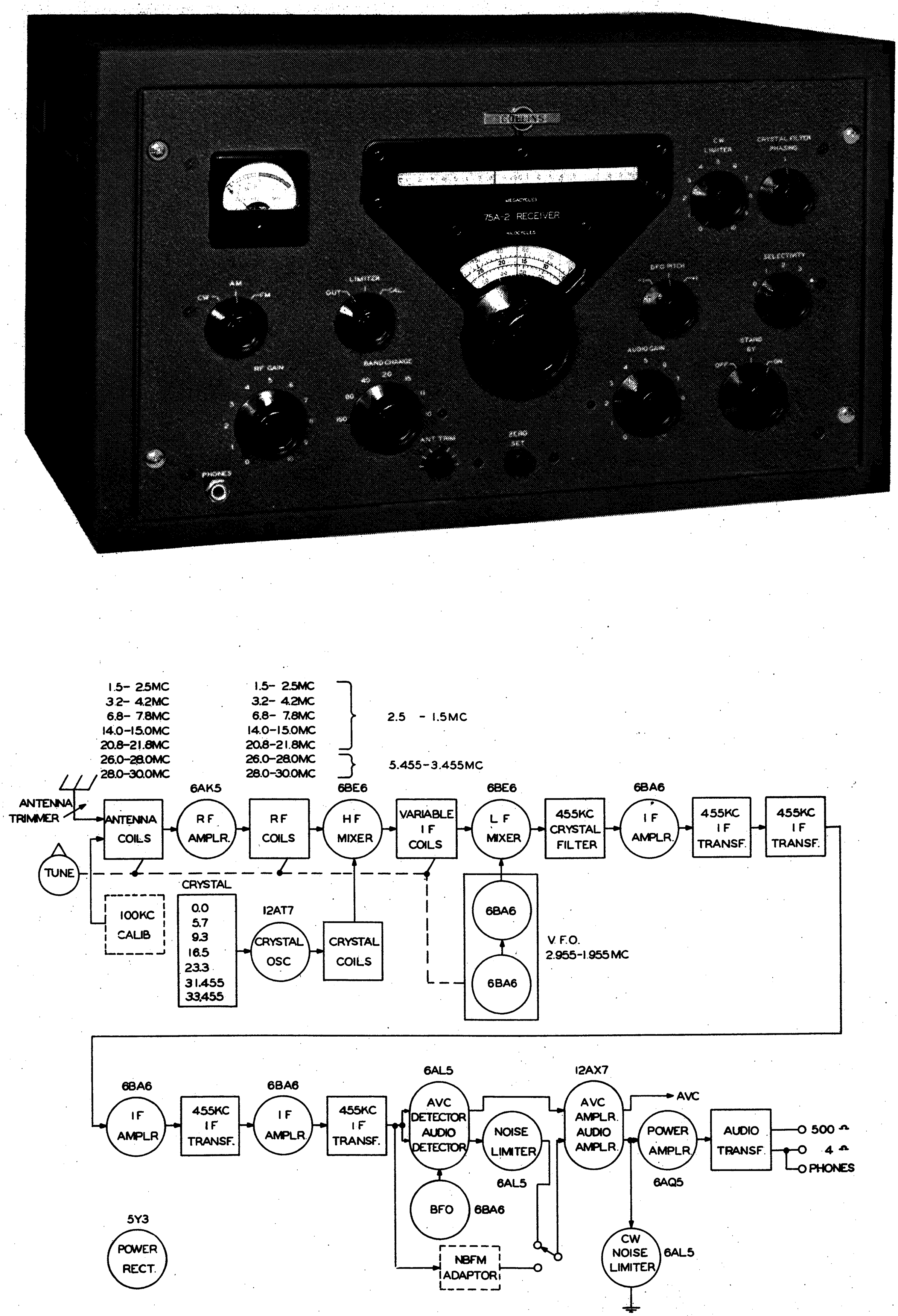

Figure 1-1 75A-2 Front View and Block Diagram

SECTION I

GENERAL DESCRIPTION

1.1. GENERAL

The Collins Model 75A-2 Receiver is designed for the amateur bands in the frequency range of 1500 kc to 30 mc. The receiver provides facilities for the reception of CW, MCW, and AM PHONE reception. Two octal sockets have been provided for internal plug-in attachment of a Narrow Band Frequency Modulation Detector unit and a Crystal Calibrator unit which provides reference frequencies every 100 kc. Controls for these accessories are provided on the front panel and are wired ready to use. The receiver uses the double-conversion superheterodyne principal to obtain high image rejection. Stability is obtained by the use of quartz crystals in the high frequency oscillator stage and a Collins Type 70E-12 sealed VFO in the low frequency oscillator circuit. Additional features of the receiver are separate noise limiters for PHONE and CW, amplified AVC, crystal filter, direct reading dial with frequency readings accurate to within 1 kc up to 21.8 mc and 2 kc from 26 to 30 mc. Provision has been made to connect a blocking bias to the receiver to mute the receiver audio when the key of an associated transmitter is closed.

1.2. DESCRIPTION

1.2.1. FREQUENCY COVERAGE - The amateur bands are covered as follows:

160 meters - 1.5 - 2.5 mc	15 meters - 20.8 - 21.8 mc
80 meters - 3.2 - 4.2 mc	11 meters - 26.0 - 28.0 mc
40 meters - 6.8 - 7.8 mc	10 meters - 28.0 - 30.0 mc
20 meters -14.0 -15.0 mc	

The above table shows the tuning ranges within which the amateur bands fall. The exact frequencies of the amateur bands are given in the latest amateur radio handbooks.

1.2.2. BANDSPREAD - The permeability tuning system employed in the 75A has been engineered to give linear tuning on each band. Ten turns of the vernier tuning dial cover each of the individual ranges shown above. Each division of the vernier tuning dial (which has 100 divisions) represents 1 kc on the 160, 80, 40, 20, and 15 meter bands, and 2 kc on the 11 and 10 meter bands.

1.2.3. ACCURACY AND STABILITY - Visual tuning accuracy to within 1 kc from 1.5 mc to 21.8 mc and 2 kc from 26 mc to 30 mc provided the vernier dial corrector (zero set control) is exactly calibrated at the centers of each tuning range. Extreme variation in plate supply voltage causes a change of only a few cycles in the CW note. Furthermore, the CW note is absolutely independent of all except the tuning controls. Physical shock will not disturb the frequency unless the shock is severe enough to change the dial settings. The stability is available after a very short warm up.

1.2.4. IMAGE AND I-F REJECTION - The circuit design of the 75A receiver has inherently high rejection to spurious frequencies. Image rejection is a minimum of 50 db. I-F rejection is 50 db minimum.

1.2.5. SENSITIVITY AND SIGNAL TO NOISE RATIO - A 6 db signal to noise ratio and one watt of audio output is obtained with signal inputs of 2 microvolts or less.

1.2.6. SELECTIVITY - The crystal filter controls provide a bandwidth that is variable in 5 steps from approximately 4 kc to 200 cycles at 2 times down (6 db down from the peak of the resonant frequency). There is only slight loss in gain caused by use of the crystal filter with the exception of the extremely sharp position which gives about 6 db loss. The fixed I-F selectivity provides a bandwidth of approximately 13 kc at 1000 times down (60 db down from the peak of the resonant frequency).

1.2.7. PHASING - The crystal filter includes a phasing control which provides a rejection notch for suppressing heterodynes. The range of rejection of this control has been extended downward to 250 cps or lower.

1.2.8. AUTOMATIC NOISE LIMITER - The 75A receiver contains a series type noise limiter which automatically adjusts its limiting threshold to all carrier levels.

1.2.9. CW-NOISE LIMITER - A shunt type noise limiter with front panel control of limiting level is provided for CW operation.

1.2.10. AUTOMATIC VOLUME CONTROL - Delayed, amplified AVC gives constant output within 6 db for a change in r-f input from 5 microvolts to 0.5 volt. AVC is applied to the r-f stages and three i-f stages. The proper amount of AVC delay is employed for maximum sensitivity on weak signals.

1.2.11. SIGNAL STRENGTH METER - The S meter is calibrated from 1 to 9 in steps of approximately 6 db each, and for 20, 40, and 60 db above S9. Zero adjustment is provided. A reading of S9 is obtained with an input of approximately 100 microvolts. The AVC amplifier tube works into an unusually low value of load impedance which permits quick recovery from noise pulses or strong signals from the associated transmitter, thus allowing fast break-in when the receiver is used to monitor operation of the transmitter.

1.2.12. AUDIO OUTPUT - 2.5 watts of audio power are available.

1.2.13. TERMINAL IMPEDANCES

a. INPUT - The antenna input circuit is designed for a nominal 50 to 150 ohms impedance but will accommodate a wide variety of antenna impedances, both balanced and unbalanced, without serious loss. Mounting holes for an Army type SO 239 coaxial connector are provided to allow convenient connection to coaxial transmission lines, such as RG-8/U (52 ohms) and RG-11/U (73 ohms).

b. OUTPUT - A 500 ohm output and two 4 ohm outputs (one of which is interlocked with the panel headphone jack) is available on a rear terminal board. The panel headphone jack is a four ohm termination so that any value of headphone impedance will function satisfactorily.

1.2.14. CONTROLS - The following controls are on the front panel of the receiver:

Tuning Control	RF Gain Control
Band Switch	Audio Gain Control
CW Pitch Control	Crystal Phasing Control
Antenna Trim Control	CW-AM-FM Switch
Off-Standby-On Switch	Noise Limiter-Calibrate Switch
Crystal Selectivity Switch	Zero Set for Tuning Control
Headphone Jack	CW Limiter Control

1.2.15. CIRCUIT - Dual Conversion superheterodyne. One r-f amplifier stage, 1st mixer stage, crystal controlled h-f oscillator, variable i-f filter, 2nd mixer, three fixed i-f amplifier stages, detector/AVC Rectifier stage, two audio amplifier stages, AVC amplifier/noise limiter stage, CW noise limiter, variable frequency oscillator, beat frequency oscillator, and power supply. All circuits concerned with the tuning process are permeability tuned and ganged to one control.

1.2.16. TUBE COMPLEMENT -

SYMBOL	TUBE TYPE	FUNCTION
V-1	6AK5	RF Amplifier
V-2	6BE6	First Mixer
V-3	6BE6	Second Mixer
V-4	12AT7	Crystal Oscillator
V-5	6BA6	455 kc IF Amplifier
V-6	6BA6	455 kc IF Amplifier
V-7	6BA6	455 kc IF Amplifier
V-8	6AL5	Detector and AVC Rectifier
V-9	12AX7	AVC Amplifier and AF Amplifier
V-10	6AL5	Automatic Noise Limiter
V-11	6AQ5	Audio Power Amplifier
V-12	6BA6	Beat Frequency Oscillator
V-13	5Y3GT	Power Rectifier
V-14	6BA6	Variable Frequency Oscillator
V-15	6BA6	VFO Isolation
V-16	6AL5	CW Noise Limiter
V-17	OA2	Voltage Regulator

1.2.17. POWER SOURCE - Power supply self-contained. Requires 115 volt 50/60 cps source. Power consumption about 85 watts.

1.2.18. DIMENSIONS - CABINET - 21-1/8" wide, 12-1/2" high, 13-1/6" deep. The receiver chassis is mounted on a standard 10-1/2" x 19" panel and can be removed from the cabinet and mounted in a standard relay rack. Depth behind the panel is 13-5/16".

1.2.19. WEIGHT - 50 lbs.

1.2.20. FINISH - St. James Gray wrinkle.

1.3. ACCESSORIES

1.3.1. SPEAKER TYPE 270G-2 - An external 10 inch speaker, not furnished, is available, mounted in a matching cabinet. The speaker cabinet measures 15" wide, 11-1/8" high, and 9-1/8" deep overall. Weight 15 lbs.

1.3.2. HEADPHONES - Any good headphones may be used. The 4 ohm receiver output impedance provides sufficient signal level for low or high impedance headphones.

1.3.3. ANTENNA - Any good antenna may be used; however, the receiver input circuit is designed for antenna impedances in the order of 50 to 150 ohms. In most cases, the transmitting antenna will also be the best choice for receiving. Connections on the rear permit the use of both balanced and unbalanced lines. Mounting holes have been provided for installing a Coaxial connector. This allows advantage to be taken of the low noise pickup of coaxial transmission lines.

1.3.4. CRYSTAL CALIBRATOR - The type 8R-1 Crystal Calibrator is available on order. The 100 kc crystal oscillator in this unit provides reference frequencies every 100 kc. This unit plugs into a socket within the receiver. Operating voltages and controls are provided in the receiver.

1.3.5. NBFM ADAPTOR, TYPE 148C-1 - This unit is also available on order. With it, narrow band FM signals can be detected and fed through the receiver audio circuits. This unit also plugs into a socket within the receiver. Operating voltages and controls are provided in the receiver.

SECTION II

INSTALLATION

2.1. UNPACKING

The model 75A receiver is packed in heavy cartons. Refer to the packing slip for a list of all equipment supplied. Open packing cartons carefully to avoid damage to the units within. Remove the packing material and carefully lift the units out of the cartons. Search all of the packing materials for small packages. Inspect each unit for loose screws and bolts. Be certain all controls such as switches, dials, and so forth, work properly. All claims for damage should be filed promptly with the transportation company. If a claim is to be filed, the original packing case and material must be preserved. See the instructions on the back of the bill of lading.

2.2. CONNECTIONS

2.2.1. ANTENNA AND GROUND - The antenna connector strip is located at the right hand side of the chassis rear wall (viewed from the rear). Balanced antennas should be connected to terminals 1 and 2. Unbalanced antennas should be connected to terminals 1 and G with terminal 2 jumpered to terminal G. Connect a good ground to terminal G for any type of antenna installation.

2.2.2. COAXIAL CONVERSION - To convert the receiver for coaxial line antenna input, remove the receiver from the cabinet, unsolder the wires from the rear of the antenna terminal strip and remove the strip. Remove the small plate adjacent to the antenna terminal strip and bolt it in place of the terminal strip. The holes exposed in the chassis when the plate was removed are correct for Collins 357 9005 00 (Army type SO 239, Amphenol 83-1R) socket (not furnished). The mating plug is a Collins 357 9014 00 (Army PL-259, Amphenol 83-1SP) (not furnished). Receptacle UG-58/U (mating plug UG-21B/U) may also be used for coaxial conversion. Connect the wire taken from terminal number 2 to the shell of the coaxial socket and the wire taken from terminal 1 to the center pin of the coaxial socket. The receiver may now be used with RG-8/U or similar 52 ohm coaxial line. The external ground can be connected to the "G" terminal of the audio or muting terminal strips.

CAUTION

> Do not subject the input circuits to r-f voltages in excess of 50 volts. Excessive r-f voltages may be encountered if the receiving antenna is not disconnected when the transmitter is operating. Capacity coupling through the antenna change-over relay may also result in excessive r-f voltage when the transmitter is operating. It is recommended that a relay be used to ground antenna terminals 1 and 2 directly to the receiver chassis with short leads when the transmitter is operating. This precaution should be taken if the transmitter signal is sufficient to light a 1/4 watt neon tube at the receiver antenna terminals.

2.2.3. OUTPUT CONNECTIONS -

a. SPEAKER - Viewing the receiver from the rear, the output connections are at the left hand edge of the chassis. Terminals G and 4 are intended for the 4 ohm voice coil in the Type 270-G2 speaker. This connection is interlocked with the phone jack on the front panel to turn the speaker off when the headphones are plugged into the panel headphone jack.

b. HEADPHONES - In addition to the front panel headphone jack, a four ohm connection is provided at the rear terminal strip at terminals G and P to which headphones may be connected by those operators who wish to avoid having headphone wire on the operating table.

c. 500 OHM CONNECTION - Terminals G and 500 provide a 500 ohm output connection which is useful for additional speakers and so forth. These also may be used for CW Sidetone input.

2.2.4. STANDBY - A pair of terminals located at the rear of the chassis marked 1 and 2 (on the center terminal strip) is provided for connecting to relay contacts or other similar device for automatically disabling the receiver for break-in operation. These terminals break the plate circuits of certain tubes and are in parallel with contacts on the OFF-STANDBY-ON switch. If these connections are used, they will be operable when the switch is in the STANDBY position and shorted when the switch is in the ON position.

2.2.5. CW BREAK-IN - Terminals M and G on the center terminal strip are provided to mute the receiver audio when the key of the associated transmitter is closed in cw operation. To use this feature a DC source which provides +20 volt minimum with the key closed and 0 voltage with the key open is required. The Collins 32V-1, 32V-2, and KW-1 transmitters provide this muting voltage. This +20 volt source may be taken from across the cathode resistor of a keyed stage that is biased to cut-off or may be taken from a resistor placed in series with the key of a cathode keyed stage. The resistor must be connected between key and ground. It may also be obtained from a battery in series with auxiliary contacts on a keying relay. If the first two methods are used, be sure and connect the G terminal of the receiver to the transmitter chassis ground. Connect the positive potential to the M terminal and the negative to the G terminal.

Note that the muting system does not provide protection to the input circuit to the receiver. See paragraph 2.2.2. for information covering input protection.

2.2.6. POWER - The receiver is powered through a 5-1/2 foot, rubber covered, permanently attached service cord equipped with a standard plug. Connect this plug to a 115 volt 50/60 cps power source only.

2.3. FUSE

The protective fuse for the receiver is contained within an extractor type fuse post located on the rear of the chassis near the left hand corner. To remove the fuse, turn the cap of the fuse post counterclockwise and pull straight out. Use only a 2 ampere fuse.

2.4. INSTALLATION OF 148C-1 NBFM ADAPTOR UNIT.

This unit plugs into the octal socket immediately behind the VFO. To install this unit, remove the receiver from its cabinet. Remove the snap button from the top of the receiver chassis. The hole thus uncovered provides access to the tuning core adjustment at the bottom of the discriminator transformer. Remove the two nuts from the spade bolts protruding from the bottom of the 418C unit, plug the unit into the adaptor socket and replace the nuts on the bottom of the spade bolts which will protrude from the bottom of the chassis. While the receiver is out of the cabinet, re-align both the NBFM unit and the last i-f transformer, T-7. See paragraph 5.3.2. in section V.

2.5. INSTALLATION OF 8R-1 CALIBRATOR UNIT.

This unit plugs into the octal socket located in the rear left hand corner of the receiver chassis. There are no mounting facilities other than the connector plug. Turn the receiver on after installation and after a warm up period, tune in some station (such as WWV) whose frequency accuracy is known and which falls on a multiple of 100 kc. Operate the LIMITER switch to the CAL position and check for zero beat (BFO off). It may be necessary to use a short antenna if the received signal is too strong. If a beat note is heard, adjust C-301 in the calibrator unit until zero beat is obtained. The ZERO SETTING knob can now be adjusted to put the hair line on calibration on any multiple of 100 kc.

SECTION III

ADJUSTMENT AND OPERATION

3.1. INITIAL ADJUSTMENTS

3.1.1. "S" METER - The "S" meter has a potentiometer for zero adjust on top of the chassis. To adjust, place the receiver in operation with the CW-AM-FM switch on AM. Set the RF GAIN CONTROL full clockwise, short the antenna input and adjust control for zero reading on the "S" meter.

3.2. OPERATION

3.2.1. FUNCTION OF CONTROLS

a. OFF-STANDBY-ON - This control knob controls the plate and filament power to the receiver. In the OFF position, the receiver is completely turned off. In the ON position, both filament and plate power are turned on. In the STANDBY position, the filaments are turned on but the plate power is disconnected from certain receiver circuits. If a receiver disabling relay is used with the transmitter, the OFF-STANDBY-ON switch should by placed in the STANDBY position. In this kind of operation, the receiver will be disabled every time the press-to-talk switch on the microphone is pressed but the signal can be monitored by turning the OFF-STANDBY-ON switch to the ON position if desired.

b. BAND CHANGE - The BAND CHANGE switch, located at the left of the tuning dial selects the amateur band upon which reception is desired.

c. KILOCYCLE - The tuning dial consists of two scales, the KILOCYCLE circular dial and the MEGACYCLE slide rule type dial. The KILOCYCLE dial is calibrated in 1 kc divisions on the 160, 80, 40, 20 and 15 meter bands and 2 kc divisions on the 11 and 10 meter bands. The lower scale on the dial is 2 kc per division while the upper center scales are 1 kc per division. The 3 scales are colored red, black and green to match the colors of the scale on the MEGACYCLE dial with which they are associated. The red scale is in reverse order to the other two scales and is used with the 160 meter slide rule scale. The green scale is used on the 10 and 11 meter bands while the black scale is used on the remaining bands.

d. MEGACYCLE - The MEGACYCLE dial is a slide rule dial calibrated in divisions of 100 kc each. Each scale is colored to match the associated scale on the KILOCYCLE dial. To read the tuning dial, combine the vernier dial (KILOCYCLE) reading with the slide rule dial reading. Thus, the 10 meter dial reading in figure 3-1 would be 28834 kc. The KILOCYCLE dial supplies the last two figures of the frequency in kilocycles on all bands and the MEGACYCLE scale supplies the first two figures of the frequency in kilocycles in the 160, 80 and 40 meter bands and the first three figures in the 20, 15, 11 and 10 meter bands.

e. CRYSTAL FILTER-SELECTIVITY - The selectivity of the receiver is varied with the SELECTIVITY control. The band width is adjustable in five steps from 4 kc to 200 cycles at two times down (6 db down from the peak of the resonant frequency). Position 4 is sharp tuning while position 0 is broad tuning.

f. CRYSTAL FILTER-PHASING - The PHASING control is used primarily to assist in rejecting interferring heterodynes. The control, when positioned on the panel mark (straight up), is properly set for CRYSTAL-PHASING. In event a high frequency heterodyne is interferring with reception, the control should be moved back and forth in the vicinity of the panel mark until the heterodyne is attenuated. If the heterodyne is low frequency (low pitched whistle), the control should be moved further out from the panel mark on either side.

g. BFO PITCH - The BFO PITCH control is located to the right of the tuning control and is used to vary the pitch of the beat note when receiving CW signals. To set the BFO PITCH control, tune in a signal "on the nose" with the BFO off and the crystal filter SELECTIVITY at position 4. Then turn the BFO ON and set BFO PITCH as desired. Tuning should be centered on the carrier and the BFO offset to give desired beat note. If an approximate frequency check of the received signal is wanted, tune the signal to zero beat with the tuning dial and add one kc to the dial reading if the BFO control is set at +1 or subtract one kc if the control is set at -1.

h. CW-AM-FM - In the CW position, this control turns the BFO on, disables the AVC system, and turns the CW noise limiter on. In the AM and FM positions, this control disables the BFO and connects the AVC circuits for AM and FM operation. In addition, in the FM position, this control re-routes the input of the first audio stage to the FM adaptor plug so that narrow band FM signals can be reproduced through the audio section (providing of course, an nbfm adaptor is plugged into the adaptor socket).

j. RF GAIN - This control is connected in the grid circuits of the first RF stage and the fixed IF amplifier stages through the AVC circuit. It is used in all classes of operation. In FM and AM operation, the RF GAIN control is placed in the full clockwise position. In CW operation the AUDIO GAIN control is turned in full clockwise position and the RF GAIN control is used to control the sensitivity of the set. It will be noted that when the RF GAIN control is turned back from the clockwise position, the "S" meter will show a minimum reading up-scale from zero.

k. AUDIO GAIN - The AUDIO GAIN control is used to control the audio amplification of the receiver. This control is used primarily during AM and FM reception when the RF GAIN control is usually turned full clockwise to get full AVC action and to permit the "S" meter to read accurately.

m. CW LIMITER - The CW LIMITER control sets the clipping level for the CW noise limiter. The CW noise limiter is turned on when the CW-AM-FM control is placed in the CW position. If limiting is not wanted in CW reception, the CW LIMITER control should be placed in the counterclockwise position (zero). Rotating this control clockwise increases limiting action. This control can be adjusted to limit at the audio level desired. Noise pulses can be limited to the same amplitude as the signal. This control is not used in phone reception since the clipping level for phone reception is pre-determined by the automatic noise limiter.

n. LIMITER - The LIMITER control turns the automatic noise limiter on when placed in the straight up position. This circuit automatically adjusts the limiting threshold according to the strength of the received carrier. It is particularly effective on steep noise pulses, such as automobile ignition noise. Where noise conditions do not warrant its use, the noise limiter may be taken out of the circuit by placing the control in the OUT position. The CAL position on this control is provided to turn on the plate power of a crystal calibrator unit (not furnished).

o. ANT. TRIM. - This control is used to correct the detuning effect which an antenna may have on the input circuit. It should be set for maximim "S" meter reading on each band.

p. ZERO SETTING - This small knob, located just beneath the kilocycle knob, is used to set the line on the KILOCYCLE scale to provide for very accurate frequency readings. This hairline can be set against the crystal calibrator (when installed) or against stations of known frequency or, on some bands, against WWV (at 30 MC on the 10 meter band 15 megacycles on the 20 meter band, and at 2.5 megacycles on the 160 meter band). A linear scale located on the bottom edge of the KILOCYCLE dial opening can be used for locating the setting of the hairline on different bands so that the dial will not have to be recalibrated each time.

q. "S" METER - The "S" meter is calibrated from one to nine in steps of approximately 6 db each, and for 20, 40 and 60 db above S-9. For "S" meter measurements the RF GAIN control should be advanced to the full clockwise position.

3.2.2. OPERATING PRACTICES - In general, the receiver tunes the same way as any conventional receiver. The operator may have to get used to the extreme selectivity of the 75A receiver to fully appreciate it. For instance, actual single signal CW reception is an inherent feature of the receiver.

In addition, interferring signals may be completely phased out or greatly attenuated with the CRYSTAL PHASING control when using the crystal filter on CW. The CRYSTAL PHASING control is very effective on heterodynes in phone reception when the SELECTIVITY control is in position #1 to 4. The phasing notch is very sharp in these positions and must be very carefully sought. It is good practice to tune the signals in, peaking them with the crystal filter in use even though there are no interferring signals at the moment since the stability of the receiver is such that, should an interferring signal appear, the operator can immediately turn the filter on and have maximum selectivity without further retuning.

Position #1 on the SELECTIVITY Control is designed to allow maximum benefit of the rejection notch of the PHASING control without appreciably reducing the width of the "nose" of the selectivity curve. This feature is useful in phone reception. High-pitched heterodynes are noticeably attenuated by the selectivity of the 455 KC I.F. system. This leaves the PHASING control available for attenuating low-pitched heterodynes. The range of the PHASING control has been extended downward to approximately 250 cycles.

In AM operation, when monitoring a frequency where the desired signals are infrequent but of good strength, the background noise with no signal can be reduced by turning back the R.F. GAIN control. This is useful in monitoring a net frequency.

For reception of single-sideband-suppressed carrier signals, the receiver first should be adjusted for AM reception and the signal tuned for maximum indication on the S meter. Then the receiver should be adjusted for CW operation, with the RF gain reduced below the overload point. The BFO PITCH control should then be adjusted carefully to zero beat the suppressed carrier. To make the modulation intelligible, the BFO will need to be adjusted to within a few cycles of the carrier frequency.

To measure most accurately the frequency of a signal, adjust the receiver for AM, set the SELECTIVITY control at position 4, and tune in a signal of known frequency accuracy (such as WWV at 2.5, 15 or 30 MC) for maximum indication on the S meter. Set the ZERO SET control to put the hair line on exact calibration. Then, with the SELECTIVITY control on position 4, tune in the signal to be measured for maximum indication on the S meter and read its frequency on the main tuning dial.

An alternate method is to adjust the receiver for CW operation and tune for exact zero beat with the known signal, then adjust the ZERO SET control to put the hair line on exact calibration. Next, without changing the setting of the BFO control, tune the unknown signal to zero beat and read the frequency from the main tuning dial. Increased accuracy can be realized by using a crystal calibrator unit and using the 100 KC point nearest the unknown signal for the reference. See paragraph 2.5 in this book.

BANDS	160	80	40	20	15	11 †	10 †
XTAL OUTPUT		5.7	9.3	16.5	23.3	31.455	33.455
DIAL READINGS	2.5	3.2	6.8	14.0	20.8	26	28
	2.4	3.3	6.9	14.1	20.9	26.2	28.2
	2.3	3.4	7.0	14.2	21	26.4	28.4
	2.2	3.5	7.1	14.3	21.1	26.6	28.6
	2.1	3.6	7.2	14.4	21.2	26.8	28.8
	2.0	3.7	7.3	14.5	21.3	27	29
	↑	3.8	7.4	14.6	21.4	27.2	↓
		3.9	7.5	14.7	21.5	27.4	
	1.7	4.0	7.6	14.8	21.6	27.6	29.6
	1.6	4.1	7.7	14.9	21.7	27.8	29.8
	1.5	4.2	7.8	15.0	21.8	28	30

*ALSO USED AS BAND PASS PRE-SELECTION COILS ON 160 MC BAND

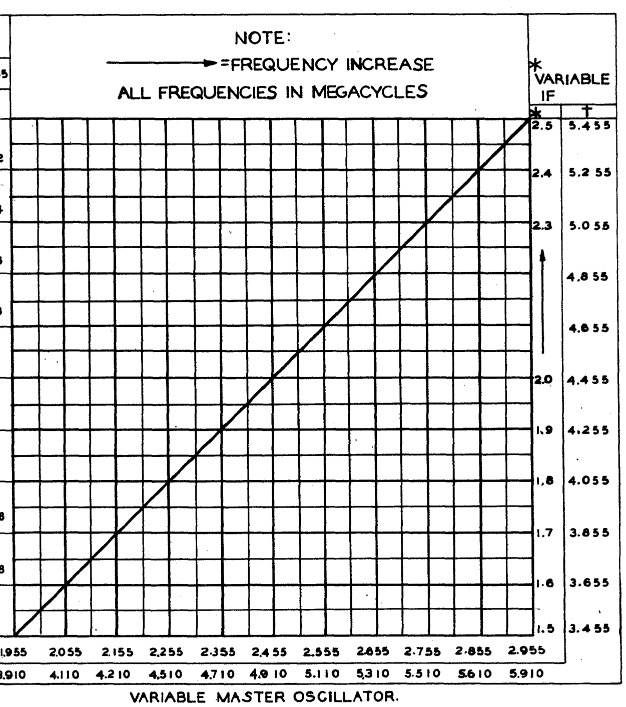

Figure 4-1 Frequency V.S. Dial Division Table

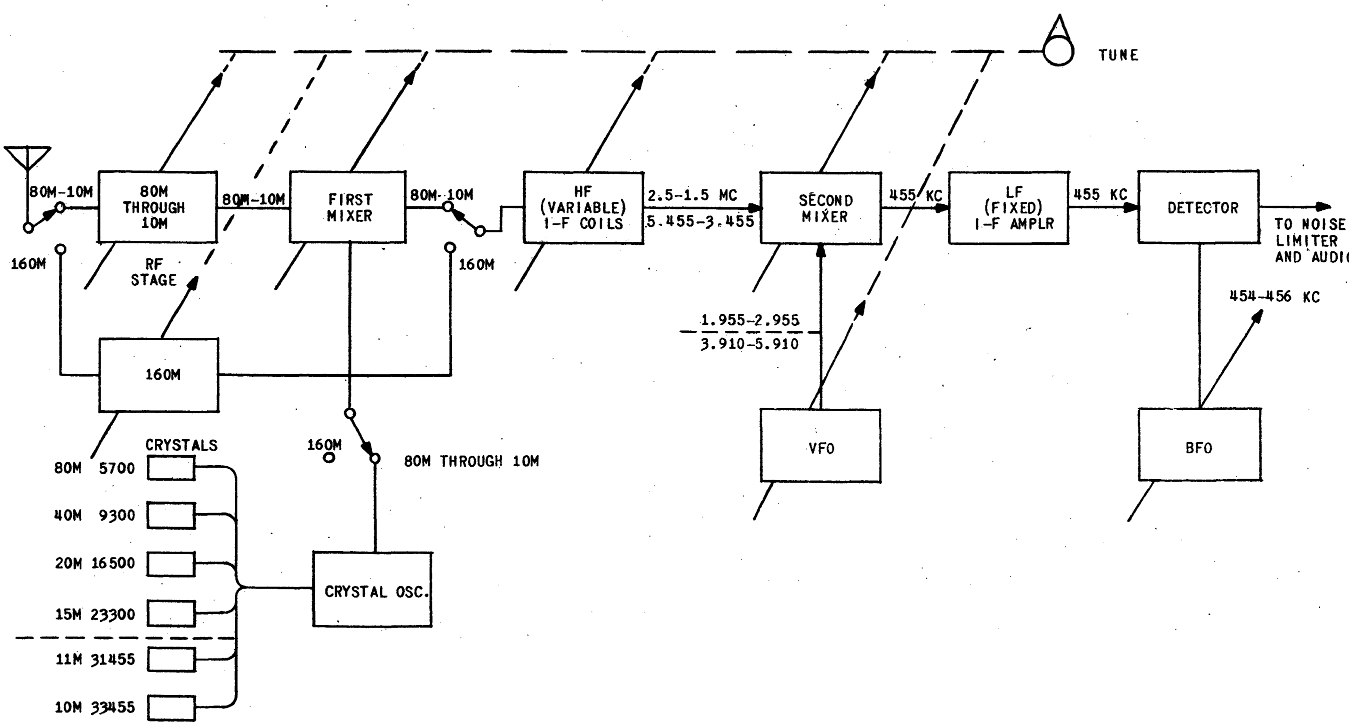

FIGURE 4-2 BLOCK DIAGRAM OF TUNING CIRCUITS

SECTION IV

CIRCUIT DESCRIPTION

4.1. MECHANICAL

4.2. GENERAL

The 75A receiver is constructed in two major units, the receiver unit and the speaker unit. The receiver is constructed on an aluminum chassis. Both the receiver and speaker cabinets are constructed of heavy gauge steel. The receiver cabinet has a hinged cover utilizing inside hinges. Ventilation openings are punched in the sides and rear of the cabinet. The front panel is flush and trimmed for neat appearance. Both the receiver and the speaker cabinets are finished in a hard St. James gray wrinkle finish.

4.3. TUNING

The vernier tuning dial is directly coupled to the lead screw of the variable frequency oscillator thus eliminating any possibility of back lash. The iron cores that tune the RF, first mixer, first IF and second mixer stages are all mounted on a movable platform. This platform is geared and belted to the BFO shaft by means of split gears and metal belts thus giving ganged tuning. The slide rule guide pointer is cable driven. The BFO coil is placed for most efficient operation and a long shaft is used to connect the tuning capacitor with the panel knob. All other stages are fixed-tuned with iron cores.

4.4. BAND SWITCHING

Band switching of RF stages is accomplished by means of a multiple section switch gang. In addition to RF circuits, the band switch selects high frequency oscillator crystals.

4.5. ELECTRICAL THEORY

4.5.1. CIRCUIT - As shown in the block diagram, figure 1-1, the receiver has one stage of pre-selection. A high gain 6AK5 tube is used here because of its excellent electrical characteristics and desirable physcial features. Following the RF stage is the first mixer of the double detection system. The signal grid of the tube, a 6BE6, is tuned to the received frequency, the injection grid receives voltage from the fixed high frequency oscillator circuits at a frequency within a band of either 2.5 to 1.5 megacycle or 5.455 to 3.455 megacycles removed from the received frequency. This oscillator voltage is supplied by a 12AT7 crystal oscillator tube. Since the high frequency oscillator frequency is fixed (by the quartz crystals) the output frequency of the first mixer tube varies. This necessitates a variable IF channel for the first intermediate frequency. Two tuned circuits are used in the variable frequency IF stage. The second mixer is a type 6BE6 tube, the injection grid of which is tuned to the frequency of the variable IF. To produce the second IF of 455 kc (fixed), the output of a precision variable frequency oscillator is fed into the signal grid of the second mixer tube. This oscillator employs a 6BA6 tube in a highly stabilized temperature compensated circuit followed by a 6BA6 isolation stage. The output of the second mixer tube is amplified by a 455 kc IF channel composed of three 6BA6 tubes. A 6AL5 tube as a detector and AVC rectifier follows the IF channel. The audio produced by the detector is amplified by 1/2 of a 12AX7 voltage amplifier and a 6AQ5 power amplifier. AVC bias is produced by 1/2 of a 12AX7 tube in an AVC amplifier circuit. A type 6BA6 tube is used in a BFO circuit coupled to the detector input for CW reception. Single conversion is employed for the 160 meter band wherein the signal is amplified by V-1 and fed directly to the grid of the second mixer through the variable IF filter.

4.5.2. TUNING - Tuning of the RF stage, the first mixer, the variable IF stage, the second mixer and the VFO is accomplished by changing the inductance of the tuned circuits by means of powdered iron cores varied within the magnetic field of the coils involved. The tuning cores of all of the above stages are ganged together and are varied as one unit. The inductance of each coil is trimmed with a similar iron core whereas the capacitance trimming of each coil is done with a variable ceramic capacitor.

An unusual method of band change is employed in the 75A receiver for all bands other than the 160 meter band. In the RF and first mixer stages, the inductance of only one set of coils, the 80 meter set, is directly varied by the tuning cores. To change bands, the 80 meter coils are paralleled with tuned circuits having characteristics which will combine with the 80 meter coils to produce tuned circuits suitable for the new frequency range. Five sets of tuned circuits are used, one set for each band. In each case, however, the 80 meter coil is the only coil in which the inductance is directly varied by the tuning apparatus. Refer to the complete schematic, figure 5-5. The 160 meter band has its own separate antenna coil. The first mixer and crystal oscillator are not used in 160 meter operation. The high frequency range of the variable IF channel is produced by paralleling the tuned i-f coils with additional fixed tuned circuits.

The tuning ranges of the coils in both the RF portions and the variable IF portions are 1000kc in the 160, 80, 40, 20 and 15 meter bands and 2000 kc in the 11 and 10 meter bands. The frequency coverages of the RF stages are:

160 meters = 2.5 to 1.5 mc	15 meters = 20.8 to 21.8 mc
80 meters = 3.2 to 4.2 mc	11 meters = 26.0 to 28.0 mc
40 meters = 6.8 to 7.8 mc	10 meters = 28.0 to 30.0 mc
20 meters =14.0 to 15.0 mc	

The frequency coverage of the variable i-f stage is: 160, 80, 40, 20, 15 meter bands = 2.5 to 1.5 mc; 11 and 10 meter bands = 5.455 to 3.455 mc. In order to produce heterodynes suitable for amplification by the variable frequency i-f stage i.e., 2.5 to 1.5 megacycle or 5.455 to 3.455 megacycle, six high frequency oscillator outputs are necessary.

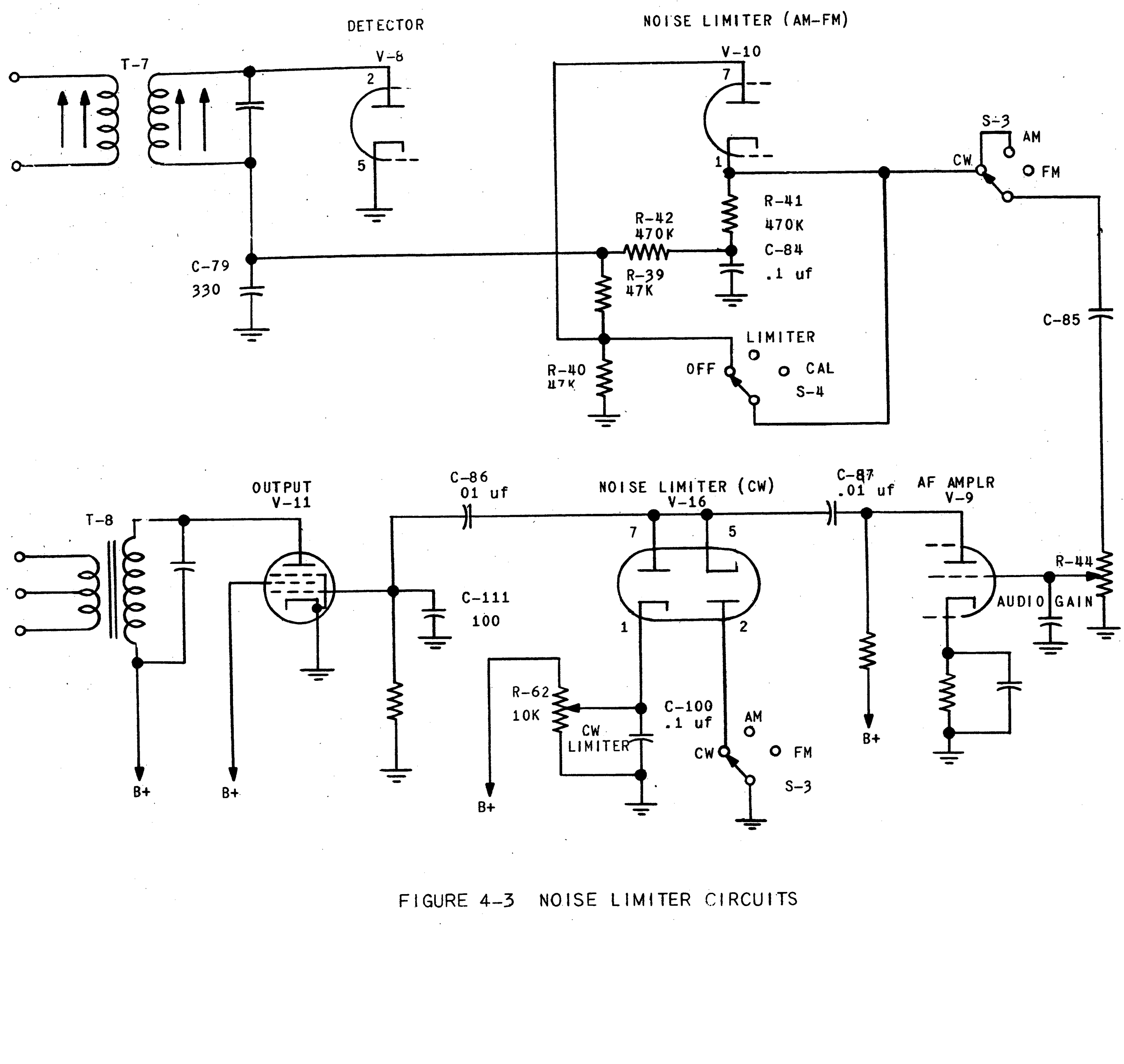

FIGURE 4-3 NOISE LIMITER CIRCUITS

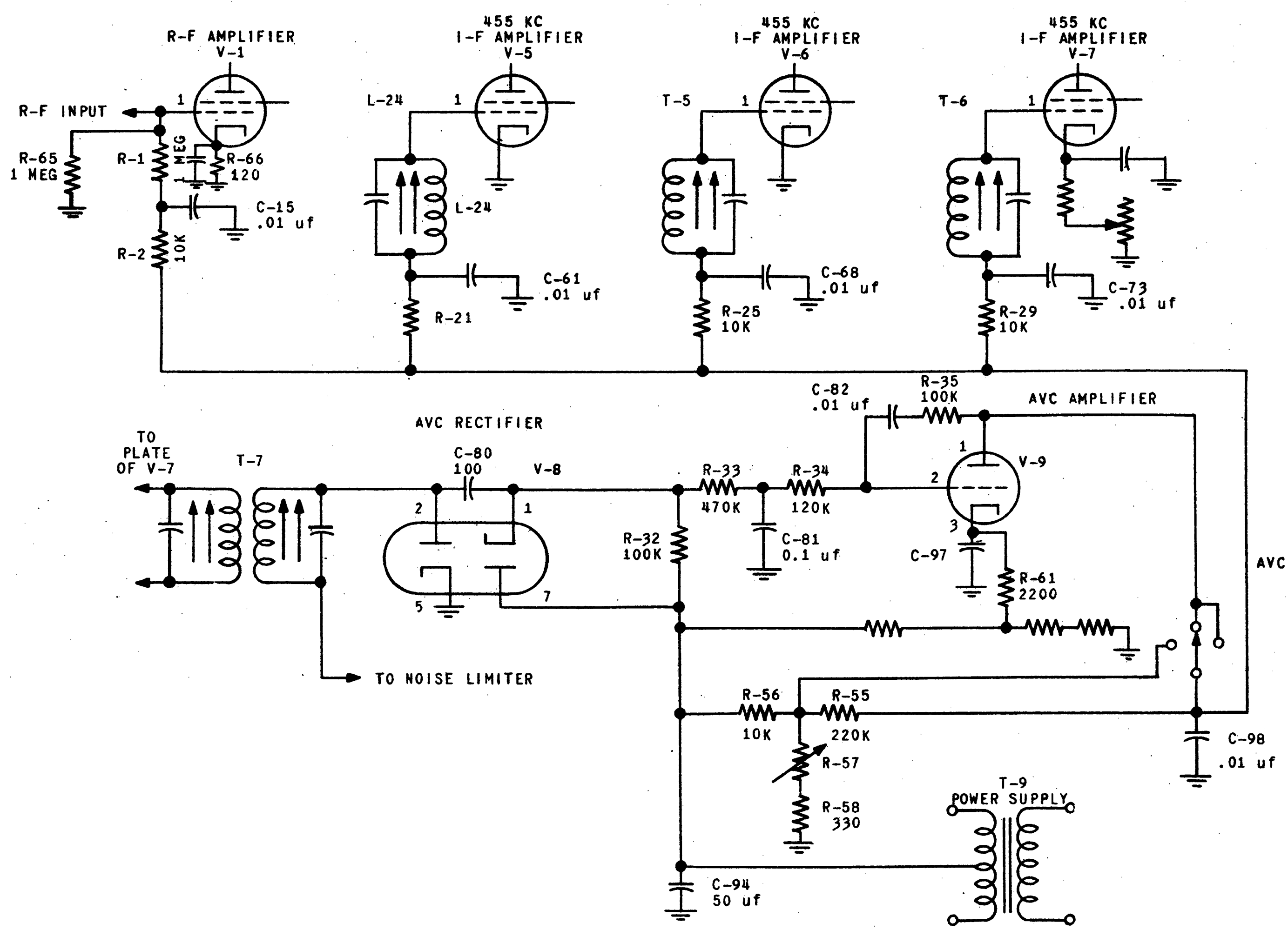

FIGURE 4-4 AVC CIRCUIT

These are obtained by the use of a crystal oscillator and six crystals (one for each band except 160 meters). Refer to figure 4-1 for a complete frequency vs. dial division table.

In each case, the high frequency oscillator output is higher in frequency than the received signal by 2.5 to 1.5 megacycle or 5.455 to 3.455 megacycle depending upon which band is being used.

Refer to figure 4-2. In order to get a 455 kc heterodyne for the second, or fixed, IF amplifier stages, it is necessary to introduce another signal to beat against the variable IF. Since the output of the variable IF changes from 2.5 to 1.5 megacycle or 5.455 to 3.455 megacycle, the output frequency of this new signal must also be variable and in the ranges 2.955 to 1.955 megacycle and 5.910 to 3.910 megacycles. These requirements are met by the use of a Collins 70E-12 precision oscillator which has a fundamental output frequency range of 2.955 to 1.955 megacycles. The second harmonic of the oscillator is 5.910 to 3.910 megacycles; the second harmonic output is used when the variable IF is 5.455 to 3.455 megacycles (when tuning in the 11 and 10 meter bands). The output of the variable i-f and the VFO are mixed in V-4 and the resultant 455 kc output is fed to the first 455 kc amplifier V-5.

The 455 kc intermediate frequency is amplified by a three stage amplifier, the output of which is rectified and sent through the noise limiter and audio amplifiers.

The beat frequency oscillator employs a 6BA6 in a highly stabilized circuit. The dial used in varying the VFO frequency is calibrated +1 and -1 kc; a feature useful in CW work for reading frequency. With the receiver tuned to zero beat, if the dial is set at +1 kc, add 1 kc to the vernier dial reading at zero beat for the exact frequency of the received station or if the dial is set at -1 kc, subtract 1 kc. The BFO PITCH control allows approximately ±2000 cps change from zero beat.

Summarizing the above description of the tuning scheme of the 75A receiver; the received signal beats against the output of a crystal oscillator and produces an intermediate frequency which varies across the band. This variable intermediate frequency is mixed with a variable oscillator output to produce a fixed 455 kc i-f signal. The 455 kc signal is rectified and the resulting audio is fed through an automatic noise limiter to the audio stages.

Linear tuning is accomplished by the use of a cam wound coil, in the VFO, which has the coil turns spaced non-linearly in such a manner that linear movement of the tuning plug within the coil produces a linear frequency output of the oscillator. In addition, a mechanical frequency correcting mechanism is attached to the oscillator tuning slug. All coils which are tuned by movement of the tuning dial are wound similar to the oscillator coil.

4.5.3. CRYSTAL FILTER - Refer to figure 5-5. The crystal filter in the 75A receiver functions as follows: The 455 kc IF channel input transformer T-3 has a tuned primary which is tuned to the intermediate frequency. The secondary on the transformer is a low impedance coil, the center tap of which is grounded.

One stator of phasing capacitor C-58, is attached to one end of this secondary winding while one side of the filter crystal is attached to the other end. A bridge circuit is formed by attaching the rotor of the phasing control to the opposite side of the crystal. This point of attachment must return to ground (or center tap of the secondary of T-3) to complete the bridge of the circuit. This is done through the SELECTIVITY control resistors R-18, R-19, and R-20 or through IF coil L-24. The bridge circuit is necessary to balance out the capacity of the filter crystal holder plates to prevent the signal from bypassing the crystal. If the point of attachment of the rotor of C-58 and the output plate of the crystal was returned directly to ground, the Q of the crystal would be too high, therefore, resistors R-18, R-19, and R-20 are placed in series with the crystal circuit to vary the Q. When the SELECTIVITY switch S-2 is in the zero position, the crystal is short circuited and the selectivity is determined by the receiver circuits only. When the SELECTIVITY control is in position 1, the crystal Q is at its lowest point because of the return circuit through L-24 (a parallel tuned circuit having high impedance). When the SELECTIVITY control is in position 2, the Q of the crystal circuit is improved because of the lower value of series resistance and so on through positions 3 and 4 until at position 4 the series resistance is at the lowest useful value and the crystal Q is highe with a resultant high degree of selectivity.

Because the phasing capacity is across L-24, detuning of L-24 would normally occur when changing the setting of the phasing condenser. To neutralize this effect, an additional set of stator plates has been placed on the phasing capacitor to compensate for this detuning.

4.5.4. NOISE LIMITER - A series type noise limiter is used in the 75A receiver for phone reception. This limiter employs 1/2 (pins 1 and 7) of the type 6AL5 dual diode tube V-10. Refer to figure 4-3. Due to AC loading of the second detector, heavy noise impulses are automatically clipped from the positive audio peaks in the detector. The noise appearing on the negative side of the audio cycle is clipped by the noise limiter. In operation, a negative voltage produced by rectification of the carrier, is developed across capacitor C-84. This voltage can not change rapidly due to the size of C-84 and R-42 through which C-84 is charged. This negative potential is placed upon the cathode of the noise limiter tube through R-41. The cathode is then negative in respect to the plate of the noise limiter tube and plate current flows. This plate current is modulated by the receiver audio. The modulated plate current produces audio on the noise limiter cathode (to which the grid of the audio amplifier section of V-9 is connected). The noise limiter diode will conduct as long as the cathode is negative in respect to the plate, however, when a heavy noise impulse is received, the plate is being driven negative faster than the cathode can follow (due to the time constant of R-42 and C-84). If the plate is driven more negative than the cathode, the tube will cease to conduct and no audio will reach the grid of the following audio tube. The audio cannot reach the cathode of the limiter tube directly from the bottom of the detector transformer because of the filtering action of R-42 and C-84. The percentage of modulation, at which the limiter clips, can be adjusted by changing the values of R-39 and R-40. Increasing R-39 and decreasing R-40 while keeping the sum of their resistances at approximately 100,000 ohms will raise the percentage of modulation at which limiting starts. In this receiver, limiting starts at approximately 35% modulation with sine wave input. Distortion will be evident on heavily amplitude modulated signals, particularly if clipping is used at the transmitter. Switch S-4 bypasses the audio signal around the noise limiter when receiving conditions do not require its use.

4.5.5. CW NOISE LIMITER - A separate noise limiter is used during CW reception. This limiter, a shunt type is bridged across the audio line to the 6AQ5 grid. This limiter short circuits the audio line on noise impulses above the level chosen by the operator. The value of limiting is adjustable by R-62, the CW LIMITER control. Refer to figure 4-3. A dual diode tube is used in this limiter. The adjusting bias applied to pin #1 is obtained from the main power supply. Capacitors C-86 and C-87 accumulate a charge so that clipping will occur equally on both the positive and negative portions of the audio cycle. This limiter is turned on automatically when placing switch S-3 in the CW position. If limiting is not wanted, the CW LIMITER control should be rotated to the counterclockwise position.

4.5.6. AUTOMATIC VOLUME CONTROL - The problem of blocking due to strong signals or heavy static is reduced by the use of an amplified AVC system and a low impedance AVC line. Refer to figure 4-4. The second triode section of V-8 is used as an AVC rectifier to produce the control voltage for the AVC section of amplifier tube V-9. The AVC voltage applied to the grids of the controlled tubes is produced by the voltage drop across resistor R-55 when plate current flows through the AVC amplifier tube V-9. Plate voltage for V-9 is obtained from the voltage drop across resistors R-36, R-37 and R-38 which are in series with the center tap of the power transformer to ground. V-9 will not draw plate current, however, with no signal input to the receiver because of approximately 11 volts of bias placed upon its grid by the voltage drop through R-36. This bias voltage for V-9 is taken from the end of R-32 through which the rectified carrier flows in opposition to the bias voltage. Thus, when the rectified carrier becomes strong enough to overcome the bias voltage on V-9, V-9 will draw plate current and produce a voltage drop across R-55 thereby producing AVC voltage in proportion to the strength of the received signal. The bias on the grid of V-9 is high enough to produce adequate delay in the generation of AVC voltage to allow the receiver to function with full sensitivity on weak signals. Resistor R-33 and capacitor C-81 form the time constant in the AVC circuit. R-34 and C-82 and R-35 are used in a degenerative circuit to prevent the AVC amplifier tube from responding to low audio frequency. The AVC is turned off by opening the plate circuit of the AVC amplifier tube V-9. Tubes controlled by the AVC bias included V-1, the RF amplifier, V-5, V-6 and V-7, the 455 kc IF amplifier tubes.

4.5.7. AUDIO AMPLIFIERS - Two stages of audio amplification are employed in the 75A receiver. The first stage utilizes the second triode section of V-9 in a resistance coupled amplifier arrangement. A type 6AQ5 miniature pentode power amplifier tube is used in the audio output stage. This stage is biased with fixed bias obtained from the voltage drop produced across R-38 in the center tap lead of the high voltage transformer secondary. The 500 ohm secondary of the audio output transformer is tapped at 4 ohms to excite the voice coil winding of a speaker directly. Both the 500 ohm and the 4 ohm outputs are terminated on the rear of the chassis on terminal strip E-3.

Headphone connections are also made to the 4 ohm tap. When the headphones are plugged into the headphone jack J-1, the speaker is disconnected and a 10 ohm loading resistor is connected across the 4 ohm winding in parallel with the headphones to load the 6AQ5.

4.5.8. 148C-1 NARROW BAND FREQUENCY MODULATION ADAPTOR - The Model 148C-1 NBFM adaptor employs a type 6AU6 tube as a limiter and a **type** 6AL5 tube as a frequency discriminator. The limiter tube provides constant input to the discriminator tube due to the high value of grid load resistance (R201). The discriminator circuit used in this adaptor relies on the phase difference between primary and secondary in coupled circuits. A 90° phase difference exists between the primary and secondary potentials of a double tuned, loosely coupled transformer when the resonant frequency is applied, and this phase angle varies as the applied frequency varies. The potentials at either end of the secondary winding with respect to a center tap on that winding are 180° out of phase. When the center tap of the secondary is connected to one end of the primary, the potentials between the other end of the primary and each end of the secondary will reach maxima, one above and the other below the center frequency. At the center frequency, the resultant difference of potential between the two is zero. These potential differences vary at audio frequency rate when a frequency modulated signal is applied to the discriminator input. The audio frequency voltage is taken from the diode load resistors and sent through a de-emphasis network, R208 and C208, to pin number 2 of the power plug P203. The unit is ready to operate at all times by merely throwing the CW-AM-FM control on the 75A-2 Receiver to the FM position which disconnects the AM detector and substitutes the FM adaptor. The regular receiver audio circuits are used for FM reproduction. Operating voltages are provided by the receiver.

4.5.9. 8R-1 CALIBRATOR UNIT - The 8R-1 Calibrator Unit uses a type 6BA6 tube in a Pierce circuit. A 100 kc crystal is used to give check harmonics at every 100 kc spot on the receiver dial. Capacitor C-301 is provided for zero beating the calibrator output with a known frequency standard such as a broadcast station in the tuning range of the 160 meter band or WWV at 2.5, 15 and 30 mc. The calibrator receives its operating voltages from the 75A-2 Receiver power supply and is turned on when the LIMITER control on the 75A-2 Receiver is placed in the CAL position. The output of the calibrator unit is coupled to the grid of the r-f amplifier tube V-1 through the capacity between pins 3 and 4 of crystal calibrator socket E-5.