INSTRUCTION BOOKLET

DIRECTION FINDER SET
AN/SRD-22

MADE FOR

DEPARTMENT OF TRANSPORTATION

UNITED STATES COAST GUARD

CONTRACTOR

INTECH INC. 33967

SANTA CLARA, CA 95050

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SECTION I – THEORY OF OPERATION

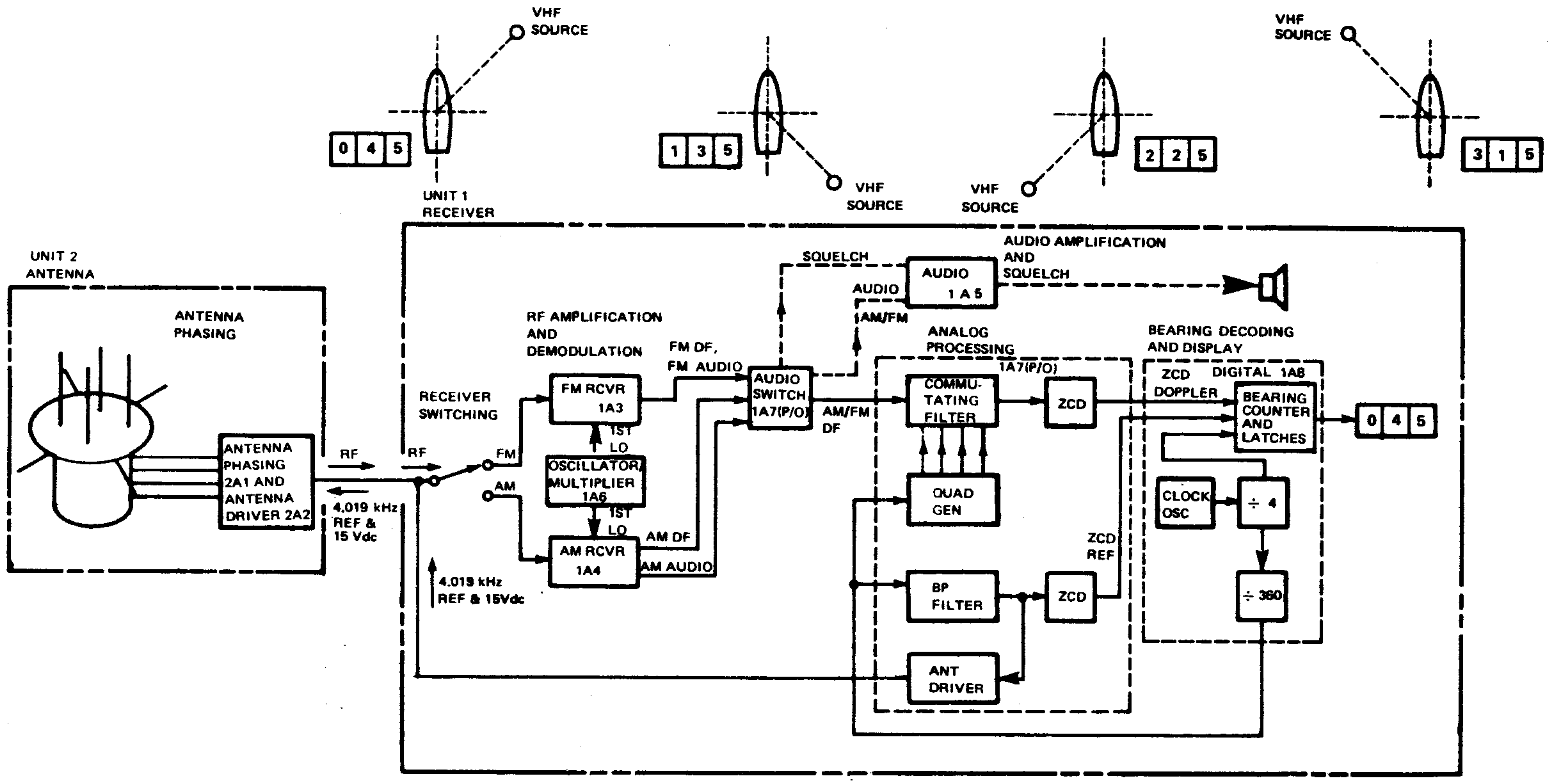
1.1 INTRODUCTION

This section is divided into four major parts: (a) a general description of the AN/SRD-22, Automatic Direction Finder Set (hereinafter referred to as the direction finder), (b) a brief description of direction finder operating principles, (c) a functional description of direction finder operation which is keyed to an overall block diagram, and (d) detailed descriptions of direction finder circuits. A simplified block diagram (figure 1-1) illustrates basic operating principles. The functional block diagram (figure 1-2) illustrates direction finder circuit functions and relates operation to direction finder subassemblies.

1.2 GENERAL DESCRIPTION

The direction finder provides a rapid determination of the relative bearing of a VHF source with respect to ship's bearing. The relative bearing is indicated on a 3-digit LED display with a resolution of one degree and an accuracy of ±3 degrees. The Doppler sensing technique used by the direction finder eliminates both directional ambiguities and receiver desensitizing during direction finding operation.

The direction finder receives FM frequencies in the 156-163 MHz frequency range and also receives the (AM) Emergency Position Indicating Radio Beacon (EPIRB) at 121.5 MHz. The direction finder can operate on any 8 of the 58 internationally assigned VHF/FM ship-to-ship and ship-to-shore communication channels, including channel 16 which is reserved for emergency use. The direction finder accommodates nine channel frequency crystals at any time. Channel assignments may be changed by replacing the crystals. One of the channels is dedicated to AM reception and eight are dedicated to FM reception.



ZCD = ZERO CROSSING DETECTOR
BP = BAND PASS

Figure 1-1. Direction Finder Simplified Block Diagram

The direction finder comprises two units; a receiver unit that contains seven circuit board assemblies, and a four-element antenna array unit that contains antenna phasing electronics. The antenna and receiver are interconnected by a single RG58C/U coax cable.

1.2.1. Antenna Unit - The antenna is a four-element vertical array with a gain of 3 dB. The vertical array is used with a horizontal ground plane array to improve reception and minimize the effect of reflections from the ship's structure. Two circuit boards containing antenna phasing circuits are mounted in the antenna base. The phasing circuits utilize a receiver-generated 4.019 kHz frequency to induce Doppler-like phase modulation in the received rf signal; thereby simulating antenna rotation.

1.2.2 Receiver Unit.- The receiver unit provides the 4.019 kHz reference drive signal to the antenna unit and receives the resulting phase-modulated rf signal from the antenna unit. Phase information and audio are extracted from the rf signal to provide a 3-digit display of relative bearing and an audio output, respectively. Volume, squelch, dimmer, and acquisition rate controls are provided on the front panel of the unit. The receiver electronic circuits are located on seven plug-in circuit boards to facilitate maintenance.

1.2.3 Specifications. - Direction Finder specifications are listed in table 1-1.

1.3 OPERATING PRINCIPLES

The direction finder, figure 1-1, uses a Doppler sensing technique to determine the relative bearing of a radio transmission source. Antenna rotation is simulated by inducing Doppler-like phase modulation into the received rf signal. The direction finder then amplifies and demodulates the signal to recover the Doppler-like signal component. The phase of the Doppler component is compared to a stable reference to determine relative bearing.

Table 1-1. Direction Finder Specifications

ITEM	PARAMETER
<u>General</u>	
Frequency Range:	121.500 MHz AM 156 to 163 MHz FM
Channel Capacity:	9 crystal controlled channels 8 FM 1 AM
Bearing Accuracy:	±3°
Receiver Dimensions:	4-1/4"H x 12"W x 15-1/2"L
Weight:	10-1/2 pounds
Antenna Dimensions:	
Height:	24-1/4"
Width:	9" without groundplane dipoles 48" with groundplane dipoles
Weight:	7-3/4 pounds
Operation in Relative Winds:	Up to 100 Knots
Interconnect Cabling	One run of RG-58C/U between antenna and receiver
Controls:	Volume, ON/OFF Squelch, DF/MON. Channel Selector Dimmer, Rate fast/ Rate slow
Operating Temperature Range:	-20 to +50°C
Input Voltage:	115 VAC @ 0.3A
<u>Receiver</u>	
Sensitivity:	≤1.0 μV for 10 dB SINAD, AM ≤0.5 μV for 12 dB SINAD, FM
Frequency Stability:	Phase locked to incoming signal
Squelch Threshold	Typ: 0.3 μV
Adjacent Channel Rejection	70 dB min

Table 1-1. Direction Finder Specifications (Continued)

ITEM	PARAMETER
Receiver (Cont.)	
Intermodulation	60 dB min
Spruious Responses	70 dB min
Modulation Acceptance Bandwidth	±7 kHz min
Audio Frequency Response	6 dB per octave deemphasis between 300 and 3,000 Hz
Antenna	Z = 50Ω, 3 dB Gain
Mounts on standard 1-1/2" antenna mast.	

The following paragraphs briefly describe direction finder operation and are keyed to figure 1-1. The principle functions to be described are Antenna Phasing (simulated rotation), rf Amplification and Demodulation, Analog Processing (recovery of the Doppler signal), Bearing Decoding and Display, and Audio Amplification and Squelch.

1.3.1 Antenna Phasing. - The antenna unit consists of a four-element antenna array with a ground plane and two circuit boards; Antenna Phasing Board 2A1 and Antenna Driver Board 2A2. A 4.019 kHz reference signal from the receiver is used to provide four antenna drive signals, identical in frequency but with a quadrature-phase relationship. These signals vary the bias on the variable attenuators (pin diodes) connected to each of the four antenna elements. The four rf signals are summed and applied to the received unit via the interconnecting coax cable. The result is that the stationary antenna array simulates a single antenna element rotating along a circular path at a rotation rate of 4.019 KHz, or 241,000 rpm.

1.3.2 RF Amplification and Demodulation. - The rf signal from the antenna is routed through a switching circuit to one of the two receivers. Each receiver is a double-conversion, superhetrodyne VHF receiver that amplifies and demodulates the rf input. When an FM channel is selected, the rf signal is applied to FM receiver 1A3. When the AM channel is selected, the rf signal is applied to AM receiver 1A4. Oscillator/Multiplier 1A6 provides the appropriate 1st local oscillator (L.O.) frequencies for both receivers.

In the FM receiver (1A3) the FM detector demodulates the rf signal to produce the FM DF and FM audio output. This signal contains voice, noise, and the Doppler component. The AM detector provides only the AGC signal for the receiver.

In the AM receiver (1A4) the FM detector produces a similar signal (voice, noise, and Doppler signal) but only the Doppler and noise components are used. The AM detector provides the AGC signal and a voice signal for direction finder audio circuits.

1.3.3 Analog Processing. - The Doppler component is recovered as follows: The demodulated FM (FM DF or AM DF) signal from the selected receiver is applied by the audio switch to a commutating filter on analog board 1A7. The narrow bandwidth of the commutating filter extracts the Doppler modulation signal (4.019 kHz). The 4.019 kHz modulation signal is then applied to a zero crossing detector (ZCD) which produces a squarewave output.

1.3.4 Bearing Decoding and Display. - Relative bearing is determined on digital board 1A8 by comparing the phase of the ZCD Doppler (4.019 kHz) modulation signal with that of the ZCD reference (4.019 kHz) signal. The 4.019 kHz reference signal resets the bearing counter to zero when the simulated antenna position is zero degrees.

The counter is then incremented by the master clock at a rate that is 360 times the antenna modulation frequency. When the simulated antenna position is in line with the source of the received signal, the ZCD Doppler modulation signal loads the contents of the counter into a latch. Therefore, the count stored in the latch is a direct indication of the relative bearing of the radio transmission source.

1.3.5 Audio Amplification and Squelch. - The AM and FM audio components are applied to audio board 1A5 by the audio switch. An audio amplifier amplifies the audio signal and drives a loudspeaker. The audio switch also applies the undeemphasized FM outputs from the AM and FM receivers directly to a squelch circuit on the audio board. If the received signals are above a selected level, the audio output to the loudspeaker is enabled and the bearing display is also enabled. However, if the received signals are below a selected level, the audio and bearing display are both inhibited.

1.4 FUNCTIONAL DESCRIPTION

The following paragraphs provide a functional description of the direction finder keyed to the functional block diagram, figure 1-2. The functional block diagram is not intended to show circuit details. Schematics and wiring diagrams are provided in Section VII.

1.4.1 Antenna Phasing. - The receiver unit applies +15Vdc and 4.019 kHz via coax cable to Antenna Driver Board 2A2. The dc voltage provides required biasing for Antenna Driver circuits. The 4.019 kHz is a sinusoidal reference signal which is converted by amplifiers U1D, U1A, UlC, and U1B of the Antenna Driver board to 0, 90, 180, and 270 degree quad-raturephased sinusoidal control signals, respectively. The four antenna drive signals, displaced from one another by 90 degrees, vary the attenuation of pin diodes CR4, CR1, CR2, and CR3 in Antenna RF Phasing Board 2A1. Each of the antenna elements is connected to a summing junction through one of the pin diodes.

The attenuation of the pin diode in each antenna path is varied independently, by one of the four antenna drive signals. The rf signal at the summing junction is phased modulated by the apparent rotational motion of the antenna elements. (The apparent rotational motion of the antenna elements is due to the quadrature relationship of the four antenna drive signals.) The summed rf signal is applied to the receiver (via board 2A2) through an isolation network. This signal contains the received rf component and a 4.019 KHz Doppler moduation component.

1.4.2 Receiver Switching.- CHANNEL switch S1 applies either the FM+ or AM+ signal to the receiver antenna switch on analog board 1A7 to enable one of the receivers. When an FM channel is selected, the rf signal is routed to FM receiver 1A3. When the AM channel is selected, the rf signal is routed to AM receiver 1A4. Positions 1 through 8 of CHANNEL switch S1 select FM channels. Position 12 of the CHANNEL switch selects the AM channel (EPIRB frequency of 121.5 MHz).

1.4.3 RF Amplification and Demodulation. FM Receiver board 1A3, AM Receiver board 1A4, and Oscillator/Multiplier board 1A6 amplify and demodulate the rf signal. When one of the FM channels is selected, the rf signal is applied to pin JB-2 of FM receiver 1A3. The corresponding crystal controlled oscillator on oscillator/multiplier 1A6 is enabled to provide the appropriate first LO frequency for that channel.

The rf signal is amplified by two-stage rf amplifier Q1 and Q2, which is tuned to the 156 to 163 MHz frequency range. The amplified signal is applied to first mixer Q3. Automatic gain control (AGC) for the two-stage amplifier is provided by an AGC voltage that is derived from the AM detector U3. The amplified rf signal is mixed with the first L.O. frequency to provide a 16.9 MHz first IF. The first IF is filtered by crystal filter FL1 and mixed with a second LO frequency of 17.34625 MHz by mixer U1 to develop the 446.25 kHz second IF. The second IF is filtered and applied to second IF amplifier/FM detector U2 and AM detector U3.

The output of the FM detector is undeemphasized FM (audio/noise and 4.019 kHz FM DF), and the output from the second IF amplifier is the amplified second IF of 446.25 kHz. Undeemphasized FM is output to the audio switch. The 446.25 kHz 2nd IF signal is returned to oscillator/multiplier board 1A6 for control of the first L.O. frequency. The AM detector output is amplified by U4A and returned to the two-stage rf amplifier as the AGC voltage.

When the AM channel is selected, the rf signal is applied to pin JB-2 of AM receiver 1A4. This receiver functions in the same manner as the FM receiver. The principle differences between the FM and AM receivers are the frequency range (the AM receiver is tuned to 121.5 MHz), and processing of the audio components.

The FM detector outputs from board 1A4 are similar to those of board 1A3, bowever, there is no audio component. The AM detector on board 1A4 provides both the AGC voltage and an audio (voice) signal which is routed to the audio switch of analog board 1A7.

Oscillator/ multiplier board 1A6 contains a phase detector and reference oscillator which, together with the first L.O. and the receiver form a phase-locked loop. When a channel is selected (AM of FM), one of nine crystals on board 1A6 is selected to produce the appropriate first L.O. frequency. The second IF frequency from the receiver is compared with a crystal oscillator-generated reference frequency (446.25 kHz) by the phase detector. The resulting error voltage controls the crystal frequency; there by adjusting the first L.O. frequency in response to frequency variations in the rf signal. The tracking action of the phase-locked loop ensures that the first IF frequency of 16.9 MHz always will be centered in the crystal filter FL1, thus eliminating bearing changes due to varies changes in the received frequency.

1.4.4 Analog Processing. - The outputs of the receivers are routed through an audio switch on analog board 1A7. If an FM channel is selected, undeemphasized FM is output to the notch filter on board 1A6 and to the commutating filter and ZCD circuits of board 1A7. In an AM channel is selected, AM audio is output to the notch filter and deemphasized FM is applied to the Commutating filter and ZCD circuits of board 1A7. The notch filter is described with the audio circuits. The commutating filter and ZCD circuits are described in the following paragraphs.

The undeemphasized FM from either the AM or FM receiver boards is applied to bandpass filter U1 in 1A7 by the audio switch via JB-9 and JA-9. Bandpass filter U1 is centered at the 4.019 kHz Doppler frequency. The output of the bandpass filter is applied to synchronous (commutating) filter U13 which has a very narrow passband centered at the 4.019 kHz Doppler modulation frequency. The bandwidth of the second commutating filter U14 may be varied by RATE switch S4 to provide for either fast acquisition or slow acquisition with a more stable display. The commutating filters are synchronized to the master clock to minimize filter-induced phase-shift errors. The output of U14 is applied to lowpass filter U4/U5 which removes commutating harmonies. The filtered 4.019 kHz Doppler modulation signal is applied to phase shifter U6 which compensates for system phase shift to adjust for bearing zero at "dead ahead". The output of the phase shifter is applied to zero crossing detector U7 which produces a squarewave output at JC-7, ZCD (4.019 kHz Doppler) signal.

The ZCD (4.019 kHz ref) signal is developed from the 4.019 kHz ref signal. The zero crossing points of the ZCD (4.019 kHz ref) signal correspond to a simulated rotational antenna position of zero degrees.

<u>1.4.5 Bearing Decoding and Display.</u> - The two ZCD outputs of anlog board 1A7 are applied to digital board 1A8. Circuits of board 1A8 compare the phase of the ZCD (4.019 kHz Doppler) signal with that of the ZCD (4.019 kHz reference) signal. This phase comparison provides an indication of the relative bearing of the radio transmission source.

The ZCD (4.019 kHz reference) signal triggers reference one shot U14 which in turn resets the bearing counter. The bearing counter is then clocked by the master clock at 1,446.8 kHz (360 times the simulated rotational rate of the antenna). The ZCD (4.019 kHz Doppler signal triggers ZCD one shot U2 which in turn loads seven-segment decoder latches U8, U9, and U10 with the bearing counter count. The decoder latch output is applied by display drivers to digital displays DS1, DS2, and DS3.

The display hold output of the squelch circuit on board 1A5 prevents loading of seven-segment decoder latcher U8, U9, and U10 when no signal is present. When the display hold signal is applied, the display is not updated but continues to display the last stored bearing. DIMMER control R4 controls the light dimmer circuit U17 and Q4, which in turn controls the intensity of the LED digital bearing display and of the dial lights.

1.4.6 Audio Amplification and Squelch. - Audio board 1A5 amplifies the audio signal from 1A7 to drive loudspeaker LS1. The squelch gate on circuit board 1A5 compares the rectified receiver noise level with a threshold level set by SQUELCH control 1R3. When no signal is received, excessive noise triggers the squelch gate to inhibit audio and provide the display hold signal to board 1A8.

For FM channels, the audio switch on board 1A7 routes the undeemphasized FM audio through de-emphasis filter R57 and C50 and to the notch filter on board 1A6. The notch filter removes the 4.019 kHz Doppler modulation component from the audio so that the Doppler signal cannot deteriorate audio quality. When the AM channel is selected, the audio switch on board 1A7 routes AM audio to the notch filter. The notch filter removes any 4.019 kHz signal which may be present on the AM audio. The audio output of the notch filter is applied via VOLUME control R2 to JA-6 of Audio board 1A5. The audio is amplified by power amplifier U2 and applied via JA-9 to loudspeaker LS1.

For both AM and FM channels, undeemphasized FM audio is routed by the audio switch on board 1A7 to the squelch circuit on board 1A5. The squelch filter removes any audio voice frequencies and passes only noise centered around 25 kHz. Comparator UlD compares the level of the rectified noise with a dc voltage level set by SQUELCH control 1R3. If the noise level is higher than the squelch gate setting, squelch gate Q3 inhibits the audio signal. In addition, the application of a ground to mute jack 1J4 inhibits the audio signal.

1.4.7 Power Supply 1A2. The power supply operates from a 115-V ac source to provide unregulated and regulated dc operating voltages for the circuits of the direction finder. The power supply is fused and provides rectified +12 V dc, regulated +15 V dc, and filtered +24 V dc to direction finder circuits.

1.5 CIRCUIT DETAILS

The following paragraphs provide detailed descriptions of direction finder circuits. Common circuits are identified but not described.

1.5.1 Antenna Unit. - The Antenna unit consists of four vertical elements, a four-element ground plane and two printed circuit boards which provide antenna drive and rf phasing. The antenna unit is connected to the receiver unit by a single coaxial cable which provides power and a 4-kHz drive signal to antenna circuits and also routes rf from the antenna to the receiver unit.

1.5.1.1 Antenna - General. - The antenna consists of four vertical rods, each of which is approximately 1/4-wavelength long (25 cm), and two circuit boards. The rods are located symmetrically about the circumference of a circle with a 4.25 cm radius. In addition four horizontal rods protruding from the antenna base create a ground plane which establishes the proper radiation pattern for the vertical elements and prevents bearing errors resulting from signals that are reflected from the ship. The two printed circuit boards are mounted within the base of the antenna.

1.5.1.2 Antenna Driver Board 2A2. - The antenna driver board consists of a voltage divider network, a phase-shift network, and four drive amplifiers. This assembly receives power and a 4.019 kHz signal from the receiver unit and provides four separate 4.019 kHz outputs to the rf phasing board. While one output is in phase with the input signal, the remaining outputs are phase-shifted 90 degrees, 180 degrees, and 270 degrees, respectively. (Refer to figure 7-21 for a schematic diagram of the antenna driver board.)

The input from the receiver unit is +15 VDC power and a 4.019 kHz oscillator-generated signal. The two inputs are applied via connector 2J1 and passed unchanged through rf choke L1. The +15 VDC input filtered and attenuated produce the +12 VDC B+ voltage and a +4.5 VDC bias voltage for the drive amplifiers. The 4.019 kHz input is applied to non-inverting operational amplifier U1A and output to rf phasing board 2A1 via emitter follower Q1. The Q1 output is also applied to the inverting input of operational amplifier U1B. The resulting signal, which is 180 degrees out of phase with the Q1 output, is routed to board 2A1 via emitter following Q2. The Q2 output is also routed through phase-shift network C10, R23, and R27, and applied to non-inverting operational amplifier U1C. The phase-shift is adjusted to 90 degrees. The resulting signal from U1C has been phase shifted 270 degrees from the J1 input. This signal is output to board 2A1 via emitter follower Q3 and applied to the inverting input of operation amplifier U1D. The resulting signal is output via emitter follower Q4 to board 2A1. As shown by the foregoing, the 4.019 kHz input from the receiver unit is output to board 2A1 as four separate 4.019 kHz signals which have a quadrature phase relationship.

In addition to providing antenna drive signals, the rf output of the antenna is routed to the receiver unit via antenna driver board 2A2. The rf signal from board 2A1 is applied through capacitor C6 and output to the receiver via connector J1. The choke (L1) prevents rf interference with the four drive amplifiers, just as capacitor C6 prevents the passage of dc (+15 V dc) and the 4.019 kHz antenna drive.

1.5.1.3 Antenna RF Phasing Board 2A1. - The antenna rf phasing board consists of four electronically-controlled variable attenuators through which the four antenna elements are connected to a common output. The four attenuators are driven by the four 4.019 kHz inputs from antenna driver board 2A2. The quadrature-phase relationship between the drive signals causes the attenuators to be varied simultaneously but in a quadrature manner. Thus, when one circuit provides its minimum attenuation, a second circuit provides its maximum attenuation and the remaining two circuits are at the midpoint of the adjustment range (one increasing, the second decreasing). The varying attenuation results in a signal which duplicates many of the characteristics found in rotating antenna systems, thus simulating antenna rotation at a 4.019 kHz rate. (Refer to figure 7-20 for a schematic diagram of the antenna rf phasing board.)

Since the four antenna circuits of board 2A1 are identical, only that portion associated with the Q1 output on board 2A2 is described here. The 4.019 kHz input is applied to resistors R5 and R9 and to capacitor C9. The ac component of the signal bypasses the resistors, is passed unchanged through rf choke L2, and is applied directly to PIN diode CR1. The dc component of the signal is passed through resistors R5 and R9 which have been factory-selected to ensure identical characteristics in each of the four circuits. The resulting current, which determines the rf resistance of PIN diode CR1, flows through resistors R5 R5 and R9, rf choke L2, PIN diode CR1, and rf choke L9.

The rf signal from the antenna is applied to PIN diode CR1 through capacitor C1. The capacitor isolates the antenna from dc voltages while rf choke L1 prevents static buildup in the antenna. The rf signal is attenuated by PIN diode CR1 and summed with signals from the other antennas at the input of inductor L10. The resulting signal is routed to the receiver unit via capacitor C6 and connector J1 on board 2A2.

1.5.2 Receiver Unit. - The receiver unit consists of the chassis assembly and seven printed circuit boards. All chassis-mounted components are mounted on the chassis baseplate and on the front and rear panels.

1.5.2.1 Power Supply 1A2. - The direction finder power supply consists of transformer T1, which is located on the chassis baseplate, and the circuits of power supply board 1A2. These circuits include a fullwave rectifier, a filter, and a voltage regulator. The power supply provides rectified +12 VDC, filtered +24 VDC and regulated +15 VDC for direction finder operation. (Refer to figure 7-13 for a schematic diagram of the power supply.)

The 115 VAC input power is applied via rear-panel connector 1J1, fuse 1F1, and the on/off switch on the VOLUME control. When the VOLUME control is set to on, input power is applied across varistor A2CR2 and to the primary of transformer 1T1. A varistor protects the direction finder from damage due to input power transients of greater than 150 volts.

The ac input is transformed to 24 volts (rms) by transformer T1, and connected to bridge rectifier A2U1. The dc output from A2U1 is routed through a filter consisting of resistors R1 and R2, and capacitors C1 and C2. The filter removes ac hum.

The filtered +24 VDC is output to audio board 1A5 and to boards 1A7 and 1A8. This voltage is also returned to board 1A2 and applied to +15 V dc regulator U2. Capacitor C3 and C4, and diode CR3 protect the regulator from oscillations and polarity reversal. The regulated +15 VDC output is supplied to all boards in the direction finder as the B+ voltage for circuit operation.

1.5.2.2 FM Receiver 1A3 (156 – 163 MHz). - The FM receiver is a crystal-controlled, double-conversion superhetrodyne VHF/FM receiver with automatic gain control (refer to figure 7-14 for a schematic diagram of FM receiver 1A3.)

The rf input from board 1A7 is applied through two dual-gate MOSFET rf amplifiers (transistors Q1 and Q2) and applied to first mixer A3. The two amplifiers are tuned to the 156 MHz to 163 MHz frequency range. Automatic gain control (AGC) for both amplifiers is implemented by varying the voltage at pins 2 of transistors Q1 and Q2. (The generation of the AGC voltage is described in following paragraphs.)

Transistor Q3 is a dual-gate MOSFET mixer. The amplified rf signal is mixed with the local oscillator (first LO) signal (from oscillator/multiplier board 1A6) to produce the first intermediate frequency (first IF) of 16.9 MHz. The tuned circuit at the mixer output (L7, C25, and C27) is tuned for 16.9 MHz. The first IF signal is then filtered by 8-pole crystal filter L1 to remove harmonics, adjacent channel frequencies, and other undesireable signal components. The narrow bandwidth of the filter (approximately 15 kHz) passes only the selected channel frequency.

The filtered first IF signal is mixed in second mixer U1 with the second local oscillator signal (17.34625 MHz from oscillator Q4/Y1) to produce the second IF frequency of 446.25 kHz. (Refer to figure 1-3 for a simplified schematic diagram of the second mixer.) The resulting signal is filtered by tuned LC filter L9, C40, C41, and C69, to remove harmonics and mixer-generated frequencies. The signal is then buffered by emitter follower Q5 and applied to FM detector U2 and AM detector U3.

The second IF amplifier/FM detector (U2) is a limiter amplifier and quadrature detector. (Refer to figure 1-4 for a simplified schematic diagram of the circuit.) The limiting amplifier amplifies and limits the IF signal to prevent the detection of AM noise. The quadrature detector demodulates the FM signal. The audio output of the second IF amplifier/FM detector is undeemphasized FM audio, which is routed to board 1A7 as the FM DF signal. Another output is the amplified second IF frequency (446.25 kHz) which is routed to oscillator/multiplier board 1A6.

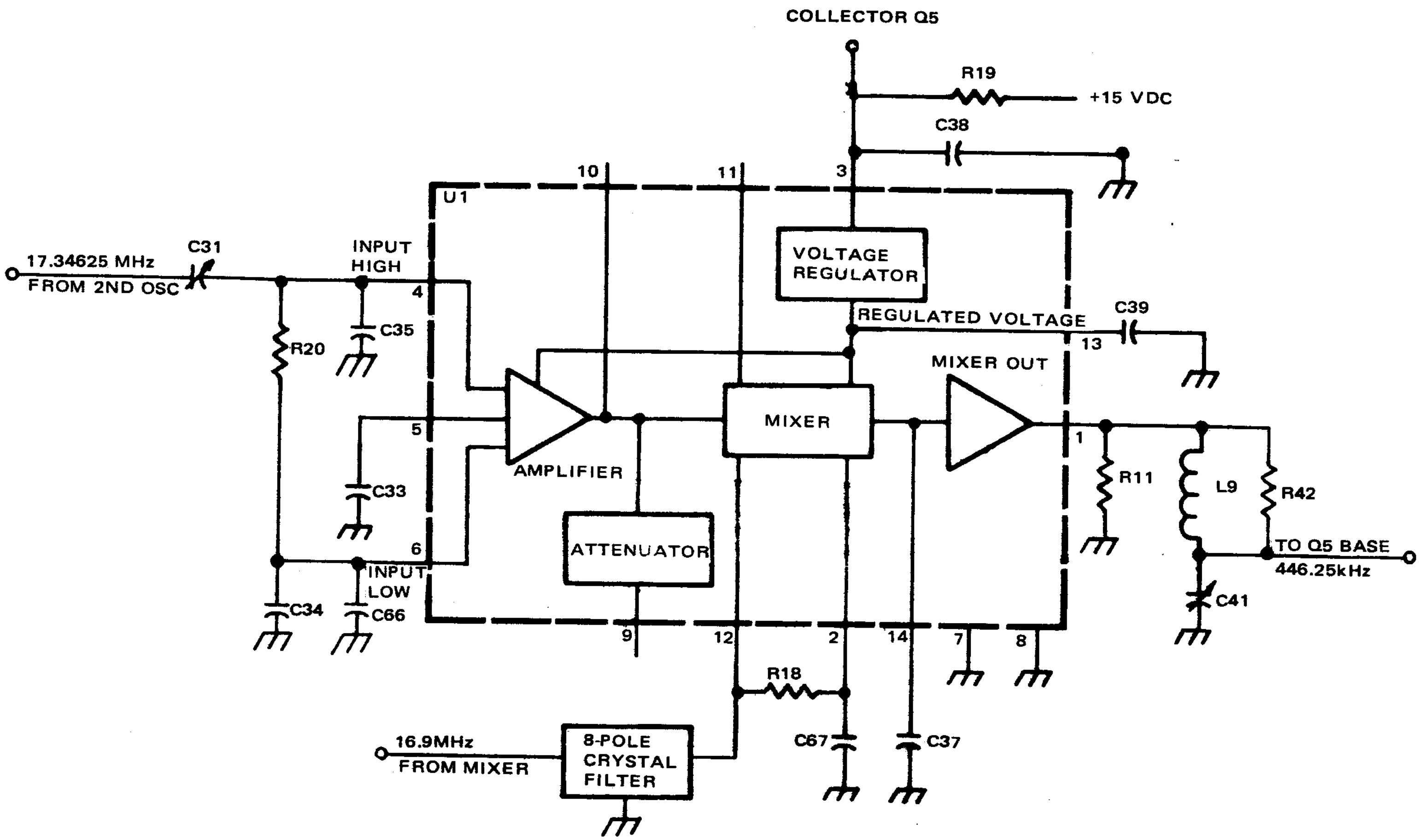


Figure 1-3. Second Mixer Simplified Schematic Diagram

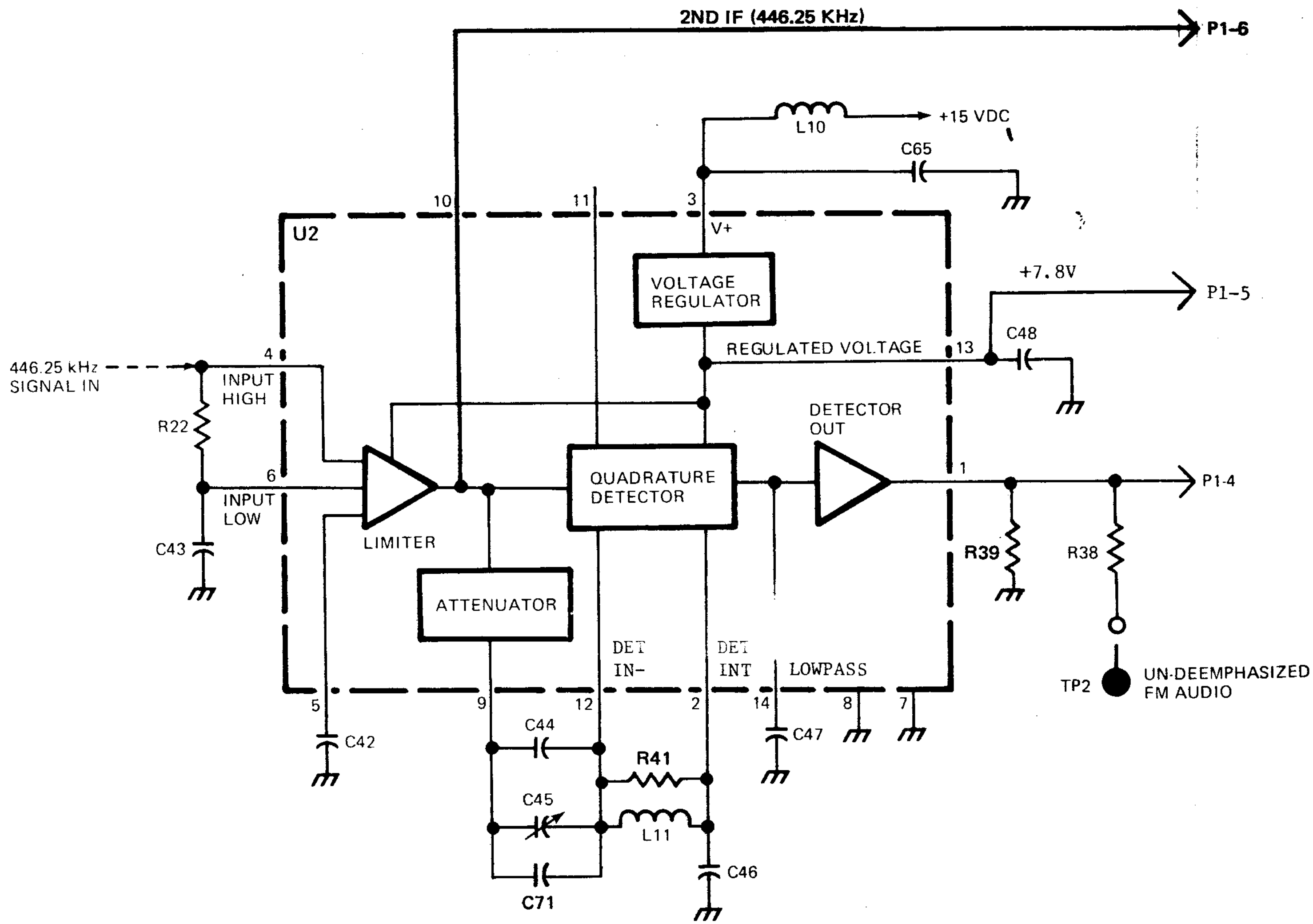


Figure 1-4. FM Limiter Amplifier and FM Quadrature Detector Simplified Schematic Diagram

The second IF frequency is also applied to AM detector U3. (Refer to figure 1-5 for a simplified schematic diagram of the circuit). This circuit detects variations in input signal strength and produces an output (pin 1) which is used to operate AGC comparator/ amplifier U4A. Amplifier U4A compares the varying dc voltage from AM detector U3 with a dc voltage from AGC potentiometer R28. (Refer to figure 1-6 for a simplified schematic diagram of the AGC system.) When the receiver input is less than expected (or no input), the voltage at pin 5 of comparator/amplifier U4A will be greater than the signal at pin 6. This condition results in an increased voltage at U4A pin 7. Conversely, when the rf input level is greater than expected, the output of comparator/ amplifier U4A will be decreased.

The U4A output is translated by diodes CR9 through CR11 and resistors R35 and R36 to a level that is suitable for application to rf amplifiers Q1 and Q2. The AGC signal is output from the assembly on pin A8 and returned to the assembly (via chassis wiring) on pin B4. The voltage is then applied to pins 2 of transistors Q1 and Q2 as the AGC voltage.

1.5.2.3 AM Receiver 1A4 (121.5 MHz). - The AM receiver is similar to the FM receiver, but is tuned to 121.5 MHz. In addition, a filter circuit U4B which is present but not used in the FM receiver, filters the AM audio signal for proper audio response. (Refer to figure 7-15 for a schematic diagram of AM receiver 1A4.)

The remaining AM receiver circuits are identical to those of the FM receiver. These circuits have been described as a part of the FM receiver and, consequently, circuit descriptions are not repeated here. (Comparison of schematic diagrams will show that the amplifiers, filters, and mixers are identical, except that the two rf amplifiers have been tuned to different frequencies.)

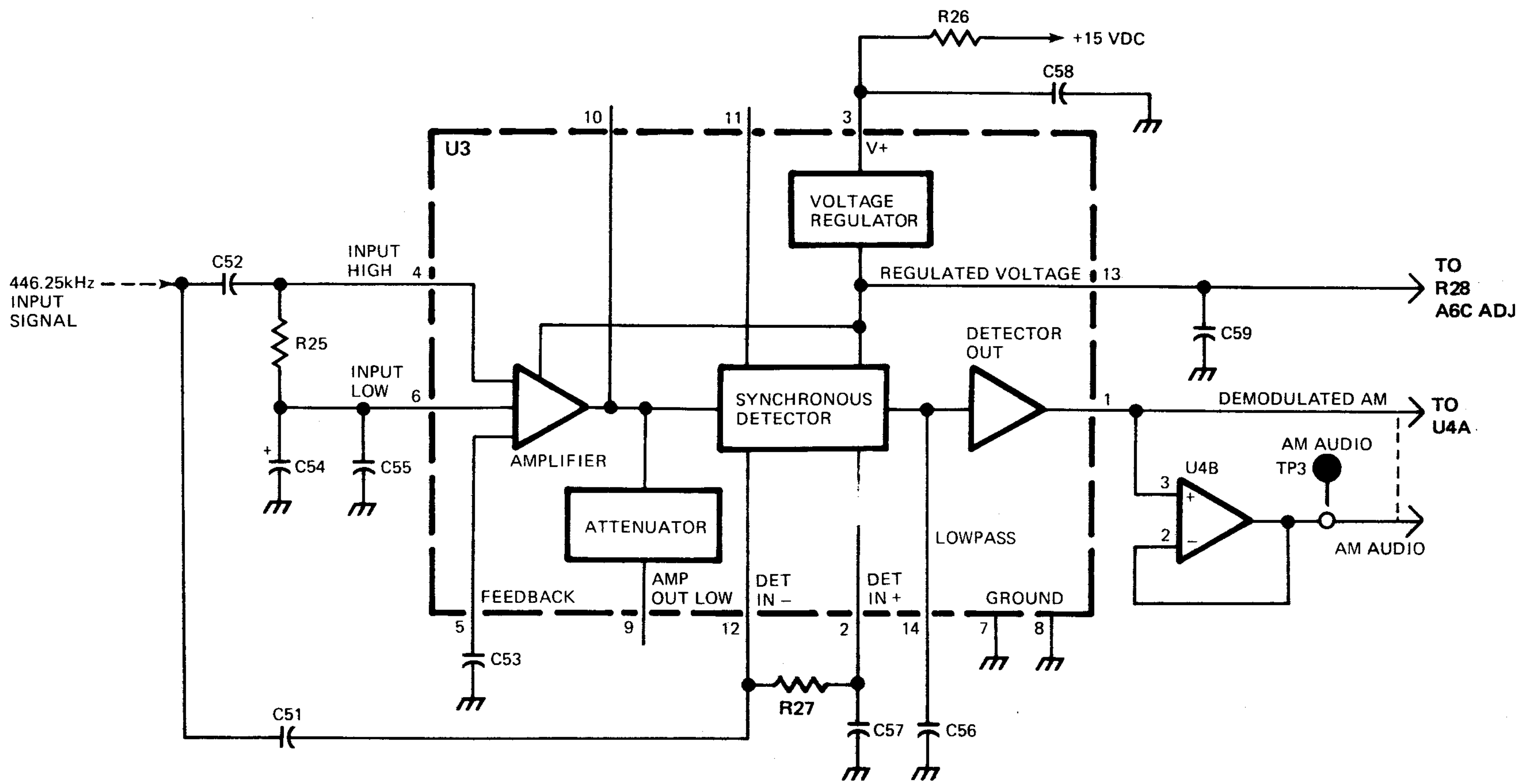


Figure 1-5. AM Synchronous Detector Simplified Schematic Diagram

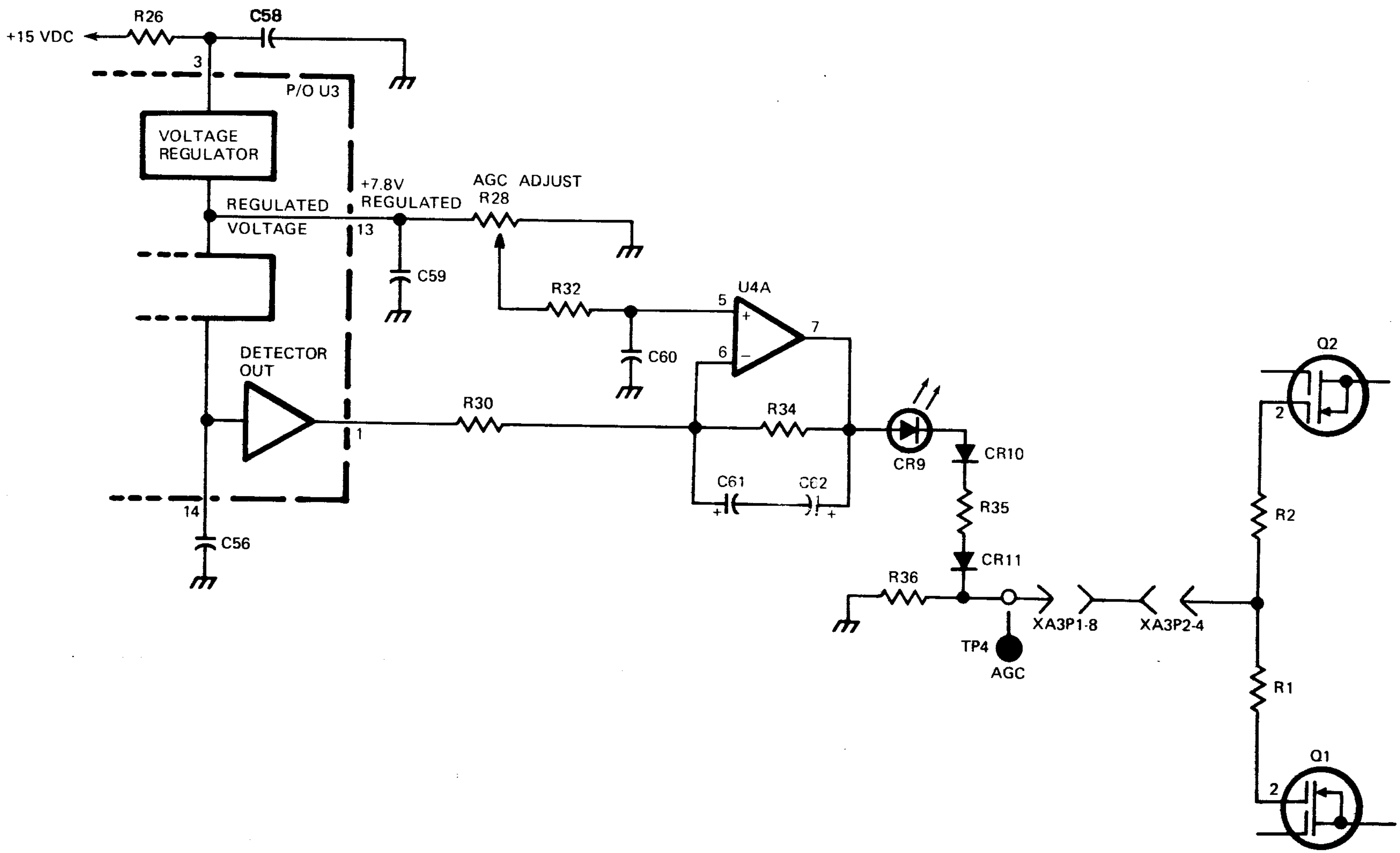


Figure 1-6. AGC System Simplified Schematic Diagram

1.5.2.4 Audio Assembly 1A5. - The audio assembly consists of the noise-activated squelch circuit and the audio power amplifier which drives the speaker. The squelch circuit provides audio noise suppression in the absence of an rf signal input to either receiver. The power amplifier provides a 2.5-watt output to the speaker. (Refer to figure 7-16 for a schematic diagram of the audio assembly.)

The squelch control input is undeemphasized FM audio (AM DF or FM DF) from the audio switch circuit on board 1A7. This signal is applied through a 25-kHz bandpass filter consisting of operational amplifiers U1A and U1B. The filter removes voice frequencies and passes only 25-kHz noise. (The output of the filter can be monitored at test point TP1.) The noise signal is then rectified by positive peak detector U1C and applied to comparator U1D.

Comparator U1D compares the level of the rectified noise signal with a dc voltage set by SQUELCH control 1R3. When no rf signal is applied to the selected receiver, the rectified noise signal will be at its maximum, and more positive then the SQUELCH-selected reference voltage. Since the noise signal is positive, the output of comparator U1D (pin 10) is high. This signal turns on squelch gate Q1, effectively grounding the audio input to the power amplifier. As the rf input to the receiver (AM or FM receiver) increases, the FM "quieting" action of the receiver decreases the level of the rectified noise signal. When this signal becomes less positive than the SQUELCH – selected reference voltage, the pin 10 output of comparator U10 goes low. This signal turns off squelch gate Q1, allowing the audio signal to be amplified (U2) and output to the speaker.

Squelch gate Q1 can also be controlled by the mute input. Applying a ground via rear panel MUTE connector 1J4 results in a high output from comparator U1D. This signal turns on the squelch gate, grounding the audio input signal.

Power amplifier U2 is a monolithic integrated circuit that amplifies the audio input to provide approximately 2.5 watts into 16-ohm speaker LS1. A description of amplifier U2 is provided in figure 7-12.

<u>1.5.2.5 Oscillator/Multiplier Board 1A6.</u> - The oscillator/multiplier board consists of two crystal oscillators, two X3 frequency multipliers, a phase detector, and filters and operational amplifiers, all of which function together with the active receiver to control the local oscillator frequency. The aforementioned circuits and the active receiver form a phase-locked loop that tracks frequency variations in the rf input and makes the appropriate adjustment in local oscillator frequency. (Refer to figure 7-17 for a schematic diagram of the oscillator/multiplier board.)

While circuit operation begins when a channel is selected, the following discussion assumes that the unit is operating normally and that a signal is being received.

Each of the nine channel selection crystals are part of a varactor-controlled crystal oscillator (VCXO) which generates the ninth subharmonic of the desired local oscillator frequency. Crystals Y1 through Y6 function with transistor Q2 while crystals Y7, Y8, and Y12 function with transistor or Q1 (implementation of frequency control is described in the following paragraphs). Only the selected crystal functions with transistors Q1 and Q2 to form the local oscillator.

While the oscillator functions at the crystal frequency, the collector of transistor Q2 is tuned to the third harmonic frequency. The resulting signal is applied to X3 multiplier Q3 to produce the first LO frequency. The signal is then filtered by tuned amplifier Q4 and output to both of the receivers.

During operation, only one of the receivers will be active for a given channel selection. The 2nd IF signal (446.25 kHz) from the active receiver is returned to the oscillator/ multiplier board for use in controlling the VCXO frequency, through the AFC, (Automatic Frequency Control) system.

The second IF input from FM receiver 1A3 or AM receiver 1A4 is applied via summing amplifier U2E. The 446.25 kHz signal is then applied as one input of phase detector U1. The second input to the phase detector is a precise 446.25 kHz from crystal oscillator Y13/ U2A. The resulting signal is filtered (R43, R44, C54) to produce a dc voltage that is proportional to the frequency difference between the inputs.

The filtered phase detector output is buffered by operational amplifier U2C and applied to VCXO diodes CR1 through CR8. The signal is also inverted by operational amplifier U2D and applied to VCXO diode CR12. (The inversion is necessary because lowside injection is used in the FM receiver while high side injection is used in the AM receiver.) If a difference exists between the second IF frequency and the reference 446.25 kHz signal, (from Y13/J2A), the resulting voltage applied to the varactor diode will correct the crystal frequency until both the 2nd IF and reference frequencies are identical.

Board 1A6 also contains a notch filter that is a part of the audio circuit. The audio output of the audio switch on board 1A7 is routed through this notch filter to remove the 4.019 kHz Doppler component. The remaining signal (audio) is output to the volume control and then to audio amplifier board 1A5.

1.5.2.6 Analog Board 1A7. - The analog board consists of the receiver antenna switch, antenna driver, audio switch, DF filter logic (bandpass and commutating filters), bearing adjust switch and phase shifter, and the DF zero crossing detector. The signals are derived from a common source to maintain fixed timing relationships. (Refer to figure 7-18 for a schematic diagram of the 1A7 board.

Antenna Drive/Receiver Switch. - As previously stated, a single cable carries +15 V dc and the 4.019 kHz drive signal to the antenna, and carries the received rf signal from antenna to receiver. The following paragraphs describe the circuits of board 1A7 which provide the antenna receiver/interface. The +15 V dc power for antenna circuits is derived from antenna driver U10/Q1. The +15 V dc input across resistor R68 is buffered by U10/Q1 and output to the antenna through rf choke L1. Resistor R74 and transistor Q2 provide short circuit protection.

The 4 kHz antenna drive signal is derived from the 4.019 kHz QA output on board 1A8 (via 1A7 – JA4). The squarewave input is first converted into a sinewave by a bandpass filter consisting of operational amplifier U8 and the associated components. The resulting sinewave is applied to zero crossing detector U9, and also routed through drive level adjust potentiometer R54 to antenna driver U10/Q1. Zero crossing detector U9 reconverts the sine wave to a squarewave for use by digital board 1A8. The drive level adjust potentiometer sets the drive level to the antenna and is nominally adjusted for a 2-volt (peak-to-peak) output on pin JC-2. (The voltage can be measured at test point TP2.) The antenna drive signal is output through rf choke L1 and pin JC-2, and routed to the antenna. The rf signal from the antenna is input via pin JC-2 but blocked from antenna driver circuits by rf choke L1. The signal is passed by capacitor C65 and applied to receiver antenna switch diodes CR1 and CR2.

If an FM channel is selected, diode CR2 is forwarded biased and the rf signal is passed to FM receiver 1A3 via pin JC-4. Conversely, if the AM channel is selected diode CR1 is forward biased and the rf signal is passed to AM receiver 1A4 via pin JC-3.

Audio Switch. - The audio switch routes undeemphasized FM and audio to the audio output circuits. The FM DF and AM DF signals are the outputs of the FM detectors in the two receivers. Depending on the selected receiver (AM or FM) one of these signals is active and is routed (via the audio switch) to the DF filter and to the squelch circuit on audio board 1A5. In addition, the AM audio signal, or FM DF after deemphasis by filter R57/C50 is routed to the audio amplifier on board 1A5 via the notch filter on oscillator/multiplier board 1A6 and the volume potentiometer.

DF Filter - The DF input (uneemphasized FM audio) is first filtered by bandpass filter U1, which removes audio, noise, and other undesireable frequencies. The remaining signal (4.019 kHz) is filtered by commutating filter consisting of U13, resistor R8, and capacitors C10 through C13. This high - Q synchronous filter is centered at 4.019 kHz, and is clocked by four signals which are derived from the quadrature generator on board 1A8.

The filtered 4.019 kHz Doppler modulation signal is buffered by operational amplifier U2. The rate switch and resistors R13 and R1 set the bandwidth of a second commutating filter (U14 and C14 through C17). The second commutating filter is also centered at 4.019 kHz.

The two commutating filters are controlled by the gates of U3. The QA, $\overline{QA}$, QB and $\overline{QB}$ inputs are the four quadrature phases of the 4.019 kHz clock. The gates of U3 convert the QA, $\overline{QA}$, QB and $\overline{QB}$ signals into four equal clock outputs which also have a quadrature-phase relationship.

The output of the second commutating filter is routed to a lowpass filter consisting of operational amplifiers U4 and U5, and the associated components. This filter removes harmonics created by the two commutating filters.

The filtered 4.019 kHz Doppler modulation signal is applied to a phase-shift network consisting of operational amplifier U6, switch U2, and the associated circuits. The switch is controlled by the front-panel channel selector which switches in either AM bearing adjust potentiometer R32 or FM bearing adjust potentiometer R33. The output of the phase-shifter is applied to zero crossing detector U7. The output of the zero crossing detector is a 4.019 kHz squarewave whose leading and trailing edges coincide with the zero crossing points of the Doppler modulation signal from the antenna.

1.5.2.7 Digital Board 1A8. - The digital board consists of a 5787.2-kHz crystal oscillator, frequency dividers which produce the basic clock frequencies from the oscillator frequency, and bearing decode and display circuits. In addition, the display dimmer is included on board 1A8. (Refer to figure 7-19 for a schematic diagram of digital board 1A8.)

Oscillator and Frequency Dividers. - Crystal oscillator Y1/Q1 produces a 5787.2 kHz output from which all direction finder frequencies are derived. The signal is applied to a divide-by-four circuit consisting of D-type flip-flops U1A and U1B. The frequency divider provides a 1446.8 kHz output which is 360 times the simulated rotational rate of the antenna. This signal is a timing reference which contains one pulse for each degree of simulated antenna rotation.

The 1446.8 kHz signal is applied to bearing decode circuits and to a divide-by-360 circuit which produces the 4.019 kHz reference for antenna and receiver operation. The 4.019 kHz signal is output via quadrature generator U16A/U16B to board 1A7.

Bearing Decode. - Bearing is decoded by comparing the phase of the ZCD (4.019 kHz Doppler) input with that of the ZCD (4.019 kHz reference) input. The ZCD (4.019 kHz Doppler) input is applied to a one-shot consisting of flip-flop U2A/U2B and the associated circuits. This circuit produces a series of 691-nanosecond pulses which occur at 249-microsecond intervals. The timing relationships are thus;

(a) 691 nanoseconds is the duration of one degree of simulated antenna rotation.

(b) 249 microseconds is the duration of one complete (simulated) antenna revolution (360^{o})

(c) The timing of the 691 nanosecond pulse, with respect to the 0 degree reference is the relative bearing of the received rf signal.

The ZCD (4.019 kHz reference) input is applied to a one-shot consisting of flip-flops U14/U14B and the associated circuits. This one-shot also produces a series of 691-nanosecond pulses occurring at 249-microsecond intervals. This 691-nanosecond pulse is the 0 degree reference.

The reference pulse from one-shot U14A/U14B zeroes counters U6B, U7A, and U7B when simulated antenna position is 0 degrees. The counter is then incremented by the 1446.8 kHz signal from the oscillator/frequency divider, providing a count which is repeatedly incremented from 000 to 359 and reset to zero, and is representative of simulated antenna position.

The pulse from ZCD one-shot U2A/U2B triggers a latching 3-bit BCD-to-seven segment decoder, which stores the contents of the counter when that count is equal to the relative bearing of the received rf signal. The output of the latching BCD to seven-segment decoder is applied to display drivers, U11, U12, and U13 which power the LED bearing display.

Display Hold. - When the signal at the output of the AM or FM receiver, respectively is below the reference level set by SQUELCH control R3, the display hold input to JA7 goes high, turning on transistor Q2. When Q2 is turned on, ZCD one shot U2 is inhibited, preventing the bearing display of the received signal. When the signal at the output of the FM or AM receiver, respectively rises above the level set by the SQUELCH control, JA7 goes low, and Q2 turns off. U2 is enabled and normal decoding of bearing continues.

Light Dimmer. - A voltage from 0 to 15 volts is applied by dimmer control R4 to display light dimmer circuit Q4 via JA-H. Potentiometer 1R4 controls the Q4 output voltage and therefore the voltage applied to the dial lights via JA9.

The variable dc voltage also controls the duty cycle of the 2-kHz squarewave at U17. This signal is applied to the blanking input of display decoders U8, U9, and U10 to control the brightness of the bearing display.

SECTION II – INSTALLATION

2.1 INTRODUCTION

This section provides installation instructions for the direction finder. Included herein are site preparation data and installation requirements, and procedures for unpacking, inspection, installation, initial turn on, and installation test.

2.2 SITE PREPARATION

Site preparation information for the direction finder includes environmental limitations, power requirements, and mounting considerations.

2.2.1 Environmental Limitations. - Environmental limitations for the direction finder are specified in table 2-1.

Table 2-1. Direction Finder Environmental Limitations

ITEM	SPECIFICATION
Temperature	
Operating	-20 C to +55 C
Storage	-30 C to +55 C
Humidity	⩽ 95 percent (non-condensing)
Wind	⩽ 100 MPH (80 MPH with up to 1/2-inch radial ice loading)

2.2.2 Power Requirements. - The direction finder operates from 115 V ac, 50 to 60 Hz, and is protected by a 1-ampere fuse. The nominal current is 0.3 amperes.

2.2.3 Mounting Requirements. - The receiver and antenna may be mounted in any convenient locations. When installing the direction finder, the following guidelines should be observed.

(a) The receiver can be mounted in any orientation (Refer to figure 2-1).

(b) If the receiver will be exposed to the elements when mounted, do not mount receiver with front or rear panels facing upwards.

(c) The antenna should be mounted above, or at least 18 feet from all metal obstructions. Reflective surfaces that are closer than 18 feet to the antenna must be at least 3 feet below the level of the antenna ground plane.

2.3 UNPACKING AND INSPECTION

When unpacking the direction finder, check for damage that may have occurred in transit. The unit should be free of mars and scratches. The direction finder is shipped in several packages. Open all containers and locate the packing list. Verify that all direction finder components have been received and are undamaged. Check for broken controls, connectors, or fuseholder, dented or scratched surfaces, and loose or broken components.

2.4 INSTALLATION REQUIREMENTS

Installation requirements are described in the following paragraphs. Insure that all installation requirements are met prior to beginning installation of the direction finder.

2.4.1 Tools Required. - The direction finder can be installed using ordinary hand tools and the coaxial cable crimping tool recommended in table 2-2.

2.4.2 Test Equipment Required. - While the direction finder can be installed without the use of test equipment, a voltmeter and ohmmeter should be available for verification of the input voltages and connector installation. Refer to table 2-2 for a list of recommended test equipment.

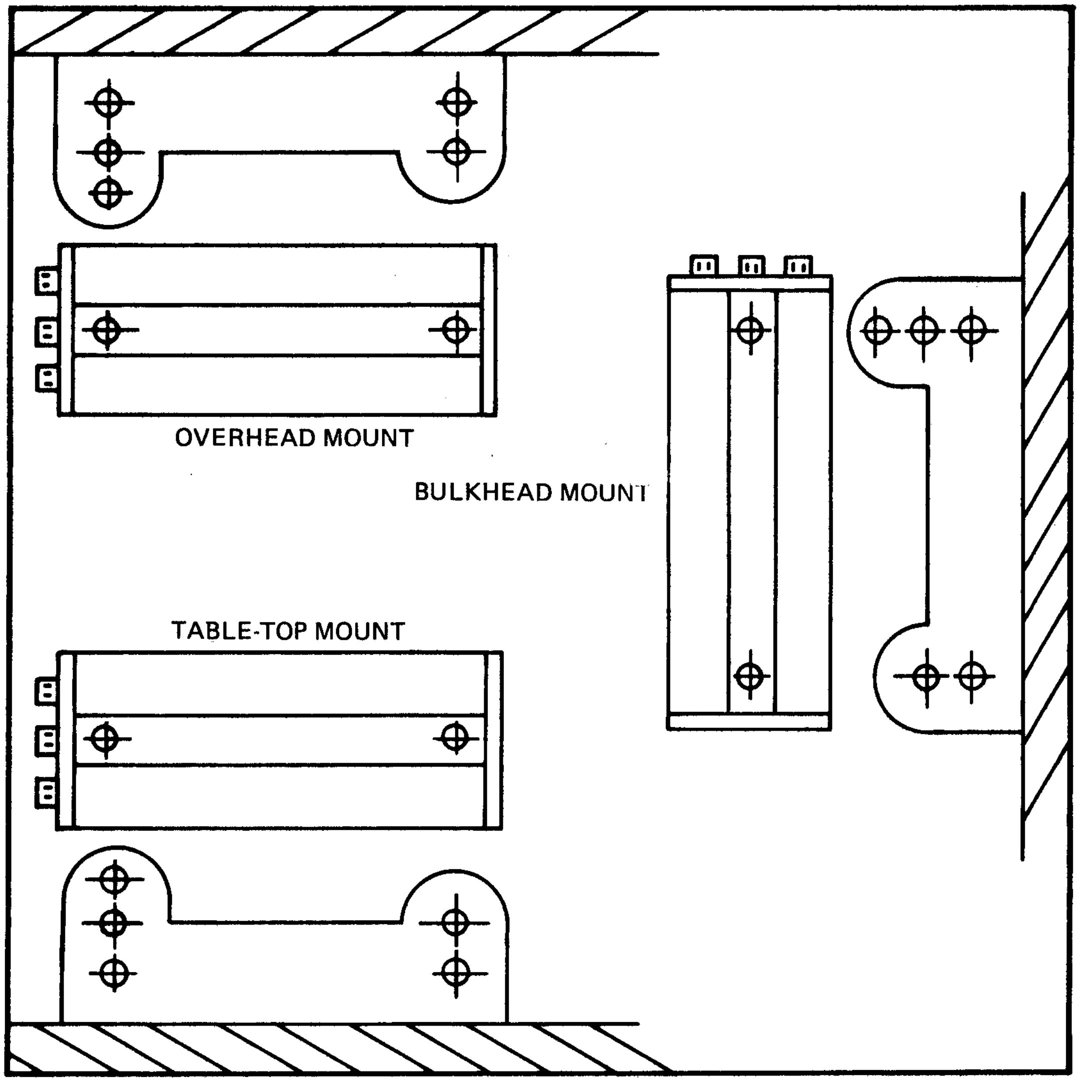


Figure 2-1. Receiver Mounting Positions

Table 2-2. Tools and Test Equipment Required for Installation

ITEM	CRITICAL SPECIFICATIONS	RECOMMENDED ITEM AND MANUFACTURER
Crimping Tool for Coaxial Cable	N/A	Part Number 69478-1, Amp Incorporated (Harrisburg, PA)
AC Voltmeter	Any standard VOM	Simpson 260
Volt-ohmmeter	Any standard VOM	Simpson 260

2.4.3 Power Source. - Prior to installation of the direction finder, verify that the power source supplies the desired voltage and that the interconnection point is wired correctly. In addition, the direction finder must be grounded. Proceed as follows:

(a) Verify that the power outlet is correctly wired with respect to ac potentials, ac neutral, and earth ground. Correct all deficiencies before proceeding.

(b) Verify supplied voltage using an ungrounded ac voltmeter. The supply voltage must be in the range of 103.5 to 126.5 volts ac (rms).

(c) Verify that the earth ground wire from the power source is connected to vessel ground.

(d) Verify that fuse 1F1 of the direction finder is a 1-ampere fuse.

CAUTION

For safety, even though a three-wire power cable is used, it is mandatory that a connection be made between the direction finder chassis and earth ground. Ensure that the earth ground wire is connected to the vessel earth ground.

2.5 INSTALLATION INSTRUCTIONS

The following paragraphs provide installation procedures for the direction finder.

2.5.1 Preliminary Procedure. - Prior to installing the direction finder, perform the following:

(a) Determine the mounting locations of the receiver and antenna. (Refer to paragraph 2.2.)

(b) Determine the length of cable required to interconnect the receiver and antenna. A 125-foot cable is provided with the direction finder. This cable may be shortened to the required length.

(c) Eliminate any rotational "play" in the antenna mast. (Antenna movement will result in bearing errors.)

2.5.2 Antenna Installation. - The antenna should be installed as high as possible to maximize reception range and minimize interference from metallic elements of the vessels structure. In addition, the antenna should have unobstructed reception paths in all directions (360 degrees) from the vessel. Reflective surfaces in the vessels structure should be at least 3 feet below the level of the antenna ground plane. In the event that it is not feasible to install the antenna above all obstructions, the antenna should be 18 feet (minimum) from obstructions to minimize their effect. Proceed as follows:

(a) Secure a 1-1/2" (OD) pipe to the mast or antenna mounting structure. The pipe must be mounted upright and secured to prevent movement and rotation.

(b) Remove antenna, antenna ground radials, and coaxial cable from shipping containers.

(c) Determine antenna mounting position and verify that the coaxial cable is of sufficient length to reach from antenna to receiver. (A 125-foot cable is supplied with the direction finder).

(d) Remove the eight No. 6-32 captive screws which secure the antenna (base) to antenna mount. (Refer to figure 2-2.) Disconnect antenna mount from antenna.

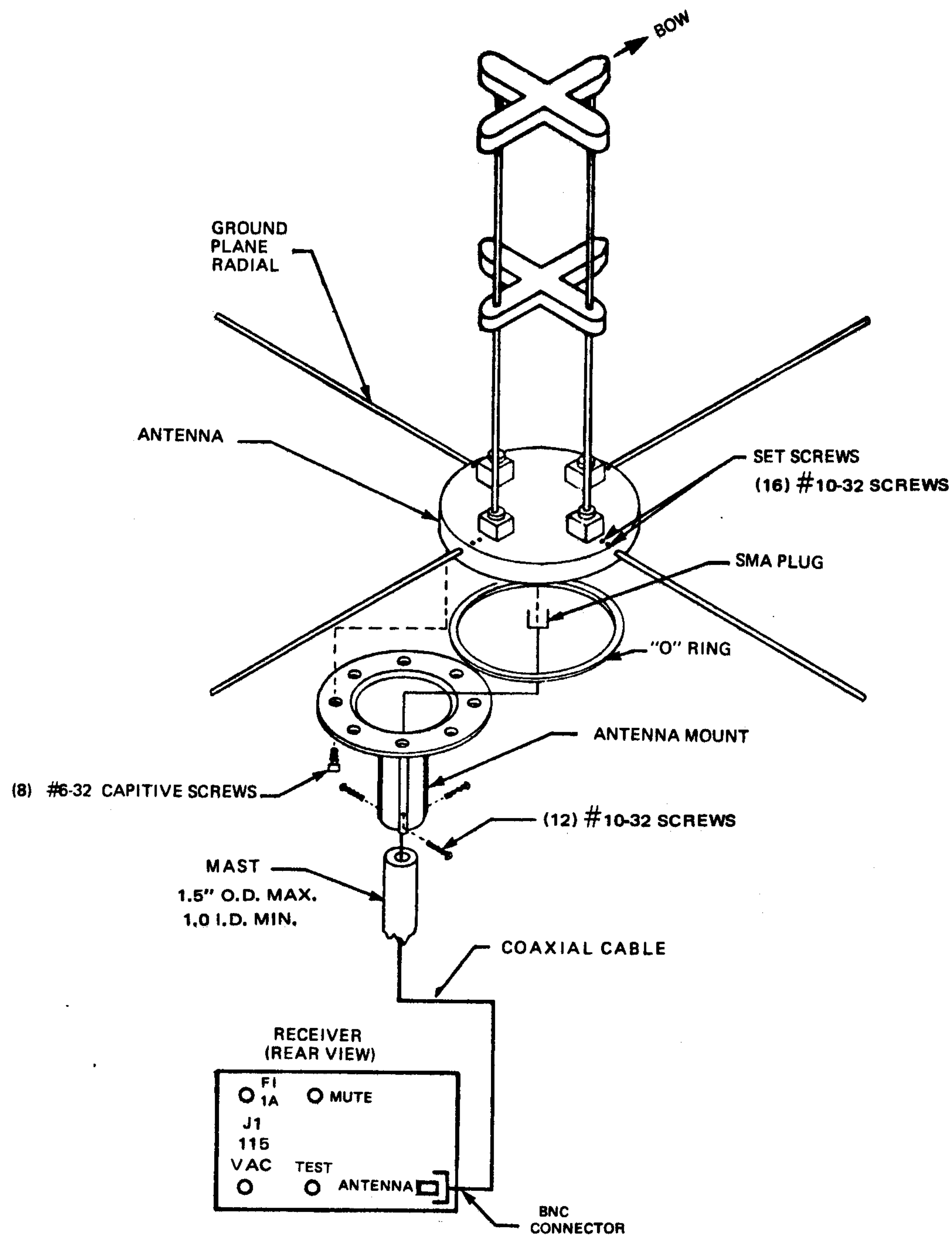


Figure 2-2 Antenna Installation Drawing (Sheet 1 of 2)

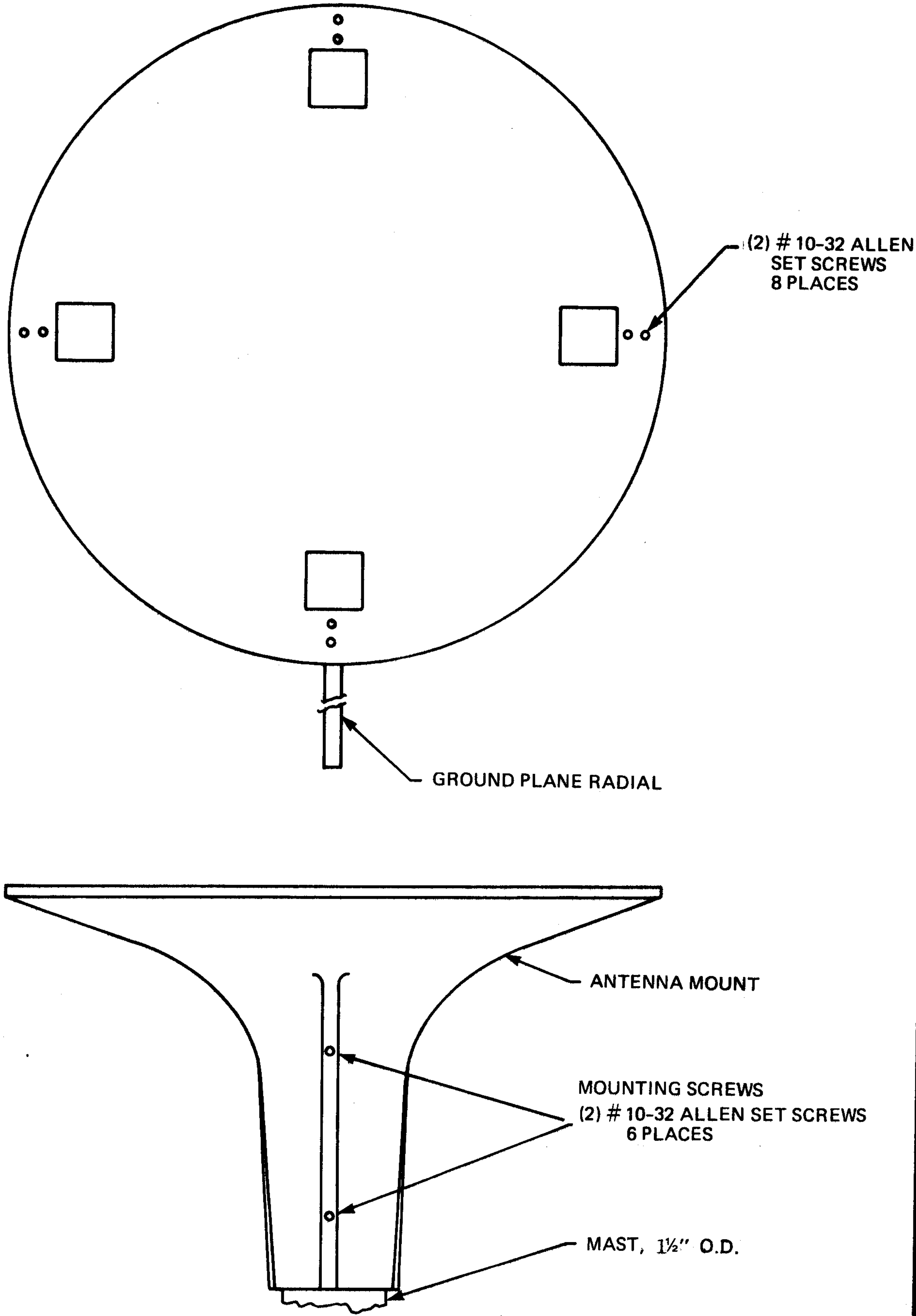


Figure 2-2. Antenna Installation Drawing (Sheet 2 of 2)

NOTE

Improper installation of the coaxial cable could affect the accuracy and stability of the direction finder. Avoid sharp bends or crimps in the cable. If cable is nicked or cut during installation, replace cable.

(e) Connect coaxial cable to antenna. (The SMA plug should be joined to connector 2A2J1 in the antenna.)

(f) Feed coaxial cable through antenna mount and secure mount to antenna, using the eight No. 6-32 screws removed in step d. (An alignment pin is provided to show the correct orientation of mount to antenna.) Allow slack in cable at antenna to facilitate later separation of antenna and mount.

NOTE

Do not allow the full weight of the coaxial cable to be supported by the SMA connector in the antenna. Use ty-wrap strain reliefs (1 each 10-feet) to support the cable.

(g) Feed coaxial cable through pipe installed in step 1. Place antenna mount on pipe, as shown in figure 2-2. (Do not secure antenna to pipe.)

(h) Rotate antenna to align 0-degree antenna element with bow to vessel. (A lump in the antenna insulators indicates 0-degrees.)

(i) Secure antenna mount to pipe using the six No. 10-32 set screws shown in figure 2-2.

(j) Install ground plane radials in antenna base. Secure ground plane radials to base using the set screws provided. Double-set screw for vibration protection.

(k) Lay cable to position of receiver unit. (Do not install BNC connector on cable until so directed by receiver installation procedures.

2.5.3 Receiver Installation. - The receiver unit may be mounted in any convenient location or orientation, as shown in figure 2-1. (Refer to paragraph 2.2.3.) The mounting bracket should be used as a template for locating the mounting screws. The mounting bracket should then be secured to the mounting surface with No. 8 screws. While mounting the receiver is a simple and obvious task, installation instructions are required for interconnection of the receiver with the antenna and power source. The cables are supplied with only one end terminated and at standard lengths. The cables must be cut to the required length and connectors installed (where required) during direction finder installation.

2.5.3.1 Power Cable. A 20-foot, 3-conductor power cable is supplied with the direction finder. This cable should be used for connection to the ac power source. Proceed as follows:

(a) Determine desired cable length and remove excess cable. (If additional length is required, replace cable. Do not locate receiver more than 50 feet from the power source/outlet.)

(b) Connect cable to power source. Each wire should be connected by crimping or solder (terminals not supplied).

(c) Connect cable to receiver unit.

Table 2-3. Power Cable Pin Assignment

WIRE COLOR	PIN	FUNCTION
Black	A	Power
Green	B	Ground
White	C	Neutral

2.5.3.2 Antenna Cable. - A 125-foot, RG58C/U coaxial cable is supplied for connecting antenna to receiver unit. This cable must be cut to the proper length and a BNC connector must be installed. Proceed as follows:

NOTE

Improper installation of the coaxial cable could affect the accuracy and stability of the direction finder. Avoid sharp bends or crimps in the cable. If cable is nicked or cut during installation, replace cable.

(a) Determine desired cable length and remove excess cable.

(b) Strip cable as shown in instructions supplied with connector.

(c) Install connector. Crimp connector to cable with crimp tool as shown in instructions supplied with tool.

(d) Disconnect cable from antenna. Using ohmmeter or continuity tester, check for short circuits with the connector.

Note: Since DC voltage is carried on the coaxial cable, a finite resistance ($\approx$13 kΩ) will be observed.

(e) Reconnect cable to antenna. Connect cable to connector 1J3 of receiver unit.

2.6 INSTALLATION TEST AND ADJUSTMENT

Upon completion of installation, perform the following procedure to test and adjust the direction finder. Proceed as follows:

(a) Verify that the power and antenna cables are properly connected to the receiver rear panel.

(b) Inspect direction finder fuse.

(c) Rotate VOLUME control clockwise to turn on direction finder.

(d) Set CHANNEL switch to an inactive (no signal) channel.

(e) Rotate DIMMER control to maximum clockwise position.

(f) Push MODE switch into DF position.

(g) Verify that the panel lights are lighted and that an LED display occurs.

(h) Rotate DIMMER control back and forth and observe that LED display is alternately bright (fully CW) and dim as DIMMER control is rotated in counterclockwise direction.

(i) Rotate SQUELCH control fully counterclockwise.

(j) Adjust VOLUME control so that noise can be heard, but at a comfortable level.

(k) Slowly rotate SQUELCH control in the clockwise direction to the point at which noise is no longer present. (Do not set SQUELCH control further clockwise than necessary.

(l) Using CHANNEL switch, select an active (signal present) channel. Check for audio and a stable bearing display.

(m) Remove top cover from receiver unit and adjust potentiometers 1A8R32 and 1A8R33 as specified in paragraph 4.5.4.

(n) Reinstall top cover on receiver unit.

(o) Slowly turn the vessel and verify that the direction finder provides the proper display as relative bearing changes.

SECTION III – OPERATION

3.1 INTRODUCTION

This section provides operating instructions for the direction finder. Controls, indicators, and connectors are illustrated and described. Operating procedures, including turn-on, normal operation, and operator checks are provided.

3.2 CONTROLS, INDICATORS, AND CONNECTORS

The controls, indicators, and connectors of the direction finder are illustrated in figure 3-1 and described in table 3-1. Table 3-1 lists the nomenclature and function of each control, indicator, and connector.

3.3 OPERATING PROCEDURES

The following paragraphs provide basic operating procedure for the direction finder.

3.3.1 Direction Finding Mode Operation. - To operate the direction finder in DF mode proceed as follows:

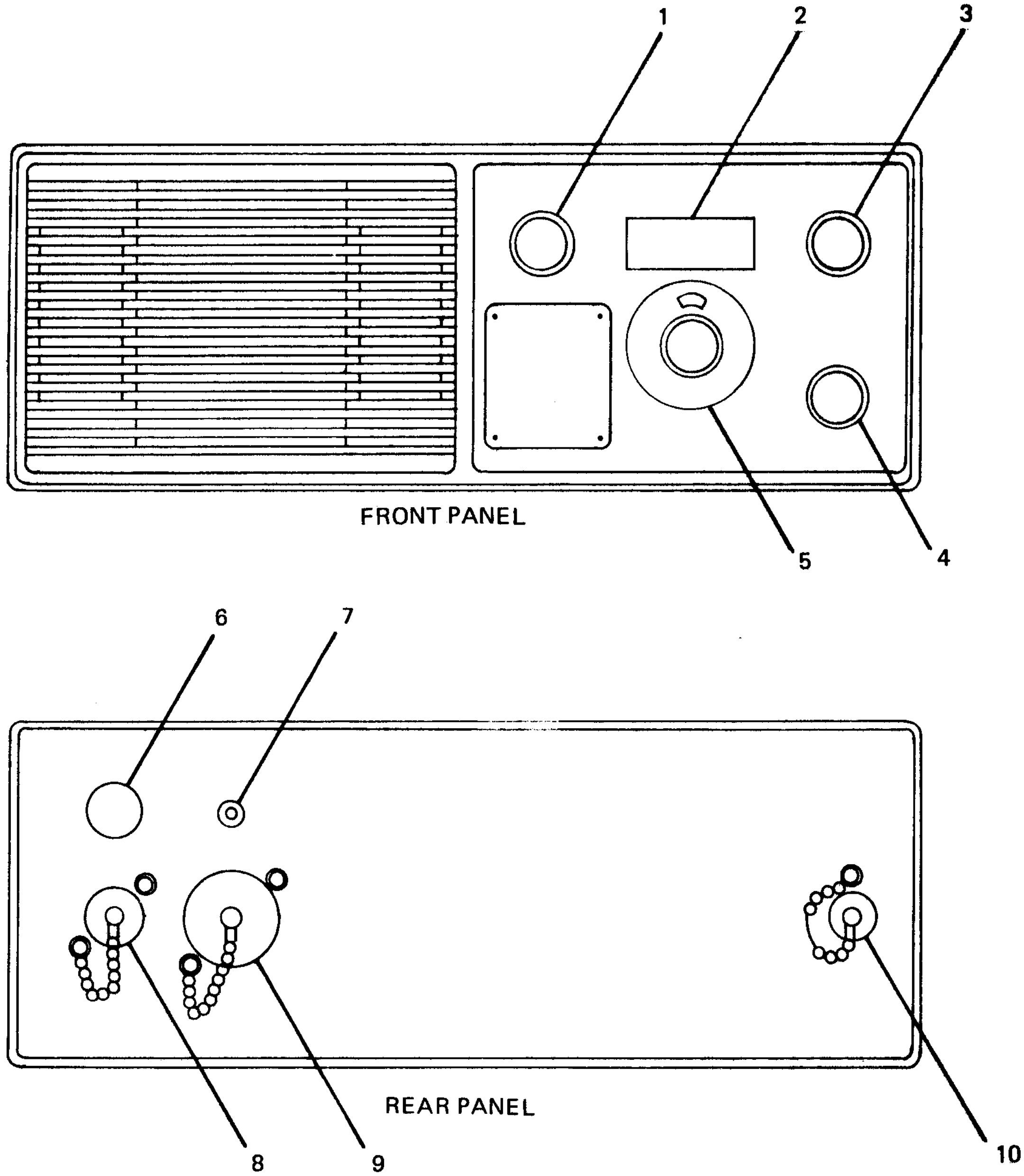
(a) Rotate VOLUME control in clockwise direction. (Do not adjust for maximum volume but apply power to the direction finder.)

(b) Set DIMMER for convenient illumination level.

(c) Rotate SQUELCH control to the maximum counterclockwise position.

(d) Set CHANNEL switch to desired channel.

(e) Set VOLUME control to convenient listening level. (Receiver noise should be heard.)



1. RATE SWITCH, DIMMER ADJUST
2. RELATIVE BEARING DISPLAY
3. MODE SWITCH, SQUELCH ADJUST
4. VOLUME, ON-OFF SWITCH
5. CHANNEL
6. FUSE 1A SLO-BLO
7. MUTE J4
8. 115VAC J1
9. TEST J2
10. ANTENNA J3

Figure 3-1. Receiver/Display Unit, Controls, Indicators, and Connectors

Table 3-1. Controls, Indicators and Connectors

FIGURE INDEX NO.	ITEM	FUNCTION
3-1-1	RATE/DIMMER 1R4	Switch/potentiometer. When pulled to out (FAST) position, fast bearing acquisition rate is selected (appr. 5 sec). When pressed to in (SLOW) position, slow stable bearing acquisition rate is selected (appro. 10 sec). Fully CCW dims panel lights and DEGREES (bearing) indicator. Fully CW is full brightness.
3-1-2	DEGREES 1DS1, 1DS2, 1DS3	Three-digit LED display. Displays relative bearing of received signal.
3-1-3	MODE/SQUELCH 1R3	Switch/potentiometer. When in MONITOR position, the direction finder functions as a receiver only. When pressed to DF position, the direction finder functions as a receiver and displays the relative bearing of the received signal. Fully CW is maximum noise SQUELCH setting. Fully CCW, is minimum noise SQUELCH setting.
3-1-4	VOLUME 1R2	Switch/potentiometer. When set to OFF (counterclockwise) position, primary power for the direction finder is turned off. Rotating the VOLUME control clockwise turns on the direction finder and sets the audio volume level.
3-1-5	CHANNEL 1S1	Rotary switch. Twelve-position switch used to select operating channel for direction finder. Switch positions are: Position / Switch Legend / Channel Frequency 1 / 06 / 156.3 MHz 2 / 12 / 156.6 MHz 3 / 13 / 156.65 MHz 4 / 14 / 156.7 MHz 5 / 16 / 156.8 MHz 6 / 22A / 157.1 MHz 7 / W1 / 162.55 MHz 8 / W2 / 162.4 MHz

Table 3-1. Controls, Indicators and Connectors (Continued)

FIGURE INDEX NO.	ITEM	FUNCTION
3-1-5 (Cont.)		<u>Position</u> / <u>Switch Legend</u> / <u>Channel Frequency</u> 9 / – / Not used 10 / – / Not used 11 / – / Not used 12 / AM / 121.5 MHz
3-1-6	1 ampere fuse F1	Fuseholder and 1-ampere fuse. Protects direction finder from excessive current.
3-1-7	115 V ac 1J1	Connector. Input connector for 115 V ac power.
3-1-8	MUTE 1J4	Connector. Input connector for mute control signal. The application of ground to this connector mutes audio circuits.
3-1-9	TEST 1J2	Connector. Provides access to major signals for test purposes, as follows: <u>Pin</u> <u>Signal</u> A +15 VDC B* Loudspeaker C* Audio D Gnd E ZCD (4.019 kHz Doppler) F ZCD (4.019 kHz Ref) * is jumpered inside Test 1J2
3-1-10	ANTENNA 1J3	Connector. Provides I/O connection for antenna interface cable.

(f) Rotate SQUELCH control in clockwise direction to the point at which receiver noise is no longer heard.

(g) Set RATE switch as desired. (RATE switch is normally set to FAST but may be set to SLOW in high seas for increased bearing acquisition stability.)

(h) Set MODE switch as desired.

(i) When a signal is heard the display will show the bearing of the signal source relative to the bow of the vessel.

(j) When no signal is received, the bearing display will show the bearing if the last signal received.

3.3.2 Monitor Mode Operation. - To operate the direction finder as an auxiliary receiver proceed as follows:

(a) Turn on direction finder as described in paragraph 3.3.1.

(b) Set RATE switch to Monitor position.

(c) The display will extinguish. All receiver functions are the same as in direction finder operation.

3.4 OPERATING CHECKS

The operator should perform one of the following tests prior to commencing maintenance on the unit. If the test indicates that the direction finder is malfunctioning, refer to section IV for maintenance procedures.

3.4.1 Operator's Test - In Port. - To verify the operation of the direction finder while in port, proceed as follows:

(a) Turn on direction finder as described in paragraph 3.3.1. Operate direction finder in DF mode.

(b) Set CHANNEL switch to receive transmissions from a known location (W1, W2, marine operator, etc.)

(c) Verify that displayed bearing approximates the known bearing of the transmitter.

(d) Set CHANNEL switch to receiver transmission from another known location. Verify that displayed bearing approximates the known bearing of the transmitter.

(e) Verify that VOLUME, SQUELCH, and DIMMER controls operate as described in table 3-1 and paragraph 3.3.1.

3.4.2 Operating Test - At Sea. - To verify the operation of the direction finder while at sea, proceed as follows:

(a) Turn on direction finder as described in paragraph 3.3.1. Operate direction finder in DF mode.

(b) Set CHANNEL switch to receive transmissions from a known location (W1, W2, marine operator, etc.)

(c) Verify that bearing approximates the known bearing of the transmitter.

(d) Change the vessel's course and verify that the displayed bearing changes by an amount equal to the course change.

(e) Verify that the VOLUME, SQUELCH, and DIMMER controls function as described in table 5-1 and paragraph 3.3.1.

SECTION IV – MAINTENANCE

4.1 INTRODUCTION

This section contains a preventive maintenance schedule, performance tests, adjustment procedures, and troubleshooting information for the direction finder. The preventive maintenance schedule is intended to improve the reliability of the direction finder and should be carried out at the intervals stated. The performance tests determine whether the direction finder is operating within its listed specifications. The adjustment procedures are provided to help maintain the direction finder within its specifications. The troubleshooting information is intended to aid in locating and correcting direction finder malfunctions.

4.2 RECOMMENDED TEST EQUIPMENT

Test equipment required for performance of test procedures, adjustment procedures, and troubleshooting is listed in table 4-1. Any equipment that satisfies the specifications given may be substituted for the recommended model.

4.3 PREVENTIVE MAINTENANCE

A good preventive maintenance schedule will result in greater direction finder reliability. A visual inspection of the units comprising the direction finder are the first step in the operation. Inspect the units for corrosion, dirt, moisture, and loose or binding connectors. Inspect the cables for wear or signs of stress. Table 4-2 details recommended preventive maintenance operations and the suggested time interval between the operations.

Table 4-1. Recommended Test Equipment

INSTRUMENT TYPE	RECOMMENDED MODEL	REQUIRED SPECS
RF Signal Generator	Hewlett-Packard Model 8640B	120 to 163 MHz, AM, FM modulation
Distortion Analyzer/ Voltmeter	Hewlett-Packard Model 334A	With 1 kHz (or tunable notch filter – voltmeter)
Isolator	Intech 8301-0088	Capacitor Coupling
Frequency Counter	Hewlett-Packard Model 5382A	20 MHz or higher. High input impedance
Oscilloscope	Hewlett-Packard Model 180A	35 MHz or higher bandwidth
Digital Multimeter	Hewlett-Packard Model 3472A	3-1/2 digits, volts and ohms
Receiver/Display Test Set	Intech 8301-0081	4.019 kHz output with phase selectable in 45 degree steps
16-ohm Dummy Load	Intech 8301-0089	16-ohm Load, Test Connector

Table 4-2. Preventive Maintenance Schedule

INTERVAL	PROCEDURE
Quarterly	1. Check units for corrosion. 2. Inspect cables for outer jacket failure. 3. Inspect all receiver connections for corrosion, dirt, and broken pins. 4. Inspect antenna coaxial connection for internal corrosion, water, and salt accumulation.
Yearly	1. Inspect antenna for mechanical damage (breakage, corrosion, etc.). 2. Lubricate with contact cleaner front panel controls and switches.

4.4 PERFORMANCE TESTS

Use the following procedures to determine if the direction finder is operating within specifications. The performance of the direction finder should be tested upon installation and at regular intervals thereafter. If the direction finder fails to meet one or more of the tests, refer to the adjustment procedures in the following paragraphs.

CAUTION

Hazardous voltages are exposed when the covers of the receiver unit are removed and power is applied.

NOTE

Plus 15 V dc is present on antenna connector. Use Isolator Intech 8301-0088 to protect equipment connected to antenna input.

4.4.1 Power Supply Test. - The test operation of the power supply, proceed as follows:

(a) Connect receiver to primary power source.

(b) Remove top cover from receiver unit.

CAUTION

Do not touch any components when power is connected to receiver as 115 V ac is present. Failure to heed this warning may result in serious or fatal injury.

(c) Connect positive lead of voltmeter to A2TP1 (Red) and negative lead to any black TP. Check that reading is 21.6 to 26.4 volts dc, with 115 V ac applied.

(d) Move positive lead to A2TP2 (Green). Check that reading is 13.5 to 16.5 volts dc.

4.4.2 Frequency Test. - To test tuning of the receiver unit, proceed as follows:

(a) At A6TP3 (Brown), check for frequency of 446.250 kHz $\pm$10 Hz. If indication is out of tolerance, refer to paragraph 4.5.1 for tuning instructions.

(b) At A8TP1 (White), check for frequency of 1.4468 MHz ±10 Hz. If indication is out of tolerance, refer to paragraph 4.5.1 for tuning instructions.

(c) At A4TP1 (White), check for frequency of 17.346250 MHz ±10 Hz. If indication is out of tolerance, refer to paragraph 4.5.1 for tuning instructions.

(d) At A3TP1 (White), check for frequency of 17.346250 MHz ±10 Hz. If indication is out of tolerance, refer to paragraph 4.5.1 for tuning instructions.

(e) Connect test equipment to receiver as shown in figure 4-1.

(f) Set CHANNEL switch to 06.

(g) At A6TP4 (Orange), check for 7.5±0.5 V. Set CHANNEL switch to remaining FM channels and check for 7.5±0.5 V at A6TP4 (Orange) for each of the FM channels. If any indication is out of tolerance, refer to paragraph 4.5.1 for tuning instructions.

(h) Set CHANNEL switch to AM.

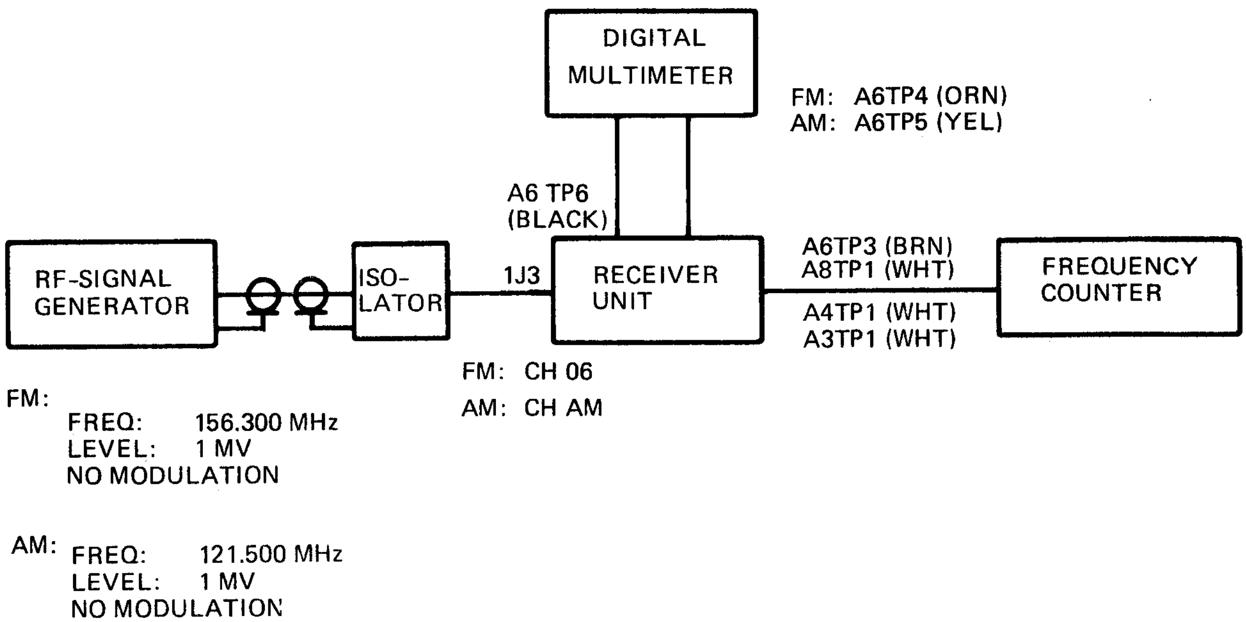


Figure 4-1. Frequency Test Setup

(i) Change rf signal generator frequency to 121.500 MHz.

(j) At A6TP5 (Yellow), check for 7.0 ± 0.5 V. If the indication is out of tolerance, refer to paragraph 4.5.1 for tuning instructions.

4.4.3 Sensitivity (12 dB SINAD) Test. - To perform this test, proceed as follows:

(a) Connect test equipment to receiver unit, as shown in figure 4-2.

(b) Set signal generator controls as follows:

Frequency:	156.300 MHz
Modulation Frequency:	1 kHz
FM Deviation	3.0 kHz
Output level:	1 mV

(c) Set receiver unit controls as follows:

CHANNEL Switch:	06
SQUELCH Control:	Fully CCW, pulled out (monitor mode)

(d) Adjust VOLUME control for 6.35 V rms/16 ohms (2.5 watts) on the distortion analyzer (in voltmeter mode).

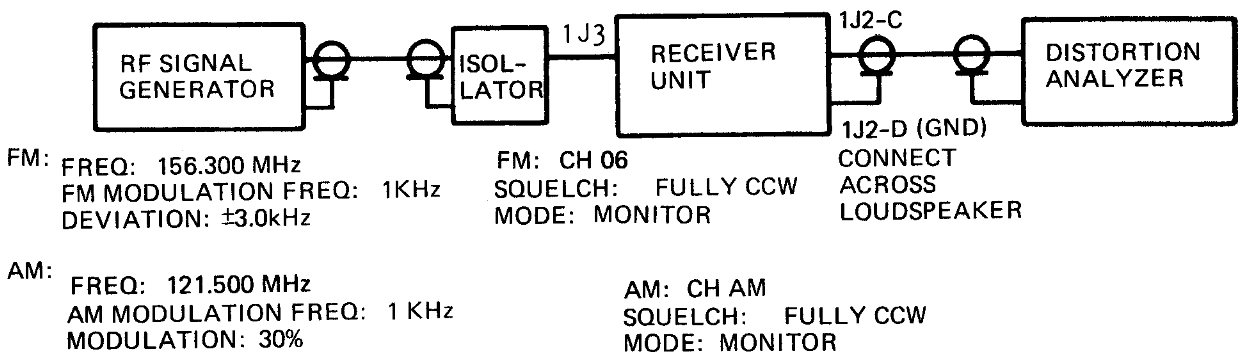


Figure 4-2. Sensitivity Check Test Setup

(e) Reduce signal generator output level until SINAD is 12 dB. Minimum specification is 0.5μV for 12 dB SINDAD.

(f) Measure the sensitivity of the remainder of the FM channels.

(g) Set signal generator controls as follows:

Frequency:	121.500 MHz
Modulation Frequency:	1 kHz
AM Modulation:	30 percent
Output Level:	1 mV

(h) Set CHANNEL switch to AM.

(i) Adjust VOLUME control for 6.35 V rms/16 ohms (2.5 watts) on the distortion analyzer (in Voltmeter mode).

(j) Reduce signal generator level until SINAD is 10 dB. Minimum specification is 1.0μV for 10 dB SINAD.

4.4.4 Audio Power Output Test. - To perform this test, proceed as follows:

FM:

(a) Connect test equipment to receiver unit as shown in figure 4-2 and set receiver controls as specified in paragraph 4.4.3.c.

(b) Set rf signal generator output level to 1 mV, rms.

(c) Adjust VOLUME control for 6.35 V rms/16 ohms (2.5 watts) on the distortion analyzer (in voltmeter mode).

(d) Measure distortion of audio output. Ensure that it is 10 percent or less.

AM:

(e) Set receiver controls as follows:

CHANNEL Switch:	AM
SQUELCH Control:	Fully CCW

(f) Repeat (b), (c), and (d).

4.4.5 Squelch Threshold Sensitivity Test. - To perform this test, proceed as follows:

(a) Connect test equipment to receiver unit as shown in figure 4-2.

(b) Set CHANNEL switch to 06 and set signal generator frequency to 156.300 MHz.

(c) Reduce rf output of signal generator to zero.

(d) Adjust SQUELCH control fully CCW, then adjust squelch control until receiver noise is no longer heard.

(e) Increase rf output of signal generator until receiver noise is again heard.

(f) Read rf signal level of signal generator. Minimum specification is 0.5 microvolts.

(g) Set CHANNEL switch to AM and set signal generator frequency to 121.500 MHz.

(h) Repeat (c), (d), (e), and (f).

4.4.6 AGC Threshold Test. - To perform the AGC threshold check, proceed as follows:

(a) Connect test equioment to receiver as shown in figure 4-3.

(b) Set CHANNEL switch to 06 and set rf signal generator for 156.300 MHz.

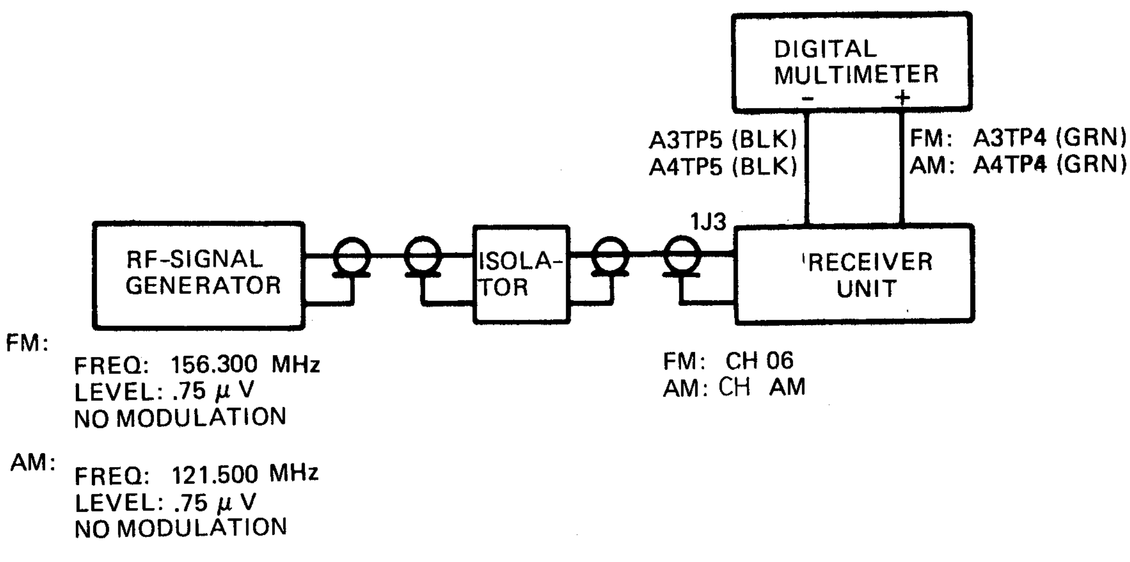


Figure 4-3. AGC Threshold Test Setup

(c) At A3TP4 (Green), check for 6.5 ±0.5 V. If indication is out of tolerance refer to paragraph 4.5.2 for adjustment instructions.

(d) Set CHANNEL switch to AM and set rf signal generator frequency to 121.500 MHz.

(e) At A4TP4 (Green), check for 6.5 ±0.5 V. If indication is out of tolerance refer to paragraph 4.5.2 for adjustment instructions.

<u>4.4.7 Antenna Drive Level Test</u>. - To perform this check proceed as follows:

(a) Connect test equipment to receiver as shown in figure 4-4.

(b) Measure dc voltage with digital multimeter connected directly on the antenna connector (coax center conductor). Specified voltage is 15.0 ± 0.5 V dc.

(c) Measure signal level with distortion analyzer (connected as a voltmeter). Minimum specification is 0.8 V rms ± 0.02 V rms. If the indication is out of tolerance, refer to paragraph 4.5.3 for adjustment instructions.

(d) Check distortion with the distortion analyzer. Distortion should be less than 10 percent.

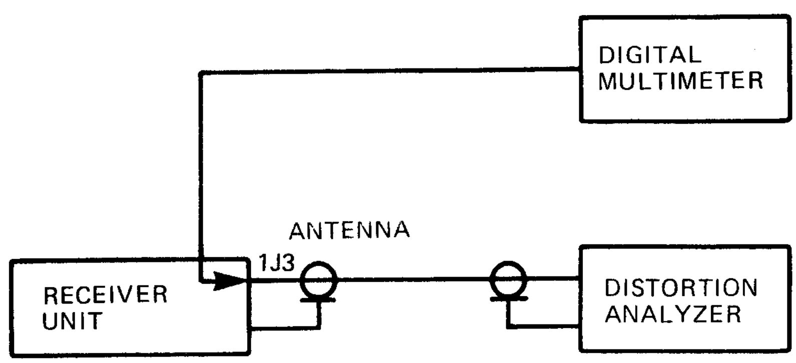


Figure 4-4. Antenna Drive Level Test Setup

4.4.8 Receiver DF Accuracy Test. - To perform this test, proceed as follows:

(a) Connect test equipment to receiver as shown in figure 4-5.

(b) Set CHANNEL switch to 06 and set rf signal generator frequency to 156.300 MHz and adjust deviation to ± 500 Hz.

(c) Set Receiver Display Test Set to switch position 1. Read and record the bearing.

(d) Set Receiver Display Test Set to switch position 2. Read and record the bearing.

(e) Continue to read and record the bearing in all switch positions of the Receiver Display Test Set including a final reading in position 1.

(f) If the beginning and the final reading in switch position 1 on the Receiver Display Test Set is identical, use this reading as a reference to calculate the errors. If the readings are different, use the average value of the two readings. The minimum specification is ± 1 degree error in all positions with respect to the reference.

4.4.9 System DF Accuracy Test.- When performing this test, make sure that the antenna is far away from large objects. Best results are obtained when the test is performed at sea with the transmitting source at a distance but in line of sight. Proceed as follows:

(a) Select a transmitting source in a known location (e.g., W1, W2, e.g.)

(b) Set the CHANNEL switch to the desired channel.

(c) Set MODE switch to select DF mode and observe the displayed bearing.

Minimum specification is ±3 degrees from the known bearing. If the indication is out of tolerance, refer to paragraph 4.5.4 for tuning instructions.

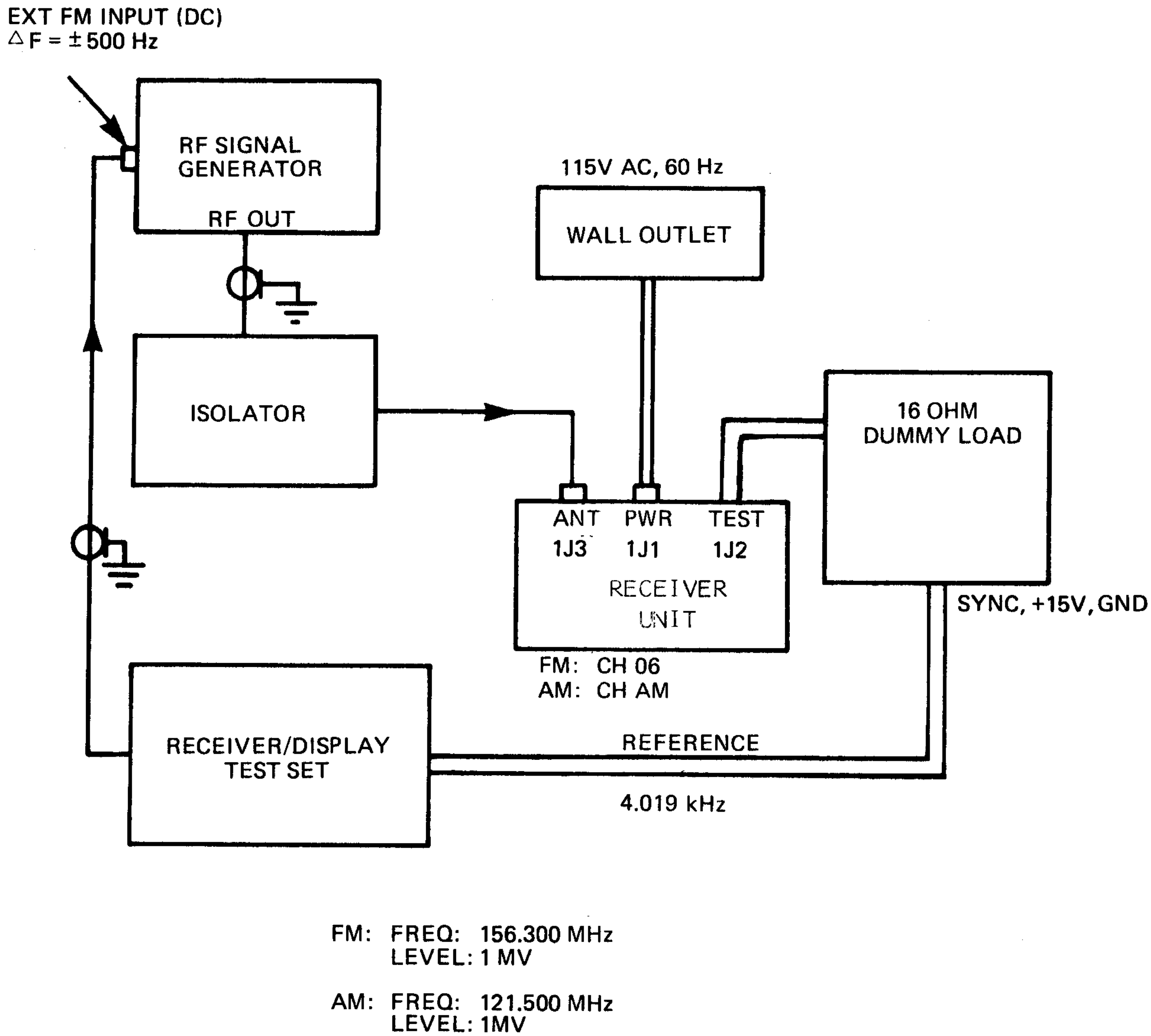


Figure 4-5. Receiver DF Accuracy Test Setup

4.5 ADJUSTMENTS

The following paragraphs provide adjustment procedures to return the direction finder to peak operating condition when alignment is required or following repair action. Adjustment controls are shown in figure 4-6 and test points are shown in figure 4-7. Refer to paragraph 4.6 for troubleshooting information. Schematics, a receiver wiring diagram, and other maintenance related data are provided in section VII of this manual.

CAUTION

Hazardous voltages are exposed when the covers of the receiver are removed and ac power is connected.

4.5.1 Oscillator Frequency Adjustments. - To adjust crystal oscillators, proceed as follows:

(a) With dc power removed (OFF), place card 1A6 on the extender card.

(b) Set up test equipment as shown in figure 4-1 and apply dc power (ON).

(c) Adjust 1A6C51 for frequency indication of 446.250 kHz ± 10 Hz at 1A6TP3.

(d) Connect counter to 1A8TP1 (White).

(e) Adjust 1A8C3 for frequency indication of 1.446800 MHz ± 10 Hz at 1A8TP1.

(f) Connect counter to 1A4TP1 (White).

(g) Adjust 1A4C31 for frequency indication of 17.346250 MHz ± 10 Hz at 1A4TP1.

(h) Connect counter to 1A3TP1 (White).

(i) Adjust 1A3C1 for frequency indication of 17.346250 MHz ± 10 Hz at 1A3TP1.

(j) Set the CHANNEL switch to the channel to be adjusted and the rf signal generator to the channel frequency.

(k) Set CHANNEL switch to 06 and set rf signal generator to 156.3 MHz.

(l) Adjust 1A6C1 for 7.5 ± 0.5 V at 1A6TP4 (Orange). (Refer to figure 7-7 for location of 1A6C1.)

(m) Repeat steps (k) and (l) while selecting each FM channel and tuning the rf signal generator to the frequency of the selected channel. Adjust the applicable trimmer capacitors

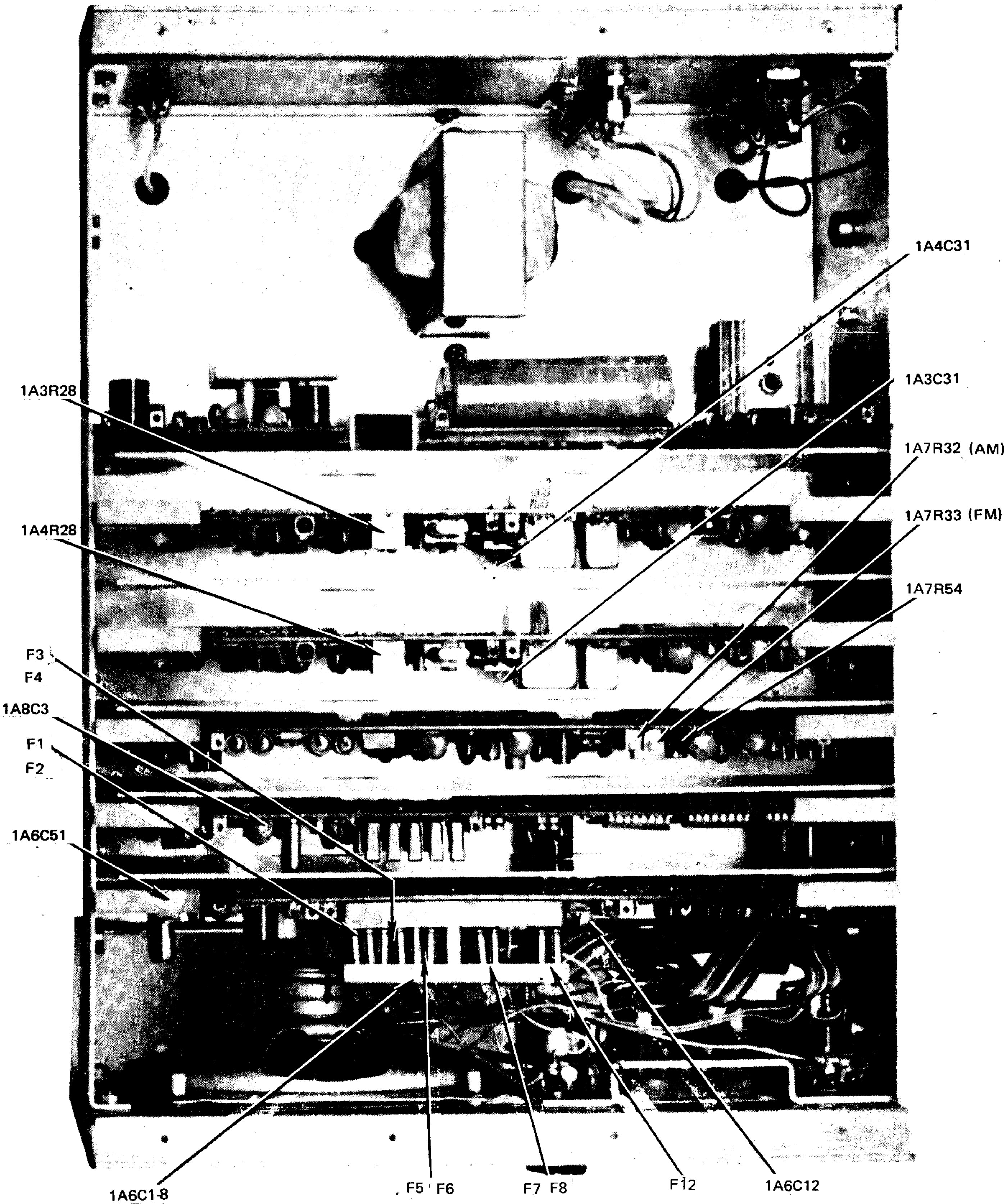


Figure 4-6. Receiver Adjustment Controls

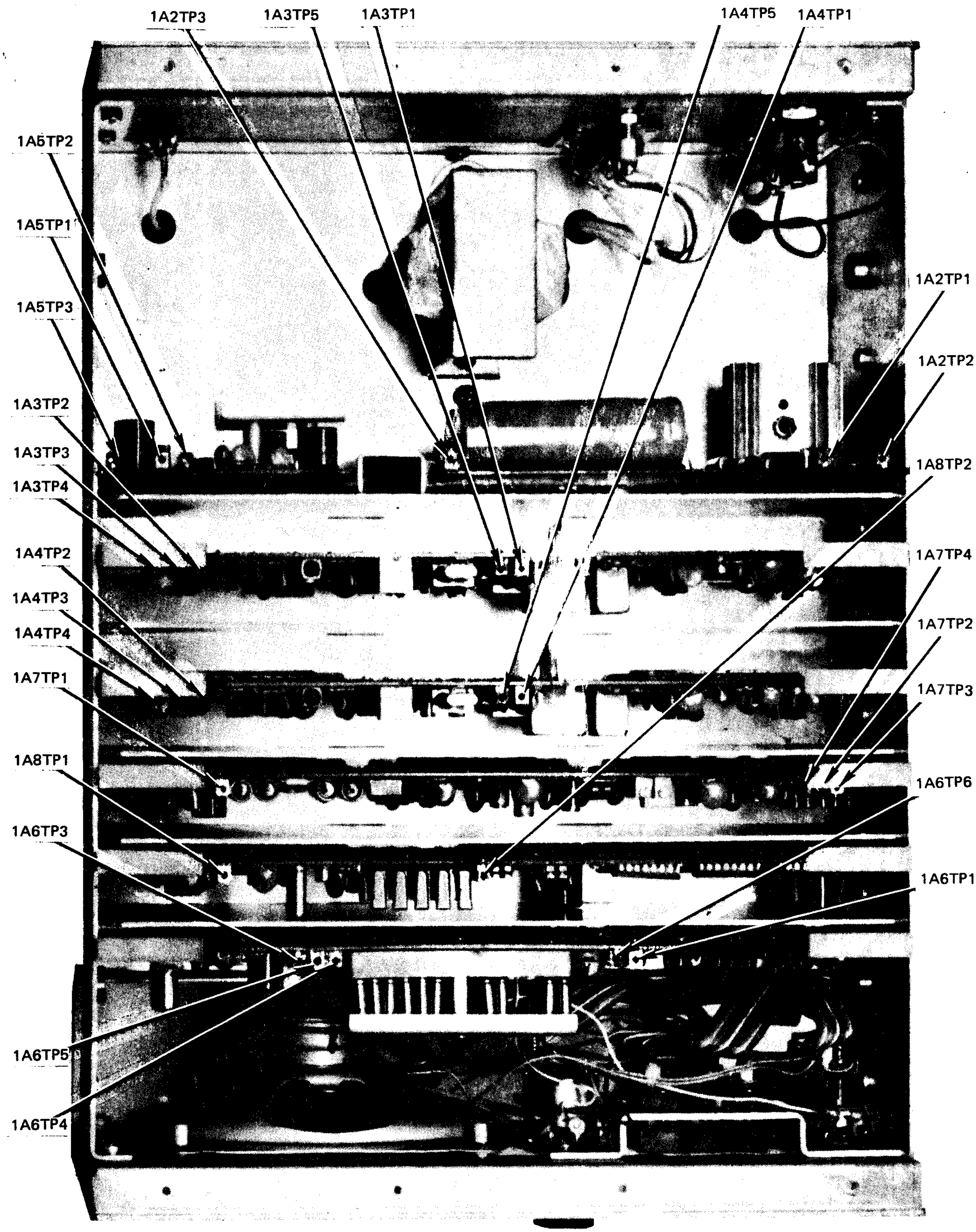


Figure 4-7. Receiver Test Points

for 7.5 ± 0.5 V at 1A6TP4 (Orange) when each channel is selected (Refer to figure 7-7 for the locations of trimmer capacitors.) The channels, frequencies, and trimmer capacitors are:

Channel	Frequency	Capacitor
06	156.30	1A6C1
12	156.60	1A6C2
13	156.65	1A6C3
14	156.70	1A6C4
16	156.80	1A6C5
22A	157.10	1A6C6
W1	162.55	1A6C7
W2	162.40	1A6C8

(n) Set CHANNEL switch to AM and set rf signal generator to 121.5 MHz.

(o) Adjust 1A6C12 for 7.0 ± 0.5 V at 1A6TP5 (Yellow). (Refer to figure 7-1 for location of 1A6C12.)

NOTE

Remove dc power before removing extender card.

4.5.2 AGC Threshold Adjustment. - To adjust AGC threshold, proceed as follows:

(a) Set up test equipment as shown in figure 4-3.

(b) For FM channels, check for 6.5 ± 0.5 V at 1A3TP4 (Green). Adjust 1A3R28 for correct level at 1A3TP4.

NOTE

A time delay between the potentiometer adjustment and the resulting voltage indication change make this adjustment somewhat time consuming.

(c) For AM channels, check for 6.5 ± 0.5 V at 1A4TP4 (Green). Adjust 1A4R28 for correct level at 1A4TP4.

NOTE

A time delay between the potetiometer adjustment and the resulting voltage indication change make this adjustment somewhat time consuming.

4.5.3 Antenna Drive Level Adjustment.- To perform this adjustment, proceed as follows.

(a) Connect test equipment to receiver as shown in figure 4-4.

(b) Check signal level with distortion analyzer (connected as a voltmeter). Signal level should be 0.8 V rms. Adjust 1A7R54 for 0.8 ± 0.02 V rms.

4.5.4 System DF Accuracy Adjustment. - To perform this adjustment, proceed as follows:

(a) Select a transmitting source in a known location, (W1, W2, e.g.)

(b) Set the CHANNEL switch to the desired channel.

(c) Set MODE switch to select DF mode and observe the displayed bearing.

(d) The bearing should be ±3 degrees from the correct relative bearing value. If required, adjust the bearing indication as follows:

NOTE

Before performing the bearing adjustment, a quick inspection of the antenna is recommended to verify that it has not shifted position.

(e) For FM channels, adjust potentiometer 1A8R33 to obtain correct bearing indication.

(f) For AM channels, adjust potentiometer 1A8R32 to obtain correct bearing indication.

NOTE

1. Know the location of vessel and transmitting source so that an accurate reference bearing can be determined with ± 3 degrees.
2. No obstructions within 100 meters or more (no tall building, masts, etc.)
3. Open water is preferred.

4.5.5 Other Adjustments. - There are no other adjustments that can be performed in the field. All other adjustments must be performed in a service depot using the proper test equipment, test fixtures, etc. Accidental adjustment of non-field adjustable components will necessitate the replacement of the board containing those components.

4.6 TROUBLESHOOTING

Successful troubleshooting is aided by an understanding of the theory of operation and by an understanding of the use of the controls and indicators. Refer to Section 1 for operating principles and theory of operation. Refer to Section III for a description of controls and indicators and for operating instructions.

If trouble is suspected, visually inspect the receiver unit and the antenna unit. Check for loose cables, burnt components, and a blown fuse. Verify that all printed circuit boards are making good contact and are not shorting to an adjacent shield. If no obvious trouble is located, check the 115-V ac power.

4.6.1 Initial Troubleshooting Procedure. - Before troubleshooting the direction finder in an attempt to locate a defective circuit board, ensure that none of the conditions listed in table 4-3 exist.

Table 4-3. Initial Symptom-Cause Checks

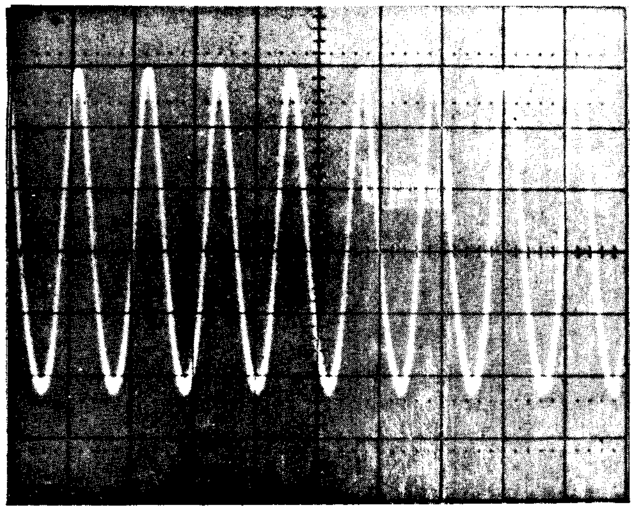
SYMPTOM	PROBABLE CAUSE
Receiver does not turn on. No Audio, No Squelch.	Defective fuse 1F1 1. Coax cable defective, or connections loose. 2. MUTE connector shorted to ground. 3. Power supply defective.

4.6.2 DC Voltages and Waveforms. - Receiver test point voltages and waveforms, and the conditions for performing these measurements are given in table 4-4 and figure 4-8. respectively. The test points are identified in figure 4-4. Since the equipment control settings for making measurements may differ from one test point to another, note the measurement conditions given.

4.6.3 Trouble Diagnosis. - By the use of the front panel controls, together with the visual and audible response of the direction finder, determine as many details of the malfunctions as possible. Following this, consult the appropriate sheet of the troubleshooting flowcharts provided in figure 4-9 and follow the instructions given for isolating and correcting the malfunction. A receiver wiring diagram, schematics, and other circuit data is provided in Section VII.

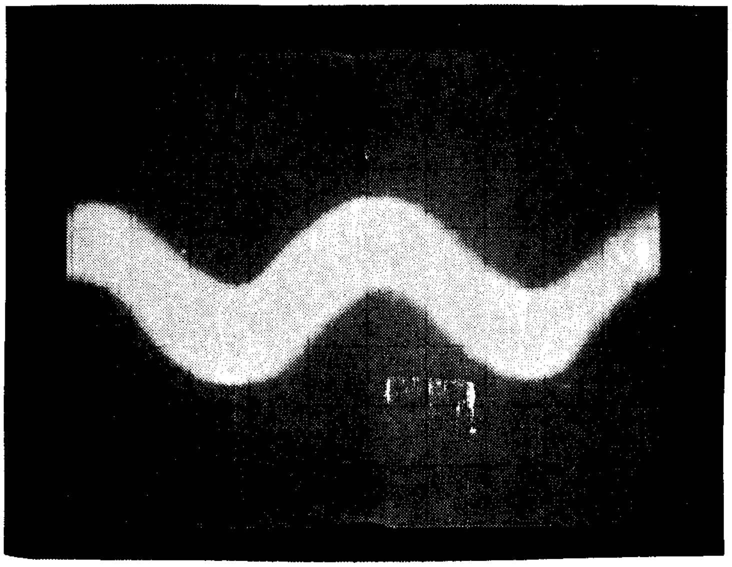
Table 4-4. Receiver DC Test Point Voltages

TEST POINT	SIGNAL	RECEIVER CONTROL SETTINGS	RF SIGNAL INPUT	DC VOLTAGE	NOTES
1A2TP1	Unregulated DC power in		None	22 to 28 V dc	
1A2TP2	Regulated +15 V dc		None	15.0 V dc ± 10%	
1A3TP4	AGC	CH 16,	See Note	≈ +7.5 V dc at no signal	Decreases to 0 V dc as signal level increases.
1A4TP4	AGC	CH AM	See Note	≈ +7.5 V dc at no signal	Decreased to 0 V dc as signal level decreases
1A3CR9	AGC Indicator (LED)	CH 16, homing mode	See Note		Maximum brilliance at no signal. Dims as signal increases.
1A4CR9	AGC Indicator (LED)		See Note		
1A5TP2	Detected Squelch Noise	CH 16 or CH AM	See Note	≈ +2.5 V dc +1.6 V dc	No signal Strong signal not affected by squelch control
1A6TP2	Rectified LO output	CH 16 or CH AM	None	⩾ +2.0 V dc	Varies with LO output level.
1A6TP5	AM AFC	CH AM	121.5 MHz, 1mV	≈ 7.0 V dc	Varies with signal generator frequency
1A6TP4	FM AFC	CH 16	156.8 MHz, 1mV	≈ 7.5 V dc	Varies with signal generator frequency
1A8TP2	Light dimmer		None	0 to 15 V dc	Varies with dimmer control setting



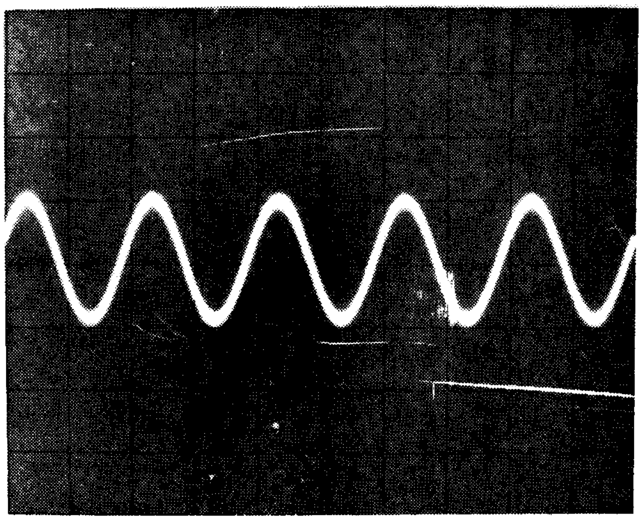
TEST POINT:	A3 TP1 OR A4 TP1
SIGNAL:	17.34625 MHz 2nd L.O.
RF INPUT:	NONE
RECEIVER CONTROLS:	CH 14 FOR A3 TP1 CH AM FOR A4 TP1
SCOPE SETTINGS:	VERT– 0.05V/div, AC HORIZ– .05 μ sec/div
COMMENT:	TYPICAL LEVEL SHOWN LEVEL CAN VARY AS MUCH AS 50% FROM UNIT TO UNIT.

Figure 4-8. Receiver Test Point Waveforms



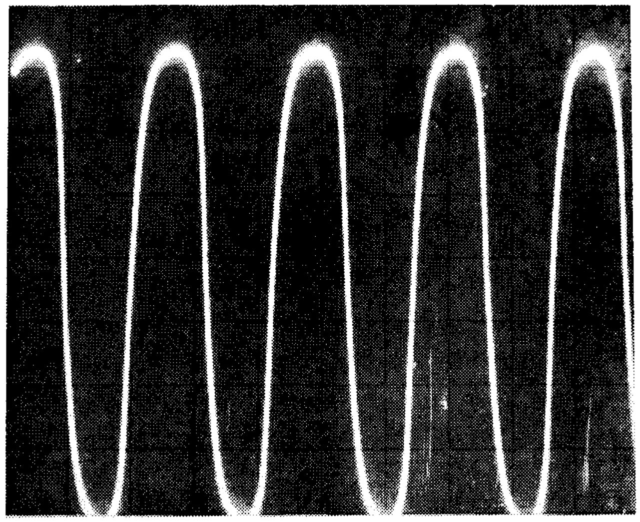
TEST POINT:	A3 TP2
SIGNAL:	UN-DEEMPHASIZED FM AUDIO
RF INPUT:	1 mV 156.700 MHz 1 kHz MODULATION, 3 kHz DEVIATION
RECEIVER CONTROLS:	CH 14
SCOPE SETTINGS:	VERT– 0.2V/div, AC HORIZ– 0.2 msec/div

Figure 4-8. Receiver Test Point Waveforms



TEST POINT:	A4 TP3
SIGNAL:	DEMODULATED AM AUDIO
RF INPUT:	1 mV 1 KHz MODULATION 30% AM MODULATION 121.5 MHz
RECEIVER CONTROLS:	CH AM
SCOPE SETTINGS:	VERT– .05V/div, AC HORIZ– .2 msec/div
COMMENT:	LEVEL CAN VARY CONSIDERABLEY FROM UNIT TO UNIT.

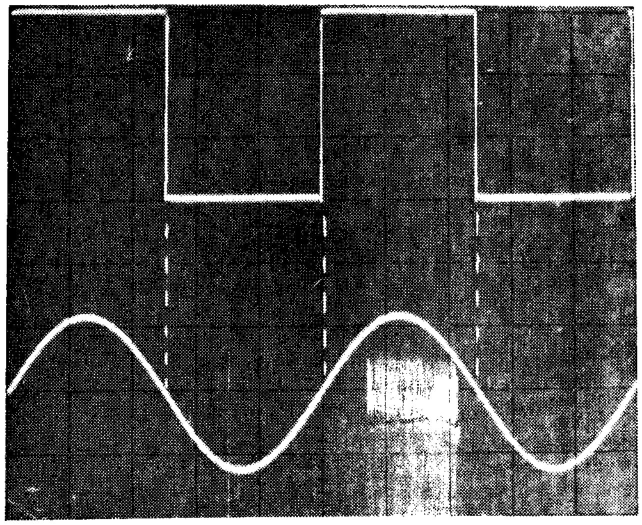
Figure 4-8. Receiver Test Point Waveforms



TEST POINT:	A6 TP3
SIGNAL:	446.25 KHz OSCILLATOR
RF INPUT:	NONE
SCOPE SETTINGS:	VERT– .2V/div, AC 10:1 PROBE HORIZ– 1 μs/div

Figure 4-8. Receiver Test Point Waveforms

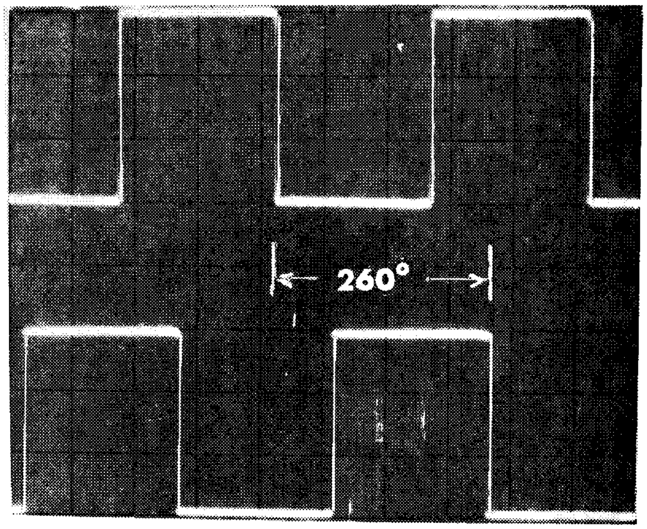
A7 TP3
REFERENCE



A7 TP2
ANTENNA
DRIVE

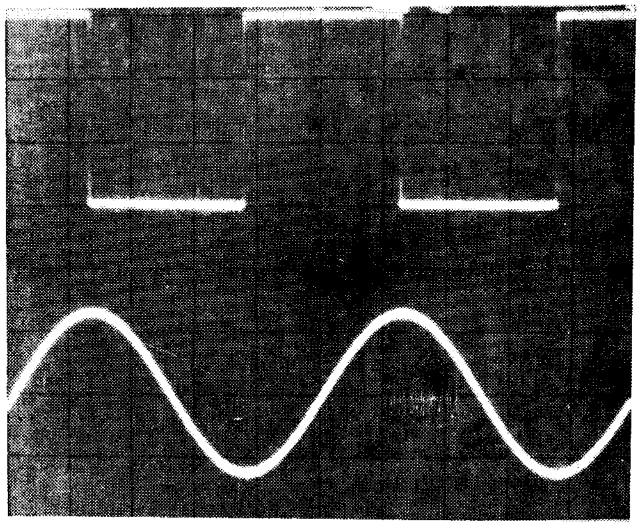
	TOP TRACE	BOTTOM TRACE
TEST POINT: SIGNAL:	A7 TP3 REFERENCE	A7 TP2 ANTENNA DRIVE
RF INPUT:	NONE	NONE
RECEIVER CONTROLS:	DF	DF
SCOPE SETTINGS	VERT–5V/div DC HORIZ– 50 μ s/div	VERT– 1V/div AC HORIZ-- 50μ s/div
COMMENT:	NOTE PHASE RELATIONSHIP	

Figure 4-8. Receiver Test Point Waveforms



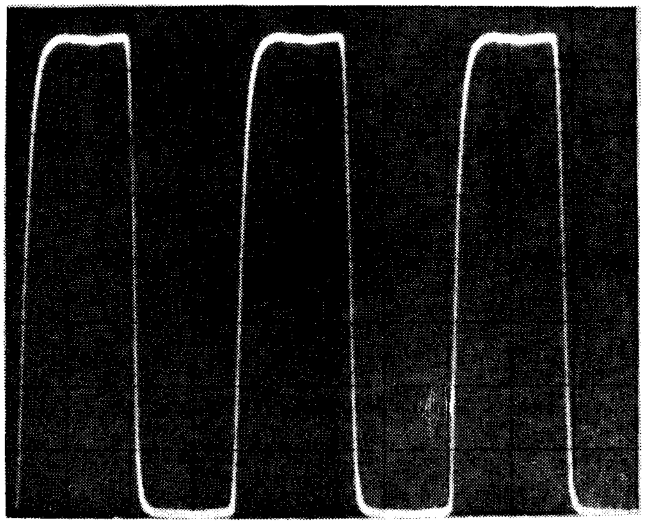
	TOP TRACE	BOTTOM TRACE
TEST POINT:	A7 TP3	A7 TP4
SIGNAL:	REFERENCE	ZCD (ZERO CROSSING DETECTOR)
RF	1 MV 156.7004 MHZ 4.019 KHz FM MODULATION AT 500 Hz DEVIATION FROM TEST BOX NO. 8301-0081 OR RECEIVED SIGNAL FROM ANTENNA (W1 OR W2)	SAME
RECEIVER CONTROLS:	DF CH 14, W1 OR W2	SAME
SCOPE SETTINGS:	VERT– 5V/div DC HORIZ– 50 μ s/div	SAME
COMMENT:	PHASE RELATIONSHIP DETERMINES BEARING. PHASE SHIFT (BEARING) SHOWN IS 260° DUTY CYCLE MUST BE 50%	

Figure 4-8. Receiver Test Point Waveforms



	TOP TRACE	BOTTOM TRACE
TEST POINT:	A7 TP4	A7 TP1
SIGNAL:	ZCD	DEMODULATED DOPPLER 4KHZ
RF INPUT:	1MV 156.700 MHZ 4.019 KHZ FM MODULATION AT 500HZ DEVIATION FROM TEST BOX NO.8301-0081 OR RECEIVED SIGNAL FROM ANTENNA (W1 OR W2)	SAME
RECEIVER CONTROLS:	DF CH 14, W1 OR W2	SAME
SCOPE SETTINGS:	VERT-5V/DIV DC HORIZ-50µS/DIV	.2V/DIV AC 50µS/DIV

FIGURE 4-8. RECEIVER TEST POINT WAVEFORMS

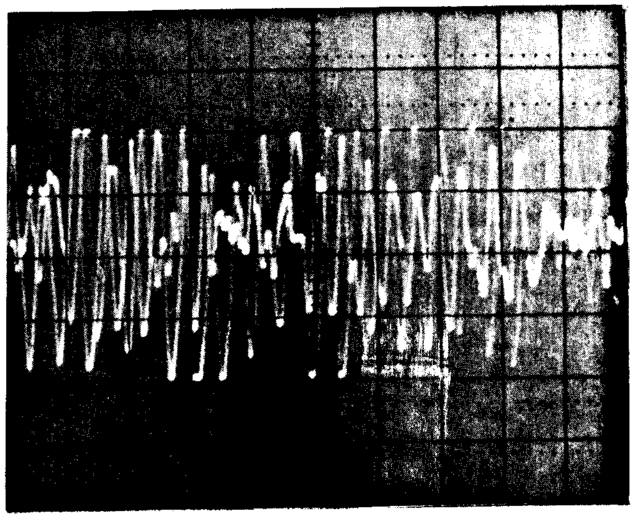


TEST POINT:	A8 TP1
SIGNAL:	1.44680 MHZ
RF INPUT :	NONE
RECEIVER CONTROLS:	DF
SCOPE SETTINGS:	VERT– .2V/div AC 10:1 PROBE HORIZ– 0.2 μ s/div

Figure 4-8. Receiver Test Point Waveforms

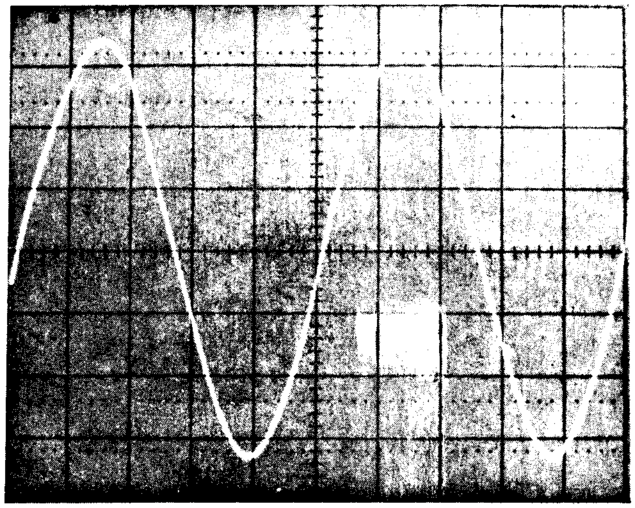
TEST POINT: SIGNAL:	A8 TP2 LIGHT DIMMER INPUT
RF INPUT:	NONE
RECEIVER CONTROLS:	DF
SCOPE SETTINGS:	VERT– 1V/div AC HORIZ– 50 μ s/div
COMMENT:	DC VOLTAGE VARIES 0 – 15 VDC WITH POSITION OF DIMMER CONTROL

Figure 4-8. Receiver Test Point Waveforms



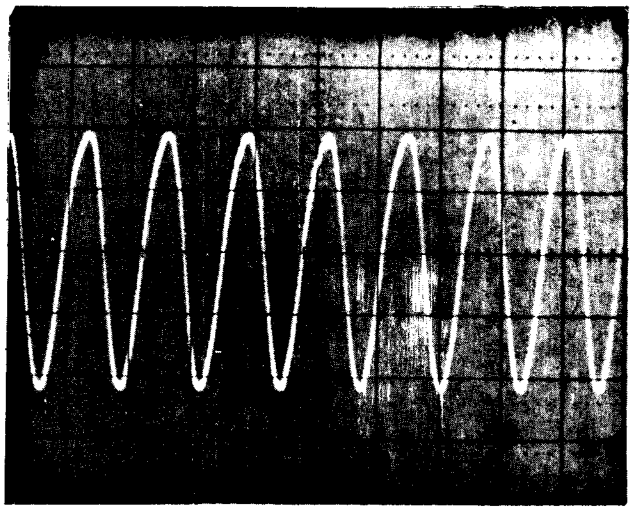
TEST POINT:	A5 TP1
SIGNAL:	SQUELCH FILTER OUT PUT
RF INPUT:	NONE
RECEIVER CONTROLS'	CH 14 OR CH AM
SCOPE SETTINGS:	VERT– 2V/div, AC HORIZ– 0.1 msec/div
COMMENT:	LEVEL CAN VARY SOME FROM UNIT TO UNIT

Figure 4-8. Receiver Test Point Wavefomrs



TEST POINT:	SPEAKER AUDIO
RF INPUT:	1MV 156.700 MHZ 1KHZ MODULATION, 3KHZ DEVIATION
RECEIVER CONTROLS:	CH 14 SQUELCH CONTROL FULLY CW, VOLUME CONTROL MID-POSITION
SCOPE SETTINGS:	VERT-0.2V/DIV HORIZ-0.2MSEC/DIV

Figure 4-8. Receiver Test Point Waveforms



TEST POINT:	A6 TP1
SIGNAL:	CRYSTAL OSCILLATOR
RF INPUT:	NONE
RECEIVER CONTROLS:	ANY CHANNNEL
SCOPE SETTINGS:	VERT– 0.1V/div AC HORIZ– 0.05 μ sec/div

Figure 4-8. Receiver Test Point Waveforms

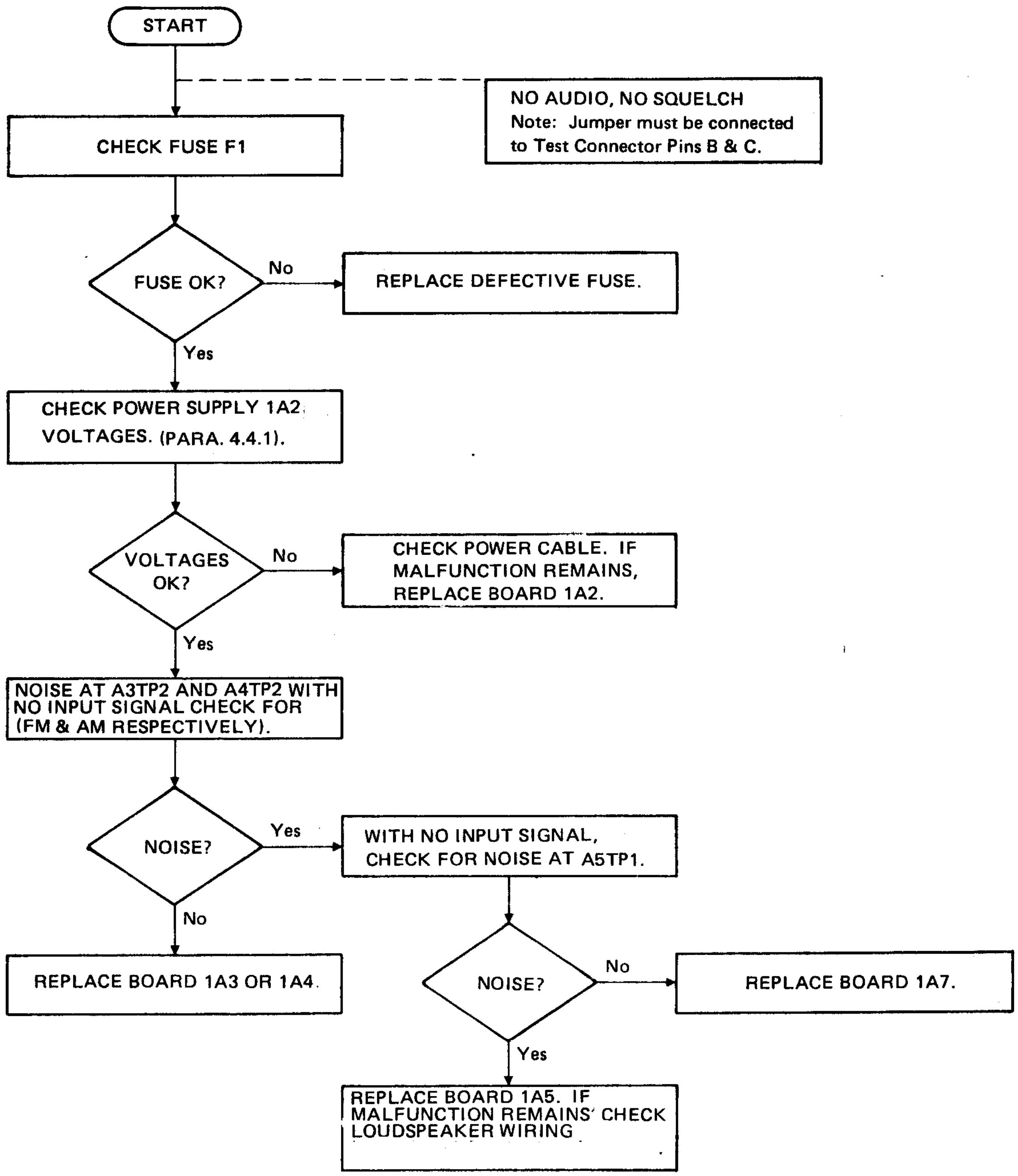


Figure 4-9. Direction Finder Troubleshooting Flowchart (Sheet 1 of 5)

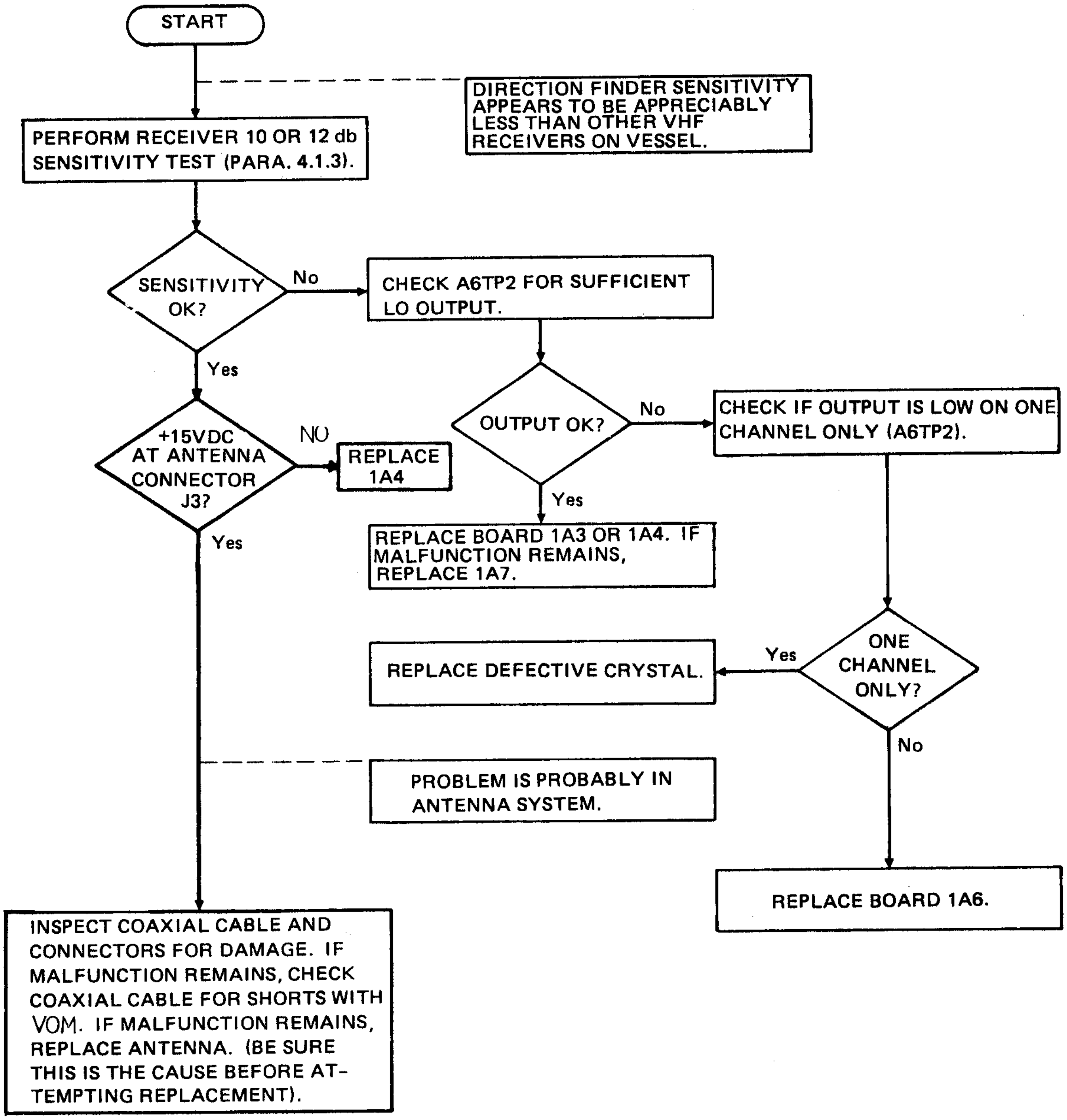


Figure 4-9. Direction Finder Troubleshooting Flowchart (Sheet 2 of 5)

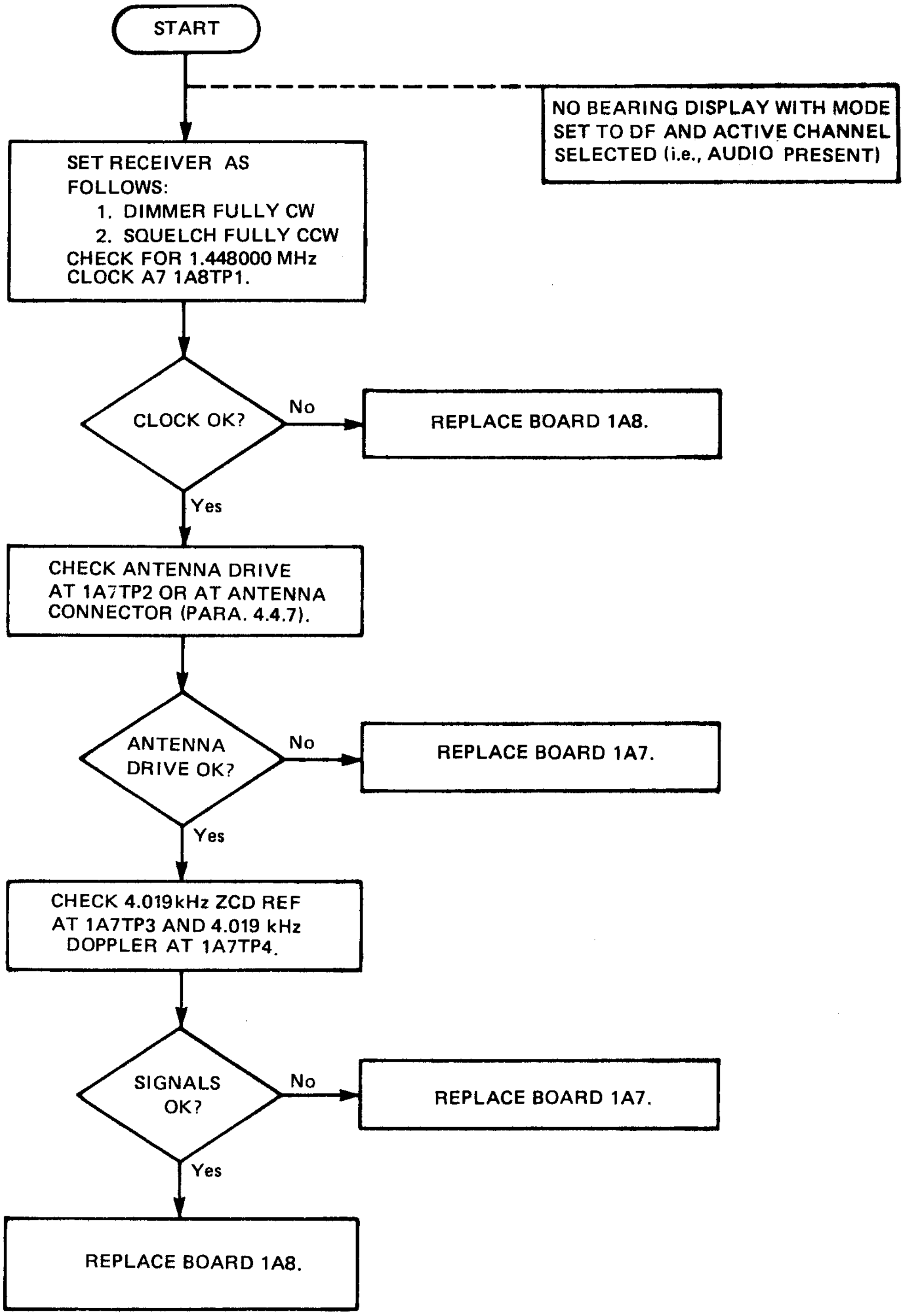


Figure 4-9. Direction Finder Troubleshooting Flowchart (Sheet 3 of 5)

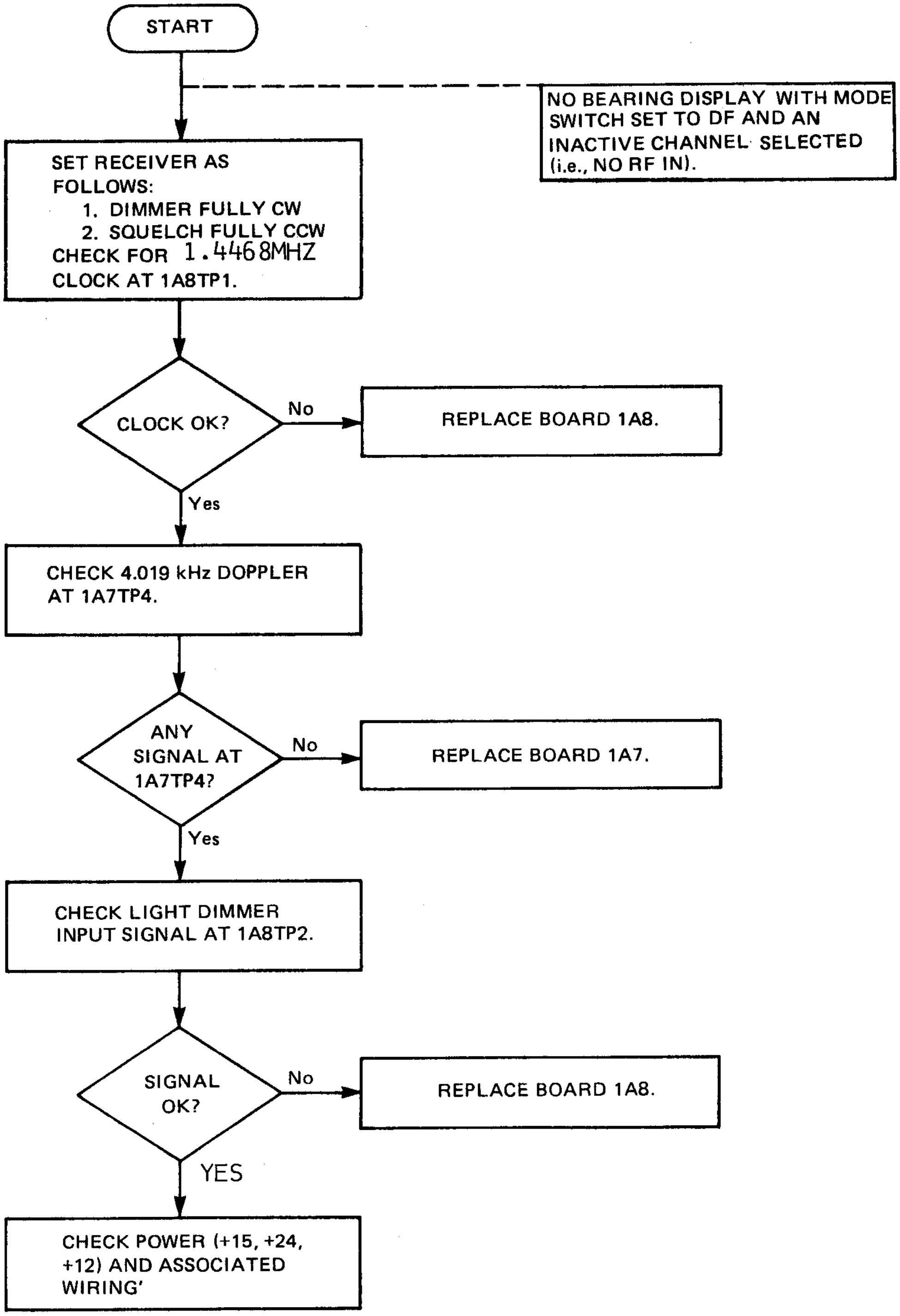


Figure 4-9. Direction Finder Troubleshooting Flowchart (Sheet 4 of 5)

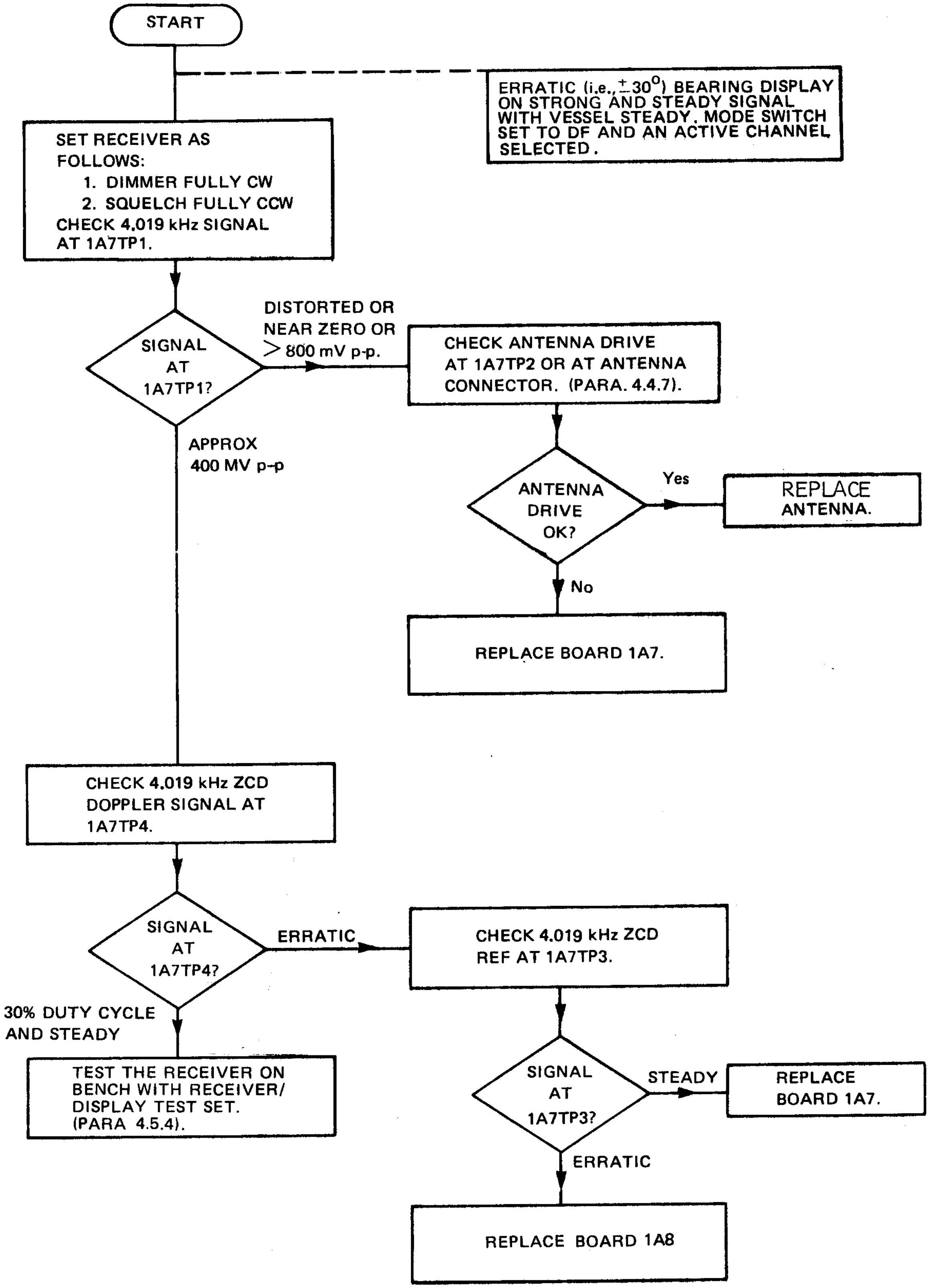


Figure 4-9. Direction Finder Troubleshooting Flowchart (Sheet 5 of 5)

5.1 INTRODUCTION

This section contains listings for all replaceable parts for the homer. Tables 5-1 through 5-3 list parts in alphanumeric order by reference designation for the receiver unit and antenna unit respectively. The tables provide the following information:

(a) REF. DESIG. The reference designation for each replaceable part.

(b) DESCRIPTION. The description for each replaceable part.

(c) MFR. CODE. Manufacturer's Federal Supply Code Number. Refer to Table 5-3 for manufacturer's name and address.

(d) MFR. PART NO. Manufacturer's part number for replaceable part.

Table 5-1. Receiver Unit 1 Parts List

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
UNIT 1	DIRECTION FINDER SET AN/SRD-22, RECEIVER	33969	9115 7433
1A1	.DELETED		
C1	...CAPACITOR, FIXED .001 μF, 1KV	56289	5GA-D10
C2	...SAME AS C1		
C3	...SAME AS C1		
C4	...SAME AS C1		
C5	...CAPACITOR, FIXED 1 μF, 63V	52763	MKT-1822-510/06
C6	...CAPACITOR, FIXED 1500 PF	52763	KP1834-215/16
DS1	...LED DISPLAYS	04404	5082 7650
DS2	...SAME AS DS1		
DS3	...SAME AS DS1		
DS4	...LED WITH MOUNTING KIT	04404	5082 4655
DS5	...SAME AS DS4		
DS6	...SAME AS DS4		
F1	...FUSE	71400	AGC-1
J1	...CONNECTOR	81349	MS-3102A-10SL-3P
J2	...CONNECTOR	81349	MS-3102A014S-6S
J3	...CONNECTOR	81349	UG-1094A/U
J4	...CONNECTOR	81349	MIL-C-39024/10 01
LS1	...SPEAKER	07109	135C2948
L1	...INDUCTOR, FIXED	33967	1200 0014
L2	...INDUCTOR, FIXED	33967	1200 0060
L3	...INDUCTOR, FIXED	17490	WEE 2.2
L4	...SAME AS L3		
MPJ2	...JUMPER	33967	5115 7547
MPLS1	...SPEAKER GRILL SHIELD	33967	5115 7397
MPR1/S1	...KNOB	32767	105
MPR2/S2	...SAME AS MPR1/S1		
MPR3/S3	...SAME AS MPR1/S1		
MPS4	...DIAL	33967	9115 7458
MP1	...GUIDE BRACKET	33967	9115 7421
MP2	...INSTRUCTION PLATE	33967	5515 7531
MP3	...COVER, TOP	33967	5115 7419
MP4	...COVER, BOTTOM	33967	5115 7420
MP5	...CLIP	78553	C12043-017
MP6	...SAME AS MP5		
MP7	...SAME AS MP5		
MP8	...SAME AS MP5		
MP9	...KNOB INSERT	32767	775-25

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
MP10	...SAME AS MP9		
MP11	...SAME AS MP9		
MP12	...SAME AS MP9		
MP13	...HEXSEAL	13074	30122
MP14	...SAME AS MP13		
MP15	...SAME AS MP13		
MP16	...SAME AS MP13		
MP17	...DISPLAY, PANEL	33967	5115 7410
MP18	...DISPLAY, SHIELD	33967	5115 7412
MP19	...GRILLE CLOTH	33967	5120 0002
MP20	...GRILLE	33967	5500 1001
MP21	...FRONT, PANEL	33967	5515 7409
MP22	...STAND OFF	88245	766
MP23	...SAME AS MP22		
MP24	...SAME AS MP22		
MP25	...SAME AS MP22		
MP26	...GUIDE BRACKET	33967	5115 7416
MP27	...CARD GUIDE	23880	1250F
MP28	...SAME AS MP27		
R3/S3	...POT, SQUELCH	71450	2700 0017
R2/S2	...POT, VOLUME	71450	2700 0000
R4/S4	...POT, DIMMER	71450	2700 0001
R1	...RESISTOR	01121	EB-330 Ω
R5	...SAME AS R1		
R6	...SAME AS R1		
S1	...SWITCH	29604	73-1074
T1	...TRANSFORMER	80089	P8604
XA1A	...DELETED		
XA2A	...CONNECTOR	54453	1SM10SREH
XA2B	...SAME AS XA2A		
XA3A	...SAME AS XA2A		
XA3B	...SAME AS XA2A		
XA4A	...SAME AS XA2A		
XA4B	...SAME AS XA2A		
XA5A	...SAME AS XA2A		
XA6A	...SAME AS XA2A		
XA6B	...CONNECTOR	54453	1SM10SREH
XA6C	...SAME AS XA2A		
XA7A	...SAME AS XA2A		
XA7B	...SAME AS XA2A		

Table 5-1. Receiver Un it 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
XA7C	...SAME AS XA2A		
XA8A	...SAME AS XA64		
XA8B	...CONNECTOR	54453	1SM22DREH
XDS1	...LED SOCKET ASSY	52072	CA-S-16M0-00-261-T0-012
XDS2	...SAME AS XDS1		
XDS3	...SAME AS XDS1		
XF1	...FUSE HOLDER	75915	342022
XJ1	...CAP, POWER	02660	9760-10
XJ2	...CAP, TEST	02660	9760-14
XJ3	...CAP, BNC	81349	CW-123A/W
XR1	...INSERT	33967	5515 7544
PC-1	...PC CARD EXTENDER ASSEMBLY	33967	9115 7546
W1	...POWER CABLE ASSEMBLY	33967	9115 7223

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A2	·CIRCUIT CARD ASSY, POWER SUPPLY	33967	9115 7202
1A2MP1	··PRINTED WIRING BOARD	33967	2315 7202
C1	···CAPACITOR, FIXED, 2100 μF, 30V	90201	TGG2120030L2L
C2	···SAME AS C1		
C3	···CAPACITOR, FIXED, .22 μF	52736	MKT-1822-227/00
C4	···CAPACITOR, FIXED, .1 μF	52736	MKT-1819-410/0
CR1	···DIODE, 1N5400	81349	1N5400
CR2	···VARISTOR, VP130LA10A	09214	V130LA10A
CR3	···DIODE, 1N4002	81349	1N4002
E1	···ZERO OHM RESISTOR, FIXED (JUMPER)	55210	L-2007-1
R1	···RESISTOR, FIXED, .47Ω, 2W	75042	BWH-0.47Ω,2W,5%
R2	···SAME AS R1		
R3	···RESISTOR, FIXED (JUMPER)	33967	2550 0096
TP1	···TEST POINT, RED	74970	105-0752-001
TP2	···TEST POINT, GREEN	74970	105-0754-001
TP3	···TEST POINT, BLACK	74970	105-0753-001
U1	···DIODE ASSY, PF05	83701	PF05
U2	···MICROCIRCUIT, MC7815CP	04713	MC7815CP

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A3	·CIRCUIT CARD ASSY, RECEIVER 156-163MHz	33967	9115 7448
1A3MP	··PRINTED WIRING BOARD	33967	2315 7448
C1	···CAPACITOR, FIXED, .001 μF	22701	1008 0047
C2	···CAPACITOR, FIXED, 330PF	22701	1008 0040
C3	···SAME AS C1		
C4	···CAPACITOR, FIXED, 5PF	22701	1008 0011
C5	···CAPACITOR, FIXED, 1PF	22701	1008 0001
C6	···CAPACITOR, FIXED, 22PF	22701	1008 0020
C7	···CAPACITOR, FIXED, 10PF	22701	1008 0015
C8	···CAPACITOR, FIXED, 8.2PF	22701	1008 0014
C9	···SAME AS C1		
C10	···SAME AS C2		
C11	···SAME AS C1		
C12	···SAME AS C1		
C13	···SAME AS C5		
C14	···SAME AS C7		
C15	···SAME AS C8		
C16	···SAME AS C8		
C17	···SAME AS C1		
C18	···SAME AS C5		
C19	···SAME AS C7		
C20	···SAME AS C7		
C21	···SAME AS C7		
C22	···SAME AS C1		
C23	···CAPACITOR, FIXED, .1 μF	52763	MKT-1819-410/0
C24	···SAME AS C1		
C25	···CAPACITOR, FIXED, 82PF	04062	DM15-820J
C26	···SAME AS C1		
C27	···CAPACITOR, FIXED, 200PF	04062	DM15-201J
C28	···CAPACITOR, FIXED, 470PF	04062	DM15-471J
C29	···SAME AS C28		
C30	···SAME AS C1		
C31	···CAPACITOR, VARIABLE, 5.5-18PF	52763	10S-TR1K0-22-N 003
C32	···SAME AS C6		
C33	···CAPACITOR, FIXED, .047 μF	51642	200-050-651-473M
C34	···SAME AS C23		
C35	···SAME AS C28		
C36	···DELETED		
C37	···SAME AS C6		
C38	···SAME AS C1		
C39	···CAPACITOR, FIXED, .047 μF	52763	MKT-1819-347/0

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A3			
C40	···CAPACITOR, FIXED, 110PF, 1%	04062	DM-15-111F
C41	···SAME AS C31		
C42	···SAME AS C33		
C43	···SAME AS C39		
C44	···SAME AS C40		
C45	···SAME AS C31		
C46	···SAME AS C39		
C47	···SAME AS C28		
C48	···SAME AS C23		
C49	···CAPACITOR, FIXED, 10 μF, 35V	31433	T368C106M035AS
C50	···CAPACITOR, FIXED, 1 μF, 25V	31433	T368A105M025AS
C51	···CAPACITOR, FIXED, .01 μF	22701	1008 0055
C52	···SAME AS C51		
C53	···SAME AS C33		
C54	···SAME AS C49		
C55	···SAME AS C39		
C56	···CAPACITOR, FIXED,.0056 μF	55112	MKT-160/0056K1 00C
C57	···SAME AS C39		
C58	···SAME AS C39		
C59	···SAME AS C23		
C60	···SAME AS C51		
C61	···SAME AS C49		
C62	···SAME AS C49		
C63	···SAME AS C49		
C64	···SAME AS C1		
C65	···SAME AS C39		
C66	···SAME AS C1		
C67	···CAPACITOR, FIXED, .015 μF	52763	MKT-1819-315/06
C68	···SAME AS C1		
C69	···SAME AS C4		
C70	···SAME AS C67		
C71	···SAME AS C4		
C72	···SAME AS C1		
C73	···SAME AS C67		
C74	···CAPACITOR, FIXED, 360PF	04062	DM15-361J
C75	···SAME AS C23		
CR1	···DIODE, 1N4148	81349	1N4148
CR2	···SAME AS CR1		
CR3	···SAME AS CR1		
CR4	···SAME AS CR1		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A3			
CR5	···SAME AS CR1		
CR6	···SAME AS CR1		
CR7	···DELETED		
CR8	···SAME AS CR1		
CR9	···DIODE, LIGHT EMITTING	72619	550-0103
CR10	···SAME AS CR1		
CR11	···SAME AS CR1		
E1	···JUMPER	55210	L-2007-1
FL1	···CRYSTAL FILTER 16.9 MHZ	25120	1457
L1	···INDUCTOR, FIXED, 3 1/4T	23880	12255
L2	···SAME AS L1		
L3	···SAME AS L1		
L4	···SAME AS L1		
L5	···SAME AS L1		
L6	···SAME AS L1		
L7	···INDUCTOR, FIXED, 17 1/4T	77630	51246
L8	···INDUCTOR, FIXED, 100 HY	99800	1025-68
L9	···INDUCTOR, FIXED, 1MHY	99800	1025-92
L10	···SAME AS L8		
L11	···SAME AS L9		
Q1	···TRANSISTOR, FIELD EFFECT, 40820	02735	40820
Q2	···SAME AS Q1		
Q3	···TRANSISTOR, FIELD EFFECT, 40673	02735	40673
Q4	···TRANSISTOR, 2N2222	81349	2N2222
Q5	···SAME AS Q4		
R1	···RESISTOR, FIXED, 100K, 1/4W, 5%	09021	CF1/4-100K, 5%
R2	···SAME AS R1		
R3	···RESISTOR, FIXED, 270Ω, 1/4W, 5%	09021	CF1/4-270Ω, 5%
R4	···RESISTOR, FIXED, 10K, 1/4W, 5%	09021	CF1/4-10K, 5%
R5	···SAME AS R4		
R6	···SAME AS R3		
R7	···RESISTOR, FIXED, 1K, 1/4W, 5%	09021	CF1/4-1K, 5%
R8	···SAME AS R4		
R9	···SAME AS R7		
R10	···RESISTOR, FIXED, 100Ω, 1/4W, 5%	09021	CF1/4-100Ω, 5%
R11	···SAME AS R7		
R12	···SAME AS R10		
R13	···SAME AS R3		
R14	···SAME AS R3		
R15	···SAME AS R7		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A3			
R16	...SAME AS R4		
R17	...SAME AS R4		
R18	...RESISTOR, FIXED, 620Ω, 1/4W, 5%	09021	CF1/4-620Ω, 5%
R19	...SAME AS R10		
R20	...RESISTOR, FIXED, 33Ω, 1/4W, 5%	09020	CF1/4-33Ω, 5%
R21	...DELETED		
R22	...RESISTOR, FIXED, 1K, 1/8W, 5%	81349	RC05S102J
R23	...SAME AS R3		
R24	...RESISTOR, FIXED, 820Ω, 1/4W, 5%	02021	CF1/4-820Ω, 5%
R25	...SAME AS R22		
R26	...RESISTOR, FIXED, 56Ω, 1/4W, 5%	09021	CF1/4-56Ω, 5%
R27	...RESISTOR, FIXED, 68Ω, 1/4W, 5%	09021	CF1/4-68Ω, 5%
R28	...RESISTOR, VARIABLE, 2K	73138	72XR2K
R29	...SAME AS R4		
R30	...SAME AS R4		
R31	...RESISTOR, FIXED, 9.1K, 1/4W, 5%	09021	CF1/4-9.1K, 5%
R32	...SAME AS R1		
R33	...SAME AS R7		
R34	...RESISTOR, FIXED,1M, 1/4W, 5%	09021	CF1/4-1M, 5%
R35	...SAME AS R7		
R36	...RESISTOR, FIXED, 2.2K, 1/4W, 5%	09021	CF1/4-2.2K, 5%
R37	...SAME AS R10		
R38	...SAME AS R7		
R39	...SAME AS R7		
R40	...SAME AS R4		
R41	...RESISTOR, FIXED, 33K, 1/4W, 5%	09021	CF1/4-33K, 5%
R42	...RESISTOR, FIXED, 15K, 1/4W, 5%	09021	CF1/4-15K, 5%
TP1	...TEST POINT, WHITE	74970	105-0751-001
TP2	...TEST POINT, BROWN	74970	105-0758-001
TP3	...TEST POINT, RED	74970	105-0752-001
TP4	...TEST POINT, GREEN	74970	105-0754-001
TP5	...TEST POINT, BLACK	74970	106-0753-001
TP6	...TEST POINT	00779	60802-2
TP7	...SAME AS TP6		
U1	...MICROCIRCUIT, μA2136DC	07263	μA2136DC
U2	...SAME AS U1		
U3	...SAME AS U1		
U4	...MICROCIRCUIT, RC1558T	07933	RC1558T
Y1	...CRYSTAL, 17.34625MHZ	00809	1618 0206
MPQ5	...FERRITE BEAD	02114	56690-65/4A

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A3			
XQ1 THRU			
XQ5	...TRANSIPAD	19080	RCT018030-2
MPY1	...SOCKET CRYSTAL	91506	8004-1G16
MP2 & MP3	...EJECTOR	32559	CP-66
MP 4	...SHEILD	33967	5115 7288

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A4	·CIRCUIT CARD ASSY, RECEIVER 121.5MHz	33967	9115 7447
1A4MP1	··PRINTED WIRING BOARD	33967	2315 7447
C1	···CAPACITOR, FIXED, .001 μF	22701	1008 0047
C2	···CAPACITOR, FIXED, 330PF	22701	1008 0040
C3	···SAME AS C1		
C4	···CAPACITOR, FIXED, 5PF	22701	1008 0011
C5	···CAPACITOR, FIXED, 1PF	22701	1008 0001
C6	···CAPACITOR, FIXED, 10PF	22701	1008 0015
C7	···CAPACITOR, FIXED, 18PF	22701	1008 0018
C8	···CAPACITOR, FIXED, 20PF	22701	1008 0019
C9	···SAME AS C1		
C10	···SAME AS C2		
C11	···SAME AS C1		
C12	···SAME AS C1		
C13	···CAPACITOR, FIXED, .68PF	04222	CN-1 NPO.68f ± 20%
C14	···SAME AS C6		
C15	···SAME AS C7		
C16	···SAME AS C8		
C17	···SAME AS C1		
C18	···SAME AS C13		
C19	···SAME AS C6		
C20	···SAME AS C8		
C21	···SAME AS C8		
C22	···SAME AS C1		
C23	···CAPACITOR, FIXED, .1 μF	52763	MKT-1819-410/0
C24	···SAME AS C1		
C25	···CAPACITOR, FIXED, 120PF	04062	DM15-121J
C26	···SAME AS C1		
C27	···CAPACITOR, FIXED, 91PF	04062	DM15-910J
C28	···CAPACITOR, FIXED, 470PF	04062	DM15-471J
C29	···SAME AS C28		
C30	···SAME AS C1		
C31	···CAPACITOR, VARIABLE, 5.5-18PF	52763	10S-TR1K0-22-N003
C32	···CAPACITOR, FIXED, 22PF	22701	1008 0020
C33	···CAPACITOR, FIXED, .047 μF	51642	200-050-651-473M
C34	···SAME AS C23		
C35	···SAME AS C28		
C36	···DELETED		
C37	···SAME AS C32		
C38	···SAME AS C1		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A4			
C39	···CAPACITOR, FIXED, .047 μF	52763	MKT-1819-347/0
C40	···CAPACITOR, FIXED, 110PF, 1%	04062	DM15-111F
C41	···SAME AS C31		
C42	···SAME AS C33		
C43	···SAME AS C39		
C44	···SAME AS C40		
C45	···SAME AS C31		
C46	···SAME AS C39		
C47	···SAME AS C28		
C48	···SAME AS C23		
C49	···CAPACITOR, FIXED, 10 μF, 35V	31433	T368C106M035AS
C50	···CAPACITOR, FIXED, 1 μF, 25V	31433	T368A105M025AS
C51	···CAPACITOR, FIXED, .01 μF	22701	1008 0055
C52	···SAME AS C51		
C53	···SAME AS C33		
C54	···SAME AS C49		
C55	···SAME AS C39		
C56	···CAPACITOR, FIXED, .0056 μF	55112	MKT-160/0056K100C
C57	···SAME AS C39		
C58	···SAME AS C39		
C59	···SAME AS C23		
C60	···SAME AS C51		
C61	···SAME AS C49		
C62	···SAME AS C49		
C63	···SAME AS C49		
C64	···SAME AS C1		
C65	···SAME AS C39		
C66	···SAME AS C1		
C67	···CAPACITOR, FIXED, .015 μF	52763	MKT-1819-315/0
C68	···SAME AS C1		
C69	···SAME AS C4		
C70	···SAME AS C67		
C71	···SAME AS C4		
C72	···SAME AS C1		
C73	···SAME AS C67		
C74	···CAPACITOR, FIXED, 360PF	04062	DM15-361J
C75	···SAME AS C23		
CR1	···DIODE, 1N4148	81349	1N4148
CR2	···SAME AS CR1		
CR3	···SAME AS CR1		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A4			
CR4	...SAME AS CR1		
CR5	...SAME AS CR1		
CR6	...SAME AS CR1		
CR7	...DELETED		
CR8	...SAME AS CR1		
CR9	...DIODE, LIGHT EMITTING	72619	550-0103
CR10	...SAME AS CR1		
CR11	...SAME AS CR1		
E1	...JUMPER	55210	L-2007-1
FL1	...CRYSTAL FILTER	25120	1457
L1	...INDUCTOR, FIXED, 3 1/4T	23880	12255
L2	...SAME AS L1		
L3	...SAME AS L1		
L4	...SAME AS L1		
L5	...SAME AS L1		
L6	...SAME AS L1		
L7	...INDUCTOR, FIXED, 17 1/4T	77630	51246
L8	...INDUCTOR, FIXED, 100 HY	99800	1026-68
L9	...INDUCTOR, FIXED, 1 MHY	99800	1025-92
L10	...SAME AS L8		
L11	...SAME AS L9		
Q1	...TRANSISTOR, FIELD EFFECT, 40820	02735	40820
Q2	...SAME AS Q1		
Q3	...TRANSISTOR, FIELD EFFECT, 40673	02735	40673
Q4	...TRANSISTOR, 2N2222	81349	2N2222
Q5	...SAME AS Q4		
R1	...RESISTOR, FIXED, 100K, 1/4W, 5%	09021	CF1/4-100K, 5%
R2	...SAME AS R1		
R3	...RESISTOR, FIXED, 270Ω, 1/4W, 5%	09021	CF1/4-270Ω, 5%
R4	...RESISTOR, FIXED, 10K, 1/4W, 5%	09021	CF1/4-10K, 5%
R5	...SAME AS R4		
R6	...SAME AS R3		
R7	...RESISTOR, FIXED, 1K, 1/4W, 5%	09021	CF1/4-1K, 5%
R8	...SAME AS R4		
R9	...SAME AS R7		
R10	...RESISTOR, FIXED, 100Ω, 1/4W, 5%	09021	CF1/4-100Ω, 5%
R11	...SAME AS R7		
R12	...SAME AS R10		
R13	...SAME AS R3		
R14	...SAME AS R3		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A4			
R15	···SAME AS R7		
R16	···SAME AS R4		
R17	···SAME AS R4		
R18	···RESISTOR, FIXED, 1.91K, 1/8W, 1%	81349	RN55D911F
	···RESISTOR, FIXED, 820Ω, 1/4W, 5%		
R19	···SAME AS R10		
R20	···RESISTOR, FIXED, 33Ω, 1/4W, 5%	09021	CF1/4-33Ω, 5%
R21	···DELETED		
R22	···RESISTOR, FIXED, 1K, 1/8W, 5%	81349	RC05S102J
R23	···SAME AS R3		
R24		09021	CF1/4-820Ω, 5%
R25	···SAME AS R22		
R26	···RESISTOR, FIXED, 56Ω, 1/4W, 5%	09021	CF1/4-56Ω, 5%
R27	···RESISTOR, FIXED 68Ω, 1/4W, 5%	09021	CF1/4-68Ω, 5%
R28	···RESISTOR, VARIABLE, 2K	73138	72XR2K
R29	···SAME AS R4		
R30	···SAME AS R4		
R31	···RESISTOR, FIXED, 9.1K, 1/4W, 5%	09021	CF1/4-9.1K, 5%
R32	···SAME AS R1		
R33	···SAME AS R7		
R34	···RESISTOR, FIXED, 1M, 1/4W, 5%	09021	CF1/4-1M, 5%
R35	···SAME AS R7		
R36	···RESISTOR, FIXED, 2.2K, 1/4W, 5%	09021	CF1/4-2.2K, 5%
R37	···SAME AS R10		
R38	···SAME AS R7		
R39	···SAME AS R7		
R40	···SAME AS R4		
R41	···RESISTOR, FIXED, 33K, 1/4W, 5%	09021	CF1/4-33K, 5%
R42	···RESISTOR, FIXED, 15K, 1/4W, 5%	09021	CF1/4-15K, 5%
TP1	···TEST POINT, WHITE	74970	105-0751-001
TP2	···TEST POINT, BROWN	74970	105-0758-001
TP3	···TEST POINT, RED	74970	105-0752-001
TP4	···TEST POINT, GREEN	74970	105-0754-001
TP5	···TEST POINT, BLACK	74970	105-0753-001
TP6	···TEST POINT	00779	60802-2
TP7	···SAME AS TP6		
U1	···MICROCIRCUIT, μA2136DC	07263	μA2136DC
U2	···SAME AS U1		
U3	···SAME AS U1		
U4	···MICROCIRCUIT, RC1558T	07933	RC1558T
Y1	···CRYSTAL, 17.34625MHZ	00809	1618 0206

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A4			
MPQ5	...FERRITE BEAD	02114	56590 65/4A
MPY1	...SOCKET CRYSTAL	91506	8004-1G10
MP2	...EJECTOR	32559	CP-66
MP3	...SAME AS MP2		
MP4	...SHIELD	33967	51157288
XQ-5	...TRANSIPAD	19080	RLT018030-2

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A5	·CIRCUIT CARD ASSY, AUDIO BOARD	33967	9115 7205
1A5MP1	··PRINTED WIRING BOARD	33967	2315 7205
C1	···CAPACITOR, FIXED, 56PF	22701	10080028
C2	···CAPACITOR, FIXED, 220PF, 500V	04062	DM15-221J
C3	···SAME AS C2		
C4	···CAPACITOR, FIXED, .01 µF	22701	1008 0055
C5	···CAPACITOR, FIXED, .1 µF	52763	MKT-1819-410/0
C6	···CAPACITOR, FIXED, 10 µF, 35V	31433	T368C106M035AS
C7	···CAPACITOR, FIXED, 4.7 µF, 10V	52763	ETP1 4.7/10
C8	···CAPACITOR, FIXED, 470PF	22701	1008 0042
C9	···SAME AS C4		
C10	···CAPACITOR, FIXED, 47 V, 6V	56289	196D476X9006JA1
C11	···CAPACITOR, FIXED, 100 µF, 16V	52763	EK 100/16
C12	···CAPACITOR, FIXED, .001 µF	22701	1008 0047
C13	···SAME AS C5		
C14	···CAPACITOR, FIXED, 330PF	22701	1008 0040
C15	···CAPACITOR, FIXED, 100 µF, 40V	22701	EK 100/40
C16	···SAME AS C15		
C17	···SAME AS C5		
CR1	···DIODE, 1N960B	81349	1N960B
CR2	···DIODE, 1N4148	81349	1N4148
CR3	···SAME AS CR2		
MPU2	···HEAT SINK	33967	5115 7271
Q1	···TRANSISTOR, 2N2222	81349	2N2222
R1	···RESISTOR, FIXED, 56K, 1/4W, 5%	09021	CF1/4-56K, 5%
R2	···RESISTOR, FIXED, 430K, 1/4W, 5%	09021	CF1/4-430K, 5%
R3	···RESISTOR, FIXED, 1M, 1/4W, 5%	09021	CF1/4-1MEG, 5%
R4	···SAME AS R3		
R5	···RESISTOR, FIXED, 680Ω, 1/4W, 5%	09021	CF1/4-680 Ω, 5%
R6	···RESISTOR, FIXED, 3.3K, 1/4W, 5%	09021	CF1/4-3.3K, 5%
R7	···RESISTOR, FIXED, 200K, 1/4W, 5%	09021	CF1/4-200K, 5%
R8	···RESISTOR, FIXED, 39K, 1/4W, 5%	09021	CF1/4-39K, 5%
R9	···RESISTOR, FIXED, 470K, 1/4W, 5%	09021	CF1/4-470K, 5%
R10	···RESISTOR, FIXED, 1.5M, 1/4W, 5%	09021	CF1/4-1.5MEG, 5%
R11	···RESISTOR, FIXED, 22K, 1/4W, 5%	09021	CF1/4-22K, 5%
R12	···RESISTOR, FIXED, 100K, 1/4W, 5%	09021	CF1/4-100K, 5%
R13	···RESISTOR, FIXED, 270Ω, 1/4W, 5%	09021	CF1/4-270 Ω, 5%
R14	···SAME AS R12		
R15	···RESISTOR, FIXED, 8.2K, 1/4W, 5%	09021	CF1/4-8.2K, 5%
R16	···SAME AS R12		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A5			
R17	···RESISTOR, FIXED, 2.2M, 1/4W, 5%	09021	CF1/4-2.2MEG, 5%
R18	···RESISTOR, FIXED, 10K, 1/4W, 5%	09021	CF1/4-10K, 5%
R19	···RESISTOR, FIXED, 1K, 1/4W, 5%	09021	CF1/4-1K, 5%
R20	···DELETED		
R21	···SAME AS R5		
R22	···RESISTOR, FIXED, 2.7K, 1/4W, 5%	09021	CF1/4-2.7K, 5%
R23	···SAME AS R18		
R24	···SAME AS R19		
R25	···RESISTOR, FIXED, 15Ω, 1/4W, 5%	09021	CF1/4-15Ω, 5%
R26	···RESISTOR, FIXED, 1Ω, 1/4W, 10%	81349	RCO 751 ROK
R27	···SAME AS R5		
R28	···SAME AS R25		
TP1	···TEST POINT, WHITE	74970	105-0751-001
TP2	···TEST POINT, RED	74970	105-0752-001
TP3	···TEST POINT, BLACK	74970	105-0753-001
U1	···MICROCIRCUIT, LM2900N	27014	LM2900N
U2	···MICROCIRCUIT, TBA800A	07263	TBA 800 A
XQ1	···TRANSIPAD, TO-18	19080	RCT018030-2

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A6	·CIRCUIT CARD ASSY, OSCILLATOR/AFC	33967	9115 7449
1A6MP1	··PRINTED WIRING BOARD	33967	2315 7449
C1	···CAPACITOR, VARIABLE, 10-40PF	52763	1104 0005 10S-TR1K0-22-N750
C2	···SAME AS C1		
C3	···SAME AS C1		
C4	···SAME AS C1		
C5	···SAME AS C1		
C6	···SAME AS C1		
C7	···SAME AS C1		
C8	···SAME AS C1		
C9	···NOT PROVIDED		
C10	···NOT PROVIDED		
C11	···NOT PROVIDED		
C12	···SAME AS C1		
C13	···CAPACITOR, FIXED, .001 μF	22701	1008 0047
C14	···SAME AS C13		
C15	···SAME AS C13		
C16	···SAME AS C13		
C17	···SAME AS C13		
C18	···SAME AS C13		
C19	···SAME AS C13		
C20	···SAME AS C13		
C21	···NOT PROVIDED		
C22	···NOT PROVIDED		
C23	···NOT PROVIDED		
C24	···SAME AS C13		
C25	···CAPACITOR, FIXED, 3900PF	22701	1008 0072
C26	···CAPACITOR, FIXED, 10 μF, 35V	31433	T368C106M035AS
C27	···SAME AS C25		
C28	···SAME AS C13		
C29	···SAME AS C13		
C30	···CAPACITOR, FIXED, 680PF	04062	DM15-681J
C31	···CAPACITOR, FIXED, 220PF	04062	DM15-221J
C32	···SAME AS C30		
C33	···SAME AS C31		
C34	···CAPACITOR, FIXED, 5PF	22701	1008 0011
C35	···CAPACITOR, FIXED, 82PF	04062	DM15-820J
C36	···SAME AS C35		
C37	···CAPACITOR, FIXED, 10PF	22701	1008 0015
C38	···SAME AS C13		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A6			
C39	···CAPACITOR, FIXED, 12 PF	22701	1008 0016
C40	···CAPACITOR, FIXED, 1PF	22701	1008 0001
C41	···SAME AS C39		
C42	···SAME AS C34		
C43	···SAME AS C13		
C44	···SAME AS C39		
C45	···CAPACITOR, FIXED, 22PF	22701	1008 0020
C46	···CAPACITOR, FIXED, 47PF	04062	DM15-470J
C47	···SAME AS C13		
C48	···CAPACITOR, FIXED, 1 µF, 63V	52763	MKT-1822-510/06
C49	···CAPACITOR, FIXED, .1 µF, 100V	52763	MKT-1819-410/06
C50	···SAME AS C26		
C51	···SAME AS C1		
C52	···CAPACITOR, FIXED, 33PF	22701	1008 0024
C53	···SAME AS C13		
C54	···CAPACITOR, FIXED, 100 µF, 16V	52763	EK100/16
C55	···SAME AS C48		
C56	···CAPACITOR, FIXED, 2.2PF	22701	1008 0005
C57	···SAME AS C26		
C58	···SAME AS C45		
C59	···CAPACITOR, FIXED, 18PF	22701	1008 0018
C60	···CAPACITOR, FIXED, 27PF	22701	1008 0022
C61	···SAME AS C26		
C62	···CAPACITOR, FIXED, 1000PF, NPO, 5%	51642	200-100-NPO-102J
C63	···SAME AS C62		
C64	···SAME AS C62		
C65	···SAME AS C62		
C66	···SAME AS C26		
C67	···SAME AS C26		
C68	···SAME AS C13		
C69	···SAME AS C49		
C70	···CAPACITOR, FIXED, .01 µF	22701	1008 0055
C71	···SAME AS C70		
CR1	···DIODE, MV1626	04713	MV1626
CR2	···SAME AS CR1		
CR3	···SAME AS CR1		
CR4	···SAME AS CR1		
CR5	···SAME AS CR1		
CR6	···SAME AS CR1		
CR7	···SAME AS CR1		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A6			
CR8	···SAME AS CR1		
CR9	···NOT PROVIDED		
CR10	···NOT PROVIDED		
CR11	···NOT PROVIDED		
CR12	···SAME AS CR1		
CR13	···DIODE, HP 5082-3168	04404	5082-3168
CR14	···SAME AS CR13		
CR15	···SAME AS CR13		
CR16	···SAME AS CR13		
CR17	···SAME AS CR13		
CR18	···SAME AS CR13		
CR19	···SAME AS CR13		
CR20	···SAME AS CR13		
CR21	···NOT PROVIDED		
CR22	···NOT PROVIDED		
CR23	···NOT PROVIDED		
CR24	···SAME AS CR13		
CR25	···DIODE, FH1100	07263	FH100
L1	···INDUCTOR, VARIABLE, 5 1/4T	23880	12256
L2	···INDUCTOR, FIXED, 100 μH	99800	1025-68
L3	···SAME AS L1		
L4	···INDUCTOR, VARIABLE, 3 1/4T	23800	12255
L5	···SAME AS L4		
L6	···SAME AS L4		
L7	···SAME AS L4		
L8	···SAME AS L2		
MPQ5	···FERRITE BEAD	02114	56590-65/4A
Q1	···TRANSISTOR, 2N918	81349	2N918
Q2	···SAME AS Q1		
Q3	···SAME AS Q1		
Q4	···SAME AS Q1		
Q5	···TRANSISTOR, 2N2222	81349	2N2222
R1	···RESISTOR, FIXED, 100K, 1/4W, 5%	09021	CF1/4-100K,5%
R2	···SAME AS R1		
R3	···SAME AS R1		
R4	···SAME AS R1		
R5	···SAME AS R1		
R6	···SAME AS R1		
R7	···SAME AS R1		
R8	···SAME AS R1		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A6			
R9	···NOT PROVIDED		
R10	···NOT PROVIDED		
R11	···NOT PROVIDED		
R12	···SAME AS R1		
R13	···RESISTOR, FIXED, 1K, 1/4W, 5%	09021	CF1/4-1K, 5%
R14	···SAME AS R13		
R15	···SAME AS R13		
R16	···SAME AS R13		
R17	···SAME AS R13		
R18	···SAME AS R13		
R19	···SAME AS R13		
R20	···SAME AS R13		
R21	···NOT PROVIDED		
R22	···NOT PROVIDED		
R23	···NOT PROVIDED		
R24	···SAME AS R13		
R25	···RESISTOR, FIXED, 18K, 1/4W, 5%	09021	CF1/4-18K, 5%
R26	···SAME AS R25		
R27	···RESISTOR, FIXED, 270Ω, 1/4W, 5%	09021	CF1/4-270Ω, 5%
R28	···SAME AS R27		
R29	···RESISTOR, FIXED, 33K, 1/4W, 5%	09021	CF1/4-33K, 5%
R30	···SAME AS R27		
R31	···RESISTOR, FIXED, 10K, 1/4W, 5%	09021	CF1/4-10K, 5%
R32	···SAME AS R29		
R33	···RESISTOR, FIXED, 560Ω, 1/4W, 5%	09021	CF1/4-560Ω, 5%
R34	···SAME AS R29		
R35	···SAME AS R33		
R36	···SAME AS R25		
R37	···SAME AS R13		
R38	···SAME AS R31		
R39	···SAME AS R13		
R40	···RESISTOR, FIXED, 22M, 1/4W, 5%	09021	CF1/4-22M, 5%
R41	···SAME AS R31		
R42	···SAME AS R31		
R43	···SAME AS R13		
R44	···RESISTOR, FIXED, 330Ω, 1/4W, 5%	09021	CF1/4-330Ω, 5%
R45	···RESISTOR, FIXED, 68K, 1/4W, 5%	09021	CF1/4-68K, 5%
R46	···SAME AS R45		
R47	···SAME AS R31		
R48	···SAME AS R45		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A6			
R49	...SAME AS R45		
R50	...SAME AS R31		
R51	...SAME AS R13		
R52	...SAME AS R13		
R53	...RESISTOR, FIXED, 6.8K, 1/4W, 5%	09021	CF1/4-68K, 5%
R54	...SAME AS R31		
R55	...SAME AS R31		
R56	...RESISTOR, FIXED, 39.2K, 1%, RN55C	81349	RN55C3922F
R57	...SAME AS R56		
R58	...SAME AS R56		
R59	...SAME AS R56		
R60	...RESISTOR, FIXED, 470Ω, 1/4W, 5%	09021	CF1/4-470Ω, 5%
R61	...RESISTOR, FIXED, 100Ω, 1/4W, 5%	09021	CF1/4-100Ω, 5%
R62	...RESISTOR, FIXED, 910Ω, 1/4W, 5%	09021	CF1/4-910Ω, 5%
TP1	...TEST POINT, WHITE	74970	105-0751-001
TP2	...TEST POINT	88245	2000B
TP3	...TEST POINT, BROWN	74970	105-0758-001
TP4	...TEST POINT, ORANGE	74970	105-0756-001
TP5	...TEST POINT, YELLOW	74970	105-0757-001
TP6	...TEST POINT, BLACK	74970	105-0753-001
U1	...MICROCIRCUIT, SCL4446A/BC	31019	SCL4446A/BC
U2	...MICROCIRCUIT, MC14069BCL	04713	MC14069BCL
XQ1	...TRANSIPAD	19080	RCT018030-2
XQ2	...SAME AS XQ1		
XQ3	...SAME AS XQ1		
XQ4	...SAME AS XQ1		
XQ5	...SAME AS XA1		
Y1	...CRYSTAL, CH6 15.488888 kHz	00809	1618 0006
Y2	...CRYSTAL, CH12 15.522222	00809	1618 0012
Y3	...CRYSTAL, CH13 15.527777	00809	1618 0013
Y4	...CRYSTAL, CH14 15.533333	00809	1618 0014
Y5	...CRYSTAL, CH16 15.44444 kHz	00809	1618 0016
Y6	...CRYSTAL, CH22A 15.577777	00809	1618 0042
Y7	...CRYSTAL, W1 16.183333	00809	1618 0000
Y8	...CRYSTAL, W2 16.166666 kHz	00809	1618 0032
Y9	...NOT PROVIDED		
Y10	...NOT PROVIDED		
Y11	...NOT PROVIDED		
Y12	...CRYSTAL, 121.5 AM 15.377777 kHz	00809	1618 0055
Y13	...CRYSTAL, 446.25KHZ	00809	1600 0403

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A6			
MPWY1-12	...CRYSTAL SOCKET FOR ALL CRYSTALS	74970	126-0110-008
MPY1-12	...BRACKET FOR ALL CRYSTALS	33967	5115 7274
MP2	...EJECTOR	32559	CP-66
MP3	...SAME AS MP2		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A7	.CIRCUIT CARD ASSY, ANALOG BD	33967	157424
1A7MP1	..PRINTED WIRING BOARD	33967	2315 7424
C1	...CAPACITOR, FIXED, 10µF, 35V TANT, 20%	31433	T368C106M035AS
C2	...CAPACITOR, FIXED, 1000PF, 5%, WEST-CAP	52763	KP-1834-210/63
C3	...CAPCITOR, FIXED, 100µF, 16V,	52763	EK 100/16
C4	... SAME AS C2		
C5	...SAME AS C1		
C6	...SAME AS C1		
C7	...SAME AS C1		
C8	...CAPACITOR, FIXED, 6.8PF, 5%, NPO	22701	1008 0013
C9	...CAPACITOR, FIXED, 200PF, 5%, SIL. MICA	04062	DM15-201J
C10	...CAPACITOR, FIXED, 22µF, 25V	56289	109D226X9025C2
C11	...SAME AS C10		
C12	...SAME AS C10		
C13	...SAME AS C10		
C14	...CAPACITOR, FIXED, 47µF, 50V TANT, 10%	56289	109D476X9050C2
C15	...SAME AS C14		
C16	...SAME AS C14		
C17	...SAME AS C14		
C18	...SAME AS C2		
C19	...CAPACITOR, FIXED, 47µF, 6V	56289	109D476X0006KA1
C20	...SAME AS C1		
C21	...CAPACITOR, FIXED, 180PF, 5%, SIL. MICA	04062	DM15-181J
C22	...SAME AS C1		
C23	...CAPACITOR, FIXED, 22PF, 5%, NPO	22701	1008 0020
C24	...CAPACITOR, FIXED, 510PF, 5%, SIL. MICA	04062	DM15-511J
C25	...CAPACITOR, FIXED, 1500PF, POLYSTYRENE	52763	KP1834-215/16
C26	...CAPACITOR, FIXED, 1000PF, 5%, NPO	51642	200-100-NPO-102J
C27	...CAPACITOR, FIXED, 3900PF, POLYSTYRENE	52763	KP1834-239/06
C28	...SAME AS C1		
C29	...SAME AS C23		
C30	...CAPACITOR, FIXED, .47µF	51642	300-100-W5R-474K
C31	...SAME AS C2		

Tabel 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A7			
C32	...SAME AS C1		
C33	...SAME AS C23		
C34	...SAME AS C1		
C35	...CAPACITOR, FIXED, 2.0PF, 5%, NPO	22701	1008 0005
C36	...SAME AS C1		
C37	...SAME AS C1		
C38	...CAPACITOR, FIXED, .022 μF, POLYESTER	52763	MKT1819-322/06
C39	...SAME AS C1		
C40	...SAME AS C23		
C41	...SAME AS C1		
C42	...SAME AS C1		
C43	...SAME AS C35		
C44	...SAME AS C1		
C45	...CAPACITOR, .010 μF. POLYSTYRENE	32440	B52A103K
C46	...SAME AS C9		
C47	...SAME AS C1		
C48	...SAME AS C1		
C49	...SAME ASC1		
C50	...CAPACITOR, FIXED, .18 μF, 50V, W5R	51642	300-050-WR5-18HK
C51	...SAME AS C1		
C52	...DELETED		
C53	...DELETED		
C54	...SAME AS C26		
C55	...CAPACITOR, .015 μF	52763	MKT1819-315/06
C56	...DELETED		
C57	...DELETED		
C58	...SAME AS C45		
C59	...SAME AS C1		
C60	...SAME AS C9		
C61	...SAME AS C1		
C62	...CAPACITOR, .001 μF, 20%, 25F	22701	10080047
C63	...SAME AS C62		
C64	...SAME AS C62		
C65	...SAME AS C62		
C66	...SAME AS C62		
C67	...SAME AS C62		
C68	...SAME AS C62		
CR1	...DIODE, HP5082-3168	04404	5082 3168
CR2	...SAME AS CR1		
E1	...WIRE, 24GA	81349	MIL-W-16878
E2	...SAME AS E1		

Table 5-1. Receiver Unit 1 Parts List (Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A7			
E3	...SAME AS E1		
E4	...SAME AS E1		
E5	...JUMPER, .4 SPACING	55210	L-2007-1
E6	...SAME AS E5		
E7	...SAME AS E5		
E8	...SAME AS E5		
E9	...SAME AS E5		
E10	...SAME AS E5		
E11	...SAME AS E1		
E12	...SAME AS E1		
E13	...SAME AS E12		
L1	...INDUCTOR, FIXED, 1000 μHy	17490	WEE -1000
L2	...SAME AS L1		
L3	...SAME AS L1		
MPQ1	...HEATSINK	13103	6073B
Q1	...TRANSISTOR, MJE1100	04713	MJE1100
Q2	...TRANSISTOR, 2N2222	81349	2N2222
R1	...RESISTOR, FIXED, 5.6K, 1/4W, 5%	09021	CF1/4-5.6K, 5%
R2	...RESISTOR, FIXED, 80.6K, 1/8W, 1%	81349	RN55C8062F
R3	...RESISTOR, FIXED, 10K, 1/4W, 5%	09021	CR1/4-10K, 5%
R4	...RESISTOR, FIXED, 154K, 1/8W, 1%	81349	RN55C1543F
R5	...RESISTOR, FIXED, 470Ω, 1/4W, 5%	09021	CF1/4-470Ω, 5%
R6	...SAME AS R3		
R7	...SAME AS R3		
R8	...SAME AS R1	09021	CF1/4-5.6K, 5%
R9	...SAME AS R1		
R10	...RESISTOR, FIXED, 12.1K, 1/8W, 1%	81349	RN55C1212F
R11	...RESISTOR, FIXED, 47.5K, 1/8W, 1%	81349	RN55C4752F
R12	...RESISTOR, FIXED, 100Ω, 1/4W, 5%	09021	CF1/4-100Ω, 5%
R13	...SAME AS R3		
R14	...RESISTOR, FIXED, 200K, 1/4W, 5%	09021	CF1/4-200K, 5%
R15	...RESISTOR, FIXED, 100K, 1/4W, 5%	09021	CF1/4-100K, 5%
R16	...RESISTOR, FIXED, 680Ω, 1/4W, 5%	09021	CF1/4-680Ω, 5%
R17	...SAME AS R12		
R18	...RESISTOR, FIXED, 562K, 1/8W, 1%	81349	RN55C5623F
R19	...SAME AS R3		
R20	...SAME AS R3		
R21	...RESISTOR, FIXED, 51Ω, 1/4W, 5%	09021	CF1/4-51Ω, 5%
R22	...RESISTOR, FIXED, 20.0K, 1/8W, 1%	81349	RN55C2002F
R23	...SAME AS R22		
R24	...RESISTOR, FIXED, 39K, 1/4W, 5%	09021	CF1/4-39K, 5%

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A7			
R25	···SAME AS R12		
R26	···RESISTOR, FIXED, 61.9K, 1/8W, 1%	81349	RN55C6192F
R27	···RESISTOR, FIXED, 11.8K, 1/8W, 1%	81349	RN55C1182F
R28	···SAME AS R22		
R29	···SAME AS R22		
R30	···SAME AS R12		
R31	···RESISTOR, FIXED, 2K, 1/4W, 5%	09021	CF1/4-2K, 5%
R32	···RESISTOR, VARIABLE, 25K	73138	89P25K
R33	···RESISTOR, VARIABLE, 10K	73138	89P10K
R34	···SAME AS R3		
R35	···SAME AS R3		
R36	···SAME AS R15		
R37	···SAME AS R15		
R38	···SAME AS R4		
R39	···SAME AS R12		
R40	···RESISTOR, FIXED, 76.8K, 1/8W, 1%	81349	RN55C7682F
R41	···RESISTOR, FIXED, 4.7K, 1/4W, 5%	09021	CF1/4-4.7K, 5%
R42	···RESISTOR, FIXED, 22K, 1/4W, 5%	09021	CF1/4-22K, 5%
R43	···RESISTOR, 33K, 1/4W, 5%	09021	CF1/4-33K. 5%
R44	···RESISTOR, FIXED, 27.4K, 1/8W, 1%	81349	RN55C2742F
R45	···RESISTOR, FIXED, 57.6K, 1/8W, 1%	81349	RN55C5762F
R46	···RESISTOR, FIXED, 6.04K, 1/8W, 1%	81349	RN55C6041F
R47	···SAME AS R12		
R48	···SAME AS R15		
R49	···SAME AS R15		
R50	···DELETED		
R51	···SAME AS R12		
R52	···SAME AS R31		
R53	···DELETED		
R54	···RESISTOR, VARIABLE, 100K	73138	72XW100K
R55	···SAME AS R15		
R56	···SAME AS R15		
R57	···RESISTOR, FIXED, 3.3K, 1/4W, 5%	09021	CF1/4-3.3KΩ,5%
R58	···SAME AS R15		
R59	···SAME AS R15		
R60	···DELETED		
R61	···DELETED		
R62	···DELETED		
R63	···DELETED		
R64	···DELETED		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A7			
R65	...DELETED		
R66	...DELETED		
R67	...SAME AS R3		
R68	...SAME AS R3		
R69	...SAME AS R42		
R70	...RESISTOR, FIXED, 270Ω, 1/4W, 5%	09021	CF1/4-270Ω, 5%
R71	...SAME AS R70		
R72	...RESISTOR, FIXED, 2.2Ω, 1/2W, 5%	01121	CF1/4-EB, 5%
R73	...SAME AS R70		
R74	...RESISTOR, FIXED, 2.7Ω, 1/4W, 5%	09021	CF1/4-2.7Ω, 5%
R75	...RESISTOR, FIXED, 1K, 1/4W, 5%	09021	CF1/4-1K, 5%
R76	...DELETED		
R77	...SAME AS R75		
TP1	...TEST POINT, WHITE	74970	105-0751-001
TP2	...TEST POINT, BROWN	74970	105-0758-001
TP3	...TEST POINT, YELLOW	74970	105-0757-001
TP4	...TEST POINT, GREEN	74970	105-0754-001
U1	...MICROCIRCUIT, LF256H	27014	LF256H
U2	...MICROCIRCUIT, LM201AH	27014	LM201AH
U3	...MICROCIRCUIT, MC14001BCL	04713	MC14001BCL
U4	...SAME AS U2		
U5	...SAME AS U2		
U6	...SAME AS U2		
U7	...MICROCIRCUIT, CA3130AS	02735	CA3130AS
U8	...SAME AS U2		
U9	...SAME AS U7		
U10	...SAME AS U2		
U11	...MICROCIRCUIT, MC14066BCL	04713	MC14066BCL
U12	...SAME AS U11		
U13	...SAME AS U11		
U14	...SAME AS U11		
VR1	...DIODE, 1N747A, 3.6V	81349	1N747A
XQ1	...SILPAD	55285	7403-10-51
XQ2	...TRANSIPAD, TO-18	19080	RCT018030-2
MP2	...EJECTOR	32559	CP-66
MP3	...SAME AS MP2		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A8	.CIRCUIT CARD ASSY, DIGITAL BOARD	33967	9115-7425
1A8MP1	..PRINTED WIRING BOARD	33967	2315 7425
C1	...CAPACITOR, FIXED, .001 μF	22701	1008 0047
C2	...CAPACITOR, FIXED, .10 μF	52763	MKT-1819-410/0
C3	...CAPACITOR, VARIABLE, 10-40PF	52763	10S-TR1KO-22-N750
C4	...CAPACITOR, FIXED, 27PF	22701	1008 0024
C5	...CAPACITOR, FIXED, 680PF	04062	DM15-681J
C6	...CAPACITOR, FIXED, 47PF	22701	1008 0026
C7	...SAME AS C6		
C8	...SAME AS C1		
C9	...CAPACITOR, FIXED, 10μF, 35V	31432	T368C106M035AS
C10	...CAPACITOR, FIXED, 3900PF	22701	1008 0072
C11	...SAME AS C1		
C12	...SAME AS C9		
C13	...CAPACITOR, FIXED 100μF, 40V	52763	EK 100/40
C14	...SAME AS C13		
C15	...SAME AS C1		
C16	...SAME AS C9		
C17	...SAME AS C9		
C18	...SAME AS C9		
C19	...SAME AS C9		
C20	...SAME AS C9		
CR1-5	...DIODE, 1N4148	81349	1N4148
L1	...INDUCTOR, 100 μH	99800	1025-68
Q1	...TRANSISTOR, 2N918	81349	2N918
Q2	...TRANSISTOR, 2N2222	81349	2N2222
Q3	...SAME AS Q2		
Q4	...TRANSISTOR, MJE1100	04713	MJE1100
R1	...RESISTOR, FIXED, 270Ω, 1/4W, 5%	09021	CF1/4-270Ω, 5%
R2	...RESISTOR, FIXED, 10K, 1/4W, 5%	09021	CF1/4-10K, 5%
R3	...SAME AS R2		
R4	...RESISTOR, FIXED, 1K, 1/4W, 5%	09021	CF1/4-1K, 5%
R5	...RESISTOR, FIXED, 100K, 1/4W, 5%	09021	CF1/4-100K, 5%
R6	...SAME AS R2		
R7	...SAME AS R5		
R8	...SAME AS R2		
R9	...SAME AS R4		
R10	...DELETED		
R11	...SAME AS R1		
R12	...RESISTOR, FIXED, 1Ω, 1/4W, 5%	09021	CF1/4-1 Ω, 5%
R13	...RESISTOR, FIXED, 47K, 1/4W, 5%	09021	CF1/4-47K, 5%

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A8			
R14	...RESISTOR, FIXED, 560Ω, 1/2W, 5%	01121	TYPE "EB"
R15	...SAME AS R14		
R16	...SAME AS R14		
R17	...SAME AS R14		
R18	...SAME AS R14		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A8			
R19	...SAME AS R14		
R20	...SAME AS R14		
R21	...SAME AS R14		
R22	...SAME AS R14		
R23	...SAME AS R14		
R24	...SAME AS R14		
R25	...SAME AS R14		
R26	...SAME AS R14		
R27	...SAME AS R14		
R28	...SAME AS R14		
R29	...SAME AS R14		
R30	...SAME AS R14		
R31	...SAME AS R14		
R32	...SAME AS R14		
R33	...SAME AS R14		
R34	...SAME AS R14		
R35	...SAME AS R5		
R36	...SAME AS R2		
R37	...SAME AS R5		
TP1	...TEST POINT, WHITE	74970	105-0751-001
TP2	...TEST POINT, GREEN	74970	105-0754-001
U1	...MICROCIRCUIT, MC14013BCL	04713	MC14013BCL
U2	...SAME AS U1		
U3	...MICROCIRCUIT, MC 1427BCL	04713	MC14027BCL
U4	...SAME AS U3		
U5	...SAME AS U1		
U6	...MICROCIRCUIT,MC14518BCL	04713	MC14518BCL
U7	...SAME AS U6		
U8	...MICROCIRCUIT,MC14511BCL	04713	MC14511BCL
U9	...SAME AS U8		
U10	...SAME AS U8		
U11	...MICROCIRCUIT,ULN2004A	56289	ULN2004A
U12	...SAME AS U11		
U13	...SAME AS U11		
U14	...SAME AS U1		
U15	...MICROCIRCUIT,MC14020BCL	04713	MC14020BCL
U16	...SAME AS U1		
U17	...MICROCIRCUIT,MC14069BCL	04713	MC1469BCL
XQ1	...TRANSIPAD TO18	19080	RCTO18030-2
XQ2	...SAME AS XQ1		
XQ3	...SAME AS XQ1		

Table 5-1. Receiver Unit 1 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
1A8			
XQ4	...SIL PAD	55285	7403-10-51
Y1	...CRYSTAL 5787 .2KHZ	00809	16600 0404
MP2	...EJECTOR	32559	CP-66
MP3	...SAME AS MPL		
MPQ4	...HEAT SINK	13103	6106-B-14

Table 2. Antenna Unit 2 Parts List

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
2	.ANTENNA UNIT ASSEMBLY, AN/SRD-22	33967	9115 7454
2A2	..ANTENNA CONTROL, A2 BD	33967	9115 7439
2A1	..ANTENNA RF PHASING, A1 BD	33967	9915 7457
MPP1	..CAP PLUG	99017	EC-5
MP1	.."O" RING 7" X .093	81349	2-167
MP2-5	..VERTICAL ELEMENTS	33967	5115 7479
MP6-9	..HORIZONTAL ELEMENTS	33967	5115 7478
MP10	..BASE BOTTOM	33967	5115 7427
MP11	..BASE TOP	33967	5115 7428
MP12	..ANTENNA SPACER	33967	5515 7429-2
MP13	..ANTENNA CAP	33967	5515 7429-1
MP14	..INSERT, TEFLON	33967	5515 7486
MP15	..SAME AS MP14		
MP16	..SAME AS MP14		
MP17	..SAME AS MP14		
W1	..ANTENNA CABLE 125 FEET	33967	9115 7455

Table 5-2. Antenna Unit 2 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
2A1	·CIRCUIT CARD ASSY, ANTENNA RF PHASING	33967	9115 7457
2A1MP1	··PRINTED WIRING BOARD	33967	2315 7457
C1	···CAPACITOR, FIXED, 430PF, 100V, ±5%	04062	DM15-431J
C2	···DELETED		
C3	···SAME AS C1		
C4	···DELETED		
C5	···SAME AS C1		
C6	···DELETED		
C7	···SAME AS C1		
C8	···DELETED		
C9	···CAPACITOR, FIXED, 620 μF, 8V, TOL +20, -15%	09214	69F2208G7
C10	···SAME AS C9		
C11	···SAME AS C9		
C12	···SAME AS C9		
C13	···CAPACITOR, FIXED, 15PF, 100V, ±10%	51642	150-100-NPO-150K
CR1	···PIN DIODE, 1N5767	81349	1N5767
CR2	···SAME AS CR1		
CR3	···SAME AS CR1		
CR4	···SAME AS CR1		
L1	···INDUCTOR, FIXED, 2.2 μH ±10%, 1/2W SIZE	17490	WEE-2.2
L2	···SAME AS L1		
L3	···SAME AS L1		
L4	···SAME AS L1		
L5	···SAME AS L1		
L6	···SAME AS L1		
L7	···SAME AS L1		
L8	···SAME AS L1		
L9	···SAME AS L1		
L10	···INDUCTOR, FIXED, 0.1 μH ±10% 1/2W SIZE	17490	WEE-0.10
R1	···DELETED		
R2	···DELETED		
R3	···DELETED		
R4	···DELETED		
R5	···RESISTOR, FIXED, FACTORY SELECT, 1/8W, 1%, MF	81349	RN55C
R6	···SAME AS R5		
R7	···SAME AS R5		

Table 5-2. Antenna Unit 2 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
2A1			
R8	···SAME AS R5		
R9	···SAME AS R5		
R10	···SAME AS R5		
R11	···SAME AS R5		
R12	···SAME AS R5		

Table 5-2. Antenna Unit 2 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
2A2	·CIRCUIT CARD ASSY, ANTENNA CONTROL	33967	9115 7439
2A2MP1	··PRINTED WIRING BOARD	33967	2315 7439
C1	··· NOT USED		
C2	···SAME AS C1		
C3	···SAME AS C1		
C4	···SAME AS C1		
C5	···CAPACITOR, FIXED, 10 μF @ 35V	31433	T368C106M035AS
C6	···CAPACITOR, FIXED, .001 μF	22701	1008 0047
C7	···CAPACITOR, FIXED, 100 μF @ 16V	52763	EK-100/16
C8	···SAME AS C7		
C9	···CAPACITOR, FIXED, .1 μF	52763	MKT-1819-410/06
C10	···CAPACITOR, FIXED, 6800PF	51642	300-100-10G-682J
CR1	···DIODE, 1N4002	81349	1N4002
CR2	···SAME AS CR1		
J1	···CONNECTOR, SMA	74970	142-0298-001
L1	···INDUCTOR, FIXED, 2.2 μHY	17490	WEE-2.2
Q1	···TRANSISTOR, 2N2219	81349	2N2219
Q2	···SAME AS Q1		
Q3	···SAME AS Q1		
Q4	···SAME AS Q1		
R1	···RESISTOR, FIXED, 680Ω, 1/4W, 5%	09021	CF1/4-680Ω, 5%
R2	···SAME AS R1		
R3	···SAME AS R1		
R4	···SAME AS R1		
R5	···RESISTOR, FIXED, 10Ω, 1/4W, 5%	09021	CF1/4-10Ω, 5%
R6	···SAME AS R5		
R7	···SAME AS R5		
R8	···SAME AS R5		
R9	···RESISTOR, FIXED, 10K, 1/8W, 1%, MF	81349	RN55C1002F
R10	···SAME AS R9		
R11	···SAME AS R9		
R12	···SAME AS R9		
R13	···RESISTOR, FIXED, 100Ω, 1/4W, 5%	09021	CF1/4-100Ω, 5%
R14	···SAME AS R13		
R15	···SAME AS R13		
R16	···SAME AS R13		

Table 5-2. Antenna Unit 2 Parts List
(Continued)

REF DESIG	1 2 3 4 5 6 7 8 9 10 DESCRIPTION	MFR CODE NO.	MFR PART NO.
2A2			
R17	...SAME AS R9		
R18	...SAME AS R9		
R19	...SAME AS R9		
R20	...SAME AS R9		
R21	...SAME AS R9		
R22	...RESISTOR, FIXED, 5.11K, 1/8W, 1%, MF	81349	RN55C5111F
R23	...SAME AS R22		
R24	...SAME AS R22		
R25	...RESISTOR, FIXED, 56 Ω, 1/4W, 5%	09021	CF1/4-56Ω, 5%
R26	...RESISTOR, FIXED, 4.75K, 1/8W, 1%	81349	RN55C4751F
R27	...RESISTOR, VARIABLE 1K	73138	89P1K
R28	...RESISTOR, 56.2K, 1/8W, 1%	81349	RN55C5622F
U1	...MICROCIRCUIT, LM224N	27014	LM224N
XQ1	...TRANSI PAD	19080	RCT05030-2
XQ2	...SAME AS XQ1		
XQ3	...SAME AS XQ1		
XQ4	...SAME AS XQ1		
XQ5	...SAME AS XQ1		
MPJ1	...CAP PLUG	99017	K-5

Table 5-4. Code List of Manufacturers

The following code numbers are extracted from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1, and H4-2, and their supplements.		
CODE NO.	MANUFACTURER	ADDRESS
00656	AEROVOX	AEROVOX NEW BEDFORD, CONN
00779	AMP INC.	AMP INC. P.O. BOX 3608 HARISBURG, PA 17105
00809	TEDFORD/HARRIS	TEDFORD/HARRIS CROVEN LTD. 500 BEECH ST. WHITBY, ONTARIO CANADA
01121	ALLEN BRADLEY CO.	ALLEN BRADLEY CO. 1201 2nd ST. SOUTH MILWAUKEE, WIS 53204
01506	GORMAN FIRE EQUIP. CO	GORMAN FIRE EQUIPMENT CO. 30D ST. SOUTH BOSTON, MA 02127
02114	FERROX	FERROXCUBE CORP. P.O. BOX 359 MT. MARION RD SAUGERTES, NY 12477
02660	AMPHENOL	BUNKER RAMO CORP. CONNECTOR DIV. 2801 S. 25th AVE BROADVIEW, IL 60153
02735	RCA	RCA CORP. SOLID STATE DIV. ROUTE 202 SOMERVILLE, NJ 08876

Table 5-4. Code List of Manufacturers

The following code numbers are extracted from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1, and H4-2, and their supplements.		
CODE NO.	**MANUFACTURER**	**ADDRESS**
04222	AVX CERAMICS	AVX CERAMICS 19th AVE SOUTH MYRTLE BEACH, SC 29577
04062	ELMENCO	ELECTRO MOTIVE CORP. SUBSIDIARY OF INTERNATION ELECTRONICS CORP. P.O. BOX 7600 LAUTER AVE FLORENCE, SC 29501 FC 72036
04404	HP	HEWLETT-PACKARD CO. AUTOMATIC MEASUREMENT DIV. 974 ARQUES AVE SUNNYVALE, CA 94086
04713	MOTOROLA	MOTOROLA INC. SEMICONDUCTOR PRODUCTS DIV. P.O. BOX 20923 5005 E. McDOWELL RD PHEONIX, AZ 85036
07109	OAKLAND IND. INC.	OAKLAND IND. INC. 704 30th MONROE WI 53566
07263	FAIRCHILD	FAIRCHILD CAMERA AND INSTRUMENT CORP. SEMICONDUCTOR DIV. 464 ELLIS ST. MOUNTAIN VIEW, CA 94042
07933	RAYTHEON	RAYTHEON CO. SEMICONDUCTOR DIV. T & Q 350 ELLIS ST. MOUNTAIN VIEW, CA 94042
09021	SPEER-AIRCO	AIRCO ELECTRONICS P.O. BOX 334 FOSTER BROOK RD BRADFORD, PA 16701

Table 5-4. Code List of Manufacturers

The following code numbers are extracted from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1, and H4-2, and their supplements.

CODE NO.	MANUFACTURER	ADDRESS
13013	THERMALLOY	THERMALLOY CO. INC. P.O. BOX 34829 2021 W. VALLEY VIEW LANE DALLAS, TX 75234
09214	G.E.	GENERAL ELECTRIC CO. SEMICONDUCTOR PRODUCTS DEPT. POWER SEMICONDUCTOR PRODUCTS OPN SEC. W. GENESSEE ST. AUBURN, NY 13021
17490	NYTRONICS	NYTRONICS INC. 105 MADISON AVE NEW YORK, NY 10016 FC 72259
19080	ROBISON	ROBISON ELECTRONICS INC. 3580 SACRAMENTO DR. SAN LUIS OBISPO, CA 93401
22360	ESSEX	ESSEX CHEMICAL CORP. 1401 BROAD ST. CLIFTON, NC 07015
22701	DILECTRON	BESTRAN CORP. DILECTRON DIV 2669 SO. MYRTLE AVE MONTROVIA, CA 91016
23600	DELMAN	THE DELMAN CO 2850 W. GRAND BLVD. DETROIT, MI 48202
23880	SAE	STANDFORD APPLIED ENGINEERING INC. 340 MARTIN AVE. SANTAN CLARA, CA 95050

Table 5-4. Code List of Manufacturers

The following code numbers are extracted from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1, and H4-2, and their supplements.		
CODE NO.	MANUFACTURER	ADDRESS
25120	PIEZO TECHNOLOGY INC.	PIEZO TECHNOLOGY INC. P.O. BOX 2400 DIVERSIFIED WAY ORLANDO, FL 32804
27014	NATIONAL	NATIONAL SEMICONDUCTOR 2900 SEMICONDUCTOR DR. SANTA CLARA, CA 95051
30122	IDEAL	IDEAL MACHINE CO. CHICAGO, ILL
30161	AAVID ENGINEERING INC.	AAVID ENGINNERING INC. 30 COOK CT. LOCONIA, NH 03246
31019	SOLID STATE SCIENTIFIC	SOLID STATE SCIENTIFIC MONTGOMERYVILLE IND. CENTER MONTGOMERYVILLE, PA 18936
31433	KEMET	UNION CARBIDE CORP. MATERIALS SYSTEMS DIV COMPONENTS DEPT. HIGHWAY 276 S.E GREENVILLE, SC 29606
32559	BIVAR	BIVAR INC. 1617 E. EDINGER AVE SANTA ANA, CA 92705
32676	GRIFFITH	GRIFFITH PLASTICS CORP. P.O. BOX 4365 1026 CALIFORNIA DR BURLINGAME, CA 94010

Table 5-4. Code List of Manufacturers

The following code numbers are extracted from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1, and H4-2, and their supplements.

CODE NO.	MANUFACTURER	ADDRESS
32440	ECC	ENGINNERING COMP. CO. 3580 SCARAMENTO DR SAN LOUIS OBISPO, CA 93406
33967	INTECH INC.	INTECH INC. 282 BROKAW RD SANTA CLARA, CA 95050
44655	OHMITE	OHMITE MFG. CO. 3601 W. HOWARD ST. SHOKIE, IL 60076
51642	CENTRE	CENTRE ENGINEERING INC. 2820 E. COLLEGE AVE STATE COLLEGE, PA 16801
52763	STETTNER-TRUSH	STETTNER-TRUSH INC. 67 ALBANY ST. CASENOVIA, NY 13035
54453	SULLINS	SULLINS ELECTRONIC CORP. P.O. BOX 757 541B TWIN OAKS VALLEY RD SAN MARCOS, CA 92069
55112	PLESSEY	PLESSEY CAP. DIV. OF PLESSEY INC. 5334 STERLING CENTER DR WESTLAKE VILLAGE, CA 91361
55210	GETTIG	GETTIG ENGINEERING & MFG. CO. INC. P.O. BOX 85 OFF RT. 45 SPRING MILLS, PA

Table 5-4. Code List of Manufacturers

The following code numbers are extracted from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1, and H4-2, and their supplements.

CODE NO.	MANUFACTURER	ADDRESS
55285	BERGQUIST	BERGQUISTCO. 4350 WEST 78th ST MINN, MINN 55435
56289	SPRAGUE	SPRAGUE ELECTRIC CO. NORTH ADAMS, MA 01247
71400	BUSS	BUSS MFG. DIV. OF McGRAW-EDISON 2536 W. UNIVERSITY ST. ST. LOUIS, MO 63106
71450	CTS	CTS CORP. 1142 W. BEARDSLEY AVE ELKHART, IN 46514
72619	DIALIGHT	DIALIGHT DIV. AMPEREX ELETRONIC CORP. 203 HARRISON PL. BROOKLYN, NY 11237
72982	ERIE TECH. PROD. INC	ERIE TECHNOLOGY PRODUCTS INC. 644 W. 12th ST LOGANSPORT, IN 46947
73138	BECKMAN	BECKMAN INSTRUMENTS INC. HELIPOT DIV. 2500 HARBOR BLVD. FULLERTON, CA 92634
74970	E.F. JOHNSON	JOHNSON E.F. CO. 299 10th AVE S.W. WASECA, MN 56093

Table 5-4. Code List of Manufacturers

The following code numbers are extracted from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1, and H4-2, and their supplements.

CODE NO.	MANUFACTURER	ADDRESS
75042	IRC	TRW ELECTRONIC COMPONENTS IRC FIXED RESISTOR PHILADELPHIA DIV. 401 N. BROAD ST. PHILADELPHIA, PA 19108
75915	LITTELFUSE	LITTELFUSE 800 E. NORTHWEST DES PLAINS, ILL 60076
77630	TRW	TRW ELECTRONIC COMPONENTS TRW ELECTRONIC FUNCTIONS DAVIS AND COPEWEED ST. CAMDEN, NJ 08103
78553	TINNERMAN	EATON CORP. P.O. BOX 6688 CLEVELAND, OHIO
80089	STANCOR	STANCOR ESSEA INTERNATIONAL INC. 3501 W. ADDISON CHICAGO, ILL 60618
81349	MIL STANDARDS	MILITARY SPECIFICATIONS PROMULGATED BY MILITARY DEPARTMENTS/AGENCIES UNDER AUTHORITY OF DEFENSE STANDARDIZATION MANUAL 4120 3-M.
83701	EDI	ELECTRONIC DEVICES INC. 21 GRAY OAKS AVE YONKERS, NY 10710
88245	LITTON	LITTON SYSTEMS INC. USECO DIV. 13536 SATICAY ST. VAN NUYS, CA 91409

Table 5-4. Code List of Manufacturers

The following code numbers are extracted from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1, and H4-2, and their supplements.

CODE NO.	MANUFACTURER	ADDRESS
90201	MALLORY	MALLORY CAPACITOR CO. DIV. OF P.R. MALLORY AND CO. INC. P.O. BOX 372 3029 E. WASHINGTON ST. INDIANAPOLIS, IN 46206
91506	AUGAT	AUGAT INC. P.O. BOX 779 633 PERRY AVE ATTLEBORO, MA 02703
99017	CAPLUG	PROTECTIVE CLOSURES CO. INC. CAPLUG DIV. 2150 ELMWOOD AVE BUFFALO, NY 14207
99800	DELEVAN	AMERICAN PRECISION INDUSTRIES INC. DELEVAN DIV. 279 QUAKER RD EASY AURORA, NY 15042

SECTION VI - PHOTOGRAPHS AND MECHANICAL DRAWINGS

SECTION VII - CIRCUIT DIAGRAMS

7-1. DIAGRAMS

Reference information for troubleshooting and repair of the direction finder is in the diagrams that follow these paragraphs. The information consists of a cabling diagram, wiring diagrams, parts location diagrams, integrated circuit diagrams, and schematic diagrams.

7.1.1 Cable Assy. Diagram.- Figure 7-1 is a Cable Assy. diagram for the AN/SRD-22. Refer to Section II of this manual for cabling details, including connectors and cables used, maximum allowable length of cables, wire color codes and connector pin assignments.

7.1.2 Wiring Diagrams.- Wiring information for the receiver unit is provided in figure 7-2. There is no internal wiring in the antenna unit.

7.1.3 Parts Location Diagrams.- Figures 7-3 through 7-11 are parts location diagrams for the printed-circuit (PC) boards contained in the receiver unit. Each diagram shows the location and appearance of the electrical parts on the PC board. The parts are identified by the reference designations used on the corresponding schematic diagrams and in the receiver unit spare parts list (Table 5-1).

7.1.4 Integrated Circuit Diagrams. - Figure 7-12 provides details of the integrated circuits (IC's) used in the receiver unit. Information provided includes logic diagrams, truth tables, and connection diagrams.

7.1.5 Schematic Diagrams. - Figures 7-13 through 7-19 provide schematics for the PC boards contained in the receiver unit. Figures 7-20 and 7-21 are schematic diagrams for the antenna unit.

RECEIVER: 10.5 lbs., 4.25"H, 12"W, 15.5"L. ALLOW 3" FOR CONNECTIONS OF REAR.

ANTENNA: 7.75LBS., 24.25"H, 48"W WITH GROUNDPLANE DIPOLES.

CABLES: SUPPLIED WITH 125 FEET OF RG-58C/U COAXIAL CABLE AND 20 FEET OF 3-WIRE POWER CABLE.

NOTE: EXCEPT FOR THE VESSEL END OF THE POWER CABLE, ALL CONNECTORS ARE PROVIDED. TO FACILITATE CABLE ROUTING NOT ALL OF THE CONNECTORS ARE INSTALLED. FOR INSTALLATION OF THE RG58C/U CONNECTORS, USE AMP CRIMP TOOL #69478-3 OR EQUIVALENT.

1. ANTENNA
2. ANTENNA MOUNT MUST BE FIRMLY FASTENED TO 2 1/2" O.D. PIPE
3. 1 1/2" O.D. PIPE
4. RG-58C/U COAX CABLE
5. 3-WIRE POWER CABLE

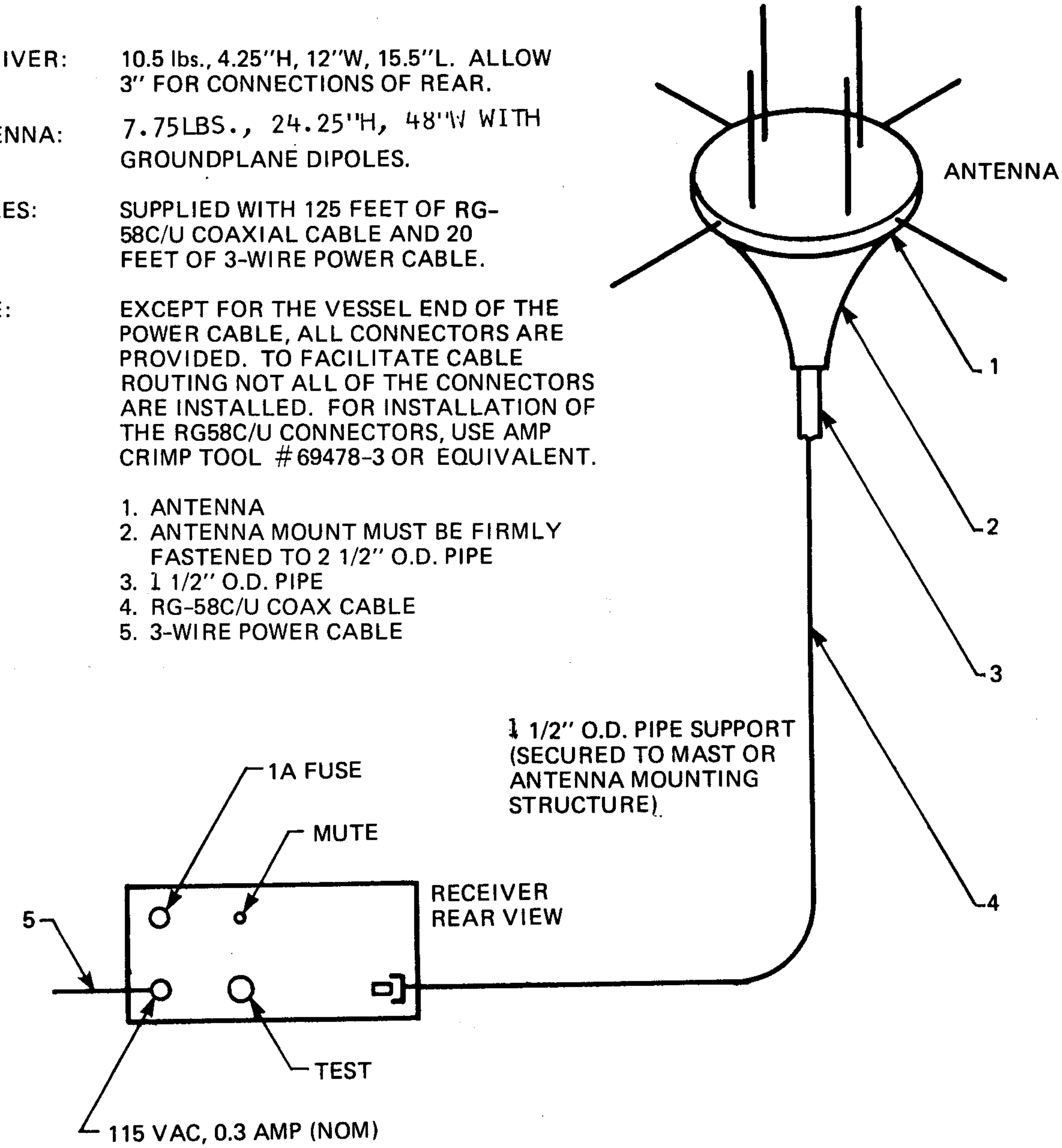
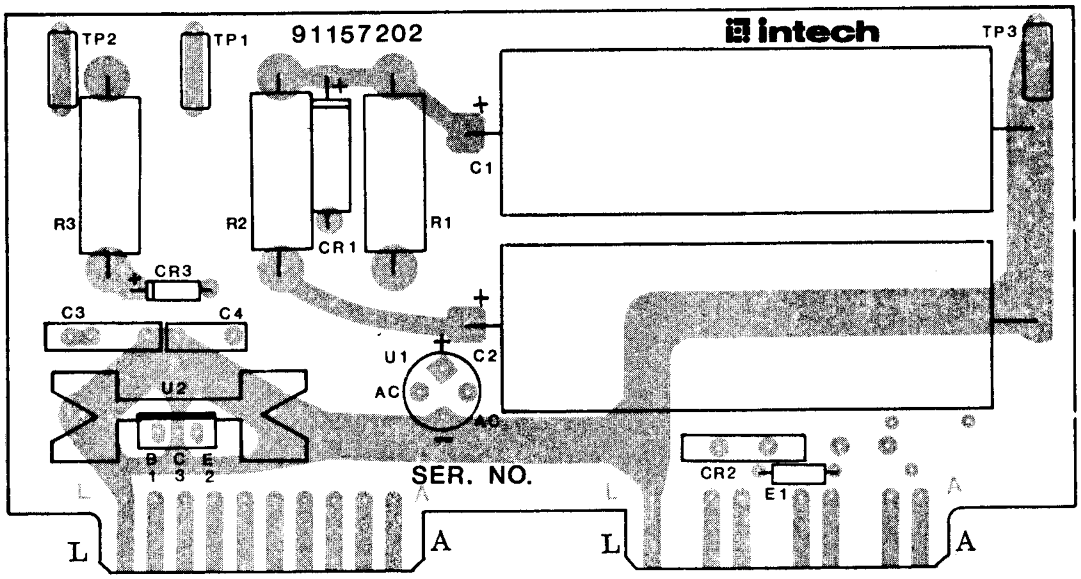


Figure 7-1. Direction Finder Cable Assembly Drawing



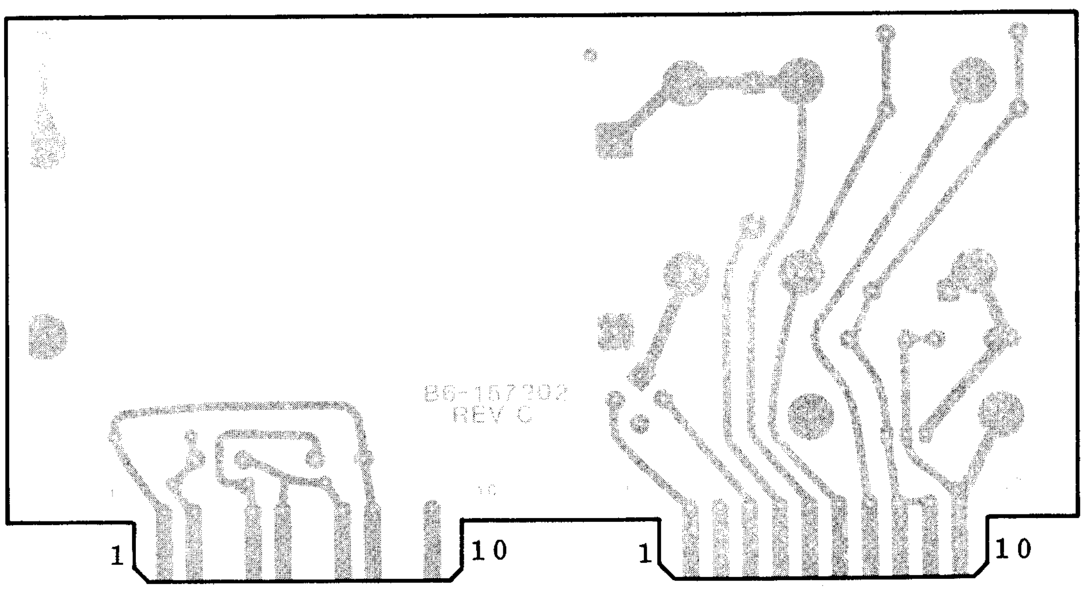


Figure 7-3. Power Supply 1A2 Component Location Diagram

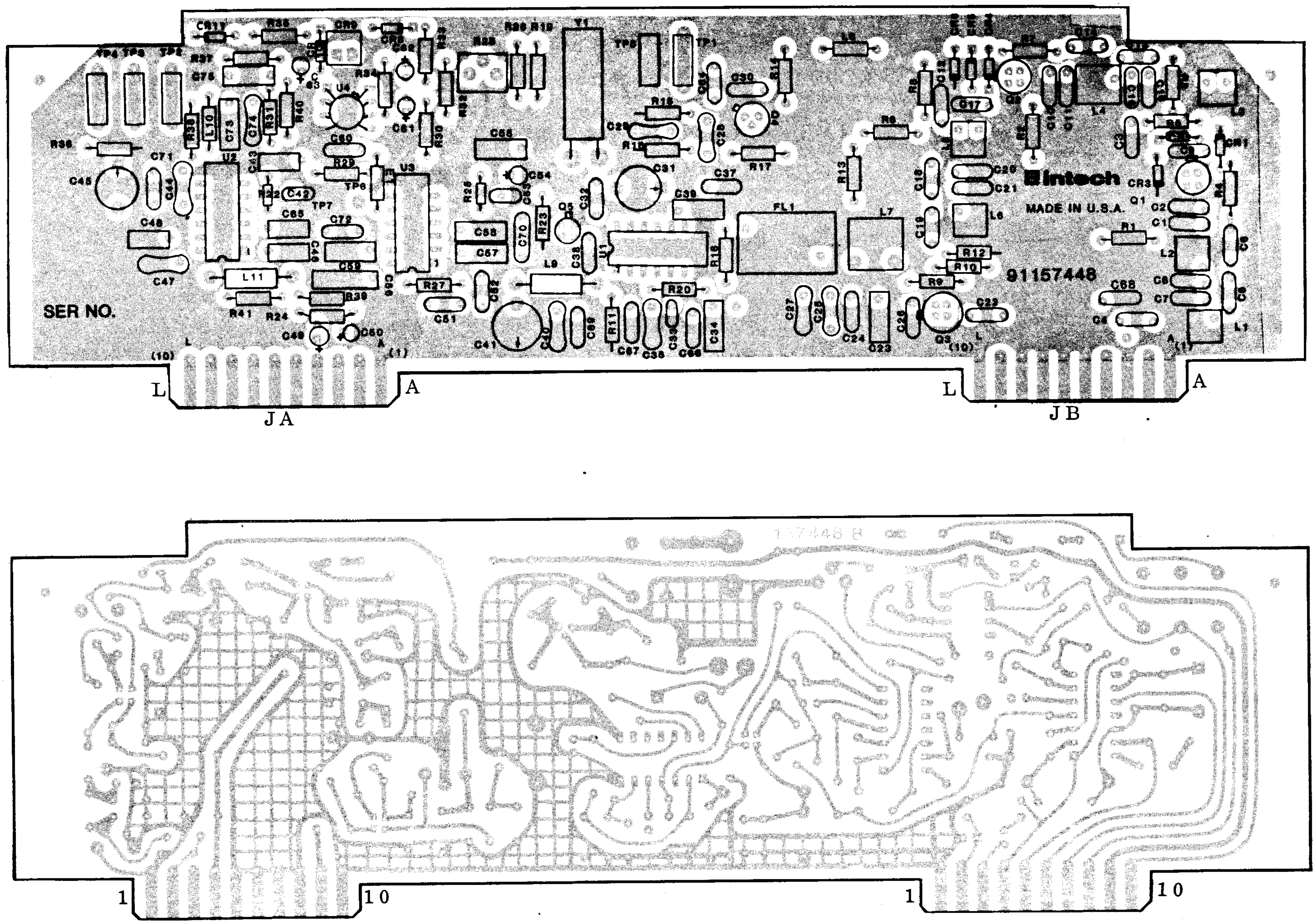


Figure 7-4. **FM Receiver 1A3 (156-163MHz) Component Location Diagram**

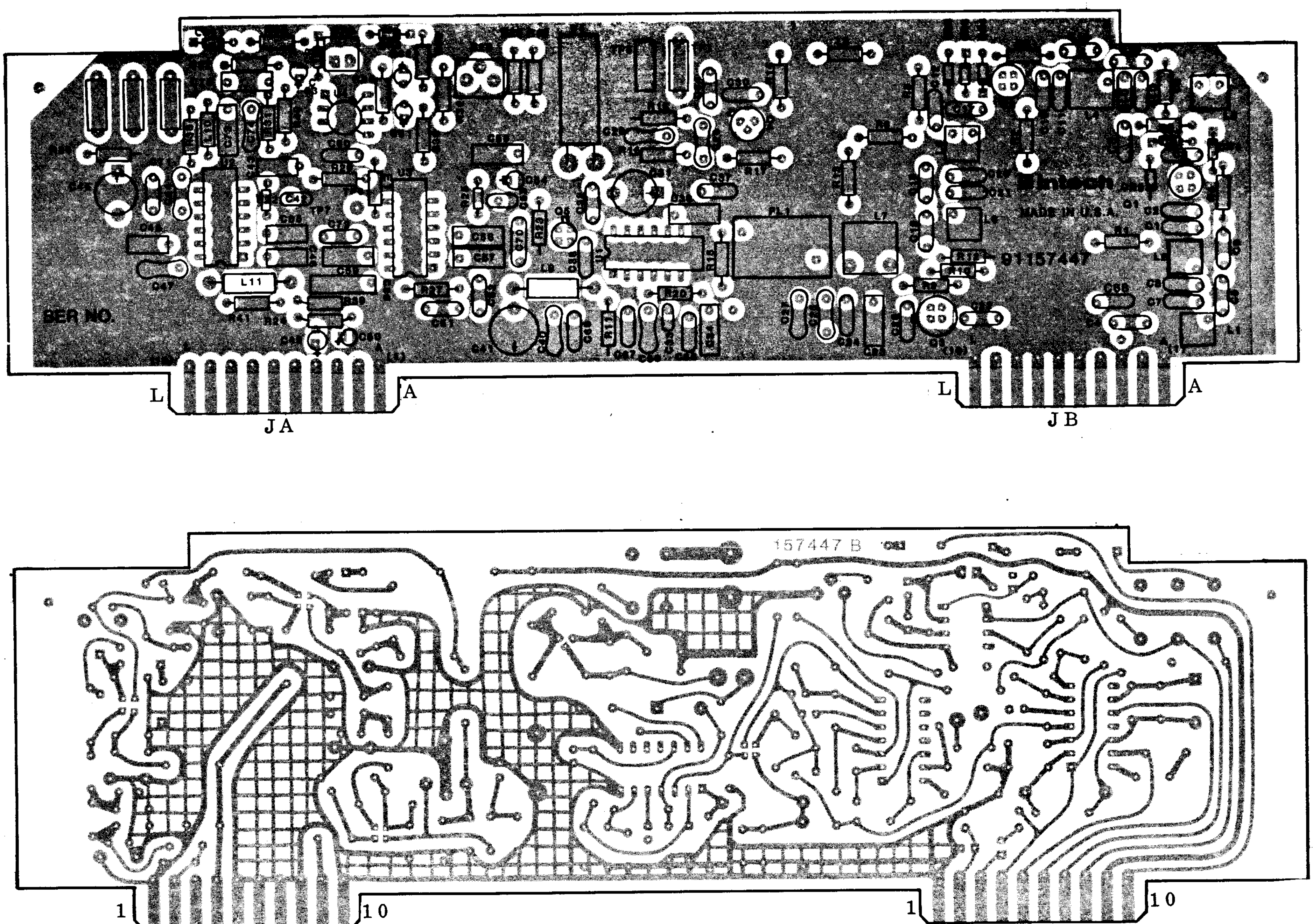


Figure 7-5. AM Receiver 1A4 (121.5 MHz) Component Location Diagram

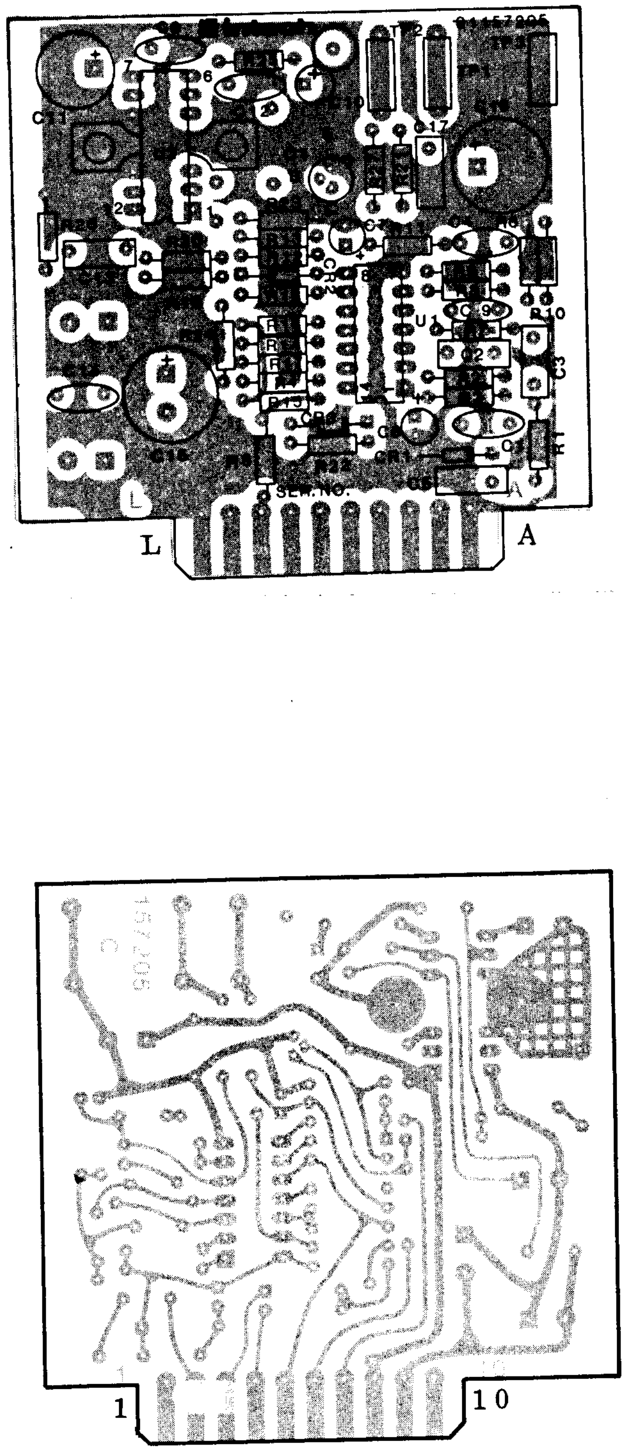


Figure 7-6. Audio 1A5 Component Location Diagram

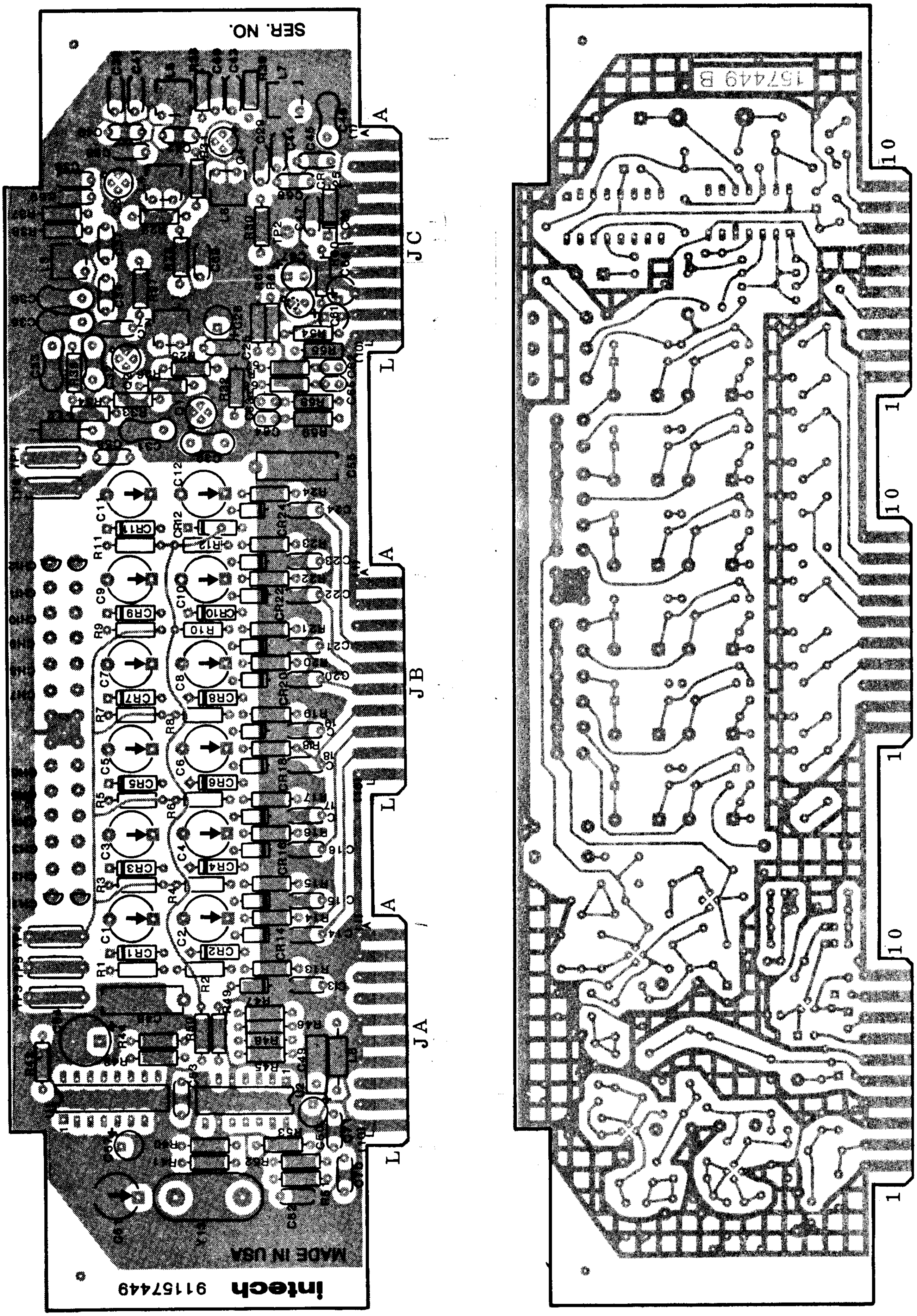


Figure 7-7. Oscillation/Multiplier 1A6 Component Location Diagram

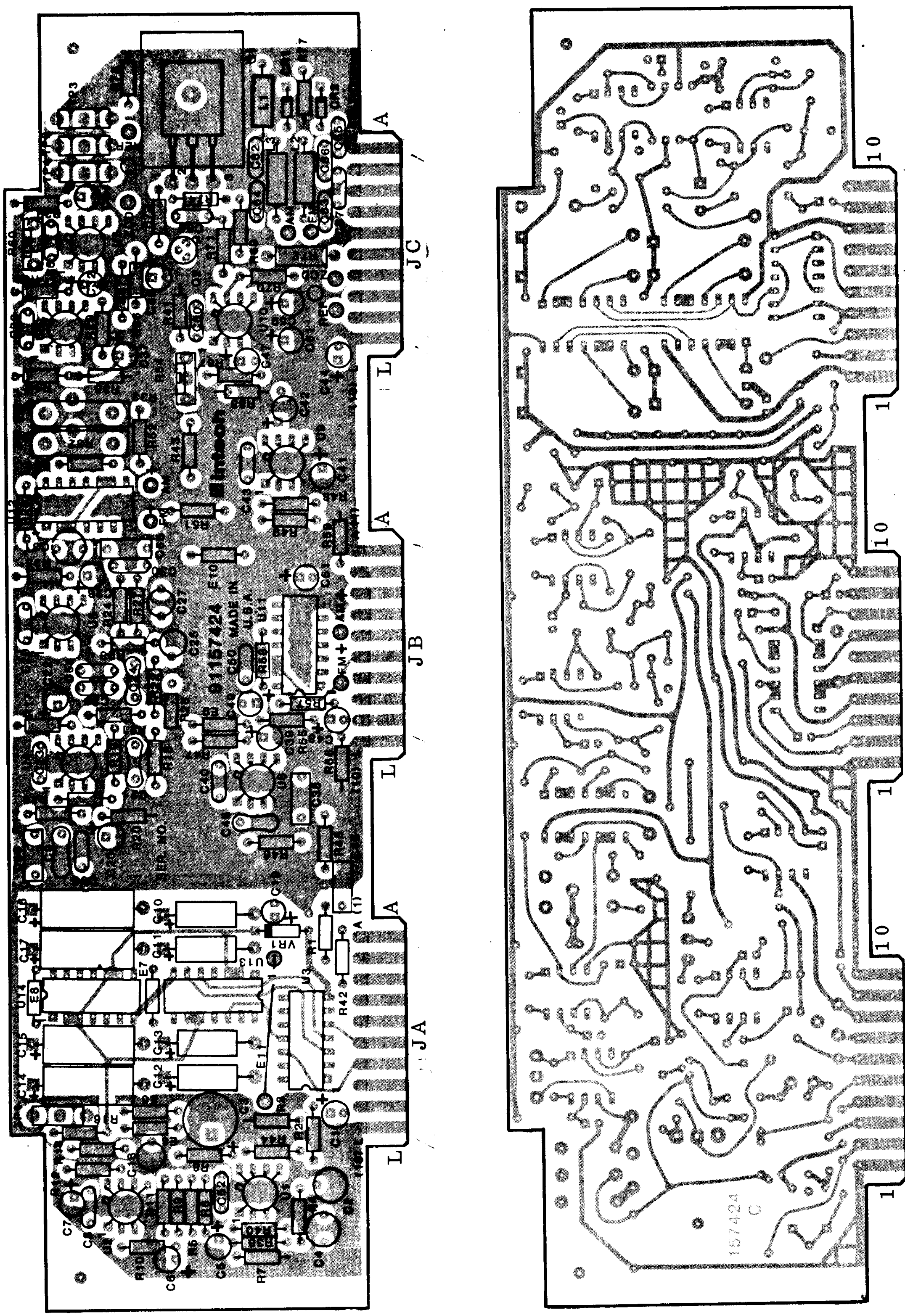


Figure 7-8. Analog 1A7 Component Location Diagram

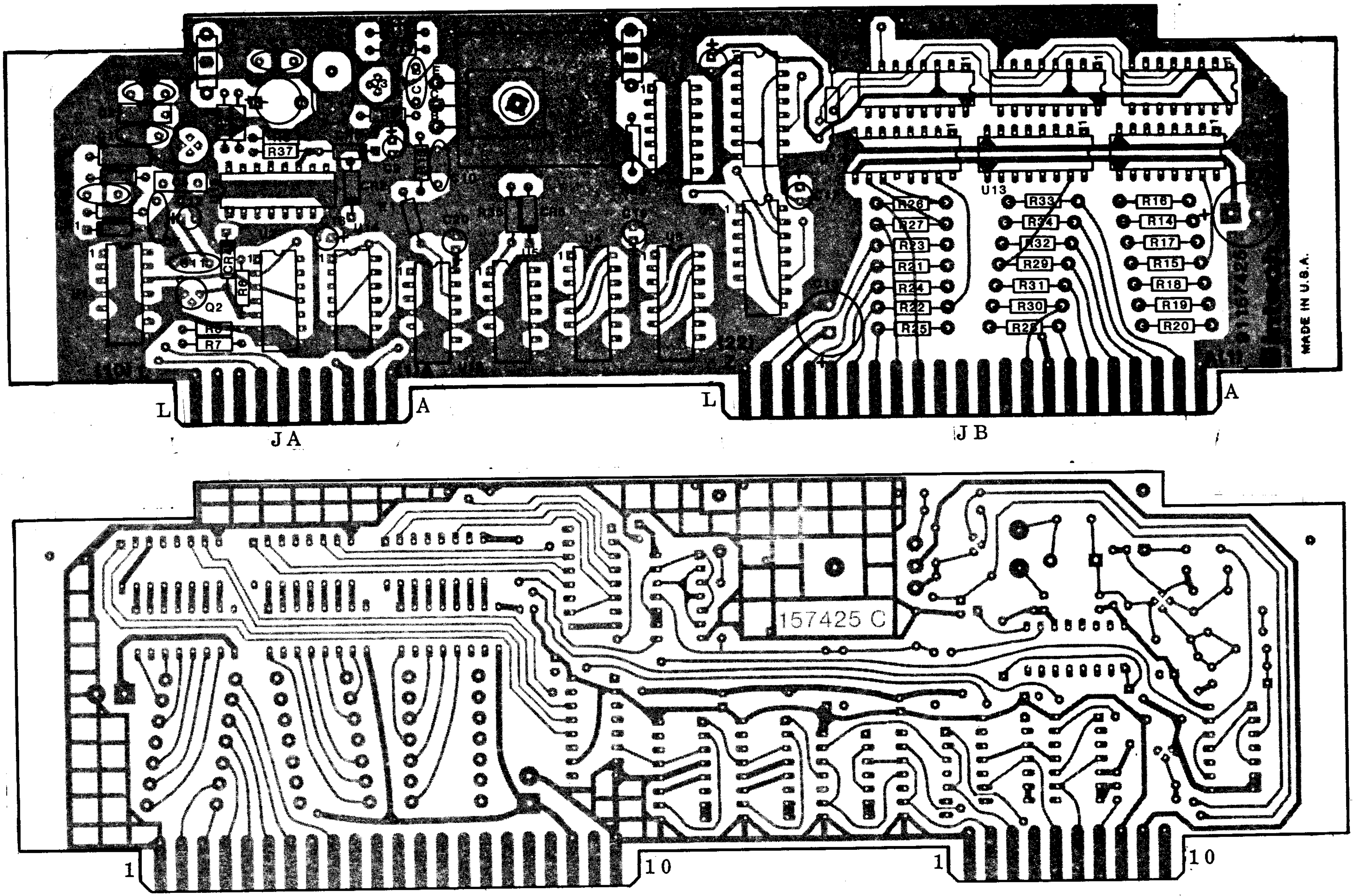


Figure 7-9. Digital 1A8 Component Location Diagram

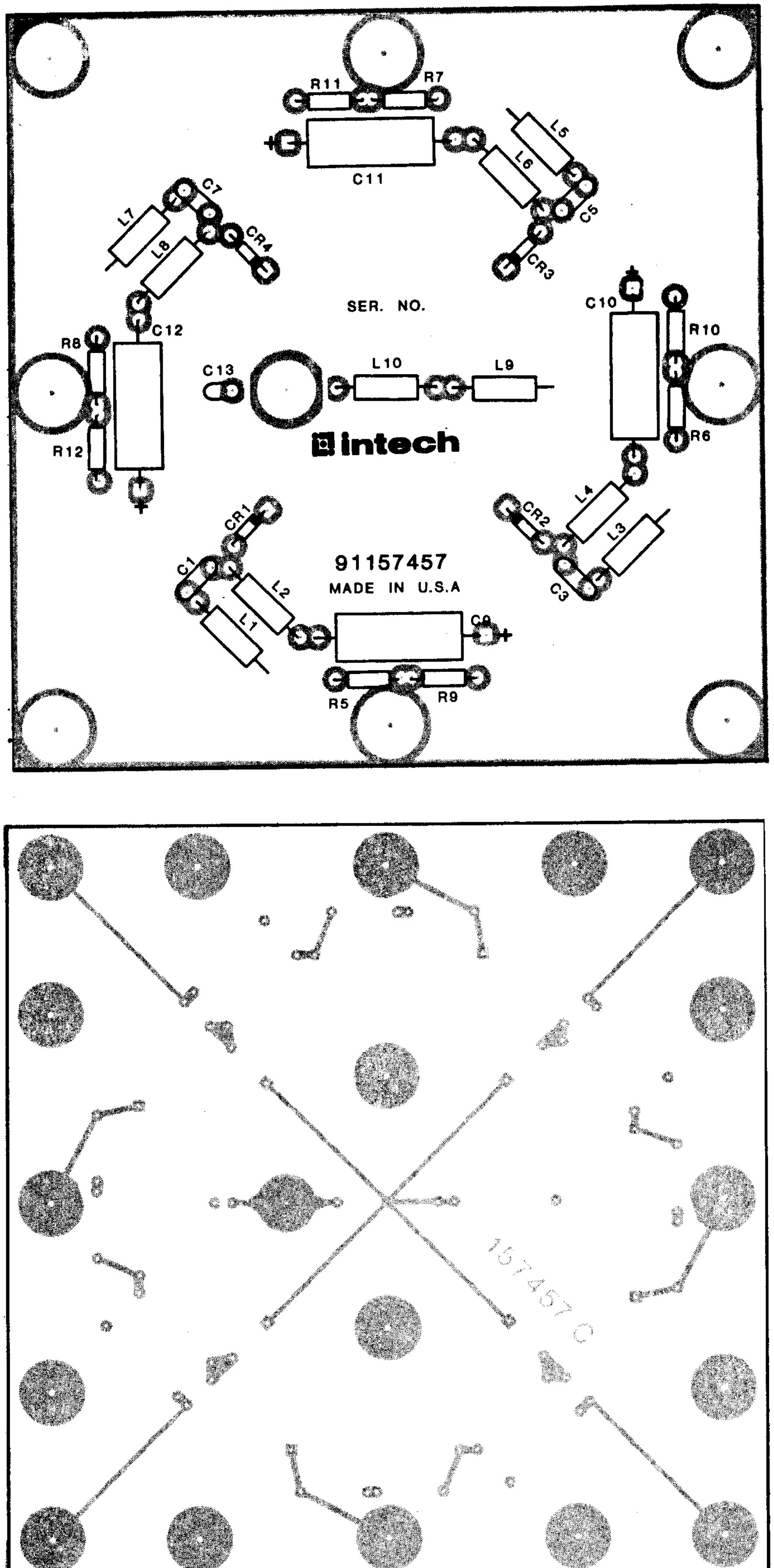
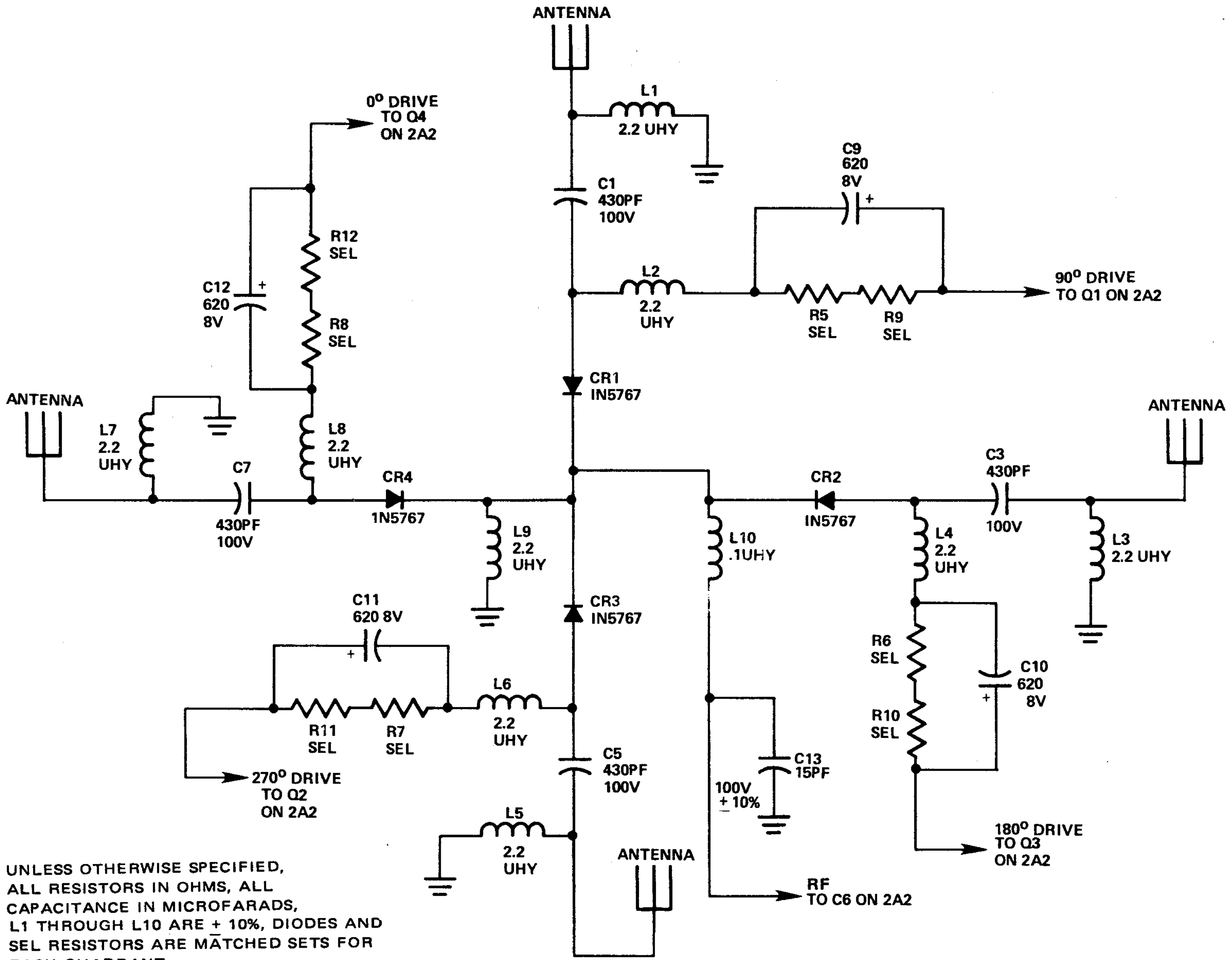
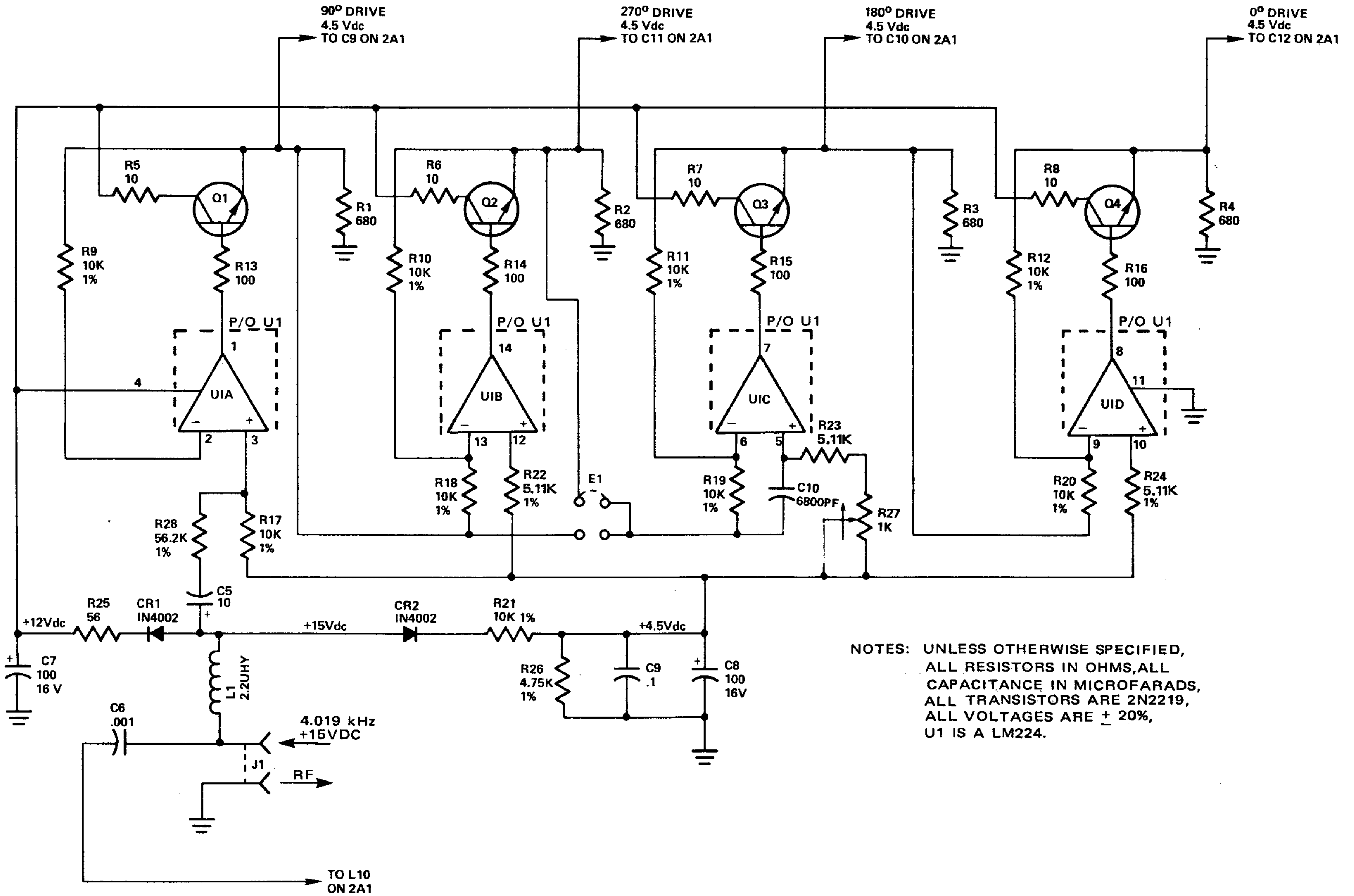


Figure 7-10. Antenna RF Phasing 2A1 Component Location Diagram



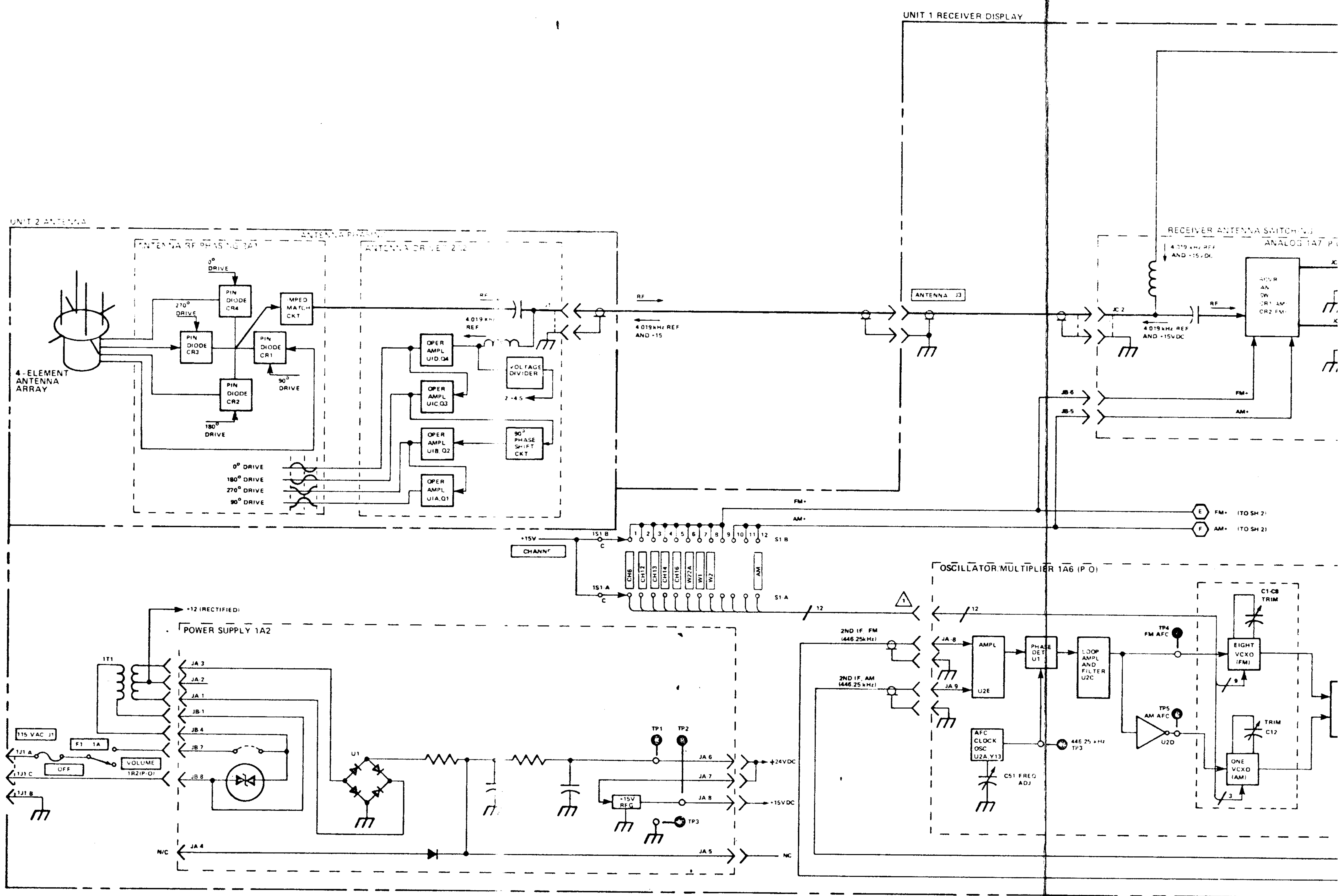
NOTES: UNLESS OTHERWISE SPECIFIED,
ALL RESISTORS IN OHMS, ALL
CAPACITANCE IN MICROFARADS,
L1 THROUGH L10 ARE ± 10%, DIODES AND
SEL RESISTORS ARE MATCHED SETS FOR
EACH QUADRANT.

Figure 7-20. Antenna RF Phasing 2A1 Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED,
ALL RESISTORS IN OHMS, ALL
CAPACITANCE IN MICROFARADS,
ALL TRANSISTORS ARE 2N2219,
ALL VOLTAGES ARE ± 20%,
U1 IS A LM224.

Figure 7-21. Antenna Driver 2A2 Schematic Diagram



UNIT 2 ANTENNA
UNIT 1 RECEIVER DISPLAY
4-ELEMENT ANTENNA ARRAY
PIN DIODE CR4
PIN DIODE CR3
PIN DIODE CR1
PIN DIODE CR2
0° DRIVE
270° DRIVE
90° DRIVE
180° DRIVE
OPER AMPL U1D Q4
OPER AMPL U1C Q3
OPER AMPL U1B Q2
OPER AMPL U1A Q1
VOLTAGE DIVIDER
90° PHASE SHIFT CKT
RF
4.019 kHz REF
4.019 kHz REF AND +15
ANTENNA J3
4.019 kHz REF AND +15VDC
RECEIVER ANTENNA SWITCH
FM+
AM+
FM+ (TO SH 2)
AM+ (TO SH 2)
+15V
1S1 B
1S1 A
S1 B
S1 A
CH6
CH12
CH13
CH14
CH16
W72A
W1
W2
AM
+12 (RECTIFIED)
POWER SUPPLY 1A2
1T1
115 VAC J1
F1 1A
OFF
VOLUME 1R2(P/O)
U1
+15V REG
TP1
TP2
TP3
+24VDC
+15VDC
N/C
NC
OSCILLATOR MULTIPLIER 1A6 (P/O)
2ND IF FM (446.25kHz)
2ND IF, AM (446.25 kHz)
AMPL
U2E
PHASE DET U1
LOOP AMPL AND FILTER U2C
AFC CLOCK OSC U2A Y13
C51 FREQ ADJ
446.25 kHz TP3
TP4 FM AFC
TP5 AM AFC
U2D
EIGHT VCXO (FM)
ONE VCXO (AM)
C1-C8 TRIM
TRIM C12

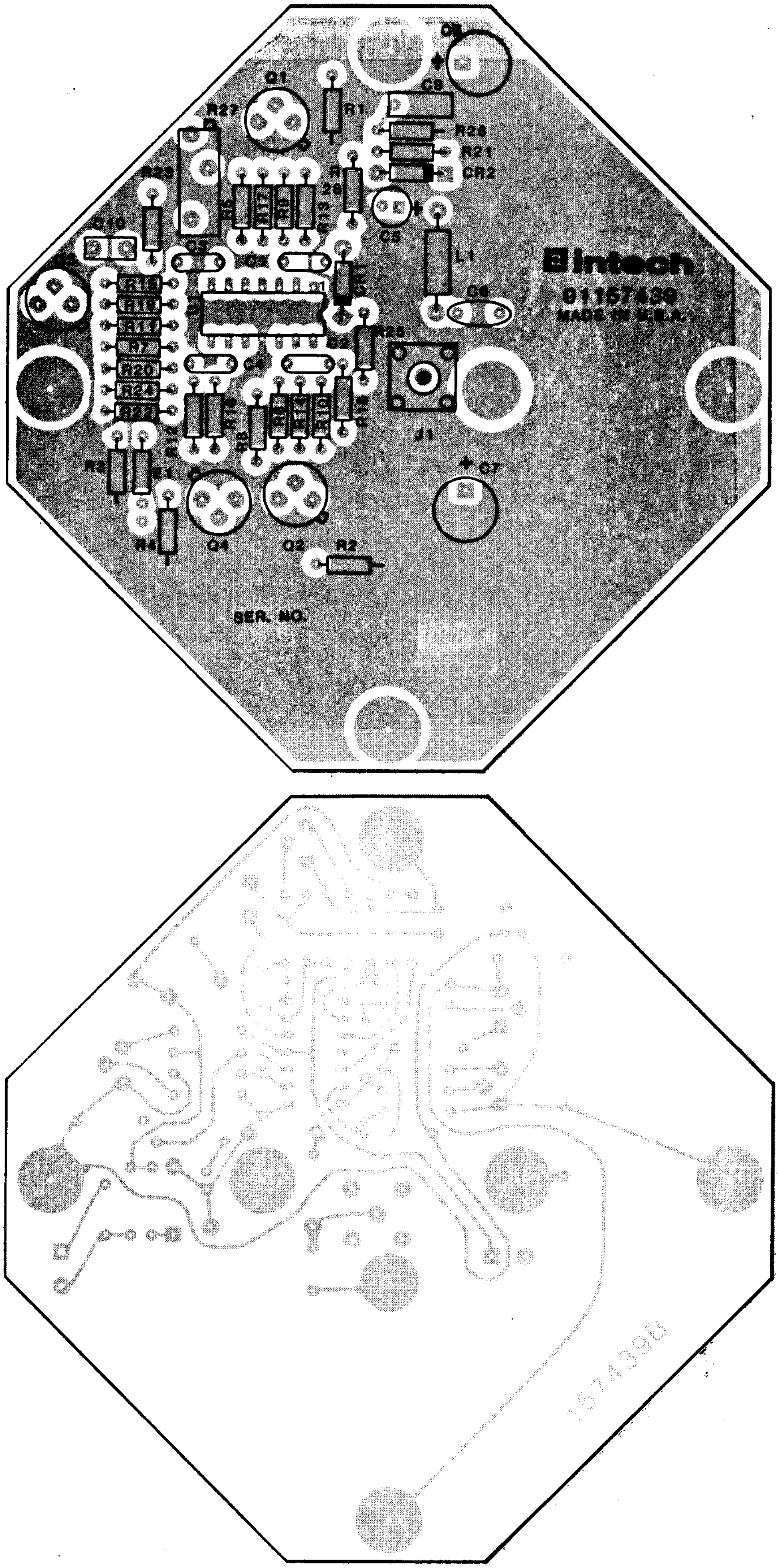


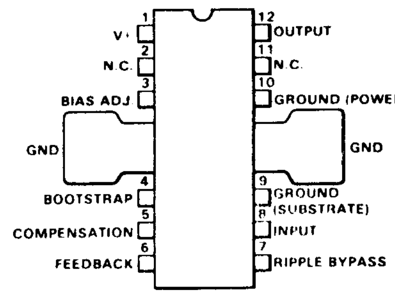
Figure 7-11. Antenna Driver 2A2 Component Location Diagram

TBA800A

GENERAL DESCRIPTION – The TBA800 is a monolithic Audio Power Amplifier constructed using the Fairchild Planar* Epitaxial process. The external cooling tabs enable 2.5 W output power to be achieved without external heat sink and 5 W output power using a small area of the pc board copper as a heat sink.

It is ideally suited as an audio amplifier in solid state television receivers and other Class B audio amplifier applications over a wide range of supply voltage (5-30 V).

CONNECTION DIAGRAM
12-PIN POWER PACKAGE
(TOP VIEW)
PACKAGE OUTLINE 9W
PACKAGE CODE P3, P4



EQUIVALENT CIRCUIT

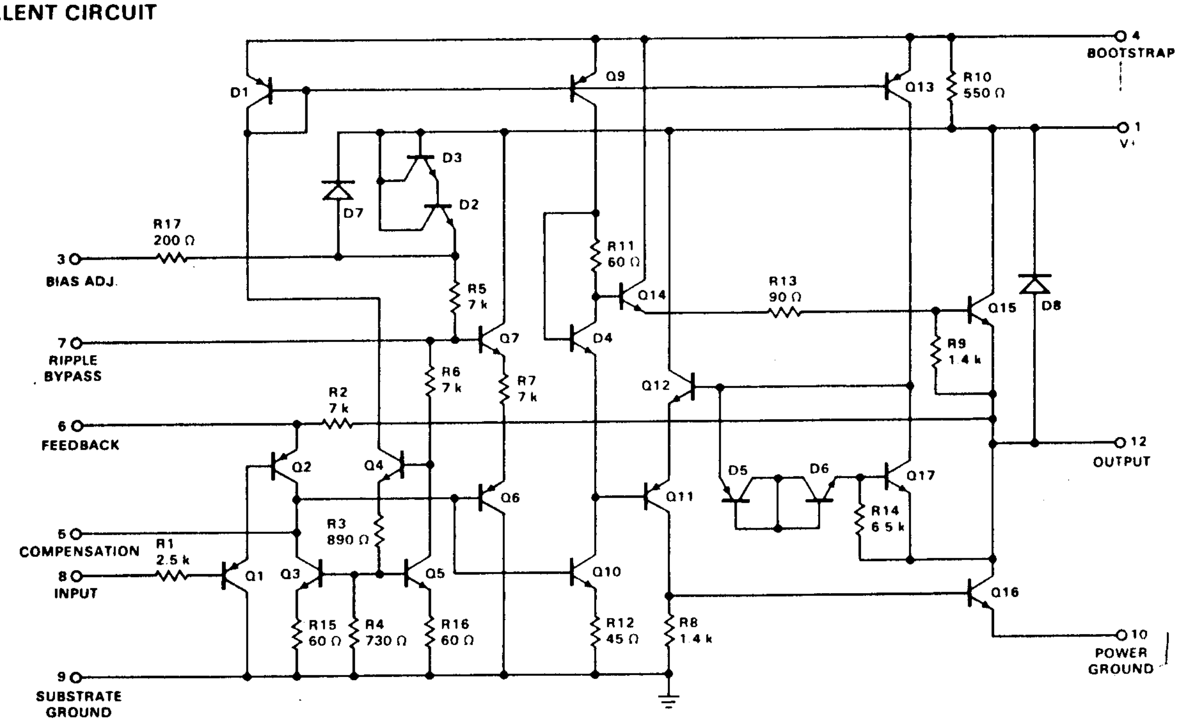
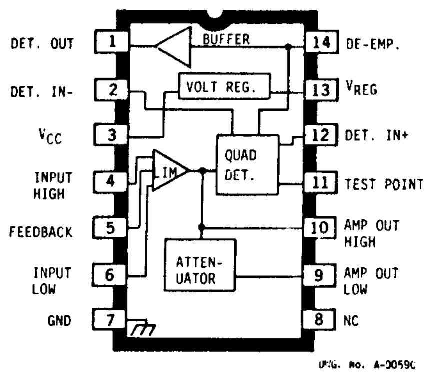


Figure 7-12 Integrated Circuit Elements

THE TYPE ULN-2136 F-M Detector and Limiter combines a limiting amplifier, a quadrature discriminator, and a voltage regulator in a single monolithic integrated circuit. Although primarily for f-m receivers, the device can be used in any f-m demodulator application.

The Type ULN-2136 features improved temperature coefficient of the detector output for better AFC stability and elimination of the detector unbalance inherent to previous designs. Detector unbalance degrades temperature coefficient of the detector output, off-station noise, AMR, and creates tuning and stability problems in a high gain i-f strip.



SCHEMATIC

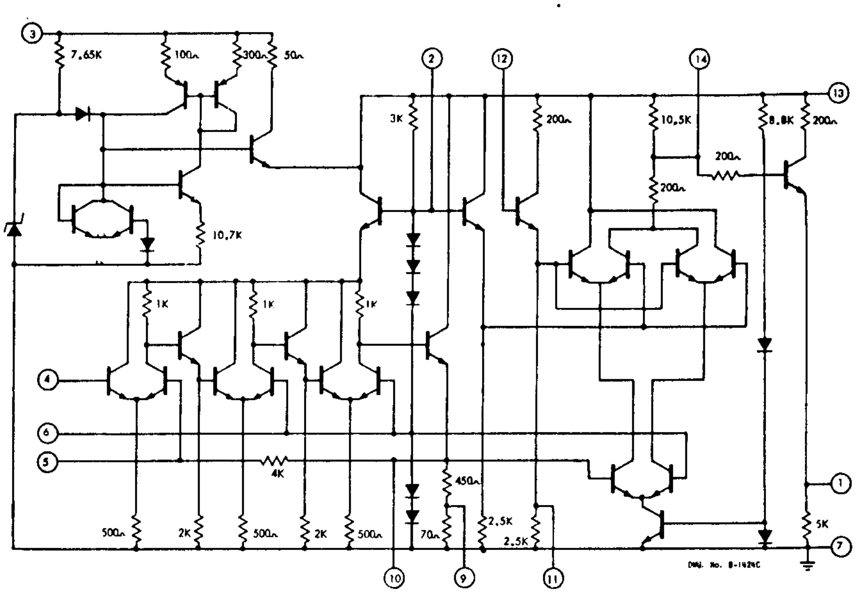


Figure 7-12 Integrated Circuit Elements

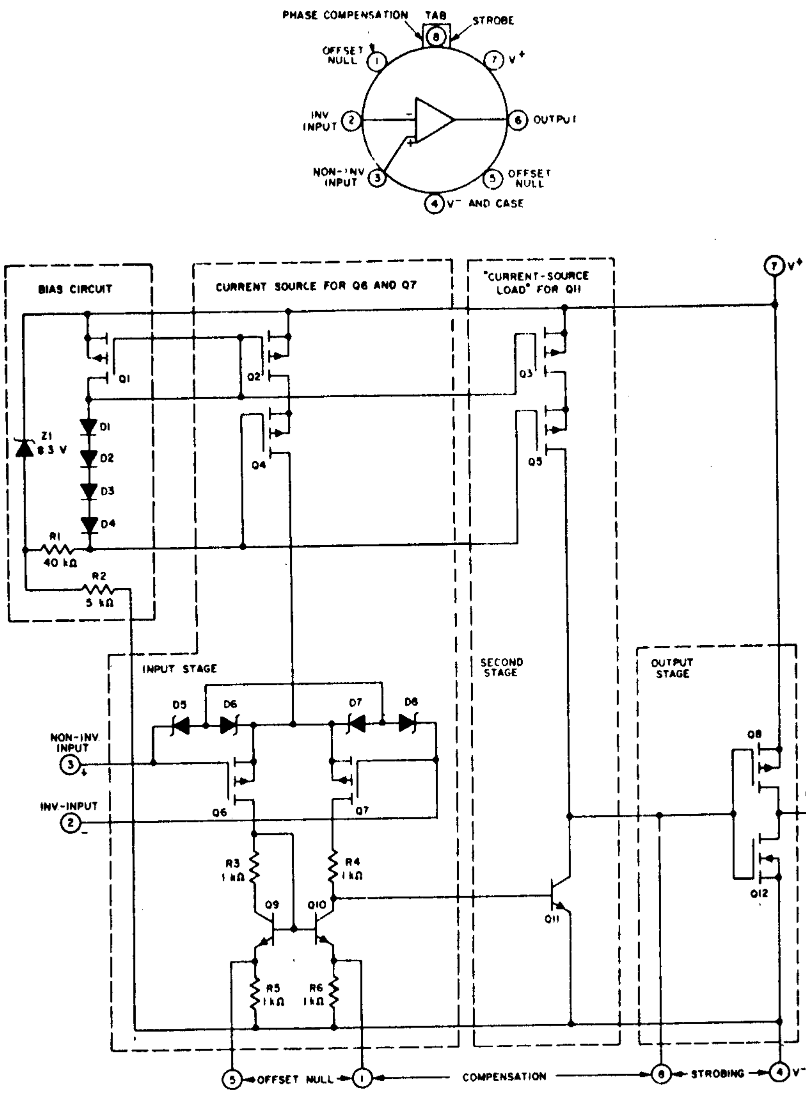
RCA CA3130T, CA3130S, CA3130AT, CA3130AS, CA-3130BT, and CA3130BS are integrated-circuit operational amplifiers that combine the advantages of both COS/MOS and bipolar transistors on a monolithic chip.

Gate-protected p-channel MOS/FET (PMOS) transistors are used in the input circuit to provide very-high-input impedance, very low-input current, and exceptional speed performance. The use of PMOS field-effect transistors in the input stage results in common-mode input-voltage capability down to 0.5 volt below the negative-supply terminal, an important attribute in single-supply applications.

A complementary-symmetry MOS (COS/MOS) transistor pair, capable of swinging the output voltage to within millivolts of either supply-voltage terminal (at very high values of load impedance), is employed as the output circuit.

The CA3130 Series circuits operate at supply voltages ranging from 5 to 16 volts, or ±2.5 to ±8 volts when using split supplies. They can be phase compensated with a single external capacitor, and have terminals for adjustment of offset voltage for applications requiring offset-null capability. Terminal provisions are also made to permit strobing of the output stage.

The CA3130 Series is supplied in either the standard 8-lead TO-5-style package (T suffix) or in the 8-lead dual-in-line formed-lead TO-5-style package "DIL-CAN" (S suffix) and operates over the full military-temperature range of −55°C to +125°C. The CA3130B is intended for applications requiring premium-grade specifications and with limits established for: input current, temperature coefficient of input-offset voltage, and gain over the range of −55°C to +125°C. The CA3130A offers superior input characteristics over those of the CA3130.



NOTE:
DIODES D5 THROUGH D8 PROVIDE GATE-OXIDE PROTECTION FOR MOS/FET INPUT STAGE

Figure 7-12 Integrated Circuit Elements

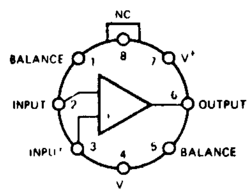
LF256H

GENERAL DESCRIPTION

These are the first monolithic JFET input operational amplifiers to incorporate well matched, high voltage JFETs on the same chip with standard bipolar transistors. These amplifiers feature low input bias and offset currents, low offset voltage and offset voltage drift, coupled with offset adjust which does not degrade drift or common-mode rejection. The devices are also designed for high slew rate, wide bandwidth, extremely fast settling time, low voltage and current noise and a low 1/f noise corner.

CONNECTION DIAGRAM
Top Views

Metal Can



DETAILED SCHEMATIC

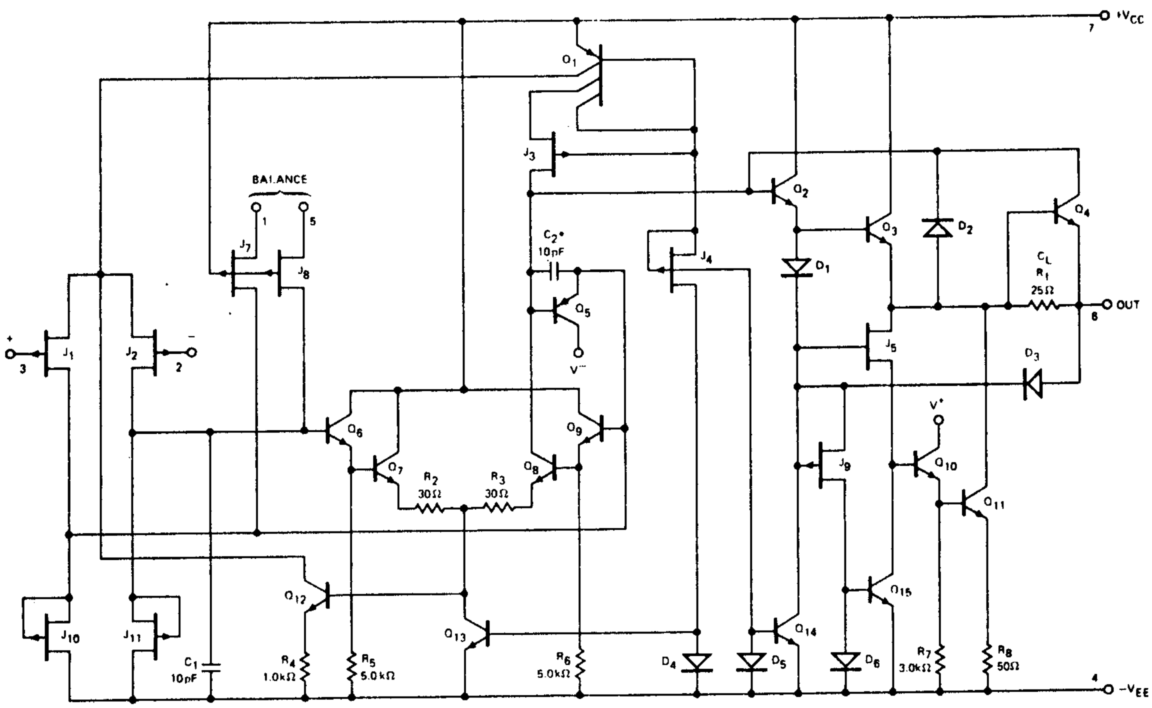


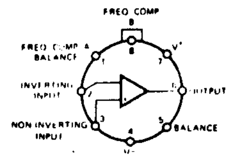
Figure 7-12 Integrated Circuit Elements

LM201AH

FUNCTIONAL DESCRIPTION

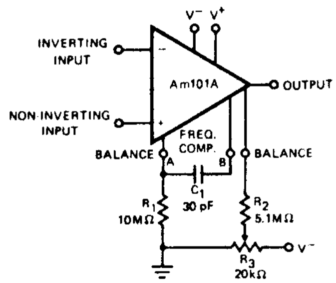
The Am101A/Am201A/Am301A are differential input, class AB output operational amplifiers. The inputs and outputs are protected against overload and the amplifiers may be frequency compensated with an external 30pF capacitor. The combination of low-input currents, low-offset voltage, low noise, and versatility of compensation classify the Am101A/Am201A/Am301A amplifiers for low level and general purpose applications.

Metal Can



NOTES:
(1) On Metal Can,
pin 4 is connected to case

FUNCTIONAL DIAGRAM

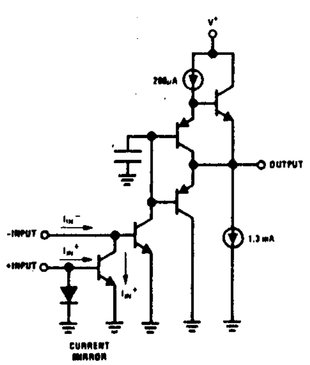


LM1900

general description

The LM1900 series consists of four independent, dual input, internally compensated amplifiers which were designed specifically to operate off of a single power supply voltage and to provide a large output voltage swing. These amplifiers make use of a current mirror to achieve the non-inverting input function. Application areas include: ac amplifiers, RC active filters, low frequency triangle, squarewave and pulse waveform generation circuits, tachometers and low speed, high voltage digital logic gates.

schematic



Dual-In-Line and Flat Package

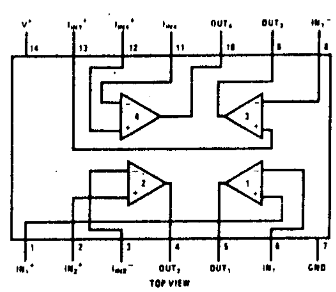


Figure 7-12 Integrated Circuit Elements

LM1558/LMI458 DUAL OPERATIONAL AMPLIFIER

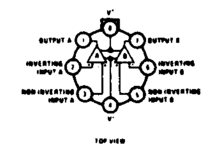
general description

The LM1558 and the LM1458 are general purpose dual operational amplifiers. The two amplifiers share a common bias network and power supply leads. Otherwise, their operation is completely independent. Features include:

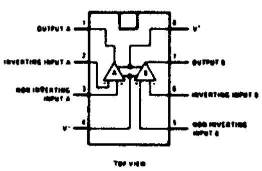
- No frequency compensation required
- Short-circuit protection
- Wide common-mode and differential voltage ranges

connection diagrams

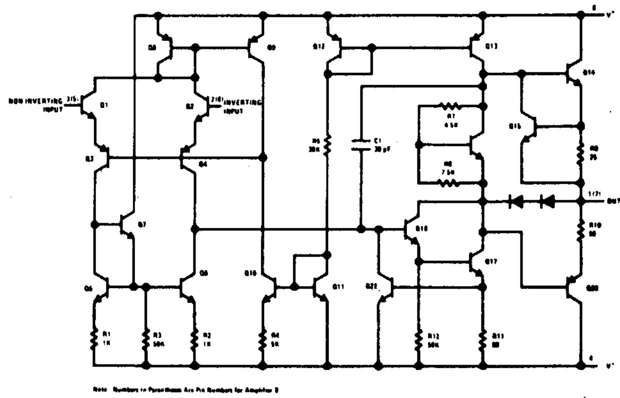
Metal Can Package



Dual-In-Line Package



schematic



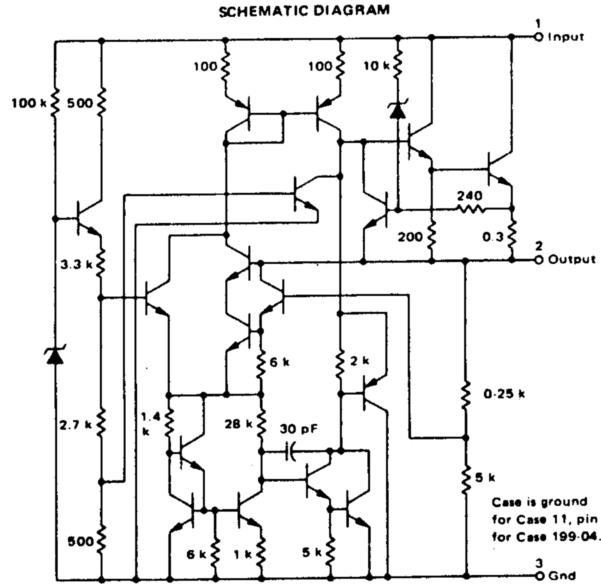
MC7815CP

MC7800C SERIES THREE-TERMINAL POSITIVE VOLTAGE REGULATORS

The MC7800C Series of three-terminal positive voltage regulators are monolithic integrated circuits designed as fixed-voltage regulators for a wide variety of applications including local, on-card regulation. Available in seven fixed output voltage options from 5.0-to-24 volts, these regulators employ internal current limiting, thermal shutdown, and safe area compensation – making them essentially blow-out proof. With adequate heatsinking they can deliver output currents in excess of 1.0 ampere. The last two digits of the part number indicate nominal output voltage.

- Output Current in Excess of 1.0 Ampere
- No External Components Required
- Internal Thermal Overload Protection
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation
- Packaged in the Plastic Case 199-04
  (Pin Compatible with the VERSAWATT[†] or TO-220)
  Or Hermetic TO-3 Type Metal Power Package (Case 11)

SCHEMATIC DIAGRAM



P SUFFIX
PLASTIC PACKAGE
CASE 199-04

Pin 1 Input (Base)
Pin 2 Output (Emitter)
Pin 3 Ground (Collector)

Heat sink surface connected to pin 3.

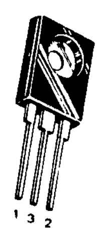
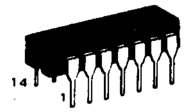


Figure 7-12 Integrated Circuit Elements

MC14001

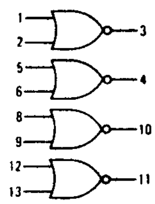
The MC14001 quad 2-Input NOR gate is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. These complementary MOS logic gates find primary use where low power dissipation and/or high noise immunity is desired.

- Quiescent Current = 0.5 nA typ/pkg @ 5 Vdc
- Noise Immunity = 45% of V_{DD} typical
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Single Supply Operation -- Positive or Negative
- High Fanout > 50
- Input Impedance = 10^{12} ohms typical
- Logic Swing Independent of Fanout
- Pin-for-Pin Replacement for CD4001A



L SUFFIX
CERAMIC PACKAGE
CASE 632

LOGIC DIAGRAM



V_{DD} = Pin 14
V_{SS} = Pin 7

CIRCUIT SCHEMATIC

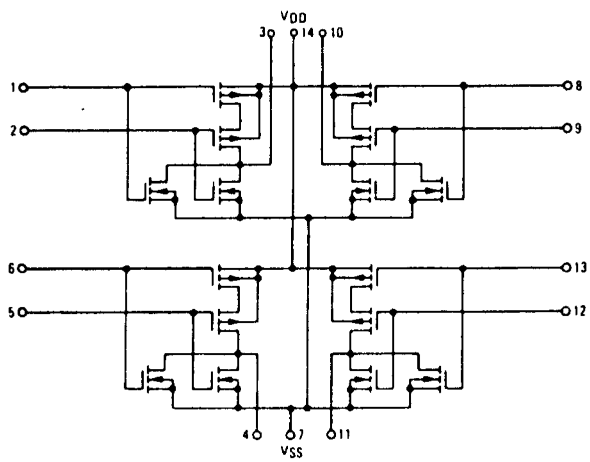
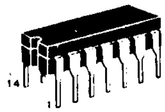


Figure 7-12 Integrated Circuit Elements

MC14013BCL

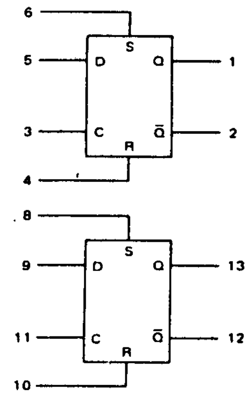
The MC14013B dual type D flip-flop is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. Each flip-flop has independent Data, (D), Direct Set, (S), Direct Reset, (R), and Clock (C) inputs and complementary outputs (Q and $\bar{Q}$). These devices may be used as shift register elements or as type T flip-flops for counter and toggle applications.

- Static Operation
- Quiescent Current = 2.0 nA/package typical @ 5 Vdc
- Noise Immunity = 45% of V_{DD} typical
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Single Supply Operation
- Toggle Rate = 4 MHz typical @ 5 Vdc
- Logic Edge-Clocked Flip-Flop Design
  Logic state is retained indefinitely with clock level either high or low; information is transferred to the output only on the positive-going edge of the clock pulse
- Capable of Driving Two Low-power TTL Loads, One Low-power Schottky TTL Load or Two HTL Loads Over the Rated Temperature Range
- Pin-for-Pin Replacement for CD4013



L SUFFIX
CERAMIC PACKAGE
CASE 632

BLOCK DIAGRAM



V_{DD} = Pin 14
V_{SS} = Pin 7

TRUTH TABLE

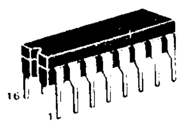
INPUTS				OUTPUTS		
CLOCK†	DATA	RESET	SET	Q	$\bar{Q}$	
↑	0	0	0	0	1	
↑	1	0	0	1	0	
↓	X	0	0	Q	$\bar{Q}$	No Change
X	X	1	0	0	1	
X	X	0	1	1	0	
X	X	1	1	1	1	

X = Don't Care
† = Level Change

MC14027BCL

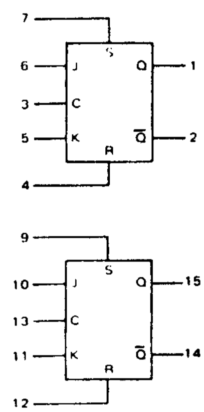
The MC14027B dual J-K flip-flop has independent J, K, Clock (C), Set (S) and Reset (R) inputs for each flip-flop. These devices may be used in control, register, or toggle functions.

- Quiescent Current = 2.0 nA/package typical @ 5 Vdc
- Noise Immunity = 45% of V_{DD} typical
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Single Supply Operation – Positive or Negative
- Toggle Rate = 3.0 MHz typical @ 5 Vdc
- Logic Swing Independent of Fanout
- Logic Edge-Clocked Flip-Flop Design –
  Logic state is retained indefinitely with clock level either high or low; information is transferred to the output only on the positive-going edge of the clock pulse
- Capable of Driving Two Low-power TTL Loads, One Low-power Schottky TTL Load or Two HTL Loads Over the Rated Temperature Range
- Pin-for-Pin Replacement for CD4027



L SUFFIX
CERAMIC PACKAGE
CASE 620

BLOCK DIAGRAM



V_{DD} = Pin 16
V_{SS} = Pin 8

TRUTH TABLE

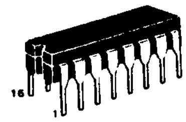
INPUTS						OUTPUTS*		
C†	J	K	S	R	Q_n‡	Q_{n+1}	$\overline{Q_{n+1}}$	
↑	1	X	0	0	0	1	0	
↑	X	0	0	0	1	1	0	
↑	0	X	0	0	0	0	1	
↑	X	1	0	0	1	0	1	
↓	X	X	0	0	X	Q_n	$\overline{Q_n}$	No Change
X	X	X	1	0	X	1	0	
X	X	X	0	1	X	0	1	
X	X	X	1	1	X	1	1	

X = Don't Care
† = Level Change
‡ = Present State
* = Next State

Figure 7-12 Integrated Circuit Elements

MC14020BCL

The MC14020B 14-stage binary counter is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. This part is designed with an input wave shaping circuit and 14 stages of ripple-carry binary counter. The device advances the count on the negative-going edge of the clock pulse. Applications include time delay circuits, counter controls, and frequency-dividing circuits.



L SUFFIX
CERAMIC PACKAGE
CASE 620

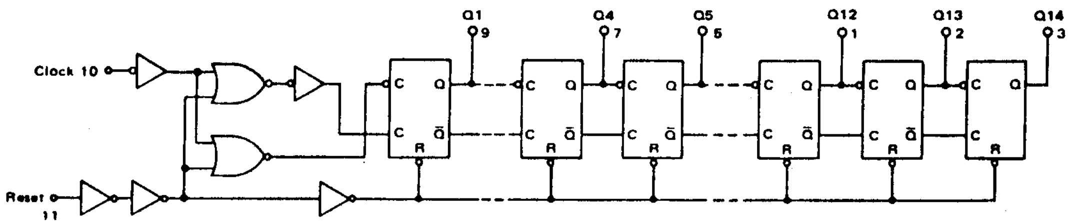
- Fully Static Operation
- Quiescent Current =5.0 nA/package typical @ 5 Vdc
- Noise Immunity = 45% of V_{DD} typical
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Capable of Driving Two Low-power TTL Loads, One Low-power Schottky TTL Load or Two HTL Loads Over the Rated Temperature Range
- Low Input Capacitance = 5.0pF typical
- Buffered Outputs Available from stages 1 and 4 thru 14
- Common Reset Line
- 13 MHz Typical Counting Rate @ V_{DD} = 15V
- Pin-for-Pin Replacement for CD4020

TRUTH TABLE

$\overline{\text{CLOCK}}$	RESET	OUTPUT STATE
_/‾	0	No Change
‾_	0	Advance to next state
X	1	All Outputs are low

X = Don't Care

LOGIC DIAGRAM



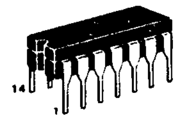
Q6 = Pin 4
Q7 = Pin 6
Q8 = Pin 13
Q9 = Pin 12
Q10 = Pin 14
Q11 = Pin 15
V_{DD} = Pin 16
V_{SS} = Pin 8

Figure 7-12 Integrated Circuit Elements

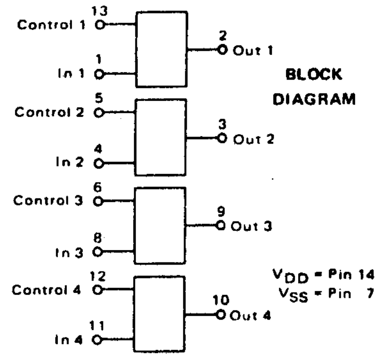
The MC14066 consists of four independent switches capable of controlling either digital or analog signals. This quad bilateral switch is useful in signal gating, chopper, modulator, demodulator and CMOS logic implementation.

The MC14066 is designed to be pin-for-pin compatible with the MC14016, but has much lower ON resistance. Input voltage swings as large as the full supply voltage can be controlled via each independent control input.

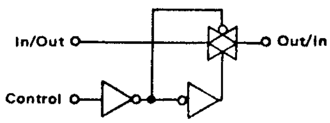
- High On/Off Output Voltage Ratio – 65 dB typical
- Quiescent Current = 0.5 nA/package typical @ 5 Vdc
- Low Crosstalk Between Switches –50 dB typical @ 8 MHz
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Transmits Frequencies Up to 65 MHz @ 10 Vdc
- Linearized Transfer Characteristics, ΔR_{ON} <60 Ω for $V_{in} = V_{DD}$ to V_{SS} (at 15V)
- Low Noise – 12 nV/$\sqrt{\text{Cycle}}$, f ≥ 1 kHz typical
- Pin-for-Pin Replacement for CD4016, CD4066, MC14016



L SUFFIX
CERAMIC PACKAGE
CASE 632



LOGIC DIAGRAM AND TRUTH TABLE
(1/4 OF DEVICE SHOWN)



Control	Switch
0	OFF
1	ON

Logic Diagram Restrictions
$V_{SS} \leq V_{in} \leq V_{DD}$
$V_{SS} \leq V_{out} \leq V_{DD}$

$V_{control}$	V_{in} to V_{out} Resistance
V_{SS}	$>10^9$ Ohms typ
V_{DD}	3×10^2 Ohms typ

CIRCUIT SCHEMATIC
(1/4 OF DEVICE SHOWN)

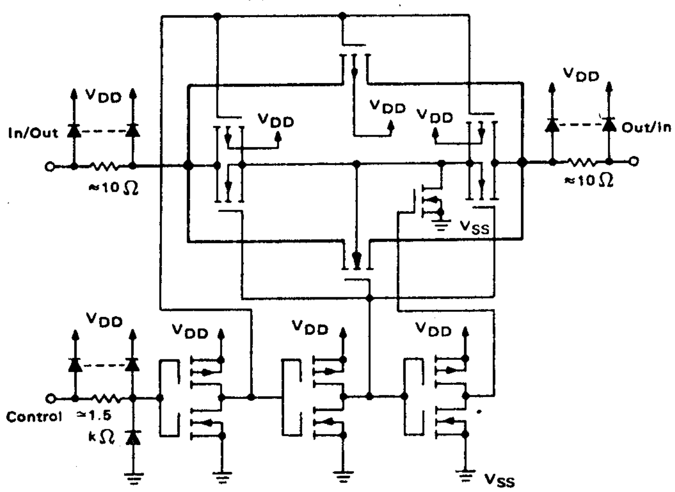
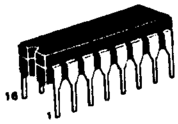


Figure 7-12 Integrated Circuit Elements

MC14518BCL

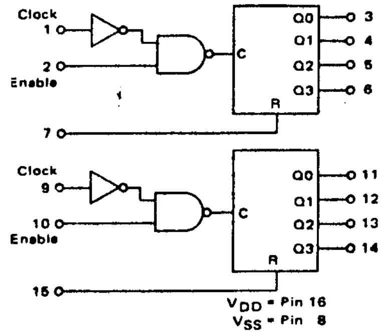
The MC14518B dual BCD counter and the MC14520B dual binary counter are constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. Each consists of two identical, independent, internally synchronous 4-stage counters. The counter stages are type D flip-flops, with interchangeable Clock and Enable lines for incrementing on either the positive-going or negative-going transition as required when cascading multiple stages. Each counter can be cleared by applying a high level on the Reset line. In addition, the MC14518B will count out of all undefined states within two clock periods. These complementary MOS up counters find primary use in multi-stage synchronous or ripple counting applications requiring low power dissipation and/or high noise immunity. Additional characteristics can be found on the Family Data Sheet.

- Quiescent Current = 5.0 nA/package typical @ 5 Vdc
- Noise Immunity = 45% of V_{DD} typical
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Low Input Capacitance = 5.0 pF typical
- Internally Synchronous for High Internal and External Speeds
- Logic Edge-Clocked Design – Incremented on Positive Transition of Clock or Negative Transition on Enable
- 6.0 MHz Counting Rate
- Capable of Driving Two Low-power TTL Loads, One Low-power Schottky TTL Load or Two HTL Loads Over the Rated Temperature Range



L SUFFIX
CERAMIC PACKAGE
CASE 620

BLOCK DIAGRAM



TRUTH TABLE

CLOCK	ENABLE	RESET	ACTION
_/‾	1	0	Increment Counter
0	‾_	0	Increment Counter
‾_	X	0	No Change
X	_/‾	0	No Change
_/‾	0	0	No Change
1	‾_	0	No Change
X	X	1	Q1 thru Q4 = 0

X = Don't Care

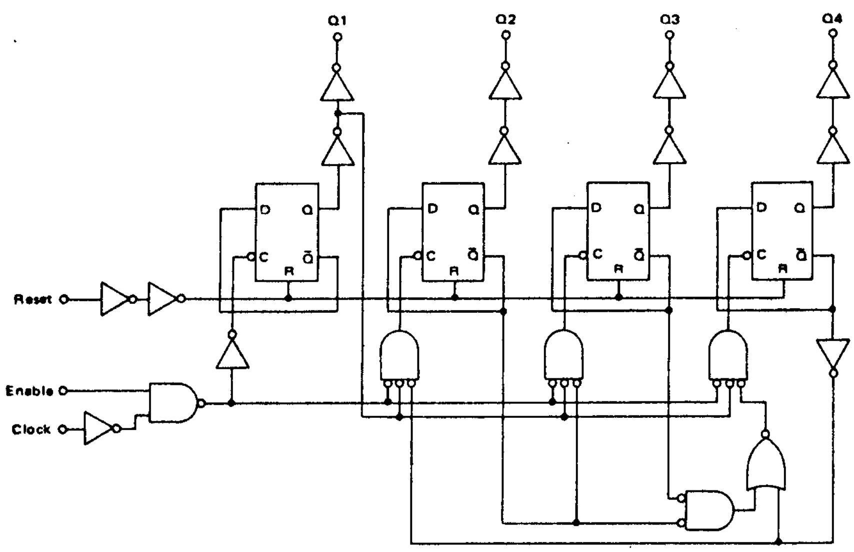


Figure 7-12 Integrated Circuit Elements

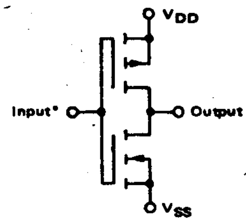
MC14069BCL

The MC14069B hex inverter is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. These inverters find primary use where low power dissipation and/or high noise immunity is desired. Each of the six inverters is a single stage to minimize propagation delays.

- **Quiescent Current = 0.5 nA typ/pkg @ 5 Vdc**
- **Noise Immunity = 45% of V_{DD} typ**
- **Supply Voltage Range = 3.0 Vdc to 18 Vdc**
- **Capable of Driving Two Low-Power TTL Loads, One Low-Power Schottky TTL Load or Two HTL Loads Over the Rated Temperature Range**
- **Double Diode Protection on All Inputs**
- **Pin-for-Pin Replacement for CD4069B**

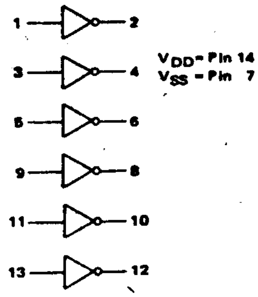
L SUFFIX
CERAMIC PACKAGE
CASE 632

CIRCUIT SCHEMATIC
(1/6 OF CIRCUIT SHOWN)



*Double diode protection on all inputs not shown.

LOGIC DIAGRAM

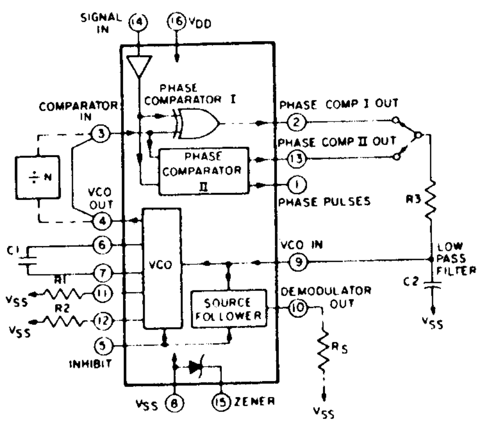


SCL4046B

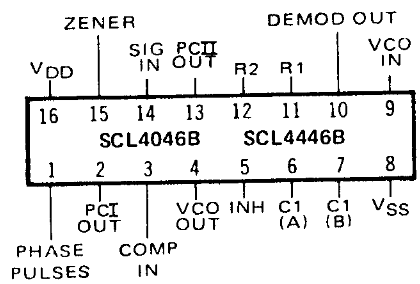
DESCRIPTION

The SCL4046B and SCL4446B phase-locked loops contain two phase comparators, a voltage-controlled oscillator (VCO), source follower, and zener diode. The comparators have two common inputs. The Signal input can be used directly coupled to large voltage signals, or indirectly coupled (with a series capacitor) to small voltage signals. The self-bias circuit adjusts small voltage signals in the linear region of the amplifier. Phase comparator I (an exclusive-OR gate) provides a digital error signal PCI_{out}, and maintains 90° phase shift at the center frequency between Signal and Comparator inputs (both at 50% duty cycle). Phase comparator II (with leading edge sensing logic) provides digital error signals $PCII_{out}$ and Phase Pulses, and maintains a 0° phase shift between input signals (duty cycle is immaterial). The linear VCO produces an output signal VCO_{out} whose frequency is determined by the voltage of input VCO_{in} and the capacitor and resistors connected to pins $C1_A$, $C1_B$, R1, and R2. The source follower output, Demod Out, with an external resistor is used where the VCO_{in} signal is needed but no loading can be tolerated. The inhibit input Inh, when high, disables the VCO and source follower to minimize standby power consumption. The zener diode can be used to assist in power supply regulation.

BLOCK DIAGRAM



CONNECTION DIAGRAM
(all packages)



Add suffix for package:

C	16-pin Cerdip
D	16-pin Ceramic
E	16-pin Epoxy
F	16-pin Flat
H	Chip

Figure 7-12 Integrated Circuit Elements

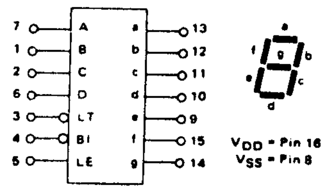
MC14511B BCD

The MC14511B BCD-to-seven segment latch/decoder/driver is constructed with complementary MOS (CMOS) enhancement mode devices and NPN bipolar output drivers in a single monolithic structure. The circuit provides the functions of a 4-bit storage latch, an 8421 BCD-to-seven segment decoder, and an output drive capability. Lamp test ($\overline{LT}$), blanking ($\overline{BI}$), and latch enable (LE) inputs are used to test the display, to turn-off or pulse modulate the brightness of the display, and to store a BCD code, respectively. It can be used with seven-segment light emitting diodes (LED), incandescent, fluorescent, gas discharge, or liquid crystal readouts either directly or indirectly.

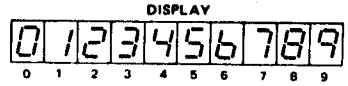
Applications include instrument (e.g., counter, DVM, etc.) display driver, computer/calculator display driver, cockpit display driver, and various clock, watch, and timer uses.

- Quiescent Current = 5.0 nA/package typical @ 5 Vdc
- Low Logic Circuit Power Dissipation
- High-Current Sourcing Outputs (Up to 25 mA)
- Latch Storage of Code
- Blanking Input
- Lamp Test Provision
- Readout Blanking on all Illegal Input Combinations
- Lamp Intensity Modulation Capability
- Time Share (Multiplexing) Facility
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Capable of Driving Two Low-power TTL Loads, One Low-power Schottky TTL Load or Two HTL Loads Over the Rated Temperature Range.

L SUFFIX
CERAMIC PACKAGE
CASE 620



DISPLAY



TRUTH TABLE

INPUTS							OUTPUTS							
LE	$\overline{BI}$	$\overline{LT}$	D	C	B	A	a	b	c	d	e	f	g	DISPLAY
X	X	0	X	X	X	X	1	1	1	1	1	1	1	8
X	0	1	X	X	X	X	0	0	0	0	0	0	0	Blank
0	1	1	0	0	0	0	1	1	1	1	1	1	0	0
0	1	1	0	0	0	1	0	1	1	0	0	0	0	1
0	1	1	0	0	1	0	1	1	0	1	1	0	1	2
0	1	1	0	0	1	1	1	1	1	1	0	0	1	3
0	1	1	0	1	0	0	0	1	1	0	0	1	1	4
0	1	1	0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	1	1	0	0	0	1	1	1	1	1	6
0	1	1	0	1	1	1	1	1	1	0	0	0	0	7
0	1	1	1	0	0	0	1	1	1	1	1	1	1	8
0	1	1	1	0	0	1	1	1	1	0	0	1	1	9
0	1	1	1	0	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	0	1	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	1	0	0	0	0	0	0	0	Blank
1	1	1	X	X	X	X	*							*

X = Don't Care

*Depends upon the BCD code previously applied when LE = 0

LOGIC DIAGRAM

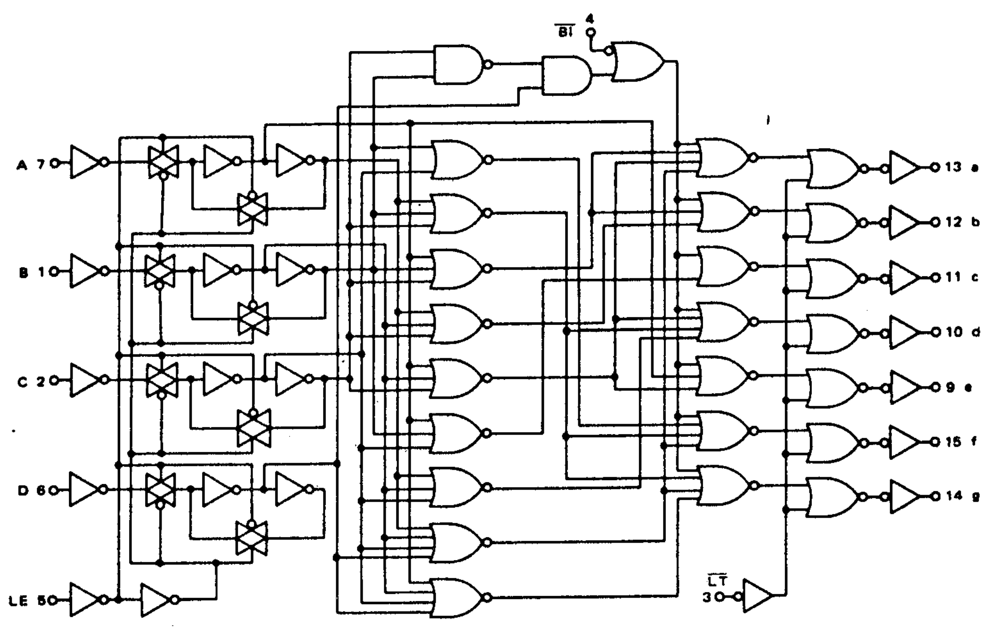
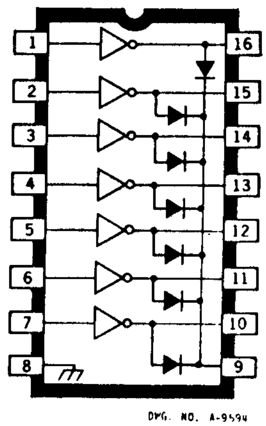


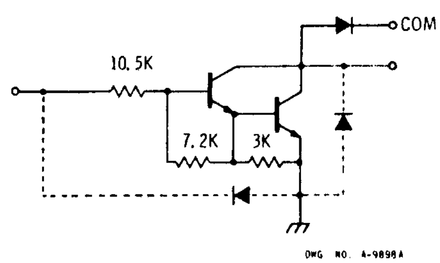
Figure 7-12 Integrated Circuit Elements

ULN2004A

THESE high-voltage, high-current Darlington transistor arrays are comprised of seven silicon NPN Darlington pairs on a common monolithic substrate. All units feature open collector outputs and integral suppression diodes for inductive loads. Peak inrush currents to 600 mA are allowable, making them ideal for driving tungsten filament lamps also.

The Type ULN-2004A has an appropriate series input resistor to allow its operation directly from CMOS or PMOS outputs utilizing supply voltages of 6 to 15 V. The required input current is below that of the Type ULN-2003A while the required input voltage is less than that required by the Type ULN-2002A.





TYPE ULN-2004A
(each driver)

Figure 7-12 Integrated Circuit Elements