Airmec Limited

DATA 2049

Operating Instructions

HF WAVE ANALYSER TYPE 853

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1. INTRODUCTION

The Wave Analyser Type 853 is a selective measuring set of great versatility, suitable for use in the frequency range 30 kc/s - 30 Mc/s.

It consists essentially of a selective amplifier operating on the heterodyne principle and incorporating both RF and LF attenuators. Indication of the output, which is in the form of an audio frequency, is provided by means of a meter and/ or headphones.

The attenuator accuracy and noise level are such that an overall accuracy of measurement of ±0.1dB is obtainable over a range of 105dB, and ±0.5dB over the complete attenuation range of 120dB. The sensitivity of the amplifier enables measurements to be made from 1μV to 1V up to a frequency of 20 Mc/s, and from 4μV to 4V above this frequency.

2. INITIAL ADJUSTMENTS

The instrument leaves the Works with the voltage tapping panel set for a mains supply of 230V. For use on mains supplies of other voltages, move the plug on the tapping panel to the appropriate tap. If the instrument is to be operated on the 105 or 125V taps, fit fuses of double the current rating given in the Components List at Table 1.

3. OPERATION

3.1. General

Allow at least 5 minutes warm up time before taking any measurements.

Check that the meter reads zero. If it needs adjusting, set all attenuators to maximum attenuation, set the input switch to off and adjust the meter to read zero with the Meter Zero control.

Detailed operating instructions are given in Sections 3.2. - 3.8; the following general points are applicable to all sections:-

3.1.1. Inputs

Alternative inputs may be connected to the Input 1 and Input 2 terminals and selected by a switch. This enables a calibrating oscillator, such as the Airmec Oscillator Type 858, to be connected permanently to one input and the signal under analysis connected to the other input. Breakthrough in the input switch may lead to an error, if the difference in signal levels at the two inputs exceeds 20dB. The signal from the calibrating oscillator will usually be considerably larger than the signal under analysis, and for this reason the Oscillator Type 858 has been provided with an Off position on the wave band switch to enable the calibrating signal to be removed without switching the oscillator off or disconnecting it. Similar precautions are required if the probe is in use together with the other inputs, where the breakthrough in the input switch is of the same order, and it should be noted that the signal at the switch from the probe is some 10dB lower than at the probe input terminals.

3.1.2. Tuning

When level measurements are taken, rocking the tuning control gives two maxima on the meter (one on either side of zero beat) corresponding to an audio tone within the pass band of the LF amplifier and filter (see Figure 4). The HF circuits have been so aligned relative to the local oscillator that the oscillator frequency is 1 kc/s lower than the signal frequency; - the correct signal to choose on the meter is the one obtained with the tuning knob anticlockwise from zero beat, and this will be found to give the greatest meter reading and will correspond to a beat frequency of approximately 1 kc/s. At low signal frequencies the selectivity of the HF circuits accounts for the discrepancy in meter reading on either side of zero beat, and at high signal frequencies the characteristics of the frequency changer give rise to a slight difference in levels.

3.1.3. Attenuators

Both HF and LF coarse attenuators are provided; in determining the relative amounts of each to be put into circuit, note that the effect of noise is reduced by employing the LF attenuator but that harmonic generation will generally be greater owing to the larger signal appearing at the RF Amplifier grid.

On the highest frequency range, some pulling of the local oscillator frequency can occur if the signal to the frequency changer (V4) exceeds a certain level. To ensure satisfactory operation on the 20 - 30 Mc/s range, keep the Set Gain control at maximum when using the full 70dB of LF attenuation, or limit the attenuation to 60dB if the Set Gain control is at minimum. At all other signal frequencies this limitation does not apply.

The LF attenuator is considerably more accurate than the HF attenuator, so that it is desirable to use the LF attenuator when making actual measurements. The operating procedures given in this Manual ensure as far as possible that the attenuators are used to best advantage.

3.1.4. Calibration Charts

Gain is equalised to give minimum variation over each frequency band, consistent with selectivity and gain requirements. Due to component tolerances, gain does vary slightly over each frequency band and between one band and another. The calibration chart provided shows the input required to give standard output over the frequency range of the instrument with the Set Gain control at maximum. When measurements of greater accuracy are required, the Set Gain control can be used to set the Wave Analyser to a particular sensitivity, in conjunction with a calibrating oscillator such as the Airmec Oscillator Type 858.

3.1.5. Input Impedance

The HF attenuator is terminated in the input tuned circuit. In the 0dB position of the HF attenuator the input impedance is therefore that of the first tuned circuit, which is nominally 75Ω, but subject to variation over each frequency band. When an accurate 75Ω input impedance is required, set the HF attenuator to 20dB or above.

When the instrument is connected to a 75Ω source, no errors of measurement are caused by the variations of the input impedance since there is a constant mismatch in all attenuator positions.

3.2. Operation as a Harmonic Analyser

When measuring the harmonic level, it is necessary to keep the level of the fundamental appearing at the grid of the HF amplifier at a low value because of harmonic generation within the instrument. For this reason it is important to keep the sum of the LF coarse and fine attenuators as small as possible when measuring the harmonic component, by using the HF attenuator and, if possible, keeping 0dB on the LF coarse attenuator. Every precaution has been taken in the design of the instrument to reduce harmonic generation and it is possible to measure second harmonic components 70dB down on the fundamental, provided that the sum of the LF coarse and fine attenuators is not greater than 20dB and the Set Gain control is at maximum when the harmonic component is measured. Third harmonic components can be measured up to 90dB down on the fundamental. In all cases the fundamental component must not exceed 1V open circuit from a 75Ω source.

Procedure for harmonic analysis is as follows:-

Tune to the fundamental and turn the Set Gain control to maximum.

Set the HF attenuator to 20dB and adjust the LF attenuator to bring the meter needle to the red line. Increase HF attenuation if greater attenuation is required than is available in the LF attenuator. Note the attenuator readings. The level of the applied signal must not exceed 1V open circuit from a 75Ω source and should be large enough for the lowest harmonic component to be not less than 1μV.

Tune the instrument to the desired harmonic and reduce LF attenuation to bring the meter needle back to the red line. If a further reduction in attenuation is required, the HF attenuator may be used. Note the attenuator readings.

The strength of the desired harmonic in dB relative to the fundamental is given by:-

$$(S_h + C_h) - (F_f + C_f)$$

Where S_h = sum of all attenuator readings when tuned to the harmonic, C_h = calibration chart reading for the frequency of the harmonic; F_f = sum of all attenuator readings tuned to the fundamental, C_f = calibration chart reading for the frequency of the fundamental.

The sign of the calibration chart readings must be observed and the result will be negative for the usual case of the harmonic being smaller in amplitude than the fundamental.

Where greater accuracy is required, use the Oscillator Type 858 to determine relative gain of the Analyser at the fundamental and harmonic frequencies instead of using the calibration chart readings. The procedure for determining gain with the Oscillator 858 is given in Section 3.3.

3.3. Operation for Selective Level Measurements

The instrument may be used to measure the absolute level of any single frequency component of a complex waveform. Discrimination against adjacent unwanted signals of higher level is governed by the bandwidth of the LF amplifier and filter at the higher frequencies, supplemented by the selectivity of the HF circuits at the lower signal frequencies. If the Analyser is tuned to a signal in the normal manner as described in Section 3.1.2. with the beat note at 1000 c/s, bandwidth is effectively from +3.5 kc/s to -1.5 kc/s, as shown in Figure 4. The effect of an adjacent high level signal can therefore be reduced by tuning to the highest acceptable beat note away from the interfering signal, if necessary using the beat note on the "incorrect" side of zero beat. In assessing the highest acceptable beat note, note that gain calibration can be up to 3dB low at 2.5 kc/s compared with 1 kc/s. If a beat note on the "incorrect" side of zero beat is used, standardise gain with the Oscillator Type 858 when tuned to the same side of zero beat. Without taking either of the precautions detailed above, it is possible to measure signals in the presence of unwanted signals 40dB higher than the wanted signal and as little as 7 kc/s on either side of it. The frequency separation can be reduced to at least 3.5 kc/s by adopting the above measures.

To measure the absolute level of any single frequency, using the Airmec Oscillator Type 858, proceed as follows:-

Connect the signal to be measured to the Input 1 terminal of the Analyser. Set the Oscillator for 100mV output and connect it to the Input 2 terminal.

Switch to Input 2, and set the Oscillator to the frequency of the signal to be measured. Tune the Analyser for maximum output with the HF attenuator set to 60dB, the LF coarse attenuator to 40dB, and the LF fine attenuator to 0dB. Adjust the Set Gain control to bring the meter needle to the red line. The Analyser is now set to measure the input signal directly in dB relative to 1μV open circuit from a 75Ω source.

Note:- If it is necessary to reduce the HF attenuator setting to 40dB before the SET GAIN control can be adjusted, add 20dB to the attenuator setting in the subsequent measurement.

Switch to Input 1, tune the Analyser to the signal to be measured and set the attenuators to bring the meter needle to the red line. The level of the input will then be indicated directly by the attenuators. The most accurate measurement will be obtained if the setting of the HF attenuator is left unchanged, but if the meter needle cannot be brought to the red line with the LF attenuators between the limits of 10dB - 60dB, adjust the HF attenuator so that the final LF attenuator setting is within the required limits. For very low or very high level signals the first and last 10dB ranges of the LF attenuator may also have to be used.

3.4. Operation as a Field Strength and Interference Measuring Set

Field strength and interference measurements may be made by using suitable aerials in conjunction with the Analyser. Signals from a 75Ω source can be measured down to 1μV open circuit up to a frequency of 20 Mc/s, and down to 4μV between 20 and 30 Mc/s. Signal level can be determined in conjunction with the calibration chart or, where a high degree of accuracy is required, a calibrating oscillator such as the Oscillator Type 858 may be used.

3.5. Operation for Insertion Gain and Loss measurements

Insertion gain and loss measurements may be made to an accuracy of 0.1dB at any frequency between 30 kc/s and 30 Mc/s over a range of 60dB by substitution of the LF attenuator. The range may be extended if required by introducing the HF attenuator as well, maintaining accuracy by checking the HF attenuator against the LF attenuators. The arrangement of equipment for these measurements is shown in Figure 2. Switches SW1 and SW2 must have negligible breakthrough and may take the form of plug connections. Note that noise can give rise to an error in measurement, and that the total LF attenuation should therefore not be less than 15dB for any measurement if an accuracy of 0.1dB is required.

When checking the HF attenuator against the LF attenuators, set the LF fine attenuator to 9dB and the coarse attenuator to 10dB with maximum HF attenuation in circuit. Then substitute the LF coarse attenuator for the HF attenuator and read the error as the difference between the new LF fine attenuator reading and 9dB.

When making noise measurements, note that overall bandwidth is influenced by the selectivity of the HF tuned circuits. The HF circuits begin to reduce the overall bandwidth below 1 Mc/s, and produce appreciable effect at the lowest frequencies. In assessing the overall bandwidth at the lower frequencies, note that the HF circuits are aligned 1 kc/s off-centre from the filter, and the LF amplifier response is therefore asymmetrical as shown in Figure 4.

3.6. Operation as a Bridge Detector

The Wave Analyser may be used as a high sensitivity bridge detector when tuned to the bridge operating frequency. Signals considerably less than 1μV may be detected by using earphones to assist in obtaining final balance. As the IF signal is at audio frequency, no BFO is required to produce an audible note. The meter circuit cannot be damaged by overload if the bridge is out of balance.

3.7. Operation as a Heterodyne Wavemeter

The tuning characteristic, which provides a meter reading for approximately 3 kc/s on either side of zero beat, makes the Analyser particularly suitable for use as a heterodyne wavemeter. The position of exact frequency is clearly defined by a dip in meter reading and by zero signal in the headphones. When a greater accuracy of frequency calibration is required than is provided by the Analyser, an accurate frequency calibrating signal may be fed into the alternative input plug and selected by the switch. The Analyser is first set to zero beat with the unknown signal and the calibrating signal then selected and adjusted to give zero beat again; the reverse procedure may be used to set another instrument accurately to frequency Note that at the lower signal frequencies a loss in sensitivity occurs around zero beat, due to the selectivity of the HF circuits.

3.8. Operation with the Probe Attachment

The probe attachment is designed for use where a high impedance input is essential; it plugs into the 6-way socket on the front of the instrument, from which it obtains its heater and HT supplies. The following characteristics must be taken into account when making measurements with the probe:-

(a) Insertion loss of the probe itself with its switch in the X1 position is approximately 10dB when fed from a 75Ω source. The variation of insertion loss is within 3dB from 30 kc/s to 10 Mc/s. The insertion loss does not increase by more than 2dB from 10 Mc/s to 30 Mc/s.

(b) With the probe switch in the X1/10 position, variation of attenuation with frequency is withIn 3dB from 30 kc/s to 30 Mc/s.

With the probe switch in the X 1/100 position, variation of attenuation with frequency is within 3dB from 30 kc/s to 10 Mc/s. The attenuation does not increase by more than 3dB from 10 Mc/s to 30 Mc/s. For accurate measurements it is therefore essential to standardize the gain by means of a calibrating oscillator connected to the probe input, and with the switch in the position in use.

(c) Harmonic generation within the probe itself produces a second harmonic component approximately 40dB down on the fundamental at an input level of 50mV in the X1 position of the switch and a third harmonic component 75dB down. The input level is correspondingly greater in the attenuated positions of the switch for the same distortion. The Analyser therefore has limited use as a harmonic analyser when the probe is employed.

4. CIRCUIT DESCRIPTION

A block schematic is shown in Figure 1. The circuit diagram is given in Figure 3 and the component schedule in Table 1.

4.1. HF Circuits

Signals applied to either Input 1 or Input 2 are selected by the switch SW1 marked 1, Off, 2, Probe, and are fed into the HF Attenuator, the input and output impedance of which is 75Ω. Attenuations of 60, 40, 20, 10 and 0dB may be selected by switch SW2.

The signal enters the input tuned circuit L1 - L7 selected by the turret wave band switch and tuned by the front section, C8a, of the three-gang capacitor, and is then passed to the grid of the HF amplifier V1, the anode circuit of which is coupled to a second tuned circuit L15 - L21, similarly selected by the turret waveband switch and tuned by the middle section C8b of the gang capacitor. Input and second tuned circuits are compensated by resistance-capacitance networks to equalise the HF gain over each frequency band.

The signal from the second tuned circuit is applied to the control grid of the frequency changer V4 where it is mixed with a signal from the local oscillator V2. The oscillator tuned circuit L8 - L14 is tuned by the rear section of the three-gang capacitor C8c to produce a beat frequency of nominally 1 kc/s, the oscillator being 1 kc/s lower in frequency than the HF circuits. Oscillator and coupling circuits to the injection grid of the frequency changer V4 are compensated by resistance-capacitance networks to equalise the injection voltage over each frequency band.

4.2. LF and Detector Circuits

A beat frequency of nominally 1 kc/s is produced at the anode of the frequency changer V4, and fed through a low pass filter L22 - L24, C54 - C57 to the precision LF coarse attenuator where attenuations of 60, 50, 40, 30, 20, 10, and 0dB are selected by switch SW3. The input and output impedance of this attenuator is 22kΩ and the cut-off frequency of the low pass filter is 3000 c/s.

This low frequency signal is fed through the LF fine attenuator R49 to the three-stage resistance-capacitance coupled amplifier V5, V6a, V6b, negative feedback being applied from the cathode circuit of V6b to the cathode of V5. After amplification the signal is applied firstly via the Set

Gain control R67 to the square low detector V7a and secondly via the Volume control to the cathode follower V7b feeding the telephone jack. A meter in the anode circuit of V7a indicates the output level, and is backed off to read zero in the absence of a signal by the Meter Zero preset control R72, accessible from the front panel, and the meter circuit is so arranged that a large signal applied to the grid of V7a cannot damage the meter.

4.3. Power Supplies

The power pack is a separate sub-unit within the instrument. HT supply is provided by the indirectly heated rectifier V8 feeding a capacitor input filter with two stages of filtering L25, C68 and L26, C69.

A stabilised HT supply of 150V is provided in the main instrument by the voltage stabiliser V3, which supplies the local oscillator V2 and also the Probe, when fitted. Loading on this stabiliser is maintained nominally the same whether the Probe is plugged in or not by bringing R115 into circuit when the Probe is inserted.

4.4. Probe Attachment

When a high input impedance is required for the Analyser, the Probe attachment may be plugged into the socket on the front panel marked Probe and the input switch set to Probe.

The signal is applied between the low-loss insulator and the adjacent earth tag on the probe to the three position potential divider, where division ratios of 1, 10 or 100 may be selected by SW1. This potential divider is compensated to suit the frequency range of the instrument. From the tapping on the divider the signal is fed to the grid of V1, the anode circuit of which feeds a coaxial cable in the Probe lead. Since the far end of the cable is terminated, the probe assembly is arranged to present an impedance of 75Ω to the input circuit of the Analyser.

5. SERVICING

5.1. General

Valve, scale lamp and fuse replacements are the only servicing changes which should normally be required. The positions of these components are shown in Figure 5.

5.2. Valve Replacement

The only valve replacements which may require re-adjustment of the instrument are V1, V4 and V2. The frequency calibration will be affected by the oscillator valve V2 and the absolute gain of the instrument by the HF Amplifier Valve V1, the frequency changer V4, and the valve in the probe attachment when employed.

5.3. Alignment of Circuit

Trimmers for setting the frequency scale calibration and aligning the HF circuits are readily accessible when the Analyser is removed from its case. Circuit re-alignment is a skilled job and should be done only if qualified personnel and appropriate test gear are available. Note that the oscillator frequency is set 1 kc/s lower than the RF circuits and therefore 1 kc/s lower than the frequency indicated on the tuning dial. Once the oscillator has been set, align the HF circuits with the beat note set to exactly 1 kc/s on the lower beat.

The trimmers are accessible through holes in the inclined lid of the turret assembly on top of the instrument. The holes are arranged in pairs for each circuit, the pair nearest the front panel being the input circuit, the middle pair the second HF circuit, and the rear pair the oscillator circuit. The front hole of each pair gives access to the capacitance trimmer and the rear hole to the inductance trimmer, for the frequency band selected by the turret knob. The capacitance trimmers may be adjusted with a small metal screwdriver at the highest frequency in each band and the inductance trimmers must be set with an insulated blade at the lowest frequency in each band. A non-hardening compound has been used for locking the dust iron cores.

5.4. Film scale and slow motion drive

Periodically apply one or two drops of thin lubricating oil to each of the bearings and gears in the slow motion drive and the film scale unit. To gain access to these parts, remove the tuning knob and then take off the cover plate by undoing the four round-headed screws around its outside edge. When putting the tuning knob back on its spindle, ensure that the reading on its scale is exactly 0 when the knob is turned anti-clockwise against the mechanical stop. This position must also correspond to a reading of 0 on the logging scale of the film scale.

5.5. Scale lamp replacement

The tuning scale is lit by two festoon type lamps behind it. To replace the lamps, take off the tuning knob and cover plate as above and gently lift the film scale until the lamps are accessible.

6. PERFORMANCE SPECIFICATION

Frequency Range

30 kc/s to 30 Mc/s in seven bands

30 kc/s to 100 kc/s
100 kc/s to 300 kc/s
300 kc/s to 1000 kc/s
1 Mc/s to 3 Mc/s
3 Mc/s to 10 Mc/s
10 Mc/s to 20 Mc/s
20 Mc/s to 30 Mc/s

Frequency Calibration

On an illuminated film scale with an effective length of approximately 4 ft. Accuracy of frequency calibration is ±1%, and an additional scale is provided for accurate logging.

Signal amplitude range

The signal levels at Inputs 1 and 2 which can be measured are:-

Nominally 1µV to 1V from 30 kc/s to 10 Mc/s,
4µV to 4V from 20 Mc/s to 30 Mc/s.

The above figures refer to an open circuit emf from a 75Ω source.

Signal amplitude calibration

A calibration chart provided with each instrument enables the relative input signal levels at various frequencies to be determined within ±2dB.

For accurate measurement of absolute or relative levels, a Set Gain control enables the overall gain to be set up using a calibrating oscillator such as the Airmec Oscillator Type 858.

Input Impedance

The input impedance at Input 1 or Input 2 terminal is 75Ω ±2% for HF attenuator settings of 20dB and above. In the 0dB position of the HF attenuator the input impedance is that of the input tuned circuit, which is nominally 75Ω.

Attenuators

The range and accuracy of the three attenuators are:-

HF Attenuator: 0, 10, 20, 40 and 60dB positions with an accuracy of ±0.2dB in each step.

LF Coarse Attenuator: 0 to 60dB in 10dB steps with an overall accuracy of 0.1dB.

LF Fine Attenuator: continuously variable between 0 and 10dB with an accuracy of 0.2dB.

Effect of noise on reading

Increase in meter reading due to internal noise when the LF Attenuators are at 0dB and the Set Gain control is at maximum is not more than 0.5dB and decreases rapidly as the LF attenuation is increased.

IF Bandwidth

The response of the low pass filter and LF Amplifier is:-

Not more than 3dB down at 450 c/s and 2500 c/s

Not less than 40dB down at 50 c/s and 5,000 c/s

Not less than 60dB down at 6,500 c/s

A typical response curve is given in Figure 4.

Harmonic Analysis

For signals at Input 1 or Input 2 terminals, second harmonic components at least 70dB down on the fundamental may be measured, provided that the sum of the LF attenuator readings when making the harmonic measurement does not exceed 20dB, and the Set Gain control is at maximum.

Third harmonic components at least 90dB below the fundamental may be measured provided that the fundamental signal does not exceed 1V.

Input Isolation and Breakthrough

At 30 Mc/s the isolation between Input 1 and Input 2 terminals is better than 40dB and at 100 kc/s is approximately 100dB.

With the Input switch in the Off position the signal breakthrough from Input 1 or Input 2 is at least 54dB down at 30 Mc/s and over 120dB down at 100 kc/s.

Probe input impedance

At 30 kc/s the probe input impedance is approximately:-

Probe switch X1	100 kΩ in parallel with 24 pF
Probe switch X1/10	1 MΩ in parallel with 9 pF
Probe switch X1/100	1 MΩ in parallel with 9 pF

Probe Input Attenuators

With the probe switch in the X1/10 position, attenuation compared with the X1 position is nominally 20dB. Variation of attenuation with frequency is within 3dB from 30 kc/s to 30 Mc/s.

With the probe switch in the X1/100 position, attenuation compared with the X1 position is nominally 40dB. Variation of attenuation with frequency is within 3dB from 30 kc/s to 10 Mc/s. From 10 Mc/s to 30 Mc/s, attenuation does not increase by more than 3dB.

Probe Insertion Loss

Approximately 10dB with the probe switch in the X1 position when fed from a 75Ω source. Variation of insertion loss is within 3dB from 30 kc/s to 10 Mc/s, and does not increase by more than 2 dB from 10 Mc/s to 30 Mc/s.

Probe Distortion

With an input of 50mV to the probe terminals, the second harmonic component generated in the probe is approximately 40dB down on the fundamental, and the third harmonic approximately 75dB down. With an input of 200mV, the corresponding figures for the second and third harmonic components are approximately 28dB and 51dB.

Power Supplies

100 - 125 and 200 - 250V, 50 - 60 c/s mains. Consumption approximately 70 watts.

Dimensions

The instrument, which is suitable for both bench use and forward mounting on a standard 19" rack, is 19" wide, 16" high, 10" deep over projections (48 x 40.6 x 25.5 cm).

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 instrument is approximately 52 lbs (23.6 kg.)

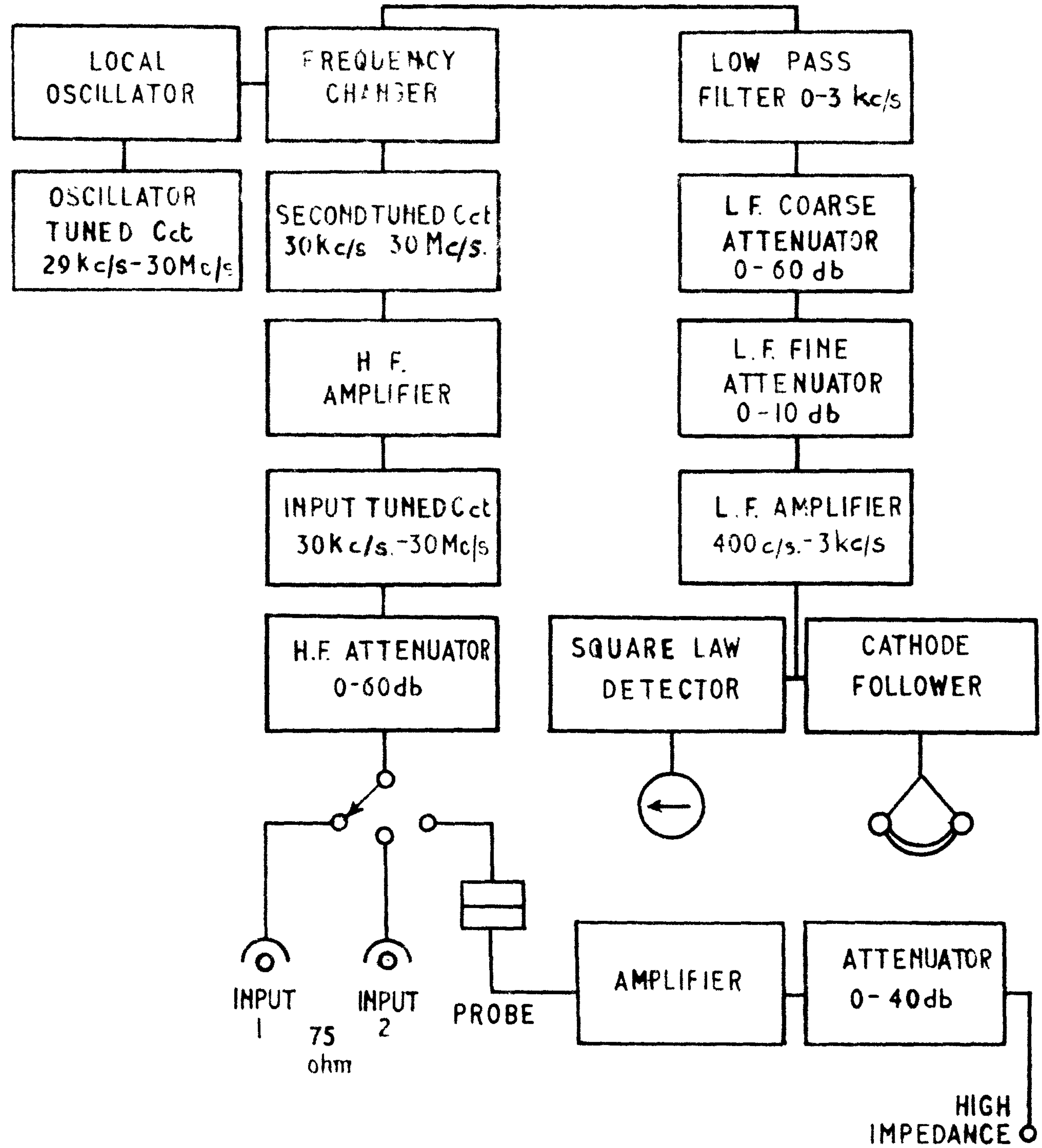

FIGURE I. WAVE ANALYSER TYPE 853.
BLOCK DIAGRAM.

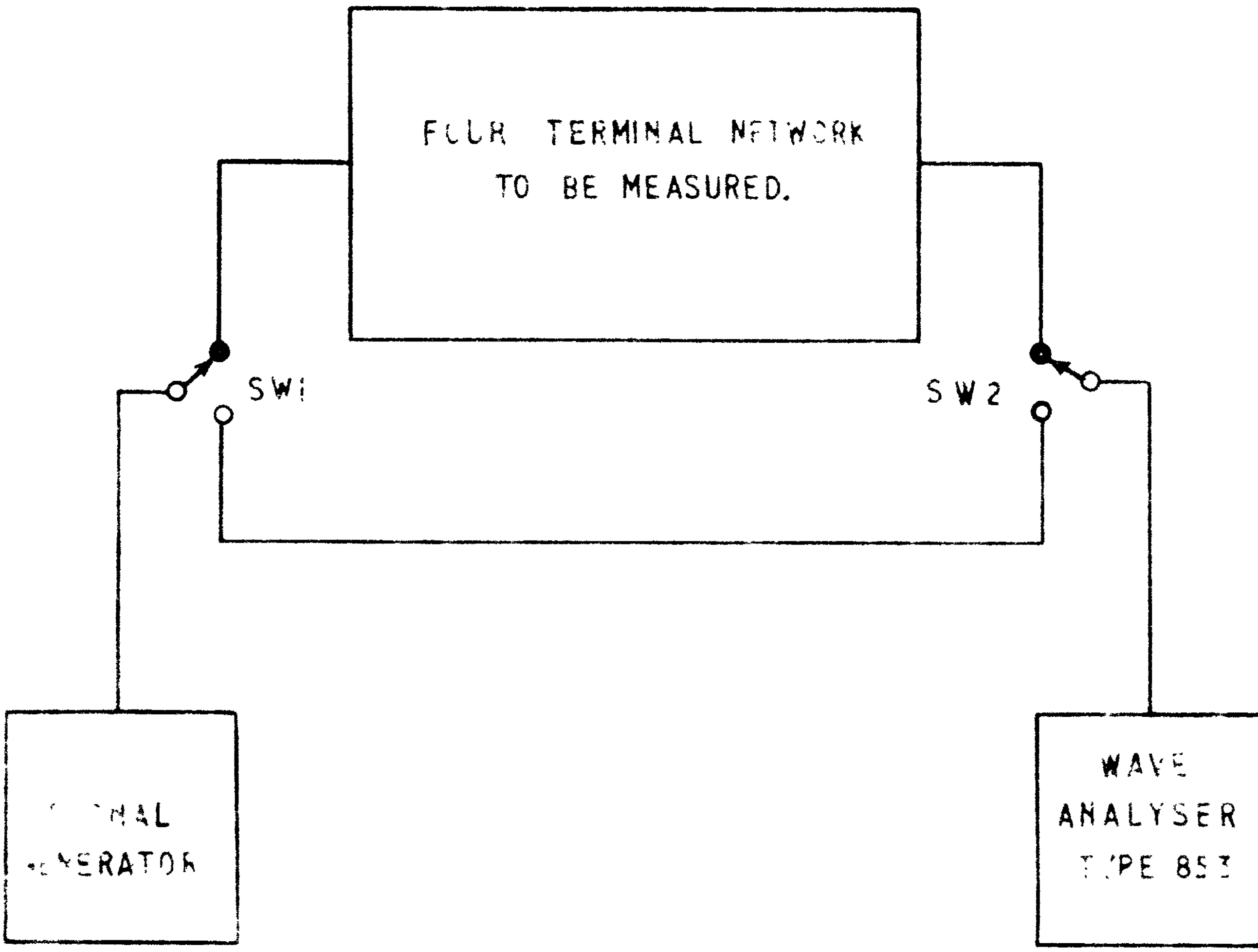

FIGURE 2. WAVE ANALYSER TYPE 853.
BLOCK DIAGRAM.

FOR INSERTION GAIN AND LOSS MEASUREMENTS.

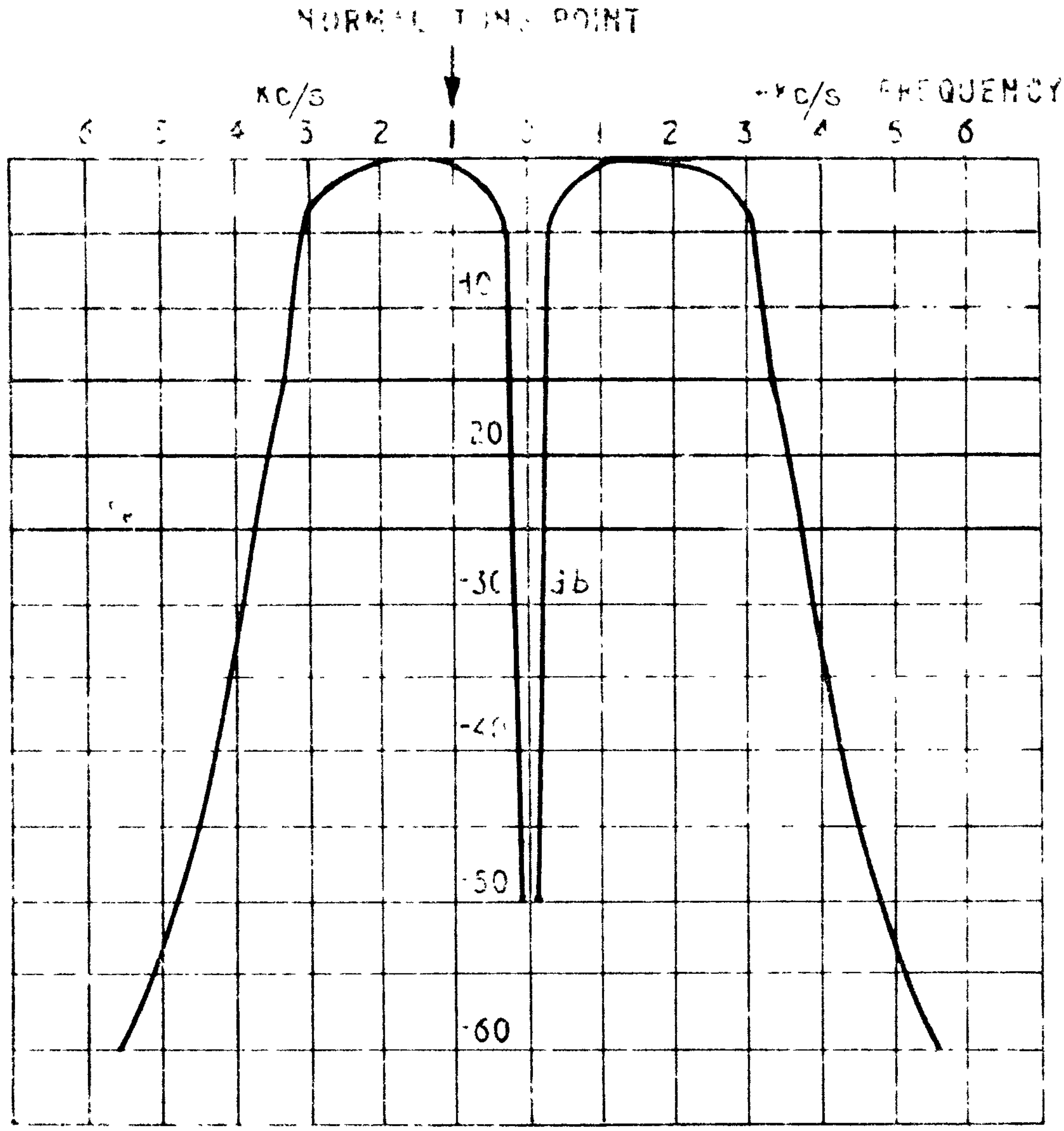

FIGURE 4 WAVE ANALYSER TYPE 853.

TYPICAL FREQUENCY RESPONSE.

FILTER AND L.F. AMPLIFIER.

TABLE 1

WAVE ANALYSER TYPE 853

COMPONENTS LIST

Circuit Reference	Description		Type	Tol ±%	Rating
Resistors					Watts
R1	107	Ω	Welwyn A3611	1	1/8
R2,R3	144	Ω	Welwyn A3611	1	1/8
R4	371	Ω	Welwyn A3611	1	1/8
R5,R6	91	Ω	Welwyn A3611	2	1/8
R7,R8	371	Ω	Welwyn A3611	1	1/8
R9	91	Ω	Welwyn A3611	2	1/8
R10	46	Ω	Welwyn A3611	2	1/8
R11	91	Ω	Welwyn A3611	2	1/8
R12,R13,R14	371	Ω	Welwyn A3611	1	1/8
R15	91	Ω	Welwyn A3611	2	1/8
R16,R17	46	Ω	Welwyn A3611	2	1/8
R18	91	Ω	Welwyn A3611	2	1/8
R19	68	Ω	Erie 109	5	1/4
R20	120	Ω	Erie 109	5	1/4
R21	33	kΩ	Erie 16	10	1/4
R22	150	Ω	Erie 8	10	1/2
R23	330	Ω	Erie 8	10	1/2
R24,R25,R26	1.0	kΩ	Erie 8	10	1/2
R27,R28	470	Ω	Erie 8	10	1/2
R29	47	Ω	Erie 8	10	1/2
R30	82	kΩ	Erie 9	10	1/4
R31	10	Ω	Erie 16	10	1/4
R32	150	kΩ	Erie 16	10	1/4
R33	4.7	kΩ	Welwyn AW3112	5	10
R34		Not used			
R35	4.7	kΩ	Erie 16	10	1/4
R36	2.2	kΩ	Erie 8	10	1/2
R37	4.7	kΩ	Erie 16	10	1/4
R38	10	kΩ	Erie 16	10	1/4
R39	100	kΩ	Erie 16	10	1/4
R40	22	kΩ	Erie 8	10	1/2
R41	470	Ω	Erie 8	10	1/2

TABLE 1
(continued)

WAVE ANALYSER TYPE 853

COMPONENTS LIST

Circuit Reference	Description	Type	Tol ±%	Rating
Resistors				Watts
R42,R43	11.43 kΩ (Resistor Ass.)	6253-269	Airmec	
R44	15.46 kΩ (10dB Pad)			
R45,R46	18 kΩ (Resistor Ass.)	6253-270	Airmec	
R47	4.44 kΩ (20dB Pad)			
R48	33 kΩ	Welwyn A3611	1	1/8
R49	50 kΩ var. Inverse S-log	CLR4039/15	2	3
R50	47 kΩ	Erie 16	10	1/4
R51	3.3 MΩ	Erie 16	10	1/4
R52	470 kΩ	Erie 16	10	1/4
R53	1.0 kΩ	Erie 8	10	1/2
R54	470 Ω	Erie 109	5	1/4
R55	1.0 MΩ	Erie 16	10	1/4
R56	4.7 kΩ	Welwyn AW3112	5	10
R57,R58	22 kΩ	Erie 16	10	1/4
R59	100 kΩ	Erie 16	10	1/4
R60	150 kΩ	Erie 16	10	1/4
R61	2.2 kΩ	Erie 16	10	1/4
R62	1.5 kΩ	Erie 8	10	1/2
R63	220 Ω	Erie 109	5	1/4
R64	1.0 MΩ	Erie 16	10	1/4
R65	15 kΩ	Welwyn A3611	1	1/8
R66,R67	500 kΩ var. linear	Morgan 'H'	20	1.1/2
R68	100 kΩ	Erie 8	10	1/2
R69	1.5 kΩ	Erie 8	10	1/2
R70	470 Ω	Erie 16	10	1/4
R71	22 kΩ	Welwyn AW3112	5	10
R72	10 kΩ var.lin.preset	Welwyn HRP22	10	3
R73	330 kΩ	Erie 9	10	1/4
R74	15 kΩ	Welwyn AW3112	5	10
R75	10 kΩ	Erie 8	10	1/2
R76	22 kΩ	Erie 16	10	1/4

TABLE 1
(continued)

WAVE ANALYSER TYPE 853

COMPONENTS LIST

Circuit Reference	Description		Type	Tol ±%	Rating
Resistors					Watts
R77	470	Ω	Erie 16	10	1/4
R78	100	kΩ	Erie 16	10	1/4
R79	1.0	kΩ	Erie 8	10	1/2
R80	3.3	kΩ	Erie 8	10	1/2
R81	1.0	kΩ	Erie 8	10	1/2
R82	10	kΩ	Erie 8	10	1/2
R83	68	Ω	Erie 8	10	1/2
R84	22	kΩ	Erie 8	10	1/2
R85	10	kΩ	Erie 8	10	1/2
R86	10	kΩ	Erie 109	5	1/4
R87,R88	100	kΩ	Erie 8	10	1/2
R89	1.0	kΩ	Erie 8	10	1/2
R90	330	Ω	Erie 8	10	1/2
R91	47	Ω	Erie 16	10	1/4
R92	100	kΩ	Erie 16	10	1/4
R93	15	kΩ	Erie 8	10	1/2
R94	100	kΩ	Erie 16	10	1/4
R95	330	Ω	Erie 8	10	1/2
R96	100	Ω	Erie 8	10	1/2
R97	10	Ω	Erie 16	10	1/4
R98	22	kΩ	Erie 8	10	1/2
R99	10	Ω	Erie 16	10	1/4
R100,R101	1.0	kΩ	Erie 8	10	1/2
R102	22	Ω	Erie 8	10	1/2
R103	6.8	kΩ	Erie 8	10	1/2
R104	2.2	kΩ	Erie 8	10	1/2
R105	1.0	kΩ	Erie 8	10	1/2
R106	47	Ω	Erie 8	10	1/2
R107	22	Ω	Erie 8	10	1/2
R108	33	Ω	Erie 8	10	1/2
R109,R110	18	kΩ (Resistor Ass.)	6253-270	Airmec	
R111	4.44	kΩ (20dB Pad)			

TABLE 1
(continued)

WAVE ANALYSER TYPE 853

COMPONENTS LIST

Circuit Reference	Description	Type	Tol ±%	Rating
Resistors				Watts
R112, R113	18 kΩ (Resistor Ass)	6253-270	Airmec	
R114	4.44 kΩ (20dB Pad)			
R115	33 kΩ	Welwyn AW3112	5	10
R116	0.8 Ω special w.w.	6318-100	Airmec	
R117	4.7 kΩ	Erie 8	10	1/2
R118	470 Ω	Erie 16	10	1/4
R119	47 Ω	Erie 16	10	1/4
R120	10 Ω	Erie 16	10	1/4
R121	150 Ω	Erie 8	10	1/2
R122	1.0 kΩ	Erie 8	10	1/2
R123	47 kΩ	Erie 16	10	1/4
R124	10 kΩ	Erie 9	10	1/4
R125	47 Ω	Erie 8	10	1/2
Capacitors				Volts
C1 to C7	4-34 pF trimmer	Polar C31-01/1		
C8a, 8b, 8c	3x532 pF Air variable	Wingrove & Rogers C60-53		
C9	0.1 μF	Hunts W48	20	150
C10, 11, 12	1000 pF lead through	Erie K120051/700B	20	500
C13	0.1 μF	Hunts W48	20	350
C14 to C18	4-34 pF trimmer	Polar C31-01/1		
C19	22 pF	Dubilier S635	10	350
C20	4-34 pF trimmer	Polar C31-01/1		
C21	470 pF	Johnson Matthey C22R	1	350
C22	68 pF	Dubilier S635	10	350
C23	4-34 pF trimmer	Polar C31-01/1		
C24	220 pF	Johnson Matthey C22R	1	350
C25	200 pF	Dubilier 635	20	350
C26	1500 pF	Erie K120051/BD	20	500

TABLE 1
(continued)

WAVE ANALYSER TYPE 853

COMPONENTS LIST

Circuit Reference	Description		Type	Tol ±%	Rating
Capacitors					Volts
C27	1000	pF lead through	Erie K120051/700B	20	500
C28	0.5	μF	Hunts W48	20	250
C29,C30	200	pF lead through	TCC. LT.2	20	500
C31	0.5	μF	Hunts W48	20	150
C32	0.1	μF	Hunts W48	20	150
C33 to C37	4-34	pF trimmer	Polar C31-01/1		
C38	470	pF	Johnson Matthey C22R	1	350
C39	200	pF	Dubilier 635	20	350
C40	22	pF	Dubilier S635	10	350
C41	4-34	pF trimmer	Polar C31-01/1		
C42	220	pF	Johnson Matthey C22R	1	350
C43	200	pF	Dubilier 635	20	350
C44	68	pF	Dubilier S635	10	350
C45	4-34	pF trimmer	Polar C31-01/1		
C46	1000	pF lead through	Erie K120051/700B	20	500
C47,C48	8+8	μF	TCC. CE35L	-20+50	350
C49,C50	1000	pF lead through	Erie K120051/700B	20	500
C51	20	μF	TCC. CE30B	-20+50	12
C52	0.1	μF	Hunts W48	20	350
C53	0.5	μF	Hunts W49	20	350
C54	2760	pF	GEC Polystyrene	2	350
C55,C56	5520	pF	GEC Polystyrene	2	350
C57	2760	pF	GEC Polystyrene	2	350
C58 and C62	16+8	μF	TCC. CE28P	-20+50	450
C59	0.001	μF	TCC. Metalmite	25	500
C60	0.002	μF	TCC. Metalmite	25	500
C61 and C63	16+8	μF	TCC. CE28P	-20+50	450
C64	500	pF	TCC. M2N	20	350
C65,C66	200	pF	TCC. M2N	20	350
C67,68,69	16+16+8	μF	Dubilier CRE1616850	-20+50	500
C70	1.0	μF	Hunts W48	20	150
C71	470	pF	Johnson Matthey C22S	1	350
C72	22	pF	Dubilier S635	10	350

TABLE 1
(continued)

WAVE ANALYSER TYPE 853
COMPONENTS LIST

Circuit Reference	Description		Type	Tol ±%	Rating
Capacitors					Volts
C73	220	pF	Johnson Matthey C22S	1	350
C74	75	pF	Erie N750-B	10	750
C75	1.0	µF	Hunts W48	20	150
C76	0.001	µF	TCC. M2N	20	350
C77	22	pF	Dubilier S635	10	350
C78	33	pF	Dubilier S635	10	350
C79	47	pF	Dubilier S635	10	350
C80	10	pF	Dubilier S635	10	350
C81	1500	pF	Dubilier S635	10	350
C82	220	pF	Dubilier S635	10	350
C83	220	pF	Dubilier S635	10	350
C84	200	pF	Dubilier 635	20	350
C85	10	pF	Dubilier S635	10	350
C86	1500	pF	Erie K120051/BD	20	500
C87	47	pF	Dubilier S635	10	350
C88, C89	1000	pF Lead through	Erie K120051/700B	20	500
C90	36	pF	Erie NPO.BD	10	750
C91	15	pF	Erie N750AD	10	500

Inductors and Transformers

L1	Coil 48.8 mH Input Assembly 1	6253-210	Airmec
L2	Coil 4.9 mH Input Assembly 2	6253-211	Airmec
L3	Coil 488 µH Input Assembly 3	6253-212	Airmec
L4	Coil 48.8 µH Input Assembly 4	6253-213	Airmec
L5	Coil 4.9 µH Input Assembly 5	6253-214	Airmec
L6	Coil 0.87 µH Input Assembly 6	6253-215	Airmec
L7	Coil 0.27 µH Input Assembly 7	6253-216	Airmec
L8	Coil 48.8 mH Osc. Assembly 1	6253-217	Airmec
L9	Coil 4.9 mH Osc. Assembly 2	6253-218	Airmec
L10	Coil 488 µH Osc. Assembly 3	6253-219	Airmec
L11	Coil 48.8 µH Osc. Assembly 4	6253-220	Airmec
L12	Coil 4.9 µH Osc. Assembly 5	6253-221	Airmec
L13	Coil 0.87 µH Osc. Assembly 6	6253-222	Airmec
L14	Coil 0.27 µH Osc. Assembly 7	6253-223	Airmec
L15	Coil 48.8 mH Mixer Assembly 1	6253-224	Airmec

TABLE 1
(continued)
WAVE ANALYSER TYPE 853
COMPONENTS LIST

Circuit Reference	Description	Type	Maker
Inductors and Transformers			
L16	Coil 4.9 mH Mixer Assembly 2	6253-225	Airmec
L17	Coil 488 μH Mixer Assembly 3	6253-226	Airmec
L18	Coil 48.8 μH Mixer Assembly 4	6253-227	Airmec
L19	Coil 4.9 μH Mixer Assembly 5	6253-228	Airmec
L20	Coil 0.87 μH Mixer Assembly 6	6253-229	Airmec
L21	Coil 0.27 μH Mixer Assembly 7	6253-230	Airmec
L22,23,24	Toroidal Choke 1.705 H	212-1301	Airmec
L25,L26	LF Choke 4.0 H	212-0301	Airmec
L27	Coil Assembly	6253-288	Airmec
T1	Mains Transformer Assembly	6340-114	Airmec
Valves			
V1	EF91 (CV138)		Mullard
V2	ECF80 (CV5215)		Mullard
V3	150C2 (CV1832)		Mullard
V4	6F33 (CV2209)		Mazda
V5	6BR7		Brimar
V6,V7	12AT7 (CV455)		Brimar
V8	5Z4G (CV1863)		Brimar
Switches			
SW1	Oak Type 'H', 1 pole 4 way	6253-170	Airmec
SW2	Oak Type 'H', 2 pole 5 way	6253-171	Airmec
SW3	Oak Type 'H', 5 pole 7 way	6253-172	Airmec
SW4	Cutler Hammer dp.st. 250V, 3A	8370-K7	B.N.S.F.
Plugs and Sockets			
P1,P2	Not used		
P3	Plug Mains, 250V, 3A	SA1403	Bulgin
P4	Panel Jack	J16	Bulgin
S1	Socket Mk 1V, 6 way	CZ49223	Plessey
S2,S3	BNC Bulkhead Socket 75Ω	GE37529	Greenpar

TABLE 1

(concluded)

WAVE ANALYSER TYPE 853

COMPONENTS LIST

Circuit Reference	Description	Type	Maker
Miscellaneous			
F1	Fuse link plug 2 pin, 2A	P62/2	Clix
LP1, LP2	Lamp festoon 6.5V, 3W	255	Osram
M1	Microammeter 100µA f.s.d. S20 Scale to 6253-205		Sangamo Weston
Ancillary Items			
-	Probe Unit	6234-100	Airmec
-	Plug Telephone	P38	Bulgin
-	Plug Coaxial Free 2 off	L781/P2	Belling Lee

TABLE 2

WAVE ANALYSER TYPE 853

PROBE UNIT (6234-100)

COMPONENTS LIST

Circuit Reference	Description	Type	Tol ±%	Rating
Resistors				Watts
R1	10 Ω	Erie 16	10	1/4
R2	150 Ω	Erie 16	10	1/4
R3	100 Ω	Erie 16	10	1/4
R4	100 kΩ	Erie 16	10	1/4
R5	220 Ω	Erie 16	10	1/4
R6	1.0 MΩ	Erie 16		
R7	1.0 MΩ	Erie 9	20	1/4
R8	10 kΩ	Erie 16	10	1/4
Capacitors				Volts
C1	0.1 μF	Hunts W48	20	250
C2	20 μF	TCC CE30B	-20+50	12
C3	150 pF	Erie N750/C	20	500
C4	3.0 pF approx. special	Adjust on Test		
C5	100 pF	Erie N750/BD	20	500
C6	0.1 μF	Hunts W48	20	250
Valves				Maker
V1	EF91 (CV138)			Mullard
Switches				
SW1	Oak Type 25 1 pole 3 way	To 6234-120		B.N.S.F.
Plugs and Sockets				
P1	Plug Mk 1V, Free, 6 pin	CZ49222		Plessey
Inductor				
L1	Inductor Assembly 1μH	6234-121		Airmec

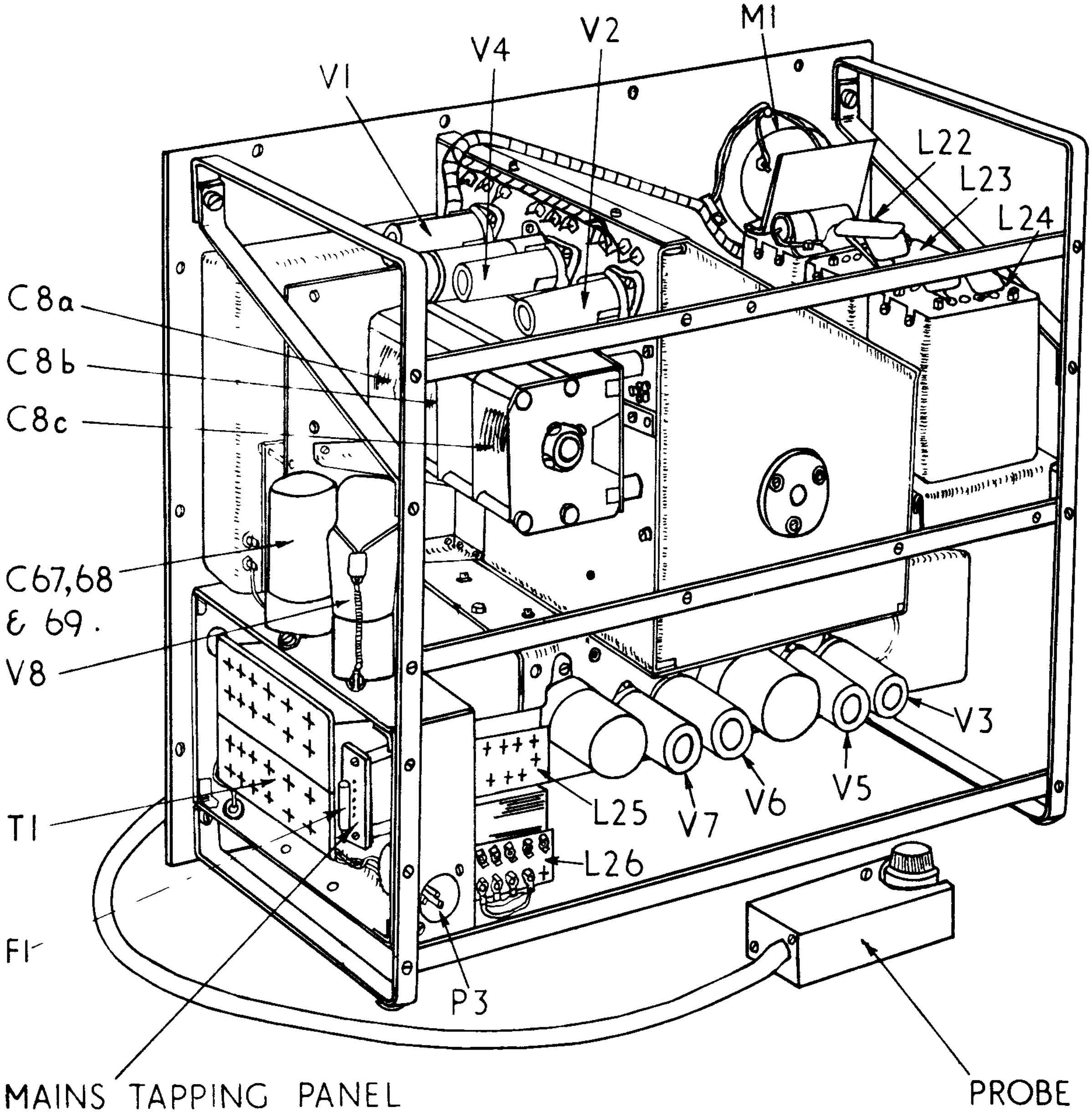

FIGURE 5. WAVE ANALYSER TYPE 853. REAR VIEW.

FIGURE 3. WAVE ANALYSER TYPE 853.
CIRCUIT DIAGRAM.