APPENDIX XII

MEASUREMENT OF VIBRATION NOISE, HUM, HISS AND MICROPHONY

1. GENERAL

This appendix describes amplifier-indicator systems suitable for measuring Vibration Noise, Hum, Hiss and microphony from valves.

The Noise, Hum and Hiss amplifier described in Clause 3, is basically a calibrated feedback amplifier system in which the valve under test forms the first stage. A calibration system is built in. For convenience, the test valve stage is in a small independent chassis unit, separate units being used for different valve types. The system can measure a wide range of amplitudes in the frequency range 50 c/s to 5 Kc/s.

The microphonic output from a valve subjected to impact in the equipment described in Appendix X, Section 2, shall be measured using an amplifier and peak to peak transient voltage indicator as described in Clause 4 of this Appendix.

2. MEASUREMENT OF VIBRATION NOISE, HUM AND HISS

2.1. Vibration Noise Measurement

The noise output from the valve under test shall be measured using an amplifier whose frequency response is 3 dB down on the mid-band gain at 30 c/s and 5.5 Kc/s, the response falling at the rate of approximately 6 dB per octave beyond these points. The amplifier described in Clause 3 below may be used.

2.2. Hum and Hiss Measurement

Hum shall be measured using the special feedback amplifier and indicator described in Clause 3 below.

Hum produced by the valve under test has two main components.

(a) Cathode Hum
(b) Grid Hum

These components are separately assessed by respectively short circuiting the grid resistor and capacitatively by-passing the cathode resistor. In addition, since the Hum components can be produced either by electro-magnetic or electrostatic coupling, each of the above measurements shall be performed by earthing each of the two heater connections in turn.

Hiss is measured under conditions which remove the Hum component by operating the heater on d.c. and at the same time short circuiting the grid resistor and by-passing the cathode resistor with a suitable capacitor.

3. FEEDBACK AMPLIFIER AND INDICATOR

This system is intended basically for the measurement of very low levels of hum and hiss but includes also an alternative condition in which the feedback is removed, making it suitable for normal levels of vibration noise. The amplifier is followed by a rectifier and moving coil type meter.

3.1. Amplifier Details

The Amplifier is intended primarily for the measurement of very low levels of Hum, Hiss and Vibration Noise but is also suitable for higher levels of audio frequency noise.

In the high sensitivity condition the amplifier shown in Figure 2 consists of V_2 and V_3, the valve under test, V_1, being arranged for convenience of operation, on a separate sub-chassis. The basic circuit arrangement for the valve under test is shown in Figure 1.

Overall feedback is applied in order that the readings referred to the input grid can be read directly and they will be unaffected by drift or by mutual conductance variations of individual valves under test.

The gain of the amplifier is adjustable in calibrated steps by means of S2 (Figure 2) which controls the feedback. Table 1 shows the sensitivities at various switch positions for one particular type of valve, namely CV4085. These sensitivities will not be applicable to other valve types but suitable circuit values will be shown in the appropriate valve specification.

For measurement of higher noise levels the output from the test chassis is injected into J1 (Figure 2), the maximum sensitivity then being 5 mV for full scale deflection.

The attenuator S3, which operates under both conditions shown above reduces the sensitivity by a factor of 10 or 100 according to the switch position.

3.2. Amplifier System Sensitivity

The figures shown in Table 1 represent the r.m.s. input voltage required from a sine wave source to give 0.4 full-scale deflection and these sensitivities will be satisfactory for the measurement of Hum and Hiss. For Vibration Noise a reduction of gain may be necessary.

TABLE 1

S2 POSITION	GAIN	R.M.S. INPUT
1	200,000	2 µV
2	100,000	4 µV
3	80,000	5 µV
4	40,000	10 µV
5	20,000	20 µV

3.3. Amplifier Frequency Response

The overall frequency response is selected according to the measurement being made. For low frequency Hum measurement, the high frequency Hiss component can be rejected by a simple low pass filter which is brought into circuit by S4 (Figure 2).

Two frequency characteristics are thus available, one for Hum and the other for Hiss measurement. During the latter measurement, introduction of a Hum component may be avoided if the heater of the test valve is operated on d.c. provided by an external accumulator and selected by S5 (Figure 2). A graph of the frequency response characteristic is shown in Figure 4.

3.4. Amplifier System Calibration

If close tolerance components are employed as indicated in the theoretical circuit diagrams and also as indicated in the specification for the test valve circuit, the overall gain in the high sensitivity condition should be within 5% of the indicated values as shown in Table 1.

The overall gain may be checked by means of the calibration input provided on the test valve sub-chassis. Application of a sinusoidal voltage of 0.5V r.m.s. at 1000 c.p.s. through 1 megohm to the test socket with S3 set to X1.0 and with full frequency response of the amplifier should give a full scale deflection of the meter in position 1 of Switch S2. The amplifier will read r.m.s., correctly but only for sine wave inputs, owing to the form of meter used. The use of this form of meter is desirable for the sake of robustness.

3.5. Amplifier Arrangement for Vibration Noise Measurement

The valve shall be operated at the specified frequency and acceleration whilst it is being held rigidly on the vibrating table with screened flexible leads making connection from the valve under test to the valveholder of the test valve sub-chassis operating under the specified circuit conditions. The output from the test valve chassis shall be connected through a short length of co-axial cable to the input Jack J1 on the main amplifier, the amplification at this point of the circuit being appropriately reduced. Since feed-back is removed when thus operating, re-calibration will be necessary with each individual valve tested using the injection socket of the test valve sub-chassis as before.

3.6. Amplifier Construction Details

The performance is critically dependent on the detailed layout of the sub-amplifier unit (Figure 3). A unit built closely to the design shown can be expected to give results in close agreement with those from the prototype, but it is recommended that a check be made with the equipment held at S.V.T.L. Haslemere.

The three basic circuits consist of:-

(a) Valve Test Circuit Unit 1. (Figure 1).
(b) Amplifier)
and) Unit 2 (Figure 2).
Indicator)

4. MICROPHONY TEST AMPLIFIER AND INDICATOR

This equipment consists of two main units:-

(a) Test Valve Unit.
(b) Peak to Peak Transient Voltage Indicator.

4.1. Test Valve Unit

This unit consists of a single stage with the valve to be tested connected as an amplifier. This circuit is mounted directly under the hammer unit in order to minimise lead length and also to allow easy modification of the circuit arrangement by inter-connection plugs for each valve type being tested. A suitable circuit will be given in the appropriate individual test specification.

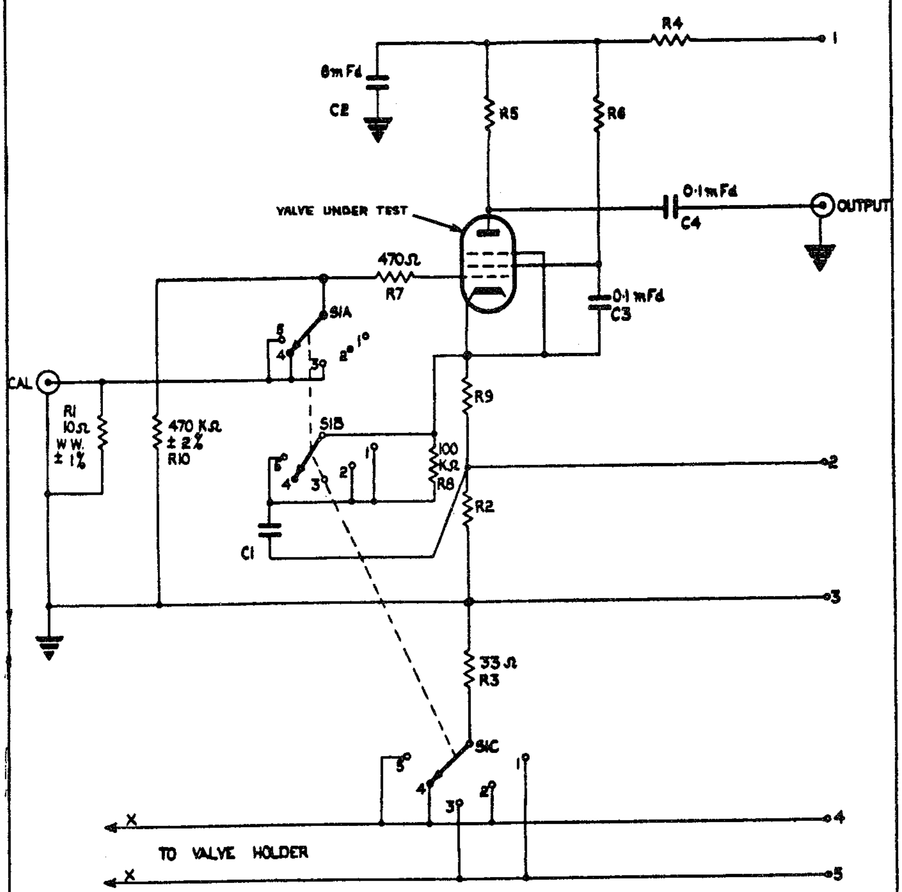
4.2. Peak to Peak Transient Voltage Indicator

In addition to a single stage amplifier and indicator, this unit contains a small stabilised power supply feeding both the unit and the test valve unit.

The peak to peak indicator consists of a single stage Pentode amplifier coupled into a phase inverter, the outputs from which are rectified and thus generate two d.c. voltages proportional to the peak of the positive and negative half cycles respectively to the applied waveform. These outputs are added in a double cathode follower the output of which feeds direct to the meter. The circuit arrangement ensures that the meter reading remains as long as the hammer operating switch is depressed. A suitable circuit is shown in Figure 5.

FIG.1 VALVE TEST CIRCUIT

(BASIC ARRANGEMENT FOR PENTODE)



Position 5 Hiss

Positions 1 & 2 Grid Hum

Positions 3 & 4 Cathode Hum

R2 Feedback Res. W.W., ±1%
R4 H.T. Dropper Res.
R5 Anode Res. H.S. Close Tol.
R6 Screen Res., H.S. Close Tol.
R9 Cathode Bias Res., H.S. Close Tol.

The value of these resistors depends on the type of valve being tested.

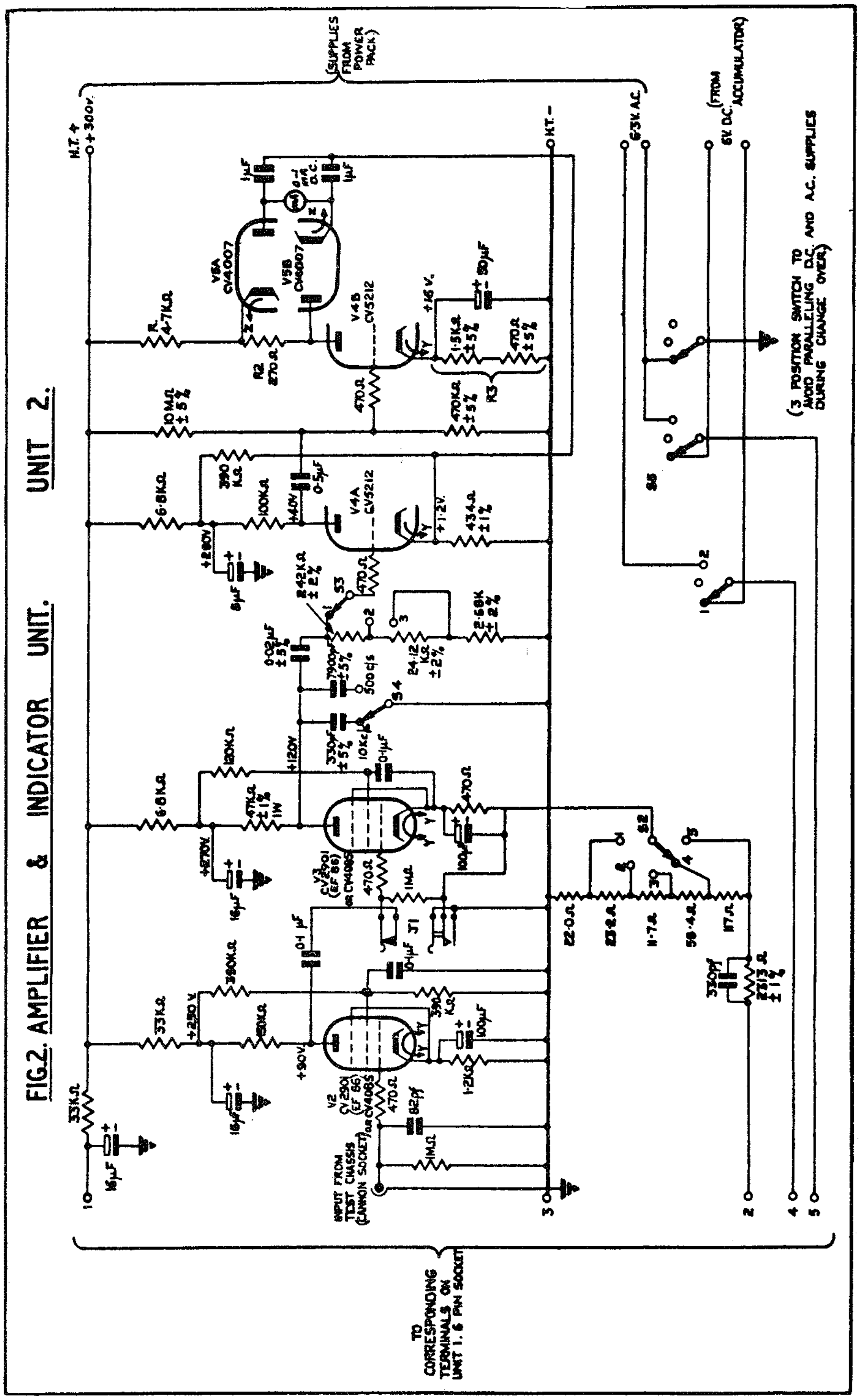
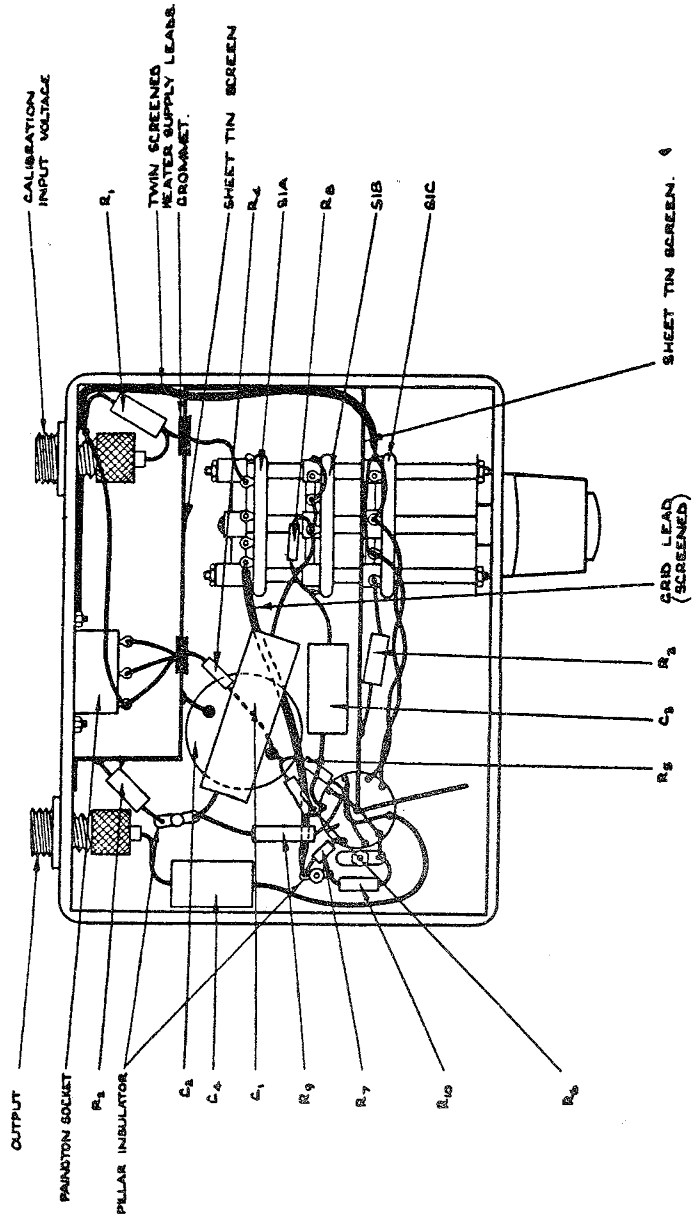


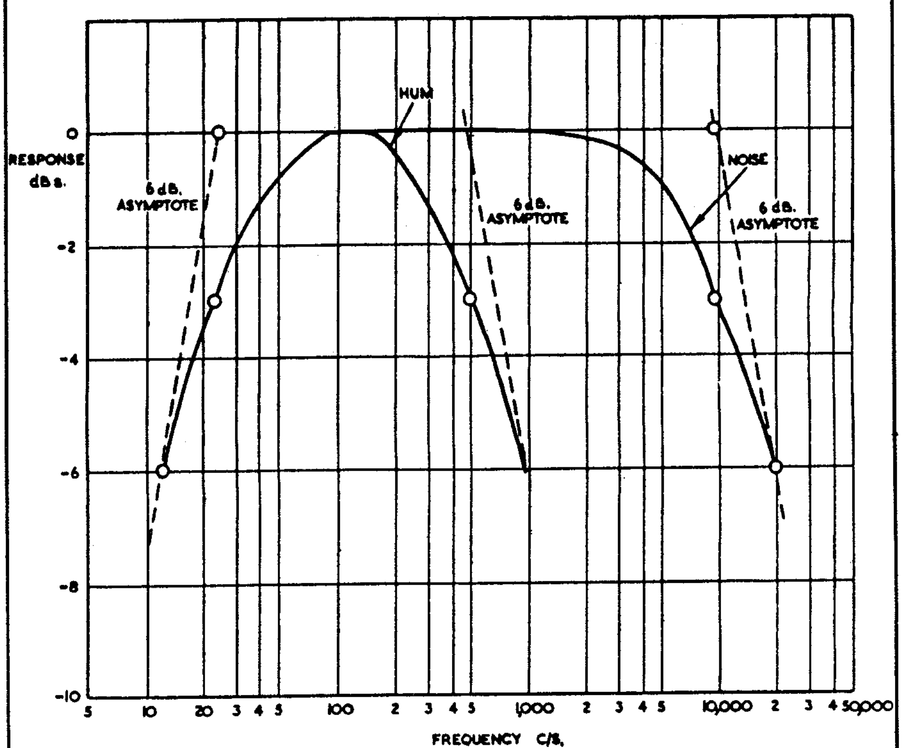
FIG.2. AMPLIFIER & INDICATOR UNIT. UNIT 2.

FIG. 3. WIRING & COMPONENT LAYOUT OF UNIT I.



AMPLIFIER FREQUENCY RESPONSE

FIG. 4.



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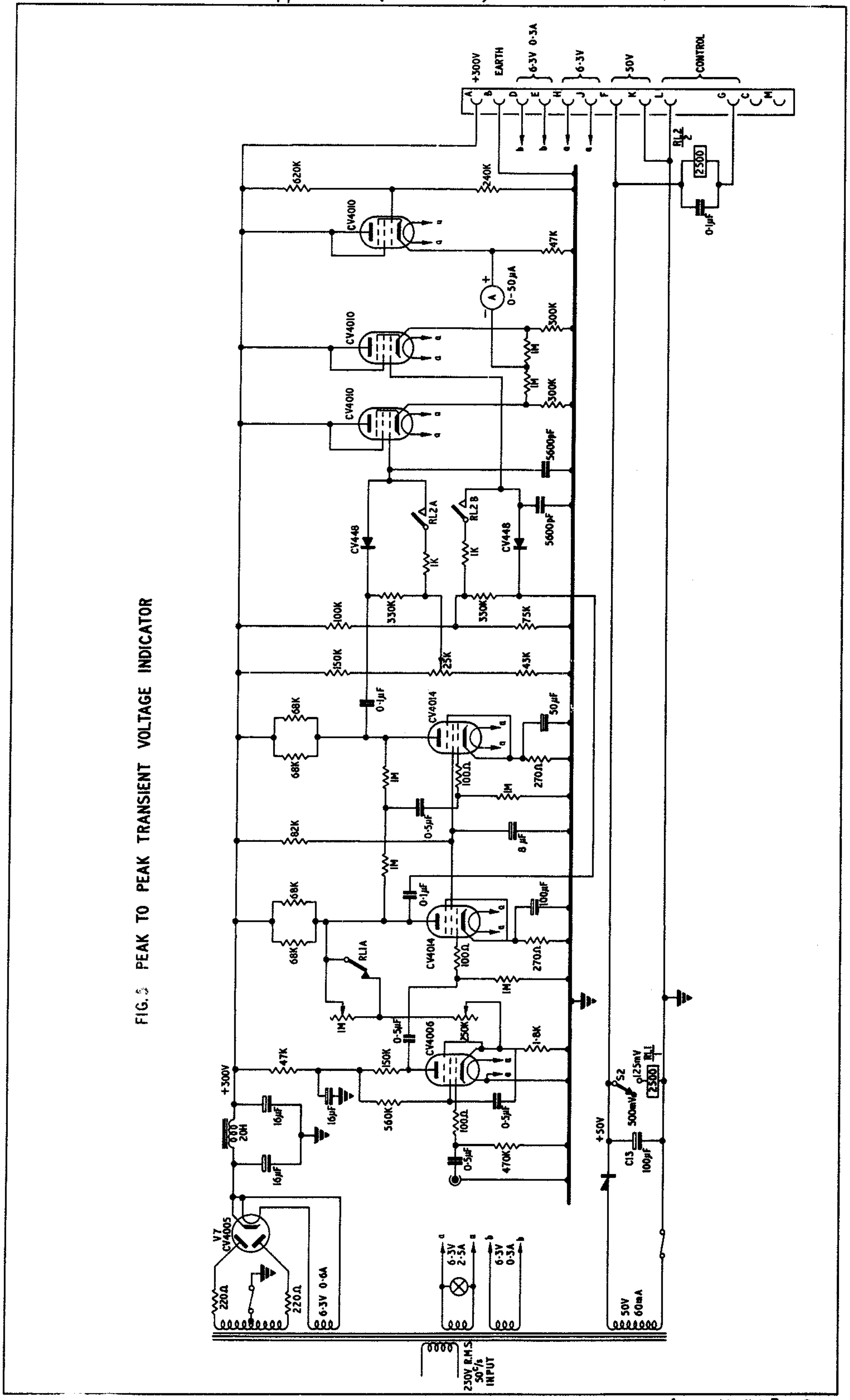

FIG. 3 PEAK TO PEAK TRANSIENT VOLTAGE INDICATOR