

Maritime Electronic P/S
64.24500



TF 2950

Mobile Radio

Test Set

**INSTRUCTION MANUAL
(O P E R A T I O N)**

MARCONI INSTRUMENTS LIMITED

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Instruction Manual

NO. E.B. 2950

for

Mobile Radio Test Set

TF 2950

MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

M.I. 1c
2/71



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General information

1.1 INTRODUCTION

The Mobile Radio Test Set, TF 2950 has been designed as a fully transistorised, multi-purpose unit capable of being driven from its own rechargeable batteries. The main application is for the testing, adjustment and servicing of mobile radio communications equipment operating in the VHF and UHF frequency bands.



As a multi-purpose instrument the TF 2950 contains five units which are as follows:-

- 1) An AM/FM signal generator covering the appropriate mobile radio VHF and UHF communications bands.
- 2) A modulation monitor for the measurement of amplitude modulation depths up to 80% and peak frequency deviations up to ± 25 kHz.
- 3) An in-line power meter with a separate 15 W r.f. load.
- 4) An audio voltmeter having a sensitivity of 10 mV f.s., an input impedance of 100 k Ω and a bandwidth of 20 kHz.
- 5) An audio oscillator with a nominal frequency of 1 kHz which is adjustable by up to $\pm 1\%$ and an output level variable up to 3 V.

- 5) An audio oscillator with a nominal frequency of 1 kHz which is adjustable by up to $\pm 1\%$ and an output level variable up to 3 V.

1.2 DATA SUMMARY

AM/FM SIGNAL GENERATOR

| | |
|-----------------------------|---|
| Frequency Ranges: | 65-84-108 MHz. 140-180 MHz & 420-470 MHz. |
| Frequency Dial Accuracy: | $\pm 0.5\%$ of dial setting. |
| Frequency Stability: | Typically 25 p.p.m. per 10 minutes after 15 minutes warm-up. |
| Electrical Fine Tuning: | ± 20 kHz directly calibrated on all r.f. ranges. |
| Accuracy: | $\pm 20\%$ of f.s. |
| R.F. Output Level: | Continuously variable from 0.1 μ V to 10 mV p.d. across 50 Ω . |
| Output Impedance: | Nominally 50 Ω . |
| R.F. Level Accuracy: | ± 3 dB ± 0.1 μ V. |
| R.F. Leakage: | Using a two turn 25 mm diameter search loop feeding into a receiver with a sensitivity of 1 μ V no signal can be detected at a distance of 25 mm. |
| Amplitude Modulation Depth: | Continuously variably up to 50% depth on all r.f. ranges up to 180 MHz. |
| Accuracy: | $\pm 10\%$ of f.s. |
| Internal Modulation: | At 1 kHz with a $\pm 1\%$ variable control. |
| External Modulation: | A.C. coupled 100 Hz to 5 kHz. |
| Spurious F.M. on A.M.: | Less than 1 kHz at 30% modulation depth. |
| Frequency Modulation: | Continuously variable up to ± 25 kHz peak deviation. |
| Deviation Ranges: | 0 to 5 kHz and 0 to 25 kHz. |
| Accuracy: | $\pm 10\%$ of f.s. |
| Internal Modulation: | At 1 kHz with a $\pm 1\%$ variable control. |
| External Modulation: | A.C. coupled 100 Hz to 5 kHz. |

MODULATION MONITOR

| | |
|-----------------------------------|--|
| Carrier Frequency Ranges: | 65-85-108 MHz, 140-180 MHz & 420-470 MHz. |
| Frequency Deviation Ranges: | 0-5 kHz and 0-25 kHz. |
| Accuracy: | $\pm 5\%$ of f.s. for sinewave modulation signals. |
| Dial Accuracy: | $\pm 1\%$ reading |
| F.M.R.F. Input Sensitivity: | 10 mV |
| Maximum Input: | 1 V |
| Amplitude Modulation Depth Range: | 0-80% |
| Accuracy: | $\pm 10\%$ of f.s. |

A.M. R.F. Input Sensitivity: 50 mV
 Maximum Input: 1 V
 Monitor Indication: Positive and Negative peak deviation.
 Peak and Trough Amplitude Modulation Depth.
 Demodulated Output: Available at front panel sockets with
 internal loudspeaker.

R.F. POWER METER

Frequency Ranges: 65-180 MHz and 420-470 MHz.
 Power Measurement Range: 0-25 W under through-line conditions.
 Using internal R.F. load 0-15 W continuous
 operation and up to 25 W for 3 minutes.
 Power Indication Accuracy: $\pm 10\%$ of f.s.
 Input Impedance: Nominally 50 Ω .

A.F. OSCILLATOR

Frequency: 1 kHz with a $\pm 1\%$ front panel variation control.
 Output Level: Continuously variable up to 3 V.
 Ranges: 3, 30, 300 mV and 3 V f.s.
 Output Level Accuracy: $\pm 5\%$ of f.s.
 Output Impedance: 200 Ω on the 3 V range, 40 Ω on all other ranges.
 Distortion: Less than 1%

AUDIO VOLTMETER

Voltage Ranges: 10, 30, 100, 300 mV and 1, 3 and 10 V f.s.
 Accuracy: $\pm 5\%$ of f.s.
 Input Impedance: Nominally 100 k Ω .
 Frequency Range: 100 Hz to 20 kHz.

POWER SUPPLIES

Internal rechargeable cells
 giving 6 to 8 hours operation
 mains supply for recharging: 100 V $\pm 15\%$ or 220 V $\pm 15\%$. 40 to 50 Hz. 10 W.

DIMENSIONS & WEIGHT

| Height | Width | Depth | Weight |
|---------|---------|--------|---------|
| 31.5 cm | 42 cm | 23 cm | 16 kg |
| (12 in) | (16 in) | (9 in) | (35 lb) |

1.3 ACCESSORIES SUPPLIED

Mains lead.
 3 free B.N.C. Plugs.
 Power meter link (50 Ω)
 4 wander plugs.

2.1 PREPARATION FOR USE

In common with other apparatus employing semiconductor devices, the performance of this instrument may be affected if it is subjected to excessive temperatures. Therefore completely remove any covering from the instrument and avoid use whilst standing on, or close to, other hot equipment.

2.2 POWER SUPPLIES

Unlike most other instruments the supply switch has three positions, ON, OFF and CHARGE and controls the power supply to the Test Set. With the switch in the ON position the power required is drawn from the internal rechargeable batteries. If the mains supply is connected to the MAINS INPUT SOCKET the batteries will still be the source of supply for the test set but will be automatically trickle charged.

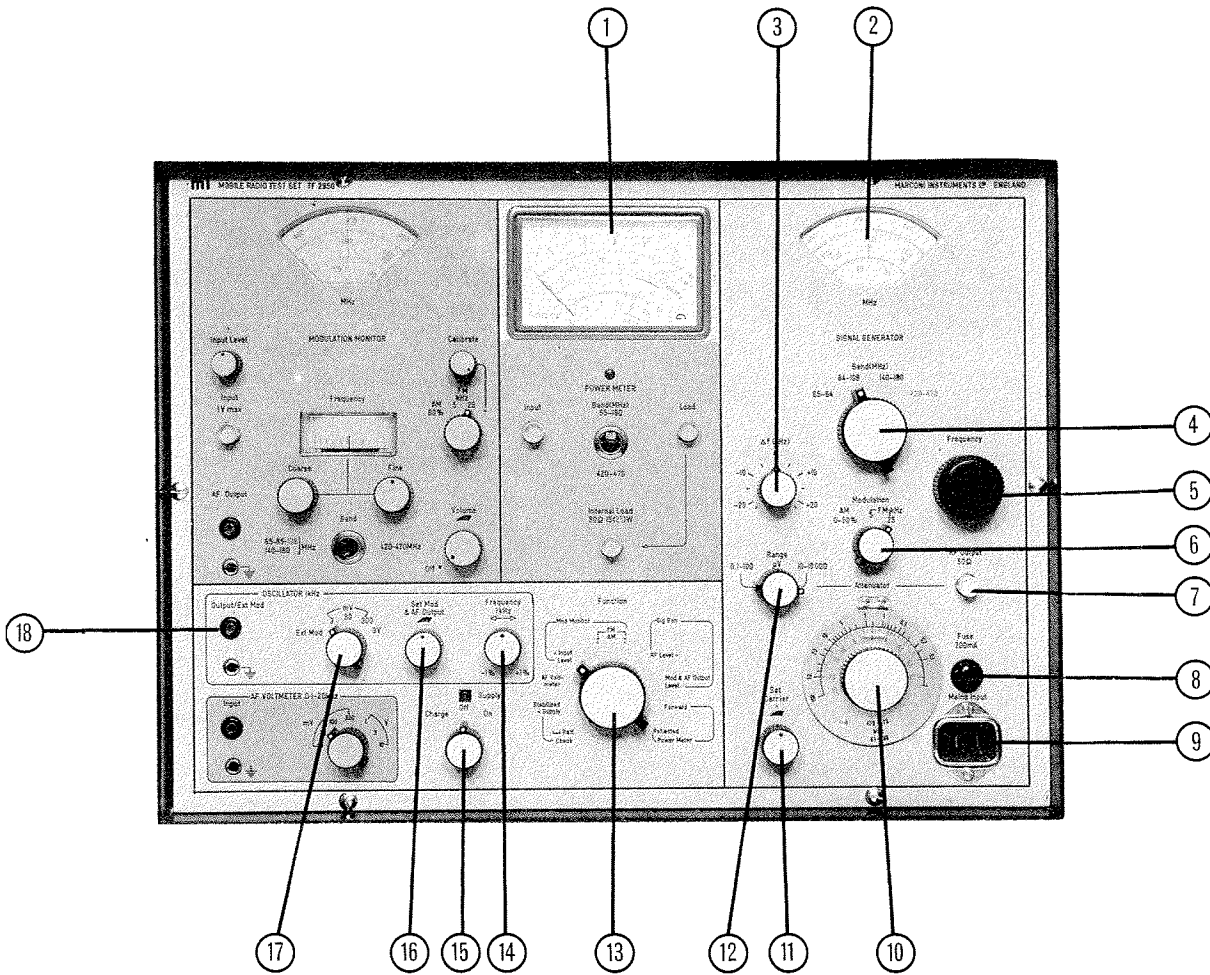
With the supply switch set to the CHARGE position the batteries are disconnected from the test set and charged at a much higher rate. A protection circuit is fitted to prevent any battery damage that may otherwise be caused by overcharging.

When the instrument is to be used, the condition of the batteries should be checked. In order to do this the 'FUNCTION SWITCH' must be set to the 'BATT CHECK' position. The meter should then read in the 'BATT' arc on the meter scale. If it does not the battery should be recharged by connecting the mains supply to the Test Set and switching to the CHARGE position. Once charged the batteries will last from 6 to 8 hours without further charging. Should the batteries become fully discharged it will take approximately 8 - 10 hours to fully recharge them.

To prevent damage to the batteries they MUST NOT be left in an uncharged condition.

Once the batteries are charged the FUNCTION SWITCH is then set to the STABILISED SUPPLY position to check the voltage stabiliser operation. The meter should indicate on the RED DOT in the centre of the meter scale. If it does not a fault condition is indicated and the Test Set should be switched OFF.

2.3 SIGNAL GENERATOR CONTROLS



2.3.1 Signal Generator Operation

- | | | | |
|-----|-----------------------------------|---|--|
| 1. | Test Set Meter | - | This is a multi-purpose monitor which indicates carrier reference level and modulation level in the signal generator mode. |
| 2. | Frequency Dial | - | Indicates output carrier frequency. |
| 3. | Electrical Fine Tuning Control | - | This is calibrated directly in kHz independent of carrier frequency. |
| 4. | Frequency Range Switch | - | Selects appropriate carrier frequency range 65-84 MHz, 84-108 MHz, 140-180 MHz or 420-470 MHz. |
| 5. | Coarse and Fine Frequency Control | - | A two speed mechanised drive. |
| 6. | Modulation Selector | - | Allows either the amplitude modulation or frequency modulation modes to be selected. |
| 7. | R.F. Output Socket | - | 50 Ω B.N.C. socket. |
| 8. | Mains Fuse | - | |
| 9. | Mains Input Socket | - | Mains supply input for battery charging circuit. |
| 10. | R.F. Output Level Control | - | Variable attenuator, calibrated directly in p.d. across a matched 50 Ω load. |

- | | | | |
|-----|---|---|--|
| 11. | Set Carrier Level Control | - | Used to bring the carrier level monitor to the reference mark (Red Dot). |
| 12. | R.F. Output Level Range Switch | - | Selects 0.1 μ V to 100 μ V or 10 μ V to 10 mV ranges. |
| 13. | Function Switch | - | Selects Test Set Function. |
| 14. | Modulation Oscillator Frequency Control | - | Allows internal 1 kHz modulation oscillator to be adjusted by up to $\pm 1\%$. |
| 15. | Supply Switch | - | Selects OFF, ON or CHARGE functions. In the OFF position all supplies to the instrument and the battery trickle charger are switched off. In the ON position all test set functions are driven from the internal rechargeable batteries. When the mains supply is connected the battery is being trickle charged. In the CHARGE position all functions are switched off but the battery is charged at a higher rate than trickle charge. |
| 16. | Modulation/Audio Oscillator Level Control | - | Adjusts amplitude modulation depth or peak frequency deviation. |
| 17. | External Modulation Selector | - | Selects external modulation function or audio oscillator output level. |
| 18. | External Modulation Terminals | - | Allows the signal generator to be externally modulated from a 300 Hz to 5 kHz source. |

When the signal generator is to be used the FUNCTION SWITCH should be set to the R.F. level position. No modulation is available in this position. The appropriate carrier frequency can now be selected with the FREQUENCY RANGE SWITCH and the COARSE AND FINE FREQUENCY CONTROL. Indication of the selected frequency appears on the FREQUENCY DIAL.

Once the frequency has been set accurate frequency changes up to a maximum of ± 20 kHz can be achieved by use of the ELECTRICAL FINE TUNING CONTROL which is calibrated directly in frequency change.

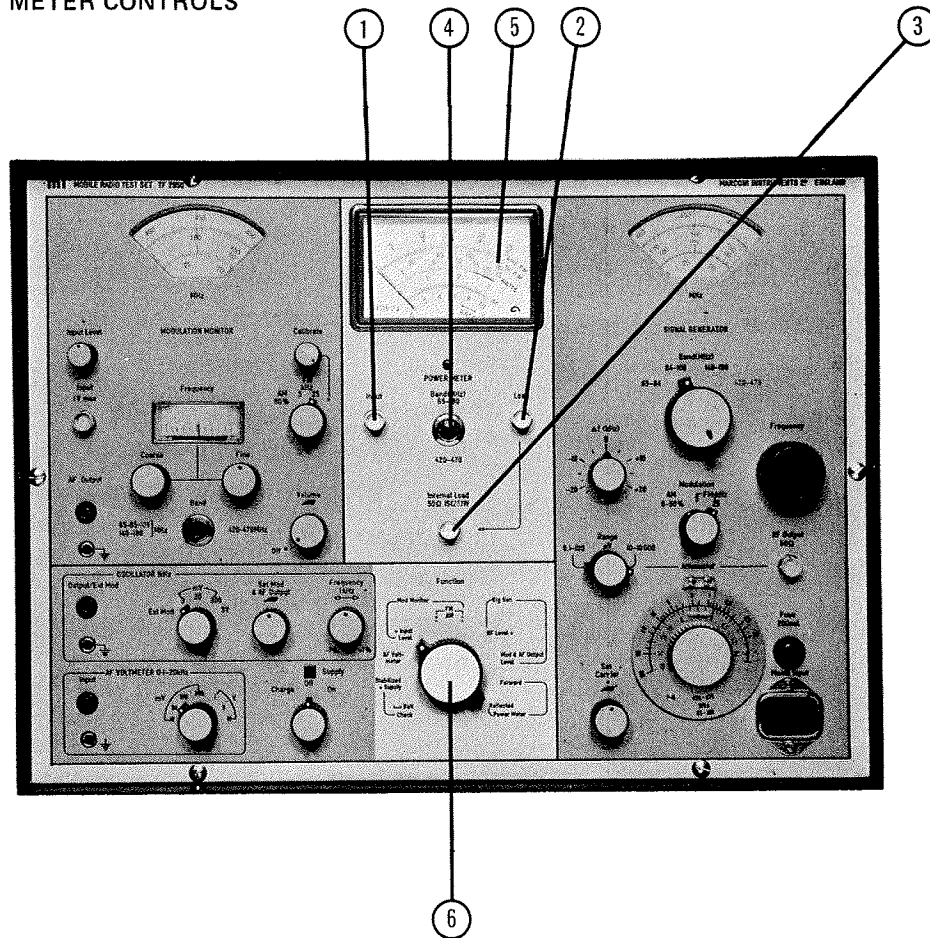
The SET CARRIER LEVEL CONTROL should now be adjusted to bring the meter to the reference mark i.e. the RED DOT. Once this has been carried out the CARRIER LEVEL RANGE SWITCH and the OUTPUT LEVEL CONTROL can be used to set the output voltage to the required value as indicated on the attenuator dial, which is calibrated in terms of p.d. across a matched 50 Ω load.

Two coloured scales are provided on the dial. Black for use up to 180 MHz carrier frequency and Red for 420-470 MHz band. The legend around the FREQUENCY RANGE SWITCH is similarly colour coded.

If modulation is required the FUNCTION SWITCH is set to the MOD AND A.F. OUTPUT LEVEL position. The type of modulation required can then be selected with the MODULATION SELECTOR, which automatically sets the monitor full scale. Ranges of 0 to 50% amplitude modulation depth on 0 to 5 kHz and 0 to 25 kHz peak deviation are available. The modulation depth or peak deviation can be adjusted with the SET MODULATION LEVEL control.

In order to facilitate measurements where accurate adjustment of the modulation frequency is necessary i.e. SINAD measurements, the MODULATION FREQUENCY CONTROL can be used to vary the internal 1 kHz modulation oscillator $\pm 1\%$. When other modulation frequencies are required the EXTERNAL MODULATION function position should be selected and an external oscillator of the required frequency used to modulate the signal generator. Frequencies between 300 Hz and 5 kHz can be used under these conditions.

2.4 R.F. POWER METER CONTROLS



- | | |
|---------------------------------------|---------------------------|
| 1. R.F. Input Socket. | 50 Ω B.N.C. Socket |
| 2. Thruline Output Socket | 50 Ω B.N.C. Socket |
| 3. 50 Ω R.F. Load Input Socket | 50 Ω B.N.C. Socket |
| 4. Frequency Range Switch | |
| 5. Power Indicator | |
| 6. Function Switch | |

2.4.1 R.F. Power Meter Operation

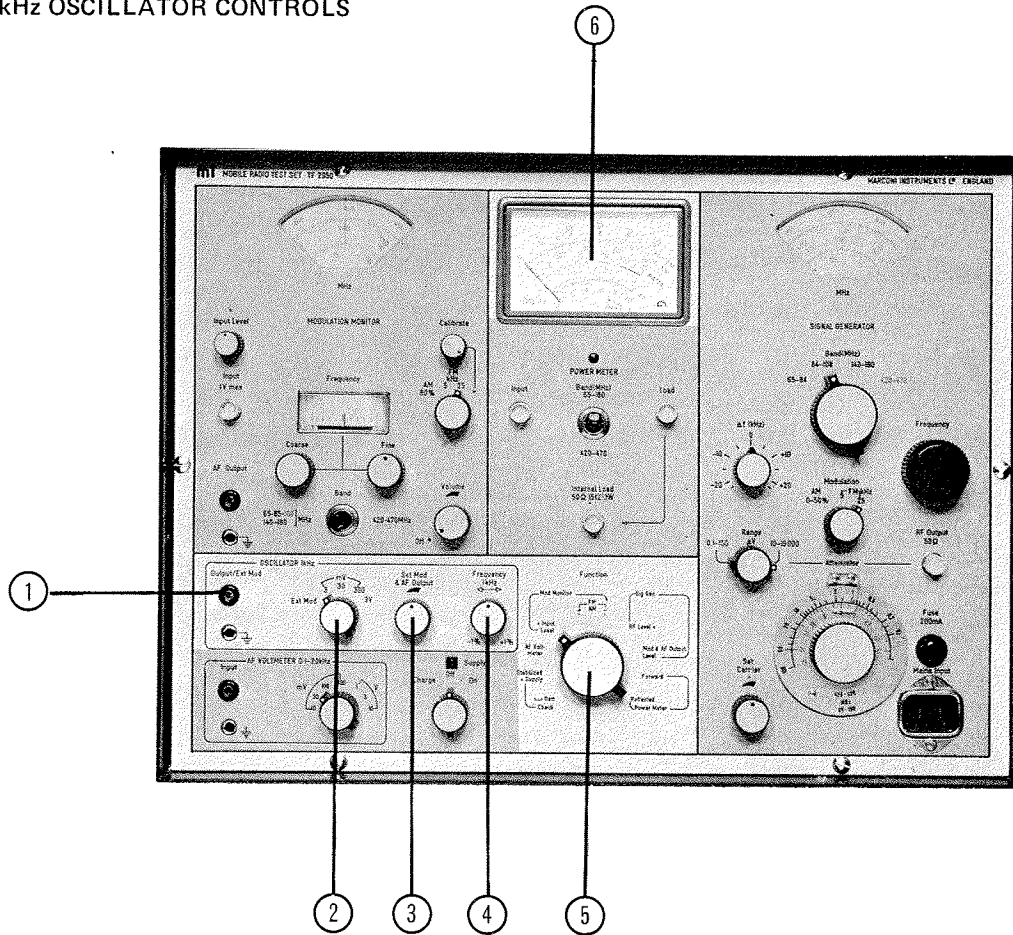
This is a dual purpose unit which comprises a 50 Ω in-line power meter and a separate 15 W 50 Ω r.f. load. This arrangement allows either in-line or Absorption type measurements to be made.

To bring the Power Meter into operation the FUNCTION SWITCH is set to the power meter mode. (Either Forward or Reflected position).

For in-line measurements the power to be measured is fed into the INPUT socket. The output is taken from the LOAD socket and fed to the appropriate load or aerial. Forward and Reflected power can be measured up to a maximum continuous rating of 25 W. As this device is frequency conscious a frequency range switch is provided to select the required frequency range.

When absorption measurements are to be made the LOAD socket of the in-line is connected to the internal 50 Ω load with the supplied cable. The rating of this load is 15 W continuous with up to 25 W for short periods i.e. approx. 3 mins.

2.5 1 kHz OSCILLATOR CONTROLS



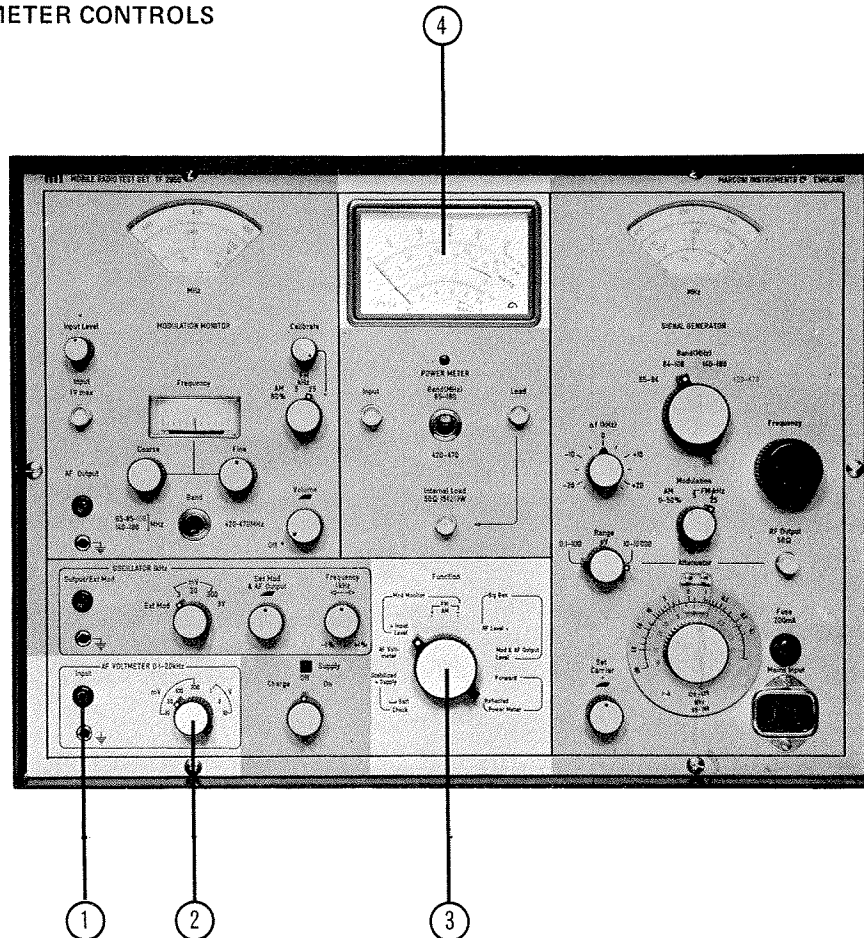
1. Oscillator Output Terminals
2. Oscillator Output Level Range Switch - selects the output level range of the 1 kHz oscillator and also the meter range full scale.
3. Oscillator Output Level Control - sets output level.
4. Oscillator Frequency Control - allows 1 kHz oscillator frequency to be varied by up to $\pm 1\%$.
5. Function Switch
6. Oscillator Level Indicator

2.5.1 1 kHz Oscillator Operation

With the FUNCTION SWITCH set to the MOD AND A. F. OUTPUT LEVEL position the 1 kHz signal is available at the OUTPUT TERMINALS. The voltage range and monitor full scale is selected by means of the OUTPUT LEVEL RANGE SWITCH. Once the voltage range has been selected the output level can be adjusted with the OUTPUT LEVEL CONTROL, and it is indicated on the test set meter.

The Output Impedance of the oscillator is 200 Ω on the 3 V full scale range and 40 Ω on all other ranges.

2.6 A.F. VOLTMETER CONTROLS



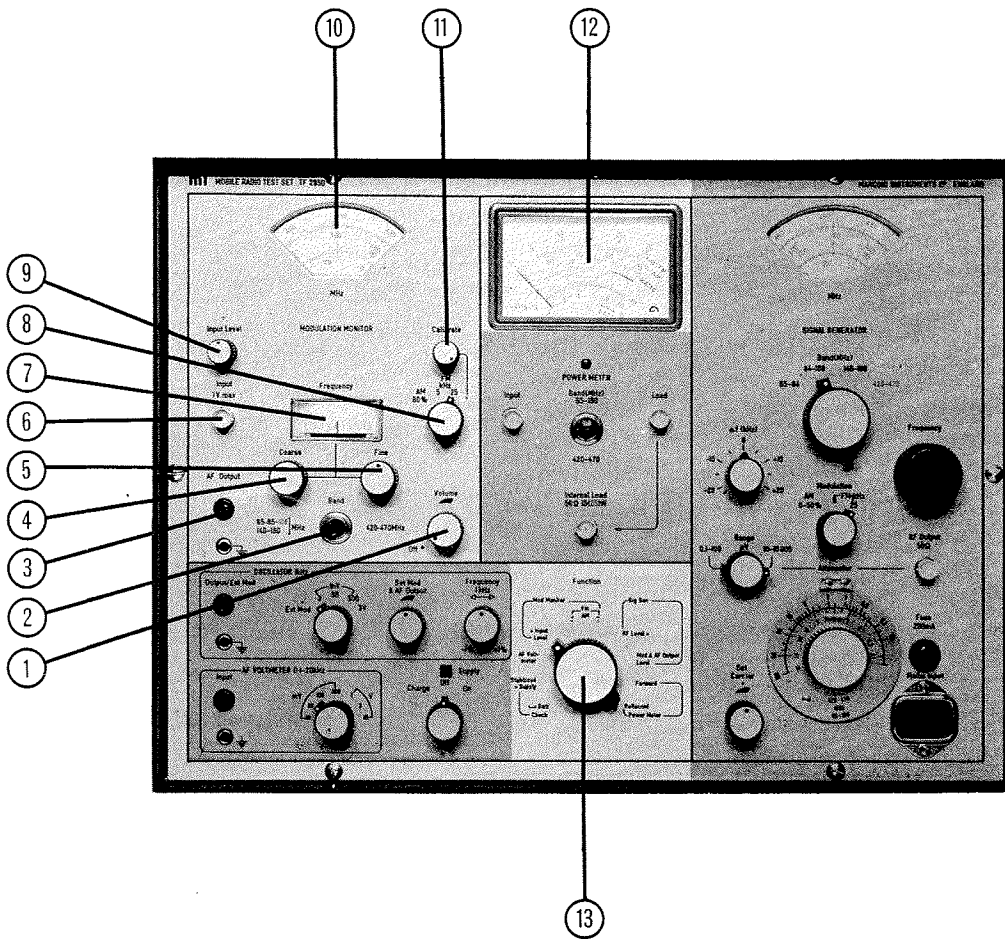
1. Voltmeter Input Terminals
2. Voltmeter Range Switch - Selects ranges of 10 mV, 30 mV, 100 mV, 300 mV, 1 volt, 3 volt and 10 volt f. s. d.
3. Function Switch
4. Voltage Monitor

2.6.1 A.F. Voltmeter Operation

When the FUNCTION SWITCH is set to the A. F. Voltmeter position and the required range selected the signal to be measured is fed to the INPUT terminals. The meter will indicate the level of the input signal.

The input impedance of the voltmeter is 100 k Ω and the frequency range is 100 Hz to 20 kHz.

2.7 MODULATION MONITOR CONTROLS



- | | | |
|---|---|---|
| 1. Loudspeaker ON/OFF Switch and Volume Control | - | switches loudspeaker into circuit and adjusts volume of audio signal. |
| 2. Input Frequency Range Switch | | |
| 3. A.F. Output Terminals | - | The demodulated output is available at these terminals for analysis. |
| 4. Coarse Frequency Control | - | Coarse adjustments of local oscillator frequency. |
| 5. Fine Frequency Control | | |
| 6. R.F. Input Socket | - | 50 Ω B.N.C. Socket. |
| 7. Local Oscillator Tuning Indicator | - | Indicates when I.F. is at correct value. |
| 8. Modulation Range Switch | - | Selects full scale indication of monitor circuit. |
| 9. R.F. Input Level Control | - | Adjusts r.f. input level to required value. |
| 10. Local Oscillator Frequency Dial | | Indicates frequency to which local oscillator is set. |

- | | | | |
|-----|--------------------|---|--|
| 11. | Calibrator Control | - | Adjusts accuracy of monitor. |
| 12. | Meter | - | Indicates percentage modulation depth and peak frequency deviation. Also used to indicate r.f. input level and modulation level. |
| 13. | Function Switch | | |

2.7.1 Modulation Monitor Operation

Before the modulation monitor is used for any measurements it is advisable to check and adjust the calibration accuracy of the unit. An internal calibration signal is provided for this purpose. In order to bring it into operation the FUNCTION SWITCH should be set to the modulation monitor FM/AM position. When the MODULATION RANGE SWITCH is set to the CALIBRATE position the CALIBRATOR CONTROL* can be used to bring the meter indication to the RED DOT. This sets the accuracy of the monitor. Care must be taken to ensure that the loudspeaker volume control is in the OFF position, i.e. anti-clockwise.

*When using the CALIBRATE control the 1 kHz oscillator must not be switched to the EXT. MOD. position.

F.M. MEASUREMENTS

The modulation monitor INPUT LEVEL position must be selected with the FUNCTION SWITCH. The signal to be measured is then fed into the R.F. INPUT SOCKET. (The level required is between 5 mV and 1 V into 50 Ω). The MODULATION RANGE SWITCH is used to select the required deviation range and the INPUT FREQUENCY RANGE SWITCH to select the local oscillator frequency coverage.

Using the COARSE LOCAL OSCILLATOR FREQUENCY CONTROL the local oscillator frequency should be set to, approximately that of the input signal. This control should then be tuned slowly to obtain a peak reading on the main meter. The R.F. INPUT LEVEL CONTROL can now be used to bring the main meter indication to the RED DOT.

In order to set the local oscillator for best operation of the modulation meter a separate TUNING INDICATOR is provided. As the frequency of the local oscillator is adjusted this meter will indicate the classical discriminator 'S' curve, i.e. as the correct tuning point is approached the meter will move from its centre indication and rise to a peak. As the frequency of the local oscillator is adjusted further the meter reading will fall and pass through the centre zero point to the other side where it will once more rise to a peak before falling once more to the centre zero position where it will remain until the next tuning point is reached. The correct tuning point is the indication of centre zero which occurs between the two peak readings. Once this has been set the modulation can be indicated.

The FUNCTION SWITCH must now be set to the +FM or -FM position. In the +FM position the peak deviation above the carrier frequency is indicated when the local oscillator is tuned above the frequency of the input signal. In the -FM position the peak deviation below the carrier frequency will be indicated. The sense of the +ve and -ve readings is reversed when the local oscillator is on the 85-108 MHz range.

A.M. MEASUREMENTS

The modulation monitor INPUT LEVEL position must be selected with the FUNCTION SWITCH. The signal to be measured is then fed into the R.F. INPUT SOCKET. (The level required is between 50 mV and 1 V into 50 Ω). The MODULATION RANGE SWITCH is used to select the 80% A.M. DEPTH RANGE and the INPUT FREQUENCY RANGE SWITCH to select the local oscillator frequency coverage.

Using the COARSE LOCAL OSCILLATOR FREQUENCY CONTROL the local oscillator frequency should be set to, approximately that of the input signal. This control should then be tuned slowly to obtain a peak reading on the main meter. The R.F. INPUT LEVEL CONTROL can now be used to bring the main meter indication to the RED DOT.

Now set FUNCTION SWITCH to either the +AM or -AM position. The +AM position of the FUNCTION SWITCH will give an indication of the peak modulation depth as measured at the peak of the modulation envelope, whereas the -AM position will give an indication of the peak modulation depth as measured in the trough of the modulation envelope.

A demodulated sample of any modulation signal is available at the A.F. output terminals where it can be used for distortion measurements, spurious noise modulation measurements etc.

An audible indication of the modulation is also available from the loudspeaker mounted on the rear panel of the test set. The LOUDSPEAKER ON/OFF SWITCH AND VOLUME CONTROL is used if this function is required. However some degradation of measurement accuracy can occur with the loudspeaker on and therefore if the most accurate measurements of modulation depth or frequency deviation are required these parameters should be measured before the loudspeaker is switched on.

The r.f. input level range is from 5 mV to 1 V. If the modulation appearing on higher signal levels i.e. above 0.5 W, needs to be measured this signal should be fed into the INPUT socket of the Power Meter. A sample of this signal is fed to the modulation meter to allow measurements to be made.

3.1 POWER SUPPLY (Fig. 3.1 and Fig. 7.2)

The supply voltage, for each of the various units which go to make up TF 2950, is derived directly from the external rechargeable batteries which are of the lead and sulphuric acid type. As such they can function in any position and require no servicing. In order to ensure maximum life and operational readiness it is important not to leave the batteries in an uncharged state and also to ensure that they are not overcharged. To alleviate the latter problem the internal charging circuit is designed to reduce from the full charging rate to the trickle charge rate once the batteries are fully charged.

The mains supply, which is used to produce the battery charging supply, is fed via a split primary transformer to a full-wave rectifier D104. The capacitor C102 is charged via D101 and R101 and the resultant p.d. developed across R101 turns on TR101 and causes LP402 to light. TR102 also switches on and the full charging current is fed to the batteries via R101, D101 and TR102. A constant voltage of 21.5 V, derived by D401, D102 and R109, is fed to the base of TR102. This voltage is adjusted by means of R109 and it therefore determines the voltage at which the full charging rate is reduced to a trickle rate. R101 is used to set the maximum charging current. The full charging rate is only selected when the supply switch is set to the CHARGE position which automatically disconnects any load from the battery.

With the supply switch set to the ON position the internal batteries are charged at a trickle rate when the mains supply is connected. Under these conditions the battery is charged at about 80% of its maximum rate. The operation of TR101 and TR102 is the same as under full CHARGE conditions but the charging voltage is reduced to 19.6 V to prevent excessive gassing of the cells. The value of the charging voltage is set by D401, D103 and R108.

The condition of the internal batteries can be monitored at any time by switching the function switch to the "BATT CHECK" position when the meter should read in the "BATT" arc if the batteries are charged up.

3.2 VOLTAGE STABILISING CIRCUIT (Fig. 3.1 and Fig. 7.2)

The D.C. supply voltage for the various units of the instrument, which is derived from the internal batteries, is fed to the stabiliser circuit in order to maintain the supply rails at a constant 14 V during the discharge cycle of the batteries. Transistor TR104 acts as a conventional Series Voltage Regulator with D105 producing the reference voltage for the control circuit. The reference voltage is fed to the base of TR106 which with TR107 forms a differential amplifier. The output of the Series Regulator appears across the resistor chain of R123, R122 and R121 and a sample is taken from the wiper of R122 and fed to the base of TR107. Any difference between this voltage and that of the D.C. reference is amplified and fed via TR105 back to the Series Regulator. This forms the control loop which provides the voltage stabilisation required. The variable resistor R122 is used to adjust the level of the 14 V line and C105 is to provide any ripple compensation necessary.

In order to protect the Series Regulator from damage that could be caused by an accidental short circuit occurring on the 14 V line, TR108 has been added. If the current drawn from TR104 rises to a dangerous level the potential difference across R117 and R118 will increase to a value sufficient to switch on TR108. This will cause TR104 to be switched off by TR105, thus preventing any damage being caused to TR104.

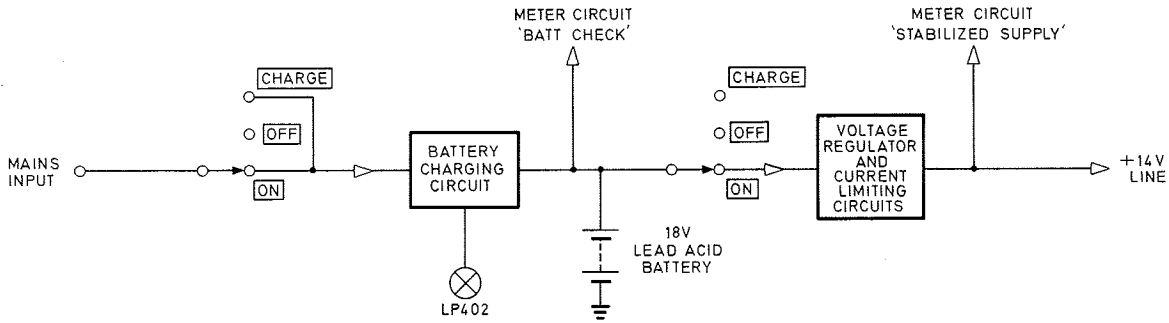


Fig. 3.1 Power Supply Block Diagram

3.3 A/F VOLTMETER (Fig. 3.2 and Fig. 7.2)

To allow small A.C. voltages to be measured in the presence of D.C. voltages up to 250 V the input circuitry is A.C. coupled with C405. The voltmeter input impedances of 100 kΩ is set by the switchable attenuator which allows full scale ranges of 10, 30, 100, 300 mV and also 1, 3 and 10.V to be selected. An 'n' channel f.e.t. is used in the first stage of the voltmeter amplifier to keep the input impedance high. This is directly coupled to the successive stages giving a total gain of 50 dB. Negative feedback, used to keep the response of the amplifier flat and the gain stable, is set by R154. The high frequency response of the amplifier is adjusted by means of C122. TR119 which is connected in a grounded emitter configuration feeds a full wave rectifier D109, D110, D111 and D112. The resultant D.C. signal is fed via the calibration resistor RV163 to the meter for monitoring purposes.



Fig. 3.2 A/F Voltmeter Block Diagram

3.4 1 kHz A/F OSCILLATOR (Fig. 3.3 and Fig. 7.2)

The circuit used for the 1 kHz oscillator is that of an R.C. Wien Bridge. The frequency determining components R128, R129, R130, R414, C109 and C110 are arranged in a series/parallel configuration. R128 is used to set the nominal frequency of the oscillator to 1 kHz while the variable resistor R414 is the front panel control which allows the nominal 1 kHz to be adjusted by $\pm 1\%$.

The transistors TR110, TR111 and TR112 are connected as a directly coupled amplifier with the feedback taken from the output of TR112 via R137 which can be adjusted to set the feedback for optimum operation. Amplitude stabilisation is achieved by means of LP401 which is connected in the emitter of TR110 where it acts as a voltage controlled resistance varying in sympathy with the feedback voltage across it. This varies the gain of TR110 and hence the amplitude of the oscillator circuit output.

From the collector of TR112 the oscillator signal is fed into the output stage comprising TR113, TR114 and TR115. Negative feedback is taken from the complementary output stage at the junction of R146 and R147 and fed to the base of TR113 via resistors R140 and R141. The optimum working point for TR113 is set by means of R140 while R139 is used to set the level of the input signal to the output amplifier.

Control of the output level is achieved by means of the SET A.F. Output and Mod. Level control R412 in conjunction with the output range attenuator. The input to the attenuator is monitored by D402 and the resultant D.C. signal fed via the calibration control R432 to the meter.

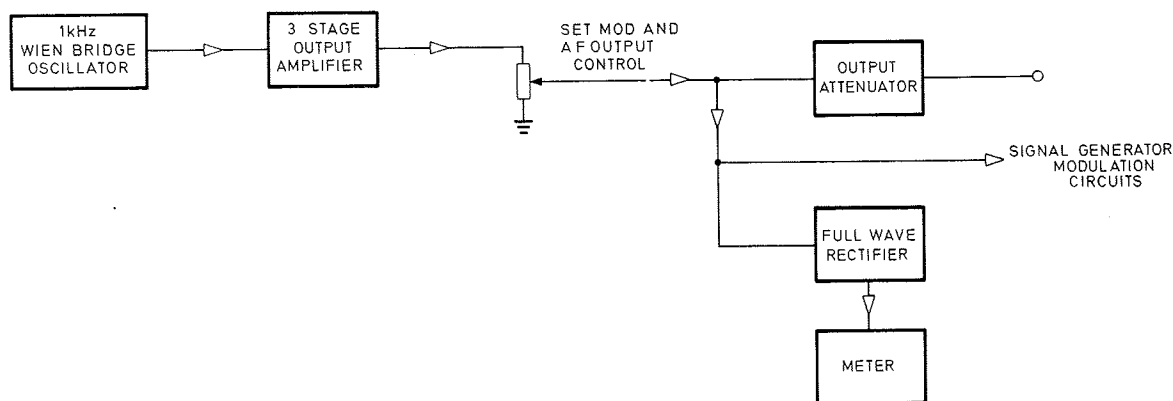


Fig. 3.3 A/F Oscillator Block Diagram

3.5 MODULATION MONITOR (Fig. 3.4 and Fig. 7.3)

The modulation monitor has the capability of measuring both peak frequency deviation and amplitude modulation depth. The standard receiver technique of mixing the input signal with that of a local oscillator to produce a fixed intermediate frequency of 10.7 MHz is used. All measurements of FM and AM are then carried out at the I.F., although due to conflicting requirements a separate I.F. amplifier is used for each type of modulation.

The local oscillator has two ranges, one covering 74 to 98 MHz and the other 214 to 241 MHz. The appropriate oscillator range is selected by switching the oscillator transistor D.C. supply. With an input frequency of 65-85 MHz the local oscillator is tuned over the range of 75.7 MHz to 95.7 MHz thus producing a difference frequency of 10.7 MHz.

When the input frequency is between 85 and 108 MHz the local oscillator is tuned over the range of 74.3 to 97.3 MHz, again producing an I.F. of 10.7 MHz. For the 140-180 MHz input range the second harmonic of the basic 74 to 98 MHz oscillator is used.

In the case of the U.H.F. band of 420-470 MHz the second harmonic of the 214-241 MHz oscillator is used.

Both oscillators are connected in the Colpitts configuration with the tuning achieved by means of the variable capacity diodes D212 and D213. The variable resistors R271 and R443 are the main tuning and fine tuning controls respectively. R271 is mechanically coupled to the modulation monitor frequency dial which is calibrated directly in input frequency. The output from each oscillator is fed to the diode mixer D209 via the buffer amplifier. TR215 which eliminates any frequency pulling that may occur between the local oscillator and input signal.

Under normal conditions the input signal is fed into the mixer via the modulation monitor RF input socket SK405. However, should the signal to be measured exceed about 500 mW it can be connected to the power meter load. A small sample of the signal is then capacitively coupled to the modulation monitor input socket by means of capacitor C213.

The output from the mixer is fed via a bandpass filter, which is used to reduce the level of unwanted signals, to the appropriate I.F. amplifier. Only the I.F. amplifier in use has the D.C. supply connected by means of the AM/FM range switch.

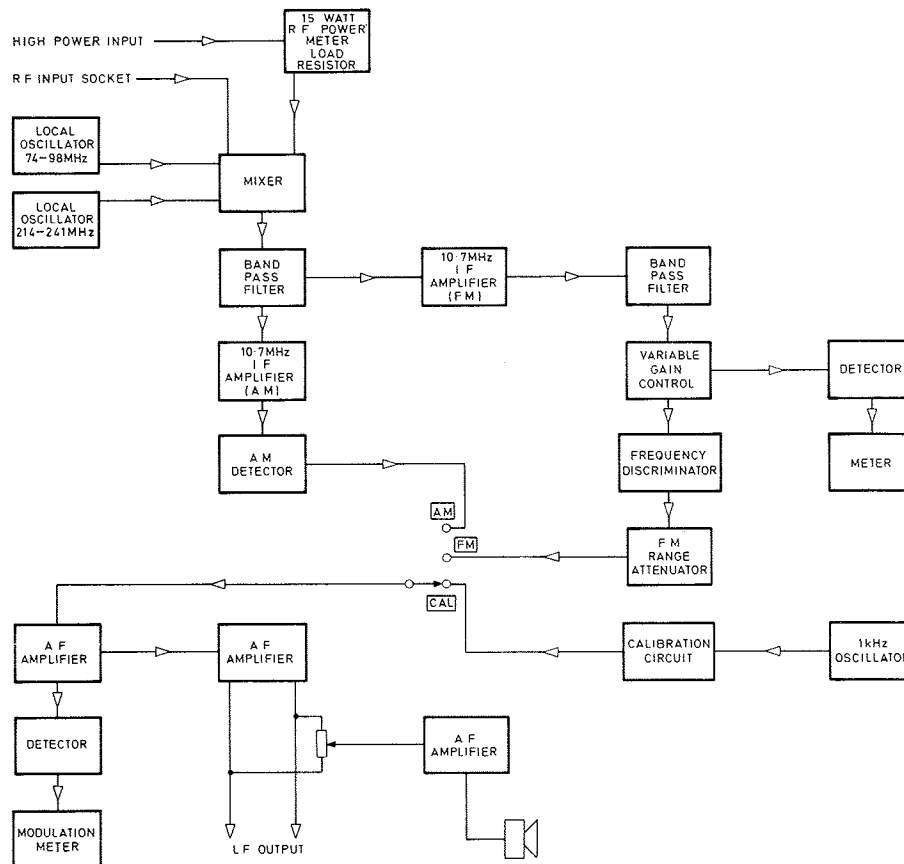


Fig. 3.4 Block Diagram of the Modulation Monitor

3.5.1 F.M. Circuitry

The output from the bandpass filter L201, C215 and C216 is fed into the integrated circuit I.F. amplifier I.C.207. This increases the level of the I.F. signal and also reduces any spurious A.M. on the F.M. signal by conventional limiter action. The I.F. amplifier is followed by another bandpass filter comprising L202, C219 and C220 and a variable gain amplifier TR208. The range of control is 40 dB and is obtained by means of R441 which is the R.F. Input Level control. This sets the gain of the amplifier according to the level of the signal at the r.f. input socket. In order to have an indication when the input level is correct a sample of the output from TR208 is rectified by D208 and fed to the instrument's meter. The Input Level control R441 is then adjusted until the meter reads on the calibration mark once the local oscillator has been set to the correct frequency.

Demodulation of the F.M. signal is achieved by means of the Foster Sealey discriminator following TR208. The average D.C. signal appearing at the output of the discriminator is monitored by meter M402 to provide an indication of when the I.F. signal is tuned to the centre of the discriminator characteristic.

The demodulated audio signal is then fed via the deviation range attenuator to the A.F. amplifier section. Here it is amplified by TR201, TR202 and TR203 which are arranged as an R.C. amplifier with an f.e.t. input stage. Negative feedback, via R205 and C203, is used to maintain the gain and frequency response of the amplifier constant. The output from TR203 is fed to a pair of diodes which provide the meter signal for the positive and negative indication depending on the position of the Function Switch. D201 gives the signal equivalent to the positive deviation and D202 the signal for the negative deviation. (Note that on the input range of 85-108 MHz the position of the positive and negative deviation indication is reversed because the local oscillator frequency is below that of the input signal).

From TR202 the signal is fed to TR204 which produces the audio output available at SK405 and this can be used for analysis purposes. An I.C. amplifier IC205 is used to raise the level of the audio signal to a sufficiently high level to drive a small loudspeaker which gives an audible indication of the demodulated signal.

A calibration signal, that is derived from the internal 1 kHz oscillator, is provided so that the gain of the audio section can be checked periodically and adjusted by means of R209 the f.m. calibrate control.

3.5.2 A.M. Circuitry

The output from the bandpass filter following the mixer is also fed to the A.M. I.F. amplifier comprising TR210 and TR211. The amplifier is only switched on when A.M. measurements are being made. During F.M. measurements it is switched off to eliminate the possibility of interference. The gain of the first stage can be varied over a range of 40 dB by R441 the r.f. Input Level control. After amplification the signal is fed to the diode demodulator D210. The d.c. output is fed to the meter via the set r.f. level (A.M.) preset R255 to give an indication of when the r.f. input level is correct.

The demodulated audio signal is fed into the A.F. amplifier, via the calibration resistor R257, where it undergoes a similar process to the F.M. demodulated signal. In the case of A.M. the diodes D201 and D202 provide the Peak and Trough modulation depth readings on all ranges.

3.6 SIGNAL GENERATOR (Fig. 3.5 and Fig. 7.4)

The oscillator circuit for each of the V.H.F. ranges is arranged in a Colpitts configuration with TR304 as the active element. Frequency range change is achieved by means of switching oscillator coils with the frequency range selector switch. Variation of the frequency across each band is obtained by means of the variable capacitor C344. This component has been produced by milling it from a solid block of metal which makes it very rigid and reduces any microphonic effects to a minimum.

A varicap diode, D301, provides both frequency modulation and electrical fine tuning facilities. It is coupled into the oscillator circuit with either C345 or C356 depending on the R.F. range. To maintain a constant F.M. deviation sensitivity over each R.F. band the variable potentiometer R326 is mechanically coupled to the main frequency drive. The modulation signal is fed via R326 to D301 and this has the result of reducing the modulation drive level as the carrier frequency is increased thus compensating for the increase in F.M. sensitivity.

Adjustment to the F.M. sensitivity on each R.F. range is made by means of R347, R348 and R349 while, R428 sets up the F.M. deviation on all bands. The F.M. deviation range switch allows ranges of 0-5 kHz or 0-25 kHz peak deviation to be selected. Variation of the D.C. bias across D301 with R410 produces the calibrated fine tuning facility of ± 20 kHz on each range.

From the oscillator the signal is fed to TR301 which is a variable gain wideband amplifier. This is used to adjust the level of the R.F. signal by means of the Set Carrier control R407.

Amplitude modulation of the V.H.F. oscillator output is produced by varying the gain of the following amplifier stage TR302 with the audio modulation signal. Internal modulation is at a 1 kHz rate and this is derived from the audio oscillator and fed to TR302 via the calibration resistor R426. The signal is then fed via the buffer amplifier TR303 and the bandpass filter F301 to the output level controls. These consist of a switchable 40 dB pad (the voltage range switch) and a continuously variable 60 dB attenuator. Collectively these controls vary the output level over the range of $0.1 \mu\text{V}$ to 10 mV from an impedance of 50Ω .

The U.H.F. band is obtained in a different manner to that used on the V.H.F. ranges. Instead of a fundamental oscillator this band uses a low frequency variable oscillator covering the range of 140-157 MHz followed by a tuned frequency tripler. The oscillator, which is connected in a Colpitts configuration is tuned by C344. On the other hand the frequency tripler is tuned by means of the variable capacity diode D303. The tuning voltage for D303 is taken from the potentiometer R326.

Frequency modulation and electrical fine tuning are carried out on the oscillator with D302 which is coupled into the tuned circuit by C346. This serves as an adjustment for the deviation.

The output from the frequency tripler is fed into the bandpass filter F301 and then to the output range switch and variable attenuator. The input to the attenuator is monitored by D304 and fed to the meter to provide the carrier level indication.

As the signal generator is used for testing high sensitivity receivers, all r.f. circuitry is contained within a screened r.f. box to reduce the spurious radiation to a minimum. All signals fed into the r.f. unit are fed in via r.f. filters for the same reason.

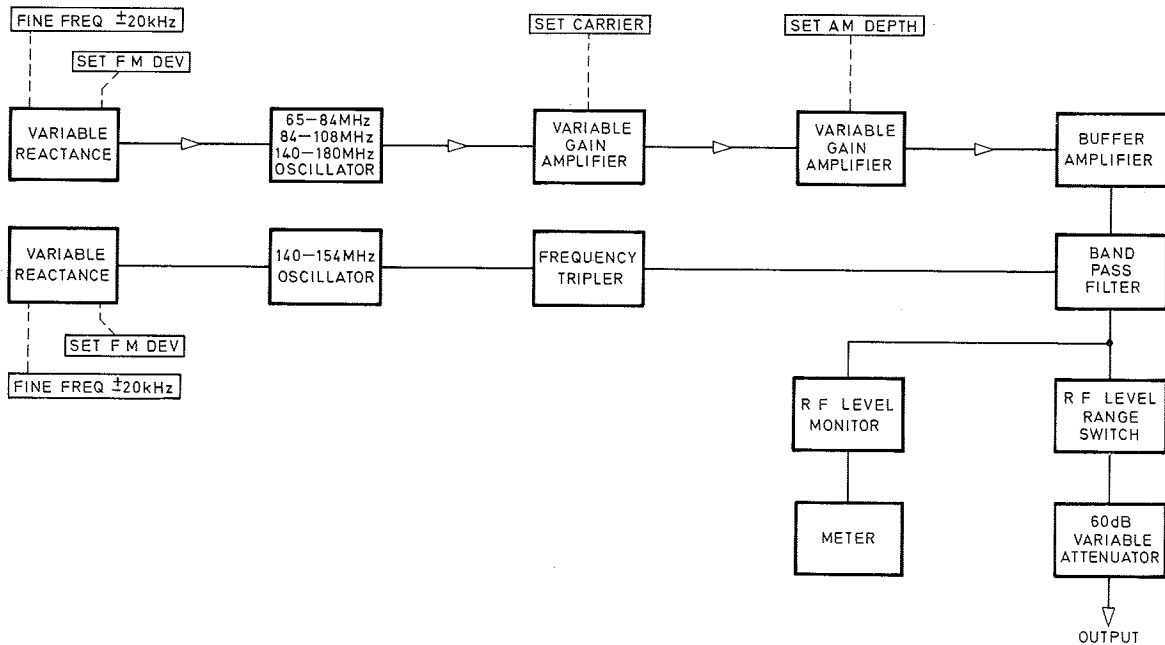


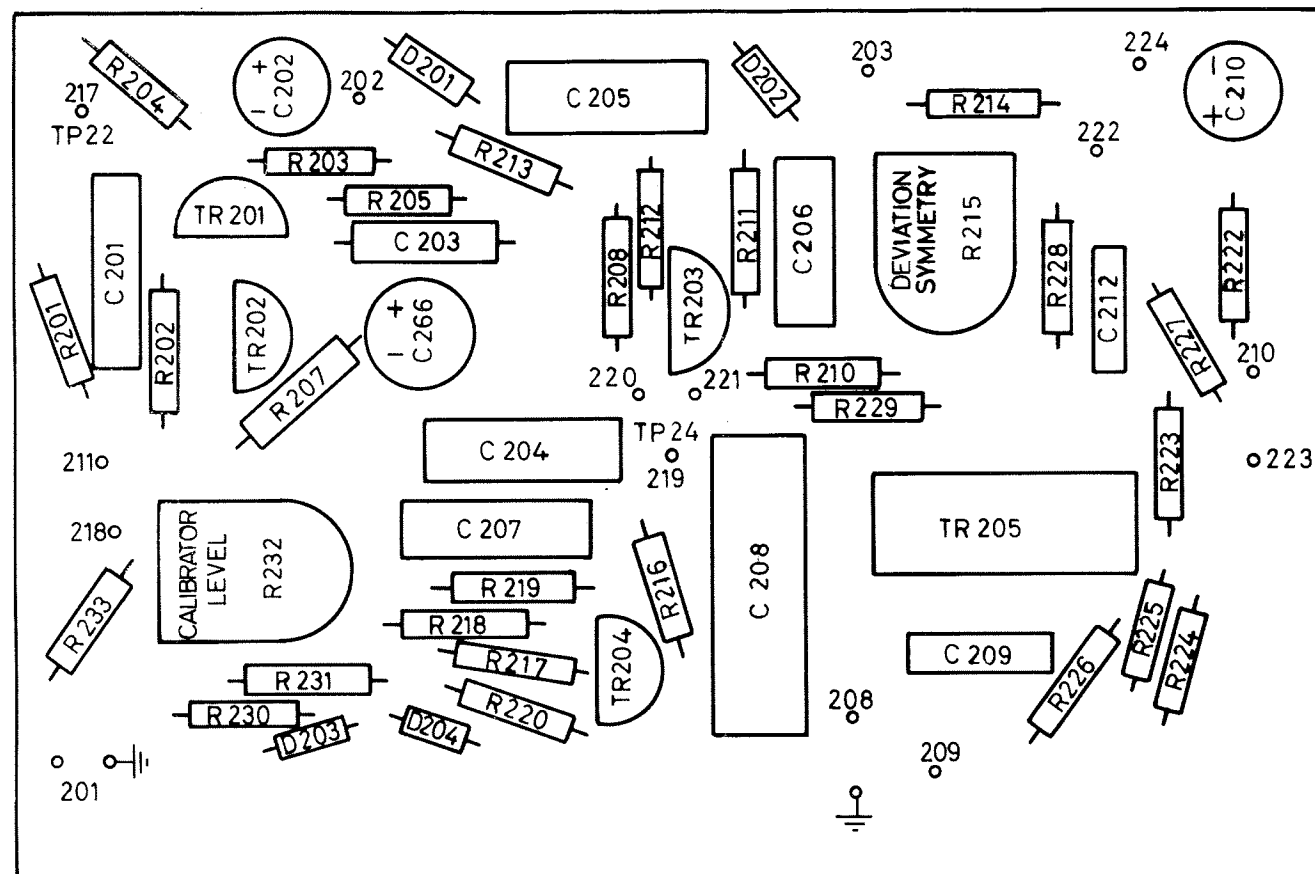
Fig. 3.5 Signal Generator Block Diagram

3.7 R.F. POWER METER

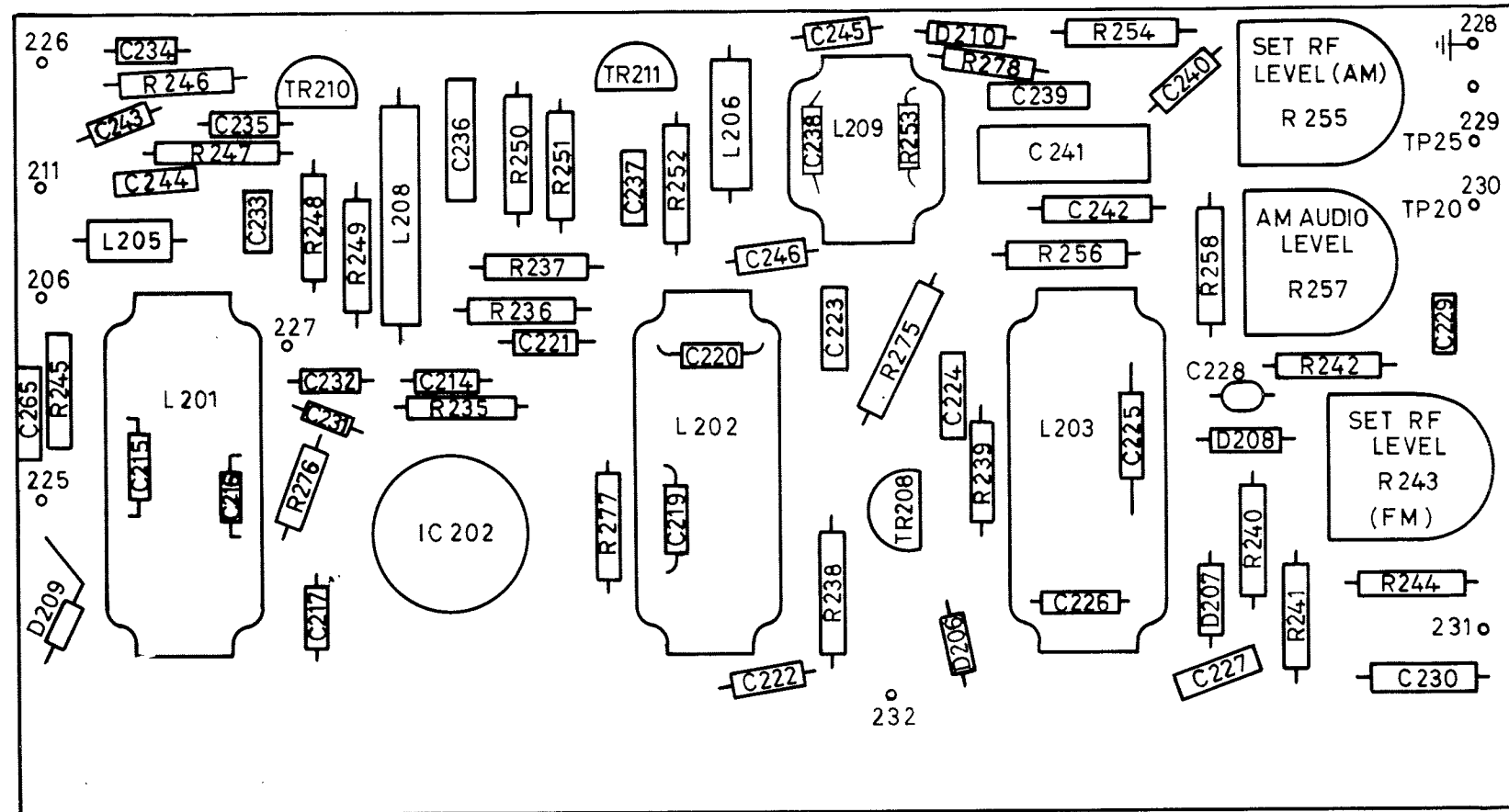
This unit works on the in-line principle. The basis of operation is the mutual inductance existing between the inductive sensing elements and the centre conductor of a short length of air spaced transmission line having a 50Ω characteristic impedance. Four inductors are arranged around the centre conductor, two for each R.F. range. One gives indication of the forward power and the other one of each pair gives the signal for the reflected power reading.

The output from each of the sensing elements L501, L502, L503 and L504 is proportioned to the directional power flowing through the power meter. A separate r.f. load resistor R519 is provided so that either in-line or absorption type power measurements can be made.

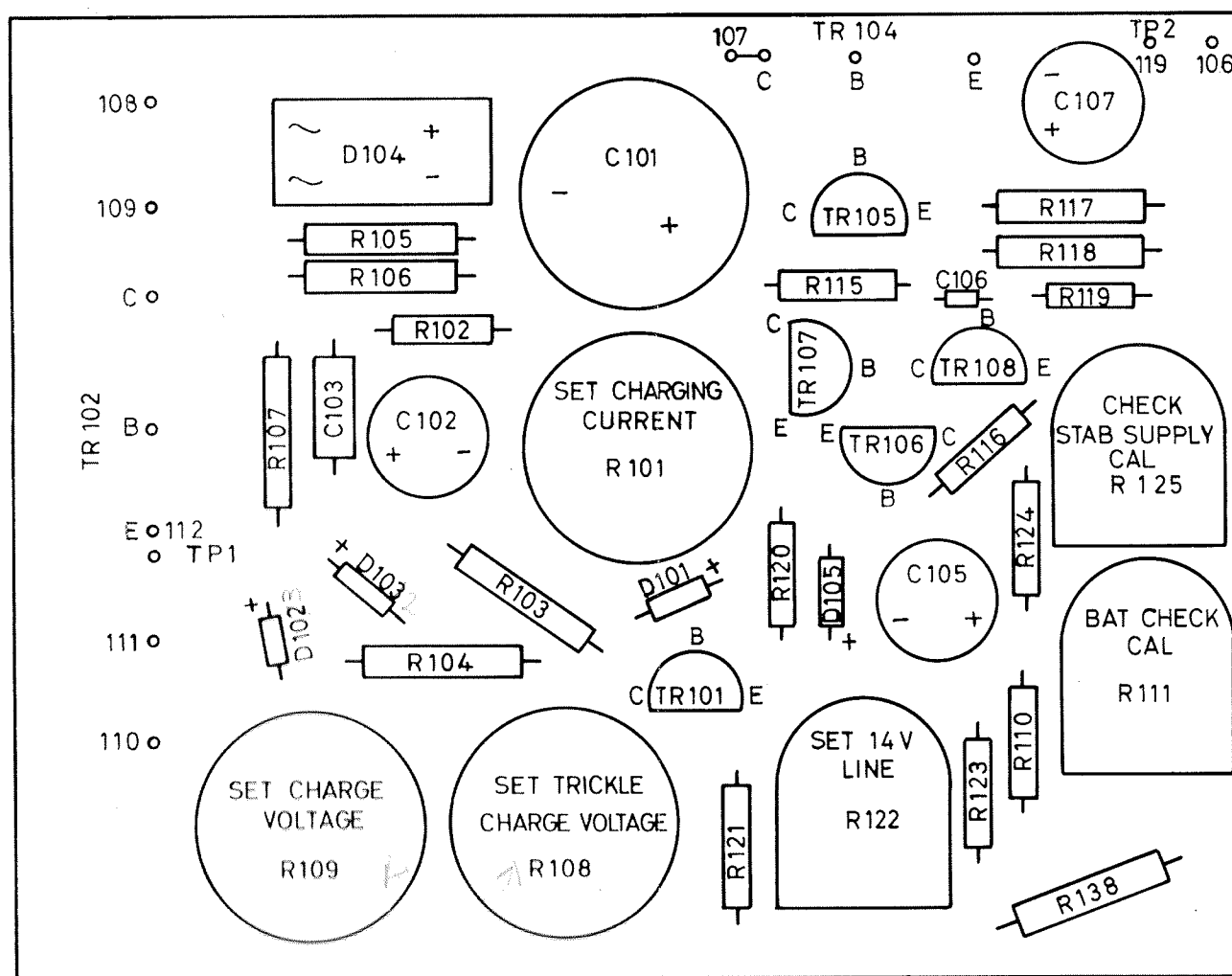
A calibration resistor is provided for each of the directional couplers so that the power meter indication can be adjusted.



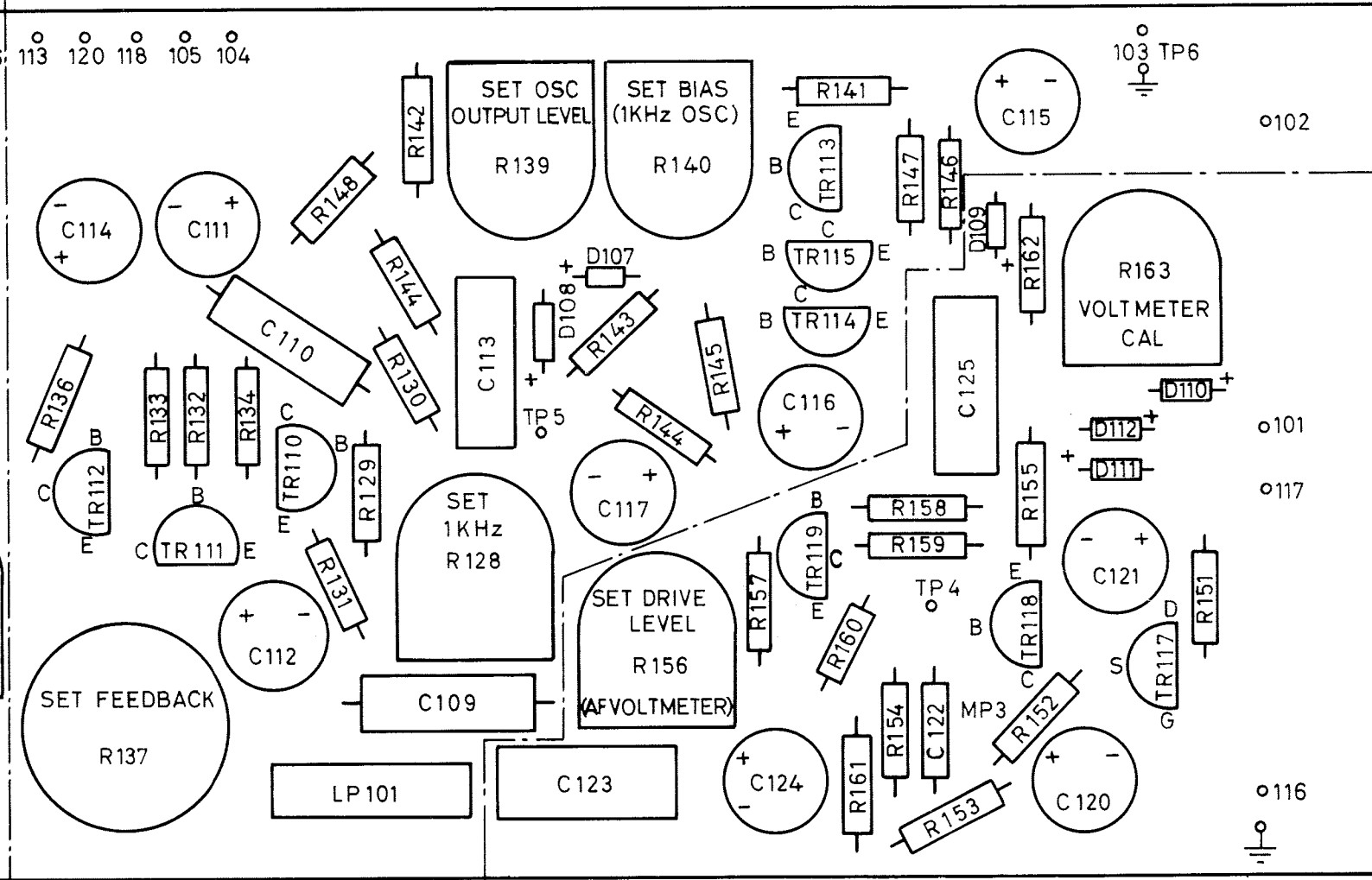
MODULATION MONITOR AUDIO AMPLIFIER



FM IF AMP AND DISCRIMINATOR
AM IF AMP AND DEMODULATOR



POWER SUPPLY AND VOLTAGE STABILISER

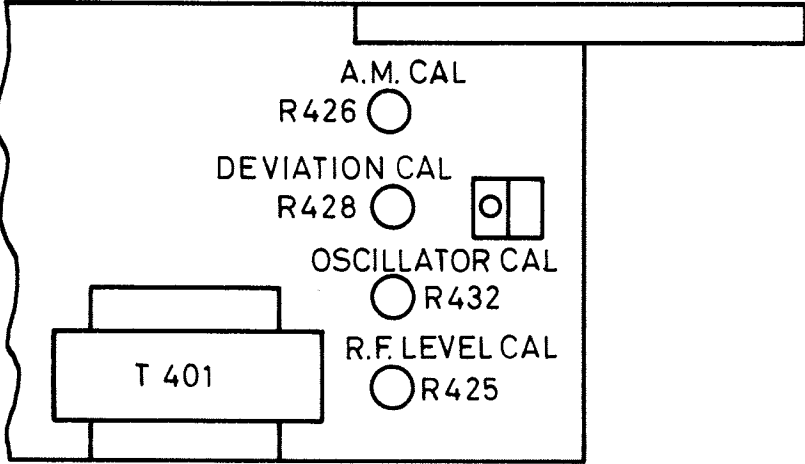


AUDIO OSC

AF VOLT METER

Fig. 5.1 P.C.B. Component Layout

CHASSIS



POWER METER

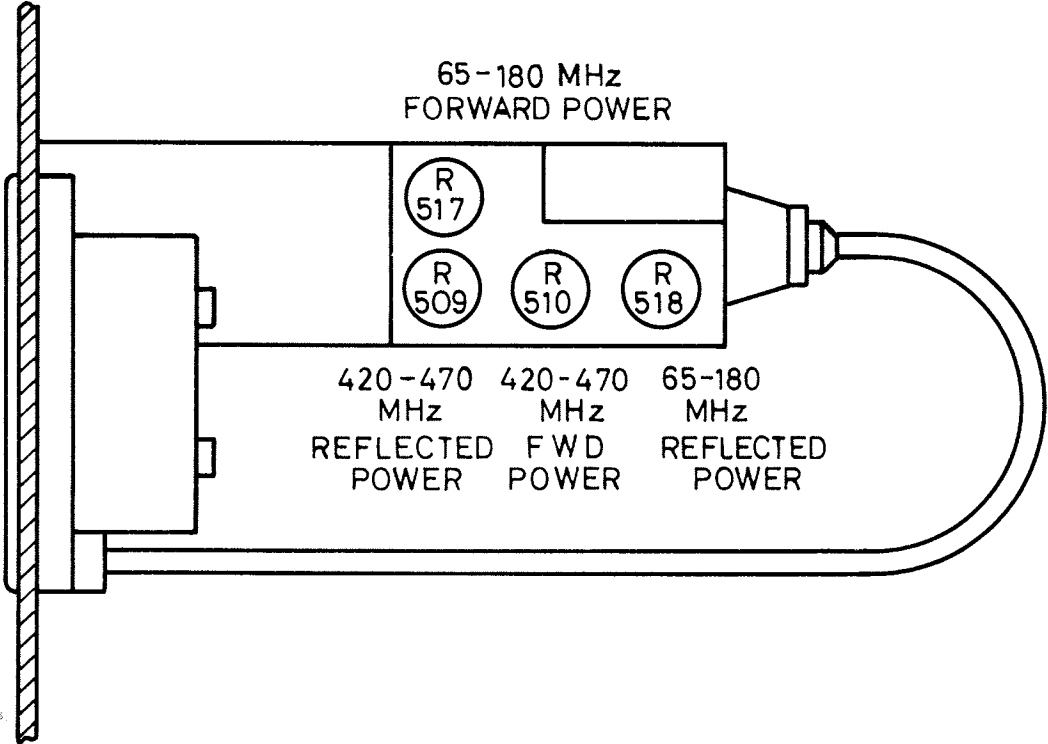


Fig. 5.2 Location of Preset Controls

6.1 INTRODUCTION

This chapter lists the replaceable parts in alphanumerical order of circuit references, sub-divided into eleven sections in the order shown below. The associated circuit diagrams are also indicated.

| | | |
|---|---|----------|
| Battery Charging Unit | - | Fig. 7.2 |
| Stabilised Power Supply | - | Fig. 7.2 |
| A.F. 1 kHz Oscillator and Final Stage | - | Fig. 7.2 |
| A.F. Voltmeter | - | Fig. 7.2 |
| Modulation Monitor - A.F. Amplifier | - | Fig. 7.3 |
| Modulation Monitor - F.M. -I.F. Amplifier | - | Fig. 7.3 |
| Modulation Monitor - A.M. -I.F. Amplifier (10.7 MHz) | - | Fig. 7.3 |
| Modulation Monitor - Oscillator | - | Fig. 7.3 |
| Signal Generator - Oscillator | - | Fig. 7.4 |
| Main Chassis Assembly | - | Fig. 7.1 |
| R.F. Power Meter | - | Fig. 7.5 |

The following abbreviations are used in the parts list -

| | | | |
|--------|--------------------|-------|-------------|
| B | Battery | Met | Metal |
| C | Capacitor | Plas. | Plastic |
| Carb. | Carbon | R | Resistor |
| Cer | Ceramic | Rect. | Rectifier |
| D | Diode | S | Switch |
| Elect. | Electrolytic | Selen | Selenium |
| FL | Filter | SK | Socket |
| FS | Fuse | Styro | Styroflex |
| IC | Integrated Circuit | T | Transformer |
| L | Inductor | TR | Transistor |
| LP | Lamp | Var | Variable |
| LS | Loudspeaker | W.W. | Wire Wound |
| M | Meter | | |

6.2 ORDERING

When ordering replacement or spare parts, address the order to our Service Division (for address see rear cover) or nearest representative. Please specify the following information for each part required.

- (i) Type and serial number of instrument (see rear data plate)
- (ii) Circuit reference number
- (iii) Description
- (iv) M.I. part number (preceded by FPP)

If a part is not listed, state its function, location and description when ordering.

Spares supplied against M.I. part numbers are electrically interchangeable with those originally fitted, but may not always be identical.

6.3 PARTS LIST

| Circuit Reference | Description | M.I. Code No. FPP/ |
|-------------------|-------------|-----------------------|
|-------------------|-------------|-----------------------|

BATTERY CHARGING UNIT

Capacitors -

| | | |
|------|-------------------------|--------------|
| C101 | Elect. 500 μ F 35 V | 50-6500-0035 |
| C102 | Elect. 50 μ F 35 V | 50-6050-0035 |
| C103 | Styro. 220 pF 100 V | 46-2220-0100 |

Diodes -

| | | |
|------|---------------------------|--------------|
| D101 | Silicon Diode EC401 | 71-3300-0401 |
| D102 | Zener Diode BZY85C13 | 72-2211-1013 |
| D103 | Zener Diode BZY85C15 | 72-2211-1015 |
| D104 | Selen. Rect. B30C 450/700 | 74-2300-1450 |

Resistors -

| | | |
|----------|---|--------------|
| R101 | Var. W.W. 100 Ω 1W | 15-2100-1151 |
| R102 | Carb. Film 18 k Ω \pm 5% 1/8W | 11-4018-1851 |
| R103 | Carb. Film 470 Ω \pm 5% 1/2W | 11-2470-1251 |
| R104 | Carb. Film 1.5 k Ω \pm 5% 1/2W | 11-3015-1251 |
| R105 | Carb. Film 15 Ω \pm 5% 1/3W | 11-2015-1351 |
| R106 | Carb. Film 15 Ω \pm 5% 1/3W | 11-2015-1351 |
| R107 | Carb. Film 3.3 k Ω \pm 5% 1/3W | 11-3033-1351 |
| R108/109 | Var. W.W. 100 Ω Preset 1W | 15-2100-1151 |
| R110 | Carb. Film 470 k Ω \pm 5% 1/8W | 11-4470-1851 |
| R111 | Var. Carb. Film 250 k Ω 1/8W | 13-4250-1851 |
| R112 | Carb. Film 1.2 k Ω \pm 5% 1/3W | 11-3012-1351 |

Transistors -

| | | |
|-------|--------------------|--------------|
| TR101 | Silicon PNP BC212B | 82-1110-0212 |
| TR102 | Silicon NPN 2N5295 | 81-2300-5295 |

STABILISED POWER SUPPLY

Capacitors -

| | | |
|------|-------------------------------|--------------|
| C105 | Elect. 10 μ F 65 V (35 V) | 50-6010-0065 |
| C106 | Ceramic Disc 1000 pF | 43-3010-0400 |
| C107 | Elect. 100 μ F 15 V | 50-6100-0015 |

Diodes -

| | | |
|------|------------------------|--------------|
| D105 | Zener Diode BZY85 C6V8 | 72-2211-1628 |
|------|------------------------|--------------|

Resistors -

| | | |
|----------|---|--------------|
| R115 | Carb. Film 33 k Ω \pm 5% 1/8W | 11-4033-1851 |
| R116 | Carb. Film 2.2 k Ω \pm 5% 1/8W | 11-3022-1851 |
| R117/118 | Carb. Film 3.3 k Ω \pm 5% 1/8W | 11-7033-1851 |
| R119 | Carb. Film 680 Ω \pm 5% 1/8W | 11-2680-1851 |
| R120 | Carb. Film 4.7 k Ω \pm 5% 1/8W | 11-3047-1851 |

| Circuit Reference | Description | M.I. Code No. FPP/ |
|---|--|-----------------------|
| Resistors (Cont) | | |
| R121 | Carb. Film 2.7 k Ω \pm 5% 1/8W | 11-3027-1851 |
| R122 | Var. Carb. 1 k Ω Preset 0.15W | 13-3010-1851 |
| R123 | Carb. Film 3.3 k Ω \pm 5% 1/8W | 11-3033-1851 |
| R124 | Carb. Film 560 ^{470k} k Ω \pm 5% 1/8W | 11-4560-1851 |
| R125 | Carb. Film 250 k Ω Preset 0.15W | 13-4250-1851 |
| Transistors - | | |
| TR104 | Silicon NPN 2N5295 | 81-2300-5295 |
| TR105-108 | Silicon NPN BC183B | 81-1100-0183 |
| <u>A.F. 1 kHz \pm 1% OSC and FINAL STAGE</u> | | |
| Capacitors - | | |
| C109/110 | Styro 6800 pF 100 V | 46-3068-0100 |
| C111 | Elect. 100 μ F 15 V (6 V) | 50-6700-0015 |
| C112 | Elect. 220 μ F 15 V | 50-6220-0015 |
| C113 | Met. Plas. Foil 0.47 μ F 100 V | 47-4470-0100 |
| C114 | Elect. 100 μ F 15 V | 50-6100-0015 |
| C115/116 | Elect. 10 μ F 65 V (35 V) | 50-6010-0065 |
| C117 | Elect. 100 μ F 15 V | 50-6100-0015 |
| Diodes - | | |
| D107/108 | Silicon Diode BA 164 | 71-2100-0164 |
| Lamps - | | |
| LP101 | Lamp 50 mA 6 V | 09-6000-0050 |
| Resistors - | | |
| R128 | Var. Carb. 5 k Ω Preset 0.15W | 13-3050-1851 |
| R129/130 | Met. Film 22 k Ω \pm 2% 1/8W | 12-4022-1821 |
| R131 | Met. Film 470 Ω \pm 2% 1/8W | 12-2470-1821 |
| R132 | Met. Film 6.8 k Ω \pm 2% 1/8W | 12-3068-1821 |
| R133 | Met. Film 1.8 k Ω \pm 2% 1/8W | 12-3018-1821 |
| R134 | Met. Film 120 Ω \pm 2% 1/8W | 12-2120-1821 |
| R135 | Met. Film 560 Ω \pm 2% 1/8W | 12-2560-1821 |
| R136 | ^{Carb} Met. Film 180 Ω \pm 2% 1/8W | 11-2180-1821 |
| R137 | Var. W.W. 100 Ω Preset 2W | 15-2100-1151 |
| R138 | Carb. Film 470 Ω \pm 5% 1/2W | 11-2470-1251 |
| R139/140 | Var. Carb. 10 k Ω 1/4W | 11-4010-1451 |
| R141 | Carb. Film 10 k Ω \pm 5% 1/8W | 11-4010-1851 |
| R142/143 | Carb. Film 1.5 k Ω \pm 5% 1/8W | 11-3015-1851 |
| R144/145 | Carb. Film 1.2 k Ω \pm 5% 1/8W | 11-3012-1851 |
| R146/147 | Carb. Film 10 Ω \pm 5% 1/8W | 11-2010-1851 |
| R148 | Carb. Film 3.3 Ω \pm 5% 1/8W | 11-7033-1851 |
| R149 | Carb. Film 33 Ω \pm 5% 1/4W | 11-2033-1451 |
| Transistors - | | |
| TR110/111 | Silicon NPN BC183B | 81-1110-0183 |
| TR112 | Silicon NPN BC232B | 81-1110-0232 |
| TR113 | Silicon NPN BC183B | 81-1110-0183 |
| TR114 | Silicon NPN BC232B | 81-1110-0232 |
| TR115 | Silicon PNP BC231B | 82-1110-0231 |

| Circuit Reference | Description | M.I. Code No. FPP/ |
|---------------------------|---|-----------------------|
| <u>A.F. VOLTMETER</u> | | |
| Capacitors - | | |
| C120/121 | Elect. 100 μ F 15 V (6 V) | 50-6100-0015 |
| C122 | Styro 220 pF 100 V | 46-2220-0100 |
| C123 | Met. Plas. Foil 1 μ F 100 V | 47-5010-0100 |
| C124 | Elect. 250 μ F (220 μ F) 15 V (6 V) | 50-6250-0015 |
| C125 | Met. Plas. Foil 1 μ F 100 V | 47-5010-0100 |
| Diodes - | | |
| D109-112 | Germanium Diode AA 132 | 70-1100-0132 |
| Resistors - | | |
| R151 | Carb. Film 4.7 k Ω \pm 5% 1/8W | 11-3047-1851 |
| R152 | Carb. Film 820 Ω \pm 5% 1/8W | 11-2820-1851 |
| R153 | Carb. Film 1.5 k Ω \pm 5% 1/8W | 11-3015-1851 |
| R154 | Carb. Film 10 k Ω \pm 5% 1/8W | 11-4010-1851 |
| R155 | Carb. Film 560 Ω \pm 5% 1/8W | 11-2560-1851 |
| R156 | Var. Carb. 5 k Ω 0.15W | 13-3050-1851 |
| R157 | Carb. Film 27 k Ω \pm 5% 1/8W | 11-4027-1851 |
| R158 | Carb. Film 120 k Ω \pm 5% 1/8W | 11-4120-1851 |
| R159 | Carb. Film 1.5 k Ω \pm 5% 1/8W | 11-3015-1851 |
| R160 | Carb. Film 56 Ω \pm 5% 1/8W | 11-2056-1851 |
| R161 | Carb. Film 390 Ω \pm 5% 1/8W | 11-2390-1851 |
| R162 | Carb. Film 39 k Ω \pm 5% 1/8W | 11-4039-1851 |
| R163 | Var. Carb. 10 k Ω 0.15W | 13-4010-1851 |
| Transistors - | | |
| TR117 | Silicon N channel FET BF256B | 83-1210-0256 |
| TR118 | Silicon PNP BC212B | 82-1110-0212 |
| TR119 | Silicon NPN BC232B | 81-1110-0232 |
| <u>MODULATION MONITOR</u> | | |
| <u>A/F AMPLIFIER</u> | | |
| Capacitors - | | |
| C201 | Met. Plas. Foil 0.1 μ F 250 V | 47-4100-0250 |
| C202 | Elect. 100 μ F 15 V (6 V) | 50-6100-0015 |
| C203 | 220pf Styro 250 pF 100 V | 46-2750-0100 |
| C204-207 | Met. Plas. Foil 0.47 μ F 100 V | 47-4470-0100 |
| C208 | Met. Plas. Foil 3.3 μ F 100 V | 47-5033-0100 |
| C209 | Met. Plas. Foil 0.047 μ F 250 V | 47-4047-0250 |
| C210 | Elect. 100 μ F 15 V | 50-6100-0015 |
| C211 | Elect. 500 μ F 35 V | 50-6500-0035 |
| C212 | 1000pf Ceramic Disc 1 μ F 400 V | 43-3010-0400 |
| C266 | Elect. 100 μ F 15 V (6 V) | 50-6100-0015 |
| Diodes - | | |
| D201/202 | Germanium Diode AA 132 | 70-1100-0132 |
| D203/204 | Zener Diode BZY85 C6V8 | 72-2211-1628 |
| Integrated Circuits - | | |
| IC201 | Integrated Cct. Amplifier PA237 | 85-6500-0237 |

| Circuit Reference | Description | M.I. Code No. FPP/ |
|-------------------|--|-----------------------|
| Resistors - | | |
| R201 | Carb. Film 1 M Ω + 5% 1/8W | 11-5010-1851 |
| R202 | Carb. Film 4.7 k Ω + 5% 1/8W | 11-3047-1851 |
| R203 | Carb. Film 820 Ω + 5% 1/8W | 11-2820-1851 |
| R204 | Carb. Film 1.5 k Ω + 5% 1/8W | 11-3015-1851 |
| R205 | Carb. Film 12 k Ω + 5% 1/8W | 11-4012-1851 |
| R207 | Carb. Film 560 Ω + 5% 1/8W | 11-2560-1851 |
| R208 | Carb. Film 47 k Ω + 5% 1/8W | 11-4047-1851 |
| R209 | Var. Carb. Film 50 k Ω 1/4W | 20-4050-8103 |
| R210 | Carb. Film 39 k Ω + 5% 1/8W | 11-4039-1851 |
| R211 | Carb. Film 220 Ω + 5% 1/8W | 11-2220-1851 |
| R212 | Carb. Film 560 Ω + 5% 1/8W | 11-2560-1851 |
| R213 | Carb. Film 47 k Ω + 5% 1/8W | 11-4047-1851 |
| R214 | Carb. Film 39 k Ω + 5% 1/8W | 11-4039-1851 |
| R215 | Var. Carb. 10 k Ω Preset 1/8W | 13-4010-1851 |
| R216 | Carb. Film 56 k Ω + 5% 1/8W | 11-4056-1851 |
| R217 | Carb. Film 39 k Ω + 5% 1/8W | 11-4039-1851 |
| R218 | Carb. Film 120 k Ω + 5% 1/8W | 11-4120-1851 |
| R219 | Carb. Film 680 Ω + 5% 1/4W | 11-2680-1451 |
| R220 | Carb. Film 150 Ω + 5% 1/8W | 11-2150-1851 |
| R222 | Carb. Film 33 Ω + 5% 1/4W | 11-2033-1451 |
| R223 | Carb. Film 220 k Ω + 5% 1/8W | 11-4220-1851 |
| R224 | Carb. Film 56 k Ω + 5% 1/8W | 11-4056-1851 |
| R225/226 | Carb. Film 100 k Ω + 5% 1/8W | 11-4100-1851 |
| R227 | Carb. Film 18 k Ω + 5% 1/8W | 11-4018-1851 |
| R228 | Carb. Film 220 k Ω + 5% 1/8W | 11-4220-1851 |
| R229 | Carb. Film 68 k Ω + 5% 1/8W | 11-4068-1851 |
| R230 | Carb. Film 6.8 k Ω + 5% 1/8W | 11-3068-1851 |
| R231 | Carb. Film 100 k Ω + 5% 1/8W | 11-4100-1851 |
| R232 | Var. Carb 50 k Ω Preset 1/8W | 13-4050-1851 |
| R233 | Carb. Film 8.2 k Ω + 5% 1/8W | 11-3082-1851 |
| R280 | Metal Film 82 k Ω 1/8W (S.I. C) | 12-4082-1821 |
| R281 | Metal Film 27 k Ω 1/8W (S.I. C) | 12-4027-1821 |
| R282 | Carb. Film 56 k Ω 1/8W (S.I. C) | 11-4056-1851 |
| R283 | Carb. Film 2.2 k Ω + 5% 1/8W | 11-3022-1851 |
| Switches - | | |
| S201 | Rotary switch 4 position 6 wafer | 61-0604-1201 |
| Transistors - | | |
| TR201 | Silicon N channel FET BF245B | 83-1210-0245 |
| TR202 | Silicon PNP BC212B | 82-1110-0212 |
| TR203 | Silicon NPN BC232B | 81-1110-0232 |
| TR204 | Silicon NPN BC183B | 81-1110-0183 |

MODULATION MONITOR
F.M. - I.F. AMPLIFIER

| | | |
|--------------|---------------------------|--------------|
| Capacitors - | | |
| C213 | Cer. Disc 6.8 22 pF 400 V | 41-1068-0400 |
| C214 | Cer. Disc 22 000 pF 63 V | 43-4022-0063 |
| C215/216 | Styro flex 100 pF 63 V | 46-2100-0063 |

| Circuit Reference | Description | M.I. Code No. FPP/ |
|-----------------------|---|--------------------|
| Capacitors (cont) | | |
| C217 | Cer. Disc 22 000 pF 63 V | 43-4022-0063 |
| C219/220 | Styro flex 100 pF 63 V | 46-2100-0063 |
| C221-223 | Cer. Disc 22 000 pF 63 V | 43-4022-0063 |
| C224 | Cer. Tubular 47 pF 400 V | 42-2047-0400 |
| C225/226 | Styro flex 50 pF 63 V | 46-2050-0063 |
| C227 | Cer. Tubular 47 pF 400 V | 42-2047-0400 |
| C228 | Cer. Disc 3.3 pF 400 V | 41-1033-0400 |
| C229 | Cer. Disc 1000 pF 400 V | 43-3010-0400 |
| C230 | Styro flex 100 pF 63 V | 46-2100-0063 |
| C231 | Cer. Disc 1000 pF 400 V | 43-3010-0400 |
| C232 | Cer. Disc 22 000 pF 63 V | 43-4022-0063 |
| C265 | Cer. Tubular 18 pF 100 V | 42-2018-0100 |
| Diodes - | | |
| D206-209 | Germanium Diode AA138 | 70-1100-0138 |
| Integrated Circuits - | | |
| IC202 | Integrated Cct. Amp CA3053 8043 | 85-5500-3053 |
| Inductors - | | |
| L201 | Input Coil 10.7 MHz | 07-2300-1400 |
| L202 | Intermediate Tuned cct 10.7 MHz | 07-2400-1400 |
| L203 | Discriminator Tuned cct 10.7 MHz | 07-2500-1400 |
| Resistors - | | |
| R234 | Carb. Film 68 Ω \pm 5% 1/4W | 11-2068-1451 |
| R235 | Carb. Film 220 Ω \pm 5% 1/2W | 11-2220-1251 |
| R236 | Carb. Film 68 k Ω \pm 5% 1/8W | 11-4068-1851 |
| R237 | Carb. Film 10 k Ω \pm 5% 1/8W | 11-4010-1851 |
| R238 | Carb. Film 820 Ω \pm 5% 1/8W | 11-2820-1851 |
| R239 | Carb. Film 560 Ω \pm 5% 1/8W | 11-2560-1851 |
| R240/241 | Carb. Film 47 k Ω \pm 5% 1/8W | 11-4047-1851 |
| R242 | Carb. Film 82 k Ω \pm 5% 1/8W | 11-4082-1851 |
| R243 | Var. Carb. 50 k Ω 1/8W | 13-4050-1851 |
| R244 | ^{27Ω} Carb. Film 10 k Ω \pm 5% 1/8W | 11-4010-1851 |
| R245 | Carb. Film 1 k Ω \pm 5% 1/8W | 11-3010-1851 |
| R275 | Carb. Film 100 Ω \pm 5% 1/8W | 11-2100-1851 |
| R276/277 | Carb. Film 15 k Ω \pm 5% 1/8W | 11-4015-1851 |
| Transistors - | | |
| TR208 | Silicon NPN BF311 | 81-120-0311 |

MODULATION MONITOR

A.M. I.F. AMPLIFIER 10.7 MHz

| | | |
|--------------|---|--------------|
| Capacitors - | | |
| C233 | Cer. Disc 1000 pF 400 V | 43-3010-0400 |
| C234/235 | Cer. Disc 22 000 pF 63 V | 43-4022-0063 |
| C236 | Cer. Tubular 68 pF 400 V | 42-4068-0400 |
| C237 | Cer. Disc 22 000 pF 63 V | 43-4022-0063 |
| C238 | Cer. Tubular 100 ²⁷ pF 400 V | 42-2027-0400 |
| C239 | Cer. Tubular 56 pF 400 V | 42-2056-0400 |
| C240 | Cer. Disc 22 000 pF 63 V | 43-4022-0063 |

| Circuit Reference | Description | M.I. Code No. FPP/ |
|-------------------|---|--------------------|
| Capacitors (cont) | | |
| C241 | Met. Plas. Foil 0.1 μ F 250 V | 47-4100-0250 |
| C242 | Styro 100 pF 100 V | 46-2100-0100 |
| C243-246 | Cer. Disc 22 000 pF 63 V | 43-4022-0063 |
| C245 | - 11- 0.1 μ F 63 V | |
| Diodes - | | |
| D210 | Germanium Diode AA138 | 70-1100-0138 |
| Inductors - | | |
| L205/206 | Ferrite Cored Choke 6 μ H | 07-2000-1400 |
| L208 | Choke 25 μ H | 07-2100-1400 |
| L209 | Tuned Circuit 10.7 MHz | 07-2200-1400 |
| Resistors - | | |
| R246 | Carb. Film 1 k Ω \pm 5% 1/8W | 11-3010-1851 |
| R247 | Carb. Film 680 Ω \pm 5% 1/8W | 11-2680-1851 |
| R248 | Carb. Film 3.9 k Ω \pm 5% 1/8W | 11-3039-1851 |
| R249 | Carb. Film 1.5 k Ω \pm 5% 1/8W | 11-3015-1851 |
| R250 | Carb. Film 4.7 k Ω \pm 5% 1/8W | 11-3047-1851 |
| R251 | Carb. Film 5.6 k Ω \pm 5% 1/8W | 11-3056-1851 |
| R252 | Carb. Film 680 Ω \pm 5% 1/8W | 11-2680-1851 |
| R253 | Carb. Film 1.8 k Ω \pm 5% 1/8W | 11-3018-1851 |
| R254 | Carb. Film 27 k Ω \pm 5% 1/8W | 11-4027-1851 |
| R255 | Var. Carb. 10 k Ω 1/8W Preset | 13-4010-1851 |
| R256 | Carb. Film 33 k Ω \pm 5% 1/8W | 11-4033-1851 |
| R257 | Var. Carb. 50 k Ω 1/8W Preset | 13-4050-1851 |
| R258 | Carb. Film 15 k Ω \pm 5% 1/8W | 11-4015-1851 |
| R278 | Carb. Film 8.2 k Ω \pm 5% 1/8W | 11-3082-1851 |
| Transistors - | | |
| TR210 | Silicon NPN BF196 | 81-1200-0196 |
| TR211 | Silicon NPN BF197 | 81-1200-0197 |

MODULATION MONITOR
OSCILLATOR

| | | |
|--------------|---|--------------|
| Capacitors - | | |
| C250 | Cer. Tubular 15 pF 400 V | 42-2015-0400 |
| C251 | Cer. Disc 3.3 pF 400 V | 41-1033-0400 |
| C252 | Cer. Tubular 39 pF (S.I.C) 400 V | 42-2039-0400 |
| C253-254 | Cer. Disc 0.6 pF 400 V | 41-1006-0400 |
| C255 | Cer. Disc 6.8 pF 400 V | 41-1068-0400 |
| C256 | Cer. Disc 3.3 pF 400 V | 41-1033-0400 |
| C257 | Cer. Tubular 15 pF 400 V | 42-2015-0400 |
| C258-262 | Feed thro' 1000 pF 400 V | 49-3010-0400 |
| C263 | Cer. Tubular 18 pF 400 V | 42-2018-0400 |
| Diodes - | | |
| D212-213 | Varactor BB105 | 73-2400-0105 |
| Inductors - | | |
| L210 | Coil (9 turns, 1 mm silver wire on 6 mm former) | 07-1600-2000 |
| L211 | Coil (3 turns, 1 mm silver wire on 6 mm former) | 07-1700-2000 |

Circuit
Reference

Description

M.I. Code No.
FPP/

Resistors -

| | | |
|----------|---|--------------|
| R262 | Carb. Film 390 Ω \pm 5% 1/8W | 11-2390-1851 |
| R263-264 | Carb. Film 8.2 k Ω \pm 5% 1/8W | 11-3082-1851 |
| R265 | Carb. Film 390 Ω \pm 5% 1/8W | 11-2390-1851 |
| R266 | Carb. Film 1.5 k Ω \pm 5% 1/8W | 11-3015-1851 |
| R267 | Carb. Film 5.6 k Ω \pm 5% 1/8W | 11-3056-1851 |
| R268-269 | Carb. Film 150 Ω \pm 5% 1/8W | 11-2150-1851 |
| R270 | Carb. Film 820 Ω \pm 5% 1/8W | 11-2820-1851 |
| R271 | Var. Carb. Film 10 k Ω 1/2W | 21-4010-1201 |

Transistors -

| | | |
|-------|------------------------------|--------------|
| TR213 | Silicon N channel FET BF256B | 83-1210-0256 |
| TR214 | Silicon N channel FET BF256B | 83-1210-0256 |
| TR215 | Silicon NPN TIS18 | 81-4400-0018 |

SIGNAL GENERATOR
OSCILLATOR

Capacitors -

| | | |
|------------|-------------------------------------|--------------|
| C301-303 | Cer. Feed thro' 1000 pF 400 V | 49-3010-0400 |
| C304 | Cer. Disc 1000 pF 400 V | 43-3010-0400 |
| C305 | Met. Plast. Foil 0.47 μ F 100 V | 47-4470-0100 |
| C306-309 | Cer. Feed thro' 1000 pF 400 V | 49-3010-0400 |
| C310 | Cer. Tubular 47 pF 400 V | 42-2047-0400 |
| C311 | Cer. Disc 1000 pF 400 V | 43-3010-0400 |
| C315 | Cer. Feed thro' 4700 pF 400 V | 48-3047-0400 |
| C316 - 317 | Cer. Feed thro' 1000 pF 400 V | 43-3010-0400 |
| C318 | Cer. Feed thro' 4700 pF 400 V | 48-3047-0400 |
| C319-320 | Cer. Feed thro' 1000 pF 400 V | 43-3010-0400 |
| C321 | Cer. Feed thro' 4700 pF 400 V | 48-3047-0400 |
| C322-326 | Cer. Feed thro' 1000 pF 400 V | 43-3010-0400 |
| C327-328 | Cer. Feed thro' 4700 pF 400 V | 48-3047-0400 |
| C329-338 | Cer. Feed thro' 1000 pF 400 V | 43-3010-0400 |
| C339 | Cer. Tubular 15 pF 400 V | 42-2015-0400 |
| C340 | Cer. Disc 3.9 pF 400 V | 41-1039-0400 |
| C341 | Cer. Disc 2.2 pF 400 V | 41-1022-0400 |
| C342-343 | Cer. Tubular 1000 pF 400 V | 44-3010-0400 |
| C344 | Var. Neuwirth 2-12 pF | 08-2000-0012 |
| C345-346 | Trimmer Neuwirth 0.3 - 1 pF | 08-3000-0001 |
| C347 | Cer. Disc 3.9 pF 400 V | 41-1039-0400 |
| C348 | Cer. Tubular 15 pF 400 V | 42-2015-0400 |
| C349 | Cer. Disc 5.6 pF 400 V | 41-1056-0400 |
| C350 | Cer. Disc (SIC) 2.2 pF 400 V | 41-1022-0400 |
| C351 | Trimmer Tubular 0.6 - 6 pF | 07-3600-1500 |
| C352 | Cer. Disc 5.6 pF 400 V | 41-1056-0400 |
| C353 | Cer. Disc 5.6 6.8 pF 400 V | 41-1068-0400 |
| C354-355 | Cer. Disc 1000 pF 400 V | 43-3010-0400 |
| C356 | Trimmer Neuwirth 0.3 - 1 pF | 08-3000-0001 |
| C357/358 | Cer disc, 22,000pf 63V | |

Diodes -

| | | |
|------|-----------------------|--------------|
| D301 | Varactor BB105 | 73-2400-0105 |
| D302 | Varactor BB105 | 73-2400-0105 |
| D303 | Varactor BB105 | 73-2400-0105 |
| D304 | Germanium Diode AA138 | 70-1100-0138 |

C359

C306

C307-309

Tantal 47pF/63V

Cer disc 1000pf/400V

Cer disc 22000 pf/400V

Circuit Reference

Description

M.I. Code No. FPP/

Filter -
FL301

Aerial Filter "Hirschmann"

07-1100-2100

Inductors -

L301
L302
L303
L304
L305
L306
L307-318 *319*

Choke, air cored, 4 turns, 4 mm dia.
Choke, air cored, 4 turns, 4 mm dia.
Osc. output coupling coil
Osc. coil
Osc. coil
Collector coil
Choke 6 μ H

07-1200-1900
07-1200-1900
07-1300-1900
07-1400-1900
07-2600-1400
07-2700-1400
07-2000-1400

Resistors -

R301
R302
R303
R304
R305
R306
R307
R308/309
R310
R311
R312
R313
R314
R315
R316
R317
R318
R319
R325
R326 (a + b)
R327
R328
R329
R330
R331
R332
R333
R334
R335
R336
R337
R338
R339/340
R341
R342
R343
R344
R345
R346
~~R347/348~~
~~R349~~
R347
R349
R350/351
R352/353
R354
R355
R356

Carb. Film 3.3 k Ω \pm 5% 1/8W
Carb. Film 100 k Ω \pm 5% 1/8W
Carb. Film 33 Ω \pm 5% 1/8W *39 Ω*
Carb. Film 180 Ω \pm 5% 1/8W
Carb. Film 27 k Ω \pm 5% 1/8W
Carb. Film 390 Ω \pm 5% 1/8W
Carb. Film 47 k Ω \pm 5% 1/8W *100k*
Var. Carb. 10 k Ω 1/4W
Carb. Film 220 k Ω \pm 5% 1/8W
Carb. Film 1 M Ω \pm 5% 1/8W
Carb. Film 220 k Ω \pm 5% 1/8W
Carb. Film 1 M Ω \pm 5% 1/8W
Carb. Film 33 Ω \pm 5% 1/8W *39 Ω*
Carb. Film 180 Ω \pm 5% 1/8W
Carb. Film 15 k Ω \pm 5% 1/8W
Carb. Film 5.6 k Ω \pm 5% 1/8W
Carb. Film 100 Ω \pm 5% 1/8W
Carb. Film 120 Ω \pm 5% 1/8W
Carb. Film 2.7 k Ω \pm 5% 1/8W
Var. Dual 2 x 10 k Ω 1/2W
Carb. Film 10 k Ω \pm 5% 1/8W
Carb. Film 18 k Ω \pm 5% 1/8W
Carb. Film 18 k Ω \pm 5% 1/8W
Carb. Film 390 Ω \pm 5% 1/8W
Carb. Film 15 Ω \pm 5% 1/8W
Carb. Film 390 Ω \pm 5% 1/8W
Carb. Film 18 k Ω \pm 5% 1/8W
Carb. Film 680 Ω \pm 5% 1/8W *560 Ω*
Carb. Film 330 Ω \pm 5% 1/8W
Carb. Film 5.6 k Ω \pm 5% 1/8W
Carb. Film 2.2 k Ω \pm 5% 1/8W *1.5 k Ω*
Carb. Film 18 k Ω \pm 5% 1/8W
Carb. Film 1.8 k Ω \pm 5% 1/8W
Carb. Film 22 Ω \pm 5% 1/8W
Carb. Film 33 Ω \pm 1% 1/8W
Carb. Film 297 Ω \pm 1% 1/8W
Carb. Film 36.6 Ω \pm 1% 1/8W
Carb. Film 297 Ω \pm 1% 1/8W
Carb. Film 66 Ω \pm 1% 1/8W
Carb. Film (SIC) 6.8 k Ω - 22 k Ω
Carb. Film (SIC) 100 Ω - 3.3 k Ω
carb film 68k \pm 5%
Var. carb. 5k
Var carb 10k
Var Carb 25k
carb film 10k
carb film 47k
carb film 1.8k

11-3033-1851
11-4100-1851
11-2033-1851
11-2180-1851
11-4027-1851
11-2390-1851
11-4047-1851
14-4010-1451
11-4220-1851
11-5010-1851
11-4220-1851
11-5010-1851
11-2033-1851
11-2180-1851
11-4015-1851
11-3056-1851
11-2100-1851
11-2120-1851
11-3027-1851
23-4010-1202
11-4010-1851
11-4018-1851
11-4018-1851
11-2390-1851
11-2015-1851
11-2390-1851
11-4018-1851
11-2680-1851
11-2330-1851
11-3056-1851
11-3022-1851
11-4018-1851
11-3018-1851
11-2022-1851
11-2033-1851
11-2297-1811
11-7366-1811
11-2297-1811
11-2066-1811
SIC
SIC

| Circuit Reference | Description | M.I. Code No. FPP/ |
|-----------------------|---|--------------------|
| Switches - | | |
| S301 | Rotary switch 4 position 4 wafer | 61-0404-1201 |
| S302 | Co-axial 2 position 1 pole | 61-0102-0000 |
| Transistors - | | |
| TR301-302 | N channel MOS FET 3N140 | 84-3300-0140 |
| TR303 | Silicon NPN 2N5179 | 81-2300-5179 |
| TR304 | Silicon N channel FET 2N4416 | 83-2300-4416 |
| TR305 | Silicon N channel FET BF256B | 83-1210-0256 |
| TR306 | Silicon NPN TIS18 <i>2N5179 (2w 5179??)</i> | 81-4400-0018 |
| MAIN CHASSIS ASSEMBLY | | |
| Batteries - | | |
| B401 | Battery Dryfit PC 3Bx3F 6 V 1.8 Ah | 07-2900-1400 |
| B402 | Battery Dryfit PC 3Bx3F 6 V 1.8 Ah | 07-2900-1400 |
| B403 | Battery Dryfit PC 3Bx3F 6 V 1.8 Ah | 07-2900-1400 |
| Capacitors - | | |
| C401 | Met. Plas. foil 1.5 μ F 100 V | 47-5015-0100 |
| C402/403 | Cer. Disc. 3,900 pF 150 V A. C. | 43-3039-0250 |
| C404 | Met. Plas. foil 0.47 μ F 100 V | 47-4470-0100 |
| C405 | Met. Plas. foil 0.1 μ F 400 V | 47-4100-0400 |
| C406 | Elect. Cond 100 μ F 15 V | 50-6100-0015 |
| Diodes - | | |
| D401 | Zener Diode BZY85 C6V8 | 72-2211-1628 |
| D402 | Germanium Diode AA132 | 70-1100-0132 |
| Fuse - | | |
| FS401 | Fuse | 07-3500-1400 |
| Inductors - | | |
| L401 | Choke Ferrite cored 6 μ H | 07-2000-1400 |
| L402 | Choke Ferrite cored 6 μ H | 07-2000-1400 |
| Lamps - | | |
| LP401/402 | Pilot Lamp Red 24 V 20 mA | 09-2400-0020 |
| Loudspeaker - | | |
| LS401 | Loudspeaker 8 Ω $\frac{1}{2}$ W | 07-3400-1400 |
| Meters - | | |
| M401 | Meter UDSSp 40 μ A | 07-3000-1400 |
| M402 | Meter UDSSp 40 μ A <i>P45 + 40 μA</i> | 07-3000-1400 |
| Resistors - | | |
| R401-403 | Metal Film 220 Ω \pm 2% 1/8W | 12-2220-1821 |
| R404 | Metal Film 270 Ω \pm 2% 1/8W | 12-2270-1821 |
| R405 | Metal Film 330 Ω \pm 2% 1/8W | 12-2330-1821 |
| R406 | H.F. Voltage divider 60 Ω $\frac{1}{2}$ W | 24-2050-1601 |
| R407 | Var. Carb. Film 1 k Ω $\frac{1}{2}$ W | 21-3010-1201 |
| R408 | Carb. Film 2.2 k Ω \pm 5% 1/8W | 11-3022-1851 |
| R409 | Carb. Film 2.7 k Ω \pm 5% 1/8W | 11-3027-1851 |
| R410 | Var. Carb. Film 2.5 k Ω | 21-3025-0901 |

| Circuit Reference | Description | M.I. Code No. FPP/ |
|-------------------|--|-----------------------|
| Resistors (cont) | | |
| R411 | Carb. Film $2.2 \text{ k}\Omega \pm 5\%$ 1/8W | 11-3022-1851 |
| R412 | Var. Carb. Film $1 \text{ k}\Omega \frac{1}{2}\text{W}$ | 21-3010-0901 |
| R413 | Carb. Film $470 \Omega \pm 5\%$ 1/8W | 11-2470-1851 |
| R414 | Var. Carb. Film $1 \text{ k}\Omega \frac{1}{2}\text{W}$ | 21-3010-0901 |
| R415 | Met. Film $47 \Omega \pm 2\%$ 1/8W | 12-2047-1821 |
| R416 | Met. Film $390 \Omega \pm 2\%$ 1/8W <i>470 Ω</i> | 12-2390-1821 |
| R417 | Met. Film $47 \Omega \pm 2\%$ 1/8W | 12-2047-1821 |
| R418/419 | Met. Film $390 \Omega \pm 2\%$ 1/8W | 12-2390-1821 |
| R420 | Met. Film $47 \Omega \pm 2\%$ 1/8W | 12-2047-1821 |
| R421 | Carb. Film $390 \Omega \frac{1}{2}\text{W}$ | 11-2390-1251 |
| R422 | Metal Film $330 \Omega \pm 2\%$ 1/8W | 12-2330-1821 |
| R423 | Metal Film $1.5 \text{ k}\Omega \pm 2\%$ 1/8W | 12-3015-1821 |
| R424 | Metal Film $270 \Omega \pm 2\%$ 1/8W | 12-2270-1821 |
| R425 | Var. Carb. $1 \text{ k}\Omega$ Preset 1/8W | 13-3010-1851 |
| R426 | Var. Carb. $10 \text{ k}\Omega$ Preset 1/8W | 13-4010-1851 |
| R427 | Carb. Film $15 \text{ k}\Omega \pm 5\%$ 1/8W | 11-4015-1851 |
| R428 | Var. Carb. 250Ω Preset 1/8W | 13-2250-1851 |
| R429 | Carb. Film $220 \Omega \pm 5\%$ 1/8W | 11-2220-1851 |
| R430 | Carb. Film $12 \text{ k}\Omega \pm 5\%$ 1/8W | 11-4012-1851 |
| R431 | Carb. Film $47 \text{ k}\Omega \pm 5\%$ 1/8W <i>68k</i> | 11-4047-1851 |
| R432 | Var. Carb. $10 \text{ k}\Omega$ Preset 1/8W <i>50k</i> | 13-4010-1851 |
| R433 | Metal Film $100 \Omega \pm 2\%$ 1/8W | 12-2100-1821 |
| R434 | Metal Film $220 \Omega \pm 2\%$ 1/8W | 12-2220-1821 |
| R435 | Metal Film $680 \Omega \pm 2\%$ 1/8W | 12-2680-1821 |
| R436 | Metal Film $2.2 \text{ k}\Omega \pm 2\%$ 1/8W | 12-3022-1821 |
| R437 | Metal Film $6.8 \text{ k}\Omega \pm 2\%$ 1/8W | 12-3068-1821 |
| R438 | Metal Film $22 \text{ k}\Omega \pm 2\%$ 1/8W | 12-4022-1821 |
| R439 | Metal Film $68 \text{ k}\Omega \pm 2\%$ 1/8W | 12-4068-1821 |
| R440 | Carb. Film $2.2 \text{ k}\Omega \pm 5\%$ 1/8W | 11-3022-1851 |
| R441 | Var. Carb. Film $1 \text{ k}\Omega \frac{1}{2}\text{W}$ | 21-3010-0901 |
| R442 | Carb. Film $1 \text{ k}\Omega \pm 5\%$ 1/8W | 12-3010-1821 |
| R443 | Var. Carb. Film $1 \text{ k}\Omega \frac{1}{2}\text{W}$ | 21-3010-0901 |
| R444 | Carb. Film $100 \Omega \pm 5\%$ 1/8W | 11-2100-1851 |
| R445 | Carb. Film $820 \Omega \pm 5\%$ 1/8W | 11-2820-1851 |
| R446 | Var. Carb. Film (with S408) $50 \text{ k}\Omega \frac{1}{2}\text{W}$ | 22-4050-0701 |
| R447 | Carb. Film $470 \Omega \pm 5\%$ 1/8W | 11-2470-1851 |
| R448 | Metal Film $4.7 \text{ k}\Omega \pm 2\%$ 1/8W | 12-3047-1821 |
| R449 | Var. Carb. $5 \text{ k}\Omega$ Preset 1/8W | 13-3050-1851 |
| Switches - | | |
| S401 | Switch, Rotary 3 position 5 wafer | 61-0603-1201 |
| S402 | Switch, Rotary 7 position 1 wafer | 61-0107-1201 |
| S403 | Switch, Rotary 5 position 4 wafer | 61-0405-0801 |
| S405 | Switch, Toggle 2 pole 2 throw | 64-0202-0000 |
| S405 | Switch, Rotary 10 position 3 wafer | 62-0310-1201 |
| S406 | Switch, Rotary 3 position 3 wafer | 61-0303-0301 |
| S407 | Switch, Toggle 2 pole 2 throw | 64-0202-0000 |
| S048 | Switch GANGED to R446 | 22-4050-0701 |
| Sockets - | | |
| SK401 | Mains input socket | 07-3200-1400 |
| SK402 | BNC socket | 07-3300-1400 |
| SK403-405 | Terminals 1 x insulated 1 x earthed | 07-3400-1400 |
| SK406-409 | BNC socket | 07-3300-1400 |

| Circuit Reference | Description | M.I. Code No. FPP/ |
|--------------------|--|--------------------|
| Transformer - T401 | Mains transformer Pri 110/220 V 350 mA Sec 25/28 V | 07-2800-1400 |

R.F. POWER METER

Capacitors -

| | | |
|----------|-------------------------------|--------------|
| C501/502 | Cer. Disc. 3.3 pF 400 V | 41-1033-0400 |
| C503/504 | Cer. Feed thro' 1000 pF 400 V | 43-3010-0400 |
| C505/506 | Tubular 25 pF (Nom.) 400 V | 42-2025-0400 |
| C507/508 | Cer. Tubular 68 pF 400 V | 42-2068-0400 |
| C509/510 | Cer disc 6.8 pf 400V | |

Diodes -

| | | |
|----------|-----------------------|--------------|
| D501-504 | Germanium Diode AA138 | 70-1100-0138 |
|----------|-----------------------|--------------|

Resistors -

| | | |
|----------|--|--------------|
| R501/502 | Carb. Film 100 Ω \pm 5% 1/3W | 11-2100-1351 |
| R503/504 | Carb. Film 150 Ω \pm 5% 1/8W | 11-2100-1851 |
| R505/506 | Carb. Film 4.7k Ω \pm 5% 1/8W 22k | 11-3047-1851 |
| R507/508 | Carb. Film 47 k Ω \pm 5% 1/8W | 11-4047-1851 |
| R509/510 | Var. Carb. 50 k Ω Preset 1/8W 25k | 14-4050-1851 |
| R511/512 | Carb. Film 100 Ω \pm 5% 1/3W | 11-2100-1351 |
| R513/514 | Carb. Film 4.7k Ω \pm 5% 1/8W 22k | 11-3047-1851 |
| R515/516 | Carb. Film 47 k Ω \pm 5% 1/8W | 11-4047-1851 |
| R517/518 | Var. Carb. 50 k Ω Preset 1/8W 25k | 14-4050-1851 |
| R519 | Carb. Film 50 Ω \pm 2% 10 W | 11-2050-1021 |

R520/821

Carb film 100 Ω \pm 5% 3W

L 505/506

choke air cored 12 turns on resistors

CIRCUIT NOTES

1. ARRANGEMENT

The inter unit wiring diagram Fig. 7.1 shows all sub-assembly units

2. VOLTAGES

Printed in italics. Signal voltage are suffixed by the abbreviation "pp" meaning peak to peak value

D.C. voltages are relative to chassis unless otherwise indicated.

4. SYMBOLS

Test point 2



Signal path

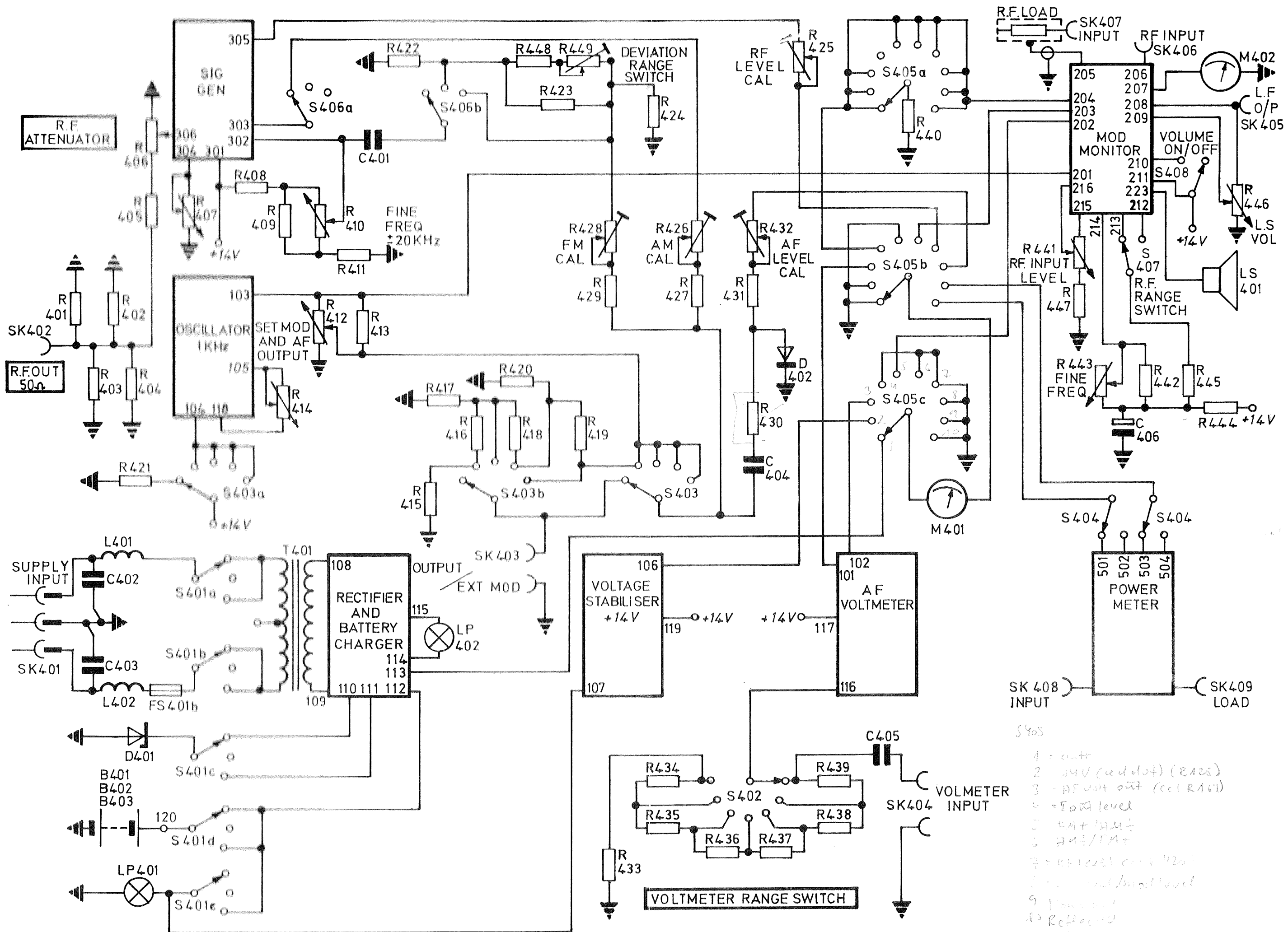


Front panel marking



Boxed circuitry indicates electrical screen





S405
 1 = 600Ω
 2 = 10V (red dot) (R125)
 3 = AF Volt out (cc1 R167)
 4 = 500Ω level
 5 = FM+AM±
 6 = AM±/FM±
 7 = RF level out (R251)
 8 = 100Ω level/100Ω level
 9 = 100Ω out
 10 = Ref. out

Fig. 7.1 Inter-Unit Wiring Circuit Diagram

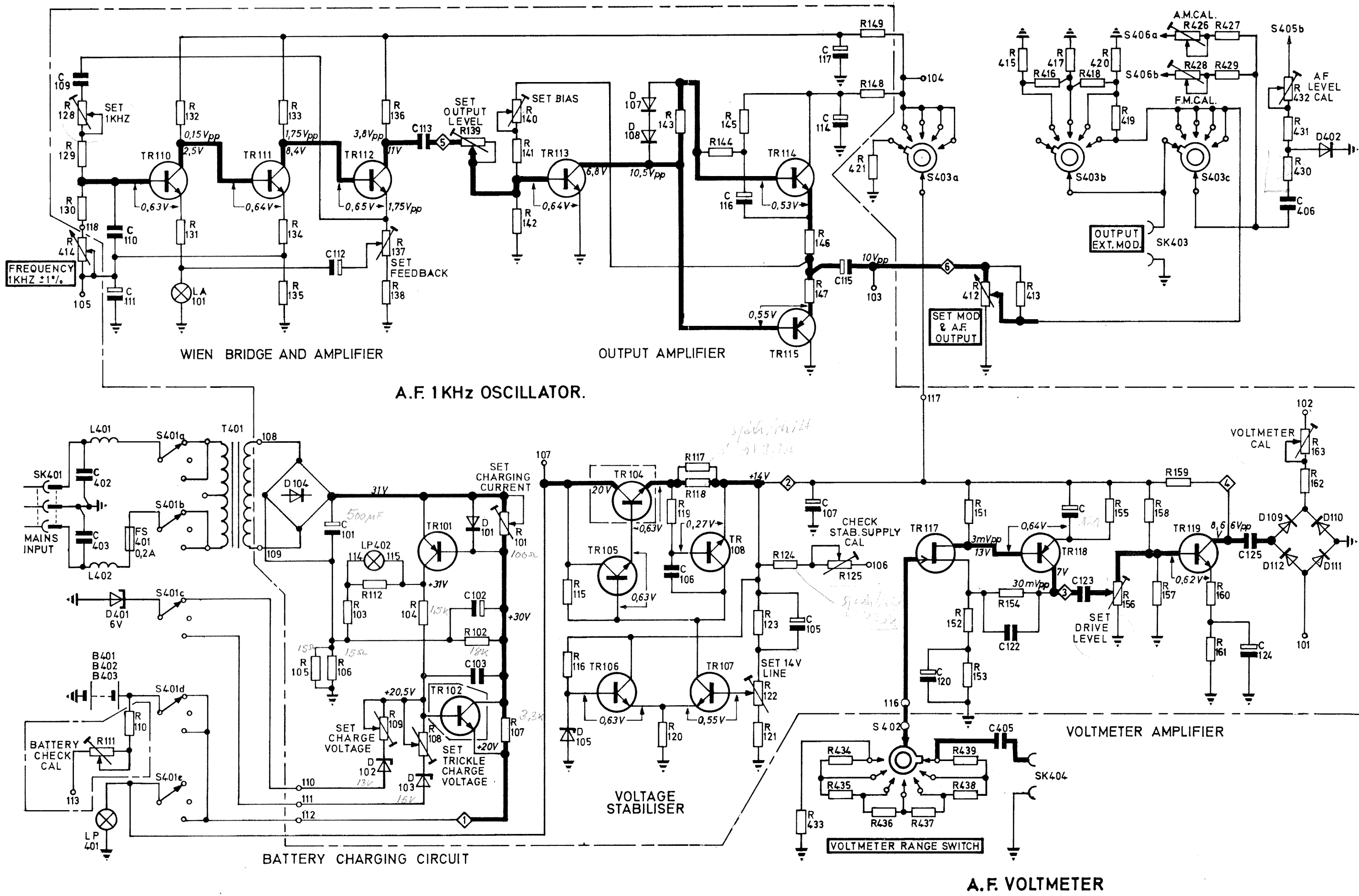


Fig. 7.2 Power Supply, A.F. 1 kHz Oscillator, A.F. Voltmeter Circuit Diagram

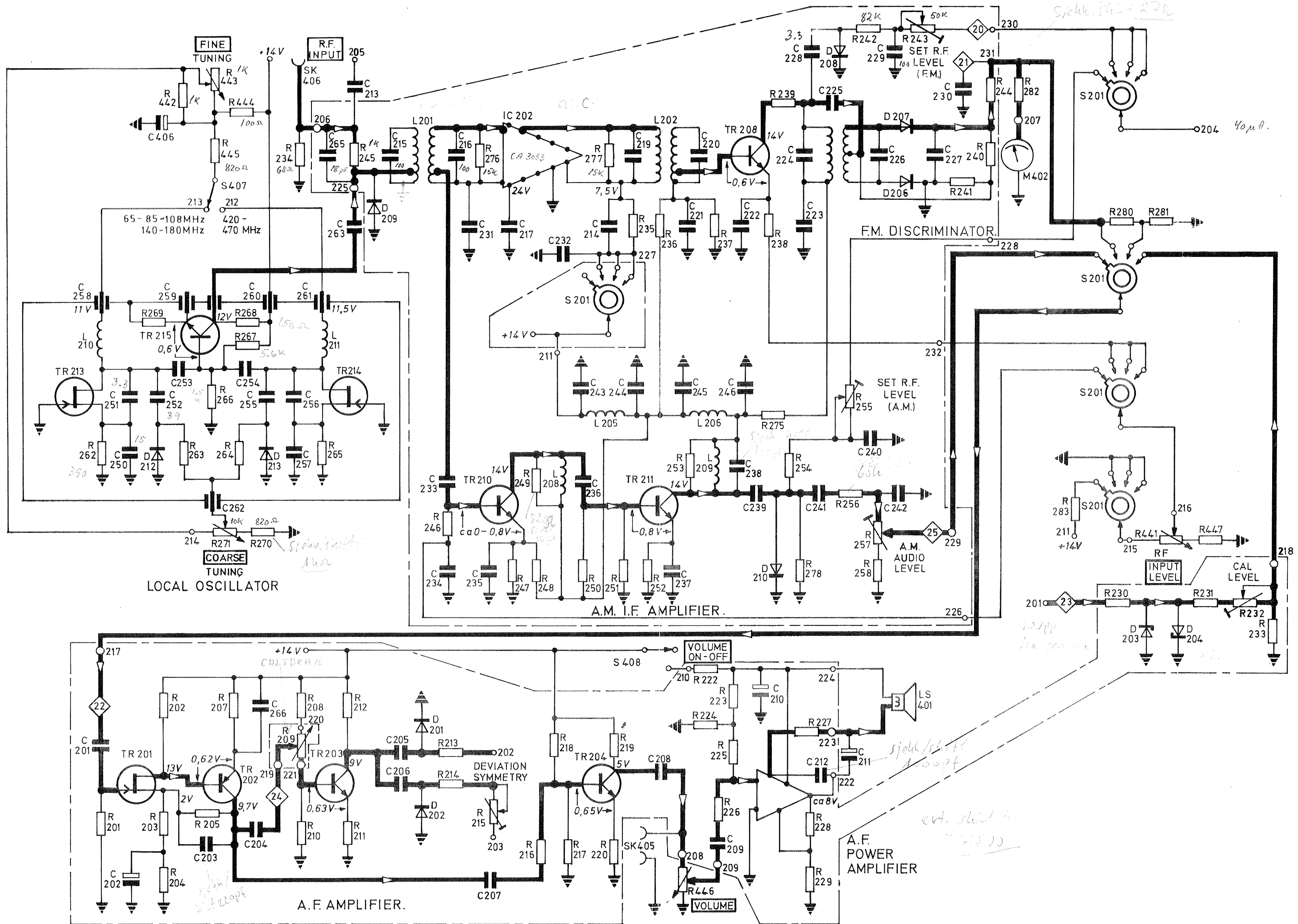


Fig. 7.3 Modulation Monitor Circuit Diagram

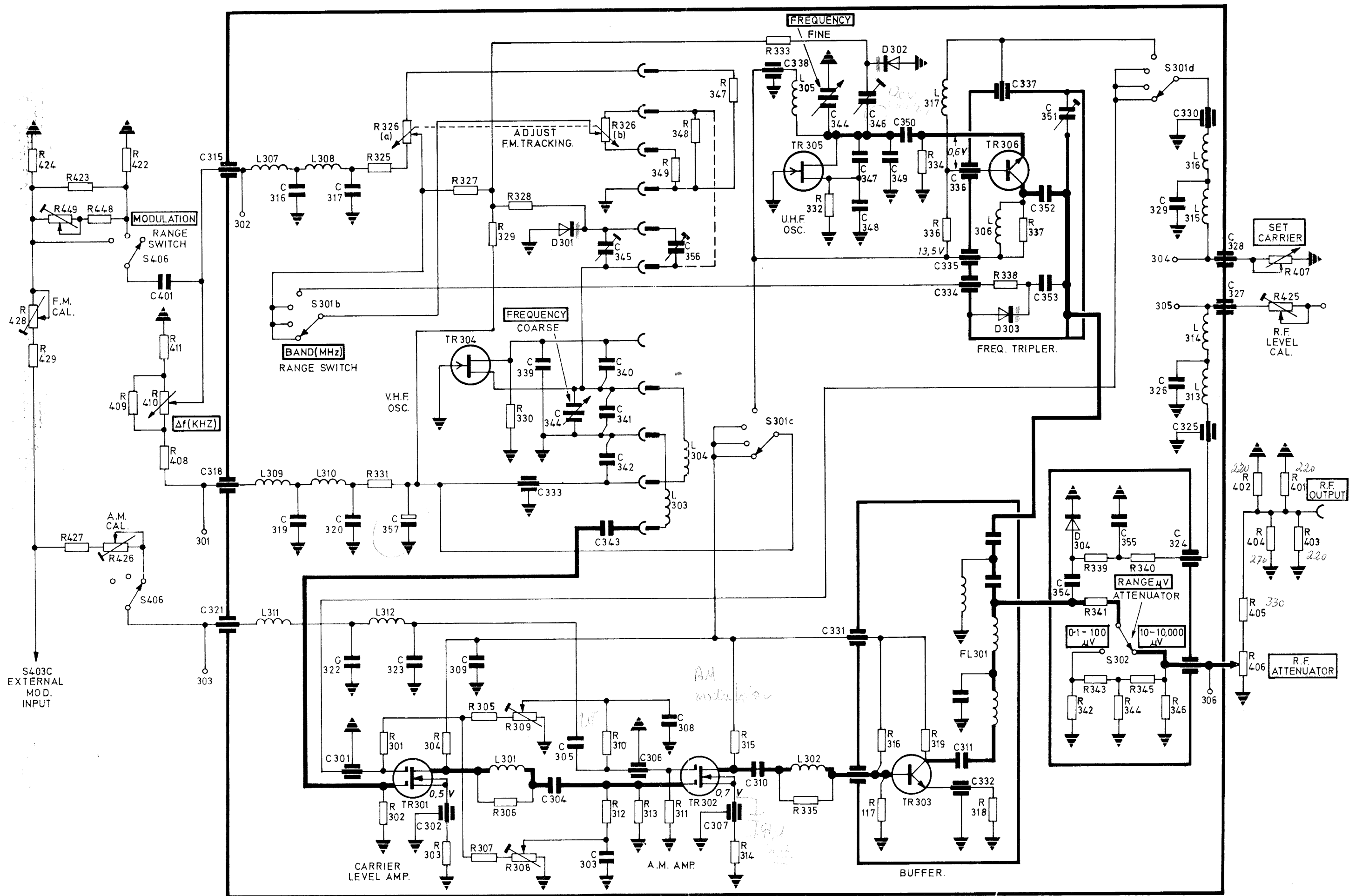


Fig. 7.4 VHF/UHF AM/FM Signal Generator Circuit Diagram

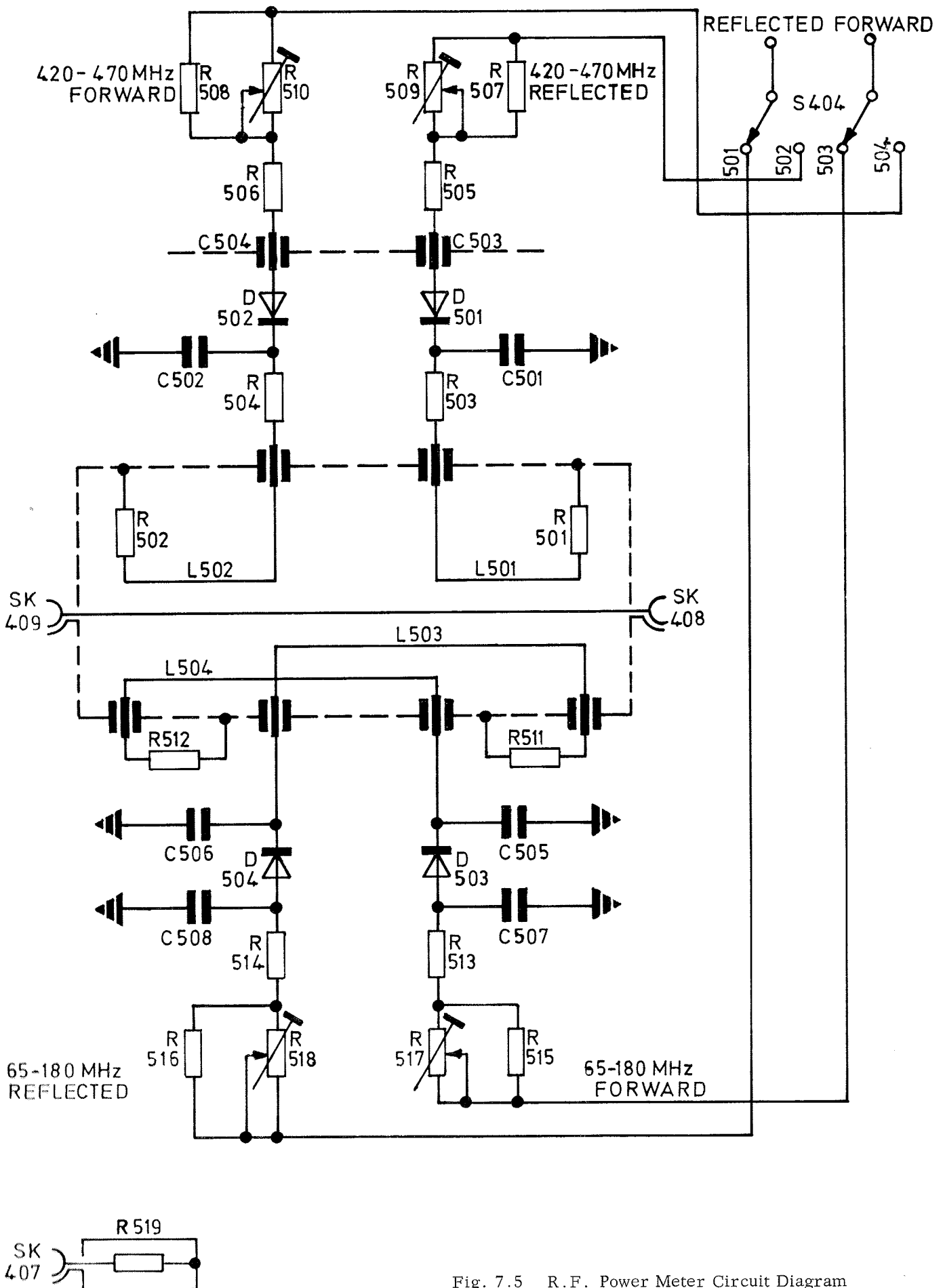


Fig. 7.5 R.F. Power Meter Circuit Diagram

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WORLD-WIDE REPRESENTATION

MANUAL CHANGES
for
MOBILE RADIO TEST SET TF 2950

Changes and errata - The following changes refer to current production. For maintenance purposes the type called for in the original handbook may be used.

- Page 24 FIG 5. 1 POWER SUPPLY AND VOLTAGE STABILISER
Amend circuit reference numbers as follows -
- D102 to read D103
 - D103 to read D102
 - R109 to read R108 and change title to read -
SET TRICKLE CHARGE VOLTAGE
 - R108 to read R109 and change title to read -
SET CHARGE VOLTAGE
- Page 27 Amend description of D104 to read -
Selen. Rect. B30C 450/700
Amend value of R117/118 to 3.3 Ω
- Page 28 Change value and code number of R124 as follows -
470 k Ω 11-4470-1851
Amend description of R136 to read -
Carb. Film
- Page 29 Change value and code number of C203 as follows -
220 pF 46-2220-0100
Change value of C212 as follows -
1000 pF
- Page 30 Amend value of C213 to read -
6.8 pF
- Page 31 Change type/value and code numbers of the following components -
- | | | |
|-------|------------------------|--------------|
| IC202 | CA3043 | 85-5500-3043 |
| R244 | 27 Ω | 11-4027-1851 |
| C238 | Styroflex 100 pF 100 V | 46-2100-0400 |
- Page 32 Add C245 after C243-246 as follows -
C245 Cer. Disc 0.1 μ F 63 V 43-4100-0063
Change values and code numbers of the following components
- | | | |
|------|---------------|--------------|
| R249 | 820 Ω | 11-2820-1851 |
| R256 | 68 k Ω | 11-4068-1851 |

Page 33 Change type/value and code numbers of the following components -

| | | |
|--------------------------|-------------------------|--------------|
| R270 | 1 k Ω | 11-3010-1851 |
| C301-303 | Cer. Disc 22 000 pF | 43-4022-0063 |
| C305 | 1 μ F | 47-5010-0100 |
| C353 | 5.6 pF | 41-1056-0400 |
| Delete C306-309 and C310 | | |
| Add - | | |
| C357/358 | Cer. Disc 22000 pF 63 V | 43-4022-0063 |
| C359 | Tantalum 47 μ F 6 V | 50-6047-0006 |
| C306 | Cer. Disc 1000 pF 400 V | 43-3010-0400 |
| C307-309 | Cer. Disc 22000 pF 63 V | 43-4022-0063 |

Page 34. Change L307-318 to read L307-319
Change values and code numbers of the following components

| | | |
|--------------------------|---|--------------|
| R303 | 39 Ω | 11-2039-1851 |
| R307 | 100 k | 11-4100-1851 |
| R314 | 39 Ω | 11-2039-1851 |
| R334 | 560 Ω | 11-2560-1851 |
| R337 | 1.5 k Ω | 11-3015-1851 |
| Delete R347/348 and R349 | | |
| Add - | | |
| R347 | Carb Film 68 k Ω + 5% $\frac{1}{8}$ W | 11-3068-1851 |
| R349 | Var. Carb 5 k Ω $\frac{1}{4}$ W | 14-3050-1451 |
| R350/351 | Var. Carb 10 k Ω $\frac{1}{4}$ W | 14-4010-1451 |
| R352/353 | Var. Carb 25 k Ω $\frac{1}{4}$ W | 14-4025-1451 |
| R354 | Carb Film 10 k Ω + 5% $\frac{1}{8}$ W | 11-4010-1851 |
| R355 | Carb Film 4.7 k Ω + 5% $\frac{1}{8}$ W | 11-3047-1851 |
| R356 | Carb Film 1.8 k Ω + 5% $\frac{1}{8}$ W | 11-3018-1851 |

Page 35 Change TR 306 type and code number as follows -

| | | |
|--|------------------------|--------------|
| TR306 | Silicon NPN 2W5179 | 81-2300-5179 |
| Amend description of C402/403 to read - | | |
| C402/403 Cer. Disc. 3,900 pF 250 V a.c. | | |
| Amend type and code number of M402 to read - | | |
| M402 | Meter P45 + 40 μ A | 07-3100-1400 |

Page 36 Change value and code numbers of the following components

| | | |
|-------------|---------------|--------------|
| R416 | 470 Ω | 12-2470-1821 |
| R431 | 68 k Ω | 11-4068-1851 |
| R432 | 50 k Ω | 13-4050-1851 |
| Delete R430 | | |

Page 37 Change values and code numbers of the following components

| | | |
|---------------------------|--|--------------|
| R505/506 | 22k Ω | 11-4022-1851 |
| R509/510 | 25 k Ω | 14-4025-1451 |
| R513/514 | 22 k Ω | 11-4022-1851 |
| R517/518 | 25 k Ω | 14-4025-1451 |
| Delete R507/508, R515/516 | | |
| Add- | | |
| C509/510 | Cer. Disc 6.8 pF 400 V | 41-1068-0400 |
| R520/521 | Carb. Film 100 Ω + 5% $\frac{1}{3}$ W | 11-2100-1351 |
| L505/506 | Choke air cored $\overline{12}$ turns of resistors | 07-1210-1900 |

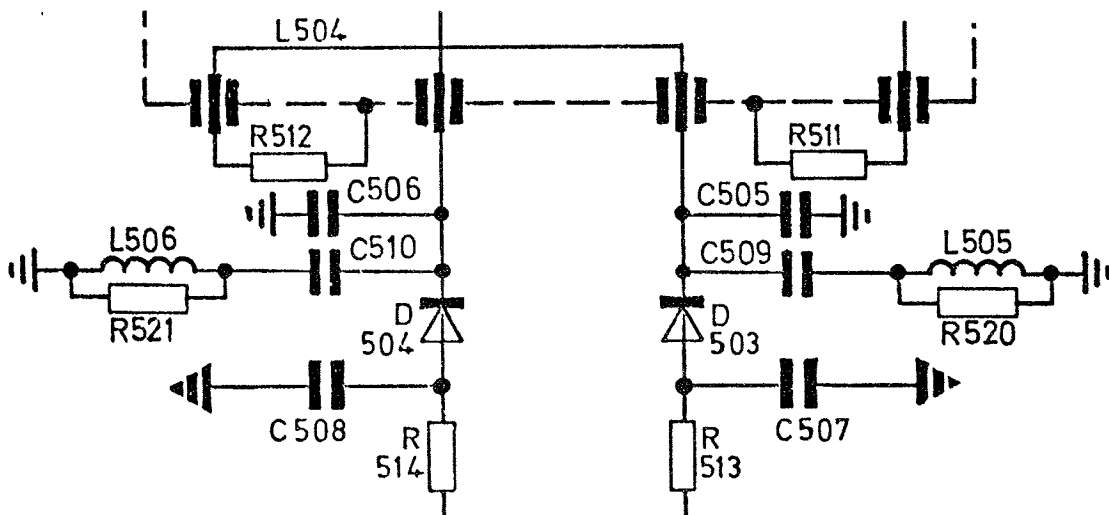
FIG 7.1 Delete R430

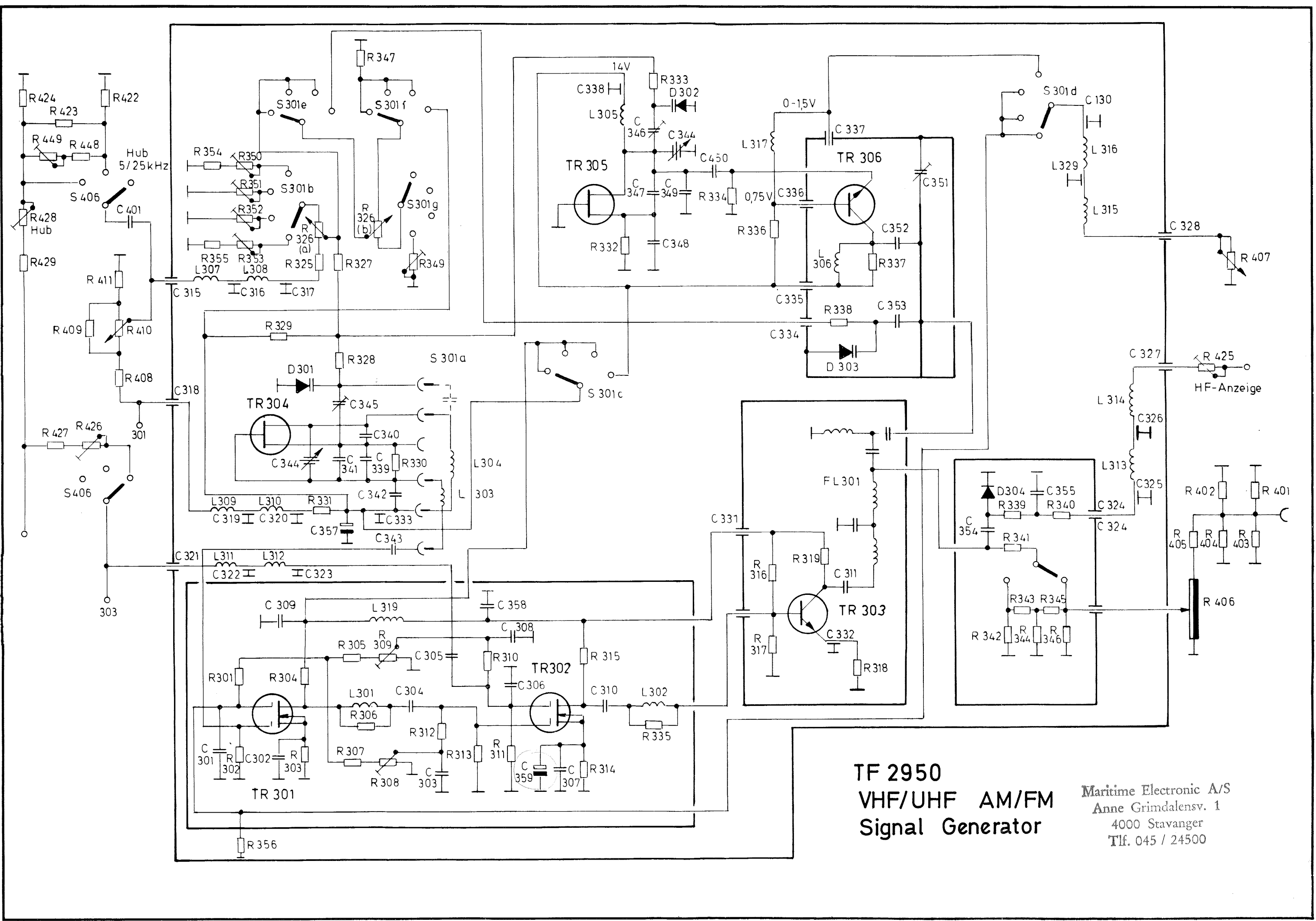
FIG 7.2 Delete R430

FIG 7.4 Amend as indicated in the last page of this change

FIG 7.5 Amend as indicated below -

Add L505/506 and R520/521
Delete R507/508 and R515/R516





TF 2950
VHF/UHF AM/FM
Signal Generator

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