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3152

INSTRUCTION BOOK

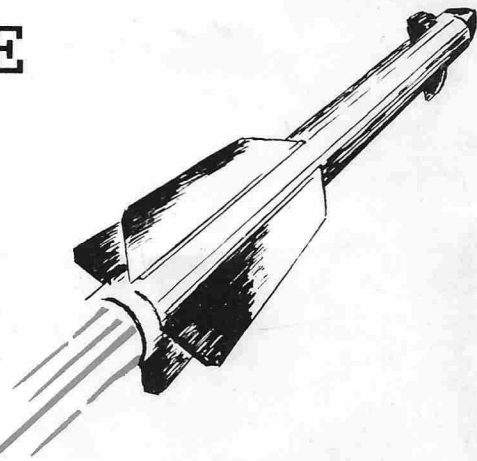
FOR

MODELS

1671, 1672, 1673 AND 1674

SPECIAL PURPOSE

RECEIVERS



NEMS CLARKE CO.

919 JESUP BLAIR DRIVE • SILVER SPRING, MARYLAND

A DIVISION OF Vitro CORPORATION OF AMERICA

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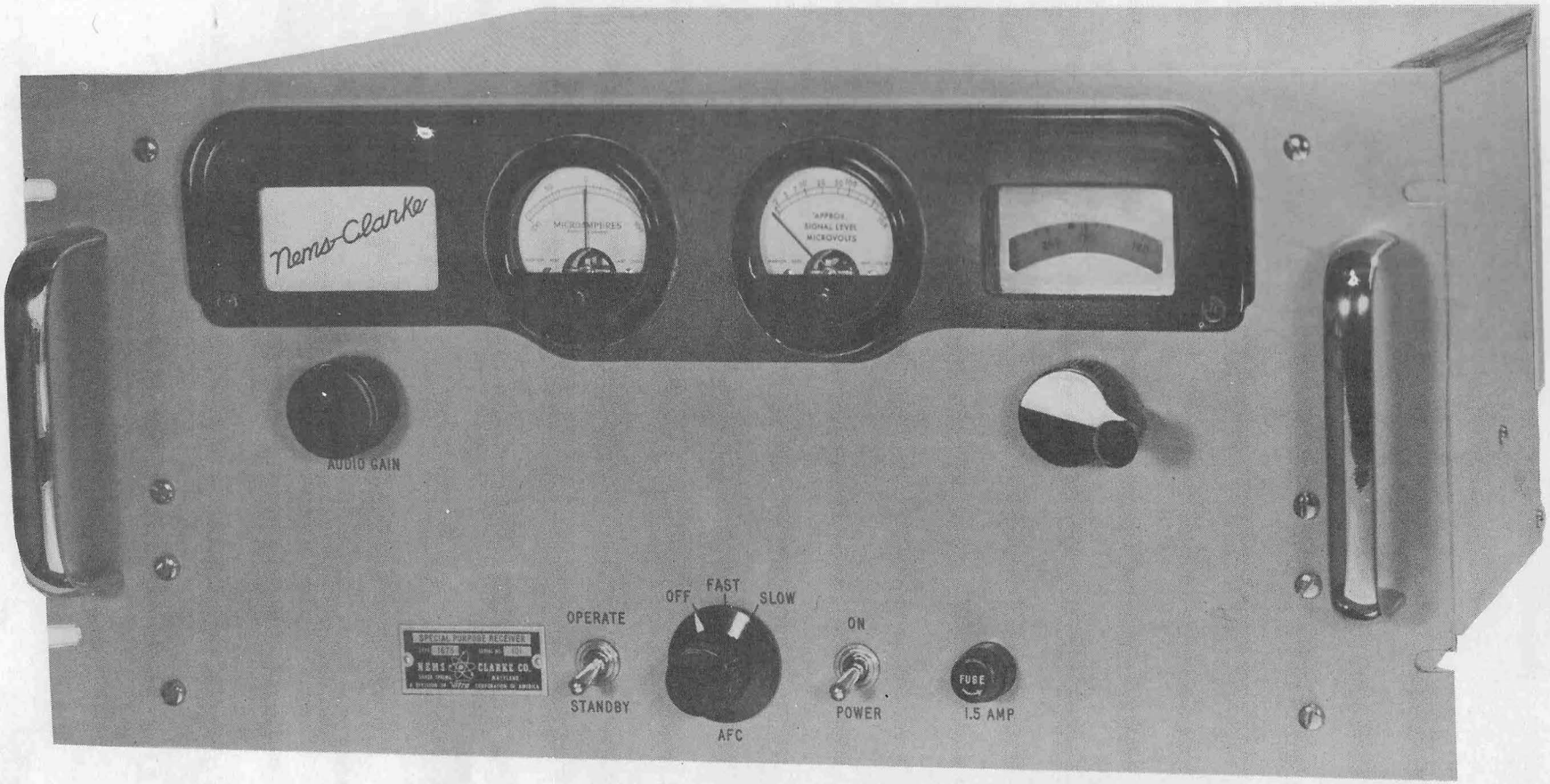


Figure 1. Special Purpose Receivers, Models 1671, 1672, 1673, and 1674.

SECTION I

GENERAL DESCRIPTION

1. PURPOSE OF EQUIPMENT.

A. The Model 1671 through 1674 Special Purpose Receivers have 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 high-quality FM receivers, they cover a tuning range of 55-260 mc in the type "A" models and 175-260 mc in the type "B" models. The receivers feature 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 at the rear of the chassis for operating an external 10-ma recorder for permanent signal strength records; terminals 4 and 5; a direct coupled d-c output, terminal 3; external signal strength meter, terminals 1 and 2; a 600 ohm output for accessory speaker, terminals 6 and 7, all on the terminal board TB-101; and a jack is provided for connecting a signal spectrum analyzer to the receiver. The receivers operate on a 117-volt power source at any frequency between 50 and 400 cycles, and requires 68 watts of power.

2. DESCRIPTION OF EQUIPMENT.

A. The front panel of the receiver, Figure 1, has a bezel centered above the center line containing, in left to right order, the speaker screen, a tuning meter, a signal level meter, and the tuning dial mask. The audio gain control knob is mounted directly below the speaker screen at the left, and the vernier-type tuning dial crank-knob is mounted directly below the tuning dial mask on the right. At the bottom of the panel are the OPERATE-and-STANDBY switch, the automatic frequency control knob, AFC, the POWER switch, and the fuse holder.

B. The receiver is 8-3/4 inches high by 19 inches wide by 15-1/2 inches deep.

Panel and chassis are of aluminum construction, and the panel is finished in smooth gray enamel.

C. 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. The top of the chassis is protected by a removable perforated cover fitted with handles. Special notice should be taken of the fact that Models 1671 and 1673 employ a type "A" RF strip, while Models 1672 and 1674 employ a type "B" RF strip. Models 1671 and 1672 employ a type "A" IF strip, and Models 1673 and 1674 employ a type "B" IF strip. Reference to these components will be in accordance with the above.

PERFORMANCE SPECIFICATIONS, MODELS 1671-1674

	1671	1672	1673	1674
Tuning Range Bandwidth Noise Figure RF Input	175-260 mc 500 kc 10 db, max. 75 ohms, nominal	55-260 mc 500 kc 11.5 db, max 75 ohms, nominal	175-260 mc 300 kc 10 db, max. 75 ohms, nominal	55-260 mc 300 kc 11.5 db, max. 75 ohms, nominal
Sensitivity	8 uv produces at least 32 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 cps modulation without band-restricting filters.
IF Frequency IF Rejection Image Rejection	21.4 mc 70 db, min. 40 db, min.	21.4 mc 70 db, min. 40 db below 130 mc. 30 db min. at any frequency.	21.4 mc 70 db, min. 40 db, min.	21.4 mc 70 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	0.10 v/kc deviation
Internal Impedance of Output Circuit	400 ohms, approximately.
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 15-3/4" deep
Weight	27 lbs.
Power Requirements	117 volts, 50 to 400 c.p.s., 68 watts

TABLE 1. PERFORMANCE SPECIFICATIONS

SECTION 2

THEORY OF OPERATION

1. ANALYSIS.

A. A block diagram of the receivers in the 1670 line is shown in Fig. 2. The tuner is designed to produce low noise figures in the frequency range covered without resorting to special tubes with critical operating conditions. 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 a direct-coupled amplifier. 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. 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 is applied to the cathode of V-201, 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 V-202 6AK5 pentode mixer by a double-tuned band-pass 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 RF section (Type A, 175-260 mc) used in the 1671 and 1673 does not have this inductor.

D. MIXER. A 6AK5 pentode, V-202, 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 C-226, 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, V-203, 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 1671 and 1672 have an IF bandwidth of 500 kc. In the 1673 and 1674 Models 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 combination grid-cutoff plate saturation limiter, which in turn drives a 6AK5 second plate saturation grid-cutoff limiter. Rectified voltages appearing at the grids of the two limiters are added to produce a voltage proportional to signal strength. 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. This current will decrease in a quasi-logarithmic manner as the signal is increased. An approximate recorder calibration can be obtained by a compari-

son 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 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 detuning and 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 circuit. A zero center meter is used as a tuning indicator and is connected in a bridge circuit consisting of the video amplifier circuit and the other half of the 12AU7. The output stage 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 panel-mounted speaker.

I. SDU OUTPUT. An output at the IF frequency is provided for connection to a signal display unit. This output is obtained from the 6AK5 mixer plate load through a capacity divider. A Spectrum Display Unit, Model 200-1, or Model 200-2 may be secured from NEMS-CLARKE CO., 919 Jesup-Blair Drive, Silver Spring, Maryland.

J. POWER SUPPLY. A conventional two-section inductive 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.

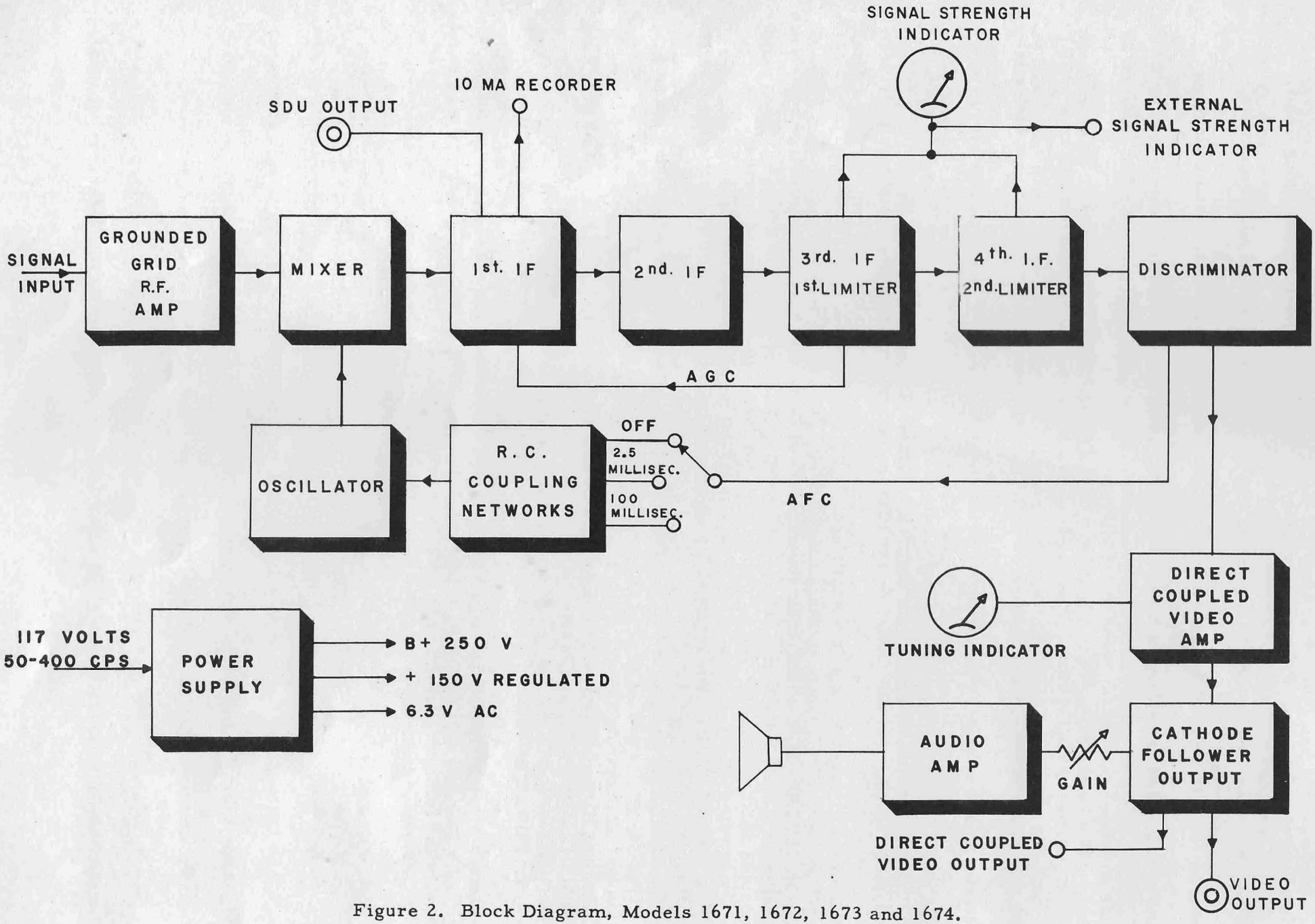


Figure 2. Block Diagram, Models 1671, 1672, 1673 and 1674.

SECTION 3

OPERATION

1. CONTROL SETTINGS.

A. Refer to Fig. 1 for location of controls on the front panel. 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 and tube noise 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 reduce hum and low frequency noise in the signal.

TABLE 2. TUBE COMPLEMENT

SYMBOL	TYPE	FUNCTION
V-101	5Y3GT	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	Second IF Amplifier
V-303	6CB6	First Limiter
V-304	6AK5	Second Limiter
V-305	6AL5	Discriminator

SECTION 4

MAINTENANCE

1. The Model 1671 through 1674 receivers are designed to give trouble-free performance in the field with a minimum of routine maintenance. High-quality components are used throughout. All 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.

A. 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, or equivalent.

b. Marker generator - RCA WR89A, or equivalent.

c. BALUN matching pad, 300 ohm.

d. Oscilloscope - Dumont 304A, or equivalent.

e. Milliampere meter - 0-15 ma.

3. PRELIMINARY ADJUSTMENTS.

A. ZERO ADJUSTMENT OF TUNING METER. Remove both the top and bottom chassis covers. 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. milliameter between terminals 4 and 5 of the terminal block on the rear of the receiver. Set "RECORDER ADJ." (R-103) so that the meter indicates 10 milliamperes.

4. I.F. ALIGNMENT PROCEDURE.

Remove I.F. sub-chassis cover. Allow receiver to warm up for 30 minutes. Turn the AFC switch to "OFF" position.

A. PRELIMINARY DISCRIMINATOR ALIGNMENT, T-308.

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

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

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

(4) Adjust the discriminator secondary so that 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, T-307.

(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 mc marker. Separation between 70% response points should be approximately 2.5 mc.

C. DISCRIMINATOR TRANSFORMER ADJUSTMENT, T-308.

(1) Leave generator as in step b.

(2) Connect the oscilloscope to TP-302.

(3) The coupling loop in the discriminator transformer has been permanently factory-set for 750 kc, $\pm$ 30 kc peak separation when tuned for 21.4 mc center frequency by adjustment of the discriminator secondary. Adjustment of the coupling loop should not be necessary unless the transformer has been replaced.

(4) Equal amplitude peaks must be obtained by adjustment of the discriminator primary 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 T-305 and T-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 T-304 and T-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, RF test point.

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

(4) Adjust T-301 and T-302 for maximum symmetrical response centered around the 21.4 mc marker. Separation between 70% response points should be 500 kc $\pm$ 100 kc for type A models, 1671 and 1672, and 300 kc $\pm$ 60 kc for type B models, 1673 and 1674.

5. RF ALIGNMENT PROCEDURE

A. PRELIMINARY TRACKING.

(1) Connect the 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-203, C-205 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 on Models 1673 and 1674 (190 mc on type A, models 1671 and 1672).

(2) Check for correct tuning dial indication at 255 mc. To correct for a high tuning dial indication, remove the RF chassis cover and reconnect C-214 closer to the inductuner. Replace RF chassis cover securely.

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

(4) If steps 5, b, (1) through (3) above fail to produce the desired results, the inductuner dial adjustment should be checked as follows;

(5) Loosen the Allen set screws of the mechanical stops on the dial shaft back of the gear train. Figure 4.

(6) Rotate the dial to the high frequency end until it is stopped by the inductuner stop mechanism. The triangle marker should be coincident with the hairline. If it is, continue with steps (8) and (9) below. If not, proceed as follows;

(7) Loosen the set screws of the gear on the inductor shaft and reset the dial triangle pointer coincident with the hairline. Tighten the screws.

(8) To set the high-end mechanical stop, turn the dial to the high frequency end until the triangle pointer is coincident with the hairline, then back to the left-hand corner of the triangle, and tighten the set screws.

(9) To set the low-end mechanical stop, turn the dial to the low frequency end until the triangle pointer is coincident with the hairline, then back to the right hand corner of the triangle, and tighten the set screws.

C. RF AND MIXER TRACKING.

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

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

NOTE: 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.

(3) Connect an oscilloscope across C-226, RF test point.

(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 marker signal.

(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, 1672 and 1674, and 80% on type A, 1671 and 1673. Decrease capacity of C-205 if necessary to achieve this result.

TABLE 3. VOLTAGE MEASUREMENTS, MODEL 1671-1674 SPECIAL PURPOSE RECEIVERS

TUBE	TYPE	PIN #1	PIN #2	PIN #3	PIN #4	PIN #5	PIN #6	PIN #7	PIN #8	PIN #9
V-101	5Y3GT	NC	*5.05AC	NC	335AC	NC	335AC	NC	*5.05AC(5)	
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	-		

NOTES: Line Voltage; 115 VAC, 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.
(5) Measured to ground; 250 VDC.

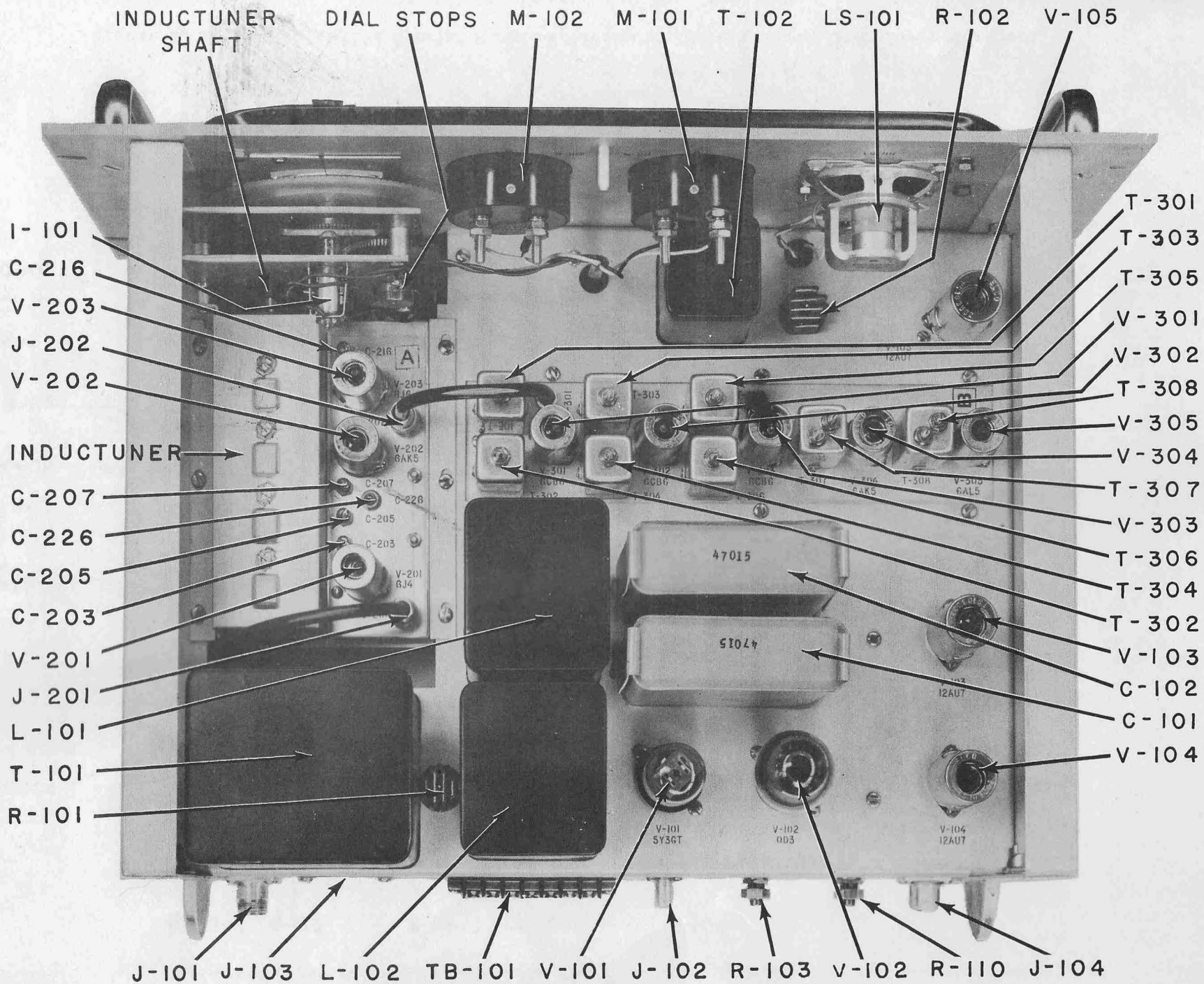


Figure 3. Models 1671-1764 Special Purpose Receivers, Top View, Cover Removed.

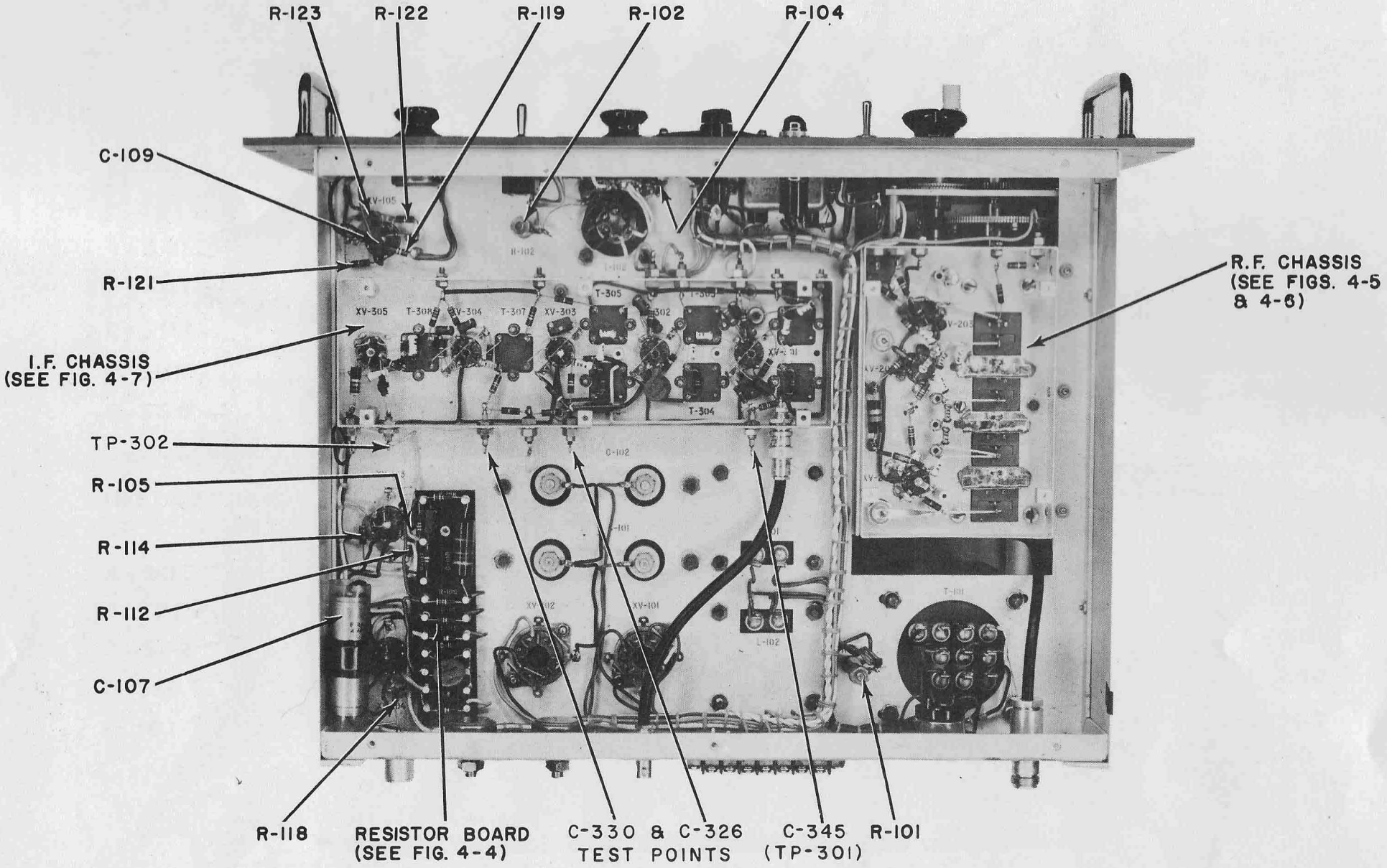


Figure 4. Models 1671-1674 Special Purpose Receivers, Bottom View, Dust Cover Removed.

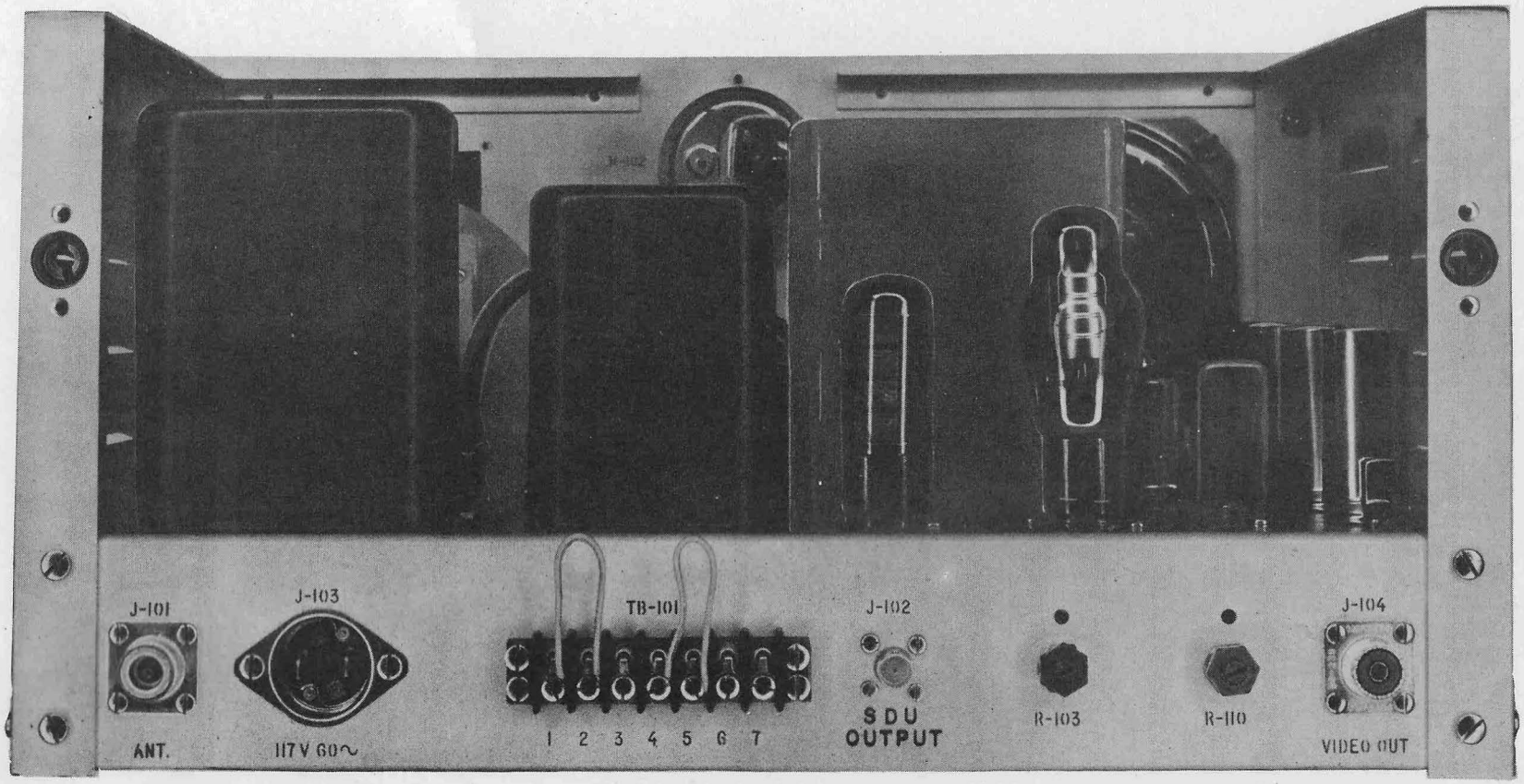


Figure 5. Models 1671-1674 Special Purpose Receivers, Rear View, Cover Removed.

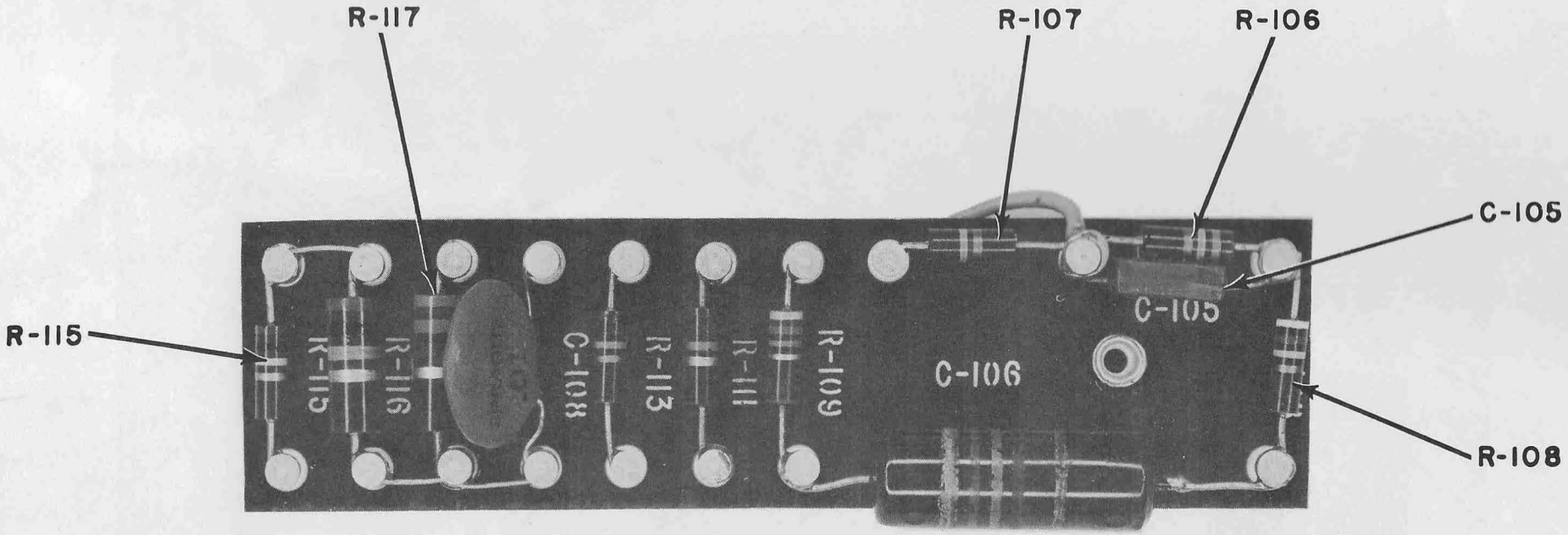


Figure 6. Resistor Board Used in Model 1671-1674 Special Purpose Receivers.

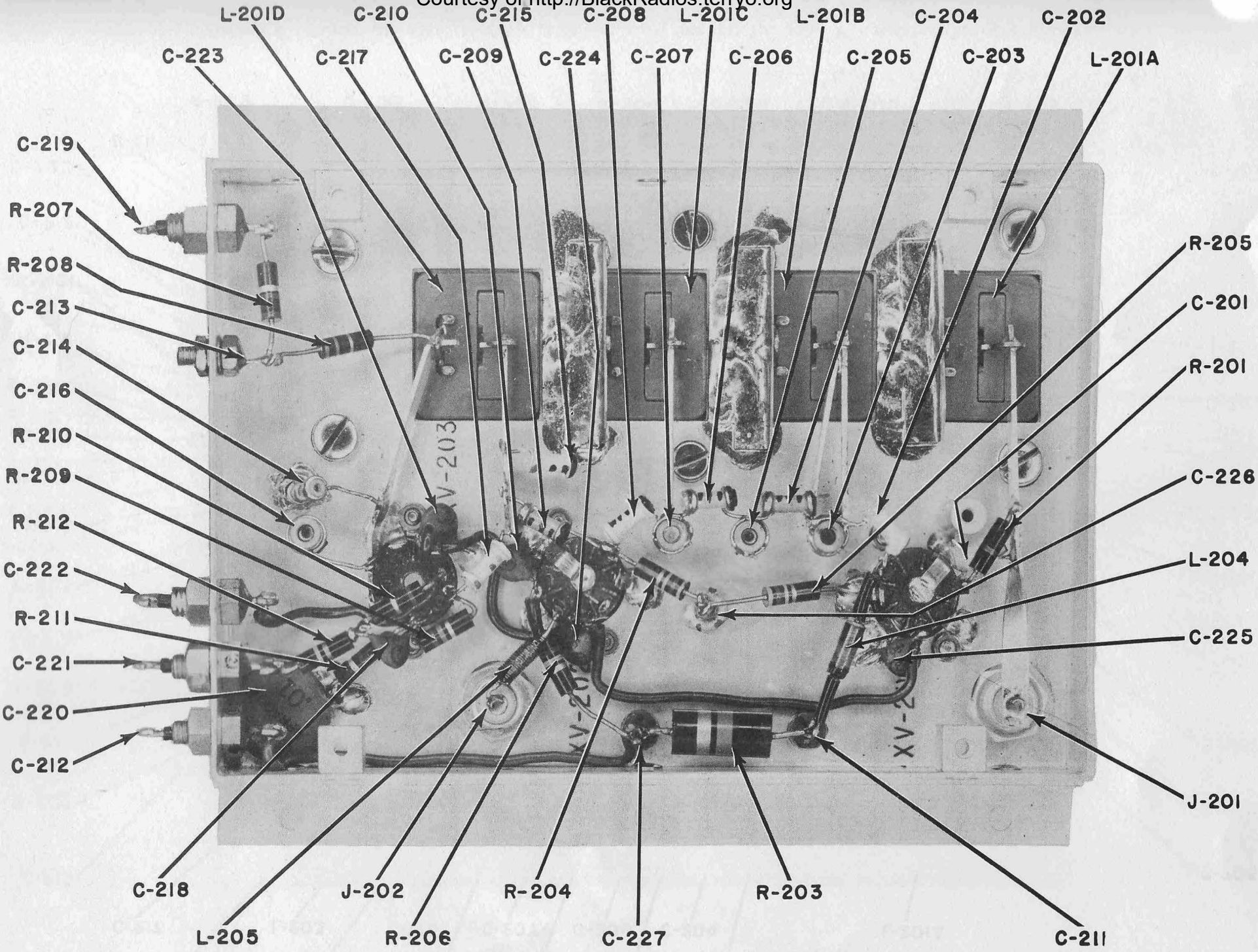


Figure 7. Tuner Chassis of Models 1671 and 1673 Special Purpose Receivers, Cover Removed.

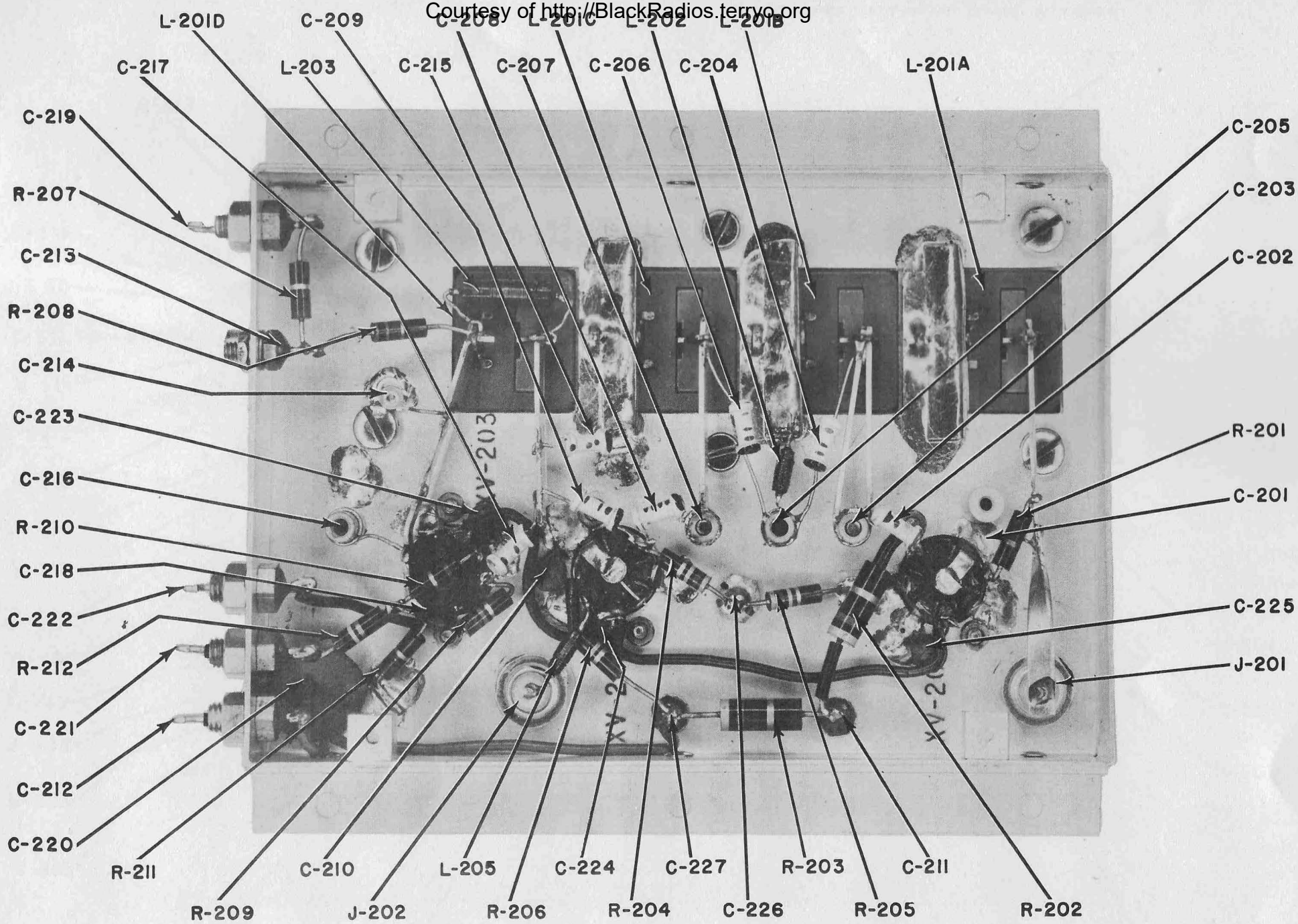


Figure 8. Tuner Chassis, Models 1672 and 1674 Special Purpose Receivers, Cover Removed.

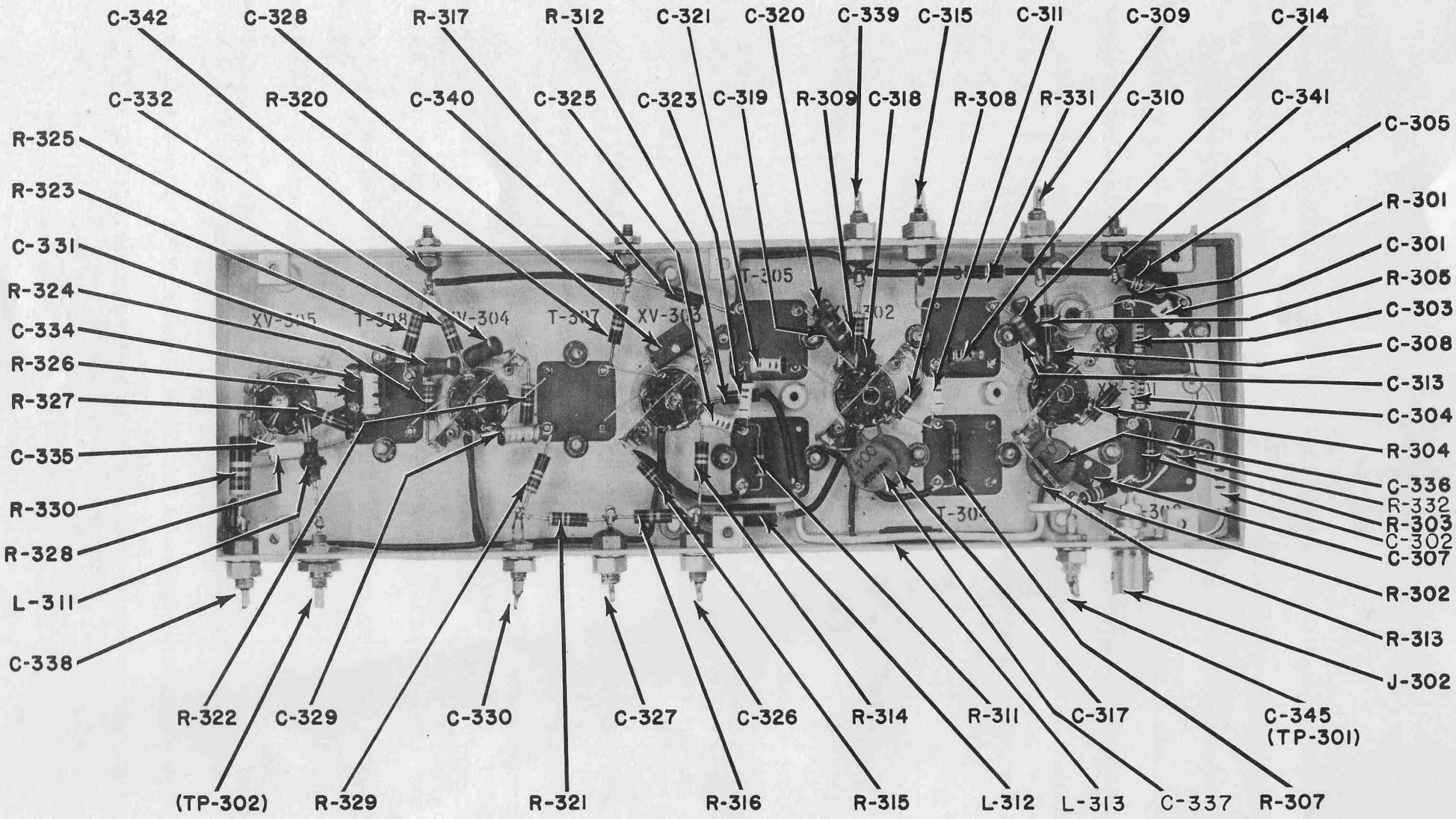
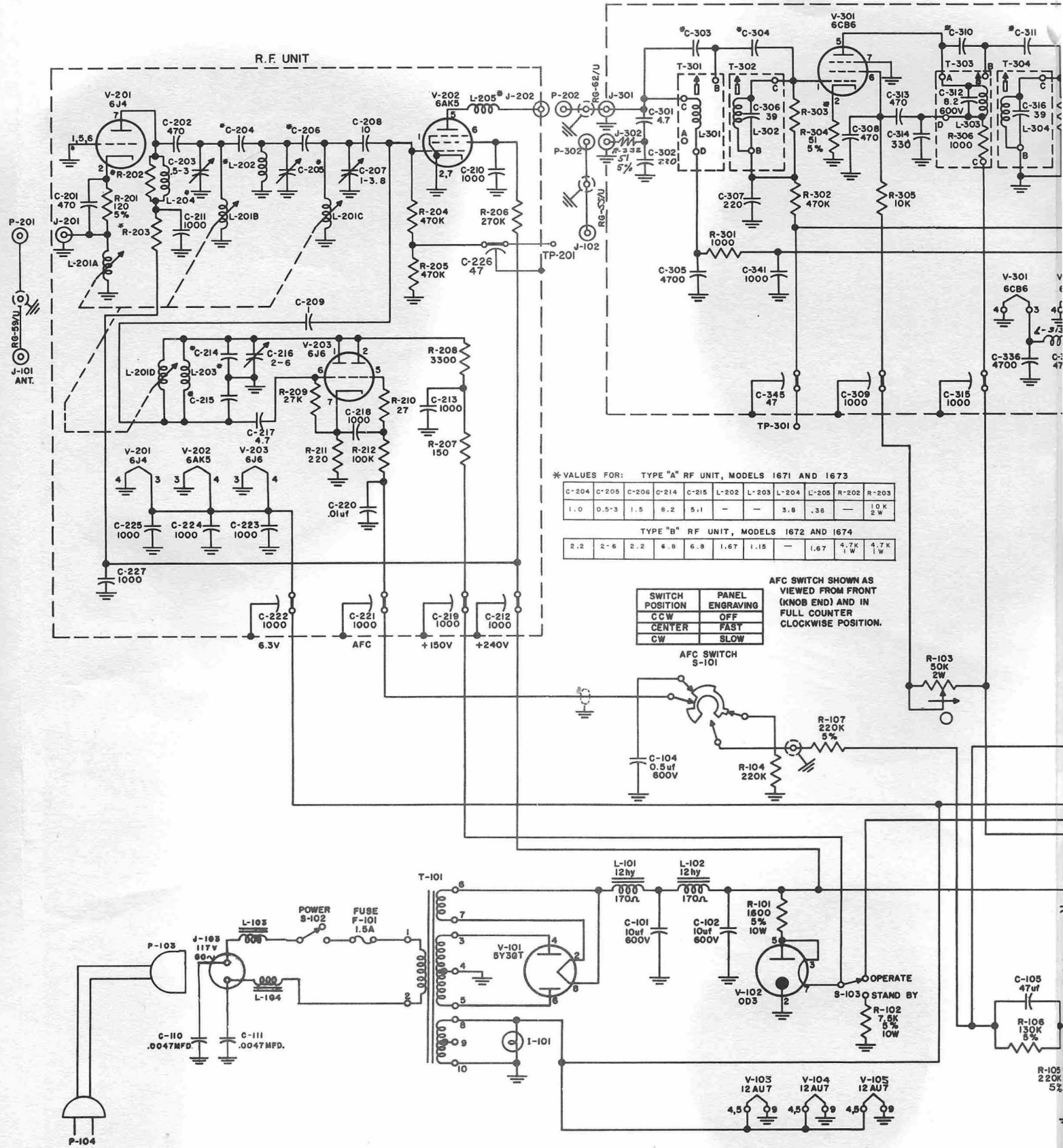


Figure 9. IF Chassis, Model 1671-1674 Special Purpose Receivers, Cover Removed.



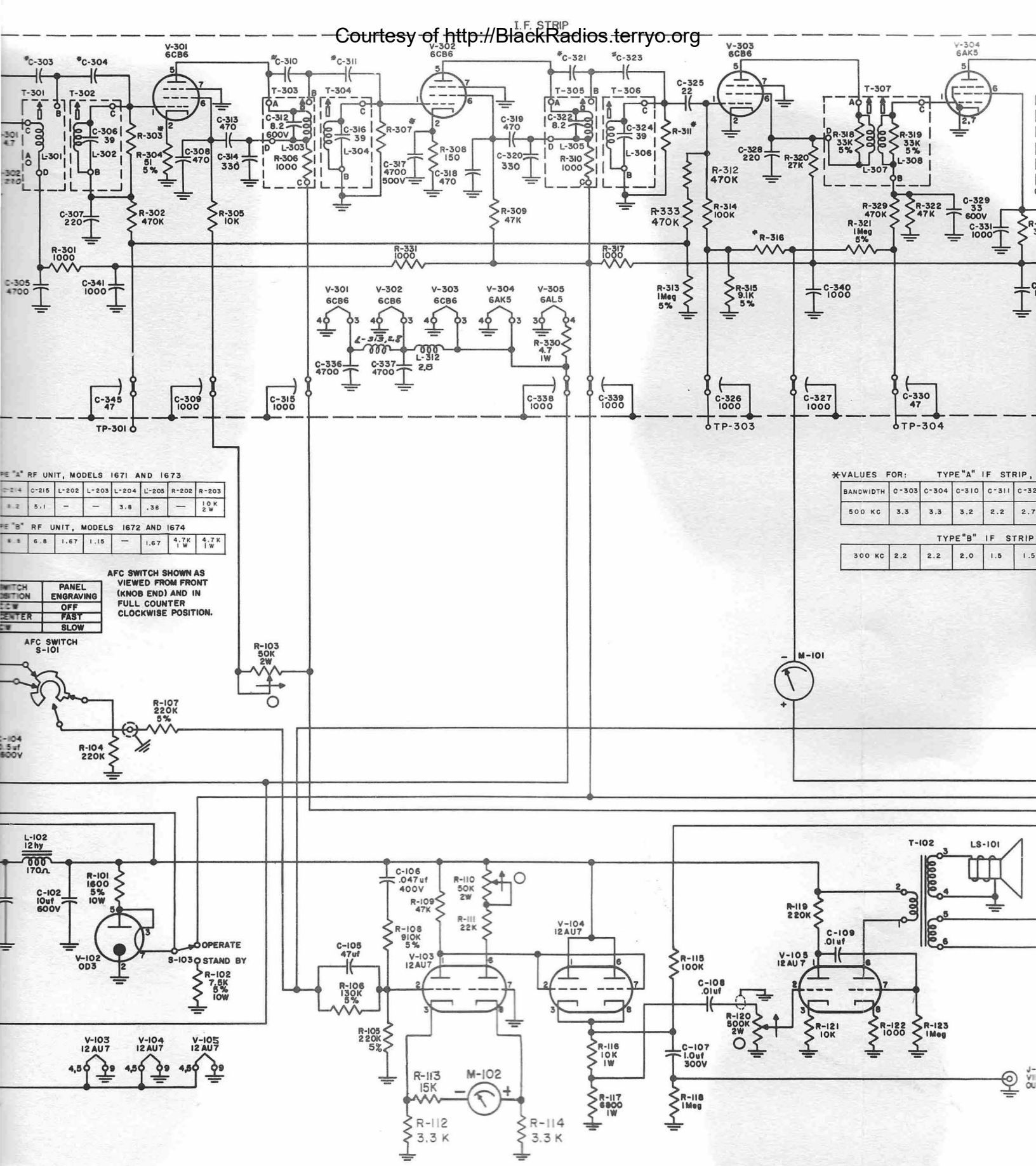
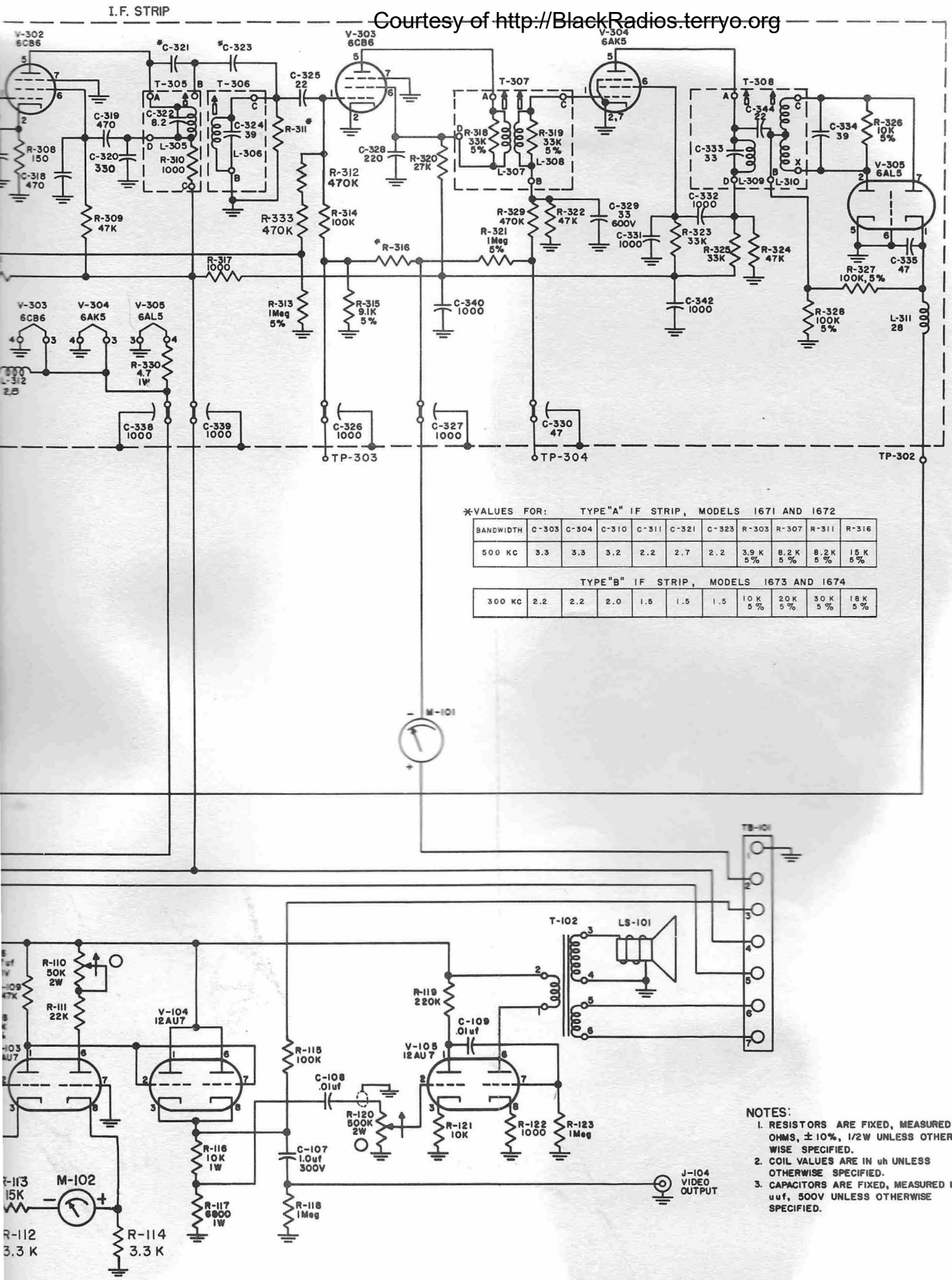


Figure 10.

Models 1

Special Pur



*VALUES FOR: TYPE "A" IF STRIP, MODELS 1671 AND 1672

BANDWIDTH	C-303	C-304	C-310	C-311	C-321	C-323	R-303	R-307	R-311	R-316
500 KC	3.3	3.3	3.2	2.2	2.7	2.2	3.9 K 5%	8.2 K 5%	8.2 K 5%	15 K 5%

TYPE "B" IF STRIP, MODELS 1673 AND 1674

300 KC	2.2	2.2	2.0	1.5	1.5	1.5	10 K 5%	20 K 5%	30 K 5%	18 K 5%

NOTES:
1. RESISTORS ARE FIXED, MEASURED IN OHMS, ± 10%, 1/2W UNLESS OTHERWISE SPECIFIED.
2. COIL VALUES ARE IN uh UNLESS OTHERWISE SPECIFIED.
3. CAPACITORS ARE FIXED, MEASURED IN uuf, 500V UNLESS OTHERWISE SPECIFIED.

Figure 10. Schematic Diagram.

Models 1671 — 1674

Special Purpose Receivers,