R.F.J.

A I R M E C   L I M I T E D

(M162)

OPERATING INSTRUCTIONS

H.F. SIGNAL GENERATOR TYPE 201

AIRMEC LIMITED,
HIGH WYCOMBE,
BUCKS.

Issue 3

V3, V9 replaced 9/3/65 – Turret Lubricated

Osc Intermittent ~ 5/65 – Capacitor found touching to earth on turret section.

Xtal check not working 14/11/65 – " " " V9!

No int mod or X lock 5/3/68 V7 H-K 10M replaced

C63 o/c replaced.

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1. SPECIFICATION

Frequency Range:

The Frequency range is from 30 kc/s to 30 Mc/s and is divided into 7 bands by turret switching, as follows:-

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

Frequency Calibration:

The frequency calibration is on an illuminated film scale having an effective length of approximately 4 ft. on each range. One inch of scale represents 1.2 kc/s at 100 kc/s, 50 kc/s at 2 Mc/s and 500 kc/s at 30 Mc/s.

The single knob frequency control has a reduction ratio of 90:1 with negligible backlash.

One division of the fine logging scale calibrated 0-100 on the tuning control represents 15 c/s at 100 kc/s, 600 c/s at 2 Mc/s and 6 kc/s at 30 Mc/s.

Frequency Scale Check:

A built-in crystal calibrator may be switched into circuit which, in conjunction with jacked-in telephones, gives scale check points at 500 kc/s intervals through the frequency range above 500 kc/s, and at harmonics of the 500 kc/s crystal and the signal frequencies below 500 kc/s.

Means are provided for standardising the crystal calibrator frequency against a standard frequency.

The frequency scales are fitted with a movable cursor to enable any scale error to be corrected.

Frequency Accuracy:

The accuracy of the scale calibration without correction is ± 1%

At most frequencies the accuracy obtainable by employing the internal crystal calibrator is better than ± 0.05%

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Stability:	15 minutes after switching on the change in output frequency in any subsequent 5 minute period does not normally exceed 0.005%. In general a 10% change in mains voltage causes a change in output frequency of considerably less than 0.01%.
Output Level:	The output level is continuously variable from 1 microvolt to 1.1 volt R.M.S. open circuit from a source impedance of 75 ohms or -116 to + 6 dB relative to 1 mW into 75 ohms.
Output Attenuators:	Coarse: 0 - 100 dB in 20 dB steps with an accuracy of ± 0.2 dB per step (± 0.25uV overall). Fine: 0 - 20 dB in 2 dB steps with a maximum error per step not exceeding 0.1 dB and an overall error not exceeding 0.5 dB. Interpolation: 0 to 2 dB continuously variable.
Output Impedance:	The output impedance is 75 ohms ± 5% at all attenuator settings.
High Output:	A HIGH OUTPUT socket provides an output of approximately 4.5 volts R.M.S. into an impedance of not less than 350 ohms resistive or not more than 30 pF capacitative.
Maximum R.F.:	A MAX R.F. position enables twice normal output to be obtained from either output socket, without modulation.
Harmonic Distortion:	The amplitude of any harmonic component relative to the fundamental signal frequency is less than 1%.
Amplitude Modulation:	Internal modulation at 1000 c/s or external modulation from 30 c/s to 10 kc/s may be applied to all carrier frequencies. At the lower carrier frequencies, the highest modulation frequency has to be restricted as tabulated below.

Modulation depth is continuously variable up to 90% with an accuracy of 5%

Frequency Band	Maximum modulation frequency for depths of		
	30%	50%	90%
30-100 kc/s	1.5 kc/s	1 kc/s	0.5 kc/s
100-300 kc/s	5 kc/s	3 kc/s	1.5 kc/s
300-100 kc/s	10 kc/s	10 kc/s	5 kc/s

The signal input required on external modulation is 100 mW into 600 ohms (7.5 volts terminal voltage).

Spurious Frequency Modulation: The spurious frequency modulation occurring with amplitude modulation is less than 300 c/s at 30% modulation depth at all carrier frequencies.

Output Level Variation: An A.G.C. circuit maintains the output constant within ± 0.5 dB over the entire frequency range.

Audio Frequency Output: Either the internal modulation signal at 1000 c/s or the output signal of an external modulation low frequency oscillator may be fed out via the output circuit and output step attenuators in the same manner as the normal R.F. signal.

External Field: The external field at distances exceeding 1 foot from the instrument is less than 1 microvolt per metre.

Power Supplies: The instrument operates from 100-130 or 200-250 volts, 50-60 c/s mains. The power consumption is approximately 130 watts.

Dimensions: The instrument is housed in a steel case measuring approximately 19" wide x 16" high x 8.1/2' deep (48 x 39 x 21.5 cms) and is suitable for use on a bench or rack mounted on a standard 19" rack.

Weight: The weight of the instrument is approximately 57 lbs. (26 kgm).

2. DESCRIPTION

2.1 General

The circuit diagram of the instrument is given in Figure 1, and the components list in Table 1.

The outline drawing of the H.F. Signal Generator Type 201, shown in Figure 2, illustrates the position of the valves and the major components.

2.2 Circuit

The signals are generated by valve V2A operating as a cathode coupled oscillator. The oscillator tuned circuit L24 to L30 is selected by the turret wave band switch and tuned by the rear section, C11C, of the ganged capacitor. The signal is taken from the oscillator circuit via a compensating resistance capacitance network and pre-set attenuator C12 to the grid of a cathode follower stage V2B which feeds the tuned modulator stage V3.

Tuned anode coupling is used between valve V3 and the power amplifier valve V4, inductors L31 to L37 being selected by the turret frequency band switch and tuned by the middle section C11.B of the ganged capacitor.

The power amplifier valve V4 feeds the output tuned circuit consisting of inductors L38 to L44 similarly selected by the turret frequency band switch and tuned by the front section, C11A, of the ganged capacitor. Neutralisation of the anode grid capacitance of valve V4 is effected by trimmer C30. A high level output is taken via the MOD. TONE switch SW12 to the HIGH OUTPUT plug on the front panel. This point also feeds the 2 dB step attenuator, the output of which is selected by switch SW14 to feed the 20 dB step attenuator and so to the attenuated output plug P11. This arrangement allows an accurate source impedance of 75 ohms to be maintained throughout the attenuated output range.

A peak reading diode voltmeter V5A and metering valve V6B monitors the high level output to the attenuators, and since the voltage is set to a constant value, a virtual zero source impedance is obtained at this point. Also fed from this point is a second diode detector V5B whose time constant is such as to give a d.c. output voltage equal to the peak value of an unmodulated carrier, whilst allowing the output to follow the modulation envelope when modulated. the switching of the time constant for the lower frequency bands is effected automatically by switches SW10 and SW11 worked from the turret frequency band switch. The d.c. output from the detector V5B feeds the grid of the first d.c. amplifier valve V8B via the 2 dB interpolation control R63. Ganged to the latter is another control R74.

in the meter circuit, the operation of which is to maintain a constant meter reading over the range of the 2 dB interpolation control although the actual output is being varied over a range of 2 dB. The dial for this control is, in effect, the cursor for the 2 dB step attenuator dial, and hence a direct reading of the continuously variable 2 dB interpolation is obtained on the dial of the 2 dB fine attenuator.

The ADJUST CARRIER control varies the delay voltage at the cathode of valve V8B and hence determines the level at which stabilisation of the output voltage takes place. Valve V8B is direct coupled to the second d.c. amplifier valve V8A, the reference voltage of its cathode being obtained from neon stabiliser V11. The controlling element for the gain of the signal chain is a thermistor X1 through which the anode current of valve V8A flows and which shunts the anode load of valve V3.

The modulation signal, generated by the 1000 c/s local oscillator valve V6A or obtained from a signal applied to the EXT. MOD. terminals, is fed to the grid of the L.F. amplifier valve V7A via the ADJUST MODULATION control R85. The signal at the anode of valve V7A is parallel fed to the suppressor grid of modulator valve V3, the d.c. potential of which relative to cathode is adjustable by pre-set resistor R78 for optimum modulation.

Under modulation conditions, the mean carrier level detector V5B produces the de-modulated signal across its load resistor and this signal after suitable attenuation, is amplified and phase inverted by valve V7B to produce a negative feedback signal at the grid of valve V7A. Thus overall negative feedback is applied from the de-modulated output signal which helps to maintain a pure modulation envelope. The modulation depth is measured by the peak reading diode voltmeter V5A the time constant of which is such as to measure the absolute peak value of the modulated envelope.

A XTAL CHECK position on the service switch SW13 applied H.T. to the crystal oscillator and mixer valve V9. The valve is operated as an electron-coupled crystal oscillator, with the high level signal output fed to the short-based suppressor grid. This arrangement gives a beat note output at the anode of V9 between the 500 kc/s crystal or its harmonics and the signal frequency or its harmonics. The switch SW13 converts valves V7B and V7A to a cascade amplifier to feed the PHONES jack, the ADJUST MODULATION control acting as a gain control between the valves.

An additional position marked MAX. RF. on the service switch SW13 enables the output from the Generator to be doubled. This is achieved by running the suppressor grid of valve V3 at zero bias relative to cathode and reducing to one half the d.c. signal from the detector V5B to the d.c. Amplifier valve V8B. No modulation can be used under these conditions, the A.G.C. control circuit is still operative.

A MAX. RF. mark is provided on the meter corresponding to double the normal R.F. output.

The H.T. supply for the instrument is provided by the full wave rectifier valve V1 working into a capacitor input filter C7A followed by a single stage of smoothing L3, C7B.

Two neon stabilised H.T. supplies are provided within the instrument. One supply at 150 volts (V10) feeds the local oscillator/cathode follower valve V2 and the first d.c. amplifier valve V8B. The second supply of 75 volts (V11) feeds the cathode of the second d.c. amplifier valve V8A, the ADJUST CARRIER control, and the meter amplifier valve V6B. A semi-stabilised supply derived from V11 feeds the screen grid of the modulator valve V3.

3. INITIAL ADJUSTMENT

The instrument is despatched from the Works with the voltage tapping panel set for a mains supply within the range 216-234 volts. If the instrument is to be used on mains supplies of other voltages, it must be removed from its case and the plug on the tapping panel moved to the appropriate mains tap. The tappings available are 105-115, 120-130, 200-215, 216-234 abd 235-255 volts. If the instrument is to be operated on either of the two lowest taps, a fuse of double the current rating to that given in the components schedule for F1, Table 1, must be fitted. When removing the instrument from its case, it is necessary to remove the 2BA screw at the rear adjacent to the mains outlet in addition to the front screws.

Apart from this, the instrument leaves the Works ready for use, and only requires to be connected to the mains supply by means of the three core lead supplied, in which the red and black cores are LINE and NEUTRAL respectively, and the third core EARTH.

If the instrument is removed from its case to adjust the mains tapping panel it is essential that all panel screws and the rear screw are replaced and securely tightened, or a serious increase in external field may result.

4. OPERATION

4.1 General

Either the probe lead or a suitable coaxial cable should be used to connect the output of the instrument to the equipment under test.

Having made the initial adjustments stated in Section 3 above, the instrument should be switched on and allowed to warm up for at least 3 minutes before use.

It is desirable to check the meter zero periodically or before accurate level measurements are made. This is done by setting the service switch to MOD. OFF and the MOD. TONE switch to MOD. TONE. The meter is then made to read to the extreme left-hand scale mark by removing the button marked SET ZERO and adjusting the screw driver slot control. The button should then be replaced and the switch returned to NORMAL.

4.2 Unmodulated Carrier

Having set the instrument to the desired frequency by means of the turret wave band switch and the main frequency calibrated tuning scale, the service switch should be set to MOD. OFF and the MOD. TONE switch to NORMAL. The ADJUST CARRIER control should be rotated until the meter reads to the SET CARRIER mark. The output level is then set to the required level by adjustment of the 20 dB step attenuator, the 2 dB step attenuator, and the small knob above the cursor of the latter control.

4.3 Amplitude Modulated Carrier

The signal generator should first be adjusted on unmodulated carrier as described in Section 4.2 above. If internal modulation at 1 kc/s is required, the service switch is set to INT. MOD. and the ADJUST MODULATION control rotated until the meter indicates the percentage modulation desired. If the signal frequency is below 300 kc/s, the modulation depth should not exceed the permissible modulation figures given in the Specification, Section 1, under 'AMPLITUDE MODULATION'.

If external modulation within the frequency range 30 c/s to 10 kc/s is required, the external oscillator is connected to the EXT. MOD. terminals on the front panel and the service switch set to EXT. MOD. The external oscillator should be capable of delivering an output of 100 milliwatts into a 600 ohm circuit (or 7.5 volts terminal voltage). The ADJJST MODULATION control is rotated until the meter indicates the percentage modulation required. If the signal frequency is below 1000 kc/s, the modulation depth should not exceed the figures in the Specification referred to above.

4.4 High Output

A 4.5 volt output independent of the attenuators is provided on the coaxial plug marked HIGH OUTPUT. The cap on this plug should be removed and connection made by means of a suitable coaxial cable. The output at this point is controlled by the A.G.C. circuit provided the resistive shunt impedance of the load is not less than 350 ohms or the shunt capacitance, including the cable, does not exceed 30 pF.

It is essential that the shielding cap is replaced on the HIGH OUTPUT plug when this plug is not in use as considerable radiation occurs from the unshielded outlet at high frequencies.

4.5 Maximum R.F.

The Signal Generator can be set to give twice normal output, on unmodulated carrier only, by rotating the service switch to the MAX. R.F. position. The A.G.C. circuit is in operation, and the ADJUST CARRIER control should be rotated until the meter reads to the MAX. R.F. mark.

4.6 Audio Frequency Output

The modulation signal, either internal or external, may be fed out via the output circuit and output attenuators. The MOD. TONE switch should be turned to MOD. TONE and the service switch set to the appropriate position, i.e. INT. MOD. or EXT. MOD. The ADJUST MODULATION control may then be rotated, until a meter deflection to the SET CARRIER mark is obtained, and the output level of the low frequency signal may be set by means of the attenuators to any value between 1 microvolt and 1.1 volts open circuit E.M.F. with a source impedance of 75 ohms. The attenuators are adjusted in the same manner as for normal carrier output as described in Section 4.2 above, but it should be noted that as the small knob above the cursor of the 2 dB step attenuator is adjusted to interpolate between the 2 dB steps, it is necessary to maintain the meter reading to the SET CARRIER mark by adjustment of the ADJUST MODULATION control. On normal carrier output, this function is of course performed by the A.G.C. circuit.

The external oscillator required to provide a variable frequency in this mann er should be capable of providing an output of 100 milliwatts into a 600 ohm load (or 7.5 volts terminal voltage). A suitable oscillator is the Airmec Signal Generator Type 252, which, when connected to the EXT. MOD. terminals of the H.F. Signal Generator enable a continuous frequency coverage from 30 c/s to 30 Mc/s to be obtained using the same output meter, attenuators, and output plug.

4.7 The Probe Unit

The probe unit has three terminals, marked E, D and AE. Connection should be made to the E (earth) terminal and either the D or AE terminals. When operating at frequencies above 10 Mc/s with a high impedance load between the E and D terminals, it is advisable to terminate the latter terminals with a 75 ohms load resistor, in which case the terminal voltage is one half the indicated open circuit voltage.

4.8 Crystal Check

The crystal check facility enables the frequency scale calibration to be checked and corrected at a large number of points in each frequency band. Lists of the major crystal check points are given in Table 2. It may be possible to identify further points intermediate between the points listed at certain parts of the frequency range, but these should be noticeably weaker than the adjacent points listed.

To use the crystal check facility, a pair of high impedance telephones requires to be plugged into the PHONES jack using the jack plug provided, and the service switch set the XTAL CHECK with the MOD. TONE switch in the NORMAL position. When the Generator is tuned to the immediate vicinity of a crystal check point an audio note should be heard in the telephones, the strength of which can be adjusted by means of the ADJUST MODULATION control. It is normally desired to correct the scale at a particular point, in which case the Generator is tuned until the nearest crystal check point gives zero beat output in the telephones. The moveable cursor is then set such that the relevant frequency scale reads exactly the crystal check frequency.

Identification of a particular crystal check point when the points are close together is achieved by identifying an immediate group of check points as read from Table 2, making use of the difference in level between points. To assist the latter, the Table also lists the orders of harmonics from which the crystal check point is derived; the higher the order of harmonics the weaker will be the crystal check point.

5. RACK MOUNTING

The instrument is designed so that it may be forward rack mounted on a standard 19 inch rack, if required. The unit should be removed from its case and the case fixed to the rack by means of O.B.A. screws through the slotted holes provided in the case for the purpose. The unit should then be replaced in its case. Note that when removing the instrument from its case, it is necessary to remove the 2 BA screw at the rear adjacent to the mains outlet in addition to the front screws. Care must be taken that all panel screws and the rear screws are replaced and securely tightened when the case is replaced.

6. SERVICING

6.1 General

Valve, scale lamp and fuse replacements are the only servicing changes which should normally be required. The respective positions of these components are shown in Figure 2.

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6.2 Alignment of R.F.Circuits

Trimmers for the setting of the frequency scale calibration and alignment of the tuned buffer stages are readily accessible when the instrument is removed from its case and the screening cover removed, but re-alignment by the customer is not recommended. However, the following information is given on the location of the trimmers.

The trimmers are accessible through holes in the inclined lid of the turret assembly on the top of the instrument. The holes are arranged in pairs for each circuit, the pair nearest the front panel being the power amplifier circuit, the middle pair the buffer circuit and the rear pair the oscillator circuit. The front hole of each pair gives access to the capacitance trimmer and the rear hole the inductance trimmer, for the frequency band selected by the turret knob. A small metal bladed but insulated screw-driver must be used for the capacitance trimmers since there is H.T. on some of them, and an insulated blade is required for the inductance trimmers. A non-hardening compound has been used for locking the dust iron cores.

6.3 Pre-set Controls

Various pre-set controls are provided within the instrument, which are set at the Works to give correct operation. Their function and adjustment is given in Table 3.

6.4 Standardisation of the Crystal Frequency

A trimmer, C37, is provided to set the frequency of the crystal check oscillator to exactly 500 kc/s. It will be found that a small output at the crystal oscillator frequency can be obtained at the HIGH OUTPUT plug with the turret wave band switch in an intermediate position and the service switch set to XTAL CHECK. This output may then be checked against a standard frequency with an instrument such as the Airmec Frequency Standard Type 761.

6.5 Film Scale and Slow Motion Drive

The design of the Film Scale and Slow Motion Drive involves the use of gears and bearings, and in common with such mechanisms periodical lubrication is required. One or two drops of this lubrication oil should be given to each of the bearings and gears in the Slow Motion Drive and the Film Scale Unit. Access to the latter is obtained by first removing the tuning knob and then the front escutcheon by means of the four round headed screws around its outside edge. When re-assembling the tuning knob on its spindle, care should be taken to ensure that the reading on its scale is exactly 0 when the knob is rotated anti-clockwise against the mechanical stop, which should also correspond to a reading of 0 on the LOG scale of the Film Scale.

6.6 Scale Lamp Replacement

The tuning scale is illuminated by two festoon type lamps located behind the transluscent scale. Access to the lamps for replacement purposes is obtained by removing the tuning knob and front escutcheon as described in Section 6.5 above. It will then be necessary to lift up the film scale gently for a distance of a few inches to replace the lamps.

6.7 Modulator Valve (V3) Replacement

To achieve the best possible modulation, selection of valve V3 may be necessary, if replaced. Unsatisfactory samples of this valve produce a secondary lobe in the trough of deep modulation.

TABLE 1

SCHEDULE OF COMPONENTS

Circuit Reference	Description			Tol. ± %	Rating
Resistors			**Grade**		**Watts**
R1	100	kohms	RMA9	20	1/4
R2	100	ohms	"	20	1/4
R3	1	kohm	"	20	1/4
R4	47	"	"	20	1/4
R5	150	ohms	"	20	1/4
R6	220	"	"	20	1/4
R7	10	kohms	"	20	1/2
R8	330	ohms	A3611	5	1/4
R9	560	"	"	5	1/4
R10	1	kohm	RMA9	20	1/4
R11	100	ohms	"	20	1/4
R12	22	kohms	"	20	1/4
R13	100	ohms	"	20	1/4
R14	10	"	"	10	1/4
R15	15	kohms	AW3112	5	10
R16	1.5	"	AW3115	5	4
R17	10	Mohms	RMA9	20	1/4
R18	470	kohms	"	20	1/4
R19	4.7	"	"	20	1/4
R20	22	"	"	20	1/4
R21	10	"	"	20	1/4
R22	680	"	"	20	1/4
R23	47	"	RMA8	10	1/2
R24	220	"	"	10	1/2
R25	3.3	"	RMA9	20	1/4
R26	100	"	RMA2	20	1
R27	3.3	"	C23	5	1/2
R28	1	Mohm	C23	5	1/2
R29-R38	39	ohms	SA3611	2	1/8
R39	330	"	SA3622	1	1/4
R40	150	"	SA3611	1	1/8
R41-R49	720	"	SA3611	1	1/8
R50	270	"	SA3611	1	1/8
R51-R55	740	"	SA3611	1	1/8
R56-R59	92	"	SA3611	2	1/8
R60	83	"	SA3611	2	1/8

TABLE 1 (CONTINUED)

SCHEDULE OF COMPONENTS

Circuit Reference	Description			Grade	Tol. ± %	Rating
Resistors				Grade		Watts
R61	47	kohms		A3611	5	1/8
R62	100	"	carbon var. linear preset	P37		1/2
R63	25	"	wirewound var.linear	CLR/4049/11S	10	3
R64	5	"	" " "	CLR/4039/11S	10	3
R65	47	"		C23	5	1/2
R66	330	"		C23	5	1/2
R67	47	"		A3611	5	1/8
R68	10	"		RMA9	20	1/2
R69	10	"		AW3112	5	10
R70	15	"		AW3112	55	10
R71	68	"		A3611	5	1/8
R72	47	"		"	5	1/8
R73	50	"	wirewound var. linear preset	P22	10	3
R74	25	"	wirewound var.linear	CLR/4049	10	3
R75	5	"	wirewound var. linear preset	P22	10	3
R76	25	"	wirewound var. linear preset	P22	10	3
R77	100	"		A3611	5	1/8
R78	25	"	wirewound var. linear preset	P22	10	3
R79	1	Mohm		RMA9	20	1/4
R80	220	ohms		"	20	1/4
R81	4.7	kohms		RMA8	10	1/2
R82	15	"		AW3112	5	10
R83	22	"		A3611	5	1/8
R84	220	"		RMA9	20	1/4
R85	2.5	"	wirewound var.linear	CLR/4039/11S	10	3
R86	22	"		A3611	5	1/8
R87	3.3	"		RMA9	20	1/4
R88	470	"		"	20	1/4
R89	10	"		RMA8	10	1/2
R90	15	"		"	10	1/2
R91	330	"		RMA9	20	1/4

TABLE 1 (CONTINUED)

SCHEDULE OF COMPONENTS

Circuit Reference	Description		Tol. ± %	Rating
Resistors		Grade		Watts
R92	47 kohms	RMA9	20	$\frac{1}{4}$
R93	33 "	"	20	$\frac{1}{4}$
R94	4.7 "	RMA8	10	$\frac{1}{2}$
R95	6.8 "	AW3112	5	10
R96	15 "	RMA9	20	$\frac{1}{4}$
R97	Not used			
R98	330 kohms	RMA8	10	$\frac{1}{2}$
R99	100 "	"	10	$\frac{1}{2}$
R100	330 ohms	RMA9	20	$\frac{1}{4}$
R101	22 kohms	RMA8	10	$\frac{1}{2}$
R102	100 "	"	10	$\frac{1}{2}$
R103	330 ohms	RMA9	20	$\frac{1}{4}$
R104	6.8 kohms	RMA8	10	$\frac{1}{2}$
R105	1 "	RMA9	20	$\frac{1}{2}$
R106	1 "	RMA8	10	$\frac{1}{2}$
R107	1.5 "	RMA9	20	$\frac{1}{4}$
R108	220 ohms	RMA8	10	$\frac{1}{2}$
R109	330 "	RMA9	20	$\frac{1}{4}$
R110	220 "	RMA8	10	$\frac{1}{2}$
R111	330 "	RMA9	20	$\frac{1}{4}$
R112	10 "	RMA8	10	$\frac{1}{2}$
R113	100 "	RMA9	20	$\frac{1}{4}$
R114	10 kohms	"	20	$\frac{1}{4}$
R115	47 "	RMA8	10	$\frac{1}{2}$
R116	Resistor Assembly 63180184	Airmec		
R117	1 Mohm	C23	5	$\frac{1}{2}$
R118	1.5 kohm	A3611	5	$\frac{1}{8}$
R119	1 Mohm	RMA9	20	$\frac{1}{2}$
R120	Not used			
R121	100 ohms	RMA9	20	$\frac{1}{4}$
R122	22 "	C23	5	$\frac{1}{8}$
R123	1 kohm	RMA9	20	$\frac{1}{4}$
R124	47 "	"	20	$\frac{1}{4}$
R125	100 ohms	"	20	$\frac{1}{4}$
R126	1 kohm	"	20	$\frac{1}{4}$
R127	100 ohms	"	20	$\frac{1}{4}$

TABLE 1 (CONTINUED)

SCHEDULE OF COMPONENTS

Circuit Reference	Description		Tol. ± %	Rating
Capacitors		Type		Volts
C1,C2	0.01 uF	Metalpack	20	1000
C3-C6	1000 pF lead through	700B	20	350
C7	32+32 uF electrolytic	KE564	-20 +50	450
C8,C9	1500 pF	HiK.BD	20	200
C10	220 "	HiK.AD	20	500
C11	Slow Motion Unit	6301-100	Airmec	
C12	10-100 pF ceramic trimmer	CVS.31		500
C13	0.1 uF	W48	25	150
C14,C15	1000 pF	100B	20	350
C16	1500 "	HiK.BD	20	500
C17	0.1 uF	W48	25	150
C18	0.005"	Metalmite	25	350
C19	0.1 "	W48	25	350
C20	0.1 "	W48	25	150
C21-C25	1000 pF	100B	20	350
C26	1500 "	HiK.BD	20	500
C27	0.1 uF	W48	25	150
C28	0.1 "	W48	25	350
C29	0.005"	Metalmite	25	350
C30	0.5 - 3 pF miniature trimmer	S50-01/2	Polar	
C31,C32	1000 pF	100B	20	350
C33	0.1 uF	W48	25	150
C34	1500 pF	HiK.BD	20	500
C35	220 "	HiK.AD	20	500
C36	0.05 uF	W48	25	250
C37	3-33 pF air trimmer	7864/01	Mullard	
C38	0.01uF	Metalmite	25	350
C39	0.1 "	W48	25	150
C40	27 pF	N750BD	5	750
C41	12 uF electrolytic	CE32D	-20 +50	50
C42	120 pF	N750BD	2	750
C43	470 "	S635	10	350
C44	1500 "	S635	10	350
C45	0.05 uF	W48	25	250
C46-C49	1000 pF lead through	700B	20	350
C50	200 "	M2N	20	350
C51	1000 " lead through	700B	20	350
C52	0.1 uF	W48	25	150

TABLE 1 (CONTINUED)

SCHEDULE OF COMPONENTS

Circuit Reference	Description			Tol. ± %	Rating
Capacitors			Type		Volts
C53	8+8	uF electrolytic	CE37L	-20 +50	350
C54,C55	1000	pF lead through	700B	20	350
C56	100	uF electrolytic		-20 +50	6
C57	8+8	" "	CE37L	-20 +50	350
C58	0.1	"	W48	25	350
C59	1	"	W48	25	250
C60,C61	1500	pF	HiK.BD	20	500
C62	1	uF	W48	25	250
C63,C64	0.05	"	W48	25	250
C65,C66	1000	pF	700B	20	350
C67-C73	3-33	" air trimmer	7864/01	Mullard	
C74-C79	22	"	NPO.HD	10	750
C80,C81	62	"	NPO.CD	10	750
C82	470	"	FK9154	1	350
C83	18	"	NPO.AD	10	750
C84	220	"	FK9154	1	350
C85	22	"	N750AD	10	750
C86	22	"	NPO.BD	10	750
C87-C93	3-33	" air trimmer	7864/01	Mullard	
C94	470	"	Polystrene	2	350
C95	18	"	N750AD	10	750
C96	220	"	Polystrene	2	350
C97	100	"	SMWN	20	350
C98	3-19.5	"	C31-01/1	Wingrove & Rogers	
C99-C104	3-33	" air trimmer	7864/01	Mullard	
C105	470	"	Polystrene	2	350
C106	10	"	N750AD	10	750
C107	220	"	Polystrene	2	350
C108	18	"	N750AD	10	750
C109	1500	"	HiK.HD	20	500
C110	33	"	NPO.BD	10	750
C111	1500	"	HiK.BD	20	500
C112, C113	4.7	"	SPM/1	20	500

TABLE 1 (CONTINUED)

SCHEDULE OF COMPONENTS

Circuit Reference	Description					
Inductors and Transformers						
L1,L2	Coil Assembly 10 uH				6045-234	Airmec
L3	Choke Assembly				6045-232	"
L4-L8	Not used					
L9-L18	Coil Assembly 20 uH				6045-233	Airmec
L19-L23	" "	1 uH			6045-235	"
L24	" "	Range	1.	Osc.	6324-221	"
L25	" "	"	2.	"	6324-222	"
L26	" "	"	3.	"	6324-223	"
L27	" "	"	4.	"	6324-224	"
L28	" "	"	5.	"	6324-225	"
L29	" "	"	6.	"	6324-226	"
L30	" "	"	7.	"	6324-227	"
L31	" "	"	1.	Buffer	6324-228	"
L32	" "	"	2.	"	6324-229	"
L33	" "	"	3.	"	6324-230	"
L34	" "	"	4.	"	6324-231	"
L35	" "	"	5.	"	6324-232	"
L36	" "	"	6.	"	6324-233	"
L37	" "	"	7.	"	6324-234	"
L38	" "	"	1.	Output	6324-235	"
L39	" ""	"	2.	"	7324-236	"
L40	" "	"	3.	"	6324-237	"
L41	" "	"	4.	"	6324-238	"
L42	" "	"	5.	"	6324-239	"
L43	" "	"	6.	"	6324-240	"
L44	" "	"	7.	"	6324-241	"
L45	Inductor				6324-256	"
L46	Not used					
L47	Coil Assembly Probe				6045-251	Airmec
T1	Transformer Mains				6324-163	

TABLE 1 (CONTINUED)

SCHEDULE OF COMPONENTS

Circuit Reference	Description		
Valves			
V1	CV1863 (5Z4G)✓	Brimar	
V2	CV455 (12AT7)✓	"	
V3	CV2209 (6F33)✓	"	
V4	CV2127 (6CH6) EL821 ✓	"	
V5	CV140 (6AL5) ✓	"	
V6,V7,V8	CV455 (12AT7)✓	"	
V9	CV2209 (6F33) ✓	"	
V10	CV1832 (150C4) OA2 ✓	Mullard	
V11	CV284		
Switches			
SW1	Mains DP. ST.250V 3A	8370-K7	N.S.F.
SW2-SW9	Not used		
SW10,SW11	Turret Spring Set Assembly	6324-147	Airmec
SW12	Switch, 2 pole, 2-way	6324-162	"
SW13	Switch, 6 pole, 5-way	6324-141	"
SW14	Switch, 11 pole, 1-way	6324-143	"
SW15	Attenuator Assembly	6324-132	"
Plugs and Sockets			
P1	Plug coaxial, free	L734/P	Belling Lee
S1,S2	Socket coaxial	L617	" "
Miscellaneous			
F1	Fuse, plug 2A	Belling Lee	
LP1,LP2	Lamps, 6.5V, 0.3A Festoon	Osram	
M1	Meter 100 uA f.s.d. S20	Weston	
X1	Thermistor A1522/100	S.T.C.	
XL1	Crystal 500 kc/s 0.01%	Quartz Crystal Co.	

TABLE 2

LIST OF THE MAJOR CRYSTAL CHECK FREQUENCIES

30 - 100 kc/s BANDS

Frequency in kc/s	Order of Harmonics	
	Signal	Crystal
31.25	16	1
33.33	15	1
35.71	14	1
38.46	13	1
41.67	12	1
45.45	11	1
50.00	10	1
52.63	19	2
55.56	9	1
58.82	17	2
62.50	8	1
66.67	15	2
71.43	7	1
75.00	20	3
76.92	13	2
78.94	19	3
83.33	6	1
88.23	17	3
90.91	11	2
93.75	16	3
95.24	21	4
100.00	5	1

TABLE 2 (CONTINUED)

LIST OF THE MAJOR CRYSTAL CHECK FREQUENCIES

100 - 300 kc/s BAND

Frequency in kc/s	Order of Harmonics		Frequency in kc/s	Order of Harmonics	
	Signal	Crystal		Signal	Crystal
100.0	5	1	187.5	8	3
105.3	19	4	192.3	13	5
107.1	14	3	194.5	18	7
111.1	9	2	200.0	5	2
115.4	13	3	205.9	17	7
117.6	17	4	214.4	7	3
125.0	4	1	218.8	16	7
131.6	19	5	222.2	9	4
133.3	15	4	227.3	11	5
136.4	11	3	230.8	13	6
138.9	18	5	233.3	15	7
142.9	7	2	235.3	17	8
147.1	17	5	250.0	2	1
150.1	10	3	267	15	8
153.9	13	4	269	13	7
156.3	16	5	273	11	6
157.9	19	6	278	9	5
166.7	3	1	281	16	9
175.5	17	6	286	7	4
178.6	14	5	292	12	7
181.8	11	4	300	5	3

TABLE 2 (CONTINUED)

LIST OF THE MAJOR CRYSTAL CHECK FREQUENCIES

300 - 1000 kc/s BAND

Frequency in kc/s	Order of Harmonics Signal	Crystal	Frequency in kc/s	Order of Harmonics Signal	Crystal
300.0	5	3	563	8	9
307.7	13	8	571	7	8
312.5	8	5	583	6	7
318.2	11	7	591	11	13
322.4	14	9	600	5	6
333.3	3	2	611	9	11
346.1	13	9	625	4	5
350.0	10	7	636	11	14
357.1	7	5	643	7	9
363.6	11	8	650	10	13
375.0	4	3	667	3	4
384.6	13	10	687	8	11
388.9	9	7	700	5	7
393.9	14	11	714	7	10
400.0	5	4	722	9	13
409	11	9	750	2	3
417	6	5	778	9	14
423	13	11	786	7	11
429	7	6	800	5	8
438	8	7	813	8	13
444	9	8	833	3	5
450	10	9	857	7	12
455	11	10	875	4	7
458	12	11	889	9	16
462	13	12	900	5	9
500	1	1	917	6	11
542	12	13	929	7	13
545	11	12	938	8	15
550	10	11	1000	1	2
556	9	10			

TABLE 2 (CONTINUED)

LIST OF THE MAJOR CRYSTAL CHECK FREQUENCIES

1 - 3 Mc/s BAND

Frequency in Mc/s	Order of Harmonics Signal	Crystal	Frequency in Mc/s	Order of Harmonics Signal	Crystal
1.000	1	2	1.625	4	13
1.0625	8	17	1.667	3	10
1.071	7	15	1.700	5	17
1.083	6	13	1.750	2	7
1.100	5	11	1.800	5	18
1.125	4	9	1.833	3	11
1.143	7	16	1.875	4	15
1.167	3	7	1.900	5	19
1.200	5	12	2.000	1	4
1.214	7	17	2.125	4	17
1.250	2	5	2.167	3	13
1.286	7	18	2.250	2	9
1.300	5	13	2.333	3	14
1.333	3	8	2.375	4	19
1.375	4	11	2.500	1	5
1.400	5	14	2.625	4	21
1.417	6	17	2.667	3	16
1.500	1	3	2.750	2	11
1.583	6	19	2.833	3	17
1.600	5	16	3.000	1	6

TABLE 2 (CONTINUED)

LIST OF THE MAJOR CRYSTAL CHECK FREQUENCIES

3 - 10 Mc/s BAND

Frequency in Mc/s	Order of Harmonics Signal	Crystal	Frequency in Mc/s	Order of Harmonics Signal	Crystal
3.000	1	6	5.833	3	35
3.167	3	19	6.000	1	12
3.250	2	13	6.167	3	37
3.333	3	20	6.250	2	25
3.500	1	7	6.333	3	38
3.667	3	22	6.5	1	13
3.750	2	15	6.667	3	40
3.833	3	23	6.750	2	27
4.000	1	8	6.833	3	41
4.167	3	25	7.000	1	14
4.250	2	17	7.167	3	43
4.333	3	26	7.250	2	29
4.500	1	9	7.500	1	15
4.667	3	28	7.750	2	31
4.750	2	19	8.00	1	16
4.833	3	29	8.25	2	33
5.000	1	10	8.50	1	17
5.167	3	31	8.75	2	35
5.250	2	21	9.000	1	18
5.333	3	32	9.25	2	37
5.556	1	11	9.50	1	19
5.667	3	34	9.75	2	39
5.750	2	23	10.00	1	20

TABLE 2 (CONTINUED)

LIST OF THE MAJOR CRYSTAL CHECK FREQUENCIES

10 - 2- Mc/s BAND

Frequency in Mc/s	Order of Harmonics Signal	Crystal	Frequency in Mc/s	Order of Harmonics Signal	Crystal
10.00	1	20	15.25	2	61
10.25	2	41	15.50	1	31
10.50	1	21	15.75	2	63
10.75	2	43	16.00	1	32
11.00	1	22	16.25	2	65
11.25	2	45	16.50	1	33
11.50	1	23	16.75	2	67
11.75	2	47	17.00	1	34
12.00	1	24	17.25	2	69
12.25	2	49	17.50	1	35
12.50	1	25	17.75	2	71
12.75	2	51	18.00	1	36
13.00	1	26	18.25	2	73
13.25	2	53	18.50	1	37
13.50	1	27	18.75	2	75
13.75	2	55	19.00	1	38
14.00	1	28	19.25	2	77
14.25	2	57	19.50	1	39
14.50	1	29	19.75	2	79
14.75	2	59	20.00	1	40
15.00	1	30			

LIST OF THE MAJOR CRYSTAL CHECK FREQUENCIES

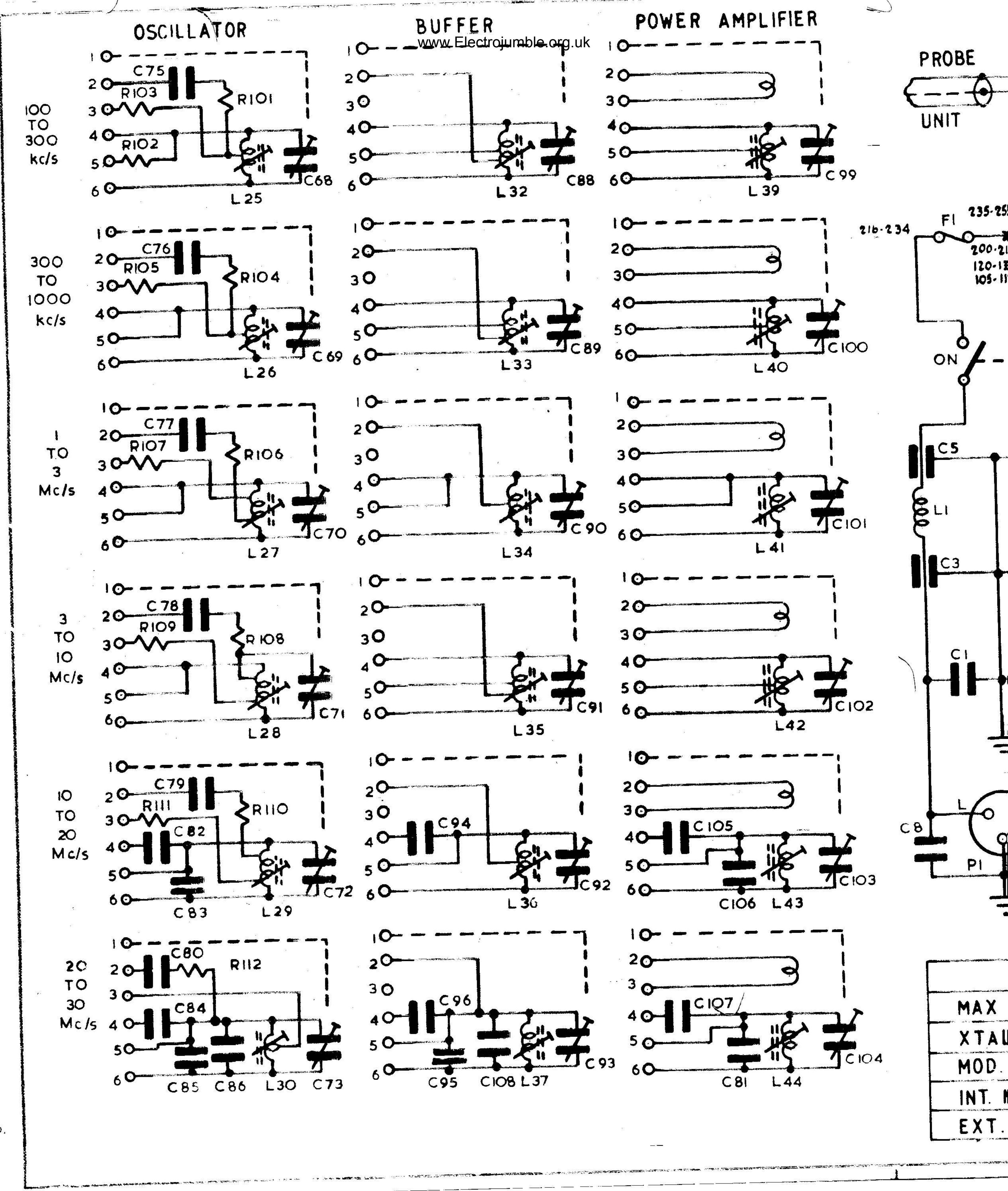
20 - 30 Mc/s BAND

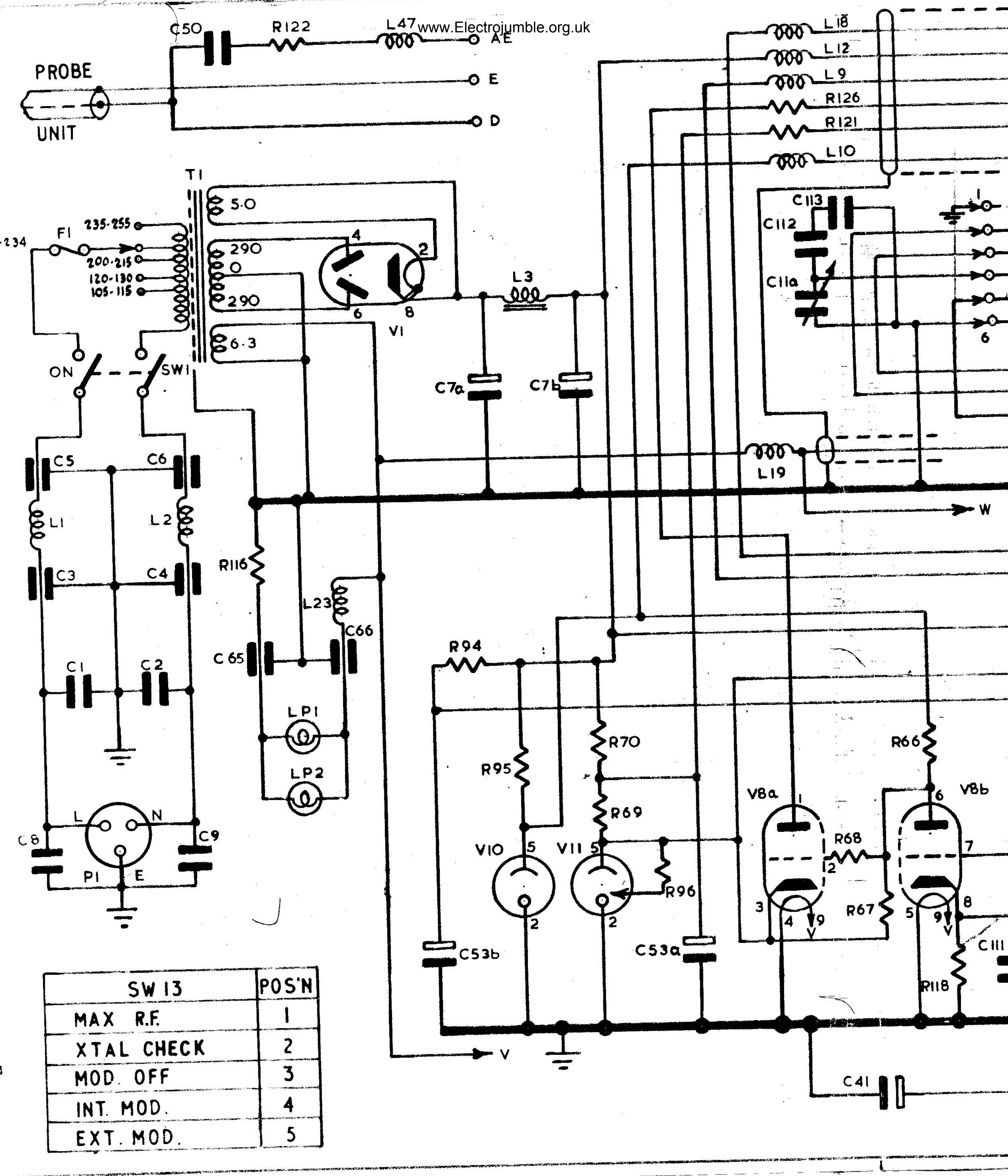
Crystal check points are at 0.5 Mc/s intervals, corresponding to the harmonics from 40 to 60 of the crystal frequency beating with the fundamental of the signal frequency.

TABLE 3

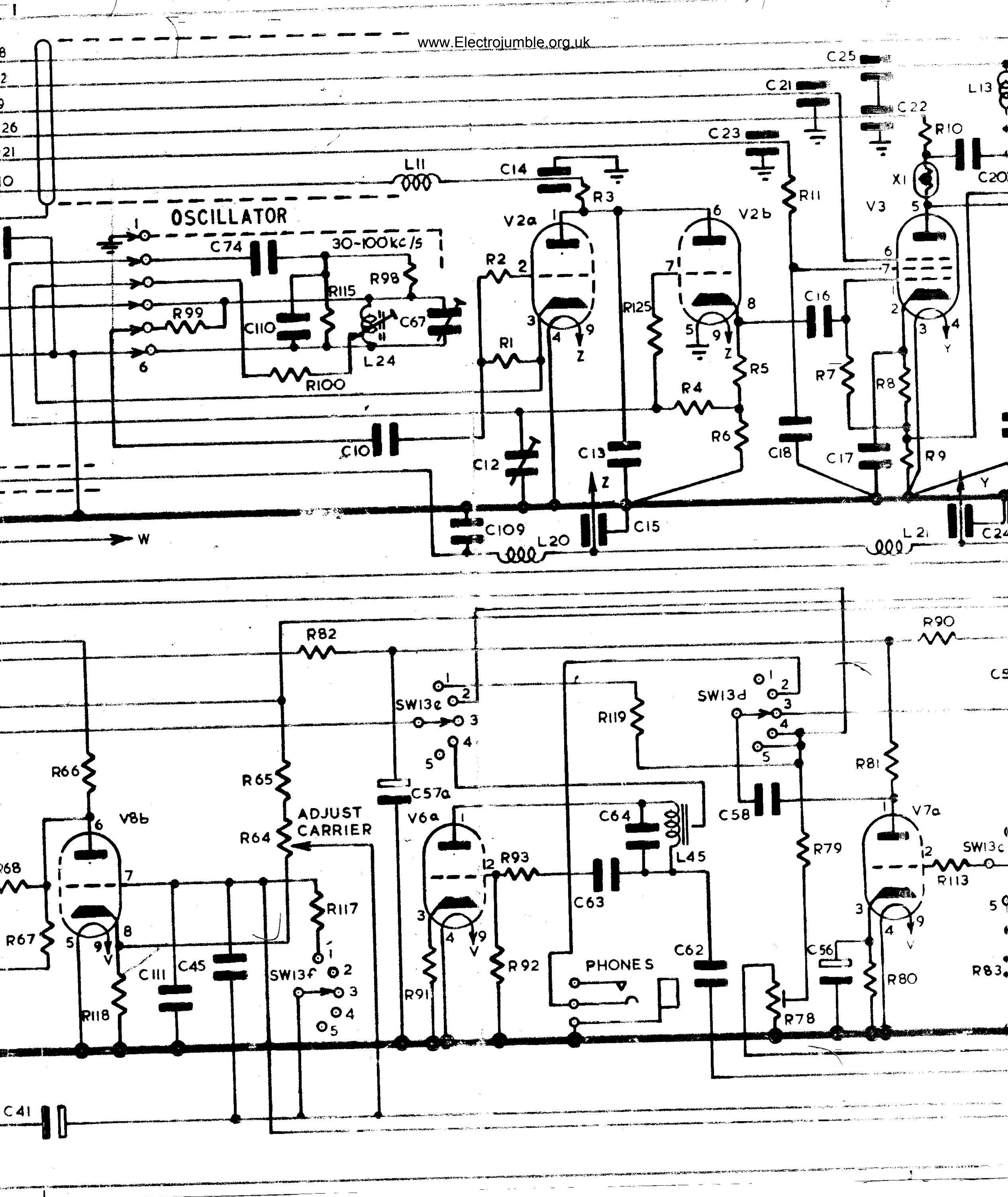
FUNCTION AND ADJUSTMENT OF PRE-SET CONTROLS

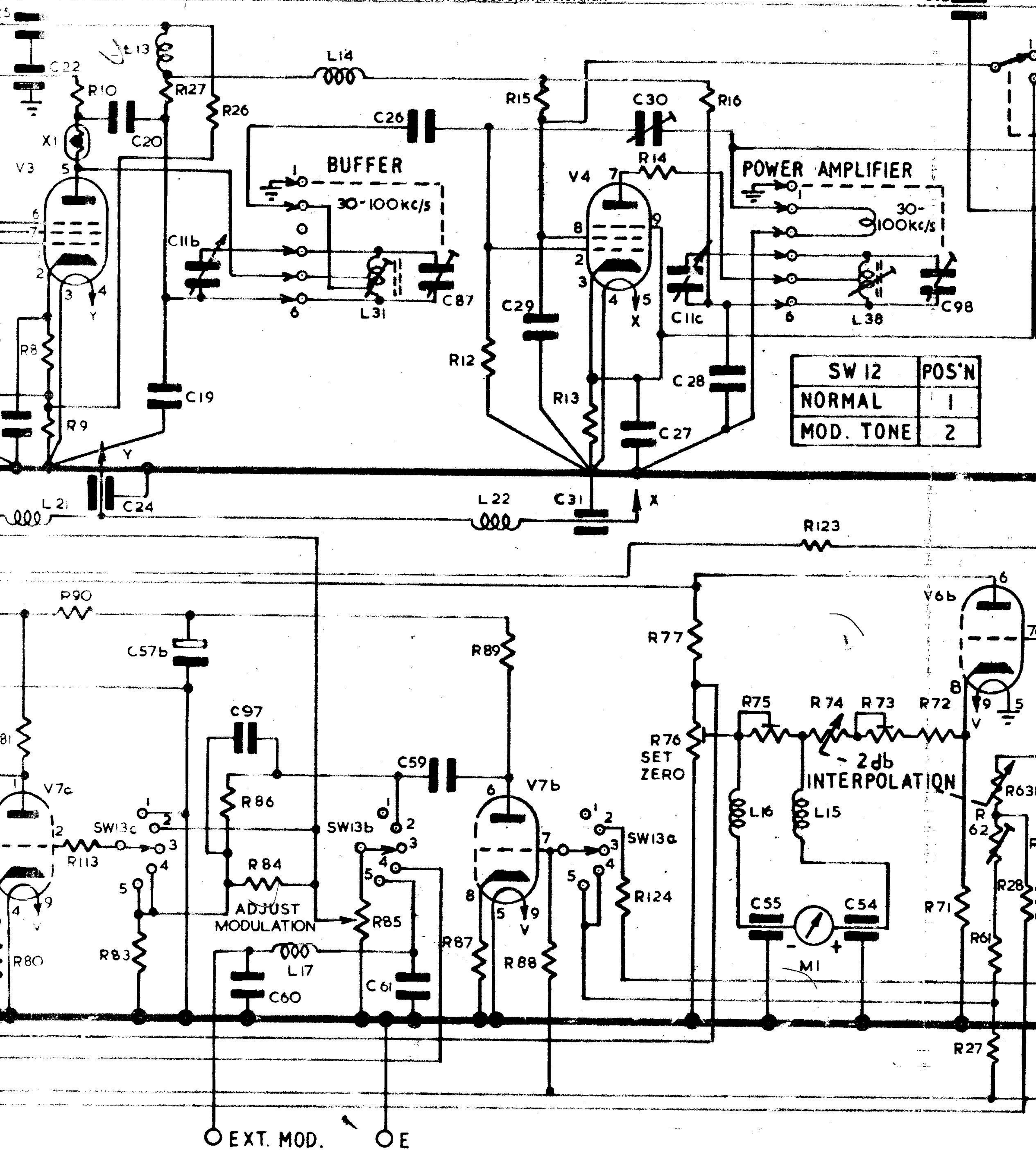
Circuit Reference	Function	Adjustment
C12	Oscillator output	Adjusted to give correct range of thermistor current over the range of the instrument
C30	Power Amplifier neutralisation of anode to grid capacitance	Adjusted at 30 Mc/s
C37	Set Crystal Frequency	Adjusted to give correct crystal frequency
R62	2 dB interpolation control. Calibration of output	Adjusted to give a 2 dB change in output over range of control
R73	2 dB interpolation control. Constant meter reading	Adjusted to give constant meter reading over range of control
R75	Meter sensitivity	Adjusted to SET CARRIER mark with correct output voltage
R78	Set suppressor grid bias of V3	Adjusted for optimum modulation


OSCILLATOR
BUFFER
POWER AMPLIFIER
PROBE
UNIT
100 TO 300 kc/s
C75
R103
R101
R102
L25
C68
L32
C88
L39
C99
300 TO 1000 kc/s
C76
R105
R104
L26
C69
L33
C89
L40
C100
1 TO 3 Mc/s
C77
R107
R106
L27
C70
L34
C90
L41
C101
3 TO 10 Mc/s
C78
R109
R108
L28
C71
L35
C91
L42
C102
10 TO 20 Mc/s
C79
R111
R110
C82
C83
L29
C72
C94
L36
C92
C105
C106
L43
C103
20 TO 30 Mc/s
C80
R112
C84
C85
C86
L30
C73
C96
C95
C108
L37
C93
C107
C81
L44
C104
F1
216-234
235-25
200-21
120-1
105-11
ON
C5
L1
C3
C1
C8
L
P1
MAX
XTAL
MOD.
INT.
EXT.

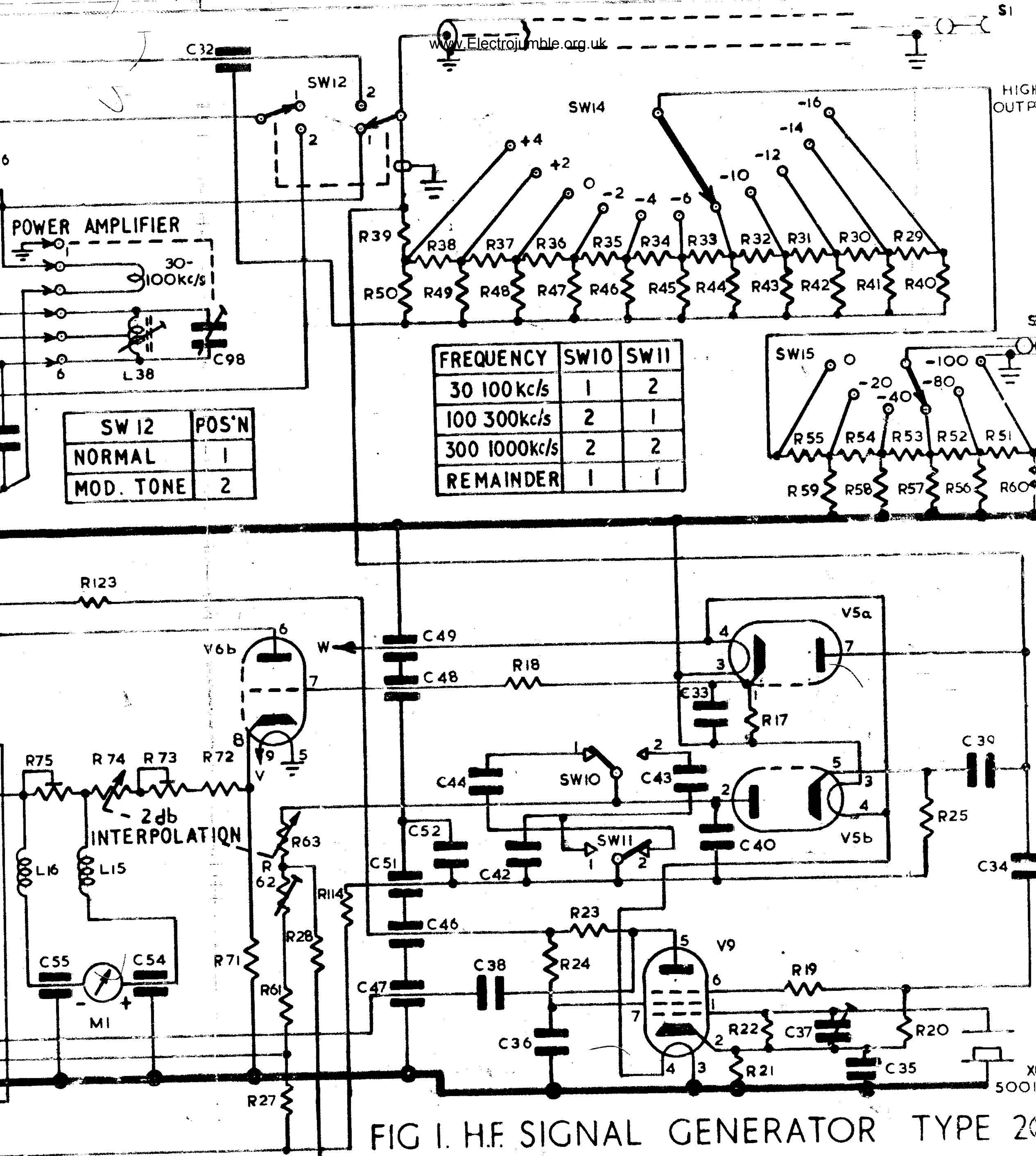


SW 13	POS'N
MAX R.F.	1
XTAL CHECK	2
MOD. OFF	3
INT. MOD.	4
EXT. MOD.	5


OSCILLATOR
30-100kc/s
C25
C21
C22
L13
C23
R10
C14
L11
R3
R11
X1
C20
V2a
V2b
V3
C74
R98
R2
R115
C110
C67
R99
R125
C16
R7
R8
L24
R1
R100
R4
R5
R6
C10
C12
C13
C18
C17
R9
C109
L20
C15
L21
C24
W
Z
Y
R82
R90
SW13e
SW13d
R119
R66
R65
R81
ADJUST
CARRIER
C57a
V6a
C64
C58
V7a
V8b
R64
R93
L45
R79
SW13c
R68
R113
R117
C63
R67
C111
C45
SW13f
R92
PHONES
C62
C56
R83
R118
R91
R78
R80
C41



SW 12	POS'N
NORMAL	1
MOD. TONE	2



SW 12	POS'N
NORMAL	1
MOD. TONE	2

FREQUENCY	SW10	SW11
30 100kc/s	1	2
100 300kc/s	2	1
300 1000kc/s	2	2
REMAINDER	1	1

FIG 1. H.F. SIGNAL GENERATOR TYPE 20
CIRCUIT DIAGRAM

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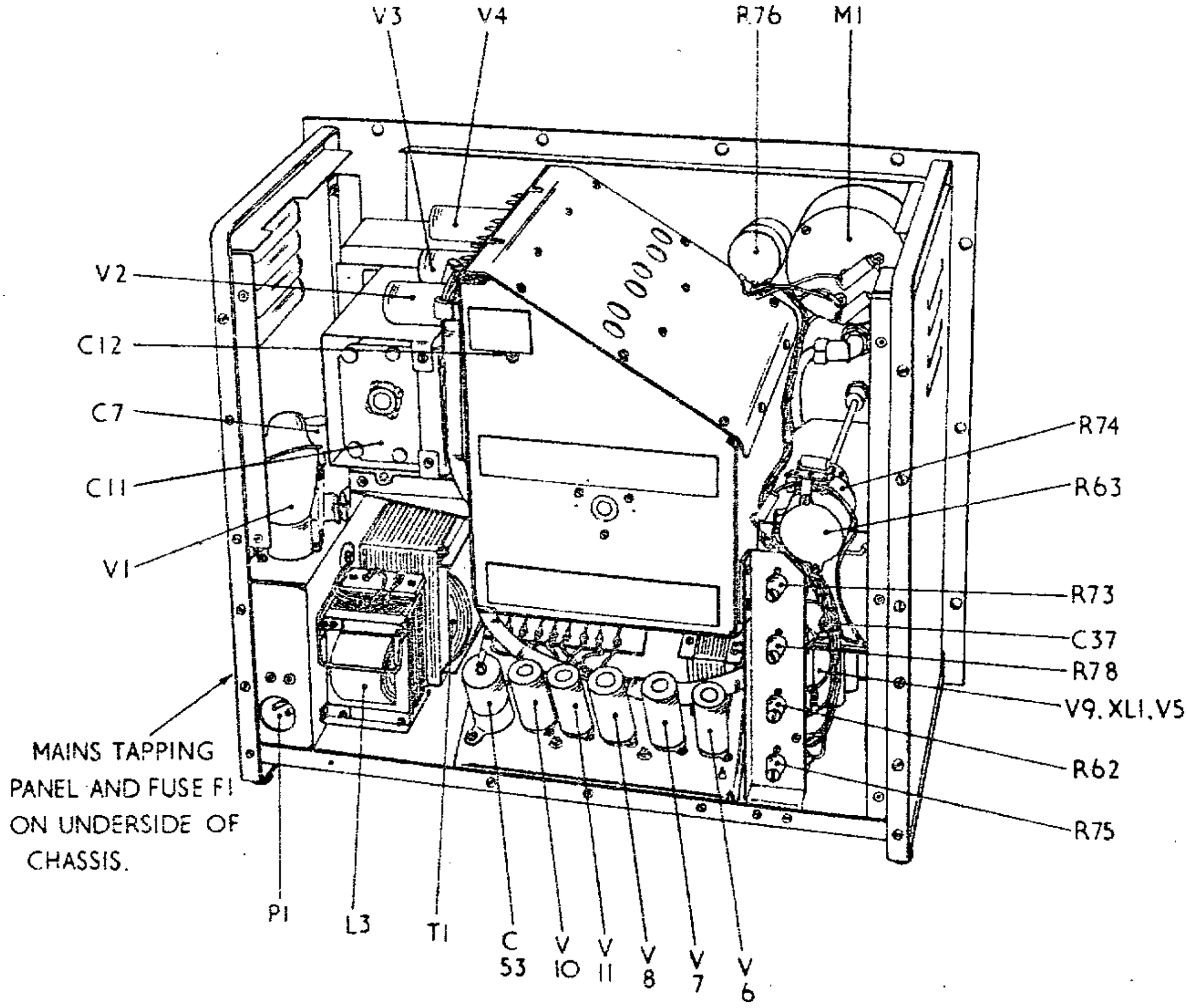

FIGURE 2. H.F. SIGNAL GENERATOR TYPE 201. REAR VIEW

GENERAL LIABILITY AND MAINTENANCE GUARANTEE

In lieu of any warranty, condition or liability implied by law, our liability in respect of any defect in or failure of the goods supplied, or for loss, injury, or damage attributable thereto, is limited to making good by replacement or repair defects which, under proper use by the original purchaser, appear therein and arise solely from faulty materials or workmanship within a period of twelve calendar months after the original goods shall have been first despatched, at the termination of which period all liability on our part ceases; provided always that such defective instruments are carefully packed and returned free to our Works unless otherwise arranged, and provided they have not been tampered with in any way. The repaired instrument will be delivered free to its destination in Great Britain, or f.o.b. British Port, for overseas shipments. Reasonable charges will be made for attendance of Personnel at Customers' premises and for any dismantling should this be necessary in order to effect the required replacements.

For components not of our manufacture we extend only such benefits as we may receive under any guarantee given to us by the makers thereof. Electronic valves and cathode ray tubes manufactured by members of the British Radio Valves Manufacturers' Association are marked with the letters B.V.A. which is a guarantee of efficiency and quality. Our equipment has been designed and tested for use with the specific types of components supplied by us therein and no responsibility can be accepted for the performance of the equipment if other components are employed.

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