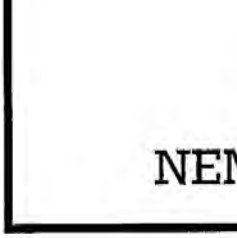
INSTRUCTION BOOK FOR MODEL 1670 SPECIAL PURPOSE RECEIVERS



NEMS CLARKE, INC.

SILVER SPRING, MARYLAND

INSTRUCTION BOOK

FOR

MODEL 1670

SPECIAL PURPOSE RECEIVER

NEMS-CLARKE, Inc.

Silver Spring, Maryland

WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised while working with this equipment.

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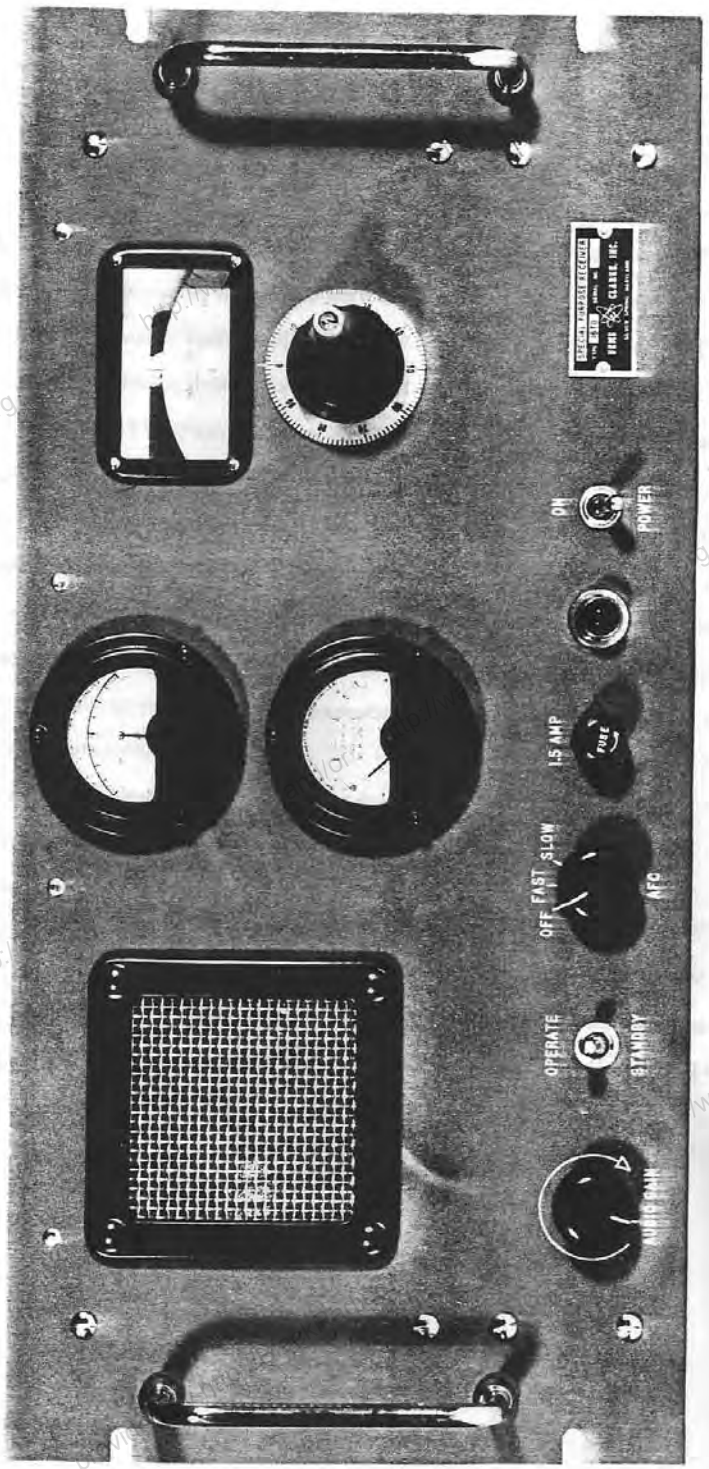


Fig. 1-1. Special Purpose Receiver, Model 1670

MODEL 1670 PERFORMANCE SPECIFICATIONS

	1670-E	1670-F	1670-G	1670-J
Tuning Range	175-260 mc	55-260 mc	175-260 mc	55-260 mc
Bandwidth	500 kc	500 kc	300 kc	300 kc
Noise Figure	10 db, max.	11.5 db, max.	10 db, max.	11.5 db, max.
RF Input	75 ohms, nominal	75 ohms, nominal	75 ohms, nominal	75 ohms, nominal
Sensitivity	8 uv produces at least 22 db S/N with 125 kc deviation and 1000 c.p.s. modulation without band-restricting filters.	8 uv produces at least 21 db S/N with 125 kc deviation and 1000 c.p.s. modulation without band-restricting filters.	8 uv produces at least 24 db S/N with 100 kc deviation and 400 c.p.s. modulation without band-restricting filters.	8 uv produces at least 23 db S/N with 100 kc deviation and 400 c.p.s. modulation without band-restricting filters.
IF Frequency	21.4 mc	21.4 mc	21.4 mc	21.4 mc
IF Rejection	70 db, min.	70 db, min.	70 db, min.	70 db, min.
Image Rejection	40 db, min.	40 db below 130 mc. 30 db min. at any frequency.	40 db, min.	40 db below 130 mc. 30 db min. at any frequency.
The Characteristics Shown Below Are Common to All Models of the Receiver				
Discriminator Linearity	± 150 kc, min.			
Video Frequency Response	20 c.p.s. to 100 kc into 20,000-ohm load			
Output	0.15 v/kc deviation			
Internal Impedance of Output Circuit	400 ohms, approx.			
Output Stability	2 db, max., for input voltages from 4 uv to 10,000 uv			
Automatic Frequency Control	3-position switch: "OFF," "FAST" (2.5 milliseconds), "SLOW" (100 milliseconds)			
Signal Strength Meter	2 uv to 10,000 uv scale			
Size	8 3/4" high x 19" wide x 13" deep			
Weight	27 lbs.			
Power Requirements	117 volts, 50 to 400 c.p.s., 68 watts			

Table 1-1. Performance Specifications

Symbol	Type	Function
V-101	5Y3	Rectifier
V-102	OD3	Voltage Regulator
V-103	12AU7	Video Amplifier
V-104	12AU7	Video Output
V-105	12AU7	Audio Output
V-201	6J4	Grounded Grid RF Amplifier
V-202	6AK5	Mixer
V-203	6J6	Local Oscillator
V-301	6CB6	First IF Amplifier
V-302	6CB6	2nd IF Amplifier
V-303	6CB6	First Limiter
V-304	6AK5	2nd Limiter
V-305	6AL5	Discriminator

Table 1-2. Tube Complement

SECTION 1

GENERAL DESCRIPTION

1. PURPOSE OF EQUIPMENT.

The Model 1670 Special Purpose Receiver has been specifically designed to meet the requirements of such applications as telemetering, guided-missile monitoring, radiosonde reception, television sound rebroadcasting, and numerous other uses where receivers of superior performance are needed. Basically a high-quality FM receiver covering a tuning range of 55-260 mc, the receiver features AFC, dual limiters, video response to 100 kc, low output distortion, and good sensitivity. Contributing to its ease of operation and versatility are the built-in audio amplifier for monitoring purposes, center tuning meter, and signal strength meter. Means are included for operating an external 10-ma recorder for permanent signal strength records, and a jack is provided for connecting a standard panoramic adapter to the receiver.

The receiver operates with a 117-volt power source at any frequency between 50 and 400 cycles, and requires 68 watts of power.

2. DESCRIPTION OF EQUIPMENT.

The Model 1670 receiver is 8 3/4 inches high by 19 inches wide by 13 inches deep. Panel and chassis are of aluminum construction, and the panel is finished in smooth gray enamel. The panel is designed for standard 19-inch relay rack mounting, although the unit is so designed that it may be used independently on a shelf or table. Terminal boards are used where practical, and the IF amplifier and RF tuner are built as completely shielded subassemblies.

Special notice should be taken of the fact that Models 1670-E and 1670-G employ a type "A" RF strip, while Models 1670-F and 1670-J employ a type "B" RF strip. Models 1670-E and 1670-F employ a type "A" IF strip, and Models 1670-G and 1670-J employ a type "B" IF strip. Reference to these components will be in accordance with the above.

SECTION 2

THEORY OF OPERATION

1. ANALYSIS, MODEL 1670 RECEIVER.

a. A block diagram of the receivers in the 1670 line is shown in Fig. 2-1. The tuner is designed to produce moderate noise figures in the frequency range covered without resorting to special tubes with critical operating conditions.

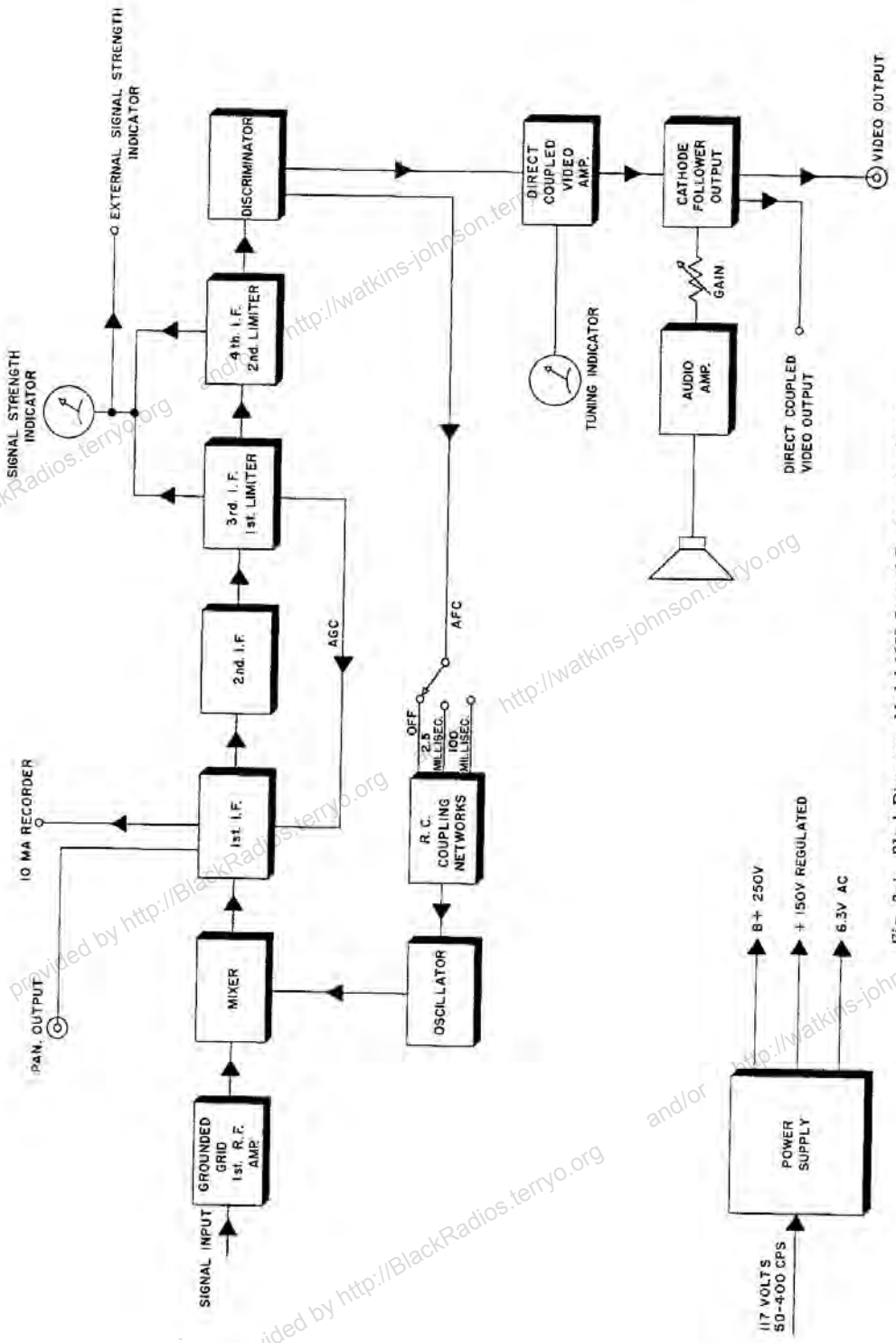


Fig. 2-1. Block Diagram, Model 1670 Special Purpose Receivers

The IF amplifier consists of two stages of amplification followed by two limiters and a phase-shift discriminator. An AGC voltage obtained at the first limiter grid is applied to the first IF amplifier. This allows the first two IF amplifiers to operate in a linear fashion over the entire range of signal inputs.

The output of the discriminator has a d-c component proportional to the difference between the frequency of the signal being received and that to which the receiver is tuned. If the "AFC" selector switch is in other than the "OFF" position, this voltage is applied to a reactance tube shunted across the oscillator to provide automatic frequency control. Thus, with this circuit in operation the effective drift in frequency of either transmitter or receiver is reduced. The composite discriminator output which contains the video output is amplified by two direct-coupled amplifiers. A direct-coupled output and a capacitively coupled output are provided on the rear apron of the receiver.

b. ANTENNA.--The input impedance of the receiver is approximately 75 ohms unbalanced over the range of frequencies covered by the various models of the 1670. A type "N" 50-ohm coaxial receptacle is provided for the signal input on the rear apron of the chassis.

c. FIRST RF STAGE.--The input signal is applied to the cathode of a 6J4 grounded-grid stage which is tuned by one section of the four-section inductuner. The plate of the 6J4 is coupled to the grid of the 6AK5 pentode mixer by a double-tuned bandpass filter. A capacitive "T" network is used to provide coupling between the primary and secondary tuned circuits. The shunt capacitor of the "T" is adjustable, thus providing control of the interstage bandwidth. Across this capacitor is a small iron-core inductor which approaches parallel resonance at 55 mc, thereby increasing the coupling at low frequencies and providing a more uniform coupling over the tuning range of 55 to 260 mc. The narrow-range front end (Type A 175-260 mc) used in the 1670-E and 1670-G does not have this inductor.

d. MIXER.--A 6AK5 pentode is used as a mixer. The oscillator signal is injected into the grid circuit, developing an operating bias proportional to the amplitude of the local oscillator signal. This causes a minimum effect on the receiver operation due to variations in local oscillator amplitude. A decoupled test point from a tap on the mixer grid resistors provides a convenient means for observing the response of the RF circuits.

e. LOCAL OSCILLATOR AND REACTANCE TUBE.--A 6J6 dual triode is used for these functions. One half serves as a modified Colpitts oscillator tuned by a section of the inductuner. Tracking is obtained by the use of an end inductor to control the high frequency end and a shunt inductor to adjust the low frequency end. The oscillator operates on the high side of the signal frequency. Frequency control of the oscillator is realized by using the other triode section as a reactance tube, thus providing automatic frequency control at the option of the user.

f. IF AMPLIFIER.--The 1670-E and 1670-F have an IF bandwidth of 500 kc. In the 1670-G and 1670-J, coupling and loading of the IF transformers has been modified to obtain a bandwidth of 300 kc; otherwise the two amplifiers are the same. The first two stages use 6CB6's with the first stage being gain controlled. The next stage is another 6CB6 used as a grid-leak limiter, which in turn drives a 6AK5 second grid-leak limiter. Rectified voltages appearing at the grids of the two limiters are added to produce a signal strength indication. Provision is made for an external signal strength meter on the rear apron of the chassis. A current of approximately 50 microamperes is obtained with an input signal of 10 millivolts. As it may be desirable to continuously record signal level, the combined plate and screen currents of the first IF amplifier, which has AGC, are made available on the rear of the receiver. By adjusting R-103 this current may be set to a value of 10 ma with no signal input. Under this condition the current will decrease in a quasi-logarithmic manner as the signal is increased. An approximate recorder calibration can be obtained by a comparison of the recorder reading to the signal strength meter on the panel of the receiver for different signal inputs. Following the second limiter is a discriminator using a 6AL5. Every effort has been made to insure the utmost in linearity so the output distortion will be low. To prevent temperature variations from causing distortion, the primary and secondary of the discriminator have been carefully compensated by the use of temperature-compensating capacitors.

g. VIDEO AMPLIFIERS.--The output of the discriminator drives one half of a 12AU7 as a direct-coupled video amplifier. A zero-center meter is used as a tuning indicator and is connected in a bridge circuit consisting of the video amplifier and the other half of the 12AU7. The output video amplifier is a 12AU7 tube connected as a direct-coupled cathode follower. A tap on the cathode resistor of the output amplifier provides the signal to operate the audio amplifiers.

h. AUDIO AMPLIFIER.--The output of V-104 is used to operate a two-stage resistance-coupled audio amplifier. The output amplifier drives a four-inch panel-mounted speaker.

i. PANORAMIC OUTPUT.--An output at the IF frequency is provided for connection to a panoramic adapter. This output is obtained from the 6AK5 mixer plate load through a capacity divider. A special panoramic adapter, type no. T-3000 CI, may be secured from Panoramic Radio Products, Inc., 10 South Second Avenue, Mount Vernon, New York.

j. POWER SUPPLY.--A conventional two-section capacitive input filter power supply delivers an output of 240 volts. V-102 provides a source of regulated 150 volts DC to supply the local oscillator and IF amplifier of the receiver.

SECTION 3

OPERATION

1. INTRODUCTION.

Fig. 1-1 shows the appearance and location of controls on the front panel of Model 1670 receivers.

2. CONTROL SETTINGS.

a. With the receiver connected to a source of 117 volts, 50 to 400 cps, turn the power switch to the "ON" position.

b. Advance the audio gain control, place the "Stand-by Switch" in the "OPERATE" position, and set the AFC switch to "Off." If the receiver is not tuned to a signal, the characteristic hiss of thermal agitation noise in the input circuits will be heard.

c. Tune the receiver to the desired signal. Proper tuning is indicated by a "zero" reading of the tuning meter. An approximate indication of the voltage at the input terminals is given by the "Signal Level" meter.

d. Compensation for frequency drift of transmitter or receiver is obtained in either the "FAST" or "SLOW" position of the AFC selector switch. The choice between "FAST" (2.5 milliseconds) and "SLOW" (100 milliseconds) is determined by the lowest modulation frequency that has to be reproduced in the video output. If low frequencies are required, the "SLOW" position is the one to use. Otherwise the "FAST" position is recommended so the automatic frequency control loop will be as tight as possible.

SECTION 4

MAINTENANCE

1. INTRODUCTION.

Model 1670 receivers are designed to give trouble-free performance in the field with a minimum of routine maintenance. High-quality components are used throughout. All meters, transformers, and chokes are hermetically sealed; no electrolytic capacitors are used. All components are operated well within their safe design limits, and the entire assembly is treated to reduce the effect of moisture and fungus.

Experience has shown that the most common trouble is a defective tube. In this case it is only necessary to locate and replace the tube in question to restore the receiver to operation.

In the event of more serious troubles the schematic diagram and voltage chart will prove invaluable in the location and correction of trouble.

Normally the receiver will maintain good alignment for long periods of time. Changing a tube will cause only minor detuning of the RF and IF circuits, so realignment is unnecessary. In case the user wishes to check or realign the receiver in the field, the procedure outlined in this section may be followed.

2. EQUIPMENT REQUIRED.

a. Sweep generator -- RCA WR59B modified for continuous coverage to 260 mc.

b. Marker generator -- RCA WR89A or equivalent.

c. Oscilloscope -- Dumont 304A or equivalent.

d. Milliampere meter -- 0-15 ma.

3. PRELIMINARY ADJUSTMENTS FOR 1670 RECEIVERS.

a. ZERO ADJUSTMENT OF TUNING METER.--Ground pin 2 of V-103. Adjust R-110 until the tuning meter reads "zero."

b. RECORDER FULL SCALE ADJUSTMENT.--With no input signal to receiver, insert D. C. milliammeter between terminals 4 and 5 of the terminal block on the rear of the receiver. Set "RECORDER ADJ." (R-103) so the meter indicates 10 milliamperes.

c. DIAL ADJUSTMENT.

(1) TYPE "A" FRONT END (175-260 MC).--Tune the receiver to as high a frequency as the inductuner stops will allow. The indicator should line up with the mark on the end of the frequency scale. If this is not the case, it will be necessary to loosen the two Allen set screws and position the dial until they do line up.

(2) TYPE "B" FRONT END (55-260 MC).--Tune the receiver to as low a frequency as the stops on the inductuner will allow. The indicator should then line up with the mark on the low end of the dial. If this is not the case, loosen the two Allen set screws and position the dial until they do line up.

4. IF ALIGNMENT PROCEDURE FOR 1670 RECEIVERS.

Allow receiver to warm up for 30 minutes. Turn AFC switch to "OFF" position.

a. PRELIMINARY DISCRIMINATOR ALIGNMENT.

(1) Connect the oscilloscope vertical amplifier to TP-302.

(2) Apply maximum IF output from an RCA 59 sweep generator to pin #1 of 6AK5 second limiter (V-304).

(3) Couple 21.4-mc marker generator to the sweep generator.

(4) Adjust the discriminator secondary so the marker is positioned on the base line, and adjust the primary for equal amplitudes above and below the base line.

b. SECOND LIMITER ADJUSTMENT.

(1) Connect the oscilloscope to C-330.

(2) Apply maximum output from sweep generator to pin #1 of 6CB6 first limiter (V-303) through 470-uuf capacitor. Adjust the transformer slugs for maximum symmetrical response centered around the 21.4 marker. Separation between 70% response points should be approximately 2.5 mc.

c. DISCRIMINATOR TRANSFORMER ADJUSTMENT.

(1) Connect the oscilloscope to TP-302.

(2) Leave generator as in step b.

(3) Adjust the coupling loop in the discriminator transformer for 750-kc $\pm$ 30 kc peak separation with the transformer tuned for 21.4 mc center frequency and equal amplitude peaks. Equal amplitude peaks must be obtained while the marker is disconnected, in order to prevent base line position shift.

d. FIRST LIMITER ADJUSTMENT.

(1) Connect oscilloscope to C-326.

(2) Apply maximum output from sweep generator to pin #1 of 6CB6 second IF amplifier (V-302).

(3) Adjust L-305 and L-306 for maximum symmetrical response centered around the 21.4-mc marker. Separation between 70% response points should be approximately 670 kc for type A, and 410 kc for type B. The response should be centered around the 21.4-mc marker within 20 kc.

e. SECOND IF AMPLIFIER ADJUSTMENT.--If this operation is performed with the bottom plate removed, care must be exercised to prevent coupling from the high level stages to the sweep generator cable.

(1) Ground sweep generator to center of V-301 socket and dress cable away from following stages. Leave oscilloscope connected to C-326.

(2) Connect sweep generator to pin #1 of 6CB6 first IF amplifier (V-301). Keep output level of sweep generator such as to provide same input to scope as in step d with same oscilloscope gain.

(3) Adjust L-304 and L-303 for maximum symmetrical response centered around the 21.4-mc marker within 15 kc. Separation between 70% response points should be approximately 530 kc for type A and 330 kc for type B.

f. FIRST IF AMPLIFIER ADJUSTMENT.

(1) Fasten cover securely on IF strip. Leave oscilloscope connected to C-326.

(2) Connect sweep generator to C-226.

(3) Ground TP-301 directly to chassis. Keep output of sweep generator so same oscilloscope pattern amplitude is obtained as in step e with oscilloscope gain unchanged.

(4) Adjust L-301 and L-302 for maximum symmetrical response centered around the 21.4-mc marker. Separation between 70% response points should be 500 kc ± 100 kc for type A, and 300 kc ± 60 kc for type B.

5. RF ALIGNMENT PROCEDURE FOR 1670 RECEIVERS.

a. PRELIMINARY TRACKING.

(1) Connect marker generator to antenna jack and set to a frequency near the low end of the tuning range. Set the receiver dial to this frequency.

(2) Adjust C-216, C-203, and C-207 for maximum indication on signal level meter. During this adjustment, keep signal level meter indication below 20 uv by reducing output of signal generator.

b. OSCILLATOR TRACKING.

(1) Adjust C-216 for correct tuning-dial indication at 100 mc (190 mc on type A).

(2) Check for correct tuning-dial indication at 255 mc. To correct for a high tuning-dial indication, reconnect C-214 closer to the inductuner.

(3) Alternate between steps (1) and (2) until the stated frequencies are indicated correctly on the dial within ± 0.2 mc.

c. RF AND MIXER TRACKING.

(1) Connect RCA WR-59B sweep generator through 300 ohm BAL/75 ohm UNBAL. matching pad.

(2) Loosely couple marker generator to the input of the receiver.

(3) Connect an oscilloscope across C-226.

(4) Set the receiver dial to 200 mc and adjust sweep generator to produce response curve. Tune marker signal generator to receiver as indicated by panel meters.

(5) Adjust C-203 and C-207 for maximum response centered around the marker signal.

(6) Adjust C-205 for an approximate 10% dip at the 70% response points.

(7) Tune the receiver, sweep generator, and marker generator across the entire tuning range of the receiver. The marker should stay above the 70% response point on the scope trace on type B, and 80% on type A. Decrease capacity of C-205 if necessary to achieve this result.

Tuning of the marker generator may not be necessary if the discontinuity on the scope trace due to loading by the IF strip is noted and used as an indication of frequency to which the receiver is tuned. This effect can be increased by removing V-301.

TUBE	TYPE	PIN #1	PIN #2	PIN #3	PIN #4	PIN #5	PIN #6	PIN #7	PIN #8	PIN #9
V-101	5Y3	NC	*5.05AC	NC	335AC	NC	335AC	NC	*5.05AC	
V-102	OD3	NC	Gnd	150	NC	150	NC	150	NC	
V-103	12AU7	137	.6	7.0	6.2AC	6.2AC	146	Gnd	6.8	Gnd
V-104	12AU7	235	138	140	6.2AC	6.2AC	235	138	140	Gnd
V-105	12AU7	98	0	5.9	6.15AC	6.15AC	230	0	9.2	Gnd
V-201	6J4	Gnd	1.22	Gnd	6.15AC	Gnd	Gnd	148		
V-202	6AK5	-1.50(1)	Gnd	Gnd	6.15AC	145	60	Gnd		
V-203	6J6	121	121	Gnd	6.15AC	-.18	—	1.45		
V-301	6CB6	-.25	.52	6.0AC	Gnd	141	93	Gnd		
V-302	6CB6	0	.82	6.0AC	Gnd	144	79	Gnd		
V-303	6CB6	-.06(2)	Gnd	6.15AC	Gnd	50	50	Gnd		
V-304	6AK5	-1.04(3)	Gnd	6.15AC	Gnd	32	75	Gnd		
V-305	6AL5	.85(4)	—	Gnd	5.0AC	Gnd	Gnd	—		

Table 4-1. Voltage Measurements, Model 1670 Special Purpose Receivers

NOTES: Line voltage: 115VAC, 60 c.p.s.

Dial tuned to 220 mc; no signal; all controls CCW; AFC off.

DC voltages taken with 11-megohm VTVM to ground.

*AC voltage between these points.

(1)Voltage measured at grid test point.

(2)Measured at C-326 TP.

(3)Measured at C-330 TP.

(4)Measured at TP-302, subject to wide variation.

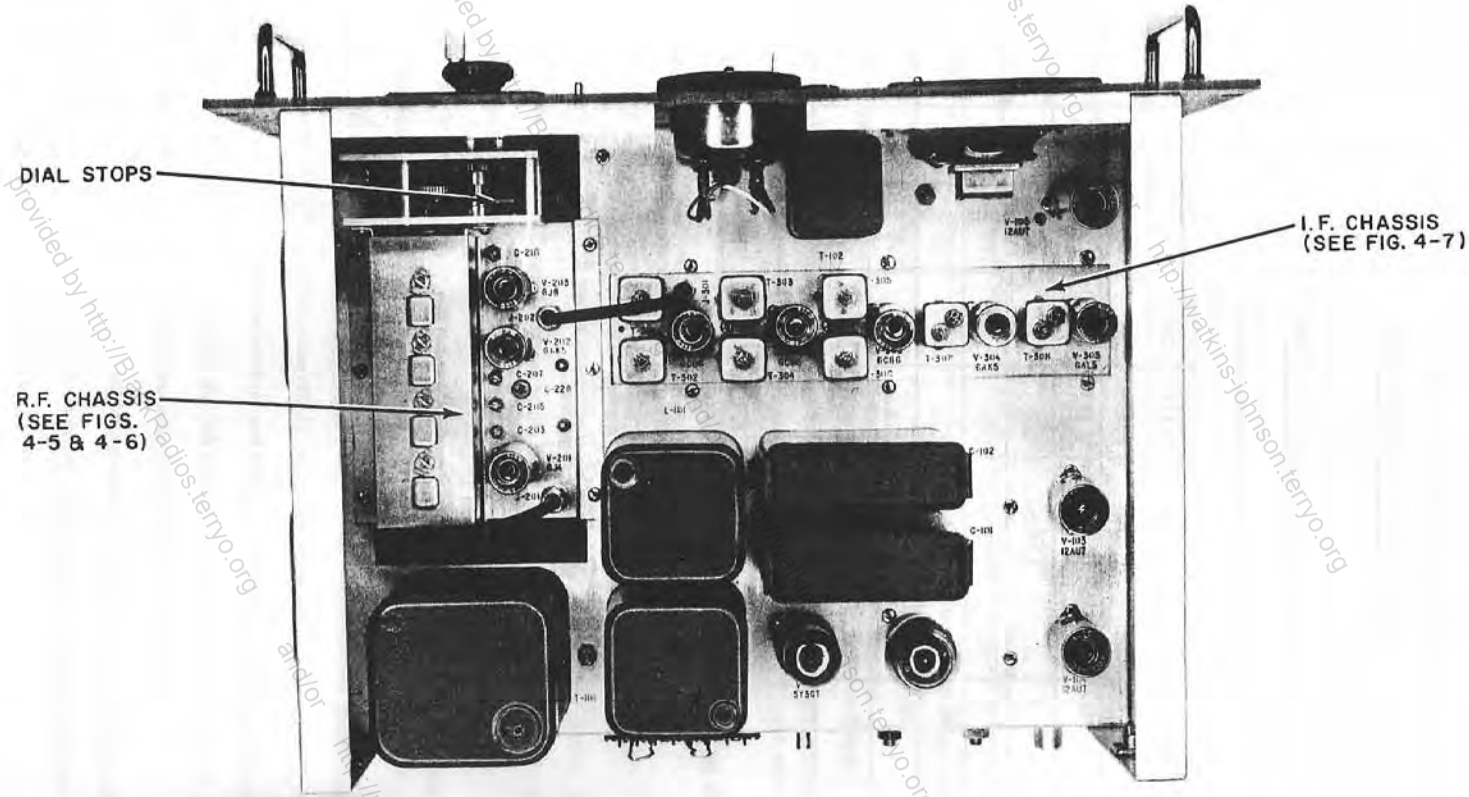


Fig. 4-1. Model 1670 Special Purpose Receiver, Top View (Dust cover removed)

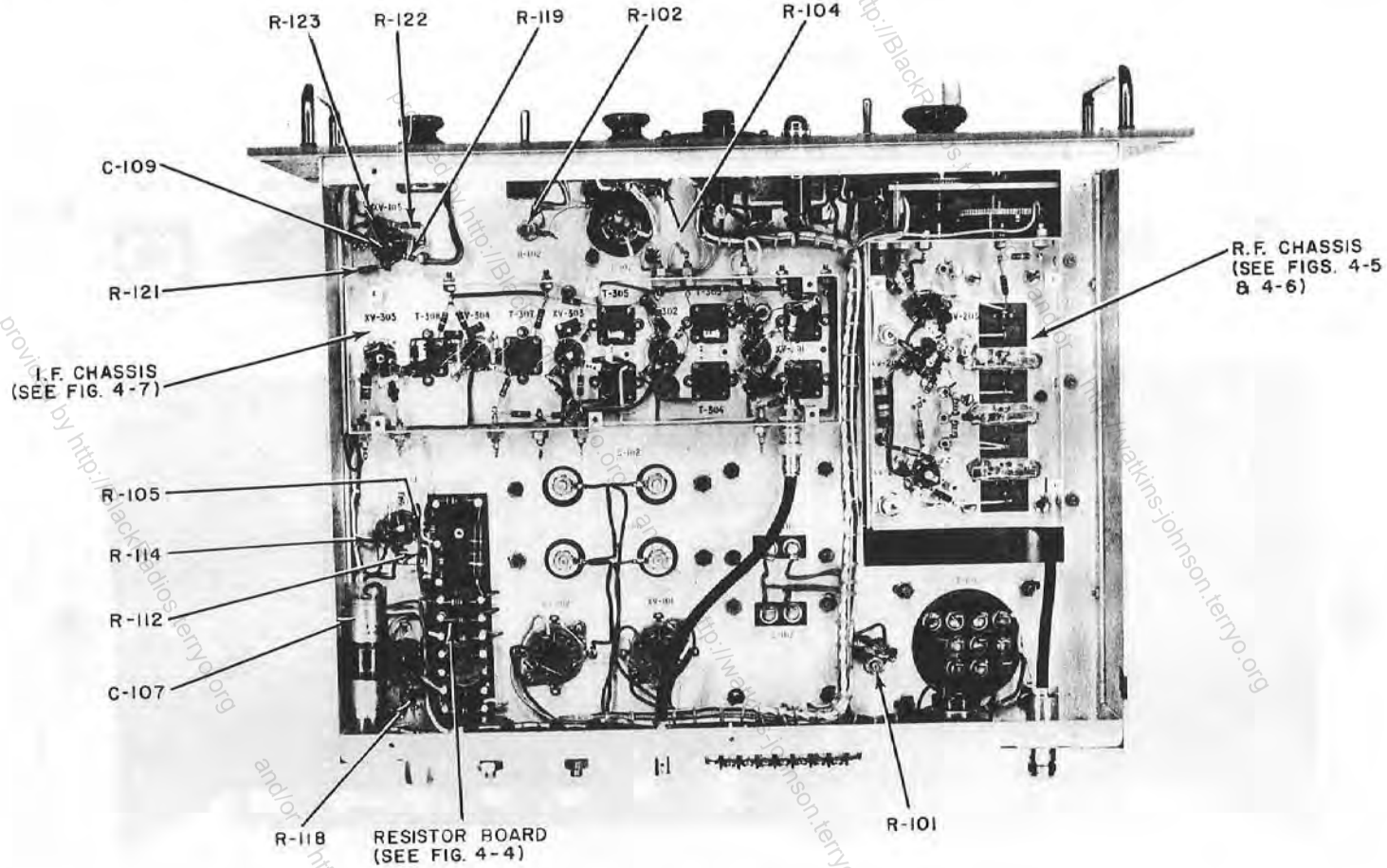


Fig. 4-2. Model 1670 Special Purpose Receiver, Bottom View (Dust cover removed)

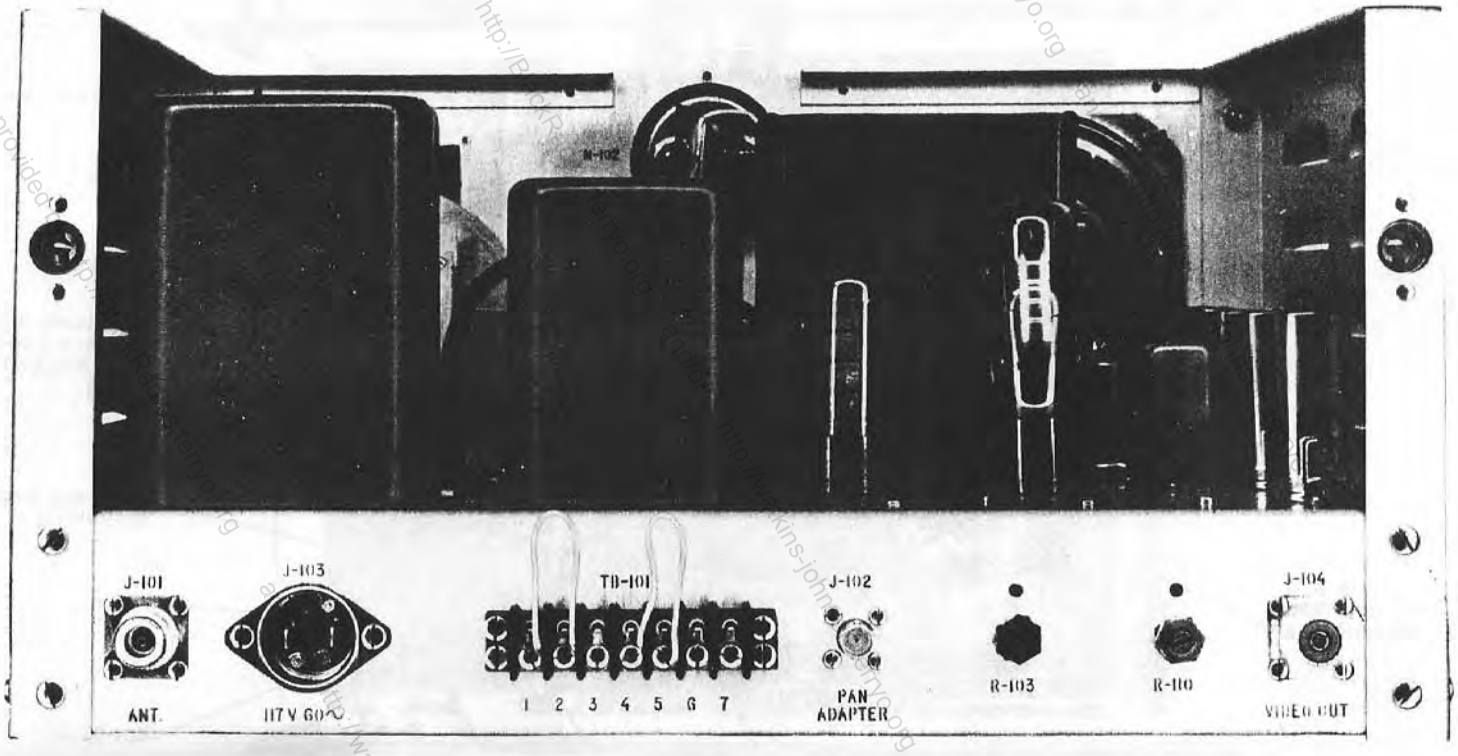


Fig. 4-3. Model 1670 Special Purpose Receiver, Rear View (Dust cover removed)

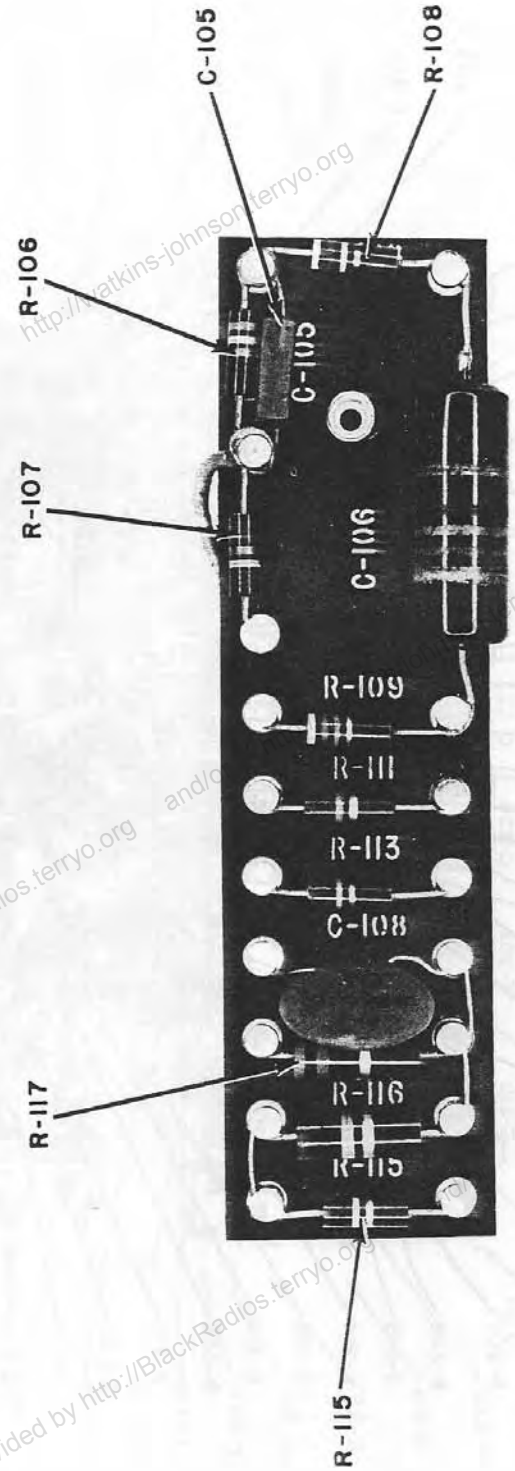


Fig. 4-4. Resistor Board Used in Model 1670 Special Purpose Receivers

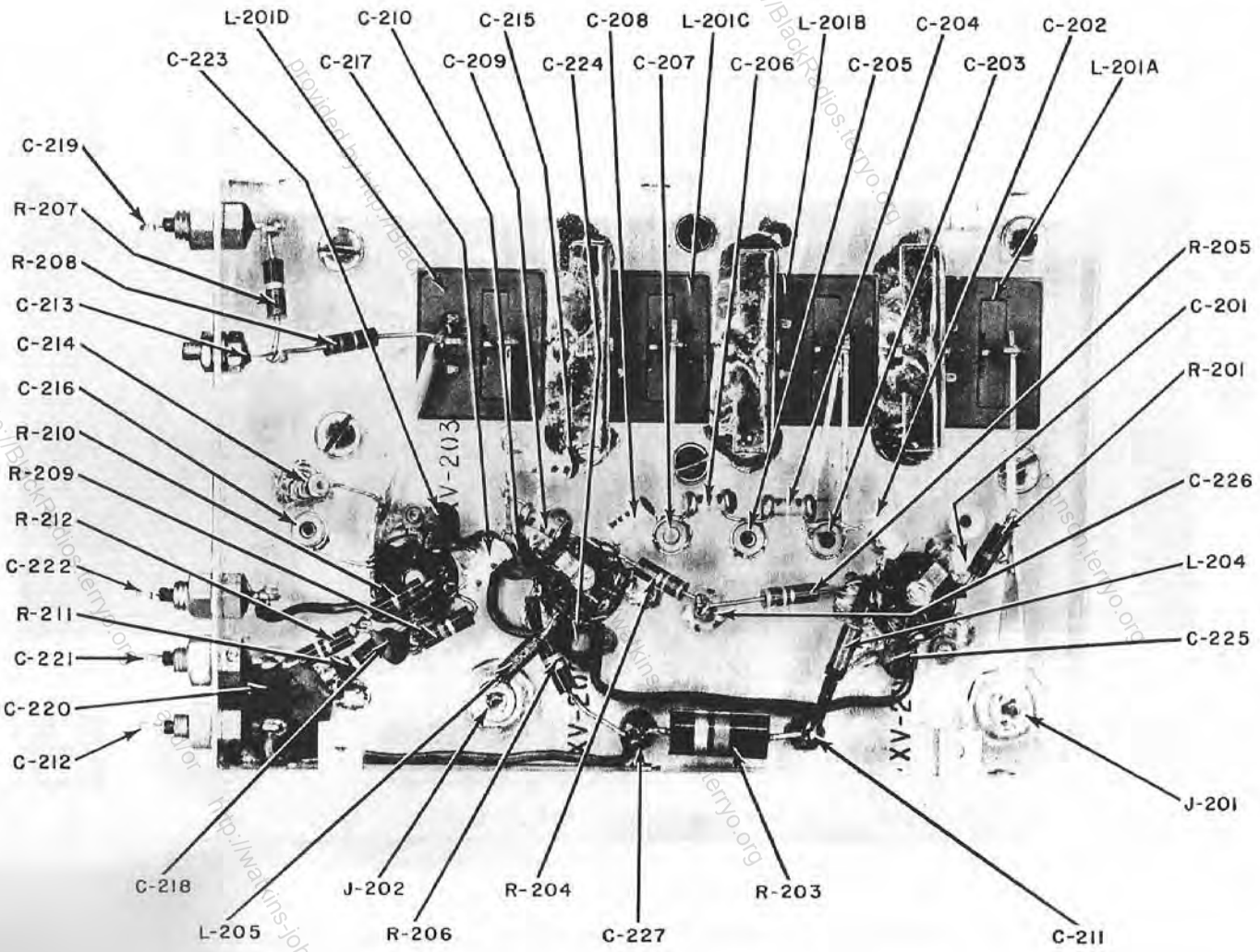


Fig. 4-5. Tuner, Models 1670-E and 1670-G Special Purpose Receivers, Bottom View (Dust cover removed)

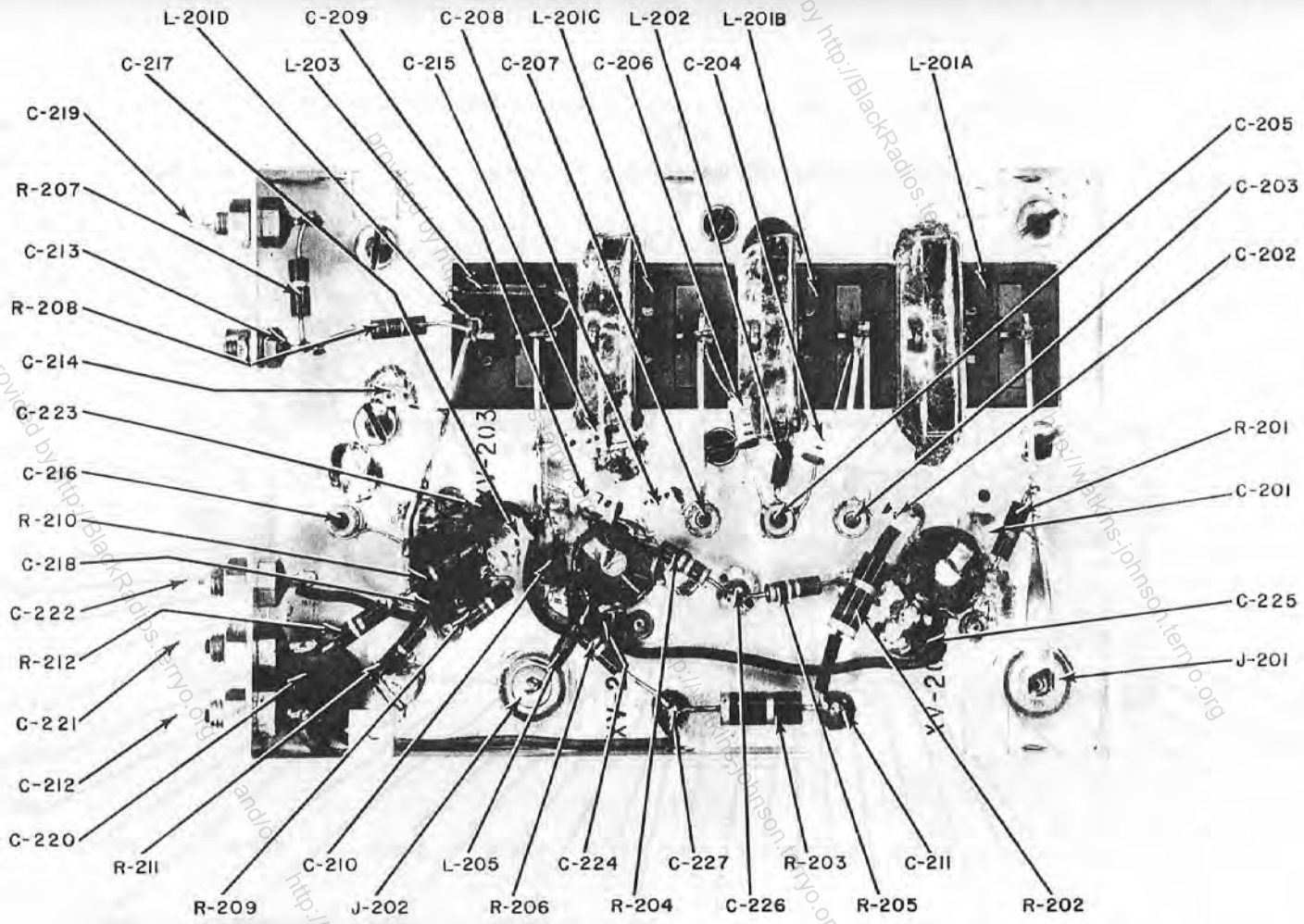


Fig. 4-6. Tuner, Models 1670-F and 1670-J Special Purpose Receivers, Bottom View (Dust cover removed)

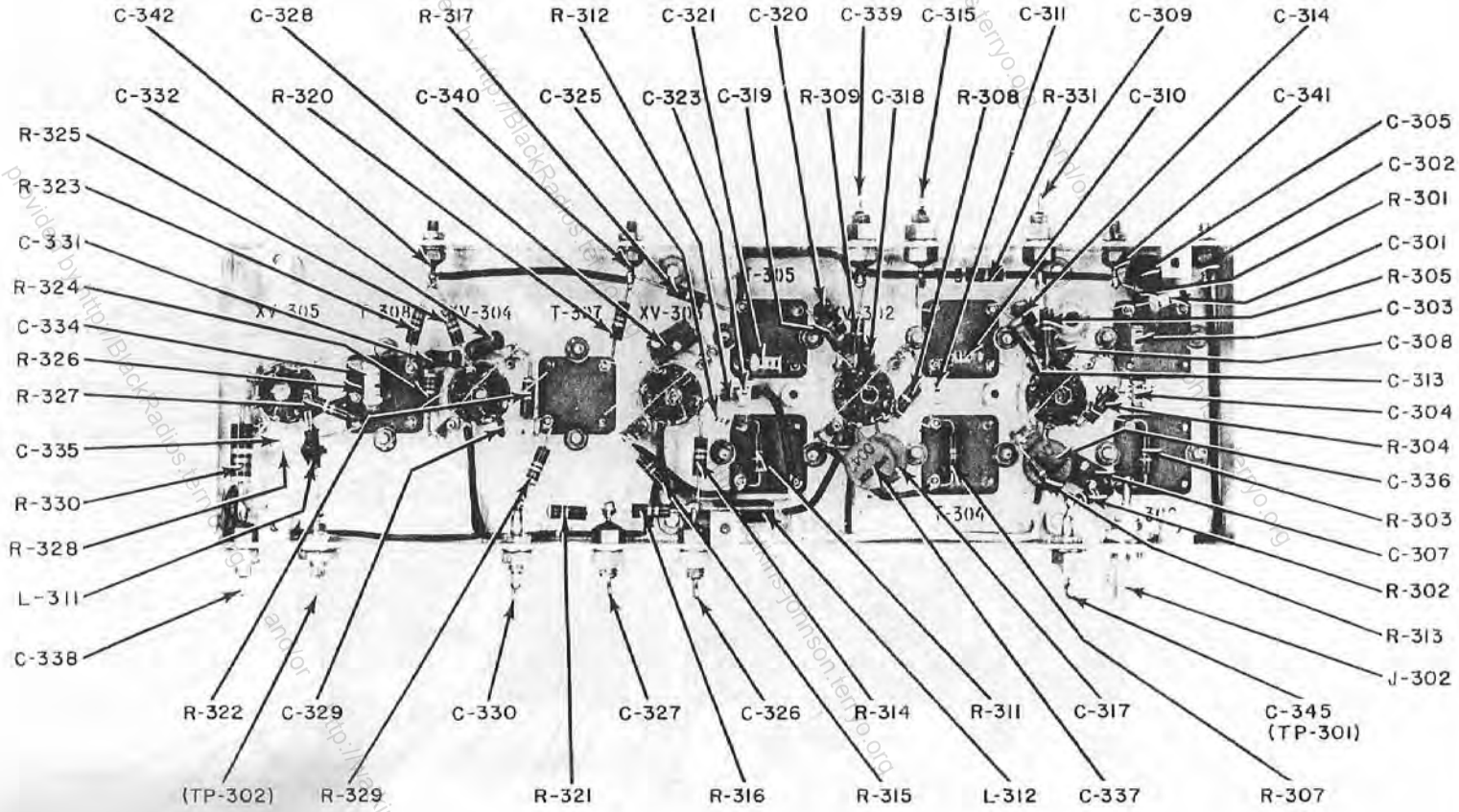
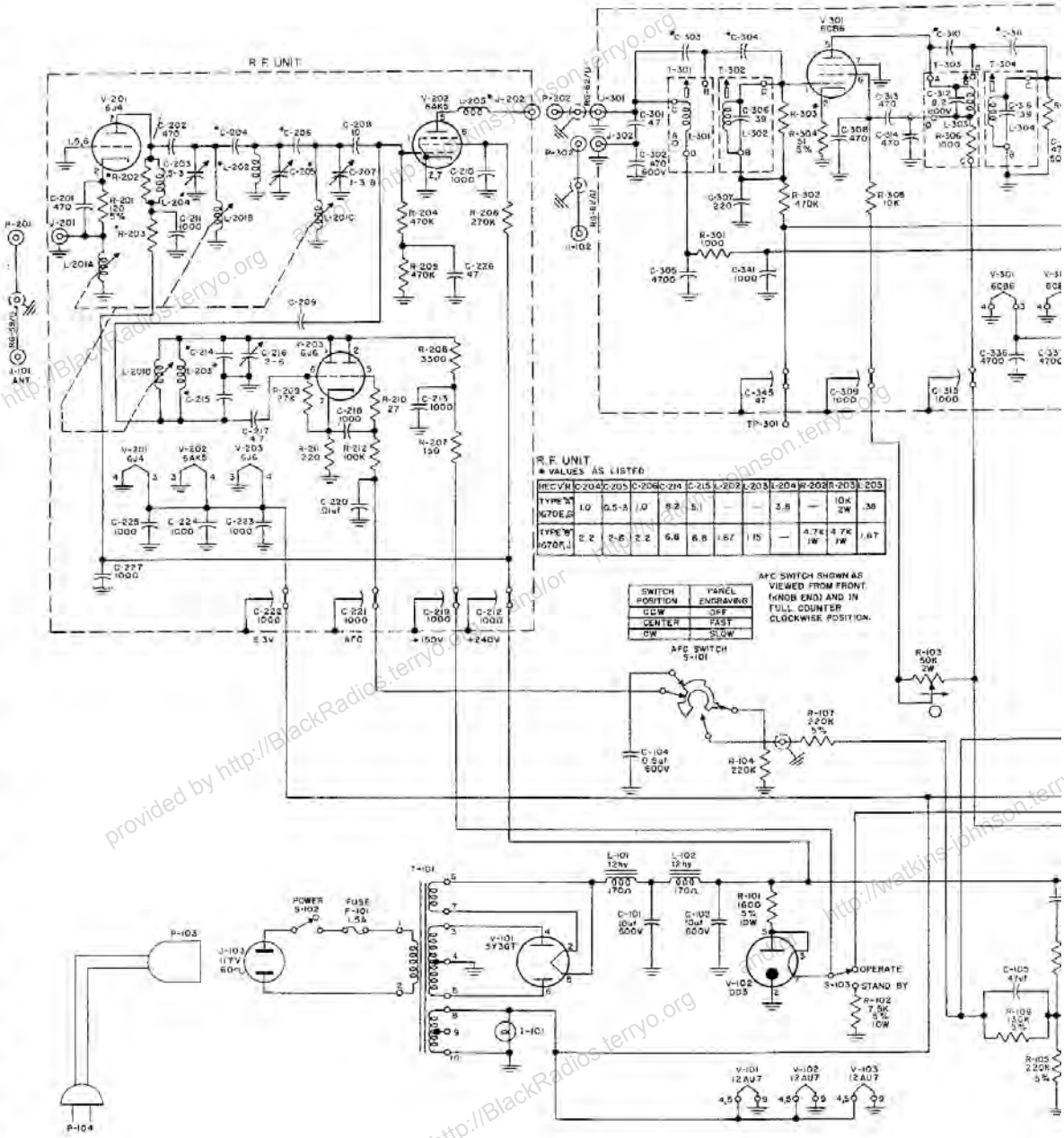


Fig. 4-7. IF Chassis, Model 1670 Special Purpose Receivers, Bottom View (Dust cover removed)


R.F. UNIT
V-201 6J4
V-202 6AK5
V-203 6J6
V-301 6CB6
R.F. UNIT
* VALUES AS LISTED
TYPE 'A' (170E,J)
TYPE 'B' (170K,L)
AFC SWITCH SHOWN AS VIEWED FROM FRONT (KNOB END) AND IN FULL COUNTER CLOCKWISE POSITION.
SWITCH POSITION
PANEL ENGRAVING
CCW
OFF
CENTER
FAST
CW
SLOW
AFC SWITCH S-101
V-101 5Y3GT
V-102 0D3
V-101 12AU7
V-102 12AU7
V-103 12AU7
POWER S-102
FUSE F-101 1.5A
OPERATE
STAND BY
S-103
P-103
P-104
J-101 ANT
TP-301

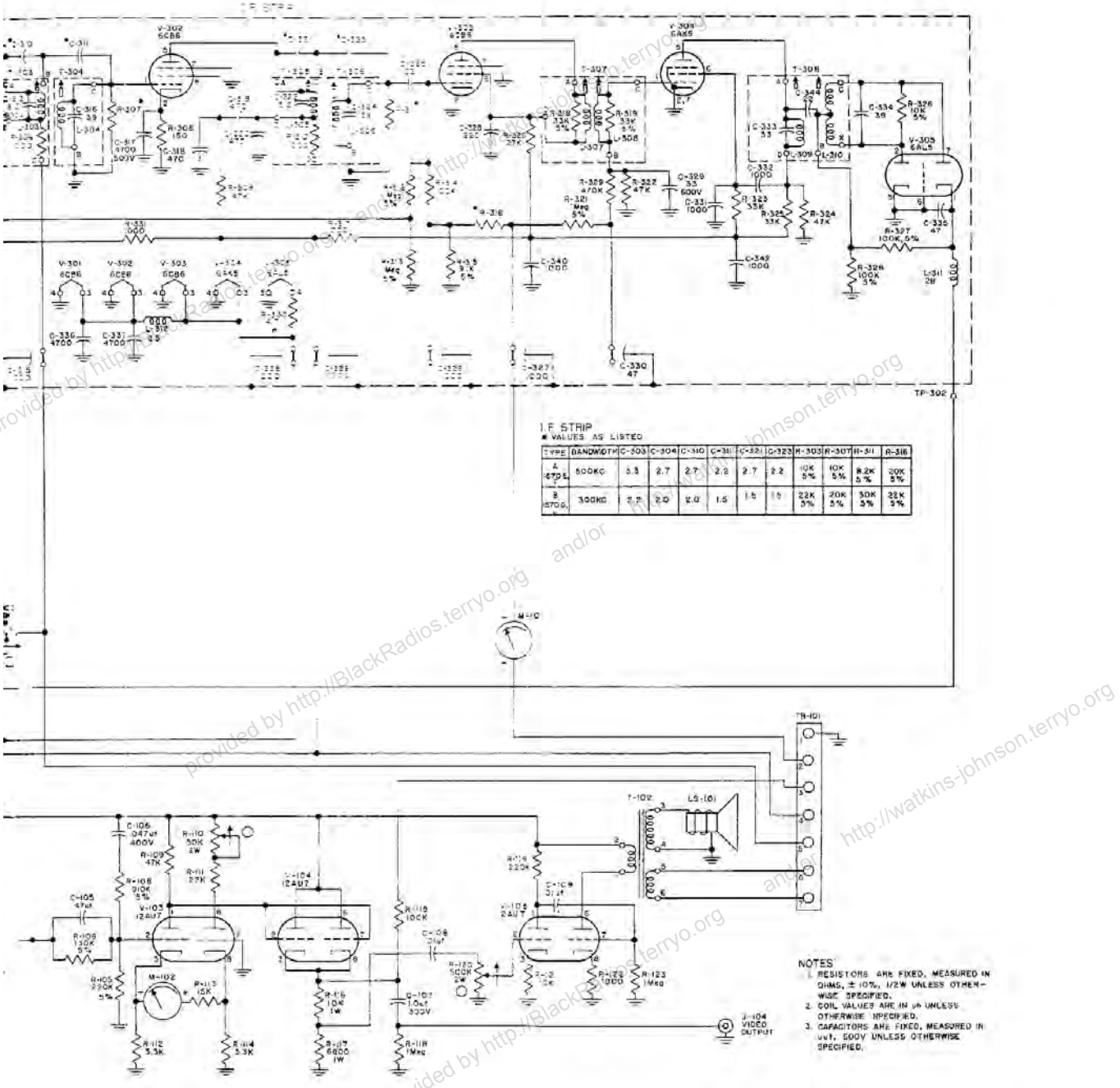


Fig. 4-8. Model 1670 Special Purpose Receivers, Schematic Diagram

SECTION 5

PARTS LIST

MODELS 1670-E, -F, -G & -J SPECIAL PURPOSE RECEIVERS

When ordering replacement parts, give the equipment name and model number, and the symbol number and description of each item ordered.

Replacement parts which will be supplied against an order may not be exact duplicates of the original parts. However, only minor differences in the electrical or mechanical characteristics will be involved and, consequently, will in no way impair the operation of the equipment.

Symbol No.				Description
1670-E	1670-F	1670-G	1670-J	
C-101, 102	C-101, 102	C-101, 102	C-101, 102	Capacitor: Paper, oil filled, 10 uf, 600V
C-103	C-103	C-103	C-103	Not used
C-104	C-104	C-104	C-104	Capacitor: Paper, bathtub, 0.5 uf, 600V
C-105	C-105	C-105	C-105	Capacitor: Silver mica, 47 uf ±5%, 500V
C-106	C-106	C-106	C-106	Capacitor: Paper, tubular, 0.047 uf ±20%, 400V
C-107	C-107	C-107	C-107	Capacitor: Paper, tubular, 1 uf, 300V
C-108, 109	C-108, 109	C-108, 109	C-108, 109	Capacitor: Ceramic, disc, 0.01 uf, 500V
C-201, 202	C-201, 202	C-201, 202	C-201, 202	Capacitor: Ceramic, GP2, uninsulated, 470 uuf, ±47 uuf, 500V
C-203	C-203	C-203	C-203	Capacitor: Ceramic, trimmer, 0.5-3 uuf, 500V
-	C-204	-	C-204	Capacitor: Ceramic, NPO, uninsulated, 2.2 uuf ±0.25 uuf, 500V
C-204	-	C-204	-	Capacitor: Ceramic, NPO, uninsulated, 1 uuf ±0.1 uuf, 500V
-	C-205	-	C-205	Capacitor: Ceramic, trimmer, 2-6 uuf, 500V
C-205	-	C-205	-	Capacitor: Ceramic, trimmer, .5-3 uuf, 500V
-	C-206	-	C-206	Capacitor: Ceramic, NPO, uninsulated, 2.2 uuf ±0.25 uuf, 500V
C-206	-	C-206	-	Capacitor: Ceramic, NPO, uninsulated, 1 uuf ±0.1 uuf, 500V
C-207	C-207	C-207	C-207	Capacitor: Ceramic, trimmer, 1-3.8 uuf, 500V
C-208	C-208	C-208	C-208	Capacitor: Ceramic, NPO, uninsulated, 10 uuf ±1 uuf, 500V
C-209	C-209	C-209	C-209	Capacitor: Ceramic, NPO, uninsulated, 1 uuf ±0.1 uuf, 500V
C-210	C-210	C-210	C-210	Capacitor: Ceramic, disc, .001 uf, 500V
C-211	C-211	C-211	C-211	Capacitor: Ceramic, button, 0.001 uf, 500V
C-212	C-212	C-212	C-212	Capacitor: Ceramic, feed-thru, 0.001 uf, 500V
C-213	C-213	C-213	C-213	Capacitor: Ceramic, button, 0.001 uf, 500V
C-214	-	C-214	-	Capacitor: Ceramic, NPO, uninsulated, 8.2 uuf ±0.5 uuf, 500V
-	C-214	-	C-214	Capacitor: Ceramic, NPO, uninsulated, 6.8 uuf ±0.5 uuf, 500V
C-215	-	C-215	-	Capacitor: Ceramic, NPO, uninsulated, 5.1 uuf ±0.25 uuf, 500V
	C-215	-	C-215	Capacitor: Ceramic, NPO, uninsulated, 6.8 uuf ±0.5 uuf, 500V
C-216	C-216	C-216	C-216	Capacitor: Ceramic, trimmer, 2-6 uuf, 500V
C-217	C-217	C-217	C-217	Capacitor: Ceramic, NPO, uninsulated, 4.7 uuf ±0.5 uuf, 500V
C-218	C-218	C-218	C-218	Capacitor: Ceramic, disc, 0.001 uf, 500V
C-219	C-219	C-219	C-219	Capacitor: Ceramic, feed-thru, 0.001 uf, 500V
C-220	C-220	C-220	C-220	Capacitor: Ceramic, disc, 0.01 uf, 500V
C-221	C-221	C-221	C-221	Capacitor: Ceramic, feed-thru, 0.001 uf, 500V
C-222	C-222	C-222	C-222	Capacitor: Ceramic, feed-thru, 0.001 uf, 500V
C-223, 224, 225	C-223, 224, 225	C-223, 224, 225	C-223, 224, 225	Capacitor: Ceramic, disc, 0.001 uf, 500V
C-226	C-226	C-226	C-226	Capacitor: Ceramic, feed-thru, 47 uuf, 500V
C-227	C-227	C-227	C-227	Capacitor: Ceramic, button, 0.001 uf, 500V
C-301	C-301	C-301	C-301	Capacitor: Ceramic, NPO, uninsulated, 4.7 uuf ±0.5 uuf, 500V
C-302	C-302	C-302	C-302	Capacitor: Ceramic, button, 470 uuf, 500V
C-303	C-303	-	-	Capacitor: Ceramic, NPO, uninsulated, 3.3 uuf ±0.25 uuf, 500V
-	-	C-303	C-303	Capacitor: Ceramic, NPO, uninsulated, 2.2 uuf ±0.25 uuf, 500V
C-304	C-304	-	-	Capacitor: Ceramic, NPO, uninsulated, 2.7 uuf ±0.1 uuf, 500V
-	-	C-304	C-304	Capacitor: Ceramic, NPO, uninsulated, 2.0 uuf, ±0.1 uuf, 500V
C-305	C-305	C-305	C-305	Capacitor: Ceramic, disc, 4700 uuf, 500V
C-306	C-306	C-306	C-306	Capacitor: Ceramic, N030, uninsulated, 39 uuf, ±5%, 500V
C-307	C-307	C-307	C-307	Capacitor: Silver mica, 220 uuf ±5%, 500V
C-308	C-308	C-308	C-308	Capacitor: Ceramic, GP2, insulated, 470 uuf ±47 uuf, 500V
C-309	C-309	C-309	C-309	Capacitor: Ceramic, feed-thru, 0.001 uf, 500V
C-310	C-310	-	-	Capacitor: Ceramic, NPO, uninsulated, 2.7 uuf ±0.1 uuf, 500V
-	-	C-310	C-310	Capacitor: Ceramic, NPO, uninsulated, 2.0 uuf ±0.1 uuf, 500V
C-311	C-311	-	-	Capacitor: Ceramic, NPO, uninsulated, 2.2 uuf, ±0.25 uuf, 500V
-	-	C-311	C-311	Capacitor: Ceramic, NPO, uninsulated, 1.5 uuf ±0.1 uuf, 500V
C-312	C-312	C-312	C-312	Capacitor: Ceramic, NPO, uninsulated, 8.2 uuf ±0.5 uuf, 600V
C-313, 314	C-313, 314	C-313, 314	C-313, 314	Capacitor: Ceramic, GP2, insulated, 470 uuf ±47 uuf, 500V

Symbol No.				Description
1670-E	1670-F	1670-G	1670-J	
C-315	C-315	C-315	C-315	Capacitor: Ceramic, feed-thru, 0.001 uf, 500V
C-316	C-316	C-316	C-316	Capacitor: Ceramic, N030, uninsulated, 39 uuf ±5%, 500V
C-317	C-317	C-317	C-317	Capacitor: Ceramic, disc, 4700 uuf, 500V
C-318, 319, 320	C-318, 319, 320	C-318, 319, 320	C-318, 319, 320	Capacitor: Ceramic, GP2, insulated, 470 uuf ±47 uuf, 500V
C-321	C-321	-	-	Capacitor: Ceramic, NPO, uninsulated, 2.7 uuf ±0.1 uuf, 500V
-	-	C-321	C-321	Capacitor: Ceramic, NPO, uninsulated, 1.5 uuf ±0.1 uuf, 600V
C-322	C-322	C-322	C-322	Capacitor: Ceramic, NPO, uninsulated, 8.2 uuf ±0.5 uuf, 500V
C-323	C-323	-	-	Capacitor: Ceramic, NPO, uninsulated, 2.2 uuf ±0.25 uuf, 500V
-	-	C-323	C-323	Capacitor: Ceramic, NPO, uninsulated, 1.5 uuf ±0.1 uuf, 600V
C-324	C-324	C-324	C-324	Capacitor: Ceramic, N030, uninsulated, 39 uuf, 500V
C-325	C-325	C-325	C-325	Capacitor: Ceramic, NPO, uninsulated, 22 uuf ±2.2 uuf, 500V
C-326, 327	C-326, 327	C-326, 327	C-326, 327	Capacitor: Ceramic, feed-thru, 0.001 uf, 500V
C-328	C-328	C-328	C-328	Capacitor: Silver mica, 220 uuf ±5%, 500V
C-329	C-329	C-329	C-329	Capacitor: Ceramic, NPO, uninsulated, 33 uuf, 600V
C-330	C-330	C-330	C-330	Capacitor: Ceramic, feed-thru, 47 uuf, 500V
C-331, 332	C-331, 332	C-331, 332	C-331, 332	Capacitor: Ceramic, GP2, insulated, 0.001 uf ±100 uuf, 500V
C-333	C-333	C-333	C-333	Capacitor: Ceramic, NPO, uninsulated, 33 uuf ±3.3 uuf, 500V
C-334	C-334	C-334	C-334	Capacitor: Ceramic, N030, uninsulated, 39 uuf ±5%, 500V
C-335	C-335	C-335	C-335	Capacitor: Ceramic, NPO, uninsulated, 47 uuf ±4.7 uuf, 500V
C-336, 337	C-336, 337	C-336, 337	C-336, 337	Capacitor: Ceramic, disc, 4700 uuf, 500V
C-338, 339	C-338, 339	C-338, 339	C-338, 339	Capacitor: Ceramic, feed-thru, 0.001 uf, 500V
C-340, 341, 342	C-340, 341, 342	C-340, 341, 342	C-340, 341, 342	Capacitor: Ceramic, button, 0.001 uf, 500V
C-343	C-343	C-343	C-343	Not used
C-344	C-344	C-344	C-344	Capacitor: Ceramic, NPO, uninsulated, 22 uuf ±2.2 uuf, 500V
C-345	C-345	C-345	C-345	Capacitor: Ceramic, feed-thru, 47 uuf, 500V
F-101	F-101	F-101	F-101	Fuse: Cartridge, 1.5 amp, 3 AG
I-101	I-101	I-101	I-101	Lamp: Pilot, 6-8 volt, 0.15 amp
J-101	J-101	J-101	J-101	Connector: Receptacle, N, UG-593/U
J-102	J-102	J-102	J-102	Connector: Receptacle, BNC, UG-262/U
J-103	J-103	J-103	J-103	Connector: Receptacle, GE #2711
J-104	J-104	J-104	J-104	Connector: Receptacle, UHF, SO-239
J-201, 202	J-201, 202	J-201, 202	J-201, 202	Connector: Receptacle, BNC, UG-1094/U
J-301	J-301	J-301	J-301	Connector: Jack, IPC, #1050
J-302	J-302	J-302	J-302	Connector: Receptacle, BNC, UG-1094/U
L-101, 102	L-101, 102	L-101, 102	L-101, 102	Choke: Filter, 12 h, 105 ma, 170 ohm, D.C.
L-201	L-201	L-201	L-201	Inductuner: Spiral, P. R. Mallory type S-4
-	L-202, 205	-	L-202, 205	Coil: 18 turns #32 H.F., 1.67 mh, part/dwg #A-14, 737
-	L-203	-	L-203	Coil: Padder, 23 turns #30 H.F., 1.15 mh, part/dwg #A-14, 806
L-204	-	L-204	-	Coil: Plate, 55 turns #36 H.F., 3.8 mh, part/dwg #A-15, 042
L-205	-	L-205	-	Coil: 20 turns #28 H.F., part/dwg #A-15, 407
L-301	L-301	L-301	L-301	Coil: 23-1/4 turns #30 H.F., part/dwg #A-14, 792
L-302	L-302	L-302	L-302	Coil: 11-3/4 turns #30 H.F., part/dwg #A-14, 791
L-303	L-303	L-303	L-303	Coil: 23-3/4 turns #30 H.F., part/dwg #A-14, 984
L-304	L-304	L-304	L-304	Coil: 11-3/4 turns #30 H.F., part/dwg #A-14, 791
L-305	L-305	L-305	L-305	Coil: 23-3/4 turns #30 H.F., part/dwg #A-14, 984
L-306	L-306	L-306	L-306	Coil: 11-3/4 turns #30 H.F., part/dwg #A-14, 791
L-307	L-307	L-307	L-307	Coil: 34-3/4 turns #34 H.F., part/dwg #A-14, 789
L-308	L-308	L-308	L-308	Coil: 35-1/4 turns #34 H.F., part/dwg #A-14, 790
L-309	L-309	L-309	L-309	Coil: 10-1/4 turns #30 H.F., part/dwg #A-14, 788
L-310	L-310	L-310	L-310	Coil: 5 turns #30 H.F., bifilar wound, part/dwg #A-14, 787

Symbol No.				Description
1670-E	1670-F	1670-G	1670-J	
L-311	L-311	L-311	L-311	Choke: R.F., 90 turns #38 single nylon enameled, 28 mh, part/dwg #A-14,804
L-312	L-312	L-312	L-312	Choke: R.F., 43 turns #30 H.F., 2.5 mh, part/dwg #A-14,805
LS-101	LS-101	LS-101	LS-101	Speaker: 4" permanent magnet
M-101	M-101	M-101	M-101	Meter: 0-50 ma, part/dwg #B-15,041
M-102	M-102	M-102	M-102	Meter: 100-0-100 ma
P-101	P-101	P-101	P-101	Not used
P-102	P-102	P-102	P-102	Not used
P-103	P-103	P-103	P-103	Connector: Molded, female, part of power cord
P-104	P-104	P-104	P-104	Connector: Molded, male, part of power cord
P-201, 202	P-201, 202	P-201, 202	P-201, 202	Connector: Plug, BNC, UG-260/U
P-301	P-301	P-301	P-301	Not used
P-302	P-302	P-302	P-302	Connector: Plug, BNC, UG-260/U
R-101	R-101	R-101	R-101	Resistor: Fixed, wire wound, 1.6K ±5%, 10W
R-102	R-102	R-102	R-102	Resistor: Fixed, wire wound, 7.5K ±5%, 10W
R-103	R-103	R-103	R-103	Resistor: Variable, composition, 50K ±10%, 2W
R-104, 105	R-104, 105	R-104, 105	R-104, 105	Resistor: Fixed, composition, 220K ±10%, 1/2W
R-106	R-106	R-106	R-106	Resistor: Fixed, composition, 130K ±5%, 1/2W
R-107	R-107	R-107	R-107	Resistor: Fixed, composition, 220K ±5%, 1/2W
R-108	R-108	R-108	R-108	Resistor: Fixed, composition, 910K ±5%, 1/2W
R-109	R-109	R-109	R-109	Resistor: Fixed, composition, 47K ±10%, 1/2W
R-110	R-110	R-110	R-110	Resistor: Variable, composition, 50K ±10%, 2W
R-111	R-111	R-111	R-111	Resistor: Fixed, composition, 22K ±10%, 1/2W
R-112	R-112	R-112	R-112	Resistor: Fixed, composition, 3.3K ±10%, 1/2W
R-113	R-113	R-113	R-113	Resistor: Fixed, composition, 15K ±10%, 1/2W
R-114	R-114	R-114	R-114	Resistor: Fixed, composition, 3.3K ±10%, 1/2W
R-115	R-115	R-115	R-115	Resistor: Fixed, composition, 100K ±10%, 1/2W
R-116	R-116	R-116	R-116	Resistor: Fixed, composition, 10K ±10%, 1W
R-117	R-117	R-117	R-117	Resistor: Fixed, composition, 6.8K ±10%, 1W
R-118	R-118	R-118	R-118	Resistor: Fixed, composition, 1 meg ±10%, 1/2W
R-119	R-119	R-119	R-119	Resistor: Fixed, composition, 220K ±10%, 1/2W
R-120	R-120	R-120	R-120	Resistor: Variable, composition, 500K, ±10%, 2W
R-121	R-121	R-121	R-121	Resistor: Fixed, composition, 10K ±10%, 1/2W
R-122	R-122	R-122	R-122	Resistor: Fixed, composition, 1K ±10%, 1/2W
R-123	R-123	R-123	R-123	Resistor: Fixed, composition, 1 meg ±10%, 1/2W
R-201	R-201	R-201	R-201	Resistor: Fixed, composition, 120 ohms, ±5%, 1/2W
-	R-202	-	R-202	Resistor: Fixed, composition, 4.7K, ±10%, 1W
-	R-203	-	R-203	Resistor: Fixed, composition, 4.7K ±10%, 1W
R-203	-	R-203	-	Resistor: Fixed, composition, 10K, ±10%, 2W
R-204	R-204	R-204	R-204	Resistor: Fixed, composition, 470K ±10%, 1/2W
R-205	R-205	R-205	R-205	Resistor: Fixed, composition, 470K ±10%, 1/2W
R-206	R-206	R-206	R-206	Resistor: Fixed, composition, 270K ±10%, 1/2W
R-207	R-207	R-207	R-207	Resistor: Fixed, composition, 150 ohms, ±10%, 1/2W
R-208	R-208	R-208	R-208	Resistor: Fixed, composition, 3.3K ±10%, 1/2W
R-209	R-209	R-209	R-209	Resistor: Fixed, composition, 27K ±10%, 1/2W
R-210	R-210	R-210	R-210	Resistor: Fixed, composition, 27 ohm ±10%, 1/2W
R-211	R-211	R-211	R-211	Resistor: Fixed, composition, 220 ohm ±10%, 1/2W
R-212	R-212	R-212	R-212	Resistor: Fixed, composition, 100K ±10%, 1/2W
R-301	R-301	R-301	R-301	Resistor: Fixed, composition, 1K ±10%, 1/2W
R-302	R-302	R-302	R-302	Resistor: Fixed, composition, 470K ±10%, 1/2W
-	-	R-303	R-303	Resistor: Fixed, composition, 22K ±5%, 1/2W
R-303	R-303	-	-	Resistor: Fixed, composition, 10K, ± 5%, 1/2W
R-304	R-304	R-304	R-304	Resistor: Fixed, composition, 51 ohm ±5%, 1/2W
R-305	R-305	R-305	R-305	Resistor: Fixed, composition, 10K ±10%, 1/2W
R-306	R-306	R-306	R-306	Resistor: Fixed, composition, 1K ±10%, 1/2W

Symbol No.				Description
1670-E	1670-F	1670-G	1670-J	
R-307	R-307	-	-	Resistor: Fixed, composition, 10K ±5%, 1/2W
-	-	R-307	R-307	Resistor: Fixed, composition, 20K ±5%, 1/2W
R-308	R-308	R-308	R-308	Resistor: Fixed, composition, 150 ohm ±10%, 1/2W
R-309	R-309	R-309	R-309	Resistor: Fixed, composition, 47K ±10%, 1/2W
R-310	R-310	R-310	R-310	Resistor: Fixed, composition, 1K ±10%, 1/2W
R-311	R-311	-	-	Resistor: Fixed, composition, 8.2K ±5%, 1/2W
-	-	R-311	R-311	Resistor: Fixed, composition, 30K ±5%, 1/2W
R-312, 313	R-312, 313	R-312, 313	R-312, 313	Resistor: Fixed, composition, 1 meg ±5%, 1/2W
R-314	R-314	R-314	R-314	Resistor: Fixed, composition, 100K ±10%, 1/2W
R-315	R-315	R-315	R-315	Resistor: Fixed, composition, 9.1K ±5%, 1/2W
R-316	R-316	-	-	Resistor: Fixed, composition, 20K ±5%, 1/2W
-	-	R-316	R-316	Resistor: Fixed, composition, 22K ±5%, 1/2W
R-317	R-317	R-317	R-317	Resistor: Fixed, composition, 1K ±10%, 1/2W
R-318	R-318	R-318	R-318	Resistor: Fixed, composition, 33K ±5%, 1/2W
R-319	R-319	R-319	R-319	Resistor: Fixed, composition, 33K ±5%, 1/2W
R-320	R-320	R-320	R-320	Resistor: Fixed, composition, 27K ±10%, 1/2W
R-321	R-321	R-321	R-321	Resistor: Fixed, composition, 1 meg ±5%, 1/2W
R-322	R-322	R-322	R-322	Resistor: Fixed, composition, 47K ±10%, 1/2W
R-323	R-323	R-323	R-323	Resistor: Fixed, composition, 33K ±10%, 1/2W
R-324	R-324	R-324	R-324	Resistor: Fixed, composition, 47K ±10%, 1/2W
R-325	R-325	R-325	R-325	Resistor: Fixed, composition, 33K ±10%, 1/2W
R-326	R-326	R-326	R-326	Resistor: Fixed, composition, 10K ±5%, 1/2W
R-327	R-327	R-327	R-327	Resistor: Fixed, composition, 100K ±5%, 1/2W
R-328	R-328	R-328	R-328	Resistor: Fixed, composition, 100K ±5%, 1/2W
R-329	R-329	R-329	R-329	Resistor: Fixed, composition, 470K ±10%, 1/2W
R-330	R-330	R-330	R-330	Resistor: Fixed, composition, 4.7 ohm ±10%, 1W
R-331	R-331	R-331	R-331	Resistor: Fixed, composition, 1K ±10%, 1/2W
S-101	S-101	S-101	S-101	Switch: Wafer, 3 pole, 3 pos.
S-102	S-102	S-102	S-102	Switch: Toggle, SPST
S-103	S-103	S-103	S-103	Switch: Toggle, SPDT
T-101	T-101	T-101	T-101	Transformer: Power, PHC-105
T-102	T-102	T-102	T-102	Transformer: Audio, part/dwg #AB-14, 487
T-301	T-301	T-301	T-301	Transformer: Mixer, part/dwg #AB-14, 989
T-302	T-302	T-302	T-302	Transformer: Mixer, part/dwg #AB-14, 793
T-303	T-303	T-303	T-303	Transformer: 1st IF, part/dwg #AB-14, 797
T-304	T-304	T-304	T-304	Transformer: 1st IF, part/dwg #AB-14, 793
T-305	T-305	T-305	T-305	Transformer: 2nd IF, part/dwg #AB-14, 797
T-306	T-306	T-306	T-306	Transformer: 2nd IF, part/dwg #AB-14, 793
T-307	T-307	T-307	T-307	Transformer: 1st Limiter, part/dwg #AB-14, 799
T-308	T-308	T-308	T-308	Transformer: 1st Limiter, part/dwg #AB-14, 976
V-101	V-101	V-101	V-101	Tube: Electron, 5Y3GT
V-102	V-102	V-102	V-102	Tube: Electron, OD3
V-103, 104, 105	V-103, 104, 105	V-103, 104, 105	V-103, 104, 105	Tube: Electron, 12AU7
V-201	V-201	V-201	V-201	Tube: Electron, 6J4
V-202	V-202	V-202	V-202	Tube: Electron, 6AK5
V-203	V-203	V-203	V-203	Tube: Electron, 6J6
V-301, 302, 303	V-301, 302, 303	V-301, 302, 303	V-301, 302, 303	Tube: Electron, 6CB6
V-304	V-304	V-304	V-304	Tube: Electron, 6AK5
V-305	V-305	V-305	V-305	Tube: Electron, 6AL5
				Fuseholder
				Shield: Tube, min., short
				Shield: Tube, min., medium
				Shield: Tube, noval, medium
				Socket: Tube, min.
				Socket: Tube, noval
				Socket: Tube, octal
				Socket: Tube, min., with shield base