MARCONI INSTRUMENTS

OM 801D/1
1* - 7/60

OPERATING AND MAINTENANCE

HANDBOOK

for

A. M. SIGNAL GENERATOR

TYPE TF 801D/1

AMENDMENTS, where applicable, are included at the end of the handbook.

Marconi Instruments Limited, St. Albans, Hertfordshire, England. Telephone : St. Albans 59292

CONTENTS

APPENDICES — Ref. No.

SCHEDULE OF PARTS SUPPLIED

The complete equipment comprises the following items :-

1. One A. M. Signal Generator Type TF 801D/1, complete with attached mains lead, and with valves, etc., as under :-

Valves:	One:	Type EA76 (5647). Diode.
	One:	Type 5R4GY, Full-Wave Rectifier.
	Two:	Type EF95 (6AK5), Pentodes.
	One:	Type 6AS6, Pentode.
	One:	Type KT66 (6L6G), Tetrode.
	One:	Type 12AT7 (ECC81), Double Triode.
	One:	Type 12AU7 (ECC82), Double Triode.
	One:	Type 5651 (85A2), Voltage Stabilizer.
	One:	Type DET22 (5861), Disk-Seal Triode.
	One:	Type QQV02-6 (6939), Double Tetrode.
Lamp:	One:	6.3-volt, 0.15-amp, M.B.C. Pilot Lamp.
Semi-conductors:	Two:	B.T.H. Type CG1-E, Germanium Diodes.
	One:	Mullard Type OC71, Junction Transistor.
	One:	B.T.H. Type CS2-A, Silicon Diode.
	Two:	Mullard Type OA202, Silicon Diodes.
Fuses:	Two:	2-amp Cartridge.
	One:	0.15-amp Cartridge.
Oscillator Crystal:	One:	5-Mc/s, Marconi Type QO 1670A.

2. Two Coaxial Free Plugs, Type N.

3. One Operating and Maintenance Handbook No. OM 801D/1.

The following items are optional accessories, supplied only if specially ordered :-

1. Output Connector (50-ohm) Type TM 4824· 36 inches long; Type N plug at both ends.

2. Output Connector (50-ohm) Type TM 4824/1; 54 inches long; Type N plug at both ends.

3. 20-dB Attenuator Pad (50-ohm) Type TM 4919; one end, Type N socket; other end, Type N plug.

4. 6-dB Attenuator Pad (50-ohm) Type TM 4919/1; one end, Type N socket; other end, Type N plug.

5. Matching Unit (50-ohm to 75-ohm) Type TM 4918: one end, Type N socket; other end, Belling-Lee Type L734/P plug.

6. Matching Unit (50-ohm) Type TM 5548· one end, Type N socket; other end, Burndept PR 4D plug.

7. Matching Unit (50-ohm to 75-ohm) Type TM 5549; one end, Type N socket; other end, Plessey Major CZ 71060 plug.

8. Matching Unit (50-ohm unbalanced to 300-ohm balanced) Type TM 4916; one end, Type N socket; other end, solder tags.

9. D. C. Isolating Unit, Type TM 4917; one end, Type N socket; other end crocodile clips.

10. Coaxial Fuse, Type TM 5753; one end, Type N socket; other end, Type N plug, 10 spare fuses are supplied.

DATA SUMMARY

TYPE TF 801D/1

Serial Nos. JA 502/001 and above

FREQUENCY

Range:	10 to 470 Mc/s in five bands.
Tuning Control:	The main dial has a total scale length of approximately 70 inches. Calibration every 2 Mc/s between 110 and 260 Mc/s; every 5 Mc/s above 260 Mc/s. The incremental dial has a uniform 0-100 calibration and makes 30 turns over each band.
Fine Frequency Control:	A separate dual-range fine frequency control allows precise frequency setting for checks on highly selective receivers.
Calibration Accuracy:	Using crystal calibrator, within ±0.2% over entire frequency range.
Resettability:	Better than ±0.1% after initial warm-up.
Crystal Calibrator:	Provides check points every 5 Mc/s over entire range. Accuracy better than 0.01% at normal ambient temperatures. Cursor on main dial adjustable to allow standardization of calibration.
Frequency Stability:	After warm-up, drift is not greater than 0.005% in a 10-minute period at ambient temperatures between 15 and 35°C. Following band-switching, a further stabilizing period is required.

R.F. OUTPUT

Level:	0.1 µV to 1 volt source e.m.f. Attenuator dial shows source e.m.f. in voltage units and in decibels relative to 1 µV, power in decibels relative to 1 mW in 50 ohms, and power relative to thermal noise in a 10-kc/s bandwidth.

DATA SUMMARY (continued)

Voltage Accuracy:	±1 dB overall for c.w. outputs up to 0.7 volt e.m.f. Level during mark periods of pulse modulation is within ±2 dB of corresponding c.w. output. Automatic level control stabilizes output during tuning.
Source Impedance:	50 ohms; v.s.w.r. not greater than 1.2.
Stray Radiation:	Negligible; permits receiver sensitivity measurements down to 0.1 µV.

MODULATION

Internal Sine A.M.:	Modulation frequency: 1,000 c/s ±10%. Depth monitored and variable up to 90% at carrier levels of 1 mW and below.
External Sine A.M.:	Modulation frequency range: 30 c/s to 20 kc/s. Modulation depth as for internal. Input requirements for 90% modulation: 1 to 5 volts, depending on carrier frequency, across 1 MΩ.
Modulation Monitor Accuracy:	±10% of full-scale.
Envelope Distortion:	Less than 5% at 30% internal modulation; less than 10% at 50% modulation.
External Pulse Modulation:	Recurrence frequency range: 50 c/s to 50 kc/s. Minimum pulse width varies between 1 µsec at 470 Mc/s and 10 µsec at 10 Mc/s. Combined rise and decay time less than 4 µsec from 40 to 260 Mc/s; and less than 1 µsec from 260 to 470 Mc/s, Carrier suppression at least 20 dB below peak pulse output. Input requirements: positive pulses of 50 volts across 1 MΩ.

DATA SUMMARY (continued)

Incidental F. M. on A. M. :	Deviation less than 0.001% of carrier frequency at 30% a.m.
Residual A. M. :	The a.m. due to hum and noise is better than 40 dB below 30% modulation.
POWER SUPPLY:	180 to 250 volts, or 100 to 150 volts after adjusting internal links: 40 to 100 c/s; 100 watts. Fuses in both mains and h.t. circuits. Filament regulation stabilizes oscillator frequency against mains voltage variation.

DIMENSIONS & WEIGHT:

Height	Width	Depth	Weight
14½ in	23½ in	10½ in	67 lb
(37 cm)	(60 cm)	(27 cm)	(31 kg)

1 DESCRIPTION

The Marconi A. M. Signal Generator Type TF 801D/1 provides c.w., sine a.m. and pulsed outputs in the frequency range 10 to 470 Mc/s. The output level is monitored and continuously variable from 0.1 μV to 1 volt e.m.f. The attenuator dial shows source e.m.f. in voltage units and in decibels relative to 1 μV, power in decibels relative to 1 mW, and power relative to thermal noise in a 10-kc/s bandwidth.

The main tuning dial is calibrated directly in frequency, and an incremental frequency dial - driven from the tuning control - allows accurate interpolation between the main dial markings. An uncalibrated fine trimmer control is also provided for very fine tuning over a small range, at any frequency.

A moveable cursor enables the frequency dial to be standardized throughout the tuning range against check points provided at 5-Mc/s intervals by a built-in crystal calibrator. To minimize the need for resetting the r.f. amplifier tracking control during tuning, an automatic level-control system is incorporated.

As well as conventional h.t. stabilization, there is a transductor-stabilized heater supply to the master oscillator valve; this is incorporated to ensure that mains variation has negligible effect on output frequency.

2 OPERATION

2.1 INSTALLATION

Unless otherwise specified, the Signal Generator is normally despatched with its valves in position, and its mains input circuit adjusted for immediate use with 240-volt mains supplies. The instrument can be adjusted for operation from any supply voltage within the ranges 100 to 150 volts and 180 to 250 volts at mains supply frequencies between 40 and 100 c/s. To check or alter the settings of the mains transformer tappings, reference should be made to Section 5.4.

2.2 PRELIMINARY ADJUSTMENTS

BEFORE SWITCHING ON, be sure that the instrument is correctly adjusted to suit the particular mains supply to which it is to be connected; then proceed as follows :-

(1) Connect the mains lead - which is stowed, when not in use, in the left hand case-handle recess - to the mains supply socket.

(2) Check that the NORMAL/HIGH OUTPUT switch is set to NORMAL.

(3) Switch ON by means of the mains supply switch - the red pilot lamp should glow.

(4) Before proceeding further, switch to the frequency band required - see (3) of Section 2.3, which follows - and allow the instrument to obtain thermal equilibrium. A warm-up period of about 15 minutes only is required for most applications; but for the full-rated stability, allow 3 hours.

2.3 TUNING THE INSTRUMENT

The carrier-frequency range of the Signal Generator is covered in five bands, which are as follows :-

2.3 (continued)

Band	Frequency Range
A	10 - 22 Mc/s
B	22 - 48 Mc/s
C	48 - 110 Mc/s
D	110 - 260 Mc/s
E	260 - 470 Mc/s

On Range E, the frequency scale is in fact calibrated down to 220 Mc/s and reduced r.f. outputs are available down to this frequency.

It should be noted, however, that considerable restriction of the full rated output, and increased spurious f.m. on a.m., may be experienced between 220 and 260 Mc/s; range D should therefore be used in most cases, except possibly when it is inconvenient to change bands and a reduced r.f. output is acceptable.

To obtain the required output frequency:

1) Check that the small red spot on the rim of the frequency dial transparent cover is in line with the yellow spot on the rim of the spun metal dial-housing. If the two spots are not in visual alignment, rotate the dial cover to obtain this condition. This operation sets the cursor to its nominally correct position. The precise position of the cursor for maximum accuracy at any point on the frequency dial can be verified by crystal-checking as described in Section 2.3.2.

2) Pull out the FREQ. TRIM knob, and set it to its mid-position.

3) Select the required bands by means of the RANGE switch. To change from one band to another, rotate this control through one-and-a-fifth turns per band until the mechanism locates positively with the knob pointing to the required band. The knob may be turned in either direction as convenient.

   NOTE: Following a band change, a frequency restabilizing period of 10 to 15 minutes is recommended where high stability is required.

4) Turn the frequency control until the required frequency is indicated on the main tuning dial. Using the central hairline on the transparent cursor, read the main tuning dial on the calibration arc appropriate to the band selected.

2.3.1 The Incremental Dial

The frequency control knob is fitted with a small incremental dial which is calibrated linearly from 0 to 100 over its whole circumference. The control knob makes approximately 25 revoluations as the main dial is turned through its complete calibrated angle of rotation.

The incremental dial can be used to sub-divide linearly any portion of the frequency cover on any band. This facility is very useful when making bandwidth or similar measurements.

First, the relationship must be determined between (i) movement of the incremental dial through one division, and (ii) the corresponding change in frequency. Tuning through one division of the incremental dial is, at the centre of each band, equivalent to a frequency-change of the following order :-

5 kc/s on Band A
10 kc/s on Band B
25 kc/s on Band C
50 kc/s on Band D
100 kc/s on Band E

It will be appreciated that, since the main tuning dial on each Signal Generator is individually calibrated, the above figures can only be regarded as typical. It follows that the relationship between the frequency-change and the incremental dial reading should be individually determined by the user - in the manner outlined below - on the particular Signal Generator he is using.

To determine the change in frequency for a one-division change in incremental dial reading, proceed as follows :-

1) Set the main tuning dial to some convenient whole number of Mc/s or at near the centre of the band to be subsequently used.

2) Holding the frequency control knob firmly to prevent the frequency dial from moving, rotate the 0-100 incremental dial relative to the frequency control knob so that its 0 is indicated by the cursor.

3) Starting with the main dial indicating the frequency chosen in (1) above, and with the incremental dial reading 0, turn the frequency control until the reading on the main dial changes by a whole number of Mc/s.

2.3.1 (continued)

4) From (a) the difference in frequency between the starting point chosen in (1) and finishing point chosen in (3),

and (b) the total number of incremental divisions traversed in tuning from one point to the other on the main tuning dial.

calculate the frequency change per division of the incremental dial; this change may be conveniently expressed in kc/s per division.

The law of the main tuning dial is substantially linear with respect to frequency. Where any departure from this law occurs, it will almost invariably be in the upper quarter of each of the five frequency bands of the Signal Generator. For general working over the lower three-quarters of each of the frequency bands it will be found that once the relationship between the frequency change and change in incremental dial reading has been established at one point near the centre of each band, the figures can be used over the whole of the lower three-quarters of their respecive bands.

When working within the upper quarter of any band, or when the highest accuracy is required at any part of the band, the relationship should be determined separately for the particular section of the frequency band over which the incremental variations are to be made.

2.3.2 Crystal Check

The frequency calibration accuracy of the Signal Generator can be maintained by using the built-in crystal calibrator; this provides check points at intervals of 5 Mc/s over the entire range of the instrument, and subsidiary check points at $2\frac{1}{2}$-Mc/s intervals on Band A.

To make use of this facility, proceed as follows :-

1) Set the frequency dial to the nearest multiple of 5 Mc/s (or $2\frac{1}{2}$ Mc/s on Band A) to the frequency at which it is desired to carry out the check. Set the MODULATION switch to OFF.

2) Plug high-resistance headphones into the PHONES socket on the front panel; this action automatically switches on the h.t. supply to the crystal calibrator. A beat note should be heard in the headphones; adjust the CALIBRATOR GAIN control as necessary.

2.3.2 (continued)

3) Gently rotate the frequency control to locate the zero-beat point. For maximum accuracy of zero-beat, swing the frequency dial through the null point once or twice to find the exact centre between the two low-frequency cut-off points.

4) Ascertain that the frequency chosen for checking (a multiple of 5 Mc/s) is aligned with the cursor. If it is not, rotate the whole frequency dial cover and cursor to achieve alignment.

NOTE: To avoid the possibility of incorrect interpretation of crystal 'pips' at the higher frequencies on Band E it is advisable to calibrate initially at 260 Mc/s and crystal check through the scale up to 485 Mc/s.

2.3.3 Frequency Trim Control

This control (C39) is incorporated to allow a small frequency excursion to be made at any part of the main frequency dial. The control can be used where, for example, bandwidth measurements are being carried out on narrow-band receivers, etc. The control knob has two main positions :- pulled out, in the FINE position, for very small changes of frequency, and pushed in where the frequency variation is slightly greater. Positions intermediate between fully in and fully out may be used to provide varying degrees of control.

At the high frequency end of the top band, only the FINE position of the FREQ. TRIM control is normally used.

NOTE: The instrument is calibrated over its entire frequency range with the FREQ. TRIM control fully out and correctly centred.

2.4 SETTING UP FOR CONTINUOUS WAVE OR MODULATED OUTPUT

The Signal Generator includes facilities for providing the following types of output :-

1) Continuous Wave.

2) Sinewave Modulated :-
   (a) from the internal 1,000-c/s oscillator.
   (b) from an external source operating within the frequency range 30 c/s to 20 kc/s.

3) Pulse modulated from an external source.

4) Squarewave modulated from an external source.

2.4 (continued)

Sections 2.4.1 to 2.4.4 which follow, detail the different setting-up procedures required to produce the various types of r.f. output listed above. For most applications of the instrument, the NORMAL/HIGH switch should be used in its NORMAL position, and the carrier level adjusted as described below. Under these conditions, c.w. outputs of between 0.1 µV and 0.7 volt. e.m.f. are obtainable, and modulation depths up to 90% can be obtained with carrier levels up to 0.46 volt e.m.f. (0 dBm), although at certain frequencies it may be necessary to use the HIGH position of the NORMAL/HIGH switch.

Outputs greater than 0·7 volt can be obtained - see Section 2.5.3 for details.

2.4.1 <u>Continuous Wave</u>

1) Set the MODULATION switch to OFF.

2) Tune to the required carrier frequency - see Section 2.3. TUNING THE INSTRUMENT.

3) Set the ATTENUATOR dial to indicate the required open-circuit output voltage. For outputs in excess of the maximum dial indication, see Section 2.5.3.

4) Adjust the SET CARRIER control to produce a small deflection on the CARRIER LEVEL meter; if no reading is obtained on the meter, turn the SET CARRIER control to a point approximately three-quarters of the way to its maximum clockwise setting.

5) Carefully tune the PEAK CARRIER control for maximum reading on the CARRIER LEVEL meter; if necessary, readjust the SET CARRIER control to keep the pointer of the CARRIER LEVEL meter on the scale.

NOTE: Due to the action of the Automatic Level Control system, some difficulty may be encountered when attempting to peak the amplifier accurately. If, therefore, accurate peaking is required, set the MODULATION switch to INT. and peak for maximum indication on the MODULATION meter.

6) Finally, adjust the SET CARRIER control to bring the pointer of the CARRIER LEVEL meter to the red SET CARRIER line.

2.4.2 Sinewave Modulation

(a) From the Internal 1,000-c/s Oscillator

(i) Set the MODULATION switch to INT.

(ii) Tune the Signal Generator and peak the output at the required carrier frequency in a manner similar to that described for c.w.

(iii) Adjust the SET MODULATION control to give the required percentage depth as indicated on the MODULATION meter.

(iv) If necessary, readjust the SET CARRIER control to maintain the CARRIER LEVEL meter reading at the SET CARRIER mark.

(b) From an External Source

(i) Set the MODULATION switch to EXT. SINE.

(ii) Connect the external source to the EXTERNAL MOD. terminals marked SINE and E. The permissible modulation frequency range is 30 c/s to 20 kc/s.

(iii) Tune the Signal Generator and peak the output at the required carrier frequency in a manner similar to that described for c.w.

(iv) Adjust the level of the input from the external source to give the required modulation depth as indicated on the MODULATION meter.

(v) If necessary, readjust the SET CARRIER control to maintain the CARRIER LEVEL meter reading at the SET CARRIER mark.

For minimum f.m. on a.m. at frequencies above 350 Mc/s, it may be helpful to put the NORMAL/HIGH switch to HIGH and to avoid using the attenuator at settings near to maximum output.

2.4.3 External Pulse Modulation

For this type of operation with the MODULATION switch set to EXT. PULSE, the grids of the r.f. amplifier valve are d.c. coupled to the EXTERNAL MOD. PULSE input socket. With no input signal applied to the PULSE inlet, the Signal Generator gives a normal c.w. output.

A positive-going pulse input signal can be used to produce the usual type of pulse modulated output, where the 'on' period is the duration of the pulse. The following procedure is applicable to pulses having a pulse length of up to 100 μsec and a duty cycle that does not exceed 5% (see table below).

Pulse length in μsec.	100	50	25	10	5	1
Max. p.r.f.'s c/s.	500	1000	2000	5000	10,000	50,000

(a) With no input signal applied to the PULSE input socket, set the MODULATION switch to EXT. PULSE.

(b) Tune to the required carrier frequency.

(c) Set the ATTENUATOR to the desired reading at the appropriate cursor line marked PULSE in yellow. For details see Section 2.5.

(d) Carefully tune the PEAK CARRIER control for a maximum reading on the CARRIER LEVEL meter, and turn the SET CARRIER control fully clockwise.

(e) Adjust the SET CARRIER PULSE control to bring the pointer of the CARRIER LEVEL meter back to the red SET CARRIER mark.

(f) Apply the pulse via a blocking capacitor of a large value, such that its time constant, in conjunction with the internal resistance of 1 MΩ presented at the PULSE socket, is large compared with the periodic time of the pulse signal.

NOTES

(a) The NORMAL/HIGH switch becomes inoperative during pulse operation.

2.4.3 (continued)

(b) When the pulse applied has a very short pulse length and very low p.r.f. it may be that an increased deflection appears on the SET CARRIER meter. If this is so, turn the SET CARRIER control anticlockwise until the meter indication no longer decreases. This setting will ensure that the best suppression is being obtained without deterioration of the pulse shape.

(c) The SET CARRIER PULSE control (RV10) is a special potentiometer, which is wound with graded wire to achieve a desired wattage/rotation characteristic. Due to the nature of the resultant stepped tracking surface, at one point on its travel a certain coarseness may be experienced during rotation.

2.4.4 External Squarewave Modulation

If a squarewave of unity mark-space ratio is applied to the PULSE input socket, the mean level of the carrier, which is 'on' during the positive periods, is reduced by half, with corresponding reduction in the CARRIER LEVEL meter reading. With the meter deflection set up to the SET CARRIER mark by means of the SET CARRIER control, and the SET CARRIER PULSE control turned fully clockwise the output level is such that the r.m.s. voltage during the 'on' period is equal to twice the voltage indicated on the attenuator dial against the appropriate C.W. cursor line. For details see Section 2.5.

The procedure is as follows :-

(a) Turn the SET CARRIER PULSE control fully clockwise.

(b) Adjust the ATTENUATOR PEAK CARRIER and SET CARRIER controls as for C.W. operation.

(c) Apply the modulating source via a suitable blocking capacitor, unless the squarewave is completely negative-going with respect to zero. This capacitor should have a value such that its time constant, in conjunction with the 1-MΩ input resistance, is large compared with the periodic time of the squarewave.

2.5 R.F. OUTPUT ARRANGEMENTS

For consideration of its output circuit, the Signal Generator should be regarded as a zero-impedance voltage generator in series with a resistance of 50 ohms. This condition is shown diagrammatically in fig. 1 of Drawing No. TLC 28189, which follows page 22. In the diagram, E is the source e.m.f., R_C is the source resistance of the Signal Generator, Z_L is the load impedance, and V_L is the voltage actually developed across the load.

The value of V_L is given by the expression :-

$$V_L = E \times \frac{Z_L}{R_O + Z_L}$$

The ATTENUATOR dial has four scales as follows :-

(i) The dBµV scale, calibrated from -20 to +117 indicates the output e.m.f. in decibels relative to 1 µV.

(ii) The e.m.f. scale, calibrated in units of voltage from 0.1 µV to 0.7 volt, indicates the e.m.f. directly.

(iii) The dBm scale, calibrated from -130 to +4 indicates the power delivered to an external 50-ohm load in terms of decibels relative to 1 mW.

(iv) The fourth and inner scale, calibrated from 0 to +70, indicates the power output to an external load in decibels relative to thermal noise for a noise-bandwidth of 10 kc/s. (The technique for applying this scale is discussed in Section 2.5.4.)

With the appropriate set carrier control adjusted to bring the pointer of the CARRIER-LEVEL meter to the SET CARRIER mark, the ATTENUATOR scales are direct reading, each in its particular units as described above. For outputs greater than the maximum attenuator calibration (i.e. 0.7 volt), see later Section 2.5.3.

The transparent cursor fitted to the attenuator dial of the TF 801D/1 has two pairs of engraved hairlines; one pair is marked E.M.F. (Zo = 50 Ω) the other pair being marked VOLTS IN 50 Ω.

2.5 (continued)

The E.M.F. (Z_o = 50 Ω) cursor lines indicate the output level in terms of source e.m.f. (E in fig. 1 of Drawing Number TLC 28189), while the other pair - inclined at an angle corresponding to a 6-dB movement of the attenuator dial - indicate the output level in terms of p.d. across a 50-ohm external load (V_L in fig. 1 of Drawing Number TLC 28189).

The yellow cursor lines of each pair are used only when the modulation switch is set to EXT. PULSE.

2.5.1 Output Accessories (Supplied only to special order)

Output Connector Type TM 4824. This is a 50-ohm coaxial lead 36 inches long, fitted at either end with a standard type N free plug (United States, Military No. UG-21 B/U; Great Britain, Transradio Ltd., type GE.071). These plugs mate with either a standard type N free socket (United States Military No. UG-23B/U Great Britain, Transradio Ltd., type 6.043) or a panel mounting type N socket (United States, Military No. UG-22 B/U; Great Britain, Transradio Ltd., type DE.071).

Output Connector Type TM 4824/1. Similar to Output Connector Type TM 4824 above but 54 inches long.

20-dB Attenuator Pad Type TM 4919. This is a conventional π-section attenuator pad with 20-dB insertion loss. The input resistance and output resistance are each 50 ohms. The applications of this Pad are dealt with in Section 2.5.2(a) which follows. It is fitted with a type N socket at its input end and a type N plug at its output end.

6-dB Attenuator Pad Type TM 4919/1. This Pad has an insertion loss of 6 dB but is otherwise similar in every way to the 20-dB Pad Type TM 4919.

50-ohm to 75-ohm Matching Unit Type TM 4918. For details of the electrical action of this unit, refer to Section 2.5.2(c). When fitted, it converts the effective source impedance of the Signal Generator from 50 ohms to 75 ohms. The Matching Unit is fitted with a type N socket at its input end and a Belling-Lee Ltd. plug type L734/P at its output end, this plug mates with a Belling-Lee Ltd. free socket type L734/J or panel-mounting socket type L604/S.

2.5.1 (continued)

50-ohm to 75-ohm Matching Unit Type TM 5548. This is similar to Matching Unit Type TM 4918 but is fitted at its output end with a Burndept PR 4D plug.

50-ohm to 75-ohm Matching Unit Type TM 5549. This is similar to Matching Unit Type TM 4918 but is fitted at its output end with a Plessey Major CZ 71060 plug.

50-ohm to 300-ohm Unbalanced to Balanced Transformer Type TM 4916. The electrical action of this unit is described in Section 2.5.2(d), and it is used when the Signal Generator output is applied to a balanced-winding input citcuit. The unit gives a line-to-line source impedance of 300 ohms. It contains resistive elements only and is not suitable for matching into a balanced input circuit which is not in the form of a winding. It is fitted with a type N socket at its input end and solder tags at its output end.

D.C. Isolating Unit Type TM 4917. This unit contains a 300-volt working 0.001-μF capacitor connected in series with the output line so that the Signal Generator may be connected to a point of high d.c. potential on the equipment under test. The Isolating Unit is fitted with a type N socket at its input end and two crocodile clips at its output end.

Coaxial Fuse, Type TM 5753. This unit prevents damage to the Signal Generator attenuator through accidental application of r.f. or h.t. power to the circuit under test. This is particularly useful in transmitter/receiver testing. Details :-

Overload Protection:	Burns out at 0.4 watt.
Insertion Loss:	Nominally 0.5 dB.
V.S.W.R.:	1.35 or less when terminated with a matched 50-ohm load. 1.6 or less when terminated with TF 801D/1 attenuator.
Connectors:	Type N plug to Type N socket.
Fuse:	1/16 amp, Littelfuse Cat. No. 361.062. 10 spares are supplied.
Dimensions:	Length, 4 7/8 in; diameter 13/16 in.

2.5.2 Coupling to the Equipment Under Test

The output impedance of the Signal Generator is nominally equal to the characteristic impedance of the Output Lead TM 4824. This cable may therefore be regarded as correctly terminated at its input end; therefore, the possibility of serious errors in the apparent e.m.f. caused by standing waves on the cable can generally be neglected even when the input impedance of the equipment under test is not equal to 50 ohms.

However, it is often important for other reasons that the source impedance is accurately matched to the load, or that it has a particular known value not equal to 50 ohms. Under these circumstances, the effective output impedance of the Signal Generator can be altered to the required value by the addition of various resistive networks. The paragraphs which follow give details of the methods of coupling the Signal Generator via a selection of impedance-correcting networks.

(a) Coupling from the 50-ohm Source

When the equipment under test has an input impedance other than 50 ohms and it is important that the signal is derived via a 50-ohm resistive source impedance, it is advisable, if the insertion loss can be tolerated, to couple the Output Lead to the equipment via the 50-ohm 20-dB Attenuator Pad.

With the Pad in circuit, the possibility of error in apparent e.m.f. or effective output impedance due to standing waves is avoided becuase it is impossible to mis-match the cable seriously - variations in the load impedance from zero to infinity cause the effective line-terminating resistance to depart from its correct value by only 1 ohm approximately.

Fig. 2 on Drawing No. TLC 28189 (following page 22) shows diagrammatically the effect of connecting the Pad into circuit. The final output conditions are equivalent to those of a zero-impedance generator producing an e.m.f. equal to E/10 in series with a resistance, R_{EO}, of 50 ohms. The p.d. across the load can, of course, be calculated in the usual way and is equal to :

$$\frac{E}{10} \times \frac{Z_L}{R_{EO} + Z_L}$$

2.5.2 (continued)

where E is the e.m.f. indicated on the ATTENUATOR dial,

R_{EO} is the effective source resistance of the Signal Generator (50 ohms),

and Z_L is the input impedance of the equipment under test.

If, however, the insertion loss of the 20-dB pad cannot be tolerated, the 6-dB Attenuator pad may be used instead. Although this pad does not isolate the Signal Generator impedance from the load to the same degree as its 20-dB counterpart, it will usually be effective enough for all normal applications.

The final output conditions with the 6-dB pad connected are equivalent to those of a zero-impedance generator producing an e.m.f. equial to E/2 in series with a resistance of 50 ohms. The p.d. across the load is, of course, equal to :

$$\frac{E}{2} \times \frac{Z_L}{R_{EO} + Z_L}$$

(b) <u>To make the Effective Source Resistance Less Than 50 ohms.</u>

If the effective source resistance is required to be less than 50 ohms, the arrangement shown in fig. 3 of TLC 28189 can be used. The resistance R_p is effectively in parallel with the source resistance of the Signal Generator so that the resistance of the system, R_{EO}, is given by the standard expression for resistances in parallel: viz:

$$R_{EO} = \frac{R_p \times R_O}{R_p + R_O}$$

where R_O is the output resistance of the Signal Generator (50 ohms).

Since the required output resistance is usually the known term, the above expression is more useful when rearranged as follows :-

$$R_p = \frac{R_O \times R_{EO}}{R_O - R_{EO}} \quad \ldots\ldots\ldots\ldots\ldots \quad (1)$$

Under these conditions, the effective source e.m.f., E_{effect}, presented to the load is given by the expression

$$E_{effect} = \frac{E \times R_p}{R_p + R_O} \quad \ldots\ldots\ldots\ldots\ldots \quad (2)$$

where E is the e.m.f. indicated on the attenuator dial.

2.5.2 (oontinued)

(c) <u>To Make the Effective Source Resistance Greater than 50 ohms</u>

If the effective source resistance is required to be greater than 50 ohms, a resistor having a value R_s can be connected in series with the output as shown in fig. 4 of TLC 28189. With this arrangement, the effective output resistance, R_{EO} is given by the expression for resistances in series, viz:

$$R_{EO} = R_O + R_s \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

or, more conveniently

$$R_s = R_{EO} - R_O \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

where R_O is the output impedance of the Signal Generator.

For the special case where R_{EO} is equal to 75 ohms, the 50-ohm to 75-ohm Matching Unit Type TM 4918 is available. This unit contains a 25-ohm resistor which, connected in series with the 50-ohm source resistance of the Signal Generator, gives an effective output resistance of 75 ohms.

When the effective output resistance is altered by either of the above methods, the Output Lead is mismatched at its output end, It is therefore advisable, if the insertion loss can be tolerated, to insert the 20-dB Pad or the 6-dB Pad between the output end of the Output Lead and the correcting resistor R_p or R_s. The effective source e.m.f. is, of course, then reduced by a factor of 20 dB or 6 dB.

(d) <u>Using the Signal Generator with Balanced Loads.</u>

With certain types of equipment, the input circuit is in the form of a balanced winding. Such equipment can be fed from the unbalanced output of the Signal Generator via two correcting resistors as shown in fig. 5 of Diagram No. TLC 28189; this arrangement makes use of the auto-transformer effect of the centre-tapped winding to simulate the behaviour of a balanced source. One resistor, R_{S1} is connected in series between the earthed screen of the coaxial Output Lead and one side of the balanced winding, and a second resistor, R_{S2}, is connected in series with the 'live' output connection and the other side of the balanced winding.

2.5.2 (continued)

The values of the two resistors, R_{S1} and R_{S2}, can be calculated from the following expressions:

$$R_{S1} = \frac{R_{EO}}{2}$$

$$R_{S2} = \frac{R_{EO}}{2} - R_O \quad \ldots\ldots\ldots\ldots\ldots \quad (5)$$

where R_{EO} is the required line-to-line output resistance of the Signal Generator.

and R_O is the source resistance of the Signal Generator (50 ohms).

The 50-ohm to 300-ohm Unbalanced to Balanced Transformer Type TM 4916 operates on the principle described above.

When feeding balanced loads by the method described above, it is advisable, if the insertion loss can be tolerated, also to include the 20-dB Pad or the 6-dB Pad. The effective source e.m.f. is, of course, then reduced by a factor of 20 dB or 6 dB.

2.5.3 Output Greater than 0.7 Volt.

NOTE: The following does not apply when operating with the MODULATION switch set to EXT. PULSE. During pulse modulation the NORMAL/HIGH switch becomes inoperative.

The attenuator is calibrated up to a maximum of 0.7 volt source e.m.f. This maximum is more than adequate for most applications of a signal generator. However, to cater for such uses as r.f. bridge excitation, higher outputs can be obtained by setting the attenuator to its maximum calibrated position and controlling the output level by means of the SET CARRIER control only; the output e.m.f. is then read directly on the CARRIER LEVEL meter, which has a nominal calibration extending from 0.5 volt to 1.4 volts. It should be noted that when a.m. outputs are obtained in this way, the calibration of the MODULATION meter is only valid when the CARRIER LEVEL meter is reading at the SET CARRIER mark (0.7 volt); at other settings it is advisable to use external means of measuring modulation depth.

2.5.3 (continued)

With the NORMAL/HIGH switch at NORMAL, the disk-seal oscillator valve operates at only a fraction of its permitted maximum anode dissipation. With the switch in its HIGH position, the h.t. voltage applied to the oscillator valve is increased, and it then operates near its maximum rating, thus giving a larger-amplitude drive to the amplifier stage. Although the HIGH output setting may be used freely when necessary, the practice of operating with the switch at NORMAL, whenever possible, greatly conserves the life of the oscillator valve.

At some frequencies, it may be necessary to set the NORMAL/HIGH switch to HIGH in order to achieve the higher outputs; c.w. outputs in excess of 1 volt can be obtained at most carrier frequencies with the NORMAL/HIGH switch set to HIGH. The output level is again determined by means of the SET CARRIER control, and is indicated on the CARRIER LEVEL meter. Setting the NORMAL/HIGH switch to HIGH does not normally cause an apparent increase in the output level, due to the action of the Automatic Level Control.

2.5.4 Measurement of Noise Factor

The attenuator dial carries a scale entitled - dB ABOVE THERMAL NOISE FOR 10 kc/s BANDWIDTH. This scale is intended for use in conjunction with the common noise-factor technique involving doubling the power output from the r.f. amplifier system under test. The scale is direct reading in noise factor when the system under test has a noise bandwidth of 10 kc/s and an input impedance of 50 ohms. The method of using the Signal Generator for noise factor measurement is outlined below.

The noise produced in the second detector and audio amplifiers of a receiver is negligible compared with the amplified noise originating in the earlier tuned circuits. The noise factor measurements are taken, therefore, on the r.f. and i.f. amplifiers only.

Ideally, the second detector should be replaced with a suitable square-law indicator calibrated in terms of power or the square of the output current or voltage.

2.5.4 (continued)

In practice, however, a meter calibrated in r.f. power but which actually measures detector current is sometimes used with satisfactory results. Alternatively, the receiver's internal b.f.o. may be used if one is fitted; the final output from the a.f. amplifier can then be monitored by means of an audio output-power meter.

(a) Receivers with 50-ohm input impedance

If the receiver has an input impedance of 50 ohms, the following test procedure should be adopted :-

(i) Connect the output of the Signal Generator directly to the 50-ohm input of the receiver under test by means of the Output Lead.

(ii) Set the Signal Generator output level to zero by turning the RANGE control to a position between the bands.

(iii) Carefully note the reading of the square-law indicator.

(iv) Set the Signal Generator for c.w. output, tune to the centre frequency of the receiver passband, and adjust the output level of the Signal Generator to double the previous reading of the square-law indicator.

If the receiver has a noise bandwidth of 10 kc/s, the reading on the "noise factor" scale of the attenuator dial is equal to the noise factor of the receiver expressed in decibels. If the noise bandwidth of the receiver is not 10 kc/s, the noise factor of the receiver can be calculated from the expression

$$F_C = F_{ind} - 10 \text{ Log } \frac{B_{eq}}{10^4} \quad \ldots\ldots\ldots \text{ (6)}$$

where F_C is the corrected noise factor of the receiver.

F_{ind} is the indicated noise factor,

and B_{eq} is the equivalent noise bandwidth of the receiver.

2.5.4 (continued)

The last term in the above expression, viz. $B_{eq}/10^4$, is really a power ratio, since the effective noise power generated at the input of the receiver is directly proportional to the bandwidth. The attenuator scale of the Signal Generator assumes a 10-kc/s bandwidth, so that the correction figure is simply the ratio, expressed in decibels, of the actual noise bandwidth of the receiver (B_{eq}) to the assumed noise bandwidth (10 kc/s). If B_{eq} is greater than 10 kc/s, the correction in decibels should be subtracted from the indicated noise factor; if it is less than 10 kc/s, the correction should be added.

To compute the equivalent noise bandwidth of a receiver, first plot its frequency response, extending either side of its centre frequency to a point where the response can be considered negligible. By the use of Simpson's rule or some other method of graphical integration, find the area enclosed by the response curve. Call this area A. Construct a rectangle on the base line, having an area A and a height H (H being the height of the response curve at mid-band). The length of the base of the rectangle thus constructed indicates the equivalent noise bandwidth (B_{eq}) of the receiver.

(b) Receivers with input impedance other than 50 ohms

If the input impedance of the receiver under test is different from 50 ohms, the procedure should be modified as described in the following instructions, and an additional correction must be made. The effective source resistance at the Signal Generator output should be matched to the load by the appropriate method as described in Section 2.4.2. Having fitted the matching resistor and coupled the Signal Generator to the receiver input, carry out operation (ii), (iii), and (iv), as described for receivers with 50-ohm input impedance.

Where the input impedance of the receiver is greater than 50 ohms and matching is accomplished by using a series resistor, the power dissipated in the load is inversely proportional to the input impedance of the receiver. The noise factor is, therefore, given by the expression:

$$F \quad F_C - 10 \text{ Log } \frac{Z_L}{R_O} \quad \ldots\ldots\ldots\ldots\ldots \quad (7)$$

where R_O is the output resistance of the Signal Generator (50 ohms),

Z_L is the input impedance of the receiver under test,

F is the true noise factor,

and F_C is the indicated noise factor after the correction is applied for equivalent noise bandwidth.

2.5.4 (continued)

The last term in the above expression, viz: Z_L/R_O, is again a power ratio since the assumed power and the actual power are directly proportional to R_O and Z_L respectively. This ratio is expressed in decibels and subtracted from the indicated noise factor F_C.

Where the input impedance of the receiver is less than 50 ohms and matching is accomplished by means of a parallel resistor, the power dissipated in the load decreases with the input impedance of the receiver, so that the noise factor is given by the expression

$$F = F_C - 10 \text{ Log } \frac{R_O}{Z_L} \quad \ldots\ldots\ldots\ldots\ldots \quad (8)$$

This correction figure is the ratio, expressed in decibels, of the assumed impedance to the actual impedance, and is subtracted from the indicated noise factor F_C.

The instructions given above apply only when the effective source resistance of the Signal Generator is matched to the input impedance of the receiver. Tests with varying source impedances, e.g., finding the source impedance for minimum noise factor, are very tedious using a single-frequency generator. A suitable standard Noise Generator, such as the Marconi Type TF 1053 (100 to 600 Mc/s) or Type TF 1106 (1 to 200 Mc/s), is more suitable for these more complicated measurements.

For precise definition of equivalent noise bandwidth and of noise factor, see B.S. 2056 "British Standard Glossary of Terms for Characteristics of Radio Receivers", paragraphs 121 to 123 and 202 to 205.

In order to clarify the above instructions, two examples of noise-factor measurement are worked below. The figures quoted are for fictitious receivers and should not be taken as typical of any particular type of receiver operating in the frequency range covered by the Signal Generator in use.

<u>Example 1.</u> A receiver has an input impedance of 75 ohms. The source resistance of the Signal Generator is matched to the receiver by means of a 25-ohm series resistor as shown in figure 4 of Drawing No. TLC 28189.

2.5.4 (continued)

Carrying out the procedure described in paragraphs (a) (ii) to (a) (iv), a reading of 25 decibels is obtained on the attenuator "noise factor" scale.

The equivalent noise bandwidth is found to be 31.6 kc/s.

Substituting in expression (6) :-

$$F_C = 25 - 10 \, \text{Log} \, \frac{31.6 \times 10^3}{10^4}$$

$$= 25 - 10 \, \text{Log} \, 3.16$$

$$= 25 - 5 = 20 \, \text{dB}$$

Correcting for input impedance using expression (7) :-

$$F = 20 - 10 \, \text{Log} \, \frac{75}{50}$$

$$= 20 - 10 \, \text{Log} \, 1.5$$

$$= 20 - 1.76 = 18.24 \, \text{dB}$$

The corrected noise factor is, therefore, 18.24 decibels.

Example 2. A receiver has an input impedance of 30 ohms. The source resistance of the Signal Generator is matched to the receiver by means of a 75-ohm resistor connected in parallel as shown in figure 3 of Drawing No. TLC 28189.

By the method described, the indicated noise factor is found to be 16 decibels.

The equivalent noise bandwidth is calculated as 20 kc/s. The ratio of the true bandwidth to the assumed bandwidth is 2:1 or, expressed in decibels, 3 dB. Since the true bandwidth is greater than the assumed bandwidth, the correction is subtracted from the indicated noise factor to give a value of F_C equal to 13 dB.

Correcting for impedance in the same way, the ratio of assumed input impedance to the true input impedance is 3:5 or, expressed in decibels 2.22 dB. Subtracting this figure from F_C gives 10.78 dB. This example could, of course be solved by applying expressions (6) and (8) in a manner similar to that in which expressions (6) and (7) were used in the previous example.

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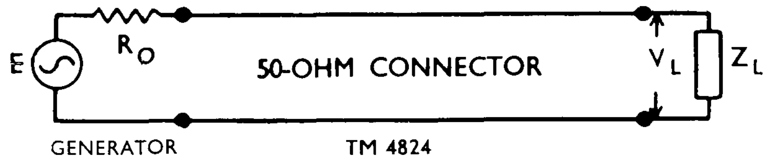


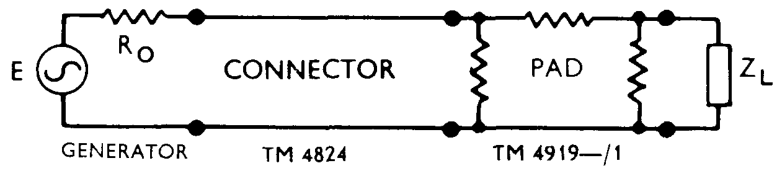
E IS THE E.M.F. INDICATED ON THE ATTENUATOR DIAL

R_O IS THE OUTPUT RESISTANCE OF THE GENERATOR = 50 OHMS

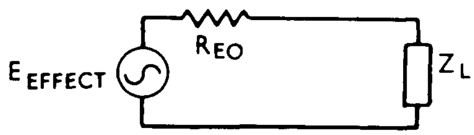
V_L IS THE P.D. ACROSS THE LOAD

Z_L IS THE LOAD IMPEDANCE

FIGURE 1 OUTPUT CONDITIONS FOR DIRECT COUPLING



OUTPUT CIRCUIT WITH 6-dB OR 20-dB PAD IN USE



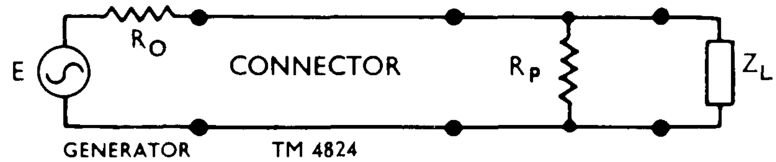
THIS IS EQUIVALENT TO:—

WHERE $E_{EFFECT} = \frac{E}{2}$ FOR 6-dB PAD

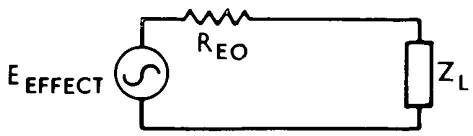
OR $\frac{E}{10}$ FOR 20-dB PAD

$R_{EO} = R_O$

FIGURE 2
OUTPUT CONDITIONS FOR COUPLING VIA AN ATTENUATOR PAD



OUTPUT CIRCUIT FOR SOURCE RESISTANCE < 50 OHMS



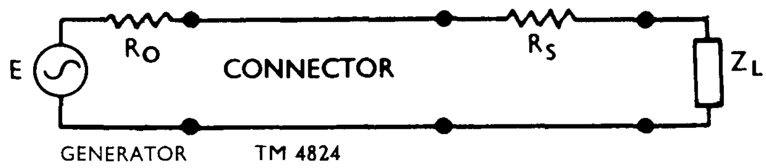
THIS IS EQUIVALENT TO —

WHERE $E_{EFFECT} = E \frac{R_P}{R_P + R_O}$

$R_{EO} = \frac{R_P R_O}{R_P + R_O}$

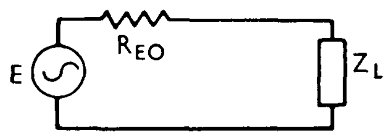
FIGURE 3 OUTPUT CONDITIONS USING PARALLEL RESISTOR

M.I. LTD. TF 801D 1 1—7 60
C.P. 2.5c. 12 61



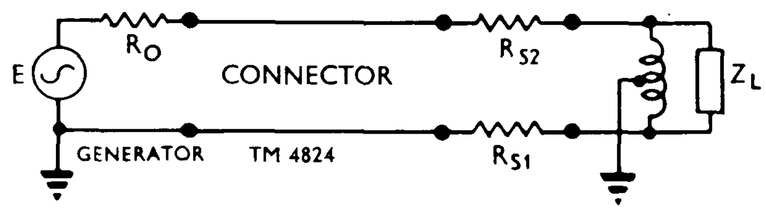
OUTPUT CIRCUIT FOR SOURCE RESISTANCE > 50 OHMS

THIS IS EQUIVALENT TO:—



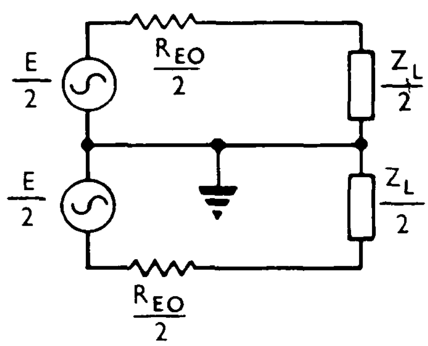
WHERE $R_{EO} = R_O + R_S$

FIGURE 4 OUTPUT CONDITIONS USING SERIES RESISTOR



OUTPUT CIRCUIT FOR BALANCED LINE-TO-LINE SOURCE RESISTANCE ≮ 100 OHMS

WHEN FEEDING INTO BALANCED WINDING THIS IS EQUIVALENT TO:—



WHERE R_{EO} = LINE-TO-LINE RESISTANCE

$$R_O + R_{S2} = \frac{R_{EO}}{2}$$

$$R_{S1} = \frac{R_{EO}}{2}$$

FIGURE 5

303 OUTPUT CONDITIONS FOR COUPLING TO BALANCED WINDING

OUTPUT ARRANGEMENT DIAGRAMS

3 OPERATIONAL SUMMARY

When the user is familiar with the principles and techniques of operation detailed in Section 2, the following abridged operation instructions may be found a convenient guide for quick reference.

GENERAL

(1) Be sure the mains transformer tappings are correctly adjusted to suit the supply, before switching on.

(2) The NORMAL/HIGH switch should be set to NORMAL whenever possible. Switch to HIGH only when the required carrier level cannot be obtained by means of the PEAK CARRIER and SET CARRIER controls. This does not apply during EXT. PULSE modulation, becuase the NORMAL/HIGH switch is rendered inoperative under these conditions.

TUNING

Check that cursor is set to its nominally correct position by alignment of red and yellow spots. Pull out FREQ. TRIM control and set to mid-position. Set range switch, and use frequency control to obtain desired frequency. For details see Section 2.3.

CRYSTAL-CHECKING

Set MODULATION switch to OFF. Plug in headphones. Adjust frequency control for zero beat at the nearest multiple of 5 Mc/s (or $2\frac{1}{2}$ Mc/s on Band A) to required frequency. Check and align cursor hair-line to the multiple of 5 Mc/s (or $2\frac{1}{2}$ Mc/s on Band A) concerned. Retune to the required frequency, For details, see Section 2.3.2.

C.W. OPERATION

Set MODULATION switch to OFF. Set ATTENUATOR dial to indicate required output voltage. Tune PEAK CARRIER control for MAX. deflection on carrier-level meter. Use SET CARRIER control to bring meter pointer to SET CARRIER mark. For details see Section 2.4.1.

3 (continued)

INTERNAL SINEWAVE MODULATION

Set MODULATION switch to INT. Adjust ATTENUATOR, PEAK CARRIER, and SET CARRIER controls as for C. W. Adjust SET MODULATION control to obtain required reading on % MODULATION meter. If necessary, re-adjust SET CARRIER control. For details, see Section 2. 4. 2.

EXTERNAL SINEWAVE MODULATION

Set MODULATION switch to EXT. SINE. Connect modulation source to E and SINE terminals. Adjust ATTENUATOR, PEAK CARRIER, and SET CARRIER controls as for C. W. Adjust input level from external source to required depth as shown on % MODULATION meter. If necessary readjust SET CARRIER control. For details, see Section 2. 4. 2.

EXTERNAL PULSE MODULATION

With no input signal, set MODULATION switch to EXT. PULSE. Set ATTENUATOR dial to indicate required output voltage at the appropriate yellow (PULSE) cursor line. Tune PEAK CARRIER control for maximum deflection on CARRIER LEVEL meter. Turn SET CARRIER control fully clockwise. Bring pointer of CARRIER LEVEL meter back to the red SET CARRIER mark by means of SET CARRIER PULSE control. Apply modulating source via series capacitor to socket marked PULSE. For details see Section 2. 4. 3.

EXTERNAL SQUAREWAVE MODULATION

Turn the SET CARRIER PULSE control fully clockwise. Adjust ATTENUATOR, PEAK CARRIER, and SET CARRIER controls as for C. W. Connect modulating source to socket marked EXT. PULSE; if positive-going squarewave, use blocking capacitor. For details, see Section 2. 4. 4.

4 TECHNICAL DESCRIPTION

It is recommended that, when the following sections are read, reference should be made to the Circuit Diagram (Drawing No. TDX 31615) and the Functional Diagram (Drawing No. TLC 31785) included at the end of this handbook.

4.1 R. F. CIRCUITS

The master oscillator valve (V2) is a disk-seal triode, working in a derived Colpitts circuit. This is followed by a twin-tetrode push-pull tuned amplifier (V6). Both the oscillator and amplifier stages have ganged turret-like tuning systems with contactless capacitance-switching. The two turret units are similar in design; each has a split-stator tuning capacitor, specially designed to give low inductance and low minimum capacitance. The stator plates of the capacitors are triangular, and the two stator sections are arranged to mesh with a single set of rotor plates. There is a two-section set of stator plates for each of the five frequency bands, and the two sections of each set are linked by the appropriate tuning inductor, which is permanently joined between them.

Each of these sets of stator plates with its attached inductor may be regarded as a stator assembly, of which there are five for each turret. The two turrets are ganged together, and rotated by operation of the band selector (RANGE) control. Each turret is mounted coaxially with its capacitor-rotor spindle so that the rotor plates mesh with each of the sets of stator plates in turn.

The active stator assemblies for the selected band are coupled to their respective valves by two pairs of coupling capacitors. These capacitors are formed by extensions of the stator plates meshing with fixed plates which are rigidly secured to the frame of the r.f. unit.

The use of this system of capacitance switching avoids the necessity for passing heavy r.f. circulating currents through metal-to-metal contacts with their inevitably varying contact resistances.

The two tuning capacitor rotors are coupled mechanically to the tuning dial and to each other by means of a wire drive system. The drive from the FREQUENCY control is coupled via a worm-and-wheel system to the oscillator rotor. To allow the amplifier to be

4.1 (continued)

tuned exactly to the frequency of the oscillator, there is a PEAK CARRIER control which, by rocking two pulley wheels, slightly varies the angular position of the amplifier rotor relative to that of the oscillator rotor. Although the automatic level control system generally permits retuning without the necessity for repeaking, it may become necessary to do so when a large change in frequency is made on any one band, or when a change from one band to another is made. The necessity for repeaking is increased at the higher frequencies, and also when maximum freedom from spurious f.m. is desirable.

The FREQUENCY TRIM control (C39) consists of a small, earthed, metal vane which can be rotated in the proximity of the anode circuit of the r.f. oscillator valve, thus slightly altering the frequency of oscillation. The control knob can be pulled out to move the plane of rotation of the vane further from the oscillator, hence allowing extra-fine frequency adjustment.

A switch (S2) operated by a cam on the frequency RANGE switch disconnects the h.t. supply from the oscillator valve while the frequency-band is being changed. During transition from one band to another, the oscillator tuned circuit is, of course, effectively removed: this would result in the oscillator valve drawing excessive anode current if the h.t. supply were left on.

The r.f. oscillator is loosely coupled to the power amplifier via a balanced capacitive attenuator, and this contributes greatly to the very low value of f.m. on a.m. A high degree of balance is achieved in the push-pull amplifier circuit; this is due to the symmetrical circuit layout, and the internal cross-neutralization feature of the type of valve employed.

NOTE: On certain instruments a Mullard Ferroxcube anti-parasitic bead (Type No. FX 1115) is fitted over the lead going to pin 9 of amplifier valve V6. This helps to eliminate parasitic oscillation at approximately 440 Mc/s.

4.2 CARRIER LEVEL MONITOR

The output level of the r.f. amplifier is monitored at the input to the piston attenuator by a crystal rectifier voltmeter circuit (incorporating M1).

The attenuator dial is calibrated from -130 to +4 decibels relative to 1 mW and also in terms of decibels relative to 1 μV e.m.f. In addition, the meter scale is calibrated to 4 dB below and 6 dB above the SET CARRIER mark, giving a total calibrated range of -134 to +10 dBm. For correct ATTENUATOR dial readings, the pointer of the carrier-level meter must be brought to the red mark by means of the appropriate set carrier control.

The disk-seal oscillator valve is normally run well below its permitted maximum rating to conserve its life; in this condition sufficient output is available for most applications. When a high output level is required (e.g., for driving an r.f. bridge), the action of putting the OUTPUT switch from NORMAL to HIGH short-circuits resistors R5 and R6 in series with V2 anode, thus increasing the oscillator drive to the output stage. With the MODULATION switch set to EXT. PULSE however, the NORMAL/HIGH switch is rendered inoperative.

4.3 AUTOMATIC LEVEL CONTROL SYSTEM

D.C. output from the carrier-level monitor circuit is also fed to an automatic level control system, incorporating V9 and V7b. This is a d.c. amplifier system, and works as follows :-

The a.l.c. circuit comprises an amplifying stage (V9), the output of which is d.c. coupled to a cathode follower (V7b). The cathode of V7b is connected via a resistance chain to a 100-volt negative line. The negative bias voltage for the r.f. amplifier is derived from a point along this chain, and is dependent on the cathode voltage of V7b.

Positive d.c. from the carrier level monitor circuit is applied to the grid of V9, the a.l.c. amplifier valve, and is compared with the d.c. voltage appearing at its cathode; this voltage is derived via a resistance chain which includes a preset potentiometer (RV6) and the SET CARRIER control (RV2). The d.c. reference voltage (and hence the r.f. amplifier bias) can thus be set according to the carrier

4.3 (continued)

level required. To avoid degeneration in the cathode resistor of V9, positive feedback is applied from the cathode of V7b. This causes the current through the cathode circuit of V9 to remain constant regardless of the voltage changes at its grid.

4.4 MODULATION

The push-pull r.f. output stage (v6) is grid modulated, either from an internal sinewave oscillator or from an external source. The internal modulation oscillator comprises a triode valve (V7a) operating in a series-fed Hartley circuit. The output is taken from the secondary winding of the modulation oscillator transformer (T2), via the SET MODULATION potentiometer RV3 and the MODULATION selector switch S4, to the grids of the r.f. amplifier valve, V6.

For external modulation, the internal 1,000-c/s oscillator is switched out of circuit, and the signal from the external source is introduced through a pair of terminals (for sinewave modulation) or a coaxial socket (for pulse modulation), both on the front panel. The grids of the r.f. oscillator are prevented from going positive during pulse modulation by a diode (V11) which, in conjunction with an external blocking capacitor and the internal resistance presented at the PULSE input socket, forms a d.c. restorer circuit.

To maintain c.w. and pulse outputs at the same level, the oscillator drive to the r.f. output stage is limited on pulse operation to a value just sufficient to produce the required output, with the SET CARRIER control fully advanced. The oscillator output is limited by a reduction of the anode voltage to valve V2, by means of a potentiometer RV10. Also, to simplify operational procedure an extra switch wafer is incorporated on S4 so that the SET CARRIER PULSE control (RV10) will be switched out except for pulse operation. Silicon rectifier MR6 is included in the pulse input circuit to decrease the charging time of the external input capacitance.

Modulation depth is monitored on a separate panel meter (M2) which is directly calibrated from 0 to 90%. The meter indication is produced by rectification of the output from a two-stage amplifier (V8a and V8b). The input to the amplifier is derived from the a.f. output component of the voltage from the carrier-level detector (MR3).

4.4 (continued)

V8a is a normal amplifier whose output feeds V8b, a cathode-follower. The output from this cathode-follower is rectified by a pair of germanium diodes (MR4 and MR5) and applied to the MOD. LEVEL meter. Indication of modulation depth is thus based on a system of absolute measurement and is independent of any indirect calibration associated with the level of modulating voltage applied to the modulator stage.

The meter is protected against switching surges by means of a shunt-connected silicon diode, MR2. This diode is back biased by the negative supply, so that it conducts when the voltage across the meter circuit exceeds a pre-determined level, equivalent to a meter reading slightly above f. s. d.

4.5 CRYSTAL CALIBRATOR

The crystal calibrator can be brought into use during c.w. operation only, the h.t. supply to the crystal oscillator valve being switched on automatically when a telephone plug is inserted into the PHONES jack.

The crystal calibrator is a combined crystal oscillator and mixer stage using a pentode (V10). The suppressor of this valve forms the control grid of the oscillator section. The r.f. output of the Signal Generator is sampled by a small capacitive pick-up in the proximity of one of the anode chokes of the r.f. amplifier. The sampled r.f. signal is applied to the control grid of V10 and, within this valve, heterodyned with the oscillator signal of 5 Mc/s. The resulting beat-note is fed to a two-stage amplifier, comprising V8a and V8b in cascade; for this purpose, V8b is switched by S4 from its normal cathode follower function to become a conventional anode-loaded amplifier. The output from V8b is taken via a capacitor to the PHONES socket on the front panel. A gain control (RV7) is incorporated in the input to V8a, in order that the strength of the audible beat note may be adjusted. On certain instruments a single stage transistor amplifier (VT1) precedes cascade amplifier V8.

4.6 POWER SUPPLY UNIT

The l.t. and h.t. supplies are all derived from the transformer T1. The positive d.c. h.t. supply is derived via full-wave rectifier V1, and a capacitance-inductrance smoothing circuit. It is electronically stabilized by a conventional circuit incorporating series control valve V3, control amplifier V4, and gas reference tube V5.

4.6 (continued)

The heater supply for the master oscillator valve is derived from a winding on T1 via a transductor (TD1). By taking advantage of the regulated h.t. supply already available for its reference voltage, the transductor effectively controls the heater current in such a manner that its value stays constant over a wide range of mains input variations. The voltage appearing at the oscillator valve heater can be preset to the required value by means of the potentiometer (RV8) which controls the level of the d.c. control current in the transductor, and hence its regulating point.

The Signal Generator circuits are protected by three fuses; one of 2-amp rating in each of the mains input lines, and one of 150-mA rating in the negative line of the 300-volt h.t. supply.

5 MAINTENANCE

5.1 GENERAL

The following items are included in this handbook to assist in the maintenance of the A. M. Signal Generator Type TF 801D/1 :-

Functional Diagram
Complete Circuit Diagram
Component Layout Illustrations
Spares Ordering Schedule with Circuit References
Valve Replacement Data Sheets

Section 4, TECHNICAL DESCRIPTION, of this handbook deals with the internal circuits of the Signal Generator and is intended to be read in conjunction with the Circuit and Functional Diagrams included at the end of this manual. It is strongly recommended that, before commencing the adjustment or replacement of component parts of the instrument, the user should familiarize himself with the principles, described in Section 4, and illustrated in the diagrams.

The Circuit Diagram shows all the electrical components contained in the instrument. The description, of these components - their types, values, ratings, etc. - are given in the Spares Ordering Schedule; the Schedule also lists certain mechanical components.

The physical location of electrical components is shown in the Component Layout Illustrations.

5.2 REPLACEMENT OF FUSES

The mains-input and h. t. circuits of the TF 801D/1 are protected by three cartridge fuses; one 2-amp fuse in each of the mains-supply lines, and a 150-mA fuse in the h. t. negative lead. These fuses are located on the left-hand side of the front panel, and can be replaced without removing the instrument from its case.

5.3 REMOVAL OF CASE

To remove the instrument from its case, lay it face downwards on a bench, and remove the four metal-domed feet; each of these domes is held at its centre by a countersunk screw. Also, remove the four

5.3 (continued)

similar domes from the back of the case. The case can now be separated from the main body of the instrument. The mains lead enters the instrument via a rectangular opening within the left-hand case-handle recess; when the case has been removed, this opening is sufficiently large to allow the entire supply lead to be passed through it.

5.4 MAINS INPUT ARRANGEMENTS

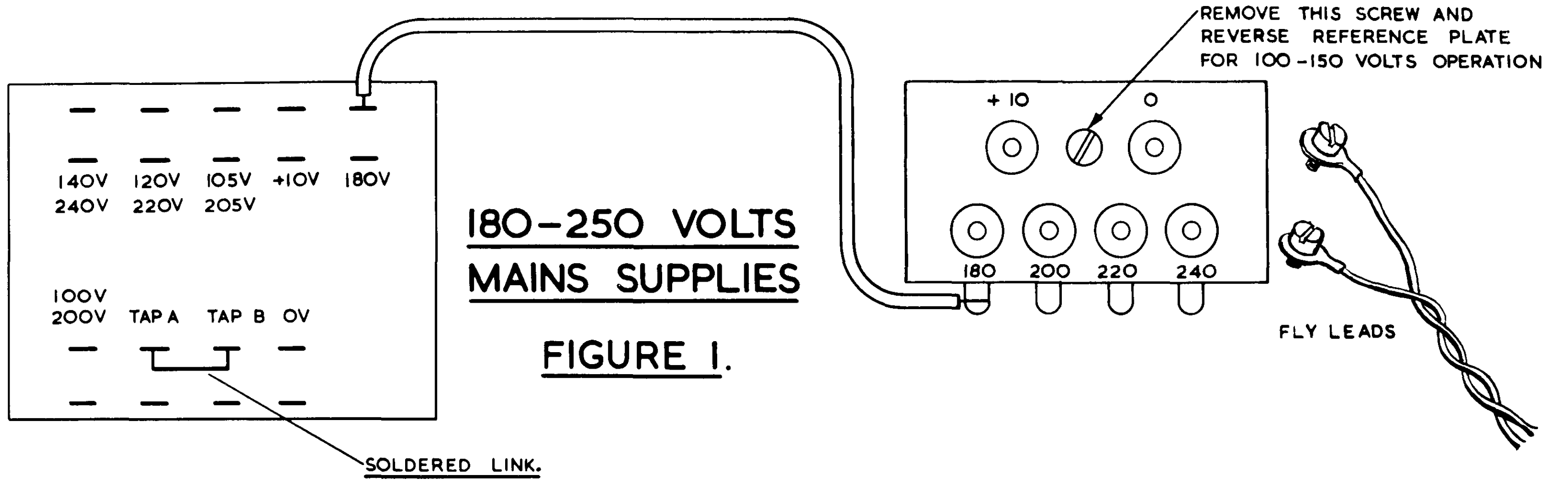
The mains transformer has a double-wound primary with the arrangements for connection of the two tapped sections in series for the 180- to 250-volts range, or in series parallel for the 100- to 150-volts range. The instrument is normally despatched with the power unit set for operation from a 240-volt mains supply. It can be adjusted for operation from other supplies at mains frequencies between 40 and 100 c/s by following the instructions given below.

The arrangements of the connections to the input of the mains transformer are shown diagrammatically on Drawing No. TLC 27612, which follows this page.

If the transformer connections are to be fully examined, the instrument must be removed from its case as described in Section 5.3 of this manual. The two sections of the double-wound primary are connected together by linking the appropriate solder tags mounted directly on the transformer, as in 'A' on the diagram. To change from one major voltage range to the other, alter the linking on the transformer as shown.

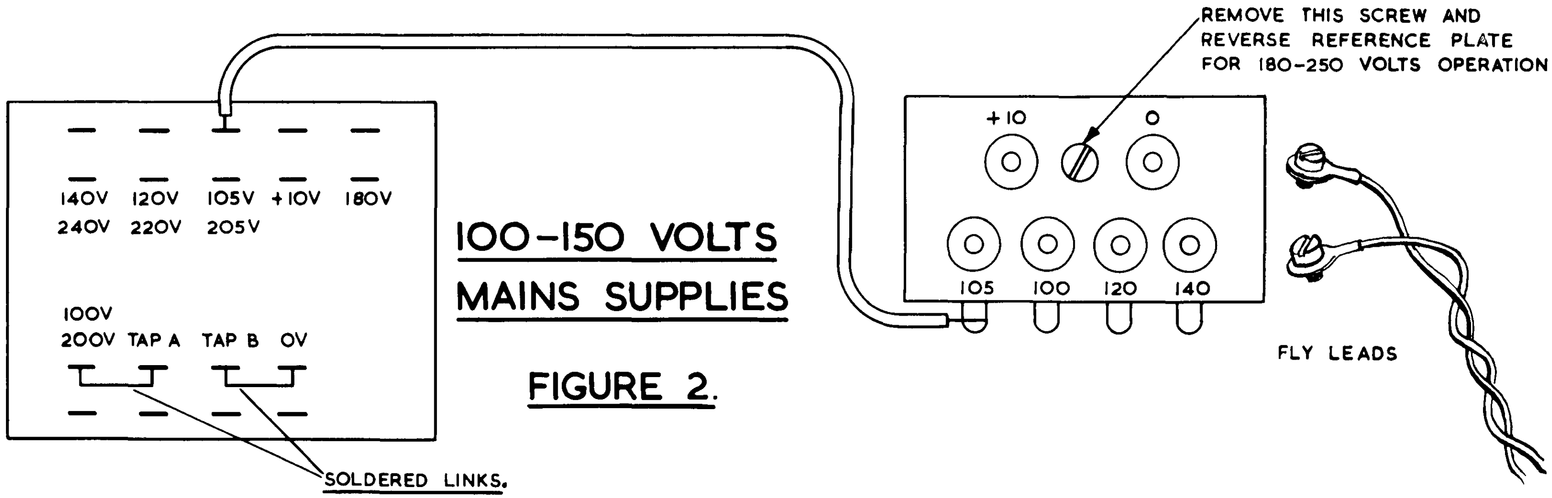
If access to the tapping panel only is required, this can be gained without taking the instrument out of its case, by removing the cover plate in the right-hand case-handle recess.

The tapping panel - 'B' on the diagram - which is for the selection of the primary tap to suit the local supply voltage, carries a reversible reference plate marked with the correct voltages for each tapping point. The voltages applicable to the 100- to 150-volt range are engraved on one side of the plate, and those for the 180- to 250-volt range on the other.



180-250 VOLTS MAINS SUPPLIES

FIGURE 1.



100-150 VOLTS MAINS SUPPLIES

FIGURE 2.

ARRANGEMENT OF PRIMARY SOLDER TAG CONNECTIONS ON MAINS TRANSFORMER

MAINS TAPPING PANEL
CONNECT THE FLY-LEADS TO GIVE A COMBINATION TO SUIT MAINS VOLTAGE. ONE FLY-LEAD MUST GO TO EITHER '+10' OR 'O' TAP

MAINS INPUT CONNECTIONS

5.5 REPLACEMENT OF VALVES AND CRYSTALS

After the removal of the instrument from its case, all valves other than the disk-seal oscillator (V2), the r.f. amplifier (V6), the crystal calibrator (V10), and the pulse-clamping diode (V11) are immediately accessible. V2, V6, V10, and V11 together with the r.f. level monitor diode (MR3) and the calibrator crystal (XL1), are contained in the double-screened r.f. unit.

To gain access to the r.f. and crystal calibrator valves, the instrument should be turned upside down with the front panel vertical. The 22 screws securing the uppermost face of the outer screening box should then be extracted. The removal of the plate held by these screws exposes a second plate secured by a further 22 screws. With this second plate removed, V2, V6, V10, V11, MR3, and XL1 are all accessible.

To remove the oscillator valve, V2, from its mounting :

(1) Pull out the FREQUENCY TRIM control and turn it to the + position.

(2) Gently pull off the central filament-supply connector.

(3) Slide the two phosphor-bronze clips upwards, thereby releasing the black thermal-shunt block from the fixed anode connecting plate.

(4) With the block removed, ease the valve out from its spring-fingered contacts.

To remove the r.f. amplifier valve V6, or the crystal calibrator valve V10, simply lift off the sprung retainer (from V6), or the screening can (from V10) and withdraw the valve from its holder.

The carrier level monitor diode, MR3, is held in a spring clip adjacent to the head of the attenuator tube and is easily removed.

The 5-Mc/s calibrator crystal, XL1, is mounted in a 2-pin socket adjacent to the crystal oscillator valve. On earlier models this crystal is identified by the chassis marking X5.

5.5 (continued)

If silicon diode MR3 is replaced, the calibration of the CARRIER LEVEL meter must be restandardized as described in Section 5.10.6; also, the accuracy of the MODULATION meter should be checked and, if necessary, the meter sensitivity adjusted as described in Section 5.10.10.

All valves can be replaced without special selection with the possible exception of valve V2.

Replacement of Valve V2

The following procedure should be carried out when replacing the master oscillator valve V2.

(1) Ensure that the Signal Generator is disconnected from the supply.

(2) Gain access to the R.F. Unit in the manner already described.

(3) Remove any shorting links across the three anode resistors of valve V2 and also any links across the three grid resistors.

(4) Connect a 0-100 mA d.c. meter between the 300-volt h.t. line and the three anode resistors.

(5) Remove the oscillator valve V2 from its mounting and insert new valve (refer to previous fitting instructions in this section).

(6) Check that the NORMAL/HIGH switch is set to NORMAL.

(7) Reconnect the supply and switch ON. With the MODULATION switch to OFF, set the RANGE control to Band E, and tune to approximately 260 Mc/s.

(8) Allow a warming-up period of two or three minutes and then switch the OUTPUT/NORMAL control to HIGH.

(9) After a stabilizing period of 5 mins., note the anode current reading on the 0-100 mA d.c. meter.

5.5 (continued)

(10) If the anode current is less than 33 mA, short out the anode resistors one at a time until the current is at least 33 mA. DO NOT however, exceed the maximum permissible anode current listed in the table below.

(11) If an anode current of 33 mA is not attainable in (10) above, short out not more than two of the three grid resistors, and repeat step (10) as necessary, still keeping within the anode current limits specified.

(12) In the unlikely event of the anode current still not reaching 33 mA, check whether there is sufficient r.f. output over Band E. If the r.f. output over this band is adequate when the valve may be used. If the r.f. output is insufficient then the valve should be rejected.

Maximum Permissible Anode Currents

Number of anode resistors effectively in circuit	Max. permissible anode current
Three	50 mA
Two	41 mA
One	36 mA
None	33 mA

NOTE: For long life of the oscillator valve V2, it is advantageous to restrict the anode current to a value which just satisfies the r.f. output requirements.

5.6 WORKING VOLTAGES

The following voltages were measured with a voltmeter having a resistance of 20,000 Ω/volt (e.g., a Model 8 AvoMeter) set to its highest convenient range, and with the mains transformer tappings set to suit the local supply, the approximate working voltages to be expected are as follows :-

5.6 (continued)

Mains Transformer, h.t. secondary:	470-0-470 volts a.c.
l.t. 1:	6.6 volts a.c.
l.t. 2:	6.5 volts a.c.
l.t. 3:	5.2 volts a.c.
Oscillator Valve (V2) heater:	6.3 volts a.c.
H.T. rectified (across C2):	550 volts d.c.
H.T. smoothed (across C6):	540 volts d.c.
H.T. stabilized (V3, pin 8):	300 volts d.c. (adjusted by means of RV1).

The following table shows the anode, screen grid, and cathode voltages with respect to chassis for all valves except the r.f. oscillator valve V2. Measurements should be made with the panel controls set as follows :-

RANGE:	Band C.
FREQUENCY:	70 Mc/s.
SET CARRIER:	Set to mid-travel.
MODULATION selector:	INT. SINE (except where stated otherwise).
SET MODULATION:	Set to Zero.
ATTENUATOR:	200 mV.
NORMAL/HIGH switch:	NORMAL.
PEAK CARRIER:	Adjust for max. meter deflection.

Valve	Va	Vg2	Vk
V3	550	540	300
V4	280	135	83
V6	200	160	0
V7a	275	-	5
V7b	300	-	102
V8a	105	-	18
V8b	300	-	130
V8b*	96	-	0.9
V9	87	83	3.5
V10	135**	50	0

* MODULATION selector set to OFF.

** Measured at the junction of R53 and R55.

5.6 (continued)

The table below gives the approximate values of anode voltage for the oscillator valve, V2, measured at the junction of L1, R61 and C53. Measurements should be made at the centre of each band for both positions of the NORMAL/HIGH OUTPUT switch.

N/H Switch	Band A	Band B	Band C	Band D	Band E
NORMAL	143	130	215	205	200
HIGH	163	150	295	290	290

5.7 ACCESS TO R.F. UNIT

General tests, or some peculiarity in the performance of the Signal Generator, may suggest the desirability of inspecting the interior of the R.F. Unit: this unit can be dismantled by following the procedure detailed below.

It must be emphasized that it is most unwise for the user to open the R.F. Unit, unless he is quite satisfied that it does, in fact, contain a fault.

Most of the circuit components in the R.F. Unit are accessible when the two cover plates are removed in the manner described in Section 5.5. In order to expose the wire-drive mechanism used on this unit, remove the outer screening cover. To do so, lay the instrument on its face, take out the 36 screws from the periphery of the outer screening cover (four of these screws clamp the R.F. Unit to the triangular strengthening bracket to the L.F. and Power Unit chassis; now remove the bracket and lift off the screening cover.

The inner covers can be removed by extracting the 43 screws holding them in position.

5.8 THE DRIVE-WIRE SYSTEMS

Both the main tuning drive and the attenuator drive utilize positive-action wire-and-pulley mechanisms. A strong stainless-steel drive-wire is used, and the necessity for wire replacement should be infrequent even if the wire receives no attention. However,

5.8 (continued)

a certain amount of friction is inevitable, and the life of the wire can be further prolonged if this friction is reduced to a minimum by the periodical application of a small amount of Price's Anti-Freeze grease. The procedure for replacing the drive-wire, in the event of breakage, is detailed in the two sections that follow.

5.8.1 Replacing the Main Tuning Drive-Wire

Refer to the illustrations entitled DRIVE-WIRE REPLACEMENT DIAGRAM, MP 801D/1-8 and R.F. UNIT - REAR, MP 801D/1-7.

Replacement drive-wires can be obtained in pairs from Marconi Instruments Ltd :- See Spares Ordering Schedule SOS/801D/1 Item 256.

(a) Take the instrument out of its case and remove the outer screening cover from the r.f. unit. Next, remove valve V3 (KT66) from its socket in the power unit chassis.

(b) Remove the set screw from drum 'B' which releases wire 1 and the spring attached to wire 2.

(c) If necessary, push out the wire-securing pin from drum 'A' to release wire 1.

(d) Remove drum 'C' from its spindle by loosening the grub screws. Take out the set screw holding the end of wire 2 and the spring attached to wire 1.

(e) Take the shorter of the two new drive-wires (this is wire 2) and insert the end of the larger loop through slot 'c' in drum 'C'. Attach this loop - together with the spring for wire 1 - to drum 'C', using the original set screw.

(f) Next, take the longer of the new drive-wires (wire 1), and fold it in half. Insert the loop so formed into slot 'a' in drum 'A' and replace the wire-securing pin; with the wires crossed over the pin, the end with the larger loop must be towards drum 'C'.

5.8.1 (continued)

(g) Pass the "smaller-loop" end of wire 1 around drum 'A', and under the rocker-drive spindle. Thread the small loop through slot 'c' in drum 'C' (which is now detached from its spindle) and attach it to the spring.

(h) Arrange the wires on drum 'C' so that wire 1 makes three quarters of a turn in an anti-clockwise direction, as viewed from the spring side of the drum, and wire 2 makes three quarters of a turn in a clockwise direction. Temporarily fix the wires in position with a piece of adhesive tape.

(i) Replace drum 'C' on its spindle, but do not tighten the grub screws.

(j) Bring drum 'A' to the position where the slot is uppermost. Arrange wire 1 so that from each side of the slot the wire makes a half turn round drum 'A', with the wires crossing at the bottom. One end of wire 1 is already connected to drum 'C'; position this wire so that, en route from drum 'C' to drum 'A', it passes over the front rocker-arm pulley.

(k) Lead the "larger-loop" free end of wire 1 over the front inclined pulley, and pass it round drum 'B' in an anti-clockwise direction (viewed from the spring side of the drum), once only. Thread the loop through slot 'b' and attach it - together with the spring for wire 2 - to the drum, by means of the set screw.

(l) Bring wire 2 from drum 'C' over the rear rocker-arm pulley, and then over the rear inclined pulley. Lead the wire around drum 'B' in a clockwise direction, thread the loop through slot 'b' and attach it to the free end of the spring. To do so, it will be necessary to apply tension to the spring.

(m) Adjust the PEAK CARRIER control to its mid-way position; remove the inner screening cover from the r.f. unit; rotate the FREQUENCY control to bring the vanes of the oscillator rotor to the same angular position as those of the amplifier rotor; then tighten the grub screws to secure drum 'C' to the spindle.

5.8.1 (continued)

(n) Turn the FREQUENCY control to its fully anti-clockwise position; slacken off the grub-screws securing drum 'A' to its spindle; then adjust the angular position of this drum so that the zero on the linear scale of the tuning dial coincides with the cursor hairline. Finally, tighten the grub screws, and replace the covers on the r.f. unit.

5.8.2 Replacing the Attenuator Drive-Wire

Refer to the illustrations entitled DRIVE-WIRE REPLACEMENT DIAGRAM, MP 801D/1-8 and END VIEW MP 801D/1-3.

Replacement lengths of drive-wire can be obtained from Marconi Instruments Ltd. - see Spares Ordering Schedule SOS/801D/1 Item 273.

(a) With the outer case removed, stand the instrument, face upwards on the bench. Remove the fixing screw from the attenuator dial centre boss, on the front panel, then take out the plastic window and cursor assembly. Unscrew the three counter-sunk fixing bolts holding the attenuator dial in position. Drum 'E' is then exposed.

(b) Remove the spring from drum 'E' by extracting the set screw. Take care that the wire-securing pin from drum 'D' is not lost; it may have dropped out of the drum, if replacement was necessitated by the wire having snapped.

(c) Adjust the ATTENUATOR control so that the rack is approximately in its mid-position and also that slot 'd' on drum 'D' is facing away from drum 'E'.

(d) Fold the 30-inch length of stainless steel drive-wire in half, and insert the loop so formed into slot 'd' in drum 'D'. Secure and cross the wire over the pin as shown in the diagram.

(e) Wind one end of the wire from slot 'd' - four-and-a-half turns clockwise and the other end three-and-a-half turns anticlockwise around drum 'D', viewed from the spring side of drum 'E'.

5.8.2 (continued)

(f) Rotate drum 'E' to the position where the slot is facing drum 'D' then lay the wire round the drum, each end making three-quarters of a turn to reach the slot.

(g) Pass the two ends of the wire through the slot, pull the wire tight round the system, and knot the ends. Attach one end of the spring to the knotted wire and anchor the other end of the spring by means of the set screw.

(h) Reassemble the dial unit in the reverse order to that given in (a).

(i) Rotate the ATTENUATOR control in an anti-clockwise direction as far as the stop, slacken off the two grub screws fixing drum 'D' to the spindle, and adjust the position of the drum on the spindle to bring the maximum-output end-mark of the attenuator dial to the cursor line.

5.9 ADJUSTMENT OF PRESET COMPONENTS

During the factory calibration of the instrument, certain of its performance characteristics are brought within close limits by means of preset components.

Following the replacement of certain fixed components in circuits where performance depends on the adjustment of a preset component, it is essential to repeat the calibration procedure by which the preset was adjusted. For example, if the Carrier Level Monitor diode MR3 is replaced, it will probably be necessary to restandardize the calibration of the CARRIER LEVEL meter.

The section dealing with the calibration procedure appropriate to each preset component is indicated in the following table. This procedure should also be carried out in the event of replacement of any of these preset components.

5.9 (continued)

Preset Component	Circuit or Operating Characteristic Affected	Section Describing Adjustment
RV1	300-volt h.t. line	5.10.3
RV4	Carrier Level Monitor	(5.10.6 (5.10.7
RV5	Modulation Monitor	5.10.10
RV6	A.L.C. Circuit	5.10.8
RV8	Oscillator Heater Voltage	5.10.3
C7, C25, C26) C27, C28)	R.F. Amplifier Tracking	5.10.5
L3, L4, L5) L6 and L7)	Osc. Frequency-coverage	5.10.4
L14, L15, L16) L17 and L18)	R.F. Amplifier Tracking Output Level Accuracy	5.10.5

5.10 SCHEDULE OF TESTS

The following sections, based on the internal test schedule to which the instrument was produced, are included to enable the user to carry out a series of bests by which the main points of performance of the instrument can be checked. The sections also give details concerning the adjustment of preset components.

5.10.1 Apparatus Required.

(a) 750-volt Insulation Tester.

(b) Multi-range voltmeter having a resistance of 20,000 Ω/volt e.g. Model 8 Avometer.

5.10.1 (continued)

(c) Wavemeters to cover frequency range 10 to 470 Mc/s with an accuracy of 0.1%, e.g. Marconi TF 1067/1.

(d) Vacuum Tube Voltmeter, 25 mV to 10 V, covering 30 c/s to 470 Mc/s. e.g. Marconi TF 1041 series.

(e) A.F. Oscillator with a calibrated output attenuator - Output at least 5 volts and frequency range 30 c/s to 20 kc/s. e.g. Marconi TF 1101.

(f) Wave Analyser, r.f. inputs 10 to 470 Mc/s, a.f. tuning 30 c/s to at least 1 kc/s, e.g. Marconi TF 455E.

(g) Cathode Ray Oscilloscope, suitable for displaying the i.f. of the receiver used in the test described in Section 4.10.10. e.g. Marconi TF 1330, TF 1104, TF 1104/1 or TF 1153.

(h) Carrier Deviation Meters covering the frequency range 10 to 470 Mc/s, deviation from 100 c/s to 5 kc/s. e.g. Marconi TF 934 or TF 934/2 (for checking range 10 to 100 Mc/s), and Marconi TF 791 Series (for checking range 100 to 470 Mc/s).

(i) Standardized Signal Generator 10 to 470 Mc/s. e.g. Marconi TF 801C, TF 801D series, or TF 1066 series.

(j) Receivers covering the range 10 to 470 Mc/s.

(k) Frequency measuring apparatus to measure 5 Mc/s to an accuracy of 0.01%. e.g. Marconi TF 1067 or TF 1067/1.

(l) Dynamometer Voltmeter, a.c. voltage 0 to 10 volts.

5.10.2 <u>Mains Insulation</u> (Apparatus required: Item a)

Check the insulation between each pin of the supply plug and chassis for both positions of the mains ON/OFF switch. The insulation resistance is normally greater than 40 MΩ.

5.10.3 Power Unit Adjustment - RV1 and RV8 (Apparatus required : Items b and l)

(1) Check the setting of the mains input tappings as described in Section 5.4.

(2) Measure the mains transformer secondary voltages, and note that they are similar to those given in Section 5.6.

(3) By means of RV8 adjust the transductor-regulated filament voltage of the R.F. Oscillator valve V2 to obtain a reading of 6.3 volts. Use a dynamometer voltmeter, as this type of instrument will indicate true r.m.s. values.

(4) By means of RV1, set the voltage between the cathode of V3 and earth to 300 volts.

5.10.4 Frequency Calibration - L3 to L7 (Apparatus required : Item c)

(1) Connect the instrument to the mains supply (of the correct voltage) and switch on. Set the MODULATION switch to OFF. Allow an initial warming-up period of at least 1 hour.

(2) Pull out the FREQuency TRIM control and turn it to the centre mark.

(3) Check that the frequency calibration is accurate to within about 0.5% on all ranges, after allowing a re-stablizing period of about 20 minutes when switching to each new range.

(4) Check the r.f. oscillator frequency coverage on all bands; this should be as in the table in Section 2.3, plus a reasonable amount of "overlap" between adjacent bands.

If the instrument fails to meet these requirements, it will be necessary to re-tune the oscillator slightly on the band affected. This can be accomplished by adjusting the tuning inductor on the appropriate stator assembly in the oscillator section of the screened r.f. box. On bands A, B, or C, adjustment is made by means of the tuning slugs of L3, L4, or L5; on bands D or E, by altering the configuration or length of the inductive loop, L6 or L7 (L7 is the smaller of the two parallel loops on Band E).

5.10.4 (continued)

Re-tuning the oscillator in this way will most probably necessitate recalibration of the appropriate scale on the frequency dial.

5.10.5 R. F. Amplifier Tracking (C7, C25 to C28, and L14 to L18)

Check that, by means of the PEAK CARRIER control, it is possible to tune the r. f. amplifier through a peak response, as indicated by the CARRIER LEVEL meter. If peaking does not occur, the amplifier tracking will require adjustment, and this should be carried out in the following manner :-

(NOTE: All the trimmers and coils referred to below are mounted on the moving stator assemblies in the amplifier compartment of the r. f. screened box.)

For Band A or B. Set the PEAK CARRIER control to its mid-position. Adjust the slug of tuning inductor L14 (on Band A), or L15 (on Band B) for optimum tracking at the low-frequency end of the band; adjust the trimmer C25 (on Band A) or C26 (on Band B) for optimum tracking at the high-frequency end of the band Readjust the tuning inductor and trimmer alternately until the required overall tracking is obtained.

For Band C or D. Set the PEAK CARRIER control to its mid-position. Adjust the slug of tuning inductor L16 (on Band C) or L17 (on Band D) for optimum tracking at the low-frequency end of the band; adjust the trimmer C27 (on Band C) or C28 (on Band D) for optimum tracking at the high-frequency end of the band. Readjust the tuning inductor and trimmer alternately until the required overall tracking is obtained.

For Band E. Set the PEAK CARRIER control to its mid-position. Adjust the configuration or length of inductor loop L18 for optimum tracking at the low-frequency end of the band; adjust trimmer C7 for optimum tracking at the high-frequency end of the band. Readjust the tuning inductor and trimmer alternately until the required overall tracking is obtained.

When carrying out the above tracking procedures avoid using the last quarter of a turn of the PEAK CARRIER control; this is to allow for temperature variations, ageing valves, etc.

5.10.6 Setting Up the Carrier Level Monitor - RV4 (Apparatus required: Item d)

(NOTE: The carrier level monitoring circuit must be set up in the manner described below whenever any adjustment has been made to the r.f. amplifier tuned circuits).

(1) Set the RANGE switch to Band A, and the frequency to approximately 15 Mc/s.

(2) Connect a 50-ohm load to the output socket of the Signal Generator. Set the output attenuator to 200 mV e.m.f.

(3) Adjust the SET CARRIER control so that a p.d. of 100 mV is developed across the load (measured by the Vacuum Tube Voltmeter).

(4) Adjust RV4 until the CARRIER LEVEL meter pointer is on the SET CARRIER mark.

5.10.7 Output Calibration - RV4 (Apparatus required : Items d, i, and j)

With the Signal Generator in its case, use the Receiver to compare its output with that of a Standardized Signal Generator at two frequencies on each band. If the output level accuracy varies from band to band, make adjustments to the positions of the r.f. amplifier coils relative to the pick-up loop of the attenuator. If the output voltage is low, move the tuning coil in such a direction as to decrease its coupling to the pick-up circuit of the monitor and to increase its coupling to that of the attenuator. If necessary, readjust RV4 to a compromise setting in order to obtain optimum accuracy on all bands.

5.10.8 Automatic Level Control - RV6

Tune the instrument to 100 Mc/s on Band C. Adjust the ATTENUATOR and SET CARRIER controls to give maximum output (i.e. 700 mV and 90% Mod.). Now set RV6 to give a meter reading which is just over f.s.d.

5.10.9 Internal Modulation Frequency (Apparatus required : Items e and g).

Set the MODULATION switch to INT. Feed the nominal 1000-c/s a.f. output from the slider of the SET MODULATION control (RV3), and also the output from the A.F. Oscillator (set to 1000 c/s) respectively to the X and Y inputs of the oscilloscope. Check that the A.F. Oscillator frequency required to produce a stationary pattern on the oscilloscope is 1000 c/s ±10%.

5.10.10 Modulation Monitor - RV5 and RV9 (Apparatus required : Items g and j)

(1) Feed the output of the Signal Generator to the receiver; connect the output of the i.f. amplifier of the receiver to the Y-deflection system of the oscilloscope.

(2) Tune the generator for maximum deflection of the c.r.o. trace, and adjust the Y-gain control to produce a display of convenient dimensions. This test is best carried out at the low end of the frequency range. This will ensure that the receiver used will have a sufficiently low i.f. for the trace to be displayed on a general purpose oscilloscope. Errors can be caused by the receiver having an inadequate bandwidth.

(3) Turn the MODULATION switch to INT., and adjust the SET MODULATION control for 50% modulation as measured on the c.r.o. screen, using the formula :-

$$M\ (\%) = \frac{D_{max} - D_{min}}{D_{max} + D_{min}} \times 100$$

where D_{max} is the peak-to-peak dimension of the c.r.o. display, and D_{min} is the trough-to-trough dimension.

(4) If necessary, adjust the preset control RV5 to bring the reading of the MODULATION meter to exactly 50%.

(5) Check the calibration accuracy of the scale up to 90% and adjust RV5, if necessary, for optimum accuracy at all modulation depths.

5.10.11 Adjustment of Modulation Meter Surge Limiter

(1) Set the slider of RV9 to its negative voltage extreme, and set the frequency range switch to Band E.

5.10.11 (continued)

(2) Set the MODULATION switch to INT.

(3) Set the modulation depth to a reading exceeding 90% on the meter.

(4) Now reduce the bias on MR2 varying RV9 until a decrease in the MODULATION meter reading is just perceptible.

(5) Switch to Band A and check that, by adjusting RV9 slightly, the bias conditions are similar to those on Band E.

(6) If there is a differenee in the potentiometer settings, adjust RV9, finally, to the position which applies the more negative bias to MR2.

5.10.12 Frequency Response to External Sine Wave Modulation

(Apparatus required : Items d, e, g, and j)

(1) Turn the MODULATION switch to EXT. SINE, and set the carrier frequency to about 15 Mc/s.

(2) Apply an audio signal of about 1000 c/s to EXT. MOD. terminals and measure its level by means of the Vacuum Tube Voltmeter.

(3) Adjust the SET MODULATION control for an indicated modulation depth of 50% and note the true modulation depth by external means (see Section 5.10.10).

(4) By varying the a.f. input to the Signal Generator maintain a constant modulation depth of 50% over the range 30 c/s to 50 kc/s. Check that to achieve this the input is not varied by more than 1.5 dB.

5.10.13 External Modulation - R.F. Pulse Level

(Apparatus required : Items g and h)

(1) Switch to EXT. PULSE and at a convenient carrier frequency set the yellow (PULSE) cursor line of the attenuator to 100 mV.

(2) With no pulse input, turn the SET CARRIER control fully clockwise, ensuring also that the PEAK CARRIER control is tuned for a maximum reading.

(3) Adjust the SET CARRIER PULSE control to bring the pointer of the CARRIER LEVEL meter back to the red SET CARRIER mark.

5.10.13 (continued)

(4) Feed the R.F. output from the Generator into the Carrier Deviation Meter, and view the resultant I.F. output on an oscilloscope. Check the c.w. level and note :

(a) The attenuator reading at the (C.W.) cursor line.

(b) The signal amplitude on the oscilloscope.

(5) Set the MODULATION switch to EXT. PULSE and apply a 15 μsec pulse at a p.r.f. of 1 kc/s.

(6) Adjust the attenuator to read the same level, at the appropriate yellow (PULSE) cursor line, as was noted in (4) for C.W.

(7) Observe the waveform on the oscilloscope, and verify that the peak amplitude is within ±2 dB of the original c.w.

(8) Repeat the above check at three frequencies on each range.

5.10.14 Crystal Calibrator (Apparatus required : Item k)

Check that the crystal calibrator operates satisfactorily over all ranges of the Signal Generator.

Before checking that the frequency of the crystal oscillator is 5 Mc/s, a period of at least one hour should elapse before a measurement is taken; this ensures the maximum degree of stability. Frequency adjustment is by means of trimmers C47 and C48.

5.10.15 Carrier Suppression. (Apparatus required : Item j)

(1) Set the carrier frequency to 10 Mc/s, and the SET CARRIER control to minimum. Set MODULATION switch to EXT. PULSE. Turn the ATTENUATOR control to a setting of 70 dB.

(2) Short-circuit the EXT. PULSE socket to Earth.

(3) Connect the Signal Generator R.F. output to the receiver and note the output level.

(4) Remove the short-circuit from the EXT. PULSE socket and reset the ATTENUATOR to give the same output level as (3). The difference in attenuator settings should be greater than 20 dB.

5.10.15 (continued)

(5) Repeat the above procedure at 470 Mc/s where similar results should be obtained.

5.10.16 Residual A.M. (Apparatus required : Item f)

(1) Set MODULATION switch to INT. Adjust the SET CARRIER control, to bring the pointer of the CARRIER LEVEL meter to the SET CARRIER mark. Turn the SET MODULATION control to obtain a 30% modulation reading.

(2) Connect the output of the Signal Generator into the R.F. socket of the Wave Analyser, which should be tuned to the 1000-c/s modulation frequency; this sets the reference level.

(3) Turn the MODULATION switch to OFF and tune the Wave Analyser to 50 c/s and 100 c/s to determine the hum modulation level. The level should be at least 40 dB below the 30% modulation reference level.

5.10.17 Spurious F.M. (Apparatus required : Item h)

Connect the output of the Signal Generator to the input of the Carrier Deviation Meter.

Set the MODULATION switch to INT. and adjust the SET MODULATION control for 30% modulation as indicated on the % MODULATION meter. Check that the f.m. deviation is generally less than 0.001% of the carrier frequency. If necessary use a frequency multiplier to check the f.m. deviation at the 10 Mc/s end of Band A.

It may be advantageous to change the oscillator valve V2, or possibly the r.f. amplifier valve V6, if the spurious f.m. level is much greater than the figure given above.

AMENDMENT SHEET No. 978/2

Operating and Maintenance Handbook

for

A. M. SIGNAL GENERATOR

TYPE TF 801D/1

In some models the following circuit changes have been made :-

(1) The 150-ohm resistor R77 connected between the tuning capacitor C8 and earth, on Range E only, has been omitted.

(2) An anti-parasitic bead L25 has been included between R21 and C12.

(3) The connections to pins 1 and 3 on V6 have been interchanged.

(4) The diode valve V11 and the feedthrough capacitor in its heater circuit, C57, have been omitted.

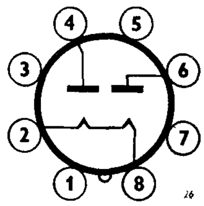
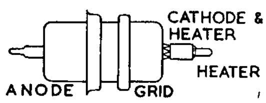
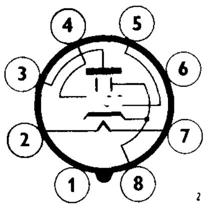
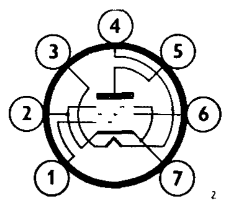
(5) A type OA 202 silicon diode, which replaces V11, has been connected between earth and the junction of R64 with filter unit TM4833C.

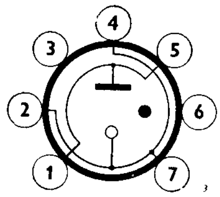
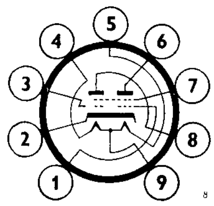
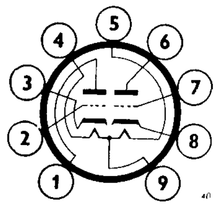
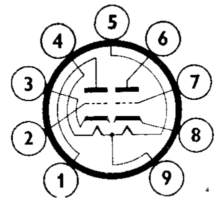
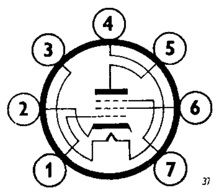
Valve Replacement Data

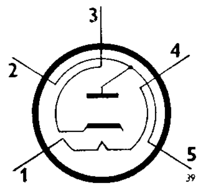
for

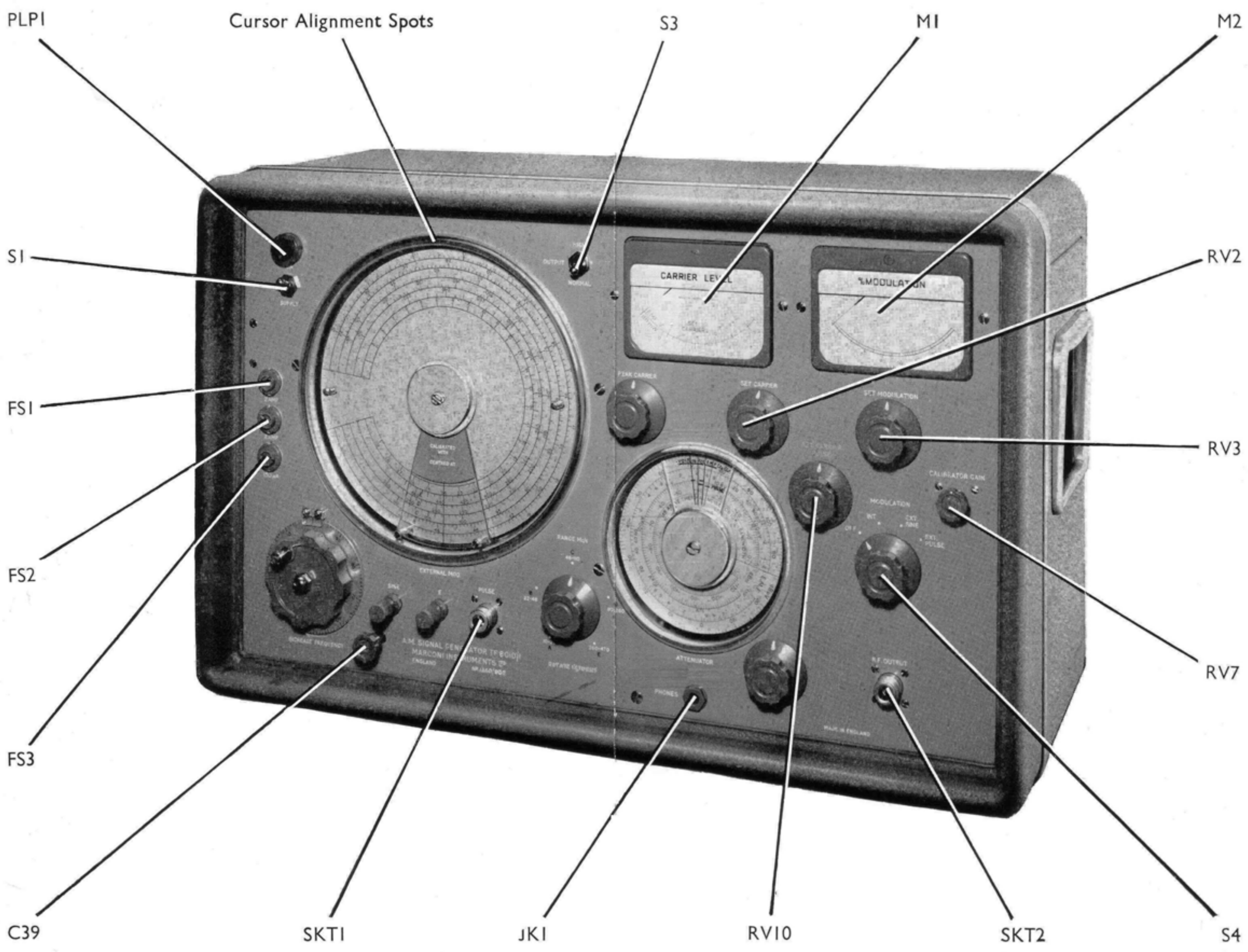
SIGNAL GENERATOR TYPE TF 801D/1

Any valve which becomes faulty should preferably be replaced by a valve of the type originally supplied in the instrument and designated in the following table. If this is not possible, the additional data given by the table may be used as a guide to suitable alternatives.

Valve	*British Commercial Equivalent*	*British Services Equivalent*	*Base*	*U.S. Equivalent*
V1 FULL-WAVE RECTIFIER BRIMAR 5R4GY		CV717	INTERNATIONAL OCTAL 	5R4GY
V2 DISK-SEAL TRIODE MARCONI DET22	TDO3-10	CV273	SPECIAL 	5861
V3 BEAM TETRODE MARCONI KT66	6L6G	CV1075 CV1947	INTERNATIONAL OCTAL 	6L6G
V4, V9 PENTODE MULLARD EF95	6AK5	CV850	MINIATURE 7-PIN (B7G) 	6AK5

Valve	*British Commercial Equivalent*	*British Services Equivalent*	*Base*	*U.S. Equivalent*
V5 VOLTAGE STABILIZER MULLARD 5651	QS1209 QS83/3 85A2	CV449	MINIATURE 7-PIN (B7G) 	5651
V6 DOUBLE TETRODE MULLARD QQV02-6		CV2466	MINIATURE 9-PIN (B9A) 	6939
V7 DOUBLE TRIODE BRIMAR 12AU7	ECC82	CV491	MINIATURE 9-PIN (B9A) 	12AU7
V8 DOUBLE TRIODE BRIMAR 12AT7	B309 ECC81	CV455	MINIATURE 9-PIN (B9A) 	12AT7
V10 PENTODE MULLARD 6AS6		CV2522	MINIATURE 7-PIN (B7G) 	6AS6

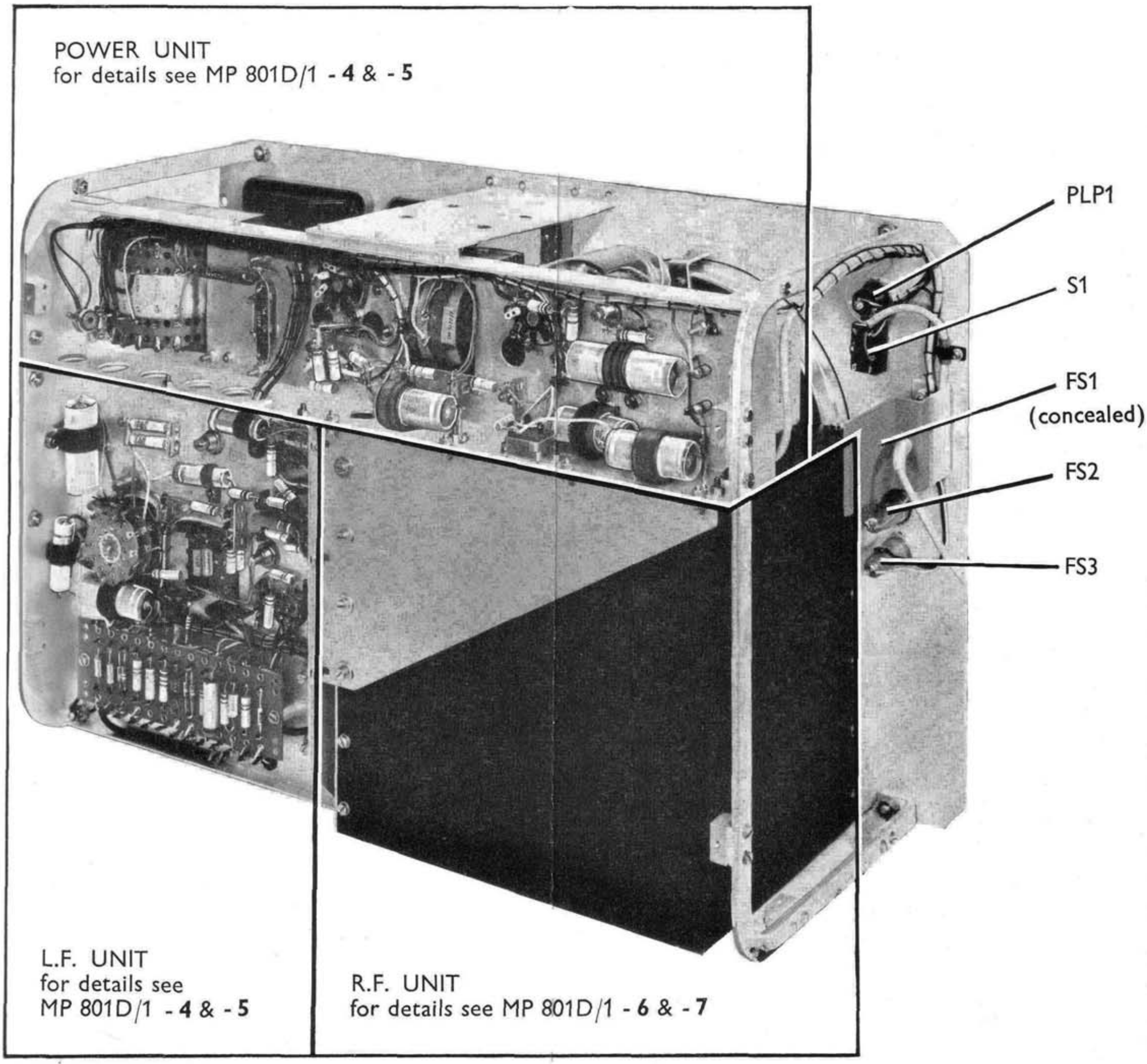
Valve	*British Commercial Equivalent*	*British Services Equivalent*	*Base*	*U.S. Equivalent*
V11 DIODE MULLARD EA76	2S/140G	CV469	SUBMINIATURE 5-LEAD (B5B/F) 	6489



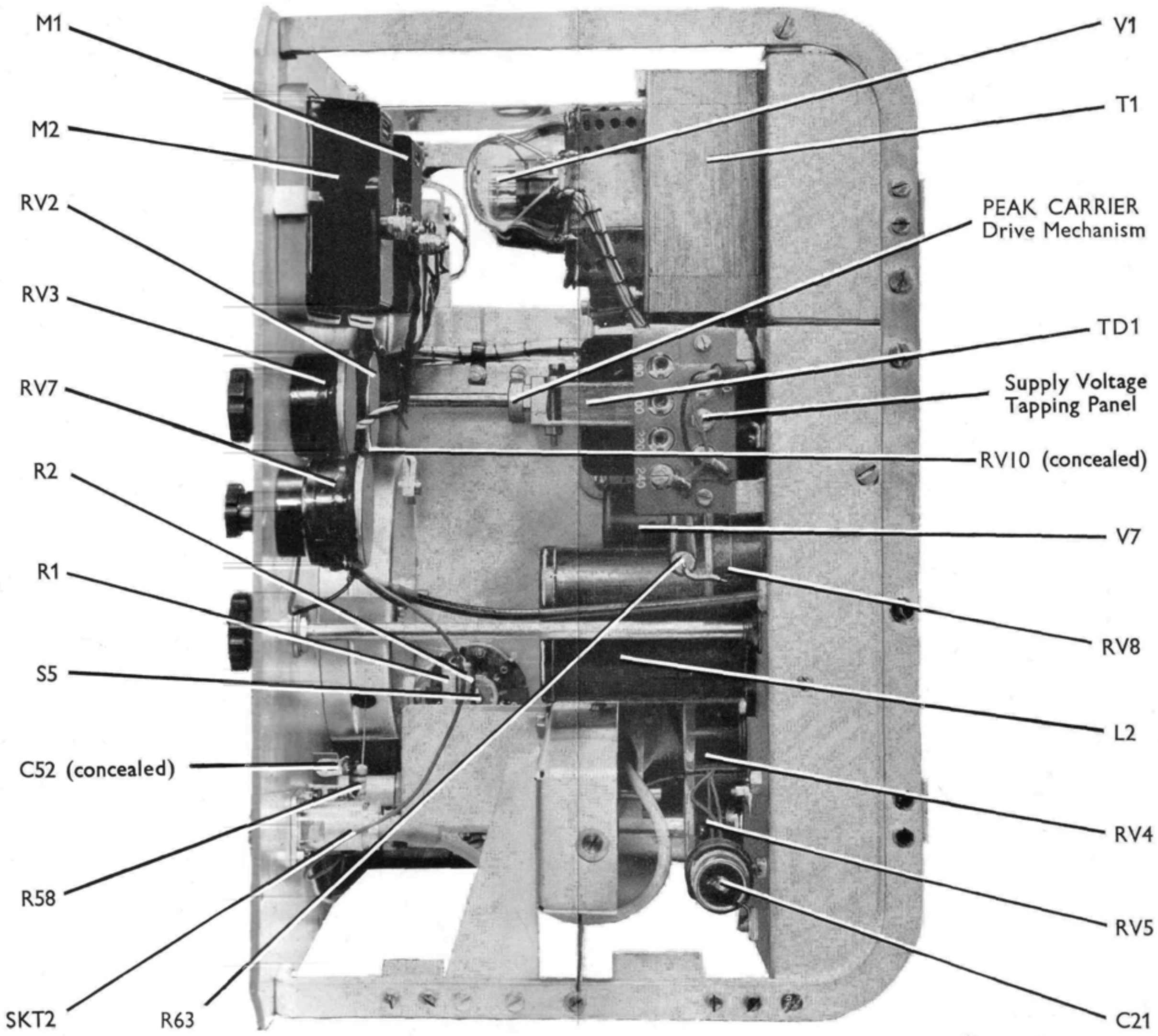
FRONT PANEL

NOTE

On later models, dual concentric knobs giving coarse (RV2) and fine (RV11) SET CARRIER adjustment have been fitted in place of the single knob illustrated.



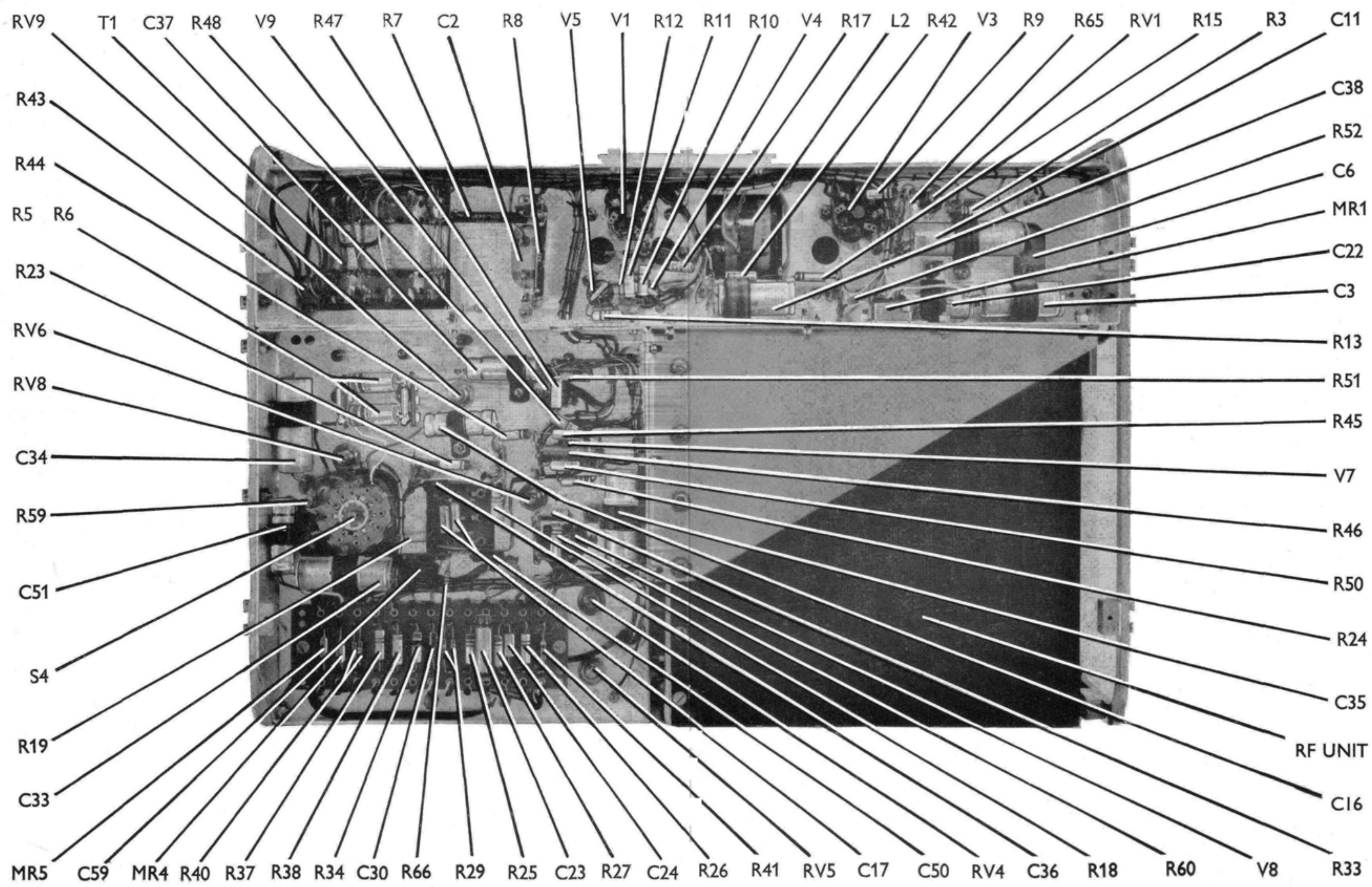
GENERAL VIEW
REAR



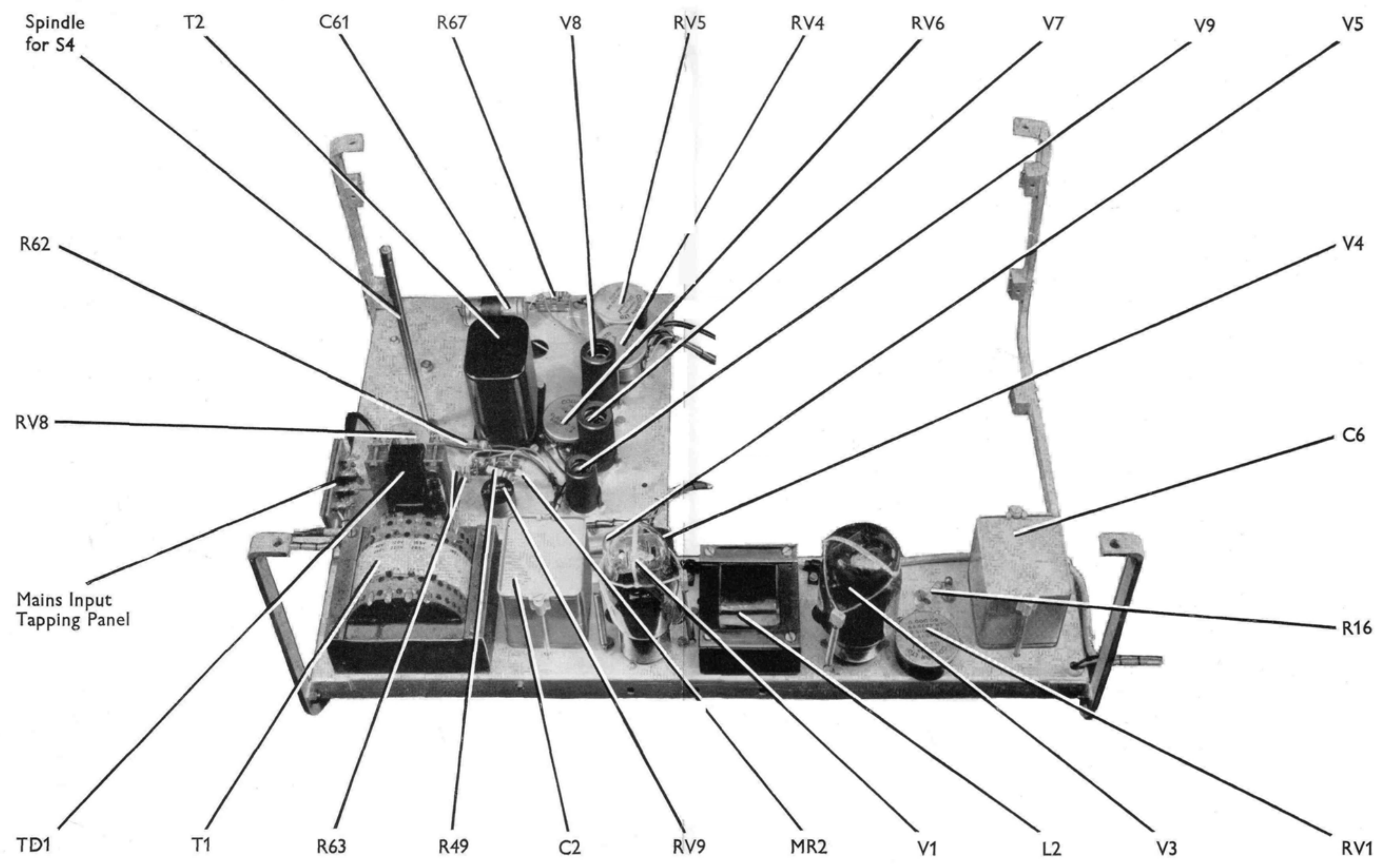
END VIEW

NOTE

On later models, a dual potentiometer (RV2, RV11) has been fitted in place of the single potentiometer (RV2) illustrated. Also, attached to the rear of the MODULATION meter, M2, is a single stage transistor amplifier on a printed board. Components C52 and R58, shown in this illustration, are now incorporated on the board

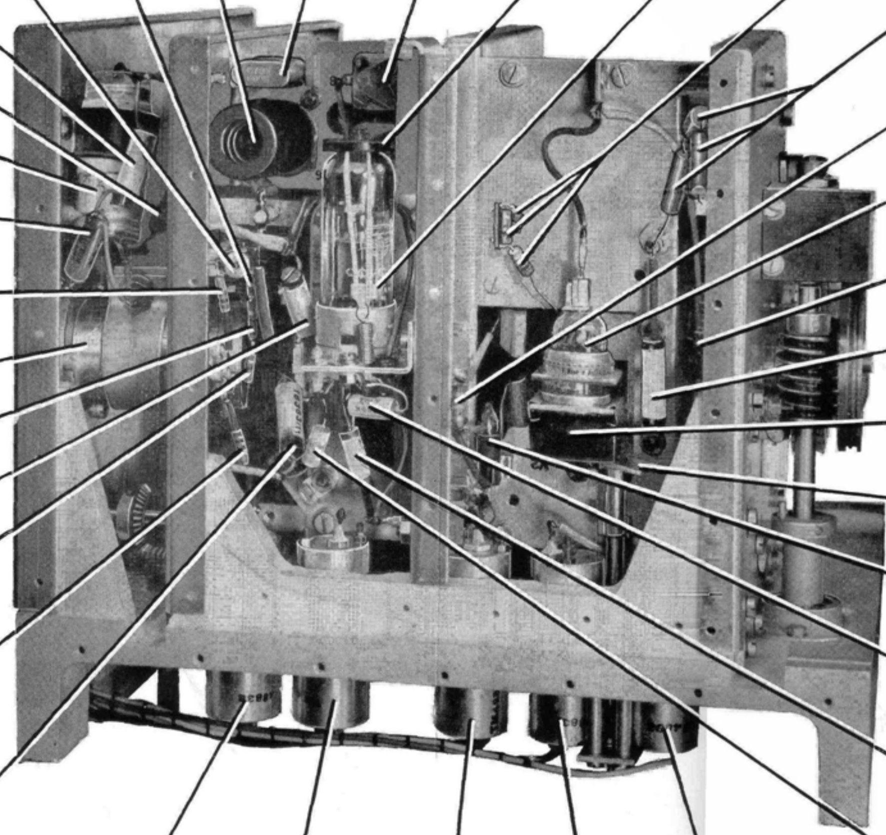


L.F. AND POWER UNIT DECK
REAR



L.F. AND POWER UNIT DECK
FRONT

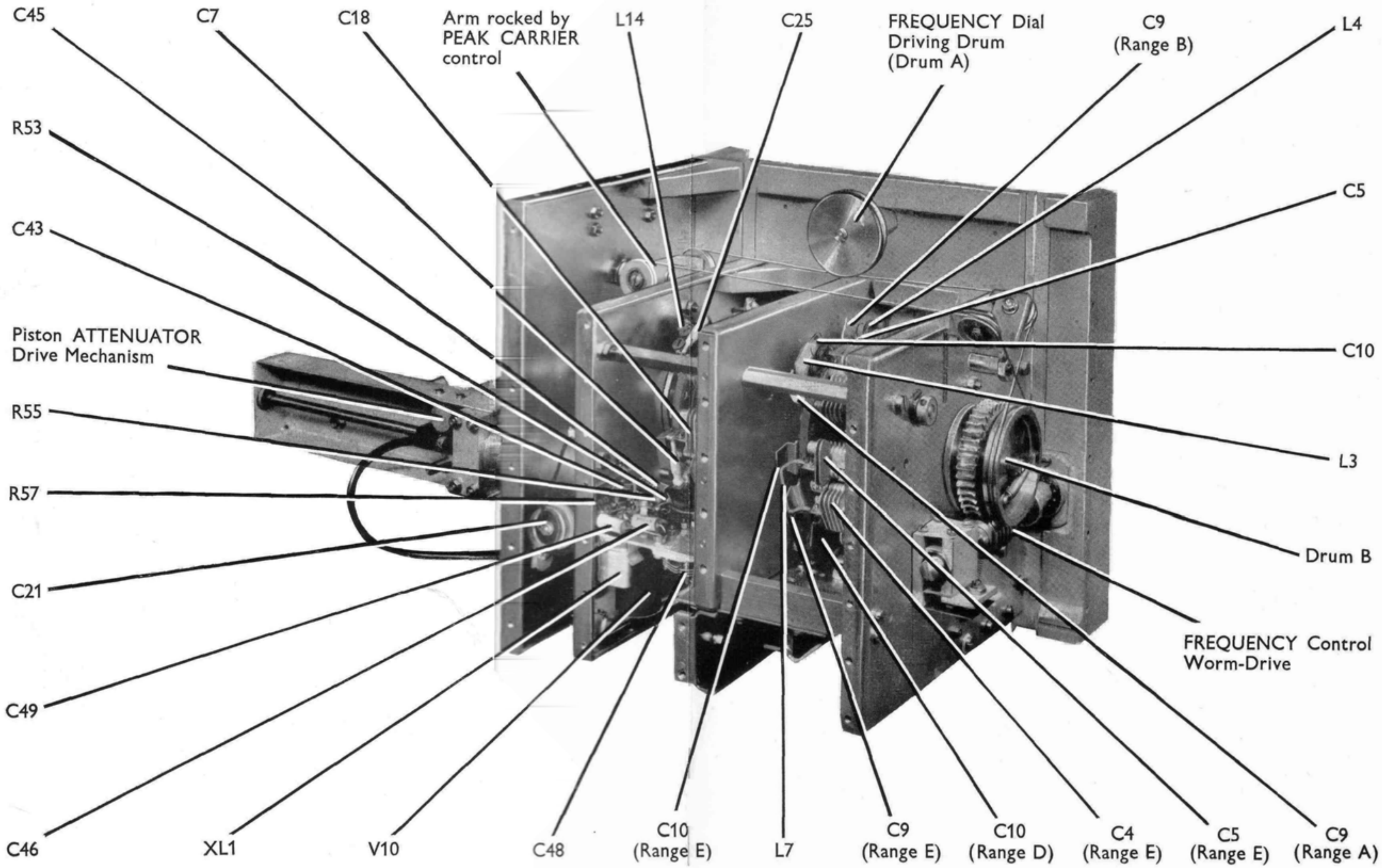
LTD. 1-7/60
2.5c. 12/61



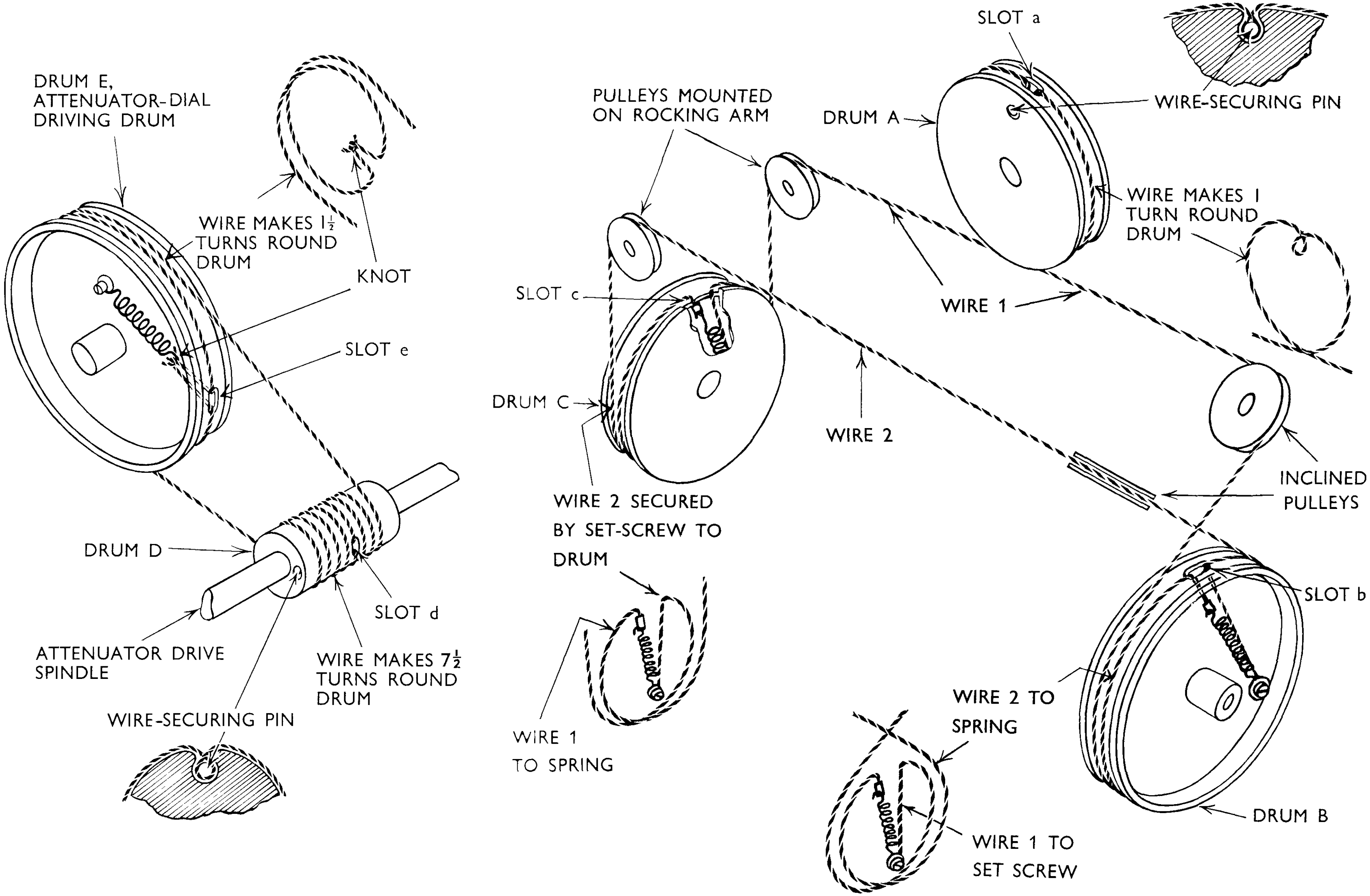
R.F. UNIT
UNDERSIDE

NOTE

On later models, the grommet to the right of V6 is replaced by a feed-through capacitor C67.


C45
C7
C18
Arm rocked by
PEAK CARRIER
control
L14
C25
FREQUENCY Dial
Driving Drum
(Drum A)
C9
(Range B)
L4
R53
C43
C5
Piston ATTENUATOR
Drive Mechanism
C10
R55
L3
R57
Drum B
C21
FREQUENCY Control
Worm-Drive
C49
C46
XL1
V10
C48
C10
(Range E)
L7
C9
(Range E)
C10
(Range D)
C4
(Range E)
C5
(Range E)
C9
(Range A)

R.F. UNIT
REAR



ATTENUATOR
SEE ALSO MP 801D/1-**3**

MAIN TUNING
SEE ALSO MP 801D/1-**7**

DRIVE—WIRE REPLACEMENT DIAGRAM

M I. LTD. 1—7 60
C.P. 2.5c. 12,61

SPARES ORDERING SCHEDULE NO. SOS/801D/1

WITH CIRCUIT REFERENCES

for

A.M. SIGNAL GENERATOR TF 801D/1

Applicable to Instruments Serial Nos :-

JA 978/001 to JA 978/250

When ordering replacement parts, always quote the TYPE NUMBER and SERIAL NUMBER of the instrument concerned.

To specify the individual parts required, state for each part the QUANTITY required and the appropriate SOS ITEM NUMBER.

For example, to order replacements for the 10-ohm resistor, R3, and the 4-μF capacitor, C2, quote as follows :-

Spares required for TF 801D/1 Serial No. 000000

1 off, SOS Item 3
1 off, SOS Item 90

It is important that the distinguishing code "SOS" preceding each item number should not be omitted.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		FIXED RESISTORS	
1	R1	Composition, 33 kΩ ± 10%, 3/4 W.	FC66612/37
2	R2	Composition, 22 kΩ ± 10%, 3/4 W.	FC66612/35
3	R3	Composition, 10 Ω ± 10%, ½W.	FC66611/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		FIXED RESISTORS (continued)	
4	R4	Composition, 4.7 kΩ ± 10%, 1/4W	PC66609/17
5	R5	Composition, 10 kΩ ± 10%, 1W.	PC66621/37
6	R6	Composition, 10 kΩ ± 10%, 1W.	PC66621/37
7	R7	Wire-wound, 22 kΩ ± 5%, 6W.	PC67010/21
8	R8	Wire-wound, 22 kΩ ± 5%, 6W.	PC67010/21
9	R9	Composition, 100 Ω ± 10%, ½W.	PC66611/13
10	R10	Composition, 4.7 kΩ ± 10%, ½W.	PC66611/33
11	R11	Composition, 680 kΩ ± 10%, ½W.	PC66611/59
12	R12	Composition, 330 kΩ ± 10%, ½W.	PC66611/55
13	R13	Composition, 47 kΩ ± 10%, ½W.	PC66611/45
14	R14	Composition, 150 kΩ ± 10%, ½W.	PC66611/51
15	R15	Composition, 100 kΩ ± 10%, ½W.	PC66611/49
16	R16	Composition, 33 kΩ ± 10%, ½W.	PC66611/43
17	R17	Composition, 68 kΩ ± 10%, ½W.	PC66611/47
18	R18	Composition, 2.7 kΩ ± 10%, ½W.	PC66611/30
19	R19	Composition, 10 kΩ ± 10%, ½W.	PC66611/37
20	R20	Composition, 47 kΩ ± 10%, 1/4W.	PC66610/45
21	R21	Composition, 47 Ω ± 10%, 1/4W.	159-TM4813/8
22	R22	Composition, 47 Ω ± 10%, 1/4W.	159-TM4813/8

SOS Item No.	Cir-cuit Ref.	Description	Works Ref.
		FIXED RESISTORS (continued)	
23	R23	Composition, 220 kΩ ± 10%, ½W.	PC66611/53
24	R24	Composition, 2.2 kΩ ± 10%, ½W.	PC66611/29
25	R25	Composition, 1 MΩ ± 10%, ½W.	PC66611/61
26	R26	Composition, 470 Ω ± 10%, ½W.	PC66611/21
27	R27	Composition, 10 kΩ ± 10%, ½W.	PC66611/37
28	R28	Composition, 220 Ω ± 10%, 1/4W.	PC66610/17
29	R29	Composition, 120 kΩ ± 10%, 1W.	16-TM4943/AW
30	R30	Composition, 50 Ω ± 2%, 1/4W.	19-TM4819/2
31	R31	Composition, 50 Ω ± 2%, 1/4W.	(See item 302)
32	R32	Composition, 180 Ω ± 10%, 1/4W.	(See item 302)
33	R33	Composition, 4.7 kΩ ± 10%, ½W.	PC66611/33
34	R34	Composition, 1 MΩ ± 10%, ½W.	PC66611/61
35	R35	Composition, 100 Ω ± 10%, 1/4W.	PC66609/7
36	R36	Composition, 100 Ω ± 10%, 1/4W.	PC66609/7
37	R37	Composition, 470Ω ± 10%, ½W.	PC66611/21
38	R38	Composition, 33 kΩ ± 10%, ½W.	PC66611/43
39	R39	Wire-wound, 3.3. kΩ ± 5%, 3W.	PC67008/16
40	R40	Composition, 22 kΩ ± 10%, ½W.	PC66611/41
41	R41	Composition, 4.7 kΩ ± 5%, 1/4W.	PC66604/33

SOS Item No.	Cir-cuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
42	R42	Composition, 120 kΩ ± 10%, $\frac{1}{2}$W.	PC66611/50
43	R43	Special, 0.42 Ω ± 10%, $\frac{1}{2}$W.	TC9638/B
44	R44	Composition, 1 MΩ ± 10%, $\frac{1}{2}$W.	PC66611/61
45	R45	Composition, 100 kΩ ± 10%, $\frac{1}{2}$W.	PC66611/49
46	R46	Composition, 47 kΩ ± 10%, 1W.	90-TF801D/1
47	R47	Composition, 680 kΩ ± 10%, $\frac{1}{2}$W.	PC66611/59
48	R48	Composition, 4.7 kΩ ± 10%, $\frac{1}{2}$W.	PC66611/33
49	R49	Composition, 100 kΩ ± 10%, $\frac{1}{2}$W.	PC66611/49
50	R50	Composition, 470 kΩ ± 10%, $\frac{1}{2}$W.	PC66611/57
51	R51	Composition, 10 kΩ ± 10%, $\frac{1}{2}$W.	PC66611/37
52	R52	Composition, 33 kΩ ± 10%, $\frac{1}{2}$W.	PC66611/43
53	R53	Composition, 10 kΩ ± 10%, $\frac{1}{2}$W.	3-TM5671
54	R54	Composition, 4.7 kΩ ± 10%, $\frac{1}{2}$W.	PC66611/33
55	R55	Composition, 22 kΩ ± 10%, $\frac{1}{2}$W.	4-TM5671
56	R56	Composition, 470 Ω ± 10%, $\frac{1}{2}$W.	5-TM5671
57	R57	Composition, 15 kΩ ± 10%, $\frac{1}{2}$W.	6-TM5671
	R58	See SOS Item No. 294.	
59	R59	Composition, 330 kΩ ± 10%, $\frac{1}{2}$W.	PC66611/55
60	R60	Composition, 100 kΩ ± 10%, 1W.	111-TF801D/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
61	R61	Composition, 680 Ω ± 10%, 1W.	216-TM4813/8
62	R62	Composition, 47 kΩ ± 10%, 3/4W.	PC66612/ 39
63	R63	High Stab., 39 kΩ ± 5%, 2W.	110-TF801D/1
64	R64	Composition, 470 Ω ± 10%, 1/4W.	PC66609/15
65	R65	Composition, 1.8 MΩ ± 10%, ½W.	PC66611/64
66	R66	Composition, 390 kΩ ± 10%, 1/4W.	PC66609/50
67	R67	Composition, 1 kΩ ± 10%, ½W.	PC66611/25
68	R68	Composition, 180 Ω ± 10%, 1/4W.	PC66609/10
69	R69	Composition, 180 Ω ± 10%, 1/4W.	PC66609/10
70	R70	Composition, 33 kΩ ± 10%, 1/4W.	169-TM4813/8
71	R71	Composition, 330 kΩ ± 10%, 1/4W.	173-TM4813/8
72	R72	Composition, 330 kΩ ± 10%, 1/4W.	173-TM4813/8
73	R73	Composition, 680 Ω ± 10%, 1W.	216-TM4813/8
74	R74	Composition, 680 Ω ± 10%, 1W.	216-TM4813/8
75	R75	Composition, 4.7 kΩ ± 10%, 1/4W.	56-TM4813/8
76	R76	Composition, 4.7 kΩ ± 10%, 1/4W.	56-TM4813/8
78	R78	Composition, 12 kΩ ± 10%, 1/4W.	183-TF 801D/1
79	R79	Composition, 330 kΩ ± 10%, 1/4W.	184-TF801D/1
79/1	R80	Composition, 47Ω ± 10%, 1/4W.	181-TF801D/1
79/2	R87	Composition 100 Ω ±10%, 1/4W.	
	R81 to R86	See SOS Item Nos. 295 to 299/1	

SOS Item No.	Circuit Ref.	Description	Works Ref.
		VARIABLE RESISTORS	
80	RV1	Wire-wound, 50 kΩ, 2W.	TB24323/1
81	RV2	Wire-wound, 2 kΩ, 1W. (Dual control RV2/RV11)	171-TF801D/1
82	RV3	Wire-wound, 2 kΩ, 1W.	TB17392/11
83	RV4	Wire-wound, 5 kΩ, 2W.	TB24323/1
84	RV5	Wire-wound, 50 kΩ, 2W.	TB24323/1
85	RV6	Wire-wound, 5 kΩ, 2W.	TB24323/1
86	RV7	Wire-wound, 100 kΩ, 3/8W.	103-TF801D/1
87	RV8	Wire-wound, 10 kΩ, 1W.	TB13015/5
88	RV9	Wire-wound, 10 kΩ, 1W.	91-TF801D/1
89	RV10	Wire-wound, 50 kΩ, $7\frac{1}{2}$W. (Special)	213-TF801D/1
89/1	RV11	Wire-wound, 200 Ω, 1W (Dual control RV2/RV11)	171-TF801D/1
		CAPACITORS	
90	C2	Paper, 4 μF ± 20%, 600 V d.c.	PC19212/3
91	C3	Electrolytic, 8 μF -20% + 50%, 450 V d.c.	PC18406/2
92	C4	Special; part of R.F. Oscillator Assembly.	
93	C5	Special; part of R.F. Oscillator Assembly.	
94	C6	Paper, 4 μF ± 20%, 600 V d.c.	PC19212/3
95	C7	Variable, Air, 0.5 - 3 μμF.	14-TM4820/5

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
96	C8	Special; part of R.F. Oscillator Assembly.	
97	C9	Special; part of R.F. Oscillator Assembly.	
98	C10	Special; part of R.F. Oscillator Assembly.	
99	C11	Paper, 0.25 μF ± 20%, 350 V d.c.	PC19202/17
100	C12	Feed-Through 10 μμF ± 30%, 350 V d.c.	146-TM4813/8
101	C13	Ceramic, 22 μμF ± 10%, 750 V d.c.	12-TM5671
102	C14	Feed-Through, 10 μμF ± 30%, 350 V d.c.	146-TM4813/8
103	C16	Paper, 0.1 μF ± 20%, 350 V d.c.	PC19202/15
104	C17	(Paper, 0.01 μF ± 10%, 400 V d.c.) (Paper, 0.005 μF ± 10%, 400 V d.c.)	8-TM1296D
105	C18	Special; part of R.F. Amplifier Assembly.	
106	C19	Special; part of R.F. Amplifier Assembly.	
107	C20	Special; part of R.F. Amplifier Assembly.	
108	C21	Electrolytic, 8 μF -20% + 50%, 450 V d.c.	PC18406/2
109	C22	Electrolytic, 8 μF -20% + 50%, 450 V d.c.	PC18406/2

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
110	C23	Paper, 0.05 μF ± 20%, 200 V d.c.	PC19201/6
111	C24	Ceramic, 220 μμF ± 20%, 350 V d.c.	PC18203/1
112	C25	Variable, Air, 0.5 - 3 μμF.	14-TM4820/5
113	C26	Variable, Air, 0.5 - 3 μμF.	14-TM4820/5
114	C27	Variable, Air, 0.5 - 3 μμF.	14-TM4820/5
115	C28	Variable, Air, 0.5 - 3 μμF.	14-TM4820/5
116	C29	Ceramic, 100 μμF ± 10%, 500 V d.c.	PC18202/13
117	C30	Paper, 0.01 μF±20%, 400 V d.c.	8-TM4943/AW
118	C31	Special, 12.0 μμF ± 1.0 μμF; part of Attenuator Assembly.	(See item 302)
119	C32	Special, 200 μμF ± 10%, part of R.F. Unit Assembly.	201-TM4813/8
120	C33	Paper, 2 μF ± 25%, 150 V d.c.	PC19301/5
121	C34	Paper, 2 μF ± 25%, 150 V d.c.	PC19301/5
122	C35	Paper, 2 μF ± 25%, 150 V d.c.	PC19301/5
123	C36	Paper, 0.01 μF ± 20%, 400 V d.c.	83-TF801D/1
124	C37	Paper, 0.1 μF ± 20%, 350 V d.c.	PC19202/15
125	C38	Electrolytic, 8 μF -20% + 50%, 450 V d.c.	PC18406/2
126	C39	Special, Variable (Vane assembly)	TB28349

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
127	C40	Feed-Through, 500 μμF ± 20%, 750 V d.c.	151-TM4813/8
128	C41	Filter Capacitor, 820 μμF ± 20%, 500 V d.c.	152-TM4813/8
129	C42	Feed-Through, 500 μμF ± 20%, 750 V d.c.	151-TM4813/8
130	C43	Paper, 0.001 μF ± 20%, 400 V d.c.	10-TM5671
131	C44	Paper, 0.001 μF±20%, 400 V d.c.	10-TM5671
132	C45	Paper, 0.01 μF ± 20%, 400 V d.c.	11-TM5671
133	C46	Ceramic, 22 μμF ± 10%, 750 V d.c.	12-TM5671
134	C47	Variable, Air, 3 - 19 μμF.	13-TM5671
135	C48	Variable, Air, 3 - 19 μμF.	13-TM5671
136	C49	Ceramic, 22 μμF ± 10%, 750 V d.c.	12-TM5671
137	C50	Paper, 0.01 μF ± 20%, 400 V d.c.	83-TF801D/1
138	C51	Paper, 0.1 μF ± 20%, 350 V d.c.	PC19202/15
	C52	See SOS Item No. 300	
140/a	C53	Feed-Through, 4700 μμF ± 30%, 350V d.c.	149-TM4813/8
141/a	C54	Feed-Through, 4700 μμF ± 30%, 350 V d.c.	149-TM4813/8
142	C55	Filter Capacitor, 820 μμF ± 20%, 500 V d.c.	152-TM4813/8
143/a	C56	Feed-Through, 4700 μμF ± 30%, 350 V d.c.	149-TM4813/8

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
144	C57	Feed-Through, 4700 μμF ± 30%, 350 V d.c.	147-TM4813/8
145	C58	Feed-Through, 10 μμF ± 30%, 350 V d.c.	146-TM4813/8
146	C59	Paper, 0.005 μF ± 20%, 400 V d.c.	84-TF801D/1
147	C60	Paper, 0.001 μF ± 20%, 400 V d.c.	85-TF801D/1
148	C61	Electrolytic, 8 μF -20% + 50%, 450 V d.c.	PC18406/2
149	C62	Paper, 0.02 μF ± 20%, 350 V d.c.	185-TF801D/1
150	C63	Electrolytic, 20 μF -20% + 50%, 12 V d.c.	PC18404/6
151	C64	Electrolytic, 20 μF 20% + 50%, 12 V d.c.	PC18404/6
152	C65	Electrolytic, 25 μF - 20% + 100, 12 V d.c.	186-TF801D/1
	C66	See SOS Item No. 301.	
152/1	C67	Feed-Through, 4700 μμF ± 30%, 350 V d.c.	147-TM4813/8
		CHOKES AND INDUCTORS	
153	L1	R.F. Inductor.	TB16363/11
154	L2	Smoothing Choke.	TM5172/7
155	L3	Oscillator Tuning Coil, Band A.	1-TM4821/5
156	L4	Oscillator Tuning Coil, Band B.	2-TM4821/5
157	L5	Oscillator Tuning Coil, Band C.	3-TM4821/5
158	L6	Oscillator Tuning Coil, Band D.	4-TM4821/5

SOS Item No.	Cir-cuit Ref.	Description	Works Ref.
		CHOKES AND INDUCTORS (continued)	
159	L7	Oscillator Tuning Coil, Band E.	5-TM4821/5
160	L8	Amplifier Centre-Tapped Grid-Choke.	TB23173/44
161	L11	Heater Lead R.F. Choke.	TB23173/43
162	L12	Amplifier Anode Choke.	TB16363/11
163	L13	Amplifier Anode Choke.	TB16363/11
164	L14	Amplifier Tuning Coil, Band A.	1-TM4820/5
165	L15	Amplifier Tuning Coil, Band B.	2-TM4820/5
166	L16	Amplifier Tuning Coil, Band C.	3-TM4820/5
167	L17	Amplifier Tuning Coil, Band D.	4-TM4820/5
168	L18	Amplifier Tuning Coil, Band E.	5-TM4820/5
169	L19	Attenuator Pick-up Coil.	(See item 302)
170	L21	R.F. Choke.	TB16363/11
171	L22	R.F. Choke.	TB16363/11
171/1	L23	Anti-Parasitic Bead.	218-TM4813/8
171/2	L24	Anti-Parasitic Bead.	218-TM4813/8
171/3	L25	Anti-Parasitic Bead.	218-TM4813/8
		TRANSFORMERS AND TRANSDUCTOR	
172	T1	Mains Transformer.	TM5150/23
173	T2	A.F. Oscillator Transformer.	TM1296D
174	TD1	Transductor.	TM5672

SOS Item No.	Circuit Ref.	Description	Works Ref.
		SWITCHES	
175	S1	Mains Switch, 2-pole Toggle.	TB23903/2
176	S2	Oscillator H. T. Switch, Special.	64-TM4813/8
177	S3	Normal/High Switch, Toggle.	TB23903/2
178	S4	Rotary, 3 Section, 4 Position.	TC31600/4
179	S5	Rotary, Oscillator H. T. Switch, 1 Section 5 Position.	TC4418/385
		VALVES, HOLDERS, AND RETAINERS	
181	V1	5R4GY, Full-Wave Rectifier.	73-TF801D/1
182		Valveholder for V1, Int. Octal.	PC81814/1
183		Retainer for V1.	TC22744/5
184	V2	DET22, Disk-Seal Triode.	145-TM4813/8
185		Thermal Shunt for V2 Anode.	TE23153/12
186		Retaining Clip for V2; L.H.	TE23094/5
187		Retaining Clip for V2; R.H.	TE23094/5A
188		Cathode Connector for V2.	TE23130/7
189		Heater Contact for V2.	132-TM4813/8
190	V3	KT66, Beam Tetrode.	79-TF801D/1
191		Valveholder for V3-Int. Octal.	PC81814/1
192		Retainer for V3.	TC22744/57

SOS Item No.	Circuit Ref.	Description	Works Ref.
		VALVES, HOLDERS, AND RETAINERS (continued)	
193	V4	EF95, Pentode.	74-TF801D/1
194		Valveholder for V4; B7G, with skirt.	TB26904/2
195		Screening Can for V4.	PC17501/1
196	V5	5651, Voltage Stabilizer.	77-TF801D/1
197		Valveholder for V5; B7G with skirt.	TB26904/2
198		Retainer for V5.	PC82501/1
199	V6	QQV2-6, Double Tetrode.	143-TM4813/8
200		Valveholder for V6; B9A.	TB26905
201		Retainer for V6.	TB27769
202	V7	12AU7, Double Triode.	75-TF801D/1
203		Valveholder for V7; B9A with skirt.	TB26905/2
204		Screening Can for V7.	PC17502/2
205	V8	12AT7, Double Triode.	78-TF801D/1
206		Valveholder for V8; B9A with skirt.	TB26905/2
207		Screening Can for V8.	PC17502/2
208	V9	EF95, Pentode.	74-TF801D/1
209		Valveholder for V9; B7G with skirt.	TB26904/2
210		Screening Can for V9.	PC17501/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		VALVES, HOLDERS, AND RETAINERS (continued)	
211	V10	6AS6, Pentode.	142-TM4813/8
212		Valveholder for V10; B7G with skirt.	TB26904/2
213		Screening Can for V10.	PC17501/1
214	V11	EA76, Diode.	144-TM4813/8
		OSCILLATOR CRYSTAL	
215	XL1	QO.1670A, 5Mc/s Crystal.	19-TM5671
216		Crystal Retaining Clip.	PC69001/1
		METAL RECTIFIERS AND SEMICONDUCTOR DIODES	
217	MR1	C2D, Metal Rectifier.	100-TF801D/1
218	MR2	OA202, Silicon Diode.	76-TF801D/1
219	MR3	CS2A, Silicon Rectifier.	122-TM4813/8
220	MR4	CG1E, Germanium Rectifier.	21-TM4943/AW
221	MR5	CG1E, Germanium Rectifier.	21-TM4943/AW
222	MR6	OA202, Silicon Diode	76-TF801D/1
		LAMPS	
223	PLP1	6.3-Volt, 0.15-amp, Pilot Lamp.	148-TF801D/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		FUSES	
224	FS1	2-amp, Glass Cartridge.	145-TF801D/1
225	FS2	2-amp, Glass Cartridge.	145-TF801D/1
226	FS3	150-mA, Glass Cartridge.	144-TF801D/1
		PLUGS, SOCKETS, AND CONNECTING LEADS	
227	JK1	Phone Jack, Type P75.	135-TF801D/1
228	SKT1	Coaxial, 50-ohm, Type N Socket.	159-TF801D/1
229	SKT2	Coaxial, 50-ohm, Type N Socket.	15-TM4819
230	PL1	* 3-pin, 5-amp, Mains Plug. (Part of Item 231)	1-TM2560BG
231		Mains Lead, Includes Item 230.	TM2560BG
232		6-dB Attenuator Pad (50-ohm).	TM4919/1
233		20-dB Attenuator Pad (50-ohm).	TM4919
234		Output Lead (50-ohm) 36 inches long.	TM4824
		METERS	
235	M1	100µA F.S.D. Meter.	TM3970/82
236	M2	100µA F.S.D. Meter.	TM3970/50

* In instances where the instrument has been supplied ready-adjusted for 100- to 150- volt operation, it is normal practice for an American-type 2-pin plug to be fitted to the supply lead instead of the 3-pin 5-amp plug specified above.

SOS Item No.	Cir-cuit Ref.	Description	Works Ref.
		KNOBS, DRIVES, AND DIALS	
237		Knob for Freqeuncy Dial, included in Item 242.	1-TM4817
238		Handle, with Screw, for Frequency Control, included in Item 242.	TD23123/5 TB23172/3
239		Incremental Frequency Dial included in Item 242	6-TM4817
240		Dome Nut, for fixing Item23 included in Item 242	TB24145/17
241		Cursor for Incremental Frequency Dial, included in Item 242.	TB25273/9
242		Complete Frequency Knob and Incremental Dial Assembly, includes Items 237 to 242.	TM4817
243		Frequency Dial.	TC28662
244		Cursor for Frequency Dial.	28-TF801D/1
245		Spacer, fits between cursor and dial window.	TB24947/29
246		Finger Knobs on Frequency Dial window.	TB28942
247		Window for Frequency Dial.	TC18378/5
248		Centre Mask, 2 inches Diameter, for Frequency Dial.	TC23983/2
249		Spun Housing, for Frequency Dial Assembly.	TD23113

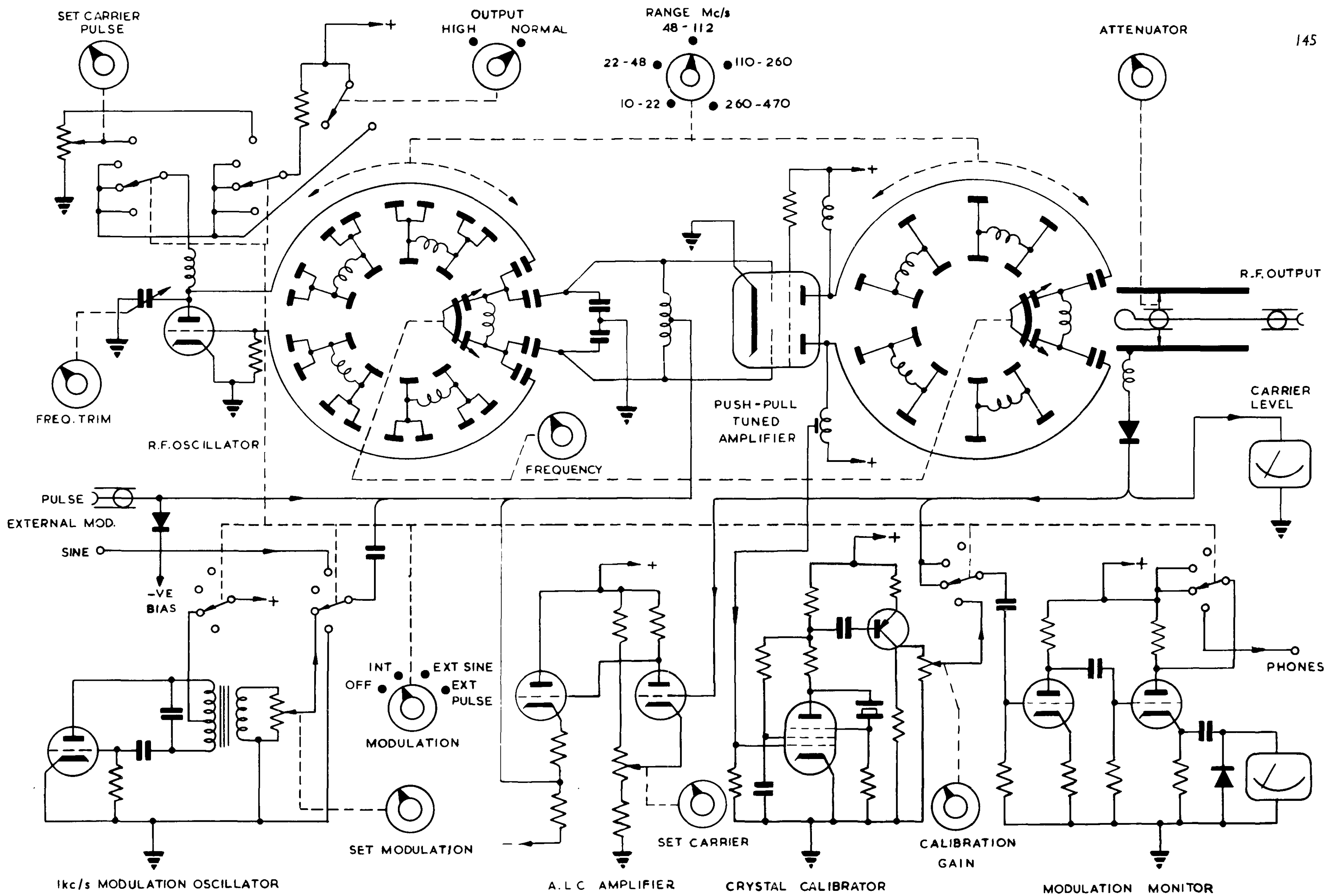
SOS Item No.	Circuit Ref.	Description	Works Ref.
		KNOBS, DRIVES, & DIALS (continued)	
250		Clamp to anchor Item 249.	TE17645/15A
251		Captive Centre-Screw, for Frequency Dial Window.	TE18339/15
252		Captive Washer, for Frequency Dial Window.	TE18339/14
253		Compression Spring, fits under Item 244.	TB25849
254		Mounting Bush for Frequency Dial.	TE 23099/8
255		Cursor Centre Retainer, fits into Item 254.	TE23099/9
256		Stainless Steel Tuning Drive Wires (Set of Two).	185-TM4813/8 186-TM4813/8
257		Wire-Retaining Spring, for either Tuning Rotor Drive Drum, (B or C).	TB15342/12
258		Wire-Retaining Pin, for Tuning Dial Drive Drum.	175-TM4813/8
259		Skirted Knob, 1 5/8 inches diameter.	TB17848/3
259/1		Skirted Knob, for RV2.	TB28179/1
260		Plain Knob, small, for C39.	153-TF801D/1
261		Plain Knob, small, for RV7.	TB23920/1
261/1		Plain Knob, small, for RV11.	TB28180/1
262		Attenuator Dial.	25-TF801D/1
263		Cursor for Attenuator Dial.	29-TF801D/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		KNOBS, DRIVES, AND DIALS (continued)	
264		Window for Attenuator Dial.	TC25848/1A
265		Centre Mask, 2 inches Diameter, for Attenuator Dial.	TC23983/2
266		Spun Housing for Attenuator Dial Assembly.	TC23121
267		Clamp, to anchor Item 266.	TE17645/15A
268		Captive Centre-Screw, for Attenuator Dial Window.	TE18339/15
269		Captive Washer, for Attenuator Dial Assembly.	TE18339/14
270		Compression Spring, to fit under Item 263	TB25849
271		Mounting Boss and Drive Drum Assembly, for Attenuator Dial.	TE23106/8
272		Fixed Spindle for Attenuator Dial.	TE23099/14
273		Stainless Steel Attenuator-Drive Wire, 30 inches long.	TB18892
274		Drive Wire Retaining Spring, for Attenuator Dial Driving Drum (E).	TB15342/5
275		Drive Wire Retaining Pin, for small Attenuator Dial Driving Drum (D).	139-TF801D/1
		MISCELLANEOUS	
276		Complete Case Assembly.	TE23540

SOS Item No.	Circuit Ref.	Description	Works Ref.
		MISCELLANEOUS (continued)	
277		Front Panel.	TE23108/10
278		Front Panel Surround.	TE23103
279		Extruded Rubber Edging Strip, fits front endge of Item 277.	TB23984
280		Extruded Aluminium Edging Strip, fits between Items 278 and 276.	21-TF801D/1
281		Case Handle Escutcheon.	TC17659
282		Case Foot.	TA11420
283		R.F. Unit Bottom Cover Plate (inner), with Packing Strip.	TE23100/3A
284		R.F. Unit Top Cover Plate (inner), with Packing Strip.	TE23100/1
285		R.F. Unit Back Cover Plate (inner).	TE23100/2A
286		R.F. Unit Bottom Cover Plate (outer).	TE23100/4
287		R.F. Unit Main Outer Cover Plate.	TE23101
288		Terminal, (SINE or E).	TB24330/5
289		Mains Voltage Tapping Panel.	TA22394
290		Translucent Plastic Transit Cover for Instrument.	173-TF801D/1
291		Operating and Maintenance Handbook.	OM801D/1

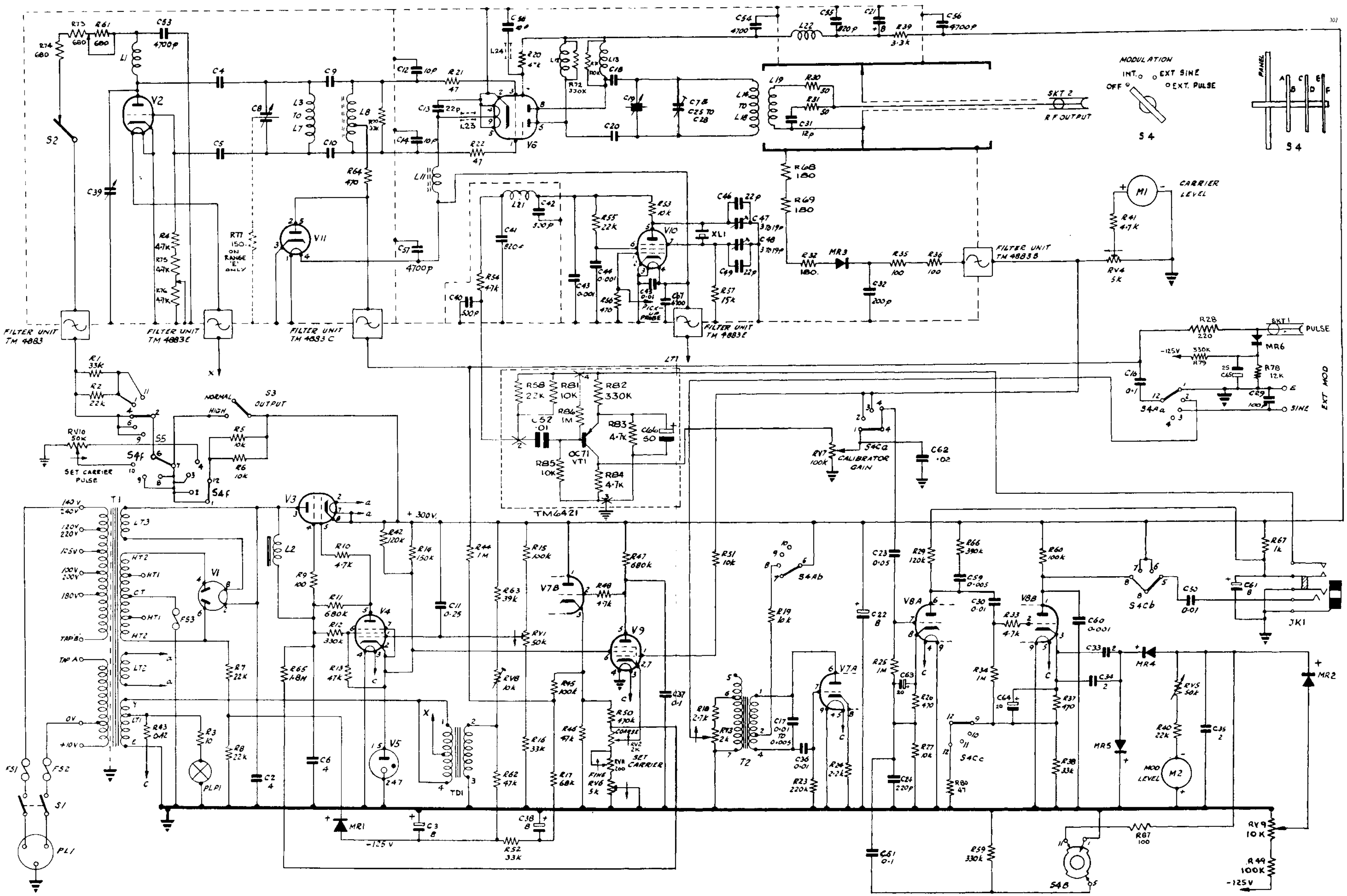
PRINTED CIRCUIT BOARD AND COMPONENTS TM 6421
(Transistor Amplifier for Crystal Calibrator)

SOS Item No.	Circuit Ref.	Description	Works Ref.
292		Printed Circuit Board.	1 - TM 6421
293	VT.1	OC 71 Junction Transistor.	13 - TM 6421
293/1		Mounting Clip for above.	14 - TM 6421
294	R58	Composition, 22 kΩ ± 10%, 1W.	6 - TM 6421
295	R81	Composition, 10 kΩ ± 10%, 1W.	5 - TM 6421
296	R82	Composition, 330 kΩ ± 10%, 1/4W.	PC66609/49
297	R83	Composition, 4.7 kΩ ± 10%, 1/4W.	PC66609/27
298	R84	Composition, 4.7 kΩ ± 10%, 1/4W.	PC66609/27
299	R85	Composition, 10 kΩ ± 10%, 1/4W.	7 - TM 6421
299/1	R86	Composition, 1 MΩ ± 10%, 1/4W.	8 - TM 6421
300	C52	Paper, 0.01 µF ± 20%, 400 V d.c.	10 - TM 6421
301	C66	Electrolytic, 50 µF - 20% + 100%, 12 V	9 - TM 6421
302		Piston Head Assembly containing items 30 31 116 and 169	2, 3, 8, 19, and 21/TM 4819/2



FUNCTIONAL DIAGRAM

M.I. LTD. TF 801D 1 1*—7,60
C.P. 2.5c. 12 61



CIRCUIT DIAGRAM

COMPONENT VALUES: **Resistors:** No suffix = ohms. k = kilohms. M = megohms.
Capacitors: No suffix = microfarads. p = picofarads.

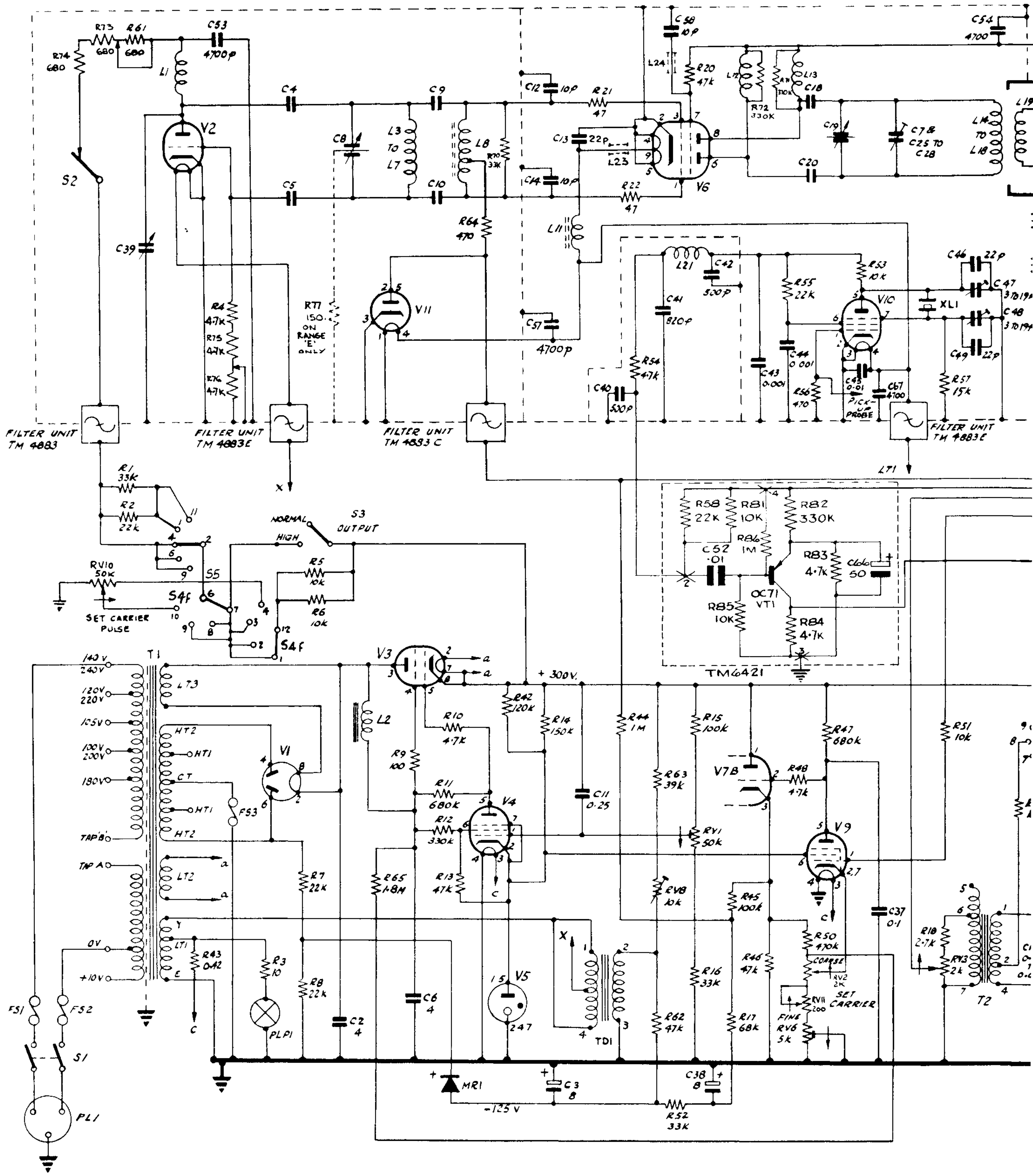
DECIBEL CONVERSION TABLE

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

DECIBEL CONVERSION TABLE

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	·006310	**22**	12·59	158·5
·06310	·003981	**24**	15·85	251·2
·05012	·002512	**26**	19·95	398·1
·03981	·001585	**28**	25·12	631·0
·03162	·001000	**30**	31·62	1,000
·02512	·0006310	**32**	39·81	1,585
·01995	·0003981	**34**	50·12	2,512
·01585	·0002512	**36**	63·10	3,981
·01259	·0001585	**38**	79·43	6,310
·01000	·0001000	**40**	100·00	10,000
·007943	·00006310	**42**	125·9	15,850
·006310	·00003981	**44**	158·5	25,120
·005012	·00002512	**46**	199·5	39,810
·003981	·00001585	**48**	251·2	63,100
·003162	·00001000	**50**	316·2	100,000
·002512	$6{\cdot}310 \times 10^{-6}$	**52**	398·1	158,500
·001995	$3{\cdot}981 \times 10^{-6}$	**54**	501·2	251,200
·001585	$2{\cdot}512 \times 10^{-6}$	**56**	631·0	398,100
·001259	$1{\cdot}585 \times 10^{-6}$	**58**	794·3	631,000
·001000	10^{-6}	**60**	1,000	10^{6}
·0005623	$3{\cdot}162 \times 10^{-7}$	**65**	1,778	$3{\cdot}162 \times 10^{6}$
·0003162	10^{-7}	**70**	3,162	10^{7}
·0001778	$3{\cdot}162 \times 10^{-8}$	**75**	5,623	$3{\cdot}162 \times 10^{7}$
·0001000	10^{-8}	**80**	10,000	10^{8}
·00005623	$3{\cdot}162 \times 10^{-9}$	**85**	17,780	$3{\cdot}162 \times 10^{8}$
·00003162	10^{-9}	**90**	31,620	10^{9}
·00001000	10^{-10}	**100**	100,000	10^{10}
$3{\cdot}162 \times 10^{-6}$	10^{-11}	**110**	316,200	10^{11}
10^{-6}	10^{-12}	**120**	10^{6}	10^{12}
$3{\cdot}162 \times 10^{-7}$	10^{-13}	**130**	$3{\cdot}162 \times 10^{6}$	10^{13}
10^{-7}	10^{-14}	**140**	10^{7}	10^{14}

AP 8876/5/62 Form 1061/2

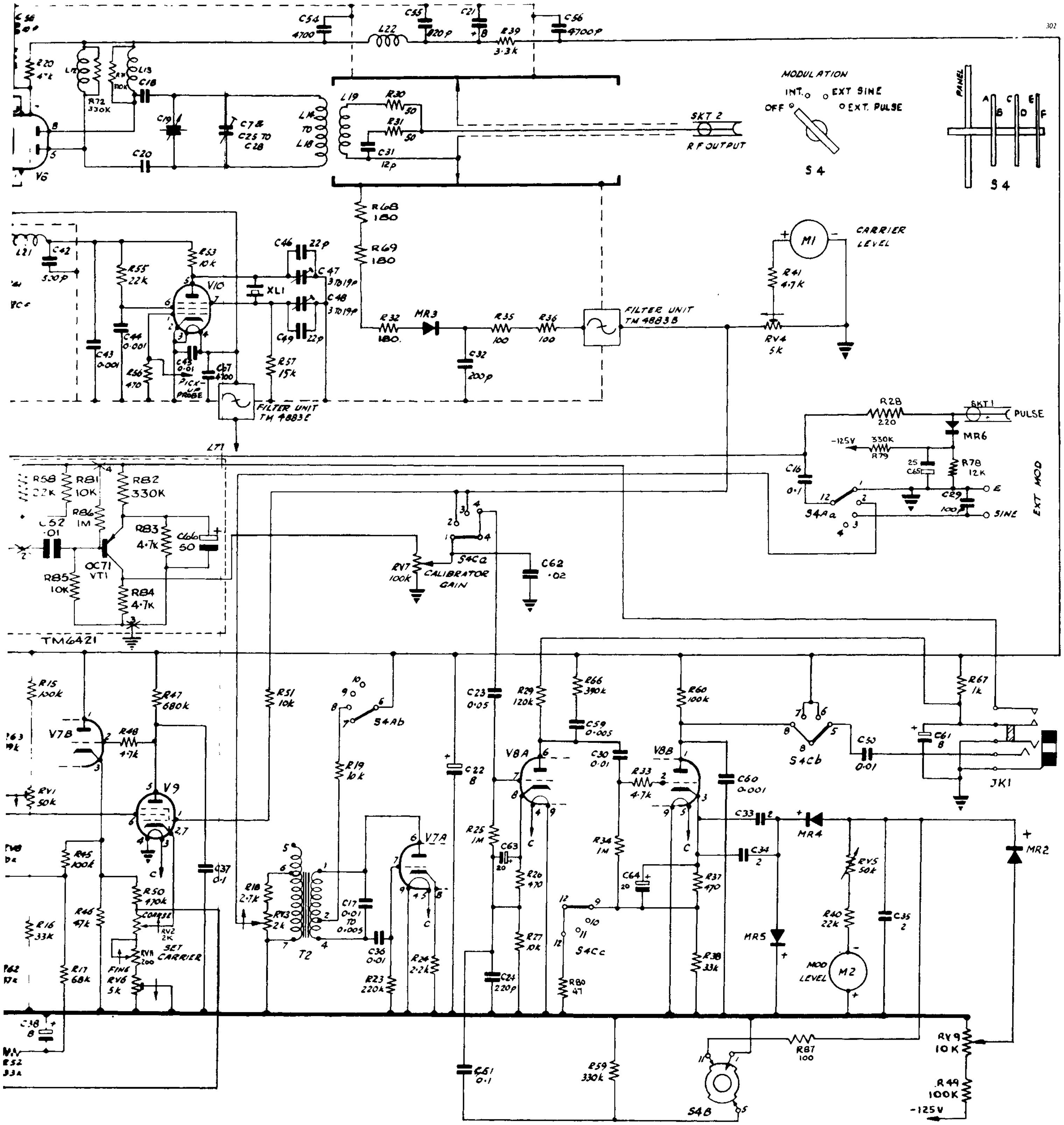


CIRC

COMPONENT VALUES: **Resistors:** No suffix — ohms. k — kilohms. M = megohms.
Capacitors: No suffix = microfarads. p = picofarads.

M.I. LTD. TF 801D/1 1** - 2.61
(XD 31615 Issue 6)

C.P. 2.5c. 12.61



CIRCUIT DIAGRAM

... k = kilohms. M = megohms.
... crofarads. p = picofarads.

TDX 31615

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