AIRMEC

RadIVet
Type 211

SPECIFICATION

R.F. SIGNAL GENERATOR

Frequency Range
0— 5 Mc/s   85— 90 Mc/s
5—10 Mc/s   90— 95 Mc/s
10—15 Mc/s   95—100 Mc/s

Tuning
Tuning is by a single control with coarse and fine linear scales. The main scale is calibrated in Mc/s only whilst the subsidiary scale covers 1 Mc/s per revolution and is calibrated in 10 kc/s divisions.

Output
Maximum approximately 50 millivolts.
Minimum approximately 5 microvolts.

Step Attenuators
Step attenuators in the RF probe and on the front panel provide ratios of 1/10, 1/100 and 1/1000 (20, 40 and 60 db.).

Variable Attenuator
A control on the front panel provides a continuously variable attenuation over a 10—1 range. (0—20 db.).

FREQUENCY MODULATION

Frequencies Available
1. 50 c/s.
2. Any frequency available from Audio Oscillator.

Deviation
1. 0—± 250 kc/s at 50 c/s.
2. 0—± 75 kc/s at Audio Oscillator frequencies.
3. Pre-emphasised signal has maximum deviation of ± 75 kc/s available at 15 kc/s. Normal B.B.C. Pre-emphasis of 50 micro-seconds is provided.

AMPLITUDE MODULATION

Frequencies Available
As for Frequency Modulation.

Depth of Modulation
Fixed at approximately 30%.

Spurious Frequency Modulation
The maximum which can occur is 1 kc/s under any conditions.

Combined Modulation
Simultaneous frequency and amplitude modulation can be applied to all ranges for checking, by means of a Wobbulator display, that limiters and ratio detectors are limiting correctly.

CRYSTAL CHECK

A 5 Mc/s crystal oscillator is provided to enable the main oscillator frequency to be set accurately.
The accuracy obtainable is :—
Better than ± 0.01% for any harmonic or sub-harmonic of 5 Mc/s.
Better than ± 40 kc/s for all other frequencies.

AUDIO OSCILLATOR

This is of the Resistance Capacity coupled type and has 11 switched output frequencies of :—
40, 60, 90, 150 and 400 c/s.
1, 3, 5, 8, 12 and 15 kc/s.

Output
The maximum output available is approximately 2.0V and this can be reduced to a minimum of approximately 5 millivolts by means of a control on the front panel.

Output Connections
The output from the Audio Oscillator can be used in the following manner :
1. As a test signal for L.F. stages. Available on audio lead.
2. To frequency modulate the R.F. output on all ranges with a deviation variable between 0 and ± 75 kc/s.
3. To Amplitude Modulate the R.F. output on all ranges to a depth of approximately 30%.
4. To simultaneously Amplitude and Frequency Modulate the R.F. output on all ranges.

OSCILLOSCOPE

The built in Oscilloscope uses a 2½" Cathode-Ray tube and focus and brilliance controls are provided.

Continued overleaf

THE RADIVET has been designed and built with the busy service engineer in mind, and is a very compact piece of test gear for completely checking, aligning and locating faults in all stages of both FM and AM broadcast receivers.

Basically it consists of three quite independent instruments housed in one case — an AM/FM Signal Generator with Crystal Calibration, an Audio Oscillator, and an Oscilloscope. These three instruments which can be used either separately or interconnected by means of switches on the front panel, enable every function of a receiver to be thoroughly investigated.

The exceptionally robust construction of the instrument, coupled with the very high quality of workmanship employed in its manufacture, ensure a long trouble free life. All controls are recessed for maximum protection and the probe leads, which are normally stowed in the end compartments, are permanently attached to avoid accidental loss. The chassis is isolated from the case and earth so that AC/DC sets can be tested as easily as AC sets.

R.F. SIGNAL GENERATOR

The radio frequency signal generator incorporated provides signals from 0-15 Mc/s and 65-100 Mc/s in 6 ranges, each range having a constant width of 5 Mc/s. It is thus usable over all the AM and FM broadcast bands and their respective IF bands. Step and variable attenuators enable the output to be varied continuously from about 5 microvolts up to about 50 millivolts.

TUNING DIAL

A feature of the Generator exclusive to Airmec is the linear tuning dial system (see Figure 1) which enables a very high direct reading accuracy to be obtained without recourse to interpolation. The main scale is calibrated in 1 Mc/s steps only, the number of kc/s being read on a subsidiary scale which is calibrated at 10 kc/s intervals. (For example 14.425 Mc/s appears as 14 on the main scale and 0.425 on the subsidiary scale as shown in Figure 1). Since one complete revolution of the subsidiary scale only changes the frequency by 1 Mc/s, an effective scale length of almost 10 inches per megacycle is obtained over the whole tuning range, even at the upper end of the highest frequency range. This expanded frequency scale not only provides a very high setting accuracy but enables bandwidths of I.F. response curves and discriminator characteristics to be measured directly in frequency when the RadiVet is used as a wobbulator.

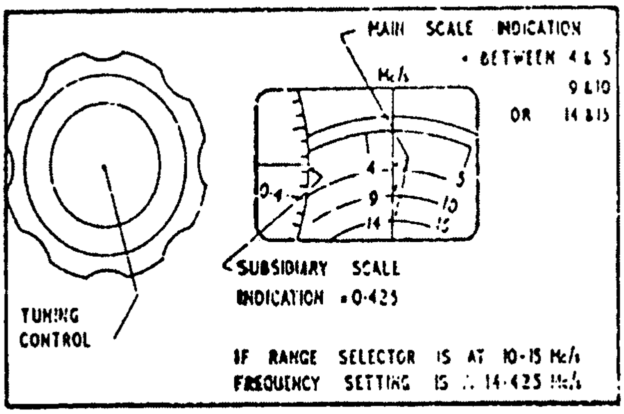

Figure 1. Tuning Dial.

It will be appreciated that full advantage can only be taken of this long tuning scale if firstly, the tuning drive is entirely free from backlash and if secondly, some means is provided for correcting the scale against a crystal standard. The first requirement is dealt with by employing a smooth anti-backlash geared coupling between the tuning knob and tuning capacitor. The second requirement is fulfilled by incorporating a crystal calibrator which is described in detail below.

CRYSTAL CALIBRATION

A 5 Mc/s Crystal Calibrator accurate to 0.01% is incorporated which enables check points to be established at the top and bottom of each of the six frequency ranges. In addition a sub-harmonic at 2.5 Mc/s gives a check point at the centre of each range.

Considerable care has been taken in the design of the calibrator to make it as simple as possible to use. The tuning dial is first set at the nearest check point to the wanted frequency and a calibrate knob adjusted until a zero beat note appears on the CRT screen. The tuning control can then be turned until the required frequency is indicated and the signal generator will be set to that frequency with very high accuracy.

The extreme simplicity of this operation is made possible by the unusual tuning system which gives a completely linear scale between the crystal check points on each range. Once the generator is standardised at a check point therefore, the direct calibration holds for all frequencies within 1.25 Mc/s on either side (that is half way to the next check point) and no arithmetical calculation is needed for interpolation.

AMPLITUDE MODULATION

The Signal Generator can be amplitude modulated by means of a built-in oscillator at frequencies throughout the entire audio range from 40 c/s to 15 kc/s.

This is another exclusive feature which is not normally found even in expensive Standard Signal Generators. Its usefulness cannot be over-estimated since it enables the overall performance of any AM receiver to be checked over its complete audio frequency range, instead of at just one frequency.

The depth of modulation is 30% and great care has been taken to ensure that the spurious frequency modulation is kept to the very low level of less than 1 kc/s.

Apart from modulation by means of the Audio Oscillator the Signal Generator can also be amplitude modulated at the mains frequency of 50 c/s.

FREQUENCY MODULATION

The Audio Oscillator can also be used to Frequency modulate the output signal over the same range of audio frequencies. The deviation under these conditions can be set to any value between 0 and ± 75 kc/s (i.e. 0 to 100% modulation) by means of the continuously variable Deviation Control on the front panel. Normally the modulation level (i.e. deviation) is constant over the whole audio frequency range, but by switching to Pre-emphasis the modulation characteristic is adjusted to that of the B.B.C. transmission. This facility enables the same overall performance checks to be made on FM receivers as on AM receivers.

Furthermore the Output Signal can be frequency modulated with a wide deviation (up to ± 250 kc/s) at the mains frequency of 50 c/s. This is used in conjunction with the Oscilloscope to give a wobbulator display of the I.F. response of F.M. and A.M. receivers and the Discriminator response of F.M. receivers (see Figures 2 and 4a). The frequency of any point on the response curves can be immediately identified by setting it under the cursor line on the CRT screen by means of the tuning control and reading the frequency directly off the tuning dial. Similarly the bandwidth of a response curve (either I.F. or discriminator) can be ascertained directly by moving it across the screen and noting the figures at which the leading and trailing edges fall under the centre cursor line. In the case of I.F. response curves if the amplitude is correctly adjusted to fill the space between the O and Infinity marks on the screen, the bandwidth between any particular levels on the curve may be determined as illustrated in Figure 3.

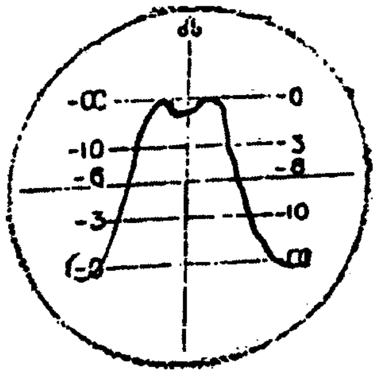

Figure 2. Typical I.F. response curve of a Frequency Modulated receiver.

Complete alignment of an F.M. receiver can therefore be carried out without the need for guesswork and in a fraction of the time taken by any other method.

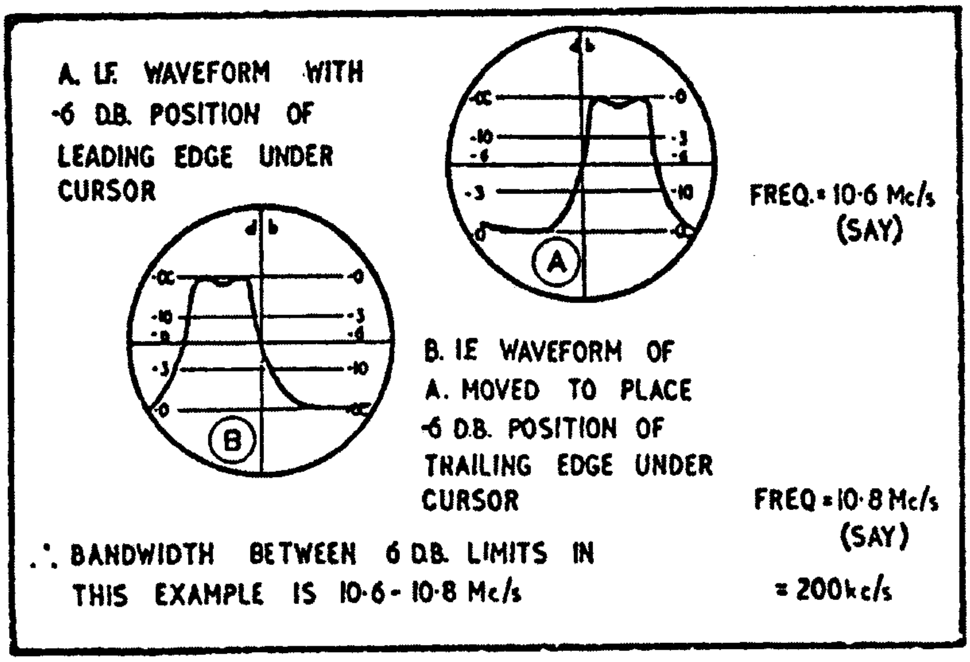

Figure 3. Bandwidth measurement of I.F. response curve.

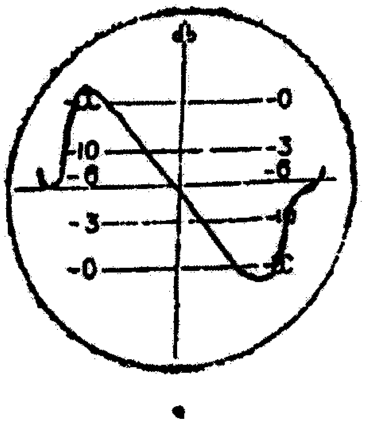

Figure 4 (a). Wobbulator display of discriminator characteristic of a Frequency Modulation receiver.

COMBINED MODULATION

A very important feature of the instrument is the ability to modulate the output signal both in amplitude and frequency at the same time. This provides the only really satisfactory method of checking and adjusting the correct limiting action of discriminators and ratio detectors.

The signal is normally frequency modulated at 50 c/s and a discriminator response obtained on the Oscilloscope. If Amplitude Modulation is then applied, the degree of limiting is immediately shown on the trace as illustrated in Figures 4b and c.

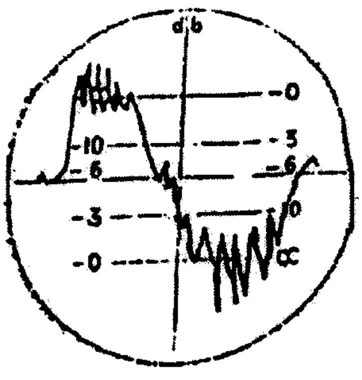

Figure 4 (b). Wobbulator display of discriminator characteristic when limiter is not operating correctly, or ratio detector is unbalanced.

AUDIO OSCILLATOR

The Audio Frequency Oscillator incorporated provides eleven fixed frequencies covering the range 40 c/s to 15 kc/s. A Resistance-Capacity type of oscillator circuit with thermistor control is employed to ensure high stability and purity of waveform.

The output signal which is continuously variable from about 5 millivolts to 2 volts peak to peak, is available for external use from an L.F. Output lead. By adjustment of the switches on the front panel it can at the same time be internally applied to either the X or Y plates of the Oscilloscope and also used to both Amplitude and Frequency Modulate the R.F. Signal.

The Output level is stabilised so that it normally remains constant over the complete audio frequency range and its amplitude can be metered by switching it to the Y plates of the Oscilloscope and measuring it with the Calibrated Y Shift.

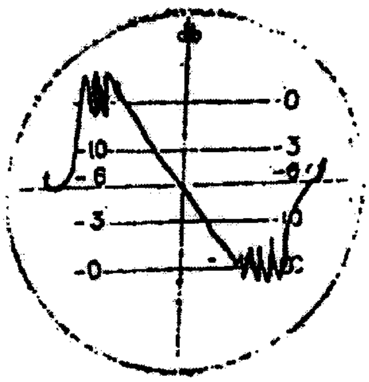

Figure 4 (c). Wobbulator display of a discriminator characteristic balanced for maximum Amplitude Modulation rejection.

When applied to frequency modulate the R.F. Signal Generator the normally constant amplitude output of the Audio Oscillator may be modified to provide a pre-emphasis identical to that employed by the B.B.C. This is obtained simply by switching from 'Normal' to 'Pre-emphasis'.

From the summary of features given above it will be seen that the Audio Oscillator is extremely versatile and can be employed for a wide range of tests. The constant output level enables the frequency response of all audio amplifiers including "Hi-Fi" types, to be rapidly checked. By using the Oscilloscope as an output meter and at the same time with the Audio Oscillator signal applied to the X plates as a time base, both the phase and harmonic distortion of the Audio amplifier can be checked as shown in Figures 5a, b and c.

Similarly the frequency response and phase and harmonic distortion characteristics of a complete AM receiver, or any stage of it, can be checked by using the Audio Oscillator to Amplitude modulate the RF signal applied to the RF or IF stages.

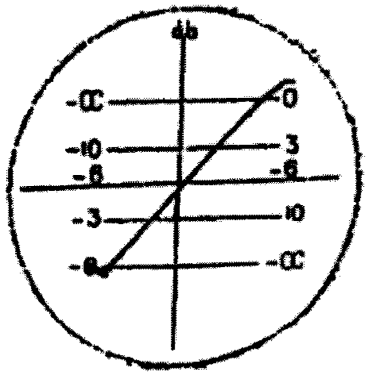

Figure 5 (a). Lissajous figure obtained when the output from the audio-oscillator is fed directly to the X-plates and through a distortionless amplifier to the Y-plates.

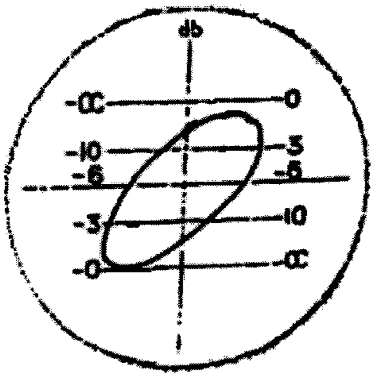

Figure 5 (c). Waveform obtained as in (a) when the amplifier is introducing phase distortion only.

In a like manner the frequency response and phase and harmonic distortion characteristics of a complete FM receiver or any stage of it, can be checked by using the Audio Oscillator to Frequency Modulate the RF signal applied to the RF or IF stages.

Finally the de-emphasis circuits provided in all FM receivers can be tested by switching to F.M. with Pre-emphasis, when as mentioned above, a circuit giving the correct 50 micro-seconds Pre-emphasis as specified by the B.B.C., is switched in. The modulated signal may be fed into the receiver via either the R.F. or the I.F. stages, and the output monitored on the Oscilloscope. If the de-emphasis circuits are operating correctly a constant output at all frequencies should be obtained.

OSCILLOSCOPE

The self-contained built in Oscilloscope employs a 2½" Cathode-Ray tube giving a display of sufficient size and clarity for general purpose servicing work. Brilliance and Focus Controls are provided and automatic flyback suppression on the Time Base is incorporated to ensure a clear display.

The Time-Base employs a hard valve circuit which provides scanning speeds continuously variable from about 50 milliseconds to 100 microseconds, in four ranges. Synchronisation is extremely good and completely automatic, no external synchronisation connections being needed. Figure 6 demonstrates just how positive this synchronisation is and it also displays the output from the Audio Oscillator at 5 kc/s.

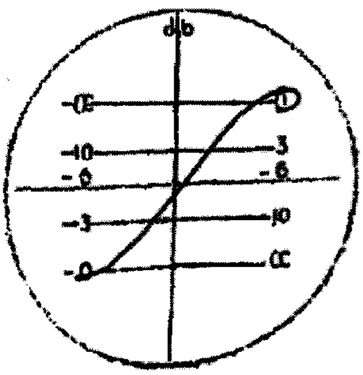

Figure 5 (b). Waveform obtained as in (a) when the amplifier is introducing harmonic distortion.

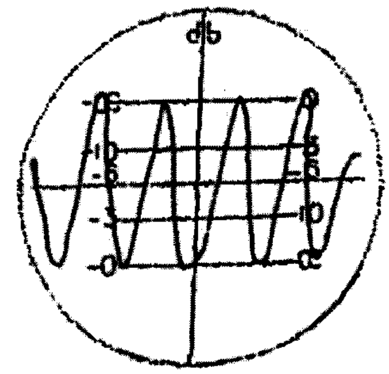

Figure 6. Output from Audio Oscillator at 5 kc/s viewed on the oscilloscope.

In addition, the X plates may be connected via the X amplifier either to an internal 50 c/s signal for use on wobbulator displays, or to the output from the Audio Oscillator. This latter facility enables harmonic and phase distortion to be detected either in the audio frequency amplifier or throughout the complete receiver. This is effected by feeding either a modulated R.F. Signal into the R.F. or I.F. stages, or an A.F. Signal to the audio frequency stages and applying the audio output to the Y plates of the Oscilloscope. If the same signal is then applied to the X plates as a time base, a straight diagonal line should appear on the CRT as shown in Figure 5a. Harmonic distortion generated in the receiver causes the trace to curve (Figure 5b) and phase distortion causes the straight line to open out into a loop (Figure 5c). Thus for the first time the Service Engineer has a tool which will tell him in less than a minute how well a receiver is performing over its entire audio frequency range.

The versatile Y amplifier has a sensitivity of approximately 0.7 volts/cm. and a frequency response from D.C. to 1 Mc/s. The input attenuator and Y shift are calibrated in both RMS values for measuring A.C. voltages and peak values for measuring pulse waveforms and D.C. Input voltages are applied via a special probe which has an input impedance of 10 megohms on D.C. connections and 1 megohm when switched to A.C. connections. Thus the Oscilloscope can not only be used for examining all types of waveforms, but is invaluable as a high impedance A.C. and D.C. valve voltmeter. Typical voltages which cannot normally be measured correctly by moving-coil meters are, for example, those appearing on valve grids due to oscillation, or a leaky coupling capacitor, those appearing on valve electrodes fed from high value resistors (particularly in battery sets where the valve currents are small), and those appearing on AVC lines, etc.. A.C. measurements from 0.1V to 230V RMS. and D.C. measurements from 1.0V to 2000V can be made.

USES OF THE RADIVET

The following is a brief list of some of the possible applications of the RadiVet showing the facilities employed.

TEST	PERFORMED ON	FACILITIES USED
I.F. response.	A.M. receivers	F.M. signal generator and oscilloscope.
Locating faults I.F. stages.	A.M. receivers	A.M. signal generator and oscilloscope.
Overall response	A.M. receivers	A.M. signal generator and oscilloscope.
Locating faults R.F. stages.	A.M. receivers	A.M. signal generator and oscilloscope.
Alignment Check on spot frequencies.	A.M. receivers	C.W. & A.M. signal generators and oscilloscope.
I.F. response.	F.M. receivers	F.M. signal generator and oscilloscope.
Discriminator response.	F.M. receivers	F.M. signal generator and oscilloscope.
Locating faults I.F. stages.	F.M. receivers	F.M. signal generator and oscilloscope.
Overall response.	F.M. receivers	F.M. signal generator and oscilloscope.
Locating faults R.F. stages.	F.M. receivers	F.M. signal generator and oscilloscope.
Alignment check on spot frequencies.	F.M. receivers	C.W. & F.M. signal generators and oscilloscope.
A.M. rejection.	F.M. receivers	F.M. & A.M. signal generators and oscilloscope.
Discriminator Limiting action.	F.M. receivers	F.M. & A.M. signal generators and oscilloscope.
Check on de-emphasis circuits.	F.M. receivers	F.M. Signal generators with Pre-emphasis and oscilloscope.
Check on phase distortion.	A.F. stages	Audio oscillator and oscilloscope.
Check on harmonic distortion.	A.F. stages	Audio oscillator and oscilloscope.
Overall response.	A.F. stages	Audio oscillator and oscilloscope.
Locating faults.	A.F. stages	Audio oscillator and oscilloscope.
Overall response.	Loudspeakers	Audio oscillator.
Output meter.		Audio oscillator, oscilloscope and calibrated Y-shift.
A.C. Valve Voltmeter.		Oscilloscope and calibrated Y-shift.
D.C. Valve Voltmeter.		Oscilloscope and calibrated Y-shift.
General Purpose Oscilloscope.		Oscilloscope with time base adjusted as required.

SPECIFICATION (Cont.)

Time Base

Hard Valve.
Scanning speeds :— 50 milliseconds to 100 micro-seconds in 4 continuously variable ranges. Additionally the time base deflection may be sinusoidal at 50 c/s or at any of the frequencies available from the Audio Oscillator.

Y-AMPLIFIER

The input impedance under A.C. conditions is 1 Megohm and under D.C. conditions is 10 Megohms. Attenuation is provided having division ratios of 1, 3, 10, 30 and 100 on A.C. connections, and 10, 30, 100, 300 and 1,000 on D.C. connections. The gain of the Y-Amplifier is approximately 50 times.

Frequency Response

D.C.—1 Mc/s, the gain at 700 kc/s being not more than 6 db down on that at 1 kc/s.

Y-Shift

The Y-shift control is calibrated from + 2.0V to − 2.0V in steps of 0.2V and in R.M.S. values 0—1.4V, in steps of 0.1V R.M.S.

Voltage Measurement

The accuracy of measurement is ± 10% on all ranges, which are :—

A.C.	50 c/s A.C. with no superimposed D.C.	D.C.
0—140V R.M.S.	0—1400V R.M.S.	0—2000V
0—40V R.M.S.	0—400V R.M.S.	0—600V
0—7.0V R.M.S.	0—70V R.M.S.	0—200V
0—2.0V R.M.S.	0—20V R.M.S.	0—60V
0—0.7V R.M.S.	0—7V R.M.S.	0 20V

PROBES

The following probes are permanently connected to the instrument and are stowed in compartments in the side of the case when not in use :—
R.F. Probe—for all Radio Frequency signal outputs.
Input Lead—for all A.C. and D.C. inputs to the oscilloscope.
Audio Lead—for all Audio Frequency outputs.

VALVES

1 off DG7-6.
1 off EZ81.
1 off 12AT7.
4 off PCF 80.

EARTHING

As the chassis is isolated from the mains earth, universal receivers may be checked without difficulty.

POWER SUPPLIES

The instrument operates from supplies of 100-130 and 200-250V at 40-60 c/s, the consumption being approximately 45 watts. The mains lead is permanently connected to the instrument and can be stowed with the probes when the instrument is being transported.

DIMENSIONS

The overall dimensions are 15½" long x 9½" deep and 8½" high. (39.4 x 24.1 x 21.6 cms.).

FINISH

The case is in dark grey hammer-finish stove enamel, and the front panel in light grey gloss.

WEIGHT

The total weight of the unit is approximately 27 lbs. (12.27 kgs.).

This specification is representative of an average instrument and we reserve the right to effect modifications.

A I R M E C   L I M I T E D
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Telephone: High Wycombe 2501 (10 lines)   Cables: Airmec High Wycombe

INTRODUCTION

The RadiVet has been designed and built primarily as a very compact piece of test gear for checking, aligning and locating faults in all stages of FM receivers. The facilities provided also enable tests to be carried out on Public Address equipment, tape decks, and AM broadcast receivers.

Basically the RadiVet consists of three independent instruments housed in one case: an AM/FM signal generator, with crystal calibration, an audio oscillator and an oscilloscope. These three instruments, which can be used either separately or in conjunction one another, enable every function of a receiver to be thoroughly investigated. The interconnections required for the different tests are set up by means of switches on the front panel.

A brief summary of the facilities of the RadiVet is given in Section 2 from which an experienced service engineer will be able to work out his own methods of employing the instrument. Full instructions for operating the RadiVet to obtain each of the facilities are given in Section 3, and the application of these facilities to testing FM and AM receivers, audio amplifiers, tape recorders and television receivers are dealt with in Sections 4 to 8.

A detailed technical description of the circuit appears in Section 9, a specification in Section 10 and maintenance instructions in Section 11.

1. SUMMARY OF FACILITIES

The facilities provided by the RadiVet are listed below and further information on voltage ranges, accuracy, etc. is given in Section 10.

Signal Generator

The signal generator covers the frequency ranges 0 to 15 mc/s and 85 to 100 mc/s, that is the normal broadcast AM band and FM IF band, and the FM transmission band. The output is in each case obtained by mixing the outputs of two oscillators, one of which may be frequency modulated and the other amplitude modulated. The signal may therefore be un-modulated, modulated with FM or AM or simultaneously with FM and AM at different modulating frequencies. In addition, signals in the bands 0-30 mc/s, 45-60 mc/s, 65-80 mc/s and 195-240 mc/s are obtainable at a lower output level (see Sect. 8).

The signal generator output is fed through a coaxial cable, to a probe unit which contains an attenuator. Output signal levels between approximately 5 micro-volts and 50 milli-volts may be obtained.

1.1. Wobbulator

The signal generator may be frequency modulated at 50 c/s with a frequency sweep of up to 500 kc/s. If this signal is applied to the IF section of an FM receiver, and the resultant audio signal is applied to the ‘Y’ plates of the crt in the RadiVet, a wobbulator display of either the IF filter characteristics or the discriminator or ratio detector characteristics may be obtained. The effect of trimming these circuits can be observed and the circuits aligned for optimum performance very rapidly. If a ratio detector is being aligned, since it is possible to provide simultaneous AM at a higher frequency, the wobbulator display so obtained enables the circuit to be set up correctly for optimum rejection of AM.

A similar procedure, using a very much lower frequency sweep, can be applied to give the response characteristics of a normal AM receiver IF filter.

1.2. Audio Oscillator

An audio oscillator providing a choice of eleven fixed frequencies between 40 c/s and 15 kc/s is incorporated in the RadiVet. This oscillator may be used for amplitude or frequency modulation of the RF oscillator, as an audio output signal for tests on audio equipment and tape recorders and to scan the ‘X’ axis of the cathode ray tube.

1.3. Oscilloscope

The crt has an associated DC coupled 'Y' amplifier and time-base. The frequency response extends from DC up to 1 mc/s and in conjunction with the saw-tooth time-base generator, provides a useful oscilloscope for general waveform investigations. The 'Y' attenuator is calibrated, and in conjunction with a calibrated 'Y-shift' control, enables the amplitude of any observed waveform to be measured.

1.4. DC valve voltmeter

The cathode ray tube, calibrated "Y" attenuator, and calibrated "Y-shift" control form a DC valve voltmeter which enables voltages to be measured without placing an appreciable loss on the circuit. This is particularly useful when measuring the potentials of valve electrodes, where an appreciable current drawn by the measuring instrument can completely change the voltage and provide very misleading results.

1.5. AC Valve Voltmeter

As mentioned in the paragraph dealing with the oscilloscope facility above, the amplitude of a waveform displayed on the crt may be measured by means of the 'Y' attenuator and calibrated 'Y-shift' control. The input impedance is high, as in the case of DC measurements, and the instrument therefore operates as an AC valve voltmeter at 50 c/s and audio frequencies.

1.6. Frequency Calibrator

The instrument contains a 5 mc/s crystal oscillator that may be used to calibrate the output frequency to a very high degree of accuracy.

1.7. Suitability for AC/DC receivers

The chassis and 'earth line' of the RadiVet are isolated from earth and from the case, and the instrument may therefore safely be used with AC/DC sets where the chassis may be 'live' relative to earth.

2. OPERATION

2.1. Initial Adjustment

The RadiVet is supplied complete and ready for use. All probes are permanently connected, and a mains lead is provided to which a plug should be connected. The red, black and green leads are live, neutral and earth respectively and it is important that the earth lead should be connected to ensure correct screening.

The RadiVet is despatched with the mains tapping panel set for operation on 230 volt supplies. If operation on supplies of different voltage is required, the fused plug on the tapping panel, which is accessible inside the right-hand probe storage aperture, should be moved to the required tap.

2.2. Frequency Calibration

If the full accuracy of the frequency calibration of which the RadiVet is capable is to be realised, it is necessary before use to reset the scale by means of the trimmer C75, which is located in the right-hand compartment of the case, as shown in Fig. 2. It is also desirable, where freedom from drift is essential, (for instance when operating on the Long and Medium broadcast bands) for the instrument to have been switched on for a period of at least twenty minutes.
The normal procedure for crystal calibration is as follows:-

(a) Set the tuning dial accurately to the check-point nearest to the frequency at which the instrument is to be used.
The check-points at 2.5 mc/s intervals are recommended for normal use. Additional points which occur at very much reduced amplitude every 5/3 and 5/4 mc/s are not reliable and should not be used unless their identity has been fully established. Both scales are linearly

calibrated in 1 mc/s steps only, whilst the number of kc/s are read off the subsidiary scale which is calibrated at 10 kc/s intervals and revolves once for every 1 mc/s.

Reference should be made to Fig. 4.which shows the tuning dials. The example illustrated could be:-

4.425 mc/s
9.425 mc/s
14.425 mc/s
89.425 mc/s
94.425 mc/s
or 99.425 mc/s

depending on the setting of the RANGE switch (which determines which of the three scales is in use) or the setting of the OUTPUT switch (which determines whether 85 mc/s is to be added to the scale reading).

Where a crystal check-point coincides with a wanted frequency, the accuracy will be 0.01% but between check points the accuracy will be better than ± 40 kc/s.

(b) Set the OUTPUT switch to XTAL CHECK, the GAIN switch to INT. CHECK, and the FM and AM switches to OFF. The ‘X’ PLATES switch may be at 50 c/s or any of the four TB ranges but not at VAR. FREQ. since the audio oscillator is operating as an amplifier for this facility.

(c) Rotate the trimmer C75, the location of which is shown in Fig. 2., until a deflection is obtained on the ‘Y’ axis of the crt. The amplitude of the deflection may then be adjusted to a convenient height by means of the RF OUTPUT control.

As the trimmer is adjusted through the correct tuning point the amplitude of the deflection will gradually rise to a maximum and then suddenly fall to zero. If adjustment is continued in the same direction the amplitude will rise equally suddenly and will then gradually fall off again. The correct setting is at the zero beat between the two amplitude peaks, but it must not be expected that this position will be completely stable and it will be sufficient if the beat is obviously of an audio frequency.

When the OUTPUT and GAIN switches are returned to the required setting the correct output frequency will be obtainable at Probe A (RF probe).

When the wobbulator facility is required the above adjustment should be made but before altering the setting of the GAIN and OUTPUT switches, the FM switch and the ‘X’ plate switch should be set to 50 c/s and the DEVIATION control advanced. The beat note will be seen to become localised at the centre of the trace into a small ‘pip’.

The frequency is now being swung at 50 c/s in synchronism with the ‘X’ plate scan and every time the frequency of the variable frequency oscillator is equal to that of a crystal harmonic this ‘pip’ is produced.

This point on the trace must now be identified since the ‘pip’ vanishes when the instrument is in normal use and in any case its retention would only serve to confuse the outline of any characteristic being traced.
To do this, it is necessary to bring the ‘pip’ exactly under the vertical graticule, using the ‘X’ shift control. Thereafter the point on the trace that appears under this graticule is at the frequency shown on the dial.

The GAIN & OUTPUT switches may now be returned for normal usage. It is assumed in all the following instructions that the frequency calibration check has previously been carried out.

2.3. HF Signal Generator

2.3.1. Un-modulated

The signal generator frequency should be set up as indicated in Section 3.2 above, and Probe A (RF) should be connected to the point at which the signal is required, using the shortest possible connecting leads. The maximum output level is 50 milli-volts with the OUTPUT control fully clockwise and the probe flying lead in the X1 socket. This may be reduced to 5 milli-volts or 500 micro-volts by plugging the probe flying lead into the divide by 10 or divide by 100 sockets, or by a further factor of 10 by turning the OUTPUT switch to the appropriate 20 db position. With any of these output conditions continuous decrease of output level by a further 10 times (20db) may be obtained using the OUTPUT control. For the signal to be un-modulated the FM and AM switches should be set to OFF.

2.3.2. Amplitude Modulation

With the signal generator set up as indicated in Section 3.3.1 above, amplitude modulation at a fixed depth of approximately 30% may be applied by turning the AM switch either to 50 c/s or VAR. FREQ. as required. If turned to VAR. FREQ. the modulating frequency will be that selected by the AUDIO OSC. FREQ. switch.

2.3.3. Frequency Modulation

Normal FM, with a maximum deviation of 75 kc/s may be obtained by setting the controls as indicated in Section 3.3. above, but with the FM switch at VAR. FREQ. NORMAL. The AM switch should be set to OFF. The modulating frequency is the audio frequency selected by the AUDIO OSC. FREQ. switch. Deviation is approximately 75 kc/s with the DEVIATION control at maximum (clockwise), and may be decreased by turning this control in an anti-clockwise direction. An FM signal having the correct BBC pre-emphasis characteristic of 50 microseconds may be obtained with the FM switch in the VAR. FREQ. PRE-EMPHASIS position. With DEVIATION control at maximum the deviation is then approximately 75 kc/s with a 15 kc/s modulating frequency and 14 kc/s at 40 c/s.

High deviation at 50 c/s may be obtained when using the instrument as a wobbulator but this facility is dealt with in Section 3.5.

2.3.4. Simultaneous FM and AM

FM at 50 c/s and AM at a variable frequency or vice versa may be obtained by placing the FM and AM switches in the appropriate positions. The former is required for checking the AM rejection of ratio detectors which is dealt with in Section 4.3.

2.4. Audio Oscillator

The output of the audio oscillator may be obtained from Probe B when the OUTPUT control is at any position other than XTAL CHECK. The audio frequency will be determined by the setting of the AUDIO OSC. FREQ. switch.

The output voltage with the AUDIO OUTPUT control in the maximum (clockwise) position is approximately 0.7 volts RMS., (2 volts peak to peak), and may be reduced by rotating the AUDIO OUTPUT control in an anticlockwise direction. The actual output voltage may be monitored and measured by turning the 'Y' GAIN control to the INT. CHECK position, when the waveform of the output signal may be observed and the voltage measured by the method described in Section 3.8.1. (Note that the waveform will disappear if the Probe B leads are short circuited.)

2.5. Wobbulator

Operation as a wobbulator involves ‘sweeping’ the HF oscillator, that is, applying FM at a relatively low frequency and high deviation, and applying this signal to the equipment under test. The frequency response of the filters or discriminators will produce an amplitude modulated output from this frequency modulated signal, and the amplitude modulation may be used to provide a ‘picture’ of the receiver’s frequency response over the sweep-frequency range. The amplitude modulation must first be rectified in the receiver and this is dealt with in Sections 4.1 and 5.1. (In the case of an FM receiver this involves making the discriminator ineffective). The rectified output is taken from the audio section of the receiver via Probe C and fed via the ‘Y’ amplifier to the ‘Y’ plates of the crt. The ‘X’ plates are connected to the modulating frequency, in this case 50 c/s, and the figure obtained on the crt represents response plotted against frequency.

The procedure to operate as a wobbulator is therefore to adjust the signal generator as described in Section 3.3.3, but with the FM switch at 50 c/s. The ‘X’ plates switch should be turned to 50 c/s and the DEVIATION control adjusted to provide the required amount of ‘sweep’, maximum corresponding to about 500 kc/s. The ‘Y’ GAIN switch should be turned to one of the AC positions, the position being chosen to give a picture of reasonable amplitude. The FOCUS, BRILLIANCE, and the ‘Y’ SHIFT controls should be manipulated to obtain a satisfactory picture.

The horizontal deflection of the trace represents frequency, and the frequency as set up on the tuning control will appear accurately under the vertical centre of the graticule. As the tuning control is rotated, therefore, the picture will move along so that any particular part of the trace may be placed under the vertical line, and the frequency measured. Bandwidths may be determined by measuring the frequency of the two ends of the response, and taking the difference. Accurate frequency calibration may be obtained by checking with the crystal calibrator, as described in Sect. 3.2.

By suitable adjustment of the RF OUTPUT and the ‘Y’ SHIFT controls the trace may be positioned so that it lies between the 0db and infinity horizontal lines on the graticule, as shown in Fig.5. The level at any particular frequency may then be measured by reference to the db scales on the cursor, two of which are provided, since the trace may be inverted.

2.6. Oscilloscope

The oscilloscope may be used to observe repetitive waveforms over a frequency range of approximately 30 c/s to 1 mc/s. Probe C should be connected to the point at which the waveform is available and the earth clip connected to a convenient point on the chassis.

The OUTPUT switch may be in any position other than the XTAL CHECK and the ‘Y’ GAIN switch should be at one of the AC positions; the position being selected to provide reasonable amplitude on the crt.

The ‘X’ PLATES switch should be turned to one of the four T.B. positions. The position chosen will depend on the frequency of the signal being observed and should be the one that enables a steady picture to be obtained at some position of the TB VEL. FINE control.

When a steady waveform of reasonable amplitude is obtained, adjust the BRILLIANCE and FOCUS controls to obtain a sharp trace and centralise the display by means of the ‘X’ shift and ‘Y’ shift controls.

2.7. Valve Voltmeter DC

Voltage measurements may be made by means of the crt, the calibrated ‘Y’ attenuator, and the ‘Y’ shift control. When making measurements on AC/DC receivers, care should be taken to ensure that

Probe A and B are not stowed or located in any position where the leads may short circuit to earth or be a danger to personnel.

The 'X' PLATES switch should not be switched to VAR.OSC. if the OUTPUT switch is at XTAL CHECK. With Probe C short circuited, set the trace on the central horizontal graticule with the 'Y' SHIFT VOLTS control and note the outer scale reading of the 'Y' SHIFT control. Set the GAIN switch to the desired DC range as follows:-

DC:-	0 - 20v	DC x 10
	0 - 60v	DC x 30
	0 -. 200v	DC x 100
	0 - 600v	DC x 300
	0 -2000v	DC x 1000

Connect Probe C to the point at which the voltage is to be measured. A deflection of the trace upward for a positive voltage and downward for a negative voltage will be observed.

The trace should be brought to the central line with the 'Y' SHIFT VOLTS control and the reading noted. The difference between the two readings multiplied by the GAIN setting gives the voltage. For example:-

First Reading		- 0.1v	
Second Reading		+ 0.9v	
Difference	=	+ 1.0v	
GAIN setting	=	x 30	
Voltage	=	1.0 x 30	= +30v

2.8. Valve Voltmeter AC

2.8.1. AC Voltage below 400 peak-to-peak

The connections are the same as for the preceding Section 3.7 except that it is not necessary first to check the zero setting. Measurement may be made at frequencies between 30 c/s and 100 kc/s and at frequencies up to 500 kc/s with reduced accuracy, using the following switch positions:-

0 - 0.7 v	RMS	AC x 1
0 - 2.0 v	RMS	AC x 3
0 - 7.0 v	RMS	AC x 10
0 - 40 v	RMS	AC x 30
0 - 140 v	RMS	AC x 100

First move the trace with the 'Y' SHIFT VOLTS control so that its top is coincident with the central horizontal graticule and note the reading of the INNER scale. Then move the trace until its bottom is coincident with the central horizontal graticule and note the new reading.

Add the two readings together (ignoring the +ve and –ve signs) and the result, multiplied by the GAIN switch setting, is the RMS value of the voltage. For example:-

	First reading		- 0.6v	
	Second reading		+ 0.6v	
	Switch setting		AC x 100	
	Voltage	=	(0.6v + 0.6v) x 100	
		=	1.2 x 100	= 120v AC RMS

2.8.2. 50 c/s Voltage above 400 peak-to-peak

In addition to the AC readings dealt with in Section 3.8.1, higher voltages at a frequency of 50 c/s and having no superimposed DC may be measured with the 'Y' GAIN control in the DC positions. The general procedure is the same as for 3.8.1 and the voltage ranges are:-

0 - 7v	RMS	DC x 10
0 - 20v	"	DC x 30
0 - 70v	"	DC x 100
0 - 400v	"	DC x 300
0 -1400v	"	DC x 1000

3. TESTS ON FM RECEIVERS

3.1. I.F. Response

Service manuals may call for either the single 'spot' frequency or wobbulator method of alignment, but whichever method is used, it must be remembered that most modern FM receivers incorporate a limiter. The signal input level should be kept as low as possible and must always be less than the minimum necessary to operate the limiter. Even if a high level limiter, such as is employed with a ratio detector is encountered, the same warning still applies.

3.1.1. Spot Frequency Alignment

Probe or Control	Connecting or setting
Probe A. (RF)	Signal grid of frequency changer
Probe B (Audio)	Not used
Probe C (Oscilloscope)	Live side of volume control (see text)
FM	OFF
AM	VAR. FREQ.
AUDIO OSC.	Any suitable frequency; say 1 kc/s
GAIN	AC x 1
PLATES	50 c/s or any of the 4 TB positions
TUNING	* Receiver intermediate frequency
RF FREQ. RANGE	as required
OUTPUT	Minimum possible consistent with reasonable deflection of the crt trace

* Some types of receiver use an IF which is higher than 15 mc/s. Since the output of the RadiVet is obtained by mixing the output from a variable frequency oscillator with 'preferred' harmonics from a 5 mc/s crystal oscillator, alternative output frequencies of 15 to 20 and 20 to 25 mc/s are present at Probe A when the RANGE switch is set at 10 to 15mc/s.

For 15 to 20 mc/s use the 5 to 10 mc/s scale and for 20 to 25 mc/s the 10 to 15 mc/s scale. In each case add 10 mc/s to the scale setting. Signals in the band 15 to 20 mc/s are approximately 12 db below the main output signal levels and the amplitude of the signals in the 20 to 25 mc/s band is, of course, still lower. No reduction in accuracy is entailed when these higher output frequencies are used.

When called for in the service manual, the local oscillator of the receiver should be rendered inoperative; this can usually be effected by connecting the oscillator grid to earth.

Remove the core from the secondary tuned circuit of the discriminator or the ratio detector and with the RadiVet connected as above, adjust all the IF cores for maximum deflection of the crt trace. Should the initial signal level be insufficient, due to a receiver fault, it may be increased by disconnecting the RF tuned circuit from the signal grid of the frequency changer, but this should not normally be necessary. The level of the signal on the crt trace can be increased by connecting Probe C to some point further along the AF amplifier chain (e.g. the grid of the power output stage) whilst any necessary reduction of the trace amplitude should, wherever possible, be effected by reduction of the signal input level.

Correct limiter action will be shown by a decreased deflection for an increased signal input beyond the limiter threshold level. For this check, it will generally be necessary to set the GAIN switch to some higher attenuation value than X1 in order to prevent overloading the ‘Y’ amplifier.

3.1.2. Wobbulator Alignment

Probe or Control	Connecting or Setting
Probe A (RF)	Signal grid of frequency changer
Probe B (Audio)	Not used
Probe C (Oscilloscope)	Live side of volume control
FM	50 c/s
DEVIATION	Maximum (fully clockwise
AM	OFF
GAIN	AC X1
‘X’-PLATES	50 c/s
TUNING (RF Frequency Range)	Receiver intermediate frequency as required
OUTPUT	Minimum possible consistent with reasonable deflection of crt trace

Remove the core from the secondary tuned circuit of the discriminator or ratio detector and adjust all cores for maximum deflection of the crt trace. Since the shape of the response will vary with the design of the IF stages, some curves will not appear as shown in Fig. 5, but will have sharp peaks. In the latter case an additional check can be made if a tuning indicator is fitted, as this will generally show maximum deflection when the cores are correctly adjusted. The final curve should, in all cases, be symmetrical about the vertical graticule and in some cases the service manual will illustrate the type of curve which should be obtained.

Correct limiter action will be shown by a flattening of the peak of the response curve when the input signal is increased beyond the limiter threshold level.

3.2. Discriminator or Ratio Detector Response

For this operation, service manuals may again call for either the ‘Spot’ frequency or the Wobbulator method of alignment. The latter method is to be preferred however, since it offers a simultaneous check of correct alignment and linearity.

3.2.1. ‘Spot’ frequency alignment

Probe connections and control settings required are those tabulated for Section 4.1.1. The RadiVet OUTPUT control should then be adjusted until the signal input is just less that that necessary to operate the limiter (i.e. deflection still increases with increased input).

If the core of the discriminator or ratio detector secondary coil is replaced and screwed in, the deflection of the crt trace will rise to a peak, decrease slightly, rise to a further peak and then return to zero. The core is correctly adjusted when the bottom of the trough, between the two peaks, is reached. When the receiver is fitted with a tuning indicator the correct core position will generally coincide with an indication of correct tuning.

3.2.2. Wobbulator Alignment

Connect the RadiVet as tabled in Section 4.1.2 and replace the core of the discriminator or ratio detector secondary coil. As the core is screwed in, at some point, providing no faults exist in the receiver, a trace similar to that shown in Fig. 3a will be obtained. The portion of the trace which crosses the horizontal axis will generally be linear and the two 'humps' of opposite polarity should be equal in amplitude. When the alignment is correct the vertical graticule, which corresponds to the exact IF, will bisect the horizontal distances between the two 'humps'.

Should the servicing data call for a specific bandwidth between either extremities of the linear portion of the response - or the two 'humps'- the bandwidth may be measured by noting the scale readings when one, and then the other limit required, is placed under the vertical graticule. The bandwidth is the difference between these two readings.

3.3. AM Rejection

Probe or Control	Connection or Setting
Probe A (RF)	Signal grid of frequency changer
Probe B (Audio)	Not used
Probe C (Oscilloscope)	Live side of volume control
FM	50 c/s
DEVIATION	Maximum (fully clockwise)
AM	VAR.FREQ.
AUDIO OSC.	Any suitable frequency; say 3 kc/s
GAIN	AC – X1
'X' PLATES	50 c/s
TUNING RF FREQ. RANGE	Receiver intermediate frequency as required
OUTPUT	Minimum possible consistent with reasonable deflection on crt trace

AM rejection is achieved in most receivers by limiter action, but when the incoming signal is below the limiter threshold value and a ratio detector is in use, some additional AM rejection is afforded. Ratio detectors will reduce AM at all frequencies and will eliminate it at the frequency at which the currents in the two diodes are equal. Discriminators however, afford no appreciable AM rejection and are usually preceded by a low-level limiter stage.

The efficiency of the AM rejection can be assessed by means of the response curve which will be obtained when the RadiVet is connected as tabled above. The curve will appear as shown in Fig. 3(b) or 3(c). It can be seen that there is one point on each curve where AM rejection is complete but in Fig. 3(c) this occurs at the incorrect tuning point. Any receiver which presents a response curve of this type would be liable to interference of amplitude modulated form (motor ignition, un-suppressed motors etc.) even when correctly tuned for minimum distortion and, in the case of a ratio detector, maximum output.

The cause of such a characteristic is differing AF paths for the two diodes. Some manufacturers insert small resistors in series with each diode load so that one, or the other, may be short circuited to bring the circuit nearer balance. In some receivers these adjustable resistors may take the form of a potentiometer (with earthed slider) inserted in series with the bias load. If no such adjustment is provided, one or both of the diode load resistor values maybe outside the limits laid down in the service manual. The resistors should be checked and, if necessary, replaced.

In extreme cases, the fault may be due to an out of balance condition of diode impedance caused by one diode losing emission, or the use of unmatched crystal diodes.

3.4. RF alignment

Since there is considerable variation in the manner in which the RF circuits of FM receivers are tuned, the specific alignment instructions in the manufacturers service data sheets must always be followed.

Probe or Switch	Connection or Setting
Probe A (RF)	Aerial input (or at point stated in service data sheets.)
Probe B (Audio)	Not used
Probe C (Oscilloscope)	Input to 1st. AF stage
FM	VAR. FREQ. NORMAL
DEVIATION	As required – see text
AM	OFF
AUDIO OSC.	Frequency required. Say 1 kc/s
GAIN	AC Position as required to prevent overloading of 'Y'- amplifier
X – PLATES	50 c/s or any of the four TB ranges
TUNING	Required alignment frequency
RF FREQ. RANGE	+ 85 mc/s (Normal or – 20 db as required
OUTPUT	As required See text

Using the above connections, adjust all trimmers etc. as laid down in the servicing instructions. The amplitude of signals on the crt should be adjusted as required by the setting of the GAIN switch and the receiver volume control. The setting of the DEVIATION control will also affect the amplitude of the crt display, but this control should be set as required by the service data sheets. Maximum deviation of 75 kc/s is obtained when the control is fully clockwise.

When aligning RF stages, great care must be taken to ensure that the signal input level is always less than that necessary to operate the limiter. After each trimmer has been adjusted, check that a slight reduction in the RadiVet output does, in fact, reduce the amplitude of the crt display. If this is not so, reduce the RadiVet output accordingly and re-check the trimmer setting.

3.5. Overall check and de-emphasis

100% modulation on the existing BBC system refers to 75 kc/s deviation. With the pre-emphasised transmission characteristic of 50 micro-seconds which is used, the modulation signal level which is necessary to provide 75 kc/s deviation at 15 kc/s will only provide 14 kc/s deviation at 40 c/s, and this accent on the higher frequencies has to be eliminated by the de-emphasis circuit on the receiver. In order to check that this de-emphasis is being correctly applied in the receiver, the RadiVet can be frequency modulated with the correct pre-emphasis characteristic by setting the FM switch to VAR. OSC – PRE-EMPHASIS.

Probe or switch	Connection or setting
Probe A (RF)	Aerial input (or at point stated in service data sheets)
Probe B (Audio)	Not used
Probe C (Oscilloscope)	Loudspeaker terminals
FM	VAR. FREQ. – PRE-EMPHASIS
DEVIATION	Maximum (fully clockwise)
AM	OFF
AUDIO OSC.	Frequency required – (see text)
GAIN	AC position as required to prevent overloading the 'Y' amplifier

X-PLATES	50 c/s or any of the 4 TB ranges
TUNING	Required alignment frequency
RF FREQ. RANGE	+85 mc/s (normal or –20 db as reqd.)
OUTPUT	Sufficiently high to just operate limiter stage

With the RadiVet connected as above, advance the RF OUTPUT control until the amplitude of the crt trace stops increasing with increased input. Continue to turn the control for approximately 1/8” past this point to ensure that the signal input is operating the limiter without overloading the receiver.

Adjust the GAIN switch and receiver volume control to obtain a crt display of about 1” in height and note any changes in display amplitude as the AUDIO OSC. control is switched over the frequency range of the audio amplifier.

A level output indicates correct de-emphasis whilst a lack of de-emphasis results in an output which increases with frequency. If the output decreases with increased frequency, the cause may be too much de-emphasis, but in any case the checks enumerated in Sections 6.1 and 6.2 (pages 19 & 20) should be carried out to prove that the AF amplifier response is normal. This provision is made because the setting of tone controls or a faulty amplifier can materially alter the overall characteristics.

4. TESTS ON AM RECEIVERS

The output frequency specification limits of ± 40 kc/s assume great importance at the low frequencies required for the correct alignment of IF stages and the Long and Medium wavebands of AM broadcast receivers. It is therefore recommended that an early opportunity be taken to check the scale accuracy at low frequencies. This should be done by calibrating the instrument at 0 and 1.25 mc/s with the Crystal Calibrator (as outlined in Sect. 3.2) and comparing the output frequencies with the tuning scale readings of a receiver of known accuracy. If the more common calibration frequencies are checked and the corrected scale readings noted, these frequencies can always be reproduced with a very high degree of accuracy.
The crystal calibration must be accurately carried out each time these low frequencies are required.

4.1. IF Response

Connect the RadiVet as tabulated in Sect. 4.1.1 and align all IF cores and trimmer capacitors for maximum output.
If it is desired to obtain a wobbulator display of the IF response, connect the RadiVet as in Sect. 4.1.2., set the DEVIATION control initially to about 1/5th of its total clockwise movement and adjust as required. A trace similar to that shown in Fig.5 will probably be obtained, but reference should be made to the service data sheets to find the correct response. A much smoother control of deviation can be obtained if the ‘X’-plates are switched to VAR.OSC., the FM switch is set at VAR.OSC.-NORMAL, and the AUDIO OSC. set to a frequency between 40 and 400 c/s. Under these conditions some receivers may present a double trace because of phasing differences and the absence of blackout on the trace return, but no confusion should arise regarding the shape of the response curve.

Bandwidth measurements may be made in the manner outlined in Fig. 5 but the value obtained will generally be of the order of 5 to 10 kc/s instead of 200 kc/s as quoted in the example.

4.2. RF Alignment Check

The frequency accuracy of the RadiVet after crystal calibration is high enough for the RF alignment of AM receivers on the short wave bands to be carried out. At the lower frequencies however, (that is in the medium and long wavebands) the RadiVet scale must be checked as indicated in Sect. 5.

The RadiVet is then connected as tabulated in Sect. 4.1.2 and the RF circuits aligned as described in the manufacturer's instructions.

An alternative method for calibrating the RadiVet at low frequencies is given below. This is very simple but only provides a series of accurate spot frequencies. Set the RadiVet to 1.25 mc/s as checked by the crystal calibrator and connect as follows:-

Probe or Switch	Connection or Setting
Probe A (RF)	Aerial input
Probe B (Audio)	Not used
Probe C (Oscilloscope)	Across loudspeaker terminals
FM	OFF
AM	VAR. FREQ.
AUDIO OSC.	Any suitable frequency; say 1 kc/s
GAIN	AC position as required to give a display of reasonable amplitude without overloading the 'Y' amp.
'X' PLATES	50 c/s or any of the first 4 TB positions
TUNING	1.25 mc/s
RANGE	0 – 5 mc/s
OUTPUT	Maximum

Tune the receiver to 1.25 mc/s until the RadiVet signal is heard. If the RadiVet is now tuned through the frequency range 100 kc/s to 1.25 mc/s a signal will be heard at each of following frequencies:-

125, 139, 156.3, 178.6, 208.3, 250, 301.25, 416.6, and 625 kc/s.

Once the positions of these spot frequencies on the RadiVet tuning dial have been determined, any of them may be used for the alignment procedure. For instance, if the manufacturer specifies alignment at 100 kc/s and 600 kc/s, the 125 kc/s and 625 kc/s signals could be employed.

4.3. Overall Check

This test is an extension of Sect. 5.2 and the RadiVet should be connected as tabulated for that section. Set the TUNING control to the required frequency and switch the AUDIO OSC. from 40 c/s to 15 kc/s. The output amplitudes at each frequency should be noted and plotted to illustrate the overall frequency response of the receiver.

5. AUDIO AMPLIFIERS

The tests outlined in Sect. 6.1 & 6.2 can be applied to any audio amplifier, either as a whole or to an individual stage. The AF stages of commercial receivers are not normally subjected to rigorous response checks, but where the overall performance of a receiver is indifferent, due perhaps to a lack of either treble or bass response, overall distortion and response tests can be informative.

Detailed information on the response of audio stages is not normally given in the servicing instructions, but it will be found that the audio stages of AM receivers will generally have a range of about 400 c/s to 5 kc/s, whilst some FM receivers might have a very much wider range. When making overall response checks on any receiver the limitations of the audio amplifier must always be borne in mind if a true picture of the performance is to be obtained.

'Hi-Fi' equipment and public address systems will probably reproduce the full range of frequencies from 400 c/s to 15 kc/s with little or no distortion.

Information on the characteristics of any type of tone control can be obtained by performing these tests with the tone control in its extreme positions and plotting the curves so obtained.

5.1. Distortion check and phase-shift measurement

Probe or Switch	Connection or Setting
Probe A (RF)	Not used
Probe B (Audio)	Input to first AF stage
Probe C (Oscilloscope)	Loudspeaker terminals
OUTPUT	Any position except XTAL CHECK
AUDIO OSC.	Frequency required. See text
AUDIO OUTPUT	As required
GAIN	AC position as required to give a crt display of reasonable amplitude without overloading the 'Y' amp.
'X' PLATES	VAR. OSC.

Connect the RadiVet as tabled above and switch the AUDIO OSC. to 40 c/s. If the output is pure, an inclined linear trace, as shown in Fig. 3d will be obtained. (A rapid check, to see that the RadiVet is not causing distortion, can be made by switching the 'Y' GAIN to INT:CHECK. A straight line will normally be seen regardless of the AUDIO OSC. frequency). By checking the non-linearity of the trace at each frequency from 40 c/s to 15 kc/s, a thorough check can be made of the distortion characteristics of the amplifier.

If harmonic distortion is present, the tips of the trace will bend towards the horizontal as shown in Fig.3g whilst overloading the amplifier will result in a trace similar to Fig. 3f. Severe overloading will cause both ends to bend sharply in the manner of Fig. 3h. If overloading is experienced before maximum rated output is reached possible causes are faulty supplies, a low emission valve or faulty biasing conditions.

The output in watts may be determined by measuring the RMS deflection of the trace and calculating as follows:-

$$\text{Watts} = \frac{(\text{Output voltage})^2}{\text{Loudspeaker impedance}}$$

If the maximum output is too loud for continuous testing, the loudspeaker should be replaced by a high-wattage resistor of the same value.

If the trace opens into an ellipse, as shown in Fig 3e, the cause is phase-shift between the input and output of the amplifier. A horizontal or vertical ellipse denotes 90° phase-shift and in other cases, the phase angle may be found by carefully centralising the ellipse about the central point O, as shown in Fig. 3e, and measuring distances OP and OQ. The phase angle may then be calculated as follows:-

$$\text{Sin } q = \frac{OP}{OQ} \text{ where q is the phase angle}$$

(NB: 180° phase-shift will produce a straight trace inclined from top left to bottom right of the crt.)

5.2. Overall response check

Connect the RadiVet as tabulated in Sect. 6.1 and with the 'X' PLATES set at 50 c/s or any of the TB positions, measure the amplitude of trace deflection on the crt at each frequency from 40 c/s to 15 kc/s. If these results are plotted they will illustrate the overall response characteristic of the amplifier.

If the characteristic has an unexpected falling tendency at either end, or in the middle, the position of any tone control should be checked. If their setting is not the cause of the unusual characteristic, examine each audio stage individually until the cause of the fault is located.

6. TESTS ON TAPE RECORDERS

The RadiVet is extremely useful for assessing the performance of, setting up and locating faults in magnetic tape recorders. When manufacturers' instructions or service data sheets are available they should be followed as closely as possible. The following instructions are intended to supplement those given for any particular machine, and in the absence of any specific servicing data, they will serve as a guide to the procedure which should be adopted.

6.1. Bias

The bias waveform must be completely free from distortion or noisy recordings may result. The bias frequency is less important: it usually lies between 40 kc/s and 60 kc/s, and quite wide latitude is permissible. Incorrect bias amplitude can cause distortion, low output and poor signal/noise ratio.

6.1.1. Bias Waveform

Use the oscilloscope facility of the RadiVet and connect Probe 'C' to the bias supply point of the 'record' head.
Any distortion of the bias oscillator waveform should be remedied until a pure waveform is obtained. A common cause of distortion is over-driving the bias oscillator valve and if distortion is apparent this possibility should be examined before more complex measurements are made.

6.1.2. Bias Frequency

Use the oscilloscope facility of the RadiVet with the 'X' PLATES switch set to VAR. OSC. Under these conditions, a Lissajou pattern (Fig. 7) will be obtained and the AUDIO OSC. switch and the recorder bias frequency control should be adjusted in conjunction with each other until the pattern is stationary. By cross-reference between the pattern and the table below, the exact frequency of oscillation can be determined and hence the oscillator adjusted to the nearest frequency to the one specified in the instructions.

Bias Frequency	Loops	AUDIO OSC. Frequency
40	5	8
42	2 x 7	12
44	2 x 11	8
45	3	15
48	4	12
50	10	5
52	2 x 13	8
54	2 x 9	12
56	7	8
60	4	15

6.1.3. Bias Amplitude

The correct level of bias is usually specified as being a level slightly greater than that required to obtain the maximum output for a given signal input. If the required level is known, the bias level can be measured using the AC valve voltmeter facility and may then be adjusted as required.

If the correct bias amplitude is unknown it may be ascertained as follows:-

Connect Probe 'B' to the 'record' input terminals, set the AUDIO. OSC. to 400 c/s, adjust the AUDIO OUTPUT and 'record' level controls to the normal recording level and measure the Bias Amplitude by means of the AC Valve Voltmeter facility. Record short lengths of tape at different bias levels and tabulate bias levels against footage indicated readings.

Play back the recorded lengths using the AC Valve Voltmeter facility to measure the output from each length of tape and tabulate the results of output against footage indicator readings.
If these two sets of results are combined to plot the curve of output amplitude with reference to bias level, the correct bias level can be determined from the curve, as illustrated in Fig. 6.

6.2. Recording

The correct recording level, which is normally taken as being half the signal input necessary for tape saturation, is important if the optimum signal/noise ratio is to be obtained whilst still permitting the recording of reasonable peaks without distortion.

If true reproduction is to be obtained using a 'playback' amplifier having the accepted 6db increase per octave below 1 kc/s, the record characteristics must be correct. It is normally level up to the anode of the final amplifier, though in some cases pre-emphasis may be applied to frequencies above 2 kc/s.

6.2.1. Recording level

Bias Frequency	Loops	AUDIO OSC. Frequency
40	5	8
42	2 x 7	12
44	2 x 11	8
45	3	15
48	4	12
50	10	5
52	2 x 13	8
54	2 x 9	12
56	7	8
60	4	15

Using the above connections record short lengths of tape at different record inputs, checking that the crt display shows no signs of distortion, (i.e. the 'record' amplifier is not being overloaded) and tabulate the levels used against footage indicator readings. The maximum input that should be used is just below the level that overloads the 'record' amplifier.

When this has been completed, disconnect Probe B, connect Probe C to some suitable point in the playback amplifier chain and play back the tape. Tape saturation will cause distortion of the waveform displayed on the oscilloscope, and the correct 'record' level can thus be identified.

6.2.2. Record characteristics

When making this check the tape may, if desired, be removed from a machine that is not fitted with an automatic stop.
Connect the RadiVet as tabled in Sect. 7.2.1 and adjust the AUDIO OUTPUT and 'record' level controls until the correct level is indicated. Set the AUDIO OSC. at 40 c/s and measure the amplitude of the deflection of the crt trace. Repeat this at all frequencies from 40 c/s to 15 kc/s and plot the results to illustrate the 'record' characteristics.

6.3. Overall characteristics

Connect Probe B to the 'record' input terminals and record a length of tape at each playing speed as follows:-

At an input frequency of 400 c/s adjust the 'record' level to slightly less that one half of its correct value and then record all frequencies from 40 c/s to 15 kc/s. Tabulate frequency against footage indicator readings.

Play back each length of tape measuring the output amplitude at each frequency by means of the AC valve voltmeter facility and tabulate the results of output against footage indicator readings.

Combine these two sets of figures to give a table of output amplitude with reference to input frequency and plot the curve. The play-back characteristics should, in general, have a level frequency response as follows:-

Approximately	40 c/s to 5 kc/s	at 3 ¾	ips tape speed.
=	40 c/s to 12 kc/s	at 7½"	ips tape speed.
=	40 c/s to 15 kc/s	at 15"	ips tape speed.

6.4. Wow, Flutter and Tape Drop-out

Record a length of tape at 400 c/s with Probe B connected to the input terminals and the AUDIO OUTPUT and 'record' level controls adjusted to give the correct level.

Play back the recording and examine the output, both aurally and by means of the oscilloscope facility of the RadiVet. If the recorder suffers from wow or flutter, the note will be heard to vary in frequency and the synchronisation on the oscilloscope will be erratic. If this is so the capstan should be checked for eccentricity.

Random variations in amplitude (sometimes known as 'drop-out') will be immediately apparent from the above. The cause is almost always a faulty tape, and the imperfect section should be excised.

6.5. Tape slip

Record a length of tape as in Sect. 7.4, but at a low frequency (say 60 c/s). Play back this recording and monitor the output using the oscilloscope facility with the 'X' PLATES set at VAR. OSC. and the AUDIO OSC. at 60 c/s. An almost stationary ellipse should be obtained. Any sudden change in the location of the ellipse is due to tape slip which is generally caused by inadequate pressure from the pinch roller.

7. TESTS ON TELEVISION RECEIVERS

The TeleVet Type 877 is designed solely for testing television receivers and the RadiVet is a complementary instrument which was not designed for this purpose. The RadiVet can, however, provide a number of useful facilities in this direction.

A large number of manufacturers instruction sheets specify the 'spot' frequency method of alignment and outputs in the following ranges can be obtained from Probe A at an amplitude of approximately 50mv:-

0 - 15 mc/s	in 3 x 5 mc/s bands	
45 - 60 mc/s	in 3 x 5 mc/s bands:	(Output switch to +85 mc/s)

The two above ranges can be amplitude modulated at 50 c/s or with any of the audio oscillator frequencies, if required.

The following ranges of weaker signals can be obtained either un-modulated or frequency modulated at 50 c/s or any of the audio oscillator frequencies.

0 – 30 mc/s	in 3 x 10 mc/s bands: (FM or AM)	This is the 2nd. harmonic of the 0 – 15 mc/s range.
65 – 80 mc/s	in 3 x 5 mc/s bands: (FM only)	Output switch to +85 mc/s. The level of signal is greater than that of the normal output ranges.
195-240 mc/s	in 3 x 15 mc/s bands:	Output switch to +85 mc/s. This is the 3rd. harmonic of the 65-80 mc/s range, but it may be of sufficient amplitude to be of use on Band III receivers.

In all cases, provided that calibration adjustments are carried out as specified in Sect. 3.2, these ranges are of the same high order of frequency accuracy as the normal output range of the RadiVet.

7.1. Alignment of vision channel.

Connect Probe A to the required signal injection point of the receiver and with Probe C connected to some point between the vision detector and the modulating electrode of the crt, carry out the aligning procedure as detailed in the service data sheets.

When amplitude modulated signals are injected, the AC Valve Voltmeter facility should be used to monitor the amplitude of signal received at the vision amplifier, whilst if un-modulated signals are injected, the DC Valve Voltmeter facility should be used to measure the changes in DC level caused by signal injection and trimming adjustment.

7.2. Alignment of sound channel.

Spot frequency alignment, using amplitude modulated signals only, may be carried out as in Sect. 8.1., but with Probe C connected to any required point between the sound detector and the loudspeaker.

The audio circuits can, of course, be checked as detailed in Sects. 6.1 and 6.2.

7.3. Time base checks.

Since the frequency response of the Oscilloscope ‘Y’ amplifier extends to at least 1 mc/s, line and frame time-base waveforms may be examined without introducing any appreciable distortion by connecting Probe C to the required point and setting the GAIN switch to the AC position which gives a display of reasonable amplitude. The waveform can be resolved by switching the ‘X’ PLATES to one of the TB positions as required and adjusting the TB VEL. FINE control until a satisfactory display is obtained.

8. DESCRIPTION OF CIRCUIT

8.1. General

The circuit diagram of the instrument is shown in Fig. 1a/1b (in the appendix) and the list of components in Table 1.
Figure 2 shows the location of the major components.

The circuit consists essentially of a signal generator, audio oscillator, oscilloscope and crystal calibrator and each of these basic units is described in turn below.

8.2. RF Signal Generator

The double triode valve V1 forms the variable frequency oscillator. One half is the reactor valve V1a and the other half is the tuned anode oscillator. The basic range is 65 – 70 mc/s. Two other ranges are obtained by means of the RANGE switch S7, which connects shunt inductors and capacitors to give ranges 70 – 75 mc/s and 75 –80 mc/s. The main tuning capacitor is C7 and this has been made linear in frequency by an adjustable capacitor C8 which is set up at each megacycle calibration point in the factory. Each calibration adjustment is accessible in turn through the plugged hole in the front panel as the dial is rotated. Re-adjustment should not be attempted without the correct equipment.

In order to be able to adjust the oscillator against the crystal calibration, a trimmer C75, which is accessible at the right-hand side of the case, has been provided.

A proportion of the common anode signal voltage of the valve V1 is fed via the quadrature network formed by the anode to grid capacitance of V1a and R1, to the grid of V1a. V1a signal current is then in quadrature with the current of V1b. Both these currents pass into the common tuned circuit and the frequency is dependant on the proportion of these currents.

The amount of quadrature current is controlled by altering the bias of V1a by means of AF signals fed to the grid via the DEVIATION control R4. This results in frequency modulation of the variable frequency oscillator.

The signal is then fed to the pentode buffer amplifier V2a. This amplifier is flatly tuned over the range 65 – 80 mc/s and shares a common anode circuit with the crystal harmonic amplifier V3a.

The oscillator valve V5b is a pentode which generates the fundamental crystal frequency of 5 mc/s by using the screen as the anode of a triode oscillator. The anode circuit L7 is tuned to 65 mc/s, (that is the 13th harmonic of the crystal). A certain amount of regeneration takes place via C57. L7 is normally tuned with circuit stray capacitance, but when the OUTPUT switch S4 is in either of the +85 mc/s positions, L7 is shunted by C76 so that it tunes to 20 mc/s – (that is the fourth harmonic of the crystal).

When the OUTPUT switch is in the central position XTAL CHECK, the damping resistor R25 flattens the tuning of L7 so that preference is not given to any crystal harmonic.

The output of the variable frequency oscillator (65-80 mc/s) therefore appears at the anode of the crystal harmonic amplifier together with either of the following:-

(a) Preferred 13th harmonic (65 mc/s) - NORMAL
(b) All crystal harmonics - XTAL CHECK
(c) Preferred 4th harmonic (20 mc/s) - +85 mc/s

These added outputs when fed to the mixer valve V2b will result in the following:-

(a)	VFO minus crystal 65 mc/s, giving 0–15 mc/s in three ranges 0-5, 5-10 and 10-15 mc/s.
(b)	Each crystal harmonic from the 13th to the 16th will produce an audio beat at 5 mc/s intervals so that the frequency of the VFO may be checked at 5 mc/s intervals. Additional beats may be found at 2.5 mc/s or even 1.667 mc/s and 1.25 mc/s intervals due to the second, third and fourth harmonics of the VFO beating with higher order harmonics of the crystal.
(c)	VFO plus crystal 20 mc/s giving 85- 100 mc/s in three ranges 85-90, 90-95 and 95-100 mc/s

Each of the outputs is controllable in amplitude by the RF OUTPUT control R22, which varies the anode voltage of the mixer valve V2b. The additional tuned circuit L10, C79 ensures that enough of the 20 mc/s signal is available at the mixer grid.

The output signal passes via C17 and S4a (which imposes 20 db attenuation in two of its settings) to the output Step Attenuator housed at the end of RF OUTPUT lead (Probe A).

It is possible to pass an audio frequency or 50 c/s signal via the 'AM' switch S2 to the screen of the crystal harmonic amplifier V3a. This will result in amplitude modulation to a constant modulation depth of the output on all ranges.

Frequency modulation at an audio frequency or 50 c/s can be passed to the DEVIATION control via the FM switch S1. C6 and R8 form a pre-emphasis network so that the audio signals may be pre-emphasised to the same degree as the BBC transmissions. This means a maximum deviation of 14 kc/s at 40 c/s rising to a maximum of 75 kc/s at 15 kc/s modulating frequency. De-emphasis should take place in the receiver.

8.3. Audio Oscillator

Triode valve V3b operates as an audio oscillator, feedback from anode to grid being applied by the phase reversing auto-transformer T1. Frequency selection is by means of the switch S5a which determines which of 11 'Wien bridge' networks is in use. The amplitude of oscillation is limited by the power sensitive thermistor R36 which loads the circuit in such a way that the output at each frequency is limited to the same value and is undistorted by the valve.

Apart from providing outputs for FM and AM the circuit also provides an output for the 'X' scan of the crt and one at Probe B, which is controllable by means of R55 (AUDIO OUTPUT).

8.4. Oscilloscope

The cathode ray tube V6 is employed in a conventional circuit with R78 and R 75 as the BRILLIANCE and FOCUS controls respectively.

The 'Y' Amplifier valve V4a is a pentode, DC coupled to the Y2 plate of the crt to provide the correct voltage sense (±) on the screen. A variable negative bias voltage is applied to the grid circuit at the bottom end of the input potentiometer S6 (GAIN). This voltage is derived from the current through the crt supply chain and its value may be set by means of the pre-set control R80 which is used to calibrate the 'Y' SHIFT VOLTS control R60. The combination of the calibrated input attenuator and 'Y' SHIFT control enables measurement to be made of AC or DC input voltages applied to Probe C. When the input attenuator S6 (GAIN) is set to INT. CHECK the output from the audio oscillator is fed out to Probe B and also to the 'Y' amplifier, so that the level may be monitored by means of the AC voltage measurement facility.

A small proportion of the anode signal voltage developed across R63 is fed via C47 to obtain synchronisation in the Time Base Generator valve V5a.

Valve V4b which is the 'X' amplifier is DC connected to the crt X1 plate. A variable DC voltage derived from the 'X' SHIFT control R71, is fed to the X2 plate.

V4b may be fed from one of the three sources selected by the 'X' PLATES control S3. They are:-

(a) 50 c/s
(b) Variable AF from the audio oscillator
(c) Saw-tooth waveform of variable frequency from the Time Base Generator valve V5a.

V5a is a clocking oscillator and T2 is the blocking transformer. Four frequency ranges may be selected by means of S3, and the frequency of each range can be varied continuously by adjustment of the resistive element of the grid discharge constant (R87, TB VEL. FINE). Synchronising signals are fed to the cathode across R88.

Fly-back suppression on the four time-base ranges is applied to the crt grid via C54. To avoid confusion, when the 50 c/s X scan is used it is preferable for only one trace, either the forward or the re-trace, to appear on the crt screen. Therefore a small 50 c/s signal, phase- shifted 90° by the components C68, R95, C69 and R81 is fed to the grid of the crt so that the forward trace is brightened and the re-trace is blacked out.

8.5. Crystal Calibrator

With the OUTPUT switch at XTAL. CHECK, the output from the variable frequency oscillator is mixed with harmonics of the 5 mc/s crystal and the mixed output is fed to the grid of V3b which functions as an amplifier when the crystal calibration facility is used. The output from V3b is applied to the 'Y' Amplifier when the GAIN switch is in the INT. CHECK position and the beat frequency appears on the crt screen. The amplitude of this beat note is dependent upon the setting of the RF OUTPUT control.

9. SPECIFICATION

9.1. RF Signal Generator:

Frequency Range:	The tuning range is 0 – 15 mc/s and 85 - 100 mc/s in six bands:- 0 – 5 mc/s 85 – 90 mc/s 0 – 10 mc/s 90 – 95 mc/s 10 – 15 mc/s 95 – 100 mc/s
Tuning:	Tuning is by a single control with coarse and fine linear scales. The main scale is calibrated in mc/s only whilst the subsidiary scale covers 1 mc/s per revolution and is calibrated in 10 kc/s divisions
Output:	The maximum output is approximately 50mv.
Step Attenuators:	Step attenuators in the RF probe and on the front panel provide ratios of 1/10, 1/100 and 1/1000 (20,40 and 60db).
Variable Attenuators:	A control on the front panel provides a continuously variable attenuator over a 10:1 range (0 – 20db).
Frequency Modulation:	The frequencies available are 50 c/s or any frequency available from the Audio Oscillator. The deviation obtainable is 0 to 250 kc/s at 50 c/s or 0 to 75 kc/s at Audio Oscillator frequencies. A pre-emphasised signal having a maximum deviation of 75 kc/s (at 15 kc/s), and having normal BBC pre-emphasis of 50 microseconds is provided.
Amplitude Modulation:	Amplitude modulation to a fixed depth of approximately 30% is available at the same frequencies as for frequency modulation (see above). The maximum spurious FM occurring with AM is 1 kc/s. Simultaneous frequency and amplitude modulation can be applied to all ranges.
Crystal Check:	A 5 mc/s crystal oscillator is provided to enable the main oscillator frequency to be set accurately. The accuracy obtainable is:- Better than ±0.01% for any harmonic or sub-harmonic of 5 mc/s. Better than ±40 kc/s for all other frequencies.

Audio Oscillator:

This is of the thermistor controlled Resistance-Capacitance coupled type and has 11 switched output frequencies:-
40, 60, 90, 150 and 400 c/s.
1, 3, 5, 8, 12 and 15 kc/s.
The maximum output available is approx. 2.0v peak-to-peak and this can be reduced to a minimum of approximately 5mv peak-to-peak by means of a control on the front panel. The output from the audio oscillator can be used in the following manner

(a) As a test signal for LF stages. Available on probe B.
(b) To frequency modulate the RF output on all ranges with a deviation variable of between 0 and 75 kc/s.
(c) To amplitude modulate the RF output on all ranges to a depth of approximately 30%.
(d) To amplitude and frequency modulate the RF output simultaneously on all ranges.

Cathode Ray Tube:

The built in oscilloscope uses a 2½" cathode ray tube and focus and brilliance controls are provided.

Time-Base:

The hard valve time-base provides scanning speeds of 50 milli-seconds to 100 micro-seconds in 4 variable ranges. Additionally the time-base 'X' deflection may be sinusoidal at 50 c/s or at any of the frequencies available from the Audio Oscillator.

'Y' Amplifier:

The gain of the 'Y' Amplifier is approximately 50 times, and the deflection sensitivity approximately 0.7 volts/cm. An input attenuator provides division ratios of 1, 3, 10, 30 and 100 on AC and 10, 30, 100, 300 and 1000 on DC connections. The frequency response of the 'Y' Amplifier is from DC to 1 mc/s, the gain at 700 kc/s being not more than 6db down on that at 1 kc/s.

Voltage Calibration Shift:

The 'Y' SHIFT control is calibrated from +2.0v to –2.0v in steps of 0.2v and in RMS values 0 to 1.4v in steps of 0.1v RMS. In conjunction with the attenuator this provides the following voltage ranges:-

AC (input impedance 1 MOhm)

0 – 140 v RMS
0 – 40 v RMS
0 – 7 v RMS
0 – 2 v RMS
0 – 0.7 v RMS

DC (Input impedance 10 MOhm)

0 – 2000 v
0 – 600 v
0 – 200 v
0 – 60 v
0 – 20 v

AC 50 c/s only. (Input impedance 10 MOhm)

0 – 7 v RMS
0 – 20 v RMS
0 – 70 v RMS
0 – 400 v RMS

0 – 1400 v RMS
The accuracy of measurement is ±10%

Probes:	The following probes are permanently connected to the instrument and are stowed in compartments in the sides of the case when not in use:- RF Probe (probe A) – for all Radio Frequency signal outputs. Input Lead (probe C) – for all AC and DC inputs to the oscilloscope. Audio Lead(probe B) – for all Audio Frequency outputs.
Earthing:	As the chassis is isolated from the mains earth, universal receivers may be checked without difficulty.
Power Supplies:	The instrument operates from supplies of 100-150 and 200-250v at 40/60 c/s with a consumption of approx. 45 watts. The mains lead is permanently connected to the instrument and can be stowed with the probes when the instrument is being transported.
Dimensions:	The overall dimensions are 15 ½" long x 9 ½" deep x 8 ½ high (39.4 x 24.1 x 21.6 cms).
Weight:	The total weight of the instrument is approximately 27 lbs. (12.27 kgs.).
Finish:	The robust steel case is stoved in oyster-grey enamel with a glass-hard hammer finish effect. The front panel is either polished black with white coding or sprayed grey with black coding.

10. MAINTENANCE

Valve types have been chosen so that replacements, if required, are available in most service departments. Any valves other than V5 or V1 may be replaced without the necessity for adjustment. If it should be found necessary to change valve V1 or V5 the following action is required:-

(a) If V5 is replaced, the RadiVet should be connected to a receiver as for IF ALIGNMENT, as detailed in Sect. 4.1. The core of L7 should be adjusted for maximum response, and then sealed with wax.
(b) If V1 is replaced, the frequency should be checked against the crystal at the HF end of the tuning scale, as detailed in Sect. 3.2, and if the adjustment of the CALIBRATION control C75 is inadequate, C9 should be adjusted (see Fig. 2) with C75 at the centre of its traverse.

No attempt should be made to adjust the linearising capacitor C8 without special equipment.

TABLE 1
SCHEDULE OF COMPONENTS

Reference	Description	Reference	Description
R1	100 ohms	R43	470,000 ohms
R2	680 ohms	R44	470,000 ohms
R3	4,700 ohms	R45	100,000 ohms
R4	20,000 ohms Var.	R46	68,000 ohms
R5	4700 ohms	R47	33,000 ohms
R6	39,000 ohms	R48	Not used
R7	220,000 ohms	R49	15,000 ohms
R8	1,000,000 ohms	R50	47,000 ohms
R9	15,000 ohms	R51	47,000 ohms
R10	100,000 ohms	R52	68,000 ohms
R11	68,000 ohms	R53	2,500 ohms Var.
R12	330 ohms	R54	3,900,000 ohms
R13	330 ohms	R55	4,700,000 ohms
R14	680 ohms	R56	620,000 ohms
R15	10,000 ohms	R57	220,000 ohms
R16	1,500 ohms	R58	68,000 ohms
R17	Not used	R59	22,000 ohms
R18	Not used	R60	10,000 ohms Var.
R19	100 ohms	R61	220,000 ohms
R20	10 ohms	R62	1,500,000 ohms
R21	60,000 ohms	R63	680 ohms
R22	50,000 ohms Var.	R64	22,000 ohms
R23	220,000 ohms	R65	100,000 ohms
R24	220,000 ohms	R66	6,800 ohms
R25	1,000 ohms	R67	1,000,000 ohms
R26	470,000 ohms	R68	100,000 ohms
R27	220,000 ohms	R69	150,000 ohms
R28	750 ohms	R70	150,000 ohms
R29	750 ohms	R71	250,000 ohms
R30	82 ohms	R72	100,000 ohms
R31	82 ohms	R73	120,000 ohms
R32	12,000 ohms	R74	330,000 ohms
R33	390 ohms	R75	250,000 ohms Var.
R34	Adjust on test	R76	330,000 ohms
R35	1,000,000 ohms	R77	22,000 ohms
R36	A1522/100	R78	100,000 ohms
R37	11,000,000 ohms	R79	1,500,000 ohms
R38	10,000 ohms	R80	1,000,000 ohms Var.
R39	22,000 ohms	R81	220,000 ohms
R40	33,000 ohms	R82	1,500,000 ohms
R41	47,000 ohms	R83	2,700 ohms
R42	120,000 ohms	R84	10,000 ohms

TABLE 1 (Contd.)
SCHEDULE OF COMPONENTS

Reference	Description	Reference	Description
R85	15,000 ohms	R93	1,000 ohms
R86	680,000 ohms	R94	470,000 ohms
R87	2,000,000 ohms Var.	R95	68,000 ohms
R88	2,200 ohms Var.	R96	Adjust on test
R89	1,000 ohms	R97	39,000 ohms
R90	33,000 ohms	R98	1,800 ohms
R91	47,000 ohms	R99	Not used
R92	1,000 ohms	R100	Not used
C1	100 pf	C33	1000 pf
C2	1,500 pf	C34	470 pf
C3	2.2 pf	C35	680 pf
C4	470 pf	C36	0.005 mf
C5	47 pf	C37	3300 pf
C6	47 pf	C38	0.005 mf
C7	16.5 pf Var.	C39	68 pf
C8	SPECIAL	C40	0.1 mf
C9	5 pf Var.	C41	3.3 pf
C10	5 pf Var.	C42	22 pf
C11	5 pf Var,	C43	68 pf
C12	4.7 pf	C44	0.1 mf
C13		C45	0.1 mf
C14	3 x 500 pf	C46	6.8 pf
C15	Not used	C47	4 mf
C16	0.01 mf	C48	0.1 mf
C17	6,800 pf	C49	470 pf
C18	0.001 mf	C50	3300 pf
C19	100 pf	C51	0.02 mf
C20	0.001 mf	C52	0.1 mf
C21	100 pf	C53	0.1 mf
C22	0.05 mf	C54	47 pf
C23	8.0 mf	C55	0.1 mf
C24	2.2 pf	C56	22 pf
C25	1500 pf	C57	4.7 pf
C26	2.0 mf	C58	0.01 mf
C27	0.5 mf	C59	32 mf
C28	470 pf	C60	32 mf
C29	0.001 mf	C61	16 mf
C30	0.005 mf	C62	0.5 mf
C31	3300 pf	C63	6800 pf
C32	0.005 mf	C64	560 pf

TABLE 1 (contd.)
SCHEDULE OF COMPONENTS

Reference	Description	Reference	Description
C65	560 pf	C73	10 pf
C66	560 pf	C74	10 pf
C67	560 pf	C75	SPECIAL
C68	0.02 mf	C76	260 pf Var.
C69	0.02 mf	C77	200 pf
C70	1500 pf	C78	22 pf
C71	1500 pf	C79	530 pf
C72	47 pf	C80	
V1	12 AT 7	V5	PCF 80
V2	PCF 80	V6	DG 76
V3	PCF 80	V7	6X5GT
V4	PCF 80		
F1	2 Amperes		
LP1	6.3v 0.3a		
X1	Crystal 5 mc/s		

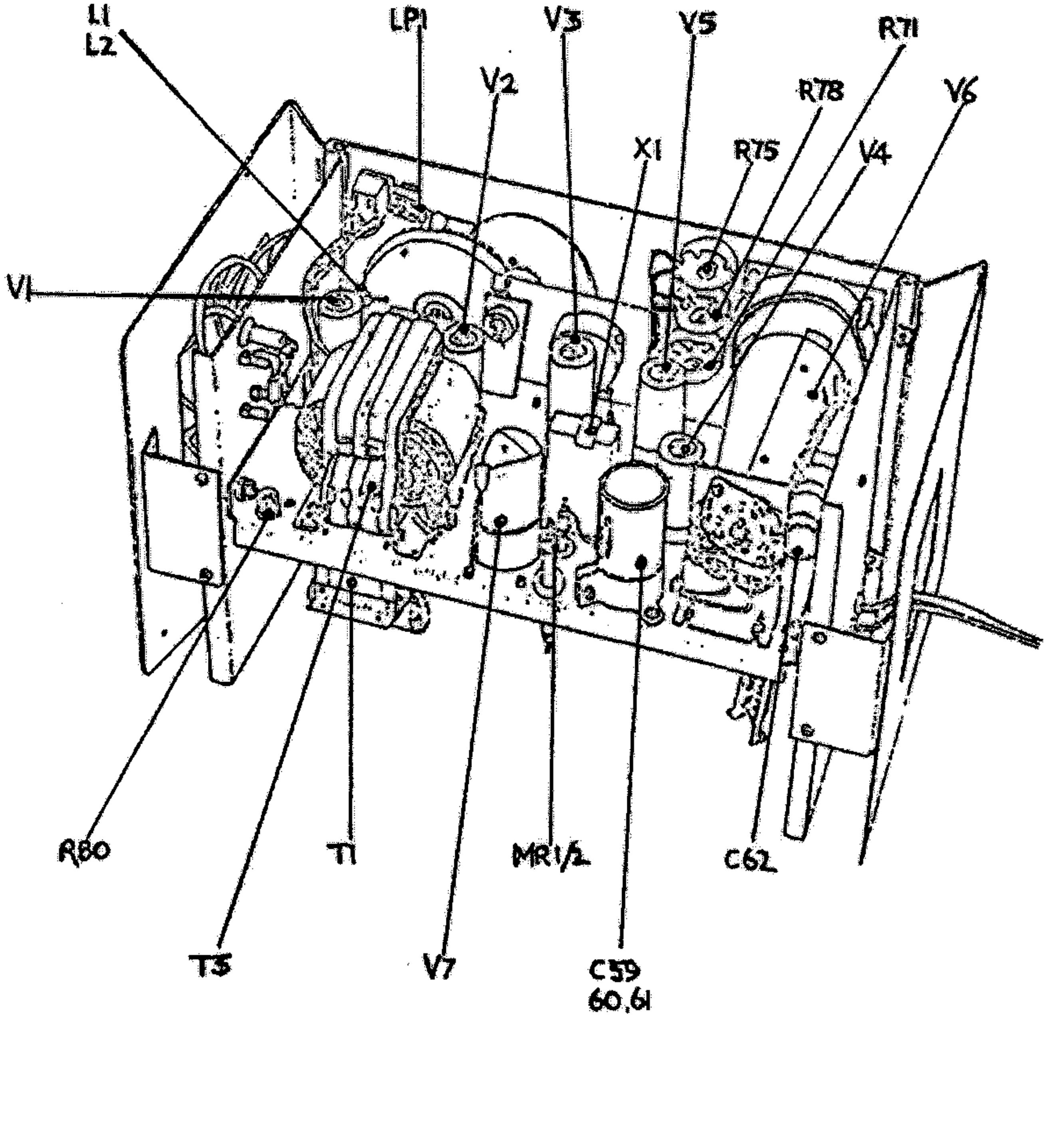


FIGURE 26 RADIVET TYPE 211 TOP VIEW
(LOCATION OF MAJOR COMPONENTS)

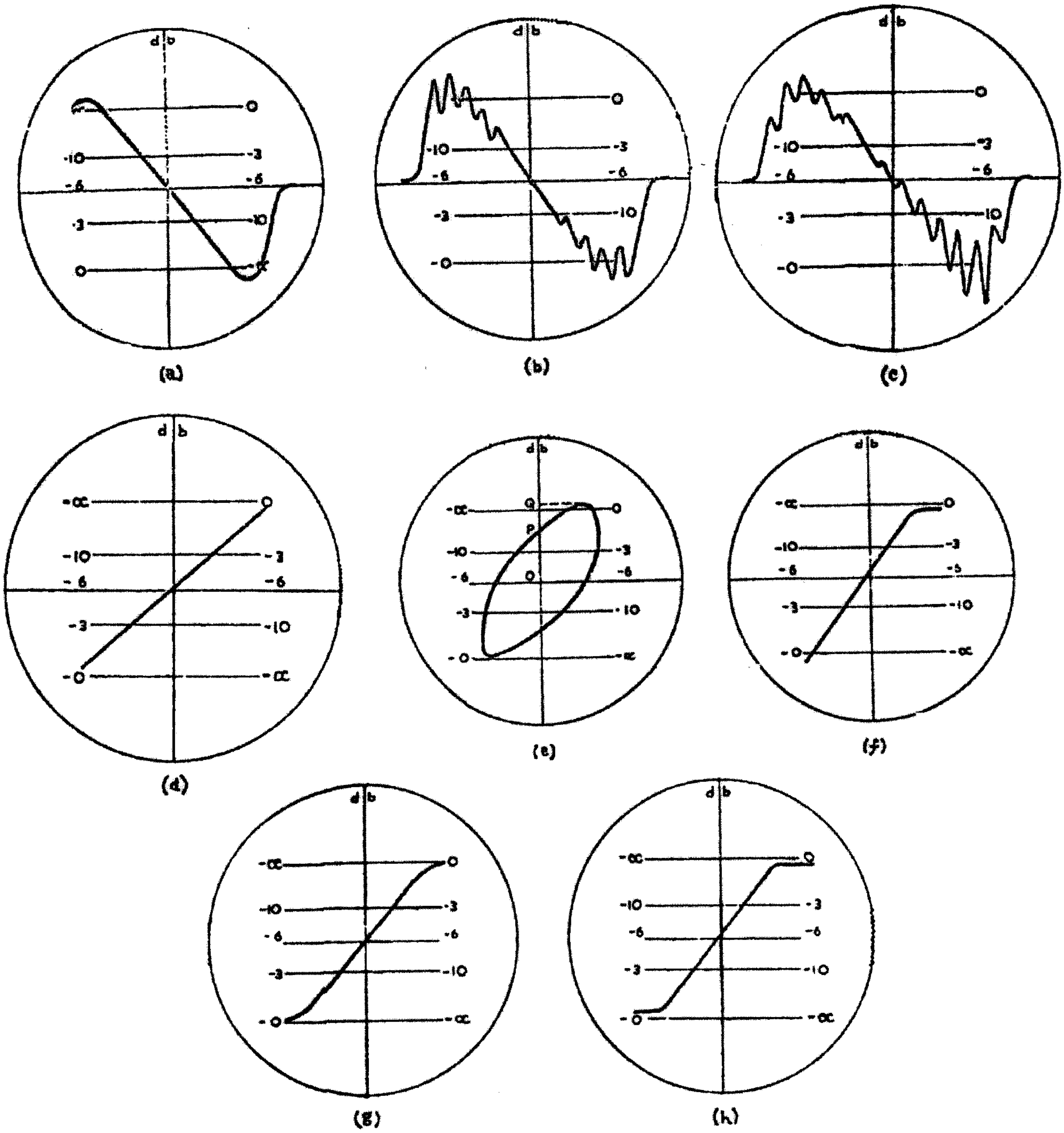
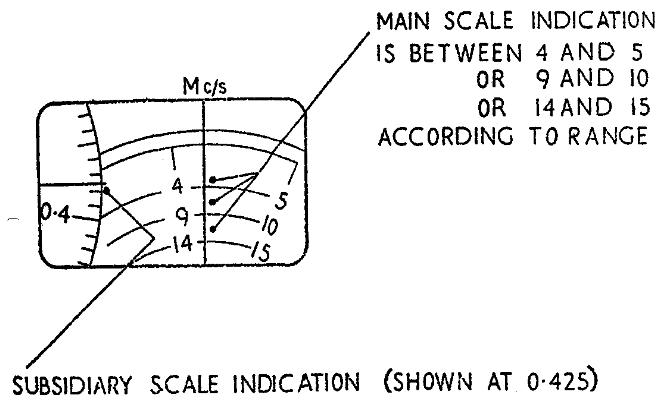
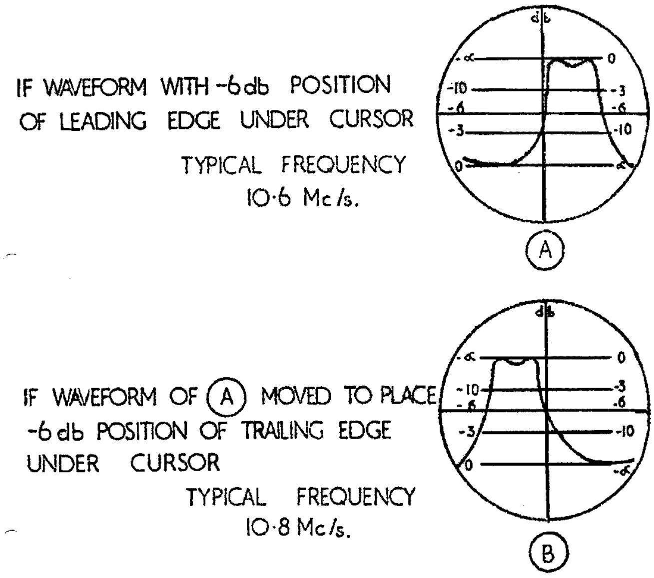


FIG. 3. RADIVET TYPE 211. WAVEFORMS.



RANGE SELECTOR IS AT 10 - 15 M c/s
FREQUENCY SETTING SHOWN IS 14·425 Mc/s.

FIGURE 4. RADIVET. TYPE 211.
TUNING DIAL.



BANDWIDTH BETWEEN 6db LIMITS IN THIS EXAMPLE IS
10·6 Mc/s -10·8Mc/s = 200 k c/s.

BANDWIDTH MEASUREMENT
FIGURE 5. RADIVET. TYPE 211.

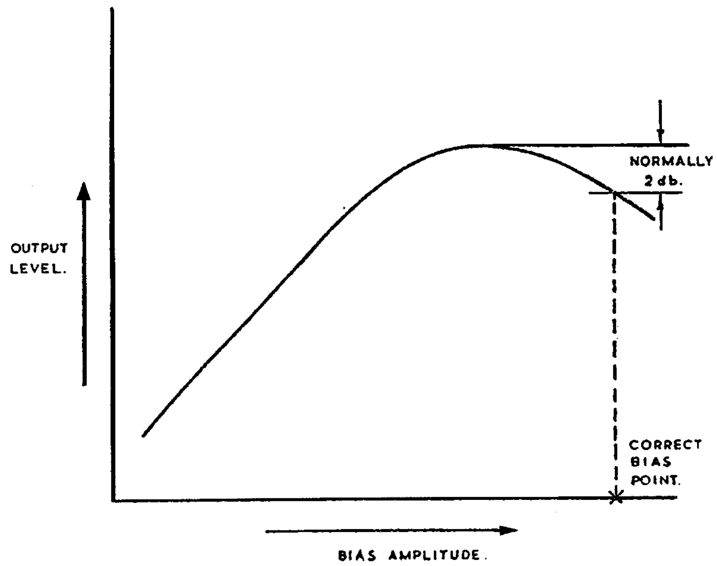


FIG. 6. RADIVET TYPE 211

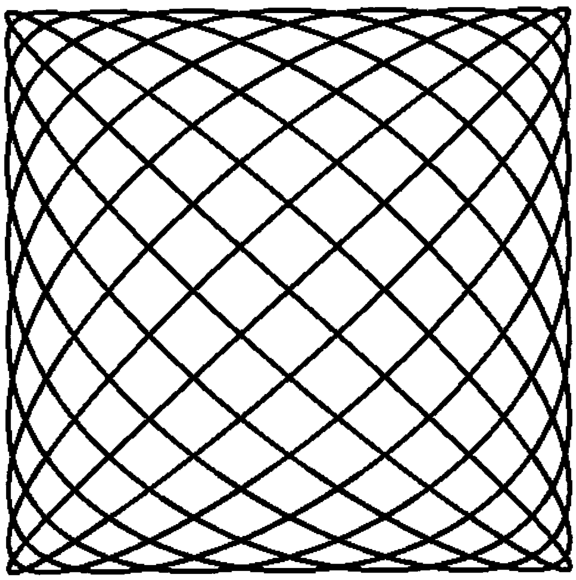
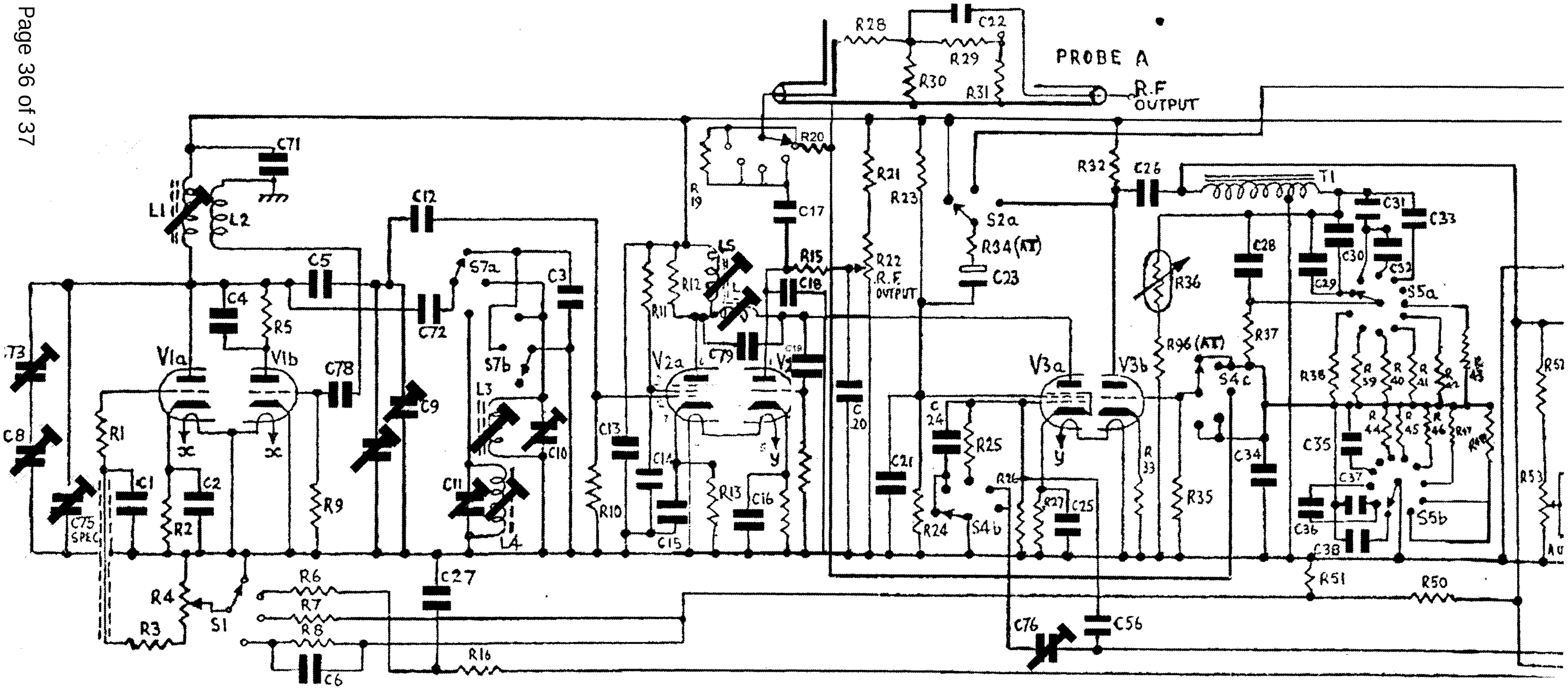


FIGURE 7: LISSAJOU PATTERN



F.M.	A.M.	X PLATES	Output	AUDIO OSC: FREQ	Y. ATTENUATOR	R.F. FREQ RANGE
S1 {1. OFF 2. 50c/s 3. VAR.FREQ.NOR 4. VAR.FREQ WITH PRE-EMPHASIS	S2 {1. OFF. 2. 50c/s 3. VAR. FREQ.	S3 {1 50c/s 2 VAR. FREQ. 3 T.B.1 4 T.B.2 5 T.B.3 6. T.B.4	S4 0-15 Mc/s 0-15 Mc/s XTAL +85 Mc/s +85 Mc/s	S5 {1. 40 c/s 2. 60 c/s 3. 90 c/s 4. 150 c/s 5. 400 c/s 6. 1 kc/s 7. 3kc/s 8 5Kc/s 9. 8kc/s 10. 12 kc/s 11. 15kc/s	S6 {1 A.C.X100 2 A.C X 30 3 A C X10 4 A C X 3 5 A C X 1 6 INT CHECK 7 DC X 1000 8 DC X 300 9 DC X 100 10 DC X 30 11 DC X 10	S7 {1. 0-5 Mc/s 2. 5-10Mc/s 3. 10-15 Mc/s

FIGURE 1a : RADIVET TYPE 211   CIRCUIT DIAGRAM.

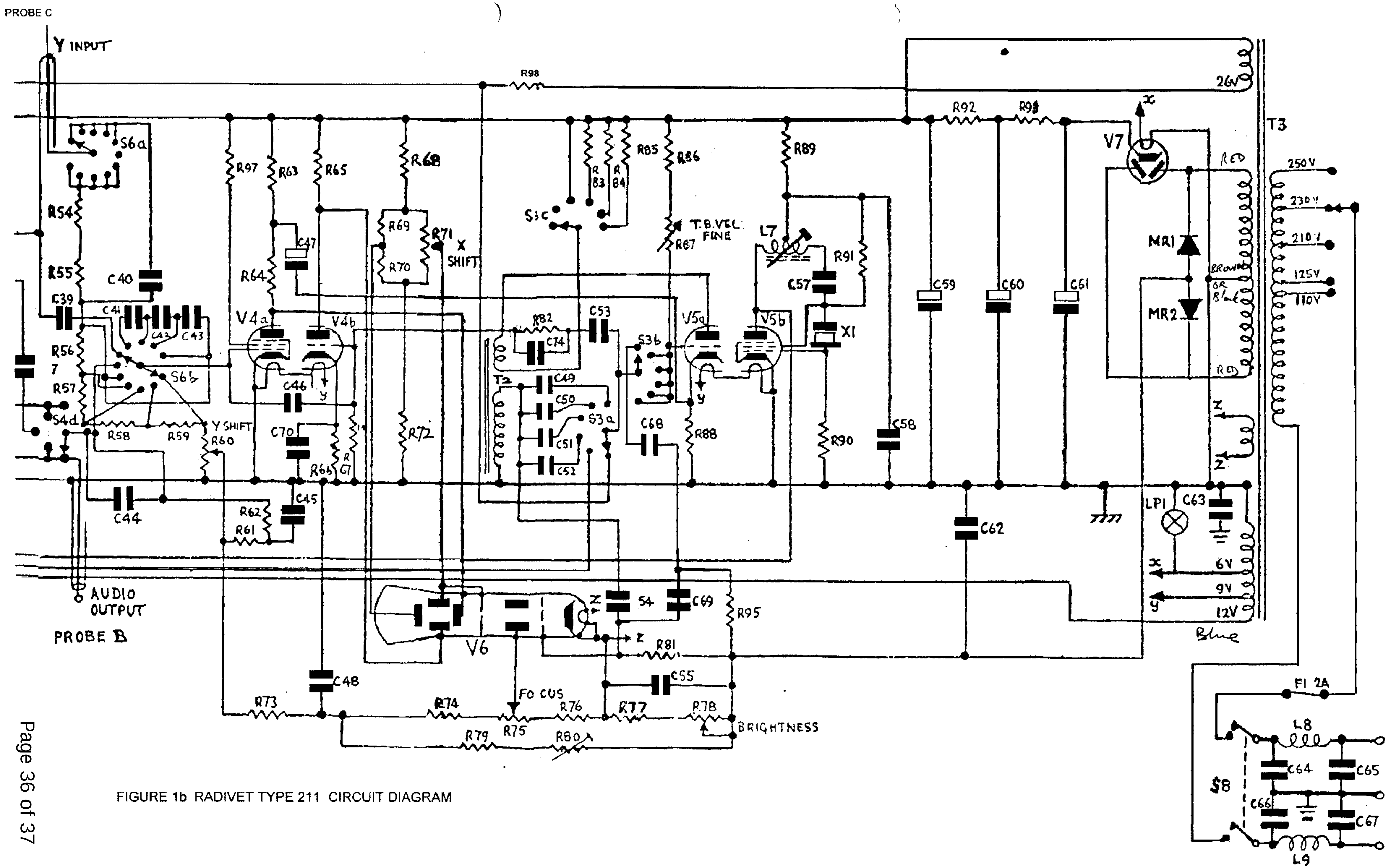


FIGURE 1b RADIVET TYPE 211 CIRCUIT DIAGRAM