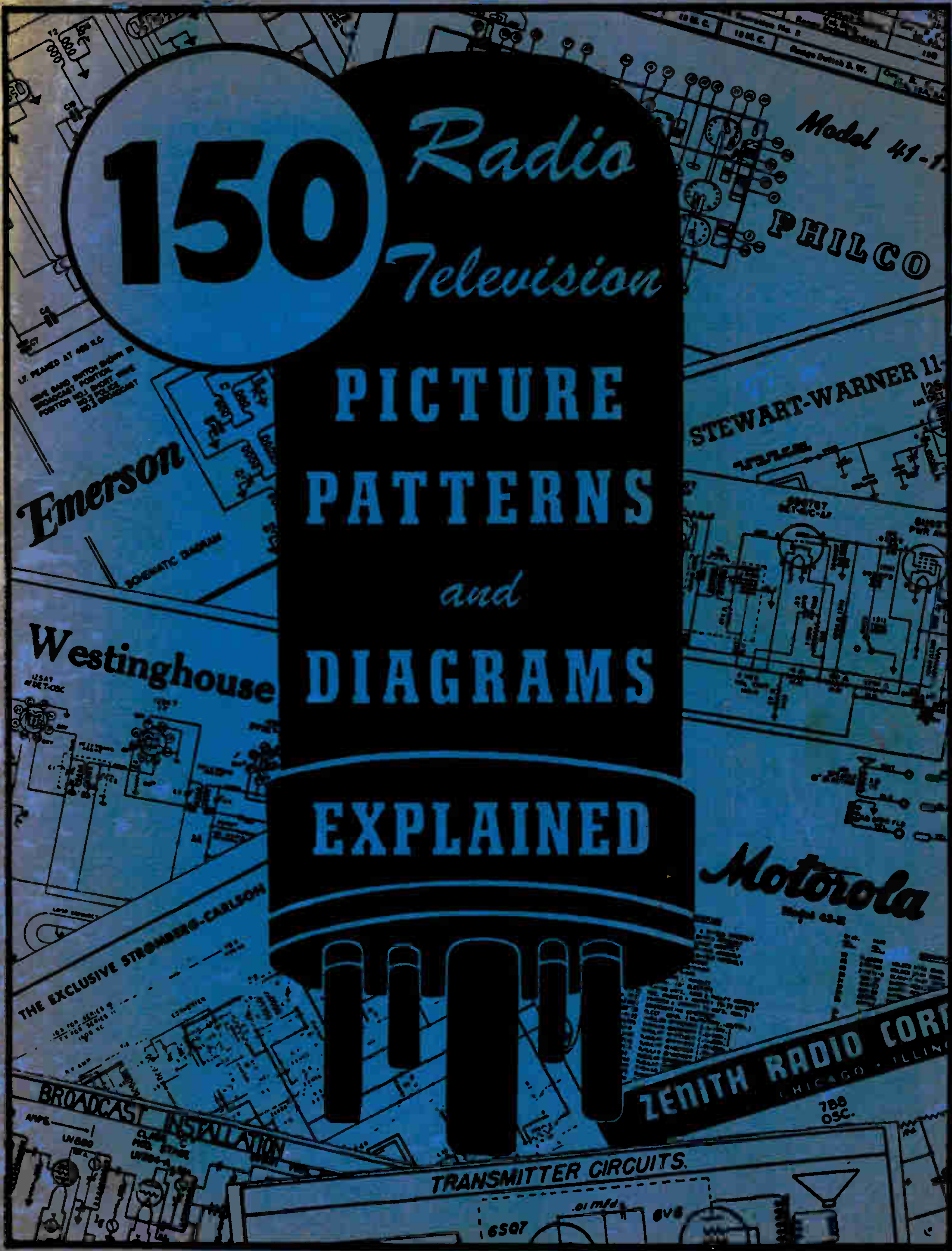
150 Radio Television PICTURE PATTERNS and DIAGRAMS EXPLAINED



FOREWORD

THE successful Radio-TV Serviceman is the man who can read diagrams—the fellow who understands symbols, circuits and details of Radio and Television construction.

A knowledge of circuit tracing and diagram analysis is to the serviceman what a knowledge of mathematics is to an accountant. This book contains diagrams of modern radio and television sets. These diagrams have been supplied to the Educational Book Publishing Division of The Coyne Electrical School by the leading Radio and Television manufacturers of the United States. They represent an effort on the part of the Industry to help Coyne put out a practical book on **How to Read Diagrams.**

Reading radio and television diagrams can be as easy as reading a newspaper if a man has a clear conception of the various signs, and the symbols used in these diagrams.

It is the purpose of this book to make clear and easy to understand these different terms and symbols that represent the component parts of radio sets, their connections and the tracing of the current thru these parts as well as other phases of scientific radio circuit tracing.

Common terms such as circuit, current, resistance and difference of potential are often used when talking about radio.

In every case as we come upon a new symbol in the special series of instructional diagrams we have especially selected to explain modern diagram analysis, we will follow this practice:

First, we will give the definition, then we will give an illustration in everyday language. We will compare the purpose of the radio or television component with something you see in everyday life. Following this practice, you will better understand the **reason** for the various parts in a radio set as well as the way they "dovetail" with all other parts.

We will break down every part of the circuits so that you can follow the logical path of the current flowing through the radio.

Many of the diagrams in this book have been prepared by the staff of Coyne School for instructional purposes. These diagrams have special notes and analyzing instructions that make them amazingly easy to understand. These diagrams have been **SHOP TESTED** by actual on the job use. That eliminates any possibility of any technical errors.

Regardless of whether you are a "beginner" or an experienced radio man you should find the material in this book of extreme value to you. We have put a great deal of up-to-date instruction methods in Radio circuit and diagram reading in this book along with dozens of valuable commercial radio diagrams.

Radio-TV diagram reading is the same as any other reading—the more you do of it the more expert you become. To succeed in Radio and Television you must know circuit tracing so give the specially prepared material in this book careful study—it can help you increase your speed and accuracy in reading diagrams.

B. W. Cooke

B. W. COOKE, President
Educational Book Publishing Division
Coyne Electrical and Radio School

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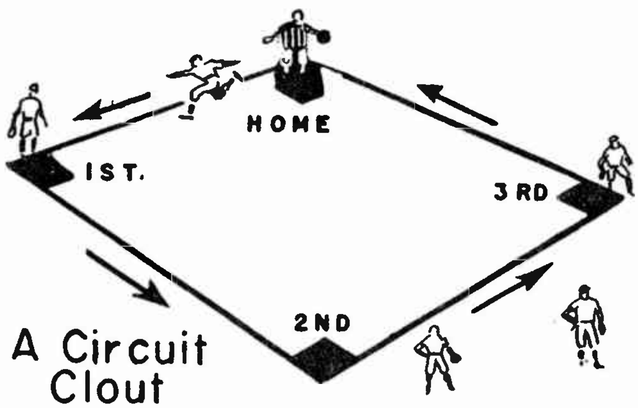
SECTION I

Schematic Diagrams and How to Read Them

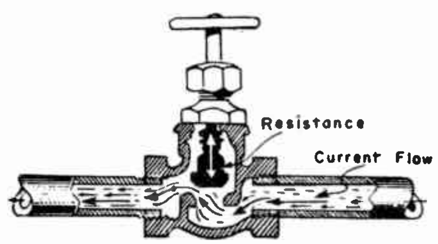
Suppose then we start with the most common expression used in radio—**a radio circuit.**

By definition "**a circuit** is the complete or closed path taken by an electrical current in flowing through a conductor from one terminal of the source of supply to the other."



No doubt you have often heard the expression "a circuit clout." This is used in baseball when a batter hits a home-run. It means the ball has been driven far enough to enable the batter to complete the "circuit" of bases. The bases form a closed loop or path for the batter to take, just as connecting wires form a closed loop or path for the current to take.

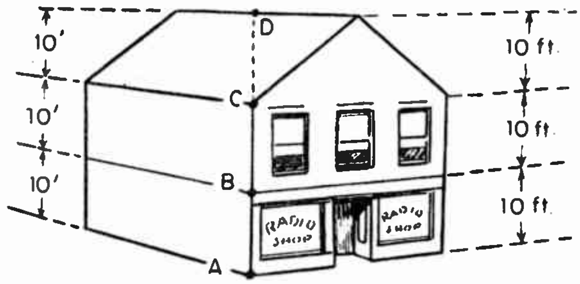
The resistance is the substance which resists or opposes the flow of current through it.



It can be compared to a valve in a water pipe to limit the flow of water.

A difference of potential or difference of pressure is the difference between the potentials or pressures at two points in a circuit.

To better understand this let's assume that we are looking at a two-story building. In measuring the distance between the street and the first floor we found it to be 10′ and the measurement to the roof was 30′. It would be correct to say that the distance between point "A" and point "B" is 10′ or that point "B" is 10′ higher than point "A". In order to make a

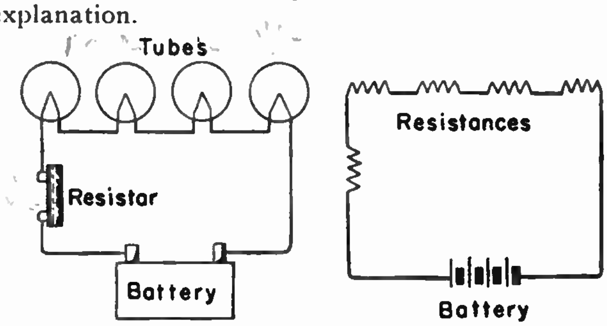


measurement we must refer one point to another. It would not be correct to say that point "C" measures 20′ because we are not sure whether the point to be measured is from "B" or "A". Point "C" does measure 20′ if we are referring it to point "A" as the other point, but it is only 10′ from point "B" or point "D".

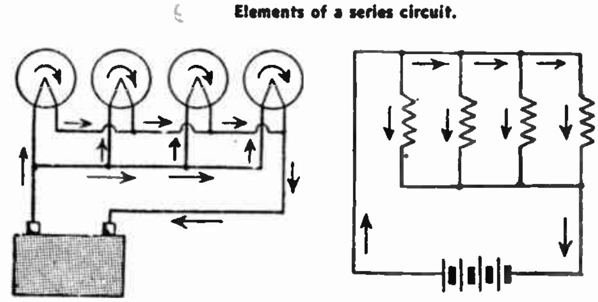
The same thing holds true in electrical circuits. The difference of potential is a measurement between a lower and a higher point in a circuit. One point is at a higher electrical degree than the other. The higher point having a deficiency of electrons while the lower point has an excess of electrons. It is the movement of these electrons that constitutes a flow of current in an electrical circuit.

The difference of potential and the opposition are circuit properties. In fact they are the determining factors as far as the current is concerned. When the opposition in any circuit is not sufficient to limit the current, wires may burn or the units connected in the circuit may be ruined beyond repair. That is the reason why they put fuses in the branch circuits in homes. To protect the conducting wires from excess current.

Diagrams are used in Radio just as blue prints are used in construction work. They tell a complete story that might otherwise require thousands of words of explanation.



Elements of a series circuit.

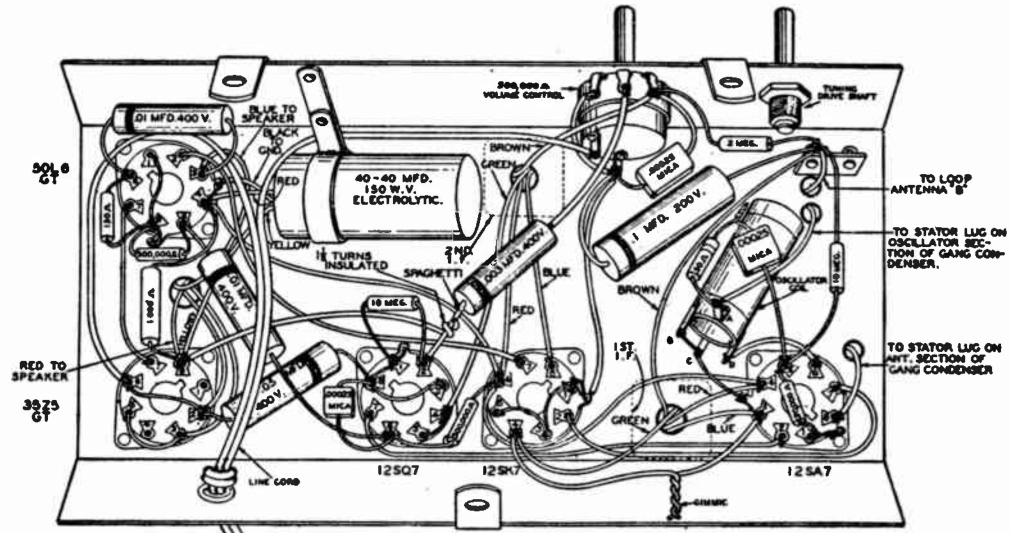


Elements of a parallel circuit.

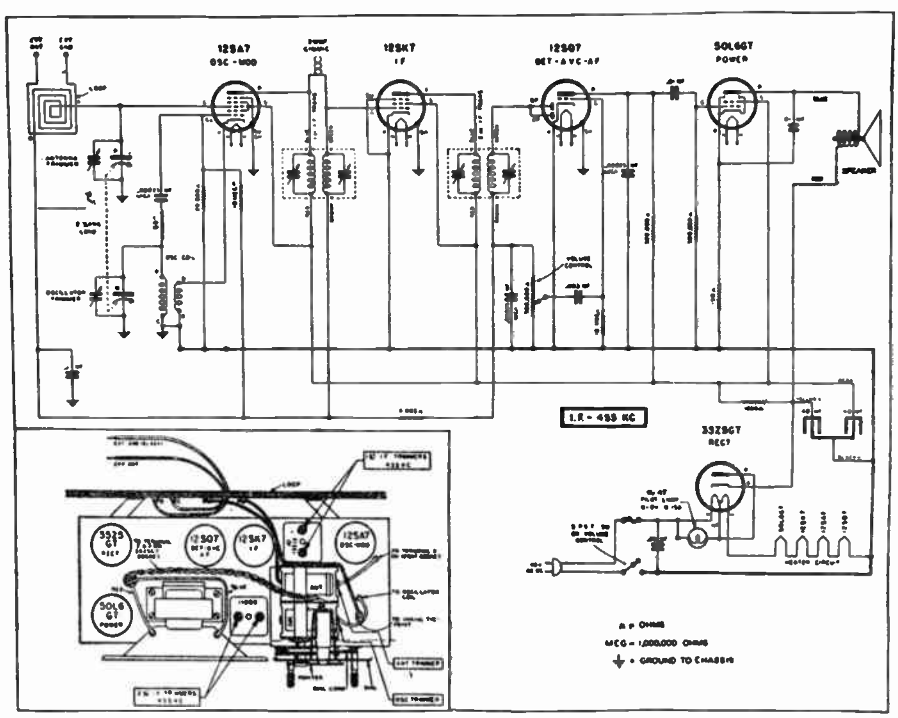
There are several types of diagrams used, just as there are different types of maps available for the man preparing to go on a journey. He may have a "pictorial diagram" which is a diagram pertaining to or illustrated through pictures.
They make the same type of diagram in Radio for the beginner as illustrated below.

Consequently, certain signs, marks or symbols, easy for all of us to duplicate, have been adapted and made standard. They represent the component parts and were originated in order that we may convey or impart our information to others, quickly.

In radio a schematic diagram shows the electrical connections of a circuit by means of symbols used in



PICTORIAL DIAGRAM

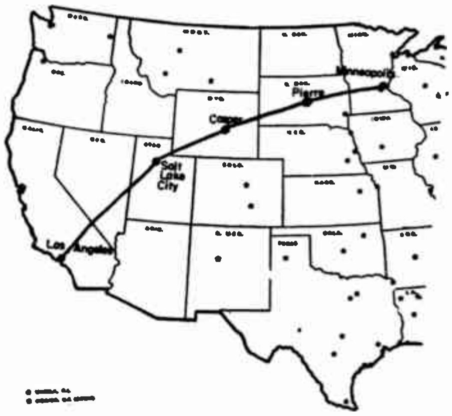


Such a diagram enables us to quickly determine the layout of all the parts. The question then arises, since a pictorial diagram has these advantages, why not use them exclusively? If we sit back for a moment and think about it, the answer would be obvious. To use these diagrams we all must be skilled or gifted with artistic talents, it takes a great deal of time and effort to put down on paper any part of the above two diagrams for the sole purpose of explaining either of them.

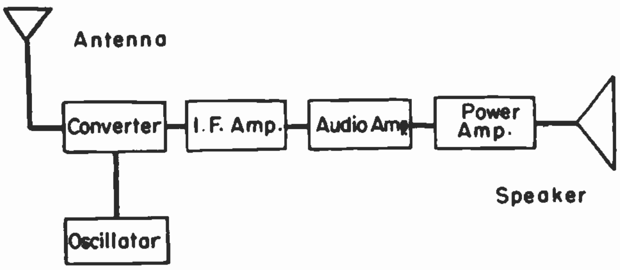
place of the actual parts. Symbols to represent the different parts are simple signs, marks, or characters used as an abbreviation. It is important to learn these symbols so that all the parts may be readily identified.

Of course, it would be impossible to expect a beginner to memorize all the existing symbols in a short time, but by constant reference to radio diagrams in magazines or books you will be surprised to note how quickly and easily you have learned to identify these symbols.

Still another type of diagram is known as a "block diagram."



In the above diagram only..the states are shown and the roads to take to get to them. Likewise in radio, a block diagram merely shows the connections of the different stages in block-form.



The diagram above is the easiest of all to explain in that the function of each stage is omitted, just as the road map above would be simple to direct a person interested to get at a certain point without explaining the different rivers he would have to cross and the cities that he would pass, etc.

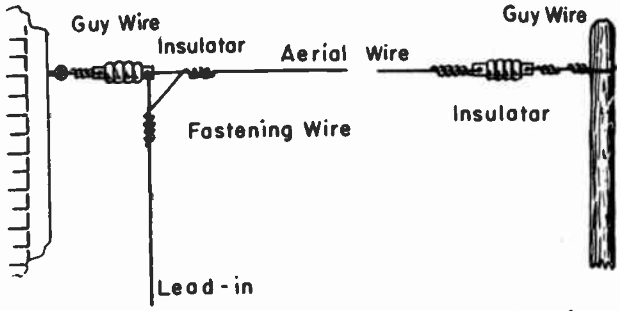
For instance, in that block diagram the electromagnetic waves radiated by means of a transmitting antenna cut the stationary conductor called the receiving antenna. These waves cause a difference of potential to be induced in the receiving antenna referred to as a signal. The converter stage receives the signal and mixes with a signal generated by the oscillator. The difference of these two signals is sent on to the I.F. stage where it is amplified, and sent to the audio stage where it is changed to an audio signal and amplified. It is received by the power amplifier where it is further amplified and moved on to the speaker.

The signal strikes a diaphragm in the speaker causing it to vibrate, thus changing the electrical impulses into sound.

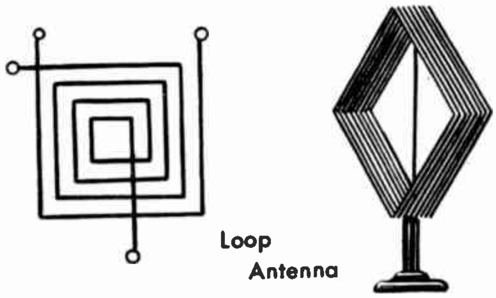
We can safely say then that block diagrams are used to give a general idea of the operating principles in a condensed form.

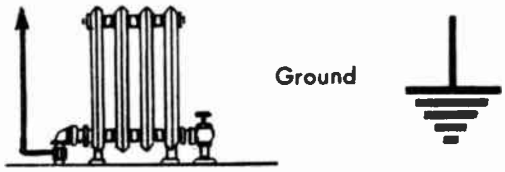
It would be well at this time to introduce some of the symbols used and show what the actual parts look like.

The antenna or aerial is a conductor used to pick up radio signals. The outdoor antenna, usually



mounted on a structure or roof is a bare wire of predetermined length. The vertical line represents the lead-in wire which makes connection between the antenna and the receiver. This type of antenna is no longer used for radio reception, but the symbol indicates an antenna regardless of design.





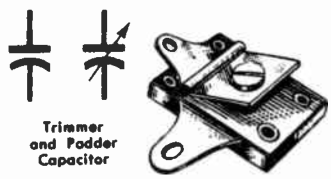
The loop antenna or aerial consists of complete turns of wire spaced on a rectangular frame of wood or attached to a cardboard. It is built into a receiver cabinet.

The ground connection is an earth connection. It may be a water pipe, a radiator or any pipe driven into the earth to insure good contact with the moist earth. It also indicates a connection to the chassis of the receiver.

This symbol is often used to simplify diagrams by eliminating unnecessary lines. The symbol shows the common connections in the circuit.

There are various types of capacitors used.

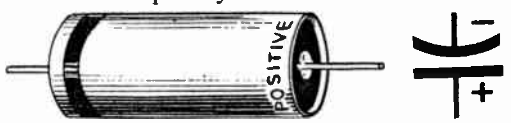
A capacitor consists of two conductors separated from each other by an insulator called a dielectric, such as air, oil, paper, glass, ceramic



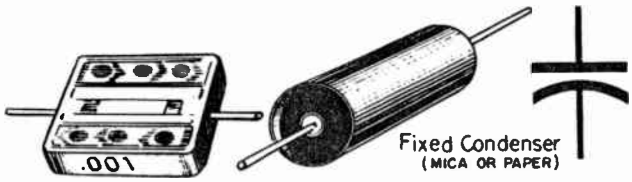
capable of storing electrical energy. They block the flow of direct current while allowing alternating and pulsating currents to pass.

Variable capacitors are used in Radio frequency and oscillator circuits. Their capacity may be conveniently varied. They are usually found in the form of a movable and fixed set of plates. The movable plates are called the rotor and the fixed plates called the stator. Air is used as a dielectric. Their main purpose is to adjust the circuits to resonance.

Padder and trimmer capacitors sometimes are mounted on the variable and can be adjusted with a screwdriver. They permit accurate alignment of the radio frequency and oscillator circuits.



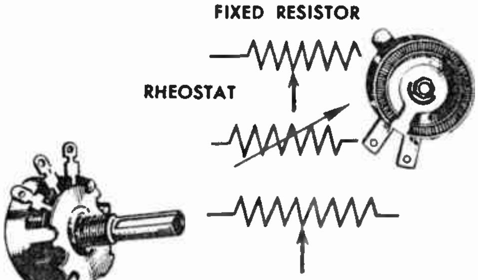
Fixed Condenser -Electrolytic



Electrolytic capacitors are a special type of fixed capacitors used in direct current circuits only. The polarity of these capacitors is clearly marked and must be observed.

These capacitors are usually found in the power supply circuit. Mica and paper capacitors are other types found in radio. The mica will be found in the radio frequency circuit, while the paper capacitor will be found almost anywhere from the low radio frequency circuits to the audio stage.


FIXED RESISTOR



POTENTIOMETER (VOLTAGE DIVIDER)

Resistors, rheostats and potentiometers are designed to oppose the flow of current whether it be direct or alternating currents.

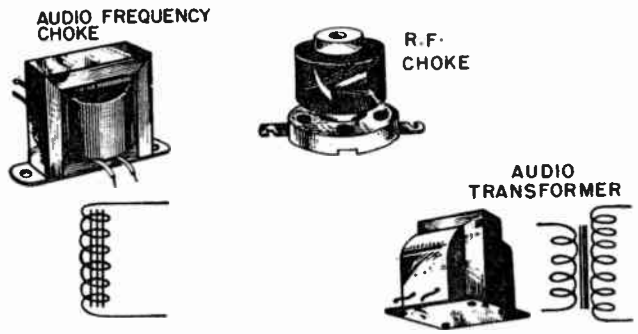
A resistor whose value remains constant is called a fixed resistor. On the other hand if the value can be changed during operation it is known as a variable resistor.

Rheostats and potentiometers are variable resistors. The rheostat can be identified by its two terminals. The potentiometers have three terminals.

There is another important property in radio circuits called inductance. It is a measure of the ability of a conductor to produce a magnetic field.

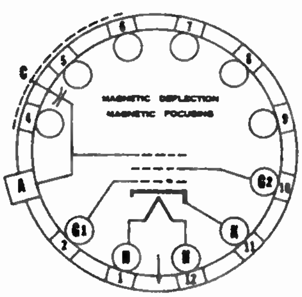
Inductance may be introduced in a circuit in the form of coils and transformers.

This property of inductance is present in a circuit only when the current changes. That is, when it is of alternating nature. As the current changes from zero to maximum the magnetic field also changes and in so doing cuts the conductor and induces in it a counter voltage which tends to oppose the change in current. You will find some type of inductance in all stages of a radio circuit.

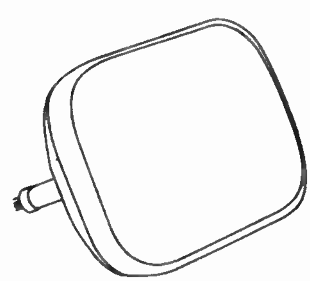


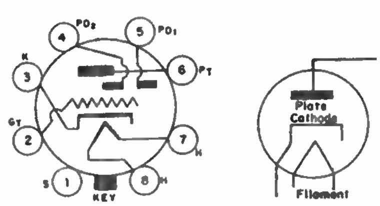
A wide variety of tubes are used in radio today. The ones most frequently encountered are the diode, the triode, the tetrode and the pentode.

Sometimes when space is limited in a radio, tubes are used that have the elements of two tubes combined in one envelope. Examples of these are the duodiode, the twin-triode, the duplex-diode pentode, etc.


12D2

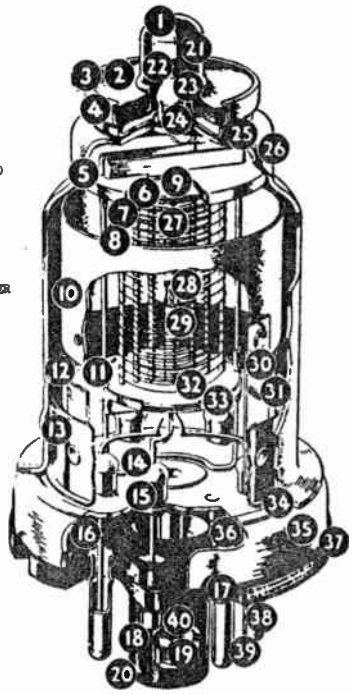
PICTURE TUBE





The schematic symbol of a tube is usually shown by the base of the socket of the tube. The tube has a marker or key that fits into a similar marker in the socket. The reason for this being a precaution against burning the elements in the tube. In this manner the tube must be inserted always in the same way. The marker or key as it is sometimes called is clearly shown at the bottom of the circle representing the tube socket. Terminals of the elements within the tube are indicated and numbered. The numbers being in a counter clockwise direction with number one located to the left of the key.

1. SOLDER
2. CAP INSULATOR
3. ROLLED LOCK
4. CAP SUPPORT
5. GRID LEAD SHIELD
6. CONTROL GRID
7. SCREEN
8. SUPPRESSOR
9. INSULATING SPACER
10. PLATE
11. MOUNT SUPPORT
12. SUPPORT COLLAR
13. GETTER TAB
14. GLASS BEAD SEAL
15. FERNICO EYELET
16. LEAD WIRE
17. CRIMPED LOCK
18. ALIGNING KEY
19. PINCHED SEAL
20. ALIGNING PLUG



21. GRID CAP
22. GRID LEAD WIRE
23. GLASS BEAD SEAL
24. FERNICO EYELET
25. BRAZED WELL
26. Steel Shell
27. CATHODE
28. HELICAL HEATER
29. CATHODE COATING
30. PLATE INS. SUPPORT
31. PLATE LEAD CONNECTION
32. INSULATING SPACER
33. SPACER SHIELD
34. SHELL TO HEADER SEAL WELD
35. HEADER
36. SHELL CONNECTION
37. OCTAL BASE
38. BASE PIN
39. SOLDER
40. EXHAUST TUBE

Cross-section of a typical RCA Metal Tube.
This diagram illustrates in detail the construction of a modern radio tube. All elements are clearly indicated. The complexity of the modern tube is here readily apparent. A good basic understanding of tube design and function is essential to good radio building.

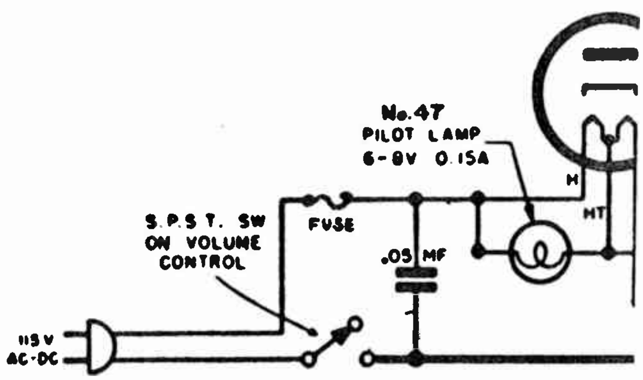
Now that we have been introduced to the actual parts and the symbols that represent those parts let us look at the schematic below and see just how many symbols we can identify.

Of course a good idea would be to make a note of the symbols you did not recognize and refer to them until you are sure you will not have that difficulty again.

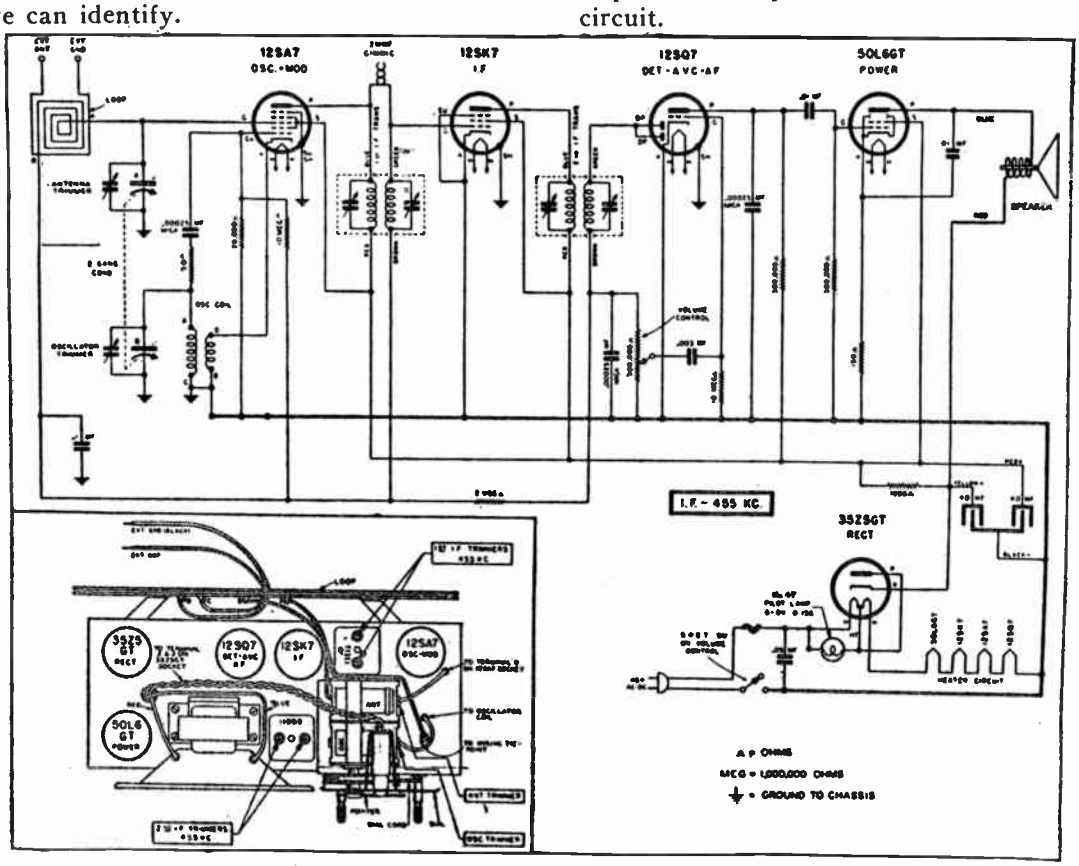
Our next step would be to know the different circuits in the radio so that we can trace the current through these circuits.

Let's start with the filament circuit in our schematic which is located in the lower left hand corner of our diagram. Incidentally those filaments are located within the tubes, but to make the diagram clearer by eliminating a lot of lines the filament circuit is usually shown in some corner of the diagram.

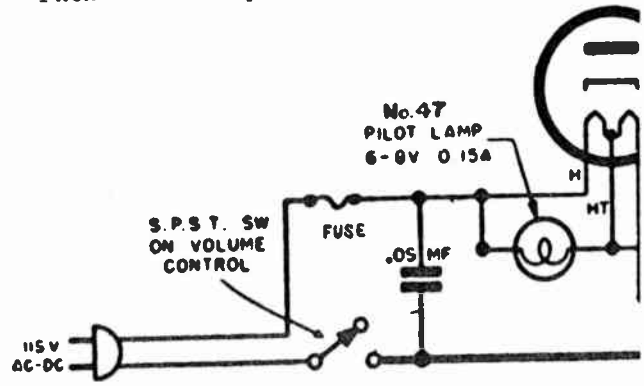
The first symbol we see is that of a male plug that fits into any wall receptacle. Then there are two lines that make connection to the plug. Starting along the bottom line we come to the switch. Its purpose is to turn the radio on or off. Above the switch is the symbol for a fuse.



It protects the parts in the radio in case of a short circuit.

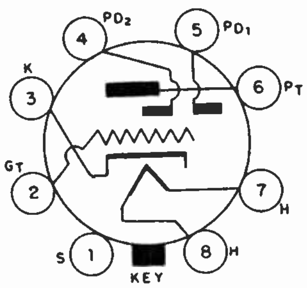


Then we see a capacitor.



We can tell it is connected across the line because of the heavy dots. When one line crosses another and no connection is intended then there is no heavy dot. Moving along the bottom line again we come to the second dot. Let's move up now and to the left to the first filament which is the 12 S Q 7. Suppose we look at the 12 S Q 7 tube and see if we can locate the terminals that connect this filament.

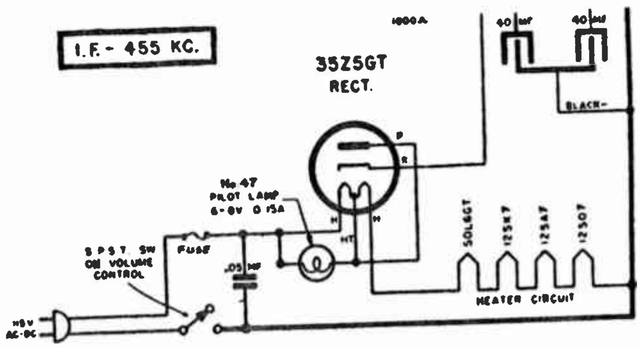
From the symbol we see that the external terminals are number seven and number eight. As we go on tracing the circuit, we pass the filaments of the 12 SA 7, the 12 S K 7 the 50L6 and the 35Z5 tubes



through the fuse and back to the plug. That completes the filament circuit.

It does seem strange to have wires inserted within the tubes and tied together to form a closed loop for no apparent reason. Any substance whether it be in a solid, liquid, or gaseous state offers resistance to the flow of current. Then why do we need a filament circuit in a radio? This same circuit is often referred to as the heater circuit and its function is to heat the cathode. The cathode plays an important part — it supplies the electrons necessary to operate the tube. It consists of a thin metal sleeve coated with electron-emitting material. The filament, or heater, is placed within the sleeve, and is insulated from it. In operation, the filament heats both the cathode sleeve and the coating to the electron-emitting temperature.

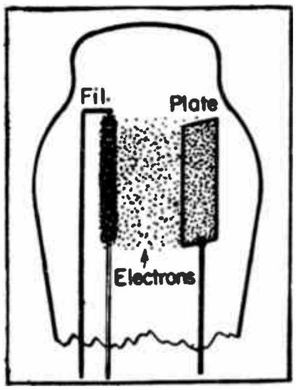
Referring to our diagram again you will notice that the filament is the only element within the tube that has two external terminals. All the rest have only one terminal to make connection with. We pointed out earlier in our explanation that in order to have a flow of current we needed a closed loop. Then something must take place within the tubes to complete the remaining circuits. The simple schematic diagram below shows a plate, a filament and a cathode.

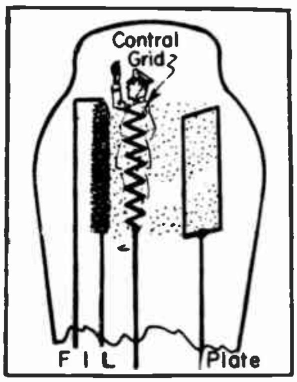


The plate is at a higher potential than the cathode. When the filament heats the cathode to the emitting temperature, the electrons move at a high velocity thru the vacuum of the tube to the plate. To illustrate

the above explanation, let's assume that a number of people are stranded on the platform of a railroad station and it is raining quite hard. To add to their misery the overhead shelter is not long enough to accommodate them all. Some of them are getting wet, therefore the general tension increases. Anxiously they look around and in the distance they see a brightly illuminated marquee. Since they notice that not many people are under it they start for it. Others that never saw the shelter join in because they think it is the wise thing to do. In the same way the electrons all rush to the brightly illuminated plate because of its higher potential. In tracing the plate circuits of all the tubes, you will notice that they all connect to one common point. The electrons then move from this common point to the cathode of the 35Z5. They go on to the plate of that tube and back to the source of supply.

The screen grid follows the same path as the plate and is used to shield the grid from the plate. The screen supplies an electrostatic force pulling electrons from the cathode to the plate. It is mounted between the control grid and plate for the purpose of reducing the capacity between those two electrodes.





The control grid has the most effective control over the flow of electrons thru the tube. It is like the traffic cop on the corner. He blows his whistle and puts up his hand to stop the traffic. Then he signals the traffic to move on again. In the same way the control grid signals the traffic of electrons to move. Sometimes more electrons move to the plate while other times there are less. It all depends upon the potential of the grid. Because of this varying voltage, an A. C. component is impressed on the D. C. potential of the plate. This changes the D. C. voltage to a pulsating D. C. The primary of a transformer is usually connected to the plate of the R.F. stage. Since the current in the plate circuit is varying it induces a voltage into the secondary of the transformer and that voltage is applied to the grid of the next tube.

Now that we have this information let's trace the signal from the antenna to the speaker.

The electro-magnetic waves thru the air strike the antenna and induce a voltage in it. This voltage is applied to the control grid of the first tube. Being of alternating nature it controls the flow of electrons thru the tube. At the same time the oscillator generates a voltage and is also applied to the same tube. The difference of these two voltages causes the change in current in the plate circuit. This change in current induces a voltage in the secondary of the transformer which is applied to the grid of the I.F. tube. As the signal is applied from stage to stage, it is amplified many times over. When it reaches the next stage the I.F. signal is changed to an audio note. It is then applied to the grid of the output tube. From there, the electrical impulses vibrate the diaphragm of the speaker. In doing so, these impulses are changed to sound, and we hear our radio programs.

The diagram we have taken you through step by step is similar to any other radio diagram you may ever be called upon to analyze.

In some sets you will find additional circuits for automatic push button tuning or combination phonograph and radio. These things are merely additions to a basic radio circuit arrangement such as we have just explained. You can trace out the circuits for these additional features in a set the same way you have checked the preceding diagrams.

The balance of this book is composed of data and diagrams. The data section includes specially prepared material to explain many important phases of servicing. You will find explanations of such things as Impedance, Inductance, Reactance, Frequency Modulation, Resonance and dozens of other important subjects.

Several pages of the book are devoted to explaining how to read and use nomograms.

The second portion of the book contains diagrams of Radio, Television sets and Public Address equipment. We have had the cooperation of the Industry in compiling this valuable collection of modern diagrams and in addition to giving you practical material for on the job servicing these diagrams also provide material you need to learn diagram tracing. With the instructions you have had you should not have any difficulty analyzing these diagrams.

Component Identification, Charts, Nomographs, Audio Data

RESISTOR COLOR CODE

Preferred Values of Resistance ±20% D = no col.	Preferred Values of Resistance ±10% D = silver	Preferred Values of Resistance ±5% D = gold	Old Standard Resistance Values	Color Coding A	Color Coding B	Color Coding C
			50	Green	Black	Black
		51		Green	Brown	Black
	56	56		Green	Blue	Black
		62		Blue	Red	Black
68	68	68		Blue	Gray	Black
		75	75	Violet	Green	Black
	82	82		Gray	Red	Black
		91		White	Brown	Black
100	100	100	100	Brown	Black	Brown
		110		Brown	Brown	Brown
	120	120		Brown	Red	Brown
		130		Brown	Orange	Brown
150	150	150	150	Brown	Green	Brown
		160		Brown	Blue	Brown
	180	180		Brown	Gray	Brown
		200	200	Red	Black	Brown
220	220	220		Red	Red	Brown
		240		Red	Yellow	Brown
			250	Red	Green	Brown
	270	270		Red	Violet	Brown
		300	300	Orange	Black	Brown
330	330	330		Orange	Orange	Brown
			350	Orange	Green	Brown
		360		Orange	Blue	Brown
	390	390		Orange	White	Brown
			400	Yellow	Black	Brown
		430		Yellow	Orange	Brown
			450	Yellow	Green	Brown
470	470	470		Yellow	Violet	Brown
			500	Green	Black	Brown
		510		Green	Brown	Brown
	560	560		Green	Blue	Brown
			600	Blue	Black	Brown
		620		Blue	Red	Brown
680	680	680		Blue	Gray	Brown
		750	750	Violet	Green	Brown
	820	820		Gray	Red	Brown
		910		White	Brown	Brown
1000	1000	1000	1000	Brown	Black	Red
		1100		Brown	Brown	Red
	1200	1200	1200	Brown	Red	Red
		1300		Brown	Orange	Red
1500	1500	1500	1500	Brown	Green	Red
		1600		Brown	Blue	Red
	1800	1800		Brown	Gray	Red
		2000	2000	Red	Black	Red
2200	2200	2200		Red	Red	Red
		2400		Red	Yellow	Red
			2500	Red	Green	Red
	2700	2700		Red	Violet	Red
		3000	3000	Orange	Black	Red
3300	3300	3300		Orange	Orange	Red
			3500	Orange	Green	Red
		3600		Orange	Blue	Red
	3900	3900		Orange	White	Red
			4000	Yellow	Black	Red
		4300		Yellow	Orange	Red
4700	4700	4700		Yellow	Violet	Red
			5000	Green	Black	Red
		5100		Green	Brown	Red
	5600	5600		Green	Blue	Red
		6200		Blue	Red	Red
6800	6800	6800		Blue	Gray	Red
		7500	7500	Violet	Green	Red
	8200	8200		Gray	Red	Red
		9100		White	Brown	Red
10,000	10,000	10,000	10,000	Brown	Black	Orange
		11,000		Brown	Brown	Orange
	12,000	12,000	12,000	Brown	Red	Orange
		13,000		Brown	Orange	Orange
15,000	15.000	15,000	15,000	Brown	Green	Orange
		16,000		Brown	Blue	Orange
	18,000	18,000		Brown	Gray	Orange
		20,000	20,000	Red	Black	Orange
22,000	22,000	22,000		Red	Red	Orange
		24,000		Red	Yellow	Orange

Preferred Values of Resistance ±20% D = no col.	Preferred Values of Resistance ±10% D = silver	Preferred Values of Resistance ±5% D = gold	Old Standard Resistance Values	Color Coding A	Color Coding B	Color Coding C
			25,000	Red	Green	Orange
	27,000	27,000		Red	Violet	Orange
		30,000	30,000	Orange	Black	Orange
33,000	33,000	33,000		Orange	Orange	Orange
		36,000		Orange	Blue	Orange
	39,000	39,000		Orange	White	Orange
			40,000	Yellow	Black	Orange
		43,000		Yellow	Orange	Orange
47,000	47,000	47,000		Yellow	Violet	Orange
			50,000	Green	Black	Orange
		51,000		Green	Brown	Orange
	56,000	56,000		Green	Blue	Orange
			60,000	Blue	Black	Orange
		62,000		Blue	Red	Orange
68,000	68,000	68,000		Blue	Gray	Orange
		75,000	75,000	Violet	Green	Orange
	82,000	82,000		Gray	Red	Orange
		91,000		White	Brown	Orange
100,000	100,000	100,000	100,000	Brown	Black	Yellow
		110,000		Brown	Brown	Yellow
	120,000	120,000	120,000	Brown	Red	Yellow
		130,000		Brown	Orange	Yellow
150,000	150,000	150,000	150,000	Brown	Green	Yellow
		160,000		Brown	Blue	Yellow
	180,000	180,000		Brown	Gray	Yellow
		200,000	200,000	Red	Black	Yellow
220,000	220,000	220,000		Red	Red	Yellow
		240,000		Red	Yellow	Yellow
			250,000	Red	Green	Yellow
	270,000	270,000		Red	Violet	Yellow
		300,000	300,000	Orange	Black	Yellow
330,000	330,000	330,000		Orange	Orange	Yellow
		360,000		Orange	Blue	Yellow
	390,000	390,000		Orange	White	Yellow
			400,000	Yellow	Black	Yellow
		430,000		Yellow	Orange	Yellow
470,000	470,000	470,000		Yellow	Violet	Yellow
			500,000	Green	Black	Yellow
		510,000		Green	Brown	Yellow
	560,000	560,000		Green	Blue	Yellow
			600,000	Blue	Black	Yellow
		620,000		Blue	Red	Yellow
680,000	680,000	680,000		Blue	Gray	Yellow
		750,000	750,000	Violet	Green	Yellow
	820,000	820,000		Gray	Red	Yellow
		910,000		White	Brown	Yellow
1.0 Meg.	1.0 Meg.	1.0 Meg.	1.0 Meg.	Brown	Black	Green
		1.1 Meg.		Brown	Brown	Green
	1.2 Meg.	1.2 Meg.		Brown	Red	Green
		1.3 Meg.		Brown	Orange	Green
1.5 Meg.	1.5 Meg.	1.5 Meg.	1.5 Meg.	Brown	Green	Green
		1.6 Meg.		Brown	Blue	Green
	1.8 Meg.	1.8 Meg.		Brown	Gray	Green
		2.0 Meg.	2.0 Meg.	Red	Black	Green
2.2 Meg.	2.2 Meg.	2.2 Meg.		Red	Red	Green
		2.4 Meg.		Red	Yellow	Green
	2.7 Meg.	2.7 Meg.		Red	Violet	Green
		3.0 Meg.	3.0 Meg.	Orange	Black	Green
3.3 Meg.	3.3 Meg.	3.3 Meg.		Orange	Orange	Green
		3.6 Meg.		Orange	Blue	Green
	3.9 Meg.	3.9 Meg.		Orange	White	Green
			4.0 Meg.	Yellow	Black	Green
		4.3 Meg.		Yellow	Orange	Green
4.7 Meg.	4.7 Meg.	4.7 Meg.		Yellow	Violet	Green
			5.0 Meg.	Green	Black	Green
		5.1 Meg.		Green	Brown	Green
	5.6 Meg.	5.6 Meg.		Green	Blue	Green
			6.0 Meg.	Blue	Black	Green
		6.2 Meg.		Blue	Red	Green
6.8 Meg.	6.8 Meg.	6.8 Meg.		Blue	Gray	Green
			7.0 Meg.	Violet	Black	Green
		7.5 Meg.		Violet	Green	Green
			8.0 Meg.	Gray	Black	Green
	8.2 Meg.	8.2 Meg.		Gray	Red	Green
			9.0 Meg.	White	Black	Green
		9.1 Meg.		White	Brown	Green
10 Meg.	10 Meg.	10 Meg.	10 Meg.	Brown	Black	Blue

Standardized coding for resistance value identification is confined to ten colors and figures as shown:

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

The body (A) of the resistor is colored to represent the first figure of the resistance value. One end (B) of the resistor is colored to represent the second figure. A band, or dot (C) of color, representing the number of ciphers following the first two figures, is located within the body color. The two diagrams illustrate two interpretations of this standard method of coding resistance value.

The color "D" appearing on the body of the axial lead resistor and on the end of the radial lead type, is used to indicate tolerance value.

If no color appears in the position shown on the resistors, the tolerance is ±20%. If the resistor has a silver dot or band, the tolerance is ±10%, while if a gold color is employed, the resistor is within ±5% of the specified value.

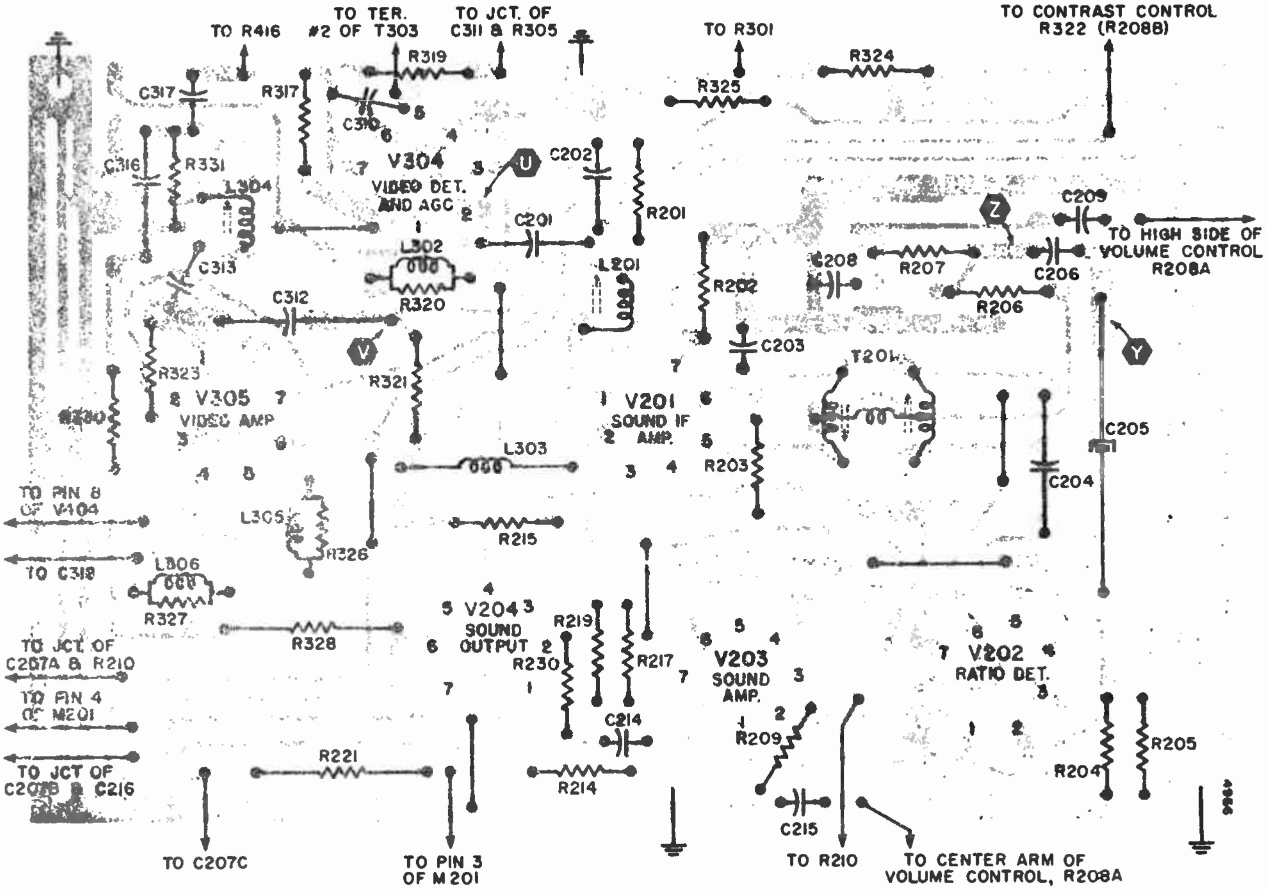


Figure 27. Top View of Printed Circuit Assembly (Used in Chassis Stamped Run 8 or Lower) Showing Printed Circuit and Electrical Connections.

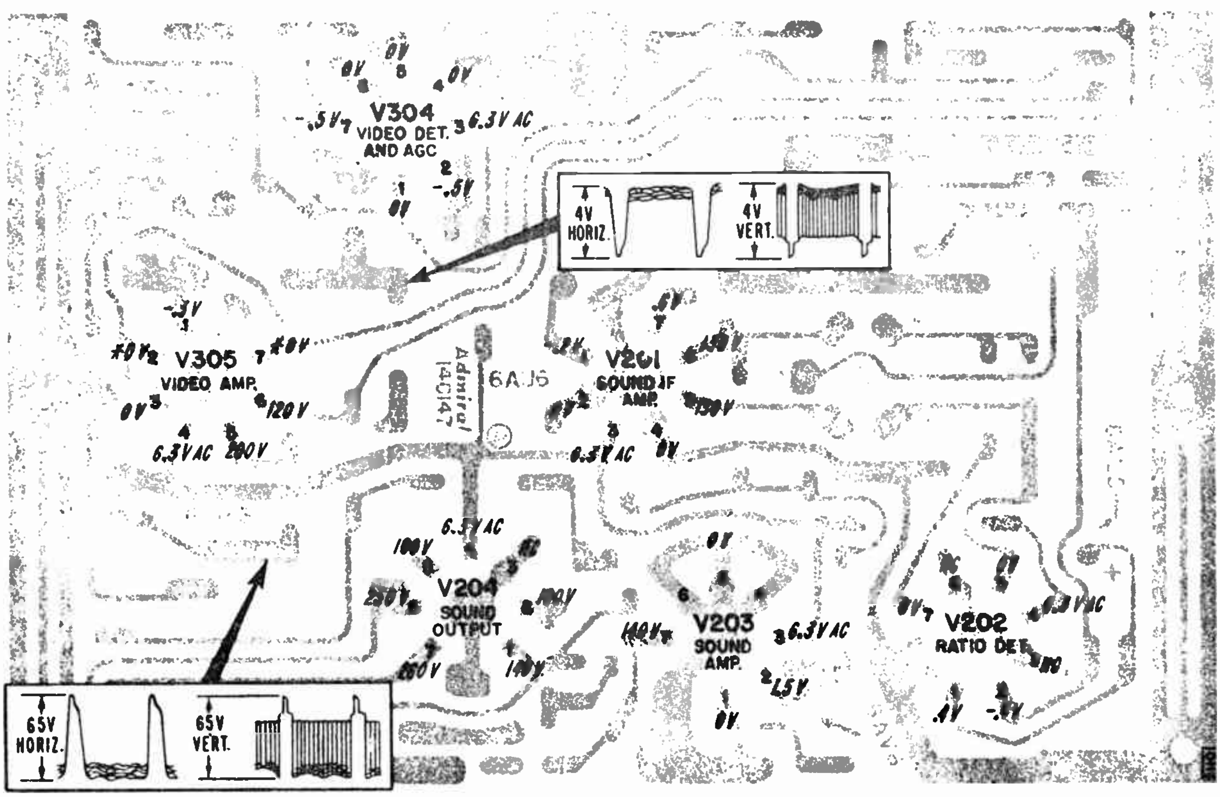


Figure 28. Top View of Printed Circuit Assembly (Used in Chassis Stamped Run 8 or Lower) Showing Voltages Measured Under Conditions Given on Schematic.

A DECIBEL NOMOGRAM

Most useful of graphic charts, the nomogram is "equivalent to an infinite number of graphs." This one can be used to find a number of solutions to decibel problems

MANY problems may be solved by graphical means. An advantage of such representations is the bird's-eye view which results. To connect two variables it is common to plot a chart which is a line or curve, every point of which indicates one variable in terms of the other. Charts may be designed to correlate frequency vs. dial setting, antenna length vs. reactance, plate voltage vs. plate current, etc.

Another type of graph is the nomograph, which is useful in certain types of problems. This is usually designed to contain three lines or curves, each calibrated in terms of a variable. The nomograph differs from the ordinary chart in that the reader supplies his own indication by the use of a straightedge, preferably a celluloid or other transparent ruler.

Suppose we wish to show the variation of three quantities: Two may be shown on a chart, but there is no way of showing the third, which will have to be assumed constant. We would need an infinite number of curves on our chart, each corresponding to some value of the third variable. *A nomograph is therefore equal to an infinite number of graphs.* This is the key to its usefulness.

A useful nomograph is that relating db gain or loss to voltage or power ratio. The three variables are input, output and decibels. In the figure, the left-hand scale is calibrated in values from 1 microvolt to 100 volts in two sections, A and B. The right-hand scale indicates from one-half volt to 500 volts. The center scale shows decibels in two sections, C corresponding to A and D corresponding to B.

As the nomograph stands it indicates voltage gain or loss, but since current varies directly with voltage in any constant impedance circuit, amperes may be substituted for volts and microamperes for microvolts. *To extend to power values the center scale must be divided by two for all readings.*

To work out a problem, connect the larger of the two voltages, currents or powers at scale E with the smaller at either A or B by means of the ruler. If the output is larger there is a gain, otherwise a loss. The answer is read off at C or D.

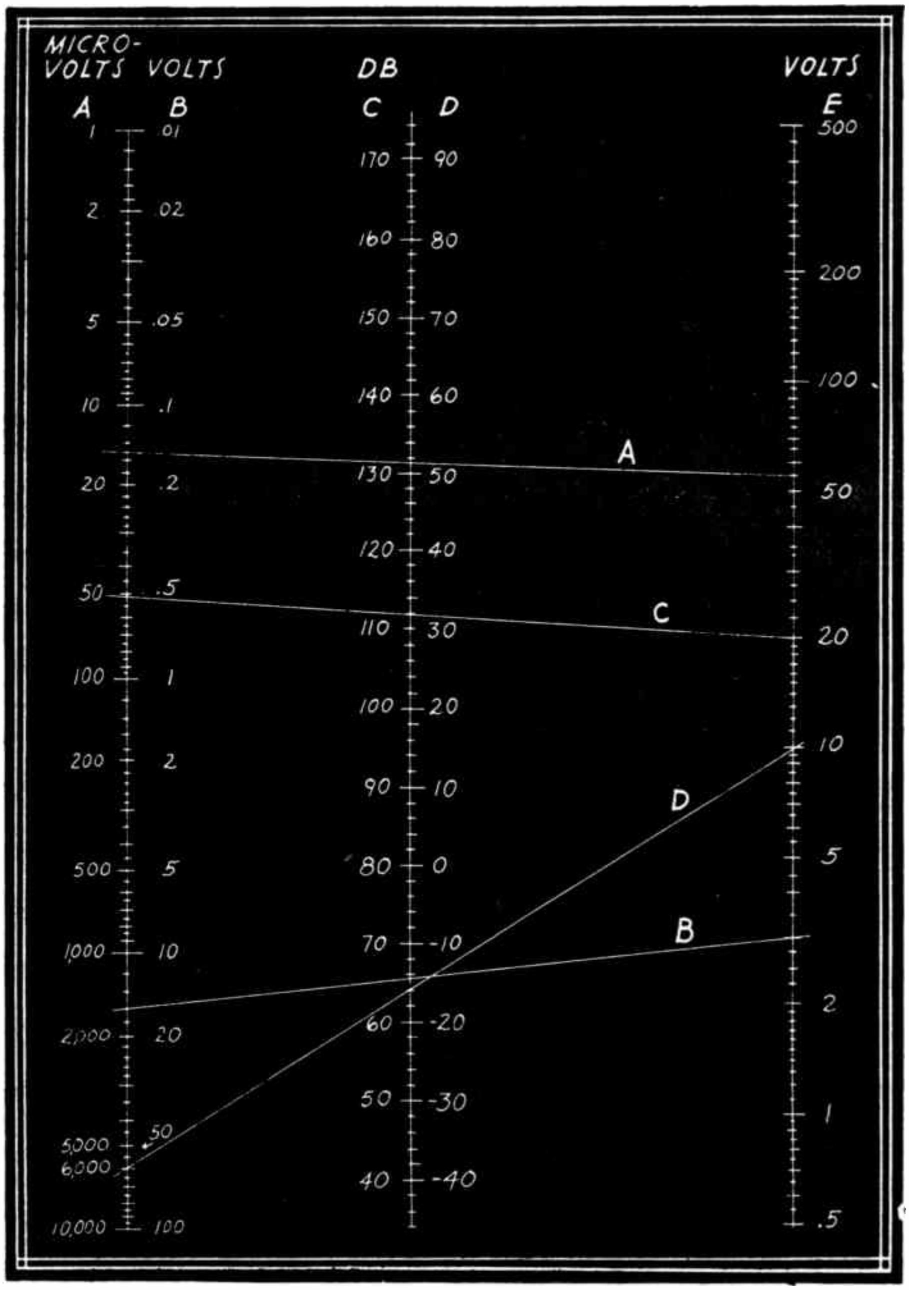
Four lines are shown on the figure as examples.

1—We wish to find the voltage gain of an audio amplifier. Making measurements with a v.t.v.m. we find the output is 55 volts when the input is .15 volt. There is a GAIN of 51.3 db (Line A).

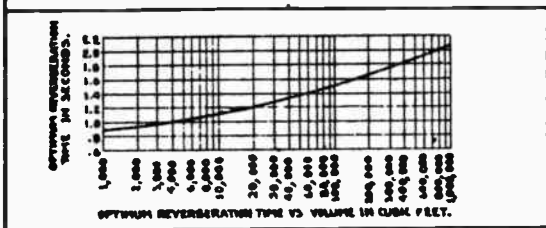
2—We have an r.f. tuner and after repairing and aligning we wish to find its amplification. Applying a signal generator to an artificial antenna we find an output of 3 volts when 1600 microvolts is measured at the input. The GAIN is 65 db (Line B).

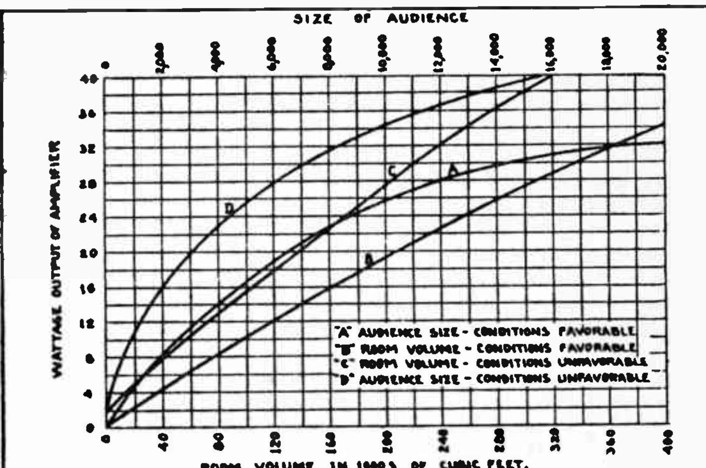
3—How much attenuation must we use to obtain an output of .51 volt when 20 volts is applied to the attenuator? All impedances are assumed matched. We must design an attenuator to have a 31.9 db loss (Line C). The same line may be used to show the output when the input and the attenuation are known.

4—As mentioned before, power calculations are the same except that the db scale is read off as one-half its value. The catalog lists a particular amplifier as having 10 watts output. What is its power gain (above 6 milliwatts)? Connect 10 at E with 6000 at A. The gain is 64.2 divided by 2, equals 32.1 db (Line D).

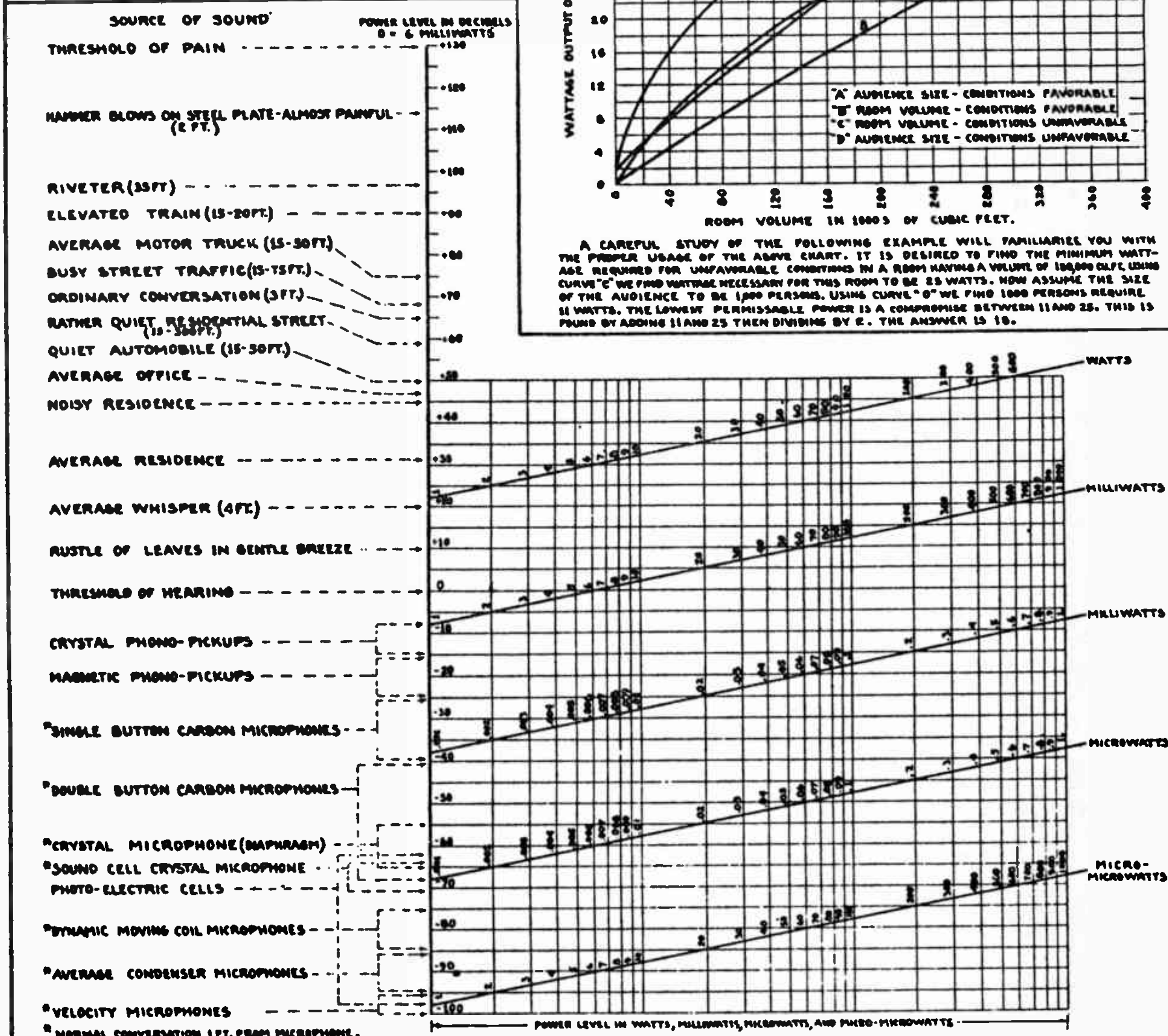


SOUND VOLUME CHART





A CAREFUL STUDY OF THE FOLLOWING EXAMPLE WILL FAMILIARIZE YOU WITH THE PROPER USAGE OF THE ABOVE CHART. IT IS DESIRED TO FIND THE MINIMUM WATTAGE REQUIRED FOR UNFAVORABLE CONDITIONS IN A ROOM HAVING A VOLUME OF 100,000 CU.FT. USING CURVE "C" WE FIND WATTAGE NECESSARY FOR THIS ROOM TO BE 25 WATTS. NOW ASSUME THE SIZE OF THE AUDIENCE TO BE 1,000 PERSONS. USING CURVE "D" WE FIND 1000 PERSONS REQUIRE 11 WATTS. THE LOWEST PERMISSABLE POWER IS A COMPROMISE BETWEEN 11 AND 25. THIS IS FOUND BY ADDING 11 AND 25 THEN DIVIDING BY 2. THE ANSWER IS 18.



COEFFICIENTS OF ABSORPTION (512 VIBRATIONS PER SECOND).

	UNITS PER SQUARE FOOT.
ACOUSTI-CELOTEX, TYPE "B", PAINTED OR UNPAINTED	.47
ACOUSTI-CELOTEX, TYPE "BB", PAINTED OR UNPAINTED	.70
BRICK SET IN PORTLAND CEMENT	.025
CARPETS	.15 TO .29
CONCRETE	.015
CORK TILE	.03
CRETONNE CLOTH	.15
CURTAINS IN HEAVY FOLDS	.50 TO 1.00
FLAXLINUM 1/2"	.34
GLASS, SINGLE THICKNESS	.027
HAIRFELT 1/2" (JOHNSMANVILLE)	.31
HAIRFELT 1" (JOHNSMANVILLE)	.59
LINOLEUM	.03
MARBLE	.01
NASHKOTE, TYPE "A", 3/4" THICK	.27

	UNITS PER SQUARE FOOT
OPEN WINDOW	1.00
PLASTER	.025 to .034
SABINITE ACOUSTICAL PLASTER	.21
SANACOUSTIC TILE, 1" ROCK WOOL FILLER	.74
WOOD SHEATHING	.061
WOOD, VARNISHED	.03

INDIVIDUAL OBJECTS

AUDIENCE, PER PERSON	4.7
COMPLETELY UPHOLSTERED CHAIRS	3.0
PARTIALLY UPHOLSTERED CHAIRS	1.6
PLAIN CHURCH PEWS, PER LINEAR FOOT	.18
PLAIN PLYWOOD AUDITORIUM CHAIRS, EACH	.24
UPHOLSTERED CHURCH PEWS, PER LINEAR FOOT	UP TO 1.6

COYNE

SOUND PRINCIPLES

FIG. 1

MOLECULES VIBRATE BACK AND FORTH PRODUCING PRESSURE VARIATIONS (SOUND WAVES)

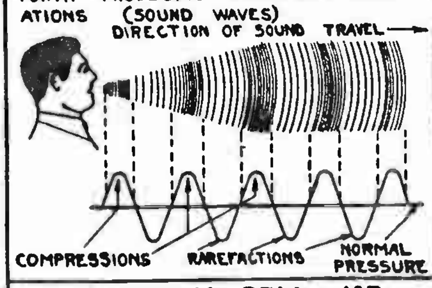


FIG. 2 **MANOMETRIC FLAME**

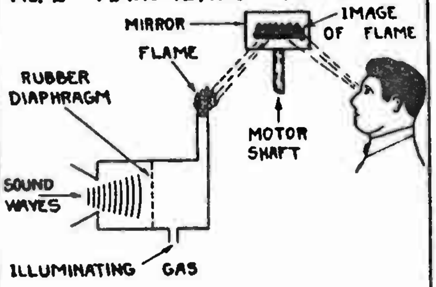


FIG. 3 **DETERMINING SPEED**

TWO HAMMERS A & B TAPPING 1/4 SECOND APART WILL BE HEARD AS ONE HAMMER IF BOTH ARE EQUIDISTANT FROM OBSERVER.

AS HAMMER B IS MOVED AWAY THE TAPS WILL BE HEARD SEPARATELY UNTIL POSITION Bp IS REACHED WHERE THE TAPS FROM B WILL BE HEARD ONE TAP BEHIND THE TAP FROM A.

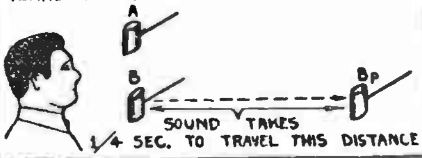
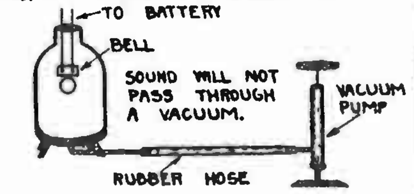


FIG. 4 **VACUUM BELL JAR**



LIGHT WILL PASS THROUGH A VACUUM

FIG. 5 **VELOCITY OF SOUND IN VARIOUS MATERIALS**

$V = \sqrt{\frac{E}{d}}$ WHERE V = VELOCITY, E = ELASTICITY, d = DENSITY

MATERIAL	VELOCITY FEET PER SEC.	DENSITY GRAMS/C.C.
AIR	1130	.001205
HYDROGEN	4136	.00009
MERCURY	4615	13.6
WATER	4793	1.0
BRICK	11979	2.0
CORK	1574	.24
IRON	16826	7.9
ELM (WOOD)	3411	.54
GLASS (FLINT)	13120	3.0

FIG. 6 **VOLUME**

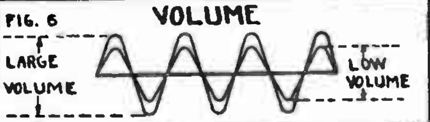


FIG. 7

INTENSITY OF SOUND VARIES INVERSELY WITH THE SQUARE OF THE DISTANCE IF NOT FOCUSED.

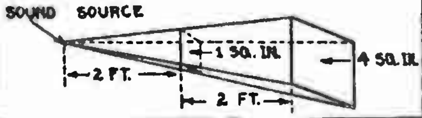


FIG. 8 **DECIBEL CONVERSION CHART**

CHANGE IN DB. $= 10 \times \log_{10} \frac{P}{P_1}$ WHERE P & P_1 ARE IN WATTS.

DECREASE OF 1 DB. = WATTS X 4/5
" " 2 " = WATTS X 2/3
" " 3 " = WATTS X 1/2
" " 10 " = WATTS X 1/10

FOR INCREASE OF GIVEN DB. INVERT FRACTION AND MULTIPLY.

TO FIND FRACTION FOR 7 DB. DECREASE—FOLLOW PROCEDURE SHOWN BELOW.

7 DB. = 2 DB. + 2 DB. + 3 DB. = 2/3 X 2/3 X 1/2 = 2/9

FIG. 9 **VOLUME LEVEL IN DECIBELS**

0 DB. = 6 MILLIWATTS

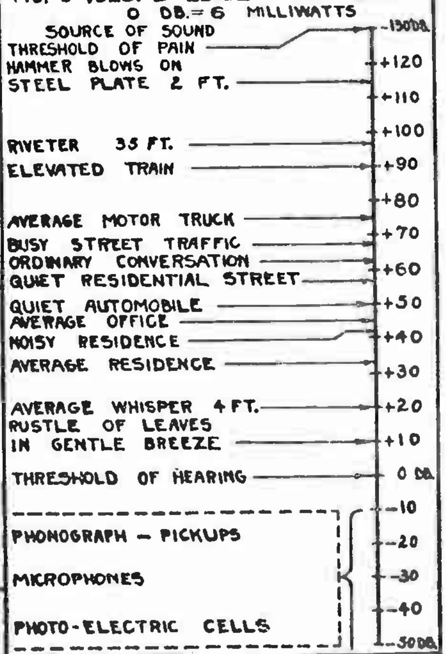


FIG. 10 **PITCH**

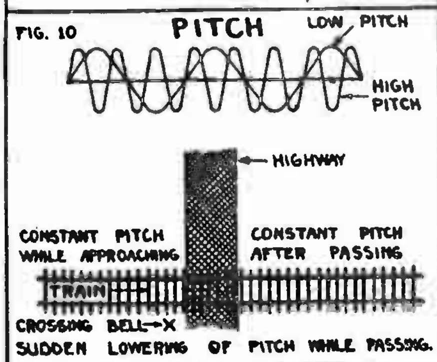
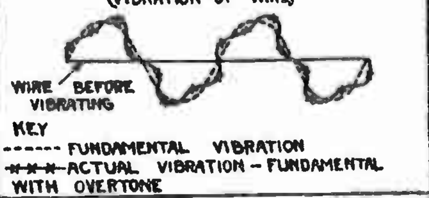


FIG. 11 **QUALITY** (VIBRATION OF WIRE)



HEMHOLTZ RESONATORS

FOR DETERMINING PRESENCE OF OVERTONES

FOR ANALYZING 500 CYCLE NOTE

FIG. 12 **REFLECTION OF SOUND** FROM A FLAT SURFACE

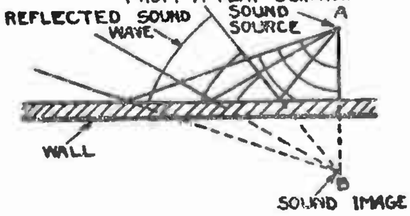
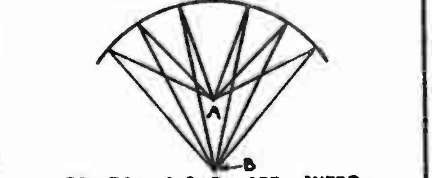


FIG. 13 **REFLECTION OF SOUND** FROM A CONCAVE SURFACE



POINTS A & B ARE INTERCHANGEABLE — CALLED CONJUGATE FOCI.

FIG. 14 **REFRACTION OF SOUND** WHEN PASSING THROUGH A BUBBLE OF GAS HEAVIER THAN AIR.

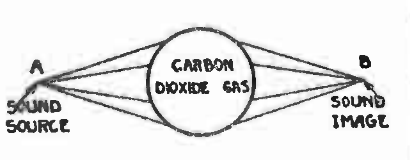


FIG. 15 **REFRACTION OF SOUND** WHEN PASSING THROUGH A BUBBLE OF GAS LIGHTER THAN AIR.

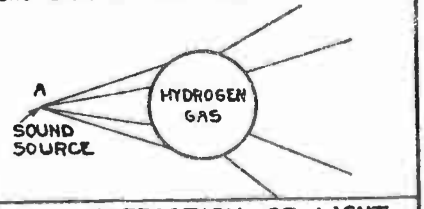


FIG. 16 **REFRACTION OF SOUND** FROM FOG-HORN

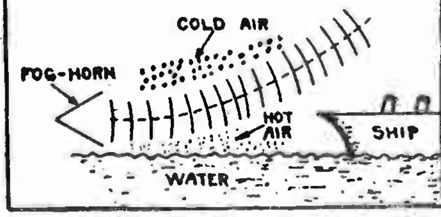


FIG. 17 **REFRACTION OF LIGHT** MAKES PUDDLES OF WATER APPEAR ON ROAD-BED.

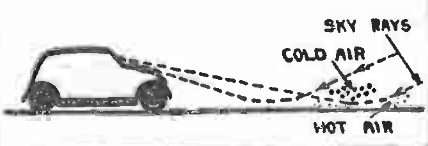


FIG. 18 **REFRACTION OF LIGHT** ON A DESERT MAY CAUSE A MIRAGE

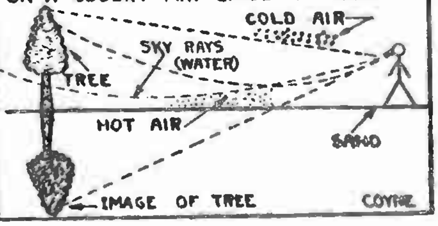
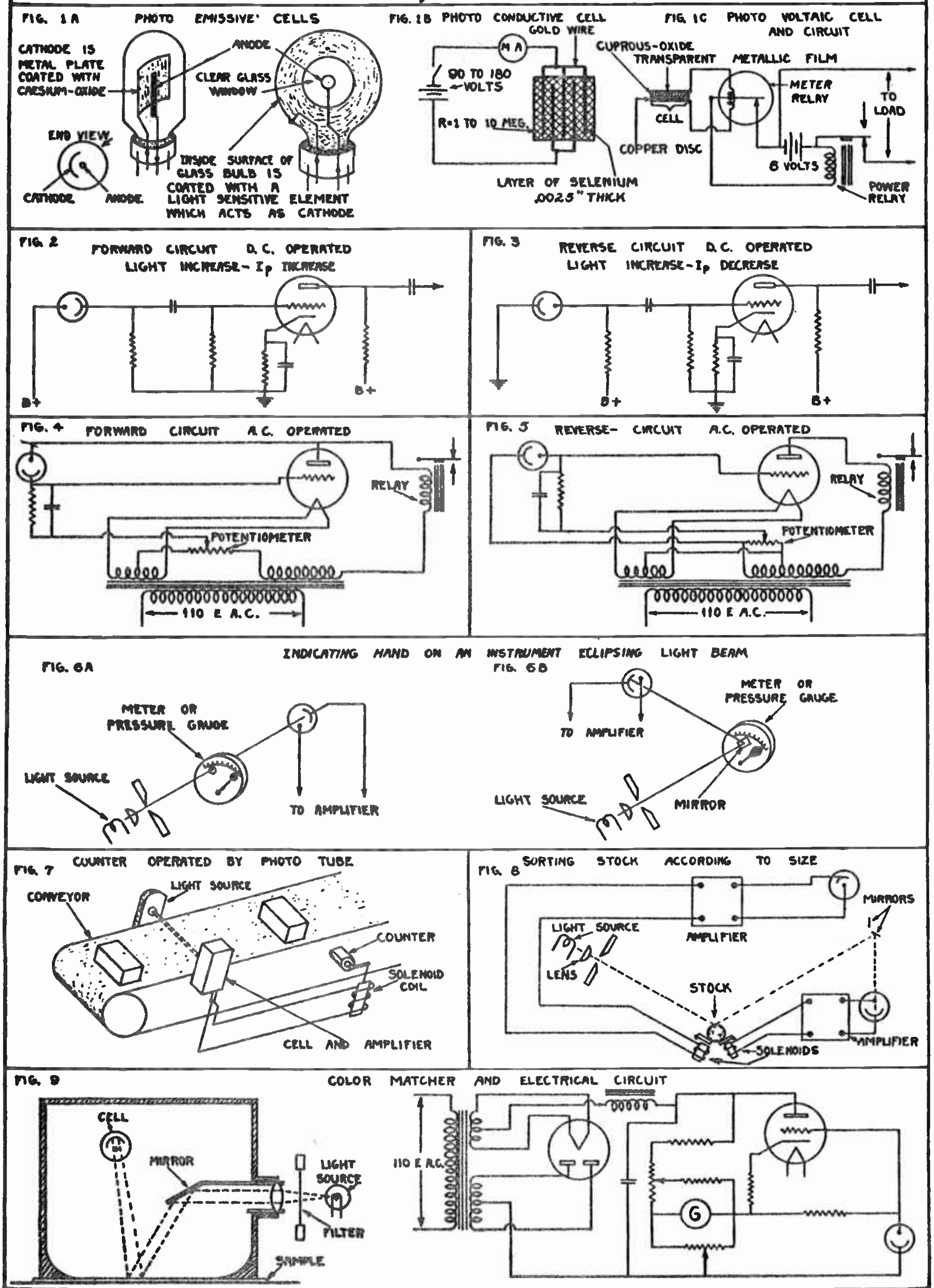
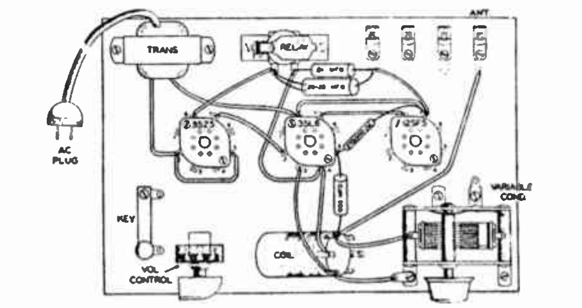


PHOTO ELECTRIC CELLS, CIRCUITS AND APPLICATIONS

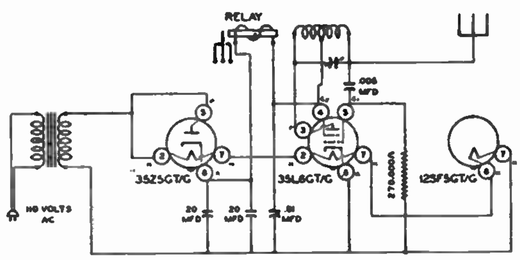


SECTION III

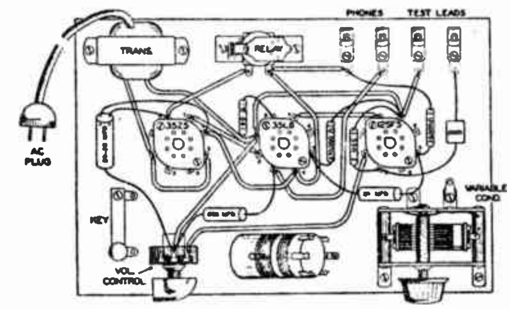
Special Purpose Units, Alignment Methods, Ratio Detector Analysis



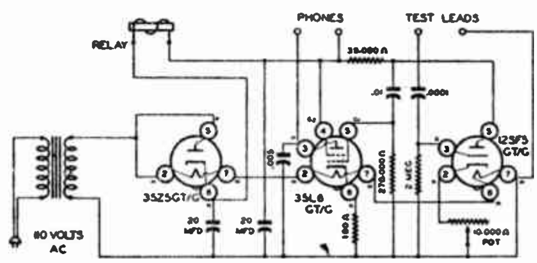
PICTORIAL DIAGRAM



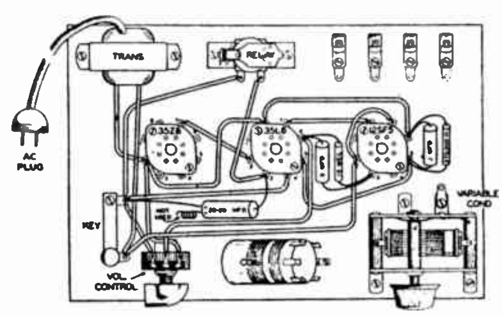
SCHEMATIC DIAGRAM
CAPACITY OPERATED RELAY



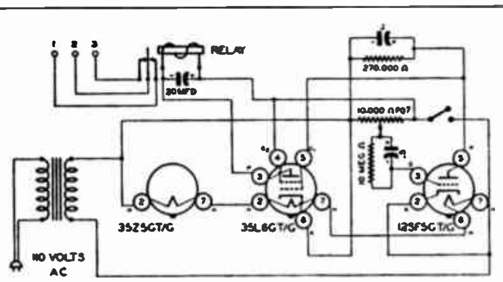
PICTORIAL DIAGRAM



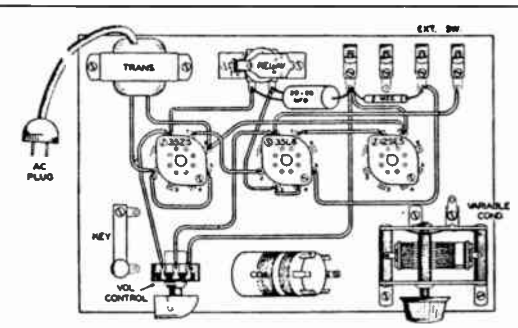
SCHEMATIC DIAGRAM
SIGNAL TRACER



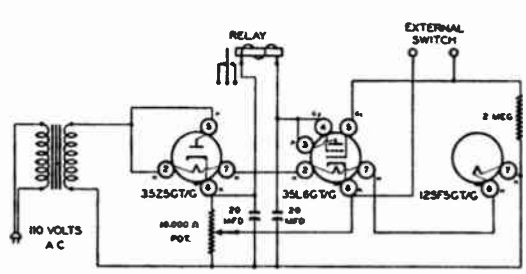
PICTORIAL DIAGRAM



SCHEMATIC DIAGRAM
ELECTRONIC TIMER



PICTORIAL DIAGRAM

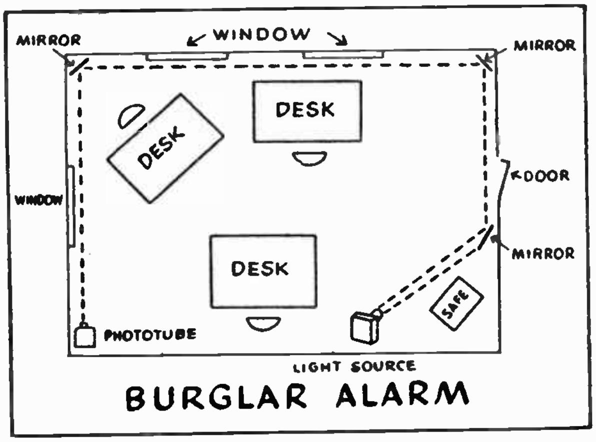


SCHEMATIC DIAGRAM
ELECTRONIC SWITCH

Applications for Phototubes

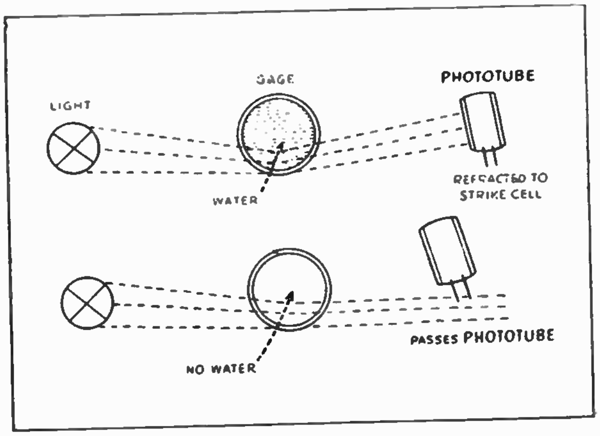
Burglar Alarm . . .

The phototube can be used to operate an alarm system when its light beam is cut off by an undesired entry of someone. It can be a fairly simple arrangement, as shown in the diagram, or quite complicated, depending on the installation. External alarms require fairly rugged weather-proof equipment and consideration must be given to operation under various weather conditions. All of the visible light from the light source can be eliminated by the use of an infra-red filter.



Water Level Gauge . . .

By means of a column of phototubes, a simple and reliable gauge to indicate the level of water or other liquid can be constructed, as shown in the diagram. When a beam of light shines through a column of liquid, it is refracted. By virtue of this fact, the beams of the light source of this water level gauge are adjusted so that they do not strike the phototubes unless there is liquid to refract them. Any desired number of tubes may be used. A meter connected to the output will read in direct proportion with the number of tubes illuminated.

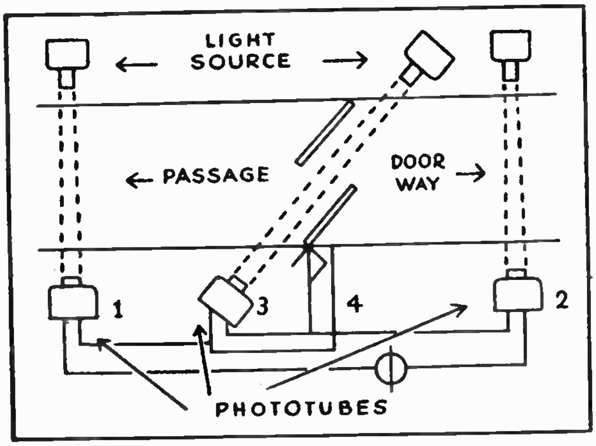


Opening and Closing Doors . . .

Mechanical door openers employing the action of opening and closing doors can be made completely automatic by the use of phototube control. This automatic device is especially suitable for garage door, restaurant kitchen door, and similar places, for the sake of convenience and time-saving.

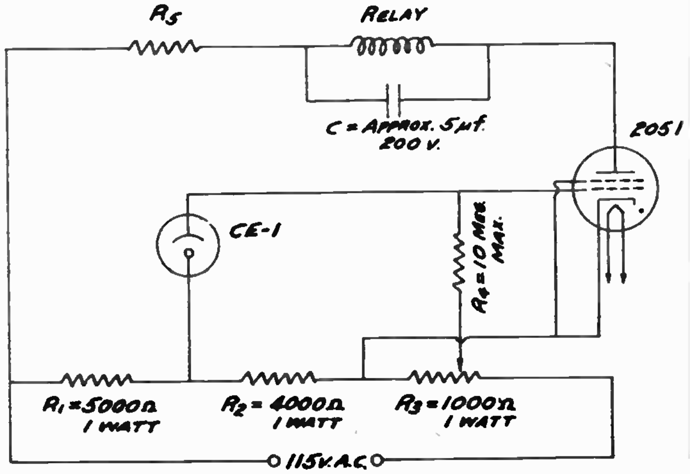
Mechanically operated garage doors are equipped with one push button for opening and another for closing. A phototube in a light-on energized circuit with its relay connected across the terminals of the opening push button may be used as a controlling device. The car driver simply shines the headlights on the phototube which energizes the circuit, operates the relay and opens the garage door.

For swinging doors in restaurants or bars, a different arrangement and circuit are to be used. Three phototubes in series are to be installed as in the diagram. Tubes 1 and 2 are operated from either approach, and tube 3 is used to hold door open when someone remains in the doorway. When the door closes, tube 3 is short-circuited by switch 4. Since the dark resistance of a tube is several times greater than that of a tube when illuminated, blocking the light beam of either tube 1 or 2 which are connected in series will greatly reduce the current output and thus operate the relay.



Relay Circuit Energized by Increase in Light . . .

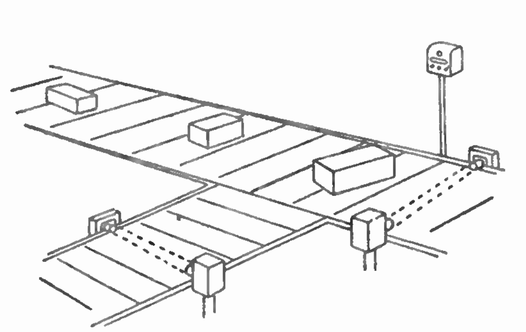
In using this circuit, adjust R_3 so that the bias voltage is just negative enough to prevent the thyratron, 2051, from conducting, at a predetermined light level. When there is an increase in light, the increase of current in the phototube, in turn, reduces the negative grid voltage through the voltage drop across R_4. The 2051 conducts and closes the relay. R_4 is to be selected according to the desired sensitivity of the circuit. The function of R_5 is to keep the current within the current rating of the relay and the 2051. It is not needed, if the relay has a sufficiently high resistance. The condenser is to prevent the relay from chattering.



Counting . . .

The simplest use of phototubes is that of counting, with the aid of relay and counter. A beam of light shines across a conveyor belt into a phototube which is used in a light-off energized circuit. When the light beam is intercepted by the object on the conveyor belt, the change in current actuates the relay which, in turn, operates the counter. If two objects of different sizes are to be counted, two phototubes may be arranged at different heights. The top beam is high enough so the large object will intercept it. When the large object cuts the top beam and the bottom beam, the phototube operates one counter. In doing so, it opens the relay of the second counter. Only when the bottom beam is cut by the small object, the second counter registers. With the same principle, three or more objects of different sizes on the same conveyor belt can be counted.

If a mechanism operated by the same relays is mounted to separate the two objects, the counting system may serve, at the same time, as a sorting system.

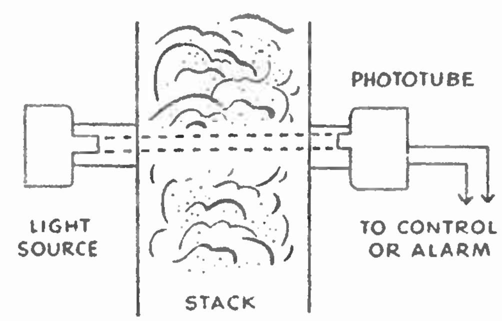


CONVEYOR BELT CONTROL

Smoke Control . . .

By virtue of the fact that the current of phototubes varies in proportion with intensity of light beam, many phototube control units have been designed to control, indicate, or adjust smoke density of industrial stacks. Aside from the fact that operating companies are required to comply with the smoke ordinances, improper combustion results in a waste of fuel. The phototube control may be used to indicate smoke density or to register a continuous or permanent record or to operate a mechanism that controls fuel feeding. Generally, when smoke density exceeds a predetermined density, an alarm is set off by the change of current in phototube.

To install a smoke indicator, two openings are cut in opposite sides of the stack. In one opening a phototube is installed and in the other a light source which directs a beam against the tube. The intensity of the beam of light transversing the stack is determined by the density of smoke, and the corresponding current in the phototube with the aid of an amplifier can be used to operate an alarm system or adjust directly the fueling mechanism. The indicating or recording instrument is usually calibrated into Rengelmann smoke units.

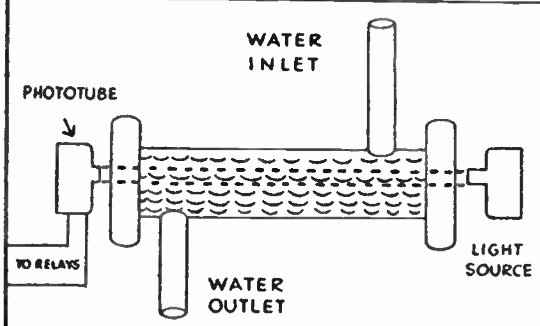


SMOKE CONTROL

Turbidity Control . . .

In the process of manufacture or purification of liquids, an automatic system can be set up to inspect the clarity or turbidity of liquid. Foreign matters picked up by rapidly moving liquid may cause contamination if they are not detected and eliminated immediately. The arrangement of this automatic system is very similar to that of smoke control.

The diameter of the pipe where the phototube is to be installed should preferably be fairly large. Arrangement as in sketch is recommended if the pipe is rather small.

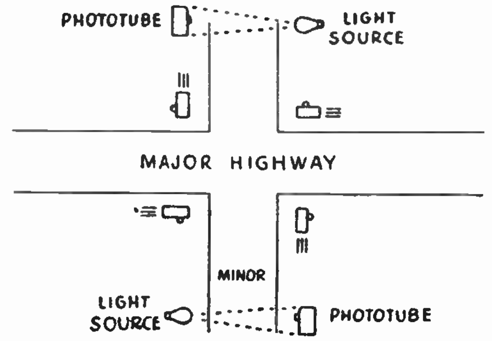


TURBIDITY CONTROL

Traffic Control

By means of phototube-controlled traffic lights, 20% of car-seconds were saved. When riding on a major highway, it is annoying as well as wasteful of time to stop at a red traffic light when there is no car travelling on the minor highway. The phototube control makes it possible to give the major highway green light all the time except when there is a car approaching the traffic light on the minor highway.

The arrangement of light sources and phototube units is shown in the diagram. The light source, quite similar to automobile spotlight, sends a beam of light across the street to the phototube unit which was equipped with a lens to permit only the beam from light source to shine on the phototube surface.



TRAFFIC CONTROL

Boat Radios

You cannot simply resign yourself to getting your feet wet, and then get out to push the boat. And you just don't handcrank a large marine engine.

Before selling and installing that radio, check the boat's storage battery capacity against its lights and contemplated radio drain. Additional storage batteries, in some cases, may not be the best solution.

Weight is important aboard ship. The deeper in the water the boat sits, the harder it's going to be to move her. If this factor is not too important, however, an additional battery may be installed, and the generator's rate of charge stepped up correspondingly. Otherwise, a dry-battery portable receiver may be needed.

Connecting the radio to the boat's power supply will introduce ignition noise, and probably auxiliary motor noise. This interference may be treated in the same fashion it would be treated ashore with one basic difference . . . don't use spark plug suppressors!

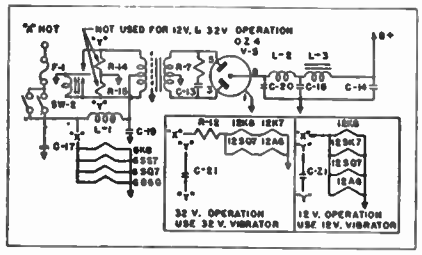
Why Suppressors Are Out

Suppressors should never be installed in a marine engine. In most cases, the inclusion of a resistance in the spark circuit will *ruin the engine*. The number of times suppressors may be used with impunity are so few that suppressors may be considered non-existent aboard ship.

The reason is this: suppressors will not interfere with the starting and running of an engine. However, at full load, or close to full load, the resistors will cut down the amount of spark and prevent *complete* combustion.

The unburnt gasoline will foul the combustion chamber and eventually dilute the crankcase oil to the point where the bearings and associated parts will burn up. The gasoline is not readily detected on the oil gauge stick or pressure gauge. However, the tachometer will show low RPM.

Suppressors can be used without ill effect on most cars, since they are very seldom, and then for a short period only, operated at full power. The modern car engine is "revved up" to full power only when the car pushes ninety, or when it is raced up a steep hill in second gear. These periods are too short to permit the gasoline to accumulate dangerously in the crankcase.



"Buccaneer" power supply for 6V, 12V, 32V. showing vibrator used off boat's starting battery.

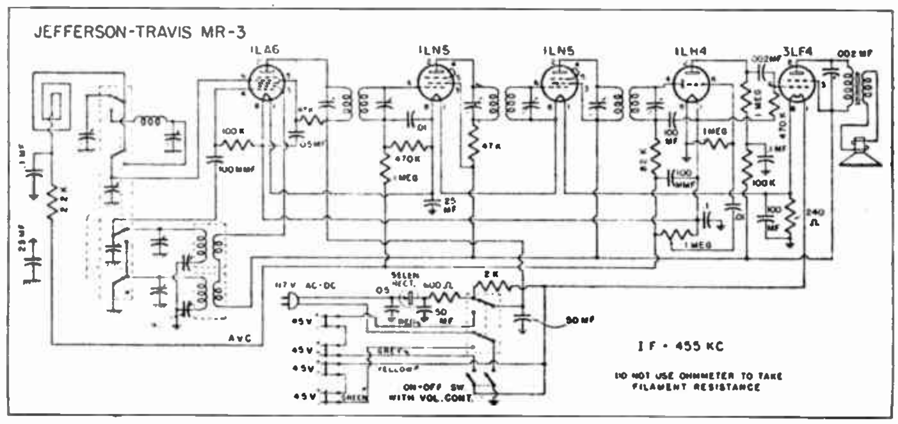
However, when a boat owner installs a hundred horse motor in his boat he uses that full hundred a great deal of the time he is under way. To double the speed of a boat you have to square the power. From this, derives the natural tendency to open the throttle and let it run.

Ignition interference, a major problem only in 2-way radiotelephone jobs, may safely be suppressed by means of complete metal shielding. A wall of metal as heavy and of as low electrical resistance as is practical is thrown around the entire ignition system, and is grounded to the engine at one, or as close to one point as possible. The high tension primary is filtered. The plugs, distributor, ignition coil are all inside the shield.

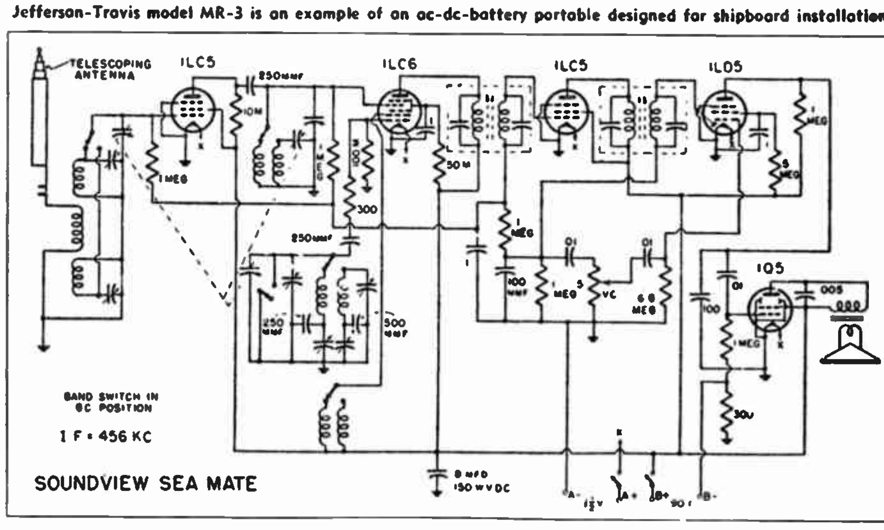
Commercial suppressor "packages," designed to be easily installed on a variety of standard marine engines, are available. They run about $150. installed. Care must be exercised in the design to include plenty of insulation and ventilation. The instantaneous voltages run upwards of fifteen thousand volts, and the ozone generated by the electric arcing across the points induces corrosion and needs to be let out.

Copper screening tacked to the inside of the engine box and bonded to form one continuous wall will sometimes help enormously. A ground plate has been found to be very ineffective so far as reception and noise suppression is concerned. It should not be resorted to except as a final measure or when needed to counterpoise a transmitting antenna.

The generator may be filtered by means of a bypass capacitor and filter choke. The same holds true for the water closet bowl, sump pump, ventilating and other auxiliary motors aboard the ship. It is almost all cut and try work. No two ships, even sister ships, built by the same company on the same day have been found to respond exactly alike.



Jefferson-Travis model MR-3 is an example of an ac-dc-battery portable designed for shipboard installation.

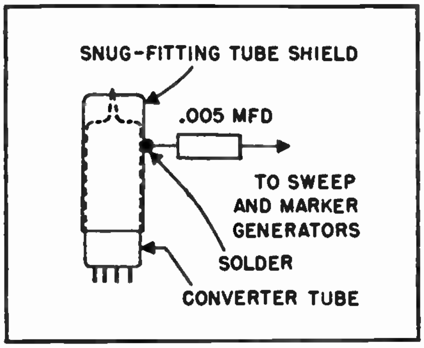


Typical marine dry battery portable, with broadcast band and 2000 kc to 6600 kc maritime band.

TV Service Hints

Coupling Sweep and Marker Generators to Receiver

When using a sweep generator, marker generator and oscilloscope to check the I-F response curves of a television receiver, it is sometimes difficult to obtain the correct balance between sweep output and marker output. This is particularly true when the ranges of the individual attenuators are limited. For best results, the amplitude of the



applied sweep voltage as well as that of the marker voltage must be adjusted to a fairly critical level.

The coupling method shown above provides additional control of the sweep and marker voltages. By sliding the tube shield up or down on the tube, the capacitance between the shield and the tube elements is varied, and the coupling can be adjusted as desired. Another advantage of this method is that it is not necessary to make a direct connection to the circuit under test; simply slide the tube shield over the converter tube. Any tube shield can be used provided that it fits the tube snugly and does not ground to the chassis. *Courtesy Westinghouse.*

Antenna Stubs

Occasionally we hear of or recommend the use of a quarter-wave stub of transmission line for trapping out unwanted signals or partially attenuating powerful interfering nearby TV stations. This is satisfactory as far as the reduction or elimination of the undesired signal is concerned, but it will also cause a change in the R-F response curve of the head-end unit on channels close to the tuned frequency of the stub. This may result in a serious impairment of the picture detail due to smearing.

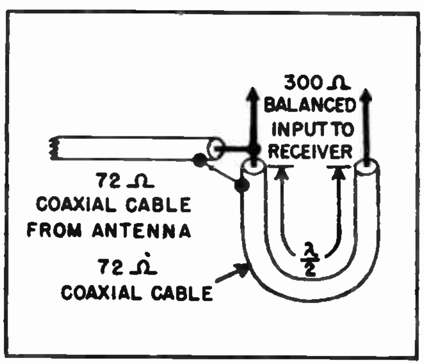
It has been found that it is much more desirable to insert a small capacitor in series with each line of the stub at the point where the stub fastens to the head-end terminals. These capacitors should be 5 mmf. for stubs in the low frequency TV spectrum and the FM band, and 2 mmf. for stubs used in the high frequency band. This gives a series parallel tuned trap which is much sharper in response and will not affect the response curve of the head-end unit unless the stub is tuned directly in the channel.

The capacitors in the tuning stubs result in a longer piece of line being used for a particular frequency. The best method of determining the proper length of line is to clip off small portions until maximum attenuation is obtained.

—*Courtesy General Electric Co.*

Matching 72 Ohm Coax Cable to 300 Ohm Balanced Input

In some areas it may be desirable to use 72 ohm coaxial cable as a transmission line between the antenna and the receiver in order to reduce noise pickup. The problem of matching the coaxial cable to the receiver input in such installations can be solved as shown.



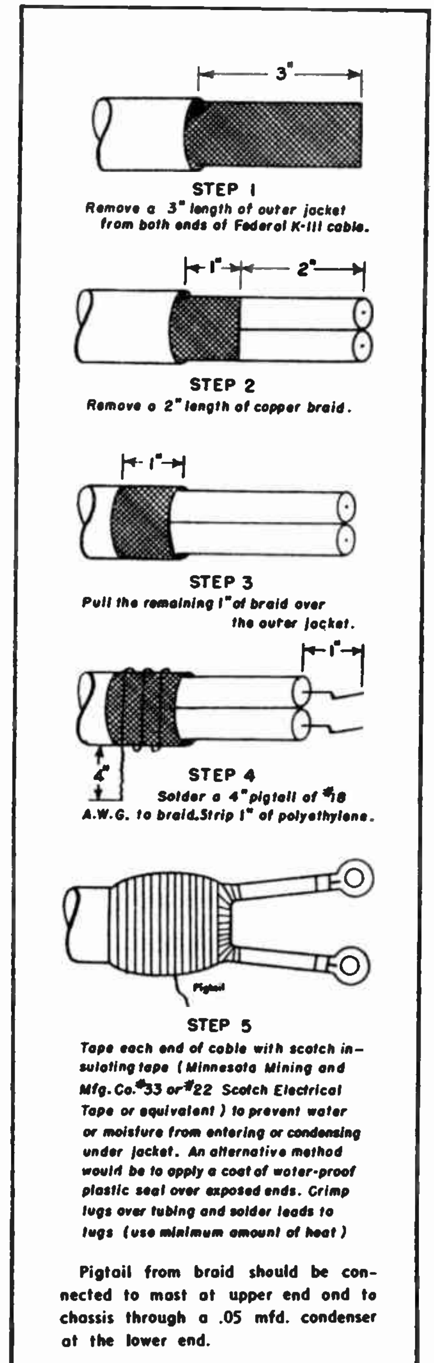
The matching section should be one half wavelength long at the most critical frequency. If reception is possible on one channel only, cut the matching section to the video carrier frequency of that channel. If operation on more than one channel is possible, cut the matching section to the video carrier frequency of the weakest signal.—*Courtesy Westinghouse.*

Ground Connection to Aquadag

Wear or vibration may sometimes develop a poor connection between the outside coating of the cathode ray tube and its grounding springs. The attendant arcing at that point can result in tearing of the picture and insufficient picture width.

To insure a permanent ground contact, a piece of aluminum foil may be inserted between the aquadag and the grounding springs. This foil, one side of which is coated with adhesive, is first cut to size of 1" x 1½". One edge is then folded ¼" over the adhesive side of the foil. Finally, the foil is placed between the aquadag and the grounding spring in such a manner that adhesive holds the foil to the aquadag, the spring bears against the uncoated side of the foil, and the uncoated side of the ¼" fold bears tightly against the aquadag.—*Courtesy Westinghouse.*

Shielded 300-Ohm Line



—*Courtesy Federal Telephone & Radio Co.*

TRANSISTORS

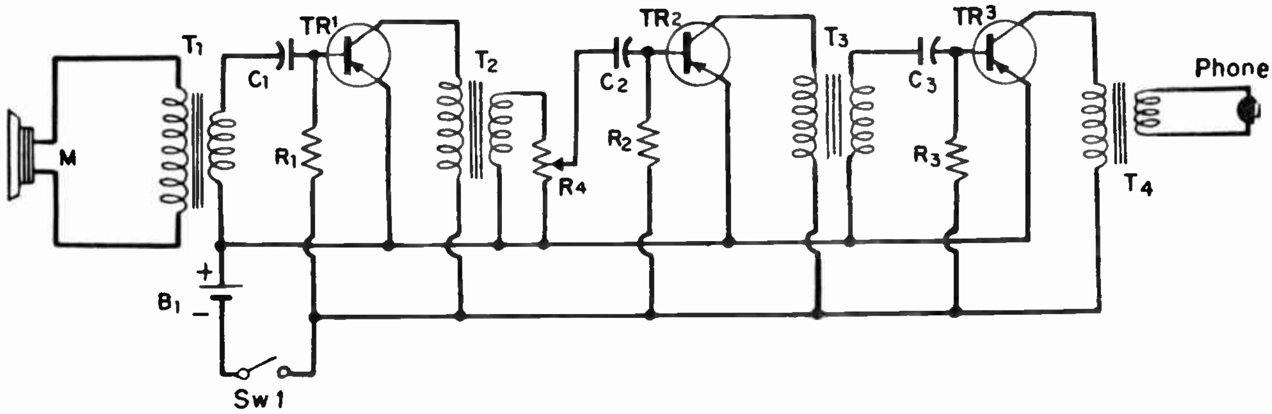


Figure 9-3. A transistorized hearing aid circuit. Parts values are as follows:

TR_1, TR_2 - RAYTHEON type CK718 PNP junction transistors.
TR_3 - RAYTHEON type CK718 or CK721 PNP junction transistors.
T_1 - STANCOR type UM112 t 'ansistor transformer.
T_2, T_3 - STANCOR type UM111 transistor transformer.
T_4, - STANCOR type UM111 transistor transformer.
R_1, R_2 - 10K-15K resistors*.
R_3 - 50K-100K resistor*.
R_4 - VOLUME control - 4K-6K.
C_1,C_2,C_3 - Large interstage coupling capacitors - 2-5 mfd.
M - High impedance microphone (crystal or dynamic).
B_1 - Power supply battery . . . 1.5 to 6.3 volts.
Sw_1 - SPST "Off-On" switch.
PHONE - Low impedance hearing aid type earphone.

*These resistor values will vary with battery voltage and transistors used. Choose final values experimentally for best operation.

CREDIT: Circuit Courtesy STANCOR.

PRACTICAL TRANSISTOR CIRCUITS

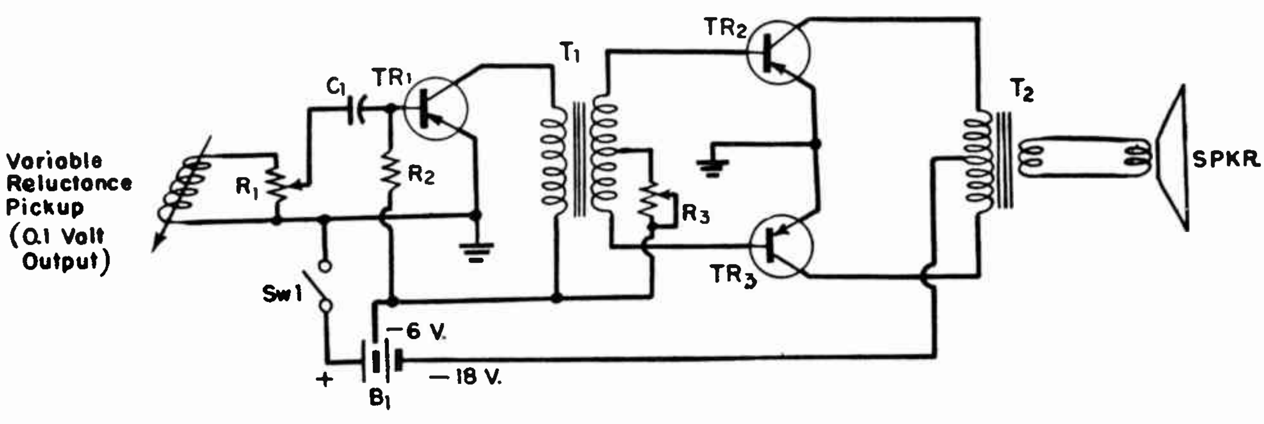
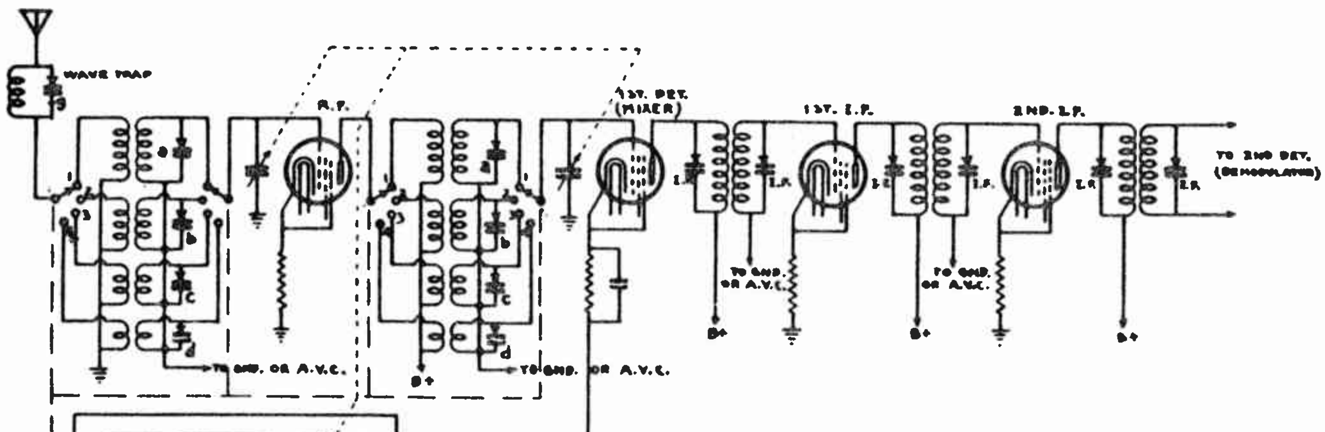


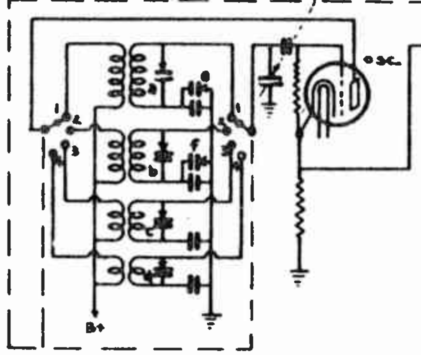
Figure 9-2. A transistor-operated phonograph amplifier. Parts values are as follows:

TR_1 - CBS-HYTRON type 2N36 PNP junction transistor.
TR_2, TR_3 - CBS-HYTRON type 2N37 PNP junction transistors.
R_1 - VOLUME control, 10K.
R_2 - 100K resistor.
R_3 - Output bias control, 25K.
C_1 - 1 mfd.
T_1 - Interstage Transformer; 3:2 turn ratio.
T_2 - Output transformer; 4000 ohms to speaker voice coil.
Sw_1 - SPST "Off-On" Switch.
B_1 - Tapped battery . . or separate batteries providing 6 and 18 volts.

CREDIT: Circuit courtesy CBS-HYTRON

ALIGNING SUPERHETERODYNE RECEIVERS.





Connect the output meter to the receiver in the conventional manner. Adjust the signal generator to the required I. F. of the receiver, connecting it to the input grid of the mixer tube, generally allowing the grid lead disconnected. Adjust the I. F. condensers to the maximum reading of the output meter. If the signal does not go thru, connect the signal generator to the input grid of the last I.F. tube, then connect the signal generator to the preceding stages.

Transfer the signal generator connections to the antenna and ground of the receiver.

Tune the receiver to band #1 (generally the broadcast band). If the receiver has a wave trap, the trimmer (g) is adjusted to minimum reading of the output meter, when the signal generator is tuned to the I. F. and the tuning condensers are tuned to the low frequency end of the broadcast band.

Adjust the signal generator and the receiver to 1400 k.c. Adjust the high frequency trimmers (a) to maximum reading of the output meter.

Adjust the signal generator and the receiver to 600 k.c. Adjust the low frequency trimmer (e) to maximum reading of the output meter.

Tune the receiver to band #2 (generally the first short wave band)

Adjust the signal generator and the receiver to the required frequency of band #2. Adjust the high frequency trimmers (b) to the maximum reading of the output meter.

Adjust the signal generator and the receiver to the required low frequency and adjust the low frequency trimmer to the maximum reading of the output meter.

The same procedure is followed with bands #3 and #4, the high frequency trimmers (c) and (d) are adjusted for maximum reading of the output meter in their respective bands.

NOTE: Keep output of the signal generator low in value, allowing just enough signal to give a readable induction on the output meter. Above frequencies do not apply to all receivers, check with manufacturers aligning data.

THE RATIO DETECTOR

The ratio detector, appearing first in RCA f-m receivers, is a device for converting a frequency modulated carrier to an audio signal, while at the same time offering a high degree of attenuation to any incident amplitude modulation. The relative insensitivity to amplitude variations, which is an inherent characteristic of ratio detectors, enables them to be used without the usual preceding limiter stage, thus affording the use of a high gain i-f stage instead of the low-gain limiter.

Theory of Operation

A brief review of the theory of the discriminator detector will help the serviceman to understand the action of the ratio detector.

Figure 1 portrays a conventional discriminator stage, and it can be seen that it consists essentially of two diode rectifiers which are differentially connected so that the d-c potentials across their respective load resistors are subtractive. These two d-c voltages (across R1 and R2 in Figure 1) are proportional to the a-c voltages applied to the diodes. The a-c voltage applied to each diode is the vector sum of E1 and the voltage across that half of L1 which is connected to the diode plate, as shown in the diagrams of Figure 4. E1 has practically the same amplitude and phase as the voltage across the tank in the limiter plate circuit. The current in this same tank circuit induces a voltage in L1, which causes a circulating current to flow in the resonant circuit composed of L1 and C1. E2 and E3 are the voltage drops which occur across each half of L1 as a result of this circulating current. When the carrier frequency is equal to the frequency at which the discriminator transformer is tuned (Fig. 4A), the a-c voltage applied to diode 1 equals that applied to diode 2, therefore the rectified voltages are equal and since they are bucking voltages, the output of the discriminator is zero.

When the carrier frequency increases during a half cycle of modulation, the phase relations between E1, E2 and E3 change in accordance with Figure 4B, and it is evident that the vector sum of the voltages applied to diode 2 exceeds the vector sum of the voltages applied to diode 1, resulting in a higher rectified voltage across R2 than across R1. The instantaneous difference of the rectified voltages appears as a negative voltage in the discriminator output. Figure 4C shows the condition occurring when the carrier frequency swings below the resonant frequency of the discriminator transformer, the end result being a positive voltage at the output of the discriminator.

The important fact in discriminator action is that the output voltage is proportional to the difference between Ediode 1 and Ediode 2. This is true because the d-c voltages appearing across R1 and R2 vary directly with Ediode 1 and Ediode 2, respectively, and the instantaneous output voltage is the difference between the rectified voltage drops.

In considering the effect of amplitude variation on discriminator output, refer again to the vector diagrams of Figure 4. An increase in the amplitude of the voltage applied to the discriminator would increase all of the vectors in the diagram proportionately. In other words, the effect would be as though the vector diagrams were enlarged photographically. It can be seen that while the phase relationships would remain the same, the difference between Ediode 1 and Ediode 2 would increase, so long as the frequency of the applied voltage differed even slightly from the receiver i-f. Thus components of amplitude modulation would be detected and passed on to the audio amplifier. Ordinarily, discriminators are preceded by limiters which remove most of the amplitude variation from the f-m carrier, but the discriminator itself is not a device capable of rejecting amplitude modulation, except when the instantaneous frequency of the applied carrier is exactly equal to the resonant frequency of the discriminator transformer. This condition occurs only twice in every modulation cycle.

Note that while an increase in the amplitudes of the vectors in Figure 4 results in a proportionate increase in the difference between Ediode 1 and Ediode 2 for off-resonant conditions, the ratio of Ediode 1 to Ediode 2 is a constant, as far as amplitude variations are concerned. Therefore, a detector responsive only to changes in the ratio of Ediode 1 to Ediode 2, and insensitive to changes in the difference between these voltages would be a detector capable not only of converting frequency variations to audio variations, but of rejecting any amplitude modulation. Such a detector is the ratio detector.

DISCRIMINATOR

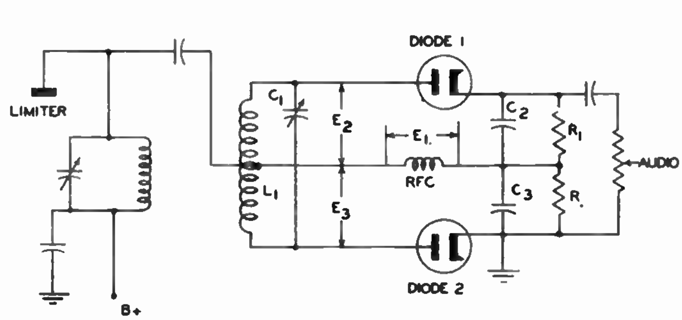


FIG. 1

RATIO DETECTOR

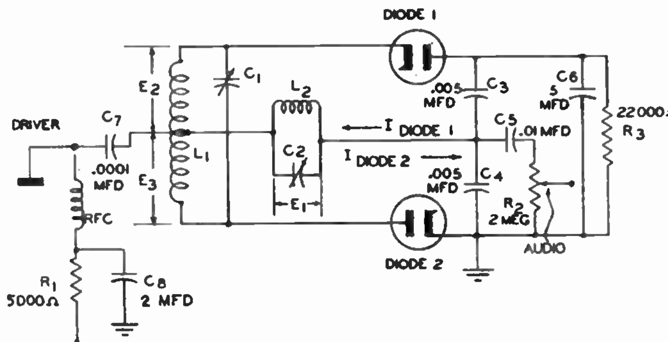


FIG. 2

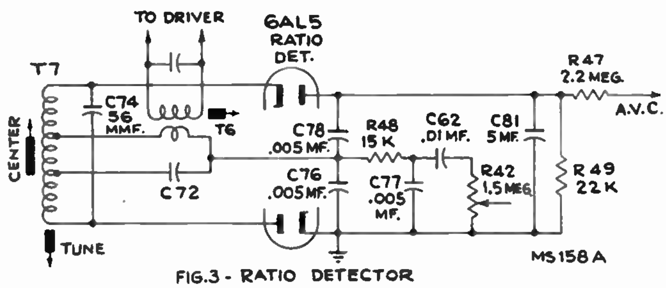
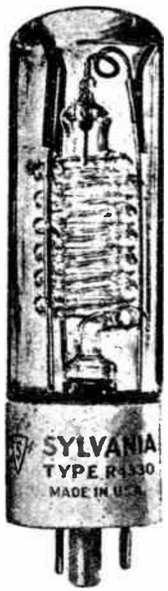


FIG.3 - RATIO DETECTOR

A schematic of the fundamental ratio detector is shown in Figure 2. C7 and C4 have very little reactance at the intermediate frequency, so it is evident that the parallel resonant circuit L2 C2 is the true load for the driver stage, this stage being shunt fed. A driver stage, in this case, is nothing more than a conventional i-f amplifier preceding the ratio detector. L2 is inductively coupled to L1, therefore a comparison of Figures 1 and 2 will show that as far as the a-c voltages applied to the diodes are concerned, these circuits are almost exactly similar, indeed, the same vector diagrams used in the analysis of Figure 1 can be used to portray the a-c voltages across the diodes in Figure 2. Here the similarity ends, because the ratio detector method of extracting intelligence from the f-m carrier differs greatly from previously used methods. Diode 1, R3, and diode 2 complete a series circuit fed by the a-c voltage across L1. Since the two diodes are in series, they will conduct on the same half cycle, and the rectified current through R3 will cause a negative potential to appear at the plate of diode 1. The time constant of R3 C6 is usually about 0.2 second, so that the negative potential at the plate of diode 1 will remain constant even at the lowest audio frequencies to be reproduced.

In servicing or experimenting with photoflash equipment, it must be remembered at all times that capacitors are charged at high voltages and very dangerous unless extreme care is taken to be sure they are properly discharged before touching terminals or leads.



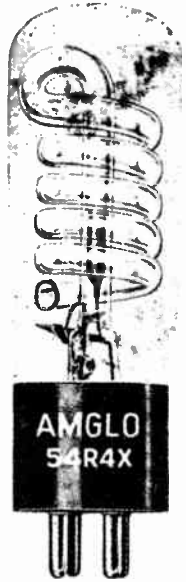


Fig. 2—A Sylvania R-4330 has the spiral glass discharge tube completely enclosed (left) and gas pressure may be higher than in the enclosing envelope. The Amglo 54R4X (right), however, secures comparable results with an open-end tube and the outer glass envelope filled with gas, as well as the tube.

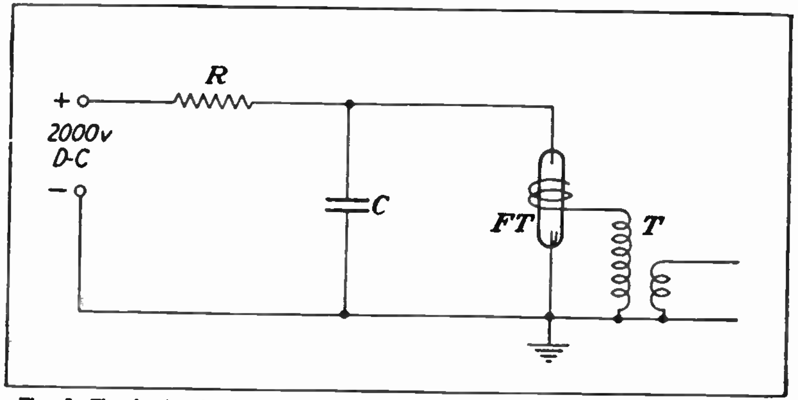


Fig. 5—The basic circuit used in G-E and Sylvania flashtubes. Gas in the tube is ionized by a high voltage between an external electrode and grounded terminal.

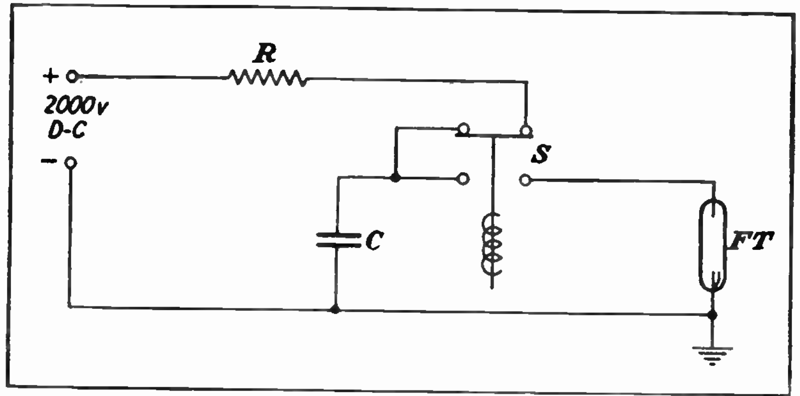


Fig. 3—Basic circuit of the flashtube with capacitor C charged from d-c source and discharged through relay S into the flashtube FT.

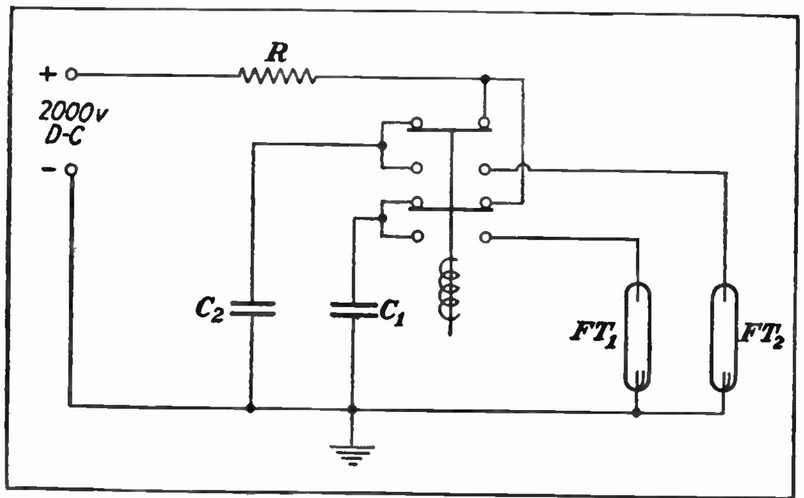


Fig. 4—Arrangement for charging capacitors in parallel but discharging them through individual flashtubes by means of a transfer relay.

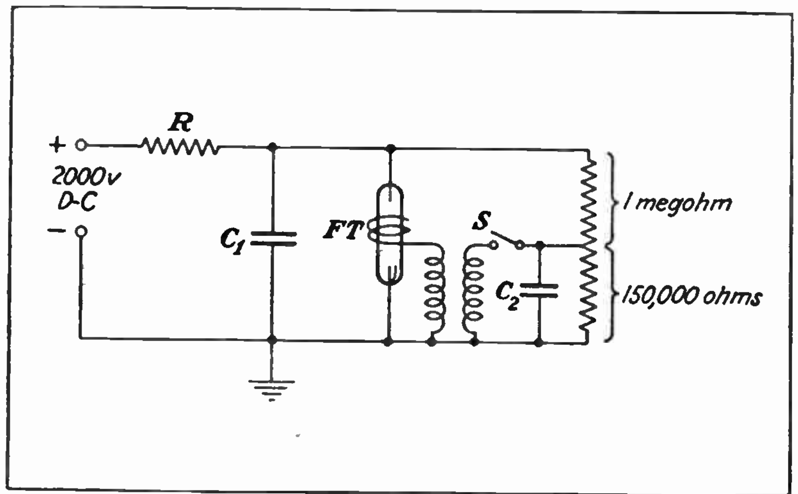


Fig. 6—Ionizing voltage may come instead from the discharge of a small condenser charged through a potentiometer from the main d-c supply.

SECTION IV

TV SERVICING with PICTURE TUBE PATTERNS

☆

Analysis of differences between abnormal and normal test patterns or television pictures often enables a serviceman to determine the kinds of troubles which may be causing the faulty reproduction. Many of the picture patterns that appear on TV receivers and the relation of these pictures to trouble shooting are described in this book.

On the following pages under the names ordinarily used to describe the appearance, due to faulty reproduction, are lists of troubles and photographs illustrating these abnormal patterns. The photographs have been provided through the courtesy of Allen B. DuMont Laboratories, Admiral Corporation, RCA, General Electric Company, Philco Corporation, Sentinel Radio Corporation and Radio Electronics Magazine.

Coyne definitely cautions any inexperienced individual against attempting to service a Television receiver. While certain adjustments for a better picture can be made from the "dials on the front" under no circumstances should anyone but a qualified TV serviceman attempt to service a television set. Even qualified servicemen are advised to observe the following precautions.

1. Extreme caution should be taken in handling the picture tube. The mounting of picture tube is usually constructed to provide adequate protection against implosion while the tube is in the receiver. Extreme caution is recommended when removal or installation of a picture tube is necessary. Here are several things to keep in mind.
2. Shut off power.
3. At no time rest the tube in the deflection yoke.
4. Wear heavy gloves and shatterproof glasses.
5. Advise everyone except qualified servicemen to stay at least 8 feet away from the set while the installing or removal of a picture tube is being done.

In any probing or testing in any part of the set it is recommended that (a) well insulated wire and hooded test clips be used; (b) use good test instruments with all lead wires adequately insulated for the voltages to be encountered. You should use extreme caution in working in or near the high voltage section; (c) do not take anything for granted—test everything—that is the only way to be sure.

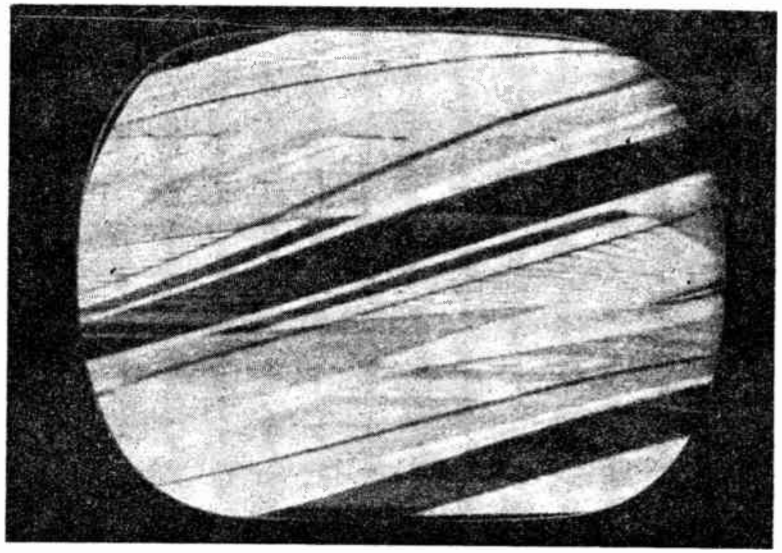


Fig. 131-3.—Bars, Sloping.

The bars change their degree of slope, their number, and their positions as the horizontal hold control is altered.

Causes for trouble.

Horizontal hold control incorrectly adjusted.

Faulty connections, resistors, or capacitors in circuits for horizontal hold control or for horizontal automatic control of sweep frequency.

See also troubles listed under *Movement, Horizontal.*

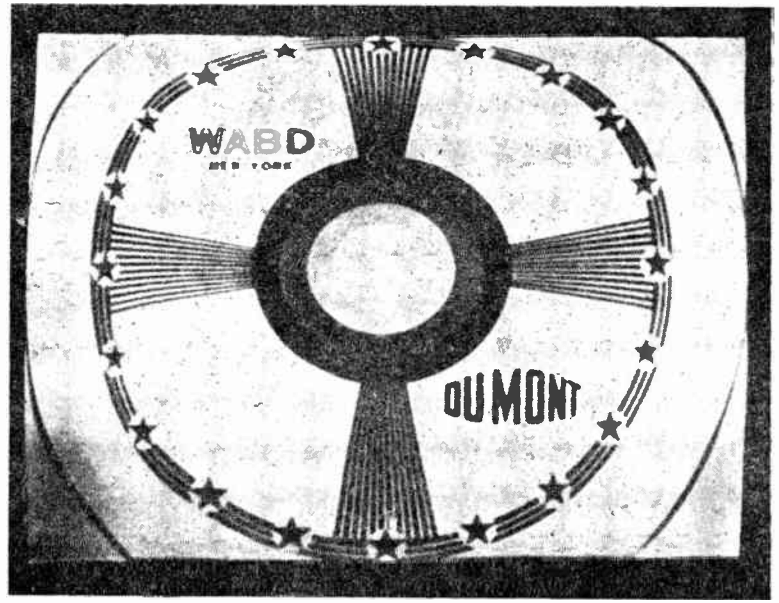


Fig. 131-16.—Linearity Poor, Vertical

With poor vertical linearity the pattern or picture is compressed or flattened from above, below, or from both directions.

Causes for trouble.

Vertical linearity control wrongly adjusted.

Defective capacitors or resistors, fixed or adjustable, in vertical linearity control circuits.

Vertical sweep oscillator tube defective, or supplied with wrong voltages.

Vertical sweep amplifier tube defective, or supplied with incorrect voltages.

Trouble in any parts which follow the vertical sweep oscillator, and which carry sawtooth voltages and currents.

Vertical sweep output transformer defective.

Shorted turns in a vertical deflection coil.

Poor filtering of low-voltage B-power supply.

FOLDS, HORIZONTAL. Figs. 8 and 9.

Only part of the picture or pattern is clearly recognizable, although more or less distorted and compressed horizontally. The remainder, usually less than half, appears to be stretched horizontally and folded back over the first portion. The folded part is indistinct, usually with only shadowy out-

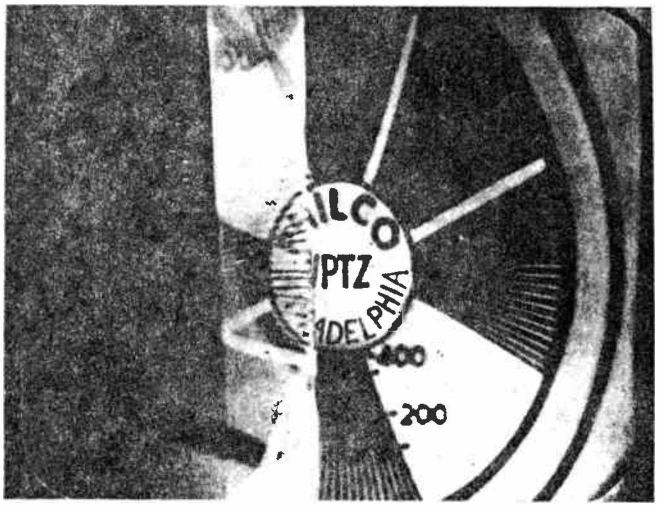


Fig. 8. The pattern is folded horizontally.

lines. There may be only one fold (Fig. 8) or there may be several (Fig. 9) to give the distinct portion of the picture a corrugated appearance.

The horizontal retrace time, due to discharge of the sawtooth capacitor in the horizontal oscillator-discharge tube circuit, actually is longer than the time allowed for horizontal retrace in received signals. The folded portions of pictures, which are indistinct and shadowy, occur during periods in which the picture tube beam should be blanked.

Damper Tube And Circuit.

Tube defective.

Capacitor on low-side circuit of damper open or disconnected.

Linearity control inductor in damper circuit shorted, otherwise defective of wrong type or wrong inductance.

Lead from horizontal output transformer and damper to the deflecting yoke has poor connections or is allowing leakage of current through faulty insulation.

Damper plate or cathode, depending on type of circuit, connected to a tap on the horizontal output transformer at which horizontal pulse voltages are not strong enough for rapid damping and retrace.

Boosted B-voltage to the horizontal output transformer and amplifier plate too low.

Frequency Control Circuits.

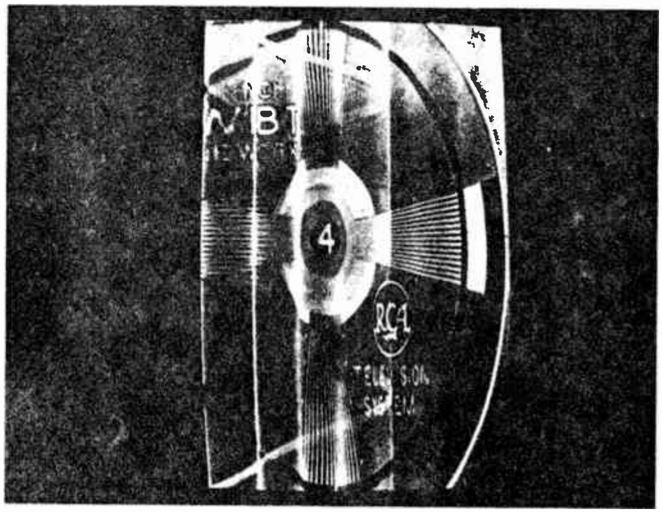


Fig. 9. One large horizontal fold and several minor ones.

Afc tube weak or otherwise defective.

Afc control misadjusted. This is a control which operates in the circuits of the afc tube, or between that tube and the horizontal oscillator.

Too much resistance in the grid return lead of the horizontal output amplifier.

Too much capacitance has been connected across part of the horizontal output transformer or across a width control inductor when increasing the width of pictures.

Unbalance in resistors on the two sections of a horizontal phase detector or discriminator, or resistors connected wrong.

Insufficient feedback to afc tube from horizontal sweep circuit. Series capacitor too small, or shunt capacitor too large. Series resistor too great, or shunt resistor too small. The feedback lead may be connected to the wrong point on the horizontal output transformer or other parts of the sweep circuits.

Vertical hold control fixed resistors or potentiometer of wrong values or defective.

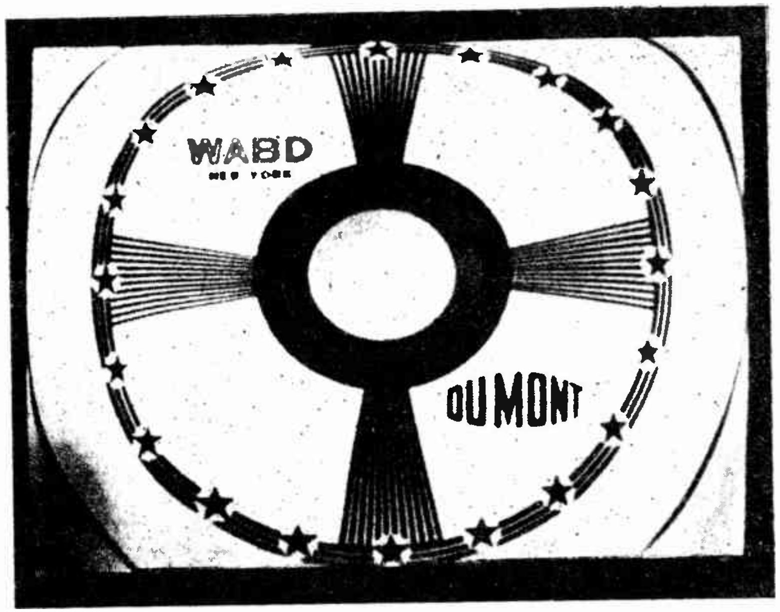


Fig. 131-16.—Linearity Poor, Vertical

With poor vertical linearity the pattern or picture is compressed or flattened from above, below, or from both directions.

Causes for trouble.

Vertical linearity control wrongly adjusted.

Defective capacitors or resistors, fixed or adjustable, in vertical linearity control circuits.

Vertical sweep oscillator tube defective, or supplied with wrong voltages.

Vertical sweep amplifier tube defective, or supplied with incorrect voltages.

Trouble in any parts which follow the vertical sweep oscillator, and which carry sawtooth voltages and currents.

Vertical sweep output transformer defective.

Shorted turns in a vertical deflection coil.

Poor filtering of low-voltage B-power supply.

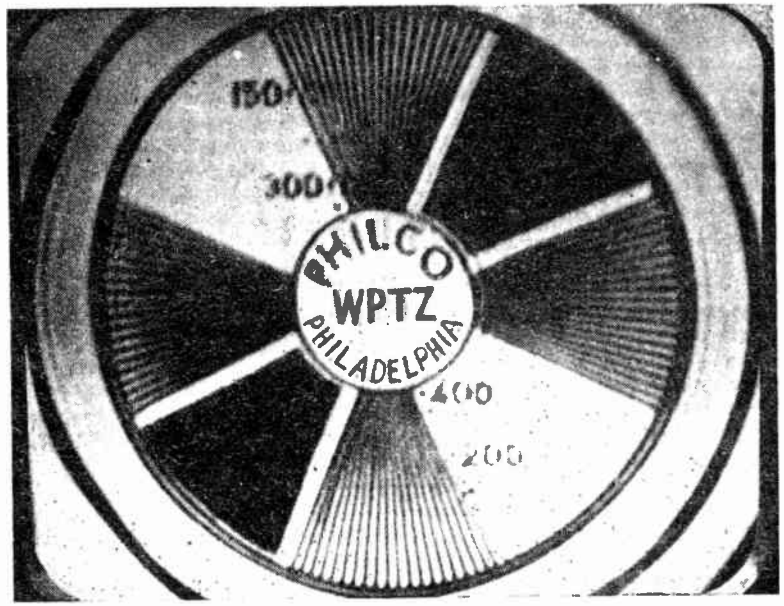


Fig. 131-13.—Ghosts.

There are multiple images in the test pattern or picture. The displaced images, of which there may be one or more, may be so close to the principal image or may be so faint as to cause only a blurring effect. In other cases the displaced images may be at a considerable fraction of inch from the principal image, and may be distinct.

Causes for trouble.

Part of the transmitted signal is being reflected from large conductive or semi-conductive objects, such as buildings, bridges, tanks, or steep hills, and the reflected portion is reaching the receiver antenna a fraction of a second later than the direct signal. Try rotating the receiving antenna to reject the reflected signal without too much loss of direct signal. Fit a reflector, and possibly also a director, on the antenna. Try the antenna in various locations.

Incorrect matching of impedances between antenna and transmission line, or between transmission line and receiver input. There are standing waves on the line. Use antenna and transmission line whose impedances match that of the receiver and of each other.

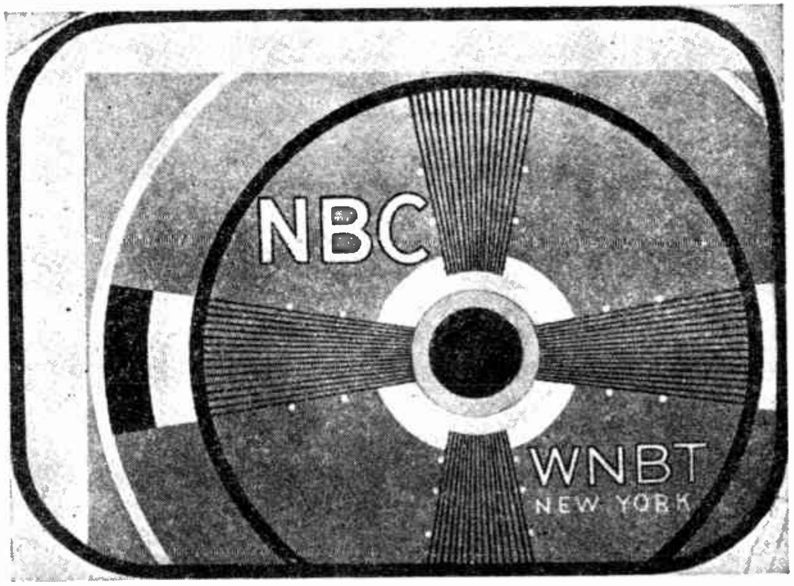


Fig. 131-6.—Centering Incorrect.

Picture or pattern may be too high or too low, incorrect vertical centering, or it may be too far to the right or left, incorrect horizontal centering, or there may be incorrect centering in both directions at once, as in the photograph.

Causes for trouble. Magnetic deflection.

Focusing control wrongly adjusted.

Ion trap magnet in wrong position on picture tube neck, or weak.

Horizontal hold control misadjusted.

Focusing coil axis direction requires adjustment. Should be in line with picture tube axis.

Focusing coil too far forward or back. Usually should be 1/4 to 3/8 inch from the deflection yoke.

Focusing coil short circuited.

Deflection yoke too far back on neck of picture tube, or not centered around neck.

Defective bypass capacitor on focusing control.

Causes for trouble. Electrostatic deflection.

Centering control or controls wrongly adjusted.

Horizontal hold control misadjusted.

Picture tube shield magnetized.

Leaky capacitor or capacitors between outputs of deflection amplifiers or oscillators and the picture tube deflection plates.

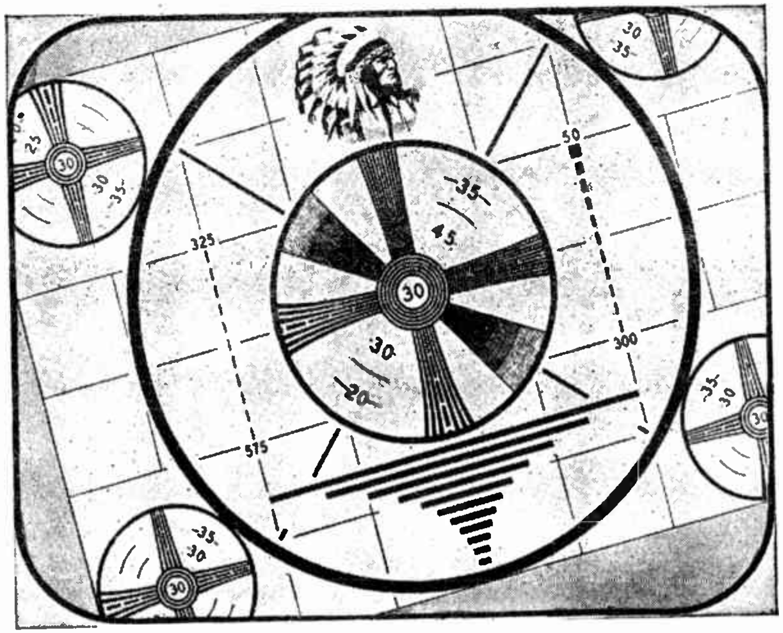


Fig. 131-30.—Tilting In Mask.

Causes for trouble.

Incorrect position of magnetic deflection yoke. Loosen the yoke fastening while rotating the yoke around the picture tube neck to straighten the pattern.

Incorrect position of electrostatic tube. Rotate the entire tube around its axis to straighten the pattern.

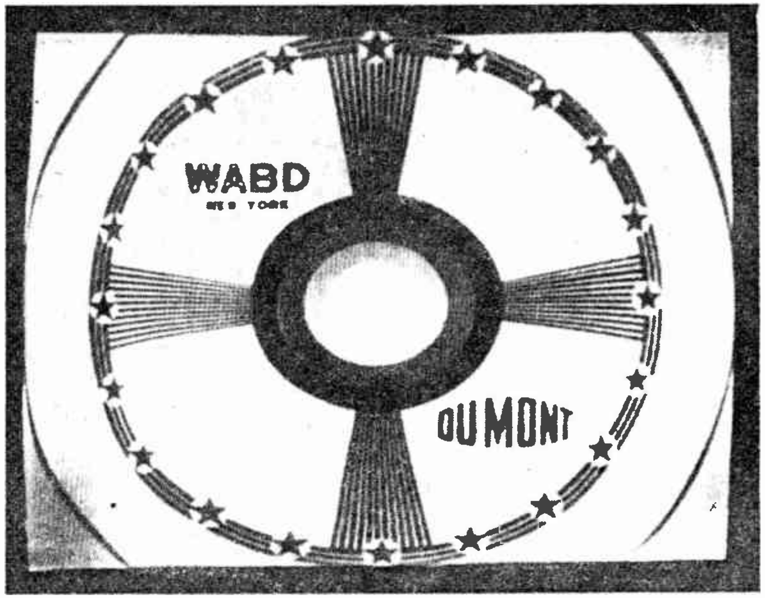


Fig. 131-18.—Lines, Narrow, Allover Pattern.

Due to beat interference from radio frequency and television frequency signals or voltages originating from outside or within the receiver. The number of cycles per second of the interfering frequency is equal approximately to the number of lines, either light or dark, but not both, multiplied by 15,750. The lines may lie vertically or diagonally on the picture tube screen. They weave or ripple and change their direction.

Causes for trouble.

Interference from f-m radio broadcasting stations operating in the area where the receiver is located. Change the direction of the receiving antenna. Tune an antenna trap to the interfering frequency. Check the transmission line for possible signal pickup.

Interference from nearby short-wave transmitters. Same remedies as for f-m interference.

Interference from television channels other than the one to which the receiver is tuned. Try adjusting the fine tuning control.

Beating frequency of 4.5 megacycles from sound section of a receiver having intercarrier sound system, or getting past the sound takeoff and reaching the picture tube grid cathode circuit through all or part of the video amplifier. Check dressing of all grid and plate leads following the takeoff.

Fig. 131-12.—Folded Pattern, Vertically.

Causes for trouble.

Vertical hold control incorrectly adjusted.

Faults in vertical hold control circuit causing vertical deflection frequency which is too high.

Waveforms

The preferred method of analyzing the operation of a TV receiver is through the use of an oscilloscope. The waveforms reproduced in this Section are typical of those found in a well-performing commercial receiver. It must be understood that circuit variations exist between different manufacturers and that the waveforms obtained will be dependent upon these circuit variations as well as the signal conditions and the quality of the oscilloscope being used.

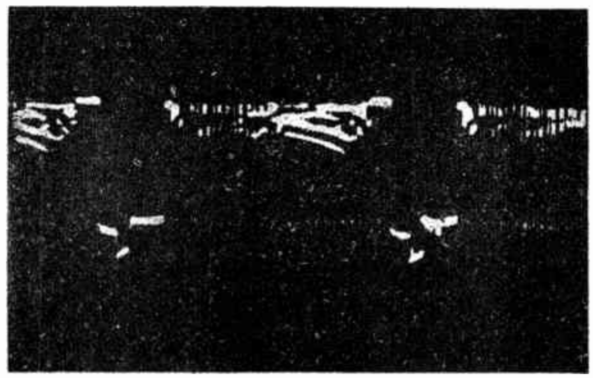


Fig. 139-1.

Fig. 139-1: Taken at the top of the video detector load resistor. This is the output of the video detector and the input to the grid circuit of the video amplifier. Here appears the entire composite television signal with picture variations, positive, at the top and with sync pulses, negative, at the bottom. Two vertical blanking intervals are plainly visible between the fields. During each blanking interval there appear in order, from left to right, the equalizing pulses which follow one field, then the vertical sync pulses at the bottommost points along the trace, and finally the remaining equalizing and horizontal sync pulses which precede the next field.

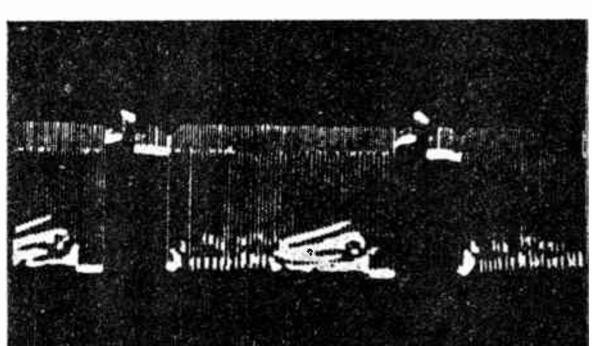


Fig. 139-2.

Fig. 139-2: Taken at the plate of the video amplifier tube. Here again is the complete compositive signal, but now the polarity has been inverted to make sync pulses positive and picture variations negative. This waveform is applied to the cathode of the picture tube, which is the point of signal input to the picture tube of this particular receiver.

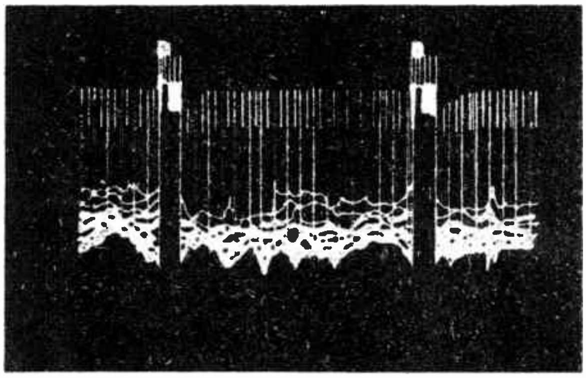


Fig. 139-3.

Fig. 139-3: Taken at the grid of the first tube in the sync section, which is a sync amplifier. The signal shown here comes from the output of the video amplifier, and accordingly is of the same polarity and has the same general characteristics as shown in Fig. 139-2.

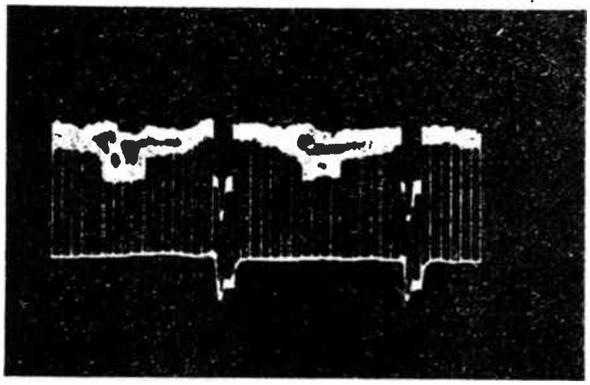


Fig. 139-4.

Fig. 139-4: Taken at the plate of the sync amplifier tube. The polarity has been inverted with respect to polarity in Fig. 139-3. The peak-to-peak voltage of this amplifier output waveform actually is about four times as great as voltage at the input to the tube.

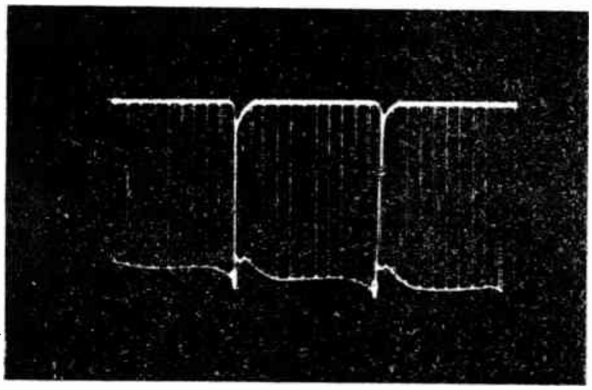


Fig. 139-5.

Fig. 139-5: Taken at the plate of the second tube in the sync section, which is operated as a separator. Picture variations have all but disappeared from the signal, while the vertical sync pulses have been retained. Polarity has not been inverted, because signal input is to the cathode rather than the grid of this separator.

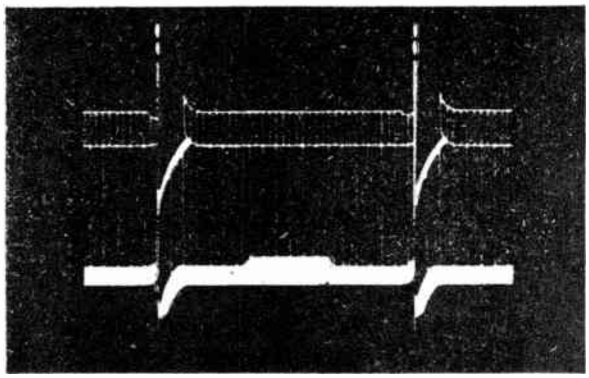


Fig. 139-6.

Fig. 139-6: Taken at the plate of the third tube in the sync section, which is operated as a clipper. Polarity has been inverted with respect to that of Fig. 139-5. Vertical sync pulse voltage peaks have become very pronounced. This is the signal which goes to the integrating filter located between the sync clipper and the input for the vertical sweep oscillator.

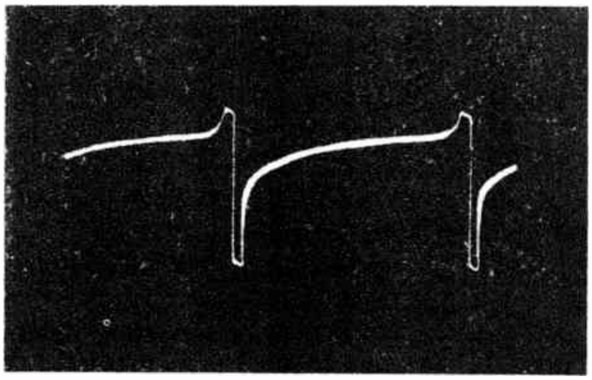


Fig. 139-7.

Fig. 139-7: Taken at the grid of the vertical sweep oscillator, which is a blocking type. Note the sudden changes of potential in the negative direction, downward on the trace, as the oscillator blocks. Then comes the quick partial recovery in the positive direction and the more gradual change preceding the positive peak that triggers this oscillator.

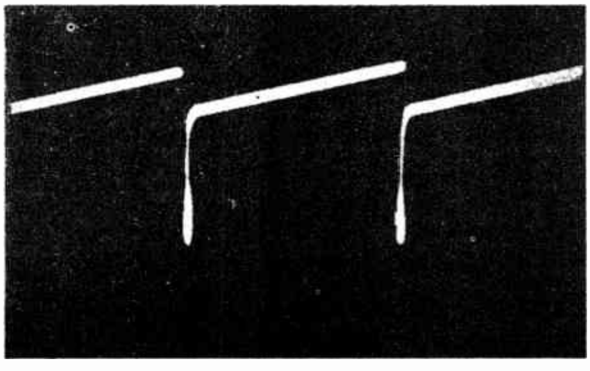


Fig. 139-8.

Fig. 139-8: Taken at the grid of the vertical sweep amplifier which follows the vertical oscillator. This is the sawtooth voltage combined with negative (downward) peaks as required for magnetic deflection.

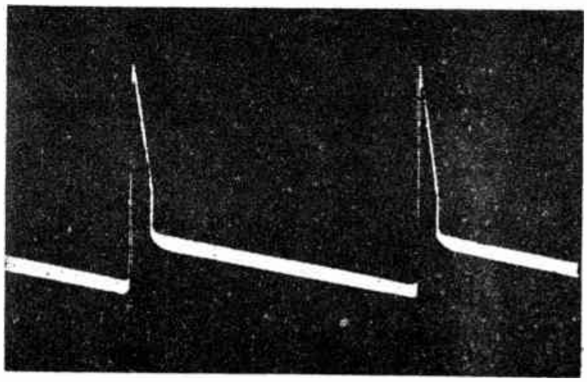


Fig. 139-9.

Fig. 139-9: Taken at the plate of the vertical sweep amplifier. Polarity has been inverted with respect to the previous trace, taken at the grid of the same tube. Peak-to-peak voltage here is about 18 times as great as at the grid.

Fig. 139-10: This final trace for the vertical deflection system is taken from the circuit which includes the secondary winding of the vertical output transformer and the two ver-

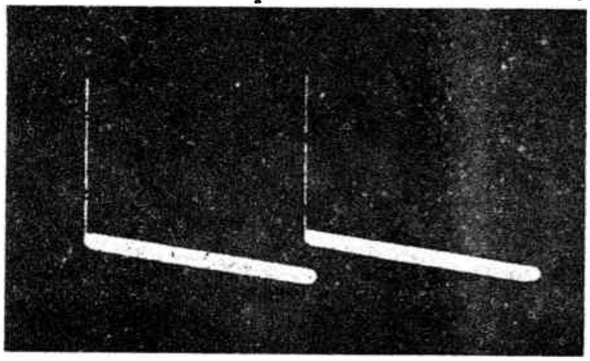


Fig. 139-10.

tical deflection coils of the yoke on the picture tube. Peak-to-peak voltage is between one-ninth and one-tenth of that at the plate of the vertical sweep amplifier, which connects to the primary of the output transformer.

Traces which are to follow in Figs. 139-11 to 139-24 are taken with the internal sweep of the oscilloscope adjusted for 7,875 cycles per second or to the frequency which produces two horizontal line periods.

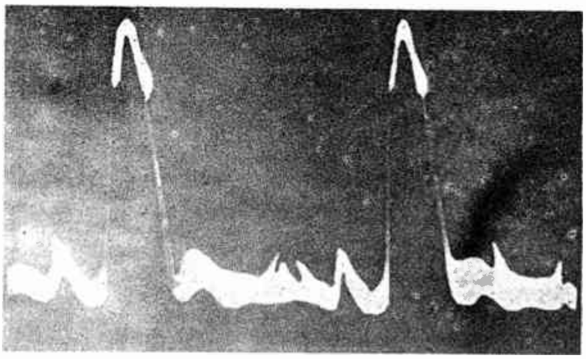


Fig. 139-12.

Fig. 139-12: From the plate of the video amplifier tube. Except for inversion of polarity this trace is similar to the one taken from the grid of this tube. Peak-to-peak voltage has been increased about nine times.

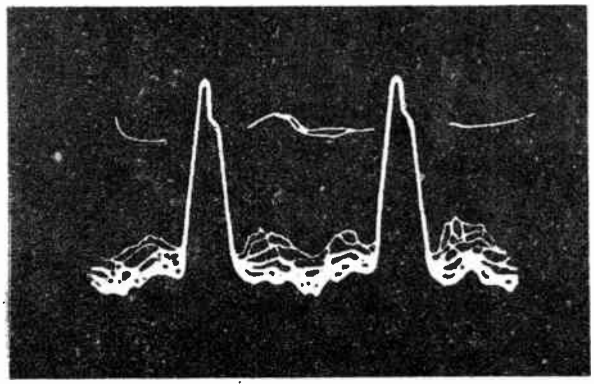


Fig. 139-13.

Fig. 139-13: From the grid of the sync amplifier, the first tube in the sync section. This signal comes from the output of the video amplifier, and is of the same polarity as in Fig. 139-12.

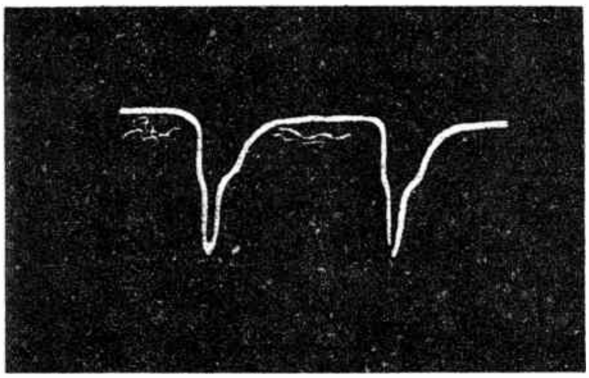


Fig. 139-14.

Fig. 139-14: From the plate of the sync amplifier. Polarity has been inverted. Voltages for picture variations have very nearly disappeared, while horizontal sync pulses have become distinct.

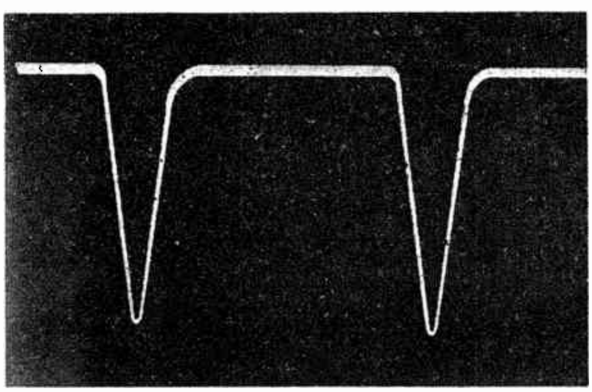


Fig. 139-15.

Fig. 139-15: From the plate of the sync separator tube. Only the horizontal sync pulses now remain. There has been no inversion of polarity, due to use of cathode input to this tube.

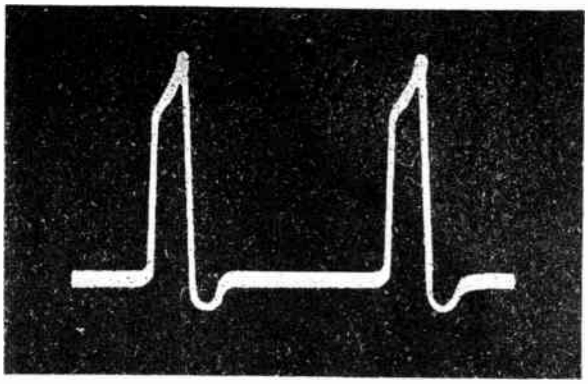


Fig. 139-16.

Fig. 139-16: From the plate of the sync clipper tube. This waveform is the input to the differentiating filter located between the clipper and the horizontal oscillator control tube of the horizontal afc system.

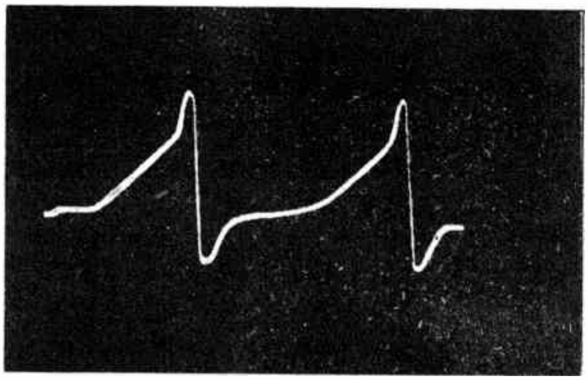


Fig. 139-17.

Fig. 139-17: From the top (ungrounded side) of the lock-in control capacitor in the grid circuit of the control tube of the horizontal afc system. This voltage results from combination of the output from the differentiating filter and a feedback voltage from the horizontal sweep output circuit, as required for this method of oscillator control. The waveform shown here is taken while a transmitted television signal is being received. The sharp or narrow positive peaks represent synchronizing voltages which result from horizontal sync pulses in the signal.

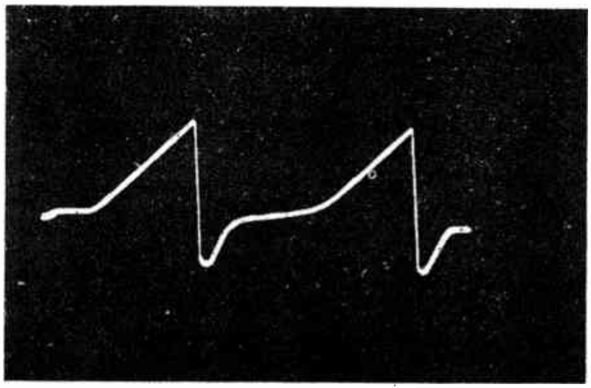


Fig. 139-18.

Fig. 139-18: This is the same as the previous trace, except that it is taken while no transmitted signal is being received. Note the absence of positive synchronizing peaks at the tops of the sawtooth portions of the wave.

SECTION VI

Typical Schematic Diagrams

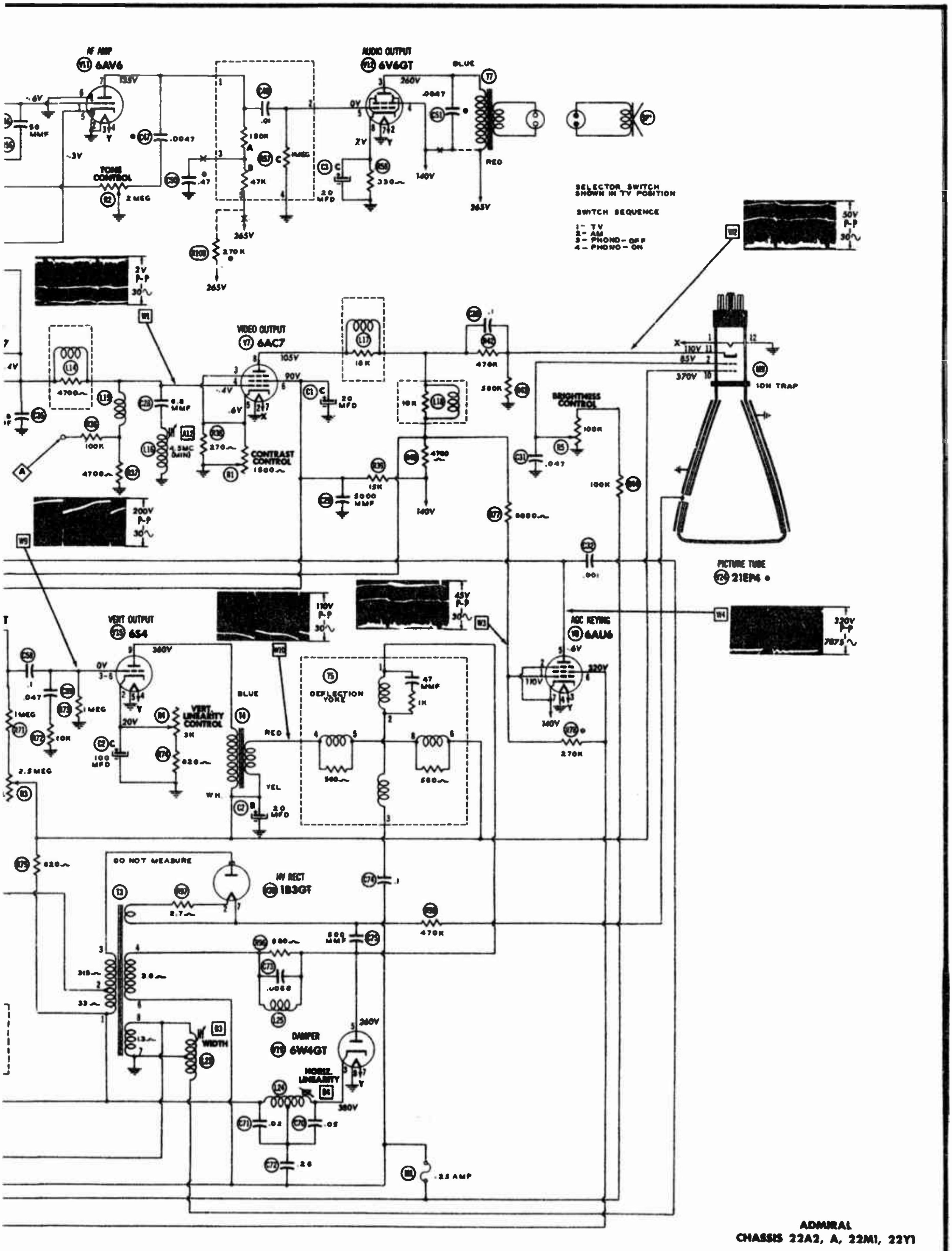
The Radio and Television diagrams reproduced here are Photo Fact Standard Notation Schematics (*) prepared by the Howard W. Sams & Co. Inc. These diagrams appear regularly in Photo Fact Folders (†) as a part of the complete service data furnished by the Howard W. Sams & Co. Inc. The sets of Photo Fact Folders are sold by Electronics Parts Distributors in all sections of the world and the diagrams are reproduced in this brochure as typical of the finest type of data available for service purposes.

The diagrams are arranged alphabetically by name of set; ADMIRAL, AIRLINE, BENDIX, etc. Diagrams on several dozen of the most popular TV sets in the country are included in this section.

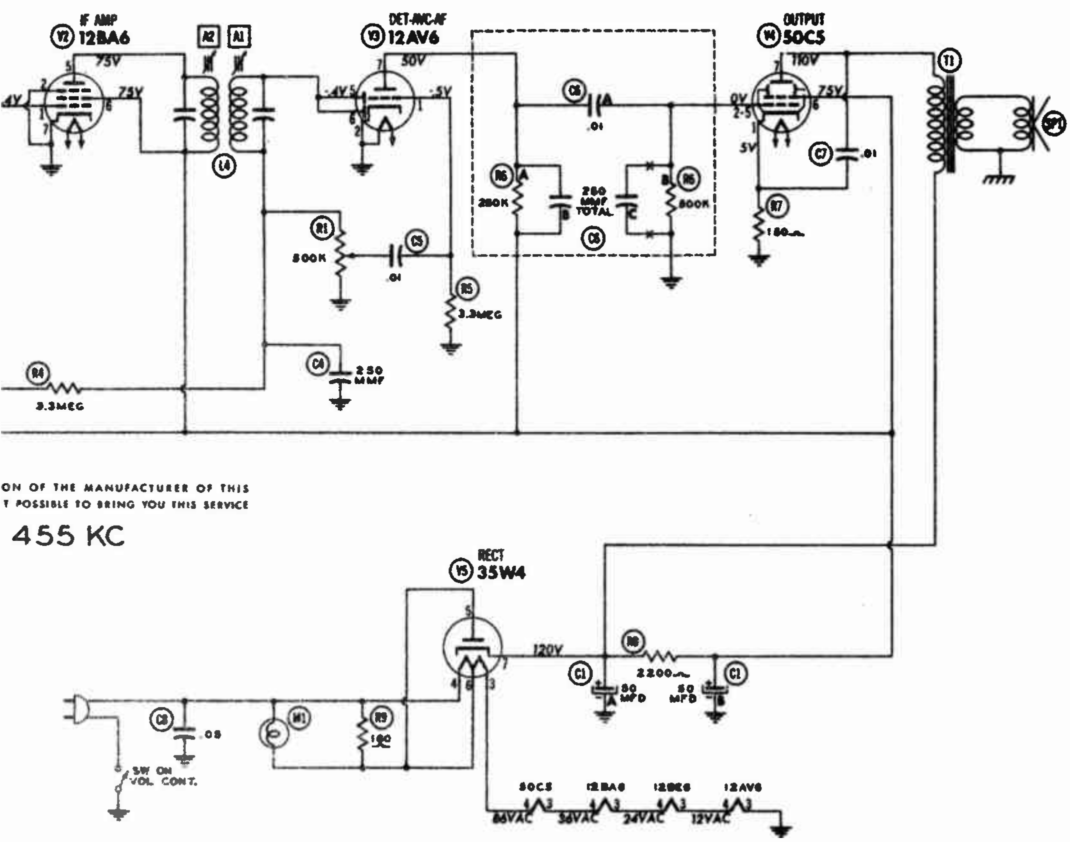
*Copyright
†Trade Mark

INDEX

COYNE



ADMIRAL
CHASSIS 22A2, A, 22M1, 22Y1



RESISTANCE READINGS

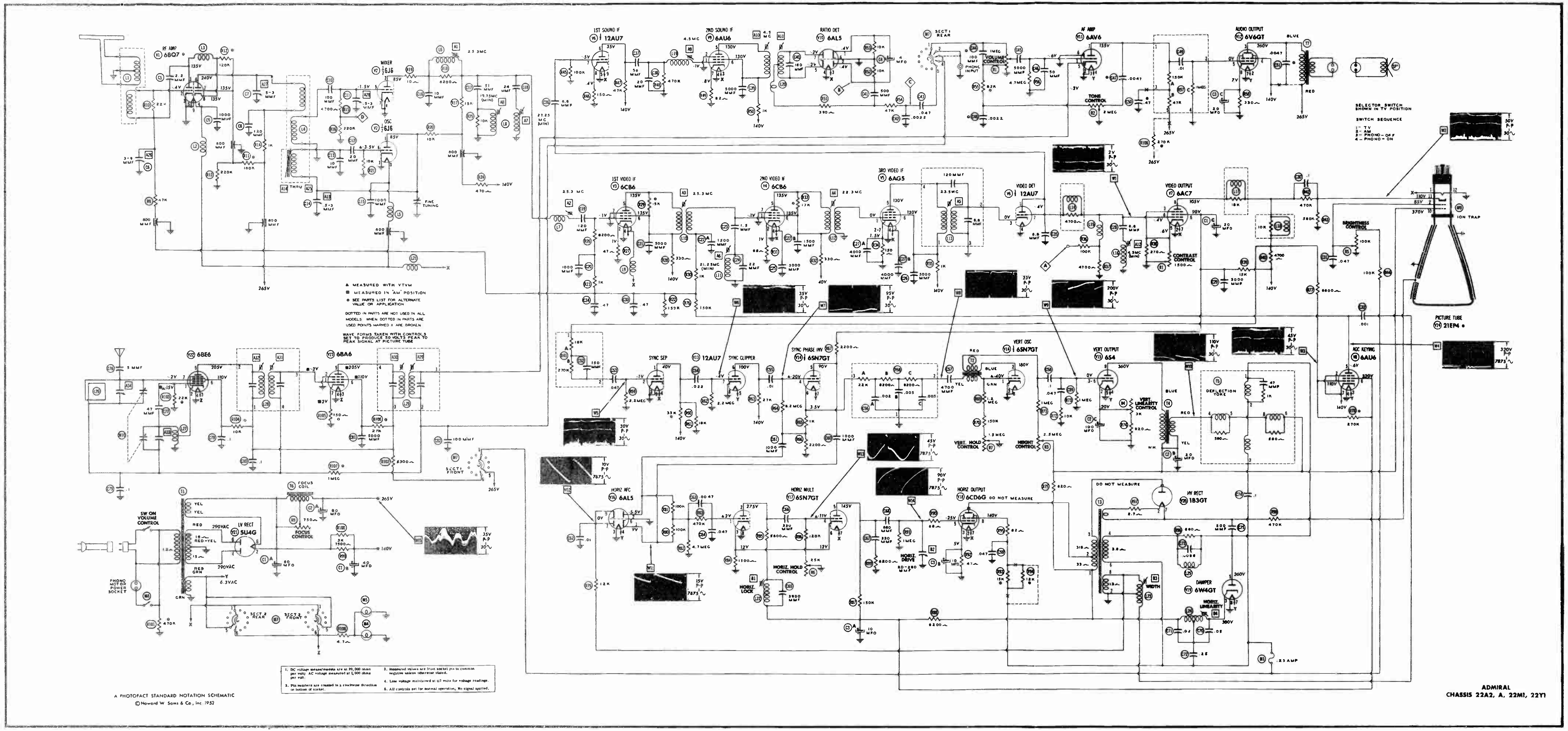
1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
	.8Ω	12Ω	24Ω	†2.2KΩ	†2.2KΩ	4.8Meg
g	0Ω	24Ω	36Ω	†2.2KΩ	†2.2KΩ	0Ω
g	0Ω	0Ω	12Ω	500KΩ	500KΩ	†250KΩ
	500KΩ	36Ω	86Ω	500KΩ	†2.2KΩ	†265Ω
	0Ω	86Ω	121Ω	105Ω	105Ω	60KΩ

† MEASURED FROM PIN 7 OF V5

TAKEN WITH VACUUM TUBE VOLTMETER

174-3

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.


RF AMP 6BQ7
MIXER 6J6
OSC 6J6
1ST SOUND IF 12AU7
2ND SOUND IF 6AU6
RATIO DET 6AL5
AF AMP 6AV6
AUDIO OUTPUT 6V6GT
SELECTOR SWITCH SHOWN IN TV POSITION
SWITCH SEQUENCE
1 - TV
2 - AM
3 - PHONO - OFF
4 - PHONO - ON
1ST VIDEO IF 6CB6
2ND VIDEO IF 6CB6
3RD VIDEO IF 6AG5
VIDEO DET 12AU7
VIDEO OUTPUT 6AC7
ION TRAP
BRIGHTNESS CONTROL
CONTRAST CONTROL
VOLUME CONTROL
TONE CONTROL
FINE TUNING
PICTURE TUBE 21EP4
AGC KEYING 6AU6
▲ MEASURED WITH VTVM
■ MEASURED IN "AM" POSITION
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 30 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
6BE6
6BA6
SYNC SEP 12AU7
SYNC CLIPPER
SYNC PHASE INV 6SN7GT
VERT OSC 6SN7GT
VERT OUTPUT 6S4
VERT LINEARITY CONTROL
VERT. HOLD CONTROL
HEIGHT CONTROL
DEFLECTION YOKE
SW ON VOLUME CONTROL
LV RECT 5U4G
FOCUS COIL
FOCUS CONTROL
PHONO MOTOR POWER SOCKET
HORIZ AFC 6AL5
HORIZ MULT 6SN7GT
HORIZ. HOLD CONTROL
HORIZ. LOCK
HORIZ DRIVE
HORIZ OUTPUT 6CD6G DO NOT MEASURE
DO NOT MEASURE
HV RECT 1B3GT
DAMPER 6W4GT
HORIZ. LINEARITY
WIDTH
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
A PHOTOFACT STANDARD NOTATION SCHEMATIC
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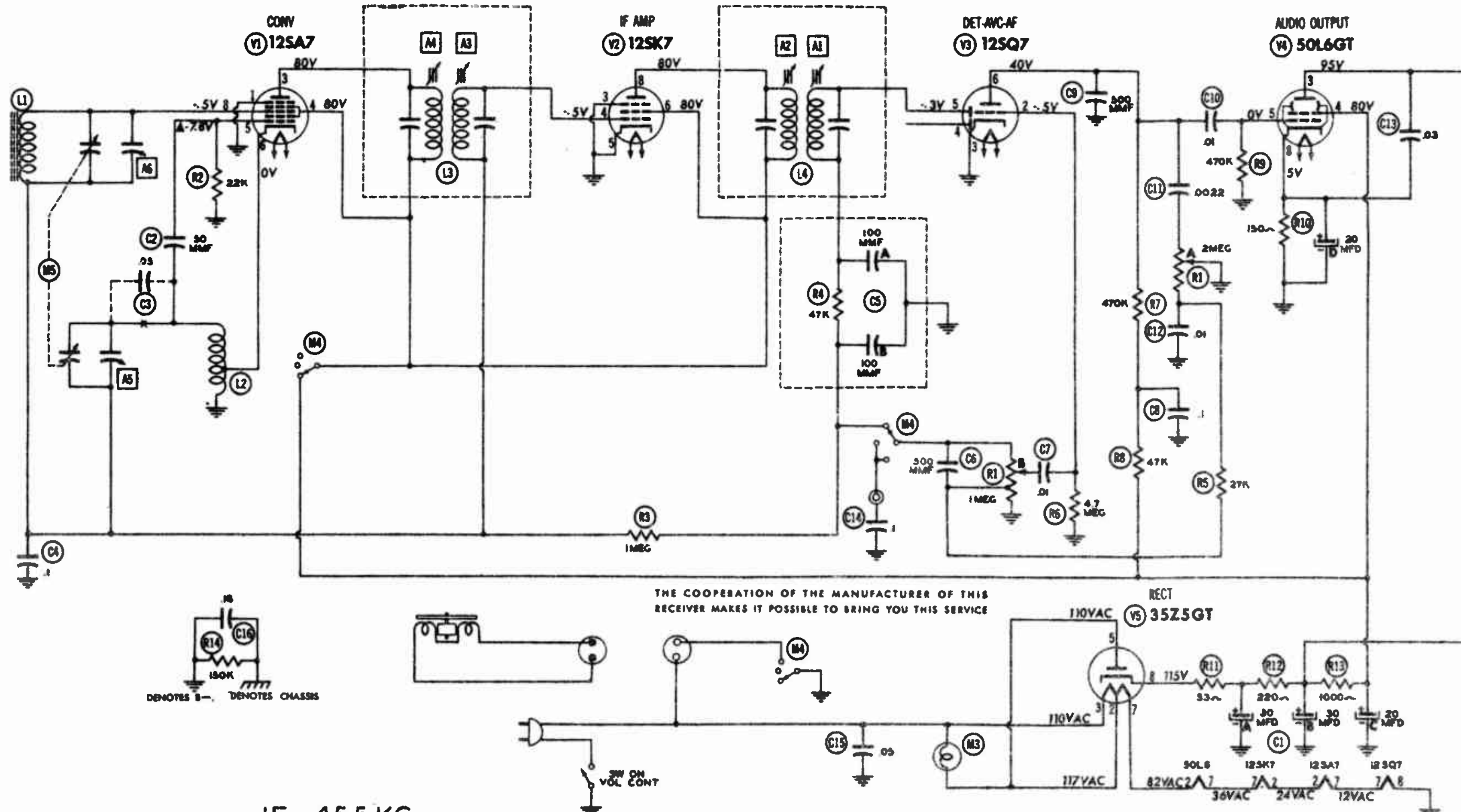
ADMIRAL
CHASSIS 22A2, A, 22M1, 22Y1



IF=455KC

FUNCTION SWITCH SHOWN IN "RADIO" POSITION.
SWITCH SEQUENCE:
1. RADIO
2. PHONO (MOTOR OFF)
3. PHONO (MOTOR ON)

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	12SA7	10Ω	24Ω	†1.2KΩ	†1.2KΩ	22KΩ	.8Ω	12Ω	1.8Meg
V 2	12SK7	90Ω	24Ω	0Ω	1.8Meg	0Ω	†1.2KΩ	36Ω	†1.2KΩ
V 3	12SQ7	90Ω	4.7Meg	0Ω	INF	500KΩ	†510KΩ	12Ω	0Ω
V 4	50L6GT	INF	88Ω	†463Ω	†1.2KΩ	470KΩ	†148KΩ	36Ω	150Ω
V 5	35Z5GT	INF	12Ω	113Ω	121Ω	113Ω	†35Ω	86Ω	25KΩ

ALL MEASUREMENTS TAKEN IN RADIO POSITION ONLY
† MEASURED FROM PIN 8 OF V5
▲ TAKEN WITH VACUUM TUBE VOLTMETER
¶ MEASURED FROM CHASSIS

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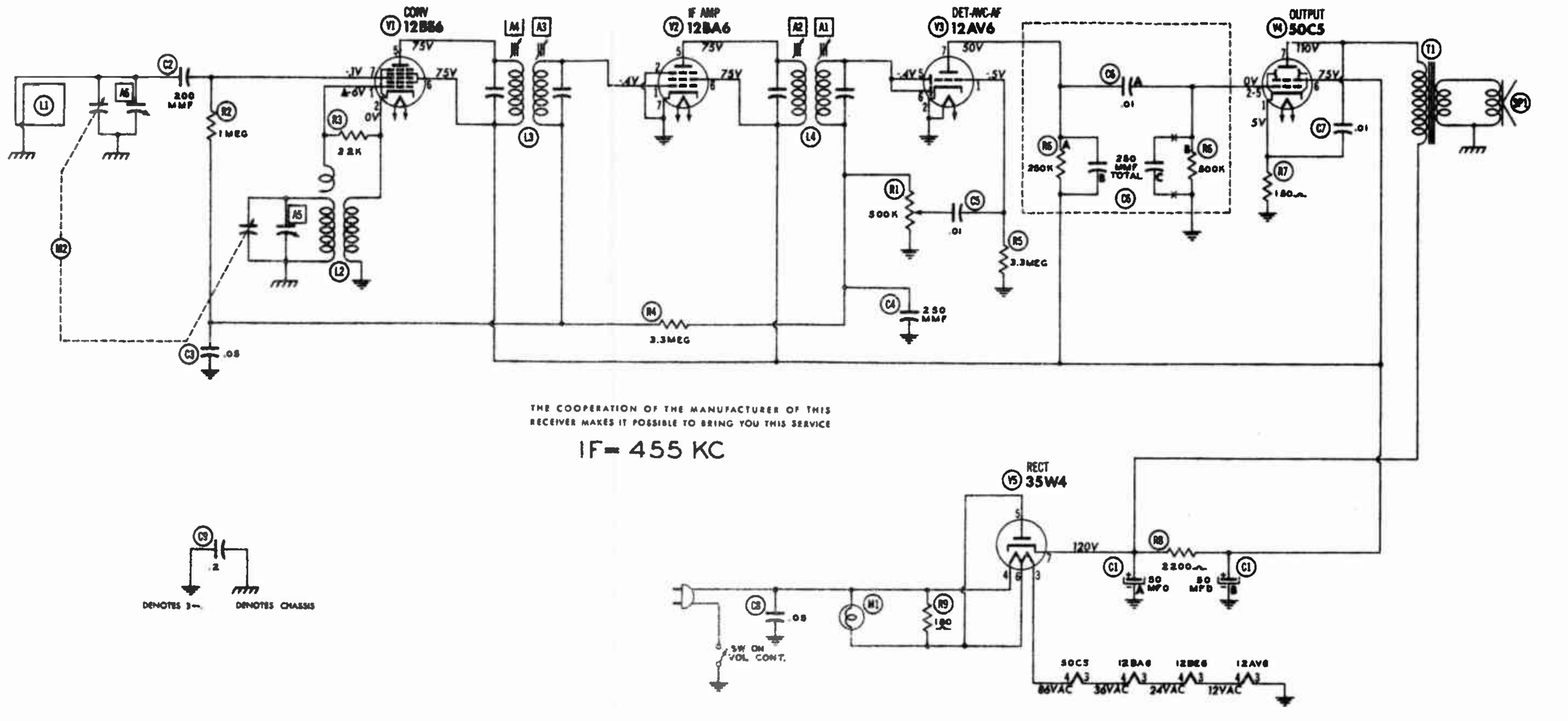
ADMIRAL - 5Y22 (5Y2)

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	12BE6	22KΩ	.8Ω	12Ω	24Ω	†2.2KΩ	†2.2KΩ	4.8Meg
V 2	12BA6	3.8Meg	0Ω	24Ω	36Ω	†2.2KΩ	†2.2KΩ	0Ω
V 3	12AV6	3.3Meg	0Ω	0Ω	12Ω	500KΩ	500KΩ	†250KΩ
V 4	50C5	150Ω	500KΩ	36Ω	86Ω	500KΩ	†2.2KΩ	†265Ω
V 5	35W4	0Ω	0Ω	86Ω	121Ω	105Ω	105Ω	60KΩ

† MEASURED FROM PIN 7 OF V5
▲ TAKEN WITH VACUUM TUBE VOLTMETER

AIRLINE - 25 GSE 1555A
25 GSE 1556A

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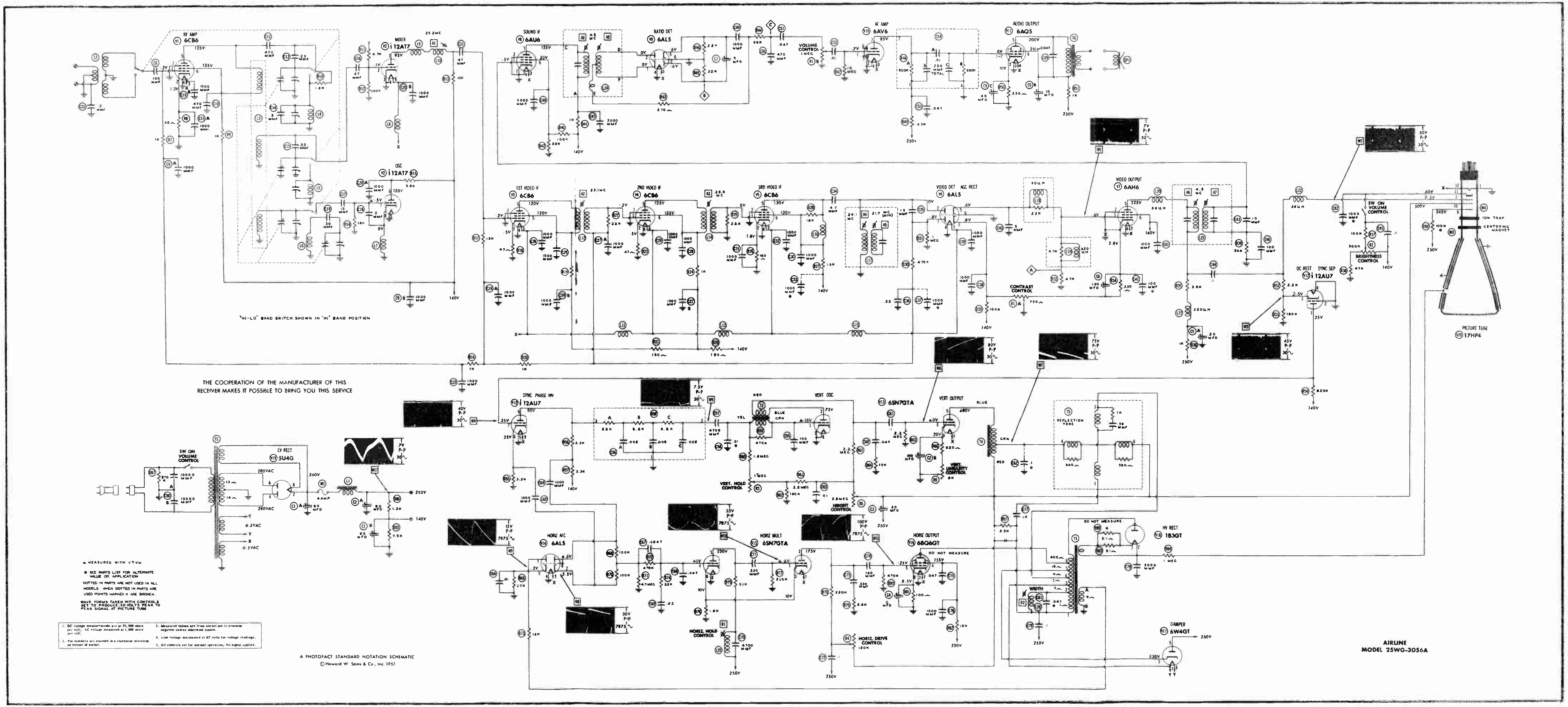
1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.


RF AMP 6CB6
MIXER 12AT7
OSC 12AT7
SOUND IF 6AU6
RATIO DET 6AL5
AF AMP 6AV6
AUDIO OUTPUT 6AQ5
1ST VIDEO IF 6CB6
2ND VIDEO IF 6CB6
3RD VIDEO IF 6CB6
VIDEO DET AGC RECT 6AL5
VIDEO OUTPUT 6AH6
DC REST SYNC SEP 12AU7
PICTURE TUBE 17HP4
SYNC PHASE INV 12AU7
VERT OSC
VERT OUTPUT
6SN7GTA
LV RECT 5U4G
HORIZ AFC 6AL5
HORIZ MULT 6SN7GTA
HORIZ OUTPUT 6BQ6GT
HV RECT 1B3GT
DAMPER 6W4GT
VOLUME CONTROL
CONTRAST CONTROL
SW ON VOLUME CONTROL
BRIGHTNESS CONTROL
VERT. HOLD CONTROL
HEIGHT CONTROL
VERT LINEARITY CONTROL
HORIZ. HOLD CONTROL
HORIZ. DRIVE CONTROL
WIDTH
DEFLECTION YOKE
ION TRAP
CENTERING MAGNET
DO NOT MEASURE
"HI-LO" BAND SWITCH SHOWN IN "HI" BAND POSITION
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
▲ MEASURED WITH VTVM
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
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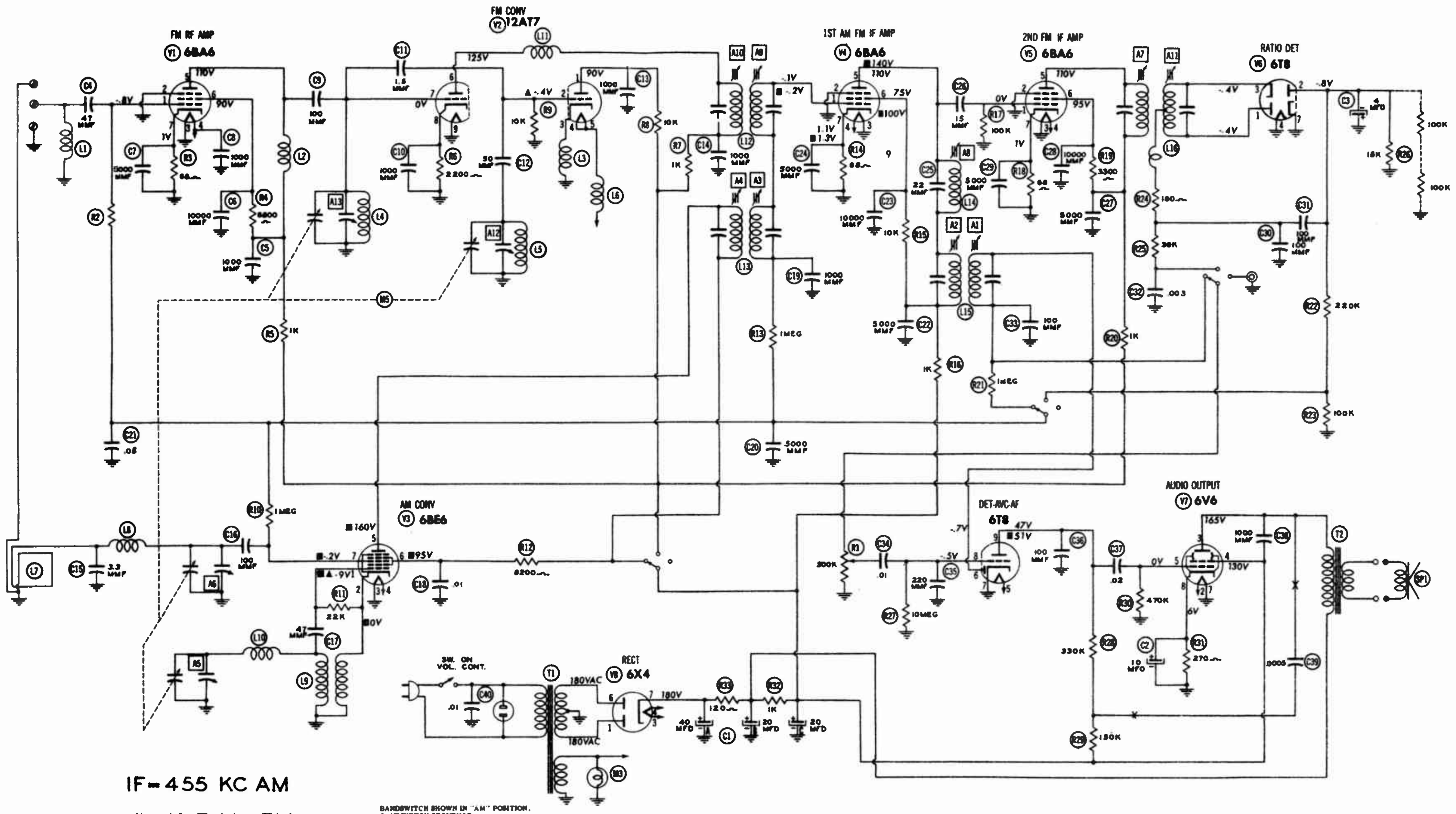
AIRLINE
MODEL 25WG-3056A



IF = 455 KC AM

IF = 10.7 MC FM

BANDSWITCH SHOWN IN "AM" POSITION.
BANDSWITCH SEQUENCE

1. AM
2. FM
3. PHONO

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V 1	6BA6	1.2Meg	0Ω	0Ω	.1Ω	†2.1KΩ	†10KΩ	0Ω		
V 2	12AT7	†12KΩ	10KΩ ▲	.1Ω	.0Ω	.0Ω	†2.1KΩ	0Ω	2.2KΩ	0Ω
V 3	6BE6	22KΩ	.0Ω	0Ω	.1Ω	●1.1KΩ	●9.5KΩ	●2.5Meg		
V 4	6BA6	1.2Meg ●2.5Meg	0Ω	0Ω	.1Ω	†2.1KΩ	†12KΩ	0Ω		
V 5	6BA6	100KΩ	0Ω	0Ω	.1Ω	†2.1KΩ	†5.4KΩ	0Ω		
V 6	6T8	540KΩ	10KΩ	540KΩ	0Ω	.1Ω	●500KΩ	0Ω	10Meg	2400KΩ
V 7	6V6GT	INF	.1Ω	†300Ω	†1.1KΩ	470KΩ	INF	0Ω	170Ω	
V 8	6X4	170Ω	†1.1KΩ	0Ω	.1Ω	†1.1KΩ	180Ω	60KΩ		

▲ TAKEN WITH VACUUM TUBE VOLTMETER
ALL MEASUREMENTS TAKEN IN FM POSITION
† MEASURED FROM PIN 7 OF V8
● MEASURED IN AM POSITION

THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.

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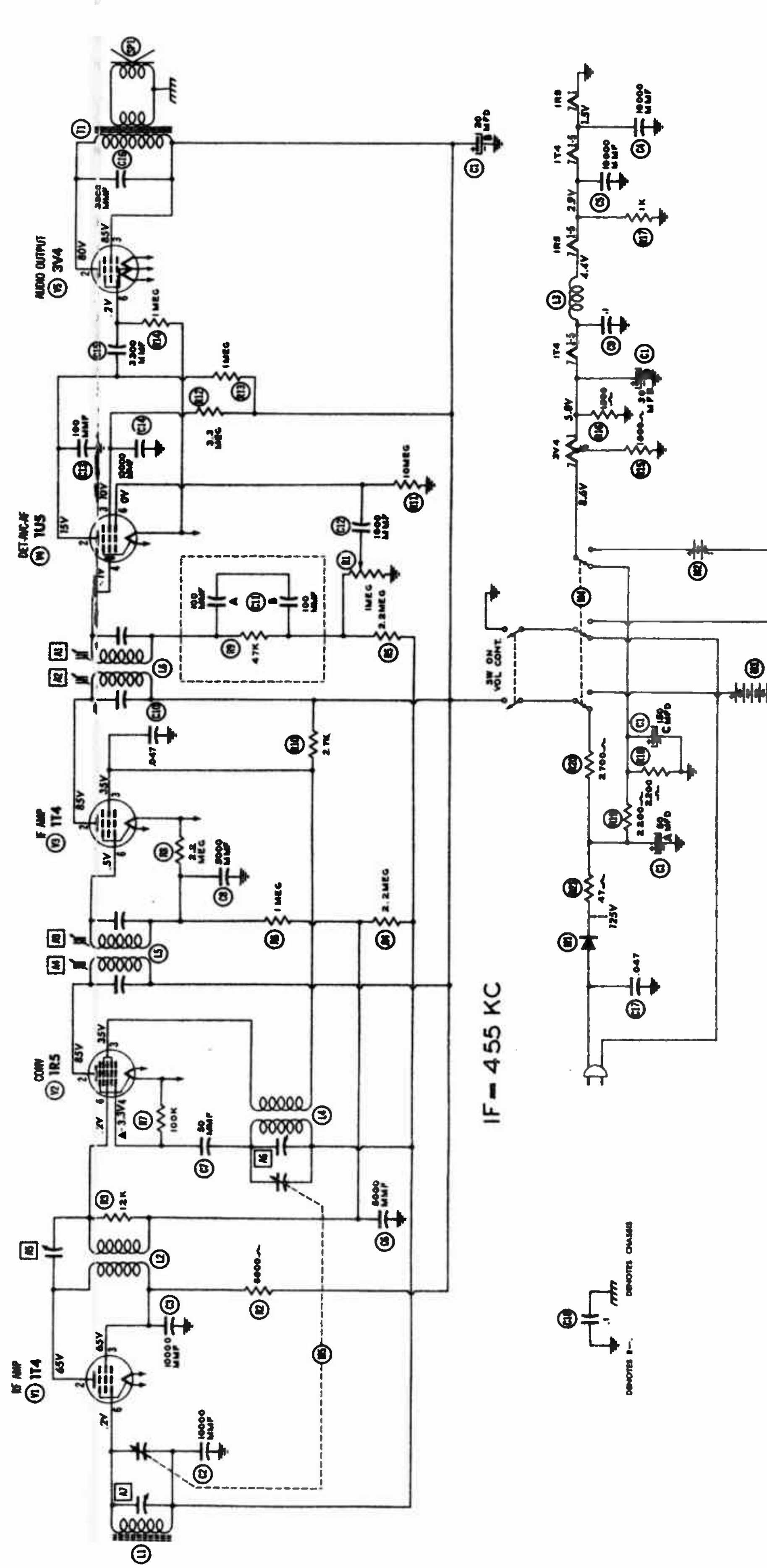
ARVIN - 582 CFB, CFM (CH. RE - 310)



IF = 455 KC

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	1T4	*	†9.5KΩ	†9.5KΩ	0Ω	*	2Meg	*
V 2	1R5	*	†2.7KΩ	†30KΩ	100KΩ	*	2Meg	*
V 3	1T4	*	†2.7KΩ	†30KΩ	0Ω	*	1.1Meg	*
V 4	1U5	*	†1Meg	†3.3Meg	1Meg	1Meg	10Meg	*
V 5	3V4	*	†2.9KΩ	†2.7KΩ	INF	*	1Meg	*

ALL MEASUREMENTS TAKEN WITH POWER CHANGEOVER SWITCH IN AC POSITION
† MEASURED FROM OUTPUT OF M
▲ TAKEN WITH VACUUM TUBE VOLTMETER
* DO NOT USE OHMMETER TO MEASURE FILAMENT RESISTANCE

THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.

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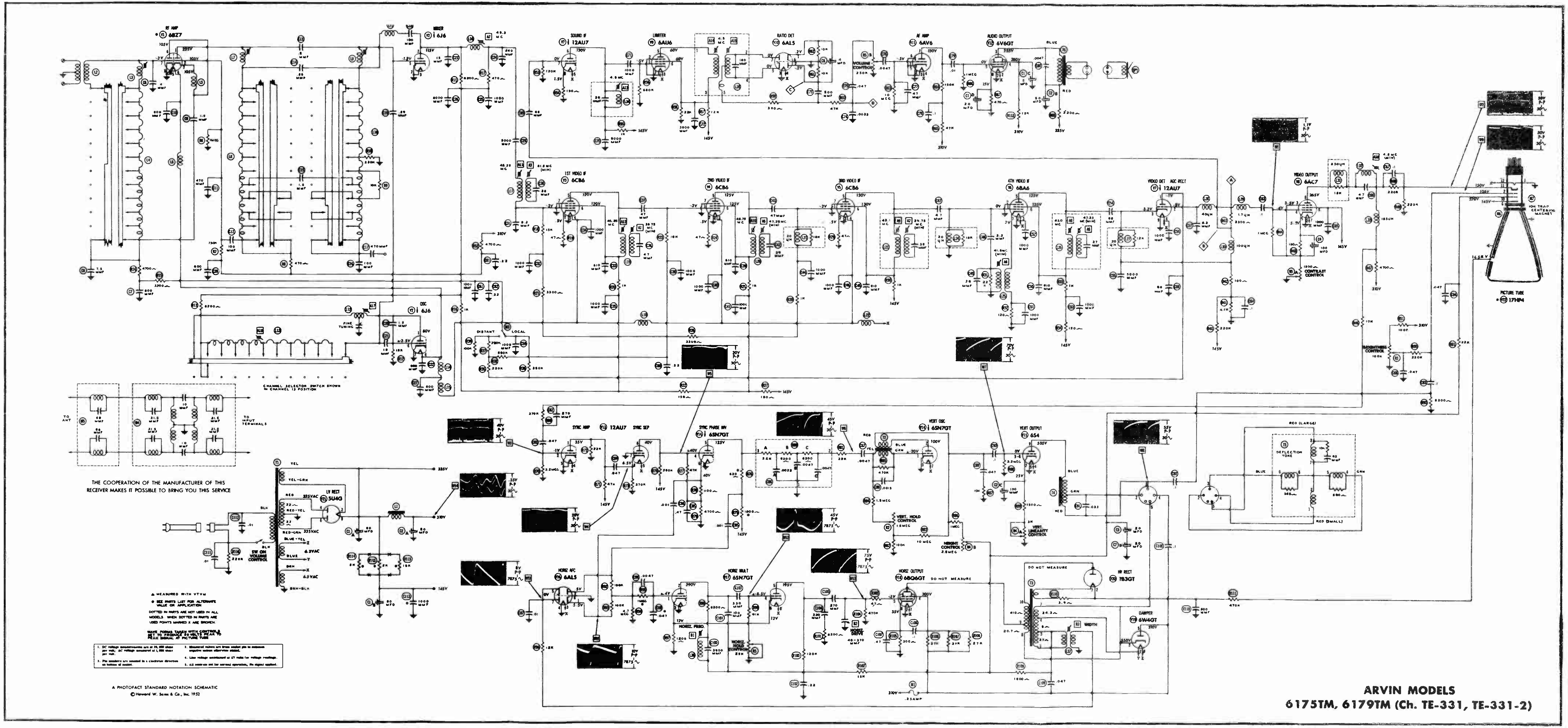
ARVIN
MODEL 850-P


THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
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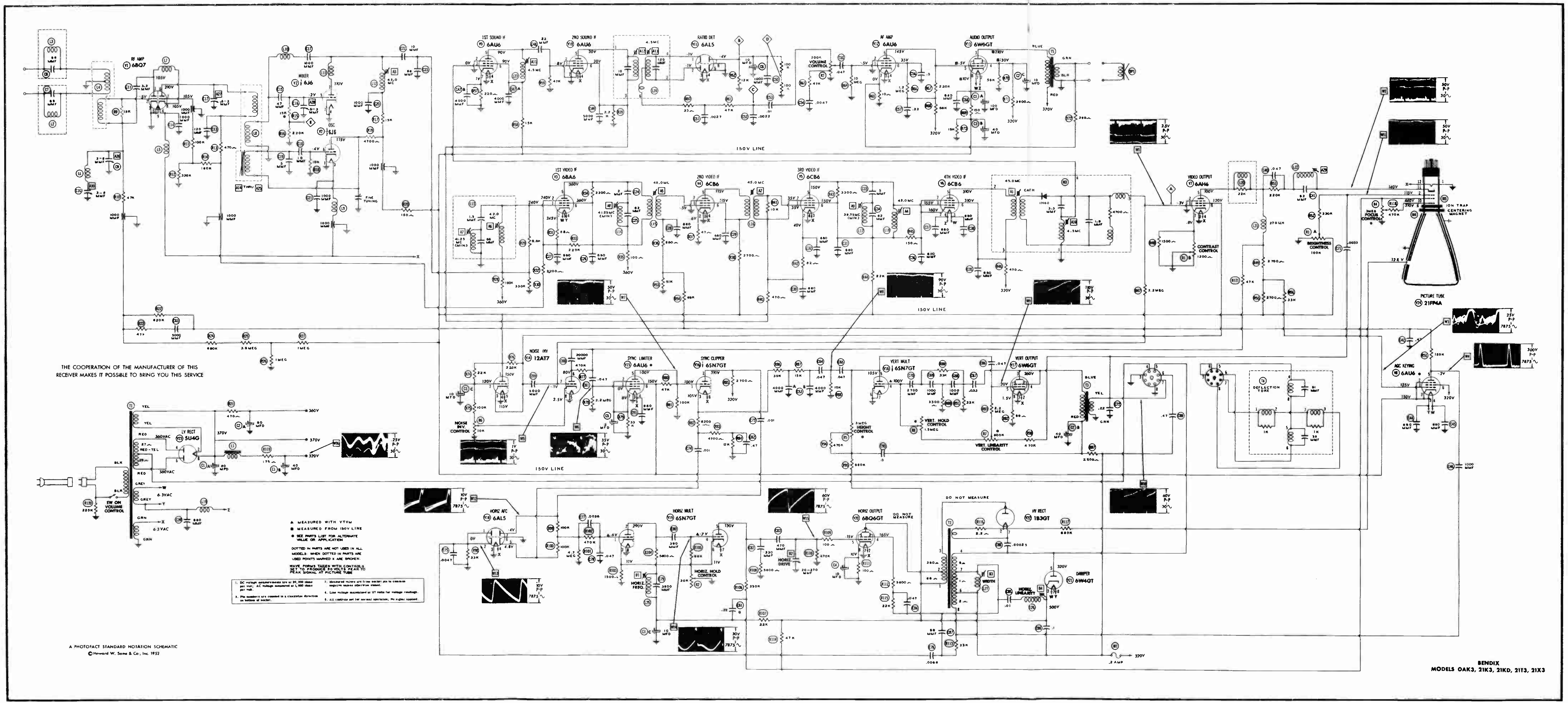
ARVIN MODELS
6175TM, 6179TM (Ch. TE-331, TE-331-2)


RF AMP 6BQ7
MIXER 6J6
OSC 6J6
1ST SOUND IF 6AU6
2ND SOUND IF 6AU6
RATIO DET 6AL5
AF AMP 6AU6
AUDIO OUTPUT 6W6GT
150V LINE
1ST VIDEO IF 6BA6
2ND VIDEO IF 6CB6
3RD VIDEO IF 6CB6
4TH VIDEO IF 6CB6
VIDEO OUTPUT 6AH6
CONTRAST CONTROL
BRIGHTNESS CONTROL
FOCUS CONTROL
ION TRAP CENTERING MAGNET
PICTURE TUBE 21FP4A
NOISE INV 12AT7
SYNC LIMITER 6AU6
SYNC CLIPPER 6SN7GT
VERT MULT 6SN7GT
VERT OUTPUT 6W6GT
VERT. HOLD CONTROL
HEIGHT CONTROL
VERT. LINEARITY CONTROL
NOISE INV. CONTROL
AGC KEYING 6AU6
DEFLECTION YOKE
LV RECT 5U4G
SW ON VOLUME CONTROL
HORIZ AFC 6AL5
HORIZ MULT 6SN7GT
HORIZ. HOLD CONTROL
HORIZ. FREQ.
HORIZ. DRIVE
HORIZ OUTPUT 6BQ6GT
HV RECT 1B3GT
DAMPER 6W4GT
WIDTH
HORIZ. LINEARITY
DO NOT MEASURE
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
▲ MEASURED WITH VTVM
■ MEASURED FROM 150V LINE
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 30 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt, AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation, No signal applied.
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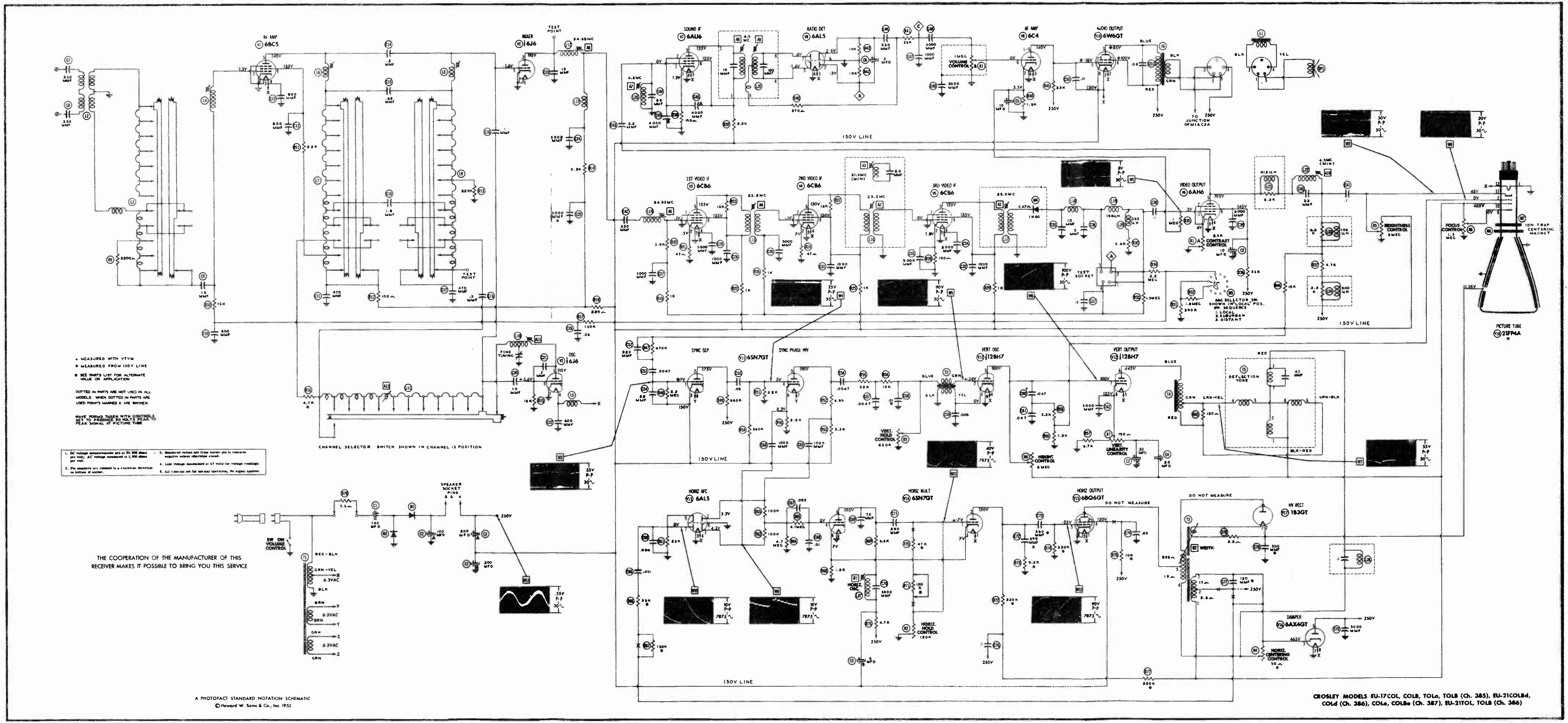
BENDIX
MODELS OAK3, 21K3, 21KD, 21T3, 21X3



RF AMP V1 6BC5
MIXER V2 6J6
OSC 6J6
SOUND IF V7 6AU6
RATIO DET 6AL5
AF AMP V9 6C4
AUDIO OUTPUT V10 6W6GT
1ST VIDEO IF V3 6CB6
2ND VIDEO IF V4 6CB6
3RD VIDEO IF V5 6CB6
VIDEO OUTPUT V6 6AH6
SYNC SEP
SYNC PHASE INV V11 6SN7GT
VERT OSC V12 12BH7
VERT OUTPUT V13 12BH7
HORIZ AFC V13 6AL5
HORIZ MULT V14 6SN7GT
HORIZ OUTPUT V15 6BQ6GT
HV RECT V17 1B3GT
DAMPER V16 6AX4GT
PICTURE TUBE V18 21FP4A
150V LINE
CHANNEL SELECTOR SWITCH SHOWN IN CHANNEL 13 POSITION
• MEASURED WITH VTVM
◆ MEASURED FROM 150V LINE
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 80 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
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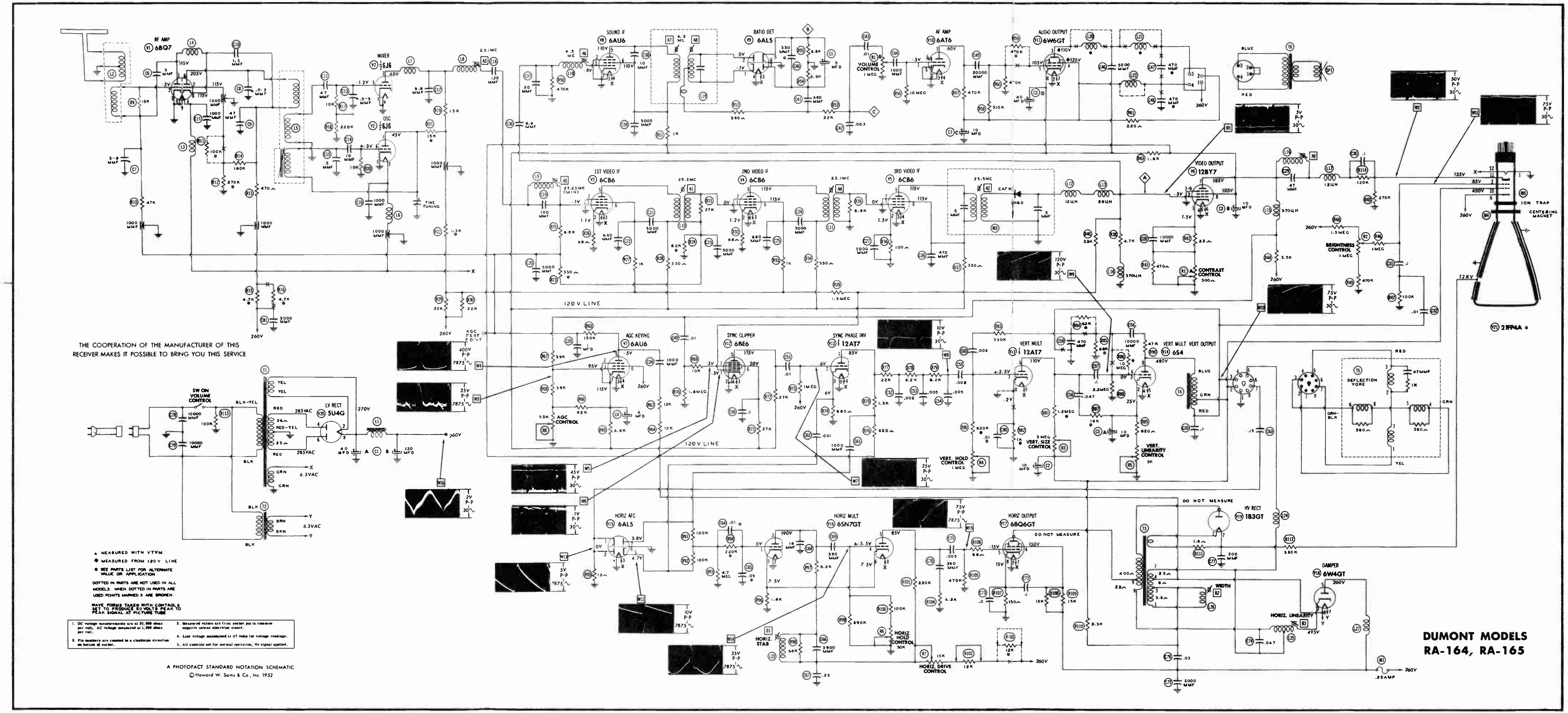
CROSLEY MODELS EU-17COL, COLB, TOLa, TOLB (Ch. 385), EU-21COLBd, COLd (Ch. 386), COLe, COLBe (Ch. 387), EU-21TOL, TOLB (Ch. 386)



THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

▲ MEASURED WITH VTVM
◆ MEASURED FROM 120 V LINE
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION

DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.

WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 80 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE

1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.

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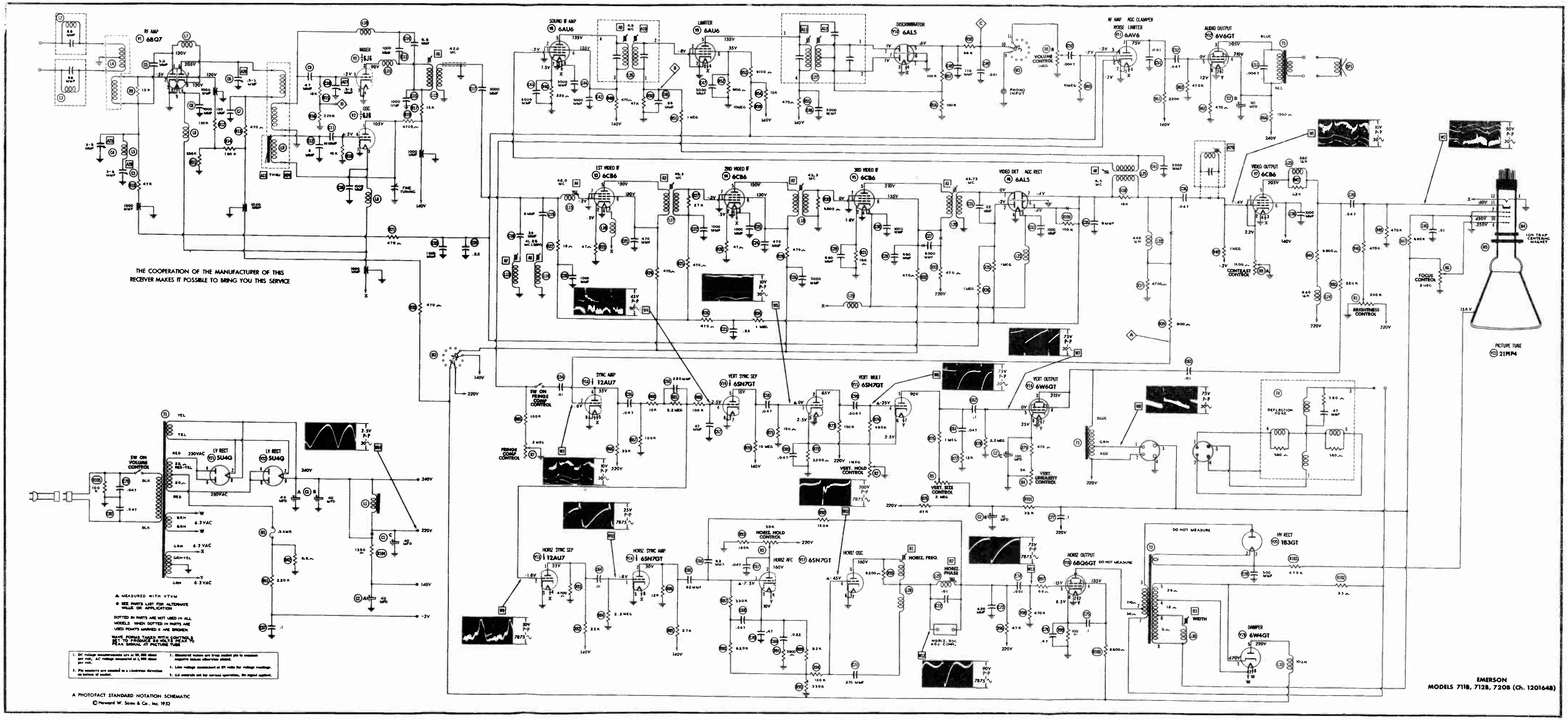
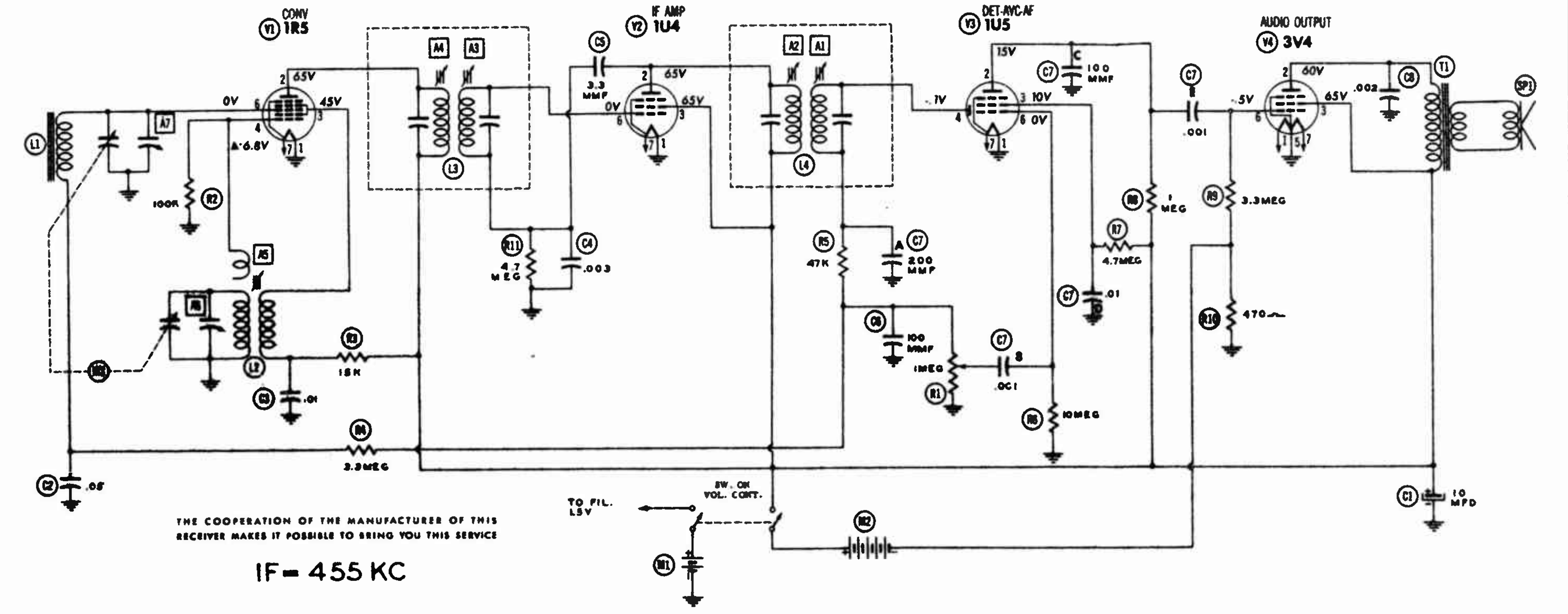
DUMONT MODELS RA-164, RA-165



RF AMP V1 6BQ7
MIXER V2 6J6
OSC V2 6J6
FINE TUNING
SOUND IF AMP V8 6AU6
LIMITER V9 6AU6
DISCRIMINATOR V10 6AL5
VOLUME CONTROL 1 MEG
PHONO INPUT
AF AMP AGC CLAMPER NOISE LIMITER V11 6AV6
AUDIO OUTPUT V12 6V6GT
1ST VIDEO IF V3 6CB6
2ND VIDEO IF V4 6CB6
3RD VIDEO IF V5 6CB6
VIDEO DET AGC RECT V6 6AL5
VIDEO OUTPUT V7 6CB6
CONTRAST CONTROL
FOCUS CONTROL 2 MEG
BRIGHTNESS CONTROL
ION TRAP CENTERING MAGNET
PICTURE TUBE V23 21MP4
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
SW ON FRINGE COMP CONTROL
FRINGE COMP CONTROL
SYNC AMP V13 12AU7
VERT SYNC SEP V14 6SN7GT
VERT MULT V15 6SN7GT
VERT HOLD CONTROL
VERT OUTPUT V16 6W6GT
VERT. SIZE CONTROL 2 MEG
VERT. LINEARITY CONTROL
DEFLECTION YOKE
SW ON VOLUME CONTROL
LV RECT V21 5U4G
LV RECT V22 5U4G
.3 AMP
6.3 VAC
HORIZ SYNC SEP V13 12AU7
HORIZ SYNC AMP V14 6SN7GT
HORIZ. HOLD CONTROL
HORIZ AFC V17 6SN7GT
HORIZ OSC
HORIZ. FREQ.
HORIZ. PHASE
HORIZ. OSC ADJ. COMP.
HORIZ OUTPUT V18 6BQ6GT
DO NOT MEASURE
HV RECT V20 1B3GT
WIDTH
DAMPER V19 6W4GT
▲ MEASURED WITH VTVM
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 80 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
A PHOTOFACT STANDARD NOTATION SCHEMATIC
© Howard W. Sams & Co., Inc. 1952
EMERSON
MODELS 711B, 712B, 720B (Ch. 120164B)



IF= 455 KC

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	1R5	0Ω	†22Ω	†15KΩ	100KΩ	0Ω	4.3Meg	*
V 2	1U4	0Ω	†22Ω	†0Ω	†0Ω	0Ω	4.7Meg	*
V 3	1U5	0Ω	†1 Meg	†4.7Meg	1 Meg	0Ω	10Meg	*
V 4	3V4	*	†420Ω	†0Ω	470Ω	0Ω	3.3Meg	*

* DO NOT USE OEMMETER TO MEASURE FILAMENT RESISTANCE.
† MEASURED FROM BATTERY B+ LEAD. (BATTERY DISCONNECTED)
▲ TAKEN WITH VACUUM TUBE VOLTMETER.

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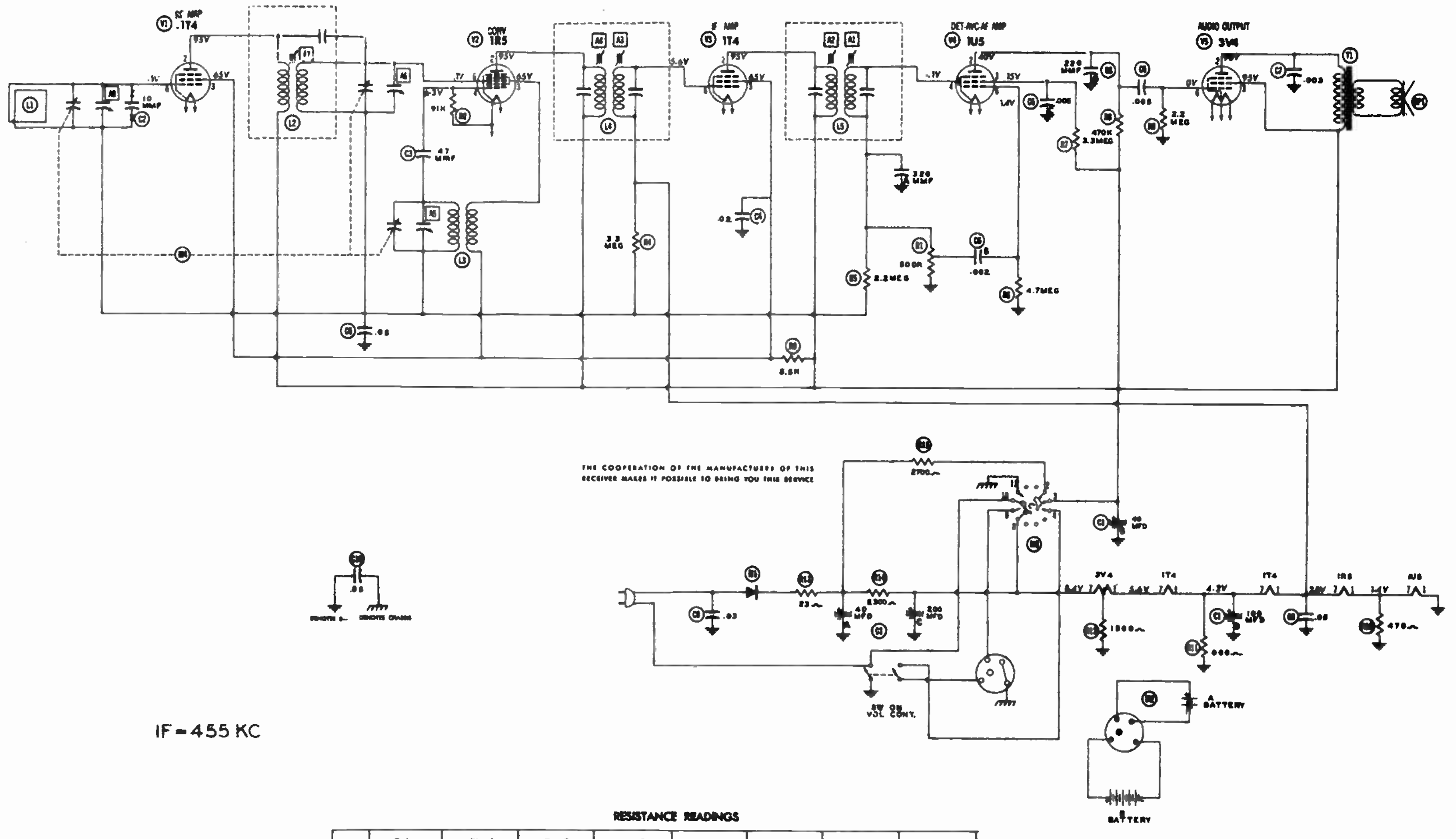
EMERSON 704 (CH. 120154 - B)

1 - DC Voltage measurements are at 20,000 ohms per volts, AC Voltages measured at 1000 ohms per volt.
2 - Socket connections are shown as bottom views.
3 - Measured values are from socket pin to common negative.
4 - Nominal tolerance on component values makes possible a variation of ±15% in voltage and resistance readings.
5 - Volume control at maximum, no signal applied for voltage measurements.



IF=455 KC

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	1T4	*	†2.7KΩ	†8.3KΩ	†2.7KΩ	*	1.8Meg	*
V 2	1R5	*	†2.7KΩ	†8.3KΩ	91KΩ	*	1.8Meg	*
V 3	1T4	*	†2.7KΩ	†8.3KΩ	INF	*	50Ω	*
V 4	1U5	0Ω	†470KΩ	†3.3Meg	500KΩ	1.8Meg	4.7Meg	*
V 5	3V4	*	†3.3KΩ	†2.7KΩ	†2.7KΩ	*	2.2Meg	*

ALL MEASUREMENTS TAKEN WITH POWER CHANGE-OVER SWITCH IN AC-DC POSITION
† MEASURED FROM OUTPUT OF M1
* DO NOT USE OHMMETER TO MEASURE FILAMENT RESISTANCE
▲ TAKEN WITH VACUUM TUBE VOLTMETER

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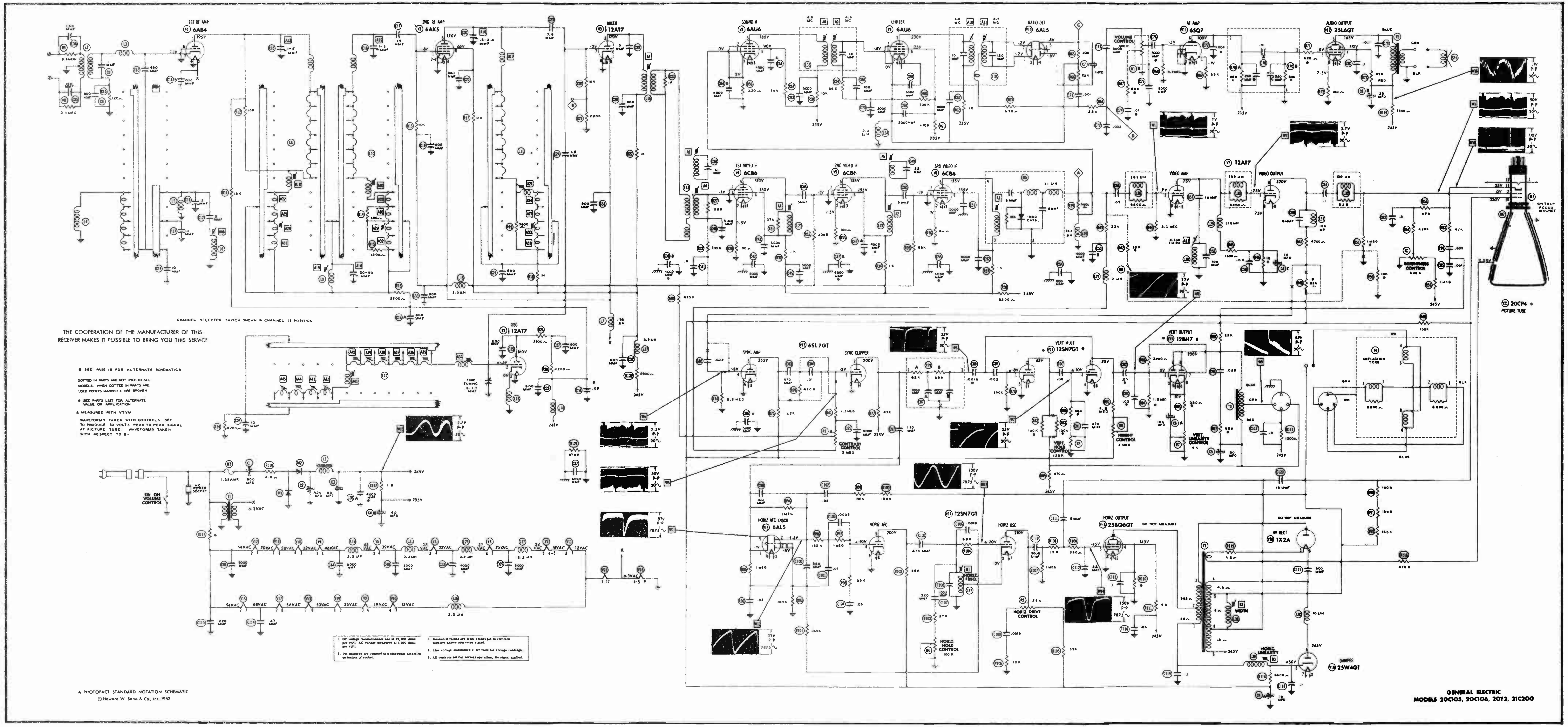
GENERAL ELECTRIC 614, 615

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

● SEE PAGE 18 FOR ALTERNATE SCHEMATICS

DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN

⊕ SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION

▲ MEASURED WITH VTVM

WAVEFORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE. WAVEFORMS TAKEN WITH RESPECT TO B-

1. DC voltage measurements are at 20,000 ohms per volt. AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.

A PHOTOFACT STANDARD NOTATION SCHEMATIC

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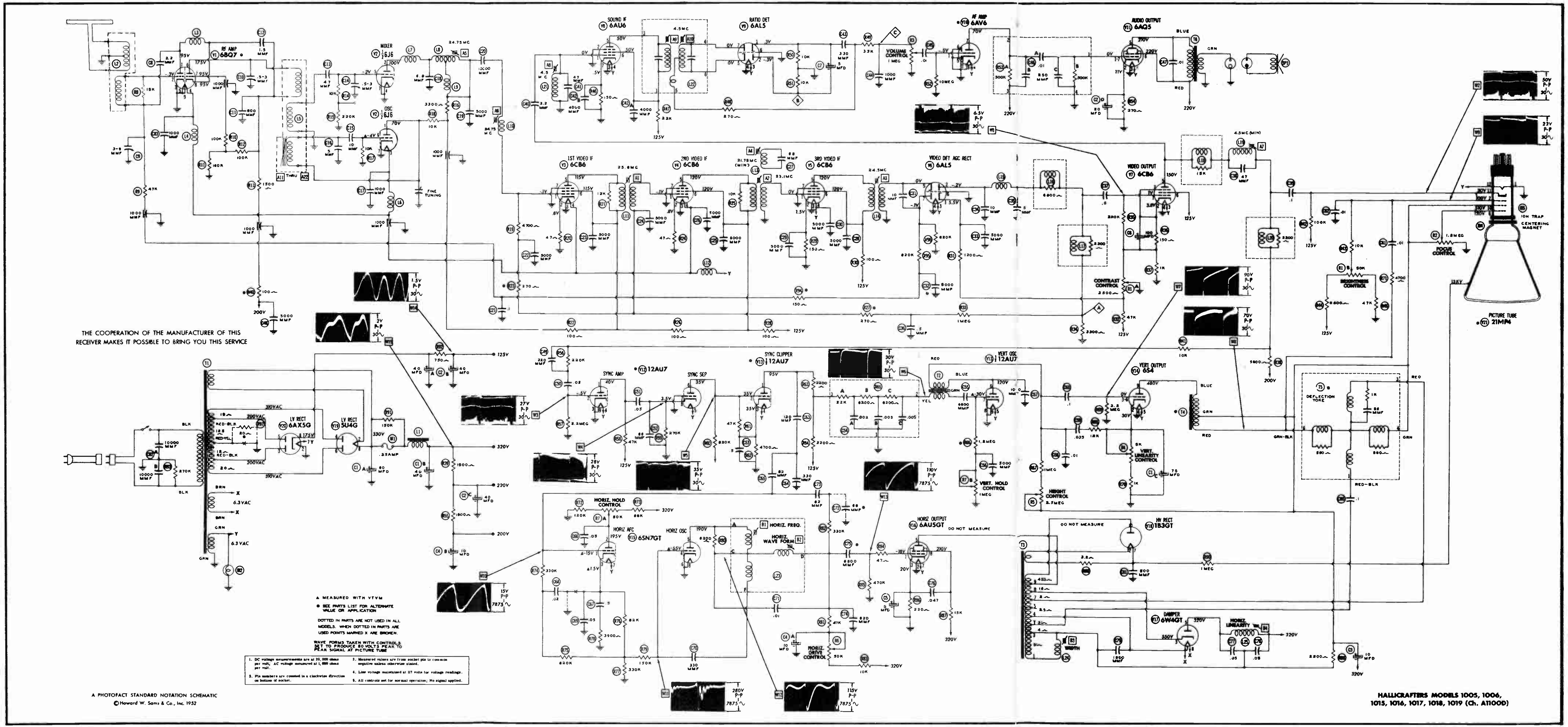
GENERAL ELECTRIC
MODELS 20C105, 20C106, 20T2, 21C200



SOUND IF V8 6AU6
RATIO DET V9 6AL5
RF AMP V10 6AV6
AUDIO OUTPUT V11 6AQ5
RF AMP V1 6BQ7
MIXER V2 6J6
OSC V2 6J6
FINE TUNING
1ST VIDEO IF V3 6CB6
2ND VIDEO IF V4 6CB6
3RD VIDEO IF V5 6CB6
VIDEO DET AGC RECT V6 6AL5
VIDEO OUTPUT V7 6CB6
CONTRAST CONTROL
VOLUME CONTROL
FOCUS CONTROL
BRIGHTNESS CONTROL
ION TRAP CENTERING MAGNET
PICTURE TUBE V21 21MP4
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
LV RECT V20 6AX5G
LV RECT V19 5U4G
SYNC AMP V12 12AU7
SYNC SEP
SYNC CLIPPER V13 12AU7
VERT OSC V13 12AU7
VERT OUTPUT V14 6S4
VERT. HOLD CONTROL
VERT. LINEARITY CONTROL
HEIGHT CONTROL
DEFLECTION YOKE
HORIZ. HOLD CONTROL
HORIZ AFC V15 6SN7GT
HORIZ OSC
HORIZ. FREQ.
HORIZ. WAVE FORM
HORIZ OUTPUT V16 6AU5GT
DO NOT MEASURE
HV RECT V18 1B3GT
DAMPER V17 6W4GT
HORIZ. LINEARITY
WIDTH
HORIZ. DRIVE CONTROL
▲ MEASURED WITH VTVM
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 80 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
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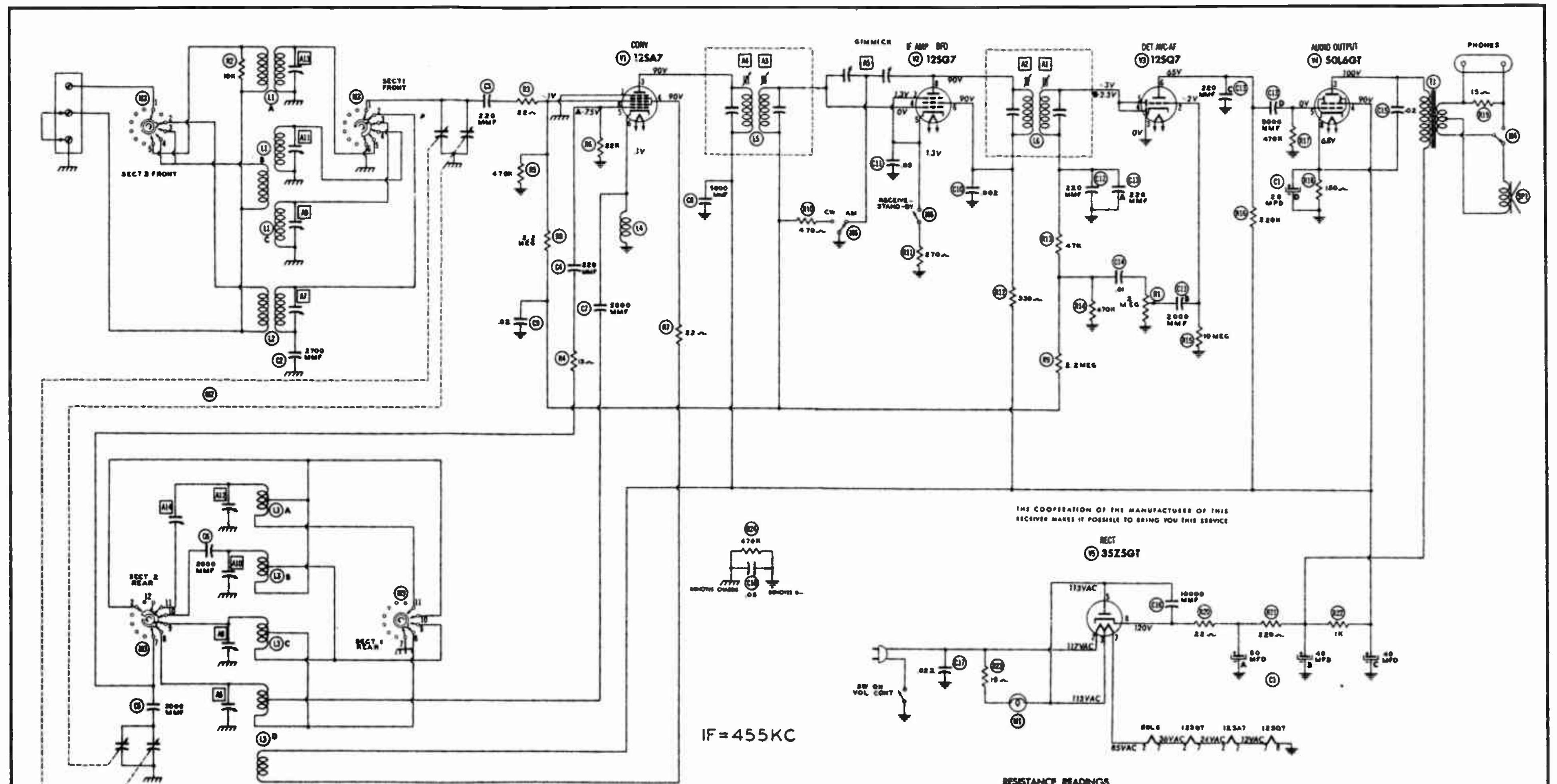
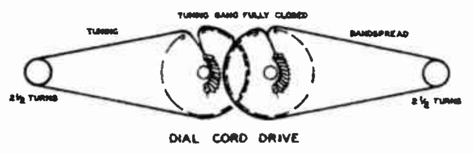
HALLICRAFTERS MODELS 1005, 1006, 1015, 1016, 1017, 1018, 1019 (Ch. A1100D)





RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	12SA7	470KΩ	24Ω	†1.2KΩ	†1.2KΩ	22KΩ	9Ω	12Ω	430KΩ ■390KΩ
V 2	12SG7	470KΩ	36Ω	270Ω	1.3Meg ■470Ω	270Ω	†1.6KΩ	24Ω	†1.6KΩ
V 3	12SQ7	470KΩ	10 Meg	0Ω	477KΩ ■437KΩ	477KΩ ■437KΩ	†220KΩ	12Ω	0Ω
V 4	50L6GT	INF	84Ω	†400Ω	†1.2KΩ	470KΩ	0Ω	36Ω	150Ω
V 5	35Z5GT	INF	118Ω	113Ω	110Ω	113Ω	0Ω	84Ω	1.2Meg

ALL MEASUREMENTS TAKEN IN "BAND 1" POSITION
ALL MEASUREMENTS TAKEN IN "AM" POSITION UNLESS OTHERWISE SPECIFIED
■ MEASURED IN "CW" POSITION
† MEASURED FROM PIN 8 OF V5
▲ TAKEN WITH VACUUM TUBE VOLTMETER

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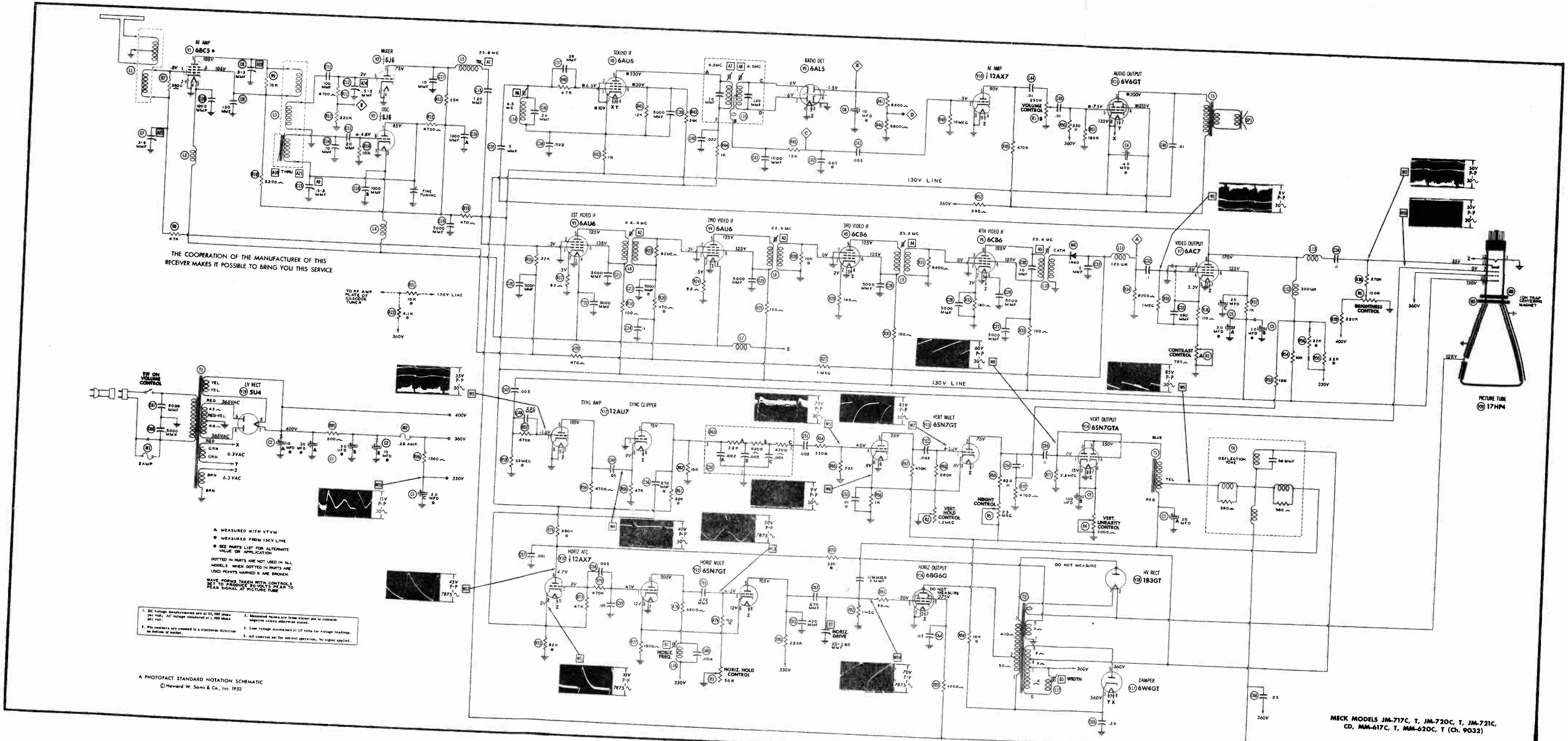
HALLICRAFTERS - S 38C (RUN 2)

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.


RF AMP
V1 6BC5
MIXER
V2 ½6J6
OSC
V2 ½6J6
FINE TUNING
SOUND IF
V8 6AU6
RATIO DET
V9 6AL5
AF AMP
V10 ½12AX7
VOLUME CONTROL
AUDIO OUTPUT
V11 6V6GT
130V LINE
1ST VIDEO IF
V3 6AU6
2ND VIDEO IF
V4 6AU6
3RD VIDEO IF
V5 6CB6
4TH VIDEO IF
V6 6CB6
VIDEO OUTPUT
V7 6AC7
CONTRAST CONTROL
BRIGHTNESS CONTROL
ION TRAP CENTERING MAGNET
PICTURE TUBE
V20 17HP4
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
TO RF AMP PLATE OF CASCODE TUNER
SW ON VOLUME CONTROL
LV RECT
V19 5U4
SYNC AMP
SYNC CLIPPER
V12 12AU7
VERT MULT
V13 6SN7GT
VERT OUTPUT
V14 6SN7GTA
HEIGHT CONTROL
VERT. HOLD CONTROL
VERT. LINEARITY CONTROL
DEFLECTION YOKE
HORIZ AFC
V10 ½12AX7
HORIZ MULT
V15 6SN7GT
HORIZ. FREQ.
HORIZ. HOLD CONTROL
HORIZ. DRIVE
HORIZ OUTPUT
V16 6BG6G
DO NOT MEASURE
HV RECT
V18 1B3GT
WIDTH
DAMPER
V17 6W4GT
▲ MEASURED WITH VTVM
■ MEASURED FROM 130V LINE
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 80 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
A PHOTOFACT STANDARD NOTATION SCHEMATIC
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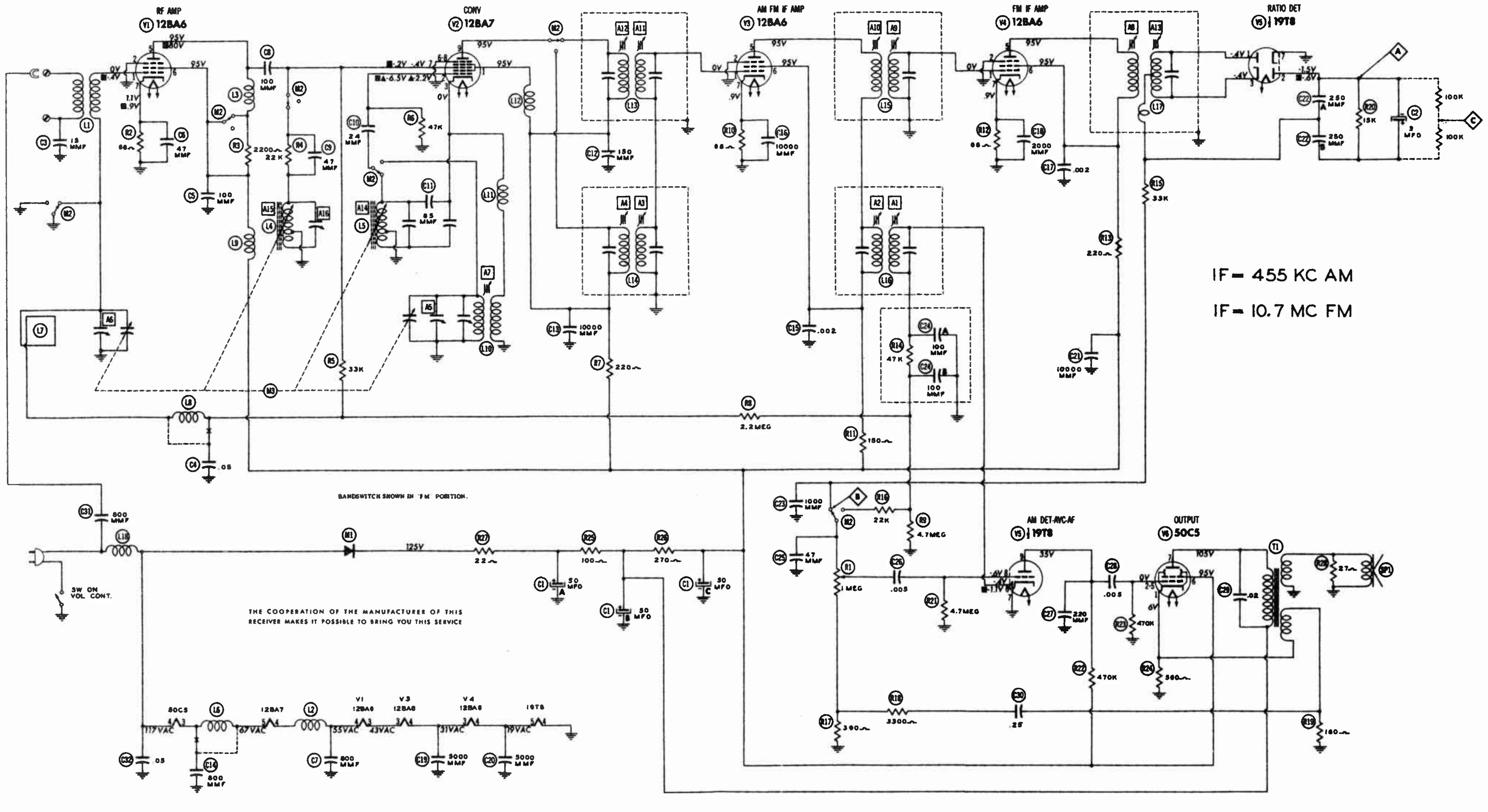
MECK MODELS JM-717C, T, JM-720C, T, JM-721C, CD, MM-617C, T, MM-620C, T (Ch. 9032)



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V 1	12BA6	.0Ω ■2.9Meg	.0Ω	43Ω	55Ω	†390Ω ■†3.6KΩ	†390Ω ■†390Ω	68Ω		
V 2	12BA7	†610Ω	47KΩ	.4Ω	55Ω	67Ω	0Ω	14KΩ ■3.9Meg	0Ω	†610Ω
V 3	12BA6	9.2Ω	0Ω	42Ω	31Ω	†540Ω	†540Ω	64Ω		
V 4	12BA6	7Ω	0Ω	31Ω	18Ω	†610Ω	†610Ω	68Ω		
V 5	19T8	1Meg	15KΩ	1Meg	0Ω	18Ω	1.8Meg ■800KΩ	0Ω	4.7Meg	†470KΩ
V 6	50C5	140Ω	470KΩ	47Ω	117Ω	470KΩ	†390Ω	†310Ω		

ALL MEASUREMENTS TAKEN IN "FM" POSITION UNLESS NOTED
† MEASURED FROM OUTPUT OF M1
■-MEASURED IN "AM" POSITION
▲-TAKEN WITH VACUUM TUBE VOLTMETER

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on compooent values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.

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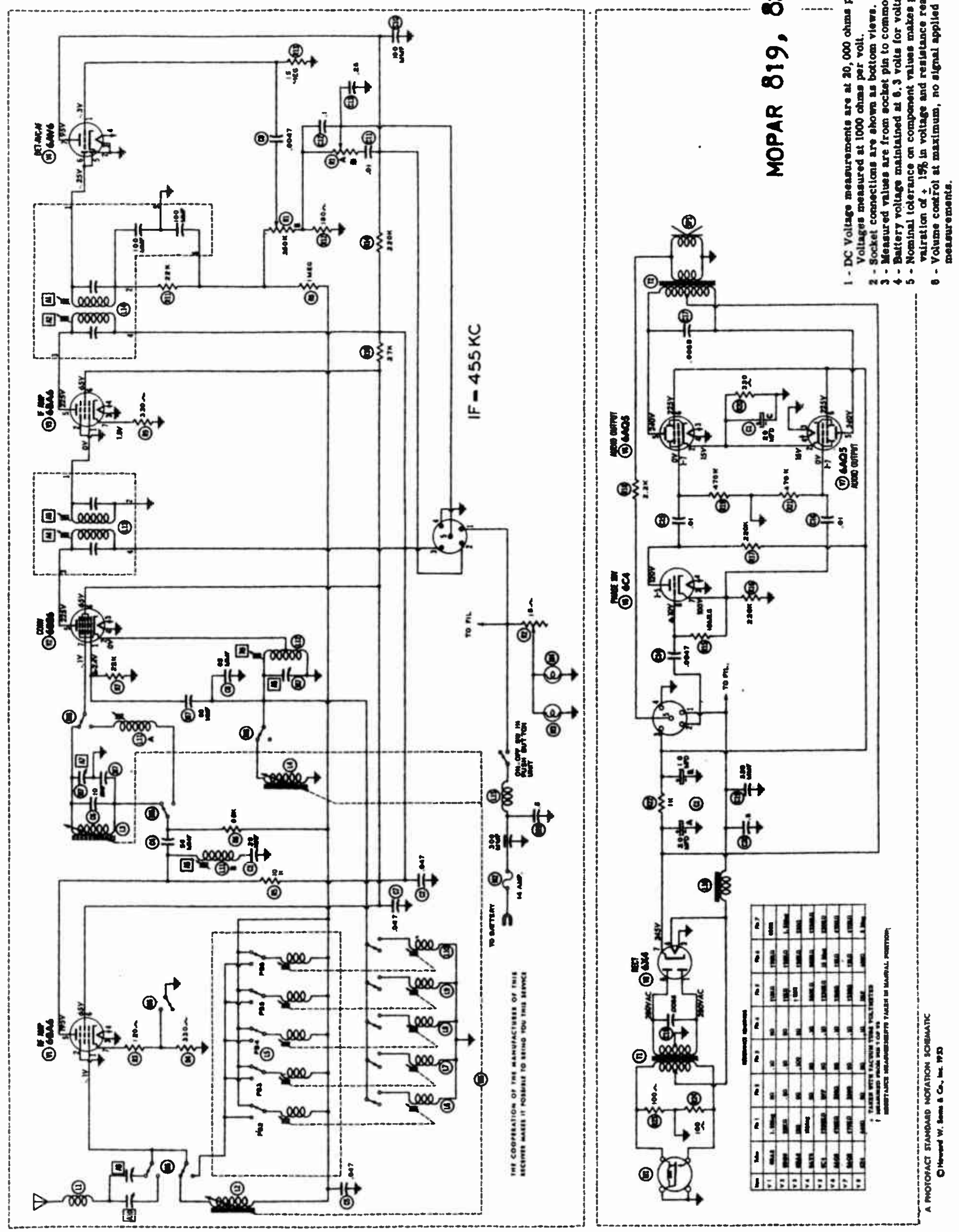
MOTOROLA - 72XM21 (CH. H5-303)



MOPAR 819, 820, 824

1 - DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1000 ohms per volt.
2 - Socket connections are shown as bottom views.
3 - Measured values are from socket pin to common negative.
4 - Battery voltage maintained at 6.3 volts for voltage readings.
5 - Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6 - Volume control at maximum, no signal applied for voltage measurements.

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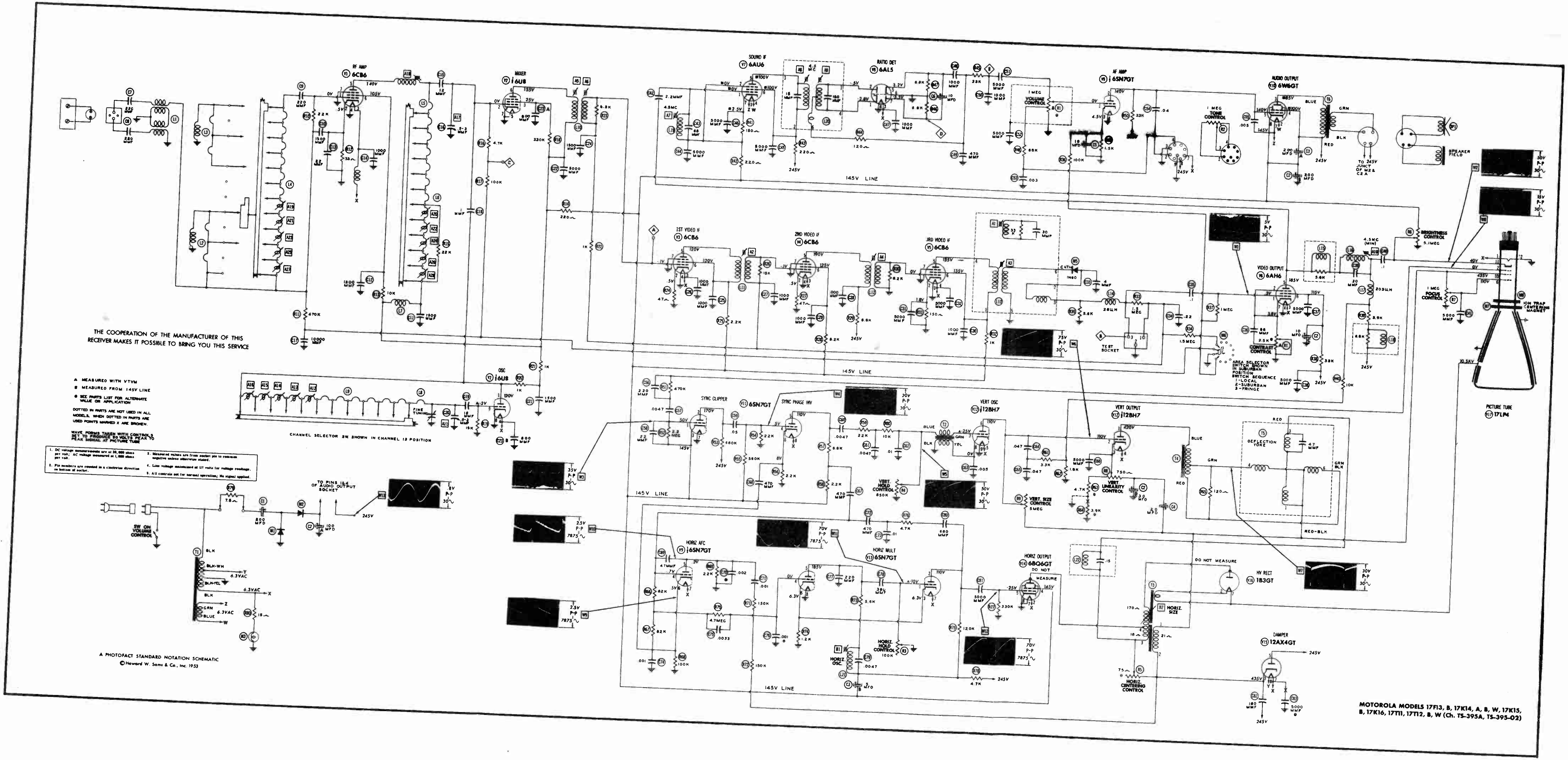
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
A MEASURED WITH VTVM
B MEASURED FROM 145V LINE
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 80 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
CHANNEL SELECTOR SW SHOWN IN CHANNEL 13 POSITION
RF AMP (V1) 6CB6
MIXER (V2) ½6U8
OSC (V2) ½6U8
SOUND IF (V7) 6AU6
RATIO DET (V8) 6AL5
AF AMP (V9) ½6SN7GT
AUDIO OUTPUT (V10) 6W6GT
1ST VIDEO IF (V3) 6CB6
2ND VIDEO IF (V4) 6CB6
3RD VIDEO IF (V5) 6CB6
VIDEO OUTPUT (V6) 6AH6
SYNC CLIPPER
SYNC PHASE INV (V11) 6SN7GT
VERT OSC (V12) ½12BH7
VERT OUTPUT (V12) ½12BH7
HORIZ AFC (V9) ½6SN7GT
HORIZ MULT (V13) 6SN7GT
HORIZ OUTPUT (V14) 6BQ6GT
HV RECT (V16) 1B3GT
DAMPER (V15) 12AX4GT
PICTURE TUBE (V17) 17LP4
145V LINE
VOLUME CONTROL
TONE CONTROL
BRIGHTNESS CONTROL
CONTRAST CONTROL
FOCUS CONTROL
ION TRAP CENTERING MAGNET
SPEAKER FIELD
AREA SELECTOR SWITCH SHOWN IN SUBURBAN POSITION
SWITCH SEQUENCE 1-LOCAL 2-SUBURBAN 3-FRINGE
TEST SOCKET
VERT SIZE CONTROL
VERT LINEARITY CONTROL
VERT HOLD CONTROL
DEFLECTION YOKE
HORIZ HOLD CONTROL
HORIZ OSC.
HORIZ. SIZE
HORIZ. CENTERING CONTROL
DO NOT MEASURE
SW ON VOLUME CONTROL
TO PINS 1&4 OF AUDIO OUTPUT SOCKET
TO 245V JUNCT OF M2 & C2A
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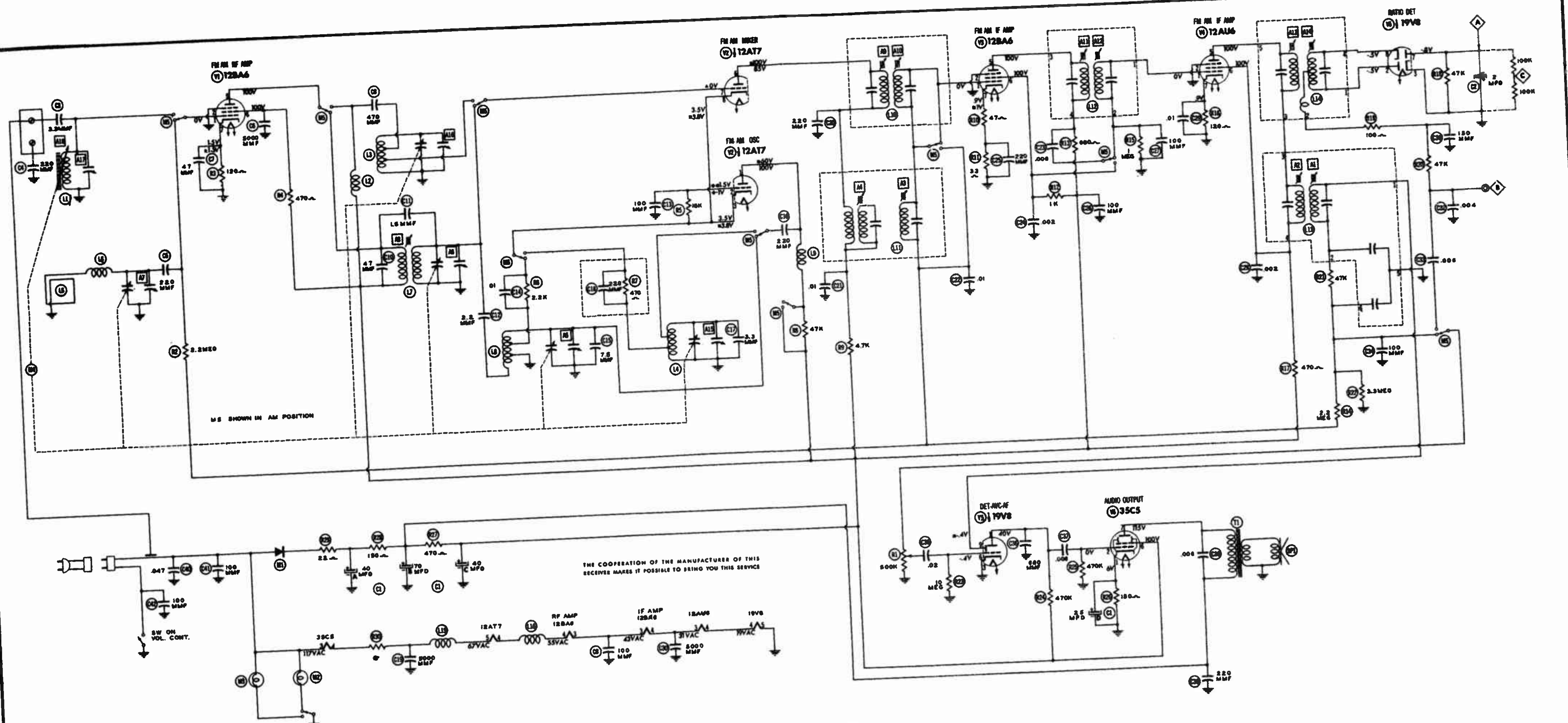
MOTOROLA MODELS 17F13, B, 17K14, A, B, W, 17K15, B, 17K16, 17T11, 17T12, B, W (Ch. TS-395A, TS-395-02)



IF=455KC -AM
IF=9.1MC - FM

* SPECIAL RESISTOR, SEE PARTS LIST FOR VALUE.

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V 1	12BA6	0Ω ■5 Meg	0Ω	43Ω	53Ω	† 650Ω	† 1.1KΩ	120Ω		
V 2	12AT7	† 650Ω ■† 47KΩ	15KΩ ■17KΩ	470Ω ■2.2KΩ	53Ω	65Ω	† 5.4KΩ	0Ω ■8Ω	470Ω ■2.2KΩ	59Ω
V 3	12BA6	5.5Meg ■3 Meg	0Ω	43Ω	31Ω	† 1.3K	† 1.6KΩ	80Ω		
V 4	12AU6	1 Meg	0Ω	31Ω	19Ω	†1.1KΩ	†1.1KΩ	120Ω		
V 5	19V8	† 470KΩ	INF	0Ω	19Ω	0Ω	10 Meg	47KΩ	INF	■400KΩ
V 6	35C5	150Ω	470KΩ	170Ω	180Ω	INF	† 650Ω	† 820Ω		

ALL MEASUREMENTS TAKEN IN "FM POSITION UNLESS OTHERWISE SPECIFIED
■ MEASURED IN "AM" POSITION
† MEASURED FROM OUTPUT OF M1
▲ TAKEN IN VACUUM TUBE VOLTMETER
♦ MEASURED FROM PIN 3 OF V2
NOTE : FILAMENT RESISTANCE MEASUREMENTS INCLUDE PARALLEL RESISTANCE OF PILOT LAMP M3

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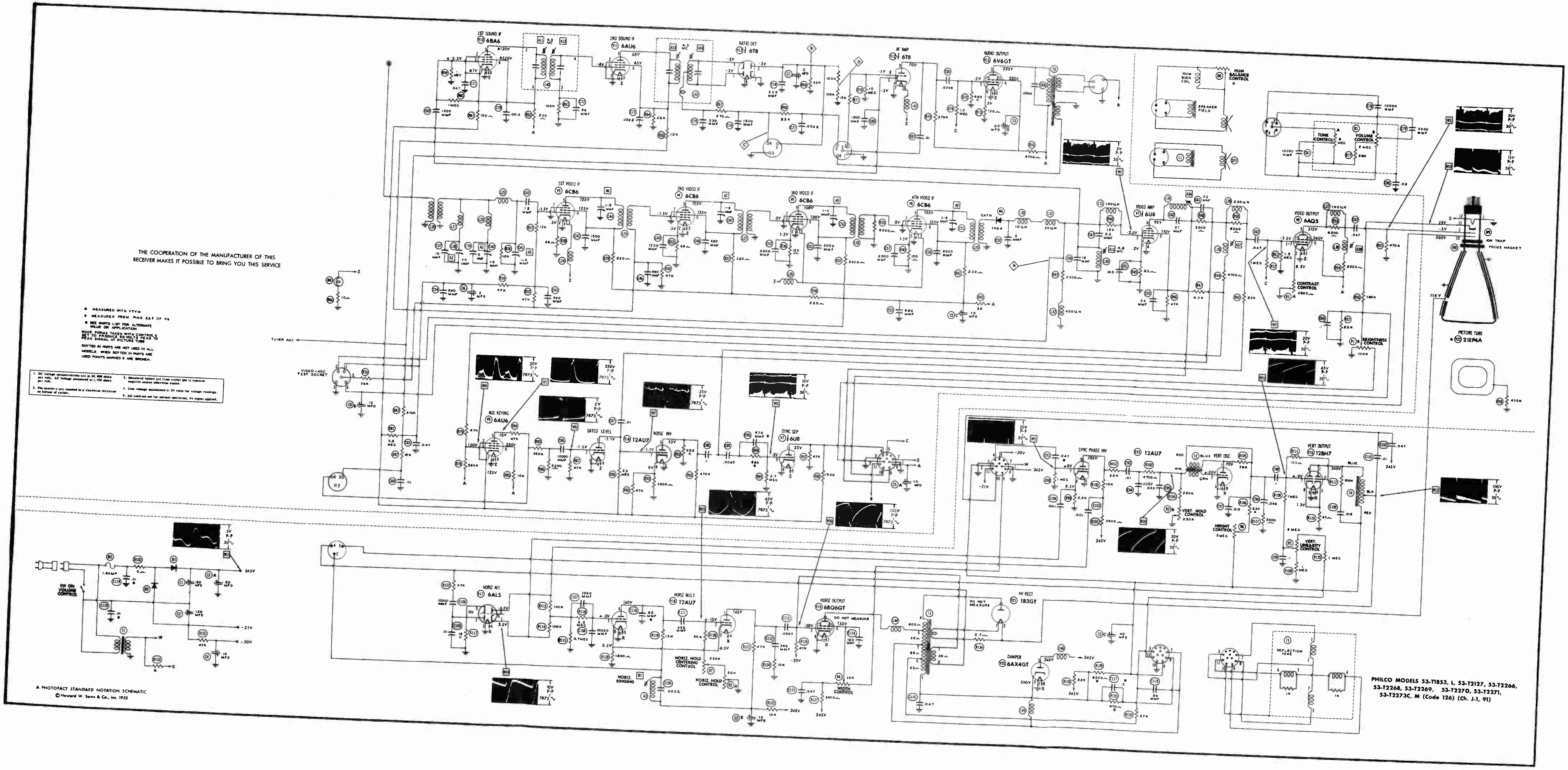
PHILCO - 53 - 958


THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
▲ MEASURED WITH VTVM
■ MEASURED FROM PINS 2&7 OF V6
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
1ST SOUND IF 6BA6
2ND SOUND IF 6AU6
RATIO DET 6T8
AF AMP 6T8
AUDIO OUTPUT 6V6GT
HUM BALANCE CONTROL
SPEAKER FIELD
TONE CONTROL
VOLUME CONTROL
1ST VIDEO IF 6CB6
2ND VIDEO IF 6CB6
3RD VIDEO IF 6CB6
4TH VIDEO IF 6CB6
VIDEO AMP 6U8
VIDEO OUTPUT 6AQ5
CONTRAST CONTROL
BRIGHTNESS CONTROL
ION TRAP
FOCUS MAGNET
PICTURE TUBE 21EP4A
TUNER AGC
VIDEO-AGC TEST SOCKET
AGC KEYING 6AU6
GATED LEVEL
NOISE INV 12AU7
SYNC SEP 6U8
SYNC PHASE INV
12AU7
VERT OSC
VERT. HOLD CONTROL
HEIGHT CONTROL
VERT OUTPUT 12BH7
VERT. LINEARITY CONTROL
SW ON VOLUME CONTROL
HORIZ AFC 6AL5
HORIZ MULT 12AU7
HORIZ. HOLD CENTERING CONTROL
HORIZ. HOLD CONTROL
HORIZ. RINGING
HORIZ OUTPUT 6BQ6GT
DO NOT MEASURE
WIDTH CONTROL
HV RECT 1B3GT
DAMPER 6AX4GT
DEFLECTION YOKE
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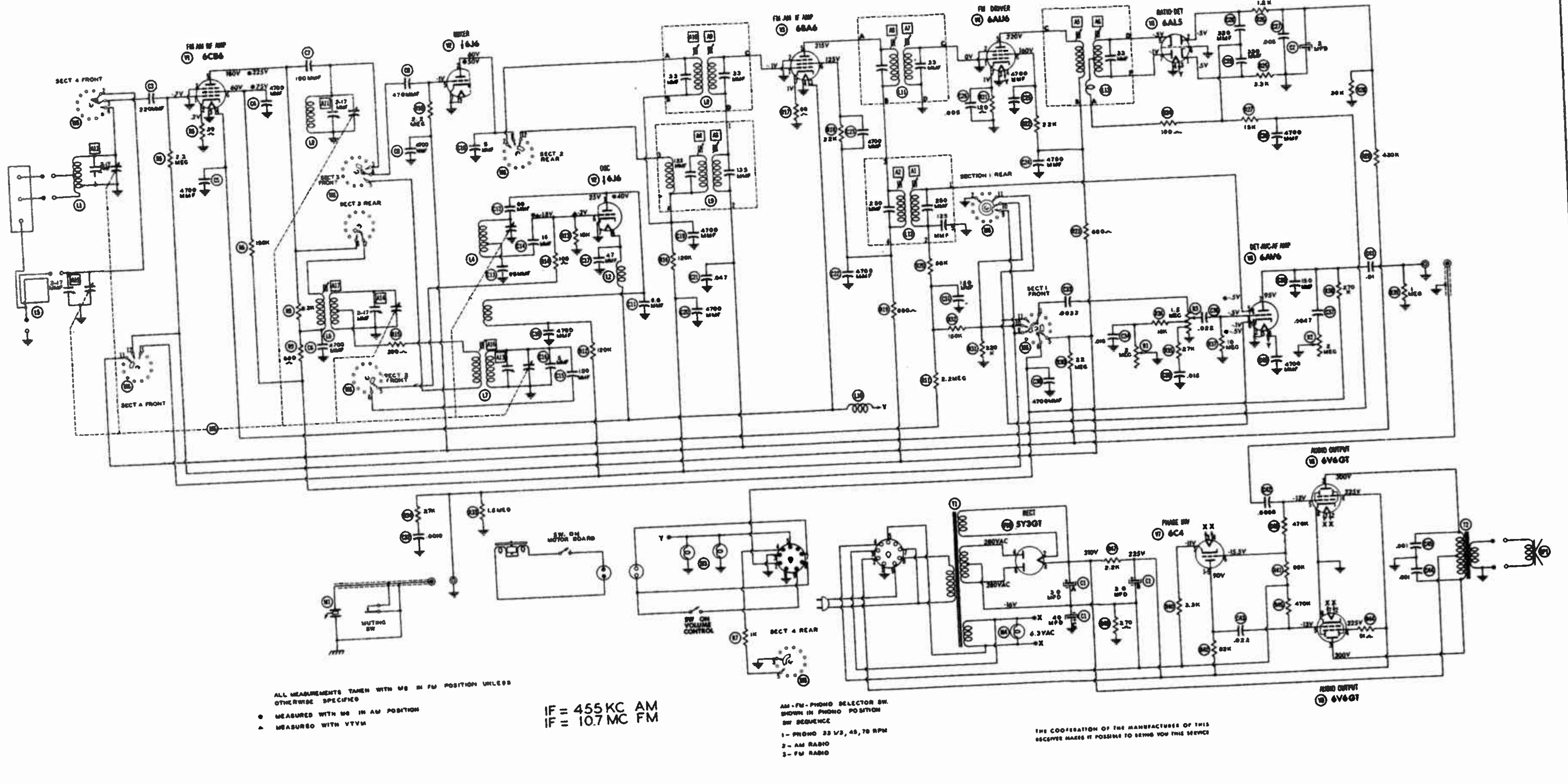
PHILCO MODELS 53-T1853, L, 53-T2127, 53-T2266, 53-T2268, 53-T2269, 53-T2270, 53-T2271, 53-T2273C, M (Code 126) (Ch. J-1, 91)



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	6CB6	■4.8Meg 2.7Meg	39Ω	0Ω	.1Ω	†12KΩ ■†2.8KΩ	†155KΩ	0Ω	
V 2	6J6	†120KΩ	†120KΩ	0Ω	.1Ω	5 Meg	18KΩ	0Ω	
V 3	6BA6	■2.8Meg 450KΩ	0Ω	.1Ω	0Ω	†2.9KΩ	†25KΩ	68Ω	
V 4	6AU6	.4Ω	0Ω	0Ω	.1Ω	†2.9KΩ	†25KΩ	120Ω	
V 5	6AL5	3.3KΩ	40KΩ	.1Ω	0Ω	14KΩ	0Ω	14KΩ	
V 6	6AV6	10Meg	0Ω	0Ω	.1Ω	■440KΩ 210KΩ	■3 Meg 450KΩ	†270KΩ	
V 7	6C4	†84KΩ	INF	INF	INF	†84KΩ	68KΩ	3.6KΩ	
V 8	6V6GT	INF	INF	†255Ω	†2.2KΩ	510KΩ	270Ω	INF	0Ω
V 9	6V6GT	INF	INF	†255Ω	†2.3KΩ	470KΩ	270Ω	INF	0Ω
V 10	5Y3GT	INF	1 Meg	INF	240Ω	INF	256Ω	INF	1 Meg

ALL MEASUREMENTS TAKEN IN "FM" POSITION UNLESS OTHERWISE STATED.
■ MEASURED IN AM POSITION.
† MEASURED FROM PIN 8 OF V10.

RCA - 2510

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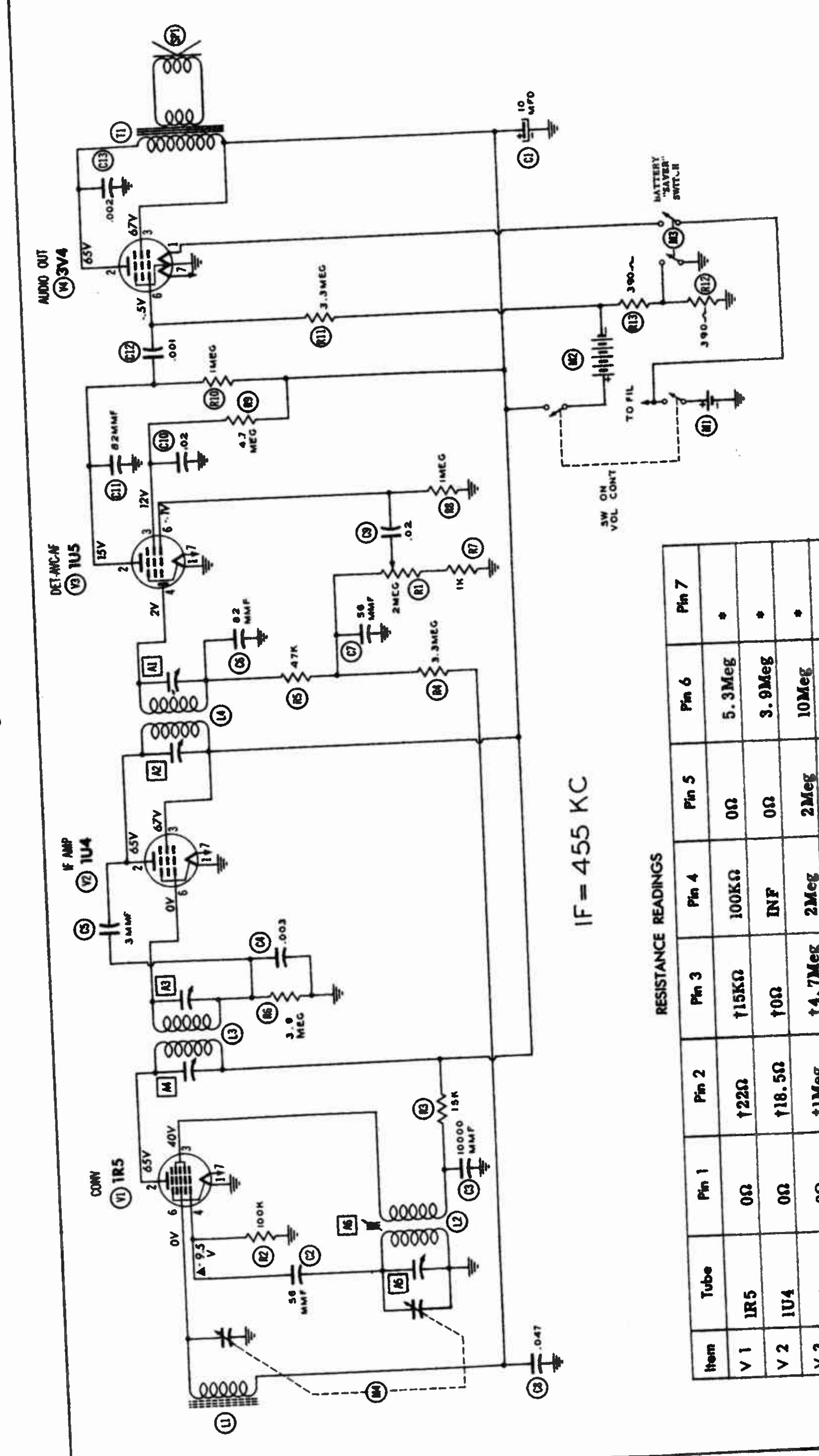
RCA-VICTOR 2B401, 2B402, 2B403 2B404, 2B405 (CH. RC 1114)



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	1R5	0Ω	†22Ω	†15KΩ	100KΩ	0Ω	5.3Meg	*
V 2	1U4	0Ω	†18.5Ω	†0Ω	INF	0Ω	3.9Meg	*
V 3	1U5	0Ω	†1Meg	†4.7Meg	2Meg	2Meg	10Meg	*
V 4	3V4	*	†347Ω	†0Ω	780Ω	0Ω	3.3Meg	*

BATTERY SAVER SWITCH IS IN "NORMAL" POSITION. (EXTREME LEFT).
† MEASURED FROM INPUT OF B+
▲ TAKEN WITH VACUUM TUBE VOLTMETER
* DO NOT USE OHMMETER TO MEASURE FILAMENT RESISTANCE

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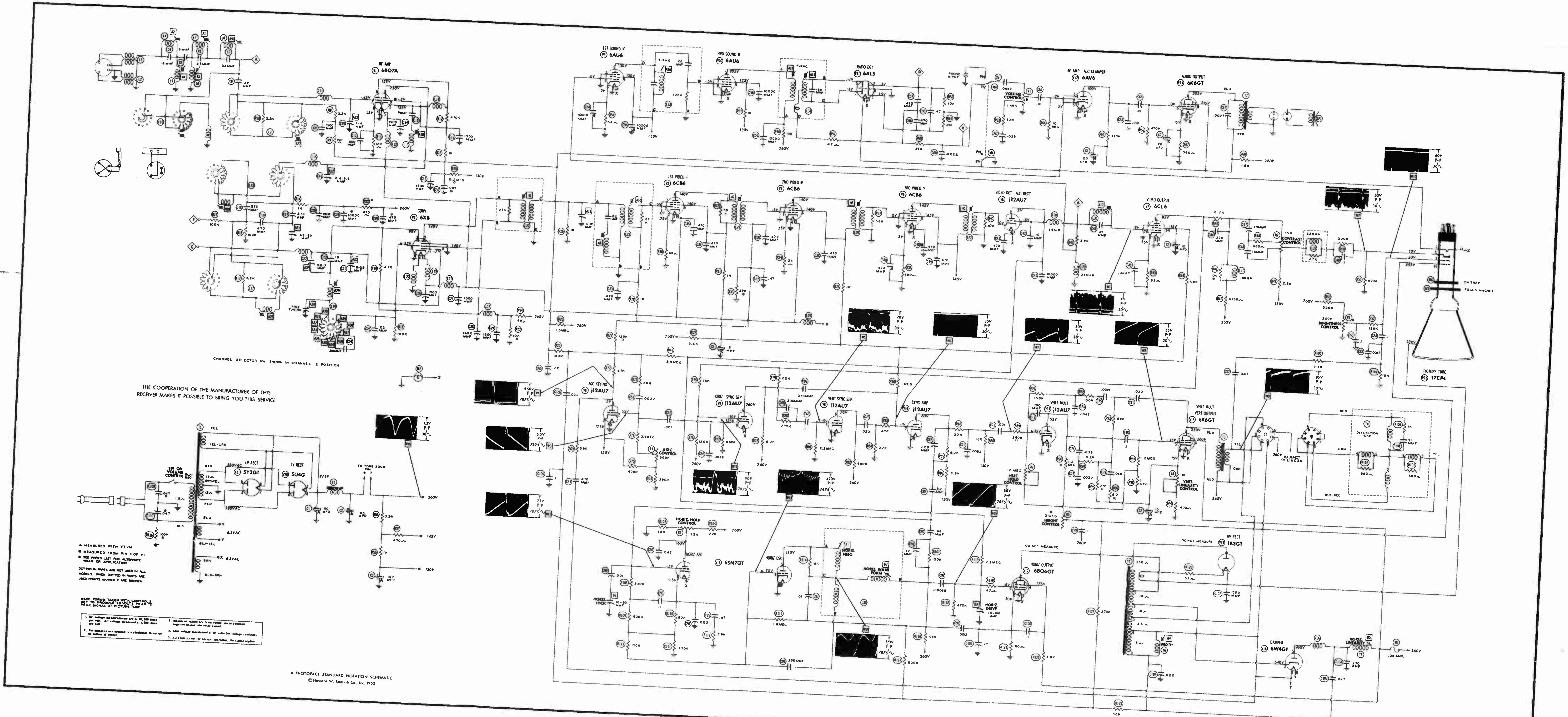
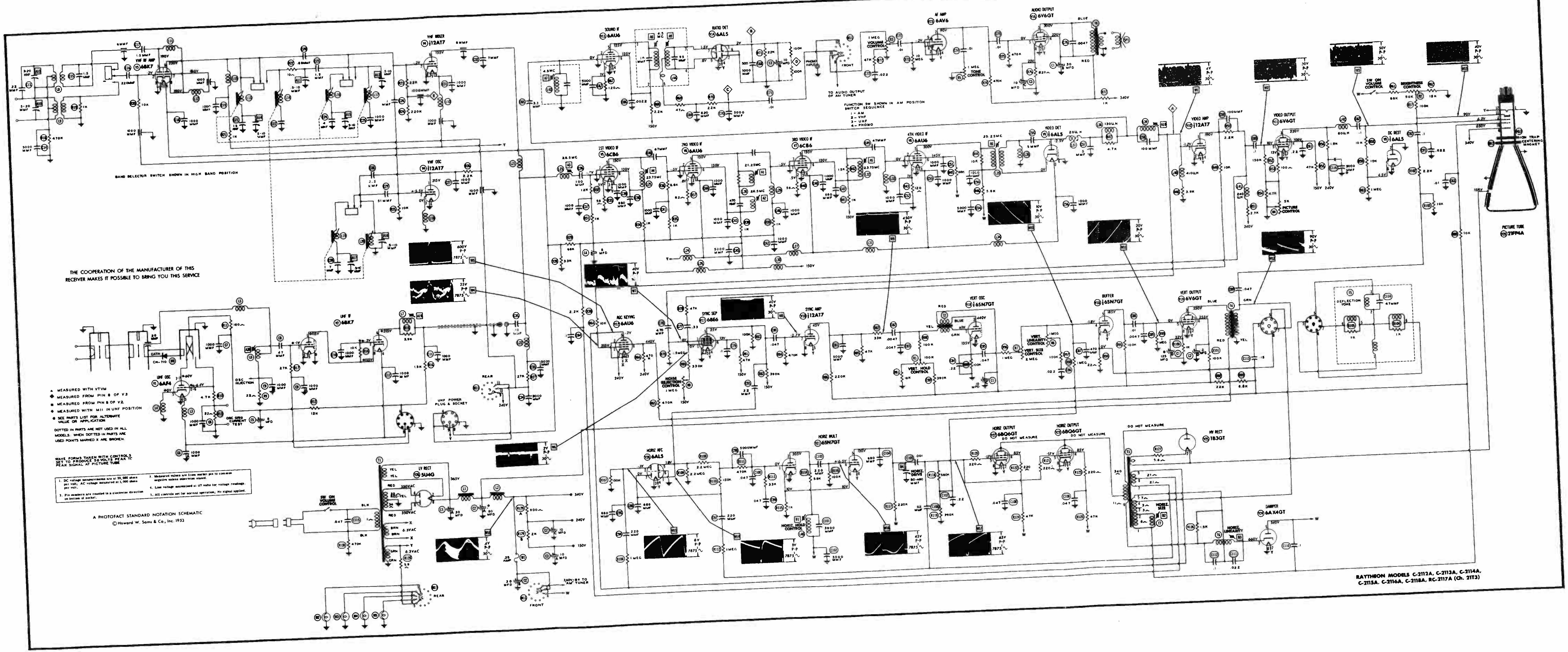


RCA VICTOR MODELS 17-T-301, U, 17-T-302, U, 17-T-310, U (Ch. KCS78, B)


THE COOPERATION OF THE MANUFACTURER OF THIS
RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
BAND SELECTOR SWITCH SHOWN IN HIGH BAND POSITION
MEASURED WITH VTVM
MEASURED FROM PIN 8 OF V3
MEASURED FROM PIN 8 OF V2
MEASURED WITH M11 IN UHF POSITION
SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
A PHOTOFACT STANDARD NOTATION SCHEMATIC
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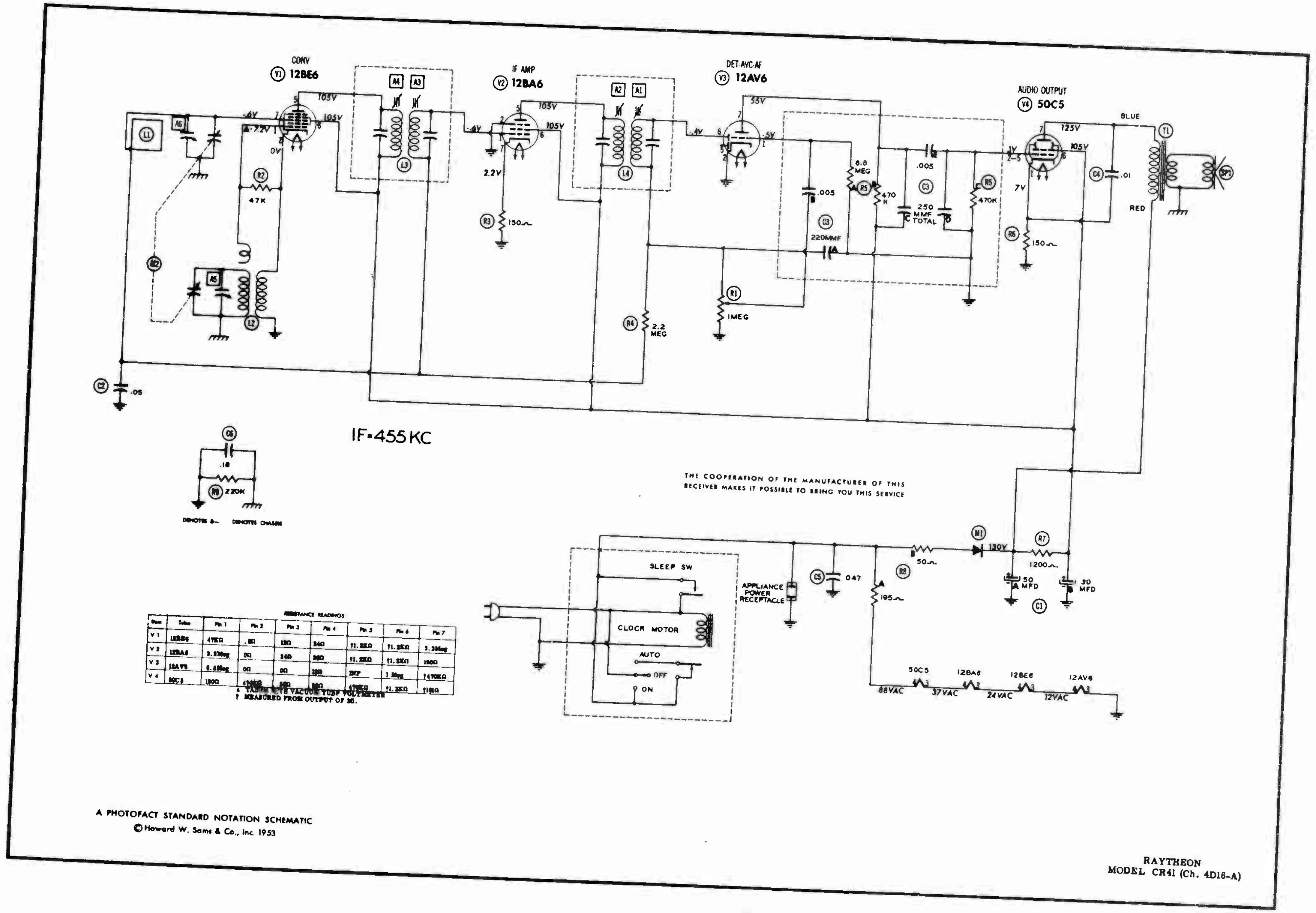
FUNCTION SW SHOWN IN AM POSITION
SWITCH SEQUENCE
1 - AM
2 - VHF
3 - UHF
4 - PHONO
TO AUDIO OUTPUT OF AM TUNER
VHF RF AMP 6BK7
VHF MIXER 12AT7
VHF OSC 12AT7
UHF OSC 6AF4
UHF IF 6BK7
SOUND IF 6AU6
RATIO DET 6AL5
AF AMP 6AV6
AUDIO OUTPUT 6V6GT
1ST VIDEO IF 6CB6
2ND VIDEO IF 6AU6
3RD VIDEO IF 6CB6
4TH VIDEO IF 6AU6
VIDEO DET 6AL5
VIDEO AMP 12AT7
VIDEO OUTPUT 6V6GT
DC REST 6AL5
PICTURE TUBE 21FP4A
ION TRAP CENTERING MAGNET
AGC KEYING 6AU6
SYNC SEP 6BE6
SYNC AMP 12AT7
VERT OSC 6SN7GT
BUFFER 6SN7GT
VERT OUTPUT 6V6GT
HORIZ AFC 6AL5
HORIZ MULT 6SN7GT
HORIZ OUTPUT 6BQ6GT
HV RECT 1B3GT
DAMPER 6AX4GT
LV RECT 5U4G
DO NOT MEASURE
RAYTHEON MODELS C-2112A, C-2113A, C-2114A,
C-2115A, C-2116A, C-2118A, RC-2117A (Ch. 21T3)



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	12BE6	47KΩ	.8Ω	12Ω	24Ω	†1.2KΩ	†1.2KΩ	3.3Meg
V 2	12BA6	3.3Meg	0Ω	24Ω	36Ω	†1.2KΩ	†1.2KΩ	180Ω
V 3	12AV6	[illegible]Meg	0Ω	0Ω	12Ω	INF	1 Meg	†470KΩ
V 4	50C5	180Ω	470KΩ	24Ω	36Ω	470KΩ	†1.2KΩ	†181Ω

‡ VALUES WITH VACUUM TUBE VOLTMETER
† MEASURED FROM OUTPUT OF M1.

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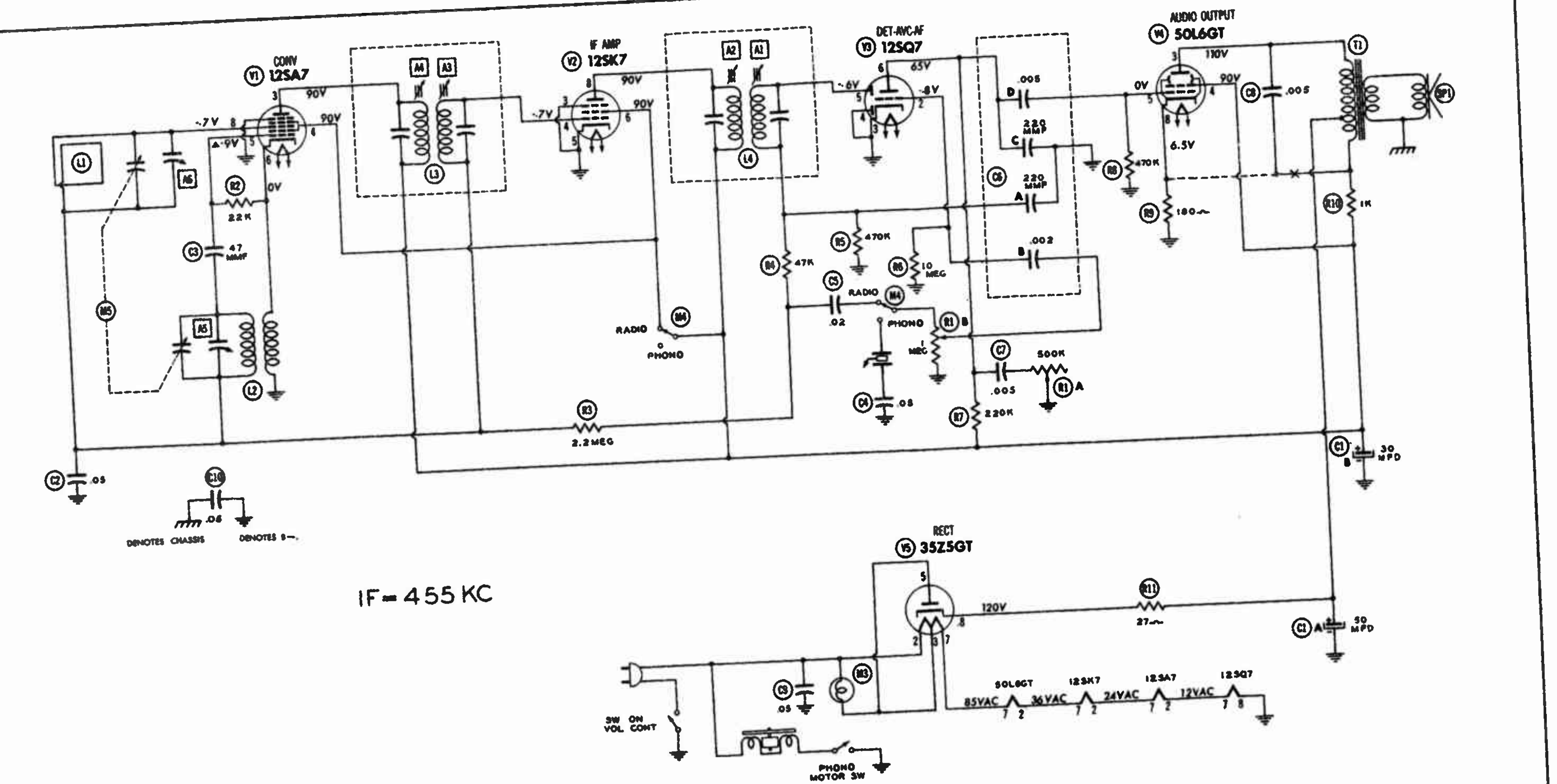
RAYTHEON
MODEL CR41 (Ch. 4D16-A)

1- DC voltage measurements are at 20,000 ohms per volt, AC voltages measured at 1000 ohms per volt.
2- Socket connections are shown as bottom views.
3- Measured values are from socket pin to common negative.
4- Line voltage maintained at 117 volts for voltage readings.
5- Nominal tolerance on component values makes possible a variation of ± 15% in voltage and resistance readings.
6- Volume control at maximum, no signal applied for voltage measurements.



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	12SA7	90Ω	13Ω	†1KΩ	†1KΩ	22KΩ	1.4Ω	24Ω	2.7Meg
V 2	12SK7	90Ω	24Ω	0Ω	2.7Meg	0Ω	†1KΩ	36Ω	1KΩ
V 3	12SQ7	9Ω	10Meg	0Ω	0Ω	470KΩ	†220KΩ	12Ω	0Ω
V 4	50L6GT	INF	36Ω	124Ω	†1KΩ	470KΩ	0Ω	36Ω	160Ω
V 5	35Z5GT	INF	12Ω	103Ω	INF	103Ω	INF	86Ω	50KΩ

ALL MEASUREMENTS TAKEN IN RADIO POSITION
† MEASURED FROM PIN 8 OF V5
▲ TAKEN WITH VACUUM VOLTMETER
¶ MEASURED FROM CHASSIS

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SILVERTONE
MODEL 1040

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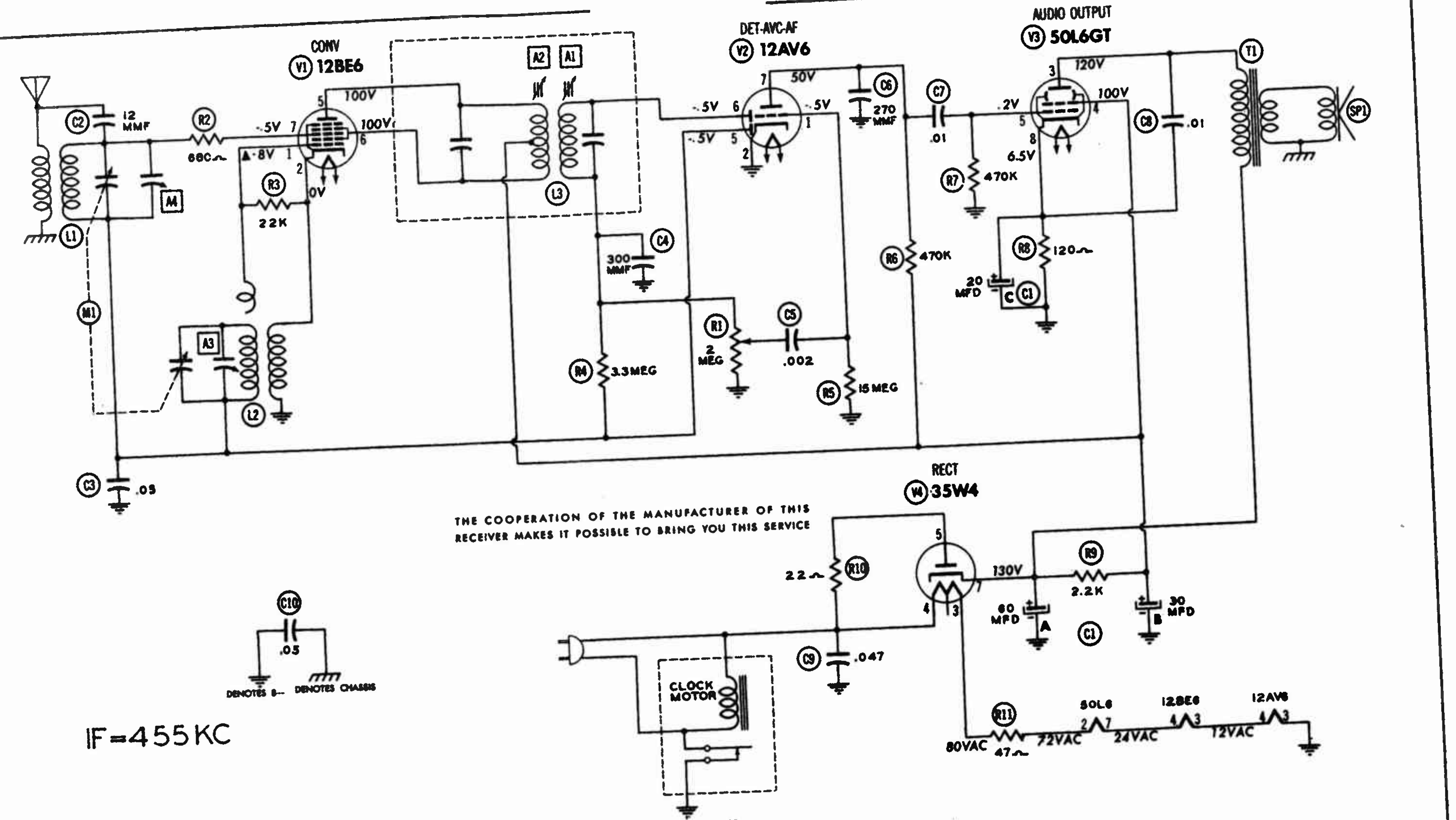
1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



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RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	12BE6	22KΩ	.6Ω	20Ω	37Ω	†2200Ω	†2200Ω	5.3Meg	
V 2	12AV6	15 Meg	0Ω	0Ω	20Ω	5.3Meg	1.5Meg	†470KΩ	
V 3	50L6GT	INF	75Ω	†2000Ω	†2200Ω	470KΩ	INF	37Ω	120Ω
V 4	35W4	INF	INF	122Ω	165Ω	157Ω	155Ω	200KΩ	

▲ TAKEN WITH VACUUM TUBE VOLTMETER
† MEASURED FROM PIN 7 OF V4

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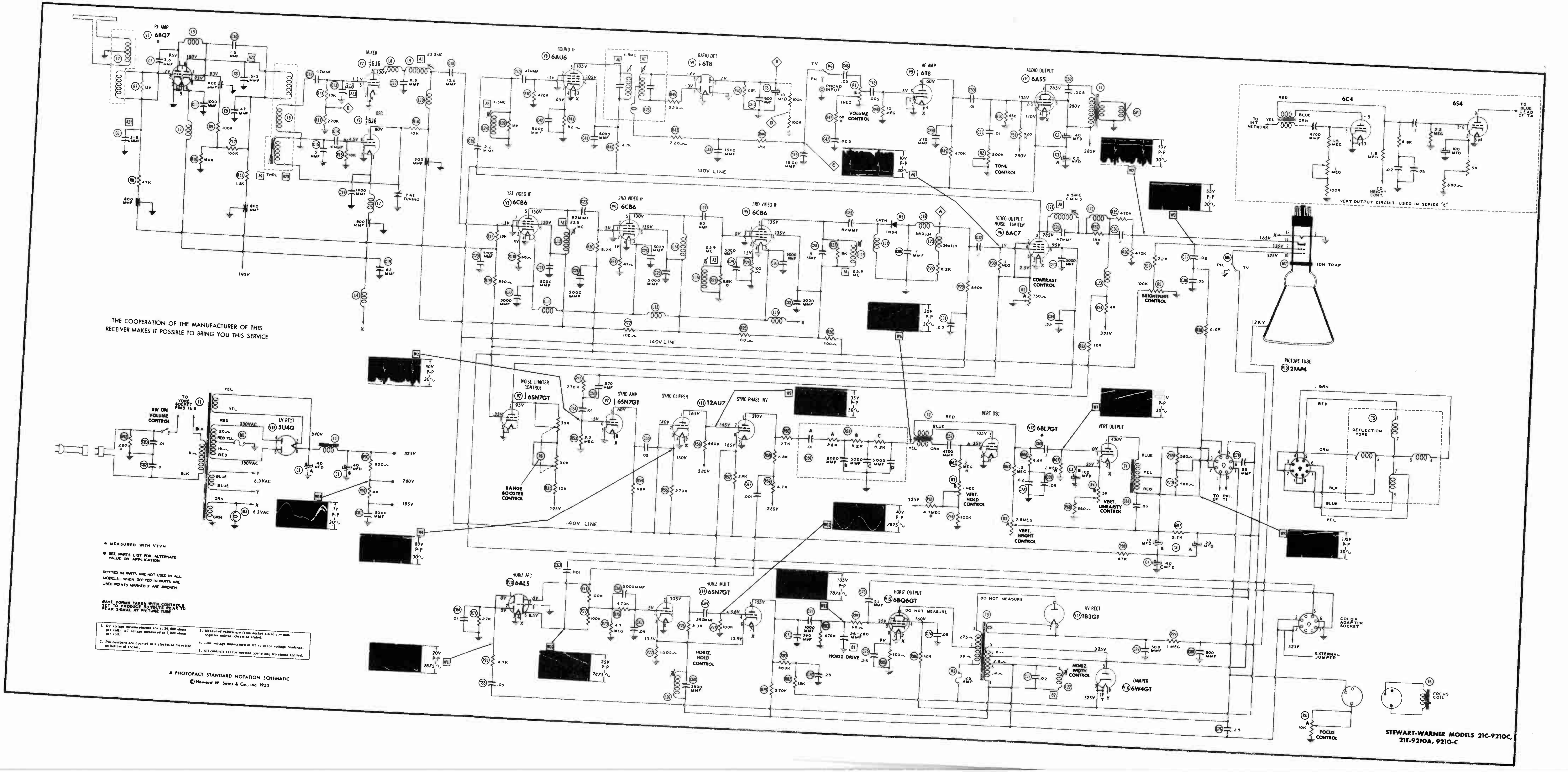
SILVERTONE
MODEL 2007 (Ch. 757.100)

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



RF AMP
6BQ7
MIXER
6J6
OSC
SOUND IF
6AU6
RATIO DET
6T8
AF AMP
6T8
AUDIO OUTPUT
6AS5
VOLUME CONTROL
TONE CONTROL
PHONO INPUT
VERT OUTPUT CIRCUIT USED IN SERIES "E"
6C4
6S4
TO BLUE LEAD OF T4
TO HEIGHT CONT.
140V LINE
1ST VIDEO IF
6CB6
2ND VIDEO IF
6CB6
3RD VIDEO IF
6CB6
VIDEO OUTPUT NOISE LIMITER
6AC7
CONTRAST CONTROL
BRIGHTNESS CONTROL
ION TRAP
12KV
PICTURE TUBE
21AP4
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
NOISE LIMITER CONTROL
6SN7GT
SYNC AMP
6SN7GT
SYNC CLIPPER
12AU7
SYNC PHASE INV
VERT OSC
6BL7GT
VERT OUTPUT
RANGE BOOSTER CONTROL
VERT. HOLD CONTROL
VERT. LINEARITY CONTROL
VERT. HEIGHT CONTROL
DEFLECTION YOKE
LV RECT
5U4G
SW ON VOLUME CONTROL
TO YOKE SOCKET PINS 1 & 8
325V
280V
195V
6.3VAC
▲ MEASURED WITH VTVM
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
A PHOTOFACT STANDARD NOTATION SCHEMATIC
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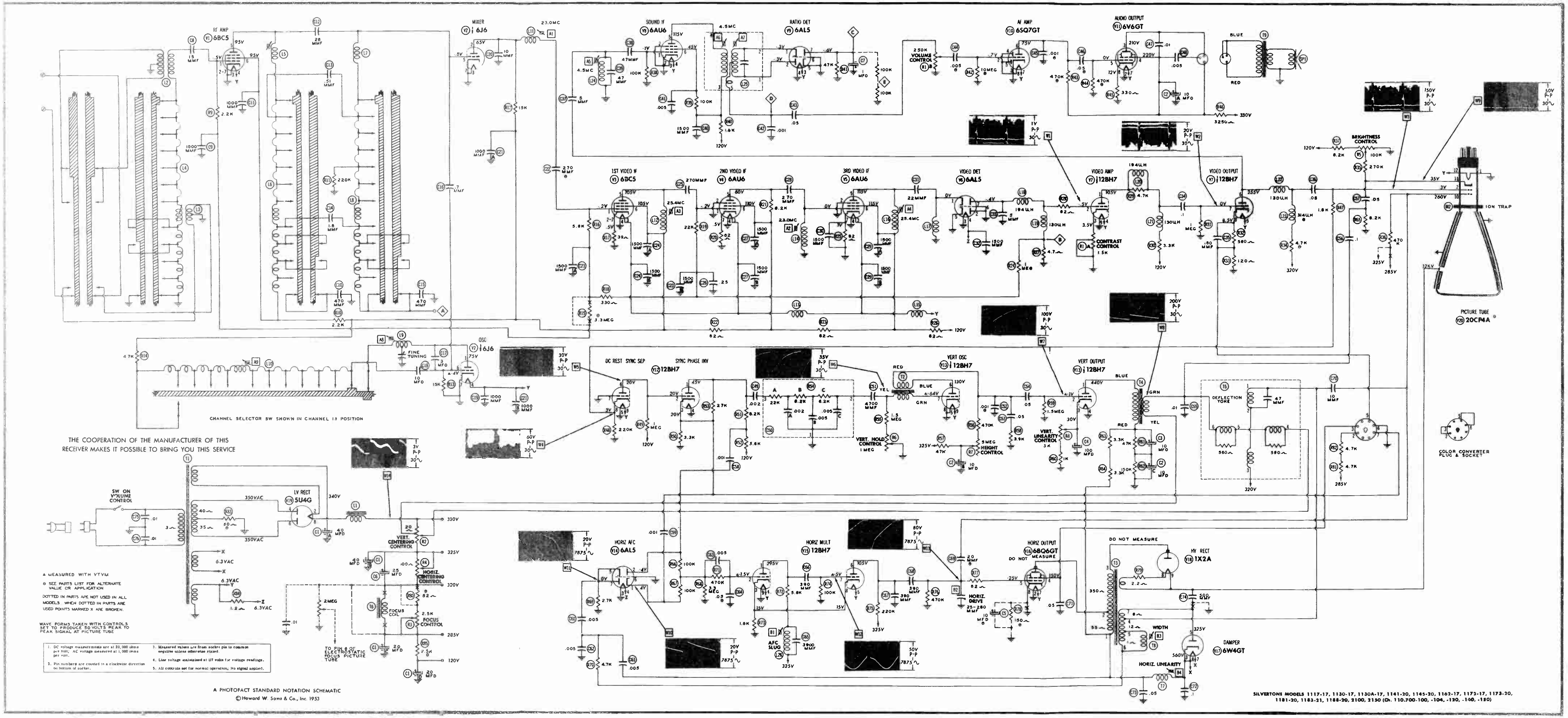
HORIZ AFC
6AL5
HORIZ MULT
6SN7GT
HORIZ. HOLD CONTROL
HORIZ. DRIVE
HORIZ OUTPUT
6BQ6GT
DO NOT MEASURE
HV RECT
1B3GT
HORIZ. WIDTH CONTROL
DAMPER
6W4GT
COLOR ADAPTOR SOCKET
EXTERNAL JUMPER
FOCUS CONTROL
FOCUS COIL
STEWART-WARNER MODELS 21C-9210C, 21T-9210A, 9210-C



RF AMP (V1) 6BC5
MIXER (V2) ½ 6J6
OSC (V2) ½ 6J6
SOUND IF (V8) 6AU6
RATIO DET (V9) 6AL5
AF AMP (V10) 6SQ7GT
AUDIO OUTPUT (V11) 6V6GT
1ST VIDEO IF (V3) 6BC5
2ND VIDEO IF (V4) 6AU6
3RD VIDEO IF (V5) 6AU6
VIDEO DET (V6) 6AL5
VIDEO AMP (V7) ½ 12BH7
VIDEO OUTPUT (V7) ½ 12BH7
PICTURE TUBE (V20) 20CP4A
DC REST SYNC SEP
SYNC PHASE INV (V12) 12BH7
VERT OSC (V13) ½ 12BH7
VERT OUTPUT (V13) ½ 12BH7
LV RECT (V19) 5U4G
HORIZ AFC (V14) 6AL5
HORIZ MULT (V15) 12BH7
HORIZ OUTPUT (V16) 6BQ6GT
HV RECT (V18) 1X2A
DAMPER (V17) 6W4GT
BRIGHTNESS CONTROL
CONTRAST CONTROL
VOLUME CONTROL
FINE TUNING
VERT. HOLD CONTROL
VERT. LINEARITY CONTROL
HEIGHT CONTROL
VERT. CENTERING CONTROL
HORIZ. CENTERING CONTROL
FOCUS CONTROL
FOCUS COIL
HORIZ. DRIVE
HORIZ. LINEARITY
WIDTH
AFC SLUG
DEFLECTION YOKE
ION TRAP
COLOR CONVERTER PLUG & SOCKET
SW ON VOLUME CONTROL
DO NOT MEASURE
CHANNEL SELECTOR SW SHOWN IN CHANNEL 13 POSITION
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
▲ MEASURED WITH VTVM
⊖ SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
TO PIN 6 OF ELECTROSTATIC FOCUS PICTURE TUBE
A PHOTOFACT STANDARD NOTATION SCHEMATIC
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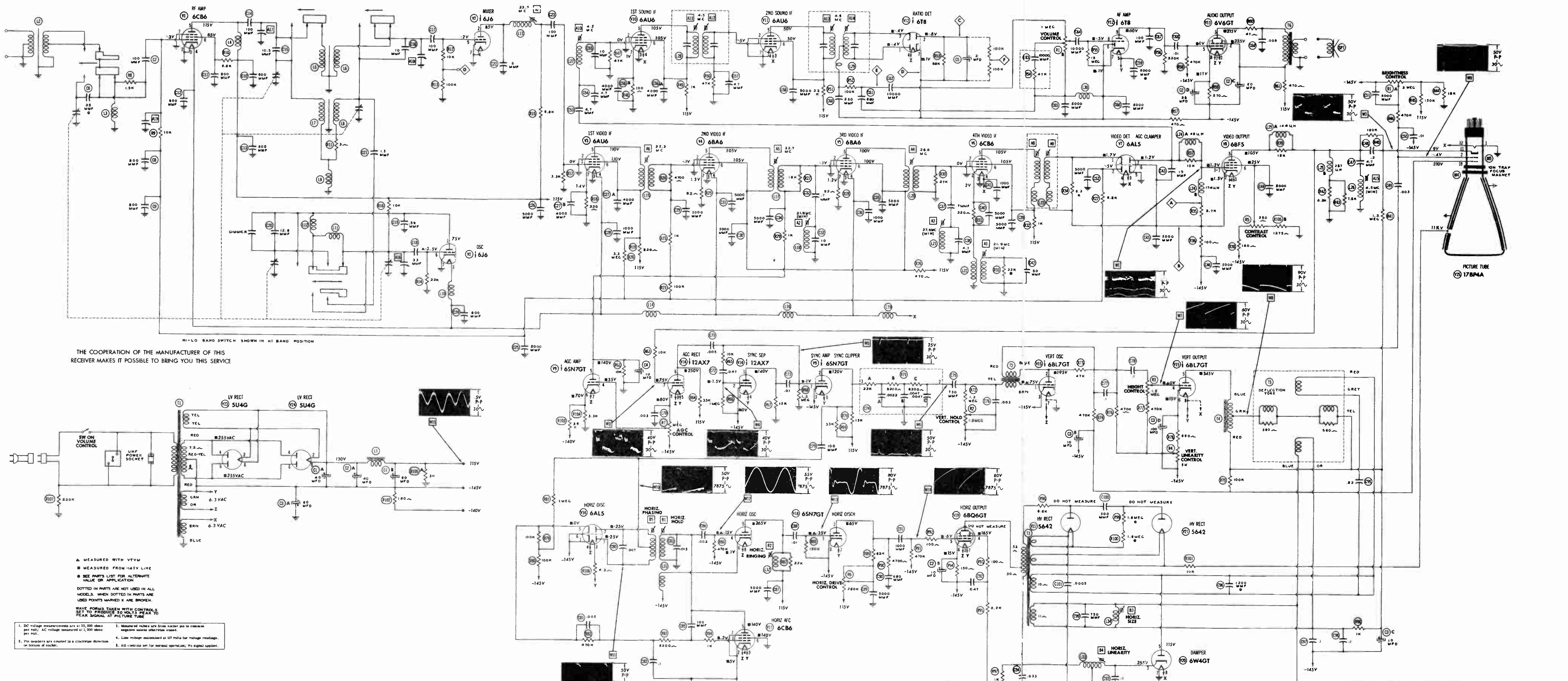
SILVERTONE MODELS 1117-17, 1130-17, 1130A-17, 1141-20, 1145-20, 1162-17, 1172-17, 1173-20, 1181-20, 1183-21, 1188-20, 2100, 2150 (Ch. 110.700-100, -104, -120, -140, -150)



THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

▲ MEASURED WITH VTVM

■ MEASURED FROM -145V LINE

● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION

DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.

WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE

1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation, No signal applied.

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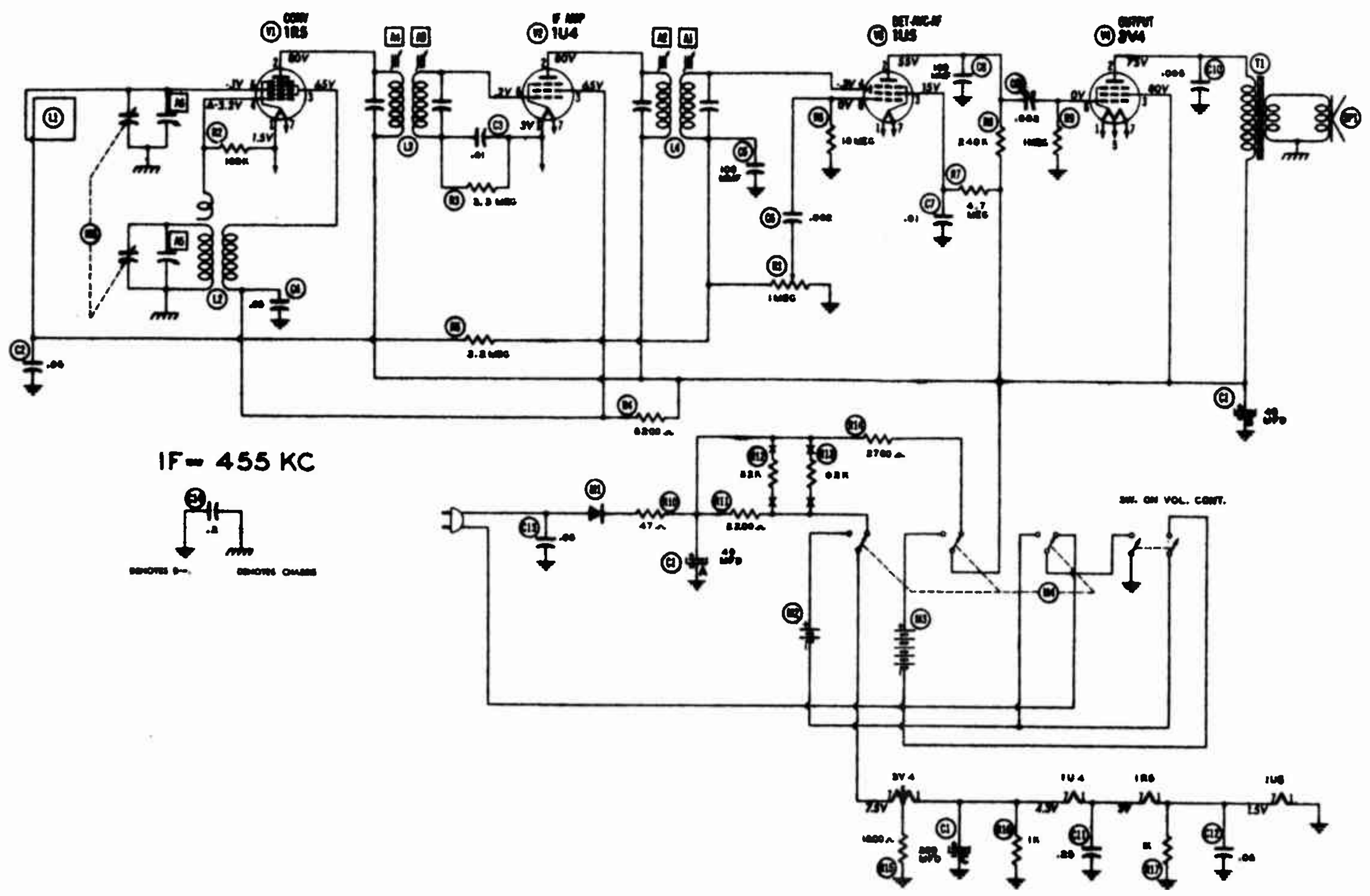
SYLVANIA MODELS 150A, L, 155A, L, M (Ch. 1-437-3) (Codes C06 and up)



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	IR5	•	†2.7KΩ	†11KΩ	100KΩ	•	3.2Meg	•
V 2	1U4	•	†2.7KΩ	†11KΩ	3.2Meg	•	3.3Meg	•
V 3	1U5	•	†240KΩ	†4.7Meg	1Meg	0Ω	10Meg	•
V 4	3V4	•	†3.2KΩ	†2.7KΩ	INF	•	1Meg	•

† MEASURED FROM OUTPUT OF M1

* DO NOT USE OHMMETER TO MEASURE FILAMENT RESISTANCE

▲ TAKEN WITH VACUUM TUBE VOLTMETER

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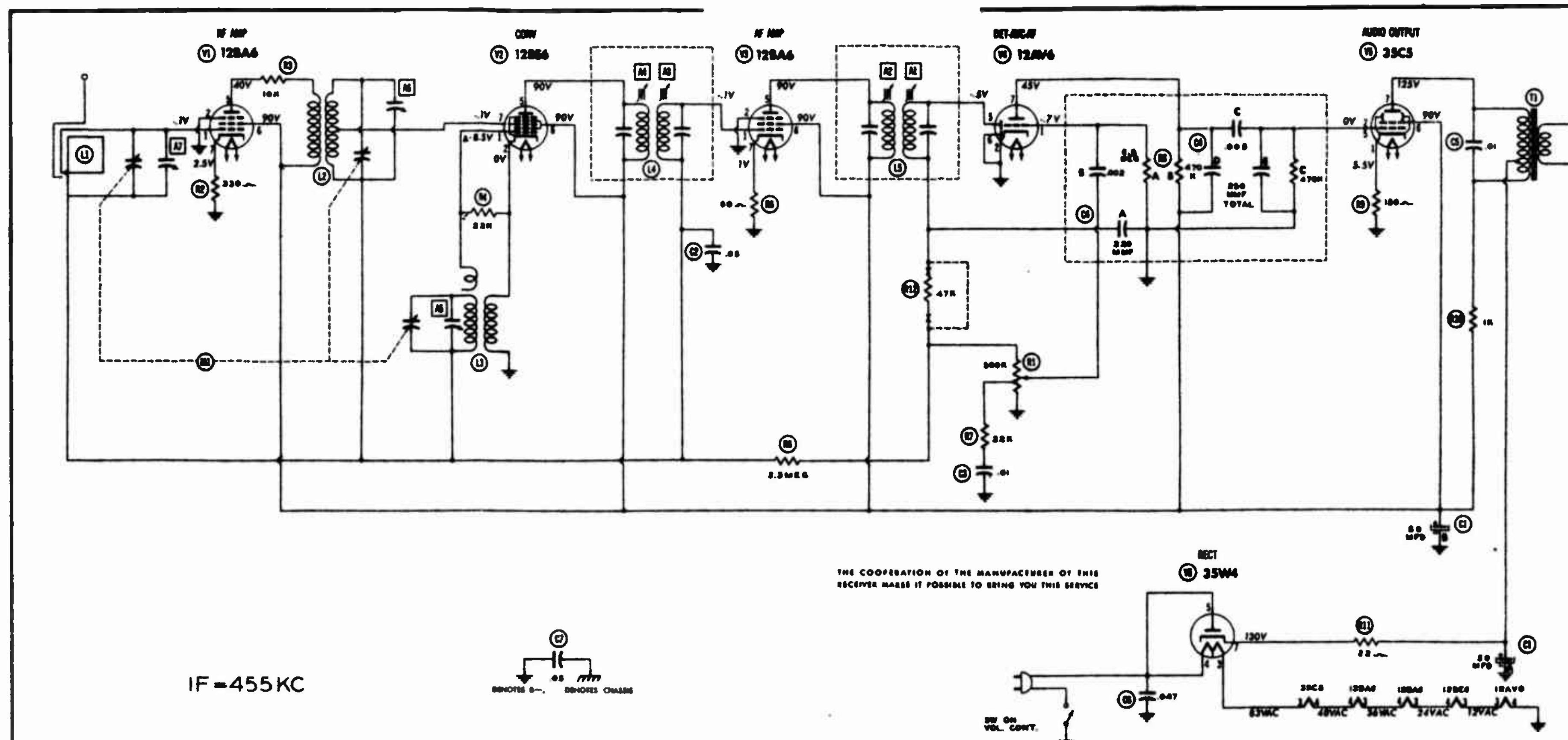
165-15

SYLVANIA
MODEL 430L

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	12BA6	3.8Meg	0Ω	24Ω	36Ω	†11KΩ	†1KΩ	330Ω
V 2	12BE6	22KΩ	1Ω	12Ω	24Ω	†1KΩ	†1KΩ	3.8Meg
V 3	12BA6	3.8Meg	0Ω	36Ω	48Ω	†1KΩ	†1KΩ	68Ω
V 4	12AV6	6.8Meg	0Ω	12Ω	0Ω	550KΩ	0Ω	†470KΩ
V 5	35C5	150Ω	470KΩ	83Ω	48Ω	470KΩ	†1KΩ	†194Ω
V 6	35W4	†22Ω	INF	83Ω	118Ω	118Ω	100Ω	40KΩ

† MEASURED FROM PIN 7 OF V6

▲ TAKEN WITH VACUUM TUBE VOLTMETER

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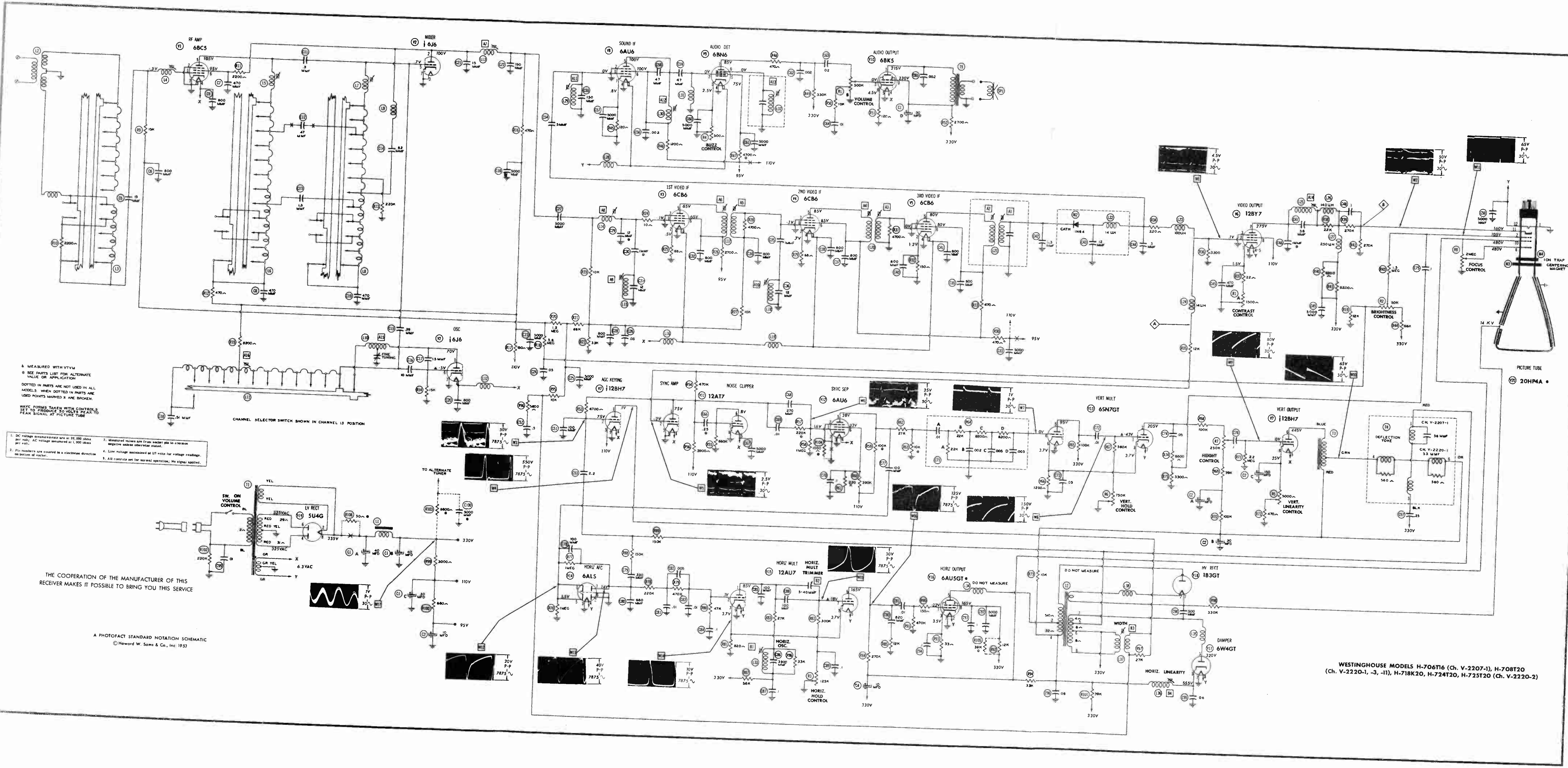
WESTINGHOUSE
MODEL H-3[illegible]T6 (Ch. V-2[illegible]-1)

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



RF AMP 6BC5
MIXER ½6J6
OSC ½6J6
SOUND IF 6AU6
AUDIO DET 6BN6
AUDIO OUTPUT 6BK5
VOLUME CONTROL
BUZZ CONTROL
1ST VIDEO IF 6CB6
2ND VIDEO IF 6CB6
3RD VIDEO IF 6CB6
VIDEO OUTPUT ½12BY7
CONTRAST CONTROL
BRIGHTNESS CONTROL
FOCUS CONTROL
ION TRAP CENTERING MAGNET
PICTURE TUBE 20HP4A
AGC KEYING ½12BH7
SYNC AMP
NOISE CLIPPER 12AT7
SYNC SEP 6AU6
VERT MULT 6SN7GT
VERT. HOLD CONTROL
HEIGHT CONTROL
VERT OUTPUT ½12BH7
VERT. LINEARITY CONTROL
DEFLECTION YOKE
LV RECT 5U4G
SW. ON VOLUME CONTROL
TO ALTERNATE TUNER
FINE TUNING
HORIZ AFC 6AL5
HORIZ MULT 12AU7
HORIZ. MULT TRIMMER
HORIZ. OSC.
HORIZ. HOLD CONTROL
HORIZ OUTPUT 6AU5GT
DO NOT MEASURE
HV RECT 1B3GT
WIDTH
HORIZ. LINEARITY
DAMPER 6W4GT
CHANNEL SELECTOR SWITCH SHOWN IN CHANNEL 13 POSITION
▲ MEASURED WITH VTVM
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
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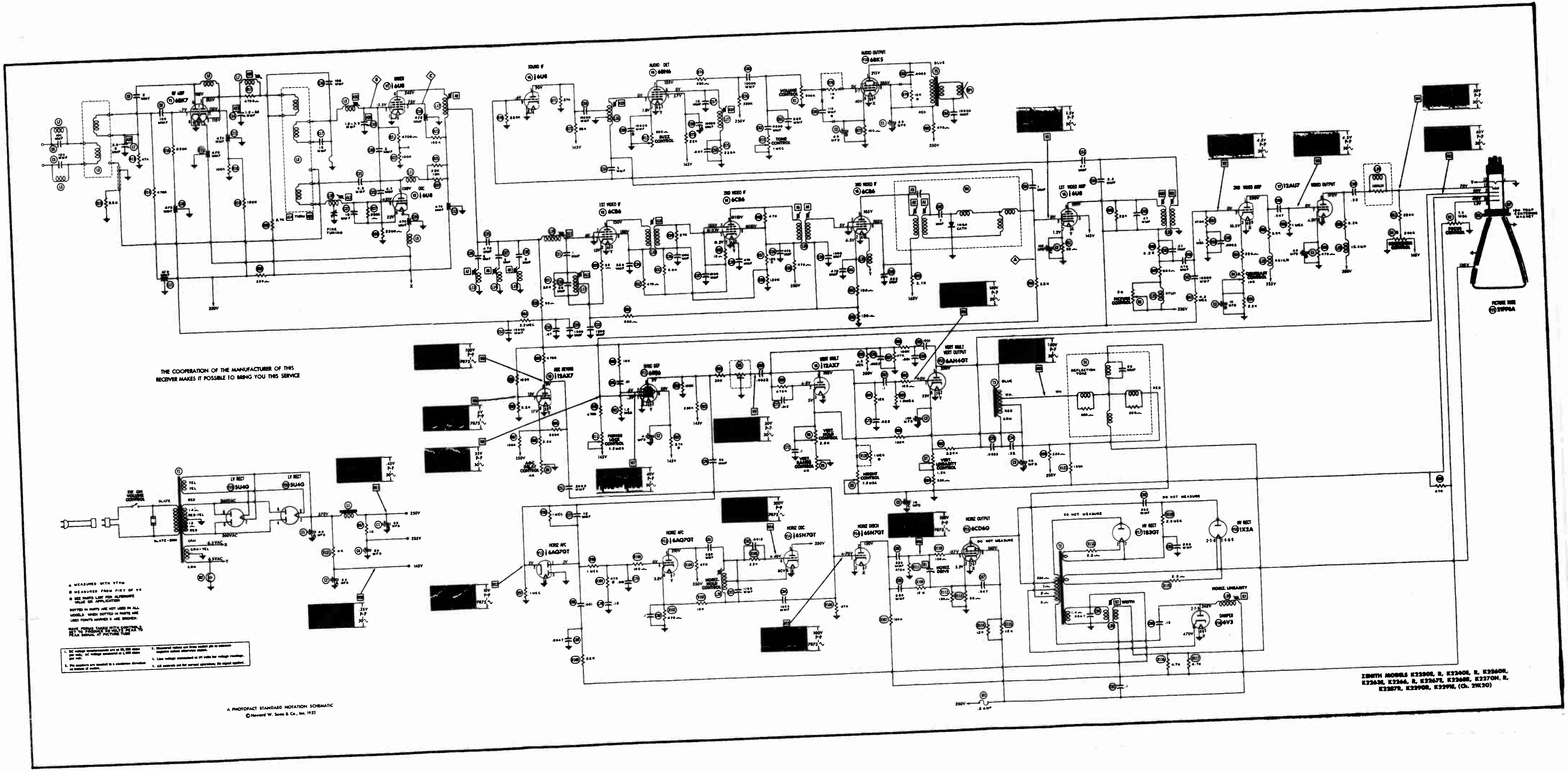
WESTINGHOUSE MODELS H-706T16 (Ch. V-2207-1), H-708T20 (Ch. V-2220-1, -3, -11), H-718K20, H-724T20, H-725T20 (Ch. V-2220-2)



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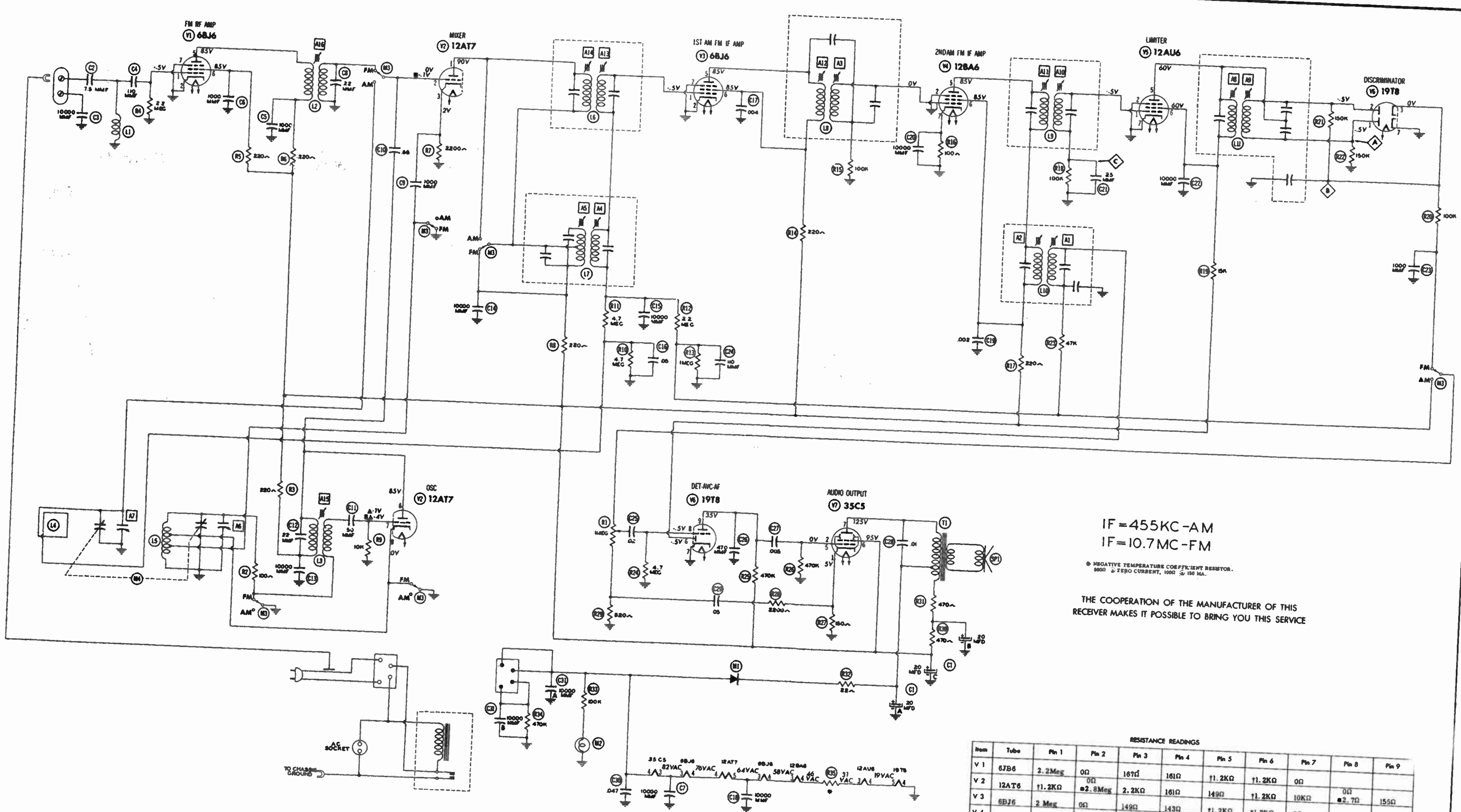
ZENITH MODELS K2230E, R, K2240E, R, K2260R, K2263E, K2266, R, K2267E, K2268R, K2270H, R, K2287R, K2290R, K2291E, (Ch. 21K20)



IF=455KC-AM
IF=10.7MC-FM

THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V 1	6JB6	2.2Meg	0Ω	167Ω	161Ω	†1.2KΩ	†1.2KΩ	0Ω		
V 2	12AT6	†1.2KΩ	0Ω ■2.8Meg	2.2KΩ	161Ω	149Ω	†1.2KΩ	10KΩ	0Ω ■2.7Ω	155Ω
V 3	6BJ6	2 Meg	0Ω	149Ω	143Ω	†1.2KΩ	†1.2KΩ	0Ω		
V 4	12BA6	100KΩ	0Ω	143Ω	131Ω	†1.2KΩ	†1.2KΩ	100Ω		
V 5	12AU6	100KΩ	0Ω	31Ω	19Ω	†16KΩ	†16KΩ	0Ω		
V 6	19T8	160KΩ 180KΩ	160KΩ ■180KΩ	250KΩ ■330KΩ	0Ω	19Ω	1 Meg ■550KΩ	0Ω	4.7 Meg	†470KΩ
V 7	35C5	150Ω	470KΩ	167Ω	202Ω	470KΩ	†965Ω	†297Ω		

ALL MEASUREMENTS TAKEN IN "FM" POSITION UNLESS NOTED
† MEASURED FROM OUTPUT OF M1
■ MEASURED IN "AM" POSITION
▲ TAKEN WITH VACUUM TUBE VOLTMETER

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.

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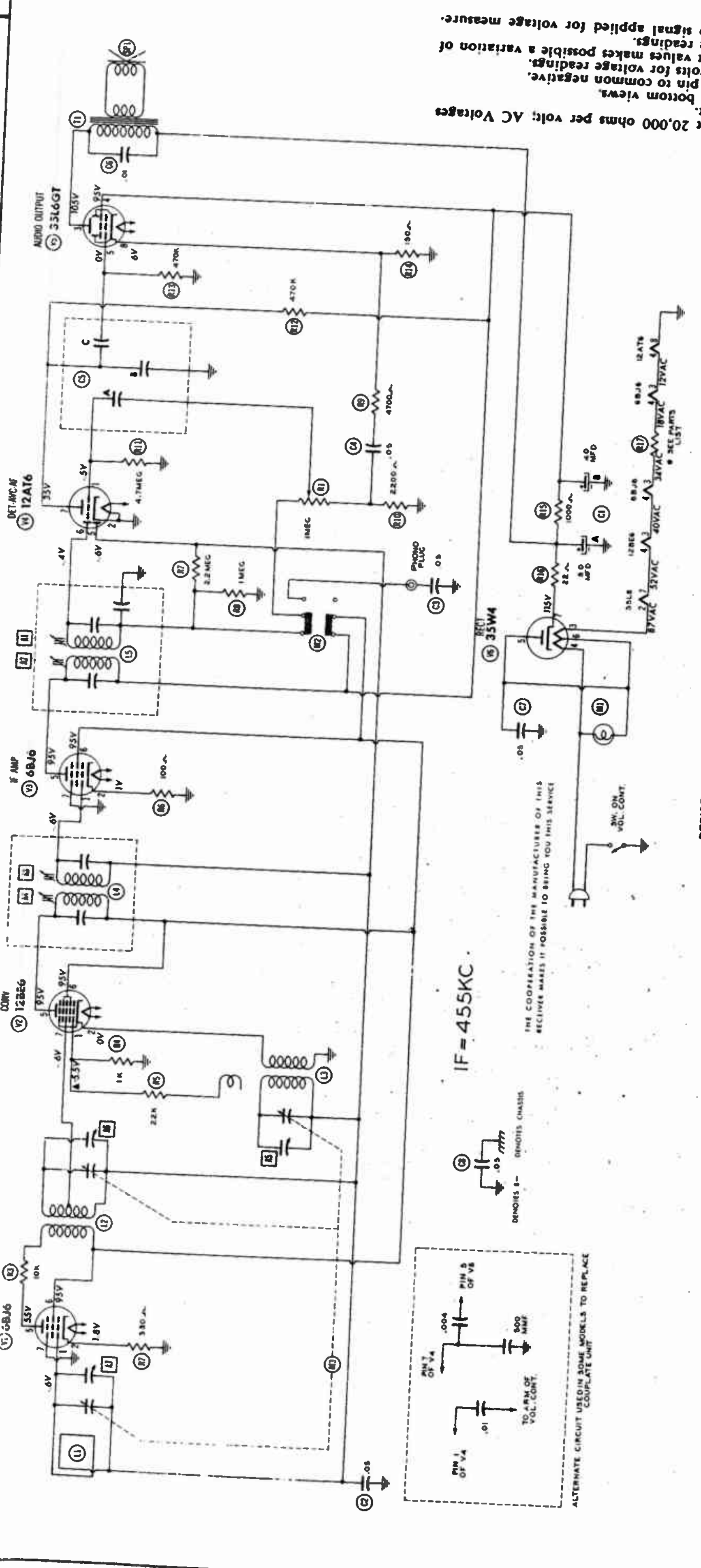
ZENITH J-733 G.R.Y. CH. 7-503

ZENITH
MODEL H615Z1 (Ch. 6G05Z1)

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	6BJ6	2.7Meg.	330Ω	118Ω	124	†1KΩ	†1KΩ	0Ω	
V 2	12BE6	22KΩ	16Ω	124Ω	136Ω	†1KΩ	†1KΩ	2.7Meg.	
V 3	6BJ6	2.7Meg.	100Ω	12Ω	18Ω	†1KΩ	†1KΩ	0Ω	
V 4	12AT6	4.7Meg.	0Ω	0Ω	12Ω	2.7Meg.	500KΩ	†470KΩ	
V 5	35L6GT	INF	171Ω	†287Ω	†1KΩ	47DKΩ	†27Ω	136Ω	150Ω
V 6	35W4	4.8KΩ	INF	171Ω	206Ω	188Ω	188Ω	65KΩ	

† MEASURED FROM PIN 7 OF V6.
▲ TAKEN WITH VACUUM TUBE VOLTMETER.

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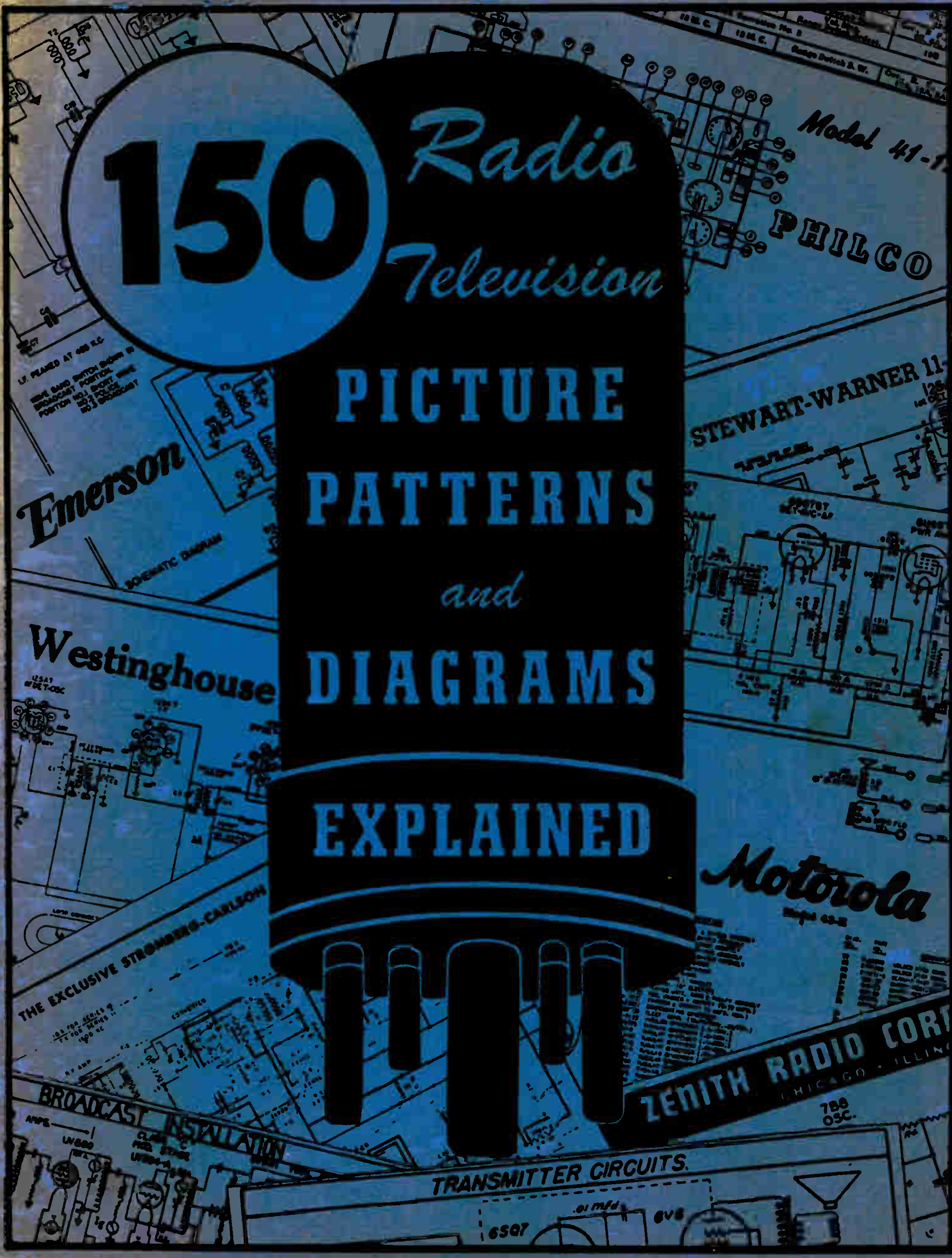
150 Radio Television

PICTURE PATTERNS and DIAGRAMS EXPLAINED



New Radio—Television Picture Patterns and Diagrams Explained

An Instruction and Reference Book on Radio and Television

Prepared and published for home study and field reference by the Educational Book Publishing Division of the Coyne Electrical and Radio School. All the data in this manual including the actual Radio diagrams has been field tested. Most of the Radio diagrams have been supplied by the research laboratories of America's leading Radio and Television companies.

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Acknowledgments

Through our close cooperation with the Electrical and Radio industry for over 50 years we have received invaluable assistance in preparing the material for this Manual. We wish to acknowledge our sincere appreciation to the following companies for their help in supplying data, illustrations and material for the preparation of this book.

Allied Radio Corp.
Electrical Contracting
Howard W. Sams & Co. Inc.
Radio Corp. of America
Radio Craft Pub. Co.
Radio & Television Retailing
Radio-Electronics
RCA Victor Co.
Western Electric

FOREWORD

THE successful Radio-TV Serviceman is the man who can read diagrams—the fellow who understands symbols, circuits and details of Radio and Television construction.

A knowledge of circuit tracing and diagram analysis is to the serviceman what a knowledge of mathematics is to an accountant. This book contains diagrams of modern radio and television sets. These diagrams have been supplied to the Educational Book Publishing Division of The Coyne Electrical School by the leading Radio and Television manufacturers of the United States. They represent an effort on the part of the Industry to help Coyne put out a practical book on **How to Read Diagrams.**

Reading radio and television diagrams can be as easy as reading a newspaper if a man has a clear conception of the various signs, and the symbols used in these diagrams.

It is the purpose of this book to make clear and easy to understand these different terms and symbols that represent the component parts of radio sets, their connections and the tracing of the current thru these parts as well as other phases of scientific radio circuit tracing.

Common terms such as circuit, current, resistance and difference of potential are often used when talking about radio.

In every case as we come upon a new symbol in the special series of instructional diagrams we have especially selected to explain modern diagram analysis, we will follow this practice:

First, we will give the definition, then we will give an illustration in everyday language. We will compare the purpose of the radio or television component with something you see in everyday life. Following this practice, you will better understand the **reason** for the various parts in a radio set as well as the way they "dovetail" with all other parts.

We will break down every part of the circuits so that you can follow the logical path of the current flowing through the radio.

Many of the diagrams in this book have been prepared by the staff of Coyne School for instructional purposes. These diagrams have special notes and analyzing instructions that make them amazingly easy to understand. These diagrams have been **SHOP TESTED** by actual on the job use. That eliminates any possibility of any technical errors.

Regardless of whether you are a "beginner" or an experienced radio man you should find the material in this book of extreme value to you. We have put a great deal of up-to-date instruction methods in Radio circuit and diagram reading in this book along with dozens of valuable commercial radio diagrams.

Radio-TV diagram reading is the same as any other reading—the more you do of it the more expert you become. To succeed in Radio and Television you must know circuit tracing so give the specially prepared material in this book careful study—it can help you increase your speed and accuracy in reading diagrams.

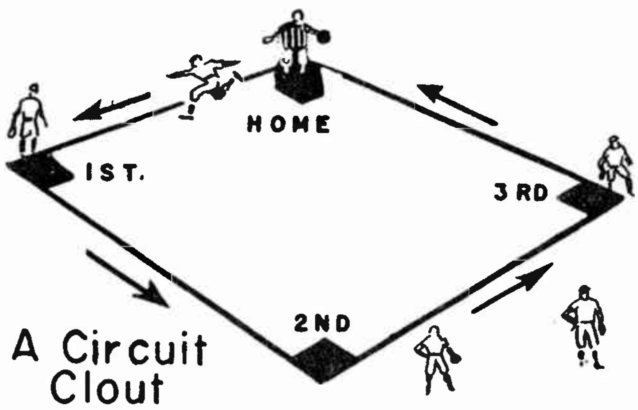
B. W. COOKE, President
Educational Book Publishing Division
Coyne Electrical and Radio School

Table of Contents

Schematic Diagrams and How to Read Them

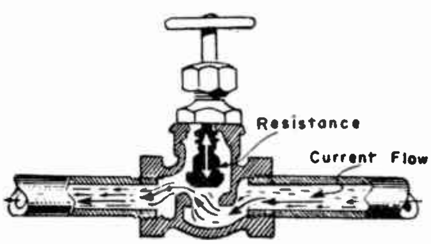
Suppose then we start with the most common expression used in radio—**a radio circuit.**

By definition "a circuit is the complete or closed path taken by an electrical current in flowing through a conductor from one terminal of the source of supply to the other."



No doubt you have often heard the expression "a circuit clout." This is used in baseball when a batter hits a home-run. It means the ball has been driven far enough to enable the batter to complete the "circuit" of bases. The bases form a closed loop or path for the batter to take, just as connecting wires form a closed loop or path for the current to take.

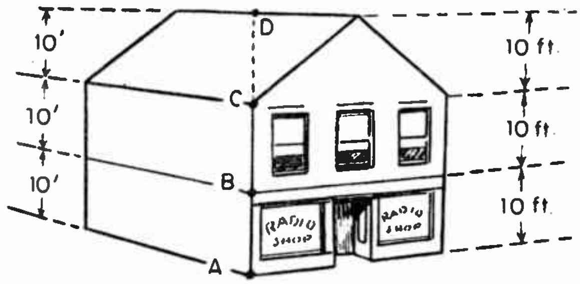
The resistance is the substance which resists or opposes the flow of current through it.



It can be compared to a valve in a water pipe to limit the flow of water.

A difference of potential or difference of pressure is the difference between the potentials or pressures at two points in a circuit.

To better understand this let's assume that we are looking at a two-story building. In measuring the distance between the street and the first floor we found it to be 10′ and the measurement to the roof was 30′. It would be correct to say that the distance between point "A" and point "B" is 10′ or that point "B" is 10′ higher than point "A". In order to make a

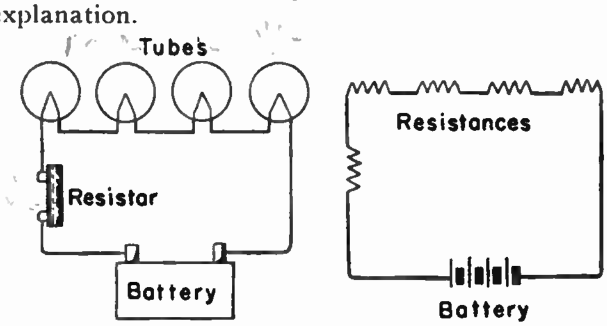


measurement we must refer one point to another. It would not be correct to say that point "C" measures 20′ because we are not sure whether the point to be measured is from "B" or "A". Point "C" does measure 20′ if we are referring it to point "A" as the other point, but it is only 10′ from point "B" or point "D".

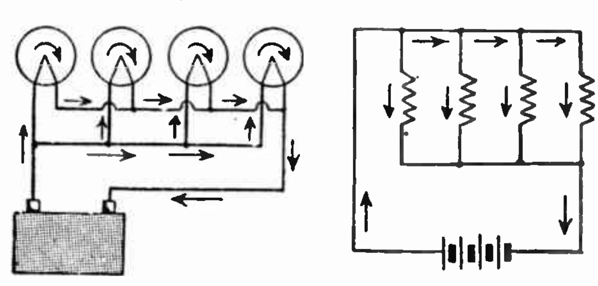
The same thing holds true in electrical circuits. The difference of potential is a measurement between a lower and a higher point in a circuit. One point is at a higher electrical degree than the other. The higher point having a deficiency of electrons while the lower point has an excess of electrons. It is the movement of these electrons that constitutes a flow of current in an electrical circuit.

The difference of potential and the opposition are circuit properties. In fact they are the determining factors as far as the current is concerned. When the opposition in any circuit is not sufficient to limit the current, wires may burn or the units connected in the circuit may be ruined beyond repair. That is the reason why they put fuses in the branch circuits in homes. To protect the conducting wires from excess current.

Diagrams are used in Radio just as blue prints are used in construction work. They tell a complete story that might otherwise require thousands of words of explanation.



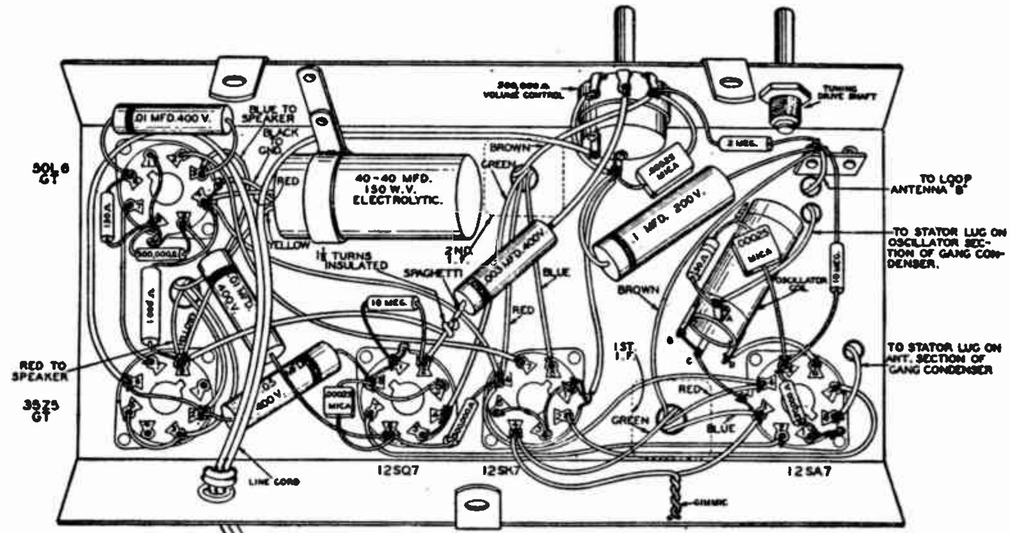
Elements of a series circuit.



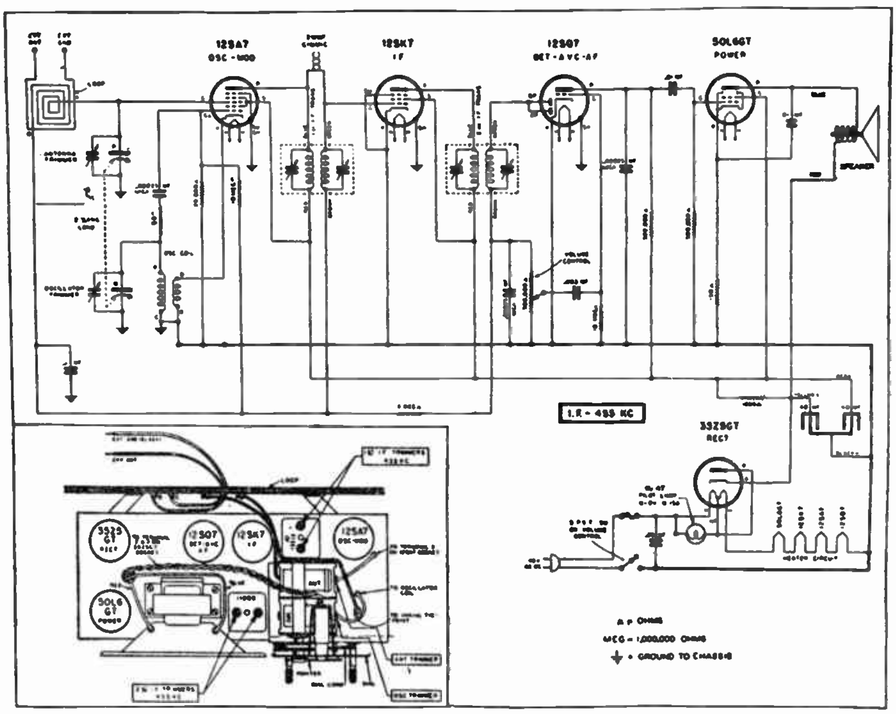
Elements of a parallel circuit.

There are several types of diagrams used, just as there are different types of maps available for the man preparing to go on a journey. He may have a "pictorial diagram" which is a diagram pertaining to or illustrated through pictures.

They make the same type of diagram in Radio for the beginner as illustrated below.



PICTORIAL DIAGRAM



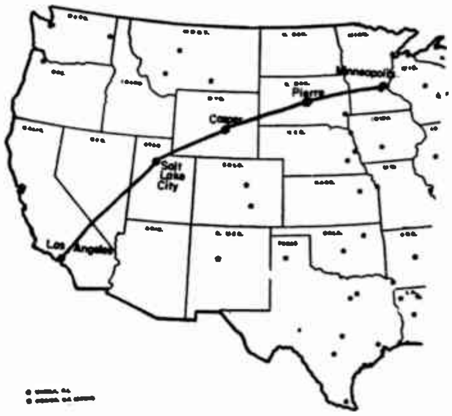
Such a diagram enables us to quickly determine the layout of all the parts. The question then arises, since a pictorial diagram has these advantages, why not use them exclusively? If we sit back for a moment and think about it, the answer would be obvious. To use these diagrams we all must be skilled or gifted with artistic talents, it takes a great deal of time and effort to put down on paper any part of the above two diagrams for the sole purpose of explaining either of them.

Consequently, certain signs, marks or symbols, easy for all of us to duplicate, have been adapted and made standard. They represent the component parts and were originated in order that we may convey or impart our information to others, quickly.

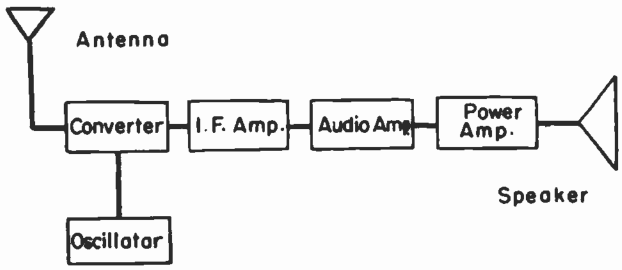
In radio a schematic diagram shows the electrical connections of a circuit by means of symbols used in place of the actual parts. Symbols to represent the different parts are simple signs, marks, or characters used as an abbreviation. It is important to learn these symbols so that all the parts may be readily identified.

Of course, it would be impossible to expect a beginner to memorize all the existing symbols in a short time, but by constant reference to radio diagrams in magazines or books you will be surprised to note how quickly and easily you have learned to identify these symbols.

Still another type of diagram is known as a "block diagram."



In the above diagram only the states are shown and the roads to take to get to them. Likewise in radio, a block diagram merely shows the connections of the different stages in block-form.



The diagram above is the easiest of all to explain in that the function of each stage is omitted, just as the road map above would be simple to direct a person interested to get at a certain point without explaining the different rivers he would have to cross and the cities that he would pass, etc.

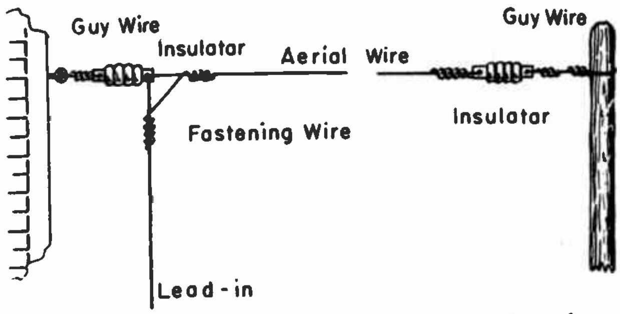
For instance, in that block diagram the electromagnetic waves radiated by means of a transmitting antenna cut the stationary conductor called the receiving antenna. These waves cause a difference of potential to be induced in the receiving antenna referred to as a signal. The converter stage receives the signal and mixes with a signal generated by the oscillator. The difference of these two signals is sent on to the I.F. stage where it is amplified, and sent to the audio stage where it is changed to an audio signal and amplified. It is received by the power amplifier where it is further amplified and moved on to the speaker.

The signal strikes a diaphragm in the speaker causing it to vibrate, thus changing the electrical impulses into sound.

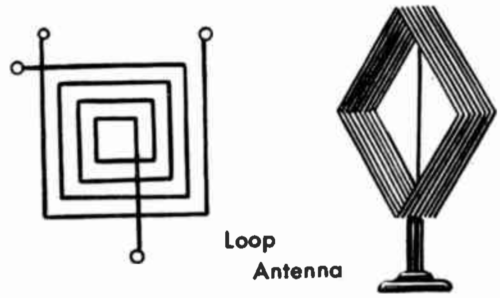
We can safely say then that block diagrams are used to give a general idea of the operating principles in a condensed form.

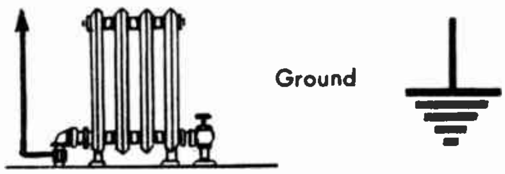
It would be well at this time to introduce some of the symbols used and show what the actual parts look like.

The antenna or aerial is a conductor used to pick up radio signals. The outdoor antenna, usually



mounted on a structure or roof is a bare wire of predetermined length. The vertical line represents the lead-in wire which makes connection between the antenna and the receiver. This type of antenna is no longer used for radio reception, but the symbol indicates an antenna regardless of design.





The loop antenna or aerial consists of complete turns of wire spaced on a rectangular frame of wood or attached to a cardboard. It is built into a receiver cabinet.

The ground connection is an earth connection. It may be a water pipe, a radiator or any pipe driven into the earth to insure good contact with the moist earth. It also indicates a connection to the chassis of the receiver.

This symbol is often used to simplify diagrams by eliminating unnecessary lines. The symbol shows the common connections in the circuit.

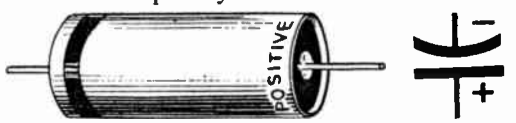
There are various types of capacitors used.

A capacitor consists of two conductors separated from each other by an insulator called a dielectric, such as air, oil, paper, glass, ceramic

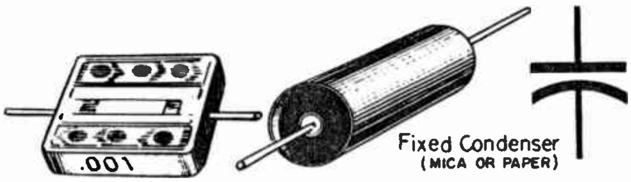
capable of storing electrical energy. They block the flow of direct current while allowing alternating and pulsating currents to pass.

Variable capacitors are used in Radio frequency and oscillator circuits. Their capacity may be conveniently varied. They are usually found in the form of a movable and fixed set of plates. The movable plates are called the rotor and the fixed plates called the stator. Air is used as a dielectric. Their main purpose is to adjust the circuits to resonance.

Padder and trimmer capacitors sometimes are mounted on the variable and can be adjusted with a screwdriver. They permit accurate alignment of the radio frequency and oscillator circuits.



Fixed Condenser - Electrolytic

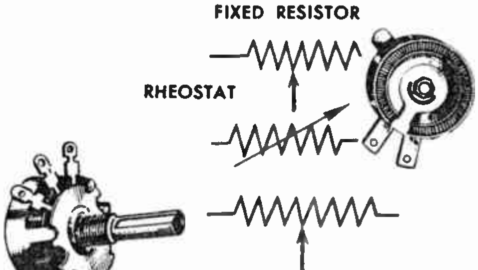


Fixed Condenser (MICA OR PAPER)

Electrolytic capacitors are a special type of fixed capacitors used in direct current circuits only. The polarity of these capacitors is clearly marked and must be observed.

These capacitors are usually found in the power supply circuit. Mica and paper capacitors are other types found in radio. The mica will be found in the radio frequency circuit, while the paper capacitor will be found almost anywhere from the low radio frequency circuits to the audio stage.


FIXED RESISTOR


RHEOSTAT

POTENTIOMETER (VOLTAGE DIVIDER)

Resistors, rheostats and potentiometers are designed to oppose the flow of current whether it be direct or alternating currents.

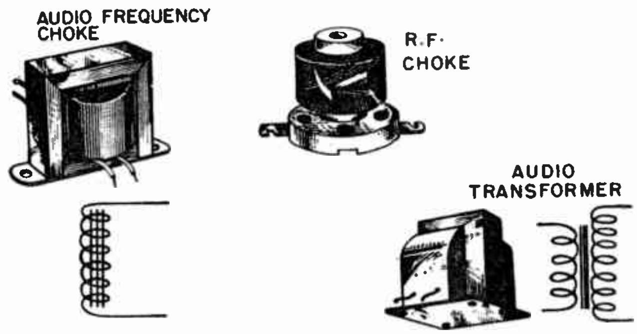
A resistor whose value remains constant is called a fixed resistor. On the other hand if the value can be changed during operation it is known as a variable resistor.

Rheostats and potentiometers are variable resistors. The rheostat can be identified by its two terminals. The potentiometers have three terminals.

There is another important property in radio circuits called inductance. It is a measure of the ability of a conductor to produce a magnetic field.

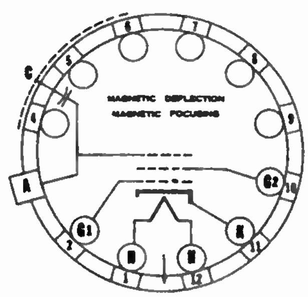
Inductance may be introduced in a circuit in the form of coils and transformers.

This property of inductance is present in a circuit only when the current changes. That is, when it is of alternating nature. As the current changes from zero to maximum the magnetic field also changes and in so doing cuts the conductor and induces in it a counter voltage which tends to oppose the change in current. You will find some type of inductance in all stages of a radio circuit.

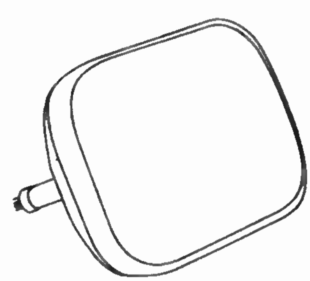


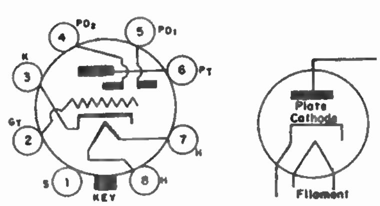
A wide variety of tubes are used in radio today. The ones most frequently encountered are the diode, the triode, the tetrode and the pentode.

Sometimes when space is limited in a radio, tubes are used that have the elements of two tubes combined in one envelope. Examples of these are the duodiode, the twin-triode, the duplex-diode pentode, etc.


12D2

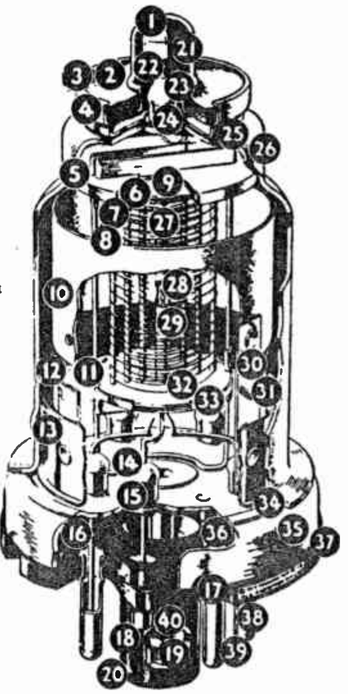
PICTURE TUBE





The schematic symbol of a tube is usually shown by the base of the socket of the tube. The tube has a marker or key that fits into a similar marker in the socket. The reason for this being a precaution against burning the elements in the tube. In this manner the tube must be inserted always in the same way. The marker or key as it is sometimes called is clearly shown at the bottom of the circle representing the tube socket. Terminals of the elements within the tube are indicated and numbered. The numbers being in a counter clockwise direction with number one located to the left of the key.

1. SOLDER
2. CAP INSULATOR
3. ROLLED LOCK
4. CAP SUPPORT
5. GRID LEAD SHIELD
6. CONTROL GRID
7. SCREEN
8. SUPPRESSOR
9. INSULATING SPACER
10. PLATE
11. MOUNT SUPPORT
12. SUPPORT COLLAR
13. GETTER TAB
14. GLASS BEAD SEAL
15. FERNICO EYELET
16. LEAD WIRE
17. CRIMPED LOCK
18. ALIGNING KEY
19. PINCHED SEAL
20. ALIGNING PLUG
21. GRID CAP
22. GRID LEAD WIRE
23. GLASS BEAD SEAL
24. FERNICO EYELET
25. BRAZED WELL
26. Steel Shell
27. CATHODE
28. HELICAL HEATER
29. CATHODE COATING
30. PLATE INS. SUPPORT
31. PLATE LEAD CONNECTION
32. INSULATING SPACER
33. SPACER SHIELD
34. SHELL TO HEADER SEAL WELD
35. HEADER
36. SHELL CONNECTION
37. OCTAL BASE
38. BASE PIN
39. SOLDER
40. EXHAUST TUBE



Cross-section of a typical RCA Metal Tube.
This diagram illustrates in detail the construction of a modern radio tube. All elements are clearly indicated. The complexity of the modern tube is here readily apparent. A good basic understanding of tube design and function is essential to good radio building.

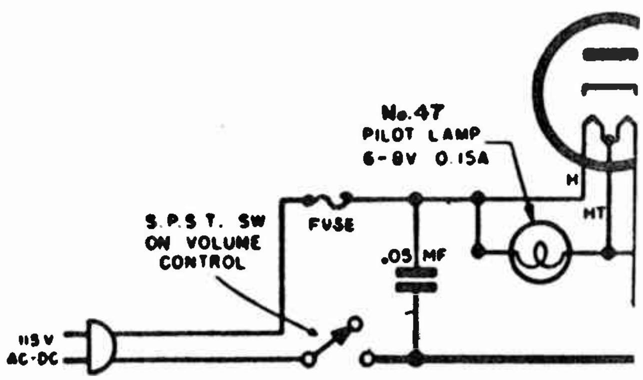
Now that we have been introduced to the actual parts and the symbols that represent those parts let us look at the schematic below and see just how many symbols we can identify.

Of course a good idea would be to make a note of the symbols you did not recognize and refer to them until you are sure you will not have that difficulty again.

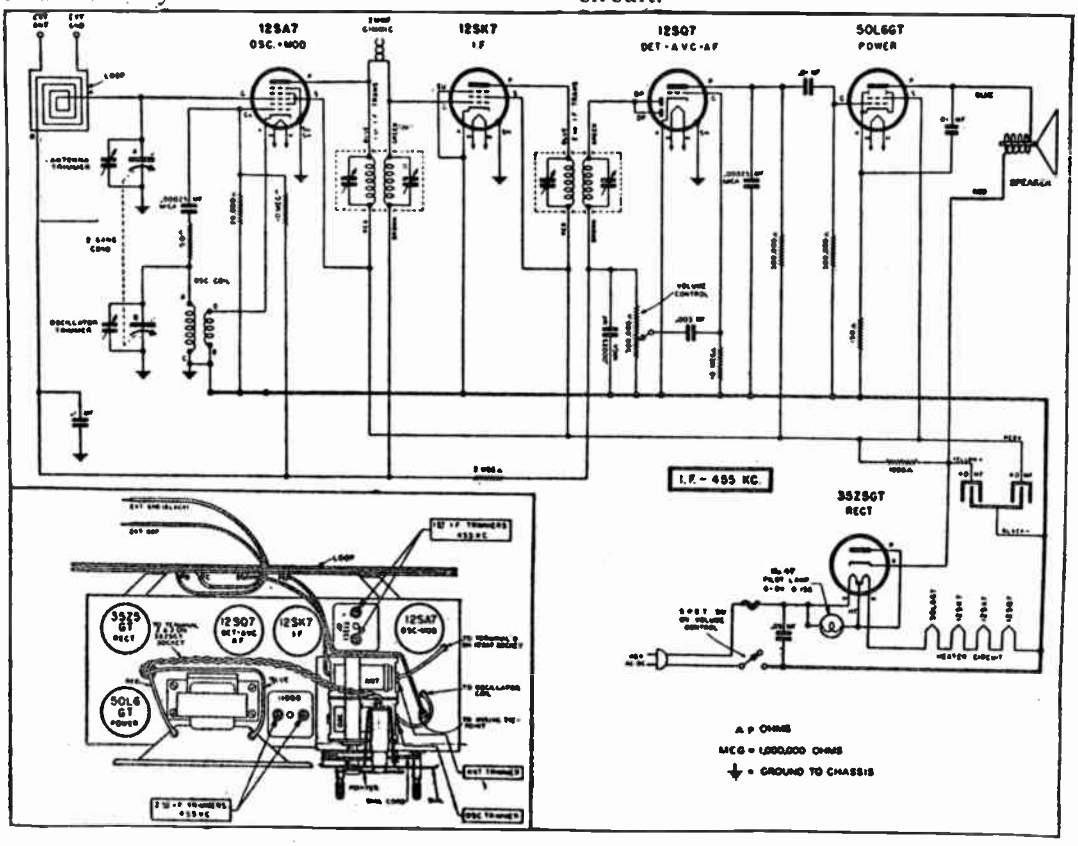
Our next step would be to know the different circuits in the radio so that we can trace the current through these circuits.

Let's start with the filament circuit in our schematic which is located in the lower left hand corner of our diagram. Incidentally those filaments are located within the tubes, but to make the diagram clearer by eliminating a lot of lines the filament circuit is usually shown in some corner of the diagram.

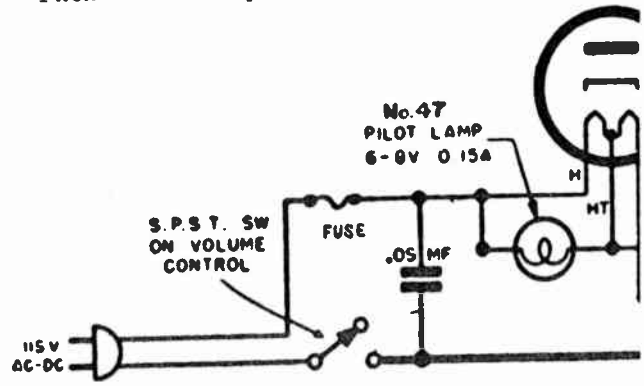
The first symbol we see is that of a male plug that fits into any wall receptacle. Then there are two lines that make connection to the plug. Starting along the bottom line we come to the switch. Its purpose is to turn the radio on or off. Above the switch is the symbol for a fuse.



It protects the parts in the radio in case of a short circuit.

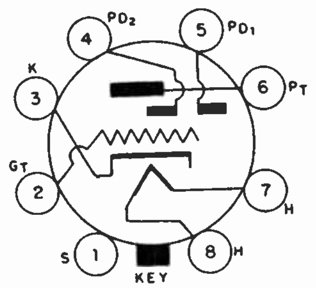


Then we see a capacitor.



We can tell it is connected across the line because of the heavy dots. When one line crosses another and no connection is intended then there is no heavy dot. Moving along the bottom line again we come to the second dot. Let's move up now and to the left to the first filament which is the 12 S Q 7. Suppose we look at the 12 S Q 7 tube and see if we can locate the terminals that connect this filament.

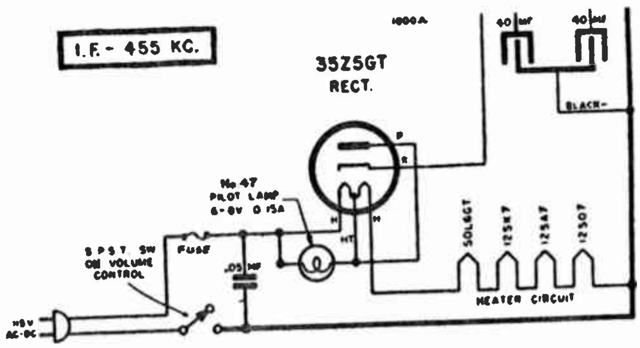
From the symbol we see that the external terminals are number seven and number eight. As we go on tracing the circuit, we pass the filaments of the 12 SA 7, the 12 S K 7 the 50 L 6 and the 35Z5 tubes



through the fuse and back to the plug. That completes the filament circuit.

It does seem strange to have wires inserted within the tubes and tied together to form a closed loop for no apparent reason. Any substance whether it be in a solid, liquid, or gaseous state offers resistance to the flow of current. Then why do we need a filament circuit in a radio? This same circuit is often referred to as the heater circuit and its function is to heat the cathode. The cathode plays an important part — it supplies the electrons necessary to operate the tube. It consists of a thin metal sleeve coated with electron-emitting material. The filament, or heater, is placed within the sleeve, and is insulated from it. In operation, the filament heats both the cathode sleeve and the coating to the electron-emitting temperature.

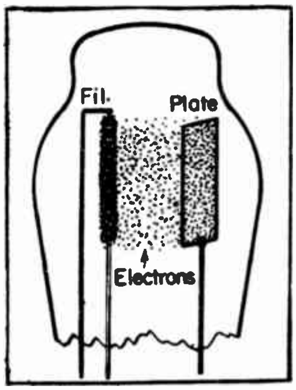
Referring to our diagram again you will notice that the filament is the only element within the tube that has two external terminals. All the rest have only one terminal to make connection with. We pointed out earlier in our explanation that in order to have a flow of current we needed a closed loop. Then something must take place within the tubes to complete the remaining circuits. The simple schematic diagram below shows a plate, a filament and a cathode.

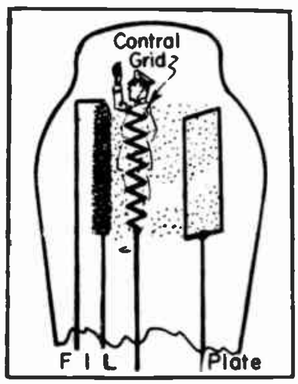


The plate is at a higher potential than the cathode. When the filament heats the cathode to the emitting temperature, the electrons move at a high velocity thru the vacuum of the tube to the plate. To illustrate

the above explanation, let's assume that a number of people are stranded on the platform of a railroad station and it is raining quite hard. To add to their misery the overhead shelter is not long enough to accommodate them all. Some of them are getting wet, therefore the general tension increases. Anxiously they look around and in the distance they see a brightly illuminated marquee. Since they notice that not many people are under it they start for it. Others that never saw the shelter join in because they think it is the wise thing to do. In the same way the electrons all rush to the brightly illuminated plate because of its higher potential. In tracing the plate circuits of all the tubes, you will notice that they all connect to one common point. The electrons then move from this common point to the cathode of the 35Z5. They go on to the plate of that tube and back to the source of supply.

The screen grid follows the same path as the plate and is used to shield the grid from the plate. The screen supplies an electrostatic force pulling electrons from the cathode to the plate. It is mounted between the control grid and plate for the purpose of reducing the capacity between those two electrodes.





The control grid has the most effective control over the flow of electrons thru the tube. It is like the traffic cop on the corner. He blows his whistle and puts up his hand to stop the traffic. Then he signals the traffic to move on again. In the same way the control grid signals the traffic of electrons to move. Sometimes more electrons move to the plate while other times there are less. It all depends upon the potential of the grid. Because of this varying voltage, an A. C. component is impressed on the D. C. potential of the plate. This changes the D. C. voltage to a pulsating D. C. The primary of a transformer is usually connected to the plate of the R.F. stage. Since the current in the plate circuit is varying it induces a voltage into the secondary of the transformer and that voltage is applied to the grid of the next tube.

Now that we have this information let's trace the signal from the antenna to the speaker.

The electro-magnetic waves thru the air strike the antenna and induce a voltage in it. This voltage is applied to the control grid of the first tube. Being of alternating nature it controls the flow of electrons thru the tube. At the same time the oscillator generates a voltage and is also applied to the same tube. The difference of these two voltages causes the change in current in the plate circuit. This change in current induces a voltage in the secondary of the transformer which is applied to the grid of the I.F. tube. As the signal is applied from stage to stage, it is amplified many times over. When it reaches the next stage the I.F. signal is changed to an audio note. It is then applied to the grid of the output tube. From there, the electrical impulses vibrate the diaphragm of the speaker. In doing so, these impulses are changed to sound, and we hear our radio programs.

The diagram we have taken you through step by step is similar to any other radio diagram you may ever be called upon to analyze.

In some sets you will find additional circuits for automatic push button tuning or combination phonograph and radio. These things are merely additions to a basic radio circuit arrangement such as we have just explained. You can trace out the circuits for these additional features in a set the same way you have checked the preceding diagrams.

The balance of this book is composed of data and diagrams. The data section includes specially prepared material to explain many important phases of servicing. You will find explanations of such things as Impedance, Inductance, Reactance, Frequency Modulation, Resonance and dozens of other important subjects.

Several pages of the book are devoted to explaining how to read and use nomograms.

The second portion of the book contains diagrams of Radio, Television sets and Public Address equipment. We have had the cooperation of the Industry in compiling this valuable collection of modern diagrams and in addition to giving you practical material for on the job servicing these diagrams also provide material you need to learn diagram tracing. With the instructions you have had you should not have any difficulty analyzing these diagrams.

SECTION II

Component Identification, Charts, Nomographs, Audio Data

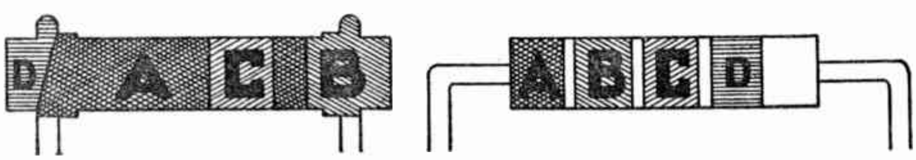
RESISTOR COLOR CODE

Preferred Values of Resistance ±20% D = no col.	±10% D = silver	±5% D = gold	Old Standard Resistance Values	Color Coding A	B	C
			50	Green	Black	Black
		51		Green	Brown	Black
	56	56		Green	Blue	Black
		62		Blue	Red	Black
68	68	68		Blue	Gray	Black
		75	75	Violet	Green	Black
	82	82		Gray	Red	Black
		91		White	Brown	Black
100	100	100	100	Brown	Black	Brown
		110		Brown	Brown	Brown
	120	120		Brown	Red	Brown
		130		Brown	Orange	Brown
150	150	150	150	Brown	Green	Brown
		160		Brown	Blue	Brown
	180	180		Brown	Gray	Brown
		200	200	Red	Black	Brown
220	220	220		Red	Red	Brown
		240		Red	Yellow	Brown
			250	Red	Green	Brown
	270	270		Red	Violet	Brown
		300	300	Orange	Black	Brown
330	330	330		Orange	Orange	Brown
			350	Orange	Green	Brown
		360		Orange	Blue	Brown
	390	390		Orange	White	Brown
			400	Yellow	Black	Brown
		430		Yellow	Orange	Brown
			450	Yellow	Green	Brown
470	470	470		Yellow	Violet	Brown
			500	Green	Black	Brown
		510		Green	Brown	Brown
	560	560		Green	Blue	Brown
			600	Blue	Black	Brown
		620		Blue	Red	Brown
680	680	680		Blue	Gray	Brown
		750	750	Violet	Green	Brown
	820	820		Gray	Red	Brown
		910		White	Brown	Brown
1000	1000	1000	1000	Brown	Black	Red
		1100		Brown	Brown	Red
	1200	1200	1200	Brown	Red	Red
		1300		Brown	Orange	Red
1500	1500	1500	1500	Brown	Green	Red
		1600		Brown	Blue	Red
	1800	1800		Brown	Gray	Red
		2000	2000	Red	Black	Red
2200	2200	2200		Red	Red	Red
		2400		Red	Yellow	Red
			2500	Red	Green	Red
	2700	2700		Red	Violet	Red
		3000	3000	Orange	Black	Red
3300	3300	3300		Orange	Orange	Red
			3500	Orange	Green	Red
		3600		Orange	Blue	Red
	3900	3900		Orange	White	Red
			4000	Yellow	Black	Red
		4300		Yellow	Orange	Red
4700	4700	4700		Yellow	Violet	Red
			5000	Green	Black	Red
		5100		Green	Brown	Red
	5600	5600		Green	Blue	Red
		6200		Blue	Red	Red
6800	6800	6800		Blue	Gray	Red
		7500	7500	Violet	Green	Red
	8200	8200		Gray	Red	Red
		9100		White	Brown	Red
10,000	10,000	10,000	10,000	Brown	Black	Orange
		11,000		Brown	Brown	Orange
	12,000	12,000	12,000	Brown	Red	Orange
		13,000		Brown	Orange	Orange
15,000	15,000	15,000	15,000	Brown	Green	Orange
		16,000		Brown	Blue	Orange
	18,000	18,000		Brown	Gray	Orange
		20,000	20,000	Red	Black	Orange
22,000	22,000	22,000		Red	Red	Orange
		24,000		Red	Yellow	Orange

Preferred Values of Resistance ±20% D = no col.	±10% D = silver	±5% D = gold	Old Standard Resistance Values	Color Coding A	B	C
			25,000	Red	Green	Orange
	27,000	27,000		Red	Violet	Orange
		30,000	30,000	Orange	Black	Orange
33,000	33,000	33,000		Orange	Orange	Orange
		36,000		Orange	Blue	Orange
	39,000	39,000		Orange	White	Orange
			40,000	Yellow	Black	Orange
		43,000		Yellow	Orange	Orange
47,000	47,000	47,000		Yellow	Violet	Orange
			50,000	Green	Black	Orange
		51,000		Green	Brown	Orange
	56,000	56,000		Green	Blue	Orange
			60,000	Blue	Black	Orange
		62,000		Blue	Red	Orange
68,000	68,000	68,000		Blue	Gray	Orange
		75,000	75,000	Violet	Green	Orange
	82,000	82,000		Gray	Red	Orange
		91,000		White	Brown	Orange
100,000	100,000	100,000	100,000	Brown	Black	Yellow
		110,000		Brown	Brown	Yellow
	120,000	120,000	120,000	Brown	Red	Yellow
		130,000		Brown	Orange	Yellow
150,000	150,000	150,000	150,000	Brown	Green	Yellow
		160,000		Brown	Blue	Yellow
	180,000	180,000		Brown	Gray	Yellow
		200,000	200,000	Red	Black	Yellow
220,000	220,000	220,000		Red	Red	Yellow
		240,000		Red	Yellow	Yellow
			250,000	Red	Green	Yellow
	270,000	270,000		Red	Violet	Yellow
		300,000	300,000	Orange	Black	Yellow
330,000	330,000	330,000		Orange	Orange	Yellow
		360,000		Orange	Blue	Yellow
	390,000	390,000		Orange	White	Yellow
			400,000	Yellow	Black	Yellow
		430,000		Yellow	Orange	Yellow
470,000	470,000	470,000		Yellow	Violet	Yellow
			500,000	Green	Black	Yellow
		510,000		Green	Brown	Yellow
	560,000	560,000		Green	Blue	Yellow
			600,000	Blue	Black	Yellow
		620,000		Blue	Red	Yellow
680,000	680,000	680,000		Blue	Gray	Yellow
		750,000	750,000	Violet	Green	Yellow
	820,000	820,000		Gray	Red	Yellow
		910,000		White	Brown	Yellow
1.0 Meg.	1.0 Meg.	1.0 Meg.	1.0 Meg.	Brown	Black	Green
		1.1 Meg.		Brown	Brown	Green
	1.2 Meg.	1.2 Meg.		Brown	Red	Green
		1.3 Meg.		Brown	Orange	Green
1.5 Meg.	1.5 Meg.	1.5 Meg.	1.5 Meg.	Brown	Green	Green
		1.6 Meg.		Brown	Blue	Green
	1.8 Meg.	1.8 Meg.		Brown	Gray	Green
		2.0 Meg.	2.0 Meg.	Red	Black	Green
2.2 Meg.	2.2 Meg.	2.2 Meg.		Red	Red	Green
		2.4 Meg.		Red	Yellow	Green
	2.7 Meg.	2.7 Meg.		Red	Violet	Green
		3.0 Meg.	3.0 Meg.	Orange	Black	Green
3.3 Meg.	3.3 Meg.	3.3 Meg.		Orange	Orange	Green
		3.6 Meg.		Orange	Blue	Green
	3.9 Meg.	3.9 Meg.		Orange	White	Green
			4.0 Meg.	Yellow	Black	Green
		4.3 Meg.		Yellow	Orange	Green
4.7 Meg.	4.7 Meg.	4.7 Meg.		Yellow	Violet	Green
			5.0 Meg.	Green	Black	Green
		5.1 Meg.		Green	Brown	Green
	5.6 Meg.	5.6 Meg.		Green	Blue	Green
			6.0 Meg.	Blue	Black	Green
		6.2 Meg.		Blue	Red	Green
6.8 Meg.	6.8 Meg.	6.8 Meg.		Blue	Gray	Green
			7.0 Meg.	Violet	Black	Green
		7.5 Meg.		Violet	Green	Green
			8.0 Meg.	Gray	Black	Green
	8.2 Meg.	8.2 Meg.		Gray	Red	Green
			9.0 Meg.	White	Black	Green
		9.1 Meg.		White	Brown	Green
10 Meg.	10 Meg.	10 Meg.	10 Meg.	Brown	Black	Blue

Standardized coding for resistance value identification is confined to ten colors and figures as shown:

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



The body (A) of the resistor is colored to represent the first figure of the resistance value. One end (B) of the resistor is colored to represent the second figure. A band, or dot (C) of color, representing the number of ciphers following the first two figures, is located within the body color. The two diagrams illustrate two interpretations of this standard method of coding resistance value.

The color "D" appearing on the body of the axial lead resistor and on the end of the radial lead type, is used to indicate tolerance value.

If no color appears in the position shown on the resistors, the tolerance is ±20%. If the resistor has a silver dot or band, the tolerance is ±10%, while if a gold color is employed, the resistor is within ±5% of the specified value.

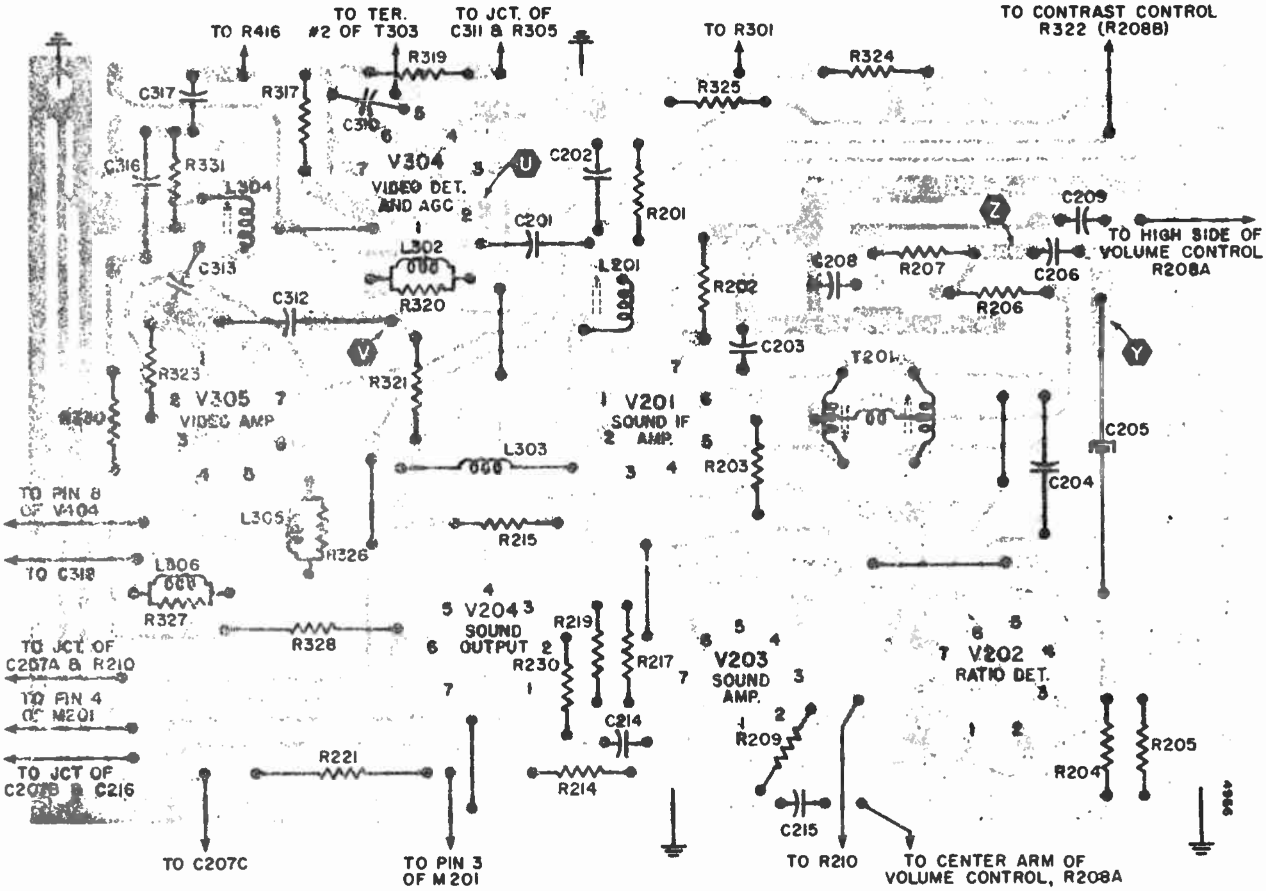


Figure 27. Top View of Printed Circuit Assembly (Used in Chassis Stamped Run 8 or Lower) Showing Printed Circuit and Electrical Connections.

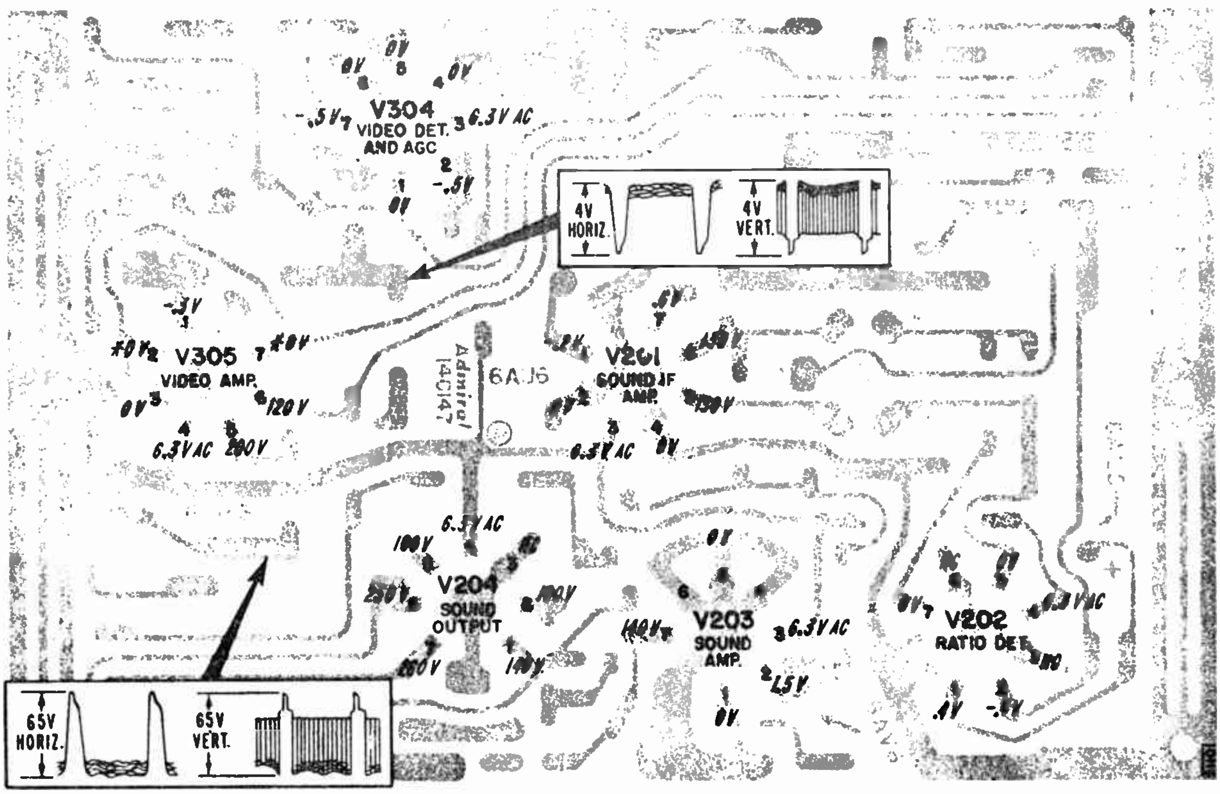


Figure 28. Top View of Printed Circuit Assembly (Used in Chassis Stamped Run 8 or Lower) Showing Voltages Measured Under Conditions Given on Schematic.

A Decibel Nomogram

Most useful of graphic charts, the nomogram is "equivalent to an infinite number of graphs." This one can be used to find a number of solutions to decibel problems

MANY problems may be solved by graphical means. An advantage of such representations is the bird's-eye view which results. To connect two variables it is common to plot a chart which is a line or curve, every point of which indicates one variable in terms of the other. Charts may be designed to correlate frequency vs. dial setting, antenna length vs. reactance, plate voltage vs. plate current, etc.

Another type of graph is the nomograph, which is useful in certain types of problems. This is usually designed to contain three lines or curves, each calibrated in terms of a variable. The nomograph differs from the ordinary chart in that the reader supplies his own indication by the use of a straightedge, preferably a celluloid or other transparent ruler.

Suppose we wish to show the variation of three quantities: Two may be shown on a chart, but there is no way of showing the third, which will have to be assumed constant. We would need an infinite number of curves on our chart, each corresponding to some value of the third variable. *A nomograph is therefore equal to an infinite number of graphs.* This is the key to its usefulness.

A useful nomograph is that relating db gain or loss to voltage or power ratio. The three variables are input, output and decibels. In the figure, the left-hand scale is calibrated in values from 1 microvolt to 100 volts in two sections, A and B. The right-hand scale indicates from one-half volt to 500 volts. The center scale shows decibels in two sections, C corresponding to A and D corresponding to B.

As the nomograph stands it indicates voltage gain or loss, but since current varies directly with voltage in any constant impedance circuit, amperes may be substituted for volts and microamperes for microvolts. *To extend to power values the center scale must be divided by two for all readings.*

To work out a problem, connect the larger of the two voltages, currents or powers at scale E with the smaller at either A or B by means of the ruler. If the output is larger there is a gain, otherwise a loss. The answer is read off at C or D.

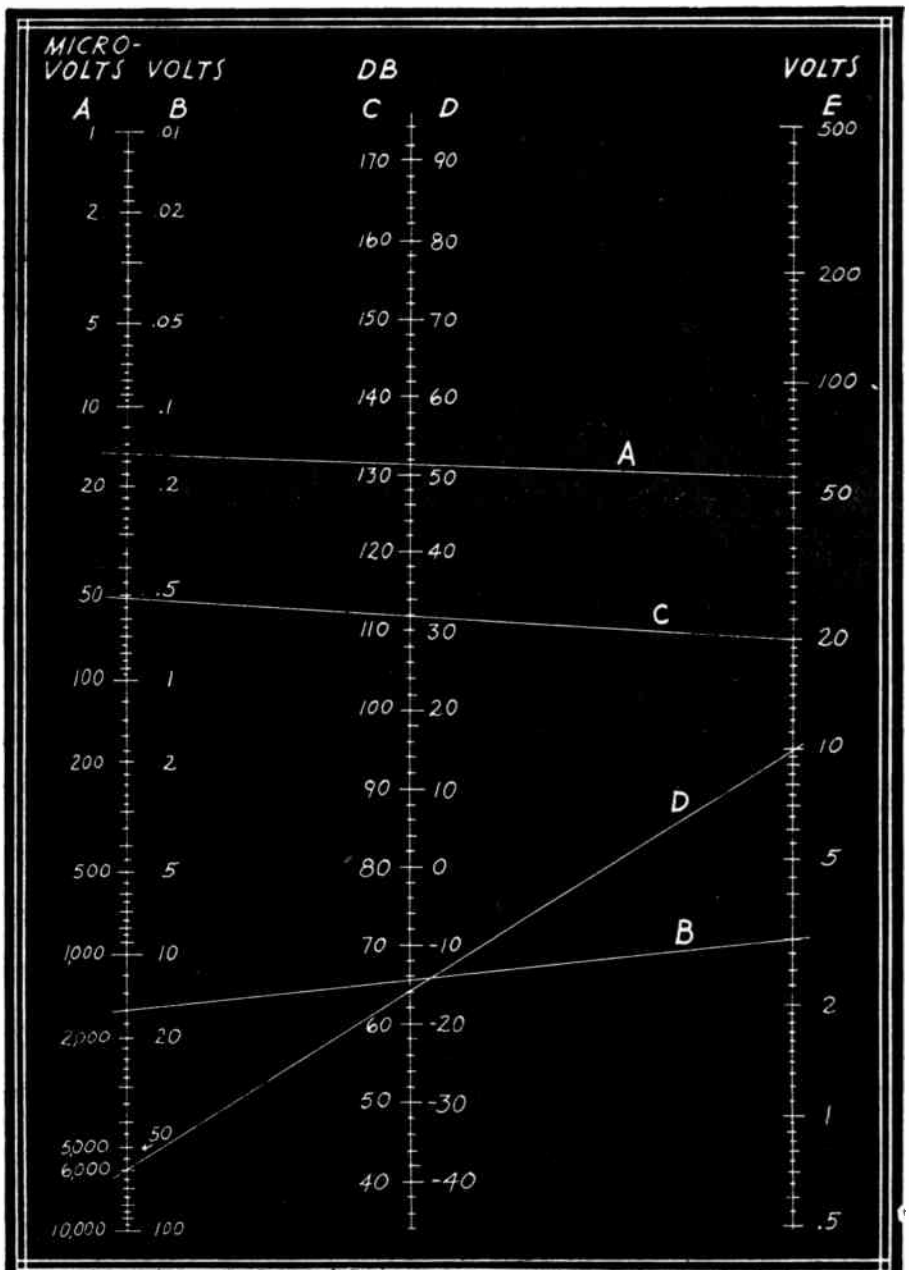
Four lines are shown on the figure as examples.

1—We wish to find the voltage gain of an audio amplifier. Making measurements with a v.t.v.m. we find the output is 55 volts when the input is .15 volt. There is a GAIN of 51.3 db (Line A).

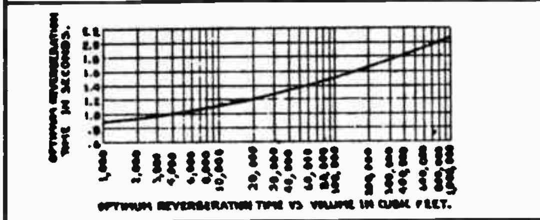
2—We have an r.f. tuner and after repairing and aligning we wish to find its amplification. Applying a signal generator to an artificial antenna we find an output of 3 volts when 1600 microvolts is measured at the input. The GAIN is 65 db (Line B).

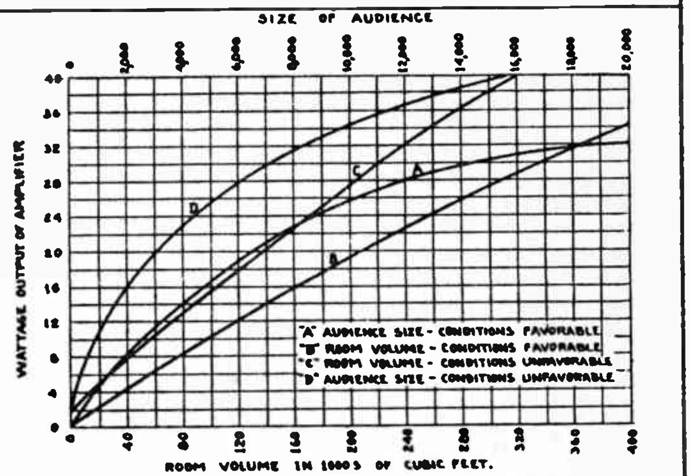
3—How much attenuation must we use to obtain an output of .51 volt when 20 volts is applied to the attenuator? All impedances are assumed matched. We must design an attenuator to have a 31.9 db loss (Line C). The same line may be used to show the output when the input and the attenuation are known.

4—As mentioned before, power calculations are the same except that the db scale is read off as one-half its value. The catalog lists a particular amplifier as having 10 watts output. What is its power gain (above 6 milliwatts)? Connect 10 at E with 6000 at A. The gain is 64.2 divided by 2, equals 32.1 db (Line D).

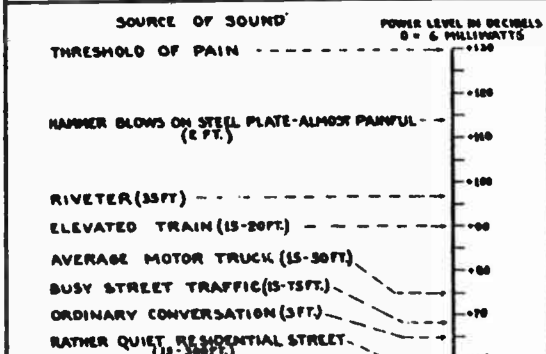
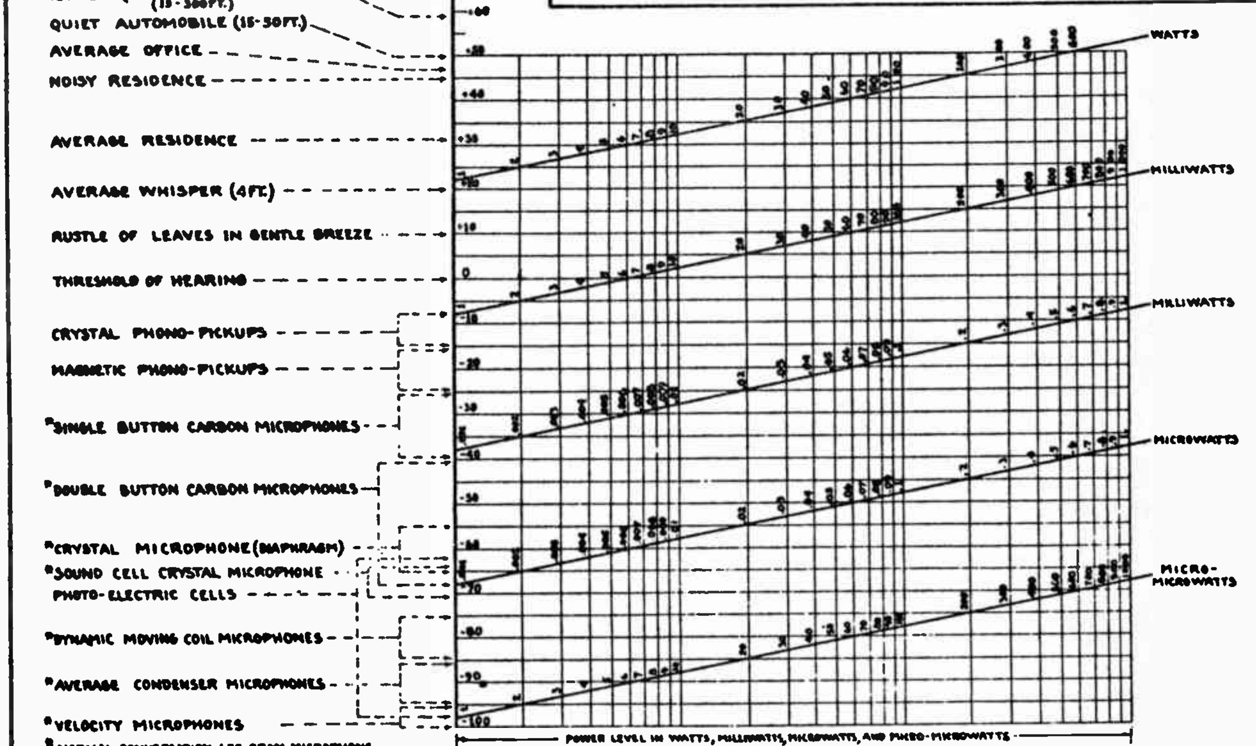


SOUND VOLUME CHART





A CAREFUL STUDY OF THE FOLLOWING EXAMPLE WILL FAMILIARIZE YOU WITH THE PROPER USAGE OF THE ABOVE CHART. IT IS DESIRED TO FIND THE MINIMUM WATTAGE REQUIRED FOR UNFAVORABLE CONDITIONS IN A ROOM HAVING A VOLUME OF 100,000 CU.FT. USING CURVE "C" WE FIND WATTAGE NECESSARY FOR THIS ROOM TO BE 25 WATTS. NOW ASSUME THE SIZE OF THE AUDIENCE TO BE 1,000 PERSONS. USING CURVE "D" WE FIND 1000 PERSONS REQUIRE 11 WATTS. THE LOWEST PERMISSABLE POWER IS A COMPROMISE BETWEEN 11 AND 25. THIS IS FOUND BY ADDING 11 AND 25 THEN DIVIDING BY 2. THE ANSWER IS 18.

COEFFICIENTS OF ABSORPTION (512 VIBRATIONS PER SECOND).

Material	Units per square foot.
ACOUSTI-CELOTEX, TYPE "B", PAINTED OR UNPAINTED	.47
ACOUSTI-CELOTEX, TYPE "BB", PAINTED OR UNPAINTED	.70
BRICK SET IN PORTLAND CEMENT	.025
CARPETS	.15 TO .29
CONCRETE	.015
CORK TILE	.03
CRETONNE CLOTH	.15
CURTAINS IN HEAVY FOLDS	.50 TO 1.00
FLAXLINUM 1/2"	.34
GLASS, SINGLE THICKNESS	.027
HAIRFELT 1/2" (JOHNSMANVILLE)	.31
HAIRFELT 1" (JOHNSMANVILLE)	.59
LINOLEUM	.03
MARBLE	.01
NASHKOTE, TYPE "A", 3/4" THICK	.27

Material	Units per square foot
OPEN WINDOW	1.00
PLASTER	.025 to .034
SABINITE ACOUSTICAL PLASTER	.21
SANACOUSTIC TILE, 1" ROCK WOOL FILLER	.74
WOOD SHEATHING	.061
WOOD, VARNISHED	.03

INDIVIDUAL OBJECTS

AUDIENCE, PER PERSON	4.7
COMPLETELY UPHOLSTERED CHAIRS	3.0
PARTIALLY UPHOLSTERED CHAIRS	1.6
PLAIN CHURCH PEWS, PER LINEAR FOOT	.18
PLAIN PLYWOOD AUDITORIUM CHAIRS, EACH	.24
UPHOLSTERED CHURCH PEWS, PER LINEAR FOOT	UP TO 1.6

COYNE

SOUND PRINCIPLES

FIG. 1

MOLECULES VIBRATE BACK AND FORTH PRODUCING PRESSURE VARIATIONS (SOUND WAVES)

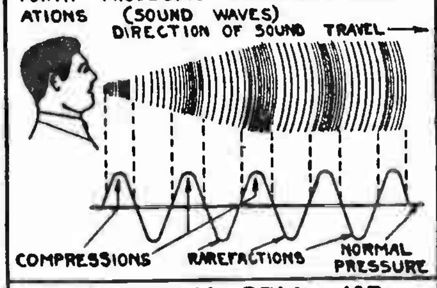


FIG. 2 MANOMETRIC FLAME

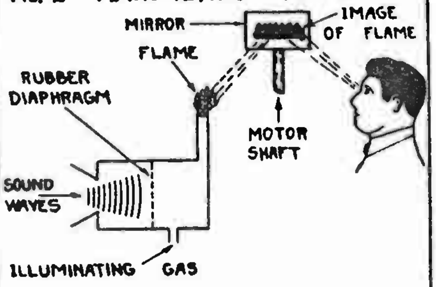


FIG. 3 DETERMINING SPEED

TWO HAMMERS A & B TAPPING 1/4 SECOND APART WILL BE HEARD AS ONE HAMMER IF BOTH ARE EQUIDISTANT FROM OBSERVER.

AS HAMMER B IS MOVED AWAY THE TAPS WILL BE HEARD SEPARATELY UNTIL POSITION Bp IS REACHED WHERE THE TAPS FROM B WILL BE HEARD ONE TAP BEHIND THE TAP FROM A.

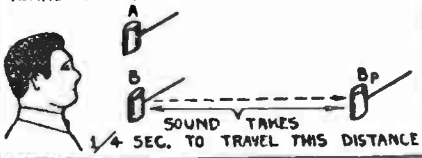
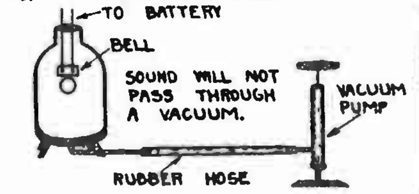


FIG. 4 VACUUM BELL JAR



LIGHT WILL PASS THROUGH A VACUUM

FIG. 5 VELOCITY OF SOUND IN VARIOUS MATERIALS

$$V=\sqrt{\frac{E}{d}}$$

WHERE V = VELOCITY
E = ELASTICITY
d = DENSITY

MATERIAL	VELOCITY FEET PER SEC.	DENSITY GRAMS/C.C.
AIR	1130	.001205
HYDROGEN	4136	.00009
MERCURY	4615	13.6
WATER	4703	1.0
BRICK	11979	2.0
CORK	1574	.24
IRON	16826	7.9
ELM (WOOD)	3411	.54
GLASS (FLINT)	13120	3.0

FIG. 6 VOLUME

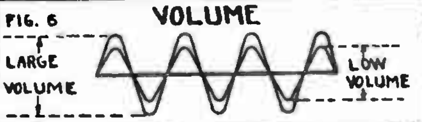


FIG. 7

INTENSITY OF SOUND VARIES INVERSELY WITH THE SQUARE OF THE DISTANCE IF NOT FOCUSED.

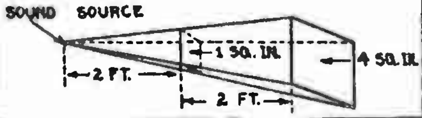


FIG. 8 DECIBEL CONVERSION CHART

CHANGE IN DB. $= 10 \times \log_{10} \frac{P}{P_1}$ WHERE P & P_1 ARE IN WATTS.

DECREASE OF 1 DB. = WATTS X 4/5
" " 2 " = WATTS X 2/3
" " 3 " = WATTS X 1/2
" " 10 " = WATTS X 1/10

FOR INCREASE OF GIVEN DB. INVERT FRACTION AND MULTIPLY.

TO FIND FRACTION FOR 7 DB. DECREASE—FOLLOW PROCEDURE SHOWN BELOW.

7DB. = 2DB. + 2DB. + 3DB. = 2/3 X 2/3 X 1/2 = 2/9

FIG. 9 VOLUME LEVEL IN DECIBELS

0 DB. = 6 MILLIWATTS

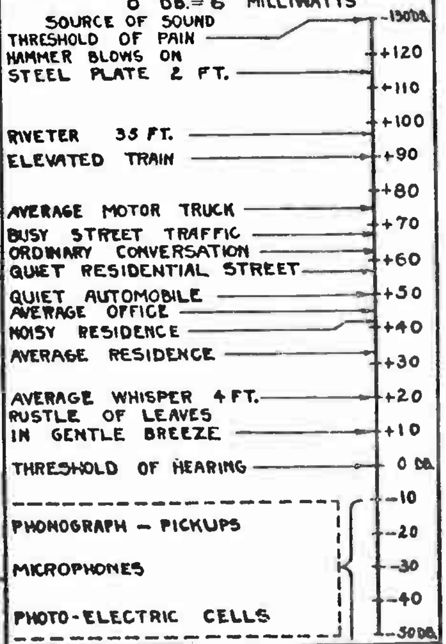


FIG. 10 PITCH

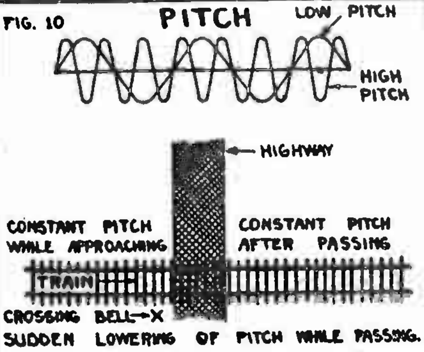
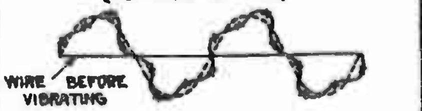


FIG. 11 QUALITY (VIBRATION OF WIRE)



KEY
------ FUNDAMENTAL VIBRATION
-x-x-x- ACTUAL VIBRATION — FUNDAMENTAL WITH OVERTONE

HEMHOLTZ RESONATORS

FOR DETERMINING PRESENCE OF OVERTONES

FOR ANALYZING 500 CYCLE NOTE

FIG. 12 REFLECTION OF SOUND FROM A FLAT SURFACE

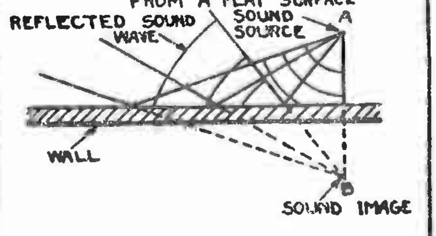
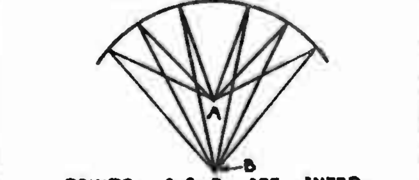


FIG. 13 REFLECTION OF SOUND FROM A CONCAVE SURFACE



POINTS A & B ARE INTERCHANGEABLE — CALLED CONJUGATE FOCI.

FIG. 14 REFRACTION OF SOUND WHEN PASSING THROUGH A BUBBLE OF GAS HEAVIER THAN AIR.

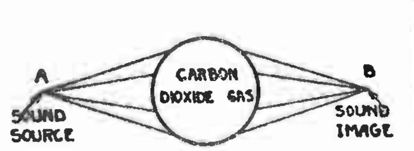


FIG. 15 REFRACTION OF SOUND WHEN PASSING THROUGH A BUBBLE OF GAS LIGHTER THAN AIR.

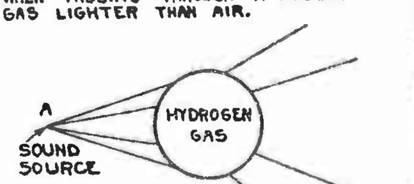


FIG. 16 REFRACTION OF SOUND FROM FOG-HORN

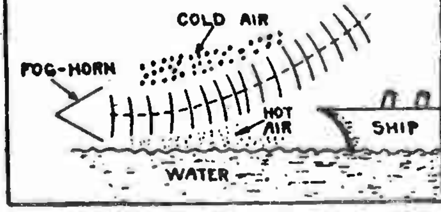


FIG. 17 REFRACTION OF LIGHT MAKES PUDDLES OF WATER APPEAR ON ROAD-BED.

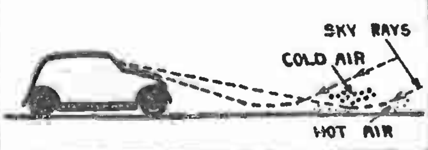


FIG. 18 REFRACTION OF LIGHT ON A DESERT MAY CAUSE A MIRAGE

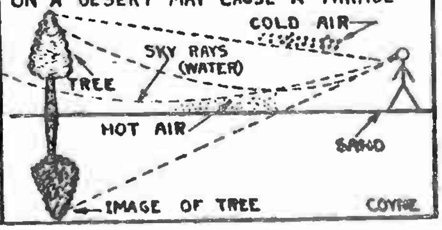


PHOTO ELECTRIC CELLS, CIRCUITS AND APPLICATIONS

FIG. 1A PHOTO EMISSIVE CELLS

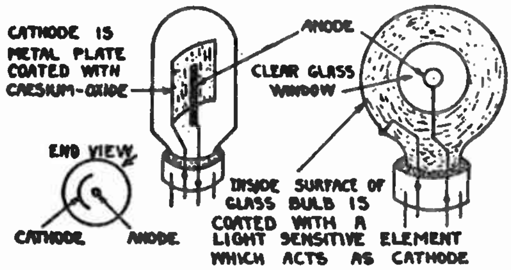


FIG. 1B PHOTO CONDUCTIVE CELL

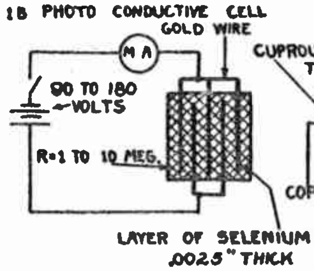


FIG. 1C PHOTO VOLTAIC CELL AND CIRCUIT

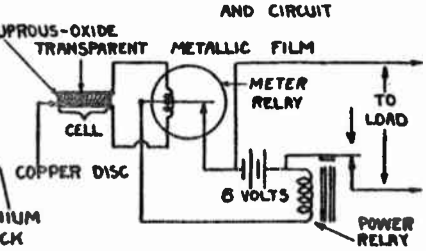


FIG. 2 FORWARD CIRCUIT D.C. OPERATED

LIGHT INCREASE – I_p INCREASE

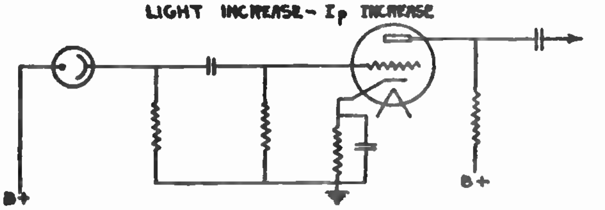


FIG. 3 REVERSE CIRCUIT D.C. OPERATED

LIGHT INCREASE – I_p DECREASE

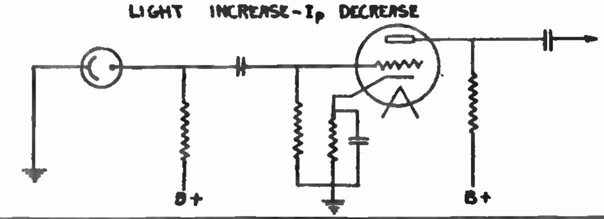


FIG. 4 FORWARD CIRCUIT A.C. OPERATED

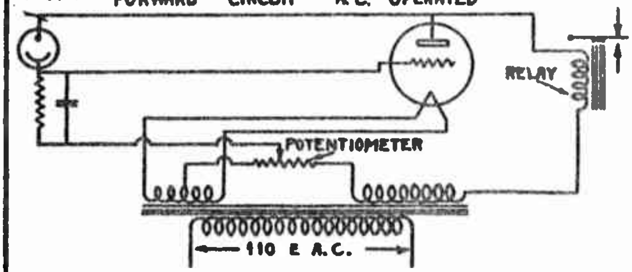
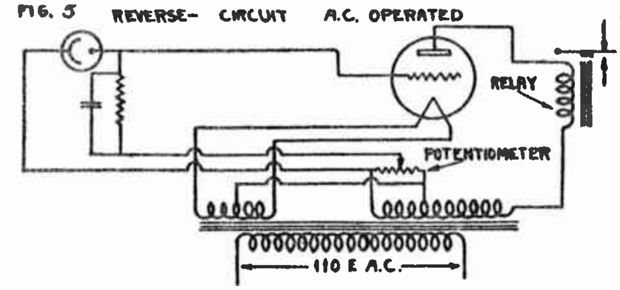


FIG. 5 REVERSE- CIRCUIT A.C. OPERATED



INDICATING HAND ON AN INSTRUMENT ECLIPSING LIGHT BEAM

FIG. 6A

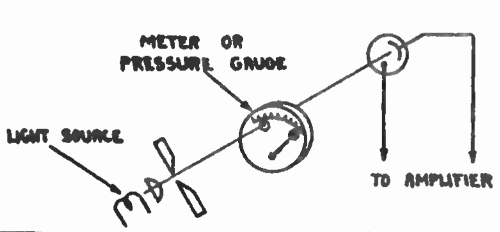


FIG. 6B

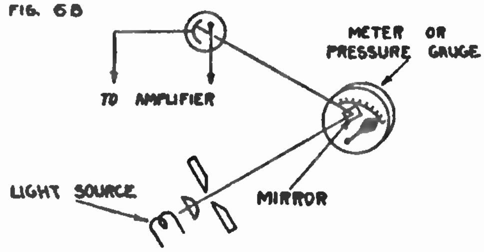


FIG. 7 COUNTER OPERATED BY PHOTO TUBE

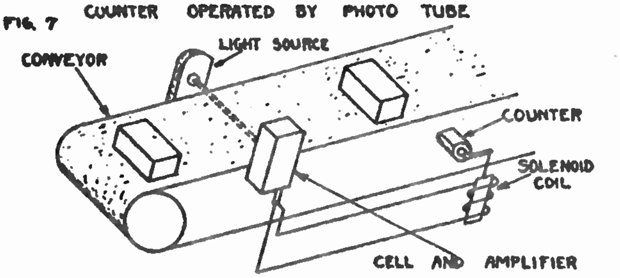


FIG. 8 SORTING STOCK ACCORDING TO SIZE

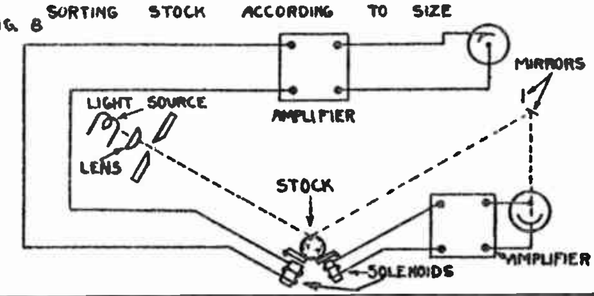
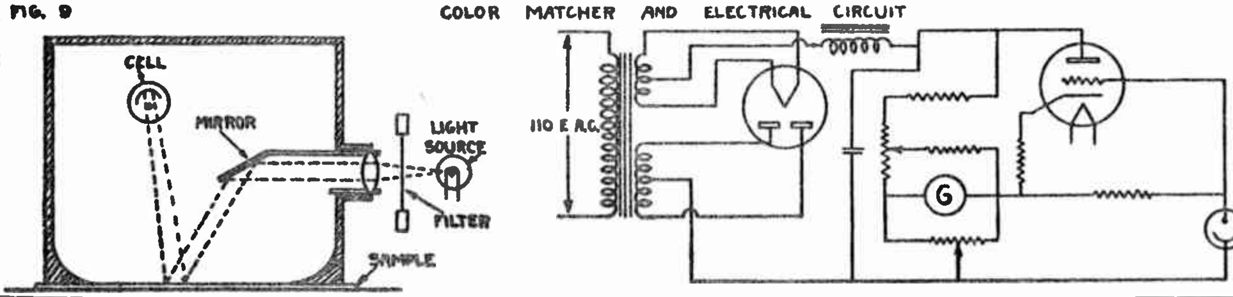
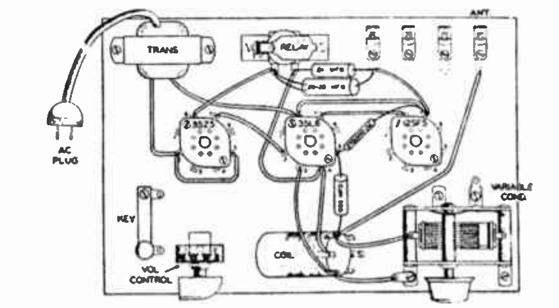


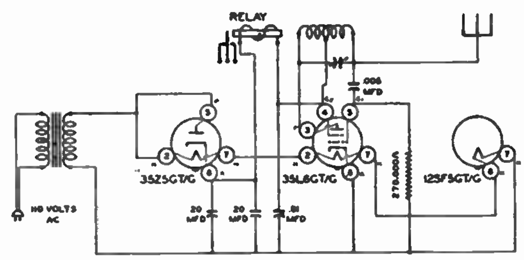
FIG. 9 COLOR MATCHER AND ELECTRICAL CIRCUIT



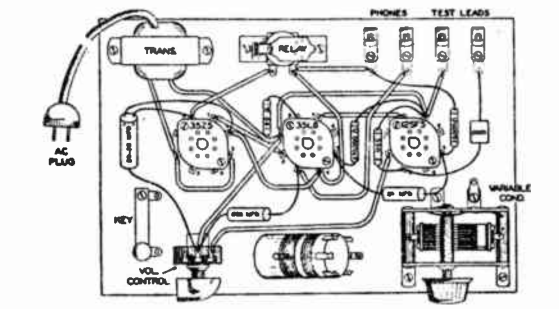
Special Purpose Units, Alignment Methods, Ratio Detector Analysis



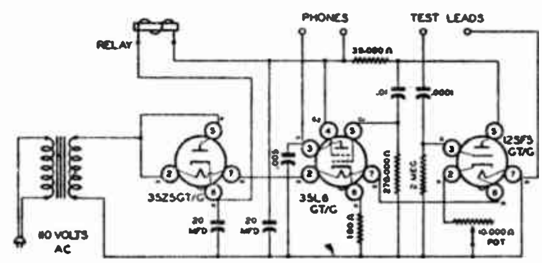
PICTORIAL DIAGRAM



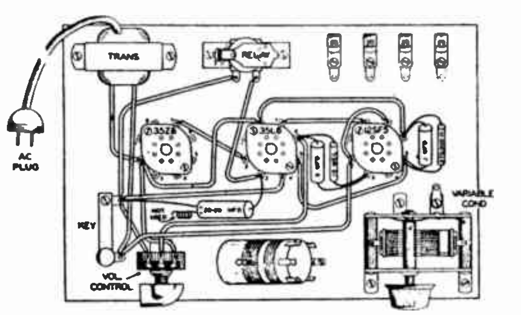
SCHEMATIC DIAGRAM
CAPACITY OPERATED RELAY



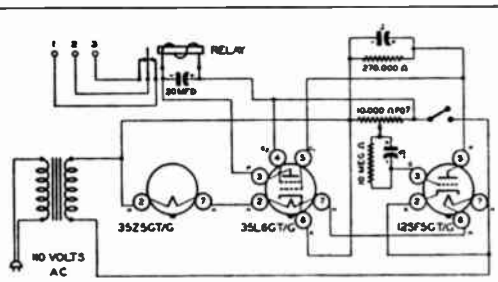
PICTORIAL DIAGRAM



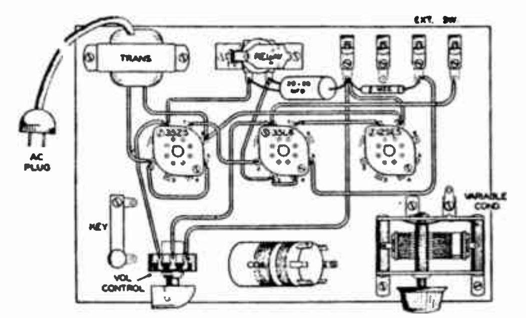
SCHEMATIC DIAGRAM
SIGNAL TRACER



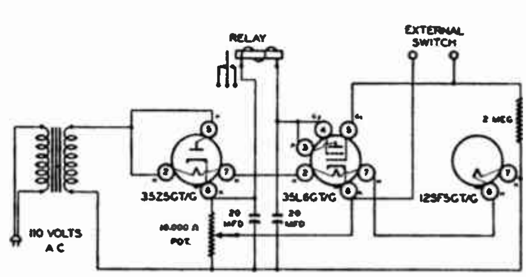
PICTORIAL DIAGRAM



SCHEMATIC DIAGRAM
ELECTRONIC TIMER



PICTORIAL DIAGRAM

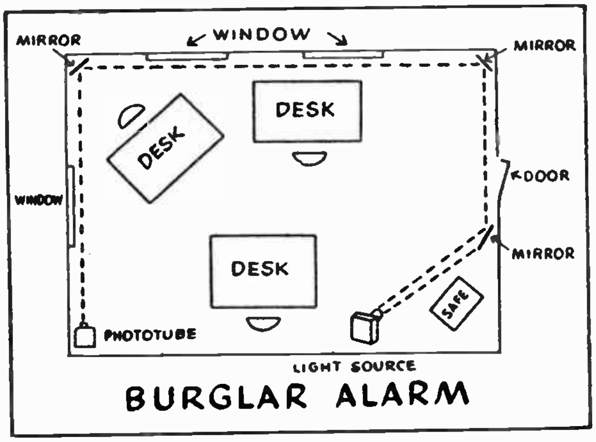


SCHEMATIC DIAGRAM
ELECTRONIC SWITCH

Applications for Phototubes

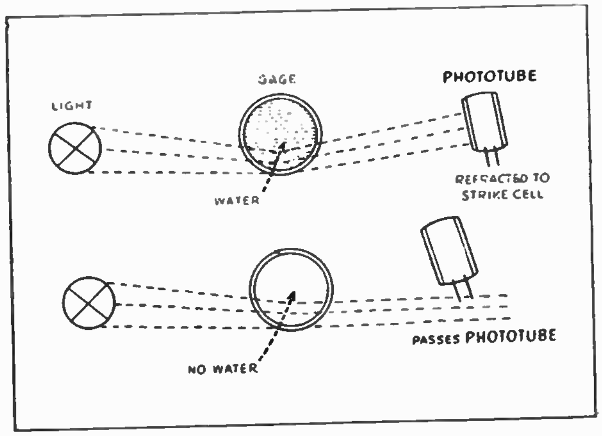
Burglar Alarm . . .

The phototube can be used to operate an alarm system when its light beam is cut off by an undesired entry of someone. It can be a fairly simple arrangement, as shown in the diagram, or quite complicated, depending on the installation. External alarms require fairly rugged weather-proof equipment and consideration must be given to operation under various weather conditions. All of the visible light from the light source can be eliminated by the use of an infra-red filter.



Water Level Gauge . . .

By means of a column of phototubes, a simple and reliable gauge to indicate the level of water or other liquid can be constructed, as shown in the diagram. When a beam of light shines through a column of liquid, it is refracted. By virtue of this fact, the beams of the light source of this water level gauge are adjusted so that they do not strike the phototubes unless there is liquid to refract them. Any desired number of tubes may be used. A meter connected to the output will read in direct proportion with the number of tubes illuminated.

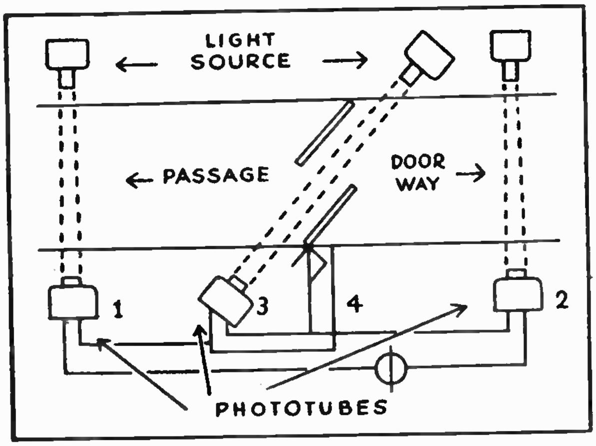


Opening and Closing Doors . . .

Mechanical door openers employing the action of opening and closing doors can be made completely automatic by the use of phototube control. This automatic device is especially suitable for garage door, restaurant kitchen door, and similar places, for the sake of convenience and time-saving.

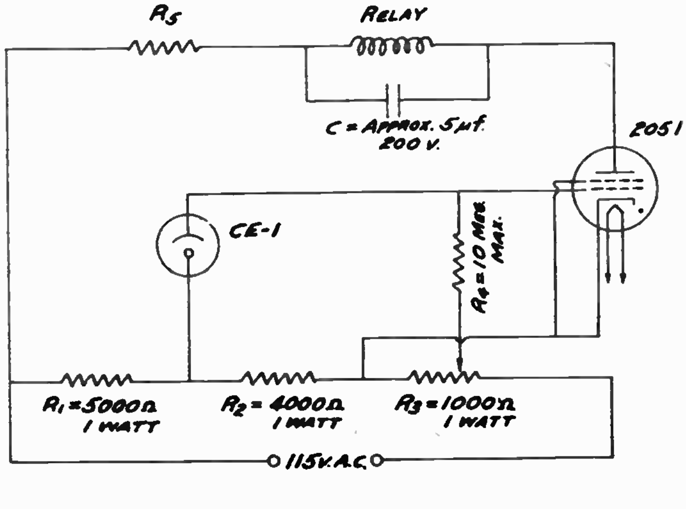
Mechanically operated garage doors are equipped with one push button for opening and another for closing. A phototube in a light-on energized circuit with its relay connected across the terminals of the opening push button may be used as a controlling device. The car driver simply shines the headlights on the phototube which energizes the circuit, operates the relay and opens the garage door.

For swinging doors in restaurants or bars, a different arrangement and circuit are to be used. Three phototubes in series are to be installed as in the diagram. Tubes 1 and 2 are operated from either approach, and tube 3 is used to hold door open when someone remains in the doorway. When the door closes, tube 3 is short-circuited by switch 4. Since the dark resistance of a tube is several times greater than that of a tube when illuminated, blocking the light beam of either tube 1 or 2 which are connected in series will greatly reduce the current output and thus operate the relay.



Relay Circuit Energized by Increase in Light . . .

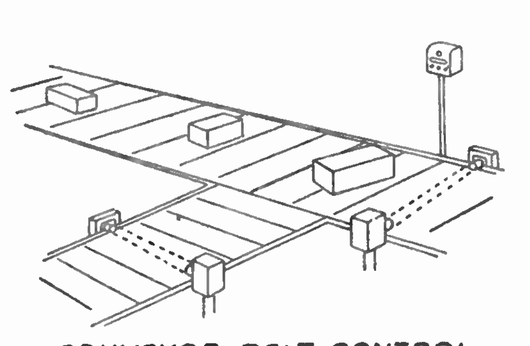
In using this circuit, adjust R_3 so that the bias voltage is just negative enough to prevent the thyratron, 2051, from conducting, at a predetermined light level. When there is an increase in light, the increase of current in the phototube, in turn, reduces the negative grid voltage through the voltage drop across R_4. The 2051 conducts and closes the relay. R_4 is to be selected according to the desired sensitivity of the circuit. The function of R_5 is to keep the current within the current rating of the relay and the 2051. It is not needed, if the relay has a sufficiently high resistance. The condenser is to prevent the relay from chattering.



Counting . . .

The simplest use of phototubes is that of counting, with the aid of relay and counter. A beam of light shines across a conveyor belt into a phototube which is used in a light-off energized circuit. When the light beam is intercepted by the object on the conveyor belt, the change in current actuates the relay which, in turn, operates the counter. If two objects of different sizes are to be counted, two phototubes may be arranged at different heights. The top beam is high enough so the large object will intercept it. When the large object cuts the top beam and the bottom beam, the phototube operates one counter. In doing so, it opens the relay of the second counter. Only when the bottom beam is cut by the small object, the second counter registers. With the same principle, three or more objects of different sizes on the same conveyor belt can be counted.

If a mechanism operated by the same relays is mounted to separate the two objects, the counting system may serve, at the same time, as a sorting system.

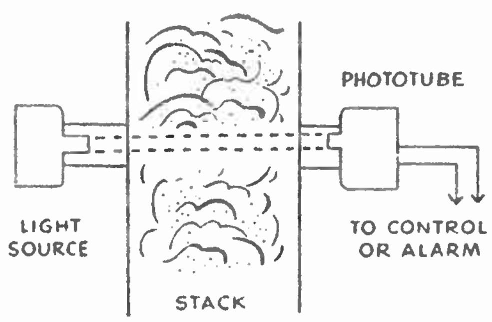


CONVEYOR BELT CONTROL

Smoke Control . . .

By virtue of the fact that the current of phototubes varies in proportion with intensity of light beam, many phototube control units have been designed to control, indicate, or adjust smoke density of industrial stacks. Aside from the fact that operating companies are required to comply with the smoke ordinances, improper combustion results in a waste of fuel. The phototube control may be used to indicate smoke density or to register a continuous or permanent record or to operate a mechanism that controls fuel feeding. Generally, when smoke density exceeds a predetermined density, an alarm is set off by the change of current in phototube.

To install a smoke indicator, two openings are cut in opposite sides of the stack. In one opening a phototube is installed and in the other a light source which directs a beam against the tube. The intensity of the beam of light transversing the stack is determined by the density of smoke, and the corresponding current in the phototube with the aid of an amplifier can be used to operate an alarm system or adjust directly the fueling mechanism. The indicating or recording instrument is usually calibrated into Rengelmann smoke units.

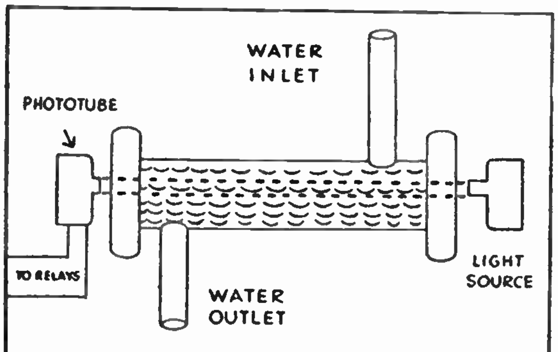


SMOKE CONTROL

Turbidity Control . . .

In the process of manufacture or purification of liquids, an automatic system can be set up to inspect the clarity or turbidity of liquid. Foreign matters picked up by rapidly moving liquid may cause contamination if they are not detected and eliminated immediately. The arrangement of this automatic system is very similar to that of smoke control.

The diameter of the pipe where the phototube is to be installed should preferably be fairly large. Arrangement as in sketch is recommended if the pipe is rather small.

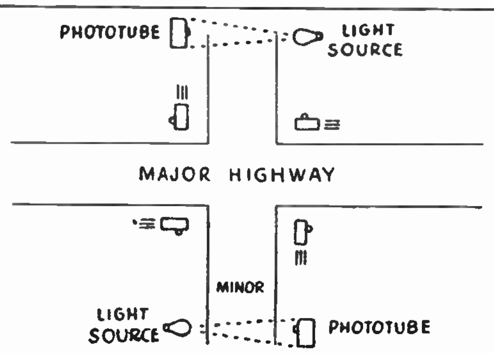


TURBIDITY CONTROL

Traffic Control

By means of phototube-controlled traffic lights, 20% of car-seconds were saved. When riding on a major highway, it is annoying as well as wasteful of time to stop at a red traffic light when there is no car travelling on the minor highway. The phototube control makes it possible to give the major highway green light all the time except when there is a car approaching the traffic light on the minor highway.

The arrangement of light sources and phototube units is shown in the diagram. The light source, quite similar to automobile spotlight, sends a beam of light across the street to the phototube unit which was equipped with a lens to permit only the beam from light source to shine on the phototube surface.



TRAFFIC CONTROL

Boat Radios

You cannot simply resign yourself to getting your feet wet, and then get out to push the boat. And you just don't handcrank a large marine engine.

Before selling and installing that radio, check the boat's storage battery capacity against its lights and contemplated radio drain. Additional storage batteries, in some cases, may not be the best solution.

Weight is important aboard ship. The deeper in the water the boat sits, the harder it's going to be to move her. If this factor is not too important, however, an additional battery may be installed, and the generator's rate of charge stepped up correspondingly. Otherwise, a dry-battery portable receiver may be needed.

Connecting the radio to the boat's power supply will introduce ignition noise, and probably auxiliary motor noise. This interference may be treated in the same fashion it would be treated ashore with one basic difference . . . don't use spark plug suppressors!

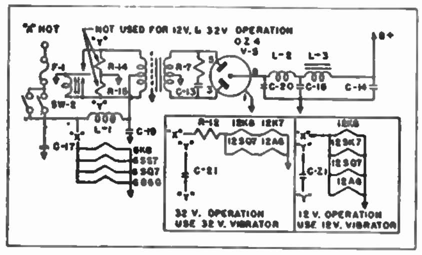
Why Suppressors Are Out

Suppressors should never be installed in a marine engine. In most cases, the inclusion of a resistance in the spark circuit will *ruin the engine*. The number of times suppressors may be used with impunity are so few that suppressors may be considered non-existent aboard ship.

The reason is this: suppressors will not interfere with the starting and running of an engine. However, at full load, or close to full load, the resistors will cut down the amount of spark and prevent *complete* combustion.

The unburnt gasoline will foul the combustion chamber and eventually dilute the crankcase oil to the point where the bearings and associated parts will burn up. The gasoline is not readily detected on the oil gauge stick or pressure gauge. However, the tachometer will show low RPM.

Suppressors can be used without ill effect on most cars, since they are very seldom, and then for a short period only, operated at full power. The modern car engine is "revved up" to full power only when the car pushes ninety, or when it is raced up a steep hill in second gear. These periods are too short to permit the gasoline to accumulate dangerously in the crankcase.



"Buccaneer" power supply for 6V, 12V, 32V., showing vibrator used off boat's starting battery.

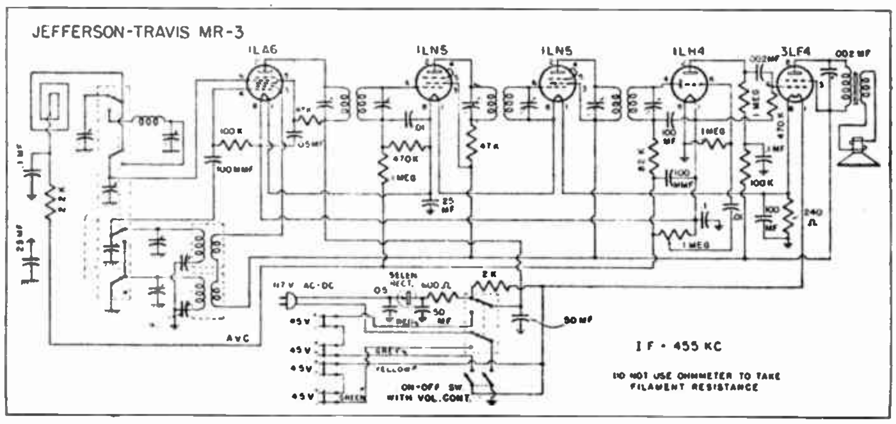
However, when a boat owner installs a hundred horse motor in his boat he uses that full hundred a great deal of the time he is under way. To double the speed of a boat you have to square the power. From this, derives the natural tendency to open the throttle and let it run.

Ignition interference, a major problem only in 2-way radiotelephone jobs, may safely be suppressed by means of complete metal shielding. A wall of metal as heavy and of as low electrical resistance as is practical is thrown around the entire ignition system, and is grounded to the engine at one, or as close to one point as possible. The high tension primary is filtered. The plugs, distributor, ignition coil are all inside the shield.

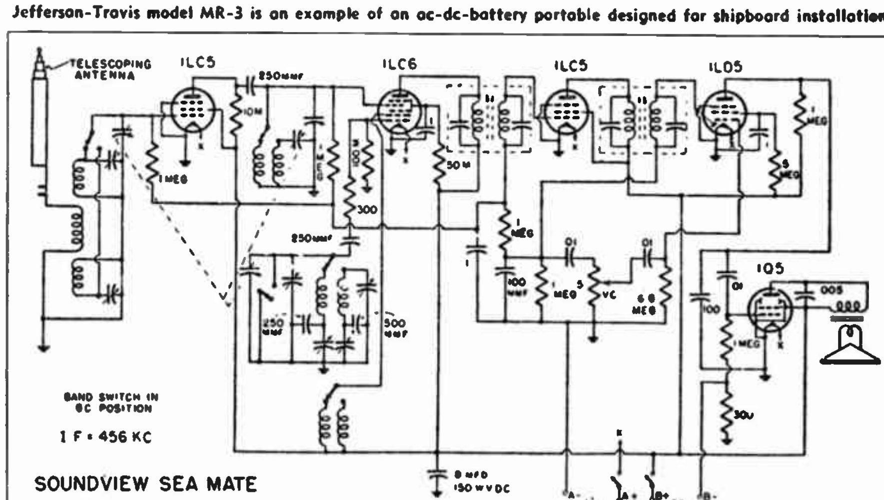
Commercial suppressor "packages," designed to be easily installed on a variety of standard marine engines, are available. They run about $150. installed. Care must be exercised in the design to include plenty of insulation and ventilation. The instantaneous voltages run upwards of fifteen thousand volts, and the ozone generated by the electric arcing across the points induces corrosion and needs to be let out.

Copper screening tacked to the inside of the engine box and bonded to form one continuous wall will sometimes help enormously. A ground plate has been found to be very ineffective so far as reception and noise suppression is concerned. It should not be resorted to except as a final measure or when needed to counterpoise a transmitting antenna.

The generator may be filtered by means of a bypass capacitor and filter choke. The same holds true for the water closet bowl, sump pump, ventilating and other auxiliary motors aboard the ship. It is almost all cut and try work. No two ships, even sister ships, built by the same company on the same day have been found to respond exactly alike.



Jefferson-Travis model MR-3 is an example of an ac-dc-battery portable designed for shipboard installation.

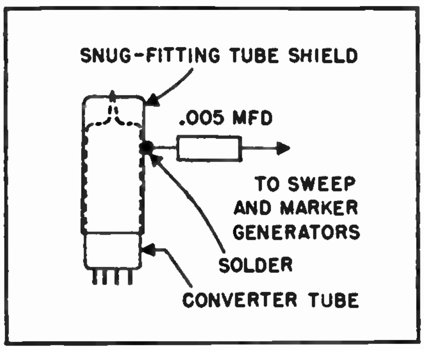


Typical marine dry battery portable, with broadcast band and 2000 kc to 6600 kc maritime band.

TV Service Hints

Coupling Sweep and Marker Generators to Receiver

When using a sweep generator, marker generator and oscilloscope to check the I-F response curves of a television receiver, it is sometimes difficult to obtain the correct balance between sweep output and marker output. This is particularly true when the ranges of the individual attenuators are limited. For best results, the amplitude of the applied sweep voltage as well as that of the marker voltage must be adjusted to a fairly critical level.



The coupling method shown above provides additional control of the sweep and marker voltages. By sliding the tube shield up or down on the tube, the capacitance between the shield and the tube elements is varied, and the coupling can be adjusted as desired. Another advantage of this method is that it is not necessary to make a direct connection to the circuit under test; simply slide the tube shield over the converter tube. Any tube shield can be used provided that it fits the tube snugly and does not ground to the chassis. *Courtesy Westinghouse.*

Antenna Stubs

Occasionally we hear of or recommend the use of a quarter-wave stub of transmission line for trapping out unwanted signals or partially attenuating powerful interfering nearby TV stations. This is satisfactory as far as the reduction or elimination of the undesired signal is concerned, but it will also cause a change in the R-F response curve of the head-end unit on channels close to the tuned frequency of the stub. This may result in a serious impairment of the picture detail due to smearing.

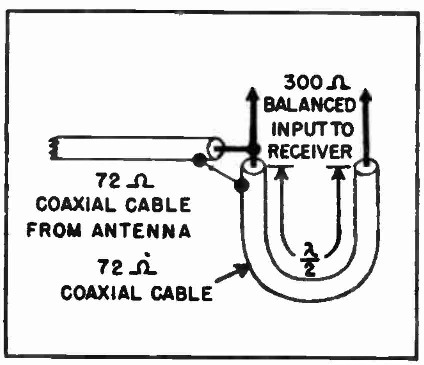
It has been found that it is much more desirable to insert a small capacitor in series with each line of the stub at the point where the stub fastens to the head-end terminals. These capacitors should be 5 mmf. for stubs in the low frequency TV spectrum and the FM band, and 2 mmf. for stubs used in the high frequency band. This gives a series parallel tuned trap which is much sharper in response and will not affect the response curve of the head-end unit unless the stub is tuned directly in the channel.

The capacitors in the tuning stubs result in a longer piece of line being used for a particular frequency. The best method of determining the proper length of line is to clip off small portions until maximum attenuation is obtained.

—*Courtesy General Electric Co.*

Matching 72 Ohm Coax Cable to 300 Ohm Balanced Input

In some areas it may be desirable to use 72 ohm coaxial cable as a transmission line between the antenna and the receiver in order to reduce noise pickup. The problem of matching the coaxial cable to the receiver input in such installations can be solved as shown.



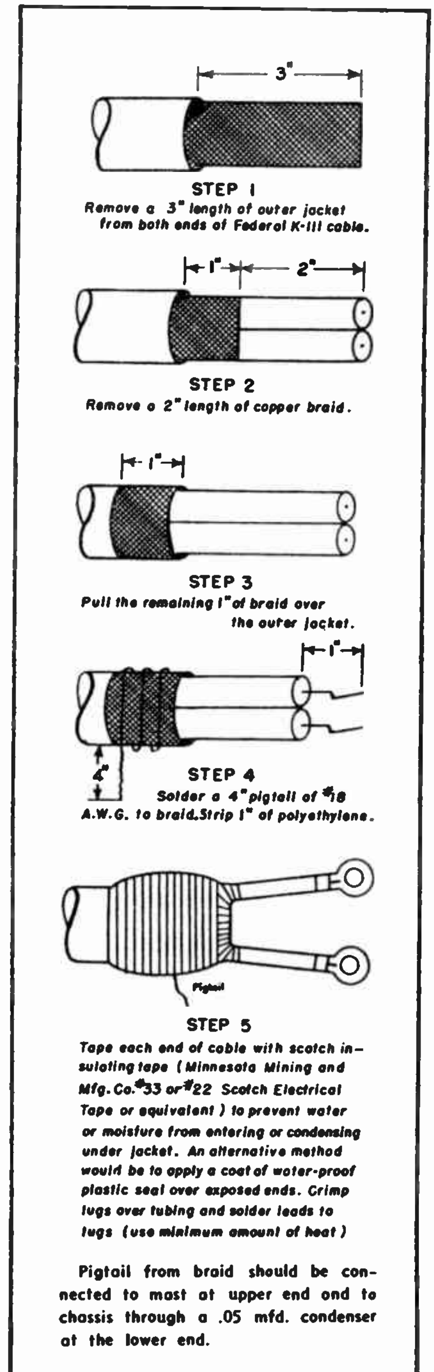
The matching section should be one half wavelength long at the most critical frequency. If reception is possible on one channel only, cut the matching section to the video carrier frequency of that channel. If operation on more than one channel is possible, cut the matching section to the video carrier frequency of the weakest signal.—*Courtesy Westinghouse.*

Ground Connection to Aquadag

Wear or vibration may sometimes develop a poor connection between the outside coating of the cathode ray tube and its grounding springs. The attendant arcing at that point can result in tearing of the picture and insufficient picture width.

To insure a permanent ground contact, a piece of aluminum foil may be inserted between the aquadag and the grounding springs. This foil, one side of which is coated with adhesive, is first cut to size of 1" x 1½". One edge is then folded ¼" over the adhesive side of the foil. Finally, the foil is placed between the aquadag and the grounding spring in such a manner that adhesive holds the foil to the aquadag, the spring bears against the uncoated side of the foil, and the uncoated side of the ¼" fold bears tightly against the aquadag.—*Courtesy Westinghouse.*

Shielded 300-Ohm Line



—*Courtesy Federal Telephone & Radio Co.*

TRANSISTORS

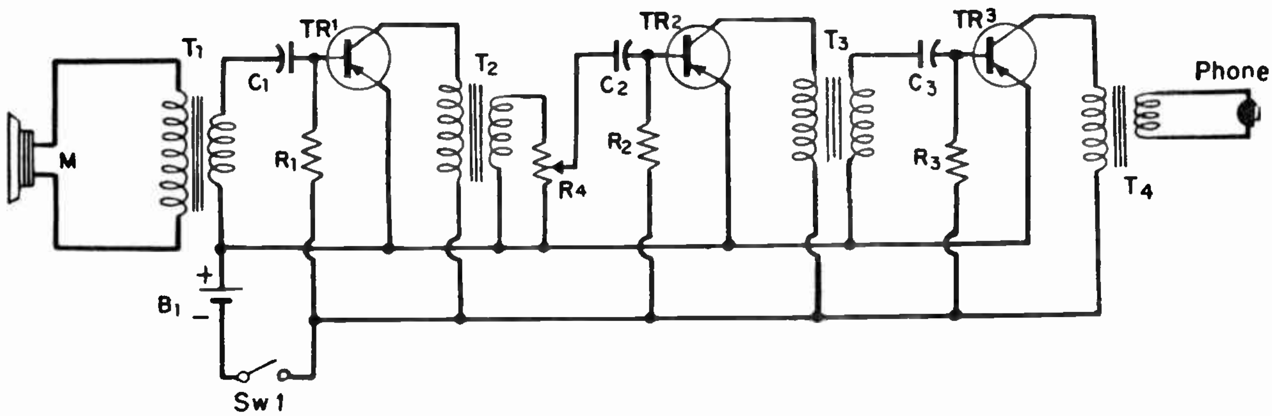


Figure 9-3. A transistorized hearing aid circuit. Parts values are as follows:

TR_1, TR_2 - RAYTHEON type CK718 PNP junction transistors.
TR_3 - RAYTHEON type CK718 or CK721 PNP junction transistors.
T_1 - STANCOR type UM112 transistor transformer.
T_2, T_3 - STANCOR type UM111 transistor transformer.
T_4, - STANCOR type UM111 transistor transformer.
R_1, R_2 - 10K-15K resistors*.
R_3 - 50K-100K resistor*.
R_4 - VOLUME control - 4K-6K.
C_1,C_2,C_3 - Large interstage coupling capacitors - 2-5 mfd.
M - High impedance microphone (crystal or dynamic).
B_1 - Power supply battery . . . 1.5 to 6.3 volts.
Sw_1 - SPST "Off-On" switch.
PHONE - Low impedance hearing aid type earphone.

*These resistor values will vary with battery voltage and transistors used. Choose final values experimentally for best operation.

CREDIT: Circuit Courtesy STANCOR.

PRACTICAL TRANSISTOR CIRCUITS

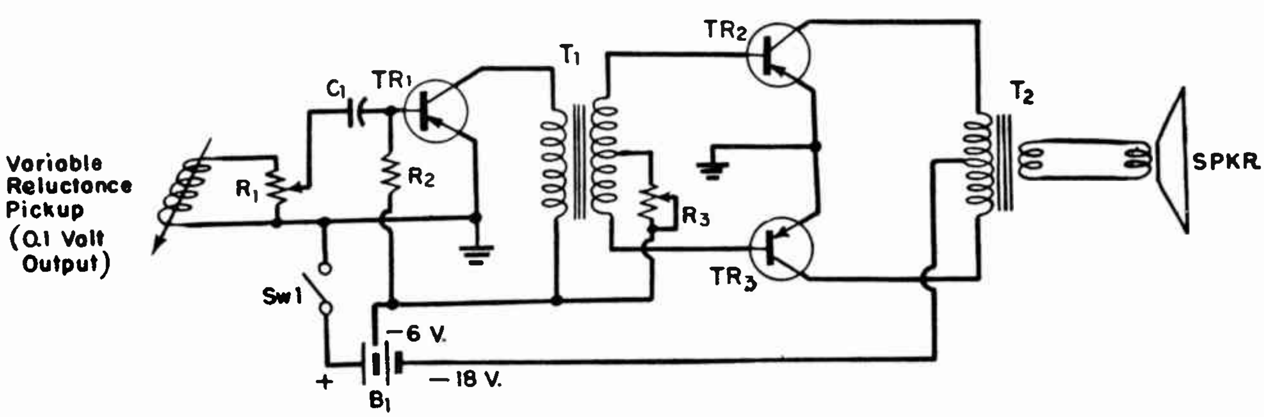
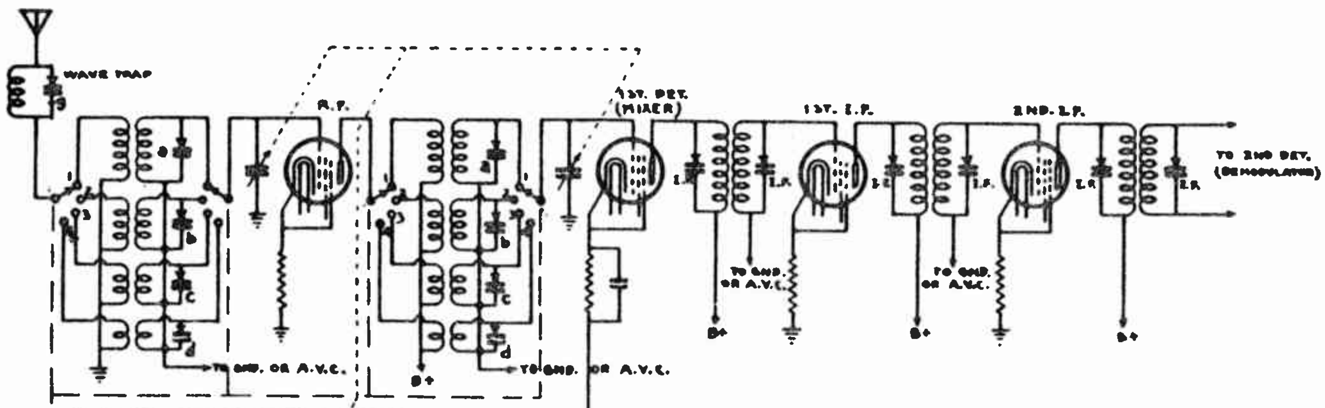


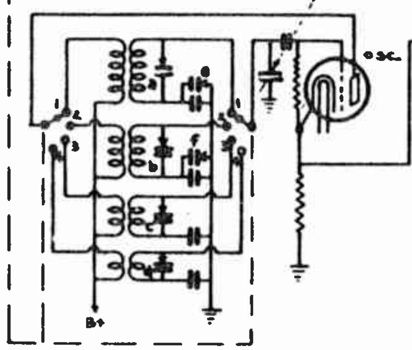
Figure 9-2. A transistor-operated phonograph amplifier. Parts values are as follows:

TR_1 - CBS-HYTRON type 2N36 PNP junction transistor.
TR_2, TR_3 - CBS-HYTRON type 2N37 PNP junction transistors.
R_1 - VOLUME control, 10K.
R_2 - 100K resistor.
R_3 - Output bias control, 25K.
C_1 - 1 mfd.
T_1 - Interstage Transformer; 3:2 turn ratio.
T_2 - Output transformer; 4000 ohms to speaker voice coil.
Sw_1 - SPST "Off-On" Switch.
B_1 - Tapped battery . . or separate batteries providing 6 and 18 volts.

CREDIT: Circuit courtesy CBS-HYTRON

ALIGNING SUPERHETERODYNE RECEIVERS.





Connect the output meter to the receiver in the conventional manner. Adjust the signal generator to the required I. F. of the receiver, connecting it to the input grid of the mixer tube, generally allowing the grid lead disconnected. Adjust the I. F. condensers to the maximum reading of the output meter. If the signal does not go thru, connect the signal generator to the input grid of the last I.F. tube, then connect the signal generator to the preceding stages.

Transfer the signal generator connections to the antenna and ground of the receiver.

Tune the receiver to band #1 (generally the broadcast band). If the receiver has a wave trap, the trimmer (g) is adjusted to minimum reading of the output meter, when the signal generator is tuned to the I. F. and the tuning condensers are tuned to the low frequency end of the broadcast band.

Adjust the signal generator and the receiver to 1400 k.c. Adjust the high frequency trimmers (a) to maximum reading of the output meter.

Adjust the signal generator and the receiver to 600 k.c. Adjust the low frequency trimmer (e) to maximum reading of the output meter.

Tune the receiver to band #2 (generally the first short wave band)

Adjust the signal generator and the receiver to the required frequency of band #2. Adjust the high frequency trimmers (b) to the maximum reading of the output meter.

Adjust the signal generator and the receiver to the required low frequency and adjust the low frequency trimmer to the maximum reading of the output meter.

The same procedure is followed with bands #3 and #4, the high frequency trimmers (c) and (d) are adjusted for maximum reading of the output meter in their respective bands.

NOTE: Keep output of the signal generator low in value, allowing just enough signal to give a readable induction on the output meter. Above frequencies do not apply to all receivers, check with manufacturers aligning data.

THE RATIO DETECTOR

The ratio detector, appearing first in RCA f-m receivers, is a device for converting a frequency modulated carrier to an audio signal, while at the same time offering a high degree of attenuation to any incident amplitude modulation. The relative insensitivity to amplitude variations, which is an inherent characteristic of ratio detectors, enables them to be used without the usual preceding limiter stage, thus affording the use of a high gain i-f stage instead of the low-gain limiter.

DISCRIMINATOR

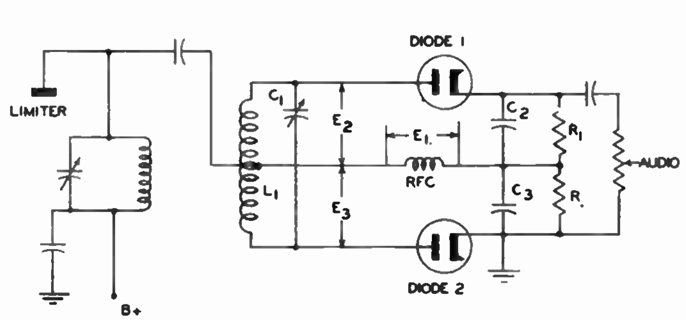


FIG. 1

Theory of Operation

A brief review of the theory of the discriminator detector will help the serviceman to understand the action of the ratio detector.

Figure 1 portrays a conventional discriminator stage, and it can be seen that it consists essentially of two diode rectifiers which are differentially connected so that the d-c potentials across their respective load resistors are subtractive. These two d-c voltages (across R1 and R2 in Figure 1) are proportional to the a-c voltages applied to the diodes. The a-c voltage applied to each diode is the vector sum of E1 and the voltage across that half of L1 which is connected to the diode plate, as shown in the diagrams of Figure 4. E1 has practically the same amplitude and phase as the voltage across the tank in the limiter plate circuit. The current in this same tank circuit induces a voltage in L1, which causes a circulating current to flow in the resonant circuit composed of L1 and C1. E2 and E3 are the voltage drops which occur across each half of L1 as a result of this circulating current. When the carrier frequency is equal to the frequency at which the discriminator transformer is tuned (Fig. 4A), the a-c voltage applied to diode 1 equals that applied to diode 2, therefore the rectified voltages are equal and since they are bucking voltages, the output of the discriminator is zero.

When the carrier frequency increases during a half cycle of modulation, the phase relations between E1, E2 and E3 change in accordance with Figure 4B, and it is evident that the vector sum of the voltages applied to diode 2 exceeds the vector sum of the voltages applied to diode 1, resulting in a higher rectified voltage across R2 than across R1. The instantaneous difference of the rectified voltages appears as a negative voltage in the discriminator output. Figure 4C shows the condition occurring when the carrier frequency swings below the resonant frequency of the discriminator transformer, the end result being a positive voltage at the output of the discriminator.

The important fact in discriminator action is that the output voltage is proportional to the difference between Ediode 1 and Ediode 2. This is true because the d-c voltages appearing across R1 and R2 vary directly with Ediode 1 and Ediode 2, respectively, and the instantaneous output voltage is the difference between the rectified voltage drops.

In considering the effect of amplitude variation on discriminator output, refer again to the vector diagrams of Figure 4. An increase in the amplitude of the voltage applied to the discriminator would increase all of the vectors in the diagram proportionately. In other words, the effect would be as though the vector diagrams were enlarged photographically. It can be seen that while the phase relationships would remain the same, the difference between Ediode 1 and Ediode 2 would increase, so long as the frequency of the applied voltage differed even slightly from the receiver i-f. Thus components of amplitude modulation would be detected and passed on to the audio amplifier. Ordinarily, discriminators are preceded by limiters which remove most of the amplitude variation from the f-m carrier, but the discriminator itself is not a device capable of rejecting amplitude modulation, except when the instantaneous frequency of the applied carrier is exactly equal to the resonant frequency of the discriminator transformer. This condition occurs only twice in every modulation cycle.

Note that while an increase in the amplitudes of the vectors in Figure 4 results in a proportionate increase in the difference between Ediode 1 and Ediode 2 for off-resonant conditions, the ratio of Ediode 1 to Ediode 2 is a constant, as far as amplitude variations are concerned. Therefore, a detector responsive only to changes in the ratio of Ediode 1 to Ediode 2, and insensitive to changes in the difference between these voltages would be a detector capable not only of converting frequency variations to audio variations, but of rejecting any amplitude modulation. Such a detector is the ratio detector.

RATIO DETECTOR

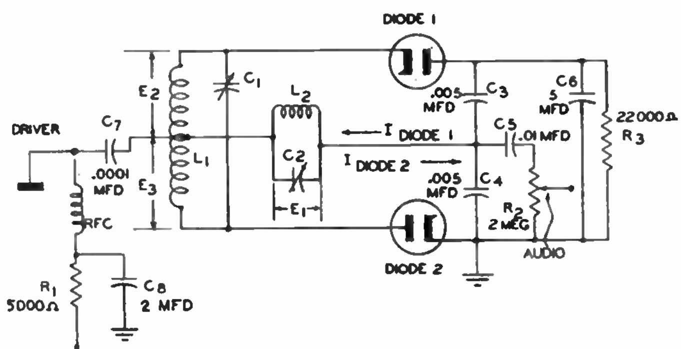


FIG. 2

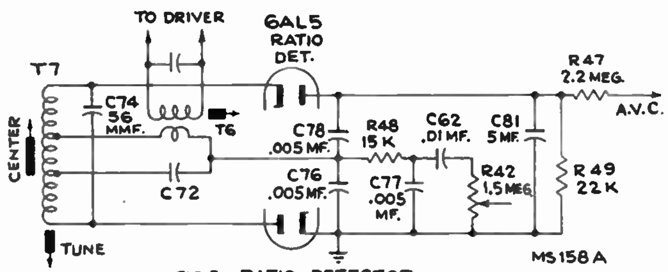


FIG.3 - RATIO DETECTOR

A schematic of the fundamental ratio detector is shown in Figure 2. C7 and C4 have very little reactance at the intermediate frequency, so it is evident that the parallel resonant circuit L2 C2 is the true load for the driver stage, this stage being shunt fed. A driver stage, in this case, is nothing more than a conventional i-f amplifier preceding the ratio detector. L2 is inductively coupled to L1, therefore a comparison of Figures 1 and 2 will show that as far as the a-c voltages applied to the diodes are concerned, these circuits are almost exactly similar, indeed, the same vector diagrams used in the analysis of Figure 1 can be used to portray the a-c voltages across the diodes in Figure 2. Here the similarity ends, because the ratio detector method of extracting intelligence from the f-m carrier differs greatly from previously used methods. Diode 1, R3, and diode 2 complete a series circuit fed by the a-c voltage across L1. Since the two diodes are in series, they will conduct on the same half cycle, and the rectified current through R3 will cause a negative potential to appear at the plate of diode 1. The time constant of R3 C6 is usually about 0.2 second, so that the negative potential at the plate of diode 1 will remain constant even at the lowest audio frequencies to be reproduced.

ELECTRONIC PHOTOFLASH UNITS

In servicing or experimenting with photoflash equipment, it must be remembered at all times that capacitors are charged at high voltages and very dangerous unless extreme care is taken to be sure they are properly discharged before touching terminals or leads.

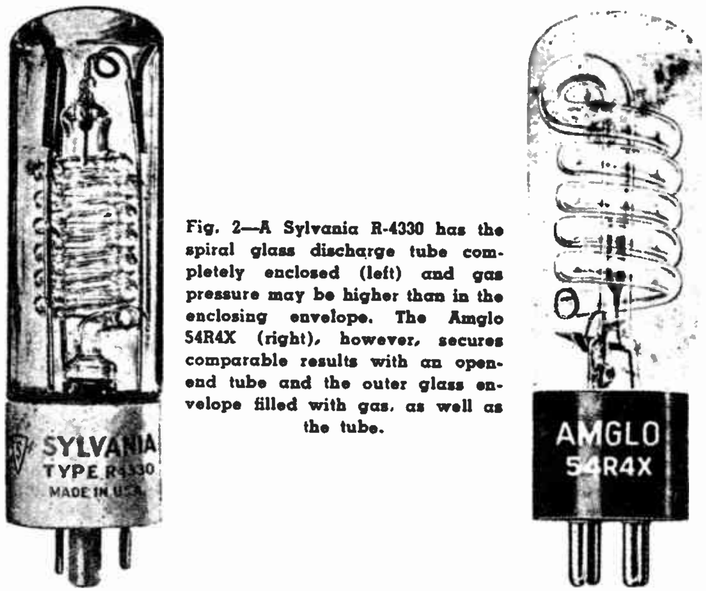


Fig. 2—A Sylvania R-4330 has the spiral glass discharge tube completely enclosed (left) and gas pressure may be higher than in the enclosing envelope. The Amglo 54R4X (right), however, secures comparable results with an open-end tube and the outer glass envelope filled with gas, as well as the tube.

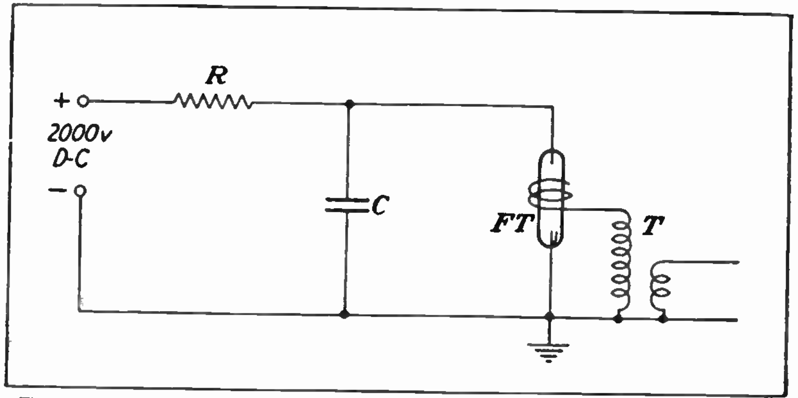


Fig. 5—The basic circuit used in G-E and Sylvania flashtubes. Gas in the tube is ionized by a high voltage between an external electrode and grounded terminal.

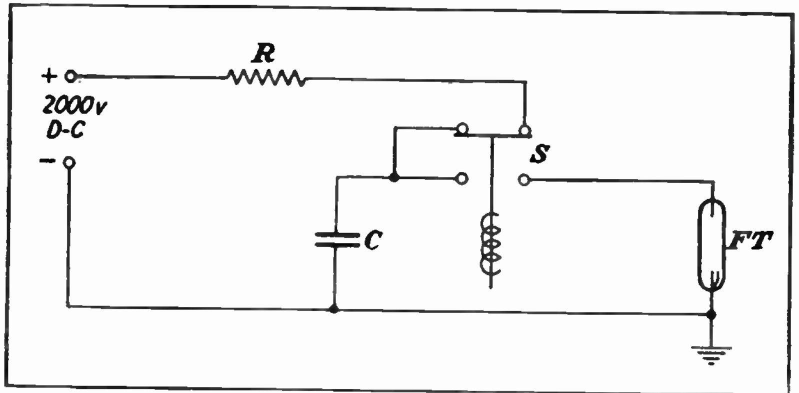


Fig. 3—Basic circuit of the flashtube with capacitor C charged from d-c source and discharged through relay S into the flashtube FT.

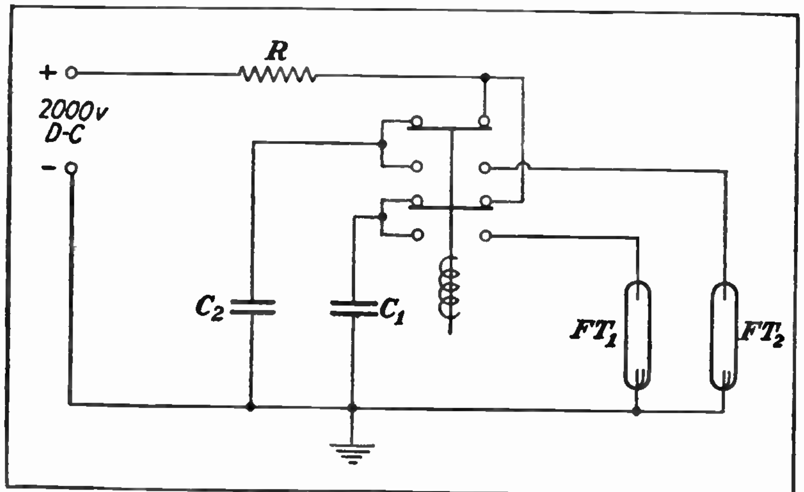


Fig. 4—Arrangement for charging capacitors in parallel but discharging them through individual flashtubes by means of a transfer relay.

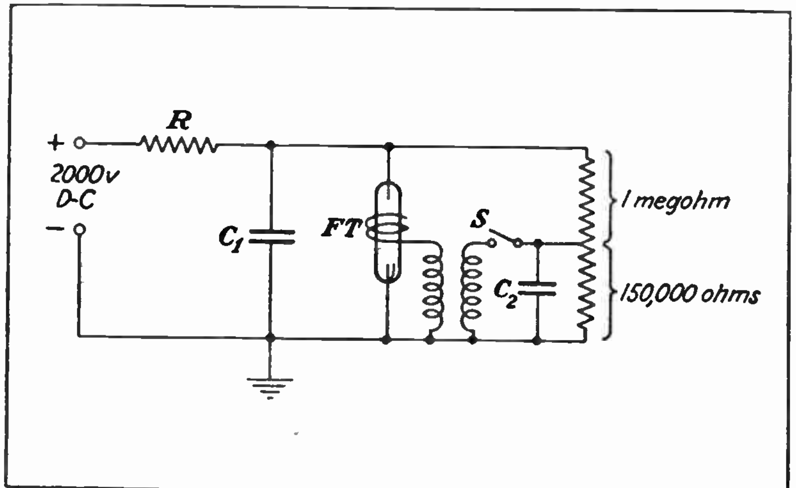


Fig. 6—Ionizing voltage may come instead from the discharge of a small condenser charged through a potentiometer from the main d-c supply.

SECTION IV

TV SERVICING with PICTURE TUBE PATTERNS

☆

Analysis of differences between abnormal and normal test patterns or television pictures often enables a serviceman to determine the kinds of troubles which may be causing the faulty reproduction. Many of the picture patterns that appear on TV receivers and the relation of these pictures to trouble shooting are described in this book.

On the following pages under the names ordinarily used to describe the appearance, due to faulty reproduction, are lists of troubles and photographs illustrating these abnormal patterns. The photographs have been provided through the courtesy of Allen B. DuMont Laboratories, Admiral Corporation, RCA, General Electric Company, Philco Corporation, Sentinel Radio Corporation and Radio Electronics Magazine.

Coyne definitely cautions any inexperienced individual against attempting to service a Television receiver. While certain adjustments for a better picture can be made from the "dials on the front" under no circumstances should anyone but a qualified TV serviceman attempt to service a television set. Even qualified servicemen are advised to observe the following precautions.

1. Extreme caution should be taken in handling the picture tube. The mounting of picture tube is usually constructed to provide adequate protection against implosion while the tube is in the receiver. Extreme caution is recommended when removal or installation of a picture tube is necessary. Here are several things to keep in mind.
2. Shut off power.
3. At no time rest the tube in the deflection yoke.
4. Wear heavy gloves and shatterproof glasses.
5. Advise everyone except qualified servicemen to stay at least 8 feet away from the set while the installing or removal of a picture tube is being done.

In any probing or testing in any part of the set it is recommended that (a) well insulated wire and hooded test clips be used; (b) use good test instruments with all lead wires adequately insulated for the voltages to be encountered. You should use extreme caution in working in or near the high voltage section; (c) do not take anything for granted—test everything—that is the only way to be sure.

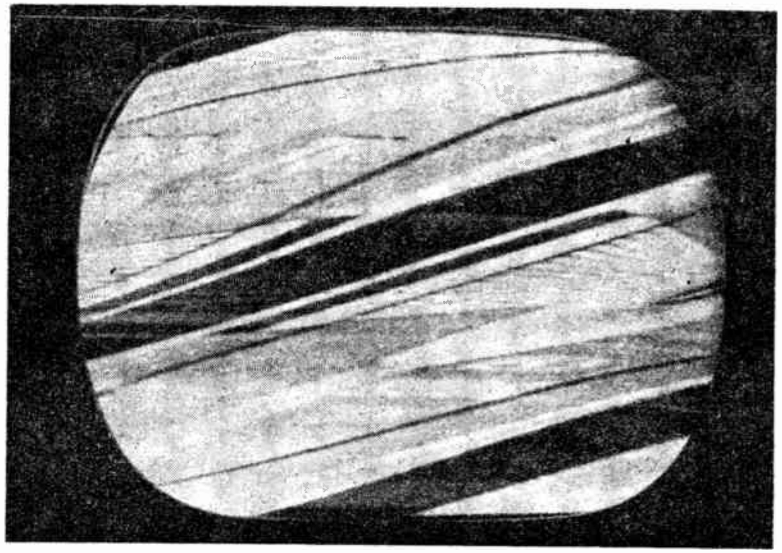


Fig. 131-3.—Bars, Sloping.

The bars change their degree of slope, their number, and their positions as the horizontal hold control is altered.

Causes for trouble.

Horizontal hold control incorrectly adjusted.

Faulty connections, resistors, or capacitors in circuits for horizontal hold control or for horizontal automatic control of sweep frequency.

See also troubles listed under *Movement, Horizontal.*

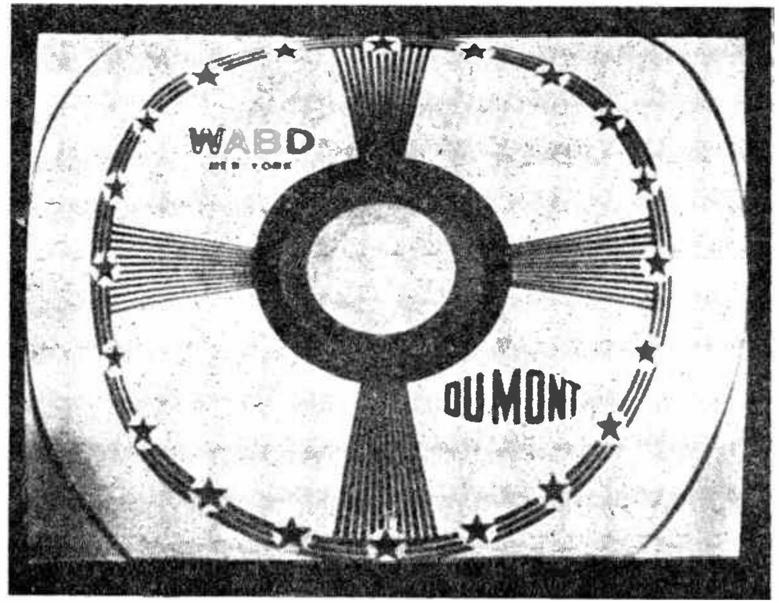


Fig. 131-16.—Linearity Poor, Vertical

With poor vertical linearity the pattern or picture is compressed or flattened from above, below, or from both directions.

Causes for trouble.

Vertical linearity control wrongly adjusted.

Defective capacitors or resistors, fixed or adjustable, in vertical linearity control circuits.

Vertical sweep oscillator tube defective, or supplied with wrong voltages.

Vertical sweep amplifier tube defective, or supplied with incorrect voltages.

Trouble in any parts which follow the vertical sweep oscillator, and which carry sawtooth voltages and currents.

Vertical sweep output transformer defective.

Shorted turns in a vertical deflection coil.

Poor filtering of low-voltage B-power supply.

FOLDS, HORIZONTAL. Figs. 8 and 9.

Only part of the picture or pattern is clearly recognizable, although more or less distorted and compressed horizontally. The remainder, usually less than half, appears to be stretched horizontally and folded back over the first portion. The folded part is indistinct, usually with only shadowy outlines. There may be only one fold (Fig. 8) or there may be several (Fig. 9) to give the distinct portion of the picture a corrugated appearance.

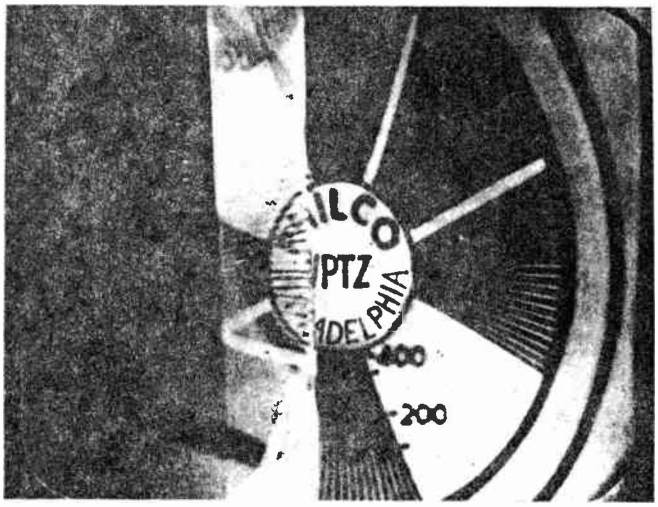


Fig. 8. The pattern is folded horizontally.

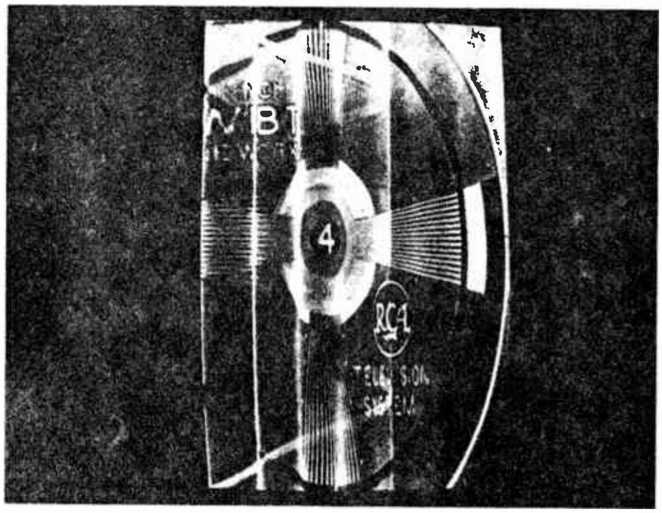


Fig. 9. One large horizontal fold and several minor ones.

The horizontal retrace time, due to discharge of the sawtooth capacitor in the horizontal oscillator-discharge tube circuit, actually is longer than the time allowed for horizontal retrace in received signals. The folded portions of pictures, which are indistinct and shadowy, occur during periods in which the picture tube beam should be blanked.

Damper Tube And Circuit.

Tube defective.

Capacitor on low-side circuit of damper open or disconnected.

Linearity control inductor in damper circuit shorted, otherwise defective of wrong type or wrong inductance.

Lead from horizontal output transformer and damper to the deflecting yoke has poor connections or is allowing leakage of current through faulty insulation.

Damper plate or cathode, depending on type of circuit, connected to a tap on the horizontal output transformer at which horizontal pulse voltages are not strong enough for rapid damping and retrace.

Boosted B-voltage to the horizontal output transformer and amplifier plate too low.

Frequency Control Circuits.

Afc tube weak or otherwise defective.

Afc control misadjusted. This is a control which operates in the circuits of the afc tube, or between that tube and the horizontal oscillator.

Too much resistance in the grid return lead of the horizontal output amplifier.

Too much capacitance has been connected across part of the horizontal output transformer or across a width control inductor when increasing the width of pictures.

Unbalance in resistors on the two sections of a horizontal phase detector or discriminator, or resistors connected wrong.

Insufficient feedback to afc tube from horizontal sweep circuit. Series capacitor too small, or shunt capacitor too large. Series resistor too great, or shunt resistor too small. The feedback lead may be connected to the wrong point on the horizontal output transformer or other parts of the sweep circuits.

Vertical hold control fixed resistors or potentiometer of wrong values or defective.

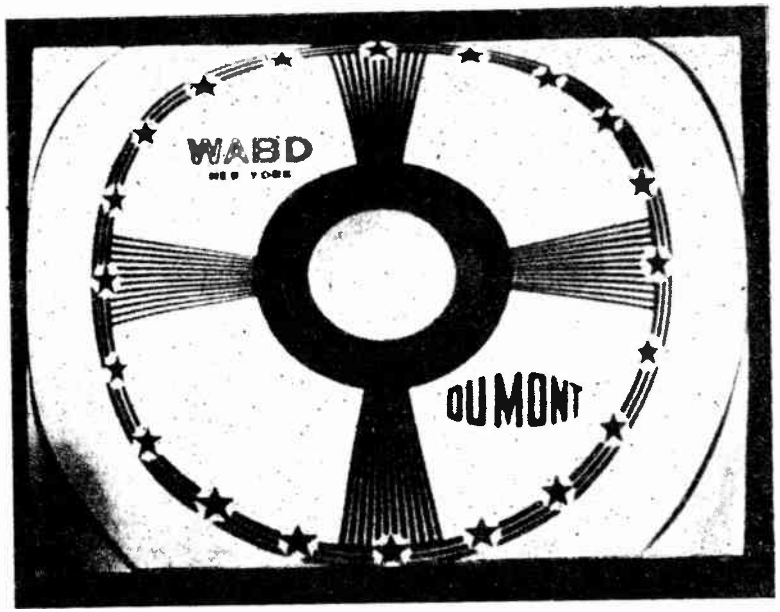


Fig. 131-16.—Linearity Poor, Vertical

With poor vertical linearity the pattern or picture is compressed or flattened from above, below, or from both directions.

Causes for trouble.

Vertical linearity control wrongly adjusted.

Defective capacitors or resistors, fixed or adjustable, in vertical linearity control circuits.

Vertical sweep oscillator tube defective, or supplied with wrong voltages.

Vertical sweep amplifier tube defective, or supplied with incorrect voltages.

Trouble in any parts which follow the vertical sweep oscillator, and which carry sawtooth voltages and currents.

Vertical sweep output transformer defective.

Shorted turns in a vertical deflection coil.

Poor filtering of low-voltage B-power supply.

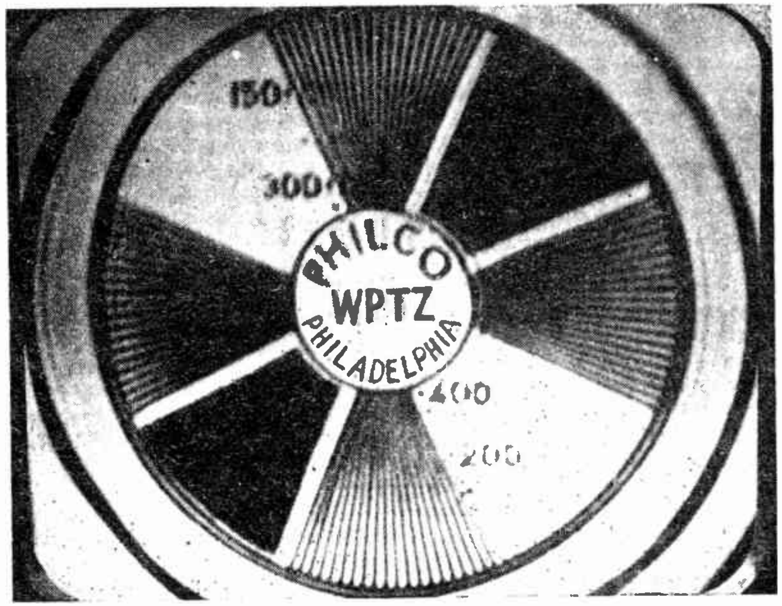


Fig. 131-13.—Ghosts.

There are multiple images in the test pattern or picture. The displaced images, of which there may be one or more, may be so close to the principal image or may be so faint as to cause only a blurring effect. In other cases the displaced images may be at a considerable fraction of inch from the principal image, and may be distinct.

Causes for trouble.

Part of the transmitted signal is being reflected from large conductive or semi-conductive objects, such as buildings, bridges, tanks, or steep hills, and the reflected portion is reaching the receiver antenna a fraction of a second later than the direct signal. Try rotating the receiving antenna to reject the reflected signal without too much loss of direct signal. Fit a reflector, and possibly also a director, on the antenna. Try the antenna in various locations.

Incorrect matching of impedances between antenna and transmission line, or between transmission line and receiver input. There are standing waves on the line. Use antenna and transmission line whose impedances match that of the receiver and of each other.

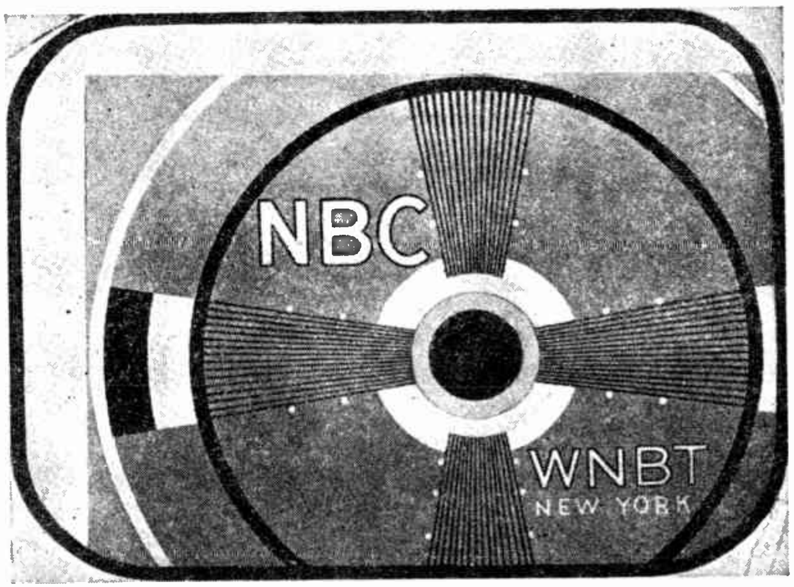


Fig. 131-6.—Centering Incorrect.

Picture or pattern may be too high or too low, incorrect vertical centering, or it may be too far to the right or left, incorrect horizontal centering, or there may be incorrect centering in both directions at once, as in the photograph.

Causes for trouble. Magnetic deflection.

Focusing control wrongly adjusted.

Ion trap magnet in wrong position on picture tube neck, or weak.

Horizontal hold control misadjusted.

Focusing coil axis direction requires adjustment. Should be in line with picture tube axis.

Focusing coil too far forward or back. Usually should be ¼ to ⅜ inch from the deflection yoke.

Focusing coil short circuited.

Deflection yoke too far back on neck of picture tube, or not centered around neck.

Defective bypass capacitor on focusing control.

Causes for trouble. Electrostatic deflection.

Centering control or controls wrongly adjusted.

Horizontal hold control misadjusted.

Picture tube shield magnetized.

Leaky capacitor or capacitors between outputs of deflection amplifiers or oscillators and the picture tube deflection plates.

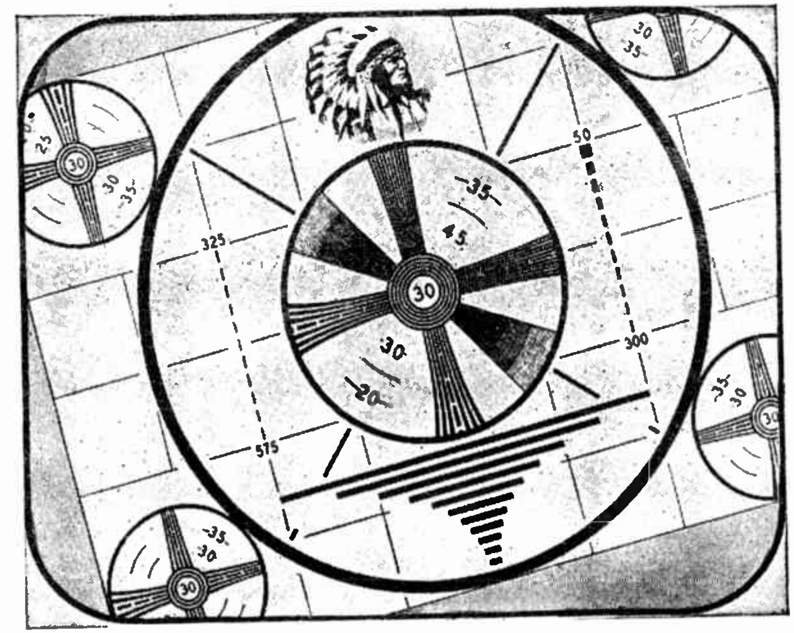


Fig. 131-30.—Tilting In Mask.

Causes for trouble.

Incorrect position of magnetic deflection yoke. Loosen the yoke fastening while rotating the yoke around the picture tube neck to straighten the pattern.

Incorrect position of electrostatic tube. Rotate the entire tube around its axis to straighten the pattern.

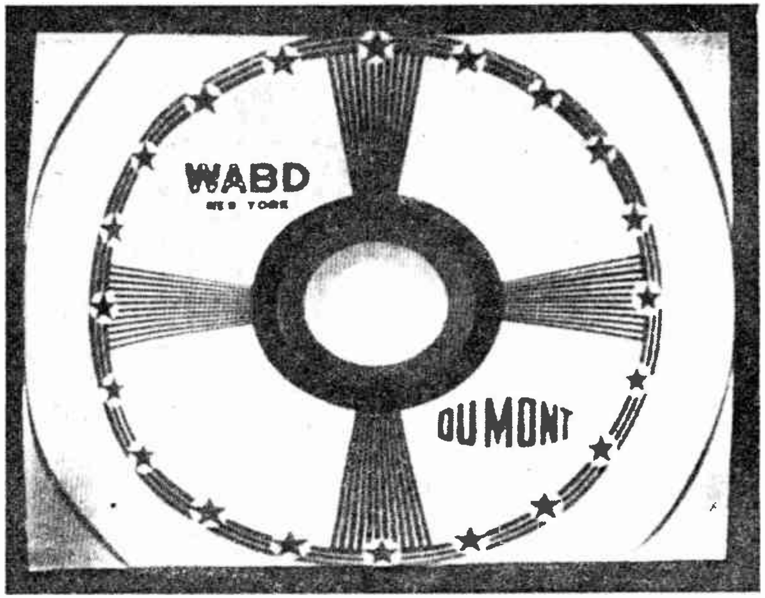


Fig. 131-18.—Lines, Narrow, Allover Pattern.

Due to beat interference from radio frequency and television frequency signals or voltages originating from outside or within the receiver. The number of cycles per second of the interfering frequency is equal approximately to the number of lines, either light or dark, but not both, multiplied by 15,750. The lines may lie vertically or diagonally on the picture tube screen. They weave or ripple and change their direction.

Causes for trouble.

Interference from f-m radio broadcasting stations operating in the area where the receiver is located. Change the direction of the receiving antenna. Tune an antenna trap to the interfering frequency. Check the transmission line for possible signal pickup.

Interference from nearby short-wave transmitters. Same remedies as for f-m interference.

Interference from television channels other than the one to which the receiver is tuned. Try adjusting the fine tuning control.

Beating frequency of 4.5 megacycles from sound section of a receiver having intercarrier sound system, or getting past the sound takeoff and reaching the picture tube grid cathode circuit through all or part of the video amplifier. Check dressing of all grid and plate leads following the takeoff.


Fig. 131-12.—Folded Pattern, Vertically.

Causes for trouble.

Vertical hold control incorrectly adjusted.

Faults in vertical hold control circuit causing vertical deflection frequency which is too high.

Waveforms

The preferred method of analyzing the operation of a TV receiver is through the use of an oscilloscope. The waveforms reproduced in this Section are typical of those found in a well-performing commercial receiver. It must be understood that circuit variations exist between different manufacturers and that the waveforms obtained will be dependent upon these circuit variations as well as the signal conditions and the quality of the oscilloscope being used.

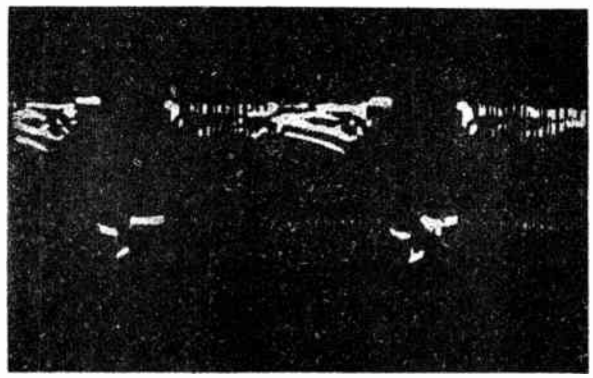


Fig. 139-1.

Fig. 139-1: Taken at the top of the video detector load resistor. This is the output of the video detector and the input to the grid circuit of the video amplifier. Here appears the entire composite television signal with picture variations, positive, at the top and with sync pulses, negative, at the bottom. Two vertical blanking intervals are plainly visible between the fields. During each blanking interval there appear in order, from left to right, the equalizing pulses which follow one field, then the vertical sync pulses at the bottommost points along the trace, and finally the remaining equalizing and horizontal sync pulses which precede the next field.

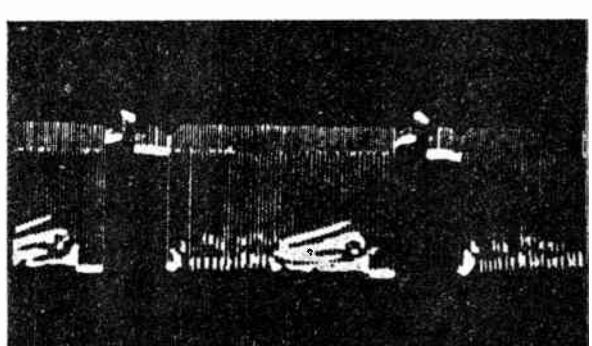


Fig. 139-2.

Fig. 139-2: Taken at the plate of the video amplifier tube. Here again is the complete compositive signal, but now the polarity has been inverted to make sync pulses positive and picture variations negative. This waveform is applied to the cathode of the picture tube, which is the point of signal input to the picture tube of this particular receiver.

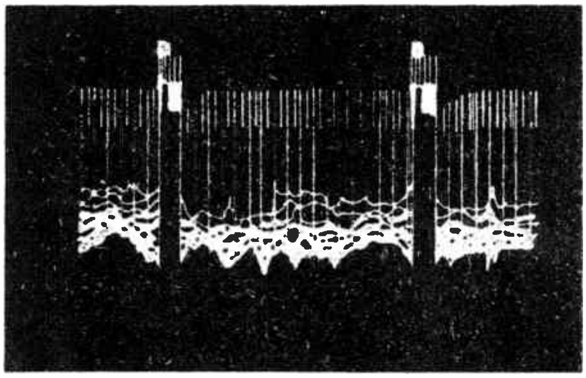


Fig. 139-3.

Fig. 139-3: Taken at the grid of the first tube in the sync section, which is a sync amplifier. The signal shown here comes from the output of the video amplifier, and accordingly is of the same polarity and has the same general characteristics as shown in Fig. 139-2.

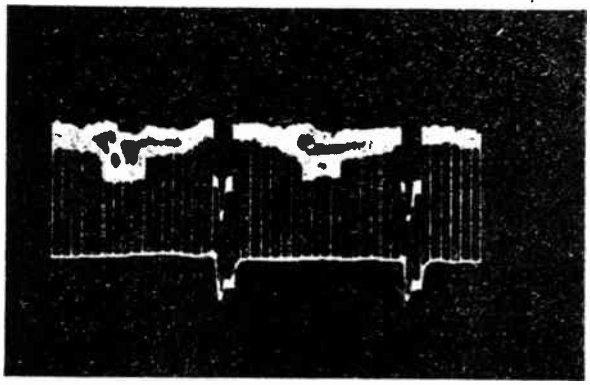


Fig. 139-4.

Fig. 139-4: Taken at the plate of the sync amplifier tube. The polarity has been inverted with respect to polarity in Fig. 139-3. The peak-to-peak voltage of this amplifier output waveform actually is about four times as great as voltage at the input to the tube.

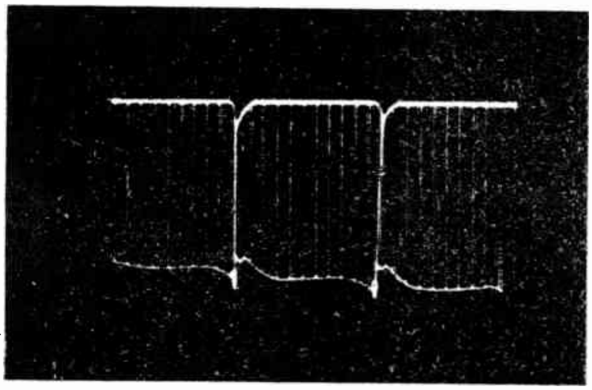


Fig. 139-5.

Fig. 139-5: Taken at the plate of the second tube in the sync section, which is operated as a separator. Picture variations have all but disappeared from the signal, while the vertical sync pulses have been retained. Polarity has not been inverted, because signal input is to the cathode rather than the grid of this separator.

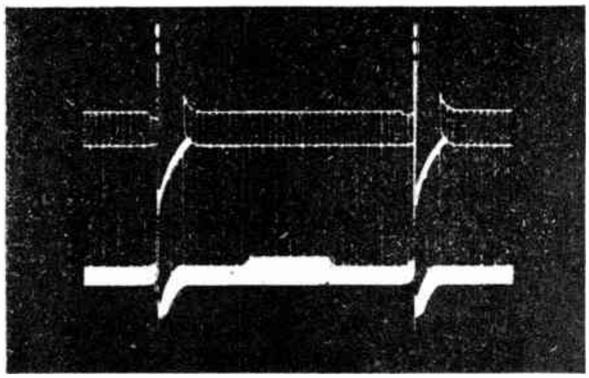


Fig. 139-6.

Fig. 139-6: Taken at the plate of the third tube in the sync section, which is operated as a clipper. Polarity has been inverted with respect to that of Fig. 139-5. Vertical sync pulse voltage peaks have become very pronounced. This is the signal which goes to the integrating filter located between the sync clipper and the input for the vertical sweep oscillator.

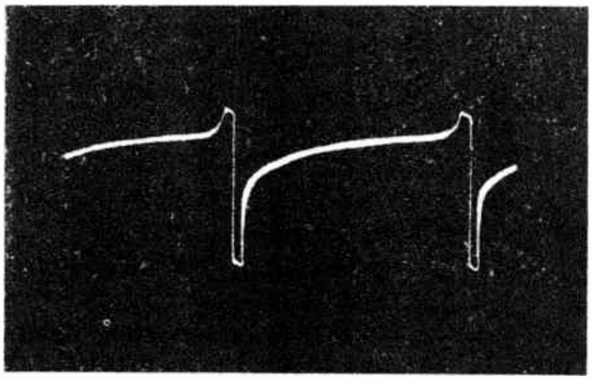


Fig. 139-7.

Fig. 139-7: Taken at the grid of the vertical sweep oscillator, which is a blocking type. Note the sudden changes of potential in the negative direction, downward on the trace, as the oscillator blocks. Then comes the quick partial recovery in the positive direction and the more gradual change preceding the positive peak that triggers this oscillator.

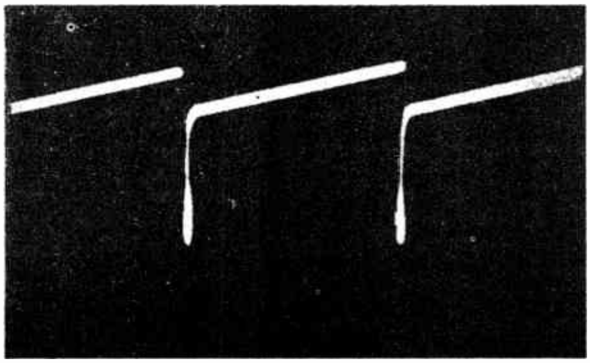


Fig. 139-8.

Fig. 139-8: Taken at the grid of the vertical sweep amplifier which follows the vertical oscillator. This is the sawtooth voltage combined with negative (downward) peaks as required for magnetic deflection.

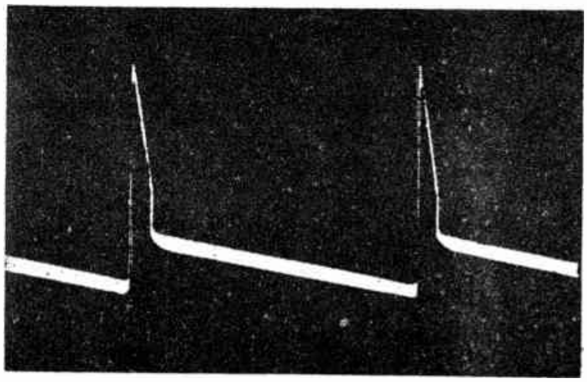


Fig. 139-9.

Fig. 139-9: Taken at the plate of the vertical sweep amplifier. Polarity has been inverted with respect to the previous trace, taken at the grid of the same tube. Peak-to-peak voltage here is about 18 times as great as at the grid.

Fig. 139-10: This final trace for the vertical deflection system is taken from the circuit which includes the secondary winding of the vertical output transformer and the two ver-

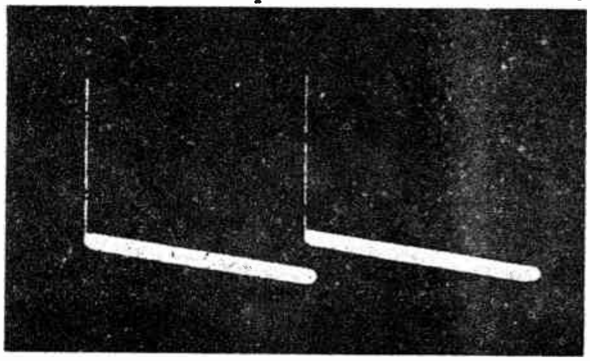


Fig. 139-10.

tical deflection coils of the yoke on the picture tube. Peak-to-peak voltage is between one-ninth and one-tenth of that at the plate of the vertical sweep amplifier, which connects to the primary of the output transformer.

Traces which are to follow in Figs. 139-11 to 139-24 are taken with the internal sweep of the oscilloscope adjusted for 7,875 cycles per second or to the frequency which produces two horizontal line periods.

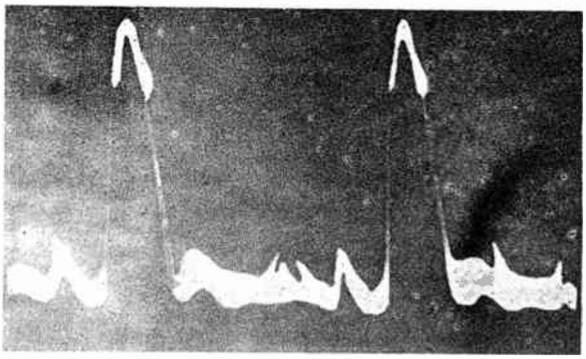


Fig. 139-12.

Fig. 139-12: From the plate of the video amplifier tube. Except for inversion of polarity this trace is similar to the one taken from the grid of this tube. Peak-to-peak voltage has been increased about nine times.

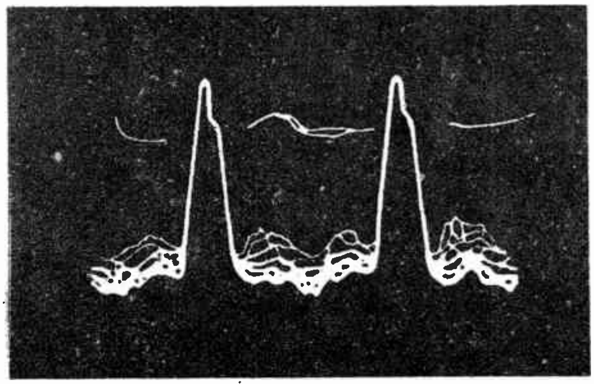


Fig. 139-13.

Fig. 139-13: From the grid of the sync amplifier, the first tube in the sync section. This signal comes from the output of the video amplifier, and is of the same polarity as in Fig. 139-12.

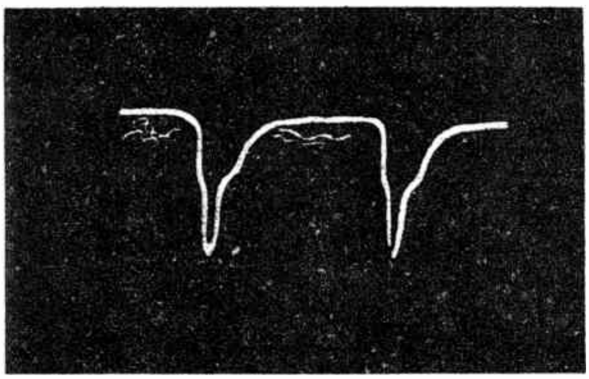


Fig. 139-14.

Fig. 139-14: From the plate of the sync amplifier. Polarity has been inverted. Voltages for picture variations have very nearly disappeared, while horizontal sync pulses have become distinct.

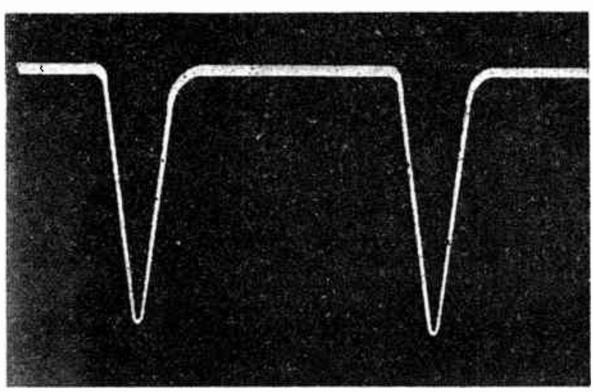


Fig. 139-15.

Fig. 139-15: From the plate of the sync separator tube. Only the horizontal sync pulses now remain. There has been no inversion of polarity, due to use of cathode input to this tube.

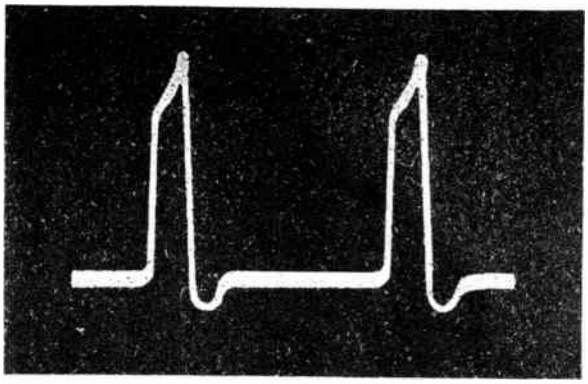


Fig. 139-16.

Fig. 139-16: From the plate of the sync clipper tube. This waveform is the input to the differentiating filter located between the clipper and the horizontal oscillator control tube of the horizontal afc system.

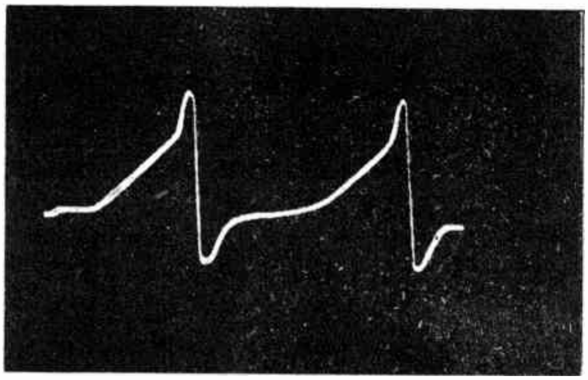


Fig. 139-17.

Fig. 139-17: From the top (ungrounded side) of the lock-in control capacitor in the grid circuit of the control tube of the horizontal afc system. This voltage results from combination of the output from the differentiating filter and a feedback voltage from the horizontal sweep output circuit, as required for this method of oscillator control. The waveform shown here is taken while a transmitted television signal is being received. The sharp or narrow positive peaks represent synchronizing voltages which result from horizontal sync pulses in the signal.

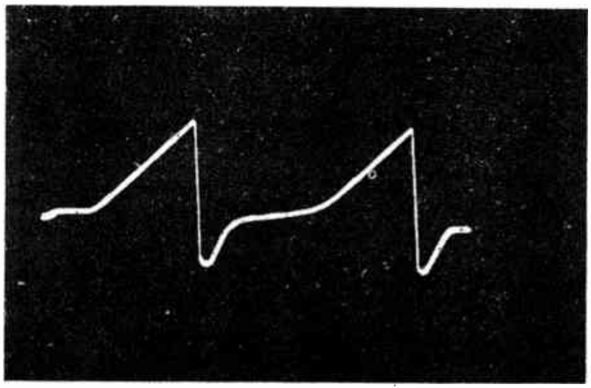


Fig. 139-18.

Fig. 139-18: This is the same as the previous trace, except that it is taken while no transmitted signal is being received. Note the absence of positive synchronizing peaks at the tops of the sawtooth portions of the wave.

SECTION VI

Typical Schematic Diagrams

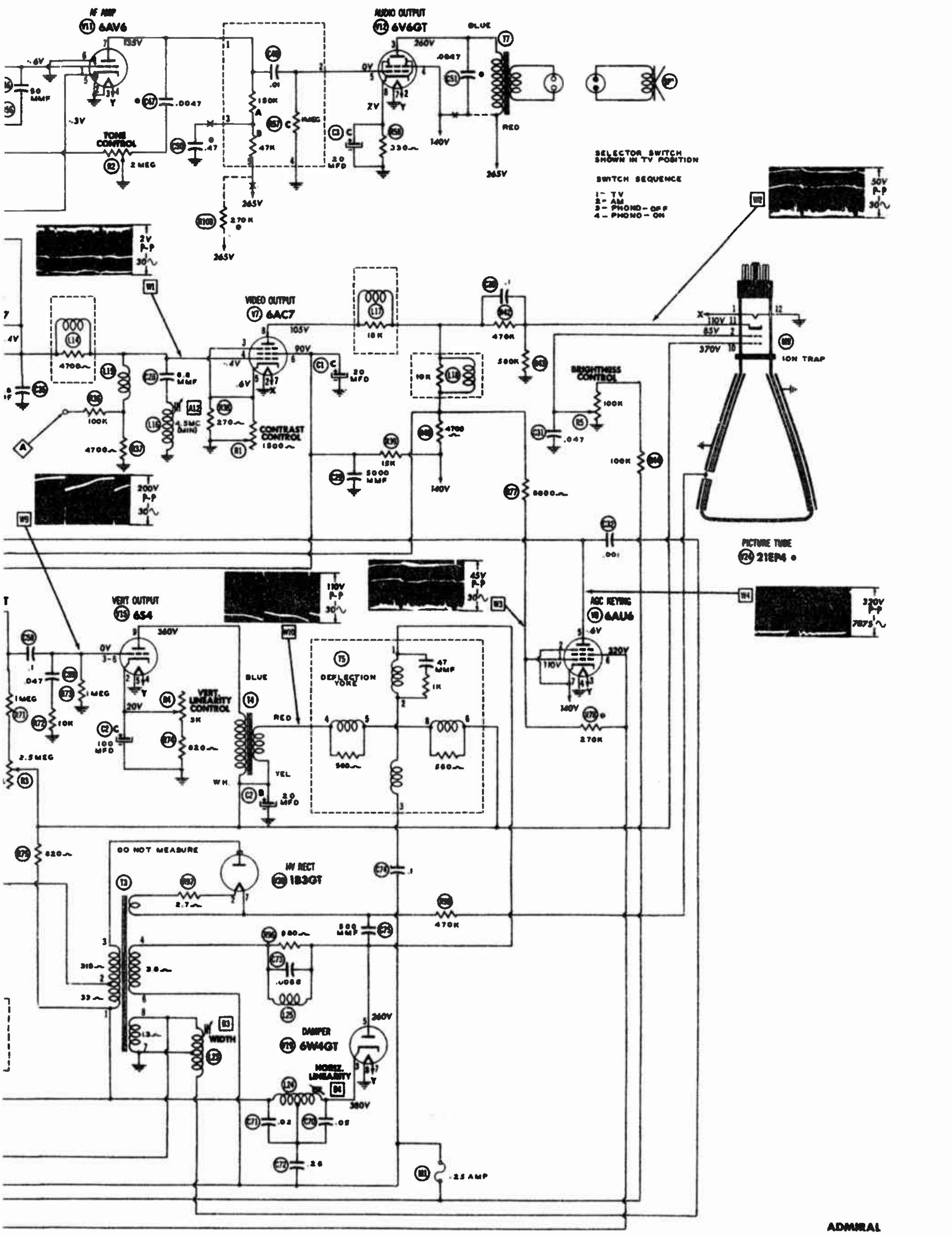
The Radio and Television diagrams reproduced here are Photo Fact Standard Notation Schematics (*) prepared by the Howard W. Sams & Co. Inc. These diagrams appear regularly in Photo Fact Folders (†) as a part of the complete service data furnished by the Howard W. Sams & Co. Inc. The sets of Photo Fact Folders are sold by Electronics Parts Distributors in all sections of the world and the diagrams are reproduced in this brochure as typical of the finest type of data available for service purposes.

The diagrams are arranged alphabetically by name of set; ADMIRAL, AIRLINE, BENDIX, etc. Diagrams on several dozen of the most popular TV sets in the country are included in this section.

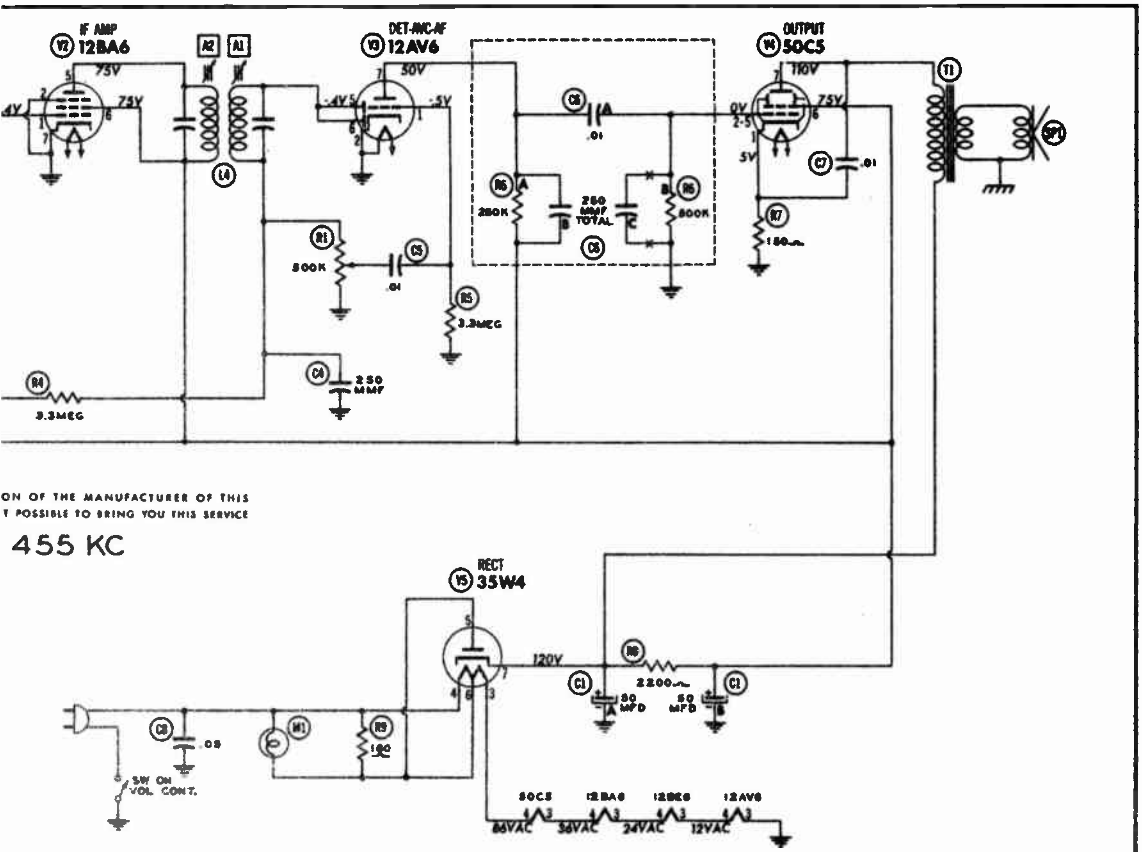
*Copyright
†Trade Mark

INDEX

COYNE



ADMIRAL
CHASSIS 22A2, A, 22M1, 22Y1

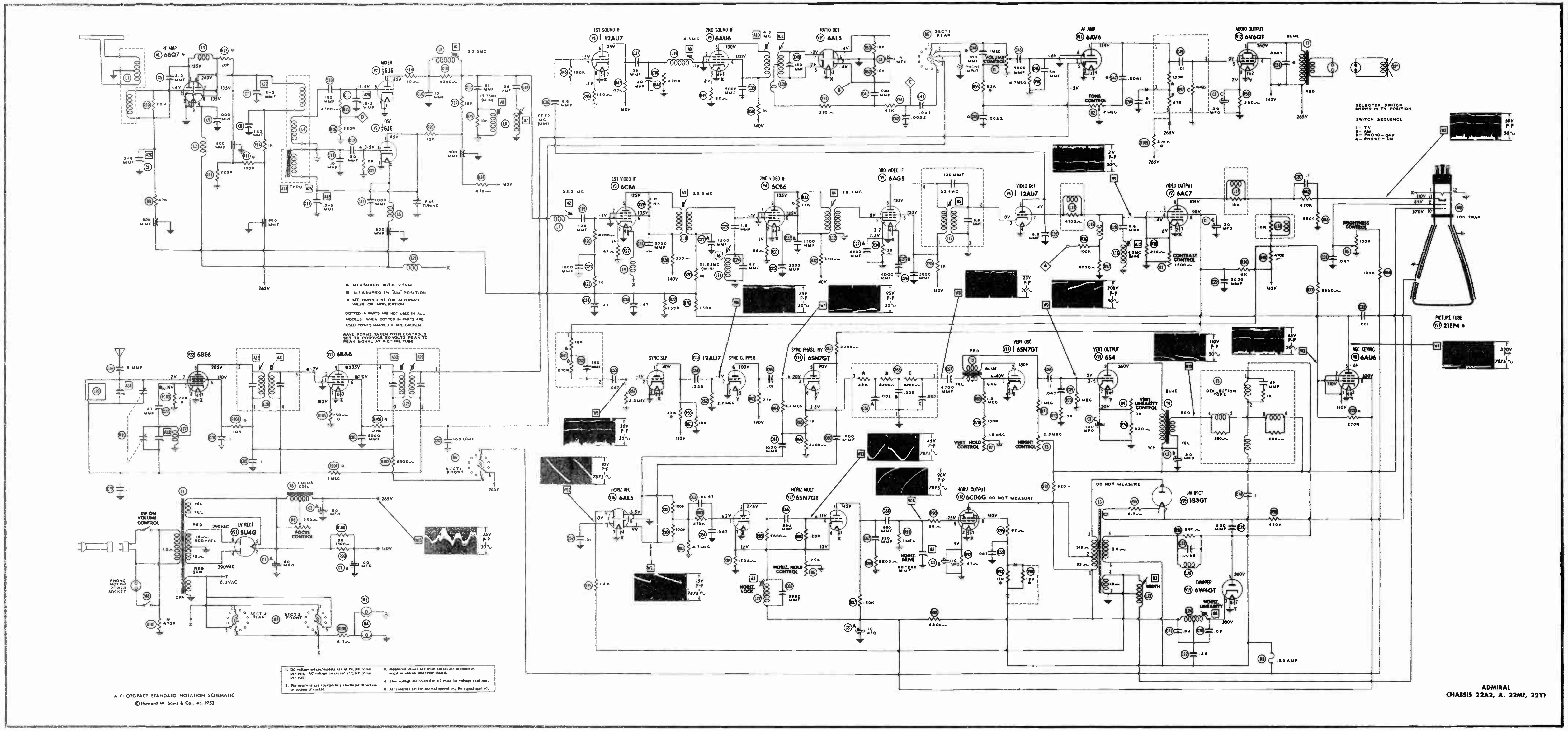


RESISTANCE READINGS

1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
	.8Ω	12Ω	24Ω	†2.2KΩ	†2.2KΩ	4.8Meg
g	0Ω	24Ω	36Ω	†2.2KΩ	†2.2KΩ	0Ω
g	0Ω	0Ω	12Ω	500KΩ	500KΩ	†250KΩ
	500KΩ	36Ω	86Ω	500KΩ	†2.2KΩ	†265Ω
	0Ω	86Ω	121Ω	105Ω	105Ω	60KΩ

† MEASURED FROM PIN 7 OF V5
▲ TAKEN WITH VACUUM TUBE VOLTMETER

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.


RF AMP (V1) 6BQ7
MIXER (V2) 6J6
OSC (V2) 6J6
FINE TUNING
1ST SOUND IF (V6) 12AU7
2ND SOUND IF (V9) 6AU6
RATIO DET (V10) 6AL5
SECT 1 REAR
PHONO INPUT
VOLUME CONTROL
AF AMP (V11) 6AV6
TONE CONTROL
AUDIO OUTPUT (V12) 6V6GT
SELECTOR SWITCH SHOWN IN TV POSITION
SWITCH SEQUENCE
1 - TV
2 - AM
3 - PHONO - OFF
4 - PHONO - ON
1ST VIDEO IF (V3) 6CB6
2ND VIDEO IF (V4) 6CB6
3RD VIDEO IF (V5) 6AG5
VIDEO DET (V6) 12AU7
VIDEO OUTPUT (V7) 6AC7
CONTRAST CONTROL
BRIGHTNESS CONTROL
ION TRAP
PICTURE TUBE (V24) 21EP4
▲ MEASURED WITH VTVM
■ MEASURED IN "AM" POSITION
⊗ SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
(V22) 6BE6
(V23) 6BA6
SECT 1 FRONT
SYNC SEP (V13) 12AU7
SYNC CLIPPER
SYNC PHASE INV (V14) 6SN7GT
VERT OSC (V14) 6SN7GT
VERT OUTPUT (V15) 6S4
VERT LINEARITY CONTROL
VERT. HOLD CONTROL
HEIGHT CONTROL
DEFLECTION YOKE
AGC KEYING (V8) 6AU6
SW ON VOLUME CONTROL
LV RECT (V21) 5U4G
FOCUS COIL
FOCUS CONTROL
PHONO MOTOR POWER SOCKET
SECT 2 REAR
SECT 2 FRONT
HORIZ AFC (V16) 6AL5
HORIZ MULT (V17) 6SN7GT
HORIZ. HOLD CONTROL
HORIZ. LOCK
HORIZ. DRIVE
HORIZ OUTPUT (V18) 6CD6G DO NOT MEASURE
DO NOT MEASURE
HV RECT (V20) 1B3GT
WIDTH
DAMPER (V19) 6W4GT
HORIZ. LINEARITY
.25 AMP
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
A PHOTOFACT STANDARD NOTATION SCHEMATIC
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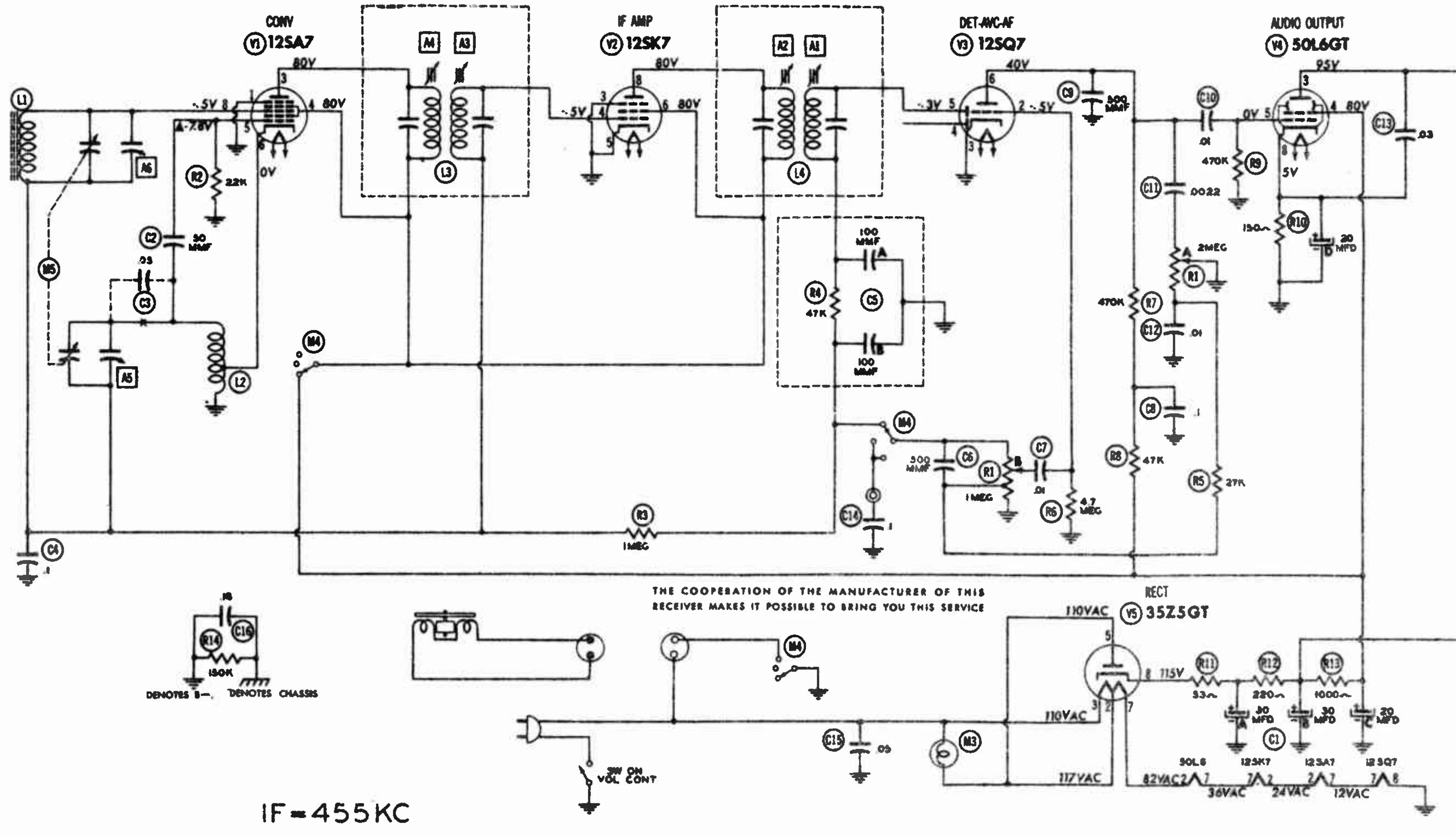
ADMIRAL
CHASSIS 22A2, A, 22M1, 22Y1



IF=455KC

FUNCTION SWITCH SHOWN IN "RADIO" POSITION.
SWITCH SEQUENCE:
1. RADIO
2. PHONO (MOTOR OFF)
3. PHONO (MOTOR ON)

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	12SA7	10Ω	24Ω	†1.2KΩ	†1.2KΩ	22KΩ	.8Ω	12Ω	1.8Meg
V 2	12SK7	90Ω	24Ω	0Ω	1.8Meg	0Ω	†1.2KΩ	36Ω	†1.2KΩ
V 3	12SQ7	90Ω	4.7Meg	0Ω	INF	500KΩ	†510KΩ	12Ω	0Ω
V 4	50L6GT	INF	86Ω	†462Ω	†1.2KΩ	470KΩ	†480KΩ	36Ω	150Ω
V 5	35Z5GT	INF	121Ω	112Ω	121Ω	112Ω	†33Ω	86Ω	25KΩ

ALL MEASUREMENTS TAKEN IN RADIO POSITION ONLY
† MEASURED FROM PIN 8 OF V5
▲ TAKEN WITH VACUUM TUBE VOLTMETER
¶ MEASURED FROM CHASSIS

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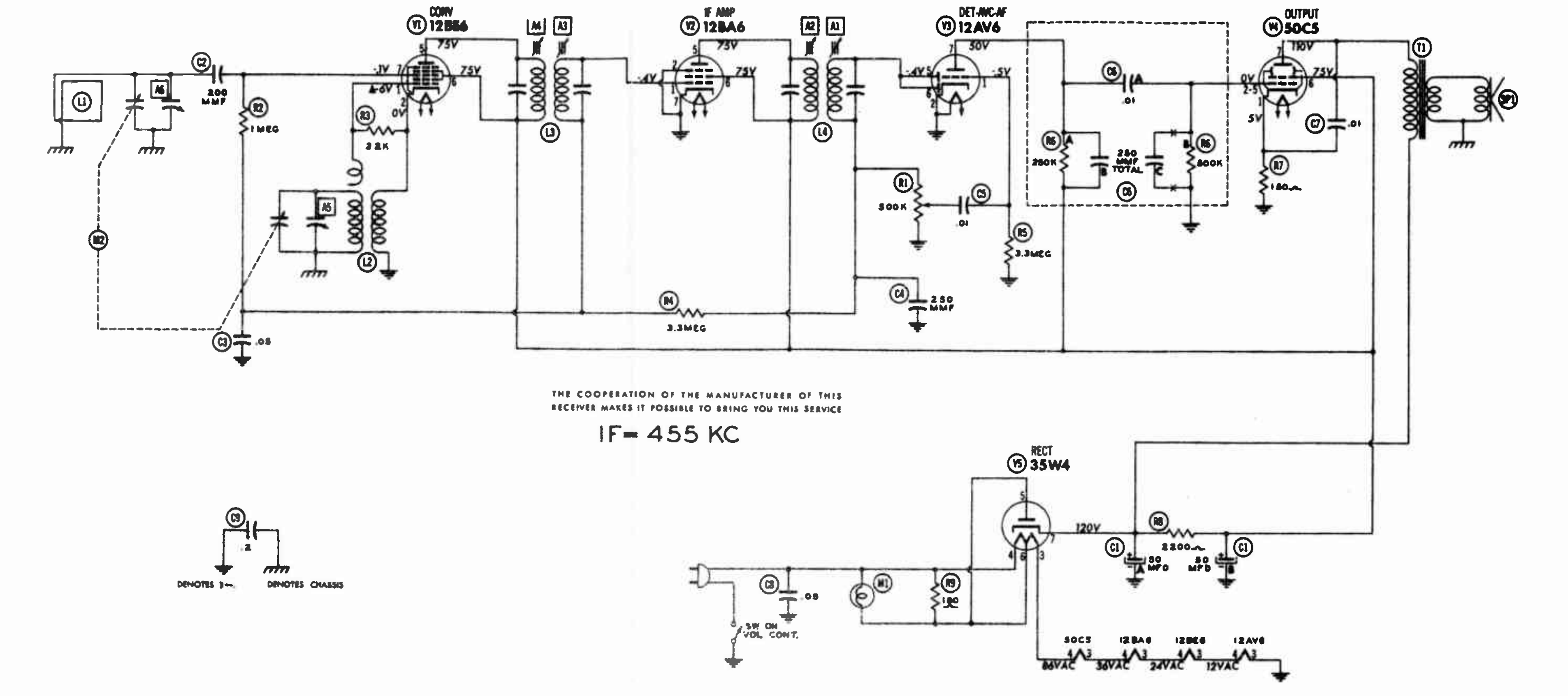
ADMIRAL - 5Y22 (5Y2)

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

IF= 455 KC

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	12BE6	22KΩ	.8Ω	12Ω	24Ω	†2.2KΩ	†2.2KΩ	4.8Meg
V 2	12BA6	3.8Meg	0Ω	24Ω	36Ω	†2.2KΩ	†2.2KΩ	0Ω
V 3	12AV6	3.3Meg	0Ω	0Ω	12Ω	500KΩ	500KΩ	†250KΩ
V 4	50C5	150Ω	500KΩ	36Ω	86Ω	500KΩ	†2.2KΩ	†265Ω
V 5	35W4	0Ω	0Ω	86Ω	121Ω	105Ω	105Ω	60KΩ

† MEASURED FROM PIN 7 OF V5
▲ TAKEN WITH VACUUM TUBE VOLTMETER

AIRLINE - 25 GSE 1555A
25 GSE 1556A

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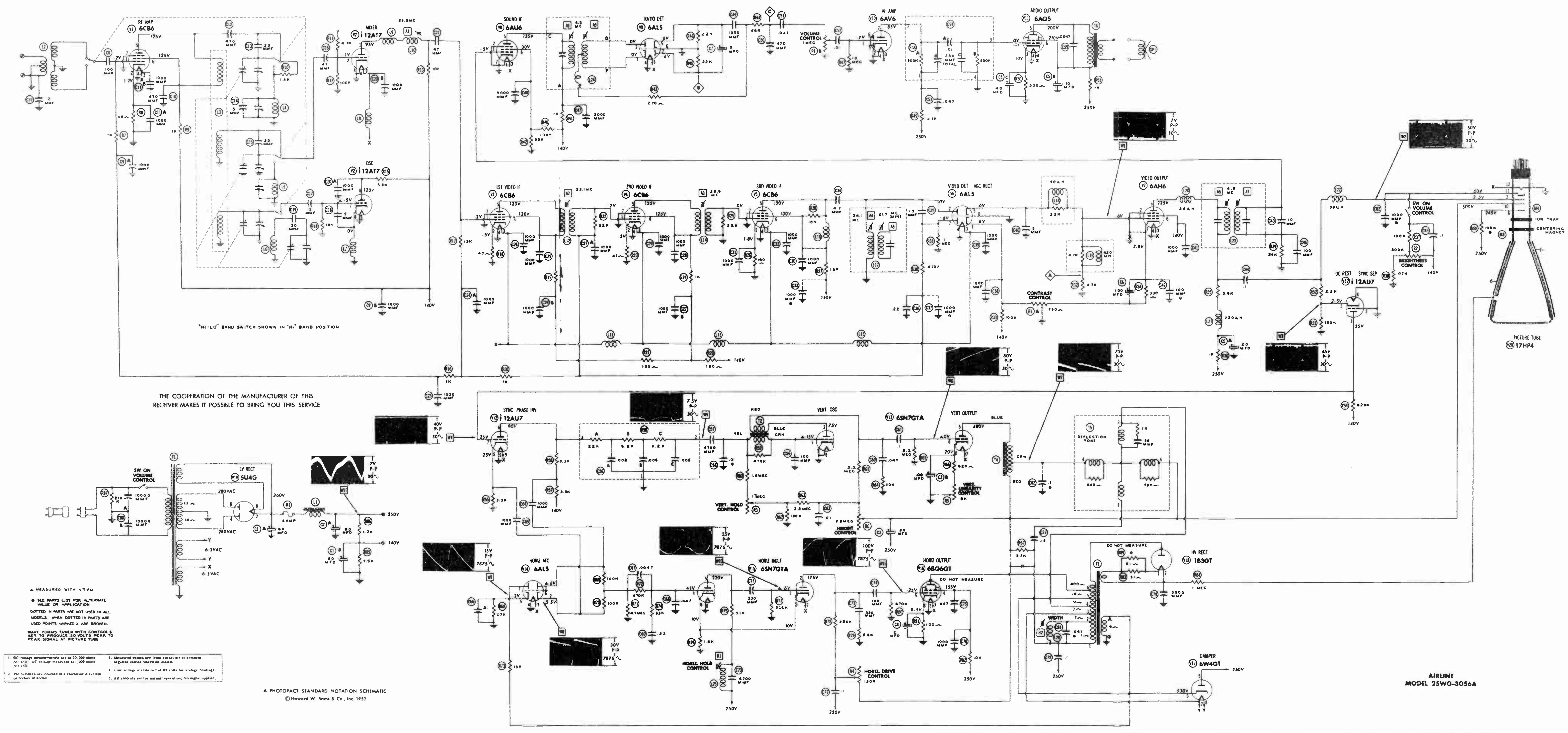
174-3

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.


RF AMP 6CB6
MIXER 12AT7
OSC 12AT7
SOUND IF 6AU6
RATIO DET 6AL5
AF AMP 6AV6
AUDIO OUTPUT 6AQ5
VOLUME CONTROL 1 MEG
1ST VIDEO IF 6CB6
2ND VIDEO IF 6CB6
3RD VIDEO IF 6CB6
VIDEO DET AGC RECT 6AL5
VIDEO OUTPUT 6AH6
CONTRAST CONTROL
DC REST SYNC SEP 12AU7
SW ON VOLUME CONTROL
BRIGHTNESS CONTROL
ION TRAP
CENTERING MAGNET
PICTURE TUBE 17HP4
"HI-LO" BAND SWITCH SHOWN IN "HI" BAND POSITION
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
SYNC PHASE INV 12AU7
VERT OSC
6SN7GTA
VERT OUTPUT
VERT. HOLD CONTROL
HEIGHT CONTROL
VERT LINEARITY CONTROL
DEFLECTION YOKE
LV RECT 5U4G
SW ON VOLUME CONTROL
6.3VAC
HORIZ AFC 6AL5
HORIZ MULT 6SN7GTA
HORIZ OUTPUT 6BQ6GT
DO NOT MEASURE
HORIZ. HOLD CONTROL
HORIZ. DRIVE CONTROL
WIDTH
HV RECT 1B3GT
DAMPER 6W4GT
▲ MEASURED WITH VTVM
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
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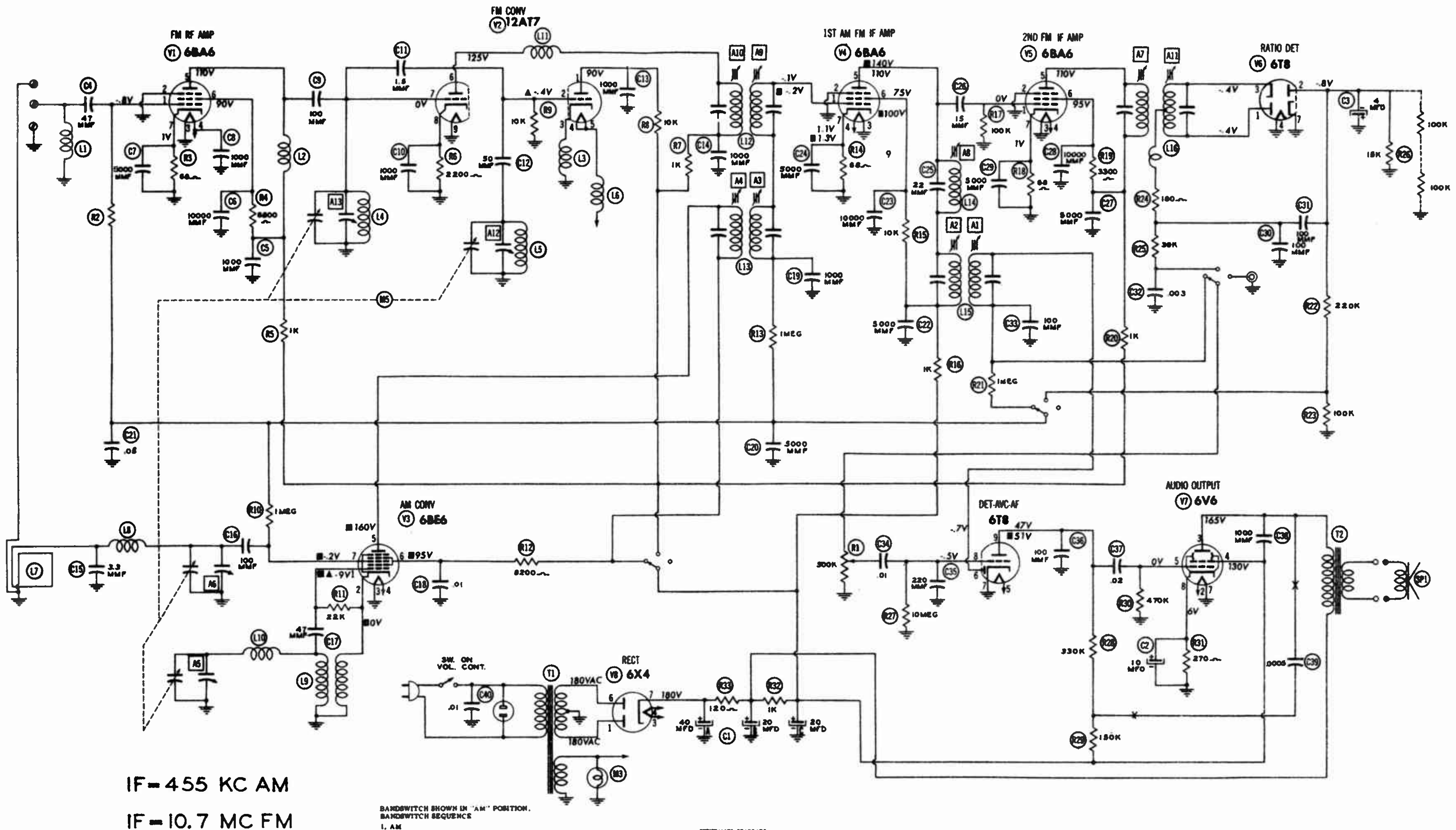
AIRLINE
MODEL 25WG-3056A



BANDSWITCH SHOWN IN "AM" POSITION.
BANDSWITCH SEQUENCE

1. AM
2. FM
3. PHONO

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V 1	6BA6	1.2Meg	0Ω	0Ω	.1Ω	†2.8KΩ	†10KΩ	68Ω		
V 2	12AT7	†12KΩ	10KΩ	.8Ω	.8Ω	.8Ω	†2.8KΩ	0Ω	2.2KΩ	0Ω
V 3	6BE6	22KΩ	.8Ω	0Ω	.1Ω	•1.8KΩ	•9.3KΩ	•2.5Meg		
V 4	6BA6	1.2Meg •2.5Meg	0Ω	0Ω	.1Ω	†2.8KΩ	†12KΩ	68Ω		
V 5	6BA6	100KΩ	0Ω	0Ω	.1Ω	†2.8KΩ	†5.4KΩ	68Ω		
V 6	6T8	540KΩ	10KΩ	540KΩ	0Ω	.1Ω	•500KΩ	0Ω	10Meg	240KΩ
V 7	6V6GT	INF	.1Ω	†300Ω	†1.8KΩ	470KΩ	INF	0Ω	270Ω	
V 8	6X4	170Ω	†1.1KΩ	0Ω	.1Ω	†1.1KΩ	180Ω	68KΩ		

▲ TAKEN WITH VACUUM TUBE VOLTMETER
ALL MEASUREMENTS TAKEN IN FM POSITION
† MEASURED FROM PIN 7 OF V8
• MEASURED IN AM POSITION

THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.

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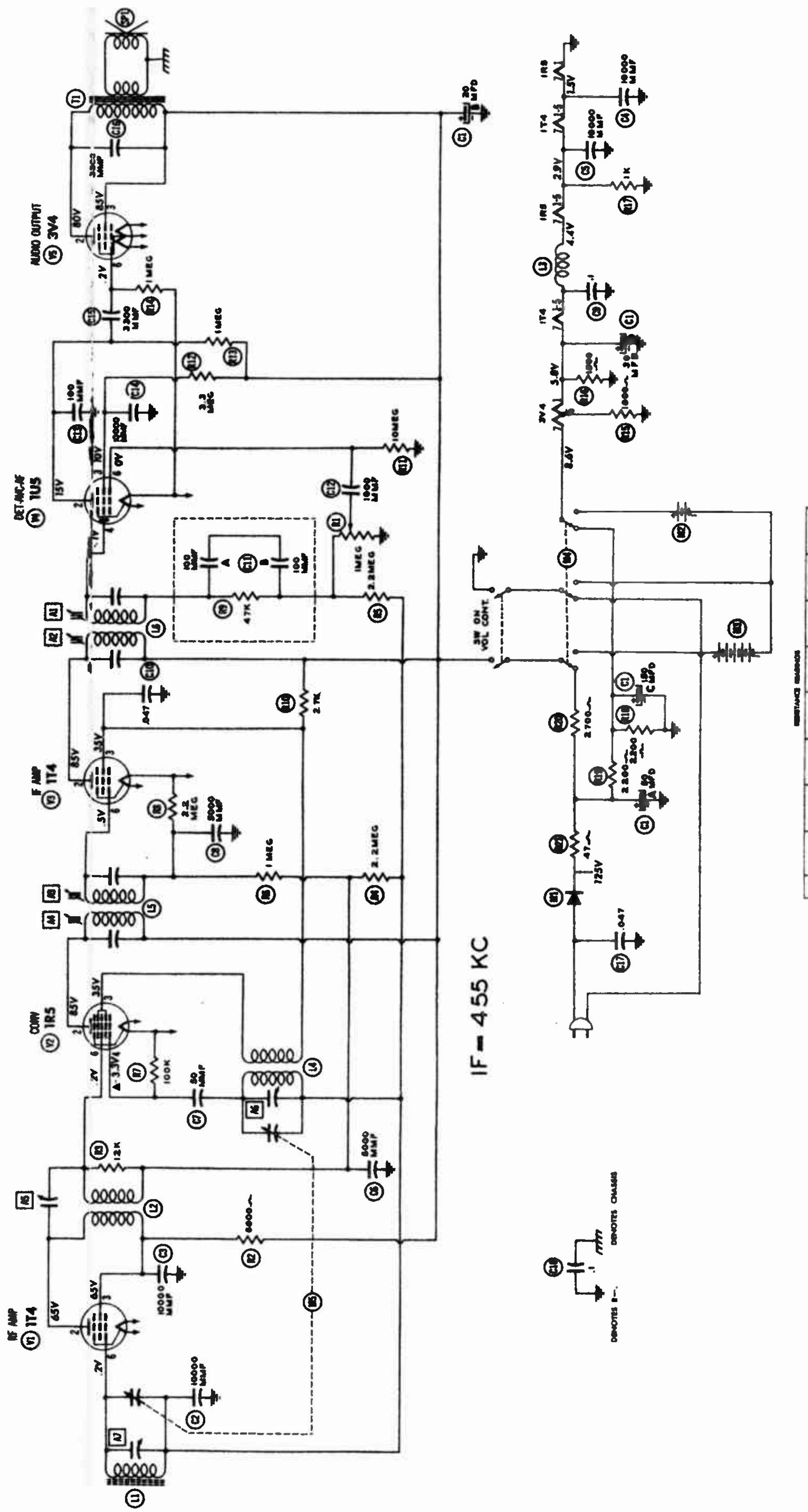
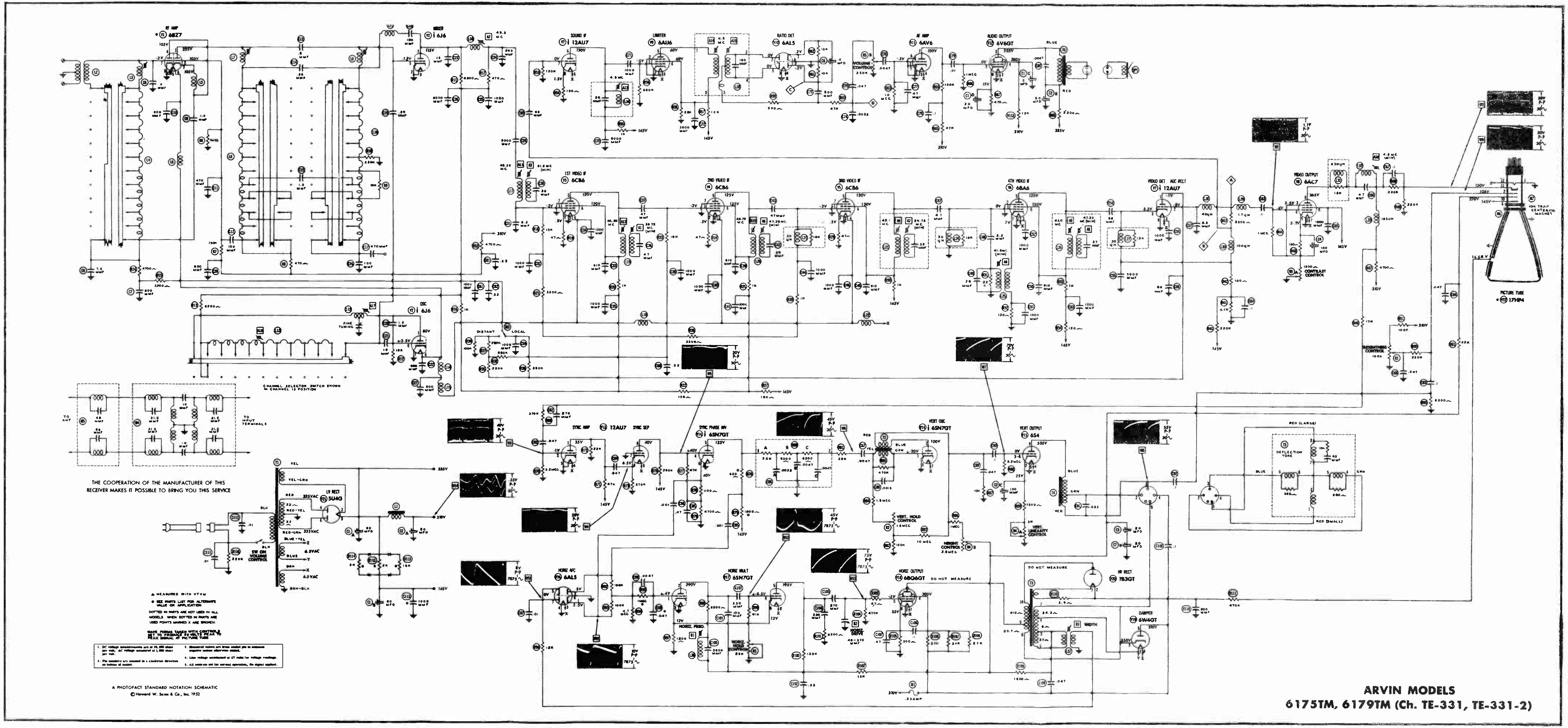
ARVIN - 582 CFB, CFM (CH. RE - 310)



ARVIN MODEL 550-P



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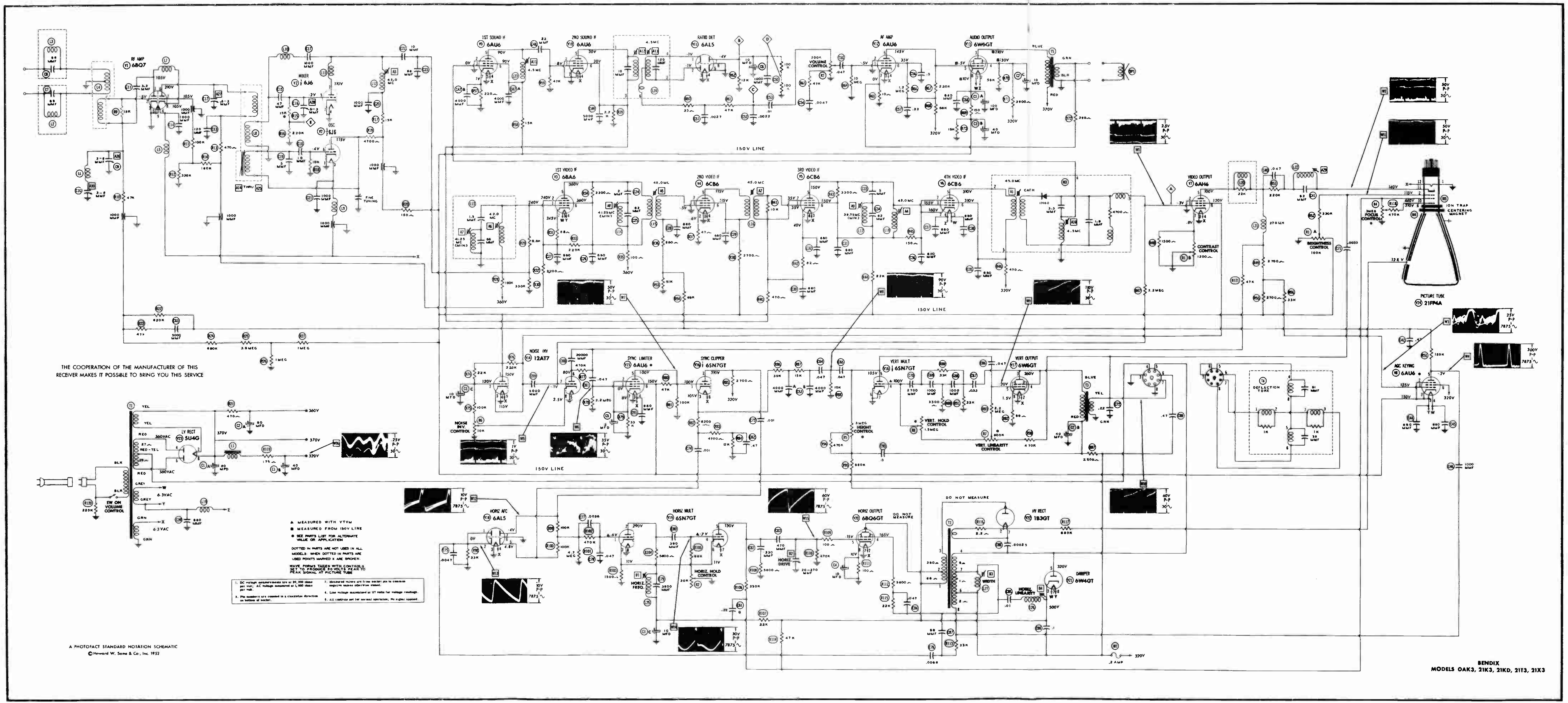
ARVIN MODELS
6175TM, 6179TM (Ch. TE-331, TE-331-2)



RF AMP 6BQ7
MIXER 6J6
OSC 6J6
1ST SOUND IF 6AU6
2ND SOUND IF 6AU6
RATIO DET 6AL5
AF AMP 6AU6
AUDIO OUTPUT 6W6GT
150V LINE
1ST VIDEO IF 6BA6
2ND VIDEO IF 6CB6
3RD VIDEO IF 6CB6
4TH VIDEO IF 6CB6
VIDEO OUTPUT 6AH6
CONTRAST CONTROL
BRIGHTNESS CONTROL
FOCUS CONTROL
ION TRAP
CENTERING MAGNET
PICTURE TUBE 21FP4A
NOISE INV 12AT7
NOISE INV. CONTROL
SYNC LIMITER 6AU6
SYNC CLIPPER 6SN7GT
VERT MULT 6SN7GT
VERT. HOLD CONTROL
HEIGHT CONTROL
VERT OUTPUT 6W6GT
VERT. LINEARITY CONTROL
AGC KEYING 6AU6
DEFLECTION YOKE
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
LV RECT 5U4G
SW ON VOLUME CONTROL
HORIZ AFC 6AL5
HORIZ MULT 6SN7GT
HORIZ. FREQ.
HORIZ. HOLD CONTROL
HORIZ OUTPUT 6BQ6GT
HORIZ. DRIVE
DO NOT MEASURE
HV RECT 1B3GT
WIDTH
HORIZ. LINEARITY
DAMPER 6W4GT
A MEASURED WITH VTVM
B MEASURED FROM 150V LINE
SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
A PHOTOFACT STANDARD NOTATION SCHEMATIC
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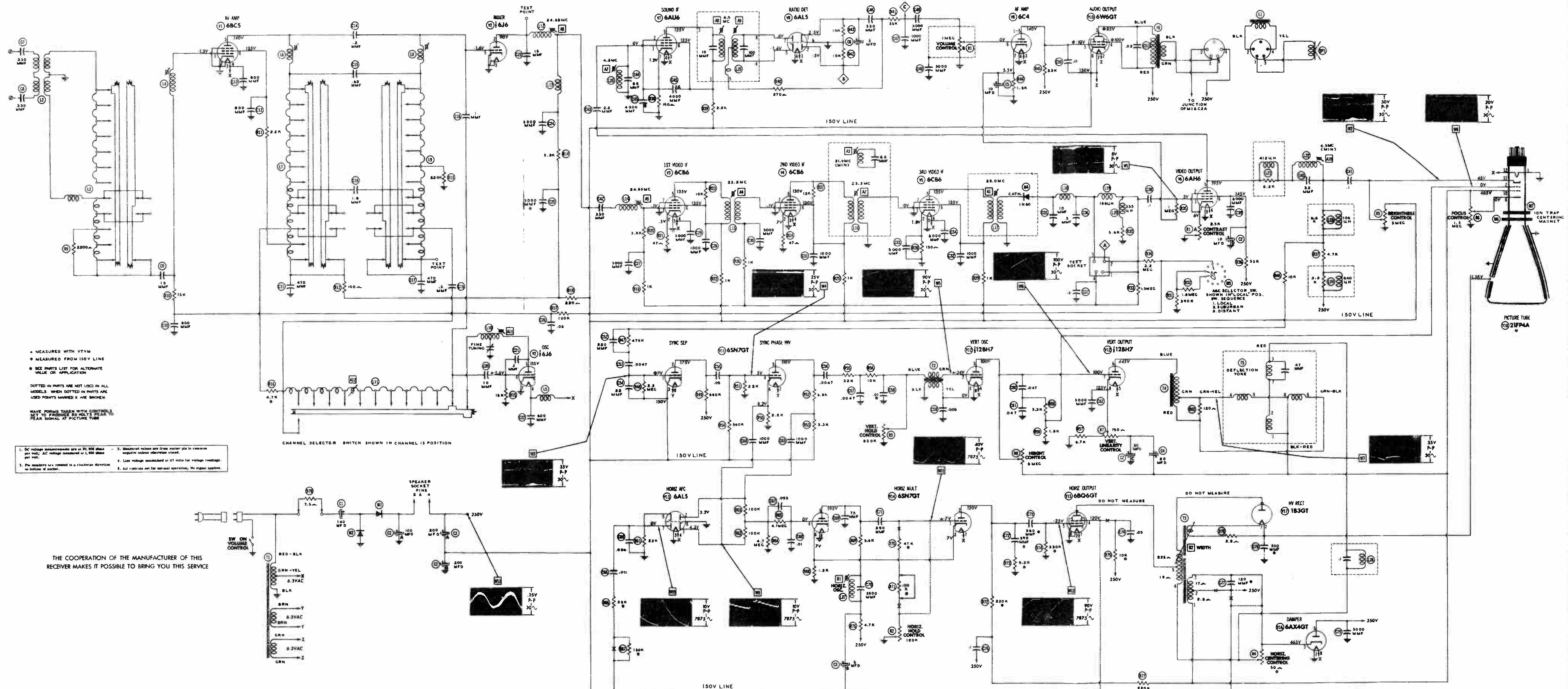
BENDIX
MODELS OAK3, 21K3, 21KD, 21T3, 21X3



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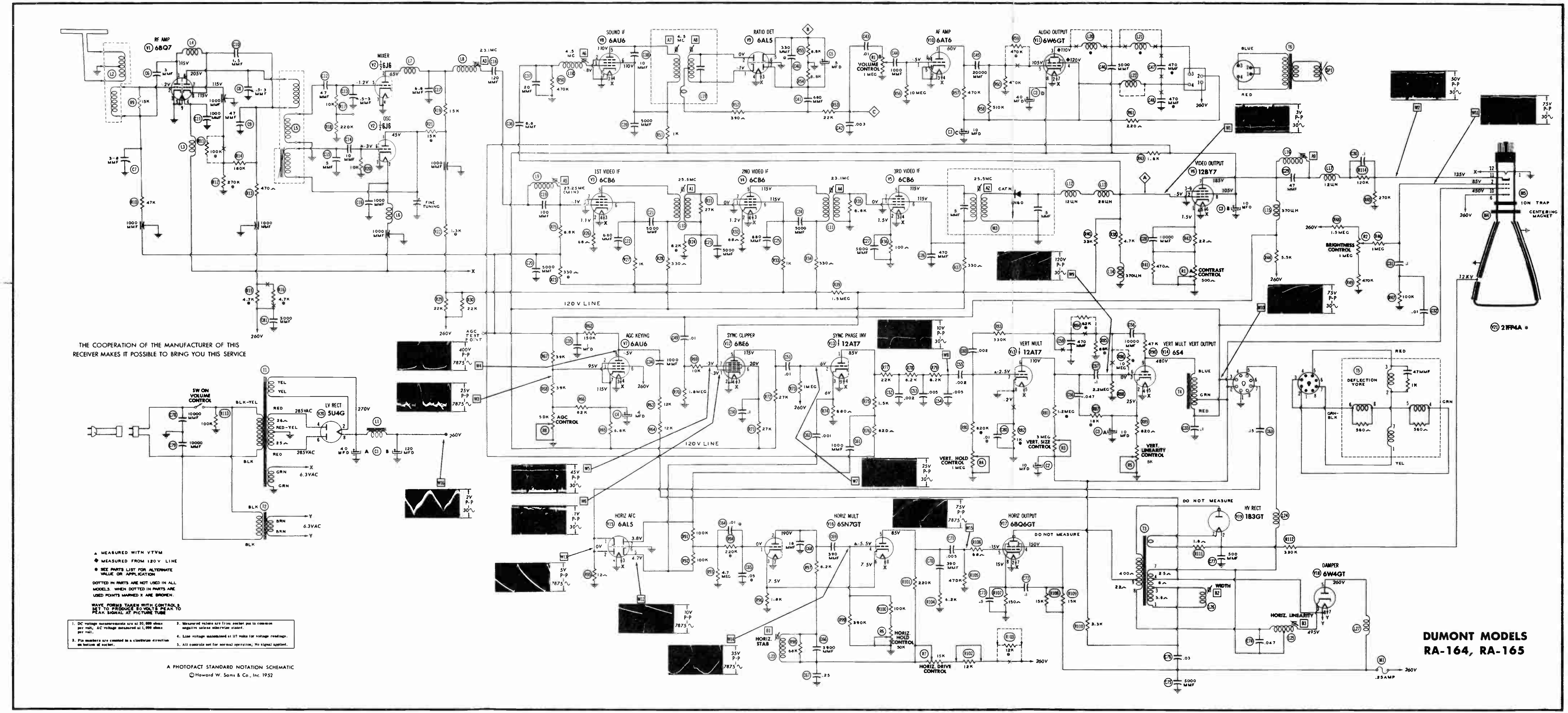
CROSLEY MODELS EU-17COL, COLB, TOLa, TOLB (Ch. 385), EU-21COLBd, COLd (Ch. 386), COLe, COLBe (Ch. 387), EU-21TOL, TOLB (Ch. 386)



DUMONT MODELS
RA-164, RA-165
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
RF AMP V1 6BQ7
MIXER V2 ½6J6
OSC V2 ½6J6
SOUND IF V8 6AU6
RATIO DET V9 6AL5
AF AMP V10 6AT6
AUDIO OUTPUT V11 6W6GT
1ST VIDEO IF V3 6CB6
2ND VIDEO IF V4 6CB6
3RD VIDEO IF V5 6CB6
VIDEO OUTPUT V6 12BY7
AGC KEYING V7 6AU6
SYNC CLIPPER V12 6BE6
SYNC PHASE INV V13 12AT7
VERT MULT V13 ½12AT7
VERT MULT VERT OUTPUT V14 6S4
LV RECT V20 5U4G
HORIZ AFC V15 6AL5
HORIZ MULT V16 6SN7GT
HORIZ OUTPUT V17 6BQ6GT
HV RECT V19 1B3GT
DAMPER V18 6W4GT
V21 21FP4A
ION TRAP
CENTERING MAGNET
DEFLECTION YOKE
SW ON VOLUME CONTROL
VOLUME CONTROL
CONTRAST CONTROL
BRIGHTNESS CONTROL
AGC CONTROL
AGC TEST POINT
VERT. HOLD CONTROL
VERT. SIZE CONTROL
VERT. LINEARITY CONTROL
HORIZ. STAB
HORIZ HOLD CONTROL
HORIZ. DRIVE CONTROL
HORIZ. LINEARITY
WIDTH
FINE TUNING
120V LINE
DO NOT MEASURE
▲ MEASURED WITH VTVM
◆ MEASURED FROM 120V LINE
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
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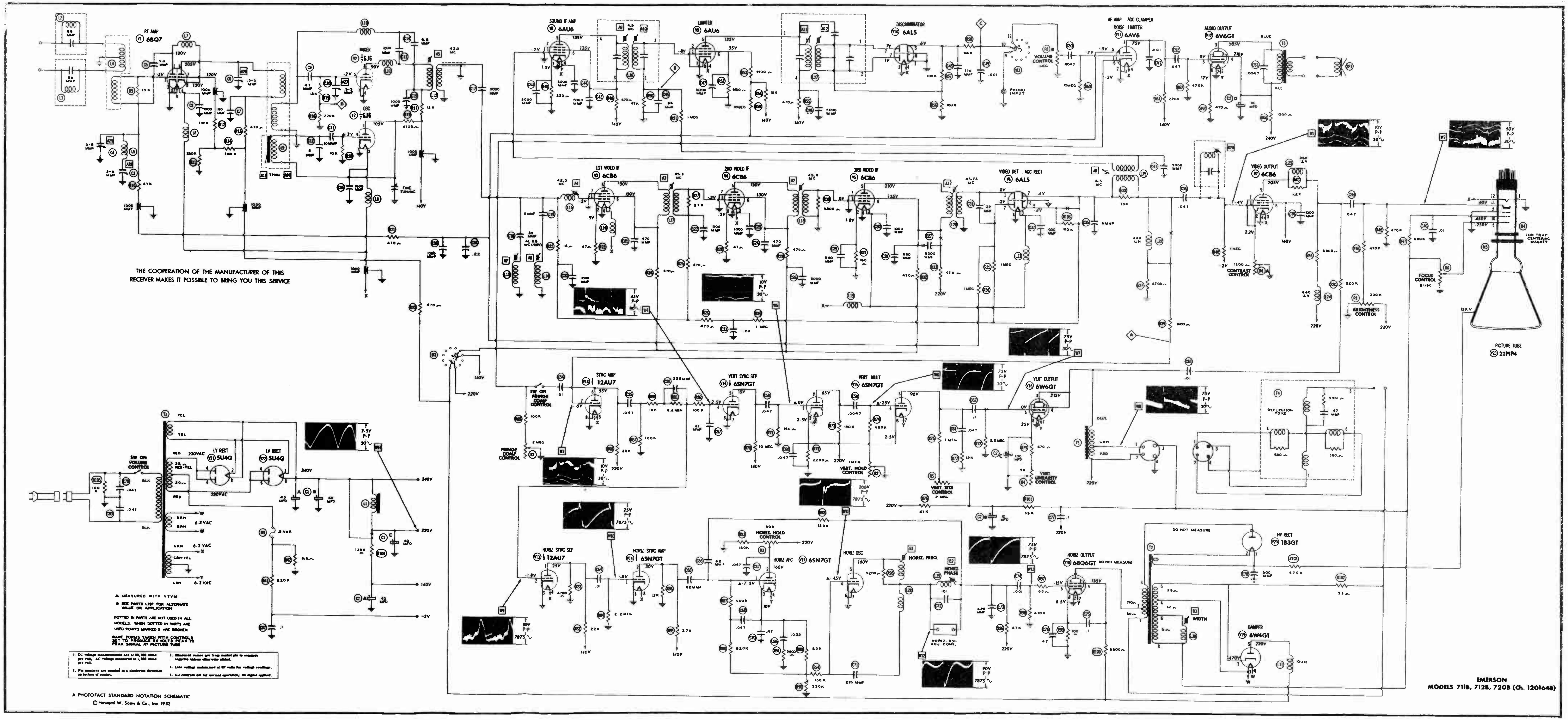
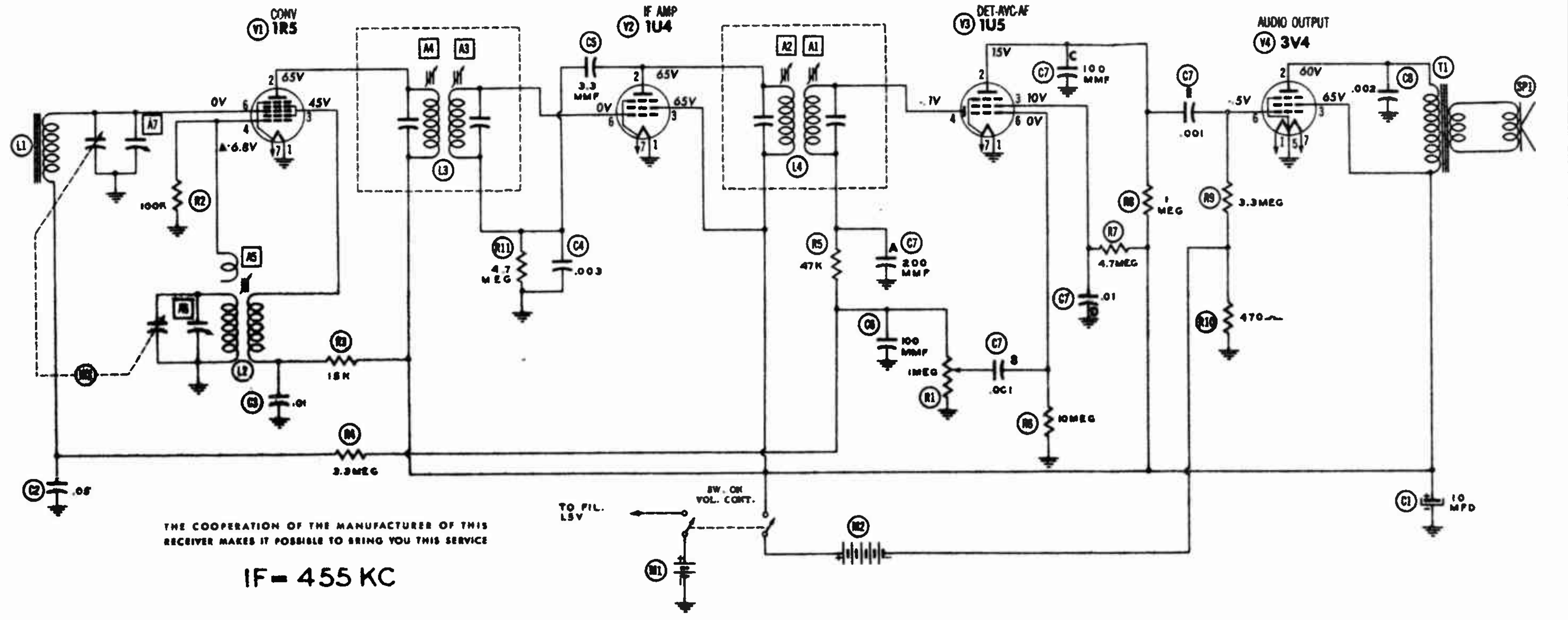

RF AMP 6BQ7
MIXER 6J6
OSC 6J6
SOUND IF AMP 6AU6
LIMITER 6AU6
DISCRIMINATOR 6AL5
AF AMP AGC CLAMPER NOISE LIMITER 6AV6
AUDIO OUTPUT 6V6GT
1ST VIDEO IF 6CB6
2ND VIDEO IF 6CB6
3RD VIDEO IF 6CB6
VIDEO DET AGC RECT 6AL5
VIDEO OUTPUT 6CB6
PICTURE TUBE 21MP4
ION TRAP CENTERING MAGNET
FOCUS CONTROL
BRIGHTNESS CONTROL
CONTRAST CONTROL
VOLUME CONTROL
PHONO INPUT
FINE TUNING
SYNC AMP 12AU7
VERT SYNC SEP 6SN7GT
VERT MULT 6SN7GT
VERT OUTPUT 6W6GT
FRINGE COMP CONTROL
VERT. HOLD CONTROL
VERT. SIZE CONTROL
VERT. LINEARITY CONTROL
DEFLECTION YOKE
LV RECT 5U4G
LV RECT 5U4G
SW ON VOLUME CONTROL
HORIZ SYNC SEP 12AU7
HORIZ SYNC AMP 6SN7GT
HORIZ AFC 6SN7GT
HORIZ HOLD CONTROL
HORIZ OSC
HORIZ. FREQ.
HORIZ. PHASE
HORIZ. OSC ADJ. COMP.
HORIZ OUTPUT 6BQ6GT
DO NOT MEASURE
HV RECT 1B3GT
DAMPER 6W4GT
WIDTH
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
▲ MEASURED WITH VTVM
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 80 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
A PHOTOFACT STANDARD NOTATION SCHEMATIC
© Howard W. Sams & Co., Inc. 1952
EMERSON
MODELS 711B, 712B, 720B (Ch. 120164B)



IF= 455 KC

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	1R5	0Ω	†22Ω	†15KΩ	100KΩ	0Ω	4.3Meg	*
V 2	1U4	0Ω	†22Ω	†0Ω	†0Ω	0Ω	4.7Meg	*
V 3	1U5	0Ω	†1 Meg	†4.7Meg	1 Meg	0Ω	10Meg	*
V 4	3V4	*	†420Ω	†0Ω	470Ω	0Ω	3.3Meg	*

* DO NOT USE OEMMETER TO MEASURE FILAMENT RESISTANCE.
† MEASURED FROM BATTERY B+ LEAD. (BATTERY DISCONNECTED)
▲ TAKEN WITH VACUUM TUBE VOLTMETER.

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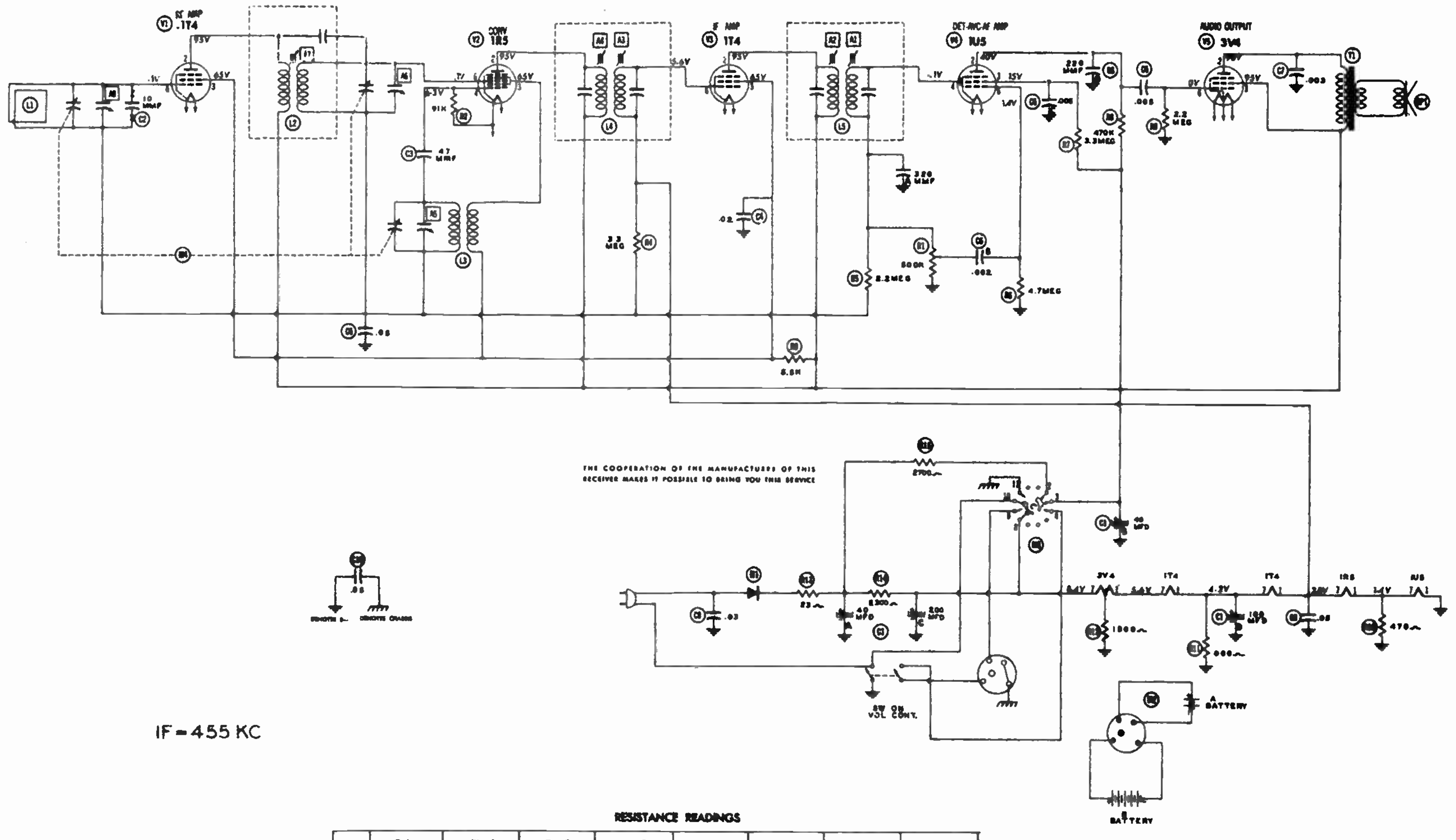
EMERSON 704 (CH. 120154 - B)

1 - DC Voltage measurements are at 20,000 ohms per volts, AC Voltages measured at 1000 ohms per volt.
2 - Socket connections are shown as bottom views.
3 - Measured values are from socket pin to common negative.
4 - Nominal tolerance on component values makes possible a variation of ±15% in voltage and resistance readings.
5 - Volume control at maximum, no signal applied for voltage measurements.



IF=455 KC

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	1T4	*	†2.7KΩ	†8.3KΩ	†2.7KΩ	*	1.8Meg	*
V 2	1R5	*	†2.7KΩ	†8.3KΩ	91KΩ	*	1.8Meg	*
V 3	1T4	*	†2.7KΩ	†8.3KΩ	INF	*	50Ω	*
V 4	1U5	0Ω	†470KΩ	†3.3Meg	500KΩ	1.8Meg	4.7Meg	*
V 5	3V4	*	†3.3KΩ	†2.7KΩ	†2.7KΩ	*	2.2Meg	*

ALL MEASUREMENTS TAKEN WITH POWER CHANGE-OVER SWITCH IN AC-DC POSITION
† MEASURED FROM OUTPUT OF M1
* DO NOT USE OHMMETER TO MEASURE FILAMENT RESISTANCE
▲ TAKEN WITH VACUUM TUBE VOLTMETER

A PHOTOFACT STANDARD NOTATION SCHEMATIC

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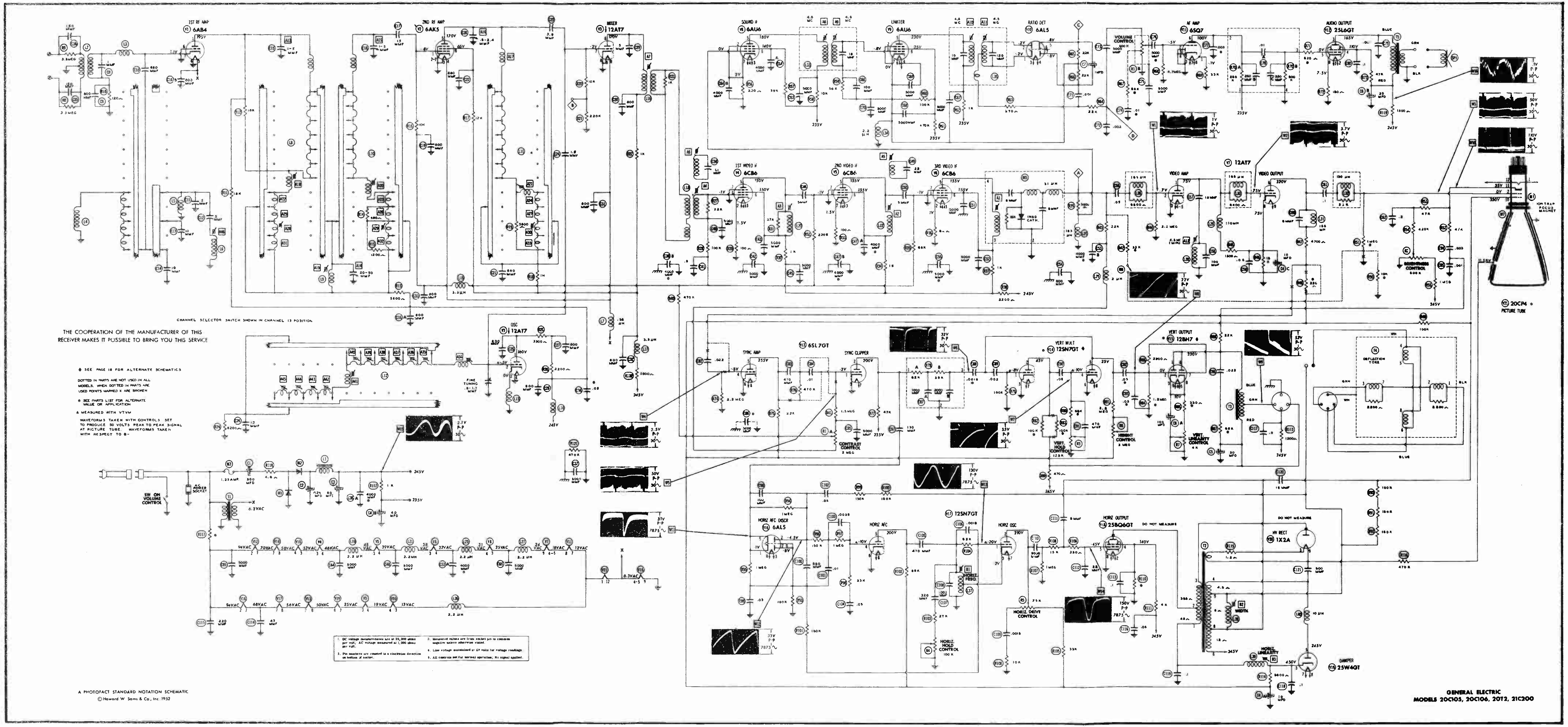
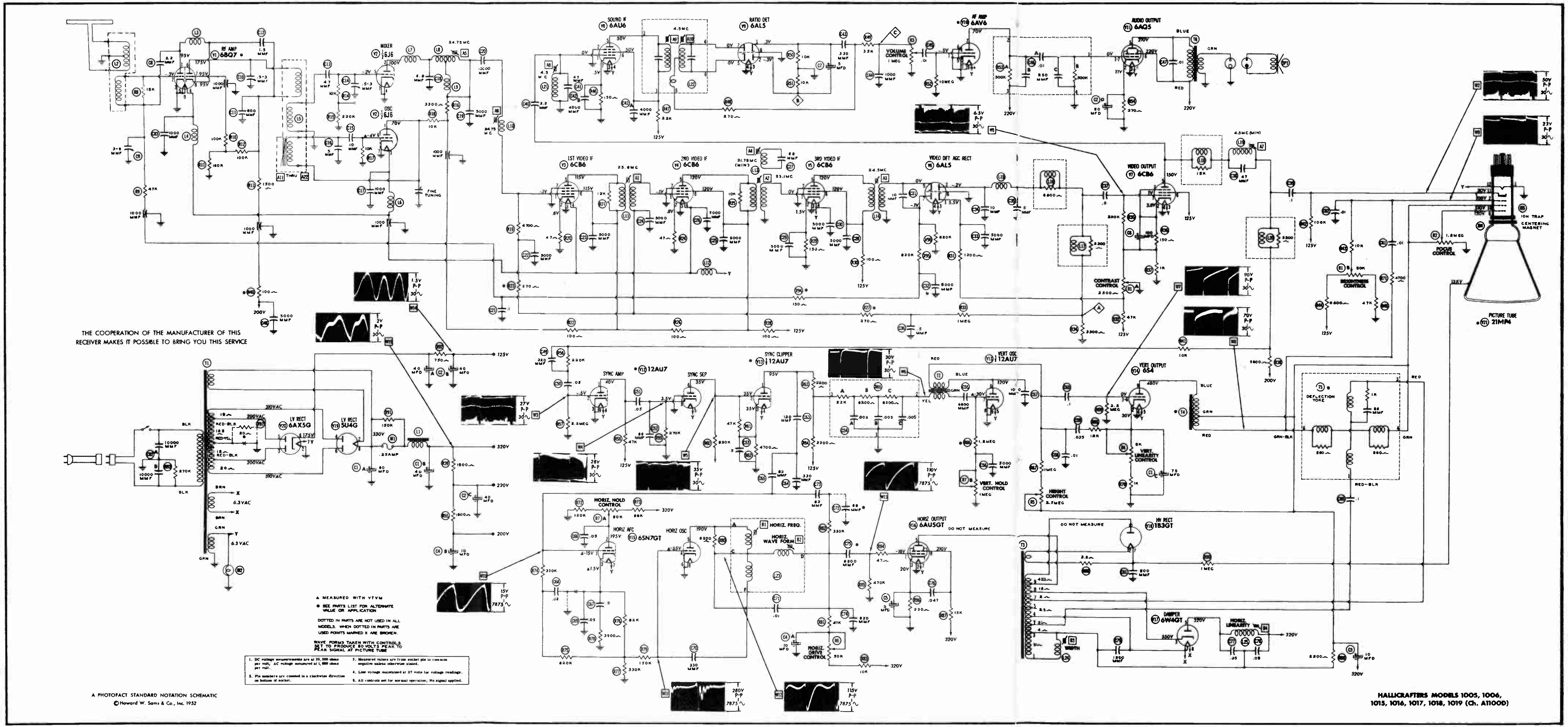
GENERAL ELECTRIC 614, 615

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.


THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
SEE PAGE 18 FOR ALTERNATE SCHEMATICS
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN
SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
MEASURED WITH VTVM
WAVEFORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE. WAVEFORMS TAKEN WITH RESPECT TO B-
CHANNEL SELECTOR SWITCH SHOWN IN CHANNEL 13 POSITION
A PHOTOFACT STANDARD NOTATION SCHEMATIC
©Howard W. Sams & Co., Inc. 1952
GENERAL ELECTRIC
MODELS 20C105, 20C106, 20T2, 21C200



THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

▲ MEASURED WITH VTVM

● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION

DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.

WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 80 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE

1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.

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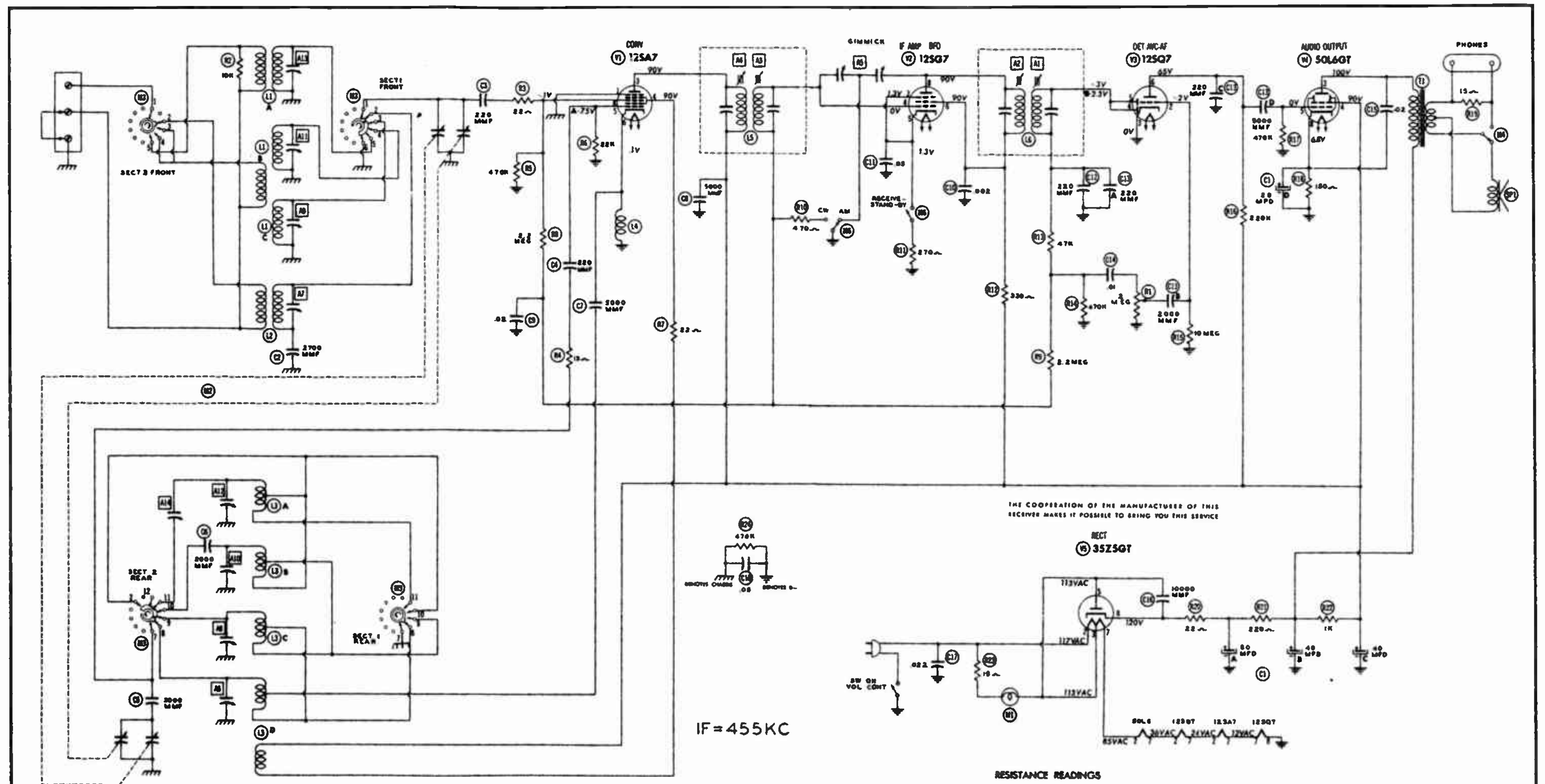
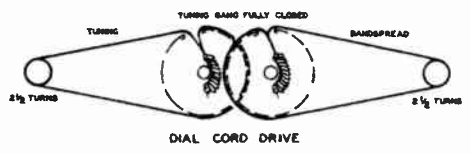
HALLICRAFTERS MODELS 1005, 1006, 1015, 1016, 1017, 1018, 1019 (Ch. A1100D)





RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	12SA7	470KΩ	24Ω	†1.2KΩ	†1.2KΩ	22KΩ	9Ω	12Ω	430KΩ ■390KΩ
V 2	12SG7	470KΩ	36Ω	270Ω	1.3Meg ■470Ω	270Ω	†1.6KΩ	24Ω	†1.6KΩ
V 3	12SQ7	470KΩ	10 Meg	0Ω	477KΩ ■437KΩ	477KΩ ■437KΩ	†220KΩ	12Ω	0Ω
V 4	50L6GT	INF	84Ω	†400Ω	†1.2KΩ	470KΩ	0Ω	36Ω	150Ω
V 5	35Z5GT	INF	118Ω	113Ω	110Ω	113Ω	0Ω	84Ω	1.2Meg

ALL MEASUREMENTS TAKEN IN "BAND 1" POSITION
ALL MEASUREMENTS TAKEN IN "AM" POSITION UNLESS OTHERWISE SPECIFIED
■ MEASURED IN "CW" POSITION
† MEASURED FROM PIN 8 OF V5
▲ TAKEN WITH VACUUM TUBE VOLTMETER

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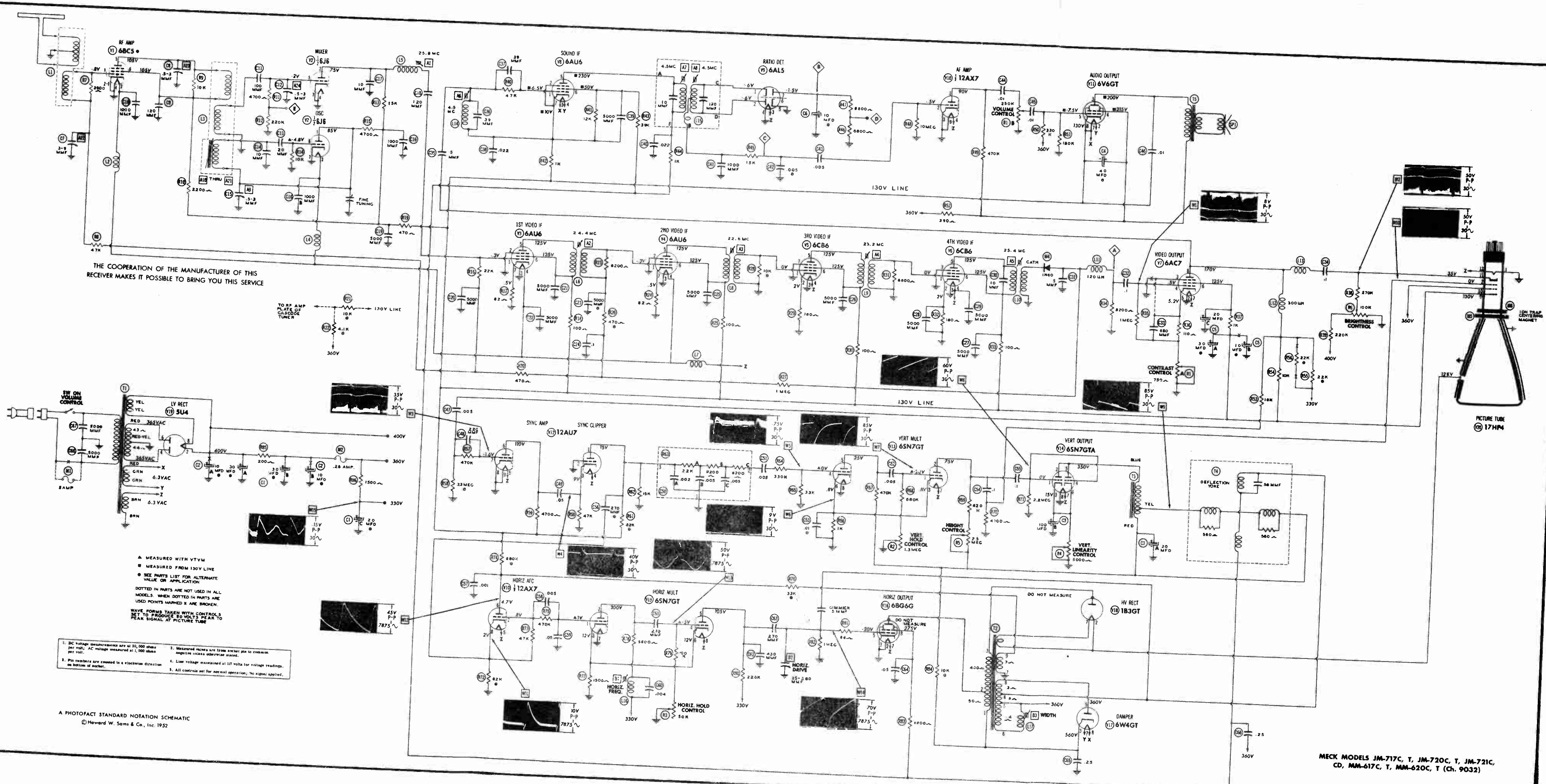
HALLICRAFTERS - S 38C (RUN 2)

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

▲ MEASURED WITH VTVM

■ MEASURED FROM 130V LINE

● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION

DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.

WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 80 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE

1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.

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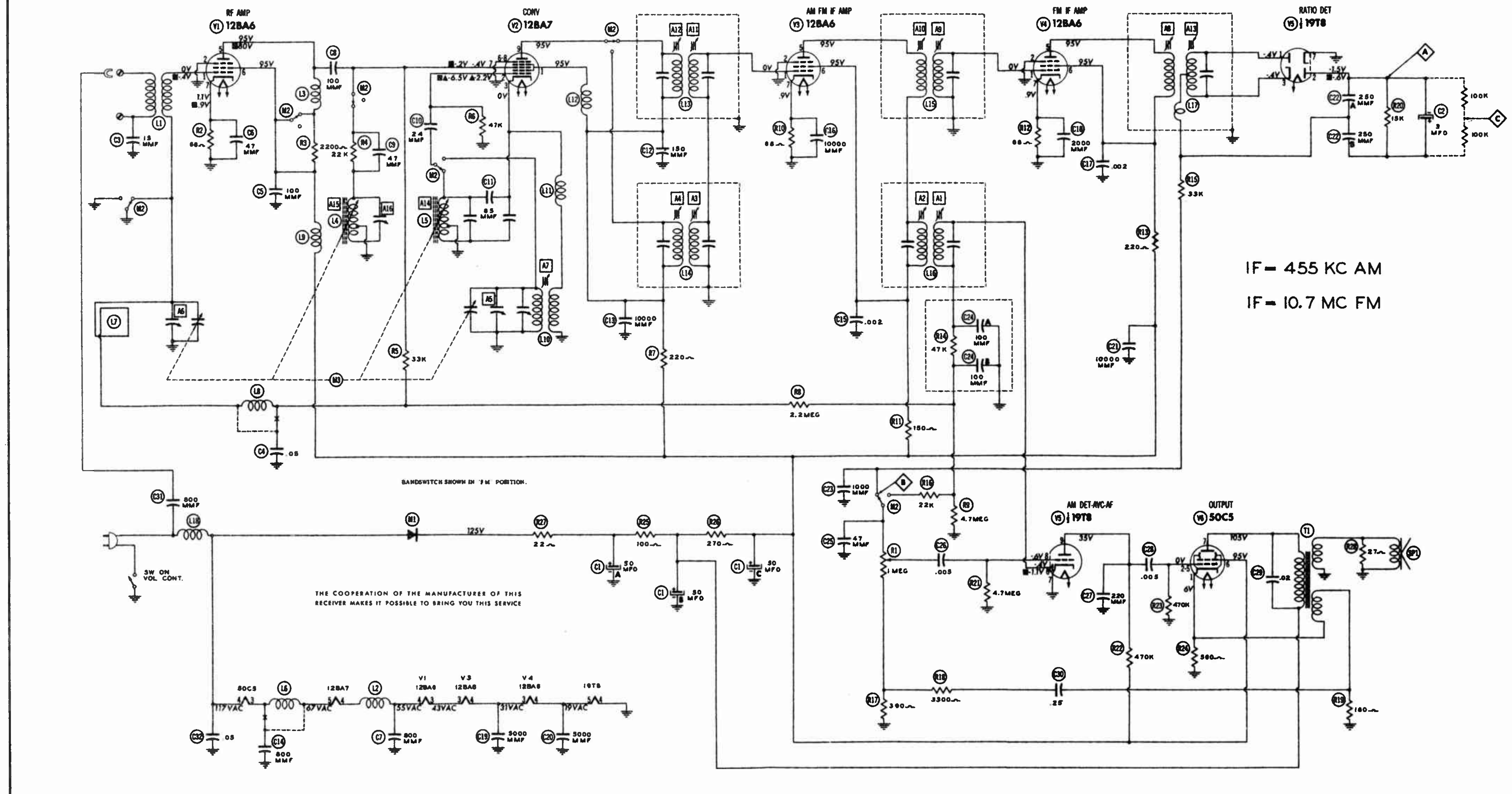
MECK MODELS JM-717C, T, JM-720C, T, JM-721C, CD, MM-617C, T, MM-620C, T (Ch. 9032)



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V 1	12BA6	.0Ω ■2.9Meg	.0Ω	43Ω	55Ω	†390Ω ■†3.6KΩ	†390Ω ■†390Ω	68Ω		
V 2	12BA7	†810Ω	47KΩ	.4Ω	55Ω	67Ω	0Ω	14KΩ ■2.9Meg	0Ω	†810Ω
V 3	12BA6	9.2Ω	0Ω	49Ω	31Ω	†540Ω	†540Ω	64Ω		
V 4	12BA6	7Ω	0Ω	31Ω	19Ω	†610Ω	†610Ω	68Ω		
V 5	19T8	1Meg	15KΩ	1Meg	0Ω	19Ω	1.8Meg ■800KΩ	0Ω	4.7Meg	†470KΩ
V 6	50C5	140Ω	470KΩ	47Ω	117Ω	470KΩ	†390Ω	†310Ω		

All MEASUREMENTS TAKEN IN "FM" POSITION UNLESS NOTED
† MEASURED FROM OUTPUT OF M1
■ - MEASURED IN "AM" POSITION
▲ - TAKEN WITH VACUUM TUBE VOLTMETER

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.

MOTOROLA - 72XM21 (CH. H5-303)

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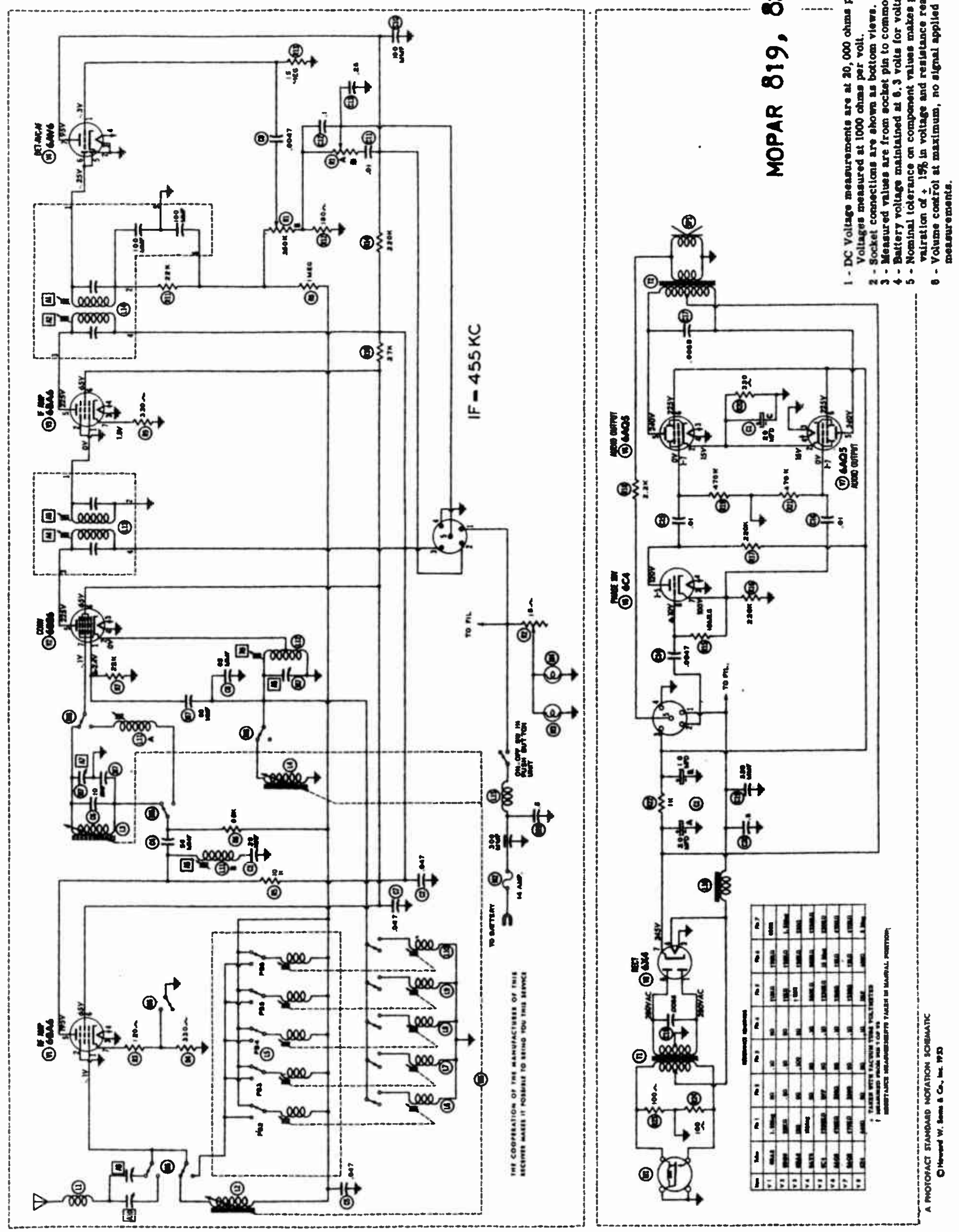
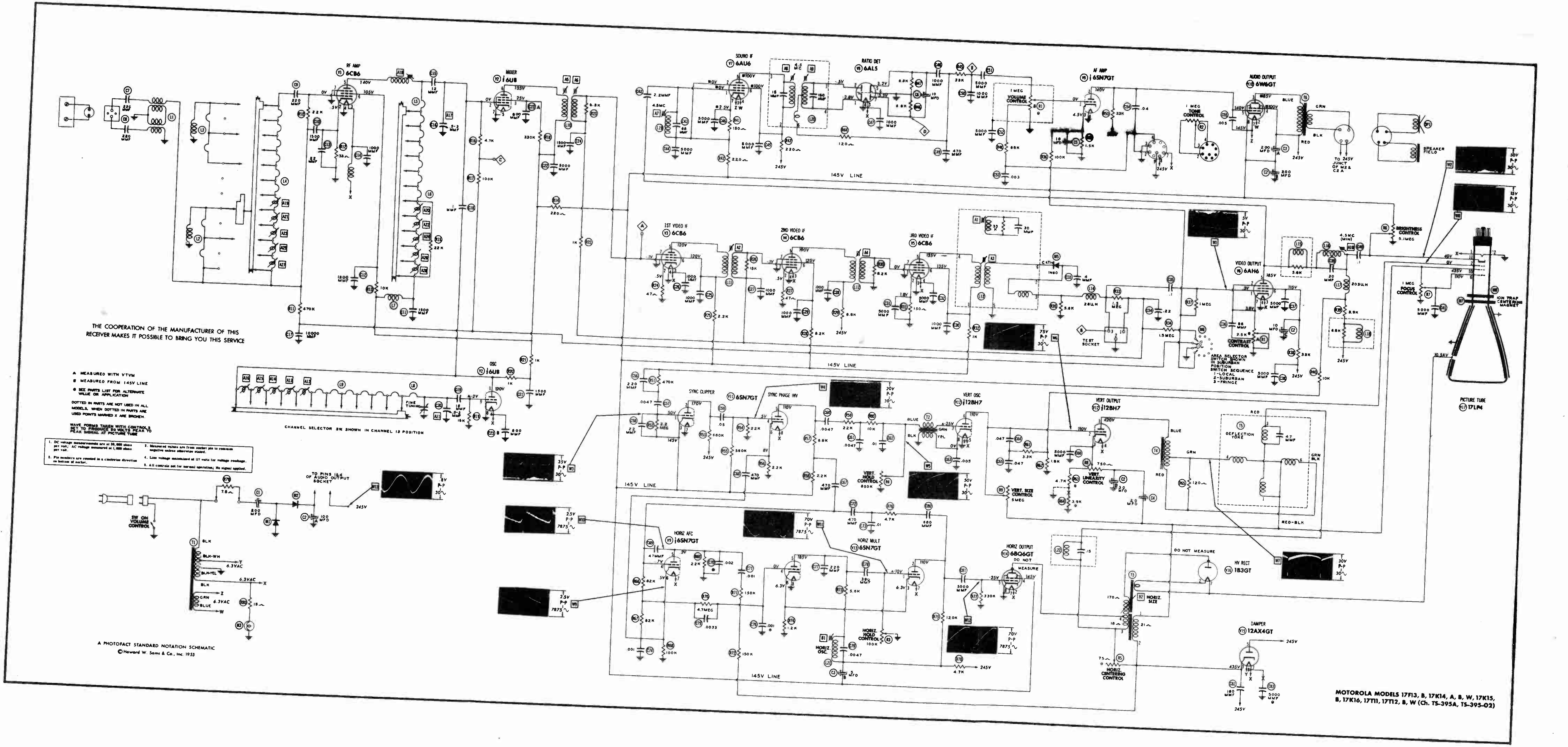
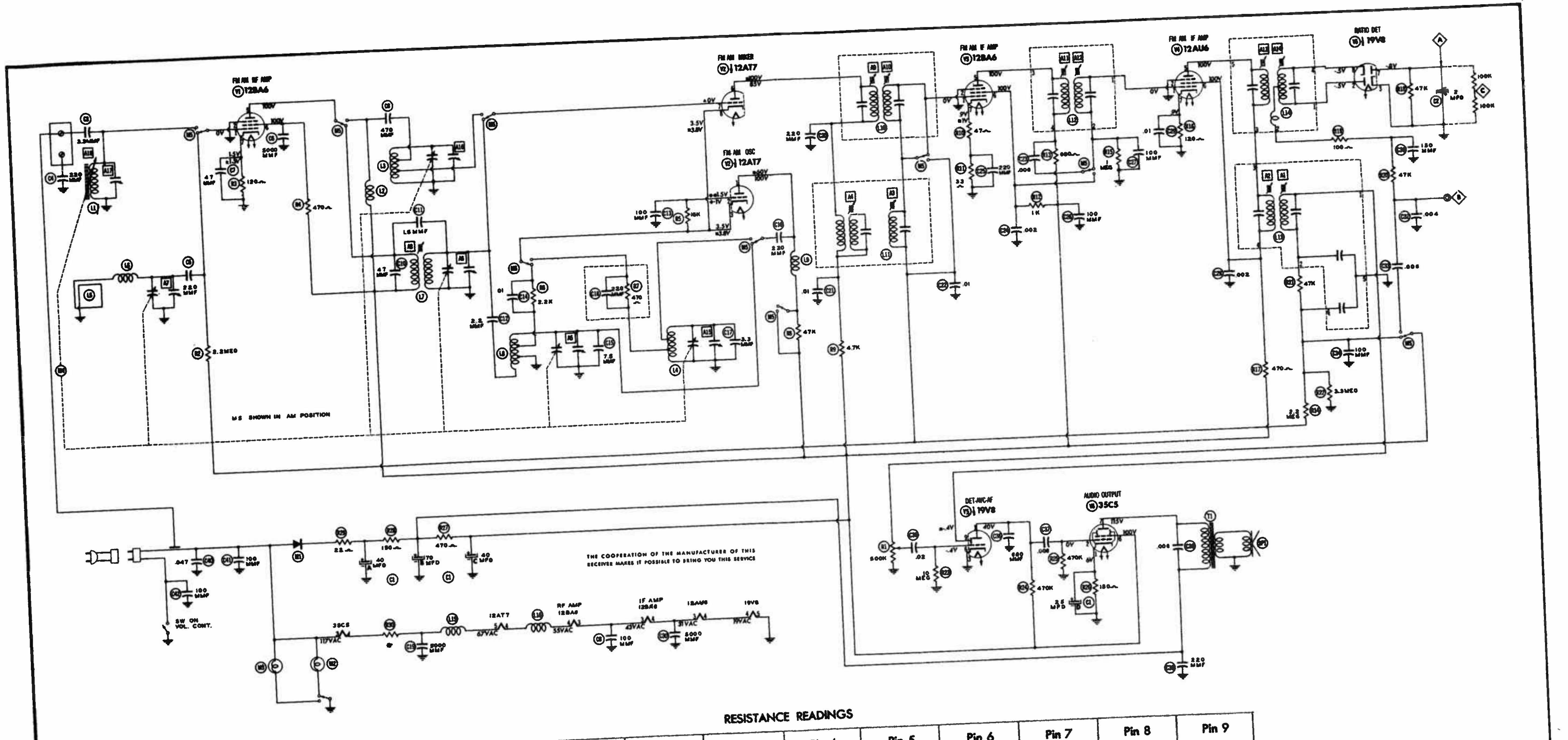


MOPAR 819, 820, 824

1 - DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1000 ohms per volt.
2 - Socket connections are shown as bottom views.
3 - Measured values are from socket pin to common negative.
4 - Battery voltage maintained at 6.3 volts for voltage readings.
5 - Nominal tolerance on component values makes possible a variation of ± 15% in voltage and resistance readings.
6 - Volume control at maximum, no signal applied for voltage measurements.


THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
A MEASURED WITH VTVM
B MEASURED FROM 145V LINE
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 80 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
CHANNEL SELECTOR SW SHOWN IN CHANNEL 13 POSITION
RF AMP 6CB6
MIXER 6U8
OSC 6U8
SOUND IF 6AU6
RATIO DET 6AL5
AF AMP 6SN7GT
AUDIO OUTPUT 6W6GT
1ST VIDEO IF 6CB6
2ND VIDEO IF 6CB6
3RD VIDEO IF 6CB6
VIDEO OUTPUT 6AH6
SYNC CLIPPER
SYNC PHASE INV 6SN7GT
VERT OSC 12BH7
VERT OUTPUT 12BH7
HORIZ AFC 6SN7GT
HORIZ MULT 6SN7GT
HORIZ OUTPUT 6BQ6GT
HV RECT 1B3GT
DAMPER 12AX4GT
PICTURE TUBE 17LP4
145V LINE
VOLUME CONTROL
TONE CONTROL
BRIGHTNESS CONTROL
FOCUS CONTROL
CONTRAST CONTROL
VERT SIZE CONTROL
VERT LINEARITY CONTROL
VERT HOLD CONTROL
HORIZ HOLD CONTROL
HORIZ OSC
HORIZ SIZE
HORIZ CENTERING CONTROL
DEFLECTION YOKE
ION TRAP CENTERING MAGNET
SPEAKER FIELD
TEST SOCKET
AREA SELECTOR SWITCH SHOWN IN SUBURBAN POSITION
SWITCH SEQUENCE
1-LOCAL
2-SUBURBAN
3-FRINGE
TO PINS 1&4 OF AUDIO OUTPUT SOCKET
SW ON VOLUME CONTROL
DO NOT MEASURE
A PHOTOFACT STANDARD NOTATION SCHEMATIC
©Howard W. Sams & Co., Inc. 1953
MOTOROLA MODELS 17F13, B, 17K14, A, B, W, 17K15, B, 17K16, 17T11, 17T12, B, W (Ch. TS-395A, TS-395-02)



IF=455KC -AM
IF=9.1MC - FM

* SPECIAL RESISTOR, SEE PARTS LIST FOR VALUE.

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V 1	12BA6	0Ω ■5 Meg	0Ω	43Ω	53Ω	† 650Ω	† 1.1KΩ	120Ω		
V 2	12AT7	† 650Ω ■† 47KΩ	15KΩ ■17KΩ	470Ω ■2.2KΩ	53Ω	65Ω	† 5.4KΩ	0Ω ■8Ω	470Ω ■2.2KΩ	59Ω
V 3	12BA6	5.5Meg ■3 Meg	0Ω	43Ω	31Ω	† 1.3K	† 1.6KΩ	80Ω		
V 4	12AU6	1 Meg	0Ω	31Ω	19Ω	†1.1KΩ	†1.1KΩ	120Ω		
V 5	19V8	† 470KΩ	INF	0Ω	19Ω	0Ω	10 Meg	47KΩ	INF	■400KΩ
V 6	35C5	150Ω	470KΩ	170Ω	180Ω	INF	† 650Ω	† 820Ω		

ALL MEASUREMENTS TAKEN IN "FM POSITION UNLESS OTHERWISE SPECIFIED
■ MEASURED IN "AM" POSITION
† MEASURED FROM OUTPUT OF M1
▲ TAKEN IN VACUUM TUBE VOLTMETER
♦ MEASURED FROM PIN 3 OF V2
NOTE : FILAMENT RESISTANCE MEASUREMENTS INCLUDE PARALLEL RESISTANCE OF PILOT LAMP M3

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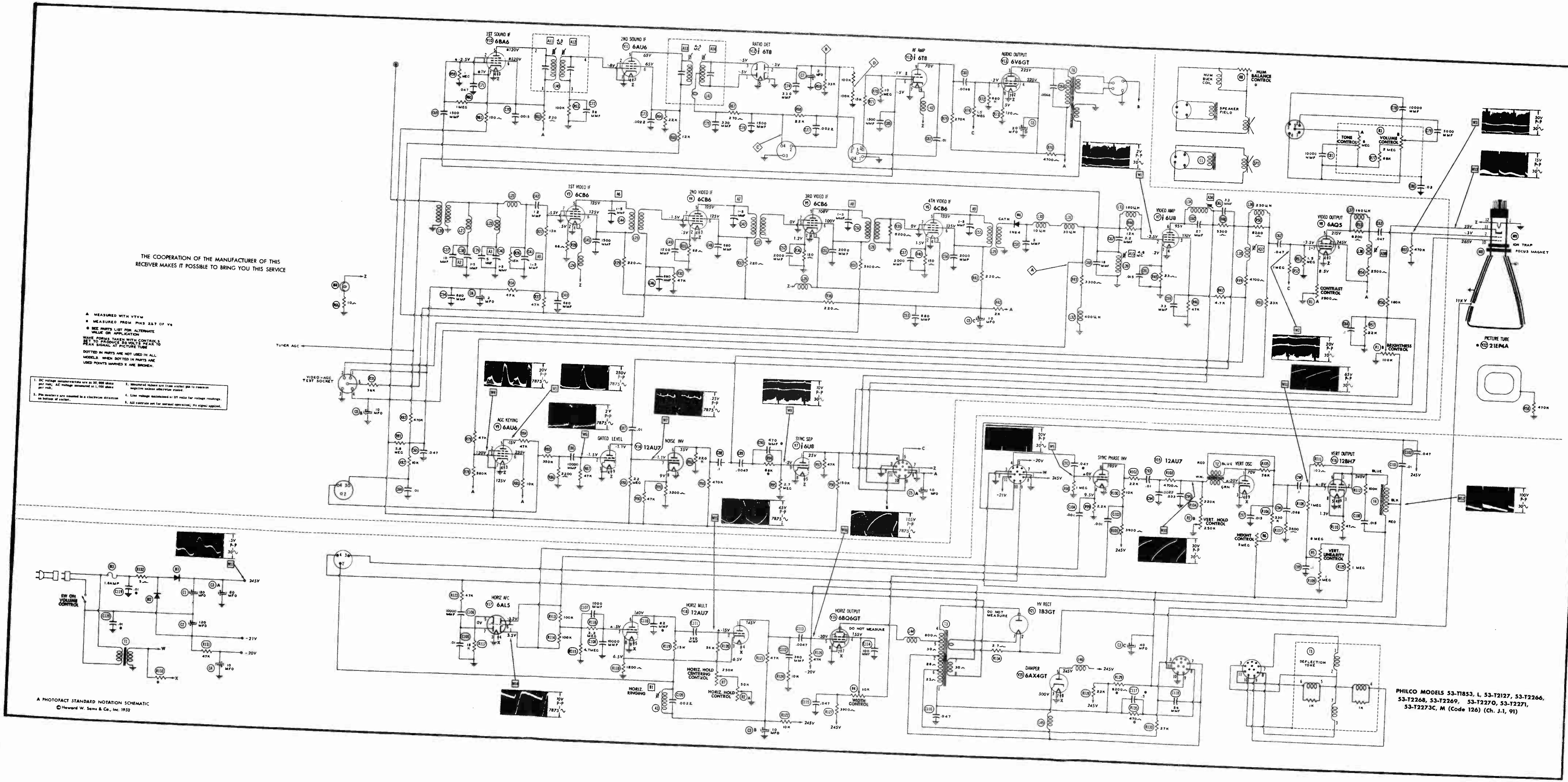
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
1ST SOUND IF 6BA6
2ND SOUND IF 6AU6
RATIO DET 6T8
AF AMP 6T8
AUDIO OUTPUT 6V6GT
HUM BALANCE CONTROL
SPEAKER FIELD
TONE CONTROL
VOLUME CONTROL
1ST VIDEO IF 6CB6
2ND VIDEO IF 6CB6
3RD VIDEO IF 6CB6
4TH VIDEO IF 6CB6
VIDEO AMP 6U8
VIDEO OUTPUT 6AQ5
CONTRAST CONTROL
BRIGHTNESS CONTROL
ION TRAP
FOCUS MAGNET
PICTURE TUBE 21EP4A
TUNER AGC
VIDEO-AGC TEST SOCKET
AGC KEYING 6AU6
GATED LEVEL
NOISE INV 12AU7
SYNC SEP 6U8
SYNC PHASE INV
12AU7
VERT OSC
VERT. HOLD CONTROL
HEIGHT CONTROL
VERT OUTPUT 12BH7
VERT. LINEARITY CONTROL
SW ON VOLUME CONTROL
HORIZ AFC 6AL5
HORIZ MULT 12AU7
HORIZ. HOLD CENTERING CONTROL
HORIZ. HOLD CONTROL
HORIZ. RINGING
HORIZ OUTPUT 6BQ6GT
DO NOT MEASURE
WIDTH CONTROL
HV RECT 1B3GT
DAMPER 6AX4GT
DEFLECTION YOKE
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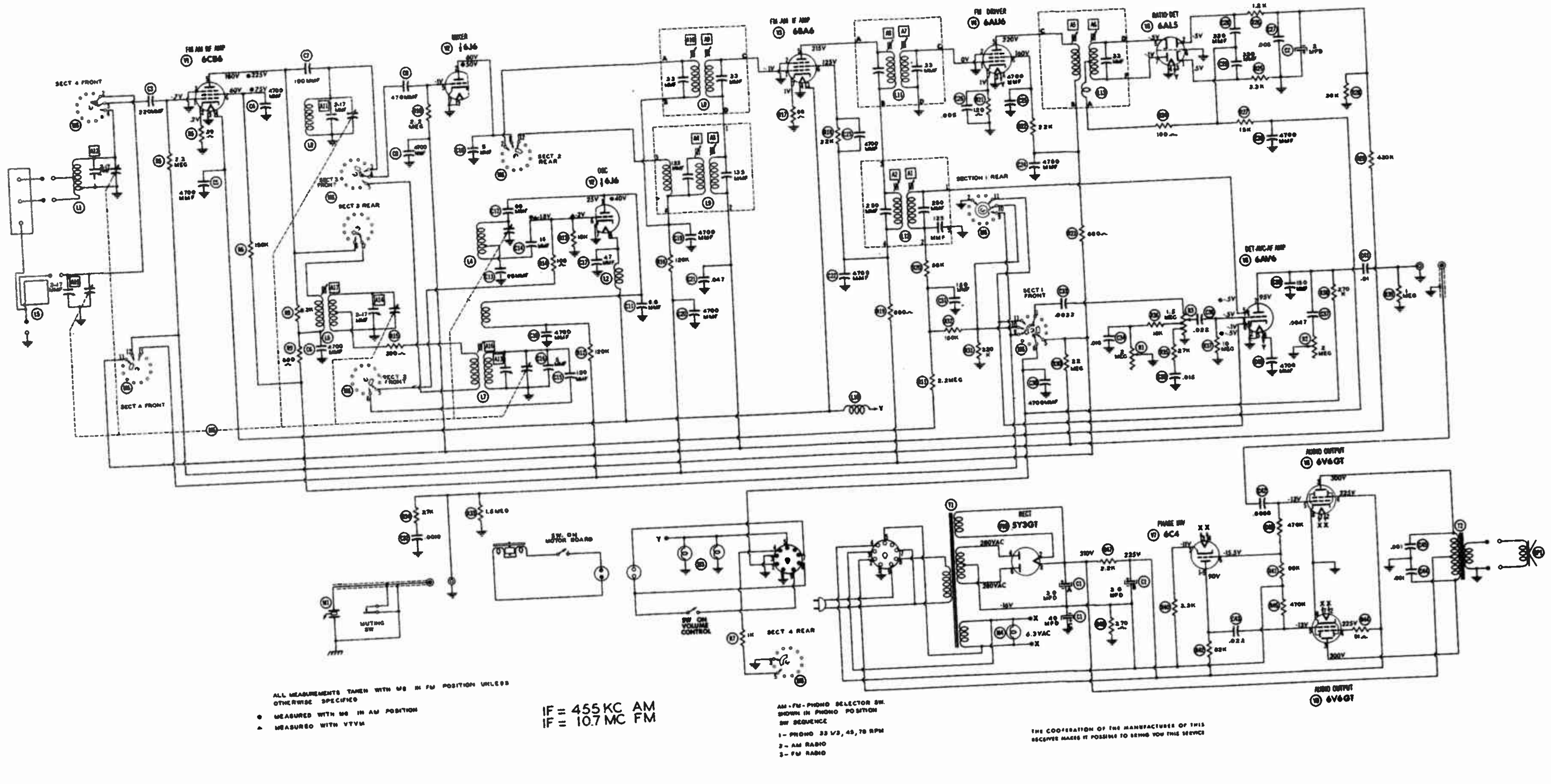
© Howard W. Sams & Co., Inc. 1952
PHILCO MODELS 53-T1853, L, 53-T2127, 53-T2266, 53-T2268, 53-T2269, 53-T2270, 53-T2271, 53-T2273C, M (Code 126) (Ch. J-1, 91)



ALL MEASUREMENTS TAKEN WITH M6 IN FM POSITION UNLESS OTHERWISE SPECIFIED
● MEASURED WITH M6 IN AM POSITION
▲ MEASURED WITH VTVM

IF = 455 KC AM
IF = 10.7 MC FM

AM-FM-PHONO SELECTOR SW. SHOWN IN PHONO POSITION
SW SEQUENCE
1- PHONO 33 1/3, 45, 78 RPM
2- AM RADIO
3- FM RADIO

THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	6CB6	■4.8Meg 2.7Meg	39Ω	0Ω	.1Ω	†12KΩ ■†2.8KΩ	†155KΩ	0Ω	
V 2	6J6	†120KΩ	†120KΩ	0Ω	.1Ω	5 Meg	18KΩ	0Ω	
V 3	6BA6	■2.8Meg 450KΩ	0Ω	.1Ω	0Ω	†2.9KΩ	†25KΩ	68Ω	
V 4	6AU6	.4Ω	0Ω	0Ω	.1Ω	†2.9KΩ	†25KΩ	120Ω	
V 5	6AL5	3.3KΩ	40KΩ	.1Ω	0Ω	14KΩ	0Ω	14KΩ	
V 6	6AV6	10Meg	0Ω	0Ω	.1Ω	■440KΩ 210KΩ	■3 Meg 450KΩ	†270KΩ	
V 7	6C4	†84KΩ	INF	INF	INF	†84KΩ	68KΩ	3.6KΩ	
V 8	6V6GT	INF	INF	†255Ω	†2.2KΩ	510KΩ	270Ω	INF	0Ω
V 9	6V6GT	INF	INF	†255Ω	†2.3KΩ	470KΩ	270Ω	INF	0Ω
V 10	5Y3GT	INF	1 Meg	INF	240Ω	INF	256Ω	INF	1 Meg

ALL MEASUREMENTS TAKEN IN "FM" POSITION UNLESS OTHERWISE STATED.
■ MEASURED IN AM POSITION.
† MEASURED FROM PIN 8 OF V10.

RCA - 2510

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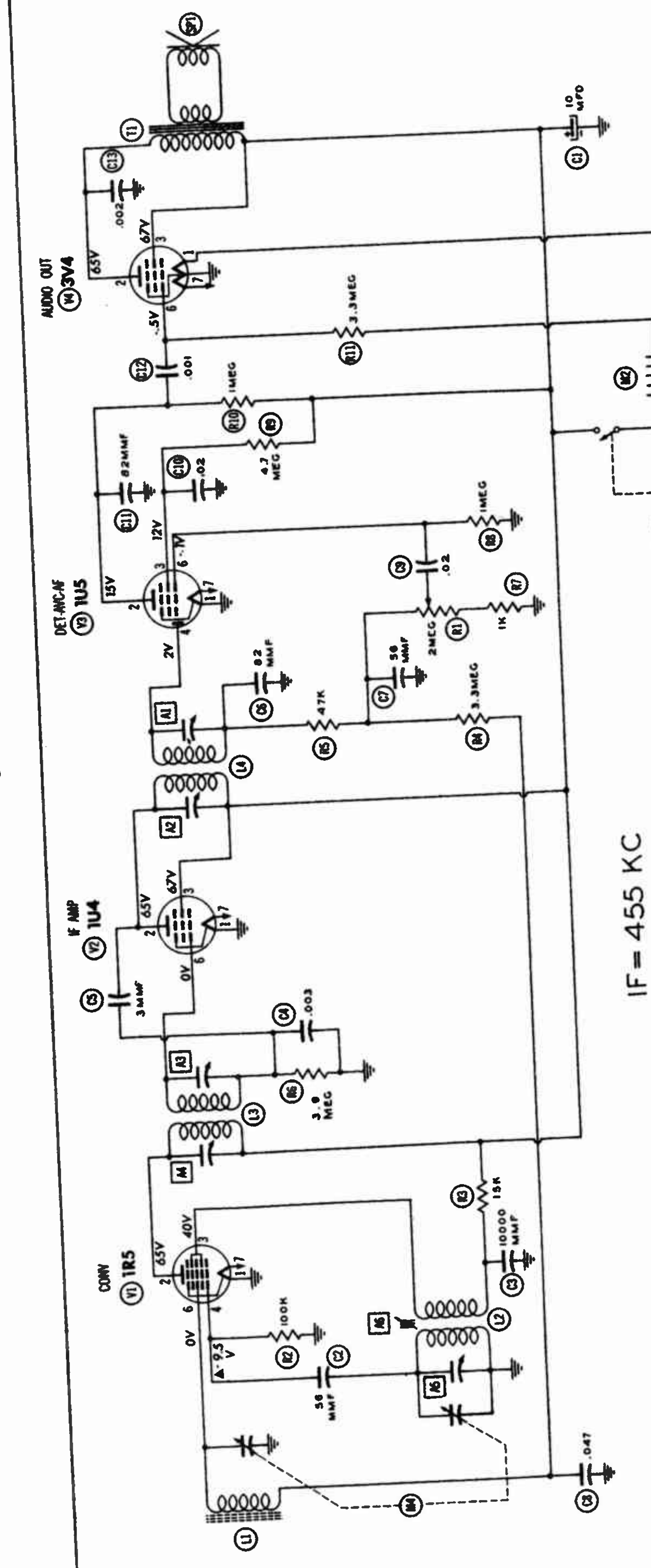
RCA-VICTOR 2B401, 2B402, 2B403, 2B404, 2B405 (CH. RC 1114)



IF = 455 KC

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	1R5	0Ω	†22Ω	†15KΩ	100KΩ	0Ω	5.3Meg	*
V 2	1U4	0Ω	†18.5Ω	†0Ω	INF	0Ω	3.9Meg	*
V 3	1U5	0Ω	†1Meg	†4.7Meg	2Meg	2Meg	10Meg	*
V 4	3V4	*	†347Ω	†0Ω	780Ω	0Ω	3.3Meg	*

BATTERY SAVER SWITCH IS IN "NORMAL" POSITION. (EXTREME LEFT).
† MEASURED FROM INPUT OF B+
▲ TAKEN WITH VACUUM TUBE VOLTMETER
* DO NOT USE OHMMETER TO MEASURE FILAMENT RESISTANCE

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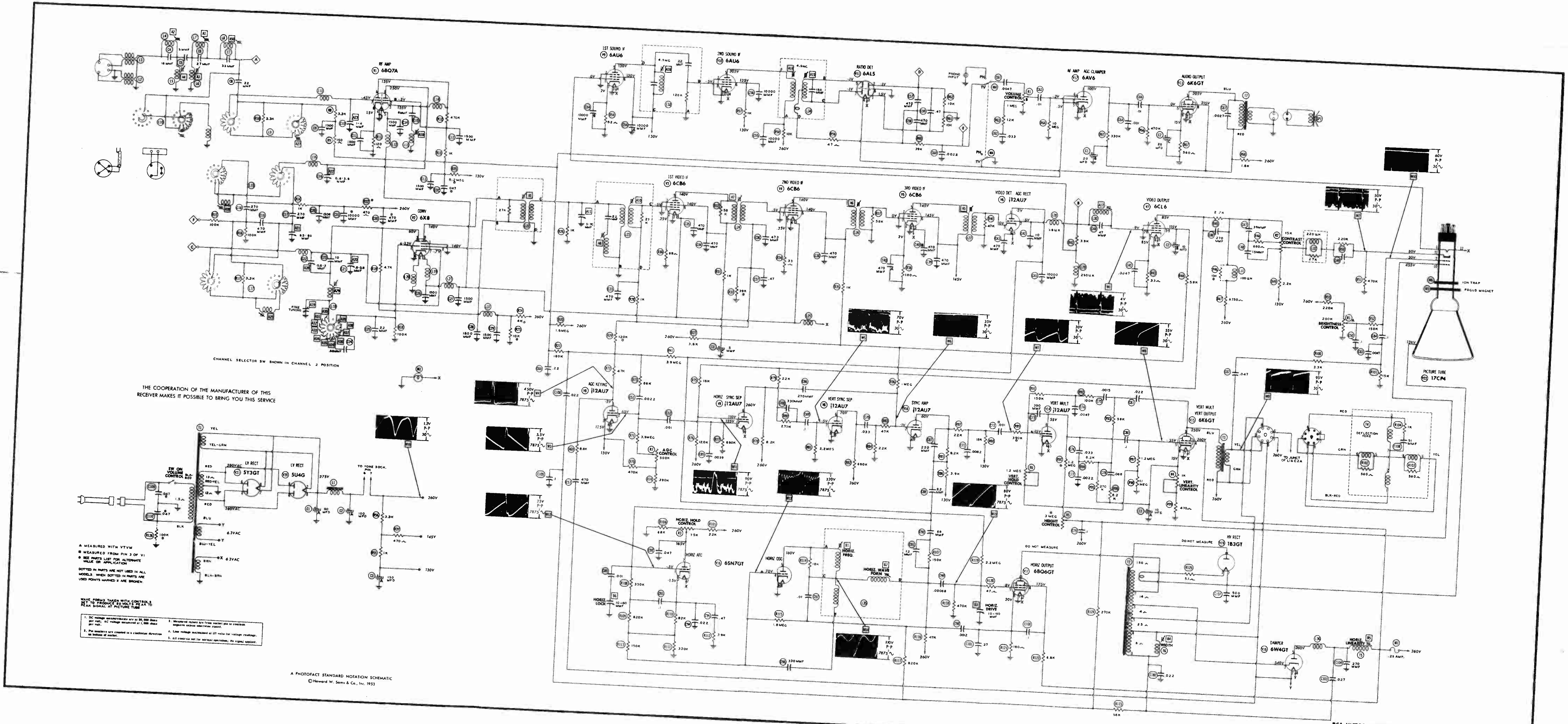
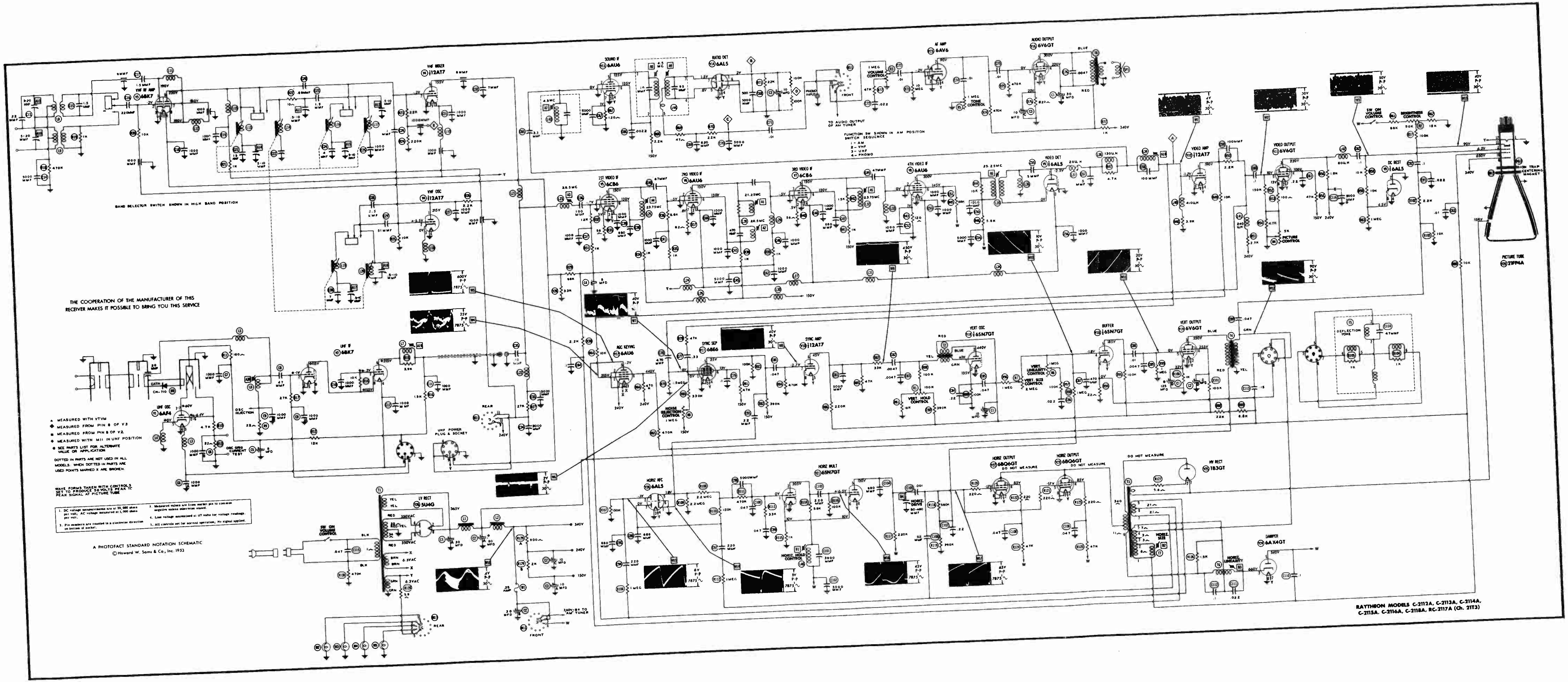


RCA VICTOR MODELS 17-T-301, U, 17-T-302, U, 17-T-310, U (Ch. KCS78, B)



THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

▲ MEASURED WITH VTVM
✱ MEASURED FROM PIN 8 OF V3
■ MEASURED FROM PIN 8 OF V2
◆ MEASURED WITH M11 IN UHF POSITION
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION

DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.

WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE

1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.

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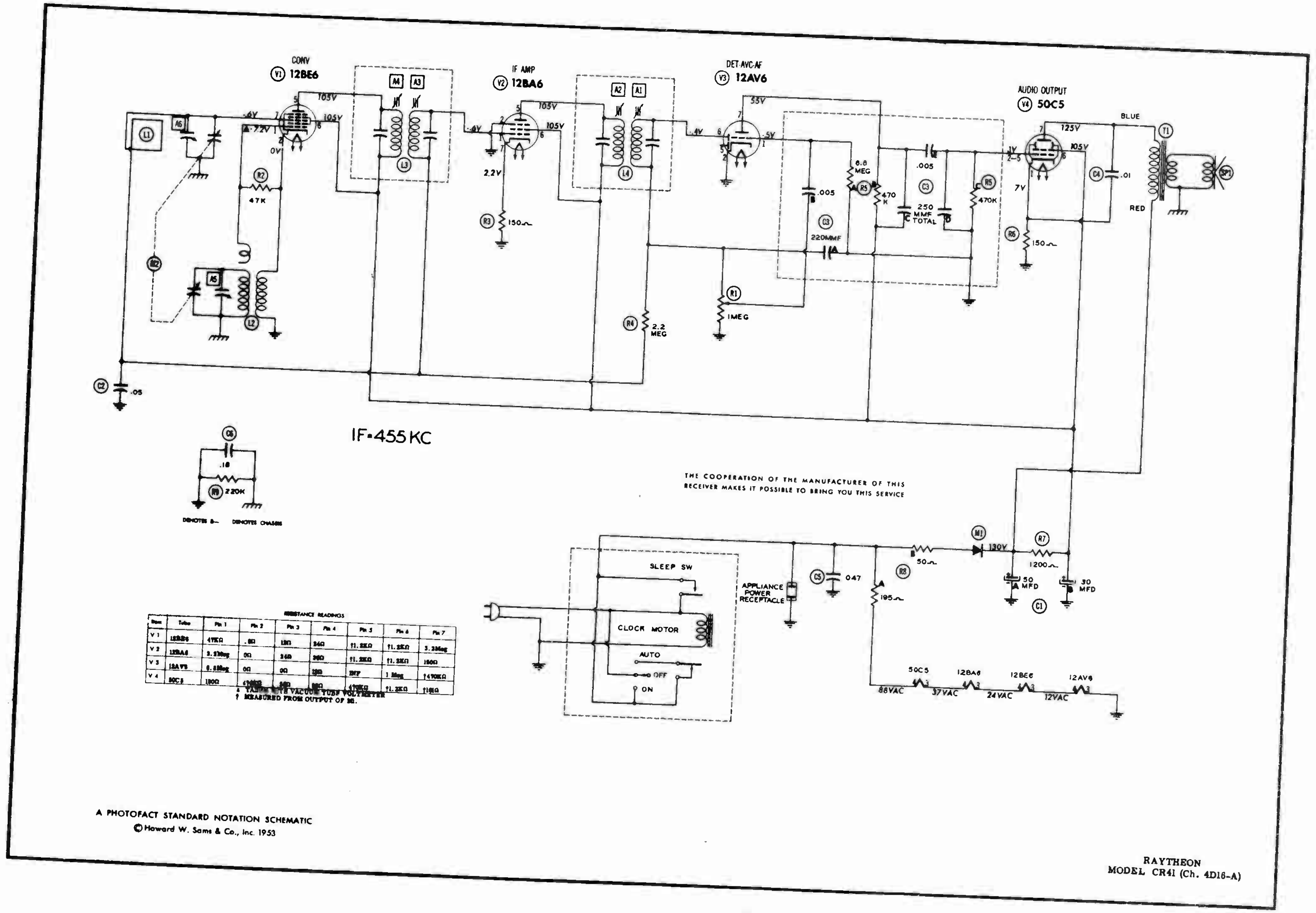
RAYTHEON MODELS C-2112A, C-2113A, C-2114A, C-2115A, C-2116A, C-2118A, RC-2117A (Ch. 21T3)

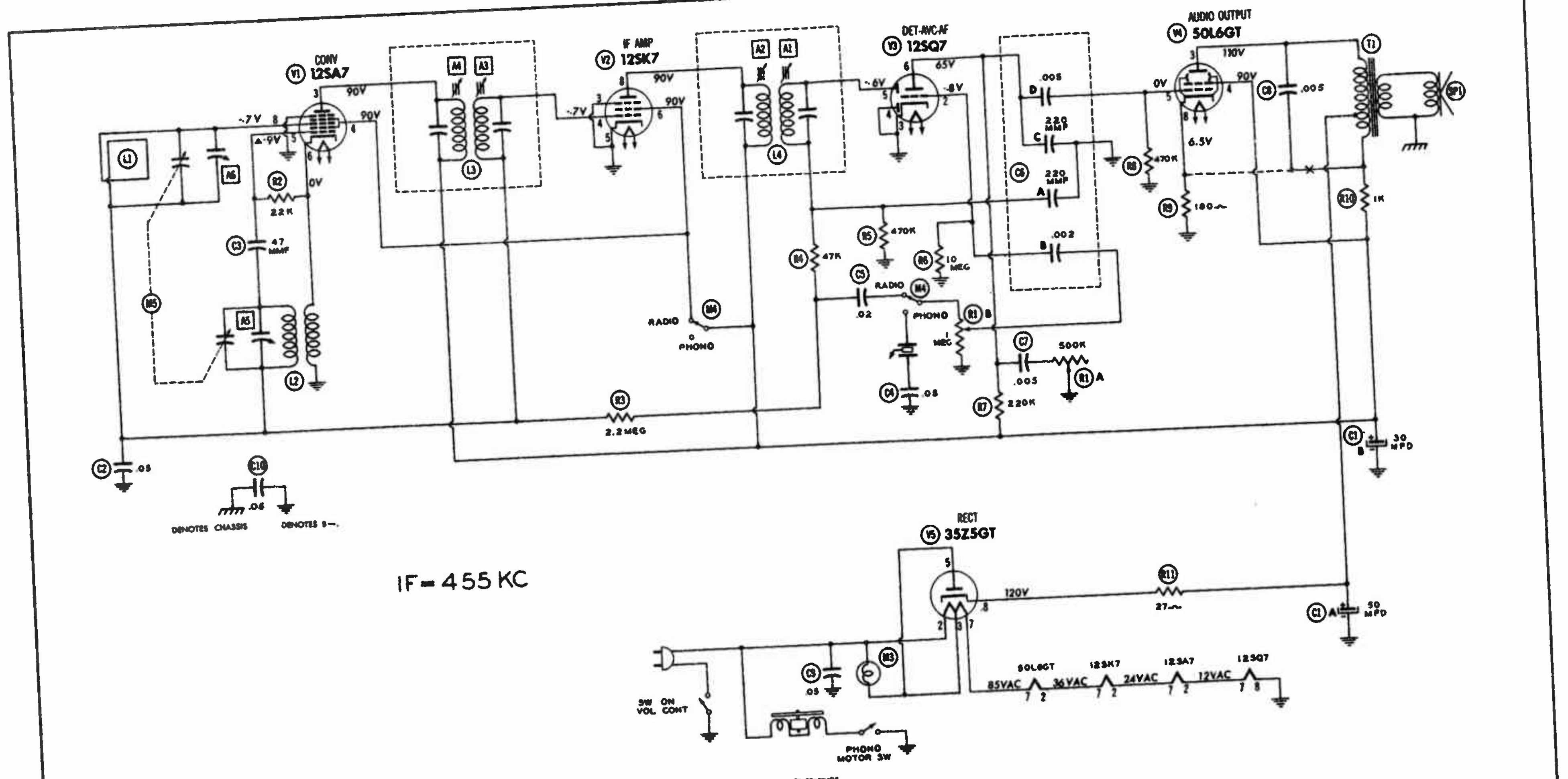


RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	12BE6	47KΩ	.8Ω	13Ω	24Ω	†1.2KΩ	†1.2KΩ	3.3Meg
V 2	12BA6	3.3Meg	0Ω	24Ω	36Ω	†1.2KΩ	†1.2KΩ	150Ω
V 3	12AV6	6.8Meg	0Ω	0Ω	13Ω	INF	1 Meg	†470KΩ
V 4	50C5	150Ω	470KΩ	36Ω	36Ω	470KΩ	†1.2KΩ	†10Ω

* VALUES WITH VACUUM TUBE VOLTMETER
† MEASURED FROM OUTPUT OF M1.

1- DC voltage measurements are at 20,000 ohms per volt, AC voltages measured at 1000 ohms per volt.
2- Socket connections are shown as bottom views.
3- Measured values are from socket pin to common negative.
4- Line voltage maintained at 117 volts for voltage readings.
5- Nominal tolerance on component values makes possible a variation of ± 15% in voltage and resistance readings.
6- Volume control at maximum, no signal applied for voltage measurements.



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	12SA7	90Ω	13Ω	†1KΩ	†1KΩ	22KΩ	1.4Ω	24Ω	2.7Meg
V 2	12SK7	90Ω	24Ω	0Ω	2.7Meg	0Ω	†1KΩ	36Ω	11KΩ
V 3	12SQ7	9Ω	10Meg	0Ω	0Ω	470KΩ	†220KΩ	12Ω	0Ω
V 4	50L6GT	INF	36Ω	1242Ω	11KΩ	470KΩ	0Ω	36Ω	100Ω
V 5	35Z5GT	INF	12Ω	103Ω	INF	103Ω	INF	86Ω	50KΩ

ALL MEASUREMENTS TAKEN IN RADIO POSITION
† MEASURED FROM PIN 8 OF V5
▲ TAKEN WITH VACUUM VOLTMETER
¶ MEASURED FROM CHASSIS

THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

SILVERTONE MODEL 1040

A PHOTOFACT STANDARD NOTATION SCHEMATIC

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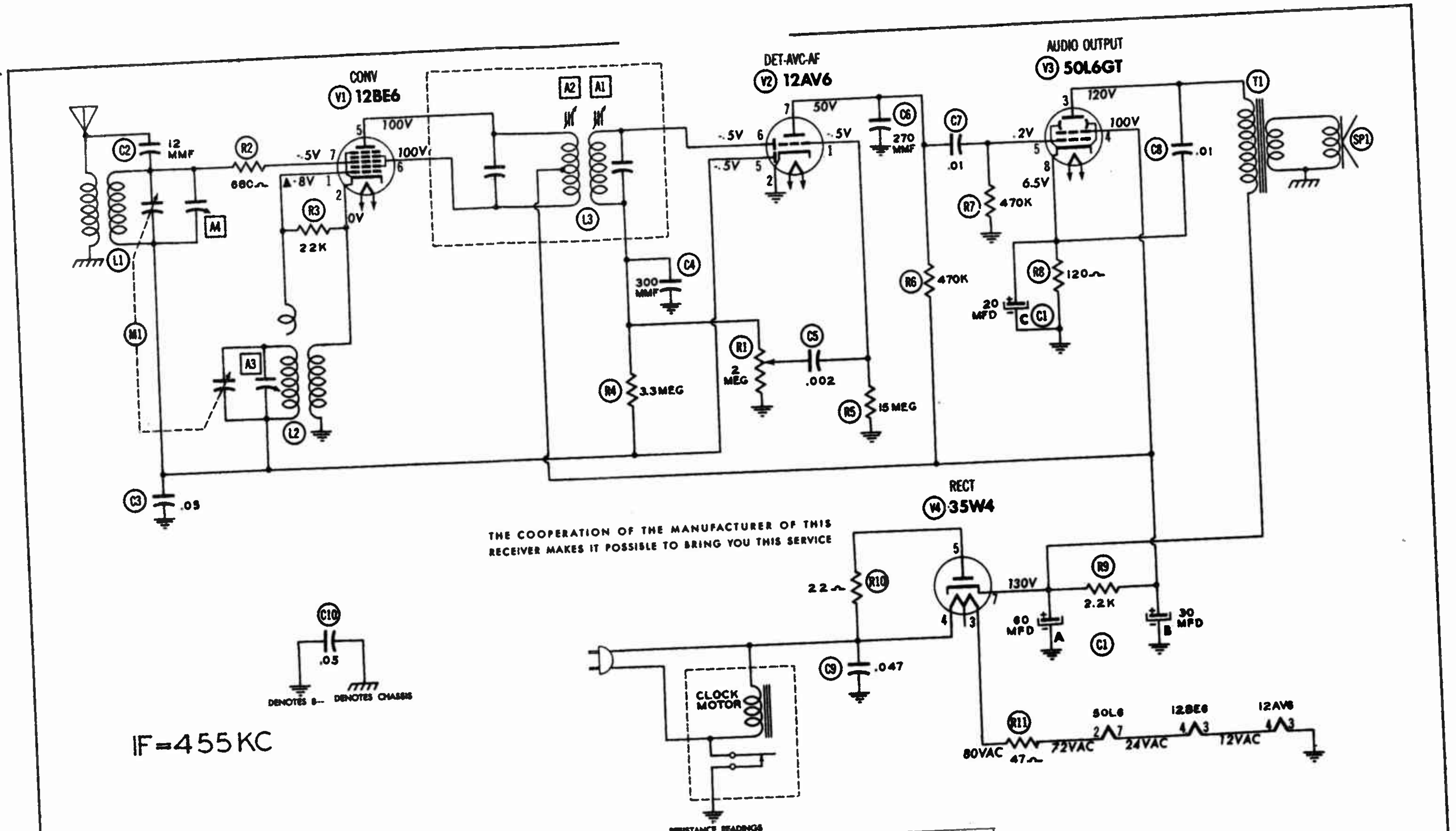
1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	12BE6	22KΩ	.6Ω	30Ω	37Ω	†2200Ω	†2200Ω	5.3Meg	
V 2	12AV6	15 Meg	0Ω	0Ω	30Ω	5.3Meg	1.5Meg	†470KΩ	
V 3	50L6GT	INF	75Ω	†2000Ω	†2200Ω	470KΩ	INF	37Ω	120Ω
V 4	35W4	INF	INF	122Ω	165Ω	157Ω	155Ω	300KΩ	

▲ TAKEN WITH VACUUM TUBE VOLTMETER
† MEASURED FROM PIN 7 OF V4

A PHOTOFACT STANDARD NOTATION SCHEMATIC

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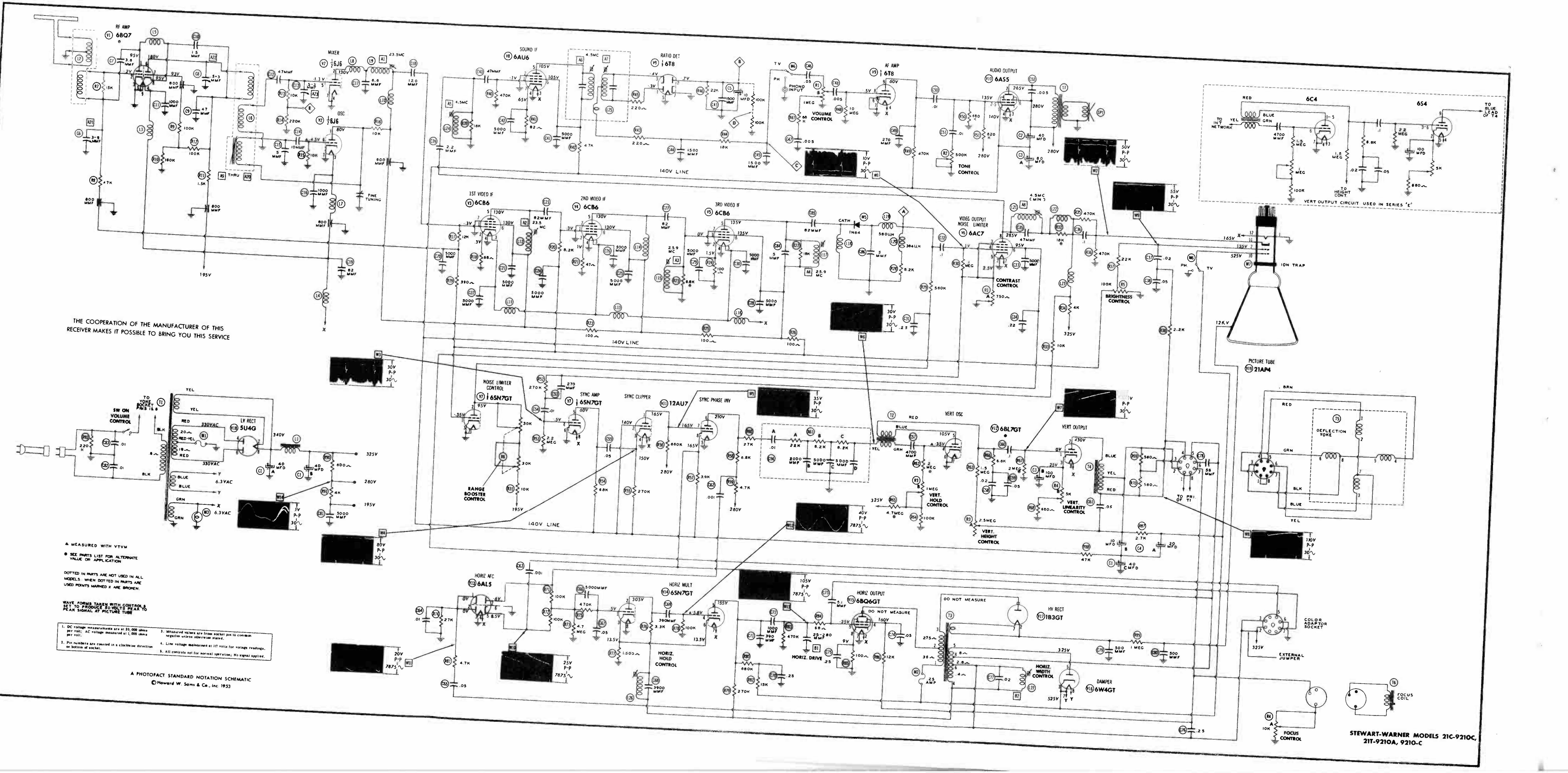
SILVERTONE MODEL 2007 (Ch. 757.100)

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



▲ MEASURED WITH VTVM

● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION

DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.

WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 30 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE

1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.

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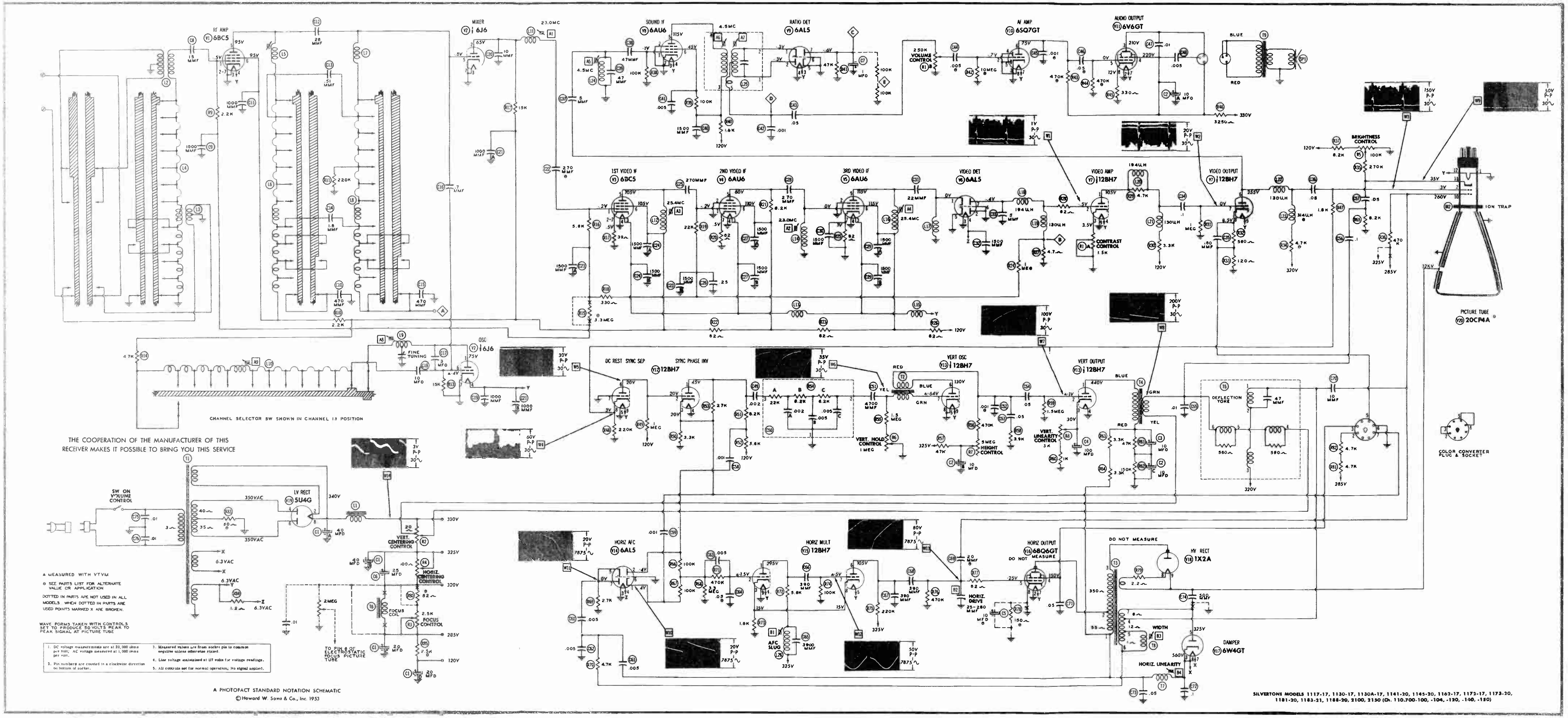
STEWART-WARNER MODELS 21C-9210C, 21T-9210A, 9210-C


RF AMP
(V1) 6BC5
MIXER
(V2) ½ 6J6
OSC
(V2) ½ 6J6
FINE TUNING
CHANNEL SELECTOR SW SHOWN IN CHANNEL 13 POSITION
SOUND IF
(V8) 6AU6
RATIO DET
(V9) 6AL5
VOLUME CONTROL
AF AMP
(V10) 6SQ7GT
AUDIO OUTPUT
(V11) 6V6GT
1ST VIDEO IF
(V3) 6BC5
2ND VIDEO IF
(V4) 6AU6
3RD VIDEO IF
(V5) 6AU6
VIDEO DET
(V6) 6AL5
VIDEO AMP
(V7) ½ 12BH7
CONTRAST CONTROL
VIDEO OUTPUT
(V7) ½ 12BH7
BRIGHTNESS CONTROL
ION TRAP
PICTURE TUBE
(V20) 20CP4A
DC REST SYNC SEP
SYNC PHASE INV
(V12) 12BH7
VERT OSC
(V13) ½ 12BH7
VERT HOLD CONTROL
HEIGHT CONTROL
VERT OUTPUT
(V13) ½ 12BH7
VERT. LINEARITY CONTROL
DEFLECTION YOKE
COLOR CONVERTER PLUG & SOCKET
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
SW ON VOLUME CONTROL
LV RECT
(V19) 5U4G
VERT. CENTERING CONTROL
HORIZ. CENTERING CONTROL
FOCUS COIL
FOCUS CONTROL
TO PIN 6 OF ELECTROSTATIC FOCUS PICTURE TUBE
HORIZ AFC
(V14) 6AL5
HORIZ MULT
(V15) 12BH7
AFC SLUG
HORIZ. DRIVE
HORIZ OUTPUT
(V16) 6BQ6GT
DO NOT MEASURE
HV RECT
(V18) 1X2A
WIDTH
HORIZ. LINEARITY
DAMPER
(V17) 6W4GT
▲ MEASURED WITH VTVM
θ SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
A PHOTOFACT STANDARD NOTATION SCHEMATIC
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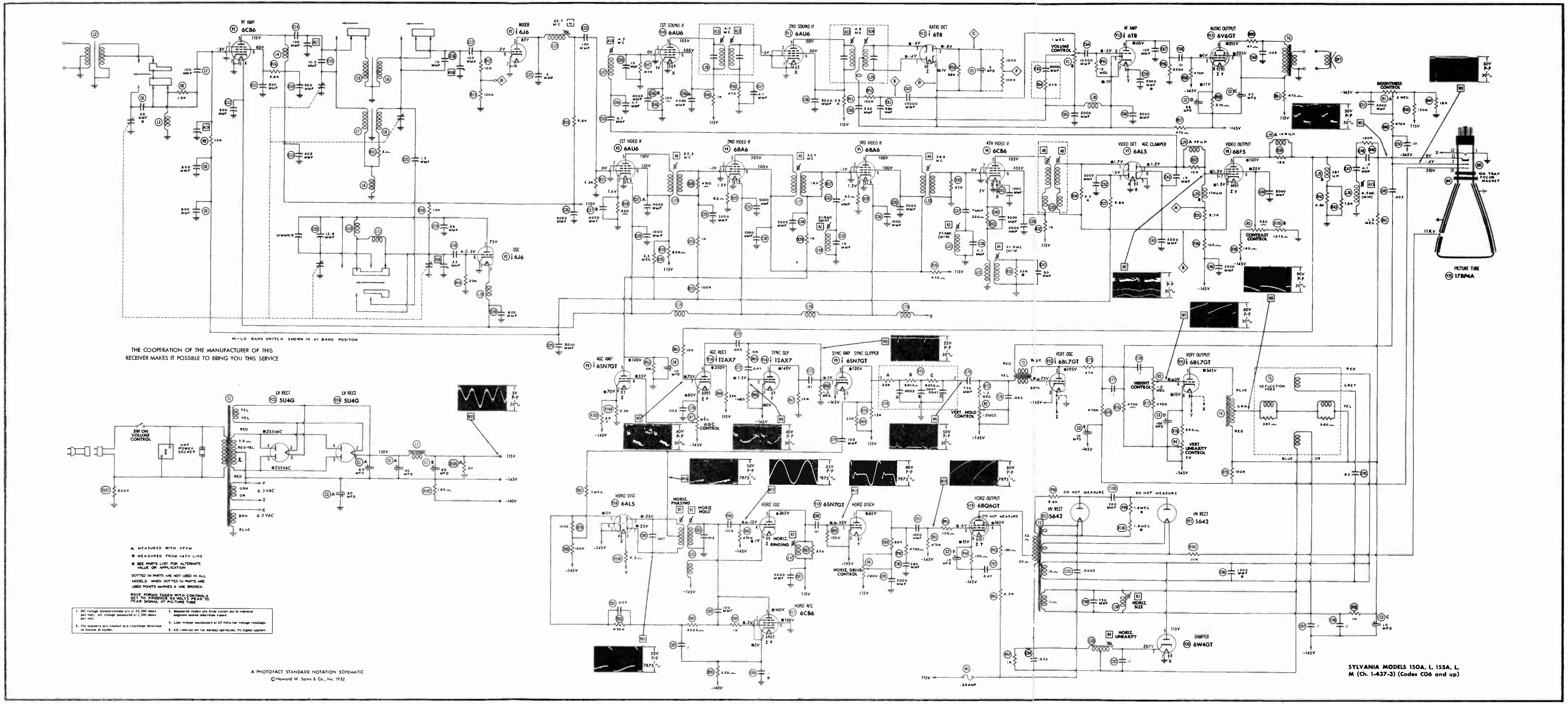
SILVERTONE MODELS 1117-17, 1130-17, 1130A-17, 1141-20, 1145-20, 1162-17, 1172-17, 1173-20, 1181-20, 1183-21, 1188-20, 2100, 2150 (Ch. 110.700-100, -104, -120, -140, -150)


HI-LO BAND SWITCH SHOWN IN HI BAND POSITION
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
▲ MEASURED WITH VTVM
■ MEASURED FROM -145V LINE
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation. No signal applied.
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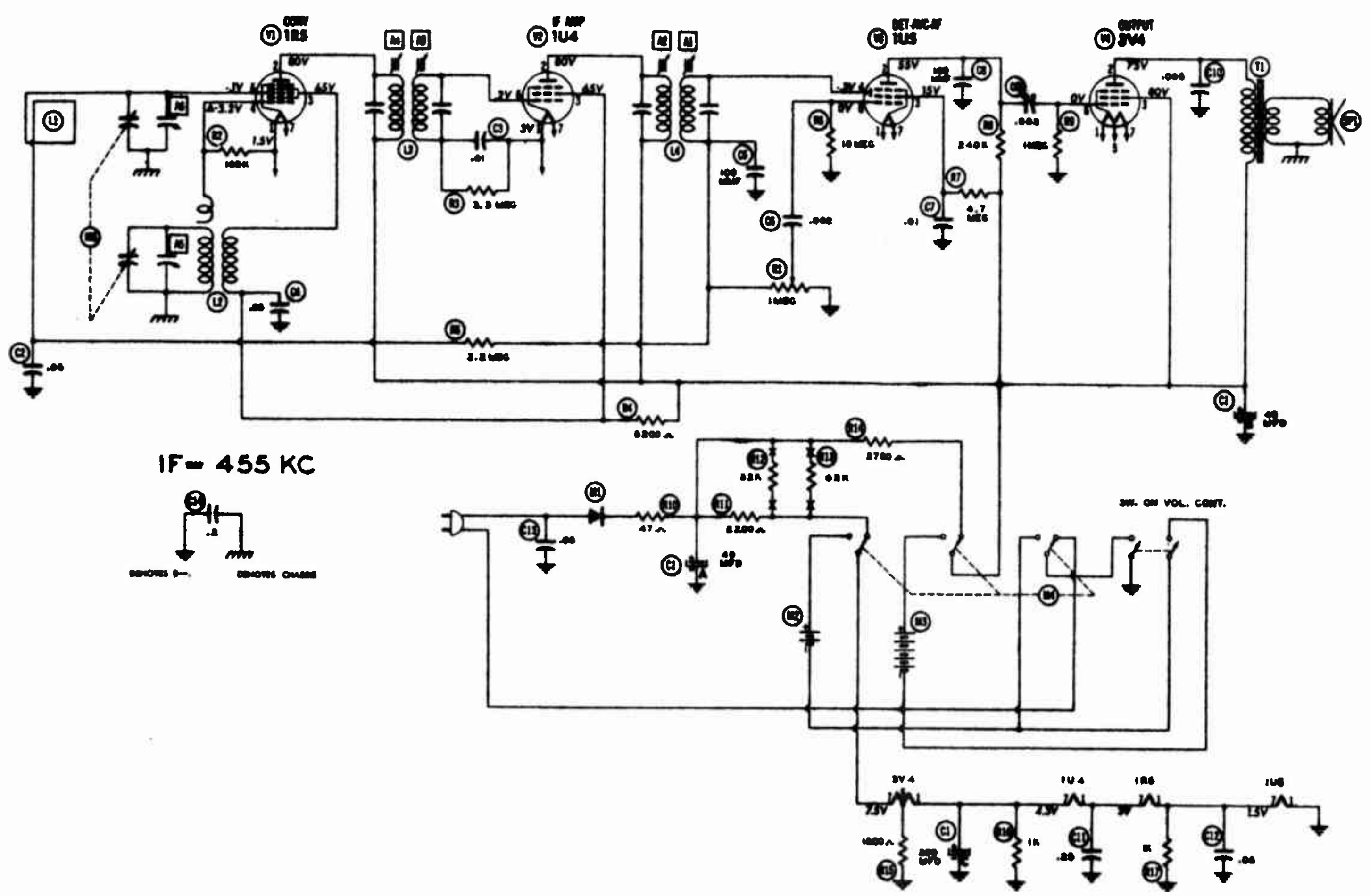
SYLVANIA MODELS 150A, L, 155A, L, M (Ch. 1-437-3) (Codes C06 and up)



IF = 455 KC

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	1R5	•	†2.7KΩ	†11KΩ	100KΩ	•	3.2Meg	•
V 2	1U4	•	†2.7KΩ	†11KΩ	3.2Meg	•	3.3Meg	•
V 3	1U5	•	†240KΩ	†4.7Meg	1Meg	0Ω	10Meg	•
V 4	3V4	•	†3.2KΩ	†2.7KΩ	INF	•	1Meg	•

† MEASURED FROM OUTPUT OF M1

* DO NOT USE OHMMETER TO MEASURE FILAMENT RESISTANCE

▲ TAKEN WITH VACUUM TUBE VOLTMETER

165-15

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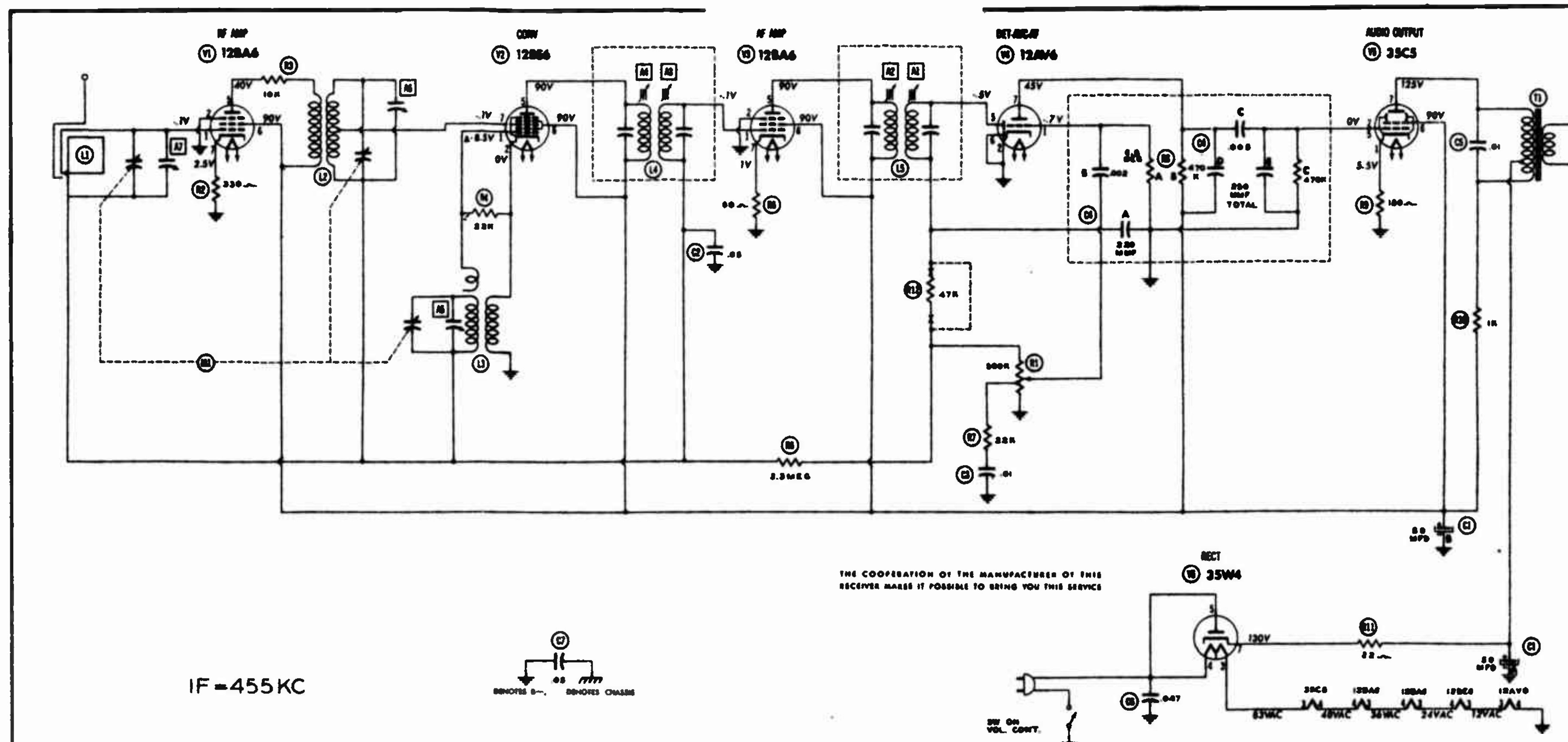
SYLVANIA
MODEL 430L

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

IF = 455 KC

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7
V 1	12BA6	3.8Meg	0Ω	24Ω	36Ω	†11KΩ	†1KΩ	330Ω
V 2	12BE6	22KΩ	1Ω	12Ω	24Ω	†1KΩ	†1KΩ	3.8Meg
V 3	12BA6	3.8Meg	0Ω	36Ω	48Ω	†1KΩ	†1KΩ	68Ω
V 4	12AV6	6.8Meg	0Ω	12Ω	0Ω	550KΩ	0Ω	†470KΩ
V 5	35C5	150Ω	470KΩ	83Ω	48Ω	470KΩ	†1KΩ	†194Ω
V 6	35W4	†22Ω	INF	83Ω	118Ω	118Ω	100Ω	40KΩ

† MEASURED FROM PIN 7 OF V6

▲ TAKEN WITH VACUUM TUBE VOLTMETER

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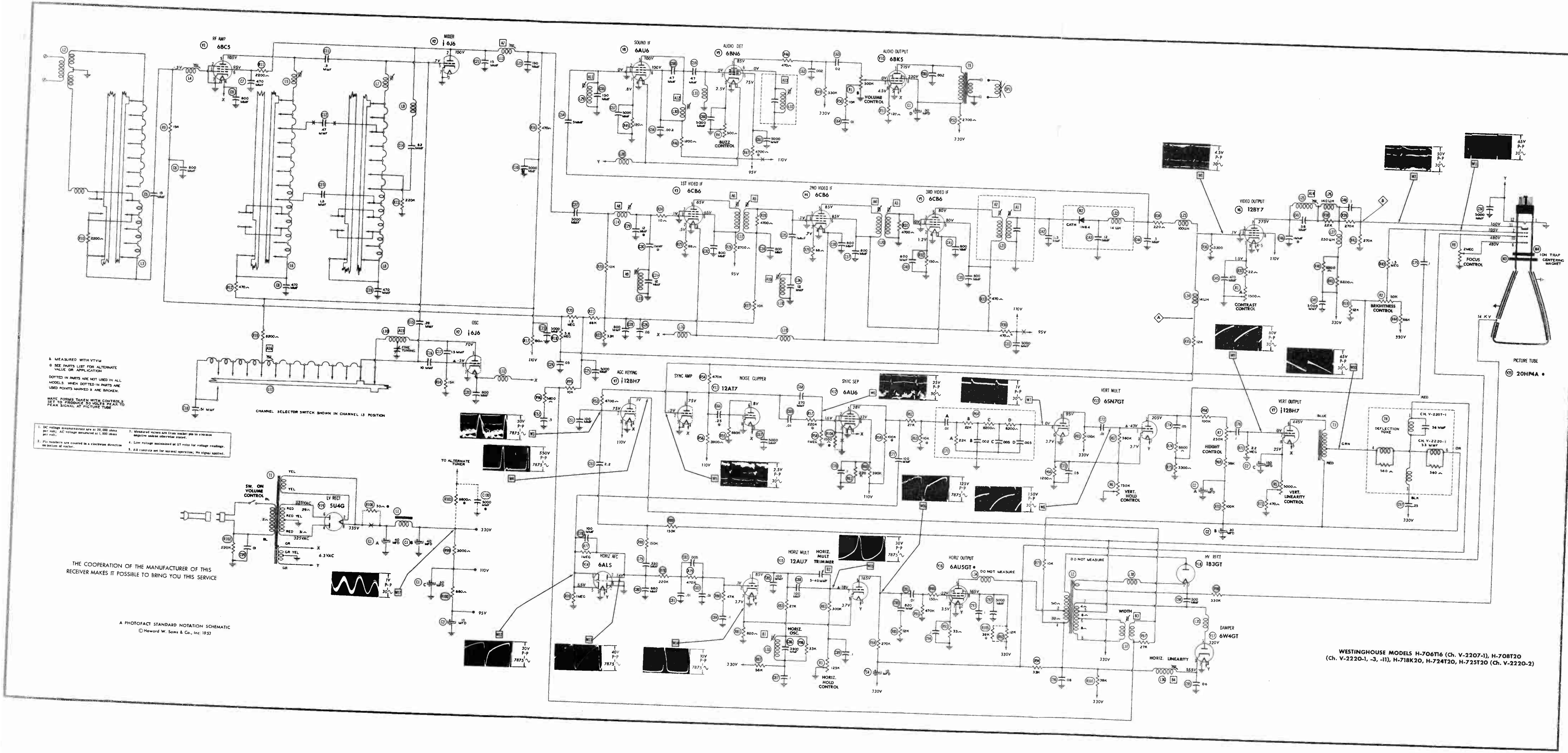
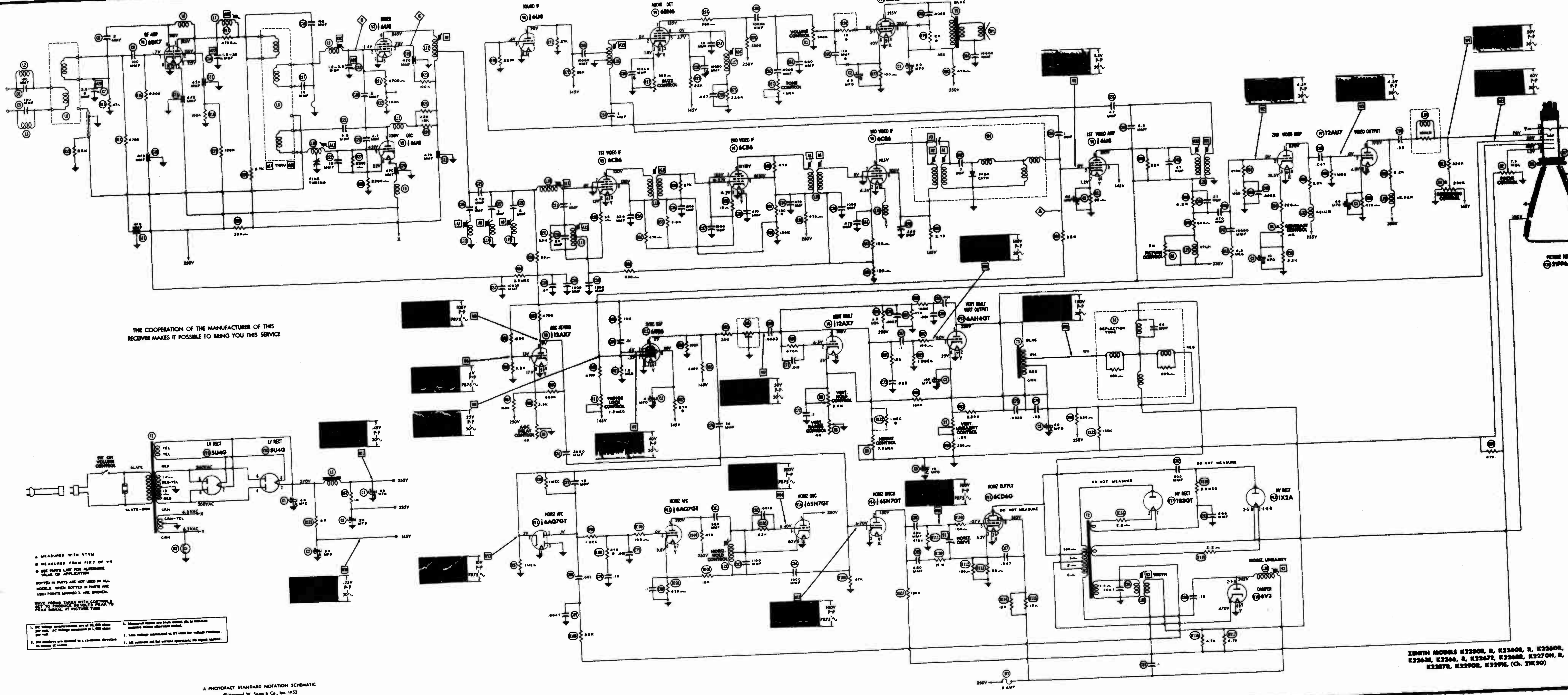
WESTINGHOUSE
MODEL H-3[illegible]T6 (Ch. V-21[illegible]-1)

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



▲ MEASURED WITH VTVM
● SEE PARTS LIST FOR ALTERNATE VALUE OR APPLICATION
DOTTED IN PARTS ARE NOT USED IN ALL MODELS. WHEN DOTTED IN PARTS ARE USED POINTS MARKED X ARE BROKEN.
WAVE FORMS TAKEN WITH CONTROLS SET TO PRODUCE 50 VOLTS PEAK TO PEAK SIGNAL AT PICTURE TUBE
1. DC voltage measurements are at 20,000 ohms per volt; AC voltage measured at 1,000 ohms per volt.
2. Pin numbers are counted in a clockwise direction on bottom of socket.
3. Measured values are from socket pin to common negative unless otherwise stated.
4. Line voltage maintained at 117 volts for voltage readings.
5. All controls set for normal operation; No signal applied.
CHANNEL SELECTOR SWITCH SHOWN IN CHANNEL 13 POSITION
THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE
A PHOTOFACT STANDARD NOTATION SCHEMATIC
©Howard W. Sams & Co., Inc. 1953
WESTINGHOUSE MODELS H-706T16 (Ch. V-2207-1), H-708T20 (Ch. V-2220-1, -3, -11), H-718K20, H-724T20, H-725T20 (Ch. V-2220-2)



THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

ZENITH MODELS K2230E, R, K2240E, R, K2260R, K2263E, K2266, R, K2267E, K2268R, K2270H, R, K2287R, K2290R, K2291E, (Ch. 21K20)

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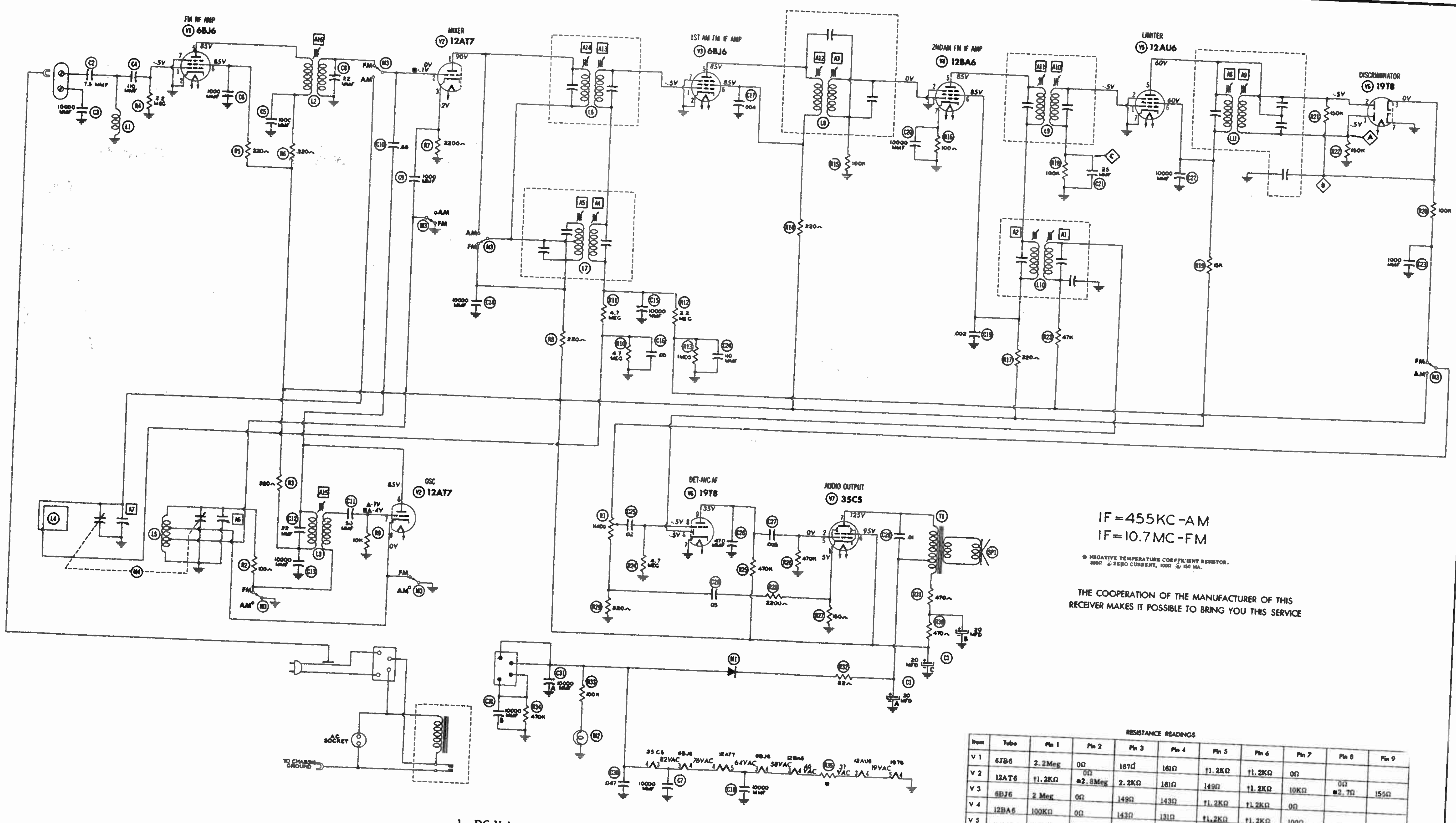

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V 1	6JB6	2.2Meg	0Ω	167Ω	161Ω	†1.2KΩ	†1.2KΩ	0Ω		
V 2	12AT6	†1.2KΩ	0Ω ■2.8Meg	2.2KΩ	161Ω	149Ω	†1.2KΩ	10KΩ	0Ω ■2.7Ω	155Ω
V 3	6BJ6	2 Meg	0Ω	149Ω	143Ω	†1.2KΩ	†1.2KΩ	0Ω		
V 4	12BA6	100KΩ	0Ω	143Ω	131Ω	†1.2KΩ	†1.2KΩ	100Ω		
V 5	12AU6	100KΩ	0Ω	31Ω	19Ω	†16KΩ	†16KΩ	0Ω		
V 6	19T8	160KΩ 180KΩ	160KΩ ■180KΩ	250KΩ ■330KΩ	0Ω	19Ω	1 Meg ■550KΩ	0Ω	4.7 Meg	†470KΩ
V 7	35C5	150Ω	470KΩ	167Ω	202Ω	470KΩ	†965Ω	†297Ω		

ALL MEASUREMENTS TAKEN IN "FM" POSITION UNLESS NOTED
† MEASURED FROM OUTPUT OF M1
■ MEASURED IN "AM" POSITION
▲ TAKEN WITH VACUUM TUBE VOLTMETER

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.

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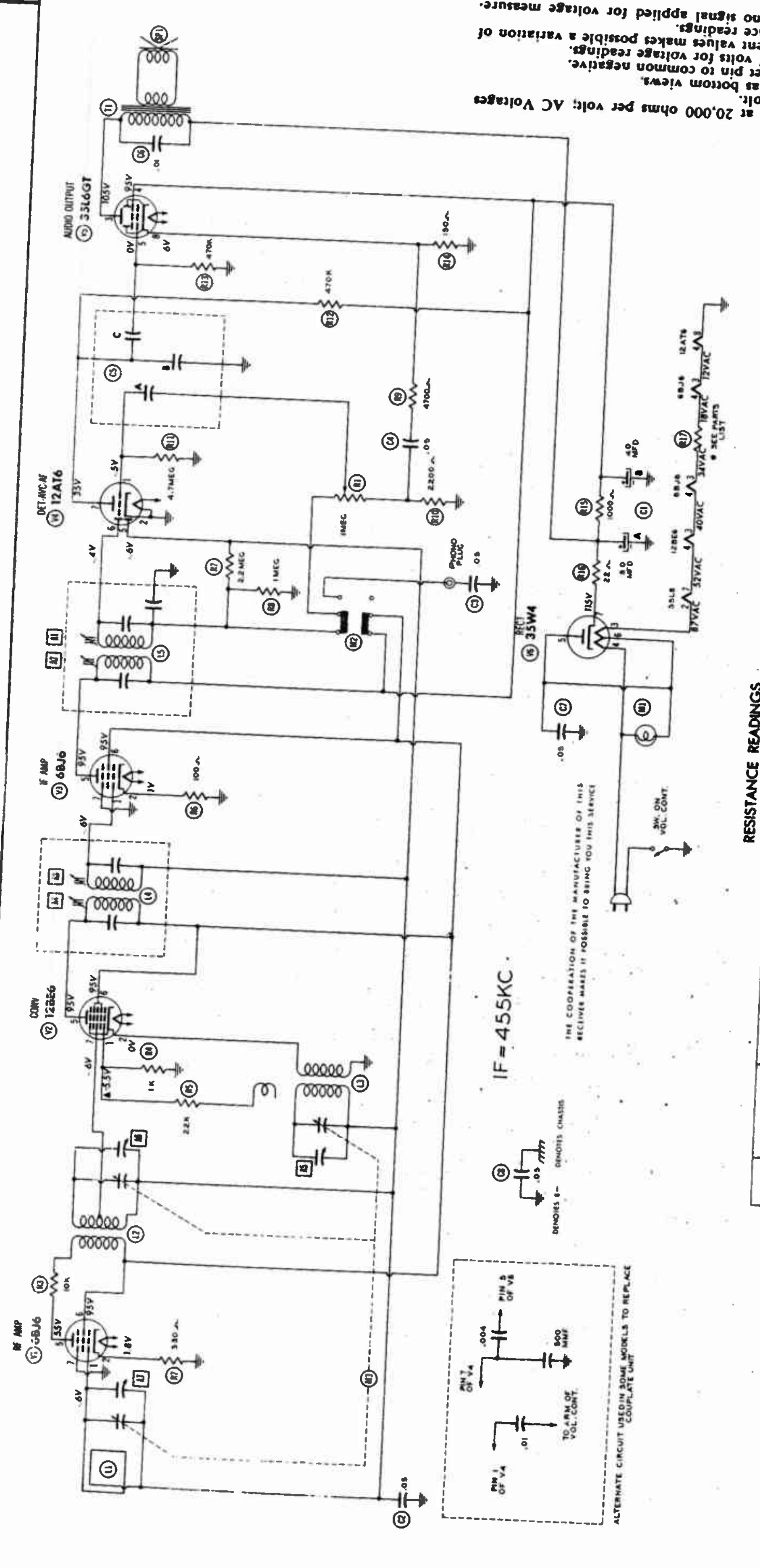
ZENITH J-733 G.R.Y. CH. 7-503

ZENITH MODEL H615Z1 (Ch. 6G05Z1)

1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ± 10% in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	6BJ6	2.7Meg.	330Ω	118Ω	124	†1KΩ	†1KΩ	0Ω	
V 2	12BE6	22KΩ	16Ω	124Ω	136Ω	†1KΩ	†1KΩ	2.7Meg.	
V 3	6BJ6	2.7Meg.	100Ω	12Ω	18Ω	†1KΩ	†1KΩ	0Ω	
V 4	12AT6	4.7Meg.	0Ω	0Ω	12Ω	2.7Meg.	500KΩ	†470KΩ	
V 5	35L6GT	INF	171Ω	†287Ω	†1KΩ	470KΩ	†27Ω	136Ω	150Ω
V 6	35W4	4.8KΩ	INF	171Ω	206Ω	188Ω	188Ω	65KΩ	

† MEASURED FROM PIN 7 OF V6.
▲ TAKEN WITH VACUUM TUBE VOLTMETER.

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