Eddystone

GENERAL-PURPOSE VHF COMMUNICATION RECEIVERS

MODEL 1990R SERIES

Model 1990R/2–S

25-500MHz

Manufactured in England by

EDDYSTONE RADIO LIMITED
MEMBER OF MARCONI COMMUNICATION SYSTEMS LIMITED
ALVECHURCH ROAD, BIRMINGHAM B31 3PP
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AMENDMENT RECORD

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The Manufacturer reserves the right to modify the content of this publication as necessary to accommodate modifications, design improvements etc. Relevant Amendment Sheets will be incorporated at date of issue.

INTRODUCTION

General

This manual provides comprehensive instructions for the installation, operation and maintenance of all models in the 1990R series of receivers. Current versions are Model 1990R/1 which covers the band 25–235MHz and Model 1990R/2 which has additional frequency ranges to extend the coverage to 500MHz. These receivers are otherwise identical and provide reception facilities for AM, FM, CW and PULSE transmissions. Provision is made for high-stability working as a standard feature and receivers are supplied with either a switched ten-channel crystal facility or a synchroniser unit which allows continuous tuning with locking facilities every 100Hz. Operating voltage can be taken from any standard 40–60Hz AC supply or 12V DC with negative earth.

The equipment is supplied either for installation in standard 483mm (19in.) racking or with a cabinet for bench mounting. Accessories available include a plinth loudspeaker, special aerial systems, and a matching panoramic display unit.

Guarantee

All 1990R receivers are suitable for continuous use under arduous operating conditions and should require very little routine maintenance over long periods of operation. With the exception of the semi-conductors all components are guaranteed by the Manufacturer for a period of one year from the date of purchase; the semi-conductors are covered by a separate guarantee.

Servicing

Spares for user servicing can be supplied and helpful advice will be given freely when required. Any enquiries relating to service matters should be directed to the "Sales and Service Dept." at our usual address.

Should major servicing become necessary the receiver can be returned to the Manufacturer at any time. The serial number should be quoted in all communications and care should be taken to ensure that the receiver is well protected against possible damage during transit.

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EDDYSTONE 1990R/3B

Eddystone Radio Model 1990R/3B is modified to facilitate 24 Volt D.C. operation and accordingly differs from the standard 1990R/3 series range in the following respects.

CIRCUIT DIAGRAM BP1342:-

With reference to the Power Supply circuit stage (module prefix 15) the following amendments should be incorporated.

DELETE	Regulator Board (Module prefix 1).
DELETE	0.15Ω resistor (15R2).
DELETE	Interconnection leads to P.C.B. pins 118, 119, 120, 122 and 123 on Regulator Board.
ADD	Regulator IC (78H12) fitted to heat sink and located on the left hand side plate.
NOTE	The interconnection lead shown from Switch 4S1A to pin 121 on Regulator Board now connects from 4S1A to the output pin of Regulator IC (78H12).
	Also, the connections shown going to pins 124 and 125 on Regulator Board now connect to the input pin of Regulator IC (78H12) and capacitor 15C5 (7500 μ) respectively.
ADD	Earth connection from Regulator IC (78H12) to earth tag.
ADD	1.8Ω 25W wire wound resistor in series with positive lead connected to Battery Plug (4PL/F). Note, the resistor is mounted to the receiver side plate.
DELETE	The wire link shown from Switch 4S1B to 4S1A.
NOTE	The foregoing points, together with Switch 4S1A and 4S1B link modifications, are clearly illustrated in Fig. 1 overleaf.

1990R/3B MODIFICATION
TO FACILITATE 24 VOLT DC

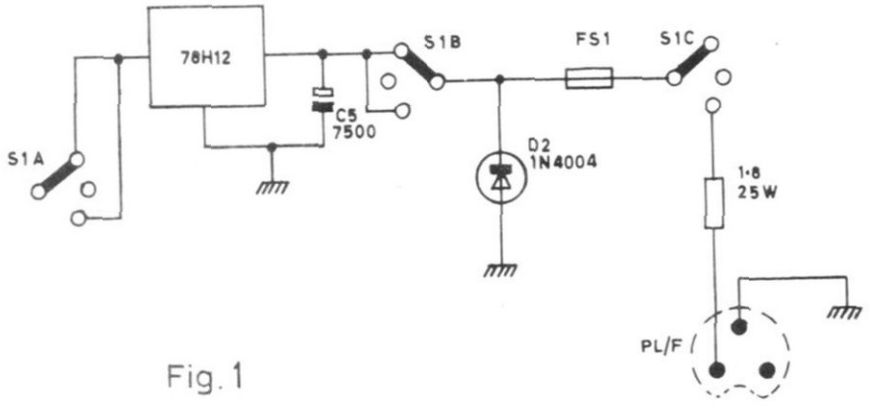

Fig. 1

EDDYSTONE 1990R/3B

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DELETE	Regulator Board (Module prefix 1).
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ADD	Regulator IC (78H12) fitted to heat sink and located on the left hand side plate.
NOTE	The interconnection lead shown from Switch 4S1A to pin 121 on Regulator Board now connects from 4S1A to the output pin of Regulator IC (78H12). Also, the connections shown going to pins 124 and 125 on Regulator Board now connect to the input pin of Regulator IC (78H12) and capacitor 15C5 (7500 μ) respectively.
ADD	Earth connection from Regulator IC (78H12) to earth tag.
ADD	1.8Ω 25W wire wound resistor in series with positive lead connected to Battery Plug (4PL/F). Note, the resistor is mounted to the receiver side plate.
DELETE	The wire link shown from Switch 4S1B to 4S1A.
NOTE	The foregoing points, together with Switch 4S1A and 4S1B link modifications, are clearly illustrated in Fig. 1 overleaf.

1990R/3B MODIFICATION
TO FACILITATE 24 VOLT DC

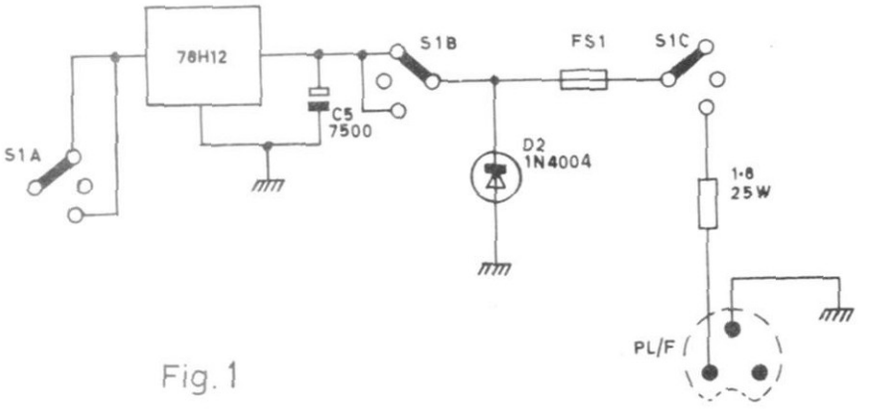


Fig. 1

1990R (SPECIAL MODEL VARIANT) SUPPLEMENT.

The Special Model Variant 1990R Receiver referred to herein is provided with the facility to connect a differential voltmeter directly across the IF/RF AGC lines, via the ANCILLARY SOCKET. The Model Variant is otherwise identical to the parent Receiver.

The relevant circuit modifications are as follows:-

Referring to the Main Circuit Diagram (BP1342 ISSUE 2);

(a) The RF AGC voltage is derived from AGC Switch 4S4A and fed via a screened lead to pin 13 of the ANCILLARY SOCKET (designated SK/E).

(b) The IF AGC voltage is derived from AGC Switch 4S4B and fed via a screened lead to pin 12 of the ANCILLARY SOCKET (SK/E).

(c) The SCREEN of each lead is joined to form the common connection to pin 15 of the ANCILLARY SOCKET.

EDDYSTONE RADIO LIMITED MARCH 1979.

Amendment No. 1.

Model 1990R/3 has been added to the range. It has the same frequency coverage as Model 1990R/2, added features being a 5MHz standard frequency output derived directly from the synchroniser standard and available on a B.N.C. Connector on the rear panel immediately to the right of the High Level IF Output (available only on Model 1990R/3S); and an FM Audio output taken from pin 23 of the FM Module and available on a BNC Connector immediately above the left-hand AC fuse.
On all models an output from the RF Oscillator suitable for feeding to a counter is now available on a BNC Connector immediately to the right of the Low Level IF Output, and pin 14 of the Ancillaries Connector now carries a 5V logic signal which is 'high' when range 5 is selected. This can be used to programme the counter with IF offset information.

Amend the pages as follows:-

Pages 5, 6. Note the outputs described above. If a lead is connected to the RF Oscillator output, it must be terminated in 50Ω.

Page 8. Table 1.1. Change the quantity of spare fuses (5A) from 2 to 1. Also change the part no. of Trimming Tool 8363P to 8451P.

Page 10. Muting. Add the note: "Muting should be switched OFF when receiving a BBC Domestic Radio Service broadcast". (The receiver will otherwise mute automatically due to the presence of a network surveillance tone at 23kHz).

Page 20. Add: RF Oscillator Output 50 - 150mV into 50Ω.
5MHz Std Output (3S Version only) 350mV into 50Ω.
FM Audio Output (3 Version only) approx 900mV into >10kΩ.

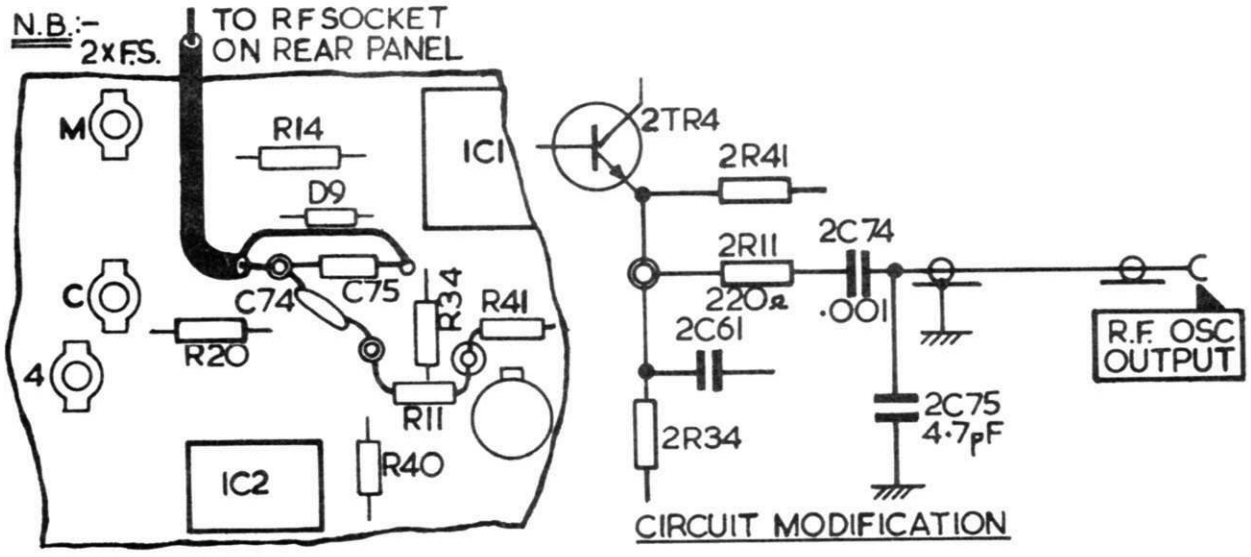
Page A3. Add: 2C74 0.001μF Disc Ceramic 20% 500V
2C75 4.7pF Tubular Ceramic ± 0.5pF, 200V

Page A11. Add: 2R11 220Ω.

Page A16. Change the type no's of 16D3 - 16D10 to BY210 - 400.

Page C2. Add the components shown below.

Circuit Diagram. Delete the test point shown at input L of the Mixer (VHF Tuner, IC1), add the circuit shown below.



Eddystone Radio Ltd., Alvechurch Road, Birmingham B31 3PP, England. Tel: 021-475-2231.
November 1976.

Section 1

INSTALLATION

ASSEMBLY INSTRUCTIONS

Accessories Kit

A kit of accessories is supplied with the receiver. The contents of the kit should be checked against Table 1.1 at the end of this Section.

Rack-mounting Receivers

Rack-mounting versions can be installed directly in 483mm (19in.) racks, using four ¼in. BSF chromium-plated screws. Suitable screws are Eddystone Ref. 40A–330. Plain washers Ref. 27E–57 should be fitted to prevent damage to the panel finish. Fixing slots conform to standard with centre spacing of 57.2mm (2.25in.). Overall dimensions of the standard rack-mounting receiver are shown in Fig. 1.1–E & F.

Bench-mounting Receivers

Four mounting feet are included with the Accessories Kit. These should be fixed to the bottom corners of the cabinet using the four 2BA screws supplied. Overall dimensions of the receiver, in cabinet fitted with standard mounting feet, are shown in Fig. 1.1–B.

Conversion of Mounting Styles

Rack-mounting receivers may easily be converted to bench-mounting and vice-versa. Accessories for this purpose are listed in Table 1.2 at the end of this section. Note that dust covers must be removed when fitting a rack-mounting receiver into a standard cabinet.

Anti-vibration Mountings

These are available to order for bench-mounting receivers. They are fitted instead of the standard mounting feet, using the same fixing holes. Overall dimensions of the receiver in cabinet fitted with anti-vibration mountings, are shown in Fig. 1.1–A. To fit the anti-vibration mountings proceed as follows:–

1. Invert the receiver.

2. Place the large neoprene washers over the fixing holes with stepped faces uppermost.

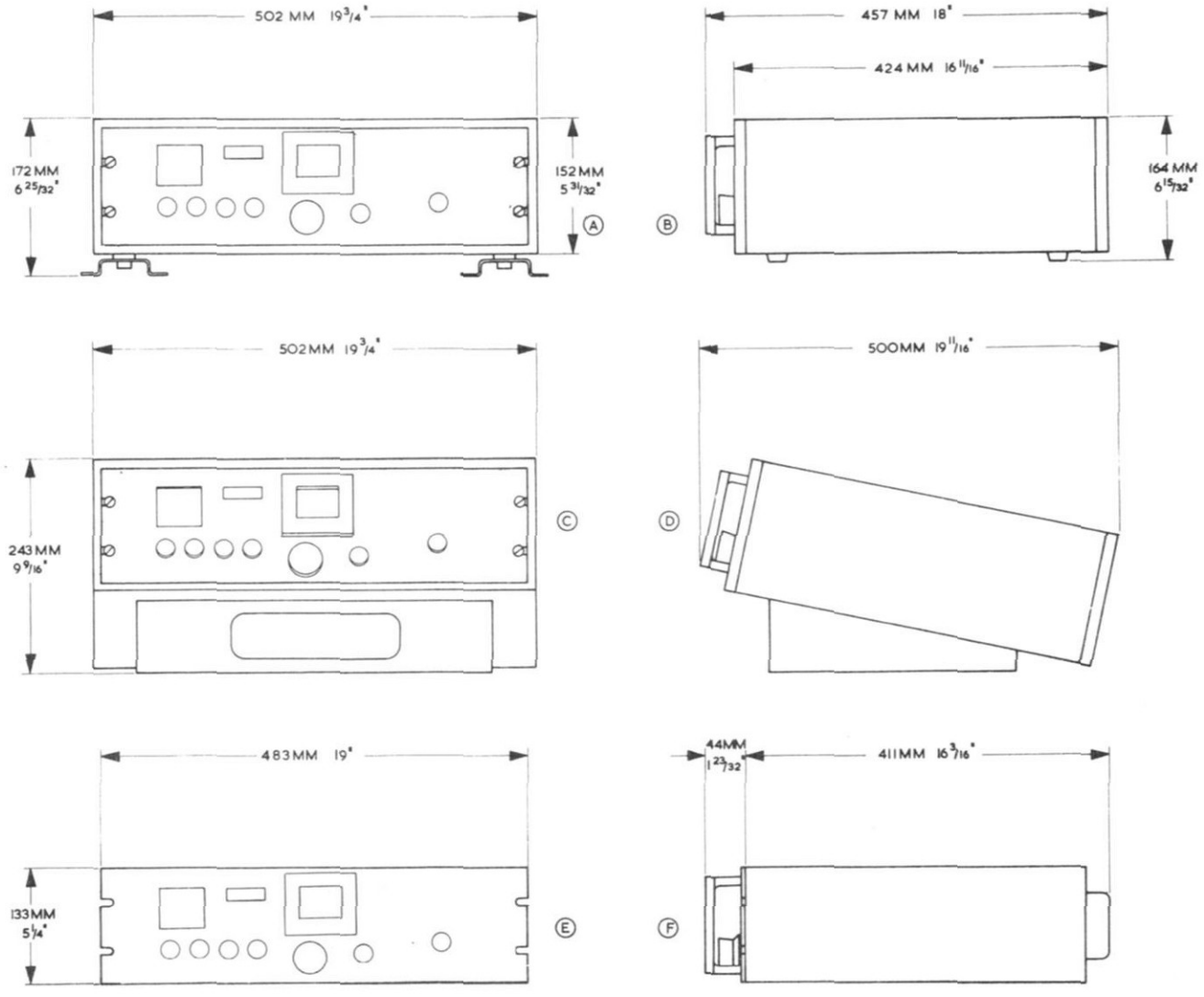
3. Lower the channel-shaped mountings onto the washers, keeping the fixing flanges towards the out*side of the receiver. Ensure that the steps on the washers* locate with the holes in the channel mountings.

4. Place the small neoprene washers on the inside of the channel mountings. Secure the mountings with the 2BA screws, fitted with brass washers.

5. Fix the mountings to the bench top with suitable screws; alternatively the mountings may be bonded to the bench if this is of metal construction.

Plinth Loudspeaker Unit

This is supplied to order for bench-mounting receivers. Overall dimensions of the receiver fitted with the Plinth Loudspeaker Unit are shown in Fig. 1.1–C & D. The Unit should be secured to the underside of the cabinet with 2BA screws, using the inner group of fixing holes provided.



A — Frontal dimensions of Receiver in Cabinet 8866P mounted on Shock-Absorbent Mountings LP2817/1.

B — Side elevation of Receiver in Cabinet 8866P fitted with standard mounting feet.

C & D — Receiver in Cabinet 8866P on Plinth Loudspeaker Unit Cat. No. 989.

E & F — Standard Rack-Mounting Receiver.

Fig. 1.1 Dimensions of Receiver in all mounting styles

POWER SUPPLIES

The receiver must be disconnected from the supply before removing covers or making adjustments to the power circuits

The Receiver may be powered from any standard 40–60Hz AC supply or from a 12V DC supply with negative earth. Changeover from one type of supply to the other is effected by means of a switch on the front panel. Before connecting the receiver to either form of supply please take particular note of the information given below.

AC Supplies

Standard receivers as dispatched from the factory are suitable for 240V operation. Other voltages may be specified at the time of ordering, in which case a label is attached to the rear of the receiver indicating the voltage to be used.

The receiver utilises a conventional mains transformer with primary tappings. These may easily be adjusted to suit any standard AC supply. The following procedure should be adopted (a soldering tool is required):—

1. Remove the bottom dust cover (or cabinet).

2. Locate the mains transformer primary connections. Remove the transparent safety cover.

3. Refer to Fig. 1.2 for the connections applicable to each voltage range. It may not be possible to adjust the primary voltage to exactly the same value as the supply voltage. In this case select the nearest primary voltage on the higher side of the supply voltage, e.g. for 115V supply select 120V tappings.

4. Replace safety cover and dust cover.

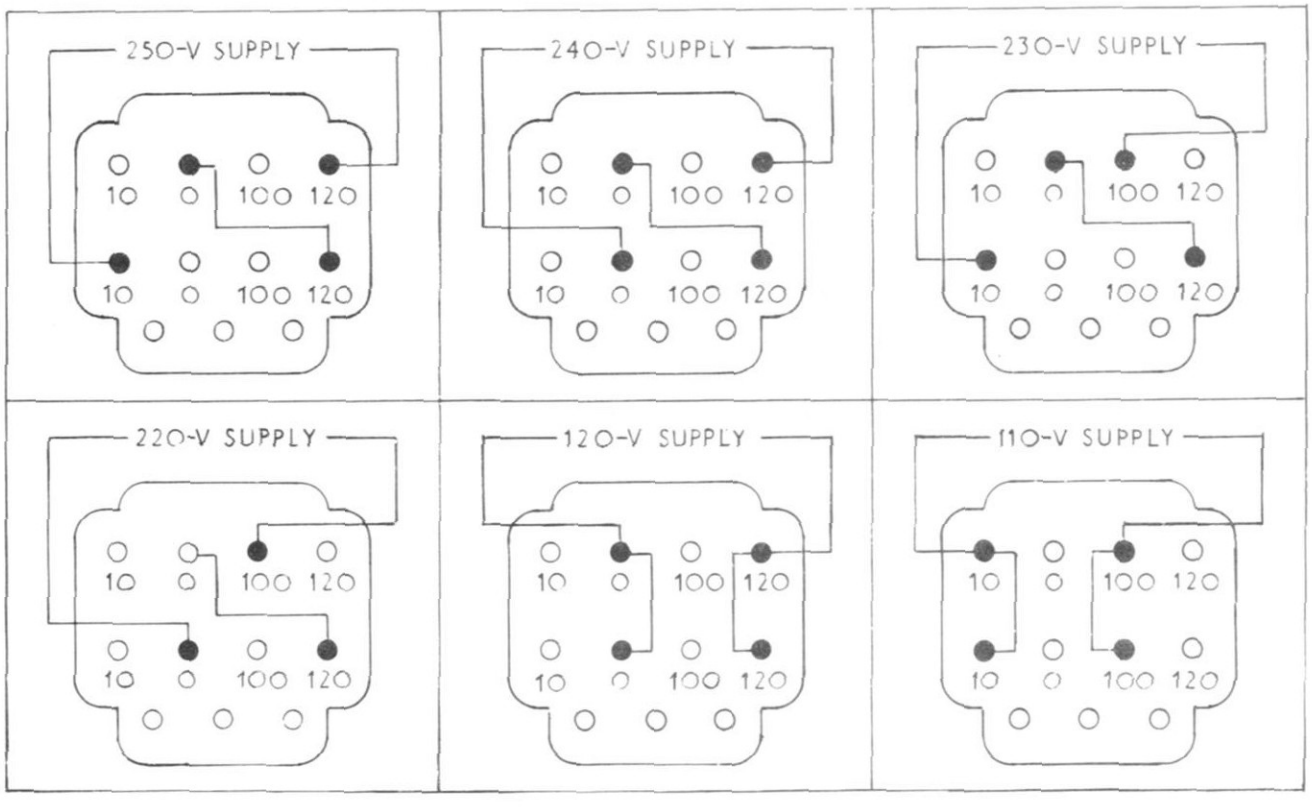


Fig. 1.2 Mains transformer primary voltage settings

AC Fuse Ratings

These should be as follows:—

105/130V : 2A 210/260V : 1A

DC Supplies

A 12V supply is required which can be derived from a battery or any other suitable source. Current consumption is approximately 1A for a receiver fitted with a Crystal Oscillator Unit and 2.7A if a Synchroniser Unit is used. Note that the negative pole of the supply is connected directly to the chassis of the receiver, which is earthed.

DC Fuse Rating

The DC fuse is rated at 5A. Spare fuses are supplied in the Accessories Kit.

EXTERNAL CONNECTIONS

General

With the exception of the telephone headset all external connections are made at the rear of the receiver. Appropriate connectors are included in the Accessories Kit. A rear view of the receiver is shown in Fig. 1.3.

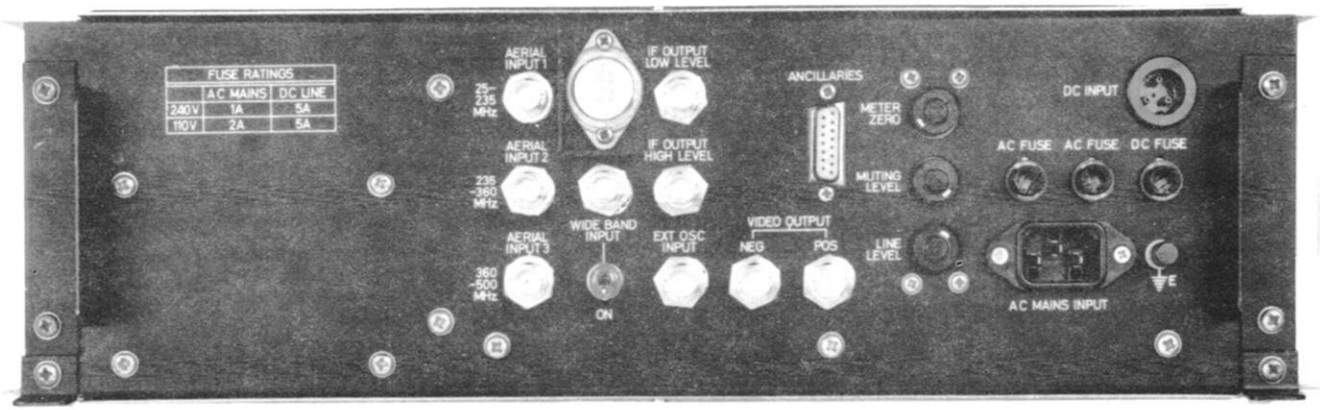


Fig. 1.3

AC Mains Input

The AC supply Connector is fitted with approx. 2 metres (78in.) of 3-core cable which is colour-coded in accordance with current European Standard, viz:—

LIVE: BROWN NEUTRAL: BLUE EARTH: GREEN/YELLOW

DC Input

The DC Supply connections are:—

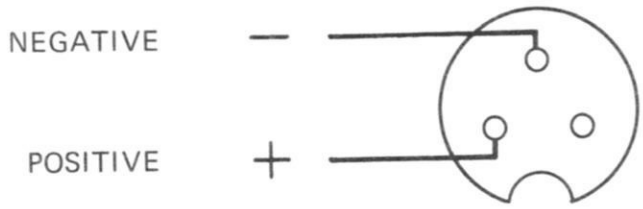


Fig. 1.4 Terminations on D.C. Supply Connector (viewed on wiring side)

Aerial Input 1

This socket is for use at all frequencies up to 235MHz. Input impedance is 50/75Ω unbalanced. Connection is by means of a BNC bayonet-lock coaxial connector.

Aerial Input 2

This socket is for use at frequencies from 235MHz to 365MHz and consequently is not fitted on Model 1990R/1 which does not cover this frequency range. Input impedance is 50/75Ω unbalanced. Connection is by means of a BNC bayonet-lock coaxial connector.

Aerial Input 3

This socket is for use at frequencies from 360MHz to 500MHz and consequently is not fitted on Model 1990R/1 which does not cover this frequency range. Input impedance is 50/75Ω unbalanced. Connection is by means of a BNC bayonet-lock coaxial connector.

Wideband Input

The aerial should be connected to this socket when the receiver is used in conjunction with ancillary equipment such as a panoramic display unit. The switch adjacent to the socket must be ON for this application.

Earth Terminal

When installing a rack-mounted receiver this terminal should be bonded to the rack. If the receiver is housed in a cabinet the terminal should be connected to supply earth.

IF Output Low Level

This socket provides a signal at the intermediate frequency of 21.4MHz suitable for driving ancillary equipment such as panoramic display units. Output level is of the order 15μV into 50Ω for 10μV at the aerial input. Connection is by means of a BNC bayonet-lock coaxial connector.

IF Output High Level

This socket serves the same purpose as the low level socket but the output level is of the order 50mV into 50Ω for 10μV at the aerial input.

Ext. Osc. Input

An external oscillator may be connected to this socket as an alternative to normal continuous tuning using the free-running internal oscillator. Connection is by means of a BNC bayonet-lock coaxial connector.

Video Output

Two sockets are provided giving separate positive and negative outputs of 1V p-p into 50Ω. Connection is by means of BNC bayonet-lock coaxial connectors.

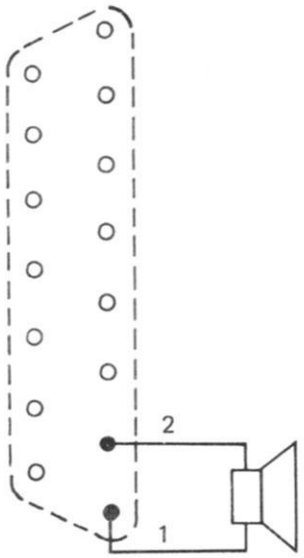


Fig. 1.5.1. External Loudspeaker connections

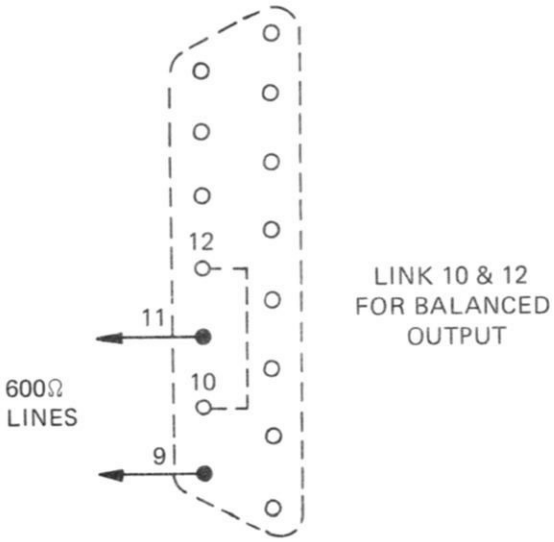


Fig. 1.5.2. 600Ω Line Output

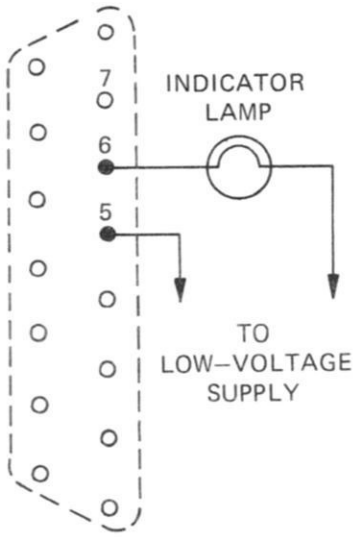


Fig. 1.5.3. Visual indication of Muting

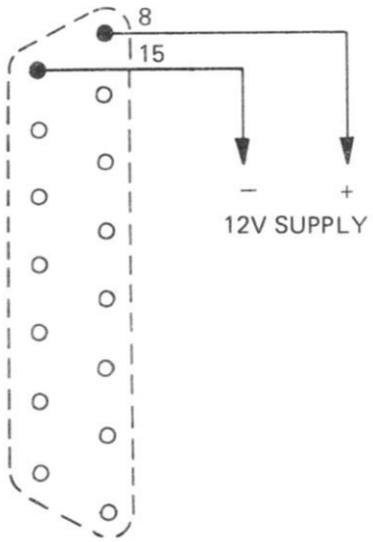


Fig. 1.5.4. Supply for ancillaries

Fig. 1.5 External connections to Ancillaries Connector (viewed on wiring side)

Ancillaries

A small 15-way connector is used for the following ancillary circuits:

1. External Loudspeaker
2. Line audio
3. Muting indication
4. 12V supply for ancillaries

The connections for these circuits are illustrated in Fig. 1.5 and details are given on opposite page.

External Loudspeaker

Connect to pins 1 and 2 (earth). Rated output power of 1.5W will be obtained when using a loudspeaker of 3Ω impedance (e.g. Cat. No. 935 or 989). A loudspeaker having a higher impedance can be used but the output will be reduced.

Line Audio

Connect to pins 9 and 11. If a balanced output is required link pins 10 and 12 (earth). The output, matched to 600Ω lines, is 20mW maximum adjustable by means of a pre-set control at the rear of the receiver.

Muting Indication

Audio or visual indication of muting can be provided with the aid of a single-pole changeover relay contact which is connected inside the receiver across pins 5, 6 (common) and 7. The contact across pins 6 and 7 is normally closed and changes over to bridge pins 5 and 6 when the muting circuit operates. A simple circuit to give visual indication of the mute condition is shown in Fig. 1.5.3. A separate low voltage supply is required. The lamp lights when the receiver output is muted.

12V Supply for Ancillaries

This DC supply is derived from the power unit in the receiver. The current drain should not exceed approx. 30mA. Note that the negative pole of the supply (pin 15) is connected to the chassis of the receiver, which is earthed.

TABLE 1.1 CONTENTS OF ACCESSORIES KIT SUPPLIED WITH RECEIVER

QTY.	DESCRIPTION	PART No.
4	*Cabinet Mounting Feet (complete with 4 x 2BA screws)	7132P
7	†BNC Bayonet-lock: coaxial plugs for aerial input, etc.	8012P
1	AC Supply Connector (complete with 3-core cable)	D4815
1	DC Supply Connector	8855P
1	Ancillaries Connector, 15-way (complete with cover)	7771P
1	Telephone Plug	6567P
1	Spare Dial Lamp (12V, 1W, 5mm, wire-ended)	8448P
2	††Spare Fuses—1A	7173P
2	Spare Fuses—5A	7814P
1	Trimming Tool	8363P
1	Trimming Tool	8333P
1	Box Spanner (for control knobs)	9057P
1	Spring Extractor	9284P
	*Not supplied for rack-mounting receiver. †An additional 2 coaxial plugs are supplied if the receiver is equipped with a UHF Tuner Unit. ††2 x 2A fuses are supplied if the Receiver is dispatched adjusted for 110/130V operation.	

TABLE 1.2 LIST OF ADDITIONAL ACCESSORIES AVAILABLE TO ORDER

DESCRIPTION	PART No.
Anti-vibration Mounting Kit (supplied unassembled)	LP2817/1
Plinth Loudspeaker Unit	Cat. 989
Cabinet Loudspeaker Unit	Cat. 935
Telephone Headset	LP3242
Telephone Headset	LP3301
Standard Receiver Cabinet (for converting rack-mounting to bench-mounting style).	8866P
Spares Kit (list of selected items on request).	—

Section 2

OPERATION

CONTROL FUNCTIONS

A front view of the Receiver equipped with a Frequency Synchroniser Unit is shown on the title page of this Manual. A similar view of the Receiver equipped with a Crystal Oscillator Unit is illustrated in Fig. 2.1 and a rear view of the Receiver is shown in Fig. 1.3. The controls referred to in this Section can be clearly seen in the illustrations.

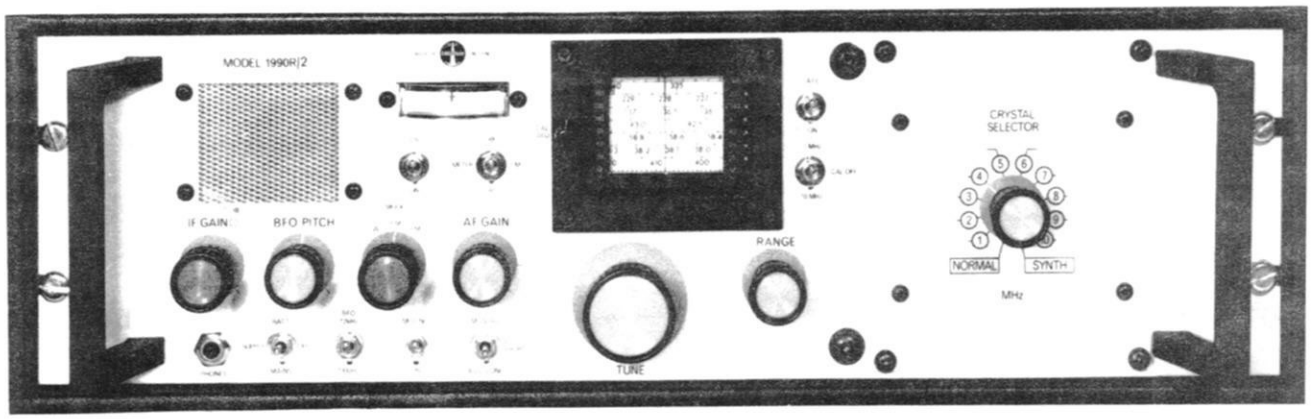


Fig. 2.1. Front view of receiver showing panel controls.

Controls at Front of Receiver

AF GAIN

Adjusts the level of audio output of the internal loudspeaker, the external loudspeaker and/or telephones

AFC

When switched down brings the Automatic Frequency Control Circuit into operation. This stabilises the frequency setting of the Variable Frequency Oscillator. On receivers with a Frequency Synchroniser the up position of the switch selects the synchroniser control circuit.

BATT–SUPPLY OFF–MAINS

Should be set to BATT in order to operate the Receiver from a suitable low-voltage DC or battery supply. Switch to MAINS for operation from AC supplies.

BFO ± 2kHz – ± 100Hz

Selects the limits of adjustment of the Beat Frequency Oscillator.

BFO PITCH

Adjusts the Beat Frequency within the limits given above. Functions only when the CW mode of reception is selected.

CAL. ADJ

Moves the cursor relative to the main tuning scale for calibration purposes.

IMHz – CAL OFF – 10MHz

Brings a crystal-controlled oscillator into service to provide calibration markers at the frequency intervals indicated.

IF GAIN

Controls the gain of the Intermediate Frequency amplifier if Automatic Gain Control is not used.

LS–ON

Brings the internal loudspeaker into service.

MANUAL–AGC SHORT–AGC LONG

When this switch is in the MANUAL position the gain of the RF and IF stages can be controlled by the Operator. In the other two positions Automatic Gain Control is applied.

METER

When switched to RF the meter indicates carrier level. In the FM position the meter serves as a tuning indicator. Line audio level is indicated when the AM position is selected.

MODE

This switch selects the desired mode of reception: CW, AM or FM.

MUTING

In the ON position the output of the Receiver is muted in the absence of a signal.

NORMAL–CRYSTAL SELECTOR–SYNTH

Housed in the Crystal Oscillator Unit. This control is an Oscillator System switch and is referred to as such in the operating procedures which follow. The NORMAL position enables the Variable Frequency Oscillator in the Receiver to be used for continuous tuning. A crystal-controlled oscillator is brought into service when any one of the ten crystal channels is selected. The SYNTH position enables the Receiver to be used in conjunction with an external Frequency Synthesizer.

RANGE

Selects the required frequency range.

RF GAIN

Controls the gain of the Radio Frequency amplifier if Automatic Gain Control is not used.

SELECTIVITY

A switch having three positions. The standard bandwidths provided are 200kHz in the WIDE position and 30kHz at position N1. Position N2 is used only when an additional filter is fitted to provide a more narrow bandwidth.

TUNE

Moves the main tuning scale relative to the cursor. Incorporates flywheel drive to facilitate rapid frequency changes.

TUNE-LOCK

This switch is housed in the Frequency Synchroniser Unit. In the TUNE position the Receiver can be tuned normally throughout its frequency range. In the LOCK position the Variable Frequency Oscillator is locked to the Frequency Synchroniser.

Controls at Rear of Receiver

LINE LEVEL

Used to pre-set the audio level into 600Ω lines.

METER ZERO

Used to set the panel meter initially to zero when RF indication is selected.

MUTING LEVEL

Pre-sets the threshold level of noise at which muting occurs.

WIDEBAND

When switched ON by-passes the RF amplifier and transfers the Wideband input directly to the Mixer.

OPERATING PROCEDURES

Before putting the Receiver into operation ensure that it has been installed correctly as described in Section 1.

Operating instructions are given here in convenient sub-sections, as follows:—

Initial Setting of Controls. These instructions apply to all Models and all modes of reception.

Operating Procedure for Receiver equipped with Crystal Oscillator Unit.

Operating Procedure for Receiver equipped with Frequency Synchroniser Unit.

General Notes on Operating Procedure. Applicable to all Models.

Ancillary Equipment. Operation of the Receiver in conjunction with ancillary equipment.

INITIAL SETTING OF CONTROLS

Set the controls as follows:—

SUPPLY switch to BATT or MAINS as required.
MUTING switch to the "off" position
MANUAL/AGC switch to AGC SHORT
RF GAIN control to mid-position
IF GAIN control to mid-position
SELECTIVITY switch to WIDE
AF GAIN control to mid-position

LS switch to ON

AFC switch to the "off" or "sync" position and TUNE/LOCK switch to "tune"

CAL. ADJ. control to mid-position

CAL switch to CAL OFF

WIDEBAND switch (at rear of receiver): except when the Receiver is used in conjunction with a Panoramic Display Unit or similar equipment this switch should be set to the "off" position.

Controls not listed above should be set as described in the operating procedures which follow:—

OPERATING PROCEDURE FOR RECEIVER EQUIPPED WITH CRYSTAL OSCILLATOR UNIT

Please read the operating procedure for AM reception first. Many parts of this apply also to the Operating procedures for CW and FM reception.

To Receive an AM Transmission

1 Set the MODE switch to AM.

2 Set the METER switch to RF.

3 Set the Oscillator System switch to NORMAL.

4 RANGE SELECTION
The RANGE control knob must be pushed towards the panel to engage the range selector.
The selected range is indicated by a small lamp adjacent to the appropriate part of the tuning scale.

5 TUNING

Tune to the required frequency using the TUNE control. Always tune for maximum deflection on the panel meter, which provides a measure of the carrier level; (initially, check that this meter indicates zero in the absence of a signal: if not, adjust the METER ZERO control at the rear of the Receiver).

With the Oscillator System switch set to NORMAL the Receiver can be tuned continuously throughout its frequency range, utilising the free-running local oscillator. When the CAL ADJ control is at mid-position the tuning scale is accurate to within 1% of the frequency setting. Precise frequency settings can be obtained by the use of the internal Crystal Calibrator: (refer to General Notes on Operating Procedure).

High-stability working at spot frequencies can be achieved by selecting an appropriate CRYSTAL CHANNEL with the CRYSTAL SELECTOR, tuning being carried out in the normal manner.

Access to the plug-in crystals is obtained by removing the four screws holding the Crystal Oscillator Unit to the front panel and sliding the Unit forward. Further information on calculation of crystal frequencies, etc., is given in Section 3, Technical Data.

The position marked SYNTH on the Oscillator System switch is for use when the Receiver is operated in conjunction with an external Frequency Synthesiser: refer to notes on Ancillary Equipment at the end of this Section.

6 SELECTIVITY

Selectivity can be increased by setting the SELECTIVITY switch to N1. On standard receivers this gives a bandwidth of 30kHz but alternative bandwidths may be provided at customer's request. A spare position on the SELECTIVITY switch, N2, may be used if an additional filter is installed to provide a more narrow bandwidth.

7 AF GAIN

Adjust this control to give the required level of audio output.

8 RF GAIN AND IF GAIN

These controls provide an alternative to Automatic Gain Control. They function only when the MANUAL/AGC switch is set to MANUAL and should be adjusted to suit reception conditions. If the gain is set too high the associated circuits may be overloaded.

9 AGC, AFC AND MUTING

For information on the use of these facilities refer to General Notes on Operating Procedure.

To Receive a CW Transmission

It is assumed that the initial setting of the controls, as described at the beginning of this Section, has been carried out. The operating procedure is then as follows:—

1 Set the MODE switch to CW.

2 Set the METER switch to RF.

3 Set the Oscillator System switch to NORMAL.

4 RANGE SELECTION
5 TUNING
6 SELECTIVITY
7 AF GAIN
8 RF GAIN AND IF GAIN

} The operating procedure given previously for AM reception also applies here.

9 AGC, AFC AND MUTING

For information on the use of these facilities refer to General Notes on Operating Procedure.

10 BFO PITCH

The BFO PITCH control enables the Beat Frequency to be adjusted within the limits of either ± 100Hz or ± 2kHz as determined by the setting of the BFO switch. Adjust the control to suit reception conditions.

To Receive an FM Transmission

It is assumed that the initial setting of the controls, as described at the beginning of this Section, has been carried out. The operating procedure is then as follows:—

1 Set the MODE switch to FM.

2 Set the METER switch to FM.

3 Set the Oscillator System switch to NORMAL.

4 RANGE SELECTION. As for AM reception.

5 TUNING. As for AM reception, with the exception that, in the FM mode, the panel meter serves as a tuning indicator, deflection from the centre of the scale being a measure of the degree of off-tuning. Correct tuning on FM signals is obtained when the meter pointer lies at the centre of the scale.

6 SELECTIVITY
7 AF GAIN
8 RF GAIN AND IF GAIN
9 AGC, AFC AND MUTING

The operating procedure given previously for AM reception also applies here.

For information on the use of these facilities refer to General Notes on Operating Procedure.

OPERATING PROCEDURE FOR RECEIVER FITTED WITH FREQUENCY SYNCHRONISER UNIT

Please read the operating procedure for AM reception first. Many parts of this apply also to the operating procedures for CW and FM reception.

To Receive an AM Transmission

It is assumed that the initial setting of the controls, as described at the beginning of this Section, has been carried out. The operating procedure is then as follows:—

1 Set the MODE switch to AM.

2 Set the METER switch to RF.

3 Set the AFC switch to SYNC.

4 Set the TUNE/LOCK switch to TUNE.

5 RANGE SELECTION

The RANGE control knob must be pushed towards the panel to engage the range selector. The selected range is indicated by a small lamp adjacent to the appropriate part of the tuning scale.

6 TUNING. Two methods of operation will be described:—

When the Signal Frequency is known precisely

(a) Adjust the tuning control knobs on the Frequency Synchroniser Unit so that an exact read-out of the signal frequency is obtained.

(b) TUNE the Receiver to the signal frequency. Lamps on the Frequency Synchroniser Unit will indicate TUNE HIGHER or TUNE LOWER as the TUNE control is adjusted until, when the main scale setting is correct, the lamps will flash alternately.

(c) The TUNE/LOCK switch should now be set to LOCK. The Synchroniser will hold the Receiver at the signal frequency.

When the Signal Frequency is not known precisely

(a) Tune the Receiver to the desired signal, using the TUNE Control.

(b) Set the tuning control knobs on the Frequency Synchroniser Unit to give the same frequency readout as the main tuning scale. Slight adjustment of these control knobs may be necessary to make the tuning indicator lamps flash alternately. When this is achieved the Synchroniser is tuned to the same frequency as the Receiver. Maximum accuracy is $\pm$100Hz; final adjustment should be made using the receiver tuning meter for reference.

(c) The TUNE/LOCK switch may now be set to LOCK. The synchroniser will now hold the Receiver at the signal frequency.

(d) If the Receiver goes off tune when the switch is set to the LOCK position this indicates that the Synchroniser is not set exactly to the signal frequency and more careful adjustment is required. An indication of the degree of synchronism between the Receiver and the Synchroniser is provided by the meter situated between the tuning indicator lamps. When the

switch is in the LOCK position the pointer on the meter will rest at centre scale if the Synchroniser is tuned to exactly the same frequency as the Receiver.

7 SELECTIVITY

Selectivity can be increased by setting the SELECTIVITY switch to N1. On standard receivers this gives a bandwidth of 30kHz but alternative bandwidths may be provided at customer's request. A spare position on the SELECTIVITY switch, N2, may be used if an additional filter is installed to provide a more narrow bandwidth.

8 AF GAIN

Adjust the AF GAIN control to give the required level of audio output.

9 RF GAIN AND IF GAIN

These controls provide an alternative to Automatic Gain Control. They function only when the MANUAL/AGC switch is set to MANUAL and should be adjusted to suit reception conditions. If the gain is set too high the associated circuits may be overloaded.

10 AGC, AFC AND MUTING

For information on the use of these facilities refer to General Notes on Operating Procedure.

To Receive a CW Transmission

It is assumed that the initial setting of the controls, as described at the beginning of this Section has been carried out. The operating procedure is then as follows:—

1 Set the MODE switch to CW.

2 Set the METER switch to RF.

3 Set the TUNE/LOCK switch to TUNE.

4 RANGE SELECTION

5 TUNING

6 SELECTIVITY

7 AF GAIN

8 RF GAIN AND IF GAIN

The operating procedure given previously for AM reception also applies here.

9 AGC, AFC AND MUTING

For information on the use of these facilities refer to General Notes on Operating Procedure.

10 BFO PITCH

The BFO PITCH control enables the Beat Frequency to be adjusted within the limits of either ± 100Hz or ± 2kHz as determined by the setting of the BFO switch. Adjust the control to suit reception conditions.

To Receive an FM Transmission

It is assumed that the initial setting of the controls, as described at the beginning of this Section, has been carried out.

The operating procedure is then as follows:—

1 Set the MODE switch to FM.

2 Set the METER switch to FM.

3 Set the TUNE/LOCK switch to TUNE.

4 RANGE SELECTION. As for AM reception.

5 TUNING. As for AM reception, with the exception that, in the FM mode, the panel meter serves as a tuning indicator, deflection from the centre of the scale being a measure of the degree of off-tuning. Correct tuning on FM signals is obtained when the meter pointer lies at the centre of the scale.

6 SELECTIVITY
7 AF GAIN
8 RF GAIN AND IF GAIN
9 AGC, AFC AND MUTING

The operating procedure given previously for AM reception also applies here.

For information on the use of these facilities refer to General Notes on Operating Procedure.

GENERAL NOTES ON OPERATING PROCEDURE

Automatic Gain Control

AGC is of greatest value: during general search tuning; when monitoring a channel occupied by stations spread over a wide area; when receiving a signal that is subject to fading. Reception conditions will dictate whether the AGC switch should be set to AGC SHORT or AGC LONG.

Automatic Frequency Control

When the free-running local oscillator has been utilised to tune the Receiver satisfactorily to a desired signal it is of advantage to set the AFC switch to ON. This stabilises the tuning at the operating frequency.

Generally it is not advisable to employ AFC when receiving a weak signal adjacent to a strong local transmission.

Use of Narrow Bandwidth Filters

The use of a synchroniser or crystal control, instead of AFC, is recommended when employing filter bandwidths of 15kHz or 7.5 kHz.

Muting

If the MUTING switch is set to ON a carrier-controlled muting circuit is introduced which suppresses noise output in the absence of a signal. This facility is primarily intended for use when the Receiver is employed in a communications role and leads to considerable reduction in operator fatigue on long listening watches. A relay is incorporated in the Receiver which can be used to provide indication of the mute condition, (see Installation, Section 1).

A MUTING LEVEL control is provided at the rear of the Receiver. This enables the threshold level of noise at which muting occurs to be pre-set. The control should be adjusted as follows:–

(a) With the MUTING switch in the "off" position and the MUTING LEVEL control fully anti-clockwise, tune to the desired signal and adjust all controls for optimum reception.

(b) Off-tune slightly to a clear channel adjacent to the signal frequency and put the MUTING switch ON.

(c) Advance the MUTING LEVEL control, stopping at the point where noise is suppressed.

(d) Re-tune to the required signal frequency and check that the Receiver operates normally when a carrier is present.

Calibration of Tuning Scale

Precise calibration of the tuning scale can be achieved by following the procedure outlined below:–

(a) Set controls as follows:–

METER switch to FM
RF GAIN control to maximum
IF GAIN control to maximum
SELECTIVITY switch to N1
AF GAIN control to mid-position
MUTING switch to the "off" position
AGC switch to MANUAL

(b) Set the CAL switch to the 10MHz position.
Calibration markers will then be obtained at 10MHz intervals from 30MHz to 500MHz. When calibrating the tuning scale on the lower frequency ranges calibration markers may be obtained at 1MHz intervals by setting the CAL switch to the 1MHz position.

(c) Set the tuning scale to the nearest scale check point. Now tune to the calibration marker, which will be found in the immediate vicinity of the check point. Adjust the TUNE control carefully for centre-zero indication on the panel meter.

(d) Set the CAL switch to CAL OFF.

(e) Maintain the setting of the TUNE control and position the scale check point by means of the CAL ADJ control.

The calibration procedure is now complete.

ANCILLARY EQUIPMENT

Ancillary Equipment

When operating the Receiver in conjunction with ancillary equipment please take note of the following information:–

Telephone Headset

Should be connected to the PHONES socket at the front of the Receiver using a standard jack plug. Audio level is determined by the setting of the AF GAIN control. Optimum results are obtained with low/medium impedance headsets.

External Loudspeaker

Audio level is determined by the setting of the AF GAIN control. The external loudspeaker is muted if a telephone headset is connected to the PHONES socket.

600–ohm Lines

Audio level is governed by the setting of the LINE LEVEL control at the rear of the Receiver: this is completely independent of the AF GAIN control.

The panel meter can be used to monitor the line audio level by setting the METER switch to AF.

External Oscillator (this facility is only available with the Crystal Oscillator Unit)

Set the Oscillator System switch to SYNTH. The oscillator may be tuned 21.4MHz above or below the desired signal frequency as convenient.

Panoramic Display Unit.

The aerial should be connected to the WIDEBAND socket and the switch adjacent to this socket must be ON.

Input to the Display Unit will be taken from one of the IF output sockets. If the IF OUTPUT HIGH LEVEL socket is used bandwidth is governed by the setting of the SELECTIVITY switch.

Section 3

TECHNICAL DATA & CIRCUIT DESCRIPTION

TECHNICAL DATA

GENERAL SPECIFICATION

Application

General-purpose solid-state VHF receiver with versatile frequency control suitable for point-to-point communications, search and surveillance, monitoring and laboratory use.

Reception Modes

AM – FM – CW – PULSE.

Frequency Coverage

Models 1990R/1-X & 1990R/1-S :: 25-235MHz in five ranges.
Models 1990R/2-X & 1990R/2-S :: 25-500MHz in seven ranges.
Suffix identity 'X' : crystal facility (ten channels)
'S' : integral synchronizer.

Intermediate Frequency

21.4MHz.

Filter Complement

Standard bandwidths: 250kHz + 30kHz.

Options: 'A' 250kHz + 30kHz + 15kHz.
'B' 250kHz + 30kHz + 7.5kHz.
'C' 250kHz + 15kHz + 7.5kHz.
'D' 250kHz + 15kHz
'E' 250kHz + 7.5kHz

Specify 30kHz filter b/w for 50kHz channelling.
15kHz 25kHz
7.5kHz 12.5kHz

NB: Use of crystal facility or synchronizer is recommended when using 7.5kHz bandwidth.

Aerial Inputs

50/75Ω unbalanced. Additional input available direct to bal.mixer for Wideband applications.

Output Facilities

Separate 'wide' and 'narrow' IF outputs, positive video, negative video, external loudspeaker, headset and 600Ω lines (bal. or unbal.).

Environmental

–10°C to +50°C (–20°C to +70°C storage).

Calibration Accuracy

Within ½% up to 235MHz and within 1% from 235MHz–500MHz without use of built-in calibrator (Cursor Adjuster at mid-position).

Calibrator provides 1MHz and 10MHz markers for precise frequency setting.

Power Supplies

AC :: 100/130V or 200/260V (40–60Hz).
DC :: 12V with negative earth.

Consumption (AC/12V) : RECEIVER – 15W/10W
RECEIVER COMPLETE WITH SYNCHRONIZER –35W/30W.

Dimensions and Weight (with Synchronizer)

Rack-mounting style:

Panel : 483mm x 133mm (19in. x 5.25in.).
Rack intrusion : 411mm (16.1875in.).
Weight : 18.4kg. (40.5lb.).

Bench-mounting style:

Width : 502mm (19.75in.).
Height: (including feet) : 164mm (6.5in.).
Depth : 457mm (18in.).
Weight: 21.3kg. (47lb.).

FREQUENCY COVERAGE

RANGE	FREQUENCY
1	25MHz–39MHz
2	39MHz–60MHz
3	60MHz–95MHz
4	87MHz–140MHz
5	140MHz–235MHz
6	235MHz–365MHz
7	360MHz–500MHz

PERFORMANCE SUMMARY

Typical data: not to be interpreted as a test specification.

Sensitivity (10dB S+N/N with standard o/p)

MODE	B/W	25-235MHz	230-500MHz
*AM	30kHz	3μV	10μV
**FM	250kHz	3μV	5μV
CW	30kHz	2μV	3μV

(*) 30% mod at 1kHz. (**) 22.5kHz deviation.

Noise Factor

Typically 4dB and of the order 8dB at any frequency: better than 10dB direct to Mixer.

Image Rejection

Greater than 50dB.to 235MHz
40dB.235/500MHz

IF Rejection

Greater than 60dB.

Stability

Free-running oscillator : 1 part in 10^5/°C.
Crystal oscillator : 1 part in 10^6/°C.
Synchronizer : 0.5 part in 10^7/°C.*
(*)–10°C to +50°C.

AFC Capture

At least 1% of signal frequency (operative in free-run mode only).

Selectivity

Dependent on filter complement (see above)
WIDE: 250kHz at –3dB (L/C filter).

NARROW:	PASSBAND (–6dB)	STOPBAND (–60dB)
	30kHz (± 15kHz)	± 50kHz
	15kHz (± 7.5kHz)	± 25kHz
	7.5kHz (± 3.75kHz)	± 12.5kHz

Dynamic Range

40dB (with AGC disabled). Taken for 5% total distortion with 60% modulation at 1kHz.

AGC Characteristic

Less than 10dB change in output for 80dB increase in input from 3μV.

FM Deviation

Linear acceptance to 75kHz.

Audio Output

Ext. loudspeaker (3Ω) : 1½ W at 10% distortion.
Line (600Ω with CT) : 20mW at 5% distortion.
Headset : Low/medium-Z.
Response : Within 3dB, 200Hz–8kHz.

Video Outputs

Separate +ve and –ve outputs of IV p-p into 50Ω.

Video Response

Level within ± 3dB from 20Hz to 250kHz.

IF Outputs (quoted for 10μV signal)

Separate wide and narrow-band outputs matched to 50Ω.

Low-level wideband output : 15μV.
Narrow-band output* : 50mV

(*) B/W set by receiver IF selectivity.

Muting

Threshold adjustable down to 3μV carrier.

CRYSTAL OSCILLATOR DATA

Calculation of Crystal Frequency

The crystal frequency should be within the limits 40,000–90,000kHz. The crystal controlled oscillator can be operated either above or below the signal frequency. A general formula is:–

CRYSTAL FREQUENCY = SIGNAL FREQUENCY $\pm$ INTERMEDIATE FREQUENCY

i.e. $f_X = f_S \pm 21400\text{kHz}$

The parameters of the crystals and the tuned circuits impose constraints on the use of the general formula and in many cases it is necessary to utilise harmonics of the crystal frequency. When a harmonic is employed it is essential that a suitable inductor is connected in the Crystal Multiplier circuit. Tables 3.1 and 3.2 list suitable inductors and show how the crystal frequency is calculated.

TABLE 3.1. OSCILLATOR OPERATING ABOVE THE SIGNAL FREQUENCY

SIGNAL FREQUENCY RANGE kHz	CRYSTAL FREQUENCY kHz	MULTIPLIER FREQUENCY	MULTIPLIER INDUCTOR PART NO.
25000-65000	$f_S + 21400$	Fundamental	7752P
65000-115000 115000-150000	$\frac{1}{2}(f_S + 21400)$	2nd Harmonic	D4897 D4898
150000-190000 190000-235000	$\frac{1}{3}(f_S + 21400)$	3rd Harmonic	D4899 D4900
235000-260000 260000-325000	$\frac{1}{4}(f_S + 21400)$	4th Harmonic	D4900 D4901
325000-360000 360000-410000	$\frac{1}{5}(f_S + 21400)$	5th Harmonic	D4901 D4902
410000-500000	$\frac{1}{6}(f_S + 21400)$	6th Harmonic	D4902

TABLE 3.2. OSCILLATOR OPERATING BELOW THE SIGNAL FREQUENCY

SIGNAL FREQUENCY RANGE kHz	CRYSTAL FREQUENCY kHz	MULTIPLIER FREQUENCY	MULTIPLIER INDUCTOR PART NO.
65000-105000	$f_S - 21400$	Fundamental	7752P
105000-135000 135000-160000 160000-195000	$\frac{1}{2}(f_S - 21400)$	2nd Harmonic	D4897 D4898 D4899
195000-210000 210000-275000	$\frac{1}{3}(f_S - 21400)$	3rd Harmonic	D4899 D4900
275000-360000	$\frac{1}{4}(f_S - 21400)$	4th Harmonic	D4901
360000-380000 380000-445000	$\frac{1}{5}(f_S - 21400)$	5th Harmonic	D4901 D4902
445000-500000	$\frac{1}{6}(f_S - 21400)$	6th Harmonic	D4902

Examples using Tables 3.1. and 3.2.

1. Oscillator operating above signal frequency:—

   Required signal frequency = 172460kHz

   From Table 3.1. $f_X = \frac{1}{3}(f_S + 21400)$

   $= \frac{1}{3}(172460 + 21400)$

   $= 64620$kHz

   The multiplier frequency is the third harmonic of the crystal frequency and a suitable multiplier inductor is Part No. D4899

2. Oscillator operating below signal frequency:—

   Required signal frequency = 172460kHz

   From Table 3.2. $f_X = \frac{1}{2}(f_S - 21400)$

   $= \frac{1}{2}(172460 - 21400)$

   $= 75530$kHz

   The multiplier frequency is the second harmonic of the crystal frequency and a suitable multiplier inductor is Part No. D4899

Crystal Specification

Inter-Services Style D (International Style AA), for series mode oscillator service. Frequency in kHz. Third or fifth overtone. Tolerance 0.002% calibrated at 25°C. Temperature range — 20°C to +70°C.

Orders placed with Eddystone Radio can be abbreviated as follows:—

Quantity — Crystal(s) for use with Model 1990R Receiver.

Frequency of **crystal(s)** quoted in kHz.

CIRCUIT DESCRIPTION

This description should be read in conjunction with the circuit diagrams bound at the rear of this Manual.

INTRODUCTION. The majority of components in the receiver are housed in sub-assemblies which are classified as modules, units or boards according to the nature of their construction. Each sub-assembly has a number. References are allocated to components in each sub-assembly in the conventional manner: R_1, R_2, C1, C2, etc.

To identify a component without ambiguity the number of the sub-assembly in which that component is located is used as a prefix to the component reference, e.g. 2R1 refers to resistor No. 1 in No. 2 Unit; 3R1 refers to resistor No. 1 in No. 3 Unit, etc. The numerical prefix is not included in the component references on the circuit diagrams or on the printed circuit boards where it is clear to which sub-assembly a particular component belongs.

This system of component identification is extended to include all components in the receiver. Power supply circuit components do not constitute a sub-assembly in the sense described above but are for convenience grouped together under the classification No. 15 Unit. Miscellaneous components that are distributed throughout the receiver (e.g. certain front panel controls) are, for identification purposes only, considered to belong to sub-assembly No.4 and are referenced accordingly.

The table which follows, lists all the sub-assemblies that make up the complete receiver. The circuit description details the function of each sub-assembly, its relationship to the other sub-assemblies and to the receiver as a whole. The associated switches and controls are also described.

TABLE 3.3. SUB-ASSEMBLIES USED IN 1990R SERIES RECEIVER

REFERENCE NO.	DESCRIPTION
1	Power Supply Regulator Board
2	VHF Tuner Unit
3	Crystal Oscillator Unit
4	Miscellaneous (see text)
5	Crystal Calibrator Unit
6	IF Preamplifier and Filter Module
7	FM Module
8	AFC Invert Board
9	Main IF Amplifier Module
10	AM Detector and IF Output Module
11	CW Detector and BFO Module
12	Muting and IF AGC Module
13	Audio/Video Splitter and Video Amplifier Module
14	Audio Board
15	Power Supply Unit
16	Voltage Inverter Unit
17	235-365MHz Tuner } UHF TUNER UNIT 360-500MHz Tuner } (Model 1990R/2 only)

VHF TUNER UNIT (Ref. No. 2)

Contains an RF Amplifier, a Variable Frequency Oscillator, a Mixer and associated circuitry. It can be operated in conjunction with either a Crystal Oscillator Unit or, alternatively, a Frequency Synchroniser Unit: details of these Units are given separately.

The VHF Tuner Unit has five frequency ranges, selected by the RANGE switch 2S1, covering the band 25-235MHz. The selected range is indicated by one of five light-emitting diodes, 2D1-2D5. Tuning is effected by a ganged four-section variable capacitor (2C6, 2C10, 2C26, 2C49).

The RANGE switch has seven positions. If the receiver is not equipped with a UHF Tuner Unit only five of the seven positions are used, a mechanical stop being fitted to prevent selection of the sixth and seventh positions. Note also that switch wafer 2S1J (B & F) is always wired in circuit but has a switching function to perform only when a UHF Tuner Unit is fitted.

R.F. Amplifier

Utilises a dual-gate MOSFET, 2TR1 (3N200). On Range 1 (25-39MHz) VHF input at the AERIAL INPUT 1 socket is applied to a tuned circuit 2L1/2C6 which presents the signal at gate 1 of 2TR1. Manual or automatic gain control voltage is applied at gate 2, this being switched into circuit as required by 1S4A.

The output of 2TR1 appears across the band-pass coupled tuned circuits 2L11/2C10 and 2L16/2C26; it is passed to the Mixer via pin diode switch 2D9.

Operation on ranges 2-5 is similar to operation on range 1, the appropriate tuned circuits being selected by 2S1.

If the WIDEBAND switch, 1S1, is set to ON the RF Amplifier is disabled and pin-diode switch 2D8 is activated. Signals may then be applied at the WIDEBAND INPUT socket, from where they are passed directly to the Mixer via 2C28 and 2D8.

Variable Frequency Oscillator

If the receiver is equipped with a Crystal Oscillator Unit the VFO is operational only when the Oscillator System switch, 3S1, is set to NORMAL.

A junction FET, 2TR2 (BFR29), is used in the tuned-gate configuration. On Range 1 (25-39MHz) the tuned circuit is 2L6/2C49, giving an oscillator frequency 21.4MHz above the signal frequency. Output from the VFO is fed to the Mixer via pin-diode switch 2D12, which is activated when the VFO is operational. 2TR3 (BFX89) is a buffer stage and 2TR4 (BFW30) matches the output impedance of the oscillator circuit to the input impedance of the Mixer. 2TR4 is also coupled to an emitter follower, 2TR5 (BFX89), which makes the VFO output available to the Frequency Synchroniser Unit (if fitted).

On Ranges 2, 3 and 4 the VFO functions in the same manner as on Range 1, the appropriate tuned circuits being selected by 2S1. On Range 5, however, the VFO frequency is arranged to be 21.4MHz below the signal frequency.

Provision is made for Automatic Frequency Control of the VFO. This is achieved by varactors 2D10 and 2D11 which receive their control voltage from an operational amplifier, 2IC2 (741).

The input to this amplifier is derived from the FM Module.

Mixer

A diode quad balanced mixer is employed: 2ICI (10514C). This gives very good two-signal performance. IF output at 21.4MHz is taken to the IF Preamplifier and Filter Module. An additional output is provided at the IF OUTPUT LOW LEVEL socket for connection to external ancillaries.

CRYSTAL OSCILLATOR UNIT (Ref. No. 3)

In addition to the Crystal Oscillator and Multiplier this Unit contains the Oscillator System switch, 3S1, which has twelve positions. The first position of 3S1, NORMAL, enables the free-running oscillator in the receiver to be used for continuous tuning; the next ten positions of 3S1 are used for selection of CRYSTAL CHANNELS for fixed frequency working; the final position, SYNTH, enables the receiver to be used in conjunction with an external Frequency Synthesizer.

Crystal Oscillator Board

A d.c. supply of +10V enters this Board via the VHF Tuner Unit and connector B-10. If NORMAL operation is selected the +10V supply is connected to the VFO via 3S1D and B-6, thus bringing the VFO into service.

When any one of the ten available Crystal Channels is selected the VFO is disabled, the +10V supply being switched by 3S1D to the Crystal Oscillator 3TR1 (BFY90). The appropriate tuned circuits are selected by 3S1B and 3S1C. Output from the Crystal Oscillator is fed to the Multiplier Board via 3C27.

Both the VFO and the Crystal Oscillator are disabled if the Oscillator System switch is set to SYNTH. In this case 3S1D is arranged to connect the +10V supply to pin diode 2D13 so that signals from an external oscillator can be fed to the Mixer.

Multiplier Board

3TR2 (BFY90) is an amplifier having a tuned collector load which is selected to suit the appropriate crystal frequency by means of 3S1A. The tuned circuit operates at either the crystal fundamental frequency or a suitable harmonic, depending on the output frequency required. An emitter follower, 3TR3 (BFY90), is used to transfer the output from the Multiplier to the Mixer.

Where the receiver is fitted with a UHF Tuner, an integrated circuit harmonic amplifier 3IC1 is included in place of C54 in the output from 3TR3. Its' power supply is 23V obtained from the −18V rail and the +5V rail via an extra wafer on the selector switch S1E.

Diodes 3D1 and 3D2 are in circuit to protect the Mixer from the effect of comparatively high voltages which may appear at the output of the Crystal Oscillator Unit, particularly when the tuned circuits are adjusted.

The Multiplier Board also carries a potential divider chain (3R14, 3RV1, 3R15) which is connected to −18V supply by B-5. A voltage derived from this chain is routed to 2IC2 via B-8. The purpose of this is to provide a standing voltage at 2IC2 such that varactors 2D10 and 2D11 function about their correct operating point when the VFO is in service but AFC is not applied. The level of the standing voltage can be pre-set by 3RV1.

FREQUENCY SYNCHRONISER UNIT

Comprehensive information for this Unit is provided in a separate handbook. A brief description of the function of the Unit is given here.

The Unit contains a constant-temperature crystal-controlled oscillator operating at 5MHz with an accuracy of ± 1 part in 10^7. Output from the oscillator is passed to a series of fixed ratio dividers to produce a reference frequency which is applied to one input of a phase detector. Another input to the phase detector is derived from the VFO in the receiver via a series of variable ratio dividers. The knobs which are used to set the variable ratio dividers are calibrated to display the tune frequency, which is offset from the VFO frequency by 21.4MHz.

When the TUNE/LOCK switch is in the TUNE position the variable ratio dividers form part of a frequency counting circuit. This circuit is used to activate either the TUNE HIGHER or TUNE LOWER light-emitting diode, depending on whether the frequency to which the receiver is tuned is below or above the frequency displayed on the Synchroniser dials. If the two frequencies are approximately the same the LED's flash alternately.

With the TUNE/LOCK switch in the LOCK position the output from the phase detector is used to synchronise the VFO with the reference frequency. When the frequency of the VFO is correctly related to the reference frequency the output from the phase detector is held constant. If the frequency of the VFO drifts the output from the phase detector changes: a voltage swing of between 0V and −12V is produced; this is applied to varactors 2D10 and 2D11 in such a manner that synchronism between the VFO and the reference frequency is maintained. The control signal from the phase detector is also applied to a meter, which is suitably biased so that the centre of the lock range is indicated by the meter needle at the centre of the scale.

CRYSTAL CALIBRATOR UNIT (Ref. No. 5)

This Unit is controlled by the Calibrator switch, 1S9, which has three positions: 10MHz, 1MHz and CAL OFF. Switching to CAL OFF simply interrupts the d.c. supply, which is connected in either of the other two positions by means of 1S9B.

5IC1 (7400) is a crystal-controlled oscillator operating at 10MHz. When the Calibrator switch is set to 10MHz output from the Oscillator is passed by 5C6 to gate 1 of the Mixer, 5TR1 (40673). A phase-shift oscillator, 5TR2 (BC107B) is utilised to provide modulation at gate 2 of the Mixer. Probes are used to couple the output from the Mixer to the VHF and UHF Tuner Units. The output is rich in harmonics, which serve as calibration markers throughout the frequency range of the Receiver.

If the Calibrator switch is placed in the 1MHz position a decade divider, 5IC2 (7490) is introduced, by means of 1S9A, into circuit between the Oscillator and the Mixer. Calibration markers are then produced in increments of 1MHz.

IF PREAMPLIFIER AND FILTER MODULE (Ref. No. 6)

Preamplifier

Accepts the IF output from the Mixer in the VHF Tuner Unit. Impedance matching is achieved by a tapping on 6L8, which is tuned to resonance at 21.4MHz by 6C17. The IF signal appears at gate 1 of the dual-gate MOSFET amplifier 6TR3 (40673), the output from which is switched to one of the IF filters. Manual or automatic gain control voltage which is applied to the RF Amplifier in the VHF Tuner Unit is also applied at gate 2 of 6TR3.

Filters

On standard receivers two IF filters are provided: an L-C filter with 200kHz bandwidth and a crystal filter having 30kHz bandwidth. Provision is made to fit a third filter with a narrower bandwidth if desired. The inputs to the filters are controlled by transistor switches 6TR1 (UC734B), 6TR4 (UC734B) and 6TR6 (UC734B). To ensure complete isolation transistor switches are also used to control the outputs of the filters: 6TR2 (UC734B) for the L-C Filter; 6TR5 (BFX89) and 6TR7 (BFX89) for the Crystal Filters. Selection of the desired IF filter is by means of the SELECTIVITY switch, 1S3, which connects +10V supply to the appropriate transistor switches.

When using the very narrow filter it is essential to prevent all possibility of IF breakthrough via the other filters. The diodes 6D1 and 6D2 are in circuit for this purpose. They offer a high impedance path to the IF except when the filter to which they are related is in use.

FM MODULE (Ref. No. 7)

Output from the IF Preamplifier and Filter Module is passed to an amplifier, 7IC1 (CA3028), via a buffer stage, 7TR1 (BFX89). After amplification the signal is coupled to the limiting amplifier and FM demodulator 7IC2 (CA3089). Audio output from 7IC2 is amplified by 7TR2 (BC107B) and fed to the Audio/Video Splitter and Video Amplifier Module when the FM mode of reception is selected by the MODE switch 1S5B.

7IC2 has three other functions to perform. Firstly, it provides AGC voltage which can be switched to the IF Preamplifier and the RF Amplifier by 1S4A. Secondly, it provides outputs to the Panel Meter for indication of carrier level and accuracy of FM tuning; these outputs are switched by 1S8. Thirdly, it provides AFC voltage which may be applied to the VFO via the AFC Invert Board.

AFC INVERT BOARD (Ref. No. 8)

On all ranges except range 5 (140-235MHz) this board takes a positive-going AFC voltage from the FM Module and inverts it to provide a negative-going control voltage to the VFO, when the AFC switch, 1S2, is ON. The voltage inversion stage is 8TR1 (BCY71). On range 5 it is necessary not only to invert the AFC voltage but also to change its sense of direction. This is achieved by 8TR2 (BCY71).

Two relays, 8RLA and 8RLB, are energised when range 5 is selected by the RANGE switch wafer 2S1AB. When 8RLA is energised relay contact 8RLA1 changes over from 8TR1 to 8TR2 to provide the correct mode of AFC voltage inversion. Relay 8RLB has a function to perform only when a Frequency Synchroniser Unit is fitted. This Unit utilises the VFO frequency correction circuitry which is otherwise used for AFC. When range 5 is selected relay contact 8RLB1 connects +5V supply to the Frequency Synchroniser Unit which ensures that the frequency control voltage from the Synchroniser is applied to the VFO in the correct sense.

MAIN IF AMPLIFIER MODULE (Ref. No. 9)

Three integrated circuits, 9IC1-2-3 (SL610), are connected in cascade to provide IF amplification. Input is taken from the IF Preamplifier and Filter Module. The output is routed to three circuits: the IF AGC circuit in the Muting and IF AGC Module; the AM Detector and IF Output Module; the CW Detector circuit in the CW Detector and BFO Module.

Gain control voltage is applied to the first two stages of the Main IF Amplifier. Manual control of the gain is provided by the IF GAIN control which forms part of a potential divider chain which is brought into circuit when switch wafer 1S4B is set to the MANUAL position. Alternatively, Automatic Gain Control may be used, the control voltage being derived from the IF AGC circuit and applied to the IF Amplifier when 1S4B is switched to AGC.

AM DETECTOR AND IF OUTPUT MODULE (Ref. No. 10)

Output from the Main IF Amplifier is taken to an emitter follower, 10TR1 (BFX89) and amplifier, 10TR2 (CN3866) which is transformer coupled to the diode detector 10D1.

IF Output

The amplifier, 10TR2, also feeds the IF OUTPUT HIGH LEVEL socket via an emitter follower 10TR3 (BFX89) which provides the correct output impedance.

CW DETECTOR AND BFO MODULE (Ref. No. 11)

DC supply to this module is connected by 1S5A only when the MODE switch, 1S5, is set to the CW position.

CW Detector

A product detector in the form of an integrated circuit, 11IC1 (MC1550G), to which inputs are applied from the Main IF Amplifier and the BFO. The audio signal is amplified by 11TR3 (BC107B) and passed to the Audio/Video Splitter circuit via 1S5B when the CW mode of reception is selected.

Beat Frequency Oscillator

A varactor, 11D1, is used to tune a crystal-controlled oscillator 11TR1 (BFX89) about the crystal frequency of 21.4MHz. A buffer amplifier, 11TR2 (BFX89), is in circuit between the oscillator and the product detector.

Varactor 11D1 receives its control voltage from one of two potential divider networks, either of which can be connected into circuit by the BFO switch, 1S6, to enable the BFO frequency to be adjusted within the limits of either $\pm$2kHz or $\pm$100Hz of the 21.4MHz IF. A potentiometer. 1RV4, forms part of the potential divider networks and serves as a control by the use of which the BFO PITCH can be varied within the limits of audio frequency set by the BFO switch.

MUTING AND IF AGC MODULE (Ref. No. 12)

Muting

Audio output from the FM Module is capacitor coupled to a noise amplifier 12TR1 (BC107B). A tuned transformer transfers the noise signal, at frequencies of 18-20kHz, to diodes 12D1 and 12D2, where it is demodulated before passing to an operational amplifier, 12IC1 (741). The output from 12IC1 is a muting control voltage which is connected to the Audio/Video Splitter circuit when the MUTING switch, 1S10, is ON. A potentiometer, 1RV3, enables the threshold level of noise, at which the muting circuit operates, to be pre-set.

IF AGC

The output from the Main IF Amplifier is further amplified by 12IC2 (SL610C) and 12TR2 (BFX89), which is transformer coupled to diode detector 12D3. An emitter follower, 12TR3 (BC107B), is used to transfer the AGC voltage to the Main IF Amplifier via 12D5 and 1S4B. The gain of 12TR3 is controlled by potentiometer 12RV1 which is used to preset the AGC voltage level.

AUDIO/VIDEO SPLITTER AND VIDEO AMPLIFIER MODULE (Ref. No. 13)

Audio/Video Splitter

A junction FET, 13TR1 (UC734B), is utilised in the splitter stage. This accepts audio signals from the FM, AM or CW circuits as selected by the MODE switch. Audio signals are routed from the drain of 13TR1 to the Audio Board. Muting control voltage, derived from the Muting and IF AGC Module, is fed to the base of 13TR2 (BCY71) when the MUTING switch is ON. The circuit is so arranged that 13TR1 is cut off if the noise exceeds a preset level.

Another transistor, 13TR3 (UC734B), which is effectively in parallel with 13TR1, energises relay 13RLA when muting occurs. Relay contact 13RLA1 can be used to provide indication of the mute condition.

Video Amplifier

Input to the Video Amplifier, 13IC1 (CA3020A), is obtained from the source of 13TR1. The input level is preset by 13RV1. The amplifier delivers video signals to the VIDEO OUTPUT NEG and POS sockets.

AUDIO BOARD (Ref. No. 14)

Main Audio Amplifier

Audio signals enter the Main Audio Amplifier from the Audio/Video Splitter, the input level being determined by the setting of the AF GAIN control potentiometer, 1RV5. The amplifier employs a two-stage circuit, 14TR1 (UC734B) being used to drive 14IC1 (TCA160). Output is taken to the PHONES jack, with 1R4 in series for impedance matching. External loudspeaker connections are also made via the PHONES jack so that the external loudspeaker is disconnected if telephones are used. Output is also taken to the internal loudspeaker, connected in series with the LS switch and 1R5, which is in circuit to limit the output power to an acceptable level.

Line Amplifier

Input to this amplifier is obtained from the Audio/Video Splitter, the input level being preset by the LINE LEVEL potentiometer, 1RV6. The preamplifier, 14TR2 (BCY72) feeds IC2 (MFC4000B), the output from which is taken via a transformer to match 600ohm lines. A centre-tap on the transformer secondary is provided to enable a balanced output to be obtained. In addition, a rectified output, derived from 14D2, is connected to the Panel Meter when the METER switch, 1S8, is in the AM position; the meter then gives an indication of line audio level. 14RV1 is used to set the meter initially to zero.

POWER SUPPLY (Ref. No. 15)

Taking its input from any standard 40-60Hz a.c. mains supply this circuit utilises a conventional step-down transformer and bridge rectifier. A voltage regulator circuit comprising 1IC2 (UA723C), 1TR2 (BFY51) and 15TR1 (2N3055), provides a nominal +12V regulated output, the exact voltage level being preset by 1RV1. A +10V output is obtained from the 12V supply by means of 15R1 in conjunction with a zener diode 15D1. The 12V supply also feeds a separate voltage regulator, 15IC1 (15805KC), from which +5V output is obtained.

When the Battery/Mains switch 15S1 (mounted on the front panel) is set to BATT the mains supply transformer and rectifiers are disconnected; the 12-V regulator is also switched out of circuit, the +12V supply being taken directly from the battery. Reverse polarity protection is provided by 15D2, which takes sufficient current to rupture the d.c. fuse, 15FS1.

VOLTAGE INVERTER UNIT (Ref. No. 16)

This Unit is designed to provide d.c. supplies of 18V and 30V when the Receiver is operated from a 12-V battery. However, it is convenient to continue to derive these supplies from the Unit when the Receiver is operated from a.c. mains.

A square-wave oscillator is used, the output from which is stepped up, rectified and voltage regulated. The oscillator circuitry is formed around 16TR1 (BDX36) and 16TR2 (BDX36), working in conjunction with transformer 16T1. Output is taken from two secondary windings on 16T1 to the bridge rectifiers 16D3-D10.

A supply of −18V is obtained from the voltage regulator circuit 16IC1 (UA723) together with 16TR3 (2N4918), the exact voltage level being preset by 16RV3. A similar circuit is used to provide −30V regulated output.

UHF TUNER UNIT (Ref. No. 17)

This unit is fitted to Model 1990R/2 only. It contains two UHF Tuners covering the ranges 235–365MHz and 360–500MHz respectively. Signal inputs are taken from Aerial Input 2 to the lower frequency unit and from Aerial Input 3 to the higher frequency unit. Of the two tuners the one not in use is disabled by having its power supply removed by the RANGE switch, this action also isolating its output by virtue of the switching diodes at the input to the mixer.

Tuning is effected by varicap diodes which receive their control voltage via a potentiometer coupled to the main TUNE control.

The 235–365MHz Tuner

R.F. Amplifier

A two-stage amplifier circuit is employed. The tuning elements consist of half-wave lines with varicap diodes (17D1-17D9 : BB105B) at each end. The high frequency limit of the tuning range is determined by the pre-set potentiometers 17RV1, 17RV2 and 17RV3 which are connected across the tuning control voltage line. The low-frequency limit of the range is set by trimmers 17C6, 17C12 and 17C18.

When the 235–365MHz range is selected, +10V is applied to the RF Amplifier via range switch wafer 2S1JF. The UHF signal input is applied to the base of the 1st R.F. transistor, 17TR1 (BFR90), via a high-pass filter having a cut-off frequency of approximately 200MHz. Output from 17TR1 is coupled to Gate 1 of the 2nd RF transistor 17TR2 (3N200). Gate 2 of 17TR2 is connected to the main R.F. A.G.C. line.

A bandpass pair of lines is employed between the output from 17TR2 and a coupling loop which transfers the output to the double-balanced mixer situated in the VHF Tuner Unit. The output is switched to the mixer via 2D18.

Variable Frequency Oscillator

When the 235–365MHz range is selected, +10V is applied to the VFO via range switch wafer 2S1JB. The oscillator is a Colpitts type, with a tuned line in the collector circuit of 17TR5 (BF362) and capacity feedback to the emitter from a tap on the line. The low-frequency limit of the VFO range is set by trimmer 17C46 and the high-frequency end by pre-set potentiometer 17RV7. 17RV7 is connected across the tuning control voltage line and tuning is by varicap diodes 17D13–17D15 (BB105B).

Output from the oscillator is amplified by 17TR4 (BFR90) and fed to the mixer in the VHF Tuner Unit by switching diode 2D15.

The 360–500MHz Tuner

The circuit configuration is similar to that of the 235–365MHz tuner except that varicap diode tuning is employed at one end of the lines only to allow operation at the higher frequencies.

Section 4

MAINTENANCE

General

The receiver is suitable for continuous use under arduous conditions and normally requires no routine maintenance, apart from occasional lamp replacement. This section describes procedures for fault diagnosis and the replacement of component modules and assemblies. The locations of these are shown in Figures 4.1 and 4.2.

Instructions are also included for Performance Testing and Realignment.

When working on the receiver it will be necessary for power to be connected. It is recommended that the receiver is fed from an isolated power supply and that normal precautions for safety under these conditions be observed.

Fuse Replacement

Double-pole fusing is employed in the AC Mains supply and single-pole fusing in the positive side of the 12V DC supply. All three fuses are standard "quick-blow" 20mm x 5mm glass cartridge type, and the fuseholders are located on the rear panel.

The fuse ratings are:–

12V DC	5A
210–260V AC	1A
110–130V AC	2A

Spare fuses are supplied in the Accessories Kit, see page 8.

Tuning Scale Lamp Replacement

In the event of one or both of the tuning scale lamps failing, the procedure for replacement is as follows:–

1 Remove the receiver from the cabinet, or rack and remove the top dust cover.

2 Remove the two screws securing the lamp mounting board, and lift the board to the limit of the slack in the wiring.

3 The soldered connections to the faulty lamp will now be accessible. Desolder the faulty lamp and fit the replacement (a spare lamp is included in the Accessories Kit).

4 Replace the lamp mounting board and screws, and refit the dust covers. Reinstate the receiver and check that both lamps now light and that it functions correctly.

Range Indicating Lamp Replacement

It is unlikely that these lamps (LED's) will fail, however if they do the procedure is as follows:–

1 Remove the receiver from the rack or cabinet and remove the top dust cover.

2 Remove the CAL ADJ knob. This is done by removing the cap and holding the knob stationary whilst turning the screw anti-clockwise to release the collet.

3 Remove the four crosshead screws at each corner of the escutcheon and remove the complete assembly, ie the outer escutcheon, the window and the inner escutcheon.

4 Remove the two screws, nuts and washers holding the LED mounting board.

5 Lift the LED mounting board upwards to the limit of the slack in the wiring.

6 The faulty LED is now accessible and may be desoldered.

7 Take the replacement LED and note the cathode lead: this is the shorter of the two. Cut the leads to match those of the original LED and solder the new one in position with the cathode lead nearest the top (highest frequency end) of the board.

8 Refit the board, escutcheon assembly, knob and cover by reversing the above procedure.

REMOVAL OF MODULES

The modules covered by this procedure are:–

FM, Main IF Amplifier, AM Detector and IF Output, Product Detector, Muting and IF AGC, Audio/Video Splitter and Video Amplifier, IF Preamplifier and Filters.

1 Remove both top and bottom dust covers.

2 Using the tool provided release the cover retaining clip and remove the cover from the module in question. Disconnect any leads to the interior of the module.

3 Stand the receiver on its side and disconnect the leads at the base of the module.

4 Remove the two screws (with earth tags) securing the module and remove the module.

5 Fit the replacement module by reversing the procedure.

N.B. Before disconnecting any leads ensure that they are identifiable to allow correct replacement, also ensure that all earth tags are replaced and make good connection.

In the case of the IF Preamplifier and Filter module, and the Main IF Amplifier module, some leads terminate in soldered joints, these leads should be disconnected where they enter other modules.

Removal of Voltage Inverter Unit

1 Remove both dust covers and stand the receiver on its side.

2 Disconnect the 6-way plug on the underside of the chassis.

3 Support the weight of the unit and remove the four screws on the underside of the chassis securing the unit. Two of these are adjacent to the connector, the remaining two are beneath the wiring between the 15-way socket and the zener diode. The unit is now free to be removed.

4 Replace the unit by reversing the procedure.

Removal of Voltage Regulator Board

1 Note the connections and unsolder all the leads.

2 Gently ease the board away from the chassis, squeezing the catches in the mounting pillars to allow the board to be removed. When replacing the board ensure the catches snap into position to secure the board.

Removal of Audio Amplifier Board

1 Remove the cover on the outside of the left-hand side plate by removing the centre screw at each end.

2 Disconnect leads and gently ease the board off the plastic mounting pillars.
Replace the board by reversing the procedure.

Removal of AFC Invert Board

1 Remove the Crystal Oscillator or Synchroniser by removing the four screws at the corners of the front panel and, in the case of the Crystal Oscillator, the 15-way connector.

2 Remove the top cover.

3 Remove the four screws, nuts and washers securing the potentiometer mounting board to the right hand side panel and allow this to hang free.

4 Remove the four crosshead screws which secure the plate carrying the AFC invert board, the 8-way socket and the coaxial socket assembly to the rear panel behind the Crystal Oscillator or Synchroniser position. This assembly may now be lifted upwards to the limit of the slack in the wiring to allow access to the nuts on the underside.

5 Disconnect the leads to the AFC Invert board, desoldering where necessary, and remove the two screws, nuts, washers and spacers securing the board to the assembly.

Replace the board by reversing the procedure. When replacing the assembly on the back panel ensure the rubber grommet which protects the cables entering the underside of the assembly is correctly located. Note that the free movement of the BNC Sockets is intentional.

Removal of Crystal Calibrator Unit

1 Remove the two screws holding the Calibrator Unit mounting bracket to the Drive Assembly.

2 Disconnect the leads and lift the Unit and mounting bracket clear of the receiver. Remove the bracket from the unit. Keep the screws holding the calibrator unit separately as these are imperial and not metric as for the other units.

Removal of UHF Tuner Units

1 Remove the cover of the Amplifier part of the tuner (the larger unit) with the four screws near each corner complete with copper and rubber gaskets. Unsolder the lid on the Oscillator part of the tuner (the smaller unit).

2 Remove the cover over the terminations and unsolder the leads from the side of the amplifier unit and from the oscillator unit.

3 Remove the screws securing the units to the mounting pillars on the VHF Tuner Unit cover. The two securing the oscillator unit are nearest the centre of the second compartment from the front and the four securing the amplifier are the left-hand two in the first compartment and the two in the sixth compartment. Care must be taken not to disturb the components inside the units.

4 Lift the units to the limit of the slack in the wiring and remove the remaining coaxial cables. The units may now be lifted clear.

5 Replace the units by reversing the procedure.

Removal of Front Panel

1 Withdraw the Crystal Oscillator Unit (or the Frequency Synchroniser Unit) after removing the four screws in the panel and, in the case of the Crystal Oscillator Unit, disconnecting the 15-way plug.

2 Place the receiver so that the front panel just overhangs the front of the workbench.

3 Remove the control knobs. This is done by removing the cap to reveal the collet, and holding the knob stationary whilst turning the collet nut anti-clockwise using the box spanner supplied in the Accessories Kit. The smaller knobs may use a screw instead of a nut, the method is the same.

4 Remove the nuts and washers securing the toggle switches and PHONES jack in position. Ensure the switches do not push back to damage the tuning scale.

5 Remove the screws, nuts and washers securing the loudspeaker and meter.

6 Remove the four large screws securing the handles and the ends of the panel, noting the make-up of the spacers at the left-hand end.

7 Slacken the nuts on the two remaining large screws and unscrew these from the centre support plate, supporting the panel as it finally becomes free.

8 To replace the panel reverse the procedure. The spacing of the nuts in step 7 can be derived from the spacers removed in step 6. The switches should be located as the panel is offered up into position and care should be taken to ensure they are not pushed back to damage the tuning scale.

Removal of VHF Tuner Unit and Drive Assembly (with UHF Tuner Units if fitted)

1 Stand the receiver on its side, having removed the dust covers.

2 Desolder the two flexible earthing leads to the VHF Tuner unit on the underside of the chassis.

3 Remove the large retaining screw, nut and rubber washers at the rear of the VHF Tuner Unit.

4 Remove the Crystal Calibrator Unit and the Front Panel as described on pages 35 and 36

5 Disconnect the 15-way plug at the rear of the Tuner Unit and disconnect the cable mounted miniature coaxial plugs and sockets in the leads to the unit.

6 Unscrew and detach the 15-way socket from the left-hand side of the Crystal Oscillator Unit housing.

7 Unscrew and detach from the rear panel the following BNC sockets:

AERIAL INPUT 1 (and AERIAL INPUT 2 and AERIAL INPUT 3 if fitted), WIDEBAND INPUT, IF OUTPUT LOW LEVEL, EXT. OSC. INPUT. Ensure each is marked so that it may be replaced correctly.

8 Remove the nuts securing the Mode switch, RF/IF Gain, BFO Pitch and Audio Gain potentiometers to the front sub-panel (which is part of the Drive Assembly).

9 Remove the four smaller hexagon-headed screws near the corners of the sub-panel. The VHF Tuner Unit and Drive Assembly may now be pulled forwards, allowing the switch and potentiometers to fall clear, and completely removed. It should be rested on a soft surface or stood on its right-hand side to avoid damage.

10 Replace the assembly by reversing the procedure.

Replacement of Tuning Scale

1 Remove the Front Panel as described on pages 35 and 36

2 Remove the two countersunk screws holding the Scale Lamp Board and the Masking Plate. The Scale Lamp Board and Masking Plate may now be tilted upwards and over towards the back of the receiver to the limit allowed by the wiring. A fibre washer is located on the pin on the radial arm between the face of the arm and the cursor – ensure this washer is not mislaid.

3 Slide the cursor sideways out of the guides, noting that the slot is vertical and at the top left-hand corner.

4 Remove the two countersunk screws in each Cursor Guide and Pressure Pad assembly and remove these complete.

5 The scale is now ready to be removed. It is retained on the take-up spools by its own tendency to curl and it is simply pulled off tangentially.

6 The new scale can now be fitted. When doing so take great care so that it is not scratched or otherwise damaged. Identify the left-hand end of the scale and feed this onto the left-hand take-up spool, allowing the scale to curl around the spool. Continue feeding the scale onto this spool until the "0" mark on the logging scale is reached. Unwind the remainder of the scale and feed the right-hand end onto the right-hand spool. (It may be advisable to practise this with the discarded scale if possible). Set the "0" mark on the logging scale as near central as possible on the sprocket drum and locate the perforations on the sprocket teeth.

7 Replace the Cursor Guide and Pressure Pad assemblies and screws.

8 Tune the receiver over the full length of the scale and check that the scale runs freely. A very slight smear of petroleum jelly on the sprocket teeth may be beneficial.

9 Clean the Cursor with a perspex cleaner incorporating an anti-static agent and replace, ensuring the slot is in the correct position. The Cursor should be free to move sideways but with enough friction to prevent movement by vibration or accident.

10 Replace the Masking Plate. Ensure the pin on the radial arm enters the slot in the cursor and that the fibre washer is located correctly between the arm and the cursor. Replace the Scale Lamp Board and screws, which will then hold the Masking Plate, and recheck the cursor movement.

11 Tune the receiver fully anti-clockwise and check that the reference mark on the masking plate, the cursor and "0" on the logging scale all line up. If they do not, the scale position may be adjusted. Remove the two screws on the take-up spool brackets and carefully move the Crystal Calibrator Unit backwards a short distance. It will then be possible to gain access to the two grub screws securing the sprocket drum. These should be slackened and the scale repositioned. Ensure both drums are tight against the bearing faces (ie towards each other) and tighten both grubscrews. Replace and secure the Crystal Calibrator.

12 Replace the front panel.

FAULT DIAGNOSIS

The purpose of this section is to provide a convenient guide to a procedure which will lead to the most rapid identification of a fault area. This is not the only method, and it does not attempt to define every fault. Where it is obvious that a fault lies in one particular module, then systematic investigation of that module is advised. The performance of any module should be compared with the figures given in the "Performance Testing" and "Realignment" sections, making due allowance for normal tolerances. Most of the transistor and integrated circuit terminal voltages are given in the voltage analysis tables.

First check that the receiver is powered and all external connections are correct, also that no fuses have blown and that all controls are set correctly.

Second, switch off MUTING, AFC, WIDEBAND; set AGC to manual; advance to about 75% rotation RF GAIN, IF GAIN, AF GAIN and LINE LEVEL; switch on LS.

Thirdly establish whether lack of reception occurs on all ranges and/or in all modes and/or in all bandwidths. Table 4.1 should then be consulted.

TABLE 4.1. FAULT LOCATION GUIDE

FAULT SYMPTOM: NO RECEPTION ON ALL RANGES AND IN ALL POSITIONS OF 'MODE' AND 'SELECTIVITY' SWITCHES

POWER SUPPLIES

Check availability of main supply voltages:—

+12V at 15C3
+10V at cathode of 15D1
+10V at 15CH3, 15CH4 and 15CH5
+10V at cathode of 15D4
+5V at 15C2

} on underside of power unit chassis.

If voltages are normal check modules, etc. in the following order:—

AUDIO AMPLIFIER BOARD

Check that +12V supply is present at Pin 84; if absent test for continuity back to power unit. Check that all other connections to the module are secure.

There are two separate audio channels and it is most unlikely that both will fail simultaneously. Therefore, if no output can be obtained on both channels and the supply voltage is satisfactory it is probable that the Audio Amplifier Board is operational and the fault lies elsewhere in the receiver.

If only one audio channel is dead check the input and output leads and the appropriate gain control before carrying out a detailed examination of the circuit.

AUDIO/VIDEO SPLITTER AND VIDEO AMPLIFIER MODULE

Check that +12V supply is present at Pin 72.

Check all other connections to the module, particularly check the output for a short circuit as this will affect both audio amplifiers. Short Pin 58 to Pin 61 to by-pass the Splitter stage. If signal output can then be obtained on the Main Audio channel the Audio/Video Splitter stage should be thoroughly checked.

If no audio output is obtained when Pin 58 is connected to Pin 61 the module is probably operational but there is no signal input. Examine the screened input lead to Pin 58 for open circuit or short circuit. Also check the contacts on MODE switch wafer 1S5B.

IF PREAMPLIFIER AND FILTER MODULE

Check that +10V supply is present at Pin 12 and Pin 19 (with SELECTIVITY switch set to WIDE) and at Pin 14 (with SELECTIVITY switch set to N1). If this voltage is absent check continuity back to power unit via SELECTIVITY switch 1S3.

It is unlikely that the WIDE and N1 selectivity circuits will fail simultaneously. Therefore, if the supply voltages are normal but reception cannot be obtained in both positions of the SELECTIVITY switch the IF Preamplifier should be checked since it provides a common output to the filter circuits.

Ensure that +10V supply is present at Pin 18. Inject a modulated 21.4MHz signal at a level of 3μV. This signal is most conveniently introduced at the IF OUTPUT LOW LEVEL socket at the rear of the receiver. Alternatively the VHF aerial can be transferred to this socket, when signals on 21.4MHz should be heard if the IF Preamplifier is working correctly.

VHF TUNER UNIT

Ensure that +10V supply is present at Pin 5 and Pin 7. This supply should also be present at Pin 1 and Pin 6 on ranges 1–5 (VHF).

If the receiver incorporates a UHF Tuner Unit and there is no reception on any range then either the Mixer stage or the associated buffer stage (2TR4) is probably faulty.

When a UHF Tuner Unit is not fitted it is necessary to establish whether the fault lies in the RF Amplifier or VFO circuitry. Transfer the aerial to the WIDEBAND INPUT socket (with switch 'ON'). If signals are received (at reduced level) the fault lies in the RF Amplifier stage. If signals cannot be received the Mixer and VFO should be checked, together with the buffer stages 2TR3 and 2TR4

FAULT SYMPTOM: NO RECEPTION ON ANY RANGE IN FM MODE ONLY

FM MODULE

Ensure that +10V supply is present at Pin 27 and check security of other connections to the module.

Examine screened output lead from Pin 23 for open circuit or short circuit. Check the contacts on MODE switch wafer 1S5B. Finally check the FM Module thoroughly.

FAULT SYMPTOM: NO RECEPTION IN AM OR CW MODES. FM MODE NORMAL

MAIN IF AMPLIFIER MODULE

Ensure that +10V supply is present at Pin 32 and check that other connections to the module are secure.

Examine coaxial lead 'R' for open circuit or short circuit. Also check for short circuit on the three coaxial output leads 'T'. Check the contacts on MODE switch wafer 1S5B. Check the module.

FAULT SYMPTOM: NO RECEPTION IN AM MODE ONLY

AM DETECTOR AND IF OUTPUT MODULE

Ensure that +12V supply is present at Pin 56. Check that all connections to the module are secure. Examine coaxial input lead 'T' for open circuit. Check for short circuit or open circuit on screened output lead from Pin 53. Also check the contacts on MODE switch wafer 1S5B.

Check the module. The IF OUTPUT HIGH LEVEL should be approx. 50mV into 50Ω for 10μV at the aerial input. If this output is obtainable the fault lies in the AM Detector stage.

FAULT SYMPTOM: NO RECEPTION IN CW MODE ONLY

CW DETECTOR AND BFO MODULE

Ensure that +10V is present at Pin 49 when MODE switch is set to 'CW'. If this supply is not present check continuity back to power unit via MODE switch wafer 1S5A.

Check that all connections to the module are secure. Examine coaxial input lead 'T' for open circuit. Check the screened output lead from Pin 50 for open circuit or short circuit. Also check the contacts on MODE switch wafer 1S5B.

Finally check the module.

FAULT SYMPTOM: NO RECEPTION ON ONE OF THE VHF RANGES. OTHERWISE NORMAL

VHF TUNER UNIT

Transfer the aerial to WIDEBAND INPUT (with switch 'ON'). If signals are received (at reduced level) the RF tuned circuits and switching should be checked on the appropriate range.

If signals cannot be received the VFO tuned circuits and switching should be checked on the appropriate range.

FAULT SYMPTOM: NO RECEPTION ON UHF RANGES. OTHERWISE NORMAL

UHF TUNER UNIT

Ensure that +10V supply is available to the UHF Tuner Unit when the RANGE switch is set to either of the UHF ranges. If voltage is absent check continuity back to power unit via RANGE switch wafer 2S1J.

Check security of all connections to the unit.

The UHF Tuner Unit contains two separate UHF Tuners and it is unlikely that both will fail simultaneously. Therefore if there is no reception on both UHF ranges and the supply voltages are normal the fault is probably external to the unit. Lack of −33V supply to the tuning potentiometer (from the Voltage Inverter Unit) will inhibit tuning on both UHF ranges.

If signals cannot be received on only one UHF range examine the appropriate output leads for open circuit or short circuit. Do not overlook the diode switches in the VHF Tuner Unit (2D15, 2D16, 2D17 and 2D18) which connect the UHF oscillator and RF signals to the Mixer.

Check the appropriate UHF Tuner.

PERFORMANCE TESTING

Overall Performance

If substandard performance is suspected, the receiver should be withdrawn from service and subjected initially to the overall performance checks detailed below. The use of the test equipment listed is recommended, but other equipment with equivalent specification and performance can be used. The internal meter can be used for many of these checks provided the line output (Ancillary socket pins 9 and 11) is terminated in 600Ω.

RF Signal Generator 10–520MHz AM/FM/CW.
1mW output into 50Ω. Marconi TF2015.

Audio Signal Generator 20Hz–20kHz.
Marconi TF2000.

Output Meter 1mW–10W, load 3Ω minimum.
Marconi TF893A.

High Impedance Voltmeter. Max. sensitivity 1mV, frequency range 0Hz–1000MHz.
Marconi TF2603.

Multimeter 20kΩ/V.
AVO 8.

HF Oscilloscope. Input impedance 1MΩ in parallel with 20pF.

Frequency Counter. Max. frequency 520MHz.
Racal 9025.

For visual alignment a Rhode and Schwartz Polyskop is recommended.

Overall Sensitivity

Set the controls as follows:

RF Gain:	MAX	Supply:	as required	
IF Gain:	MAX	BFO:	±2kHz	
BFO Pitch:	CENTRE	Muting:	OFF	
Selectivity:	NI	AGC:	SHORT	
Mode:	AM	AFC:	UP (AFC OFF)	
AF Gain:	As required	Cal:	OFF	
LS:	ON	Tune/Lock:	TUNE	} depends if Synchroniser or
Meter:	AF	Crystal:	NORMAL	} Crystal Unit is fitted

Set the signal generator to 180MHz, 30% Amplitude modulation at 1kHz and connect to AERIAL INPUT 1.

Connect the AF Power Meter to Pins 1 and 2 on ancillaries socket and match to 3Ω impedance. Tune the receiver on range 5 and check that a Signal/Noise ratio of 10dB is obtained for an RF input of less than 5μV.

Repeat this for a frequency near the centre of each range. Note that AERIAL INPUT 2 and AERIAL INPUT 3 should be used for ranges 6 and 7 respectively, for units fitted with UHF tuners. The figures which should be obtained are listed in Table 4.2. If several, but not all, ranges are low it is likely that the RF stages are faulty. If all ranges are consistently low repeat with Mode set to CW and signal generator MODULATION OFF. Repeat again with Mode set to FM and signal generator set to FM 22.5kHz deviation at 1kHz. The figures in Table 4.2 should be obtained.

If all are again consistently low, then it is likely that a fault lies in the IF Preamplifier, Filter, Audio/Video splitter or Audio Output stages.

Transfer the Power Meter to the 600Ω output (Ancillaries socket pins 9 and 11) to determine whether this also is low, but beware of double-terminating this. It should agree with the internal meter and should be 10mW at maximum gain.

Check also the video outputs – nominal output is 1V p-p into 75Ω (or 1.6mW into 75Ω). If all are consistently low, then the fault is likely to be in the IF stages.

IF Sensitivity

Set the signal generator to 21.4MHz, 30% Amplitude Modulation at 1kHz. Disconnect the coaxial lead between the VHF Tuner and the IF Preamplifier and Filter Module (lead E) and connect the signal generator to this. With the AF gain control set to maximum and Selectivity to WIDE, the output should be 100mW for 6μV input. Check that the same output ±2.5dB is obtained with the selectivity control set to NARROW 1. Check that a S/N ratio of 10dB is obtained for all positions of the selectivity switch for an input of 4μV. This will reveal if the IF sensitivity is low. Reconnect lead E.

Image Rejection

Set the signal generator to 3μV and connect to Input 1. Tune the receiver to a convenient frequency near the centre of each band and tune the signal generator to a frequency 42.8MHz above the signal except for range 5, when the signal generator should be 42.8MHz below signal frequency. Figures of greater than 50dB should be obtained for frequencies in the range 25–235MHz, >35dB for 240–500MHz. (N.B. Use inputs 2 and 3 for ranges 6 and 7 respectively).

IF Rejection

Set the signal generator to 3μV and connect to Input 1. Tune the receiver to a convenient frequency near the centre of each band and with the signal generator set to 21.4MHz check the rejection is >45dB from 25–39MHz, >70dB from 40–500MHz. (N.B. Use inputs 2 and 3 for ranges 6 and 7 respectively).

AFC Capture

Set AFC off, Synthesiser to TUNE or Crystal to NORMAL as appropriate, and Muting OFF. With the signal generator set to 10μV output at 220MHz, tune in the receiver. Adjust the receiver frequency by ½% either side of the centre frequency and check that when AFC is switched ON, the receiver pulls into tune. Recheck at 135MHz on range 4.

Selectivity

Disconnect the coaxial lead between the VHF tuner and the IF Preamplifier and Filter Module (lead E) and connect the signal generator to this. Set the signal generator to 5μV output at 21.4MHz and the AF gain to a suitable value. Check which filters are in use and check that the following figures are obtained.

Wide (LC filter)	–3dB points at 21.4MHz ±125kHz	
Narrow (30kHz)	–3dB points at 21.4MHz ±15kHz	–60dB at ±50kHz
Narrow (15kHz)	–3dB points at 21.4MHz ±7.5kHz	–60dB at ±25kHz
Narrow (7.5kHz)	–3dB points at 21.4MHz ±3.75kHz	–60dB at ±12.5kHz

Reconnect lead E.

AGC Action

Connect the signal generator to Input 1. With the generator and receiver set to the same frequency, check that the output of the receiver changes by less than 10dB for a change in the input of 80dB, starting from the figure given (e.g. 3μV →30mV). Check at the frequencies given in Table 4.2. (N.B. Use inputs 2 and 3 for ranges 6 and 7 respectively).

IF Outputs

With the signal generator set to 10μV at any convenient frequency, check that the IF outputs are as follows.

Low level output 15μV into 50Ω	(Wide bandwidth)
High level output 50mV into 50Ω	(Bandwidth as set by selectivity control).

Muting Action

Connect the signal generator to Input 1, set at 180MHz, 30% AM at 1kHz. Set Muting ON, muting preset control to MAXIMUM. The muting should lift for an input >5μV. Check that the figures given in Table 4.2 are obtained over the rest of the range.

Frequency Accuracy

Set "calibration adjust" control central, set internal crystal oscillator to 10MHz and check that a harmonic of the crystal oscillator appears every 10MHz over the entire range with an accuracy of ±½% up to 235MHz and ±1% above 235MHz. It may be convenient to use the 1MHz facility on the lower ranges. Spurious responses from the crystal should be at least 20dB below the wanted harmonics.

Range	1			2			3			4			5			6			7		
Frequency (MHz)	25	34	39	38.5	52	60	60	82	95	88	120	140	140	200	235	240	290	360	360	410	500
CW Sensitivity (μV)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	2	2	2	2	2	2	2	2
AM Sensitivity (μV)	3	3	3	3	3	3	3	3	3	3	3	5	5	5	5	5	5	5	5	5	5
AGC Action (AM) Onset for 10dB Change for 80dB input range (μV)	3	3	3	3	3	3	3	3	3	3	3	5	5	5	5	5	5	5	5	5	5
Muting Level (AM) (μV)	3	3	3	3	3	3	3	3	3	3	3	5	5	5	5	5	5	5	5	5	5
FM Sensitivity (μV)	3	3	3	3	3	3	3	3	3	3	3	5	5	5	5	5	5	5	5	5	5

Table 4.2 Performance Data (also see text)

REALIGNMENT

General

All modules and units employed in the receiver are pre-aligned on factory test jigs before they are fitted to the main chassis assembly, and further adjustment to the module circuits is not normally required. Replacement Modules or Units supplied for user servicing are also pre-aligned in this way and can be installed without the need for major adjustment. Instructions for carrying out any minor adjustments which may be required in some cases due to design or other changes will be furnished with the replacement item.

Realignment should be carried out only by skilled technicians having a sound knowledge of the procedures and the special techniques involved, particularly where adjustments to the UHF tuners may be contemplated. If there is any doubt as to the ability to carry out the complete realignment, then the receiver may be returned to the manufacturer for attention, full details are given in the introduction to this manual. When dealing with the modules where high frequency operation is involved it will be necessary to manufacture locally dummy lids which have the necessary holes cut to allow access to the adjustment points. The original lids may be used as templates for this. After making the adjustments, refit the original lid and ensure that the adjustment is still correct. A very slight readjustment may in some cases be required. All preset adjustments – trimmers, cores etc. – are self-locking, and need not be sealed with wax or similar compounds.

Power Supply and Voltage Inverter Unit

WARNING: DISCONNECT COMPLETELY FROM SUPPLY AND ALLOW ALL ELECTROLYTIC CAPACITORS TO DISCHARGE COMPLETELY

Check the supply rails for short circuits, the resistance to earth should be approx. 16Ω for the +12V, +10V to RF head, +10V general; 10Ω for the +5V; 700Ω (with synchroniser fitted) for the −18V and and 7kΩ and 20kΩ for the −30V negative and zero lines respectively to the UHF tuner.

Check the resistance from mains input live and neutral to earth, this should be greater than 20MΩ.

Now connect the mains to the receiver and switch on.

Check the +12V line (Red leads on terminations adjacent to electrolytic capacitors) and adjust if necessary by means of 15RV1 to obtain exactly +12V.

Check both +10V lines (measure across zener diodes 15D1 and 15D4). These should be within the range +9.5V to +10.5V.

Check the +5V line (measure across 15C2). This should be within the range +4.75V to +5.25V.

Check the −18V line (measure on pin 110, Yellow lead) and adjust 16RV3 for exactly −18V.

Check the 33V supply (screened lead on voltage inverter unit pins 115 and 116) and adjust if necessary by means of 16RV4 to obtain exactly 33V. Note that this supply is floating with respect to ground and should be measured across pins 115 and 116.

Initially set the controls as follows:

RF Gain:	MAX	Muting:	OFF	
IF Gain:	MAX	AGC:	MANUAL	
Mode:	AM	Waveband:	RANGE 1	
Selectivity:	WIDE	Crystal:	NORMAL	as appropriate
AF Gain:	MID position	Synchroniser:	TUNE	as appropriate

IF Stages

Connect an output power meter matched to 3Ω to pins 1 and 2 of ancillary socket. Disconnect tuner output from IF input (lead E). Set the signal generator to 21.4MHz Amplitude modulated 30% at 1kHz and connect to IF input (lead E). Adjust the AF gain to maximum and set the signal generator to obtain an output of 100mW, (the generator level should be approx. 2μV). Repeat with the selectivity control set first to N1 then to N2. The output for each should be 100mW ±2.5dB.

Slowly decrease the IF gain and check that the output falls in sympathy with this. Any instability will be revealed by the output rising and then falling away more quickly. If instability is present check all connections to the IF amplifier and selectivity modules paying particular attention to the earth connections.

Set the signal generator output to obtain a signal/noise ratio of 10dB. It should be approx. 4μV for all positions of the selectivity control.

CW Detector and BFO Module

Remove the modulation from the signal generator and set to 5μV, set Mode switch to CW and BFO switch to ±2kHz. Adjust RV1 and RV4 in BFO module to give ±2kHz (+0.5kHz −0) at each end of the BFO Pitch control and zero at centre. Similarly adjust RV2 and RV3 with the switch set to ±100Hz (+100Hz −0). Switch BFO off.

Filter Unit

Set Mode switch to AM and selectivity to WIDE.

(a) Set the signal generator to 21.4MHz with 30% AM at 1kHz to give a receiver output of 100mW. Start with all cores near the top of the formers. Tune cores of L1, L4, L7 and L8 for maximum output, reducing the generator voltage as necessary.

(b) Set the signal generator to 22.7MHz, increase output to give a receiver output of 50mW and tune L2 and L5 for minimum, increasing generator voltage as necessary.

(c) Set the generator to 20MHz and adjust output to give a receiver output of 50mW and tune L3 for minimum, increasing generator voltage as necessary.

(d) Set the generator to 19.9MHz and adjust output to give a receiver output of 50mW and tune L6 for minimum, increasing generator voltage as necessary.

Repeat operations (a)—(d) until no further improvement is possible.

Tune the generator to 21.4MHz and adjust to give a receiver output of 50mW. Check that in both NARROW positions of the selectivity switch the output does not vary from the WIDE position by more than 3dB. If output in WIDE is more than 3dB below that in NARROW 1, readjust the core of L2 slightly in an anti-clockwise direction to improve the balance.

Check that the selectivity is within the limits below:

SELECTIVITY	−3dB	−6dB	−60dB
WIDE	180—250kHz	250—350kHz	1800—2250kHz
NARROW*	28—32kHz		45—65kHz
NARROW*	14—16kHz		25—35kHz
NARROW*	7—8kHz		12.5—17.5kHz

(*) according to filter fitted.

For both the NARROW positions of the switch check that the ripple is less than 3dB.

AM Detector and IF Output

Adjust signal generator for 60% modulation, and adjust output for 10mV measured at input T of the module, using a high impedance RF millivoltmeter.

Adjust C8 for maximum output from receiver. The audio output measured across pins 53 and 54 should be 3.2—4.4V p-p and IF output high level on pin U should be 1.5—2.5V p-p.

Do not adjust T1 core.

FM Module

Set Mode switch to FM, tune signal generator to 21.4MHz modulation off. Connect a valve voltmeter to the test point, set to 10mV range. Start with all cores near the top of the formers, and adjust L1 and L2 for maximum at test point, reducing signal generator output as necessary. Set the generator for 20mV at the test point, and check that the −3dB points are within the limits (21.1MHz–21.25MHz) and (21.55MHz–21.7MHz). Set the generator to 21.4MHz and transfer the meter to terminals 22 and 25. Set the internal meter to either AM or RF and the external meter to 1.5mA centre zero. Adjust L3 for zero current increasing meter sensitivity as necessary. Check the discriminator curve lies within the limits below:

21.1MHz	16–22.5μA
21.2MHz	10.5–14.5μA
21.3MHz	5.5–6.5μA
21.4MHz	0
21.5MHz	5.5–6.5μA
21.6MHz	11.5–15.5μA
21.7MHz	19–25μA

Muting and IF AGC Module

Check voltage across 12D3 is +6V ±10%.

Set Generator to 21.4MHz, modulation off. Disconnect lead T and connect generator set to 10mV output. Adjust RV1 fully anti-clockwise from the top of the board. Connect a 2.2kΩ resistor across terminals 40 and 42, also connect the voltmeter in parallel on 10V range. Set AGC Switch to Manual. Tune trimmer C17 for maximum keeping voltmeter reading below 4V by adjusting generator output as necessary, then check that the maximum output voltage obtainable is between 5.5V and 5.85V. Reduce generator output and check that for 5V DC generator output is 1–2.1mV. Reduce generator output further and check that for 2V DC generator output has been reduced by 5–7dB. Set generator to 1.8mV and adjust RV1 for +3V.

Reconnect lead T.

Switch Muting off. Connect Generator to E and set to 21.4MHz FM at 23kHz. Set Muting Level to give 3V at pin 39.

Switch receiver to FM and connect a valve voltmeter across pins 34 and 35, also connect a valve voltmeter to test point set to 1.5V DC.

Tune core of T1 for maximum reading. Check the voltage on pin 38, this should be 1.8–2.0V for zero input (pin 34), 9V for 40–55mV input and 1.8–2.0V for 30–40mV input.

Audio/Video Splitter

Disconnect input lead from pin 58 and connect audio generator set to 50mV rms at 1kHz.

Adjust RV1 to give 1V p-p on each video output (pins 70 and 71). Check that the response is less than 3dB down at 20Hz and less than 3dB down at 1MHz.

Check the audio output is in the range 90–120mV p-p and that the relative response is less than 6dB down at 20Hz and 14kHz.

Reconnect lead E.

Switch meter to RF, switch signal generator carrier off and adjust 4RV7 at rear of receiver to set meter to LH end of the scale. Switch carrier on and check that the approximate calibration is as follows:

(deflection as a percentage of full scale)

1μV	15–22.5
10μV	18–32
100μV	38–50
1mV	72–93
10mV	76–96

Crystal Calibrator

Switch calibrator to 10MHz and check that the crystal is oscillating. Connect a frequency counter to G1 of TR1 (i.e. junction of R3, R4 and C5) and adjust C3 to give a frequency of 10.0000MHz. Switch to 1MHz and check frequency is 1MHz. Check that the output is modulated at approx. 800Hz.

Crystal Oscillator Unit

Connect signal generator set to 5μV CW output to aerial input 1, set receiver mode to CW, BFO ON and BFO pitch MID-POSITION. Switch the crystal selector to the 1st position and tune signal generator to the frequency shown. Tune the receiver to the approximate frequency to give maximum amplitude on the receiver internal meter (set to RF).

Adjust the crystal trimmer capacitor C1 to obtain approximately the correct frequency and then adjust the core of the crystal coil L1 to give zero audio beat. Adjust trimmer C40 on multiplier board to give maximum RF level on the internal meter and note the reading. De-select and re-select the crystal a few times and ensure that it oscillates each time. If necessary adjust C1 and repeat the procedure.

Repeat for each crystal fitted, using the appropriate adjustments (XL2, L2, C41, C2; XL3, L3, C42, C3 etc.).

Switch crystal selector to manual and tune in signal. Check that the signal level is 5μV (10μV on UHF) ±3dB to obtain the same meter reading as above.

Adjust RV1 on multiplier board to give approximately −5.1V on the wiper. Switch AFC ON and tune receiver to the centre of the AFC capture range, reducing the signal generator output as necessary. Switch AFC OFF and slightly adjust RV1 to tune the signal correctly.

PROCEDURE WITH A NEW CRYSTAL

Switch crystal selector to the new crystal channel and tune signal generator and receiver as above. Adjust crystal trimmer (C1–C10 as appropriate) until crystal oscillates, then adjust crystal coil (L1–L10) for zero beat frequency. If this is not possible and the frequency is lower than that required, remove the centre top lead from the crystal coil and insert a small capacitor in the range 4.7–68pF in series. Readjust the crystal coil as necessary and adjust the trimmer on the multiplier board with the correct multiplier coil fitted for maximum RF as above. De-select and re-select the new crystal a few times and check that it oscillates each time. Adjust the crystal trimmer if necessary and repeat the procedure.

VHF Tuner

Disconnect lead C and connect a supply of −5.0V to terminal C. Connect frequency counter to oscillator test point.

1 Switch to range 1 and set to 25MHz on dial. Adjust L6 for a counter reading of 46.4MHz.

2 Set to 39MHz on dial and adjust C43 for a counter reading of 60.4MHz.

Repeat this procedure for ranges 2, 3, 4 and 5 as per Table 4.3 below.

Range	Dial Freq.	Adjust	Counter Freq.	Dial Freq.	Adjust	Counter Freq.
1	25MHz	L6	46.4MHz	39MHz	C43	60.4MHz
2	39MHz	L7	60.4MHz	60MHz	C44	81.4MHz
3	60MHz	L8	81.4MHz	95MHz	C45	106.4MHz
4	87MHz	L9	108.4MHz	140MHz	C46	161.4MHz
5	140MHz	L10	118.6MHz	235MHz	C47	213.6MHz

Table 4.3 VHF Tuner Alignment Oscillator Section

Check the oscillator output voltage (measured at the test point) is within the limits below.

Range 1	500–900mV
Range 2	500–900mV
Range 3	500–900mV
Range 4	450–650mV
Range 5	400–650mV

Connect Polyskop output to aerial input and high level IF output to Polyskop input. Switch receiver filter to WIDE and mode to AM.

3 Switch to range 1 and set dial to 25MHz. With Polyskop set to appropriate range adjust L1, L11 and L16 for maximum output, keeping Polyskop output at minimum.

4 Set dial to 39MHz and adjust C1, C16 and C21 for maximum.

Repeat 3 and 4 until no further change is required.

Repeat this procedure for ranges 2, 3, 4 and 5 as per Table 4.4 below.

Range	Dial Freq.	Adjust	Dial Freq.	Adjust
1	25MHz	L1, L11, L16	39MHz	C1, C16, C21
2	39MHz	L2, L12, L17	60MHz	C2, C17, C22
3	60MHz	L3, L13, L18	95MHz	C3, C18, C23
4	87MHz	L4, L14, L19	140MHz	C4, C19, C24
5	140MHz	L5, L15, L20	235MHz	C5, C20, C25

Table 4.4 VHF Tuner Alignment Amplifier Section

With the receiver set to Range 5, switch selectivity to N1 and mode to CW. Remove Polyskop and switch crystal calibrator to 10MHz and check frequency calibration from 230MHz down to 140MHz. The maximum error should be within 0.5%. If not, start at the highest frequency and adjust the vanes of the oscillator section gang to correct this.

Reconnect Polyskop, and set receiver up as before. Starting at 235MHz, adjust mixer, RF and aerial section vanes for correct tracking down to 140MHz. Ensure that the tuning gang rotates freely and that there are no short circuits.

Connect Polyskop input to low level IF output and disable oscillator by removing its power supply link in the +10V rail. Check the bandwidth of RF circuits at LF, Centre and HF end on all ranges. The 6dB points should lie within the limits below.

Range 1	1–2.5MHz
Range 2	1.5–4.5MHz
Range 3	1.5–4.5MHz
Range 4	2.5–8.5MHz
Range 5	3.5–8.5MHz

Finally reconnect lead C and check the Signal/Noise ratio, image rejection and IF rejection on ranges 1–5 as in the 'Performance Testing' section.

UHF Tuner (235–365MHz Range)

Connect frequency counter to terminal J and switch to range 6.

Switch AFC OFF.

Set trimmer C46 approx. 1/16" below top and set RV7 to mid position.

1 Tune to 235MHz and adjust C46 to produce a frequency of 256.4MHz.

2 Tune to 365MHz and adjust RV7 to produce a frequency of 386.4MHz.

Repeat 1 and 2 as necessary until no further adjustment is required.

Check that the frequency coverage is smooth without any jumps over the range.

Replace the counter by a valve voltmeter and check that the output is 350–600mV at the HF end and 500–900mV at the LF end.

Remove the valve voltmeter and connect a signal generator to aerial input 2. Set trimmers C6, C12 and C18 level with the top and set RV1, RV2 and RV3 to mid position.

Connect the valve voltmeter on 1mV range to pin M.

3 Set the generator to 365MHz with an output level of 10mV and set receiver to 365MHz. Adjust RV1, RV2 and RV3 for maximum, reducing generator output as necessary.

4 Set generator and receiver to 235MHz and adjust C6, C12 and C18 for maximum, reducing generator output as necessary.

Repeat 3 and 4 until no further adjustment is required.

Check that gain is within the limits below.

235MHz	14–20dB
290MHz	18–24dB
360MHz	16–22dB

Check that the image rejection at these frequencies +42.8MHz is greater than 40dB.

UHF Tuner (360–500MHz Range)

Connect frequency counter to terminal K and switch to range 7. Switch AGC OFF.

Set trimmer C56 approx. 3/16" below top and set RV8 to mid position.

1 Tune to 360MHz and adjust trimmer C56 to produce a frequency of 381.4MHz.

2 Tune to 500MHz and adjust RV8 to produce a frequency of 521.4MHz.

Repeat 1 and 2 as necessary until no further adjustment is required.

Check that the frequency coverage is smooth without any jumps over the range.

Replace the counter by a valve voltmeter and check that the output voltage is 300–600mV at the HF end and 500–800mV at the LF end.

Remove the valve voltmeter and reconnect to terminal N. Set to 1mV range. Connect a signal generator to aerial input 3.

3 Set the signal generator to 10mV at 500MHz and set the receiver to 500MHz. Adjust RV4, RV5 and RV6 for maximum, reducing generator output as necessary.

4 Set the generator and receiver to 360MHz and adjust C26, C32 and C38 for maximum, reducing the generator output as necessary.

Repeat 3 and 4 until no further adjustment is required.

Check that the gain is within the limits below.

365MHz	12–16dB
410MHz	14–18dB
500MHz	15–20dB

Check that the image rejection at these frequencies +42.8MHz is greater than 40dB.

AFC

Connect generator to lead E. Connect meter on 12V DC range to terminal S on FM Module and check that the AFC voltages are within the limits below.

21.3MHz	5.15–5.55V
21.4MHz	4.9 –5.3V
21.5MHz	4.6 –5.0V

Similar, but negative, voltages should also appear on VHF Tuner Unit lead C with AFC switched ON (except on range 5, when the sense is reversed (21.5MHz: 5.35V nominal, 21.3MHz: 4.8V nominal) to take account of the inverted IF).

On the UHF Tuner Unit lead L, the voltages should be:

21.3MHz	-5.15 – -5.55V
21.4MHz	-4.9 – -5.3V
21.5MHz	-4.6 – -5.0V

Meter

Switch to FM and in the absence of any signal slightly adjust L1 and L2 in the FM module to give centre scale.

Switch to AF, signal generator modulation OFF and adjust RV1 on audio amplifier board to set the meter pointer to the left-hand end of the scale. Switch modulation ON and adjust for 10mW audio (line) output. If necessary adjust 14R16 so that the meter reads to within $\pm 1/8$" (3mm) of "10mW" scale marking.

The RF position will have been checked with the FM module.

Frequency Synchroniser

This unit is extremely complex and cannot normally be adjusted without the use of test jigs. In the event of a fault developing, the unit should be returned to the manufacturer for attention. If this is impractical, a separate manual is available but it will be necessary to manufacture locally an extender jig to enable the receiver power supplies to be used. Alternatively laboratory power supplies may be used.

Only the oscillator adjustment and meter zero are accessible without removing the case. Access to the former is by removing the plated button on the bottom of the unit, and should be adjusted so as to tune a known frequency exactly. The latter is located immediately behind the front panel and should be set so that a correctly tuned frequency gives a meter deflection in the centre of the scale.

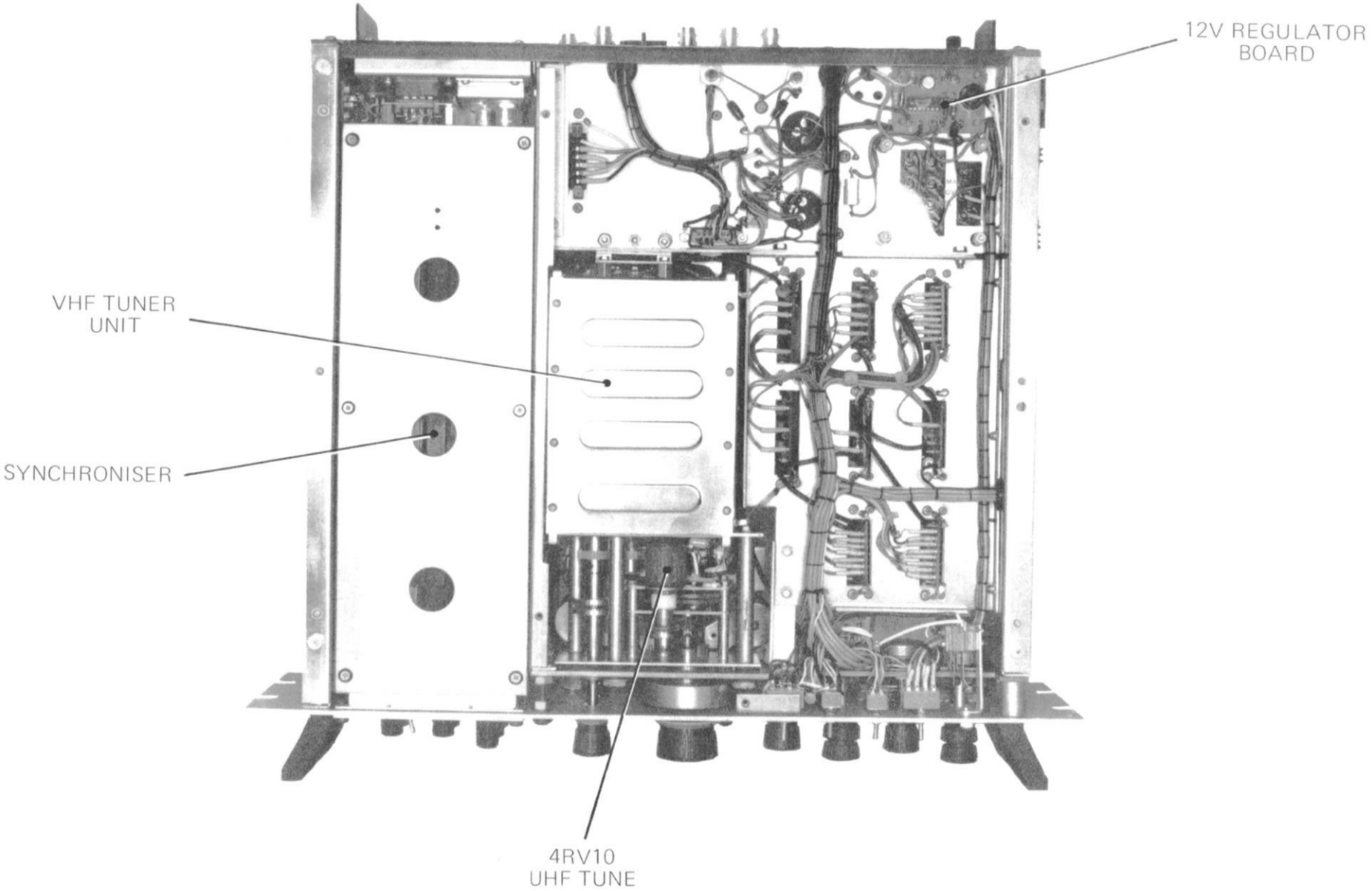


Fig. 4.1 Underside view of receiver with covers removed

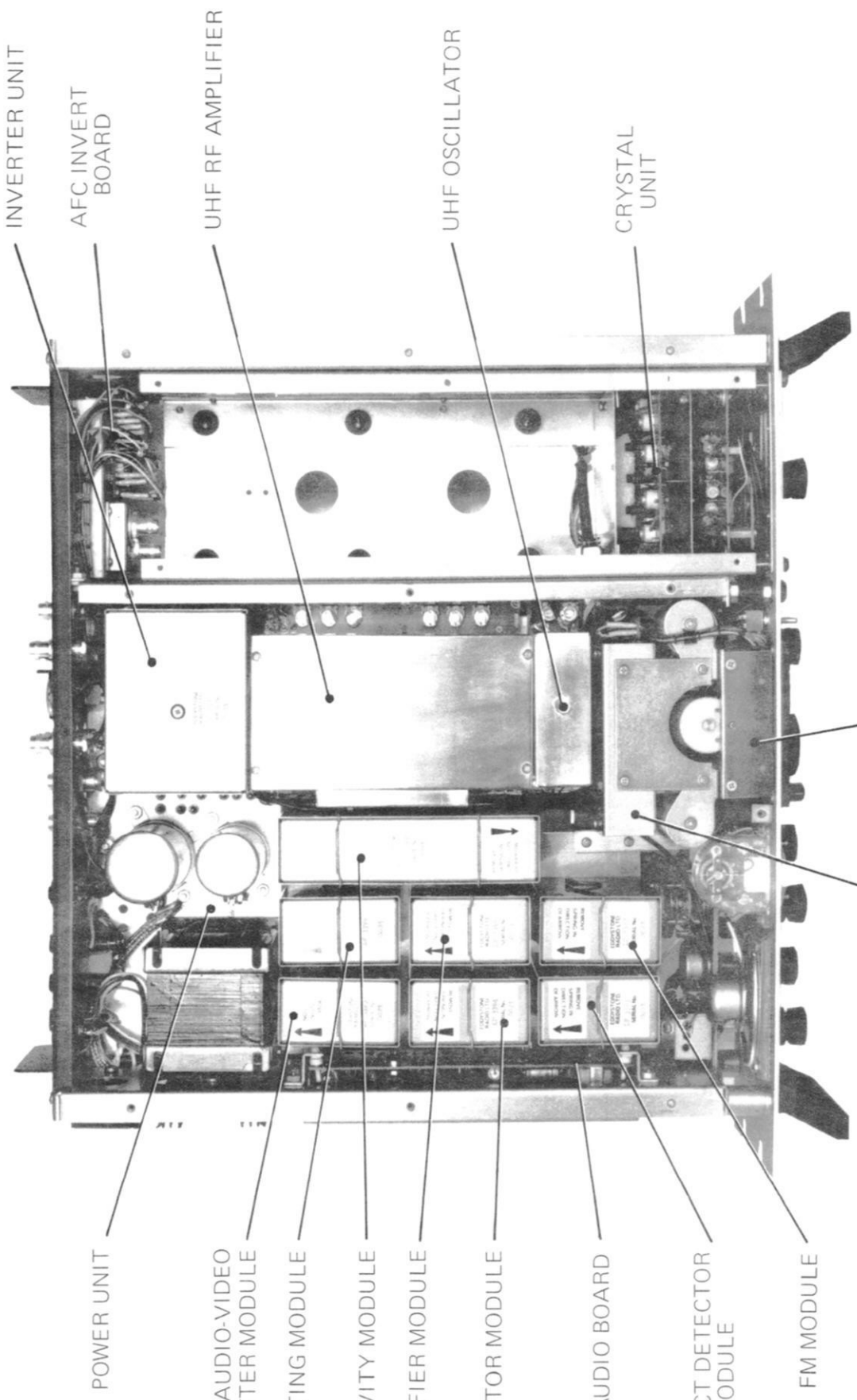


Fig. 4.2 Plan view of receiver with covers removed

REF.	EMITTER/ SOURCE	BASE/ GATE 1	GATE 2	COLLECTOR/ DRAIN
1TR2	13.3V	13.7V	–	19.0V
2TR1	1.7V	1.3V	3.8V	9.0V
2TR2	1.3V	0V	–	9.0V
2TR3	7.6V	7.5V	–	9.6V
2TR4	5.0V	5.5V	–	9.0V
2TR5	3.8V	4.6V	–	8.1V
3TR1	2.1V	2.6V	–	9.5V
3TR2	0.65V	1.0V	–	9.6V
3TR3	6.6V	7.3V	–	9.6V
5TR1	1.25V	1.65V	2.35V	7.0V
5TR2	1.75V	2.3V	–	5.5V
6TR1	0.75V	0V	–	9.8V
6TR2	1.6V	0V	–	9.9V
6TR3	1.9V	1.3V	2.9V	9.2V
6TR4	0.9V	0V	–	9.8V
6TR5	1.5V	2.2V	–	6.2V
6TR6	0.9V	0V	–	9.8V
6TR7	1.3V	2.0V	–	6.3V
7TR1	4.2V	5.0V	–	9.6V
7TR2	1.9V	2.3V	–	5.7V
8TR1	5:7V	5.0V	–	–5.1V
8TR2	0.7V	0V	–	–5.1V
10TR1	0.75V	1.45V	–	11.25V
10TR2	0V	0.75V	–	7.3V
10TR3	2.6V	3.3V	–	11.75V
11TR1	1.5V	2.0V	–	9.8V
11TR2	0.7V	1.5V	–	6.6V
11TR3	1.7V	2.3V	–	6.3V
12TR1	4.4V	4.9V	–	9.2V
12TR2	3.0V	3.7V	–	9.2V
12TR3	0V	0V	–	10V
13TR1	1.2V	0V	–	9.0V
13TR2	0V	–0.7V	–	0V
13TR3	0.1V	0V	–	6.6V
14TR1	1.1V	0V	–	11.7V
14TR2	4.1V	3.2V	–	0.7V
15TR1	12.5V	13.3V	–	19.0V
16TR1	0V	0.65V	–	11.5V
16TR2	0V	0.65V	–	11.5V
16TR3	–18V	–19.5V	–	–28.5V
16TR4	–33V	–34.1V	–	–40.5V
16TR5	–19.5V	–28.5V	–	–18.5V
16TR6	–27V	–40.5V	–	–34.1V

Table 4.5 Transistor Voltages

REF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2IC2	–	-5V	-5V	-18V	–	-10.8V	10V	–	–	–	–	–	–	–	–	–
3IC1	+5V	–	-18V	–	-18V	–	–	–	–	–	–	–	–	–	–	–
5IC1	1.4V	1.4V	1.3V	1.3V	1.3V	1.2V	0V	1.2V	1.2V	1.2V	1.4V	1.2V	1.2V	5.4V	–	–
5IC2	1.48V	0V	–	–	5.4V	0V	–	–	–	0V	0.8V	2.2V	–	0.8V	–	–
7IC1	–	3.5V	0V	2.8V	7V	10V	10V	–	–	–	–	–	–	–	–	–
7IC2	1.8V	1.8V	1.8V	0V	0V	5V	5V	5.6V	5.6V	5.6V	10V	–	1.5V	0V	4.6V	0V
9IC1	–	6.4V	1.8V	0V	0.9V	0.9V	0V	0V	–	–	–	–	–	–	–	–
9IC2	–	6.4V	2.0V	0V	0.9V	0.9V	0V	0V	–	–	–	–	–	–	–	–
9IC3	–	6.4V	2.1V	0V	0.9V	0.9V	0V	0V	–	–	–	–	–	–	–	–
11IC1	1.6V	0.9V	0.9V	1.6V	5.2V	8.4V	0V	5.4V	9.3V	5.3V	–	–	–	–	–	–
12IC1	–	2V	0.05V	0V	–	2V	10V	–	–	–	–	–	–	–	–	–
12IC2	–	6.2V	2V	0V	1V	1V	0V	0V	–	–	–	–	–	–	–	–
13IC1	1.4V	3.1V	2.5V	2.5V	11.4V	1.5V	1.4V	11.3V	12V	12V	3.6V	3.8V	–	–	–	–
14IC1	0V	7V	–	6.3V	–	6V	–	9.5V	11.6V	–	12V	–	6.3V	–	–	–
14IC2	0V	0.7V	9.5V	4.5V	–	–	–	–	–	–	–	–	–	–	–	–
15IC1	5V	12V	0V	–	–	–	–	–	–	–	–	–	–	–	–	–
16IC1	–	–	–	14.6V	14.6V	11V	-18V	–	18.5V	–	6V	6V	11V	–	–	–
16IC2	–	–	–	27V	27V	23V	-30V	–	31V	–	18V	18V	23V	–	–	–

Table 4.6 Integrated Circuit Voltages

APPENDIX A

LIST OF CAPACITORS, RESISTORS AND SEMICONDUCTORS

Location Code

Each component reference in the Tables which follow is prefixed by a number which will assist in component location. Coding is as follows:—

1. Regulator Board
2. VHF Tuner Unit
3. Crystal Oscillator Unit
4. Miscellaneous
5. Crystal Calibrator Unit
6. IF Preamplifier and Filter Module
7. FM Module
8. AFC Invert Board
9. Main IF Amplifier Module
10. AM Detector and IF Output Module
11. CW Detector and BFO Module
12. Muting and IF AGC Module
13. Audio/Video Splitter and Video Amplifier Module
14. Audio Board
15. Power Supply Unit
16. Voltage Inverter Unit
17. 235—365MHz Tuner / 360—500MHz Tuner } UHF Tuner Unit

Capacitors

Ref.	Value	Type	Tolerance	Wkg. Voltage
1C4	500pF	Polystyrene	5%	125V
2C1	2.5—6pF	Ceramic Trimmer	—	—
2C2	2.5—6pF	Ceramic Trimmer	—	—
2C3	2.5—6pF	Ceramic Trimmer	—	—
2C4	2.5—6pF	Ceramic Trimmer	—	—
2C5	0.8—6pF	Ceramic Trimmer	—	—
2C6	5—37pF	Air-spaced variable	—	—
2C7	10pF	Disc Ceramic	5%	200V
2C8	0.001μF	Leadless Disc Ceramic	20%	500V
2C9	0.001μF	Leadless Disc Ceramic	20%	500V
2C10	5—37pF	Air-spaced variable	—	—
2C11	0.001μF	Disc Ceramic	20%	500V
2C12	0.01μF	Disc Ceramic	+80%—20%	250V
2C13	0.001μF	Leadless Disc Ceramic	20%	500V
2C14	0.001μF	Leadless Disc Ceramic	20%	500V

Capacitors (Cont.)

Ref.	Value	Type	Tolerance	Wkg. Voltage
2C15	0.001 µF	Leadless Disc Ceramic	20%	500V
2C16	2.5–6pF	Ceramic Trimmer	—	—
2C17	2.5–6pF	Ceramic Trimmer	—	—
2C18	2.5–6pF	Ceramic Trimmer	—	—
2C19	2.5–6pF	Ceramic Trimmer	—	—
2C20	0.8–6pF	Ceramic Trimmer	—	—
2C21	4.5–20pF	Ceramic Trimmer	—	—
2C22	4.5–20pF	Ceramic Trimmer	—	—
2C23	4.5–20pF	Ceramic Trimmer	—	—
2C24	4.5–20pF	Ceramic Trimmer	—	—
2C25	1.2–10pF	Ceramic Trimmer	—	—
2C26	5–37pF	Air-spaced variable	—	—
2C27	100pF	Disc Ceramic	5%	200V
2C28	0.001 µF	Disc Ceramic	20%	500V
2C29	0.001 µF	Disc Ceramic	20%	500V
2C30	0.001 µF	Disc Ceramic	20%	500V
2C31	82pF	Tubular Ceramic	5%	200V
2C32	150pF	Tubular Ceramic	5%	200V
2C33	150pF	Tubular Ceramic	5%	200V
2C34	150pF	Tubular Ceramic	5%	200V
2C35	4.7pF	Tubular Ceramic	.5pF	200V
2C36	15pF	Tubular Ceramic	5%	200V
2C37	4.7pF	Tubular Ceramic	.5pF	200V
2C38	12pF	Tubular Ceramic	5%	200V
2C39	4.7pF	Tubular Ceramic	.5pF	200V
2C40	8.2pF	Tubular Ceramic	.5pF	200V
2C41	3.3pF	Tubular Ceramic	.5pF	200V
2C42	3.3pF	Tubular Ceramic	.5pF	200V
2C43	2.5–6pF	Ceramic Trimmer	—	—
2C44	2.5–6pF	Ceramic Trimmer	—	—
2C45	2.5–6pF	Ceramic Trimmer	—	—
2C46	2.5–6pF	Ceramic Trimmer	—	—
2C47	0.8–6pF	Ceramic Trimmer	—	—
2C48	3.3pF	Tubular Ceramic	.5pF	200V
2C49	5–37pF	Air-spaced variable	—	—
2C50	0.001 µF	Leadless Disc Ceramic	20%	500V
2C51	0.001 µF	Disc Ceramic	20%	500V
2C52	10pF	Tubular Ceramic	10%	750V
2C53	0.001 µF	Leadless Disc Ceramic	20%	500V
2C54	0.001 µF	Disc Ceramic	20%	500V
2C55	0.1 µF	Polycarbonate	20%	100V
2C56	0.001 µF	Disc Ceramic	20%	500V
2C57	0.001 µF	Disc Ceramic	20%	500V
2C58	0.001 µF	Disc Ceramic	20%	500V
2C59	470pF	Disc Ceramic	10%	100V
2C60	0.001 µF	Leadless Disc Ceramic	20%	500V
2C61	4.7pF	Tubular Ceramic	.5pF	750V
2C62	2.2pF	Tubular Ceramic	10%	750V
2C63	82pF	Tubular Ceramic	10%	750V
2C64	0.001 µF	Disc Ceramic	20%	500V
2C65	470pF	Disc Ceramic	10%	100V
2C66	4.7pF	Tubular Ceramic	.5pF	200V

Capacitors (Cont.)

Ref.	Value	Type	Tolerance	Wkg. Voltage
2C67	0.001μF	Leadless Disc Ceramic	20%	500V
2C68	3pF	Tubular Ceramic	.5pF	750V
2C69	4.7pF	Tubular Ceramic	.5pF	750V
2C70	4.7pF	Tubular Ceramic	.5pF	750V
2C71	68μF	Tantalum Electrolytic	20%	20V
2C72	0.001μF	Disc Ceramic	20%	500V
2C72	0.001μF	Leadless Disc Ceramic	20%	500V
2C73	0.001μF	Disc Ceramic	20%	500V
3C1	10–60pF	Ceramic Trimmer	–	–
3C2	10–60pF	Ceramic Trimmer	–	–
3C3	10–60pF	Ceramic Trimmer	–	–
3C4	10–60pF	Ceramic Trimmer	–	–
3C5	10–60pF	Ceramic Trimmer	–	–
3C6	10–60pF	Ceramic Trimmer	–	–
3C7	10–60pF	Ceramic Trimmer	–	–
3C8	10–60pF	Ceramic Trimmer	–	–
3C9	10–60pF	Ceramic Trimmer	–	–
3C10	10–60pF	Ceramic Trimmer	–	–
3C11	0.001μF	Disc Ceramic	20%	500V
3C12	0.001μF	Disc Ceramic	20%	500V
3C13	0.001μF	Disc Ceramic	20%	500V
3C14	0.001μF	Disc Ceramic	20%	500V
3C15	0.001μF	Disc Ceramic	20%	500V
3C16	0.001μF	Disc Ceramic	20%	500V
3C17	0.001μF	Disc Ceramic	20%	500V
3C18	0.001μF	Disc Ceramic	20%	500V
3C19	0.001μF	Disc Ceramic	20%	500V
3C20	0.001μF	Disc Ceramic	20%	500V
3C21	0.001μF	Disc Ceramic	20%	500V
3C22	0.001μF	Disc Ceramic	20%	500V
3C23	0.001μF	Disc Ceramic	20%	500V
3C24	0.001μF	Disc Ceramic	20%	500V
3C25	.01μF	Disc Ceramic	+80%–20%	250V
3C26	1.5pF	Tubular Ceramic	5%	200V
3C27	22pF	Tubular Ceramic	5%	200V
3C28	–			
3C29	0.001μF	Disc Ceramic	20%	500V
3C30	0.001μF	Disc Ceramic	20%	500V
3C31	0.001μF	Disc Ceramic	20%	500V
3C32	0.001μF	Disc Ceramic	20%	500V
3C33	0.001μF	Disc Ceramic	20%	500V
3C34	0.001μF	Disc Ceramic	20%	500V
3C35	0.001μF	Disc Ceramic	20%	500V
3C36	0.001μF	Disc Ceramic	20%	500V
3C37	0.001μF	Disc Ceramic	20%	500V
3C38	0.001μF	Disc Ceramic	20%	500V
3C39	0.001μF	Disc Ceramic	20%	500V
3C40	4.5–20pF	Ceramic Trimmer	–	–
3C41	4.5–20pF	Ceramic Trimmer	–	–

Capacitors (Cont.)

Ref.	Value	Type	Tolerance	Wkg. Voltage
3C42	4.5–20pF	Ceramic Trimmer	–	–
3C43	4.5–20pF	Ceramic Trimmer	–	–
3C44	4.5–20pF	Ceramic Trimmer	–	–
3C45	4.5–20pF	Ceramic Trimmer	–	–
3C46	4.5–20pF	Ceramic Trimmer	–	–
3C47	4.5–20pF	Ceramic Trimmer	–	–
3C48	4.5–20pF	Ceramic Trimmer	–	–
3C49	4.5–20pF	Ceramic Trimmer	–	–
3C50	0.001μF	Disc Ceramic	20%	500V
3C51	0.001μF	Disc Ceramic	20%	500V
3C52	22pF	Tubular Ceramic	10%	200V
3C53	0.001μF	Disc Ceramic	20%	500V
3C54	0.001μF	Disc Ceramic	20%	500V
3C55	0.001μF	Disc Ceramic	20%	500V
3C56	0.01μF	Disc Ceramic	+80%–20%	250V
3C57	10pF	Tubular Ceramic	10%	200V
3C58	0.001μF	Disc Ceramic	20%	500V
3C59	0.001μF	Disc Ceramic	20%	500V
3C60	0.001μF	Disc Ceramic	20%	500V
3C61	0.001μF	Disc Ceramic	20%	500V
3C62	0.001μF	Disc Ceramic	20%	500V
3C63	0.001μF	Disc Ceramic	20%	500V
4C1	100μF	Tubular Electrolytic	+50%–10%	25V
4C2	0.1μF	Polycarbonate	20%	100V
4C3	0.01μF	Disc Ceramic	+80%–20%	250V
4C4	0.01μF	Disc Ceramic	+80%–20%	250V
4C5	0.01μF	Disc Ceramic	+80%–20%	250V
4C6	0.001μF	Disc Ceramic	20%	500V
4C7	68μF	Tantalum Electrolytic	20%	16V
4C8	10μF	Tubular Electrolytic	+50%–10%	25V
4C9	0.47μF	Polycarbonate	20%	100V
4C10	0.01μF	Disc Ceramic	+80%–20%	250V
4C11	0.47μF	Polycarbonate	20%	100V
4C12	0.01μF	Disc Ceramic	+80%–20%	250V
5C1	–			
5C2	22μF	Tantalum	20%	20V
5C3	10–60pF	Ceramic Trimmer	–	–
5C4	15pF	Tubular Ceramic	5%	200V
5C5	100pF	Disc Ceramic	5%	200V
5C6	100pF	Disc Ceramic	5%	200V
5C7	0.01μF	Disc Ceramic	+80%–20%	200V
5C8	10μF	Tantalum	20%	20V

Capacitors (Cont.)

Ref.	Value	Type	Tolerance	Wkg. Voltage
5C9	1.0μF	Tantalum	20%	35V
5C10	22pF	Tubular Ceramic	5%	200V
5C11	0.1μF	Polyester	20%	250V
5C12	0.1μF	Polyester	20%	250V
5C13	0.1μF	Polyester	20%	250V
5C14	10μF	Tantalum	20%	20V
5C15	22μF	Tantalum	20%	20V
6C1	0.01μF	Disc Ceramic	+80%–20%	25V
6C2	25pF	Tubular Ceramic	10%	750V
6C3	150pF	Silvered Mica	2%	350V
6C4	0.01μF	Disc Ceramic	+80%–20%	25V
6C5	0.01μF	Disc Ceramic	+80%–20%	25V
6C6	15pF	Silvered Mica	2%	350V
6C7	15pF	Silvered Mica	2%	350V
6C8	220pF	Silvered Mica	2%	350V
6C9	39pF	Silvered Mica	2%	350V
6C10	39pF	Silvered Mica	2%	350V
6C11	150pF	Silvered Mica	2%	350V
6C12	100pF	Disc Ceramic	5%	750V
6C13	0.01μF	Disc Ceramic	+80%–20%	25V
6C14	0.01μF	Disc Ceramic	+80%–20%	25V
6C15	0.01μF	Disc Ceramic	+80%–20%	25V
6C16	100pF	Tubular Ceramic	10%	750V
6C17	22pF	Silvered Mica	2%	350V
6C18	100pF	Tubular Ceramic	10%	750V
6C19	0.01μF	Disc Ceramic	+80%–20%	250V
6C20	0.01μF	Disc Ceramic	+80%–20%	250V
6C21	0.01μF	Disc Ceramic	+80%–20%	250V
6C22	0.01μF	Disc Ceramic	+80%–20%	250V
6C23	0.01μF	Disc Ceramic	+80%–20%	250V
6C24	25pF	Tubular Ceramic	10%	750V
6C25	0.01μF	Disc Ceramic	+80%–20%	250V
6C26	0.01μF	Disc Ceramic	+80%–20%	250V
6C27	25pF	Tubular Ceramic	10%	750V
6C28	0.01μF	Disc Ceramic	+80%–20%	250V
6C29	0.01μF	Disc Ceramic	+80%–20%	250V
6C30	100pF	Tubular Ceramic	10%	750V
6C31	22pF	Tubular Ceramic	10%	750V
6C32	100pF	Tubular Ceramic	10%	750V
6C33	0.01μF	Disc Ceramic	+80%–20%	250V
6C34	25pF	Tubular Ceramic	10%	750V
6C35	0.01μF	Disc Ceramic	+80%–20%	250V
6C36	25pF	Tubular Ceramic	10%	750V
6C37	0.01μF	Disc Ceramic	+80%–20%	250V
6C38	0.01μF	Disc Ceramic	+80%–20%	250V
6C39	100pF	Tubular Ceramic	10%	750V
6C40	22pF	Tubular Ceramic	10%	750V

Capacitors (Cont.)

Ref.	Value	Type	Tolerance	Wkg. Voltage
6C41	0.01μF	Disc Ceramic	+80%–20%	250V
6C42	0.01μF	Disc Ceramic	+80%–20%	250V
6C43	100pF	Tubular Ceramic	10%	750V
6C44	0.01μF	Disc Ceramic	+80%–20%	250V
6C45	—			
6C46	2.2pF	Tubular Ceramic	10%	750V
6C47	0.01μF	Disc Ceramic	+80%–20%	250V
7C1	—			
7C2	0.001μF	Disc Ceramic	+80%–20%	500V
7C3	0.01μF	Disc Ceramic	+80%–20%	250V
7C4	0.001μF	Disc Ceramic	+80%–20%	500V
7C5	0.01μF	Disc Ceramic	+80%–20%	250V
7C6	0.01μF	Disc Ceramic	+80%–20%	250V
7C7	0.01μF	Disc Ceramic	+80%–20%	250V
7C8	150pF	Silvered Mica	2%	350V
7C9	0.01μF	Disc Ceramic	+80%–20%	250V
7C10	4.7μF	Tantalum	20%	20V
7C11	1.5pF	Disc Ceramic	.25pF	750V
7C12	150pF	Silvered Mica	2%	350V
7C13	0.01μF	Disc Ceramic	+80%–20%	250V
7C14	0.01μF	Disc Ceramic	+80%–20%	250V
7C15	0.01μF	Disc Ceramic	+80%–20%	250V
7C16	0.01μF	Disc Ceramic	+80%–20%	250V
7C17	47pF	Silvered Mica	2%	350V
7C18	0.01μF	Disc Ceramic	+80%–20%	250V
7C19	0.01μF	Disc Ceramic	+80%–20%	250V
7C20	0.01μF	Disc Ceramic	+80%–20%	250V
7C21	1μF	Tantalum	20%	20V
7C22	22μF	Tantalum	20%	20V
7C23	1μF	Tantalum	20%	20V
7C24	22μF	Tantalum	20%	20V
7C25	0.01μF	Disc Ceramic	+80%–20%	250V
9C1	0.047μF	Disc Ceramic	+80%–20%	25V
9C2	0.047μF	Disc Ceramic	+80%–20%	25V
9C3	0.047μF	Disc Ceramic	+80%–20%	25V
9C4	0.047μF	Disc Ceramic	+80%–20%	25V
9C5	0.047μF	Disc Ceramic	+80%–20%	25V
9C6	0.047μF	Disc Ceramic	+80%–20%	25V
9C7	0.047μF	Disc Ceramic	+80%–20%	25V
9C8	0.047μF	Disc Ceramic	+80%–20%	25V
9C9	0.047μF	Disc Ceramic	+80%–20%	25V

Capacitors (Cont.)

Ref.	Value	Type	Tolerance	Wkg. Voltage
9C10	0.047μF	Disc Ceramic	+80%–20%	25V
9C11	0.047μF	Disc Ceramic	+80%–20%	25V
9C12	0.047μF	Disc Ceramic	+80%–20%	25V
9C13	0.047μF	Disc Ceramic	+80%–20%	25V
9C14	0.047μF	Disc Ceramic	+80%–20%	25V
9C15	0.047μF	Disc Ceramic	+80%–20%	25V
9C16	0.047μF	Disc Ceramic	+80%–20%	25V
10C1	0.01μF	Disc Ceramic	+80%–20%	250V
10C2	22μF	Tantalum	20%	16V
10C3	0.001μF	Disc Ceramic	20%	500V
10C4	22μF	Tantalum	20%	16V
10C5	0.01μF	Disc Ceramic	+80%–20%	250V
10C6	0.01μF	Disc Ceramic	+80%–20%	250V
10C7	0.01μF	Disc Ceramic	+80%–20%	250V
10C8	7–35pF	Ceramic Trimmer	–	–
10C9	0.01μF	Disc Ceramic	+80%–20%	250V
10C10	15pF	Tubular Ceramic	5%	750V
10C11	470μF	Tubular Electrolytic	+50%–10%	25V
10C12	22pF	Tubular Ceramic	5%	750V
10C13	0.01μF	Disc Ceramic	+80%–20%	250V
10C14	–			
10C15	3.3pF	Tubular Ceramic	5%	750V
10C16	0.01μF	Disc Ceramic	+80%–20%	250V
10C17	150μF	Tubular Electrolytic	+50%–10%	16V
10C18	0.01μF	Disc Ceramic	+80%–20%	250V
10C19	0.001μF	Disc Ceramic	20%	500V
11C1	68pF	Tubular Ceramic	10%	750V
11C2	0.001μF	Polystyrene	5%	125V
11C3	0.01μF	Disc Ceramic	+80%–20%	250V
11C4	0.01μF	Disc Ceramic	+80%–20%	250V
11C5	68pF	Tubular Ceramic	10%	750V
11C6	47pF	Tubular Ceramic	10%	750V
11C7	47pF	Tubular Ceramic	10%	750V
11C8	0.01μF	Disc Ceramic	+80%–20%	250V
11C9	0.001μF	Disc Ceramic	20%	500V
11C10	0.01μF	Disc Ceramic	+80%–20%	250V
11C11	10μF	Tantalum	20%	20V
11C12	0.01μF	Polycarbonate	20%	250V
11C13	0.047μF	Polycarbonate	20%	250V
11C14	150μF	Tubular Electrolytic	+50%–10%	16V
11C15	0.01μF	Disc Ceramic	+80%–20%	250V

Capacitors (Cont.)

Ref.	Value	Type	Tolerance	Wkg. Voltage
11C16	10μF	Tantalum	20%	20V
11C17	0.001μF	Disc Ceramic	20%	500V
11C18	10μF	Tantalum	20%	20V
11C19	1μF	Tantalum	20%	35V
11C20	1μF	Tantalum	20%	35V
11C21	0.01μF	Disc Ceramic	+80%–20%	250V
12C1	1μF	Tantalum	20%	35V
12C2	2.2μF	Tantalum	20%	20V
12C3	1μF	Tantalum	20%	35V
12C4	0.0032μF	Polystyrene	5%	125V
12C5	0.01μF	Disc Ceramic	+80%–20%	250V
12C6	1μF	Tantalum	20%	35V
12C7	22μF	Tantalum	20%	20V
12C8	22μF	Tantalum	20%	20V
12C9	68μF	Tantalum	20%	20V
12C10	0.001μF	Disc Ceramic	20%	500V
12C11	0.01μF	Disc Ceramic	+80%–20%	250V
12C12	0.01μF	Disc Ceramic	+80%–20%	250V
12C13	0.001μF	Disc Ceramic	20%	500V
12C14	0.01μF	Disc Ceramic	+80%–20%	250V
12C15	0.01μF	Disc Ceramic	+80%–20%	250V
12C16	0.01μF	Disc Ceramic	+80%–20%	250V
12C17	4.5–20pF	Ceramic Trimmer	–	–
12C18	0.001μF	Disc Ceramic	20%	500V
12C19	0.01μF	Disc Ceramic	+80%–20%	25V
12C20	22μF	Tantalum	20%	20V
12C21	0.01μF	Disc Ceramic	+80%–20%	25V
12C22	22μF	Tantalum	20%	20V
12C23	22μF	Tantalum	20%	20V
12C24	.68μF	Tantalum	20%	35V
13C1	10μF	Tantalum	20%	20V
13C2	0.47μF	Polycarbonate	20%	100V
13C3	68μF	Tantalum	20%	20V
13C4	0.047μF	Polycarbonate	20%	100V
13C5	10μF	Tantalum	20%	20V
13C6	68μF	Tantalum	20%	20V
13C7	0.01μF	Disc Ceramic	+80%–20%	250V
13C8	10μF	Tantalum	20%	20V
13C9	10μF	Tubular Electrolytic	+50%–10%	25V

Capacitors (Cont.)

Ref.	Value	Type	Tolerance	Wkg. Voltage
14C1	0.047μF	Polycarbonate	20%	100V
14C2	22μF	Tantalum	20%	20V
14C3	0.22μF	Polycarbonate	20%	100V
14C4	0.0047μF	Silvered Mica	5%	50V
14C5	220μF	Tubular Electrolytic	+50%–10%	16V
14C6	22μF	Tantalum	20%	20V
14C7	22μF	Tantalum	20%	20V
14C8	0.22μF	Polycarbonate	20%	100V
14C9	68μF	Tantalum	20%	20V
14C10	470μF	Tubular Electrolytic	+50%–10%	25V
14C11	4.7μF	Tantalum	20%	20V
14C12	0.0047μF	Silvered Mica	5%	50V
14C13	150μF	Tubular Electrolytic	+50%–10%	16V
14C14	68μF	Tantalum	20%	20V
14C15	22μF	Tantalum	20%	20V
14C16	150μF	Tubular Electrolytic	+50%–10%	16V
14C17	220μF	Tubular Electrolytic	+50%–10%	16V
15C1	7500μF	Tubular Electrolytic	+50%–10%	16V
15C2	7500μF	Tubular Electrolytic	+50%–10%	16V
15C3	7500μF	Tubular Electrolytic	+50%–10%	25V
15C4	—			
15C5	7500μF	Tubular Electrolytic	+50%–10%	25V
15C6	0.005μF	Disc Ceramic	+80%–20%	3000V
15C7	0.005μF	Disc Ceramic	+80%–20%	3000V
15C8	0.005μF	Disc Ceramic	+80%–20%	3000V
16C1	0.47μF	Polycarbonate	20%	100V
16C2	100μF	Tubular Electrolytic	+50%–10%	25V
16C3	0.1μF	Polycarbonate	20%	100V
16C4	2200μF	Tubular Electrolytic	+50%–10%	40V
16C5	100pF	Polystyrene	5%	125V
16C6	1000μF	Tubular Electrolytic	+50%–10%	25V
16C7	1000μF	Tubular Electrolytic	+50%–10%	63V
16C8	100pF	Polystyrene	5%	125V
16C9	680μF	Tubular Electrolytic	+50%–10%	40V
16C10	0.1μF	Polycarbonate	20%	100V
16C11	0.1μF	Polycarbonate	20%	100V
16C12	3.3μF	Tantalum Electrolytic	20%	35V
16C13	3.3μF	Tantalum Electrolytic	20%	35V

Capacitors (Cont.)

Ref.	Value	Type	Tolerance	Wkg. Voltage
17C1	0.47μF	Polycarbonate	20%	100V
17C2	0.001μF	Disc Ceramic	20%	500V
17C3	15pF	Tubular Ceramic	5%	750V
17C4	15pF	Tubular Ceramic	5%	750V
17C5	0.001μF	Leadless Disc Ceramic	20%	500V
17C6	1.2–10pF	Ceramic Trimmer	–	–
17C7	4.7pF	Tubular Ceramic	0.5pF	750V
17C8	0.001μF	Leadless Disc Ceramic	20%	500V
17C9	100pF	Tubular Ceramic	5%	750V
17C10	0.001μF	Leadless Disc Ceramic	20%	500V
17C11	0.001μF	Leadless Disc Ceramic	20%	500V
17C12	1.2–10pF	Ceramic Trimmer	–	–
17C13	4.7pF	Tubular Ceramic	0.5pF	750V
17C14	0.001μF	Leadless Disc Ceramic	20%	500V
17C15	0.001μF	Leadless Disc Ceramic	20%	500V
17C16	0.001μF	Disc Ceramic	20%	500V
17C17	150μF	Tubular Electrolytic	+50%–20%	16V
17C18	1.2–10pF	Ceramic Trimmer	–	–
17C19	4.7pF	Tubular Ceramic	0.5pF	750V
17C20	0.001μF	Disc Ceramic	20%	500V
17C21	–			
17C22	0.001μF	Disc Ceramic	20%	500V
17C23	15pF	Tubular Ceramic	5%	750V
17C24	15pF	Tubular Ceramic	5%	750V
17C25	0.001μF	Disc Ceramic	20%	500V
17C26	1.2–10pF	Ceramic Trimmer	–	–
17C27	–			
17C28	0.001μF	Leadless Disc Ceramic	20%	500V
17C29	100pF	Tubular Ceramic	5%	750V
17C30	0.001μF	Leadless Disc Ceramic	20%	500V
17C31	0.001μF	Leadless Disc Ceramic	20%	500V
17C32	1.2–10pF	Ceramic Trimmer	–	–
17C33	–			
17C34	0.001μF	Leadless Disc Ceramic	20%	500V
17C35	0.001μF	Leadless Disc Ceramic	20%	500V
17C36	0.001μF	Disc Ceramic	20%	500V
17C37	150μF	Tubular Electrolytic	+50%–20%	16V
17C38	1.2–10pF	Ceramic Trimmer	–	–
17C39	–			
17C40	0.001μF	Disc Ceramic	20%	500V
17C41	0.47μF	Polycarbonate	20%	100V
17C42	150μF	Tantalum Electrolytic	20%	16V
17C43	0.001μF	Disc Ceramic	20%	500V
17C44	0.001μF	Disc Ceramic	20%	500V
17C45	20pF	Leadless Disc Ceramic	20%	500V
17C46	1.2–10pF	Ceramic Trimmer	–	–
17C47	0.001μF	Leadless Disc Ceramic	20%	500V
17C48	6.8pF	Tubular Ceramic	0.5pF	750V
17C49	0.001μF	Disc Ceramic	20%	500V
17C50	0.001μF	Leadless Disc Ceramic	20%	500V
17C51	27pF	Tubular Ceramic	5%	750V
17C52	150μF	Tantalum Electrolytic	20%	16V
17C53	0.001μF	Disc Ceramic	20%	500V

Capacitors (Cont.)

Ref.	Value	Type	Tolerance	Wkg. Voltage
17C54	0.001μF	Disc Ceramic	20%	500V
17C55	0.001μF	Leadless Disc Ceramic	20%	500V
17C56	1.2–10pF	Ceramic Trimmer	—	—
17C57	0.001μF	Leadless Disc Ceramic	20%	500V
17C58	3.3pF	Tubular Ceramic	0.5pF	750V
17C59	0.001μF	Disc Ceramic	20%	500V
17C60	0.001μF	Leadless Disc Ceramic	20%	500V
17C61	10pF	Tubular Ceramic	5%	750V

Resistors

Tolerance on resistance values: 5%

Power rating: 0.3W (unless otherwise indicated)

Ref.	Value OHMS
1R1	—
1R2	—
1R3	2.2K
1R4	3.3K
2R1	680
2R2	100K
2R3	100K
2R4	470K
2R5	220
2R6	100
2R7	1K
2R8	1.5K
2R9	1.5K
2R10	2.2K
2R11	—
2R12	470
2R13	470
2R14	470
2R15	100K
2R16	470K
2R17	100K
2R18	47K
2R19	39K
2R20	3.3K
2R21	82
2R22	100

Ref.	Value OHMS
2R23	220
2R24	3.3K
2R25	12K
2R26	33
2R27	1K
2R28	470
2R29	470
2R30	470
2R31	820
2R32	1.2K
2R33	33
2R34	220
2R35	2.2K
2R36	2.2K
2R37	100
2R38	220
2R39	—
2R40	47
2R41	10AOT
2R42	22
3R1	100
3R2	47K
3R3	27K
3R4	680
3R5	100K
3R6	22K
3R7	100
3R8	330
3R9	3.3K

Ref.	Value OHMS
3R10	12K
3R11	33
3R12	1K
3R13	470
3R14	4.7K
3R15	12K
4R1	47K
4R2	1K
4R3	680
4R4	3.3K
4R5	22*
4R6	10K
4R7	27K
4R8	27K
4R9	220K
4R10	180K
4R11	18K
4R12	10K
5R1	560
5R2	68*
5R3	15K
5R4	3.3K
5R5	10K
5R6	3.3K

Ref.	Value OHMS
5R7	470
5R8	220
5R9	470
5R10	—
5R11	4.7K
5R12	1.5K
5R13	820
5R14	330
5R15	560
5R16	560
6R1	390
6R2	100K
6R3	220
6R4	100
6R5	100K
6R6	100
6R7	2.2K
6R8	2.2K
6R9	470K
6R10	100K
6R11	100K
6R12	1M
6R13	100
6R14	3.3K
6R15	220
6R16	100K
6R17	100
6R18	270
6R19	100

Resistors (Cont.)

Ref.	Value OHMS
6R20	1K
6R21	1.5K
6R22	470
6R23	1K
6R24	120
6R25	220
6R26	100K
6R27	100
6R28	270
6R29	100
6R30	270
6R31	8.2K
6R32	2.2K
6R33	120
6R34	220
6R35	1K
6R36	100
7R1	3.3K
7R2	3.3K
7R3	100
7R4	820
7R5	2.2K
7R6	1K
7R7	2.2K
7R8	22K
7R9	10K
7R10	10K
7R11	4.7K
7R12	2.7K
7R13	4.7K
7R14	47K
7R15	22K
7R16	6.8K
7R17	5.6K
7R18	100
7R19	2.2K
7R20	22K
8R1	3.3K
8R2	33K
8R3	33K
8R4	330

Ref.	Value OHMS
8R5	2.7K
8R6	—
8R7	—
9R1	100
9R2	1K
9R3	1K
9R4	100
9R5	1K
9R6	100
9R7	47*
10R1	2.2K
10R2	1.2K
10R3	470
10R4	470
10R5	2.7K
10R6	150
10R7	100
10R8	8.2K
10R9	3.3K
10R10	6.8K
10R11	4.7K
10R12	1.2K
10R13	1.5K
10R14	560
10R15	22
10R16	120
11R1	15K
11R2	3.9K
11R3	270K
11R4	270K
11R5	470
11R6	2.2K
11R7	8.2K
11R8	1.5K
11R9	1K
11R10	47

Ref.	Value OHMS
11R11	150
11R12	330
11R13	8.2K
11R14	330
11R15	330
11R16	1K
11R17	1K
11R18	22K
11R19	6.8K
11R20	5.6K
11R21	330
11R22	2.2K
11R23	100
12R1	10K
12R2	10K
12R3	470
12R4	100
12R5	470K
12R6	100K
12R7	100
12R8	100K
12R9	4.7M
12R10	1K
12R11	150
12R12	100
12R13	1.2K
12R14	680
12R15	150
12R16	47
12R17	100
12R18	2.2K
12R19	22K
12R20	470
12R21	1K
13R1	470
13R2	100K
13R3	100K
13R4	27K
13R5	5.6K
13R6	100K
13R7	10

Ref.	Value OHMS
13R8	150
13R9	10K
13R10	4.7K
13R11	1K
13R12	47w.w.*
13R13	47w.w.*
13R14	82
13R15	82
14R1	47K
14R2	470
14R3	100
14R4	2.2K
14R5	100
14R6	2.2w.w*
14R7	100
14R8	4.7K
14R9	56K
14R10	33K
14R11	10K
14R12	68
14R13	1K
14R14	22K
14R15	100
14R16	6.8K
14R17	2.2K
15R1	5*
15R2	0.15*
15R3	—
15R4	—
15R5	10w.w.
15R6	10K
16R1	1K
16R2	470
16R3	470
16R4	22
16R5	1K

Resistors (Cont.)

Ref.	Value OHMS
16R6	4.7K*
16R7	820*
16R8	680*
16R9	3.3K*
16R10	3.3K*
16R11	1K*
16R12	15K*
16R13	1.5K*
16R14	1.8K*
16R15	3.9K*
16R16	3.9K*
16R17	1K*
16R18	56*
16R19	56*

Ref.	Value OHMS
17R1	6.8K
17R2	2.7K
17R3	1K
17R4	220K
17R5	470K
17R6	100K
17R7	100K
17R8	220
17R9	220K
17R10	220K
17R11	470
17R12	6.8K
17R13	2.7K
17R14	100
17R15	220
17R16	220K

Ref.	Value OHMS
17R17	470K
17R18	100K
17R19	100K
17R20	220
17R21	220K
17R22	220K
17R23	470
17R24	—
17R25	—
17R26	—
17R27	—
17R28	—
17R29	—
17R30	—
17R31	5.6K
17R32	2.2K

Ref.	Value OHMS
17R33	470
17R34	220K
17R35	47
17R36	470
17R37	150
17R38	470
17R39	—
17R40	—
17R41	5.6K
17R42	2.2K
17R43	470
17R44	220K
17R45	68
17R46	470
17R47	150
17R48	470

16R6, 16R7, 16R9, 16R10, 16R12, 16R14, 16R15, 16R16 are rated $^{1}/_{10}$W high stability
1R3, 1R4, 5R2, 9R7, 13R12, 13R13, 16R2, 16R3, 16R4, 16R6, 16R8, 16R13 are rated 0.5W
4R5, 15R1, 15R5, 16R2, 16R3, 16R18, 16R19 are rated 3W
15R2 is rated 5W
14R6 is rated 6W

Potentiometers

Ref.	Value OHMS	Law	Type	Function
1RV1	1K	Lin.	Carbon pre-set	+12V Adj.
3RV1	500	Lin.	Cermet pre-set	VFO Freq. Adj.
4RV1	50K	Lin.	Carbon	RF Gain
4RV2	1K	Lin.	Carbon Dual Concentric	IF Gain
4RV3	10K	Lin.	Carbon pre-set	Muting level
4RV4	10K	Lin.	Carbon pre-set	BFO Pitch
4RV5	50K	Log.	Carbon	AF Gain
4RV6	47K	Lin.	Carbon pre-set	Line Audio Level
4RV7	10K	Lin.	Carbon pre-set	RF Meter Zero Set
4RV8	10K	Lin.	Carbon pre-set	AFC Invert
4RV9	10K	Lin.	Carbon pre-set	AFC Invert
4RV10	100K	Lin.	10 Turn Wire wound	UHF Tune

Potentiometers (Cont.)

Ref.	Value OHMS	Law	Type	Function
11RV1	47K	Lin.	Cermet pre-set	BFO Pitch Adj.
11RV2	10K	Lin.	Cermet pre-set	BFO Pitch Adj.
11RV3	560	Lin.	Cermet pre-set	BFO Pitch Adj.
11RV4	47K	Lin.	Cermet pre-set	BFO Pitch Adj.
12RV1	47K	Lin.	Cermet pre-set	IF AGC Level
13RV1	500	Lin.	Cermet pre-set	Video Amp. Gain
14RV1	10K	Lin.	Carbon pre-set	AF Meter Zero Set
16RV1	–			
16RV2	–			
16RV3	470	Lin.	Cermet pre-set	−18V Adj.
16RV4	470	Lin.	Cermet pre-set	−33V Adj.
17RV1	500K	Lin.	Carbon pre-set	UHF Tuner Adjust
17RV2	500K	Lin.	Carbon pre-set	UHF Tuner Adjust
17RV3	500K	Lin.	Carbon pre-set	UHF Tuner Adjust
17RV4	500K	Lin.	Carbon pre-set	UHF Tuner Adjust
17RV5	500K	Lin.	Carbon pre-set	UHF Tuner Adjust
17RV6	500K	Lin.	Carbon pre-set	UHF Tuner Adjust
17RV7	500K	Lin.	Carbon pre-set	UHF Oscillator Adjust
17RV8	500K	Lin.	Carbon pre-set	UHF Oscillator Adjust

Thermistors

Ref.	Type
4TH1	VA1066B

Diodes

Ref.	Type	Manufacturer	Circuit Function
2D1	0M100	F.R.	Range Indicator LED
2D2	0M100	F.R.	Range Indicator LED
2D3	0M100	F.R.	Range Indicator LED
2D4	0M100	F.R.	Range Indicator LED

Diodes (Cont.)

Ref.	Type	Manufacturer	Circuit Function
2D5	0M100	F.R.	Range Indicator LED
2D6	0M100	F.R.	Range Indicator LED
2D7	0M100	F.R.	Range Indicator LED
2D8	5082–3188	H. Packard	Wideband to Mixer Switch
2D9	5082–3188	H. Packard	VHF Amp. to Mixer Switch
2D10	BB105B	Mullard	Varicap. VFO Freq. Control
2D11	BB105B	Mullard	Varicap. VFO Freq. Control
2D12	5082–3188	H. Packard	VHF Oscillator to Mixer Switch
2D13	5082–3188	H. Packard	Ext. Osc. to Mixer Switch
2D14	5082–3188	H. Packard	Crystal Osc. to Mixer Switch
2D15	5082–3188	H. Packard	235–365MHz Osc. to Mixer Switch
2D16	5082–3188	H. Packard	360–500MHz Osc. to Mixer Switch
2D17	5082–3188	H. Packard	235–365MHz Tuner to Mixer Switch
2D18	5082–3188	H. Packard	360–500MHz Tuner to Mixer Switch
3D1	BAX13	Mullard	Mixer input protection
3D2	BAX13	Mullard	Mixer input protection
5D1	BZY88C5V1	Mullard	Zener Regulator
6D1	BAX13	Mullard	Filter Isolation
6D2	BAX13	Mullard	Filter Isolation
7D1	BAX13	Mullard	RF AGC Delay
9D1	BZY88C6V2	Mullard	Zener Regulator
10D1	0A47	Mullard	AM Detector
11D1	BB105B	Mullard	Varicap. BFO Freq. Control
12D1	0A47	Mullard	Noise Demodulator
12D2	0A47	Mullard	Noise Demodulator
12D3	BZY88C6V2	Mullard	Zener Regulator
12D4	5082–2800	H. Packard	IF AGC Rectifier
12D5	BAX13	Mullard	IF AGC Delay
13D1	IN4000	ITT	Video Amp. Bias
13D2	IN4000	ITT	Video Amp. Bias
13D3	BZY88C10	Mullard	Zener Regulator
14D1	BZY88C9V1	Mullard	Zener Regulator
14D2	0A47	Mullard	AF Meter Rectifier

Diodes (Cont.)

Ref.	Type	Manufacturer	Circuit Function
15D1	BZY93C10	Mullard	Zener Regulator
15D2	IN4004	ITT	Reverse Polarity Protection
15D3	1B40K05	Texas	Bridge Rectifier
15D4	BZY93C10	Mullard	Zener Regulator
16D1	BAV10	Mullard	Clamp
16D2	BAV10	Mullard	Clamp
16D3	BYZ10–400	Mullard	Bridge Rectifier
16D4	BYZ10–400	Mullard	
16D5	BYZ10–400	Mullard	
16D6	BYZ10–400	Mullard	
16D7	BYZ10–400	Mullard	Bridge Rectifier
16D8	BYZ10–400	Mullard	
16D9	BYZ10–400	Mullard	
16D10	BYZ10–400	Mullard	
16D11	BZY88C12	Mullard	Zener Regulator
16D12	BZY88C12	Mullard	Zener Regulator
17D1	BB105B	Mullard	UHF Tune Freq. Control
17D2	BB105B	Mullard	UHF Tune Freq. Control
17D3	BB105B	Mullard	UHF Tune Freq. Control
17D4	BB105B	Mullard	UHF Tune Freq. Control
17D5	BB105B	Mullard	UHF Tune Freq. Control
17D6	BB105B	Mullard	UHF Tune Freq. Control
17D7	BB105B	Mullard	UHF Tune Freq. Control
17D8	BB105B	Mullard	UHF Tune Freq. Control
17D9	BB105B	Mullard	UHF Tune Freq. Control
17D10	BB105B	Mullard	UHF Tune Freq. Control
17D11	BB105B	Mullard	UHF Tune Freq. Control
17D12	BB105B	Mullard	UHF Tune Freq. Control
17D13	BB105B	Mullard	UHF Tune Freq. Control
17D14	BB105B	Mullard	UHF Tune Freq. Control
17D15	BB105B	Mullard	UHF Tune Freq. Control
17D16	BB105B	Mullard	UHF Tune Freq. Control

Transistors

Ref.	Type	Manufacturer	Circuit Function
1TR2	BFY51	Mullard	Voltage Regulator
2TR1	3N200	RCA	VHF Tuner RF Amp.
2TR2	BFR29	Mullard	VHF Tuner VFO
2TR3	BFX89 or BFY90	Mullard	Buffer Amp.
2TR4	BFW30	Mullard	Emitter Follower (Mixer Feed)
2TR5	BFX89 or BFY90	Mullard	Emitter Follower (Synch. RF Drive)

Transistors (Cont.)

Ref.	Type	Manufacturer	Circuit Function
3TR1	BFY90	Mullard	Crystal-controlled oscillator
3TR2	BFY90	Mullard	Crystal Osc. Multiplier
3TR3	BFY90	Mullard	Emitter follower (Mixer Feed)
5TR1	40673	RCA	Crystal Calibrator Mixer
5TR2	BC107B	Mullard	Phase-shift Osc. (Modulator)
6TR1	UC734B	Union Carbide	L-C Filter Input Switch
6TR2	UC734B	Union Carbide	L-C Filter Output Switch
6TR3	40673	RCA	IF Preamplifier
6TR4	UC734B	Union Carbide	Crystal Filter Input Switch
6TR5	BFX89	Mullard	Crystal Filter Output Switch
6TR6	UC734B	Union Carbide	Crystal Filter Input Switch
6TR7	BFX89	Mullard	Crystal Filter Output Switch
7TR1	BFX89	Mullard	Emitter Follower (FM Amp. Driver)
7TR2	BC107B	Mullard	AF Amplifier
8TR1	BCY71 or BCY72	Mullard	AFC Voltage Inverter
8TR2	BCY71 or BCY72	Mullard	AFC Voltage Inverter
10TR1	BFX89	Mullard	Emitter Follower (Buffer)
10TR2	2N3866	RCA	IF Amplifier
10TR3	BFX89	Mullard	Emitter Follower (IF Output)
11TR1	BFX89	Mullard	Beat Freq. Oscillator
11TR2	BFX89	Mullard	BFO Amplifier
11TR3	BC107B	Mullard	AF Amplifier
12TR1	BC107B	Mullard	Noise Amplifier
12TR2	BFX89	Mullard	IF AGC Amplifier
12TR3	BC107B	Mullard	Emitter Follower (IF AGC Output)
13TR1	UC734B	Union Carbide	Audio/Video Splitter
13TR2	BCY71	Mullard	Muting Control
13TR3	UC734B	Union Carbide	Muting Indication
14TR1	UC734B	Union Carbide	Main Audio Preamplifier
14TR2	BCY72	Mullard	Line Audio Preamplifier
15TR1	2N3055	RCA	Voltage Regulator

Transistors (Cont.)

Ref.	Type	Manufacturer	Circuit Function
16TR1	BDX36	Mullard	Square-wave Oscillator
16TR2	BDX36	Mullard	
16TR3	2N4918	Motorola	Voltage Regulator
16TR4	2N4919	Motorola	Voltage Regulator
16TR5	BF245B	Mullard	Current Source
16TR6	BF245B	Mullard	Current Source
17TR1	BFR90	Mullard	UHF Tuner-Amplifier
17TR2	3N200	RCA	UHF Tuner-Amplifier
17TR3	BFR90	Mullard	UHF Tuner-Amplifier
17TR4	3N200	RCA	UHF Tuner-Amplifier
17TR5	BF362	Mullard	UHF Tuner-Oscillator
17TR6	BFR90	Mullard	UHF Tuner-Oscillator
17TR7	BF362	Mullard	UHF Tuner-Oscillator
17TR8	BFR90	Mullard	UHF Tuner-Oscillator

Integrated Circuits

Ref.	Type	Manufacturer	Circuit Function
1IC2	UA723C	Fairchild	Voltage Regulator
2IC1	10514C	H. Packard	Mixer
2IC2	741	Motorola	AFC Voltage Amplifier
3IC1	0M175	Mullard	Crystal Harmonic Amplifier
5IC1	SN7400	Texas	Crystal Calibrator Oscillator
5IC2	SN7490	Texas	Decade Divider
7IC1	CA3028A	RCA	FM Amplifier
7IC2	CA3089E	RCA	FM Limiting Amp. and Demod.
9IC1	SL610C	Plessey	IF Amplifier
9IC2	SL610C	Plessey	IF Amplifier
9IC3	SL610C	Plessey	IF Amplifier
11IC1	MC1550G	Motorola	CW Product Detector
12IC1	741P	Plessey	Muting Output Amp.
12IC2	SL611C	Plessey	IF Amplifier (AGC)

Integrated Circuits (Cont.)

Ref.	Type	Manufacturer	Circuit Function
13IC1	CA3020A	RCA	Video Amplifier
14IC1	TCA160	Mullard	Main Audio Amplifier
14IC2	MFC4000B	Motorola	Line Audio Amplifier
15IC1	7805KC	Fairchild	Voltage Regulator
16IC1	UA723	Fairchild	Voltage Regulator
16IC2	UA723	Fairchild	Voltage Regulator

LIST OF SPARES FOR THE 1990R SERIES RECEIVERS

The following list details all major spares for the 1990R Series Receivers. Spares should be ordered by quoting the Circuit Reference (where applicable), the description and the part number given in the list. All orders and enquiries should be directed to the address below, quoting the Type and Serial Nos. of the receiver in all communications.

EDDYSTONE RADIO LTD.,
SALES AND SERVICE DEPT.,
ALVECHURCH ROAD,
BIRMINGHAM. B31 3PP
ENGLAND

TELEPHONE: 021-475-2231
TELEX: 337081
CABLES: EDDYSTONE BIRMINGHAM

Ref.	Description	Part No.
	MODULES AND UNITS	
9	IF Amplifier Module	LP3391
7	FM Module	LP3392
11	Product Detector Module	LP3393
10	AM Detector Module	LP3394
13	Audio/Video Splitter Module	LP3395
12	IF/AGC Muting Module	LP3396
6	Selectivity Module (without crystal filters)	LP3397
16	Inverter Unit	LP3398
	Synchroniser Unit	LP3400
17	UHF Tuner Unit	LP3412
2	RF Unit	LP3413
5	Crystal Calibrator Module	LP3414
3	Crystal Oscillator Module (1990R/1)	LP3415
3	Crystal Oscillator Module (1990R/2)	LP3415/1
	Tuning Drive and Scale (1990R/1)	LP3416
	Tuning Drive and Scale (1990R/2)	LP3416/1
	Tuning Scale (5 range: 1990R/1)	9100/1P
	Tuning Scale (7 range: 1990R/2)	9100/P
4RV10	UHF Tuning Potentiometer: 100kΩ 10 Turn. Bourns 3500S-2-104 (1990R/2 only)	9474P
	Tuning Drive and RF Unit Assembly (1990R/1)	LP3417
	Tuning Drive and RF Unit Assembly (1990R/2)	LP3417/1
	UHF Oscillator Unit	LP3493
	PRINTED CIRCUIT BOARDS (INCLUDING COMPONENTS	
1	12V Regulator Board	LP3399/1
	Inverter Board	LP3399/2
	−18V and −33V Regulator Board	LP3399/3
14	3Ω and 600Ω Audio Board	LP3399/4
	Audio/Video Splitter Board	LP3399/5
	AM Detector Board	LP3399/6
	FM Board	LP3399/7
	AM/IF Amplifier Board	LP3399/8
	IF/AGC Muting Board	LP3399/9
	Product Detector Board	LP3399/10
	Selectivity Board	LP3399/11
	VHF Tuner Board	LP3399/12

Ref.	Description	Part No.
8	VHF Oscillator Coil Board	LP3399/13
	Mixer Board	LP3399/14
	VHF RF Board	LP3399/15
	VHF Aerial Board	LP3399/16
	Crystal Calibrator Board	LP3399/17
	UHF Tuner Board	LP3399/18
	AFC Inverter Board	LP3399/19
	Scale Lamp Board	LP3399/20
	Crystal Oscillator Board	LP3399/21
	Crystal Multiplier Board	LP3399/22
	Range Indicator Board (1990R/1)	LP3399/23
	Range Indicator Board (1990R/2)	LP3399/24
	Crystal Harmonic Amplifer Board (1990R/2 only)	LP3399/25
	UHF Oscillator Potentiometer Mounting Board (1990R/2 only)	LP3399/26
	SWITCHES AND SWITCH ASSEMBLIES	
4S1	Wideband	7352P
4S2	AFC	7352P
4S3	Selectivity (concentric with 4S5)	9020P (Part)
4S4	AGC Time Constant	8828P
4S5	Mode (concentric with 4S3)	9020P (Part)
4S6	BFO Pitch Select	7352P
4S7	LS OFF/ON	7352P
4S8	Meter	8828P
4S9	Cal Frequency	9480P
4S10	Muting	7352P
2S1	Range 9 Pole 7 Way Comprising:	
B, C	2-off Wafer 1 Pole 5 Way	9105P
D, E, F, G, H	5-off Wafer 1 Pole 5 Way	9105/1P
A, J	2-off Wafer 2 Pole 7 Way	9113P
	Spindle and clicker mechanism	9103P
	Extension spindle	9304P
	Coupler	7353P
3S1	Crystal Channel 5 Pole 12 Way Comprising:	
C	1-off Wafer 1 Pole 10 Way	8308P
A, B	2-off Wafer 1 Pole 10 Way	9293P
D, E	2-off Wafer 1 Pole 12 Way	8388P
	Clicker mechanism	9318P
	Spindle	9304P
	Coupler	7353P
15S1	Mains	8634P

Ref.	Description	Part No.
	TRIMMER CAPACITORS	
2C1, 2C2, 2C3, 2C4	2.5 – 6pF	7288P
2C5	0.8 – 6pF (Part of Tuner Unit)	–
2C16, 2C17, 2C18, 2C19	2.5 – 6pF	7288P
2C20	0.8 – 6pF (Part of Tuner Unit)	–
2C21, 2C22, 2C23, 2C24	4.5 – 20pF	7289P
2C25	1.2 – 10pF (Part of Tuner Unit)	–
2C43, 2C44, 2C45, 2C46	2.5 – 6pF	7288P
2C47	0.8 – 6pF (Part of Tuner Unit)	–
3C1, 3C2, 3C3, 3C4, 3C5, 3C6, 3C7, 3C8, 3C9, 3C10	10 – 60pF	7290P
3C40, 3C41, 3C42, 3C43, 3C44, 3C45, 3C46, 3C47, 3C48, 3C49	4.5 – 20pF	7567P
5C3	10 – 60pF	7290P
10C8	7 – 35pF	7291P
12C17	4.5 – 20pF	7289P
	PLUGS AND SOCKETS	
SKA	15 Way Socket (VHF Tuner)	7770P
PLA	15 Way Plug (VHF Tuner)	7772P
SKB	15 Way Socket (Crystal Oscillator)	7770P
PLB	15 Way Plug (Crystal Oscillator)	7772P
SKC	6 Way Socket (Inverter)	6082P

Ref.	Description	Part No.
PLC	6 Way Plug (Inverter)	6081P
SKD	8 Way Socket (Synchroniser)	9496P
SKE	15 Way Socket (Ancillaries)	7770P
PLE	15 Way free plug with cover (Ancillaries)	8631P
SKF	3 Way free socket (12V DC Supply)	8855P
PLF	3 Way plug (12V DC Supply)	7130P
SKG	3 Way socket and lead (Mains)	D4815
PLG	3 Way plug (Mains)	8730P
E, F, J	Internal coaxial connector. Supplied, fitted with lead of the correct length. Specify code letter when ordering.	
K	Plug	7768P
W	Socket	7769P
	Aerial Input 1	
	Aerial Input 2	
	Aerial Input 3	
	Wideband Input	
	Ext. Osc. Input — 50Ω BNC Socket	7225P
	IF Low Level Output	
	IF High Level Output	
	Video Output Positive	
	Video Output Negative	
	50Ω BNC Plug	8012P
	Phones Output Socket	8736P
	Phones Plug	6567P
	CRYSTALS	
5XL1	10MHz Series Mode Style J 0 – 60°C	7298P
11XL1	21390kHz Parallel Mode Style J 30pF	9475P
3XL1 –3XL10	Inter-Services Style D. Frequency according to requirements.	9479P
	FILTERS	
FL2 or FL3	21.4MHz 30kHz Bandwidth SEI QC1246	9476P
	21.4MHz 15kHz Bandwidth SEI QC1246BQ	9477P
	21.4MHz 7.5kHz Bandwidth SEI QC1246BP	9478P
	COILS	
2L1	Aerial Input Range 1	D4795
2L2	Aerial Input Range 2	D4796
2L3	Aerial Input Range 3	D4797

Ref.	Description	Part No.
2L4	Aerial Input Range 4	D4798
2L5	Aerial Input Range 5	D4799
2L6	Oscillator Range 1	D4810
2L7	Oscillator Range 2	D4811
2L8	Oscillator Range 3	D4812
2L9	Oscillator Range 4	D4813
2L10	Oscillator Range 5	D4814
2L11	R.F. Range 1	D4800
2L12	R.F. Range 2	D4801
2L13	R.F. Range 3	D4802
2L14	R.F. Range 4	D4803
2L15	R.F. Range 5	D4804
2L16	Mixer Range 1	D4795
2L17	Mixer Range 2	D4796
2L18	Mixer Range 3	D4797
2L19	Mixer Range 4	D4798
2L20	Mixer Range 5	D4799
3L1	Crystal Oscillator Channel 1	
3L2	Crystal Oscillator Channel 2	
3L3	Crystal Oscillator Channel 3	
3L4	Crystal Oscillator Channel 4	
3L5	Crystal Oscillator Channel 5	D4903
3L6	Crystal Oscillator Channel 6	
3L7	Crystal Oscillator Channel 7	
3L8	Crystal Oscillator Channel 8	
3L9	Crystal Oscillator Channel 9	
3L10	Crystal Oscillator Channel 10	
3L11		
3L12		
3L13		
3L14		
3L15	Crystal Multiplier, channels 1–10	
3L16	Variable according to Crystals fitted, see Pages 21 and 22	
3L17		
3L18		
3L19		
3L20		
6L1	LC IF Filter	D4789
6L2	LC IF Filter	D4790
6L3	LC IF Filter	D4791
6L4	LC IF Filter	D4792
6L5	LC IF Filter	D4793
6L6	LC IF Filter	D4794
6L7	LC IF Filter	D4841
6L8	IF Pre-amp.	D4788
7L1	FM Output Coil	D4786
7L2	FM Input Coil	D4785
7L3	FM Discriminator Coil	D4787

Ref.	Description	Part No.
	CHOKES	
2CH1	14μH	D4919
2CH2	4μH	D4782
2CH3	4μH	D4782
3CH1	3μH	D2854
3CH2	10μH	9384P
3CH3	3μH	D2854
5CH1	100μH	9491P
6CH1	4μH	D4782
6CH2	4μH	D4782
6CH3	4μH	D4782
6CH4	47μH	9492P
6CH5	4μH	D4782
6CH6	4μH	D4782
6CH7	4μH	D4782
6CH8	4μH	D4782
6CH9	4μH	D4782
6CH10	4μH	D4782
7CH1	4μH	D4782
7CH2	4μH	D4782
7CH3	4μH	D4782
7CH4	4μH	D4782
7CH5	10μH	9384P
9CH1	4μH	D4782
9CH2	4μH	D4782
9CH3	4μH	D4782
9CH4	4μH	D4782
9CH5	4μH	D4782
9CH6	4μH	D4782
9CH7	4μH	D4782
10CH1	4μH	D4782
10CH2	4μH	D4782
10CH3	4μH	D4782
11CH1	4μH	D4782
11CH2	4μH	D4782
11CH3	10μH	9384P
12CH1	4μH	D4782
12CH2	4μH	D4782
12CH3	4μH	D4782
13CH1	4μH	D4782
15CH1	3μH	D2854
15CH2	3μH	D2854
15CH3	4μH	D4782
15CH4	4μH	D4782
15CH5	4μH	D4782
	TRANSFORMERS	
10T1	AM Detector Coupling	D4844
12T1	Muting	D3719
12T2	AGC Amplifier	D4783
14T1	Audio Output	8641P

Ref.	Description	Part No.
15T1	Mains	9274P
16T1	Inverter	D4784
	POTENTIOMETERS	
1RV1	1KΩ Preset, linear, cermet SET +12V	9485P
3RV1	500Ω Preset, linear, cermet AFC CENTRE FREQ.	9484P
4RV1	50KΩ linear, carbon RF GAIN } Concentric	9104P
4RV2	1KΩ linear, carbon IF GAIN } Concentric	
4RV3	10KΩ Preset, linear, carbon MUTING LEVEL	6480P
4RV4	10KΩ Preset, linear, carbon BFO PITCH	6480P
4RV5	50KΩ logarithmic, carbon AF GAIN	9114P
4RV6	47KΩ Preset, linear, carbon LINE LEVEL	6488P
4RV7	10KΩ Preset, linear, carbon METER ZERO	6480P
4RV8	10KΩ Preset, linear, carbon AFC CENTRE FREQ.	6480P
4RV9	10KΩ Preset, linear, carbon AFC CENTRE FREQ.	6480P
11RV1	47KΩ Preset, linear, cermet BFO PITCH	9489P
11RV2	10KΩ Preset, linear, cermet BFO PITCH	9488P
11RV3	560Ω Preset, linear, cermet BFO PITCH	9487P
11RV4	47KΩ Preset, linear, cermet BFO PITCH	9489P
12RV1	47KΩ Preset, linear, cermet AGC ONSET	9489P
13RV1	500Ω Preset, linear, cermet VIDEO AMP.	9484P
14RV1	10KΩ Preset, linear, carbon METER FSD	9490P
16RV3	470Ω Preset, linear, cermet SET −18V	9486P
16RV4	470Ω Preset, linear, cermet SET −30V	9486P
17RV1	500KΩ Preset, linear, cermet	9483P
17RV2		
17RV3		
17RV4		
17RV5		
17RV6		
17RV7		
17RV8		
	KNOBS	
	RF Gain } Dual Concentric	LP3462/1
	IF Gain } Dual Concentric	
	BFO Pitch	LP3460
	Selectivity } Dual Concentric	LP3462/2
	Mode } Dual Concentric	
	AF Gain	LP3460
	Tune	LP3459
	Range	LP3460

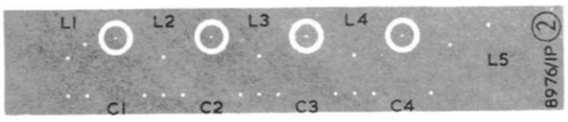
Ref.	Description	Part No.
	MISCELLANEOUS	
FS1-3	Fuseholder	8458P
	Earth Terminal	6371P
	Top Cover	9109P
	Bottom Cover	9110P
	Loudspeaker 2" x 3" 8Ω	8657P
	Loudspeaker Fret	8651P
	Meter 50-0-50μA	9019P
	Fuse 5A F270/5A	7814P
	Fuse 2A F270/2A	6704P
	Fuse 1A F270/1A	7173P
	Lamp 12V 80mA wire-ended	8448P
	Box Spanner	9057P
	Spring extractor (for module covers)	9284P
	Trimming tool	8333P
	Trimming tool	8363P
	Relay	8445P
	Cabinet Assembly	LP3481
	Crystal Frequency Label	9290P

APPENDIX C

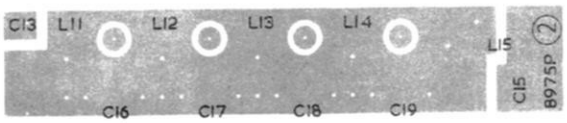
CIRCUIT DATA

All boards are shown viewed from the legend side, i.e. the copper track is seen through the laminate. The VHF Tuner board and Harmonic Amplifier board are shown again with the earth plane and legend superimposed; on the board the legend is printed onto the earth plane. There is no legend for the Scale Lamp Board or the LED Mounting Board.

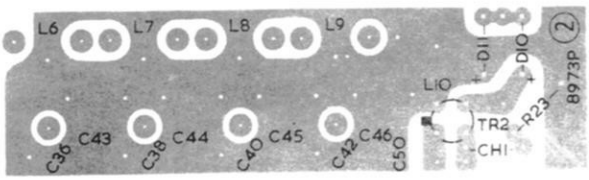
All illustrations are actual size.



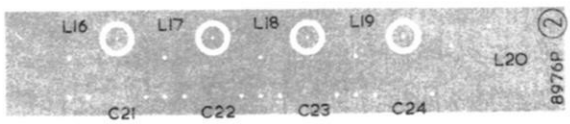
AERIAL COIL BOARD



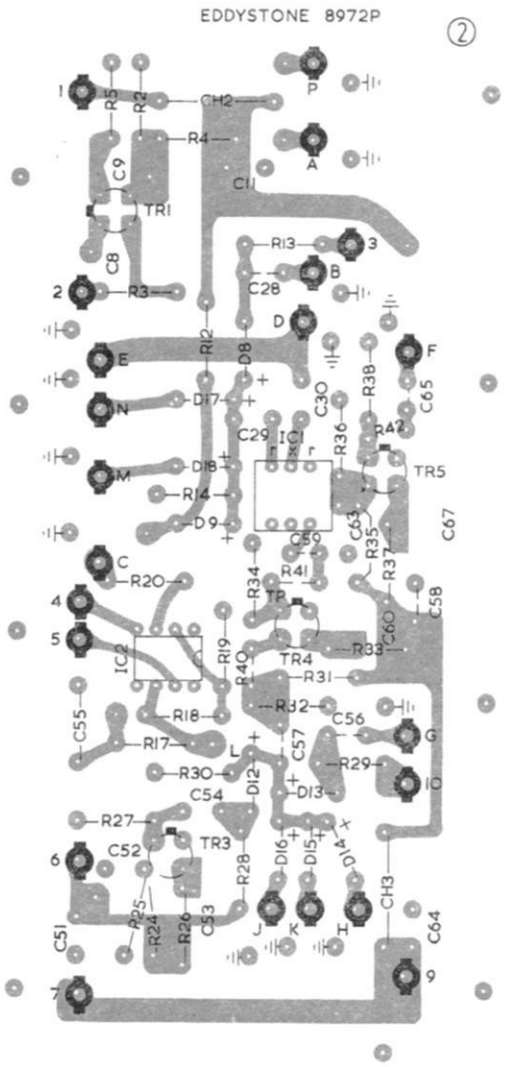
RF COIL BOARD



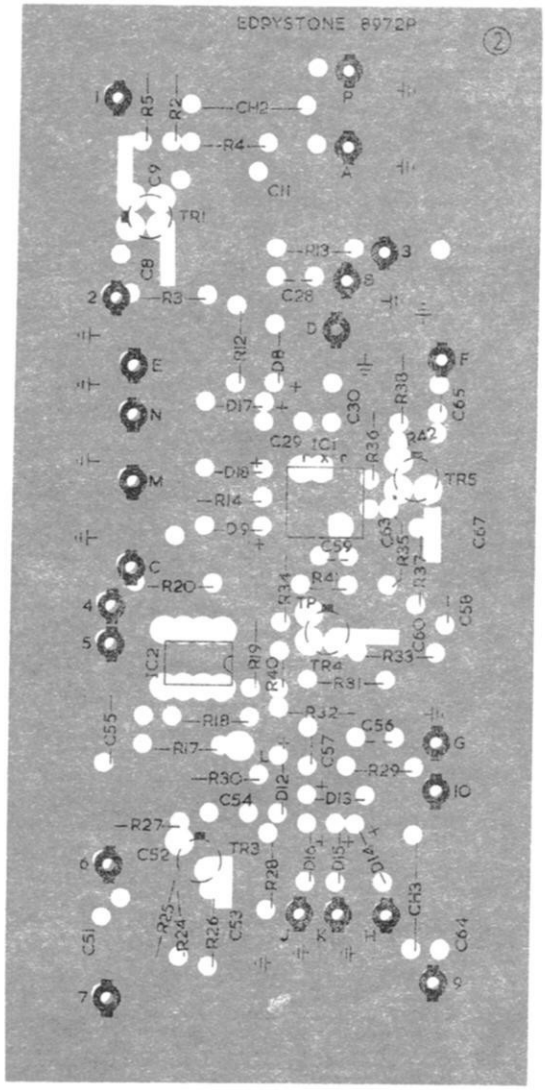
VFO COIL BOARD



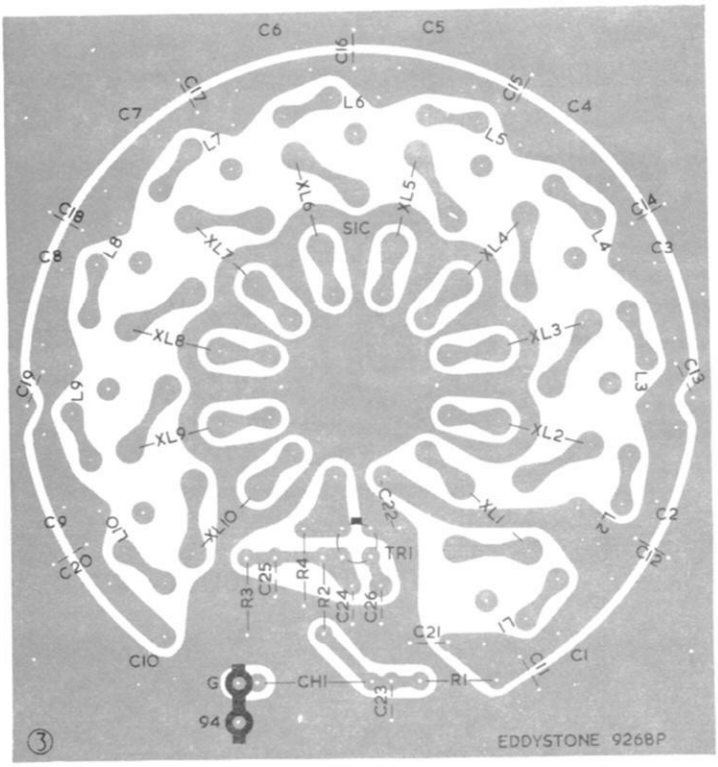
MIXER COIL BOARD



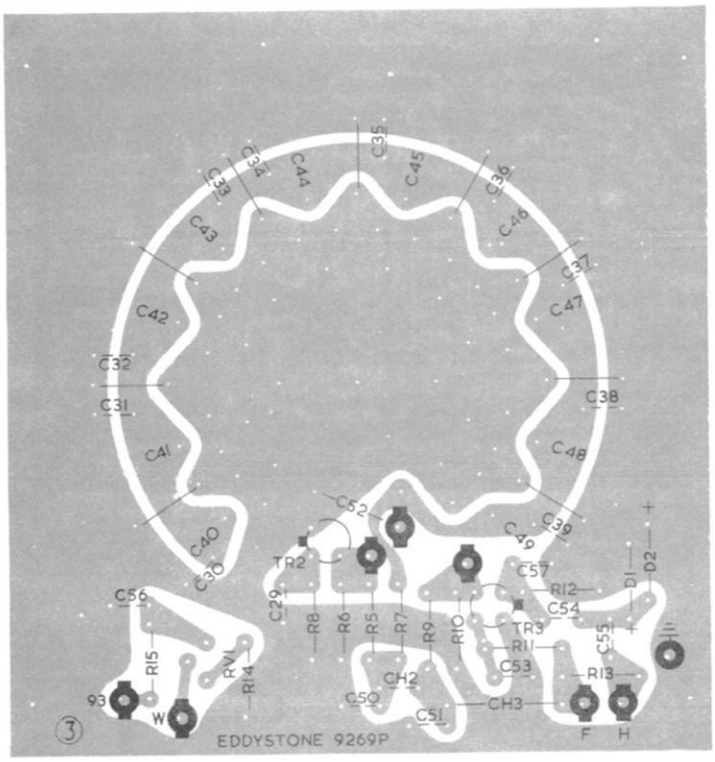
VHF TUNER BOARD showing copper track



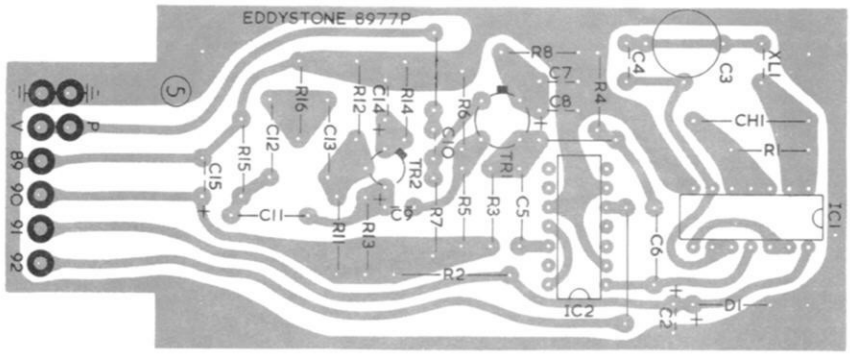
VHF TUNER BOARD showing earth plane



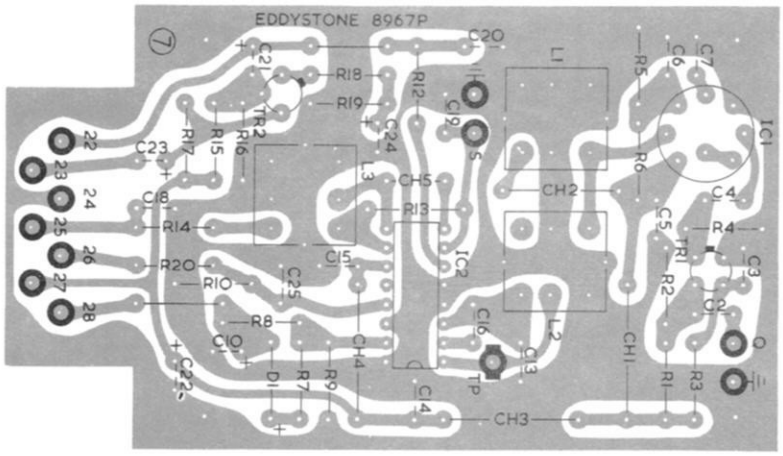
CRYSTAL OSCILLATOR BOARD



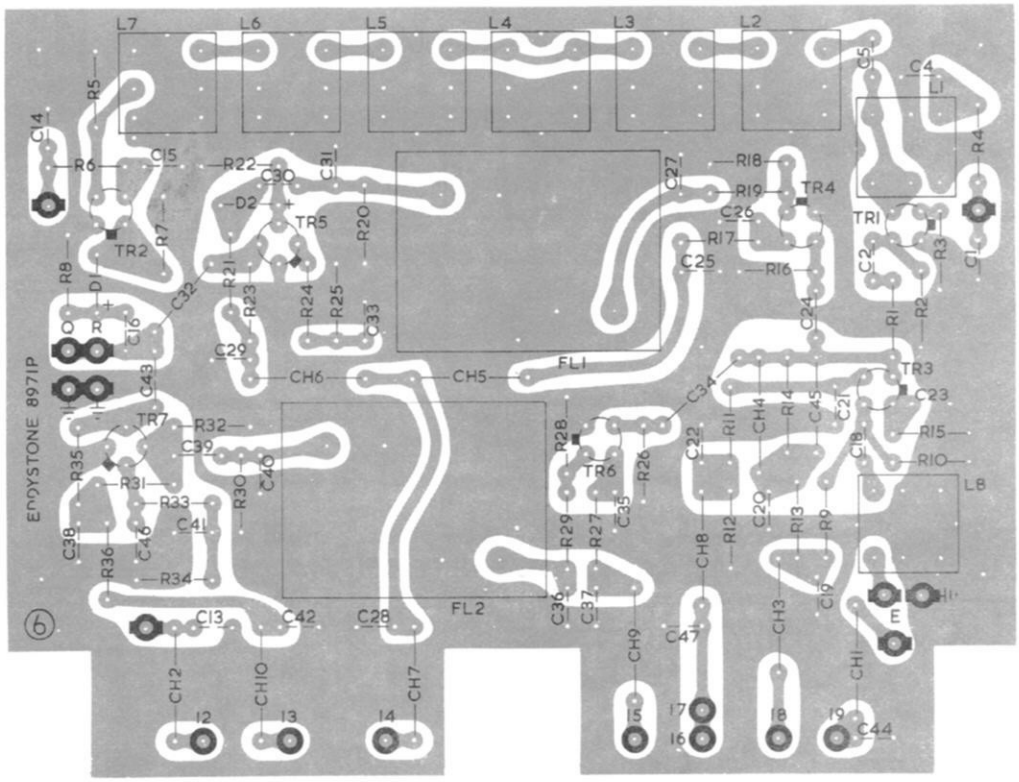
CRYSTAL MULTIPLIER BOARD



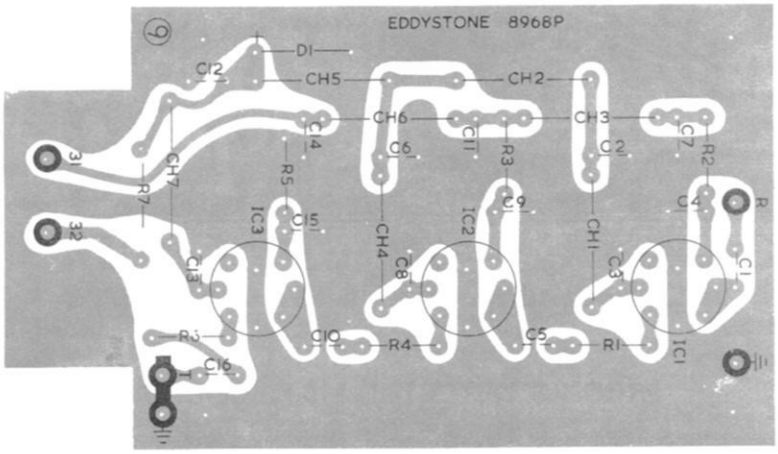
CALIBRATOR MODULE



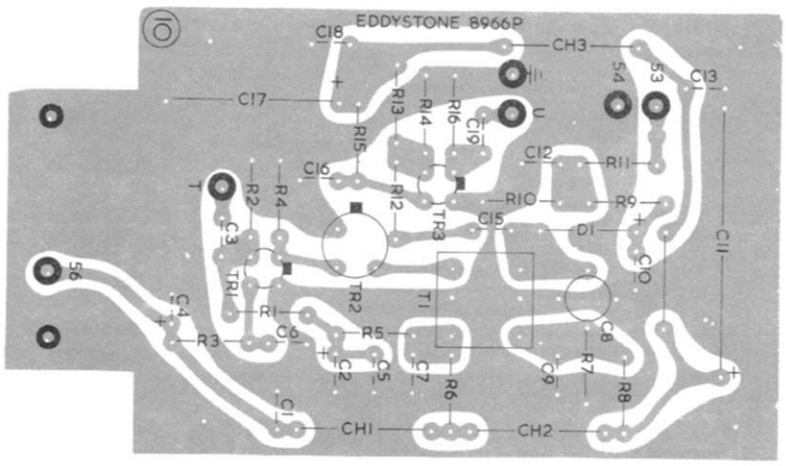
FM MODULE



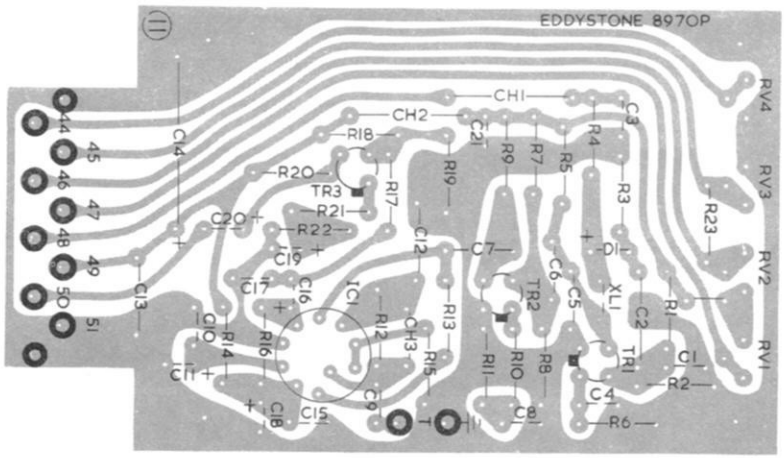
SELECTIVITY MODULE



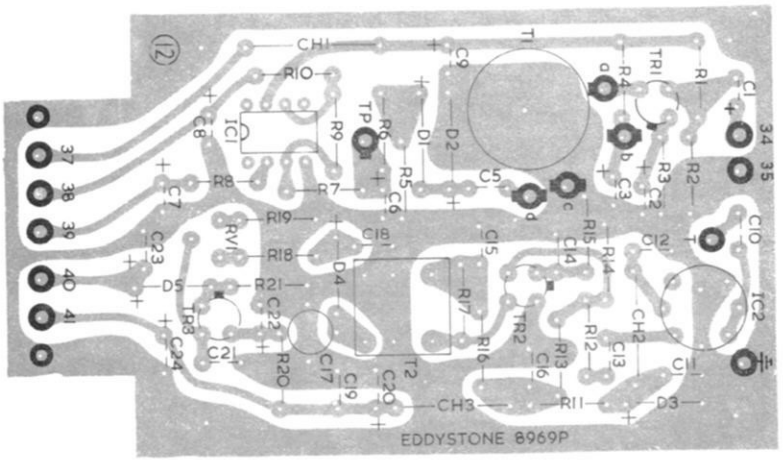
MAIN IF AMP MODULE



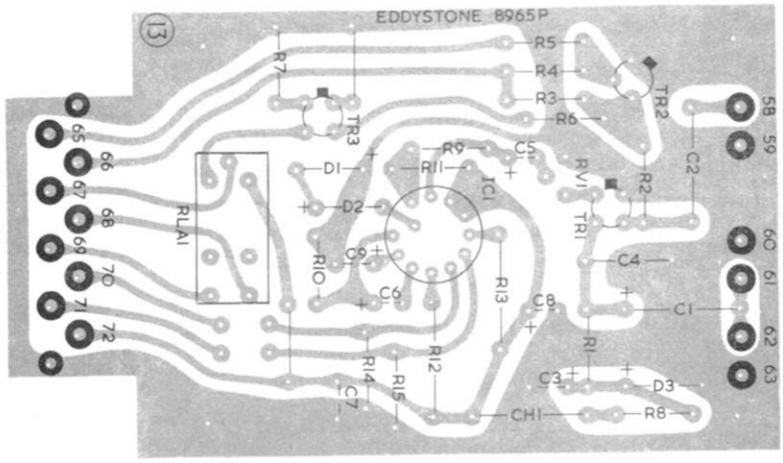
AM DETECTOR & IF OUTPUT MODULE



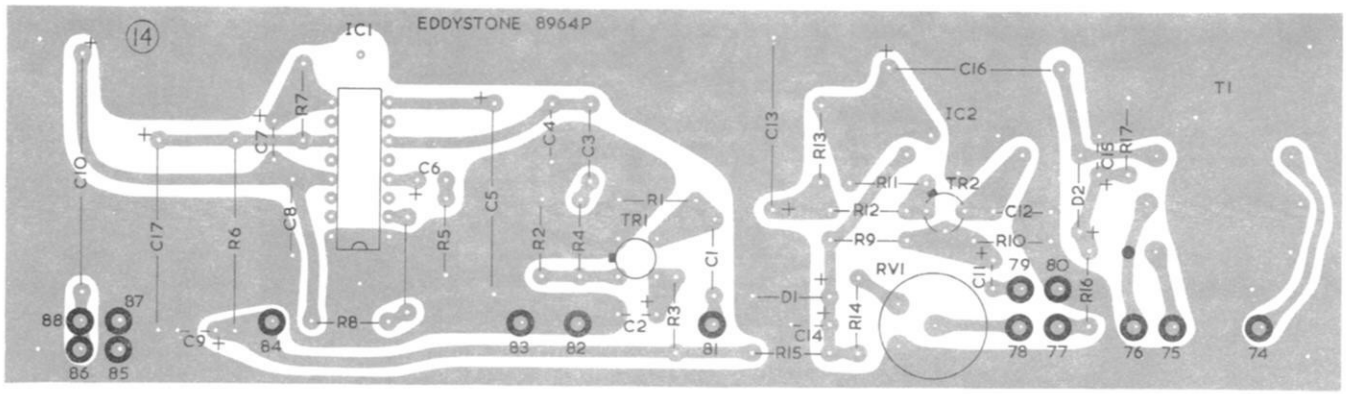
PRODUCT DETECTOR & B.F.O. MODULE



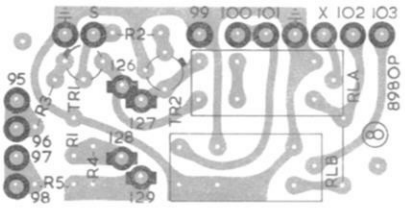
MUTING & IF AGC MODULE



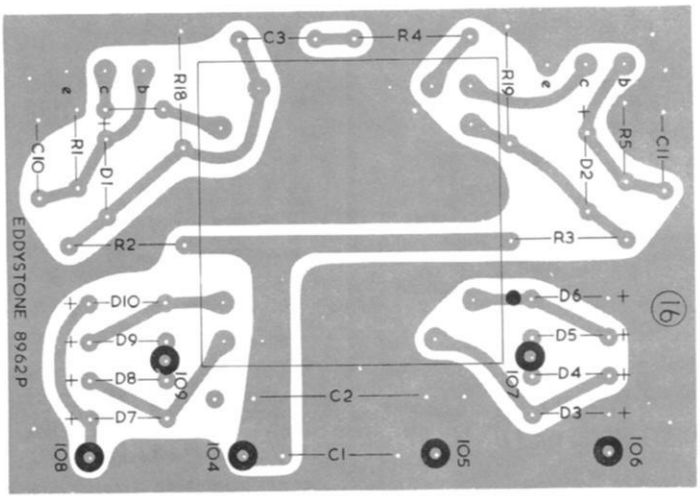
AUDIO-VIDEO SPLITTER MODULE



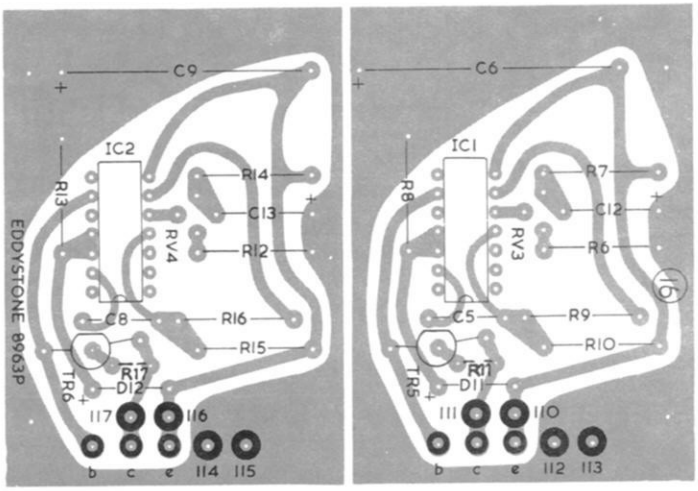
AUDIO AMPLIFIER BOARD



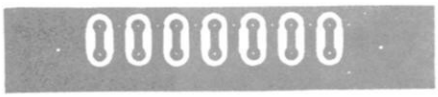
AFC INVERT BOARD



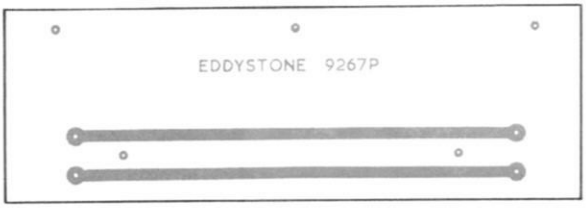
INVERTER OSCILLATOR BOARD



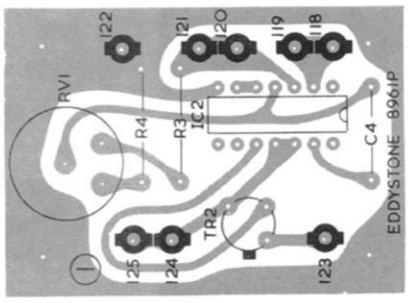
INVERTER REGULATOR BOARD



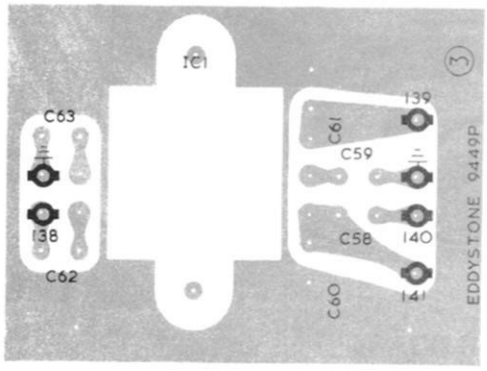
LED MOUNTING BOARD



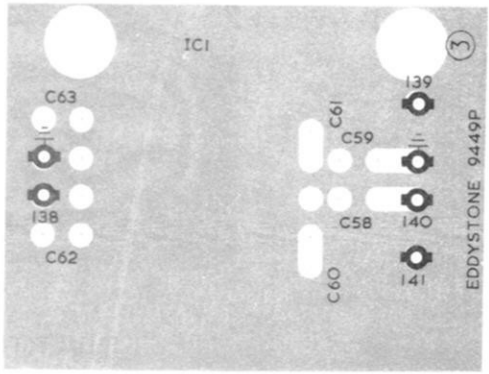
SCALE LAMP BOARD



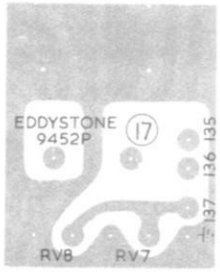
PSU REGULATOR BOARD



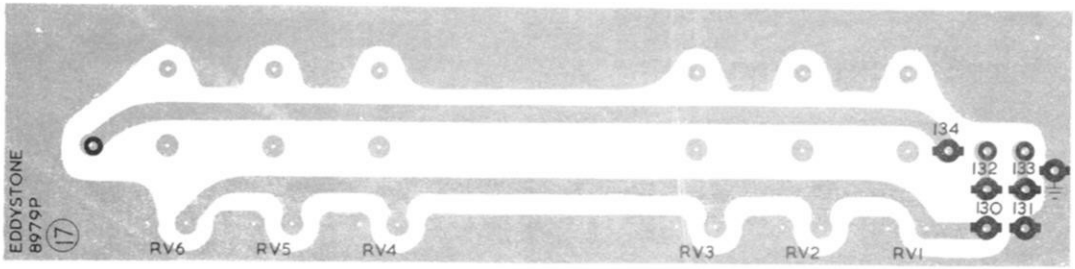
CRYSTAL HARMONIC AMPLIFIER BOARD
showing wiring side



CRYSTAL HARMONIC AMPLIFIER BOARD
showing Earth Plane



UHF OSC. POT. MOUNTING BOARD



UHF TUNER BOARD

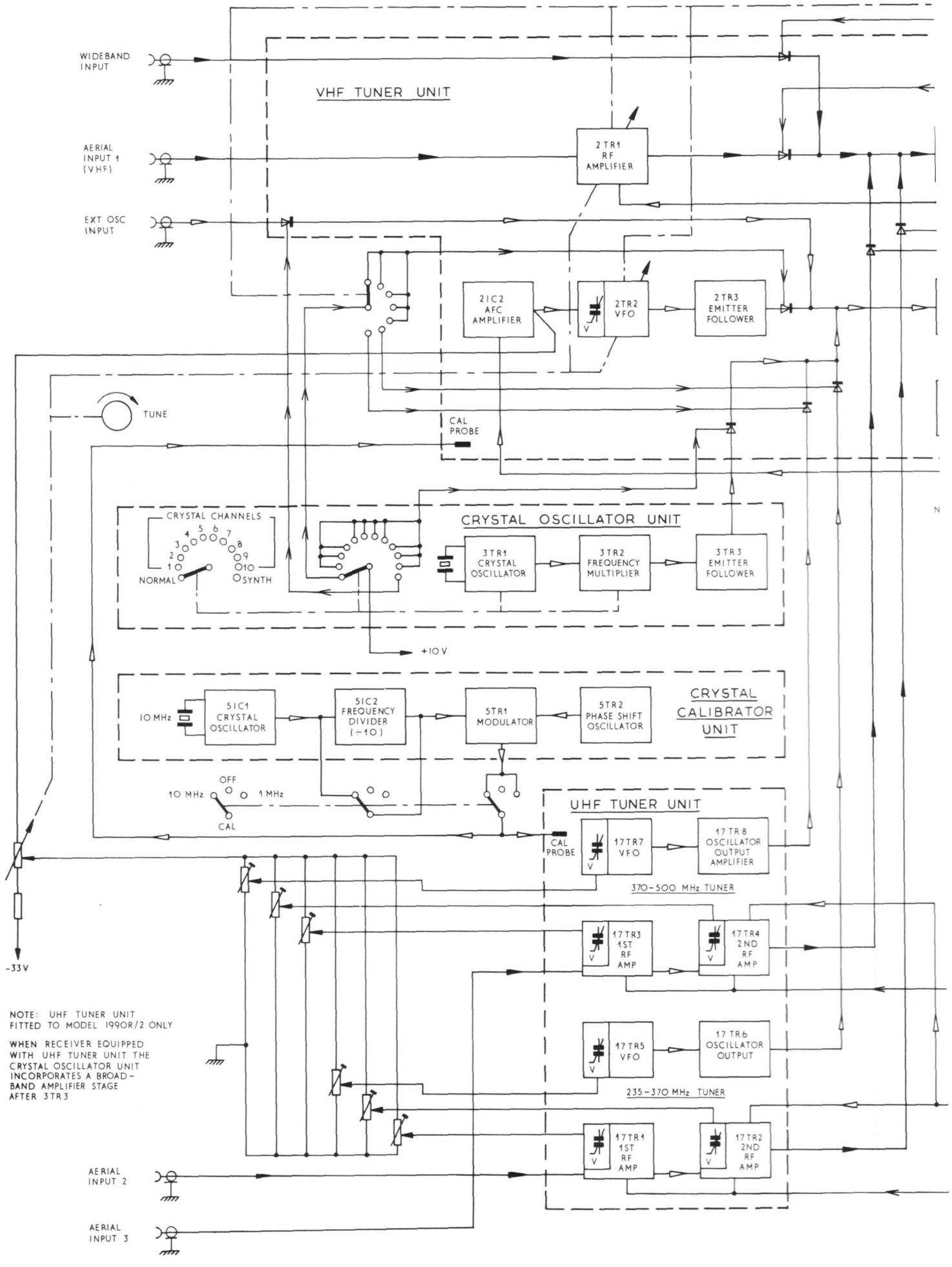
MODULE WIRING DETAILS

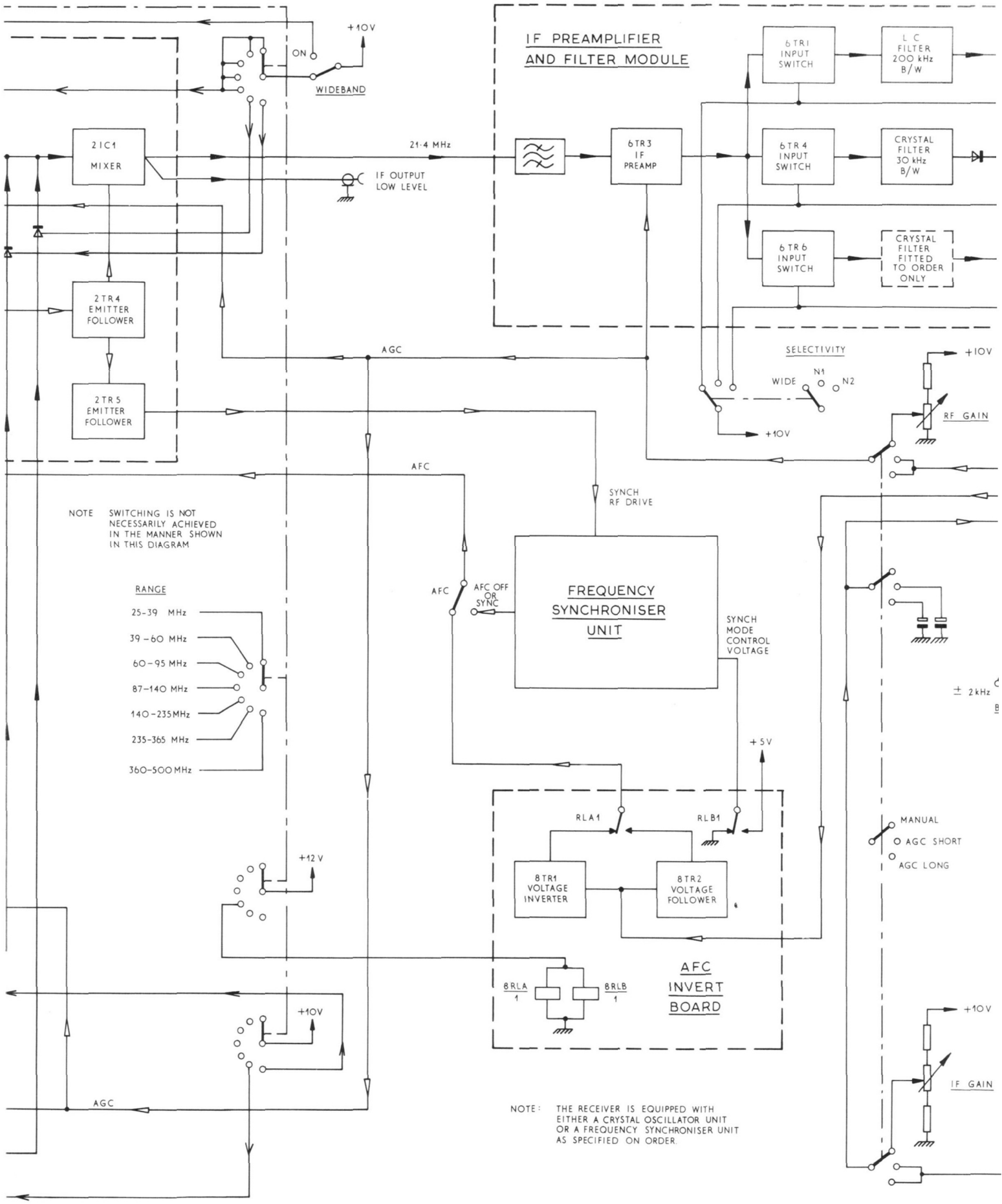
This list is correct for Model 1990R/2. Those wires not required on Model 1990R/1 are marked (*), although they may be present in the cableform. The annotations "source" and "destination" are for identification only and do not refer to current flows or signal paths. Only wires which may be the subject of incorrect identification are listed.

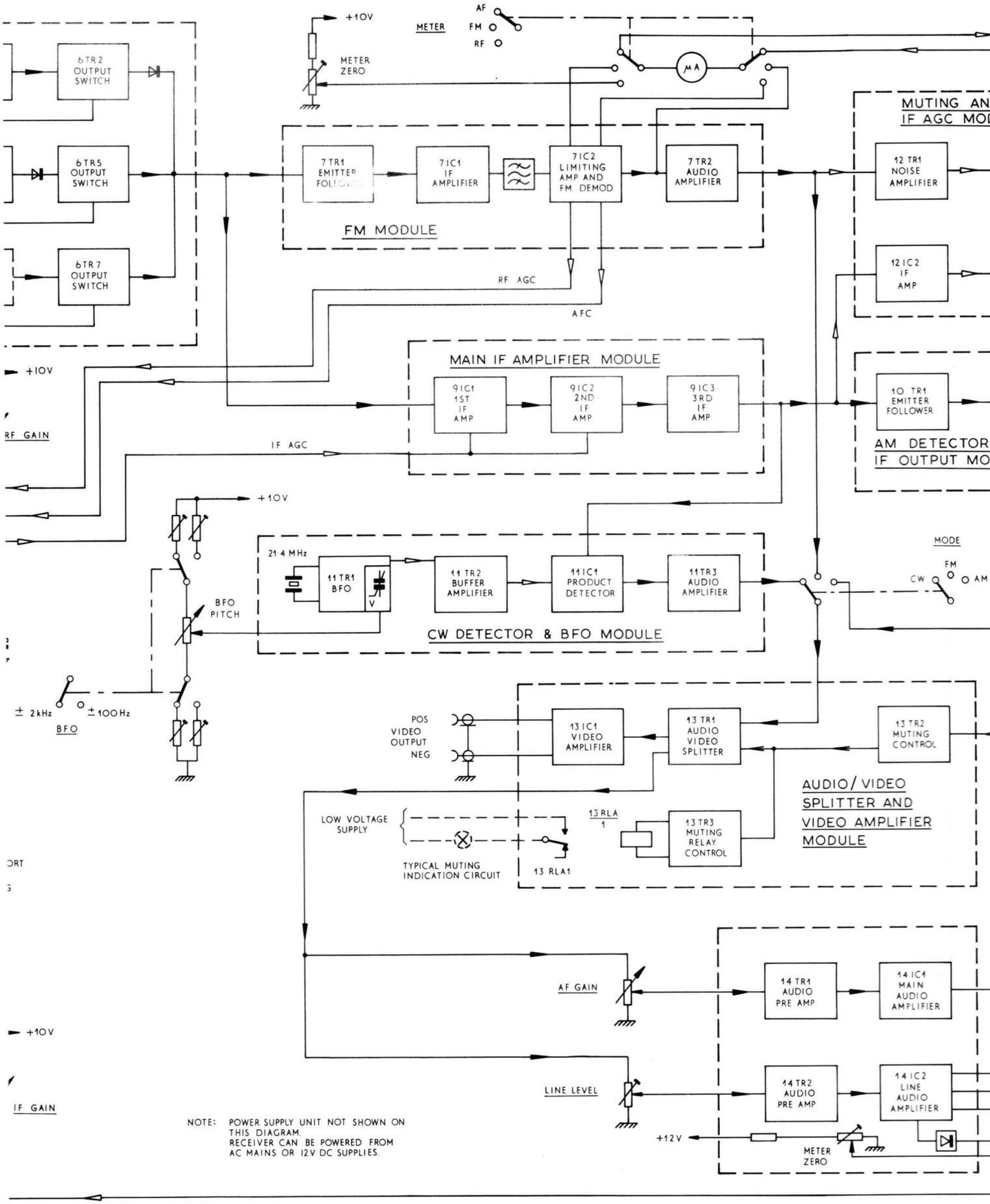
Source		Wire Colour	Destination
Module	Pin		
6 (Selectivity)	12	Orange	Selectivity Switch 4S3 – Wide
	13	Green	Selectivity Switch 4S3 – N2
	14	Blue	Selectivity Switch 4S3 – N1
	15	Green	Selectivity Switch 4S3 – N2
	16	Brown	AGC Switch 4S4A – Wiper
	17	Grey	SKA Pin 2
	18	White	Power Supply – +10V via CH4
	19	Orange	Selectivity Switch 4S3 – Wide
7 (FM)	22	Pink	Meter Switch 4S8B – FM
	23	Inner Braid † Black Screened	Mode Switch 4S5B – FM
	24		Earth
	25	Grey	Meter Switch 4S8A – FM
	26	Yellow	Meter Switch 4S8B – RF
	27	Blue	Power Supply – +10V General
	28	Orange	AGC Switch 4S4A – Short, Long
9 (IF Amp)	31	Purple	AGC Switch 4S4C – Wiper
	32	White	Power Supply – +10V via CH4
12 (Muting)	34	Inner Braid Black Screened	Mode Switch 4S5B – FM
	35		Earth
	37	Blue	Power Supply – General (+10V)
	38	White	Muting Switch 4S10 – ON
	39	Brown	Muting Level 1RV3 – Wiper
	40	Green	AGC Switch 4S4B – Short, Long
	41	Grey	Power Supply – Point 1 (+10V)

† On Model 1990R/3 a parallel feed is taken to a rear panel socket.

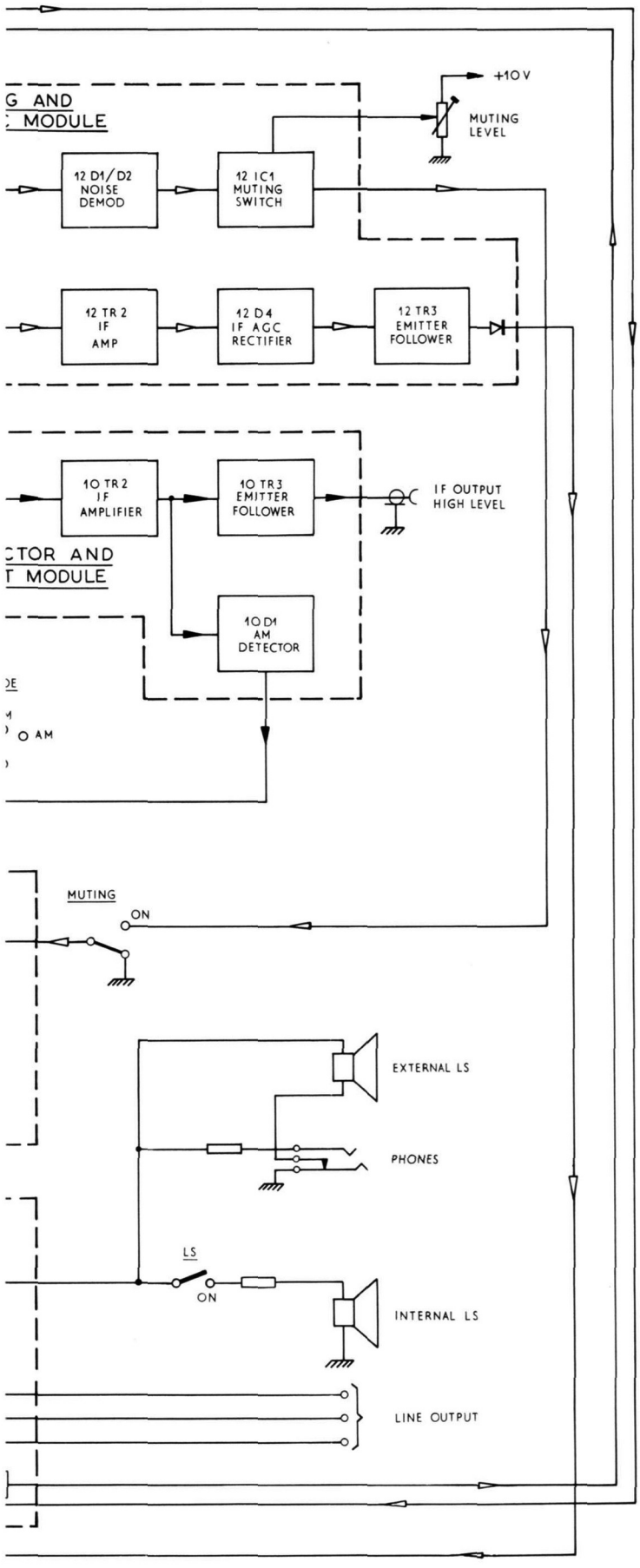
Source		Wire Colour	Destination
Module	Pin		
11 (Prod. Det)	44	Green	BFO Switch 4S6B – 2kHz
	45	White	BFO Switch 4S6B – 100Hz
	46	Red	BFO Switch 4S6A – 100Hz
	47	Yellow	BFO Switch 4S6A – 2kHz
	48	Purple	BFO Pitch 4RV4 – Wiper
	49	Blue	Mode Switch 4S5A – CW
	50	Inner } Black Screened	Mode Switch 4S5B – CW
	51	Braid }	Earth
10 (AM Det.)	53	Inner } Black Screened	Mode Switch 4S5B – AM
	54	Braid }	Earth
	56	Red	Power Supply – General +12V
13 (A.V.Splitter)	58	Inner } Black Screened	Mode Switch 4S5B – Wiper
	59	Braid }	
	60	Braid } Black Screened	AF Gain 4RV5 – Top End
	61	Inner }	
	62	Inner } Black Screened	Line Level 4RV6 – Top End
	63	Braid }	
	65	Pink	Muting Switch 4S10 – Wiper
	66	Yellow	Power Supply – –18V
	67	Orange	SKE Pin 6
	68	Purple	SKE Pin 5
	69	Brown	SKE Pin 7
	70	Co-axial	Video Output Pos
	71	Co-axial	Video Output Neg
	72	Red	Power Supply – General +12V
5 (Crystal Cal)	89	Black	Earth
	90	Blue	Calibrator Switch 4S9B – 1MHz & 10MHz
	91	Pink	Calibrator Switch 4S9A – Wiper
	92	Orange	Calibrator Switch 4S9A – 1MHz
Range Indicator	Range 1	Brown	Range Switch S1AF
	Range 2	White	Range Switch S1AF
	Range 3	Grey	Range Switch S1AF
	Range 4	Yellow	Range Switch S1AF
	Range 5	Green	Range Switch S1AF
	Range 6	Blue *	Range Switch S1AF
	Range 7	Purple *	Range Switch S1AF
RF Co-axial Cables			
10	U		IF Output
5	P		Pin P – VHF Tuner
5	V		Pin V – UHF Tuner

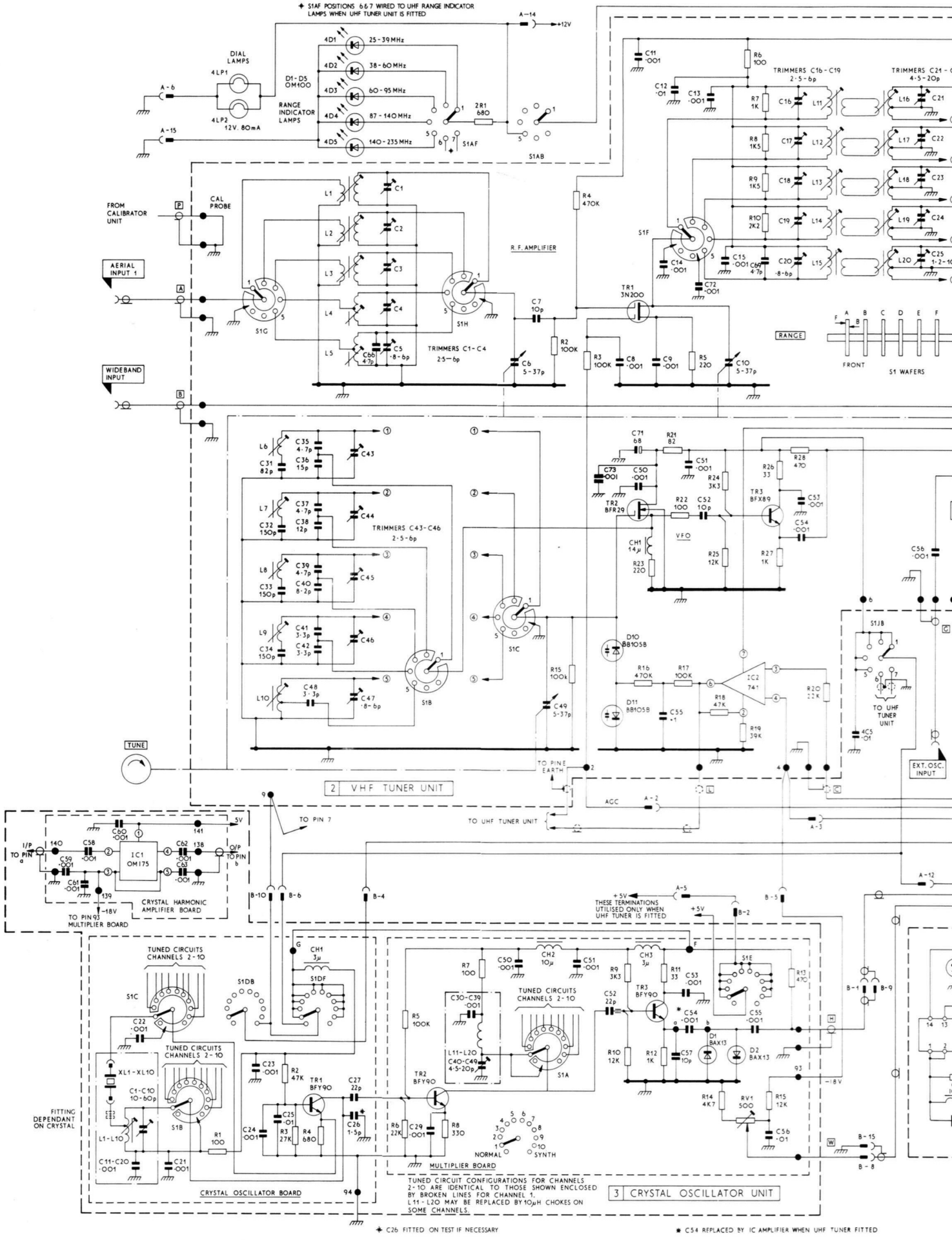

WIDEBAND INPUT
VHF TUNER UNIT
AERIAL INPUT 1 (VHF)
2 TR1 RF AMPLIFIER
EXT OSC INPUT
2 IC2 AFC AMPLIFIER
2 TR2 VFO
2 TR3 EMITTER FOLLOWER
TUNE
CAL PROBE
CRYSTAL CHANNELS
NORMAL
SYNTH
CRYSTAL OSCILLATOR UNIT
3 TR1 CRYSTAL OSCILLATOR
3 TR2 FREQUENCY MULTIPLIER
3 TR3 EMITTER FOLLOWER
+10 V
10 MHz
5 IC1 CRYSTAL OSCILLATOR
5 IC2 FREQUENCY DIVIDER (÷10)
5 TR1 MODULATOR
5 TR2 PHASE SHIFT OSCILLATOR
CRYSTAL CALIBRATOR UNIT
OFF
10 MHz
1 MHz
CAL
UHF TUNER UNIT
CAL PROBE
17 TR7 VFO
17 TR8 OSCILLATOR OUTPUT AMPLIFIER
370–500 MHz TUNER
17 TR3 1ST RF AMP
17 TR4 2ND RF AMP
17 TR5 VFO
17 TR6 OSCILLATOR OUTPUT
235–370 MHz TUNER
17 TR1 1ST RF AMP
17 TR2 2ND RF AMP
-33 V
AERIAL INPUT 2
AERIAL INPUT 3
NOTE: UHF TUNER UNIT FITTED TO MODEL 1990R/2 ONLY
WHEN RECEIVER EQUIPPED WITH UHF TUNER UNIT THE CRYSTAL OSCILLATOR UNIT INCORPORATES A BROAD-BAND AMPLIFIER STAGE AFTER 3 TR3

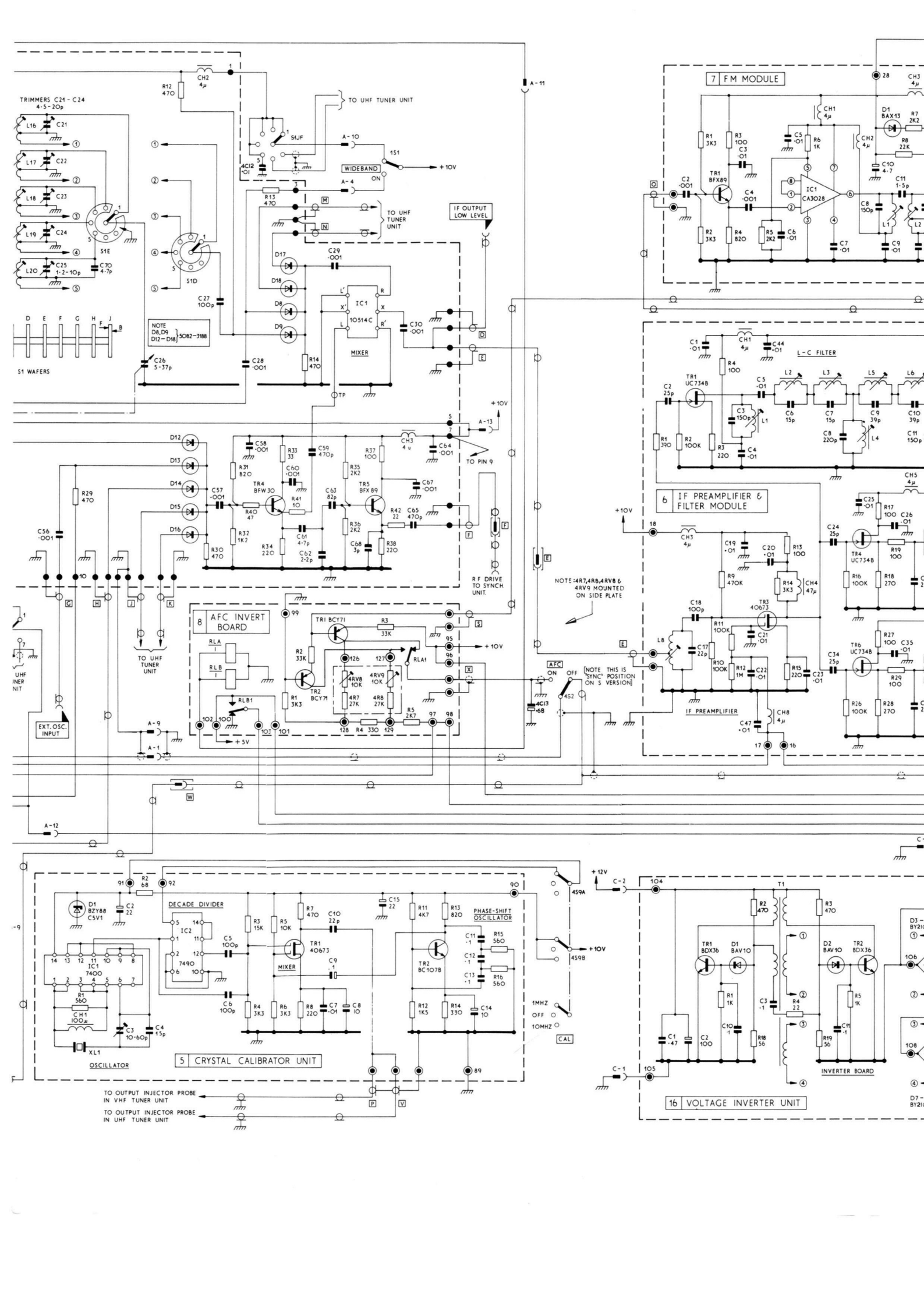

IF PREAMPLIFIER AND FILTER MODULE
+10V
ON
WIDEBAND
2 IC 1 MIXER
21·4 MHz
IF OUTPUT LOW LEVEL
6 TR 1 INPUT SWITCH
L C FILTER 200 kHz B/W
6 TR 3 IF PREAMP
6 TR 4 INPUT SWITCH
CRYSTAL FILTER 30 kHz B/W
6 TR 6 INPUT SWITCH
CRYSTAL FILTER FITTED TO ORDER ONLY
2 TR 4 EMITTER FOLLOWER
2 TR 5 EMITTER FOLLOWER
AGC
SELECTIVITY
WIDE
N1
N2
+10V
RF GAIN
AFC
SYNCH RF DRIVE
NOTE SWITCHING IS NOT NECESSARILY ACHIEVED IN THE MANNER SHOWN IN THIS DIAGRAM
RANGE
25-39 MHz
39-60 MHz
60-95 MHz
87-140 MHz
140-235MHz
235-365 MHz
360-500MHz
AFC
AFC OFF OR SYNC
FREQUENCY SYNCHRONISER UNIT
SYNCH MODE CONTROL VOLTAGE
+5V
± 2kHz
RLA1
RLB1
MANUAL
AGC SHORT
AGC LONG
8 TR1 VOLTAGE INVERTER
8 TR2 VOLTAGE FOLLOWER
+12 V
8RLA 1
8RLB 1
AFC INVERT BOARD
+10V
IF GAIN
AGC
NOTE: THE RECEIVER IS EQUIPPED WITH EITHER A CRYSTAL OSCILLATOR UNIT OR A FREQUENCY SYNCHRONISER UNIT AS SPECIFIED ON ORDER.

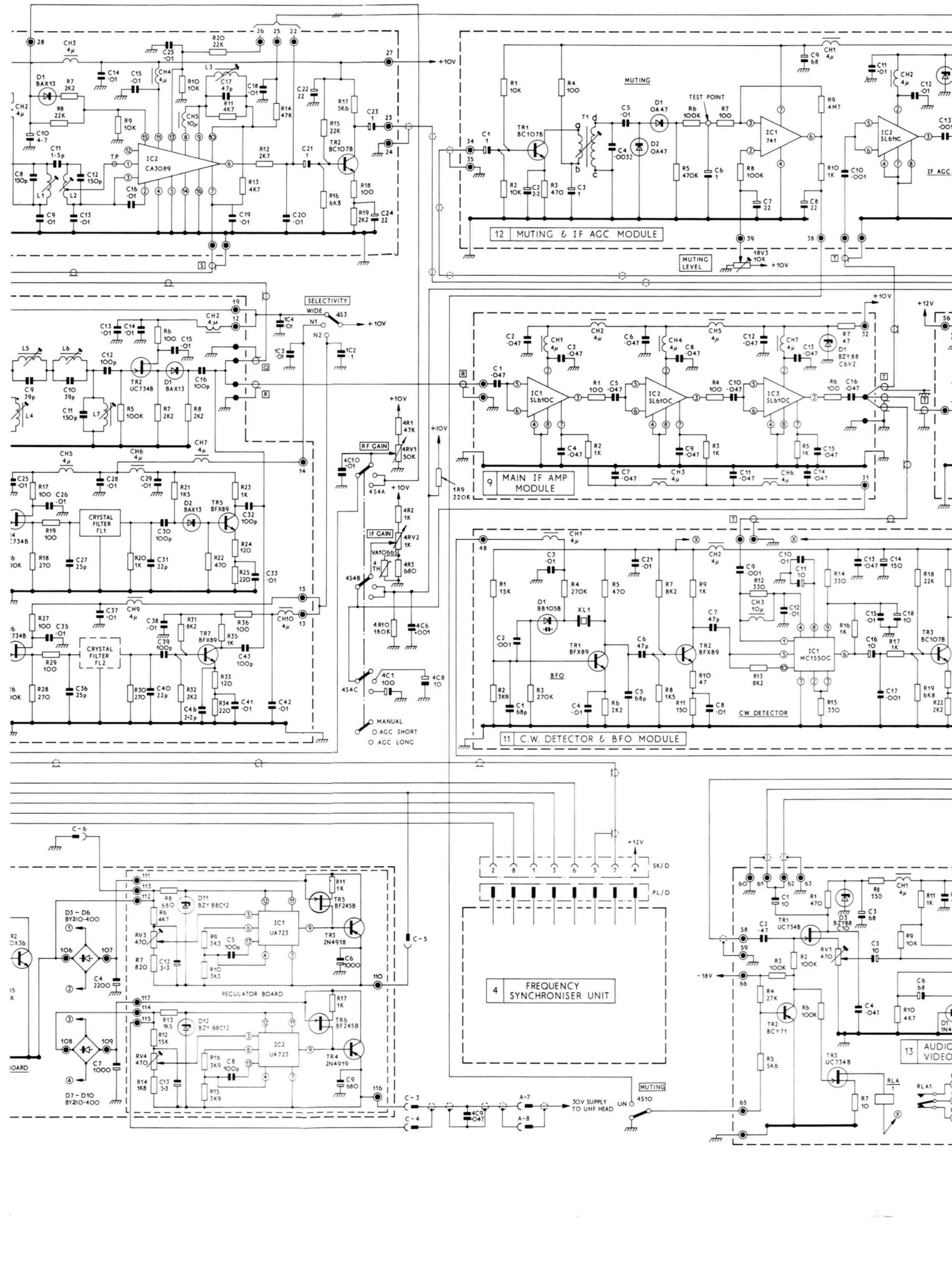


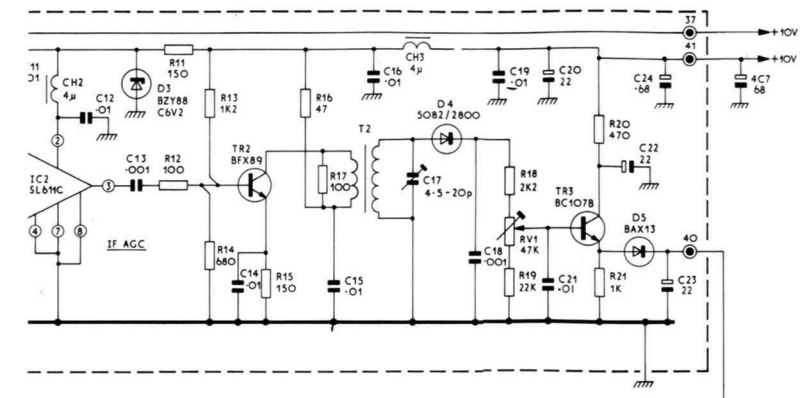
BLOCK DIAGRAM MODEL 1990R

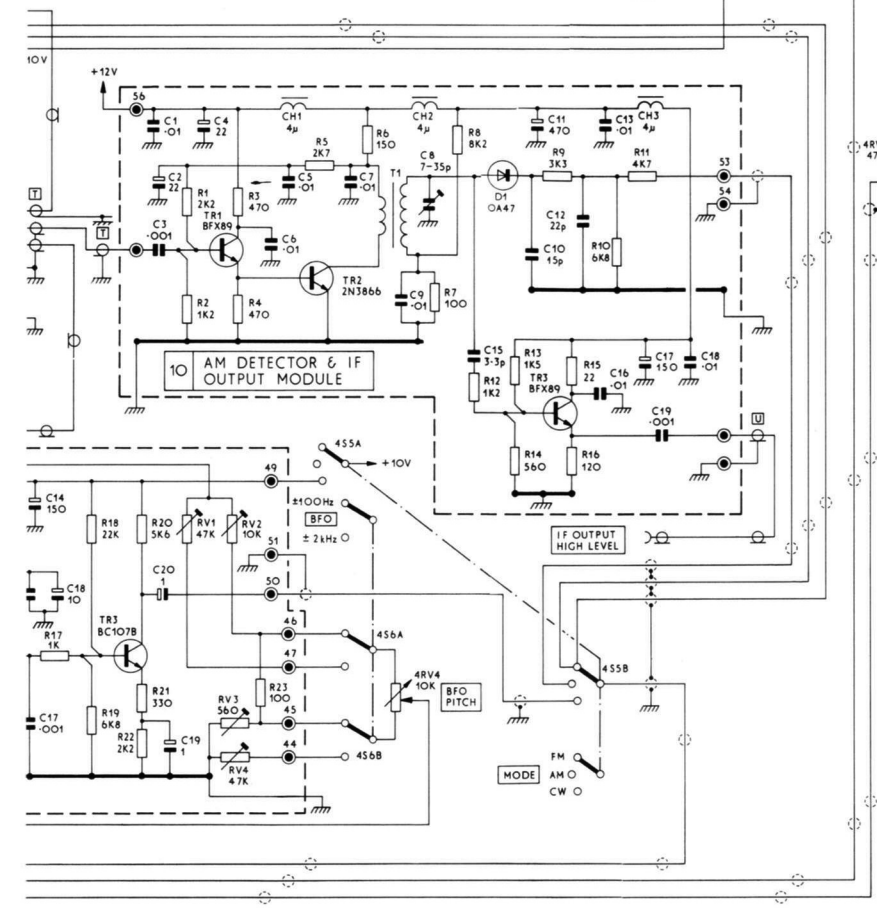

+10V
MUTING LEVEL
12 D1/D2 NOISE DEMOD
12 IC1 MUTING SWITCH
12 TR2 IF AMP
12 D4 IF AGC RECTIFIER
12 TR3 EMITTER FOLLOWER
10 TR2 IF AMPLIFIER
10 TR3 EMITTER FOLLOWER
IF OUTPUT HIGH LEVEL
10 D1 AM DETECTOR
MUTING
ON
EXTERNAL LS
PHONES
LS
ON
INTERNAL LS
LINE OUTPUT

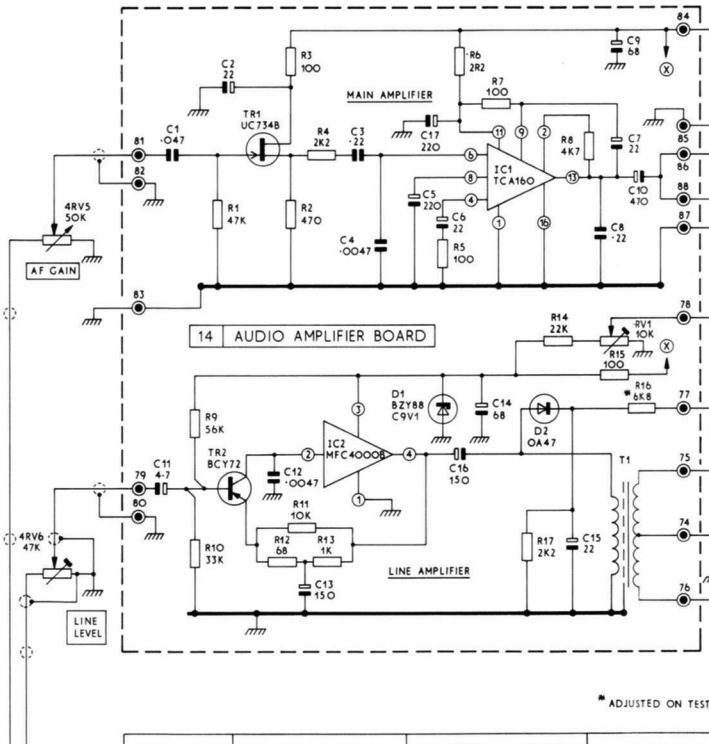

✦ S1AF POSITIONS 6 & 7 WIRED TO UHF RANGE INDICATOR LAMPS WHEN UHF TUNER UNIT IS FITTED
DIAL LAMPS
4LP1
4LP2
12V. 80mA
RANGE INDICATOR LAMPS
D1-D5 OM400
4D1 25-39MHz
4D2 38-60MHz
4D3 60-95MHz
4D4 87-140MHz
4D5 140-235MHz
2R1 680
S1AF
S1AB
A-14
+12V
A-6
A-15
TRIMMERS C16-C19 2-5-6p
TRIMMERS C21-C24 4-5-20p
TRIMMERS C25-C28 1-2-10p
FROM CALIBRATOR UNIT
CAL PROBE
AERIAL INPUT 1
WIDEBAND INPUT
R.F. AMPLIFIER
TRIMMERS C1-C4 2-5-6p
S1G
S1H
S1F
TR1 3N200
RANGE
FRONT
S1 WAFERS
TRIMMERS C43-C46 2-5-6p
S1C
S1B
VFO
TR2 BFR29
TR3 BFX89
D10 BB105B
D11 BB105B
IC2 741
S1JB
TO UHF TUNER UNIT
EXT. OSC. INPUT
TUNE
TO PIN E EARTH
AGC
2 VHF TUNER UNIT
TO UHF TUNER UNIT
TO PIN 7
I/P TO PIN a
O/P TO PIN b
IC1 OM175
CRYSTAL HARMONIC AMPLIFIER BOARD
TO PIN 93 MULTIPLIER BOARD
THESE TERMINATIONS UTILISED ONLY WHEN UHF TUNER IS FITTED
TUNED CIRCUITS CHANNELS 2-10
S1DB
S1DF
S1A
S1E
TR1 BFY90
TR2 BFY90
TR3 BFY90
D1 BAX13
D2 BAX13
XL1-XL10
C1-C10 10-60p
L1-L10
C11-C20
C21
FITTING DEPENDANT ON CRYSTAL
NORMAL
SYNTH
MULTIPLIER BOARD
CRYSTAL OSCILLATOR BOARD
TUNED CIRCUIT CONFIGURATIONS FOR CHANNELS 2-10 ARE IDENTICAL TO THOSE SHOWN ENCLOSED BY BROKEN LINES FOR CHANNEL 1.
L11-L20 MAY BE REPLACED BY 10μH CHOKES ON SOME CHANNELS.
3 CRYSTAL OSCILLATOR UNIT
✦ C26 FITTED ON TEST IF NECESSARY
✱ C54 REPLACED BY IC AMPLIFIER WHEN UHF TUNER FITTED


7 FM MODULE
6 IF PREAMPLIFIER & FILTER MODULE
L-C FILTER
8 AFC INVERT BOARD
5 CRYSTAL CALIBRATOR UNIT
16 VOLTAGE INVERTER UNIT
TRIMMERS C21 - C24 4-5 - 20p
S1 WAFERS
TO UHF TUNER UNIT
WIDEBAND
IF OUTPUT LOW LEVEL
MIXER
TO PIN 9
R.F DRIVE TO SYNCH. UNIT.
NOTE: 4R7, 4R8, 4RV8 & 4RV9 MOUNTED ON SIDE PLATE
[NOTE: THIS IS 'SYNC' POSITION ON 'S' VERSION]
IF PREAMPLIFIER
EXT. OSC. INPUT
DECADE DIVIDER
PHASE-SHIFT OSCILLATOR
OSCILLATOR
INVERTER BOARD
TO OUTPUT INJECTOR PROBE IN VHF TUNER UNIT
TO OUTPUT INJECTOR PROBE IN UHF TUNER UNIT

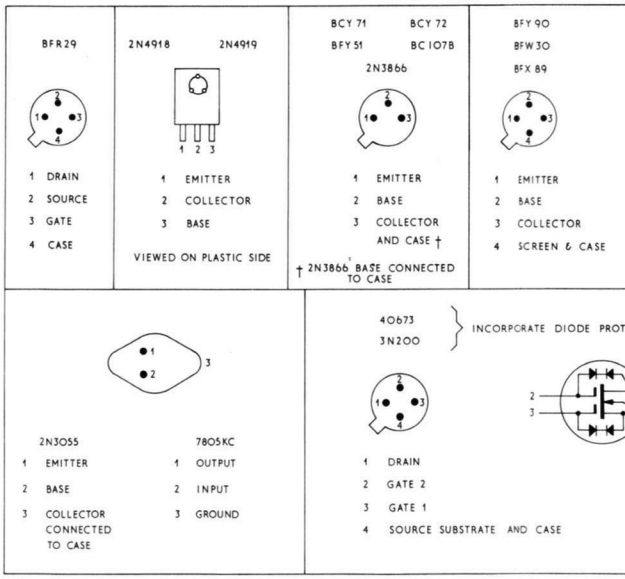

12 MUTING & IF AGC MODULE
9 MAIN IF AMP MODULE
11 C.W. DETECTOR & BFO MODULE
4 FREQUENCY SYNCHRONISER UNIT
13 AUDIO VIDEO
REGULATOR BOARD
MUTING
MUTING LEVEL
TEST POINT
SELECTIVITY
WIDE
453
RF GAIN
IF GAIN
MANUAL
AGC SHORT
AGC LONG
CRYSTAL FILTER FL1
CRYSTAL FILTER FL2
BFO
CW DETECTOR
+10V
+12V
-18V
SK/D
PL/D
30V SUPPLY TO UHF HEAD
IC1 CA3089
IC2 CA3089
IC1 SL610C
IC2 SL610C
IC3 SL610C
IC1 741
IC2 SL61HC
IC1 MC1550G
IC1 UA723
IC2 UA723

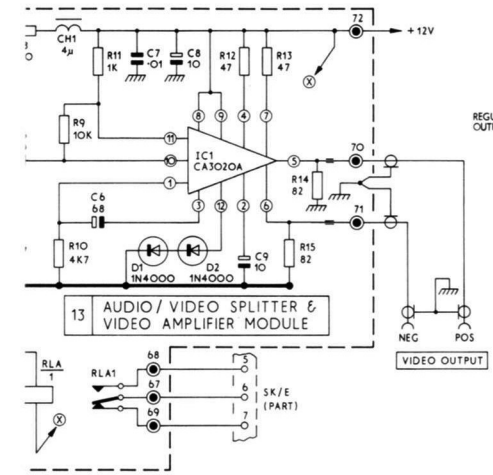


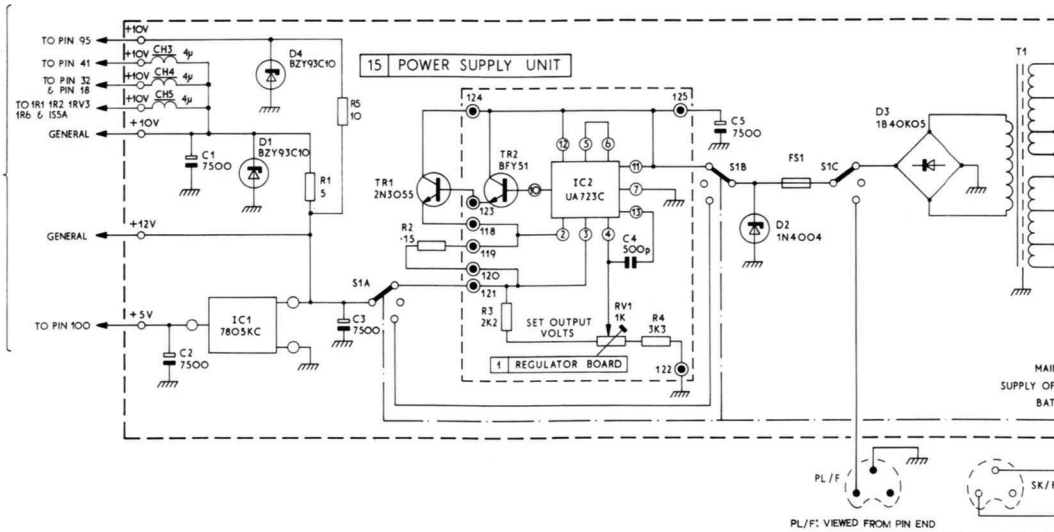


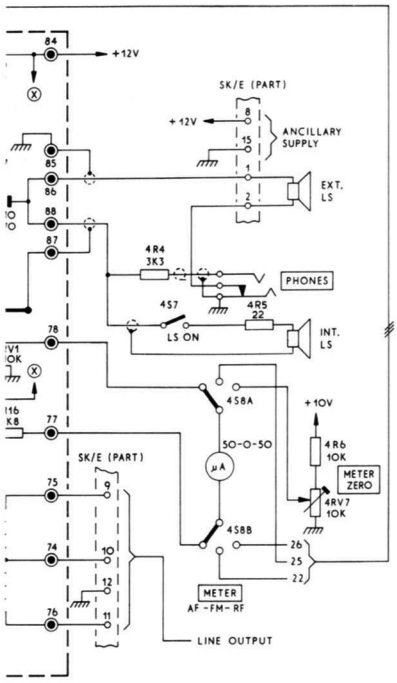


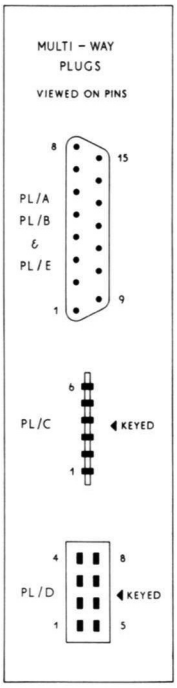
* ADJUSTED ON TEST



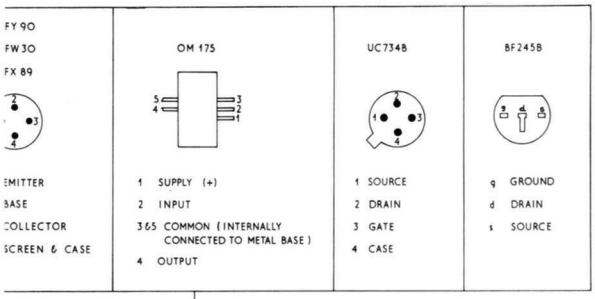


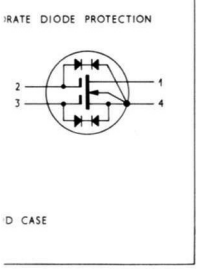




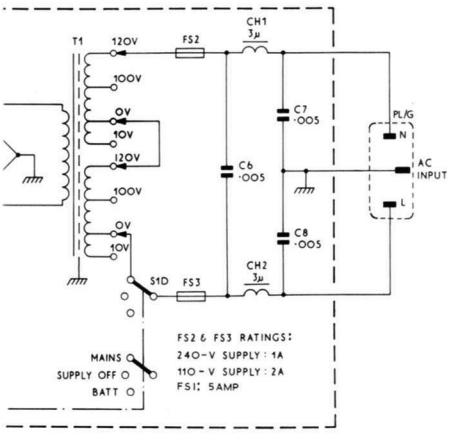


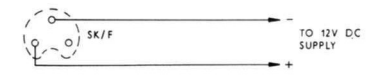
STED ON TEST



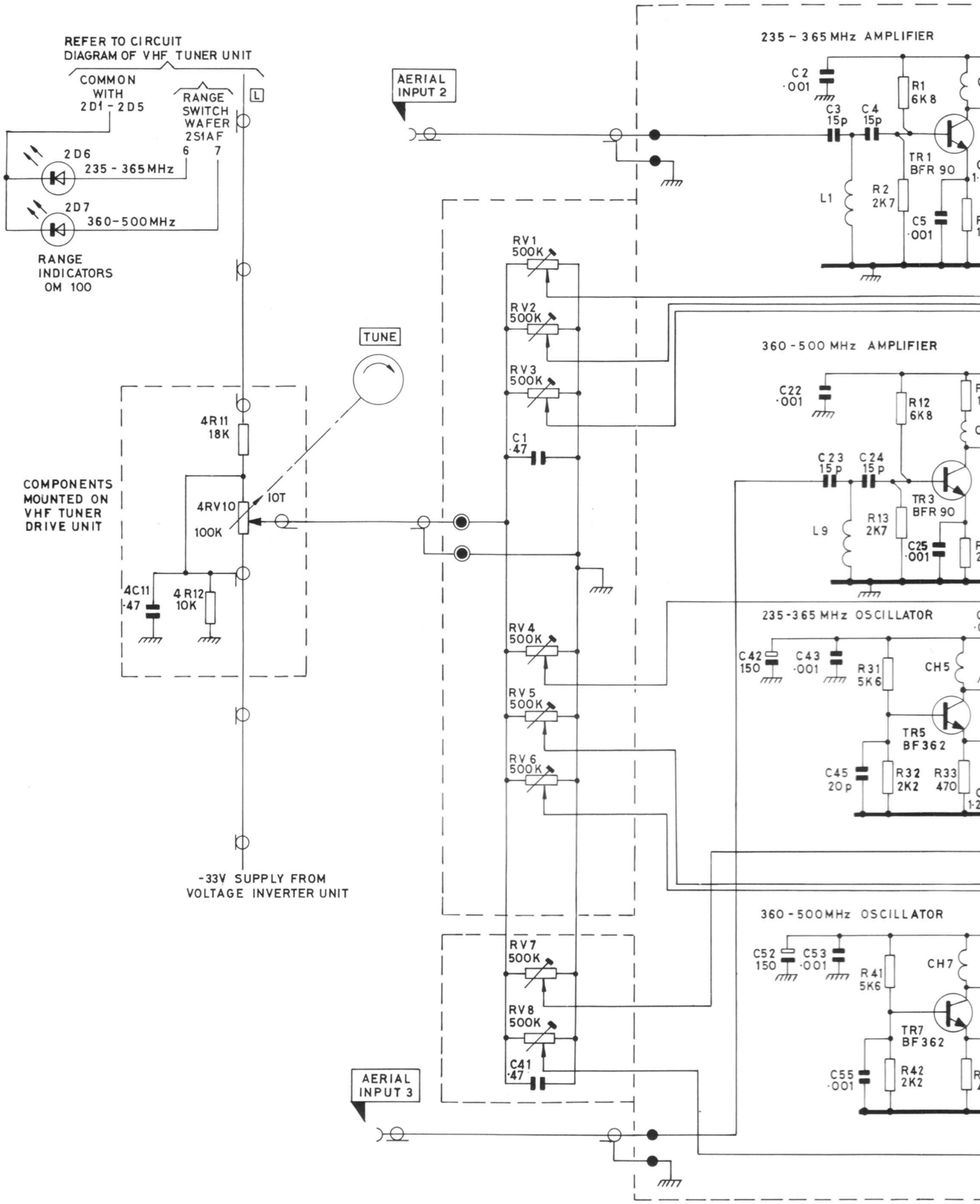


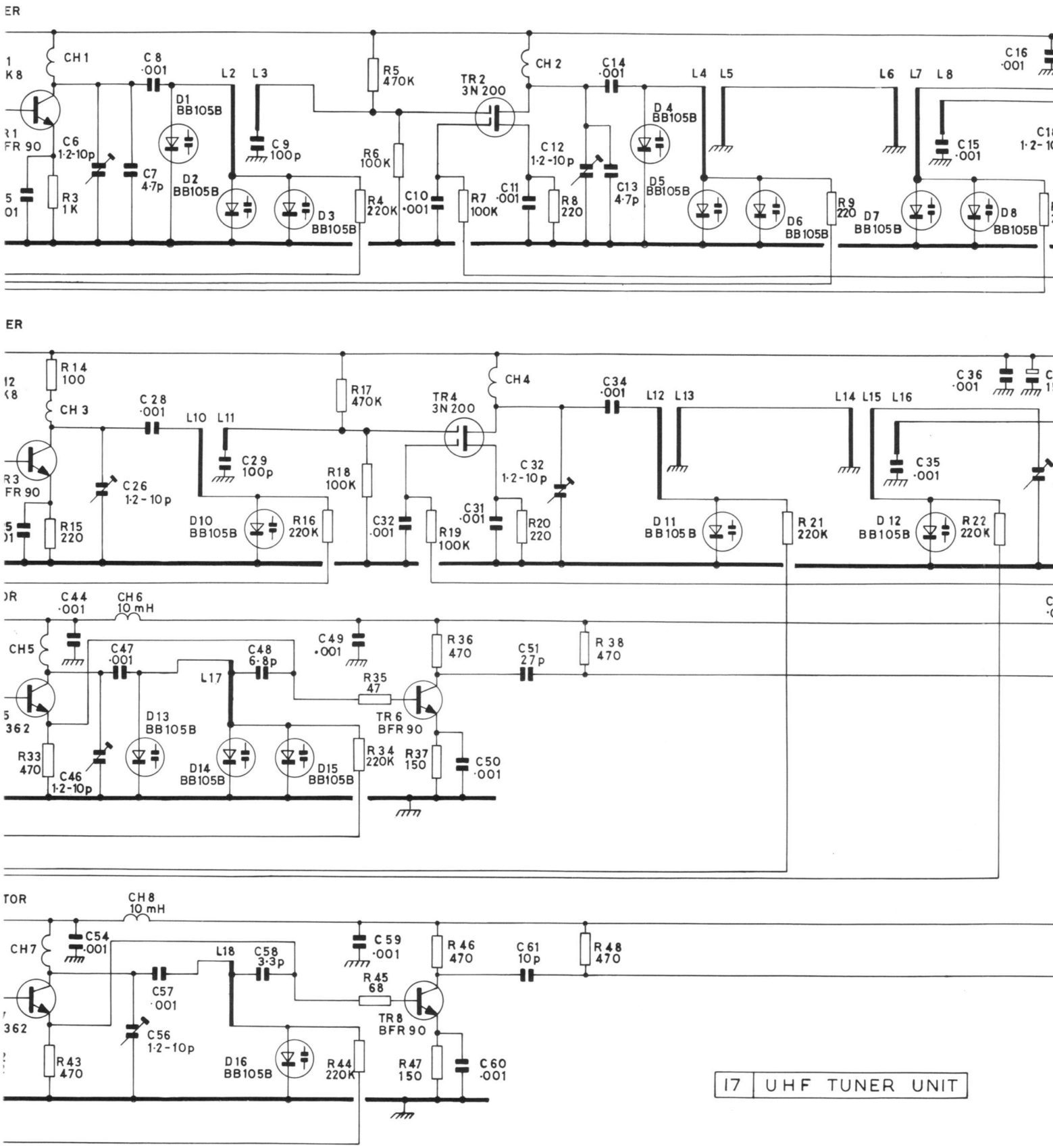
MODEL 1990R
BP1342
ISSUE 2



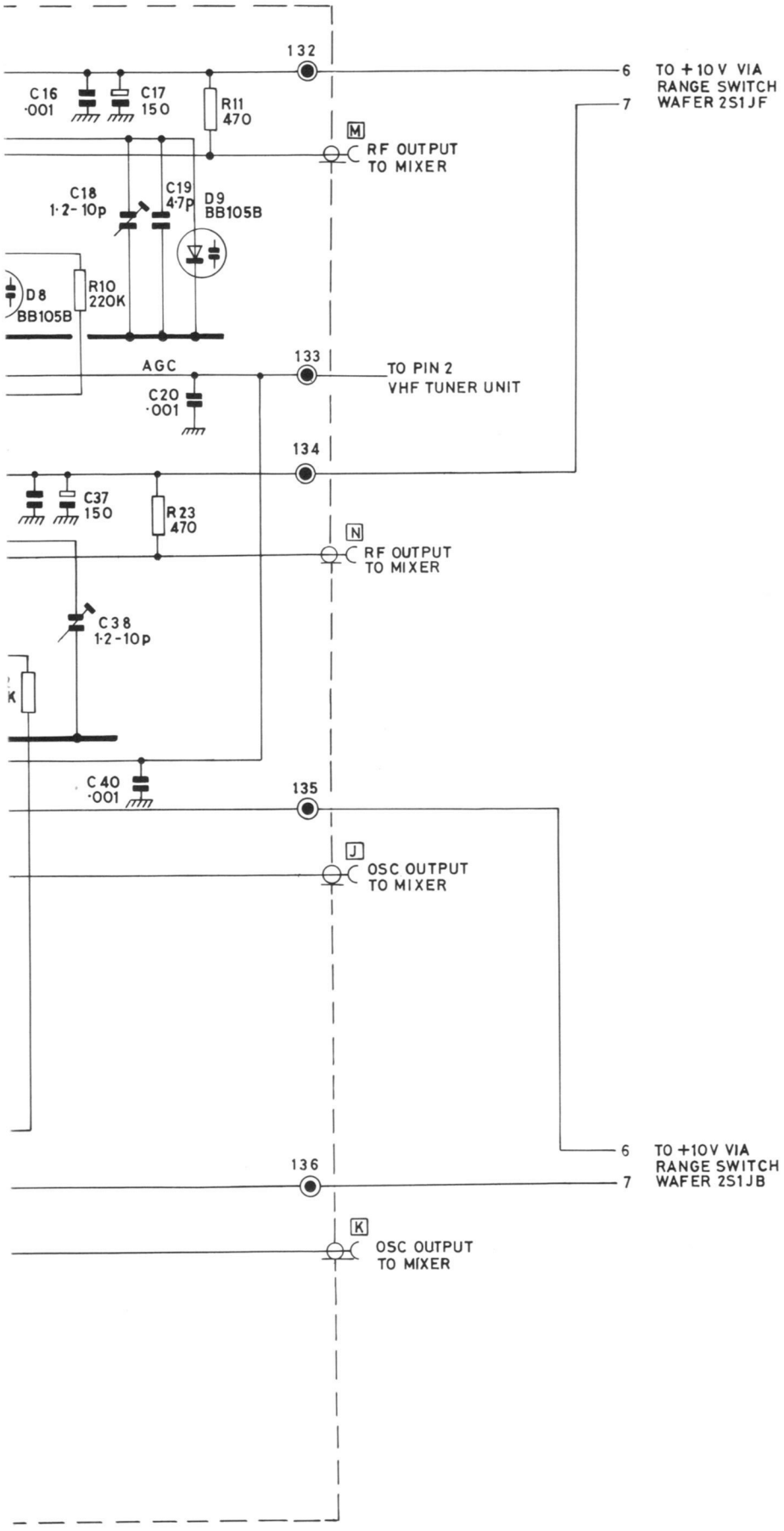


K/F: VIEWED FROM WIRED SIDE


REFER TO CIRCUIT DIAGRAM OF VHF TUNER UNIT
COMMON WITH 2D1 - 2D5
RANGE SWITCH WAFER 2S1AF
L
2D6
235 - 365MHz
6
7
2D7
360-500MHz
RANGE INDICATORS OM 100
AERIAL INPUT 2
235 - 365MHz AMPLIFIER
C2 ·001
R1 6K8
C3 15p
C4 15p
TR1 BFR 90
L1
R2 2K7
C5 ·001
RV1 500K
RV2 500K
RV3 500K
C1 ·47
TUNE
360 - 500 MHz AMPLIFIER
C22 ·001
R12 6K8
C23 15p
C24 15p
TR3 BFR 90
L9
R13 2K7
C25 ·001
4R11 18K
COMPONENTS MOUNTED ON VHF TUNER DRIVE UNIT
4RV10 100K
10T
4C11 ·47
4R12 10K
235-365 MHz OSCILLATOR
C42 150
C43 ·001
R31 5K6
CH5
TR5 BF362
C45 20p
R32 2K2
R33 470
RV4 500K
RV5 500K
RV6 500K
-33V SUPPLY FROM VOLTAGE INVERTER UNIT
360 - 500MHz OSCILLATOR
C52 150
C53 ·001
R41 5K6
CH7
TR7 BF362
C55 ·001
R42 2K2
RV7 500K
RV8 500K
C41 ·47
AERIAL INPUT 3



17 | UHF TUNER UNIT


132
6
TO +10V VIA
RANGE SWITCH
WAFER 2S1JF
7
C16
·001
C17
150
R11
470
M
RF OUTPUT
TO MIXER
C18
1·2-10p
C19
4·7p
D9
BB105B
D8
BB105B
R10
220K
AGC
133
TO PIN 2
VHF TUNER UNIT
C20
·001
134
C37
150
R23
470
N
RF OUTPUT
TO MIXER
C38
1·2-10p
C40
·001
135
J
OSC OUTPUT
TO MIXER
6
TO +10V VIA
RANGE SWITCH
WAFER 2S1JB
136
7
K
OSC OUTPUT
TO MIXER