22 WATT HIGH FIDELITY AMPLIFIER

MODEL

HF-22

EICO

INSTRUCTION

MANUAL

ELECTRONIC INSTRUMENT CO. INC.
3300 NORTHERN BLVD., L. I. CITY 1, N. Y.

EICO

MODEL HF-22

22 WATT

HIGH FIDELITY AMPLIFIER

general description

GENERAL

The EICO HF-22 is a basic power amplifier designed for flawless reproduction of the entire dynamic and frequency range achieved in present-day microgrove and tape recordings. Undistorted reserve power, excellent transient response, and exceptional stability result in effortless response to peak power demands, well-defined bass, clean treble, and an overall crystal clarity of the reproduced sound without false emphasis anywhere in the audio spectrum.

The circuit employed is a variant of the British Mullard type including a genuine Ultra-Linear output stage, a combination now recognized as one of the very best possible amplifier designs. The full potential of the circuit is realized through the use of an extremely high quality, fully potted output transformer providing 4, 8, and 16 ohms output taps. Other factors worth considering in the choice of an amplifier are detailed in the list of features below.

The HF-22 has been designed to maintain its excellent characteristics under speaker load as well as the resistive load normally used for testing. Phase corrections have been provided at both extremes of the audio spectrum to insure stability under all conceivable conditions and to insure that variations in components and construction will not affect the performance. Overload characteristics are excellent and the HF-22 will not exhibit bounce or flutter under pulsed conditions.

The Model HF-22 can be operated from any source capable of delivering a 0.6 volt input signal. The source may be any preamplifier-control unit or a combined tuner-preamplifier-control unit. An excellent preamplifier-control unit, designed to take its operating power from the HF-22, is the EICO Model HF-65A High Fidelity Master Control. The Model HF-65 is identical to the HF-65A except that it contains its own power supply.

FEATURES

1. EF86 phenomenally low-noise, high gain, voltage preamplifier.

2 Direct coupling between voltage preamplifier and phase inverter to eliminate a time constant.

3. 6SN7GTB cathode-coupled ("long-tailed") phase inverter for forced balance over the entire frequency and dynamic range. Provides drive for the output stage from equal and comparatively low impedances.

4. 6L6GB output pentodes in a push-pull Ultra-Linear output stage.

5. Carefully balanced, extremely high quality wide-band output transformer employing grain-oriented steel and extensively interleaved windings. A superb high-frequency roll-off characteristic permits achievement of the virtually absolute stability sought for in the design. The transformer is supplied fully potted and with 4, 8, and 16 ohm output taps.

6. Heavy duty power transformer with reserve capacity for powering any preamplifier.

7. Rugged 5U4GB rectifier tube.

8. Input level control.

9. Fuse and panel mount fuse holder.

10. Standard octal socket provided for preamplifier power.

11. Switched and unswitched AC convenience outlets.

12. Heavy guage steel chassis.

SPECIFICATIONS

Rated Output Power: 22 watts continous; 44 watts peak.

IM Distortion (60&6000 cps at 4 : 1): below 1% at 22 watts; 0.25% at 10 watts.

Total Harmonic Distortion: below 1% at any frequency from 20 cps to 20 kc within 1 db of 22 watts.

Undistorted Sinudoidal Frequency Response: ± 0.5 db 5cps to 50kc at 1 watt level; ±0.1 db 25 cps to 30 kc at any level from 1 milliwatt to 22 watts; no peaking or raggedness outside audio range.

Square Wave Response: 20 cps to 20 kc essentailly undistorted; 3.5 micro-seconds rise time; no overshoot at any frequency or power level nor visible rounding below 15kc.

Inverse Feedback: 20 db

Stability Margin: 15 db

Damping Factor: above 12, 20 cps to 20kc; 21 at 1 kc.

Hum: 85 db below rated output.

Speaker Connections: 4, 8, and 16 ohms.

Tubes: 2-6L6GB, 1-EF86/Z729, 1-6SN7GTB, 1-5U4GB.

Power Source: 110-120 volts, 60 cycles; 90 watts, 3 amp fuse.

Size: HWD: 7" X 8"

Weight: 25 lbs

mechanical installation

GENERAL

a)HEAT DISSIPATION (VENTILATION): In common with other electronic equipment, the Model HF-22 produces a great deal of heat in normal operation. Unless continuous and adequate air flow is obtained around the heat producing elements, these elements will overheat and their useful life will be greatly curtailed. Adequate ventilation will be provided if the amplifier is installed in an open-back console provided that the top of the amplifier is spaced at least two inches below any shelf mounted above it. If the cabinet is enclosed at the rear, provide several large holes or slots as low down and as high up in the cabinet back as possible. As an alternate, holes may be provided in the sides, bottom, or top of the cabinet. The important thing to remember is that effective ventilation requires provision for cool air to enter at the bottom and to leave at the top.

If the amplifier is not installed in a console, it should be situated preferably on an open surface. An attractively finished matching cover for the Model HF-22 is available which will provide a "finished" appearnace as well as protection when the amplifier is not installed in a console. Four rubber feet are also provided so that the amplifier will not mar the surface of furniture on which it is placed.

b)ACCESSIBILITY TO PARTS: Tubes are the most frequently replaced items in electronic equipment. If the amplifier is placed in a console, sufficient space should be allotted to reach and remove any tube in the amplifier. Furthermore, input and output terminals of the amplifier should be accessible to permit easy interchanging of system components for comparison. If antennas are strung around the back of the console in which the amplifier is installed, arrange them so they will not interfere.

c)ELECTRICAL ISOLATION: To realize the full benefit of having a power amplifier physically separate from the preamplifier-control unit and/or tuner, the power amplifier should be placed at least one foot away (more if possible) from either or both of these units.

d)ACOUSTICAL ISOLATION: If amplifier and speaker are installed in the same cabinet, provide sufficient separation to minimize mechanical speaker vibration reaching the amplifier. The minimum separation is about one foot.

CONSOLE MOUNTING

Having determined a proper location for the amplifier in the particular console, the correct procedure for mounting the amplifier chassis is as follows: a) If the rubber feet have been inserted in the bottom plate, remove them (pry out with a thin screwdriver). b) Remove the 10 screws which fasten the bottom plate to the chassis. c) Place the bottom plate (bumps facing up) at the location on the shelf or other mounting surface in which it is desired to mount the amplifier. With a sharp pencil, placed with its point directly against the edge of the lower surface of the bottom plate, draw the outline of the bottom plate on the shelf and also mark the positions of the two extreme holes on both the long sides (front & rear). d) Remove the bottom plate and drill each of the marked holes on the shelf to a diameter of 1/4". e) Refasten the bottom plate to the chassis with the 6#8X3/8 screws previously removed, using the center holes on each of the long sides and the two holes on each of the short sides. f) Replace the chassis on the shelf, positioning it exactly in the outline previously drawn. g) From the bottom side of the shelf, insert a #8 X 1" screw with a 1/2" flat washer against the head through each of the four front and rear holes. These screws engage the stamped nut over each hole on the chassis flange and when tightened secure the the chassis to the shelf.

electrical installation

POWER

a)POWER REQUIREMENTS: The EICO Model HF-22 requires 90 watts at 110 to 120 volts, 60 cycles AC.

b) REMOTE SWITCHING: The EICO Model HF-22, although not provided with its own ON-OFF power switch has provision for remote switching, through an octal socket mounted on the chassis. Pins 6 and 7 of the octal socket are internally connected to the ends of a break in one power transformer primary lead and are externally connected together by a jumper in a male octal plug inserted in the octal socket. When this male plug is removed, pins 6 and 7 may be brought out to an external AC switch, usually in a preamplifier unit. This is one of the connection functions accomplished with the octal plug and cable attached to the EICO HF-65A preamplifier-control unit. If the HF-22 power amplifier is being used with a self-powered preamplifier, such as the EICO HF-65 or a self-powered tuner-preamplifier, the octal plug furnished with the HF-22 remains inserted in the octal socket (to connect the primary of the power transformer the AC line and to ground one side of the filament winding) and the line cord of the HF-22 is inserted in a switched 117VAC convenience outlet in the control unit. Note: When using a self-powered preamplifier-control unit, touch one end of a wire to the preamplifier chassis and the other end to the power amplifier chassis. If a spark occurs, pull out the HF-22 line cord plug and re-insert it with the prongs reversed.

c) POWERING AUXILIARY PREAMPLIFIER: The same octal socket provides all necessary filament and B+ voltages for operating an auxiliary preamplifier-control unit. 6.3 volts AC filament voltage, at 1 ampere, may be obtained from pins 1 and 2; pin number 4 on the socket supplies 350 volts DC, at a maximum current of 10 milliamperes; and pin 3 is connected to ground. As stated above, control of 117 volt AC line power to the power amplifier, and, indirectly, power for the preamplifier-control unit itself, is made available through the connections to pins 6 and 7. This arrangement is exactly suitable for powering the EICO HF-65A* preamplifier-control unit; all that need be done is to remove the octal plug provided with the HF-22 from the octal socket and insert the octal plug-and-cable of the HF-65A in its stead. Note that a jumper between pins 2 and 3 of the octal plug furnished with the HF-22 effectively grounds one side of the filament winding; removal of the octal plug leaves the filament winding floating. This arrangement is used because a hum balance control is connected across the filament leads in the EICO HF-65A preamplifier and the arm of this control is returned to ground.

d) CONVENIENCE OUTLETS: When the HF-22 is used with the preamplifier that takes power from it, such as the EICO HF-65A, the convenience outlets of the HF-22 will be found useful. The outlet marked "117VAC SW." ("SW." is an abbreviation for "SWITCHED") is "live" or "dead" depending on whether the preamplifier power switch turned to ON or OFF; plug tuners into this outlet. The outlet marked "117VAC" is not switched and is "live" whenever the HF-22 line cord plug is inserted in a wall outlet; plug a record changer into this outlet in order to protect the mechanism. When the HF-22 is used with a self-powered preamplifier, such as the EICO HF-65A, normally the convenience outlets on the preamplifier will be used. However, the HF-22 outlets may be used also, if desired, in which case both of them will be "switched".

INTERCONNECTION OF COMPONENTS: SIGNAL

a) PREAMPLIFIER-CONTROL TO POWER AMPLIFIER: Single conductor, shielded cable must be used to interconnect the preamplifier-control unit or tuner-preamplifier-control unit and the power amplifier. Unless the source has a low impedance output, such as a cathode follow (with which up to 50 ft. of cable can be used), use the shortest possible connection; in any case, use a low capacity type of shielded cable (as low as 25 mmf capacity per foot is available). Both ends of the cable must be fitted with RCA type phono plug connectors.

b) SPEAKER CONNECTIONS: To connect your speaker to the amplifier properly, you must know its rated impedance, which is usually marked on the speaker or specified in the manufacturer's literature. Connect one speaker lead to the terminal on the rear apron marked "G" and the other speaker lead to the nearby terminal designated by the rated speaker impedance (4, 8, or 16 ohms). Plastic covered lamp cord may be used for distances up to 50 ft. with little power loss. For shorter distances, tv antenna lead can be used particularly if it is desired to run the speaker lead under a rug.

If it is desired to use two similar or identical full-range speakers of the same rated impedance (either 8 or 16 ohms only) for better sound distribution, connect one speaker lead of each pair to "G" and the two remaining leads to the terminal with a number equal to half of one of the speaker's rated impedance. (It may be necessary to "phase" the two speakers by reversing both of the leads from one of the speakers.) This may not be done if each of the speakers is designed for reproduction of a different part of the audio spectum (woofer-tweeter combinations), in which case a cross-over network is required which connects to the amplifier with only one pair of leads.

INTERCONNECTION PROCEDURE

a) Make all system interconnections before applying AC power. Making or breaking interconnections while AC power is applied will result in a momentary overload of both the power amplifier and speaker system with possible damage to either or both.

b) If the EICO HF-65A or HF-61A preamplifier control unit (not self-powered) has been obtained in kit form, remove all the jumper connections in the octal plug supplied with the HF-22 and wire the preamplifier power take-off leads to this plug as follows:

Color of Preamp. Lead	Pin of Octal Plug Connected to
grey	6
grey	7
brown	1
brown	2
red	4
black	3

Wired HF-65A and HF-61A preamplifier will have the preamplifier leads connected to the octal plug as in the table above

c) If it is desired to use a preamplifier without a power supply other than the HF-65A or HF-61A, the power take-off leads of the preamplifier should be connected to the HF-22 octal plug (after removing the jumpers) as follows:

Preamp. Power Lead	Pin of Octal Plug Connected to
AC ON-OFF	6
AC ON-OFF	7
filament (6.3 VAC)	1
filament (6.3 VAC)	2
B+	4 or 5*
ground	3

*If the preamplifier requires 350VDC, use pin 4; if the preamplifier requires less than 350VDC, use pin 5 and connect a dropping resistor of appropriate value and voltage rating from pin 4 to 5 of the octal socket on the HF-50 chassis. For example, if the preamplifier in question requires 300 VDC B+ voltage at 10 ma drain, the dropping resistor will be required to drop the voltage by 50 volts (350-300=50) at a current of 10 ma. By Ohm's Law, the required resistance in ohms is the voltage drop in volts divided by the current in amperes or 50 volts/.01 amp.= 5000 ohms. The power dissipated in the resistor in watts is equal to the voltage drop in volts multiplied by the current in amperes or 50 volts X .01 amp = 0.5 watts. For safety, a resistor of double the wattage rating should be used. Therefore, a 5000 ohm 1 watt resistor is required.

maintenance

CONTROL ADJUSTMENTS

INPUT LEVEL ADJ. is set after all the systems components are interconnected and are actually operating. If the INPUT LEVEL ADJ. will not be accessible after mechanical installation, then the systems components should be interconnected and turned on before mechanical installation to permit the proper setting of this control.

The INPUT LEVEL ADJ. control is intended to protect the speaker system from "blasting" should someone turn the preamplifier-control unit level controls to full, by permitting you to attenuate the preamplifier output signal by any desired amount at the input to the power amplifier where it can not be "fiddle" with. Start by setting the INPUT LEVEL maximum counter-clockwise (maximum attenuation), using a screwdriver. Set the LOUDNESS control on your preamplifier to the maximum clockwise position and the LEVEL control at the midpoint of its range of rotation. Turn your phonograph on and play on average orchestral record. Then slowly rotate the INPUT LEVEL ADJ. control clockwise until the music is at normal (or concert-listening level. This completes the adjustment which need not be repeated.

TROUBLE-SHOOTING PROCEDURES

Your amplifier should require little service except for normal tube replacement. We recommend no substitutions for the tube types used in this amplifier. The EF86 is distributed nationally by the Amperex Electronic Corporation (230 Duffy Ave., Hicksville, L.I., N.Y.) and Mullard Ltd. (International Electronics Corp., 81 Spring St., N.Y.) If necessary, replacements can be obtained directly from EICO.

The HF-22 is intended for operation at a line voltage of 117 volts AC. Component failure is likely at a line voltage above 125 volts AC. If the line voltage at your location is higher than 125 volts, use a voltage adjusting device or voltage regulator of adequate volt-ampere capacity (minimum 200 VA).

To facilitate servicing, remedial and trouble-shooting procedures have been provided in the TROUBLE SHOOTING CHART that follows. A VOLTAGE AND RESISTANCE CHART is also provided as an aid in locating defective components and to permit a careful, stage-by-stage check of the amplifier. DC operating voltages are given both at no signal and at a signal developing 22 watts output as well as the corresponding 1 kc signal voltage.

To isolate the source of unusual hum or noise in your system, first turn off the AC power and then unplug the audio cable connecting to the amplifier input. Then turn the AC power on again and note whether hum or noise has decreased. If it has, the fault is in the preamplifier or associated equipment and measures should be taken to correct it as described in the service notes for these units. If it is desired to provide a good building ground for your entire system, run a lead from under speaker connection terminal "G" to a cold water pipe. Do not connect such a ground wire to other components in the system.

If the trouble is no output or low output and the amplifier is suspected, check AC signal voltages starting at the input and work step-by-step toward the output, using a sine-wave audio signal generator and a VTVM. Turn the INPUT LEVEL ADJ. control maximum clockwise (no attenuation) and set the input signal to 0.6 volt. The corresponding grid and plate signal voltage for this input are indicated on the schematic diagram. This procedure should suffice to localize the defective stage.

If the trouble is an excessively distorted output, try tube replacement, signal tracing or procede directly to voltage and resistance measurements.

When the defective stage is localized, procede to a resistance and voltage check of the stage, using the data in the Resistance and Voltage chart. Disconnect the amplifier from the power line and discharge capacitors prior to making any resistance check and prior to removing either or both of the 6L6 GB output tubes. <u>Do not turn the amplifier on with either of the output tubes removed</u>.

CHECKING A TYPICAL TUBE STAGE

1. Check tube.
2. Check plate and cathode resistors.
3. Check coupling capacitors for leakage or short.
4. For output stage, check dc resistance of transformer windings.
5. Check grid leak resistor for open.
6. Check cathode by-pass capacitors for short.
7. If wiring and circuit components check O.K., but B+ voltage is high, low, or non-existant, see trouble-shooting chart for possible causes and remedies.

TROUBLE-SHOOTING CHART

SYMPTOM	CAUSE	REMEDY
House power line fuse blows; fuse, F1, remains intact.	Short in line cord, J2, J3 or associated equipment plugged into J2 or J3.	Repair
Fuse, F1, blows.	If the amplifier causes a replacement fuse to blow with rectifier tube V5 removed, primary or high voltage secondary windings to T2 are incorrectly wired or shorted.	Check and repair or replace.
	If the amplifier does not cause F1 to blow when V5 is out of the socket, but does cause F1 to blow when V5 is placed back in the socket, then check for short in B+ circuits, or defective V5, C10, C11.	Check and repair or rep ace.
V5 filament not lit.	Incorrect wiring of fil. leads to V5 socket. V5 fil. winding of T2 open.	Repair
Any or all other tube filaments not lit.	Open lead from 6.3 V winding of T2 6.3 V winding to T2 open	Repair Replace T2
DC voltage at V5 cathode (pin 8) is incorrect as specified below.		
a) No voltage	Defective V5. C10 shorted internally or externally.	Replace Replace
	Connection to center-tap of high-voltage winding of T2 is open.	Repair
b) Low voltage	C11 shorted internally or externally.	Replace or Repair
	Connection to C10 from pin 8 of V5 is broken, or open C10.	Repair or Replace
	Excessive current drain in amplifier.	Repair
c) High voltage	Output tubes V3 & V4 over-biased and not drawing current. V3 or V4 defective.	Repair Repalce
	Open R9 or R10.	Replace

VOLTAGE AND RESISTANCE CHART

TUBE	PIN#	DC VOLTS NO SIGANL	DC VOLTS 22W OUT	AC VOLTS (1 kc) 22W OUT	RESISTANCE UNIT OFF
EF86/Z729	1	68	68	0.47	740k
	2	0	0	0	0
	3	1.5	1.5	0.45	1.2kΩ
	4&5	filament (6.3 V AC between)			-
	6	55	55	5	500KΩ
	7	0	0	0	0
	8	1.4	1.4	0.45	1.2KΩ
	9	0	0	0.5	1 Meg Ω
6SN7GTB	1	50	50	.0083	1.3 Meg Ω
	2	315	310	2.6	43 KΩ
	3	70	70	2.5	18 KΩ
	4	55	55	5	400 KΩ
	5	315	310	26	42 KΩ
	6	70	70	2.5	18 KΩ
	7&8	filament (6.3 V AC between)			
6L6GB (both)	1	0	0	0	0 Ω
	2&7	filament (6.3 V AC between)			-
	3	405	400	200	155 Ω
	4	410	405	83	65 Ω
	5	0	0	26	120 KΩ
	6	0	0	26	120 KΩ
	8	36	41	.07	350 Ω
5U4GB	1		-		
	2	filament 420 (5.0V AC to pin 8 - remove tube to measure)			above 200KΩ
	3				
	4			370	83Ω
	5	--	-		
	6			370	83Ω
	7	-	-		
	8	filament 420	410		above 200KΩ

All voltages and resistances are measured to chassis with the input level control set maximum clock wise (full gain). Voltages are measured with a high input impedance VTVM. All resistance measurements are made with pin 8 of the 5U4GB grounded except, of course, when the resistance to ground at pins 2 and 8 of the 5U4GB is being checked. Operating line voltage at which voltage measurements are made is 117 volts AC, 60cps. NOTE: ALL VOLTAGE & RESISTANCE VALUES MAY VARY NORMALLY BY ± 15%.

SERVICE

If trouble developes in your instrument which you can not remedy yourself, write to our service department listing all possible indications that might be helpful. If desired, you may return the instrument to our factory where it will be placed in operating condition for $5.00 plus the cost of parts replaced due to their being damaged in the course of construction. NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the instrument, giving your home address and the trouble with the unit. Pack very carefully in a rugged container, using sufficient packing material (cotton, shredded newspaper, or excelsior), to make the unit completely immovable within the container. The original shipping carton is satisfactory, providing the original inserts are used or sufficient packing material is inserted to keep the instrument immovable. Ship by prepaid Railway Express, if possible, to Electronic Instrument Co., Inc. 33-00 Northern Blvd., Long Island City., N.Y. Return shipment will be made by express collect. Note that a carrier cannot be held liable for damages in transit if packing IN HIS OPINION, is insufficient.

REPLACEMENT PARTS LIST

Stock#	Sym.	Description	Am't.
20042	C1	cap., molded, .05 mfd - 400V, ±10%	1
22533	C2	cap., disc., 47 mmf, ±10%	1
23007	C3	cap., elec., 50 mfd - 25V	1
20044	C4	cap., molded, .25 mfd - 400V, ±10%	1
20039	C5, 7	cap., molded, .1 mfd - 400V, ±10%	2
22515	C6	cap., disc., 500 mmf, ±10%	1
22542	C8	cap., disc., 750 mmf - 1000V, ±10%	1
22514	C9	cap., disc., 850 mmf, ±10%	1
24001	C10, 11	cap., elec., 2x20 mfd - 450V	2
23011	C12	cap., elec., 50 mfd - 50V	1
20043	C13	cap., molded, .03 mfd - 600V	1
91005	F1	fuse, 3Amp	1
50014	J1	jack, single phono	1
50016	J2, 3	outlet, convenience	2
97032	J4	jack, octal	1
16016	R1	pot., 1MΩ, audio	1
10400	R2	res., 10KΩ, 1/2W, ±10% (brown, black, orange, silver)	1
11531	R3	res., 470KΩ, 1/2W, ± 5% (yellow, violet, yellow, gold)	1
11527	R4	res., 100KΩ, 1/2W, ± 5% (brown, black, yellow, gold)	1
11505	R5	res., 100Ω, 1/2W, ± 5% (brown, black, brown, gold)	1
11510	R6	res., 1.138Ω, 1/2W, ± 5%	1
10407	R7	res., 1MΩ, 1/2W, ±10% (brown, black, green, silver)	1
10416	R8	res., 15KΩ, 1/2W, ±10% (brown, green, orange, silver)	1
10417	R9	res., 220KΩ, 1/2W, ±10% (red, red, yellow, silver)	1
10853	R10, 19	res., 10KΩ, 1W, ±10% (brown, black, orange, silver)	2
11543	R11, 12	res., 1.8KΩ, 1/2W, ± 5% (brown, grey, red, gold)	2
11600	R13	res., 18KΩ, 1W, ± 5% (brown, grey, orange, gold)	1
11601	R14	res., 28.75KΩ, 1W, ± 5%	1
11602	R15	res., 33KΩ, 1W, ± 5% (orange, orange, orange, gold)	1
10444	R16, 17	res., 120KΩ, 1/2W, ±10% (brown, red, yellow, silver)	2
14302	R18	res., 350Ω, 10W, ±10%	1
10432	R20, 21	res., 1KΩ, 1/2W, ±10% (brown, black, red, silver)	2
32004	T1	transformer, output	1
30016	T2	transformer, power	1
54500	TB1	terminal board, 4 post	1
54003	TB2, 5	terminal strip, 2 post	2
54004	TB3	terminal strip, 2 post w/ground	1
54006	TB4	terminal strip, 3 post, 2 right	1
54001	TB6	terminal strip, 1 post right	1
90042	V1	tube, EF86	1
90041	V2	tube, 6SN7	1
90031	V3, 4	tube, 6L6 GB	2
90032	V5	tube, 5U4 GB	1
97800	XF1	fuseholder	1
97027	XV1	socket, 9 pin miniature	1
97032	XV2-5	socket, octal	4
40000		nut, #6-32 hex	21
40001		nut, #3/8-32 hex	1
40005		nut, #10-24 hex	10
40007		nut, #4-40 hex	2
40016		nut, #1/2-24 hex	1
40017		nut, #8-32 tinnerman	10
41000		screw, #6-32 x 1/4 Bd. H.	21
41003		screw, #8-32 x 3/8	10
41006		screw, #10-24 x 3/8 Bd. H.	10
41016		screw, #4-40 x 1/4	2
41028		screw, #8-32 x 1	4
42000		washer, #3/8 lock	1
42001		washer, #3/8 flat	1
42002		washer, #6 lock	20
42004		washer, #10 lock	10
42007		washer, #4 lock	2
42011		washer, #10 flat	10
42029		washer, rubber, 1/2 ID	1
42032		washer, #8 flat	4
43000		lug, #6 ground	1
43002		lug, #10	1
46000		grommet, 3/8 rubber	1
46006		bumper, rubber	4
51006		input plug	1
51007		octal plug and hood	1
57000		line cord	1
58004		wire, hook-up	length
58300		spaghetti	length
58501		wire, bare #22	length
81097		bottom plate	1
81162		chassis	1
81903		cable clamp	1
97300		tube shield	1
66068		manual of instruction (wired)	1
66317		manual of instruction (kit)	1

GENERAL INSTRUCTIONS

The section of the manual beginning with this page is the CONSTRUCTION section. All pages in this section have page numbers followed by "C" (1C, 2C, etc.). The INSTRUCTION section resumes on the pages following the CONSTRUCTION section. Note that the CONSTRUCTION section is located centrally in the book and may be removed without disrupting the INSTRUCTION section that both precedes it and follows it.

Care taken in the construction of this instrument will reward the constructor with many years of satisfactory service and greater confidence in his instrument. We urge you to not rush the construction, but to take all the time necessary for proper assembly and wiring.

Furthermore, we urge strongly that you follow the wire and parts layout shown in the pictorial diagrams as closely as possible. Very often wires are placed as shown for a good reason, and certainly the appearance of the completed instrument will be improved and the difficulty of finding a wiring error will be reduced by the following the wire and parts layout shown.

UNPACKING THE KIT: Unpack the kit carefully and check each part against the parts list including those parts that are mounted to the chassis. If you have trouble identifying any parts refer to the pictorial diagrams or the color code chart.
You will find that the value of a component will vary within the allowable circuit tolerance. For example, the 4.7KΩ, ±10% resistor may measure anywhere between 4.2KΩ and 5.2KΩ. Tolerances on paper capacitors are substantially greater, and the tolerance for electrolytics is usually +100% and -50%.

CONSTRUCTION HINTS: USE THE BEST GRADE OF ROSIN CORE SOLDER ONLY, preferably one containing the new activated fluxes such as Kester "Resin-Five", Ersin "Multicore" or similar types. UNDER NO CIRCUMSTANCES USE ACID CORE SOLDER OR ACID FLUX since acid flux can cause serious corrosion. Before soldering make a certain of a good mechanical connection. Use a clean, freshly tinned soldering iron, no smaller than 100 watts, and place the solder on the joint (not on the iron) so that the solder is melted by the heat from the joint itself. Do not remove the soldering iron until the solder flows and check to see that the resulting joint is smooth and shiny when the solder has cooled. There are two extremes to be avoided; too little heat and too much heat. If too little heat is supplied, the joint will appear pitted and grey, indicating a rosin joint which is unsatisfactory. On the other hand, if too much heat is applied to a joint, the parts connected to it may either change value, loose their protective coating, or break down. If you are soldering close to a part, hold the lead between the part and the joint being soldered with the tip of a pair of longnose pliers. The pliers will conduct the heat away and prevent the component from being unduly overheated. If for any reason it is necessary to resolder a joint, be sure to use new solder.

It should also be noted that the leads on resistors, capacitors, and transformers are often longer than required. These leads should be trimmed to the proper length when necessary. Do not cut any lead until you have determined the required length when the lead is routed as shown in the diagrams.

BASIC TOOLS REQUIRED: These basic tools are required for the construction of the amplifier.

1. Screwdriver - 3/16" to 1/4" blade
2. Screwdriver - 1/8" blade
3. Longnose pliers - 5 or 6"
4. Diagonal cutters
5. Soldering Iron (100 watts), or soldergun, or pencil iron (35 watts)
6. Gas pliers
7. High quality rosin or equivalent synthetic flux core solder. Do not use acid or paste flux under any circumstances.

A set of spintites and a wire stripper are also very useful supplementary tools.

PARTS IDENTIFICATION: Please note that very many of the parts for which color coding is given may not be color coded, but have their values and ratings printed. The letter K is a multiplier (X1000) and on resistors or capacitors indicates that the printed numerical value must be multiplied by one thousand to obtain the value in ohms or micro-micro farads respectively. Note also that one microfarad (mf) is equal to one million; micro-microfarads (mmf). To aid in rapid identification, keep in mind that 5%, 10%, and 20% resistors are color coded whereas 1% resistor have their values printed; also that molded tubular capacitors may or may not be color coded, whereas disc capacitors and electrolytics will always have their values printed. Please note the following relationships between the units used to express resistance or capacity.

1,000,000 ohms (Ω) = 1000 kilohms (KΩ) = 1 megohm (MΩ)
1,000,000 micro-micro farads (mmf) = 1 micro farad (mf)

CONSTRUCTION PROCEDURE: The complete step-by-step mounting and wiring procedure follows. To keep the drawings uncrowded, unnecessary repetition of mounting or wiring details may be omitted. Note: The abbreviation (C) means connect but do not solder (until other leads have been connected). The abbreviation (S) means connect and solder. The number after the (S) indicates the number of leads at the terminal when soldering. Since all leads must be soldered, this is a check on wiring accuracy.
Bend the ground lug tabs on the sockets toward the chassis to prevent accidental shorting to the socket pins.

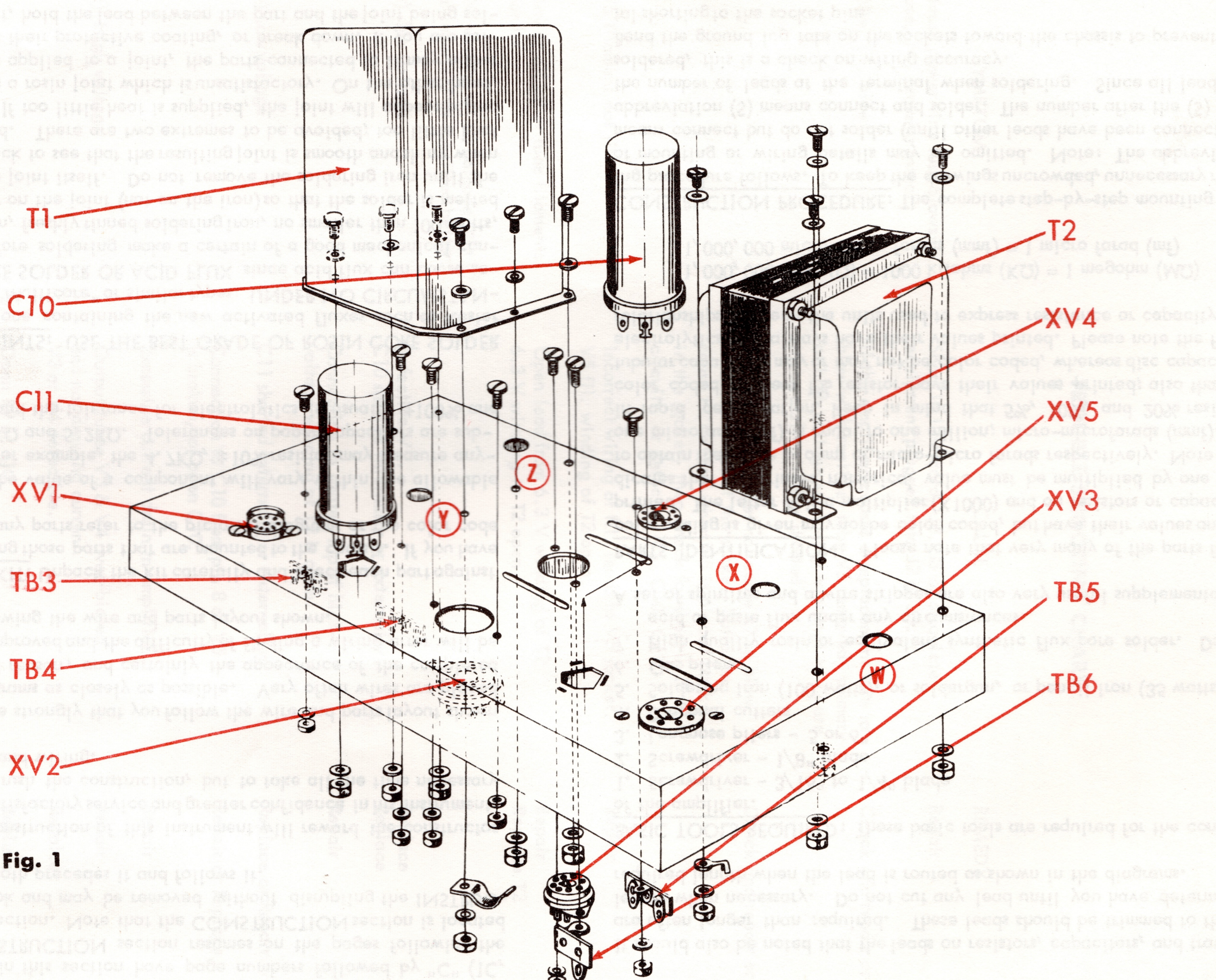


Fig. 1

TOP OF CHASSIS ASSEMBLY

1. (✓) Fig. 1. On the output transformer T1, cut the red and red-yellow leads to 6", the brown and brown yellow leads to 5", the blue and blue-yellow lead to 7", the black lead to 4", the white (slate) lead to 3 1/2", the green lead to 3" and the yellow lead to 2 1/2". Strip insulation back 1/4" from the end and tin the exposed wire with solder by dipping it into a solder pot or melting solder onto the wire with a hot soldering iron. Mount as shown, pushing the wires through the two large holes provided. Note that when oriented properly, the black, white, yellow, and green lead are easily pushed through hole "Z", while all other leads are pushed through hole "Y". Use six #10-24 screws and six #10 flatwashers above the chassis and six #10 lockwashers and six #10-24 hex nuts below chassis. Under one of the hex nuts, mount the cable clamp as shown, and run all the leads from hole "Y" under this clamp (Fig. 3).

2. (✓) Fig. 1. On power transformer T2, cut the two red leads to 6", the red-yellow and bare lead to 2", the yellow leads to 7", the black and green leads to 4 1/4". Strip the insulation back 1/4" from the end and tin the exposed wire with solder by dipping it into a solder pot or melting solder on the wire with a hot soldering iron. Mount as shown, pushing the wires through the two large holes provided. The green leads and all other leads coming from this same hole in the transformer are pushed through hole "X" in the chassis. All other leads are pushed through hole "W". Use four #10-24 screws, four #10 flatwashers above the chassis, four #10 lockwashers and four #10-24 hex nuts below the chassis. Mount one #10 ground lug under one of the hex nuts (Fig. 3).

~~NOT~~ SOLDERED

3. ( ) Fig. 1. Mount the electrolytic can capacitors C10 and C11 as shown. Note the half moon and triangle near the lugs to determine direction of mounting (Fig. 3). Insert the mounting tabs into the slots in the chassis and twist the tabs somewhat less than a quarter turn. DO NOT twist the tabs excessively or they will shear off. Solder the tab on each without a hole, to the chassis at its slot.

4. (✓) Fig. 1. Mount the octal sockets XV2, XV3, XV4 and XV5, as shown, from below the chassis. Note direction of orientation in Fig. 3. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts. Under one of the hex nuts of XV3, mount the one post right terminal strip, TB6.

5. (✓) Fig. 1. Mount the 9 pin miniature tube socket, XV1, from the top of the chassis, as shown. Note direction of orientation in Fig. 3. Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts.

6. (✓) Fig. 1. Mount the two post with ground terminal strip, TB3, three post two right terminal strip, TB4, and two post terminal strip, TB5 as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut on each.

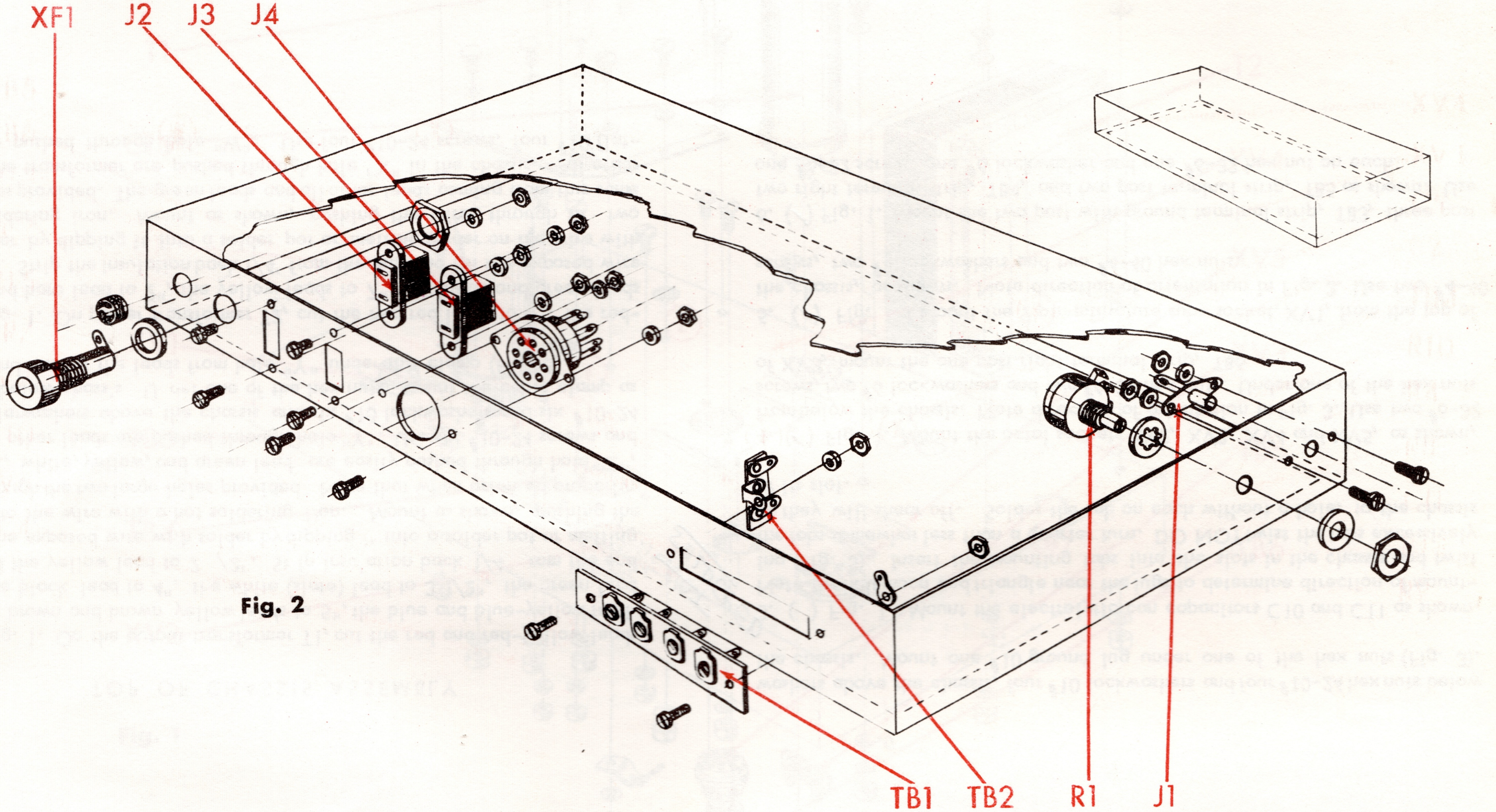


Fig. 2

BOTTOM OF CHASSIS ASSEMBLY

Note that the view shown in figure 2 is from the top of the chassis, as if part of the top were cut away.

1. (✓) Fig. 2. On the side of the chassis, mount level control pot, R1, as shown. Use one 3/8 lockwasher, one 3/8 flat washers and one 3/8 hex nut.

2. (✓) Fig. 2. Mount input jack J1, as shown. (Fig. 3). Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts.

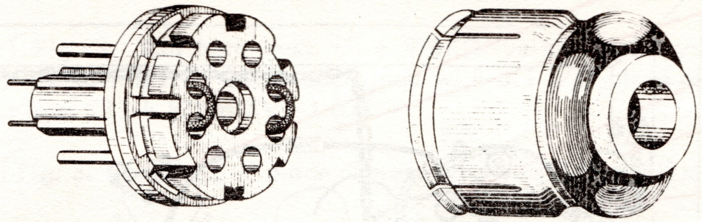
3. (✓) Fig. 2. Mount the four screw terminal board, TB1, from the outside of the chassis, as shown. Use two #6-32 screws and two #6-32 hex nuts. Under one of the hex nuts, mount a #6 ground lug. Under the other hex nut, mount the two post terminal strip, TB2 and a #6 lockwashers.

4. (✓) Fig. 2. Mount the octal socket, J4, as shown. Note orientation. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts.

5. (✓) Fig. 2. Mount the two convenience outlets, J2 and J3, as shown. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts on each.

6. (✓) Fig. 2. Mount the fuseholder XF1, as shown. Use rubber washer outside of the chassis and the hex nut inside of the chassis. Do not tighten the hex nut too much or fuseholder will crack.

7. (✓) Fig. 2. Mount the 3/8" rubber grommet in the remaining hole on the rear apron.



8. ( ) Fig. 2A. Cut two 2" lengths of black hook-up wire. Strip 3/4" of insulation from both ends of each. This will leave 1/2" of insulation at the exact center of each wire. Bend each wire into a "U" shape. One will be used as a jumper between pins 2 and 3 of the octal plug and the other as a jumper between pins 6 and 7 of the octal plug.

9. ( ) Fig. 2A. Push one end of one lead into pin 2 of the octal plug and the other end of the same lead into pin 3. When the lead ends have reached the ends of the pins, only the insulation will be visible at the rear of the plug.

10. ( ) Fig. 2A. Similarly connect plug pins 6 and 7 with the other 2" lead.

11. ( ) Fig. 2A. Form a puddle of solder at the tip of the soldering iron. Hold the plug with the pins down directly above the tip of the soldering iron. Dip each of the pin-ends into which iwres have been inserted one at a time into the solder puddle and hold there for several seconds until the solder rises up into the pin by capillary action.

12. ( ) Fig. 2A. Press the cap down over the octal plug. It may be left off if there is inadequate room at the desired location for mounting the chassis.

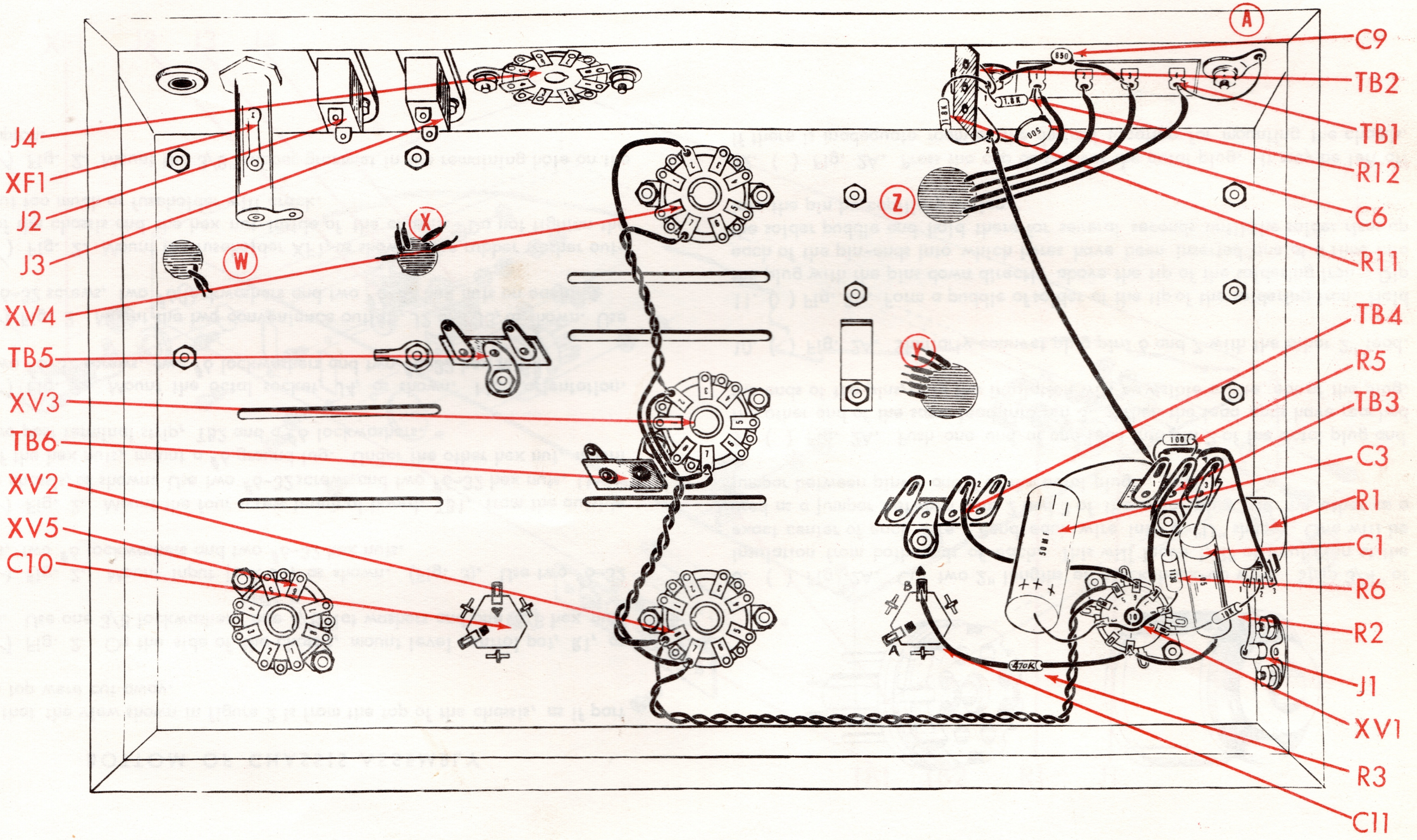

A
C9
TB2
TB1
R12
C6
R11
TB4
R5
TB3
C3
R1
C1
R6
R2
J1
XV1
R3
C11
J4
XF1
J2
J3
XV4
TB5
XV3
TB6
XV2
XV5
C10
W
X
Y
Z
470K
850
.005
1.8K
100
50MF

Fig. 3

CHASSIS WIRING

1. ( ) Fig. 3. Connect a 1 1/2" piece of bare wire from TB1-4 (C) to ground lug "A" (S).

2. ( ) Fig. 3. Connect a 6" piece of black wire from TB2-2 (C) to TB3-1 (C).

3. ( ) Fig. 3. From the output transformer T1, connect the leads from hole "Z" as follows: black to TB1-4 (S2), white (or slate) to TB1-3 (C), green to TB1-2 (S1) and yellow to TB1-1 (C).

4. ( ) Fig. 3. Cut all leads on two 1.8KΩ (brown, grey, red, gold) resistor, R11 and R12, to 3/4". Connect one resistor R11 from TB2-1 (C) to TB2-2 (C) and the second resistor from TB1-1 (C) to TB2-1 (C).

5. ( ) Fig. 3. Cut both leads on a 850mmf disc capacitor, C9, to 1". Cover each lead with a 3/4" piece of spaghetti. Connect from TB1-3 (S2) to TB2-1 (S3).

6. ( ) Fig. 3. Cut both leads on a 500mmf disc capacitor C6, to 3/4". Connect from TB1-1 (S) to TB2-2 (S3).

S3

7. ( ) Fig. 3. Cover a 1 1/2" piece of bare wire with a 1" piece of spaghetti. Connect from TB3-1 (C) to ~~TB3-2~~ (C).

~~(S3) TB3-2 (S3)~~

8. ( ) Fig. 3. Connect a 1/2" piece of bare wire from the center pin of XV1-10 (S) to XV1-7 (C).

9. ( ) Fig. 3. Cover a 1 3/4" piece of bare wire with a 1 1/4" piece of spaghetti. Connect from XV1-7 (S2) to TB3-2 (C).

10. ( ) Fig. 3. Cut both leads on a 100Ω (brown, black, brown, gold) resistor, R5, to 1/2". Connect from TB3-1 (C) to TB3-2 (C).

11. ( ) Fig. 3. Cut both leads on a 1.138KΩ resistor, R6, to 3/4". Connect from TB3-3 (C) to XV1-8 (C).

12. ( ) Fig. 3. Connect a 1 1/4" piece of wire covered with a 3/4" piece of spaghetti from XV1-8 (S2) to XV1-3 (C).

13. ( ) Fig. 3. Connect one end of a 9" piece of yellow wire to XV1-5 (S1) and one end of a 9" piece of brown wire to XV1-4 (S1). Twist the leads and run along the chassis, as shown. Connect the other end of the yellow wire to XV2-8 (C) and the other end of the brown wire to XV2-7 (C).

14. ( ) Fig. 3. Cut both leads on a 470KΩ (yellow, violet, yellow, gold) resistor, R3, to 1 1/2". Cover each lead with a 1 1/4" piece of spaghetti. Connect from C11-b (C) to XV1-1 (C).

15. ( ) Fig. 3. Connect a 4" piece of green wire from XV1-6 (S1) to TB4-2 (C).

16. ( ) Fig. 3. Cut both leads on a 50mfd, 25V, electrolytic capacitor, C3, to 1 1/4". Cover both leads with a 1" piece of spaghetti. Connect the positive (+) lead to XV1-3 (S2) and the negative lead (-) to TB3-1 (~~S3~~).
(S4)

17. ( ) Fig. 3. Cut one lead on a .05mfd (green, black, orange, black, yellow) capacitor, C1, to 1 1/4" and the other lead to 3/4". Cover the longer lead with a 1" piece of spaghetti and connect to XV1-1 (S2). Connect the other lead to TB3-3 (S3).

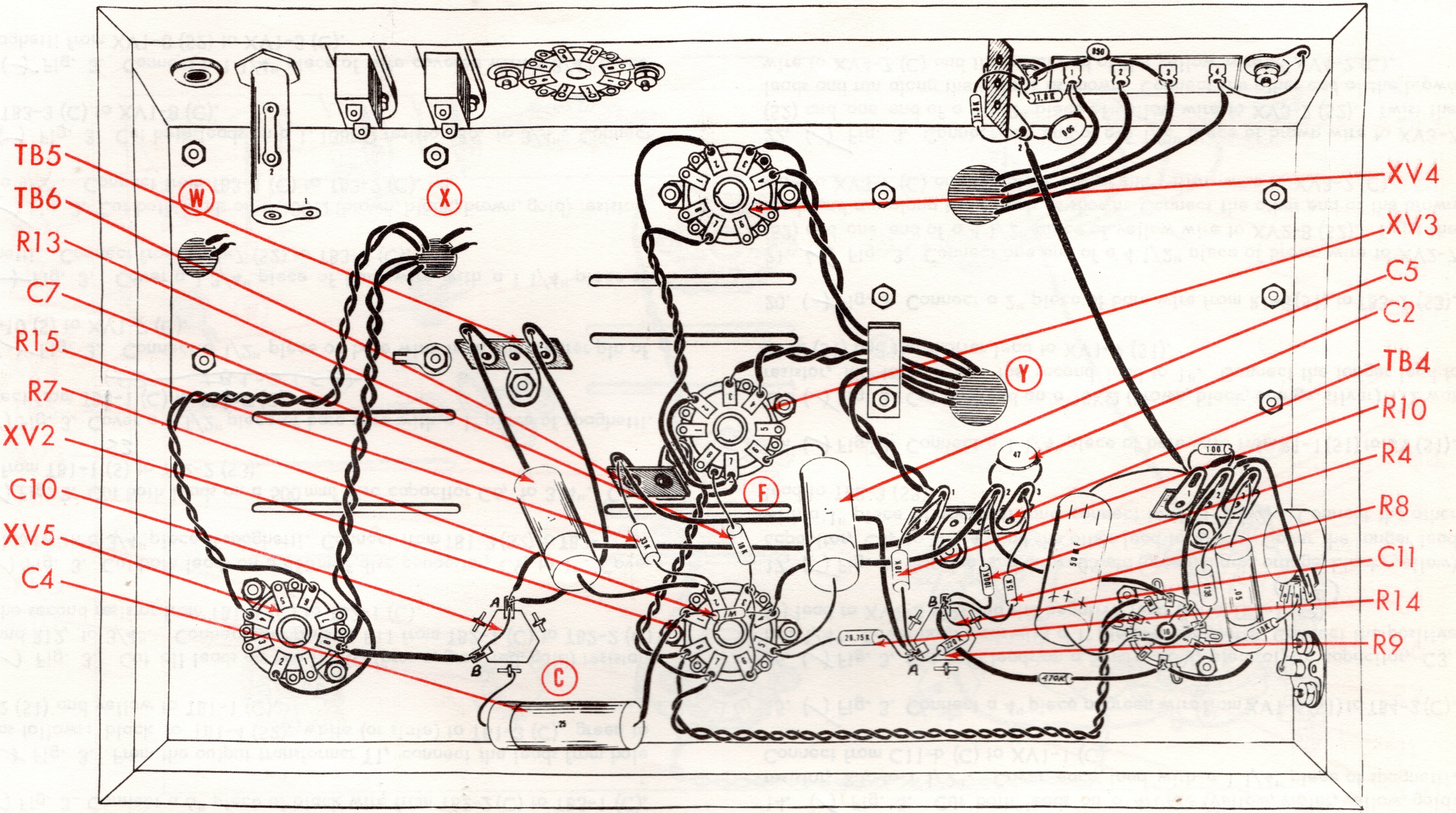
18. ( ) Fig. 3. Connect a 1 1/4" piece of bare wire from R1-1 (S1) to J1 (S1).

19. ( ) Fig. 3. Cut one lead on a 10KΩ (brown, black, orange, silver) 1/2 watt resistor, R2, to 1/2" and the second lead to 1". Connect the longer lead to R1-2 (S1) and the shorter lead to XV1-9 (S1).

20. ( ) Fig. 3. Connect a 2" piece of bare wire from R1-3 (S1) to TB3-2 (S3).

21. ( ) Fig. 3. Connect one end of a 4 1/2" piece of brown wire to XV2-7 (S2) and one end of a 4 1/2" piece of yellow wire to XV2-8 (S2). Twist the leads and run along the chassis as shown. Connect the other end of the brown wire to XV3-7 (C) and the other end of the yellow wire to XV3-2 (C).

22. ( ) Fig. 3. Connect one end of a 5 1/2" piece of brown wire to XV3-7 (S2) and one end of a 5 1/2" piece of yellow wire to XV3-2 (S2). Twist the leads and run along the chassis as shown. Connect the other end of the brown wire to XV4-7 (C) and the other end of the yellow wire to XV4-2 (C).



TB5
TB6
R13
C7
R15
R7
XV2
C10
XV5
C4
W
X
Y
F
C
A
B
XV4
XV3
C5
C2
TB4
R10
R4
R8
C11
R14
R9

Fig. 4

1. ( ) Fig. 4. From hole "Y" of output transformer T1, twist the red and red-yellow leads together. Connect both leads to TB4-1 (C).

2. ( ) Fig. 4. From hole "Y" of the output transformer T1, twist the brown and brown-yellow leads together. Connect the brown lead to XV3-3 (C) and the brown-yellow lead to XV3-4 (S1).

3. ( ) Fig. 4. From hole "Y" of the output transformer T1, twist the blue and blue-yellow leads together. Connect the blue lead to XV4-3 (S1) and the blue-yellow lead to XV4-4 (S1).

4. ( ) Fig. 4. Connect a 4 1/2" piece of green wire from TB4-2 (C) to XV2-4 (C).

5. ( ) Fig. 4. Cut both leads on a 47 mmf disc capacitor, C2, to 1/2". Connect from TB4-2 (C) to TB4-3 (C).

6. ( ) Fig. 4. Cut both leads on a 100KΩ (brown, black, yellow, gold) resistor, R4, to 3/4". Connect from C11-B (C) to TB4-2 (S4).

7. ( ) Fig. 4. Cut both leads on a 15KΩ (brown, green, orange, silver) 1/2W resistor, R8, to 3/4". Connect from C11-B (C) to TB4-3 (S2).

8. ( ) Fig. 4. Cut both leads on a 220KΩ (red, red, yellow, silver) resistor, R9, to 1/2". Connect from C11-A (C) to C11-B (S4).

9. ( ) Fig. 4. Connect a 5" piece of red wire from C10-A (C) to TB5-2 (C).

10. ( ) Fig. 4. Connect a 6" piece of red wire from C10-A (C) to TB4-1 (C).

11. ( ) Fig. 4. Connect a 5" piece of red wire from C11-A (C) to TB6 (C).

12. ( ) Fig. 4. Cut both leads on a 10KΩ (brown, black, orange, silver) 1 watt resistor, R10, to 1/2". Connect from TB4-1 (S4) to C11-A (C).

13. ( ) Fig. 4. Cut both leads on a 28.75KΩ resistor, R14, to 3/4". Connect from XV2-5 (C) to C11-A (S4).

14. ( ) Fig. 4. Connect a 1 1/4" piece of bare wire covered with a 1" piece of spaghetti from XV2-6 (S1) to XV2-3 (C).

15. ( ) Fig. 4. Cut both leads on a 1MΩ (brown, black, green, silver) resistor, R7, to 1/2". Connect from XV2-1 (C) to XV2-4 (S2).

16. ( ) Fig. 4. Cut both leads on an 18KΩ (brown, grey, orange, gold) resistor, R13, to 3/4". Connect from XV2-3 (S2) to ground lug "F" (S1) on XV3.

17. ( ) Fig. 4. Cut both leads on a 33KΩ (orange, orange, orange, gold) resistor, R15, to 3/4". Connect from TB6 (S2) to XV2-2 (C).

18. ( ) Fig. 4. Cut both leads on a .25 mfd (red, green, yellow, white, yellow) capacitor, C4, to 1". Cover one lead with a 3/4" piece of spaghetti and connect to XV2-1 (S2). Connect the other lead to ground lug "C" (S1) at C10.

19. ( ) Fig. 4. Cut both leads on a .1 mfd (brown, black, yellow, white, yellow) capacitor, C5, to 1". Connect from XV2-5 (S2) to XV3-6 (C).

20. ( ) Fig. 4. Cut both leads on a .1 mfd (brown, black, yellow, white, yellow) capacitor, C7, to 1 1/2". Cover each lead with a 1 1/4" piece of spaghetti. Connect from XV2-2 (S2) to TB5-1 (C).

21. ( ) Fig. 4. Twist the two red leads from hole of power transformer T2, and run along the chassis as shown. Connect one red lead to XV5-4 (S1) and the other red lead to XV5-6 (S1).

22. ( ) Fig. 4. Twist the two yellow leads from hole "X", of the power transformer T2, and run along the chassis as shown. Connect one yellow lead to XV5-2 (S1) and the other yellow lead to XV5-8 (C).

23. ( ) Fig. 4. Connect a 3" piece of red wire from XV5-8 (S2) to C10-B (C).

24. ( ) Fig. 4. Connect a 1 1/4" piece of bare wire from C10-B (S2) to C10-A (S3).

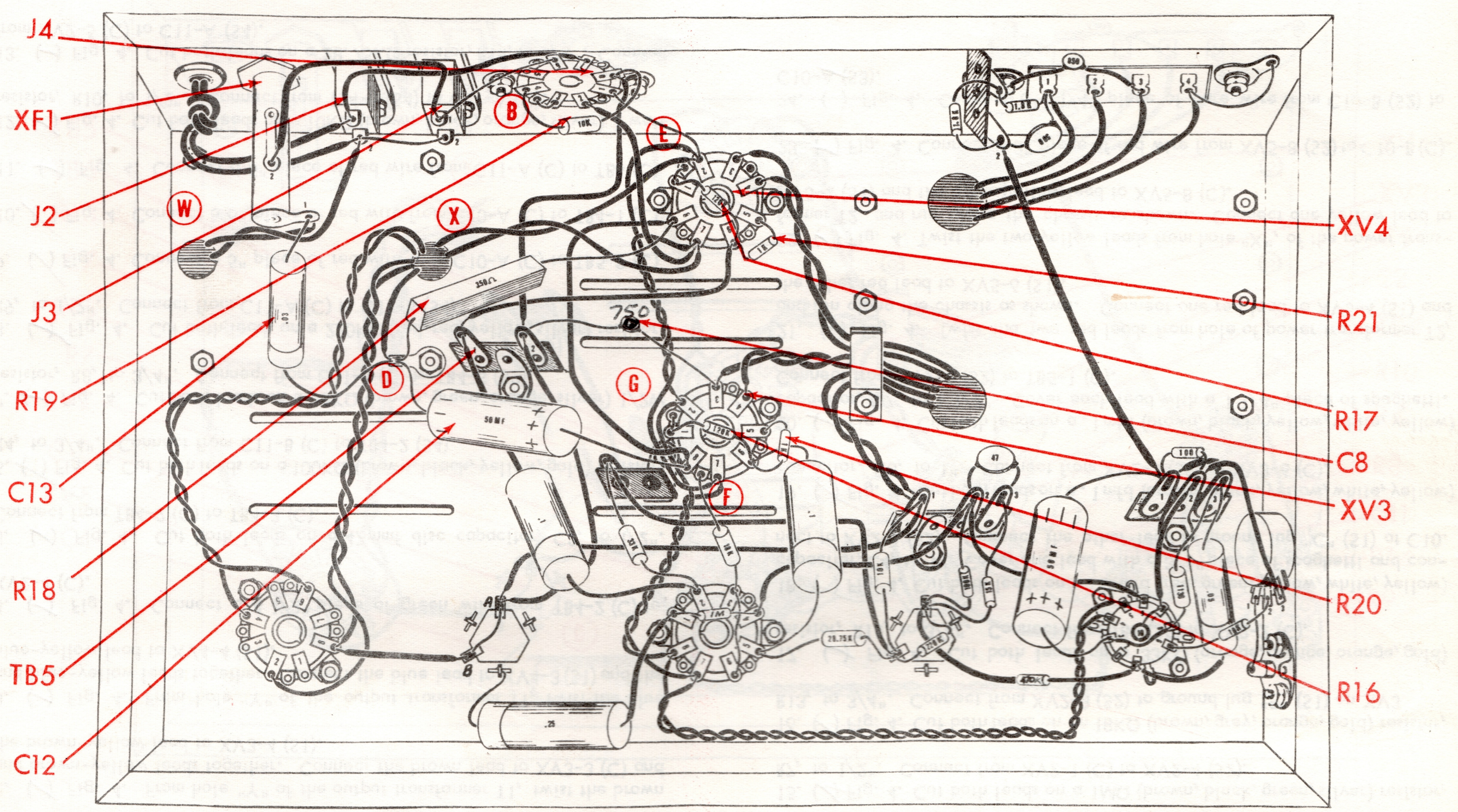

J4
XF1
J2
J3
R19
C13
R18
TB5
C12
XV4
R21
R17
C8
XV3
R20
R16
B
E
W
X
D
G
F
10K
250Ω
50 MF
750

Fig. 5

1. (✓) Fig. 5. Connect the shield braid and the red-yellow leads from hole "X" to ground lug "D" (C).

2. (✓) Fig. 5. Connect one black lead from hole "W" to J2-2 (C) and the second black lead to XF1-1 (C).

3. (✓) Fig. 5. Cut both leads on a .03 mfd (orange, black, orange, black, blue) capacitor, C13, to 1". Connect from XF1-1 (S2) to ground lug "D" (C).

4. (✓) Fig. 5. Connect a 5" piece of yellow wire from XV4-8 (C) to XV3-8 (C).

5. (✓) Fig. 5. Connect a 5 1/2" piece of green wire from TB5-1 (S2) to XV4-6 (C).

6. (✓) Fig. 5. Connect a 4 1/2" piece of red wire from TB5-2 (C) to J4-8 (C).

7. (✓) Fig. 5. Twist the two green leads from hole "X" on the power transformer T2, as shown. Connect one lead to XV4-7 (C) and the other lead to XV4-2 (C).

8. (✓) Fig. 5. Connect a 1 1/4" piece of bare wire from XV4-2 (S3) to J4-1 (S1).

9. (✓) Fig. 5. Connect a 3" piece of brown wire from XV4-7 (S3) to J4-2 (S1).

10. (✓) Fig. 5. Connect a 3/4" piece of bare wire from J4-3 (S1) to ground lug "B" (S1) on J4.

11. (✓) Fig. 5. Cut both leads on a 10KΩ (brown, black, orange, silver) 1 watt resistor, R19, to 1/2". Connect from J4-8 (S2) to J4-4 (S1).

12. (✓) Fig. 5. Connect a 1 1/2" piece of bare wire covered with a 1" piece of spaghetti from J4-6 (S1) to J3-1 (C).

13. (✓) Fig. 5. Connect a 3 1/2" piece of yellow wire from J4-7 (S1) to J2-1 (C).

14. (✓) Fig. 5. Connect a 3 1/2" piece of brown wire from J3-1 (S2) to XF1-2 (S1).

15. (✓) Fig. 5. Connect a 1 1/4" piece of bare wire from J3-2 (S1) to J2-2 (C).

16. (✓) Fig. 5. Connect a 3/4" piece of bare wire from XV4-1 (C) to ground lug "E" (S1) on XV4.

17. (✓) Fig. 5. Connect a 3/4" piece of bare wire from XV3-1 (C) to ground lug "G" (S1) on XV3.

18. (✓) Fig. 5. Cut one lead on the 350Ω resistor, R18, to 1 1/2" and the other lead to 3/4". Cover the longer lead with a 1 1/4" piece of spaghetti and connect to XV4-8 (S2). Connect the other lead to ground lug "D" (C). Dress this resistor flat against the chassis. Dress all leads away from this resistor.

19. (✓) Fig. 5. Cut both leads on a 50 mfd, 50 volt, electrolytic capacitor C12, to 1 1/4". Connect the positive (+) lead to XV3-8 (S2) and the negative lead to ground lug "D" (S5).

20. (✓) Fig. 5. Cut all leads on two 1KΩ (brown, black, red, silver) resistors, R20 and R21, to 1/2". Connect one resistor, R20 from XV3-6 (C) to XV3-5 (S1) and the other resistor, R21 from XV4-6 (C) to XV4-5 (S1).

21. (✓) Fig. 5. Cut all leads on two 120KΩ (brown, red, yellow, silver) resistor, R16 and R17, to 3/4". Connect one resistor from XV3-6 (S3), ~~R16 to~~ TO XV3-1 (S2). Connect the second resistor from XV4-6 (S3) to XV4-1 (S2).

22. (✓) Fig. 5. Pass the tinned leads from the line cord through the grommet at the rear of the chassis. Make a knot 3" from the end of the solder lead, so that the line cord cannot be pulled through the grommet. Connect one tinned lead to J2-1 (S2) and the other tinned lead to J2-2 (S3).

23. ( ) Fig. 5. Cut both leads on a 750 mmf disc capacitor, C8, to 3/4". Connect from TB5-2 (S3) to XV3-3 (S2).

FINAL STEPS

You have now completed the assembly and wiring of your amplifier. When you have completed the following steps your amplifier will be ready for use.

1) To catch any wiring errors, it is suggested that the entire wiring be checked point-by-point against the wiring instructions (and preferably also against the schematic wiring diagram in order to become more familiar with the component layout and circuitry). While doing so, check for rosin joints, loose lumps of solder, poor lead dress, and accidental shorts or leakage paths arising from the flow of rosin between contacts (remove with a stiff brush dipped in carbon tetrachloride).

2) Clean socket XV1 with carbon tetrachloride using a stiff brush. It is also advisable to remove the tube and shield from XV1, and clean the socket and pins on top of the chassis.

3) Insert tubes V1 through V5 in their correct sockets and the fuse in the fuse holder. Place a shield over V1.

4) Insert the octal plug into octal socket J4.

5) IMPORTANT: BE SURE TO MAKE THE FOLLOWING RESISTANCE CHECKS BEFORE CONNECTING TO THE AC LINE: Check for a cold dc resistance of at least 1.2 ohms across the AC pulg; check for a resistance of at least 45 ohms between ground and pins 4 and 6 of XV5; check for a resistance of at least 200K ohms between pin 8 of the rectifier tube V5 and ground. Allow sufficient time for the electrolytic capacitors to be charged by the ohmmeter battery in this last measurement. These measurements constitute a reasonable check of the power supply components and wiring before applying power. If you fail to obtain these resistance values, do not proceed to the next step until the cause is discovered and the condition remedied. If the measurements are satisfactory, proceed to CONTROL ADJUSTMENTS in the MAINTENANCE section of the book. DO NOT CONNECT TO THE AC LINE until you have completed the preliminary BIAS ADJ. and BALANCE ADJ. control adjustments, at which point you will be instructed to do so. When you have completed the CONTROL ADJUSTMENTS, proceed to the step following this one, after having disconnected the amplifier from the AC line.

6) Press a speed nut in place over each hole on the bottom flange of the chassis (see Fig. 6).

7) If the amplifier is not going to be fastened to some surface, insert the rubber feet in the openings provided in the bottom plate and mount the bottom plate on the chassis, using 10 #8-32 X 3/8" screws. Do not use the 1" long screws for this purpose (possibility of shorting input jack). If the amplifier is to be fastened to a surface, the feet will not be used and the bottom plate will be required as a template before it is attached to the amplifier.

8) Read the MECHANICAL INSTALLATION and ELECTRICAL INSTALLATION sections of the instruction book carefully, and install and connect the amplifier according to the information given.

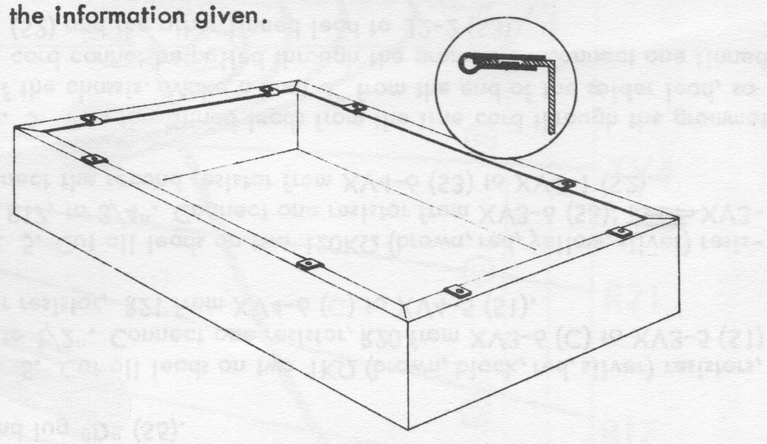
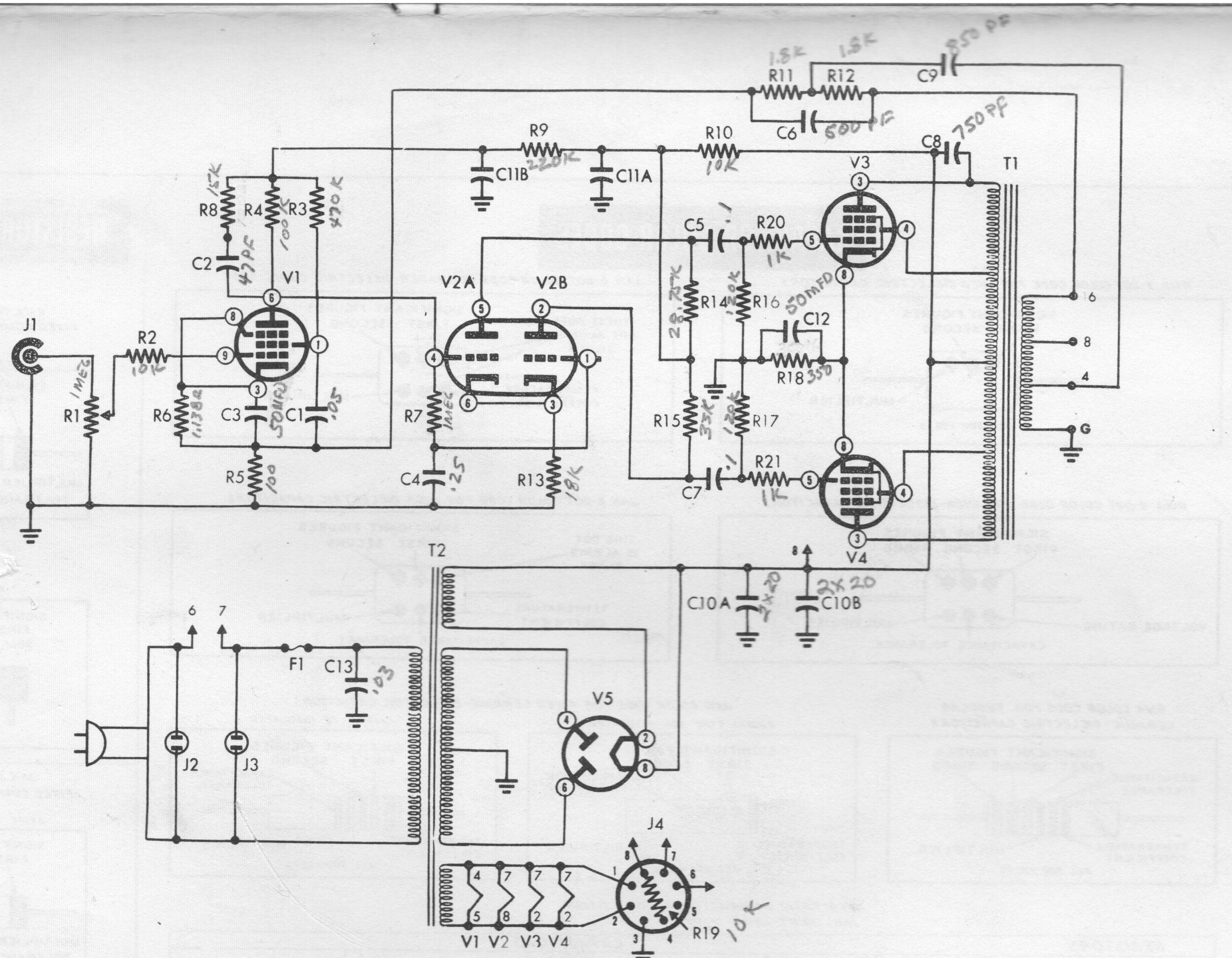


Fig. 6

SERVICE

If you are still having difficulty, write to our service department listing all possible indications that might be helpful. If desired, you may return the instrument to our factory where it will be placed in operating condition for $5.00 plus the cost of parts replaced due to their being damaged in the course of construction. This service policy applies only to completed instruments constructed in accordance with the instructions as stated in the manual. Instruments that are not completed or instruments that are modified will not be accepted for repair. Instruments that show evidence of acid core solder or paste fluxes will be returned not repaired. NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the instrument, giving your home address and the trouble with the unit. Pack very carefully in a rugged container, using sufficient packing material (cotton, shredded newspaper, or excelsior), to make the unit completely immovable within the container. The original shipping carton is satisfactory, providing the original inserts are used or sufficient packing material is inserted to keep the instrument immovable. Ship by prepaid Railway Express, if possible, to the Electronic Instrument Co., Inc., 33-00 Northern Blvd. L.I.C. 1, New York. Return shipment will be made by express collect. Note that the carrier cannot be held liable for damages in transit if packing, IN HIS OPINION, is insufficient.

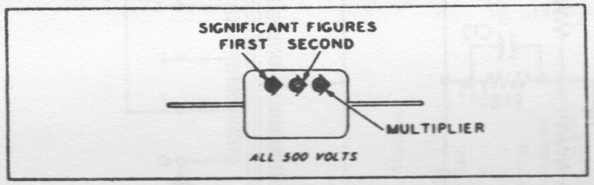


Sym.	Description	Sym.	Description	Sym.	Description	Sym.	Description	Sym.	Description	Sym.	Description
C1	cap., molded, .05 mfd - 400 V, ±10%	C9	cap., disc., 850 mmf, ±10%	J3	jack, 117 VAC	R7	res., 1MΩ, 1/2W, ±10%	R15	res., 33KΩ, 1W, ± 5%	T1	transformer, output
C2	cap., disc., 47 mmf, ±10%	C10	cap., elec., 2 x 20 mfd - 450 V	J4	jack, preamp power	R8	res., 15KΩ, 1/2W, ±10%	R16	res., 120KΩ, 1/2W, ±10%	T2	transformer, power
C3	cap., elec., 50 mfd - 25 V	C11	cap., elec., 2 x 20 mfd - 450 V	R1	pot., 1MΩ, audio	R9	res., 220KΩ, 1/2W, ±10%	R17	res., 120KΩ, 1/2W, ±10%	V1	tube, EF86
C4	cap., molded, .25 mfd - 400 V, ±10%	C12	cap., elec., 50 mfd - 50 V	R2	res., 10KΩ, 1/2W, ±10%	R10	res., 10KΩ, 1W, ±10%	R18	res., 350Ω, 10W, ±10%	V2	tube, 6SN7
C5	cap., molded, .1 mfd - 400 V, ±10%	C13	cap., molded, .03 mfd - 600 V	R3	res., 470KΩ, 1/2W, ± 5%	R11	res., 1.8KΩ, 1/2W, ± 5%	R19	res., 10KΩ, 1/2W, ±10%	V3	tube, 6L6 GB
C6	cap., disc., 500 mmf, ±10%	F1	fuse, 3 amp	R4	res., 100KΩ, 1/2W, ± 5%	R12	res., 1.8KΩ, 1/2W, ± 5%	R20	res., 1KΩ, 1/2W, ±10%	V4	tube, 6L6 GB
C7	cap., molded, .1 mfd - 400 V, ±10%	J1	jack, input	R5	res., 100Ω, 1/2W, ± 5%	R13	res., 18KΩ, 1W, ± 5%	R21	res., 1KΩ, 1/2W, ±10%	V5	tube, 5U4 GB
C8	cap., disc., 750 mmf - 1000 V, ±10%	J2	jack, 117 VAC	R6	res., 1.138Ω, 1/2W, ± 5%	R14	res., 28.75KΩ, 1W, ± 5%				

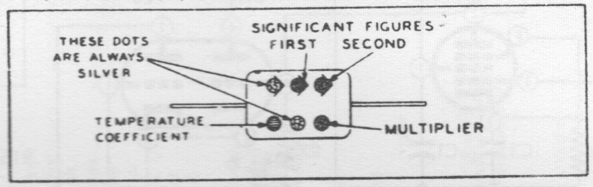
MODEL HF-22 22 WATT HIGH FIDELITY AMPLIFIER

CAPACITOR COLOR CODES

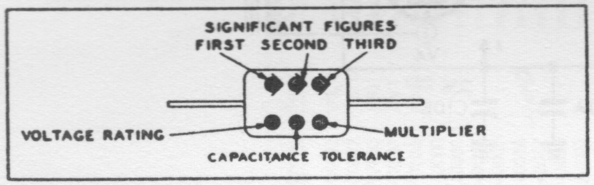
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



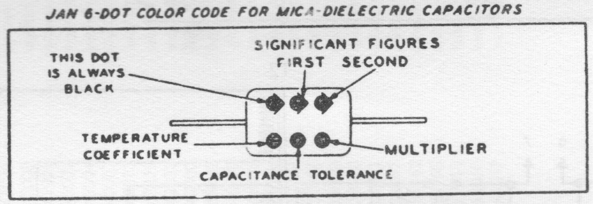
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



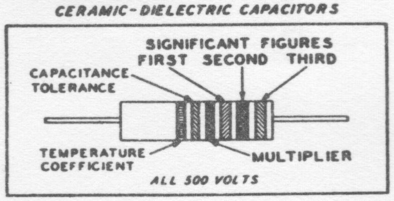
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

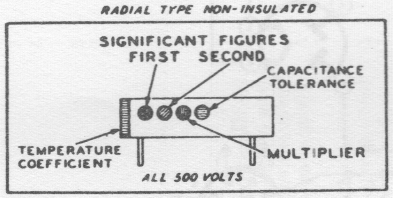


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

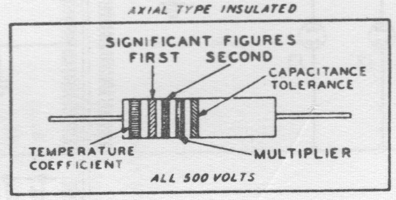


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON-INSULATED



AXIAL TYPE INSULATED



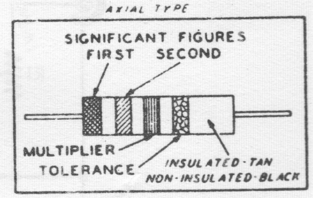
RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY

RESISTORS				CAPACITORS				
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	MULTIPLIER: RMA MICA AND CERAMIC-DIELECTRIC	MULTIPLIER: JAN MICA AND PAPER-DIELECTRIC	MULTIPLIER: JAN CERAMIC DIELECTRIC	VOLTAGE RATING	TEMPERATURE COEFFICIENT
	1	0	BLACK	1	1	1		A
	10	1	BROWN	10	10	10	100	B
	100	2	RED	100	100	100	200	C
	1,000	3	ORANGE	1,000	1000	1000	300	D
	10,000	4	YELLOW	10,000			400	E
	100,000	5	GREEN	100,000			500	F
	1,000,000	6	BLUE	1,000,000			600	G
	10,000,000	7	VIOLET	10,000,000			700	
	100,000,000	8	GRAY	100,000,000		0.01	800	
	1,000,000,000	9	WHITE	1,000,000,000		0.1	900	
5	0.1		GOLD	0.1	0.1		1000	
10	0.01		SILVER	0.01	0.01		2000	
20			NO COLOR				500	

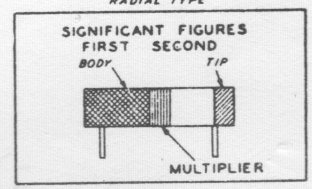
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

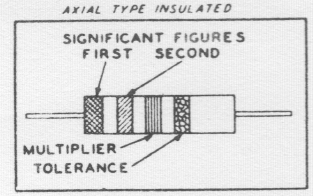


RADIAL TYPE

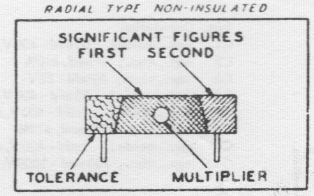


JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED



MODEL HF-22 ADDENDA

Please make the following corrections in your HF-22 construction book.

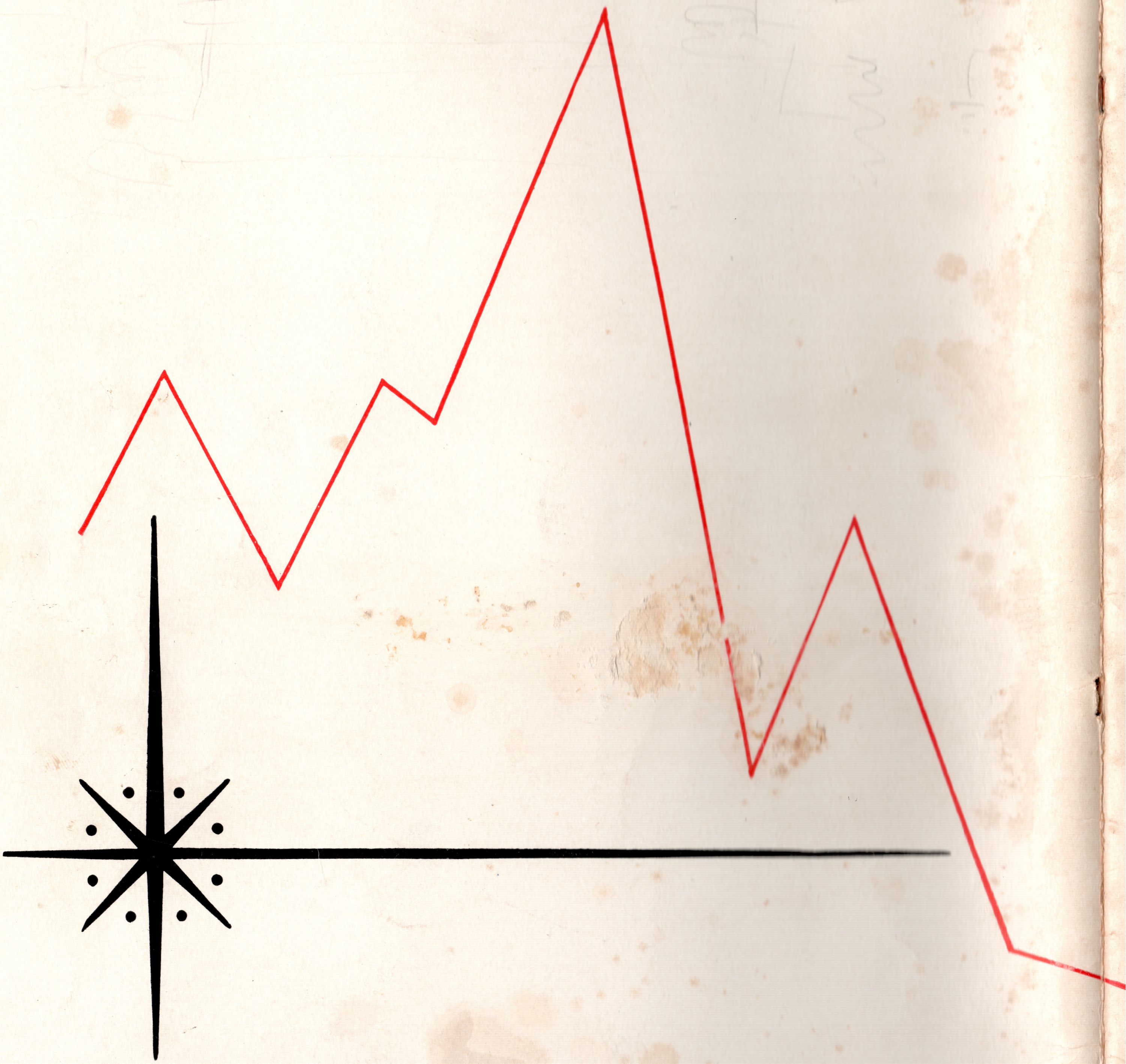
1. Page 11C, Step 21. Second sentence should read: "Connect one resistor from XV3-6 (S3) to XV3-1 (S2).

2. Page 10C, Fig. 5. Change C8 from 150 to 750.

3. Page 7C, Step 6. Second sentence should read: "Connect from TB1-1 (S3) to TB2-2 (S3).

I. E. 1192 Electronic Instrument Co., Inc., 33-00 Northern Blvd., L. I. C. 1, N. Y.

$1.00



EICO ANOTHER PERFORMANCE PROVEN PRODUCT