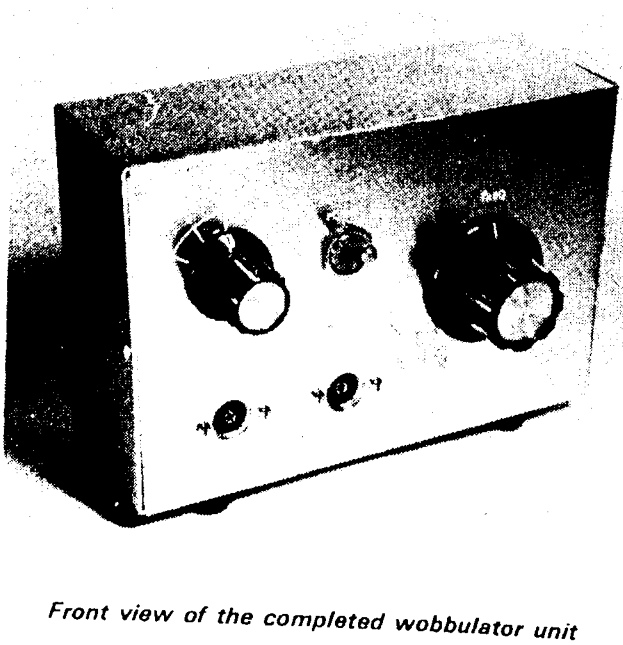
LOW COST WOBBULATOR

by P. R. Arthur

A very simple and inexpensive design which is primarily intended for the investigation of the r.f. and i.f. passbands of a.m. receivers. Its fundamental output may be tuned in on the medium wave band and the second harmonic on a short wave band.

Most electronics enthusiasts would probably consider a wobbulator to be something of a luxury and, admittedly, a comprehensive instrument is rather expensive. However, a basic wobbulator may be built for a very modest monetary outlay, and can prove to be very useful for anyone who has an oscilloscope and is involved in the building and alignment of receivers.

This article describes a simple wobbulator which will enable any oscilloscope having a timebase output to display the passband of medium wave and some short wave receivers. Not all oscilloscopes have the requisite timebase output facility but the wobbulator can still be employed with such oscilloscopes if an external timebase generator is employed. Details of a suitable generator which, like the wobbulator, is an inexpensive design, will be given in next month's issue.



Front view of the completed wobbulator unit

WOBBULATOR FUNCTION

The function of a wobbulator is to trace the passband of a receiver on an oscilloscope screen. This can be extremely helpful when testing and aligning complex i.f. filters, and can even be useful when aligning an ordinary medium wave broadcast superhet receiver. Here the i.f. transformers would normally be set up to the same frequency, resulting in a comparatively narrow and peaked response.

Improved audio quality can be achieved by slightly detuning one or more of the i.f. transformer coils, giving a slightly broader response towards the centre of the passband but without significantly increasing the overall bandwidth. This process can be very quickly and accurately carried out with the aid of an oscilloscope and wobbulator, but without these it becomes a matter of guesswork.

Fig. 1 illustrates the way in which a wobbulator functions. The timebase output of the oscilloscope is used to control a voltage controlled oscillator (v.c.o.) operating about the centre of the receiver's reception frequency. As the timebase signal sweeps the spot across the face of the oscilloscope tube, it also sweeps the v.c.o. frequency across the receiver's passband. The output of the v.c.o. is loosely coupled to the input of the receiver. The Y input of the oscilloscope is connected to the output of the receiver detector, and so the vertical deflection of the spot at any instant is proportional to the gain of the receiver at the particular frequency of the v.c.o. to which it corresponds.

As the spot is swept across the face of the tube it thus traces out the i.f. passband of the receiver, always providing of course that the basic v.c.o. frequency and level of sweep are correct.

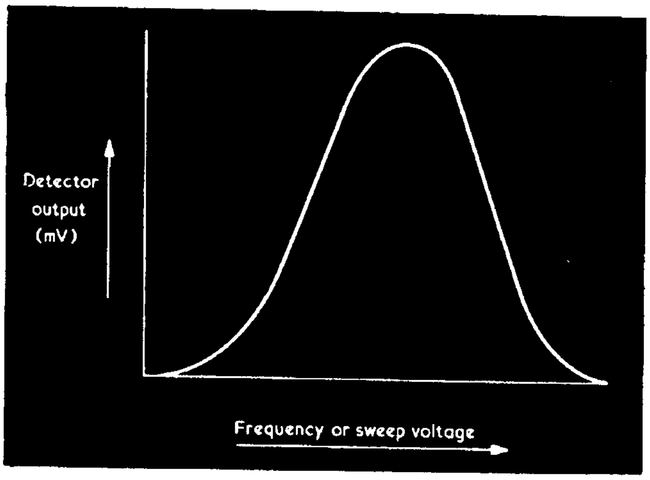


Fig. 1. Illustrating how a wobbulator and oscilloscope may display the response curve of a tuned amplifier

THE CIRCUIT

The circuit diagram of the wobbulator appears in Fig. 2. As we have already seen, a wobbulator basically consists of a radio frequency v.c.o.

A simple feedback oscillator using TR1 as a common emitter amplifier forms the basis of the unit. L2 is the collector load for TR1 and L1 provides positive feedback to the transistor base via C2, which is a d.c. blocking capacitor. VC1 permits some variation in the operating frequency of the unit, and R1 is the base bias resistor.

The timebase input is coupled to VR1 by way of the input socket and C4. A controlled amount of the input is then fed by way of R2 to a pair of parallel connected variable capacitance diodes. As the timebase signal

COMPONENTS

Resistors
R1 560kΩ ¼ watt 5%
R2 100kΩ ¼ watt 5%
VR1 470kΩ potentiometer, linear

Capacitors
C1 0.1μF plastic foil, type C280 (Mullard)
C2 470pF ceramic or silvered mica
C3 680pF polystyrene or silvered mica
C4 0.47μF plastic foil, type C280 (Mullard)
VC1 100pF variable (see text)

Inductor
L1, 2 Miniature Transistor Tuning Coil, Yellow, Range 2T (Denco)

Semiconductors
TR1 BC108
D1 BA102
D2 BA102

Switch
S1 s.p.s.t., toggle

Sockets
B9A valveholder
2-off coaxial sockets, flush mounting

Miscellaneous
9 volt battery type PP3 (Ever Ready)
Battery connector
Aluminium box type AB13, 6 x 4 x 2in.
2-off control knobs
Plain Veroboard, 0.1in. matrix
20 s.w.g. aluminium
4-off small rubber feet

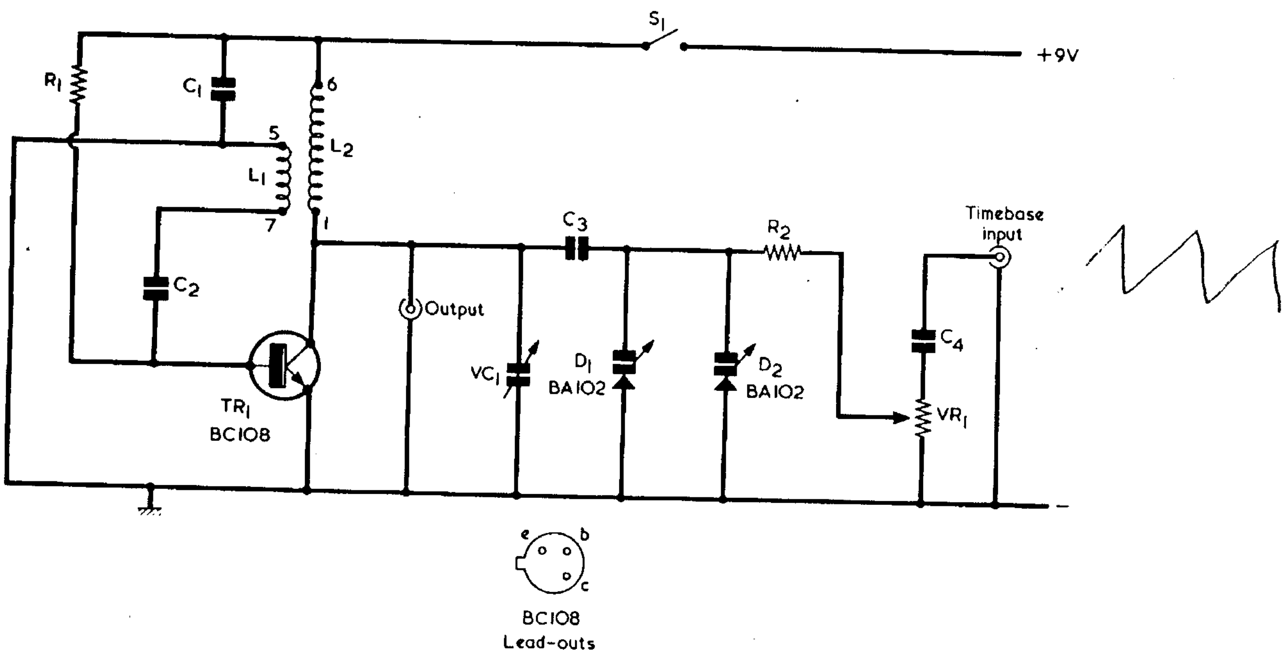


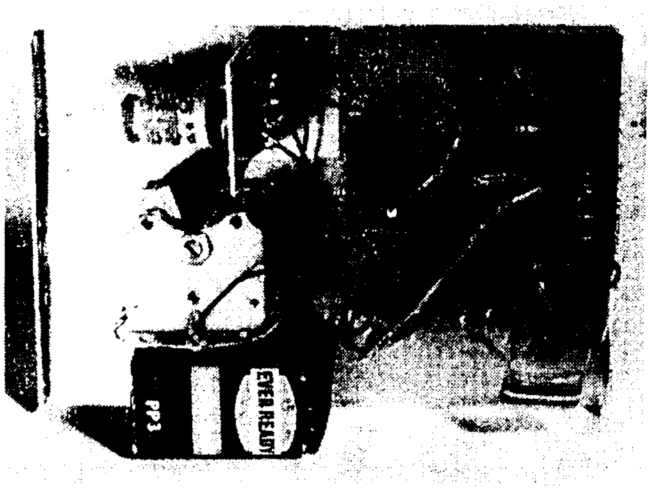
Fig. 2. The circuit of the low cost wobbulator. Despite its simplicity it offers a very useful frequency sweep

voltage increases, the reverse bias across the diodes rises and their depletion layer becomes larger. The depletion layer of a diode forms the dielectric for the capacitance it possesses so that, as the timebase signal voltage increases the diode capacitance reduces.

The two diodes are coupled via C3 to VC1 and L2, and their reducing capacit. nce causes a correspon-ding increase in the frequency of the oscillator. Two diodes are needed to provide an adequate capacitance swing.

VR1 controls the sweep level, and S1 is the on-off switch.

Ideally, there should be a linear relationship between frequency change and sweep voltage but this is not realised with the present simple arrangement, resulting in some distortion of the trace in this respect. Another factor when comparing the unit with more complex instruments is that it is not equipped with a calibrator to enable the graticule of the oscilloscope to be directly related to frequency. However, for a very small initial outlay the unit described here provides a reasonably accurate picture of a receiver's passband, and it has proved to be a very useful alignment aid in the author's workshop.



The components are mounted on the rear of the front panel. VR1 is behind the component panel

THE CASE

The prototype is housed in an aluminium box type AB13, which measures 6 by 4 by 2 in. The lid is employed as the front panel and, in the author's unit, was modified by having the flanges on the two long sides cut off. This modification is not reaily necessary, however, and other units may employ the lid in its original form. Four small cabinet feet are secured to the bottom 6 by 2in. side of the box.

Drilling details for the front panel are given in Fig. 3. A single hole is shown for VC1, but if this is of the Jackson '00' or '01' type it will also require three 4BA clear holes for short mounting bolts which pass into 4BA tapped holes in its front plate. Spacing washers are required on the bolts between the panel and the capacitor, and the bolt ends must not pass the inside surface of the capacitor front plate or they may damage its vanes. The value required in VC1 should be around 100pF, and the author employed the 176pF section of a Jackson type '00' 2-gang 208 + 176pF capacitor which was to hand at the time of construc-

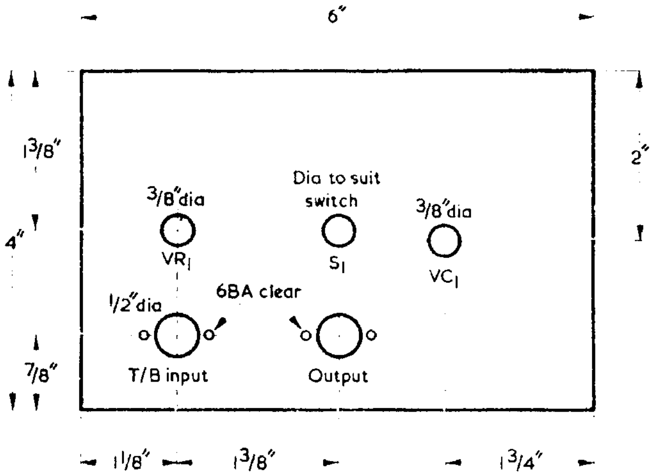


Fig. 3. Drilling details for the front panel

tion. If a variable capacitor is to be obtained specifically for the project, a Jackson 100pF type C804 component would be a good choice, and this requires only a single bush-mounting hole.

The coil fits into a B9A valveholder, and the latter is mounted on the bracket shown in Fig. 4. The bracket is affixed to the rear of the front panel in the position shown in the accompanying photographs. The author secured the bracket in place with an epoxy adhesive but it can alternatively be mounted by means of two 6BA bolts and nuts, for which the requisite holes will need to be drilled.

The coil is fitted with an adjustable dust core, but this is not required and is removed. The coil has a second coupling winding, not used in the present circuit, which connects to its pins 8 and 9. This winding is not shown in Fig. 1 and no connections are made to its two pins.

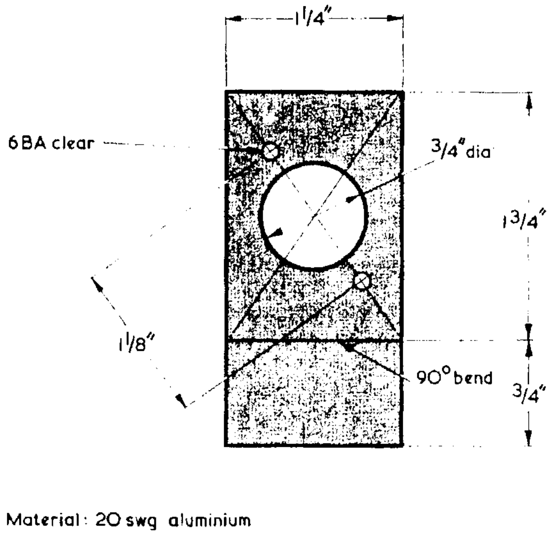


Fig. 4. The coil fits into a B9A valveholder mounted on the bracket shown here

COMPONENT PANEL

All the small components with the exception of C4 are wired up on a small plain perforated s.r.b.p. board having a matrix of 0.1in. This has 22 by 18 holes and the layout and underside wiring are shown in Fig. 5.

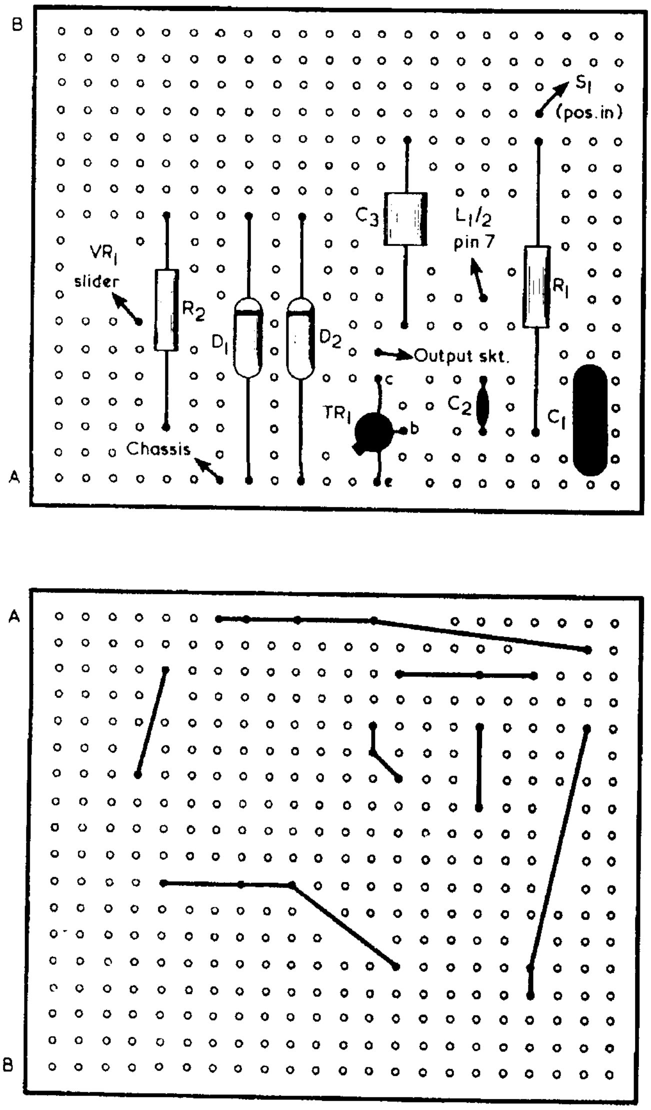
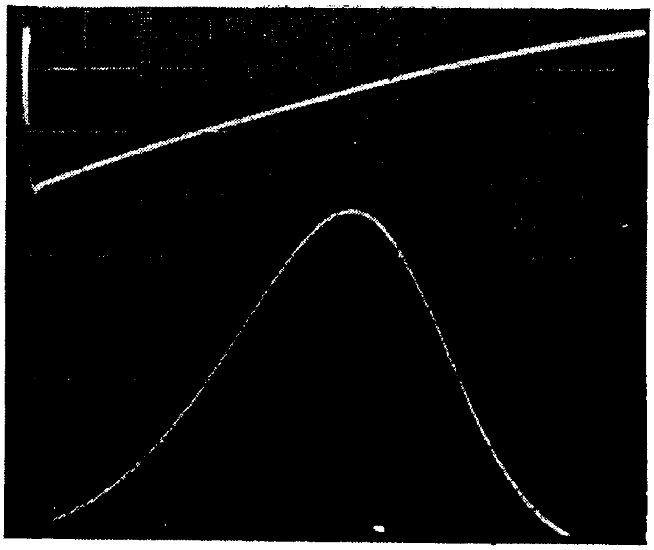


Fig. 5. Layout and wiring of the components on the perforated panel

Short insulated heavy gauge wires are used to connect the board to S1, the output socket and the slider of VR1. The board is positioned behind VR1 with C1 at top right as viewed from the rear of the front panel. As it is quite light, the three thick wires provide it with a perfectly adequate mounting. The board is fitted in place after connections have been made to the track tags of VR1.

Thinner wires pass from the board to pin 7 of the coil holder and to chassis. The chassis connection is given by a solder tag under one of the mounting nuts for the output socket. Also connected to this tag are the negative battery lead and the earthy end of VR1 track. The frame of VC1 is earthed to chassis via its mounting, and a lead travels from its moving vane tag to pin 5 of the coil. The output socket tag connects to the fixed vane tag of VC1 and then carries on to pin 1 of the coil. Pin 6 of the coil is connected to the same tag of S1 as is the thick wire from the board. The positive battery lead connects to the other tag of S1. C4 connects between the input socket and the remaining track tag of VR1.



Oscillogram obtained with a double beam oscilloscope. The lower trace shows an i.f. amplifier response obtained with the aid of the wobbulator. The upper trace is the output sweep of the timebase generator which will be described in next month's issue

The battery fits beneath VC1 and should be positioned so that it is firmly held lengthwise between the front and rear of the case when the panel is screwed into position.

Should it be found when the unit has been completed that TR1 does not oscillate, the effect of transposing the connections to pins 5 and 7 of the coil should be tried. The winding to which these pins connect is an inter-stage coupling winding which is not normally intended for oscillator feedback, and it may be connected to its pins with the alternate phase in some coils. The current consumption from the 9 volt battery will vary with different transistors, and is typically 4.5mA.

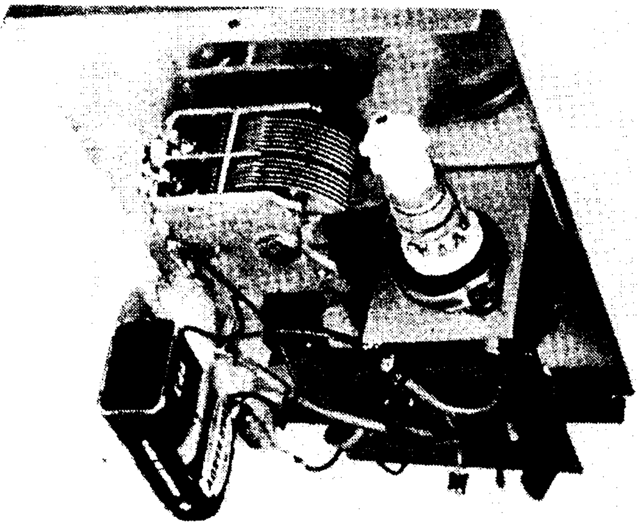
USING THE UNIT

If the oscilloscope has a timebase output which provides a positive-going sweep voltage with an amplitude of 4 volts peak-to-peak or more, this output is coupled to the input of the wobbulator. Should there be no timebase output, the separate timebase generator to be described next month will be needed.

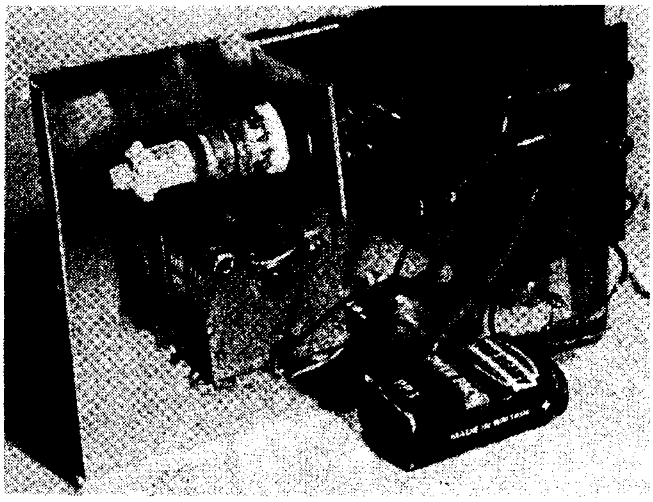
Some oscilloscopes incorporating valves have quite high timebase output voltages, these often being 50 volts peak-to-peak or more. If the wobbulator is employed with such an oscilloscope, VR1 must always be kept turned well back to avoid possible damage to the two variable capacitance diodes. These have a maximum reverse voltage rating of 20 volts. In cases where the wobbulator will always be employed with a particular oscilloscope having a high timebase output voltage a fixed resistor of appropriate value may be inserted in series between C4 and VR1 to ensure that the latter cannot be accidentally set to apply too high a voltage to the diodes.

It is normally quite a simple matter to connect the Y input of the oscilloscope to the receiver detector load, as this is usually the volume control. It is therefore merely necessary to connect the oscilloscope input across the receiver volume control.

A fairly low timebase frequency must be used or the set-up will not function satisfactorily. A frequency of 25 to 100Hz should be satisfactory. There should not be a tight coupling between the wobbulator and the receiver input as this can cause a.g.c. action in the receiver to give a flat top to what should be a rounded trace. The wobbulator output is high, at about 1 volt peak-to-peak. It is also at a high impedance since it connects directly to the oscillator tuned winding. The self-capacitance of a screened cable connected to the output socket is added to the capacitance tuning the winding; however, the self-capacitance of the 1 to 2ft of coaxial cable which will normally be used will not cause any difficulties here. A very loose coupling to the receiver, given by positioning an unscreened section of the output lead near the receiver aerial input circuit should in many cases be sufficient.



Looking at the rear of the front panel from its right hand end



Another view of the parts behind the front panel. The component panel is held in place by the three stout leads which connect to it

The basic operating frequency of the wobbulator is about 1.4MHz, but this can be reduced somewhat by adjusting VC1. It is essential that the wobbulator be tunable, as it must be set to a part of the band that is free from stations. If a signal from a station is present inside the wobbulator sweep it will beat with the wobbulator output and modulate the trace. VC1 and the receiver tuning control are adjusted to produce a trace which is properly centred on the screen.

VR1 controls the level of sweep, and is normally adjusted so that the curved part of the trace virtually fills the screen from side to side. The oscilloscope Y gain is adjusted for a trace of suitable height. By advancing VR1 a little and adjusting VC1 it is possible to effectively magnify any part of the trace so that it can be examined in detail. Taking VC1 on either side of the setting which gives a central trace will also show up any spurious i.f. responses that may be present; these frequently occur when crystal or ceramic devices are used in the receiver i.f. stages.

The second harmonic of the wobbulator output gives a range of about 2 to 3 MHz, and this can be used to display the passband of short wave receivers which cover these frequencies. Apart from the fact that the second harmonic is being employed the set-up is essentially the same as with a medium wave receiver. ■

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