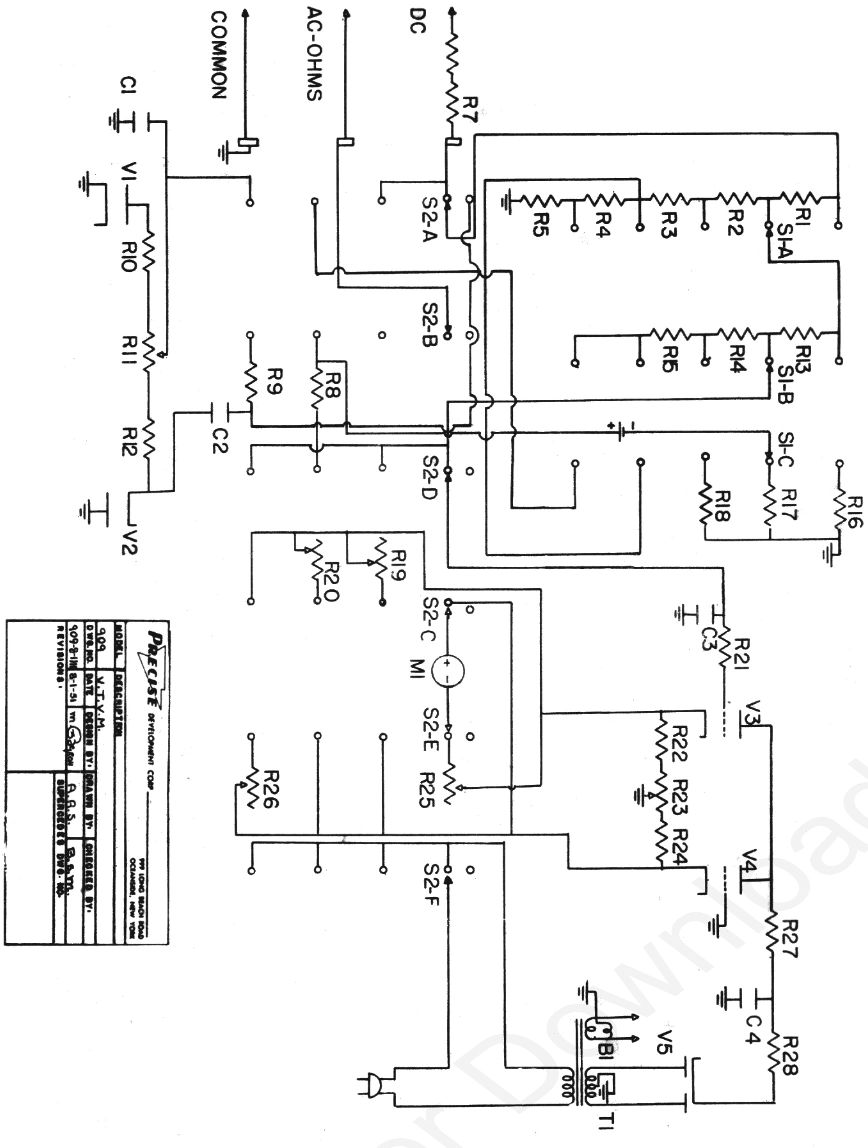


DESCRIPTION	PART#	AM'T
8M ohm Res.*	R-1	1
1.8M ohm Res.*	R-2	1
.1M " " *	R-3	1
50K " " *	R-4,R-5	2
15M " "	R-7	1
5M or 6M Res.	R-8	1
820K ohm Res.	R-9	1
1.5M " "	R-10	1
2M ohm Potentiometer	R-11	1
1.5M ohm Res.	R-12	1
3.9M " "	R-13	1
1.5M " "	R-14	1
100K " "	R-15	1
10 ohm Res.*	R-16	1
100 " " *	R-17	1
10K " " *	R-18	1
2K ohm Potentiometer	R-19	1
" " " "	R-20	1
1.2M ohm Res.	R-21	1
470 " "	R-22	1
2K ohm Potentiometer	R-23	1
470 ohm Res.	R-24	1
2K ohm Potentiometer	R-25	1
" " " "	R-26	1
15K ohm Res.	R-27	1
15K ohm Res.	R-28	1
6AL5 Tube	V-1,V-2	1
6SN7 "	V-3,V-4	1
6X5 "	V-5	1

construction book

909 VTVM

C-1-1761

PRECISE

PRECISE DEVELOPMENT CORP.
Oceanside, L. I., N. Y.

INTRODUCTION:

The construction of an instrument from its kit form, is as important as any of the major components used within the instrument. Realizing this, the PRECISE DEVELOPMENT CORP. used extreme care in the preparation of this construction book- with such innovations as two-color pictorials and photographs, plus schematic diagrams. Above all, the basic construction was made as a simple series of steps which may readily be followed by even the most inexperienced person. If a moderate amount of care is used,and the instructions are carried out step-by-step there is very little possibility of ending with anything other than a truly professional piece of equipment. PRECISE certainly appreciates the anxiety felt by the constructor and has therefore taken every intelligent short-cut to reduce the construction time- but do not try to go too quickly. Care is your assurance of an instrument with many years of fine service ahead.

WIRING TECHNIQUE:

The charts and pictorials on the following pages have been prepared to show you both the points to which a wire should be connected and the way to route the wire. The routing at first may not seem important,but at high frequencies it is of major concern.It also reduces the undesireable effects of distributed capacity and inductance. For these reasons do not cable leads.

SOLDERING:

Excessive heat will adversely effect parts by causing them to either change value,lose their protective coating or actually break down. To avoid this hold the tip of a pair of longnose pliers on the lead between the part and the junction that is being soldered. The pliers will conduct a sufficient amount of heat away to prevent damage.

Too little heat applied to connections may cause what is technically called a "rosin joint". These may simply be avoided by making certain that the solder flows and that all the flux has been "burned-off". The resulting contact should be smooth and shiny. A "rosin joint" will often appear pitted, grey,and show the dark brown rosin in the connection proper. Although rosin is very important in the basic soldering process,and no other type of flux should be used, it can cause trouble by leakage between contacts. This may give rise to inaccurate readings, especially in the case of switches where rosin flowing between contacts develops leakage. Rosin may be removed by briskly going over the area with a stiff brush that has been saturated with carbon-tetrachloride. Be very careful not to spring the contacts when cleaning switches.

PARTS LIST:

The following pictorial, and parts list should be checked to both familiarize the constructor with each of the parts used, and to make certain of actual count. The incorporation of a check balance system at PRECISE makes it unlikely that any of the parts should be missing. If a discrepancy does occur,however,please write and action will be taken immediately. Since resistors and condensers are often color coded, rather than marked directly, the standard RMA Color Code is reprinted in this manual. It should be retained for future use.
In order to maintain a continuous supply of parts, orders are placed with several reputable manufacturers at the same time. You may find, therefore, that the parts list calls for a particular value although another is supplied. The substituted part will work equally well inasmuch as the circuit has a normal 20% tolerance. i.e. a 39K resistor may be substituted for a 47k resistor without altering the circuit operation. This, of course. does not apply to precision parts.

Note: Please see ADDENDA, in rear of this book, before proceeding with the actual construction.

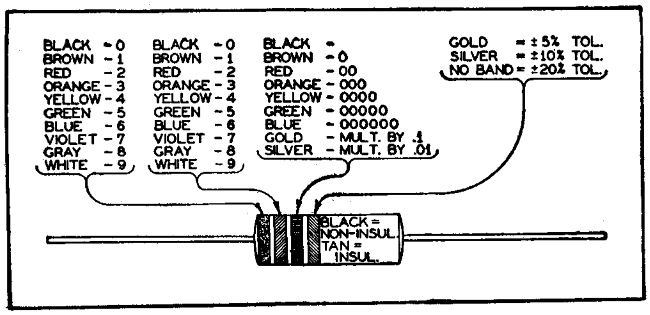
CHECK	DESCRIPTION	PART#	AM'T	REMARKS
	Pilot Light & Bracket	B-1	1	
	.01 ufd Cond.	C-1,C-2,C-5	3	
	.0015 ufd Cond.	C-3	1	
	24 ufd Cond.	C-4	1	
	Rubber Grommet	H-1	1	
	3/8" I.D. Hex Nut	H-2	5	
	3/8" I.D. Lockwasher	H-3	5	
	Large Octal Socket	H-4A,H-4B	2	
	6-32x½" Screw	H-5	4	
	6-32 Palnut	H-6	15	
	6-32 x ¼" Screw	H-7	7	
	7 Pin Miniature Socket	H-8	1	
	Small Machine Screw	H-9	2	
	Small Hex Nut	H-10	2	
	Small Lockwasher	H-11	2	
	4 Lug Terminal Strip	H-12	1	
	Chassis Connector	H-13	1	
	Banana Jack	H-14	1	
	¼" I.D. Lockwasher	H-15	1	
	¼" I.D. Hex Nut	H-16	1	
	Battery	H-17	1	
	Jewel Light	H-18	1	
	½" I.D. Hex Nut	H-19	1	
	Pin Jack & Star Washer	H-20	1	
	#6 Solder Lug	H-22	2	
	Panel	H-23	1	
	Chassis	H-24	1	
	Brass Meter Terminal Washer	H-25	2	
	Brass Meter Terminal Hex Nut	H-26	2	
	Meter Solder Lug	H-27	2	
	Phone Tip Plug	H-28	1	
	Alligator Clip	H-29	1	
	Black Test Prod	H-30A	1	
	Red Test Prod	H-30B	1	
	Spaghetti	H-31	1	
	Microphone Connector	H-32	1	
	Banana Plug	H-33	1	
	Handle Eyelet	H-34	2	
	#6 Flat Metal Washer	H-36	2	
	Self-Tapping Screw	H-37	7	
	Leather Handle	H-38	1	
	Cabinet	H-39	1	
	Battery Bracket	H-40	1	
	Pointer Knob	H-42	2	
	Round Knob	H-43	2	
	Meter	M-1	1	

CHECK	DESCRIPTION	PART#	AM'T	REMARKS
	8M ohm Res.*	R-1	1	
	1.8M ohm Res.*	R-2	1	
	.1M " " *	R-3	1	
	50K " " *	R-4,R-5	2	
	15M " "	R-7	1	
	5M or 6M Res.	R-8	1	
	820K ohm Res.	R-9	1	
	1.5M " "	R-10	1	
	2M ohm Potentiometer	R-11	1	
	1.5M ohm Res.	R-12	1	
	3.9M " "	R-13	1	
	1.5M " "	R-14	1	
	100K " "	R-15	1	
	10 ohm Res.*	R-16	1	
	100 " " *	R-17	1	
	10K " " *	R-18	1	
	2K ohm Potentiometer	R-19	1	
	" " " "	R-20	1	If 3/8" long bushing is used, add 1-H2
	1.2M ohm Res.	R-21	1	
	470 " "	R-22	1	
	2K ohm Potentiometer	R-23	1	If 3/8" long bushing is used, add 1-H2
	470 ohm Res.	R-24	1	
	2K ohm Potentiometer	R-25	1	
	" " " "	R-26	1	
	15K ohm Res.	R-27	1	
	15K ohm Res.	R-28	1	
	3 Pole-5p Switch (1 wafer)	S-1	1	If 3/8" long bushing is used, add 1-H2
	6 Pole-5p " (2 wafer)	S-2	1	
	Power Transformer	T-1	1	
	6AL5 Tube	V-1,V-2	1	
	6SN7 "	V-3,V-4	1	
	6X5 "	V-5	1	
	Wire,Hookup	W-1	1	
	Line Cord	W-2	1	
	Test Lead Wire	W-3	2	
	Coaxial Lead	W-4	1	
	Instruction & Construction Book		1	

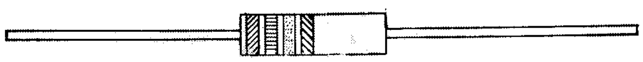
* indicates PRECISION CERAMIC or WIREWOUND resistors. NOTE: Certain components may have hardware already attached- these should be included in count. I.D. means Inside Diameter.

RMA Color Code STANDARD

RESISTORS



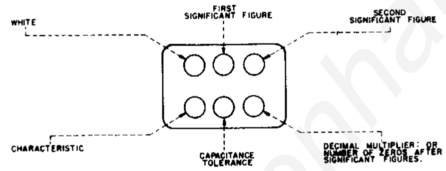
½ WATT



1 WATT

MICA CAPACITORS

RMA REC 115 COLOR CODE



Color	Figure or Multiplier	Character-istic Letter	Tolerance	Color	Figure or Multiplier	Character-istic Letter	Tolerance
Black	0	A	20% (M)	Blue	6	....	....
Brown	1	B	....	Violet	7	....	....
Red	2	C	2% (G)	Gray	8	I	....
Orange	3	D	3% (H)	White	9	J	....
Yellow	4	E	....	Gold	.1	....	....
Green	5	....	5% (J)	Silver	.01	....	10% (K)

RMA REC 115 CHARACTERISTIC LETTERS

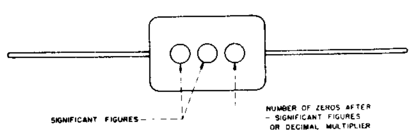
Class	Temperature Coefficient Parts/Million/ Deg. C	Capacitance Drift Not More Than
A	± —1000	± —(5% +1 mmf)
B	± —500	± —(3% +1 mmf)
C	± —200	± —(0.5% +0.5 mmf)
I	+150 — 50	± —(0.3% +0.2 mmf)
D	± —100	± —(0.3% +0.1 mmf)
J	+100 — 50	± —(0.2% +0.2 mmf)
E	+100 — 20	± —(0.1% +0.1 mmf)

RMA COLOR CODE

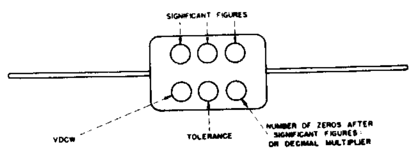
SHEET 419 JUNE 1, 1938

THREE DOT

USED FOR 500 VDCW CAPACITORS WHOSE TOLERANCE IS GREATER THAN 10%

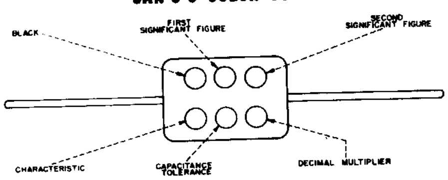


SIX DOT



Color	Significant Figure, or No. of Zeros, or Decimal Multiplier	VDCW	Tolerance	Color	Significant Figure, or No. of Zeros, or Decimal Multiplier	VDCW.	Tolerance
Black	0	....	....	Violet	7	700	7%
Brown	1	100	1%	Gray	8	800	8%
Red	2	200	2%	White	9	900	9%
Orange	3	300	3%	Gold	.1	1000	....
Yellow	4	400	4%	Silver	.01	2000	10%
Green	5	500	5%	None	....	500	20%
Blue	6	600	6%				

JAN-C-5 COLOR CODE

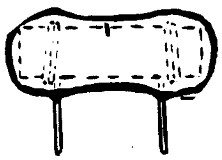


Color	Figure or Multiplier	Character-istic Letter	Tolerance	Color	Figure or Multiplier	Character-istic Letter	Tolerance
Black	0	A	20% (M)	Blue	6	G	....
Brown	1	B	....	Violet	7	....	....
Red	2	C	2% (G)	Gray	8	....	....
Orange	3	D	....	White	9	....	....
Yellow	4	E	....	Gold	.1	....	5% (J)
Green	5	F	....	Silver	.01	....	10% (K)

JAN-C-5 CHARACTERISTIC LETTERS

Char-acter-istic	Temperature Coefficient Parts/Million/ Deg. C	Maximum Capacitance Drift	Verification of Characteristics By Production Test
A	Not Specified	Not Specified	Not Required
B	Not Specified	Not Specified	Not Required
C	—200 to +200	± — 0.5%	Not Required
D	—100 to +100	± — 0.3%	Not Required
E	—20 to +100	± —(0.1% + 0.1 mmf)	Not Required
F	0 to +70	± —(0.05% + 0.1 mmf)	Required
G	0 to —50	± —(0.05% + 0.1 mmf)	Required

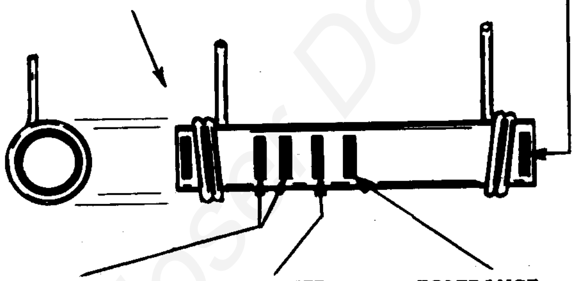
CERAMIC, CAPACITORS



Silver end dot denotes bypass and coupling capacitor.

VOLTAGE

Brown - - 150
Orange - - 350
Omitted - 500



CAPACITY

Black - - - 0
Brown - - - 1
Red - - - - 2
Orange - - 3
Yellow - - 4
Green - - - 5
Blue - - - - 6
Violet - - - 7
Gray - - - - 8
White - - - 9

MULTIPLIER

Black - - - - 1
Brown - - - 10
Red - - - - 100
Orange - - 1000

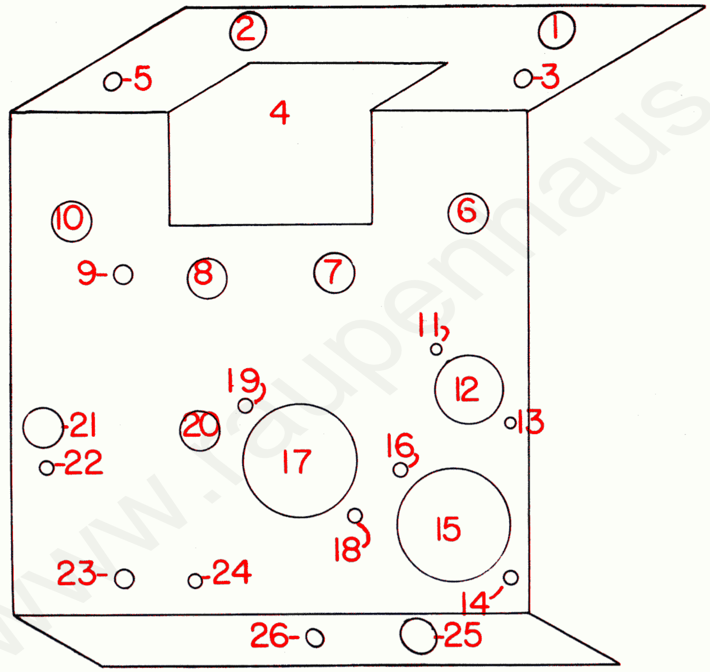
TOLERANCE

Black - - - ±20%
White - - ±10%
Omitted — Guar. Min. Value

The position of the capacitor illustrates the relation of the leads to the color code. **The left end is the termination of the inner electrode.**

CHASSIS MOUNTING INSTRUCTIONS

DIAGRAM 1 CHASSIS PRE-ASSEMBLY BOTTOM VIEW

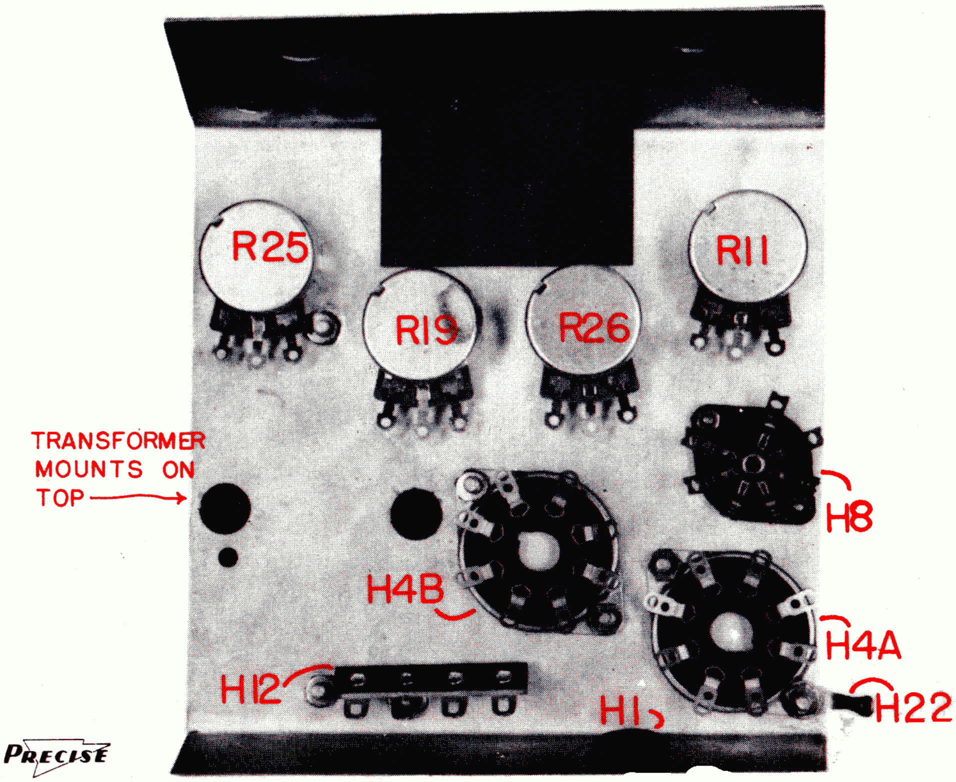


Place chassis so that it is as shown in Diagrams 1 & 2. Mount parts in the order described below. Make certain the direction of each part is as shown in Diagram 2.

PART	PART #	MOUNT IN HOLE #	WITH AM'T	PART #	REMARKS
2M Potentiometer	R-11	6			Snaptite. Press into place.
2K "	R-26	7			"
2K "	R-19	8			"
Large Octal Socket	H-4A	14 15 16	2 2 1	H-6 H-7 H-22	Mount solder lug over hole 14
"	H-4B	17 18 19	2 2	H-6 H-7	
7 Pin Minature Socket	H-8	11 12 13	2 2 2	H-9 H-10 H-11	
4 Lug Terminal Strip	H-12	24	1 1	H-6 H-7	
Transformer	T-1	9 23	2 2	H-6 H-7	Blk or Yel-Blk thru hole 21, rest thru 20.
2K Potentiometer	R-25	10			Snaptite. Press into place.
Rubber Grommet	H-1	25			Press into place

PALNUTS-
The Palnuts have been incorporated into this unit in order to simplify, speed-up and improve the mechanical assembly. Since this nut is a self locking device, it eliminates the necessity of lockwashers. It is most important that these nuts be placed on properly. The solid(concave) side is the side applied to the screw.

DIAGRAM 2 ASSEMBLED CHASSIS BOTTOM VIEW



PRECISE

PANEL MOUNTING INSTRUCTIONS

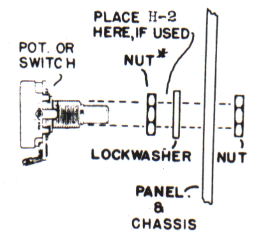
PART	PART #	MOUNT IN HOLE #	WITH AM'T	PART #	REMARKS
Meter	**M-1**	28 29 33 34	2	H-6	Place Nuts on Screws thru holes 28 & 29
Chassis Connector	H-13	41	1 1	H-2 H-3	
Banana Jack	**H-14**	42	1 1	H-15 H-16	
Pilot Light Bracket	**B-1**	43	1 1	H-18 H-19	
Pin Jack	H-20	44			**Press Star Washer onto Pin Jack once on Panel.**

Mount chassis to panel by means of the two **meter screws** through holes 33 & 34. Use 2 H-6, and 1 H-22. Lug H-22 mounts over hole number 34. Do not tighten **nuts** as yet.

PART	PART #	MOUNT IN HOLE #	WITH AM'T	PART #	REMARKS
2 K Potentiometer	R-23	37	1 1	H-2 H-3	See insert
2 K Potentiometer	R-20	36	1 1	H-2 H-3	See insert Tighten Meter **nuts.**
Switch	S-1	38	1 1	H-2 H-3	Mount in same manner as potentiometers.
Switch	S-2	39	1 1	H-2 H-3	"
Meter	M-1		2 2	H-27 H-25	Mount onto meter terminals

You have now completed the mounting of all the major components. It is usually advisable to quickly recheck here, before wiring.

POTENTIOMETER MOUNTING



* USE EXTRA NUT, WHEN ATTACHING TO PANEL, IF 3/8" LONG BUSHING IS USED ON SWITCHES AND POTENTIOMETERS.

DIAGRAM 3 PANEL PRE-ASSEMBLY REAR VIEW

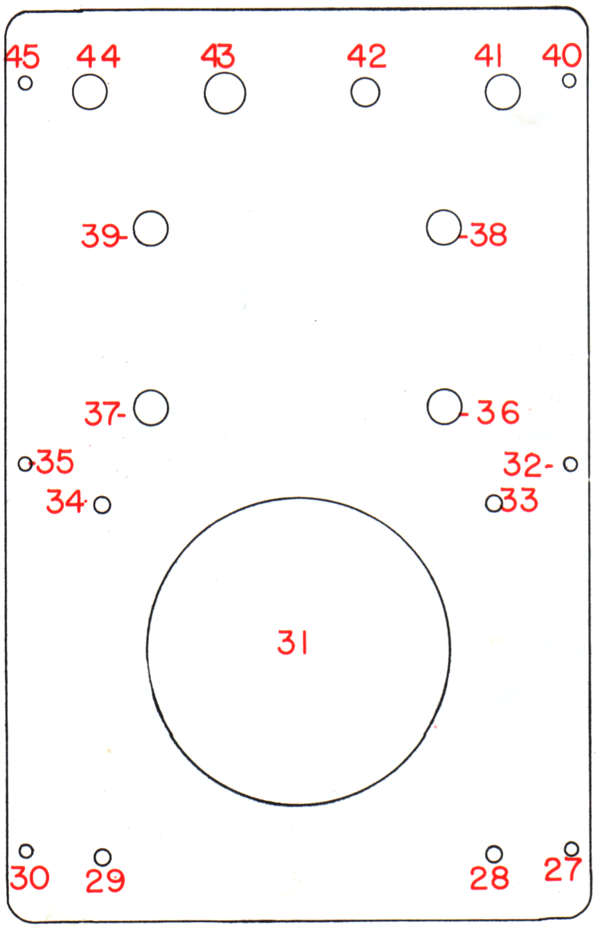
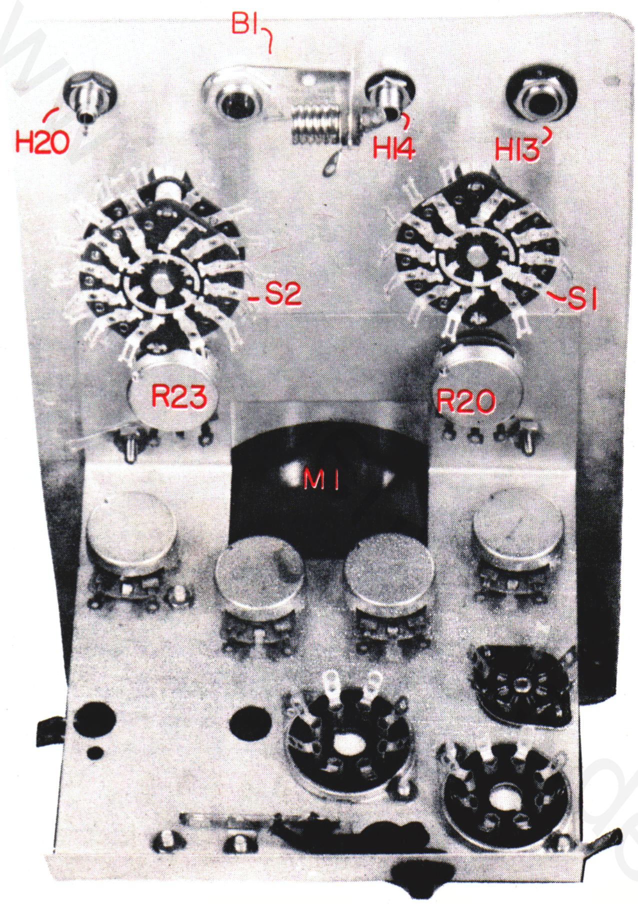


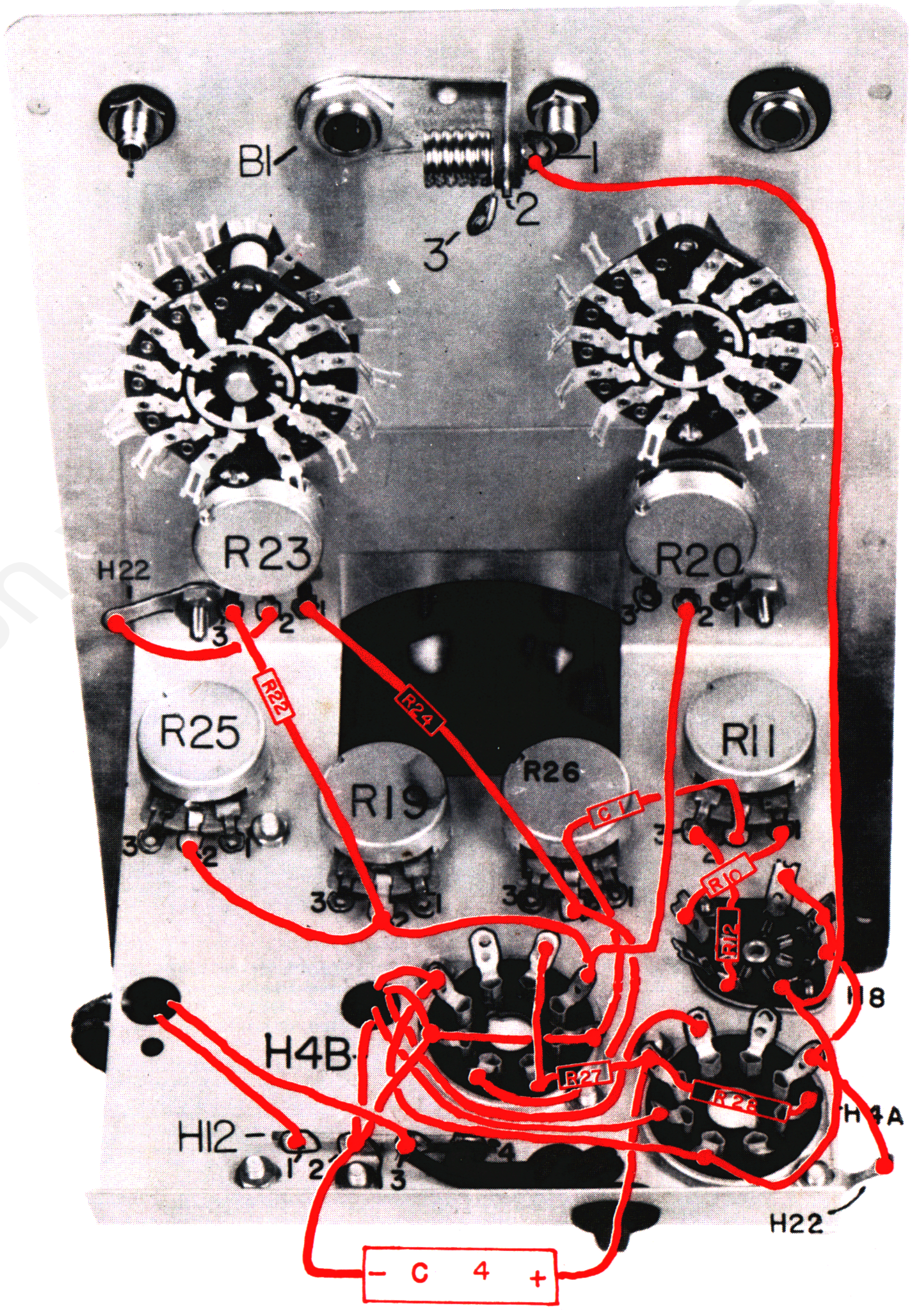
DIAGRAM 4 PANEL ASSEMBLY REAR VIEW



NOTE: * means solder. If no asterisk appears simply connect the wire to that contact and leave it there. It will be soldered later on.

CHECK	PART	PART #	WIRE FROM	WIRE TO	REMARKS
	Line Cord	W-2		H12#4	Thru grommet and knot wire
	" "	"		H12#3	Other lead
	Trans.	T-1		H12#3*	Yellow-blk. or blk. wire
	"	"		H4A#3*	Red wire
	"	"		H4A#5*	Other red wire
	"	"		H12#2	Red-yellow wire
	"	"		H12#1	Other yellow-blk. or blk. wire
	"	"		H4B#8	Yellow wire
	"	"		H4B#7	Other yellow wire
	Wire	W-1	H4B#7	H4B#4	
	"	"	H4B#7*	H12#2	
	"	"	H4B#8*	H4A#2	
	"	"	H4A#2*	H8#4	
	"	"	H8#4*	B1#1*	
	"	"	H4A#7	H22*	
	"	"	H4A#7*	H8#3	
	"	"	H8#3*	H8#2	
	"	"	H8#2*	H8#1*	
	15K Res.	R-28	H4A#8*	H4A#4	Spaghetti
	15K "	R-27	H4A#4	H4B#5	
	Wire	W-1	H4B#5*	H4B#2*	
	24 ufd Cond.	C-4	H12#2*	H4A#4*	Plus side to #4
	Wire	W-1	R25#2*	R19#2	
	"	"	R19#2	H4B#3	
	"	"	H4B#3*	R20#2	
	470 ohm Res.	R-22	R19#2*	R23#3*	Spaghetti
	" " "	R-24	R23#1*	R26#2	"
	Wire	W-1	R23#2*	H22*	
	"	"	R26#2	H4B#6*	
	1.5M Res.	R-10	H8#7*	R11#1*	Spaghetti
	" "	R-12	H8#5	R11#3*	"
	.01 Cond.	C-1	H4B#4*	R11#2	"

PURPOSE OF THE CIRCUIT: Is to explain the function of the major components and their location. To those who are not too familiar with the operation of VTVM's, we suggest reading the explanatory section of the instruction book before trying to digest this section. By necessity this must be brief. The first steps, thru condenser C4, represents the filaments and full-wave rectifier power supply.
The next wiring, up to the resistors R10 & R12 is part of the connections to the Zero and Calibration potentiometers. These allow each function of the instrument to be separately calibrated and operates by virtue of adjusting the sensitivity of the meter movement for each Function selected. It thereby corrects for meter inaccuracies, variations in tubes, etc.
R10 & R12 serve as limiting and decoupling resistors in the AC rectifier circuit. Conceivably they could be omitted, but stability and ease of adjustment would be somewhat reduced.
R21 & C3 are an AC decoupling network and prevent both grid overload and spurious pickup in the first ½ of the bridge amplifier. C1 acts as a part of the decoupling network keeping raw AC from the meter circuit.



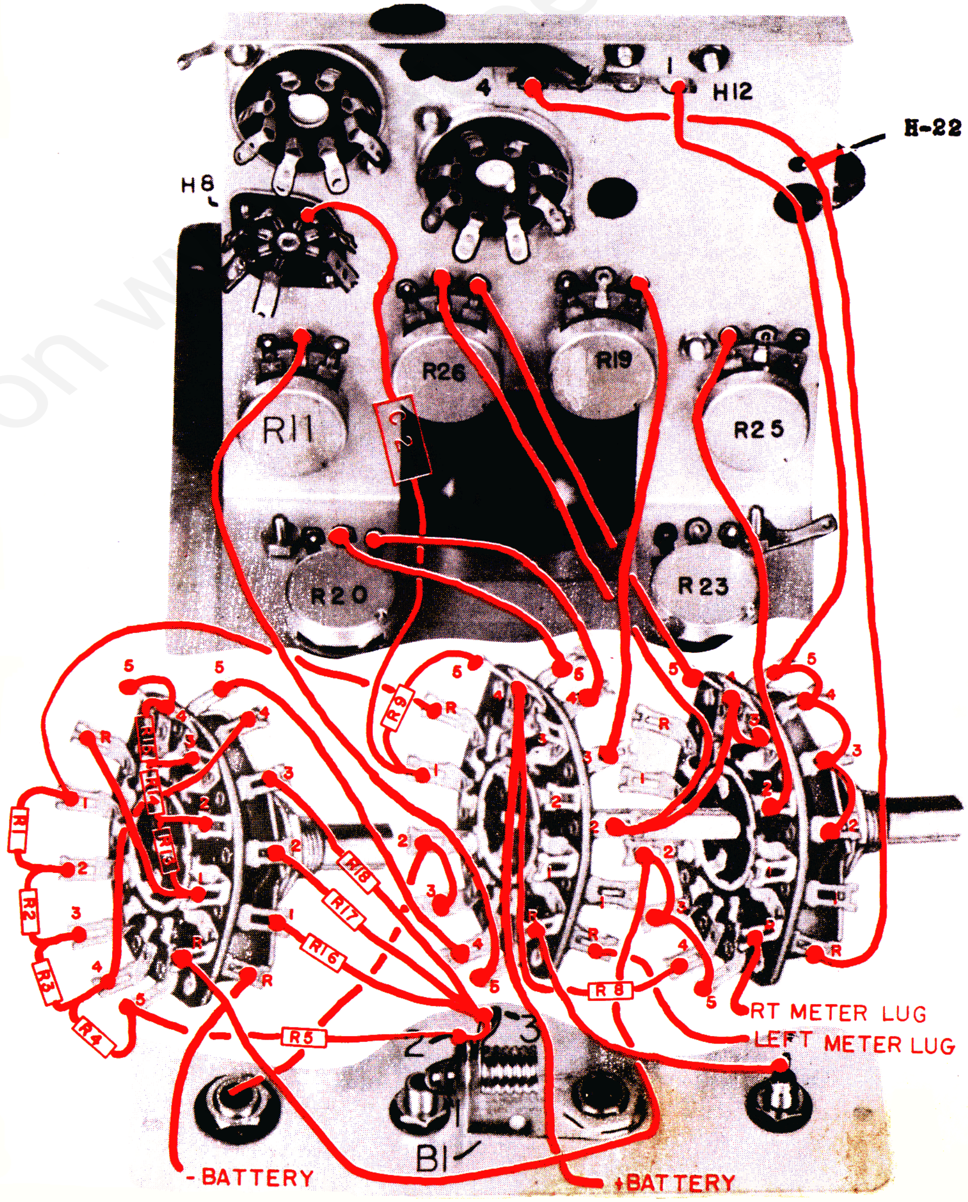
FINAL WIRING

CHECK	PART	PART#	WIRE FROM	WIRE TO	REMARKS
	8M Res.	R-1	S1A#1	S1A#2	
					Precision Res. Spaghetti
	1.8M Res.	R-2	S1A#2*	S1A#3	" " "
	100K "	R-3	S1A#3*	S1A#4	" " "
	50K "	R-4	S1A#4	S1A#5	" " "
	" "	R-5	S1A#5*	B1#2	" " "
				& B1#3	Do not solder B1#3
	10 ohm Res.	R-16	S1C#1*	B1#3	Precision Res. Spaghetti
	100 " "	R-17	S1C#2*	B1#3	" " "
	10K Res.	R-18	S1C#3*	B1#3	" " "
	Wire	W-1	S1C#4*	S1A#4*	
	"	"	S1A#R*	S1B#1	
	3.9M Res.	R-13	S1B#1*	S1B#2	Spaghetti
	1.5M "	R-14	S1B#2*	S1B#3	"
	100K "	R-15	S1B#3*	S1B#4*	"
				& #5*	
	Wire	W-1	S2F#2*	S2F#3	
	"	"	S2F#3*	S2F#4	
	"	"	S2F#4*	S2F#5	
	"	"	S2F#5*	H12#1*	
	"	"	S2E#3*	S2E#4	
	"	"	S2E#4*	S2C#2	
	"	"	S2E#5*	R26#3*	
	"	"	S2C#2*	R26#2*	
	"	"	S2F#R*	H12#4*	
	"	"	S2C#3*	R19#3*	
	"	"	S2C#4*	R20#3*	
	"	"	S2E#2*	R25#1*	
	"	"	S2C#5*	R20#2*	
	"	"	S2D#5*	S2D#3	
	"	"	S2D#3*	S2D#2	
	"	"	S2D#2*	S1B#R*	
	5M or 6M Res.	R-8	S2D#4*	S2B#4	
	Mount Battery into Battery Bracket securing with 1 H-5 & 1 H-6. Place onto hole #22 securing with 1 H-5 & 1 H-6, plus side of Battery toward panel under chassis.				
	Wire	W-1	S2B#4	+side Battery	
	.01 Cond.	C5	S2B#4*	B1 2*	
	820K Res.	R-9	S2B#5*	S2A#1	Spaghetti
	.01 Cond.	C-2	S2A#1*	H8#5*	"
	Wire	W-1	S2B#R*	AC Jack*	
	"	"	S2A#R*	S1A#1*	
	"	"	S2A#3*	S2A#2	
	"	"	S2A#2*	Chassis Connec- tor	Strip wire ¼"- push thru and solder at center- cut off surplus.
	Wire	W-1	S2A#5*	R11#2*	
	"	"	S2A#4*	S1C#5*	
	"	"	S2E#R*	Meter Lug*	Right Meter Lug See Diagram #9
	Wire	W-1	S2C#R*	Meter Lug*	Left Meter Lug See Diagram #9
	"	"	S1C#R*	Battery*	Negative side
	1.2M Res.	R21	H4B#1*	S2D#R	Not shown on diagram
	.0015 Cond.	C3	S2D#R*	B1#3*	Not shown on diagram

PURPOSE OF THE CIRCUIT:Thru R-5 represents the precision multipliers. The input voltage is applied across all in series and S1-A selects the percentage to be applied to the meter;i.e.selects the range.Thru R-13 are the precision ohmmeter resistors. Since these are in series with the battery and unknown resistor,the meter reading is their ratio and is calibrated directly in ohms.
The resistors through R-15 serve to maintain zero-adjust as the meter is switched from one range to another. These do not require the precision accuracy and serve only to keep a constant grid impedance.
The wiring to S2-F is part of the AC "on-off" circuit.
S2-E & S2-C are part of the calibration circuit as previously mentioned.
S2-D is the grid selector circuit for switching to DC, Ohms or AC.
R-8 both protects the ohmmeter circuit and keeps an impedance match.
S2-B is the AC-OHMS lead selector.
S2-A selects the circuit for the multipliers R-1 through R-5.

DIAGRAM 6 — SWITCH NUMBERING — SIDE VIEW

DIAGRAM 7 — PANEL & CHASSIS WIRING — REAR VIEW



DC PROBE LEAD: Strip the top insulation and shielded braid off about 1 inch from 1 end of the coaxial wire. Remove the inside insulation about 1/4" exposing the inner conductor. Solder Resistor R-7 to the exposed wire. Unscrew the small metal sleeve from the tip of the Red Test Prod. Insert the Resistor and Cable into the Red Prod and gradually press in until the wire from R-7 appears in the small hole in the metal tip of the Prod. Pull the lead through as far as it will go, without too much pressure. Clip off until about 1/4" of the lead is protruding through the hole. Bend wire around and secure by reattaching metal sleeve to tip.

Strip top insulation of other end of coaxial cable about 1 inch. Do not remove braid. Loosen screw of microphone connector and remove the spring. Slip spring over cable with smaller diameter end toward the stripped portion of cable. Bend braid over as far as it will go over smaller diameter portion of spring. Remove about 5/8 inch of inside insulation, and slip exposed twisted wire through hole in the center of the microphone connector, allowing it to extend through small hole in front of connector. Make certain that all exposed wires come thru at once, since these can cause shorts. Press small spring and braid into mike connector and secure by tightening set screw. Solder wire in front of connector and cut off all excess. Go over the end with carbon tetrachloride to remove rosin.

COMMON LEAD: Clean off about 1/4" of wire from each end of one of the black test leads. Solder one end to alligator clip. Remove the black plastic cover from the banana plug and slip it over the other end of the wire. Solder wire to brass plug on banana plug and screw insulator back on.

AC LEAD: Remove the small metal sleeve from one end of the black test prod. Strip about 1/4" from each side of test lead wire and thread wire through prod until it extends through the hole in the metal tip. Bend wire around tip and secure by reconnecting the metal sleeve. Remove the black plastic cover of the pin plug, and slip it over the other end of the wire. Solder exposed wire of test lead to the top of the plug. Screw black cover back on.

DIAGRAM 8 LEADS

PRELIMINARY MECHANICAL ASSEMBLY:

You have now completed the wiring of your instrument. Before proceeding, carefully recheck all connections for the possibility of shorts between wires, unsoldered terminals, loose solder particles, rosin between lugs and shorted contacts. Make certain that all nuts are tight. Secure knobs to switch, and potentiometer shafts on the front panel. When aligning knobs, both switches should be in their maximum counter-clockwise position. The knob pointer should be in the "OFF" position of the FUNCTION switch, and in the "5V" position of the SELECTOR switch. Insert tubes in sockets as indicated in diagram 9.

ELECTRICAL TEST:

If an ohmmeter is available, connect it between #8 of the 6X5 and ground. The reading should be at least 50,000 ohms. If less, recheck circuit carefully before inserting line cord. Adjust the mechanical Zero Adjust (located in the center of the meter case) to zero, on the left side of the scale, before power is turned on.

ELECTRICAL CALIBRATION:

Insert line cord and turn power on by rotating the FUNCTION selector to the -DC position. Turn the SELECTOR switch to the "5V" position. Note: The pilot light and tubes should light immediately. If they do not, turn power off and recheck circuit for the possibility of a short or open circuit. Allow set an initial warm-up period of about a half hour.

-DC CALIBRATION: Short the COMMON and DC PROBE leads together; adjust the ZERO ADJUST potentiometer for a zero reading on the left side of the meter scale. On low voltage ranges, a change in zero setting may be observed when the leads are unshorted. This should not be of concern as it is due to the extreme sensitivity of the meter. Connect three 1½ volt batteries in series, thus giving an open circuit voltage of 4.68 volts. (The open circuit voltage of a flashlight battery is 1.56 volts.) Connect the COMMON lead to the plus side of the batteries and the DC PROBE lead to the negative side. Adjust the -DC CALIBRATION potentiometer (located on the chassis) for 4.68 volts on the top DC scale. See Diagram 9.

+DC CALIBRATION: Repeat as in -DC CALIBRATION except that the FUNCTION switch is rotated to the +DC position; the leads to the battery are reversed and the +DC CALIBRATION potentiometer is adjusted.

OHMS CALIBRATION: The ohmmeter is automatically calibrated and it operates as indicated in the following instruction book.

AC CALIBRATION: Rotate the FUNCTION switch to the AC VOLTS and the SELECTOR switch to the "5V" range. Short the AC and COMMON leads together and adjust the AC ZERO potentiometer (located on chassis) for a zero reading on the left side of the meter scale. A standard AC meter should actually be used during this calibration. But for accuracies as normally encountered, the following may be used: rotate the SELECTOR switch to the 250 volt range and connect the COMMON lead to one side of the 110 volt AC power line and the AC-OHMS lead to the other side. (Note: Since the COMMON lead is connected to the panel of the meter, and this lead is being connected to one

AC CALIBRATION (cont'd):

side of the AC line, be very careful not to ground yourself during this adjustment. Use one hand and make sure you are standing on a dry surface.) Adjust the AC CALIBRATION potentiometer for 110 volts on the 250 volt range (near center reading).

FINAL CALIBRATION: Vacuum tubes have what is technically called an "aging characteristic". The tube ages rapidly at first and then tapers off to a balanced or equilibrium condition. Before aging has taken place, the meter may have a tendency to lose its zero adjust or readings may be a bit non-linear. A true calibration occurs after the tubes have been used over a period of a few months. It is suggested, therefore, that a final calibration be made several months after the instrument has been in use. At that time the CALIBRATION and ZERO potentiometers should be re-adjusted and finally sealed by sealing wax or a touch of varnish between the shaft and screw assembly.

MOUNTING HANDLE

Secure the handle to the cabinet by using two 6-32x½ screws; two #6 Flat Metal Washers; two Brass Eyelets and two Palnuts. Place Flat Metal Washer onto screw, then handle, then eyelet, then through cabinet and secure with palnut.

MOUNTING PANEL AND CHASSIS TO CABINET:

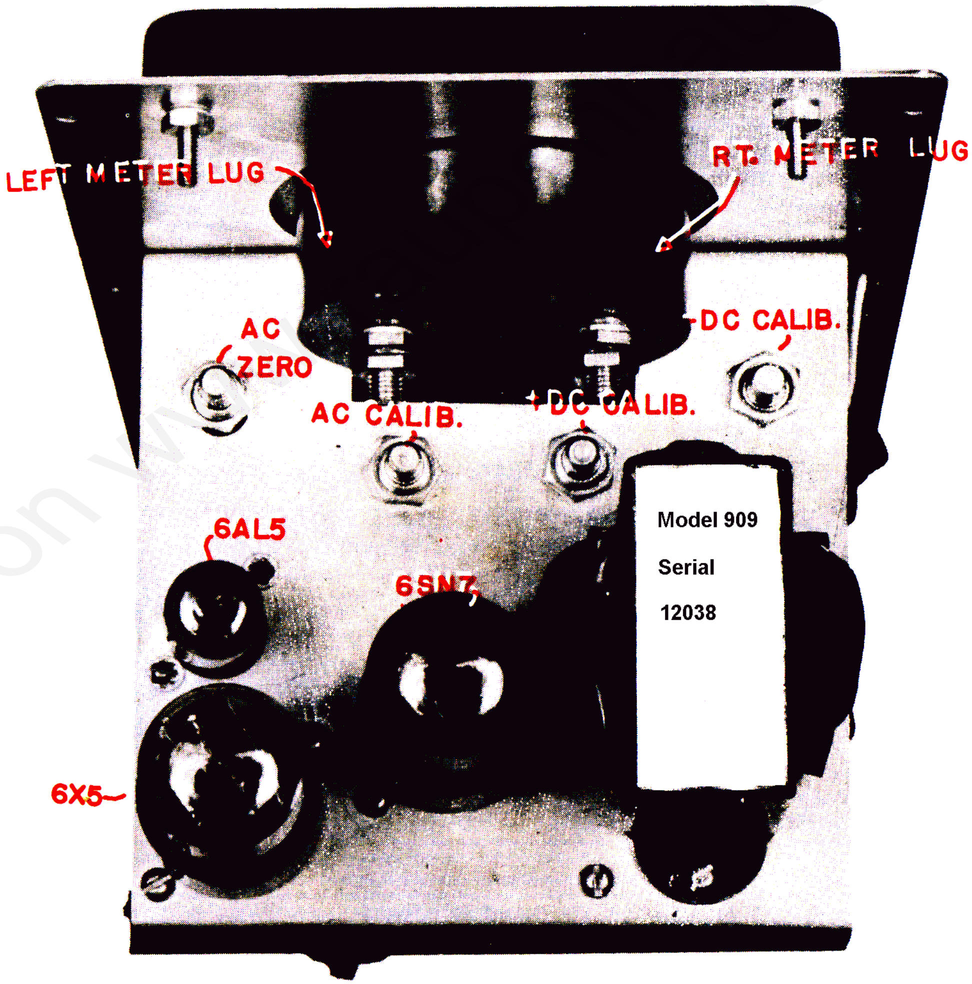
Thread line cord through hole in rear of cabinet. Note: Never use a battery which is wet or does not have an insulated sleeve on it. Slide set into cabinet and secure by means of a self-tapping screw at the rear of the chassis. Secure panel to cabinet by using 6 self-tapping screws. Note: Attach screws, but do not tighten until all have been started. Be very careful to use a large screw driver which will not slip. If screws thread at an angle, they will straighten as the screw is tightened.

SERVICING:

In the event of difficulty recheck the wiring carefully. Most troubles may be immediately traced to wiring mistakes, rosin joints, rosin between contacts or shorts.

FACTORY REPAIR:

If a question should arise, write to our Engineering Department listing all possible readings, etc. which may aid in analyzing the problem. Your letter will be answered promptly. Your instrument may, if you so desire, be returned to the factory for final repair and calibration at a service charge of $5.50. This does not include the cost of parts that may have been damaged due to misuse. Pack your instrument carefully in the original carton, if possible. Ship prepaid.



ADDENDA

In order to maintain your instrument in its most modern form, certain improvements are made from time to time. These will be noted in the following space. If none are listed, no changes are immediately contemplated. If changes are listed, correct the wiring, etc. in the construction book before proceeding with the actual construction.

COMMONLY USED RADIO FORMULAS

$R = \frac{E}{I}$ $E = IR$ $I = \frac{E}{R}$

$X_C = \frac{1}{2\pi fC}$

$X_L = 2\pi fL$

$f = 1/2\pi\sqrt{LC}$ at resonance

$Z = \frac{E}{I}$ $E = IZ$ $I = \frac{E}{Z}$

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

$Z = R + j(X_L - X_C)$

Z of inductive — resistive circuit(magnitude) $= (R^2 + X_L^2)^{\frac{1}{2}}$

" " capacitive & " " " $= (R^2 + X_C^2)^{\frac{1}{2}}$

Approximate Pentode Amplifier Gain $= g_m Z_L$

" Triode " " $= uR_L/(R_p + R_L)$

" Cathode Follower Z $= 1/g_m$

R - ohms
E - volts
I - Amperes
X_C - Capacitive Reactance
X_L - Inductive Reactance
Z - AC Impedance
C - Capacitance
L - Inductance
j - Operator
g_m - Plate transconductance
Z_L - Plate Load Z
R_L - Plate Load R
R_p - Plate R
u - Amplification Factor

PERTINENT DATA

Type of Instrument: ____________________

Purchased from: ____________________

Address: ____________________

Date Purchased: ____________________

Registered on: ____________________

Constructed on: ____________________

1st Calibration: ____________________

2nd Calibration: ____________________

3rd Calibration: ____________________

Tubes Replaced on: ____________________

Changes Made: ____________________

Accessories Purchased: ____________________

PRECISE

RESISTANCE MEASUREMENTS (cont'd):

(4) Short the OHMS and COMMON leads together and adjust the ZERO ADJUST knob for "0" on the top of the scale.

(5) Remove the short across the test leads and adjust the OHMS ADJUST knob for "∞" on the OHMS scale.

(6) Place the test leads across the part to be measured and multiply the reading on the OHMS meter scale by the multiplier shown on the SELECTOR switch. Caution: Whenever OHMS measurements are being made, make certain that no voltage is applied to the part being tested.

DECIBELS:

(1) Proceed as described in AC VOLTS except for the following:

(a) All measurements are made on the DB meter scale.

(b) For each AC Setting on the SELECTOR switch, the following chart should be used for determining the number of DB to be added to that read:

AC RANGE	Add the following DB
25	+0
250	+20
500	+26
1000	+32

As an example: If the meter read +21 db, and the 250 volt range were used- the true reading would be: +21 +20 = +41 db. The 5 Volt AC Range is not used on DB measurements.

FM ALIGNMENT SCALE:

(1) Proceed as in DC, except that the meter is ZERO ADJUSTED to the "0" shown on the bottom of the scale. Note: Use the +DC range on the FUNCTION switch, if the -DC range is used the polarities indicated on the scale are reversed.

C I R C U I T   D E S C R I P T I O N

This instrument has a proved and advanced circuit that may be best appreciated by consulting the block diagram of Figure 1.

DC CIRCUIT:

In the DC position of the FUNCTION switch, the DC voltage being measured is directed as follows:

(1) The voltage is applied to the DC lead.

(2) The FUNCTION DECADE, composed of Precision Resistors, drops the voltage to the proper ratio.

DC CIRCUIT (cont'd):

(3) The output voltage is applied to the CATHODE-FOLLOWER DC AMPLIFIER and then to one side of the DC meter.

(4) The BALANCE BRIDGE AMPLIFIER is connected to the other side of the meter and, by bridge action, stabilizes and insures reading accuracy.

(5) The +DC and -DC CALIBRATION POTENTIOMETERS adjust the meter to the proper reading by setting the upper portion of the scale- the lower portion was set by the ZERO ADJUST.

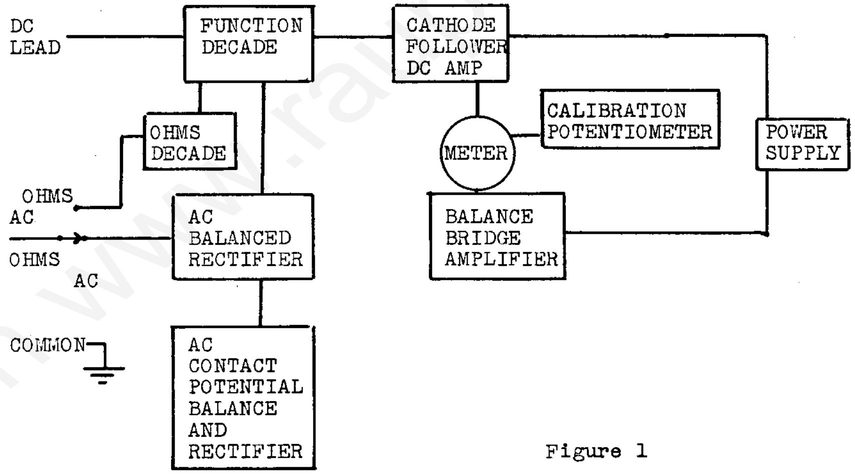


Figure 1

AC CIRCUIT:

(1) In the AC position of the FUNCTION switch, the AC voltage follows a similar pattern to that shown in DC, except that it is sent to the AC BALANCED RECTIFIER where it is connected to the DC circuit. The contact potential is balanced in order to keep Zero Adjust and to maintain accuracy.

DB CIRCUIT:

(1) The DB circuit operates in the same manner as that described under AC CIRCUIT.

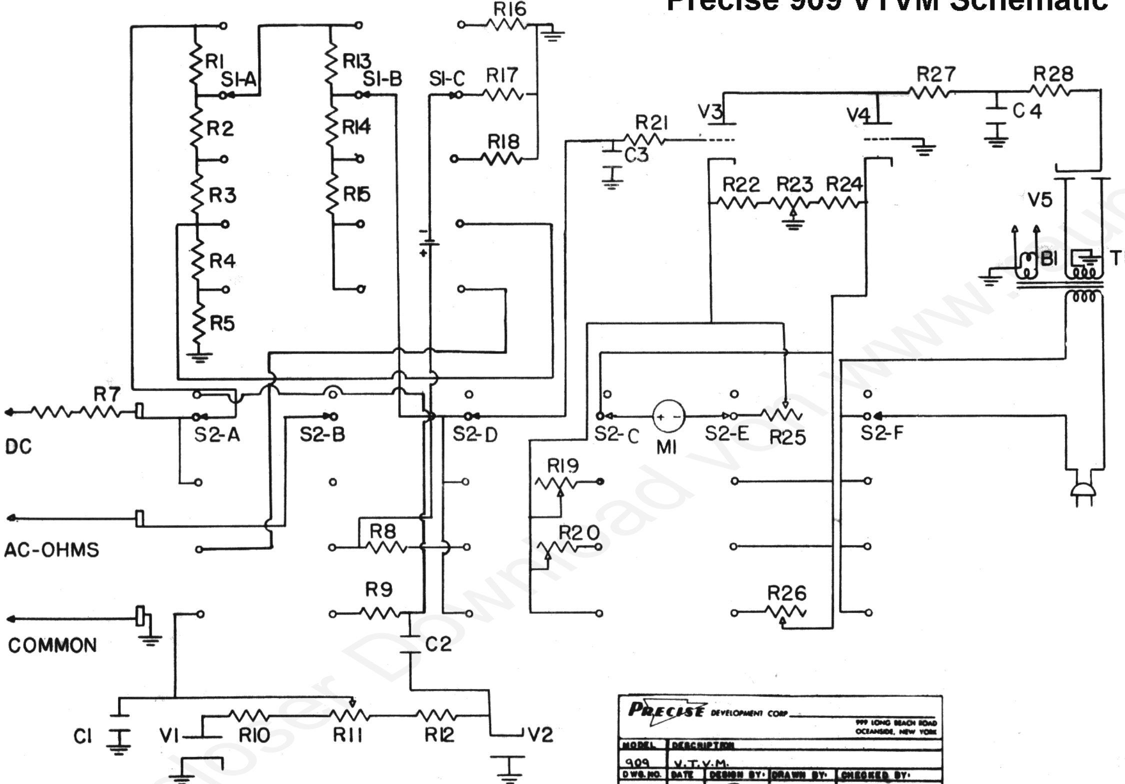
OHMS CIRCUIT:

(1) In the OHMS Circuit the battery voltage is applied to the Precision Ceramic resistors of the OHM'S decade. The series voltage drop across the unknown resistance is then measured by the CATHODE FOLLOWER DC AMPLIFIER as described under DC VOLTS.

W A R R A N T Y

All merchandise is warranted to be free from defects in material and workmanship, and is fully protected by the standard RMA guarantee.

Precise 909 VTVM Schematic



DESCRIPTION	PART#	AM'
8M ohm Res.*	R-1	1
1.8M ohm Res.*	R-2	1
.1M " " *	R-3	1
50K " " *	R-4.R-5	2
15M " "	R-7	1
5M or 6M Res.	R-8	1
820K ohm Res.	R-9	1
1.5M " "	R-10	1
2M ohm Potentiometer	R-11	1
1.5M ohm Res.	R-12	1
3.9M " "	R-13	1
1.5M " "	R-14	1
100K " "	R-15	1
10 ohm Res.*	R-16	1
100 " " *	R-17	1
10K " " *	R-18	1
2K ohm Potentiometer	R-19	1
" " " "	R-20	1
1.2M ohm Res.	R-21	1
470 " "	R-22	1
2K ohm Potentiometer	R-23	1
470 ohm Res.	R-24	1
2K ohm Potentiometer	R-25	1
" " " "	R-26	1
15K ohm Res.	R-27	1
15K ohm Res.	R-28	1
6AL5 Tube	V-1,V-2	1
6SN7 "	V-3,V-4	1
6X5 "	V-5	1

PRECISE DEVELOPMENT CORP
999 LONG BEACH ROAD
OCEANSIDE, NEW YORK

MODEL	DESCRIPTION			
909	V.T.V.M.			
DWG. NO.	DATE	DESIGN BY:	DRAWN BY:	CHECKED BY:
909-8-1111	8-1-51	m. [illegible]	A.R.S.	B.S.M.

REVISIONS:

SUPERCEDES DWG. NO.