# RA. 1217

# H.F. COMMUNICATIONS RECEIVER

## VOLUME I

## OPERATORS MANUAL

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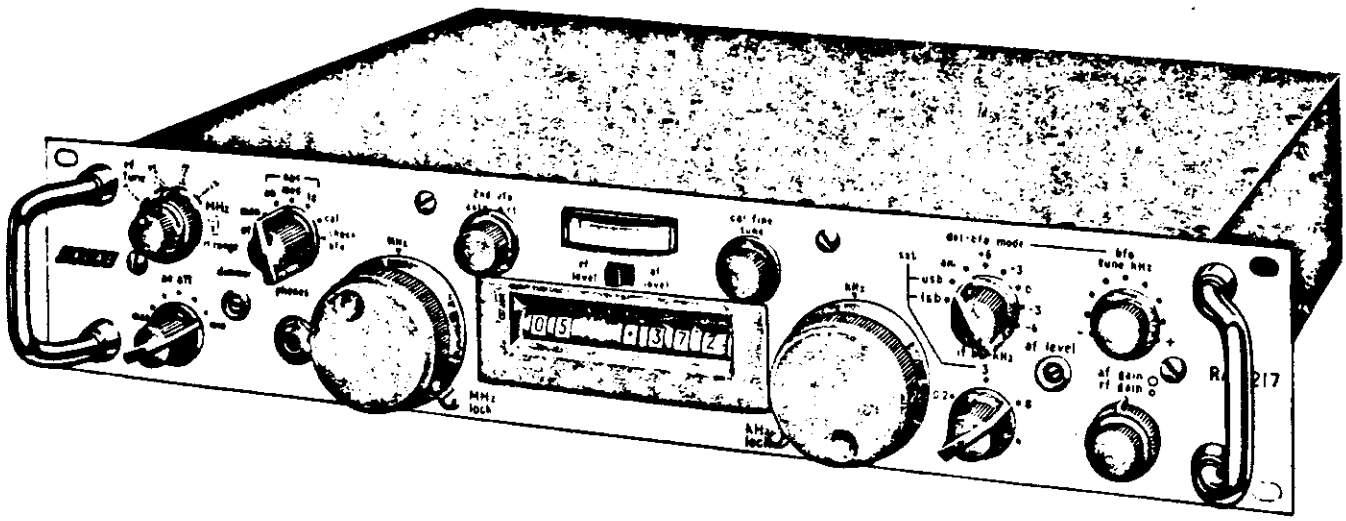

# RA.1217 TRANSISTORISED H.F. COMMUNICATIONS RECEIVER

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## APPENDICES

# TECHNICAL SPECIFICATION

| | |
|---|---|
| **Frequency Range:** | 1 to 30 MHz |
| **Modes of Reception:** | D.S.B. M.C.W., C.W., S.S.B. (U.S.B. or L.S.B.) |
| **Tuning:** | Digital presentation in units of kilohertz/second with interpolation calibration at 200 Hz intervals. |
| **Resetting Accuracy:** | ±200 Hz |
| **Calibration Accuracy:** | ±500 Hz (when calibrated to nearest 100 kHz checkpoint) |
| **Calibration:** | A 100 kHz signal, derived from the 1 MHz standard crystal oscillator having an accuracy of 5 parts in $10^6$, provides check points at 100 kHz intervals. |
| **Frequency Stability:** | (a) ±50 Hz over an eight hour period at constant ambient temperature and humidity after 2 hours from switching on.<br>(b) Better than 50 Hz per degree Centigrade at constant humidity after 2 hours from switching on. |
| **Antenna Input:** | (a) Nominal impedance 75 ohms unbalanced<br>(b) Wideband, or tuned in five automatically selected bands:<br>(i) 1 to 2 MHz<br>(ii) 2 to 4 MHz<br>(iii) 4 to 8 MHz<br>(iv) 8 to 16 MHz<br>(v) 16 to 30 MHz |
| **Sensitivity:** | In 3 kHz bandwidth:<br>(a) C.W., S.S.B: 1 μV for 15 dB signal/noise ratio.<br>(b) M.C.W., D.S.B: 30% modulated at 400 Hz: 3 μV for 15 dB signal/noise ratio. |

**Selectivity:**

Three i.f. bandwidths fitted as standard, although positions available for up to five filters.

Standard Filters:

| 3 dB Bandwidth | 6/60 dB Shape Factor |
|---|---|
| 8 kHz | 1 : 4 |
| 3 kHz | 1 : 4 |
| 200 Hz | 1 : 10 |

Additional Filters Available:

| | |
|---|---|
| 13 kHz | 1 : 4 |
| 1.2 kHz | 1 : 4 |
| 500 Hz | 1 : 10 |

**Cross Modulation:**

For a wanted signal of level up to 1 mV and with appropriate use of Aerial Attenuator (AE ATT) control, an interfering signal 20 kHz removed and modulated 30% must have a level greater than 45 dB above that of the wanted signal to produce a cross modulation of 3%. The ratio of wanted to unwanted signal level is improved at the rate of 2 dB for each one percent up to 10 percent off tune.

**Intermodulation:**

Better than 80 dB on 1 microvolt for interfering signals at least 10% removed from the wanted signal.

**Blocking:**

For levels of wanted signal up to 1 mV, and with appropriate use of the Aerial Attenuator (AE ATT control) an interfering signal 20 kHz removed must have a level 56 dB greater than the wanted signal to reduce the signal by 3 dB. The ratio of wanted to unwanted signal level is improved at the rate of 2 dB per one percent up to 10% off tune.

**Spurious Response to External Signals (Image, etc):**

(a) External signal less than 10% off tune shall be greater than plus 60 dB relative to 1 microvolt to produce a spurious signal equivalent to 1 microvolt.

(b) With tuned aerial (antenna) external signals more than 10% off tune shall be greater than plus 80 dB relative to 1 microvolt to produce a spurious signal equivalent to 1 microvolt.

| | |
|---|---|
| **Internally Generated Spurious Responses:** | Not greater than 2 dB above noise level in a 3 kHz bandwidth. |
| **Noise Factor:** | Not greater than 10dB throughout entire range. |
| **I.F. Output: (A.G.C. 'on')** | (a) At 1.6 MHz: 0.1V at high impedance (nominal)<br>(b) At 100 kHz: 0.27V (1 mW) nominal in 75 ohms.<br>(c) At 455 kHz: 0.22V (1 mW) nominal in 50 ohms. |
| **Automatic Gain Control:** | (a) Time Constants: |

| | Charge (nominal) | Discharge (nominal) |
|---|---|---|
| (i) Short | 15 mS | 15 mS |
| (ii) Medium | 50 mS | 200 mS |
| (iii) Long | 100 mS | 4 Sec. |

(b) Output Change:
An increase in input of 85 dB above 2 μV will produce a change in output level of not greater than 4 dB.

| | |
|---|---|
| **B.F.O.** | (a) Variable ±8.0 kHz<br>(b) Crystal controlled ±1.5 kHz<br>(c) Short-term stability ±15 Hz for less than 5 minutes.<br>±25 Hz for less than 30 minutes. |
| **A.F. Output:** | (a) Headphone output: 10 mW in 600 ohms<br>(b) Line output: 1 mW in 600 ohms<br>(c) 1 watt into 15 ohms. |
| **A.F. Distortion:** | Less than 3% |
| **A.F. Response:** | 100 to 6000 Hz. Flat within 3 dB. |
| **Hum Level:** | 40 dB below rated output |
| **Metering:** | (a) 'S' Scale - dB ref. 1 μV.<br>(b) Line Level |

**Controls:**

(a) Meter Switch (AF level/R.F. level)
(b) Frequency Readout - In-line Digital
(c) 'Megahertz' Tuning
(d) 'Kilohertz, Tuning
(e) System Switch
(f) DET/B.F.O. Mode
(g) B.F.O. Tune
(h) R.F. Gain Control
(i) A.F. Gain Control
(j) A.F. Line Level
(k) R.F. Tune
(l) R.F. Bandswitch
(m) Tuning Lock
(n) Dimmer
(o) Calibrate - Fine Tune
(p) I.F. Bandwidth
(q) R.F. Attenuator
(r) 2nd V.F.O. INT/EXT

**External Connections:**

(a) Antenna Input
(b) I.F. Output 1.6 MHz
(c) A.F. Line Output
(d) A.F. Phone Output
(e) A.G.C. Line
(f) Power Input
(g) I.F. Output 100 kHz or 455 kHz
(h) Detector
(i) 2nd V.F.O. Output
(j) 2nd V.F.O. Input
(k) 1 MHz Output
(l) 1 MHz Input
(m) 1.7 MHz (100 kHz) or 1.145 MHz (455 kHz) output.

(n) 1.7 MHz (100 kHz) or 1.145 MHz (455 kHz) input.

(o) L.F. Adaptor Input

(p) Panoramic Adaptor Output

(q) A.C. or D.C. Supply input

(r) -16 volts output

(s) 24 volts output (unregulated)

(t) Diversity A.G.C.

(u) Muting Relay

(v) L.F. Adaptor h.t.

(w) L.F. Adaptor a.g.c.

**Power Supplies**

Alternative power units are available as follows:

(a) (i) 100-125V or 200-250V, 45-400 Hz, single phase a.c.
or (ii) 21-27V d.c. positive earth

(b) 9-15V or 18-30V d.c. positive or negative earth.

**Power Consumption:**

10 VA approx.

**Dimensions:**

3.5 in. (8.9 cm) high x 19 in. (48.25 cm) wide x 16 in. (40.6 cm) deep.

**Weight:**

30 lb (13.6 kg) approximately.

**Environmental Conditions:**

The equipment is, in general, designed to meet the requirements of specification DEF 133 L2, operating within the ambient temperature range of -5°C to +55°C.

**Construction:**

The unit is of modular construction.

# CHAPTER 1

# GENERAL DESCRIPTION

## INTRODUCTION

1. The RA.1217 is a versatile high-stability h.f. communications receiver designed for use in a 19-inch (48.25 c.m.) rack mounting under all climatic conditions. Solid state techniques are used throughout. The frequency range is 1 to 30 MHz. Operation down to 200 kHz (but with slightly degraded performance) can be obtained by linking terminals on the rear panel. A comprehensive range of ancillary units can be connected to the receiver.

## TECHNICAL INFORMATION

2. This handbook contains installation and operating information with a brief technical description. The circuits at the rear of the book are for information only. For detailed technical descriptions, alignment instructions and component details, the user must refer to the RA.1217 Maintenance Manual.

## RA.1217 VARIANTS

3. The RA.1217 is adaptable to a variety of customer requirements. The principal variations, however, are in respect of :

(a) Power supply unit.

(b) Final i.f. output (455 kHz or 100 kHz).

Other modifications may be introduced in receivers fitted to specially designed receiver terminals. Such variations will be described in the handbook for the receiver terminal, or in appendices to this handbook.

## ANCILLARY EQUIPMENT

4. The RA.1217 is provided with a number of outlets which permit the attachment of additional units such as :-

(a) A frequency synthesizer or pre-set channel oscillator which can provide very precise and stable frequency setting of the receiver.

(b) Panoramic adaptor to provide visual display of a portion of the frequency spectrum.

(c) L.F. Adaptor which extends the lower frequency limit of the receiver to 3 kHz.

(d) Diversity switching unit for linking two RA.1217 receivers in dual diversity reception.

(e) Line amplifier, signal frequency measuring equipment, i.s.b. adaptor etc.

## GENERAL INFORMATION

### Tuning

5. The receiver is tuned by two principal controls, one control is set to indicate the 'megahertz' content of the signal frequency, the other is set to indicate the 'kilohertz' content. The frequency indication is by a mechanical in-line readout system providing a digital display. Scale markings enable the frequency to be set to an accuracy of 0.2 kHz.

6. The RA.1217 can be tuned over its entire frequency range with no mechanical band-switching. The r.f. input can be set to 'wideband' or tuned circuits can be switched into the r.f. input stage to obtain improved rejection of adjacent channels. An r.f. attenuator control permits selected attenuation of the input signals to minimize the effects of severe interference or excessive signal strength.

7. The Megahertz (MHZ) and Kilohertz (KHZ) tuning controls can be mechanically locked to their selected positions. A calibrate and fine tune control provides a range of tuning adjustment of 8 kHz, this is useful as a clarifier in single sideband reception or as a fine adjustment when the main controls are locked. Calibration signals at 100 kHz intervals, derived from the internal reference crystal oscillator are available for aligning the kilohertz tuning readout.

## Audio Outputs

8. An audio level of approximately 10 mW is available at the front panel phones socket. At the rear panel a balanced 1 mW output is available for for feeding into a 600 ohm line. An unbalanced output at 1 watt is provided for driving a separate 15 ohm loudspeaker.

## Construction

9. The receiver is of modular construction, each module being a separate unit connected by plugs and sockets. The main chassis is of cast aluminium to which the individual modules are attached. A range of alternative sub-assemblies is available, providing for the choice of either 100 kHz or 455 kHz output, and for the provision of non-standard bandwidths to meet special requirements.

## Individual Modules and Assemblies

10.

(a) Main Chassis

(b) R.F. Unit

(c) 1st V.F.O.

(d) 1st Mixer and 40 MHz Filter

(e) 2nd Mixer

(f) 37.5 MHz Generator
1 MHz Osc. and calibrator

(g) 37.5 MHz B.P. Filter

(h) 3rd Mixer

(i) 2nd V.F.O.

(j) First I.F. Amplifier

(k) Main I.F. Unit

(l) B.F.O. and Bandwidth Assembly

(m) Power Unit.

## Power Supply

11. The standard power unit is the PU.1153 which can operate from the following power sources :

(a) A.C. 100 - 125 or 200 - 250V 45 - 400 Hz Single phase

(b) D.C. 21 - 27 V, positive earth.

An alternative power unit is available, to operate from d.c. only in the supply

range 9 to 30 V with either positive or negative earth. The receiver power consumption is 10 VA approximately. The attachment of ancillary units will increase the power consumption by a further 10 VA approximately.

### Optional I.F. Outputs

12. Two types of i.f. unit are available. One provides an i.f. output of 100 kHz, the other of 455 kHz. The customer can check that the correct type is fitted to the receiver by noting the engraving on the i.f. outlet panel which is located at the lower left hand corner when viewing the rear of the receiver. The lower right hand socket is engraved with i.f. output frequency, either 100 kHz OUT, or 455 kHz OUT. Unless otherwise requested, the 100 kHz i.f. unit will be supplied.

## HANDBOOK NOTES

### Circuit References

13. Receiver construction is based upon a number of sub-assemblies. Each sub-circuit is separately manufactured and has an individual sequence of component numbering. When studying a technical description or component list, note whether the circuit consists of more than one assembly and ensure that the correct portion of the circuit is referred to. In the R.F. unit it has been considered necessary to allocate a special prefix figure to each sub-circuit in the circuit diagram, but in the other modules it is considered that there should be no difficulty in correct identification of a component.

### Control References

14. The controls are engraved on the front panel in lower case lettering, but in the handbook such markings will frequently be printed in capital letters (e.g. R.F. TUNE) to add clarity and emphasis to an instruction.

### Modifications

15. Before studying this Manual refer to the Handbook Change Information sheet at the beginning of the book and note whether any amendments have been introduced since the book was printed.

# CHAPTER 2

# INSTALLATION

## INTRODUCTION

1. The chapter contains information under three principal headings. "General Information" gives information on the various receiver outlets and connections ; "Preparation for use" describes the essential checks prior to operating the receiver for the first time, and "Connections to Ancillary Units" gives instructions for connecting a Synthesizer, L.F. Adaptor and I.S.B. Adaptor. All connections are made at the rear of the receiver.

## GENERAL INFORMATION

### REMOVAL OF COVERS

#### Dust Covers

2. To obtain access to the various modules and chassis components it is necessary to remove the following covers.

(a) The top cover.

(b) Left-hand side cover (viewed from the front) for access to the R.F. Module.

(c) Right-hand side cover for access to the I.F. Module.

(d) A small cover on the underside for acess to the Audio Amplifier Board.

All covers are secured by screws which are self evident.

#### Module Covers

3. CAUTION: The various module covers are retained by screws which must be tightened securely to maintain a high standard of screening, but when tightening do not apply excessive force which could cause the screw-hole threads to become damaged.

## REAR PANEL CONNECTIONS

4. A brief description is given of each rear panel connection to assist the user in making connections for a particular system or to ancillary units such as i.s.b. adaptor etc. A rear view of the receiver is shown in Fig. 19.

### R.F. Input (Antenna)

5. The antenna should be connected using a coaxial connector and 75Ω unbalanced transmission line to the socket marked R.F. Input.

### 12-way Socket SKT11

NOTE: The free plug and the accessory set for connection to external wiring are :
Plug : Plessey MK4 2CZ83302/5
Accessory Set : 508/1/03013/205

6.

| Pin | Function |
|---|---|
| A, B | 1 mW audio output (balanced) |
| C | Not used |
| D | 1 watt audio output (unbalanced suitable for driving a loudspeaker (15Ω impedance) |
| E | -16 volts d.c. power supply suitable for an ancillary unit such as RA.298 i.s.b. adaptor |
| F | Unregulated d.c. output at 20 to 24 volts |
| G | Antenna muting. An earth loop connected to this terminal operates the muting relay, to protect the receiver input when keying an associated high power transmitter. |
| H | Diversity a.g.c. connection from associated diversity receiver, or a.g.c. from i.s.b. adaptor. |
| J | Screen to pin H |
| K | L.F. H.T. Provides -16V d.c. to L.F. Adaptor Unit |
| L | L.F. A.G.C. Provides a.g.c. to L.F. Adaptor Unit |
| M | Screen to pin L. |

## Terminal Block TB1

NOTE: Terminals 1 to 4 on TB1 provide a linking facility to permit receiver operation down to 200 kHz.

7.

| Pin No. | Identification | Remarks |
|---|---|---|
| 1 | H.T. R.F. | For operation down to 200 kHz link pin 1 to pin 2, and and pin 3 to pin 4. Remove the links if an L.F. Adaptor unit is in use. Pins 2 and 4 are in parallel with pins K and L respectively in the 12-way socket SKT11. |
| 2 | H.T. L.F. | |
| 3 | A.G.C. R.F. | |
| 4 | A.G.C. L.F. | |
| 5 | DET | Provides a low-level audio output for driving an external amplifier. |

## Coaxial Outlets

8. NOTE 1 : Refer to Table 1 and 2 at the end of this chapter for details of the r.m.s. levels applicable to the following outlets.

NOTE 2: For connecting external wiring to the coaxial sockets SKT1 to 3 and SKT12 to 17 use 75 ohm plug Transradio BNC1/7. (British NATO number 5935-99-580-9636). For a 455 kHz I.F. output at SKT2 use a 50 ohm plug type UG/88U.

| Identification | Impedance | Function |
|---|---|---|
| SKT1 1.6 MHz | 1 kΩ | 1.6 MHz I.F. Output |
| SKT2 100 KHz OUT | 75Ω | 100 kHz I.F. Output |
| or | | |
| SKT2 455 kHz | 50Ω | 455 kHz I.F. Output |
| SKT3 1.7 MHz IN/OUT (100 kHz i.f.) | 75Ω | Accepts 1.7 MHz (or 1.5 MHz) input to 100 kHz i.f. converter Remove the 1.7 MHz crystal when the external 1.7 MHz is in use. |
| or | | |
| SKT3 1.145 MHz IN/OUT (455 kHz i.f.) | 50Ω | Accepts 1.145 MHz input to 455 kHz i.f. converter, or provides output to slave receiver in diversity. |

NOTE: Outlets SKT1 to SKT3 are part of the i.f. module assembly, (Fig. 12).

REAR PANEL CONNECTIONS (Continued)

| Identification | Impedance | Function |
|---|---|---|
| SKT12 2nd V.F.O. IN | 75Ω | Accepts 3.6 to 4.6 MHz from synthesizer |
| SKT13 2nd V.F.O. OUT | 75Ω | Provides 2nd VFO control of a slave receiver. |
| SKT14 L.F. | 75Ω | Accepts the r.f. signal from an l.f. adaptor. |
| SKT15 PAN | 75Ω | Connects the 2 to 3 MHz i.f. spectrum from the 2nd Mixer to a panoramic adaptor unit. |
| SKT16 1 MHz IN | 75Ω | Accepts an external 1 MHz frequency standard. The internal 1 MHz crystal must be removed when this external source is in use. |
| SKT17 1 MHz OUT | 75Ω | Provides a 1 MHz output from the internal crystal oscillator. |

Earth (Ground) Terminal

9. A terminal is provided on the rear panel for connection to the earthing system of a cabinet.

Power Module Connections

10. 3-Way Plug PL1

| | |
|---|---|
| Pin A | A.C. connection to line or D.C. +ve |
| Pin B | A.C. neutral connection, or D.C. -ve |
| Pin C | A.C. supply earth (ground) connection. |

The free socket and the accessory set for connecting the external power cable are :

| | |
|---|---|
| Socket: | Plessey 2 CZ 83283/5 |
| Accessory Set: | 508/1/03008/205 |

## PREPARATION FOR USE

### GENERAL INSPECTION

11. (1) Remove the top cover from the receiver.

(2) Check that the receiver assembly is clean and free from damage and that all interconnecting leads and module covers are secure. Note particularly that all gear wheels are clean and free from packing materials and other extraneous matter.

(3) Move the lock controls (adjacent to each tuning knob) upward to the "free" position. Check that each tuning control rotates freely over the complete tuning range.

(4) Set the 2nd V.F.O. switch to INT.

(5) Check that the correct i.f. module is fitted by noting the engravings on the i.f. outlet panel at the rear of the receiver, which will indicate either a 100 kHz, or 455 kHz i.f. output.

(6) Check the settings of the A. C. /D. C. switch and the Voltage Selector switch on the power module. If necessary, re-set these switches as follows:

### A. C. /D. C. Switch

12. A locking plate displays the required type of power input either 'A. C.' or 'D. C.' If the indication is not correct remove the locking plate (one screw) set the switch in the alternative position and replace the locking plate in the reversed position so that the correct indication is displayed.

### Voltage Selector Switch

13. This switch is in use when the A. C. /D. C. switch is set to A. C. It should display the correct a. c. supply voltage range, either 100-125 or 200-250. If the setting is not correct, remove the locking plate (two screws) re-set the switch and replace the locking plate in the reversed position, so that the correct voltage range is indicated.

### Fuses

14. Check that the fuses at the rear of the power module are correct in accordance with the rating engraved on the rear panel. The replacement fuse links must be of the anti-surge type. Beswick Type TDC134 is recommended.

GENERAL INSPECTION (Continued)

Power Supply Connection

15. A free connector assembly is normally supplied with the receiver for connection to the 3-way plug on the power module. If not supplied, refer to paragraph 10 for details. Connections should be as follows.

16. A. C. Supply

| | |
|---|---|
| Pin A | Line |
| Pin B | Neutral |
| Pin C | Earth (ground) |

or

17. D. C. Supply

| | |
|---|---|
| Pin A | +ve |
| Pin B | -ve |

Phones

18. Headphones (600Ω) may be plugged into front panel jack socket. The phones jack plug is an Igranic P50.

Operating Down to 200 kHz

19. (1) On the rear panel link the terminal H.T R.F to the terminal H.T L.F.

(2) Link the terminal A. G. C. R. F. to the terminal A. G. C. L. F.

Other Connections

20. Other connections will be according to the users requirements. Refer to paragraphs 6 to 8 under General Information.

## CONNECTIONS TO ANCILLARY UNITS

### SYNTHESIZER CONNECTIONS

General

21. The synthesizer, or channel oscillator, should provide the following inputs to the receiver. Inputs (a) and (b) are essential. Input (c) is required only if the external i.f. (100 kHz or 455 kHz) is to be used.

(a) 3.6 to 4.6 MHz (variable). Level to be 100 mV e.m.f. from 75Ω.

(b) 1 MHz (fixed). Level to be 100 mV e.m.f. from 75Ω.

(c) An additional fixed frequency at 1.7 MHz is required for use in receivers equipped for 100 kHz i.f. output, or at 1.145 MHz for receivers with 455 kHz i.f. output. The voltage of the applied frequency must be not less than 50 mV in 75 ohms.

NOTE : The output levels from the Synthesizer Type MA. 350B are 2 volts e.m.f. therefore attenuating connectors must be used with this instrument.

Connecting the Synthesizer

22. (1) Set the 2nd V.F.O. switch on the front panel to EXT

(2) Remove the receiver cover

(3) Remove the cover from the 37.5 MHz Generator Module

(4) Remove the 1 MHz crystal from its holder and store it in a safe place. Replace the module cover.

NOTE: Operations (5) and (6) are required only if the external i.f. (100 kHz or 455 kHz) is to be used.

(5) Remove the cover from the i.f. module.

(6) Remove the 1.7 MHz (or 1.145 MHz) crystal, and store in a safe place.

(7) Replace the cover on the i.f. module.

(8) Replace the receiver cover and make the following connections to the rear panel.

(9) Connect the 3.6 to 4.6 MHz output from the synthesizer to the socket SKT13 '2nd V.F.O. IN'. Refer to paragraph 21 (a) regarding drive level.

(10) Connect the synthesizer 1 MHz output to socket SKT16 '1 MHz IN'. Refer to paragraph 21 (b) regarding drive level.

(11) If the receiver is equipped for an i.f. output of 100 kHz, a frequency of 1.7 MHz should be connected to SKT3 (1.7 MHz IN/OUT). If the receiver has an i.f. output of 455 kHz, the 1.145 MHz from the synthesizer should be connected to the same socket which is marked 1.145 MHz IN/OUT.

## L.F. ADAPTOR CONNECTIONS

23. An l.f. adaptor unit such as the RA.337 must be supplied with -16V d.c. power, and a.g.c. voltage from the receiver. These connections can be taken from the 12-way connector SKT11 or from the terminal block TB1, whichever is more convenient.

CAUTION: If links have been fitted to the terminal block TB1, for operation down to 200 kHz, these links must be removed prior to operation with an l.f. adaptor.

(1) Connect pin K of SKT11 (l.f. h.t.) to the h.t. terminal on the L.F. Adaptor unit.

(2) Connect pin L of SKT11 (l.f. a.g.c.) to the a.g.c. input terminalof the L.F. Adaptor unit.

(3) Connect the antenna feeder to the antenna socket of the L.F. Adaptor unit.

(4) Connect the signal output of the L.F. Adaptor unit to the socket marked 'LF' on the RA.1217. Use 75Ω coaxial cable.

(5) Turn the MHz tuning control of the RA.1217 fully anti-clockwise against its stop. The MHz drum should indicate '00'.

(6) Refer to the L.F. Adaptor handbook and set switches as required.

(7) Tune the RA.1217 as described in Chapter 3. Do not move the MHz tuning control.

## I.S.B. ADAPTOR CONNECTIONS

24. The following instructions apply to the I.S.B. Adaptor Type RA.298C & D.

(1) Remove the 1.7 MHz crystal from the i.f. converter in the i.f. module of the receiver, and store in a safe place.

(2) Connect SKT2 (100 kHz OUT) to the 100 kHz input of the I.S.B. Adaptor.

(3) Connect SKT3 (1.7 MHz IN/OUT) to the socket "1.7 MHz to receiver" on the I.S.B. Adaptor.

(4) Connect pin H (Diversity A.G.C.) of the 12-way socket SKT11 to the AGC pin of the 12-way outlet PL1 on the I.S.B. Adaptor.

(5) Connect pin E of SKT11 (-16V HT) to the -16V pin of PL1 on the I.S.B. Adaptor.

(6) Connect pin J of SKT11 (screen) to the 0 volt (earth) pin of PL1 on the I.S.B. Adaptor.

Refer to the RA.298 Technical Manual for further details.

(Refer to the next page for data on input and output levels.)

## REAR PANEL SOCKETS

## CONCISE DATA

### TABLE 1

### External Inputs

NOTE: All external source impedances are 75 ohms. If the voltage applied to the receiver exceeds 100 mV an attenuating connector must be used.

| Facility | Frequency | Socket | Level (Nominal) |
|---|---|---|---|
| 1 MHz frequency Reference | 1 MHz | 1 MHz IN | 100 mV e.m.f. |
| Kilohertz tuning (Synthesizer) | 3.6 to 4.6 MHz | 2nd V.F.O. IN | 100 mV e.m.f |
| Final i.f. Converter Heterodyne | 1.7 MHz<br>1.145 MHz | 1.7 MHZ IN/OUT<br>1.145 MHz IN/OUT | 100 mV e.m.f. |

### TABLE 2

### External Outputs

| Facility | Socket | Level r.m.s. | Termination |
|---|---|---|---|
| 1.6 MHz I.F. | 1.6 MHz OUT | 100 mV | High Z |
| 1.7 MHz oscillator | 1.7 MHz IN/OUT | 50 mV | 75 Ω |
| 100 kHz I.F. | 100 kHz OUT | 270 mV | 75 Ω |
| 1.145 MHz oscillator | 1.145 MHz IN/OUT | 50 mV | 75 Ω |
| 455 kHz I.F | 455 kHz OUT | 220 mV | 50 Ω |
| 1 MHz reference | 1 MHz OUT | 50 mV | 75 Ω |
| 3.6 - 4.6 MHz | 2nd V.F.O. OUT | 50 mV | 75 Ω |

# CHAPTER 3

# OPERATING INSTRUCTIONS

## INTRODUCTION

1. Before operating the receiver check that it has been prepared for service in accordance with the information in Chapter 2.

CAUTION: Before switching on for the first time check that the A.C./D.C. switch and voltage selector switch at the rear of the receiver are correctly set.

## FUNCTIONS OF CONTROLS

2. References to the controls and their settings are in capital letters in accordance with the engraving on the front panel.

### SYSTEM SWITCH

(1) This switch provides facilities for power OFF, MAN, CAL, CHECK B.F.O. and three alternative A.G.C. time-constants. Moving the switch from the OFF position to any other setting connects the external power supply to the power module.

(2) MAN. In the MAN. position the receiver a.g.c. system is not operative, and the receiver gain is controlled manually by the R.F. GAIN control.

(3) A.G.C. settings: The use of the time-constants SH (short) MED (medium) and LG (long) is dependent upon operating mode and propagation conditions.

(4) CAL. In the CAL position, harmonic frequencies derived from a crystal source, provide audio marker notes at discrete 100 kHz intervals of the kHz tuning scale. The tuning scale may be corrected by using the CAL-FINE TUNE control.

(5) Check B.F.O. In this position the B.F.O. frequency may be set to coincide with the i.f. centre frequency by setting the B.F.O. MODE switch to the '0' position and adjusting the B.F.O. TUNE kHz control to provide an audio null.

| | |
|---|---|
| R.F. RANGE CONTROL (large knob) | This switch provides for the selection of any one of five frequency ranges, or a wideband (WB) position. The selected range (or WB) is displayed in a small aperture adjacent to the switch. The WB position is very suitable for signal search, but if strong interference is present care must be taken to avoid tuning to an adjacent channel instead of the wanted signal. |
| R.F. TUNE CONTROL (centre knob) | This control tunes the coil selected by the R.F. RANGE switch. Four tuning marks are engraved adjacent to the control, which together with the associated groups of figures, indicate the approximate frequency for each range at the point of rotation. If maximum sensitivity is not required the antenna need not be tuned, but the presence of strong interfering signals anywhere within the spectrum may cause cross-modulation unless the antenna is tuned. |
| AE ATT CONTROL. (Antenna Attenuator) | This control may be used to reduce the level of all incoming signals, and it must be used when strong interfering signals are present which cannot be entirely eliminated by use of the R.F. TUNE control, or if the wanted signal is sufficiently powerful to cause overloading of the earlier stages. Very strong signals should be reduced by the use of the AE ATT control rather than by turning down the R.F. GAIN or A.F. GAIN controls. |
| MHz | This control is the electronic band selector which selects the megahertz portion of the required signal frequency. The control should be set so that the required megahertz, digits are displayed on the tuning readout. A locking arm which projects from behind the knob can be moved fully clockwise to mechanically lock the control. By setting the MHz control to indicate '00', microswitches are actuated which connect power and a.g.c. lines for use in the L.F. Adaptor Type RA.337. Alternatively, the '00' setting can be used for reception down to approximately 200 kHz provided the micro-switches have been linked out. Refer to Chapter 2 for information on the links. |
| kHz | This control selects the last three digits of the required frequency which are displayed on the tuning readout. The final digit in the readout is marked in divisions to permit a setting accuracy of 0.2 kHz. To avoid the necessity to reset the MHz control when tuning through either end of the band the kHz scale has upper and lower extensions of approximately 25 kHz. Thus when the scale is tuned below 000 kHz a minus sign appears in the readout, indicating that the true frequency |

kHz (Cont'd)

is one megahertz less than the figure indicated by the MHz display. Conversely, when the kHz tuning is set above 999 a +sign appears indicating that the true frequency is one megahertz higher than the displayed MHz digits. A locking arm, similar to that on the MHz control, can be moved anti-clockwise to lock the kHz control.

2nd V.F.O. Switch (EXT - INT)

In the INT position the kHz tuning control operates normally, using the internal 2nd v.f.o. as already described. In the EXT position an external 3.6 to 4.6 MHz source such as a synthesizer or master receiver can be connected to take the place of the 2nd V.F.O. and the kHz tuning control is not operative.

R.F. - A.F. LEVEL Switch and Meter

This switch connects the meter to monitor either the r.f. signal level or the a.f. level of the 1 mW audio line. The meter is calibrated as an 'S' meter in decibels relative to 1 microvolt. A zero setting adjuster (located within the receiver) is operative in the R.F. position of the Meter switch. (Fig. 18)

DET-B.F.O. MODE and B.F.O. TUNE kHz

The positions L.S.B. and U.S.B. select off-set crystal oscillators for single sideband reception. The A.M. position provides reception without use of b.f.o. The positions +6 through to -6 provide coarse settings of the b.f.o. heterodyne note. In each of the coarse settings a fine adjustment of the b.f.o. note can be made by the adjacent B.F.O. TUNE kHz control, which provides a variation of approximately plus or minus 3 kHz.

I.F. BW kHz

This switch is marked in the i.f. bandwidths which are provided by crystal filters. Each passband is symmetrical about the i.f. centre frequency. A choice of bandwidths is available at customers option, as follows.

| Full Range | Standard Range |
|---|---|
| kHz | kHz |
| 0.2 | 0.2 |
| 1.2 | --- |
| 3.0 | 3.0 |
| 8.0 | 8.0 |
| 13.0 | --- |

R.F. GAIN and A.F. GAIN — These are concentric controls. The R.F. GAIN is the smaller (central) knob. It functions only in the MAN position of the System switch, in which it manually biases the a.g.c. line. In accordance with normal operating practice the R.F. GAIN should be set to the minimum level consistent with the best signal-to-noise ratio.

The A.F. GAIN is the larger (peripheral) control. It adjusts the audio level to the headphones and the 1 watt audio output at the rear panel.

A.F. LEVEL — A preset control which is entirely independent of the A.F. GAIN control. It sets the level of the 1 mW audio line output.

DIMMER — This control adjusts the brightness of the tuning readout illumination.

## CALIBRATION

The kHz readout and the b.f.o. should be calibrated before using the receiver.

### kHz Readout Calibration

3. (1) Insert a pair of high impedance headphones into the PHONES socket.

(2) Set the System switch to CAL

(3) Set the DET-B.F.O. MODE switch to A.M.

(4) Set the IF BW switch to 3.0 kHz

(5) Set A.F. GAIN control the the mid-position.

(6) Turning the kHz tuning control should result in beat notes being heard at each multiple of 100 kHz.

(7) Set the kHz tuning control accurately to the 100 kHz multiple which is nearest to the operating frequency required, and adjust the CAL-FINE TUNE control to produce a null in the beat note. To retain calibration the CAL-FINE TUNE control should not be moved.

## B.F.O. Calibration

4. (1) Insert the headphones in the PHONES socket.

(2) Set the DET - B.F.O. MODE switch to '0'

(3) Set the System switch to CHECK B.F.O.

(4) Adjust the B.F.O. TUNE kHz control for a null in the beat note, which should occur approximately in the mid position of the control movement.

## RECEIVER TUNING

NOTE: The following procedure is given as a general guide to the correct use of the controls.

5. (1) Connect the headphones

(2) Set the LOCK controls to 'off' (upwards)

(3) Set the System switch to A.G.C. MED

(4) Set the R.F. RANGE switch to WB (wideband)

(5) Set the AE ATT control to MIN (fully clockwise)

(6) Set the DET-B.F.O. MODE as required (refer to (14) below)

(7) Set the MHz tuning control to indicate the required frequency in megahertz on the readout indicator, then lock the control

(8) Set the kHz, tuning control to indicate the required kilohertz reading on the the readout indicator. The scale divisions on the final figure will facilitate precise tuning.

NOTE: When operating with the R.F. RANGE switch set to WB it is possible for strong interfering signals to render station identification difficult. In such conditions the AE ATT control should be turned one or two steps from MIN towards MAX to obtain the best signal-to-noise ratio consistent with the satisfactory elimination of cross-modulation effects.

(9) Adjust the kHz tuning to identify the required signal.

(10) Set the R.F. RANGE switch to the appropriate frequency range.

(11) Adjust the R.F. TUNE control for maximum signal strength. The markings adjacent to the control give a guide to the approximate tuning point.

(12) Make fine adjustments of kHz tuning, R.F. TUNE and A.F. GAIN controls for optimum clarity and level of signal.

(13) If signal strength is excessive, set the AE ATT control in an anti-clockwise direction and re-adjust the A.F. GAIN control for a satisfactory audio level.

(14) Set the DET-B.F.O. MODE switch to A.M. for A2 or A3 reception, or to a setting between +6 and -6 for A1. Adjust the variable B.F.O. TUNE control for the required pitch of beat note on c.w. or f.s.k.

(15) Lock the kHz tuning control

(16) The CAL-FINE TUNE control may be used for fine tuning, if necessary.

NOTE: When the CAL-FINE TUNE control has been used for fine tune purposes it will be necessary to perform the kilohertz calibration procedure (para. 3) whenever precise kHz readout accuracy is again required.

Single Sideband Reception

6. (1) Tune the receiver as instructed in paragraph 5 except that in operation (6) the DET-B.F.O. MODE switch must be set to L.S.B. for lower sideband reception, or to U.S.B. for upper sideband reception.

(2) Set the I.F. BW switch to 3 kHz.

(3) Adjust the kHz tuning control to obtain the strongest and clearest audio signal.

(4) Lock the tuning controls and make fine tuning adjustments with the CAL-FINE TUNE control to clarify the signal.

Operating with a Synthesizer

7. (1) Check that the synthesizer is correctly connected as instructed in Chapter 2.

(2) Check that the 2nd V.F.O. switch on the RA.1217 is set to EXT.

(3) Switch on the synthesizer and allow a suitable warming-up period (minimum 15 minutes ; recommended 3 hours.)

(4) Tune the receiver as instructed in para.5 of this chapter, but in operations (8) and (12) the kilohertz frequency is set on the

synthesizer dials. The receiver kHz, tuning control is not in use and the CAL-FINE TUNE control cannot be used for fine tune purposes. Refer to the synthesizer handbook for kHz tuning instructions.

Operating with an L.F. Adaptor

8. (1) The l.f. adaptor should be connected to the receiver as instructed in Chapter 2. The antenna should be connected to the l.f. adaptor.

(2) Set the MHz tuning control on the RA.1217 fully anticlockwise so that '00' is indicated on the megahertz readout.

(3) Set the RA.1217 System switch to A.G.C. (MED)

(4) Tune the RA.1217 using the kHz control only. The MHz control R.F. RANGE, R.F. TUNE and AE ATT controls are not in use. The remaining controls may be used as in normal operating.

## ADDITIONAL OPERATING INFORMATION

### Receiving Down to 200 kHz

9. The following modification will give reception down to approx.200 kHz but with degraded performance.

(1) At the rear of the receiver link the terminal 'h.t., l.f.' to terminal 'h.t., r.f.'

(2) Link terminal 'a.g.c., l.f.' to terminal a.g.c., r.f.' This bypasses the micro-switches which normally disconnect h.t. and a.g.c. from the receiver input stages when the MHz tuning is set to '00'.

(3) Set the 'MHz' tuning control to indicate '00' on the MHz readout. Lock the control.

(4) Tune with the kHz control and all other controls in the normal way.

NOTE: The links should be removed when an L.F. Adaptor unit is to be connected.

# CHAPTER 4

# BRIEF TECHNICAL DESCRIPTION

## INTRODUCTION

1. This chapter describes the basic principles of the receiver design. Only the more significant design features will be referred to. A detailed description of the circuits is given in the Maintenance Handbook. Throughout this chapter reference should be made to the block diagrams, Fig. 2 and Fig. 3 at the rear of the book.

## WADLEY SYSTEM

2. The main feature of the receiver is the tuning system which is based on a principle often referred to as the 'Wadley system (fig. 2). This system is specifically designed to counteract frequency drift. Its most characteristic features are that the tuning system is separated into MEGAHERTZ and KILOHERTZ tuning, and no mechanical band switching is required, although pre-tuning of the antenna circuit may be provided.

3. The 'Megahertz' tuning section selects a 1 MHz band of signal frequencies, which contains both wanted and unwanted signals, and transfers this band of frequencies to the 'Kilohertz' section. The 'Kilohertz' section serves as an interpolation receiver, and selects the wanted signal from within this 1 MHz band. It is essential to grasp this conception of a spectrum of frequencies being transferred, rather than a single frequency as in a conventional superheterodyne system.

## MEGAHERTZ TUNING SECTION

### Drift Cancellation

4. The 'Megahertz' tuning system is specifically designed to eliminate the effects of drift in the first v.f.o. stage. Any tendency for the receiver to drift off tune due to first v.f.o. instability is automatically corrected by a technique of self-cancelling frequency change.

5. For descriptive purposes the system may be divided into two loops which will be referred to as the 'signal loop' and the 'harmonic mixer loop'. The first v.f.o. is tuned by the Megahertz tuning control, and its output is supplied to both loops.

6. In the signal loop one of the first v.f.o. outputs is mixed with the incoming r.f. signals to produce an output spectrum slightly more than 1 MHz wide. In the harmonic mixer loop another output from the first v.f.o. is mixed with a harmonic from a 1 MHz crystal oscillator. These separate mixer outputs are filtered and then subtracted in the second mixer stage. Since the first v.f.o. has contributed equally to both loops, any drift in the signal loop is

cancelled by an equivalent drift in the harmonic mixer loop. Thus drift or displacement of the first v.f.o. frequency has no effect on the receiver output. The stability of the Megahertz section is determined by the 1 MHz reference oscillator. This crystal oscillator can be replaced by an external 1 MHz source of even greater stability, if required. The following paragraphs describe the 'Megahertz' tuning in more detail.

Signal Loop (Fig. 3)

7. This loop comprises the r.f. input stage, the first mixer, the first v.f.o. and the 40 MHz band-pass filter. Incoming r.f. signals between 0.98 MHz and 30 MHz are amplified and fed to the first mixer, together with an output from the first v.f.o. This produces a frequency spectrum (first i.f.) centred on 40 MHz with a bandwidth of ±650 kHz at the output from the 40 MHz band-pass filter. This 1 MHz spectrum contains the wanted signal together with other, unwanted signals.

8. The first v.f.o. can be tuned by the Megahertz (MHZ) control over the range 41.5 MHz (setting 01) to 69.5 MHz (setting 29). At each setting there will be a particular 1 MHz spectrum within the 0.98 to 30 MHz signal range which will produce an output from the first mixer which can pass through the 40 MHz band-pass filter. Thus, by tuning the first v.f.o. the entire signal range of 0.98 to 30 MHz can be selected in discrete 1 MHz steps without mechanical band switching. It should be noted that the passband of the 40 MHz filter exceeds 1 MHz by a tolerance of ±150 kHz. This will be referred to later. A separate 29-channel oscillator unit can be supplied which replaces the first v.f.o., thus providing remotely controlled 'megahertz' tuning.

Harmonic Mixer Loop

9. This loop comprises the 1 MHz crystal oscillator, the harmonic generator, the harmonic mixer and the 37.5 MHz band-pass filter. The 1 MHz oscillator drives the harmonic generator which produces a wide range of harmonics of the 1 MHz crystal. An output from the first v.f.o. is applied to the harmonic mixer together with all the harmonics (up to the 32nd) of the 1 MHz crystal.

10. The output of the harmonic mixer is a band-pass filter with a pass-band of plus or minus 150 kHz centred on 37.5 MHz. Thus, whatever the setting of the first v.f.o. tuning, an output is obtained only when the first v.f.o. frequency minus a harmonic of 1 MHz crystal produces 37.5 MHz. This occurs at discrete 1 MHz steps in the first v.f.o. tuning range, therefore the Megahertz tuning control must always be set in 1 MHz steps.

11. It will be noted that the passband of the 37.5 MHz filter is the same (±150 kHz) as the tolerance in the 40 MHz band-pass filter. This is the permitted allowance for first v.f.o. drift or tuning error, from which it is evident that the setting of the Megahertz tuning control is not critical. The control should, however, always be set to the point of maximum receiver noise, thus ensuring that the mixer output frequencies are centred in their respective filter passbands.

Second Mixer

12. The signal loop and the harmonic mixer loop are brought together in the second mixer where the 37.5 MHz is subtracted from the 1 MHz spectrum (39.5 MHz to 40.5 MHz) of the signal loop. The resultant output (2nd i.f.) is a 1 MHz spectrum covering the range 2 MHz to 3 MHz. This is amplified, filtered to a more exact 1 MHz bandwidth, and applied to the third mixer, where, by means of the second v.f.o. the 'Kilohertz' tuning is performed. Numerical examples of 'Megahertz' tuning are given in the next paragraph.

Examples of Megahertz Tuning

13. TABLE 1

(1) MHZ control set to ..... 5 MHz

| Signal Loop | MHz | Harmonic Loop | MHz |
|---|---|---|---|
| VFO - 1 | 45.5 | VFO - 1 | 45.5 |
| Signal Frequency | 5 to 6 | Harmonic (8) | 8.0 |
| 1st i.f. | 39.5 to 40.5 | Mixer Output | 37.5 |

2nd Mixer

2nd I.F. = 2 to 3 MHz

(2) MHZ control set to ..... 29 MHz

| Signal Loop | MHz | Harmonic Loop | MHz |
|---|---|---|---|
| VFO - 1 | 69.5 | VFO - 1 | 69.5 |
| Signal Frequency | 29 to 30 | Harmonic (32) | 32.0 |
| 1st i.f. | 39.5 to 40.5 | Mixer Output | 37.5 |

2nd Mixer

2nd I.F. = 2 to 3 MHz

KILOHERTZ TUNING

Third Mixer and Second V.F.O.

14. The 2 to 3 MHz second i.f. spectrum contains the wanted signal. This signal frequency is precisely tuned in the third mixer stage by the second v.f.o. (KHZ tuning) which has a tuning range of 3.6 to 4.6 MHz. This second v.f.o. output is mixed with the second i.f. and the difference frequency of 1.6 MHz becomes the third intermediate frequency. Thus the third mixer and second v.f.o. may be regarded as an interpolation receiver operating over the range 2 to 3 MHz. For optimum stability the second v.f.o. may be replaced by an external frequency synthesizer or controlled by an automatic frequency stabilizer such as the "Racalator".

## Frequency Inversion

15. It should be noted that the 1 MHz spectrum in the antenna circuit is transferred and inverted to a 3 to 2 MHz spectrum in the second i.f. stage. For example a 15.45 MHz signal becomes 2.55 MHz in the second i.f. stage, and a 15.75 MHz r.f. signal becomes 2.25 MHz. This inversion is of no significance to the user unless the design or suitability of an l.f. adaptor or synthesizer is under consideration. The inversion arises because the first v.f.o. frequency is above the signal frequency whereas the harmonic mixer output (37.5 MHz) is below the first i.f. A frequency from the harmonic mixer which is higher than the first i.f. cannot be employed as it would require for its generation a harmonic of zero order when tuned to the 2 to 3 MHz signal band. (1st V.F.O. tuned to 42.5 MHz).

## Calibration

16. The setting accuracy of the kilohertz tuning control can be checked at 100 kHz intervals by means of a calibrator circuit when the system switch is set to CAL. The calibrator circuit generates a 100 kHz fundamental obtained from a divider circuit driven by the 1 MHz crystal reference source. The 100 kHz is fed to the third mixer where the harmonics beat with the second v.f.o. frequency. The kHz control is set to indicate a multiple of 100 kHz and the CAL-FINE TUNE control on the front panel is then adjusted to shift the 2nd v.f.o. frequency which produces a zero beat frequency in the phones.

17. The CAL-FINE TUNE control is a variable resistor which adjusts the bias on a varactor diode in the second v.f.o. tuned circuit. This control can also be used to make fine adjustments of signal tuning when, for example, the main tuning controls are locked. The frequency range of the fine tune adjustment varies over the kilohertz tuning range but should be not less than 8 kHz.

## L.F. Adaptor Unit

18. To receive frequencies lower than 0.98 MHz an external l.f. adaptor is required, the output from which is a 1 MHz spectrum in the band 2 to 3 MHz. This signal spectrum is fed into the second i.f. stage in lieu of the spectrum from the second mixer. When the l.f. adaptor is in use the receiver r.f. stage, first v.f.o., first mixer and harmonic mixer are not required and the h.t. supply to these stages is disconnected. Terminals on the rear panel of the receiver provide h.t. and a.g.c. connections for an l.f. adaptor unit. The h.t. and a.g.c. are automatically switched through to the l.f. adaptor when the receiver MHZ tuning control is set to '00'.

## Panoramic Adaptor Unit

19. The 2 to 3 MHz second i.f. spectrum can be displayed on a panoramic adaptor unit, thus permitting visual display of the activity in any selected 1 MHz band of signals between 980 kHz and 30 MHz. (Down to 3 kHz if the l.f. Adaptor RA.337 is connected). The signal input to the Pan

Adaptor is taken from the coaxial outlet PAN at the rear of the receiver. The -16V and -24V power supplies for the Pan. Adaptor may be obtained from the RA. 1217 receiver via the appropriate pins on the 12-way outlet.

TABLE 2

OVERALL TUNING EXAMPLE

RA. 1217 Tuned to a Signal of 15.48 MHz

| | MHz |
|---|---|
| **Dial Settings** | |
| Megahertz control set to indicate | 15 |
| Kilohertz control set to indicate | .480 |
| **Signal Loop** | |
| VFO - 1 Tuning (MHZ) set to | 15 |
| VFO - 1 Frequency (40.5 +15) | 55.5 |
| 1st i.f. spectrum (55.5 minus 15 to 16) | 39.5 to 40.5 |
| Wanted signal within the spectrum is 55.5 minus 15.48 | 40.02 |
| **Harmonic Mixer Loop** | |
| VFO - 1 frequency | 55.5 |
| VFO - 1 minus 18th harmonic of 1 MHz | 37.5 |
| **2nd Mixer** | |
| 1st i.f. spectrum minus 37.5 MHz provides 2nd i.f. | 2 to 3 |
| Wanted signal within the 2nd i.f. spectrum is 40.02 minus 37.5 MHz | 2.52 |
| **3rd Mixer and 2nd VFO** | |
| VFO - 2 tuning (KHZ) set to 480 which tunes VFO - 2 to required setting (2.52 +1.6) | 4.12 |
| 3rd i.f. is (4.12 minus 2.52) which is | 1.6 |
| **100 kHz i.f. Converter** | |
| Converter oscillator (1.7 MHz) minus 3rd i.f. (1.6 MHz) | 100 kHz |
| **455 kHz i.f. Converter** | |
| 1.6 MHz minus converter osc. (1.145 MHz) | 455 kHz |

## FINAL I. F. STAGES

20. The final intermediate frequency used within the receiver is 1.6 MHz. Four amplifiers at this frequency provide the greater part of the receiver gain. Crystal band-pass filters are included to provide the requisite selectivity. An additional intermediate frequency is available for external use with ancillary equipment such as an i. s. b. adaptor, f. s. k. converter, etc. The particular external frequency available (either 100 kHz or 455 kHz) is dependent upon the type of i. f. module fitted to the receiver and should be specified by the purchaser. (Refer also to para. 32).

## A. G. C. CIRCUITS

21. A. G. C. is obtained by detecting an output from the 1. 6 MHz i. f. Three time-constants are available, selected by the System Switch. An interconnection via the I. F. Bandwidth switch ensures that the short time-constant is not operative whenever the I. F. Bandwidth switch is set to either 0. 2 or 1. 2 kHz. If the System switch is set to A. G. C. SH (short) the Bandwidth switch inserts A. G. C. medium time-constant whenever either of these narrow bandwidths are selected. The receiver gain can be controlled from an external a. g. c. source such as a companion diversity receiver, or an i. s. b. adaptor etc.

### R. F. GAIN Control

22. In the MAN position of the System switch the a. g. c. line is disconnected from the a. g. c. source and a manually controlled bias derived from -16V via the R. F. GAIN control is substituted. In all other settings of the System switch the R. F. GAIN control has no function

## DETECTOR AND B. F. O. CIRCUITS

### Detector Circuits

23. The detector circuit has two separate functions:

(a) As a product detector in all positions of the B. F. O. switch except A. M.

(b) As an a. m. demodulator in the A. M. position of the B. F. O. switch.

24. Product Detector. The output from the i. f. amplifier stage is fed to the product detector together with one of the following frequencies, dependent upon the setting of the B. F. O. switch.

(a) 1601. 5 kHz (B. F. O. switch at L. S. B.) or
(b) 1598. 5 kHz (B. F. O. switch at U. S. B.) or
(c) A 1. 6 MHz frequency which is variable by means of the B. F. O. TUNE control. (B. F. O. switch at +6 through -6).

25. A.M. Detector. In the A.M. position of the B.F.O. switch the 1.6 MHz i.f. signal is demodulated. The B.F.O. frequencies referred to in the previous paragraph are switched out.

B.F.O. Circuits

26. CW (A1) Reception. The local heterodyne oscillator provides a 600 kHz nominal frequency which can be varied through a range of plus or minus 9 kHz by suitable combinations of the switch settings +6 to -6, and variable adjustment of the B.F.O. TUNE control.

B.F.O. Circuits

27. The variable 600 kHz output is fed via a buffer amplifier to a mixer on the detector board in the i.f. module. A fixed frequency of 1 MHz from a crystal oscillator (the same source as that which drives the harmonic generator) is supplied to the same mixer. The combined output at 1.6 MHz (plus or minus any variation applied to the 600 kHz via the B.F.O. TUNE control) is supplied to the product detector stage to heterodyne the 1.6 MHz intermediate frequency.

28. Single-Sideband Reception. The positions L.S.B. and U.S.B. on the B.F.O. switch provide electronic switching of two oscillator frequencies on the detector board. In the L.S.B. setting a crystal controlled frequency of 1601.5 kHz is generated. This is fed to the product detector stage to serve as a stable inserted carrier 1.5 kHz above the 1.6 MHz i.f. thus permitting lower sideband reception. In the U.S.B. setting of the B.F.O. switch a 1598.5 kHz crystal is substituted in the oscillator circuit which then provides carrier insertion 1.5 kHz below the 1.6 MHz i.f. thus facilitating upper sideband reception. The 3 kHz i.f. bandwidth setting should be used so that the inserted carrier is placed at one edge of the filter thus allowing the required sideband to occupy the whole of the passband.

29. It may be noted that the mixer to the 1 MHz and 600 kHz frequencies (para. 27) becomes an amplifier when the B.F.O. switch is set to L.S.B. or U.S.B. The 600 kHz b.f.o. is switched off, thus there is no variable b.f.o. facility available when the L.S.B. or U.S.B. positions are selected.

AUDIO STAGES

30. The output from the a.m. detector or the product detector is fed via a buffer stage to an audio amplifier board located on the underside of the receiver. The amplifier supplies the following outputs.

(a) 1 mW in 600 ohms for line use.

(b) 1 watt for driving an external loudspeaker.

(c) 10 mW at high impedance to the headphones outlet on the front panel.

The level of the 1 mW output is adjusted by the pre-set A. F. LEVEL control. The 1 watt and 10 mW output levels are adjusted by the variable A. F. GAIN control.

## I. F. CONVERTERS

31. Two alternative types of converter board are available for fitting into the i. f. module. The particular type fitted is determined whether the intermediate frequency output is required to be 100 kHz or 455 kHz.

32. The 1. 6 MHz intermediate frequency is supplied to the converter board where it is mixed with the output from a crystal controlled oscillator, the difference frequency is the required final i. f. Thus if the final i. f. is to be 100 kHz the converter oscillator crystal is required to be 1. 7 MHz. For an i. f. of 455 kHz a crystal frequency of 1. 145 MHz is required. These crystal frequencies can be injected from an external source such as a synthesizer. When an external source is employed the internal crystal should be removed.

## POWER SUPPLY MODULE

33. The standard power module Type PU. 1153 is a plug-in unit which can operate from either a. c. or d. c. supplies. It provides outputs at -16V (regulated) and 20 to 24V nominal (unregulated) capable of supplying the power requirements of the receiver and also ancillary units such as an l. f. adaptor, i. s. b. adaptor etc. Refer to the Technical Specification at the front of this handbook for performance data.

34. The A. C. /D. C. and Voltage Selector switches must be correctly set before operating the receiver, as instructed in Chapter 2. Two fuses are provided; the 250 mA fuse protects the input when an a. c. supply is in use. The h. t. fuse, which is in circuit with both a. c. and d. c. power inputs, protects the -16V and -24V outputs.

35. The receiver has no independent power switch. The input to the power supply is connected via a pair of microswitches which are actuated when the System switch is moved from the OFF position.

# CHAPTER 5

# INITIAL FAULT LOCATION

## INTRODUCTION

1. The advice in this chapter provides a simple test procedure which will assist the location of an elementary fault. It is assumed that the only instrument available is a universal testmeter, and that the receiver is not connected to a synthesizer, l.f. adaptor or other external unit. If the fault cannot be located it will be necessary to refer to the more detailed test procedures described in the RA. 1217 maintenance handbook.

## PRELIMINARY CHECKS

2. If the receiver is newly installed check the following items:

(a) AC/DC selector switch correctly set. (rear panel).

(b) 2nd V.F.O. switch set to INT (front panel).

(c) MHz tuning control not set to '00'

(d) Power connection: Note that the polarity of a d.c. supply must be correct. (Refer to Chapter 2).

(e) Antenna connected

## INITIAL FAULT LOCATION PROCEDURE

### Controls

3. Set the receiver as follows and check for signals or noise.

(1) System switch to MAN

(2) DET-BFO switch to A.M.

(3) Meter switch to R.F.

(4) A.F. GAIN to maximum (clockwise)

(5) I.F. BW switch to 3 kHz

(6) R.F. GAIN to maximum (clockwise).

(7) AE ATT control to the MINIMUM position (MIN)

(8) R.F. RANGE switch to 'WB'.

(9) Ensure that the MHz tuning control is not set to '00'

### General Diagnosis

4. The most useful indication in elementary fault diagnosis is receiver noise, or 'mush'. The controls should be set as listed in paragraph 3 and the receiver tuned over a suitable portion of the h.f. band. At each step of the MHz tuning control make a fine adjustment and

listen for a rise in receiver noise level. If no noise can be heard, check that the phones are serviceable and, if possible, listen at an alternative audio outlet as well as at the phones jack socket.

## POWER CHECK

5. If the receiver appears dead (no noise) and the dial lights are not illuminated, check the h.t. voltage in the receiver as follows:

(1) Connect the testmeter (30 volt d.c. range, or higher) to the terminal 'RF. HT' on terminal block TB1 at the rear of the receiver. The reading should be -16 volts relative to chassis. If no reading is obtained at this point it is probable that a fault exists in the power unit or power supply. If connected to a d.c. supply check that the polarity of the connections is correct. (Refer to Chapter 2).

## I.F. MODULE CHECK

6. If noise can be heard, vary the setting of the I.F. BW switch. A change of noise level at each switch movement indicates that the i.f. module is serviceable.

7. If no noise is heard, switch on the b.f.o. (DET-BFO switch to +3 or -3 kHz). The meter (R.F. position) should show a reading and b.f.o. noise should be heard. If a meter reading is obtained but no noise is heard, the fault may be in the detector board of the i.f. module, or in the audio amplifier and its connections. If b.f.o. noise is heard the fault may be in the i.f. amplifier stages of the i.f. module, or in various stages of the receiver prior to the i.f. module. Carry out a front end check.

## FRONT END CHECK

8. Set the DET-BFO switch to A.M. Listen intently and slowly rotate the MHz tuning control. If a very slight rise in noise level can be heard as the MHz tuning passes through each resonant point it suggests that the 37.5 MHz loop is functioning and therefore the fault is more likely to be in the antenna circuit, R.F. Module or 1st Mixer. Make the check in the WB setting of the R.F. RANGE switch as well as in the tuned antenna condition (adjust RF TUNE control). Thoroughly check all front end connections as follows:

(1) Check antenna.

(2) Check continuity through the 500 mA fuselink in the R.F. Module.

(3) Check that the antenna spark gap is not short circuited.

(4) Check the flying lead connections between the R.F. Module and the 1st Mixer, and between 1st VFO and 1st Mixer.

9. If, when tuning the MHz control as described in the previous paragraph, no noise can be heard, the 1st VFO or its connections may be faulty. Check connections from 1st V.F.O. to 1st Mixer and 37.5 MHz Generator at the bracket on the underside of the main chassis.

RF HT Check

10. On the terminal block TB1 at the rear of the receiver connect the terminal HT RF to the terminal HT LF. If the receiver then functions correctly the microswitch 1SB (Fig. 16, Fig. 18) should be checked.

1 MHz Check

11. Set the System switch to CAL and tune the KHz control to the 100 kHz calibration check frequencies. If the calibration whistle is heard at each point it indicates that the 1 MHz oscillator is functioning. If no calibration whistles are heard, turn the System switch to CHECK BFO and set the DET-BFO switch to +6, +3, -3 and -6 kHz in turn. If, again, no heterodyne whistles are heard, it indicates a faulty 1 MHz crystal oscillator. Check that the crystal is correctly fitted in the upper deck of the 37.5 MHz Generator Module.

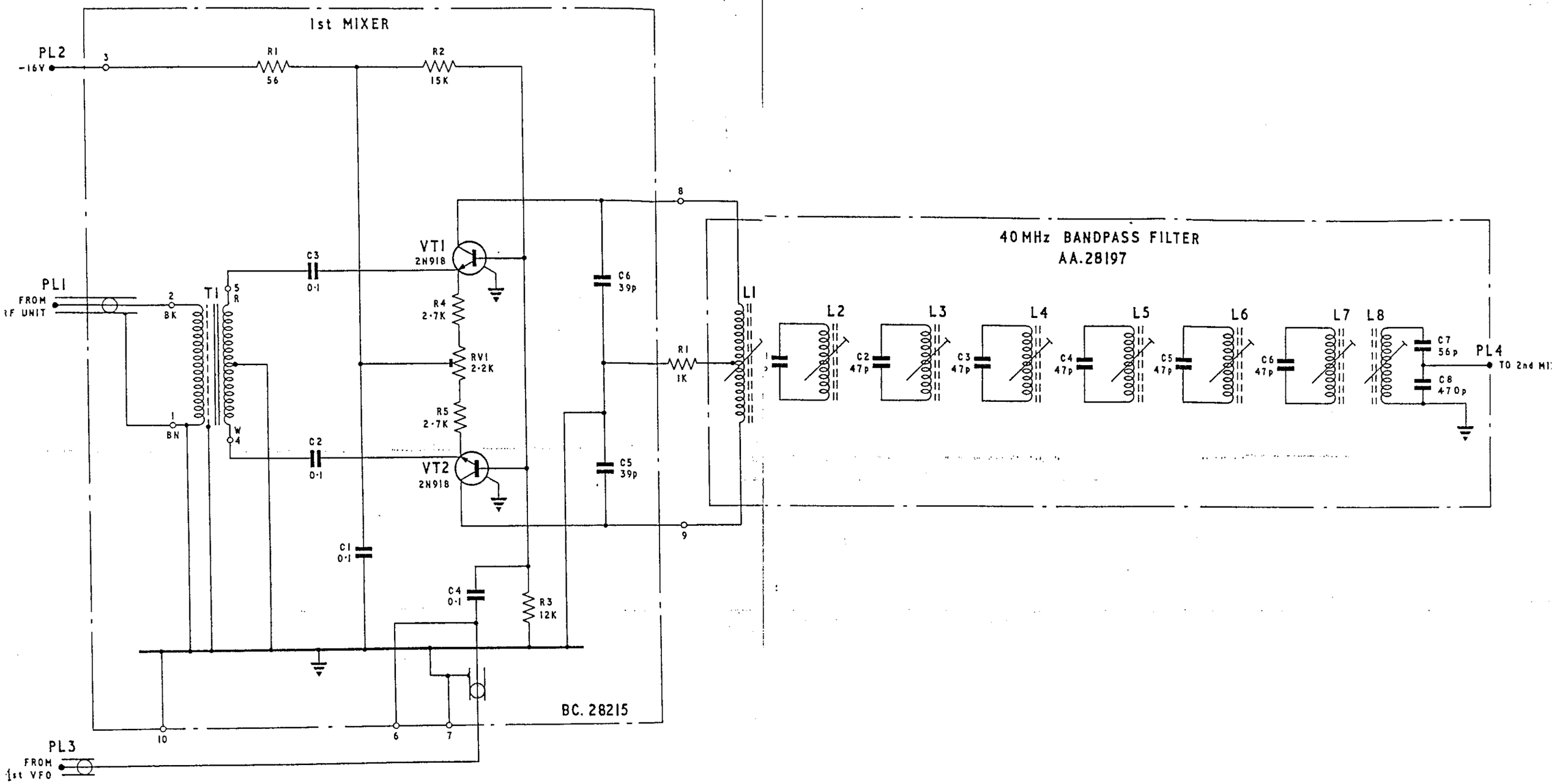
A.G.C. FAULT

12. If the receiver operates satisfactorily with manual r.f. gain control (System switch to MAN) but overloads on strong signals in the a.g.c. settings of the System Switch check as follows:

(1) Tune the receiver to a strong signal. Set the System switch to AGC Med and the Meter switch to R.F. If the meter indicates a reading appreciably greater than 1 microvolt the a.g.c. board in the I.F. Module is serviceable. If no reading is obtained the fault is probably in the I.F. Module.

(2) If the meter reading is satisfactory, connect the test meter negative lead to the terminal AGC RF on the rear panel (positive lead to chassis). As the receiver is tuned through a powerful signal the a.g.c. level should change from -4V (weak signal) to approximately 0 volts (strong signal). If no reading is obtained check the microswitch 1SA adjacent to the MHz tuning shaft. (Fig. 16 Fig. 18)

NOTE: The levels quoted in para. 12, cannot be given exactly because the level of a strong signal is not defined.

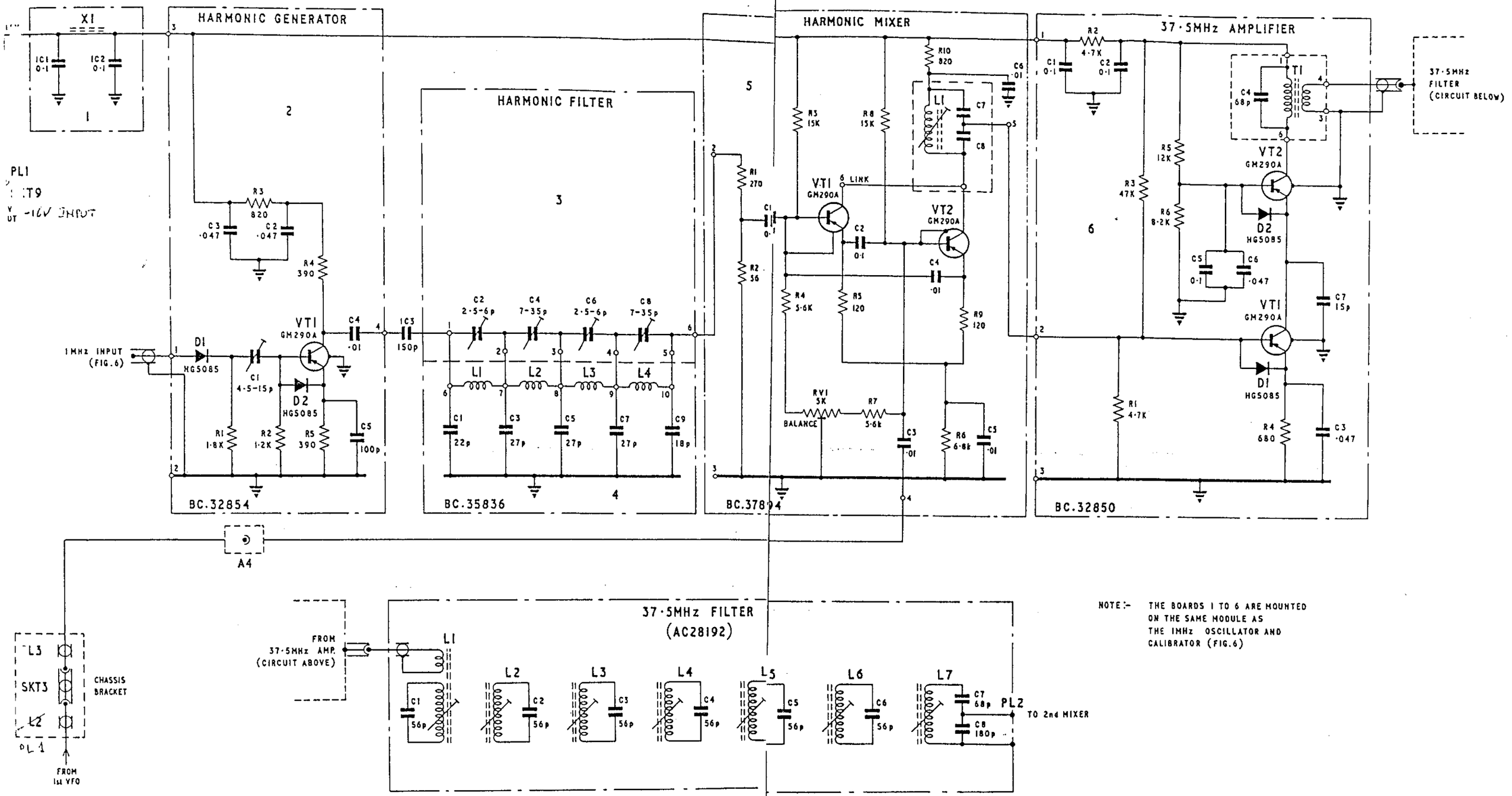



| BC28211 | 281/8 |
|---|---|
| 2 \| 4 | |

Circuit : 1st Mer and 40MHz. Filter

1st MIXER

Fig. 8




NOTE:- THE BOARDS 1 TO 6 ARE MOUNTED ON THE SAME MODULE AS THE 1MHz OSCILLATOR AND CALIBRATOR (FIG.6)

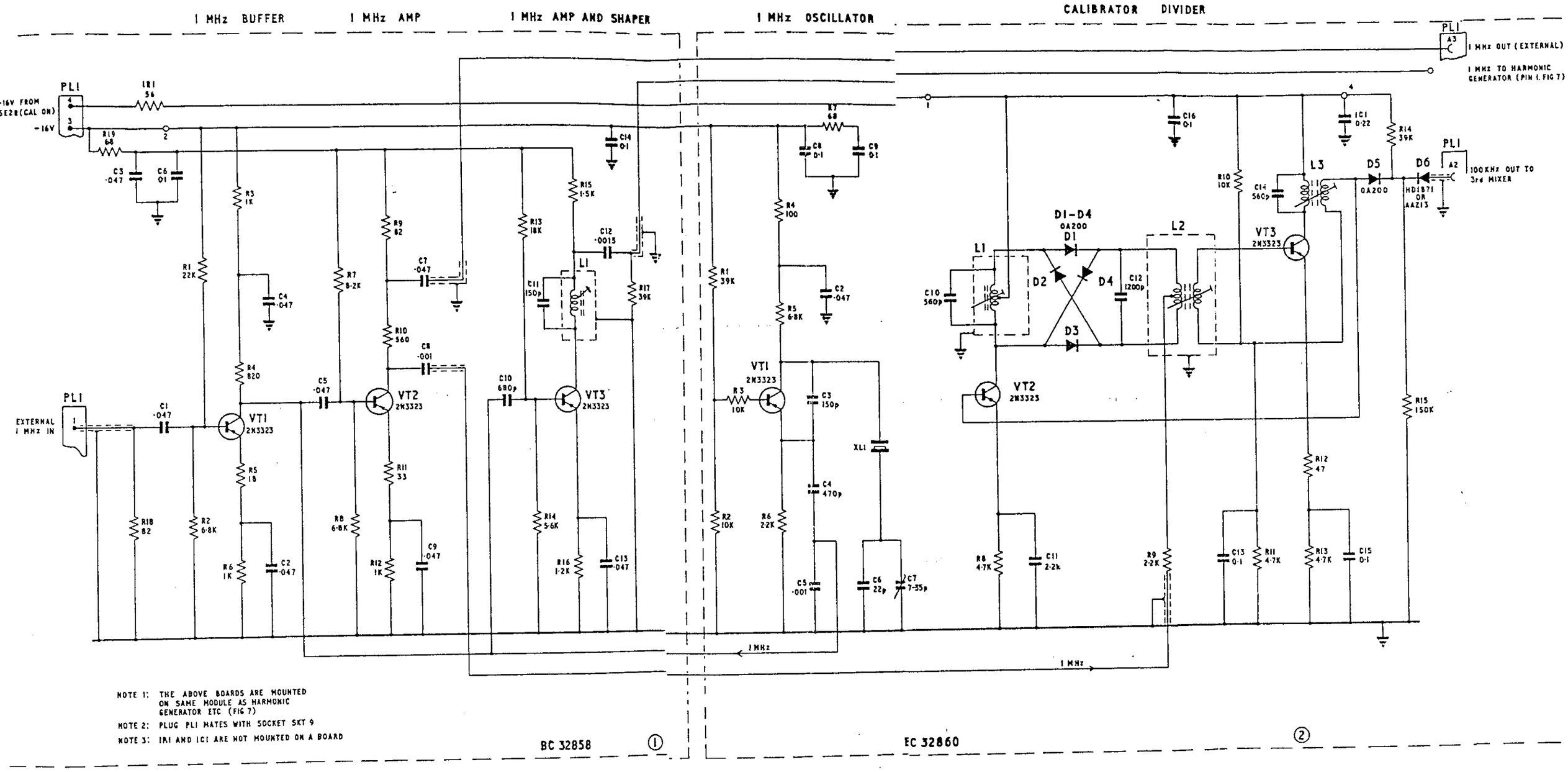
BC26284/B | 281/7

AC28192 | 3

Circuits: Harmonic Generator Mixer and 37·5MHz Filter (37·5 MHz Generator)

Fig.7

HARMONIC GENERATOR.




NOTE 1: THE ABOVE BOARDS ARE MOUNTED ON SAME MODULE AS HARMONIC GENERATOR ETC (FIG 7)

NOTE 2: PLUG PL1 MATES WITH SOCKET SKT 9

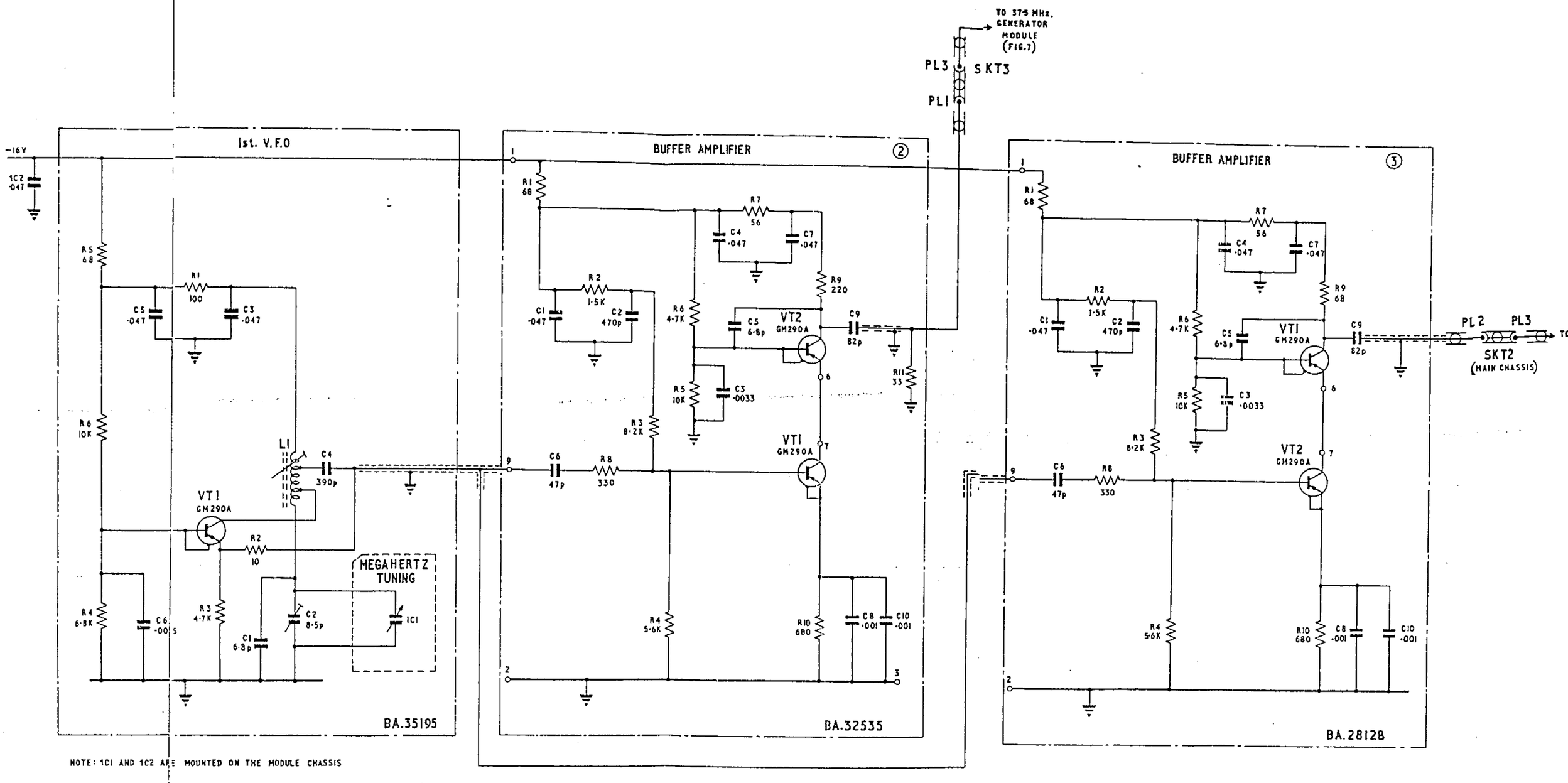
NOTE 3: IR1 AND IC1 ARE NOT MOUNTED ON A BOARD

| CC28285/B | 281/6 |
|---|---|
| 1 | |

Circuit : 1MHz Amplifiers, Oscillator and Calibrator

Fig.6

1MHz
OSC
CAL

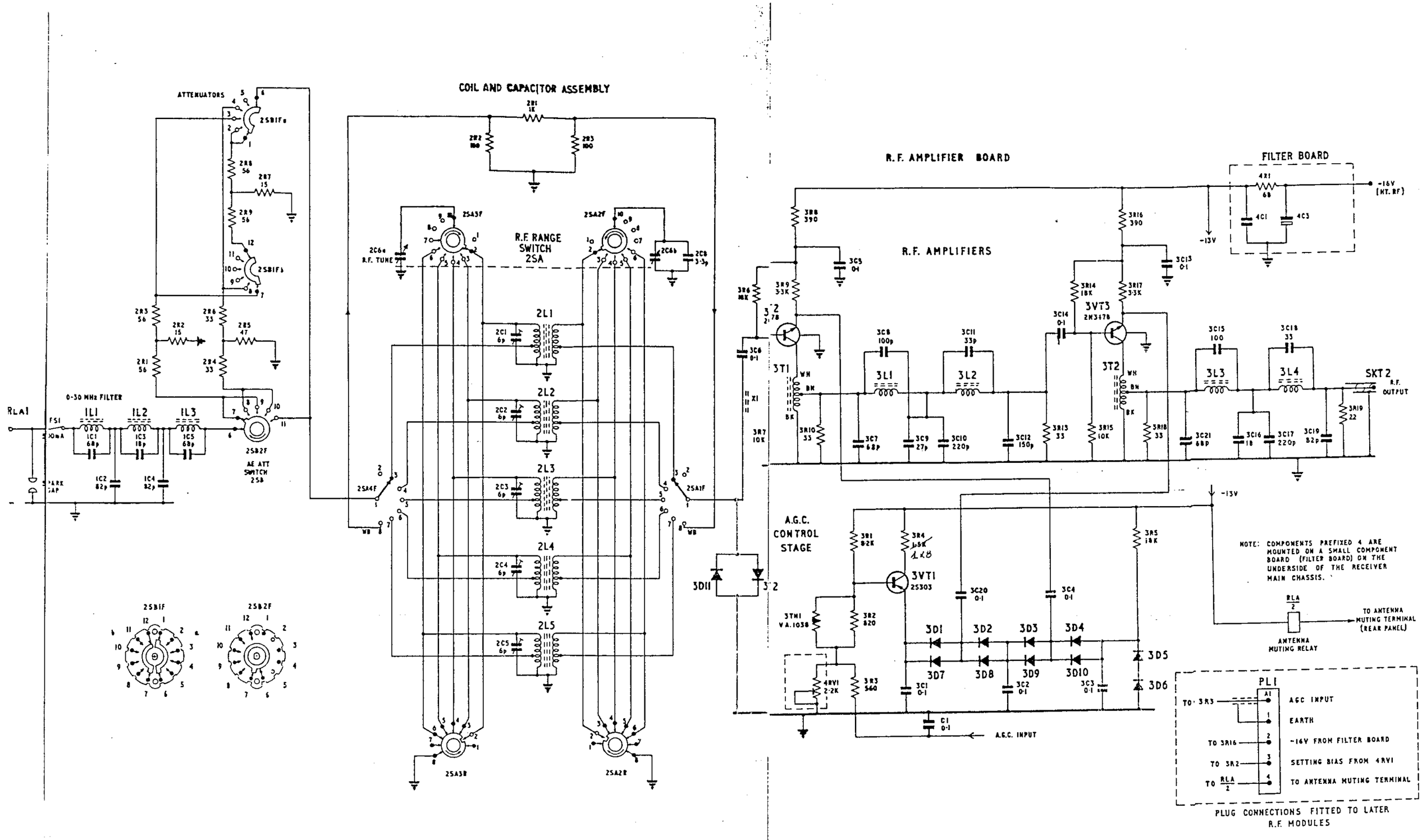



NOTE: 1C1 AND 1C2 ARE MOUNTED ON THE MODULE CHASSIS

| BC28120 | 281/5 |
|---|---|
| 4 7 8 9 10 | |

Circuit: Ist. V.F.O

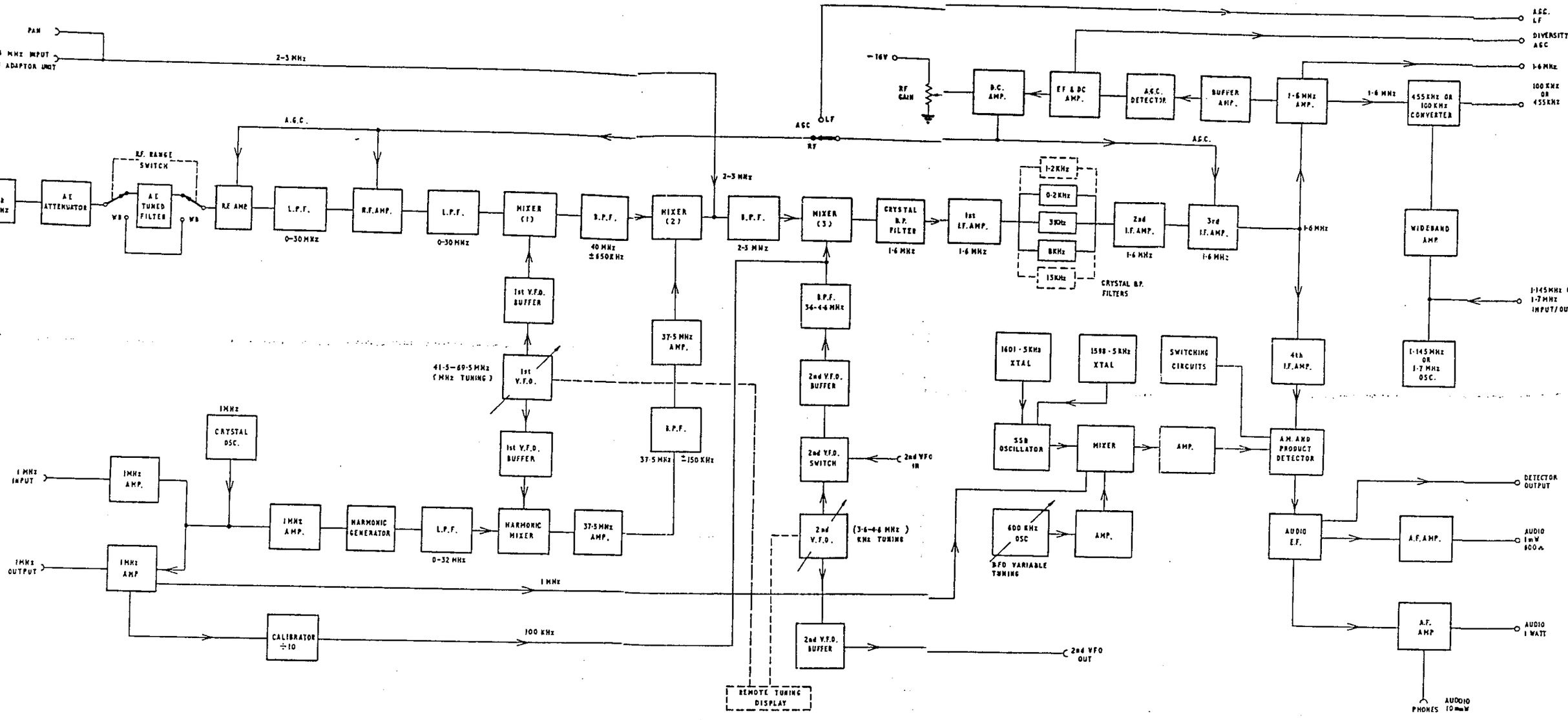
FIG 5




Circuit : R.F. Module

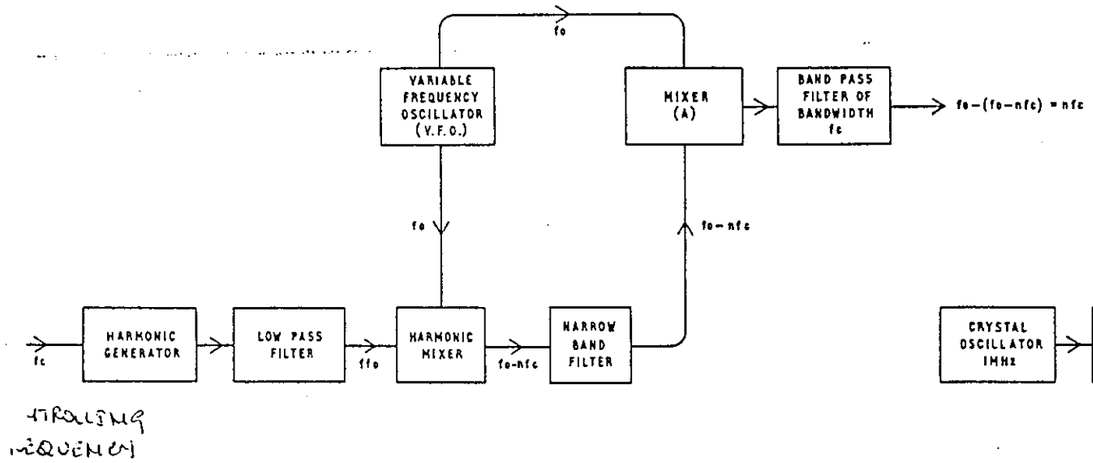
Fig.4

RF MODULE

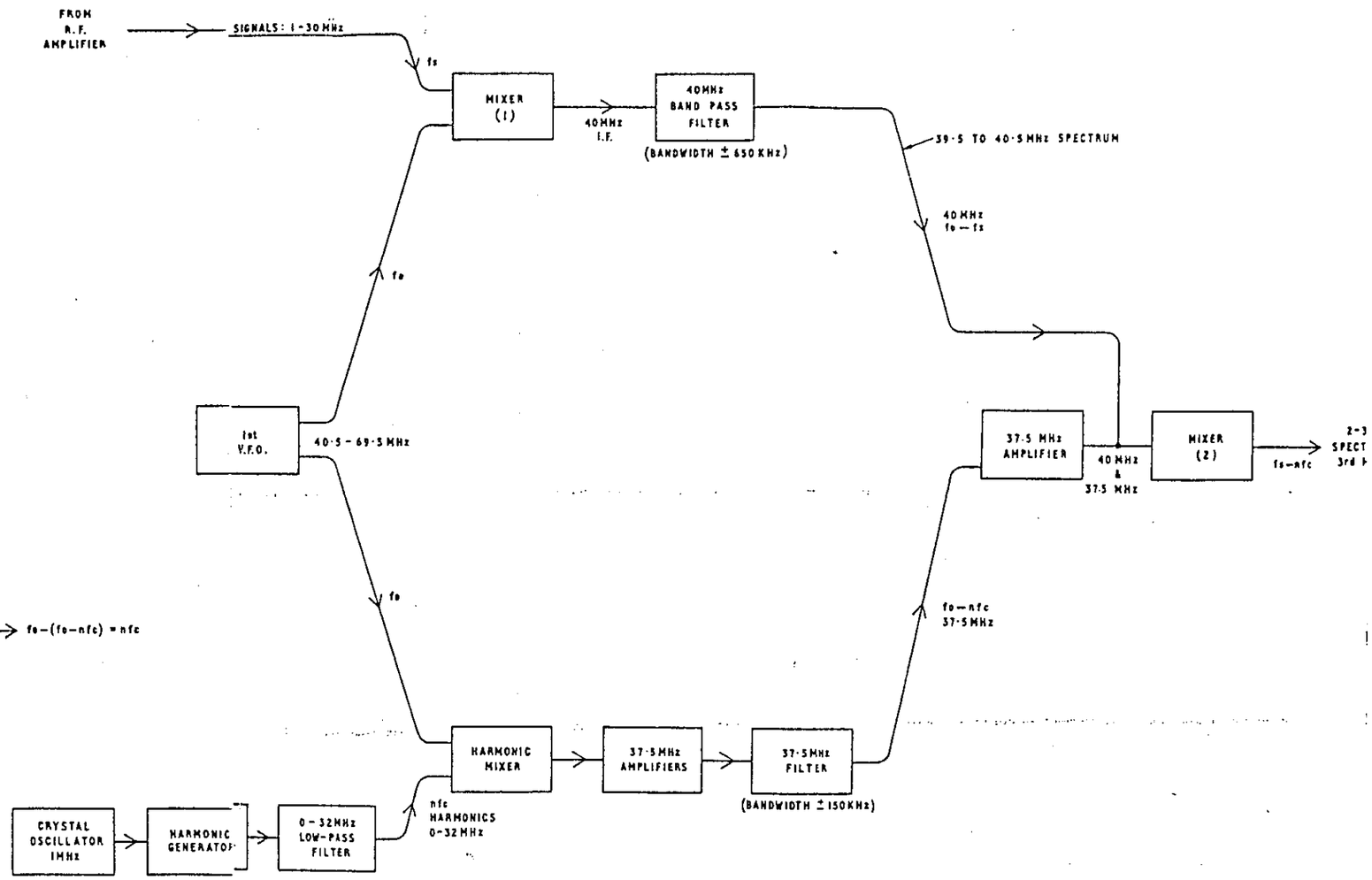



Block Diagram : RA1217

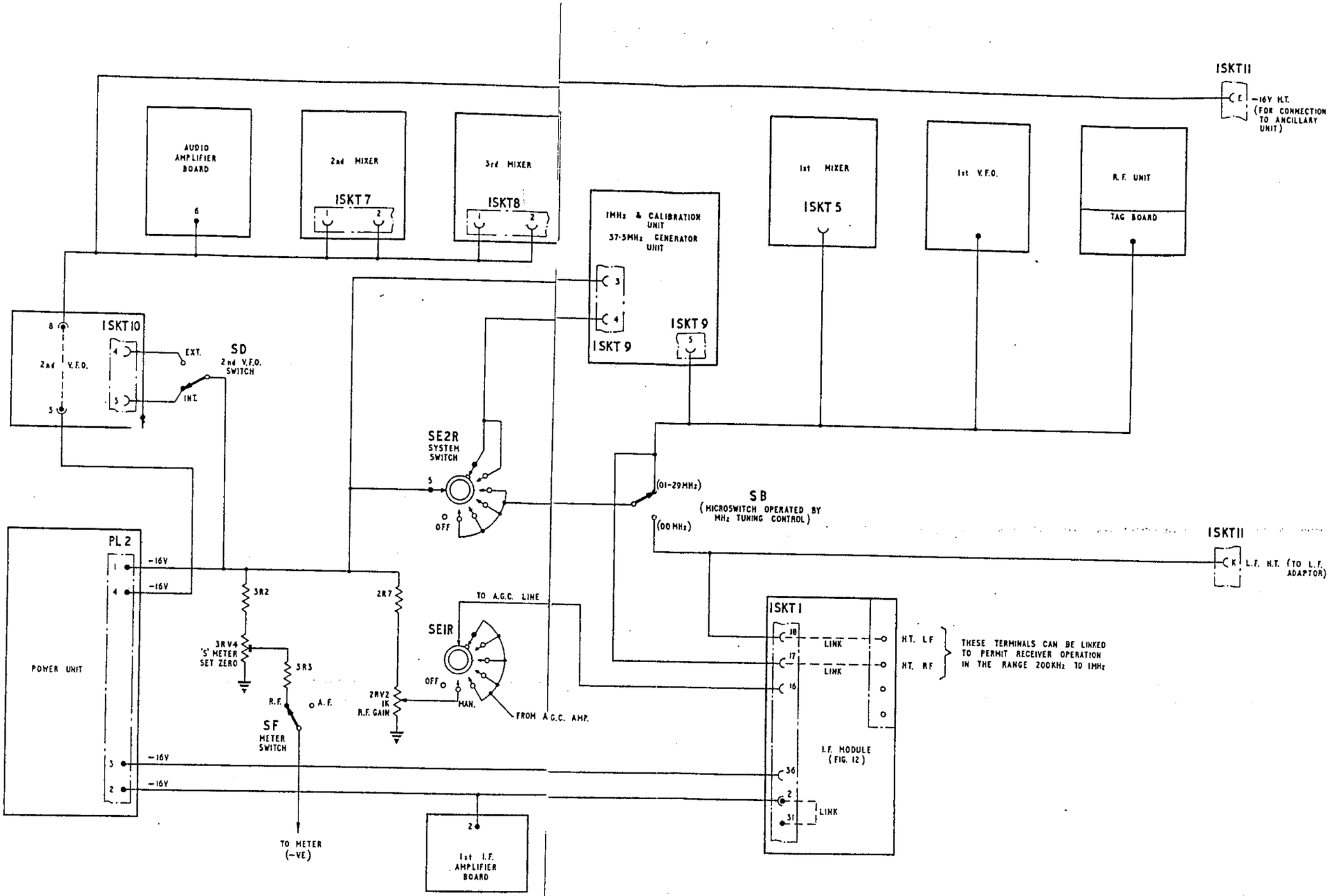
Fig3




Wadley System – Block Diagram Fig.1




Electronic Band Selection – Explanatory Block Diagram Fig. 2

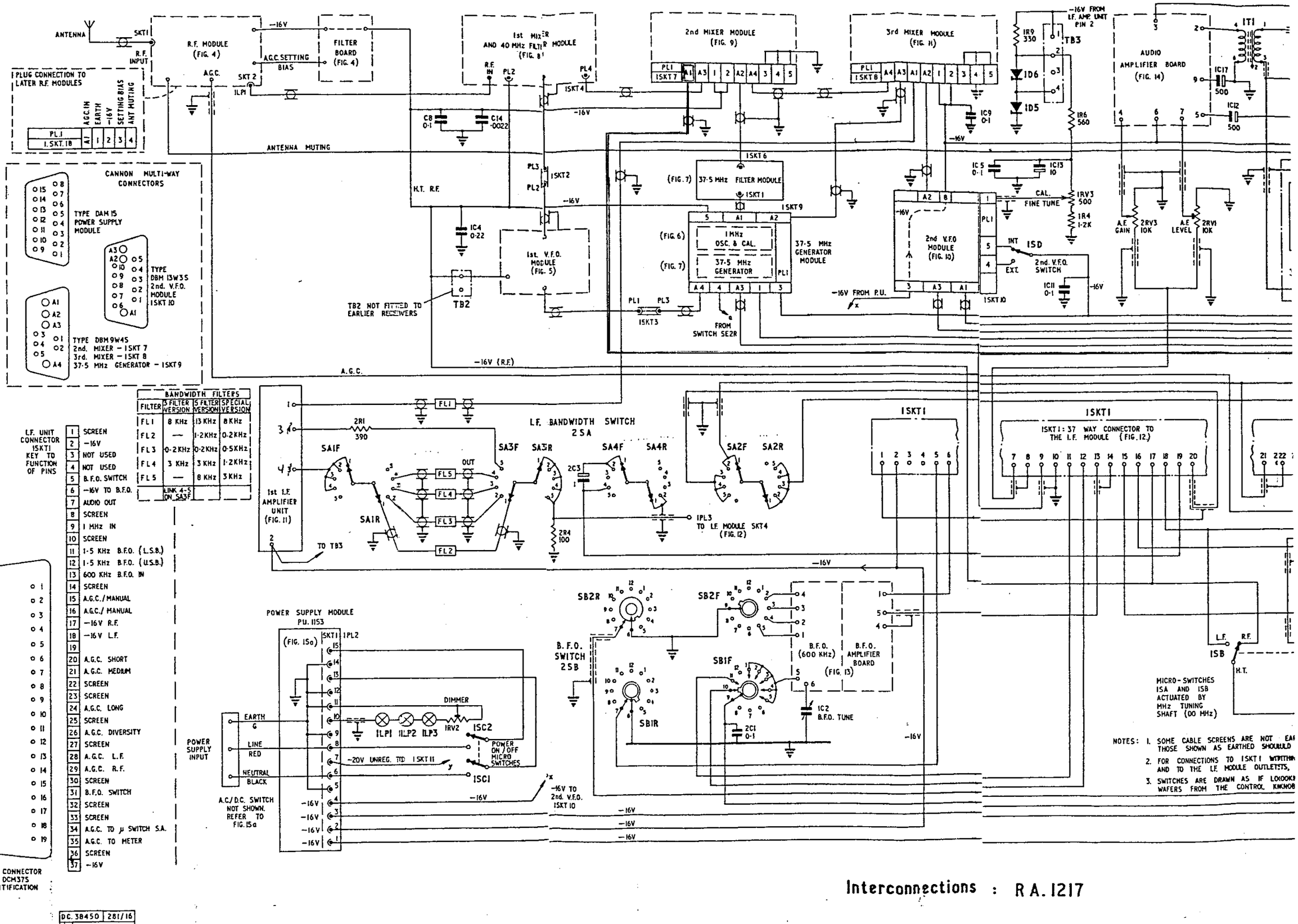



281/17

Interconnection Diagram : 16 Volt Supplies RA.1217

Fig. 17

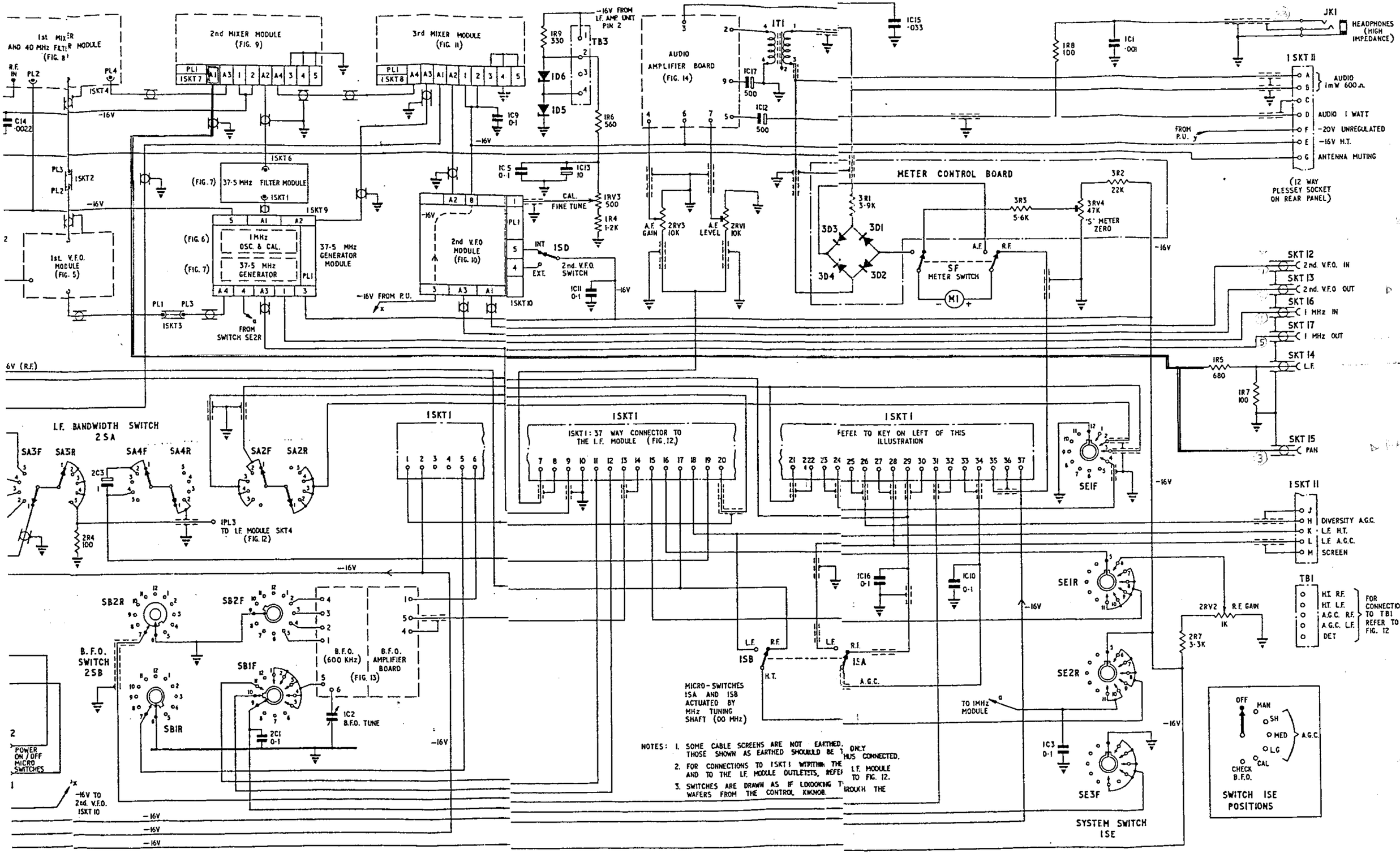
INTERCONNECTIONS
16V SUPPLY




Interconnections : R A. 1217

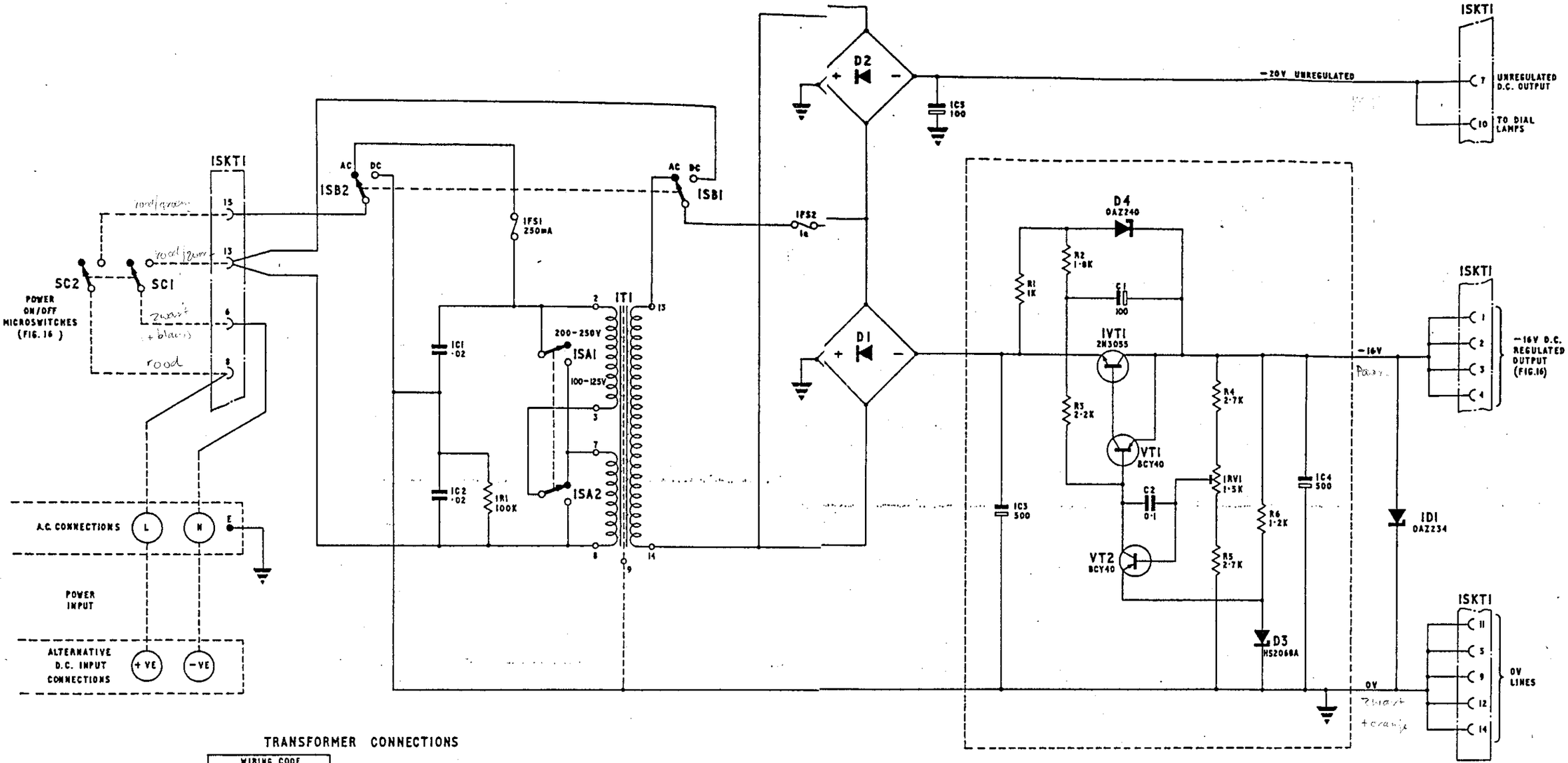
Fig. 16b

DC. 38450 | 281/16
113



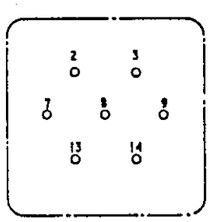

Interconnections : R A. 1217

Fig. 16a




TRANSFORMER CONNECTIONS

| WIRING CODE | |
|---|---|
| TERMINAL | COLOUR |
| 2 | RED/GREEN |
| 3 | RED/WHITE |
| 7 | BLUE/WHITE |
| 8 | RED/BLACK |
| 9 | BLACK |
| 13 | RED/BLUE |
| 14 | RED/BLUE |




IT1 TRANSFORMER TERMINALS

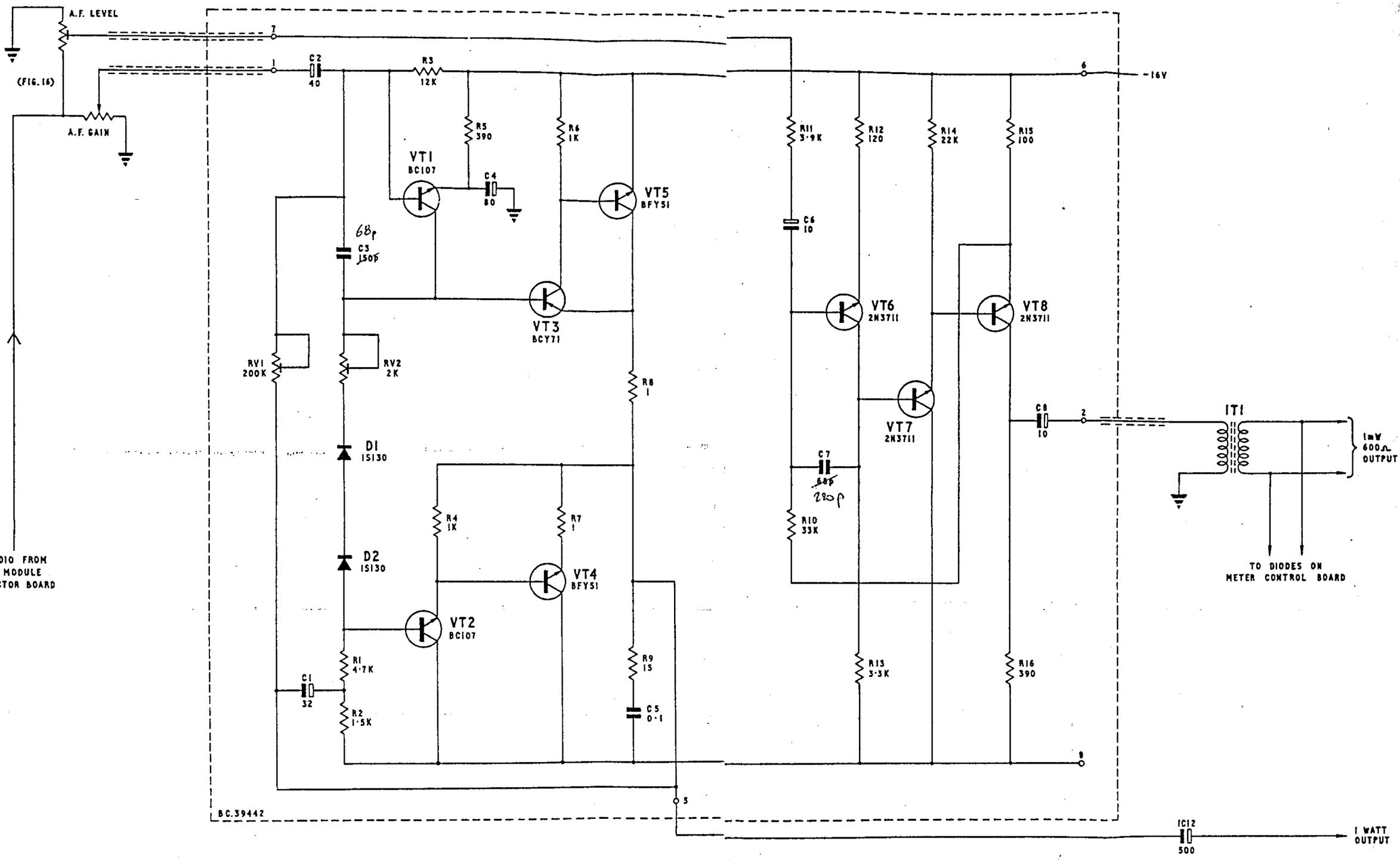
NOTE: COMPONENTS PREFIXED ! ARE NOT MOUNTED ON THE PRINTED CIRCUIT BOARD

| BC 38640 | 281/15 |
|---|---|
| 1 | |

Circuit: Power Unit Type PU.1153

Fig.15(a)

POWER SUPPLY
PU. 1153

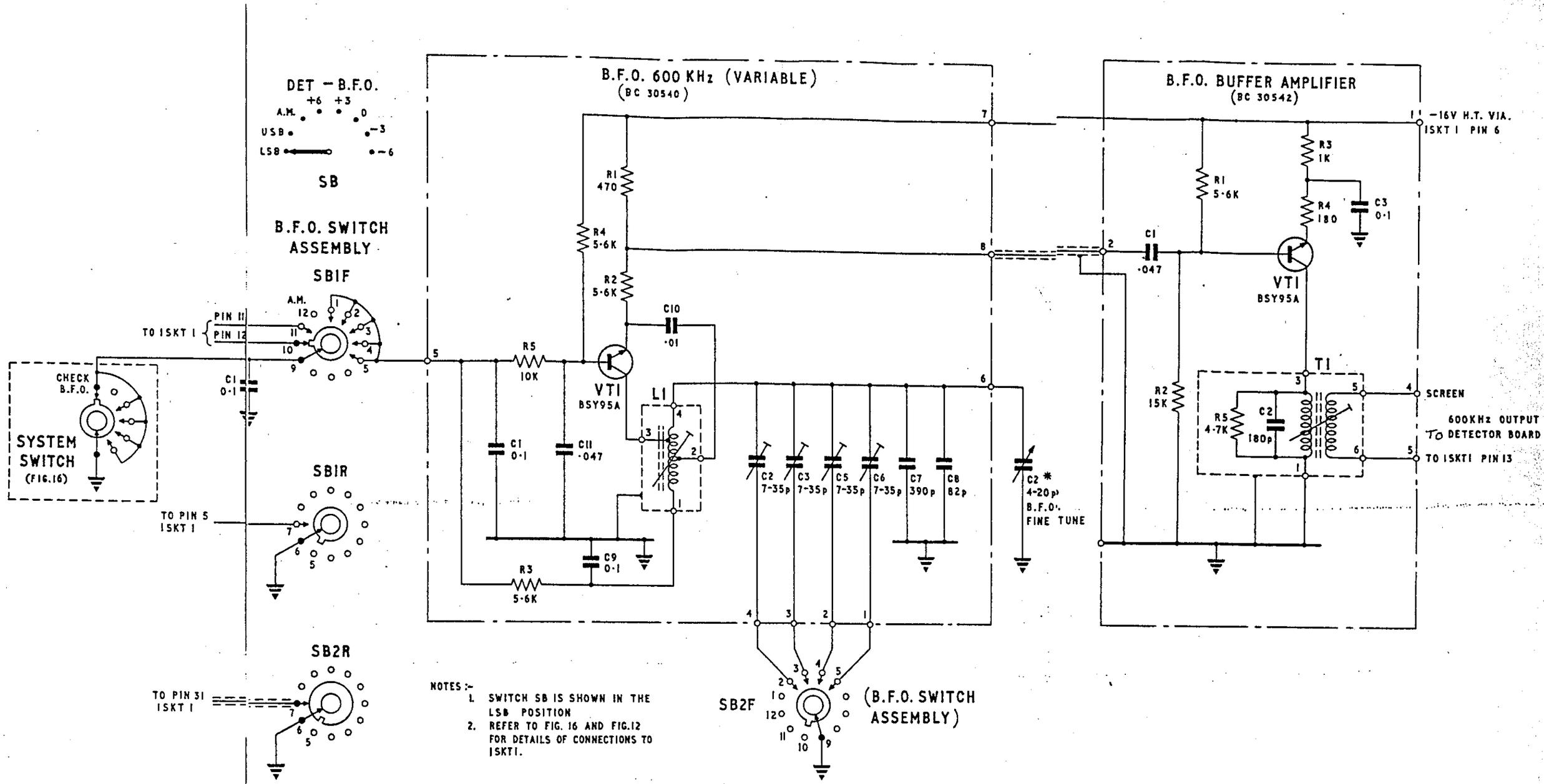



DC.38450 281/14
1

Circuit: Audio Amplifier Board

AUDIO
AMPLIFIER

Fig.14



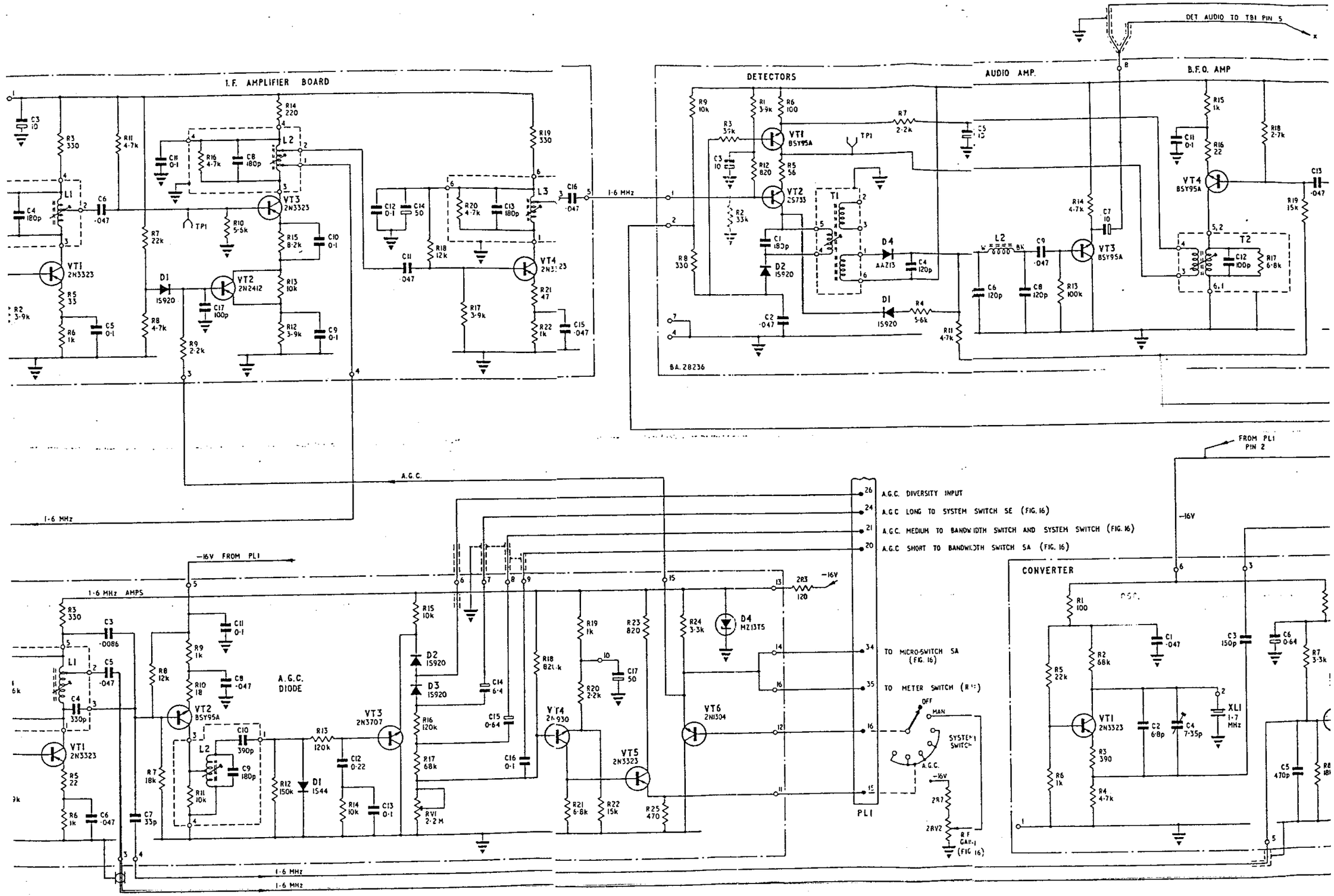

NOTES :-

1. SWITCH SB IS SHOWN IN THE LSB POSITION
2. REFER TO FIG. 16 AND FIG.12 FOR DETAILS OF CONNECTIONS TO ISKT1.

| DC 38450 | 281/13 |
|---|---|
| 1 | |

Circuit : B.F.O. Unit

BFO. FIG. 13




Circuit : I.F. Module

Fig. 12b

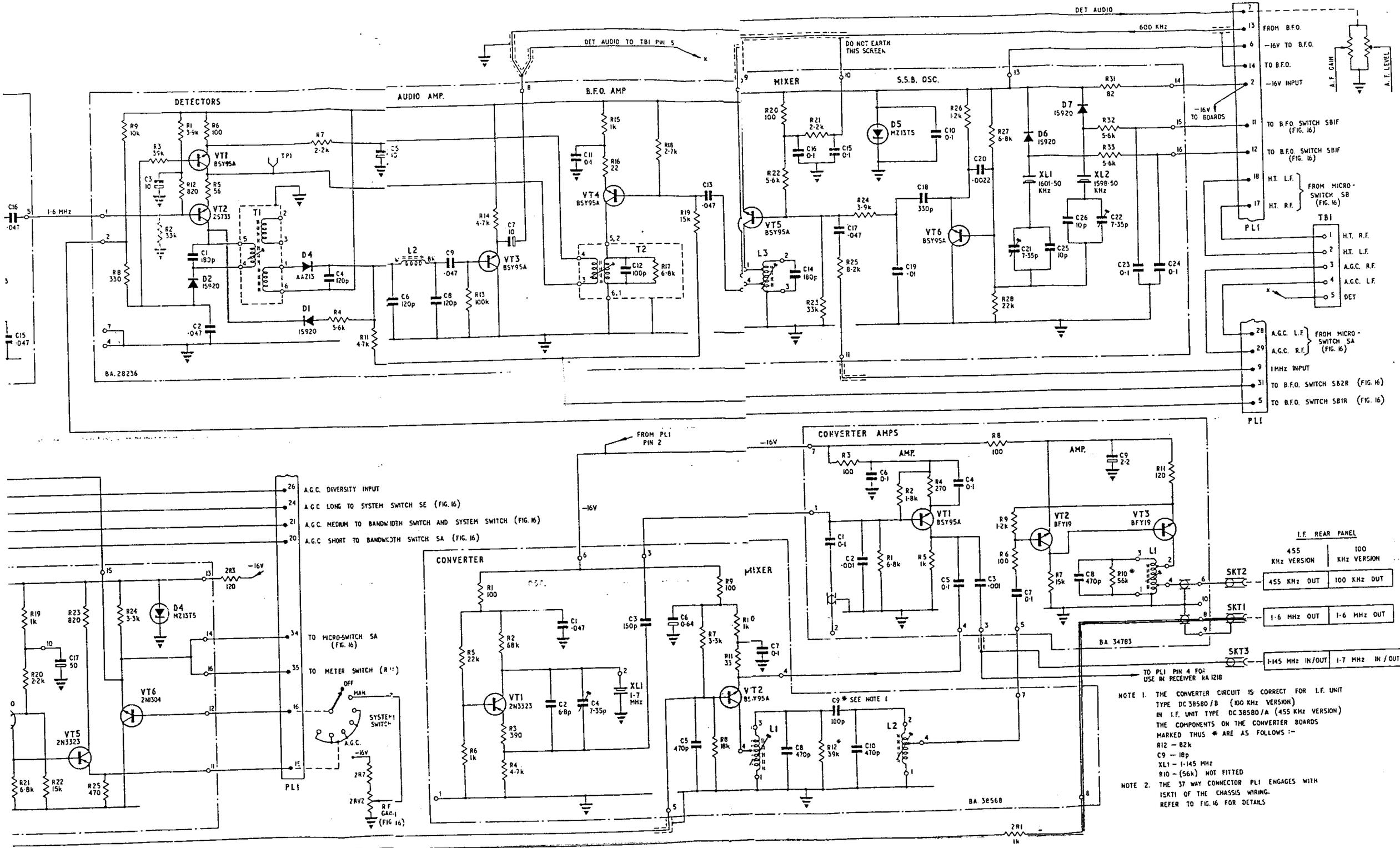
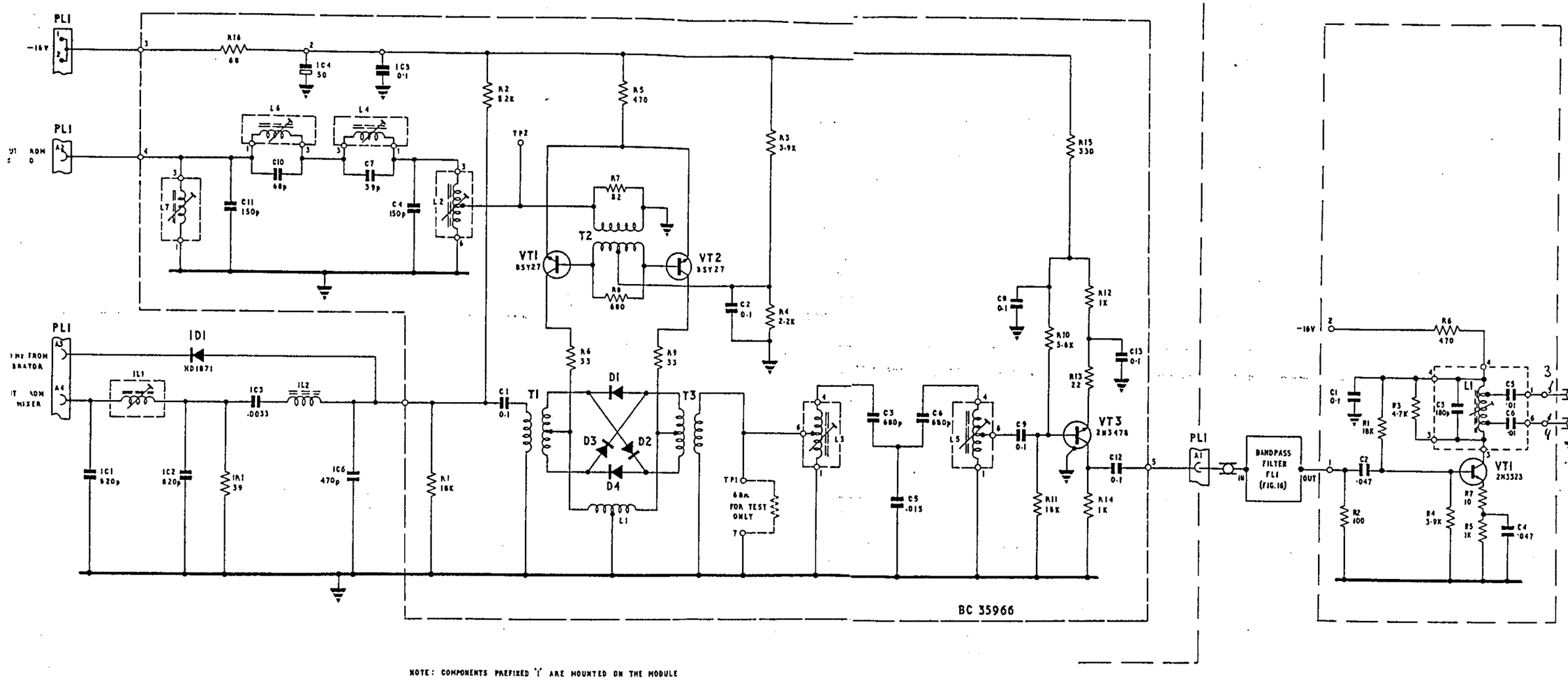



Fig. 12a

Circuit : I.F. Module




NOTE: COMPONENTS PREFIXED 'I' ARE MOUNTED ON THE MODULE BUT NOT ON THE CIRCUIT BOARD

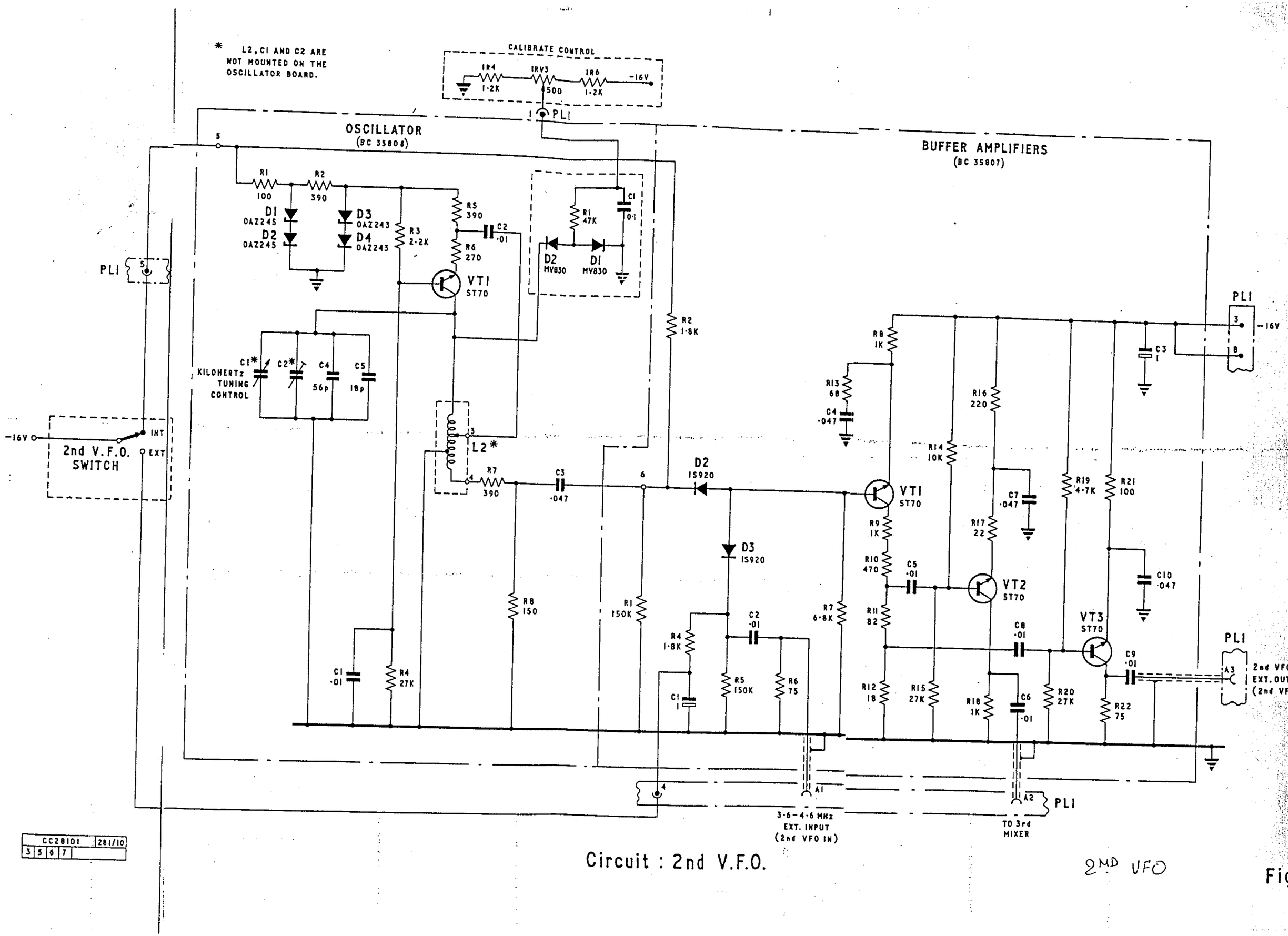
3rd Mixer Module

1st I.F. Amplifier Unit

3RD MIXER

Circuit : 3rd Mixer Module and 1st I.F. Amplifier Unit

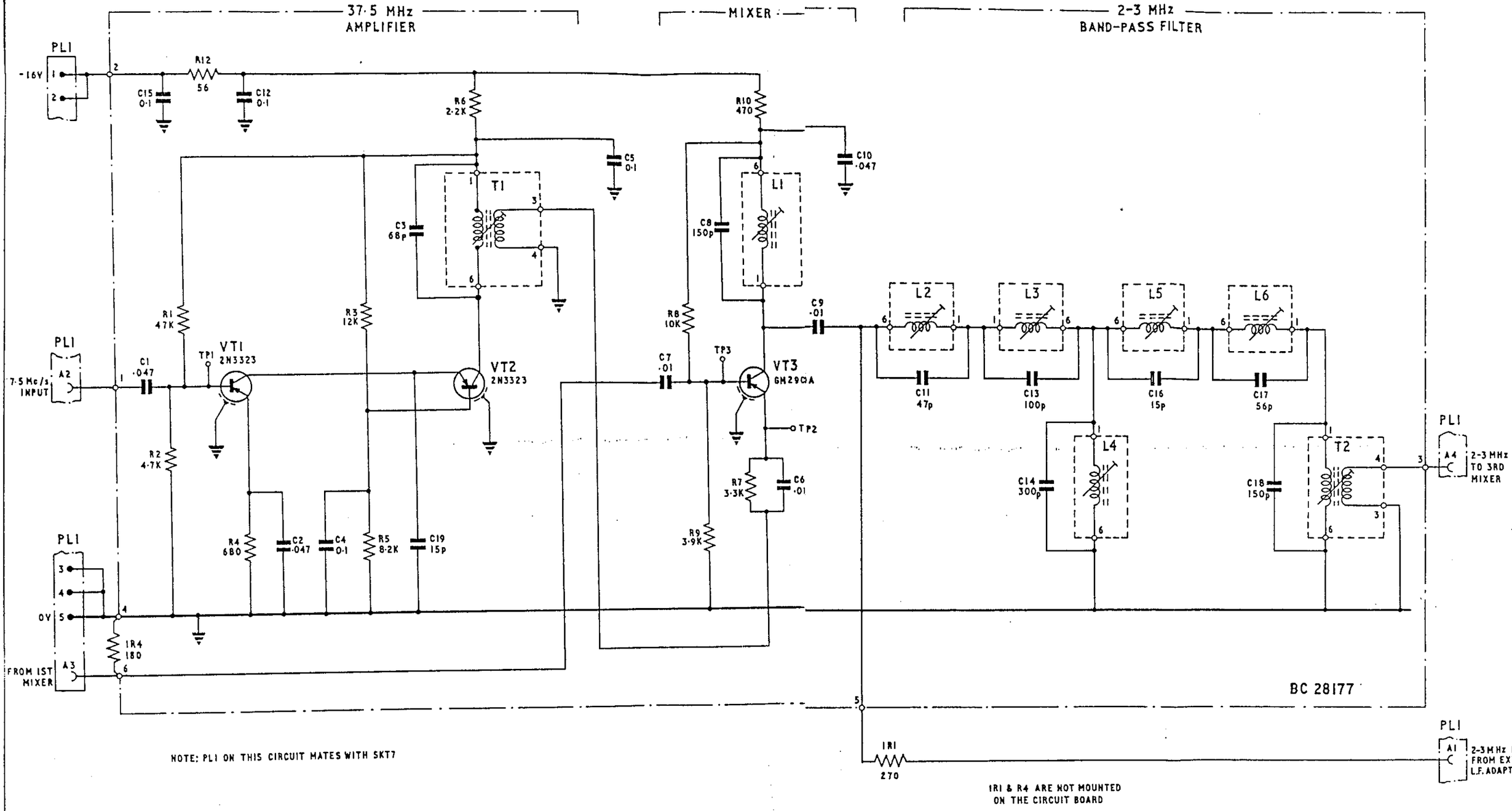
Fig. 11




Circuit : 2nd V.F.O.

2ND VFO

Fig.1C

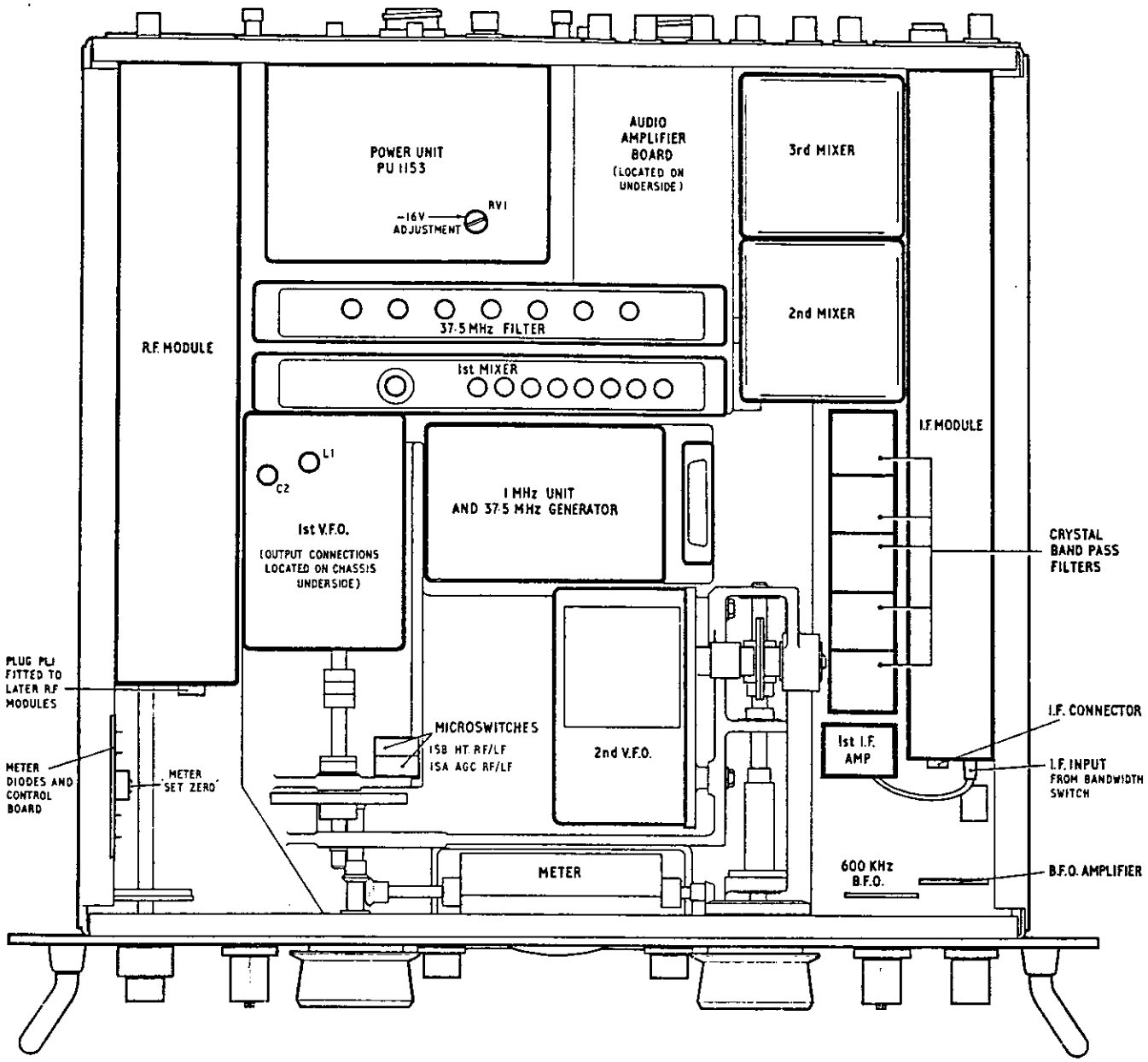



| BC30959 | 281/9 |
|---|---|
| 6 | 9 |

Circuit : 2nd Mixer

2ND MIXER

FIG 9

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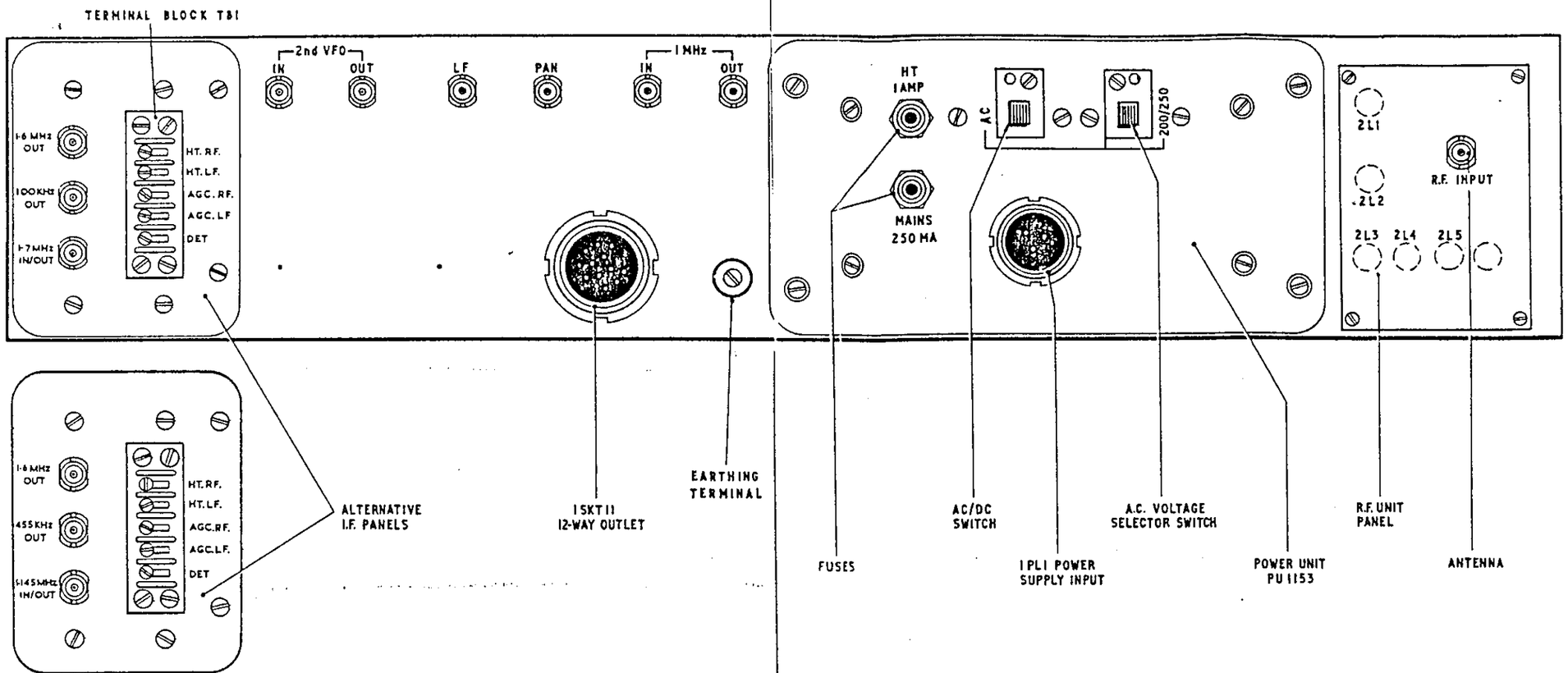
Chassis Upperside RA1217

Fig. 18

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Rear Panel. RA1217

Fig. 19

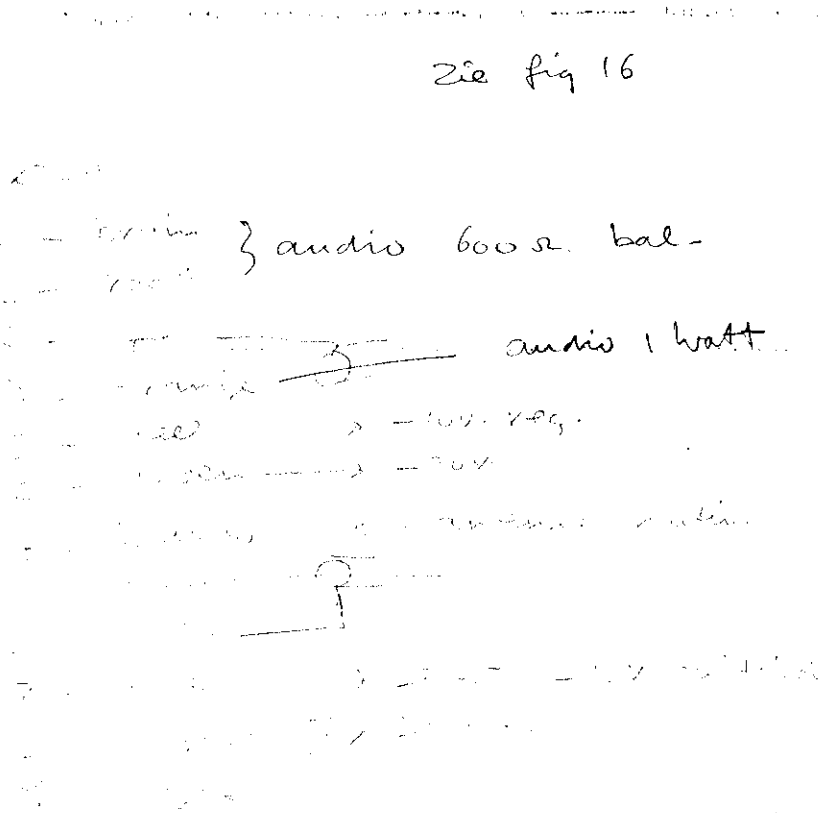
REAR PANEL.

## HANDBOOK CHANGE INFORMATION

At RACAL, we continually strive to keep up with the latest electronic developments by adding circuit and component improvements to our equipments.

Sometimes, due to printing and despatch requirements, we are unable to incorporate these changes immediately into printed handbooks. Hence, your handbook may contain new change information on following pages.

The user is recommended to hand-amend this handbook, as soon as possible, in accordance with the corrections, if any, which follow this sheet.



# K4XL's  BAMA

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