OPERATING
AND
MAINTENANCE
HANDBOOK
No. OM 791D

Carrier Deviation Meter

TYPE TF 791D

Serial numbers prefixed 52102

MARCONI INSTRUMENTS LTD., ST. ALBANS, HERTS., ENGLAND

L.P. 5c 9/62/C

OM 791D
1***9/62

Handbook Change
For
TF 791D
Carrier Deviation Meter

(1) This book also applies to instruments with serial numbers prefixed 52154.
(2) A pulley wheel is no longer fitted to the tuning drive cord. Items 328- 333 inclusive in the SOS are therefore deleted.
(3) R78 is now 1 KΩ +/- 5%, 3W.

M.I. Ltd.

Contents

Schedule of Parts Supplied

The complete equipment comprises the following items:-

1		One Carrier Deviation Meter Type TF 791D complete with attached mains lead and with valves, etc., as under:-
	Valves:	Eleven Type 6AK5 (EF95), Pentodes.
		Four: Type EA76(6489), Diodes.
		Two: Type 6C4 (EC90),
		Triodes. One: Type 6CD6G, Tetrode.
		One: Type 6AS6, Pentode.
		One: Type OB2 (108C1), Voltage Stabilizer.
		One: Type 5651 (85A2), Voltage Stabilizer.
		One: Type 5Z4G, Full-Wave Rectifier.
	Crystals:	Two: Type 1N34 (CV425), Germanium Diodes.
		One: Type CV291, Silicon Diode.
		One: Type QO1654B 100/B/30 (Marconi) 100-kc/s Oscillator Crystal.
	Lamp:	One: 6.3-volt, O.15-amp, M.B.C. Pilot Lamp.
	Fuses:	Two: 2-amp, Glass Cartridge. One: 250-mA, Glass Cartridge.
2		One Coaxial, 50-ohm, Free Plug, Type BNC.
3		One Instruction Book, No. OM 791D.

If specially ordered:-

Coaxial Input Lead, 50-ohm, Type TM 4969; 36 inches long; Type BNC plugs both ends.

Local Oscillator Locking Crystals, miniature 2-pin; Marconi Type QO1670 (Series).

Data Summary

Carrier Frequency Range:	4 to 1,024 Mc/s in eight bands, each of 2:1 frequency coverage.
Calibration Accuracy:	±3%; the calibration is in terms of local oscillator frequency.
Crystal Locking:	Local oscillator can be locked at any frequency within its range by crystals between 4 and 10 Mc/s - see Accessories Available.
Deviation Measurement Ranges:	±5, ±25, ±75, and ±125 kc/s full-scale. Using crystal lock, deviation down to about 10 c/s can be measured on an external indicator at the I.F. output terminals.
Accuracy:	For modulation frequencies between 50 c/s and 25 kc/s, ±3% of full-scale. For modulation frequencies between 25 and 35 kc/s, ±3% of full-scale ±3 % of the reading.
R.F. Input Impedance:	Nominally 50 Ohms.
Signal E.M.F. at 50 Ohm Source:	Minimum: 25 mV up to 256 Mc/s, 50 mV up to 512 Mc/s, 1 volt up to 1,024 Mc/s. Maximum: 5 volts.
L.F. Output Impedance:	Approximately 1,000 ohms unbalanced.
Level:	Approximately 1.5 volts E.M.F. at full scale deviation.
F.M. Noise:	Using crystal lock, hum and noise in the band 50 c/s to 20 kc/s does not exceed -50 dB relative to full-scale deviation on the 5-kc/s range. Without crystal lock, approx. -30 dB relative to 5 kc/s deviation between 4 and 470 Mc/s.
Power Supply:	200 to 250 volts, or 100 to 150 volts after adjusting internal links, 40 to 100 c/s; 100 watts.

	Height	Width	Depth	Weight
Dimensions and Weight:	13 in (33 cm)	18 in (46 cm)	11 in (28 cm)	40 lb (18 Kg)

1 - Introduction

The TF791D is a direct-reading instrument for the measurement of the deviation up to 125 kc/s of F.M. signals between 4 and 1,024 Mc/s. The modulation frequency range is from 50 c/s to 35 kc/s.

Basically the instrument consists of an F.M. receiver using a counter-type discriminator. The L.F. demodulated output is fed to a diode voltmeter calibrated directly in terms of kc/s deviation; the voltmeter has four ranges corresponding to deviations of 5, 25, 75, and 125 kc/s full-scale. Output terminals, fed from a separate buffer stage, provide an outlet for the L.F. products of demodulation; the output from these terminals can be applied to any suitable measuring instrument for monitoring waveform, A.F. response, etc.

The instrument also includes a crystal oscillator, and switched sockets are provided for up to four crystals. Crystals are supplied if ordered separately. By use of the crystal oscillator the tuned local oscillator can be locked at multiples of the customer-chosen crystal frequencies. The crystal-lock facility ensures freedom from microphony and allows deviations down to about 10 *c/s* to be measured on an external indicator connected to the L.F. output terminals; this is of particular advantage in the measurement of F.M. hum and noise on transmitters for V.H.F. sound broadcasting and mobile close-channel working. At low input frequencies the crystal oscillator can be used directly in place of the tuned local oscillator.

To aid the measurement of asymmetric modulation, positive or negative deviation can be displayed on the meter by means of a front-panel switch, thus eliminating the need for retuning.

2- Operation

2.1 Installation

Unless otherwise specified, the Deviation Meter is normally dispatched with its valves in position and with its mains input circuit adjusted for immediate use with a 240-volt A.C. mains supply. The instrument can be adjusted for operation from any supply voltage in the ranges 100 to 150 volts and 200 to 250 volts. To check or alter the setting of the mains transformer tappings, the user should refer to Section 5.4.

2.2 Switching On and Warming Up

Before switching on, be quite 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 in the right-hand case-handle recess-to the mains supply socket.

(2) Switch ON by means of the **Supply** switch; the red pilot lamp should now glow.

(3) Before proceeding further, allow a short time - say five minutes - to elapse for the internal circuits to warm up. If a particularly high order of stability is required, this time should be extended to at least 30 minutes.

2.3 Setting Up and Making a Measurement

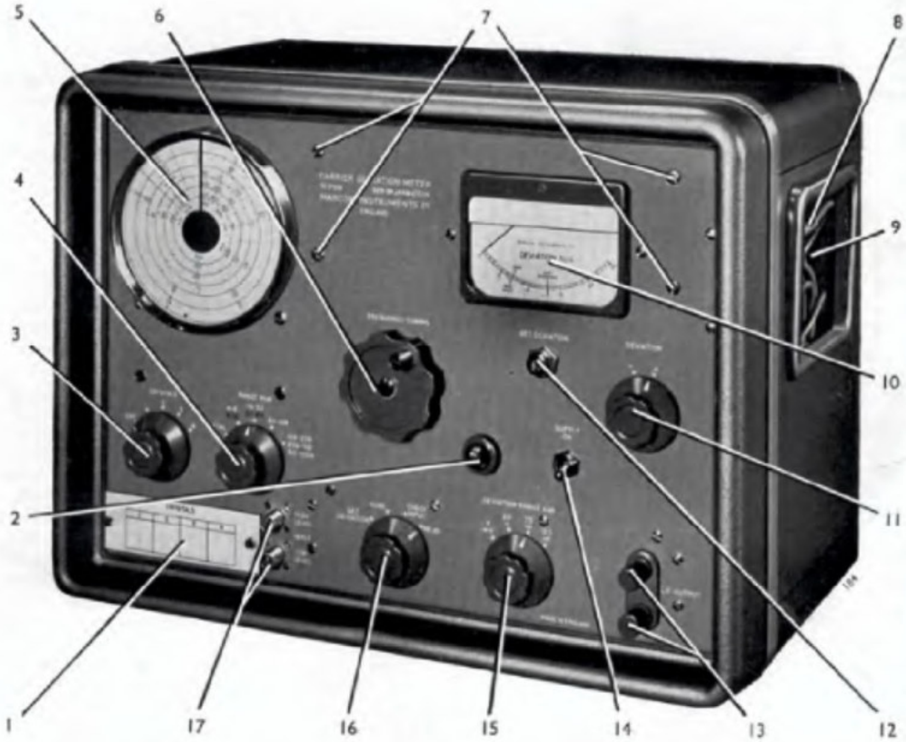
The following sub-sections give details of the setting up and use of the instrument excluding the crystal locking facility. Where crystals are fitted the user should refer also to Section 2.4. (The choice and fitting of crystals is dealt with in Sections 5.7 and 5.8.) For the measurement of deviations less than 200 *c/s,* see also Section 2.6.1.

2.3.1 Standardizing the Deviation Scale

Turn the selector switch, below the **Frequency Tuning** control, to **Set Deviation** and the **Deviation** switch to '**+**'. The meter should deflect to the **Set Deviation** mark on the scale. If necessary, adjust the **Set Deviation** preset control below the meter until this reading is obtained.

This check is not necessary before every measurement but should be made periodically.

When the instrument is operated from a supply having a frequency other than 50 *c/s,* the user should refer to Section 2.7.



1. **Crystals** in holders, covered by record plate
2. **Pilot Lamp**
3. **Crystals Switch**
   Selects crystal required
4. **Range Switch**
   Selects local-oscillator range
5. **Frequency Dial**
   Calibrated in effective local-oscillator frequency
6. **Frequency Tuning**
7. **Power Unit Fixing Screws**
   Removal permits raising power unit for servicing
8. **Mains Lead**
   Stowed in case-handle recess
9. **Voltage Tapping Panel and Fuses**
   Situated in case-handle recess
10. **Deviation Meter**
    Reads deviation directly in kc/s
11. **Deviation Switch**
    Selects positive or negative deviation measurement
12. **Set Deviation**
    Adjusts meter reading to reference line when selector switch is at SET DEVIATION; thereby sets gain
13. **L.F. Output**
    Terminals for connection to extra sensitive indicator, wave analyser, etc.
14. **Supply Switch**
15. **Deviation Range Switch**
    Selects deviation sensitivity
16. **Selector Switch**
    Selects circuits for setting-up procedure and deviation measurement
17. **Input Sockets**
    BNC, UG-447/U
    HIGH LEVEL or LOW LEVEL to be used according to input amplitude

Fig. 2.1 Controls and Operating Facilities.

2.3.2 Applying Signal to be Measured

The **High Level** and **Low Level** inlets on the instrument are both BNC, Type UG-447U sockets. For making connections to either of these sockets, use a BNC, Type UG-88U plug; one is supplied with the instrument. *If specially ordered,* a 3-ft coaxial lead with BNC plugs at both ends, Type TM 4969, is also supplied.

Both inlets have a nominal input impedance of 50 ohms. The minimum signal E.M.F. necessary at a 50-ohm source to be connected to either inlet varies with frequency: using the **Low Level** inlet, it must be approximately 25 mV between 4 and 256 *Mc/s,* 50 mV between 256 and 512 *Mc/s,* and 1 volt between 512 and 1,024 *Mc/s*. The **High Level** inlet is connected to the **Low Level** inlet via an attenuator pad of nominally 20 dB (reducing at the upper frequencies) and will accept an input from a 50-ohm source having an E.M.F. up to 5 volts. When it is known that a signal is less than 5 volts E.M.F., but its exact value is uncertain, the **High Level** inlet should be employed initially; if, in the level test that follows tuning, the signal is found to be too weak, it can be transferred to the **Low Level** inlet.

When using the Deviation Meter at frequencies between 512 and 1,024 *Mc/s,* it may be possible to obtain higher input sensitivities than stated above. This may be done by using an alternative harmonic of the frequency doubler output. For example, with an input signal of 1,000 *Mc/s* and the **Frequency Tuning** dial set to 1,000 *Mc/s,* the input signal is heterodyned with the 4th harmonic output of the frequency doubler stages V5 and V7; however, increased input sensitivity may be obtained if the **Frequency Tuning** dial is set to 800 *Mc/s* (frequency doubler fundamental output is now 200 *Mc/s)* and the 5th harmonic output is used. In general, by turning the selector switch to **Check Input** and tuning through the range 512 to 1,024 *Mc/s,* the frequency doubler harmonic which provides the maximum input sensitivity will be indicated by maximum meter deflection.

Note that the R.F inlets are D.C. connected to the mixer X5, and therefore D.C. potentials must not be applied with the R.F Input.

2.3.3 Tuning, Checking Input Level, and Reading Deviation

(1) Turn the selector switch to **Tune** and the **Crystals** switch to OFF. (See Section 2.4 for use of crystal locking facility.)

(2) Set the **Range** switch to the appropriate band and adjust the tuning dial-by means of the **Frequency Tuning** control-to the frequency of the input signal.

Note: Two positions of the **Range** switch have figures engraved in both white and red; these two pairs of ranges correspond to the two outer scales on the tuning dial which each have calibrations that are common to both the fundamental and second harmonic local oscillator frequency. The common calibration points are marked with corresponding white and red frequency figures.

The fully clockwise position of the **Range** switch is engraved in white with three sets of figures corresponding to the three inner scales on the tuning dial. A common **Range** switch setting is used for these three local oscillator ranges as they are all derived from the frequency multiplier stages (see Section 4.2).

(3) Slowly tune through the input signal. It will be found that two maxima are indicated by the meter - one below and one above the carrier frequency. These maxima are separated by a central point of minimum response at which the local oscillator of the Deviation Meter coincides in frequency with the carrier of the source under test. See Fig. 2.2.

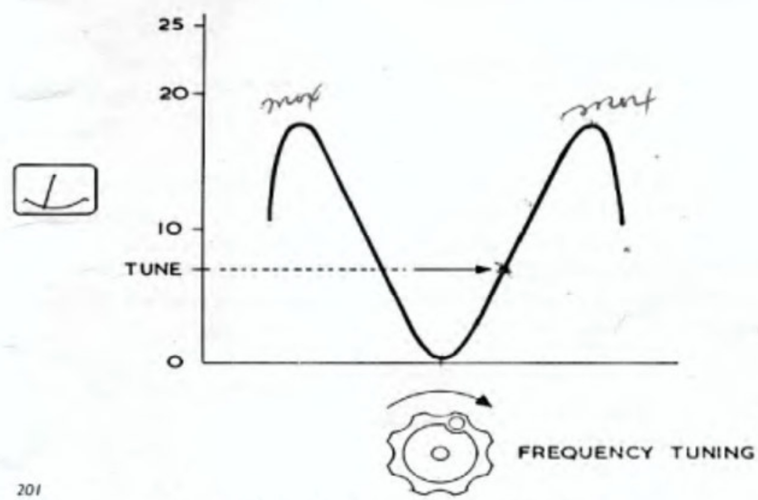


Fig. 2.2 Tuning Characteristic.

(4) Working from the central point of minimum response, slowly tune the Deviation Meter towards the *higher frequency* maximum point - (i.e. move the frequency dial clockwise) and continue until the meter reads at the **Tune** mark on the scale.

Notes:

(i) Do not continue tuning beyond the peak and set up on the sloping response on the far side; it is essential that the setting-up should be done on the side adjacent to the central point of minimum response.

(ii) The Deviation Meter must be tuned above the incoming signal in order that the **Deviation** switch should indicate the correct polarity.

(5) Turn the selector switch to **Check Input** and observe that the meter deflects above the **Min. Input** mark on the scale.

If it fails to do so, transfer the input signal to the **Low Level** inlet and/or increase the signal level until a reading above the **Min. Input** mark is obtained; then repeat steps (3) and (4) so that the meter again reads at the **Tune** mark.

When the input is adequate, moderate variation of the level of the incoming signal should not change the meter indication when it has been set to **Tune** as in steps (3) and (4).

(6) Set the **Deviation Range** switch to 125 kc/s-or, when the approximate magnitude of the deviation is already known, to the appropriate range. Turn the selector switch to **Read**. Reset the **Deviation Range** switch, if necessary, to use the most sensitive range which does not cause a deflection over full scale. Read the deviation, multiplying the meter indication by the factor engraved at the **Deviation Range** switch setting.

Readings may be taken with the **Deviation** switch at both ' **+** ' and ' **-** ' to check asymmetric modulation as described in Section 2.5.

2.4 Use of Crystal Oscillator

The Deviation Meter includes a crystal oscillator which can be used to lock the tuned local oscillator. In particular, this enables measurements of very low deviations such as F.M. hum and noise to be made using the crystal lock, hum and noise in the band 50 c/s to 20 kc/s - due to the Deviation Meter itself - does not exceed – 50 dB relative to full-scale deviation on the 5-kc/s range. Below 20 Mc/s, the crystal oscillator can be used directly in place of the tuned local oscillator.

With an instrument fitted with customer-chosen-crystals (see Section 5.7 for advice on choice of crystals) the procedure for operating the crystal -locking facility is as follows:

(1) Standardize the deviation scale on the meter as described in Section 2.3.1.

(2) Turn the **Crystals** switch to select the crystal whose fundamental or harmonic is equal to the frequency of the input signal plus the I.F. of 325 kc/s.

For input signals between 4 and 20 Mc/s the crystal oscillator output can be used direct. In this case, provided that the crystal frequency or its harmonic is equal to the input frequency plus the I.F. of 325 kc/s, turn the **Range** switch to XTAL, select the appropriate crystal using the **Crystals** switch, and proceed with (6).

(3) Set the **Range** switch and adjust the **Frequency Tuning** control to bring the frequency dial as near as possible to the required frequency.

(4) Without applying the signal to be tested, turn the selector switch to **Check Input** and move the **Frequency Tuning** control very slowly to locate the narrow range over which locking occurs. Tuning the local oscillator to this range from a higher or lower frequency produces a gradual increase of meter deflection (due to a beat between the two oscillator frequencies) followed by a sharp drop to a minimum over the range where locking occurs.

Adjust the **Frequency Tuning** control to the centre of this range of minimum meter indication.

In certain cases, the range of minimum meter indication is not clearly defined and it is therefore advisable to make certain that locking is taking place by carrying out the procedure already described and then:

(5) If a sensitive indicator is connected to the L.F. **Output** terminals disconnect it. Turn the selector switch to **Read**, and the **Deviation Range** switch to 25 kc/s. If the tuned local oscillator has been correctly adjusted to a locking point in (4), there will be some deflection of the meter pointer (usually below half full-scale). Readjusting the **Frequency Tuning** control slowly will cause a sharp upward meter deflection (usually over full-scale) in the immediate vicinity of the locking point followed by decreasing meter deflection as the local oscillator is adjusted away from the locking point.

(6) Connect the input signal under test, switch to **Tune** and confirm that the meter reads at the **Tune** mark within approximately 3/4 division; check the input level and read the deviation as described in Section 2.3.3 (5) and (6).

2.5 Asymmetric Modulation and Carrier Shift

The deviation indicated by the panel meter is the result of rectification of the L.F. products of demodulation. When the Deviation Meter has been tuned as described in Section 2.3.3 or 2.4, and with the **Deviation** switch in the ' **+** ' position, the indication is derived from the peak value of the positive half of the L.F. waveform, corresponding to deviation towards a higher frequency. With the **Deviation** switch in the ' **-** ' position the indication is derived from the negative half of the L.F. waveform, corresponding to deviation towards a lower frequency (see Figure 4.3). If different deviation readings are obtained at the two positions of the **Deviation** switch, this is an indication that the input is asymmetrically modulated.

Note: It is possible, by tuning towards the *lower frequency* maximum point in step (4) of Section 2.3.3, to reverse the indication of the **Deviation** switch.

Significant changes in the effective carrier frequency due to modulation can be detected by first tuning the Deviation Meter to the unmodulated signal and then, with the selector switch still at **Tune**, applying the modulation. If the meter indication alters above or below the **Tune** mark on the application of modulation, this is an indication of carrier shift.

2.6 Use of L.F. Output Terminals

These terminals are provided so that the modulation waveform carried on the input signal may be checked visually or aurally by connecting an oscilloscope, distortion factor meter, wave analyser, head telephones, or high-fidelity monitoring equipment to the output of the L.F. amplifiers.

The terminals are fed via an independent buffer stage. The output impedance is of the order of 1,000 ohms, and the open-circuit level is approximately 1.5 volts when the meter is indicating full- scale.

It should be noted that the L.F. response of the instrument is substantially level up to 35 kc/s. No de-emphasis arrangements are included. Without using the crystal lock facility, internally generated noise is approximately -30 dB relative to 5 kc/s deviation up to 470 Mc/s.

2.6.1 Measurements of Small Deviations

When using the crystal lock facility or the crystal oscillator directly, measurements of small values of deviation such as those of F.M. hum and noise on transmitters can be made.

By using a low-pass filter (see Fig. 5.6) in series with the **L.F. Output** terminals, the L.F. bandwidth of the Deviation Meter may be restricted to the range 50 c/s to 20 kc/s; in this band, internally generated noise does not exceed -50 dB relative to full-scale deflection on the 5-kc/s deviation range. By restricting the bandwidth to narrower limits, an improved figure can be obtained.

The lowest calibration point on the deviation meter scale corresponds to 200 c/s deviation; to measure deviations below this level it is necessary to use an external indicator calibrated in voltage and/or decibels such as a wave analyser, distortion factor meter, or sensitive valve voltmeter capable of giving an indication of voltage down to approximately 3 mV.

To measure small deviations, it is necessary to compare the demodulated output at the **L.F. Output** terminals with the L.F. output obtained for a known deviation as follows:

(1) Connect an external indicator to the L.F. **Output** terminals

(2) Applying a carrier which can be modulated to a deviation of 1 kc/s, set up the instrument as described in Sections 2.3.1, 2.3.2, and 2.3.3 paragraphs (1.) to (5).

Note: It is advisable to apply a carrier signal at a level of approximately 6 dB above that shown in Section 2.3.2 in order to be certain of obtaining the low internal noise levels quoted above.

(3) Turn the **Deviation Range** switch to 5 kc/s and frequency modulate the carrier to exactly 1 kc/s.

(4) Note the reading on the external indicator.

(5) Remove the signal modulated to 1 kc/s deviation. Set up the instrument, following the procedure of Section 2.4 if using the crystal oscillator, apply the signal to be measured, and read the deviation. Where the F.M. hum and noise of a transmitter is to be measured, this step may simply consist of removing the modulating signal which gave 1 kc/s deviation.

(6) *Express the deviation either* :

(a) In terms of decibels relative to the reference level of output at 1 kc/s as indicated in (4).
(For an alternative reference level, add the appropriate number of decibels; e.g. for a reference level of 50 kc/s, add 34 dB.) or;

(b) In terms of deviation; e.g. if the output in (4) corresponding to 1 kc/s deviation equals 0.3 volt, then an output of 30 mV measured in (5) corresponds to 100 c/s deviation.

2.7 Setting Up on Supplies Other Than 50 c/s.

If the Deviation Meter is operated from a supply having a frequency other than 50 c/s, the deflection which should be obtained when the selector switch is turned to **Set Deviation** (as in Section 2.3.1) is above or below the **Set Deviation** mark on the meter in accordance with the following table, which shows approximate substitute indications. The **Set Deviation** preset control below the meter must be adjusted accordingly.

Table 1

Supply	When switch SA is at **Set Deviation**, meter should indicate:-
50 c/s	" 13 kc/s"
40 c/s	" 13.25 kc/s"
60 c/s	" 12.9 kc/s"
100 c/s	" 12.5 kc/s"

Alternatively, if it is expected that the instrument will usually be operated at a supply frequency other than 50 c/s, the user may find it preferable to reset preset potentiometer RV4, as described in Section 5.12.16, employing the anticipated supply frequency. It will then be correct to set up the instrument to read exactly at the **Set Deviation** mark; Table 1 will then no longer be valid.

3 - Operational Summary

Once the user is familiar with the principles and techniques of operation detailed in Section 2, the following abridged instructions may be found convenient.

Before Switching On
Be *sure the mains transformer tappings are correctly set.*

Standardizing Deviation Scale
Set selector switch to **Set Deviation** and **Deviation** switch to ' **+** '. Meter should read **Set Deviation**. Adjust preset **Set Deviation** control if necessary.

Tuning Local Oscillator

(a) Without crystal locking
Apply signal under test to appropriate inlet.
Turn selector switch to **Tune** and **Crystals** switch to **Off**. Set **Range**, and tune to point giving minimum indication, at centre of response to signal; then slowly tune higher in frequency until meter reads **Tune**.

(b) With crystal locking
Select crystal by **Crystals** switch. Set **Range** and **Frequency Tuning** to required frequency. Without applying signal, turn selector switch to **Check Input** and carefully adjust **Frequency Tuning** to centre of locking range (low indication between two peaks). Apply signal under test to appropriate inlet. Turn selector switch to **Tune** and confirm that meter reads **Tune** approximately.

(c) *Using crystal oscillator alone*
Select crystal by **Crystals** switch. Apply signal under test to appropriate inlet. Turn selector switch to **Tune** and confirm that meter reads **Tune** approximately.

Checking Input
Turn selector switch to **Check Input**. Meter should deflect above **Min. Input**. If necessary, transfer input to **Low Level** inlet, or adjust level, until meter reads above **Min. Input**; then repeat tuning.

Reading Deviation
Set **Deviation Range** switch to 125 kc/s. Turn selector switch to **Read**. Reset **Deviation Range** switch if necessary. Read deviation, multiplying meter indication by factor engraved at setting of **Deviation Range** switch.

4 - Technical Description

In addition to the block diagrams included with the following circuit descriptions, the reader is recommended to refer to the Circuit Diagram, Fig. 8.1 at the end of this handbook.

4.1 Input

The frequency-modulated input is applied to either of the two front-panel BNC inlets depending on the amplitude of the signal. The **Low Level** inlet is connected to the cathode of the silicon-diode mixer, X5, via a parallel C-R network, R40 and C37. The minimum E.M.F. that can be applied to this inlet varies between 25 m V and 1 volt depending on the frequency. The **High Level** inlet is coupled to the **Low Level** inlet by a resistive π network which introduces an attenuation of nominally 20 dB.

4.2 Local Oscillator and Frequency Doublers

The input signal is mixed with harmonics of the tuned local-oscillator signal on all but two ranges. Harmonics are used for two reasons:

(i) to prevent the input signal from pulling the local oscillator, and

(ii) to allow the tuned local oscillator to be locked by the crystal oscillator whose basic frequency range is 4 to 10 Mc/s.

The tuned local oscillator uses a pentode valve, V2, in a Colpitts circuit. Crystal locking is achieved by injecting the locking signal at the suppressor grid of V2. The tuned local oscillator has three basic ranges of 4 to 8 Mc/s, 16 to 32 Mc/s, and 32 to 64 Mc/s, provided by the ganged tuning capacitor C7 and coils L1, L2, and L3 respectively. The second harmonic output generated with the 32 to 64 Mc/s circuit is used to provide the 64 to 128-Mc/s range. For frequencies above 128 Mc/s, the 32- to 64-Mc/s output is applied to two frequency doublers, V5 and V7, from which the 4th, 8th, and 16th harmonics are used to provide the upper three frequency ranges of 128 to 256 Mc/s, 256 to 512 Mc/s, and 512 to 1,024 Mc/s respectively. The crystal oscillator can be switched to act directly in the place of the tuned local oscillator at spot frequencies below 20 Mc/s.

The operation of the local oscillator circuit and the means by which the total frequency coverage is obtained are summarised in Table 2.

Table 2

Range switch position	*Frequency Range*	*Oscillator operation*
1	XTAL	Crystal oscillator output connected directly to mixer. Variable oscillator inoperative.
2	4 to 8 Mc/s	V2, C7, C66, and L1 circuit oscillates over the range 4 to 8 Mc/s.
	8 to 16 Mc/s	Utilizes 4 to 8 Mc/s circuit; second harmonic output is employed.
3	16 to 32 Mc/s.	V2, C7, C69, and L2 circuit oscillates over the range 32 to 64 Mc/s Utilizes 16 to 32 Mc/s circuit; second harmonic output is employed.
4	64 to 128 Mc/s	V2, C7, C68, and L3 circuit oscillates over the range 32 to 64 Mc/s; second harmonic output employed to achieve 64 to 128 Mc/s coverage.
5	128 to 256 256 to 512 Mc/s 512 to 1,024 Mc/s	Mc/s Position 4 fundamental output (32 to 64 Mc/s), applied to two frequency doublers, V5 and V7. Fourth, eighth and sixteenth harmonic output respectively serve to give required frequency coverage.

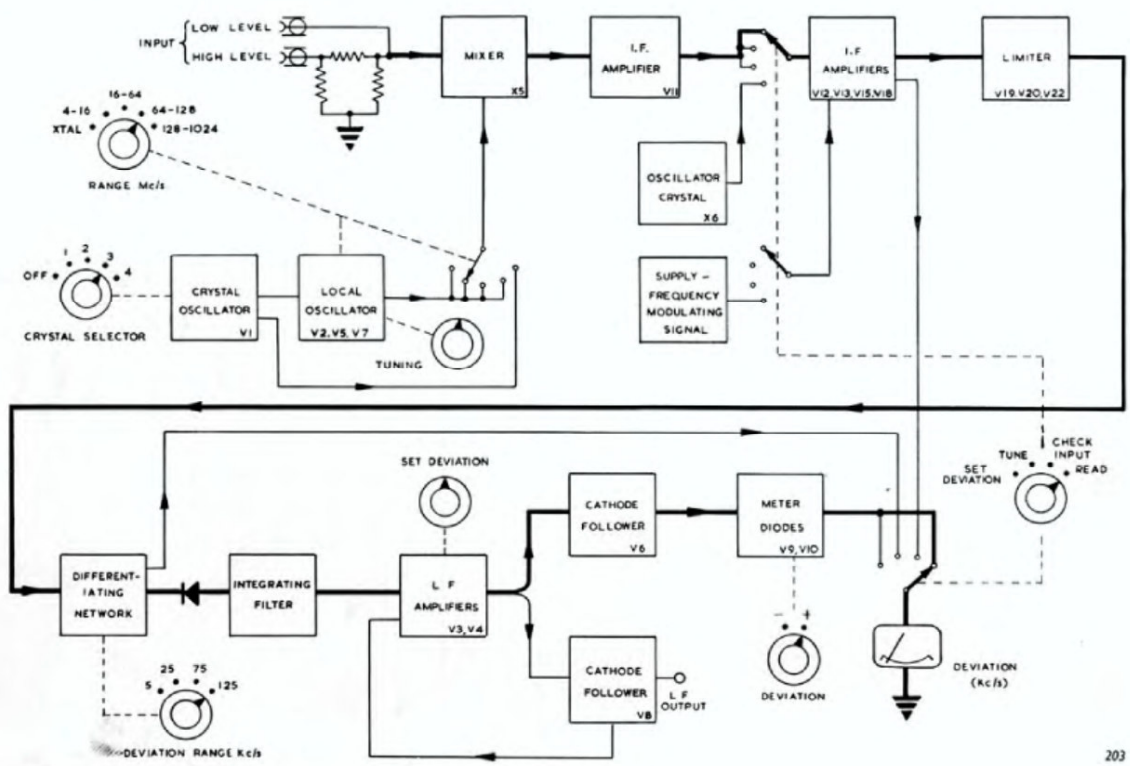


Fig. 4.1 *Block Schematic Diagram.*

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4.3 Crystal Oscillator

When the instrument is fitted with crystals, the tuned local oscillator can be locked to any frequency within its range by means of the built-in crystal oscillator, V1. The crystal oscillator is a Colpitts circuit using anyone of four crystals, X1 to X4, selected by the front-panel switch SC, and will operate satisfactorily with crystals in the range 4 to 10 Mc/s. Crystals are supplied with the instrument if their inclusion is specified, or they can be ordered later. (See Section 5.7 of this handbook for further details regarding selection of crystals.)

The crystal-oscillator output is taken from the anode of V1 and applied, via capacitor V6, to the suppressor grid of the variable oscillator V2; locking takes place at the fundamental frequency of the variable oscillator. A separate screen dropping resistor, selected by the **Crystals** switch SC, is provided for each crystal so that the screen voltage can be adjusted to suit any particular crystal in use and to provide optimum crystal oscillator output without overloading.

4.4 Mixer

The local-oscillator output voltage is developed across a resistive load connected in series with the silicon-diode mixer, X5. This load is formed by V2 cathode load, R13, over the range 4 to 128 Mc/s, and resistor R42 when the local-oscillator signal is multiplied by the frequency doubler, i.e; above 128 Mc/s. When the crystal oscillator is used in place of the local oscillator, the voltage across R3 is applied to the mixer. These local signals are selected by the switch SD.

4.5 I.F. Amplifiers

The output from the mixer X5 is fed, via a low-pass filter, to the I.F. amplifiers, which consist of three single-valve stages, including V11, V12, and V13 respectively, and a fourth stage employing V15 and V18 in parallel. These are untuned R-C coupled amplifiers with an overall response having a centre frequency at about 325 kc/s. The circuits of V12 and V13 incorporate switching whereby an artificial signal is generated internally to facilitate checking the accuracy of the instrument; this facility is described in Section 4.8.

4.6 Demodulator

The output from the final I.F. amplifier stage is fed via capacitor C63 to a limiting circuit employing the two diodes V19 and V20 and the stabilizer V22. The cathode of the diode V20 is maintained at +108 volts by the stabilizer and the resistor R89, thereby limiting the amplitude of the signal wave at the diode anode to this voltage; the diode V19 conducts when the signal wave fed via C63 falls below earth potential. As a result, the I.F. signal at the junction of C63 and C65 approximates to a square wave having a constant peak-to-peak amplitude of 108 volts.

C65 forms a differentiating circuit with one of the four resistors R92 to R95, whichever is selected by the **Deviation Range** switch SB. The circuit also includes the two germanium diodes X7 and X8. If the two germanium diodes were absent, the differentiating action of C65 and the selected resistor would produce similar positive and negative pulses from the square wave: but, owing to the shunting effect of X7 and the high series reverse resistance of X8 with respect to positive voltage, only negative pulses appear across the selected resistor and are applied to the integrating filter that follows. Thus the signal fed to the integrating filter consists of negative pulses whose frequency swings above and below the mean I.F. in an excursion corresponding to the deviation of the input. The width of the negative pulses varies depending on the resistor selected by the **Deviation Range** switch - the greater the deviation measurement range the narrower the pulses.

The negative pulses are integrated by the filter and create a voltage whose level varies in proportion to the frequency of the pulses. The amplitude of the alternating component of the voltage waveform is a measure of the deviation, and its frequency is that of the original modulation. This alternating component, a facsimile of the I.F. signal originally frequency-modulating the carrier, is applied to the I.F. amplifier stages.

Fig. 4,2 is a simplified circuit diagram of the demodulator and Fig. 4.3 illustrates, in idealized form, waveforms present at various points of the demodulator circuit.

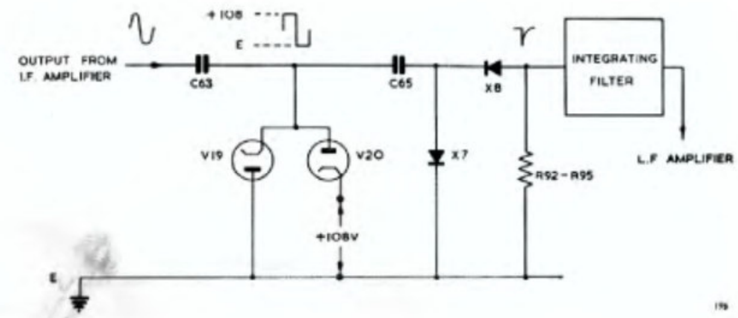


Fig. 4.2 Simplified Circuit of Demodulator

4.7 L.F. Amplifiers And Diode Voltmeter

The I.F. circuit consists of a conventional two-stage R-C coupled amplifier, V3 and V4, feeding two cathode-follower output stages, V6 and V8 simultaneously.

A feedback loop, via R20, links the cathode-follower stage V8 and the first I.F. amplifier stage V3. The degree of feedback is adjusted by the **Set Deviation** preset potentiometer R VI in the cathode of V3, which acts as again control.

The output from the cathode follower V8 is applied to the **L.F. Output** terminals on the front panel. The L.F. output represents the frequency-modulation of the R.F. input to the TF 791D, and may be checked on external equipment such as an oscilloscope or a wave analyser. The output impedance at these terminals is about I KΩ.

The output of the cathode follower V6 is applied to the diode voltmeter including V9 and V10, and the meter M1. A method of determining the degree of asymmetry in a frequency modulated signal is to tune to each side of the input F.M. signal in turn and note the deviation. This is not possible when the local oscillator is locked to the crystal oscillator. Therefore, to eliminate the necessity for retuning, the switch SE is included to interchange the anode and cathode connections of the diode V9, enabling positive or negative deviation to be measured. V10, which acts as a standing-current balancing diode, also has its connections interchanged by SE. Standing-current neutralization is set up by adjustment of the preset variable resistor RV2, in series with V10.

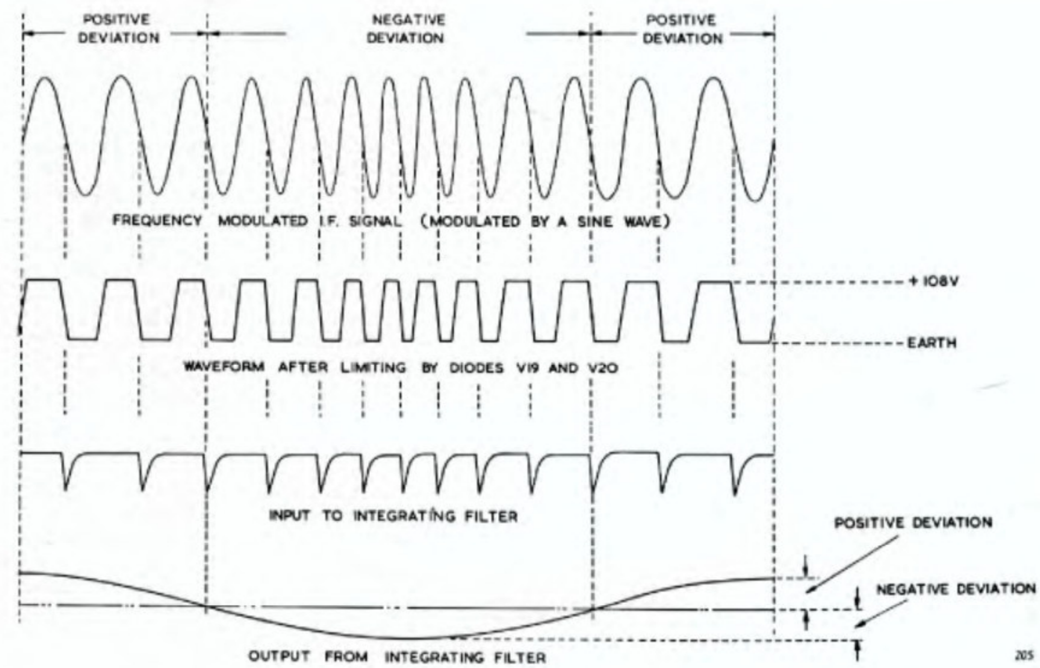
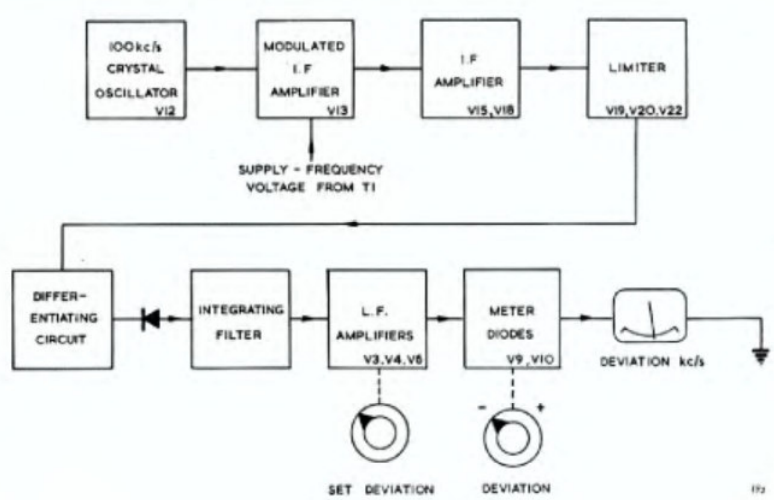


Fig. 4.3 Idealized Demodulator Waveforms

Fig. 4.4 Circuits Connected for Standardizing the Deviation Meter Scale



4.8 Standardizing and Checking Facilities

The four-position selector switch, SA, on the front panel, provides, on the first three positions, facilities for setting up the instrument and checking the amplitude of the input signal before the fourth position is used for making a deviation measurement.

At the first switch position, **Set Deviation**, the first I.F. amplifier, V11, and preceding circuits are disconnected, and the second I.F stage, V12, is connected as a crystal oscillator operating at 100 kc/s. At the same time, a potential at the mains supply frequency is fed from the H.T. winding on the mains transformer, T1, to the screen of the third I.F. amplifier, V13. The negative half cycles of the voltage applied to the screen of V13 render the valve non-conducting so that it produces cyclic bursts of 100 kc/s output. This forms a test signal of constant effective deviation against which the meter deviation scale can be standardized by adjustment of the **Set Deviation** preset control, RV1. The above circuit arrangement is shown in the block diagram Fig. 4.4.

With the switch at its second position, **Tune**, the circuits through the instrument as far as the limiter function normally. The output of the limiter, resulting from the F.M. signal under investigation, is differentiated as described in Section 4.6. In this case, negative pulses are developed across R91 in series with R90 and are applied to the front panel meter, which deflects proportionately with the recurrence frequency of the negative pulses and hence proportionately with the frequency of the I.F. signal. The front panel meter is marked to indicate the correct operating mean I.F., enabling the local oscillator to be tuned so that the correct mean I.F. is obtained prior to deviation measurement. The above circuit arrangement is shown in the block diagram Fig. 4.5.

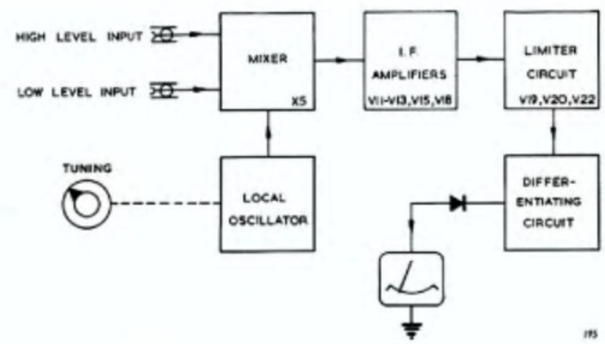


Fig. 4.5 Circuits Connected for Tuning the Local Oscillator.

When the selector switch is turned to its third-position, marked **Check Input**, the I.F. amplifier signal level, represented by the grid current of V15/V18, is indicated on the front panel meter. This facility enables a check to be made that there is sufficient signal amplitude available for the correct functioning of the limiter circuit. Fig. 4.6 shows the circuit arrangement for this.

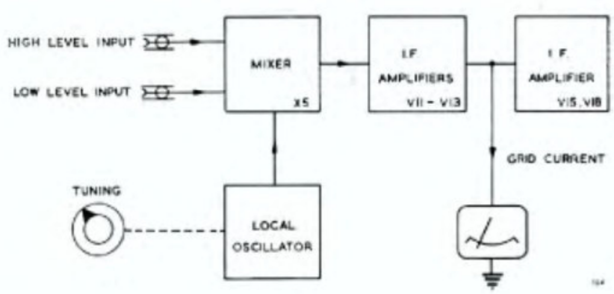


Fig. 4.6 Circuits Connected for Checking the Amplitude of the Signal Applied to the Limiter.

4.9 Power Supply Circuit

The internal power unit of the Deviation Meter includes a mains transformer, T, full-wave rectifier, V17, and a series-regulator H.T. stabilizing circuit employing V14, V16, and V21. The primary connections of the transformer can be adjusted so that the instrument is suitable for operation from 40 to 100-c/s supplies within the voltage ranges 100 to 150 volts and 200 to 250 volts.

5 - Maintenance

5.1 General

It is recommended that the user should become familiar with the principles described in Section 4, Technical Description, and illustrated in the Block Schematic Diagram before commencing the adjustment or replacement of component parts of the instrument.

The Circuit Diagram, included at the end of this Handbook, shows the valve electrode voltages and the circuit component values used in the instrument. Details of component ratings, etc., are given in the Spares Ordering Schedule (Section 7) which also lists certain mechanical items.

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

5.2 Fuse Replacement

The circuits of the Deviation Meter are protected by three fuses: two of these, FS1 and FS2, are in series with the supply input connections to the mains transformer T1; the third, FS3, is in series with the earth connection from the centre-tap of the H.T. winding of T1. T he fuses are rated at 2 amp, 2 amp, and 250 mA respectively. When the instrument is to be operated from 100 to 150 Volt a.c. supplies the two 2-amp fuses should be replace by 5-amp ones.

The three fuse holders are accessible in the right hand case-handle recess. The location of these is shown in Figs. 2.1 and 6.7.

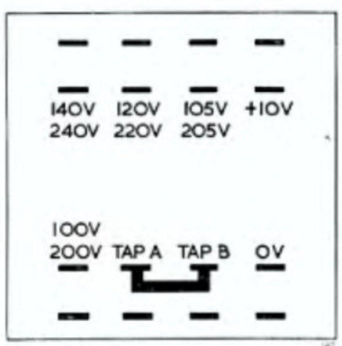


Fig. 5.1 Transformer Link for 200 to 250 Volts.

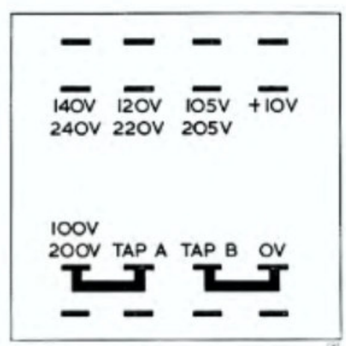


Fig. 5.2 Transformer Links for 100 to 150 Volts.

5.3 Removal of Case

To remove the rear section of the case, first lay the Deviation Meter face downwards on a bench and remove the four metal domes on which the instrument normally stands - each of these domes is held at the centre by a countersunk screw. Next, remove the four similar domes from the back of the case. The rear section of the case can now be separated from the main body of the instrument. The mains supply lead passes through to the inside of the instrument via the right-hand case-handle recess; feed the cable through as the rear section of the case is lifted upwards.

The front section of the case remains, framing the front panel. This section does not obstruct access to the interior of the instrument, but may be removed, if necessary, by withdrawing the ten screws, which can now be seen, holding it to the periphery of the front panel.

5.4 Mains Input Arrangements

The instrument can be operated from 40 to 100 c/s supplies within the ranges 200 to 250 volts and 100 to 150 volts. It is usually dispatched ready for operation from 240 volt supplies. Adjustment for other supply voltages can be made by altering the primary connections to the mains transformer T1.

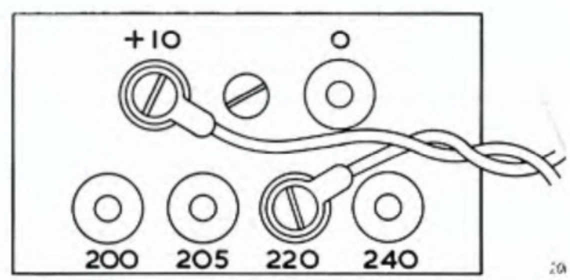


Fig. 5.3 Tapping Panel Connections for 230 Volts.

This transformer has a double-wound primary whose two tapped sections are connected in series for the 200 to 250-volt range, or in series-parallel for the 100 to 150 volt range; tapping points for the selection of intermediate voltages within either range are brought out to a tapping panel situate in the right-hand case-handle recess.

The procedure for changing voltage ranges o for adjustment of voltages within these ranges is described below.

Before making any adjustments, make sure the mains plug is disconnected from the supply.

(a) *To change from one voltage range to the other* i.e. from the 200 to 250 volt range to the 100 to 150 volt range, or vice-versa, first remove the case as described in Section 5.3.

Reconnect the soldered links between the tags on the transformer T1 as shown in Fig. 5.1 or Fig. 5.2 as appropriate. Do not remove the flexible leads connected to these tags.

Reverse the reference plate on the main tapping panel so as to reveal the side marked with the voltages appropriate to the new range as shown in Fig. 5.3 and Fig. 5.4.

(b) *To change from one intermediate voltage to another* within the selected range, e.g. from 240 to 230 volts, do not take off the case, but remove the small cover plate in the right-hand case handle recess to expose the mains tapping panel Reposition the two screw secured fly-leads to the tapping points that give a combination to suit the supply voltage. For example, take the leads to the tapping points marked '220' and '+10' for 230-volt working. The tapping panel is illustrated in Fig. 5.3 and Fig. 5.4.

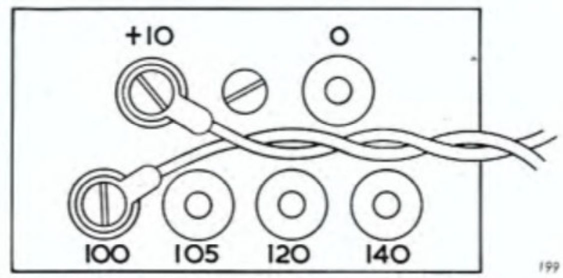


Fig. 5.4 Tapping Panel Connections for 110 Volts.

5.5 Access To Sub-Assemblies

In maintaining or servicing the Deviation Meter, the user may need to obtain access to the interior of one of the sub-assemblies which form part of the instrument. The procedure for the power unit also serves to give access to the top of the main chassis (I.F. and L.F. chassis).

5.5.1 Power Unit

The power unit is open at one side, which is normally facing the rear of the front panel. To raise the power unit so that its interior can be examined through this open side, or so that the power unit is moved from its position close to the top of the main chassis, proceed as follows:

(1) Remove the two pairs of 2-BA countersunk screws securing the power unit to the front panel. These screws are situated approximately 1 inch to the right and 3½ inches to the left of the meter. This leaves the power unit suspended between two points in the framework of the instrument.

(2) Remove the tapped case-fixing block from the framework at the top left-hand corner of the instrument, viewed from the rear.

(3) Swing the power unit backwards and upwards until it comes to rest on the two stops provided on the framework.

5.5.2 Integrating Filter

The integrating filter, situated at the left-hand end of the main chassis (viewed from the rear of the instrument), is fitted with a cover secured by one screw in the centre of its top.

Before removing the cover, raise the power unit by the procedure described in Section 5.5.1. Then withdraw the screw and lift off the cover.

It is possible to remove the cover after extracting the 5Z4G rectifier from the power unit, instead of raising the power unit; but particular care must be taken to ensure that components in the filter are not damaged by the movements of the cover which are necessary to withdraw it.

5.6 Working Voltages

The voltages given in Tables 3 and 4 for guidance when servicing the instrument are representative of the readings to be expected if measurements are made with a meter having a resistance of 20,000 ohms per volt (e.g. Avometer model 8).

On individual instruments some difference in voltage readings may be expected due to normal variations of valve performance and component values.

Table 3

Supply	*Measured between:*	*Voltage*
L.T.1	L.T.1 tags on transformer T1.	6.3 V a.c.
L.T.2	L.T.2 tags on transformer T1.*	6.3 V a.c.
L.T.3	L.T.3 tags on transformer T1.	6.3 V a.c.
L.T.4	L.T.4 tags on transformer TI.*	350 V a.c.
H.T. a.c.	Each H.T. tag on T1 and chassis	350 V a.c.
H. T. rect.	Cathode of V17 and chassis	350 V d.c.
H.T. stab. (Set by RV5)	Cathode of V16 and chassis	250 V d.c.

* **Warning**: *Tags L.T.2 and L.T.4 on transformer T1 are at an H.T. potential with respect to chassis.*

The supply voltage should be close to that for which the instrument is adjusted.

Table 4 shows valve electrode voltages with respect to chassis. Except where otherwise indicated by notes, the controls of the instrument should be set as follows.

Range switch to 4 to 8/8 to 16 Mc/s.
Tuning Dial to 6/12 Mc/s.
Deviation Range Switch to 125 Kc/s.
Selector Switch to check Input.

Table 4

Valve No.	*Anode Volts*	*Screen Volts*	*Cathode Volts*	*Notes*
V1	155	115	0.2	A
V2	155	100	0.15	B
V3	30	10.5	0.4	
V4	130	83	2.7	
V5	120	135	0	B
V6	250	-	39	
V7	110	83	0	B
V8	250	-	52	
V11	22	16	0.2	
V12	50	36	0.75	
V13	125	93	1.7	
V14	240	120	85	
V15	205	140	3.2	
V16	345	345	250	
V17	–	-	350	
V18	205	140	3.2	
V19	0	–	54	
V20	54	–	108	
V21	85	-	0	
V22	108	-	0	
V13	220	160 (a.c.)	0.4	C

Notes:
A: Range switch at XTAL; 5 Mc/s crystal selected by Crystals switch; 68-kΩ screen resistor.

B: Crystals switch at OFF.
C: Selector switch at Set Deviation.

5.7 Selection of Crystals.

The Deviation meter includes a crystal oscillator which may be employed either as the local oscillator, at low frequencies, or to lock the tuned local oscillator at selected points over its range. For this purpose, the instrument is designed to accommodate up to four switched miniature 2-pin crystals, Marconi type QO1670 (Series), having frequencies chosen by the user within the range 4 to 10 Mc/s. The crystal oscillator can be used directly up to 20 Mc/s (Range Switch to Xtal) or it can be used to lock the tuned local oscillator to the fundamental or a harmonic of the crystal frequency; the basic tuned local oscillator frequency range is from 4 to 64 Mc/s.

To choose a crystal for use with input frequencies up to 20 Mc/s:

(1) Add the I.F. of 325 Kc/s to the input frequency in use.

Note: It is important that the local oscillator frequency should be 325 Kc/s *above* the input frequency in order to obtain correct indication of the Deviation Switch SE.

(2) Choose a crystal whose fundamental or second harmonic frequency is equal to that found in step (1) and whose fundamental frequency lies within the range 4 to 10 Mc/s.

Some approximation is permissible in specifying the crystal frequency, since a variation of ±10% may be allowed in the I.F. of 325 kc/s.

Example:
Input frequency = 18 Mc/s. Input frequency + I.F. = 18.325 Mc/s.

Therefore crystal frequency should be 9.1625 Mc/s.
(It would be satisfactory to specify 9.16 Mc/s.)

To choose a crystal for use in locking the tuned local oscillator:

(1) Add the I.F. of 325 kc/s to the input frequency in use.

Note: It is important that the local oscillator frequency should be locked at 325 kc/s *above* the input frequency in order to obtain correct indication of the Deviation switch SE.

(2) Divide the frequency found in step (1) by the appropriate local oscillator harmonic factor given in Table 5.

Table 5

Frequency Range Mc/s	Local Oscillator Harmonic Factor
4 to 8	1
8 to 16	2
16 to 32	1
32 to 64	2
64 to 128	2
128 to 256	4
256 to 512	8
512 to 1,024	16

This will give the local oscillator fundamental frequency for a given input frequency.

(3) Choose a crystal whose fundamental or (more usually) harmonic frequency is equal to the local oscillator fundamental frequency found in step (2). The crystal fundamental frequency must lie within the range 4 to 10 Mc/s.

It is advisable to use the lowest order harmonic in order to ensure sufficient harmonic output.

Summarizing, to choose a crystal for use in locking the tuned local oscillator the following formula may be used:

$$\text{Crystal frequency (Mc/s} = \frac{(F_s + 0.325)}{H} x \frac{1}{N}$$

Where:

Fs = Input frequency (Mc/s).
H = Local oscillator harmonic factor (see -Table 5).
N = Crystal harmonic used (lowest harmonic possible).

Example:

Evaluate the frequency of the crystal to be used with an input frequency of 150 Mc/s.

F. = 150; H = 4 (from Table 5).

$$\text{Crystal frequency (Mc/s)} \frac{(150 + 0.325)}{4} x \frac{1}{N} = \frac{37.58125}{N}$$

By inspection, to use the lowest harmonic of a fundamental crystal frequency in the range of 4-10 Mc/s, N is 4; therefore

$$\text{Crystal frequency} = \frac{37.58125}{4} = 9.3953 \text{ Mc/s.}$$

Note: Since it is desirable to obtain an I.F. of 325 kc/s within ±10%, the crystal frequency must be specified precisely when the input frequency is high.

When ordering crystals, a type suitable for a circuit capacitance of 30 pF and a temperature rise approximately 10°C above the anticipated external ambient temperature should be specified.

Details of fitting the crystals and setting up the crystal oscillator are given in Section 5.8 which follows.

Note: When it is intended that the crystal lock facility will be used to measure the deviation of an input signal which it is anticipated may include some spurious signals, e.g. sub-harmonics from multiplier stages in a transmitter, special care is necessary in choosing the crystal frequency. The fundamental frequency of the crystal should be so selected that its harmonic frequencies will not combine with the spurious signals to produce a signal within the I.F. range of the instrument.

5.8 Fitting Crystals and Setting up Crystal-Oscillator

The four crystal holders are located behind the cover plate at the bottom left-hand corner of the front panel. The cover plate bears the title crystals and facilitates the marking of the frequency of each crystal under its crystals switch position number.

To fit the crystals:

(1) Remove the cover plate after extracting its two retaining screws.

(2) Insert the crystals into the appropriate two-pin holders. Reading from left to right the holders correspond to circuit references X1 to X4, i.e. Crystals switch positions 1 to 4.

(3) Replace the cover plate and mark the crystal frequency on the plate under the crystal number.

To set up the Crystal Oscillator.

(1) Adjust preset capacitors C1 and C4 – accessible through two holes in the crystal compartment – to mid travel.

(2) Turn the Range switch to Xtal, turn the Crystals switch to position 1 and adjust the value of resistor R4 – located across the wafers of the Crystals Switch SC – so that the sum of the R.F. voltage at the grid (pin 1) and anode (pin 5) of V1 totals approximately 18 volts.

(3) Turn the Crystal switch to positions 2,3, and 4 in turn and repeat the procedure described in Step (2), adjusting the values of resistors R5, R6, and R7 respectively.

(4) Check the crystal oscillator frequency at each switch position

(5) Small corrections to the oscillator frequency can be made using preset capacitors C1 and C4. This may be necessary to secure the correct I.F. (i.e. tune indication) when the input frequency is high.

5.9 Replacement Of Valves

The types of valve used in the instrument and -their base connections are shown in Table 6. Any valve which becomes faulty should preferably be replaced by a valve of the type originally supplied in the instrument. If this is not possible, the additional data given by the table may be used as a guide to suitable alternatives.

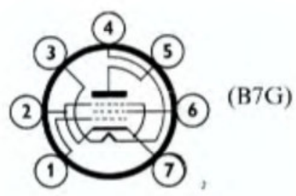
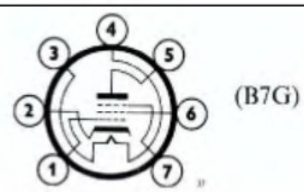
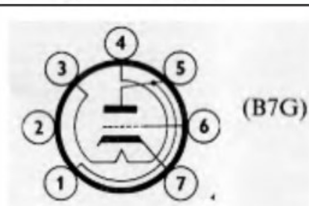
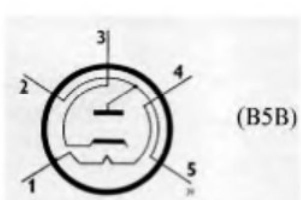
All valves are immediately accessible on removing the rear section of the case as described in Section 5.3. However, it may be found advantageous to raise the power unit, as described in Section 5.5.1, before withdrawing valves at the front of the main chassis.

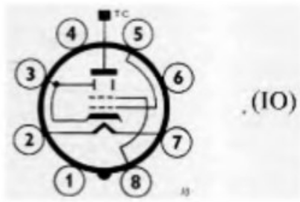
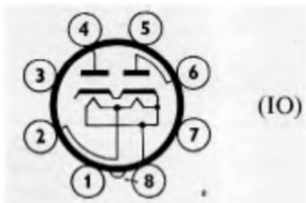
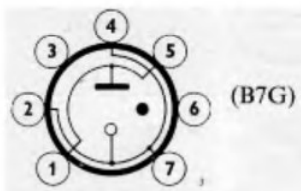
The valves may normally be replaced without special selection with the exception of V3. To obtain the required low hum output from the A.F. amplifier it may be necessary to select a replacement for V3; see Section 5.12.5.

If either of the meter diodes, V9 or V10, is replaced, it should first be aged for 100 hours.

In certain cases, replacement of valves may necessitate some readjustment of associated preset components; Table 7 lists those valves whose replacement is more likely to involve some readjustment and indicates the appropriate procedure.

Table 6

Valve	Type	Base	British Commercial Equivalent	British Services Equivalent	U.S. Equivalent
V1, V3, V4, V5, V7, V11, V12, V13, V14, V15, V18	6AK5 Pentode		EF95 M8100†	CV850 CV4010†	6AK5
V2	6AS6 Pentode		M8196†	CV2522 CV4011†	6AS6
V6, V8	6C4 Triode		EC90 M8080†	CV133 CV4058†	6C4
V9, V10, V19, V20	EA76 Diode			CV469	6489

Valve	Type	Base	British Commercial Equivalent	British Services Equivalent	U.S. Equivalent
V16	6CD6G Tetrode				6CD6G
V17	5Z4G Full-Wave Rectifier			CV1863	5Z4G
V21 ---------- V22	5651 Voltage Stabiliser ------------- - OB2 Voltage Stabiliser		85A2 M8908† ----------------- - 10C1 M8224†	CV449 CV4048† --------------- - CV1833 CV4028†	5651 --------------- - OB2

† High-reliability type

Table 7

Valve No.	Check or Readjust	Section Describing Readjustment.
V1	Crystal Oscillator Output.	5.8
V3	Amplifier Hum level	5.12.5
V9, V10	Diode Standing-Current	5.12.3
V14, V16 V17, V21	Stabilised H.T. Voltage	5.12.3

5.10 Preset and Selected Components

When the TF 791D is initially factory tested, its performance is brought within specification limits by means of preset controls and the selection of certain component values.

If, in servicing the instrument, any of these components are replaced, it will usually be necessary to repeat the procedure by which the component was originally adjusted or selected. Also, when replacing any other components in a circuit which has its performance set by a preset or selected component, the user should consider carefully whether readjustment or reselection is necessary.

Table 8 lists the preset and selected components, and shows the section of the instruction book in which the adjustment or selection procedure is described.

Table 8

Preset Component	Section Describing Adjustment	Selected Component	Section Describing Selection
RV1	5.12.16	R4	5.8
RV2	5.12.3	R5	5.8
RV4	5.12.16	R6	5.8
RV5	5.12.2	R7	5.8
		R20	5.2.16
RV6	5.12.5		
L1	5.12.9	R76	5.12.6
L2	5.12.9	R91	5.12.8
L3	5.12.9	C215.	12.4
L10	5.12.13	C55	5.12.17
L11	5.12.13		
L12	5.12.7		
L13	5.12.7		
L14	5.12.7		
L15	5.12.16		
CI	5.8 (5)		
C4	5.8 (5)		
C66	5.12.9		
C68	5.12.9		
C69	5.12.9		
C24	5.12.11		
C33	5.12.11		

5.11 Cord Drive System

Both the main tuning drive and the dial drive utilize cord mechanisms. A fibre-glass cord covered with a nylon sleeve is used and the necessity for cord replacement should be infrequent. The procedure for replacing the drive cord, in the event of breakage, is outlined in the two sections that follow.

The Drive Cord Diagram Fig. 5.5 and the illustration Top View of Main Chassis Fig. 6.4 should be referred to when reading the instructions contained in the two sections that follow.

Replacement drive cord can be obtained from Marconi Instruments Ltd.; see the Spares Ordering Schedule.

The cord should not be put in the mouth to obtain a sharp point before passing through a loop, etc., because of the danger resulting from small particles of the glass fibres breaking away. The nylon sleeve covering, however, gives adequate protection for normal handling.

The drive cord should be pre-stretched for a period of 24 hours before use by attaching a 14-lb weight at one end of the cord while the other end is suspended from some suitable anchorage.

5.11.1 Replacing The Main Tuning Drive Cord

(1) Take the instrument out of its case and raise the power unit, as described in Section 5.5.1, to provide easy access to the interior of the instrument. Stand the instrument normally on the bench with its back towards you.

(2) Remove the broken drive cord.

(3) Rotate drum B, on the tuning capacitor shaft, until the capacitor vanes are fully meshed.

(4) Loosen the 4-BA nut securing the jockey pulley and lower the pulley to the bottom of the slot in the bracket on the side of the R.F. chassis.

(5) Cut off a 36-inch length of the new nylon drive cord. Lay the two halves of this length side by side by bringing the two ends together, thus forming a loop at one extremity with the two ends at the other. Pass the loop through the upper ring of the tension spring on drum B, and thread the two ends of the cord over the ring and through the loop, thus securing the centre of the length of cord to the spring.

(6) Bring the two free ends of the cord through slot b in drum B and wind these in opposite directions round drum B and onto drum A as in the diagram, passing over the jockey pulley and through the rubber grommet in the R.F. chassis as shown. There should be a total of one and a half turns on each drum so that both drums are capable of the half-turn movement necessary to fully open the capacitor.

(7) To fix the cord on drum A, pass one end of the cord through the ring at the top end of the tension spring on drum A, and pass the other end of the cord through the ring from the reverse side. Pull on both ends of the cord until the rings on the springs of both drums are drawn up to the rims of the drums and finish off by making a knot. Cut off the surplus cord about a quarter of an inch from the knot.

(8) Raise the jockey pulley upwards until a good positive drive is obtained and then lock the pulley in position by means of the 4-BA securing nut.

(9) Check that the tuning capacitor traverses its full swing when operated by the frequency tuning control.

5.11.2 Replacing The Dial Drive Cord

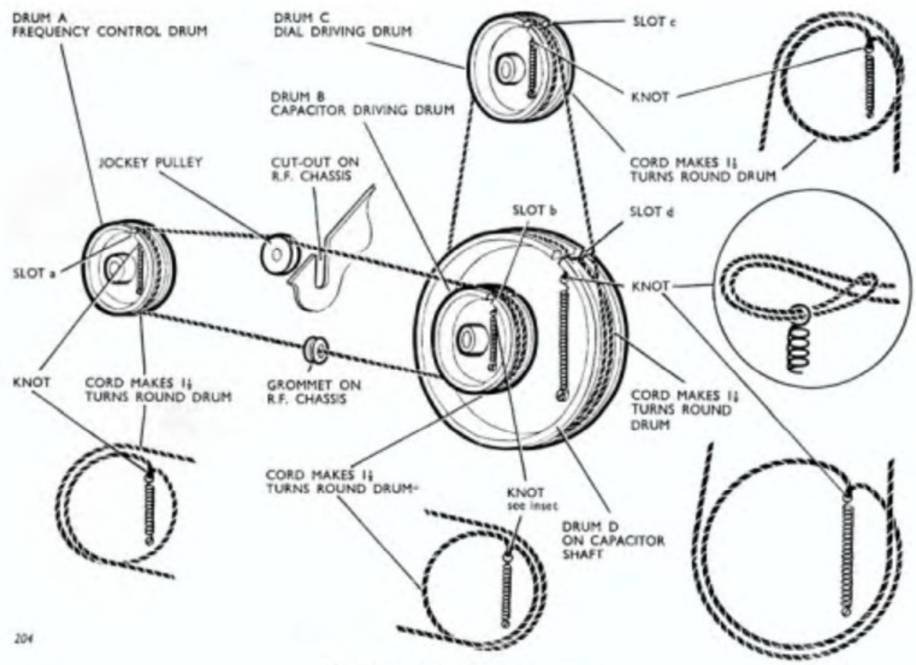


Fig. 5.5 Drive Cord Diagram.

(1) Take the instrument out of its case and raise the power unit, as described in Section 5.5.1, to provide easy access to the interior of the instrument. Stand the instrument normally on the bench with its back towards you.

(2) Remove the broken drive cord.

(3) Rotate drum D, on the tuning capacitor shaft, until the capacitor vanes are fully meshed.

(4) Cut off a 24-inch length of the new nylon drive cord. Lay the two halves of this length side by side by bringing the ends together, thus forming a loop at one extremity with the two ends at the other. Pass the loop through the upper ring of the tension spring on drum D, and thread the two ends of the cord over the ring and through the loop, thus securing the centre of the length of cord to the spring.

(5) Bring the two free ends of the cord through slot d in drum D and wind these in opposite directions round drum D and onto drum C as in the diagram. There should be a total of one and a half turns on each drum so that both drums are capable of the necessary turning movement to accommodate the full traverse of the capacitor vanes and rotation of the dial.

(6) To fix the cord on drum C, pass one end of the cord through the ring at the top end of the tension spring on drum C, and pass the other end of the cord through the ring from the reverse side. Pull on both ends of the cord until the rings on the springs of both drums are drawn up to the rims of the drums and finish off by making a knot. Cut off the surplus cord about a quarter of an inch from the knot.

(7) Check that the lines marked on the tuning dial indicating maximum and minimum capacity coincide with the cursor for the settings of the capacitor vanes when fully meshed and when fully separated respectively. If this does not occur, loosen the two hexagon set screws in the bush of the dial drum C, and rotate the dial to the correct position. Retighten the set screws after this adjustment.

5.12 Schedule Of Tests

The following information is based on extracts from the internal Factory Test Schedule, and is included to enable the user to carry out a series of tests by which the main points of performance of the instrument may be checked. Details concerning the adjustment of preset components and the choice of value of selected components are included.

5.12.1 Apparatus Required

(a) **Avo-meter model 8**, or similar multi-range meter; 20,000 ohms/volt.
(b) **Variable mains transformer**; e.g. Variac.
(c) **L.F. Oscillator**, covering 50 c/s to 35 kc/s; e.g. Marconi R.C. Oscillator Type TF 1101.
(d) **Decade Potentiometer** (voltage dividing resistance box); 0 to 100 KΩ; 1% accuracy.
(e) **Variable Attenuator**; accuracy ±0.2 dB at 1 kc/s; e.g. Marconi A.F. Attenuator Type TF 338C.
(f) **Wave Analyser**; e.g. Marconi Type TF455E.
(g) **Video Oscillator**, covering 25 kc/s to 1 Mc/s; e.g. Marconi Type TF 885A/I.
(h) **Crystal Calibrator**, containing a crystal controlled oscillator and a mixer stage, for accurate frequency measurement; 200 kc/s to 256 Mc/s; e.g. Marconi Crystal Calibrator Type TF 1374.
(i) **Wavemeter**, covering 4 to 64 Mc/s; e.g. Marconi Wavemeter Type TF 975.
(j) **Valve Voltmeter**, for measuring about 0 to 400 m V and about 0 to 3 V a.c. with minimum circuit reactive loading; e.g. Marconi Types TF 1041B or TF 1300.
(k) **F.M. Signal Generator**, 50Ω output impedance, 10 Mc/s to about 1,000 Mc/s; e.g. Marconi Types 1066A or TF 995A/2M and TF1060.
(l) **Crystal Controlled or Locked Signal Source**, covering 10 to about 500 Mc/s and free from modulation hum.
(m) **C.R. Oscilloscope**; 10 mV sensitivity, with facilities for voltage measurement; e.g. Marconi Type TF 1330.
(n) **Panoramic Receiver**, to monitor Item k.
(o) **L.F. source** covering 0 to 35 kc/s having particularly accurate frequency calibration; e.g. Muirhead Decade Oscillator.
(p) **Tuned A.F. Detector**; e.g. Marconi Distortion Factor Meter Type TF 142F.

(q) **R-C Low-pass Filter** as shown in Fig. 5.6.

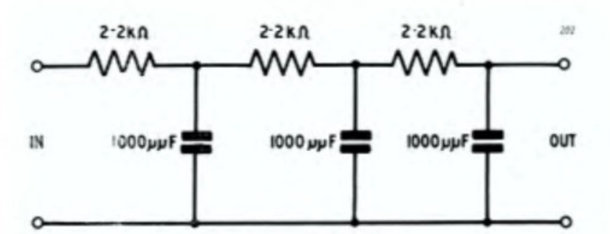


Fig. 5.6 R-C Filter.

(r) **D.C. Potentiometer**, suitable for measuring up to 1 volt; e.g. Tinsley Potentiometer.

5.12.2 Power Unit-H.T. Voltage and Mains Ripple
(Apparatus required: a, b, and m)
Adjustments to the power unit are made before the instrument is despatched. It is not expected that further adjustments will normally be necessary. To check the correct functioning of the power unit:

(1) Set the supply voltage, by means of a variable transformer, so that it is exactly the value for which the Carrier Deviation Meter is adjusted on its tapping panel.

(2) Adjust the preset variable resistor RV5, on the power unit chassis, so that the stabilized H.T. voltage measured between the cathode (pin 3) of V16 and chassis is 250 volts. Then check that the other power unit voltages are in agreement with those given in Section 5.6.

(3) Connect the oscilloscope between the stabilized H.T. supply (pin 3 of V16) and chassis, turn the selector switch to **Tune**, and examine the ripple waveform; its peak-to-peak amplitude should not be more than about 10 mV.

5.12.3 Meter Circuits
(Apparatus required; c and d)
The deviation meter should read zero with no input signal or noise. This condition is obtained by adjustment of RV2, in series with diode V10, which can be set so that the standing current of V10 cancels that of the I.F. detector, V9. The combined linearity of the I.F. amplifiers and meter circuits may also be checked. Make this adjustment and test as follows:

(1) Short-circuit the integrating filter input terminal to chassis.

(2) Turn the selector switch to **Read** and adjust the preset variable resistor RV2 until the meter indicates zero reading with the **Deviation** switch turned to either the ' -' or ' +' position. This variable resistor is situated on the underside of the main chassis, near to the meter diodes.

(3) Remove the short circuit to chassis at the input terminal of the integrating filter, and disconnect the input lead to the filter.

(4) Connect the I.F. oscillator, via the decade potentiometer, to the control grid of V3 (pin 1).

(5) Set the I.F. oscillator to give a 1-kc/s output of sufficient amplitude to produce full-scale deviation meter deflection.

(6) Using the decade potentiometer as a potential divider, check that the meter scale is linear. The non-linearity should not exceed about 2 % of full-scale deflection.

(7) Reconnect the input to the integrating filter unit.

5.12.4 L.F. Amplifiers And Integrating Filter Unit- Frequency Response
(Apparatus required; c and e)
The frequency response of the I.F. amplifiers and the integrating filter unit may be checked as follows:

(1) Remove the normal input connection to the integrating filter unit and turn the selector switch to **Read**.

(2) Connect the I.F. oscillator to the input of the integrating filter unit via the variable attenuator.

(3) Turn the **Set Deviation** preset control to its mid position.

(4) Tune the I.F. oscillator to 1 kc/s.

(5) Adjust the output voltage from the L.F. oscillator and the setting of the variable attenuator to give a reading of 15 kc/s on the deviation meter scale.

(6) Increase the variable attenuator setting by -0.5 dB and note the deviation meter reading. Then reduce the variable attenuator setting 0.5 dB relative to that in (5) and again note the deviation meter reading.

(7) Disconnect the variable attenuator and connect the L.F. oscillator directly to the input of the integrating filter unit.

(8) With the I.F. oscillator tuned to 1 kc/s, adjust its output voltage to produce a 15 kc/s reading on the deviation meter. (This signal amplitude should be about 30 mV.)

(9) Keeping the output voltage of the L.F. oscillator constant, vary its frequency between 50 c/s and 35 kc/s and, using the dB calibration of the deviation meter obtained in (5) and (6), check that the meter reading does not alter more than about ±0.1 dB when the I.F. oscillator is tuned through the range 50 c/s to 25 kc/s; check that the meter reading does not alter more than about ±0.3 dB over the range 25 to 35 kc/s.

(10) If this frequency response is not obtained, adjust the value of C21 (in the cathode circuit of Y3).

5.12.5 L.F. Amplifiers - Distortion and Supply - Frequency Hum
(Apparatus required: c and l)

The degree of 2nd and 3rd harmonic distortion introduced by the I.F. amplifiers may be checked. Supply-frequency hum, present at the L.F. **Output** terminals, is reduced to a minimum by adjusting the preset variable resistor RV6. Test and adjust as follows:

(1) Remove the normal input connection to the integrating filter unit and instead apply to the filter the output from the I.F. oscillator, via a 1 kc/s pass filter (included in a TF 1101 R-C Oscillator).

(2) Turn the selector switch to **Read**.

(3) Set the I.F. oscillator to give an output signal at a frequency of 1 kc/s of sufficient amplitude to produce a full-scale deviation-meter deflection.

(4) Using the wave analyser, connected to the L.F. **Output** terminals, measure the amplitude of the 2nd and 3rd harmonic distortion introduced by the amplifier. Also record the amplitude of the 1-kc/s signal at these terminals. Relative to the amplitude of the 1-kc/s signal, the 2nd harmonic component should be of the order of –60 dB and the 3rd harmonic component of the order of -70 dB.

(5) Disconnect the L.F. oscillator from the instrument and short circuit the input to the integrating filter unit, leaving the wave analyser connected to the L.F. **Output** terminals of the instrument.

(6) Tune the wave analyser to the mains supply frequency and adjust RV6 (connected across the LT3 winding of T1) to obtain, at the L.F. **Output** terminals of the instrument, a minimum voltage at the supply frequency. (RV6 is situated on the main chassis.)

(7) Tune the wave analyser to the 2nd, and then the 3rd, harmonic of the frequency of the mains supply and note the amplitude, in each case, of the voltage indicated by the wave analyser. Relative to the amplitude of the 1-kc/s signal measured in (4) above, the fundamental supply frequency hum voltage should be of the order of -65 dB, the 2nd harmonic voltage of the order of -50 dB, and the 3rd harmonic voltage of the order of -60 dB.

(8) Remove the short circuit and reconnect the input to the integrating filter unit.

Note: It may be necessary to select V3 in order to reduce the hum output to a satisfactory minimum.

5.12.6 I.F. Amplifiers-Sensitivity
(Apparatus required: g) -

The overall sensitivity of the I.F. stages and the **Min. Input** meter calibration of the instrument may be checked as follows:

(1) Turn the selector switch to **Check Input**.

(2) Feed a signal of 325 kc/s from the video oscillator between the junction R46C42 (in the input circuit of VII) and chassis.

(3) Adjust the amplitude of this signal until the deviation meter reads at the **Min. Input** mark on the meter scale and check that the amplitude of the input signal is about 4 mV. If other than 4 mV is required to obtain a reading of **Min. Input**, adjust the value of R76 so that about 4 mV is required and ensure that satisfactory limiting is obtained as in Section 5.12.8.

5.12.7 I.F. Amplifiers - Frequency Response
(Apparatus required: g)

The low-pass filter may be tuned by means of adjustable cores in the coils to give the I.F. amplifiers the required frequency response as follows:

(1) Turn the selector switch to **Check Input**.

(2) Disconnect the silicon diode mixer, X5, and connect the output of the video oscillator, via a 3.3 KΩ resistor, between the junction L12R101 (the input to the low-pass filter) and chassis.

(3) Tune the video oscillator to 325 kc/s, adjust its output to make the deviation meter read at **Min. Input**, and note the amplitude of the signal required.

(4) Vary the frequency of the signal from the video oscillator from 25 to 1,000 kc/s and tune L12; L13, and L14, by means of their adjustable slugs, to obtain as closely as possible, the following frequency response relative to the signal voltage required in (3) above:

25 to 550 kc/s	...	0 to -4 dB.
800 kc/s	...	more than 20 dB down
1,000 kc/s	...	more than 55 dB down

(5) Reconnect the silicon diode mixer, X5.

5.12.8 Demodulator Linearity, 'Tune' Calibration, And Limiting
(Apparatus required: g, h, and r)
The demodulator linearity, the calibration of the **Tune** mark on the deviation meter scale, and the action of the limiter, may be checked as follows:

(1) Connect the d.c. potentiometer between the input to the integrating filter unit and chassis.

(2) Connect the video oscillator so that its output is applied between the junction R46C42 (in the input circuit of V11) and chassis.

(3) Turn the selector switch to **Check Input**.

(4) Tune the video oscillator to exactly 325 kc/s, with the aid of the crystal calibrator. Disconnect the crystal calibrator and increase the video oscillator output until the meter deflects well above **Min. Input**.

(5) Turn the selector switch to **Read** and the **Deviation Range** switch to 125.

(6) Using the d.c. potentiometer, measure and note the d.c. voltage at the input to the integrating filter unit. Then maintaining its output level, tune the video oscillator in turn to exactly 200 kc/s and exactly 450 kc/s and note the d.c. potential measurements at each of these frequencies. The mean of the potentiometer measurements at 200 kc/s and 450 kc/s should be within 1% of the measurement at 325 kc/s.

Note: If the video oscillator can only be crystal checked at, say, every 10 kc/s, or every 100 kc/s, then the measurements may be made at 200, 320, and 440 kc/s, or at 200, 300, and 400 kc/s respectively.

(7) Tune the video oscillator accurately to 325 kc/s with the aid of the crystal calibrator.

(8) Turn the selector switch to **Check Input** and apply the 325-kc/s video oscillator signal between the junction R46C42 and chassis.

(9) Adjust the amplitude of this signal to give a deviation meter indication at the **Min. Input** mark on the scale.

(10) Turn the selector switch to **Tune** and select R91 (on contact 8 of the switch SAab) to bring the meter pointer to the **Tune** mark on the deviation meter scale.

(11) Increase the output signal from the video oscillator by 20 dB and check that the deviation meter reading does not change from that in (10) by more than about 1 %. (See Section 5.12.6).

5.12.9 Local Oscillator- Setting Frequency Ranges
(Apparatus required: h and i)

The following procedure is included to enable the end frequencies, marked on the tuning dial for each range, to be accurately set.

(1) Turn the **Crystals** switch to OFF and the **Range** switch to 4-8 Mc/s.

(2) Set the frequency tuning dial to 4 Mc/s and adjust the oscillator tuning coil, L1, by means of its adjustable core to give an oscillator frequency of 4 Mc/s, using the wavemeter to measure the frequency.

(3) Connect the inlet of the crystal calibrator, via a 100 pF capacitor, to the junction R13/R8 in the grid/cathode circuit of V2 and accurately determine the frequency of the local oscillator. Make the required adjustment to L1 to obtain exactly 4 Mc/s.

(4) Set the frequency tuning dial to 8 Mc/s and, with the aid of the wavemeter and the crystal calibrator, adjust the trimmer capacitor, C66, to give an oscillator frequency of 8 Mc/s.

(5) Repeat (3) and (4) to ensure that the calibration at both ends of the tuning dial is correct.

(6) Turn the **Range** switch to 16-32 Mc/s and adjust the local-oscillator tuned circuit by means of L2 and C69 for frequency tuning-dial

settings of 16 and 32 Mc/s respectively, to give the correct frequencies, using the wavemeter first and then the crystal calibrator for monitoring the oscillator frequencies, as explained above.

(7) Turn the **Range** switch to 64-128 Mc/s and adjust the local-oscillator tuned circuit by means of L3 and C68 for frequency tuning-dial settings of 32 and 64 Mc/s respectively, using the wavemeter first and then the crystal calibrator for monitoring the oscillator frequencies, as explained above.

Note: On each range, except the lowest, check that the local oscillator functions at frequencies at least 325 kc/s below and above the minimum and maximum frequencies marked on the tuning dial.

5.12.10 Local Oscillator- Frequency Calibration

(Apparatus required: h and i)

The calibration of the existing tuning dial may be checked (or a new tuning dial calibrated) as follows:

(1) Check the frequency limits on ranges 4 to 8 Mc/s, 16 to 32 Mc/s and 64 to 128 Mc/s, as described in Section 5.12.9. (The minimum and maximum frequency positions on the dial should be not less than 1 inch from the mechanical limits of rotation.)

(2) Check the frequencies shown on the dial for the first three frequency bands of the **Range** switch, using the crystal calibrator.

(3) Turn the **Range** switch to the fourth frequency band position and check the dial for frequencies from 128 to 256 Mc/s, using the crystal calibrator connected across R42.

Note: the frequency markings on the dial for the 4 to 8 Mc/s range coincide with those for the 8 to 16 Mc/s range; i.e. the calibration mark for 4 Mc/s also serves for 8 Mc/s, the 4.5 Mc/s mark serves for the 9 Mc/s mark on the dial, etc. Also the same applies for the 16 to 32 Mc/s and 32 to 64 Mc/s ranges, and for the 128 to 256 Mc/s, 256 to 512 Mc/s, and 512 to 1,024 Mc/s ranges. The fundamental frequency of the oscillator used on each range is shown in Table 2 of Section 4.2.

5.12.11 Frequency Doublers

(Apparatus required)

The tuned circuits in the frequency doubling stages may be adjusted to ensure tracking over their frequency range as follows:

(1) Turn the **Crystals** switch to OFF.

(2) Turn the **Range** switch to 128-256 Mc/s.

(3) Connect a valve voltmeter across R31, in the grid circuit of V7, and check that the voltage across this resistor is of the order of 3 volts over the entire range.

(4) Adjust the spacing between the turns of the coil L7 at the low-frequency end of the tuning dial, and adjust the trimming capacitor C24 at the high-frequency end of the tuning dial, for a maximum voltage as indicated on the valve voltmeter.

(5) Connect the valve voltmeter across R42 (on contact 11 of switch SDeb) and check the voltage across this resistor. This should normally be greater than 400 m V over the entire range.

(6) Adjust the spacing between the turns of the coils L8 and L9 at the low-frequency end of the tuning dial, and adjust the trimming capacitor C33 at the high-frequency end of the tuning dial, for a maximum voltage as indicated on the valve voltmeter.

5.12.12 R.F. Input Level

(Apparatus required: k)

The overall sensitivity of the R.F. and I.F. circuits may be checked as follows:

(1) Connect the output from a signal generator to the **Low Level** input socket of the Carrier Deviation Meter.

(2) Adjust the signal generator to produce 25 mV E.M.F. at a frequency of 10 Mc/s.

(3) Turn the selector switch to **Tune**, the **Crystals** switch to OFF, and tune the local oscillator to the input signal (as described in Section 2.3.3.).

(4) Turn the selector switch to **Check Input** and check that the meter deflects above the **Min. Input** mark on the scale.

(5) Transfer the input to the Carrier Deviation Meter from the **Low Level** to the **High Level** socket.

(6) Increase the voltage output from the signal generator to give a deviation meter reading to the **Min. Input** mark on the scale; this latter generator output signal amplitude should be about 20 dB above that required when the signal was applied to the **Low Level** input socket of the instrument.

5.12.13 Adjusting the I.F. Traps

(Apparatus required: l and m)

To reduce the I.F. breakthrough signal reaching the L.F. **Output** terminals and the meter circuit to a minimum, I.F. traps are included in the cathode circuits of V6 and V8. These traps are tuned to reject the I.F. signal as follows:

(1) Connect the output from a signal generator, free from modulation hum, to either the **Low Level** or the **High Level** input sockets of the Carrier Deviation Meter.

(2) Tune the signal generator to give an unmodulated output signal of any frequency within the range of the Carrier Deviation Meter.

(3) Turn the **Deviation Range** switch to 5 kc/s.

(4) Connect an oscilloscope to the L.F. **Output** terminals on the Carrier Deviation Meter.

(5) Tune the Carrier Deviation Meter to the output signal from the signal generator, as described in Section 2.3.3.

(6) Adjust the slug of the coil L11, in the cathode circuit of V8, to reduce the amplitude of the I.F. signal, displayed on the oscilloscope, to a minimum.

(7) Disconnect the oscilloscope from the L.F. **Output** terminals and reconnect it, via a 10 KΩ resistor, to the junction R36L10 in the cathode circuit of V6.

(8) Adjust the slug of the coil L10 to reduce the amplitude of I.F. signal, displayed on the oscilloscope, to a minimum.

Note: A simple filter, having a pass characteristic centred on 325 kc/s, fitted in series with the inlet to the oscilloscope, gives some advantage in the above procedure.

5.12.14 Signal to Noise Ratio - Unlocked
(Apparatus required: c, l, p, and q)
The overall signal to noise ratio of the instrument may be checked as follows:

(1) Connect the output from the L.F. oscillator, tuned to 1 kc/s, to the input to the integrating filter unit.

(2) Turn the selector switch to **Read** and the **Deviation Range** switch to 5.

(3) Adjust the amplitude of the L.F. oscillator output signal to give a full-scale deflection on the deviation meter.

(4) Connect the L.F. **Output** terminals on the Carrier Deviation Meter, via the R-C filter, to the input of the tuned A.F. detector.

(5) Adjust the sensitivity of the tuned A.F. detector to give a convenient reading, and note this reading.

(6) Disconnect the L.F. oscillator from the input to the integrating-filter unit.

(7) Turn the **Range** switch to 256-512 Mc/s and the **Crystals** switch to OFF.

(8) Connect the output from an R.F. signal generator, free from modulation hum, tuned to a frequency of 450 Mc/s, to the **Low Level** input socket and tune the local oscillator in the Carrier Deviation Meter to the generator signal, as described in Section 2.3.3.

(9) Turn the selector to **Check Input** and adjust the output of the R.F. signal generator to give a deviation meter deflection of not less than half of full-scale deflection. Return the selector switch to **Read**.

(10) Adjust the sensitivity of the tuned A.F. detector to give the same reading as in (5) above.

(11) The change in gain of the tuned A.F. detector in dB for the two measurements in (5) and (10) above expresses the noise of the instrument relative to 5 kc/s deviation, which should be approximately -30 dB for a carrier frequency of 450 Mc/s.

(12) This procedure should be repeated at other carrier frequencies with the range switch positioned at each of the other three lower frequency ranges. The signal to noise ratio should gradually improve as the carrier frequency is reduced.

5.12.15 Deviation Measurement - Positive And Negative

The correct polarity for the ' + ' and ' – ' positions of the **Deviation** switch may be checked as follows:

(1) Set the **Deviation Range** switch at 125.

(2) Set the **Deviation** switch at ' - '.

(3) Set the selector switch at **Read**.

(4) Connect a 3.9 MΩ resistor between the H.T. positive line and the junction of C36 with tag 1 of the switch SEca.

(5) Check that the deviation meter indicates approximately half of full-scale deflection.

5.12.16 Deviation Reading Accuracy

(Apparatus required: k, n, and o)

(1) Connect the F.M. signal generator, externally modulated by the L.F. oscillator, to the **Low Level** socket on the Carrier Deviation Meter and also to the input of the panoramic receiver.

(2) Tune the F.M. signal generator to any frequency within the range of the Carrier Deviation Meter and tune the latter to this signal, as described in Section 2.3.3.

(3) Tune the panoramic receiver to the F.M. signal generator carrier frequency.

(4) Turn the **Deviation Range** switch on the Carrier Deviation Meter to 75 kc/s.

(5) Adjust the frequency of the I.F. oscillator signal to precisely 4.152 kc/s and slowly increase the modulation from zero until the carrier component, viewed on the panoramic receiver, has disappeared six times.

(6) Adjust the **Set Deviation** control, RV1, on the front panel, so that the meter correctly shows 75 kc/s deviation. RV1 when adjusted should be more than approximately 45° from either end stop. If this condition is not obtained, select the resistor R20, in the cathode circuit of V8, to bring the setting of RV1 more than 45° from either end stop.

(7) Repeat (5) for a number of frequencies and deviations, as shown by Table 9, to confirm that the resistors R92, R93, and R95 determining the meter indication on the other three ranges are correct.

(8) Turn the selector switch to **Set Deviation** and the **Deviation** switch to ' + '.

(9) Adjust RV4 to bring the meter pointer to the **Set Deviation** mark on the scale. Check that wide adjustment of the slug of coil L15, in the screen circuit of V12, does not affect the deviation indication on the meter (this confirms that crystal is controlling frequency).

(10) Return the slug of the coil L15 to its mid-way position.

(11) Recheck the setting of RV4 and the accuracy of the instrument at one deviation setting after the instrument has been left switched on for two hours.

Table 9

Modulation Frequency (kc/s)	Carrier Disappearance	True Deviation (kc/s)
22.65	2	125
8.372	5	125
33.27	1	80
4.529	2	25
2.079	1	5
4.16 (4.152)	6	75
4.16 (4.153)	5	62
4.16 (4.156)	4	49
4.16 (4.160)	3	36
4.16 (4.167)	2	23
4.16 (4.159)	1	10

Note: In the last six sets of figures, the exact modulation frequency is in brackets. One frequency, 4.16 kc/c, may be used for a sequence of six checks, introducing only a very small approximation.

5.12.17 Set Deviation-Indication at Other Than 50 c/s

When the instrument is despatched, normally the **Set Deviation** mark on the meter scale is calibrated for use on a 50-c/s mains supply and the user is referred to Section 2.7 and Table 1 when operating from supplies other than 50 c/s. To ensure that the instrument conforms with Table 1, follow the procedure of 5.12.16 and then:

(1) Connect the Carrier Deviation Meter to a mains supply of 100 c/s or 60 c/s (preferably the former), ensuring that the primary of the mains transformer, T1, is adjusted correctly to the supply voltage.

(2) Turn the selector switch to **Set Deviation**.

(3) Select the value of C55, in the screen circuit of V13, to obtain a deviation meter indication at 12.5 kc/s if using 100-c/s supply or 12.9 kc/s if using a 60-c/s supply.

5.12.18 Supply Voltage Variations
(Apparatus required: b and k)
The instrument may be checked to ensure that normal fluctuations in the mains supply voltage do not cause errors in deviation measurement as follows:

(1) Connect the Carrier Deviation Meter to the mains supply via a variable mains transformer.

(2) Adjust the primary tappings of the mains transformer, T1, for 200-volt working.

(3) Set the variable mains transformer to give an output of 200 volts.

(4) Turn the selector switch to **Set Deviation** and adjust RV1 to give a meter deflection to the **Set Deviation** mark on the scale.

(5) Connect the output from a F.M. signal generator, set to any convenient frequency and deviation level, to the **Low Level** socket on the Carrier Deviation Meter.

(6) Tune the Carrier Deviation Meter to the frequency of the F.M. signal generator, as described in Section 2.3.3, and read the deviation indication.

(7) Adjust the variable mains transformer, first, to give an output voltage of 180V and then 220V and check that the deviation meter reading does not change by more than about 1% from the previous reading obtained for a mains voltage of 200V.

5.12.19 Signal to Noise Ratio - Crystal Locked
(Apparatus required: k, l, p, and q)
The overall signal to noise ratio of the instrument when using the crystal oscillator locking facility may be checked as follows:

(1) Connect the L.F. **Output** terminals of the Carrier Deviation Meter to the input of a tuned A.F. detector, via the R-C filter.

(2) Lock the tuned local oscillator, in the Carrier Deviation Meter, to the crystal oscillator as described in Section 2.4. The frequency at which the local oscillator is locked must be 325 kc/s above the frequency at which the crystal controlled signal generator will be set in (10) and within the highest range of the Carrier Deviation Meter.

(3) Connect the output from a F.M. signal generator to the **Low Level** input socket on the Carrier Deviation Meter.

(4) Turn the selector switch to **Tune**.

(5) Tune the F.M. signal generator approximately to the frequency setting of the local oscillator. Then, slowly tune the signal generator away from the frequency of the TF 791D local oscillator until the meter reads at the **Tune** mark when the signal generator is just below the local oscillator frequency. (This tuning procedure is similar to that described in Section 2.3.3, but the F.M. signal generator is tuned instead of the TF 791D.)

(6) Turn the selector switch to **Check Input** and adjust the output voltage of the F.M. signal generator to give a deviation meter reading above **Min. Input**.

(7) Turn the selector switch to **Read** and the **Deviation Range** switch to 5.

(8) Adjust the modulation level of the F.M. signal generator to give a deviation meter reading of 5 kc/s.

(9) Adjust the sensitivity of the tuned A.F. detector to give a convenient meter deflection and note this reading.

(10) Remove the F.M. signal generator connection to the inlet of the Carrier Deviation Meter and in its place connect a crystal controlled signal generator, free from modulation hum, tuned to exactly 325 kc/s below the frequency of the crystal locked local oscillator in the Carrier Deviation Meter .

(11) Turn the selector switch to **Check Input** and adjust the output voltage of the crystal controlled signal generator to give a deviation meter deflection above **Min. Input**.

(12) Turn the selector switch to **Read** and the **Deviation Range** switch to 5.

(13) Adjust the sensitivity of the tuned A.F. detector to give the same meter reading as was obtained using the F.M. signal generator input in (9). The change in gain in dB, denoted by the difference between the two sensitivity settings of the tuned A.F. detector, expresses the noise relative to 5 kc/s deviation, which should not exceed –50 dB.

(14) This procedure should be repeated at about three carrier frequencies within the frequency range of the Carrier Deviation Meter.

6 – Component Layout Illustrations

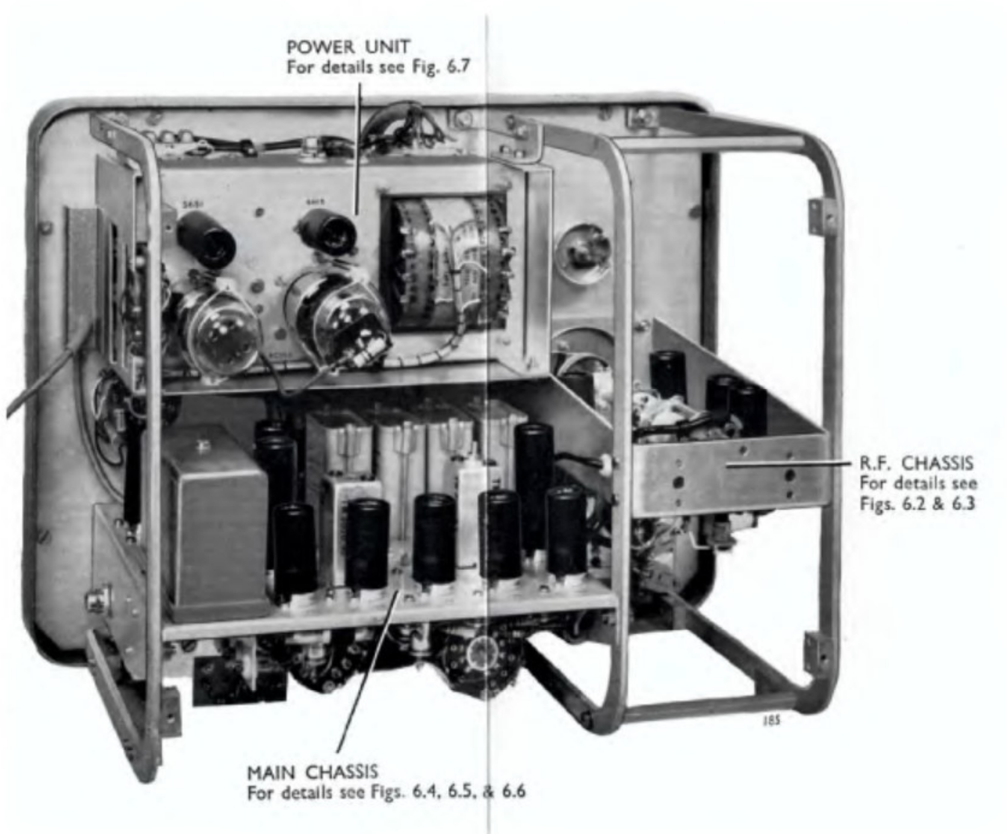


Fig 6.1 – General View from Rear.

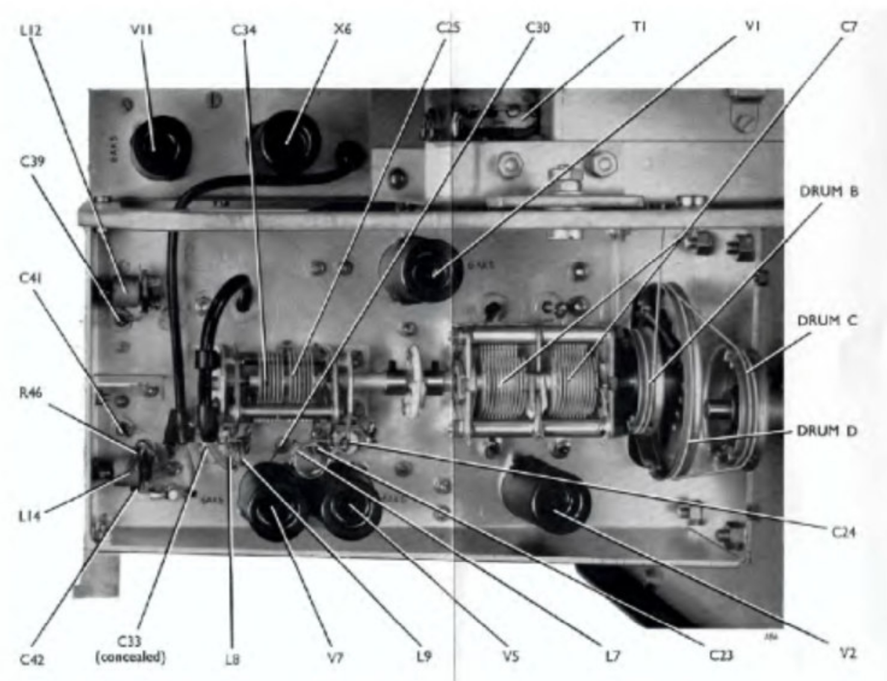


Fig 6.2 Top View of R.F. Chassis.

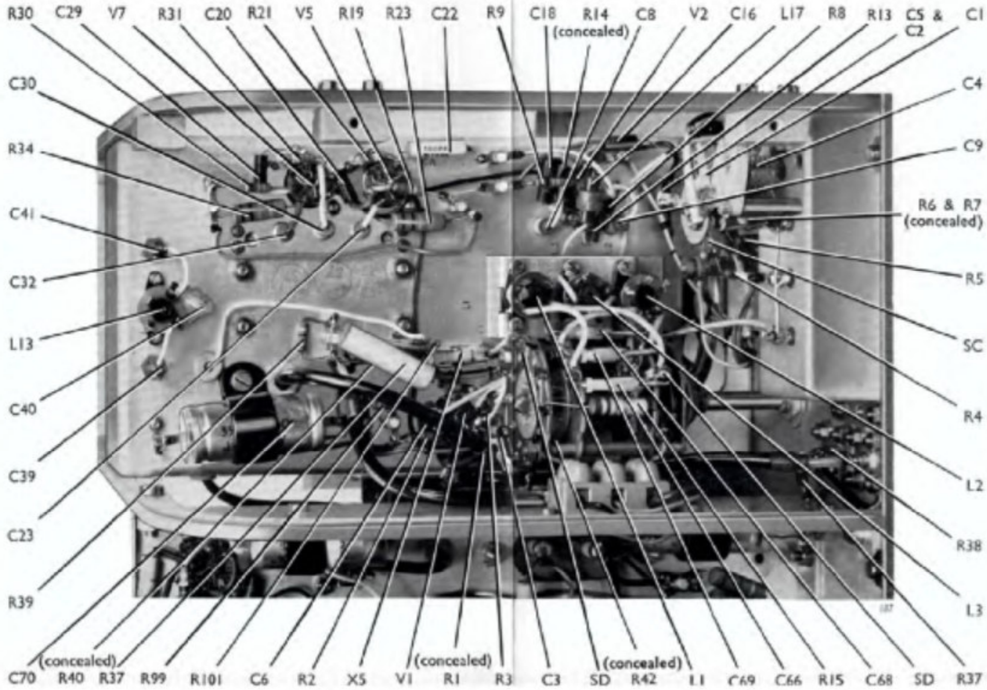


Fig 6.3 Underside of R.F. Chassis.

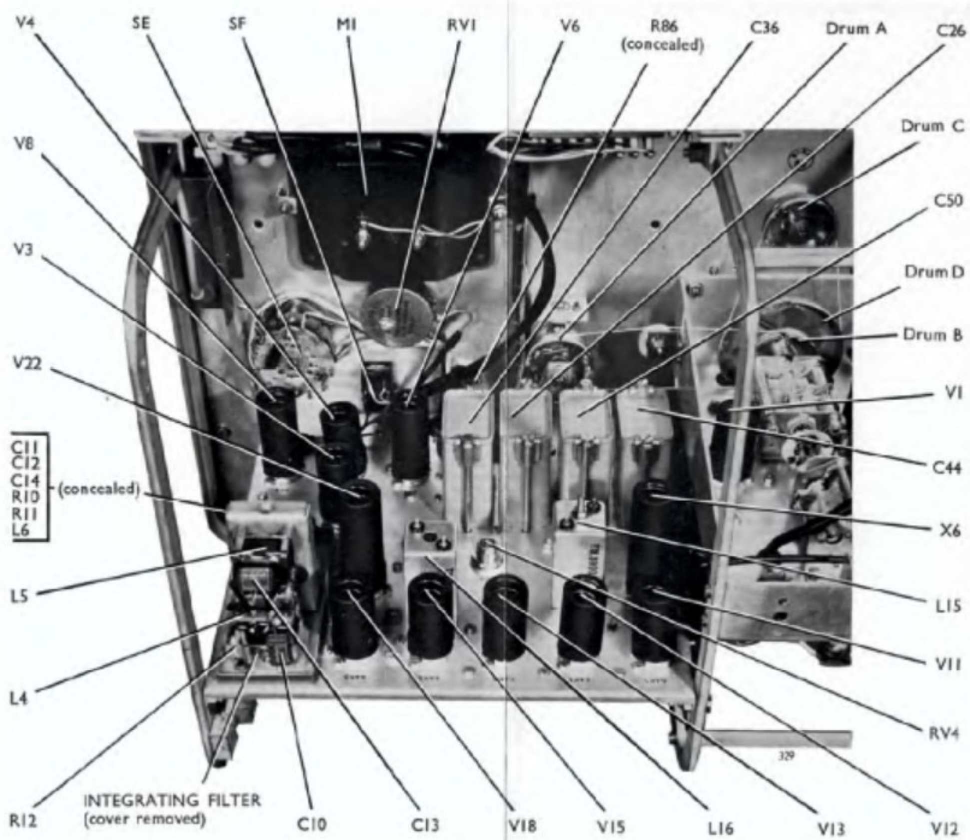


Fig. 6.4 Top View of Main Chassis.

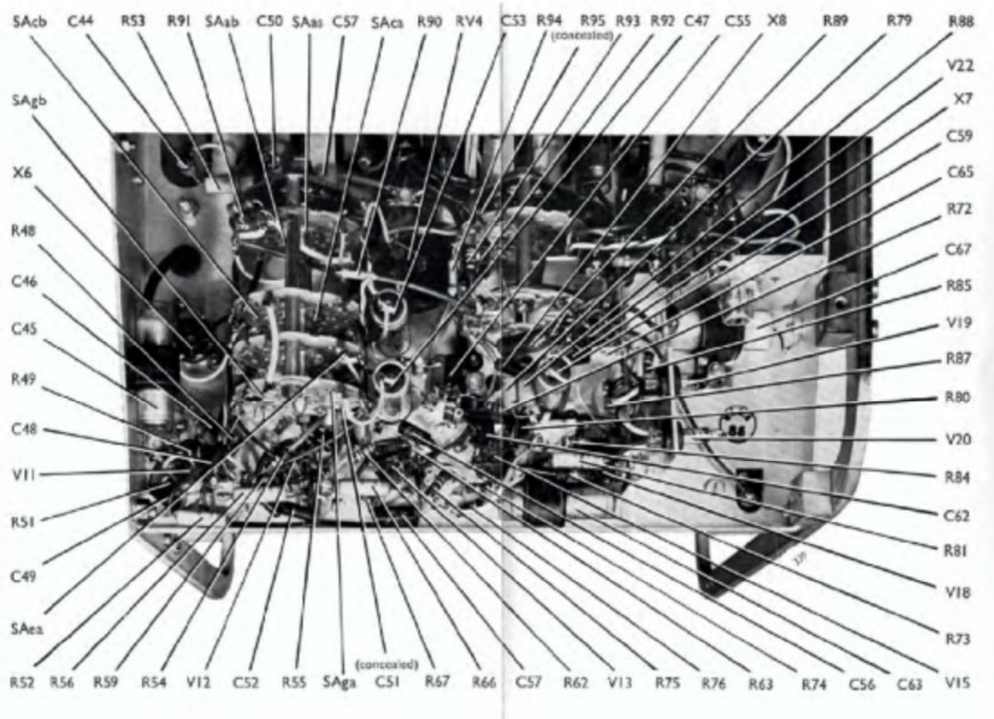


Fig. 6.5 Underside of main Chassis (I.F. Section)

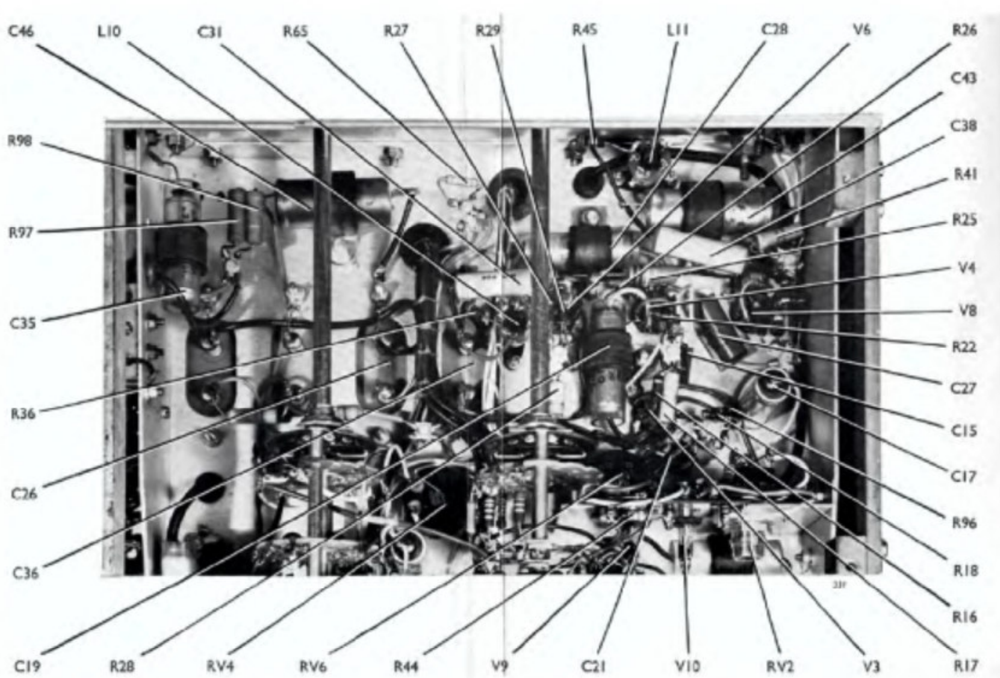


Fig. 6.6 Underside of main Chassis (L.F. Section).

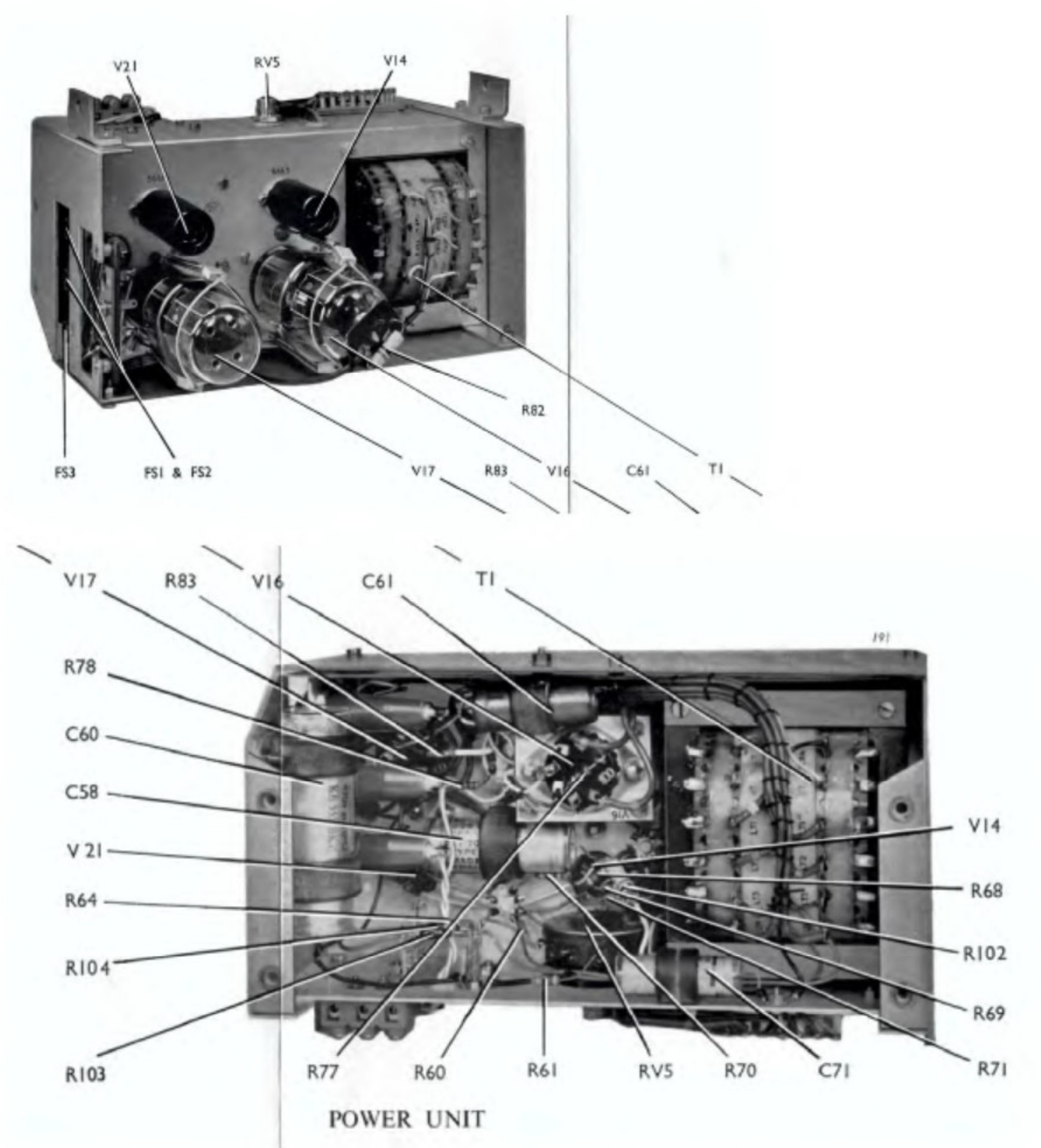


Fig. 6.7 Power Unit

7 - Spares Ordering Schedule

for Carrier Deviation Meter Type TF 791D

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 33Ω resistor, R3, and the 0.1 uF capacitor, C27, quote as follows:

Spares required for TF-791D, Serial Number 000000

1 off, SOS Item 3
1 off, SOS Item 136

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

SOS Item No.	Circuit Ref.	Description	Value	Tol.	Watts.	Works Ref.
		Fixed Resistors				
1	R1	Composition,	100 KΩ	± 10%,	¼ W.	26-TM5773
2	R2	Composition,	10 KΩ	± 10%,	¼ W.	16-TM5773
3	R3	Composition,	33 Ω	± 10%,	¼ W.	20-TM5773
4	R4	Composition,	68 KΩ*,		¼ W.	25-TM5773
5	R5	Composition,	68 KΩ*,		¼ W.	25-TM5773
6	R6	Composition,	68 KΩ*,		¼ W.	25-TM5773
7	R7	Composition,	68 KΩ*,		¼ W.	25-TM5773
8	R8	Composition,	10 KΩ	± 10%,	¼ W.	16-TM5773
9	R9	Composition,	10 KΩ	± 10%,	¼ W.	16-TM5773
10	R10	Carbon, High Stability,	16 KΩ	± 2%,	¼ W.	19-TM5094
11	R11	Composition,	1 M.Q	± 10%,	¼ W.	20-TM5094
12	R12	Carbon, High Stability,	16 KΩ	± 2%,	¼ W.	19-TM5094
13	R13	Composition,	15 Ω	± 10%,	¼ W.	22-TM5773
14	R14	Composition,	47 KΩ	± 10%,	¼ W.	17-TM5773
15	R15	Composition,	22 KΩ	± 10%,	½ W.	27-TM5773
16	R16	Composition,	1.5 MΩ	± 10%,	¼ W.	85-TF791D
17	R17	Composition,	330 KΩ	± 10%,	½ W.	109-TF791D
18	R18	Carbon, High Stability,	1 KΩ	± 5 %,	¼ W.	84-TF791D
19	RI9	Composition,	22 KΩ	± 10%,	¼ W.	18-TM5773
20	R20	Composition,	470 KΩ*,		¼ W.	90-TF791D
21	R21	Composition,	22 KΩ	± 10%,	¼ W.	18-TM5773
22	R22	Composition,	1MΩ	± 10%,	¼ W.	86-TF791D
23	R23	Composition,	10 KΩ	± 10%,	1W.	30-TM5773
24	R24	Composition,	33 KΩ	± 10%,	¼ W.	76-TF791D
25	R25	Composition,	100 KΩ	± 10%,	1W.	110-TF791D
26	R26	Composition,	2.4 KΩ	± 5%,	¼ W.	87-TF791D
27	R27	Composition,	1 M.Q	± 10%,	¼ W.	86-TF791D
28	R28a	Composition,	22 KΩ	± 10%,	1W.	108-TF791D
29	R29	Composition,	1 KΩ	± 10%,	¼ W.	65-TF791D
30	R30	Composition,	47 KΩ	± 10%,	¼ W.	17-TM5773

SOS Item No.	Circuit Ref.	Description	Value	Tol.	Watts.	Works Ref.
31	R31	Composition,	22 KΩ	± 10%,	¼ W.	18-TM5773
32	R32	Composition,	1 M.Ω	± 10%,	¼ W.	86-TF791D
33	R33	Composition,	15 KΩ	± 10%,	¼ W.	88-TF791D
34	R34	Composition,	10 KΩ	± 10%,	1W.	30-TM5773
35	R35	Composition,	470Ω	± 10%,	¼ W.	98-TF791D
36	R36	Composition,	22 KΩ	± 10%,	¼ W.	72-TF791D
37	R37	Composition,	56Ω	± 10%,	¼ W.	23-TM5773
38	R38	Composition,	270Ω	± 10%,	¼ W.	24-TM5773
39	R39	Composition,	56 Ω	± 10%,	¼ W.	23-TM5773
40	R40	Composition,	10 KΩ	± 10%,	1W.	16-TM5773
41	R41	Composition,	3.3 KΩ	± 5%,	1W.	69-TF791D
42	R42	Composition,	100Ω	± 10%,	¼ W.	21-TM5773
43	R43	Composition,	2.2 KΩ	± 10%,	¼ W.	66-TF791D
44	R44	Composition,	68 KΩ	± 10%,	¼ W.	91-TF791D
45	R45	Composition,	2.2 KΩ	± 10%,	¼ W.	66-TF791D
46	R46	Composition,	3.3 KΩ	± 10%,	¼ W.	19-TM5773
47	R47	Composition,	47 KΩ	± 10%,	¼ W.	71-TF791D
48	R48	Composition,	47 KΩ	± 10%,	¼ W.	71-TF791D
49	R49	Composition,	100 KΩ	± 10%,	¼ W.	68-TF791D
50a	R50	Composition,	33 KΩ	± 10%,	1W.	76-TF791D
51	R51	Composition,	220Ω	± 10%,	¼ W.	73-TF791D
52	R52	Composition,	22 KΩ	± 10%,	1W.	108-TF791D
53	R53	Composition,	47 KΩ	± 10%,	1W.	96-TF791D
54	R54	Composition,	100 KΩ	± .10%,	1W.	68-TF791D
55	R55	Composition,	220 KΩ	± 10%,	1W.	74-TF791D
56	R56	Composition,	22 KΩ	± 10%,	1W.	108-TF791D
57	R57	Composition,	47 KΩ	± 10%,	1W	96-TF791D
58	R58	Composition,	100 KΩ	± 10%,	¼ W.	68-TF791D
59	R59	Composition,	330 Ω	± 10%,	¼ W.	99-TF791D
60	R60	Composition,	68 KΩ	± 10%,	¼ W.	70-TF791D
61	R61	Composition,	47 KΩ	± 10%,	¼ W.	71-TF791D
62	R62	Composition,	22 KΩ	± 10%,	¼ W.	72-TF791D
63	R63	Composition,	220 KΩ	± 10%,	¼ W.	74-TF791D
64	R64	Composition,	47 KΩ	± 10%,	¼ W.	115-TF791D
65	R65	Carbon, High Stability,	500.Ω	± 1 %,	¼ W.	102-TF791D
66	R66	Composition,	22 KΩ	± 10%,	1W.	108-TF791D
67	R67	Composition,	220 Ω	± 10%,	¼ W.	73-TF791D
68	R68	Composition,	4.7 KΩ	± 10%,	¼W.	89-TF791D
69	R69	Composition,	680 KΩ	± 10%,	¼ W.	94-TF791D
70	R70	Composition,	47 KΩ	± 10%,	¼ W.	71-TF791D
71	R71	Composition,	330 KΩ	± 10%,	¼ W.	75-TF791D
72	R72	Composition,	33 KΩ	± 10%,	¼ W.	76-TF791D
73	R73	Composition,	1 KΩ	± 10%,	¼ W.	65-TF791D
74	R74	Composition,	1 KΩ	± 10%,	¼ W.	65-TF791D
75	R75	Composition,	22 KΩ	± 10%,	¼ W.	72-TF791D
76	R76	Composition,	47 Ω*,	-	¼ W.	101-TF791D
77	R77	Composition,	100 Ω	± 10%,	¼ W.	95-TF791D
78	R78	Composition,	1 KΩ	± 10%,	¼ W.	65-TF791D
79	R79	Composition,	6.8 KΩ	± 10%,	1W.	78-TF791D
80	R80	Composition,	47 Ω	± 10%,	¼ W.	101-TF791D
81	R81	Composition,	220Ω	± 10%,	1W.	97-TF791D
82	R82	Composition,	47 Ω	± 10%,	1W.	112-TF791D
83	R83	Composition,	330 KΩ	±10%,	¼ W.	75-TF791D

SOS Item No.	Circuit Ref.	Description	Value	Tol.	Watts.	Works Ref.
84	R84	Composition,	47 Ω	± 10%,	¼ W.	101-TF791D
85	R85	Composition,	220 KΩ	± 10%,	¼ W.	74-TF791D
86	R86	Composition,	10Ω	± 10%,	1W.	92-TF791D
87	R87	Composition,	220 KΩ	± 10%,	¼ W.	74--TF791D
88	R88	Composition,	6.8 KΩ	± 10%,	1W.	78-TF791D
89	R89	Wire-wound,	10 KΩ	±10%,	3W.	93-TF791D
90	R90	Carbon, High Stability,	126.Ω	± 1 %,	¼ W.	81-TF791D
91	R91	Composition,	15 Ω*,		¼ W.	79-TF791D
92	R92	Carbon, High Stability,	2120 .Ω	± 1 %,	¼ W.	83-TF791D
93	R93	Carbon, High Stability,	388 Ω	± 1 %,	¼ W.	82-TF791D
94	R94	Carbon, High Stability,	126.Ω	± 1 %,	¼ W.	105-TF791D
95	R95	Carbon, High Stability,	78.1Ω	± 1 %,	¼ W.	80-TF791D
96	R96	Composition,	4.7 KΩ	± 10%,	¼ W.	89-TF791D
97	R97	Composition,	2.2 KΩ	± 10 %,	¼ W.	64- TF791D
98	R98	Composition,	2.2 KΩ	± 10%,	¼ W.	64-TF791D
99	R99	Composition,	2.2 KΩ	± 10%,	¼ W.	29-TM5773
100	R101	Composition,	470Ω	± 1.0%,	¼ W.	31-TM5773
101	R102	Composition,	1 KΩ	± 10%,	1W.	116-TF791D
102	R103	Wire-wound,	100Ω	± 5%,	½W.	113-TF791D
103	R104	Wire-wound,	100 Ω	± 5%,	1½.	113-TF791D

* Nominal value; actual value determined in test procedure.

SOS Item No.	Circuit Ref.	Description	Value	Tol.	Watts.	Works Ref.

Variable Resistors

104	RV1	Wire-wound, preset,	500.Q	± 10%,	1W, Linear.	59-TF791D
105a	RV2	Composition, preset,	100 KΩ	± 20%,	tw, Linear.	57-TF791D
106	-	-	-	-		
107	RV4	Composition, preset,	50 KΩ	± 20%,	1W, Linear.	62-TF791D
108	RV5	Wire-wound, preset,	50 KΩ	± 10%,	1W, Linear.	60-TF791D
109	RV6	Wire-wound, preset,	1 KΩ ±	±10%,	1W, Linear.	61-TF791D

* Nominal value; actual value determined in test procedure.

SOS Item No.	Circuit Ref.	Description	Value	Tol.	Voltage.	Works Ref.

Capacitors

110	C1	Trimmer,	3-19 uuF.	-	-	130-TF791D
111	C2	Ceramic,	33 uuF	± 10%,	750 V d.c.	38-TM5773
112	C3	Ceramic,	33 uuF	± 10%,	750 V d.c.	38-TM5773
113	C4	Trimmer,	3-19 uuF.			130-TF791D
114	C5	Paper,	0.001 uF	± 20%,	400 V d.c.	45-TM5773
115	C6	Paper,	0.001 uF	± 20%,	400 V d.c.	45-TM5773
116	C7	Var. Cap.	7-100 uuF.			34-TM5773
117	C8	Ceramic,	47 uuF	± 10%,	750 V d.c.	39-TM5773
118	C9	Ceramic,	47 uuF	± 10%,	750 V d.c.	39-TM5773
119	C10	Mica,	370 uuF	± 2%,	350 V d.c.	24-TM5094
120	C11	Mica,	290 uuF	± 2%,	350 V d.c.	25-TM5094
121	C12	Paper,	0.1 uuF	± 20%,	150 V d.c.	23-TM5094
122	C13	Mica,	12.5 uuF	± 1 uuF,	350 V d.c.	26-TM5094
123	C14	Mica,	200 uuF	± 2%,	350 V d.c.	27-TM5094
124	C15	Mica,	150 uuF	± 20%,	250 V d.c.	133-TF791D
125	C16	Paper,	0.001 uF	± 20%,	400 V d.c.	45-TM5773
126	C17	Paper,	0.1 uF	± 20%,	350 V d.c.	117-TF791D
127	C18	Paper,	0.01 uF	± 20%,	350 V d.c.	46-TM5773
128	C19	Paper,	0.1 uF	±20%,	350 V d.c.	122-TF791D
129	C20	Paper,	0.001 uF	± 20%,	400 V d.c.	45-TM5773
130	C21	Paper,	0.001 uF*,		400 V d.c.	119-TF791D
131	C22	Ceramic,	100. uuF	± 10%,	750 V d.c.	42-TM5773
132	C23	Ceramic,	22 uuF	± 10%,	750 V d.c.	40-TM5773
133	C24	Trimmer,	1.25-5 .uuF.			47-TM5773
134	C25	Var. Cap.,	3.3-42.3 uuF.			35-TM5773
135	C26	Paper,	2 uF	± 20%,	350 V d.c.	120-TF791D
136	C27	Synthetic dielectric,	0.1 .uF	± 20 %,	350 V d.c.	135-TF791D
137	C28	Paper,	0.1 .uF	± 20%,	350 V d.c.	122-TF791D
138	C29	Paper,	0.001 .uF	± 20%,	400 V d.c.	45-TM5773
139	C30	Ceramic,	22 uuF	± 10%,	750 V d.c.	40-TM5773
140	C31	Ceramic,	390 uuF	± 20%,	750 V d.c.	132-TF791D
141	C32	Ceramic,	22 uuF	± 10%,	750 V d.c.	40-TM5773
142	C33	Trimmer,	1.25-5 uuF.			47-TM5773
143	C34	Var. Cap.	3.3-42.3 uuF.			35-TM5773
144	C35	Paper,	0.1 uuF	± 20%,	350 V d.c.	122-TF791D
145	C36	Paper,	2 uF	± 20%,	350 V d.c.	120-TF791D
146	C37	Ceramic,	150 uuF	± 5 %,	750 V d.c.	41-TM5773
147	C38	Ceramic,	390 uuF	± 20%,	750 V d.c.	132-TF791D
148	C39	Ceramic, lead through,	91 uuF	± 20%,	750 V d.c.	43-TM5773
149	C40	Ceramic,	32 uuF	± 2%,	500 V d.c.	44-TM5773
150	C41	Ceramic, lead through,	91 uuF	± 20%,	750 V d.c.	43-TM5773
151	C42	Paper,	0.001 uF	± 20%,	400 V d.c.	45-TM5773
152	C43	Electrolytic,	100 uF,		6 V d.c.	125-TF791D
153	C44	Paper,	2 uF	± 20%,	350 V d.c.	120-TF791D
154	C45	Paper,	0.1 uF	± 20%,	350 V d.c.	122-TF791D
155	C46	Paper,	0.001 uF	± 20%,	400 V d.c.	119-TF791D
156	C47	Paper,	0.1 uF	± 20%,	350 V d.c.	117-TF791D

SOS Item No.	Circuit Ref.	Description	Value	Tol.	Voltage.	Works Ref.
157	C48	Paper,	0.001 uF	± 20%,	400 V d.c.	119-TF791D
158	C49	Paper,	0.002, uF	± 20%,	400 V d.c.	131-TF791D
159	C50	Paper,	2 uF	± 20%,	350 V d.c.	120-TF791D
160	C51	Paper,	0.001 uF	± 20%,	400 V d.c.	119-TF791D
161	C52	Paper,	0.001 uF	± 20%,	400 V d.c.	119-TF791D
162	C53	Paper,	0.1 uF	± 20%,	350 V d.c.	117-TF791D
163	C54	Paper,	0.002 uF	± 20%,	400 V d.c.	131-TF791D
164	C55	Paper,	0.0002 uF*,		600 V d.c.	134-TF791D
165	C56	Paper,	0.001 uF	± 20%,	400 V d.c.	119-TF791D
166	C57	Paper,	0.005 uF	± 20%,	400 V d.c.	121-TF791D
167	C58	Paper,	0.25 uF	± 20%,	350 V d.c.	127-TF791D
168	C59	Paper,	0.1 uF	± 20%,	350 V d.c.	117-TF791D
169	C60	Electrolytic,	32 uF,		450 V d.c.	128-TF791D
170	C61	Electrolytic,	8 uF,		450 V d.c.	126-TF791D
171	C62	Paper,	0.001 uF	± 20%,	400 V d.c.	119-TF791D
172	C63	Paper,	0.1 uF	± 20%,	350 V d.c.	122-TF791D
173	C64	Electrolytic,	8 uF,		450 V d.c.	126-TF791D
174	C65	Ceramic,	56 uuF	± 10%,	750 V d.c.	124-TF791D
175	C66	Trimmer,	3.3 uuF swing.			36-TM5773
176	C67	Paper,	0.5 uF	± 25%,	150 V d.c.	123-TF791D
177	C68	Trimmer,	3.3 uuF swing.			36-TM5773
178	C69	Trimmer,	3.3 uuF swing.			36-TM5773
179	C70	Electrolytic,	4uF,	350 V d.c.		48- TM5773
180	C71	Paper,	0.1 uF	± 20%,	350 V d.c.	136-TF791D
180/1	C72	Paper,	0.01 uF	± 20%,	400 V d.c.	118-TF791D

*Nominal value; actual value determined in test procedure.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		Transformers And Inductors	
181	T1	Mains Transformer.	TM5150/8
182	L1	Tuning Inductor.	TB28627
183	L2	Tuning Inductor.	TB28626
184	L3	Tuning Inductor.	TB28625
185	L4	Integrating Filter Inductor.	TM5142
186	L5	Integrating Filter Inductor.	TM5142/1
187	L6	Integrating Filter Inductor.	TM5142/2
188	L7	Tuning Inductor.	TB28630
189	L8	Tuning Inductor.	TB28631
190	L9	Tuning Inductor.	TB28632
191	L10	I.F. Trap Inductor.	TB25326/10
192	L11	I.F. Trap Inductor.	TB25326/10
193	L12	Low-pass Filter Inductor.	TB25326/1
194	L13	Low-pass Filter Inductor.	TB25326/2
195	L14	Low-pass Filter Inductor.	TB25326/1
196a	L15	100-kc/s Oscillator Inductor.	TM3900/98
197	L16	R.F. Choke.	TM3900/93
198	L17	R.F. Choke.	TB23173/56

SOS Item No.	Circuit Ref.	Description	Works Ref.
		Valves and Valve Holders	
199	V1	Pentode, Type 6AK5.	151-TF791D
200		Holder for V1, B7G with skirt.	TB26904/2
201		Screening Can for V1.	55-TM5773
202	V2	Pentode, Type 6AS6.	157-TF791D
203		Holder for V2, B7G with skirt.	TB26904/2
204		Screening Can for V2.	55-TM5773
205	V3	Pentode, Type 6AK5.	151-TF791D
206		Holder for V3, B7G with skirt.	TB26904/2
207		Screening Can for V3.	164-TF791D
208	V4	Pentode, Type 6AK5.	151-TF791D
209		Holder for V4, B7G with skirt.	TB26904/2
210		Screening Can for V4.	164-TF791D
211	V5	Pentode, Type 6AK5.	151-TF791D
212		Holder for V5, B7G with skirt.	TB26904/2
213		Screening Can for V5.	55-TM5773
214	V6	Triode, Type 6C4.	149-TF791D
215		Holder for V6, B7G with skirt.	TB26904/2
216		Screening Can for V6.	165-TF791D
217	V7	Pentode, Type 6AK5.	151-TF791D
218		Holder for V7, B7G with skirt.	TB26904/2
219		Screening Can for V7.	55-TM5773
220	V8	Triode, Type 6C4.	149-TF791D
221		Holder for V8, B7G with skirt.	TB26904/2
222		Screening Can for V8.	165-TF791D
223	V9	Diode, Type EA76.	155-TF791D
224		Mounting Grommet for V9.	TB27940/4
225	V10	Diode, Type EA76.	155-TF791D
226		Mounting Grommet for V10.	TB27940/4
227	V11	Pentode, Type 6AK5.	151-TF791D
228		Holder for V11, B7G with skirt.	TB26904/2
229		Screening Can for V11.	164-TF791D
230	V12	Pentode, Type 6AK5.	151-TF791D
231		Holder for V12, B7G with skirt.	TB26904/2
232		Screening Can for V12.	164-TF791D
233	V13	Pentode, Type 6AK5.	151-TF791D
234		Holder for V13, B7G with skirt.	TB26904/2
235		Screening Can for V13.	164-TF791D
236	V14	Pentode, Type 6AK5.	151-TF791D

SOS Item No.	Circuit Ref.	Description	Works Ref.
237		Holder for V14, B7G with skirt.	TB26904/2
238		Screening Can for V14.	164-TF791D
239	V15	Pentode, Type 6AK5.	151-TF791D
240		Holder for V15, B7G with skirt.	TB26904/2
241		Screening Can for V15.	164-TF791D
242	V16	Tetrode, Type 6CD6G.	153-TF791D
243		Valve Top Cap Connector for V16; including mounting for R82.	158-TF791D
244		Holder for V16, international octal.	161-TF791D
245		Valve Retainer for V.16.	TC22744/12
246	V17	Full-wave Rectifier, Type 5Z4G.	152-TF791D
247		Holder for V17, international octal.	161-TF791D
248		Valve Retainer for V17.	TC22744/12
249	V18	Pentode, Type 6AK5.	151-TF791D
250		Holder for V18, B7G with skirt.	TB26904/2
251		Screening Can for V18.	164-TF791D
252	V19	Diode, Type EA76.	155-TF791D
253		Mounting Grommet for V19.	TB27940/4
254		V20 Diode, Type EA76.	155-TF791D
255		Mounting Grommet for V20.	TB27940/4
256	V21	Voltage Stabilizer, Type 5651.	154-TF791D
257		Holder for V21, B7G with skirt.	TB26904/2
258		Screening Can for V21.	165-TF791D
259	V22	Voltage Stabilizer, Type OB2.	150-TF791D
260		Holder for V22, B7G with skirt.	TB26904/2
261		Screening Can for V22.	166-TF791D

SOS Item No.	Circuit Ref.	Description	Works Ref.
		Quartz Crystal, Holder And Screening Can	
262	X6	Quartz Crystal, 100-kc/s, M.W.T. Type QO1654B 100/B/30.	148-TF791D
263		Holder for Quartz Crystal, B7G with skirt.	TB26904/2
264		Screening Can for Quartz Crystal.	166-TF791D

SOS Item No.	Circuit Ref.	Description	Works Ref.
		Semiconductor Diodes	
265	X5	Silicon Diode, Type CV291.	71-TM5773
266		Holder for X5.	TM4070
267	X7	Germanium Diode, Type 1N34 (CV425)	141-TF791D
268	X8	Germanium Diode, Type 1N34 (CV425).	141-TF791D

SOS Item No.	Circuit Ref.	Description	Works Ref.
		Lamp and Holder	
269	PLP1	Pilot Lamp, 6.3 V, 0.15 A, Type M.B.C.	143-TF791D
270		Holder for PLP1 (red lens).	TB25073/2

SOS Item No.	Circuit Ref.	Description	Works Ref.
		Fuses and Holders	
271	FS1	2-A, Cartridge.	145-TF791D
272		Holder for FS1.	TB24330/1
273	FS2	2-A, Cartridge.	145-TF791D
274		Holder for FS2.	TB24330/1
275	FS3	250-mA, Cartridge.	144-TF791D
276		Holder for FS3. TB24330/1	

SOS Item No.	Circuit Ref.	Description	Works Ref.
		Meter	
277	M1	Moving Coil 0-100 uA, 500Ω nominal; including mounting brackets.	TM3970/54

SOS Item No.	Circuit Ref.	Description	Works Ref.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		Plugs, Sockets, Terminals, And Connecting Leads	
278		Mains Lead, complete with Plug, Item 279, and Grommet- Sleeve, Item 280.	TM2560AU
279	PL1	Plug, 3 pin 5-A; included in Item 278.	1-TM2560AU
280		Grommet-Sleeve; included in Item 278.	4-TM2560AU
281	SKT1	Chassis Receptacle, Coaxial, Type BNC.	146-TF791D
282	SKT2	Chassis Receptacle, Coaxial, Type BNC.	146-TF791D
283		Plug, Free, Coaxial, Type BNC, UG-88/U, to fit Items 281 and 282.	236-TF791D
284		L.F. Output terminals Mounting Moulding.	TA8224/1
285		L.F. Output terminal.	TB24330/5
286		Input Lead, Coaxial, 50-Ω.	TM4969

SOS Item No.	Circuit Ref.	Description	Works Ref.
		Switches	
287	SA	Rotary, 8-pole, 4-position, 4-wafer.	TC4428/488
288	SB	Rotary, 1-pole, 4-position, 2-wafer.	TC4428/393
289	SC	Rotary, 2-pole, 5-position, 2-wafer.	TC4428/486
290	SD	Rotary, 4-pole, 5-position, 3-wafer.	TC4428/487
291a	SE	Rotary, 6-pole, 2-position, 2-wafer.	TC4428/485
292	SF	Toggle, 2-pole, Changeover.	TB23903/2

SOS Item No.	Circuit Ref.	Description	Works Ref.
		Knobs, Drives, And Dials	
293	Knob, for Crystals switch (SC).		TB17848/3
294	Knob, for Range switch (SD).		TB17848/3
295	Knob, for selector switch (SA).		TB17848/3
296	Knob, for Deviation Range switch (SB).		TB17848/3
297	Knob, for Deviation switch (SE).		TB17848/3
298	Knob, for Frequency Tuning control.		TD23123/2A
299	Securing screw, for Item 298.		TD23123/7
300	Reduction Ball-Drive, for Frequency Tuning control (Rear).		TB28609
301	Stops, for Item 300.		TB28611
302	Reduction Ball-Drive, for Frequency Tuning control (Front).		TB28610
303	Steel pin, for Item 302.		224-TF791D
304	Handle, for Item 298.		TB23123/5
305	Securing screw, for Item 304.		TB23172/3
306	Drum A.		53-TF791D
307	Drive-Cord Tension Spring, for Item 306.		TB15342/55
308	Spindle, for Item 306.		TB22881/63
309	Bush, for Item 308.		TB14790/12
310	Nut, for Item 309.		TB15245/43
311	Mounting Bracket for Frequency Tuning control assembly (Large)		TC28622.
312	Mounting Bracket for Frequency Tuning control assembly (Small).		TB28623

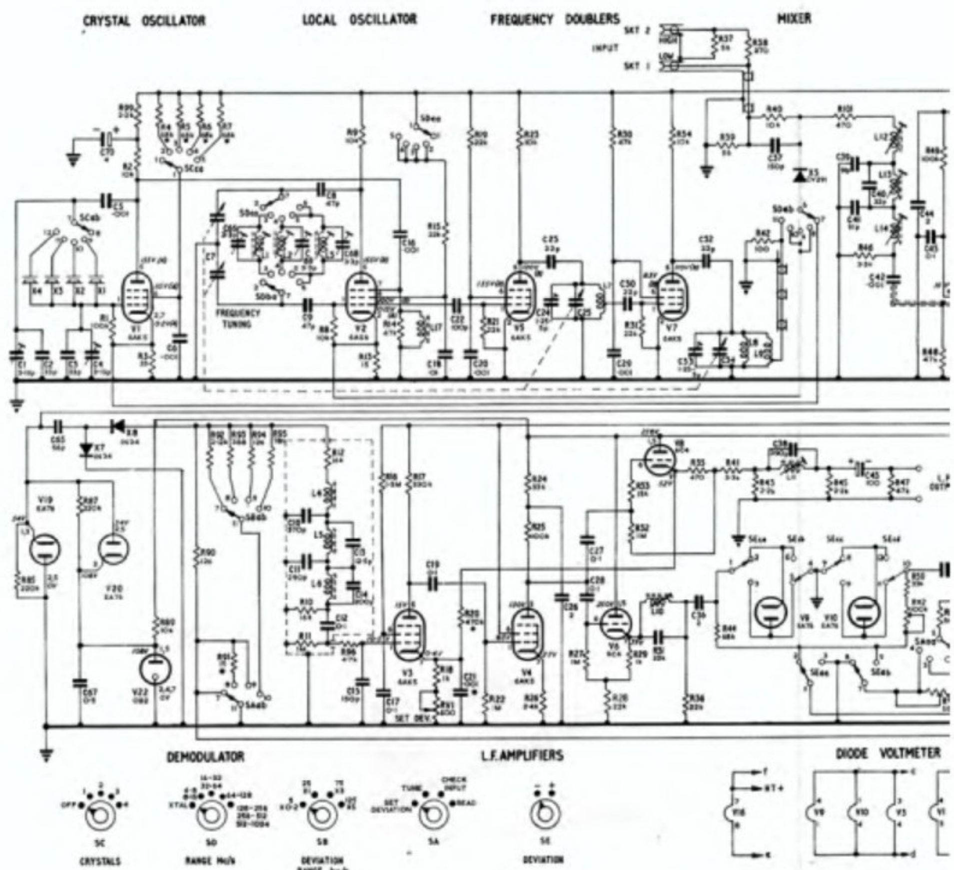
SOS Item No.	Circuit Ref.	Description	Works Ref.
313		Frequency Tuning Dial (Blank).	TB4691A/26
314		Spindle, for Item 313.	TB28607
315		Bush, for Item 314.	TB28606
316		Frequency Tuning Dial Escutcheon.	TD20670/l
317		Escutcheon Ring, for Item 316.	TD20670/2
318		Rubber Tubing, for Items 316 and 317.	205-TF791D
319		Perspex Cover, for Item 313.	TB28612
320		Drum C.	53-TF791D
321		Drive-Cord Tension Spring, for Item 320.	TB15342/5S
322		Drum B.	Il-TM5773
323		Drive-Cord Tension Spring, for Item 322.	TB15342/55
324		Drum D.	12-TM5773
325		Drive-Cord Tension Spring, for Item 324	TB15342/56
326		Nylon Drive Cord. (Specify length).	220-TF791D
327		Frequency Tuning Capacitor Coupling.	10-TM5773
328		Drive-Cord Jockey Pulley.	TB23156/2
329		Bearing, for Item 328.	77-TM5773
330		Securing Screw, for Item 328.	TB23172/18
331		Washer, for Item 328.	TB6775/430
332		4-BA Nut, for Item 330.	
333		Mounting Bracket, for Item 328.	TB28829

SOS Item No.	Circuit Ref.	Description	Works Ref.

Miscellaneous

334		Case Assembly, rear section.	TE23540/5
335		Case Assembly, front section.	TE23103/5
336		H-section strip, joining Items 334 and 335.	TD23713/6
337		Handle Escutcheon.	TC17659
338		Cover Plate, for right-hand handle recess.	TE23106/2
339		Supply Voltage Selector Panel.	TA21425
340		Reversible Reference Plate, for Item 339.	TA21484
341		Case Fixing Block.	TE23106/3
342		Case Foot.	TA11420
343		Front Panel.	TE28603
344		Dome Nut, for Set Deviation control.	TA7342
345		Locking Nut, for RV2-RV6.	TB24000/l
346		Integrating Filter Screening Cover.	8-TM5094
347		Crystals Housing Box.	TC28605
348		Crystal Socket, for XI-X4.	48-TF791D
349		Crystal Retaining Clip.	169-TF791D
350		Crystals Record Plate.	TB28616
351		Securing Screw, for Item 350.	TB22656/12
352		Input Lead, 50Ω	TM4969
353		Operating and Maintenance Handbook.	OM791DI

8 - Circuit Diagram



NOTES

1. **COMPONENT VALUES**
   Resistors: No suffix = ohms. k = kilohms. M = megohms.
   Capacitors: No suffix = microfarads. p = picofarads.
   * Value selected during factory testing; nominal value shown.

   VOLTAGES
   These are relative to chassis and, except where bracketed letters follow, are with:
   RANGE switch at 4 to 8/8 to 16 Mc/s
   Tuning dial at 6/12 Mc/s
   DEVIATION RANGE switch at 125 kc/s
   Selector switch at CHECK INPUT
   Letters after voltages indicate the following different settings:
   (A) = RANGE switch at XTAL, 5-Mc/s crystal selected by CRYSTALS switch, V1 screen fed via 68 kΩ.
   (B) = CRYSTALS switch at OFF.
   (C) = Selector switch at SET DEVIATION.

CIRCUIT

EX TD 28621 IS. 14
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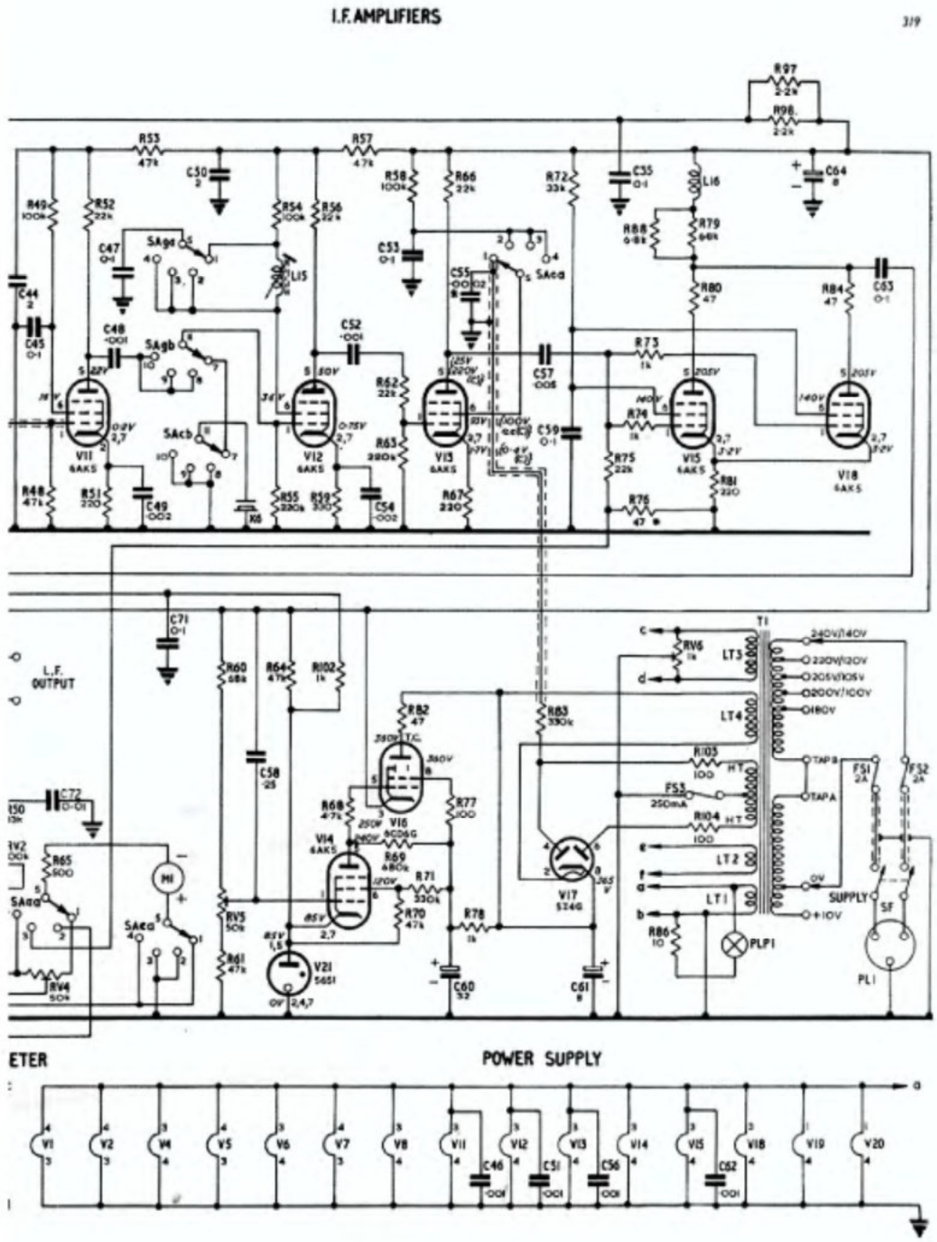

UIT DIAGRAM

Fig. 8.1

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
.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

Ratio Down			*Ratio Up*	
.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	6.310×10^{-6}	52	398.1	158,500
.001995	3.981×10^{-6}	54	501.2	251,200
.001585	$2.512 \mathrm{x} 10^{-6}$	56	631.0	398,100
.001259	$1.585 \mathrm{x} 10^{-6}$	58	794.3	631,000
.001000	10^{-6}	60	1,000	10^{6}
.0005623	3.162×10^{-7}	65	1,778	3.162×10^{6}
.0003162	10^{-7}	70	3,162	10^{7}
.0001778	3.162×10^{-8}	75	5,623	3.162×10^{7}
.0001000	10-8	80	10,000	10^{8}
.00005623	3.162×10^{-9}	85	17,780	3.162×10^{8}
.00003162	10^{-9}	90	31,620	10^{9}
.00001000	10^{-10}	100	100,000	10^{10}
3.162 x $^{10-6}$	10^{-11}	110	316,200	10^{11}
10^{-6}	10^{-12}	120	10^{6}	10^{12}
3.162×10^{-7}	10^{-13}	130	3.162×10^{6}	10^{13}
10^{-7}	10^{-14}	140	10^{7}	10^{14}