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TF 2005R
AF TWO-TONE SIGNAL SOURCE

Instruction Manual

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AF Two-tone Signal Source
TF 2005R

Code No : 52005-301D

MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

Part No. 46881-381L Print code : A-11/79 M.I. 0.5c

CONTENTS

PRELIMINARIES

CHAPTERS

Note ...

Each page bears the date of the original issue or the code number and date of the latest amendment (Am.1, Am. 2 etc.). New or amended material of technical importance introduced by the latest amendment is indicated by triangles positioned thus ▶ ..... ◀ to show the extent of the change. When a chapter is re-issued the triangles do not appear.

Any changes subsequent to the latest amendment state of the manual are included on inserted sheets coded C1, C2 etc.

NOTES AND CAUTIONS

ELECTRICAL SAFETY PRECAUTIONS

This equipment is protected in accordance with IEC Safety Class I. It has been designed and tested according to IEC Publication 348, 'Safety Requirements for Electronic Measuring Apparatus', and has been supplied in a safe condition. The following precautions must be observed by the user to ensure safe operation and to retain the equipment in a safe condition.

Defects and abnormal stresses

Whenever it is likely that protection has been impaired, for example as a result of damage caused by severe conditions of transport or storage, the equipment shall be made inoperative and be secured against any unintended operation.

Removal of covers

Removal of the covers is likely to expose live parts although reasonable precautions have been taken in the design of the equipment to shield such parts. The equipment shall be disconnected from the supply before carrying out any adjustment, replacement or maintenance and repair during which the equipment shall be opened. If any adjustment, maintenance or repair under voltage is inevitable it shall only be carried out by a skilled person who is aware of the hazard involved.

Note that capacitors inside the equipment may still be charged when the equipment has been disconnected from the supply. Before carrying out any work inside the equipment, capacitors connected to high voltage points should be discharged; to discharge mains filter capacitors, if fitted, short together the L (live) and N (neutral) pins of the mains plug.

Mains plug

The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension lead without protective conductor. Any interruption of the protective conductor inside or outside the equipment is likely to make the equipment dangerous.

Fuses

Note that there is a supply fuse in both the live and neutral wires of the supply lead. If only one of these fuses should rupture, certain parts of the equipment could remain at supply potential.

To provide protection against breakdown of the supply lead, its connectors, and filter where fitted, an external supply fuse (e.g. fitted in the connecting plug) should be used in the live lead. The fuse should have a continuous rating not exceeding 6 A.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse holders shall be avoided.

Chapter 1

GENERAL INFORMATION

CONTENTS

INTRODUCTION

1. Purpose — To provide low distortion signals for determining the intermodulation distortion in amplifiers, or (using one oscillator only) for general purpose testing.

2. Description — (1) An AF Two-tone Signal Source TF 2005R consists of two AF Oscillators TF 2100 (less case) and one AF Monitored Attenuator TF 2160/1 (less case), all fitted in a case suitable for rack mounting.

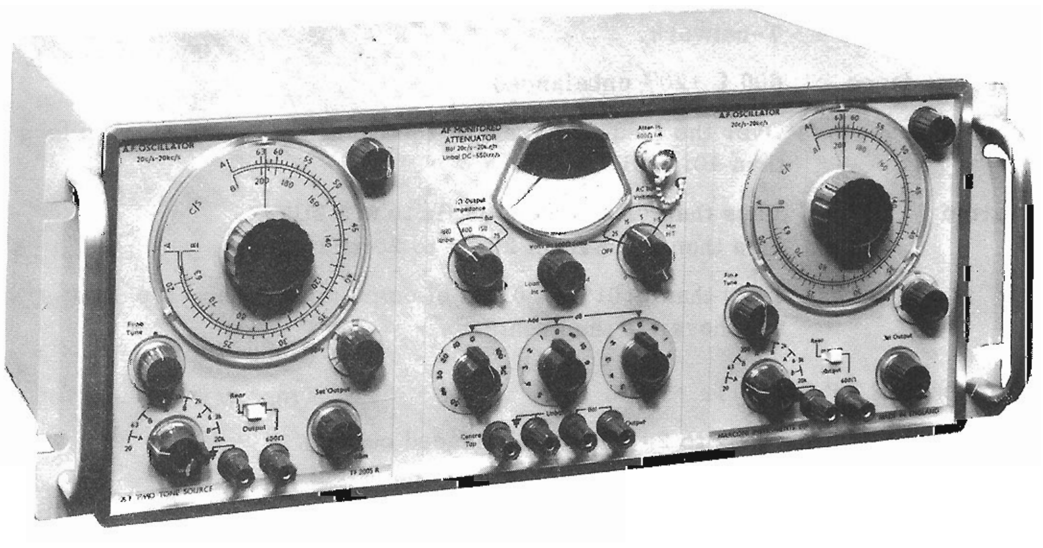


Fig. 1 AF Two-tone Signal Source TF 2005R

(2) Each oscillator has its frequency indicated on a calibrated dial which covers a range of 3 to 1. The six frequency ranges between 20 Hz and 20 kHz are selected by means of a range switch. There is also a fine tune control. The output level is adjusted by means of coarse and fine controls. Each oscillator is isolated by means of a switch when the output level of the other oscillator is being adjusted.

(3) The two oscillators are connected in parallel to the attenuator which has three switches having steps of 10 dB, 1 dB and 0.1 dB. Various output load conditions are selected by means of two switches. The input is monitored by means of an electronic voltmeter. The four voltage ranges from 1.5 V f.s.d. to 25 V are selected by means of a range switch.

ELECTRICAL DATA

3. Composite instrument (TF 2005R)

Frequency range	20 Hz to 20 kHz in six bands. (Each oscillator can be adjusted independently.)
Amplitude	Reference level : Up to +10 dBm from each oscillator. Attenuator range : 111 dB in 0.1 dB steps.
Harmonic distortion	Less than 0.05% between 63 Hz and 6 kHz when using unbalanced output. Generally less than 0.1% under other conditions.
Intermodulation	Below -80 dB with respect to the wanted signal.
Hum	Below -80 dB with respect to the wanted signal.

4. Oscillator (TF 2100)

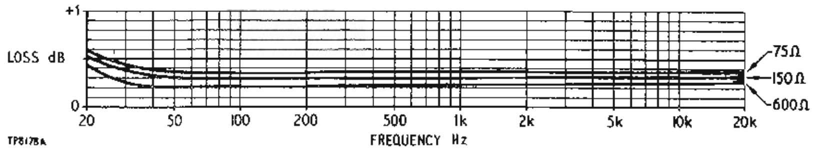
Frequency range	20 Hz to 20 kHz in six bands. Auxiliary fine control.
Frequency accuracy	±1% ±0.2 Hz.
Output power	+15 dBm (31.6 mW) into 600 Ω. Over 8.5 V open circuit.
Output control	At least 40 dB range of attenuation, by continuously variable T-network.
Output impedance	600 Ω ±20% unbalanced.
Frequency response	Over the frequency range, the change in output level is less than ±0.4 dB.
Distortion	Less than 0.05% from 63 Hz to 6.3 kHz; less than 0.1% from 20 Hz to 20 kHz.
Hum	Less than 0.01% (-80 dB) of output signal, or -100 dBm, whichever is the greater.

5. Attenuator (part of TF 2160/1)

Frequency range	20 Hz to 20 kHz with balanced output. DC to 550 kHz with unbalanced output.
Attenuation range	0 to 111 dB in 0.1 dB steps.

Residual loss

Unbalanced : Less than 0.01 dB at d.c.
Balanced : Varies with frequency and impedance as follows :

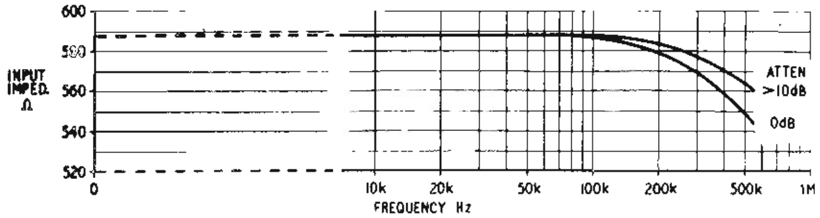


Attenuation accuracy

20 Hz to 20 kHz : ±1% of dB setting ±0.2 dB;
at d.c. : ±1% of dB setting ±0.01 dB;
20 Hz to 550 kHz : ±2% of dB setting ±0.2 dB.

Input impedance

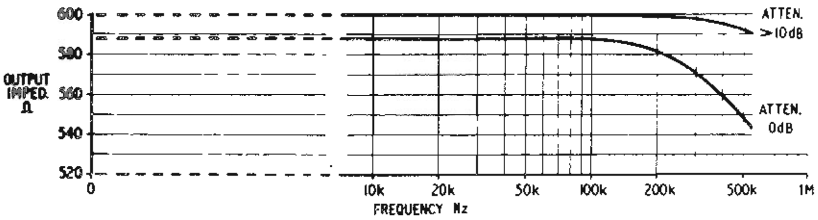
(With 600 Ω load.) 600 Ω unbalanced.
When input voltmeter is switched in, varies with frequency and impedance as follows :-



(With input voltmeter switched out, the linear part rises to 600 Ω.)

Output impedance

(With 600 Ω source.) Balanced : 600 Ω, 150 Ω and 75 Ω via transformer.
Unbalanced : 600 Ω. When input voltmeter is switched in, varies with frequency and attenuation as follows :-



(With input voltmeter switched out, both linear parts are at 600 Ω.)

Power input

1 W (25 V maximum), continuous a.c. or d.c.

Frequency response

Output is flat within ±0.2 dB from 20 Hz to 20 kHz, and within ±1 dB from 20 Hz to 550 kHz at any attenuator setting, with input voltmeter reading held constant.

Distortion

At balanced output with matched load with +15 dBm (31.6 mW) pure input, output distortion factor does not exceed 0.1% from 50 Hz to 20 kHz and 0.3% from 30 Hz to 50 kHz.

6. Input voltmeter (part of TF 2160/1)

Ranges

1.5, 5, 15 and 25 V full-scale; also marked -6 dBm to +30 dBm.

Accuracy

±5% of full-scale from 20 Hz to 550 kHz.

7. Power requirements

AC supply

45 Hz to 500 Hz : 95 V to 130 V or 190 V to 260 V.
500 Hz to 1000 Hz : 105 V to 130 V or 210 V to 260 V.

Power consumption	14 VA.
DC supply	65 V to 90 V; 60 mA.

DIMENSIONS AND WEIGHT

8. Height : 200 mm (7 3/4 in)
Width : 475 mm (18 3 1/4 in)
Depth : 270 mm 10 1/2 in)
Weight : 16.5 kg (36.3 lb)

SAFETY

9. Designed to meet the requirements of IEC 348.

RADIO FREQUENCY INTERFERENCE

10. This equipment conforms with the requirements of EEC Directive 76/889 as to limits of r.f. interference.

ACCESSORIES

11. The instrument includes the following supplied accessories :-

Mains lead TM 7052. Code 43122-017.
HT lead (supplies power to monitored attenuator) TM 7053. Code 43125-029.
Two coaxial leads (connect each oscillator to the monitored attenuator) TM 6958. Code 43125-028.
Coaxial free plug, type BNC. Code 23443-305B.
Shielded adaptor (provides BNC outlet from terminals) CE 51003. Code 43168-008.
Instruction Manual. **Code 46881-381L**

Chapter 2

INSTALLATION

CONTENTS

UNPACKING AND REPACKING

1. Retain the packing materials and the packing instruction note (if included) in case it is necessary to reship the instrument.

2. If the instrument is to be returned for servicing attach a label indicating the service required, type or model number (on rear label), serial number and your return address. Pack the instrument in accordance with the general instructions below or with the more detailed information in the packing instruction note.

(1) Place the plywood/felt cap (without finger holes) in the bottom of the inner (fibreboard) carton.

(2) Lower the instrument into the carton with the feet facing the cut-outs in the bottom cap surround.

(3) Place the top plywood/felt cap (with finger holes) in position, with the cut-outs facing the feet.

(4) Fold down and seal the inner carton with tape.

(5) Fit the foam cushion pads in the outer (wooden) case.

(6) Wrap the instruction manual and accessories in a padded parcel and lay it in the bottom of the case.

(7) Lower the packed inner carton into the outer case and fold over the cushion pads to obtain a snug fit.

(8) Fit the top lid and secure with wood screws.

(9) Mark the case FRAGILE to encourage careful handling.

Note ...

If the original container or materials are not available, use a strong double-wall carton packed with a 7 to 10 cm layer of shock absorbing material around all sides of the instrument to hold it firmly. Protect the front panel controls with a plywood or cardboard load spreader; if the rear panel has guard plates or other projections a rear load spreader is also advisable.

Chapter 3

OPERATION

CONTENTS

CONTROLS AND CONNECTORS

1. The controls and connectors on the front panel of the oscillators (Fig. 1) are as follows :-

(1) SUPPLY switch. For switching on the a.c. or the d.c. supply.

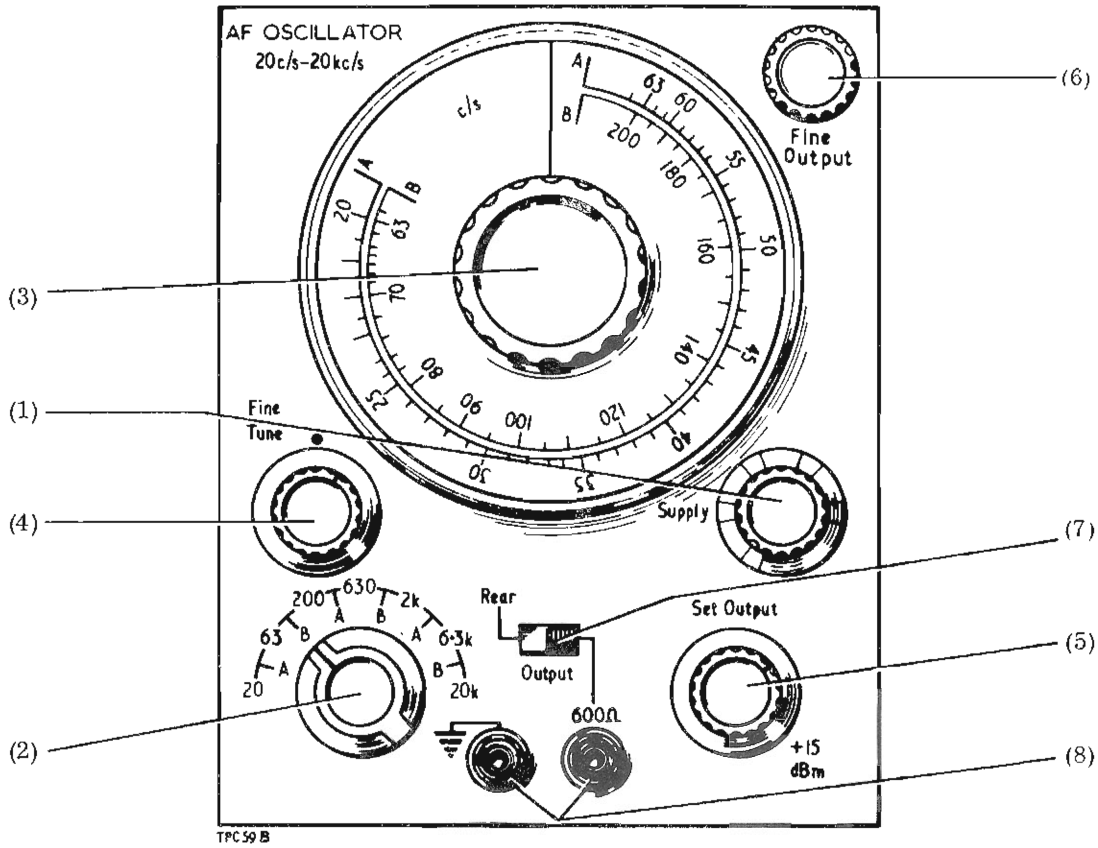


Fig. 1 Controls and connectors on front panel of oscillator

(2) FREQUENCY RANGE switch. For selecting the appropriate range for the frequency required.

(3) FREQUENCY control and dial. For setting the frequency using the outer scale A or the inner scale B according to the setting of the FREQUENCY RANGE switch.

(4) FINE TUNE control. For fine adjustment of the frequency.

(5) SET OUTPUT control. For setting the output level required up to a maximum level of +15 dBm into 600 Ω.

(6) FINE OUTPUT control. For fine adjustment up to 0.7 dB.

(7) OUTPUT switch. For switching the output to the OUTPUT terminals on the front panel or to the OUTPUT socket on the rear panel.

(8) OUTPUT terminals. For connecting apparatus directly to the oscillator.

2. The controls and connectors on the rear panel of the oscillators are as follows :-

(1) MAINS inlet. For connecting the a.c. supply by means of mains lead TM 7053.

(2) BATTERY terminals. For connecting the d.c. supply.

(3) BATTERY/MAINS switch. For selecting the appropriate supply.

(4) HT outlet. For connecting the monitored attenuator by means of h.t. lead TM 7053.

(5) OUTPUT socket. For connecting the monitored attenuator by means of coaxial lead TM 6958.

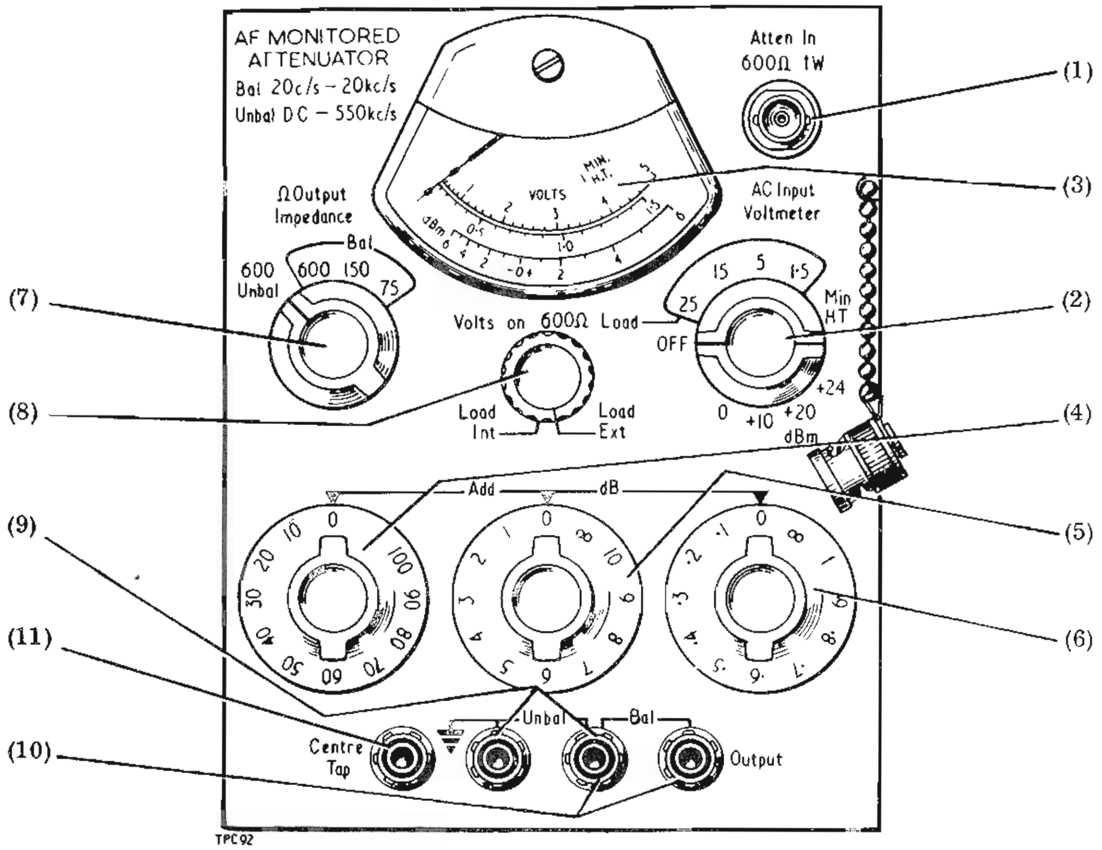


Fig. 2 Controls and connectors on front panel of monitored attenuator

3. The controls and connectors on the front panel of the monitored attenuator (Fig. 2) are as follows :-

(1) INPUT socket. For connecting apparatus to the monitored attenuator (in parallel with the oscillators connected at the rear).

(2) METER RANGE switch. For switching on the h.t. supply and selecting the required voltmeter sensitivity, and also for checking the h.t. level.

(3) METER. For indicating the input level according to the setting of the METER RANGE switch, and also for checking the h.t. level.

(4) 10 dB switch. For setting the attenuation up to 100 dB.

(5) 1 dB switch. For setting the attenuation up to 10 dB.

(6) 0.1 dB switch. For setting the attenuation up to 1 dB.

(7) OUTPUT IMPEDANCE switch. For selecting the appropriate output impedance, balanced or unbalanced.

(8) LOAD switch. For switching in a matched internal load across the attenuator output.

(9) UNBALANCED terminals. For connecting apparatus of 600 Ω impedance unbalanced.

(10) BALANCED terminals. For connecting apparatus of 600, 150 or 75 Ω impedance balanced.

(11) CENTRE TAP terminal. For connecting the earth of balanced apparatus.

4. The controls and connectors on the rear panel of the monitored attenuator are as follows :-

(1) HT inlet. For connecting one of the attenuators by means of h.t. lead TM 7053.

(2) INPUT sockets. For connecting the oscillators by means of coaxial leads TM 6958.

PREPARATION FOR USE

Power supply

5. The instrument can be operated from an a.c. supply or a d.c. source, according to the setting of the BATTERY/MAINS switches at the rear of the oscillators.

6. The instrument is adjusted for an a.c. supply of 95 V to 130 V or 190 V to 260 V (Chap.5). After checking that the mains voltage adjustment is correct, connect to the mains by means of lead TM 7052. When fitting a supply plug ensure that the conductors are connected as follows :- Earth - green/yellow, Neutral - blue. Live - brown.

7. A d.c. source can be between 65 V and 90 V. It must be floating. Dry batteries can be used, but it should be noted that the drain is about 60 mA. Connect leads from the source to the appropriate terminals marked + and - at the rear of the oscillators.

Interconnections

8. DC is required by the monitored attenuator. This is fed from one of the oscillators by means of lead TM 7053.

9. It is usually most convenient to use the instrument with the OUTPUT sockets on the rear panels of the oscillators linked to the INPUT sockets on the rear panel of the monitored attenuator by means of leads TM 6958.

Switching on

10. Switch on one oscillator and the monitored attenuator by turning the appropriate SUPPLY switch clockwise. Switch on the other oscillator, if required, by turning its SUPPLY switch clockwise. The instrument is ready for use almost immediately; the time taken to reach a high degree of stability depends on the frequency range, but is normally less than $\frac{1}{2}$ min.

11. If a load is already connected, and is sensitive, it may be advisable to turn the SET OUTPUT controls counter-clockwise before switching on. Initially, the generated signal may rise to approximately 50% above normal amplitude before stabilization takes place. Also - when the load impedance is high and the SET OUTPUT control is fully clockwise - a d.c. pulse of several volts appears briefly when the instrument is switched on and switched off, the pulse being positive and negative respectively.

SETTING FREQUENCY

12. Set an oscillator to a particular frequency as follows :-

(1) Set the FREQUENCY RANGE switch to the range which includes the required frequency. On the front panel, each position of the switch falls between two figures, which indicate in Hz the frequency limits of the range obtained in that position. Each position is also marked with a letter, A or B, indicating whether scale A or B must be read on the frequency dial.

(2) Turn the FREQUENCY control so that the dial indicates the required frequency, reading scale A or B according to the setting of the FREQUENCY RANGE switch. Readings on the scales are either direct reading or require to be multiplied by 10 or 100 according to the range selected.

(3) Set the FINE TUNE control to the mark on the panel, i.e. the centre of its range of adjustment.

13. The tuning elements are ganged wire wound resistors. As a result of the contacts passing over the discrete turns of wire, some fluctuation of output may occur. Stabilization of the output level will take place after any adjustment.

14. The FINE TUNE control gives gradual and precise frequency adjustment over a limited range in the region of the setting of the main FREQUENCY control. It can be used to minimize the frequency calibration error of the main dial at a particular frequency and its vicinity; by adjusting the FINE TUNE control, the reading of the main dial can be standardized against the indication of a counter connected to the output. The FINE TUNE control also facilitates setting the instrument exactly to the optimum pass or rejection frequency of a highly selective circuit, such as a filter having a narrow frequency response.

OSCILLATOR OUTPUT

15. Before connecting a sensitive load to the instrument, turn the SET OUTPUT controls fully counter-clockwise to avoid applying too much output.

16. Output from an oscillator can be taken from the front panel OUTPUT terminals, or from the OUTPUT coaxial socket at the rear, depending on the setting of the OUTPUT switch above the terminals on the front panel. Set this to the right for front terminals output, or to the left for use of the rear coaxial socket. The front terminals contain sockets for 4 mm plugs and will accept a twin plug having 19 mm pin spacing.

Note...

The 'live' front panel terminals and the centre socket of the rear coaxial outlet are fed internally through a reversible electrolytic capacitor. Damage may result if the load applies more than ±25 V d.c. back to the instrument.

17. The OUTPUT switches situated above the front panel terminals of each oscillator can be used to bring the oscillators into circuit independently when they are both connected to the monitored attenuator. As the two oscillators are connected simply in parallel it is necessary when setting the output level of one to simulate the shunt impedance of the other. This is done by making use of the fact that the attenuator internal load resistor when switched in with zero attenuation appears directly across the attenuator input.

18. To set output level proceed as follows :-

(1) Connect the load to the appropriate attenuator OUTPUT terminals.

(2) Turn the LOAD switch to INT.

(3) Turn the attenuator switches to 0 dB.

(4) Connect one oscillator only to the attenuator by pressing the OUTPUT switch of one oscillator to the left (REAR) and the other OUTPUT switch to the right.

(5) The oscillator that is connected may now be brought up to the desired level, as indicated by the input voltmeter of the attenuator.

(6) Interchange the oscillators by reversing the settings of both the OUTPUT switches and adjust the output level of the other oscillator.

(7) Now connect both oscillators by pressing both OUTPUT switches to the left (REAR) and disconnect the internal load by turning the LOAD switch to EXT.

19. When the SET OUTPUT control has been rotated through a small angle from the extreme

counter-clockwise position, it enters upon an approximately linear range of at least 40 dB adjustment. Maximum output, when the control is fully clockwise, is at least +15 dBm into a 600 Ω load, or up to more than 8.5 V across a high impedance load. Make small adjustments to the level with the FINE OUTPUT control. This control has a range of approximately 0.7 dB.

20. The output impedance of the signal source with no attenuation will be that of the two oscillators in parallel, i.e. 300 Ω. If, however, 10 dB or more of attenuation is used, the effective output impedance will rise to 600 Ω.

21. If it is desired to use the instrument as a single tone signal source the oscillator not in use should be disconnected; either by pressing the OUTPUT switch to the right, or by breaking the plug and socket connection at the rear. If this precaution is not taken, and the unwanted oscillator simply switched off, it will remain as a non-linear load across the output of the oscillator in use, giving rise to distortion.

MONITORED ATTENUATOR INPUT

22. Set the METER RANGE switch to a position suitable for the input to be applied; set it to OFF if the input will not be a sine wave. The input should not exceed 25 V a.c. or d.c.

23. The INPUT socket on the front panel is a type BNC. Cover this socket with the cap provided when the INPUT sockets on the rear panel are being used. All the sockets are in parallel.

24. The input impedance is 600 Ω, providing that the output impedance is matched by the load. If the output is mismatched, the input impedance is still 600 Ω provided that a substantial amount of attenuation is in use; if the load has a very high or a very low impedance relative to the matching value, the attenuation can be reduced to about 13 dB or less before a 10% variation arises in the input impedance. When the load has a very high impedance, the internal termination should normally be used, and the output will then be approximately matched.

READING INPUT SIGNAL LEVEL

25. Turn the METER RANGE switch clockwise to the most sensitive range that can be used without the meter deflection exceeding full-scale. Read the appropriate scale on the meter according to the setting of the switch. Readings on the scales for the lower two ranges are direct reading and for the higher two ranges require to be multiplied by 10 and 5. The meter reading is the r.m.s. value of the input voltage, assuming that the signal is a sine wave. The reading may be inaccurate if the signal is not sinusoidal, or if its frequency is less than 20 Hz.

26. The meter also has a scale calibrated -6 dBm to +6 dBm. The 0 dBm mark on this scale corresponds to the voltage, on the 0 to 1.5 V scale, that will produce 1 mW input to the attenuator. When the voltmeter is used on higher voltage ranges, the dBm scale is effectively extended by addition of the dBm increments marked at the range switch positions.

27. When the OUTPUT IMPEDANCE switch is set to one of the BAL positions, if the wanted output is such that less than 10 dB of attenuation is required, first switch in 10 dB and terminate the attenuator internally or externally before setting the input and reading the meter. Then reduce the attenuation as required, and do not compensate for any rise in meter reading.

28. The dBm reading indicates the power fed into the attenuator networks assuming that the input impedance is 600 Ω. This will not be so if the instrument is mismatched at its outlet and the value of attenuation is low (para. 24).

29. The dBm scale and the dBm markings on the METER RANGE switch can be used to relate in dB different levels of applied signal without regard to the actual values of power concerned.

SETTING OUTPUT IMPEDANCE

30. The different output impedances available as follows are only obtained providing the input to the attenuator comes from a 600 Ω generator, or providing a substantial amount of attenuation is in use (over 13 dB ensures an output impedance close to the selected nominal value).

31. The OUTPUT terminals contain sockets for 4 mm plugs and any pair of adjacent terminals will accept a twin plug having 19 mm pin spacing. Carrying a BNC socket, the shielded adaptor can be plugged into the two UNBAL terminals to provide good shielding and facilitate employing coaxial leads.

600 Ω, 150 Ω or 75 Ω balanced

32. Set the controls and connect the load as follows :-

(1) Set the OUTPUT IMPEDANCE switch to whichever of the BAL positions indicates the required source impedance.

(2) Set the LOAD switch to EXT.

(3) Connect the load to the two BAL terminals.

33. If the BAL terminals alone are used, a floating source is obtained. To balance the source relative to earth, connect the CENTRE TAP terminal to earth. The left-hand UNBAL terminal, which is connected internally to case and chassis, serves as an earth point assuming that the outer of the coaxial inlet socket on the attenuator is earthed by the input lead.

34. Under these conditions the matching transformer is in use and the frequency range of the instrument is 20 Hz to 20 kHz.

600 Ω unbalanced

35. Set the controls and connect the load as follows :-

(1) Set the OUTPUT IMPEDANCE switch to 600 Ω UNBAL.

(2) Set the LOAD switch to EXT.

(3) Connect the load to the two UNBAL terminals. The left-hand one, which is connected internally to case and chassis, serves as an earth point assuming that the outer of the coaxial inlet socket on the attenuator is earthed by the input lead.

36. Under these conditions the output is obtained directly from the attenuating networks and the frequency range of the instrument extends from d.c. to 550 kHz (except that the input voltmeter becomes inaccurate below 20 Hz).

150 Ω or 75 Ω unbalanced

37. Set the controls and connect the load as follows :-

(1) Set the OUTPUT IMPEDANCE switch to BAL 150 Ω or BAL 75 Ω, according to the required value of source impedance.

(2) Set the LOAD switch to EXT.

(3) Connect the load to the two BAL terminals. Connect one of these terminals to earth, as required. The left-hand UNBAL terminal, which is connected internally to case and chassis, serves as an earth point assuming that the outer of the coaxial inlet socket on the attenuator is earthed by the input lead. Leave the CENTRE TAP terminal disconnected.

three dials from the dBm value of input power indicated by the input meter and its range switch.

Voltage output

48. When the output impedance is arranged to be 600 Ω and the load matches this value, the output voltage developed across the load is the input voltage reduced by the total attenuation reading. The output voltage is therefore the input voltage multiplied by the appropriate factor (Table 1). Alternatively, the output voltage across a 600 Ω load can be determined from the dBm value of the output read from the meter and dials (Fig. 3).

TABLE 1

Decibel conversion

Ratio down			Ratio up	
Voltage	Power	Decibels	Voltage	Power
1·0	1·0	**0**	1·0	1·0
·9886	·9772	**·1**	1·012	1·023
·9772	·9550	**·2**	1·023	1·047
·9661	·9333	**·3**	1·035	1·072
·9550	·9120	**·4**	1·047	1·096
·9441	·8913	**·5**	1·059	1·122
·9333	·8710	**·6**	1·072	1·148
·9226	·8511	**·7**	1·084	1·175
·9120	·8318	**·8**	1·096	1·202
·9016	·8128	**·9**	1·109	1·230
·8913	·7943	**1·0**	1·122	1·259
·8710	·7586	**1·2**	1·148	1·318
·8511	·7244	**1·4**	1·175	1·380
·8318	·6918	**1·6**	1·202	1·445
·8128	·6607	**1·8**	1·230	1·514
·7943	·6310	**2·0**	1·259	1·585
·7762	·6026	**2·2**	1·288	1·660
·7586	·5754	**2·4**	1·318	1·738
·7413	·5495	**2·6**	1·349	1·820
·7244	·5248	**2·8**	1·380	1·905
·7079	·5012	**3·0**	1·413	1·995
·6683	·4467	**3·5**	1·496	2·239
·6310	·3981	**4·0**	1·585	2·512
·5957	·3548	**4·5**	1·679	2·818
·5623	·3162	**5·0**	1·778	3·162
·5309	·2818	**5·5**	1·884	3·548
·5012	·2512	**6**	1·995	3·981
·4467	·1995	**7**	2·239	5·012
·3981	·1585	**8**	2·512	6·310
·3548	·1259	**9**	2·818	7·943
·3162	·1000	**10**	3·162	10·000
·2818	·07943	**11**	3·548	12·59
·2512	·06310	**12**	3·981	15·85
·2239	·05012	**13**	4·467	19·95
·1995	·03981	**14**	5·012	25·12
·1778	·03162	**15**	5·623	31·62

TABLE 1 (cont.)

Ratio down			Ratio up	
Voltage	Power	Decibels	Voltage	Power
·1585	·02512	**16**	6·310	39·81
·1413	·01995	**17**	7·079	50·12
·1259	·01585	**18**	7·943	63·10
·1122	·01259	**19**	8·913	79·43
·1000	·01000	**20**	10·000	100·00
·07943	$6{\cdot}310 \times 10^{-3}$	**22**	12·59	158·5
·06310	$3{\cdot}981 \times 10^{-3}$	**24**	15·85	251·2
·05012	$2{\cdot}512 \times 10^{-3}$	**26**	19·95	398·1
·03981	$1{\cdot}585 \times 10^{-3}$	**28**	25·12	631·0
·03162	$1{\cdot}000 \times 10^{-3}$	**30**	31·62	1,000
·02512	$6{\cdot}310 \times 10^{-4}$	**32**	39·81	$1{\cdot}585 \times 10^{3}$
·01995	$3{\cdot}981 \times 10^{-4}$	**34**	50·12	$2{\cdot}512 \times 10^{3}$
·01585	$2{\cdot}512 \times 10^{-4}$	**36**	63·10	$3{\cdot}981 \times 10^{3}$
·01259	$1{\cdot}585 \times 10^{-4}$	**38**	79·43	$6{\cdot}310 \times 10^{3}$
·01000	$1{\cdot}000 \times 10^{-4}$	**40**	100·00	$1{\cdot}000 \times 10^{4}$
$7{\cdot}943 \times 10^{-3}$	$6{\cdot}310 \times 10^{-5}$	**42**	125·9	$1{\cdot}585 \times 10^{4}$
$6{\cdot}310 \times 10^{-3}$	$3{\cdot}981 \times 10^{-5}$	**44**	158·5	$2{\cdot}512 \times 10^{4}$
$5{\cdot}012 \times 10^{-3}$	$2{\cdot}512 \times 10^{-5}$	**46**	199·5	$3{\cdot}981 \times 10^{4}$
$3{\cdot}981 \times 10^{-3}$	$1{\cdot}585 \times 10^{-5}$	**48**	251·2	$6{\cdot}310 \times 10^{4}$
$3{\cdot}162 \times 10^{-3}$	$1{\cdot}000 \times 10^{-5}$	**50**	316·2	$1{\cdot}000 \times 10^{5}$
$2{\cdot}512 \times 10^{-3}$	$6{\cdot}310 \times 10^{-6}$	**52**	398·1	$1{\cdot}585 \times 10^{5}$
$1{\cdot}995 \times 10^{-3}$	$3{\cdot}981 \times 10^{-6}$	**54**	501·2	$2{\cdot}512 \times 10^{5}$
$1{\cdot}585 \times 10^{-3}$	$2{\cdot}512 \times 10^{-6}$	**56**	631·0	$3{\cdot}981 \times 10^{5}$
$1{\cdot}259 \times 10^{-3}$	$1{\cdot}585 \times 10^{-6}$	**58**	794·3	$6{\cdot}310 \times 10^{5}$
$1{\cdot}000 \times 10^{-3}$	$1{\cdot}000 \times 10^{-6}$	**60**	1,000	$1{\cdot}000 \times 10^{6}$
$5{\cdot}623 \times 10^{-4}$	$3{\cdot}162 \times 10^{-7}$	**65**	$1{\cdot}778 \times 10^{3}$	$3{\cdot}162 \times 10^{6}$
$3{\cdot}162 \times 10^{-4}$	$1{\cdot}000 \times 10^{-7}$	**70**	$3{\cdot}162 \times 10^{3}$	$1{\cdot}000 \times 10^{7}$
$1{\cdot}778 \times 10^{-4}$	$3{\cdot}162 \times 10^{-8}$	**75**	$5{\cdot}623 \times 10^{3}$	$3{\cdot}162 \times 10^{7}$
$1{\cdot}000 \times 10^{-4}$	$1{\cdot}000 \times 10^{-8}$	**80**	$1{\cdot}000 \times 10^{4}$	$1{\cdot}000 \times 10^{8}$
$5{\cdot}623 \times 10^{-5}$	$3{\cdot}162 \times 10^{-9}$	**85**	$1{\cdot}778 \times 10^{4}$	$3{\cdot}162 \times 10^{8}$
$3{\cdot}162 \times 10^{-5}$	$1{\cdot}000 \times 10^{-9}$	**90**	$3{\cdot}162 \times 10^{4}$	$1{\cdot}000 \times 10^{9}$
$1{\cdot}000 \times 10^{-5}$	$1{\cdot}000 \times 10^{-10}$	**100**	$1{\cdot}000 \times 10^{5}$	$1{\cdot}000 \times 10^{10}$
$3{\cdot}162 \times 10^{-6}$	$1{\cdot}000 \times 10^{-11}$	**110**	$3{\cdot}162 \times 10^{5}$	$1{\cdot}000 \times 10^{11}$
$1{\cdot}000 \times 10^{-6}$	$1{\cdot}000 \times 10^{-12}$	**120**	$1{\cdot}000 \times 10^{6}$	$1{\cdot}000 \times 10^{12}$
$3{\cdot}162 \times 10^{-7}$	$1{\cdot}000 \times 10^{-13}$	**130**	$3{\cdot}162 \times 10^{6}$	$1{\cdot}000 \times 10^{13}$
$1{\cdot}000 \times 10^{-7}$	$1{\cdot}000 \times 10^{-14}$	**140**	$1{\cdot}000 \times 10^{7}$	$1{\cdot}000 \times 10^{14}$

49. If the output impedance is adjusted to any of the other possible values and the load matches this value, then, although the attenuation of power is that read from the dials as described above, some dB correction must be added to determine the output voltage. This correction represents the voltage step-down ratio of the output matching transformer. The output voltage across a matched load, V_{om} = (A + R) dB below V_{in}

where A is the total attenuation indicated by the dials in dB,
R is the voltage step-down ratio of the output matching transformer in dB (Table 2)
and V_{in} is the input voltage read on the input meter.

TABLE 2

Transformer voltage step-down ratios

Output impedance Ω	OUTPUT IMPEDANCE switch position	Terminals connected to load	Voltage step-down ratio	Voltage step-down dB (R)
600	600 Ω UNBAL	UNBAL	1:1	0
600	BAL 600 Ω	BAL	1:1	0
150	BAL 150 Ω	BAL	1:0.5	6
75	BAL 75 Ω	BAL	1:0.35	9
37.5	BAL 150 Ω	One BAL and CENTRE TAP	1:0.25	12
18.75	BAL 75 Ω	One BAL and CENTRE TAP	1:0.177	15

50. When the output impedance and the matching load are less than 600 Ω, the output voltage is the input voltage multiplied by the same factor as for 600 Ω (Fig. 3) reduced by the voltage step-down ratio of the output matching transformer (Table 2).

OUTPUT TO A MISMATCHED LOAD

51 If the load connected to the attenuator has an impedance differing from any of the output impedances obtainable on the instrument, it is possible to find the voltage across such a load by applying a correction to the value of voltage that would be developed if the load matched. This correction can be derived from the general expression for the voltage developed across a load fed from a source of known impedance. The voltage across an unmatched load,

$$V_o = \frac{E \times R_L}{R_O + R_L}$$

where E is the e.m.f. or open-circuit voltage of the source,
R_O is the output impedance of the source
and R_L is the load impedance.

52. When the load matches the source, the voltage developed across it is half the value of E, and if the load is greater or less than the output impedance, the voltage across the load is greater or less than half of E. This variation in voltage relative to the value when the load is matched, expressed in dB, is a correction that can be applied to the expression for V_{om} above. The output voltage across the load, V_o = (A + R + M) dB below V_{in}

where A is the total attenuation indicated by the dials in dB,
R is the voltage step-down ratio of the output matching transformer, in dB (Table 2),
M is the correction, in dB, depending on the relation of the load R_L to the output impedance R_O (Fig. 4)
and V_{in} is the input voltage, read on the input meter, applied from a 600 Ω generator.

Note...

(1) The corrections given for a mismatching load are not valid unless the actual output impe-

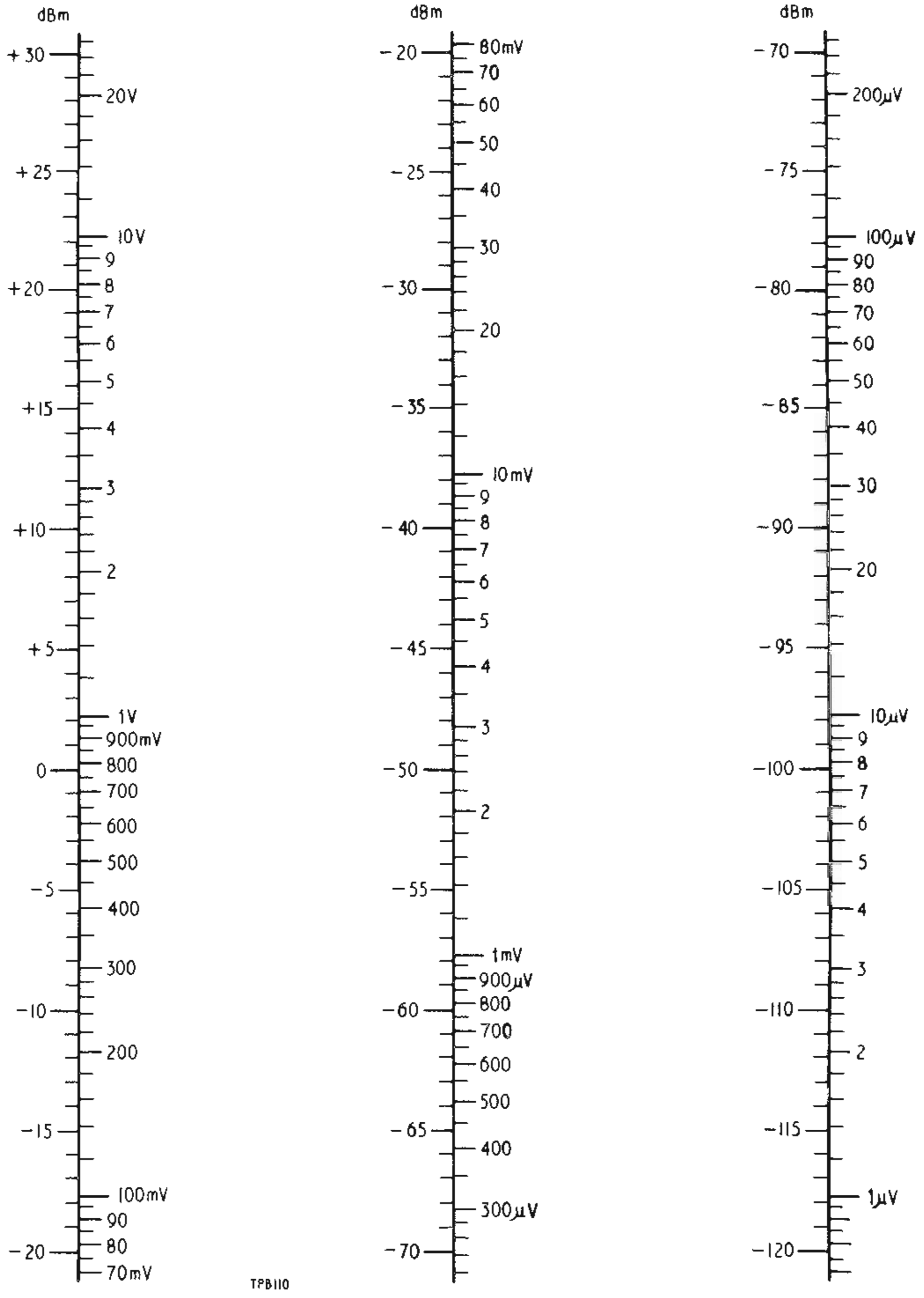


Fig. 3 Output voltage corresponding to dBm when output impedance and load are 600 Ω

dance of the attenuator is the same as the nominal value. To ensure this, the input should be fed from a 600 Ω generator, or the attenuation dial readings should be kept above 13 dB.

(2) When the load does not match the output impedance, if the attenuation employed is not substantial, the input impedance of the attenuator may differ from 600 Ω. If this is suspected, temporarily introduce an extra 20 dB attenuation to obtain the reading of V_{in} valid for use in the preceding expressions.

53. If the load impedance is particularly high compared with the output impedance, turn the LOAD switch to INT. This introduces an internal resistor that acts as a matching load irres-

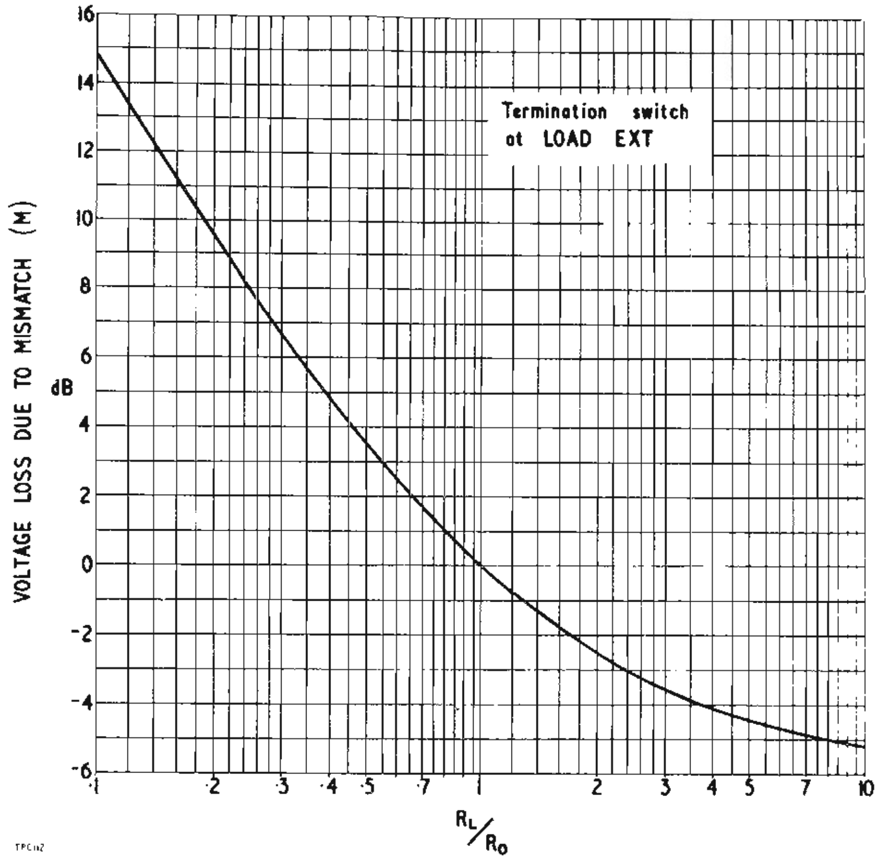


Fig. 4 Mismatch loss with external load

pective of the setting of the OUTPUT IMPEDANCE switch. The internal load will be effectively in parallel with the external load; but, if the latter has a high value, the resultant value of the combination will differ little from the matching value. This has the advantage that it can make a correction for mismatching unnecessary in finding the output voltage, and it permits the attenuation to be adjusted to low values without effect on the input meter reading. If the external load is not very much greater in value than the output impedance, and the internal load is switched in, a correction must be added to find the voltage across the load. The voltage across the load, V_o = (A + R + N) dB below V_{in}

where A, R, and V_{in} are as defined previously
and N is the correction, in dB, depending on the relation of the load to the output impedance (Fig. 5).

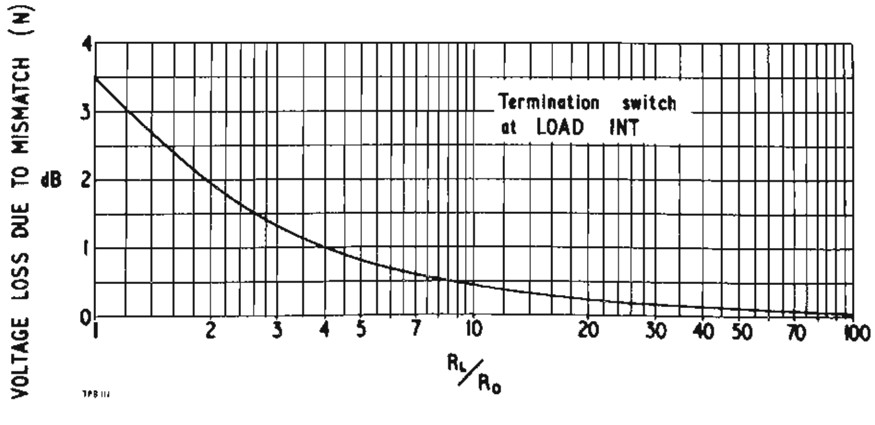


Fig. 5 Mismatch loss with internal load

TABLE 3

Transformer voltage step-up ratios

Terminals used as inlet	OUTPUT IMPEDANCE switch position	Voltage step-up ratio	Impedance step-up ratio	Output impedance if source is 600 Ω
BAL	BAL 600 Ω	1:1	1:1	600 Ω
BAL	BAL 150 Ω	1:2	1:4	2.4 kΩ
BAL	BAL 75 Ω	1:2.8	1:8	4.8 kΩ
One BAL and CENTRE TAP	BAL 600 Ω	1:2	1:4	2.4 kΩ
One BAL and CENTRE TAP	BAL 150 Ω	1:4	1:16	9.6 kΩ
One BAL and CENTRE TAP	BAL 75 Ω	1:5.7	1:32	19.2 kΩ

USING THE OUTPUT MATCHING TRANSFORMER TO OBTAIN A VOLTAGE STEP-UP

54. The transformer in the attenuator can be employed as a voltage step-up device at audio frequencies by applying a signal to the BAL terminals normally connected to a load, and by taking output from the front or rear INPUT socket normally used as an inlet. One BAL terminal, and the CENTRE TAP terminal can also be used for applying an input. The nominal voltage ratios obtainable are the square roots of the impedance ratios (Table 3).

55. In most cases, it is necessary to set all the attenuation dials to 0 in order that the attenuation circuits should not load the output obtained in this manner, but the attenuation controls can be turned to other positions to reduce and adjust the output if required.

56. The input voltmeter of the attenuator can be used to monitor the output, but its shunt impedance (approximately 30 kΩ) is significant in comparison with some of the values of output impedance which are obtained by this inverted use of the transformer, and consequently it may lower the voltage and effective output impedance obtained. To disconnect the voltmeter circuit, turn the METER RANGE switch to OFF.

57. The transformer is not particularly designed to operate in this fashion, and in doing so it has a relatively poor frequency response, which is worst at the highest ratios. However, the voltmeter, used to monitor the output, facilitates making adjustments to compensate for variation in the output. The transformer also causes distortion to become serious at low frequencies (below 400 Hz) when high step-up ratios are used.

Chapter 4

TECHNICAL DESCRIPTION

CONTENTS

OSCILLATOR

1. Basically, the oscillator consists (Fig. 1) of a multistage transistor amplifier, two overall feedback loops creating and stabilizing oscillation, and an attenuator controlling the output. The instrument also contains a power supply circuit.

Amplifier and output control

2. The first stage of the amplifier is transistor VT5 in a common-collector or emitter follower circuit. The input is the net signal derived from the two feedback paths. The transistor used is a silicon n-p-n type, as are all the others in the amplifier.

3. The voltage gain in the system is provided by the second stage VT6 in a common-emitter circuit which produces high gain as a result of a high effective a.c. collector load impedance obtained by a bootstrap arrangement; the collector load resistor is not fed directly from the d.c. supply but from the emitter of an auxiliary transistor VT7 driven from a further point in the amplifier chain.

4. The two following stages are emitter followers VT8 and VT9. At the output of the first, the auxiliary transistor VT7 receives its drive; and also at this point diode limiter MR6 is connected, to control the amplitude of initial oscillations at switch-on. The second emitter follower VT9 drives the output stage.

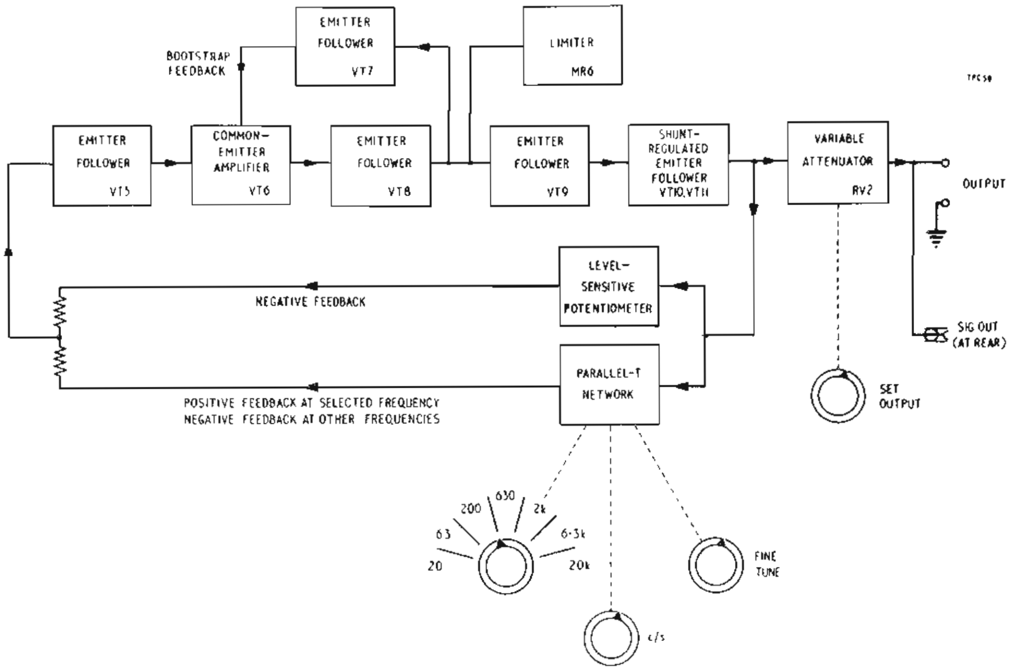


Fig. 1 Block diagram of oscillator

5. In the final stage, a low source impedance and low distortion output are provided by a shunt-regulated emitter follower VT10 and VT11. The two paths of a.c. feedback derive their signals from the output of this stage. Beyond, the low output impedance is padded up by resistance to present a constant and suitable value of source for the output level control circuit. The output stage has its working conditions stabilized by d.c. negative feedback, returned from it to the first transistor of the amplifier, all the transistors being d.c. coupled.

6. The output level of the oscillator is determined primarily by a 600 Ω T network attenuator; fine control is achieved by a small variable resistor in series with the attenuator. Both controls are continuously variable and un-calibrated. The attenuator is connected to either the front panel terminals or the rear coaxial socket according to the setting of S3.

Feedback

7. Two a.c. feedback paths exist between the output of the final stage and the input of the first stage of the amplifier. One of these determines the frequency of oscillation by providing positive feedback at a chosen frequency through a variable parallel T network. This network has continuously variable resistors RV6a to RV6c which are ganged together and form a tuning control over a frequency band, and switched capacitors C17 to C29 enabling a series of six bands to be covered. At frequencies above and below the chosen frequency phase changes in the network cause the feedback to be negative; this provides a considerable measure of harmonic distortion suppression.

8. The other a.c. feedback path conveys negative feedback at all frequencies. At the selected frequency of oscillation it is overcome by the positive feedback at the junction where the two feedback paths enter the amplifier. This wide-band negative feedback is derived from two successive resistive potentiometers at the output of the amplifier. In the first potentiometer, thermistor TH1 occupying the upper arm is sensitive to the level of output and varies its resistance, and therefore varies the negative feedback, so that the level of output is stabilized, and also so that the strength of oscillation is always moderate (and therefore generates a minimum of distortion). In the second potentiometer, a physically larger thermistor TH2 in the lower arm is

primarily sensitive to ambient temperature and compensates for the effect of this on the first thermistor.

Power supply circuit

9. The oscillator has a mains transformer and a full-wave rectifier circuit, feeding the instrument through a series regulating circuit employing p-n-p transistors VT1 to VT4.

10. On the mains transformer T1 are two primary windings which can be linked in series or parallel to permit operation from a.c. supplies giving between 190 V and 260 V or between 95 V and 130 V respectively.

11. Terminals and switch S2 at the rear allow the input of the regulating circuit to be fed from an external d.c. source. A series semiconductor diode MR1 protects the instrument against the application of the wrong polarity.

MONITORED ATTENUATOR

12. The monitored attenuator consists (Fig. 2) of a 111 dB step attenuator, an input voltmeter and an output circuit including a multi-ratio matching transformer.

Step attenuator

13. The step attenuator provides a range of 111 dB in three decades. The three controls of these permit adjustment in steps of 10 dB from 0 up to 100 dB, in steps of 1 dB from 0 to 10 dB, and in steps of 0.1 dB from 0 to 1 dB. The last two decades can also be switched to completely break the signal path through the instrument.

14. Each decade uses four symmetrical T networks, which are switched into use alone or in different series combinations to provide ten steps of attenuation. Each network has a characteristic impedance of 600 Ω. High-stability resistors are used throughout. The complete step attenuator assembly is in a separate box.

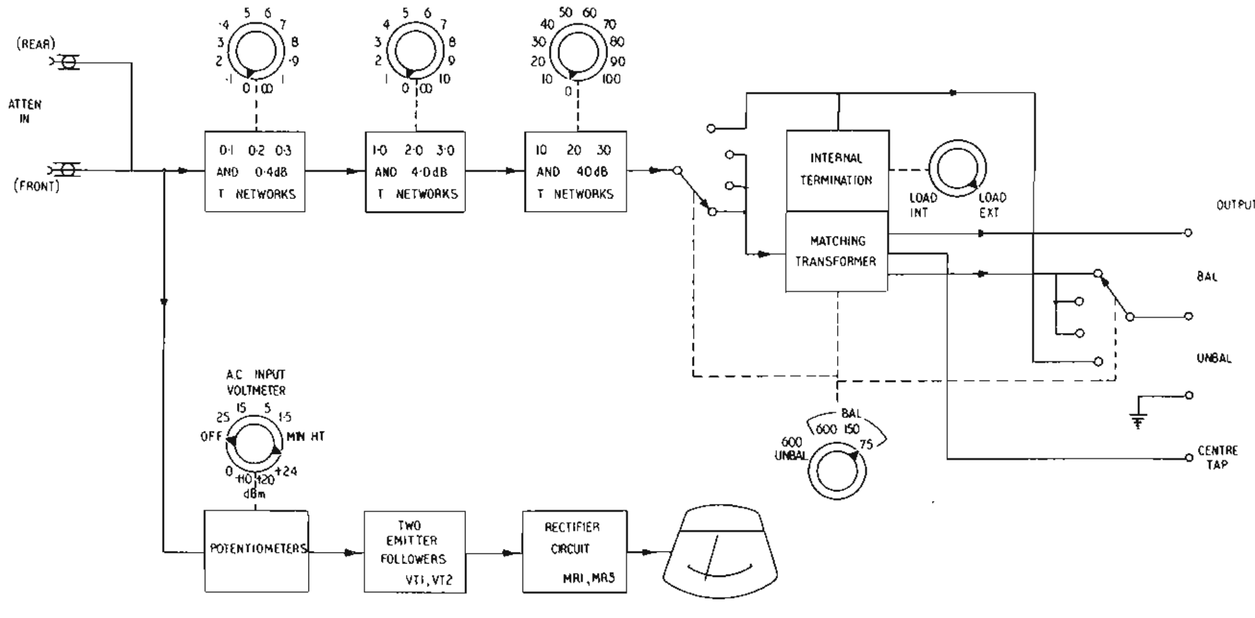


Fig. 2 Block diagram of monitored attenuator

Input voltmeter

15. Connected in parallel with the inlets to the step attenuator, the input meter measures the voltage applied to the instrument. If switch SC is turned off, the voltmeter is disconnected and ceases to monitor the input to the instrument.

16. The basic voltmeter consists of two germanium diodes MR1 and MR3 in a voltage doubling rectifier circuit, feeding the moving-coil meter M1. The rectifier circuit is preceded by two transistors VT1 and VT2 arranged as emitter followers in cascade. These present a higher effective input impedance for the voltmeter and isolate the distorting effects due to rectification.

17. The first transistor VT1 receives the input voltage of the attenuator via potentiometer circuits selected by the range switch SC. On the most sensitive range, one potentiometer alone is used, consisting of R1 in series with RV1 in one arm and the input impedance of the first emitter follower circuit. On each of the other three ranges this potentiometer is preceded by one other supplementary potentiometer, selected by the switch from the three formed by R4, RV4 and R15; R3, RV3 and R14; R2, RV2 and R13. The potentiometer arms have shunt capacitors, some trimmers, which preserve the required voltage drop at the higher frequencies.

18. The transistors receive their d.c. supply via socket SKTB and reverse-polarity protection diode MR2. The voltmeter circuit has no d.c. connection to the rest of the instrument. It has a reference point with an a.c. tie to chassis via C10, and there is a d.c. blocking capacitor C6 in series with the signal input path.

Output matching

19. This part of the instrument receives the output of the step attenuator. It consists mainly of a multi-ratio matching transformer and switching arrangements by which the taps on the secondary of the transformer are selected or the transformer is bypassed (Fig. 3).

20. At three positions of the output impedance selector switch SA, the output of the step attenuator is applied to the primary of the matching transformer T1 via a d.c. blocking capacitor C17. At these three positions SA also connects in turn three pairs of taps on the secondary of the transformer to the balanced output terminals on the front panel, so that output impedances of 600 Ω, 150 Ω and 75 Ω are obtained. The secondary is floating and has a centre tap connected to another terminal on the front panel.

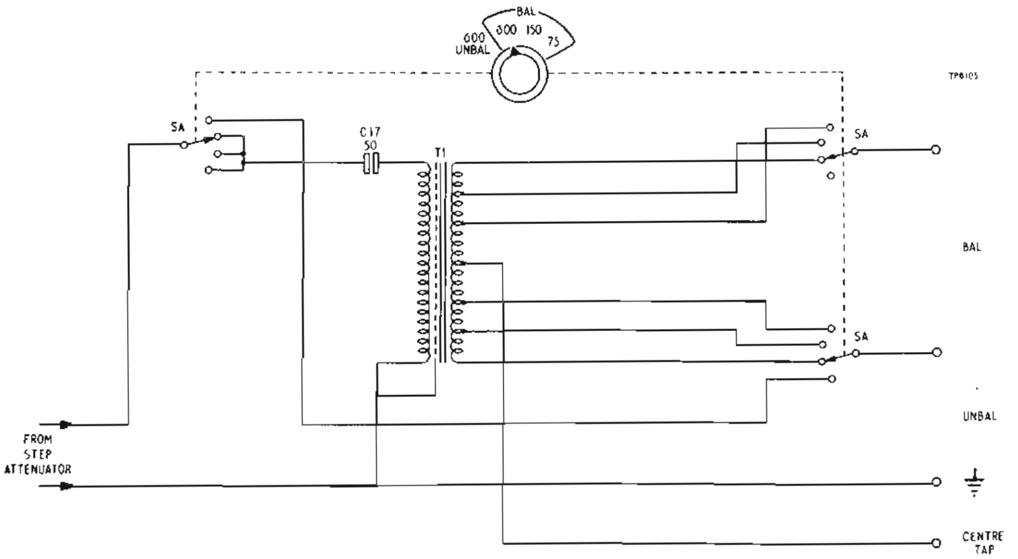


Fig. 3 Output matching stage (less switched internal load)

21. At a fourth position of SA, the output of the step attenuator is fed to the unbalanced terminals; the transformer is bypassed in this case. The switching arrangements are such that one unbalanced terminal is one that serves as a balanced terminal at the other positions of SA. The other unbalanced terminal is a chassis connection.

22. A 600 Ω resistor R19 can be switched into use as a matching load for the attenuator. This can be done at any position of the impedance selector SA. The switching arrangements of SA are such that at the three positions where different balanced output impedances are obtained, R19 is connected via SB across the 600 Ω taps of the transformer secondary.

Chapter 5

MAINTENANCE

CONTENTS

PERFORMANCE TESTS

1. Test procedures described in this chapter may be simplified and of restricted range compared with those that relate to the generally more comprehensive factory test facilities which are necessary to demonstrate complete compliance with the specifications. Performance limits quoted are for guidance and should not be taken as guaranteed performance specifications unless they are also quoted in the Performance Data in Chap. 1. When making tests to verify that the instrument meets the stated performance limits, allowance must always be made for the uncertainty of the test equipment used.

SERVICING GUIDE

2. Maintenance is not to be undertaken except by authorized personnel. Before attempting any maintenance the information given should be read with reference to the preceding Technical Description chapter.

CAUTION

Semi-conductor devices are used throughout the instrument, and although these have inherent long term reliability and mechanical ruggedness, they are susceptible to damage by over-loading, reversed polarity and excessive heat or radiation. Avoid hazards such as prolonged soldering, strong r.f. fields or other forms of radiation, the use of insulation testers or accidentally applied short circuits.

Fuses

3. The circuits of the oscillators are protected by three fuses, FS1 and FS3 in series with each supply input connection to the mains transformer and FS2 in series with the centre tap of the secondary of the mains transformer or in series with the positive input from a battery, depending on the setting of the BATTERY/MAINS switch S2.

4. The fuse holders are accessible at the rear of the oscillators The holder for FS1 and FS3 marked 250 mA - 115 V and 100 mA - 230 V; the marked voltages are representative of the overall ranges 90 V to 130 V and 190 V to 260 V, for which 250 mA and 100 mA fuses should be fitted respectively. The holder of FS2 is marked 250 mA HT.

5. Replacement fuse links should be 20 mm x 5 mm cartridges of the low breaking capacity type (in accordance with Sheet II of International Electrotechnical Commission Publication 127).

ACCESS TO COMPONENTS

6. To remove the case, proceed as follows :-

(1) Withdraw the coin-slotted screws from the rear of the instrument and remove the rear cover.

(2) Slide the assembly of the three units and the bezel forward from the case.

To separate the three units, withdraw the screws attaching them to the bezel.

Opening the oscillator chassis

7. The chassis consists of the front panel and three other sections hinged to it. The four sections are normally arranged in the form of a rectangle when viewed from above, and are held in this position by screws. The four sections can be hinged open as follows (Fig. 1) :-

(1) Underneath, near the rear, slacken the two 6 BA screws in slots, one at each side of the web that spans the chassis.

(2) Slacken the two relatively large screws at the left-hand side of the rear section until the shoulders under the heads of the screws are clear of the slots through which the screws pass. It should then be possible to separate the chassis at this corner, so that the sections can be hinged open.

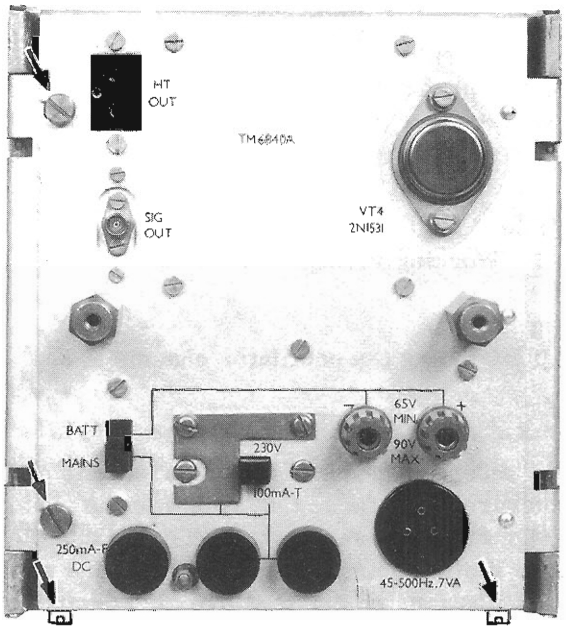


Fig. 1 Opening the oscillator chassis.

8. A printed board is framed in each of the two longer sections of the chassis. The wiring sides are facing outwards. Each board is held in its frame by plastic clips. Press these to release the board, having disconnected such leads as necessary.

Opening the monitored attenuator chassis

9. The chassis consists of the step attenuator box at the bottom, the input voltmeter box behind the voltmeter range switch and the matching transformer box on the other side.

10. The components of the step attenuator can be examined and limited access can be obtained by removing the bottom cover of the step attenuator box. To do this, withdraw the ten 6 BA screws that hold it.

To remove the step attenuator box completely, proceed as follows :-

(1) Remove the bottom cover of the box as described above.

(2) Remove the bar at the back of the unit by withdrawing the two 4 BA countersunk screws in the bar.

(3) Slacken the 4 BA socket-headed set screws in all the control knobs and remove the knobs.

(4) Disconnect the meter, release the meter clamp (behind the front panel), and remove the meter.

(5) Remove the front panel mask which is now free.

(6) Remove the side cover of the voltmeter box, by withdrawing the two screws that hold it. Unplug the coaxial connector to the step attenuator box and withdraw the 6 BA screw securing the attenuator box to the voltmeter box. Be careful not to lose the spacer between the two units which may fall out when the screw is removed.

(7) Disconnect from the front panel terminals, and from the step attenuator, the five leads that enter the step attenuator box through a hole near the front. Also unsolder the connection to the front panel earth terminal.

(8) Slacken the screw entering the matching transformer box, and withdraw the screw entering the step attenuator box, in the small bar joining the rear of the two boxes. Swing the bar aside.

(9) Unscrew and remove the hexagon-headed bushes through which the shafts of the three attenuation controls enter the instrument while supporting the step attenuator box, which will then be freed.

11. When the attenuator box is separated from the instrument, the sides of the box can be detached by withdrawing the screws and nuts that hold them.

12. To examine the components in the voltmeter box (behind the voltmeter range switch), withdraw the two 6 BA screws that hold the side cover of the box and remove the cover. The two boards carrying the majority of the components are held in position by the four, outer, corner screws in the larger board.

13. To obtain access to the components in the matching transformer box, withdraw the two 6 BA screws holding its side cover and remove the cover.

MAINS TRANSFORMER CONNECTIONS

14. The equipment is normally supplied for connection to supplies between 190 V - 260 V. Switch S5 the mains selector switch is secured in this position by the switch plate. If the input supply voltage lies between 95 V - 130 V remove the switch plate and reverse it, switch S5 to the 115 V position and refit the plate.

15. If the a.c. supply voltage will lie between 190 V and 260 V, the two primaries must be in series and have a link between the finish F of one and the start S of the other. The a.c. input must be applied to the other F and S terminals.

16. If the a.c. supply voltage will lie between 95 V and 130 V, the two primaries must be in parallel and have a link between the two terminals marked S and a second link between the two terminals marked F. The a.c. input must be applied to one S terminal and one F terminal.

WORKING VOLTAGES

17. The voltages given (Table 1) are representative of those to be expected on an a.c. operated instrument if measurements are made with a multi-range meter having a sensitivity of 20 kΩ/V using the lowest range suitable for each reading with a supply voltage at the mean of the range for which the instrument is set. When checking these voltages, allowance should be made for permissible variations in semiconductor performance and component values which may be found on an individual instrument. It is assumed that the stabilized d.c. supply voltage is correctly set at 55 V (para. 19).

TABLE 1

Working voltages

Unit	Transistor	Base (V)	Emitter (V)	Collector (V)	Voltage datum
Oscillator	VT1	-36	-36	-56	Positive d.c. supply line
	VT2	-56	-56	-87	
	VT3	-56	-56	-87	
	VT4	-56	-56	-87	
	VT5	2.6	2	17	Negative d.c. supply line
	VT6	2.2	2	29	
	VT7	35	33.5	55	
	VT8	29.2	28.8	55	
	VT9	28.6	28	55	
	VT10	28	27.5	53.2	
	VT11	2.4	1.9	26.7	
Voltmeter	VT1	-4.5	-4.55	-8	Positive d.c. supply line
	VT2	-4.55	-4.3	-8	

PRESETS - OSCILLATOR

18. Although small adjustments can be made to any of the presets RV1 and RV3 to RV5 alone, it is preferable to check and, if necessary, adjust them all in the order RV1, RV4, RV3 and RV5.

Resistor RV1

19. This control determines the voltage of the stabilized d.c. supply feeding the amplifier.

The potential should be +55 V at tag 12, relative to tag 9, on the component side of the right-hand printed board.

20. It is probable that readjustment of RV1 will be necessary if any of the transistors VT1 to VT4 are changed.

Resistor RV3

21. This control is used to set the gain of the amplifier. The gain should be 400 between test points TP1 and TP2, on the right-hand printed board, measured as follows :-

(1) Disconnect the positive feedback at tag 11 on the component side of the board.

(2) Apply 25 mV at 1 kHz from a 600 Ω source to TP1 on the wiring side of the board, using tag 21 on the component side as earth.

(3) Read the output on a high impedance voltmeter connected to TP2 on the wiring side of the board, using tag 21 as earth. Adjust RV3, if necessary, to obtain 10 V r.m.s.

22. RV3 may require readjustment if any of the transistors VT5 to VT11 are changed, particularly VT6.

Resistor RV4

23. Distortion in the output can be minimized by means of this control. It also varies the positive d.c. voltage at test point TP2 on the wiring side of the right-hand printed board, relative to tag 9 on the component side. This voltage must lie in the range 26 V to 29 V when RV4 is set.

Changing any of the transistors VT5 to VT11 may make readjustment of RV4 necessary.

Resistor RV5

24. Variable resistor RV5, forming part of the level-sensitive potentiometer network, is a means of setting the negative feedback providing level stabilization, as follows :-

(1) Set the instrument so that it is oscillating normally at 1 kHz.

(2) Check the voltage at test point TP2 on the wiring side of the right-hand printed board, relative to tag 21 on the component side, using a high impedance voltmeter. It should be 11 V r.m.s. Adjust RV5 if necessary.

25. RV5 may need readjustment if thermistor TH1 or TH2 is changed.

Resistors RV8 to RV19

26. These set the limits of the frequency bands. Normally, they should not be moved.

PRESETS - VOLTMETER

27. In the monitored attenuator, only the voltmeter circuit has preset controls. If it is necessary to change components in the input voltmeter, check afterwards that the presets are set correctly if the best accuracy is required, although it is unlikely that much readjustment will be needed.

28. To check and, if necessary, adjust the presets proceed as follows :-

(1) Remove the plastic plate beneath the trimming-hole mask, on the top of the voltmeter

box, after withdrawing the screws at the corners of the mask. (One screw at the rear can be left in position, but slackened, and the plastic plate swung clear.)

(2) Turn the range switch SC to 1.5 V. Apply to the attenuator inlet a 1 kHz sine wave; adjust this input to 1.5 V r.m.s., measured on an external standardized high impedance voltmeter; and set RV1 so that the meter on the attenuator indicates 1.5 V exactly.

(3) Apply a 500 kHz sine wave to the attenuator; adjust the input to 1.5 V r.m.s., measured on the external standardized meter; and set C1 so that the meter on the attenuator indicates 1.5 V.

(4) Turn the switch to 5 V and repeat the above with an input of 5 V r.m.s., measured on the external standardized meter; but adjust RV4 and C4, at 1 kHz and 550 kHz respectively, for an indication on the attenuator of 5 V exactly.

(5) Turn the switch to 15 V and repeat the above with an input of 15 V r.m.s., measured on the external standardized meter; but adjust RV3 and C3, at 1 kHz and 550 kHz respectively, for an indication on the attenuator of 15 V exactly.

(6) Turn the switch to 25 V and repeat the above with an input of 25 V r.m.s., measured on the external standardized meter; but adjust RV2 and C2, at 1 kHz and 550 kHz respectively, for an indication on the attenuator of 25 V exactly.

Chapter 6

REPLACEABLE PARTS

CONTENTS

INTRODUCTION

1. Each sub-assembly or printed circuit board in this instrument has been allocated a unit identification, e.g. TM 6885.

2. The complete component reference carries its unit number as a prefix, e.g. TM 6885 Capacitor C3 but for convenience in the text and on circuit diagrams the prefix is not used. However, when ordering replacements or in correspondence the complete component reference must be quoted.

ABBREVIATIONS

3. The components are listed in alphanumerical order of the complete circuit reference and the following abbreviations are used :

C	:	capacitor
D	:	semiconductor diode
FS	:	fuse
L	:	inductor
LP	:	lamp
ME	:	meter
Pl	:	plug
R	:	resistor
S	:	switch
SK	:	socket
T	:	transformer
TP	:	terminal
TR	:	transistor
Var	:	variable
W	:	watts at 70°C
WW	:	wirewound
†	:	value selected during test; nominal value listed

COMPONENT VALUES

4. One or more of the components fitted in this instrument may differ from those listed in this chapter for any of the following reasons :

(a) Components indicated by a † have their values selected during test to achieve particular performance limits.

(b) Owing to supply difficulties, components of differing value or type may be substituted provided the overall performance of the instrument is maintained.

(c) As part of a policy of continuous development, components may be changed in value or type to obtain detail improvements in performance.

5. When there is a difference between the component fitted and the one listed, always use as a replacement the same type and value as found in the instrument.

ORDERING

6. When ordering replacements, address the order to our Service Division (address on rear cover) or nearest agent and specify the following for each component required :

(1) Type * and serial number of instrument

(2) Complete circuit reference

(3) Description

(4) Marconi Instruments code no.

*As given on the serial number label at the rear of the instrument; if this is superseded by a model number label, quote the model number instead of the type number.

OSCILLATOR

Circuit ref.	Description				Code no.
C1	Capacitor, ceramic	0.001 μF	±20%	500 V	26364-302
C2	Capacitor, electrolytic	100 μF	+50-20%	350 V	26417-497
C3	Capacitor, plastic	0.1 μF	±10%	400 V	26555-475
C4	Capacitor, electrolytic	5 μF	+100-20%	70 V	26417-118
C5	Capacitor, electrolytic	100 μF	+50-20%	100 V	26415-816
C6	Capacitor, electrolytic	4.7 μF	+100-20%	63 V	26415-801
C7	Capacitor, plastic	0.01 μF	±10%	630 V	26555-463
C8	Capacitor, electrolytic	47 μF	+100-20%	10 V	26415-809
C9	Capacitor, electrolytic	25 μF	+100-20%	25 V	26415-695
C10	Capacitor, electrolytic	4.7 μF	+100-20%	63 V	26415-801
C11	Capacitor, ceramic	10 pF	±0.5 pF	750 V	26324-085
C12	Capacitor, electrolytic	100 μF	+50-20%	100 V	26415-816
C13	Capacitor, ceramic	220 pF	±10%	500 V	26364-157
C14	Capacitor, electrolytic	100 μF	+100-20%	63 V	26415-815
C15	Capacitor, electrolytic	1000 μF	+100-20%	16 V	26415-825
C16	Capacitor, electrolytic	100 μF	+100-20%	25 V Reversible	26417-326
C17a	Capacitor, plastic	0.5 μF	1.771 μF total		
C17b	Capacitor, plastic	0.5 μF			
C17c	Capacitor, plastic	0.5 μF			
C17d	Capacitor, plastic	0.271 μF	±1.1%	125 V	26518-397
C18	Capacitor, plastic	0.56 μF	±1.1%	125 V	26518-375
C19	Capacitor, plastic	0.1771 μF	±1.1%	125 V	26518-325
C20	Capacitor, plastic	0.056 μF	±1.1%	125 V	26518-265
C21	Capacitor, plastic	0.01771 μF	±1.1%	125 V	26518-223
C22	Capacitor, plastic	5600 pF	±1.1%	125 V	26518-201
C23	Capacitor, plastic	1750 pF	±1%	125 V	26513-425
C24	Capacitor, plastic	1750 pF	±1%	125 V	26513-425

Circuit ref.	Description				Code no.
C25	Capacitor, plastic	5600 pF	±1.1%	125 V	26518-201
C26	Capacitor, plastic	0.01771 μF	±1.1%	125 V	26518-223
C27	Capacitor, plastic	0.056 μF	±1.1%	125 V	26518-265
C28	Capacitor, plastic	0.1771 μF	±1.1%	125 V	26518-325
C29	Capacitor, plastic	0.56 μF	±1.1%	125 V	26518-375
FS1 &	Fuse, cartridge	100 mA - T (or)	230 V supply		23411-052
FS3	Fuse, cartridge	250 mA - T	115 V supply		23411-055
FS2	Fuse cartridge	250 mA-F			23411-004
FS1-3	Fuse holder				23416-192
FS1-3	Fuse holder cover				23416-198
MR1	Silicon diode	1N4004			28357-028
MR2	Silicon diode	DDO 58			28358-817
MR3	Silicon diode	DDO 58			28358-817
MR4	Zener diode	ZOB18			28372-587
MR5	Zener diode	ZOB18			28372-587
MR6	Germanium diode	OA95			28323-287
MR7	Silicon diode	1N4004			28357-028
MR8	Germanium diode	OA95			28323-287
PL1	Plug, three pin				23423-151
	Cover for PL1				23435-301
R1	Resistor, metal film	33 kΩ	±2%	¼ W	24773-309
R2	Resistor, metal oxide	820 kΩ	±2%	½ W	24573-143
R3	Resistor, metal film	470 Ω	±2%	¼ W	24773-265
R4	Resistor, metal film	10 Ω	±2%	¼ W	24773-225
R5	Resistor, metal film	22 kΩ	±2%	¼ W	24773-305
R6	Resistor, metal film	10 Ω	±2%	¼ W	24773-225
R7	Resistor, metal film	4.7 kΩ	±2%	¼ W	24773-289
R8	Resistor, metal film	22 Ω	±2%	¼ W	24773-233

Circuit ref.	Description				Code no.
R9	Resistor, metal film	10 kΩ	±2%	¼ W	24773-297
R10	Resistor, metal film	3.3 kΩ	±2%	¼ W	24773-285
R11	Resistor, metal film	11.75 kΩ	±1%	¼ W	24637-501
R12	Resistor, metal film	4 kΩ	±1%	¼ W	24637-205
R13	Resistor, metal film	100 Ω	±2%	¼ W	24773-249
R14	Resistor, metal oxide	6.8 kΩ	±2%	½ W	24573-093
R15	Resistor, metal oxide	33 kΩ	±2%	½ W	24573-109
R16	Resistor, metal oxide	10 kΩ	±2%	½ W	24573-097
R17	Resistor, metal film	22 kΩ	±2%	¼ W	24773-305
R18	Resistor, metal film	2.2 kΩ	±2%	¼ W	24773-281
R19	Resistor, metal film	10 kΩ	±2%	¼ W	24773-297
R20	Resistor, metal film	3.3 kΩ	±2%	¼ W	24773-285
R21	Resistor, metal film	100 kΩ	±2%	¼ W	24773-321
R22	Resistor, metal film	47 kΩ	±2%	¼ W	24773-313
R23	Resistor, metal film	6.8 kΩ	±2%	¼ W	24773-293
R24	Resistor, metal film	100 Ω	±2%	¼ W	24773-249
R25	Resistor, metal film	1 kΩ	±2%	¼ W	24773-273
R26	Resistor, metal oxide	33 kΩ	±2%	½ W	24573-109
R27	Resistor, metal oxide	4.7 kΩ	±2%	½ W	24573-089
R28	Resistor, metal film	100 Ω	±2%	¼ W	24773-249
R29	Resistor, metal film	22 kΩ	±2%	¼ W	24773-305
R30	Resistor, metal oxide	82 Ω	±2%	½ W	24573-047
R31	Resistor, metal film	47 Ω	±2%	¼ W	24773-241
R32	Resistor, metal oxide	13 kΩ	±2%	½ W	24573-100
R33	Resistor, metal oxide	1 kΩ	±2%	½ W	24573-073
R34	Resistor, metal oxide	15 kΩ	±2%	½ W	24573-101
R35	Resistor, metal film	1 kΩ	±2%	¼ W	24773-273
R36	Resistor, metal film	5.6 kΩ	±2%	¼ W	24773-291
R37	Resistor, metal film	1 kΩ	±2%	¼ W	24773-273
R38	Resistor, metal film	549 Ω	±1%	¼ W	24636-811
R39	Resistor, metal film	100 kΩ	±2%	¼ W	24773-321
R41	Resistor, metal film	3860 Ω	±½%	¼ W	24635-103
R42	Resistor, metal film	3860 Ω	±½%	¼ W	24635-103
R43	Resistor, metal film	1675 Ω	±½%	¼ W	24635-002
R44	Resistor, metal oxide	33 kΩ	±2%	½ W	24573-109
R45	Resistor, metal film	1 kΩ	±2%	¼ W	24773-273

Circuit ref.	Description				Code no.
R46	Resistor, metal film	10 Ω	±2%	¼ W	24773-225
RV1	Resistor, variable carbon	10 kΩ	±20%	¼ W	25611-213
RV2a, RV2b, RV2c	Resistor, variable wire wound T pad	600 Ω	±20%	1 W	25877-305
RV3	Resistor, variable carbon	1 kΩ	±20%	¼ W	25611-114
RV4	Resistor, variable carbon	4.7 kΩ	±20%	¼ W	25611-122
RV5	Resistor, variable carbon	1 kΩ	±20%	¼ W	25611-114
RV6a	Resistor, variable wire wound	10 kΩ	±2%	4 W	ganged 44371-216
RV6b	Resistor, variable wire wound	10 kΩ	±2%	4 W	
RV6c	Resistor, variable wire wound	5 kΩ	±2%	4 W	
RV7	Resistor, variable wire wound	100 Ω	±10%	1 W	25814-145
RV8	Resistor, variable carbon	470 Ω	±20%	¼ W	25611-110
RV9	Resistor, variable carbon	470 Ω	±20%	¼ W	25611-110
RV10	Resistor, variable carbon	470 Ω	±20%	¼ W	25611-110
RV11	Resistor, variable carbon	470 Ω	±20%	¼ W	25611-110
RV12	Resistor, variable carbon	470 Ω	±20%	¼ W	25611-110
RV13	Resistor, variable carbon	470 Ω	±20%	¼ W	25611-110
RV14	Resistor, variable carbon	220 kΩ	±20%	¼ W	25611-142
RV15	Resistor, variable carbon	220 kΩ	±20%	¼ W	25611-142
RV16	Resistor, variable carbon	220 kΩ	±20%	¼ W	25611-142
RV17	Resistor, variable carbon	220 kΩ	±20%	¼ W	25611-142
RV18	Resistor, variable carbon	220 kΩ	±20%	¼ W	25611-142
RV19	Resistor, variable carbon	220 kΩ	±20%	¼ W	25611-142
RV20	Resistor, variable wire wound	100 Ω	±10%	1 W	25814-145
S1	Switch, four pole, two way				44321-406
S2	Switch, slider, two-way				23467-161
S3	Switch, single pole, double throw				23462-252
S4	Switch, five wafer, six-way				44324-811
S5	Switch, slider, two-way				23467-161
	Switch plate for S5				35901-430

Circuit ref.	Description	Code no.
SKT1	Socket, two pin	23421-504
SKT2	Socket, miniature coaxial	23441-044
T1	Mains transformer	43490-070
	Transformer terminal cover	37574-541
TH1	Thermistor, A54	25683-269
TH2	Thermistor, CZ3	25683-644
TP1	Terminal, miniature	23235-176
TP2	Terminal, miniature	23235-176
TP3	Terminal, miniature	23235-176
TP4	Terminal, miniature	23235-176
VT1	Transistor, ACY17	28426-497
VT2	Transistor, ACY17	28426-497
VT3	Transistor, ACY17	28426-497
VT4	Transistor, MJ491	28435-876
VT5	Transistor, BC 237A	28455-421
VT6	Transistor, BC 237A	28455-425
VT7	Transistor, BC 237A	28455-421
VT8	Transistor, BC 237A	28455-421
VT9	Transistor, BC 237A	28455-421
VT10	Transistor, MM 3001	28458-406
VT11	Transistor, MM 3001	28458-406

INPUT VOLTMETER AND OUTPUT MATCHING CIRCUIT

Circuit ref.	Description				Code no.
C1	Capacitor, ceramic	4-20 pF Trimmer			26847-244
C2	Capacitor, ceramic	3-12 pF Trimmer			26847-242
C3	Capacitor, ceramic	3-12 pF Trimmer			26847-242
C4	Capacitor, ceramic	4-20 pF Trimmer			26847-244
C5	Capacitor, ceramic	10 pF	±0.5 pF	750 V	26324-085
C6	Capacitor, electrolytic	16 μF	+100-20%	50 V Reversible	26418-368
C7	Capacitor, electrolytic	22 μF	+100-20%	25 V	26415-805
C8	Capacitor, electrolytic	220 μF	+100-20%	25 V	26415-818
C9	Capacitor, plastic	0.01 μF	±10%	630 V	26555-463
C10	Capacitor, electrolytic	470 μF	+100-20%	25 V	26415-822
C11	Capacitor, electrolytic	47 μF	+100-20%	40 V	26415-810
C12	Capacitor, plastic	0.1 μF	±10%	400 V	26555-475
C13	Capacitor, ceramic	100 pF	±2%	750 V	26324-897
C14	Capacitor, ceramic	47 pF	±2%	750 V	26324-833
C15	Capacitor, ceramic	0.001 μF	±10%	500 V	26364-302
C16	Capacitor, ceramic	0.001 μF	±10%	500 V	26364-302
C17	Capacitor, electrolytic	50 μF	+100-20%	50 V	26417-320
C18	Capacitor, ceramic	15 pF	±5%	750 V	26324-795
C19	Capacitor, plastic	0.001 μF	±2%	160 V	26516-481
M1	Meter	100 μA		1000 Ω	44572-221
MR1	Germanium diode	CG92H			28321-161
MR2	Germanium diode	OA95			28323-287
MR3	Germanium diode	CG92H			28321-161
PLA	Plug, miniature coaxial				23441-014
PL101	Plug, two pin				23421-204

Circuit ref.	Description				Code no
R1	Resistor, metal oxide	7.5 kΩ	±2%	½ W	24573-094
R2	Resistor, metal oxide	27 kΩ	±2%	½ W	24573-107
R3	Resistor, metal oxide	24 kΩ	±2%	½ W	24573-106
R4	Resistor, metal oxide	18 kΩ	±2%	½ W	24573-103
R5	Resistor, metal oxide	33 kΩ	±2%	½ W	24573-109
R6	Resistor, metal oxide	47 kΩ	±2%	½ W	24573-113
R7	Resistor, metal film	10 kΩ	±2%	¼ W	24773-297
R8	Resistor, metal oxide	3.3 kΩ	±2%	½ W	24573-085
R9	Resistor, metal film	1 kΩ	±2%	¼ W	24773-273
R10	Resistor, metal film	1 kΩ	±2%	¼ W	24773-273
R11	Resistor, metal film	99 kΩ	±1%	¼ W	24637-652
R12	Resistor, metal oxide	10 kΩ	±2%	½ W	24573-097
R13	Resistor, metal oxide	2.2 kΩ	±2%	½ W	24573-081
R14	Resistor, metal oxide	3.6 kΩ	±2%	½ W	24573-086
R15	Resistor, metal oxide	15 kΩ	±2%	½ W	24573-101
R16	Resistor, metal film	47 Ω	±2%	¼ W	24773-241
R19	Resistor, metal film	600 Ω	±1%	1 W	24666-802
RV1	Resistor, variable carbon	10 kΩ	±20%	¼ W	25611-178
RV2	Resistor, variable carbon	10 kΩ	±20%	¼ W	25611-178
RV3	Resistor, variable carbon	10 kΩ	±20%	¼ W	25611-178
RV4	Resistor, variable carbon	10 kΩ	±20%	¼ W	25611-178
SA	Switch, two wafer, four way				44321-407
SB	Switch, single pole, double throw				23462-111
SC	Switch, two wafer, six way				44324-816
SKTB	Socket, two pin				23421-504
SKTC	Socket, BNC 50 Ω				23443-444

Circuit ref.	Description	Code no.
T1	Transformer, matching	43514-006
TP1	Terminal, miniature	23235-176
TP2	Terminal, miniature	23235-176
TP3	Terminal, miniature	23235-176
TP4	Terminal, miniature	23235-176
VT1	Transistor, BCY 71	28435-235
VT2	Transistor, BCY 71	28435-235

STEP ATTENUATOR

Circuit ref.	Description				MI code
R1	Resistor, metal film	3.45 Ω	±0.05 Ω	¼ W	24634-026
R2	Resistor, metal film	52.1 kΩ	±1%	¼ W	24637-601
R3	Resistor, metal film	3.45 Ω	±0.05 Ω	¼ W	24634-026
R4	Resistor, metal film	6.91 Ω	±1%	¼ W	24636-051
R5	Resistor, metal film	26.1 kΩ	±1%	¼ W	24637-552
R6	Resistor, metal film	6.91 Ω	±1%	¼ W	24636-051
R7	Resistor, metal film	10.36 Ω	±1%	¼ W	24636-104
R8	Resistor, metal film	17.4 kΩ	±1%	¼ W	24637-503
R9	Resistor, metal film	10.36 Ω	±1%	¼ W	24636-104
R10	Resistor, metal film	13.8 Ω	±1%	¼ W	24636-105
R11	Resistor, metal film	13 kΩ	±1%	¼ W	24637-502
R12	Resistor, metal film	13.8 Ω	±1%	¼ W	24636-105
R13	Resistor, metal film	34.5 Ω	±1%	¼ W	24636-228
R14	Resistor, metal film	5.20 kΩ	±1%	¼ W	24637-302
R15	Resistor, metal film	34.5 Ω	±1%	¼ W	24636-228
R16	Resistor, metal film	68.8 Ω	±1%	¼ W	24636-354
R17	Resistor, metal film	2.58 kΩ	±1%	¼ W	24637-203

Circuit ref.	Description				Code no.
R18	Resistor, metal film	68.8 Ω	±1%	$\frac{1}{4}$ W	24636-354
R19	Resistor, metal film	102.6 Ω	±1%	$\frac{1}{4}$ W	24636-607
R20	Resistor, metal film	1.7 kΩ	±1%	$\frac{1}{4}$ W	24637-106
R21	Resistor, metal film	102.6 Ω	±1%	$\frac{1}{4}$ W	24636-607
R22	Resistor, metal film	135.7 Ω	±1%	$\frac{1}{4}$ W	24636-609
R23	Resistor, metal film	1.26 kΩ	±1%	$\frac{1}{2}$ W	24657-102
R24	Resistor, metal film	135.7 Ω	±1%	$\frac{1}{4}$ W	24636-609
R25	Resistor, metal film	312 Ω	±1%	1 W	24666-701
R26	Resistor, metal film	422 Ω	±1%	$\frac{1}{2}$ W	24656-701
R27	Resistor, metal film	312 Ω	±1%	1 W	24666-701
R28	Resistor, metal film	491 Ω	±1%	1 W	24666-702
R29	Resistor, metal film	121 Ω	±1%	$\frac{1}{4}$ W	24636-608
R30	Resistor, metal film	491 Ω	±1%	1 W	24666-702
R31	Resistor, metal film	563 Ω	±1%	1 W	24666-801
R32	Resistor, metal film	38.0 Ω	±1%	$\frac{1}{4}$ W	24636-229
R33	Resistor, metal film	563 Ω	±1%	1 W	24666-801
R34	Resistor, metal film	588 Ω	±$\frac{1}{2}$%	1 W	24664-801
R35	Resistor, metal film	12.0 Ω	±$\frac{1}{2}$%	$\frac{1}{4}$ W	24634-102
R36	Resistor, metal film	588 Ω	±$\frac{1}{2}$%	1 W	24666-801
SA	Switch, six wafer, eleven way				44326-213
SB	Switch, five wafer, twelve way				44326-412
SC	Switch, five wafer, twelve way				44326-412
SKTA	Socket, miniature coaxial				23441-044
SKTB	Socket, miniature coaxial				23441-044
SKTD	Socket, miniature coaxial				23441-044

Chapter 7

SERVICING DIAGRAMS

CONTENTS

CIRCUIT NOTES

Component values

1. Resistors : No suffix = ohms, k = kilohms, M = megohms.
   Capacitors : No suffix = microfarads, p = picofarads.
   Inductors : No suffix = henrys, m = millihenrys, μ = microhenrys.
   SIC : value selected during test, nominal value shown.

Symbols

2. Symbols conform to BS 3939.

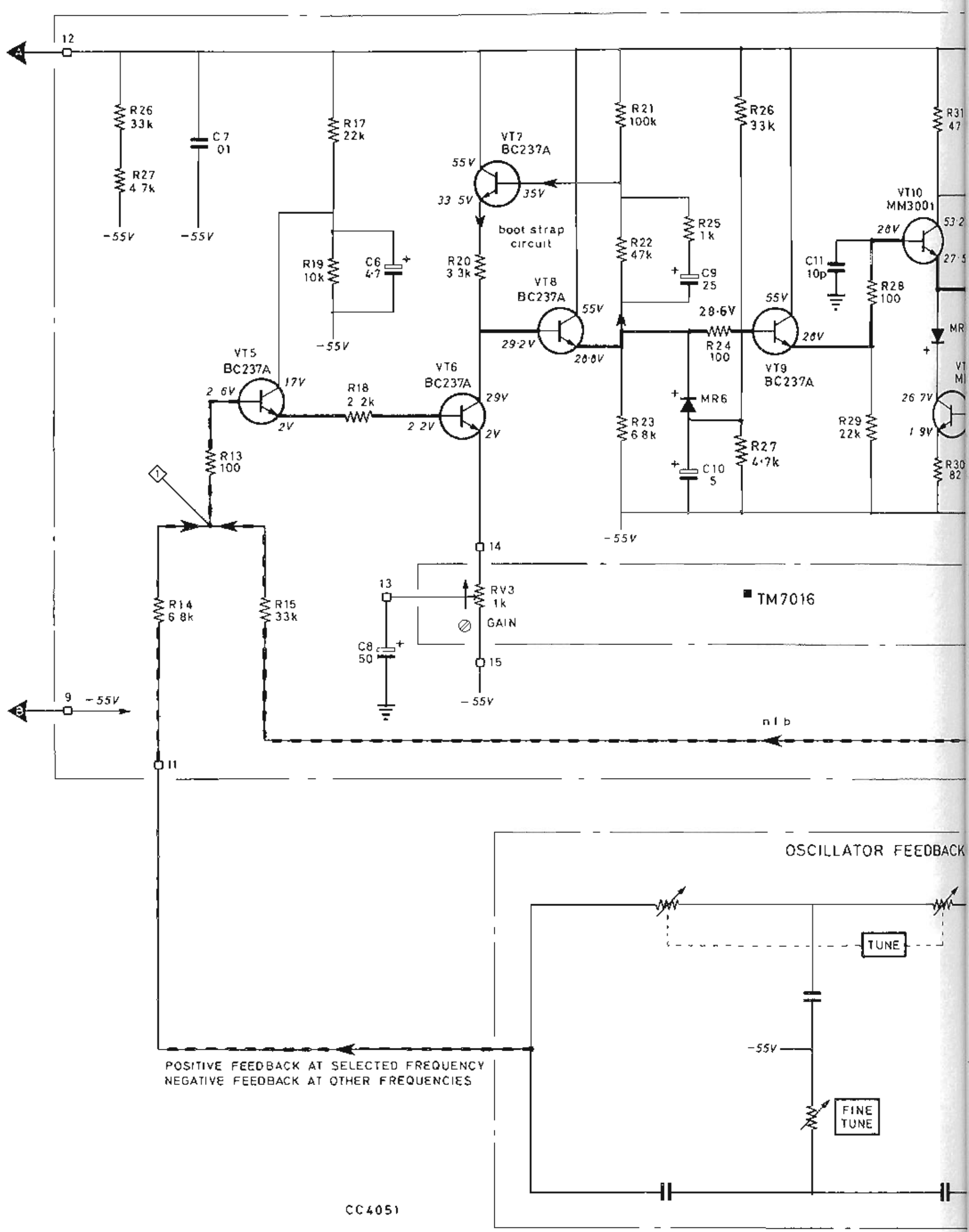
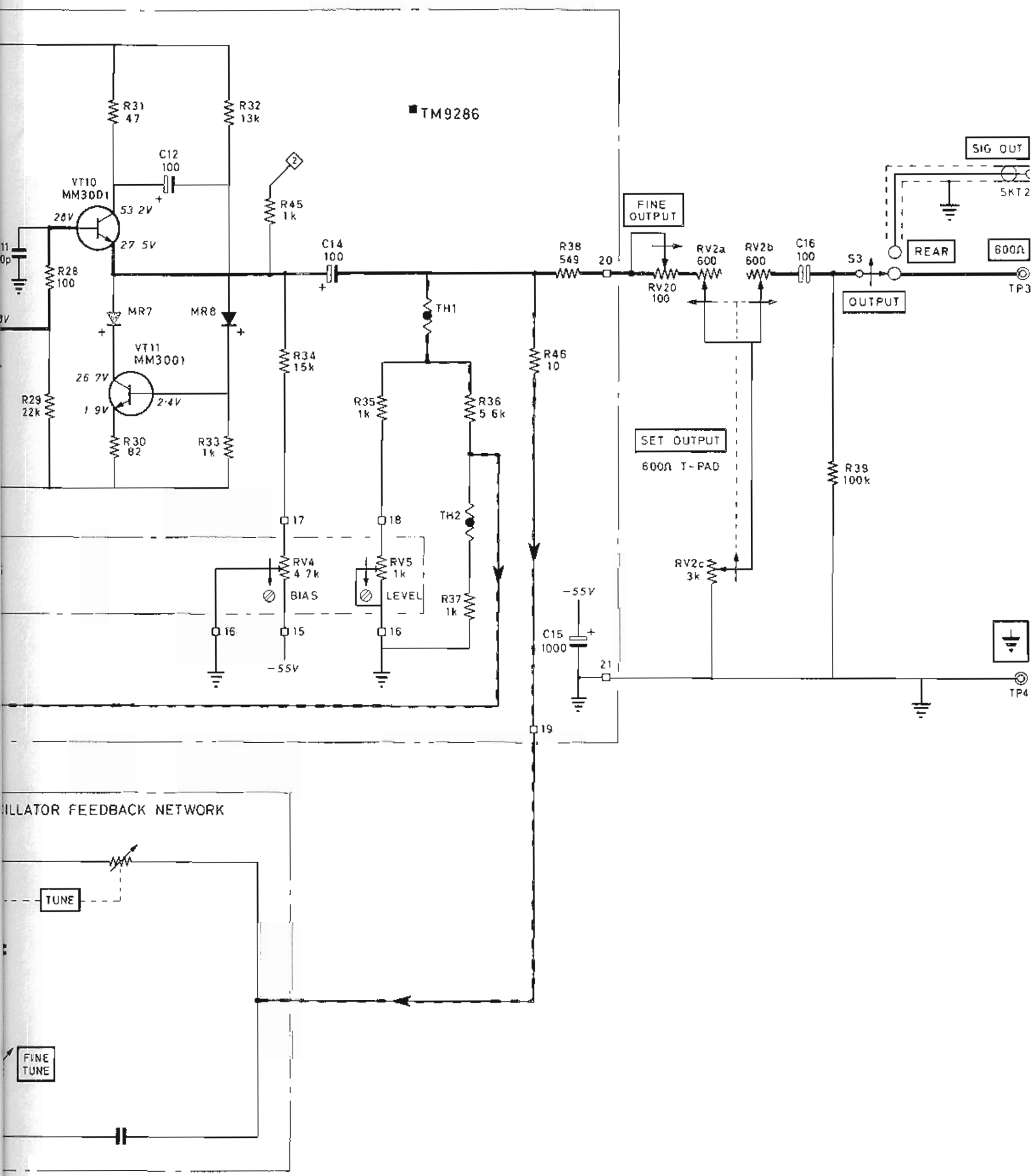


Fig. 1

Oscillator -



Oscillator - circuit

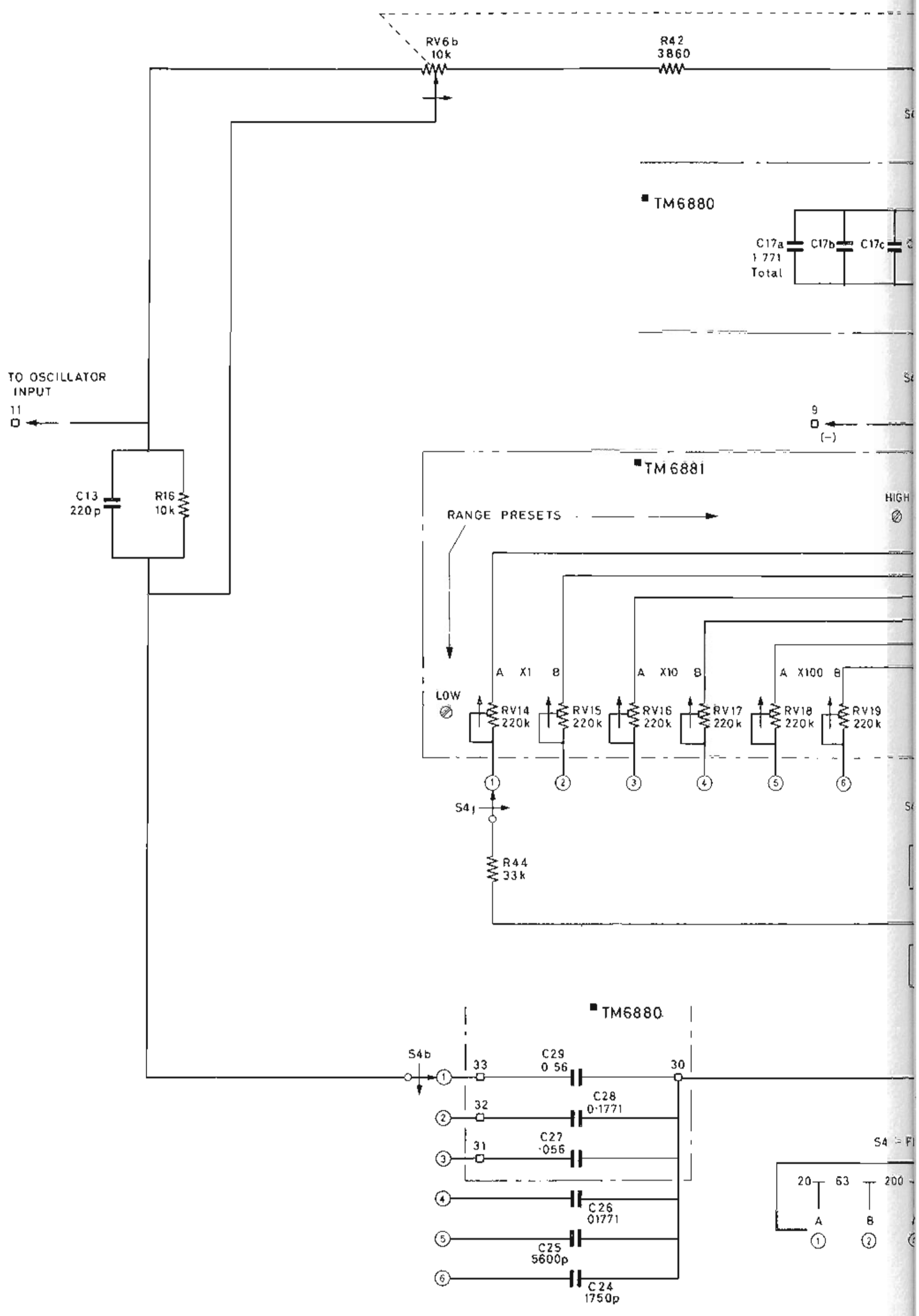


Fig. 2 Oscillator feed

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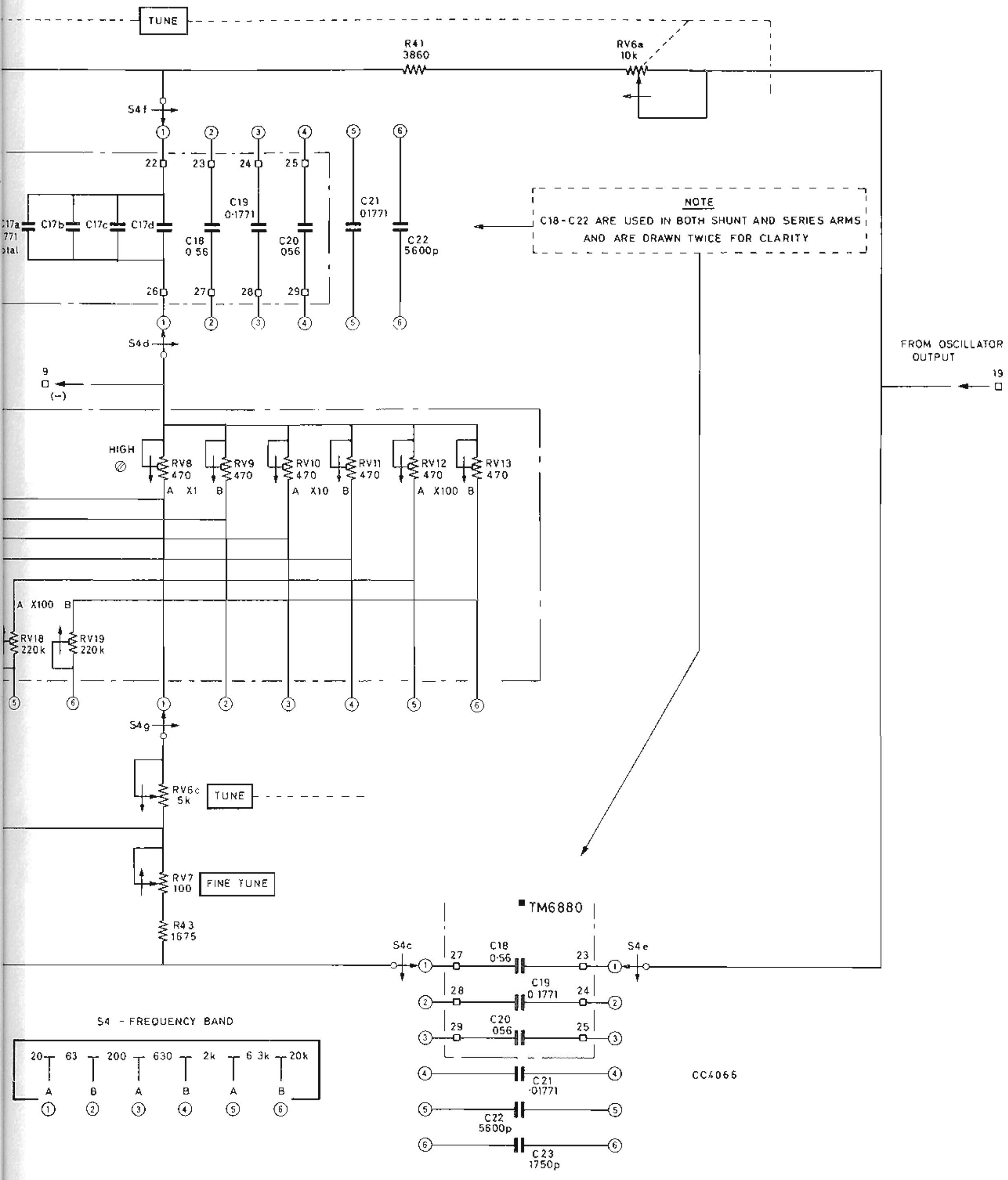

cillator feedback network - circuit

Fig. 2

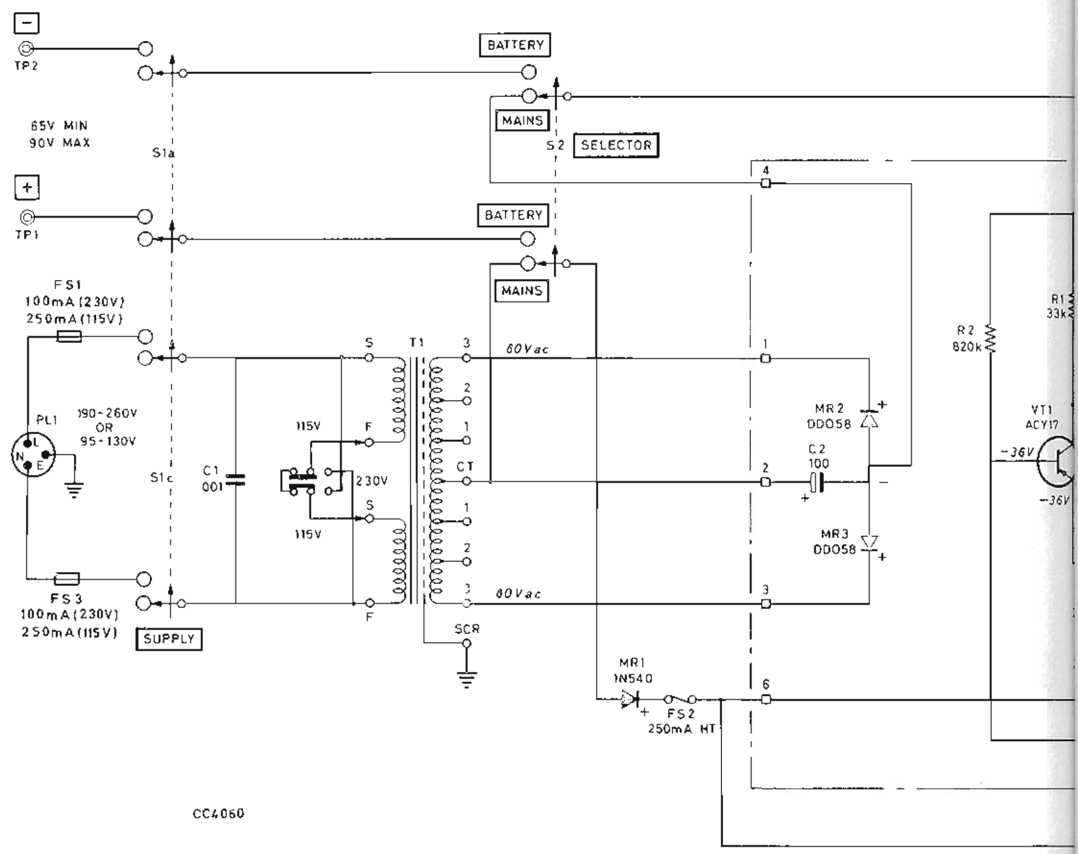

Fig. 3 Power suppl

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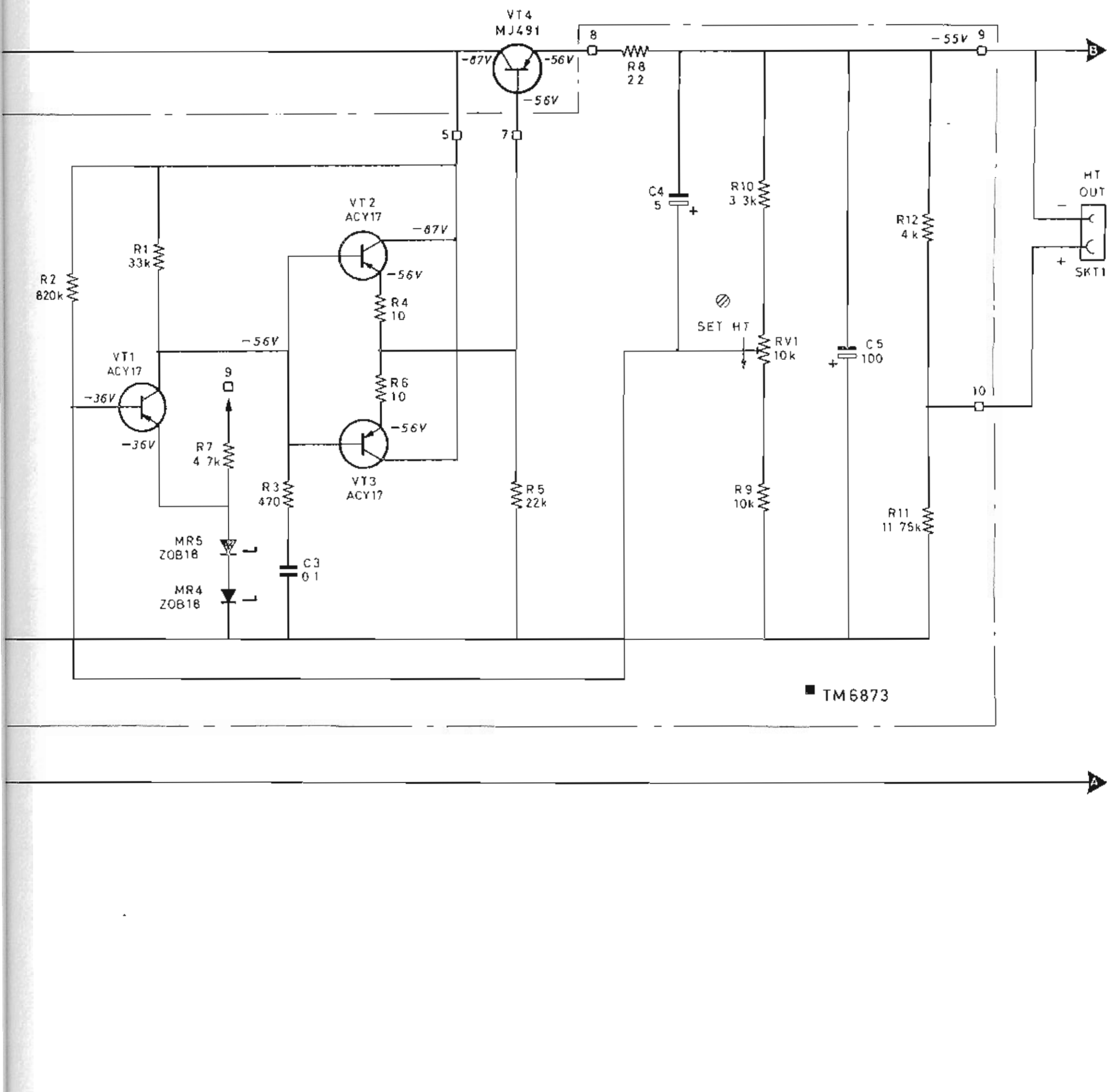
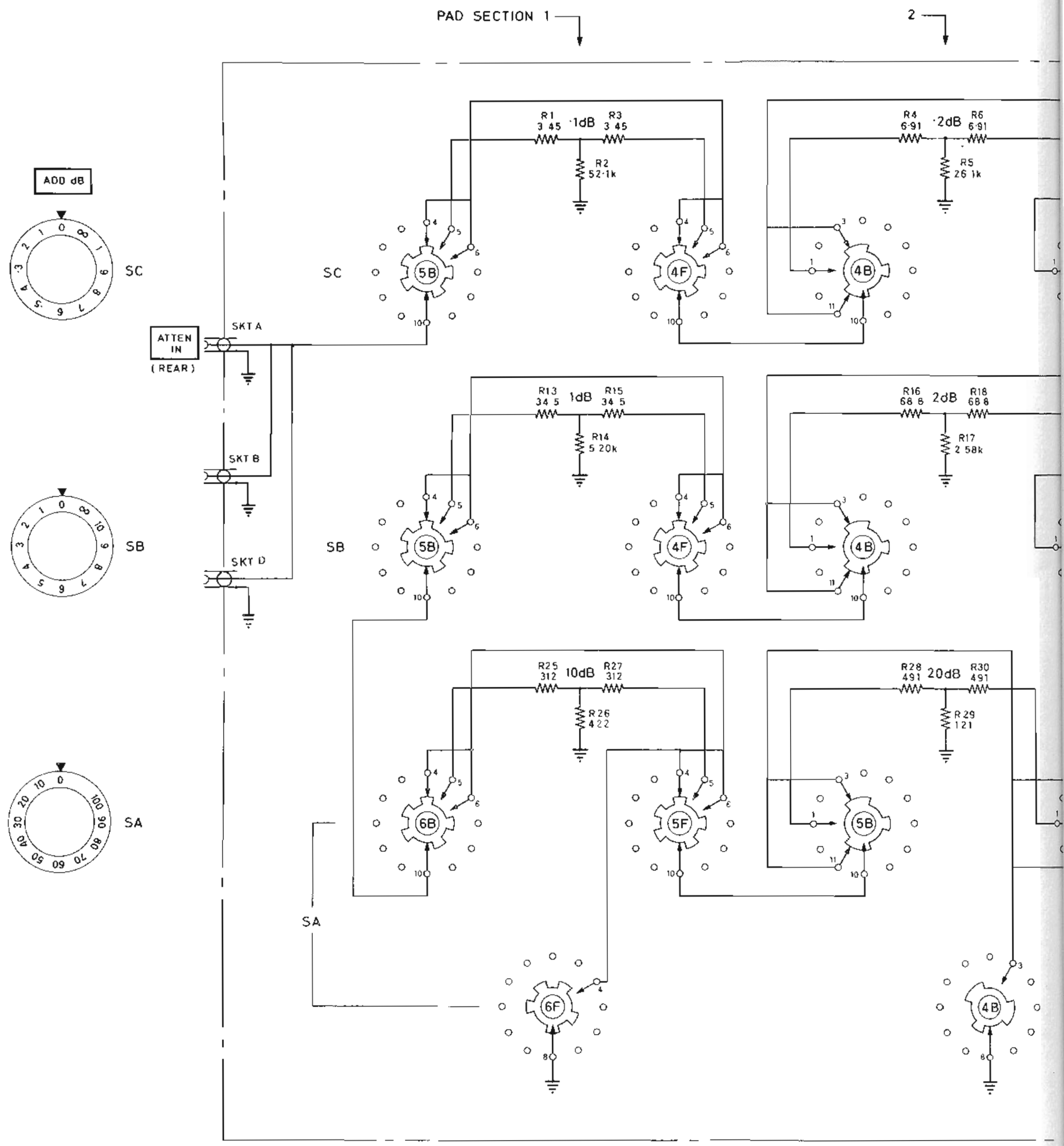


Power supply - circuit

Fig. 3

Decade step - SA, SB or SC	Pad section in circuit 1	2	3	4
0	—	—	—	—
1	T	—	—	—
2	—	T	—	—
3	T	T	—	—
4	—	—	—	T
5	T	—	—	T
6	—	T	—	T
7	—	—	T	T
8	T	—	T	T
9	—	T	T	T
10	T	T	T	T
∞	—	—	O	T

T - T SECTION
— - SHORTING LINK
O - OPEN CIRCUIT
∞ SETTING APPLIES TO SB AND SC ONLY



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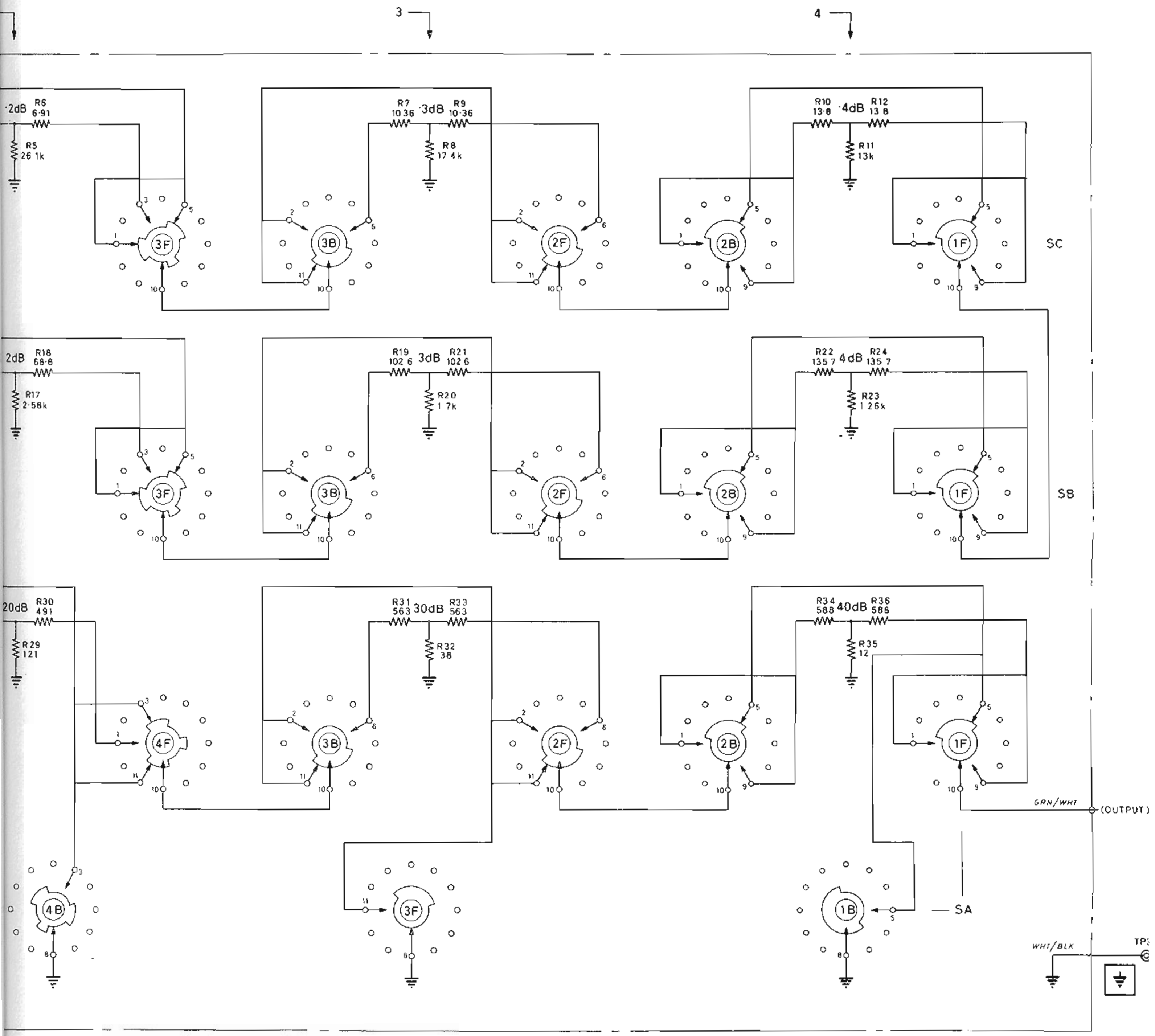

Step attenuator - circuit

Fig. 4

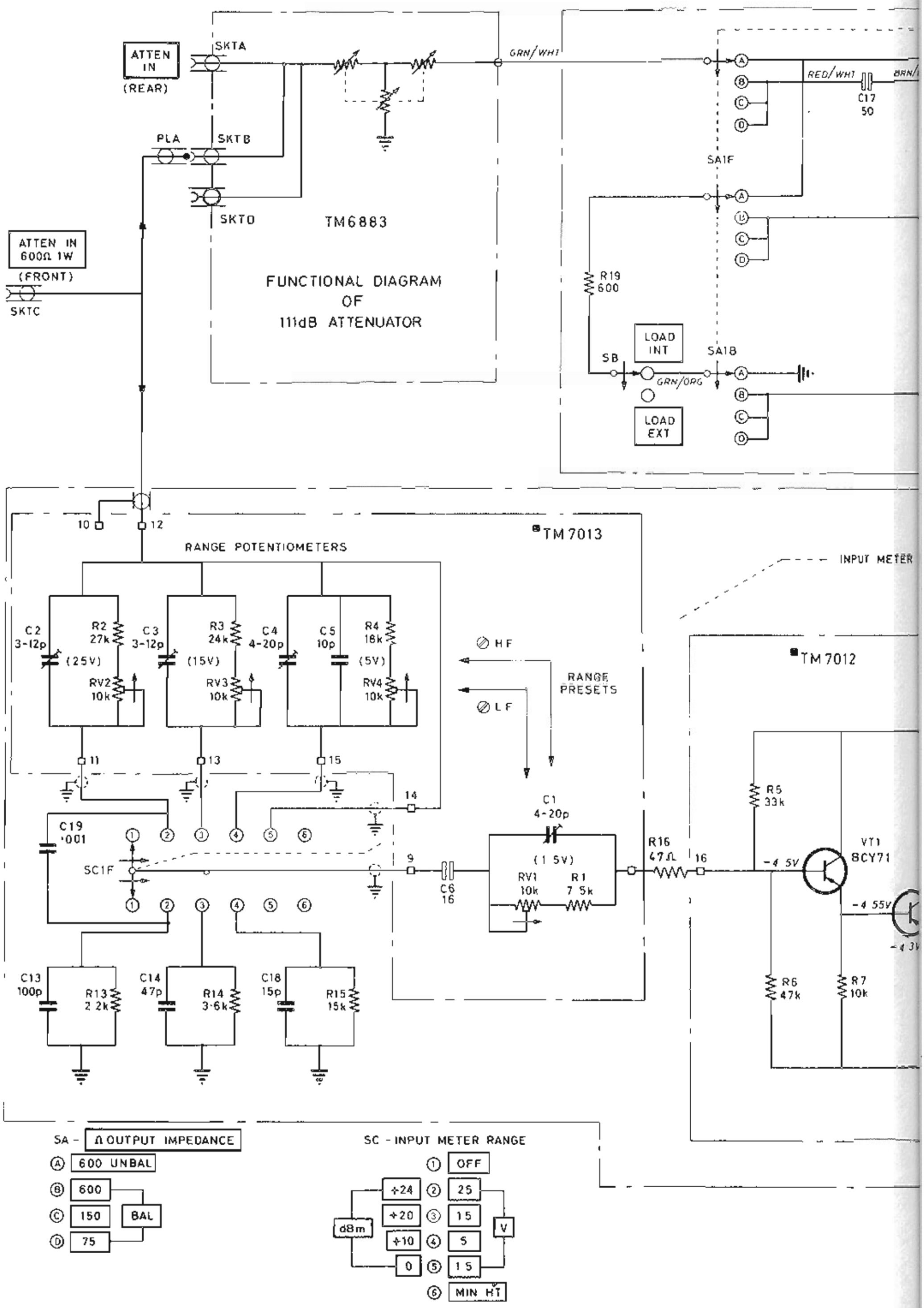

Fig. 5

Input voltmeter and outpu

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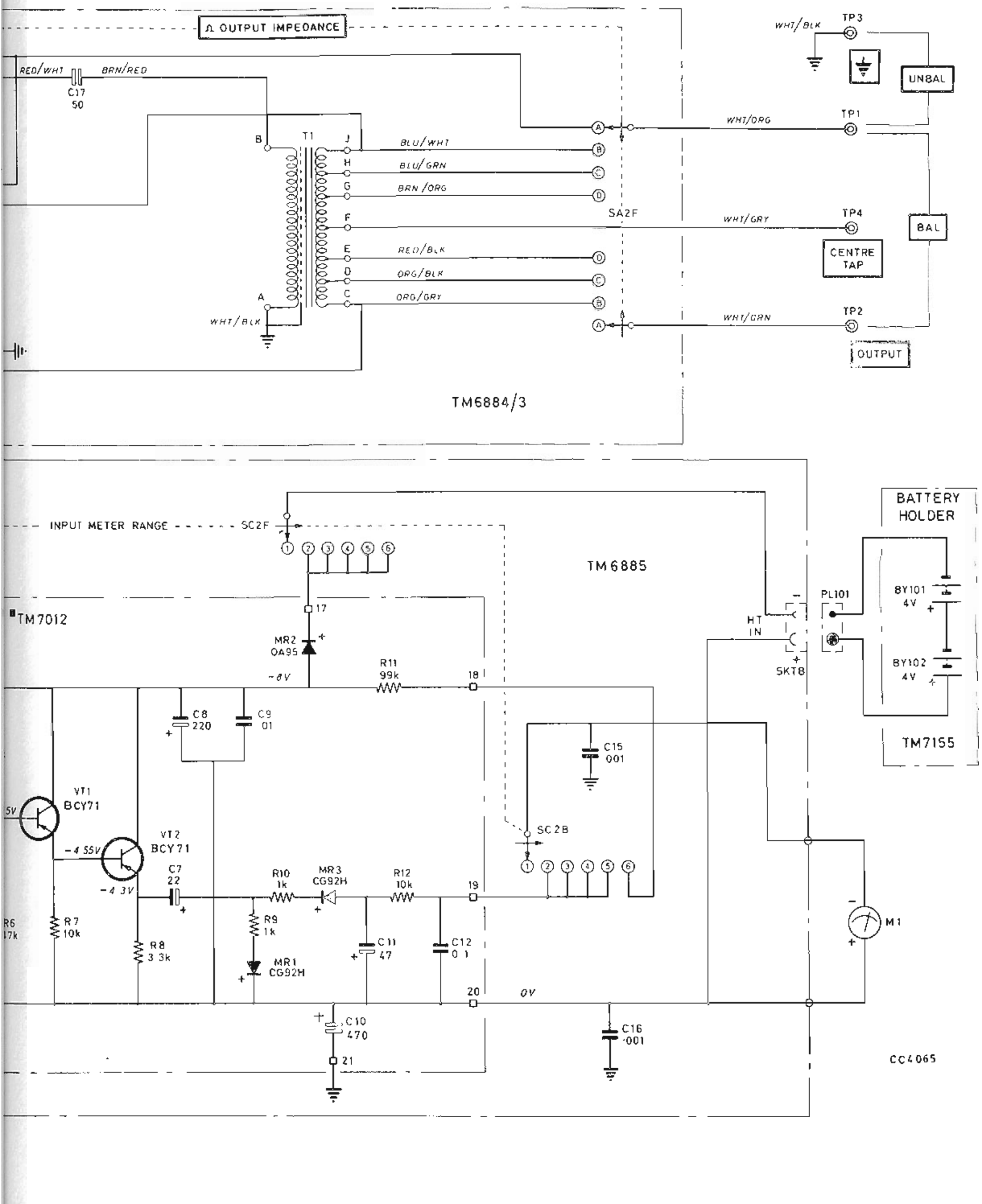

er and output matching stage-circuit

Fig. 5