A Constructor's Oscilloscope

—A Construction of the Mullard Design

Part 3

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I. High Impedance Attenuator Probe

THE VERY SIMPLE CIRCUIT OF THIS, TOGETHER WITH constructional sketches, is shown in Figs. 7 and 8. The small trimmer is provided to balance the capacity of the coaxial lead, which should be of the specified length. In the prototype, this trimmer was made from a miniature air-spaced type with rotary moving vanes, and consisted of one fixed and one moving vane.

Construction

The probe is built around standard Neosid coil components. Firstly, the central portion of the coil former is filed away leaving a piece of semi-circular cross-section supporting the top end, in which a $\frac{1}{8}$in hole is drilled as shown. A standard brass core is drilled through its axis to take the prod of $\frac{1}{16}$in

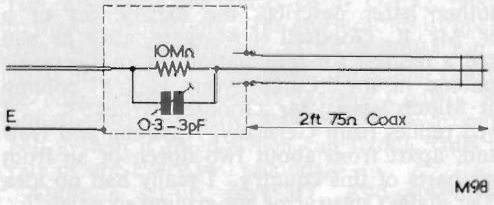


Fig. 7. High impedance attenuator probe

Components List
(High Impedance Attenuator Probe)

1 10MΩ resistor 10% $\frac{1}{4}$ watt
1 Trimmer 0.3–3pF (see text)
1 Former assembly, Neosid 5000B, complete with insulated top plate
1 Brass core (to fit former assembly)
1 Crocodile clip (Bulgin)
1 Coaxial plug (Belling-Lee L734/P)
75Ω Coaxial cable (2ft)
$\frac{1}{16}$in brass rod, screws, etc.

brass rod, which may either be sweated in or made a tight fit. A radial hole in the core is drilled and tapped 6BA such that, with the core screwed flush

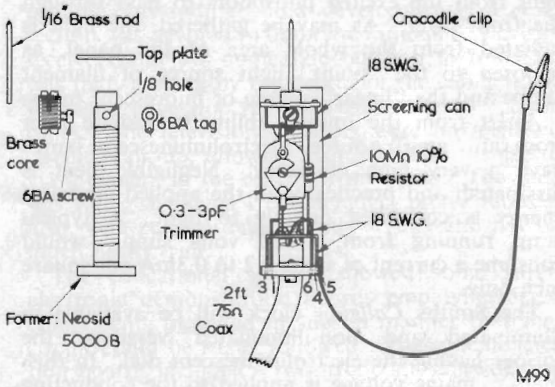
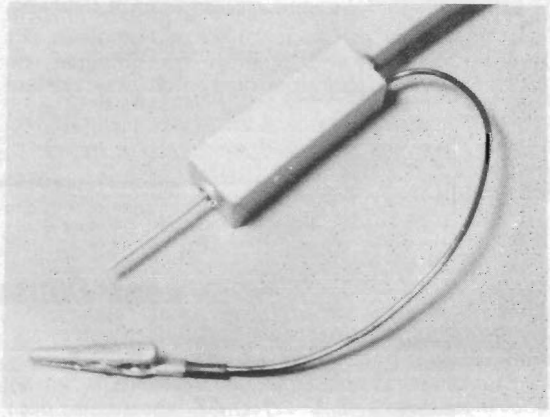


Fig. 8. Construction details of the high impedance attenuator probe (see text)

with the end of the former, a 6BA screw may be fitted through the former to retain it, a solder tag being provided for the electrical connection.

The top plate is fitted in position and three pieces of 18 s.w.g. tinned copper wire are bent and fitted into the spill holes of the top plate and base as shown.



The high impedance attenuator probe

The components may then be soldered in position. An earth lead fitted with a crocodile clip is taken from the earth spill through one of the spare spill holes. The coil can is earthed by means of a piece of copper foil, cut to a suitable shape, which is soldered to the earth spill and bent under the former

Components List
(High Gain Probe)

Resistors

R_1	470kΩ ¼W 10%
R_2	47kΩ ¼W 10%
R_3	470kΩ ¼W 10%
R_4	1.5kΩ ¼W 10%
R_5	120kΩ ¼W 10%
R_6	470kΩ ¼W 10%

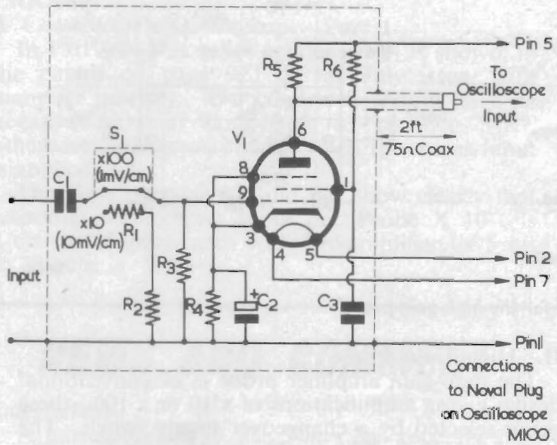


Fig. 9. Circuit diagram of the high-gain probe

Condensers

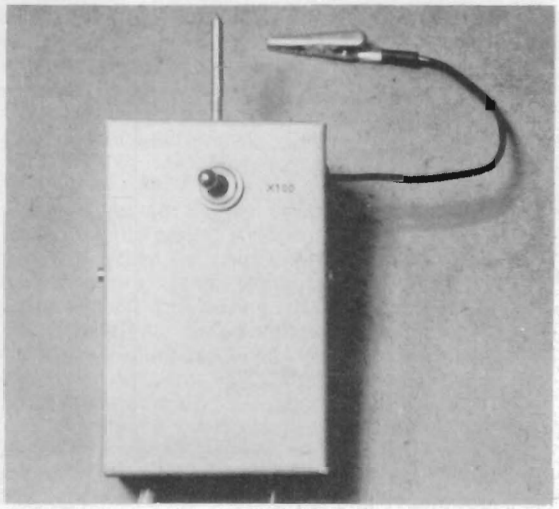
C_1	0.1μF 350V paper
C_2	100μF 6V electrolytic
C_3	0.1μF 350V paper

Miscellaneous

S_1	Double-pole changeover toggle switch, N.S.F. Type 8373/K7
V_1	Mullard EF86

Also required—

1 Noval valve base (McMurdo) Type BM9/U
1 Noval plug (McMurdo Type BLM9/USP1 with No. 22 cover)
2ft of 75Ω coaxial cable
1 Coaxial plug (Belling-Lee L.734/P)
2ft 4 way p.v.c. cable
1 crococile clip (Bulgin)
Prod assembly (see Fig. 11)
Chassis and box (see Fig. 10)
1 Tagstrip, Bulgin Type T19 with R.H. tag removed



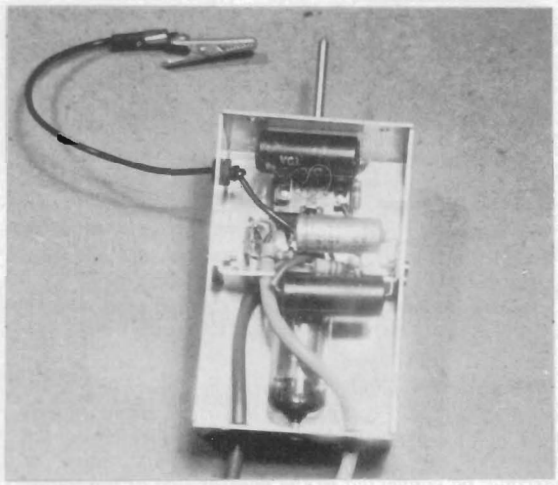
External view of the high-gain probe

base. Upon fitting the can one of the fixing lugs is clamped to the copper foil by means of its 6BA fixing screw.

As can be seen the coaxial lead is fed up the centre of the former. It will be found a tight fit, and will necessitate being tapered and screwed in. To enable the trimmer to be adjusted when the probe is assembled, a hole is drilled in the side of the can.

Checking

As explained earlier, the purpose of the trimmer is to make the whole circuit (including all stray capacity) aperiodic. Alignment of this condenser can be achieved by connecting the input of the high impedance attenuator probe from the oscilloscope to the cathode of the tube in a television receiver.



Rear view of the high-gain probe unit with back plate removed

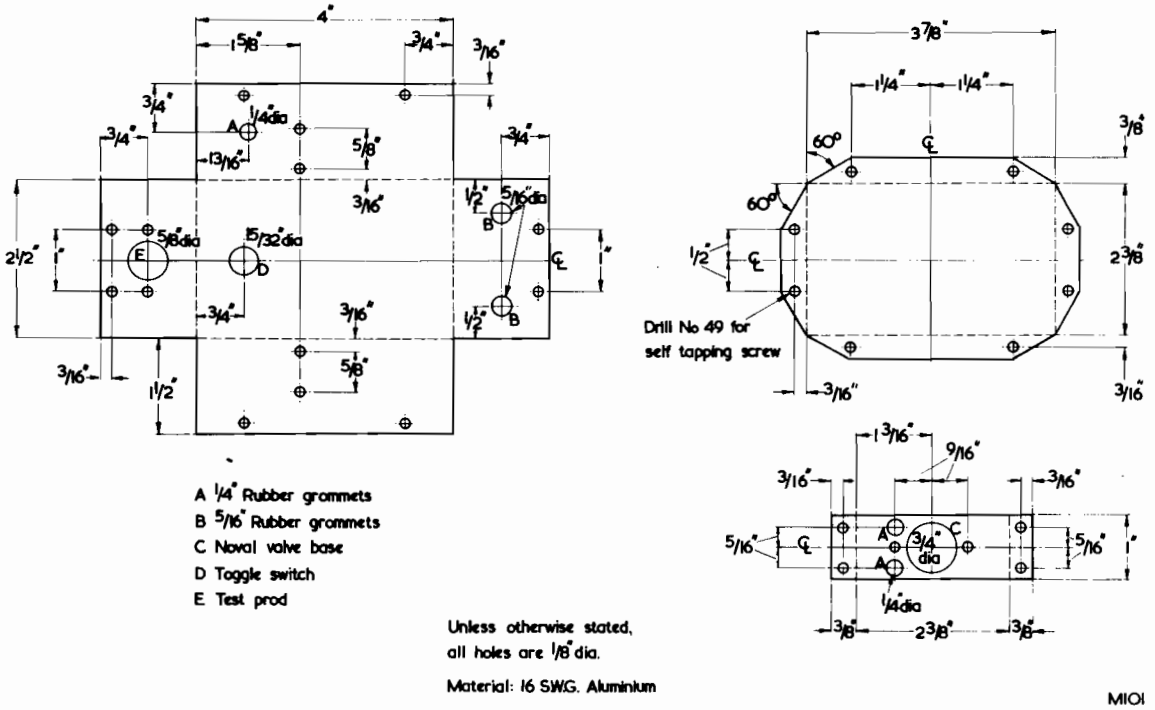


Fig. 10. Chassis drilling details for the high-gain probe

If, now, the timebase is adjusted to the line frequency, the line sync pulse should be obtained, and the trimmer adjusted until it appears as a rectangular pulse with no overshoot.

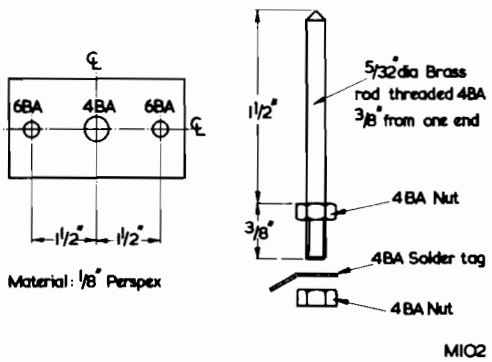


Fig. 11. Details of the prod for the high-gain probe

It must be remembered that, when checking waveforms of a.c./d.c. equipment, the oscilloscope chassis must not be earthed, but must be connected to the chassis of the a.c./d.c. equipment. This should, if possible, be connected to the neutral side of the mains in order to minimise hum pick-up and also to ensure safety to the user.

II. High Gain Probe

The high-gain amplifier probe is of conventional design giving amplifications of x 10 or x 100—these being selected by a changeover toggle switch. The circuit is given in Fig. 9. The x 100 position, with a maximum input of 300mV, gives a sensitivity of 1mV/cm., whilst, on the x 10 position, the maximum input is 3V and the sensitivity is 10mV/cm. The probe is designed primarily for a.f. amplifier work and has a bandwidth of 5 c/s to 20 kc/s.

Construction

The probe is mounted in a small box 4 x 2½ x 1½in made from 16 s.w.g. aluminium. The valve is mounted on a small bracket inside, and the prod is fitted to one end on a piece of ⅛in Perspex, an earth lead being provided through a rubber grommet at the side. The construction of this should be clear from Figs. 10 and 11.

From the opposite end to the prod, two leads leave the unit. One is the four-way power supply cable terminated by a noval plug which connects with the socket at the rear of the oscilloscope chassis. The other is the signal lead consisting of a 2ft length of ordinary 75Ω television type coaxial cable. The positions of the various components can quite readily be seen from the photograph.

Checking

The high-gain probe unit may be checked by feeding its input to a calibrated audio oscillator.

With maximum Y-gain, a display of 1 cm. amplitude should be obtained with an input of 1mV on the x 100 switch position. If the specified length of coaxial cable is used, the response should be found to be flat to within 3dB up to about 20 kc/s.

Conclusion

The writers have found this Mullard circuit to give very pleasing results in a unit which compares favourably in size with the average commercial kit, and they wish to express their appreciation and thanks to Mullard Ltd. for their kind co-operation, without which this article could not have been produced.

References

1. *Mullard Technical Communications*, Vol. 4, No. 32, "Circuit for a Simple Oscilloscope", pages 33–38. (Based on a report prepared by L. S. Brown of the Mullard Applications Research Laboratory).
2. *Scope for Service*. Mullard Publication No. TP374.

ERRATA

A Constructor's Oscilloscope—Part 1

In Part 1 of this series condenser C_1 is shown, in the circuit on page 923 of the July issue, with incorrect polarity. The condenser should have its negative terminal connected to rectifier MR_1, otherwise damage may result when the mains input is applied.

The table on page 921 did not show clearly that response, with Direct Input or "Probe X 10", is 2 c/s to 2.5 Mc/s and, with Pre-amplifier, is 5 c/s to 20 kc/s.

NEWS AND COMMENT

Interference

A correspondent to *The Times* has recently suggested, presumably not too seriously, that 4-star hotels should lose a star or two if television or radio are installed in the only comfortable lounge. Such a comment underlines the difficulty, in a heavily populated country, of how to allow freedom to one type of person without depriving another. A current difficulty is with transistor portables. Complaints of annoyance have been made when these have been used on motor bus and beach. This latter can readily be appreciated as these words are being written at a spot where normally one can only hear the sound of waves breaking on the seashore, but today some holiday-makers are listening (?) to programmes on their portable and the rest of us perforce . . .

This matter has been pinpointed by a statement issued by the Town Clerk of Eastbourne, attention being drawn to the fact that there is a bye-law which makes it an offence to operate radio sets, record players or other amplifying equipment in streets and public places. Offenders can be fined up to £5. The statement was put out after complaints of annoyance had been received from holiday-makers on the beaches and promenades. For the same reason London Transport has reminded its staff that the use of portable radios on buses contravenes regulations. A possibly more serious misuse is the monitoring of police messages by criminals to warn them of the approach of the law.

However, probably every great discovery has been misused by someone, and, when the novelty has worn off, we do not expect to hear so much about this kind of interference.

Viewing

According to figures issued by the B.B.C. in respect of the period April to June, 2 million more people watched t.v. compared with the same period a year before. It is estimated that 32 million sets are switched on during the average day! The B.B.C. compute that commercial programmes are tuned into more frequently than their own to the extent of 63% to 37%; the exception being the Saturday afternoon "Grandstand".

The number of current t.v. receiving licences issued in England and Wales is now comfortably in excess of 10 million, and in Scotland over 1 million. Taking Great Britain and Northern Ireland together the numbers are likely soon to reach $11\frac{1}{2}$ million. (Sound only licences are just short of 4 million of which nearly $\frac{1}{2}$ million are for car radios.)

The Home Secretary, Mr. R. A. Butler, speaking at a British Medical Association conference dinner, referred to irresponsibility among young people and mentioned, among other things, the immaturity and irresponsibility of many television programmes. One method of achieving a more responsible attitude might be to follow the somewhat facetious advice given on one of our office calendars "instead of standing them in a corner, children nowadays are best corrected by standing them with their backs to the television".

Wired Sound and Television

The chairman's statement issued with the accounts of Rediffusion Ltd., reveal the considerable overseas use of wired sound and television broadcasts. In references to a subsidiary's activities in Western Nigeria, it was stated that the majority of the world's population live in scattered communities, without power supply or radio and that anyone finding a successful means of bringing them information and entertainment will have almost limitless opportunities.

Wired sound and television was, naturally, dealt with in some detail. It was mentioned that regional agreements had been made with branches of the R.T.R.A. for co-operation with the general radio trade. It was interesting to note that Rediffusion hope to persuade manufacturers to incorporate modifications in television receivers so that viewers may receive signals from either aerial or land-line.

In Brief

● The B.B.C. estimate that an average audience of 15 million people had watched "*The Valiant Years*" each week, 10 million in the first and 5 million in the second showing. These figures were issued just before the conclusion of the series.

(continued on page 144)