A Constructor's Oscilloscope

—A Construction of the Mullard Design

Part 2

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Chassis Construction

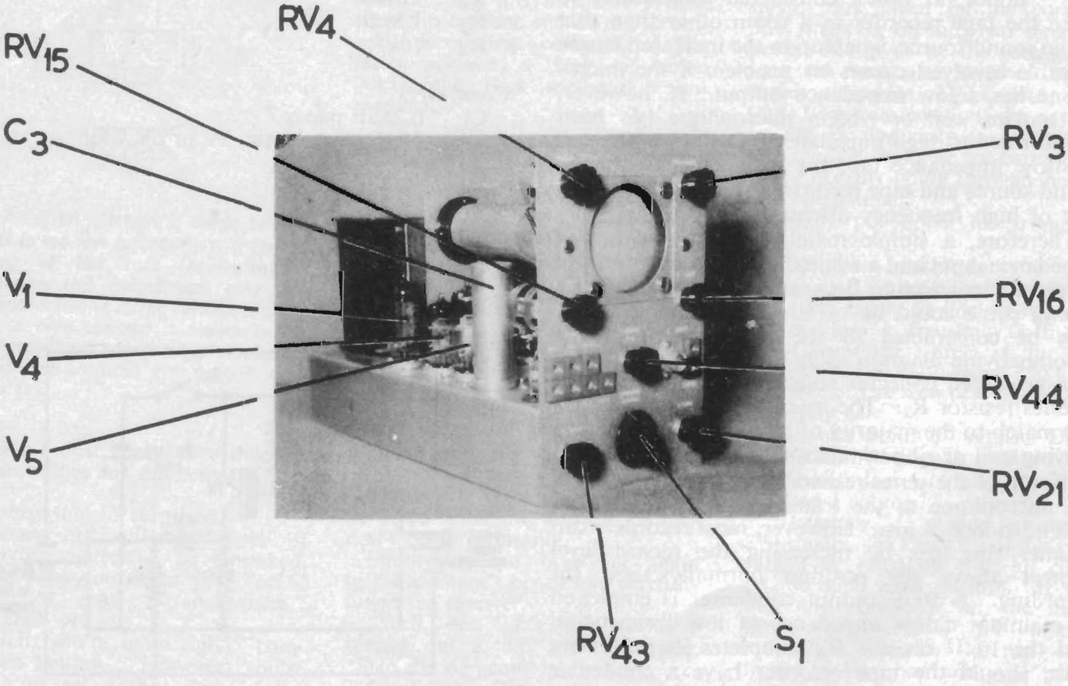
ALTHOUGH THE CIRCUIT IS NOT PARTICULARLY critical, care is needed in the layout and the wiring, the timebase and Y amplifier being kept as far apart as practicable.

The instrument is built on a conventional type of chassis 11 x 5 x 2in of 16 s.w.g. aluminium (Fig. 2). In order to prevent the trace being affected by the magnetic field of the mains transformer, this component is mounted at the rear of the chassis.

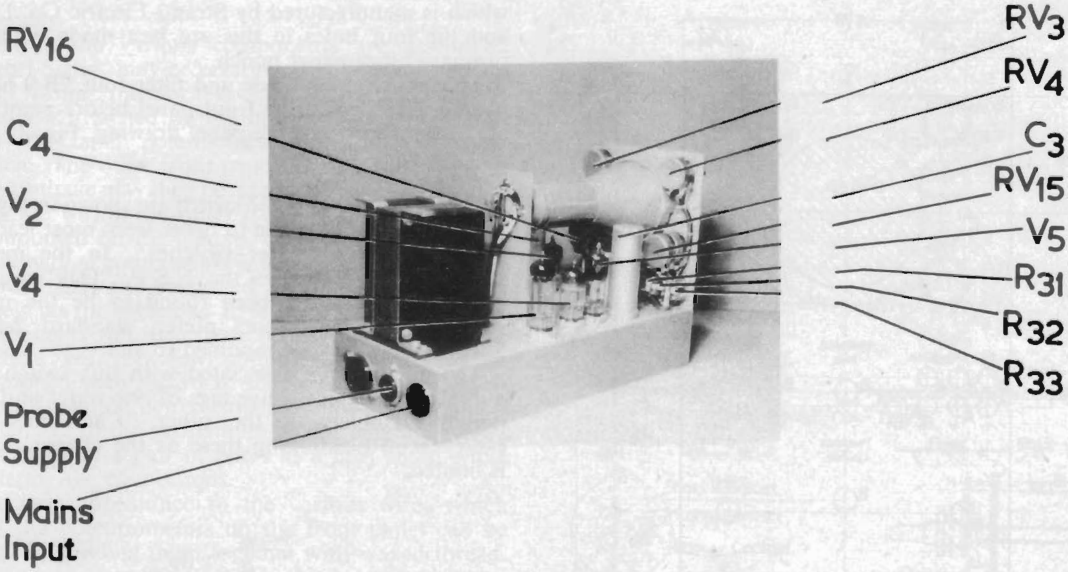
The positions and types of the various Bulgin tagstrips are indicated on the chassis drawing. For ease of assembly, the orientation of the valve holders is shown, the dots at the valveholder holes indicating the space between pins 1 and 9.

The front panel is made of 16 s.w.g. aluminium, and the drawing (Fig. 3) is similarly self-explanatory. The panel drawing also carries information with regard to the wording used and the positions of the Data Publications "Panel-Signs". No allowance has been made on the front panel for overlap to enable the oscilloscope to be fitted into a cabinet. If it is required that the instrument be fitted into a case, the necessary adjustments to the dimensions of the panel should be made to suit individual requirements.

The tube is fitted with a rubber mask and mumetal screen, and is supported front and rear. The front support consists of an aluminium ring riveted to two feet. The assembly is then screwed to the front panel. At the rear it is supported on a tube base mounted on a bracket. Full information of the tube mounting arrangements is given in Fig. 4.



Three-quarter view of front panel and chassis



Three-quarter rear view of the chassis with the main components being clearly designated

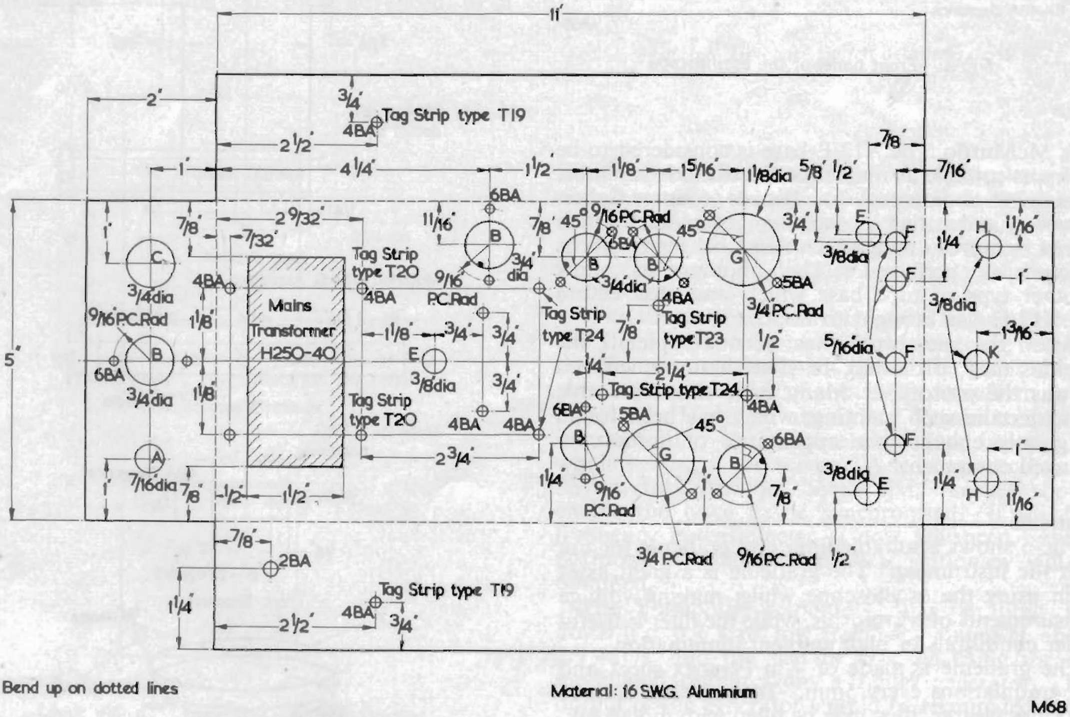


Fig. 2. Mullard oscilloscope chassis drilling dimensions. Key: A, Fuse holder (Belling-Lee type L575); B, Noval bases; C, Mains socket (Bulgin type P429); D, Westalite contact cooled rectifier; E, ⅜in rubber grommets; F, ½in rubber grommets; G, electrolytic condensers; H, potentiometers and K timebase switch S1a, S1b

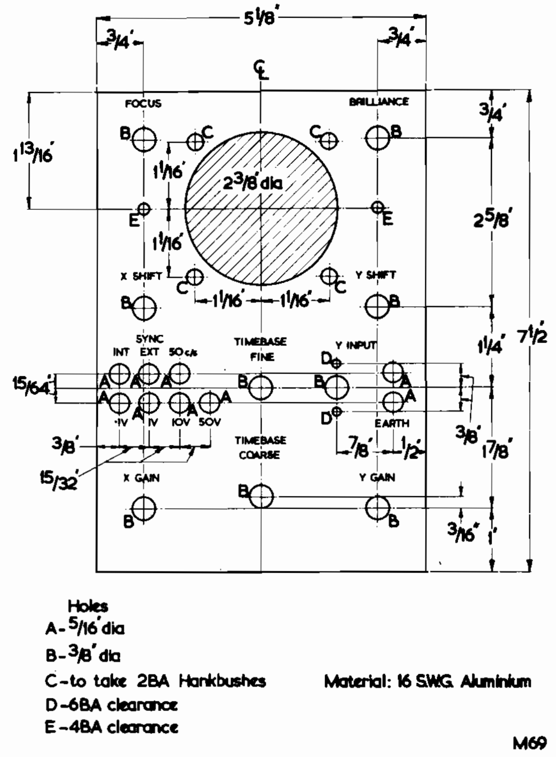


Fig. 3. Front panel of the oscilloscope

A McMurdo type X12/E base is considered to be the most suitable available for the cathode ray tube. This base is intended for decade counter tubes, however, and it has a central spigot contact which is not required, and which may be sawn off or ignored as preferred. The photographs show another type of tube base which was used before the X12/E was brought to notice.

After the metalwork has been completed the sections may, if desired, be silver-hammer sprayed as was the prototype. Many cycle shops are able to undertake such painting, which has been found to greatly enhance the appearance of home constructed equipment.

Graticule

Fig. 5 shows a suitable filter and graticule for use with the instrument. The graticule is a great asset when using the oscilloscope whilst making voltage measurements of waveforms, while the filter is useful under conditions of high ambient illumination.

The graticule is made of $\frac{1}{16}$in Perspex sheet and has gradulations every 5mm. To make the scribed markings clearer, they may be filled with indian ink, the surplus of which can be wiped off after it has dried.

The green filter is recommended if the oscilloscope is to be used in daylight. It is made of green gelatine which is manufactured by Strand Electric Co. Ltd., and the four holes in this are best made with an ordinary office paper punch.

To retain the graticule and filter four 2BA hank bushes are fitted to the front panel before painting, as can be seen from the panel drawing, Fig. 3.

Timebase Switch

Details of the timebase switch are shown in Fig. 6. The switch can be made to order from most leading manufacturers of wafer switches. In the model shown, the switch uses the N.S.F. "Oak" wafers type H, which have been found to be the most suitable. If constructors prefer, standard 2-pole 5-way wafers may be modified to suit.

The components associated with this switch are mounted between the live tags of one wafer and the dummy contacts of the other. Care must be exercised in positioning these as the chassis depth is limited.

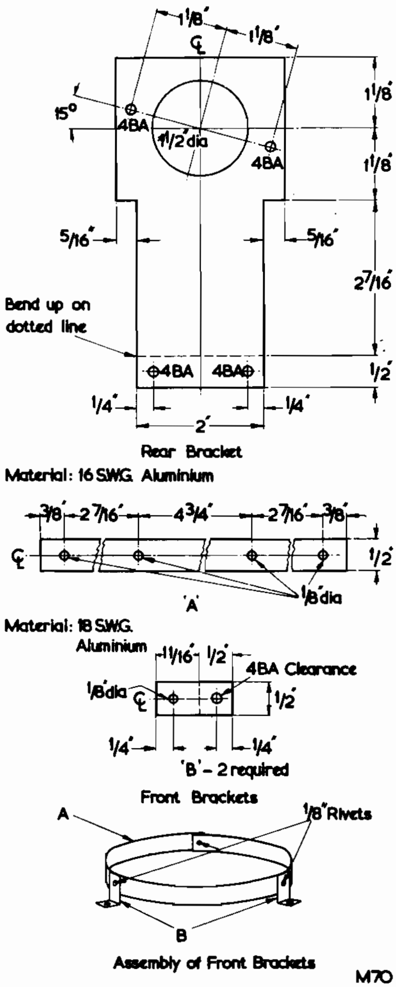


Fig. 4. Tube mounting brackets

Assembly

Before the various components are assembled "Panel-Signs" may be positioned on the front panel. After fitting the sockets to the front panel, the chassis is attached by the bushes of the "X-Gain" and "Y-Gain" potentiometers and the timebase switch. The other front panel control, tube support and graticule may then be fitted. Before commencing with the wiring the other fixed components should be mounted on the chassis. Although the position of individual components is not critical, it is recommended that the suggested layout be followed as closely as possible, as it will be found that the components will then more readily fall into place.

There are very few points which need to be mentioned with regard to the wiring of the instrument. It should be remembered that the prevention of damage to the germanium diodes can be ensured by the use of a pair of pliers as a heat shunt while soldering the connections.

A neat appearance to the various wires which feed the potentiometers on the front panel can be given by binding them together with waxed thread.

The lead from the EF80 timebase oscillator valve (V5) to the potentiometer (RV_{43}) should employ screened wire to avoid spurious hum pick-up.

Performance Checking

The brilliance control should be turned to a minimum before switching on, then advanced to a suitable level after a sufficient time has elapsed to permit warming up. The trace may then be focused, and the X-gain control should increase its length when turned clockwise. Similarly, movement of the shift control should displace the trace in the appropriate directions.

With the timebase controls turned to their extreme low-frequency positions, a lead connected between the Y-input and the 1-volt calibration point should permit several cycles of the 50 c/s waveform to be displayed. Upon advancing the Y-gain control to its maximum, the trace should just occupy the whole height of the screen. A lead connecting the "Sync. Int." to the "Sync. Ext." socket should enable the trace to be synchronised. If the fine frequency potentiometer is now advanced, several positions at which the trace is stationary will be obtained.

The Y-amplifier response should be about 3dB down (i.e. 0.7 x its low frequency value) at about 2.5 Mc/s, and this can be checked using the unmodulated output from a signal generator. The output of the generator should be terminated by an 82Ω resistor and connected to the Y-input socket. With a suitable output level from the generator, and the Y-gain set at maximum, the trace should not shrink to less than 0.7 of its value at 300 kc/s when the frequency is increased to 2.5 Mc/s.

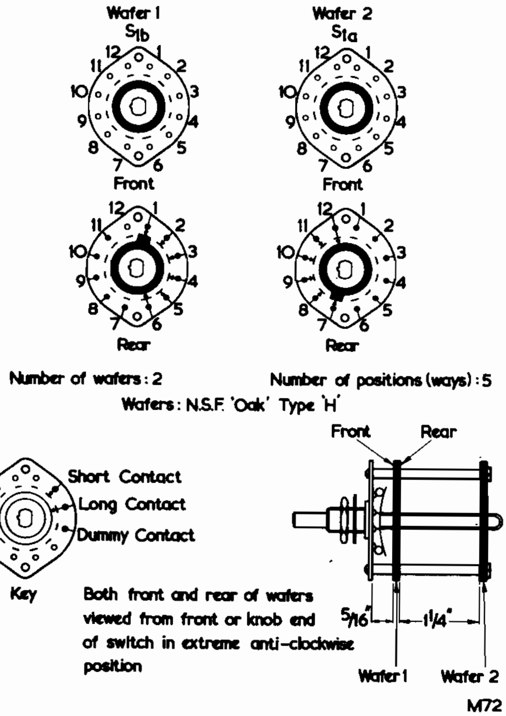


Fig. 6. Timebase switch details S_{1a}, S_{1b}

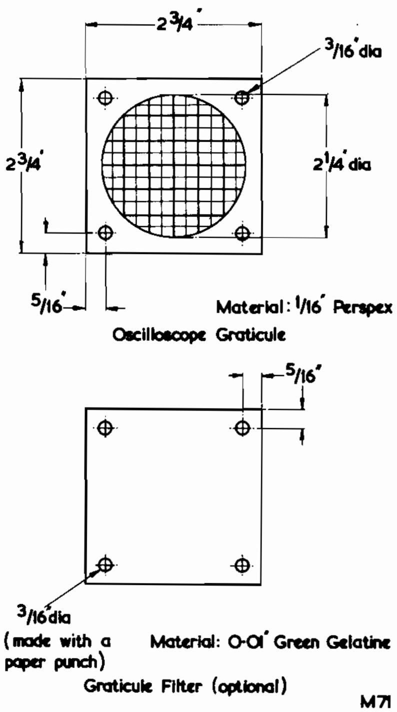


Fig. 5. Oscilloscope graticule and filter

If the oscilloscope passes these tests, its performance may be deemed satisfactory; but to assist in diagnosing possible faults, the voltages measured at various points in the circuit are set out herewith.

Voltage Table

	Meter Reading (Volts)	Meter Range (Volts)
V_1 cathode	310	1,000
Junction R_6–C_3 ..	300	1,000
Junction R_7–C_3 ..	300	1,000
Junction R_8–C_4 ..	200	250
Junction R_9–C_4 ..	105	250
CRT a_1, a_3 (pin 8) ..	310	1,000
CRT a_2 (pin 4) ..	−100	250
CRT g (pin 2) ..	−240	250
CRT k (pin 3) ..	−200	250
V_2 k_t (pin 8)	41	100
V_2 a_p (pin 6)	81	100
V_2 k_p (pin 7)	1.5	10
V_3 a_p (pin 6)	166	250
V_3 k_p (pin 7)	3.1	10
V_3 a_t (pin 1)	125	250
V_3 k_t (pin 6)	75	100
V_4 a′ (pin 6)	120	250
V_4 a″ (pin 1)	115	250
V_5 a (pin 7)	150	250
V_5 g_2 (pin 8)	215	250
V_5 g_3 (pin 9)	50	250

The above readings were taken with the timebase running at 50 c/s and with no input to the Y-amplifier. The brilliance and focus controls were adjusted to give a normally focused trace. They are typical of the values which may be encountered; but some variation is to be expected.

These voltage measurements were taken with an Avometer model 8 (resistance 20,000 ohms per volt).

(To be continued)

Answers to Valve Codes (*see page* 57)

GZ32	5 volt full wave rectifier, octal base (Mullard).
X78	Frequency changer. (Marconi).
1T4	1.4 volt, 4 electrode. (American.)
6D2	6.3 volt diode. (Mazda.)
PCF80	0.3 amp, triode-pentode, B9A base. (Mullard.)
UU8	Full wave rectifier. (Mazda.)
12AX7	12.6 volt, 7 electrode. (American.)
KTW61M	Variable-mu, metallised pentode. (Marconi.)
EABC80	6.3 volt, triple diode triode, B9A base. (Mullard.)
6SK7G	6.3 volt, single ended, 7 electrode valve with large glass envelope. (American.)
N66	Output pentode. (Marconi.)

A small Bass Reflex Enclosure suitable for the "Axiette" loudspeaker

by M. J. PITCHER, B.SC.

IT GOES WITHOUT SAYING THAT A GOOD AMPLIFIER deserves a good loudspeaker, yet how many constructors give their speaker as much priority as the rest of the equipment in their budget? There is no doubt that a good loudspeaker with almost any amplifier may sound better than an inferior one with the very best system. There is, in consequence, a good case for considering the speaker before building, or buying, the associated amplifier.

Economy is the factor which generally weighs against the provision of a satisfactory speaker system; considerations of cost, size, performance, and decorative value are bound to conflict on a tight budget—so why not build your own?

The main problem with Hi-Fi reproduction is to produce sufficient bass of reasonable quality and the enclosure described in this article meets this requirement very effectively. The Axiette speaker* was chosen for the enclosure because of its wide frequency range, but methods of adapting the enclosure for other speakers will be explained.

Construction

The form of construction is to screw pieces of wood all round two large panels, which then become the top and bottom of the enclosure. (Fig. 1.) The pieces of wood are set in by their thickness so that, when finally assembled, the enclosure has great rigidity. The joints can be glued if desired, but do not glue the back in position because it may be necessary to make an alteration to the interior some time later.

The $\frac{3}{8}$in plywood panels specified in Fig. 1 may seem to be too thin to keen students of Hi-Fi literature, but prolonged listening tests have shown that the material can be recommended without reservation. Liberal use of screws is, however,

* The Axiette speaker is manufactured by Goodmans Industries Ltd., Axiom Works, Wembley, Middlesex.