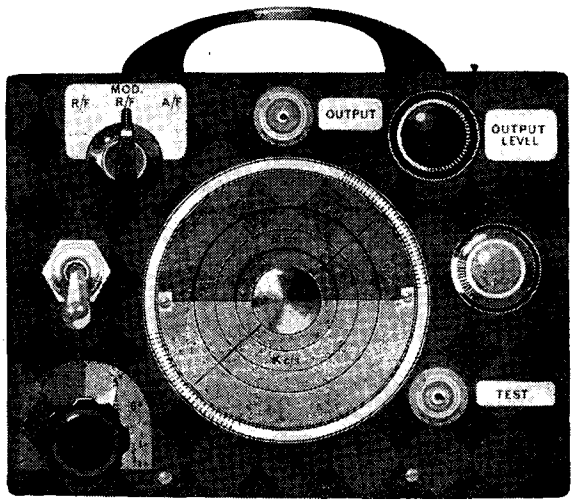
A SIMPLE SIGNAL GENERATOR

James Hossack



THE signal generator described here uses a conventional twin-triode oscillator circuit for both the r.f. and a.f. sections, and has a frequency coverage of 120kc/s to 50Mc/s, thus enabling tests to be carried out on most domestic radio and television apparatus (with the exception of u.h.f. receivers), harmonics being used to cover up to 200Mc/s. The method of construction is somewhat unusual in that it employs the "Cir-kit" technique, enabling an extremely satisfactory printed circuit board to be made without the use of chemicals or other etching medium.

CIRCUITRY

The theoretical circuit is shown in Fig. 1, and apart from resistor and capacitor values, both halves of the signal generator are identical. Briefly, damped oscillations set up in the grid inductance of the left-hand triode of each valve are maintained by feedback of the correct phase supplied from the right-hand anode via the appropriate coupling capacitor. In the case of the a.f. section, a tightly-coupled coil, actually the primary of the a.f. transformer T1, whose secondary comprises the audio oscillator coil, picks up the oscillation and employs it to modulate the anode of the r.f. section when a modulated output is required. Final calibration of the generator is simplified if a second, calibrated, generator can be borrowed, although an alternative, but less accurate, procedure is described later.

THE CASE

Although a suitable die-cast metal box can be purchased for a reasonable cost, it was decided to press into service a discarded metal container measuring 8 × 6½ × 4½in., replacing the ebonite base with an aluminium sheet 8½ × 6½in. which then becomes the front panel. Drilling details for the latter are shown in Fig. 2.

A small metal sub-frame 6 × 4in. constructed of angle aluminium and bolted to this panel at XX carries the printed circuit board, the coils being bolted directly to the lower part of the front panel, or else supported on a small strip of Bakelite, as in Fig. 3. Coil-winding details are given in Table 1. Figure 3 also indicates a convenient method for mounting the coils. The three lowest-frequency coils are supported on a length of ⅜in. ferrite rod bolted to the front panel, while coils 4 and 5 can be wound on a suitable short-wave coil former from which the core has been removed. The coil for the highest range, which is self-supporting, is best inserted after

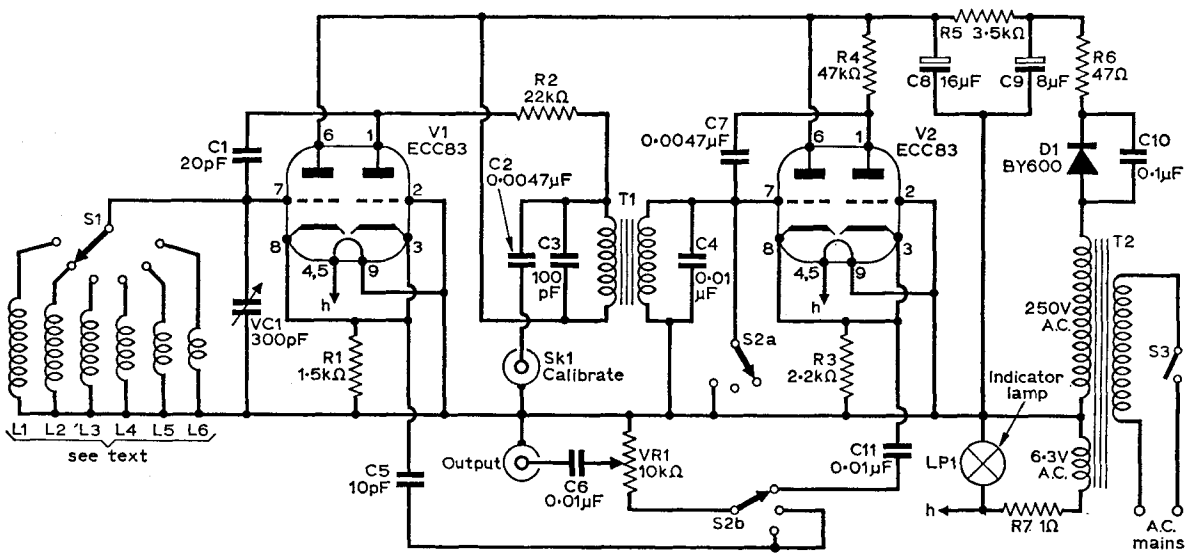


Fig. 1: Circuit diagram of the simple signal generator.

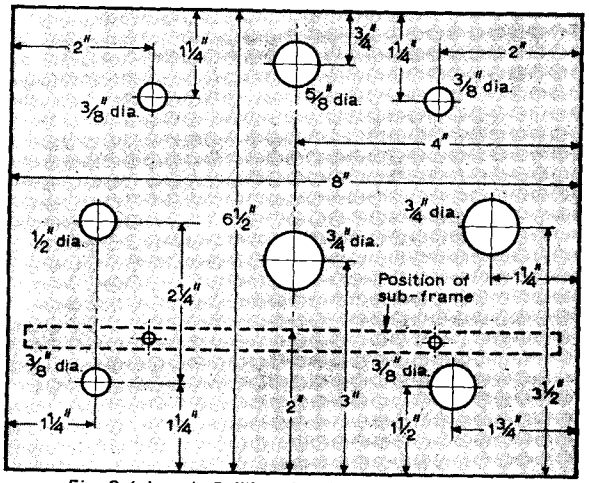
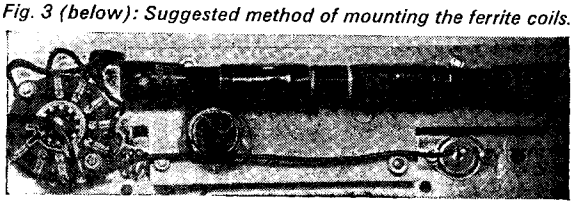


Fig. 2 (above): Drilling details of the front panel.

Fig. 3 (below): Suggested method of mounting the ferrite coils.



the generator has been set up and calibrated on the lower ranges as in this way it can be checked that the coverage is complete without excessive overlap. Since two-terminal coils are used, coverages for all coils may in any case be altered fairly easily, after construction has been completed, owing to the "open" nature of the printed circuit layout. For example, if a more conventional type of mounting is desired for the l.f. coils in preference to the ferrite rod method, the turns for coils 1-3 should be increased by about 30%, and adjusted finally, by removal of turns, to give the desired coverage.

After mounting coils, range switch, and output terminals, the remaining front panel components, consisting of on/off and modulation switches, output control, and indicator lamp, are bolted in position. The lamp, though not essential, is a desirable addition, since it has been found, in practice, that test equipment may be inadvertently left switched

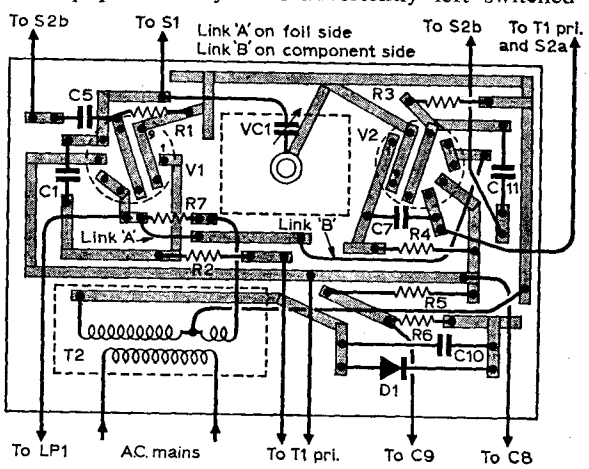


Fig. 4: Wiring diagram of the underside of the "chassis" using Cir-kit copper strip.

on for long periods, with possible overheating. As a further precaution in this respect, due to the poor ventilation consequent upon nearly complete screening, it was considered desirable to include the 1Ω dropping resistor, R7, which reduces the heater voltage to a safe 5·8V.

CONSTRUCTION

The next step is to cut and drill the paxolin "Cir-kit" board to take valve holders (B9G, printed circuit type), tuning capacitor, mains transformer, and all fixed capacitors and resistors, including the silicon diode, D1, but excluding C8 and C9, which are mounted on the back of the sub-chassis. C3 and C4 are soldered respectively across the primary and secondary of the modulation transformer, which is also bolted directly to this chassis. Make sure that the tuning capacitor is efficiently earthed with a piece of heavy gauge wire—do not rely on the "Cir-kit" strip for this purpose, since oscillation may be impaired on the highest-frequency range.

Now, lay the copper strip on the underside of the board, following the layout of Fig. 4, and taking care to leave sufficient overlap at corners to facilitate subsequent soldering. Finally, the "Cir-kit" strips are pierced with a pin where they underlie the component holes, and all resistors, capacitors, etc. can be threaded through and soldered into position. R5 and the silicon rectifier should be spaced about ½in. above the paxolin board to assist heat dissipation. At the same time, solder the valve-holder pins to the appropriate strips, insert and

Range	Coverage	No. of turns	Wire gauge s.w.g.	Former
1	120-300kc/s	250	32	⅜in. ferrite rod
2	300-650kc/s	120	32	
3	600-2000kc/s	64	32	
4	1·9-6·0Mc/s	50	32	pile wound on ¼in. former
5	5·1-22Mc/s	14	28	
6	20-50Mc/s	4	16	self-supporting

Table 1: Winding details for the coils.

solder the mains transformer leads, and place a spot of solder at each strip junction, as previously mentioned.

The flying leads connecting the p.c. board to the under chassis components (coil, range switch, modulation transformer, and smoothing capacitors) and to those above chassis (modulation switch, indicator lamp, and other controls), can also be soldered on at this stage, leaving sufficient lengths to reach the appropriate connections on the front panel (compare Fig. 4).

ASSEMBLY

The completed circuit board is now screwed on to the sub-chassis frame, the latter bolted to the front panel, and all flying leads soldered into position. Figure 5 is a top view of the completed assembly. Unless a separate signal source is available and it is desired to use the heterodyne method of calibration, with headphones, it will probably be better to leave the generator out of its cabinet meantime, since this will enable sufficient output to be picked up on

a nearby receiver without the necessity for a coupling lead or dummy aerial.

Initial calibration is best carried out with the modulation off. Switch to the lowest frequency range (range 1), and tune the generator for zero beat with the long-wave light programme on the adjacent receiver. This enables the 200kc/s point to be accurately marked. Leaving the generator set to this point, tune in the harmonics of 200kc/s on the receiver at 600, 800, and 1,000kc/s. Leaving the receiver set to the latter frequency, switch on the internal modulation, and tune the generator, on range 3, for maximum response from the receiver

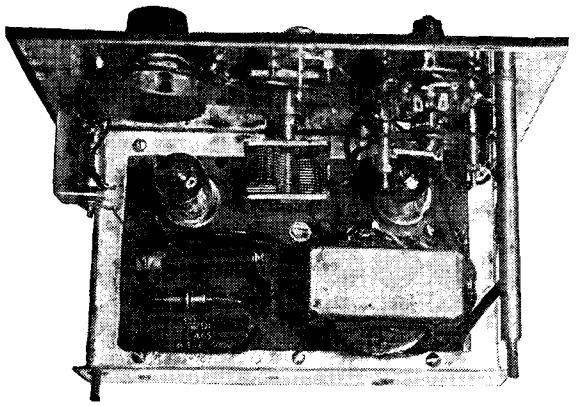


Fig. 5: Top view of the completed unit.

at this new frequency. Mark this point 1Mc/s. Harmonics will now be available at 2, 3, 4 etc. Mc/s, and the receiver can be tuned to detect any or all of these frequencies, depending on its short-wave coverage. After each setting has been found on the receiver, leave the latter untouched, and retune the generator for maximum response on the receiver, this representing the fundamental of the frequency to which the receiver is tuned.

Although this procedure will not produce accuracy comparable with the use of a second (calibrated) generator, nevertheless, it should be sufficiently accurate for general testing purposes. A useful check can be made by graphing frequency against dial reading for each range, and this will also ensure that spurious responses—particularly troublesome when the receiver used is a small transistor type—are not confused with the fundamentals or main harmonics. ■

★ components list

Resistors:

R1	1·5kΩ ½ watt	R5	3·5kΩ 5 watt
R2	22kΩ 1 watt	R6	45Ω 1 watt
R3	2·2kΩ ½ watt	R7	1Ω 1 watt
R4	47kΩ 1 watt	VR1	10kΩ pot.

Capacitors:

C1	20pF	C7	0·0047pF
C2	0·0047μF	C8	16μF 350V electrolytic
C3	100pF	C9	8μF 350V electrolytic
C4	0·01μF	C10	0·1μF 650V
C5	10pF	C11	0·01μF
C6	0·01μF	VC1	300pF variable

Valves:

V1	ECC83	V2	ECC83

Inductors:

L1–L6 see table
T1 3:1 or 5:1 intervalve transformer
T2 0–250V at 25mA, 6·3V at 1·2A

Switches:

S1 1 pole 6 way
S2 2 pole 3 way
S3 SPST mains toggle

Miscellaneous:

Silicon rectifier type BY600; dial bulb and holder; coil formers and wire for coils; two B9A valve holders; two co-ax sockets; Cir-kit copper strip; materials for chassis and case; nuts and bolts; solder etc.

new books

AMATEUR RADIO CIRCUITS BOOK
Compiled by G. R. Jessop, G6JP. Published by Radio Society of Great Britain, 28 Little Russell Street, London, W.C.1. 119 pages. Size 8¼ x 5¼in. Price 10s 6d.

THIS second edition is packed with circuits for the Ham. It does not give full details of how to build each project, but supplies the circuit and sufficient information for most amateurs to construct the units described. Just about every aspect of amateur radio is catered for and circuits are given for a.t.u.'s; front ends; speech amplifiers; oscillators; transistor transmitters; test gear etc. A large number of the circuits are transistorised and one depicts a 70 and 144Mc/s converter using field effect transistors.

This edition is a decided improvement on its predecessor in that it appears to contain even more detailed information. For the amateur enthusiast or ham who likes all those useful circuits in one place this is a good ten-and-sixpence worth, and can be confidently recommended.—*DLG.*

WORLD AT THEIR FINGERTIPS
By John Claricoats, G6CL. Published by Radio Society of Great Britain, 28 Little Russell Street, London, W.C.1. 307 pages. Size 8¼ x 5¼in. Price 12s 6d. (De-luxe—45s.)

DEFINITELY a must for the Historians, the curious and for those radio enthusiasts who like to read an interesting book which is devoid of maths and other such features which makes some works rather heavy going. This book is the story of Amateur Radio in the United Kingdom and a history of the Radio Society of Great Britain. John Claricoats is certainly to be congratulated on producing some interesting and informative reading, coupled with a huge number of facts many of which are quite an eye-opener.

Scene 1 commences with the very first meeting of a group of enthusiasts with their "coherer"—". . . a ½-inch diameter glass tube, 1 inch long, filled with iron filings. Corks were pressed into the ends of the tube and copper wires were passed through into the iron filings so that they did not quite meet". Finally, after chapters of interesting facts and photographs, the book arrives at the present-day.

One is often surprised by the odd snippits of information which come out, for instance the various people who have held membership in the Society—Sir Oliver Lodge, Senatore Guglielmo Marconi to name just two.

Just who were the first amateurs and what did they get up to. Well, there was . . . no, you buy the book and read for yourself.—*DLG.*