OSCILLATOR TEST NO. 1

TECHNICAL HANDBOOK - TECHNICAL DESCRIPTION

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INTRODUCTION

1. The Oscillator Test No. 1 provides a r.f. signal of known frequency and amplitude primarily for the alignment and checking of the performance of Service wireless receivers. It operates in the frequency range 85kc/s to 32Mc/s, and is complementary to the Oscillator Test No. 2. The signal may be continuous wave (c.w.), amplitude modulated (a.m.) or frequency modulated (f.m.); this latter facility is available only above 2Mc/s. The output may be varied in steps of 2dB from 1μV to 100mV. For a.m. the depth is fixed at approximately 30% at 1 kc/s and for f.m. the deviation may be varied up to 30kc/s. The a.m. tone of 1kc/s is available at separate terminals for checking a.f. circuits. The equipment may be operated from a.c. mains or a 12V battery.

BRIEF DESCRIPTION

2. The block diagram, Fig. 1, shows the principle of operation. The master oscillator V2 is a tuned anode oscillator covering the frequency range as follows:-

Band 1	85 kc/s - 250 kc/s
Band 2	250 kc/s - 700 kc/s
Band 3	700 kc/s - 2 Mc/s
Band 4	2 Mc/s - 4 Mc/s
Band 5	4 Mc/s - 8 Mc/s
Band 6	8 Mc/s - 16 Mc/s
Band 7	16 Mc/s - 32 Mc/s

The reactance valve V1 is switched in on bands 4 to 7 inclusive. The valve stages V3 and V4 together comprise a wide-band amplifier. On a.m. the a.f. oscillator V5 is connected to the screen of the second amplifier stage V4, whilst on f.m. the output from V5 is fed to the grid of the reactance valve V1.

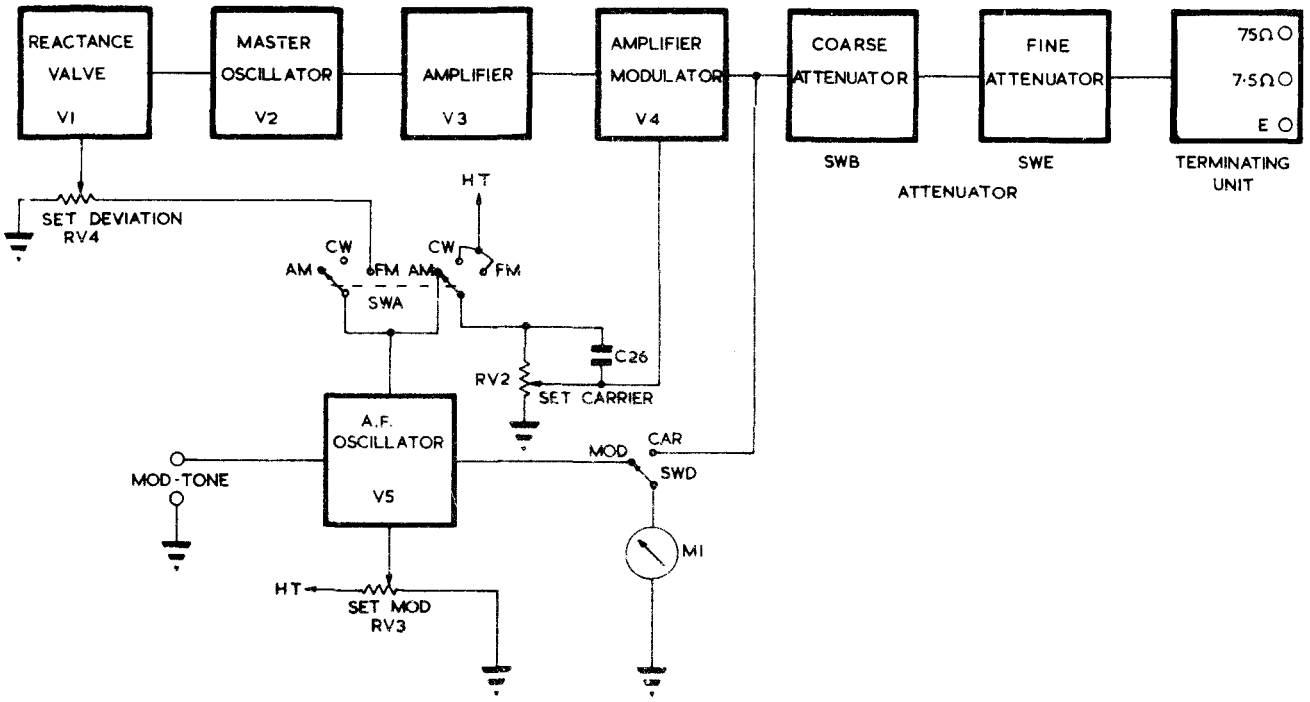

Fig. 1 Block diagram

POWER SUPPLIES

3. The equipment is operated either from a.c. mains or a 12V battery. The mains supply may be 110V, 115V, 120V, 230V or 240V, 45-65 c/s. To adjust the transformer tap the equipment must be unsealed and removed from the case. The power consumption is approximately 42 watts for battery operation and 50VA for mains.

NOTE. It is important when using the 12V battery supply that the lead for the a.c. supply is removed and that the cover is replaced on the a.c. input plug PLA. Similarly, when using a.c. supply the battery lead must be removed and the cover replaced on the battery input plug PLB.

MECHANICAL CONSTRUCTION

4. The test oscillator is a completely self-contained instrument housed in a hermetically sealed case. The equipment consists of a r.f. unit in a screened box, with a number of sub-assemblies arranged around it. The whole of the assembly is mounted on the panel and is withdrawn from the case when the sealing is broken and the panel lifted. Being of the sealed type the instrument should not be opened unless suitable drying and seal testing equipment is available (see paras. 18 and 20).

5. The case is of die-cast aluminium alloy to which the front panel is bolted. All controls and battery and mains sockets are on the front panel. A lid is provided which is held in position during transit by quick-release clips. Connecting leads

and minor spares are carried in a compartment in the lid, and a webbing strap is fitted to the case for carrying the instrument. The overall size of the equipment is 8 3/4 inches by 13 inches by 10 3/4 inches, and the total weight is 30 lb.

TECHNICAL DESCRIPTION

Main Oscillator and Amplifier Circuits

6. The complete circuit diagram is shown in Figs. 2001a and b. The main oscillator is V2, which is of the tuned anode type. Selection of the appropriate anode inductance, L1 to L4 or L25 to L27, for the required frequency band is by switch SWCb, and of the associated grid coupling coil, L1a to L4a or L25a to L27a, by switch SWCc. Each of the grid coils is inductively coupled to the corresponding anode coil and the grid circuit incorporates a grid capacitor, C92 to C98, suitable for the frequency band selected. The oscillator is tuned on the three lowest bands 1, 2 and 3, 85kc/s to 2Mc/s, by capacitors C36a and C36b in parallel. On the higher bands C36b is replaced by V1, connected as an inductive reactance of fixed value for each band (see para. 10).

7. The h.t. supply for the anodes and screens of V1 and V2 is stabilised at 150 volts obtained from across the terminals of the stabiliser valve V6. The anode circuit of V2 is decoupled, according to the frequency band selected, as follows:-

Band	
1 and 2	By R9 (470 ohms) and C60 (0.1 µF)
3	By R76 (470 ohms) and C42 (0.01 µF), C76 (0.035 µF)
4 and 5	By R10 (470 ohms) and C32 (0.02 µF)
6	By R5 (470 ohms) and C80 (0.01 µF), C113 (6,000 pF)
7	By R15 (470 ohms) and C99 (0.005 µF), C110 (6,000 pF).

8. The output from the oscillator is taken from the grid via C101 to the grid of V3, a resistance-capacity buffer stage with an anode load R62 of 390 ohms. The gain of this stage is therefore not much greater than unity, but is maintained reasonably well to the high frequency end of the band. The final stage V4 incorporates a tuned circuit in its anode on all bands. The anode load comprises L5 and one of capacitors C114 - C118, selected by SWCz for bands 1 to 5, and L5 and circuit and valve stray capacities on bands 6 and 7. The resulting tuned circuits have very flat frequency characteristics and their purpose is to ensure that the output from V4 is level within prescribed limits for each band. The anode inductance L5 is shunted by the input resistance of the ladder attenuators in series with R47 (some 300 ohms). It is provided with a pre-set iron slug which allows for adjustment of the tuned circuits and to give compensation for the slight falling off in response exhibited by V3 in band 7. With SWA and SWD set at CW and CAR respectively the level of the carrier is monitored by M1. Adjustment of the carrier level is by means of the SET CAR control RV2 which controls the screen voltage of V4. The setting for RV2 to give correct carrier level corresponding to the attenuator marking is determined by adjusting RV2 until the meter M1 reads at the CAL position.

Amplitude Modulation

9. Amplitude modulation is provided by applying an a.f. voltage of suitable value to the screen of the output valve V4. This a.f. is generated by V5 operating as a Hartley oscillator in conjunction with the tuned circuit L7 and C24, resonant at

1,000 c/s. With SWA in the AM position the output from V5 is fed via C26 to the screen of V4. The amplitude of the a.f. output is determined by the standing voltage on the screen grid of V5. This voltage is controlled by the setting of the potentiometer formed by R24, R69, RV3 and R70 across the main h.t. supply and can be varied between pre-determined values by the setting of the SET MOD control RV3. The setting of RV3 thus determines the modulation depth. With the carrier correctly adjusted as in para. 8 and RV3 in about the central position the modulation depth produced in the output is approximately 30%. With SWA at AM and SWD at MOD the a.f. output is monitored on meter M1. The setting for RV3 to give a modulation depth of 30%, with the carrier correctly adjusted, is then determined by varying RV3 until the meter M1 reads at the CAL position. The a.f. output is also fed via C33 to the MOD TONE terminals for direct application when required for a.f. tests.

Frequency Modulation

10. For frequency modulation, the a.f. from V5 is fed via C79 and a network of fixed and variable resistors to the grid of V1. This valve behaves as a reactance valve (see EMER Tels A 013) since its grid voltage is approximately in quadrature with its anode voltage. The phase shifting network between anode and grid comprises C34, R13, C27 and C22, C18 or C21, depending on the frequency band selected. On the highest frequency band C27 and the grid/cathode capacitance of V1 together with the switch and wiring capacitance is sufficient to ensure the correct phase shift. The capacitor C34 has a sufficiently low reactance at all frequencies used on f.m. to be neglected; it is included to isolate the h.t. from the grid. The phase shifting network is thus R13 and C22 with C27 in parallel on, for example, band 4. This circuit is predominantly resistive over the band (2 Mc/s - 4 Mc/s), i.e. the capacitive reactance is small in relation to the resistance of R13 (4.7K). The current through this circuit therefore leads the voltage by a relatively small angle. The voltage at the grid, however, lags this current by 90° and thus the valve, as a whole, appears as an inductive reactance across the oscillator tuned circuit. The actual value of reactance is determined by the mutual conductance of V1 which is varied by the application to its control grid of the a.f. voltage from V5, thus resulting in frequency modulation of the oscillator. The amplitude of the a.f. fed to the reactor is determined by the settings of the controls RV1, RV4, pre-set resistors RV8 - RV11 and R7, which form a potentiometer network across the output of V5. The correct value of a.f. to produce the deviation indicated by the setting of the DEVIATION control RV4 varies from band to band and also throughout each band. The pre-set resistors RV8 - RV11 are switched in to set up the correct voltage for each band and the potentiometer RV1 is ganged to the main tuning control C36 to adjust the voltage to the correct value throughout the band.

11. To compensate for the valve tolerances should V1 be changed, C27 and R8 have alternative values shown in Fig. 2001 and Table 2001. The most suitable value to give the appropriate specification figures should be fitted during repair and test of the instrument (see EMER TELS Z344).

12. As for a.m., the actual deviation is dependent upon the a.f. output from V5 being of the correct amplitude. It is adjusted by the SET MOD control RV3 and monitored by the meter M1. The variable resistor RV5 is used to bring the pointer of the meter coincident with the CAL mark, and the a.f. output is then of the correct amplitude.

Attenuators and Metering

13. The r.f. output from V4 is fed direct to the fine attenuator network R27 - R46.

This provides a range of attenuation in 2dB steps from 0 - 20dB depending on the setting of SWB. The tapping of the fine attenuator is connected to the coarse attenuator network R48 - R55 which provides steps of 20dB up to 80dB. Thus the complete range of the two attenuators is 100dB. The output is taken via a 75 ohm cable to a terminating unit. Terminals on this unit allow for the selection of a source impedance of 75 ohms or 7.5 ohms. In the latter condition, the output signal voltage is one-tenth of the nominal output. The maximum open-circuit output voltage across the 75 ohm terminals is 100mV. If the oscillator is loaded with an impedance of the same order as the source impedance, then the usual calculation must be made to determine the true voltage across the load, e.g. if the load is the input of a wireless set designed to match a coaxial cable with an impedance of 75 ohms resistive, then the voltage delivered to the set will be the indicated voltage as read on the attenuators divided by two.

14. The correct carrier level is monitored by the meter M1 when the switch SWD is switched to CAR. The r.f. output from V4 is rectified by the full-wave rectifier circuit comprising the crystal rectifiers MR2 and MR4, and an r.f. filter consisting of L29, L30, C39, C48, R16, R17, C28, C29, and the feed-through capacitors C14 and C17. When the carrier level is measured as being 100mV at the terminating unit (with the two attenuator switches fully clockwise) the carrier level meter pointer is adjusted to be coincident with the CAL mark by the pre-set potentiometer RV7.

15. The a.m. modulation depth and f.m. deviation are monitored as described in paras. 9 and 12 respectively.

POWER SUPPLIES

Input

16. Two separate sockets are provided on the front panel into which the appropriate supply lead for either a.c. mains or 12V battery is plugged. The mains supply is filtered and feeds the mains transformer TR1 at the appropriate tapping point. Mains fuses are provided in each leg. For battery operation the battery supplies a vibrator VB1, which feeds an additional primary winding on TR1. Both the input and the output of the vibrator are filtered and suppressed to reduce "hash" and remove it from the operational frequency band of the instrument. Fuses are provided in each leg of the battery supply. A filter box is provided for use when a common battery is used to supply the oscillator and any other equipment. This box contains two electrolytic capacitors C150, C151, in series across the battery and centre-tapped to earth. It is connected in the battery supply lead and filters out any r.f. introduced via the battery.

Output

17. The mains transformer TR1 has two secondaries, one for the h.t. supply, the other, a 6 volt winding, for valve heater supply. The dial lamp LP1 is connected across the 6 volt winding. The h.t. secondary winding output is rectified by the full-wave rectifier V7 and smoothed and filtered by L13, R66, C52 and C51. An h.t. fuse is included in the positive line immediately before the filtering and smoothing. The h.t. supplies to the reactor V1 and the master oscillator V2 are stabilised by V6. All supplies fed into the screened r.f. box are filtered at the point of entry.

DETAIL OF COMPLETE EQUIPMENT

18. The complete equipment comprises the following main items:

(a)	Oscillator, Test, No. 1	ZD 00783
(b)	Lid Assembly	ZD 00837
(c)	Units, Terminating, r.f. No. 3	ZD 00293
(d)	Connector, 3-Point, No. 102, 5 ft.	ZD 01505
(e)	Connector, 2-Point 4 ft. 6 in. and Filter Assembly No. 1	ZD 02335
(f)	Sundry spare fuses, etc.	

Items (c) to (f) inclusive are carried in (b).