2 Channel

INSTALLATION AND MAINTENANCE DATA

FOR YOUR

Draws over 2.5 amps DC

KAAR MODEL TR326

CLASS D CITIZEN'S RADIOTELEPHONE

1650KC
2 Channel
For 12 volt batteries

Manufactured by

KAAR ENGINEERING CORPORATION

Palo Alto, California, U.S.A.

WARNING: FCC RULES APPLY.- Use of the transmitter is governed by the rules and regulations of the Federal Communications Commission. Do not attempt to put the transmitter on the air at full power without a valid Class D citizens station/operating license. License applications are enclosed with the set for that purpose. If you wish to get on the air immediately, each transmitter in your system may be modified to qualify under Part 15 of the rules (Incidental and Restricted Radiation Devices). This modification can be performed by any person holding a first or second class commercial radio operator license. When modified, a certificate will be attached to each set to indicate compliance with the technical requirements of Part 15. DO NOT operate any transmitter without a license and without the certified modification. When so modified, the range will be reduced to at least one-fourth of the full power range. After receiving your Class D license, return the sets to the commercial operator, and he will restore them to full power output. While operating under Part 15, communications is not allowed with regular Class D stations (your operations should be confined to communication between two or more of your own modified units). After receiving your Class D license, you may contact units of other Class D licensees, but this should be done for justifiable business or personal reasons, not as an experiment (e.g. amateur radio operations, such as calling "CQ" and "working DX" are unlawful in the Class D citizens service). ALWAYS operate your station in accordance with the FCC rules; the terms of the license make this your responsibility.

INSTALLATION PROCEDURE.- The unit is pre-tuned at the factory and is ready to operate when ground, antenna, and power connections are made. The installation procedure differs for 117 volt a-c models and the d-c models. For 117 volt a-c models, proceed as follows: (1) Connect ground terminal to water pipe or other good ground. (2) Install antenna according to the instructions supplied with the antenna. In general, antenna should be located clear of building and as high as possible (within limits of lead-in supplied). Install connector supplied with set, if lead-in does not have a connector. (3) Plug in antenna and a-c power cord, and proceed with initial tuneup. For 6 and 12 volt d-c models, proceed as follows: (1) Locate mounting hood under dash or other convenient location (note that leads supplied with set may have to be lengthened if set is mounted elsewhere). (2) Connect ground wire (the wire with the black sleeve) to chassis ground on back of set, and the other end to a cleaned metal spot on vehicle chassis. Bolt securely. (3) Install antenna as directed in instruction sheet supplied with antenna. (4) Run d-c supply lead to ignition switch or accessory binding post in vehicle. For normal installations, this should be a post which is switched on and off by the ignition key. (5) Hang set on bracket and fasten in place. Insert antenna and power cord plug, and proceed with initial tuneup.

INITIAL TUNEUP.- To place set in operation, rotate volume control clockwise and set the channel switch in position "A". After set warms up, rotate both squelch and volume controls until noise or signals are heard. Set squelch control as follows: rotate control while there are no signals on the air, until the noise stops. Advance control slightly beyond the point where the noise drops out; at this point, any signal, even very weak ones, will cause the sound to come back on again. Key transmitter by pressing microphone button. Turn the power tuning control to the point where the meter reads maximum (for most sets, this will be between 4 and 6 on the scale. Give call sign and observe other operating procedures which are required by the FCC rules.

TUNEUP ON OTHER CHANNELS.-The factory supplies a pair of crystals installed in the Channel "A" position. The unit may, however, be operated on any one or two of the 23 channels available on the Class D Citizen's band. The channel numbers and frequencies available are as follows:

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
1	26.965	9	27.065	17	27.165
2	26.975	10	27.075	18	27.175
3	26.985	11	27.085	19	27.185
4	27.005	12	27.105	20	27.205
5	27.015	13	27.115	21	27.215
6	27.025	14	27.125	22	27.225
7	27.035	15	27.135	23	27.255
8	27.055	16	27.155		

To set up a second channel, order a pair of crystals from your dealer, and have him, or any authorized service technician, install them in your set. If desired, another pair of crystals may also be substituted for the factory supplied crystals in the Channel "A" position. For tuneup, use the initial tuneup procedure described above for the first channel, then switch to the second channel. If the meter reading changes, retune the POWER TUNING control for maximum each time when switching from one channel to the other.

INTERNAL ADJUSTMENTS.- The equipment is factory tuned so that internal adjustments will seldom be needed at time of installation. This is to permit the station licensee (Class D Citizen's) to perform installation and initial tuneup, as given on this sheet. If the transmitter operating frequency is to be changed (new crystals in sockets "A" and/or "B"), the necessary crystals should be installed by a properly licensed technician (see the FCC rules). No internal adjustments are needed when this is done, due to the broad tuning characteristics of all internal adjustments. While performing this service, however, the service technician may elect to retune both transmitter and receiver to the specific operating frequencies. In some cases he may obtain a slight improvement in performance. The internal adjustments are covered in the paragraph on service tuneup.

HOW TO ASSEMBLE ANTENNA CONNECTOR to a coaxial lead-in cable: (1) Remove outer sheath to point A (do not cut into braid). (2) Unravel braid and form into two opposite wires as shown. (3) Strip off installation to B (do not nick inner conductor). (4) Assemble with center wire projecting through hole in tip of connector. Solder wire to tip and trim off excess wire. (5) Solder braid to shell, two places as shown.

PARTS LIST.- Use standard replacement parts equivalent to those listed below. The manufacturer and the manufacturer's part number is given in parentheses after the description. If part is special (made to a Kaar specification), the part number is the Kaar specification number; it may be ordered from Kaar Engineering stock or directly from the original manufacturer. Common replacement capacitors and resistors are grouped and described at the beginning of the C or R listing, as applicable.

ITEM	DESCRIPTION
C--	Capacitor, mica: The following are std 500 volt micas, (El Menco VDM-15 or equal), of capacitance on schematic, tolerance ±5%.
C3, C5, C6, C15, C17, C22, C34, C51, C56, C57, C64, C66, C67, C68	
C--	Capacitor, ceramic disc: The following are std 500 volt ceramic disc type, (Allen Bradley 36-103W or equal), of capacitance on schematic, tolerance +80% -20%.
C8, C18, C19, C21, C23, C24, C25 C26, C27, C29, C30, C31, C32, C33, C36, C39, C42, C44, C52, C54, C59, C63	
C--	Capacitor, ceramic, tubular: The following are temperature compensating tubular ceramics Char. NO80, 500 vdcw (Erie 331 or equal), of capacitance given on the schematic, tolerance ±5%.
C1, C2, C4, C12, C14, C16, C20 C35, C53, C55, C60	
C7 C9 C10	Capacitor, ceramic disc: .002µf ±10%, 1000 vdcw. (RMC-B2000)
C11	Capacitor, air variable: 3.0 - 14.2µµf, .020" space, single hole mtg type O. (ASP-JAN CT2 Code 14-L CT20014)
C13	Capacitor, mica trimmer: 110-580µµf, 7 plates; 350 vdct, 175 vdcw. (El Menco-467)
C28 C37	Capacitor, molded tubular: 0.1µf ±20%, 200 vdcw. (El Menco-467)
C38	Capacitor, ceramic disc: .05µf +80 -20%, 100 vdcw (RMC-BT-.05-3/4")
C40 C41	Capacitor, ceramic feed-thru: .001µf, 500 vdcw. (El Menco-C52421-1)
C43	Capacitor, molded tubular paper: .068µf ±20%, 600 vdcw. (Sprague-109P68306)
C45 C46	Capacitor, dual electrolytic: 80 - 80µf, 200 - 200 vdcw. (CD-UP-E9C173)
C47 C48	Capacitor, dual electrolytic: 30 - 30µf, 350 - 350 vdcw. (CD-UP-3335)
C49	Capacitor, ceramic disc: .005µf +100% -0%, 1000 vdcw. (RMC-B5000)
C50	Capacitor, electrolytic tubular: 50µf, 25 vdcw. (CD-BBR50-25T)
C58	Capactior, electrolytic tubular: 5µf, 25 vdcw. (Sprague TE-1303)
C61 C62	Same as C7
C65	Same as C38
C69	Same as C40
F1	Fuse, glass tube: 1/4" x 1-1/4", Rating 6 amperes in 12 volt model, rating 10 amperes in 6 volt model (Buss-AGC)
F2	Fuse, glass tube: 1/4" x 1-1/4", Rating 1 ampere (Buss AGC)
K1	Relay, 3PDT, 100 vdc coil, 10K ohm (Potter-B KA14D)
L1	Inductor, r-f choke: 4.7µh ±10%, 250 ma. (Wilco-213-115)
L2	Inductor, slug tuned: .7-1.4µh. (Miller-Kaar 2213)
L3	Same as L1
L4	Inductor, r-f: 5/8" dia 16

ITEM	DESCRIPTION
	turns/in soldereaz #20 approx 1" lg; approx 1.4μh (Illumitronics Kaar 2213)
L5	Inductor, r-f choke: 0.47μh ±15%, 250 ma. (Wilco - 201-115)
L6	Same as L2
L7	Same as L2. NOTE: This may be same as L10 in some units; (a choke instead of a coil); in such cases, C53 is not used.
L8	Same as L1
L9	Inductor, hash choke: 25μh (Fast-A5495)
L10	Inductor, r-f choke: 2.7μh ±10%, 250 ma. (Wilco - 210-113)
L11	Same as L10
L12	Inductor, r-f choke: 2.5 mh ±10%, 100 ma (West. Coil - 2111)
M1	Meter: 0-1 ma d-c with special scale per Kaar drawing 6119. (Kyoritsu MR-2P)
R--	Standard 1/2 watt resistors: All resistors NOT listed below are standard 1/2 watt composition resistors, Allen Bradley Style EB or equal, of the resistance value given on the schematic, tolerance ±10%.
R7	Resistor, variable wire wound "humdinger": 3K ohms total, 2 watts (Clarostat 39-3000)
R12	Resistor, fixed comp.: 68K ±10%, 1 watt (AB - GB)
R24	Resistor, variable comp.: 10K ohms ±10% total, linear taper, 1/4 watt; bushing 3/8" shaft 3/4" lg, slotted. (CRL Kaar 5001)
R30	Resistor, fixed comp.: 15 ohms ±10%, 2 watt. (AB-HB)
R33 R34	Resistor, fixed wire wound: 200 ohms ±10%, 4 watt. (IRC - PW4)

ITEM	DESCRIPTION
R36	Resistor, variable comp.: 50K ohm ±10%, linear taper, 1/4 watt; bushing 3/8", shaft 1/2" lg, slotted. (CRL - Kaar 5010)
R40	Resistor, fixed comp.: 10K ohm ±10%, 2 watt (AB - HB)
R44	Resistor, fixed comp.: 470 ohm ±10%, 1 watt (AB - GB)
R49	Resistor, variable comp.: 250K ohm ±20%, 1/4 watt, C taper (audio); bushing 3/8", shaft 3/4" lg, slotted; with DPST switch rated 3A125 vac and 10A24 vdc. (CRL-Kaar 5003)
R61	Resistor, fixed comp.: 22K ohm ±10%, 2 watt. (AB - HB)
S1	Part of R49
T1	Transformer, audio freq. output: 5500 to 3.2 ohm. (Excel - Kaar 1030)
T2	In 12 vdc model: Transformer, vibrator power: pri 12 vidc, sec rated 250 vdc/0.1A voltage dblr; pri 124T #19E, sec 730T #29E (Excel - Kaar 1188) In 6 vdc model: Transformer, vibrator power; pri 6 vidc, sec rated 250 vdc/0.1A voltage dblr; pri 52T #16E, sec 730T #29E (Excel - Kaar 1191)
T3	Transformer, power, step-up and step down: pri 117 vac, sec #1 117 vac/0.2A, sec #2 12.6 vac/2A. Pri 540T #25E, sec #1 540T #29, sec #2 66T #19E. (Excel - Kaar 1189)
V--	Ten tubes, types as given on schematic and tube location diagram (RCA)
Z1	Transformer, r-f input: consists of one inductor, same as L2, overwound with 3 turns #20 wire.
Z2 Z3 Z4	Transformer, i-f: 1.5 mc. (Automatic - M1-898K)

Vibrator is Mallory #1501 6volt "A" base with external dropping resister.

DESCRIPTION, POWER SUPPLY and CONTROL CIRCUITS.- The power supply may be any one of three circuits, according to input voltage. For 117 volt a-c input, the line voltage is stepped up by one winding of power transformer T3 for application of high voltage a-c to the rectifier and d-c filter, and is stepped down by another winding to supply heater voltage to all tubes. For 12 volt d-c input, vibrator VIB-1 acts as a chopper to supply interrupted d-c to the vibrator transformer T2. For 6 volt d-c input, minor changes are made in the same circuit, such as removing the vibrator dropping resistor (which reduces the voltage to the coil from 12 volts to 6 volts), and adding more hash filters, plus replacing the vibrator transformer with one having a primary wound for 6 volts interrupted d-c. In every case, high voltage is applied to points A-A, the input to the rectifier-filter system which is common to all power supplies. CR1 and CR2, together with C45 and C46, form a voltage doubler which delivers pulsating d-c to the filter R33 and C47. C48 is in parallel with C47 in the d-c model, but is separated by an added resistor R34 in the 117 volt a-c model (giving more effective filtering). The d-c output is applied directly to the audio driver and output stages V7 and V10, and to K1, the coil of the keying relay. The coil of the keying relay is actuated by grounding the low end through the microphone button. When receiving, the microphone button is up, and the back contacts of K1 energize the receiver as follows: K1A connects the antenna to the receiver, K1B applies B+ to all stages of the receiver except the audio driver and audio output stages (V7B and V10), and K1C grounds the speaker to place it in operation. The audio driver and output stages are supplied with d-c continuously, because these two stages are used for both transmitting and receiving. When the microphone button is pressed, K1 closes, the contacts place the transmitter on the air as follows: K1A transfers the antenna to the transmitter output, K1B applies B+ to the transmitter oscillator, V1A, and K1C grounds the cathodes of both the oscillator and the power amplifier, to place transmitter carrier on the air.

CIRCUIT DESCRIPTION, RECEIVER.- The receiver is a fixed-tuned superheterodyne with squelch, automatic noise limiting, and noise controlled avc circuits, all included to give superior reception properties. The incoming signal is amplified by V3, the r-f amplifier, and applied to the mixer grid (V4A). A signal 1650 kc higher than the channel frequency is coupled to the grid from the oscillator section V4B, an independent triode in the same envelope. The oscillator is a Colpitts circuit, with frequency doubling in the plate circuit. The mixer grid is avc controlled through V8B, the mixer avc gate diode. This diode conducts for avc voltage, but prevents the oscillator injection voltage from feeding back into the avc bus. The i-f is amplified by two conventional i-f stages V5 and V6, which differ only in that the gain of V5 is avc controlled, and the gain of V6 is fixed by the cathode resistor R18. The detector, V9A, supplies audio to the audio driver V7B through a series-gate noise limiter circuit. This consists of the gating diode V9C, capacitors C65 and C68, and resistors R55, R56, R58, and R59. Due to the r-c time constants, V9C is biased to conduct (and pass audio signals) for normal voice signals, but stops conducting for high amplitude noise pulses of short duration. The second detector also supplies avc voltage, a noise controlling voltage to modify the avc voltage, and squelch voltage. The avc system consists of R20 and C28, a conventional r-c filter, with carrier signal taken from the secondary of Z4. Another r-c filter from this point (C67-R57) responds to short duration noise pulses only; these are passed through C66 to drive the noise amplifier V1B. The amplified noise is then rectified by V8C and applied as a positive bias to

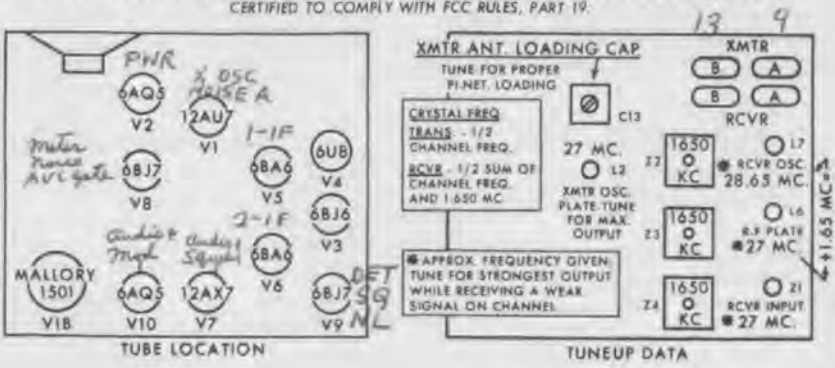
the avc bus. This arrangement keeps the receiver gain high in the presence of noise, thus making it possible to receive weak messages through noise. Without this arrangement, such weak messages would otherwise be lost. The squelch system disables the audio driver V7B whenever the received carrier amplitude is less than a given value, as determined by the setting of the squelch control V7A. The squelch rectifier tube V9B rectifies carrier to develop a negative voltage which opposes the positive voltage from the squelch control R24. For normal reception, the total voltage is negative to ground by an amount great enough to keep the squelch control tube V7A from conducting. The audio driver tube V7B now acts as a regular Class A r-c coupled amplifier, with bias due to contact potential current through R47. When the receiver signal is removed, or the level drops below the value selected for squelching, the bias for V7A goes more positive, and V7A conducts. The plate current of V7A flows through R46 and R27 to B+; the resulting voltage drop across R46 biases V7B beyond cut-off, and the audio is removed (squelched). The noise amplifier-rectifier system V1B-V8C) adds a positive bias to the grid of V7A (through resistor R22) during squelched conditions, causing the squelch to hold steadily under noisy conditions. The audio output stage is a conventional Class A audio power amplifier with transformer coupling to the four ohm speaker. For receiving, the signal level meter is connected into a bridge circuit. One side of the bridge consists of R37, R36, and R35. The other side consists of resistors R16-17 to B+ and the effective cathode-to-screen resistance of V5 and R15 to ground. The METER ZERO control is set to zero reading with no signal; with signal, the effective cathode-screen resistance changes directly as the avc voltage varies. This unbalances the bridge to give a reading which varies approximately as the signal strength varies.

CIRCUIT DESCRIPTION, TRANSMITTER.- The transmitter is a master oscillator-power amplifier circuit with crystal control of the operating frequency. The oscillator stage uses one triode section of a 12AU7 in a Colpitts circuit. The oscillator plate tank (L2-C4) is tuned to the channel frequency, while the grid circuit operates at one-half the channel frequency. The r-f developed across the plate tank drives the grid of the power amplifier tube (V2) a Type 6AQ5. The plate of V2 is tuned to the channel frequency by a pi-section network consisting of L4, antenna loading capacitor C13, and the power tuning capacitor C11. The power amplifier operates Class C, with grid bridge neutralization (Rice system). Capacitor C12 is the neutralizing capacitor. L5 and C15, together with a portion of the loading capacitance (C13), act as a second pi-network which is fixed-tuned to reduce possible radiation of harmonic frequencies above the highest channel. The output from the second filter is fed to the antenna through one set of contacts of the antenna transfer relay K1A. The meter rectifier tube rectifies a small portion of the r-f voltage developed across the output loading capacitor, and the signal level meter reads the rectified voltage. The modulating signal for the transmitter is obtained through V7B and V10. These stages serve as the audio driver and the modulator stages, respectively, while transmitting. The audio from the microphone is fed through the "cold" end of the volume control, amplified by V7B, a conventional Class A resistance coupled audio voltage amplifier, and again by V10, a conventional Class A audio power amplifier. Since the speaker is disconnected while transmitting, due to K1C, the primary of T1 acts as a choke across which the audio modulating voltage is developed. This in turn modulates the plate and screen voltage of the r-f power amplifier stage in what is commonly referred to as a "choke coupled" or "Heising" modulation system.

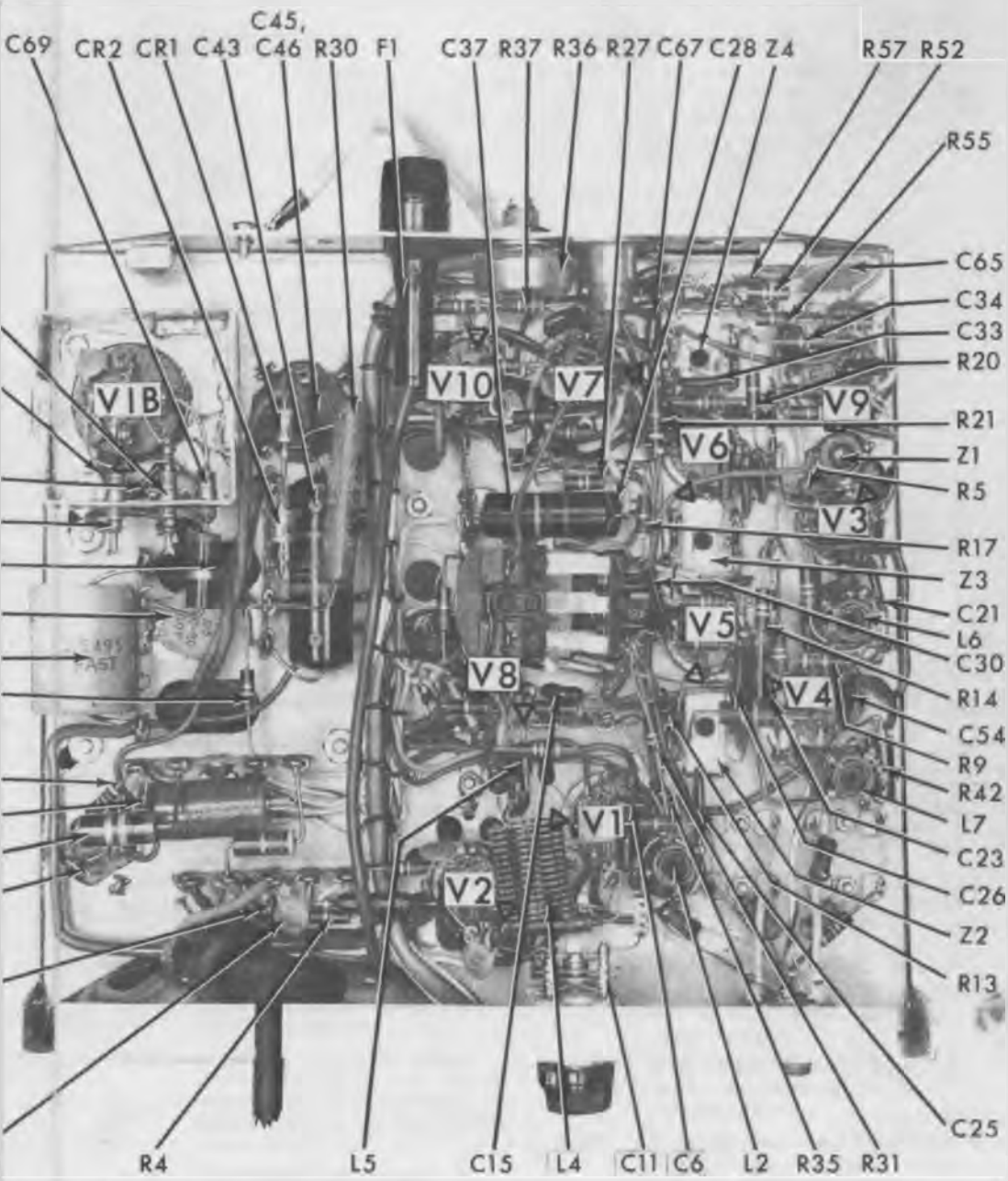
CLASS D CITIZENS RADIOTELEPHONE **KAAR MODEL TR326**

MFD BY KAAR ENGINEERING CORP., 2995 MIDDLEFIELD RD. PALO ALTO, CALIF., U.S.A.

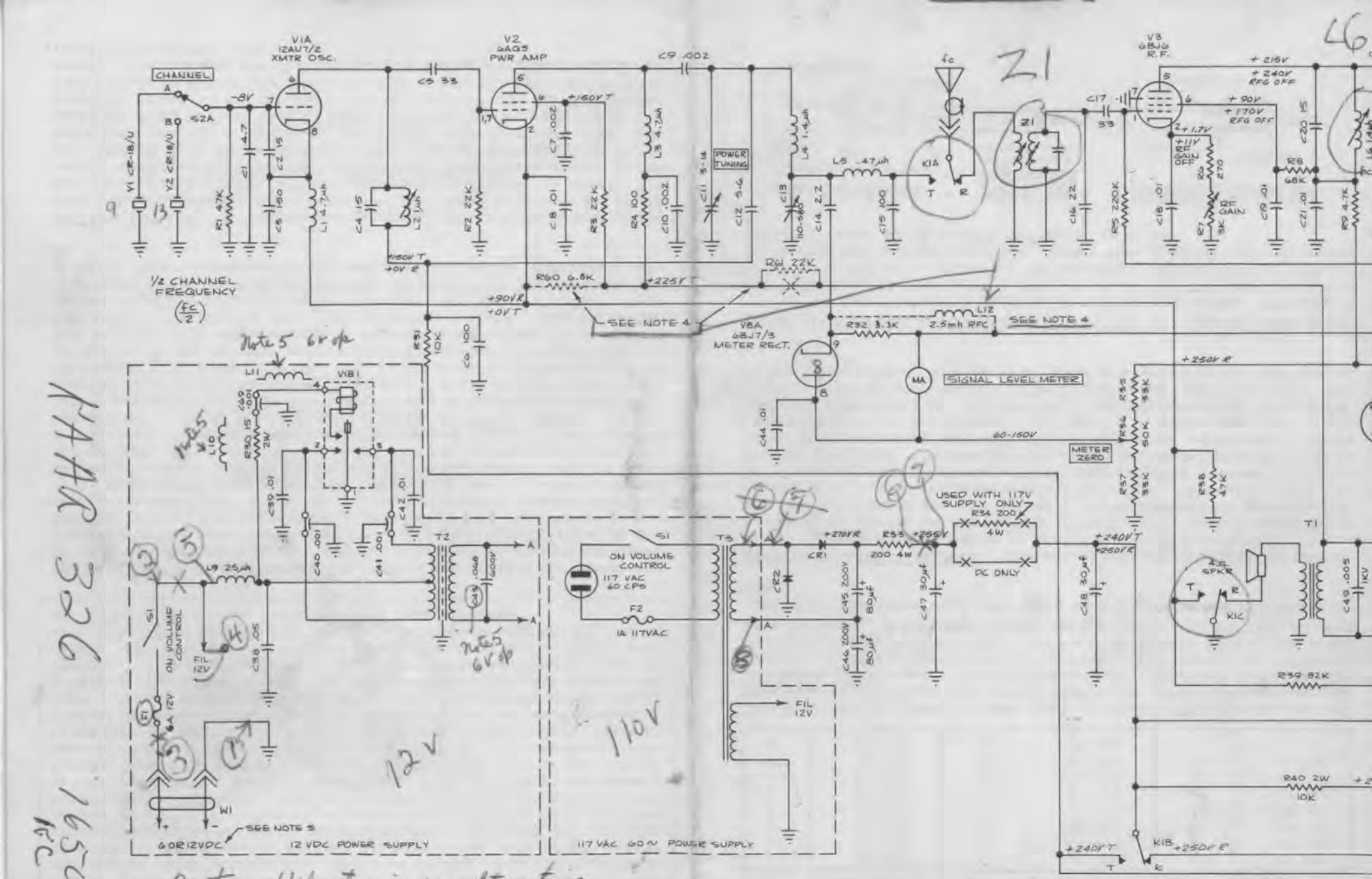
CERTIFIED TO COMPLY WITH FCC RULES, PART 19.



SERVICE TUNEUP.- The unit normally comes factory tuned to one of the channels in the middle of the band (see paragraph on internal adjustments). Re-tuning to specific operating frequencies may improve performance in some cases, particularly if two widely separated frequencies are used, or if both channels are at one end of the band. In the case of two widely separated channels, a compromise setting may be required for the circuits which are tuned to the channel frequencies. To make a compromise setting, find point of maximum response for each tuned circuit, first with the channel switch in the "A" position, then in the "B" position, and leave the control in a compromise position between them. The transmitter tuneup procedure is as follows: (1) Tune L2 for maximum output. (2) Tune POWER TUNING control for maximum meter reading. (3) With service voltmeter, read voltage at plate of V2 and the voltage developed across resistor R4. Calculate the plate current flow through R4, then calculate the plate power input (P equals EI). If plate power input is five watts or 100 milliwatts (whichever limit applies to set being tuned), no further internal adjustments are needed in transmitter section. (4) If power input must be changed, reset C13 by rotating clockwise or counterclockwise by a small amount, then repeat steps (1), (2), and (3). If power input is not correct, again reset C13 and repeat these steps until the correct reading is obtained. For receiver tuneup, a simple peaking adjustment of the antenna, r-f, and oscillator tuned circuits will usually be all that is necessary. To do this, use the signal level meter to tune L7, L6, and Z1 for maximum while receiving a weak signal. The receiver i-f transformers should be left alone unless there is definite evidence that tuning is needed. If this is the case, apply a 1650 kc signal to the mixer grid and tune for maximum meter reading, as in conventional receiver alignment technique. The frequency should be exactly 1650 kc, however, to avoid possible loss of some stations which may be operating near the limits of channel frequency tolerance. To confirm accuracy of signal generator calibration at 1650 kc, use local broadcast stations to establish check points.



Above: Bottom view, D Phone, 12 volt model. - Refer first to schematic diagram; if part in question is connected directly to a tube socket terminal, it is not identified on the photograph. Diamond over tube socket indicates location of the number one pin.



* Note - Vibrator in 12 volt set is Mallory #1501 6 volt vibrator "A" base with external dropping resistor

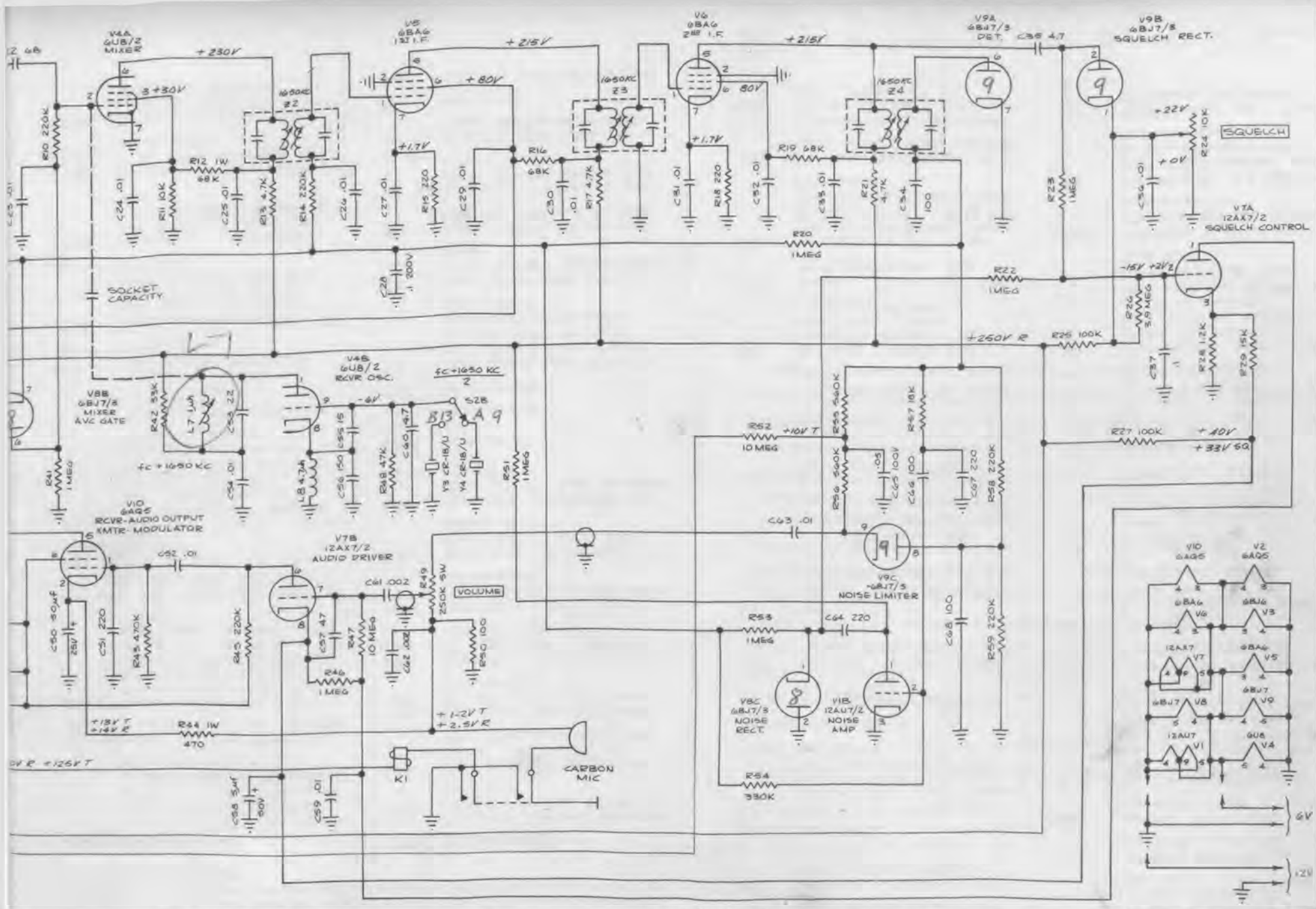
NOTE 1 CAPACITANCE VALUES ONE AND OVER IN μμf, LESS THAN ONE IN μf, AND 500V UNLESS OTHERWISE INDICATED

NOTE 2 RESISTANCE VALUES IN OHMS, AND 1/2 WATT UNLESS OTHERWISE INDICATED

NOTE 3 TYPICAL VOLTAGES ARE INDICATED UNDER NORMAL OPERATING CONDITIONS (RECEIVE 'R' OR TRANSMIT

NOTE 4 R60 & R61 ARE COMPONENTS ADDED TO DECREASE TRANSMITTER POWER INPUT FROM 5 WATTS TO 100 ... UNIT UNDER FCC RULES PART 15. L12 MAY ALSO BE ADDED TO INCREASE METER SENSITIVITY (FOR 100

100 MW



Volt op 2

1. MEASUREMENTS MADE WITH 11 MEGOHM VTVM.

LLIWATTS, FOR LICENSING AS A LIMITED POWER W USE ONLY)

NOTE 5 SCHEMATIC SHOWS 12 VOLT VIBRATOR POWER SUPPLY CIRCUIT. 6 VOLT MODEL USES SAME CIRCUIT EXCEPT AS FOLLOWS: (A) L10 REPLACES R30, (B) L11 IS INSERTED BETWEEN C69 AND V181, (C) C43 VALUE IS 0.1μf AT 600V, (D) F1 VALUE IS 10A.

SCHEMATIC DIAGRAM

KAAR MODEL TR326

CLASS D CITIZEN'S RADIOTELEPHONE

PURPOSE OF THIS SHEET.- This sheet provides useful information on installation and maintenance of your "D" Phone. The installation and initial tuneup may be performed by the station licensee; the instructions on this side of the sheet are for that purpose. The other side of the sheet contains details on more technical matters, such as diagrams, circuit explanation, parts location diagrams, and technician's service adjustment procedures. The remaining space contains the parts list and miscellaneous data which will be needed for long term operation of your "D" Phone. This sheet should be kept with the equipment, and should go with it if the unit is sent to any electronics technician for installation of crystals, internal tuning adjustments, or other maintenance. Supplementary information on separate sheets may be included with the set; this may include literature on antennas, licensing data, information on noise reduction techniques for vehicles, and data on other Kaar equipment which is currently available for meeting special needs in communications work.

INSTALLATION AND MAINTENANCE DATA

FOR YOUR

Draws over 2 1/2 Amp at 12 V D.C.

KAAR MODEL TR326A

CLASS D CITIZEN'S RADIOTELEPHONE

455 KC
4 Channel

Manufactured by

KAAR ENGINEERING CORPORATION

Palo Alto, California, U.S.A.

WARNING: FCC RULES APPLY.- Use of the transmitter is governed by the rules and regulations of the Federal Communications Commission. Do not attempt to put the transmitter on the air at full power without a valid Class D citizens station/operating license. License applications are enclosed with the set for that purpose. If you wish to get on the air immediately, each transmitter in your system may be modified to qualify under Part 15 of the rules (Incidental and Restricted Radiation Devices). This modification can be performed by any person holding a first or second class commercial radio operator license. When modified, a certificate will be attached to each set to indicate compliance with the technical requirements of Part 15. DO NOT operate any transmitter without a license and without the certified modification. When so modified, the range will be reduced to at least one-fourth of the full power range. After receiving your Class D license, return the sets to the commercial operator, and he will restore them to full power output. While operating under Part 15, communications is not allowed with regular Class D stations (your operations should be confined to communication between two or more of your own modified units). After receiving your Class D license, you may contact units of other Class D licensees, but this should be done for justifiable business or personal reasons, not as an experiment (e.g. amateur radio operations, such as calling "CQ" and "working DX" are unlawful in the Class D citizens service). ALWAYS operate your station in accordance with the FCC rules; the terms of the license make this your responsibility.

INTERNAL ADJUSTMENTS.- The equipment is factory tuned so that the station licensee may perform installation and initial tuneup without technical supervision. When so installed, the set will usually perform satisfactorily without further adjustments. It is strongly recommended, however, that a qualified service technician be called in to check the installation and to perform internal tuning adjustments as described on the other side of this sheet. This will also be a good time to activate the set on other citizen's band channels, as described in the paragraph to follow.

TUNEUP ON OTHER CHANNELS.- The Class D citizens band is divided into 23 channels, as follows:

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
1	26.965	9	27.065	17	27.165
2	26.975	10	27.075	18	27.175
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4	27.005	12	27.105	20	27.205
5	27.015	13	27.115	21	27.215
6	27.025	14	27.125	22	27.225
7	27.035	15	27.135	23	27.255
8	27.055	16	27.155		

The "D" Phone is normally shipped with one set of crystals, unless the factory order calls for additional crystals. These crystals are usually installed in the set so that it will operate with the channel selector switch in the position marked "1", and additional pairs of crystals, if ordered, are installed in the number "2", then "3" and "4" positions. The set will operate only on the channel (or channels) for which crystals are supplied.

To set up additional channels after installation, or to change channels, arrange with a qualified service technician to install the necessary crystals. When he installs the crystals, he will also check frequency and loading, and will make appropriate internal adjustments as needed.

INSTALLATION PROCEDURE.- The unit is pre-tuned at the factory and is ready to operate when ground, antenna, and power connections are made. The installation procedure differs for 117 volt a-c models and the d-c models. For 117 volt a-c models, proceed as follows: (1) Connect ground terminal to water pipe or other good ground. (2) Install antenna according to the instructions supplied with the antenna. In general, antenna should be located clear of building and as high as possible (within limits of lead-in supplied). Install connector supplied with set, if lead-in does not have a connector. (3) Plug in antenna and a-c power cord, and set is ready for operation. For 6 and 12 volt d-c models, proceed as follows: (1) Locate mounting hood under dash or other convenient location (note that leads supplied with set may have to be lengthened if set is mounted elsewhere). (2) Connect ground wire (the wire with the black sleeve) to chassis ground on back of set, and the other end to a cleaned metal spot on vehicle chassis. Bolt securely. (3) Install antenna as directed in instruction sheet supplied with antenna. (4) Run d-c supply lead to ignition switch or accessory binding post in vehicle. For normal installations, this should be a post which is switched on and off by the ignition key. (5) Hang set on bracket and fasten in place. Insert antenna and power cord plug, and set is ready for operation.

HOW TO ASSEMBLE ANTENNA CONNECTOR to a coaxial lead-in cable: (1) Remove outer sheath to point A (do not cut into braid). (2) Unravel braid and form into two opposite wires as shown. (3) Strip off installation to B (do not nick inner conductor). (4) Assemble with center wire projecting through hole in tip of connector. Solder wire to tip and trim off excess wire. (5) Solder braid to shell, two places as shown.

OPERATING PROCEDURE.- To place set in operation, rotate volume control clockwise and set the channel switch in position 1 (or other channel known to be ready for operation). After the set warms up, rotate both squelch and volume controls until noise or signals are heard. Set squelch control as follows: rotate control while there are no signals on the air, until the noise stops. Advance control slightly beyond the point where the noise drops out; at this point, any signals, even weak ones, will cause the sound to come back on again. Key transmitter by pressing microphone button. Turn the power tuning control to the point where the meter reads maximum (for most sets, this will be between 4 and 6 on the scale). Give call sign and observe other operating procedures which are required by the FCC rules. Follow the same procedure when selecting another channel - e.g. the squelch, volume, and power tuning controls will have to be re-set after switching from one channel to another.

PARTS LIST.- Use standard replacement parts equivalent to those listed below. The manufacturer and the manufacturer's part number is given in parentheses after the description. If part is special (made to a Kaar specification), the part number is the Kaar specification number; it may be ordered from Kaar Engineering stock or directly from the original manufacturer. Common replacement capacitors and resistors are grouped and described at the beginning of the C or R listing, as applicable.

ITEM	DESCRIPTION
C--	Capacitor, mica: The following are std 500 volt micas, (El Menco VDM-15 or equal), of capacitance on schematic, tolerance ±5%.
C3, C5, C6, C15, C17, C22, C34, C51, C56, C57, C64, C66, C67, C68	
C--	Capacitor, ceramic disc: The following are std 500 volt ceramic disc type, (Allen Bradley 36-103W or equal), of capacitance on schematic, tolerance +80% -20%.
C8, C19, C21, C23, C24, C25 C26, C27, C29, C30, C31, C32, C33, C36, C39, C42, C44, C52, C54, C59, C63	
C--	Capacitor, ceramic, tubular: The following are temperature compensating tubular ceramics Char. NO80, 500 vdcw (Erie 331 or equal), of capacitance given on the schematic, tolerance ±5%.
C1, C2, C4, C12, C14, C16, C20 C35, C53, C55, C60	
C7 C9 C10	Capacitor, ceramic disc: .002µf ±10%, 1000 vdcw. (RMC-B2000)
C11	Capacitor, air variable: 3.0 - 14.2µµf, .020" space, single hole mtg type O. (ASP-JAN CT2 Code 14-L CT20014)
C13	Capacitor, mica trimmer: 110-580µµf, 7 plates; 350 vdct, 175 vdcw. (El Menco-467)
C28 C37	Capacitor, molded tubular: 0.1µf ±20%, 200 vdcw. (El Menco-467)
C38	Capacitor, ceramic disc: .05µf +80 -20%, 100 vdcw (RMC-BT-.05-3/4")
C40 C41	Capacitor, ceramic feed-thru: .001µf, 500 vdcw. (El Menco-C52421-1)
C43	Capacitor, molded tubular paper: .068µf ±20%, 600 vdcw. (Sprague-109P68306)
C45 C46	Capacitor, dual electrolytic: 80 - 80µf, 200 - 200 vdcw. (CD-UP-E9C173)
C47 C48	Capacitor, dual electrolytic: 30 - 30µf, 350 - 350 vdcw. (CD-UP-3335)
C49	Capacitor, ceramic disc: .005µf +100% -0%, 1000 vdcw. (RMC-B5000)
C50	Capacitor, electrolytic tubular: 50µf, 25 vdcw. (CD-BBR50-25T)
C58	Capactior, electrolytic tubular: 5µf, 25 vdcw. (Sprague TE-1303)
C61 C62	Same as C7
C65	Same as C38
C69	Same as C40
F1	Fuse, glass tube: 1/4" x 1-1/4". Rating 6 amperes in 12 volt model, rating 10 amperes in 6 volt model (Buss-AGC)
F2	Fuse, glass tube: 1/4" x 1-1/4". Rating 1 ampere (Buss AGC)
K1	Relay, 3PDT, 100 vdc coil, 10K ohm (Potter-B KA14D)
L1	Inductor, r-f choke: 4.7µh ±10%, 250 ma. (Wilco-213-115)
L2	Inductor, slug tuned: .7-1.4µh. (Miller-Kaar 2213)
L3	Same as L1
L4	Inductor, r-f: 5/8" dia 16

ITEM	DESCRIPTION
	turns/in soldereaz #20 approx 1" lg; approx 1.4μh (Illumitronics Kaar 2213)
L5	Inductor, r-f choke: 0.47μh ±15%, 250 ma. (Wilco - 201-115)
L6	Same as L2
L7	Same as L2. NOTE: This may be same as L10 in some units; (a choke instead of a coil); in such cases, C53 is not used.
L8	Same as L1
L9	Inductor, hash choke: 25μh (Fast-A5495)
L10	Inductor, r-f choke: 2.7μh ±10%, 250 ma. (Wilco - 210-113)
L11	Same as L10
L12	Inductor, r-f choke: 2.5 mh ±10%, 100 ma (West. Coil - 2111)
M1	Meter: 0-1 ma d-c with special scale per Kaar drawing 6119. (Kyoritsu MR-2P)
R--	Standard 1/2 watt resistors: All resistors NOT listed below are standard 1/2 watt composition resistors, Allen Bradley Style EB or equal, of the resistance value given on the schematic, tolerance ±10%.
R12	Resistor, fixed comp.: 68K ±10%, 1 watt (AB - GB)
R24	Resistor, variable comp.: 10K ohms ±10% total, linear taper, 1/4 watt; bushing 3/8" shaft 3/4" lg, slotted. (CRL Kaar 5001)
R30	Resistor, fixed comp.: 15 ohms ±10%, 2 watt. (AB-HB)
R33 R34	Resistor, fixed wire wound: 200 ohms ±10%, 4 watt. (IRC - PW4)

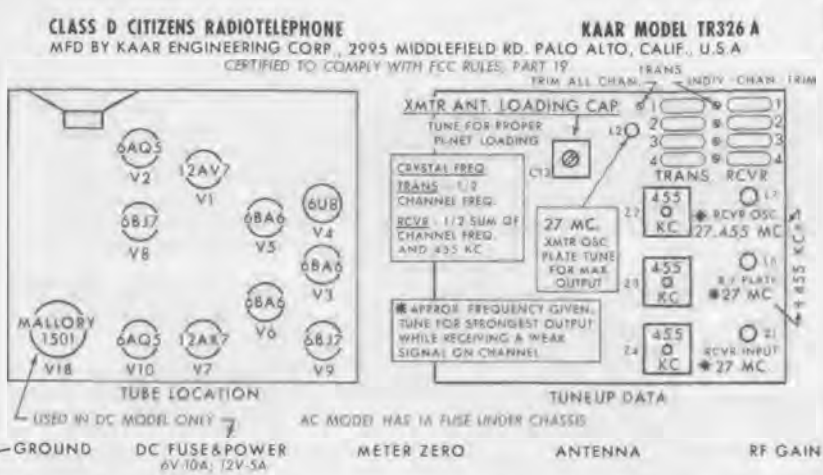
ITEM	DESCRIPTION
R36	Resistor, variable comp.: 50K ohm ±10%, linear taper, 1/4 watt; bushing 3/8", shaft 1/2" lg, slotted. (CRL - Kaar 5010)
R40	Resistor, fixed comp.: 10K ohm ±10%, 2 watt (AB - HB)
R44	Resistor, fixed comp.: 470 ohm ±10%, 1 watt (AB - GB)
R49	Resistor, variable comp.: 250K ohm ±20%, 1/4 watt, C taper (audio); bushing 3/8", shaft 3/4" lg, slotted; with DPST switch rated 3A125 vac and 10A24 vdc. (CRL-Kaar 5003)
R61	Resistor, fixed comp.: 22K ohm ±10%, 2 watt. (AB - HB)
S1	Part of R49
T1	Transformer, audio freq. output: 5500 to 3.2 ohm. (Excel - Kaar 1030)
T2	In 12 vdc model: Transformer, vibrator power: pri 12 vidc, sec rated 250 vdc/0.1A voltage dblr; pri 124T #19E, sec 730T #29E (Excel - Kaar 1188) In 6 vdc model: Transformer, vibrator power; pri 6 vidc, sec rated 250 vdc/0.1A voltage dblr; pri 52T #16E, sec 730T #29E (Excel - Kaar 1191)
T3	Transformer, power, step-up and step down: pri 117 vac, sec #1 117 vac/0.2A, sec #2 12.6 vac/2A. Pri 540T #25E, sec #1 540T #29, sec #2 66T #19E. (Excel - Kaar 1189)
V--	Ten tubes, types as given on schematic and tube location diagram (RCA)
Z1	Transformer, r-f input: consists of one inductor, same as L2, overwound with 3 turns #20 wire.
Z2 Z3 Z4	Transformer, i-f: 455 kc. (Automatic - 1655-2)

DESCRIPTION, POWER SUPPLY and CONTROL CIRCUITS.- The power supply may be any one of three circuits, according to input voltage. For 117 volt a-c input, the line voltage is stepped up by one winding of power transformer T3 for application of high voltage a-c to the rectifier and d-c filter, and is stepped down by another winding to supply heater voltage to all tubes. For 12 volt d-c input, vibrator VIB-1 acts as a chopper to supply interrupted d-c to the vibrator transformer T2. For 6 volt d-c input, minor changes are made in the same circuit, such as removing the vibrator dropping resistor (which reduces the voltage to the coil from 12 volts to 6 volts), and adding more hash filters, plus replacing the vibrator transformer with one having a primary wound for 6 volts interrupted d-c. In every case, high voltage is applied to points A-A, the input to the rectifier-filter system which is common to all power supplies. CR1 and CR2, together with C45 and C46, form a voltage doubler which delivers pulsating d-c to the filter R33 and C47. C48 is in parallel with C47 in the d-c model, but is separated by an added resistor R34 in the 117 volt a-c model (giving more effective filtering). The d-c output is applied directly to the audio driver and output stages V7 and V10, and to K1, the coil of the keying relay. The coil of the keying relay is actuated by grounding the low end through the microphone button. When receiving, the microphone button is up, and the back contacts of K1 energize the receiver as follows: K1A connects the antenna to the receiver, K1B applies B+ to all stages of the receiver except the audio driver and audio output stages (V7B and V10), and K1C grounds the speaker to place it in operation. The audio driver and output stages are supplied with d-c continuously, because these two stages are used for both transmitting and receiving. When the microphone button is pressed, K1 closes, the contacts place the transmitter on the air as follows: K1A transfers the antenna to the transmitter output, K1B applies B+ to the transmitter oscillator, V1A, and K1C grounds the cathodes of both the oscillator and the power amplifier, to place transmitter carrier on the air.

CIRCUIT DESCRIPTION, RECEIVER.- The receiver is a fixed-tuned superheterodyne with squelch, automatic noise limiting, and noise controlled avc circuits, all included to give superior reception properties. The incoming signal is amplified by V3, the r-f amplifier, and applied to the mixer grid (V4A). A signal 455 kc higher than the channel frequency is coupled to the grid from the oscillator section V4B, an independent triode in the same envelope. The oscillator is a Colpitts circuit, with frequency doubling in the plate circuit. The mixer grid is avc controlled through V8B, the mixer avc gate diode. This diode conducts for avc voltage, but prevents the oscillator injection voltage from feeding back into the avc bus. The i-f is amplified by two conventional i-f stages V5 and V6, which differ only in that the gain of V5 is avc controlled, and the gain of V6 is fixed by the cathode resistor R18. The detector, V9A, supplies audio to the audio driver V7B through a series-gate noise limiter circuit. This consists of the gating diode V9C, capacitors C65 and C68, and resistors R55, R56, R58, and R59. Due to the r-c time constants, V9C is biased to conduct (and pass audio signals) for normal voice signals, but stops conducting for high amplitude noise pulses of short duration. The second detector also supplies avc voltage, a noise controlling voltage to modify the avc voltage, and squelch voltage. The avc system consists of R20 and C28, a conventional r-c filter, with carrier signal taken from the secondary of Z4. Another r-c filter from this point (C67-R57) responds to short duration noise pulses only; these are passed through C66 to drive the noise amplifier V1B. The amplified noise is then rectified by V8C and applied as a positive bias to

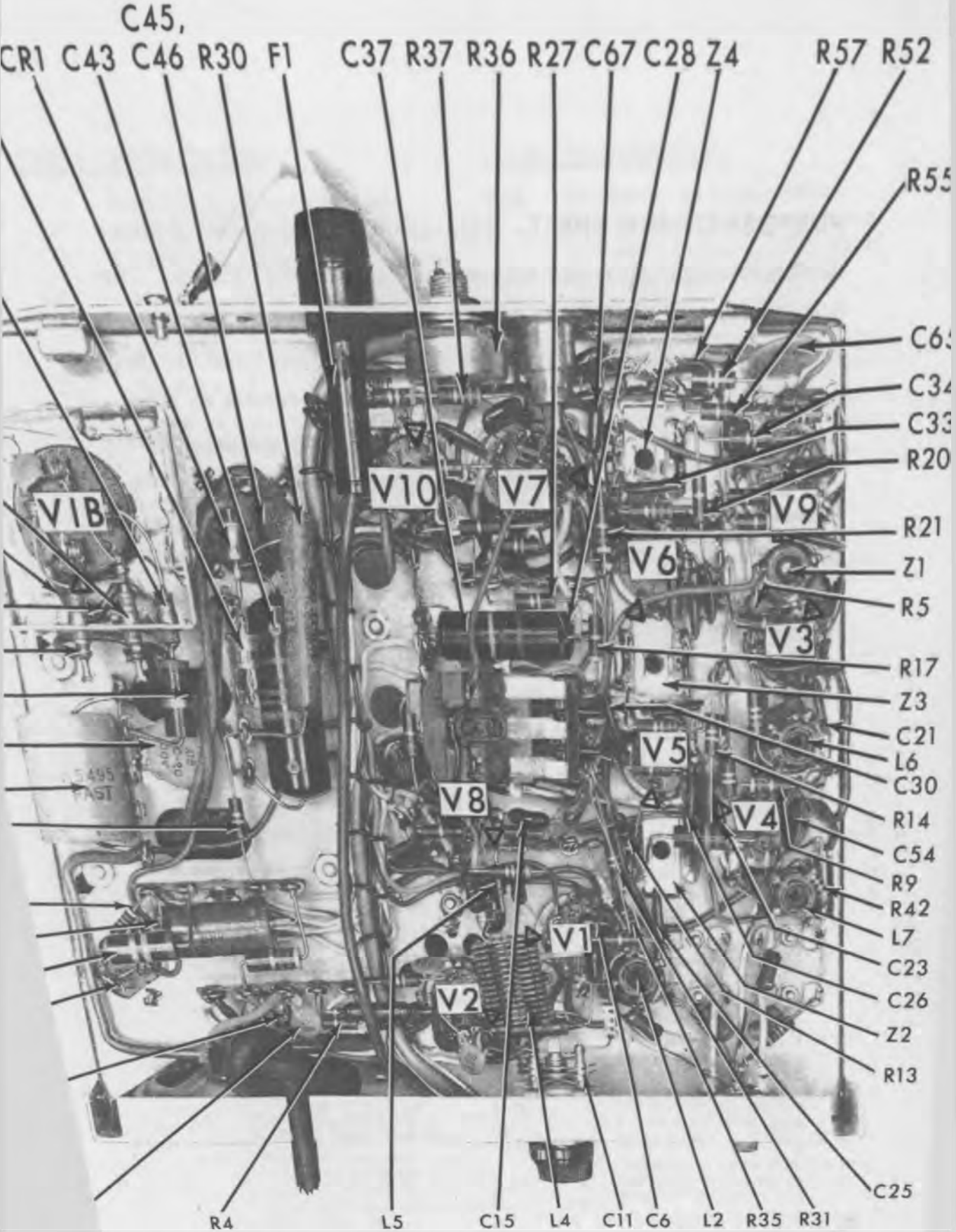
the avc bus. This arrangement keeps the receiver gain high in the presence of noise, thus making it possible to receive weak messages through noise. Without this arrangement, such weak messages would otherwise be lost. The squelch system disables the audio driver V7B whenever the received carrier amplitude is less than a given value, as determined by the setting of the squelch control V7A. The squelch rectifier tube V9B rectifies carrier to develop a negative voltage which opposes the positive voltage from the squelch control R24. For normal reception, the total voltage is negative to ground by an amount great enough to keep the squelch control tube V7A from conducting. The audio driver tube V7B now acts as a regular Class A r-c coupled amplifier, with bias due to contact potential current through R47. When the receiver signal is removed, or the level drops below the value selected for squelching, the bias for V7A goes more positive, and V7A conducts. The plate current of V7A flows through R46 and R27 to B+; the resulting voltage drop across R46 biases V7B beyond cut-off, and the audio is removed (squelched). The noise amplifier-rectifier system V1B-V8C) adds a positive bias to the grid of V7A (through resistor R22) during squelched conditions, causing the squelch to hold steadily under noisy conditions. The audio output stage is a conventional Class A audio power amplifier with transformer coupling to the four ohm speaker. For receiving, the signal level meter is connected into a bridge circuit. One side of the bridge consists of R37, R36, and R35. The other side consists of resistors R16-17 to B+ and the effective cathode-to-screen resistance of V5 and R15 to ground. The METER ZERO control is set to zero reading with no signal; with signal, the effective cathode-screen resistance changes directly as the avc voltage varies. This unbalances the bridge to give a reading which varies approximately as the signal strength varies.

CIRCUIT DESCRIPTION, TRANSMITTER.- The transmitter is a master oscillator-power amplifier circuit with crystal control of the operating frequency. The oscillator stage uses one triode section of a 12AV7 in a Colpitts circuit. The oscillator plate tank (L2-C4) is tuned to the channel frequency, while the grid circuit operates at one-half the channel frequency. The r-f developed across the plate tank drives the grid of the power amplifier tube (V2) a Type 6AQ5. The plate of V2 is tuned to the channel frequency by a pi-section network consisting of L4, antenna loading capacitor C13, and the power tuning capacitor C11. The power amplifier operates Class C, with grid bridge neutralization (Rice system). Capacitor C12 is the neutralizing capacitor. L5 and C15, together with a portion of the loading capacitance (C13), act as a second pi-network which is fixed-tuned to reduce possible radiation of harmonic frequencies above the highest channel. The output from the second filter is fed to the antenna through one set of contacts of the antenna transfer relay K1A. The meter rectifier tube rectifies a small portion of the r-f voltage developed across the output loading capacitor, and the signal level meter reads the rectified voltage. The modulating signal for the transmitter is obtained through V7B and V10. These stages serve as the audio driver and the modulator stages, respectively, while transmitting. The audio from the microphone is fed through the "cold" end of the volume control, amplified by V7B, a conventional Class A resistance coupled audio voltage amplifier, and again by V10, a conventional Class A audio power amplifier. Since the speaker is disconnected while transmitting, due to K1C, the primary of T1 acts as a choke across which the audio modulating voltage is developed. This in turn modulates the plate and screen voltage of the r-f power amplifier stage in what is commonly referred to as a "choke coupled" or "Heising" modulation system.

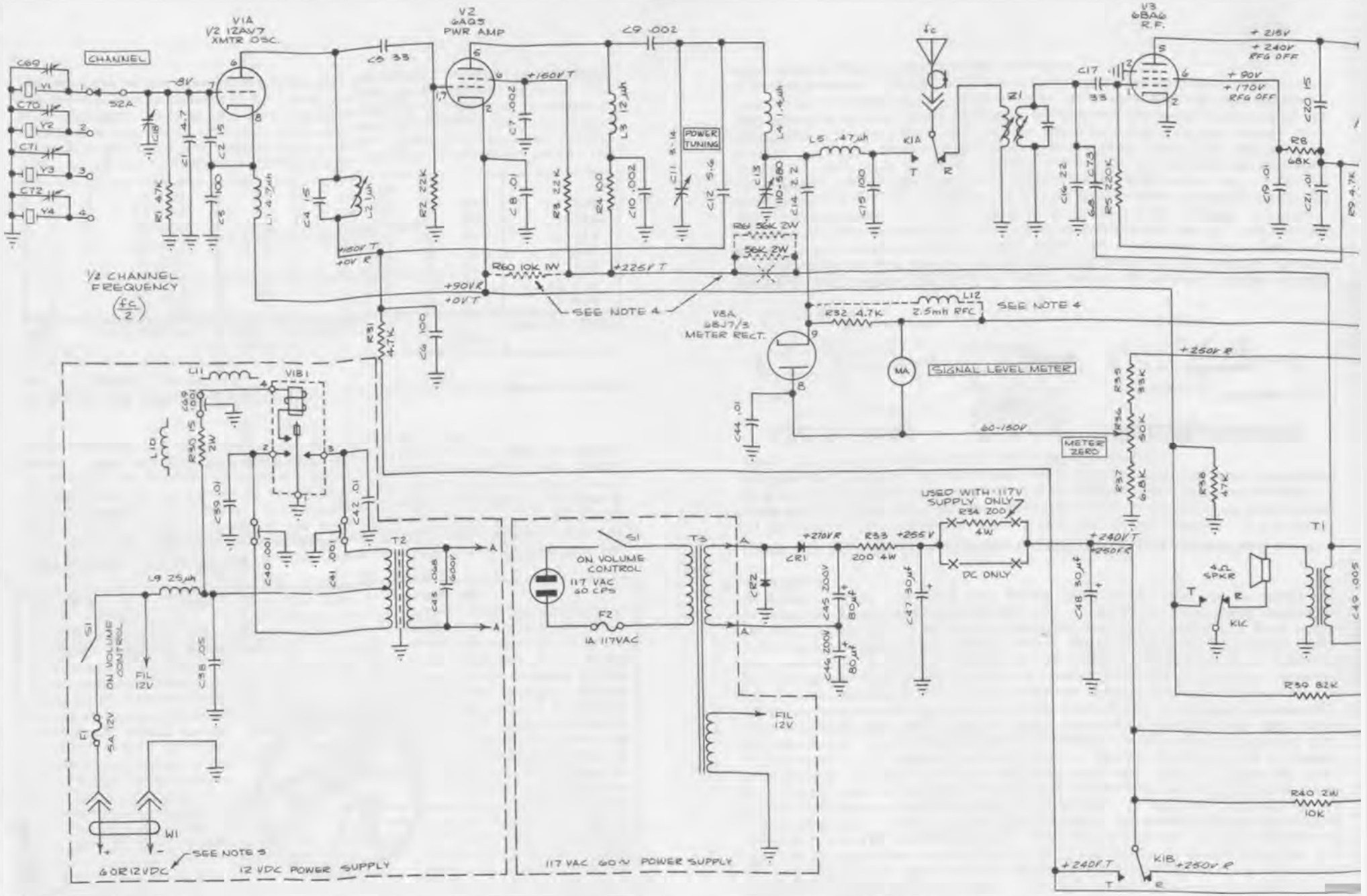


SERVICE TUNEUP.- The unit normally comes factory tuned to one of the channels in the middle of the band (see paragraph on internal adjustments). Re-tuning to specific operating frequencies may improve performance in some cases, particularly if two widely separated frequencies are used, or if both channels are at one end of the band. In the case of two widely separated channels, a compromise setting may be required for the circuits which are tuned to the channel frequencies. To make a compromise setting, find point of maximum response for each tuned circuit, first with the channel switch in the "A" position, then in the "B" position, and leave the control in a compromise position between them. The transmitter tuneup procedure is as follows: (1) Tune L2 for maximum output. (2) Tune POWER TUNING control for maximum meter reading. (3) With service voltmeter, read voltage at plate of V2 and the voltage developed across resistor R4. Calculate the plate current flow through R4, then calculate the plate power input (P equals EI). If plate power input is five watts or 100 milliwatts (whichever limit applies to set being tuned), no further internal adjustments are needed in transmitter section. (4) If power input must be changed, reset C13 by rotating clockwise or counterclockwise by a small amount, then repeat steps (1), (2), and (3). If power input is not correct, again reset C13 and repeat these steps until the correct reading is obtained. For receiver tuneup, a simple peaking adjustment of the antenna, r-f, and oscillator tuned circuits will usually be all that is necessary. To do this, use the signal level meter to tune L7, L6, and Z1 for maximum while receiving a weak signal. The receiver i-f transformers should be left alone unless there is definite evidence that tuning is needed. If this is the case, apply a 455 kc signal to the mixer grid and tune for maximum meter reading, as in conventional receiver alignment technique. The frequency should be exactly 455 kc, however, to avoid possible loss of some stations which may be operating near the limits of channel frequency tolerance. To confirm accuracy of signal generator calibration at 455 kc, use local broadcast stations to establish check points.

C41
C39
C42
C40
R30
C38
L9
R25
R38
R39
R40
C47, C48
R50
C62



Above: Bottom view, D Phone, 12 volt model. - Refer first to schematic diagram; if part in question is connected directly to a tube socket terminal, it is not identified on the photograph. Diamond over tube socket indicates location of the number one pin.

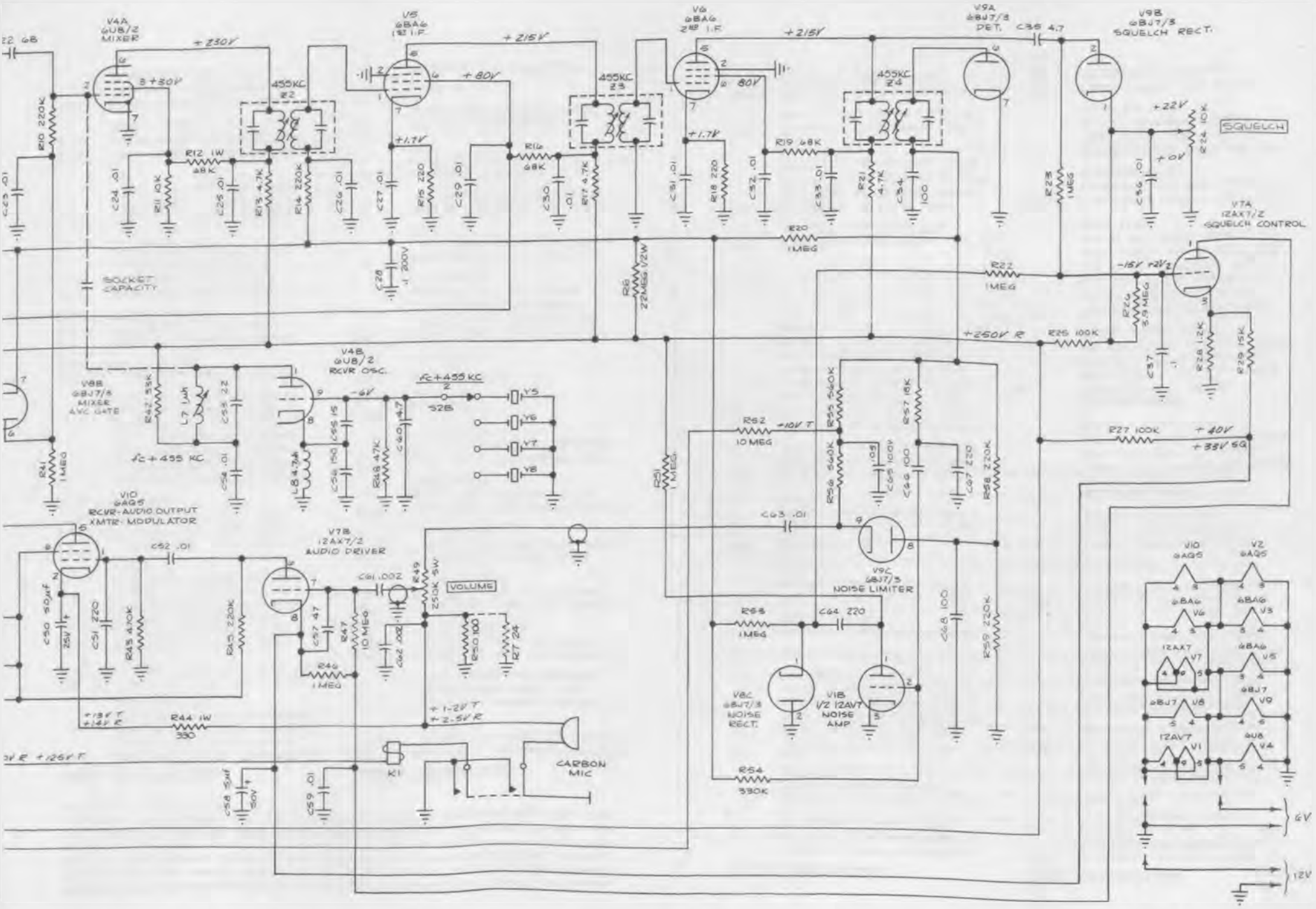


NOTE 1 CAPACITANCE VALUES ONE AND OVER IN μμf, LESS THAN ONE IN μf, AND 500V UNLESS OTHERWISE INDICATED

NOTE 2 RESISTANCE VALUES IN OHMS, AND 1/2 WATT UNLESS OTHERWISE INDICATED

NOTE 3 TYPICAL VOLTAGES ARE INDICATED UNDER NORMAL OPERATING CONDITIONS (RECEIVE 'R' OR TRAN

NOTE 4 R60 & R61 ARE COMPONENTS ADDED TO DECREASE TRANSMITTER POWER INPUT FROM 5 WATTS TO UNIT UNDER FCC RULES PART 15. L12 MAY ALSO BE ADDED TO INCREASE METER SENSITIVITY (FO



1. MEASUREMENTS MADE WITH 11 MEGOHM VTVM.

LIWATTS, FOR LICENSING AS A LIMITED POWER
W USE ONLY)

NOTE 5 SCHEMATIC SHOWS 12 VOLT VIBRATOR POWER SUPPLY CIRCUIT. 6 VOLT MODEL USES SAME CIRCUIT EXCEPT AS FOLLOWS: (A) L10 REPLACES R30. (B) L11 IS INSERTED BETWEEN C69 AND V1B1. (C) C43 VALUE IS 0.1µf AT 600V. (D) F1 VALUE IS 10A.

SCHEMATIC DIAGRAM

KAAR MODEL TR326A

CLASS D CITIZEN'S RADIOTELEPHONE

PURPOSE OF THIS SHEET.- This sheet provides useful information on installation and maintenance of your "D" Phone. The installation and initial tuneup may be performed by the station licensee; the instructions on this side of the sheet are for that purpose. The other side of the sheet contains details on more technical matters, such as diagrams, circuit explanation, parts location diagrams, and technician's service adjustment procedures. The remaining space contains the parts list and miscellaneous data which will be needed for long term operation of your "D" Phone. This sheet should be kept with the equipment, and should go with it if the unit is sent to any electronics technician for installation of crystals, internal tuning adjustments, or other maintenance. Supplementary information on separate sheets may be included with the set; this may include literature on antennas, licensing data, information on noise reduction techniques for vehicles, and data on other Kaar equipment which is currently available for meeting special needs in communications work.