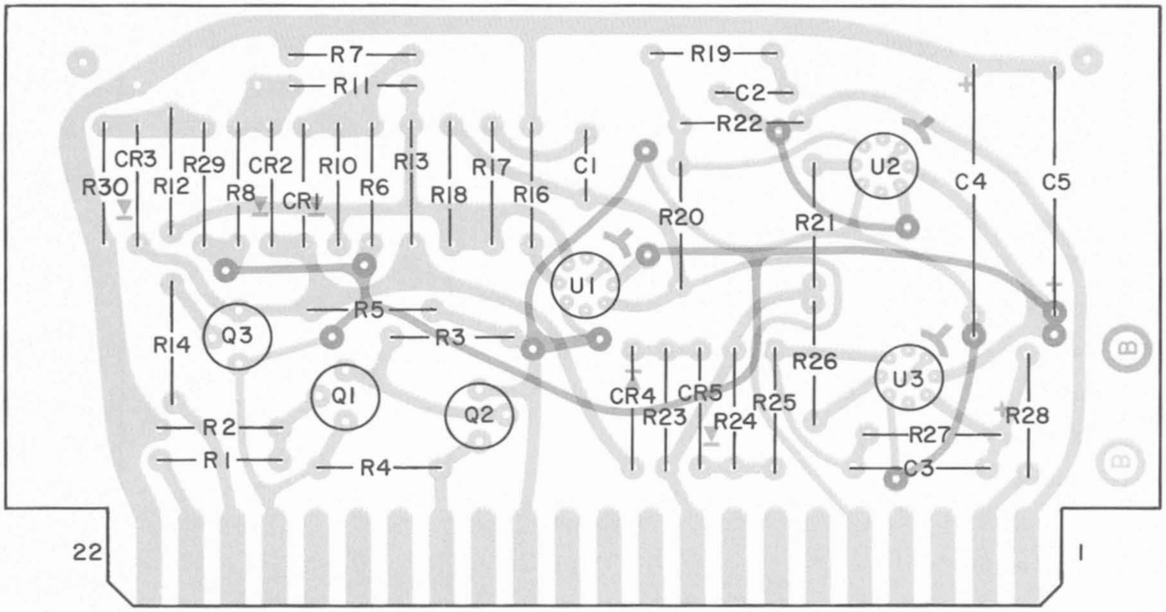


Figure 5-24. Type 79983 Gain Control (A18), Component Locations

5.4.20 Type 72360 IF Buffer REF DESIG PREFIX A19

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 100V	3	C023B101F103M	56289	
C2	CAPACITOR, ELECTROLYTIC, TANTALUM: 1 μF, 10%, 500V	1	CS13BF105K	73899	
C3	CAPACITOR, CERAMIC, DISC: 0.1 μF, +80 -20%, 25V	3	DFJ3	73899	
C4	Same as C1				
C5	CAPACITOR, MICA, DIPPED: 68 pF, 5%, 500V	1	CM05ED680J03	81349	72136
C6	Same as C1				
C7	CAPACITOR, ELECTROLTYIC, TANTALUM: 22 μF, 20%, 25V	1	109D226X0025C2	56289	
C8	CAPACITOR, ELECTROLYTIC, TANTALUM: 6.8 μF, 10%, 35V	1	CS13BF685K	81349	56289
C9	Same as C3				
C10	Same as C3				
Q1	TRANSISTOR	3	2N2222A	80131	04713
Q2	Same as Q1				
Q3	Same as Q1				
R1	RESISTOR, FIXED, COMPOSITION: 220 Ω, 5%, 1/4W	1	RCR07G221JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 18 kΩ, 5%, 1/4W	5	RCR07G183JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 4.7 kΩ, 5%, 1/4W	2	RCR07G472JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 470 Ω, 5%, 1/4W	1	RCR07G471JS	81349	01121
R5	RESISTOR, FIXED, COMPOSITION: 2.2 kΩ, 5%, 1/4W	2	RCR07G222JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 82 Ω, 5%, 1/4W	1	RCR07G820JS	81349	01121
R7	Same as R3				
R8	RESISTOR, VARIABLE, FILM: 500 Ω, 30%, 1/2W	1	62PAR500	73138	
R9	RESISTOR, FIXED, COMPOSITION: 100 Ω, 5%, 1/4W	5	RCR07G101JS	81349	01121
R10	Same as R9				
R11	Same as R9				
R12	Same as R2				
R13	Same as R2				
R14	Same as R2				
R15	Same as R2				
R16	Same as R9				
R17	RESISTOR, FIXED, COMPOSITION: 1 kΩ, 5%, 1/4W	1	RCR07G102JS	81349	01121
R18	Same as R9				
R19	Same as R5				
R20	RESISTOR, FIXED, COMPOSITION: 39 Ω, 5%, 1/4W	2	RCR07G390JS	81349	01121
R21	Same as R20				

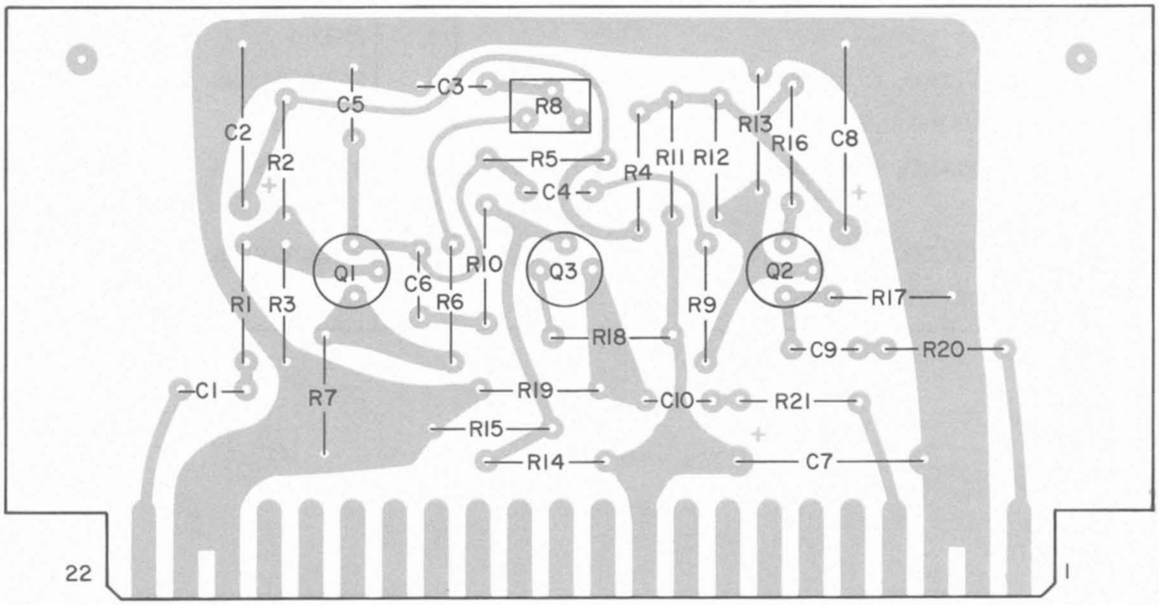


Figure 5-25. Type 72360 IF Buffer (A19), Component Locations

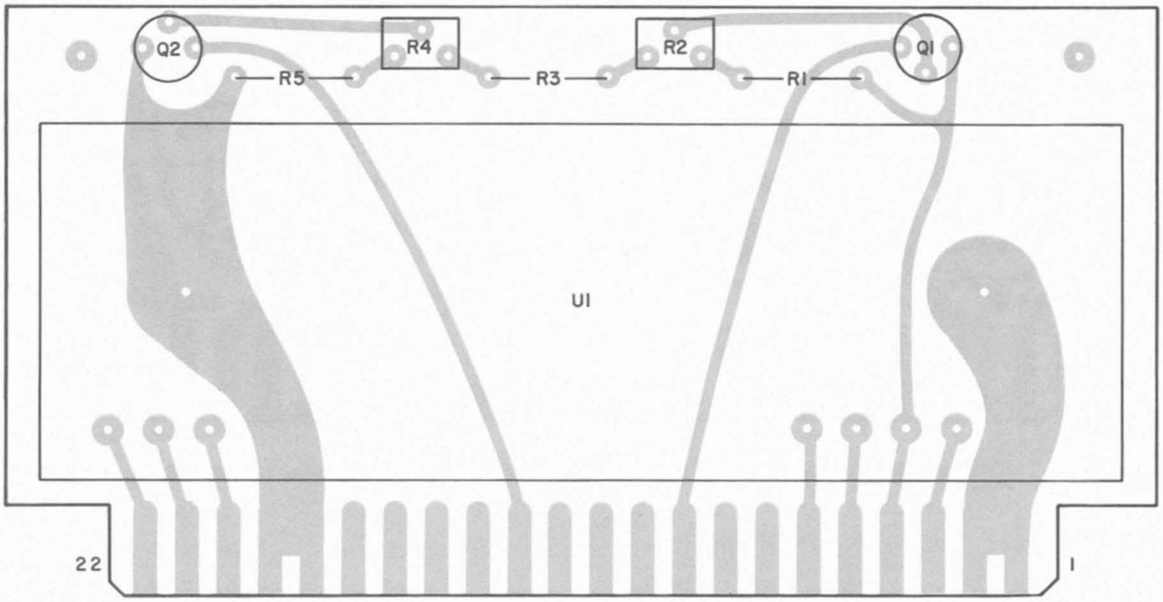


Figure 5-26. Type 79953 CW Demodulator (A20), Component Locations

5.4.21 Type 79953 CW Demodulator REF DESIG PREFIX A20

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
Q1	TRANSISTOR	1	2N929	80131	04713
Q2	TRANSISTOR	1	2N3251	80131	04713
R1	RESISTOR, FIXED, COMPOSITION: 16 kΩ, 5%, 1/4W	1	RCR07G163JS	81349	01121
R2	RESISTOR, VARIABLE, FILM: 2 kΩ, 30%, 1/4W	2	62PAR2K	73138	
R3	RESISTOR, FIXED, COMPOSITION: 2 kΩ, 5%, 1/4W	1	RCR07G202JS	81349	01121
R4	Same as R2				
R5	RESISTOR, FIXED, COMPOSITION: 3.9 kΩ, 5%, 1/4W	1	RCR07G392JS	81349	01121
U1	CW DEMODULATOR ASSEMBLY	1	79938	14632	

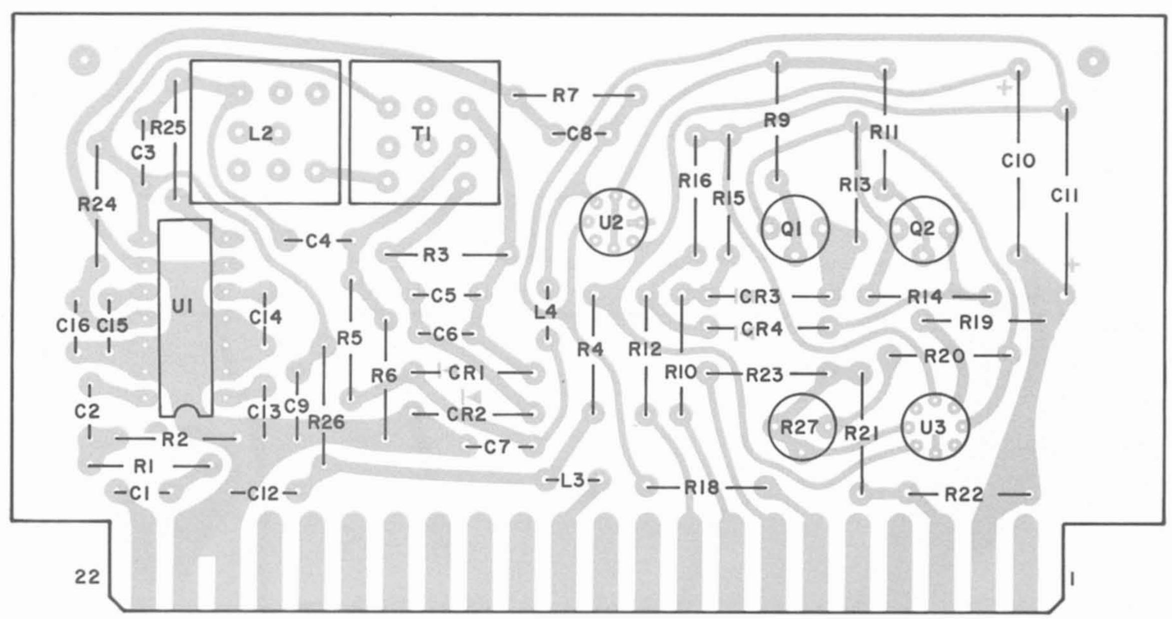


Figure 5-27. Type 79933 FM Demodulator (A21), Component Locations

5.4.22 Type 79933 FM Demodulator REF DESIG PREFIX A21

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 200V	2	8131A200Z5U0-103M	72982	
C2	Same as C1				
C3	CAPACITOR, MICA, DIPPED: 470 pF, 5%, 500V	1	DM15-471J	72136	
C4	CAPACITOR, MICA, DIPPED: 330 pF, 5%, 500V	2	CM05FD331J03	81349	72136
C5	CAPACITOR, MICA, DIPPED: 390 pF, 5%, 500V	1	CM05FD391J03	81349	72136
C6	CAPACITOR, CERAMIC, DISC: 150 pF, 10%, 75V	1	1U150RK	93958	
C7	Same as C4				
C8	CAPACITOR, CERAMIC, DISC: 4700 pF, 10%, 200V	1	CK06BX472K	81349	56289
C9	CAPACITOR, CERAMIC, DISC: 0.1 μF, -20+80%, 25V	2	DFJ3	73899	
C10	CAPACITOR, ELECTROLYTIC, TANTALUM: 4.7 μF, 10%, 35V	2	CS13BF475K	81349	56289
C11	Same as C10				
C12	Same as C9				
C13	CAPACITOR, CERAMIC, DISC: 0.1 μF, 20%, 100V	4	8131M100-651-104M	72982	
C14	Same as C13				
C15	Same as C13				
C16	Same as C13				
CR1	DIODE	4	1N4446	80131	93332
CR2	Same as CR1				
CR3	Same as CR1				
CR4	Same as CR1				
L1	NOT USED				
L2	COIL, VARIABLE	1	30705-12	14632	
L3	COIL, FIXED, MOLD: 1.2 mH, 10%	1	3635-38	71279	
L4	COIL, FIXED, MOLD: 4.7 mH, 10%	1	3635-45	71279	
Q1	TRANSISTOR	2	U1899E	15818	
Q2	Same as Q1				
R1	RESISTOR, FIXED, COMPOSITION: 1 kΩ, 5%, 1/4W	2	RCR07G102JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 100 Ω, 5%, 1/4W	3	RCR07G101JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	2	RCR07G103JS	81349	01121
R4	Same as R1				
R5	RESISTOR, FIXED, COMPOSITION: 39 kΩ, 5%, 1/4W	1	RCR07G393JS	81349	01121
R6	RESISTOR, FIXED, COMPOSITION: 56 kΩ, 5%, 1/4W	1	RCR07G563JS	81349	01121
R7	RESISTOR, FIXED, COMPOSITION: 100 kΩ, 5%, 1/4W	1	RCR07G104JS	81349	01121
R8	NOT USED				
R9	RESISTOR, FIXED, COMPOSITION: 68 kΩ, 5%, 1/4W	1	RCR07G683JS	81349	01121

REF DESIG PREFIX A21

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R10	RESISTOR, FIXED, COMPOSITION: 150 kΩ, 5%, 1/4W	4	RCR07G154JS	81349	01121
R11	RESISTOR, FIXED, COMPOSITION: 30 kΩ, 5%, 1/4W	1	RCR07G303JS	81349	01121
R12	Same as R10				
R13	RESISTOR, FIXED, COMPOSITION: 22 MΩ, 5%, 1/4W	2	RCR07G226JS	81349	01121
R14	Same as R13				
R15	Same as R10				
R16	Same as R10				
R17	NOT USED				
R18	Same as R2				
R19	RESISTOR, FIXED, COMPOSITION: 15 kΩ, 5%, 1/4W	1	RCR07G153JS	81349	01121
R20	RESISTOR, FIXED, COMPOSITION: 20 kΩ, 5%, 1/4W	1	RCR07G203JS	81349	01121
R21	Same as R3				
R22	RESISTOR, FIXED, COMPOSITION: 3.9 kΩ, 5%, 1/4W	1	RCR07G392JS	81349	01121
R23	Same as R2				
R24	RESISTOR, FIXED, COMPOSITION: 820 Ω, 5%, 1/4W	1	RCR07G821JS	81349	01121
R25	RESISTOR, FIXED, COMPOSITION: 47 Ω, 5%, 1/4W	1	RCR07G470JS	81349	01121
R26	RESISTOR, FIXED, COMPOSITION: 150 Ω, 5%, 1/4W	1	RCR07G151JS	81349	01121
R27	RESISTOR, VARIABLE, FILM: 10 kΩ, 10%, 1/2W	1	62PR10K	73138	
T1	TRANSFORMER	1	30705-14	14632	
U1	INTEGRATED CIRCUIT	1	MC1355P	04713	
U2	INTEGRATED CIRCUIT	2	U5B7741393	07263	
U3	Same as U2				

5.4.23 Type 72308 AM Demodulator REF DESIG PREFIX A22

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, CERAMIC, DISC: 0.01 μF, 20%, 100V	2	C023B101F103M	56289	
C2	CAPACITOR, ELECTROLYTIC, TANTALUM: 1.0 μF, 10%, 20V	2	CS13BF105K	81349	56289
C3	CAPACITOR, CERAMIC, DISC: 4700 pF, 10%, 200V	2	CK06BX472K	81349	56289
C4	Same as C2				
C5	CAPACITOR, MICA, DIPPED: 270 pF, 5%, 500V	1	CM05FD271J03	81349	72136
C6	CAPACITOR, ELECTROLYTIC, TANTALUM: 6.8 μF, 10%, 35V	2	CS13BF685K	81349	56289
C7	Same as C6				
C8	Same as C3				
C9	Same as C1				
CR1	DIODE	1	1N4446	80131	93332
L1	COIL, FIXED: 3900 μH, 5%	1	2500-56	99800	
Q1	TRANSISTOR	2	2N2222A	80131	04713
Q2	Same as Q1				
Q3	TRANSISTOR	1	2N3251	80131	04713
Q4	TRANSISTOR	1	2N929	80131	04713
R1	RESISTOR, FIXED, COMPOSITION: 1.0 kΩ, 5%, 1/4W	4	RCR07G102JS	81349	01121
R2	RESISTOR, FIXED, COMPOSITION: 22 kΩ, 5%, 1/4W	2	RCR07G223JS	81349	01121
R3	RESISTOR, FIXED, COMPOSITION: 10 kΩ, 5%, 1/4W	2	RCR07G103JS	81349	01121
R4	RESISTOR, FIXED, COMPOSITION: 330 Ω, 5%, 1/4W	1	RCR07G331JS	81349	01121
R5	Same as R1				
R6	RESISTOR, FIXED, COMPOSITION: 820 Ω, 5%, 1/4W	1	RCR07G821JS	81349	01121
R7	RESISTOR, FIXED, COMPOSITION: 56 Ω, 5%, 1/4W	1	RCR07G560JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 12 kΩ, 5%, 1/4W	1	RCR07G123JS	81349	01121
R9	Same as R3				
R10	Same as R1				
R11	RESISTOR, FIXED, COMPOSITION: 33 Ω, 5%, 1/4W	1	RCR07G330JS	81349	01121
R12	Same as R2				
R13	RESISTOR, FIXED, COMPOSITION: 47 Ω, 5%, 1/4W	1	RCR07G470JS	81349	01121
R14	RESISTOR, FIXED, COMPOSITION: 47 kΩ, 5%, 1/4W	1	RCR07G473JS	81349	01121
R15	RESISTOR, FIXED, COMPOSITION: 100 Ω, 5%, 1/4W	2	RCR07G101JS	81349	01121
R16	RESISTOR, FIXED, COMPOSITION: 3.3 kΩ, 5%, 1/4W	1	RCR07G332JS	81349	01121
R17	Same as R15				
R18	Same as R1				
R19	RESISTOR, FIXED, COMPOSITION: 2.7 kΩ, 5%, 1/4W	1	RCR07G272JS	81349	01121
R20	RESISTOR, FIXED, COMPOSITION: 8.2 kΩ, 5%, 1/4W	1	RCR07G822JS	81349	01121

REF DESIG PREFIX A22

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R21	RESISTOR, FIXED, COMPOSITION: 82 Ω, 5%, 1/4W	1	RCR07G820JS	81349	01121
T1	TRANSFORMER	1	70-130	06978	

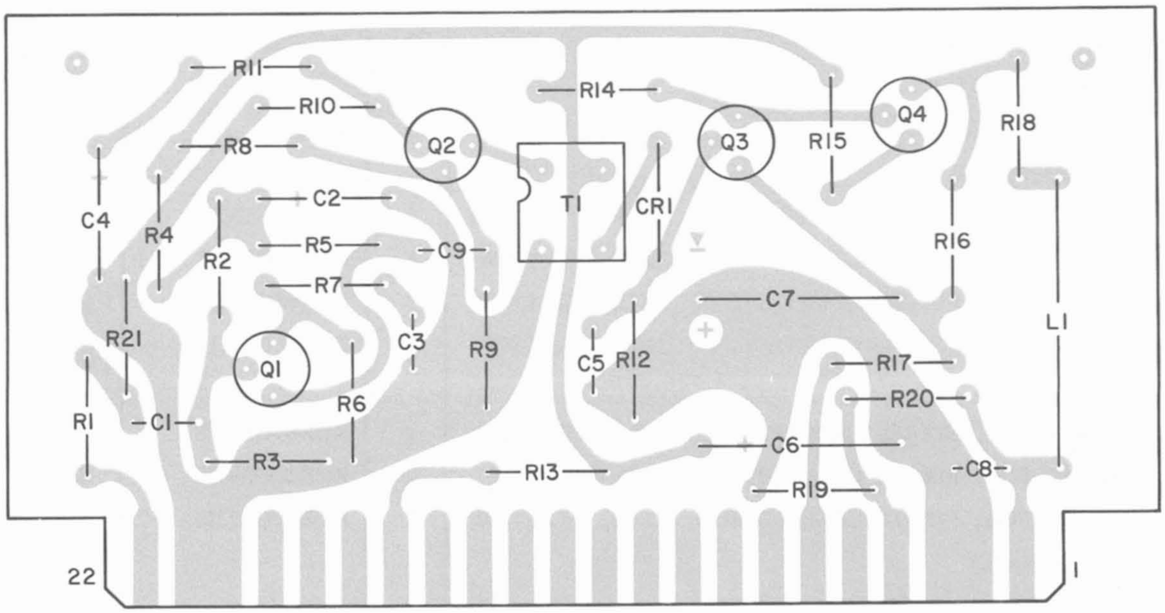


Figure 5-28. Type 72308 AM Demodulator (A22), Component Locations

5.4.24 Type 7448 Audio Amplifier REF DESIG PREFIX A23

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, ELECTROLYTIC, TANTALUM: 1.0 μF, 10%, 20V	3	CS13BF105K	81349	56289
C2	Same as C1				
C3	Same as C1				
C4	CAPACITOR, ELECTROLYTIC, TANTALUM: 0.47 μF, 10%, 35V	1	CS13BF474K	81349	56289
C5	CAPACITOR, ELECTROLYTIC, TANTALUM: 4.7 μF, 10%, 35V	1	CS13BF475K	81349	56289
C6	CAPACITOR, ELECTROLYTIC, TANTALUM: 10 μF, 10%, 20V	2	CS13BE106K	81349	56289
C7	Same as C6				
C8	CAPACITOR, ELECTROLYTIC, TANTALUM: 22 μF, 10%, 35V	2	CS13BF226K	81349	56289
C9	CAPACITOR, CERAMIC, TUBULAR: 3.0 pF, ± 0.25 pF, 500V	1	301-000C0J0-309C	72982	
C10	Same as C8				
Q1	TRANSISTOR	3	2N929	80131	04713
Q2	Same as Q1				
Q3	Same as Q1				
R1	RESISTOR, FIXED, COMPOSITION: 33 kΩ, 5%, 1/4W	6	RCR07G333JS	81349	01121
R2	Same as R1				
R3	Same as R1				
R4	Same as R1				
R5	Same as R1				
R6	Same as R1				
R7	RESISTOR, FIXED, COMPOSITION: 3.3 kΩ, 5%, 1/4W	1	RCR07G332JS	81349	01121
R8	RESISTOR, FIXED, COMPOSITION: 100 Ω, 5%, 1/4W	1	RCR07G101JS	81349	01121
R9	RESISTOR, FIXED, COMPOSITION: 3.0 Ω, 5%, 1/4W	1	RCR07G3R0JS	81349	01121
R10	RESISTOR, FIXED, COMPOSITION: 560 Ω, 5%, 1/4W	1	RCR07G561JS	81349	01121
T1	TRANSFORMER, AUDIO	1	124-5K	70674	01121
U1	INTEGRATED CIRCUIT	1	U5B771639X	07263	
XU1	SOCKET, INTEGRATED CIRCUIT	1	8058-1G49	91506	

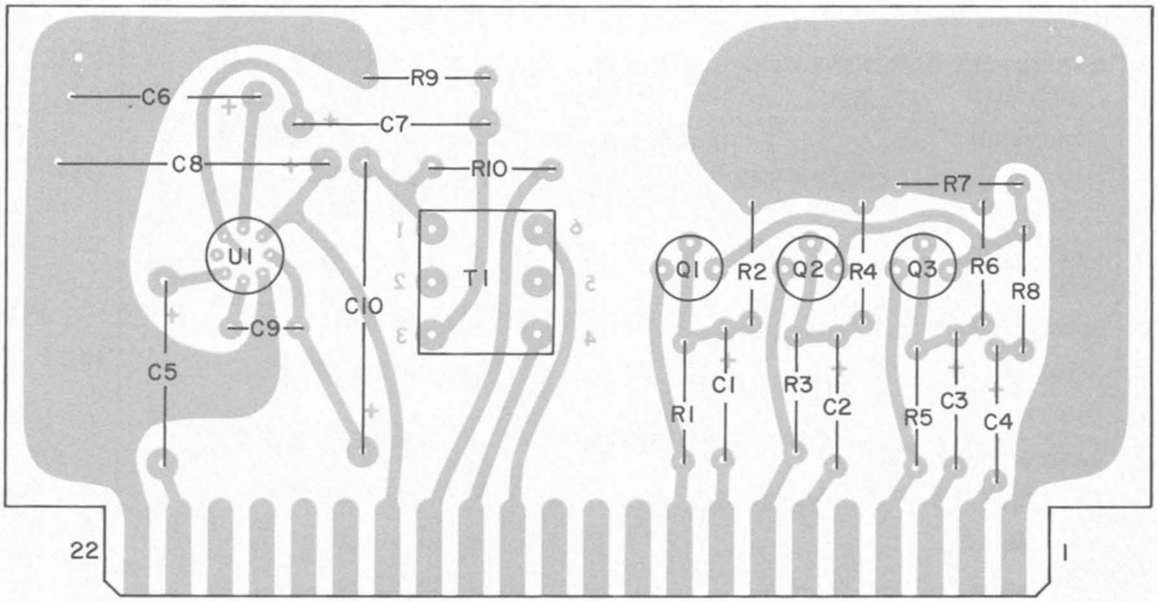


Figure 5-29. Type 7448 Audio Amplifier (A23), Component Locations

5.4.25 Type 79966 Input Transformer/High Pass Filter REF DESIG PREFIX A24

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	INPUT TRANSFORMER, HIGH PASS FILTER	1	16334-1	14632	
J1	CONNECTOR, RECEPTACLE	1	BJ77	14949	
J2	CONNECTOR, RECEPTACLE	1	UG1094U	80058	74868
J3	CONNECTOR, RECEPTACLE	1	46025	74868	
MP1	COVER, MARKED	1	16742-1	14632	

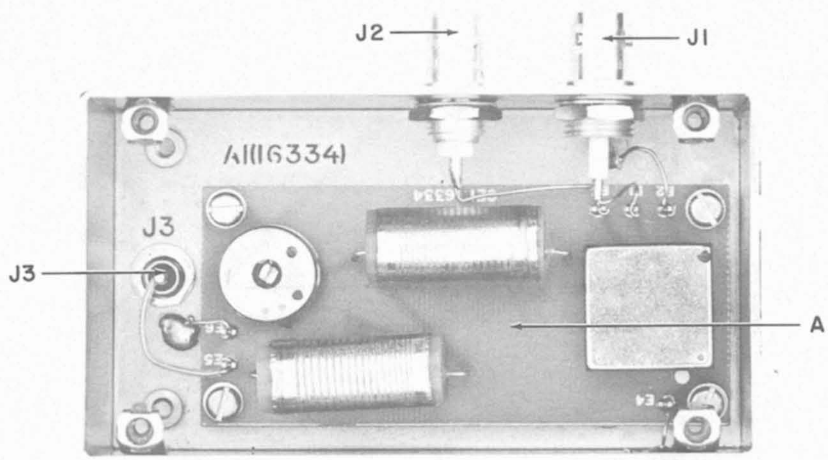


Figure 5-30. Type 79966 Input Transformer/
High Pass Filter (A24), Component Locations

5.4.25.1 Part 16334-1 Input Transformer/High Pass Filter REF DESIG PREFIX A24A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	CAPACITOR, PLASTIC, TUBULAR: 3.3 μF, 10%, 250V	2	B32231A3335K	25088	
C2	Same as C1				
L1	COIL, VARIABLE	1	30312-133	14632	
T1	TRANSFORMER	1	33009-1	14632	

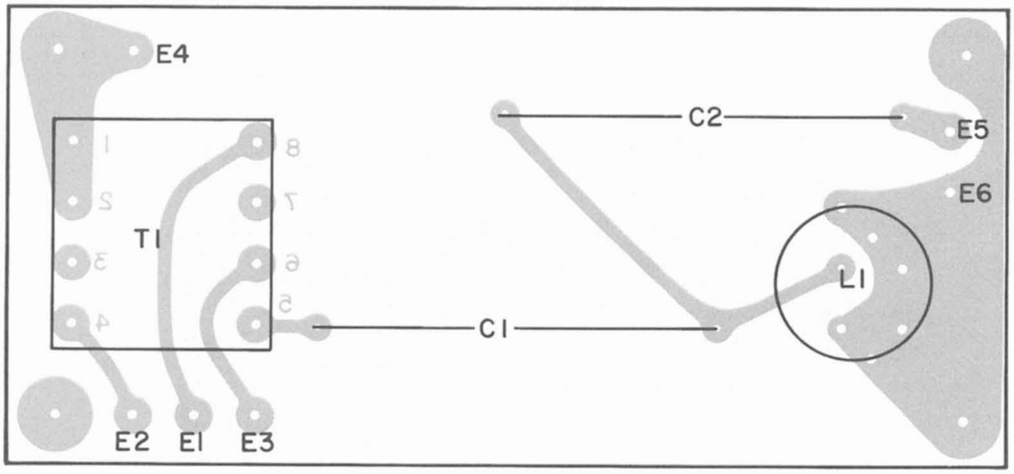


Figure 5-31. Part 16334-1 Input Transformer/ High Pass Filter (A24A1), Component Locations

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
1	FRONT PANEL	1	41599-1	14632	
2	BEARING/BALL	2	SFR1883PP	83086	
3	SPACER-TAPPED	4	20740-97	14632	
4	RING/RETAINING	1	5100-25	79136	
5	SHAFT	1	1002-98	14632	
6	COLLAR	2	11581-10	14632	
7	SPRING/TENSION	AR	3502-14-47	78189	
8	CLUTCH BEARING	2	11582-10	14632	
9	GEAR/SPUR	1	2984-19	14632	
10	THRUST BEARING	1	TT-504	70417	
11	REAR GEAR PLATE	1	22782-1	14632	
12	GEAR/ANTI-BACKLASH	1	20180-23	14632	
13	SET SCREW #4-40 x 1/8 LENGTH	AR	MS51021-9	96906	06540
14	POTENTIOMETER AND HARDWARE (R2)	REF	8106R10KL-25	80740	
15	SCREW/MACHINE PAN HEAD #6-32 x 3/8 LENGTH	AR	MS51957-28	96906	06540
16	WASHER/LOCK #6	AR	MS35338-136	96906	06540

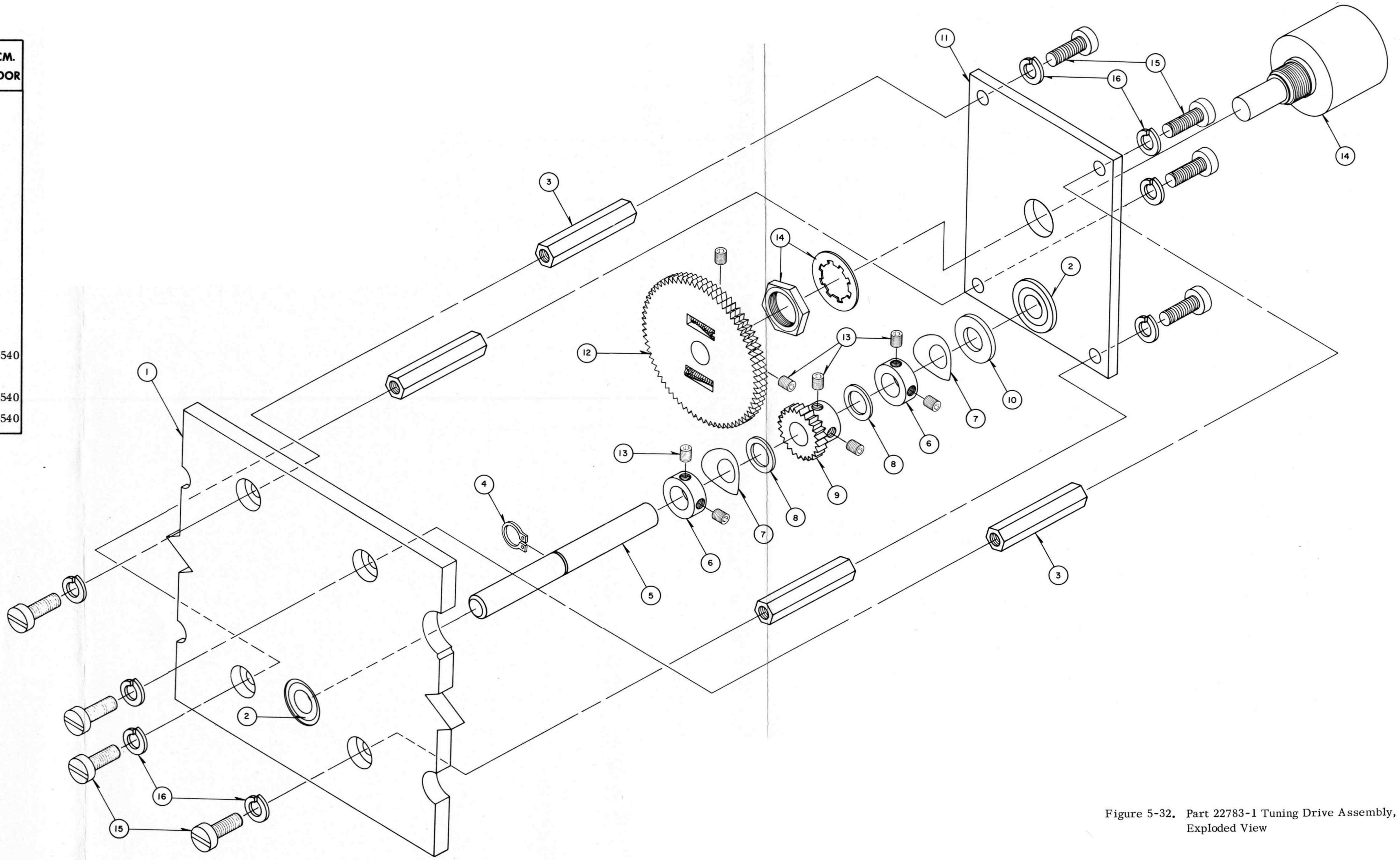
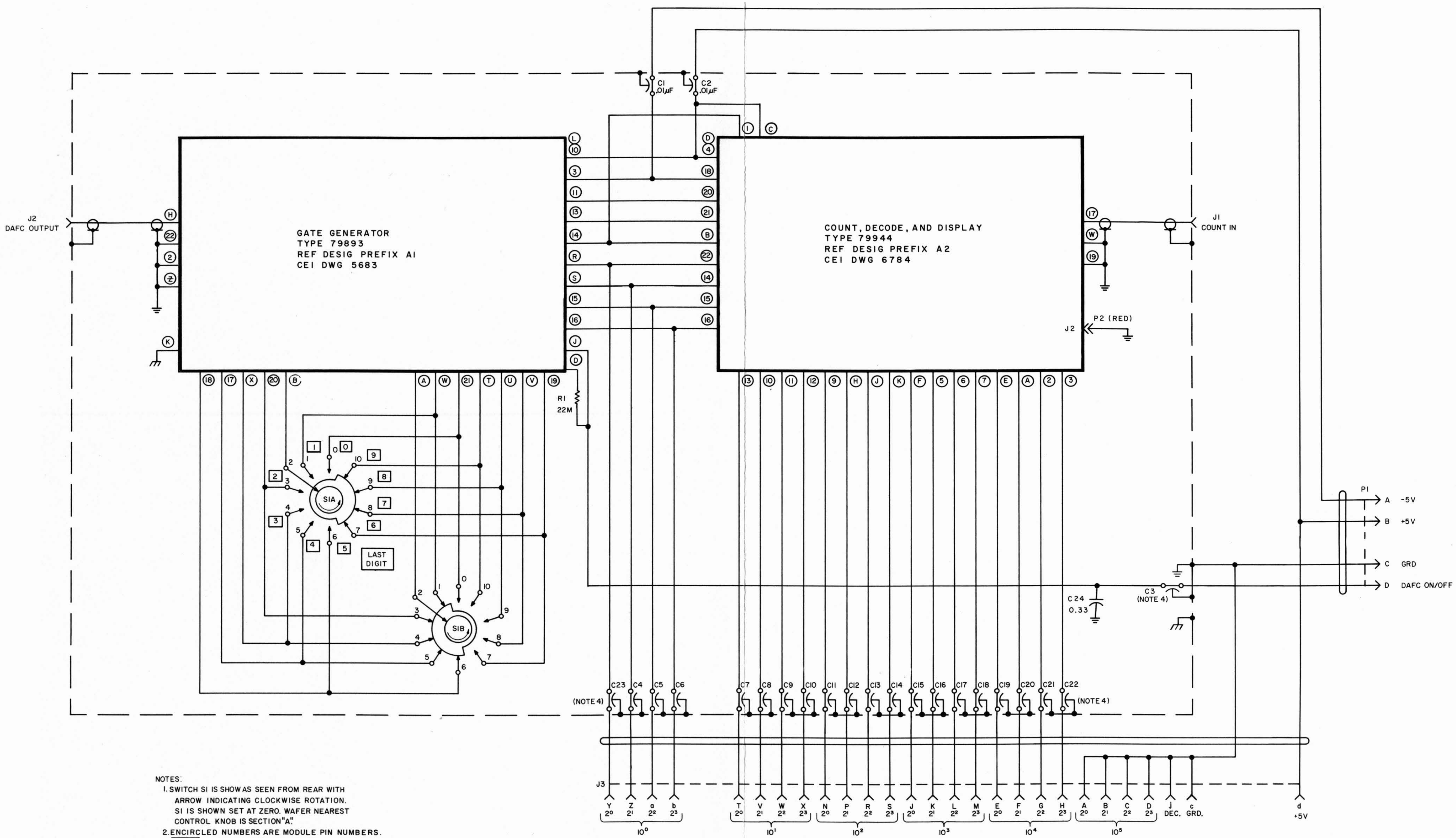


Figure 5-32. Part 22783-1 Tuning Drive Assembly, Exploded View

SECTION VI

SCHEMATIC DIAGRAMS



NOTES:

1. SWITCH S1 IS SHOWN AS SEEN FROM REAR WITH ARROW INDICATING CLOCKWISE ROTATION. S1 IS SHOWN SET AT ZERO. WAFER NEAREST CONTROL KNOB IS SECTION "A".
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
3. ▭ INDICATES FRONT PANEL CONTROL.
4. CAPACITORS C3 THRU C23 ARE .05μF.
5. DASH-1 OMIT C4 THRU C23 AND OMIT J3.

Figure 6-1. Type 79832-1 High Frequency Counter Assembly (A1), Schematic Diagram

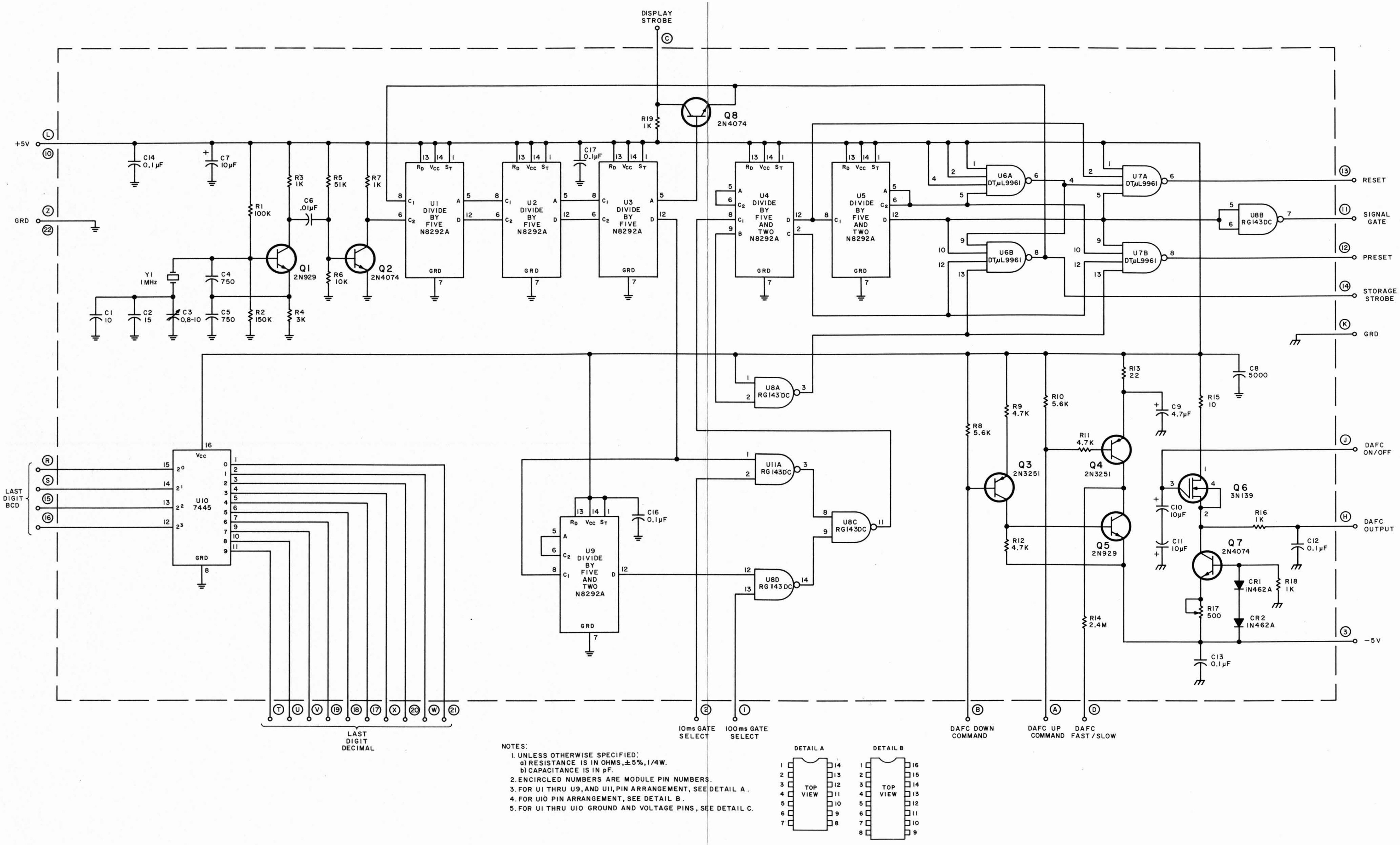


Figure 6-2. Type 79873 Gate Generator and DAFC (A1A1), Schematic Diagram

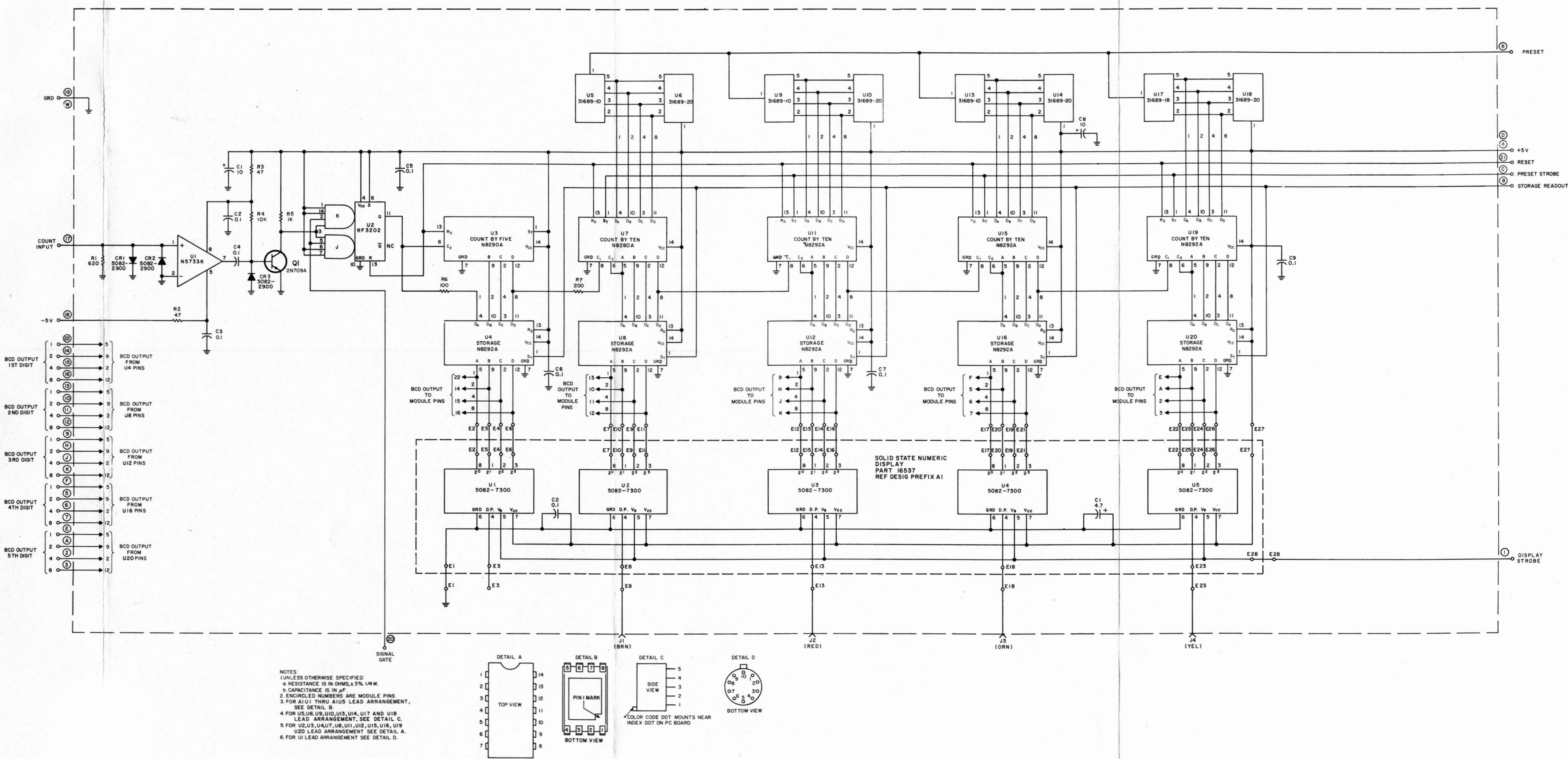
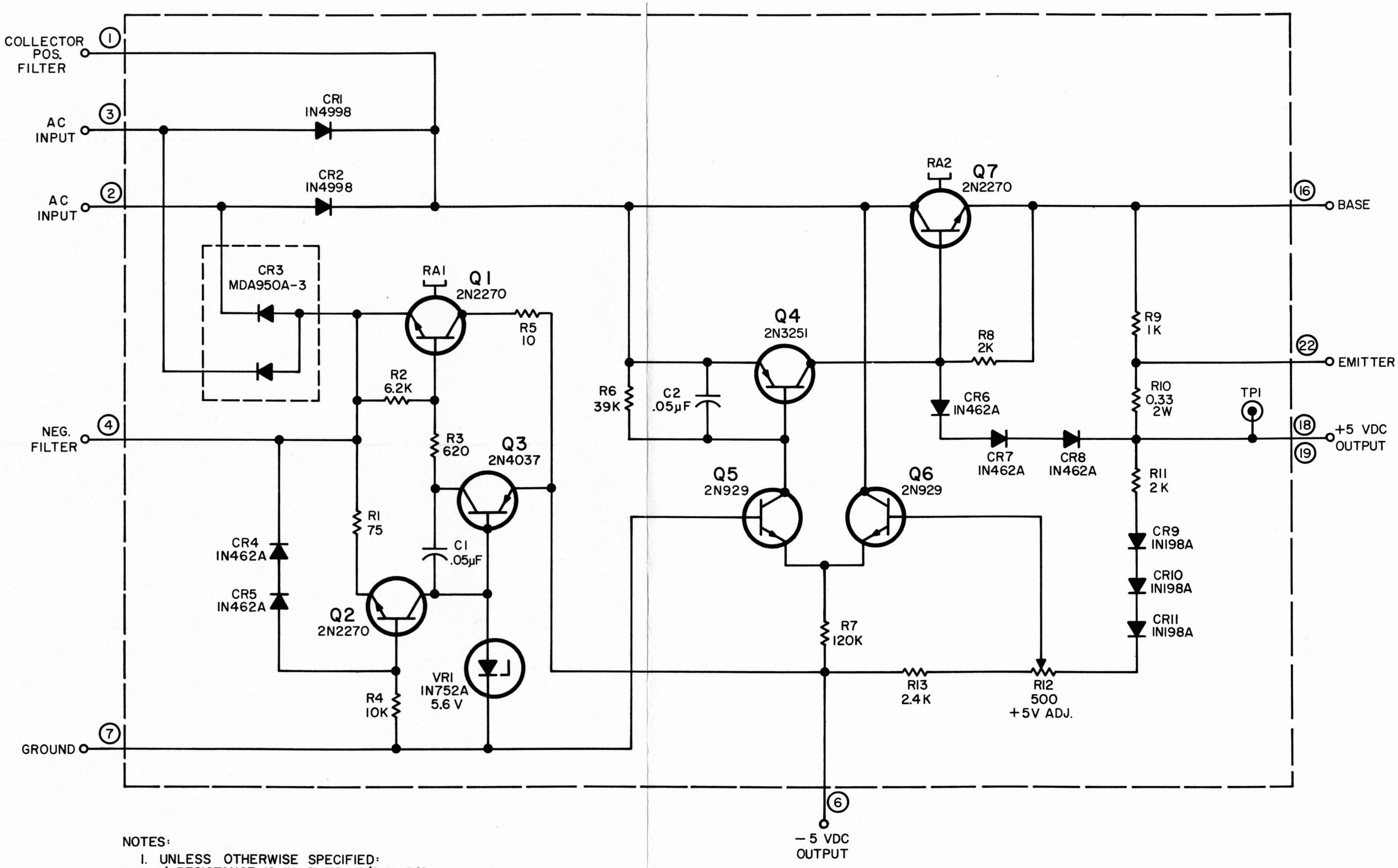
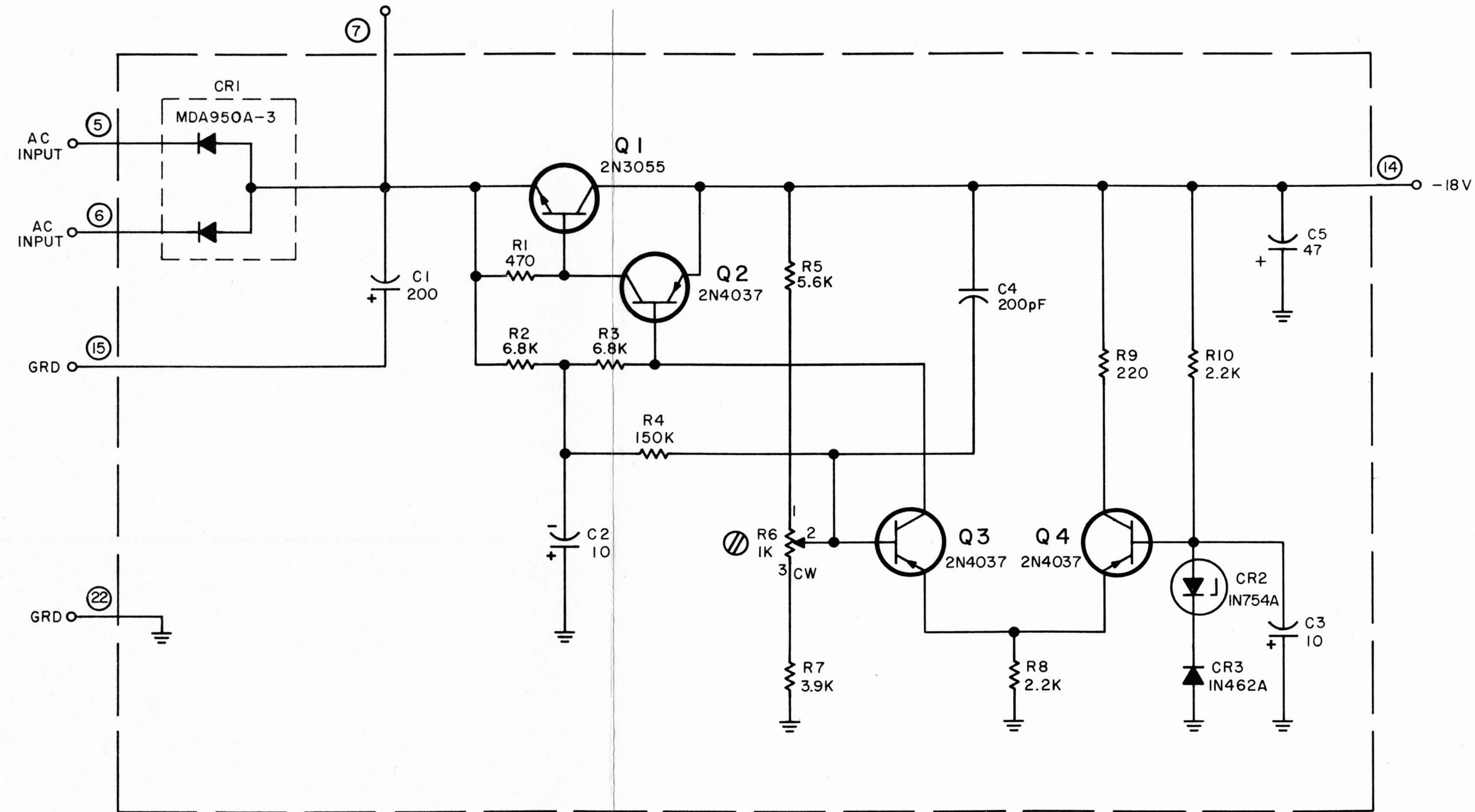


Figure 6-3. Type 79944 Count, Decode, and Display (A1A2), Schematic Diagram



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, 1/4 W, 5%.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.

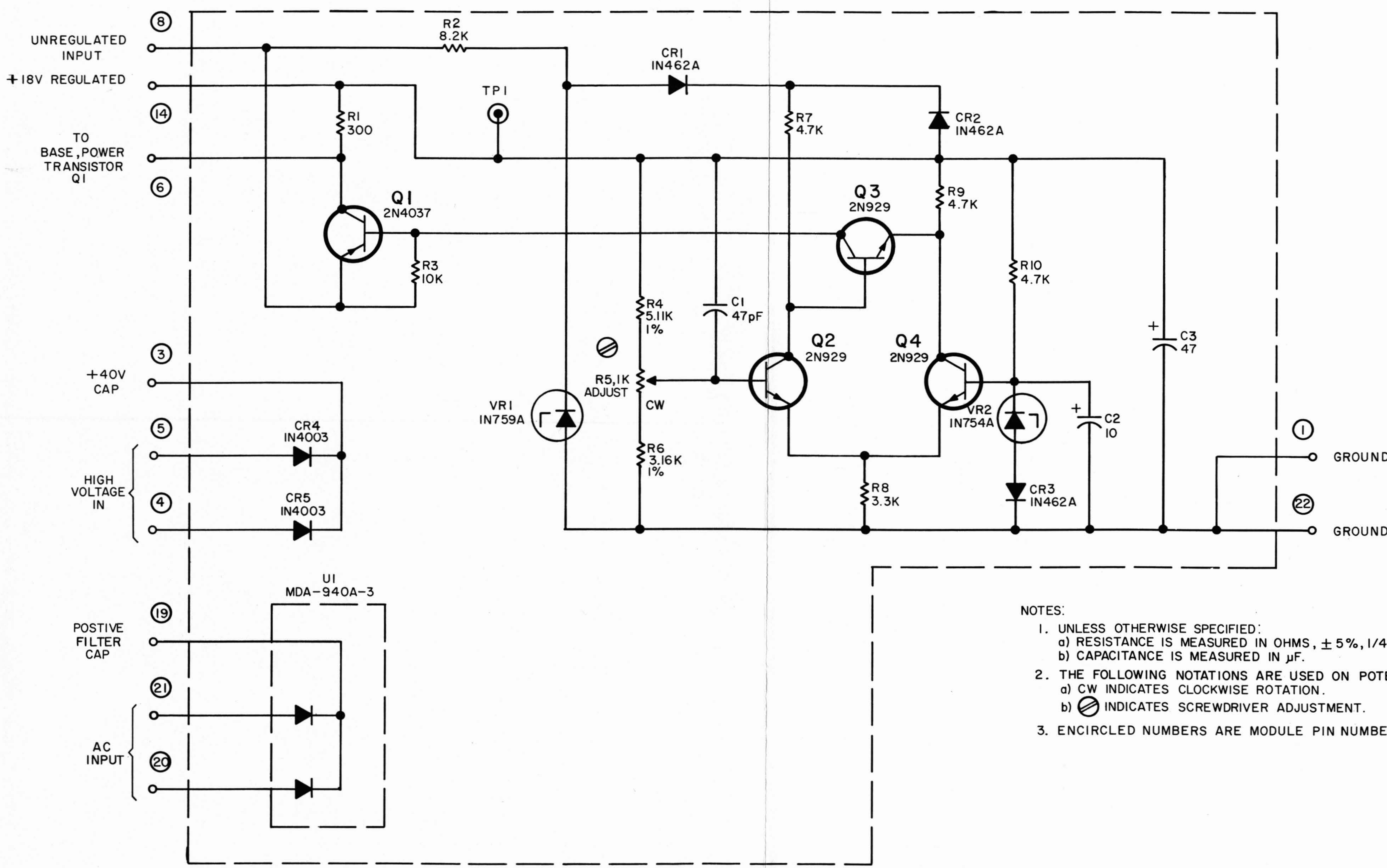
Figure 6-4. Type 76211 +5V and -5V Power Supply (A3), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. RESISTANCE IS MEASURED IN OHMS, ±5%, 1/4W.
   B. CAPACITANCE IS MEASURED IN μF.
2. THE FOLLOWING NOTATIONS ARE USED ON POTENTIOMETERS:
   CW INDICATES CLOCKWISE ROTATION
   ⊘ INDICATES SCREWDRIVER ADJUSTMENT.
3. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.

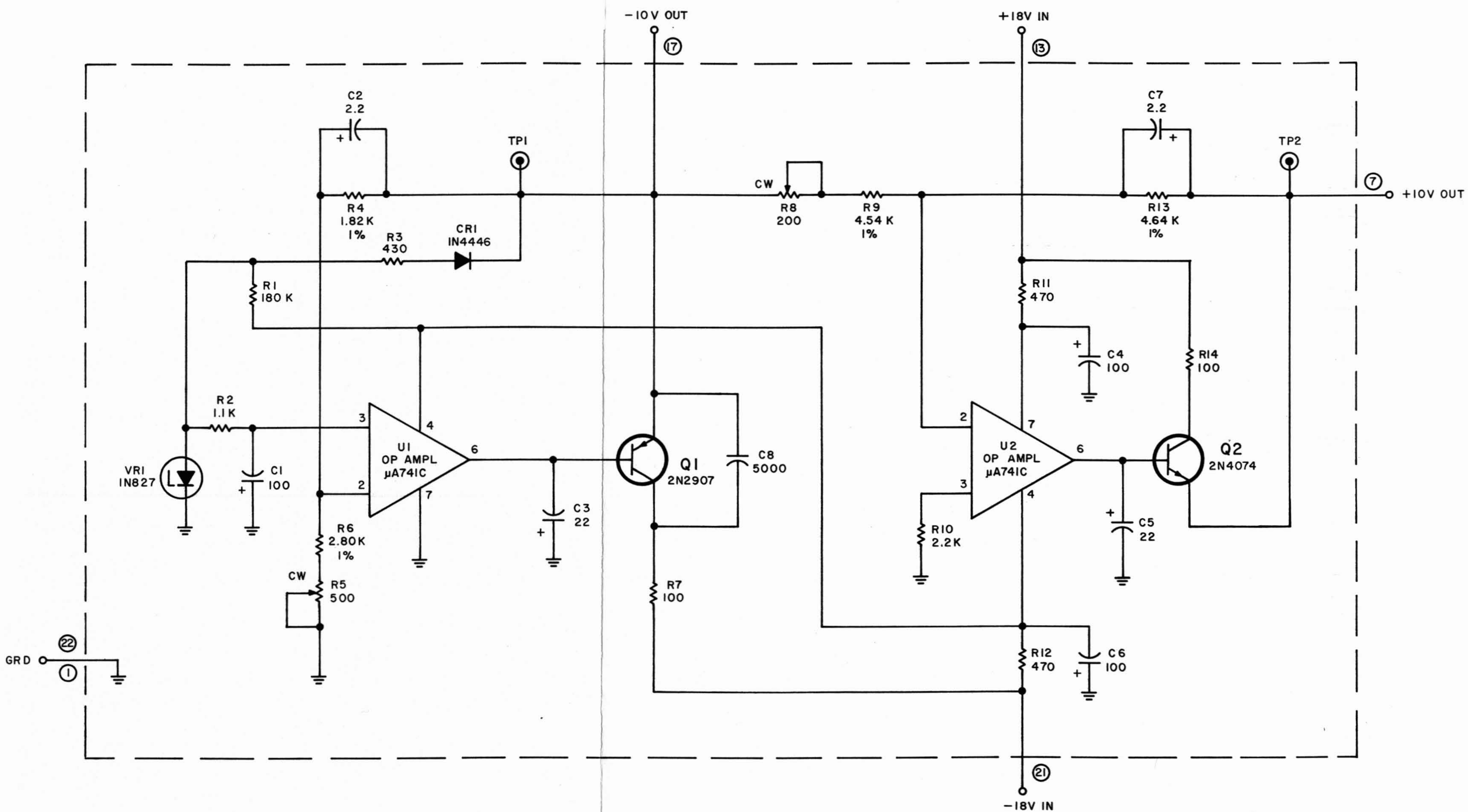
Figure 6-5. Type 76160 -18V Regulated Power Supply (A3), Schematic Diagram



NOTES:

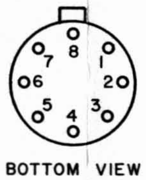
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS MEASURED IN OHMS, ±5%, 1/4 W.
   b) CAPACITANCE IS MEASURED IN μF.
2. THE FOLLOWING NOTATIONS ARE USED ON POTENTIOMETERS:
   a) CW INDICATES CLOCKWISE ROTATION.
   b) ⊘ INDICATES SCREWDRIVER ADJUSTMENT.
3. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.

Figure 6-6. Type 76181 +18V Regulated Power Supply (A4), Schematic Diagram



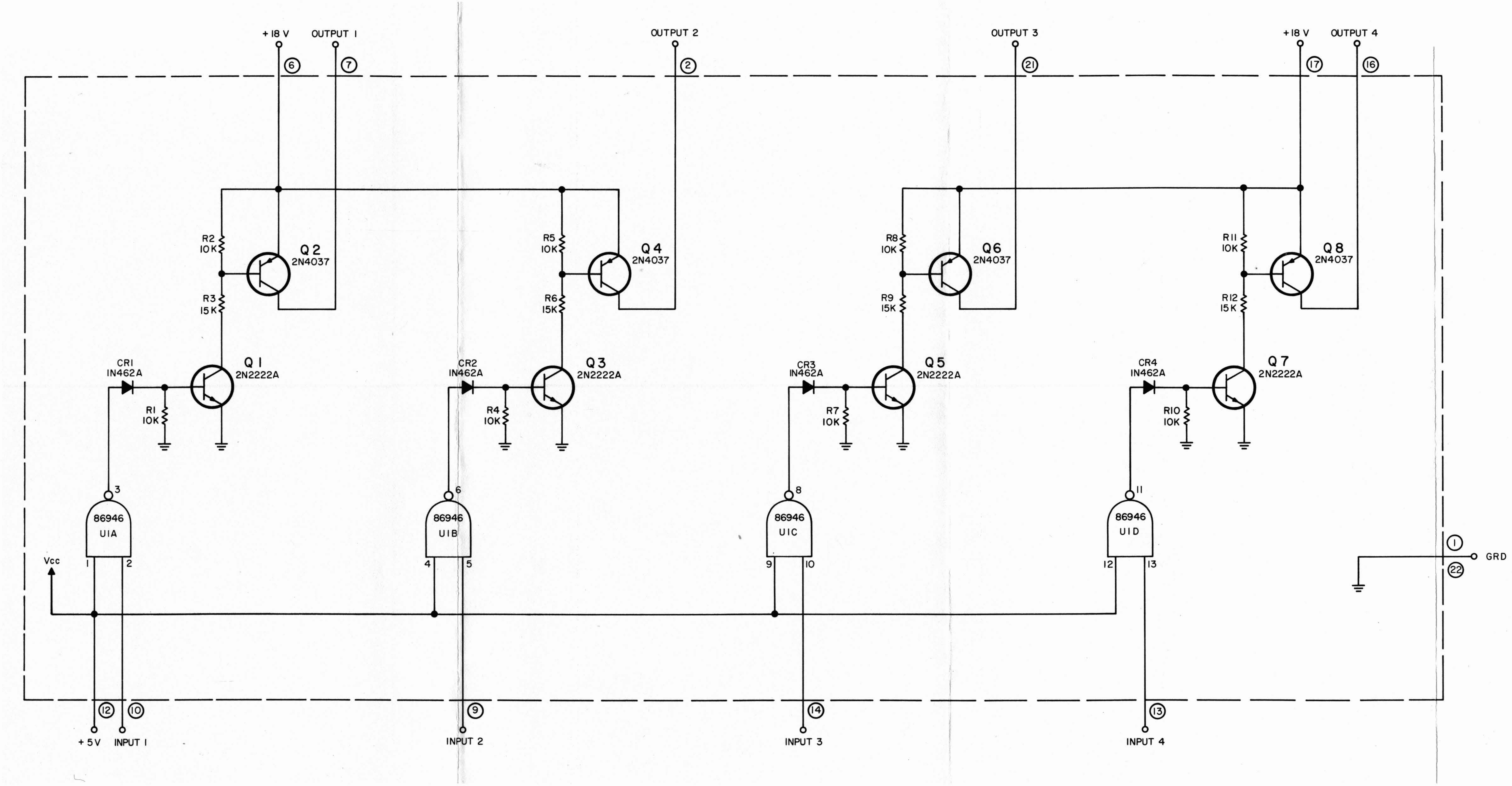
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
a) RESISTANCE IS MEASURED IN OHMS, ±5%, 1/4 W.
b) CAPACITANCE IS MEASURED IN μF.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
3. CW ON R5, AND R8 INDICATES CLOCKWISE ROTATION OF ACTUATOR.
4. FOR U1 AND U2 LEAD ARRANGEMENT SEE DETAIL A.

DETAIL A



BOTTOM VIEW

Figure 6-7. Type 76195 ±10V Precision Power Supply (A5), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, 1/4 W, 5%
2. FOR LEAD ARRANGEMENT OF U1 SEE DETAIL A.
3. Vcc AND GROUND CONNECTIONS TO U1 ARE SHOWN BELOW:

IC	Vcc	GRD
U1	14	7

4. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.

DETAIL A

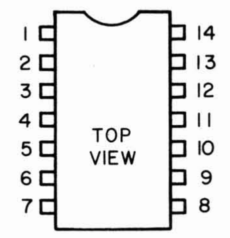


Figure 6-8. Type 79952 Bandwidth Control (A6), Schematic Diagram

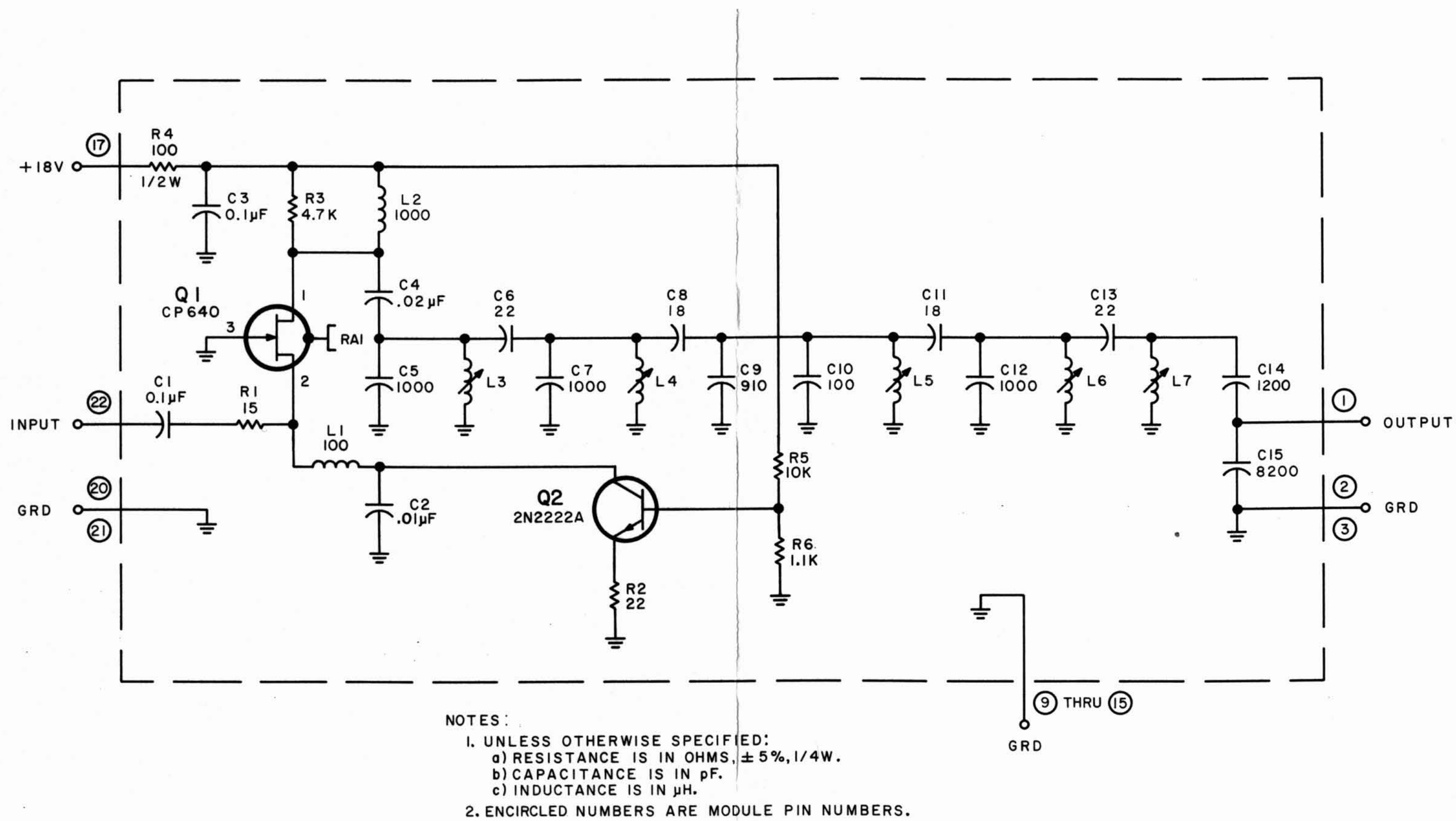


Figure 6-9. Type 72370 IF Driver Amplifier (A7), Schematic Diagram

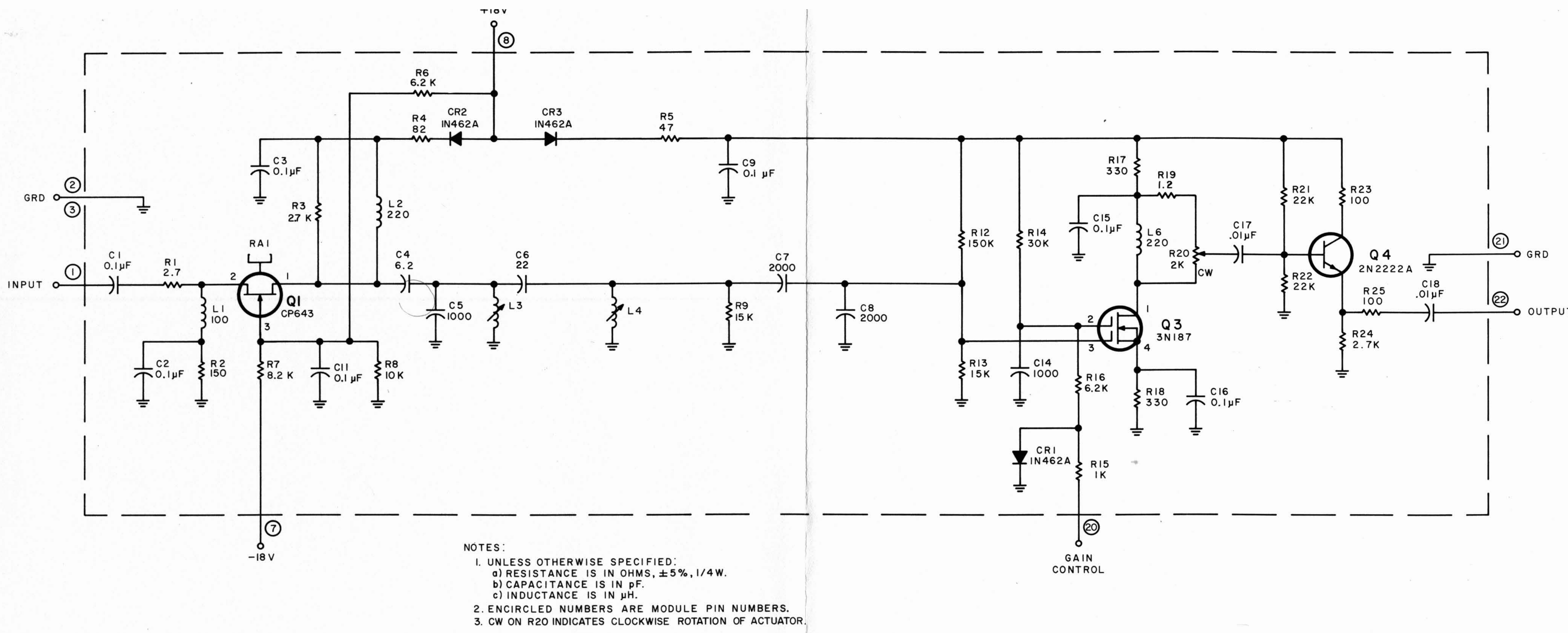
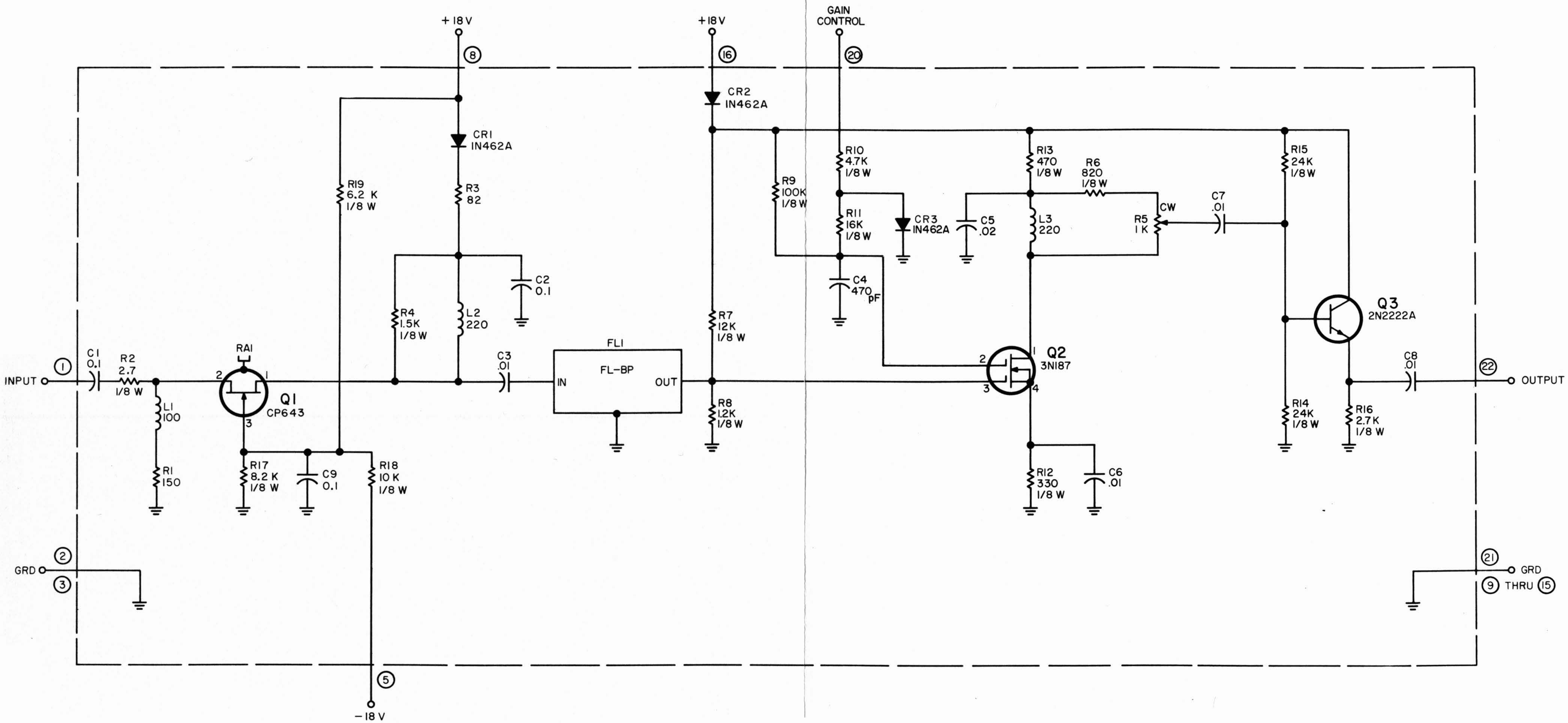


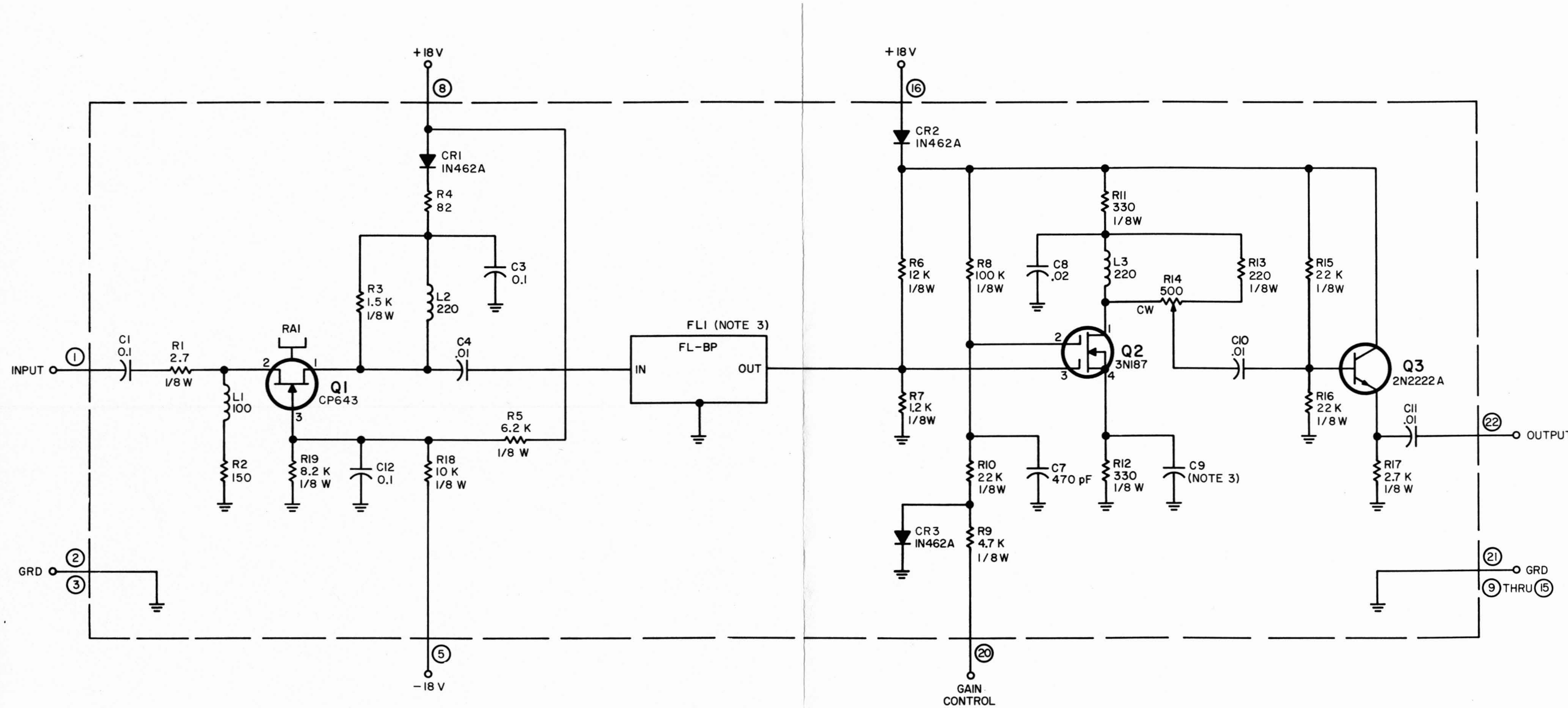
Figure 6-10. Type 72407 IF Amplifier (50 kHz) (A8), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4 W.
   b) CAPACITANCE IS IN μF.
   c) INDUCTANCE IS IN μH.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
3. CW ON R5 INDICATES CLOCKWISE ROTATION OF ACTUATOR.

Figure 6-11. Type 72408 IF Amplifier (20 kHz) (A9), Schematic Diagram



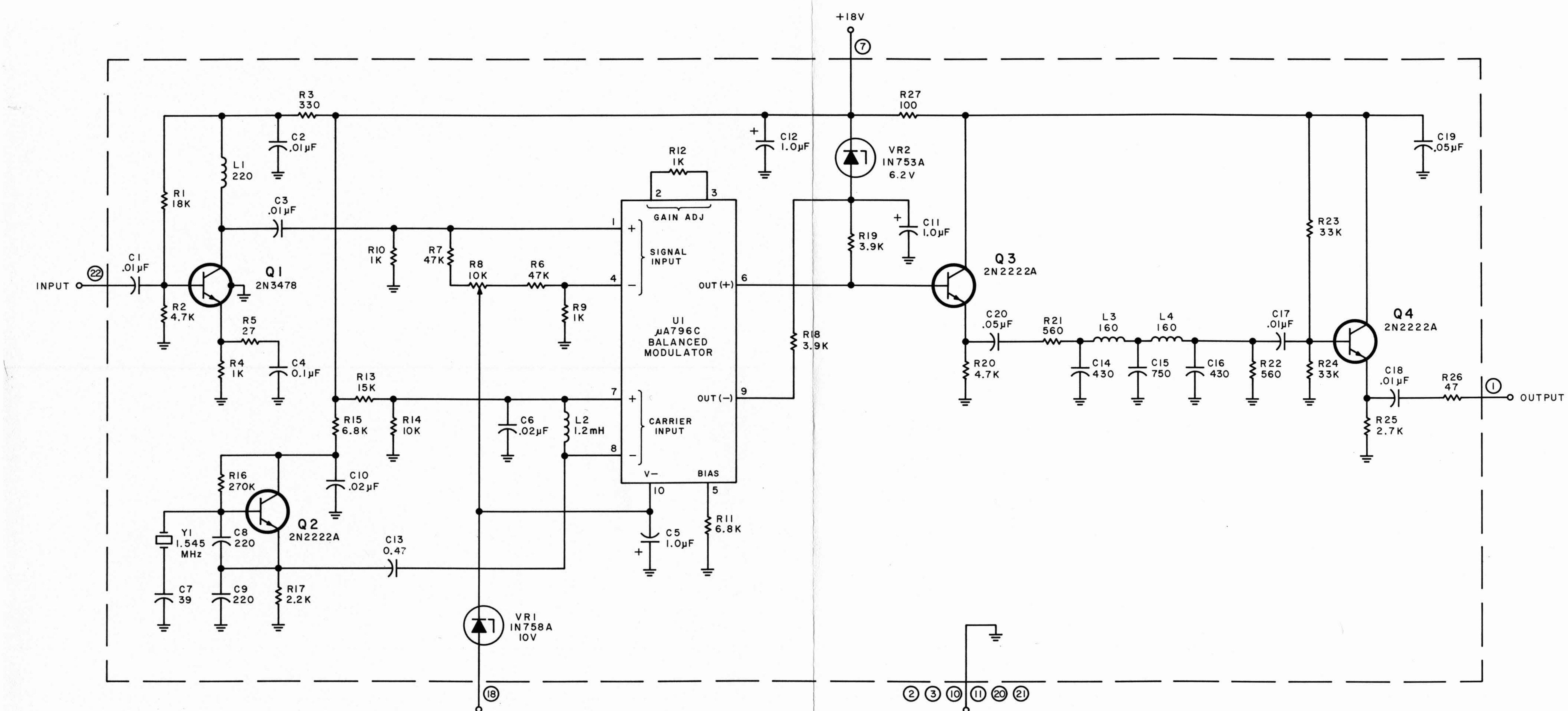
NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ± 5%, 1/4 W.
   b) CAPACITANCE IS IN μF.
   c) INDUCTANCE IS IN μH.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
3. DIFFERENCE BETWEEN TYPES IS AT FL1, AND C9 SEE DETAIL A.
4. CW ON R14 INDICATES CLOCKWISE ROTATION OF ACTUATOR.

DETAIL A

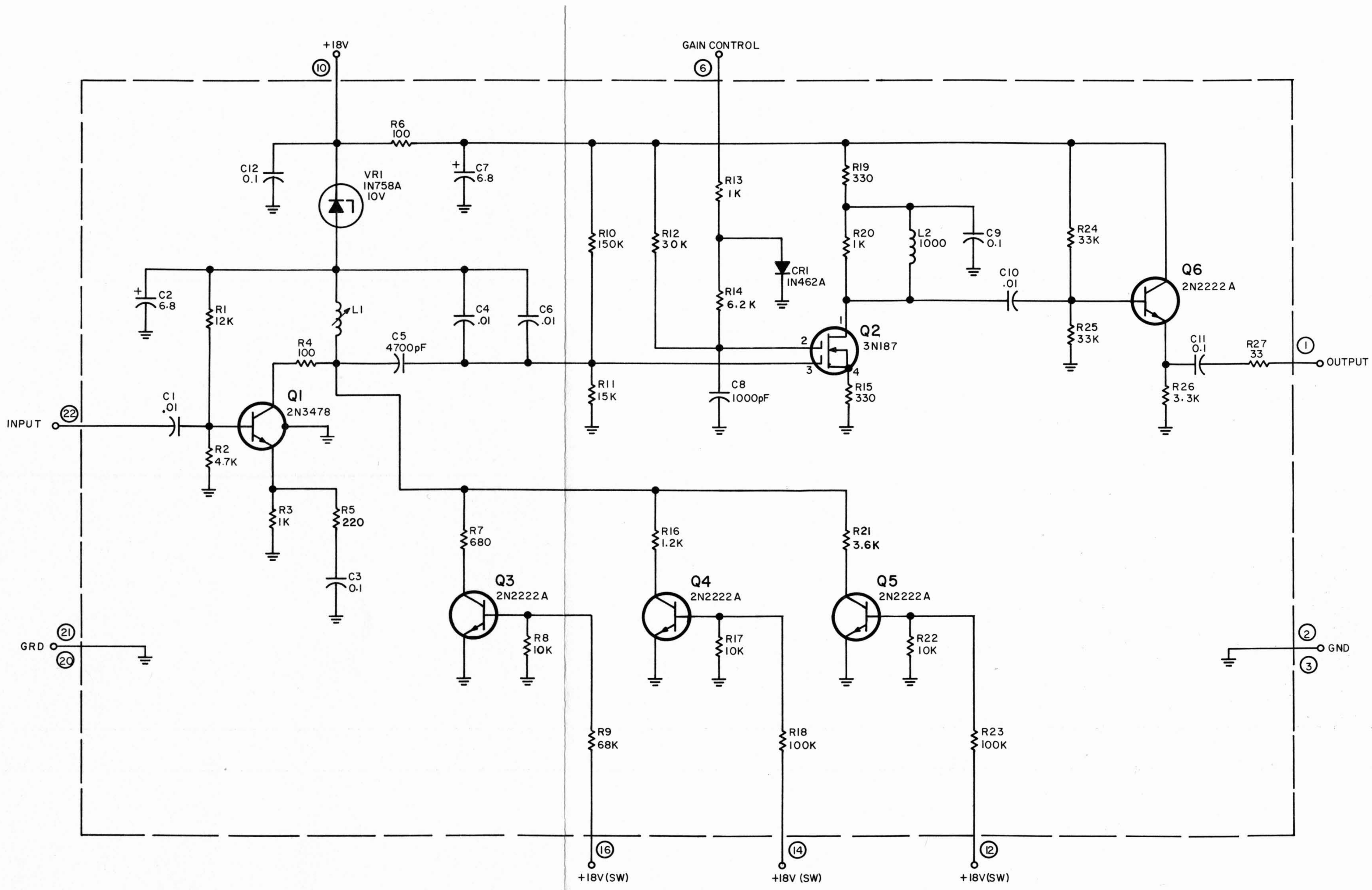
TYPE	FL1	BW	C9
72406 - 1	9710319	1 KHz	470 pF
72406 - 2	9710320	6 KHz	.02
72406 - 3	9720350	150Hz	.02
72406 - 4	6093693	3KHz	.02
72406 - 5	9720389	12 KHz	.02

Figure 6-12. Type 72406 IF Amplifier (6 kHz and 1 kHz) (A10, A11), Schematic Diagram



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
a) RESISTANCE IS IN OHMS, ±5%, 1/4
b) CAPACITANCE IS IN pF.
c) INDUCTANCE IS IN μH.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
3. FOR U1 LEAD ARRANGEMENT, SEE DETAIL A.

Figure 6-13. Type 7766 Second Converter (A12), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN μF
   c) INDUCTANCE IS μH
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS

Figure 6-14. Type 72362 455 kHz IF Amplifier (A13), Schematic Diagram

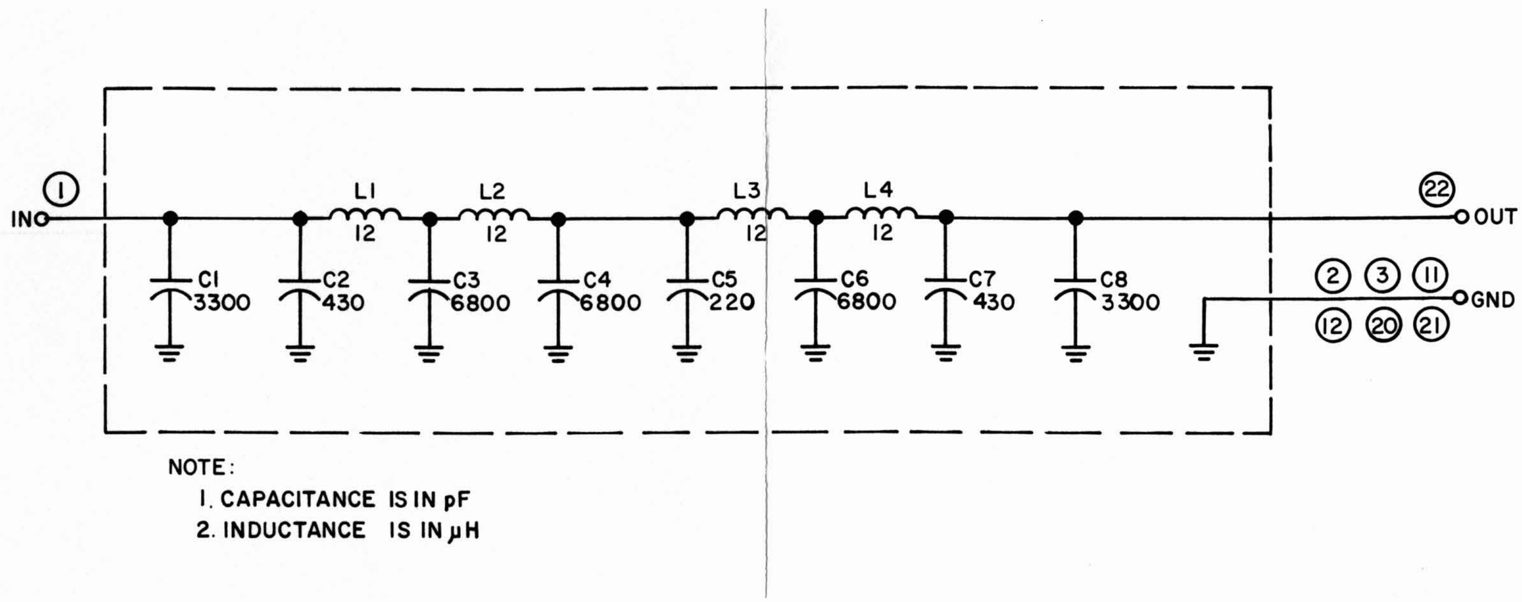
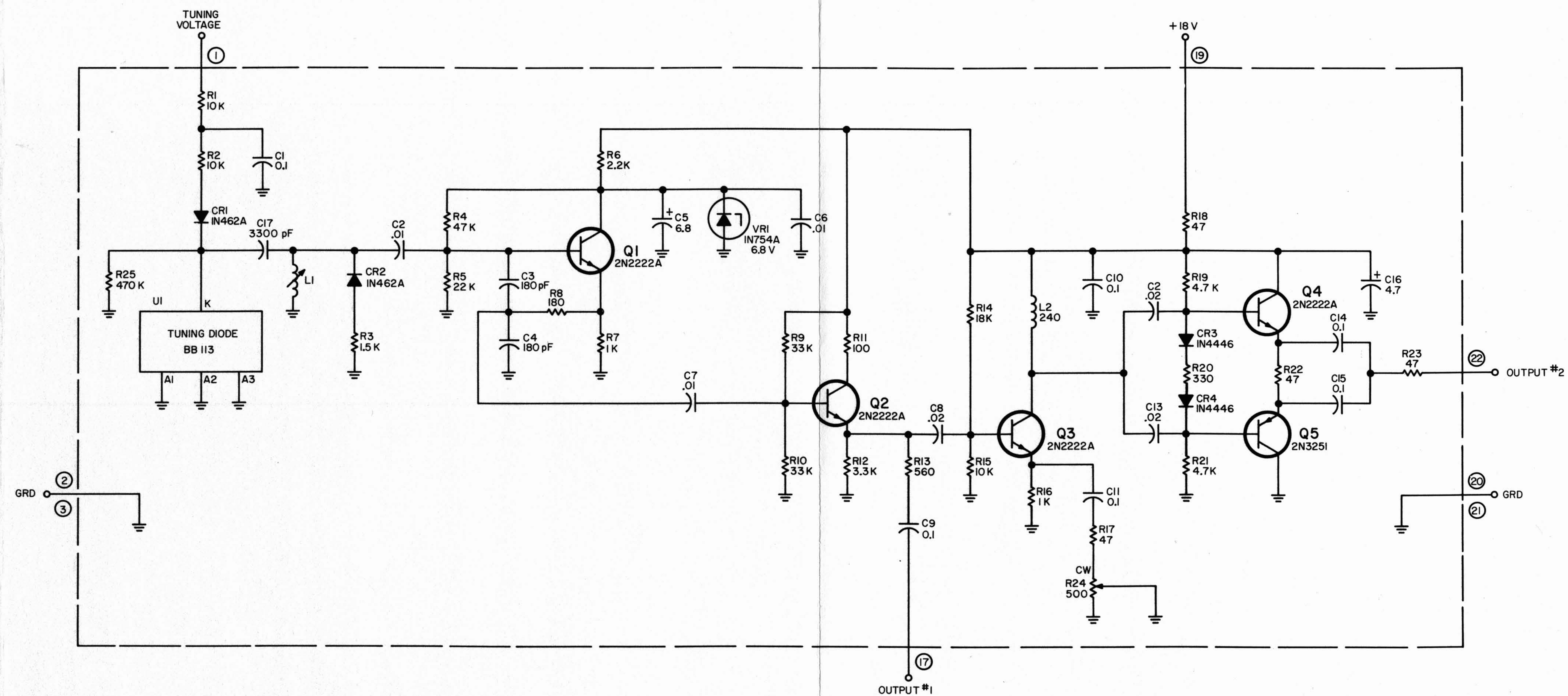


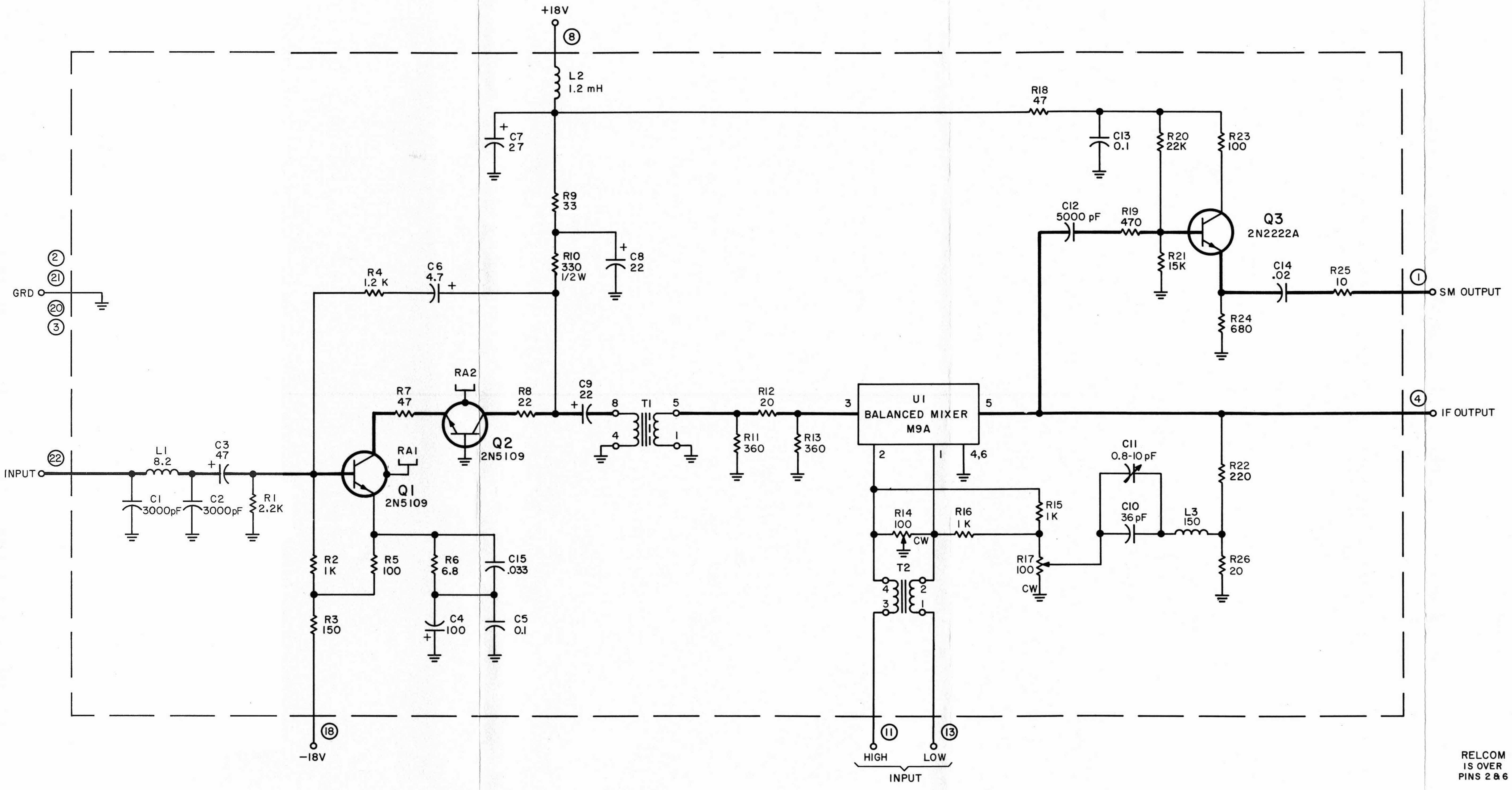
Figure 6-15. Type 79869 Low Pass Filter (A14), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4 W.
   b) CAPACITANCE IS IN μF.
   c) INDUCTANCE IS IN μH.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
3. CW ON POTENTIOMETERS INDICATES CLOCKWISE ROTATION OF ACTUATOR.

Figure 6-16. Type 7768 Variable Frequency Oscillator (A15), Schematic Diagram

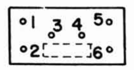


NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a.) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b.) CAPACITANCE IS IN μF.
   c.) INDUCTANCE IS IN μH.
2. HEAVY LINE INDICATES MAIN SIGNAL PATH.
3. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
4. PIN ARRANGEMENT OF U1 IS SHOWN IN DETAIL A.
5. CW ON R14, R17 INDICATES CLOCKWISE ROTATION OF ACTUATOR.

DETAIL A

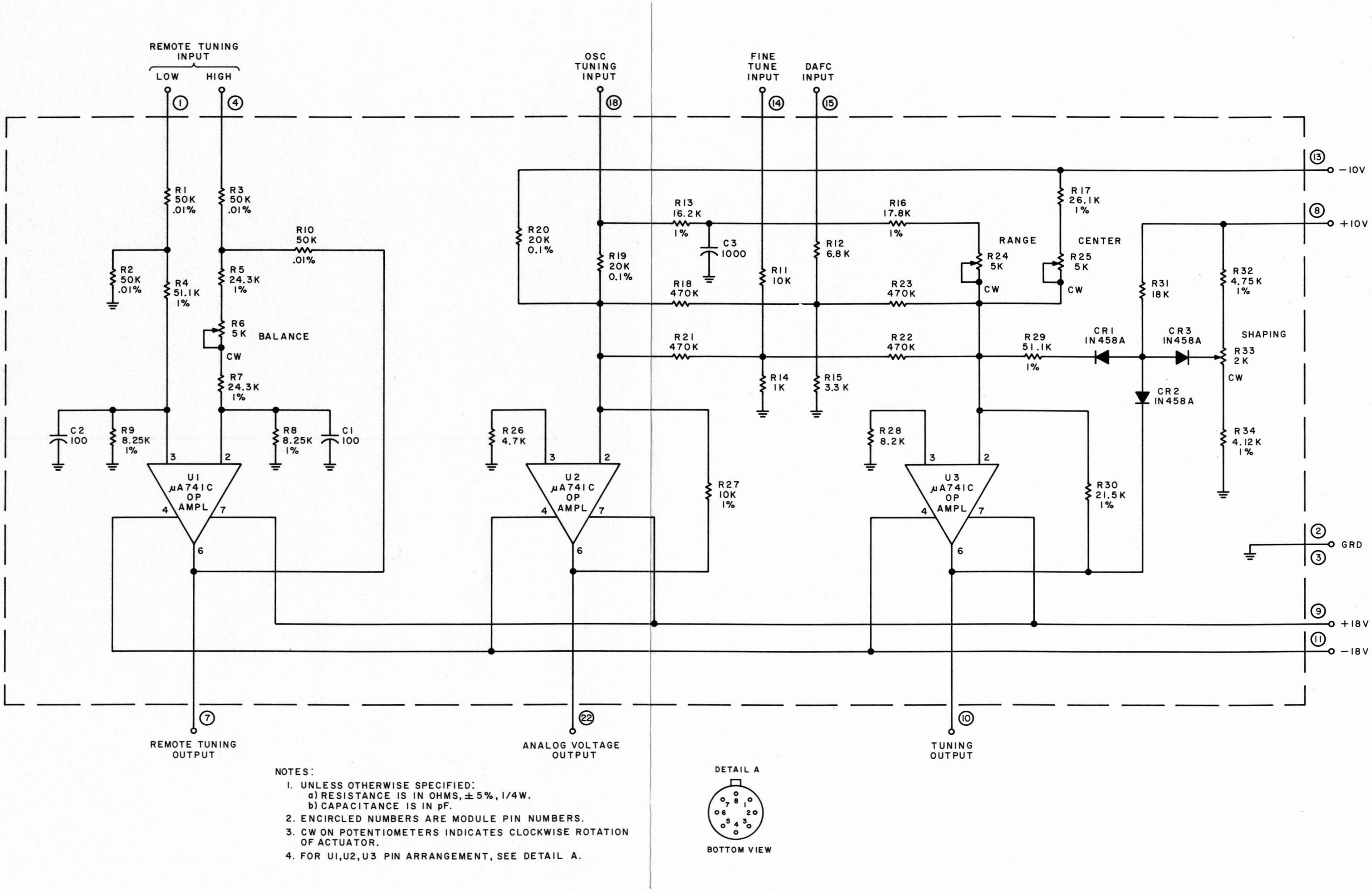
RELCOM IS OVER PINS 2 & 6



BOTTOM VIEW

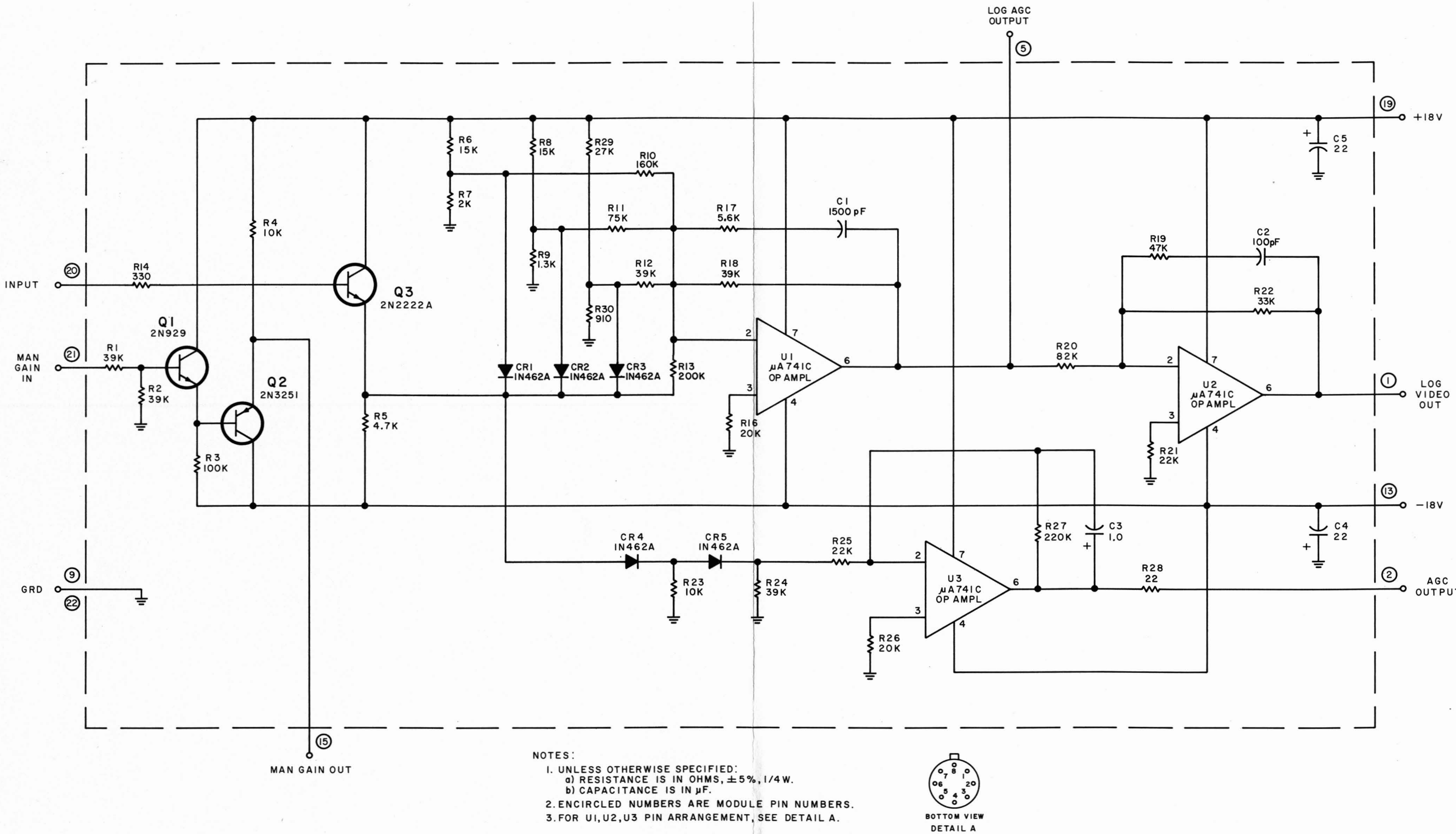
HIGHEST REF DESIG USED	REF DESIG NOT USED
C14	–
R26	–
L3	–
Q3	–
U1	–
RA2	–
T2	–

Figure 6-17. Type 71372 Input Converter (A16), Schematic Diagram



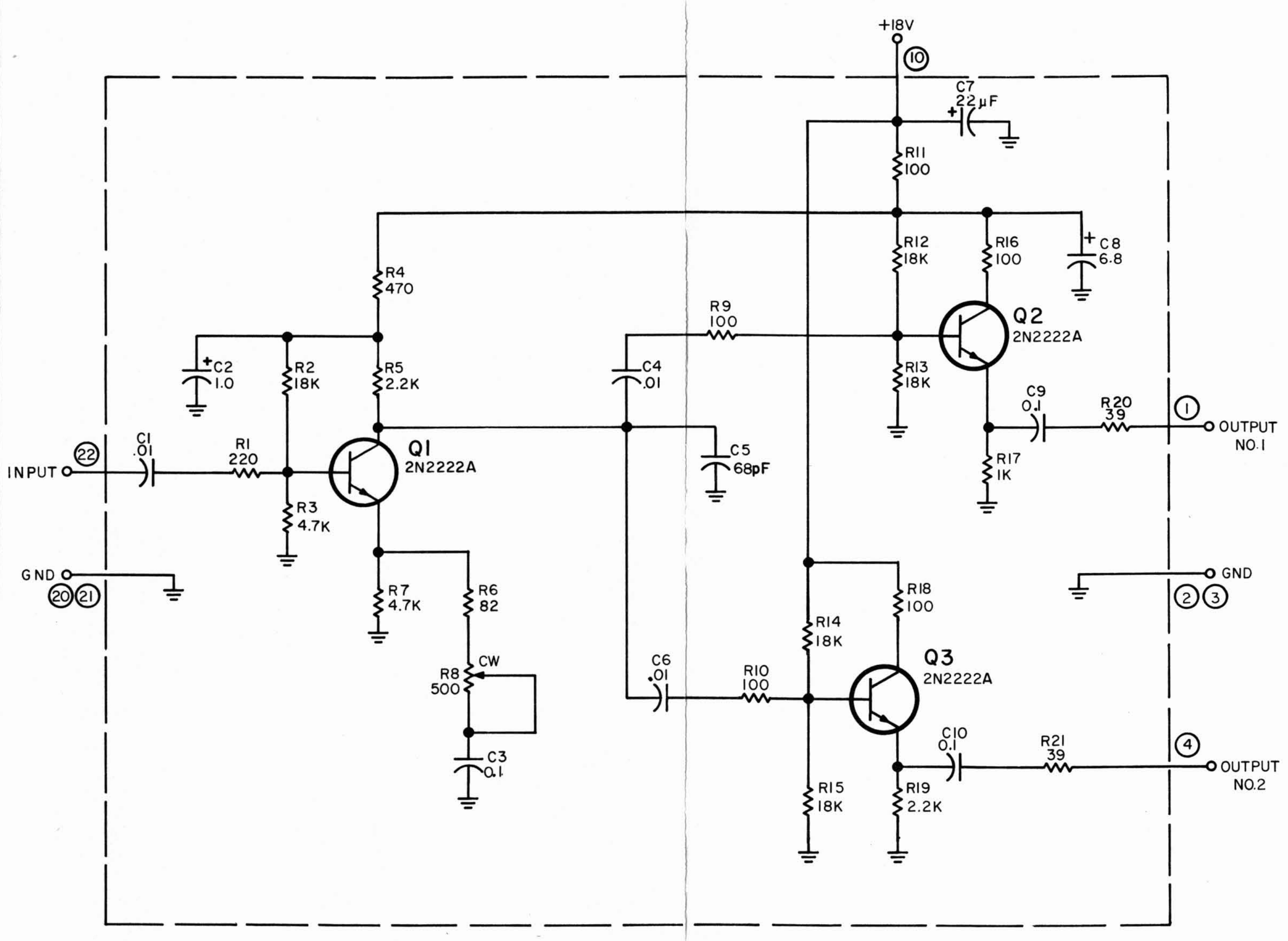
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN pF.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
3. CW ON POTENTIOMETERS INDICATES CLOCKWISE ROTATION OF ACTUATOR.
4. FOR U1, U2, U3 PIN ARRANGEMENT, SEE DETAIL A.

Figure 6-18. Type 79969 VFO Control (A17), Schematic Diagram



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4 W.
   b) CAPACITANCE IS IN μF.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
3. FOR U1, U2, U3 PIN ARRANGEMENT, SEE DETAIL A.

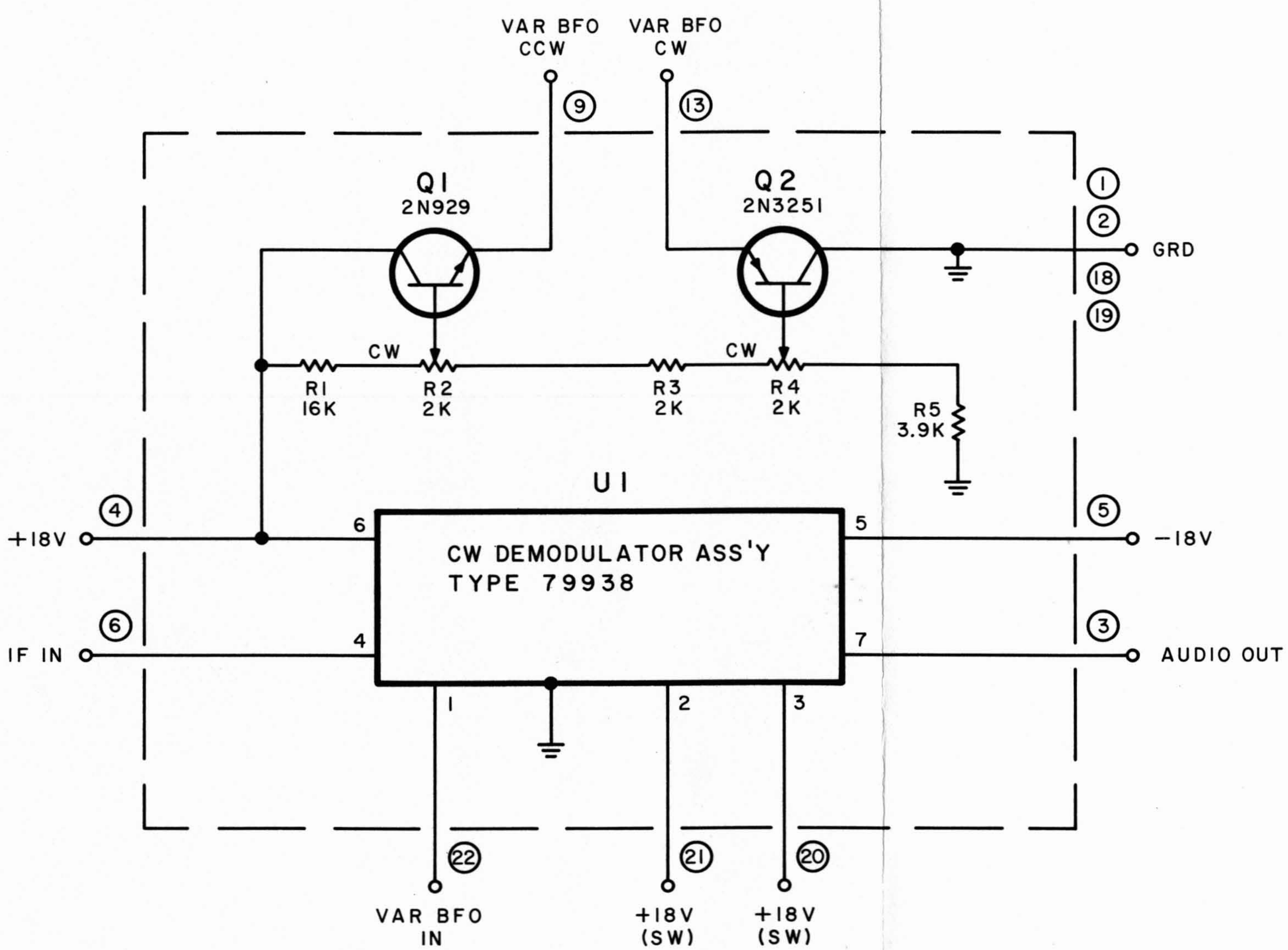
Figure 6-19. Type 79983 Gain Control (A18), Schematic Diagram



NOTES:

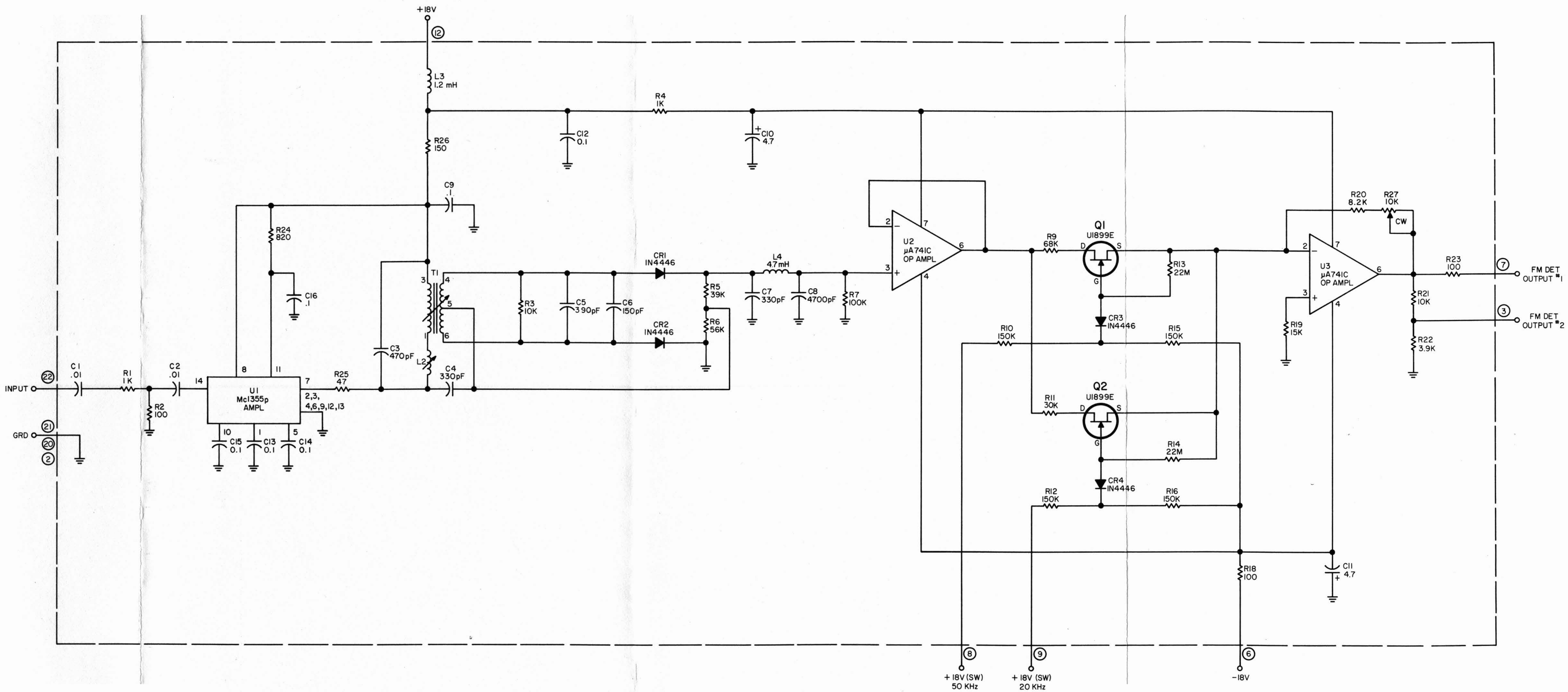
1. UNLESS OTHERWISE SPECIFIED
   a) CAPACITANCE IS IN µF
   b) RESISTANCE IS IN OHMS, 5%, 1/4W

Figure 6-20. Type 72360 IF Buffer (A19), Schematic Diagram

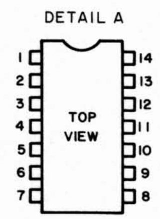


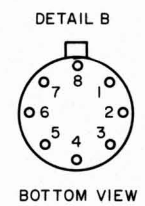
NOTES:
1. RESISTANCE IS IN OHMS, ±5%, 1/4W.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
3. CW ON R2 AND R4 INDICATES CLOCKWISE ROTATION OF ACTUATOR.

Figure 6-21. Type 79953 CW Demodulator (A20), Schematic Diagram



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4 W.
   b) CAPACITANCE IS IN μF.
   c) INDUCTANCE IS IN μH.
2. FOR U1 PIN ARRANGEMENT, SEE DETAIL A.
3. FOR U2 & U3 PIN ARRANGEMENT, SEE DETAIL B.
4. FOR Q1 & Q2 LEAD ARRANGEMENT, SEE DETAIL C.
5. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.





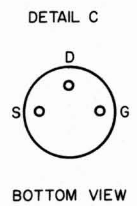
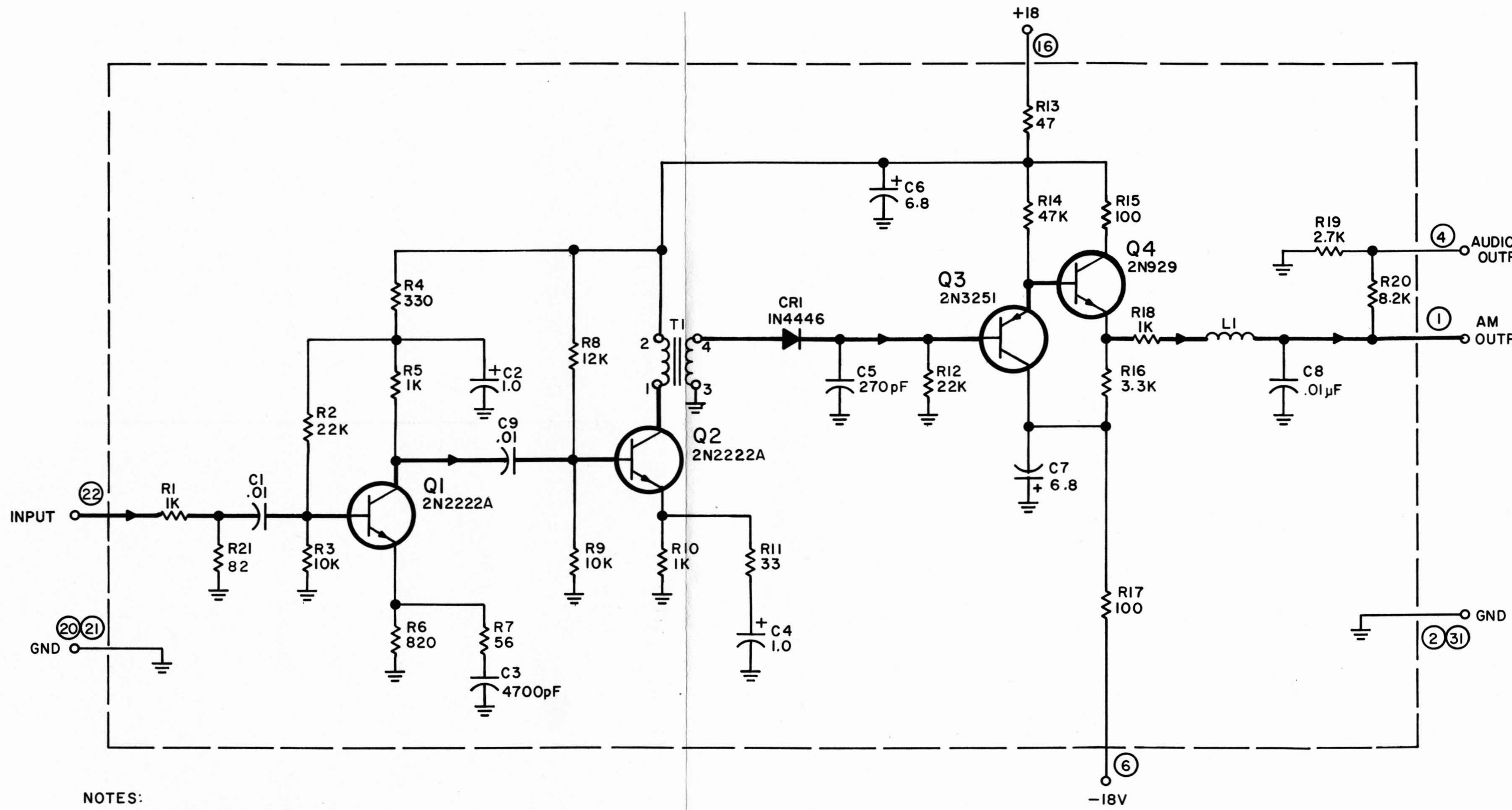


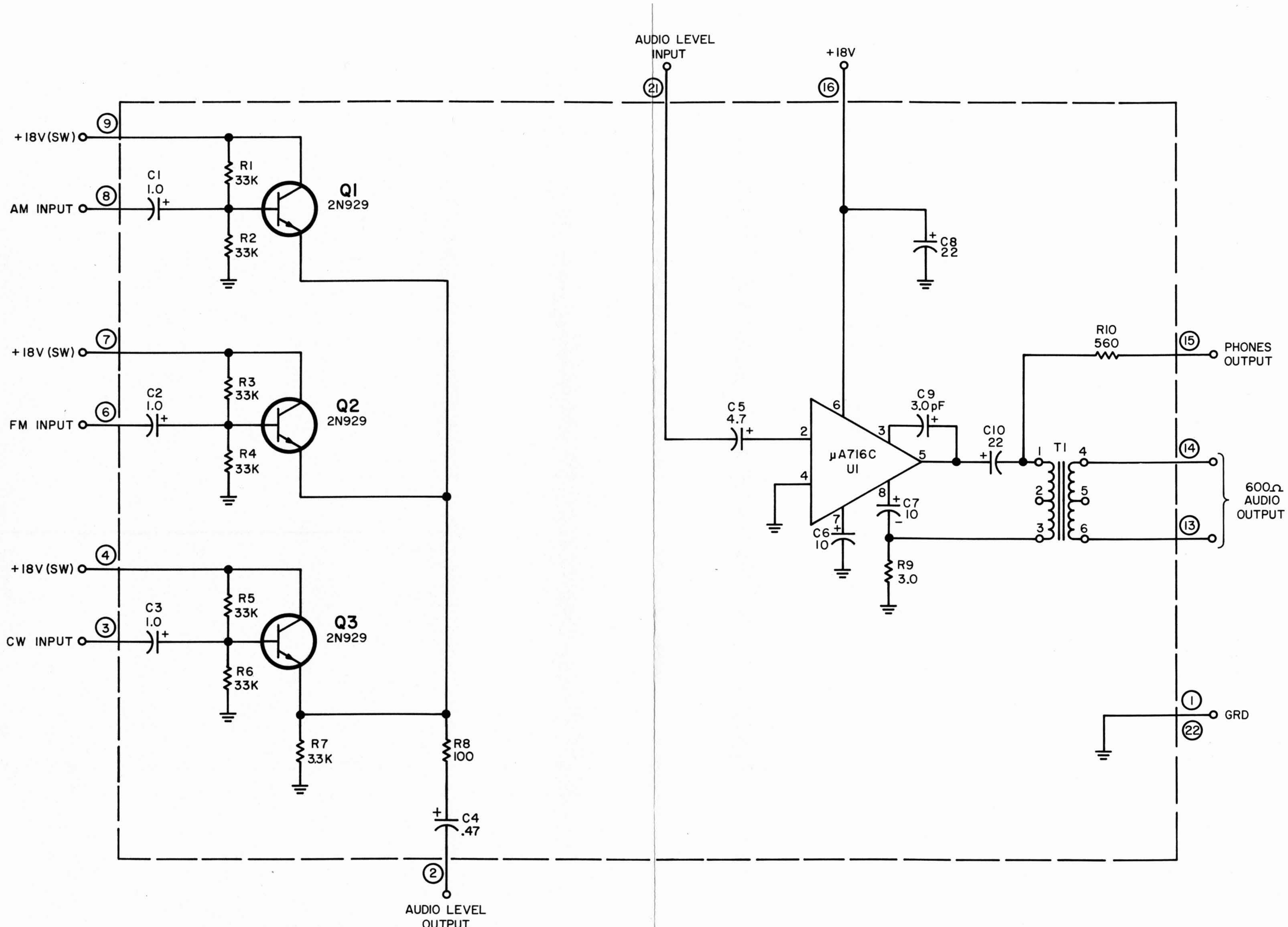
Figure 6-22. Type 79933 FM Demodulator (A21), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE ARE MEASURED IN OHMS, ±5%, 1/4W
   b) CAPACITANCE ARE MEASURED IN μF.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS
3. HEAVY LINE INDICATES MAIN SIGNAL PATH

Figure 6-23. Type 72308 AM Demodulator (A22), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED.
   a) RESISTANCE IS IN OHMS, 1/4 W, 5%.
   b) CAPACITANCE IS IN µF.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
3. FOR LEAD ARRANGEMENT OF U1 SEE DETAIL A.

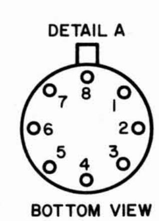
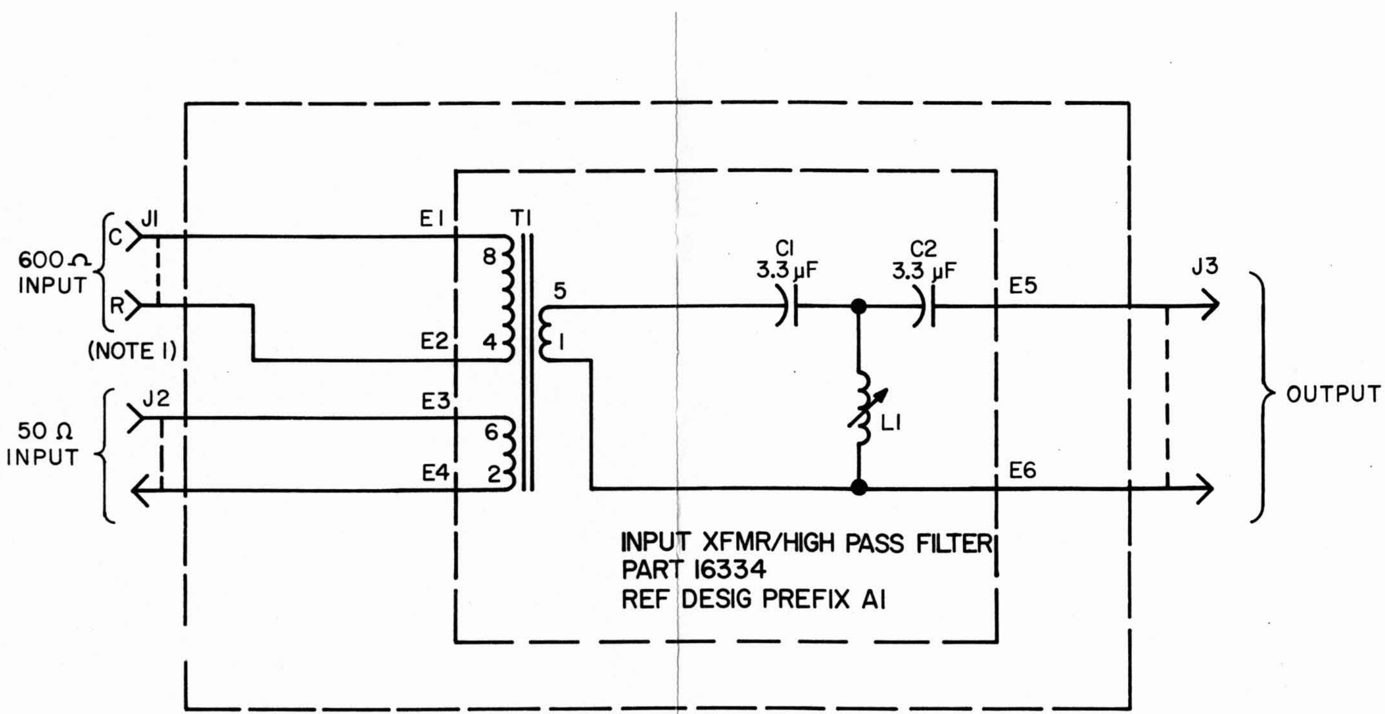


Figure 6-24. Type 7448 Audio Amplifier (A23), Schematic Diagram



NOTE:

1. J1 PIN CONNECTIONS:
   a) C INDICATES CENTER CONDUCTOR.
   b) R INDICATES RING.

Figure 6-25. Type 79966 Input Transformer/High Pass Filter (A24), Schematic Diagram

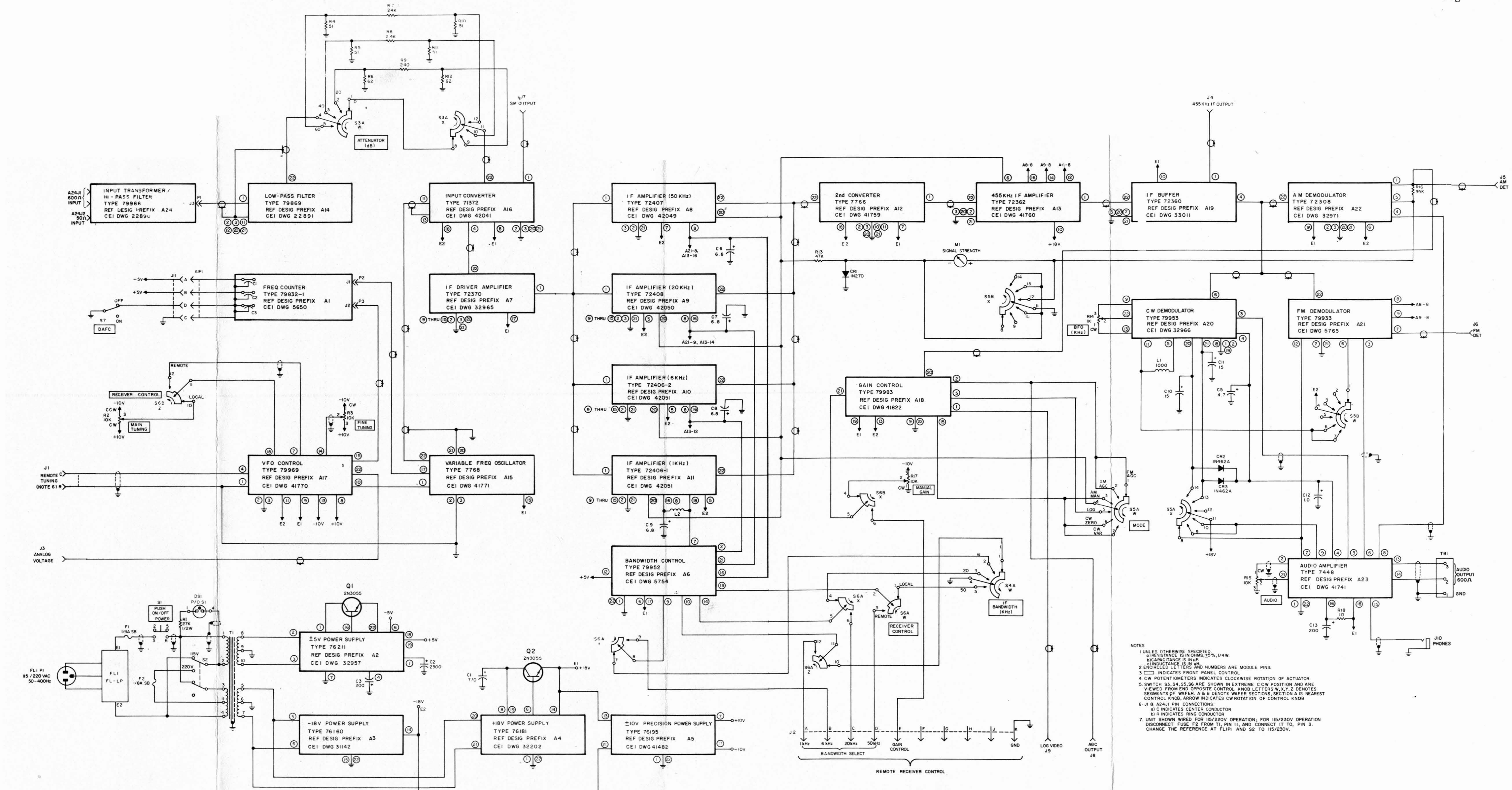


Figure 6-26. Type 340A VLF Receiver, Main Chassis Schematic Diagram