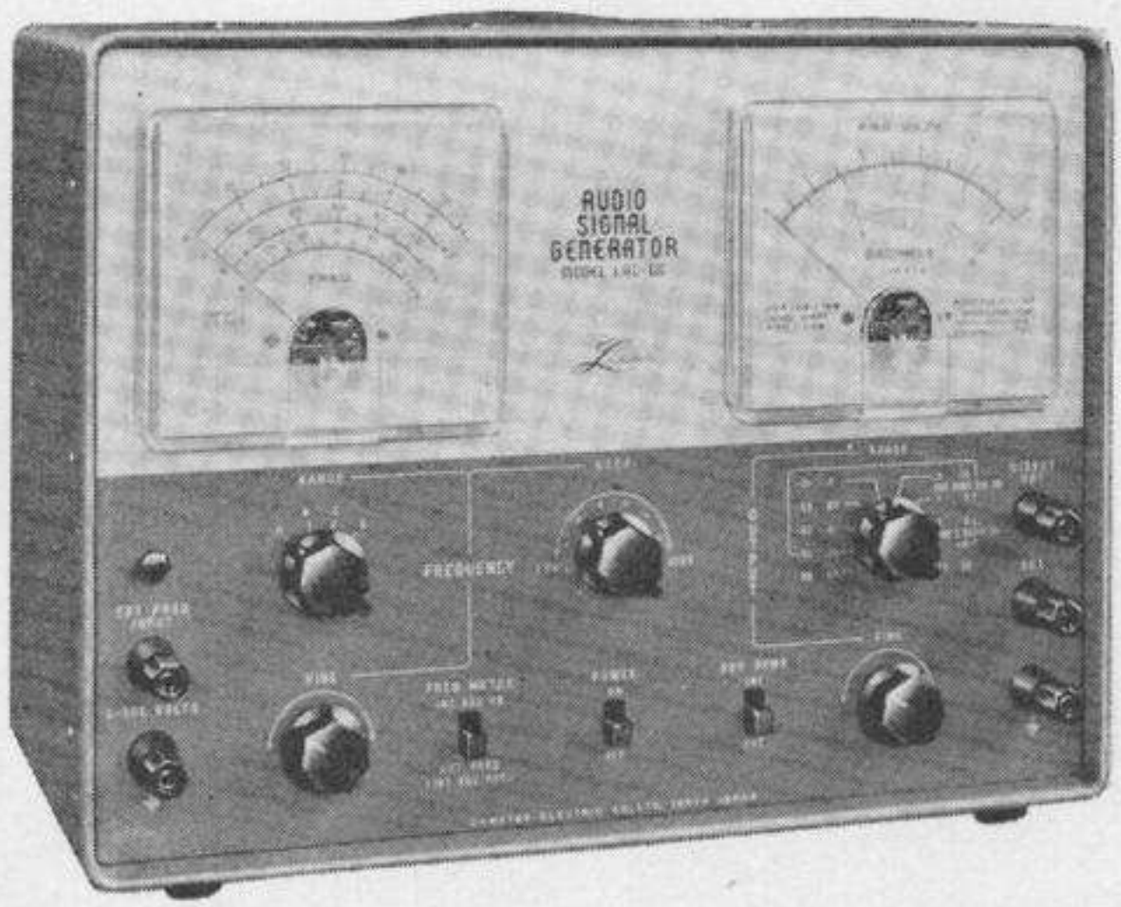
LEADER TEST INSTRUMENTS

MODEL LAG-66

AUDIO SIGNAL GENERATOR

OPERATING INSTRUCTIONS



OHMATSU ELECTRIC CO., LTD.

MODEL LAG-66

AUDIO SIGNAL GENERATOR

GENERAL

The Model LAG-66 has been designed, for use in the development laboratories, plant, educational institutions, etc., where a covenient source of known audio frequencies and voltages covering a wide range is required.

The generator is composed of a low distortion audio oscillator and a frequency meter. Two wide scale meters are used for frequency and output indications.

The audio frequencies are read on a 4-scale instrument. Frequencies are set by the range, stepped selector and fine adjuster.

The output voltage is determined by an accurate attenuator system and a voltmeter. The lowest scale reading is 0.0001 volt, or 0.1mV. Decibel scales are calibrated with 1 volt as reference for 0 db, and will be found useful for the gain and loss measurements in amplifiers, filters, etc.

The audio frequency meter can be used independently of the generator by connection to an external source for detemining the frequencies of oscillators, horns and other devices within its range.

The Model LAG-66 is manufactured for high performance standards, stability and troublefree operation.

SPECIFICATIONS

Oscillator

Frequency Range	11 to 110,000 cps in 4 decades
	10 steps per decade, with fine adjuster
Output Voltage	Continuously variable
	600 Ω load: 0 to 1 volt
	HIGH Z load: 0 to 10 volts
Attenuator	600 Ω: 6 10-db steps
	HIGH Z: 2 10-db steps
Output Impedance	600 Ω ±10%; HIGH Z, 3V: 800-1KΩ
	10V: 0-2KΩ
Meter	Voltage scales: 0-3V, 0-10V
	DB scales: −10 to 0 to +10 db
Meter Accuracy	Volts: ±5% full scale
	DB : within 0.5 db
Distortion	less than 0.3% : 20 to 20,000 cps
Frequency Stability	within 1% for ±5% line voltage change

Frequency Meter	
Range	10 cps to 110 kc in 4 ranges
Input Voltage	5 to 300 volts; sine or square
Input Impedance	200 KΩ, approx.
Meter	4 scales, one for each decade range
Accuracy	10 cps to 11 kc: ±(2% f.s. + 2 cps)
	11 to 110 kc: ±3% f.s.
Tube Complement	2-6AU6 1-6CL6 1-6AQ5 1-6AL5
	1-6X4 1-OA2
Power Supply	AC 50/60 cps; 100, 115 or 230 volts;
	65 VA
Size and Weight	360×230×185mm (14$\frac{1}{4}$×10$\frac{1}{2}$×7$\frac{1}{2}$ in. approx);
	8.5 kg (19 lb)

DESCRIPION

A block diagram of the LAG-66 is shown in Fig. 1

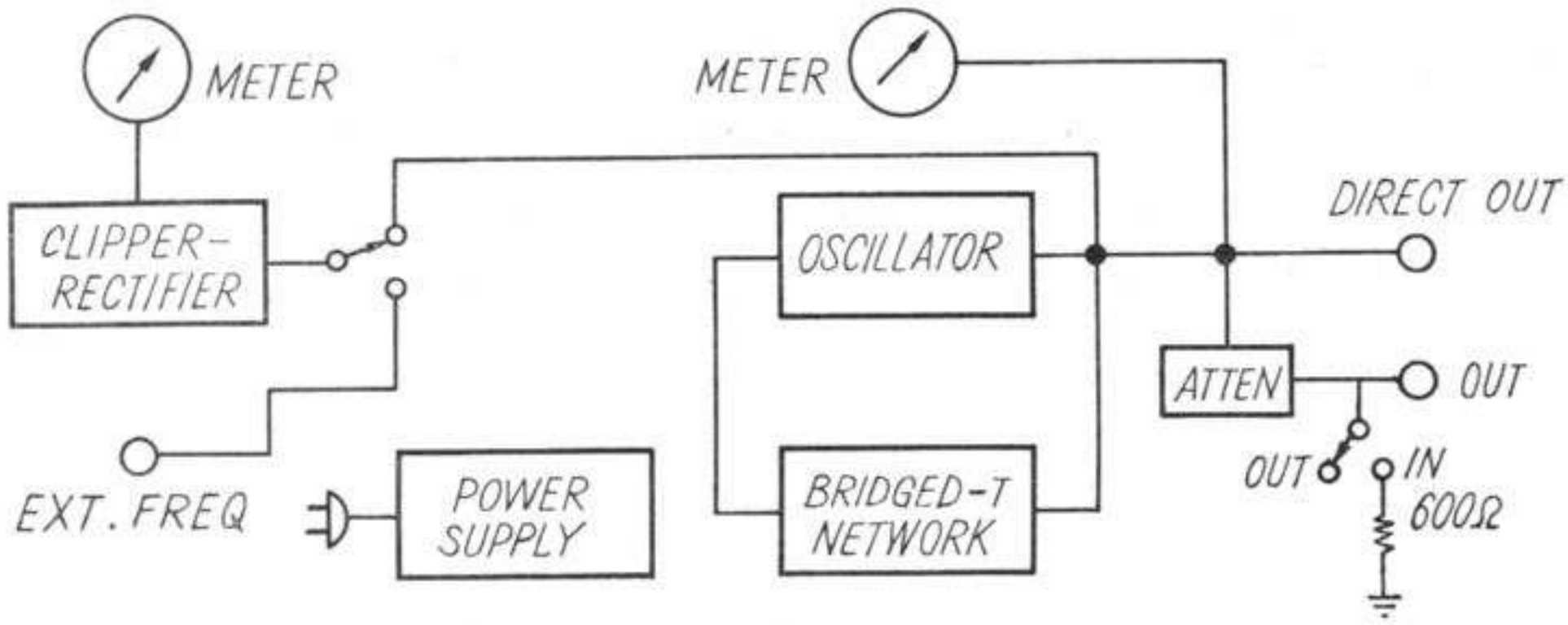


Fig. 1 Block Diagram, LAG-66

The oscillator is a bridged-T resistance-capacitance type which produces exceptionally pure waveform. A high gain 6AU6 stage is coupled to a 6CL6 cathode follower stage for a low impedance output. A positive feedback to the input is used to generate the oscillations and a negative feedback to limit the amplitude. A lamp is placed in the negative feedback circuit to stabilize the output level and further to pnrify the waveform.

The oscillator output is fed into an attenuator system to provide known voltages into the load. The voltages across the load can be read on the meter at the right by applying the range multiplier. The levels in decibels are determined in the similar manner.

A 6-step attenuator and a fine adjuster are used for the 600 Ω output control. The HIGH Z output for voltages up to 10 volts is controlled in two steps and by the fine adjuster. The overall output voltage range is 0 to 10 volts.

The generated frequencies are indicated on the meter at the left. Four scales are used, one for each decade. These ranges are set by the frequency range switch. A 2-stage clipper made up of a 6AU6 and

6AQ5 is used to feed the amplitude limited wave into a pulse forming network. These pulses are applied to the rectifier, a 6AL5, and a DC meter is used for counting the average number per second. The meter deflection is proportional to the signal frequency.

A 6X4 rectifier tube and a OA2 regulator are used for the plate supplies.

CONTROLS and TERMINALS

Frequency Setting.

The operating frepuency is set by the three controls, RANGE, STEP and FINE, and the meter at the left. The positions A, B, C and D of RANGE are for ranges corresponding to the meter dial readings. Each position covers one frequency decade. The STEP switch covers one decade in 10 fixed steps and the FINE adjuster is used for the closer settings. Very smooth and accurate frequency adjustments are possible.

Output Controls.

Output is adjusted by 2 controls, RANGE and FINE, and is indicated on the VOLTS-DB meter.

The RANGE switch is marked for outputs from .003 to 1 volt full scale for 600 ohms in 6 steps and up to 10 volts full scale in 2 steps.

The FINE adjuster controls the output from 0 to the RANGE level.

The terminals at lower left are for connecting the generator to the load.

The 600-OHM switch places the internal 600 Ω resistor on or out of the load circuit. At the EXT position, the generator impedance is 600 ohms, and 300 ohms (600 Ω source impedance in parallel with 600 Ω resistor at the INT position.

On the HIGH Z ranges, 0-3 and 0-10 volts, the output can be read directly from the meter scales.

Terminal D OUT is used for obtaining a high voltage (about 10V) into a high impedance load.

Detailed information on the various settings and loads are given in the following section on "Operation".

Frepuency Meter.

External frepuencies can be determined by setting the FREQ METER switch to EXT INT-OSC-OFF and connecting the source to the EXT FREQ terminals.

The frequency is read on the meter scale for the range in use.

OPERATION

The LAG-66 has been designed for use on AC 50 or 60 cps, 100, 115 or 230 volts. Make certain that the correct AC voltage is being supplied. Do not use on DC lines.

A typical equipment layout is shown in Fig. 2.

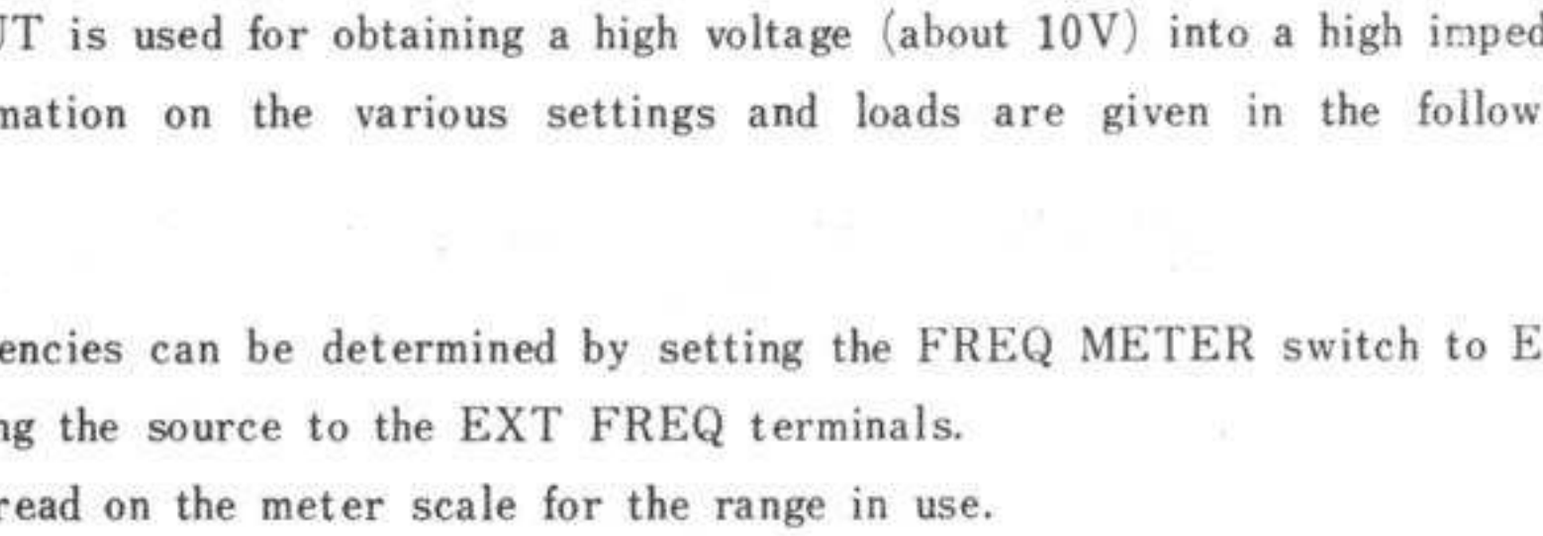


Fig. 2 Test Layout for Response Measurements

1. Set the controls as follows:
   A. OUTPUT FINE full counterclockwise.
   B. FREQ METER switch to INT OSC ON.
   C. 600 OHM switch to EXT.
   D. POWER switch to ON.
2. The pilot light will indicate that the generator is ready for use. Allow a 15-minute warm-up time.
3. Set to the desired frequency by adjusting RANGE, STEP and FINE, observing the frequency meter scale for the range in use.

Voltage and DB Settings.

There are four methods for obtaining the output from the generator, depending on the load impedance, as shown in the following table.

TABLE 1 Generator Output

	VOLTAGE	LOAD	600 OHM SWITCH	ATTENUATION
1	0—1 V	600 ohms	EXT	6-step + FINE
2	0—2 V	over 30,000 ohms	EXT	6-step + FINE
3	0—1 V	over 15,000 ohms	INT	6-step + FINE
4	0—10 V	over 10,000 ohms	EXT	2-step + FINE

1-A. 600 ohm Load (0-1V, −60 to 0 db)

a. When a 60 Ω load is connected to the OUT terminals, the output voltage is set by the RANGE switch and FINE adjuster. The 600 OHM switch is set to EXT. The ranges are shown in TABLE 2.

TABLE 2 Ranges for 600 Ω Load

RANGE (full scale)	SCALE	MULTIPLIER for SCALE
1 V	0—10	0.1
.3	0—3	0.1
.1	0—10	0.01
.03	0—3	0.01
.01	0—10	0.001
.003	0—3	0.001

Example: RANGE = .1
METER = 4.8V
Voltage = 4.8 × 0.01 = 0.048V

b. The output level in DB is determined by adding the RANGE DB to the meter indication. The red markings on the scale are used. Note that the values are minus (−).
A reference of 0 db = 1 volt is used in this generator for convenience. The ranges are shown in TABLE 3.

TABLE 3 DB Ranges

Switch Setting	Range db	Switch Setting	Range db
0	−10 to 0	−30	−40 to −30
− 10	−20 to −10	−40	−50 to −40
− 20	−30 to −20	−50	−60 to −50

The level is determined by adding the number of db on the meter to the RANGE DB.

Example: RANGE = −20
METER = − 8
Level = (−20) + (− 8) = −28 db

c. For tests on a 600 ohm load using a 0 db reference of 1 milliwatt, (0.774V), then 2.2 db must be subtracted from the indicated level. The 0 db reference for this case will be a −2.2 db on setting 1 of RANGE DB.

2-A. Loads over 30,000 ohms (0-2V, −54 to + 6 db)

For loads over about 30,000 ohms, output voltages from 0.0002V(200μV) to 2V are available from the generator.

The 600 OHM switch is set to EXT.

The voltage readings must be multiplied by 2 and for the levels +6 db must be added. (The internal impedance of the generator is 600 ohms, and since an "open" circuit operation is being employed, the output voltage is twice the loaded condition).

Example: RANGE = .1
METER = 5.0V
Voltage = (.01×5) × 2 = 0.1V
Level = (−20) + (− 6) + (+ 6) = −20 db

The error in the output voltage will be less than 2% for loads exceeding 30,000 ohms. For other loads, see TABLE 5 which lists the proper voltage multiplying factors and DB corrections.

3-A. Loads over 15,000 ohms (0-1V, −60 to 0 db)

The 600 OHM switch is set to INT. The readings for the voltages and db are taken direct from the range settings and meter indications. The values will be within 2% for loads over 15,000 ohms. Lower impedances will require corrections as listed in TABLE 5.

The generator impedance is now 300 ohms and if the load is 300 ohms, the voltage is 50% of the indicated values and the level is lowered by 6 db.

4-A. Loads over 10,000 ohms (0-10V, 0 to +20 db)

Voltages from 0.1 to 10 volts are available for loads exceeding 10,000 ohms at the HIGH Z ranges. The voltages are read directly from the meter scales. It will be noted that there are only 2 range steps and a fine adjusting control.

The following tables list the voltage and db ranges.

TABLE 4 HIGH Z Ranges

VOLTAGE	
RANGE	SCALE
3	0 — 3
1 0	0 — 10

DECIBEL	
RANGE	SCALE (Black marking)
0	0 to +10
+ 10	+ 10 to + 20

Examples :	RANGE	METER	LEVEL
	0	+6	+6 db
	+10	+6	+16 db

Care should be taken that the load is higher than 10.000 ohms. For lower impedances, it is recommended that a reliable AC VTVM be connected at the generator output for voltage measurements.

5-A. D OUT Terminal

The LAG-66 is equipped with a direct output oscillator connection. The purpose is to provide a high voltage source which is useful in the determination of phase shift, harmonic distortion and other characteristics with the use of an oscilloscope.

a. Phase Shift. The equipment layout is shown in Fig. 3.

Oscilloscope connections :

The D OUT terminal is connected to the vertical input.

Connect the amplifier output, across load resistor to the horizontal input.

Set horizontal selector to external input. The sweep, or timing, circuit is not used.

Operation.

Adjust the amplifier controls for flat response, and volume control to maximum output.

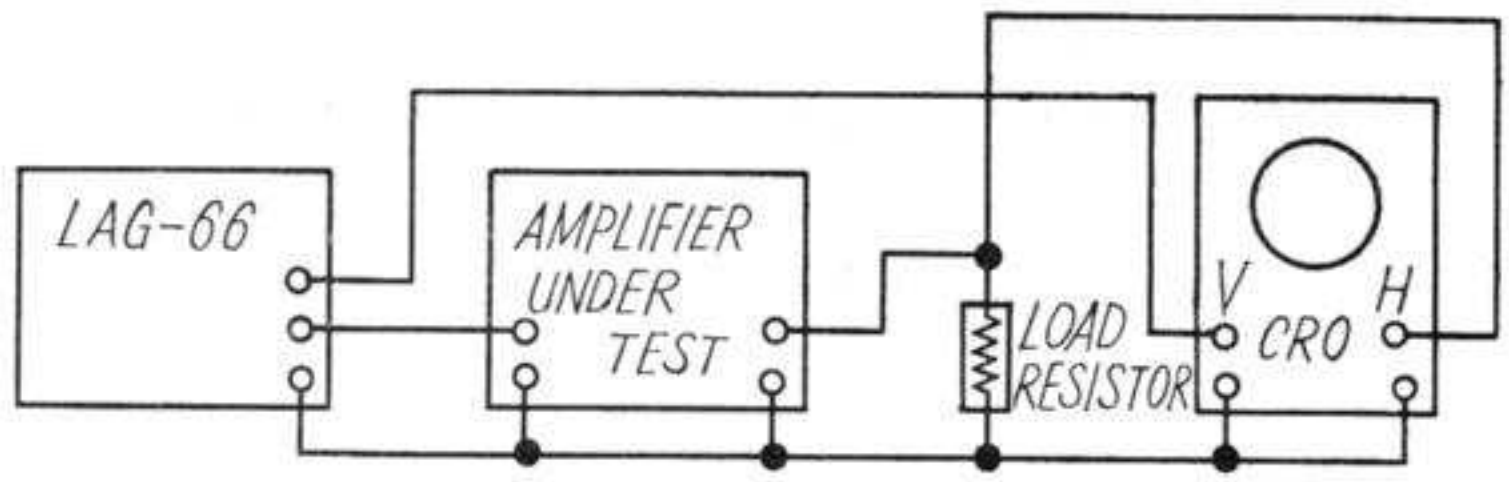


Fig. 3 Layout for PHASE SHIFT Observation

Set oscillator to about 1 kc.

Adjust oscillator output and oscilloscope controls so a 45 ° line trace is "fitted" on the graticule of the scope, Fig. 3-A. Lower the oscillator frequency gradually until an opened-out trace as shown in Fig. 3-B is observed. This indicates that there is a 90 ° phase shift, and the gain is 3 db less than at the midfrequencies.

Read the frequency meter for this −3 db point.

Next, raise the frequency slowly until a similar trace appears on the screen. Read this frequency, which is the point at which the gain has dropped 3 db at the high end.

This is a rapid method whereby amplifiers can be tested for the frequency response and gain. Other tests, such as the effects of volume control at different settings, speaker load, etc., can be quickly determined.

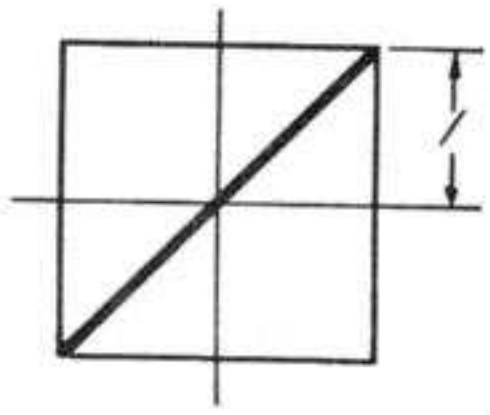


Fig. 3-A
Pattern at Mid-Freq

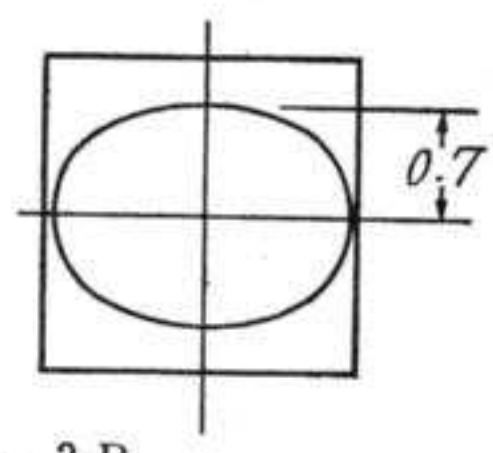


Fig. 3-B
Pattern at −3 db, 90°
phase shift

b. Harmonic Distortion. This form of distortion can be indicated by balancing the fundamental and observing the harmonic components visually. Full details are described in the book "AUDIO MEASUREMENTS" page 91 et seq) by Norman H. Crowhurst. This book is highly recommended to workers in the audio field for the comprehensive treatment of not only such measurements but also of allied subjects.

MEASUREMENT of EXTERNAL FREQUENCIES (11 cps to 110 kc)

1. Set the switch at lower left center to EXT INT OSC OFF. This cuts out the internal oscillator.
2. Set the FREQUENCY RANGE switch to the desired range as per meter scales as follows :

A	11 to 110 cps	C	1.1 to 11 kc
B	110 to 1,100 cps	D	11 to 110 kc

3. Connect the unknown frequency source to the terminals EXT FREQ. The input should be 3 volts minimum, and up to 300 volts maximum. The waveform must be symmetrical, and either sine or square waves can be applied.
4. Read the frequency on the meter scale.
5. If the frequency is not known, set the range selector to RANGE D, and lower the range until a suitable swing is obtained.
6. For frequencies below approximately 20 cps. there will be a certain amount of pointer vibration. The average indication must be taken.

TABLE 5 LOAD CORRECTION FACTORS FOR 600 OHM SWITCH POSITIONS, EXT or INT

EXT(see NOTES below)			INT	
Add db	Voltage Multiplier	LOAD, Ω	Add db	Voltage Multiplier
+6.0	2.0	OPEN	0	1.0
+5.9	1.98	60 K		.995
+5.8	1.96	30 K		.99
+5.7	1.94	20 K	−0.1	.985
+5.6	1.92	15 K	−0.17	.98
+5.5	1.88	10 K	−0.28	.97
+5.2	1.82	6 K	−0.4	.95
+5.0	1.78	5 K	−0.5	.94
+4.4	1.66	3 K	−0.83	.91
+3.7	1.54	2 K	−1.2	.87
+1.9	1.25	1 K	−2.3	.77
0	1.0	600	−3.5	.67
		300	−6.0	.50

NOTES : a. These figures can be applied directly to the meter readings since the factor "2" explained in Parag. 2-A has been included and likewise, the "+6" for db.

b. These figures apply to the LAG-66 meter calibration only.

Tube Voltages.

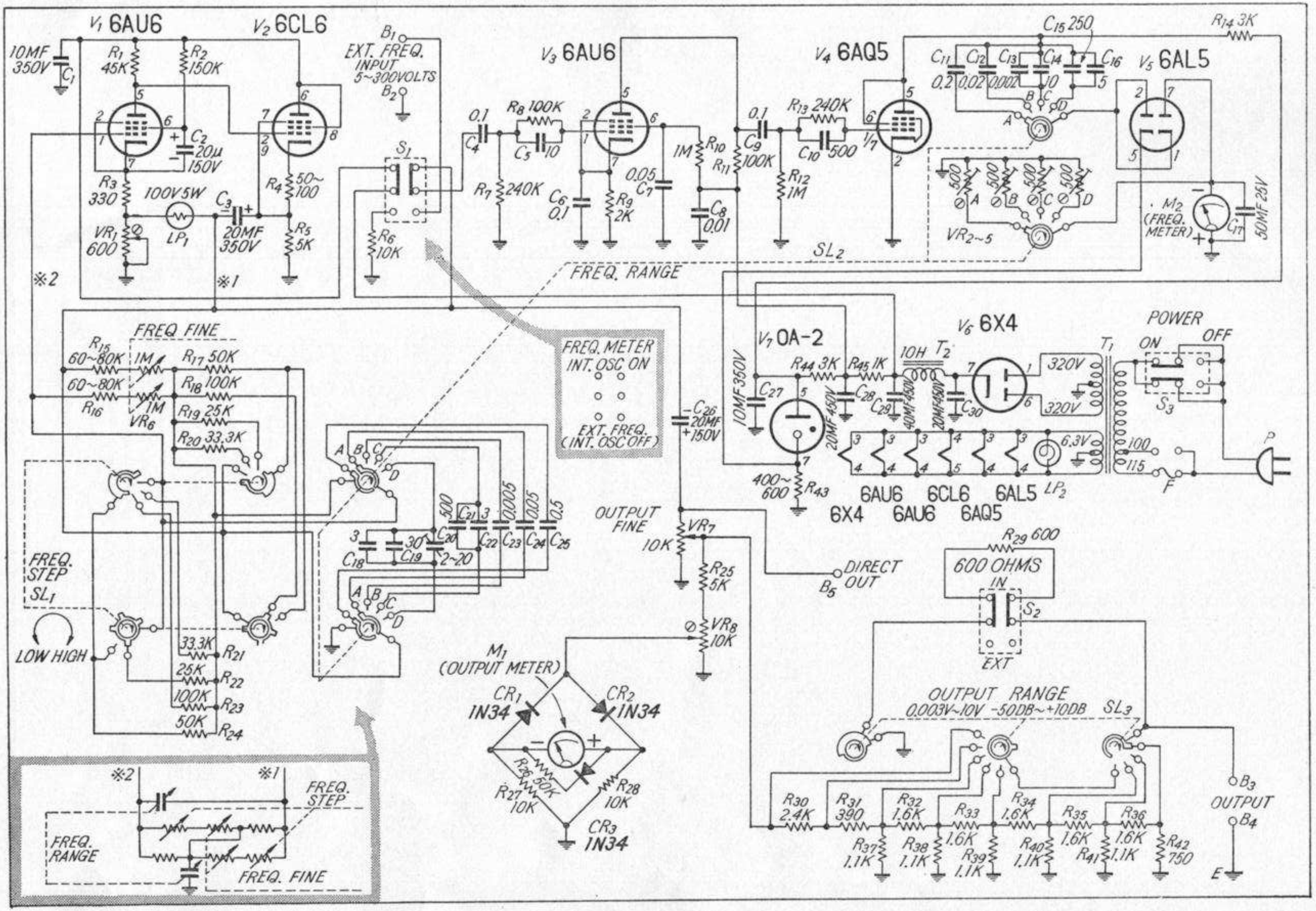
TABLE 6 gives the typical voltages at the pins of the vacuum tubes as measured with a DC VTVM at rated line voltage. These voltages should not vary by more than 15%.

TUBE	PIN 1	2	3	4	5	6	7	8	9
V1 6AU6	−1.5	−3	H	H	165	120	−3		
V2 6CL6	170	165	320	H	H	320	170	320	170
V3 6AU6	−8.5	−2	H	H	210	32	−2		
V4 6AQ5	−50		H	H	130	130	−50		
V5 6AL5	7.5	7.5	H	H	15				
V6 6X4	AC 290		H	H		AC 290	350		
V7 OA2					175				

Conditions : Generator set at 1,000 cps

Voltages are DC except AC and H, measured to chassis. "H" is AC 3 V.

LAG-66 AF SIGNAL GENERATOR



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Printed in Japan.