SURPLUS RADIO CONVERSION MANUAL

VOLUME No. 1
Third Edition

By

R. C. EVENSON AND O. R. BEACH

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PREFACE

Since the beginning of the "surplus era" a real need has existed for a publication devoted entirely to the conversion information necessary to permit practical use of surplus equipment. The amateur radio operator has had especial need for such a publication. The authors have endeavored to fulfil that need in the following pages by compiling the necessary instructions and diagrams for the practical conversion of a number of the most popular items of surplus equipment.

Theory of circuit operation has not been included in this manual so that conversion data on the largest number of equipments could be included. It has been assumed that those persons interested in a manual of this nature are generally familiar with the operation of electronic equipment. It should be noted that the operation of any radio transmitting equipment, including that described herein, requires the issuance of both an operator's license and a station license by the Federal Communications Commission.

The authors regret that time does not permit them to engage in individual correspondence regarding these or other surplus items, and the publisher has been requested not to forward letters.

We have no information on surplus items other than those in these several Manuals

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SCR-211 FREQUENCY METER SET
(BC-221)

The SCR-211 Frequency Meter Set consists of several minor components and the major component, the BC-221 Frequency meter. It is designed to radiate or measure radio frequencies between 125 kc. and 20,000 kc. This frequency measuring device is a precision instrument and is capable of making frequency measurements to a high degree of accuracy.

It should be noted that no conversion of this unit is required for normal use unless it is desired to use an a-c power supply in the place of the required batteries. If the a-c power supply is desired, reference is made to fig. 3 which is self-explanatory.

Since this article is of a descriptive nature, pertaining to the operation and use of the BC-221, the discussion will be made under the following sections:

(a) General Description
(b) Principles of Operation
(c) General Use of the Instrument

(a) General Description

There are many models of the SCR-211 Frequency Meter Set, which include the SCR-211-A, B, C, D, E, F, J, K, L, M, N, O, P, Q, R, T, AA, AC, AE, AF, AG, AH, AJ, AK, and AL.

Even though many of the models are quite similar, there are numerous minor changes. These changes are too numerous to mention in the scope of this article; however the discussion covers the general operation and characteristics which pertain to all models.

All models of the SCR-211 consist of the following components:

1 ea. Calibration Book, MC-177
1 ea. Crystal Unit, DC-9
Set of vacuum tubes, installed
Set of batteries, 6 ea. BA-2 ("B" Batteries)
4 ea. BA-23 ("A" Batteries)
Headset and Cord (applicable type)

There are two types of cases that enclose the BC-221, the wooden type and the aluminum alloy type. The dimensions of the aluminum case are 12-1/2" high, 10" wide, and 9-1/4" deep; the wooden case is slightly larger.

The self-contained battery compartment is designed to hold 6 BA-2 batteries (22-1/2 volts each) and 4 BA-23 batteries (1-1/2 volts each). This gives the required "B" supply voltage of 135 volts and 6 volts for the "A" supply. (Note: minimum voltages for satisfactory operation are 5.4 volts and 121.5 volts for the "A" and "B" supply respectively.)

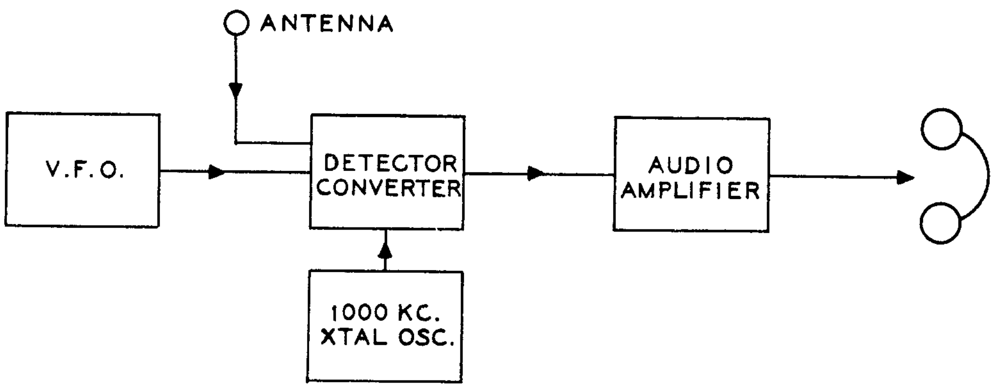
Six different control panel designs appear in the BC-221's varying with the different models and the different manufacturers. This variation is not important since the control labeling and the included unit instructions make the operation self-explanatory.

Each BC-221 unit contains an individually calibrated book, MC-177, permanently attached to the front panel cover.

(b) Principles of Operation

The BC-221 is a heterodyne type of frequency meter employing a 1000 kc. crystal oscillator which furnishes 1000 kc. check points for the variable frequency oscillator. Manual tuning of the variable frequency oscillator is brought out on the control panel with its associated dials.

Two calibration ranges are provided, the 125-250 kc. range and the 2000-4000 kc. range. By use of the 2nd, 4th, and 8th harmonics, the low frequency range covers 250 to 2000 kc. By use of the 2nd, 4th, and 5th harmonics, the high frequency range covers 4000 to 20,000 kc.



With reference to the block diagram of the BC-221, the output of the v.f.o. is heterodyned with the incoming signal from the antenna. After detection the beat frequency is amplified by the audio amplifier and its output connected to headphones.

When the beat frequency reaches the audible range it is heard in the headphones and the final tuning adjustment is made with the v.f.o. to produce a "zero-beat". This indicates the incoming frequency and the dial reading is taken.

The above description of operation refers to an incoming signal such as checking a transmitter. Since the BC-221 also radiates its v.f.o. signal, receiver calibration and checks are made similarly by the "zero-beat" method as heard in the receiver output.

From the following factors: mechanical shocks, locking action of dial, warming up, change of load at antenna, 10 per cent change in battery voltage, error in calibration, and error in crystal frequency, the maximum error should not exceed .034 per cent at 4000 kc. Normally the errors tend to cancel each other so that the normal error should not exceed .02 per cent.

(c) General Use of the Instrument

Reading the frequency meter dial consists of three individual steps. The first two digits are read on the hundreds dial (drum dial). From the large circular dial, labeled "units", the second two digits are read. The vernier scale (located on circular dial) provides the fractional digit in the conventional manner. Thus the following example reading can be obtained: 45 87 . 5. This dial reading is then checked in the calibration book to obtain the frequency of the signal being measured.

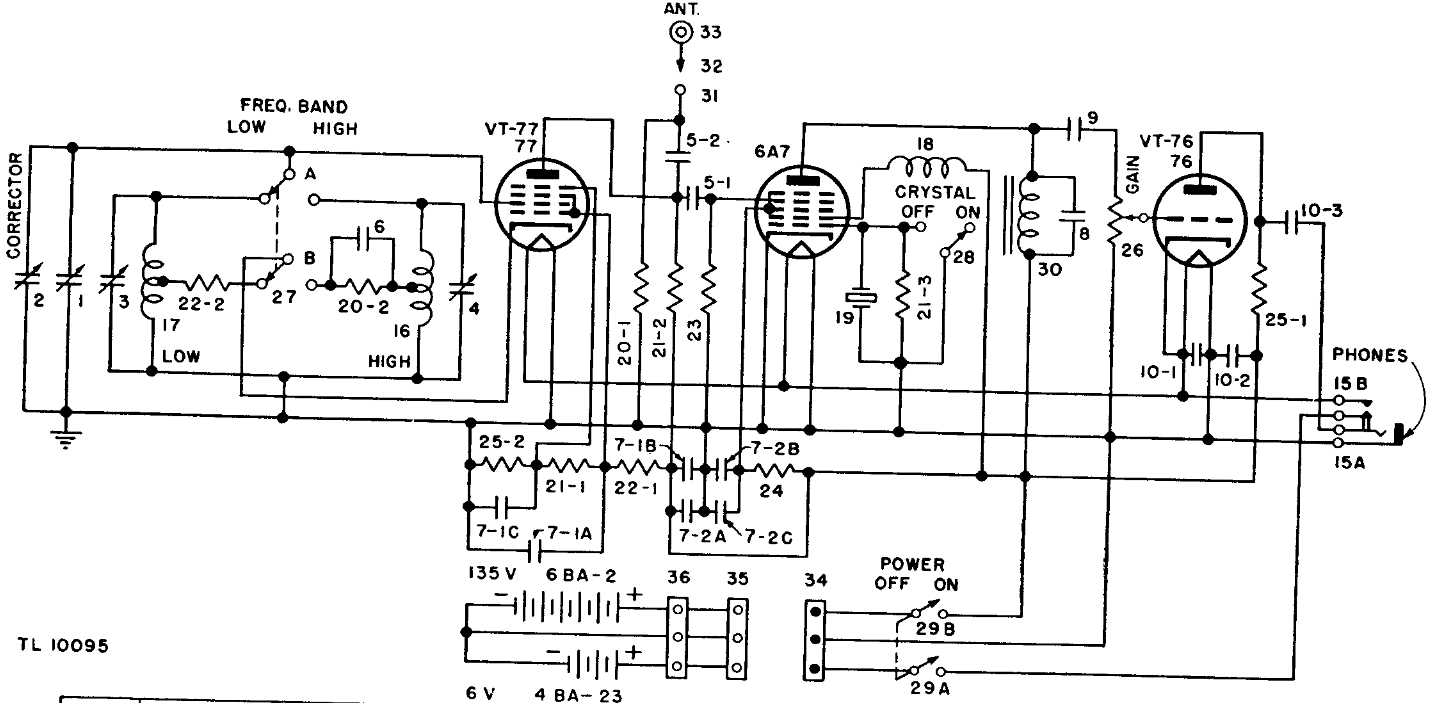
For transmitter frequency measurements, a 2-foot piece of rigid copper wire is adequate for the frequency meter antenna. The antenna should be only in reasonable proximity to the transmitter output. Care should be exercised to avoid allowing excess r-f to enter the frequency meter which can cause permanent damage.

In making frequency checks or dial calibrations with a receiver, the frequency meter antenna lead should be only loosely coupled to the receiver input. This can be close proximity or the wrapping of the respective leads.

At no time should the frequency meter be directly connected for frequency measurement purposes.

In all models of the BC-221, high impedance headphones should be used for optimum performance. The earlier models specified the P-18 and the P-20 headphones while the later models specified the HS-30.

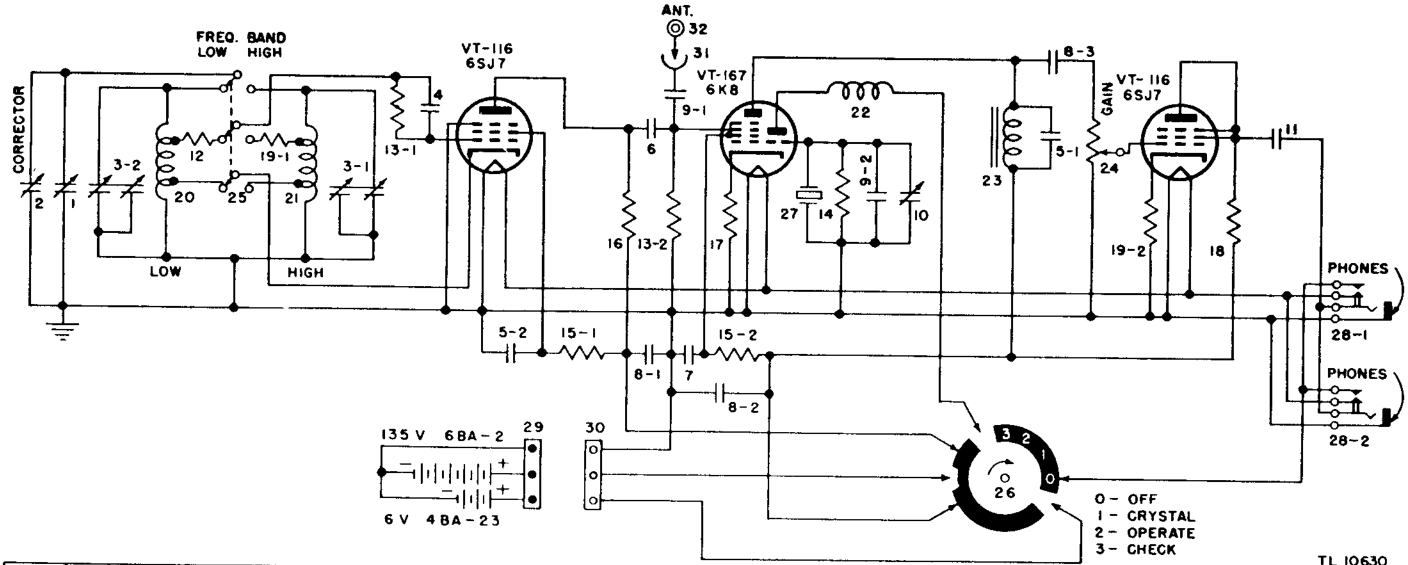
A point worthy of mention is that in certain measurements where visual observation of the "zero-beat" is desired, an output meter with an appropriate impedance matching device can be used in place of the headphones.



TL 10095

REF	DESCRIPTION	REF	DESCRIPTION	REF	DESCRIPTION	REF	DESCRIPTION	REF	DESCRIPTION
1	150 μμf	7–1C	0.1 μf	15B	FIL. SWITCH	23	1 MEGOHM	31	ANT. PLUG
2	2 μμf	7–2A	0.1 μf	16	HIGH FREQ. COIL	24	30,000 OHM	32	CONTACT SPRING
3	10 μμf	7–2B	0.1 μf	17	LOW FREQ. COIL	25–1&2	15,000 OHM	33	BINDING POST
4	10 μμf	7–2C	0.1 μf	18	1.7 MILLIHY	26	0.5 MEGOHM	34	POWER PLUGS
5–1&2	10 μμf	8	.001 μf	19	CRYSTAL	27	SWITCH	35	POWER JACKS
6	250 μμf	9	.02 μf	20–1&2	5,000 OHM	28	SWITCH	36	BATTERY TERM
7–1A	0.1 μf	10–1,2,3	0.5 μf	21–1,2,3	50,000 OHM	29	SWITCH		
7–1B	0.1 μf	15A	JACK	22–1&2	10,000 OHM	30	450 HENRYS		

FIG 1 *Frequency Meters BC–221–C and BC–221–D, schematic diagram.*



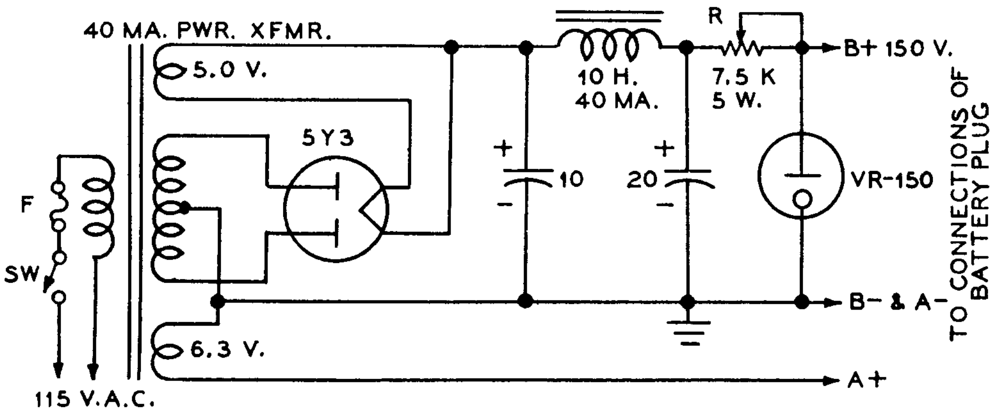
REF	DESCRIPTION	REF	DESCRIPTION	REF	DESCRIPTION	REF	DESCRIPTION	REF	DESCRIPTION
1	220 μμf	8-1,2,3	.05 μf	15-1&2	8,750 OHM	22	735 MICROHY	29	POWER PLUGS
2	1 μμf	• 9-1&2	12 μμf	16	50,000 OHM	23	300 HENRYS	30	POWER JACKS
3-1&2	25+4 μμf	10	12 μμf	17	75 OHM	24	1 MEGOHM	31	ANT. CLIP
4	100 μμf	11	2 μf	18	12,500 OHM	25	SWITCH	32	BINDING POST
5-1&2	.002 μf	12	4,500 OHM	19-1&2	350 OHM	25	SWITCH		
6	50 μμf	13-1&2	150,000 OHM	20	6.5 MILLIHY	27	CRYSTAL		
7	.001 μf	14	1 MEGOHM	21	25 MICROHY	28-1&2	JACKS		

• REF. NO. 9-2 IS 6μμf

FIG 2 *Frequency Meter BC-221-Q, schematic diagram.*

REGULATED POWER SUPPLY FOR THE BC-221

Figure 3 shows an easily constructed voltage-regulated power supply for operation of the BC-221 frequency meter. The series resistor R should be adjusted, with the BC-221 serving as a load for the power supply, until the current from the cathode terminal of the VR-150 to ground is approximately 15 ma.

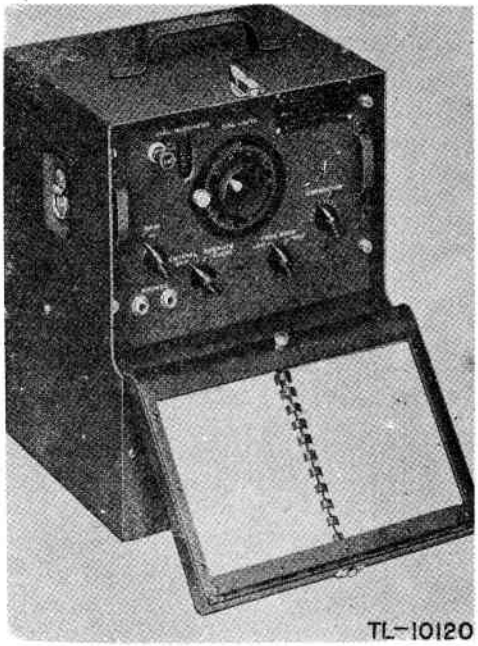


The existing "OFF, CRYSTAL, OPERATE, CHECK" switch is removed from the "A" (+) battery circuit. The positive "A" heater lead from the power plug is connected directly to the ungrounded side of the filament buss.

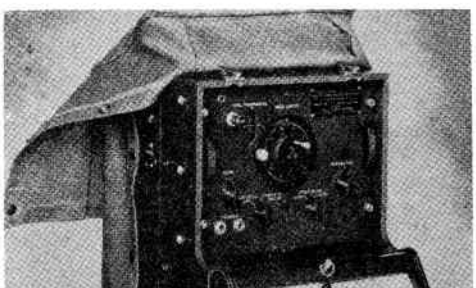
In earlier models of the BC-221 such as the BC-221C, fig. 1, the cathode of the amplifier tube may be connected directly to the filament which provided its bias. In such cases it is necessary to break this connection and run the cathode to ground through a proper value cathode resistor. If this is not done excessive hum will result in the frequency meter output.

On certain models such as the BC-221Q, fig. 2, the "B" (+) lead may be left intact with the original switch. This arrangement in conjunction with the power "OFF-ON" switch permits warm-up of the unit without signal radiation.

The switch for the new power supply (Sw) may be located on the frequency meter cabinet or chassis as desired.



Frequency Meter BC-221-(&), in metal cabinet.



Frequency Meter BC-221-(&), in wooden cabinet.

CONVERTING THE BC-342 RECEIVER

Though the BC-342 Signal Corps short-wave receiver has not appeared in quantity on the surplus market, the BC-312 has been widely available. Either is considered an ideal piece of equipment that can be readily modified and used very nicely as a communications receiver. Either can be made to perform comparably with receivers that sell on the current market for three and four times the price.

The BC-342 is designed to operate on 115 volts ac, 50 or 60 cycles. The direct current version of the BC-342 is the BC-312 (12 volts, dc). Since the major part of the BC-312's conversion is identical to that of the BC-342, only a small part will be devoted to it under a separate title with general reference directed to this article.

Among the most recent models of the BC-342 and BC-312 appearing on the market are the "M" and "N" models. Since the later models are not greatly different from the earlier models, the converting procedure can apply to all of them without regard to the slight variations. The most apparent variation is the omission of the Crystal Filter on the later models of the BC-312.

As is immediately apparent, these Signal Corps receivers were built for service rather than for beauty. Even though it is not as pretty as the modern communications receiver, the ham can be reasonably assured that this receiver is one of the most rugged, both mechanically and electrically, that has ever been built. It has relatively high sensitivity and good stability. Its frequency range is 1500 to 18000 kc. thereby not covering the broadcast band or the 10-meter band. Converters for the high-frequency bands work nicely with this receiver, since direct coaxial coupling to the antenna input is provided on the front panel of the receiver.

The BC-342 has the following tube line-up with the respective functions:

2 ea	6K7	(VT-86)	1st & 2nd RF amplifiers
	6C5	(VT-65)	RF oscillator
	6L7	(VT-87)	1st Detector
2 ea	6K7	(VT-86)	1st & 2nd IF amplifiers
	6R7	(VT-88)	2nd Detector, AVC, 1st Audio amp.
	6C5	(VT-65)	CW Oscillator
	6F6	(VT-66)	Audio output amplifier
	5W4	(VT-97)	Rectifier

The r.f. oscillator stage has been well stabilized, making the drift and dial calibration quite accurate. The frequency coverage of the receiver is accomplished in six bands, with directly calibrated, fast and slow vernier knobs. Since the military requirements were not those generally required for ham use, the following modifications and refinements will be covered:

(a) Modification for the RF Stages
(b) Modifying the Crystal Filter
(c) Backlash Improvement in the Tuning Mechanism

(d) Reducing the Audio Hum Level
(e) Connection for the "send-receive" Switch
(f) Improvement for the Audio Section
(g) Additional Circuit Refinements
(h) Optional Refinements and Suggestions

(a) Modification for the R.F. Stages

Since the r-f stages are operated with a higher than rated grid bias and lower than rated screen voltage, the receivers have a noticably lower signal to noise ratio than is expected in good communication receivers. Increasing the gain of the r-f stages materially improves this condition.

The existing cathode resistors of the 1st and 2nd r-f stages, R_1 and R_7, are 500 ohms. These should be reduced to 250 ohms. The screen resistors, R_3 in the 1st r-f stage and R_9 in the 2nd r-f stage, should be reduced from the original value of 40,000 ohms to 20,000 ohms. These changes give a grid bias of about -3 volts relative to the cathode and a screen voltage of approximately 130 volts. Another recommended feature is the removal of the 1st r-f stage from the manual r-f gain control permitting this stage to operate at maximum gain when using the MVC. This change provides optimum signal-to-noise ratio when the manually controlled gain is reduced to the desired listening level.

To make the above alterations it is necessary to remove the shield plate at the rear of the chassis behind the mixer and the r-f amplifier tubes. The screen resistors are located underneath the plate on the mounting strip and are identified from the schematic diagram as R_3 and R_9. An easy way of making the change is to shunt the existing 40,000-ohm resistors with similar and equal resistors thus giving a value of 20,000 ohms.

The existing cathode resistors are located at the sockets of the tubes requiring the removal of the tube mounting plate. Substitute 250-ohm, 1/2-watt resistor for R_1, soldered between the cathode pin and pin No. 1 (ground). R_7 is replaced with a 250-ohm resistor between the same points as the original resistor.

The increase in gain from the above changes should show a definite peak noise by tuning the trimmer on the 1st r-f stage with the antenna disconnected.

(b) Modifying the Crystal Filter

The crystal filter, which is electrically located just before the 1st i-f stage, is a crystal tuned bridge circuit intended to give greatly increased selectivity. Since the military version seriously reduces the signal level, its operation is not considered up to the requirements to warrant its use; however, the following modification will give radical improvement.

As it is, switching the filter in and out changes the shunting capacitance across the secondary of the i-f transformer to such an extent that the stage is considerably detuned, thus reducing the sensitivity. To avoid this radical change in capacitance at the switching point, which is done by a switch on the capacitor shaft, the switching point should be changed mechanically to close when the phasing capacitor is at minimum capacitance.

The best method of doing this is to force the switch blade around 180 degrees on its collar. Since all switches are not conducive to this treatment without breaking it may be necessary to solder the blade to the collar in its new position. After this change is made and functioning properly it is necessary to readjust the alignment of the i-f transformer secondary in which the crystal filter operates. This adjustment is made at the top of the first detector transformer. It is preferable to align it on noise with the crystal switch out. Now the signal strength should be the same with the filter out, or peaked on the noise when it is in. The crystal selectivity is not too great but considered good for ordinary operation.

A refinement frequently made to make the crystal filter tuning less critical, is to reduce the capacitance of the variable phasing capacitor. This is done by removing (breaking) approximately half of the stator plates from the capacitor. Since it is not necessary to remove the filter assembly for this operation, it is an easy refinement to add.

(c) Backlash Improvement in the Tuning Mechanism

Generally backlash is not considered as being too bad in these receivers. However, it is always the general desire to minimize this condition. The largest part of the backlash occurs between the worm gear and its mating gear on the capacitor shaft. To tighten the mesh of these two gears is a major operation generally not recommended since it requires considerable dismantling of the mechanical tuning assembly. However, in most cases improvement can be obtained by reducing the amount of end play on the worm-gear shaft. This is done by increasing the spring tension on the worm. To do this, loosen the collar, pressing it lightly against the spring, and retighten it in its new position.

(d) Reducing the Audio Hum Level

Frequently a relatively high hum level is present in these receivers. It is generally due to insufficient power supply filtering and use of the output stage for headphone reception.

If insufficient filtering in the power supply is apparent, it is recommended that midget 8 mfd. filter capacitors be shunted across the existing filter capacitors C89 and C90 in the power supply section.

Modification of the audio section as discussed under section (f) of this article will give definite improvement in the hum level for headphone reception.

(e) Connection for the "send-receive" Switch

The "send-receive" switch does not operate the receiver since it is connected into the external plug on the front of the receiver. To make it operate in the normal fashion, it is necessary to remove the leads from the switch and connect one terminal of the switch to the chassis (ground). Disconnect the high-voltage center-tap lead from the negative terminal of the filter capacitor in the power supply and connect this lead to the other side of the "send-receive" switch. This lead is brown in color and long enough to reach the switch through the grommet in the power supply case. The "send-receive" switch should be kept in the center tap lead so as to keep it in the low-potential side of the "B" circuit thus avoiding high voltage at the switch and also eliminating switch "pops" that occur when switching in the high-potential side.

(f) Improvement for the Audio Section

Since this set is capable of supplying adequate audio volume for headphones at the output of the first audio amplifier stage, it is advisable to shift the lower phone jack connection to the output of the first audio stage. This stage is the triode section of the 6R7. Hum and noise which may normally be picked up by the additional audio output stage is reduced considerably.

This change can be accomplished by connecting the lower jack, at the right side of the front panel and labeled 2nd audio phones, to the grid (pin No. 5) of the output tube, the 6F6. In some models this modification will not be necessary since one of the jacks is already connected in the first audio output and labeled accordingly.

To improve further the above modification, it may be preferred to replace the existing jack with an open-circuiting type jack which opens the grid circuit to the output tube when the headphones plug is inserted. This is normal practice in most communication receivers since it removes the speaker output when the headphones are used. If the speaker is not connected, the open-circuiting jack removes the possibility of very high voltages that may be developed at the plate of the output tube with large signals when the circuit is not loaded. These voltages can easily be high enough to arc between the electrodes in the output tube or break down the insulation in the output transformer.

Transformer T_1 is an audio interstage transformer that is used in some models for headphones output from the first audio amplifier. In other models, the transformer is connected to the external plug on the front panel and serves no purpose in the normal operation of the set.

Since the output transformer, T_2, has an output impedance of approximately 3000 ohms, it is not considered practical for normal use. It is generally desired to replace this transformer with a standard output transformer matching the 6F6 to the desired voice coil impedance. This works out nicely with a 6 or 8 inch PM speaker. When changing output transformers, it is possible to select the physical size which can be squeezed into the original position of T_2. The secondary leads can be brought out as before to the speaker jack with the jack labeled accordingly.

If the changing of output transformers is not desired, the existing output of transformer T_2 can be fed directly into another output transformer having a primary impedance of 3000 or 4000 ohms when connected to the speaker voice coil. This method has been used satisfactorily and will eliminate the work in changing transformers.

Additional refinements considered advisable, especially if more audio volume is desired, are changing the following circuit components in the audio section of the receiver.

Replace the 6R7 detector first audio tube with the high mu 6Q7. This is an easy change since the socket connections are the same and only the cathode resistor, R_{28}, must be altered for the proper bias. This is easily done by shunting the existing resistor, R_{28}, with a 300-ohm, 1/2 watt resistor.

The diode filter resistor, R_{49}, is a relatively high value, being 0.5 megohms. Considerable increase in volume can be obtained by reducing this value to normal proportions. This can be conveniently done by shunting the existing resistor with a 100K 1/2-watt resistor.

It will also be noted that the grid resistor, R_{33}, of the output stage is considerably lower than normally used. This resistor should be increased from the existing 50K to 250K.

The above changes will give much increased audio volume which will be more than adequate for speaker and headphone operation.

(g) Additional Circuit Refinements

Noise Limiter:

To bring your receiver up into the top class of communication receivers, the addition of the suggested noise-limiter circuit will be well worth while. This is a series-type limiter using the 6H6 diode with an IN-OUT switch. The schematic diagram should be self-explanatory as shown in fig. 1.

If desired, the entire limiter, tube and all, can be encased in an old i-f transformer can. This will give a professional appearance to the installation, and the assembly may be easily mounted inside the receiver on the chassis.

"S" Meter:

Since many hams do not consider the communication receiver complete without a signal-strength meter, the circuit shown in fig. 1 is recommended. This circuit is standard and considered quite satisfactory.

It is generally considered inconvenient to mount even a small meter on the front panel of the receiver. This is true because of limited space and the thickness of the panel which makes cutting of the hole rather difficult. In most cases, the meter is mounted externally on a bracket to the receiver case.

Separate R.F. Gain Control:

An optional feature that is sometimes desired, is separate and individual r-f and a-f gain controls that are not switched in and out with the AVC switch, SW-12.

This control, as in the military version, consists of the tandem potentiometers, R-34 and R-35. To separate them it is necessary to disconnect one, preferably the a-f, R-34, and add an additional 500K potentiometer to the panel for the new a-f gain control. After this is done, the

MODIFIED AUDIO SECTION OF BC-342 & BC-312

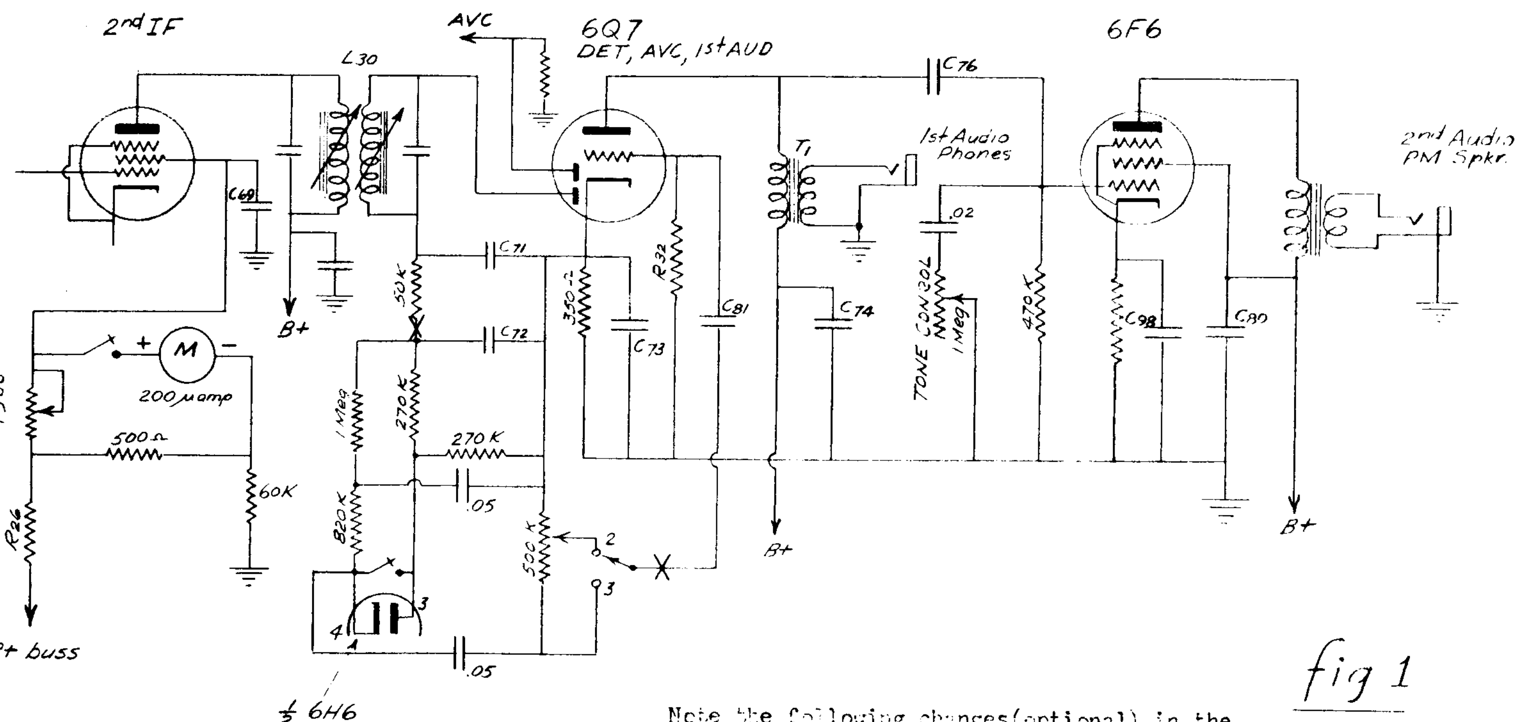


fig 1

NOTE- R25 replaced by S-Meter circuit resistor of 60KΩ. This value is adjusted for meter full scale sensitivity.

Note the following changes (optional) in the completely modified audio section.

1. Output transformer, Plate to Voice Coil
2. 6Q7 for 1st Audio Stage
3. Added "S"-Meter Circuit
4. Added Noise Limiter Circuit (between X's)
5. Tone Control Circuit
6. All indicated condenser and resistor values represent changed values.

leads to the two controls should be reconnected to by-pass switch, SW-12. With this change, the switch in the 2nd and 3rd position only controls the AVC circuit, being either ON or OFF.

Tone Control:

Occasionally a tone control is desired for listening ease and can be added to the receiver. This is quite convenient especially if the receiver does not have the crystal phasing control which is physically replaced with the dial light rheostat on the panel. Since the rheostat is useless in most cases, it can readily be replaced with any other desired control or in this case, the tone control.

A simple type of tone control circuit is shown in Fig. 1.

(h) Optional Refinements and Suggestions:

Among the many personal touches that may be added to the BC-342 and BC-312 for appearance and ease of operation, the following may prove to be ådvantageous or possibly stimulate new ideas:

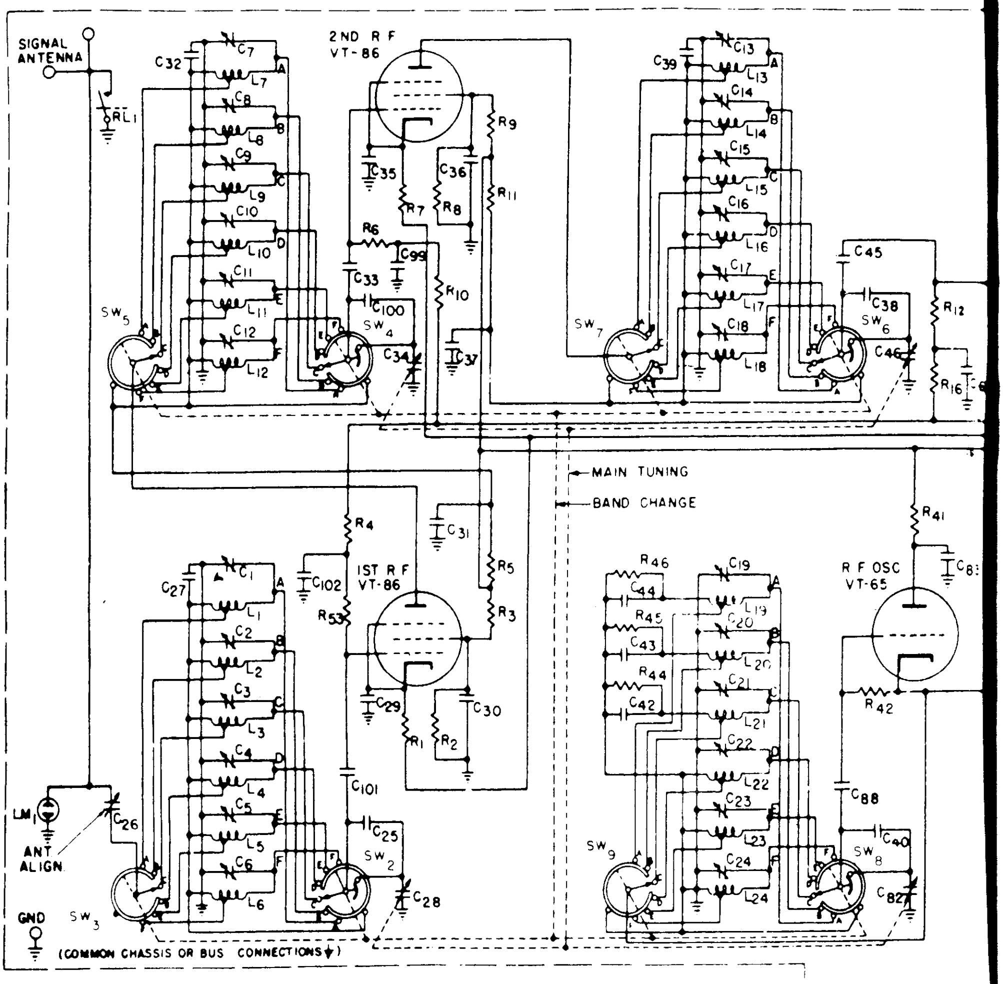
The external plug, SO-1, located on the front panel was intended for use with other associated equipment of which the receiver was a component part. Ordinarily there is no particular need for this plug and it can be removed from the panel. The remaining hole can be plugged or used for added controls. The leads to plug SO-1 should be removed at convenient points in the receiver.

The small vernier tuning knob (1/4" shaft) can be replaced with a larger and more attractive knob which will facilitate fine tuning.

Rubber grommets, inserted in the slide fastener holes on bottom of the receiver case, will serve as a partial shock mount and will eliminate the possibility of sliding or scratching.

The unused jacks on the front panel can also be put to use as desired, such as a phono or audio input to the audio amplifier section. There may be other uses for the jacks that will apply the individual's particular needs.

As will be apparent to the average ham, a number of the above suggestions for conversion of the BC-342 or the BC-312 are optional and will be up to the personal requirements of the individual concerned. With the above conversions this receiver can be made very suitable for ham use with its performance comparable to the high priced communication receivers.



Radio Receiver BC-342-M
Schematic Diagram

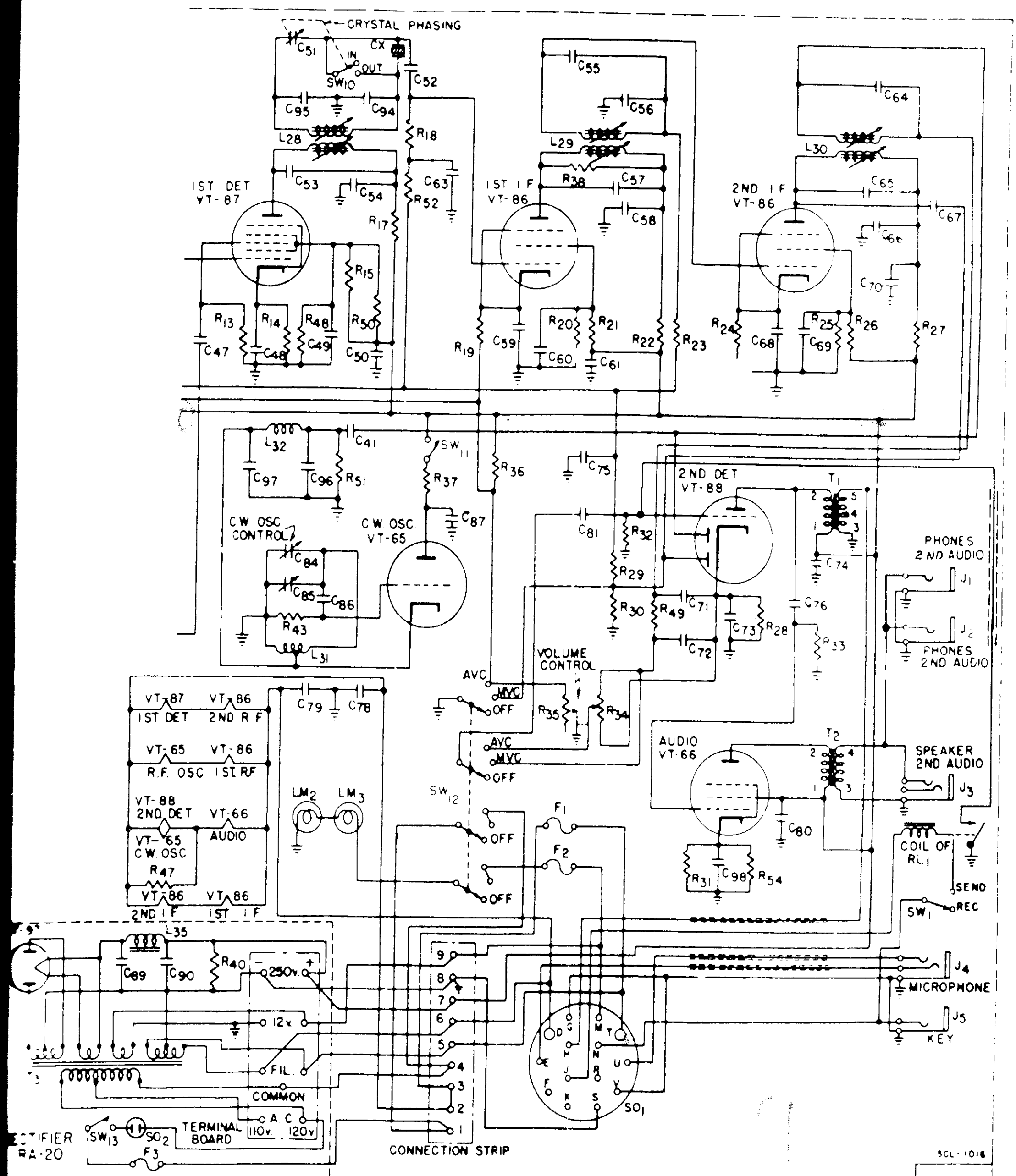


FIG 2

Radio Receiver BC-342-M
Schematic Diagram

CONVERTING THE BC-312 RECEIVER

This conversion directly supplements the conversion of the BC-342 receiver since the BC-312 is identical to the BC-342 with the exception that it is the direct current version designed to operate from battery power.

Again it should be noted that the different models of this receiver, as indicated by the alphabetical letter, have minor differences. The BC-312A has a thermostatically controlled heater in the oscillator compartment and a noise balancing network in the antenna circuit. The noise balancing network was retained in the "C" model but omitted in later models. Models A, C, D, E, F, and G, all have the crystal filter, but in later models some were supplied with and some without. This was generally dependent on the manufacturer that made them. On models made after the "G", some sets were designed to operate on 24-28 volts and were designated by the letter "X" after the alphabetical letter. However, most of the BC-312 receivers were designed to operate on 12 volts d.c. at approximately 7 amperes.

If it is desired to operate the set on direct current, connections may be made directly into the socket on the front panel with the 12 volt connections made as indicated on the schematic diagram, Fig. 4. For this operation it is also necessary to ground lug No. 8 on the terminal strip located near the front right corner of the chassis.

This article applies to the conversion of the BC-312 for a-c operation. Other conversion data for the receiver is covered in the conversion of the BC-342.

After inspection of the BC-312, it will be apparent that the dynamotor must be replaced with a conventional power supply and that the series-parallel wiring of the tube heaters must be revamped if 6-volt heater operation is desired. An alternate method, which eliminates the difficult rewiring of the heater circuit, is to leave the wiring as is and operate the heaters on slightly less than 12 volts a.c. This is accomplished by using the 6X5 rectifier with the 5 and 6 volt windings connected in series thus supplying approximately 11.3 volts a.c.

The least difficult method of adding the new power supply is to make it an external unit to the receiver. However, this makes for a more bulky arrangement with connecting leads between the power supply and the receiver. With careful selection of parts and a little extra time devoted to the job, the new power supply can be contained in the dynamotor case and thereby kept inside the receiver as is done in the BC-342.

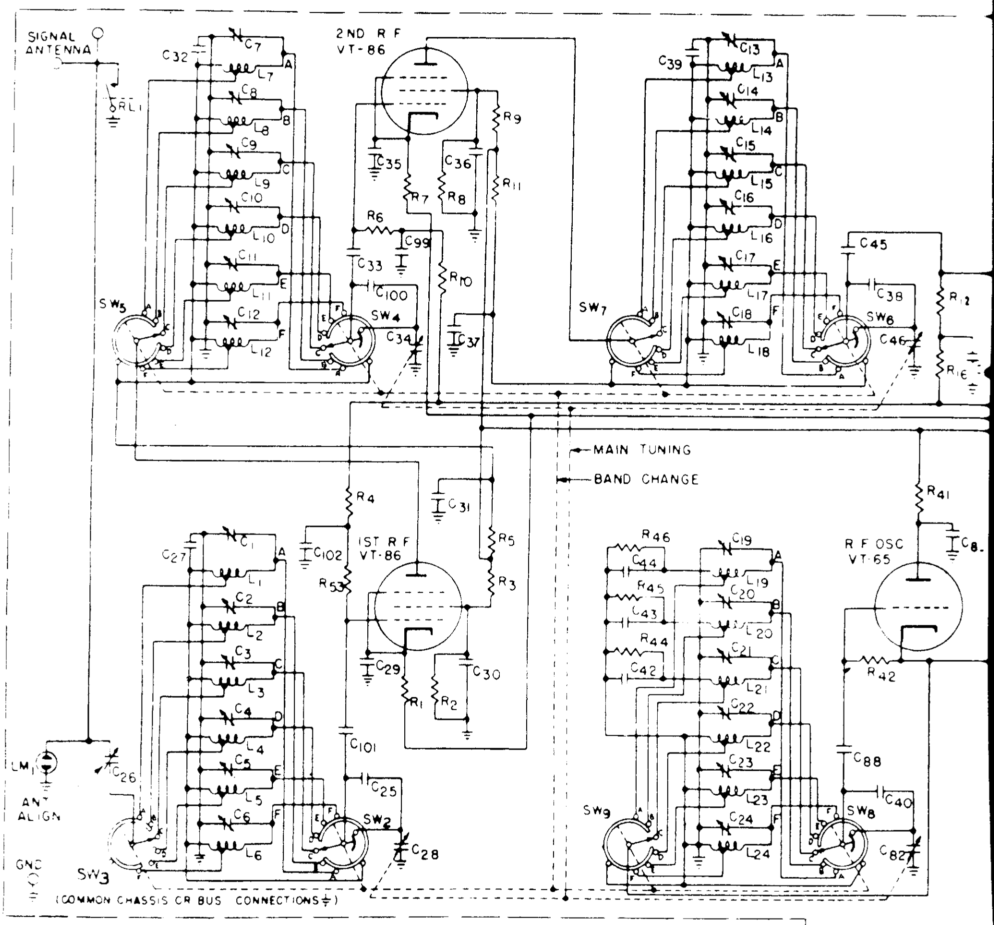
A point worthy of mention is that there have been a few of the BC-342 power supplies, the RA-20, on the surplus market. These are a fortunate find for the BC-312. The RA-20 power supply can be directly interchanged with the dynamotor assembly.

In constructing the new power supply unit, a selected 90-ma. power transformer with both the 5 and 6 volt windings can be fitted with a filter choke, a 16-16 mfd. filter capacitor, bleeder resistor, and the rectifier, 5Y3GT, in the old dynamotor case. This will cause a rather crowded condition but is well worth while if it is desired to have the power supply inside the receiver.

Both the 6-volt and the 12-volt heater version of the recommended power supply, with parts list and connection diagram, are shown in Fig. 3.

It will be noted that the existing OFF-ON switch, SW-12, and the fuse on the front panel are incorporated in the 115-volt circuit of the new power supply. The dial lights are connected directly across the heater circuit at any convenient point in the set. These leads should be twisted and kept away from the grid and plate circuits as much as possible.

For other circuit refinements and modifications, refer to "Conversion of the BC-342."



Radio Receiver BC-312-M
Schematic Diagram

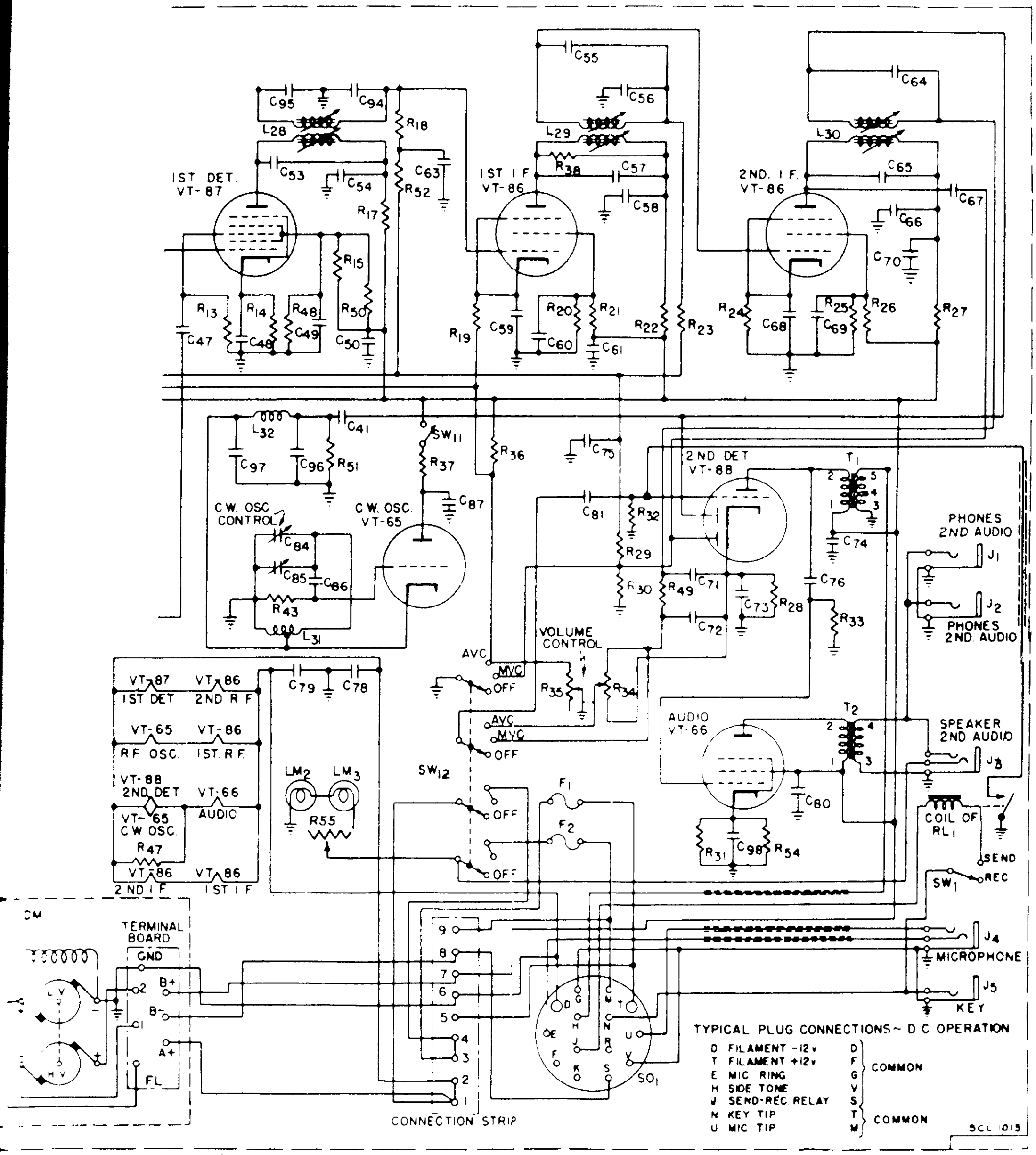


FIG 4 -RADIO RECEIVER BC-312-M SCHEMATIC DIAGRAM

POWER SUPPLY FOR BC-312 RECEIVER

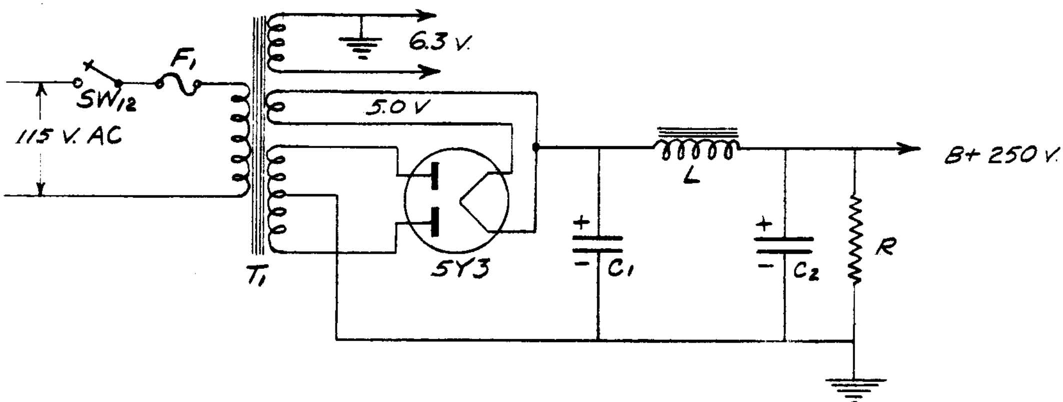
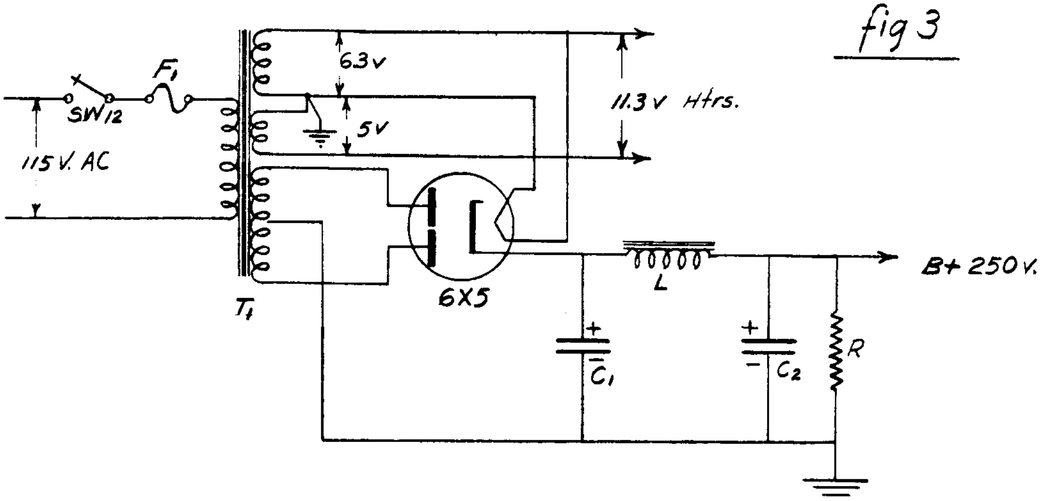
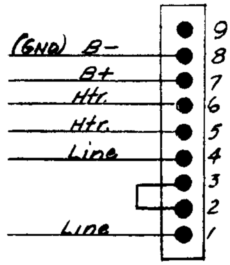


fig 3



PARTS LIST	
T1	Power X'former, 300-CT-300 V/90 MA, 6.3 V., 5 V.
L	Filter Choke 15 H, 90 MA
C1-2	Condenser, Filter 16-16 MFD, 450 V.
R	Resistor, 50,000 Ω, 5 WATT
SW12	Switch, MVC-AVC in Receiver
F1	Fuse on Receiver Panel, 2 Amp.



COMPONENT PARTS LIST FOR BC312 RECEIVER

CAPACITORS

C1	CA-289	3-25 uuf.
C2	CA-291	6-100 uuf.
C3	CA-291	6-100 uuf.
C4	CA-290	4-50 uuf.
C5	CA-290	4-50 uuf.
C6	CA-290	4-50 uuf.
C7	CA-289	3-25 uuf.
C8	CA-291	6-100 uuf.
C9	CA-291	6-100 uuf.
C10	CA-290	4-50 uuf.
C11	CA-290	4-50 uuf.
C12	CA-290	4-50 uuf.
C13	CA-289	3-25 uuf.
C14	CA-291	6-100 uuf.
C15	CA-291	6-100 uuf.
C16	CA-290	4-50 uuf.
C17	CA-290	4-50 uuf.
C18	CA-290	4-50 uuf.
C19	CA-289	3-25 uuf.
C20	CA-291	6-100 uuf.
C21	CA-291	6-100 uuf.
C22	CA-290	4-50 uuf.
C23	CA-290	4-50 uuf.
C24	CA-290	4-50 uuf.
C25	CA-294	125 uuf.
C26	CA-293	10-210 uuf.
C27	CA-284	.05 uf.
C28	CA-292	13-226 uuf.
C29		.05 uf.
C30	CA-195	.05 uf.
C31		.05 uf.
C32	CA-284	.05 uf.
C33	CA-266	100 uuf.
C34	CA-292	13-226 uuf.
C35		.05 uf.
C36	CA-195	.05 uf.
C37		.05 uf.
C38	CA-294	125 uuf.
C39	CA-284	.05 uf.
C40	CA-294	125 uuf.
C41	CA-278	5 uuf.
C42	CA-300	3000 uuf.
C43	CA-297	1600 uuf.
C44	CA-299	750 uuf.
C45	CA-266	100 uuf.
C46	CA-292	13-226 uuf.
C47	CA-266	100 uuf.
C48		.05 uf.
C49	CA-195	.05 uf.
C50		.05 uf.
C51	CA-323	4-50 uuf.
C52	CA-266	100 uuf.
C53	CA-296	400 uuf.
C54	CA-281	.01 uf.
C55	CA-295	50 uuf.
C56	CA-281	.01 uf.
C57	CA-295	50 uf.
C58	CA-281	.01 uf.
C59		.05 uf.
C60	CA-302	.05 uf.
C61		.05 uf.
C62	CA-284	.05 uf.
C63	CA-281	.01 uf.
C64	CA-295	50 uuf.
C65	CA-295	50 uuf.
C66	CA-281	.01 uf.
C67	CA-279	10 uuf.
C68		.05 uf.
C69	CA-301	.05 uf.
C70		.05 uf.
C71	CA-218	150 uuf.
C72	CA-193	500 uuf.
C73		.05 uf.
C74	CA-301	.05 uf.
C75		.05 uf.
C76	CA-281	.01 uf.
C77	CA-295	50 uuf.
C78		0.1 uf.
C79	CA-276	0.1 uf.
C80		0.1 uf.
C81	CA-281	.01 uf.
C82	CA-292	13-226 uuf.
C83	CA-277	0.1 uf.
C84	CA-280	1-10 uuf.
C85	CA-253	4-75 uuf.
C86	CA-266	100 uuf.
C87	CA-284	.05 uf.
C88	CA-266	100 uuf.
C89	CA-211	.002 uf.
C90	CA-211	.002 uf.
C91	CA-295	50 uuf.
C92	CA-295	50 uuf.
C93	CA-295	50 uuf.
C94	CA-298	800 uuf.
C95	CA-298	800 uuf.
C96	CA-286	75 uuf.
C97	CA-286	75 uuf.
C98	CA-275	4 uf.
C99	CA-284	.05 uf.
C100	CA-294	125 uuf.
C101	CA-266	100 uuf.
C102	CA-284	.05 uf.

CX CRYSTAL DC-6
DM DYNAMOTOR DM-17-A
F1 FUSE FU-21
F2 FUSE FU-21
J1 JACK JK-34 (1st AUDIO)
J2 JACK JK-34 (2nd AUDIO)
J3 JACK JK-33 (SPEAKER)
J4 JACK JK-33 (MICROPHONE)
J5 JACK JK-34 (KEY)

COILS

L1
L2
L3 1st R.F. COILS
L4
L5
L6
L7
L8
L9 2nd R.F. COILS
L10
L11
L12
L13
L14
L15 1st DET. COILS
L16
L17
L18
L19
L20
L21 OSC. COILS
L22
L23
L24
L25
L26 IGN. SUPP. COILS
L27
L28 TRANSFORMER C-202
L29 TRANSFORMER C-203
L30 TRANSFORMER C-204
L31 BEAT OSC.
L32 FILTER COIL
LM1 NEON LAMP
LM2 LAMP LM-27
LM3 LAMP LM-27

RESISTORS

R1	RS-164	500 ohms 1 watt
R2	RS-169	60,000 ohms 1/2 watt
R3	RS-149	40,000 ohms 1/2 watt
R4	RS-172	100,000 ohms 1/3 watt
R5	RS-167	1,000 ohms 1/3 watt
R6	RS-173	2 MEG. 1/3 watt
R7	RS-164	500 ohms 1 watt
R8	RS-169	60,000 ohms 1/2 watt
R9	RS-149	40,000 ohms 1/2 watt
R10	RS-172	100,000 ohms 1/3 watt
R11	RS-167	1,000 ohms 1/3 watt
R12	RS-173	2 MEG. 1/3 watt
R13	RS-168	50,000 ohms 1/3 watt
R14	RS-166	350 ohms 1 watt
R15	RS-140	30,000 ohms 1/2 watt
R16	RS-172	100,000 ohms 1/3 watt
R17	RS-125	1,000 ohms 1/2 watt
R18	RS-172	100,000 ohms 1/3 watt
R19	RS-164	500 ohms 1 watt
R20	RS-163	60,000 ohms 1 watt
R21	RS-149	40,000 ohms 1/2 watt
R22	RS-125	1,000 ohms 1/2 watt
R23	RS-150	100,000 ohms 1/2 watt
R24	RS-164	500 ohms 1 watt
R25	RS-163	60,000 ohms 1 watt
R26	RS-149	40,000 ohms 1/2 watt
R27	RS-125	1,000 ohms 1/2 watt
R28	RS-171	750 ohms 1 watt
R29	RS-162	.25 MEG. 1/2 watt
R30	RS-161	1 MEG. 1/3 watt
R31	RS-165	1,000 ohms 1 watt
R32	RS-162	250,000 ohms 1/2 watt
R33	RS-131	50,000 ohms 1/2 watt
R34	POTENTIOMETER	0-500,000 ohms
R35	RS-174	0-50,000 ohms
R36	RS-150	100,000 ohms 1/2 watt
R37	RS-150	100,000 ohms 1/2 watt
R38	RS-178	12 ohms 15 watts
R39	RS-178	12 ohms 15 watts
R40	RS-178	12 ohms 15 watts
R41	RS-139	30,000 ohms 1 watt
R42	RS-140	30,000 ohms 1/2 watt
R43	RS-148	200,000 ohms 1/2 watt
R44	RS-127	3,000 ohms 1/2 watt
R45	RS-128	5,000 ohms 1/2 watt
R46	RS-177	7,500 ohms 1/2 watt
R47	RS-176	60 ohms 1/2 watt
R48	RS-169	60,000 ohms 1/2 watt
R49	RS-133	500,000 ohms 1/2 watt
R50	RS-140	30,000 ohms 1/2 watt
R51	RS-129	10,000 ohms 1/2 watt
R52	RS-175	10,000 ohms 1/3 watt
R53	RS-173	2 MEG. 1/3 watt

RL1 RELAY BK-13
SO1 SOCKET SO-94
SW1 SWITCH SW-131
SW2
SW3 1st R.F. SW.
SW4
SW5 2nd R.F. SW.
SW6
SW7 1st DET. (MIXER) SW.
SW8
SW9 OSC. SW.
SW10 CRYSTAL SW.
SW11 BEAT OSC. SW.
SW12 SWITCH SW-119
SW13 SWITCH SW-131
T1 TRANSFORMER C-205
T2 TRANSFORMER C-160

CONVERTING THE BC-348 RECEIVER

Introduction:

The BC-348 series of receivers was manufactured for the Armed Forces and was designed to operate from a 28-volt d-c supply. As these sets were used in aircraft, they are extremely compact and much smaller than their equivalent in present commercial cummunications receivers. The following conversion data will cover the changes necessary to adapt the unit to 115-volt a-c operation. Various circuit improvements will also be elaborated on as applicable to amateur radio use.

Many models of the BC-348 were built but, with the exception of the BC-348J, Q and N, they are electrically and mechanically similar. It is of special note that the B minus of the 348Q is not grounded. The BC-224 series is identical except for the heater circuits.

The receiver covers the frequency range of 1500 to 18,000 kc. and 200 to 500 kc. by means of a directly-calibrated vernier dial. It will be noted that the 10-meter amateur band as well as the standard broadcast band is neatly skipped. Converters will be necessary if these bands are desired.

The receiver has two r-f stages and three i-f stages. The intermediate frequency is 915 kc. A crystal filter is included in the circuit also.

The tube line up is as follows:

1st RF	6K7
2nd RF	6K7
RF Osc.	6C5
1st Det.	6J7
1st IF	6K7
2nd IF and CW Osc.	6F7
3rd IF and 2nd Det.	6B8
Audio	41

It is assumed that the reader would not attempt this conversion without enough technical knowledge to make unnecessary the tedious "wire by wire" descriptions generally encountered and, with the suggestions and conversions given here, satisfactory results should be easily obtained. It is important to bear in mind that, due to the numerous models, and circuit differences, common sense will be required in many of the operations as exact component symbols and wire movements have been eliminated in this article.

The following sections of the conversion procedure will be covered in detail:

(a) Power supply
(b) Filament circuit
(c) Speaker matching
(d) Operation
(e) Additional audio stage
(f) Noise silencer
(g) General notes

(a) Power Supply:

As the receiver was designed for operation from a 28-volt d-c source, it will be necessary to build a 115-volt a-c supply.

Since an external speaker and matching transformer will be required, and in order to keep heat out of the receiver compartment, it is advised that the power supply be built into the speaker cabinet along with the speaker matching transformer, and connections be brought out through a cable and plug system.

It should be possible to obtain, on the surplus market, the plug for power connections that was intended for use with the receiver. But if not, the present socket can be replaced with a standard octal tube socket by removing the present socket and filing the retaining bracket to take the octal tube socket.

The circuit shown in Fig. 1 will work nicely and, by referring to the plug connections given at the end of this article, the connecting cable can be made up.

(b) Filaments:

For 6.3-volt a-c operation, it will be necessary to rewire all tube filaments in parallel and to remove the balancing resistor which was used in the d-c system. Fortunately, all tubes are of the 6.3-volt type and no substitutions are required. The fixed and variable dimming controls associated with the pilot lamp circuit should be removed as this feature is not essential.

Fig. 2 is self-explanatory for the filament conversion, and careful examination will show the few actual wire changes necessary. The 6.3-volt lead should be brought out to pin 3 or pin 4 of the power plug. (These two terminals originally were the 28-volt input connections.)

(c) Speaker Matching:

The output of the receiver was originally designed for headphone operation and consisted of two output connections, for 500 ohms or 4500 ohms, depending upon the tap used on the output transformer. As most permanent magnet dynamic speakers are around 8 ohms, a matching transformer will be required to match one of the original outputs to the speaker. This transformer can be mounted in the speaker cabinet as discussed in the paragraph dealing with the power supply. An alternative is the replacement of the original output transformer with one designed to match the output tube to a PM dynamic speaker. However, the former is to be preferred as it does not necessitate circuit changes.

(d) Operation:

After completion of the previous steps, the receiver will function by merely applying power and connecting together terminals 2 and 6 of the output plug. Terminal 2 is the B plus connection and 6 is the screen-grid lead to the i-f's. These two terminals provide a very simple method of adding an "S" meter to the set. Examination of Fig. 3 will show that this circuit can be inserted between terminals 2 and 6 with no other circuit changes being required. The meter can be mounted in the upper right hand corner of the front panel, providing a very small one is used. The adjustable pot should be of the screwdriver adjusting type and also mounted on the front panel for zero setting the "S" meter. Calibration of the meter in "S" units or in "DB's" will be necessary. This addition is not necessary for operation but will add considerably to the versatility of the receiver for amateur use.

(e) Additional Audio Stage:

The audio gain of the receiver is not quite adequate, and an additional stage is required for satisfactory results. Fig. 4 is a proven circuit consisting of a 6J5 tube in a simple resistance coupled stage to be inserted directly ahead of the 41 power amplifier. With this additional stage the gain will be sufficient.

It is suggested that this added stage be built onto the small removable chassis upon which the dynamotor was originally mounted. The terminal strip on the chassis can be used to bring out all necessary connections and will make a neat and compact unit.

(f) Noise Silencer:

On the higher frequency band of the receiver, and especially if higher frequency converters are to be used, the noise problem becomes one of importance. A shunt-type noise silencer circuit employing a small 1N34 crystal is shown in Fig. 3A. This circuit can be added easily to the receiver schematic. Addition of any noise silencer circuit will normally cause some distortion in the output and therefore should be used only when ignition noise, fluorescent lighting, etc. gives trouble. If properly connected, the silencer should have very little effect on the receiver gain when connected in the circuit and no effect when out of the circuit.

Difficulty may be encountered in using the added audio stage in conjunction with the noise silencer due to the common cathode resistor on the second detector and third i-f stages. This may be remedied by removing the wire between the two cathodes and shorting out "R105".

Note: In 348E, M and P this is not possible as the two stages are in the same tube.

(g) General Notes:

If desired, the audio and RF gain controls, which are originally on a common shaft, may be separated, especially for CW use. This will necessitate disconnecting one of the controls and running the leads to an added control of the same value but mounted elsewhere on the front panel.

The antenna and ground connections may be extended to the rear of the set and terminals added for convenience.

The AVC-OFF-MVC switch has several contacts which were originally used in the 28-volt d-c circuit and which are now useless. These contacts may be used as a standby switch breaking the B minus lead when the switch is in the OFF position and applying it again when in AVC or MVC positions. Careful circuit tracing will be necessary here in order not to disconnect the wrong wires on the switch. An alternative is the use of a simple SPST toggle switch mounted on the front panel and wired in accordance with Fig. 1.

Connections to the output plug (original) are as follows:

1- Output (phones or speaker)
2- B plus
3- 28 volts plus
4- 28 volts plus
5- Output
6- Screen grid voltage to IF
7- Ground (B minus, filament common)

BC-348 Power Supply & Filament Circuit

fig 1

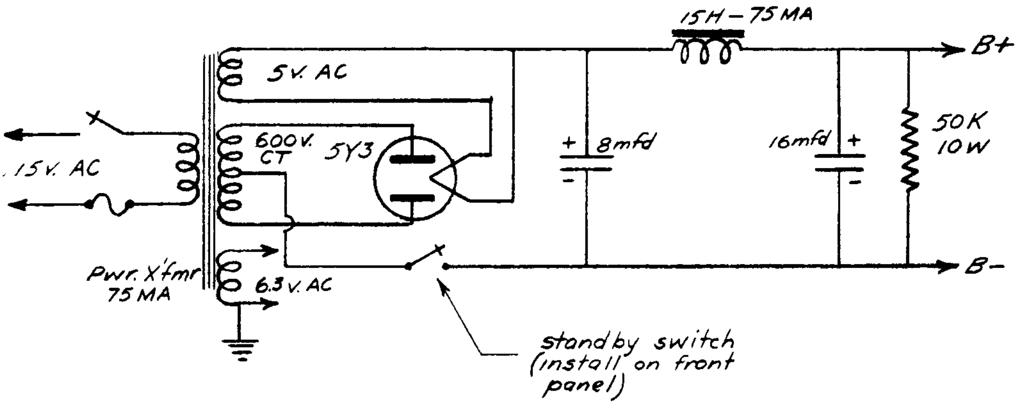
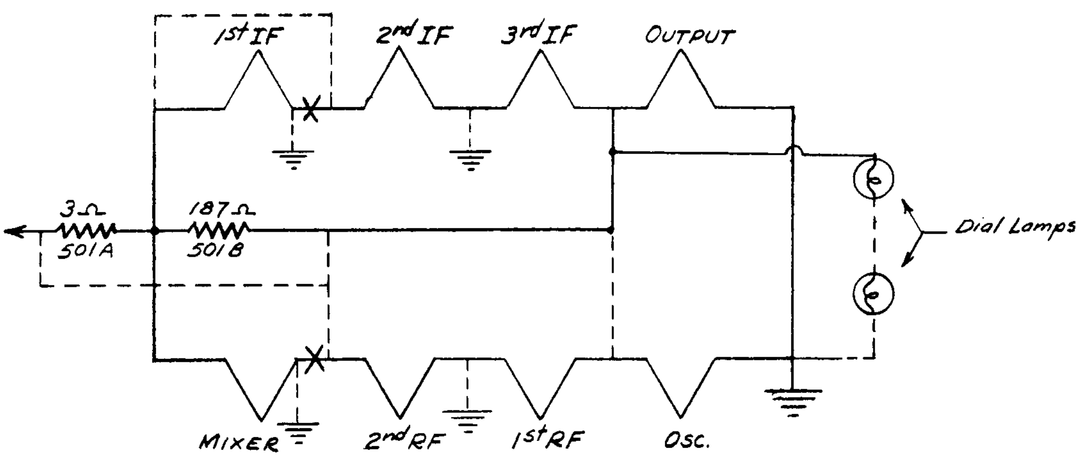


fig 2



Solid lines — Original Circuit
Dotted lines — Added Circuit (modification)
X — Places to break original circuit
NOTE: Osc. can need not be opened.

S-METER CIRCUIT

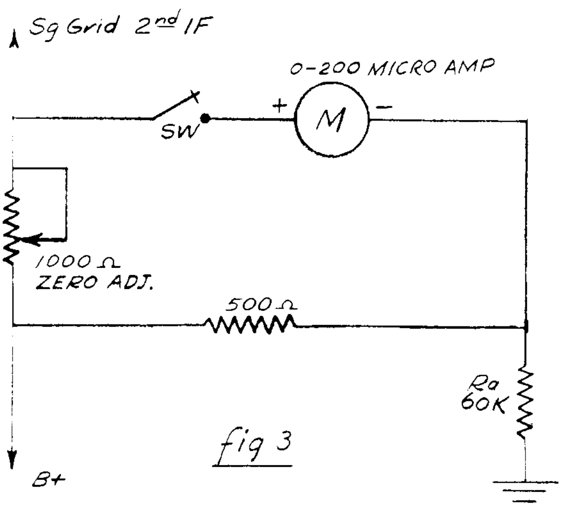


fig 3

NOTE: B+ connection & screen lead to IF Amp are terminals 2 & 6 respectively on the power plug. These connections are normally strapped for operation but the S-Meter can be inserted instead.

For desired swing of meter adjust value of Ra. This value will vary with the sensitivity of the meter movement used.

SERIES TYPE NOISE SILENCER

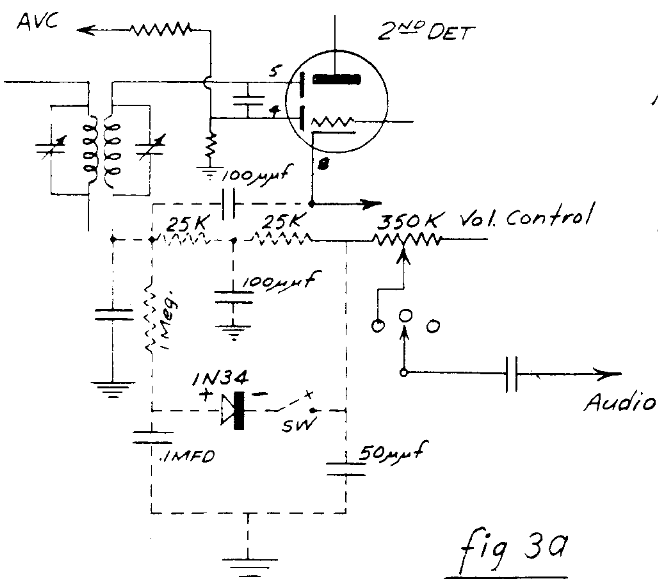


fig 3a

NOTE: Remove lead from rear pot (the one to 4th IF) and add the dotted line components in series with this lead and the pot. Switch should be located on front panel of receiver

ADDED AUDIO STAGE FOR BC-348

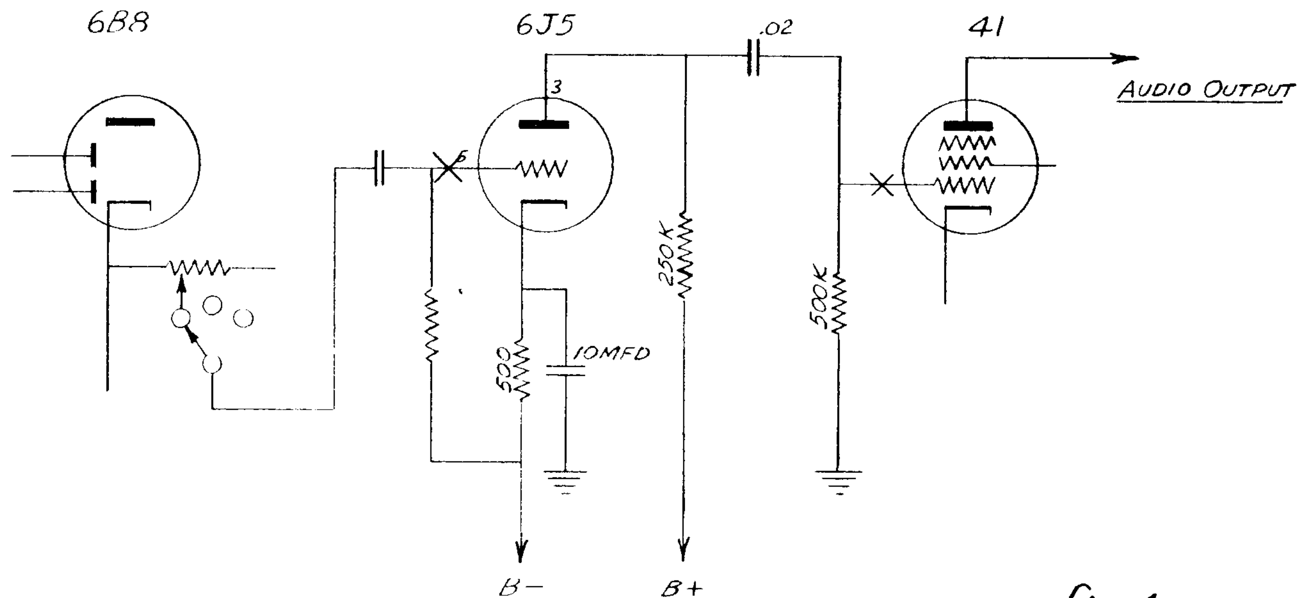
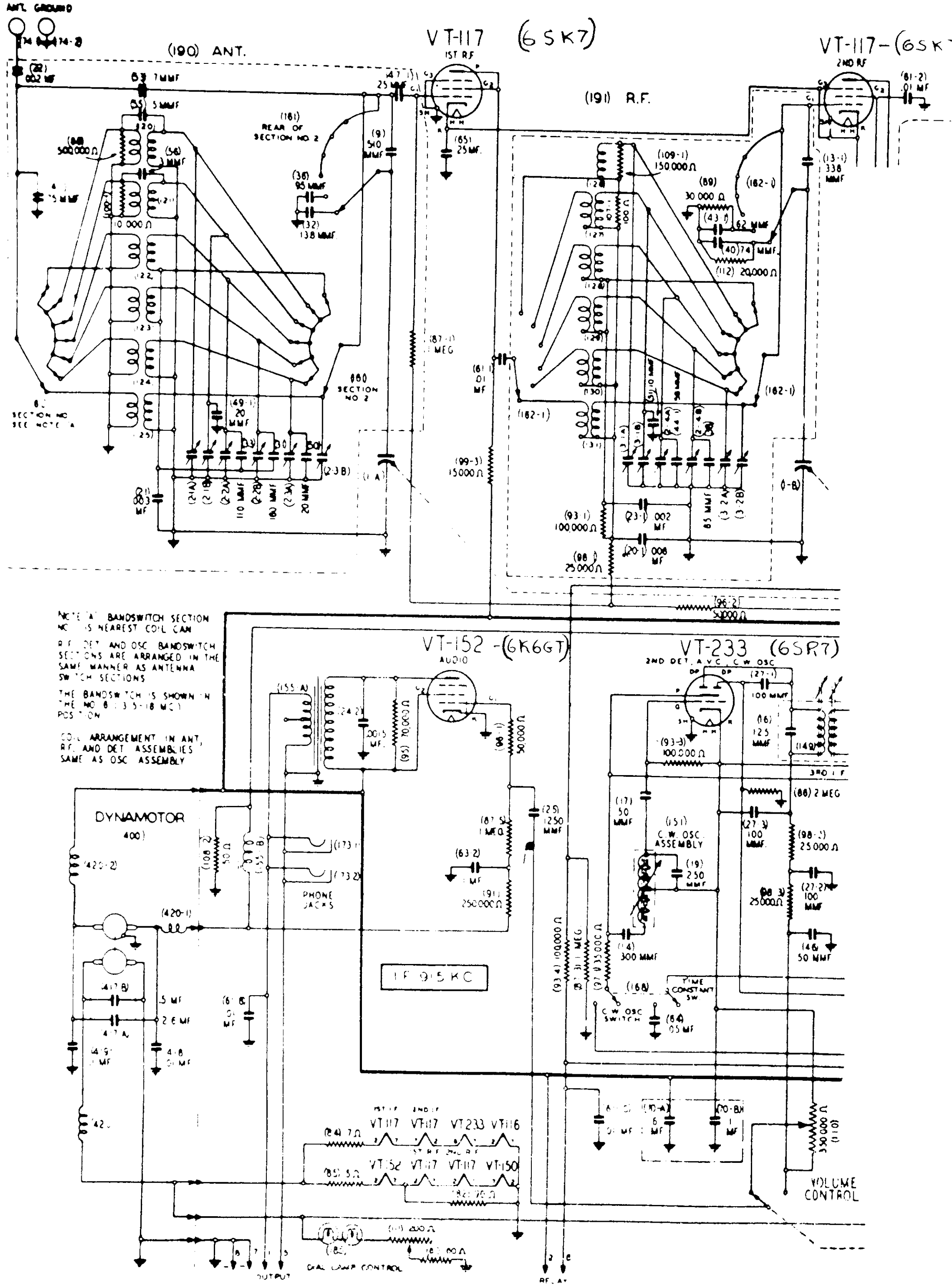


fig 4

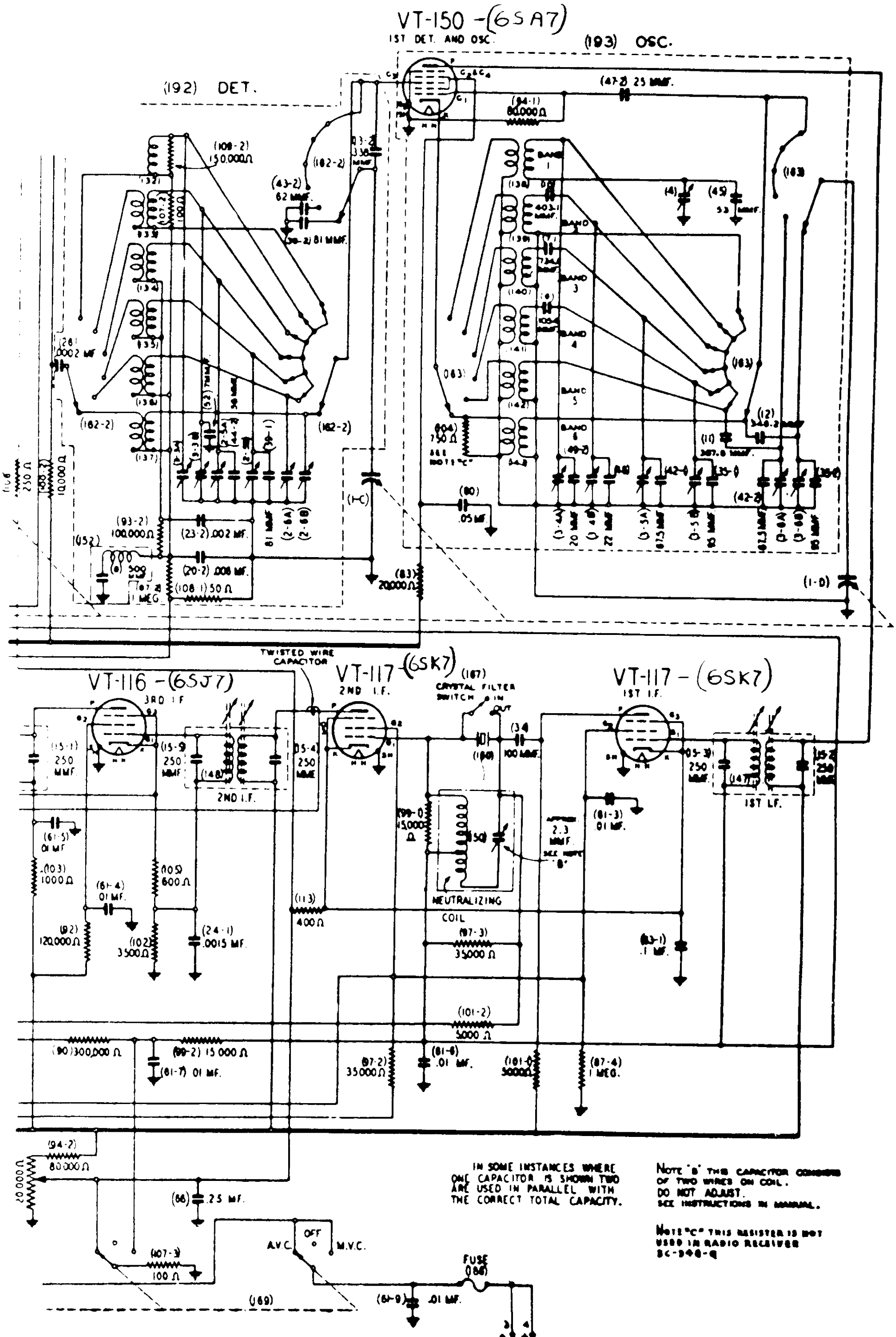
NOTES:

Cathode not grounded in models where B- is not normally grounded.

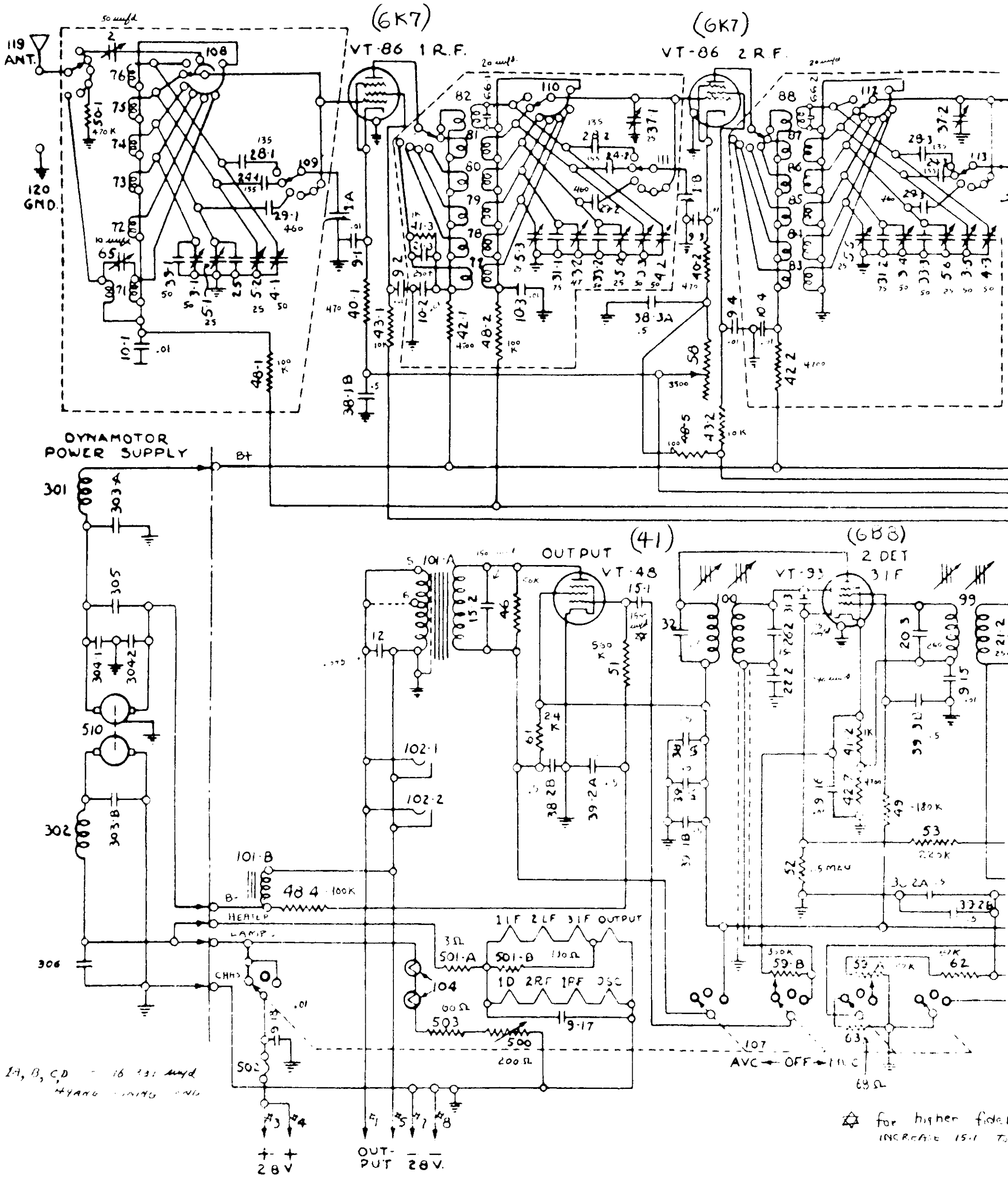
New stage is inserted between points indicated by X's



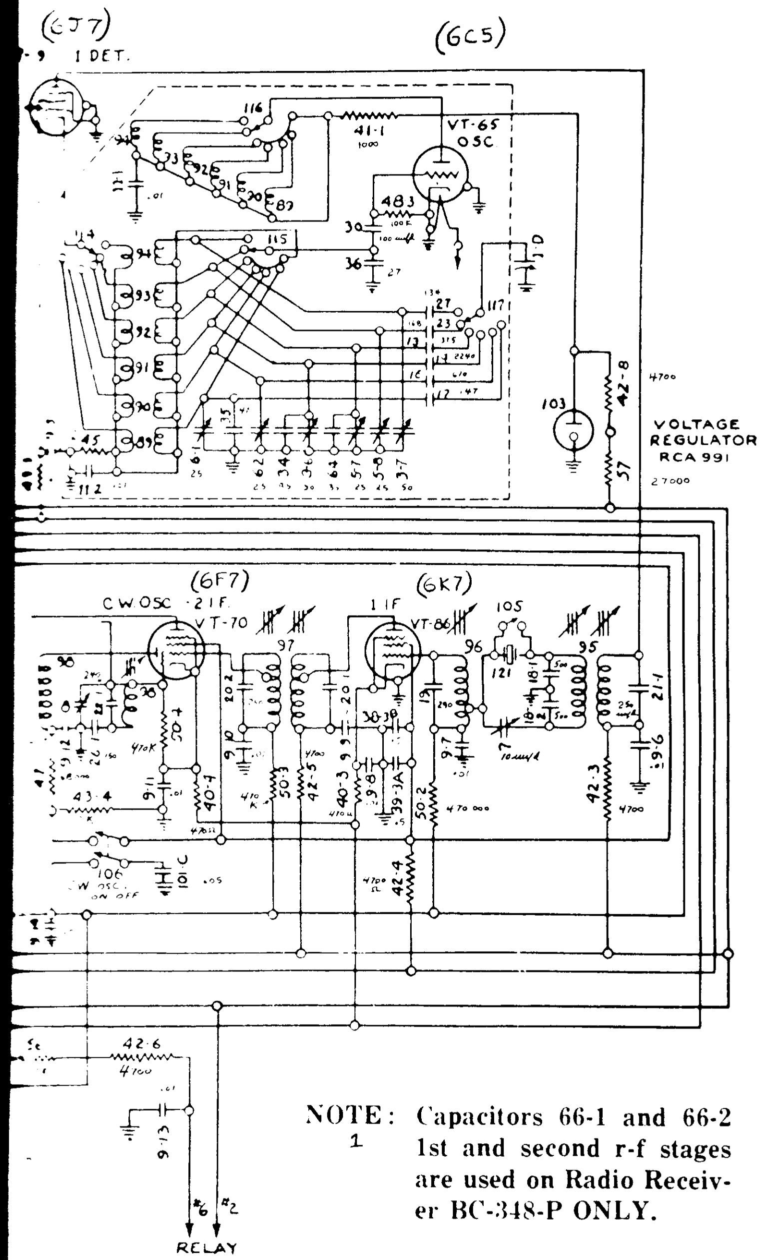
SCHEMATIC DIAGRAM FOR BC-348J,
and will apply to N, and Q models.



CHEMATIC DIAGRAM FOR BC-348J,
d will apply to N, and Q models.



SCHEMATIC DIAGRAM
FOR BC-348E,M,P,
(and will apply to,
C,K,L,R,H,).



NOTE: 1 Capacitors 66-1 and 66-2 1st and second r-f stages are used on Radio Receiver BC-348-P ONLY.

NOTE 2 These contacts are normally shorted for recieve operation. They should be opened for transmit.

SCHEMATIC DIAGRAM
FOR BC-348E,M,P,
(and will apply to,
C,K,L,R,H,).

CONVERSIONS FOR THE BC-412 OSCILLOSCOPE

The BC-412 radar oscilloscope was a component of the first mass-produced ground radar set, the SCR-268. This unit is easily recognizable by its rounded-top case and its excessive weight. Its approximate dimensions are 13 x 20 x 27 inches.

In addition to the 5-inch CRT, the BC-412 scope consists of 12 tubes which make up its associated video amplifiers, sweep circuits, and the high and low voltage power supplies. It operates from 115 volts a.c., at 50 or 60 cycles.

The outstanding feature of this radar scope unit is its two power supplies, the high-voltage CRT supply and the low-voltage 150-ma. supply. With these power supplies and the conversions described herein, the BC-412 can be made over into a laboratory test oscilloscope or a well performing television receiver.

This article attempts to briefly outline the conversion procedure for the television receiver and the laboratory oscilloscope with reference to the before and after schematic diagrams. It is assumed that anyone undertaking either of these conversions, will have a general working knowledge of this type equipment.

A WORD OF CAUTION: Always be extremely careful when working with circuits connected with the high voltage supply! Operating voltages are of several thousand volts and warrant the use of well insulated tools. Always turn off the power and short-circuit the high voltage condensers (with a well insulated tool) before attempting work or adjustments on this unit. Remember the old phrase, "Death is so permanent."

TELEVISION RECEIVER CONVERSION

Before any work toward conversion is begun, it is desirable to discard the heavy case and base which eventually can be replaced with a lighter and more attractive one.

After noting the HV and LV power supplies and their respective components, it is necessary to strip the entire chassis of its wiring and components with the exception of the two mentioned power supplies. The high voltage wiring (ignition cable) should be saved for use in the converted high voltage circuits. It will be found that a number of the removed parts can be used in the new circuits.

In this conversion, it is recommended that the RF/Oscillator section, the Video section, and the Audio section be constructed and used on separate chassis which are mounted on the main scope chassis. This method affords a much easier conversion as well as accessibility for maintenance or future changes.

(a) Power Supplies

The low voltage power supply is modified by merely reconnecting its components as shown in fig. 3. It will be noted that the filter section utilizes both chokes (44-1 & 44-2) and two of the dual 8-mfd. filter capacitors (12-3 & 12-4). The d-c supply voltage under loaded conditions should not exceed 300 volts.

The high-voltage supply is reconnected so that its output voltage is positive with respect to ground. Also slight changes are made in the filter section in order to obtain the correct voltages for the 5-inch CRT (5BP4). For this circuit arrangement refer to the schematic diagram, fig. 4.

By modifying the high-voltage filter, sufficient voltage may be obtained to operate a 7-inch CRT such as the 7EP4 or 7JP4. This involves increasing the value of the first filter capacitor and reducing the value of the series filter resistance. For this condition refer to the schematic diagram in fig. 3.

Should a slightly higher voltage be desired, it can be obtained by utilizing the potential voltage of the low voltage supply. This is frequently done in commercial sets and is accomplished by connecting the low potential side of the HV transformer secondary (grounded side) to the high potential side of the LV, d-c supply. This arrangement adds the low supply voltage to the CRT supply voltage.

(b) CRT Circuits

The CRT circuits include the vertical oscillator, vertical amplifier, horizontal oscillator, horizontal amplifier, synchronizing amplifier and the CRT controls. The five mentioned stages are grouped in the location shown in fig. 2, and occupy the former tube sockets on the main scope chassis.

Controls for the CRT circuits, which require least adjustment during normal operation are brought out on the side of the chassis on a separate panel. These controls include Height, Width, Vertical Position, Horizontal Position, and Focus. Due to the high voltages involved and the fact that the ordinary potentiometers are not designed to operate in these ranges, the panel must be of the insulated type. Bakelite or similar material should be used with insulated couplings or shafts to the HV controls.

Location and layout of the above controls are shown in fig. 2.

(c) RF & Oscillator Section

This section consists of the mixer (first detector) and the R-F oscillator with their respective components.

It is necessary to construct this section on a completely separate chassis. The layout of parts is critical to the extent of maintaining as short leads as possible. The control shafts are located to coincide with the panel layout as shown in fig. 2.

For simplicity and ease of operation, a two-section tuning selector switch is used in conjunction with mica trimmer capacitors to tune the RF mixer input and HF oscillator. These capacitors are pretuned to the desired frequencies and are then switched in or out of the circuit with the tuning selector switch. To provide optimum tuning, a fine tuning control is employed which separately tunes the oscillator in the band-spread method. This is accomplished with a variable capacitor of approximately

3-30 mmfd. which is brought out to the front panel through an insulated shaft or coupling. During the alignment of the RF/oscillator section, the fine-tuning variable capacitor should be set approximately to its mid-capacitance position.

The coils for the RF/oscillator section are made in accordance with the following data:

L-1, (ant. coil) - 2 turns, No. 18 enamel, 3/4-inch diameter, with grounded center-tap; loosely coupled to the mixer coil.

(mixer coil) - Approximately 3 turns, No. 14 enamel, 3/4-inch diameter.

L-2, (osc. coil) - 3 turns, No. 14 enamel, 3/4-inch diameter, with cathode tap approximately 1 turn from the grounded end of coil.

The above coils are self-supporting, air-wound, and mounted as close to their connection points and as rigidly as possible. Sufficient coupling between the oscillator and mixer coil is obtained from their close proximity.

In order to bring the coils to the proper tuning range, they may have to be compressed or expanded in order to lower or raise their tuning frequency. The normal spacing of turns will be approximately 1/8 inch.

Even though the RF/oscillator chassis includes the mixer IF transformer and the tuned "sound trap", essentially they are IF components and are discussed under section (d).

For the general layout of components and location of the RF/oscillator chassis, refer to fig. 2.

(d) Video IF Section

To avoid the tedious construction work for the video IF coils, effort should be made to obtain an IF amplifier strip that has the approximate band pass, frequency, and amplification. There are a number of such strips available on the surplus market which can be tuned within the 12 to 27 Mc. range.

One of the preferable IF amplifier strips consists of 5 stages using WE-717's with a frequency of 19 Mc. Since four stages of this strip offer sufficient amplification, the 5th stage is replaced with the 2nd detector/clipper (6H6). The video amplifier stage is also added to the chassis to complete the video section.

Should a satisfactory IF amplifier strip not be available, other coils, such as the 20-Mc. IF, slug-tuned coils, from the BC-404 Receiver (component of the SCR-270 & 271) can be used. These coils will function well in the stagger-tuned video amplifier.

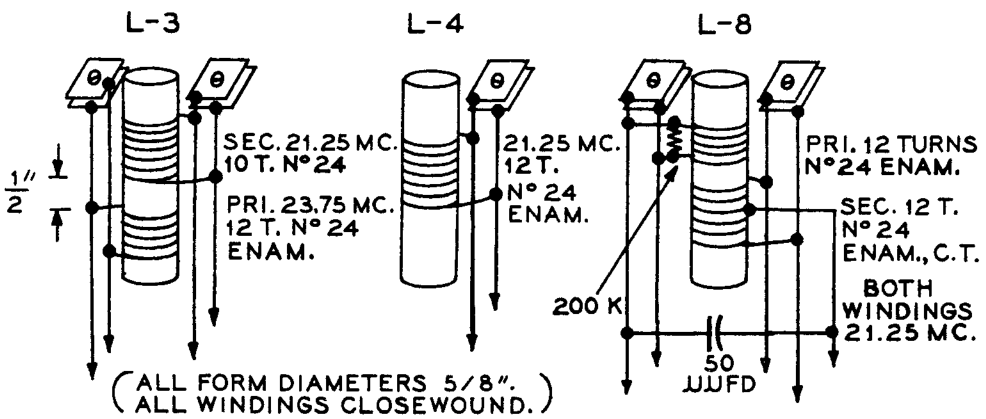
The mixer IF transformer consists of two tuned windings. The primary is tuned to the approximate midpoint between the audio and video IF frequencies, while the secondary is tuned to the audio IF frequency.

Should coils of the above description not be available, they can be made from old IF transformers from the data given below.

Alignment frequencies for single-tuned coils, as described above, in order to obtain the required video band pass (3.5 to 4.0 Mc.) are given in section (f).

The contrast control, in the cathode circuit of the second IF stage, varies the video IF gain. It is physically mounted underneath the main chassis directly below the second IF stage. An extended shaft is used to control the rheostat from the front panel in the position shown in the panel layout.

Peaking coils used in conjunction with the video amplifier, (La & Lb) consist of 50 turns of No. 32 wire, wound in approximately 1/2 inch length on 500K, 2-watt resistors.



(e) Audio Section

This section consists of an IF amplifier stage, operating approximately 4.5 Mc. below the video IF, an FM audio detector, first and second audio amplifier stages, and the associated speaker.

The signal input to the audio chassis is taken from the mixer output IF transformer, L-3. The inter-connecting lead between the secondary of L-3 and the grid of the audio IF amplifier should be as short as possible.

A conventional discriminator circuit is used for the audio detector with the double-tuned IF transformer tuned to the audio IF frequency. If the discriminator IF transformer is not readily available, it can be made from an old IF transformer from the winding data given above.

A 6-inch PM speaker is used with the conventional plate-to-voice-coil output transformer, and is mounted to the audio chassis as shown in fig. 2. The speaker grill consists of symmetrically drilled, 1/4-inch holes, in the side of the main chassis at the speaker location.

(f) Adjustments for Operation

After the power supply and CRT circuits are completed, they can be checked for proper operation. These circuits must function properly before further tests can be made.

Normal operation of the CRT circuits is indicated when a rectangular pattern, formed by the vertical and horizontal sweep, can be adjusted to its proper size, position, intensity, and focus on the CRT screen. Improper position, size, intensity, and focus indicates improper voltage on the element concerned in the CRT.

So as to obtain proper alignment, of the video IF amplifier, a signal generator should be used. This is essential to stagger the peaking of the different stages for the proper video band pass. The band pass should be between 3.5 and 4.0 Mc. Each stage is peaked to the following frequency:

L-3 (primary)	23.75 Mc.
(secondary)	21.25 Mc.
L-4 (sound trap)	21.25 Mc.
L-5, 1st IF	25.75 Mc.
L-6, 2nd IF	25.00 Mc.
L-7, 3rd IF	23.75 Mc.
L-8 (sound dis.)	21.25 Mc.

It should be noted that other video IF's can be used in the 12 to 30 Mc. range, with alignment similar to that given above. Occasionally interference problems may be encountered from other transmitted signals. Such an example can be a strong or local 10-Meter amateur signal coming through an IF amplifier operating in the 28 to 30 Mc. range.

This effect can be reduced considerably with the addition of a tuned RF stage ahead of the first detector, or a tuned trap circuit to reject the undesired frequency.

Alignment of the audio section is simply accomplished by peaking the discriminator, IF transformer to the audio IF which is 4.5 Mc. below the video IF. Final adjustment may be made audibly for the best output.

After aligning the video IF section, the RF and oscillator circuits are tuned to the desired channels by means of the mica trimmers for each position of the tuning selector switch. In order to utilize the full range of fine tuning capacitor, it should be set to its mid-position when aligning the RF & oscillator circuits. The above alignment can be done by visually observing the CRT screen for optimum picture.

A conventional folded dipole antenna with its associated reflector element is recommended and as shown in fig. 1. The antenna should be as high as practical in an unobstructed area. Direction for the antenna is best determined experimentally by rotating it in the horizontal plane for maximum signal. Frequently the final position will be a compromise for the several television stations in the locality.

For additional receiver circuit information, the schematic diagram, fig. 4, reprinted from the August '47 issue of the Radio News magazine, has been included.

LABORATORY TEST OSCILLOSCOPE

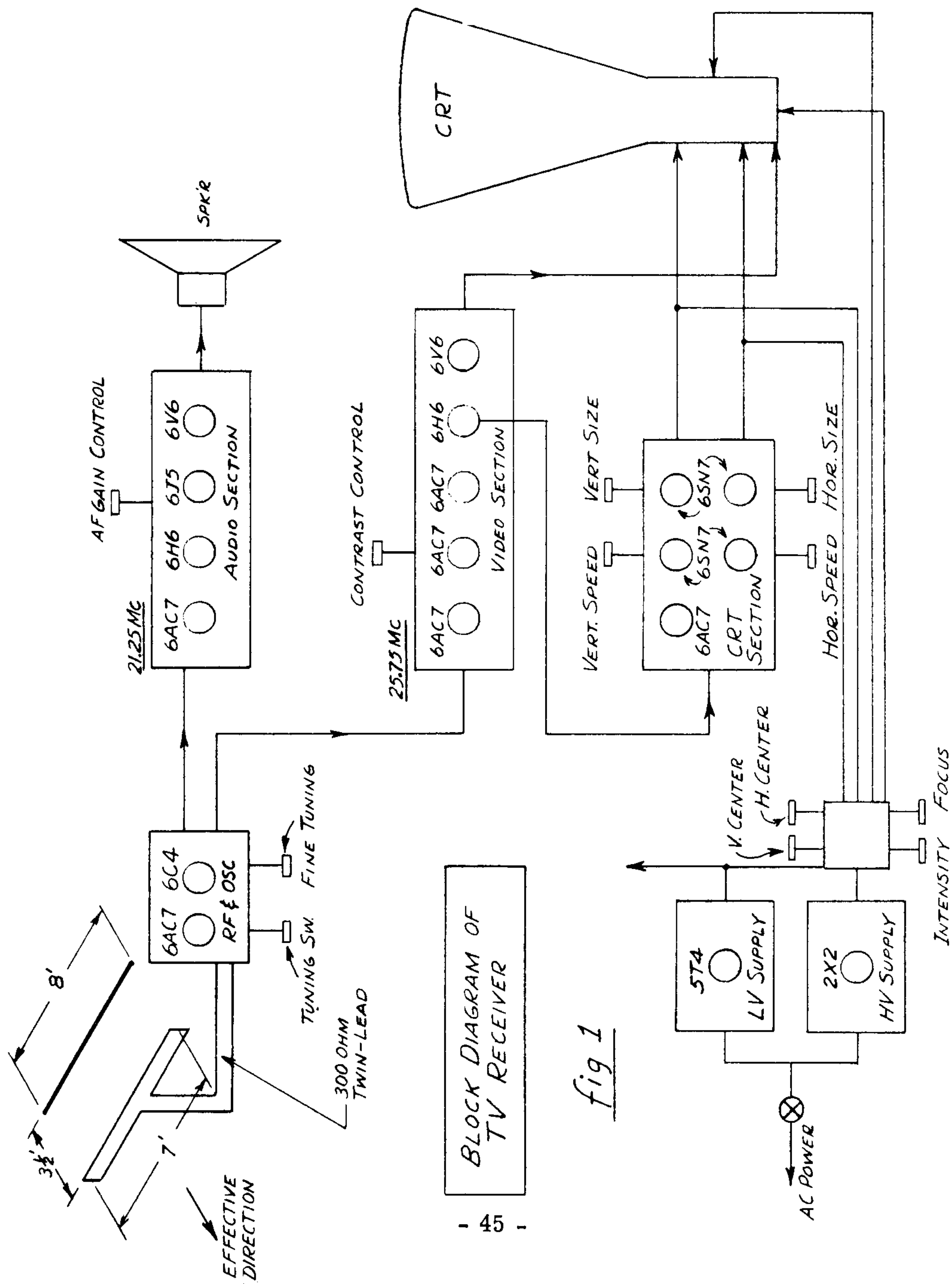
After the BC-412 chassis is stripped of everything except the two power supplies, the laboratory test oscilloscope can be built from the schematic diagram as shown in fig. 5.

This is a proven circuit which follows the conventional form, and offers a high sensitivity with a flat response from 20 to 20,000 cps.

For test scope use, the 5BP1, with which the BC-412's are usually equipped, is satisfactory.

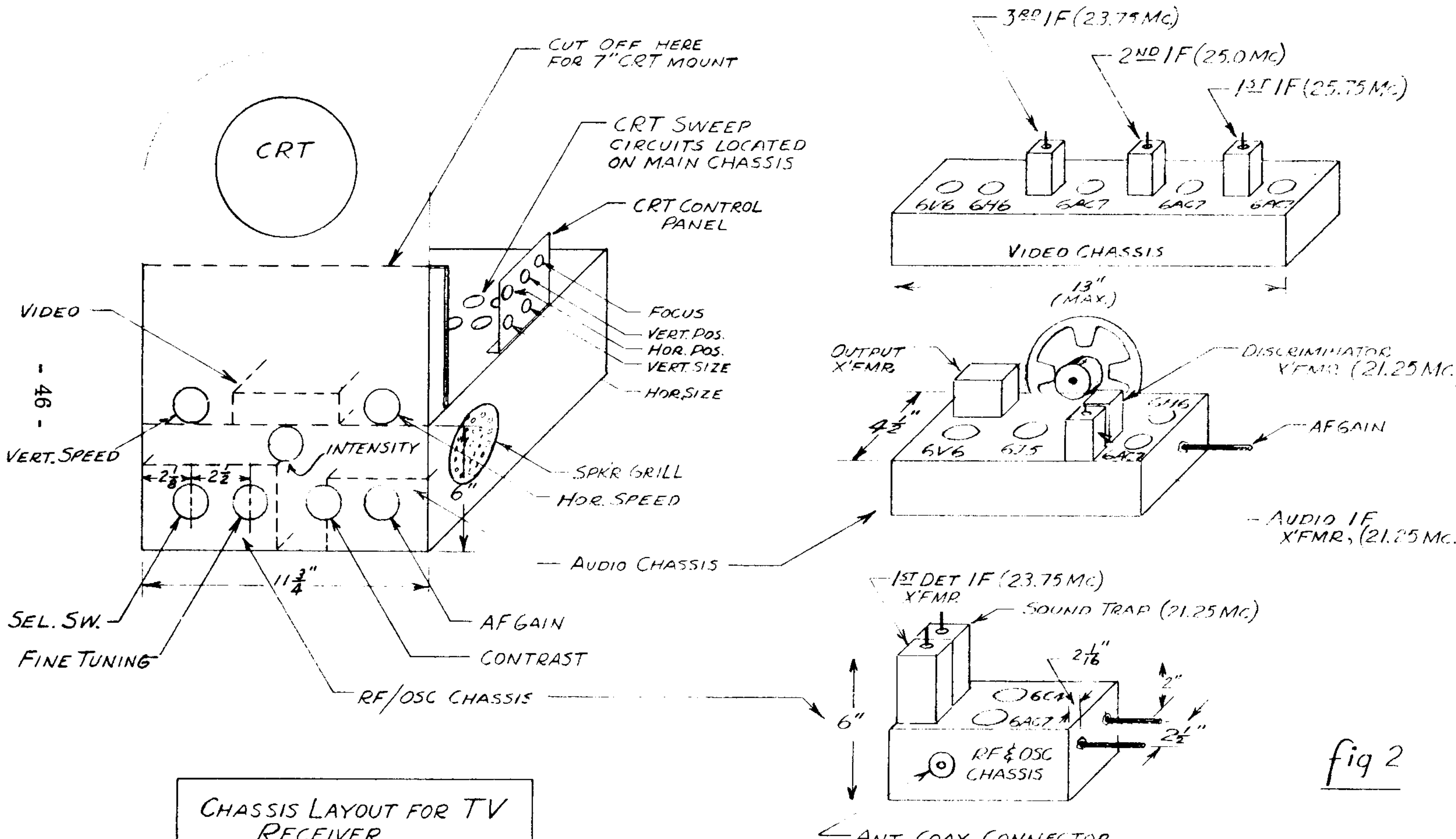
In order to obtain sufficient over-lap of the coarse frequency adjustment, it may be necessary to select capacitor values for the proper sweep frequency range.

The bulky and heavy case is discarded for a lighter and more attractive one which will add to the appearance of the completed test instrument.



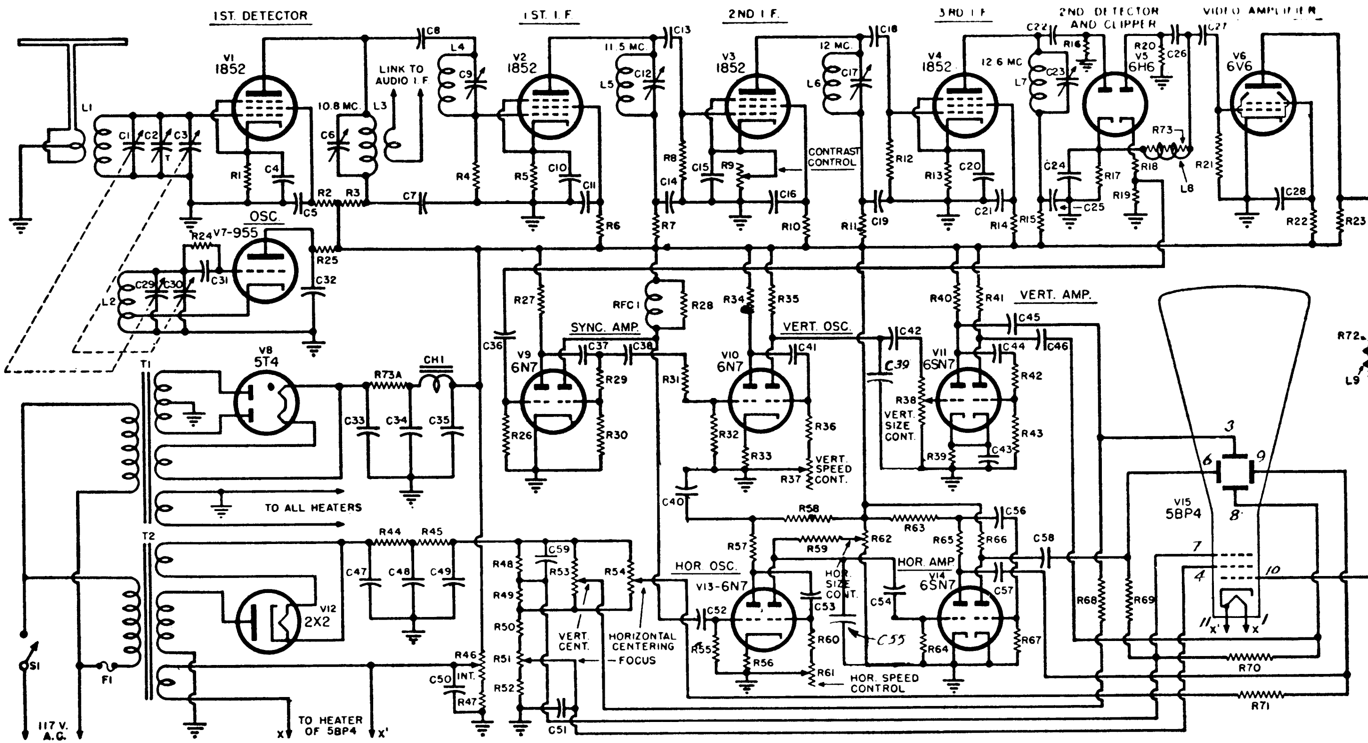
BLOCK DIAGRAM OF TV RECEIVER

fig 1



CHASSIS LAYOUT FOR TV RECEIVER

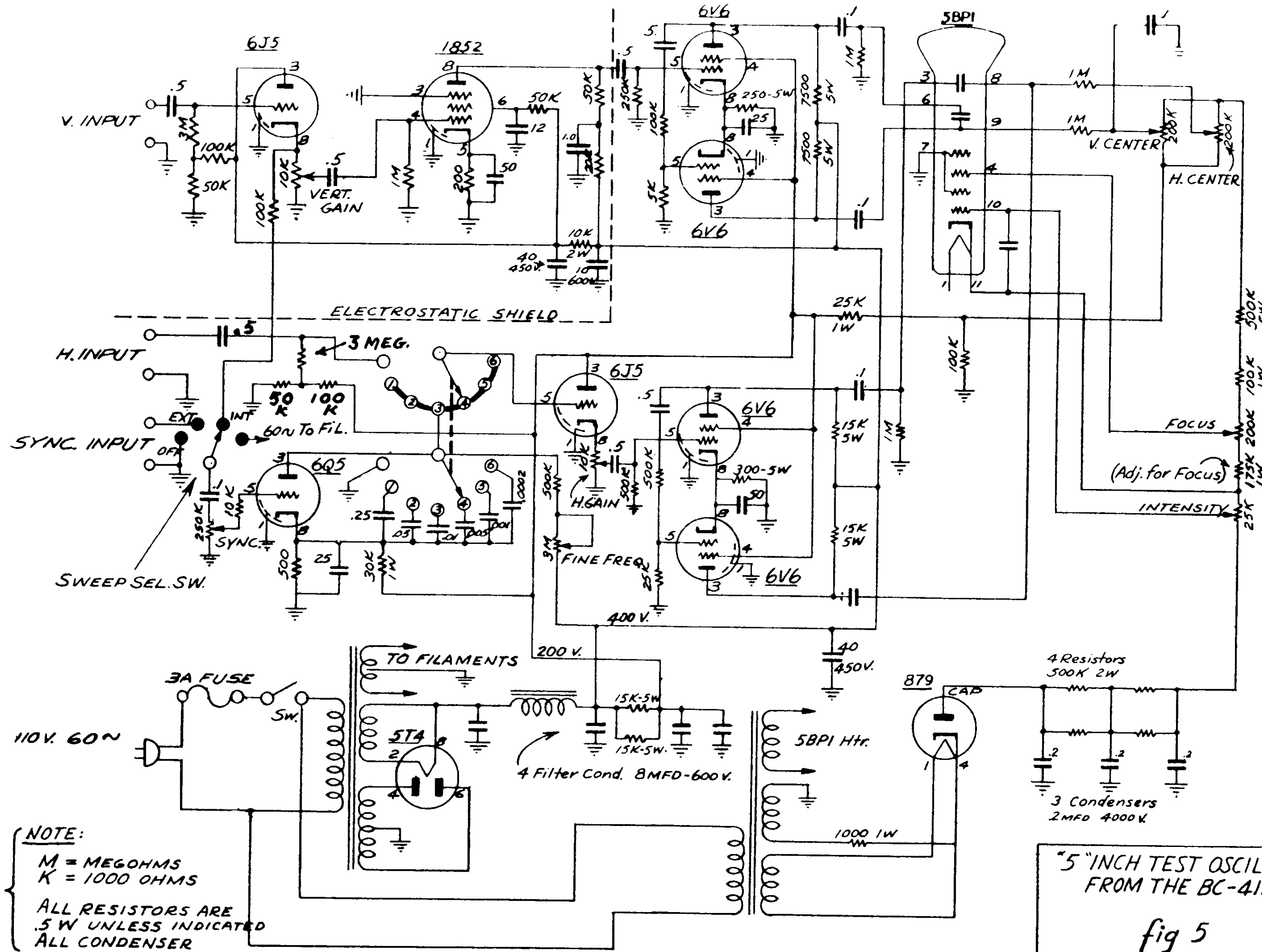
fig 2



R_1, R_{33}, R_{56}—500 ohm, ½ w. res.
R_2, R_6, R_{10}, R_{14}, R_{22}, R_{47}—100,000 ohm, ½ w. res.
R_3, R_7, R_{11}, R_{15}—1000 ohm, ½ w. res.
R_4, R_8, R_{12}, R_{16}—2500 ohm, ½ w. res.
R_5, R_{13}—200 ohm, ½ w. res.
R_9—50,000 ohm pot. with sw.
R_{17}, R_{39}—4000 ohm, ½ w. res.
R_{18}—5000 ohm, ½ w. res.
R_{19}, R_{28}, R_{55}, R_{63}—2000 ohm, ½ w. res.
R_{20}, R_{32}, R_{67}, R_{69}, R_{71}—1 megohm, ½ w. res.
R_{21}, R_{34}, R_{35}, R_{36}, R_{40}, R_{41}, R_{45}, R_{50}, R_{59}—500,000 ohm, ½ w. res.
R_{23}—5000 ohm, 10 w. res.
R_{24}, R_{25}, R_{31}—20,000 ohm, ½ w. res.
R_{26}, R_{30}, R_{42}, R_{64}, R_{68}, R_{70}—2 megohm, ½ w. res.
R_{27}, R_{29}, R_{60}—10,000 ohm, ½ w. res.
R_{37}, R_{62}—500,000 ohm pot.
R_{38}—2 megohm pot.
R_{43}—60,000 ohm, ½ w. res.
R_{44}, R_{57}, R_{58}, R_{65}, R_{66}—50,000 ohm, ½ w. res.
R_{46}, R_{61}—100,000 ohm pot.
R_{48}, R_{49}, R_{52}—200,000 ohm, ½ w. res.
R_{51}, R_{53}, R_{54}—200,000 ohm pot.
R_{72}, R_{73}—.5 megohm 2 w. res. (See coil table)
R_{73A}—300 ohm, 50 w. res.
C_1, C_{29}—50 μμfd. variable cond.
C_2—2-plate trimmer (Comp. type)
C_3, C_{30}—10 μμfd. trimmer (Fine tuning cond.)
C_4, C_5, C_8, C_{10}, C_{11}, C_{13}, C_{15}, C_{16}, C_{18}, C_{20}, C_{21}, C_{22}, C_{32}, C_{41}, C_{54}—.01 μfd., 600 v. cond.
C_6, C_9, C_{12}, C_{17}, C_{23}—See text
C_7, C_{14}, C_{19}, C_{25}, C_{56}—.006 μfd., 600 v. cond.
C_{24}—25 μμfd. mica cond.
C_{26}, C_{27}, C_{28}, C_{36}, C_{37}, C_{38}, C_{39}, C_{40}, C_{42}, C_{43}, C_{44}, C_{50}, C_{51}, C_{59}—.1 μfd., 600 v. cond.
C_{31}—100 μμfd. temp. compensated cond.
C_{33}, C_{34}, C_{35}—8 μfd., 450 v. elec. cond.
C_{45}, C_{46}—.01 μfd., 2500 v. cond.
C_{47}, C_{48}, C_{49}—.1 μfd., 4000 v. cond.
C_{52}—100 μμfd. mica cond.
C_{53}, C_{55}—.001 μfd., 600 v. cond.
C_{57}, C_{58}—.002 μfd., 2500 v. cond.
L_1, L_2, L_3, L_4, L_5, L_6, L_7, L_8, L_9—See coil table
RFC_1—2½ mh. r.f. choke
S_1—S.p.s.t. sw. on R_9
F_1—110 v., 1 amp. fuse
CH_1—8 hy., 150 ma. filter choke
T_1—Power trans. 375-0-375 v. @ 150 ma.; 5 v. @ 2 amps.; 6.3 v. @ 8.5 amps.
T_2—Power trans. 2500 v. @ 10 ma.; 2.5 v. @ 1.75 amps.; 6.3 v. @ .6 amp.

Reprinted from the August 1947 issue RADIO NEWS

fig 4

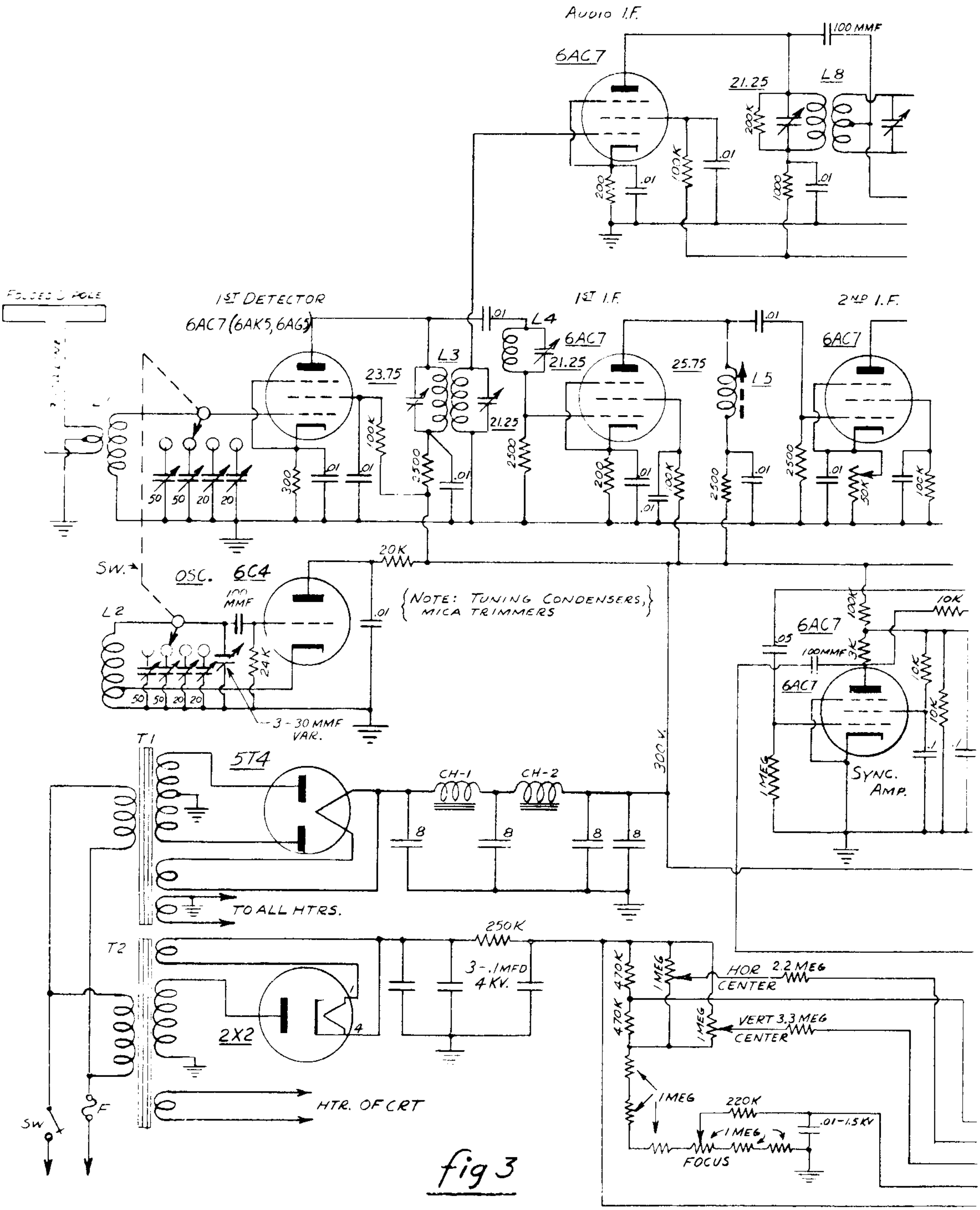


NOTE:
M = MEGOHMS
K = 1000 OHMS
ALL RESISTORS ARE .5 W UNLESS INDICATED
ALL CONDENSER VALUES IN M.F.D

"5" INCH TEST OSCILLOSCOPE FROM THE BC-412

fig 5

Courtesy Bardwell & McAlister, Inc., Hollywood, Calif.



AUDIO I.F.
6AC7
100 MMF
21.25
L8
200K
100K
.01
200
1000
1ST DETECTOR
6AC7 (6AK5, 6AG5)
1ST I.F.
2ND I.F.
L3
L4
L5
6AC7
23.75
21.25
25.75
2500
300
100K
50K
10K
50
20
SW.
OSC. 6C4
100 MMF
24K
20K
L2
3-30 MMF VAR.
(NOTE: TUNING CONDENSERS, MICA TRIMMERS)
.05
100 MMF
3K
1 MEG
SYNC. AMP.
T1
5T4
CH-1
CH-2
8
300 V.
TO ALL HTRS.
T2
250K
3-.1 MFD 4 KV.
2X2
470K
1 MEG
HOR CENTER
2.2 MEG
VERT CENTER
3.3 MEG
220K
.01-1.5 KV
FOCUS
HTR. OF CRT
SW
F

fig 3

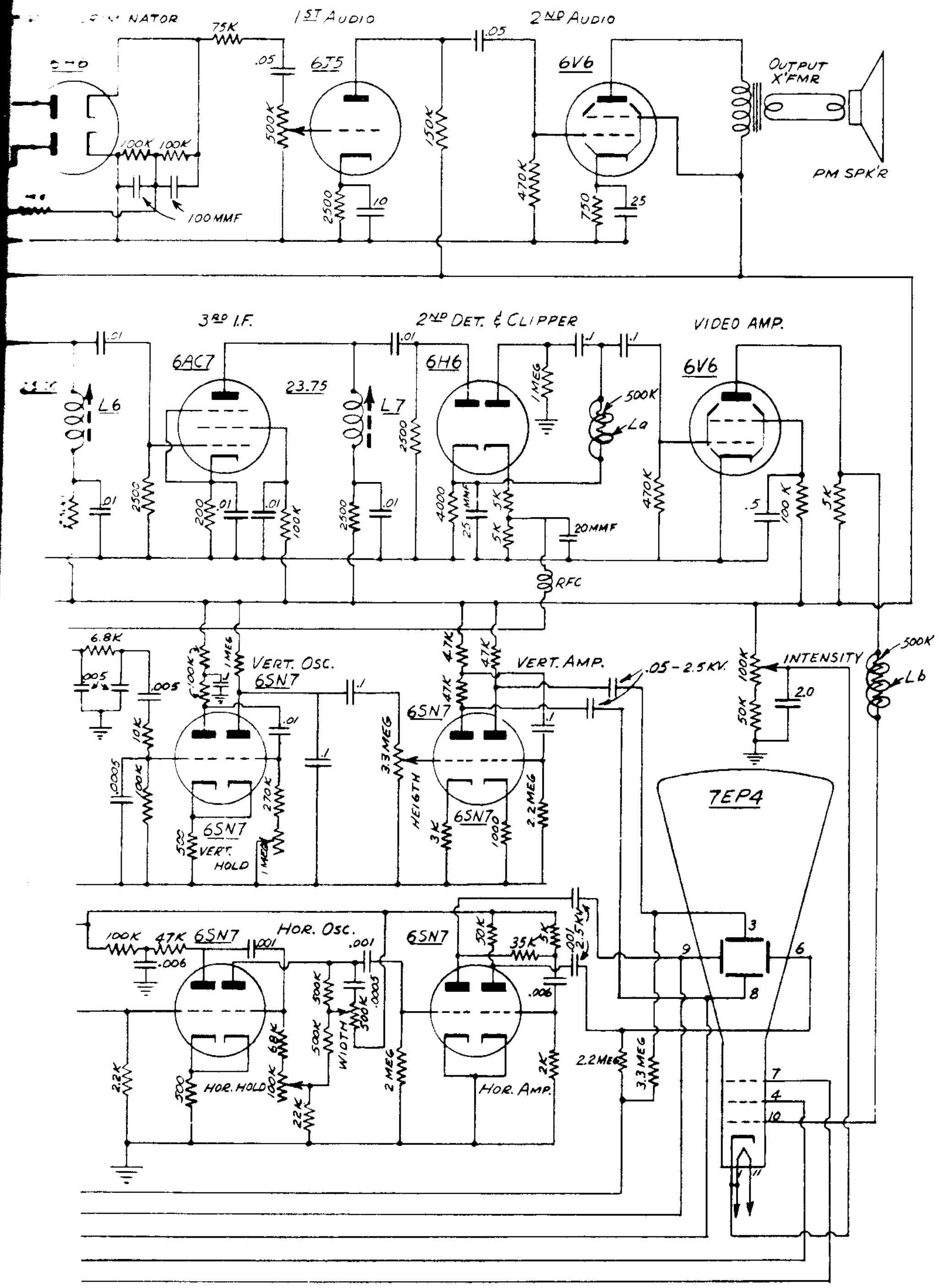

1ST AUDIO
2ND AUDIO
75K
.05
6J5
6V6
500K
150K
470K
2500
10
750
25
100K
100K
100MMF
OUTPUT X'FMR
PM SPK'R
3RD I.F.
2ND DET. & CLIPPER
VIDEO AMP.
6AC7
23.75
6H6
6V6
L6
L7
La
500K
1 MEG
2500
4000
5K
20MMF
RFC
470K
.5
100K
5K
200
.01
VERT. OSC.
6SN7
VERT. AMP.
6SN7
.05 - 2.5 KV.
INTENSITY
500K
Lb
6.8K
.005
.0005
10K
1 MEG
270K
3.3 MEG
HEIGTH
2.2 MEG
3K
1000
500
VERT. HOLD
7EP4
50K
2.0
HOR. OSC.
6SN7
100K
47K
.006
.001
500K
300K
.0005
WIDTH
68K
22K
500
HOR. HOLD
2 MEG
2K
HOR. AMP.
50K
35K
.001
2.5 KV
2.2 MEG
3.3 MEG
3
9
6
8
7
4
10
11

fig 3

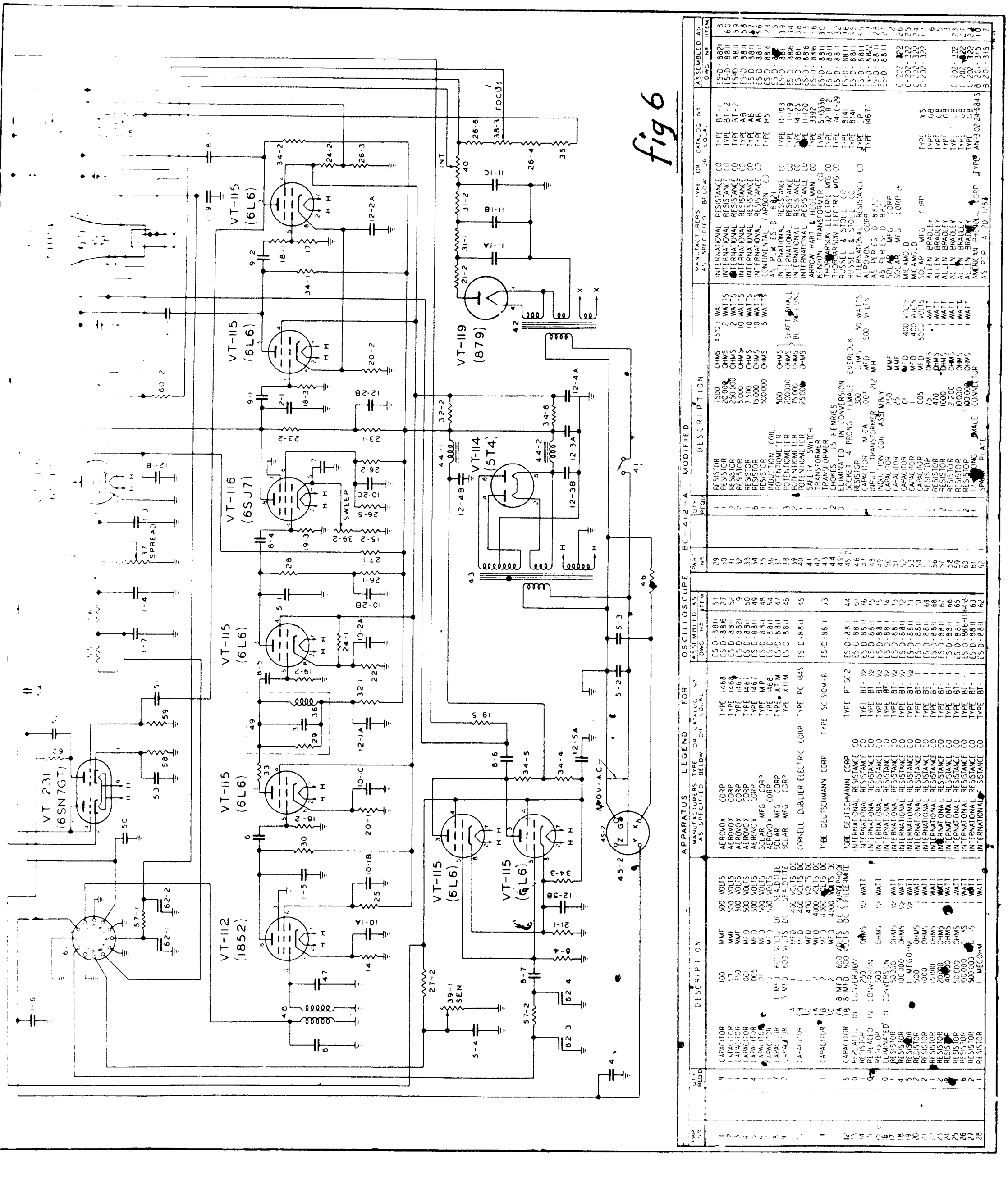


fig 6
VT-115
(6L6)
VT-116
(6SJ7)
VT-112
(1852)
VT-231
(6SN7GT)
VT-114
(5T4)
VT-119
(879)
FOCUS
SWEEP
SPREAD
SEN
INT
APPARATUS LEGEND FOR OSCILLOSCOPE BC-412-A MODIFIED

BC-645 CONVERSION FOR 420-MC. OPERATION

Although the BC-645 originally was designed for use by the armed forces an airborne IFF equipment, the equipment may be converted to form a complete transmitter and receiver for the 420-Mc. band. The unit originally operated in the frequency range between 470 and 495 Mc. and transmitted either a pulse signal or a c-w signal modulated by a 30-kc. wave. The unit acted as a transpondor when it emitted pulse signals; that is to say that the pulse emissions of the transmitter were triggered by incoming pulse signals which had been detected by the receiver.

The overall dimensions of the BC-645 are 10-1/2" by 13-1/2" by 4-1/2", with the weight of the unit being about 25 pounds. Power for both the transmitter and the receiver were supplied by a PE-101 dynamotor which operated from either a 12-volt or a 24-volt d-c source.

This article describes the BC-645 and its conversion in the following sections with references to the included diagrams:

(a) General Description and Operation
(b) Transmitter Conversion
(c) Receiver Conversion
(d) Mechanical Modifications
(e) Power Supply
(f) Operation of the Converted Unit

(a) General Description and Operation:

The transmitter section includes the following tubes with their respective functions:

WE-316A	(VT-15)	Self-excited power oscillator
6F6	(VT-13)	Pulse modulator
6F6	(VT-14)	30kc. oscillator/modulator
7F7	(VT-12)	Pulse amplifier

The WE-316A is a self-excited power oscillator using a tuned-line tank circuit which determines its frequency. Its output is coupled to the antenna plug through a variable pick-up loop and a short section of rigid coaxial line. Two separate 6F6 modulators are used. One is used as a pulse modulator which is driven by the 7F7 pulse amplifiers. The other 6F6 is a 30kc. oscillator and modulates the power oscillator when brought into the circuit by relay No. 6.

The superhet receiver and its associated output circuits consist of 11 tubes. Tuned lines are employed in the antenna input and the hf oscillator circuits. Acorn type, 955 tubes are used for the hf oscillator and the first detector with the first detector functioning as a diode with an injector grid.

The IF amplifier consists of three stages operating at 40 Mc. and uses 7H7 type tubes in all three stages.

The second detector output, after being amplified by the three video stages, is divided, half of which is used to pulse modulate the transmitter through the pulse amplifiers. The other half operates the sequence relays through appropriate timing multivibrator circuits.

Before beginning the circuit conversion of this unit, it is suggested that all excess components be removed from the chassis. This is essential because of the limited space in the unit; also, removal of these parts will result in a neater looking conversion.

The unused components that should be removed include the following:

(1) All relays except relay #1
(2) All potentiometers
(3) Two-position switch at front of case
(4) 30-kc. oscillator coil (used with VT-14)
(5) Resistor/capacitor terminal boards (the two located on each side of the center divider on underside of chassis)

(b) Transmitter Conversion:

In order to lower the tuning of the self-excited power oscillator to the 420-450 Mc. band, it is necessary electrically to lengthen the tuning line. This is accomplished by adding a circular type neutralizing capacitor across the open end of the line. The removal of relay #2 provides space for the added capacitor. By this method of lowering the tuning to the 420-450 Mc. band, the increase in equivalent physical length would approximate 1/2 inch.

The remainder of the transmitter conversion consists of revamping the modulator for voice modulation.

In order to obtain 100 per cent modulation of the WE-316A, it is necessary to use both 6F6's (VT-13 & VT-14) operating in parallel. These stages are driven from the two-stage speech amplifier, 7F7 VT-12, converted as shown in Fig. 2. Sufficient gain is provided by the speech amplifier for crystal or dynamic microphone use.

It will be noted from the converted diagram that the two parallel Heising modulators require a heavier modulating choke than was used in the existing circuit.

Relay #1 is used as the send-receive relay and is actuated from the microphone circuit. This relay operates from 12 volts at approximately 3 ma.

(c) Receiver Conversion:

Since the antenna circuit will tune down to the 420-450 Mc. band, no alteration is required; however, the hf oscillator line must be physically lengthened to tune down to this range. This is accomplished by soldering a 1/2 inch extension to the end of the line (the end away from the oscillator tube.) The shorting bar is then moved to the new end of the tuning line.

No other changes are required in the RF and oscillator sections of the receiver.

Even though the IF amplifier section will operate satisfactorily as is without bias (other than the AVC), better performance can be obtained by adding cathode resistors to ground with their respective by-pass capacitors. This providing of cathode bias for the IF stages gives a better signal-to-noise ratio. For the above alteration, refer to the circuit diagram in fig. 2.

The existing audio section requires considerable modification to adapt it for A2 or A3 reception.

Beginning at the second detector, the 7E6 (VT-6) stage is changed to function as the second detector, AVC, and the first audio amplifier in the conventional manner. If more audio gain is desired, the 7E6 may be replaced with a higher mu (triode section) equivalent, such as the 7B6. The only circuit alteration required for this change is the substitution of the proper value cathode resistor.

An AF gain control is added in the grid circuit of the first audio stage as shown in fig. 2.

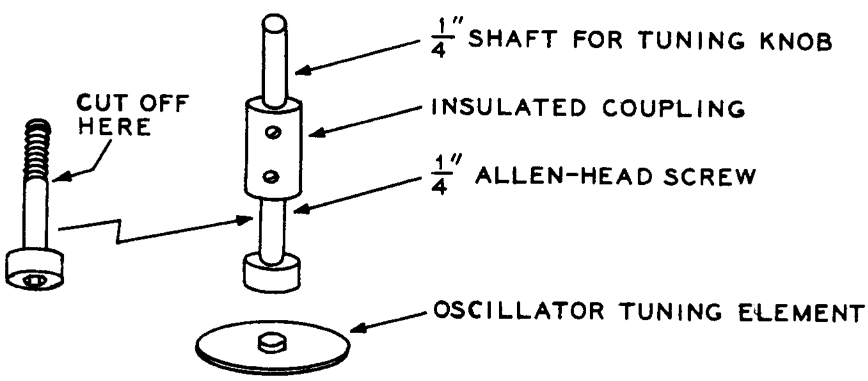
For the audio output stage a 7C5 tube is added with an appropriate plate-to-voice-coil output transformer. This stage is RC coupled from the first audio stage in the normal manner, and replaces the former 7F7 (VT-9) tube. Due to its height the added 7C5 must occupy the location of the former relay #3. Required socket connections and added components are shown in fig. 2.

In adding the 7C5 output tube, it will be noted that its complementary series tube, VT-8, in the 12-volt heater circuit is shunted with a 40-ohm 2-watt resistor to provide the proper heater current for the 7C5.

(d) Mechanical Modifications:

As previously mentioned, all excess circuit components should be removed for the ease of conversion. This becomes apparent when in some cases special long soldering iron tips have been recommended for working in these close quarters. It should also be noted that the IF coils are quite fragile and extreme care should be exercised to avoid damaging them.

To provide an external oscillator tuning control, the following approach is quite simple and eliminates a special "hex-nut" alignment tool:



It is suggested that the existing antenna connectors be replaced with standard coaxial fittings. This is advisable since the mating plugs for the present connectors are difficult to obtain and are also quite expensive.

To add the final touch to the converted BC-645, a front panel arrangement should be made to carry the controls, jacks, power plug, and any other refinements that may be desired.

The panel can be made of 1/16-inch aluminum with the receiver gain control and speaker jack on the left side and the transmitter mike gain control and mike jack on the right. The power plug can be mounted in the center of the panel.

(e) Power Supply:

The power requirements for the converted BC-645 are 400 volts d.c. at 165 ma., and 12 volts at approximately 2.4 amperes.

The a-c power supply shown in fig. 3 is designed to fill the above requirements and should be self explanatory. It should be noted that the 12 volt d-c source required for relay #1 is obtained from a tap on the bleeder resistor. This relay may be operated from a 12-volt battery with a current drain of approximately 3 ma.

Should the BC-645 be desired for mobile operation, the regular dynamotor PE-101 can be used as shown in the plug connections diagram in fig. 4.

For 6-volt operation, revision of the filament circuit is required. It should be noted that this is a rather difficult job and may also cause instability in the IF amplifiers.

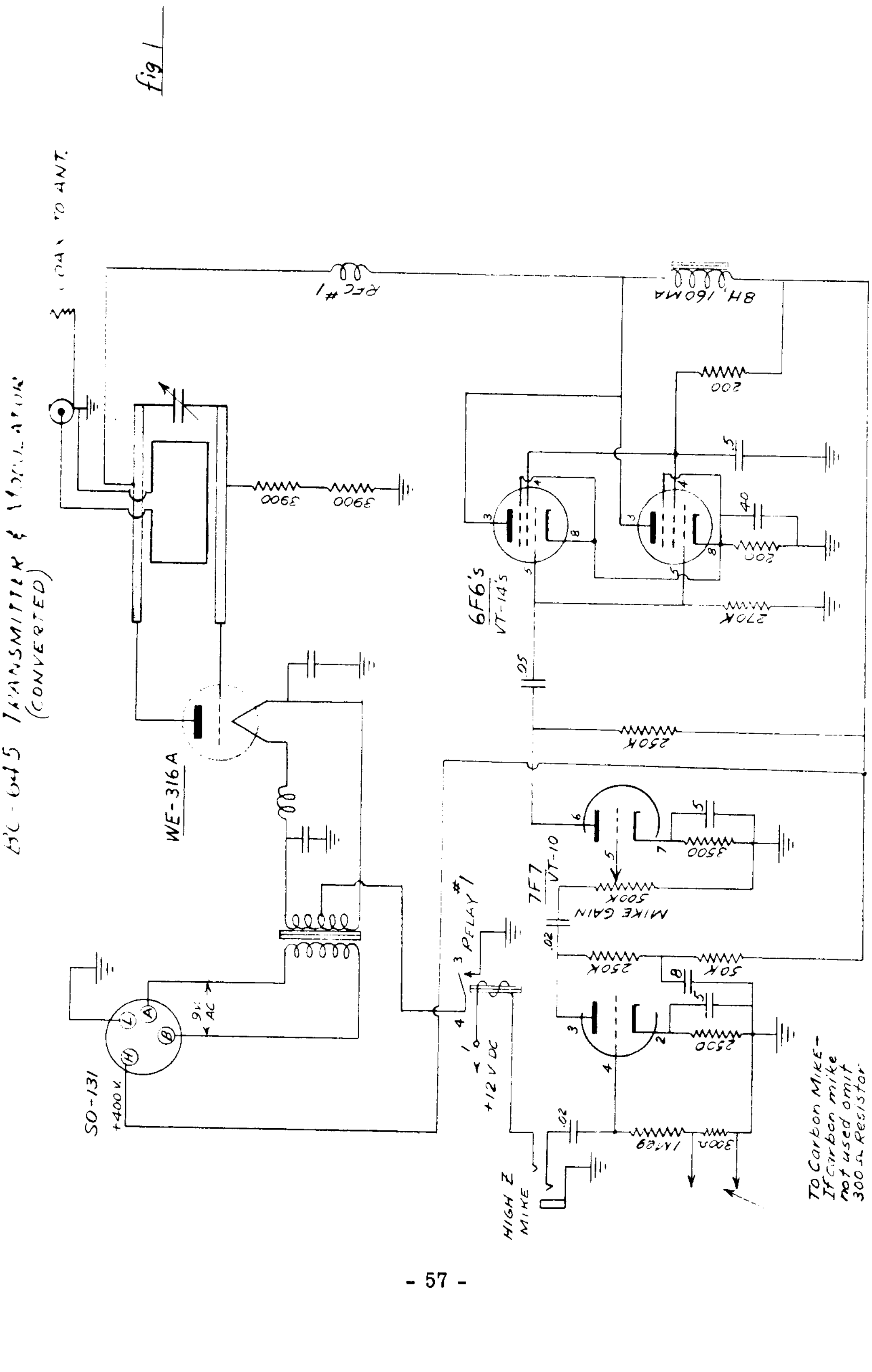
(f) Operation of the Converted Unit:

The transmitter is simply tuned by the capacitor located at the end of its tuned-line tank circuit. A 6-volt (blue bead) pilot lamp makes a good resonance indicator and will burn from 1/2 to full brilliance when brought in contact with the antenna or the center lead of the coax cable.

Before operation the receiver tubes should be checked for their proper "B" voltage. The voltage on the acorn tubes (955's) should be 200 to 250 volts with approximately 250 volts on the other tubes. The series dropping resistor in the plate voltage supply lead may have to be changed for the above voltages.

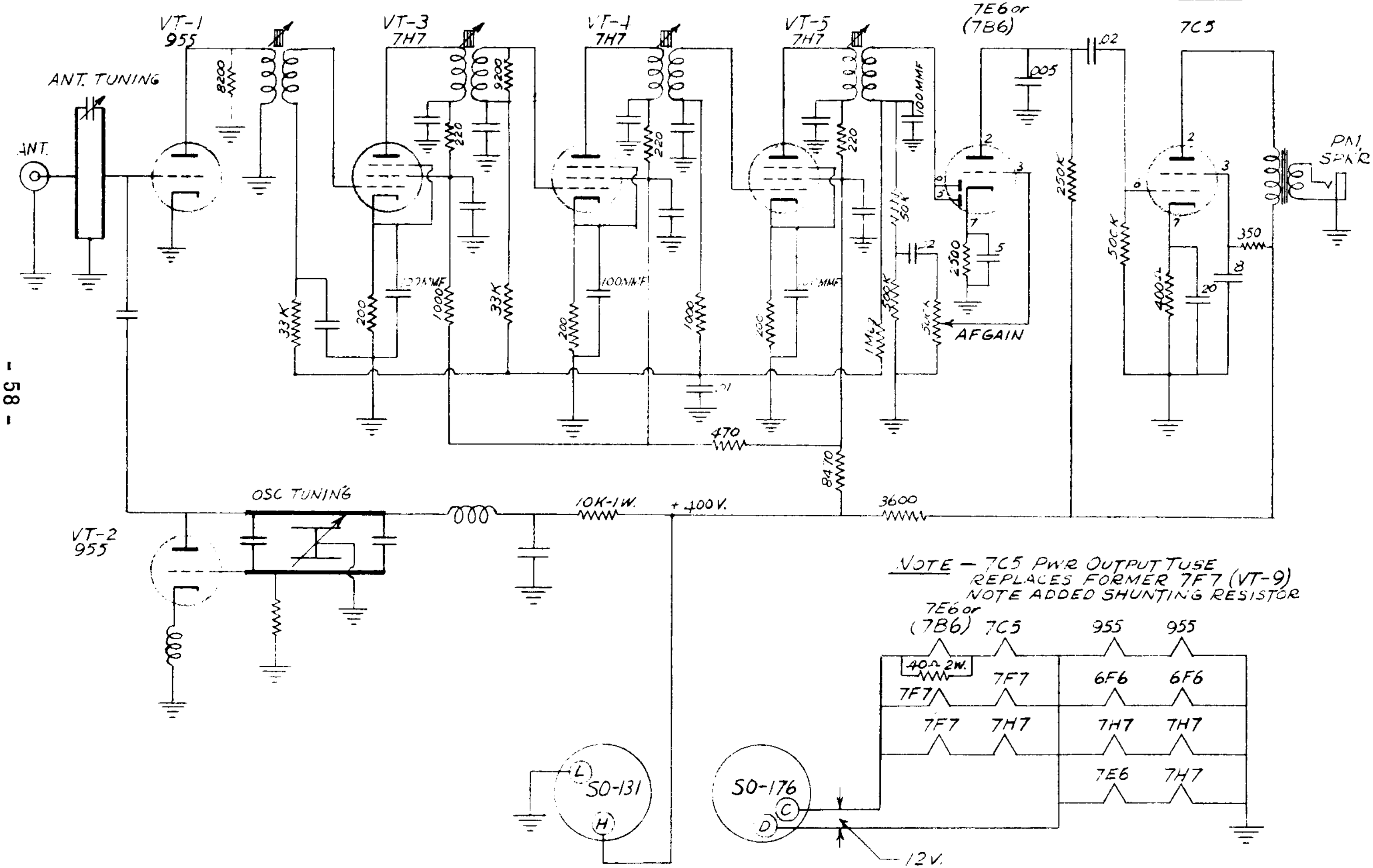
A tuning reaction between the oscillator and antenna circuits will be apparent when tuning the receiver. Simultaneous tuning of the two circuits, rechecking the antenna tuning after each change in oscillator tuning provides the best adjustment.

Both receiver and transmitter are designed for a 50-ohm load. RG-8/U coaxial cable which is available on the surplus market meets the above requirements.


BC-645 TRANSMITTER & MODULATOR
(CONVERTED)
fig 1
COAX TO ANT.
RFC #1
8H, 160MA
WE-316A
3900
3900
200
.5
40
200
270K
6F6's
VT-14's
.05
250K
7F7
VT-10
3500
5
500K
MIKE GAIN
RELAY #1
.02
250K
50K
8
5
2500
SO-131
+400V.
9V. AC
+12 V DC
.02
1 MEG
300Ω
HIGH Z
MIKE
TO Carbon Mike-
If carbon mike
not used omit
300 Ω Resistor

CONVERTED BC-645 RECEIVER

fig 2



AC POWER SUPPLY FOR THE BC-645

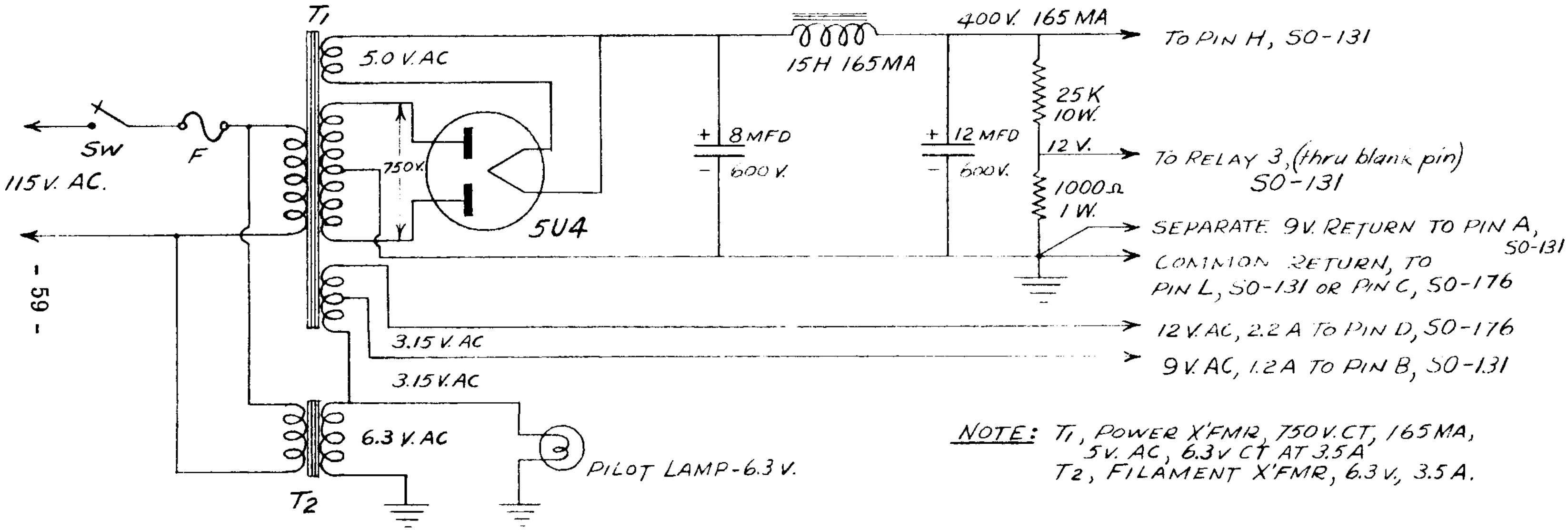
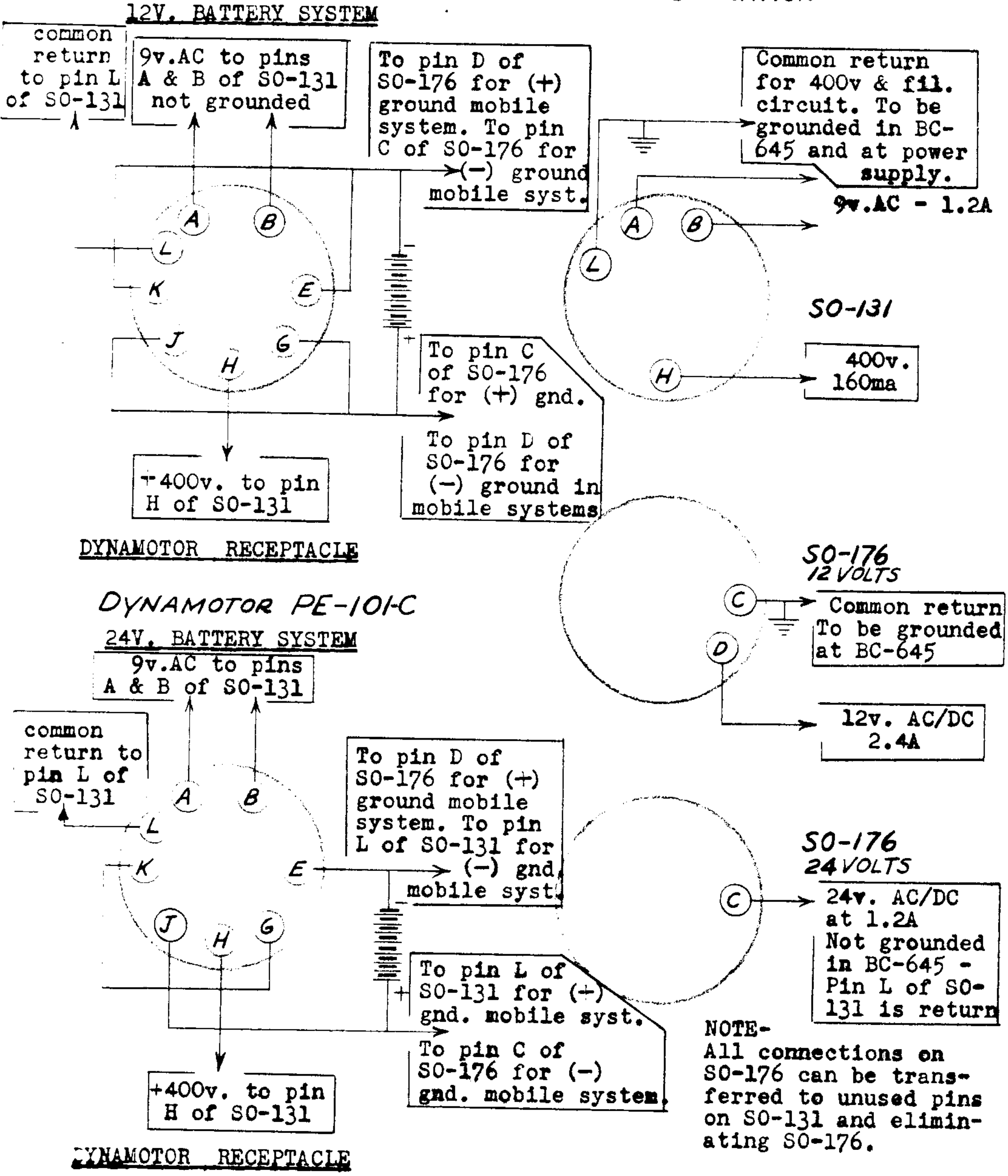


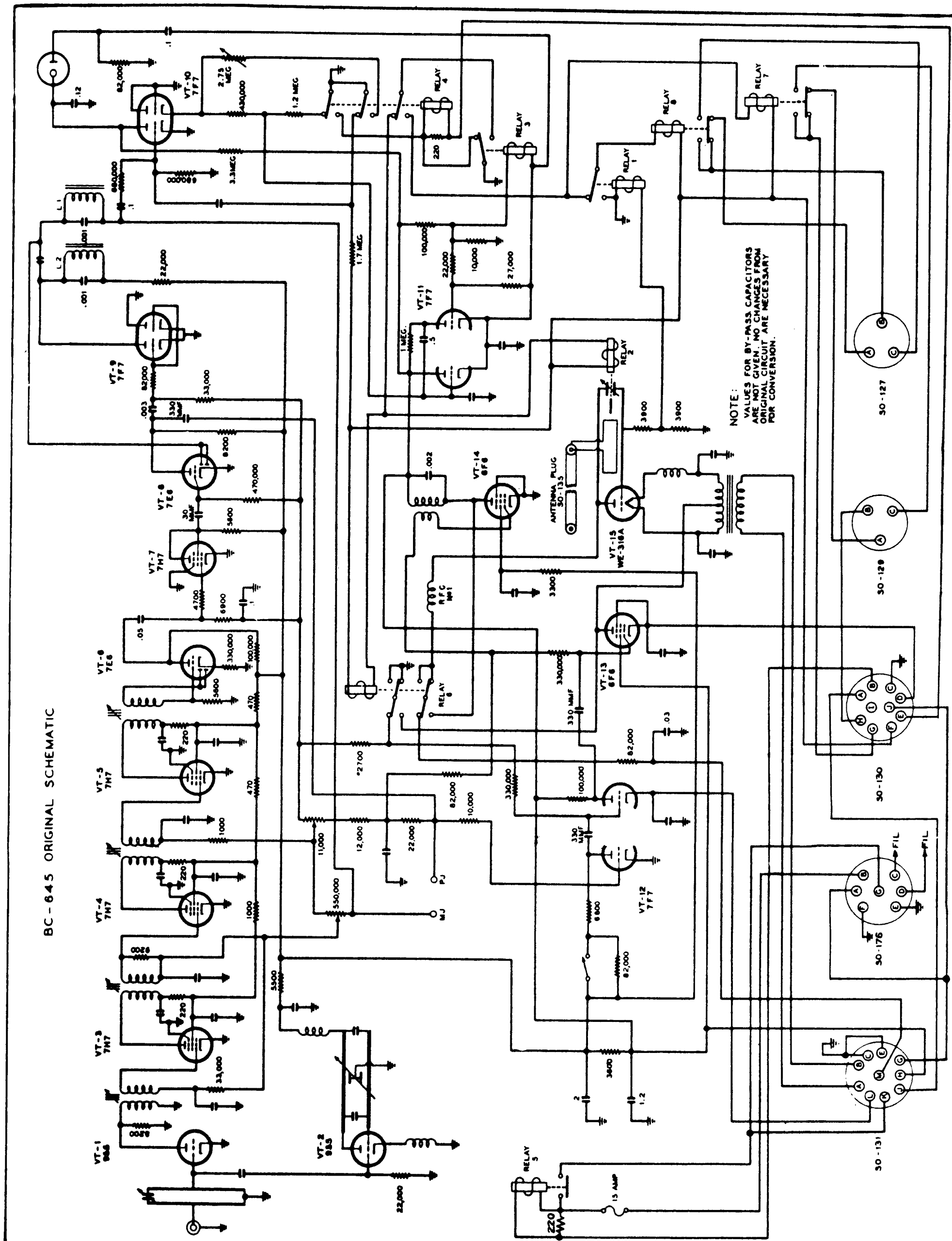
fig 3

SOCKET CONNECTIONS FOR BC-645 OPERATION



NOTE- All connections on SO-176 can be transferred to unused pins on SO-131 and eliminating SO-176.

fig 4



Courtesy Belmont Radio Corporation FIG 5

BC-946-B RECEIVER - CONVERSION FOR USE ON 6 VOLTS D.C. (AUTO RADIO)

Introduction:

The BC-946-B receiver is one designed for use in Army aircraft and is of all aluminum construction. It weighs about 6 pounds and is approximately 5" x 8" x 12" in size.

The unit incorporates a 6-tube superhet circuit covering the frequency range of 520 kc. to 1500 kc. by means of a directly calibrated vernier dial. The unit is designed to operate from a 28-volt d-c dynamotor, but the instructions herein will explain how it can be easily adapted for 6-volt battery operation. The receiver's excellent shielding makes it a natural for mobile use.

The conversion data as covered in this article will cover a typical auto installation in use at present by the author in conjunction with a 10-meter converter.

Conversion Instructions:

In order that he may have the general picture in mind, it is suggested that the reader briefly scan this entire article before commencing work on the receiver.

The following steps will be covered in detail:

(a) Removal of present CW oscillator stage
(b) Addition of first a-f stage in place of c-w Osc.
(c) Rewiring filaments for 6 volts
(d) Replacing output transformer
(e) Moving antenna post
(f) Addition of vibrator power supply or dynamotor
(g) Installation using FT-220-A rack
(h) Selectivity adjustments
(i) Noise limiter circuit

(a) Removal of Present CW Oscillator Stage:

Remove all wires to terminals 6 and 2 of the 12SR7 tube, and all wires to terminal 5 of the 12A6 tube. This operation makes the following component parts useless and they should be removed to give space: R14, C26, L12, L13, C27, C28, R15, C25, R18, R19, R20, R16, R17, C29. (It will be necessary to refer to the circuit diagram in order to locate and remove these parts.)

(b) Addition of First A-F Stage In Place Of C-W Oscillator:

The triode section of the 12SR7 tube is now free after the above change, and a stage of resistance-coupled amplification can be substituted. The diagram (Fig. 2) will clearly show the manner in which this is added. It will be noted that an audio volume control is included in the revision. The control is physically mounted on the front panel in place of the present plug. The plug wiring is removed completely and discarded except for the wire labeled "Gain control line" on the circuit diagram. (Front plug is J1.) This wire is removed and connected to ground.

This is the RF gain control line. Originally an external control was used to control the gain. However, in this modification an AF gain control is used and the RF gain control line is connected to ground, leaving the RF gain wide open as is normal in broadcast receivers.

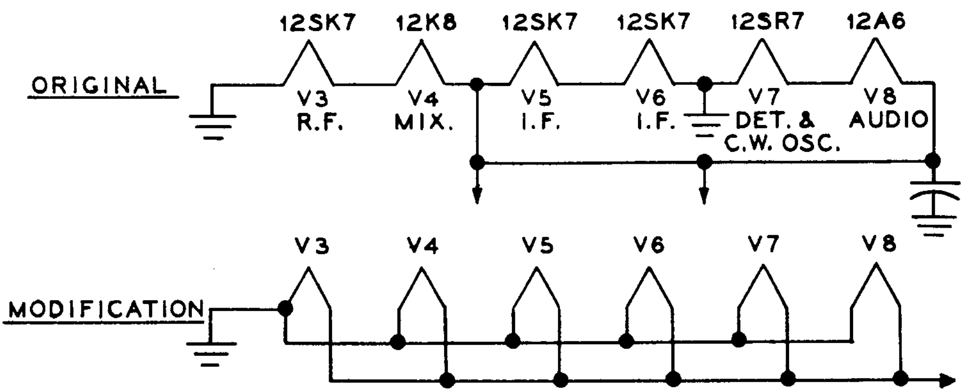
A dural plate is made to just fit in place of the plug, and the AF gain control (500,000 ohms) is mounted in the center of the plate.

It will also be noted that a noise silencer circuit is included in the circuit. This can be built as an individual unit if desired and mounted in a small can alongside the receiver, or it can be built directly into the set, depending upon whether the reader desires to use the silencer for other purposes at some future date.

(c) Rewiring Filament For 6 Volts:

This step might have been accomplished first, but the removal of the CW osc circuit allows more room for rewiring the filaments.

Rewire all tubes in parallel as in the diagram below. Attention to the original filament circuit as given will readily show the few wires necessary to be moved.



It will be necessary to replace the 12-volt tubes with their 6-volt equivalents as follows: replace 12SK7 with 6SK7, 12K8 with 6K8, 12SR7 with 6SR7 or 6SQ7, and replace the 12A6 with either a 6K6, 6V6, or 6F6.

(d) Replacement of the Output Transformer:

The present output transformer should be replaced with a unit which will match the chosen output tube to the voice coil of a PM dynamic speaker. If a very small transformer of the replacement type is obtained it may be installed in the place of the original transformer. The output lead (one side is grounded) is run directly to the rear plug in accordance with the general diagram of figure 3.

(e) Moving of Antenna Post:

It is advisable to remove the present antenna post and replace it with a standard bayonet receptacle as used on most auto radios. In addition, it is suggested that this receptacle be installed on the side of the receiver instead of in front for convenience.

(f) Addition of Vibrator Power Supply or Dynamotor:

Any standard 6-volt vibrator power supply that will give approximately 160 to 250 volts at 40 ma. can be used on this receiver. The supply can be mounted on the space where the former dynamotor was installed. It can be a commercial ready-built unit such as a Mallory Vibrapack, or a standard circuit built and mounted on the rear of the chassis.

A very easily obtained power supply for this unit can be created by using a 12-volt dynamotor such as is used in the BC-312 receiver. This dynamotor will run from 6 volts d.c. and put out sufficient voltage with no conversion.

It will be necessary to remove the former dynamotor plug on top of the chassis. Remove the plug and all wires except the B plus connection which should be removed and connected to the B plus of the power supply used.

(g) Installation Using FT 220 A Rack:

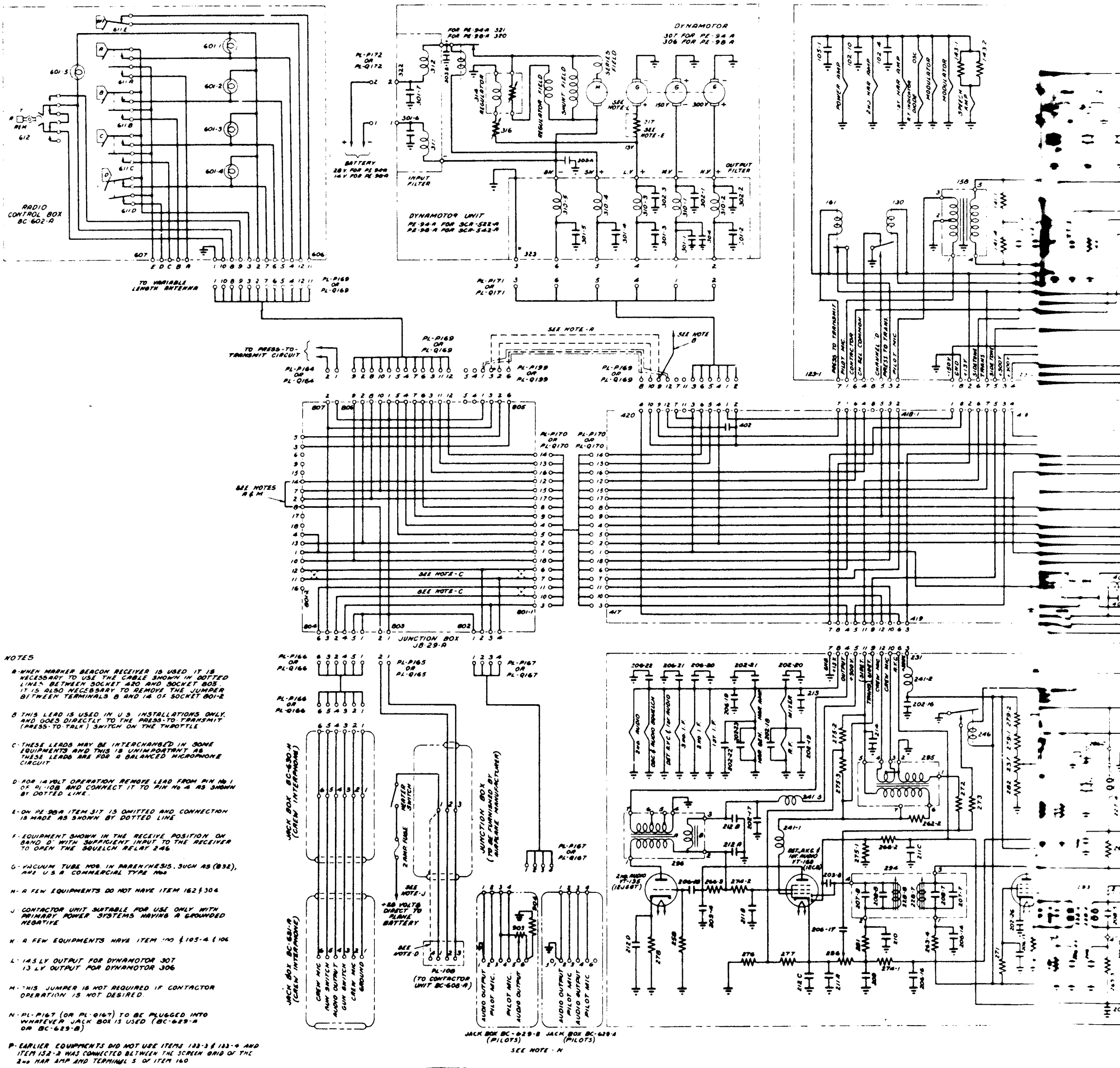
In the author's installation, the FT 220 A rack was purchased for less than $1 and one section sawed off to take the receiver. (The rack is made for 3 receivers.) The rack is mounted under the dash of the car and allows the receiver to slip in and out quite easily. The fuse mounted on the rear of the rack was used for the A voltage fuse, and the toggle switch on front was rewired for a standby switch in the B plus lead as shown in figure 3.

(h) Selectivity Adjustments:

The selectivity of the receiver is quite high for broadcast reception. If desired, the tuning can be broadened by increasing the coupling of the IF transformers. This can be done by pushing down, all the way, the small fibre rod protruding from the IF cans.

(i) Noise Limiter Circuit:

The noise silencer circuit shown in figure 2 has proven to be very effective. The neon-tube peak limiter across the output transformer is then not needed.

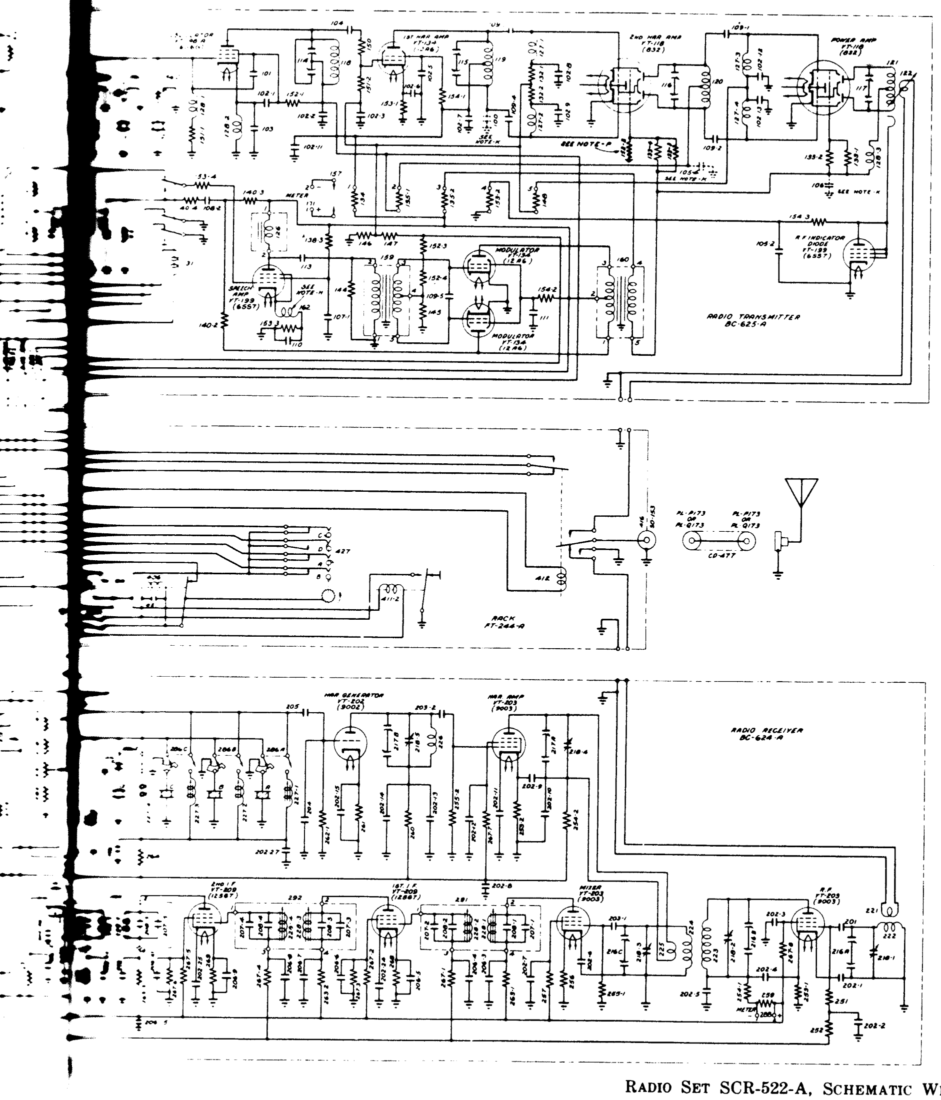


RADIO SET SCR-522-A, SCHEMATIC WIRING DIAGRAM

REVISED 4 SEPTEMBER 1943
181–182

FIG 4

For text, see page 90;
also 97, 82.



RADIO SET SCR-522-A, SCHEMATIC WIRING DIAGRAM

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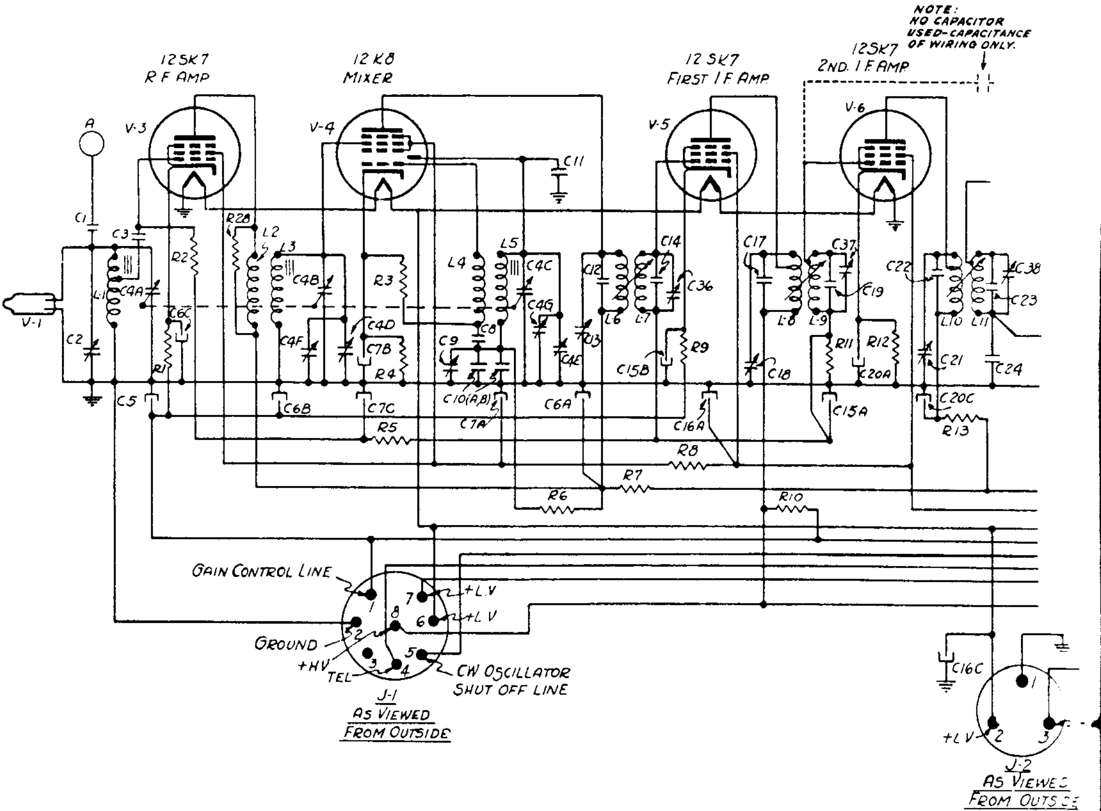
181–182

FIG 4

For text, see page 90;
also 97, 82.



CIRCUITS IN RF COIL SET, IF COUPLING UNITS, CW OSCILLATOR, & OUTPUT TRANSFORMER
THE TERMINAL NUMBERS ON THESE UNITS AGREE WITH THOSE SHOWN AT THE CORRESPONDING LOCATIONS ON THE WIRING DIAGRAM

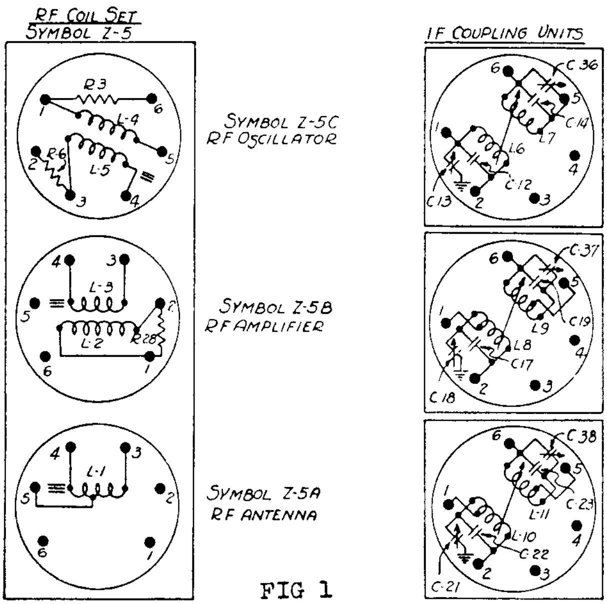
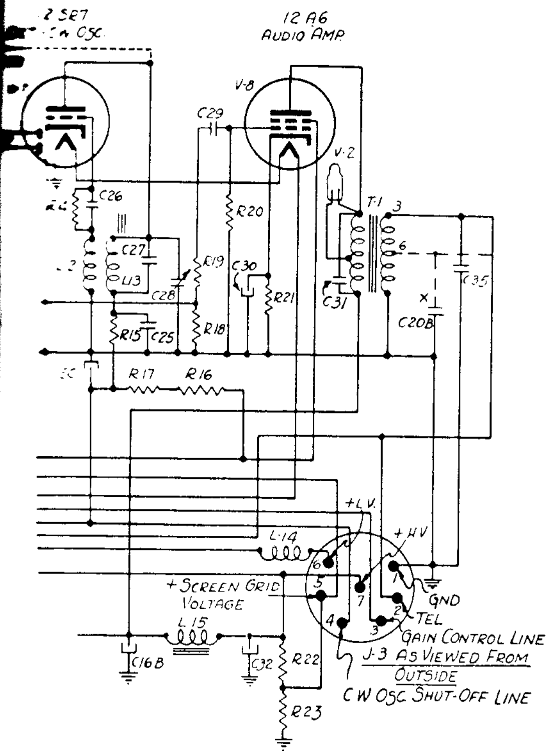
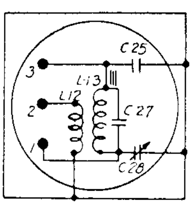


FIG 1

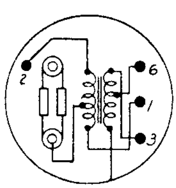
Radio Receiver BC-946-B — Schematic Wiring Diagram



CAPACITANCES		INDUCTANCES		RESISTANCES	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C-1	11 MMF	L-1	ANT. INPUT	R-1	620
C-2	15 MMF	L-2, L-3	RF AMP	R-2	2,000,000
C-3	100 MMF	L-4, L-5	RF OSC	R-3	51,000
C-4(A TOG)	GANG(346 MMF)	L-6, L-7	IN FIRST IF	R-4	620
C-5	3 MFD	L-8, L-9	IN 2ND IF	R-5	150,000
C-6(A,B,C)	.05/05/05 MFD.	L-10, L-11	IN 3RD IF	R-6	300,000
C-7(A,B,C)	05/05/.05 MFD	L-12, L-13	CW OSC	R-7	200
C-8	200 MMF	L-14	RF CHOKE	R-8	200
C-9	40 MMF		112 MICRO-	R-9	620
C-10 (AB)	670 MMF TOTAL		HENRIES	R-10	360,000
C-11	3 MMF	L-15	AF CHOKE	R-11	100,000
C-12	180 MMF		3 HENRIES	R-12	510
C-13	17 MMF			R-13	200
C-14	180 MMF			R-14	100,000
C-15(A,B,C)	05/.05/05 MFD			R-15	20,000
C-16(A,B,C)	.22/.22/.22 MFD			R-16	100,000
C-17	180 MMF			R-17	100,000
C-18	17 MMF			R-18	510,000
C-19	180 MMF			R-19	100,000
C-20(A,B,C)	05/.01/.05 MFD			R-20	2,000,000
C-21	17 MMF			R-21	1500
C-22	180 MMF			R-22	7000
C-23	180 MMF			R-23	7000
C-24	200 MMF			R-28	51,000
C-25	.001 MFD				
C-26	100 MMF				
C-27	335 MMF				
C-28	34 MMF				
C-29	.006 MFD				
C-30	15 MFD				
C-31	.001 MFD				
C-32	5 MFD				
C-33	WIRING CAPACITANCE LESS THAN 2 MMF				
C-35	750 MMFD (SEE NOTE ④ BELOW)				
C-36	17 MMF				
C-37	17 MMF				
C-38	17 MMF				

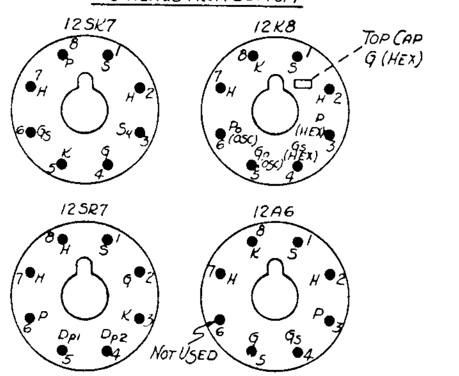


SYMBOL Z-4
CW OSCILLATOR
(239 KC)



SYMBOL T-1
OUTPUT TRANSFORMER

TUBE SOCKET TERMINALS
AS VIEWED FROM BOTTOM



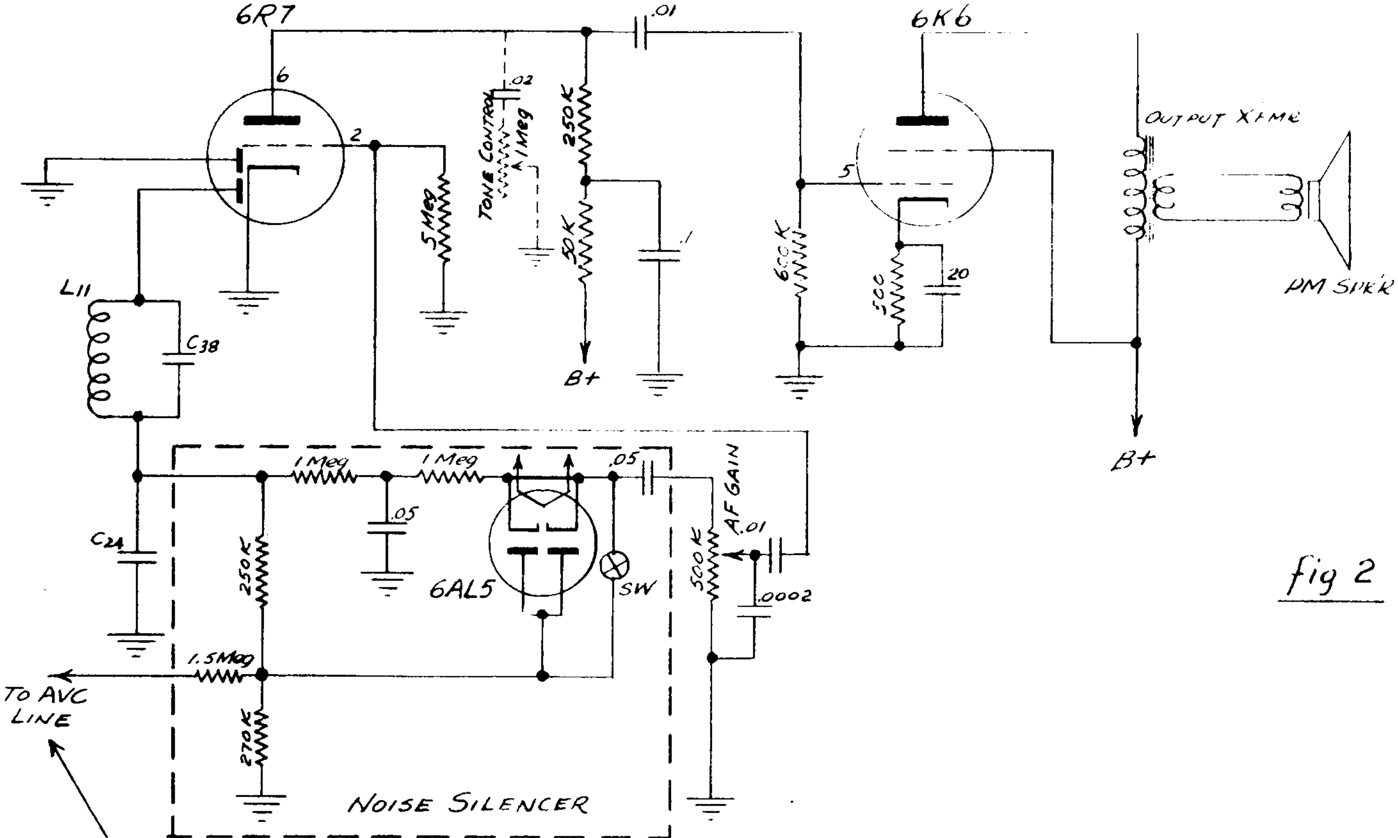
④
C35 & TERMINAL 3 TO BE USED FOR 4000 OHM OUTPUT
C20B & TERMINAL 6 TO BE USED FOR 300 OHM OUTPUT

TUBE TERMINAL CODE

- S = SHELL
- H = HEATER
- K = CATHODE
- S_u = SUPPRESSOR GRID
- D_{p1} = FIRST DIODE PLATE
- D_{p2} = SECOND DIODE PLATE
- G = CONTROL GRID
- G_S = SCREEN GRID
- G_S(HEX) = SCREEN GRID, HEXODE SECTION
- G_O(OSC) = CONTROL GRID, OSC SECTION
- P = PLATE
- P(HEX) = PLATE, HEXODE SECTION
- P_O(OSC) = PLATE, OSC. SECTION
- G(HEX) = CONTROL GRID, (HEXODE SECTION

Radio Receiver BC-946-B — Schematic Wiring Diagram

MODIFIED AUDIO SECTION OF BC-946-B



NOTE: Remove R11 from original circuit and connect AVC to ungrounded side of C15A

fig 2

NOTES - Noise Silencer Circuit Added.
1st Audio Stage Replaces Original CW Oscillator.
Tone Control, optional — (dotted circuit)

CONNECTION DIAGRAM FOR BC-946B RECEIVER
USING THE FT-220A RACK
(TYPICAL AUTO INSTALLATION)

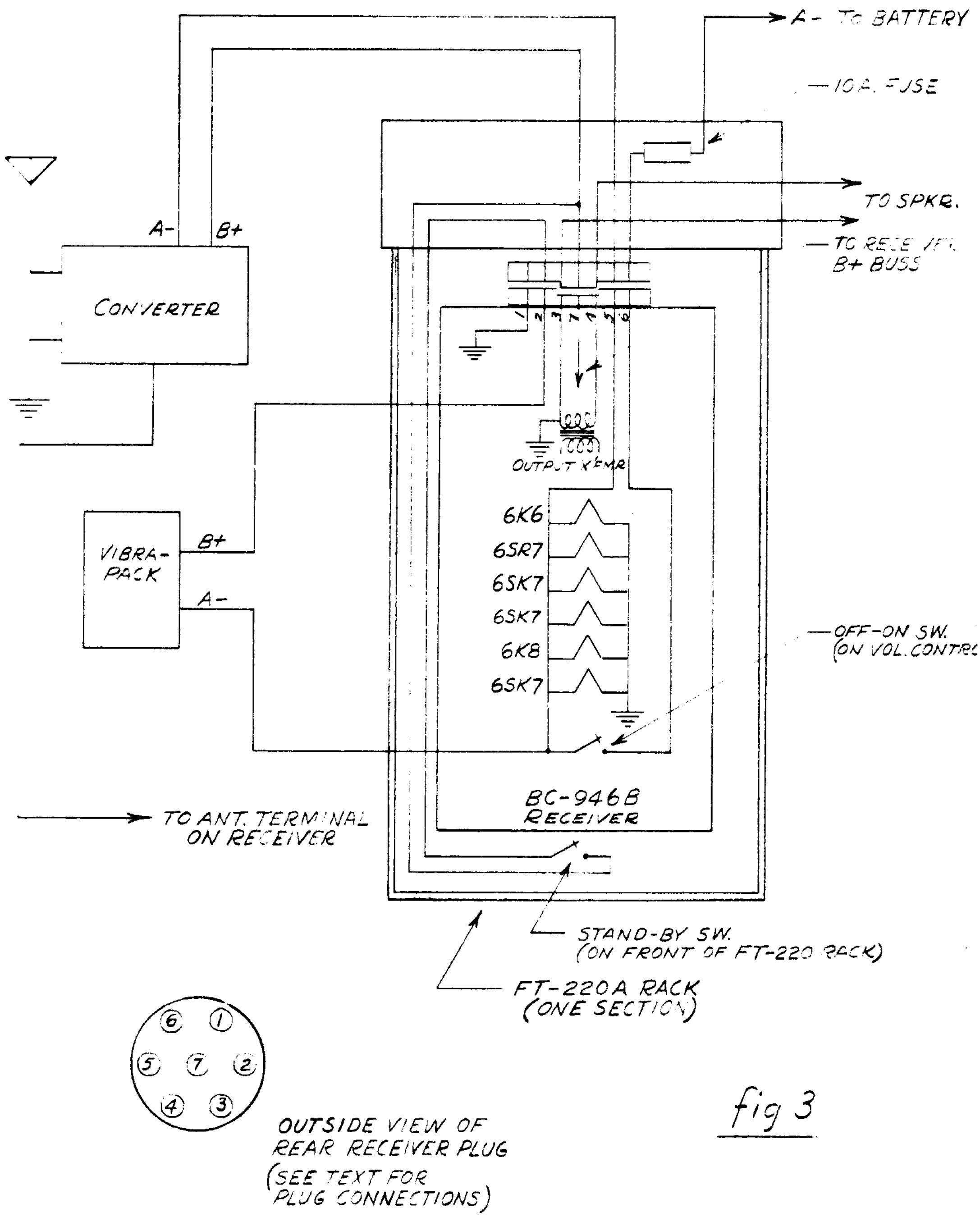
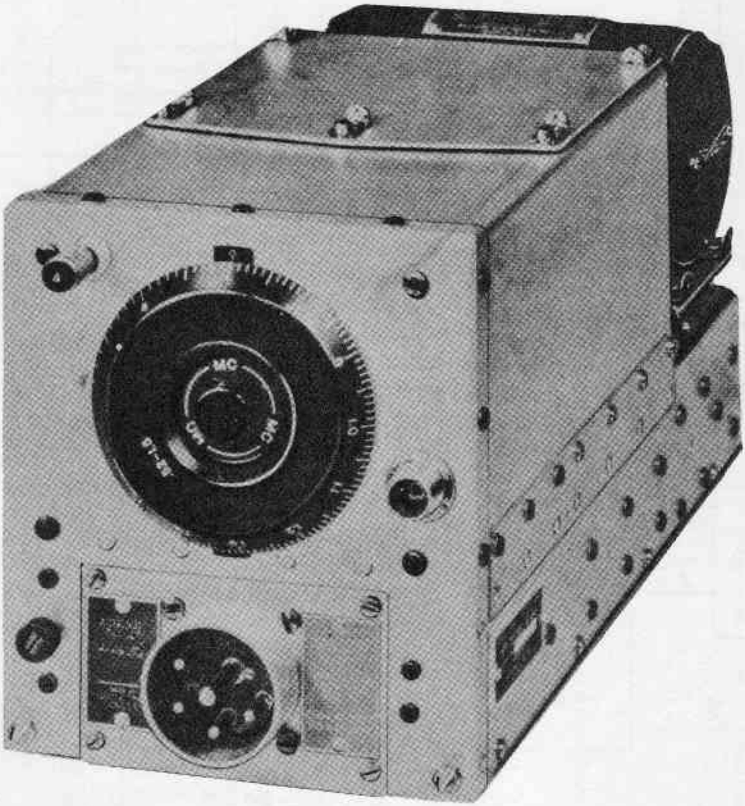


fig 3



BC-946B RECEIVER(Before conversion)

Typical of Command Set type Receivers

CONVERTING THE SCR-274N COMMAND SET RECEIVERS
(BC-453 Series)

"Q-5'er" CONVERSION — 10-METER CONVERSION

Introduction:

The SCR-274N series of command-set receivers includes the BC-453, BC-454, and the BC-455. Almost identical counterparts to these three are available in the ARC-5 command-set series.

The BC-453 (and its ARC-5 equivalent) is quite effective and justifiably popular as a "sharp-channel" i-f system to follow a conventional communications receiver. Either the BC-454 or the BC-455 may be used intact as a communications receiver, but it will be found that the receivers are excessively broad in selectivity due to the high value of intermediate frequency which is employed. However, due to this relatively high i.f. either of the latter types of receiver may be converted for image-free operation on the 10-meter band by revamping the r-f coil assembly and the main tuning capacitor. In addition, several changes are required in the audio circuit. These changes are similar to those suggested previously for the BC-946B conversion.

(a) General Description:

The command-set receivers, designed for aircraft use, are light, very compact, and totally shielded in an aluminum case. Each is a 6-tube superheterodyne with one r-f stage, two i-f stages, mixer, detector, beat oscillator and audio. All are designed to operate from a 28-volt d-c source, with a dynamotor supplying the plate voltage.

The units of this series are substantially identical with the exception of the main tuning capacitor, and the r-f and i-f coils which are plug-in units. Frequency coverages and intermediate frequencies are as follows:

Unit	Frequency Coverage	Intermediate Frequency
BC-453	190 to 550 kc.	85 kc.
BC-454	3 to 6 Mc.	1415 kc.
BC-455	6 to 9.1 Mc.	2830 kc.

(b) Ten-Meter Conversion--Modifying the R-F Coil Assembly:

This modification involves rewinding of the coils in the plug-in coil assembly to obtain coverage of the 28-Mc. band. Modification of the tuning capacitors to obtain bandspread operation is discussed in a later paragraph.

L 1 (Ant. coil) - Remove the existing winding and rewind with 6 turns of #18 enameled wire, space wound the full length of the coil form.

L 2 (RF mixer coil) - Remove the existing "honey-comb" coil with the exception of the last layer. This will leave approximately 9 turns for L 2.

L 3 (RF mixer coil) - Remove the existing winding and rewind with 5 turns of #18 enameled wire, spacing the winding evenly the full length of the coil form.
L 4 (Osc. coil) - No alteration is necessary on this coil.
L 5 (Osc. coil) - Remove the existing winding and rewind with 5 turns of #18 enameled wire, close spaced. L 5 should be between 1/8 and 3/16 inch from L 4.

(c) Modify ing the Tuning Capacitor:

In order to provide sufficient spread of the 10-meter band, it is necessary to reduce the capacitance of each section of the tuning capacitor. This is accomplished by removing all the rotor plates except the two end ones in each section. Care should be taken so as not to damage the remaining plates.

With two rotor plates in each section, the band spread for 27 to 30 Mc. will be approximately 3.5 to 4.7 on the calibrated dial. Using only one rotor plate per section, the 27 to 30 Mc. band will cover approximately the entire dial of the receiver.

To facilitate alignment of the receiver after modification, drill necessary holes (1/4") to expose the trimmer capacitor adjustment screws with the shields in place. Since the added cppacitance of the shields tends to detune the circuit, it is preferable to align the receiver with the coil shields in place.

It should be noted that the oscillator frequency must be tuned above the incoming frequency to obtain tracking over the entire dial.

(d) Changes in the Audio Circuit:

Unless the BFO (V-7 stage) is specifically desired, it should be converted to a first audio amplifier. This additional stage gives sufficient increase in audio gain for satisfactory speaker operation.

Even though some conversions use the existing RF gain control method (approximately 20K. variable between cathode and ground), it is generally preferred to have the RF gain remain maximum and use the conventional AF gain control. This is a convenient addition, especially if stage V-7 is changed to the first audio amplifier as mentioned above and as shown in Fig. 1. When the AF gain control is used, the cathode buss lead (labeled "gain control line") to pin #1 of J-1 is connected directly to ground.

With reference to Fig. 1 it will be noted that the 12A6 (V-8) is used as the output stage, R-C coupled to the first audio stage through the AF gain control. A conventional plate to voice-coil output transformer replaces the existing output transformer T1. The output transformer used must match the speaker voice-coil impedance to the required plate load impedance of the 12A6; this is approximately 7500 ohms. The existing output transformer, T1, is designed for a load impedance of either 300 ohms or 4000 ohms. These outputs were used for headphone reception.

V2 is a neon type, peak-limiting device and should be removed unless specifically desired.

For headphone reception with the above modification of the audio circuit, and open-circuiting type jack should be used at the plate output of the first audio amplifier. This jack is inserted between the coupling capacitor, C-29, and the grid of the 12A6.

(e) AVC Circuit:

For optimum signal to noise performance, the RF stage should operate at maximum gain. This requires removing the AVC voltage from this stage. To do this, disconnect R2 from the AVC line and ground at some convenient point. (R2 is V3 grid resistor.)

Due to the high gain of the RF and IF sections of this set, some AVC action is obtained from the existing circuit. (Diode action of control grid of second IF amplifier.) If more AVC is desired, it can be obtained from the unused diode plate of V-7 (12SR7) in the conventional manner. For this change refer to Fig. 1.

In using the diode section of V-7 for the AVC, it is necessary to remove R11 from the V-6 grid circuit. Refer to Fig. 1 for the added AVC components to V-7.

(f) Power Supply:

The most convenient AC power supply to use with these receivers is the one shown in Fig. 2. By using the cathode type rectifier (6X5), the 5 and 6.3 volt windings are used in series which gives approximately 12 volts for filament supply. This permits the use of the existing tubes with just minor changes in the filament circuit as shown in Fig. 2.

Correct polarity (phasing) of the two filament windings should be observed to obtain the proper additive voltage.

(g) Mechanical Modifications:

To complete the receiver conversion, the following mechanical modifications should be made:

The added controls, OFF-ON switch, volume control, and headphone jack should be brought out in the front panel. This is accomplished by removing all of the hardware of the J-1 plug assembly located on the front panel. An aluminum plate is mounted over the opening left by the J-1 plug and serves as a panel mount for the controls.

When removing J-1, all connecting leads can be removed from the set except the one labeled "gain control line" which is connected to pin #1. This lead is grounded as stated above in section (d).

With a bit of ingenuity and patience, the power supply can be located on the receiver chassis in the former dynamotor position. However, if the power supply is constructed as a separate component, the J-3 position can be used as the connecting plug.

All leads can be removed from J-2; lead to pin #2 is the filament lead and is connected to the new filament source.

It is apparent that the several components connected to J-3 are not needed for AC operation and can be removed to provide more space for the modifications and additional parts as were the BFO components of the V-7 stage.

NOTE: For schematic diagram refer to Fig. 1 of the BC 946.

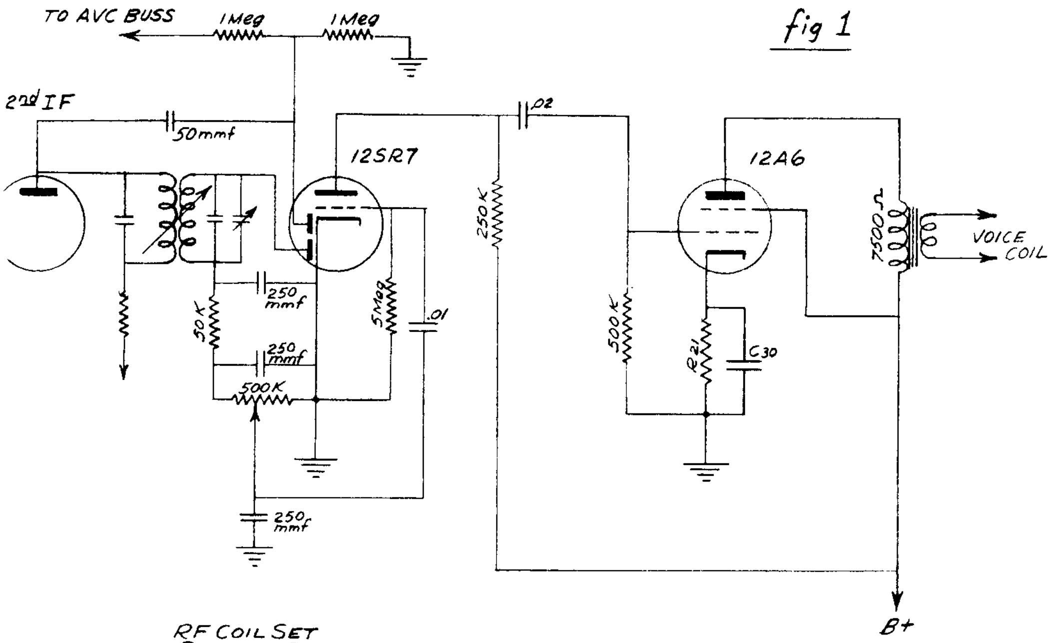
(h) Use of the BC-453A as a "Q-5'er":

The BC-453A command receiver operates with an i.f. of 85 kc., which permits it to have an unusually sharp response characteristic. The normal method of using this receiver as a "Q-5'er" is to convert the audio system and the power supply as just described, and then to couple a shielded wire with a probe on the end into the communications receiver in the region of the last i-f stage. The BC-453 will operate, without modification, as a sharp i-f channel for any receiver having an intermediate frequency from 190 to 550 kc. Greatest selectivity will be obtained with the fiber rods which protrude from the center of the top of each of the i-f transformers pulled out as far as they will go for each of the three transformers. This degree of selectivity, which may be too much for comfortable listening to a phone contact, may be reduced by stagger tuning the i-f transformers slightly, or by pushing down one or more of the fiber rods.

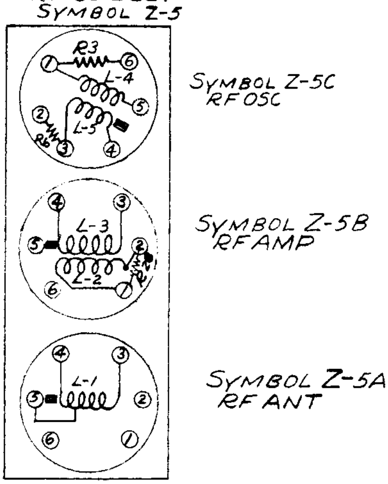
The BC-453A may be operated in conjunction with a BC-348 as a sharp channel either by making modifications in the r-f coil assembly of the BC-453A or by using a frequency-converter stage. It is possible to remove turns from the coils in the r-f assembly until the front end of the receiver will tune to the 915-kc. i.f. of the BC-348. The alternative method of using the BC-453A in conjunction with the BC-348 is to use an outboard mixer stage between the output of the BC-348 and the input of the BC-453A. This mixer stage should accept the 915 kc. signal from the BC-348 and convert it, using conventional broadcast receiver components, to a frequency in the vicinity of 456 kc. for feeding to the input of the BC-453A. A 6SA7 tube is ideally suited to performing the frequency conversion which is required.

Audio Section for Converted SCR-274N (BC-453A) Series Receiver

fig 1



RF COIL SET
SYMBOL Z-5



NOTE: Should Noise Limiter Circuit be desired refer to conversion of BC-946, page 57

For original schematic diagram refer to BC-946, page 58

POWER SUPPLY FOR SCR-274N RECEIVERS

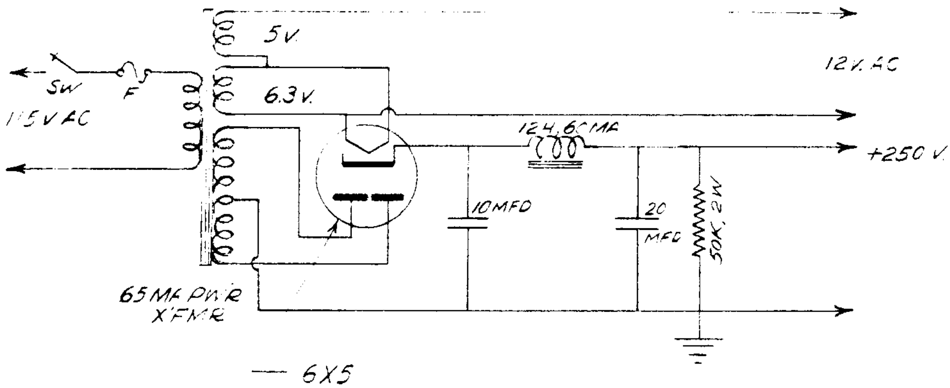
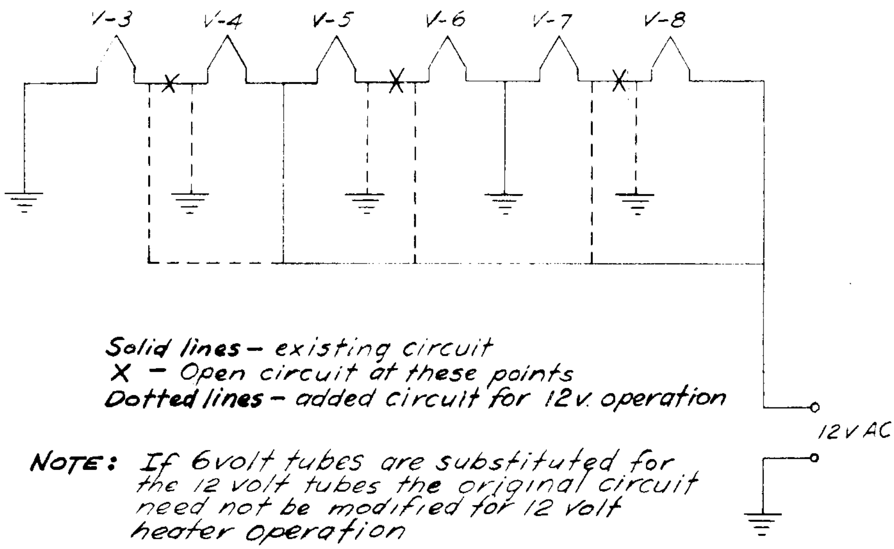


fig 2

FILAMENT CIRCUIT



Solid lines — existing circuit
X — Open circuit at these points
Dotted lines — added circuit for 12v. operation

NOTE: If 6 volt tubes are substituted for the 12 volt tubes the original circuit need not be modified for 12 volt heater operation

CONVERTING THE BC-457A TRANSMITTER SERIES (SCR-274N) FOR USE AS VFO

Introduction:

This series of transmitters was designed for use in Army aircraft and, for all practical purposes, the following data will also be applicable to the Navy version (ARC-5 Series).

Frequency coverage of units:

BC	457A	4 to 5.3 Mc.	(Crystal check point at 4600 kc.)
"	458A	5.3 to 7 Mc.	(" " " " 6200 ")
"	459A	7 to 9.1 Mc.	(" " " " 8000 ")
"	696A	3 to 4.0 Mc.	(" " " " 3500 ")

The circuit schematic included as part of this article is for the BC 458A, but it is typical of all the models including the Navy ARC-5 series.

The output frequency is governed by the directly calibrated tuning dial and has nothing to do with the crystal in the unit. This crystal is merely used as a check on dial calibration and can be changed to any frequency desired, providing the pin connections are observed on the crystal.

The tuning eye (1629) originally obtained part of it's operating bias from the 24-volt DC source, and, in order to allow this tube to function normally with AC on the filaments, remove resistors R-70 and R-77 from V-53. Replace R-77 with a 2000 or 2500-ohm 1-watt resistor. The tuning eye will now function nicely. To calibrate the unit, set the dial to frequency of the crystal in the unit and insert a screwdriver in the opening under the slide in front of the 1629 compartment. Adjust this trimmer (Osc trimmer) for maximum shadow on the 1629 tuning eye. Clockwise rotation lowers the frequency.

Connections to the unit will be greatly simplified if a rack is purchased which was designed to hold this size unit, and if not used intact, the plug can be removed and used to make power connections. Otherwise the power leads will have to be soldered directly to the terminals of the plug on the rear of the unit.

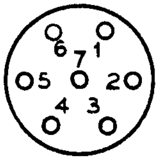
To Convert For Use As VFO:

1. Jam the bottom relay closed (K53) or short out the associated contacts. (This relay was used as a keying relay and applied plate voltage to the Osc while at the same time shorting out R75.)
2. Solder the top relay (K54) to the antenna post. This relay originally grounded out the antenna when the transmitter was not in use.
3. Connect 24 volts AC (1 amp), to terminals 1 and 6 of the plug for filament voltage. (If desired, the filaments may be easily rewired for 12 volts by referring to the schematic.)

4. Connect approximately 300 volts to terminals 1 and 7 for the Power Amplifier plate voltage (1625's). (Terminal 1 is ground.)
5. Connect approximately 200 volts to terminals 1 and 4 for the Power Amplifier Screen voltage.
6. Connect 180 to 200 volts to terminals 1 and 3 for the Osc plate voltage. (For stable operation this should be from a regulated supply.)
7. Couple the output of the unit thru a coaxial cable or twisted pair to your transmitter's v.f.o. input.
8. If trouble is experienced with oscillations, it may be wise to remove the antenna tuning coil L52 completely from the unit. If this is done, the secondary of T54 can be brought out to the original antenna post and to an added one, allowing a balanced (ungrounded) line to your transmitter.
9. It may also be desirable to add a midget phone jack in the lower left hand corner of the unit and wire in series with the 1625 cathode circuit. A milliammeter may then be plugged into this jack to read plate current of the 1625's.

NOTE: All terminal designations given above are for BC-457A series, the plug connections, of which are shown immediately below. For the ARC-5 series, refer to the alternative plug-connection diagram below.

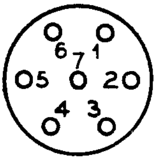
PLUG CONNECTIONS AFTER MODIFICATION FOR V.F.O. (BC457A SERIES)



FACING REAR OF TRANSMITTER

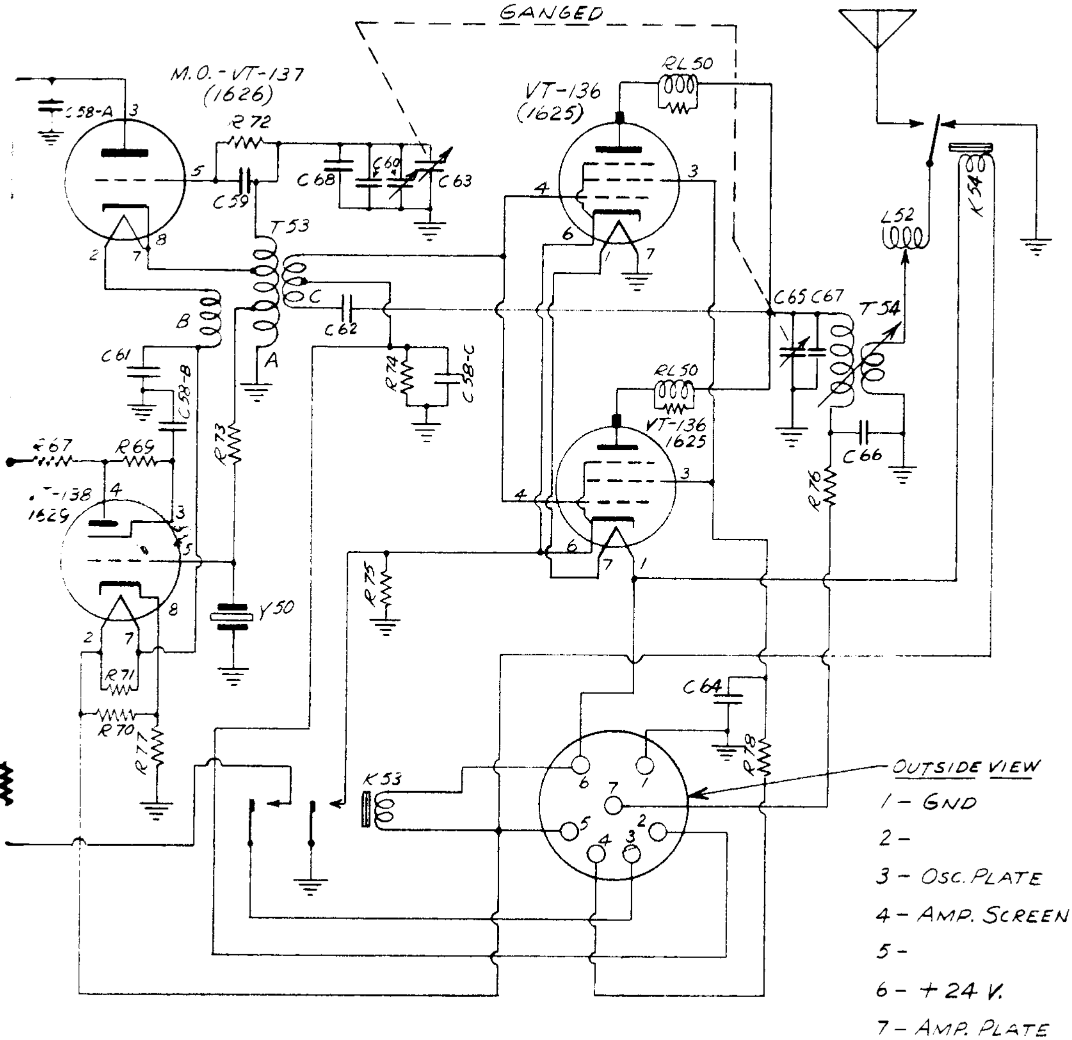
1. 24 VOLTS AC
2. NOT USED
3. OSC. PLATE VOLTAGE (1626)
4. PA SCREEN VOLTAGE (1625)
5. NOT USED
6. 24 VOLTS AC
7. PA HIGH VOLTAGE (1625'S)

PLUG CONNECTIONS AFTER MODIFICATION FOR V.F.O. (ARC-5 SERIES)



1. NOT USED
2. OSC. PLATE VOLTAGE
3. NOT USED
4. 24 VOLTS (GND)
5. 24 VOLTS
6. PA SCREEN VOLTAGE
7. PA HIGH VOLTAGE

SCHEMATIC OF BC-458A (5.3 - 7 Mcs)



C58A,C58B,C58C - .05 uf
C59 - .00018 uf
C60 - Master Osc. padding
C61 - .006 uf
C62 - Fixed Neutralizing
C63 - Master Osc. tuning
C64 - .002 uf
C65 - P.A. tuning
C66 - .01 uf
C67 - P.A. padding
C68 - 3.0 uuf
C69 - 50 uuf
K53 - Xmttr Selector Relay
K54 - Xmttr Output Relay

L52 - Ant. Loading Coil
R67,R72,R75, - 51,000 ohms
R68,R76, - 20 ohms
R69 - 1 Megohm
R70 - 1000 ohms
R71 - 126 ohms
R73,R74, - 15,000 ohms
R77 - 390 ohms
R78 - 51 ohms
RL-50 - Parasitic Suppressors
T53 - Oscillator Coils
T54 - Amplifier Coils
Y50 - Crystal Unit

CONVERTING THE SCR-522
(Transmitter-Receiver)

A popular piece of v.h.f. radio equipment that has been quite common on the surplus market is the SCR-522 (also SCR-542) communication transmitter-receiver. In the military service it was generally known as the v.h.f. communication set used in the larger aircraft for inter-aircraft and air-ground communication. The ground version of the SCR-522 included several additional components such as a power unit, antenna, and antenna mast.

Power requirements for the SCR-522 are 28 volts d.c., at 11.5 amperes (maximum), with the PE-94A dynamotor furnishing the required "B" supply. Identical to the SCR-522, the SCR-542 operates from 14 volts dc., at 23 amperes, and uses the PE-98A dynamotor.

This set, consisting of an automatically-tuned, four-channel, crystal-controlled transmitter-receiver, operates in the range of 100 to 156 Mc. The frequency channels are determined by the four sets of crystals used. This frequency range covers many of the important services including airport control, police, railroad, air navigation aids, facsimile, urban telephone, and of course the 144 to 148 Mc. amateur band.

The complete SCR-522 Radio Set consists of the following components:

Transmitter.	BC-625
Receiver.	BC-624
Dynamotor Unit	PE-94A
Rack	FT-224
Case	CS-80
Control Box.	BC-602
Jack Boxes (for crew interphone).	BC-629, BC-630, and BC-631

The conversion of the SCR-522 for amateur use involves the two basic components, the transmitter, BC-625, and the receiver, BC-624. These will be discussed separately since it is generally preferable to use them as separate units for stationary operation. For mobile operation, the units may be replaced in their original case and operated from the original dynamotor, PE-94A.

Transmitter, BC-625:

The conversion and modification of the BC-625 is discussed under the following section headings:

(a) General Description and Operation
(b) Circuit Changes
(c) Power Supply
(d) Mechanical Modifications

(a) General Description and Operation:

This transmitter with only slight modification makes an excellent low-power transmitter for either stationary or mobile use. With the recommended power supply, it will deliver 12 to 15 watts to the antenna; or it may be successfully used to drive a large power amplifier on 144 Mc. where higher power is desired.

The transmitter tube complement consists of seven tubes, three of which comprise the modulator, and four in the RF section.

Beginning with the RF section, VT-198A (6G6-G) is a modified Pierce crystal oscillator which doubles its frequency in the plate circuit. For operation in the 144-148 Mc. range, it is necessary to use a crystal frequency in the range of 8.0 to 8.255 Mc.; the power amplifier output is the 18th harmonic of the crystal frequency.

The plate output of the crystal oscillator, which is at 16 Mc., is tripled in the next stage to 48 Mc. This stage is the VT-134 (12A6) and drives the third stage, VT-118 (832), which also is a tripler. This brings the frequency up to the final frequency of 144 Mc. The output of the second tripler is coupled into the final with the hair-pin type of tank tuned with a split-stator butterfly capacitor. The final power amplifier VT-118 (832) operates as a straight amplifier and is coupled to the antenna through a variable swinging link.

It will be noted upon inspection that all coils are of the silver-plated type. Another point worthy of mention, is that the antenna loading can be anything between 20 and 500 ohms. However, it will be most convenient to use 52 ohm coaxial cable which matches the receiver input impedance and which also is the most readily available on the surplus market.

In some models of the SCR-522, a VT-199 (6SS7) stage is used as an RF indicator. This stage is connected as a diode and coupled with a pick-up loop into the final tank circuit.

The modulator section of the transmitter consists of a speech amplifier, VT-199 (6SS7), which is driven by a carbon mike through the input transformer 158. This stage also acts as an audio oscillator when tone modulation is used. The speech amplifier in turn drives the push-pull modulators, VT-134's (12A6's), which modulate the plate and screen of the final RF amplifier and the screen of the driver stage through the modulation transformer 160.

(b) Circuit Changes:

Voice modulation with the existing modulator is accomplished with a single or double button carbon mike through input transformer 158. If a single button mike is used, only half of the transformer primary is used with the center-tap grounded as shown in fig. 1. If a crystal mike is considered, it will be necessary to add an additional pre-amplifier to the modulator input. This can be a conventional voltage amplifier using a high mu triode with a 12-volt heater such as the 12F5. An alternative approach is using the unnecessary RF indicator stage VT-199 (6SS7) rewired in the conventional manner as the pre-amplifier stage.

The T-17, which is readily available on the surplus market, will operate very satisfactorily with the transmitter as a carbon mike.

If modulated c-w operation is desired, in addition to voice, it can be easily obtained by keying the cathode circuit of the speech amplifier, 6SS7

(VT-199), when it operates as an audio oscillator. This is conveniently done by inserting a normally-closed-circuit keying jack in the cathode circuit as shown in fig. 1. It is also necessary to install a double-throw single-pole switch in the grid circuit of the 6SS7. This switch changes the operation of the normal speech amplifier to an audio oscillator, thus giving the audio tone necessary for ICW. This switch as shown in fig. 1 merely replaces the grid circuit contacts that formerly existed on relay No. 131.

Since the mechanical tuning arrangement is removed from the transmitter and discarded as discussed in section (d), it is necessary to provide a crystal selector switch in order to utilize the different crystals. This is accomplished by a four-position single-pole switch as shown in fig. 1. The switch is physically located on the front panel as shown in the panel layout, fig. 2.

To facilitate tuning and operation, it is necessary to meter the plate and grid circuits in the conventional manner. This was accomplished by a switching arrangement and metering leads which were brought out to jacks for a separate external meter. As shown in fig. 2, a O-1 d-c milliammeter can be mounted on the panel with the metering leads run directly to the meter. The selector switch shaft is then extended and controlled from the panel.

Since metering is practically a necessity for tuning up a transmitter, the added meter is a worth-while addition that will complete and dress-up the appearance of the converted transmitter.

After the BC-625 is converted and connected to the power supply, described in section (c), it can be tuned up on the 144 Mc band in the conventional manner. The following chart gives the resonant conditions of the different stages, using the O-1 milliammeter in the respective circuit positions as selected by the metering selector switch:

Sw. Pos.	Circuit	Normal Meter Reading	Actual Current (ma)	Full Scale Represents
No. 1	1st freq. mult. plate	0.4	40	50
No. 2	2nd freq. mult. plate	0.5	50	100
No. 3	PA plate *	0.6 - 0.7	60-70	100
No. 4	Not used **			
No. 5	PA grid	0.5 - 1.0	1.0 - 2.0	2
No. 6	OFF (open position)			

* Adjust antenna loading.

** Used on some models in conjunction with RF indicator, full scale represents 1 ma.

The above data are the approximate values that can be expected when using a plate supply of 300 volts at approximately 260 ma. This represents approximately 20 watts input to the final which under normal conditions should give about 12 watts to the antenna.

(c) Power Supply:

The power supply required to operate the BC-625 has to supply 12 volts at 2.4 amperes for the heaters, and to supply a plate load of 260 ma. at 300 volts. A fixed negative bias of 150 volts is also required.

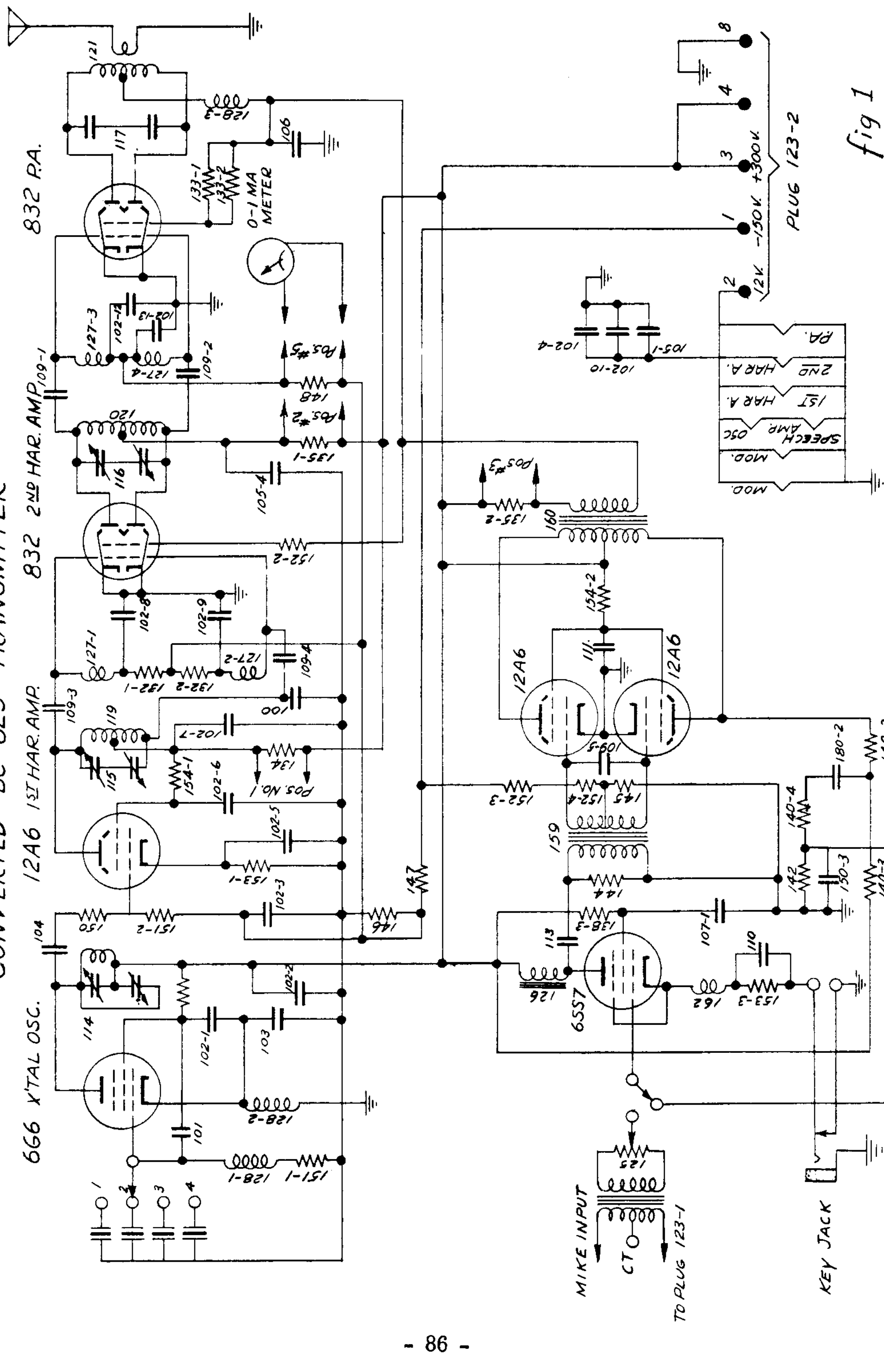
The easiest method for obtaining the bias voltage is from the bleeder which is tapped at ground thus giving the required bias voltage below ground potential. If this method is not convenient, the bias may be obtained from a battery source since the current drain is very low.

A power supply designed to meet the above requirements is shown complete in fig. 3, and should be self-explanatory. It will be noted that the recommended rectifier tube operates very near its upper limit; however for normal transmitter use, it will operate very satisfactorily.

(d) Mechanical Modifications:

The mechanical modifications primarily pertain to the added panel with its associated controls as shown in fig. 2. In order to add the necessary tuning controls, it is necessary to disconnect the tuning capacitor shafts from the ratchet tuning mechanism. It is not necessary to remove the ratchet assembly itself since the shaft extensions extend through this assembly.

The panel used is of standard relay rack dimensions and is mounted to the transmitter chassis with 3 inch brackets. It carries all of the designated controls as well as the O-1 milliammeter.


CONVERTED BC-625 TRANSMITTER
6G6 X'TAL OSC.
12A6 1ST HAR. AMP.
832 2ND HAR. AMP.
832 P.A.
0-1 MA METER
12A6
12A6
6SS7
PLUG 123-2
12V.
-150V.
+300V.
MIKE INPUT
CT
TO PLUG 123-1
KEY JACK
MOD.
SPEECH AMP. OSC
1ST HAR. A.
2ND HAR. A.
P.A.
POS. NO. 1
POS. #2
POS. #3
POS. #5
fig 1

BC-625 PANEL LAYOUT

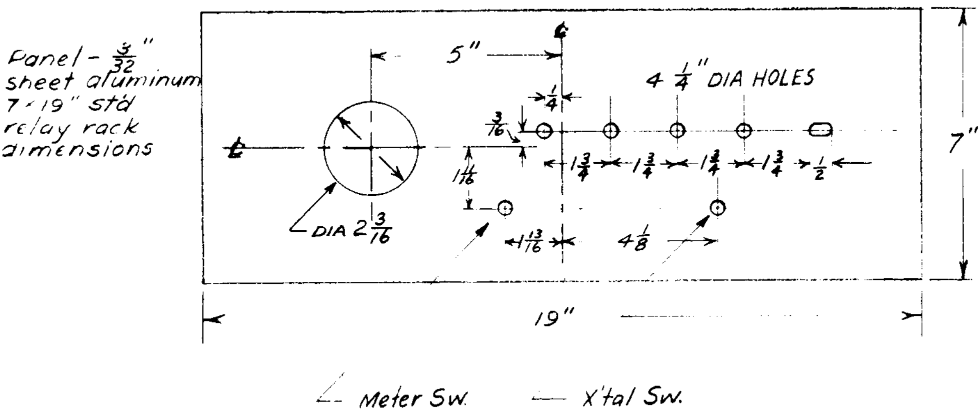
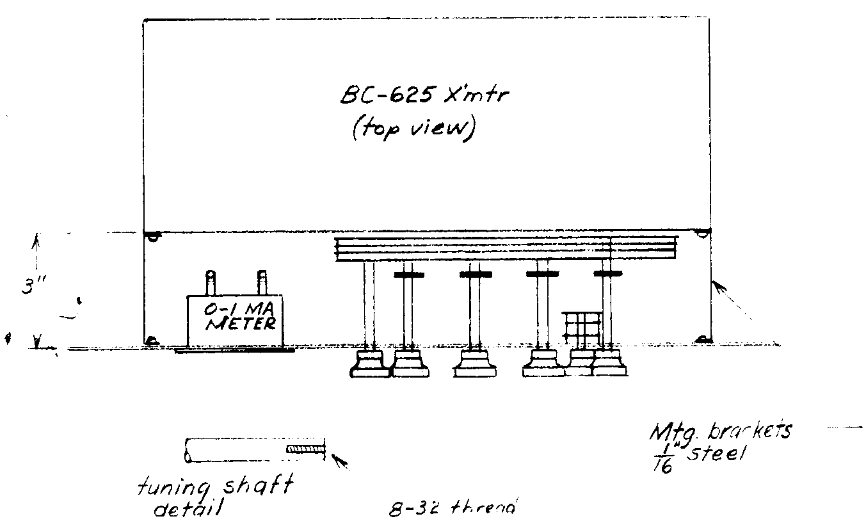
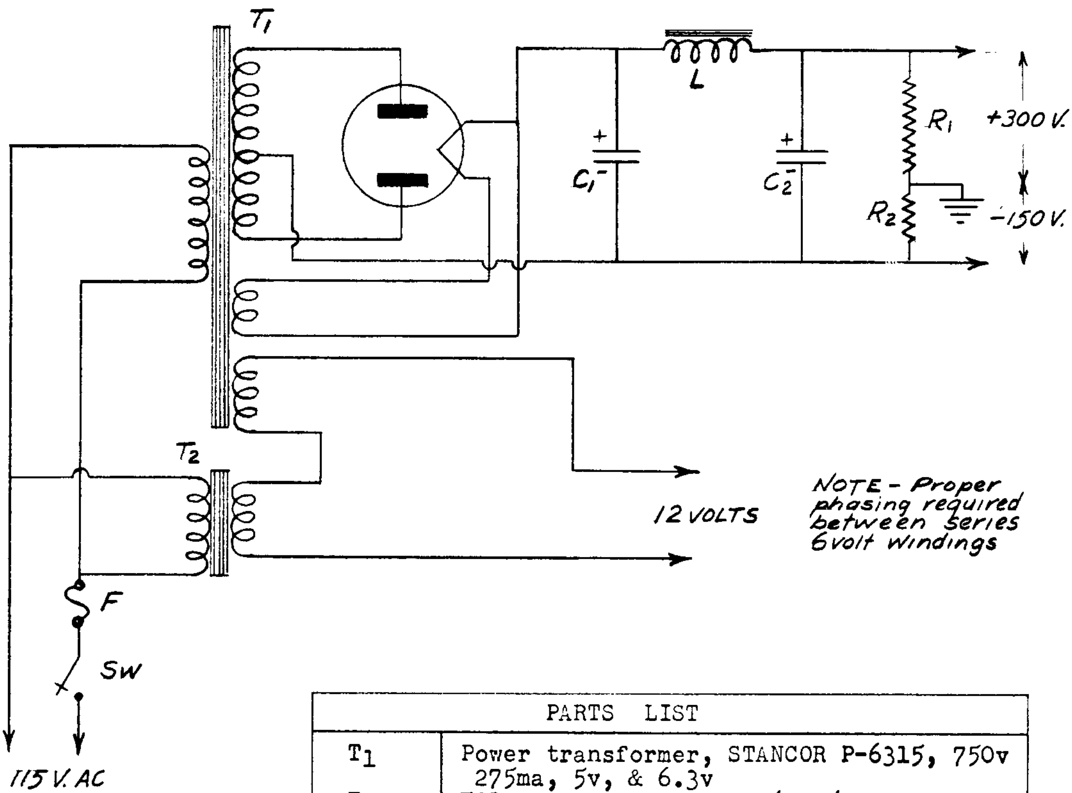


fig 2



POWER SUPPLY FOR BC-625

fig 3



PARTS LIST	
T_1	Power transformer, STANCOR P-6315, 750v 275ma, 5v, & 6.3v
T_2	Filament transformer, 6.3v/2A
Rect.	5Z3 or 5U4
L	Filter Choke, 10 h., 250 ma.
C_1	Filter Condenser, 8 mfd, 600 v.
C_2	Filter Condenser, 16 mfd, 600 v.
R_1	Resistor, 35,000 ohms, 10 watt.
R_2	Resistor, 750 ohms, 5 watt.
F	Fuse, 2 amp.
Sw	Switch, toggle

Receiver, BC-624:

As the receiver component of the SCR-522, the BC-624 lends itself nicely to conversion for the two meter enthusiasts.

From the general description it becomes apparent that there is more required in converting the BC-624 than its companion component, the BC-625 transmitter. Even though the conversion appears difficult, it is generally considered a rather easy and interesting one to the average ham.

It will also be apparent that some of the described refinements are optional and not essential for putting the set into operation. However, in most instances, these optional features are incorporated as well as a number of the personal touches. This is not out of line in doing justice to a well designed receiver such as the BC-624 which will perform with best of them.

The following topics of conversion will be discussed in detail with references to the schematic diagrams and drawings:

(a) General Description and Operation
(b) The HF Oscillator Circuit
(c) Revamping the Second Detector and Adding the Noise Limiter
(d) The First Audio and Addition of the "S"-Meter
(e) Adding the Second Audio, Power Amplifier Stage
(f) Power Supply for the BC-624
(g) Tuning Mechanism
(h) Mechanical Modifications and Panel Layout
(i) Performance Information

(a) General Description and Operation

This receiver is a 10-tube superhet with an intermediate frequency of 12 Mc. In its military form it is a 4-channel receiver which has a preset tuning arrangement and a crystal-controlled high-frequency oscillator.

The three principal models of the BC-624 are the BC-624A, the BC-624AM, and the BC-624C. The "A" model is the earlier model with the "AM" being the modified "A" model. This modification was the military improvement and consisted of an additional tube (12H6) installed under the chassis which functioned as a noise limiter and delayed AVC. The latest model is the "C", which incorporates several modifications over the earlier sets. These changes consist of an added "squelch" circuit and an extra audio stage.

From the above information, it is apparent that the later models are the preferable ones since the addition of the noise limiter and AVC is an important improvement toward the receiver's operation. This modification was later made by the Army on almost all of the earlier sets.

The existing tube line-up with their respective functions are as follows:

9003 (VT-203) First RF Amplifier
9003 (VT-203) Mixer (first detector)
12AH7GT (VT-207) Crystal Osc. and Audio Squelch

9002	(VT-202)	Harmonic Generator
9003	(VT-203)	Harmonic Amplifier
12SG7	(VT-209)	First IF Amplifier
12SG7	(VT-209)	Second IF Amplifier
12SG7	(VT-209)	Third IF Amplifier
12C8	(VT-169)	Second Det., AVC, and First Audio
12J5	(VT-135)	Second Audio Amplifier

(b) The HF Oscillator Circuit:

The existing crystal oscillator operates on four preset crystal frequencies in the range of 8.0 to 8.7 Mc. The harmonic generator selects the desired harmonic, (11th to the 18th) while the harmonic amplifier amplifies the relatively weak harmonic frequency to usable strength for the mixer stage.

To obtain continuous coverage of the band, it is obvious that the oscillator must be changed from the crystal controlled type to the variable tuned type. This is accomplished by eliminating the existing crystal oscillator stage and converting the harmonic generator to the variable-tuned HF oscillator. This becomes an easy matter since the harmonic generator tuning capacitor, 217B now becomes the new oscillator tuning capacitor.

All four crystal circuits and the former oscillator circuit are eliminated in this change and can be removed to provide additional space. The circuit modification is self-explanatory from the before and after circuit diagrams in fig. 4* and fig. 5 respectively.

For the required mechanical tuning arrangement of the oscillator, refer to section (g).

(c) Revamping the Second Detector and Adding the Noise Limiter:

As mentioned before, the later models of the BC-624 have the modification that incorporates the 12H6 (duo-diode) as the Second detector and the noise limiter. This stage is mounted on a bracket under the chassis. To add this modification to the earlier models, should it be necessary, it should be noted that the 12H6 replaces the original 12C8 tube. From the modified schematic diagram, one half of the 12H6 serves as the detector and also furnishes AVC voltage in the conventional manner. The other half of the duo-diode serves as the noise limiter with its respective circuit and may be manually switched in or out. This stage should be wired as per the modified circuit as shown in fig. 5.

(d) The First Audio and Addition of the "S"-Meter:

The former 12C8 tube location is used for the 12AH7, dual triode, one section of which serves as the first audio amplifier. This stage is coupled to the second detector output in the conventional manner through a .5-meg. volume control.

An optional feature which is frequently added to facilitate tuning and to estimate signal strength, is the "S"-Meter. The circuit includes a 0-1 milliampere meter which can be attractively added to the panel of the

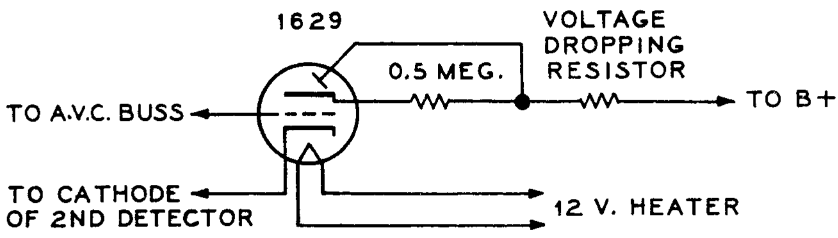
*For Fig. 4 - see pg. 66.

receiver as shown in the panel layout. This "S"-Meter differs from the more conventional type since it utilizes the AVC voltage for its operation. The AVC voltage controls the meter bridge circuit through the triode amplifier, 12AH7 (second section). For manual adjustment of the meter deflection, a 0.25-meg. potentiometer in the 12AH7's grid circuit is used to obtain the proper amount of the AVC voltage. A switch is provided in this circuit for switching the "S"-Meter in or out as desired.

Another version of the above described "S"-Meter circuit incorporates the tuning-eye instead of the 0-1 millampere meter and the meter bridge circuit. This is primarily a tuning indicator and involves fewer parts and less expense if parts have to be purchased.

The 12-volt version of the 6E5 (magic eye tube) is the 1629 (VT-138) and is readily obtainable on the surplus market. It can be conveniently mounted at the rear of the receiver panel projecting through the panel in the approximate location shown for the meter in fig. 6.

Operation of the tuning-eye is directly controlled by the AVC voltage; however, due to the relatively low AVC voltage, the circuit shown below is recommended for optimum operation.



(e) Adding the Second Audio, Power Amplifier Stage:

In order to obtain sufficient audio volume for speaker operation, the power output stage, 12A6, is added with the conventional plate-to-voice-coil output transformer. In the later models this stage would replace the existing second audio stage, (12J5). In the earlier models this stage can be located in place of the squelch transformer 295. The "squelch" circuit is generally not considered practical and is completely removed from the receiver to make room for added modifications.

The audio power amplifier is coupled to the first audio amplifier (12AH7) in the normal R-C manner. Output transformer, 296, intended for headphone use (50, 300, and 4000 ohms) is replaced with a conventional plate-to-voice-coil output transformer. The impedance match for the 12A6 from the PM speaker voice coil should be approximately 7500 ohms.

It may be desired to add a closed circuit jack in the grid circuit of the power amplifier, 12A6, for headphone operation. Both jacks, first audio phones and second audio speaker, can be brought out to the panel of the receiver as shown in the panel layout.

(f) Power Supply for the BC-624:

The power requirements for this receiver are a plate potential of 300 volts at 60 ma., and a 12-volt heater supply at approximately 1.7 amperes. A power supply for these requirements can be conveniently constructed as shown in fig. 5. A 70-ma. power transformer is used with the 5 and 6 volt windings connected in series, and using the 6X5 (cathode type) rectifier. Polarity of the two filament windings must be observed in order to avoid phase cancellation. This can be determined by experiment so as to obtain the correct additive voltage. The conventional filter is used with a stand-by switch placed in the center tap lead for use with the transmitter.

Even though it is possible to build the power supply inside the receiver with careful layout of parts, it is considered preferable to keep it as a separate component with a connecting cable and plug to the receiver. If desired, the power supply OFF-ON switch may be located on the receiver panel with the leads brought out to the above mentioned power supply connecting plug.

(g) Tuning Mechanism:

The manual tuning capacitor controls of the converted receiver involve the two-ganged capacitor which tunes the oscillator and the harmonic amplifier, and the three-ganged, RF amplifier grid, the RF amplifier plate, and Mixer grid tuning capacitor.

The original preset ratchet selector and tuning mechanism is not particularly adaptable for ham operation and should be completely removed from the receiver chassis. This then makes available both shafts of the above mentioned tuning capacitors.

Due to the highly compressed 2-Meter band, as appearing on the capacitor shafts, it is quite necessary to use considerable mechanical reduction for manual tuning. This is particularly true for the oscillator tuning, since the band appears in a very narrow sector of its 90 degree rotation.

For the three-ganged capacitor, the National velvet vernier dial, such as found in the surplus BC-375 tuning units, is quite satisfactory. This type of dial is quite compact and easy to use, being well appearing on the receiver panel.

Due to the very narrow section in the oscillator tuning, it is apparent that even the National vernier dial is not sufficient reduction to afford practical tuning or dial calibration. For this problem there has appeared a variety of tuning arrangements that include both the electrical band spread method as well as the various mechanical methods.

The electrical method is probably the most desirable but does involve considerable effort for installation. This is generally accomplished by using a separate two-ganged condenser having only two or three plates per section, and connecting it in parallel with the existing condenser.

Of the different mechanical reduction arrangements, this one as described below, is probably the most straight forward and fool-proof. It consists of the national, type "A", vernier dial used in conjunction with a belt (dial cord) driven reduction. The dial cord and pulley arrangement is supported between a frame-work consisting of two metal plates. This assembly is mounted directly on the receiver chassis, positioned to couple the drum to the oscillator capacitor shaft and to locate the tuning knob in a symmetrical position on the panel. The drawing in fig. 2 shows this assembly in detail.

The described tuning assembly gives very satisfactory and smooth tuning reduction. This reduction will be such that the 144-Mc. band will be approximately 50 divisions on the 100 division vernier dial. Parts for the dial cord and pulley arrangement are easily made or readily available.

(h) Mechanical Modifications and Panel Layout:

After the removal of the slider-ratchet tuning mechanism from the front of the receiver, brackets are made to support the panel approximately 3 inches from the front of the receiver. The 3-inch space between the panel and chassis is ample for the tuning reduction assembly and all of the other controls.

If all the modifications listed herein are contemplated, the front panel will carry the two National dials, the "S"-Meter or tuning indicator, volume control, AVC switch, send-receive switch, "S"-Meter" switch (if used) noise limiter switch, and the power OFF-ON switch.

(i) Performance Information:

As was originally true in the military version of the BC-624, the converted receiver should have a signal sensitivity of approximately 3 microvolts for an audio signal to noise ratio of 10 db.

The receiver input is designed to operate from a 50-ohm antenna circuit. Should higher impedance lines be used, it will be necessary to increase the number of turns on the antenna coupling coil. The increase of turns is small, being approximately 2-1/2 turns (total) required for a 600-ohm line.

Should a balanced antenna input be desired, the grounded side of the coupling coil should be lifted.

It will be found that the modified high-frequency oscillator can be tuned either 12 Mc above or below the incoming signal. After becoming experienced with the tuning characteristics of the receiver, the operator should be able to use the preferable frequency (above or below) without difficulty.

An interesting note in connection with the exceptional oscillator tuning range is, that by squeezing the RF and mixer coils slightly, the receiver will tune down to the 88-108 Mc. FM band. By utilizing the above and below tuning of the oscillator, as mentioned above, the FM band can be covered without sacrificing any of the 144-Mc. band, thus a total coverage from 88 to 148 Mc. Since the IF band pass is approximately 150kc., it can be made to operate nicely on FM by incorporating a limiter and discriminator circuit.

From the above information, the 2-meter enthusiast should be able to have, at a very nominal cost, a smooth operating and attractive receiver. The performance of this unit will be found to compare favorably with the best receivers of this type.

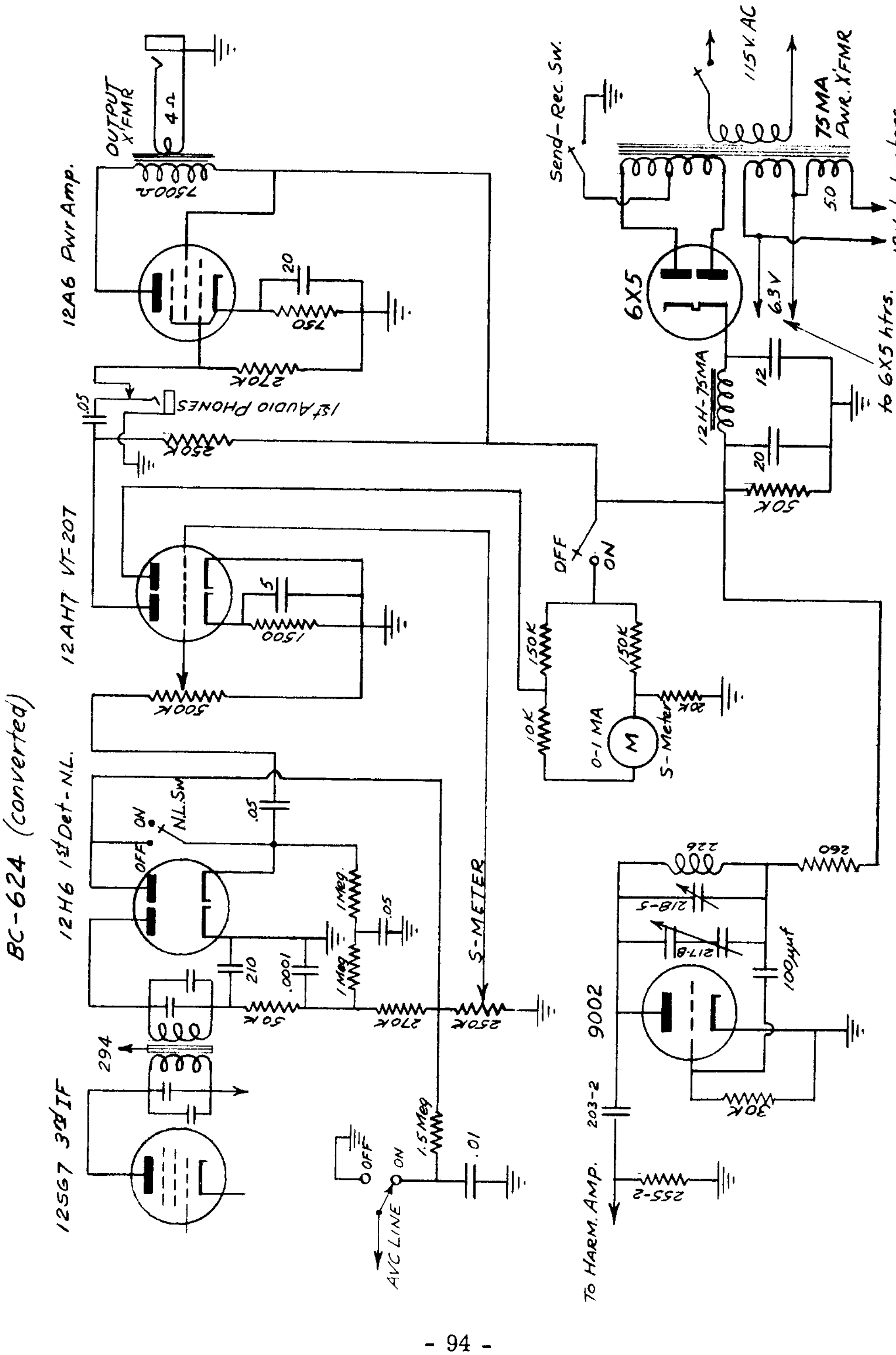

BC-624 (converted)
12SG7 3rd IF
294
12H6 1st Det-N.L.
OFF
ON
N.L.Sw
210
.0001
50K
1Meg
1Meg
.05
270K
250K
S-METER
1.5Meg
.01
OFF
ON
AVC LINE
500K
12AH7 VT-207
5
1500
250K
.05
1st AUDIO PHONES
270K
12A6 Pwr Amp.
20
750
7500Ω
OUTPUT X'FMR
4Ω
OFF
ON
150K
150K
10K
0-1 MA
M
S-Meter
20K
Send-Rec. Sw.
115 V. AC
75MA Pwr. X'FMR
5.0
12V. to heaters
6X5
6.3V
to 6X5 htrs.
12H-75MA
12
20
50K
226
260
218-5
217-8
100μμf
9002
30K
203-2
255-2
To HARM. AMP.

fig 5

PANEL & MECHANICAL LAYOUT FOR BC-624

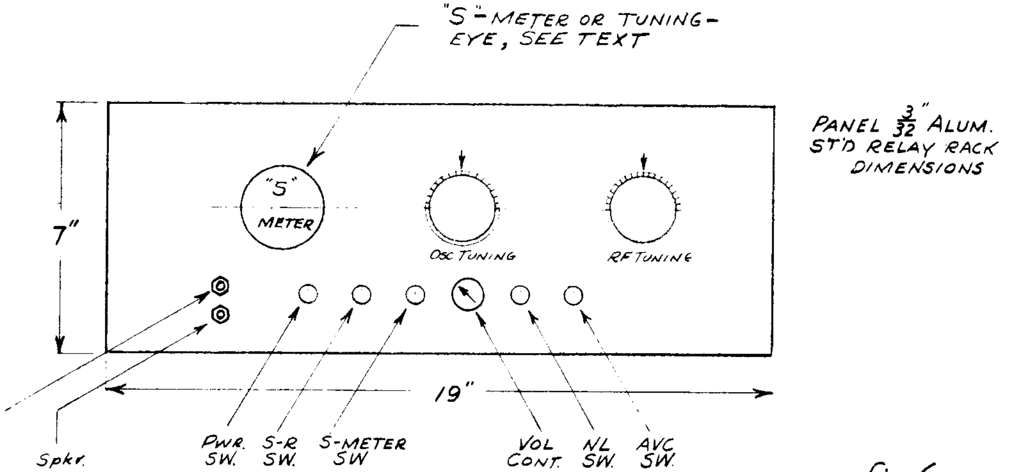
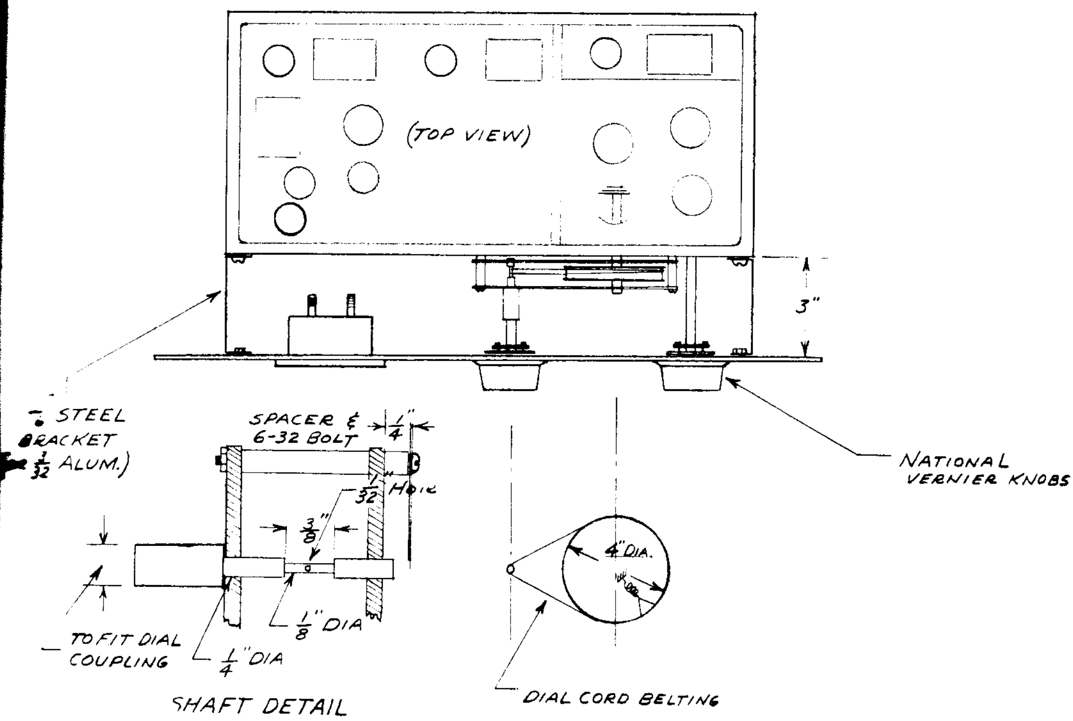
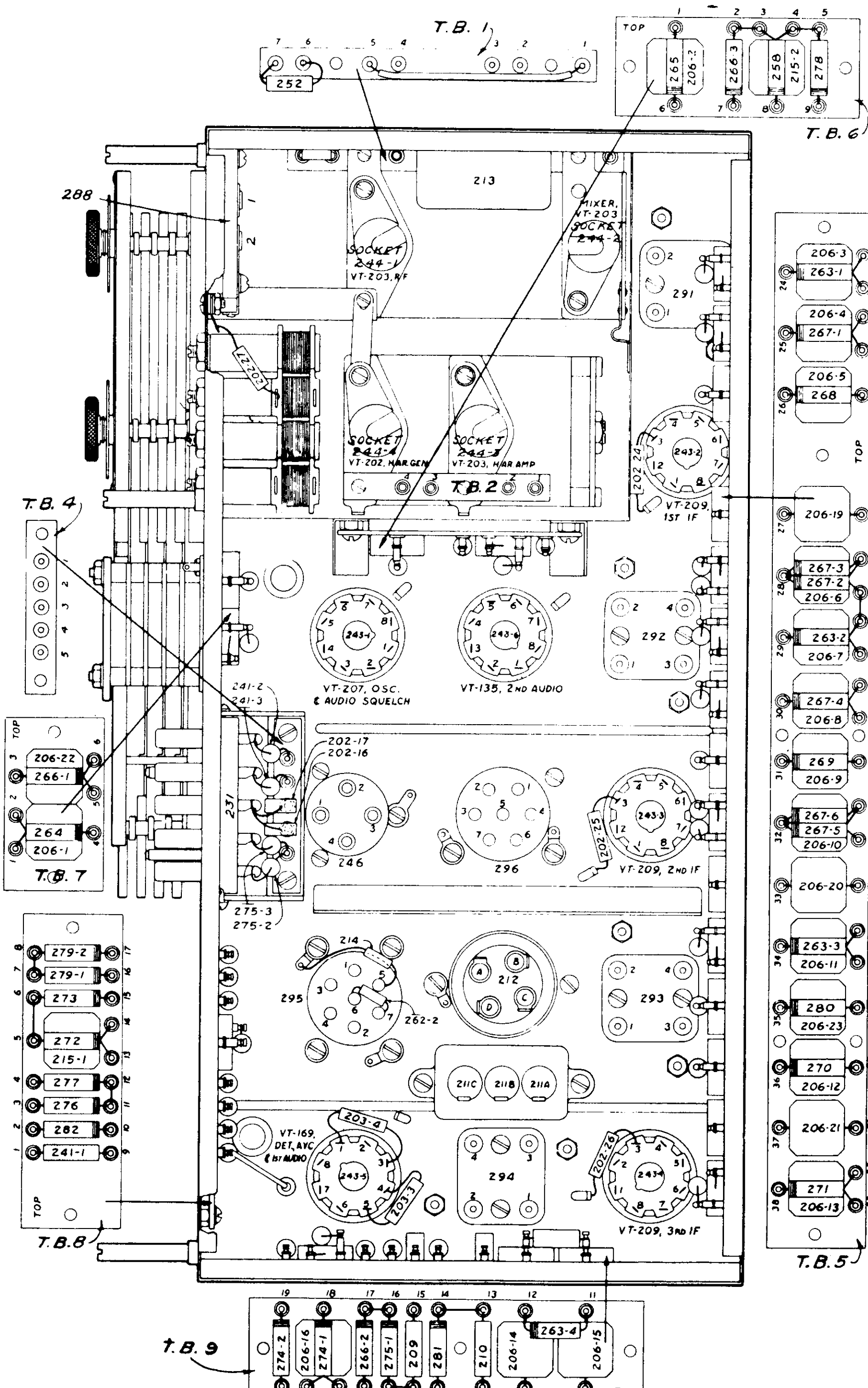
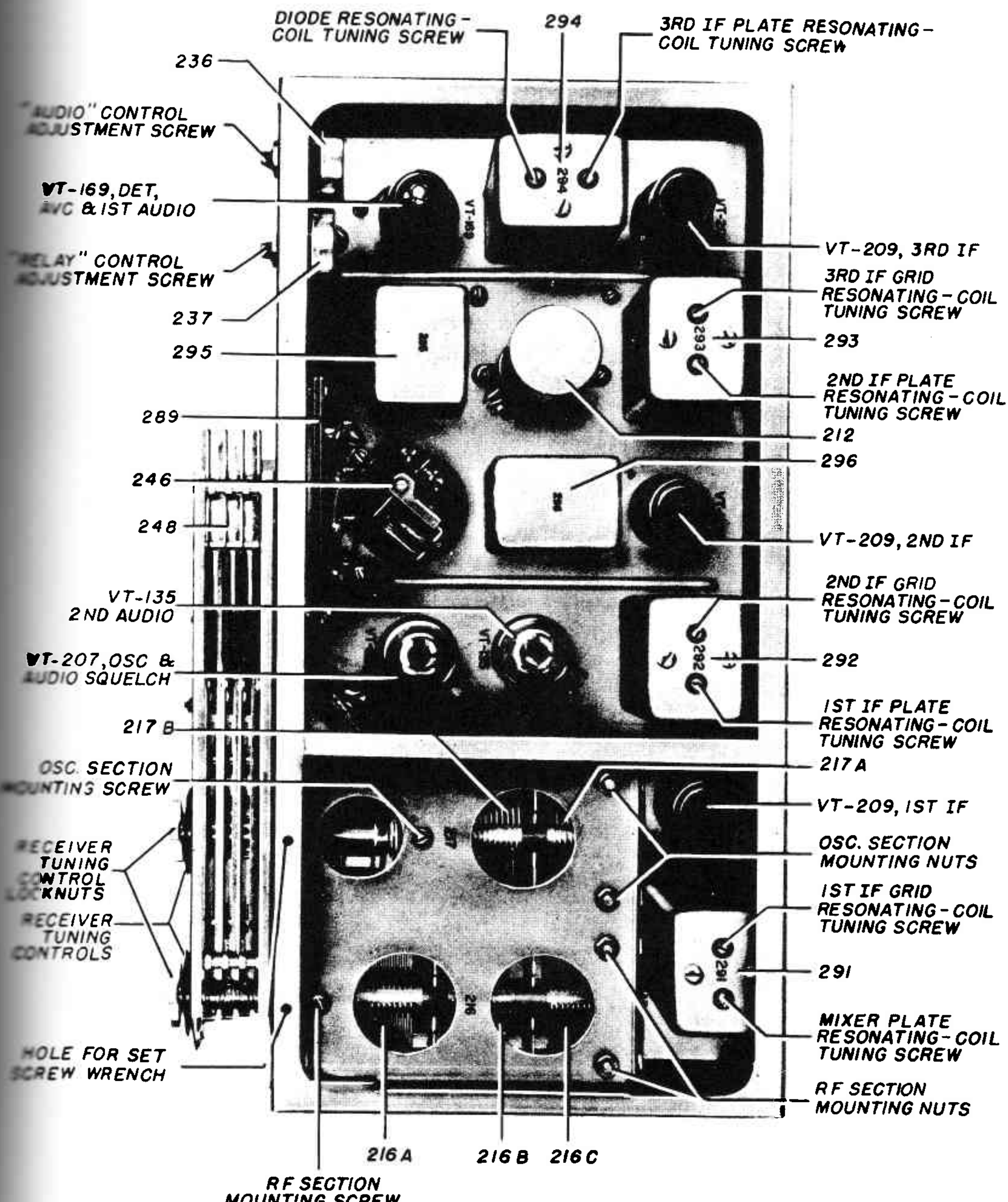


fig 6





RECEIVER CONTINUITY TEST DIAGRAM



RADIO RECEIVER BC-624-A, REAR VIEW

CONVERTING THE TBY TRANSCEIVER FOR CRYSTAL CONTROLLED OPERATION ON THE 10 AND 6 METER AMATEUR BANDS

Introduction:

The model TBY transmitter receiver was designed for the US Navy's landing operations. It is an ultra-portable unit, weighing less than 50 pounds complete and comes equipped with a canvas carrying case that may be strapped to the back if desired.

The unit is excellent for mobile or portable operation and has a nominal power output of 1/2 watt.

The frequency range is from 28 to 80 Mc. and, as originally used, was continuously variable over this range. However, the frequency stability, along with the fact that the tuning dials are not calibrated directly in frequency, makes it necessary to convert the unit to a crystal-controlled circuit.

The unit was built to operate from either a special battery pack or a combination vibrator-storage battery pack which clips onto the bottom of the Transmitter/Receiver unit. The special pack of batteries is not available (at least not with fresh batteries) leaving the vibrator pack for practical use. This supply consists of a 4-volt leak proof storage battery and a vibrator unit supplying 2.35, 3.3, 4.2, 8.6, and 158 volts. The storage battery will last about 15 hours and can be recharged from any standard 6 volt charger or from a car battery.

Upon purchase of the unit, the following accessories should be obtained:

1. Combination vibrator-storage battery pack
2. Whip Antenna (9 ft)
3. Mike and Phones plus cables

The original tube line up is as follows:

	(2)	958A's	--	PP self excited oscillator
Transmitter	(1)	30	--	Tone generator
	(1)	1E7	--	PP modulators
	(1)	959	--	RF stage
Receiver	(1)	958A	--	Super Regenerative Detector
	(1)	30	--	1st audio (Same tube acts as tone generator in xmtr.)
	(1)	1E7	--	PP audio (Same tube acts as modulator in xmttr.)

Crystal Calibrator (1) 30

Spare tubes usually come with the set, and a complete set of accessories will come in handy if available.

Conversion Procedure:

The actual conversion is quite simple. Only one change need be made in the circuit, but two additional tubes must be added as a crystal controlled oscillator and buffer. The one change necessary is that of lifting the grid leads of the two push-pull 958A tubes in the transmitter circuit from the turret coil assembly and running these leads out to the added stages.

The added stage consists of a 1S4 crystal oscillator and a 958A buffer. To provide space for these circuits, the tube type 30 (directly behind the meter) is removed. This tube originally acted as a crystal calibrator and will not be needed now.

The 1S4 crystal stage can be built on a small piece of bakelite and mounted in the space made available by removing the 30 tube. The 958A buffer can be mounted on an insulated plate alongside the detector shield can. The smallest components possible should be used, as space is at a premium, but the construction can be accomplished by careful planning and a little ingenuity.

The circuits in Fig. 1 and 2 are self-explanatory, and only the dotted components need be added. The crystal for the oscillator should be in the range of 7125-7425 kc. for the 10-meter phone band, and in the range 8333 -9000 kc. for the 6-meter band.

The complete schematic is also included with this article for information.

The coil data is as follows (per Fig. 2):

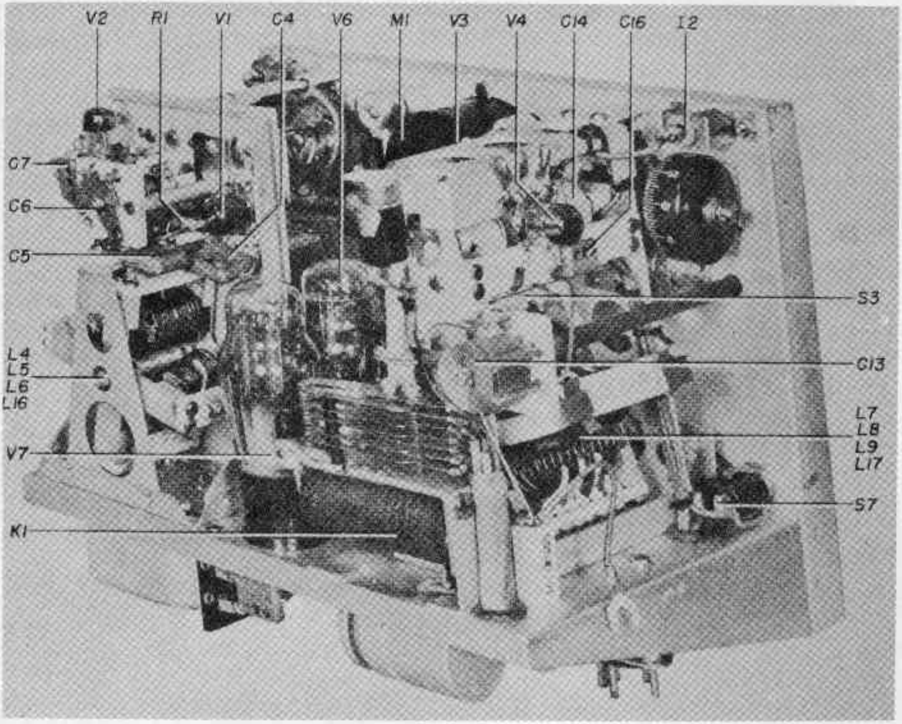
L1 (28 Mc.)	--	14 turns of #16 enameled 5/8" inside diameter, air wd.
L1 (50 Mc.)	--	6 turns of #16 enameled 5/8" inside diameter 1" long
L2	--	14 turns #16 enameled, close wound on 1" form
L3, L4	--	8 turns each of #20 DCC and the two wound side by side on 1" form.

Note: C6 need not be touched after initial adjustment (not critical).

Operation:

The meter indicates either filament voltage or plate current, depending upon the switch position. Originally, the unit was designed so that both these readings were normal when the meter read mid-scale. However, with the additional stages (1S4 and 958A) the readings will be higher than midscale and should read about 3/4 scale on plate current. Adjust the volume of the receiver to mid position and advance the regeneration control until a definite rushing or hissing sound is heard. Adjust the REC ANT tuning to resonance and when a signal is heard, readjust the REGN control to a point just above where the rushing sound starts. The transmitter is tuned as any conventional one, and now that the OSC is crystal controlled, a pronounced dip in plate current will indicate resonance on the meter. This should occur about 3/4 up the meter scale.

Although the power output is low, this unit will surprise you and is well worth the cost.


V2
R1
V1
C4
V6
M1
V3
V4
C14
C16
I2
C7
C6
C5
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L4
L5
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L17
V7
S7
K1

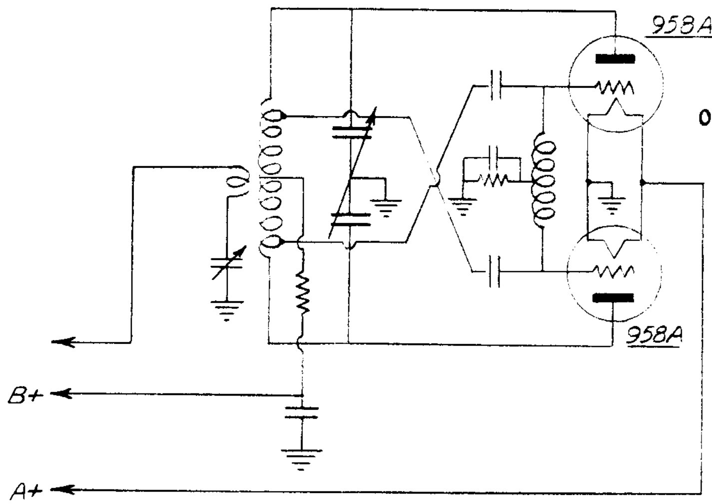
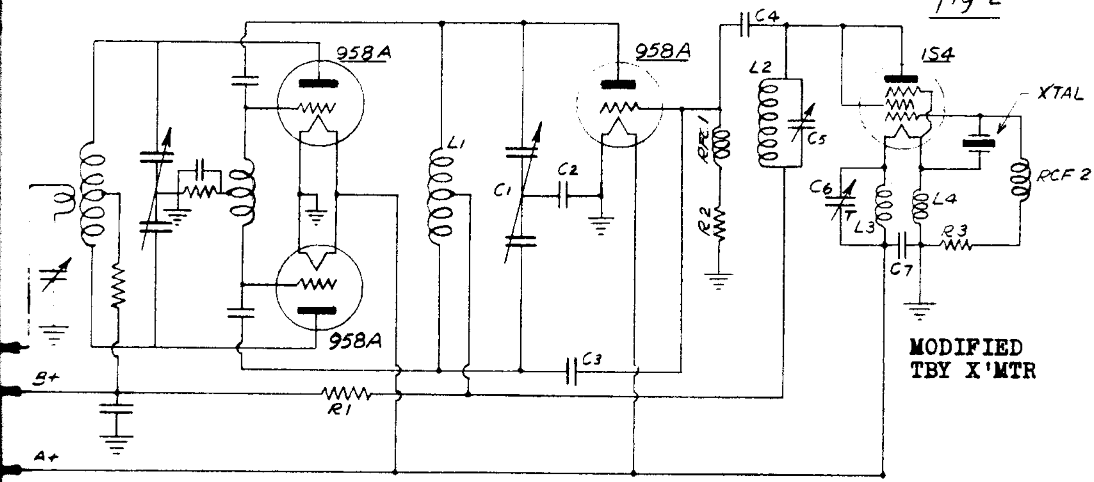


fig 1

ORIGINAL TRANSMITTER SECTION

fig 2

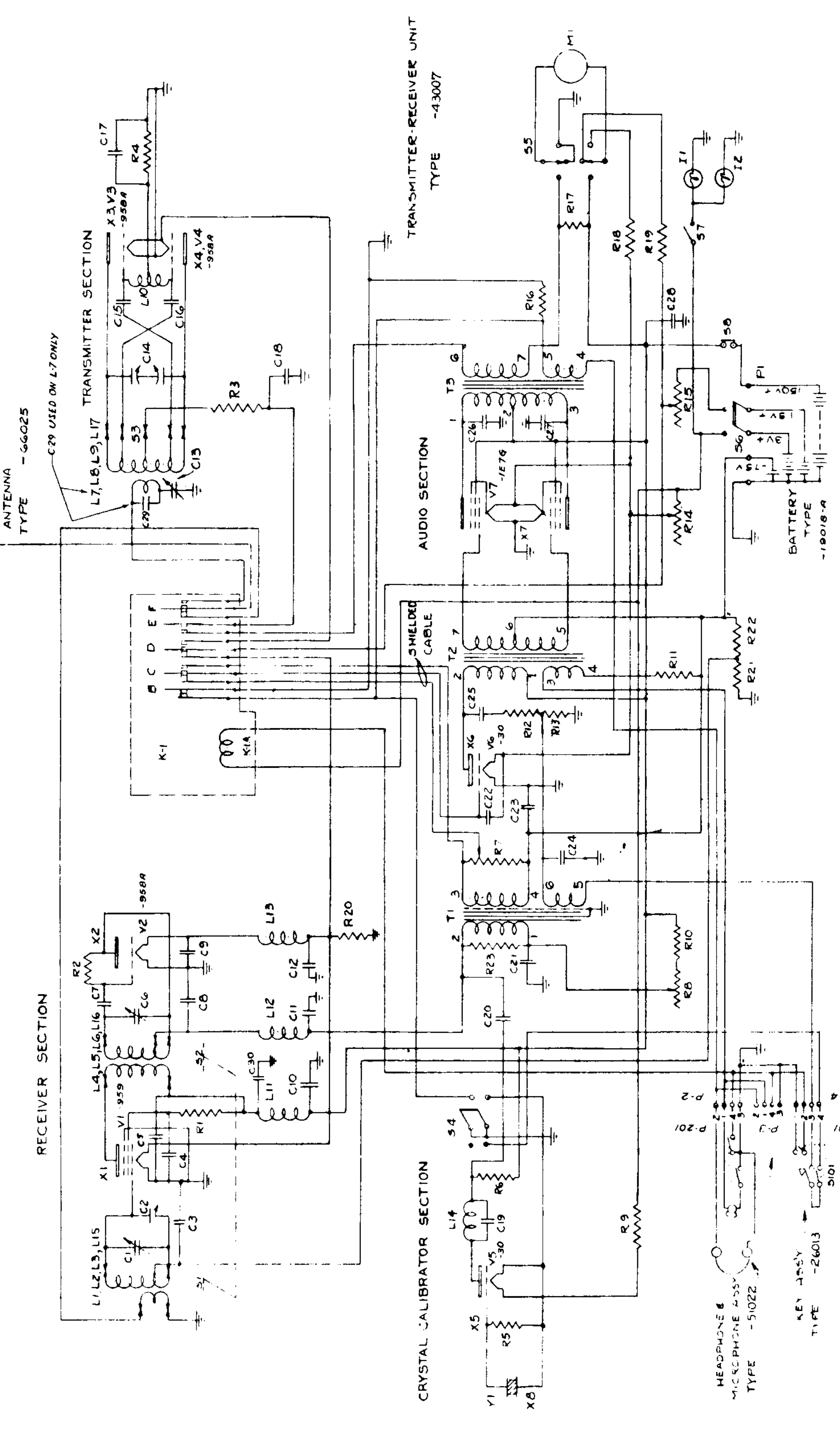


MODIFIED TBY X'MTR

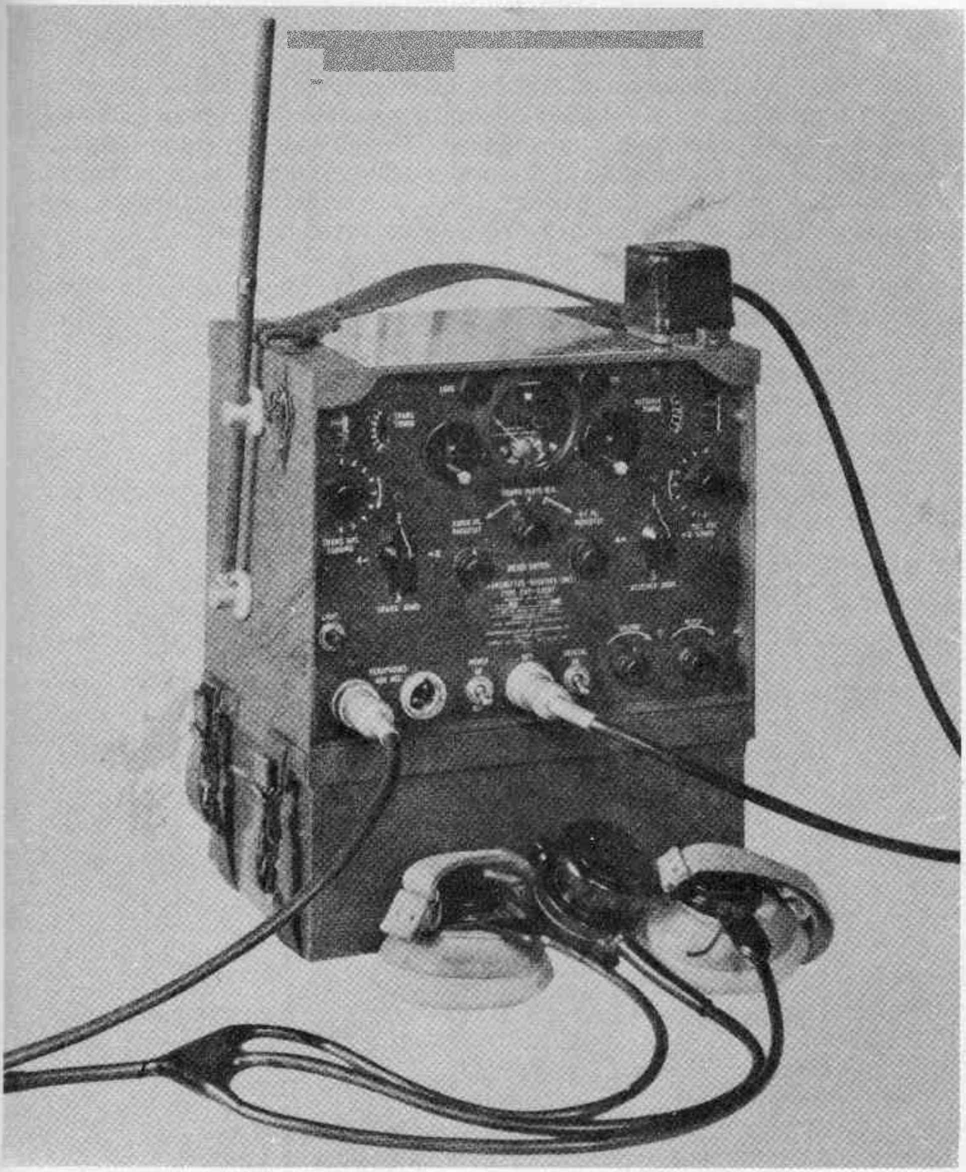
PARTS LIST FOR ADDED STAGES

R-1 - 10,000 ohm, ½ w
R-2 - 150,000 ohm, ½ w
R-3 - 100,000 ohm, ½ w
C-1 - 25 mmfd (each sec) variable
C-2 - .002 mfd, mica
C-3 - 2 mmfd, mica
C-4, C-7 - .001 midget mica
C-5 - 100 mmfd, midget var.
C-6 - 100 mmfd, trimmer
L-1, L-2, L-3, L-4 See text
RFC-1, RFC-2 - 2.5 mh. RF chokes
Crystal - See Text

TBY SCHEMATIC



F/G 3



TBY TRANSCEIVER

PE-103A DYNAMOTOR

The PE-103A Dynamotor will deliver 160 ma. at 500 volts from either a 6 or 12 volt battery. The battery drain when used on a 6-volt battery is approximately 22 amps and when used on a 12-volt battery is approximately 11 amps. (This assumes that the full load of 160 ma. is being drawn.) Under no-load conditions the battery drain is approximately 5 amps. Actually the unit will deliver much more than its rated current.

The lower housing of the unit contains filter components and circuit breakers for overload protection as follows:

Right	40 Amps	(Dynamo primary overload)
Center	.22 Amps	(High-voltage overload)
Left	7.5 Amps	(Control and filament overload)

A switch located on top of the housing under a protective cap can be set for either 6 or 12 volt operation.

When used on a 6-volt battery, the green-white wire from the rotary switch "3-S-1" should be removed to prevent a small drain when the unit is not in operation. (This lead is in a relay circuit for the 12-volt section.)

The pin connections are as follows:

1- Not used.
2- Not used.
3- Negative 6 volts through relay.
4- Start coil.
5- Common, positive 6 volts and negative 500 volts.
6- Not used.
7- Negative 6 volts.
8- Positive 500 volts.

For typical operation using a 6-volt battery with positive gnd:

Connect terminal 5 to ground.
Turn switch on top to 6-volt position.
Start dynamo by connecting terminal 4 to ground.
A minus will appear at terminal 3 (A plus is ground).
B plus will appear at terminal 8 (B minus is ground).

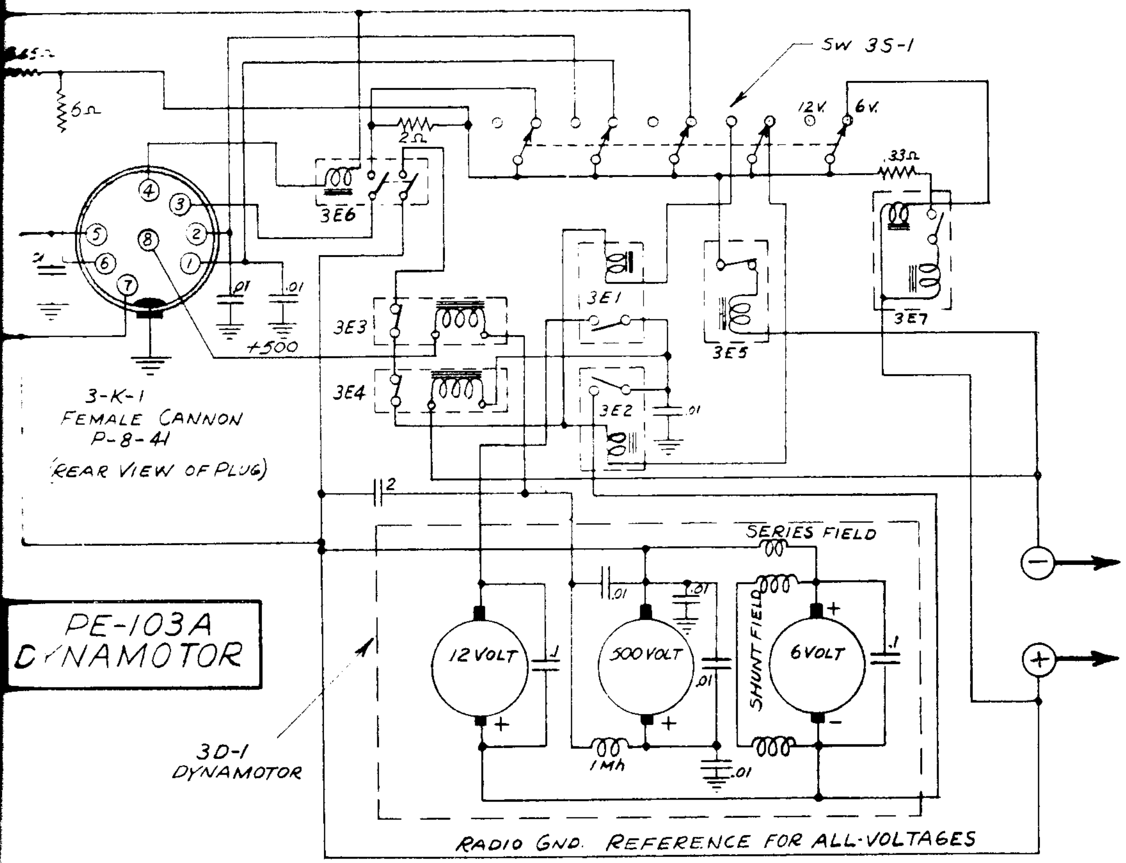
Connections for 255 volts at 80 ma:

By connecting the armature for 12 volts and actually running it on 6 volts, and running the six-volt field directly from the battery, the no-load current is 3 amps. This will give an output of 255 volts at 80 ma., but under loaded conditions the drain is only about 7 amps. This provides excellent efficiency and by throwing the 12v-6v switch, power may be stepped up.

General Notes On Dynamotors:

Dynamotors intended for 12 volts can be operated at 6 volts by connecting the field coils in parallel instead of in series (watch polarity). Under these conditions the output voltage will be cut in half.

Parallel connection for the field coils of 24 volt dynamotors will normally allow operation from 6 volts but with only a quarter of the normal output voltage.



CONVERTING THE 1068A OR 1161A RECEIVER TO 144-148 MC. (2 METERS)

Introduction:

These receivers were designed originally for the US Army and were used as IFF receivers in conjunction with the SCR268-271 series of Radar equipment.

The receiver comes complete in an olive-drab steel case which is approximately 16" x 16" x 10" and weighs about 75 lbs. It contains a built in 110-volt AC power supply and covers the range of 155 to 200 Mc. before conversion.

The IF transformers are normally stagger tuned with the center on 11 Mc., and have a band width of approximately 4 Mc.

The unit contains 14 tubes, used as follows:

6SH7	1st RF Amp. -no VT No.
6SH7	2nd RF Amp. -no VT No.
9006	1st Det. (Mod) -no VT No.
6J5	Osc. - VT 94
6AC7	1st IF Amp. -VT 112
6AC7	2nd IF Amp. -VT 112
6AC7	3rd IF Amp. -VT 112
6AB7	4th IF Amp. -VT 176
6AB7	5th IF Amp. -VT 176
6H6	2nd Det. -VT 90
6SH7	Video Amp. -no VT No.
6SN7	Output Amp. -VT 231
6E5G	Tuning Indicator -VT 215
5U4G	Rectifier -VT 244

Conversion Instructions:

The conversion will be discussed under the following headings:

(a) Preliminary Steps
(b) RF Modifications
(c) AF Modifications
(d) IF Modifications
(e) General notes

(a) Preliminary Steps:

The first step necessary in converting the unit for 2 meter operation, is to replace the 3 connectors (123-124-125) on the rear of the chassis with more suitable ones. Connector 123 can be replaced with a female coaxial chassis plug, 124 with any standard AC connector, such as an Amphenol 61-M-10, and 125 can be replaced with a standard phone jack (for the loudspeaker).

The spare-fuse holder and automatic pilot-lamp switch should be removed from the front panel. The wires from the pilot lamps which were removed from the automatic pilot-lamp switch are soldered together and should be connected to the heater circuit. The B plus lead to the tuning indicator tube which was also removed from the switch is soldered to the lead coming from the tuning eye tube.

(b) RF Modifications:

The two RF stages and first detector must be changed to tune the 144-148 Mc. range. This is done by decreasing the spacing between turns on the 3 coils concerned (do not change the oscillator coil). This will increase the inductance and should be sufficient. However, if necessary, small 10-mmfd. trimmers can be shunted across the 3 coils. Be careful so as to not damage the coil windings, and don't allow the turns to touch and short out.

If band-spread tuning is desired on the 2-meter band, a small 2-plate midget variable capacitor may be mounted beneath the chassis near the oscillator coil. The shaft for this capacitor is inserted in the hole provided by removal of the automatic pilot-lamp switch.

(c) AF Modifications:

Replace resistor 67-2 (video amplifier grid resistor) with a 500,000 ohm pot. (arm of pot. goes to grid of the video amplifier). This will allow control of the audio gain. This pot. can be mounted in one of the holes in the front panel. The pot. should be of the type with a switch on the back which is used as the AC switch in place of the present one, which can now be used as a standby switch by placing it in series with the center tap of the HV power transformer winding.

(d) IF Modifications:

A 5000-ohm wire-wound pot. (used as a rheostat) is installed in a spare hole and used as an IF gain control. The center arm is grounded and one side is connected to the "B" wire on plug 125 (see diagram).

(e) General Notes:

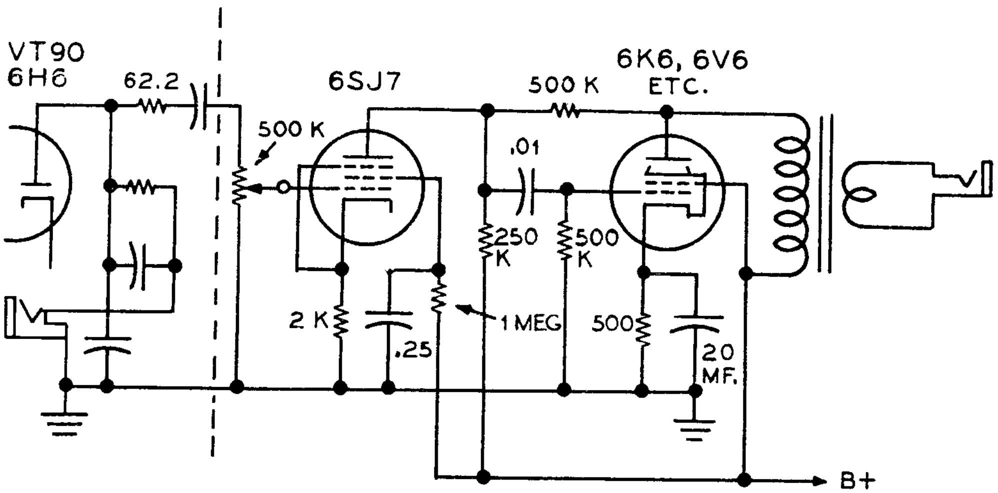
The RF gain can be increased by replacing the RF tubes with the WE717 type and also by replacing the loading resistors across the IF transformer windings (secondary) with 100,000 ohm resistors. This will narrow the IF band pass and increase the gain.

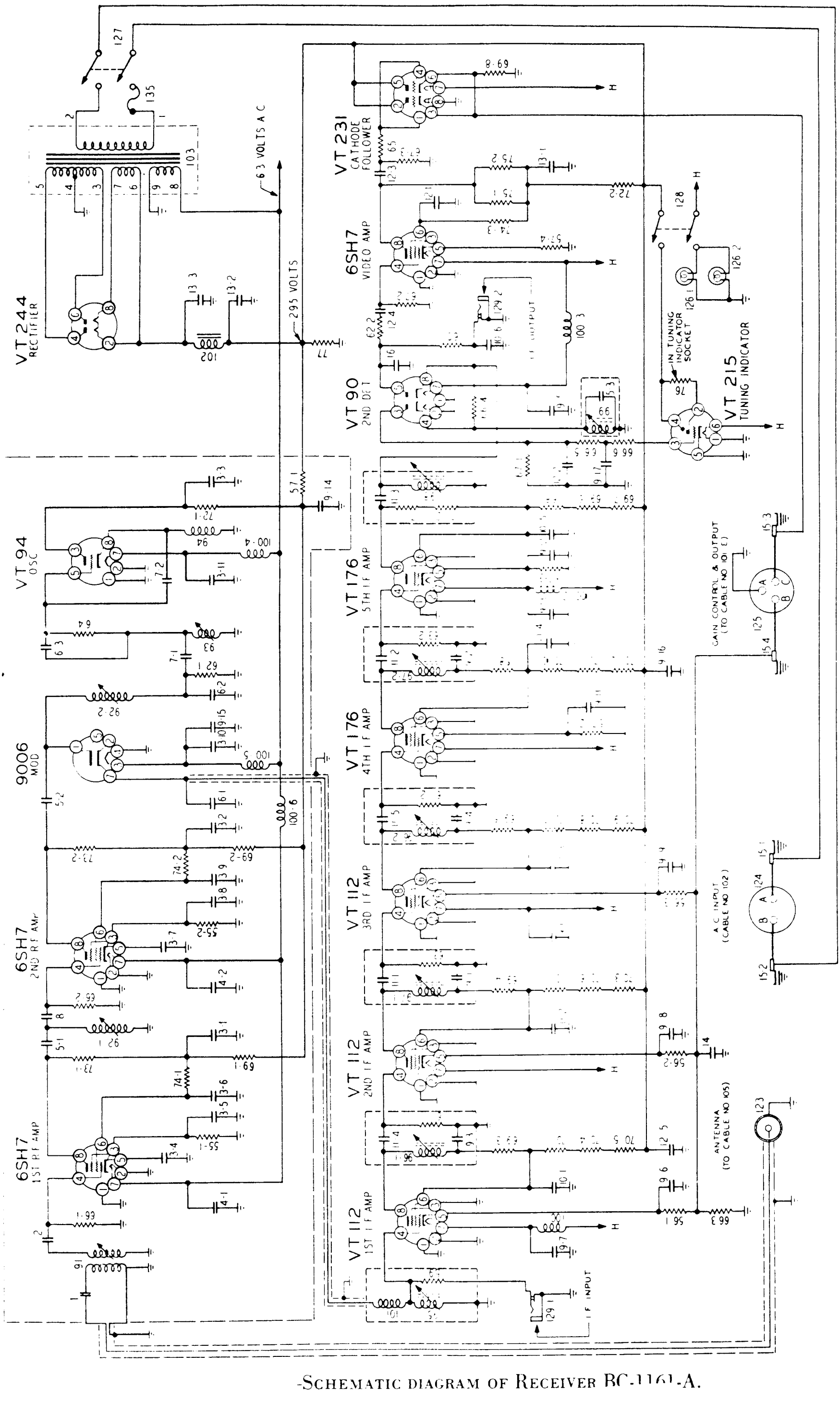
In addition, an S meter (0-1 ma.) can be connected to the phone jack marked "IF amp. out" and calibrated in S units.

The receiver is aligned in the usual manner and can be done on a good local signal.

If the audio gain is not adequate, it may be advisable to replace the 6SN7 output stage with another consisting of a 6SJ7 and 6V6 or 6K6.

Diagram of audio modification. The 6SH7 and 6SN7 (VT231) are eliminated and this circuit inserted in their place.





-Schematic diagram of Receiver BC-1161-A.

BC-1161A RECEIVER(Before conversion)

ADF	Navy receiver, 15 to 1750 kc., in 6 bands, 8 tubes - (3) 6D6, (2) 76, (2) 6C6, (1) 41.
AM-26/21C	Interphone Amplifier containing (2) 12J5, (2) 12A6 tubes, designed for use from 28-volt DC dynamotor.
APA-10	Pan-Oscillo Receiver: is 115vAC operated and contains panoramic adapter with IF of 405-505 kc., 4.75 to 5.75 Mc., and 29 to 31 Mc.
APN-1	Altimeter: 418-462 Mc. Transmitter and Receiver which measures 3 to 4000 feet altitude, weighs 25 lbs. and is 18" x 9" x 7". Designed to operate from 28 volts DC and contains the following tubes: (4) 12SH7, (3) 12SJ7, (2) 12H6, (1) VR 150, (2) 955, (2) 9004.
APN-4	Radar Oscilloscope containing 25 tubes, 18" x 9" x 12", and weighs 50 lbs.
R65/APN-9	Loran Indicator and Receiver containing 35 tubes and 3" scope. 110 volts, 400 cycles.
APQ-9	VHF Radar.
RT34/APS-13	Transmitter and Receiver containing following tubes: (5) 6J6, (9) 6AG5, (1) VR 150, (2) 2D21. 410-420 Mc. 30 Mc. IF Freq.
APS-15	Radar set, 45 tubes, 3 meters, four 115 volt 400 cycle supplies, multivibrators, 5" and 2" scopes.
APT-5	Transmitter - 1500 Mc., uses 115VAC filaments, no plate supply included. (2) 6AC7, (1) 6L6, (2) 829, (1) 931A, (1) 522, (1) 6AG7.
ARB	Navy 4-band receiver, 195 to 9 Mc., uses (1) 12SA7, (4) 12SF7, (1) 12A6, weighs 28 lbs., and is 6" x 7" x 15".
ARC-4	Transmitter and Receiver using 4 crystal channels, in 140 Mc. range for 24 or 12 volt DC operation. Transmitter has 7 tubes. Receiver has 13 tubes.

ARC-5 — Navy aircraft equipment:

Receivers:	Transmitters	Modulator is
190 to 550 kc.	500 to 800 kc.	MD-7/ARC5
1.5 to 3 Mc.	800 to 1300 kc.	2-1625's
3 to 6 Mc.	1.3 to 2.1 Mc.	
6 to 9.1 Mc.	3 to 4 Mc.	
	4 to 5.3 Mc.	
	5.3 to 7 Mc.	
	7 to 9.1 Mc.	
	100 to 156 Mc.	

ARC-429 — 2 band receiver, 201 to 400 Kcs and 2500 to 4700 Kcs (aircraft).

ARC-429A — 2 band receiver, 201 to 400 Kcs and 4150 to 7700 Kcs (aircraft).

R-89/ARN-5A — Glide Path Receiver
11 tube superhet on 332 to 335 Mcs
fixed tuning
Glide path receiver
(7) 6AG5
(1) 12SR7
(2) 12SN7
(1) 28D7

Crystal frequencies are:
332.6 Mcs
333.8 "
335.0 "

weighs 12 lbs.
size 13" x 5" x 6"

R-5/ARN-7 — Radio Compass Receiver - covers 200 to 1750 Kcs in 3 bands with 17 tubes.

ART-13, or ATC — Collins Auto tune transmitter: 2 to 18.1 Mcs in 11 channels, weighing 70 lbs. and is 23" x 13" x 11" 150 watts voice, cw or mcw. Uses 813 in final and 811's in PP modulator. v.f.o. and crystal calibrator.

ASB — Radar equipment, 515 Mc.

ATD — Aircraft transmitter - 540 to 9050 Kcs CW or Phone requires 380 volts and 1000 volts DC.

RF osc - 6L6	6SL7 speech	PP 6L6 mod.
RF amp - 814	6L6 driver	Designed for dyna-
Weight 75 lbs.	size 11" x 12" x 21"	motor operation

AVT-112A — Aircraft transmitter - 2500 to 6500 Kcs Phone, operates from 6, 12, or 24 volt source. Has 6 tubes and weighs 6 lbs.

B-19	Mark II Transmitter and receiver covering 40 to 80 meter bands.
BC-191	Same as 375E transmitter except operates on 12 or 14 volts.
BC-221	Frequency meter: Up to 125th harmonic. Basic frequency is 125 to 250 Kcs and 2000 to 4000 Kcs. Better than .005% accurate.
BC-222	Receiver/Transmitter. 28-38 Mcs and 38-52 Mcs. Similar to BC-322.
BC-223AX	Transmitter, covering medium frequencies. Uses 801 Osc, 801 Pa (2) 46 Mod, (1) 46 SP amp. 10 to 30 watts output on tone, voice or CW 4 crystal frequencies and master oscillator on switch. 3 coils, TU 17A 2000 to 3000 Kcs " 18 3000 to 4500 Kcs " 25 3500 to 5250 Kcs Black wrinkle case with 2 separate cases for spare coils.
BC-224	Receiver, 200 to 500 Kcs and 1500 to 18,000 Kcs. Operates from 14 volt dynamotor (identical with BC-348 except for input voltage).
BC-306A	Antenna tuning unit for BC-375 transmitter. Operates from 150 to 800 Kcs.
BC-312	Receiver - 1500 to 18,000 Kcs. Uses 9 tubes with 2 RF stages. (4) 6K7, (1) 6L7, (2) 6C5, (1) 6R7, (1) 6F6.
BC-314	Same as BC-312 except covers 150-1500 Kcs.
BC-322	Receiver/Transmitter 52-65 Mcs.
BC-342	Same as BC-312 except will operate on 115 VAC.
BC-344	Similar to BC-312 except covers 150 to 1500 Kcs and is 115 VAC operated.
BC-348	Receiver - 1500 to 18,000 Kcs and 200 to 500 Kcs. Automatic noise compensator (neon). Output 300 or 4000 ohms. Crystal filter, AVC-MVC-BFO. 1st RF 6K7 2nd RF 6K7 RF Osc 6C5 1st Det 6J7 1st IF 6K7 2nd IF & CW Osc 6F7

	3rd IF & 2nd Det 6B8 Audio 41 Operates from 28 volts DC
BC-357J	Beacon Receiver for 75 Mcs.
BC-375	Transmitter - 150 watts output, 200 to 12000 Kcs (less BC), 211 Osc, 211 RF amp, 10 Speech amp, (2) 211 PP modulators, 5 tuning units as follows: TU 5B 1500 to 3000 Kcs " 6B 3000 to 4500 " " 7B 4500 to 6200 " " 8B 6200 to 7700 " " 10B 10,000 to 12,500 Kcs
BC-403	Radar oscilloscope, 5" scope 115 volt 60 cycles operation, component of SCR-270 and 271.
BC-404	Radar receiver for SCR-270 and 271, 102 to 110 Mcs, 12 tubes, operates from 115 volts 60 cycles.
BC-406	Receiver from SCR-268 unit covering 201 to 210 Mcs, with 15 tubes and 115 VAC operated.
BC-412	Oscilloscope from SCR-268 radar.
BC-450A	Control box for 453A type receivers.
BC-453A	Army aircraft receiver: This is merely one of a group in this series. The receivers are of all aluminum construction weighing about 6 lbs. and are approximately 5" x 8" x 12". Power required is 250 volts at 50 ma and 25.2 volts at .45 A. Receivers have hi and low impedance output (300 or 4000 ohms) and are for voice, mcw or cw. Tubes contained are (3) 12SK7 (1) 12SR7 (1) 12A6 (1) 12K8 BC-453A covers 190 to 550 Kcs 454A covers 3 to 6 Mcs 455A covers 6 to 9.1 Mcs The 274N command set consists of 3 receivers, 2 transmitters, 4 dynamotors, 1 modulator, 2 control boxes, and ant coupling and total of 26 tubes. Receivers cover 190 to 550 Kcs, 3 to 6 Mcs and 6 to 9.1 Mcs. Transmitters cover 3-4 Mcs and 4 to 5.3 Mcs.

BC-454A	See data on BC-453A.
BC-455A	See data on BC-453A.
BC-456A	Is modulator unit for BC-457A Series transmitters.

BC-457A — Series Transmitters are designed for use with BC-453A Series receivers in Army aircraft and are similar in appearance but slightly larger. Rated output is 30-40 watts. Have directly calibrated vernier dial and contain the following tubes:

(2) 1625 PA
(1) 1626 Osc
(1) 1629 Tuning Indicator
All units have crystal for check on calibration.

BC-457A	4 to 5.3 Mcs	(Crystal 4600 Kcs)
BC-458A	5.3 to 7 Mcs	(" 6200 Kcs)
BC-459A	7 to 9.1 Mcs	(" 8000 Kcs)
BC-696	3 to 4 Mcs	(" 3500 Kcs)

BC-458A — See BC-457A.

BC-459A — See BC-457A.

BC-603 — 10 channel FM receiver using push buttons or manual 20 to 30 Mcs, Superhet, BFO, 12 volt operation. 10 tube.

BC-604 — 10 channel FM transmitter push button or manual 20 to 30 Mcs using 1625 final with 20 watts output for 12 volt operation. 8 tubes.

BC-620A — Transmitter and Receiver covering 20 to 27.9 Mcs Crystal controlled FM with 13 tubes.

(4) 1LN5	(4) 1299
(1) 1LC6	(1) 1294
(1) 1LH4	
(2) 1291	Weighs 38 lbs.

BC-624 — Receiver component of SCR-522, 10 tube superhet.

BC-645 — Transmitter and Receiver (IFF).
435 to 500 Mcs with 15 tubes.
400 volts at 135 ma required plus 9 volts at 1.2 Amp AC.

(4) 7F7	(2) 955
(4) 7H7	(1) 316A
(2) 7E6	
(2) 6F6	Weighs 25 lbs.

BC-653A	Transmitter - 100 watts CW, 22 watts phone. 2 to 4.5 Mcs 807 buffer (2) 1613 MO and Mod (2) 814 Final
BC-654A	Transmitter and Receiver. 3800 to 5800 Kcs Calibration every 10 Kcs 200 Kcs crystal for check points Power output is 12 watts voice or 25 watts CW 7 tube superhet receiver using (3) 1N5, (1) 1A7, (2) 3Q5, (1) 1H5 6 tube transmitter uses (2) 307A in final Requires 1.5 volts, 45 volts, 90 volts for receiver Requires 1.5 volts, 6 volts, 51 volts, 84 volts, and 500 volts for transmitter. Operates from PE 103A dynamotor.
BC-659	Transmitter and Receiver. FM voice only 27 to 38.9 Mcs Crystal controlled 2 watt output battery operated
BC-684/683	Transmitter and Receiver. FM units Receiver uses 9 tubes in 10 channels (push buttons) Transmitter uses 8 tubes in 10 channels (" ") 35 watt output 27 to 38.9 Mcs
BC-696	See BC-457A.
BC-701	VHF receiver, 170 to 180 Mcs. IF freq. is 30.5 Mcs, 11 tubes, self contained power supply.
BC-704A	Radar indicator unit, part of SCR-521. (4) 6AC7 (1) 5BP1 (3) 6H6
BC-728	Push button receiver. 2-5 Mcs 2 or 6 volts 6 tubes
BC-733D	Localizer Receiver. Blind landing equipment with 6 Crystal frequencies. 108 to 120 Mcs with 10 tubes.

	(3) 717A 12SQ7 12A6	(2) 12SG7 12AH7 (2) 12SR7
BC-788	Receiver. 420 to 450 Mc. 6 IF stages using 6AG5's 30 Mcs broad band width	
BC-929	Army radar oscilloscope, 110 volts, 400 cycle.	
BC-939	Antenna tuning unit for BC-610 transmitter.	
BC-946B	See BC-453A receivers - covers 520 to 1500 Kcs.	
BC-947A	UHF transmitter. 3000 Mcs 115 volt AC operation with blower	
BC-966A	IFF, approximately 2 meters, 14 tubes, 350 volt dynamotor with 12 volt input.	
BC-1023A	Marker Beacon Receiver. 75 Mcs using 6S07, 6U6G, 6SC7, 12SH7 12 or 24 volt DC operation	
BC-1068A	Receiver (see BC-1161A).	
BC-1072A	Transmitter: 115 volt AC operation 150 to 200 Mcs 11 tubes	
BC-1161A	Receiver used with 1072A transmitter. 115 volt AC operation with 14 tubes 10" x 16" x 15" 1- 6SN7 Cathode follower 1- 6H6 2nd Det. 2- 6SH7 1st and 2nd RF 1- 6SH7 Video amp 3- 6AC7 1st, 2nd and 3rd IF 2- 6AB7 4th, 5th IF 1- 9006 Mod. 1- 6J5 Osc. 1- 5U4G Rect. 1- 6E5 tuning ind. Component of RC 150 IFF Same as BC-1068A	IF Band Pass is 4 Mc

BC-1206C	Setchell Carlson Beacon Receiver: (2) 25L6, 6SK7, 6SF7, 6SA7, 6K7 195 or 420 Kcs Weighs 4 lbs., 4" x 4" x 6-5/8"
BC-1267	Transmitter and receiver, 154 to 186 Mcs. 1 KW pulse oscillator superhet circuit, 2 RF stages, and 5 stagger tuned IF's
BD-77Km	Dynamotor, input 14 volts DC, output 1000 volts at 350 ma. Used with BC-191.
C-1	Auto Pilot Amplifier. For radio controlled models etc. (3) 7F7 Amps. (3) 7N7 Signal discriminators (1) 7Y4 Rectifier
CCT-46077	Transmitter: 2-20 Mcs, 12 Volt input. 30 lbs. Unit of RBM-2 Equipment.
CRV-46151	Aircraft receiver. 4 bands covering 195 to 9,050 Kcs. 6 tube superhet
DAG-33A	Dynamotor, input 18 volts DC, output 450 volts DC at 60 ma.
DM-21	Dynamotor, input 14 volts DC, output 235 volts at 90 ma.
DM-33A	Dynamotor, input 28 volts DC, output 540 volts DC at 250 ma. (Power supply for modulator of SCR-274N series.)
EE-8	Field telephone.
GF-11	Equipment consists of: CW 52063A Transmitter CW 52014 Transmitter base CW 23097 Transmitter control box CW 23098 Extension control box CW 23049 Relay unit CW 47092 Coil set
GO-9	Transmitter with power supply, 200 to 18.100 Kcs, 115 volt, 800 cycles. 803 final, v.f.o., 150 watt.
GP-7	Navy transmitter, 125 watts, 350 to 9050 Kcs with plug-in tuning units.

PC-77	Dynamotor, input 12 volts DC, output 175 volts at 100 ma and 500 volts at 50 ma.
PE-73CM	Dynamotor, input 28 volts, output 1000 volts at 350 ma, used with BC-375.
PE-86	Dynamotor, input 28 volts DC, output 250 volts DC at 60 ma.
PE-101C	Dynamotor, input 12 or 24 volts, output 800 volts at 20 ma and 400 volts at 135 ma, plus 9 volts at 1.1 amps. Used with BC-645.
PE-103A	Dynamotor, 500 volts at 160 ma from either 6 or 12 volts DC.
PE-104	Dynamotor, 90 volts at 50 ma from 6 or 12 volts DC input.
PE-109	Direct current power plant. Gasoline engine driven generator, has 32 volt output at 2000 watts.
PRS-1	Mine detector.
RAK-7	Navy Receiver. 9 tubes, 115 volt AC operation 6 bands 15 Kc to 600 Kc
RA-20	115 v. 60 cycle power supply for BC-312, BC-342.
RA-38	Rectifier, 15 KVA, output is 15 KV at 500 ma, variable, weight 2040 lbs., 63" x 54" x 57".
RA-58A	Hi voltage supply. 500 to 15,000 volt continuously variable at 35 ma for breakdown tests, 115 volt AC operation.
RA-63A	Rectifier, input 115 volts at 60 cycles, output 12 volts at 8 amps.
RA-105	Rectifier, 117 volt, 60 cycles input, output is 2000 volts, 610 v, 415 v, 300 v, 200 v, all DC plus 6.3 volts AC. Weighs 119 lbs. and is 10" x 24" x 19".
RAX-1	Receiver combination. #1- 4 bands from 200 to 1500 Kcs #2- 4 bands from 1500 to 9000 #3- 5 bands from 7 to 27 Mcs Operates from 24 volt dynamotor
RC-150	IFF equipment, used with SCR-270 and 271.

RC-188A	IFF equipment, 157 to 185 Mcs, Transmitter/Receiver indicator, 62 tubes, operates from 110 volts, 60 cycles.
RL-9	Interphone amplifier from 24 volt DC dynamotor.
RT-1248	GE transmitter and receiver. 435 to 500 Mcs 20 watts out 5 tubes using WE 316A final Receiver uses 10 tubes 955 1st Det, 955 Osc, (3) 7H7 IFs, 7E6, 7H7 12 volts required
RU-16/GF-11	Transmitter - Receiver. 3000 to 4525 and 6000 to 9050 Kcs Transmitter 195 to 13,575 KC receiver 12 watt voice or CW 100 lbs. and 13" x 31"
SCR-195	Transceiver Walkie-Talkie. 52.8 to 65.8 Mcs 27 lbs. with knapsack 25 mile range handset and spare parts plus antenna (telescope)
SCR-269F	Radio compass. 17 tube superhet receiver 200 to 1750 Kcs in 3 bands
SCR-274N	Command set composed of 453A series receivers and 457A transmitters (see those listings).
SCR-474	Portable transmitter and receiver, covering 40 and 80 meter bands, 1 volt tubes in receiver. Has 6V6 v.f.o., 6V6 power amp., and 6V6 modulator.
SCR-522	Transmitter and Receiver: 100 to 156 Mcs 12 watts output on voice 4 crystal frequencies antenna is AN-104-B 1/4 wave Transmitter alone is BC-625 Receiver is BC-624 Tubes used: (2) 832, (3) 12A6, (1) 6G6, (2) 6SS7, (1) 12J5, (1) 12C8, (1) 9002, (3) 9003, (1) 12AH7, (3) 12SG7

SCR-536	Walkie Talkie. 1- 1R5 1- 1T4 1- 1S5 2- 3S4
SCR-578	Gibson girl transmitter. Automatic SOS for sea rescue.
SCR-625	Mine detector. Balanced inductance bridge with 1000 cycle osc. 2 tube amplifier 1G6 and 1N5 2 flashlight batteries plus 100 volts B battery weighs 15 lbs.
SPR-2A	Receiver. Superhet 1000 to 3100 Mcs 2C40 UHF osc. 115 VAC operation 15 tubes. Weighs 15 lbs. and is 8" x 10" x 23"
T-17B	Carbon hand mike, 200 ohms single button press to talk.
TA-12	Bendix 100 watt transmitter; v.f.o., par 807 final.
TBW	Transmitter, similar to GO-9. 3-18,100 kc., 150 watts.
TBY	Transmitter/Receiver 28-80 Mcs, Voice and MCW Output 1/2 watt. Portable.
TCS-9	Transmitter and Receiver, 25 watt output. 1500 to 12,000 Kcs 115 Volts AC Crystals or VFO
TU-5B, 6B, etc.	Tuning units for BC-375 Transmitter (see listing of BC-375).
I-152AM	Radio altimeter indicator. 3 each 6AG5, 2X2, 3DP1, operates from 110 volts, 400 cycles.
I-122A	Signal generator, self contained, 115 volts 60 cycle supply, with crystal calibrator, 8-15 Mcs and 150-230 Mcs, with harmonics covers 8 to 308 Mcs.
I-233	Range calibrator. (2) 6SN7, (2) 6L6, (2) 6V6, (1) 6SJ7, (1) 5Y3.
602A-41	Amplifier 2 stage RF amp for UHF.

CROSS INDEX OF ARMY VT NUMBERS AND COMMERCIAL NUMBERS

Tube Listings by VT Numbers

VT Number	Commercial Number	VT Number	Commercial Number	VT Number	Commercial Number
VT-1	WE-203A**	VT-43	845	VT-88	6R7
VT-2	WE-205B	VT-44	32	VT-88A	6R7G
VT-3	**	VT-45	45	VT-88B	6R7GT
VT-4A	**	VT-46	866	VT-89	89
VT-4B	211	VT-46A	866A	VT-90	6H6
VT-4C	JAN 211	VT-47	47	VT-90A	6H6GT
VT-5	WE-215A	VT-48	41	VT-91	6J7
VT-6	212A**	VT-49	39/44	VT-91A	6J7GT
VT-7	WX-12**	VT-50	50	VT-92	6Q7
VT-8	UV-204**	VT-51	841	VT-92A*	6Q7G
VT-10	**	VT-52	45 spec	VT-93	6B8
VT-11	**	VT-53	(VT-42A)	VT-93A	6B8G
VT-12	**	VT-		VT-94	6J5
VT-13	**	VT-54	34	VT-94A	6J5G
VT-14	**	VT-55	865	VT-94B	6J5 spec selec
VT-16	**	VT-56	56	VT-94C	6J5G " "
VT-17	860	VT-57	57	VT-94D	6J5GT
VT-18	**	VT-58	58	VT-95	2A3
VT-19	861	VT-60	850	VT-96	6N7
VT-20	**	VT-62	801,801A	VT-96B	6N7 spec selec
VT-21	**	VT-63	46	VT-97	5W4
VT-22	204A	VT-64	800	VT-98	6U5/6G5
VT-23	**	VT-65	6C5	VT-99	6F8G
VT-24	864	VT-65A	6C5G	VT-100	807
VT-25	10	VT-66	6F6	VT-100A	807 mod
VT-25A	10 spec	VT-66A	6F6G	VT-101	837
VT-26	22	VT-67	30 spec	VT-102	canceled
VT-27	30	VT-68	6B7	VT-103	6SQ7
VT-28	24, 24A	VT-69	6D6	VT-104	12SQ7
VT-29	27	VT-70	6F7	VT-105	6SC7
VT-30	01-A	VT-72	842	VT-106	803
VT-31	31	VT-73	843	VT-107	6V6
VT-32	**	VT-74	5Z4	VT-107A	6V6GT
VT-33	33	VT-75	75	VT-107B	6V6G
VT-34	207	VT-76	76	VT-108	450TH
VT-35	35/51	VT-77	77	VT-109	2051
VT-36	36	VT-78	78	VT-111	5BP4/1802P4
VT-37	37	VT-80	80	VT-112	6AC7/1852
VT-38	38	VT-83	83	VT-114	5T4
VT-39	869	VT-84	84/6Z4	VT-115	6L6
VT-39A	869A	VT-86	6K7	VT-115A	6L6G
VT-40	40	VT-86A	6K7G	VT-116	6SJ7
VT-41	851	VT-86B	6K7GT	VT-116A	6SJ7GT
VT-42	872	VT-87	6L7	VT-116B	6SJ7Y
VT-42A	872A spec	VT-87A	6L7G	VT-117	6SK7

CROSS INDEX OF ARMY VT NUMBERS AND COMMERCIAL NUMBERS

Tube Listings by VT Numbers

VT Number	Commercial Number
VT-117A	6SK7GT
VT-118	832
VT-119	2X2/879
VT-120	954
VT-121	955
VT-122	530
VT-123	RCA A-5586
superceded by VT-128	
VT-124	1A5GT
VT-125	1C5GT
VT-126	6X5
VT-126A	6X5G
VT-126B	6X5GT
VT-127	spec tube
VT-127A	" "
VT-128	1630(A5588)
VT-129	304TL
VT-130	250TL
VT-131	12SK7
VT-132	12K8 spec
VT-133	12SR7
VT-134	12A6
VT-135	12J5GT
VT-135A	12J5
VT-136	1625
VT-137	1626
VT-138	1629
VT-139	VR-150/30
VT-140*	1628
VT-141	531
VT-142	WE-39DY1
VT-143	805
VT-144	813
VT-145	5Z3
VT-146	1N5GT
VT-147	1A7GT
VT-148	1D8GT
VT-149	3A8GT
VT-150	6SA7
VT-150A	6SA7GT
VT-151	6A8G
VT-151B	6A8GT
VT-152	6K6GT
VT-152A	6K6G
VT-153	12C8 spec

VT Number	Commercial Number
VT-154	814
VT-155	spec tube
VT-156	" "
VT-157	" "
VT-158	" "
VT-159	" "
VT-160	" "
VT-161	12SA7
VT-162	12SJ7
VT-163	6C8G
VT-164	1619
VT-165	1624
VT-166	371A
VT-167	6K8
VT-167A	6K8G
VT-168A	6Y6G
VT-169	12C8
VT-170	1E5-GP
VT-171	1R5
VT-171A	1R5(loctal)
VT-172	1S5
VT-173	1T4
VT-174	3S4
VT-175	1613
VT-176	6AB7/1853
VT-177	1LH4
VT-178	1LC6
VT-179	1LN5
VT-180*	3LF4
VT-181	7Z4
VT-182	3B7/1291
VT-183	1R4/1294
VT-184	VR-90/30
VT-185	3D6/1299
VT-186	spec tube
VT-187	575A
VT-188	7E6
VT-189	7F7
VT-190	7H7
VT-191	316A
VT-192	7A4
VT-193	7C7
VT-194	7J7
VT-195	1005
VT-196	6W5G

VT Number	Commercial Number
VT-197A	5Y3GT/G
VT-198A	6G6G
VT-199	6SS7
VT-200	VR-105/30
VT-201	25L6
VT-201C	25L6GT
VT-202	9002
VT-203	9003
VT-204	HK24G
VT-205	6ST7
VT-206A	5V4G
VT-207	12AH7GT
VT-208	7B8
VT-209	12SG7
VT-210	1S4
VT-211	6SG7
VT-212	958
VT-213A	6L5G
VT-214	12H6
VT-215	6E5
VT-216	816
VT-217	811
VT-218	100TH
VT-219	**
VT-220	250TH
VT-221	3Q5GT
VT-222	884
VT-223	1H5GT
VT-224	RK-34
VT-225	307A
VT-226	3EP1/1806P1
VT-227	7184
VT-228	8012
VT-229	6SL7GT
VT-230	350A
VT-231	6SN7GT
VT-232	E-1148
VT-233	6SR7
VT-234	HY-114B
VT-235	HY-615
VT-236	836
VT-237	957
VT-238	956
VT-239	1LE3
VT-240	710A

CROSS INDEX OF ARMY VT NUMBERS AND COMMERCIAL NUMBERS

Tube Listings by VT Numbers

VT Number	Commercial Number
VT-241	7E5/1201
VT-243	7C4/1203A
VT-244	5U4G
VT-245	2050
VT-246	918
VT-247	6AG7
VT-248	1808P1
VT-249	1006
VT-250	EF50
VT-251	441
VT-252	923
VT-254	304TH
VT-255	705A
VT-256	ZP486
VT-257	K-7
VT-259	829
VT-260	VR-75/30
VT-264	3Q4
VT-266	1616
VT-267	578
VT-268	12SC7
VT-269	717A
VT-277	417
VT-279	GY-2
VT-280*	C7063
VT-281*	HY-145ZT
VT-282	ZG489
VT-283*	QF-206
VT-284	QF-197
VT-285*	QF-200C
VT-286	832A
VT-287	815
VT-288	12SH7
VT-289	12SL7GT

* Indicates VT number canceled.

** Obsolete.

$3.50
Cat. No. EE-311