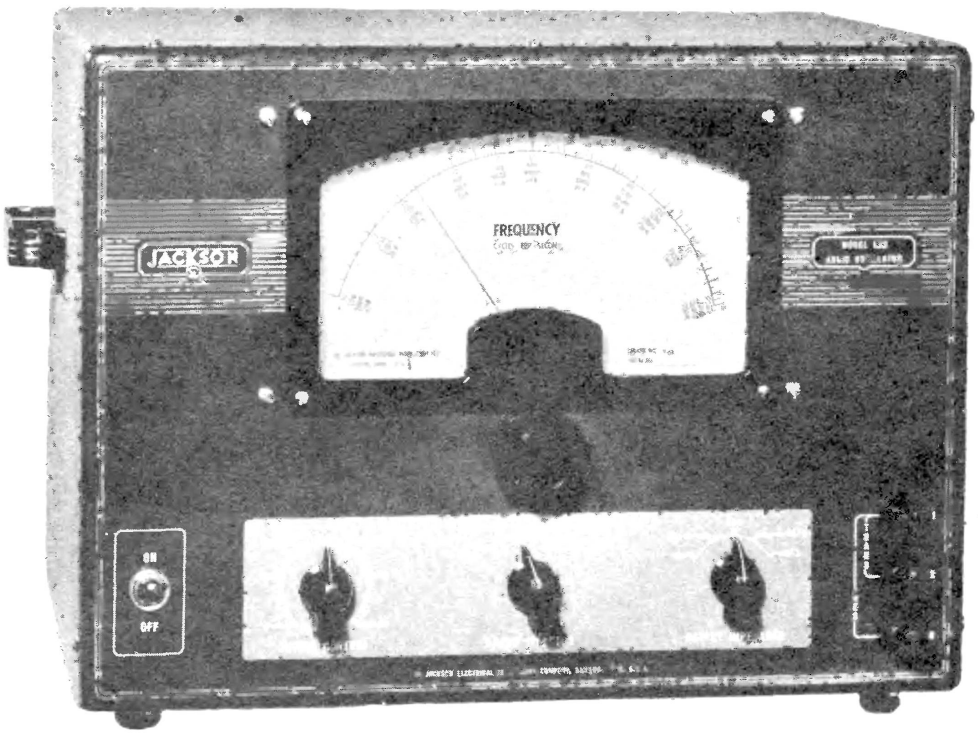
JACKSON Radio Testing Equipment

MODEL 655

AUDIO FREQUENCY OSCILLATOR



OPERATING INSTRUCTIONS

SERIAL No. _____

THE JACKSON ELECTRICAL INSTRUMENT COMPANY, DAYTON, OHIO

OPERATING INSTRUCTIONS FOR MODEL 655 AUDIO FREQUENCY OSCILLATOR

The Model 655 is a wide range oscillator providing voltages throughout the frequency range of 20 to 200,000 cycles. The signal is generated at its fundamental frequency by a capacity-resistance tuned bridge circuit which provides improved operating characteristics. No zero adjustments are required in the operation of this instrument.

The full frequency range is covered in four logarithmic ranges providing a long effective scale length for maximum readability and accuracy.

For the audio spectrum 20 to 20,000 cycles, a choice of either transformer coupled or resistive output is available. A selection of four transformer coupled load impedances in the output circuit provide matching facilities for various load conditions. When using transformer coupled output it is extremely important that the load matches the output impedance selected. (If the load is not matched, bad waveform will result.)

Three binding posts are provided for connecting the output voltage to the load. Binding posts No. 1 and No. 2 are used to transformer couple the instrument to the load if an ungrounded voltage is required. If a grounded voltage is necessary, binding posts 2 and G can be connected together. The output power available when using transformer coupling is 500 milliwatts and the output control provides continuous adjustment of the output voltage from zero to maximum.

The voltage developed throughout the full frequency range of the instrument can also be resistively coupled to the load. In the 20 to 200 kilocycle range, the output must always be resistively coupled to the load. The output impedance switch must be set to RES and binding posts No. 1 and G used. The maximum open circuit voltage developed under the conditions of resistance coupling is 35 volts. When the instrument is resistively coupled to the load, a close impedance match is not required. It is not recommended, however, when flat response is required throughout the entire frequency range, that the resistive tap be loaded less than 5000 ohms.

OPERATION

The Model 655 is supplied complete with tubes and is ready to use. To place in operation insert line cord in power receptacle and turn the "OFF-ON" switch to the "ON" position. Allow a few minutes for the tubes to warm up to a stable operating temperature. The instrument is now ready to use.

Range Selector: The four ranges, 20-200, 200-2000, 2000-20,000 and 20,000 to 200,000 cycles are selected by this switch.

Output Control: This control provides continuous adjustment of the output voltage from zero to maximum.

Output Impedance: The output circuit of the Model 655 consists of a transformer with four taps providing the proper output impedance for working into loads of 10, 250, 500 and 5000 ohms. In addition, a position marked RES, changes the output from a transformer coupled to a resistive coupled output circuit. The RES position must always be used for the 20,000 to 200,000 cycle range.

With the output control at maximum using transformer coupling into the proper resistive load, the following voltages are available at the binding posts:

10	ohm	load	--	2.23	volts	- 500 Milliwatts
250	"	"	--	11.2	"	- " "
500	"	"	--	15.8	"	- " "
5000	"	"	--	50	"	- " "

Binding Posts: Three binding posts No. 1, No. 2, G (Ground) are provided. Binding Posts Nos. 1 and 2 are used for securing transformer coupled output. Binding posts No. 1 and G are used for resistive coupled output. In normal use, binding post #2 can be connected to binding Post G so that one side of the output voltage is at ground potential.

SPECIFICATIONS

Line Voltage	105-120 Volts, 50-60 Cycle
Input Watts	60 Watts
Frequency Range	20 to 200,000 Cycles
Calibration Curve	Logarithmic
Accuracy	3% or 1 Cycle whichever is greater
Output Impedance	10, 250, 500 & 5000 ohms - also resistive
Output Power	500 Milliwatts (20 to 20,000 Cycles Transformer coupled.)
Output Control	Continuously variable
Waveform	Less than 5% distortion at all frequencies
Frequency Characteristic	Plus or minus 1 DB 30-15,000 Cycles using transformer coupled output
Hum Level	Down more than 60 DB of maximum
Tubes	1-6G6G, 1-6SL7GT, 2-6V6GT & 1-5Y3GT furnished installed
Case Dimensions	13" Wide x 9½" High, 9½" Deep

APPLICATIONS

MEASUREMENT OF THE AUDIO SIGNAL

In order to make quantitative measurements on the audio equipment it is necessary to measure the input and output audio voltages. Vacuum tube voltmeters, rectifier type voltmeters and thermocouple meters can be used. The shunting impedance of the meter should be considered in matching the input and output load conditions when exact measurments are desired. The Vacuum tube AC voltmeter presents negligible load on the circuit and is the preferred type to use.

In many measurements such as amplifier gain tests it is necessary to use a very small input signal voltage. It is difficult to accurately measure small AC voltages on high impedance circuits. Therefore, a larger signal voltage which can be conveniently measured is used together with an attenuator. The attenuator reduces the voltage by a constant ratio producing a small voltage of known magnitude.

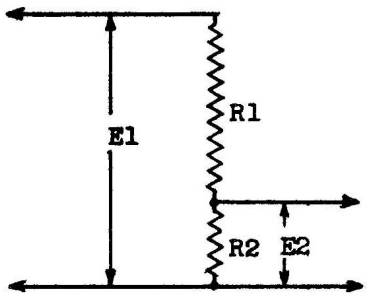


Fig. 1

ATTENUATION RATIO	250 OHM TAP		500 OHM TAP		5000 OHM TAP	
	R1	R2	R1	R2	R1	R2
10	225	25	450	50	4500	500
100	247.5	2.5	495	5	4950	50
1000	249.75	.25	499.5	.5	4995	5

The attenuator may be of the "L" or "T" type or the simple voltage divider type shown in figure 1. Resistors R1 and R2 comprise the attenuator network. The total resistance of R1 and R2 should be made equal to the output impedance of the audio frequency oscillator. The ratio of voltage at E2 is equal to the ratio of R2 to the total resistance of R1 and R2. The table at the right shows the resistor values for attenuation ratios of 10, 100 and 1000 for the 250, 500 and 5000 ohm load impedances. The use of the attenuator provides a known small voltage for test. For example, if it is desired to apply .01 volts to the input of an amplifier, an attenuator having a ratio of 1000 can be used and voltage E1 at the input of the attenuator adjusted to 10 volts. The resistance value of R2 must be low compared to the input impedance to which it is connected or allowance made for the shunting effect of the load for highest accuracy.

TESTING SPEAKERS, HEADPHONES ETC.

The Model 655 produces an output power of .5 watt. This is sufficient for direct connection to most speakers, headphones etc. for audible testing. If it is desired to test large speakers at full output load, it is necessary to use a separate amplifier capable of supplying the required power.

The frequency response of the speaker is checked by holding the input audio voltage constant and varying the frequency of the audio oscillator throughout the audio range. Resonance peaks and rattles can be quickly located in this manner.

Headphones and magnetic type speakers having no output transformer can be tested by connecting directly to the output posts of the audio oscillator. For speakers and phones designed to work out of the plate circuit of output tubes the 5000 ohm load impedance tap will ordinarily provide the best impedance match. For speakers or phones designed for other loads, the appropriate output load should be chosen.

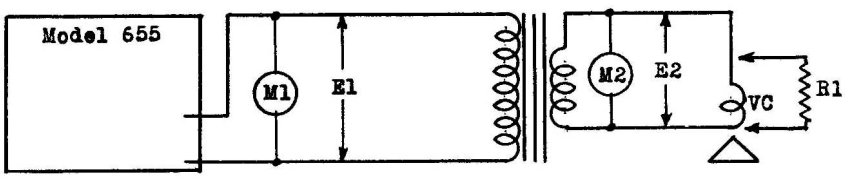


Fig. 2a

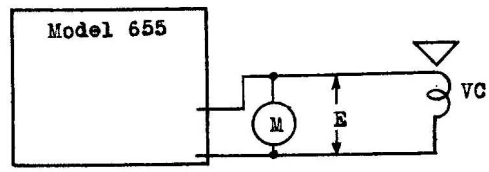


Fig. 2b

CONNECTIONS FOR SPEAKER TEST

Permanent magnet or separately excited dynamic speakers can be tested as shown in Figs. 2. If the speaker has a field coil it must be excited with the proper DC current when the tests are made. Figure 2a shows the connection of the audio oscillator to the speaker output transformer. The input voltage E1 is held constant throughout the audio frequency range. The output voltage E2 may be measured across the voice coil. The characteristics of the transformer alone can be checked by substituting a load resistor R1 equal to the voice coil impedance. By using the 10 ohm impedance tap on the Model 655 the speaker can be tested by connecting directly to the voice coil as shown in figure 2b.

AUDIO AMPLIFIER RESPONSE

The arrangement for checking the frequency response of audio amplifiers is shown in Figure 3. For low gain amplifiers where the input voltage can be readily measured, the attenuator shown can be omitted and the input to the amplifier connected directly to the audio oscillator output. However, for high gain amplifiers where the input level is small, it is generally necessary to use an attenuator to accurately determine the voltage to the amplifier input.

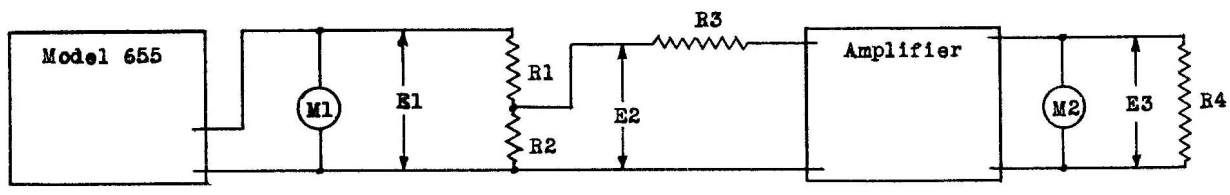


Fig. 3 CONNECTIONS FOR AUDIO AMPLIFIER TEST

The output of the amplifier should be connected to a load resistor of the proper value or to the speaker or device into which the amplifier works. When the input circuit of the amplifier is a transformer and the attenuator is used, a resistor R3 should be placed in series as shown. The value of this resistor should be equal to the input impedance of the amplifier.

The input voltage to the amplifier E2 is equal to the voltage applied to the attenuator E1 divided by the attenuation ratio. The output is read across the output load resistor R4. The shunting effect of the meter resistance of M2 should be considered in determining the value of R4 for best accuracy.

The gain of the amplifier is the output voltage E3 divided by the input voltage E2. A frequency response curve can then be made by checking the gain throughout the audio range of the amplifier.

AUDIO TRANSFORMERS AND FILTERS

High gain input transformers can be tested in the same manner as described for audio amplifiers. The input resistance R3 should be equal to the input impedance of the transformer. The output load R4 should be equal to the output load impedance of the transformer. Where the output normally works into a vacuum tube grid circuit the correct impedance will be approximated by the load offered by the vacuum tube voltmeter without any additional load resistance.

When testing interstage and output transformers, it may be necessary to pass the normal DC plate current through the primary winding. This may be done as shown in Figure 4 by connecting a battery and milliameter M2 in series with the primary winding. The battery voltage is adjusted to provide the normal primary current through the transformer.

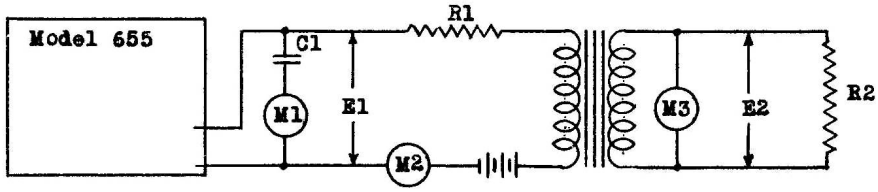


Fig. 4 CONNECTIONS FOR TRANSFORMER TEST

Resistance R1 should be made equal to the plate impedance of the tube from which the transformer normally works. R2 should be made equal to the output impedance of the transformer. If the output normally works into the grid circuit of a vacuum tube, a vacuum tube voltmeter will approximate this load condition. Any special loading conditions offered by the circuit in which the transformer is used should be included in the test set-up. The condenser C1 is connected in series with the input voltmeter to prevent any DC from introducing error in the meter readings.

For transformers having push-pull primaries, no DC polarizing current is necessary for test. The input signal should be connected to the total primary winding and the input resistance R1 made equal to twice the plate impedance of a single output tube.

When testing audio filters, R1 and R2 should be made equal to the input and output characteristic impedances of the filter.

OVERALL RECEIVER FIDELITY TESTS

The overall fidelity of a receiver is determined by externally modulating a R.F. Test Oscillator with the Model 655 Audio Oscillator as shown in figure 5.

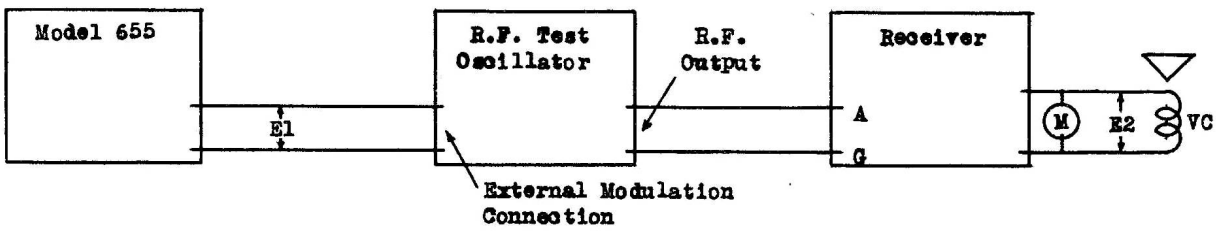


Fig. 5 CONNECTIONS FOR RECEIVER FIDELITY TEST

The R.F. Test Oscillator is connected to the receiver Antenna-Ground posts. The Model 655 Audio Oscillator is connected to the external modulation terminals on the R.F. Test Oscillator. The proper load impedance should be chosen and the audio voltage E1 adjusted to produce 30% modulation of the R.F. test oscillator.

Connect a meter across the voice coil of the speaker. Adjust the R.F. Test Oscillator to 1000 KC or at any other frequency at which it is desired to run the test. Carefully tune the receiver to the test oscillator frequency making sure that it is on exact resonance and not on one of the sideband peaks. It will be noted that the output meter will give maximum readings on the side band peaks on either side of exact resonance. The correct setting is at the position where the output meter gives minimum indication between the two peaks.

Now the Model 655 can be varied over the audio range keeping the input voltage E1 constant. The variations of the output meter are now recorded to produce the overall response curve.

HIGH FREQUENCY RANGE

The preceeding information dealt with applications for which the audio frequency spectrum 20 cycles to 20,000 cycles is normally used. A high frequency range, 20 kilocycles to 200 kilocycles is provided in the instrument for supersonic and low radio frequency test purposes. This range bridges the gap between the audio and radio frequency spectrums.

Since most applications in the supersonic range are of a very specialized nature, no specific instructions for use are included in this manual.

When using the 20 to 200 kilocycle range the Output Impedance switch must be in the "RES." position and the resistive output binding posts used.

SERVICE NOTES

The Model 655 is a negative feedback type oscillator which generates the signal at its fundamental frequency. The instrument consists of a two stage oscillating feedback amplifier, a buffer stage and a power amplifier stage, together with the power supply.

Tubes V1 and V2 form the oscillating feedback circuit. Two feedback paths from V1 provide frequency selective and amplitude control feedback to the grids of V2. A resistance-capacitance network forms the frequency determining element. Voltage from I3 provides amplitude controlled feedback.

The buffer amplifier V3 provides isolation between the oscillating circuit and the power amplifier stage.

The amplifier stage V4 has the Output Control located in its grid circuit. For the Output Impedance taps 10, 250, 500 and 5000 ohms, transformer T1 is connected in the plate circuit. With the Output Impedance switch in the "RES." position, R25 becomes the plate resistance and C14 the coupling condenser thus forming a resistive output system. This provides transformer coupled output throughout the audio frequency range and resistively coupled output throughout the entire range of the instrument.

The power supply consists of V5 connected in a conventional rectifier-filter power supply system.

Due to the self compensating nature of the circuit, the output voltage remains practically constant throughout a wide range of input line voltage. The feedback control R16 has been adjusted at the factory to provide good wave form and the proper output voltage. It should require no adjustment throughout the life of the instrument.

Trimmer condensers C4 and C5 across the main variable condenser C6 have been adjusted to provide a balanced circuit and correct calibration. Trimmer C7 is used to compensate the frequency at the 200 kilocycle point only. These adjustments have been carefully calibrated at the factory and no further adjustments should be necessary to maintain the accuracy of the instrument.

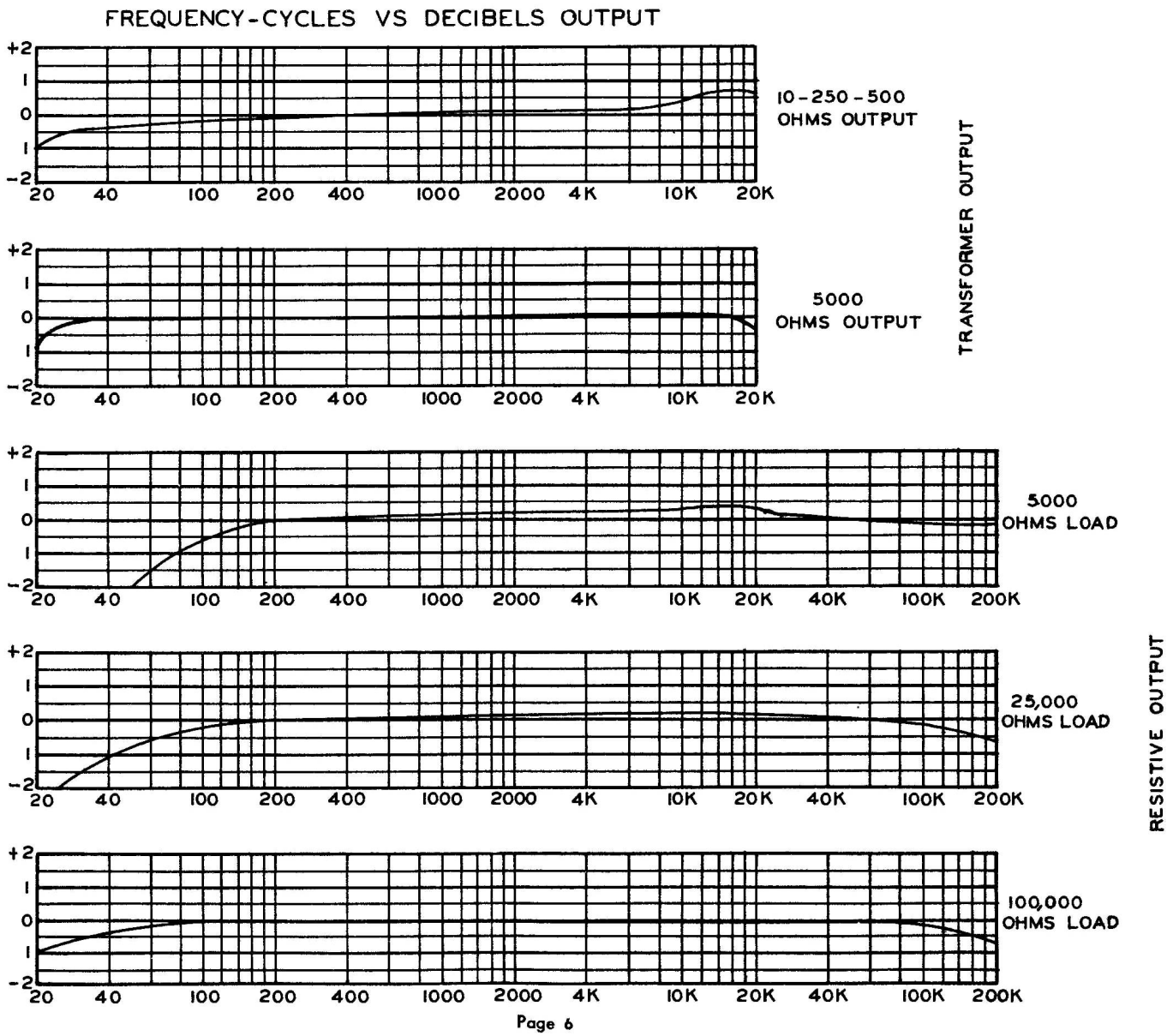
The Dial Lamps may be replaced by removing the four screws which hold the bakelite dial escutcheon. The chassis is removed from the case by removing the ten screws on the front panel and two screws from the bottom of the case.

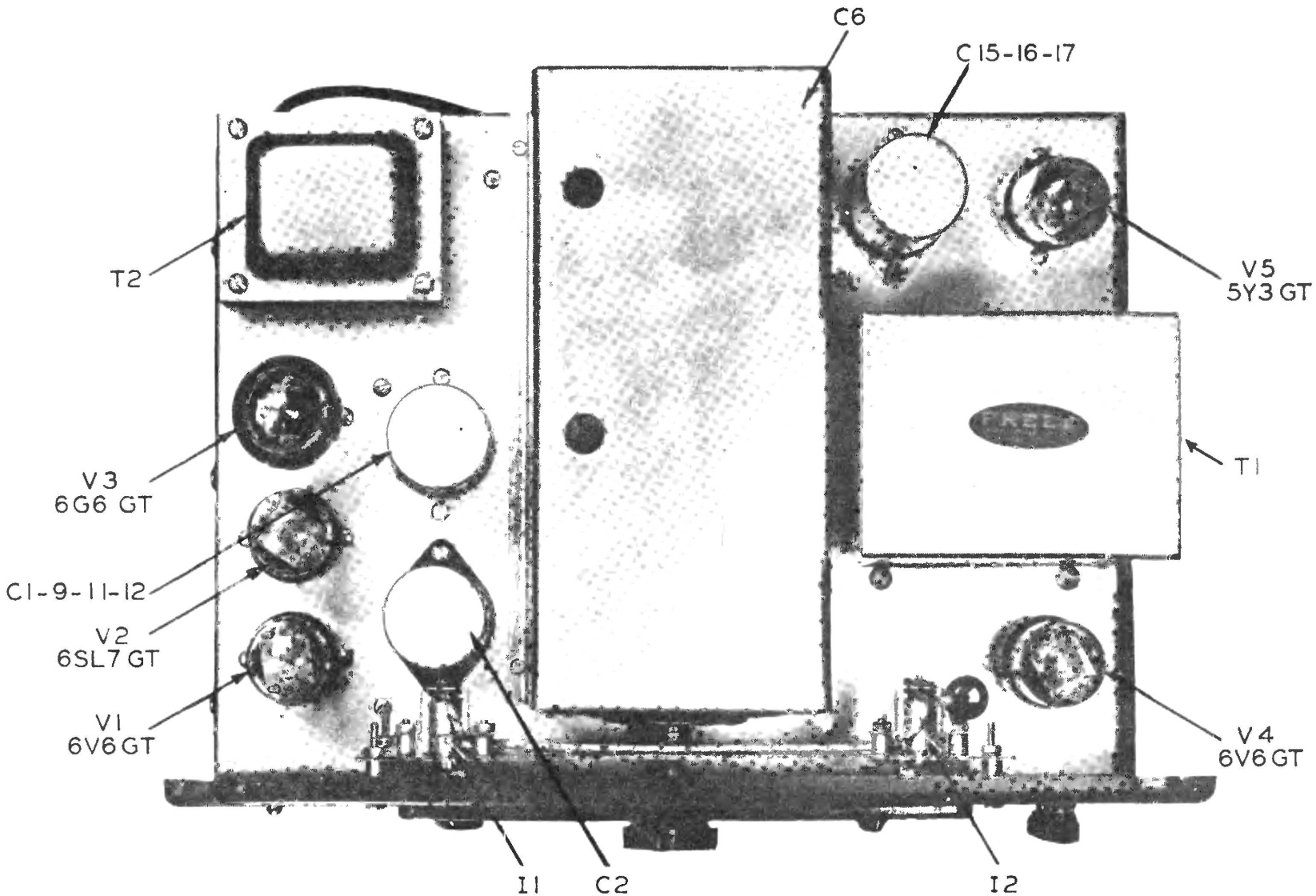
The curves below show the frequency response characteristics of the Model 655 Audio Oscillator. The transformer coupled output curves terminate at 20,000 cycles while those using resistive output cover the full range of the instrument.

It will be noted that the low frequency response is dependent upon the value of the load when using resistive output.

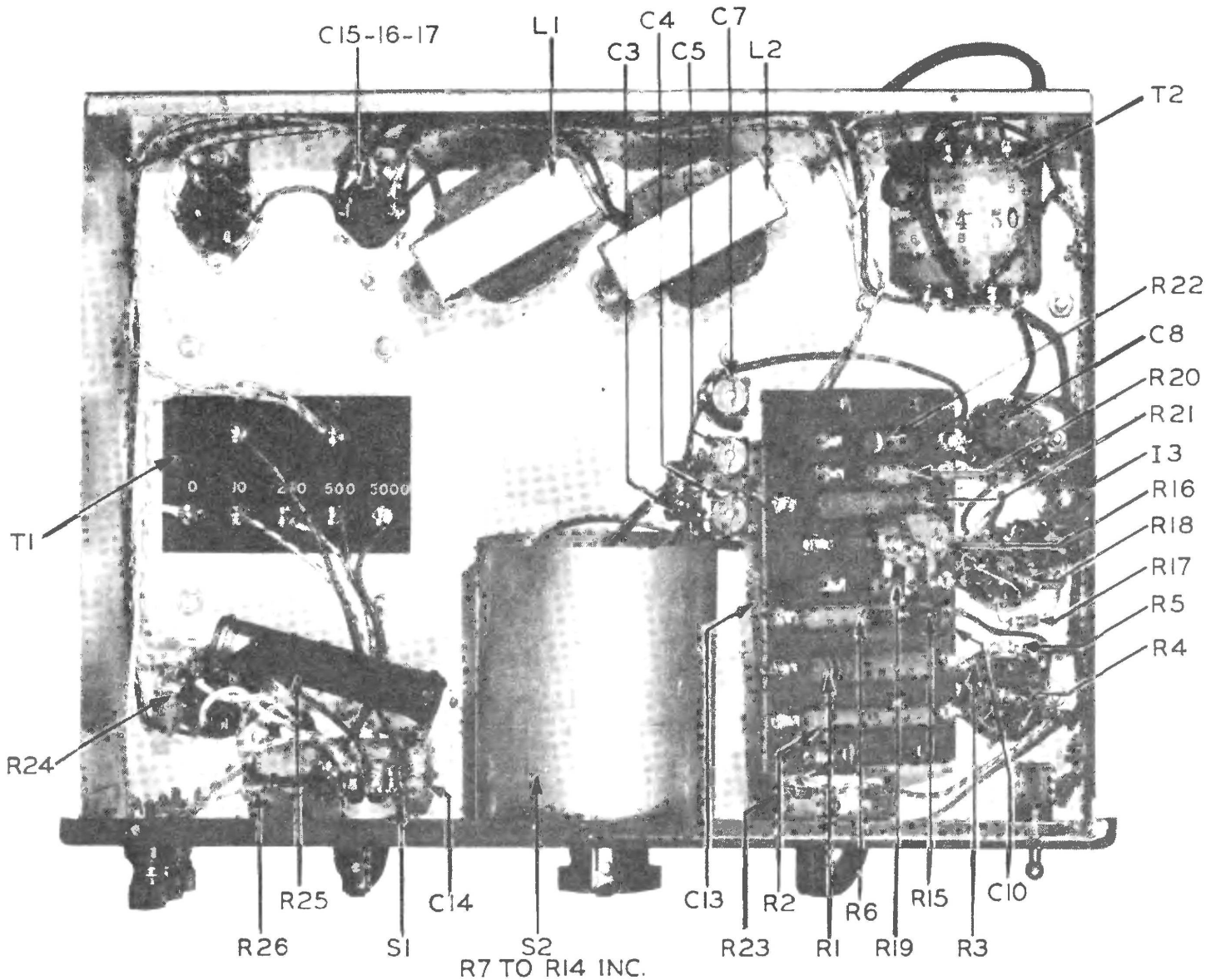
All curves were taken with the Output Control in the full on position. Slight variations may result in the 50 to 200 kilocycle region with reduced output applied to the load.

FREQUENCY RESPONSE CURVES

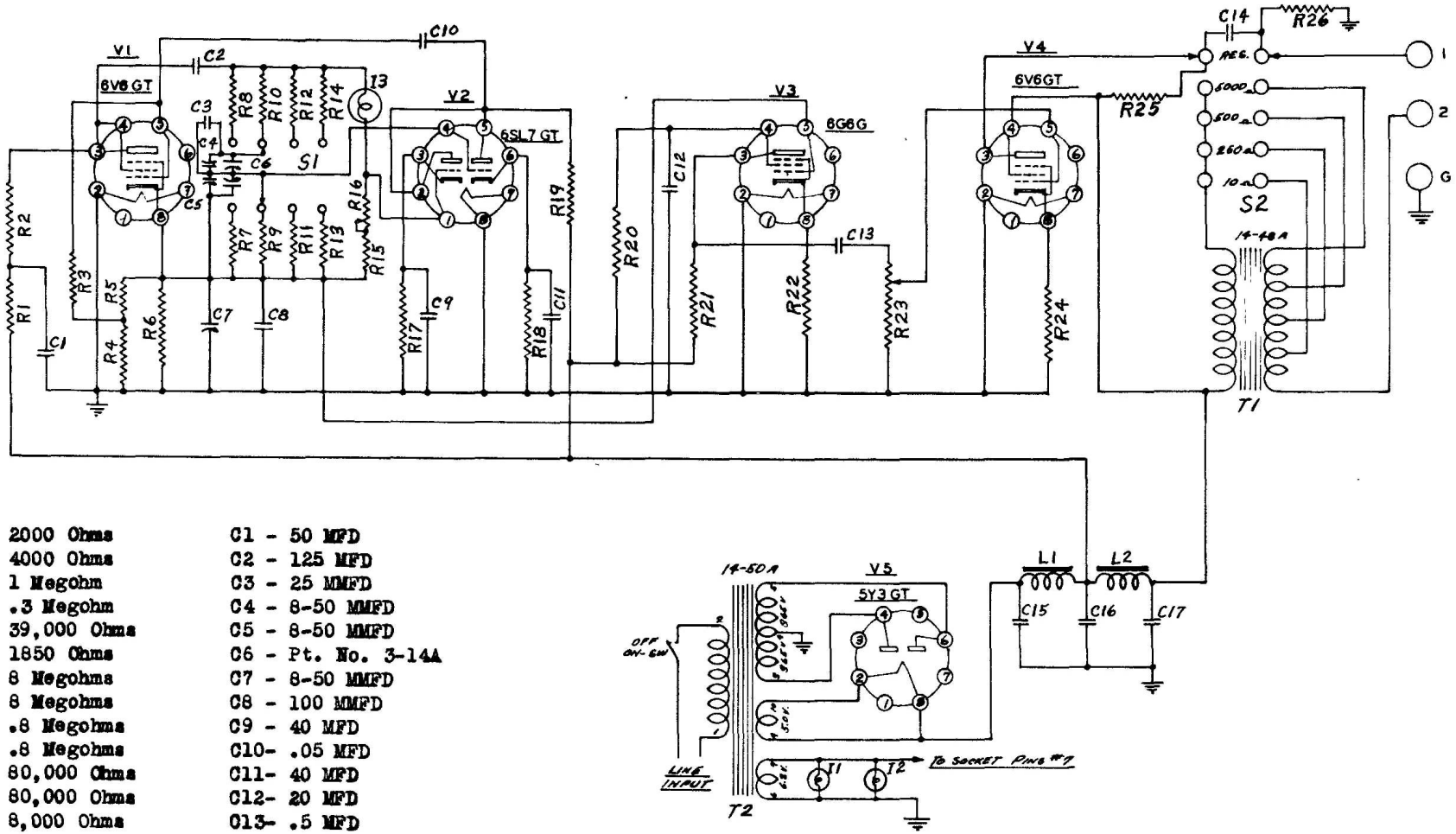




TOP VIEW OF CHASSIS



BOTTOM VIEW OF CHASSIS



R1 - 2000 Ohms
R2 - 4000 Ohms
R3 - 1 Megohm
R4 - .3 Megohm
R5 - 39,000 Ohms
R6 - 1850 Ohms
R7 - 8 Megohms
R8 - 8 Megohms
R9 - .8 Megohms
R10- .8 Megohms
R11- 80,000 Ohms
R12- 80,000 Ohms
R13- 8,000 Ohms
R14- 8,000 Ohms
R15- 680 Ohms
R16- 500 Ohms Adj.
R17- 75,000 Ohms
R18- 75,000 Ohms
R19- 62,000 Ohms
R20- 27,000 Ohms
R21- 7,500 Ohms
R22- 2,400 Ohms
R23- 50,000 Ohms
R24- 390 Ohms
R25- 5,000 Ohms
R26- 47,000 Ohms

C1 - 50 MFD
C2 - 125 MFD
C3 - 25 MMFD
C4 - 8-50 MMFD
C5 - 8-50 MMFD
C6 - Pt. No. 3-14A
C7 - 8-50 MMFD
C8 - 100 MMFD
C9 - 40 MFD
C10- .05 MFD
C11- 40 MFD
C12- 20 MFD
C13- .5 MFD
C14- .5 MFD
C15- 10 MFD
C16- 50 MFD
C17- 20 MFD
L1 - 10 Hy
L2 - 10 Hy
I1 - S-51 Lamp
I2 - S-51 Lamp
I3 - 3 W. Lamp
S1 - 2 Cir., 4 Pos. Range Sel.
S2 - 2 Cir., 5 Pos. Output Sel.
T1 - Pt. No. 14-48A Output Trans.
T2 - Pt. No. 14-50A Power Trans.

THE JACKSON ELECTRICAL INSTRUMENT CO.
DAYTON, OHIO

MODEL 655 AUDIO OSCILLATOR

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DRAWING NO. C-488	