HANDBOOK OF MAINTENANCE INSTRUCTIONS

FOR

FREQUENCY METER SETS

SCR-211-A	SCR-211-B	SCR-211-C	SCR-211-D
SCR-211-E	SCR-211-F	SCR-211-J	SCR-211-K
SCR-211-L	SCR-211-M	SCR-211-N	SCR-211-O
SCR-211-P	SCR-211-Q	SCR-211-R	SCR-211-T
SCR-211-AA	SCR-211-AC	SCR-211-AE	SCR-211-AF

This Handbook replaces T. O. No. 08-10-102 dated 30 June 1942, T. O. No. 08-10-101 dated 15 December 1942, and T. O. No. 08-10-100 dated 10 December 1942.

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LIST OF REVISED PAGES ISSUED

NOTE: A heavy black vertical line, to the left of the text on revised pages, indicates the extent of the revision. This line is omitted where more than 50 percent of the page is revised.

This issue contains no revisions.

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CAUTION

Handle this equipment with care as it is a sensitive precision instrument. Do not tighten the dial lock more than necessary; excessive tightening will cause the dial setting to be disturbed. Never make a direct connection between a transmitter and the frequency meter.

Destruction of Abandoned Materiel in the Combat Zone

In case it should become necessary to prevent the capture of this equipment and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:-

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper, or wood.
4. Grenades and shots from available arms.
5. Burying all debris or disposing of it in streams or other bodies of water, where possible and when time permits.

Procedure:-

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch- and instrument-boards.
3. Destroy all controls, switches, relays, connections, and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil and water-cooling systems in gas-engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving, or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

Unsatisfactory Report

For U. S. Army Air Force Personnel:

In the event of malfunctioning, unsatisfactory design, or unsatisfactory installation of any of the component units of this equipment, or if the material contained in this book is considered inadequate or erroneous, an Unsatisfactory Report, AAF Form No. 54, or a report in similar form, shall be submitted in accordance with the provisions of Army Air Force Regulation No. 15-54 listing:

1. Station and organization.
2. Nameplate data (type number or complete nomenclature if nameplate is not attached to the equipment).
3. Date and nature of failure.
4. Airplane model and serial number.
5. Remedy used or proposed to prevent recurrence.
6. Handbook errors or inadequacies, if applicable.

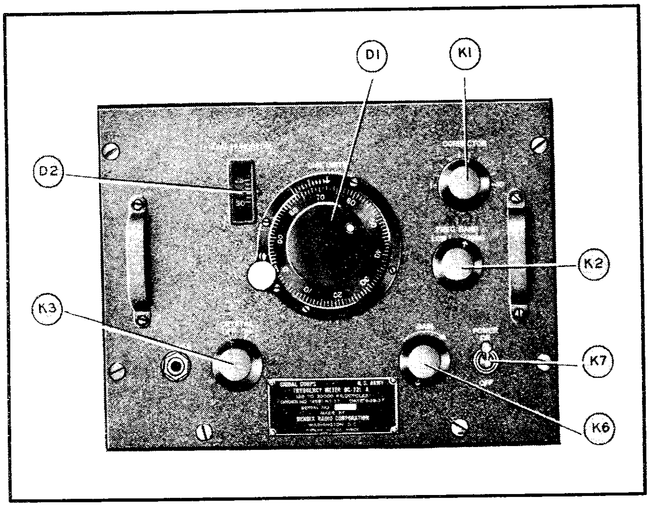
For U. S. Navy Personnel:

Report of failure of any part of this equipment during its guaranteed life shall be made on N. Aer. 4112, "Report of Unsatisfactory or Defective Material," or a report in similar form, and forwarded in accordance with the latest instructions of the Bureau of Aeronautics. In addition to other distribution required, one copy shall be furnished to the inspector of Naval Materiel (location to be specified) and the Bureau of Ships. Such reports of failure shall include:

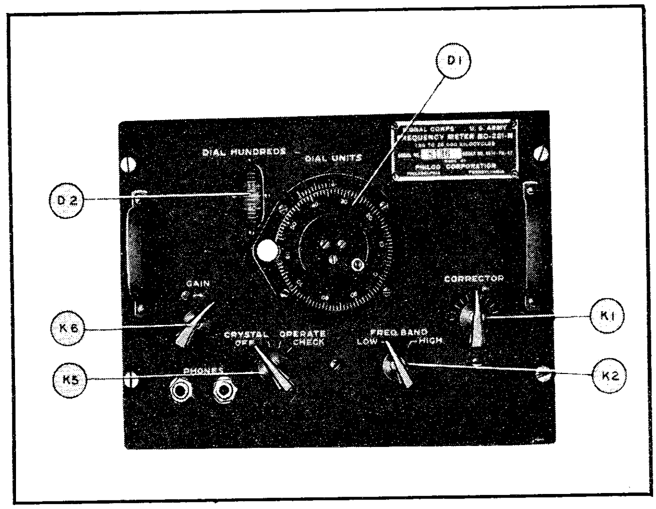
1. Reporting activity.
2. Nameplate data.
3. Date placed in service.
4. Part which failed.
5. Nature and cause of failure.
6. Replacement needed (yes—no).
7. Remedy used or proposed to prevent recurrence.

For British Personnel:

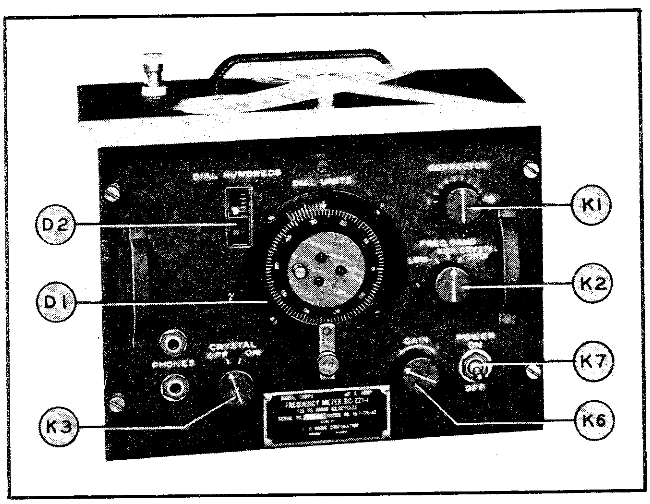
Form 1022 procedure shall be used when reporting failure of radio equipment.



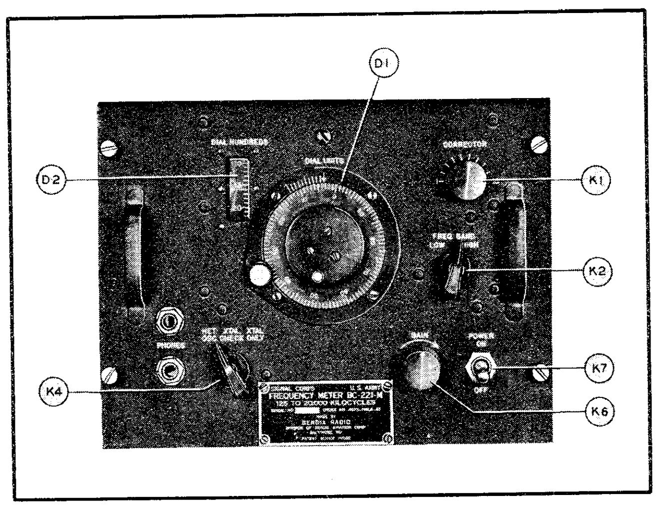
Frequency Meter BC-221-A, -C, or -D



Frequency Meter BC-221-B, -E, -N, -Q, -AA, or -AE



Frequency Meter BC-221-F, -J, -K, or -L



Frequency Meter BC-221-M, -O, -P, -R, -T, -AC, or -AF

Frontispiece—Frequency Meter BC-221-(*)—Front View

SPECIAL NOTICE

Instructions in this handbook cover 20 models in Frequency Meter Set SCR-211-A, -B, -C (and subsequent production models) series. They are as follows: Frequency Meter Sets SCR-211-A, SCR-211-B, SCR-211-C, SCR-211-D, SCR-211-E, SCR-211-F, SCR-211-J, SCR-211-K, SCR-211-L, SCR-211-M, SCR-211-N, SCR-211-O, SCR-211-P, SCR-211-Q, SCR-211-R, SCR-211-T, SCR-211-AA, SCR-211-AC, SCR-211-AE, and SCR-211-AF. Some of these models are electrically and mechanically identical; others differ in detail but not in general purpose.

For convenience in reference in this handbook, an asterisk (*) enclosed in parentheses is used in place of the suffix letters (e.g., "-A," "-B," "-C," etc.) of the different models and their components in the series. However, when information is applicable only to a specific equipment, or component, the appropriate suffix letter is used.

SECTION I
GENERAL DESCRIPTION

1. PURPOSE OF EQUIPMENT.

Frequency Meter Set SCR-211-(*) is an instrument designed to measure the frequency of radio waves. It is portable and self-contained. The set can be used either in a laboratory or in the field for calibrating radio transmitters and receivers or for measuring any frequency within the range of 125 to 20,000 kilocycles.* The meter contains a 1000-kilocycle crystal which is used to calibrate the meter's heterodyne oscillator at a number of points in each band.

2. PRINCIPAL COMPONENTS.

Principal components of each Frequency Meter Set SCR-211-(*) are listed in table 1-1.

3. WEIGHT AND OVERALL DIMENSIONS.

The weight and overall dimensions of each Frequency Meter Set SCR-211-(*), complete and ready for service, are listed in the table below.

Set	*Weight (pounds)*	*Dimensions (inches)*
SCR-211-A	38.5	13-7/8 x 10 x 9-7/8
SCR-211-B	38.0	14 x 10-3/16 x 9-3/4
SCR-211-C	38.5	13-1/8 x 10-1/8 x 9-7/16
SCR-211-D	38.5	13-1/8 x 10-1/8 x 9-7/16
SCR-211-E	38.3	13-5/8 x 10-1/16 x 9-7/16
SCR-211-F	38.0	13-11/16 x 10 x 9-11/32
SCR-211-J	38.0	13-1/8 x 10-1/8 x 9-7/16
SCR-211-K	38.0	13-1/8 x 10-1/8 x 9-7/16
SCR-211-L	38.0	13-1/8 x 10-1/8 x 9-7/16
SCR-211-M	31.25	13-1/8 x 10-1/8 x 9-7/16

* Although the calibrated range of the frequency meter is from 125 to 20,000 kilocycles, by proper use of harmonics and the calibration book, frequencies above 20,000 kilocycles may be determined with corresponding accuracy.

Set	*Weight (pounds)*	*Dimensions (inches)*
SCR-211-N	36.4	
SCR-211-O	38.0	
SCR-211-P	38.8	13-11/16 x 10 x 9-11/32
SCR-211-Q	50.6	14 x 9-3/4 x 10-3/16
SCR-211-R	38.0	
SCR-211-T	42.3	
SCR-211-AA	35.2	
Aluminum Case	35.4	13-11/16 x 10 x 9-1/4
Wooden Case	35.8	15 x 10 x 10-3/4
SCR-211-AC	43.0	
SCR-211-AE	36.0	15 x 10 x 10-3/4
SCR-211-AF	39.5	15-1/6 x 10-1/4 x 10-1/2

4. POWER CONSUMPTION.

All power required for the operation of this equipment is supplied by the batteries listed in table 1-1.

5. DESCRIPTION OF COMPONENTS.

a. FREQUENCY METER BC-221-(*). *(See frontispiece.)*

(1) CABINET.—The frequency meter is completely inclosed in a three-section cabinet. The top and largest compartment contains the frequency meter chassis; the next smaller compartment at the bottom rear contains the batteries; and the smallest compartment at the bottom front contains spare tubes, wrenches for the Bristo setscrews, and the clip for the spare Crystal Unit DC-9-(*) when one is supplied. A carrying handle, an antenna binding post, and a snap latch are mounted on the top surface of the cabinet. At the sides of the cabinet are mounted two small rings to which the carrying strap is ordinarily hooked.

(2) CONTROLS.—The control panel and a calibration book are exposed when the snap latch is released and the front cover lowered. The controls are as follows:

(a) "CORRECTOR" control (K1) adjusts the frequency of the heterodyne oscillator to correspond with the frequency of the crystal at a crystal check point.

(b) "FREQ. BAND" switch (K2) is used to select either the "HIGH" or "LOW" frequency range positions. On Frequency Meters BC-221-F, -J, -K, and -L this switch has a third position, "CRYSTAL ONLY," which is used only when the output of the crystal oscillator is desired.

(c) "CRYSTAL ON-OFF" (K3), found on Frequency Meters BC-221-A, -C, -D, -F, -J, -K, and -L, turns the crystal oscillator on and off.

(d) "HET. OSC. -XTAL CHECK-XTAL ONLY" switch (K4), found on Frequency Meters BC-221-M, -O, -P, -R, -T, -AC, and -AF, enables the heterodyne oscillator to be operated alone when the switch is at "HET. OSC.," the crystal oscillator to be operated alone when the switch is at "XTAL ONLY," or both oscillators to be operated simultaneously when the switch is at "XTAL CHECK."

(e) "OFF - CRYSTAL - OPERATE - CHECK" switch (K5), found on Frequency Meters BC-221-B, -E, -N, -AA, and -1AE, turns the set off when in the "OFF" position, enables the crystal oscillator to be operated in the "CRYSTAL" position, the heterodyne oscillator to be operated in the "OPERATE" position, or both oscillators to be operated in the "CHECK" position.

(f) "GAIN" control (K6) adjusts the volume of sound in the headset.

(g) "DIAL HUNDREDS" (D2) is a drum dial on the shaft of the main tuning capacitor. It is graduated into 50 equally spaced divisions.

(h) "DIAL UNITS" (D1) is a disc-type dial graduated into 100 divisions. It is used to read "DIAL HUNDREDS" more accurately. One complete revolution of "DIAL UNITS" moves "DIAL HUNDREDS" through one division. In order to improve still further the accuracy of reading the frequency meter, a vernier scale is provided to split the individual divisions of the "DIAL UNITS" into tenths.

(i) One or two "PHONES" jacks are provided for plugging in the headset.

(j) "POWER" switch (K7) is on all meters except Frequency Meters BC-221-B, -E, -N, -AA, and -AE. It controls all of the battery voltages applied to the tubes in the frequency meter.

(k) In general, the antenna post is located on top of the meter cabinet. Exceptions are Frequency Meters BC-221-AA, -AC, -AE, and -AF, on which the antenna post is located on the front panel.

(3) CALIBRATION BOOK MC-177-(*).—This book lists the settings to which the main tuning dial is turned for any desired frequency. It is mounted in the hinged front cover of the instrument case and is viewed through a window in a hinged cover door. The first column indicates the dial settings. The second column lists the fundamental frequency, and the succeeding columns list the useable harmonics for the calibrated range.

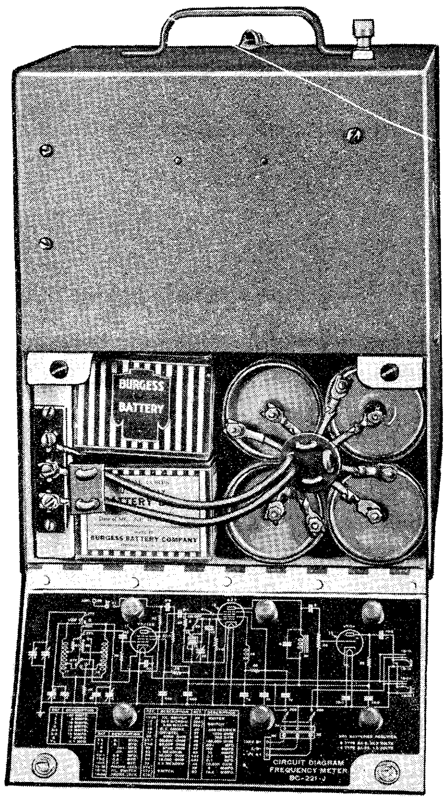


Figure 1-1. Frequency Meters BC-221-P and BC-221-T —Rear of Cabinet—Battery Compartment

(4) BATTERY COMPARTMENT.—At the lower rear of the cabinet is the battery compartment which contains the batteries necessary for operation of the frequency meter.

(5) SPARE PARTS COMPARTMENT.—At the lower front of the cabinet is a compartment containing spare tubes and a wrench for the Bristo setscrews used in the knobs. The compartment is closed by a flat cover which is held in place by machine screws. On Frequency Meter Sets SCR-211-AA, -AC, -AE, and -AF, spare parts provided are mounted on the chassis.

TABLE 1-1
[P]ARTS OF FREQUENCY METER SET SCR-211-(*)

					EQUIPMENT REQUIRED BUT NOT SUPPLIED				MISCELLANEOUS
[...]s for [...]ws	*Strap*	*Spare Crystal Unit*	*Spare Calibration Book*	*Number of Spare Tube Sets*	*Headset*	*Number of Batteries BA-23*	*Number of Batteries BA-2*	*Strap*	
[...]o. 6 [...]o. 8		DC-9-A	MC-177-A untyped	2	Note 5	4 in use 4 spare	6 in use 6 spare	ST-19-A	
[...]o. 6		DC-9-B Note 4	MC-177-B untyped	2	Note 5	4 in use 4 spare Note 3	6 in use 6 spare Note 3	ST-19-A	One battery tray (furnished) Antenna (stiff copper wire) appro[...] 12" long (not furnished)
[...]o. 6 [...]o. 8		DC-9-C	MC-177-C untyped	2	Note 5	4 in use 4 spare	6 in use 6 spare	ST-19-A	
[...]o. 6 [...]o. 8		DC-9-D	MC-177-D	2	Note 5	4 in use 4 spare	6 in use 6 spare	ST-19-A	
[...]o. 6 [...]o. 8		DC-9-E Note 1	MC-177-E	4	Note 5	4 in use 4 spare	6 in use 6 spare	ST-19-A	
[...]o. 8		DC-9-F	MC-177-F	4	Note 5	4 in use	6 in use	ST-19-A	
[...]o. 8	ST-19-A		MC-177-J	2	Note 5	4 in use	6 in use		
[...]o. 8			MC-177-K	2	Note 5	4 in use	6 in use	ST-19-A	
[...]o. 8		DC-9-L	MC-177-L	2	Note 5	4 in use	6 in use	ST-19-A	
[...]o. 6 [...]o. 8	ST-19-A			Note 2	Note 5	4 in use 4 spare	6 in use 6 spare		
[...]o. 8	ST-19-A			1	Note 5	4 in use 4 spare	6 in use 6 spare		
[...]o. 8	ST-19-A			1	Note 5	4 in use 4 spare	6 in use 6 spare		
[...]o. 8				1	Note 5	4 in use 4 spare	6 in use 6 spare	ST-19-A	
[...]o. 8	ST-19-A			1	Note 5	4 in use 4 spare	6 in use 6 spare		One battery tray (furnished). Antenna (stiff copper wire) appro[...] 18" long (not furnished).
[...]o. 8	ST-19-A			1	Note 5	4 in use 4 spare	6 in use 6 spare		
[...]o. 8				1	Note 5	4 in use 4 spare	6 in use 6 spare	ST-19-A	
[...]o. 8	ST-19-A			1	Note 5	4 in use	6 in use		
[...]o. 8	ST-19-A			1	Note 5	4 in use	6 in use		
[...]o. 8	ST-19-A			1	Note 5	4 in use	6 in use		
[...]o. 8	ST-19-A			1	Note 5	4 in use	6 in use		

Note 5. Headset HS-33, Cord CD-307-A, and Headset Adapter MC-385-( ) are required when the meter is used by Air Forces for ground operations. No headset is issued when the meter is used as airborne equipment. Headset HS-30-( ) and Cord CD-605 is required when the meter is used by ground forces. If these are not available, use Headset P-18.

Note 6. Used only on aluminum case model.

COMPONENT PARTS

	EQUIPMENT SUPPLIED							
Model	*Frequency Meter*	*Crystal Unit*	*Calibration Book*	*Technical Manual or Instruction Book*	*Tube Set In Use*	*Bag*	*Wrenches for Setscrews*	
SCR-211-A	BC-221-A	DC-9-A	MC-177-A	SCR-211-A	JAN-76 JAN-77 JAN-6A7	BG-81-A or BG-81-AD	Bristo No. 6 Bristo No. 8	
SCR-211-B	BC-221-B	DC-9-B	MC-177-B	SCR-211-B	JAN-6SJ7 JAN-6SJ7 JAN-6K8	BG-81-B or BG-81-AD	Bristo No. 6	
SCR-211-C	BC-221-C	DC-9-C	MC-177-C	SCR-211-C	JAN-76 JAN-77 JAN-6A7	BG-81-C or BG-81-AD	Bristo No. 6 Bristo No. 8	
SCR-211-D	BC-221-D	DC-9-D	MC-177-D	SCR-211-D	JAN-76 JAN-77 JAN-6A7	BG-81-D	Bristo No. 6 Bristo No. 8	
SCR-211-E	BC-221-E	DC-9-E	MC-177-E	SCR-211-E	JAN-7C7 7B8 JAN-7A4	BG-81-E or BG-81-AD	Bristo No. 6 Bristo No. 8	
SCR-211-F	BC-221-F	DC-9-F	MC-177-F	SCR-211-F	JAN-76 JAN-6SJ7Y JAN-6A7	BG-81-F	Bristo No. 8	
SCR-211-J	BC-221-J	DC-9-J	MC-177-J	SCR-211-J	JAN-76 JAN-6SJ7Y JAN-6A7	BG-81-J	Bristo No. 8	ST
SCR-211-K	BC-221-K	DC-9-K	MC-177-K	SCR-211-K	JAN-76 JAN-6SJ7Y JAN-6A7	BG-81-K or BG-81-AD	Bristo No. 8	
SCR-211-L	BC-221-L	DC-9-L	MC-177-L	SCR-211-L	JAN-76 JAN-6SJ7Y JAN-6A7	BG-81-L	Bristo No. 8	
SCR-211-M	BC-221-M	DC-9-M	MC-177-M	SCR-211-M	JAN-6SJ7 JAN-6K8 JAN-6SJ7Y	BG-81-D or BG-81-AD	Bristo No. 6 Bristo No. 8	ST
SCR-211-N	BC-221-N	DC-9-N	MC-177-N	SCR-211-N	JAN-6SJ7 JAN-6SJ7 JAN-6K8	BG-81-N or BG-81-AD	Bristo No. 8	ST
SCR-211-O	BC-221-O	DC-9-M or DC-9-P or DC-9-AD	MC-177-O	SCR-211-O and SCR-211-R	JAN-6SJ7 JAN-6SJ7Y JAN-6K8	BG-91-O or BG-81-AD	Bristo No. 8	ST
SCR-211-P	BC-221-P	DC-9-P	MC-177-P	SCR-211-P plus one spare	JAN-6SJ7Y JAN-6SJ7Y JAN-6K8	BG-81-P or BG-81-AD	Bristo No. 8	
SCR-211-Q	BC-221-Q	DC-9-Q or DC-9-B	MC-177-Q	SCR-211-Q	JAN-6SJ7 JAN-6SJ7 JAN-6K8	BG-81-Q or BG-81-AD	Bristo No. 8	ST
SCR-211-R	BC-221-R	DC-9-R or DC-9-A or DC-9-AD	MC-177-R	SCR-211-O and SCR-211-R	JAN-6SJ7 JAN-6SJ7Y JAN-6K8	BG-81-R or BG-81-AD	Bristo No. 8	ST
SCR-211-T	BC-221-T	DC-9-T	MC-177-T	SCR-211-T	JAN-6K8 JAN-6SJ7Y JAN-6SJ7Y	BG-81-T or BG-81-AD	Bristo No. 8	
SCR-211-AA	BC-221-AA	DC-9-AA	MC-177-AA	SCR-211-AA	JAN-6SJ7 JAN-6SJ7 JAN-6K8	BG-81-N Note 6	Bristo No. 8	ST
SCR-211-AC	BC-221-AC	DC-9-M DC-9-P DC-9-AD	MC-177-AC	SCR-211-AC	JAN-6SJ7 JAN-6SJ7Y JAN-6K8		Bristo No. 8	ST
SCR-211-AE	BC-221-AE	DC-9-AE	MC-177-AE	TM11-300AE plus one spare	JAN-6SJ7 JAN-6SJ7 JAN-6K8		Bristo No. 8	ST
SCR-211-AF	BC-221-AF	DC-9-AF	MC-177-AF	TM11-300AF	JAN-6SJ7 JAN-6SJ7Y JAN-6K8		Bristo No. 8	ST

Note 1. Frequency Meter Set SCR-221-E (Order No. 2478-Chi-41) does not include spare crystal.
Note 2. Frequency Meter Set SCR-211-M (Order No. 17134-Phila-42) includes two spare sets of tubes.
Note 3. On Order No. 17930-NY-39 and Order No. 4584-Phila-42, no spare batteries are issued.
Note 4. Spare Crystal Unit DC-9-B is not issued on Order No. 4584-Phila-42.

(6) CRYSTAL UNIT DC-9-(*).—This is a 1000-kilocycle crystal used as the frequency standard in the crystal oscillator circuit. It is also used in the calibration of the heterodyne oscillator.

(7) SPARE CRYSTAL.—A clip is provided in the spare parts compartment or on the frequency meter chassis to hold a spare crystal when issued.

(8) WRENCH.—A wrench is mounted in the cabinet to release or tighten all setscrews used on dials, knobs, and other parts of the assembly.

b. HEADSET.—The headset, necessary for the operation of the frequency meter, is carried in the compartment on the top of Bag BG-81-(*) or in a special compartment in the cabinet.

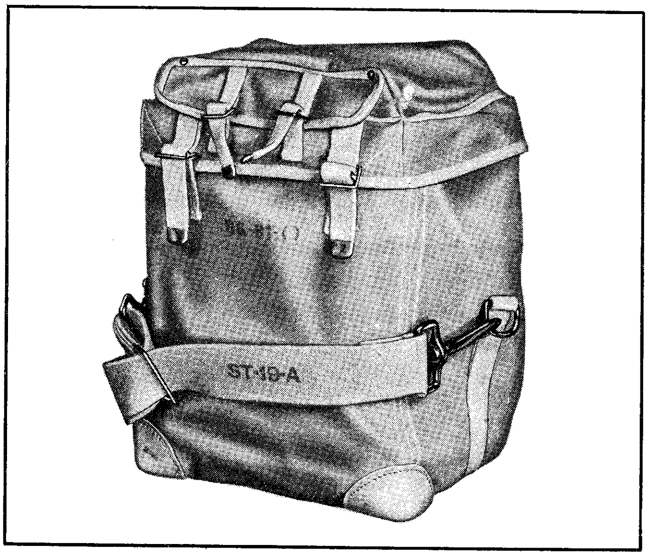
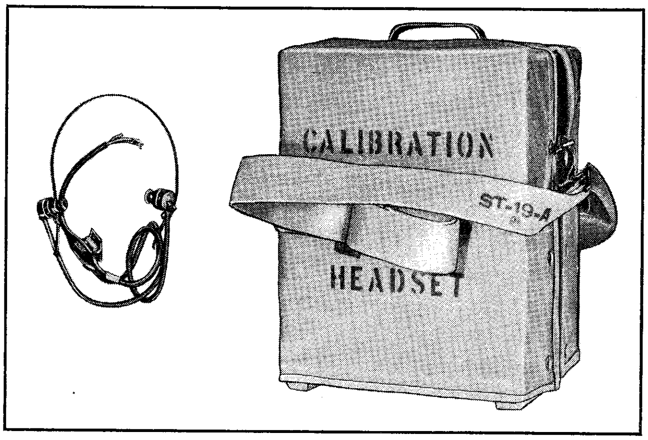


Figure 1-2. Bag BG-81-(*)

c. BAG BG-81-(*).—The carrying bag (see fig. 1-2) is designed to include all components of the frequency meter set. The bottom is felt-padded. The top, hinged at the rear, has overhanging sides and front to exclude dust and water. This cover is fitted with webbing straps so that it may be conveniently secured by buckles on the front of the bag. Suitable rings are secured with webbing to each side of the bag to which an adjustable strap may be attached. Frequency Meter Sets SCR-211-AC, -AE, -AF, and the wood cabinet model of Frequency Meter Set SCR-211-AA have a two-piece cover as illustrated in figure 1-3.



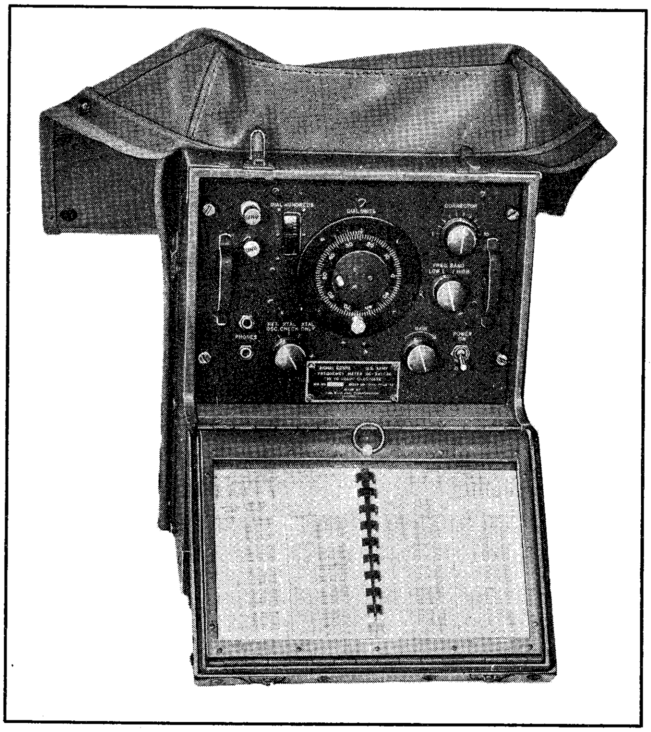


Figure 1-3. Two Piece Non-Removable Cover

d. TUBES.—Refer to table 1-1 for the exact tube complement of the various models of the frequency meter set. Three tubes are used in each set, one for the heterodyne oscillator circuit, one for the combination crystal oscillator and detector, and one for the audio amplifier circuit. The spare tubes furnished with each set can be interchanged with those in the meter circuit of that set without need for recalibration except for the usual procedure of resetting the "CORRECTOR" control.

SECTION II
INSTALLATION AND ADJUSTMENT

1. UNPACKING THE FREQUENCY METER.

The frequency meter set comes from the factory inclosed in a carrying bag. All tubes are inserted in their sockets and stamped. The batteries are not ordinarily installed at the factory.

Unpack the equipment and thoroughly inspect all compartments of the cabinet for possible damage during shipment. Use caution in handling the equipment as it is a precision laboratory instrument even though ruggedly built.

2. INSTALLATION OF BATTERIES.

Note

This procedure applies to all models except Frequency Meters BC-221-B and BC-221-Q. For their installation refer to paragraph 3 below.

Remove the frequency meter chassis from the cabinet as a precaution while installing and connecting batteries.

a. Select four Batteries BA-23, each of which measures 1.35 volts or higher. Select six Batteries BA-2, each of which measures 20.25 volts or higher. (Test batteries under loads as indicated in sec. VI, table 6-1.)

Note

If there is any choice of batteries, use those with the highest voltages as they will give the longest service. Do not install batteries which measure lower than the above mentioned voltages except as an emergency measure.

b. Open the battery compartment in the lower rear of the cabinet. Loosen the binder-head screw on the right outer side (looking from the rear) in order to release the metal strap which clamps the filament batteries.

Note

Frequency Meter BC-221-AF has a battery retaining board which must be removed by turning the thumb screw to the left.

c. Insert four Batteries BA-23 under the strap with their terminal posts facing out and push well forward. Turn the batteries so their terminals are in the positions shown in figure 1-1, and connect in series. (See fig. 2-1.)

Note

In Frequency Meter BC-221-A turn the four negative posts inward along diagonals through the four positives. In Frequency Meter BC-221-AF turn the batteries so the special connecting board will fit over the proper terminals.

d. Hold the wiring harness so that the two lugs of the main cables reach the "A+" and the "A−" terminals on the battery terminal board. Tighten the securing strap.

e. Connect the six Batteries BA-2 in series as shown in figure 2-1. Tape all joints securely to prevent an accidental short circuit of any of the batteries and arrange the batteries in two layers of three each. Have

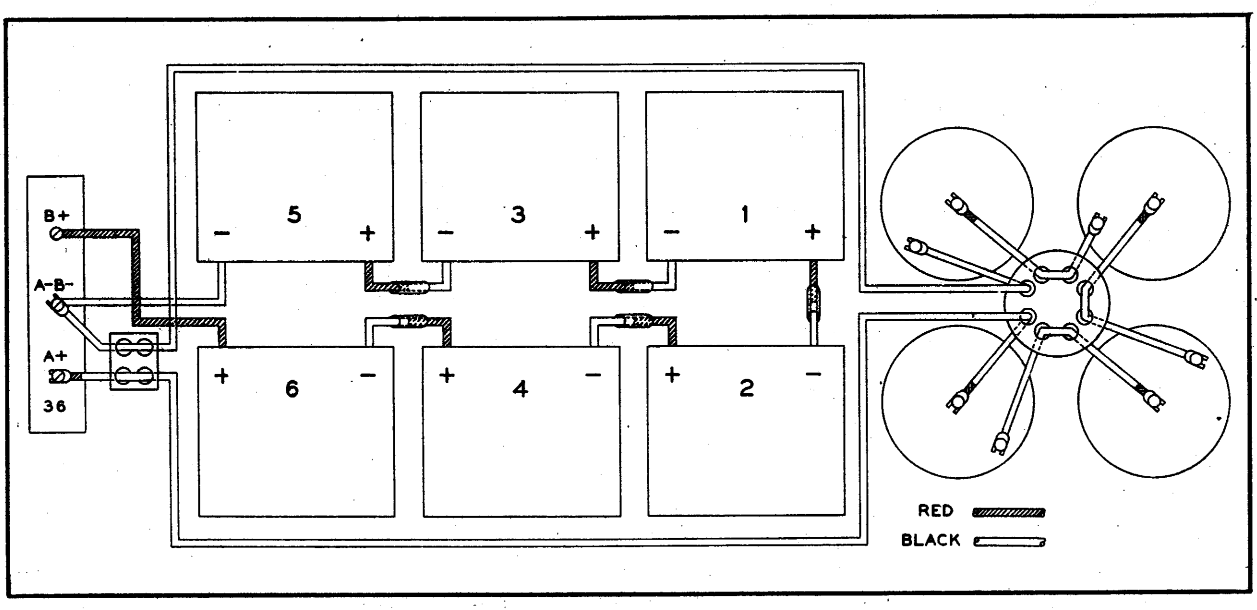


Figure 2-1. Frequency Meter BC-221-(*)—Wiring of Batteries

the batteries in the bottom row right side up and those on the top row upside down.

f. Connect the positive (red) lead of the Battery BA-2 group to the "B+" terminal of the strip at the left side of the battery compartment. Connect the negative (black) lead to the "B—" terminal.

g. Check the battery connections for 6- and 135-voltmeter readings, respectively, at the battery terminal board. Check all connections for tightness and see that the wiring harness will not prevent closing the rear door.

3. INSTALLATION OF BATTERIES IN FREQUENCY METERS BC-221-B AND BC-221-Q.

Remove the frequency meter chassis from the cabinet as a precaution while installing and connecting batteries.

a. Select four Batteries BA-23, each of which measures 1.35 volts or higher. Select six Batteries BA-2, each of which measures 20.25 volts or higher. (Test batteries under loads as listed in sec. VI, table 6-1.)

Note

If there is any choice of batteries, use those with the highest voltages as they will give the longest service. Do not install batteries which measure lower than the above mentioned voltages except as an emergency measure.

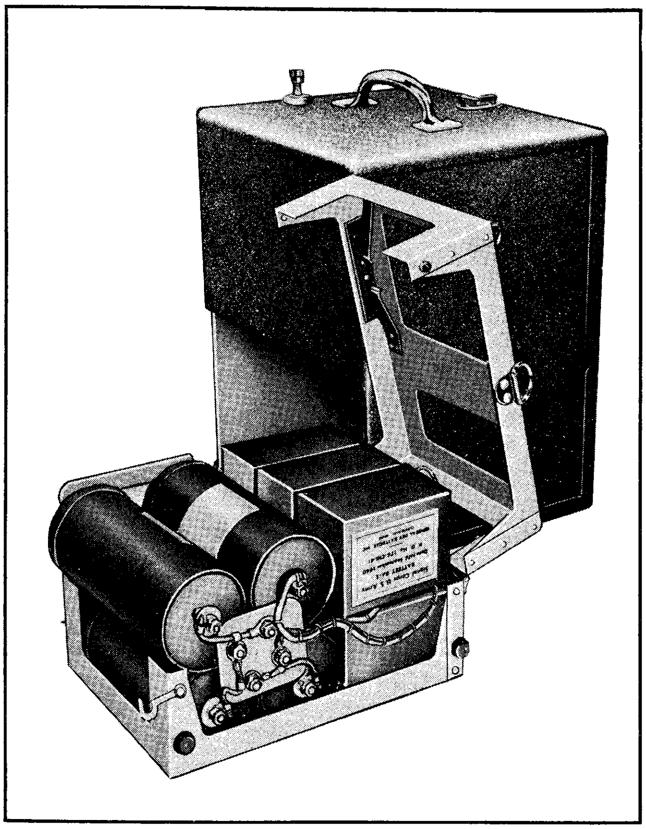


Figure 2-2. Frequency Meter BC-221-B—Loaded Battery Tray With Sections Separated To Show Installation

b. Release the two small catches at the lower rear of the set by revolving them a half turn with a screw driver. Open the door to the battery compartment.

c. Pull out the battery tray by grasping the ring at the top of the tray. (See fig. 2-2.) Do not detach the cables.

d. Release the two hooks which hold the two halves of the battery tray together.

e. Place three Batteries BA-2 right side up in the lower-right section of the tray, close to the terminal board.

f. Bring the black lead of the first battery through the first minus hole in the lower row of holes in the terminal board. Connect it to the top screw of the double connector marked "A-B."

g. Bring the red lead through the adjacent plus hole and connect it to the screw under it.

h. Successively pull through the leads of the other two batteries and connect them to the respective posts.

i. Put the other three Batteries BA-2 upside down over the first group. Pull their wires through the top row of the holes in the terminal board and connect them to the respective screw posts.

j. Remove the nuts on the binding posts of Batteries BA-23. Put these batteries in the tray so that their outside (negative) terminals pass through the holes in the small terminal plate which is permanently connected to the remaining wires of the large terminal board.

k. Connect Batteries BA-23 in series with the wires on the small terminal plate.

l. Check the battery connections for 6- and 135-voltmeter readings, respectively, at the battery terminal board. Check all connections for tightness and see that the wiring harness will not interfere with closing the tray.

m. Close the tray, locking the hooks, and place it in the battery compartment with the removing ring facing outward. Close the door.

4. INSTALLATION OF ANTENNA.

Some form of antenna is necessary on the frequency meter in order that an adequate signal may be received or radiated.

a. RIGID ANTENNA.—Use a rigid antenna when the frequency meter is to be used in fixed service or carried over small distances. Attach about 1 foot of No. 12 wire to the antenna terminal of the meter. Bend the wire so that it will be free and will run parallel and close to the antenna lead of the receiver or transmitter.

b. FLEXIBLE ANTENNA.—Use a flexible antenna where conditions do not permit the use of the rigid antenna.

(1) Skin the insulation from one end of a piece of flexible insulated wire. Fasten this end to the antenna terminal of the meter.

(2) If a small test clip is available, make a cou-

pling device by dulling the sharp edges of the jaws of the clip and insulating with tape. Attach this clip to the other end of the wire, and use it to couple the frequency meter to any desired point.

CAUTION

Never connect the antenna terminal of the frequency meter directly to any part of a transmitter or receiver.

SECTION III
OPERATION

NOTICE

For greatest accuracy, carry out all operations in the shortest possible time. Otherwise changes in voltage or temperatures may cause the frequency meter to drift. However, turn on the power switch and plug in the headset at least 10 minutes before the meter is to be used.

1. CORRECTING THE FREQUENCY METER TO CALIBRATION.

Preparatory to using the frequency meter, proceed as follows:

a. Push the plug of the headset into the "PHONES" jack.

b. Turn the "POWER" switch to the "ON" position and allow the tubes to heat for 10 minutes. (On Frequency Meters BC-221-M, -P, -T, -AA, and -AE the power switch is incorporated in the "OFF-CRYSTAL-OPERATE-CHECK" switch.)

c. Turn the crystal oscillator on in the check position as follows:

On Frequency Meters BC-221-A, -C, -D, -F, -J, -K, and -L turn the "CRYSTAL" switch to the "ON" position. On Frequency Meters BC-221-M, -O, -P, -R, -T, -AC, and -AF turn the "HET. OSC.-XTAL CHECK-XTAL ONLY" switch to the "XTAL CHECK" position. On Frequency Meters BC-211-B, -E, -N, -AA, and -AE turn the "OFF-CRYSTAL-OPERATE-CHECK" switch to the "CHECK" position.

d. Turn the "FREQ. BAND" switch to "LOW" if the desired frequency value is between 124 and 2000 kilocycles, or to "HIGH" if the desired frequency value is between 2000 and 20,000 kilocycles.

e. Open the calibration book to the page listing the desired frequency. At the bottom of this page, the nearest crystal check point (refer to par. 3, this section) will appear in red and the associated dial setting in black.

f. Set the main tuning dial (refer to sec. VI, par. 1) to correspond with the appropriate dial setting as found according to instructions in paragraph *e.*, above.

g. Rotate the "GAIN" control clockwise about half way or until a sound is heard in the headset.

h. Turn the "CORRECTOR" control until exact zero beat is obtained. (Refer to sec. VI, par. 2 for further explanation of zero beat.)

Note

Do not disturb the "CORRECTOR" control adjustment from here on. When correcting the heterodyne oscillator to calibration, numerous beat points will be heard. (For further explanation refer to sec. IV, par. 4.)

2. TUNING A TRANSMITTER TO A DESIRED FREQUENCY VALUE.

The method of tuning a transmitter to a desired frequency value consists of zero beating the transmitter signal with the proper heterodyne oscillator signal.

a. Correct the heterodyne oscillator to calibration at the crystal check point nearest to the desired frequency value as explained in paragraph 1, above.

b. Depending upon the model being used, set the switches in the following positions:

(1) On Frequency Meters BC-221-A, -C, -D, -F, -J, -K, and -L set the "CRYSTAL ON-OFF" switch to the "OFF" position.

(2) On Frequency Meters BC-221-M, -O, -P, -R, -T, -AC, and -AF, set the "HET. OSC.-XTAL CHECK-XTAL ONLY" switch to the "HET. OSC." position.

(3) On Frequency Meters BC-221-B, -E, -N, -AA, and -AE, set the "OFF-CRYSTAL-OPERATE-CHECK" switch in the "OPERATE" position.

c. From the calibration book determine the dial setting for the desired frequency. (Refer to sec. IV, par. 4.)

d. Turn the main tuning dial to the correct dial setting. Lock the dial.

e. Loosely couple the frequency meter antenna to the transmitter output and tune the transmitter to give an audible sound in the headset. Adjust the "GAIN" control to obtain a comfortable volume in the headphone.

f. Tune the transmitter to zero beat with the frequency meter. The transmitter is now radiating at the same frequency value as the frequency meter.

3. USE OF THE CALIBRATION BOOK.

a. FINDING THE MAIN TUNING DIAL SETTING FOR A GIVEN FREQUENCY.

(1) Open the book to the page on which the main tuning dial settings for a particular frequency are listed. Use index of frequencies listed at the top of the page as an aid in locating the correct page.

(2) Look down the right-hand columns until the desired frequency is found. Look along the same line to the left to find the correspondingly correct dial setting.

b. FINDING THE FREQUENCY FOR A GIVEN MAIN TUNING DIAL SETTING.

(1) Open the book to the page in the calibration book on which the main tuning dial setting is listed. Use the index of dial settings listed at the top of each page as an aid in locating the correct page.

(2) Look down the left-hand column of dial settings until the dial setting nearest the desired setting is found. Look along that same line to the appropriate column of frequencies and find the corresponding frequency.

c. DETERMINING INTERMEDIATE VALUES BETWEEN LISTED FREQUENCIES.

(1) The error introduced by merely reading the nearest frequency listed instead of splitting the difference, does not exceed 0.025 percent in the high band, or 0.04 percent on the low band.

(2) If an accuracy equal to or better than 0.012 percent on the high band and 0.02 percent on the low band is desired, compute mid-points between the listed values and read the frequency or the dial setting as a listed point or a mid-point, whichever is closer.

4. MEASURING THE FREQUENCY OF A LOCAL TRANSMITTER, APPROXIMATE VALUE KNOWN.

a. Correct the heterodyne oscillator to calibration at the crystal check point nearest the approximate frequency as explained in paragraph 1, this section.

b. Depending upon the model being used, set the switches in the following positions:

(1) On Frequency Meters BC-221-A, -C, -D, -F, -J, -K, and -L set the "CRYSTAL ON-OFF" switch to the "OFF" position.

(2) On Frequency Meters BC-221-M, -O, -P, -R, -T, -AC, and -AF, set the "HET. OSC.-XTAL CHECK-XTAL ONLY" switch in the "HET. OSC." position.

(3) On Frequency Meters BC-221-B, -E, -N, -AA, and -AE, set the "OFF-CRYSTAL-OPERATE-CHECK" switch in the "OPERATE" position.

c. Loosely couple the meter to the transmitter. Turn the main tuning dial to the frequency to be checked by turning the tuning dial from the low frequency end to the high frequency end of the dial and obtain zero beat at the unknown frequency.

d. Open the calibration book to the dial setting found according to the directions in paragraph *c.* above, and read the corresponding frequency.

5. TUNING A CW RECEIVER TO A DESIRED FREQUENCY.

a. Correct the heterodyne oscillator to calibration at the crystal check point nearest to the desired frequency as explained in paragraph 6, this section.

b. Depending upon the model being used, set the switches in the following positions:

(1) On Frequency Meters BC-221-A, -C, -D, -F, -J, -K, and -L set the "CRYSTAL ON-OFF" switch to the "OFF" position.

(2) On Frequency Meters BC-221-M, -O, -P, -R, -T, -AC, and -AF, set the "HET. OSC.-XTAL CHECK-XTAL ONLY" switch in the "HET. OSC." position.

(3) On Frequency Meters BC-221-B, -E, -N, -AA, and -AE, set the "OFF-CRYSTAL-OPERATE-CHECK" switch in the "OPERATE" position.

c. Open the calibration book to the page on which the desired frequency is listed.

d. Turn the main tuning dial to the correct dial setting. Lock the dial.

e. Connect a headset or loudspeaker to the output of the radio receiver. (Do not remove the headset from the frequency meter jack as this will open the filament circuit and render the meter inoperative.)

f. Loosely couple the frequency meter antenna to the radio receiver and tune the receiver to produce an audible tone.

g. Adjust the tuning control of the radio receiver to a zero beat.

Note

If the receiver has a beat oscillator, turn it on and tune in the signal from the frequency meter in the same manner as tuning for any other signal. (On Radio Receiver BC-312-(*), turn the "CW-OSC. ADJUST" control so that the arrow is in the horizontal position.) If the receiver is of the regenerative type, advance the regenerative control until the detector starts to oscillate. In this condition the receiver will respond to CW signals and may be set to a frequency in the same manner as the receiver with a beat oscillator.

6. TUNING A RECEIVER TO A DESIRED FREQUENCY WHEN THE RECEIVER HAS NO MEANS OF PRODUCING A BEAT NOTE.

a. Use the following method when a local transmitter is available which can be modulated and operated either with a normal antenna at reduced power or with a phantom antenna.

(1) Adjust the transmitter to the desired frequency by the method described in paragraph 2, this section.

(2) Tune the receiver to the transmitter signal while the latter is modulated either by its built-in tone generator, if it has one, or by voice.

b. Use the following method when operation of a transmitter is undesirable.

(1) Correct the heterodyne oscillator to calibration at the crystal check point nearest to the desired frequency as explained in paragraph 7, this section.

(2) Tune the receiver across the signal from the frequency meter and listen carefully for a change in the tone of the natural noise of the receiver. If static or other noise is low, operate the receiver at relatively high sensitivity to produce a rushing noise. A change in the character of the rushing or hissing noise will be noted when the receiver is tuned past the frequency meter signal. To distinguish the frequency meter signal from signals received from other transmitters, touch the antenna terminal of the frequency meter with a bare finger many times in rapid succession. This will produce a corresponding number of changes in signal strength which can be identified.

7. MEASURING THE FREQUENCY OF A DISTANT TRANSMITTER.

a. This procedure requires the use of a radio receiver in conjunction with the frequency meter.

(1) Tune in the signal from the distant transmitter on the radio receiver. Determine the approximate frequency from the dial setting.

Note

If the transmission is CW, use either a receiver with a beat oscillator or a regenerative type receiver. Turn on the beat oscillator or turn up the regeneration control until the receiver oscillates. Tune the receiver to zero beat.

(2) Tune the beat oscillator or adjust the regenerative receiver to a nonoscillating condition before proceeding.

b. Correct the heterodyne oscillator to calibration at the crystal check point nearest the approximate frequency indicated by the receiver dial, as explained in paragraph 1, this section.

c. Depending upon the model being used, set the switches in the following positions:

(1) On Frequency Meters BC-221-A, -C, -D, -F, -J, -K, and -L set the "CRYSTAL ON-OFF" switch to the "OFF" position.

(2) On Frequency Meters BC-221-M, -O, -P, -R, -T, -AC, and -AF, set the "HET. OSC.-XTAL CHECK-XTAL ONLY" switch in the "HET. OSC." position.

(3) On Frequency Meters BC-211-B, -E, -N, -AA, and -AE, set the "OFF-CRYSTAL-OPERATE-CHECK" switch in the "OPERATE" position.

d. Loosely couple the frequency meter to the receiver antenna lead. While listening to the receiver with a head set, turn the main tuning dial of the frequency meter in the region of the approximate frequency until a beat note is heard between the transmitter signal and the signal from the frequency meter.

Note

It may be necessary to vary the coupling between the meter and the receiver in order to obtain a satisfactory beat note. When the received signal is weak, the coupling must be loose, and when the signal is strong, the coupling must be correspondingly tighter. The coupling may be varied by changing the amount of antenna on the frequency meter or the spacing between the meter and the receiver.

e. Refer to the dial setting in the calibration book and read the corresponding frequency.

8. MEASURING THE FREQUENCY OF A TRANSMITTER, APPROXIMATE FREQUENCY UNKNOWN.

a. Determine the frequency to an approximation with an absorption type wavemeter. Then follow procedure described in paragraph 4, this section.

b. When absorption type wavemeter is not available, follow the procedure below.

(1) Correct the heterodyne oscillator to calibration at the 181.8-kilocycle crystal check point as explained in paragraph 1, this section.

(2) Loosely couple the frequency meter antenna to the source of the unknown frequency.

(3) Depending upon the model in use set the switches in the following positions:

(a) On Frequency Meters BC-221-A, -C, -D, -F, -J, -K, and -L set the "CRYSTAL ON-OFF" switch to the "OFF" position.

(b) On Frequency Meters BC-211-M, -O, -P, -R, -T, -AC, and -AF, set the "HET. OSC.-XTAL CHECK-XTAL ONLY" switch in the "HET. OSC." position.

(c) On Frequency Meters BC-221-B, -E, -N, -AA, and -AE, set the "OFF-CRYSTAL-OPERATE-CHECK" switch in the "OPERATE" position.

(4) Turn the main tuning dial from the low to the high end. Listen carefully for beat notes.

(5) If only one loud beat note is heard between 125 and 250 kilocycles, determine the heterodyne oscillator fundamental frequency which corresponds to the zero beat point dial setting (left columns of the calibration book). The frequency so indicated is approximately the unknown frequency.

(6) If more than one loud beat note is heard, consecutive harmonics of the heterodyne oscillator signal are beating with the signal of unknown frequency. For example, if the unknown frequency signal were 1000 kilocycles, consecutive harmonic beat notes would be obtained at the 8th harmonic of 125 kilocycles, the 7th of 142.8, the 6th of 166.7, the 5th of 2003, and the 4th of 250 kilocycles. Determine the heterodyne oscillator fundamental frequencies corresponding to the dial settings for any two adjacent, consecutive, harmonic, zero-beat points, and apply the following equation:

$$\frac{f_1 \times f_h}{f_h + f_1} = \text{the approximate unknown frequency}$$

where f_h = the higher heterodyne oscillator fundamental, obtained from the left frequency column in the calibration book, and f_1 = the lower heterodyne oscillator fundamental, also obtained from the left frequency column in the calibration book.

(7) If no useable consecutive-harmonic beat notes are found in the "LOW" band, switch to the "HIGH" band and correct the heterodyne oscillator to the 3000-kilocycle check point.

(8) Search the "HIGH" band following the procedure given in this paragraph.

Note

Do not use this method when the signal being measured contains any appreciable harmonics, because it will be difficult to distinguish between the many beat notes produced.

9. DIRECT USE OF THE CRYSTAL FREQUENCY.

Frequency Meter BC-221-(*), when the appropriate switch is set, will radiate a 1000-kilocycle signal and its harmonics. The switch settings for each model are as follows:

a. On Frequency Meters BC-221-F, -J, -K, -L set the "CRYSTAL ON-OFF" switch in the "ON" position. Set the "FREQ. BAND" switch in the "CRYSTAL ONLY" position.

b. On Frequency Meters BC-221-M, -O, -P, -R, -T, -AC, and -AF set the "HET. OSC.-XTAL CHECK-XTAL ONLY" switch in the "XTAL ONLY" position.

c. On Frequency Meters BC-221-B, -E, -N, -AA, and -AE set the "OFF - CRYSTAL - OPERATE - CHECK" switch in the "CRYSTAL" position.

d. It is not advisable to use Frequency Meters BC-221-A, -C, and -D in this manner.

10. MEASURING THE FREQUENCY TO WHICH A RECEIVER IS TUNED.

a. Correct the heterodyne oscillator to calibration at a crystal check point nearest to the approximate frequency to which the receiver is tuned. Refer to paragraph 1, this section.

b. Depending upon the model in use, set the switches in the following positions:

(1) On Frequency Meters BC-221-A, -C, -D, -F, -J, -K, and -L set the "CRYSTAL ON-OFF" switch to the "OFF" position.

(2) On Frequency Meters BC-221-M, -O, -P, -R, -T, -AC, and -AF, set the "HET. OSC.-XTAL CHECK-XTAL ONLY" switch in the "HET. OSC." position.

(3) On Frequency Meters BC-221-B, -E, -N, -AA, and -AE, set the "OFF-CRYSTAL-OPERATE-CHECK" switch in the "OPERATE" position.

c. Place the frequency meter with its antenna near and parallel to, but not touching the receiver antenna or antenna lead.

d. If the receiver has a beat frequency oscillator, turn it on. Then turn the main tuning dial of the frequency meter to a position near the approximate frequency at which the maximum audio output is obtained from the receiver under test. At the same time, vary the frequency of the CW oscillator in the receiver in such a way as to keep the audio output at some convenient frequency.

e. Read the main tuning dial of the frequency meter and look up the corresponding frequency in the calibration book.

f. If the receiver has no local CW oscillator, couple an external oscillator loosely to the receiver antenna. Use the external oscillator in the same manner as the receiver heterodyne oscillator in paragraph 1, this section.

11. SETTING UP A RADIO NET.

A radio net consists of a group of three or more stations transmitting and receiving on the same frequency. Any one of the group may transmit, while the others listen.

a. SETTING UP A NET OF LOCAL STATIONS DURING RADIO SILENCE.

(1) Connect each transmitter to a phantom antenna which will permit setting the transmitter to frequency without radiating a signal strong enough to be picked up by the enemy. (For instructions on connection of phantom antenna refer to the handbook of maintenance instructions for the transmitter.)

(2) Tune each transmitter to the desired frequency by the method described in paragraph 2, this section. Use the same frequency meter for adjustments.

(3) If no phantom antenna is available, set the transmitter frequencies according to their calibration charts.

(4) Set the receivers to the desired frequency. Follow procedures given in paragraphs 5 or 6, this section, whichever is most applicable.

b. SETTING UP A NET OF DISTANT STATIONS DURING RADIO SILENCE.

(1) Adjust each transmitter to the desired frequency as described in paragraph 2, this section. Use a separate frequency meter for each transmitter.

(2) Adjust each receiver to the desired frequency. Follow procedures given in paragraph 5 or 6, this section, whichever is most applicable.

(3) If necessary, make further desired adjustments after radio silence is broken.

c. SETTING UP A NET OF LOCAL STATIONS WHEN RADIO SILENCE IS NOT REQUIRED.

(1) Adjust the net control transmitter to the desired frequency. Follow the directions given in paragraph 4, this section.

(2) Adjust the net control receiver to the same frequency according to the directions given in paragraphs 5 and 6, this section.

(3) Attach a 10- to 25-foot antenna to the "ANT." terminal of the frequency meter.

(4) Direct one of the stations to operate and transmit a series of easily identified characters. Tune the frequency meter to zero beat.

(5) Read the dial of the frequency meter and determine the frequency by reference to the calibration book.

(6) Notify the operator of the remote transmitter which way and how far to shift the frequency of his transmitter to get it on the net frequency.

(7) Repeat this process of measuring and shifting until the first transmitter is on frequency.

(8) Repeat the process with each of the remaining stations until the entire net is set up.

Note

In some locations, where several radio nets may be operating simultaneously, considerable interference may be experienced. In such cases and in cases where the transmitters are too far distant to give an adequate signal in the frequency meter, measure the signal frequencies according to the procedure outlined in paragraph 7, this section. Then give instructions to the distant operator which will allow him to adjust his transmitter to the net frequency.

d. SETTING UP A NET OF DISTANT STATIONS WHEN RADIO SILENCE IS NOT REQUIRED.

(1) Instruct each station with a frequency meter to tune its own transmitter and receiver according to directions given in paragraphs 2, 5, and 6, this section. After these adjustments are made, the net control station can check the frequency of each station and give directions to bring all stations to the same frequency if correction is desired.

(2) If a frequency meter is available at only one station, that station should set its own frequency correctly first, and then measure the frequency of each distant transmitter according to directions in paragraphs 4, 7, and 8, this section. Each remote operator should have instructions to permit him to set his transmitter to the correct frequency and all receivers be set by tuning to the net control stations.

SECTION IV
MECHANICAL AND ELECTRICAL CHARACTERISTICS

1. GENERAL.

Frequency Meter Set SCR-211-(*) consists of an electrical circuit made up of four principal parts. Figure 4-1 shows these parts.

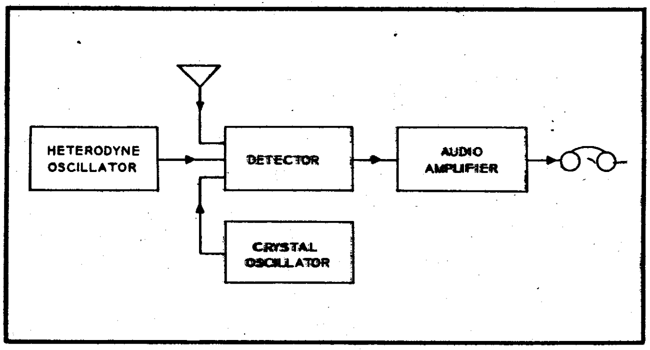


Figure 4-1. Block Diagram of Function of Individual Circuits

The functions of the circuits are as follows:

a. HETERODYNE OSCILLATOR CIRCUIT.—This circuit generates a signal whose frequency can be accurately adjusted to any value between 125 and 250 kilocycles, and between 2000 and 4000 kilocycles. The signal contains many strong harmonics.

b. CRYSTAL OSCILLATOR CIRCUIT.—This circuit generates a signal whose frequency is accurately set at 1000 kilocycles. The signal also contains many strong harmonics.

c. DETECTOR CIRCUIT.—This circuit mixes two signals together to produce a beat frequency signal at the output. The two signals mixed may be either:

(1) The heterodyne oscillator signal and crystal oscillator signal.

(2) The heterodyne oscillator signal and any signal received by the frequency meter antenna.

d. AUDIO AMPLIFIER CIRCUIT. — This circuit amplifies the beat-frequency signal produced by the detector circuit so that it may be heard in the headset.

2. ELECTRICAL AND MECHANICAL FEATURES OF COMPONENT PARTS.

As an aid in explaining the electrical features of the various models of Frequency Meter BC-221-(*), a simplified schematic diagram, figure 4-2, which shows the principal parts, is included and will be referred to in this paragraph. Because of differences in the circuits of the various models, such parts as voltage-dropping resistors, bypass capacitors, and circuit constants have not been included in this diagram. For this information, see the schematic diagram and the table of replaceable parts for the specific model.

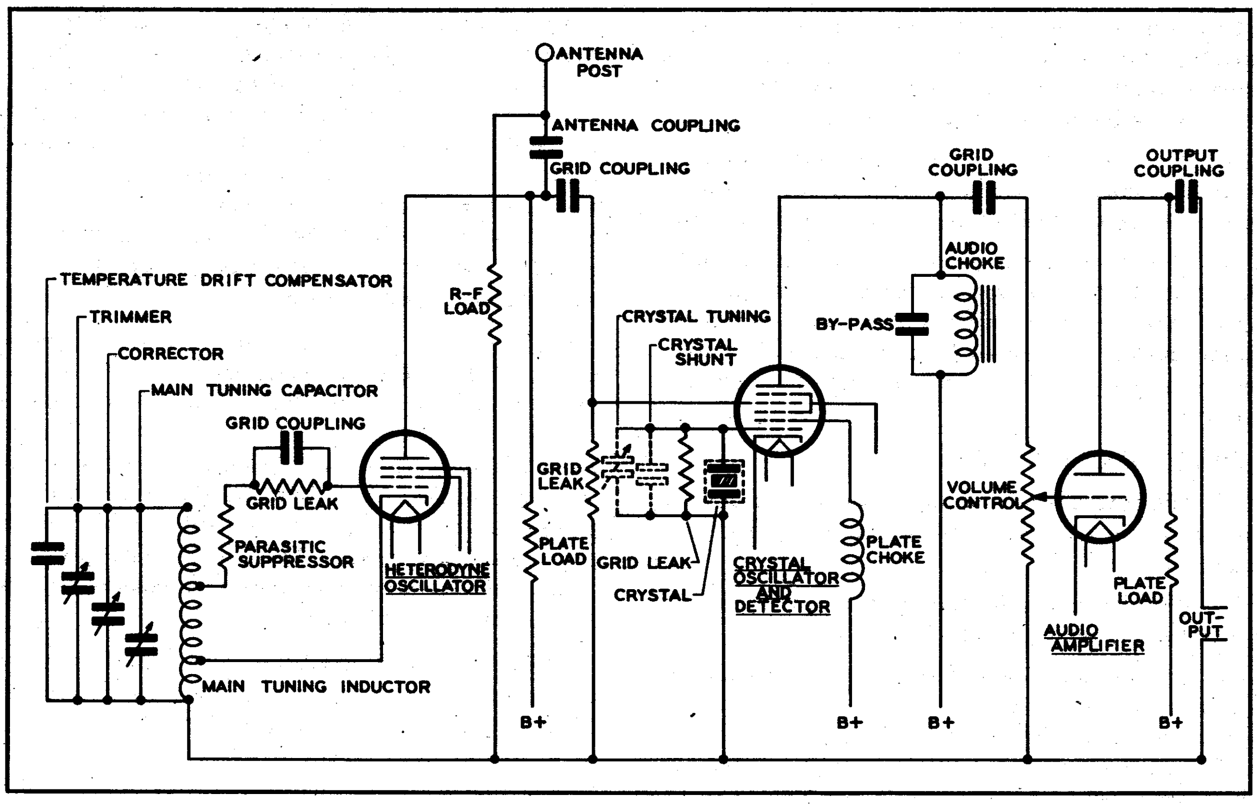


Figure 4-2. Frequency Meter BC-221-(*)—Simplified Schematic Diagram

a. HETERODYNE OSCILLATOR CIRCUIT.

(1) MAIN TUNING CAPACITOR.—The main tuning capacitor is part of the tuning circuit which determines the frequency of the heterodyne oscillator signal. It is rotated by the main tuning dial on the panel, through a worm and worm wheel designed to reduce backlash.

(2) MAIN TUNING INDUCTORS.—The main tuning inductors are part of the tuning circuit. (There are two inductors: one for the "LOW" band, and one for the "HIGH" band.) They are wound on ceramic forms and are treated with wax to reduce any changes in characteristics caused by absorption of moisture.

(3) TRIMMER CAPACITORS.—These capacitors are connected in parallel with the main tuning capacitor and are of relatively low capacity. They are provided to aid in obtaining a uniform distribution of frequency values over the main tuning dial. Adjustment is made at the factory and further adjustments are generally not required. (If readjustment becomes necessary refer to sec. V, par. 8.)

(4) TEMPERATURE-DRIFT COMPENSATOR CAPACITORS.—These capacitors are also connected in parallel with the main tuning capacitor and have a low capacitance. They are small, tubular, ceramic dielectric capacitors which reduce the effect of temperature upon the frequency of the heterodyne oscillator signal. This is accomplished through the use of a dielectric material which changes dielectric constant slightly with temperature.

(5) BAND-SELECTOR SWITCH. *(Not shown on simplified diagram.)*—This switch is used to select either one of two tuning circuits, one for the "HIGH" frequency band and one for the "LOW" frequency band. It may be a two-, three-, four-, five-, or six-pole switch, depending upon the model of the meter.

(6) "CORRECTOR" CAPACITOR.—This capacitor is connected in parallel with the main tuning capacitor and is controlled from a knob on the panel of the meter. Its function is to make it possible to set the heterodyne oscillator to calibration when compared with the crystal oscillator.

(7) GRID LEAK RESISTOR AND GRID COUPLING CAPACITOR.—This resistor and capacitor cause the heterodyne oscillator to be self-biased.

(8) PLATE LOAD RESISTOR.—This resistor is connected in series with the plate of the heterodyne oscillator tube. The output voltage of the tube is developed across this resistor.

b. CRYSTAL OSCILLATOR CIRCUIT.

(1) Crystal Unit DC-9-(*) is a 1000-kilocycle crystal whose cut and mounting are such as to cause a minimum of frequency shift with temperature changes. The crystal is contained in a hermetically-sealed, octal, metal-tube-type envelope and is plugged into a ceramic octal socket.

(2) The grid leak resistor shunted across the crystal is necessary because the crystal is an insulator and does not furnish a conducting path from grid to cathode of the tube. The resistor provides a path for grid current similarly to the grid leak resistor in the heterodyne oscillator tube circuit.

(3) The crystal shunt variable capacitor (on most models) is provided for tuning the crystal oscillator to a more accurate value than could economically be ob-

tained by grinding the crystal alone. The total amount of possible shift is about 30 cycles. The capacitor is adjusted at factory so as to produce a signal frequency of 1000 kilocycles or —5 cycles at 20°C (68°F).

(4) The crystal shunt fixed capacitor (on most models) minimizes any change in the crystal oscillator frequency caused by small changes in crystal capacitance.

(5) The crystal plate choke is found in the plate circuit (grid 2 of some detector tubes) of all models and furnishes the plate load for the crystal oscillator. On some models it is tuned by a fixed capacitor to a frequency slightly higher than the crystal oscillator frequency.

c. DETECTOR CIRCUIT.

(1) The heterodyne coupling capacitor couples the output of the heterodyne oscillator to the grid of the detector.

(2) The detector grid leak resistor provides self grid bias for the detector tube.

(3) The audio choke and associated bypass capacitor make up the plate load on the detector tube. The output circuit of the detector is made responsive to low audio frequencies by using a choke of high inductance which is resonated to a frequency below 500 cycles by the capacitor connected across it.

(4) The antenna coupling capacitor couples the signal received at the antenna post to the grid of the detector tube.

d. AUDIO AMPLIFIER CIRCUIT.

(1) The audio input grid coupling capacitor couples the output of the detector to the audio amplifier.

(2) The gain control potentiometer regulates the sound level in the headset by adjusting the input to the audio amplifier.

(3) The audio plate resistor is connected in series with the plate of the audio amplifier tube. The output voltage of the tube is developed across this resistor.

Note

Frequency Meter Sets SCR-211-AE and SCR-211-AF use transformer coupling from the output of the audio amplifier.

(4) The audio output coupling capacitor couples the output of the audio amplifier tube to the headset. It also prevents any high voltages from existing between the headset and ground. Refer to note, above.

3. THEORY OF OPERATION.

a. The heterodyne oscillator is designed to generate an adjustable, fundamental-frequency signal accompanied by many strong harmonics. These harmonics cover the total frequency range of the meter from 125 to 20,000 kilocycles. To cover this band of frequencies, low and high frequency tuning circuits are provided.

(1) On the low band, the fundamental frequency of the oscillator is 125 to 250 kilocycles. The frequency range from 250 to 500 kilocycles is covered by the 2nd harmonic of the fundamental, while the range from 500 to 1000 kilocycles is covered by the 4th harmonic, and from 1000 to 2000 kilocycles by the 8th harmonic. Other harmonics such as the 3rd, 5th, 6th, and 7th are also present in the output and are relatively strong. They will also produce beat notes but are not listed in the calibration book. It is therefore essential that the operator know the approximate frequency of the device he is measuring or adjusting.

(2) On the high band, the fundamental frequency covers 2000 to 4000 kilocycles. From 4000 to 8000 kilocycles is covered by the 2nd harmonic and from 8000 to 16,000 kilocycles by the 4th harmonic. The range from 16,000 to 20,000 kilocycles is covered by a part of the 5th harmonic. The harmonics beyond the 5th are present in decreasing strength and capable of giving correspondingly weaker beat notes. The presence of many unlisted harmonics makes it possible to obtain notes that can cause errors.

b. The output of the heterodyne oscillator is fed to the antenna post and to the grid of the detector tube. Thus its signal may be radiated from the antenna post or it may be fed into the detector to be mixed with a second signal.

c. To increase the accuracy of the meter, the heterodyne oscillator is arranged so that it may calibrate against a crystal oscillator whose frequency is more stable. The active tube elements of the crystal oscillator circuit consist of the cathode, inner grid, and anode grid of the combination crystal oscillator-detector tube. The remaining elements of this tube, comprising the control grid, screen grid, and plate are used as a high gain screen grid, detector, to which, by structure, the crystal oscillator is electronically coupled. Thus, whenever the crystal oscillator is operating, its signal output is mixed with any signal impressed on the grid of the combination oscillator-detector tube. To stop the operation of the crystal oscillator, it is necessary either to short circuit the crystal or to disconnect the plate voltage. A switch is provided for this purpose.

d. Calibration of the heterodyne oscillator with a crystal oscillator may be accomplished at any one of numerous crystal check points uniformly selected over the range of the meter. These crystal check points utilize harmonics of both the heterodyne oscillator and the crystal oscillator. For example, a crystal check point may be found at 153.84 kilocycles on the low range. The lowest harmonics which will beat together at this frequency are the 13th for the heterodyne oscillator and the 2nd for the crystal oscillator. Thus it will be the 2000-kilocycle signal harmonics for each oscillator which are beating together, (e.g. 13 $\times$ 153.84 and 2 $\times$ 1000). This will serve to calibrate the dial of the heterodyne oscillator in the neighborhood of 153.8 kilocycles or the listed harmonics of 307.6, 615.2, and 1230.4 kilocycles.

e. The detector tube rectifies the radio frequency potentials that are applied to its operating grids. If two potentials with identical frequencies are applied to the grids of this tube, the combined energy is rectified and a steady, non-varying plate current results. If the two frequencies differ even slightly, the plate current will increase and decrease at a rate depending upon their differences and will produce a signal frequency that is equal to the difference between them. This is the beat frequency.

f. The beat frequency signal is amplified by the audio amplifier tube. The amount of gain in this circuit is adjustable by means of the gain control potentiometer.

g. No locking-in will occur between the heterodyne oscillator and any source of radio frequency with which it may be coupled at any beat frequency down to 5 cycles-per-second in the low fundamental range or down to 50 cycles-per-second in the high fundamental range.

4. BEAT POINT IDENTIFICATION.

a. When correcting the heterodyne oscillator to calibration, it will be found that there are numerous beat points which are not listed as crystal check points in the calibration book.

b. The crystal check points are made at harmonic combinations at which the output is relatively high.

c. The intensity of the unlisted beat points is generally low relative to the listed crystal check points.

d. The various lowest harmonic combinations of the two oscillators which produce beat points are listed in table 4-1. The relative output intensity for a typical frequency meter is listed in the right-hand column. Observe that many of the points of highest output are also crystal check points (as designated by asterisks for a typical frequency meter).

e. The location and number of crystal check points is not uniform for all models of frequency meters. For further information, refer to the calibration book.

5. SPECIAL FEATURES OF SOME MODELS OF FREQUENCY METER BC-211-(*).

a. The grid circuit tape on some tuning coils of the heterodyne oscillator are made well away from the ends of the coils to reduce the effect of variations, in inter-electrode capacities of the tube, upon the frequency.

b. Detuning and anti-resonant functions are accomplished in some cases by short circuiting all or part of the heterodyne tuning coil which is not being used, or by connecting a capacitor across a portion of it. For example, when a high band is in use, the detuning arrangements are made on the low coil.

c. In some cases, the audio amplifier tube obtains its grid bias by having the cathode connected to the "A+" side of the filament. Connection of the one end of the volume control potentiometer to the "A—" or ground side then causes a grid bias voltage equal to the A battery voltage.

TABLE 4-1. FREQUENCY METER BEAT POINTS

Beat Point (in kilocycles)	*Lowest Heterodyne Harmonic*	*Lowest Crystal Harmonic*	*Relative Output (500 cps beat)*
Low Band			*For Typical Meters*
125.00*	8	1	19.0
128.21	39	5	.4
129.03	31	4	1.2
130.43	23	3	3.2
131.57	38	5	0.1
133.33*	15	2	15.0
135.13	37	5	0.2
136.36	22	3	6.5
137.93	29	4	3.0
138.88	36	5	0.2
142.86	7	1	21.0
147.05	34	5	0.1
148.14	27	4	1.6
150.00	20	3	9.0
151.51	33	5	1.2
153.85	13	2	19.0
156.25	32	5	2.9
157.89	19	3	13.5
160.00	25	4	4.5
161.29	31	5	2.0
166.67*	6	1	19.0
172.41	29	5	2.5
173.91	23	4	7.5
176.47	17	3	16.0
178.57	28	5	4.5
181.82	11	2	22.5

Beat Point (in kilocycles)	*Lowest Heterodyne Harmonic*	*Lowest Crystal Harmonic*	*Relative Output (500 cps beat)*
Low Band			*For Typical Meters*
185.18	27	5	3.0
187.50	16	3	10.0
190.47	21	4	4.0
192.31	26	5	0.5
200.00*	5	1	20.5
208.33	24	5	0.3
210.53	19	4	16.0
214.29*	14	3	9.0
217.39	23	5	2.0
222.22*	9	2	26.0
230.77*	13	3	10.0
235.29	17	4	19.0
238.09	21	5	2.5
250.00*	4	1	17.0
2000*	11	2	40.0
2125	8	17	17.0
2143	7	15	20.0
2167	6	13	22.0
2200	5	11	25.0
2250*	4	9	30.0
2286	7	16	13.5
2333	3	7	30.0
2375	8	19	7.0
2400	5	12	24.0
2429	7	17	12.5

TABLE 4-1. FREQUENCY METER BEAT POINTS (Continued)

Beat Point (in kilocycles)	*Lowest Heterodyne Harmonic*	*Lowest Crystal Harmonic*	*Relative Output (500 cps beat)*
Low Band			*For Typical Meters*
2500*	2	5	34.0
2571	7	18	14.0
2600	6	13	23.0
2625	8	21	5.5
2666.7*	3	8	30.0
2714	7	19	8.5
2750*	4	11	26.0
2800	5	14	21.0
2833	6	17	12.0
2857	7	20	5.0
2875	8	23	0.3
3000*	1	3	35.0
3125		25	4.0
3143	7	22	6.5
3167	6	19	15.0
3200	5	16	17.0
3250*	4	13	25.0
3286	7	23	5.0
3333.3*	3	10	28.0
3375	8	27	1.2
3400	5	17	17.0
3429	7	24	4.0
3500*	2	7	30.0
3571	7	25	4.0
3600	5	18	15.0
3625	8	29	1.0
3666.7	3	11	26.0
3714	7	26	2.0
3750*	4	15	20.5
3800	5	19	13.0
3833	6	23	5.0
3857	7	27	1.4
3875	8	31	0.4
4000*	1	4	32.0

*Crystal check points.

SECTION V
MAINTENANCE

IMPORTANT

Repairs listed under paragraphs 4 to 10, inclusive, are authorized only at Signal Corps repair depots and Signal Corps radio sections at air depots.

1. LUBRICATION.

Occasionally put a single drop of Pioneer Ball Bearing Oil for Aircraft Instruments No. 2, or watch oil, on the worm and worm gear of the main tuning capacitor. Do not lubricate any other part of the meter and do not use common lubricating oils or greases as they will interfere with smooth operation at low temperature.

2. BATTERY CHECK.

During normal service, check the battery voltages under normal load at weekly intervals. Also check them after periods of idleness of more than one week.

a. Place the meter in operation in the crystal check position and allow about a minute for the tubes to warm up.

b. Open the battery compartment to expose the battery terminal strip.

c. Measure the B-voltage between the "B+" and the "B—, A—" terminals. Use a 1000-ohms-per-volt voltmeter with full scale range of at least 150 volts. If this voltage is below 120 volts, replace Batteries BA-2. (Refer to sec. II, pars. 2-3.)

d. Measure the A voltage between the "A" and "A—B—" terminals. Use a 1000-ohms-per-volt voltmeter with full scale range of at least six volts. If this voltage is below 5.4 volts, replace Batteries BA-23. (Refer to sec. II, pars. 2-3.)

3. SIMPLE TESTS FOR CIRCUIT TROUBLES.

Note

When the meter fails to operate, make the following tests. If the fault is not found, send the meter to a Signal Corps repair shop or Signal Corps radio section at an air depot.

a. Open the battery compartment and inspect all battery connections to see that they are tight.

b. Check battery voltages. (Refer to par. 2, above.)

c. Check headset and cord for continuity of circuit between the tip and the sleeve of the headset plug with a continuity meter or ohmmeter. If no such meter is available, open the battery compartment of the frequency meter and touch the tip of the headset plug to one terminal of the A— battery while the sleeve is in contact with the other terminal. A distinct click should be heard at each make and each break of the circuit.

d. Remove the meter from the case. Push all tubes firmly into their sockets. Tighten all connections to tube top caps by pinching the clip together with the fingers. Feel each tube with the bare hand after allowing the meter to operate for 5 minutes. Replace from the spare parts compartment any tube which feels colder than the others.

e. Replace the tubes one at a time. Test the meter after each replacement until the meter operates or until all tubes have been replaced. Return original good tubes to their sockets.

f. Replace the crystal with a spare one or with one from another frequency meter. If a faulty crystal is not found, be sure to return crystals to original location. If the crystal is faulty and a new one is installed, readjust the crystal oscillator circuit to produce exactly 1000 kilocycles. (Refer to par. 9, this section.)

Note

Use all tubes of a given type supplied with the equipment before using tubes from the general stock.

4. DETERMINATION OF A FAULTY CIRCUIT.

a. Faulty operation may be due to the failure of the following:

(1) The heterodyne oscillator circuit.

(2) The crystal oscillator circuit.

(3) The detector circuit.

(4) The audio amplifier circuit.

b. To find the circuit in which the trouble is located, make the following tests:

(1) To determine whether the crystal oscillator circuit has failed, put the meter into operation according to the method given in section III, paragraph 5. Loosely couple the receiver (regenerative type or one equipped with a beat oscillator) to the frequency meter antenna and tune the receiver to 1000 kilocycles. A beat note heard in the receiver headset will indicate that the crystal oscillator is operating.

(2) To determine whether the heterodyne oscillator circuit has failed, put the meter into operation as for tuning a CW receiver to a desired frequency. (Refer to sec. III, par. 5.) Use a separate receiver (regenerative type or one equipped with a beat oscillator) loosely coupled to the frequency meter antenna and tune both to the same frequency. Listen for a beat note with the receiver headset, which will indicate that the heterodyne oscillator is operating.

(3) An alternative method of isolating a faulty circuit is as follows:

(a) Remove the meter chassis from the cabinet and connect it to batteries by means of laboratory test leads.

(b) Place the frequency meter in operation in a crystal check position and allow the tubes to become warm. Advance the "GAIN" control to maximum clockwise position.

(c) Hold one end of a wire or screw driver in contact with the chassis. Touch the other end a few times in rapid succession to the connection between the crystal and the crystal oscillator grid terminal of the detector tube. If a loud click is heard each time the wire makes or breaks contact, the crystal oscillator is operating.

(d) Touch the finger a few times in rapid succession to the lead connected to the stator of the "CORRECTOR" capacitor. If a loud click is heard each time the finger makes or breaks contact with the lead, the heterodyne oscillator is operating.

(e) Remove the detector tube from the socket a few times. If a loud click is heard in the headset each time, the audio amplifier and the detector tube plate circuit are operating.

IMPORTANT

The tests described in paragraph (3) above are indications that the circuits are operating. Absence of clicks, however, does not indicate that they are not operating.

5. LOCATING THE TROUBLE WITHIN A FAULTY CIRCUIT.

When one of the tests indicates the fault is within the crystal oscillator, heterodyne oscillator, detector, or audio amplifier circuits, and if all simple tests have been made with no success, measure the various socket voltages. Use a 1000-ohm voltmeter with a scale of at least 150 volts for "B+" voltage measurements and a scale of at least 6 volts for "A" measurement; compare the measurement result with the values given in paragraph 6, this section for the model concerned. The voltages may vary as much as 15 percent from the listed values and still be satisfactory. When any test shows zero where a voltage should be present, trace the circuit with the aid of the appropriate wiring and schematic diagrams (sec. VIII) until a point is reached where the voltage present agrees reasonably well with the voltage specified. Find the defective element and replace it with a spare. If there is a bypass capacitor connected from the chassis to the point of zero voltage, first check across the capacitor with a continuity meter or ohmmeter. *Turn the power off or disconnect batteries while making this check.* If the ohmmeter reading is nearly zero, it is likely that the capacitor is shorted.

6. TUBE AND CIRCUIT VOLTAGES.

a. FREQUENCY METER BC-221-A.—The following tabulation shows vacuum-tube terminal voltages with respect to ground (chassis) when the controls are set in the listed positions:

Switch	*Position*
"GAIN"	Maximum
"FREQ BAND"	"LOW"
"CRYSTAL"	"ON"
"POWER"	"ON"

Socket Terminal	*Voltage to Ground*		
	VT-77	*6A7*	*VT-76*
Filament 1	6.0	6.0	0.0
Filament 2	0.0	0.0	6.0
Cathode	17.5	0.0	6.0
Inner grid	none	—4.0	none
Anode grid	none	132.0	none
Control grid	0.0	—0.2	0.0
Screen	100.0	65.0	none
Suppressor	17.5	none	none
Plate	90.0	130.0	105.0

b. FREQUENCY METERS BC-221-B AND BC-221-Q.—With all tubes in place and filaments heated, the following socket voltages will be noted in a set operating normally. These voltages are measured with respect to ground using the lowest voltmeter-scale range consistent with the voltage to be measured. The "OFF-CRYSTAL-OPERATE-CHECK" switch should be set in the "CHECK" position.

Tube Type	*Function*	*Terminals of Sockets*								
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*Cap*
6SJ7	Heterodyne Oscillator	0	0	0	none	none	120.0	6.0	45.0	(with "FREQ. BAND" switch at "HIGH")
									115.0	(with "FREQ. BAND" switch at "LOW")
6K8	Mixer	0	0	133.0	110.0	0	135.0	6.0	0.4	0
6SJ7	Audio Amplifier	0	0	80.0	0	1.4	80.0	6.0	80.0	

c. FREQUENCY METERS BC-221-C AND BC-221-D.—The following tabulation, showing vacuum-tube terminal voltages with respect to ground (chassis), is typical for 6-volt filament and 135-volt plate supply with "GAIN" control set at maximum:

Socket Terminal	*Voltages to Ground*		
	VT-77	*6A7*	*VT-76*
Filament 1	6.0	6.0	0
Filament 2	0	0	6.0
Cathode	20.0	0	6.0
Inner Grid	none	—10.0	none
Anode Grid	none	132.0	none
Control Grid	0	—0.2	0
Screen	100.0	58.0	none
Suppressor	23.0	none	none
Plate	134.0	125.0	103.0

Note

The above values were obtained with a 1000 ohms-per-volt voltmeter with a head set plugged into the "PHONES" jack and the switches set to the following positions:

Switch	*Position*
"FREQ. BAND"	"LOW"
"CRYSTAL"	"ON"
"POWER"	"ON"

d. FREQUENCY METER BC-221-E.—The following tabulation, which shows vacuum-tube terminal voltages with respect to ground (chassis), is with 6-volt filament supply and 135-volt plate supply, with "GAIN" control set at zero, operation switch in "CHECK" position, phone plugged in, and the "FREQ. BAND" switch on the high-frequency band. (Set the main tuning control for a frequency of approximately 2000 kilocycles.)

Tube Socket	*Pin Numbers*							
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
VT-192	0	+120.0	+120.0	+120.0	+120.0	0	+5.95	+5.95
VT-193	+5.95	+29.0	+120.0	0	0	0	0	0
VT-208	+5.95	+127.0	+135.0	0	106.0	—1.5	0	0

The following tabulation, also showing vacuum-tube terminal voltages with respect to ground (chassis), is under all the above conditions of operation except that the "FREQ. BAND" switch is on the low frequency band. (Set the main tuning control for a frequency of approximately 125 kilocycles.)

Tube Socket	*Pin Numbers*							
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
VT-192	0	120.0	120.0	120.0	120.0	0	5.95	5.95
VT-193	5.95	68.0	120.0	0	0	0	0	0
VT-194	5.95	127.0	130.0	0	106.0	—4.0	0	0

e. FREQUENCY METERS BC-221-F, BC-221-J, BC-221-K, and BC-221-L.—The following tabulation, which shows vacuum-tube terminal voltages with respect to ground (chassis), is typical with 6-volt filament and 135-volt plate supply with "GAIN" control set at maximum:

Socket Terminal	*Voltage to Ground*		
	6SJ7Y	*6A7*	*VT-76*
Filament 1	6.0	6.0	0
Filament 2	0	0	6.0
Cathode	0	0	6.0
Inner Grid	none	—6.0	none
Anode Grid	none	130.0	none
Control Grid	0	—0.2	0
Screen	120.0	60.0	none
Suppressor	0	none	none
Plate	80.0	125.0	110

Note

The above values were obtained with a 1000 ohms-per-volt voltmeter with a headset plugged into "PHONES" jack and the switches set to the following positions:

Switch	*Position*
"FREQ. BAND"	"LOW"
"CRYSTAL"	"ON"
"POWER"	"ON"

f. FREQUENCY METER BC-221-M.—The following diagram (fig. 5-1), which shows vacuum-tube terminal voltages with respect to ground (chassis), is typical with 6-volt filament and 135-volt plate supply with "GAIN" control set at maximum:

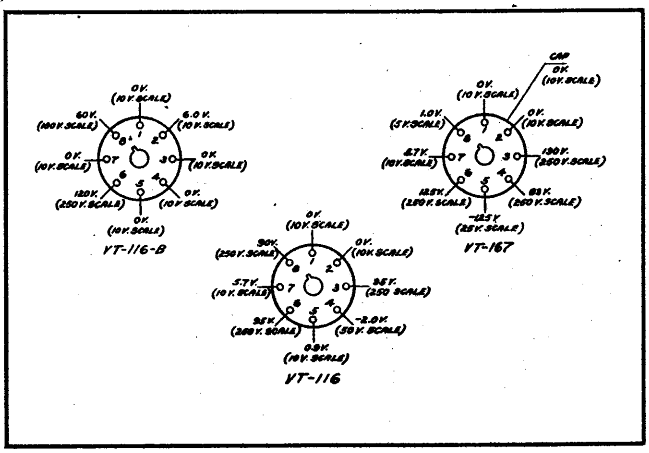


Figure 5-1. Frequency BC-221-M—Socket Pin Voltages

Note

The above values were obtained with a 1000-ohm-per-volt voltmeter with a headset plugged into the "PHONES" jack and the switches set to the following positions:

Switch	*Position*
"FREQ. BAND"	"LOW"
"CRYSTAL"	"XTAL CHECK"
"POWER"	"ON"

g. FREQUENCY METERS BC-221-O AND BC-221-R.—See figure 5-2.

h. FREQUENCY METERS BC-221-P AND BC-221-T.—See figure 5-3.

i. FREQUENCY METER BC-221-AA.—The following tabulation, which shows vacuum-tube terminal voltages with respect to ground (chassis), is typical with 6-volt filament and 135-volt plate supply with "GAIN" control set at maximum.

Socket Pin	*Oscillator (VT-166)*	*Detector (VT-167)*	*Audio (VT-116)*
1	0	0	0
2	0	0	0
3	0	125.0	65.0
4	—0.2	70.0	0
5	0	—0.05	1.4
6	105.0	—0.05	65.0
7	5.8	5.8	5.8
8	14.0	1.1	65.0
Grid Cap		—0.05	

Note

The above values were obtained with a 1000 ohms-per-volt voltmeter. Variations as much as 10 percent may be expected. Control settings are as follows:

Switch	*Position*
"OFF-CRYSTAL-OPERATE-CHECK"	"CHECK"
"FREQ. BAND"	"LOW"
"CORRECTOR"	Center
"POWER"	"ON"

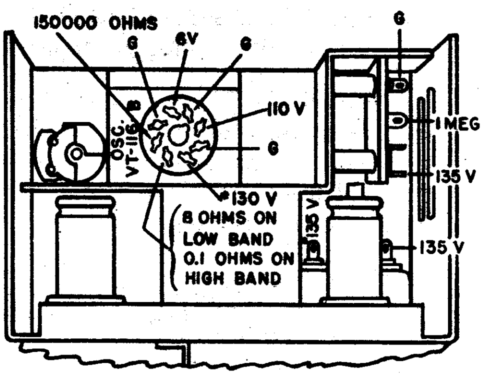
j. FREQUENCY METER BC-221-AC.—See figure 5-4.

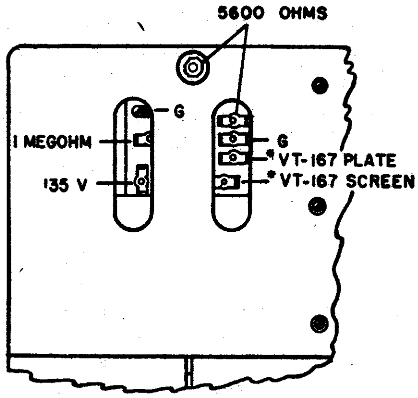
k. FREQUENCY METER BC-221-AE.—The following tabulation, which shows vacuum-tube terminal voltages with respect to ground (chassis), is typical with 6-volt filament and 135-volt plate supply with "GAIN" control set at maximum.

Socket Pin	*Oscillator (JAN-6SJ7)*	*Detector (JAN-6K8)*	*Audio (JAN-6SJ7)*
1	0	0	0
2	0	0	0
3	0	135.0	135.0
4	—0.2	105.0	0
5	0	—0.05	1.4
6	105.0	—0.05	135.0
7	5.8	5.8	5.8
8	85.0	1.1	135.0
Grid Cap		—0.25	

Note

The above values were obtained with a 1000 ohms-per-volt voltmeter. Variations as much as 10 percent may be expected. Control settings are as follows:

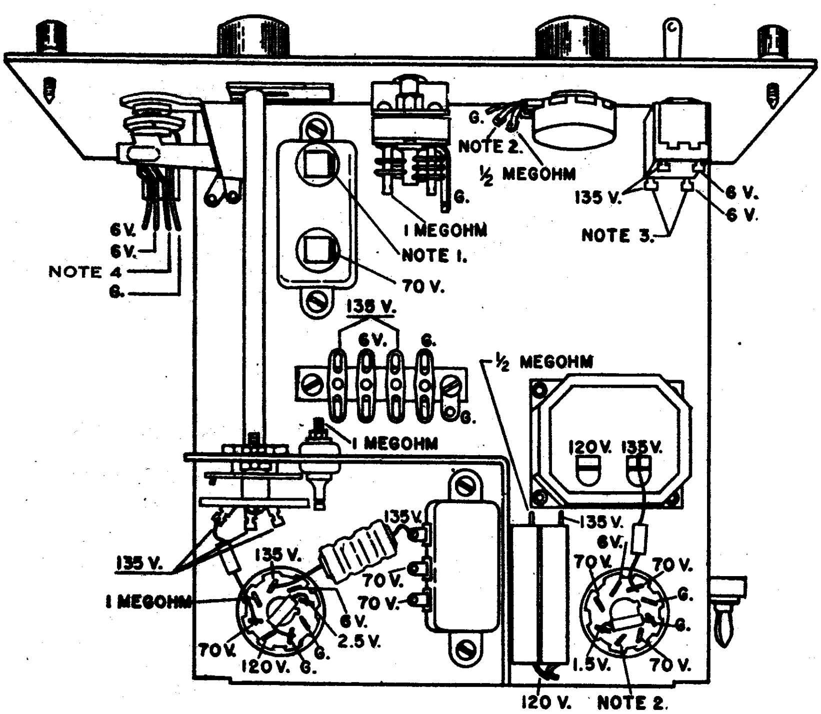




*Varies with resistance of voltmeter. Voltage measurements made with oscillator tube removed from socket. Resistances shown are measured to chassis with power switch "OFF," operation switch in "XTAL" CHECK position.

Resistances shown are measured to chassis with power switch off. Operation switch in "XTAL CHECK" position. Oscillator tube VT116-B operating.

*Voltage varies over wide limits from one band to the other and from one end to the other.



Note 1. This point connected to tip contact of jack. If phones are plugged in its resistance to chassis is the d-c resistance of the phones.

Note 2. Resistance to chassis: 0-250 ohms when "GAIN" control set at minimum (counterclockwise); ½ megohm when "GAIN" control set at maximum (clockwise).

Note 3. When "POWER" switch is in "OFF" position, all voltages in Frequency Meter except these two are zero.

Note 4. Measurements at any terminal of this jack should be the same as at corresponding terminal of other jack.

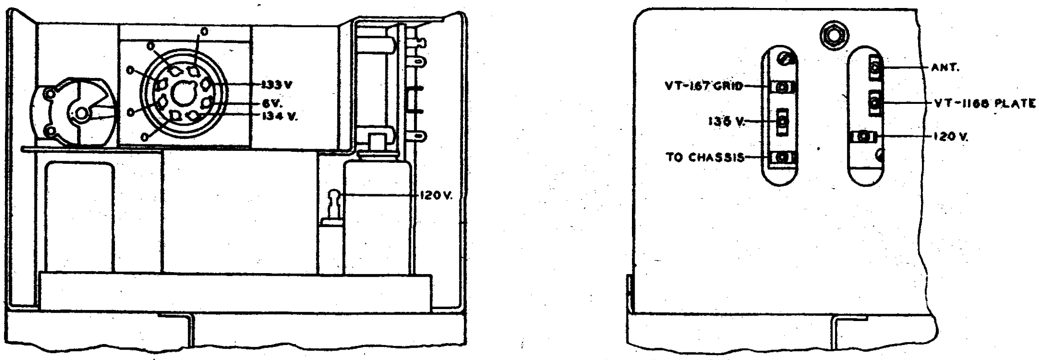
Figure 5-2. Frequency Meters BC-221-O and BC-221-R—Voltage Check Points

Switch	*Position*
"OFF-CRYSTAL-OPERATE-CHECK"	"CHECK"
"FREQ. BAND"	"LOW"
"CORRECTOR"	Center
"POWER"	"ON"

l. FREQUENCY METER BC-221-AF.—See figure 5-5.

7. RESISTANCE VALUES FOR CHECKING FREQUENCY METERS BC-221-B, BC-221-D, BC-221-Q, BC-221-AA, AND BC-221-AE.

a. FREQUENCY METER BC-221-B.



VT-116B Voltages measured from top of socket—Tube removed.

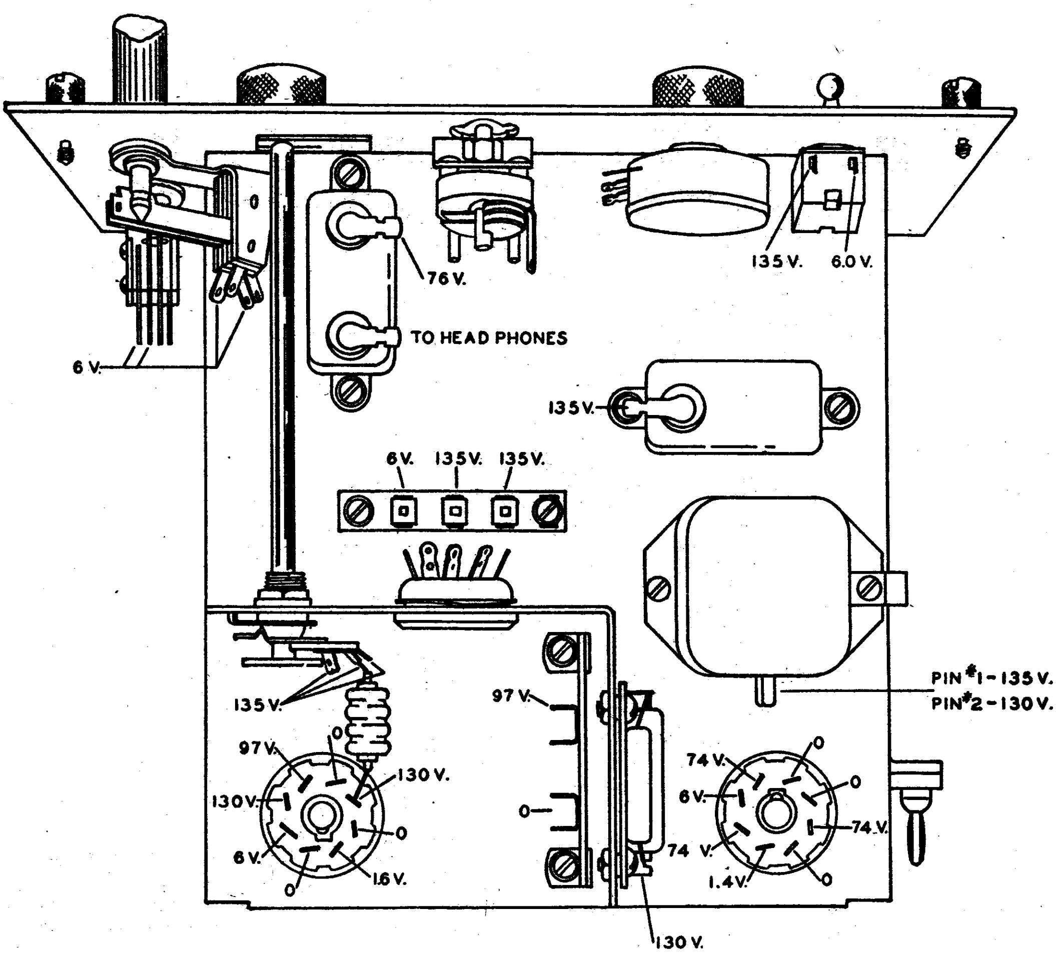


Figure 5-3. Frequency Meters BC-221-P and BC-221-T—Tube Operating Voltages

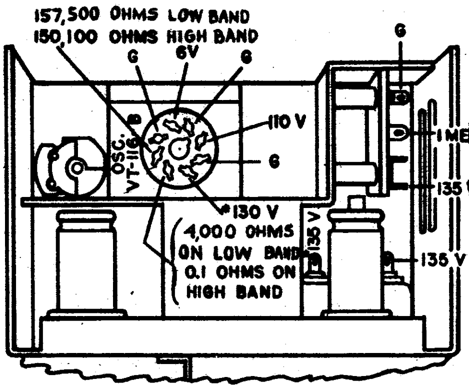
(1) To make resistance measurements with Test Set I-56-A, remove the frequency meter set from its cabinet and turn the "OFF-CRYSTAL-OPERATE-CHECK" switch to "CHECK" position.

CAUTION

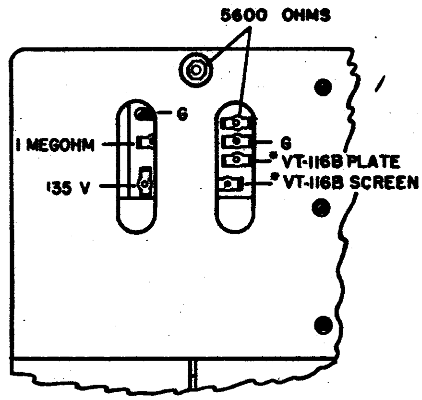
Do not apply voltage to terminal plugs 31-1, 31-2, and 31-3 during these tests.

(2) With the frequency meter disconnected from its power source and the headset removed, the indication on the test set across capacitors 6-2, 7, 8-2, 9a, 9b, 10-1, 12, and 13 should be infinity.

(3) The resistance indicated across capacitors 1 and

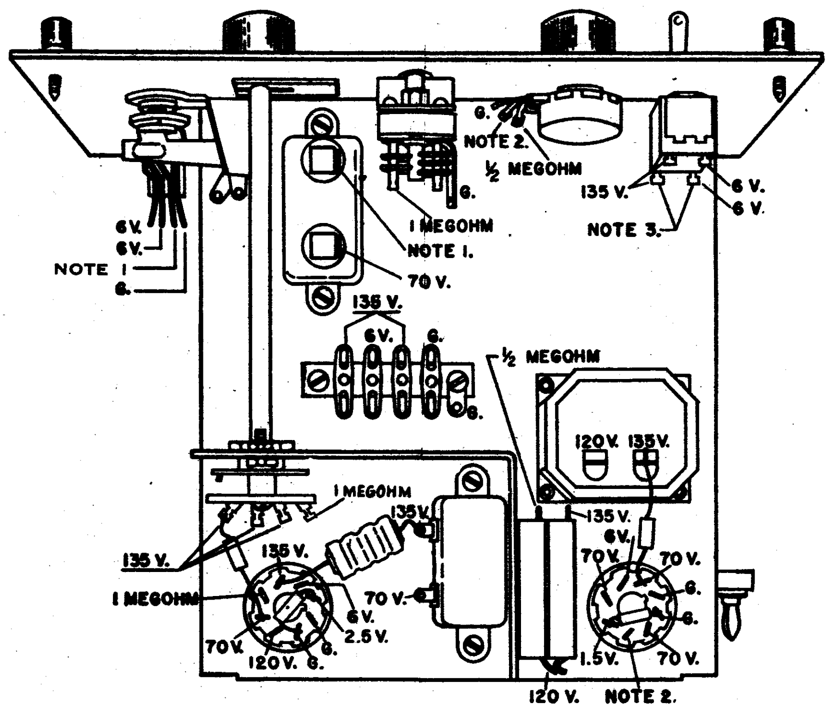


*Varies with resistance of voltmeter. Voltage measurements made with oscillator tube removed from socket. Resistances shown are measured to chassis with power switch "OFF," operation switch in "XTAL CHECK" position.



Resistances shown are measured to chassis with power switch off. Operation switch in "XTAL CHECK" position. Oscillator tube VT116-B operating.

*Voltage varies over wide limits from one band to the other and from one end to the other.



Note 1. This point connected to tip contact of jack. If phones are plugged in its resistance to chassis is the d-c resistance of the phones.

Note 2. Resistance to chassis: 0-250 ohms when "GAIN" control set at minimum (counterclockwise); ½ megohm when "GAIN" control set at maximum (clockwise).

Note 3. When "POWER" switch is in "OFF" position, all voltages in Frequency Meter except these two are zero.

Note 4. Measurements at any terminal of this jack should be the same as at corresponding terminal of other jack.

Figure 5-4. Frequency Meter BC-221-AC—Voltage Check Points

2 is that of the oscillator inductor connected by the "FREQ. BAND" selector switch. The resistance of the low band inductor is approximately 28 ohms, and that of the high band is about 1 ohm. The resistance from the cathode tap to ground is about one-tenth of the total resistance of the inductor in each case. Measurement from the grid tap on each inductor to ground will show resistor 18 or 21-1 in series.

(4) The resistance across the other capacitors is as follows: 3-1 and 4a about 1 ohm, 3-2 and 4b about 28 ohms, 5 about 0.15 megohm, 6-1 about 4500 ohms, 8-1 about 2 ohms, 11 about one megohm.

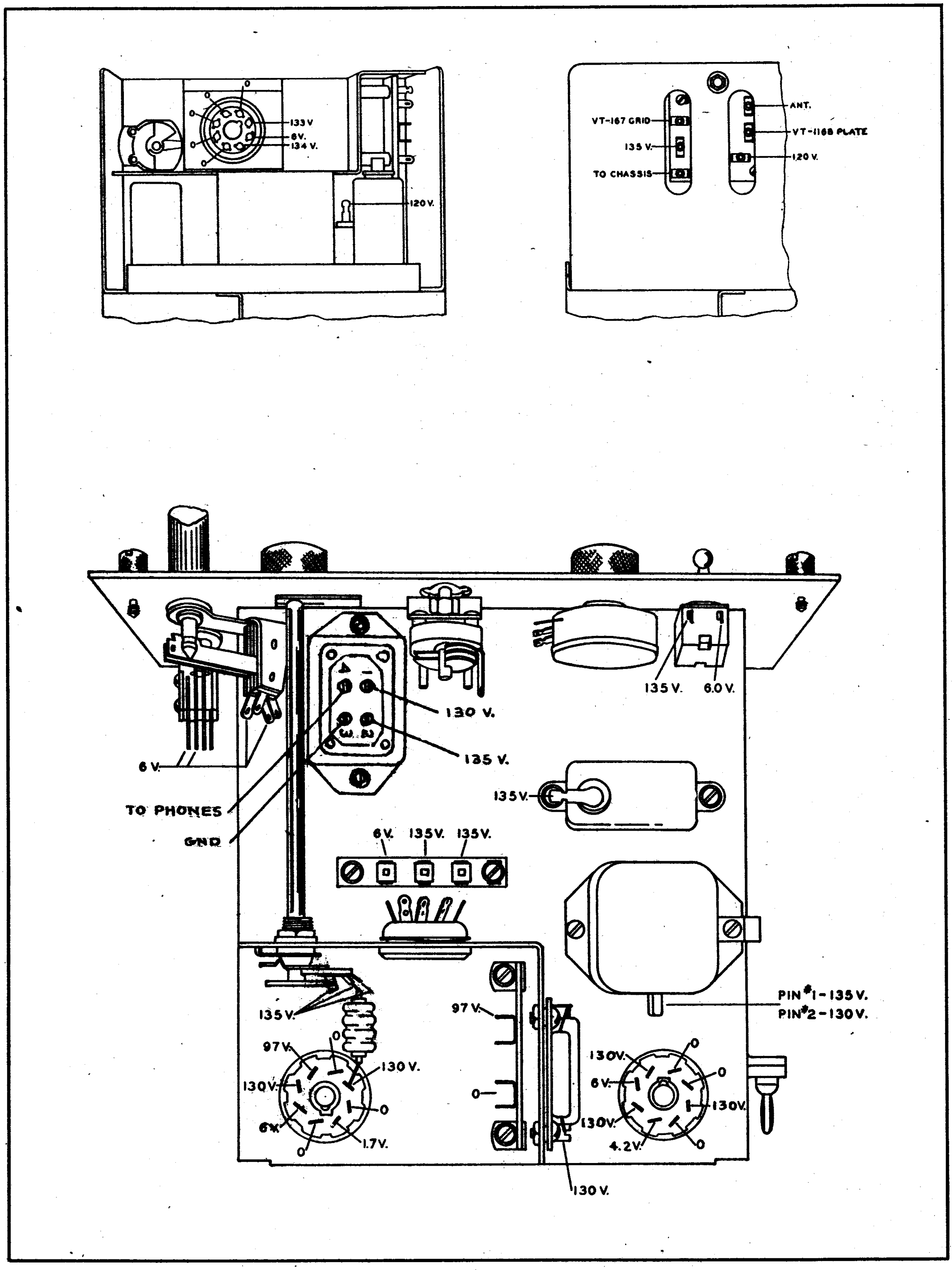


Figure 5-5. Frequency Meter BC-221-AF—Voltage Check Points

TABLE 5-1
FREQUENCY METER BC-221-B—RESISTANCE VALUE TO GROUND

Tube Type	*Tube VT*	*Application*	*Terminals of Sockets*								
			1	2	3	4	5	6	7*	8*	Cap
6SJ7	116	Oscillator High Band	0	0	0	0.150 meg.	1 ohm	inf.	1 ohm	inf.	
6SJ7	116	Oscillator Low Band	0	0	0	0.154 meg.	3 ohm	inf.	1 ohm	inf.	
6K8	167	Mixer	0	0	inf.	inf.	1 meg.	inf.	1 ohm	75 ohms	1 meg.
6SJ7	116	Audio Amplifier	0	0	inf.	0.5 meg.	350 ohm	inf.	1 ohm	inf.	

*Tubes cold.

TABLE 5-2
FREQUENCY METER BC-221-B—RESISTANCE ACROSS COMPONENTS

Reference No.	*Resistance*	*Reference No.*	*Resistance*	*Reference No.*	*Resistance*
14	0.15 meg.	17	60,000 ohms†	21-2*	350 ohms
15-1	1.0 meg.	18*	4500 ohms	22	28 ohms
15-2	1.0 meg.	19	75 ohms	23	1 ohm
16-1	8750 ohms	20	12,500 ohms	24	9 ohms
16-2	8750 ohms	21-1	350 ohms	25	400 ohms
				26	0.5 meg. (max)

*Inside of coil containers; not normally accessible.

†50,000 ohms on some "B" models.

b. FREQUENCY METER BC-221-D.—The resistance values should agree to within ±10 percent of the values given below. All measurements are made from the indicated terminal to ground. During the measurements turn the "POWER" switch "OFF," the "CRYSTAL" switch "ON," plug the headset into the jack, and plug all tubes into their sockets. *Disconnect all power supply connections during these tests.*

(1) Resistance values measured at the tube sockets are listed in the following table.

Tube Sockets	*TUBES*			
	Tube VT-77		*Type 6A7*	*Tube VT-76*
Pin #1	0 ohm		0 ohm	0 ohm
Pin #2	125,000 ohms		80,000 ohms	90,000 ohms
Pin #3	65,000		78,000 ohms	0 to 500,000 ohms (pot.)
Pin #4	15,000 ohms		75,000 ohms	0 ohm
	"FREQ. BAND" Switch			
	"LOW"	"HIGH"		
Pin #5	10,000 ohms	5000 ohms	50,000 ohms Crystal 0 ohm Crystal	Switch "ON" 0 ohm Switch "OFF"
Pin #6	0 ohm		0 ohm	
Pin #7			0 ohm	
	"FREQ. BAND" Switch			
	"LOW"	"HIGH"		
Cap	50 ohms	50 ohms	1 megohm	

(2) External antenna post to ground 5000 ohms.

(3) Set the "POWER" switch to "ON" and measure the resistance from the terminals of terminal board 34 to ground.

"B+"..............75,000 ohms

"A— B—"...... 0 ohm

"A"..................Infinity ohm (with headset removed from jack)
0 ohm (with headset in jack)

(4) With a set of headphones plugged into the phone jack, check the resistance across the terminals of phone jack 15a. (See schematic diagram, fig. 8-4.) The resistance indicated should be equal to the resistance of the headset (usually marked on the case of each telephone receiver). The resistance should be infinity with the phones removed from the jack.

(5) The procedure above will furnish a fairly complete continuity check of the unit. Generally, a low reading will indicate a short circuit (check associated capacitor) and a high reading will indicate either a burned out resistor, a loose connection, or an open circuit. If the tubes are removed from the circuit, or if the tube filaments are burned out, the following tube socket terminals will have a resistance reading of infinity to ground: Tube VT-76 #4 and #5, Tube VT-77 #1, and commercial type tube 6A7 #1.

c. FREQUENCY METER BC-221-Q.

(1) To make resistance measurements with Test Set I-56-A remove the frequency meter set from its cabinet and turn the operation switch to "CHECK" position.

CAUTION

Do not supply voltage to terminal jacks 30-1, 30-2, and 30-3 during these tests.

(2) With the frequency meter disconnected from its power sources and headset removed, the indication on the test set across capacitors 5-1, 5-2, 7, 8-1, 9-1, 11, and 8-3 should be infinity.

(3) The resistance across capacitors 1 and 2 is that of the oscillator inductor which is connected by the "FREQ. BAND" selector switch. The resistance of the low band inductor is approximately 28 ohms, and that of the high band inductor about 1 ohm. The resistance from the cathode tap, measured to ground, is about one-tenth of the total resistance of the inductor in each case. Measurement from the grid tap on each inductor to ground will show resistor 12 or 191 in series.

(4) Table 5-3 lists the resistance to ground from each socket terminal.

(5) Table 5-4 lists the resistance across other components of the circuit.

d. FREQUENCY METER BC-221-AA.—Resistance measurements made from tube pins to ground (chassis) in ohms, with batteries and tubes removed are as follows:

Socket Pin	*Oscillator (VT-116)*	*Audio (VT-116)*	*Detector (VT-167)*
1	0	0	0
2	0	0	0
3	0	open	open
4	330,000	500,000	open
5	0.1	350	1 meg.

TABLE 5-3
FREQUENCY METER BC-221-Q—RESISTANCE TO GROUND

Tube Type	Tube VT	Application	Terminals of Sockets 1	2	3	4	5	6*	7*	8	Cap
6SJ7	116	Oscillator high band	0	0	0	0.150 meg.	1 ohm	inf.	1 ohm	inf.	
6SJ7	116	Oscillator low band	0	0	0	0.154 meg.	3 ohms	inf.	1 ohm	inf.	
6K8	167	Mixer	0	0	inf.	inf.	1 meg.	inf.	1 ohm	75 ohms	0.15 meg.
6SJ7	116	Audio amplifier	0	0	inf.	1 meg.	350 ohms	inf.	1 ohm	inf.	

*Tubes cold.

TABLE 5-4
FREQUENCY METER BC-221-Q—RESISTANCE ACROSS COMPONENTS

Reference No.	Resistance	Reference No.	Resistance	Reference No.	Resistance
13-1	0.15 meg.	16	50,000 ohms	19-2	350 ohms
13-2	0.15 meg.	12	4500 ohms	20	28 ohms
14	1.0 meg.	17	75 ohms	21	1 ohm
15-1	8750 ohms	18	12,500 ohms	22	9 ohms
15-2	8750 ohms	19-1*	350 ohms	23	4500 ohms
				24	1 meg. (max.)

*Inside of coil containers; not normally accessible.

Socket Pin	*Oscillator (VT-116)*	*Audio (VT-116)*	*Detector (VT-167)*
6	open	open	open
7	1.4	1.4	1.4
8	open	open	150

Grid cap of Tube VT-167 is 1 megohm above ground. Control settings are as follows:

Switch	*Position*
"GAIN"	"MAXIMUM"
"OFF-CRYSTAL-OPERATE-CHECK"	"CHECK"
"FREQ. BAND"	"HIGH"

e. FREQUENCY METER BC-221-AE.—Resistance measurements made from tube pins to ground (chassis) in ohms, with batteries and tubes removed are as follows:

Socket Pin	*Oscillator (JAN-6SJ7)*	*Audio (JAN-6SJ7)*	*Detector (JAN-6K8)*
1	0	0	0
2	0	0	0
3	0	open	open
4	330,000	500,000	open
5	0.1	560	470,000
6	open	open	open
7	1.4	1.4	1.4
8	open	open	150

Grid cap of the JAN-6K8 tube is 1 megohm above ground.

Control settings are as follows:

Switch	*Position*
"GAIN"	"MAXIMUM"
"OFF-CRYSTAL-OPERATE-CHECK"	"CHECK"
"FREQ. BAND"	"HIGH"

8. READJUSTMENT OF TRIMMER CAPACITORS.

When the heterodyne oscillator cannot be corrected to agree with the calibration, reset the heterodyne trimmer capacitors according to the method described in this paragraph. Do not touch these trimmer capacitors under any other conditions. In general, this capacitor adjustment will be required only when the meter is to be used in a locality where either extremely high or low humidity prevails.

a. Remove the frequency meter from the cabinet and place o.. a firm foundation to the right and in front of the cabinet.

b. Interconnect the power input plugs and jacks with laboratory test leads. Operate the meter for at least 10 minutes before proceeding.

c. Set the "FREQ. BAND" switch to "LOW."

d. Open the calibration book to the page listing the frequency value of 250 kilocycles. Observe the dial reading which corresponds to this frequency. Set the "DIAL UNITS" and "DIAL HUNDREDS" to agree with this reading.

e. Set the "CORRECTOR" dial at midscale. Set meter for crystal check. (Refer to sec. III, par. 1.)

f. Recheck settings obtained according to instructions in paragraphs *c., d., and e.* (Refer to sec. III, par. 1.)

g. Rotate the trimmer capacitor ("LOW") toward the right with a small screw driver until a zero beat is obtained. The "LOW" and "HIGH" trimmer capacitors are adjusted through holes in the right-hand wall of the frequency meter chassis. (On Frequency Meters BC-211-B, -E, -N, -AA, and -AE the trimmer capacitors are adjusted from the bottom side of the chassis.) (See figs. 5-6 and 5-7.)

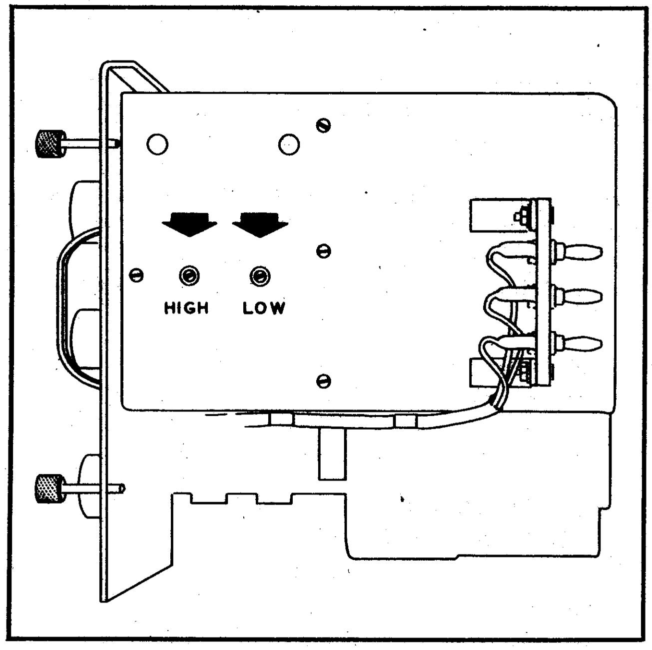


Figure 5-6. Frequency Meters BC-221-A, -C, -D, -F, -J, -K, -L, -M, -O, -P, -Q, -R, -T, -AC and -AF—Right Side View of Chassis

h. Check the ability of the "CORRECTOR" capacitor to reset to zero beat at all crystal check points listed for the low frequency band.

i. If the "CORRECTOR" reaches 10 and there are some crystal check points that cannot be corrected, repeat steps *g.* and *h.* with the "CORRECTOR" set 1 division to the left of center. If zero beat still cannot be reached at all crystal check points, set the "CORRECTOR" 2 divisions to the left of center and repeat, etc. until all of the crystal check points can be brought to zero beat.

j. If, instead of going off scale at 10, the "CORRECTOR" reaches 1 without being able to produce zero beat at all crystal check points, repeat steps *g.* and *h.* with the "CORRECTOR" set 1, 2, or 3 divisions to the right of midscale as required.

k. Repeat the above described process with the "FREQ. BAND" switch set to "HIGH" and the "DIAL UNITS" and "DIAL HUNDREDS" scales set to agree

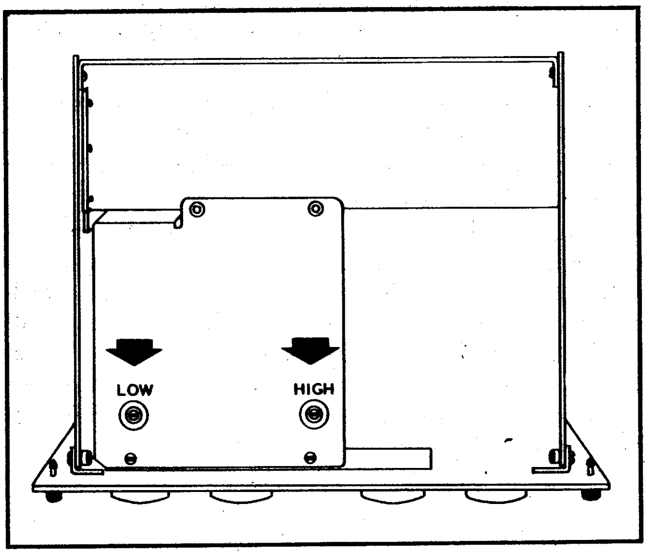


Figure 5-7. Frequency Meters BC-221-B, -E, -N, -AA and -AE—Bottom View of Chassis

with the reading given for 4000 kilocycles in the calibration book. Adjust the "HIGH" trimmer capacitor until it is possible to adjust the "CORRECTOR" to zero beat at each of the crystal check points in the high band.

Note

Many beat notes will be heard for a very slight rotation of the trimmers because of the abundance of harmonics. Select the loudest one in the vicinity of the above mentioned position.

9. ADJUSTING THE FREQUENCY OF THE CRYSTAL OSCILLATOR.

Note

Make this adjustment only when the crystal is replaced or when the accuracy of the crystal oscillator is suspected. Make this adjustment only in models which contain a variable capacitor connected across the crystal.

a. Set up a radio receiver capable of receiving the standard frequency signals (5000 or 15,000 kilocycles) of station WWV, the Bureau of Standards Station. If these signals cannot be received, use another frequency meter whose adjustments are believed to be correct.

b. Prepare the frequency meter for operation of the crystal oscillator only. (Refer to sec. III, par. 9.) Allow it to operate for about 20 minutes.

c. Couple the frequency meter that is to be adjusted to the antenna lead of the radio receiver.

d. Tune the radio receiver to hear the beat note resulting from the crystal oscillator signal beating with the standard signal.

e. Loosen the locknut around the shaft of the crystal capacitor. (On some models the crystal variable shunt capacitor can be reached after removing the nameplate on the front panel. On other models it is found in the approximate center of the bottom of the chassis and can be reached after the chassis has been removed from the cabinet.)

f. Rotate the capacitor until exact zero beat is obtained in the reveiver headset. (When possible, make this adjustment with the chassis in the cabinet.)

g. Tighten the locknut. Replace the nameplate if it has been removed.

10. REPAIR OF PANEL AND CHASSIS ASSEMBLY.

The repair of panel and chassis assembly of field units is prohibited. If such repairs are believed necessary, send the equipment to an authorized depot where sufficient test equipment is available for this work.

SECTION VI
SUPPLEMENTARY DATA

1. READING THE MAIN TUNING DIAL.

a. The adjustment of the main tuning capacitor is indicated directly by reading the "DIAL HUNDREDS" control.

b. One revolution of the "DIAL UNITS" control advances the "DIAL HUNDREDS" control one division. This subdivides each division on the "DIAL HUNDREDS" control into 100 parts.

c. A vernier (see fig. 6-1) is provided to subdivide each division accurately on the "DIAL UNITS" control. To read the vernier, observe which graduation on the vernier scale aligns with a graduation on the "DIAL UNITS" control. Start with the arrow as zero, count over to this graduation. The resulting number expresses in tenths, the fraction of a "DIAL UNITS" division.

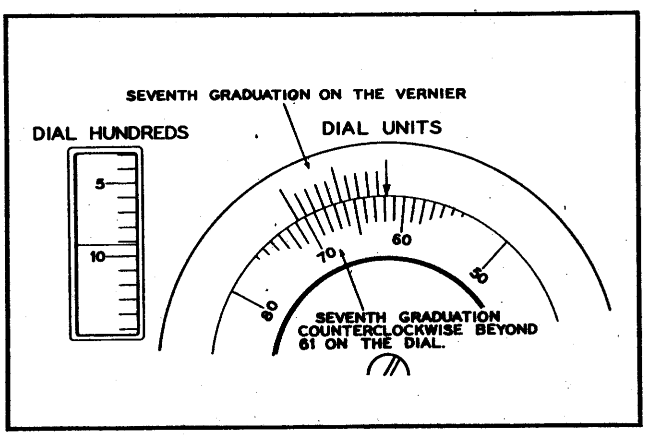


Figure 6-1. Main Tuning Dial Scale

d. For example, observe the dial setting in figure 6-1. The setting is as follows:

"DIAL HUNDREDS" 0900
"DIAL UNITS" .... 61.
Vernier 0.7

Correct reading 0961.7

e. Before using the frequency meter for actual measurements, practice on the dial until settings can be established or read off quickly and accurately.

2. ZERO BEAT.

a. When two signals of slightly different frequencies are combined (such as in the detector circuit of the frequency meter) a signal results whose frequency is equal to the difference between the original two. This is called the beat frequency.

b. When the beat frequency is a few thousand cycles or less, it is in the audible range and can be heard in a headset.

c. As the frequencies of the two signals come closer together, the beat frequency becomes lower. Thus, the whistle or tone heard in the headset decreases in pitch.

d. When the frequencies of the two signals become nearly equal, a continuous series of muffled beating sounds is heard in the headset.

e. When these sounds disappear and there is complete silence in the headset, the frequencies of the two signals are exactly equal. This is the point of zero beat.

f. As the tuning dial is rotated slowly to either side of the zero beat point, muffled beating sounds are heard and then the tone rises in pitch.

3. CURRENT REQUIREMENTS.

The current requirements at the specified voltage limits are given in table 6-1.

TABLE 6-1. FREQUENCY METER BC-221-(*)—CURRENT REQUIREMENTS

Frequency Meter Sets	*Filament Voltages (volts)*	*Filament Current (amperes)*	*Plate Voltage (volts)*	*Plate Current (amperes)*
SCR-211-A	5.4 to 6.0	0.86 to 0.91	121.5 to 135.0	0.0091 to 0.0106*
SCR-211-B	5.4 to 6.0	0.86 to 0.91	121.5 to 135	0.0145 to 0.0170†
SCR-211-C	5.4 to 6.0	0.86 to 0.92	121.5 to 135	0.0131 to 0.0173*
SCR-211-D	5.4 to 6.0	0.79 to 0.86	121.5 to 135	0.013 to 0.017
SCR-211-E	6	0.71	135	0.0109 "CHECK"
				0.0141 "OPERATE"
				0.0078 "CRYSTAL"
SCR-211-F	5.4 to 6.0	0.86 to 0.92	121.5 to 135.0	0.0126 to 0.0146*
SCR-211-J	5.4 to 6.0	0.86 to 0.92	121.5 to 135.0	0.0126 to 0.0146*
SCR-211-K	5.4 to 6.0	0.86 to 0.92	121.5 to 135.0	0.0126 to 0.0146*
SCR-211-L	5.4 to 6.0	0.86 to 0.92	121.5 to 135.0	0.0126 to 0.0146*
SCR-211-M	5.4 to 6.0	0.8 to 0.9	121.5 to 135.0	0.012 to 0.014‡
SCR-211-N	6	0.85	135	0.014 "CHECK"
				0.018 "OPERATE"
				0.012 "CRYSTAL"
SCR-211-O	5.4 to 6.0	0.86 to 0.91	121.5 to 135	0.015 to 0.017‡
SCR-211-P	5.4 to 6.0	0.86 to 0.92	121.5 to 135.0	0.015 to 0.017‡
SCR-211-R	5.4 to 6.0	0.86 to 0.91	121.5 to 135	0.015 to 0.017‡
SCR-211-T	5.4 to 6.0	0.86 to 0.91	121.5 to 135	0.015 to 0.017‡
SCR-211-Q	5.4 to 6.0	0.86 to 0.91	121.5 to 135	0.0145 to 0.017
SCR-211-AA	6	0.85	135	0.014 "CHECK"
				0.018 "OPERATE"
				00.012 "CRYSTAL

*"CRYSTAL" switch in "OFF" position for maximum plate currents.

†The cabinet and circuit of this meter are so arranged that a suitable power line voltage source can be substituted for the batteries without changing the wiring or affecting the calibrations. A power supply unit has been designed for this service, operating from 115-volt, 60-cycle lines. This unit occupies the battery compartment tray and connects to the power line through the small hole in the side of the cabinet.

‡"XTAL CHECK" position for maximum current.

SECTION VII
TABLE OF REPLACEABLE PARTS

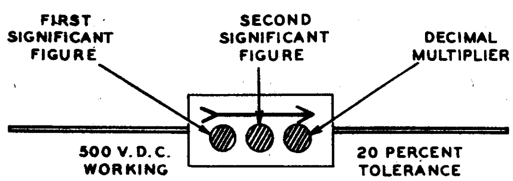
ORDERING SPARE PARTS

Each Service using this list has established certain depots and service groups for the storage and issue of spare parts to its organizations requiring them. The regulations of each Service should be studied to determine the method and source for requisitioning spare parts. The information in this list, as to manufacturer's or contractor's name, type, model, or drawing number, is not to be interpreted as authorization to field agencies to attempt to purchase identical or comparable spare parts direct from the manufacturer or a wholesale or retail store except under emergency conditions as covered by existing regulations of the Service concerned.

U. S. ARMY PERSONNEL: This table is for information ONLY and is not to be used as a basis for requisitioning parts. Authorities for obtaining maintenance items are as follows: for using organizations, applicable service publications of the 00-30 series of Army Air Forces Technical Orders; for higher maintenance and supply echelons, the applicable Standard Maintenance List.

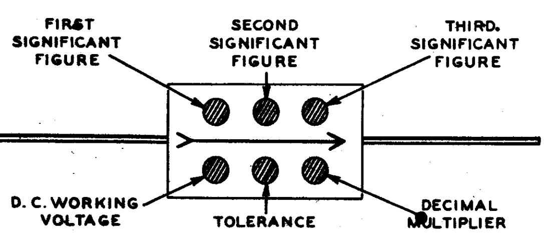
RMA COLOR CODES

CAPACITORS (MMFD)



CAPACITORS (MMFD)

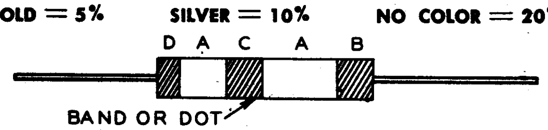
Color	Numeral	Volts	Multiplier	Tolerance
Black	0		1	
Brown	1	100	10	1%
Red	2	200	100	2%
Orange	3	300	1,000	3%
Yellow	4	400	10,000	4%
Green	5	500	100,000	5%
Blue	6	600	1,000,000	6%
Violet	7	700	10,000,000	7%
Gray	8	800	100,000,000	8%
White	9	900	1,000,000,000	9%
Gold		1000	0.1	5%
Silver		2000	0.01	10%
No Color		500		20%



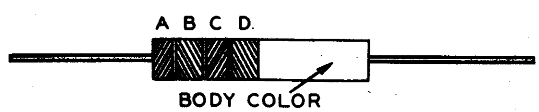
RESISTORS (OHMS)

Color	A 1st Digit	B 2nd Digit	C Multiplier
Silver			0.01
Gold			0.1
Black		0	1.0
Brown	1	1	10
Red	2	2	100
Orange	3	3	1,000
Yellow	4	4	10,000
Green	5	5	100,000
Blue	6	6	1,000,000
Purple	7	7	10,000,000
Gray	8	8	100,000,000
White	9	9	

D - TOLERANCE CODE:
GOLD = 5% SILVER = 10% NO COLOR = 20%



OLD COLOR ARRANGEMENT



NEW COLOR ARRANGEMENT

Body Color (New Color Arrangement Only) Indicates Type of Resistor, as Follows:-
- **Black: Composition, Non-Insulated**
- **Tan, Olive, or White: Composition, Insulated**
- **Dark Brown: Wire-Wound, Insulated**

TABLE OF REPLACEABLE PARTS

MODEL: FREQUENCY METER SET SCR-211-A **MAJOR UNIT: FREQUENCY METER BC-221-A**

Reference Symbol	Army Stock No. Navy Stock No. British Ref. No.	Name of Part and Description	Function	Mfr. and Desig. AWS Type	Cont. or Govt. Dwg. or Spec. No.
1		CAPACITOR: variable; air dielectric with 5 micromicrofarad compensator; 150 micromicrofarads	Tuning	Bendix	Bendix A-L 70036-1
2		CAPACITOR: variable; air dielectric; 2 micromicrofarads	Connector	Hammarlund	Bendix A-A 10205
3		CAPACITOR: adjustable; air dielectric; 10 micromicrofarads	Low frequency trimmer	Hammarlund	Bendix A-A 10178-2-A
4		CAPACITOR: same as 3	High frequency trimmer		Bendix A-A 10178-1-A
5		CAPACITOR: molded mica; 500 micromicrofarads ±10%; 500 volts d.c.	Bypass	Cornell-Dubilier	Bendix A 1727-4
6		CAPACITOR: molded mica; 25 micromicrofarads ±10%; 500 volts d.c.	Coupling	Cornell-Dubilier	Bendix A 1727-2
7		CAPACITOR: molded mica; 50 micromicrofarads ±10%; 500 volts d.c.	Coupling	Cornell-Dubilier	Bendix A 10179-1
8.1		CAPACITOR: oil paper dielectric; 2 x 100,000 micromicrofarads ±10%; 400 volts d.c.	Bypass	Cornell-Dubilier	Bendix A 204-3-5
8.2		CAPACITOR: same as 8.1			
9.1		CAPACITOR: oil paper dielectric; 3 x 100,000 micromicrofarads ±10%; 400 volts d.c.	Bypass	Cornell-Dubilier	Bendix A 205-2-A
9.2		CAPACITOR: same as 9.1			
9.3		CAPACITOR: same as 9.1			
10		CAPACITOR: molded mica; 1000 micromicrofarads ±10%; 600 volts d.c.	Bypass	Cornell-Dubilier	Bendix A 1728-31
11		CAPACITOR: molded mica; 20,000 micromicrofarads ±10%; 600 volts d.c.	Coupling	Cornell-Dubilier	Bendix A 1728-1
12		CAPACITOR: oil paper dielectric; 500,000 micromicrofarads +10%; 400 volts d.c.	Filament bypass	Cornell-Dubilier	Bendix A 203-2
13		CAPACITOR: same as 12	Audio plate bypass		
14		CAPACITOR: oil paper dielectric; 2.0 microfarads +10%; 400 volts d.c.	Coupling	Cornell-Dubilier	Bendix A 6680-1
19.1		JACK: filament control; single circuit	Phone jack, filament switch	Yaxley	Bendix A 10364
19.2		JACK: same as 19.1			
22		INDUCTOR: 1.7 millihenries ±5%	R-F choke	Bendix	Bendix A-A 1665-A
24		RESISTOR: 50,000 ohms ±10%; ½ watt	Bleeder	IRC	Bendix A 266-8-A
25		RESISTOR: 10,000 ohms ±10%; ½ watt	Screen resistor	IRC	Bendix A 266-4-A
26		RESISTOR: 50,000 ohms ±10%, ½ watt	Plate load	IRC	Bendix A 266-8-A
27		RESISTOR: 1.0 megohm ±10%; ½ watt	Grid leak	IRC	Bendix A 266-13-A
29		RESISTOR: 5,000 ohms ±10%; ½ watt	Bias resistor	IRC	Bendix A 266-3-A
30		RESISTOR: 10,000 ohms ±10%; ½ watt	Bias resistor	IRC	Bendix A 266-4-A
31		RESISTOR: 50,000 ohms ±10%, ½ watt	Grid resistor	IRC	Bendix A 266-8-A

TABLE OF REPLACEABLE PARTS—Continued

MODEL: FREQUENCY METER SET SCR-211-A **MAJOR UNIT: FREQUENCY METER BC-221-A**

Reference Symbol	Army Stock No. Navy Stock No. British Ref. No.	Name of Part and Description	Function	Mfr. and Desig. AWS Type	Cont. or Govt. Dwg. or Spec. No.
32		RESISTOR: 30,000 ohms ±10%; ½ watt	Screen resistor	IRC	Bendix A 266-7-A
33		RESISTOR: 15,000 ohms ±10%; ½ watt	Plate load	IRC	Bendix A 266-15-A
34		POTENTIOMETER: 500,000 ohms ±10%; 1 watt; curve No. 1	Volume control	Centralab	Bendix A 10365
35.1		SWITCH: rotary; DPDT	Range switch	Oak	Bendix A 1615-1-D
35.2		SWITCH: same as 35.1			
36		SWITCH: rotary; DPDT	Crystal switch	Oak	Bendix A 1615-2-D
37.1		SWITCH: toggle; DPDT	Power switch	Hart & Hageman	Bendix A 300-2-A
37.2		SWITCH: same as 37.1			
38		INDUCTOR: 600 henries; 1.0 milliampere d.c.	Audio choke	Raytheon	Bendix A 1716-E
39		PLUG: single contact; isolantite	Antenna plug	Bendix	Pendix A 7253 A 4143
40		JACK: single contact; isolantite	Antenna jack	Bendix	Bendix A 7252 A 10860
41		POST: plunger type captive nut	Antenna post	Eby	Bendix A 10236
42		PLUG: 3-contact	Power input	Bendix	Bendix A-A 10260
43		JACK: 3-contact	Power input	Bendix	Bendix A-A 7740-A
44		TERMINAL: screw type; 3-contact	Battery terminal board	Bendix	Bendix A-A 7740-A

MODEL: FREQUENCY METER SET SCR-211-B **MAJOR UNIT: FREQUENCY METER BC-221-B ORDER NO. 384-NY-41 ORDER NO. 6024-NY-41**

Reference Symbol	Army Stock No. Navy Stock No. British Ref. No.	Name of Part and Description	Function	Mfr. and Desig. AWS Type	Cont. or Govt. Dwg. or Spec. No.
1	2C1411B/C1	CAPACITOR: main tuning; complete with drive assembly and dial	Tuning	Cardwell	Cardwell 3-860
5	3D342	CAPACITOR: mica, 100 micromicrofarads ±2%	Grid coupling	Cornell-Dubilier	Cardwell 3-990
6-1	3DA2-33	CAPACITOR: 2000 micromicrofarads ±10%	Bypass	Cornell-Dubilier	Cardwell 2-866 2-996
6-2		CAPACITOR: same as 6-1			
7	2C4528.7/4-8	CAPACITOR: mica; 50 micromicrofarads	Grid Coupling	Cornell-Dubilier	Cardwell 2-993
8-1	3DA1-22	CAPACITOR: fixed; 1000 micromicrofarads ±5%; 500 volts d.c. working; 1000 volts d.c. test	Bypass	Cornell-Dubilier	Cardwell 2-996
8-2		CAPACITOR: same as 8-1			
9a	3DA100-122	CAPACITOR: 2 x 100,000 micromicrofarads +14% —6%; 600 volts	Bypass	Cornell-Dubilier	Cardwell 1-793
9b		CAPACITOR: same as 9a			
10	3D9008-2	CAPACITOR: mica; 8 micromicrofarads	Antenna coupling	Cornell-Dubilier	Cardwell 2-993
11x	3D9025-16	CAPACITOR: silver mica; 25 micromicrotarads ±5%	Crystal shunt	Cornell-Dubilier	Cardwell 2-865
12	3DB2.5	CAPACITFOR: oil-filled paper 2 microfarads; 600 volts d.c.	Output coupling	Cornell-Dubilier	Cardwell 1-793
13	3DA250-13	CAPACITOR: oil-filled paper; 250,000 micromicrofarads 600 volts d.c.	Grid coupling	Cornell-Dubilier	Cardwell 1-793
14	3Z6715-1	RESISTOR: 150,000 ohms ±10%; ½ watt	Grid leak	Allen-Bradley	Cardwell 4-980

15-1	3Z4534	RESISTOR: 1 megohm; ½ watt	Grid leak	Allen-Bradley	Cardwell 2-865
15-2		RESISTOR: same as 15-1			
16-1	3Z6587-1	RESISTOR: 8750 ohms ±10%	Screen resistor	Allen-Bradley	Cardwell 2-996
16-2		RESISTOR: same as 16-1			
17	3Z4531	RESISTOR: 50,000 ohms ±10%; ½ watt	Plate load	Allen-Bradley	Cardwell 2-996
18	3Z6450-3	RESISTOR: 4500 ohms ±10%; ½ watt	Parasitic suppressor	Allen-Bradley	Cardwell 2-864
19	3Z6007E4	RESISTOR: 75 ohms	Grid bias	Allen-Bradley	Cardwell 2-996
20	3Z7712-1	RESISTOR: 12,000 ohms; ½ watt	Plate load	Allen-Bradley	Cardwell 2-996
21-1	3Z4523	RESISTOR: 350 ohms ±10%; ½ watt	Parasitic suppressor	Allen-Bradley	Cardwell 2-863
21-2		RESISTOR: same as 21-1	Grid bias		
25	3C307-1	COIL: choke, 300 henries	Plate choke	Cardwell	Cardwell 2-886
27	2C1411B/52	SWITCH: 2-pole; 4-position	Power switch		Cardwell 2-838
28*	2Z7285-1	POTENTIOMETER: gain control; 500,000 ohms ±10%; 1 watt; impregnated strip; curve No. 1	Volume control	Centralab	Cardwell 1-797
30-1	2C1411B/J1	JACK: long frame; open circuit and filament closing	Phone jack, filament switch	Yaxley	Cardwell 1-792
30-2		JACK: same as 30-1			
33	2C1411/B2	BINDING POST	Antenna connection	Cardwell	Cardwell 1-974
	3D9024	CAPACITOR: silver mica; 24 micromicrofarads ±5%			
	2C1501F/C1	CATCH: door, front; consists of 1 catch and hasp	Door catch		
	2Z5751-1	KNOB: control with set screw; bakelite; small arrow on face	Door catch		
	6L5303-44x	LOCK: screw for panel; nickel finish			
	2Z7856.4*	RING AND CLASP ASSEMBLY			
	6L5302-20*	SCREW: panel lock			
	3Z9825-43	SWITCH: 3-pole; 2-position; 9 terminals; shaft 2" long	Range switch		Cardwell 2-843
	2C1501B/A2†	RING AND CLAMP ASSEMBLY			
	6L7956†	SCREW: panel lock			

* Order No. 6024-NY-41 only
† Order No. 484-NY-41 only

TABLE OF REPLACEABLE PARTS—Continued

MODEL: FREQUENCY METER SETS SCR-211-C AND SCR-211-D **MAJOR UNIT: FREQUENCY METER BC-221-C**

Reference Symbol	*Army Stock No. Navy Stock No. British Ref. No.*	*Name of Part and Description*	*Function*	*Mfr. and Desig. AWS Type*	*Cont. or Govt. Dwg. or Spec. No.*
1	3DA150V	CAPACITOR: variable; air dielectric; 150 micromicrofarads; with 5 micromicrofarad thermal compensator	Heterodyne tuning	Bendix	Bendix AC55780-1
5-1	3D9010-3	CAPACITOR: fixed; 10 micromicrofarads ±10%; 500 volts d.c. working	Heterodyne coupling	Aerovox	Bendix A18935-1
5-2		CAPACITOR: same as 5-1			
6	3D9250-9	CAPACITOR: fixed; 250 micromicrofarads ±10%; 500 volts d.c. working	Heterodyne cathode bypass	Aerovox	Bendix A25784-1
7-2a	3DA100-21	CAPACITOR: 3 x 100,000 micromicrofarads —6% +10%; 200 volts d.c. working; three terminals on top	Crystal anode and detector screen bypass	Aerovox	Bendix A18933-1
7-2b		CAPACITOR: same as 7-2a			
7-2c		CAPACITOR: same as 7-2a			
8	3DA1-18	CAPACITOR: fixed; 1000 micromicrofarads ±10%; 600 volts d.c. working	Detector plate bypass	Aerovox	Bendix A18936-1
9	3DA20-11	CAPACITOR: fixed; 20,000 micromicrofarads ±10%; 600 volts d.c. working	Audio input coupling	Aerovox	Bendix A18936-2
10-1	3DA500-24	CAPACITOR: 500,000 micromicrofarads +14% —6%; 200 volts d.c. working; two terminals on top	Filament bypass	Aerovox	Bendix A18932-1
10-2		CAPACITOR: same as 10-1	Audio plate bypass		
10-3		CAPACITOR: same as 10-1	Audio coupling		
15a	2C1501C/J1	JACK: phone	Phone jack, filament switch	Yaxley	Bendix A18946
15b		JACK: same as 15a			
20-1	3Z4528	RESISTOR: fixed; 5000 ohms ±10%; ½ watt	R-F output terminating	IRC	Bendix A11207-23
20-2		RESISTOR: same as 20-1			
21-1	3Z4531	RESISTOR: fixed; 50,000 ohms ±10%; ½ watt	Suppressor resistor	IRC	Bendix A11207-42
21-2		RESISTOR: same as 21-1	Plate resistor		
22-1	3Z4529	RESISTOR; fixed; 10,000 ohms ±10%; ½ watt	Screen resistor	IRC	Bendix A11207-29
22-2		RESISTOR: same as 22-1	Cathode resistor		
23	3Z4534	RESISTOR: fixed; 1 megohm ±10%; ½ watt	Detector grid leak	IRC	Bendix A11207-57
24	3Z4540	RESISTOR: fixed; 30,000 ohms ±10%; ½ watt	Screen resistor	IRC	Bendix A11207-39
25-1	3Z4614	RESISTOR: fixed; 15,000 ohms ±10%; ½ watt	Plate resistor	IRC	Bendix A11207-34
25-2		RESISTOR: same as 25-1	Bleeder resistor		
26	2Z7285-1	POTENTIOMETER: gain control; 500,000 ohms ±10%; 1 watt	Volume control	Centralab	Bendix A18948
27a	2C1501C/S1	SWITCH: wafer; DPST; band switch; shaft 4" long; 6 terminals	Band switch	Oak	Bendix C56544-1
27b		SWITCH: same as 27a			
28	2C1501/S8	SWITCH: wafer; DPST; shaft 5" long; 6 terminals	Crystal switch	Oak	Bendix C56544-2

29a	3Z9858	SWITCH: toggle; DPST; 1 ampere 250 volts; 3 amperes 125 volts	Power switch	Hart & Hageman	Bendix A18947
29b		SWITCH: same as 29a			
30	2C1501C/C1	COIL: choke, audio; 450 henries +20% —10%; 1 milliampere d.c.; 2 terminals	Audio choke	Bendix	Bendix AA16988-1
33	3Z767	BINDING POST: antenna assembly; 1 nut; 1 split ring metal washer; 1 phenolic cylinder; 2 ceramic insulators; 2 large treated washers; 1 small treated washer; 1" stud	Antenna terminal	Bendix	Bendix A10236
	2C1501C/B1	CATCH: 5 rivets; 1 catch; 1 hasp; 1 plate for hasp; 1 plate for catch	Front door catch		Bendix A10242
	2Z7856	RING: assembly; 1 plate; 1 Dee ring; 2 screws; 2 nuts	Attaching strap to cabinet	Bendix	Bendix A11756 A10363

MODEL: FREQUENCY METER SET SCR-211-E **MAJOR UNIT: FREQUENCY METER BC-221-E**

1		CAPACITOR: variable; 200 micromicrofarads	Tuning	Radio Condenser	Philco 368-1046
2		CAPACITOR: variable; 3 to 5 micromicrofarads	Connector	Radio Condenser	Philco 361-1002
3-1		CAPACITOR: variable; 3 to 29 micromicrofarads	Trimmer	Radio Condenser	Philco 361-1003
3-2		CAPACITOR: same as 3-1			
4		CAPACITOR: 5 micromicrofarads ±0.5 micromicrofarads; 300 volts; thermal	Thermal compensator	Erie Resistor	Philco 306-1030
5		CAPACITOR: 5 micromicrofarads ±0.5 micromicrofarads; 300 volts; thermal	Thermal compensator	Erie Resistor	Philco 306-1031
6-1		CAPACITOR: molded mica; 25 micromicrofarads ±10%	Crystal shunt	Aerovox	Philco 306-1029
6-2		CAPACITOR: same as 6-1	Damping		
7		CAPACITOR: molded low loss; 15 micromicrofarads ±10%	Coupling	Aerovox	Philco 306-1025
8-1		CAPACITOR: molded low loss; 25 micromicrofarads ±10%; 500 volts d.c.	Coupling	Aerovox	Philco 306-1027
8-2		CAPACITOR: same as 8-1			
9		CAPACITOR: molded low loss; 4000 micromicrofarads ±10%; 500 volts d.c.	Bypass	Aerovox	Philco 306-1026
10-1		CAPACITOR: oil-filled; 4 x 100,000 micromicrofarads +14% —6%; 200 volts d.c.	Bypass	Aerovox	Philco 306-1-12
10-2		CAPACITOR: same as 10-1			
10-3		CAPACITOR: same as 10-1			
10-4		CAPACITOR: same as 10-1			
11		CAPACITOR: oil-filled; 250,000 micromicrofarads +14% —6%; 200 volts d.c.	Coupling	Aerovox	Philco 306-1013
12		CAPACITOR: oil-filled; 2 microfarads +14% —6%; 200 volts d.c.	Coupling	Aerovox	Philco 306-1014
13		INDUCTOR: 15.8 microhenries	Cathode choke	Sickles	Philco 362-1002
14		RESISTOR: 27 ohms ±10%; ½ watt	Parasitic suppressor	Stackpole	Philco 363-1023
15		RESISTOR: 1500 ohms ±10%; ½ watt	Parasitic suppressor	Stackpole	Philco 363-1024
16-1	3Z4529	RESISTOR: 10,000 ohms ±10%; ½ watt	Screen resistor	IRC	Philco 363-1009
16-2		RESISTOR: same as 16-1			
17		RESISTOR; 15,000 ohms ±10%; ½ watt	Plate Load	IRC	Philco 363-1002
18	3Z4531	RESISTOR: 50,000 ohms ±10%; ½ watt	Plate Load	IRC	Philco 363-1008

TABLE OF REPLACEABLE PARTS—Continued

MODEL: FREQUENCY METER SET SCR-211-E **MAJOR UNIT: FREQUENCY METER BC-211-E**

Reference Symbol	Army Stock No. Navy Stock No. British Ref. No.	Name of Part and Description	Function	Mfr. and Desig. AWS Type	Cont. or Govt. Dwg. or Spec. No.
19		RESISTOR: 330,000 ohms ±10%; ½ watt	Grid Leak	IRC	Philco 363-1022
20-1		RESISTOR: 1 megohm ±20%; ½ watt	Grid Leak	IRC	Philco 363-1005
20-2		RESISTOR: same as 20-1			
21	3Z4538	RESISTOR: 5000 ohms ±10%; ½ watt	Load resistor	IRC	Philco 363-1016
23		INDUCTOR: 735 microhenries ±10%	Plate choke	Sickles	Philco 368-1041
24		INDUCTOR: 300 henries ±10%	Audio choke	Jefferson	Philco 362-7002
26		POTENTIOMETER: 500,000 ohms ±20%	Volume control	Chicago Telephone	Philco 365-5000
27		SWITCH: 3-pole; 2-position	Range switch	Oak	Philco 462-1005
28		SWITCH: 2-pole; 4-position	Operation switch	Oak	Philco 462-1004
29		PLUG: single contact	Antenna plug	Fox	Philco 268-1091
31-1		JACK: filament contact	Phone jack, filament switch	Mallory	Philco 368-1043
31-2		JACK: same as 31-1			
32 } 33 }		POST: screw plunger type assembly	Antenna post	Eby	Philco 268-1151
34		PLUG	Power input	Ucinite	Philco 368-1044
35		JACK	Power input	Ucinite	Philco 368-1035
44		CAPACITOR: 5 micromicrofarads ±10%; 500 volts d.c.	Bypass	Aerovox	Philco 306-1028

MODEL: FREQUENCY METER SETS SCR-211-F, SCR-211-J, SCR-211-K, SCR-211-L **MAJOR UNIT: FREQUENCY METERS BC-221-F, BC-221-J BC-221-K, BC-221-L**

Reference Symbol	Army Stock No. Navy Stock No. British Ref. No.	Name of Part and Description	Function	Mfr. and Desig. AWS Type	Cont. or Govt. Dwg. or Spec. No.
1	3DA150V	CAPACITOR: variable; 150 micromicrofarads; with 5 micromicrofarad thermal compensator	Tuning	Cornell-Dubilier	Zenith 22G8
5-2	3D9010-3	CAPACITOR: fixed; 10 micromicrofarads ±10%; 500 volts d.c. working	Antenna coupling	Cornell-Dubilier	Zenith 22G6
6	3D9006ES	CAPACITOR: thermal compensating; 7 micromicrofarads	Thermal compensating	Centralab	Zenith 22G14
7A	3DA100-21	CAPACITOR: 3 x 100,000 micromicrofarads; 200 volts d.c. working	Bypass	Aerovox	Zenith 22G4
7B		CAPACITOR: same as 7A			
7C		CAPACITOR: same as 7A			
8	3DA1-18	CAPACITOR: fixed 100 micromicrofarads ±10%; 600 volts d.c. d.c. working	Plate bypass	Aerovox	Zenith 22G1
9	3DA20-11	CAPACITOR: fixed; 20,000 micromicrofarads ±10%; 600 volts d.c. working	Audio coupling	Aerovox	Zenith 22G2
10-1	3DA500-24	CAPACITOR: 500,000 micromicrofarads; 200 volts d.c. working	Filament bypass	Solar	Zenith 22G3
10-2		CAPACITOR: same as 10-1	Plate bypass		
10-3		CAPACITOR: same as 10-1	Output coupling		

TABLE OF REPLACEMENT PARTS—Continued

MODEL: FREQUENCY METER SET SCR-211-Q **MAJOR UNIT: FREQUENCY METER SET BC-221-Q**

Reference Symbol	Army Stock No. Navy Stock No. British Ref. No.	Name of Part and Description	Function	Mfr. and Desig. AWS Type	Cont. or Govt. Dwg. or Spec. No.
1		CAPACITOR: variable; 200 micromicrofarads	Tuning	Cardwell	Cardwell A-4.080
2		CAPACITOR: variable; 1 micromicrofarad	Connector	Radio Condenser	Cardwell 5.038
3.1		CAPACITOR: variable; 29 micromicrofarads	Trimmer	Cardwell	Cardwell A-5.082
3.2		CAPACITOR: same as 3.1			Cardwell A-5.095
4	3D9100-25	CAPACITOR: molded mica; 100 micromicrofarads +20% —10%; 500 volts d.c.	Coupling	Cornell-Dubilier	Cardwell 5.505
5-1	3DA2-50	CAPACITOR: molded mica; 2000 micromicrofarads ±10%; 500 volts d.c.; low loss	Bypass	Cornell-Dubilier	Cardwell 6.012
5-2		CAPACITOR: same as 5-1			
6	3D9050-20	CAPACITOR: molded mica; 50 micromicrofarads ±10%; 500 volts d.c.	Coupling	Cornell-Dubilier	Cardwell 7.010
7	3DA1-29	CAPACITOR: molded low loss; 1000 micromicrofarads ±10%; 500 volts d.c.	Bypass	Cornell-Dubilier	Cardwell 9.010
8-1	3D284	CAPACITOR: molded bakelite; 50,000 micromicrofarads —10%; +30%; 400 volts d.c.	Coupling	Micamold	Cardwell 9.016
8-2		CAPACITOR: same as 8-1			
8-3		CAPACITOR: same as 8-1			
9-1	3D9012-8	CAPACITOR: molded mica; 12 micromicrofarads ±2%; 500 volts d.c.	Coupling	Cornell-Dubilier	Cardwell 8.009
9-2	3D9006-5	CAPACITOR: 6 micromicrofarads ±10%; 500 volts d.c.	Crystal shunt	Erie	Cardwell 8.009 spec
10		CAPACITOR: variable; 12 micromicrofarads	Crystal shunt	Radio Condenser	Cardwell 8.021
11	3DB2.6200-1	CAPACITOR: oil-filled paper; 2 microfarads +14% —6%	Coupling	Cornell-Dubilier	Cardwell 10.012
12	3Z6450-6	RESISTOR: 4500 ohms ±20%; 1 watt	Suppressor resistor	Allen-Bradley	Cardwell 5.024
13-1	3Z6715-10	RESISTOR: 150,000 ohms ±20%; 1 watt	Grid leak	Allen-Bradley	Cardwell 7.008
13-2		RESISTOR: same as 13-1			
14	3Z6801-22	RESISTOR: 1 megohm ±20%; 1 watt	Grid leak	Allen-Bradley	Cardwell 8.011
15-1	3Z6587E5-1	RESISTOR: 8750 ohms ±10%; 1 watt	Screen resistor	Allen-Bradley	Cardwell 9.013
15-2		RESISTOR: same as 15-1			
16	3Z6650-33	RESISTOR: 50,000 ohms ±20%; 1 watt	Plate resistor	Allen-Bradley	Cardwell 9.012
17	3Z6007E5-4	RESISTOR: 75 ohms ±5%; 1 watt	Grid bias	Allen-Bradley	Cardwell 9.014
18	3Z6612A5-12	RESISTOR: 12,500 ohms ±20%; 1 watt	Plate resistor	Allen-Bradley	Cardwell 9.017
19-1	3Z6035-13	RESISTOR: 350 ohms ±10%; 1 watt	Resistor	Allen-Bradley	Cardwell 9.015
19-2		RESISTOR: same as 19-1	Cathode resistor		
22		INDUCTOR: 0.735 millihenries; 9 ohms	Plate choke	Cardwell	Cardwell 8.004
23	3C306-1	INDUCTOR: 300 henries	Plate choke	Cardwell	Cardwell A-6.023
24	287285-1	POTENTIOMETER: 1.0 megohm ±20%	Volume control	Centralab	Cardwell 10.021
25	2C1411B/S1	SWITCH: 3-pole; 2-position	Range switch	Oak	Cardwell A-5.090
26	2C1411B/S2	SWITCH: 2-pole; 4-position	Power switch	Centralab	Cardwell 10.006

TABLE OF REPLACEMENT PARTS—Continued

MODEL: FREQUENCY METER SET SCR-211-Q **MAJOR UNIT: FREQUENCY METER SET BC-221-Q**

Reference Symbol	Army Stock No. Navy Stock No. British Ref. No.	Name of Part and Description	Function	Mfr. and Desig. AWS Type	Cont. or Govt. Dwg. or Spec. No.
1		CAPACITOR: variable; 200 micromicrofarads	Tuning	Cardwell	Cardwell A-4.080
2		CAPACITOR: variable; 1 micromicrofarad	Connector	Radio Condenser	Cardwell 5.038
3.1		CAPACITOR: variable; 29 micromicrofarads	Trimmer	Cardwell	Cardwell A-5.082
3.2		CAPACITOR: same as 3.1			Cardwell A-5.095
4	3D9100-25	CAPACITOR: molded mica; 100 micromicrofarads +20% —10%; 500 volts d.c.	Coupling	Cornell-Dubilier	Cardwell 5.505
5-1	3DA2-50	CAPACITOR: molded mica; 2000 micromicrofarads ±10%; 500 volts d.c.; low loss	Bypass	Cornell-Dubilier	Cardwell 6.012
5-2		CAPACITOR: same as 5-1			
6	3D9050-20	CAPACITOR: molded mica; 50 micromicrofarads ±10%; 500 volts d.c.	Coupling	Cornell-Dubilier	Cardwell 7.010
7	3DA1-29	CAPACITOR: molded low loss; 1000 micromicrofarads ±10%; 500 volts d.c.	Bypass	Cornell-Dubilier	Cardwell 9.010
8-1	3D284	CAPACITOR: molded bakelite; 50,000 micromicrofarads —10%; +30%; 400 volts d.c.	Coupling	Micamold	Cardwell 9.016
8-2		CAPACITOR: same as 8-1			
8-3		CAPACITOR: same as 8-1			
9-1	3D9012-8	CAPACITOR: molded mica; 12 micromicrofarads ±2%; 500 volts d.c.	Coupling	Cornell-Dubilier	Cardwell 8.009
9-2	3D9006-5	CAPACITOR: 6 micromicrofarads ±10%; 500 volts d.c.	Crystal shunt	Erie	Cardwell 8.009 spec
10		CAPACITOR: variable; 12 micromicrofarads	Crystal shunt	Radio Condenser	Cardwell 8.021
11	3DB2.6200-1	CAPACITOR: oil-filled paper; 2 microfarads +14% —6%	Coupling	Cornell-Dubilier	Cardwell 10.012
12	3Z6450-6	RESISTOR: 4500 ohms ±20%; 1 watt	Suppressor resistor	Allen-Bradley	Cardwell 5.024
13-1	3Z6715-10	RESISTOR: 150,000 ohms ±20%; 1 watt	Grid leak	Allen-Bradley	Cardwell 7.008
13-2		RESISTOR: same as 13-1			
14	3Z6801-22	RESISTOR: 1 megohm ±20%; 1 watt	Grid leak	Allen-Bradley	Cardwell 8.011
15-1	3Z6587E5-1	RESISTOR: 8750 ohms ±10%; 1 watt	Screen resistor	Allen-Bradley	Cardwell 9.013
15-2		RESISTOR: same as 15-1			
16	3Z6650-33	RESISTOR: 50,000 ohms ±20%; 1 watt	Plate resistor	Allen-Bradley	Cardwell 9.012
17	3Z6007E5-4	RESISTOR: 75 ohms ±5%; 1 watt	Grid bias	Allen-Bradley	Cardwell 9.014
18	3Z6612A5-12	RESISTOR: 12,500 ohms ±20%; 1 watt	Plate resistor	Allen-Bradley	Cardwell 9.017
19-1	3Z6035-13	RESISTOR: 350 ohms ±10%; 1 watt	Resistor	Allen-Bradley	Cardwell 9.015
19-2		RESISTOR: same as 19-1	Cathode resistor		
22		INDUCTOR: 0.735 millihenries; 9 ohms	Plate choke	Cardwell	Cardwell 8.004
23	3C306-1	INDUCTOR: 300 henries	Plate choke	Cardwell	Cardwell A-6.023
24	287285-1	POTENTIOMETER: 1.0 megohm ±20%	Volume control	Centralab	Cardwell 10.021
25	2C1411B/S1	SWITCH: 3-pole; 2-position	Range switch	Oak	Cardwell A-5.090
26	2C1411B/S2	SWITCH: 2-pole; 4-position	Power switch	Centralab	Cardwell 10.006

28-1	2C1411B/J1	JACK: open circuit; filament closing	Phone jack, filament switch	Yaxley	Cardwell 10.000
28-2		JACK: same as 28-1			
29-1		PLUG	Power input	Cardwell	Cardwell 1.766
29-2		PLUG: same as 29-1			
29-3		PLUG: same as 29-1			
30-1		JACK	Power input	Cardwell	Cardwell 3.049
30-2		JACK: same as 30-1			
31		POST	Antenna post	Cardwell	Cardwell 7.019 7.020
32		POST	Antenna post	Cardwell	Cardwell 1.122
32-3		JACK	Power input	Cardwell	Cardwell 3.049
34		INSULATOR: ceramic	Antenna post	Cardwell	Cardwell 1.501
35		INSULATOR: ceramic	Antenna post	Cardwell	Cardwell 1.502
42		INSULATOR	Antenna clip	Cardwell	Cardwell 7.018

MODEL: FREQUENCY METER SETS SCR-211-P AND SCR-211-T MAJOR UNIT: FREQUENCY METERS BC-221-P AND BC-221-T

5-1	3D9010-32	CAPACITOR: ceramic; 10 micromicrofarads ±20%; 500 volts	Grid coupling	Centralab	22G496
5-2		CAPACITOR: same as 5-1	Antenna coupling		
6	3D9007	CAPACITOR: thermal; 7 micromicrofarads	Thermal compensator	Centralab	22G14
7	3Z6018-1	RESISTOR: 180 ohms ±10%; ½ watt	Grid bias	IRC	63G23
9	3DA20-39	CAPACITOR: molded paper; 0.02 microfarads ±20%; 300 volts	Grid coupling	Micamold	22G498
10	3DA50-56	CAPACITOR: paper; 0.05 microfarads ±20%; 200 volts	Output coupling	Solar	22G3
15-1a, 15-1b	2Z5598-1	JACK ASSEMBLY: headphone	Phone jack, filament switch	Mallory	44G1
20	3Z4528	RESISTOR: 5000 ohms ±10%; ½ watt	R-F load resistor	IRC	63G6
21	3Z4531	RESISTOR: 50,000 ohms ±10%; ½ watt	Plate resistor	IRC	63G4
22-1	3Z6587	RESISTOR: 8750 ohms ±10%; ½ watt	Screen resistor	IRC	63G8
23-1	3Z4534	RESISTOR: 1 megohm ±10%; ½ watt	Grid leak	IRC	63G7
25	3Z4614	RESISTOR: 15,000 ohms ±10%; ½ watt	Plate resistor	IRC	63G2
26	2Z7285-1	POTENTIOMETER: 500,000 ohms ±10%; 1 watt	Volume control	Centralab	63G1
27a, 27b, 27c, 27d, 27e	3Z9825-59	SWITCH: rotary type; assembly	Band switch	Oak	85G14
28a, 28b	3Z9825-58	SWITCH: rotary type; assembly	Crystal switch	Centralab	85G15
29a, 29b	3Z9858-8	SWITCH: toggle; assembly	Power switch	Arrow—Hart & Hegeman	85G1
30	3C317-3	CHOKE: 450 henries +20% —10%	Plate choke	Chicago Transformer	95G1
31	2Z7111	PLUG: single contact	Antenna plug	General Engineering	58G3
32	2Z3194.5	SPRING: contact	Antenna terminal	Zenith	80G1
33	3Z739	ANTENNA TERMINAL POST	Antenna terminal	E. F. Johnson	8G1

TABLE OF REPLACEABLE PARTS—Continued

MODEL: FREQUENCY METER SETS SCR-211-P AND SCR-211-T **MAJOR UNIT: FREQUENCY METERS BC-221-P AND BC-221-T**

Reference Symbol	Army Stock No. Navy Stock No. British Ref. No.	Name of Part and Description	Function	Mfr. and Desig. AWS Type	Cont. or Govt. Dwg. or Spec. No.
	3G112-16	BUSHINGS: isolantite		American Lava	94G9
34	2Z9403.2	PLUG: 3-contact	Power input	Zenith	SG4
35	2Z9403.1	JACK: 3-contact	Power input	Zenith	SG25
36	2Z9403.3	TERMINAL BOARD: 3-contact	Battery connector	Zenith	SG24
37	3Z6450-3	RESISTOR: 4500 ohms ±10%; ½ watt	Parasitic suppressor	IRC	63G11
38-1	3Z4523	RESISTOR: 350 ohms ±10%; ½ watt	Parasitic suppressor	IRC	63G10
39	3Z6715-1	RESISTOR: 150,000 ohms ±10%; ½ watt	Grid leak	IRC	63G9
40-1	3DA1-50	CAPACITOR: mica; 0.001 microfarads ±20%; 500 volts	Filament bypass	Cornell-Dubilier	22G17
40-2		CAPACITOR: same as 40-1	Screen bypass		
40-3		CAPACITOR: same as 40-1	Plate bypass		
42	3D9100-89	CAPACITOR: ceramic; 100 micromicrofarads ±20%	Grid coupling	Centralab	22G495
43	3D9010-31	CAPACITOR: ceramic; 10 micromicrofarads ±1 micromicrofarad	Thermal compensator	Centralab	22G187
44	3DA100-138	CAPACITOR: paper; 0.1 microfarad +14% —6%; 200 volts	Screen bypass	Aefovox	22G127
45	3DA700	CAPACITOR: paper; 0.7 microfarad +14% —6%; 200 volts	Plate bypass	Solar	22G128
49	3D9006-4	CAPACITOR: ceramic; 6 micromicrofarads ±½ micromicrofarad	Crystal shunt	Centralab	22G151
	2Z5816.3	KNOB: tuning assembly; dial	Tuning knob		5G715
	6D7047T	CALIBRATION BOOK	Calibration	Zenith	SG1838
	6Z1747	DOOR CATCH: bolt	Door catch	Excelsior	156G4
	6Z1747/1	DOOR CATCH: keeper	Door catch	Excelsior	156G5
	2Z5829	KNOB: control; set screw		Zenith	SG1440
	2Z7856.1	RING: retaining plate		Zenith	57G18
	2Z7856.1	DEE RING	Attach strap	Industrial	188G1
	2Z6195.1	DIAL: lock plate		Zenith	57G153
	2Z6195	LOCK STRIP ASSEMBLY		Zenith	5G434
	6L7932-9-1.40	DIAL: lock knob		Crown	46G16
	6L976-2-24	PIN: cotter		Supplies	56G5
	2Z6195.2	SPRING: lock		Industrial	80G39

MODEL: FREQUENCY METER SET SCR-211-AA **MAJOR UNIT: FREQUENCY METER BC-221-AA**

Reference Symbol	Army Stock No. Navy Stock No. British Ref. No.	Name of Part and Description	Function	Mfr. and Desig. AWS Type	Cont. or Govt. Dwg. or Spec. No.
1		CAPACITOR: variable; 200 micromicrofarads	Tuning		Philco 358-2519
2		CAPACITOR: variable; 3 micromicrofarads; 300 volts working	Connector		Philco 361-1011
3-1		CAPACITOR: variable; 18 micromicrofarads; 300 volts working	Trimmer		Philco 361-1027
3-2		CAPACITOR: same as 3-1			
4a		CAPACITOR: ceramic; thermal; 10 micromicrofarads ±0.5 micromicrofarad; 300 volts working	Thermal compensator		Philco 305-1254
4b		CAPACITOR: same as 4a			Philco 306-1074

MODEL: FREQUENCY METER SET SCR-211-AA **MAJOR UNIT: FREQUENCY METER BC-221-AA**

4c	3D9010-38	CAPACITOR: ceramic; 10 micromicrofarads ±0.5 micromicrofarad; 300 volts d.c. working	Choke shunt	Philco 306-1058
5		CAPACITOR: ceramic; 6.5 micromicrofarads ±0.5 micromicrofarad; 300 volts d.c. working	Crystal shunt	Philco 306-1084
6	3D9250-20	CAPACITOR: molded mica; 250 micromicrofarads ±10%; 200 volts d.c. working	Cathode	Philco 306-1078
7		CAPACITOR: molded low loss; 15 micromicrofarads ±10%; 200 volts d.c. working	Coupling	Philco 306-1025
8-1	3D9025-27	CAPACITOR: molded low loss; 25 micromicrofarads ±20%; 200 volts d.c. working	Coupling	Philco 306-1076
8-2		CAPACITOR: same as 8-1		
9	3DA2-66	CAPACITOR: molded phenolic; 2000 micromicrofarads ±10%; 500 volts d.c. working	Bypass	Philco 306-1061
10-1		CAPACITOR: oil-filled paper; 100,000 micromicrofarads +14% —6%; 200 volts d.c. working	Screen resistor	Philco 306-1012
10-2		CAPACITOR: same as 10-1		
11		CAPACITOR: oil-filled paper; 250,000 micromicrofarads +14% —6%	Coupling	Philco 306-1013
12		CAPACITOR: oil-filled paper; 20 microfarads +14% —6%; 200 volts d.c. working	Coupling	Philco 306-1014
13	3DA1-73	CAPACITOR: molded low loss; 1000 micromicrofarads ±10%; 300 volts d.c. working	Bypass	Philco 306-1016
14	3Z6002G7-2	RESISTOR: 27 ohms ±10%; ½ watt; carbon	Suppressor	Philco 363-1023
15	3Z6150-26	RESISTOR: 1500 ohms ±10%; ½ watt; carbon	Suppressor	Philco 363-1024
16	3Z6610-57	RESISTOR: 10,000 ohms ±10%; ½ watt; metalized filament	Screen resistor	Philco 66-3103370
17		RESISTOR: 15,000 ohms ±10%; ½ watt; metalized filament	Plate load	Philco 66-3153370
18	3Z6650-50	RESISTOR: 50,000 ohms ±10%; ½ watt; metalized filament	Plate load	Philco 66-3503370
19	3Z6733-12	RESISTOR: 330,000 ohms ±10%; ½ watt; carbon	Grid resistor	Philco 363-1022
20-1		RESISTOR: 1.0 megohm ±20%; ½ watt; metalized filament	Grid resistor	Philco 66-5103570
20-2		RESISTOR: same as 20-1	Crystal shunt	
21-1	3Z6500-83	RESISTOR: 5000 ohms ±10%; ½ watt; metalized filament	Antenna shunt	Philco 66-250337
21-2		RESISTOR: same as 21-1	Cathode resistor	
23		INDUCTOR: 735 microhenries ±10%	Plate choke	Philco 368-1323
24		INDUCTOR: 40 henries +20% —10%; at 1.0 milliampere d.c.	Audio choke	Philco 362-7002
26	2Z7272-14	POTENTIOMETER: 500,000 ohms ±20%	Volume control	Philco 363-5000
27		SWITCH: 3-pole; 2-position	Range switch	Philco 462-1016
28		SWITCH: 2-pole; 4-position	Operation switch	Philco 462-1004
31-1		JACK: single circuit	Phone jack, filament switch	Philco 368-1043
31-2		JACK: same as 31-1		
33		POST: spring plunger type	Antenna post	Philco 258-3878
34		PLUG: banana; 3 on a panel	Power input	Philco 368-1044
35		JACK: 3 on a terminal board	Power input	Philco 368-1035
36		TERMINAL BOARD	Battery connection	Philco 368-1089

TABLE OF REPLACEABLE PARTS—Continued

MODEL: FREQUENCY METER SET SCR-211-AA — **MAJOR UNIT: FREQUENCY METER BC-221-AA**

Reference Symbol	*Army Stock No. Navy Stock No. British Ref. No.*	*Name of Part and Description*	*Function*	*Mfr. and Desig. AWS Type*	*Cont. or Govt. Dwg. or Spec. No.*
37		CAPACITOR: variable; 15.1 micromicrofarads ±7%	Crystal shunt		Philco 361-1033
38	3Z4530	RESISTOR: 20,000 ohms ±10%; ½ watt; metalized filament	Screen resistor		Philco 66-3203370
39	3Z6015-1	RESISTOR: 150 ohms ±10%; ½ watt; metalized filament	Bias resistor		Philco 66-1153370
40	3Z6035-14	RESISTOR: 350 ohms ±10%; ½ watt; metalized filament	Bias resistor		Philco 66-1353370
	2Z5822-13	KNOB: smooth grip bakelite	Controls		Philco 368-1419
	6Z7855-1	DEE PLATE: brass	Mounting plate		Philco 268-1195
	6Z7855-1	DEE RING: brass			Philco 268-1193
		BUSHING: bakelite			Philco 257-7783
		POST: spring plunger type			Philco 2583878
		BUSHING: isolantite			Philco 257-7782
		WASHER: untreated fish paper			Philco 257-8052
		WASHER: untreated fish paper			Philco 267-4023

MODEL: FREQUENCY METER SET SCR-211-AC — **MAJOR UNIT: FREQUENCY METER BC-221-AC**

Reference Symbol	*Army Stock No. Navy Stock No. British Ref. No.*	*Name of Part and Description*	*Function*	*Mfr. and Desig. AWS Type*	*Cont. or Govt. Dwg. or Spec. No.*
1	3D9170V	CAPACITOR: variable; 170 micromicrofarads	Oscillator tuning	Rauland	
2	3D9003V-6	CAPACITOR: variable; 3 micromicrofarads	Corrector	Rauland	
3-1a, 3-1b		CAPACITOR: variable, 16 micromicrofarads	Trimmer—low band	Rauland	
3-2a, 3-2b		CAPACITOR: variable; 16 micromicrofarads	Trimmer—high band	Rauland	
5-1		CAPACITOR: mica; 25 micromicrofarads ±10%; 500 volts	Antenna coupling	Micamold	
5-2		CAPACITOR: same as 5-1	Grid coupling, mixer	Micamold	
8	3DA1-18	CAPACITOR: mica; .001 microfarads ±10%; 600 volts	Audio choke, tuning	Cornell-Dubilier	
9	3DA20-11	CAPACITOR: mica; 0.02 microfarad ±10%; 600 volts	Grid coupling, amplifier	Cornell-Dubilier	
10	3DA500-24	CAPACITOR: 0.5 microfarad +14% —6%; 200 volts	Audio coupling	Rauland	
11	2Z8795.2	TUBE SOCKET: octal ceramic	VT-116-B socket	American Phenolic	
12-1	2Z8795.9	TUBE SOCKET: octal phenolic	VT-116, VT-167 crystal socket	American Phenolic	
12-2		TUBE SOCKET: same as 12-1			
12-3		TUBE SOCKET			
13-1a, 13-1b	2Z5598.1	JACK: single circuit; filament assembly	Headphone jack	Mallory	
13-2a, 13-2b		JACK: single circuit; filament	Headphone jack	Mallory	

14		INDUCTANCE: high frequency	Heterodyne oscillator inductance, high band	Rauland
15		INDUCTANCE: low frequency	Heterodyne oscillator inductance, low band	Rauland
16	2C1501-O/C1	COIL: r-f choke	Crystal plate choke	Rauland
17	2Z3501-9M1000	CRYSTAL ASSEMBLY: type DC-9-( ); 1000 kc.	Crystal oscillator	
18	3Z6506-3	RESISTOR: 5600 ohms ±10%; ½ watt; carbon	R-F output terminating	Stackpole
19	3Z6656	RESISTOR: 56,000 ohms ±10%; ½ watt; carbon	Heterodyne oscillator plate	Stackpole
20-1	3Z6801-36	RESISTOR: 1 megohm ±10%; ½ watt; carbon	Mixer grid leak	Stackpole
20-2		RESISTOR: same as 20-1	Crystal oscillator grid leak	Stackpole
21	3Z6015-15	RESISTOR: 150 ohms ±10%; ½ watt; carbon	Crystal oscillator, mixer cathode	Stackpole
22	3Z6591	RESISTOR: 9100 ohms ±5%; ½ watt; carbon	Heterodyne oscillator screen dropping	Stackpole
23	3Z6715-21	RESISTOR: 150,000 ohms ±10%; ½ watt; carbon	Heterodyne oscillator grid leak	Stackpole
24-1	3Z6615-33	RESISTOR: 15,000 ohms ±10%; ½ watt; carbon	Mixer screen dropping	Stackpole
24-2		RESISTOR: same as 24-1	Amplifier plate	
26	2Z7260-500M.1	POTENTIOMETER: 0.5 megohm ±10%; carbon	Gain control	Stackpole
27a, 27b, 27c, 27d		SWITCH: rotary assembly; 4-pole; 2-position; ceramic	Band switch	Rauland
28		SWITCH: rotary; special; phenolic	Crystal switch	Rauland
29a, 29b	3Z9845-11	SWITCH: toggle assembly double pole; single throw	"POWER ON-OFF"	Cutler-Hammer
30	3C317-3	CHOKE: 450 henries +20% —10%	Mixer plate	Chicago Transformer
33		ANTENNA POST ASSEMBLY		Rauland
37	3Z6575-19	RESISTOR: 7500 ohms ±10%; ½ watt; carbon	Heterodyne oscillator grid, low band	Stackpole
38	3Z6010-43	RESISTOR: 100 ohms ±10%; ½ watt; carbon	Heterodyne oscillator grid, high band	Stackpole
39	3DA1-73	CAPACITOR: mica; .001 microfarad ±10%; 500 volts	Heater bypass	Micamold
40	3D9100-71	CAPACITOR: mica; 100 micromicrofarads ±10%; 500 volts	Heterodyne oscillator grid coupling	Micamold
41	3Z6030-27	RESISTOR: 300 ohms ±10%; ½ watt; carbon	Amplifier cathode	Stackpole
42	3D9012V	CAPACITOR: variable; 12 micromicrofarads	Crystal trimmer	Rauland
43-1a	3DA100-98	CAPACITOR: 0.1 x 0.1 microfarads ±14% —6%; 200 volts	Heterodyne oscillator screen, plate bypass	Rauland

TABLE OF REPLACEABLE PARTS—Continued

MODEL: FREQUENCY METER SET SCR-211-AC **MAJOR UNIT: FREQUENCY METER BC-221-AC**

Reference Symbol	Army Stock No. Navy Stock No. British Ref. No.	Name of Part and Description	Function	Mfr. and Desig. AWS Type	Cont. or Govt. Dwg. or Spec. No.
43-1b		CAPACITOR: same as 43-1a			
43-2a		CAPACITOR: same as 43-1a	Crystal oscillator plate, mixer screen bypass	Rauland	
43-2b		CAPACITOR: same as 43-1a	Crystal oscillator plate, mixer screen bypass		
44-1	3D9006-4	CAPACITOR: ceramic; 6 micromicrofarads ±10%	Fixed high band shunt cap	Rauland	
44-2		CAPACITOR: same as 44-1	Fixed crystal shunt cap	Rauland	
46		RESISTOR: 4000 ohms ±5%; ½ watt; carbon	Heterodyne oscillator cathode filter	Stackpole	
47		CAPACITOR: silver mica; 50 micromicrofarads ±10%; 500 volts	Heterodyne oscillator cathode filter	Micamold	
K-1		KNOB: control	Corrector	Rauland	
K-2		KNOB: control	Band switch	Rauland	
K-3		KNOB: control	Gain	Rauland	
K-4		KNOB: control	Crystal switch	Rauland	
K-5		KNOB: main tuning		Rauland	
		FRONT COVER CATCH ASSEMBLY		Rauland	
		DEE RING ASSEMBLY		Rauland	
VT-116B		TUBE: type 6SJ7-Y	Heterodyne oscillator	RCA Ken-Rad	
VT-167		TUBE: type 6K8	Mixer	RCA Ken-Rad	
VT-116		TUBE: type 6SJ7	Audio	RCA Ken-Rad	

MODEL: FREQUENCY METER SET SCR-211-AF **MAJOR UNIT: FREQUENCY METER BC-221-AF**

Reference Symbol	Army Stock No. Navy Stock No. British Ref. No.	Name of Part and Description	Function	Mfr. and Desig. AWS Type	Cont. or Govt. Dwg. or Spec. No.
1		CAPACITOR: variable; air; capacity, minimum 11.5 micromicrofarads, maximum 160 micromicrofarads; 360° rotation; pyrex glass insulators supplied with gears mounted on rotor shaft, driven by vernier worm; approx. overall dimensions 3" x 3" x 4¾"; special	Oscillator tuning	Zierick	
2	3D9003V-6	CAPACITOR: variable; air; maximum capacity, 3 micromicrofarads +15% —0; air gap .040"; 2 plates; ceramic insulator; ¼" diameter shaft 3-13/16" long; 9/32" diameter bearing bushing; type 550-AT	Corrector	American Steel Package	

3-1	3D9010V-6	CAPACITOR: variable; air; maximum capacity, 10 micromicrofarads; 2 rotor plates, 2 stator plates; air gap .030; 360° rotation; shaft 9/32" diameter x 5/16" long; type 550-AT	Low frequency trimmer	American Steel Package	
3-2		CAPACITOR: same as 3-1	High frequency trimmer		
5-1	3D9010-32	CAPACITOR: fixed; mica; 10 micromicrofarads ±20%; 500 volts d.c. working; brown moulded bakelite case; 3/16" x 29/64" x 25/32"; axial wire leads, No. 20 AWG tinned copper wire 1¼" long; type 5S	Oscillator coupling	Cornell-Dubilier	
5-2		CAPACITOR: same as 5-1	Antenna coupling		
6	3D9007	CAPACITOR: fixed; silver on ceramic; 7 micromicrofarads +2 micromicrofarads —0 micromicrofarads; 500 volts d.c. working; temperature coefficient —.0024 micromicrofarads /C°; 5/32" diameter x 7/16" long; wire leads, No. 22 AWG tinned copper wire 1-1/2" long; type 809-126	Low frequency compensator	Centralab	
7	3Z6018-1	RESISTOR: fixed; 180 ohms ±10%; ½ watt; carbon insulated; 5/32" diameter x ⅜" long; axial wire leads, No. 20 AWG tinned copper wire 1½" long; type EB-1811	Cathode bias	Allen-Bradley	
9	3DA20-39	CAPACITOR: fixed; paper dielectric; 20,000 micromicrofarads ±20%; 400 volts d.c. working; black moulded bakelite case; ⅜" x ¾" x 1-7/16"; axial wire leads, No. 20 AWG tinned copper wire 1½" long; type 342-12	Audio coupling	Micamold	
10		TRANSFORMER: output; primary 5675 turns No. 41 AWG enamel copper wire; secondary 747 turns No. 36 AWG enamel copper wire; overall dimensions 1.410" x 2" x 2⅜"; 4 split lug type terminals mounted on bakelite strip on top of case for external connections; type No. 10070	Output transformer	Chicago transformer	
11	2Z8762-2	SOCKET: tube; octal; steatite; 8-contact; supplied with steel retaining ring overall dimensions including contacts 1¼" diameter x 13/16"; type 55-8M	For tube VT-116B	American Phenolic	
12	2Z8799-137	SOCKET: tube; octal; black moulded bakelite 8-contact; supplied with steel retaining ring; overall dimensions including contacts 1¼" diameter x 13/16"; type 78-S8M	For tube VT-167	American Phenolic	
13		SOCKET: same as 12	For tube VT-116B		
14		SOCKET: same as 12	For crystal		
15-1a	2Z5589-1	JACK: filament control; single circuit; 3/8-32 thread mounting bushing 3/8" long; overall dimensions 3/4" x 1-11/16"; type 703	Phone jack, filament switch	Mallory	
15-1b		JACK: same as 15-1a			
15-2a 15-2b	2Z5598-1	JACK: same as 15-1a			
16		COIL: oscillator; high freq ncy; single winding; 32¼ turns 7 strands No. 42 (LITZ) double celanese enamel copper wire; taps at 18½ and 6½ turns; assembly impregnated with wax; isolantite form 1⅛" diameter x 1-15/16" long; 4 solder lugs for external connections; special	Heterodyne oscillator inductance	Zierick	
17		COIL: oscillator; low frequency; 6PI Universal winding; assembly impregnated with wax; isolantite form 1½" diameter x 2" long; 4 solder lugs for external connections; special	Heterodyne oscillator inductance	Zierick	

TABLE OF REPLACEABLE PARTS—Continued

MODEL: FREQUENCY METER SET SCR-211-AF **MAJOR UNIT: FREQUENCY METER BC-221-AF**

Reference Symbol	*Army Stock No. Navy Stock No. British Ref. No.*	*Name of Part and Description*	*Function*	*Mfr. and Desig. AWS Type*	*Cont. or Govt. Dwg. or Spec. No.*
18		COIL: choke; radio frequency; 4 PI Universal winding; winding form 9/32" diameter x 7/8" long; leads, No. 20 AWG tinned copper wire; 1½" long; special	Crystal plate choke	Zierick	
19	2Z3501-9T	CRYSTAL: type DC-9; metal shell; overall dimensions 1-5/16" diameter x 2⅝" long; Signal Corps specifications 71-1355, type MS432	Crystal oscillator	Bliley	
20	3Z4528	RESISTOR: fixed; 5000 ohms ±10%; ½ watt; carbon insulated; 3/16" diameter x ⅝" long; axial wire leads, No. 20 AWG tinned copper wire 1½" long; type BT-½	Radio frequency output	Allen-Bradley	
21	3Z4531	RESISTOR: same as 20	Heterodyne plate		
22-1	3Z6587	RESISTOR: fixed; 8750 ohms ± 10%; ½ watt; carbon insulated; 3/16" diameter x ⅝" long; axial wire leads, No. 20 AWG tinned copper wire 1½" long; type BT-½	Heterodyne oscillator screen	Allen-Bradley	
22-2		RESISTOR: Same as 22-1	Detector screen		
23-1	3Z4534	RESISTOR: fixed; 1.0 megohm ±10%; ½ watt; carbon insulated; 3/16" diameter x ⅝" long; axial wire leads, No. 20 AWG tinned copper wire 1½" long; type BT-½	Crystal oscillator grid	Allen-Bradley	
23-2		RESISTOR: same as 23-1	Detector grid		
24		COIL: choke; radio frequency; inductance 15.8 microhenries; moulded bakelite form; 3/16" diameter x ⅝" long; axial wire leads, No. 22 AWG tinned copper wire 1½" long; special	Cathode choke	Zierick	
25	3Z6100-53	RESISTOR: fixed; 1000 ohms ±10%; ¼ watt; carbon insulated; ⅛" diameter x ⅜" long; axial wire leads, No. 20 AWG tinned copper wire 1½" long; type BTS	Audio cathode	Allen-Bradley	
26	2Z7285-1	POTENTIOMETER: gain control; 500,000 ohms ±10%; ½ watt; ¼" diameter shaft; ⅜-32 thread x ⅜" long bushing; solder lug type terminals; type S1-010-1578	Gain control	Chicago Telephone	
27a, 27b, 27c, 27d, 27e	3Z9825-59	SWITCH: rotary single section; 6-pole; 2-position; ¼" diameter shaft; ⅜-32 thread mounting bushing ⅜" long; overall length 3-13/16"; type 26141QHC	High-low range switch	Oak	
28a, 28b	3Z9825-58	SWITCH: rotary; single section; 2-pole; 3-position; ¼" diameter shaft; ⅜-32 thread mounting bushing ⅜" long: overall length 4-15/16"; type TW6360	Crystal "ON-OFF"	Oak	
29a, 29b	3Z9858-8	SWITCH: toggle; double pole; single throw; body dimensions ⅝" x 11/16" x 1¼"; 15/32-32 thread mounting bushing x 11/32" long; type 81009-S	"POWER ON-OFF"	Arrow — Hart & Hegeman	
30	3C317-3	COIL: choke; audio frequency; inductance 450 henries at .001 ampere d.c.; steel case; 1-23/32" x 2"; 2 split type terminals mounted on bakelite terminal board, spaced ⅜" apart; type 7477	Detector plate choke	Chicago Transformer	

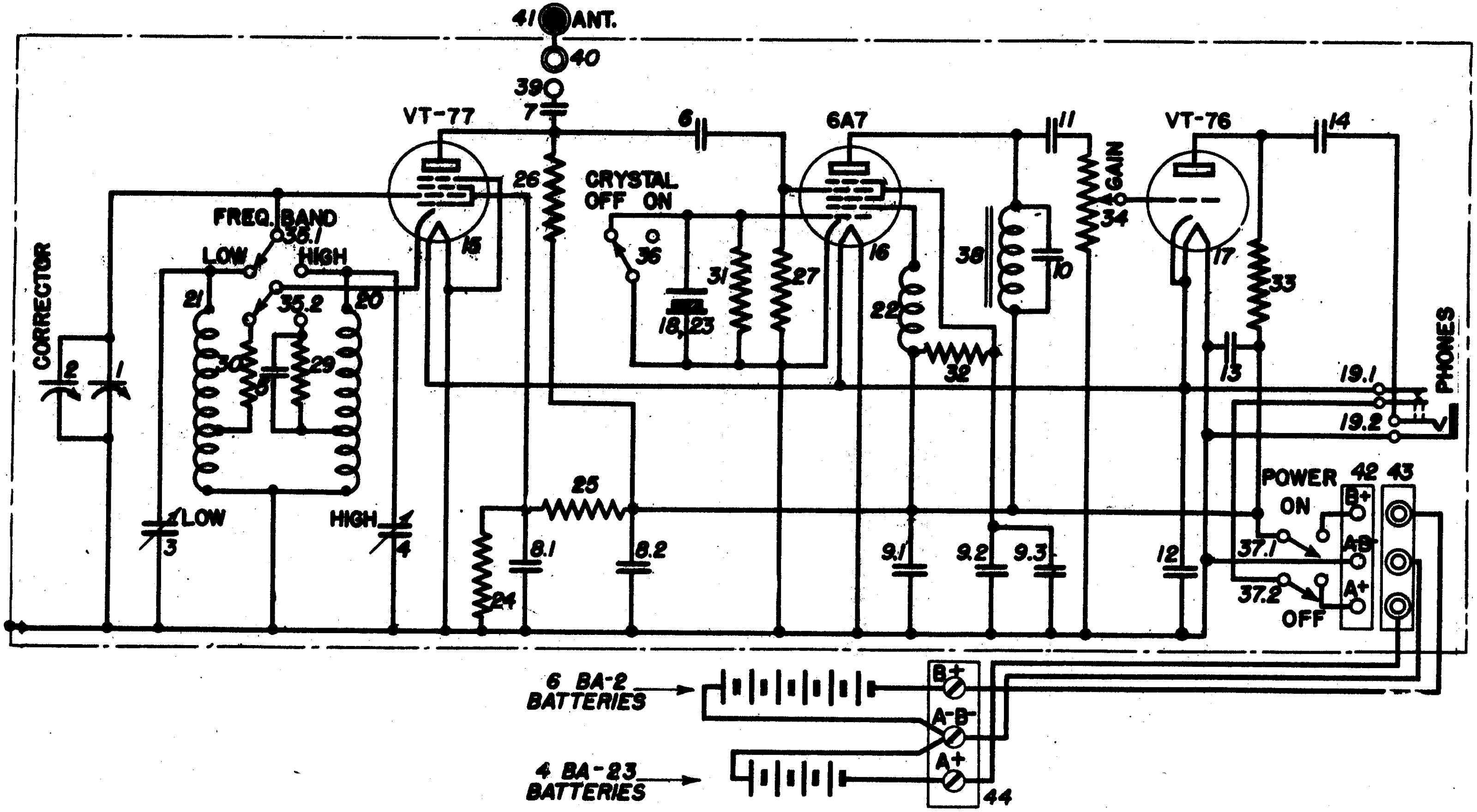
32	3Z739	POST: binding; push type; body dimensions 1/2" diameter x 3/4" long; threaded stud 9/16" long; overall length 1-5/16"; type Z-714	Ground post	Soreng-Mangold
33		POST: Same as 32	Antenna post	
34	2Z9403.2	PLUG: power; assembly; composed of 3 banana type plugs mounted 5/8" apart on phenolic strip 3/16" thick x 1/2" wide x 2-9/16" long; "B+," "—AB," and "A+"; special	Power input	Zierick
35	2Z9403.1	JACK STRIP ASSEMBLY: composed of 3 single plug jacks mounted 5/8" apart on phenolic strip 3/16" thick x 1/2" wide x 2 5/8" long; marked "B+", "—AB," and "A+"; special	Power input	Zierick
36	2Z9403.3	BOARD: terminal; composed of 3 screw and solder lug type terminals mounted 3/4" apart on phenolic strip 1/8" thick x 3/4" x 3 1/8" long; marked "B+", "—AB", and "A+"; special	Battery connector	Zierick
37	3Z6587	RESISTOR: fixed; 8750 ohms ±10%; 1/2 watt; carbon insulated; 3/16" diameter x 5/8" long; axial wire leads, No. 20 AWG tinned copper wire 1 1/2" long; type BT-1/2	Heterodyne oscillator low frequency grid	
38	3Z4523	RESISTOR: fixed; 350 ohms ±10%; 1/2 watt; carbon insulated; 3/16" diameter x 5/8" long; axial wire leads, No. 20 AWG tinned copper wire 1 1/2" long; type BT-1/2	Heterodyne oscillator high frequency grid	Allen-Bradley
39	3Z6715-1	RESISTOR: fixed; 150,000 ohms ±10%; 1/2 watt; carbon insulated; 3/16" diameter x 5/8" long; axial wire leads, No. 20 AWG tinned copper wire 1 1/2" long; type BT1/2	Oscillator grid leak	Allen-Bradley
40-1	3DA1-50	CAPACITOR: fixed; mica; 1000micromicrofarads ±20%; 500 volts d.c. working; brown moulded bakelite case; 3/16" x 29/64" x 25/32"; axial wire leads, No. 20 AWG tinned copper wire 1 1/4" long; type 5WS	Filament bypass	Cornell-Dubilier
40-2		CAPACITOR: same as 40-1	Detector screen	
40-3		CAPACITOR: same as 40-1	Detector plate	
41		CLIP: tube grid; steel; 1/4" inside diameter x 1/4" long; clip formed to accommodate soldering of wire lead; type 223	For tube T-167	Zierick
42	3D9100-89	CAPACITOR: fixed; mica; 100 micromicrofarads ±20%; 500 volts d.c. working; moulded bakelite case; 3/16" x 29/64" x 25/32"; axial wire leads, No. 20 AWG tinned copper wire 1 1/4" long; type 5WLS	Grid coupling	Cornell-Dubilier
43	3D9010-31	CAPACITOR: fixed; silver on ceramic; 10 micromicrofarads ±1.0 micromicrofarad; 500 volts d.c. working; temperature coefficient —.0020 micromicrofarads/C°; 5/32" diameter x 7/16" long; wire leads, No. 22 AWG tinned copper wire 1 1/2" long; type N200K	Compensator	Centralab
44	3DA100-138	CAPACITOR: fixed; paper; wax-impregnated; 100,000 micromicrofarads ±20%; 200 volts d.c. working; metal case; 7/8" x 1" x 1-13/16"; 1 insulated terminal	Heterodyne oscillator screen bypass	Solar
45	3DA-700	CAPACITOR: fixed; paper; wax-impregnated; 700,000 micromicrofarads ±20%; 200 volts d.c. working; metal case; 7/8" x 1" x 1-13/16"; 1 insulated terminal; 1 side grounded to case	Audio screen bypass	Solar
46	2T116	TUBE: vacuum; VT-116; triple grid; type 6SJ	Heterodyne oscillator	RCA
47	2T167	TUBE: vacuum; VT-167; converter; type 6K8	Crystal oscillator and detector	KenRAD

TABLE OF REPLACABLE PARTS—Continued

MODEL: FREQUENCY METER SET SCR-211-AF **MAJOR UNIT: FREQUENCY METER BC-221-AF**

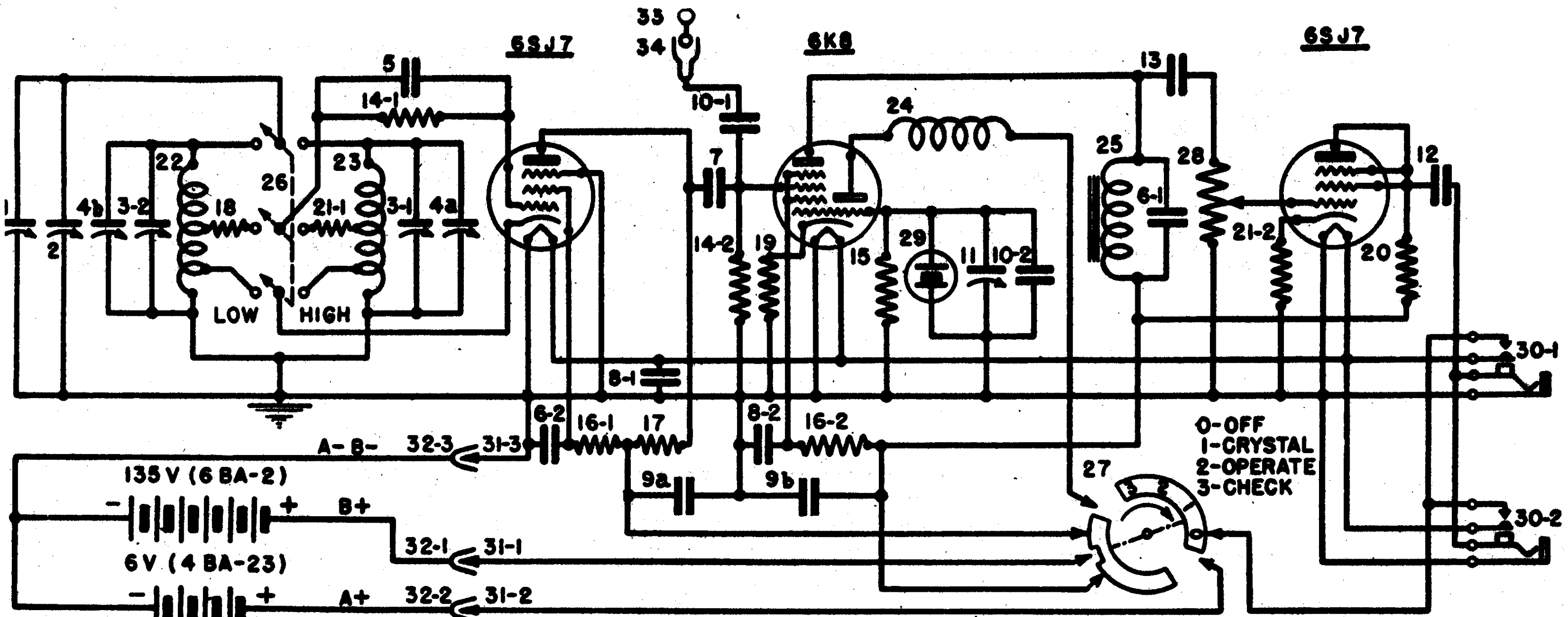
Reference Symbol	*Army Stock No. Navy Stock No. British Ref. No.*	*Name of Part and Description*	*Function*	*Mfr. and Desig. AWS Type*	*Cont. or Govt. Dwg. or Spec. No.*
48	2T116B	TUBE: vacuum; VT-116B triple grid type 6SJ7Y	Audio amplifier	RCA	
49	3D9006-4	CAPACITOR: fixed; silver on ceramic; 6.0 micromicrofarads ±0.5 micromicrofarad; 500 volts d.c. working; zero temperature coefficient wire leads, No. 22 AWG tinned copper wire 1½" long; type No. 312-156	Crystal shunt	Centralab	
50		CAPACITOR: variable; air; maximum capacity 14.5 micro microfarads, minimum 2.5 micromfarads; 3 rotor plates, 2 stator plate air gap .030; 360° rotation; ceramic insulation; shaft 17/32" long	Crystal shunt	American Steel Package	
65	2Z5816.3	KNOB: tuning control; assembly; composed of bakelite knob, handle, stud, and washer	Turning control	Zierick	
66	2Z5788-9	KNOB: bar; black bakelite 1¼" long x ⅝" high; for ¼" diameter shaft; index line filled with permanent white; supplied with No. 8/32 Bristo setscrew	Control knob	Zierick	
67		KNOB: dial lock; threaded stud type; No. 8/32 thread 9/16" long; knurled head ½" diameter overall length ⅞"	Dial lock	Zierick	
	2C1411 ( )	FREQUENCY METER BC-221-C-( ): range 125 to 20,000 kilocycles			
	3A2	BATTERY: 22.5 volts			
	3A23	BATTERY: 1.5 volts			
	2B830	HEADSET: HS-30-( )			
	2T76	TUBE: JAN-76(VT-76)			
	2T77	TUBE: JAN-77(VT-77)			
	2V6A7	TUBE: JAN-6A7			
	2T116	TUBE: JAN-6SJ7(VT-116)			
	2T116B	TUBE: JAN-6SJ7Y(VT-116B)			
	2T167	TUBE: JAN-6K8(VT-167)			
	2Z481 ( )	BAG BG-81-( )*			
	6R55231	WRENCH: Bristo No. 8 setscrew			
	2B1300	INSERT M-300: for Headset HS-30-( )			
	2Z9019A	STRAP ST-19-A			
	3E1605-6.5	CORD CD-650: 6½ feet; 2-conductor; Plug PL-55 at one end, Transformer C-410 at other			
	3E1874	CORD CD-874: 6½ feet; 2-conductor; Plug PL-55 at one end, Junction Box JB-47 at other *Bag BG-160 is available for amphibious operations.			

SECTION VIII
DRAWINGS



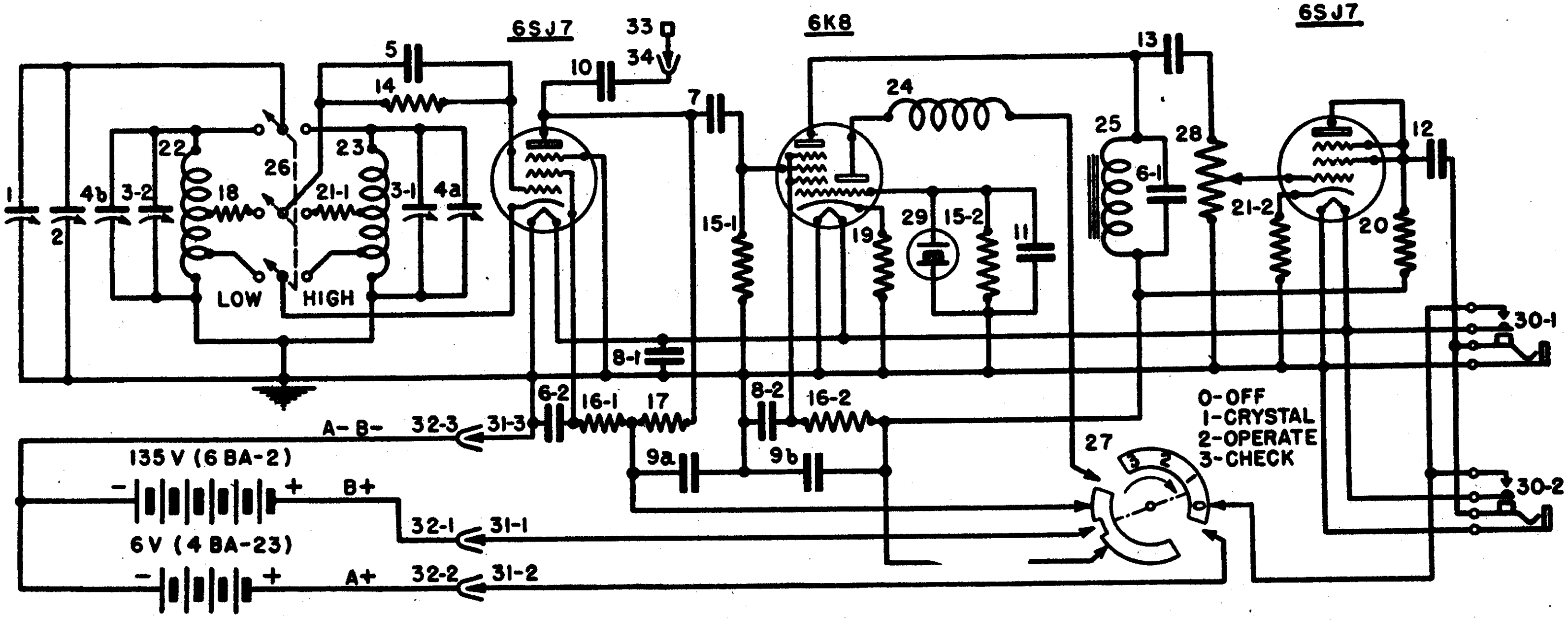
REF	DESC	REF	DESC	REF	DESC	REF	DESC	REF	DESC
1	0.00015 mf	8.1	0.1 mf	12	0.5 mf	25	10,000 ohm	33	15,000 ohm
2	2.0 mmf	8.2	0.1 mf	13	0.5 mf	26	50,000 Ohm	34	500,000 ohm
3	10.0 mmf	9.1	0.1 mf	14	2.0 mf	27	1.0 megohm	38	600 h
4	10.0 mmf	9.2	0.1 mf	20	0.0000385 mh	29	5,000 ohm		
5	0.0005 mf	9.3	0.1 mf	21	10.1 mh	30	10,000 ohm		
6	25 mmf	10	0.001 mf	22	1.7 mh	31	50,000 ohm		
7	50 mmf	11	0.02 mf	24	50,000 ohm	32	30,000 ohm		

Figure 8-1. Frequency Meter BC-211-A—Schematic Diagram



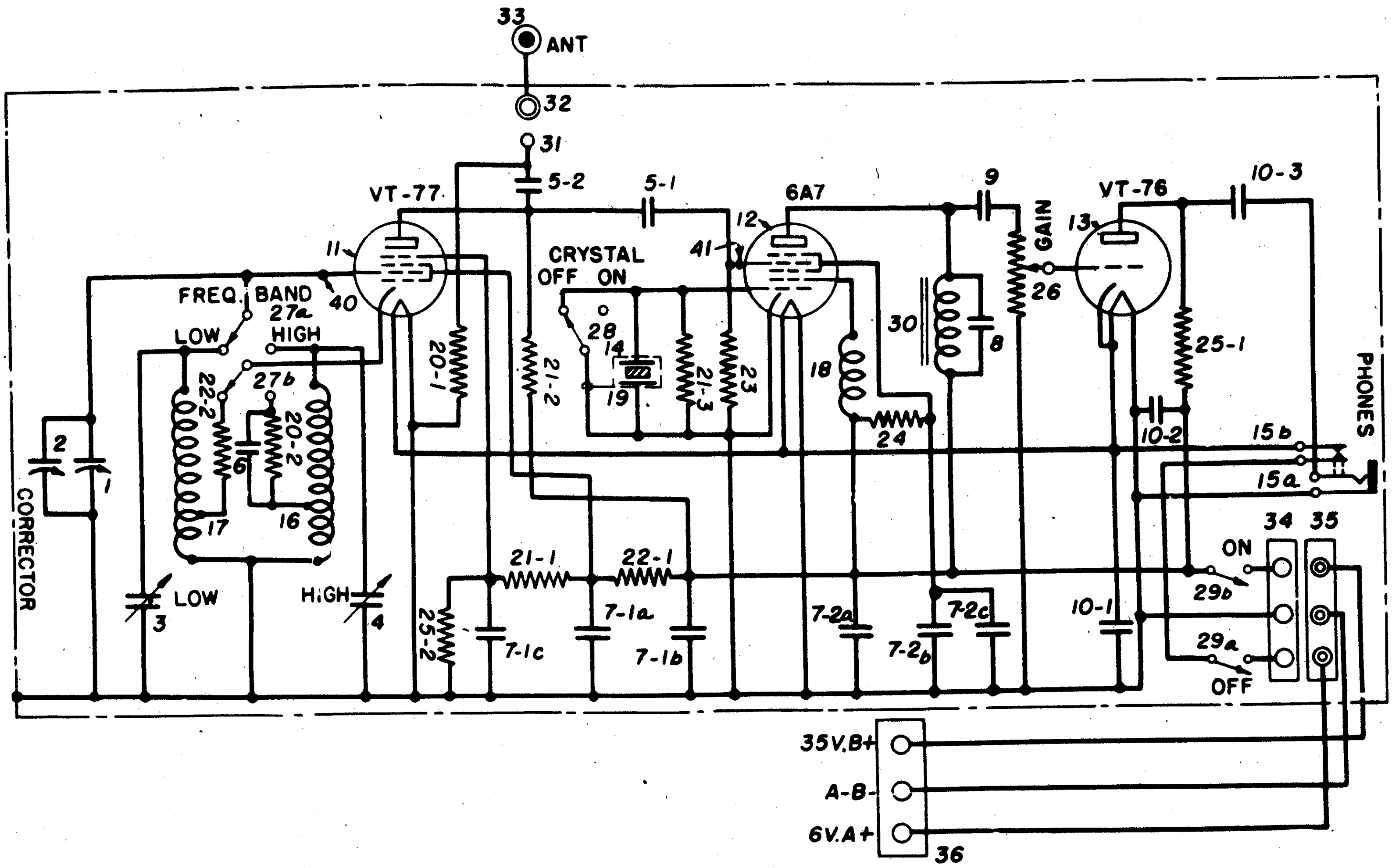
REF	DESC	REF	DESC	REF	DESC	REF	DESC	REF	DESC
1	235 mmf	6-1	0.002 mf	10-1	12 mmf	15	1.0 meg	21-1	350 ohm
2	1 mmf	6-2	0.002 mf	10-2	12 mmf	16-1	8750 ohm	21-2	350 ohm
3-1	25 mmf	7	50 mmf	11	11 mmf	16-2	8750 ohm	22	6.5 mh
3-2	25 mmf	8-1	0.001 mf	12	2.0 mf	17	50,000 ohm	23	24.8 microh
4a	1 mmf	8-2	0.001 mf	13	0.25 mf	18	4500 ohm	24	0.735 millih
4b	1 mmf	9a	0.1 mf	14-1	0.15 meg	19	75 ohm	25	300 h
5	100 mmf	9b	0.1 mf	14-2	0.15 meg	20	12,500 ohm	28	0.5 meg

Figure 8-2. Frequency Meter BC-211-B—Schematic Diagram for Order No. 3665-Phila-42



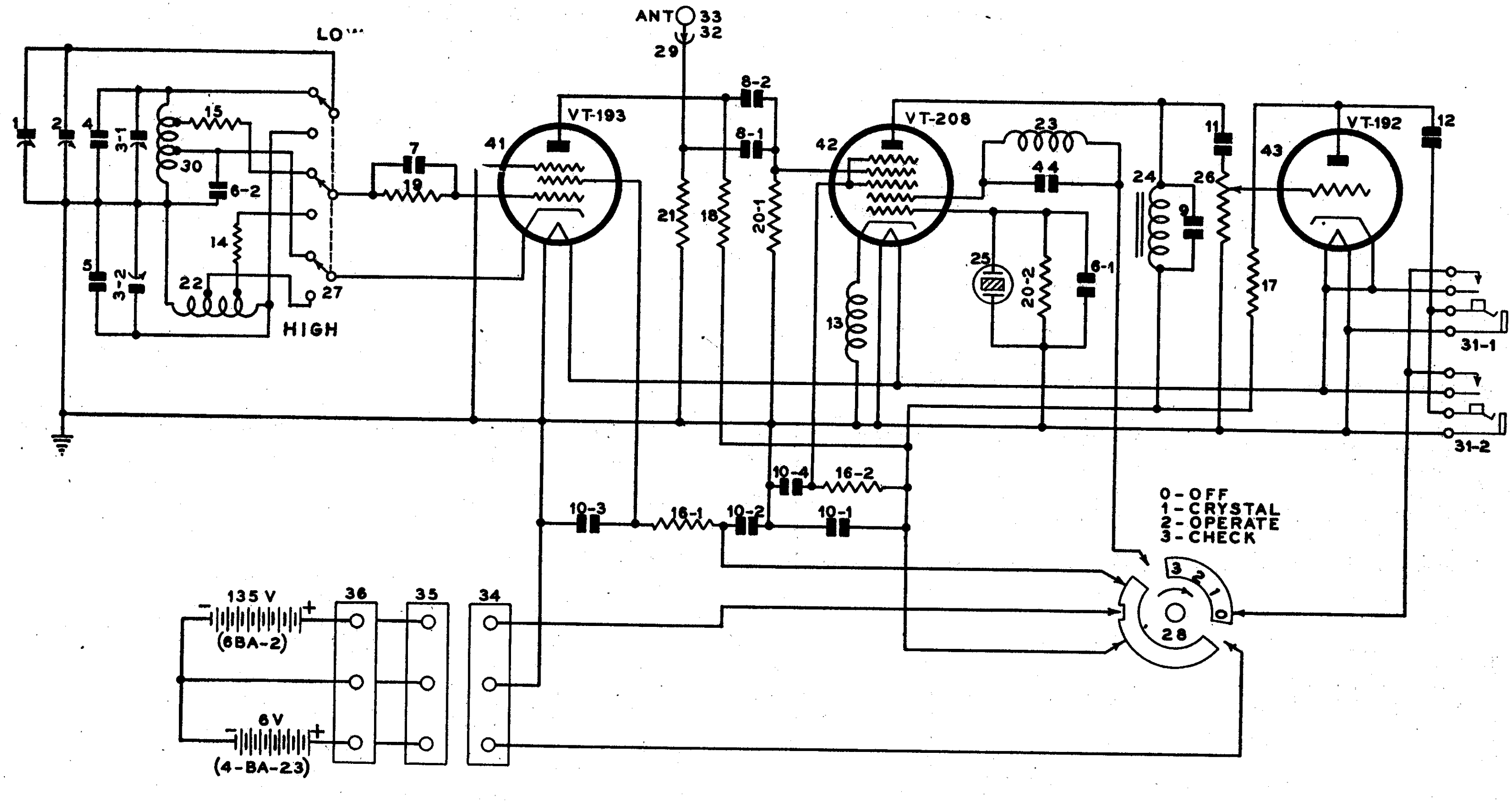
REF	DESC	REF	DESC	REF	DESC	REF	DESC	REF	DESC
1	235 mmf	6-1	0.002 mf	10	8 mmf	16-1	8750 ohm	21-2	350 ohm
2	1 mmf	6-2	0.002 mf	11	25 mmf	16-2	8750 ohm	22	6.5 millih
3-1	25 mmf	7	50 mmf	12	2 mf	17	50,000 ohm	23	24.8 microh
3-2	25 mmf	8-1	0.001 mf	13	0.25 mf	18	4500 ohm	24	0.735 millih
4a	1 mmf	8-2	0.001 mf	14	0.15 meg	19	75 ohm	25	300 h
4b	1 mmf	9a	0.1 mf	15-1	1 meg	20	12,500 ohm	28	0.5 meg
5	100 mmf	9b	0.1 mf	15-2	1 meg	21-1	350 ohm		

Figure 8-3. Frequency Meter BC-211-B—Schematic Diagram for Order No. 6024-NY-41



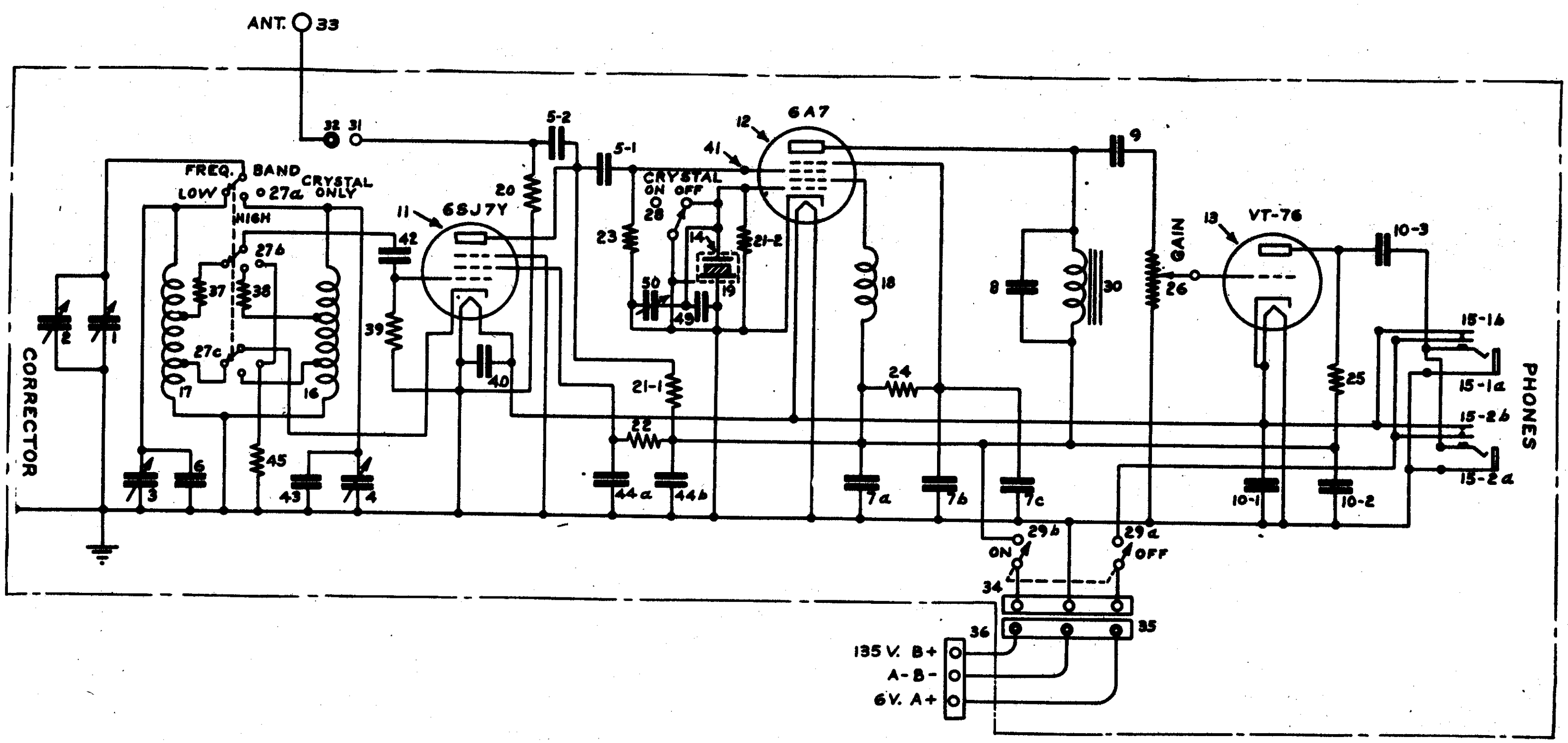
REF	DESC	REF	DESC	REF	DESC	REF	DESC	REF	DESC
1	0.00015 mf	7-1a	0.1 mf	9	0.02 mf	21-1	50,000 ohm	25-2	15,000 ohm
2	2 mmf	7-1b	0.1 mf	10-1	0.5 mf	21-2	50,000 ohm	26	500,000 ohm
3	10 mmf	7-1c	0.1 mf	10-2	0.5 mf	22-1	10,000 ohm	30	450 h
4	10 mmf	7-2a	0.1 mf	10-3	0.5 mf	22-2	10,000 ohm	21-3	50,000 ohm
5-1	10 mmf	7-2b	0.1 mf	18	1.7 millih	23	1.0 meg		
5-2	10 mmf	7-2c	0.1 mf	20-1	5000 ohm	24	30,000 ohm		
6	250 mmf	8	0.001 mf	20-2	5000 ohm	25-1	15,000 ohm		

Figure 8-4. Frequency Meters BC-211-C and BC-221-D—Schematic Diagram



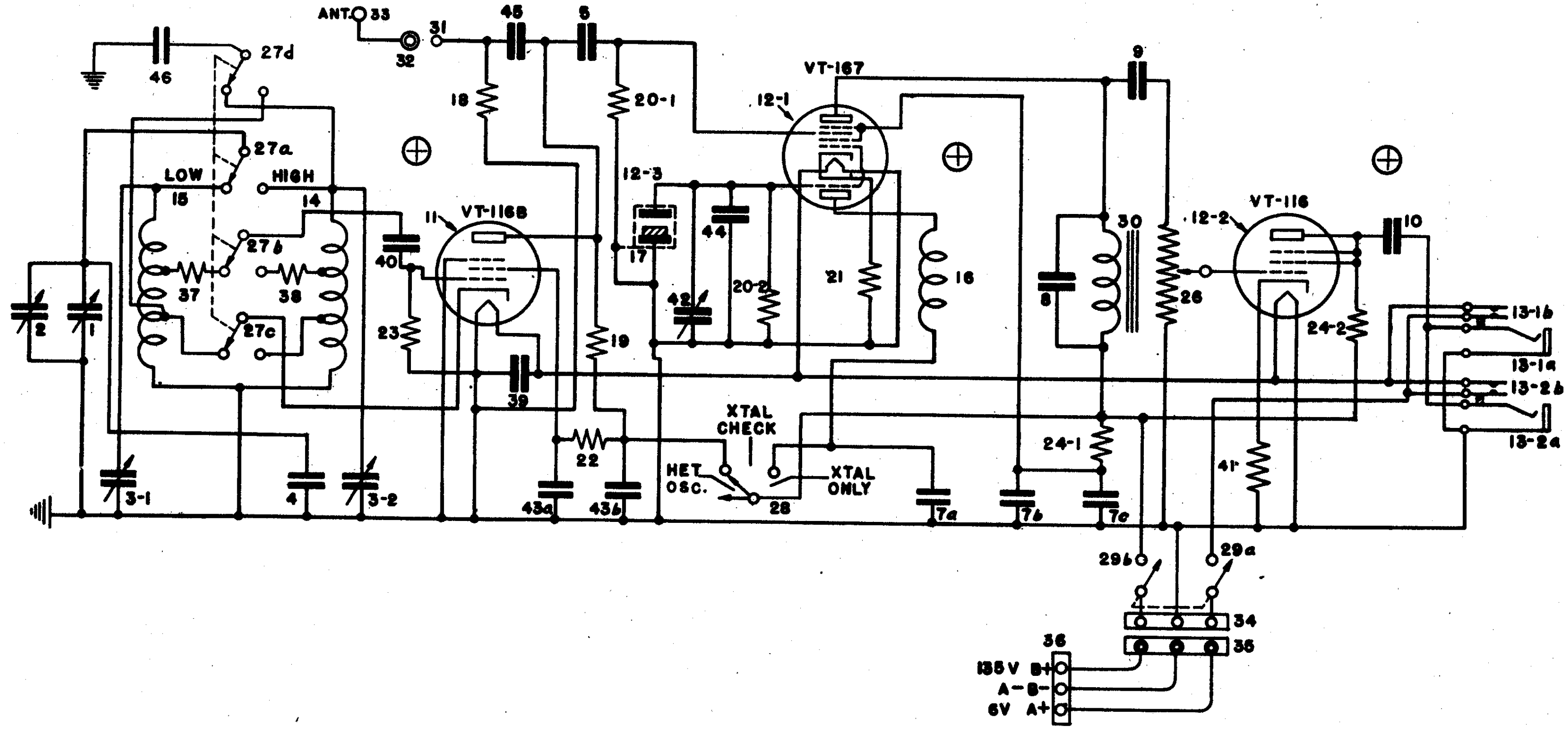
REF	DESC	REF	DESC	REF	DESC	REF	DESC	REF	DESC
1	200 mmf	6-2	25 mmf	10-3	0.1 mf	16-1	10,000 ohm	21	5000 ohm
2	3-5 mmf	7	15 mmf	10-4	0.1 mf	16-2	10,000 ohm	23	735 microh
3-1	3-29 mmf	8-1	25 mmf	11	0.25 mf	17	15,000 ohm	24	300 h
3-2	3-29 mmf	8-2	25 mmf	12	2 mf	18	50,000 ohm	26	500,000 ohm
4	6.5 mmf	9	0.004 mf	13	15.8 microh	19	330,000 ohm	44	5 mmf
5	5 mmf	10-1	0.1 mf	14	27 ohm	20-1	1 meg		
6-1	25 mmf	10-2	0.1 mf	15	1500 ohm	20-2	1 meg		

Figure 8-5. Frequency Meter BC-221-E—Schematic Diagram



REF	DESC	REF	DESC	REF	DESC	REF	DESC	REF	DESC	REF	DESC
1	175 mmf	7a	0.1 mf	10-3	0.5 mf	22	8750 ohm	38	350 ohm	45	10,000
2	3 mmf	7b	0.1 mf	16	34 microh	23	1 meg	39	150,000 ohm	49	13 mmf
3	10 mmf	7c	0.1 mf	17	9.1 millih	24	30,000 ohm	40	0.001 mf	50	11 mmf
4	10 mmf	8	0.001 mf	18	1.7 millih	25	15,000 ohm	42	100 mmf		
5-1	10 mmf	9	0.02 mf	20	5000 ohm	26	500,000 ohm	43	10 mmf		
5-2	10 mmf	10-1	0.5 mf	21-1	50,000 ohm	30	450 h	44a	0.1 mf		
6	6.5 mmf	10-2	0.5 mf	21-2	50,000 ohm	37	4500 ohm	44b	0.1 mf		

Figure 8-6. Frequency Meters BC-221-F, BC-221-J, BC-221-K, and BC-221-L—Schematic Diagram



REF	DESC	REF	DESC	REF	DESC	REF	DESC	REF	DESC	REF	DESC
1	160 mmf	7b	0.1 mf	16	844 microh	23	150,000 ohm	39	0.001 mf	45	15 mmf
2	3 mmf	7c	0.1 mf	18	5600 ohm	24-1	15,000 ohm	40	100 mmf	46	47 mmf
3-1	10 mmf	8	0.001 mf	19	56,000 ohm	24-2	15,000 ohm	41	300 ohm		
3-2	10 mmf	9	0.02 mf	20-1	1.0 meg	26	500,000 ohm	42	12 mmf		
4	5 mmf	10	0.5 mf	20-2	1.0 meg	30	450 h	43a	0.1 mf		
5	8 mmf	14	36.5 microh	21	150 ohm	37	7500 ohm	43b	0.1 mf		
7a	0.1 mf	15	10.4 millih	22	9100 ohm	38	100 ohm	44	5 mmf		

Figure 8-7. Frequency Meter BC-221-M—Schematic Diagram

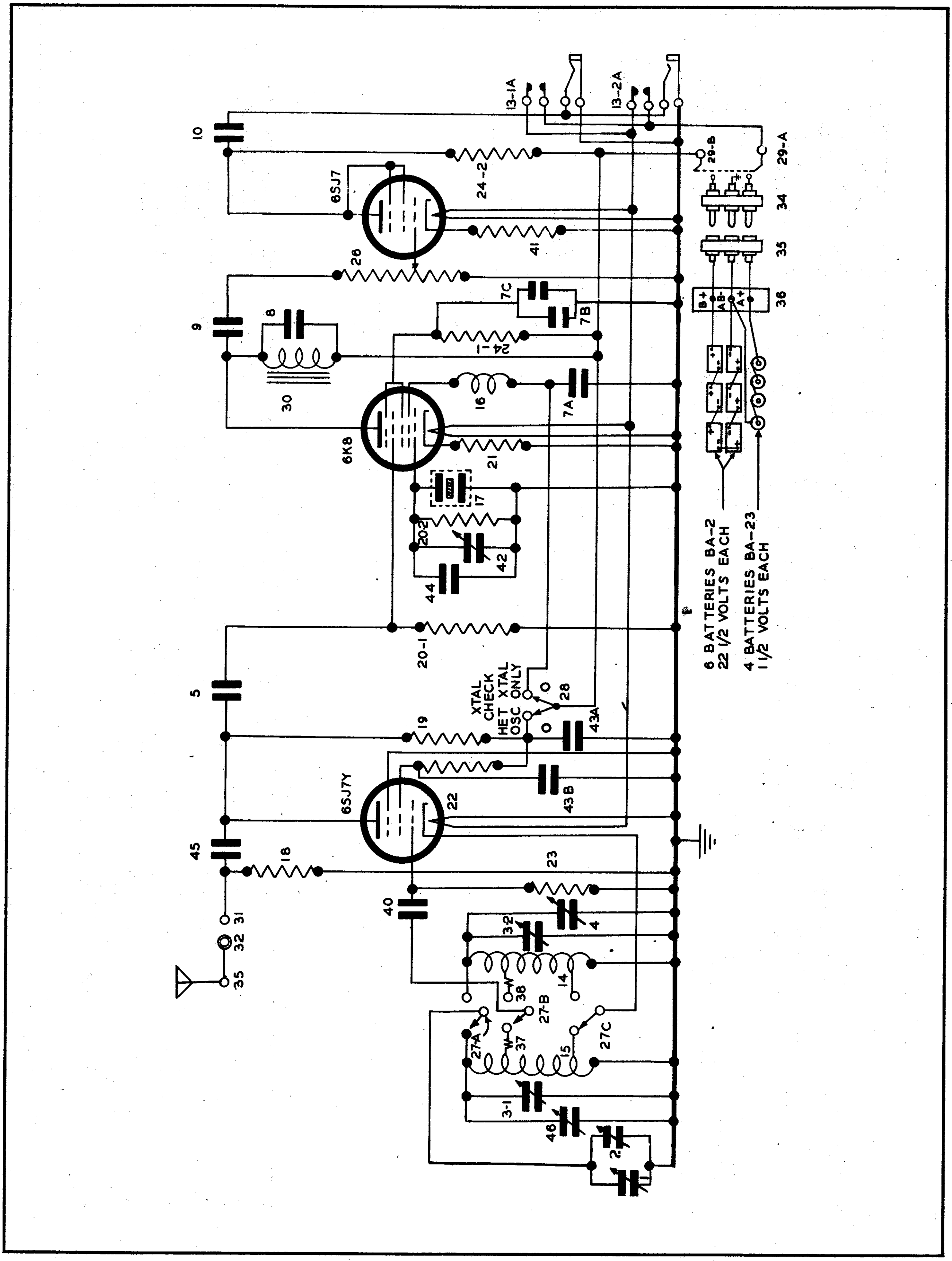
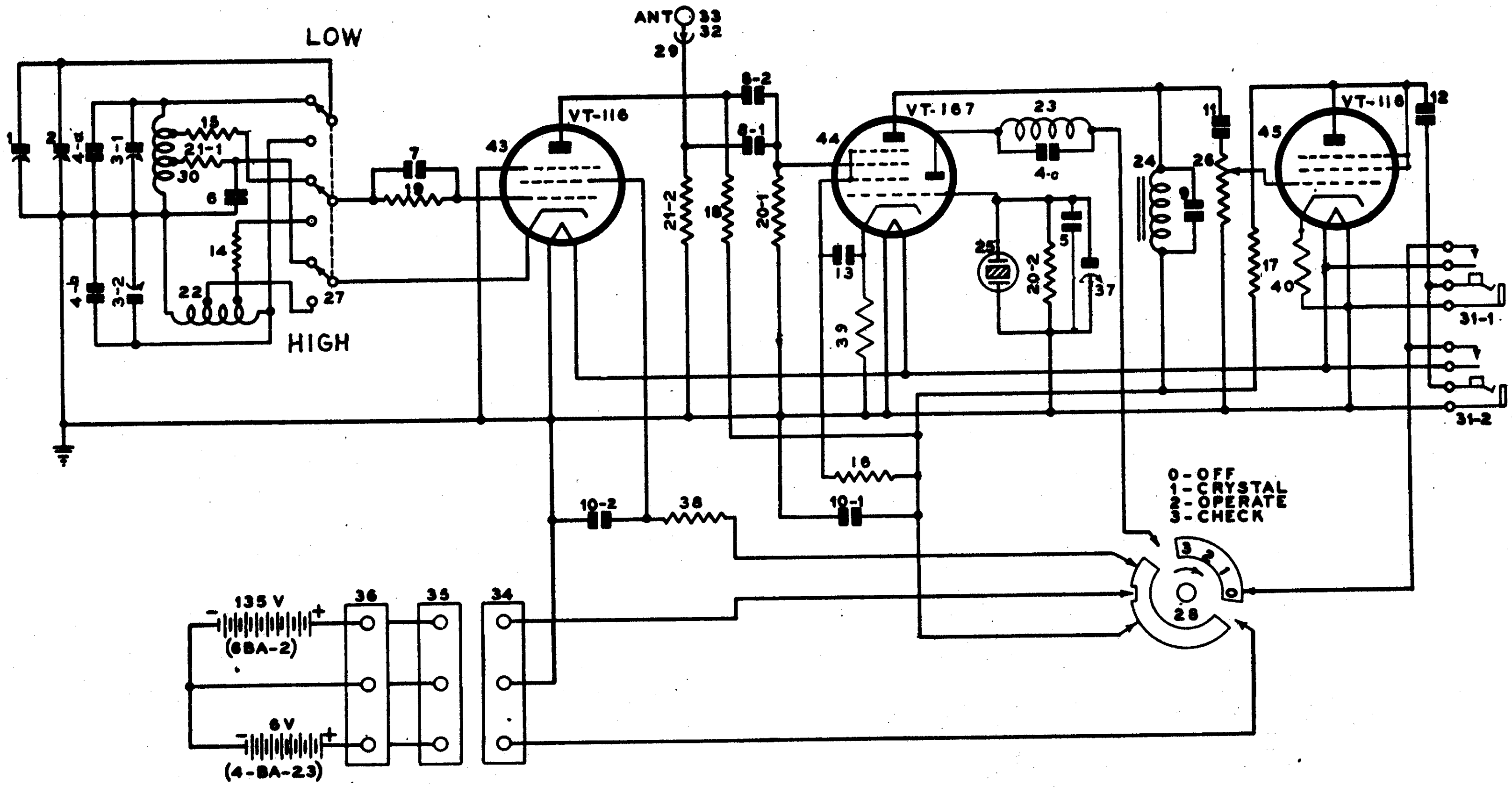


Figure 8-9. Frequency Meters BC-221-O and BC-221-R—Schematic Diagram

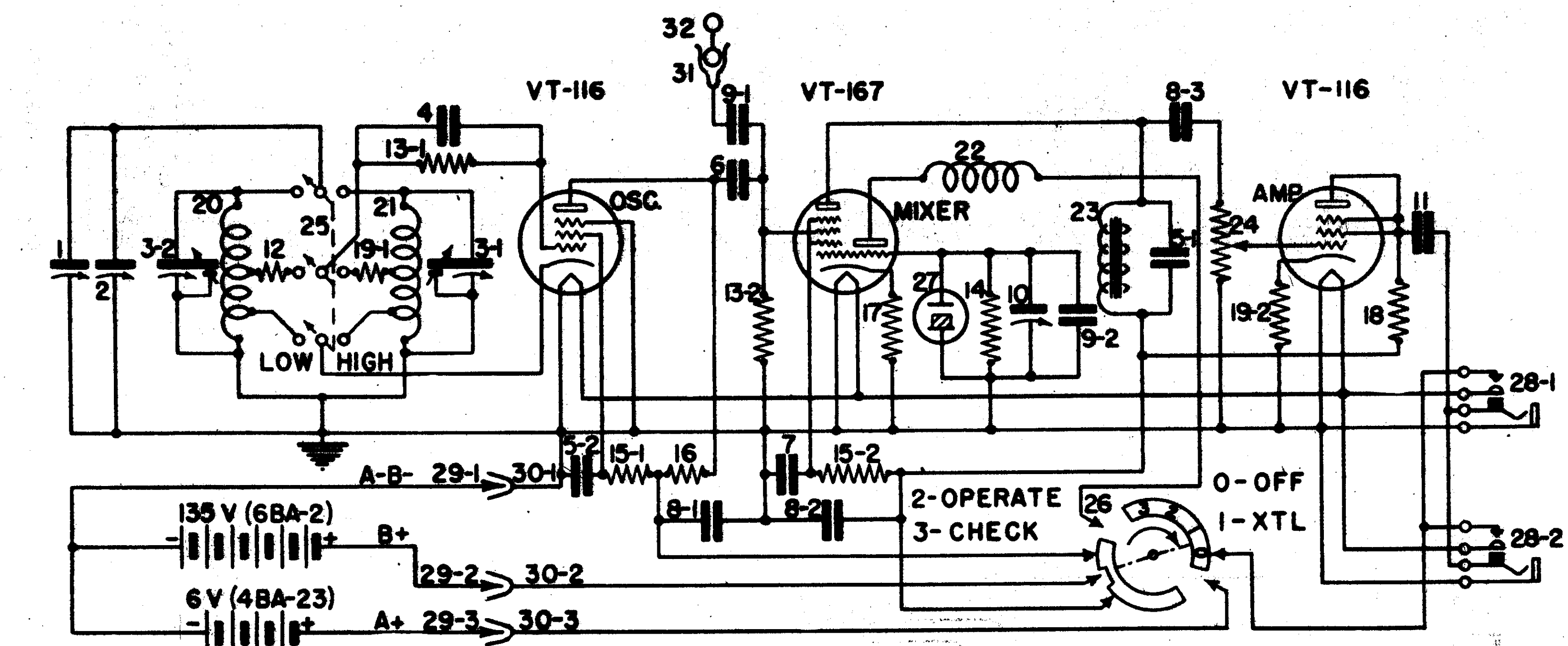


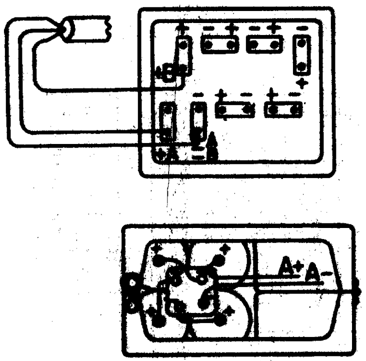
REF	DESC	REF	DESC	REF	DESC	REF	DESC
1	200 mmf	7	15 mmf	14	27 ohm	21-2	5000 ohm
2*	1.2 mmf	8-1	25 mmf	15	1500 ohm	22	25.84 microh
3-1*	15 mmf	8-2	25 mmf	16	10,000 ohm	23	0.735 microh
3-2*	15 mmf	9	0.002 mf	17	15,000 ohm	24	40 h
4a	10.0 mmf	10-1	0.1 mf	18	50,000 ohm	26	0.5 meg
4b	10.0 mmf	10-2	0.1 mf	19	330,000 ohm	30	7.06 millih
4c	10.0 mmf	11	0.25 mf	20-1	1.0 meg	37*	8.0 mmf
5*	8.5 mmf	12	2.0 mf	20-2	1.0 meg	38	20,000 ohm
6	250 mmf	13	0.001 mf	21-1	5000 ohm	39	150 ohm
						40	350 ohm

*The following values apply to BC-221-AA

2	3.0 mmf
3-1	18.0 mmf
3-2	18.0 mmf
5	6.5 mmf
37	15.1 mmf

Figure 8-8. Frequency Meters BC-221-N and BC-221-AA—Schematic Diagram

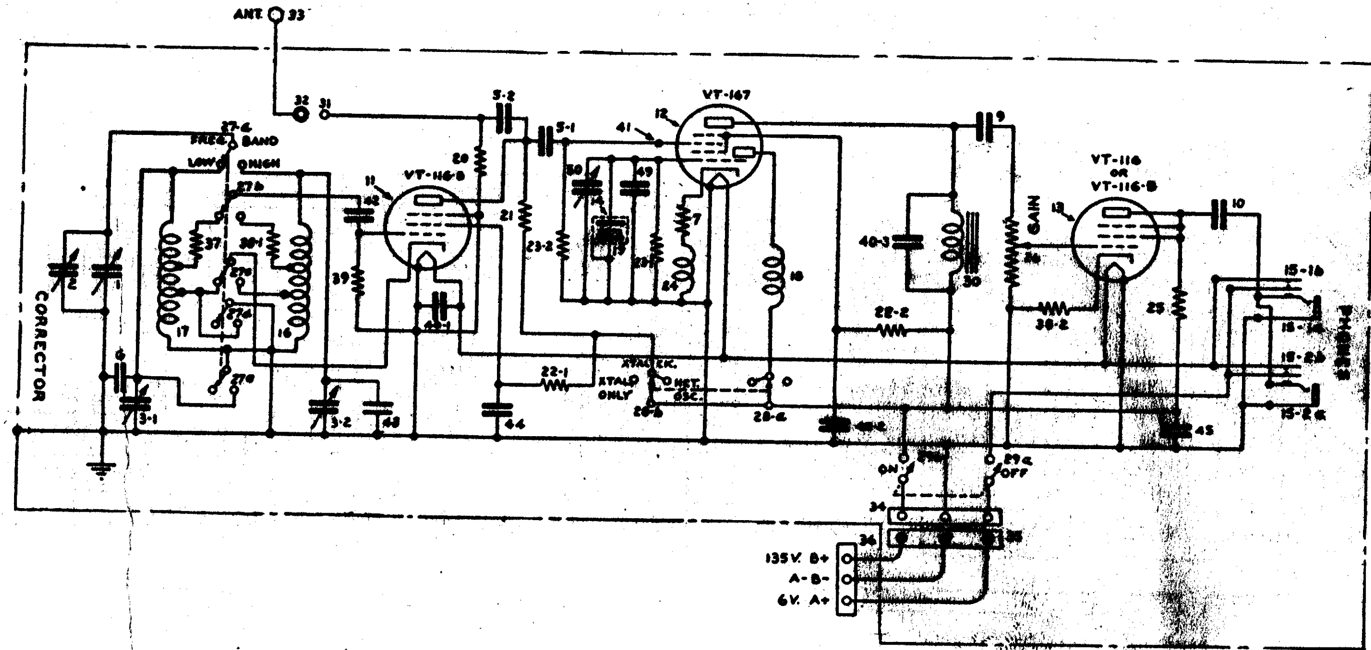




REF.	DESCRIPTION	REF.	DESCRIPTION	REF.	DESCRIPTION	REF.	DESCRIPTION
1	220 μμf	9-1	12 μμf	17	75 OHMS	27	CRYSTAL
2	1 μμf	9-2	12 μμf	18	12,500 OHMS	28-1	HEADSET JACK
3-1	25+4 μμf	10	12 μμf	19-1	350 OHMS	28-2	HEADSET JACK
3-2	25+4 μμf	11	2 μf	19-2	350 OHMS	29-1	PLUG
4	100 μμf	12	4,500 OHMS	20	6.5 MILLIH.	29-2	PLUG
5-1	0.002 μf	13-1	0.15 MEG.	21	0.025 MILLIH.	29-3	PLUG
5-2	0.002 μf	13-2	0.15 MEG.	22	0.735 MILLIH.	30-1	JACK
6	50 μμf	14	1 MEG.	23	300 HENRIES	30-2	JACK
7	0.001 μf	15-1	8,750 OHMS	24	1 MEGOHM	30-3	JACK
8-1	0.05 μf	15-2	8,750 OHMS	25	SWITCH (BAND)	31	ANTENNA CLIP
8-2	0.05 μf	16	50,000 OHMS	26	SWITCH (POWER)	32	BINDING POST
8-3	0.05 μf						

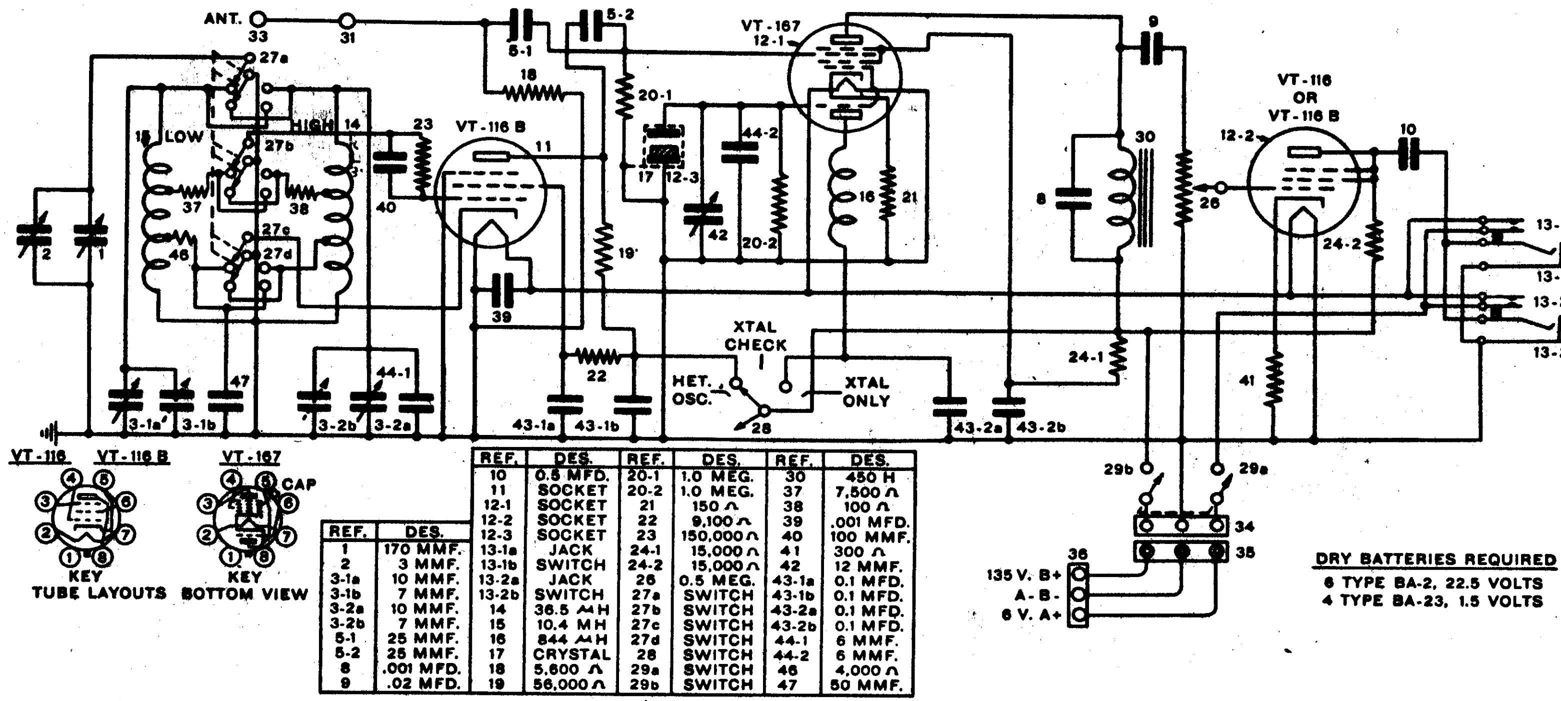
FREQUENCY METER BC-221-Q
THE ALLEN D. CARDWELL MFG. CORP'N

Figure 8-10. Frequency Meter BC-221-Q—Schematic Diagram for Order No. 4761-Phila-42



REF	DESC	REF	DESC	REF	DESC	REF	DESC	REF	DESC
1	[illegible] mmf	7	180 ohm	21	50,000 ohm	26	500,000 ohm	40-2	0.001 mf
2	3 mmf	9	0.02 mf	22-1	8750 ohm	30	450 h	40-3	0.001 mf
3-1	10 mmf	10	0.5 mf	22-2	8750 ohm	37	4500 ohm	42	100 mmf
3-2	10 mmf	16	34.0 microh	23-1	1 meg	38-1	350 ohm	43	10 mmf
5-1	10 mmf	17	9.05 millih	23-2	1 meg	38-2	350 ohm	44	0.1 mf
5-2	10 mmf	18	735 microh	24	15.8 microh	39	150,000 ohm	45	0.7 mf
6	7 mmf	20	5000 ohm	25	15,000 ohm	40-1	0.001 mf	49	6.0 mmf
								50	14.5 mmf

Figure 8-11. Frequency Meters BC-221-P and BC-221-T—Schematic Diagram



REF.	DES.
1	170 MMF.
2	3 MMF.
3-1a	10 MMF.
3-1b	7 MMF.
3-2a	10 MMF.
3-2b	7 MMF.
5-1	25 MMF.
5-2	25 MMF.
8	.001 MFD.
9	.02 MFD.

REF.	DES.	REF.	DES.	REF.	DES.
10	0.5 MFD.	20-1	1.0 MEG.	30	450 H
11	SOCKET	20-2	1.0 MEG.	37	7,500 Ω
12-1	SOCKET	21	150 Ω	38	100 Ω
12-2	SOCKET	22	9,100 Ω	39	.001 MFD.
12-3	SOCKET	23	150,000 Ω	40	100 MMF.
13-1a	JACK	24-1	15,000 Ω	41	300 Ω
13-1b	SWITCH	24-2	15,000 Ω	42	12 MMF.
13-2a	JACK	26	0.5 MEG.	43-1a	0.1 MFD.
13-2b	SWITCH	27a	SWITCH	43-1b	0.1 MFD.
14	36.5 μH	27b	SWITCH	43-2a	0.1 MFD.
15	10.4 MH	27c	SWITCH	43-2b	0.1 MFD.
16	844 μH	27d	SWITCH	44-1	6 MMF.
17	CRYSTAL	28	SWITCH	44-2	6 MMF.
18	5,600 Ω	29a	SWITCH	46	4,000 Ω
19	56,000 Ω	29b	SWITCH	47	50 MMF.

Figure 8-12. Frequency Meter BC-221-AC—Schematic Diagram

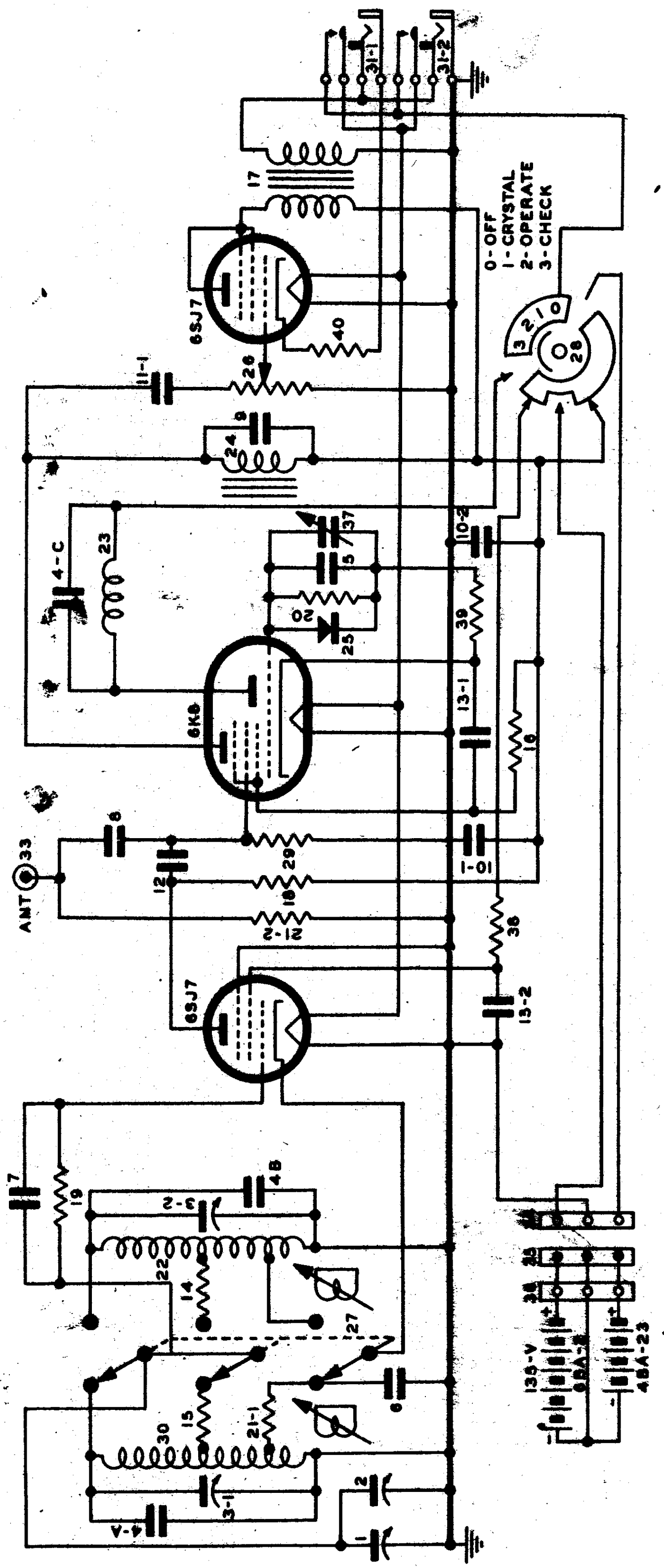
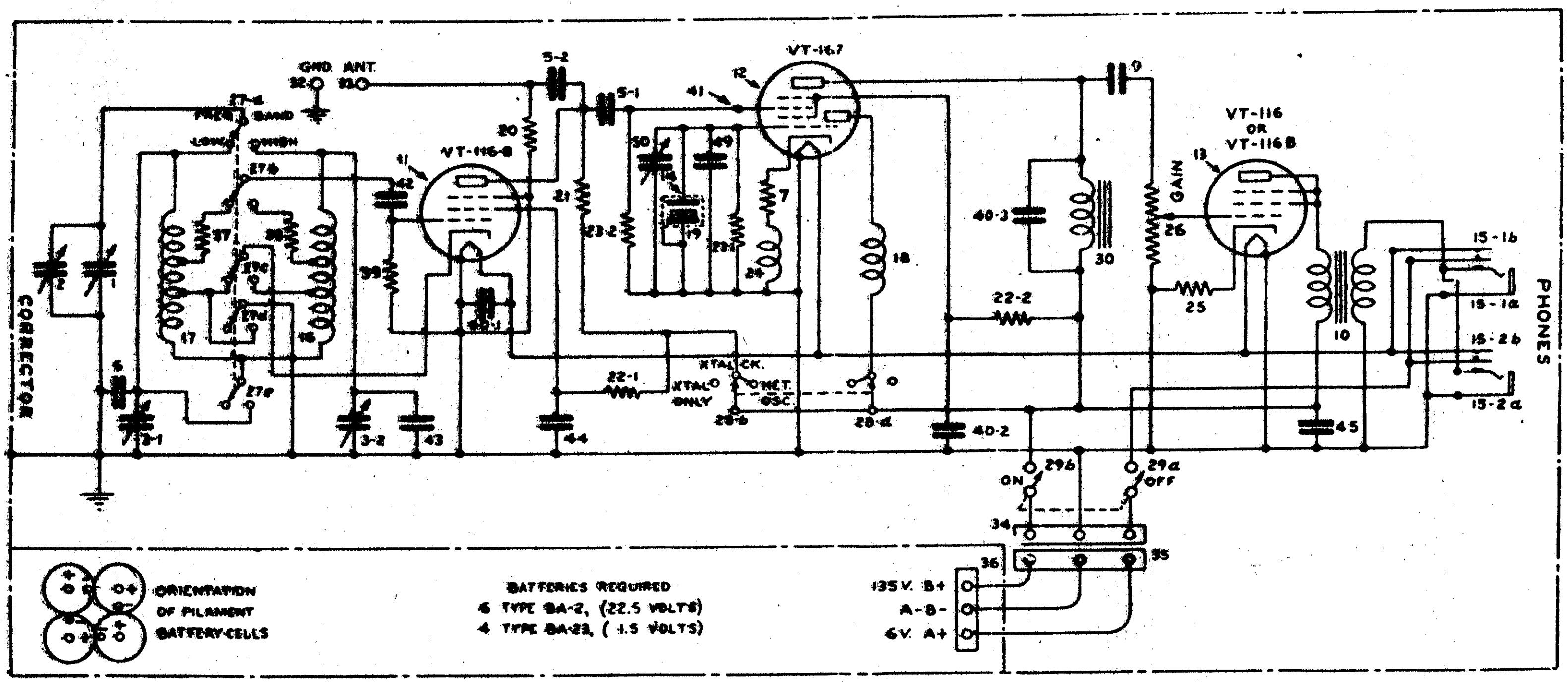


Figure 8-13. Frequency Meter BC-221-AE—Schematic Diagram



REF.	DESCRIPTION	REF.	DESCRIPTION	REF.	DESCRIPTION	REF.	DESCRIPTION
1	160 μμf	15-2a	Phone Jack	24	15.8 Micro-H	38-1	350 Ohm
2	3 μμf	15-2b	Fil. Switch	25	1,000 Ohm	39	150,000 Ohm
3-1	10 μμf	16	34.0 Micro-H	26	0.5 Megohm	40-1	.001 μf
3-2	10 μμf	17	9.06 Milli-H	27a thru 27e	Switch	40-2	.001 μf
5-1	10 μμf	18	735 Micro-H			40-3	.001 μf
5-2	10 μμf	19	Crystal			42	100 μμf
6	7 μμf	20	5,000 Ohm	28a 28b	Switch	43	10 μμf
7	180 Ohms	21	50,000 Ohm			44	0.1 μf
9	.02 μf	22-1	8,750 Ohm	29a	Switch	45	0.7 μf
10	0.5 μf	22-2	8,750 Ohm	29b	Switch	49	8.0 μμf
15-1a	Phone Jack	23-1	1 Megohm	30	450 Henries	50	14.5 μμf
15-1b	Fil. Switch	23-2	1 Megohm	37	8,750 Ohm		

Figure 8-14. Frequency Meter BC-221-AF—Schematic Diagram

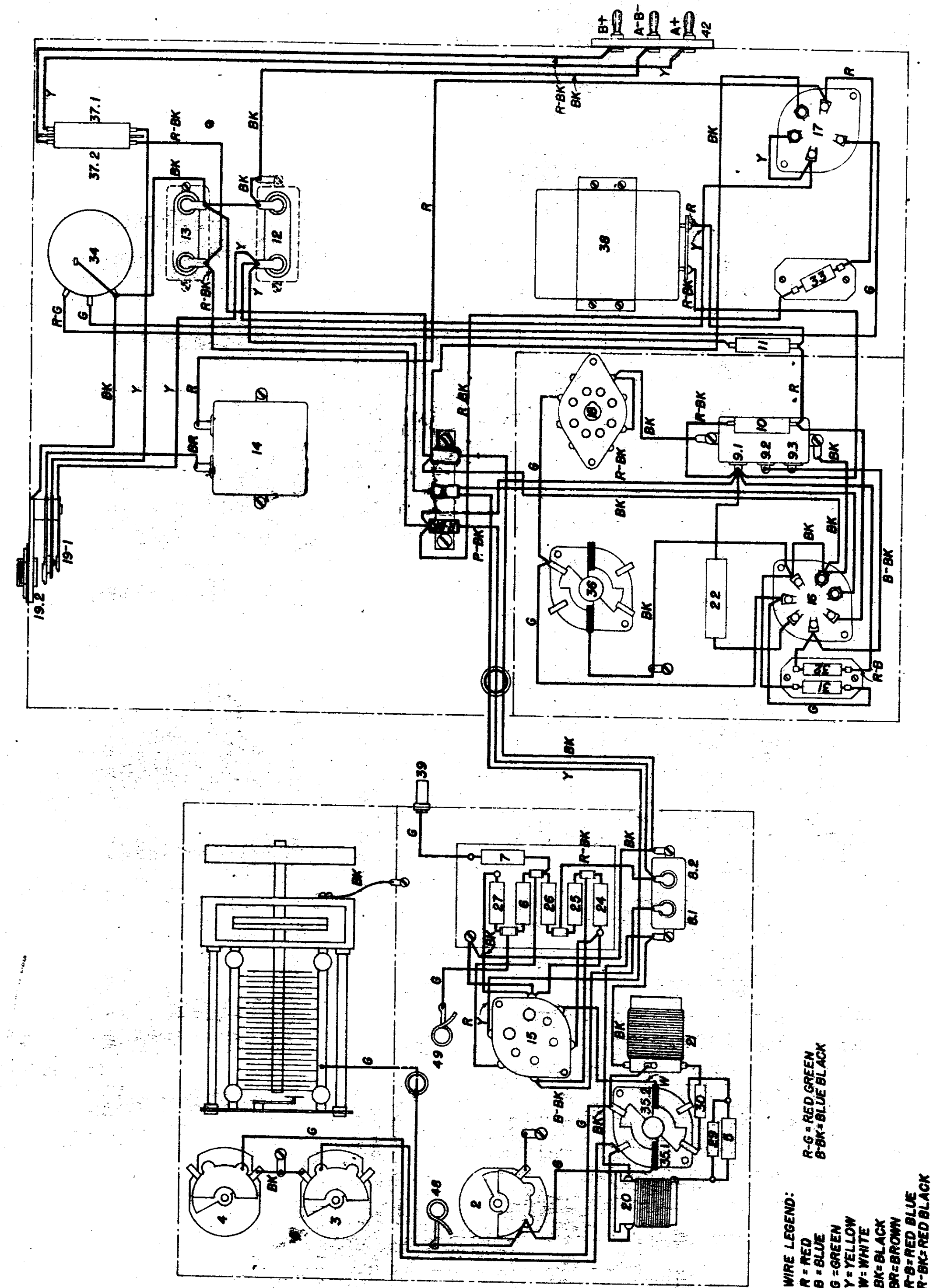


Figure 8-15. Frequency Meter BC-221-A—Chassis Wiring Diagram

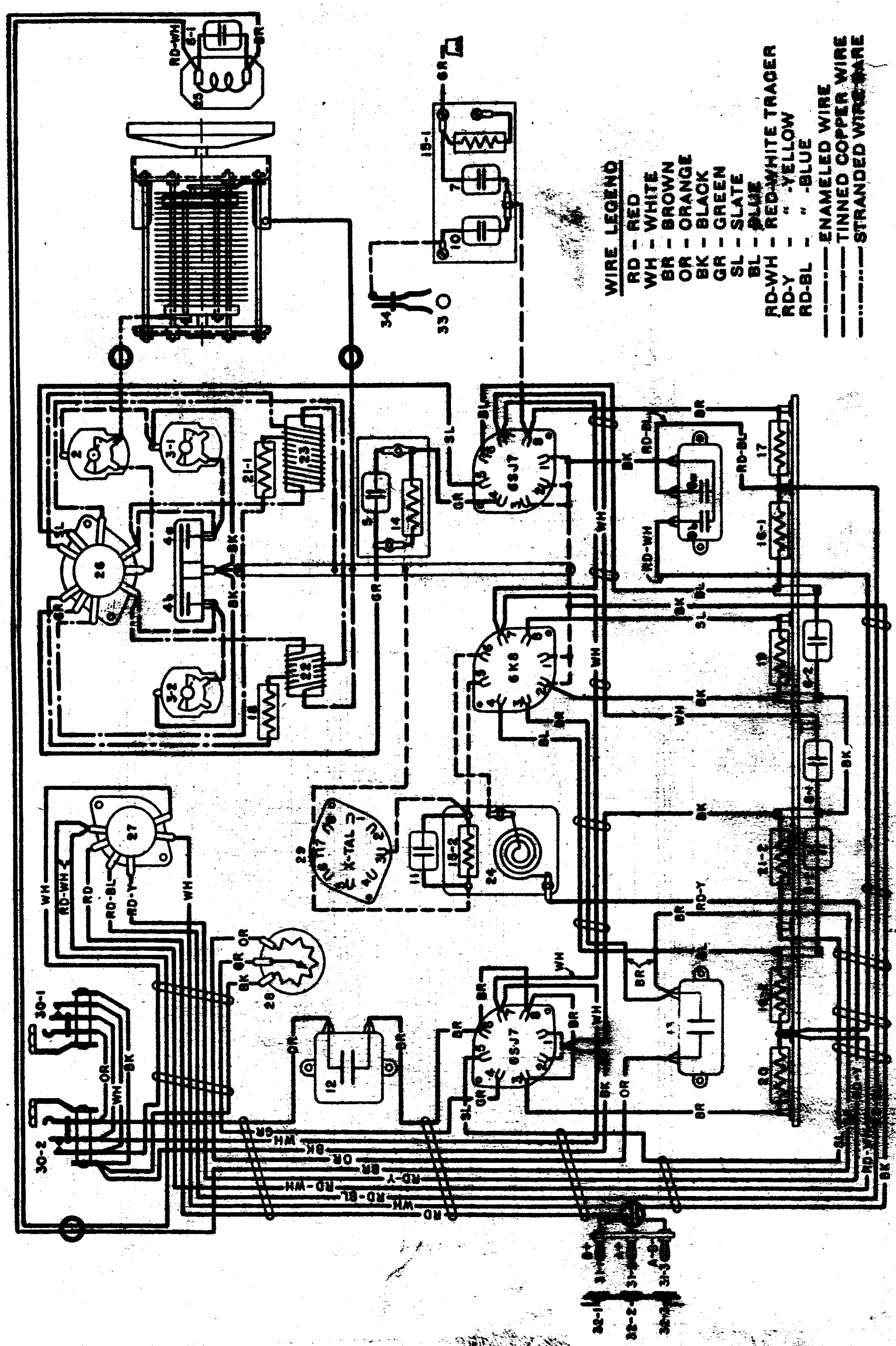


Figure 8-16. Frequency Meter BC-221-B—Chassis Wiring Diagram

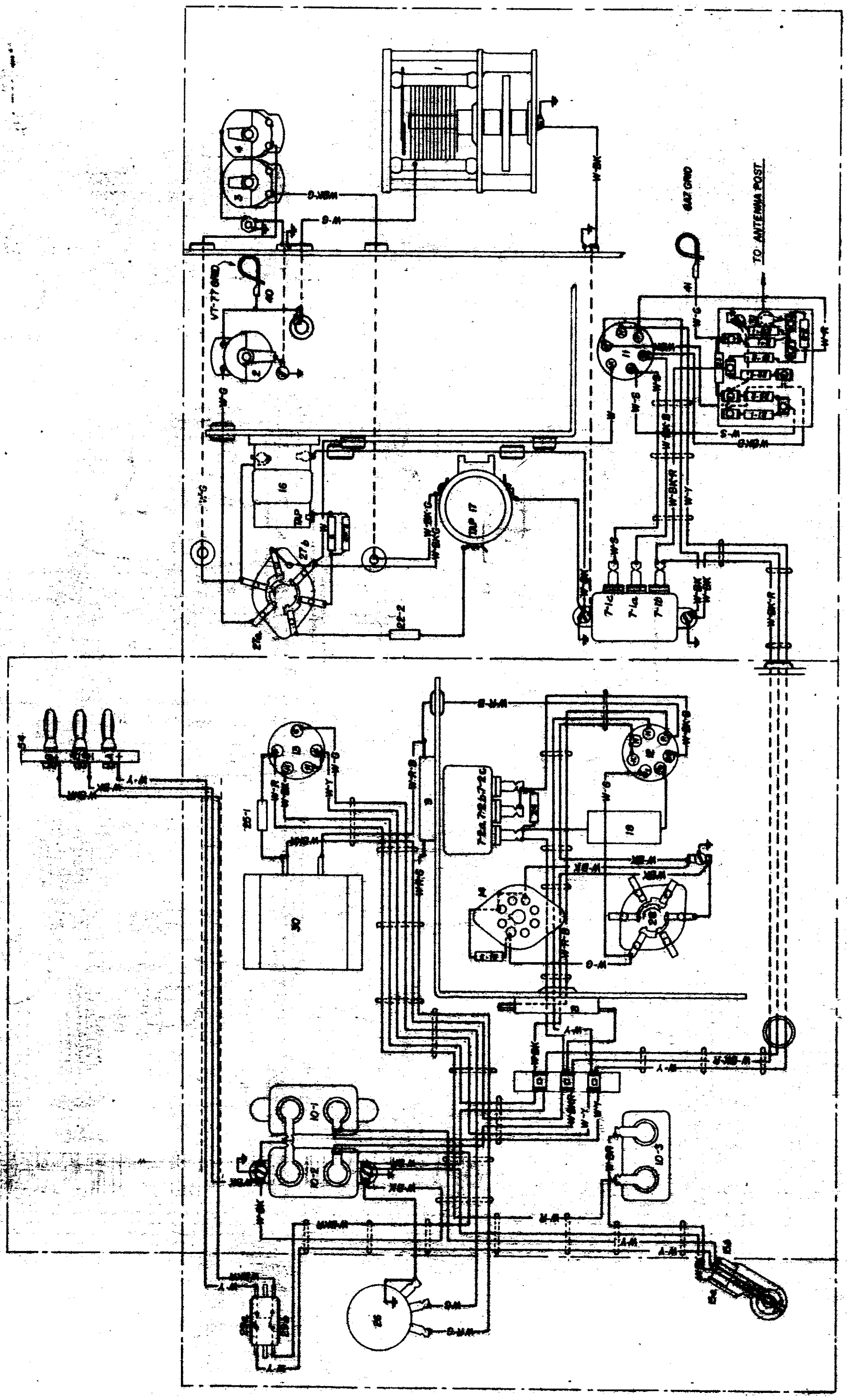


Figure 8-17. Frequency Meters BC-221-C and BC-221-D—Chassis Wiring Diagram

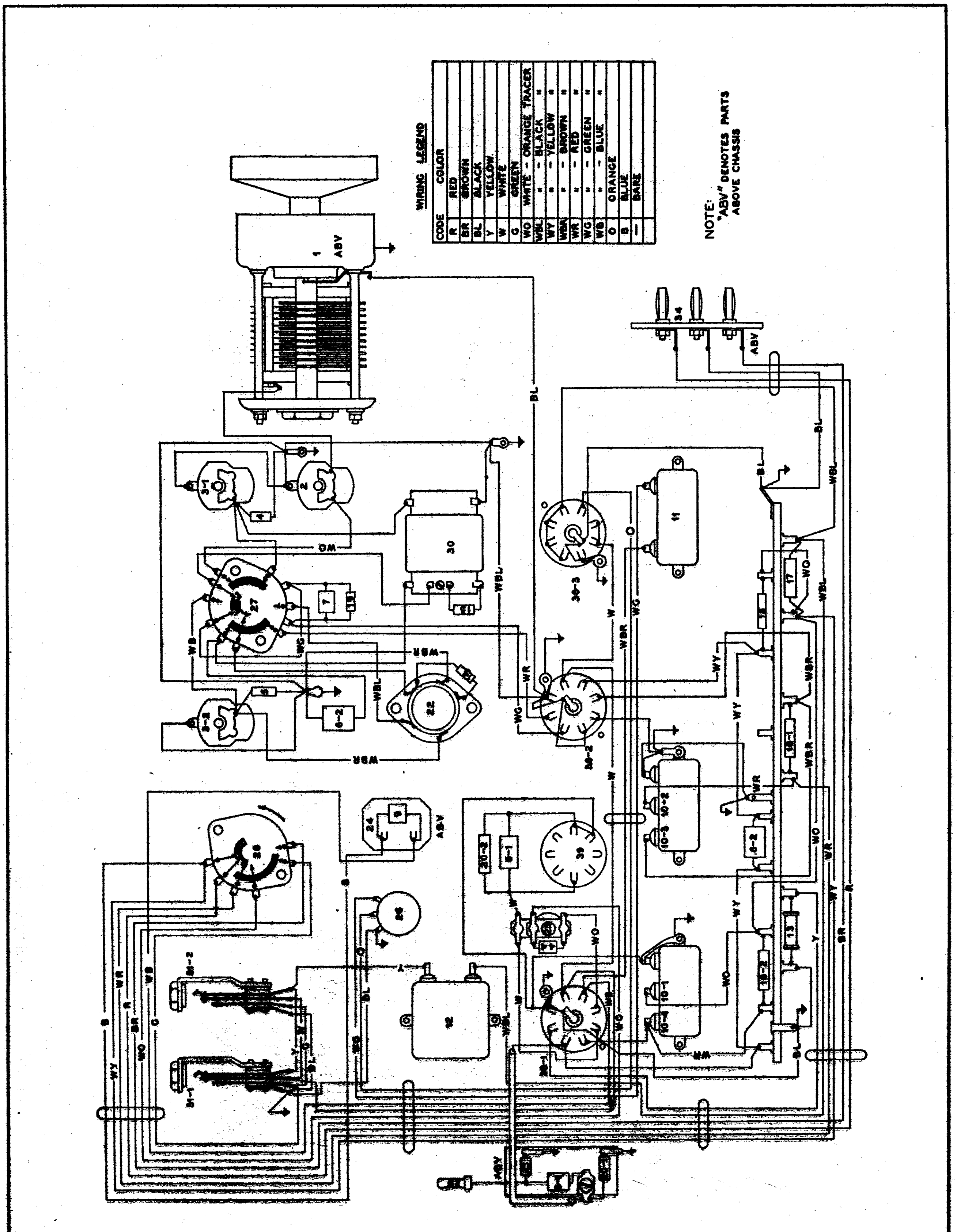


Figure 8-18. Frequency Meter BC-221-E—Chassis Wiring Diagram

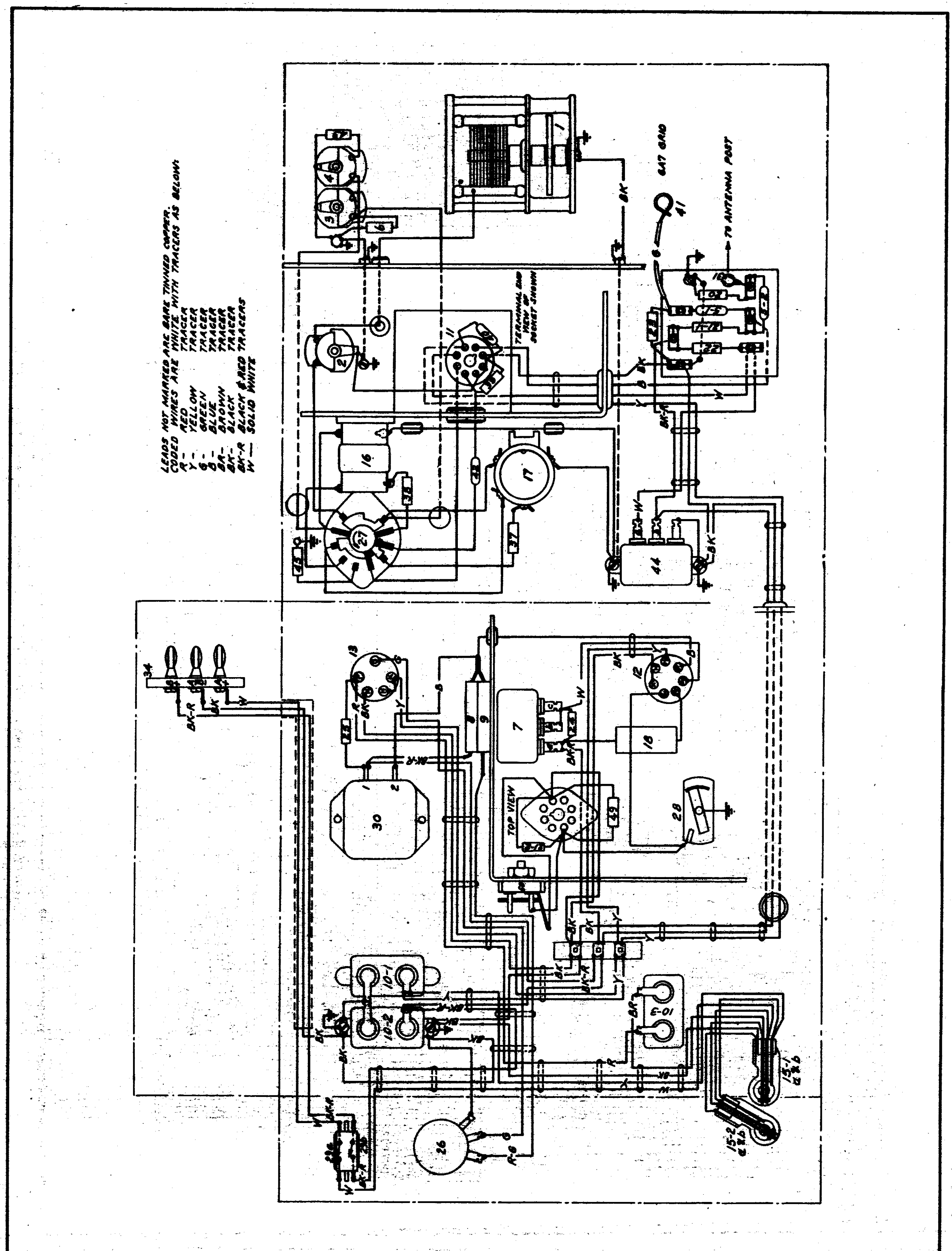


Figure 8-19. Frequency Meters BC-221-F, BC-221-J, BC-221-K, and BC-221-L—Chassis Wiring Diagram

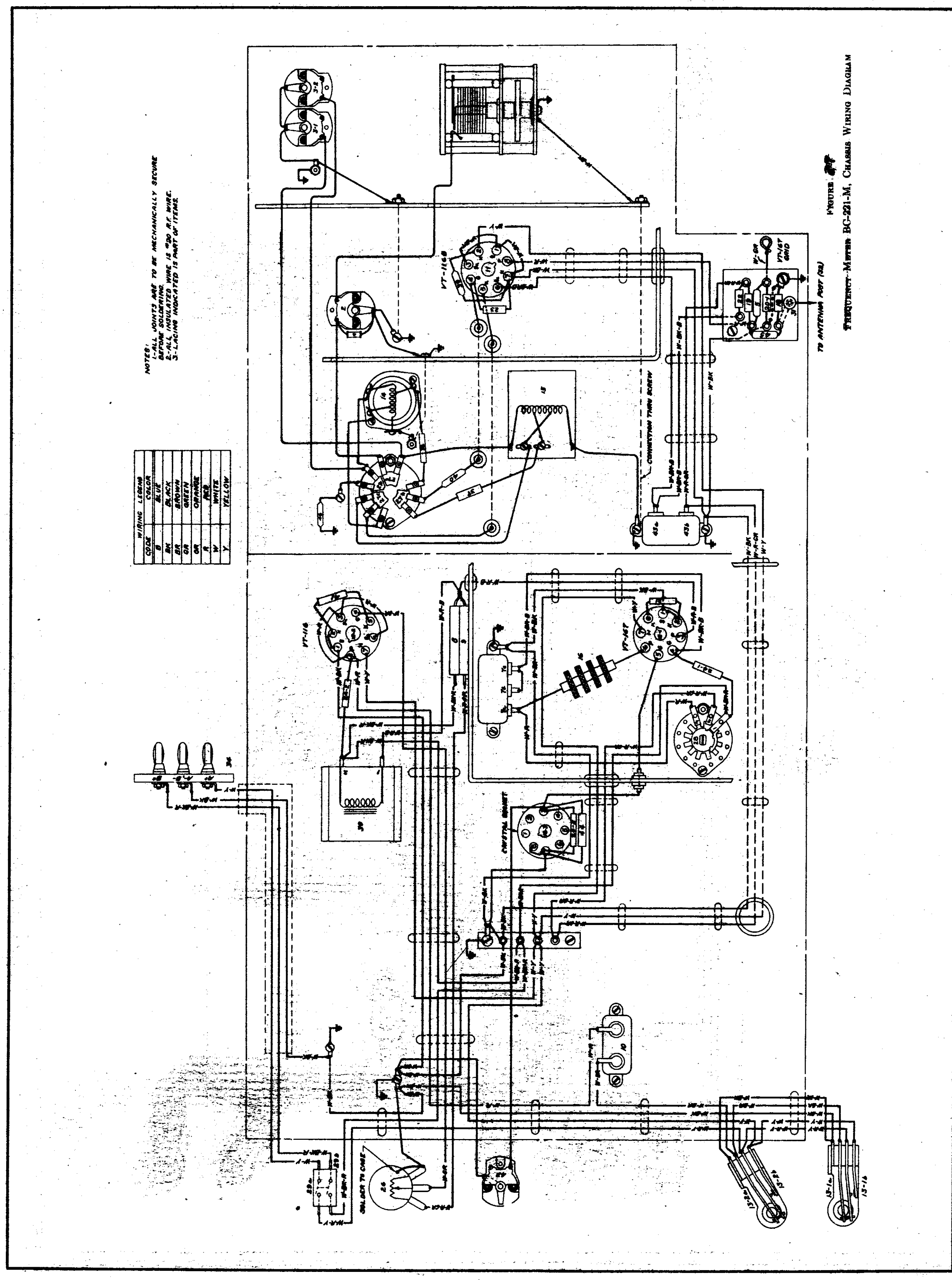


Figure 8-20. Frequency Meter BC-221-M—Chassis Wiring Diagram

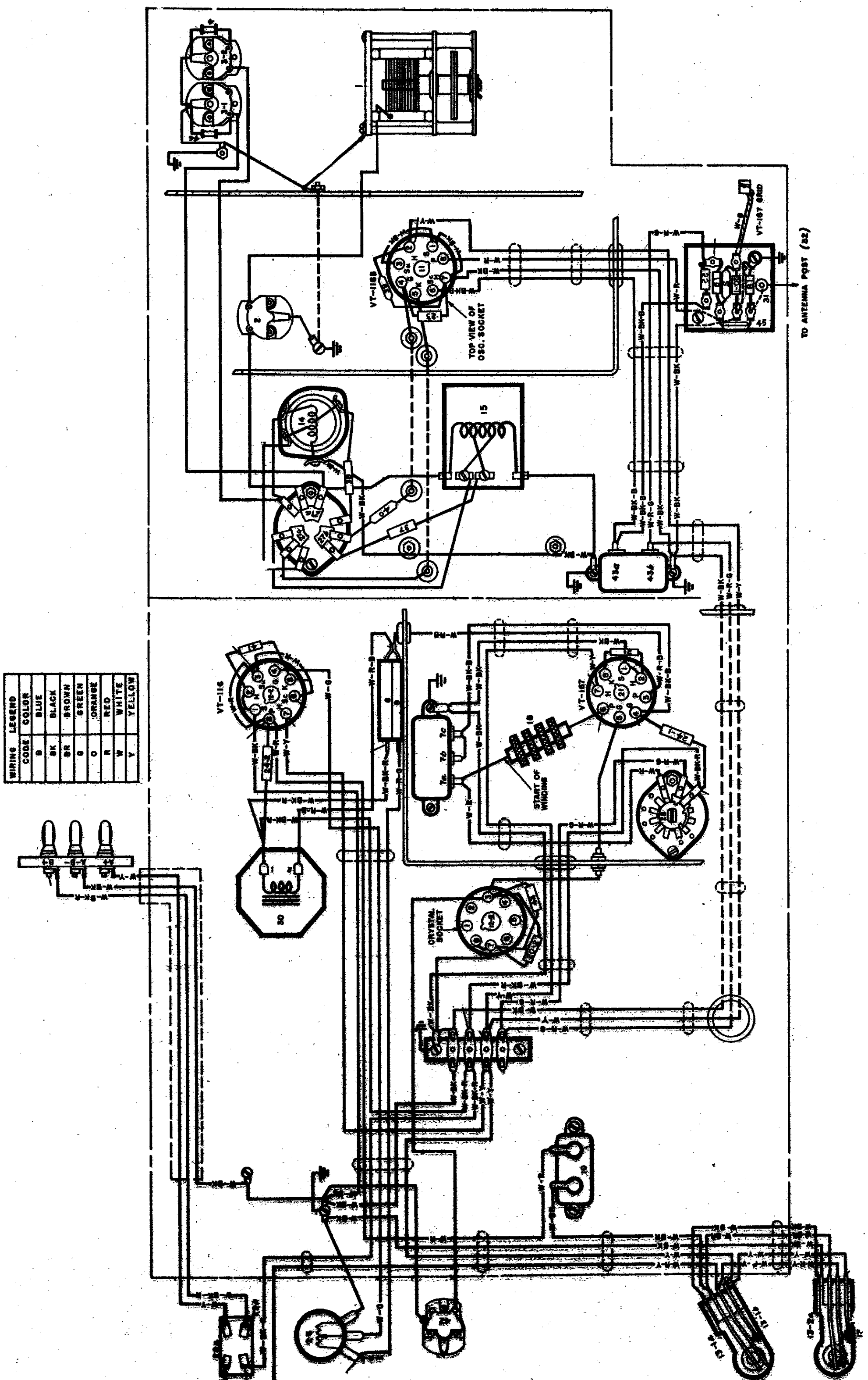


Figure 8-21. Frequency Meters BC-221-O and BC-221-R—Chassis Wiring Diagram

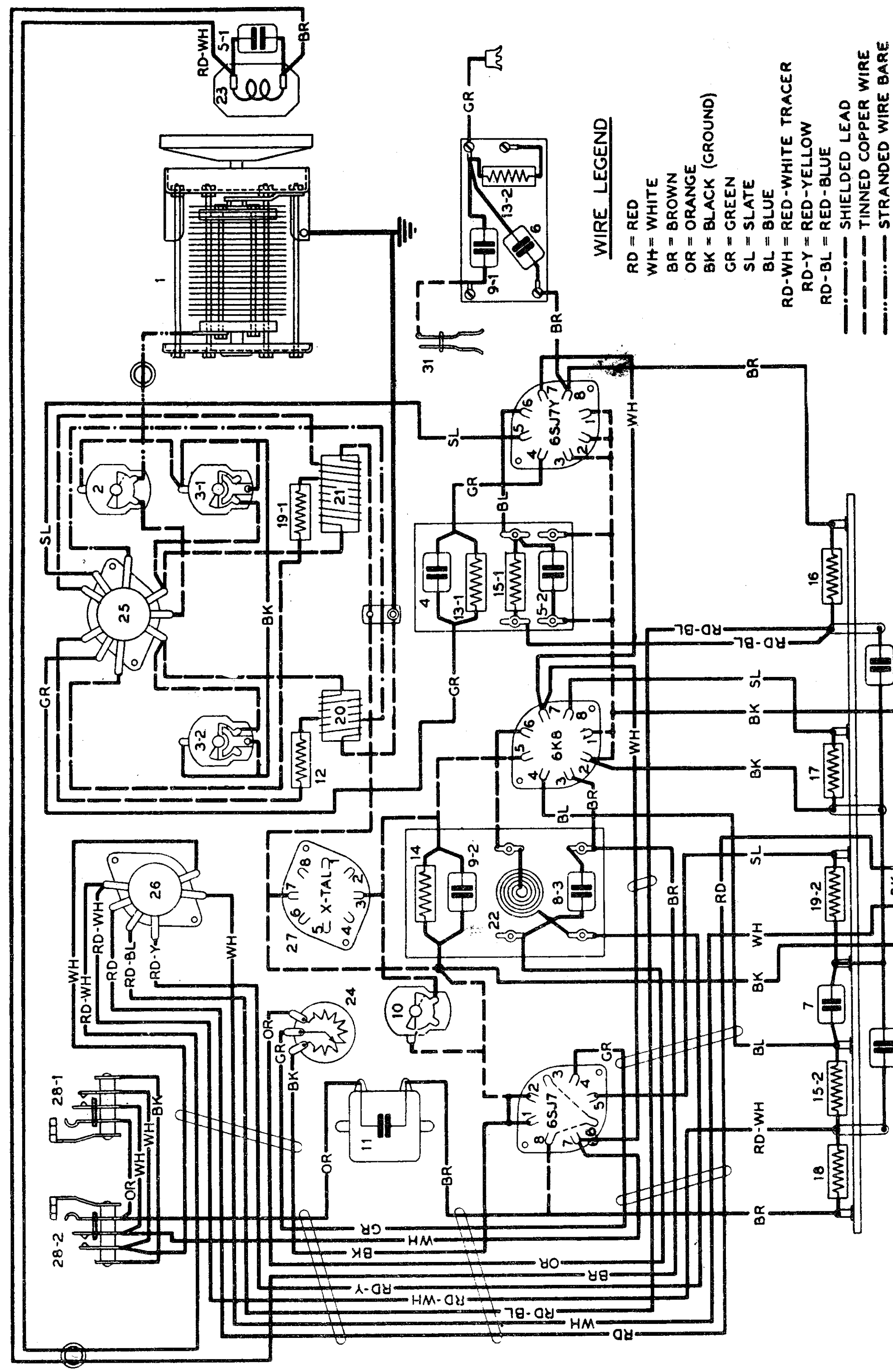


Figure 8-22. Frequency Meter BC-221-Q—Chassis Wiring Diagram

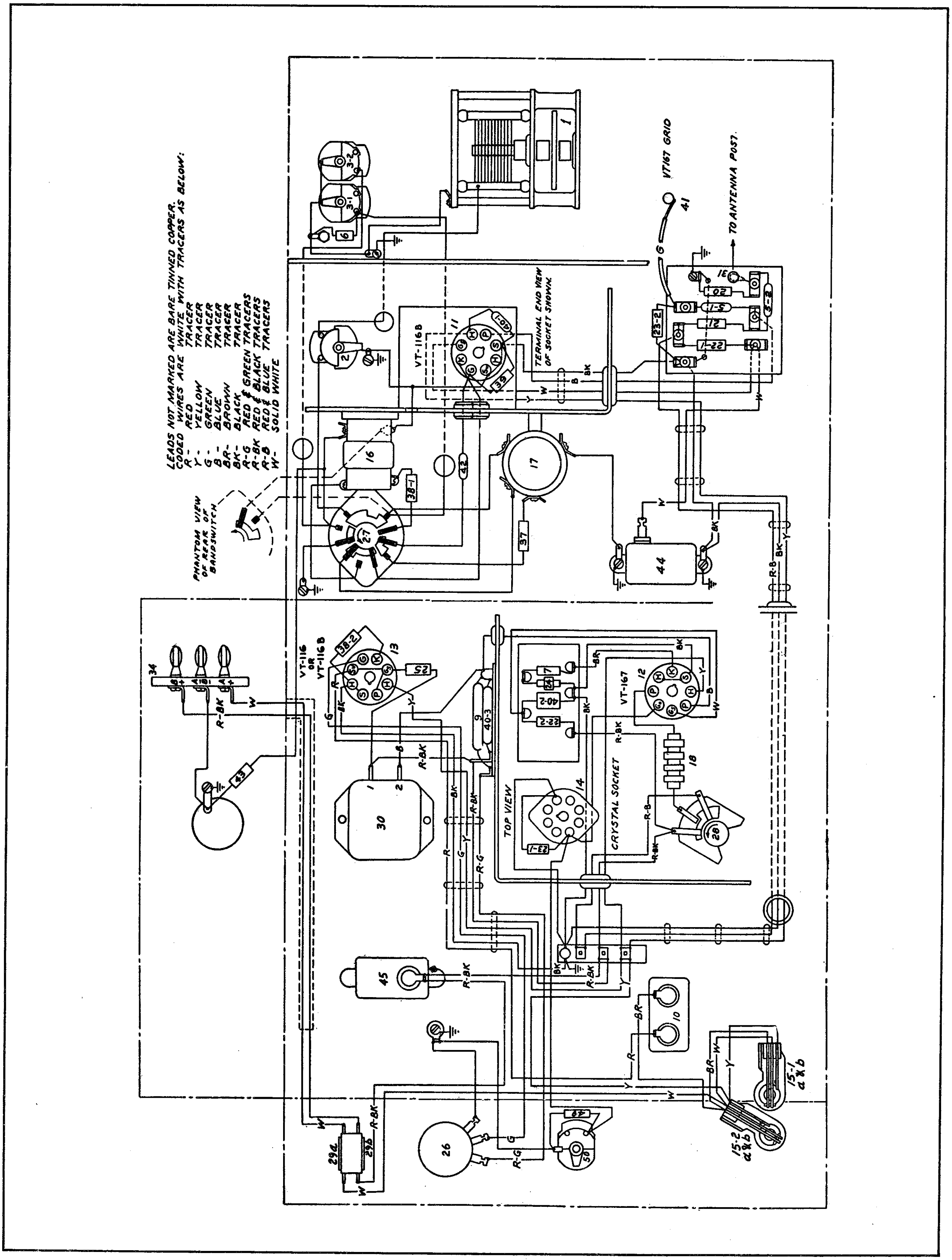


Figure 8-23. Frequency Meters BC-221-P and BC-221-T—Chassis Wiring Diagram

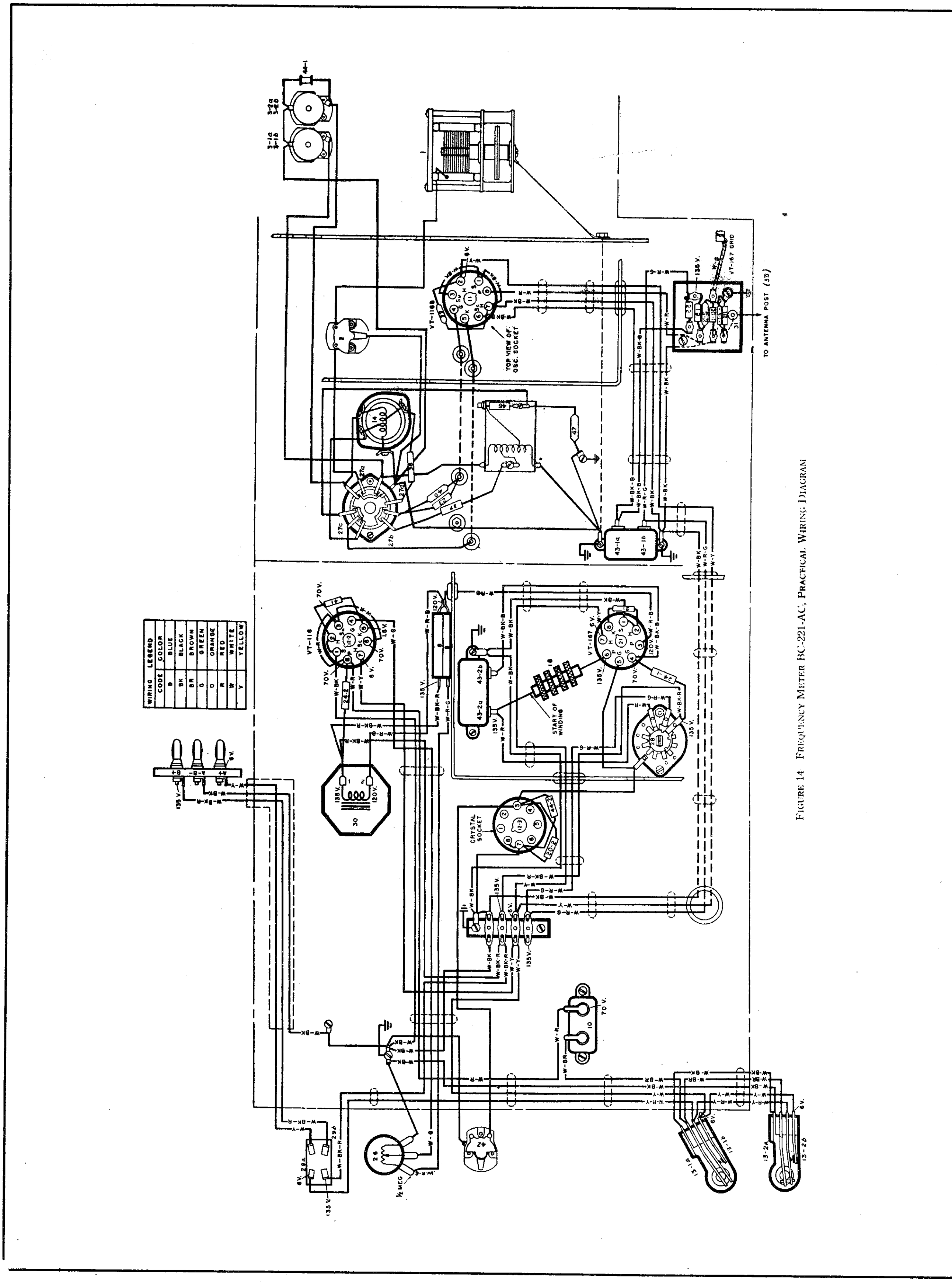


Figure 8-24. Frequency Meter BC-221-AF—Chassis Wiring Diagram

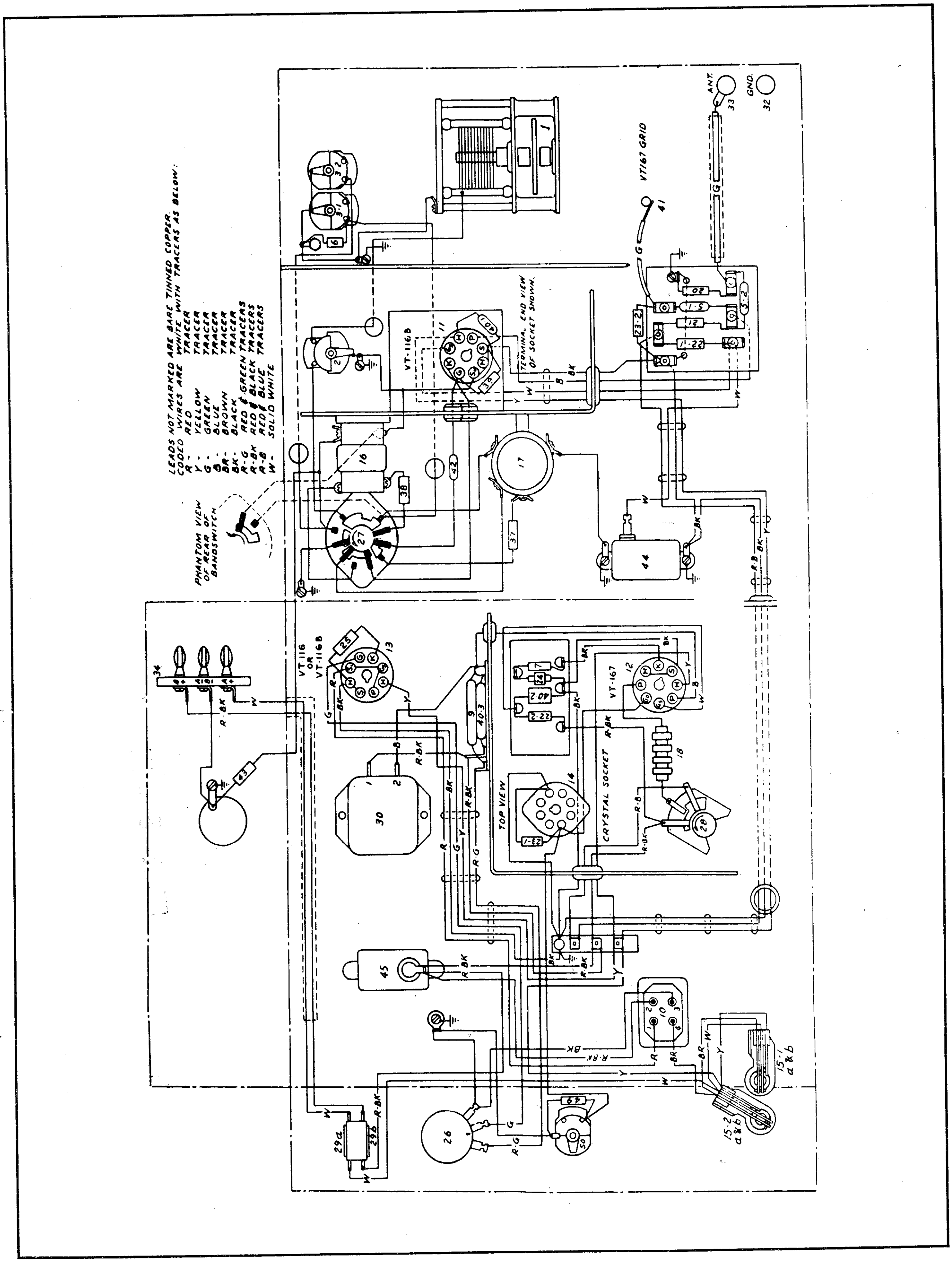


Figure 8-25. Frequency Meter BC-221-AF—Chassis Wiring Diagram