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INSIDE INFORMATION

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SIGNAL GENERATORS

In our previous issue we dealt with two aspects of the measurement of performance of signal generators. Again we return to the general subject of signal generators but this time concentrating upon the repair and modification of one of M.I's most widely used designs, the A.M. Signal Generator Type TF 801D.

This generator, often considered as a "Standard" in several senses of the word, is the current version of a long line of instruments of which several thousands are in daily use.

We hope that the contents of this issue will be of interest to the users of these generators.

YOUR FUTURE COPIES

In view of the specialised appeal of this publication, aimed as it is towards those readers who have occasion to service M.I. test equipment, we invite those who wish to remain on the distribution list to complete and return the enclosed reply-paid card.

M.W.G.H.

IN THIS ISSUE

SERVICING GUIDE TO A.M. SIGNAL GENERATORS TYPE TF 801D AND SERIES

By A.W. Spencer
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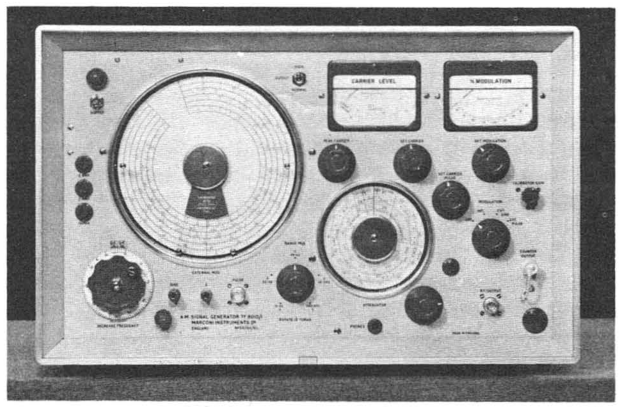
The following information, gathered from Design, Production and Service Engineers and from practical experience, will, we hope, help to overcome some of the problems encountered in Servicing A.M. Signal Generators TF 801D series. The article gives an account of easy testing methods, modifications, general fault finding and correction procedure.



1. Frequency coverage

In the handbook for TF 801D, it can be found that the oscillator frequency on ranges *D* and *E* may be varied by adjustment of the configuration or length of the inductive loops of L6 and L7, respectively.

Difficulty may be experienced either in setting the amplifier tracking, or in obtaining enough output on ranges *D* and *E*, when the carrier is modulated. This difficulty is avoided if the following conditions are met when setting the frequency coverage.

(a) On range *D* 260 MHz should be set at a point corresponding to 27 turns of the fine tuning dial.

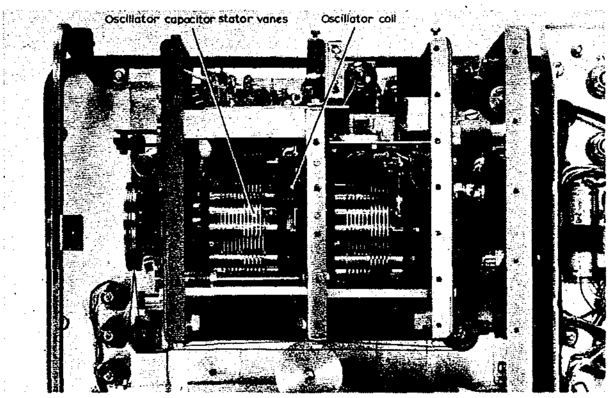
After setting 260 MHz at one end of range *D* tune to the other end of the range and check that 108 MHz lies at a point corresponding to at least 1·5 turns of the fine tuning dial.

(b) On range *E*, 470 MHz (or 485 MHz for the high frequency version) should be set at a point corresponding to 27 turns of the fine tuning dial.

After setting 470 MHz (or 485 MHz) at one end of range *E* tune to the other end of the range and check that 260 MHz lies at a point corresponding to at least 9·5 turns of the fine tuning dial.

Having set the high frequency ends of the ranges at the points given above, it may not be possible to obtain the correct positioning for the low frequency points on each range. It will then be necessary to adjust slightly the positioning of the two fixed stator vanes in the oscillator section of the turret tuning capacitor, to increase the coverage of the range.

If, however, this is attempted, extreme care must be exercised to avoid the stator and rotor vanes coming into contact with one another. The easiest method of checking that these vanes are not shorting, is to apply about 500 volts d.c., from an insulation tester, turn the rotor from one end of its range to the other, and look for sparking between the plates.



Rear view of R.F. box assembly with covers removed showing the oscillator capacitor stator vanes and the oscillator coil (range C). The 4 B.A. nuts may be slackened using a cranked spanner.
The fixing holes have sufficient clearance to permit the necessary adjustment for frequency coverage.

2. Setting the Carrier Level Monitor—Adjustment of RV4

Trouble has been experienced in the past when servicing instruments which were originally fitted with oscillator valves of above average efficiency. This is due to the fact that the method used for setting the value of the carrier level monitor preset (RV4), has not allowed completely for the valve subsequently being replaced by one of average or below average efficiency. It is therefore recommended that the following procedure is adopted when the output levels have to be reset after adjustment to the oscillator or amplifier.

Tune to 15 MHz on range *A* and set RV4 to minimum, (i.e. so that there is maximum deflection on the *Carrier Level* meter). Adjust the *Set Carrier* control to give a *Carrier Level* meter reading of $1\frac{1}{2}$ divisions above the *Set Carrier* mark. Re-adjust RV4 to bring the meter reading back to the *Set Carrier* mark.

3. Output Calibration

The following is a recommended method for setting the attenuator scale law and output calibration after the carrier level monitor has been set as detailed in section 2.

Tune to 15 MHz on range *A* and set the piston attenuator to read 200 mV e.m.f. *Peak* and set the *Carrier Level* control to give a deflection, on the *Carrier Level* meter, to the *Set Carrier* mark. Monitor the output level, using an r.f. voltmeter loaded in 50 Ω. This will give a reading of 100 mV on the r.f. voltmeter for an output level of 200 mV e.m.f. Set the output level to 200 mV e.m.f., when the *Carrier Level* meter is reading at the *Set Carrier* mark, by adjustment both of the *Carrier Level* control and the position of range *A* amplifier coupling coil. Then set the *Attenuator* to 700 mV e.m.f. and check that the reading obtained on the r.f. voltmeter is 350 mV ±0·5 dB, when the *Carrier Level* meter is set at the *Set Carrier* mark.

If the reading is high it will be necessary to increase the spacing of the attenuator pick-up coil. If it is low the reverse would apply. Reset the *Attenuator* to 200 mV and repeat the above procedure until both the 200 mV and 700 mV e.m.f. positions are set accurately at 15 MHz.

Switch to range *E* with the dial set to the position corresponding to 15 MHz on range *A*. Set the *Attenuator* to indicate 200 mV e.m.f. and adjust the true output level to 200 mV e.m.f. by varying the position of range *E* amplifier coupling coil, when the carrier level is *Peaked* and reading at the *Set Carrier* mark on the *Carrier Level* meter. Set the attenuator to 700 mV e.m.f. and check that the r.f. voltmeter reading is 350 mV ±0·5 dB. If the reading is high, it will be necessary to unsolder the amplifier coupling coil and slide it away from the attenuator pick-up coil. If the reading is low, of course, the reverse will apply. Reset the *Attenuator* to 200 mV and repeat the above procedure until both the 200 mV and 700 mV *Attenuator* positions are set accurately on range *E*.

Switch to ranges *B, C* and *D* in turn, tuned to positions corresponding to 15 MHz on range *A*. Set the *Attenuator* to 200 mV e.m.f. and adjust the output levels to 200 mV e.m.f. by adjustment of the position of each amplifier coupling coil, when the carrier level is *"peaked"* and reading at the *Set Carrier* mark on the *Carrier Level* meter. It is not necessary on ranges *B, C* and *D* to check the attenuator scale law since the amplifier coupling coils are mounted on the same type of former as that used on range *A*.

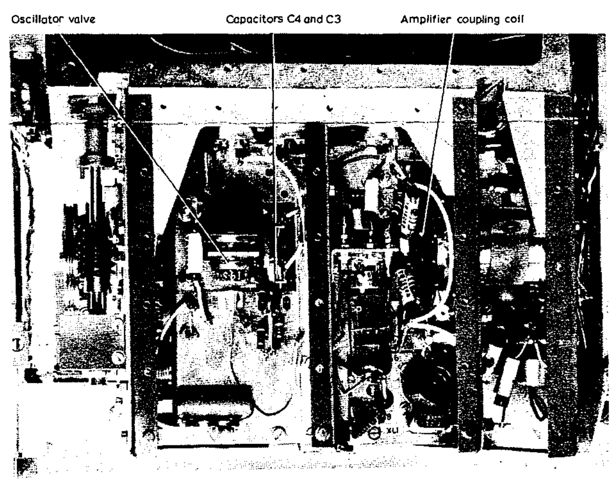
4. Automatic Level Control Adjustment—RV6

On latter models of the TF 801D series, the *Set Carrier* control has been divided into a *Coarse* and *Fine* control. The following method of setting the a.l.c. adjustment (RV6) may be used.

Tune to 15 MHz on range *A peak* the amplifier and set the function switch to *Internal Modulation.* Set the *Coarse Carrier* control to minimum, (fully anticlockwise), the *Fine Carrier* control to maximum, (fully clockwise) and the modulation control to maximum, (fully clockwise). Adjust the a.l.c. adjustment (RV6) to give a standing reading of 20% on the *Modulation* meter. Check that this reading can be brought back to zero by adjusting the *Fine Carrier* control to minimum (fully anticlockwise).

It may be found that it is possible to duplicate the result obtained with another setting of the a.l.c. adjustment (RV6); it is therefore important to obtain the correct setting. Adjust RV6 until the neon tube (V5), is extinguished, then turn back until the *modulation depth* meter reads 20%.

To check the a.l.c. circuit operation, switch to C.W. and tune to 170 MHz on range *D. Peak* the carrier and adjust the *Set Carrier* control to give a deflection at the *Set Carrier* mark on the *Carrier Level* meter. Switch to each range in turn and check that the meter reading does not vary by more than ±1,5 dB, after the carrier has been *Peaked.*



Bottom view of R.F. box assembly with covers removed showing the oscillator valve, V2, and the capacitors C4 and C5 which may be adjusted to reduce spurious f.m.
The amplifier coupling coil may also be seen. This is set for a calibrated output level.

5. Audio Modulation Frequency

Set up and *Peak* the carrier at 15 MHz on range *A*. Switch to *Internal Modulation* and set the modulation depth to 50%. Apply a signal from an R.C.

Oscillator (i.e. TF 1101 or TF 1370), at a frequency of approximately 1 kHz and a level of approximately 2 volts r.m.s., via an isolating capacitor, to the *Pulse input* socket of the signal generator. Carefully tune the R.C. Oscillator through 1 kHz until the modulation meter indication starts to beat. Obtain the null point and then read off the input frequency directly from the R.C. Oscillator.

6. Spurious Frequency Modulation

Since the f.m. deviation of the TF 801 D is generally less than 0·001% of the carrier frequency, it can be difficult to measure accurately; e.g., for a carrier frequency of 10 MHz the f.m. deviation is generally much less than 100 Hz.

The method described below for checking f.m. deviation below 1 kHz employs a Carrier Deviation Meter with a Distortion Factor Meter connected across its L.F. terminals. The Distortion Factor Meter acts as a more sensitive indicator for this measurement and is particularly useful since it has a *Set Reference* control.

Connect an F.M. Signal Generator, set to the frequency of measurement, to the input of the Carrier Deviation Meter. Tune the Carrier Deviation Meter and switch to *Read* on the 0 to 5 kHz *Deviation Range*. Increase the deviation level of the F.M. Signal Generator to give a deviation reading of 1 kHz as read on the Carrier Deviation Meter. Connect a Distortion Factor Meter to the L.F. terminals of the Carrier Deviation Meter. Set the controls of the Distortion Factor Meter as follows:—

Balance Controls to zero.

Frequency to the highest range.

Function switch to *Reject Fundamental.*

By means of the Set Reference control and the *Attenuator,* set the indication to a convenient point on the meter scale. Having calibrated the D.F.M. to give f.s.d. for 1 kHz deviation, remove the F.M. Signal Generator and replace it with the signal generator to be tested.

Set the signal generator to the frequency of measurement, set its *Attenuator* to 0 dB. *Peak* and set the carrier and apply 30% internal modulation. The resulting reading on the D.F.M. is the true spurious f.m. deviation. Thus by decreasing the voltage scale attenuation by 20 dB, from its original setting, the full scale deflection can be expanded to give a reading representing 100 Hz deviation. Similarly a decrease of 40 dB would represent an f.s.d. of 10 Hz deviation and a decrease of 60 dB would represent an f.s.d. of 1 Hz deviation.

To improve the spurious f.m. deviation figure for the instrument under test, adjustments to C4 and C5 can be made. High spurious f.m. signals are more common on the two highest frequency ranges *D* and *E*, since C4 and C5 are usually tightly coupled, for maximum output. However, if adjustments to C4 and C5 are made it is necessary to re-check that the frequency calibration remains unchanged and that maximum output can still be obtained on these two ranges.

7. Pulse Modulation and Carrier Suppression

Switch the signal generator, under test, to *External Pulse Modulation,* tune to 470 MHz on range *E* and adjust the *Attenuator* to 100 mV. With no input pulse, turn the *Set Carrier* control fully clockwise and increase the *Pulse Level* control to give a convenient deflection on the *Carrier Level* meter. Peak the carrier and turn the *Set Carrier Pulse* control to minimum (fully anti-clockwise), ensure that when the control is slowly increased again, the reading on the *Carrier Level* meter does not jump from zero deflection to above the *Set Carrier* mark.

If this does occur, it probably implies that the oscillator valve (V2) is extremely efficient, and that it starts to oscillate with an unusually low h.t. voltage. This may cause the pulse modulated waveform to be distorted.

Having checked that the sensitivity of the pulse modulation facility is satisfactory, set to the *Set Carrier* mark by further adjustment of the *Set Carrier Pulse* control. Feed the r.f. output of the signal generator into a suitable mixer-amplifier unit which is also fed by a local oscillator. The output of the mixer-amplifier unit should then be fed into the Y input socket of an oscilloscope.

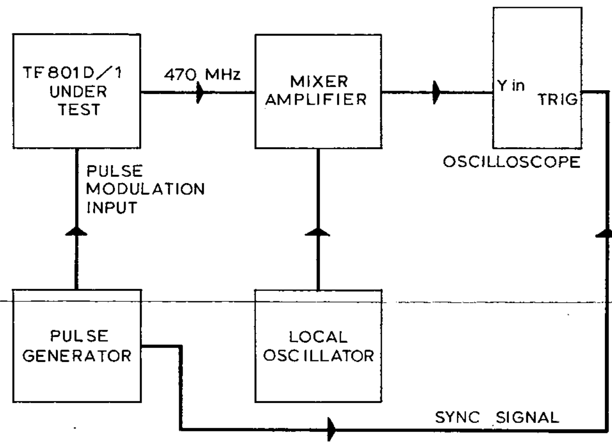


Fig. 1 Test gear arrangement for checking pulse modulation performance.

N.B. A Marconi Instruments FM/AM Modulation Meter TF 2300 includes a suitable oscillator and mixer/amplifier.

Adjust the frequency of the local oscillator to give a suitable display of the amplified difference frequency on the oscilloscope. Measure the peak-to-peak amplitude of the displayed signal and note the result. Apply a 15 μsec pulse at a p.r.f. of 1 kHz, from a pulse generator, at a peak amplitude of greater than 50 volts across 1 MΩ, to the *Pulse Input* socket. Feed a synchronizing signal from the pulse generator to the external trigger terminals of the oscilloscope (see Fig 1). Display the pulse obtained on the oscilloscope and adjust the attenuator of the signal generator to give the same peak-to-peak deflection as the c.w. signal obtained previously. Verify that the peak-to-peak amplitude of the pulse does not differ by greater than ±2 dB from the original peak-to-peak amplitude (see Fig 2).

To check the carrier suppression, note the *Attenuator* setting required to give the same peak-to-peak amplitude as the original c.w. signal. Decrease the output level of the signal generator, by adjustment of its *Attenuator,* until the pulse just disappears into the trace base line. The difference between the two attenuator settings should be more than 20 dB at any frequency.

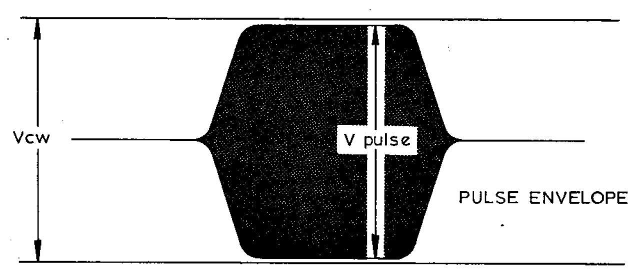


Fig. 2 Diagram of oscilloscope displays. Adjust attenuator to bring V $_{pulse}$ equal to V $_{carrier}$. Attenuator movement should not exceed 2 dB.

8. Modifications to increase the life span of the oscilloscope valve (V2)

The insertion of a limiting resistor in series with the *High-Normal* switch was found to be necessary to give the oscillator valve (V2) an increased life span, if the instrument was used continuously in the *High* output position. The changes are as follows:—

Insert a single pole dot tag adjacent to the tag strip mounted on the side of the r.f. box. Unsolder the lead on the tag strip going to the *High-Normal* switch and re-solder to the new dot tag. Add a wire link between this dot tag and the original tag strip solder lug. This enables a limiting resistor to be fitted of a value determined by the following method:—

Switch to range *E* and tune to 260 MHz, *Peak* and set the *Carrier Level* control to maximum. Adjust the *attenuator* to give maximum output (i.e. 700 mV). It is necessary to load the output in 50 Ω, at this stage, before taking any measurements (a 20 dB attenuator pad will suffice as a load for this measurement). If the deflection on the *Carrier Level* meter is far in excess of 1·1, remove the wire link and replace it with a selected 3 watt resistor, to give a deflection of just above 1·1. Normally the value of resistance required is less than 2·2 KΩ.

MODIFICATION KITS—TF 801D/3M1

In our previous issue we drew the reader's attention to the availability of Modification Kits which enable extra facilities, or enhanced performance to be provided on certain instruments.

It is our intention to deal with these Kits in greater detail as appropriate, and also to review the complete list from time to time.

Since this edition of "Inside Information" is devoted largely to the TF 801D series of signal generators, the following note may be found to be of interest.

V.O.R. Modification Kit for TF 801D series Signal Generators No. 355/25

"A signal generator for Airborne Navigation Aids" was described in the September 1964 issue of our companion journal "Marconi Instrumentation". The article describes how the specification of the TF 801D series instruments requires to be amended to provide the special facilities needed to assess the performance of the receivers which constitute part of the V.O.R., I.L.S. and G.C.A. systems.

The modifications to the modulator, which facilitate the testing of the V.O.R. receiver, namely the reduction of phase shift between the modulating waveform and the modulation envelope to less than 0·1°, are probably the most important and are such that they may be readily undertaken by users of the equipment. The inclusion of these changes results in an instrument which may be identified as a TF 801D/3M1.

Three operations are involved which may be summarised as follows:—

(1) The provision of extra capacitors to the external modulation input circuit to reduce the phase shift at low frequencies.

(2) An additional co-axial socket is mounted on the front panel to enable the a.c. components of the demodulated signal which drives the carrier level meter to be used as a reference signal. The small inherent phase shift in the generator may thus be eliminated from subsequent measurements.

(3) Additional filtering is applied to the h.t. supply so preventing the low modulating frequencies from appearing at the oscillator anode which would result in spurious frequency modulation.

The Kit consists of the components and fixings necessary for these circuit changes with the descriptive drawings and amendments sheets for the handbook.

Unfortunately, the other modifications described in the original article, are of such a nature that they are really only practicable during the initial construction of the instrument.

However, our Service Division can carry out one further modification, which is the fitting of a Counter Output facility, so easing the precise setting of the required 70 MHz carrier frequency during the testing of the I.L.S. receiver.

REPAIR NOTES

1. TF 801 series—Reduction of Hum Level.

Signal Generators are undoubtedly used in the main in connection with receiver testing. The present availability of transistors possessing a wide-bandwidth amplifying capability has led to the use of broad-band aperiodic amplifiers having band-widths extending from a few hertz to several hundred megahertz.

Whereas the selectivity of the tuned amplifier tends to reject unwanted signals, the broad-band amplifier will pass them, so placing extra emphasis on the need for the signal generator output to be free from spurious components.

In the case of TF 801 series Signal Generators it has been found that to reduce the level of hum superimposed on the output signal it is desirable when carrying out repairs or recalibration to ensure that there is no paint beneath the screws which secure the R.F. box to the front panel.

2. Extension Board for TF 2330

The F.M./A.M. Modulation Meter is supplied with an extension board, TM 7926, to ease printed board repairs. It should be noted that this board will be found mounted inside the equipment, at the rear, attached by two coin-screws.

CHANGE NOTES

Continuing the publication of information which we feel will be of interest to those customers who wish to incorporate some of the latest changes, this issue of "Inside Information" covers changes to oscilloscopes types TF 2203, 2200A/1 and TF 2201.

Reference No. 04

Oscilloscope, Type TF 2203

On certain equipments with Serial Numbers prior to H1099, should it ever be necessary to change the convertor transformer, the opportunity may be taken to fit the latest type offering improved efficiency.

The transformer, T1 mounted on the Power Supply and Trigger Circuit printed board is replaced and the associated circuitry modified.

A complete repair kit and assembly instructions with a modification sheet for the handbook may be obtained from Service Dept. under type number TM 9817.

Reference No. 05

Oscilloscope, Type TF 2200A/1

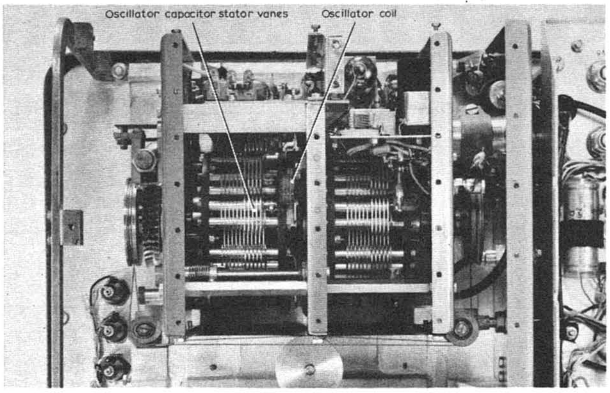
For instruments with batch numbers up to and including 54799, a kit is available (TM 9759) which permits the fitting of replacement cathode-ray tubes embracing a greater range of tolerance of overall length.

Reference No. 06

Oscilloscope, Type TF 2201

This change is also applicable to TF 2201 for batch numbers up to and including 54834.

method of checking that these vanes are not shorting, is to apply about 500 volts d.c., from an insulation tester, turn the rotor from one end of its range to the other, and look for sparking between the plates.



Rear view of R.F. box assembly with covers removed showing the oscillator capacitor stator vanes and the oscillator coil (range C). The 4 B.A. nuts may be slackened using a cranked spanner.
The fixing holes have sufficient clearance to permit the necessary adjustment for frequency coverage.

2. Setting the Carrier Level Monitor—Adjustment of RV4

Trouble has been experienced in the past when servicing instruments which were originally fitted with oscillator valves of above average efficiency. This is due to the fact that the method used for setting the value of the carrier level monitor preset (RV4), has not allowed completely for the valve subsequently being replaced by one of average or below average efficiency. It is therefore recommended that the following procedure is adopted when the output levels have to be reset after adjustment to the oscillator or amplifier.

Tune to 15 MHz on range *A* and set RV4 to minimum, (i.e. so that there is maximum deflection on the *Carrier Level* meter). Adjust the *Set Carrier* control to give a *Carrier Level* meter reading of 1½ divisions above the *Set Carrier* mark. Re-adjust RV4 to bring the meter reading back to the *Set Carrier* mark.

3. Output Calibration

The following is a recommended method for setting the attenuator scale law and output calibration after the carrier level monitor has been set as detailed in section 2.

Tune to 15 MHz on range *A* and set the piston attenuator to read 200 mV e.m.f. *Peak* and set the *Carrier Level* control to give a deflection, on the *Carrier Level* meter, to the *Set Carrier* mark. Monitor the output level, using an r.f. voltmeter loaded in 50 Ω. This will give a reading of 100 mV on the r.f. voltmeter for an output level of 200 mV e.m.f. Set the output level to 200 mV e.m.f., when the *Carrier Level* meter is reading at the *Set Carrier* mark, by adjustment both of the *Carrier Level* control and the position of range *A* amplifier coupling coil. Then set the *Attenuator* to 700 mV e.m.f. and check that the reading obtained on the r.f. voltmeter is 350 mV ±0·5 dB, when the *Carrier Level* meter is set at the *Set Carrier* mark.

If the reading is high it will be necessary to increase the spacing of the attenuator pick-up coil. If it is low the reverse would apply. Reset the *Attenuator* to 200 mV and repeat the above procedure until both the 200 mV and 700 mV e.m.f. positions are set accurately at 15 MHz.

Switch to range *E* with the dial set to the position corresponding to 15 MHz on range *A*. Set the *Attenuator* to indicate 200 mV e.m.f. and adjust the true output level to 200 mV e.m.f. by varying the position of range *E* amplifier coupling coil, when the carrier level is *Peaked* and reading at the *Set Carrier* mark on the *Carrier Level* meter. Set the attenuator to 700 mV e.m.f. and check that the r.f. voltmeter reading is 350 mV ±0·5 dB. If the reading is high, it will be necessary to unsolder the amplifier coupling coil and slide it away from the attenuator pick-up coil. If the reading is low, of course, the reverse will apply. Reset the *Attenuator* to 200 mV and repeat the above procedure until both the 200 mV and 700 mV *Attenuator* positions are set accurately on range *E*.

Switch to ranges *B, C* and *D* in turn, tuned to positions corresponding to 15 MHz on range *A*. Set the *Attenuator* to 200 mV e.m.f. and adjust the output levels to 200 mV e.m.f. by adjustment of the position of each amplifier coupling coil, when the carrier level is *"peaked"* and reading at the *Set Carrier* mark on the *Carrier Level* meter. It is not necessary on ranges *B, C* and *D* to check the attenuator scale law since the amplifier coupling coils are mounted on the same type of former as that used on range *A*.

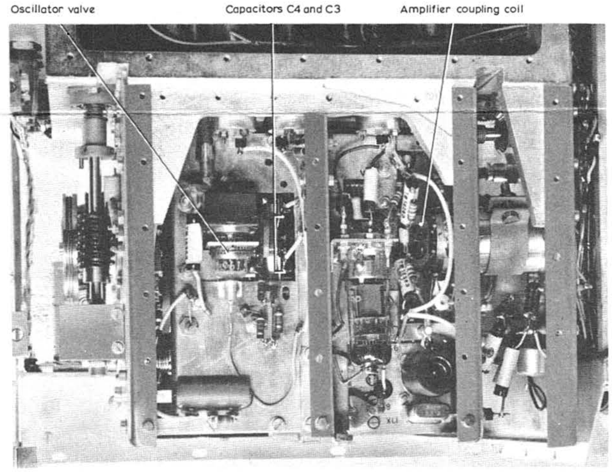
4. Automatic Level Control Adjustment—RV6

On latter models of the TF 801D series, the *Set Carrier* control has been divided into a *Coarse* and *Fine* control. The following method of setting the a.l.c. adjustment (RV6) may be used.

Tune to 15 MHz on range *A peak* the amplifier and set the function switch to *Internal Modulation.* Set the *Coarse Carrier* control to minimum, (fully anticlockwise), the *Fine Carrier* control to maximum, (fully clockwise) and the modulation control to maximum, (fully clockwise). Adjust the a.l.c. adjustment (RV6) to give a standing reading of 20% on the *Modulation* meter. Check that this reading can be brought back to zero by adjusting the *Fine Carrier* control to minimum (fully anticlockwise).

It may be found that it is possible to duplicate the result obtained with another setting of the a.l.c. adjustment (RV6); it is therefore important to obtain the correct setting. Adjust RV6 until the neon tube (V5), is extinguished, then turn back until the *modulation depth* meter reads 20%.

To check the a.l.c. circuit operation, switch to C.W. and tune to 170 MHz on range *D. Peak* the carrier and adjust the *Set Carrier* control to give a deflection at the *Set Carrier* mark on the *Carrier Level* meter. Switch to each range in turn and check that the meter reading does not vary by more than ±1,5 dB, after the carrier has been *Peaked.*



Bottom view of R.F. box assembly with covers removed showing the oscillator valve, V2, and the capacitors C4 and C5 which may be adjusted to reduce spurious f.m.
The amplifier coupling coil may also be seen. This is set for a calibrated output level.

5. Audio Modulation Frequency

Set up and *Peak* the carrier at 15 MHz on range *A.* Switch to *Internal Modulation* and set the modulation depth to 50%. Apply a signal from an R.C.