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Colin Hinson
In the village of Blunham, Bedfordshire.

AP 116E-0145-16
June 1989

3 CHANNEL V/UHF RADIO
DMW TYPE ATR-3

GENERAL AND TECHNICAL INFORMATION

REPAIR AND RECONDITIONING INSTRUCTIONS

BY COMMAND OF THE DEFENCE COUNCIL

Ministry of Defence

Sponsored for use in the
ROYAL AIR FORCE by D SIGS (AIR)

Prepared by: DMW Associates (Electronics) Ltd Daventry England

Publications authority: ATP/MOD (PE)

Service users should send their comments through
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WARNINGS

CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH

MAKE SURE YOU KNOW THE SAFETY PRECAUTIONS AND FIRST AID INSTRUCTIONS BEFORE YOU USE A HAZARDOUS SUBSTANCE

READ THE LABEL ON THE CONTAINER IN WHICH THE SUBSTANCE IS SUPPLIED

READ THE DATA SHEET APPLICABLE TO THE SUBSTANCE

OBEY THE LOCAL ORDERS AND REGULATIONS

WARNINGS

(1) BERYLLIUM/BERYLLIA. THIS EQUIPMENT CONTAINS COMPONENTS THAT ARE MADE OF BERYLLIUM/BERYLLIA. REFER TO JSP(F)395 AND AP 100(N)-0140 (NAVY) FOR SAFETY PRECAUTIONS.

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CONTENTS

Preliminary material

Chapters

INTRODUCTION

▶ **CAUTION**

ELECTROSTATIC SENSITIVE DEVICES. SPECIAL PRECAUTIONS SHOULD BE TAKEN TO MINIMISE THE RISK OF DAMAGE, BY ELECTROSTATIC DISCHARGE, TO ELECTROSTATIC SENSITIVE DEVICES. DEVICES EMPLOYING METAL OXIDE SILICON (MOS) TECHNOLOGY ARE PARTICULARLY SUSCEPTIBLE. ESD's ARE MARKED WITH EITHER A PROMINENT CONTRASTING YELLOW BAND OR SPOT, OR THE FOLLOWING SYMBOL:

REFER TO AP 100N-0140 (NAVY). ◀

PREFACE

1 This publication describes an equipment which is self contained in one enclosure designed primarily for mounting in a standard nineteen inch rack. The equipment is intended for use in a fixed ground environment, protected from severe climatic conditions and in general a benign weather-proof location.

2 The equipment forms a transmitter/receiver operating on one of three selectable channels in the VHF and UHF bands, and in the Simplex mode.

3 Three elements of equipment will be required to operate with the transmitter/receiver and these are not covered by this publication. The elements are:

3.1. Antennae Systems
3.2. Microphone Systems
3.3. External Power Sources

In general, any 50 ohm transmitter antenna designed for operation in the appropriate band may be used, and the equipment is designed to accommodate a 200 ohm, moving coil microphone, fitted with a single pole press-to-transmit switch and terminated in a standard 4 pin NATO jack plug.

4 The equipment normally operates from single phase 240 volts maints 50/60 Hz but includes facilities for operation from, and charging of, an external 24 volt lead acide type battery.

5 Each page of this publication bears the date of issue or the date and amendment number with which it was issued. Changes of technical import will be indicated by black triangles, thus ▶--◀ placed outside the textual area affected or by the words '(completely revised)' beneath the title of the completely re-issued element.

MODIFICATION RECORD

The following record confirms that this publication incorporates all the technical changes necessitated by the modifications listed below. Information on modification titles, classification categories and mark applicabilities is given in Topic 2.

LEADING PARTICULARS

NAME	3-CHANNEL V/UHF RADIO
TYPE	DMW TYPE ATR-3
▶ NATO STOCK No.	51GA/5820-99-917-0806 ◀
SIZE	19x14x3½ inches (48.3x26.6x6.7 cm)
WEIGHT	26 lbs (12 Kg)
POWER SUPPLY	Primary: 220-240 V 50/60 Hz Secondary:External 24 V dc Battery
FREQUENCY RANGE	(i) VHF: 117 to 137 MHz (ii) UHF: 225 to 400 MHz
No. OF CHANNELS	Three pre-set, selectable from any integer of 25 kHz within the specified ranges.
FREQUENCY STABILITY	(i) VHF: Less than ± 4 ppm (±500 Hz) (ii) UHF: Less than ± 4 ppm (±1600 Hz)
AM RECEIVER SENSITIVITY ...	5 microvolt emf amplitude signal modulated at 80 % by 1 kHz produces a 10 dB signal-to-noise ratio.
FM RECEIVER SENSITIVITY ...	2 microvolt emf amplitude signal modulated at 1 kHz with peak deviation of 3 kHz produces 12 dB SINAD.
IF SELECTIVITY	(i) 3 dB Bandwidth : 15 kHz (ii) 70 dB Bandwidth : 50 kHz
IF REJECTION	Better than 55 dB
FM ADJACENT CHANNEL REJECTION ...	Greater than 50 dB for reduction of half of s + n/n ratio (6 dB).
AM ADJACENT CHANNEL REJECTION ...	Exceeds 55 dB
TRANSMITTER OUTPUT POWER	5 watts minimum
DUTY CYCLE	Continuous at 20°C
LINE INPUT IMPEDANCE ...	600 ohms ± 25 %, balanced
MICROPHONE	Electro-magnetic noise cancelling to DEF. STAN 59-43.

AM MODULATION FREQUENCY RESPONSE	Within ± 2 dB of the level at 1 kHz over the range 0.3 to 3 kHz.
AM MODULATION DISTORTION	Less than 5%
AUDIO OUTPUT LEVEL	Greater than 15 mW into 600 ohms.
SIDE TONE LEVEL	6 dB below audio level with standard input.
AUDIO OUTPUTS	Internal Loudspeaker or Earphones.
FM DEVIATION	Pre-settable between ± 3 kHz and ± 8 kHz.
FM MODULATION	Peak deviation of 5.5 kHz ± 1 kHz.

ENVIRONMENTAL

(i)	STORAGE TEMPERATURE ...	-20 °C to +60 °C.
(ii)	OPERATING TEMPERATURE ...	(i) 0 °C to +35 °C for 5 watts. (ii) -10 °C to +50 °C for 1 watt.
(iii)	AIR TRANSPORT	Withstand 752 millibars continuous.
(iv)	HUMIDITY	0 to 80 % R.H. (non-condensing).

Chapter 1

GENERAL INFORMATION

CONTENTS

INTRODUCTION

PURPOSE OF EQUIPMENT

1 The three channel V/UHF Radio DMW Type ATR-3 is a transmitter-receiver designed for simplex operation in a benign environment. The equipment offers facilities for amplitude modulation reception and transmission in the aeronautical VHF and UHF bands and frequency modulation reception and transmission in the aeronautical UHF band.

2 The purpose of the Radio is to provide three, operator selectable, channels of voice communications in either of the following frequency ranges:

2.1. VHF : 117 to 137 MHz

2.2. UHF : 225 to 400 MHz

3 Facilities are included in the design to allow operation of the Radio from a standard mains voltage supply or from an external battery with a built-in automatic changeover from mains to battery, (in the event of mains failure) and automatic reversion when the mains supply is restored.

Application

4 The V/UHF Radio is designed for static ground based applications, though the mechanical construction is such as to readily permit fitting in mobile installations, for example in vehicles or ships.

5 Although essentially a commercial product, with a number of proprietary circuits included, considerable effort has been made to meet the needs of military equipment.

6 In particular the following aspects have been fully addressed during the design phase:

6.1. The need for reliable, high quality components and consequent high mean time between failures (MTBF).

6.2. Ease of maintenance considerations, with recognition of the need for fast turn round times and repair to module level at station locations.

6.3. Robust construction able to withstand the rigours of a prolonged Service life.

7 The resulting design is therefore suitable for use in a wide variety of both civil and military applications where a low powered speech transmitter-receiver system is required. Additionally, the equipment is suitable for use in co-location applications where up to 3 units may be co-located and used simultaneously, provided a minimum of 3 MHz channel separation is applied.

Associated Equipment

8 A single enclosure contains all of the circuitry required for the 3 - channel V/UHF Radio DMW Type ATR-3, including the mains power supply and automatic battery take-over and charging circuitry. However, for a fully operational system, associated equipment, not forming part of the Radio, is required.

9 Table 1 provides details of the associated items.

TABLE 1 ASSOCIATED EQUIPMENT

ITEM NO.	DESCRIPTION
1	V/UHF Antennae system complete with coaxial feeder cable.
2	Microphone with p-to-t button.
3	24 Volt Lead acid battery with leads.
4	Earphones (optional).
5	12 to 24 Volt DC to DC converter unit (optional).

10 Depending upon particular applications of the equipment, an overall enclosure may be used. This permits the Radio to be a free standing installation not constrained to rack mounting. Each Radio is supplied with such an enclosure.

11 As an optional extra up to three Radios may be fitted in a single '6U' (21 inch) high enclosure as a free standing, multiple, and co-located installation. Alternatively, up to three Radios may be fitted to standard 19 inch racks to form the multiple installation.

EQUIPMENT DESCRIPTION

CONSTRUCTION

12 The 3 Channel V/UHF Radio DMW Type ATR-3 is formed round a welded steel chassis, plated and passivated to protect against corrosion. The chassis is designed for mounting in a standard nineteen inch rack or in a free standing enclosure.

13 Top and bottom steel access panels are fitted and, when removed, provide for easy access to all internal areas. A rear panel, engraved or silk screened, is fitted into the recessed(and therefore protected) rear of the chassis and this contains most of the input and output connectors, together with mains and battery fuses.

14 An aluminium front panel is fitted, on which is mounted the operating controls, indicators, loudspeaker and microphone/telephone jack sockets. Two handles are also fitted, one on each side of the front panel. Figs. 1 and 2 show the Front and Rear panel layouts respectively.

Mechanical Details

15 At the rear of the chassis is fitted the power supply circuitry and battery take-over/charging circuitry. These are hard wired and form an integral part of the Chassis sub-assembly.

16 Most of the internal space is taken up by six, readily removable, modules or sub-assemblies. These are printed circuit boards fitted within aluminium enclosures which are screwed to internal chassis members. Connections between modules are via plugs/sockets thereby making for easy replacement.

17 The front and rear panels are painted black and have white markings for maximum contrast. The remainder of the chassis is not painted and exhibits the plated and passivated metallic finish.

Electrical Details

18 The Radio basically comprises a receiver section, which is largely common to both the VHF and UHF bands, two transmitter sections, (one for VHF operation and one for UHF operation), an audio/control section, and a power supply section.

19 A single, crystal controlled reference frequency is used to control all the operating frequencies and thus provide good accuracy and stability via a number of synthesisers.

20 Power supplies are normally derived from standard 240 volt 50 Hz, but provision is also made for operation from an external 24 volt dc source. The external dc source is automatically selected when the mains fails or is disconnected, and is therefore a 'stand-by' or 'back-up' power supply able to offer uninterrupted operation.

21 Operation on amplitude modulation (am) is provided on both VHF and UHF bands. Frequency modulation (fm) is only available on the UHF band.

22 3 channels are available for selection by the operator, via a front panel switch. However, because the equipment is fully synthesised, it is possible to pre-set the 3 channels to any frequency in the band selected. This facility is not directly available to the operator because it requires the changing of firmware within the equipment.

23 Received audio is available on an internal loudspeaker (which may be switched off), headphones or by rear panel 600 ohm line connection. Transmitter sidetone is available only on headphones or line connection.

24 The receiver section is a triple conversion circuit shared by VHF and UHF bands, with a switchable, front end, filter to discriminate between the bands. The transmitter sections have drivers and power amplifiers for each band and are modulated from either am or fm circuits, depending on operator switch selection.

OPERATION INSTRUCTIONS

INSTALLATION

25 Installation of the equipment is straightforward and requires only the supply of appropriate power sources and interfacing with the associated equipment listed in Table 1.

26 The procedures outlined in Table 2 provide the necessary information.

TABLE 2 INSTALLATION PROCEDURES

ITEM NO.	EQUIPMENT	OPERATION
1	ATR-3	(i) Remove from transit packaging. (ii) Visually inspect for signs of damage. (iii) Ensure fitted with firmware (EPROM) giving the frequencies required. (iv) If necessary, fit channel frequency card.

(continued)

TABLE 2 INSTALLATION PROCEDURES (continued)

ITEM NO.	EQUIPMENT	OPERATION
	ATR-3 (cont'd)	(v) Locate & secure in position required. (vi) Connect mains lead to 240V 50 Hz supply.
2	Antenna	Connect to rear panel
3	Battery (if fitted)	Connect to rear panel
4	Line Connector	Connect to rear panel
5	Microphone	Connect to front panel
6	Earphones, (if required)	Connect to front panel
7	External Signal Present Circuit (if fitted)	Connect to rear panel terminals
8	ATR-3	(i) Switch on & ensure MAINS indicator illuminates. (ii) Select required channel. (iii)Select am or fm as required. (iv) Using DIM control set lamp intensity as required.
9	System/ATR-3	(i) Carry out a full functional test & set SQUELCH & MONITOR LEVEL controls to optimum positions. Ensure FAULT Indicator is extinguished at all times. (ii) Using a screwdriver, adjust the rear panel pre-set LINE O/P control to desired level for the particular installation. (iii)Switch off or disconnect mains supply at the mains socket &, where battery is fitted, ensure MAINS indicator extinguishes, BATTERY indicator illuminates & system operates correctly from battery supply.

(continued)

TABLE 2 INSTALLATION PROCEDURES (continued)

ITEM NO.	EQUIPMENT	OPERATION
	System/ATR-3 (cont'd)	(iv) Switch on mains supply & ensure BATTERY indicator extinguishes & MAINS indicator illuminates. (v) Where SIGNAL PRESENT external circuitry is fitted ensure this operates whenever the squelch is broken. (vi) Set controls for frequency & mode (am/fm) operationally required.

Notes:

(1) Where equipment is to be used with the Enclosure Type ATR-37, it is important that the equipment lids be removed before being fitted to the enclosure. This helps prevent potential overheating problems.

(2) Where used in tropical environments or adjacent to heat sources, cooling by air convection (fans) is required.

27 Successful completion of the installation procedures indicates the equipment is available for operational use.

OPERATION

28 Table 3 contains the procedures necessary for operating the installed equipment.

TABLE 3 OPERATING PROCEDURES

ITEM NO.	EQUIPMENT	OPERATION
1	Preliminaries ATR-3	
	(a) POWER switch	Switch on & ensure switch MAINS indicator illuminates.
	(b) FM/AM switch	Select AM or FM as required.
	(c) FREQ SELECT switch	Select CH1, CH2 or CH3 as necessary.
	(d) DIM control	Set for optimum intensity.
	(e) SPEAKER ON/OFF switch	Set to ON

(continued)

TABLE 3 OPERATING PROCEDURES (continued)

ITEM NO.	EQUIPMENT	OPERATION
2	Microphone	Ensure plugged into ATR-3.
3	Earphones	Ensure plugged into ATR-3 (if required).
4	Reception (Local) ATR-3	
	(a) SQUELCH control	)During normal receiving,
	(b) MONITOR LEVEL Control.	)set to optimum levels)to suit particular operator
5	Reception (Remote) ATR-3	
	(a) SPEAKER switch	Set to OFF
	(b) MIC	Disconnect.
	(c) MONITOR PHONES	Disconnect (if fitted).
		Note On remote operation audio is taken from the rear panel to the required location.
6	Transmission (Local) ATR-3	
	(a) MIC	Operate button on the microphone to transmit.
7	Transmission (Remote) ATR-3	
	(a) Rear Panel	Operate remote p-to-t connected via LINE I/P & O/P.
8	Mains Failure ATR-3	In the event of mains failure the equipment will automatically switch to an external battery, (if fitted), & this condition is indicated by illumination of the 'BATTERY indicator'. Reversion to mains power is also automatic.
9	Channel Change ATR-3	
	(a) FREQ SELECT switch	Set to required channel.

(continued)

TABLE 3 OPERATING PROCEDURES (continued)

ITEM NO.	EQUIPMENT	OPERATION
10	Mode Change ATR-3 (a) FM/AM switch	Select required mode. (Note FM available on UHF band only).
11	Switching off ATR-3 (a) POWER switch	Set to OFF
12	Fault Conditions ATR-3 (a) FAULT indicator	This indicator will remain extinguished during normal operation. If the indicator illuminates, one of the following causes can be assumed: (i) One or more synthesisers out of lock. (ii) Low or no Transmitter output power. (iii) Incorrect selection of am/fm mode. i.e. fm selected with VHF frequency (channel). (iv) Incompatible firmware fitted

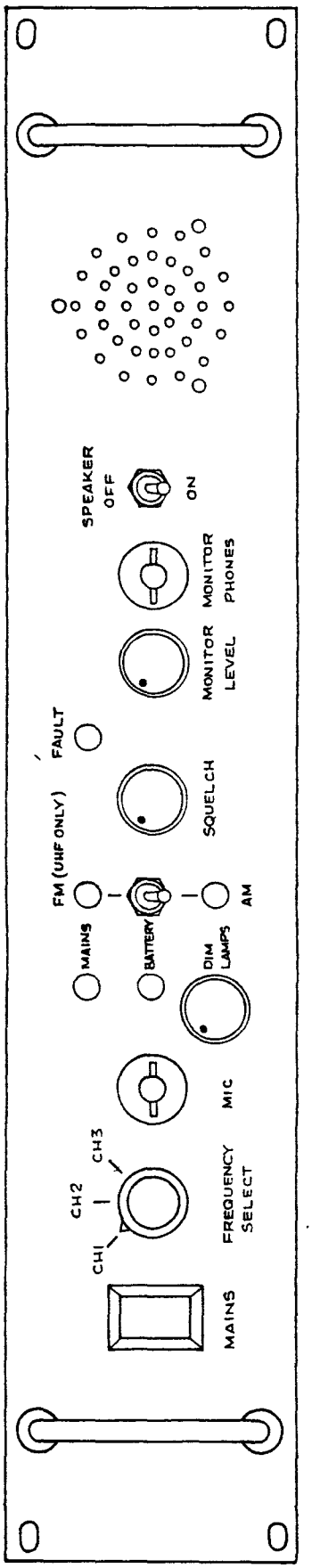


Fig. 1 Front Panel Layout

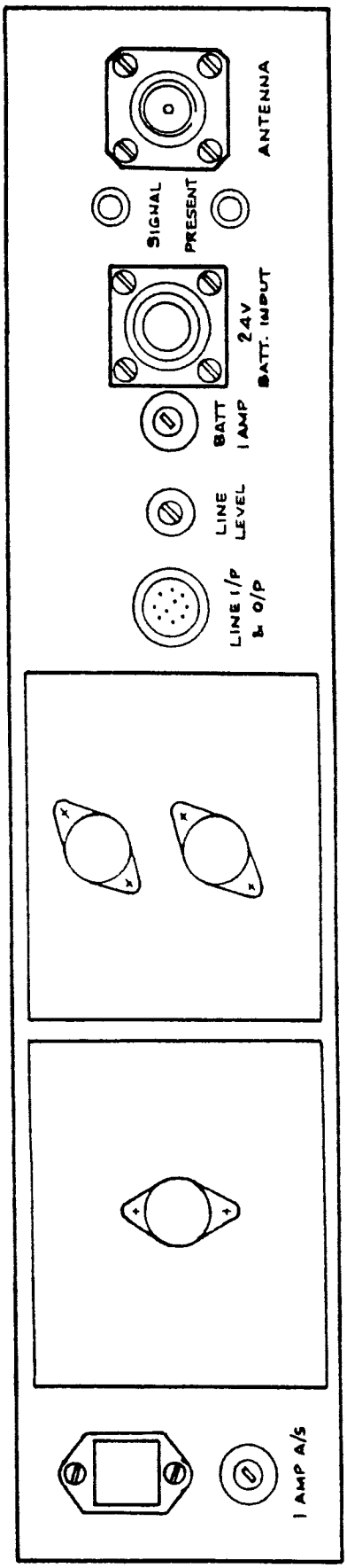


Fig.2 Rear Panel Layout

Chapter 2

TECHNICAL INFORMATION

CONTENTS

INTRODUCTION

TECHNICAL DETAIL

1 The purpose of this chapter is to provide sufficient technical details to allow the reader to obtain a full understanding of the equipment in the widest sense.

2 Included at the end of the chapter are a number of drawings or illustrations which will prove most beneficial if studied in conjunction with the associated descriptive text.

FUNCTIONAL OUTLINE

BLOCK DIAGRAM

3 Fig. 1 shows a functional block diagram of the 3 Channel V/UHF Radio Type ATR-3. In the diagram, sub-assemblies or modules are shown bounded by dotted lines and each is allocated a specific type number. Table 1 lists the sub-assemblies/modules fitted and provides details of the type and description of each.

TABLE 1 SUB-ASSEMBLIES

ITEM NO.	DESCRIPTION	TYPE
1	Receiver Module	ATR-30
2	Receiver Local Oscillator Module	ATR-43
3	Audio and Control Module	ATR-32
4	Transmitter Driver Module	ATR-33
5	VHF Power Amplifier Module	ATR-34
6	Chassis Assembly (including Power Supply and Reference Oscillator)	ATR-36
7	UHF Power Amplifier Module	ATR-38
8	Free Standing Enclosure	ATR-37
9	Cable Asssembly (Mains)	ATR-39

4 A common Receiver/Transmitter antenna is applied to a coaxial change over relay which is essentially controlled by the "press-to-transmit" switch fitted to a microphone. When on "Receive", the antenna is connected to the Receiver Module Type ATR-30 via a 1.9 GHz to 2.2 GHz bandstop filter for image rejection purposes.

5 The Receiver Module ATR-30 contains all the circuitry required for the reception of VHF and UHF voice modulated signals except the local oscillators, reference oscillator and audio circuits.

6 A triple conversion receiver technique is used in which the three intermediate frequencies (IF's) are:-

6.1. 892.7 MHz

6.2. 157.3 MHz

6.3. 10.7 MHz

7 To protect against swamping the receiver, a DIODE LIMITER is fitted, prior to which the incoming signal is directed to one of two bandpass filters. When "VHF" is used a 116 to 137 MHz bandpass filter is in circuit. When UHF operation is required the bandpass filter used is 220 to 400 MHz.

8 The bandpass filters are followed by an a.g.c. controlled, passive attenuator, which then feeds a mixer.

9 The second input to the mixer is from the first local oscillator via a 1.0 to 1.3 GHz bandpass filter. The first local oscillator operates on one of three frequencies as determined by the front panel channel selection switch. A fully synthesised circuit is employed and the basic accuracy is established from a 5.25 MHz Crystal controlled frequency reference.

10 When operating at VHF, the first local oscillator will generate frequencies in the band 1009.7 to 1029.7 MHz and on UHF the generated band is 1117.7 to 1292.7 MHz.

11 The first IF is 892.7 MHz and two stages of amplification are provided at this frequency. The amplifier stages sandwich a two-cavity Helical bandpass filter centred on the IF.

12 Following first IF amplification, a second mixer stage is fitted, this accepts a fixed 1050 MHz frequency from the second local oscillator to produce the second IF of 157.3 MHz. The second local oscillator is a fixed frequency synthesiser deriving its accuracy from the 5.25 MHz crystal controlled reference frequency.

13 A three-cavity helical bandpass filter centred on 157.3 MHz provides additional selection, and further amplification offers gain to compensate for the filter insertion loss and isolates the filter from the third mixer.

14 The third mixer has a fixed frequency of 168 MHz applied from the third local oscillator and the difference frequency between this and the 157.3 MHz second IF is selected to be the final IF of 10.7 MHz. Again the local oscillator is formed by a synthesiser driven from the 5.25 MHz crystal derived reference frequency.

15 10.7 MHz from the third mixer is matched into an eight-pole crystal bandpass filter centred on 10.7 MHz and with a 20 KHz pass band. This provides much of the selectivity performance inherent in the receiver.

16 Some 70 dB of Automatic Gain Controlled (AGC) amplification is provided at the final IF which is further filtered to reduce noise, then applied simultaneously to a FM discriminator and an AM detector.

17 The appropriate demodulation circuit output is selected by the front panel AM/FM switch and applied via a "squelch" circuit, which is adjustable by the operator, to an audio amplifier stage. The "squelch" circuit also provides a "Signal Present" output for use externally.

18 Demodulated voice signals are taken from the Receiver Module ATR-30 to the Audio and Control Module ATR-32 for further processing.

19 Receiver Local Oscillator Module Type ATR-43 contains the three synthesisers forming the local oscillators. These provide the appropriate frequencies as already described and all are derived from the 5.25 MHz reference circuit contained in the Reference Oscillator Module Type ATR-42.

20 The Audio and Control Module Type ATR-32 accepts the demodulated audio from the Receiver Module Type ATR-30 and applies this to three amplifiers simultaneously. One amplifier is used to drive a pair of earphones which may be plugged into the front panel.

21 A second audio amplifier drives an integral loudspeaker whilst the third provides for a balanced 600 ohm line output for use externally. During periods of transmission, a small portion of energy is picked off the power amplifier output, rectified, and used as a dc control line to inhibit the loudspeaker output and enable line and earphone outputs. At the same time audio from the microphone amplifier circuit is switched through to the line output and earphone amplifiers as sidetone.

22 The modulator amplifiers may be fed by a microphone connected to the front panel, or an externally provided audio, via a 600 ohm balanced line input connector on the rear panel.

23 Audio from the microphone amplifiers is switched by the AM/FM switch to one of two circuits. On AM operation a modulation amplifier stage is driven by the audio signal and used to amplitule modulate either the VHF or UHF power amplifier stages.

24 On FM operation the audio output from the microphone amplifier is used to frequency modulate a synthesiser in the Transmitter Drive Module Type ATR-33.

25 The Transmitter Drive Module Type ATR-33 contains a synthesiser circuit comprising voltage controlled oscillators enabling two bands of modulated frequencies to be generated. On VHF operation frequencies in the range 117 to 137 MHz are created, whilst on UHF operation the generated frequencies are in the band 225 to 400 MHz. Actual frequency selection being achieved via the front panel channel switch.

26 Outputs from the synthesiser circuit are applied to the appropriate power amplifiers in the VHF and UHF Power Amplifier Modules Type ATR-34 and ATR-38, after amplification in each case.

27 The UHF Power Amplifier Module Type ATR-38 consists of two cascaded stages of amplification producing a nominal 7 watts AM or FM modulated as determined by the front panel switch. The output of the final amplifier is applied via a harmonic reduction, 410 MHz, low pass filter to a co-axial switch and thence to a coupler circuit fitted on the VHF Power Amplifier Module Type ATR-34.

28 When on VHF operation, the VHF Power Amplifier Module Type ATR-34 provides two cascaded gain stages also producing a nominal 7 watts and these are followed by a 140 MHz, low pass, filter designed to reduce harmonic content.

29 The output from the coupler is taken, via the Transmit/Receive relay, to the antenna system. As previously described, a proportion of the r.f. is rectified in the VHF Power Amplifier Module Type ATR-34 and used as a sidetone enable control line.

30 The circuitry described thus far, is contained in readily removable Modules. The remaining circuitry is hardwired into the main chassis and comprises mainly the Power Supply, input and output connections to the rear panel, front panel controls and indicators, and miscellaneous items. The chassis sub-assembly is identified as Chassis Sub-assembly Type ATR-36.

31 Primary power is from the standard 240 volt 50 Hz domestic mains supply. This is transformed, rectified and made available as a nominal +32 volts dc from the mains power supply (Mains PSU).

32 A voltage regulator, fitted to the rear panel of the equipment controls a nominal 27 volts output which is used for two purposes. These are:-

32.1. As an input to a second regulator, also rear panel mounted, providing a regulated 18 volt output which is the main dc supply to the equipment.

32.2. To float charge an external 24 volt lead acid battery when the mains supply is available.

33 The main 18 volt dc supply to the equipment is, in turn, also used as an input to a third rear panel mounted regulator to provide a +12 volt dc supply used by most modules. A further dc supply of +5 volts is used in some modules and, where used, on-board five volt regulators control the output from the +12 volts input.

34 In the event of mains supply failure, changeover circuitry is included in the Power Supply and Chassis Sub-assembly Type ATR-36 to automatically allow the equipment to operate from the external 24 volt battery system.

Conversely, when a failed or disconnected mains supply is restored to the unit, the primary power source is automatically reverted to and the external battery resumes its float charging, standby role.

MAIN EQUIPMENT CHARACTERISTICS

GENERAL

35 The 3 Channel VHF/UHF Radio Type ATR-3 provides a means of two way speech communication between fixed or mobile ground based installations and aircraft. Table 2 lists the main equipment general characteristics.

TABLE 2 GENERAL EQUIPMENT CHARACTERISTICS

PARAMETER	CHARACTERISTIC
Size	19x14x3.5 inches (48.3x26.6x6.7 cm)
Weight	26 lbs (12 Kg)
Power Supply	Primary: 240 volts 50 Hz domestic mains. Secondary: 24 volt lead acid battery.
Frequency of operation	VHF : 117 to 137 MHz. UHF : 225 to 400 MHz.
No. of channels	Three : operator selectable.
Storage Temperature	-20 °C to +60 °C.
Operating "	(a) 0 °C to +35 °C for 5 watt output. (b) -10 °C to +50 °C for 1 watt output.
Air Transport-ability	Withstands 752 millibar pressures continuously.
Humidity	0 to 80 % Relative Humidity (Non-condensing).
Modes of operation	VHF : Amplitude modulation only. UHF : Amplitude or Frequency modulation.
Output Power	Nominal 5 watts

36 More detailed characteristics for the various elements which make-up the equipment are provided in successive paragraphs.

Transmitter - Amplitude Modulation

37 Table 3 provides details of the transmitter characteristics when operating in the Amplitude Modulation mode:

TABLE 3 TRANSMITTER CHARACTERISTICS AM MODE

PARAMETER	CHARACTERISTIC
Frequency Stability	Better than ± 4 ppm
Output Power	5 watts
Duty Cycle	Continuous
Modulation Frequency Response	Within ± 2 dB of the level at 1 kHz over the range 0.3 to 3 kHz.
Modulation Distortion	Less than 15%
Sidetone Level	6 dB below audio level with standard input.
Modulation Depth	Nominally 80 %

Transmitter - Frequency Modulation

38 Table 4 provides details of the transmitter characteristics when operating in the Frequency Modulation mode:-

TABLE 4 TRANSMITTER CHARACTERISTICS FM MODE

PARAMETER	CHARACTERISTIC
Frequency Stability	VHF : Better than ± 500 Hz UHF : Better than ± 1600 Hz
Output Power	5 watts
Duty Cycle	Continuous, at 20°C,for up to 10 mins.
FM Deviation	Presettable between ± 3 kHz & ±8 kHz
FM Modulation	Peak deviation of 5.5 kHz ± 1 kHz
Sidetone Level	6 dB below audio level with standard input.

39 A "standard input" indicates an input at the selected channel frequency applied to the antenna connector with a level of 1 millivolt emf from a 50 ohm source. In the AM mode, the input signal shall be modulated to a depth of 30 % by a 1 kHz sinewave. For F.M. operation, the input signal is to contain no amplitude modulation but shall be deviated at 1 kHz to a peak deviation of ± 2.5 kHz.

Receiver - Amplitude Modulation

40 Table 5 provides details of the receiver characteristics when operating in the Amplitude Modulation mode:

TABLE 5 RECEIVER CHARACTERISTICS AM MODE

PARAMETER	CHARACTERISTIC
Frequency stability	Better than ± 4 ppm
Receiver Sensitivity	5 microvolt emf signal amplitude modulated at 80 % by 1kHz sinewave produces at least a 10 dB signal-to noise ratio.
IF Selectivity	3 dB Bandwidth : 15 kHz 70 dB Bandwidth : 50 kHz
IF Rejection	Better than 55 dB
AM Adjacent channel Rejection.	Exceeds 55 dB
Audio Output Level	Greater than 15 mW into 600 ohms. (with Standard Input)

Receiver - Frequency Modulation

41 Table 6 provides details of the receiver characteristics when operating in the Frequency Modulation mode:

TABLE 6 RECEIVER CHARACTERISTICS FM MODE

PARAMETER	CHARACTERISTIC
Frequency Stability	VHF : Better than ± 500 Hz UHF : Better than ± 1600 Hz
Receiver sensitivity	2 microvolt emf signal frequency modulated at 1 kHz with peak deviation of 3 kHz produces 12 dB SINAD.

(continued)

TABLE 6 RECEIVER CHARACTERISTICS FM MODE (continued)

PARAMETER	CHARACTERISTIC
FM Adjacent Channel Rejection	Greater than 50 dB for reduction to 6 dB of S + n/n ratio.
Audio Output Level	Greater than 15 mW into 600 ohms. (with Standard Input)

Frequencies/Channels

42 Three operator selectable channels are provided, the required channel being selected via a rotary panel switch. The channels may be any combination of VHF/UHF frequencies within the specified bands, provided they are an integer of 25 kHz.

43 The choice of frequencies available for selection at the front panel switch is set by firmware. EPROMS are pre-programmed to the users choice and re-allocation of the three channel frequencies can be achieved by replacement, or reprogramming, of the EPROMS.

44 Included in the EPROM programming is data which will automatically set the circuitry for operation at VHF or UHF, depending on the frequency selected. This obviates the need for an operator control to select VHF or UHF operation.

CONTROLS INDICATORS & EXTERNAL CONNECTIONS

FRONT PANEL CONTROLS

45 Local operation of the 3 channel V/UHF Radio Type ATR-3 is achieved via a number of front panel controls. These are listed in Table 7 together with a description of the function of each.

TABLE 7 FRONT PANEL CONTROLS

CONTROL	FUNCTION
POWER switch	Push button switch used to apply or remove power to the equipment whether mains or battery.
FREQ SELECT switch	3 position rotary switch used to select 1 of 3 available channels of operation
DIM LAMPS control	Potentiometer used to set the intensity of illumination of front panel indicators.

(continued)

TABLE 7 FRONT PANEL CONTROLS (continued)

CONTROL	FUNCTION
FM/AM switch	2 position toggle switch used to select AM or FM mode of operation. Note FM mode is available on UHF frequencies only.
SQUELCH control	Potentiometer used to set the squelch threshold level.
MONITOR LEVEL control	Potentiometer used to set the volume of audio signal in earphones or loudspeaker.
SPEAKER ON/OFF control	2 position toggle switch used to switch the loudspeaker in or out of circuit.

Front Panel Indicators

46 Five indicators are fitted to the front panel. Table 8 lists these and provides a description of the purpose of each.

TABLE 8 FRONT PANEL INDICATORS

INDICATOR	FUNCTION
MAINS LED	Red LED used to indicate that the equipment is operating from domestic mains supplies.
BATTERY LED	Red LED used to indicate that the equipment is operating from an external 24 volt battery.
FM (UHF ONLY) LED	Red LED used to indicate that equipment is operating in Frequency Modulation mode.
AM LED	Red LED used to indicate that equipment is operating in Amplitude Modulation mode.
FAULT LED	Red LED used to indicate a fault condition caused by one or more of the following conditions:- (continued)

TABLE 8 FRONT PANEL INDICATORS (continued)

INDICATOR	FUNCTION
FAULT LED (cont'd)	(a) LOW or no transmitter r.f. power. (b) Any of the four internal synthesisers out-of-lock for any reason. (c) In the event the two EPROMS fitted (one for Receiver, one for Transmitter), are not compatible in terms of VHF/UHF operation (i.e. if Rx EPROM is set for VHF & Tx EPROM is set for UHF or vice versa.)

Front Panel Connectors

47 Two connectors are fitted to the front panel. These permit connection of the earphones and microphone to the equipment.

48 The microphone recommended for use with the equipment includes a "press-to-transmit" button and the connector makes provision for this "p-to-t" circuit, the wiring being compatible with standard NATO microphone requirements.

REAR PANEL CONTROLS

49 Only one rear panel mounted control is fitted. This is a presettable potentiometer used to adjust the audio output level on the line output connector. The control offers the possibility of 0 dBm to -20 dBm levels when measured with a 600 ohm load.

Rear Panel Connectors

50 Table 9 lists the rear panel connectors and describes the function of each.

TABLE 9 REAR PANEL CONNECTORS

CONNECTOR	FUNCTION
MAINS INPUT	3 pin quick release IEC type used to connect domestic mains supply at 240 V 50 Hz to the equipment.
BATTERY INPUT	2 pin circular quick release type used to connect external 24 volt lead acid battery.

(continued)

TABLE 9 REAR PANEL CONNECTORS (continued)

CONNECTOR	FUNCTION
ANTENNA	'N' type 50 ohm used to connect equipment to the antenna.
LINE I/P & O/P	Multipin circular miniature quick release type used to connect line input and line outputs to external equipment.
SIGNAL PRESENT INDICATOR CONNECTOR	Two terminals used to indicate the presence of a signal. With squelch lifted (i.e. signal present) the two terminals are short circuited by a relay contact within the equipment.

MECHANICAL CONSTRUCTION

MATERIALS USED

51 The 3 Channel V/UHF Radio Type ATR-3 is constructed mainly from sheet steel and sheet aluminium. Steel is used to form a welded chassis onto which are secured a top and bottom lid. The resulting box-like structure is a strong, rigid frame into which the various internal assemblies may be fitted.

52 A three millimeter thick aluminium plate forms the front panel and this is used to mount the operators controls, indicators and some connectors. Two pre-formed handles, capable of taking the overall unit weight, are secured through the front panel and front face of the steel chassis.

53 Internally, a number of fabricated steel brackets and trays are fitted. Onto these are mounted six modules and a number of power supply components.

54 The six modules are formed by aluminium enclosures into which electronic printed circuit boards are fitted.

ASSEMBLY & FITTING

55 Each enclosure has connectors secured to the walls to provide for electrical connection between the printed circuit board and the remainder of the unit.

56 The modules are attached to the chassis by screws which secure the modules to two solid, tapped, bars which are in turn held in position by steel brackets.

57 Removal of the modules is readily accomplished by releasing the electrical plug/socket connections, and removing the screws securing each module. All remaining components form part of the power supply and chassis assembly.

58 When used in rack mounted applications the top and bottom lids provide increased rigidity and also serve as dust covers. However, where the rack also contains excessive heat sources, it is permissible to remove the lids to increase air circulation around the modules and thereby help cooling by convection. In extreme cases forced air cooling by provision of a fan within the confines of the rack should be considered.

59 If mounted in the supplied free standing enclosure, the top and bottom lids may be fitted or omitted as desired.

DETAILED ELECTRICAL DESCRIPTION

INTRODUCTION

60 The following paragraphs provide a detailed electrical description of each area of the equipment. All definable modules are described separately, followed by details of interconnections between modules and chassis and finally power supply arrangements.

61 Mechanical layout and circuit diagrams for each module are located at the end of this chapter.

Receiver Module Type ATR-30

62 The Receiver Module Type ATR-30 is an aluminium enclosure into which is fitted three printed circuit board sub-modules containing all the circuits necessary for the reception of VHF & UHF voice transmissions. Figure 2 shows the outline detail of the module which includes coaxial and multiway connectors for interfacing.

63 Figures 3 and 4 show the layout for the two sides of the Filter Board, which contains two switchable filter circuits, and a 157.3 MHz trap circuit.

64 Figure 5 shows the circuit diagram of the Filter Board.

65 During receiving operation the RF input signals are selected to one of two bandpass filters by Relay RL2. The relay operates through TR1 & TR2 which effectively grounds the energising coil when UHF mode is selected, the Rx VHF/UHF control line going low. D2 provides transient suppression and helps speed relay operation.

66 The components C6, L4, C8, C9, L6, C11, C14, C13, L8, C17, L10, C20, and C21 form a 116-137 MHz bandpass filter offering minimum rejection for the VHF signals, whilst attenuating out of band signals.

67 A UHF bandpass filter providing a pass characteristic for frequencies between 220 and 400MHz is formed by the components C5, L3, C7, L5, C10, L7, C12, C16, C15, L9, C18, C19, L11, C23 and C22. The appropriate filter output is selected, by relay RL3 which is operated, simultaneously with RL2, by TR1, via the link AB at P5 & P6. D3 provides transient suppression for RL3, the output from which is applied to the Mixer Board.

68 The Mixer Board Layout is shown on Figures 6 and 7. The board circuit diagram is shown at Figure 8. The output from RL3 is applied to a diode attenuator circuit formed by the components surrounding D1-D3. This is an AGC controlled pin diode attenuator arrangement, using IC1A and its associated components to set the level of attenuation relative to received signal strength. T2 is an 892 MHz trap implemented by using a quarter wavelength of coaxial cable. This enhances the IF rejection performance.

69 C3 couples the incoming signal to mixer M1. The second input to the mixer being from the first local oscillator, passing via amplifier IC6 and an attenuator R16,R17 and R18. These components ensure a good 50 ohm termination for the first L.O. Bandpass filter. The frequency applied will be in the band 1009.7 to 1029.7 MHz when VHF is selected and 1117.7 to 1297.7 MHz when UHF is selected.

70 A first IF of 892.7 MHz is selected, after amplification in IC2, by FL1 which is a two cavity helical bandpass filter. A quarter wave coaxial trap, T1, cut to 1050 MHz, improves rejection of spurious signals. Further amplification is provided by IC3, the output of this being applied to a second mixer M2. The inductors and capacitors surrounding the first and second IF circuit offer decoupling.

71 A fixed frequency of 1050 MHz, derived from the Oscillator module, is used as the second local oscillator frequency and the second IF of 157.3 MHz is amplified by IC4, selected by a three cavity helical bandpass filter FL2, and further amplified by IC5. The third mixer, M3, operates on the 157.3 MHz and the third local oscillator frequency of 168 MHz, to provide a final IF of 10.7 MHz. This is applied to the IF Demodulator Module.

72 The IF Demodulator Board layout is shown on Figures 9 and 10, whilst the circuit diagram is Figure 11. 10.7 MHz IF is applied to TR8 via P8, TR8 and its associated components amplify and match the 10.7 MHz to a bandpass filter. FL2 is an eight pole crystal filter centred on 10.7 MHz and providing the main selectivity for the receiver. Two stages of AGC controlled amplification are provided by IC6 and IC7.

73 Amplifier TR7 matches the output of IC6 to a further bandpass filter FL1 and this is succeeded by an emitter follower TR5, the output of which is applied simultaneously to a.m. detector and f.m. discriminator circuits. IC6 and IC7 require only a 6 volt supply rail and this is provided by R33 and Zener diode D2.

74 IC4 is an a.m detector and AGC amplifier circuit. The detected audio from IC4 is capacitively coupled via C18 to IC2A. A frequency modulation discriminator circuit is provided by IC3, T1, and associated components. The audio output from the discriminator is applied as a second input to IC2A via amplifier IC1B.

75 IC2 is a dual analogue switch the first section of which (IC2A) selects either the a.m. derived audio from IC4 or the f.m. derived audio from IC1B. The selection is accomplished by the AM/$\overline{FM}$ control line. With this line high the a.m. derived audio is selected. The selected audio is applied to the second section of IC2 (IC2B).

76 IC2B allows no signals through to the amplifier IC1A unless a pre-determined signal level is available. The level is set by IC5B which also forms part of the squelch control circuit.

77 A signal level O/P from IC3 is applied as one input to IC5B, the other being a dc level set by the squelch control located on the front panel. When the signal level is sufficient to overcome the set squelch level, IC5B output will switch IC2B on to allow the audio through. At the same time IC5B output will turn on TR6, energising RL1 to close the "Signal Present" contacts supplied for external equipment use. Switch SW1 is fitted to disable the Squelch during receiver testing, when the switch is pulled to the "up" position.

78 Audio signals from IC2B are amplified by IC1A, the level being set by R4, and capacitively coupled via C2 to the Audio and Control module. Components on the board annotated AOT (Adjust on Test) are normally factory set and require no further change. VR1 & VR2 are voltage regulators. These devices accept +18 volts dc and provide identical +12 volt dc outputs, which are designated +12VA and +12VB. The two voltages are used as the dc supply for all areas of the Filter, Mixer and IF Demodulator Boards.

79 Figure 12 shows the interconnections between the three sub-modules which go to make up the Receiver Module Type ATR-30.

Audio & Control Module Type ATR-32

80 The Audio and Control Module Type ATR-32 is an aluminium enclosure, with multiway quick release connectors, into which is fitted a single printed circuit board. Figure 13 shows an outline of the module.

81 As the name implies the circuits included in the module are concerned with audio frequencies, both incoming and outgoing, and with the generation of control logic used throughout the equipment.

82 Figures 14 and 15 depict the layout of each side of the printed circuit board which has components mounted on either side. Figure 16 is the circuit diagram for the board.

83 Two voltage regulators are fitted to the board. VR1 accepts +18 volts dc and regulates this down to +9 volts dc for use throughout the circuit. VR2 also has +18 volts as an input and the output, set by R14, is used with the line input transformer, T1, to provide a dc control line for keying purposes.

84 Received audio is connected, from the Receiver Module, to IC14A. This, together with IC14B, form an active filter used to roll off the higher audio frequencies and thereby improve the audio response and overall quality. The output from the filter circuit is applied to IC3A.

This is one section of an analogue switch used to select received audio or microphone/line input audio through to amplifiers. When receiving, IC3A passes the audio from the Receiver Module through to IC9, via C21 and a front panel mounted volume control. IC9 provides gain, set by R55, and is used to drive the loudspeaker. The same audio is amplified by IC10 and made available to the front panel mounted headphone connector.

85 In addition to providing drive to the loudspeaker and headphones, the output from IC3A is applied to the second section of the analogue switch IC3B. This will switch the audio through to the line output driver IC1C given no fault conditions. The gain of IC1C is set by a rear panel mounted pre-set level control. Line isolation is provided by T2.

86 In the transmit condition a high logic level is applied from the MIC Tx switch (PTT) through switch SW1B to IC3A and IC9. This disconnects the received audio and inhibits the loudspeaker output. Note: Switch SW1 selects whether local or remote operation is to be used. SW1A selects remote and SW1B local operation.

87 Microphone signals, applied via L1 and C4 are amplified by IC1A, the gain of which is set by R13, and directed to IC1B for further amplification. Also applied as an input to IC1B is the line input signal from T1 when using remote control.

88 The output of IC1B is applied to IC2 which is a VOGAD offering a 50 dB dynamic range. Further gain is provided by the three sections of IC5 (IC5 A, B and C). The output from IC5C is simultaneously applied to IC3A and IC3C. On transmit, the microphone signals are selected through as sidetone to the headphones and line output, provided no fault condition exists.

89 IC3C is the third section of the analogue switch and is used to select the microphone or line input to the chassis mounted modulation transformer via IC20 if on a.m. mode, or directly to the Transmitter Drive Module as the frequency modulating signal applied to a synthesiser. The gain of IC20, and hence amplitude modulation depth is set by R65 on VHF and by R87 on UHF. The appropriate adjusting resistor being selected by IC15A, an analogue switch, operating from the Tx VHF/$\overline{\text{UHF}}$ logic.

90 A number of fault circuits exist and these are designed to prevent operation or alert the operator in the event certain pre-conditions are not satisfied.

91 TR4 is used to drive an error or "fault" LED which is front panel mounted. This LED is illuminated if any of the fault conditions listed in Table 10 exist.

TABLE 10 - FAULT CONDITION DATA

CONDITION	CIRCUIT
1. Any of the three receiver synthesisers fall out of lock (Logic 1 = High on TR11 gate input. Logic 0 = LOW on TR9 & TR10 gate inputs).	IC7A, IC7B, IC7C, IC7D, & IC12A, TR9, TR10, TR11.
2. Transmitter synthesiser falls out of lock (Logic 1 = high on TR8 gate).	TR8, IC7A-D, and IC12A.
3. If receiver and transmitter synthesiser VHF/UHF programming flags are incompatible.	IC8B, IC12A, IC13, TR12, TR13
4. If transmitter power output falls below pre-set level.	IC8A, IC7D, IC12A

92 Should an error condition exist, and the fault LED be illuminated, IC3B prevents audio/sidetone being applied to the line output.

93 The circuit formed by IC6A, B, C and IC8D controls the switching on of the VHF and UHF power amplifiers, (PA's), when the press-to-transmit is operated, (either locally or via the line input), a logic 1 (high) is present at IC6A pin 2. This switches on TR1 to put the T/R relay on the chassis mounted filter module to the "transmit" position. Simultaneously the "high" is applied to IC8A pin 1 to enable the low power fault detect circuit. If sufficient power is available, a 'high' is also available at IC8A pin 2. IC8A then has a 'low' on pin 3 which holds off the FAULT LED if no other fault condition exists.

94 Provided the transmitter synthesiser is in lock, IC6A pin 3 is 'high' and this enables both IC6B and IC6C. IC6C will then switch the UHF PA on via IC8D, if the transmitter synthesiser VHF/UHF flag is set for UHF operation. In this state the VHF PA on is inhibited by the low on IC6B pin 6. The VHF PA is switched on via IC6D IC6B and IC12B, provided the transmitter synthesiser VHF/UHF flag is set for VHF operation (TR13 gate is high).

95 Front panel mounted 'AM' and 'FM' LED indicators are operated as follows. With 'AM' selected on the front panel switch, IC12B pin 5 is 'high' switching on TR7 and the 'AM' LED, the other side is taken to +9 volts via a dimmer control circuit formed round TR6, and the front panel dimmer potentiometer. At this point the 'FM' LED is held off by the non-conducting TR5, since the inverter IC8C has two high inputs. The 'FM' mode is disabled in VHF by a 'high' on IC12B pin 6.

96 With 'FM' selected at the front panel a 'low' is at IC12B pin 5 from the switch. 'FM' operation is permissible only on UHF, therefore a transmitter synthesiser UHF flag must be available, ('low' on IC12B pin 6). Under these conditions the inverter IC8C switches on TR5 and the 'FM' LED illuminates through the dimmer control circuit described previously.

Oscillator Module Type ATR-43

97 The Oscillator Module Type ATR-43 consists of a base plate on which is mounted three oscillator sub-models. These sub-models are hardwired together but have a multiway connector and several coaxial connectors to permit ready removal of the overall module from the unit. Figure 17 shows an outline of the module.

98 The three sub-modules each provide a local oscillator frequency required by the Receiver Module and are identified as follows:-

98.1. 1st Local Oscillator - Type ATR-31

98.2. 2nd Local Oscillator - Type ATR-40

98.3. 3rd Local Oscillator - Type ATR-41

99 Each sub-module provides an output frequency which is synthesised from a Reference Frequency of 5.25 MHz made available from the Reference Oscillator Module Type ATR-42.

100 The 1st Local Oscillator consists of two printed circuit areas. These are identified as the Logic and VCO Boards. Figures 18 and 19 show the layout of the Logic Board. Figure 20 is the circuit diagram.

101 Considering Figure 20, this section of the equipment requires two supply voltage levels. These are +5 volts dc, & +7.5 volts dc. These are derived as follows:-

101.1 +5 volts dc from VR1 & VR3 which are supplied from 7.5 volts dc.

101.2 +7.5 volts dc from VR2 which is supplied from off board 18 volts dc.

102 The components surrounding VR1, VR2 and VR3 provide for decoupling, anti-parasitic stoppers and, in the case of the resistors associated with VR2, output voltage level setting.

103 The bulk of this board of the 1st LO is the first local oscillator, logic which provides one of three frequencies depending upon front panel switch settings and EPROM (IC5) programming. The frequencies may be in either of the following ranges.

103.1 VHF - 1009.7 to 1029.7 MHz.

103.2 UHF - 1117.7 to 1292.7 MHz.

104 The front panel mounted frequency selection switch causes a logic '1' (high) to be placed on A4 or A5 depending on channel selection. This forms a unique address to IC5 which is programmed to provide an output, on demand, to a synthesiser based round IC8.

105 Whenever the front panel switch position is changed, the circuit formed by IC3B, IC3C, TR1, IC2A & B, IC1D, IC1C and IC1B provides a pulse to IC7 pin 11. This causes IC7 to load in the data from IC5 output and thereby set the synthesiser frequency of operation. The same effect is caused at switch on by R4, C8 and IC1B which is a switch on reset or "load" circuit.

106 During the period IC7 is loading IC5 data, a programmed data bit, (VHF/UHF flag), is available at IC5 pin 15. This is programmed such that when a VHF frequency is loaded, a logic '1' (high) is made available at the board output (IC6B pin 13) and conversely, when a UHF frequency is Rx VHF/UHF and is used, together with a similar logic line in the transmitter sythesiser, to indicate via the 'Fault' lamp whether the Receiver and Transmitter EPROM's are compatibly programmed. It is also used to select the appropriate circuitry, for example filters and power amplifiers, to be used for the programmed frequency.

107 The synthesiser IC7 forms part of the phase locked oscillator loop comprising a voltage controlled oscillator, loop filter and prescaler circuit. The voltage controlled oscillator (VCO) is contained on a separate board and is described together with the Logic Board circuits because of the necessary interaction. Figures 21 and 22 show the layout of the VCO Board, the circuit diagram for which is Figure 23.

108 TR1 is the active oscillator component which is connected in the grounded gate configuration. The tuning elements are formed by varacter D1 and a transmission line created by a length of 50 ohm semi-rigid coaxial line bent in the shape of an "S". The control voltage is applied to the circuit from the Logic Board via P4.

109 The tuning voltage (VCTL I/P) is derived from the loop filter (IC8 on Logic Board), prescaler (IC1 on VCO Board) and the oscillator itself. The input to IC8 is the synthesiser (IC7) output voltage and this will depend upon the data loaded from IC5 and the IC7 internal phase detector output.

110 IC7 internal phase detector has, as its input, the output of the prescaler, (IC1 of the VCO Board), which is a divide by 128/129 circuit driven from the VCO via a power splitter formed by R5/R6. The VCO output taken via C12 drives IC2 to saturation and this stage is used as a frequency doubler. C14, L5 & C15 form a 1 GHz high pass filter offering some rejection of the fundamental frequency. IC3 buffers and amplifies the required final 1st Local Oscillator frequency which is then applied to the Receiver module via C17, P7 and external 1.0 to 1.3GHz Band Pass filter.

111 An out-of-lock (OOL1) output is provided at IC7 pin 10. This is used to illuminate the fault lamp on the front panel should an "unlocked" condition occur.

112 Figure 24 shows the interconnections between the two 1st Local Oscillator boards. This also includes a resistor and capacitor which provides the positive Voltage supply to TR1 (VCO) via L2.

113 The 2nd Local Oscillator Sub-module contains three printed circuit boards within a brass enclosure. Figure 25 shows the functional interconnection of the boards which are identified as:-

113.1. Voltage Controlled Oscillator Board (VCO)

113.2. Frequency Divider Board.

113.3. Phase Detector Board.

114 Figures 26 & 27 show the layout of both sides of the VCO board and Figure 28 shows the circuit diagram. VR1 accepts +18 volts and regulates this down to +12V for use with MOD 1. This is a small sealed oscillator, the output of which is 1050 MHz.

115 A 10 dB attenuator pad formed by R3, R5 & R6 offers buffering to prevent loading on the oscillator. The output is then split equally by R2, R4 & R7 to feed IC1 and IC2. The 2nd Local Oscillator frequency is applied to the Receiver Module via IC2 whilst the output of IC1 is applied to the Frequency Divider Board.

116 Figures 29 & 30 show the layouts of the two sides of the Frequency Divider Board, whilst Figure 31 provides circuit details. The VCO frequency at 1050 MHz is applied at Pin 1 (C) and IC1 is a divide by 20/21 device set to divide by 20. Further division by a factor of 10 is provided by IC2.

117 VR1 accepts +12V2 and regulates this down to +5 volts (+5V2). The output from the board at Pin 4(B) is connected to the Phase Detector Board.

118 Figures 32 and 33 show the layout of the two sides of the Phase Detector Board and Figure 34 shows the circuit diagram.

119 VR1 is a 5 volt regulator operating on an 18 volts input to the board which is also supplied at Pin 2. IC3 accepts the divided down frequency from the Frequency Divider Board at Pin 5 (B), together with a 5.25 MHz reference frequency (2nd FREF) from the Reference Frequency Oscillator Module. Two of the three on-board phase detectors are used in IC3 to drive the loop filter circuit formed round IC1 via an analogue switch IC2.

120 Two phase detectors are used, one to provide good capture, (acquisition), performance and the other for optimum lock range. IC2 selects the appropriate detector output under control of the 'out-of-lock' detector circuit formed around IC4. Thus when 'in lock' the optimum detector output is switched by IC2 to IC1. However, when the out of lock condition is detected the second phase detector output is selected by IC2 and this provides improved acquisition to obtain the required lock state.

121 The output from loop filter IC1 is made available at Pin 4 (A) for connection back to the VCO board to drive the oscillator and thereby maintain a stable frequency. The out-of-lock logic is taken to Pin 7 (OOL 2) and thence to the Audio module for use with the fault detector circuits.

122 Figures 35 and 36 show the layout of the two sides of the 3rd Local Oscillator sub-module. This is enclosed in an aluminium enclosure and operates at a fixed frequency of 168 MHz. Figure 37 shows the circuit diagram of the sub-module which also contains two voltage regulators. VR1 provides a +15 volt supply from the off-board +7.5 volts. VR2 generates a further +5 volt supply (+5V1) from the off-board +12 volts (+12V2). An +18 volts is also available on the board.

123 In this circuit the voltage controlled oscillator is formed round TR1 and is tuned by D2 and D3. The output from the VCO is buffered by TR2 and applied to the divide by 32 pre-scaler IC4. IC1 is the phase detector which has the pre-scaler output and the 5.25 MHz reference frequency (FREF) as inputs. The resultant error, if any, is applied to the loop filter circuit formed round IC3 and thence to the tuning diodes.

124 As with the 2nd LO, an out-of-lock logic (OOL3) is provided. This is derived from IC1, IC2D and IC2A and used to illuminate the fault lamp under conditions of no lock. A second output from TR2 is applied to a filter circuit formed by C25, L5 and C27, this attenuates harmonics and is coupled to an attenuator pad (R18-20) before amplification by IC5 and eventual use as the 3rd Local Oscillator frequency (168 MHz) in the Receiver Module.

125 The three sub-modules are interconnected as shown on Figure 38.

Transmitter Drive Module Type ATR-33

126 The Transmitter Drive Module Type ATR-33 is an aluminium enclosure with coaxial and multiway connectors containing three elements. These are:

126.1. Transmitter Drive Board - Type ATR-47
126.2. UHF VCO Board - Type ATR-48
126.3. UHF Driver - Type ATR-49

The three areas are hardwired together and all are removed as a single module. Figure 39 shows the outline drawing of the module.

127 The circuitry contained on the Transmitter Drive printed circuit board includes a frequency synthesiser which is used to generate the transmitted frequency, and which is phase locked to the 5.25 MHz reference frequency, a voltage controlled oscillator and 2 stages of VHF amplification providing sufficient power to drive the succeeding VHF power amplifier module.

128 A double sided printed circuit board is used and the layout of each side is shown in Figures 40 and 41. Figure 42 shows the circuit diagram of the board.

129 Two voltage regulators are included on the board. VR1 accepts an off-board +12 volts dc and regulates this down to +5 volts dc. VR2 also operates from the same +12 volts dc input to provide +7.5 volts dc (VS). Two further dc voltages are used on the board, these are +18 volts dc and +12 volts dc. The +12 volts is selected either to the VHF or UHF elements by RL1 under control of TR11 when on transmit. RL2 disconnecting the supply when on Receive via TR13 & TR12. Similarly the +5 volts is switched either to VHF or UHF circuits by TR9 & TR10.

130 In most essentials the synthesiser circuit design is similar to the first local oscillator of the receiver. However, in this application the circuit can be used to generate a fixed frequency, as is required when AM operation is selected, or the varying frequency which selection of the FM mode demands.

131 When selected for VHF operation the synthesiser loop circuit comprises pre-scaler IC9, Loop Filter IC6 and the VCO formed around TR3, and TR4. This being selected by IC7A and B which is a quad bilateral switch. In this condition, the UHF mode pre-scaler IC8 is switched out of circuit by the same IC (IC7). Control of IC7A and B being achieved by the $\overline{\text{VHF}}$/UHF flag available at IC4 pin 15, this is converted to the Tx $\overline{\text{VHF}}$/UHF logic by IC10A, IC11A and IC10B (pin 13) and an inverted version is available at IC10B pin 12. ($\overline{Q}$). TR2 again inverts and the two logic levels operate on IC7A and B.

132 Conversely, with UHF operation selected, IC7A and B switch in a second synthesiser loop circuit comprising pre-scaler IC8 and the UHF VCO circuit board. The overall loop filter stage IC6 is common to both VHF and UHF operation.

133 On FM operation the modulating signal is applied to IC5 pin 24 via C19. This varies the synthesiser output frequency at the rate of the modulating frequency and by an amount equal to the deviation specified. This facility is only available on UHF and is front panel selected.

134 The board contains two VHF preamplifier or driver stages. With AM selected and the correct VHF/UHF flag, TR5, TR6 and associated components provide amplification of the selected VHF carrier frequency.

135 Both cascaded stages of amplification are class A with dc bias set from the +12 VB volts dc rail via R45/R46 and R49/50 respectively. TR5 provides an output of some 10 milliwatts and TR6 approximately 50 milliwatts. Adjustable inductors L6, L7, L9 and L10 are factory set and are used to optimise gain and frequency response. C43 provides an adjustment, used during setting up to ensure the correct drive level is provided to the VHF Power Amplifier module.

136 The UHF VCO board accepts the synthesiser control from the Transmitter Drive board and oscillates to provide the necessary UHF transmitter frequency. Figures 43 and 44 show the board layouts, side A and B respectively whilst Figure 45 is the circuit diagram of the board.

137 A dc input is applied via R1 and R2 to the varacter diodes D1 and D2 to set the oscillator frequency of TR1 circuit. The output from TR1 is buffered and split by TR2 before being amplified by IC1 and IC2 to provide the two outputs. One output (VCO O/P B) is returned to the synthesiser for control purposes, the other is applied to the UHF Driver.

138 The UHF Driver circuit is shown as Figure 46. This is an amplifier device, contained in its own screened enclosure, providing some 30 dB of gain and delivering approximately 250 milliwatt output power to the UHF Power Module Type ATR-38. Figure 47 shows the Interconnections between the three elements which make up the Transmitter Drive Module Type ATR-33.

VHF Power Amplifier Module Type ATR-34

139 The VHF Power Amplifier Module Type ATR-34 is an aluminium enclosure into which is fitted a single printed circuit board and which contains a number of coaxial and multiway connectors. Figure 48 shows the outline of the module.

140 Figures 49 and 50 show the layouts of the two sides of the board fitted within the module. The primary aim of the board is to provide power gain for frequencies in the band 117 to 137 MHz. The board also contains a relay for selection of either VHF or UHF power amplifier outputs to the antenna, and a coupler or "pick off" circuit designed to sample the power output.

141 The circuit diagram for the VHF Power Amplifier board is depicted in Figure 51. An input from the Transmitter Drive Module ATR-33 of some 50 milliwatts is applied to TR1 via matching and tuning capacitors and inductors (C1, C2, L1, R14). This is an amplifier stage operating in class C bias with a tuned collector circuit matched into the input gate of a further amplifier TR5.

142 TR5 is a power amplifier set to operate in class A/B by R4 which is factory set. This stage raises the power level to approximately 7 watts at its output. A number of variable components are used to obtain a reasonably flat frequency response over the band whilst maintaining an adequate power output level. Normally the adjustable inductors are factory set and the adjustable capacitors are used to optimise performance. It should be noted that the adjustable components are inter-active and should only be touched during prescribed alignment procedures.

143 The output of TR5 is applied to a seven element, Chebychev low pass filter. This filter has an insertion loss of some 0.1 dB and begins to roll-off at approximately 145 MHz.

144 The cascaded power amplifiers are switched on under the control of the logic line VHF PA ON/$\overline{\text{OFF}}$. When this line is "high" TR3 switches on TR2 which allows the off-board +12 volts dc to be applied to the collector of TR1, to TR5 bias network and to RL1 and D1. Simultaneously, TR6 and TR4 apply a modulated dc supply to TR5. Thus causing the output from TR5 to be amplitude modulated.

145 A Tx VHF/$\overline{\text{UHF}}$ flag logic from the Transmitter Drive Module is "high" when a VHF frequency is selected, and this switches on TR7 to energise RL1 and select the output of the VHF Power Amplifiers through to a -20 dB coupler formed by D2 and its associated components.

146 The coupler circuit "picks off" r.f energy which is used to enable sidetone circuits in the Audio and Control Module and to inhibit transmissions should the power output level fall below 1 watt. This condition being indicated to the user by the illumination of the fault LED on the front panel.

147 The full r.f output from the contacts of relay RL1, whether VHF or UHF, is taken from the module to the antenna via the Filter Module which contains the transmit/receive change over relay.

UHF Power Amplifier Module Type ATR-38

148 The UHF Power Amplifier Module Type ATR-38 is an aluminium enclosure in which two printed circuit boards are fitted. Connections to and from the module are made via a number of coaxial and multiway connectors. Figure 52 shows an outline of the module.

149 Figure 53 shows the layout of the boards whose primary aim is to raise the power level from a nominal 250 milliwatts to five watts at the antenna connector.

150 The circuit diagram for the UHF Power Amplifier Module is shown in figure 54. An input from the transmitter Drive Module is transformer coupled by T1 on the subsidiary printed circuit board (shown in dotted lines), to an amplifier, the main supply to which is modulated. The output from the subsidiary board is again transformer coupled by T1 on the main board to a class A amplifier formed around TR3.

151 Bias for TR3 is set by R7. This is normally factory set and requires readjustment only when TR3 is replaced. The bias voltage is referenced to 7.5 volts by D1

152 TR1 and TR2 form a switch which applies voltage to the bias circuits. TR7 and TR6 form a switch which applies the modulated +18V to the drains of TR3, TR4 and TR5. These switches are operated by a "high" logic level from the audio and control module on the "UHF PA ON/OFF" input. Test points TP1 and TP2 allow monitoring of the drain current to TR3, while TP3 and TP4 perform the same purpose for TR4 and TR5 which share a supply rail.

153 The output from TR3 is coupled by balun T2 to a matching transformer T3. This provides matched push-pull input to the Class AB power amplifiers TR4 and TR5. The bias arrangements for TR4 and TR5 are set by R17 and R13 respectively, two separate potentiometers being used to allow the stages to be fully balanced.

154 T4 is an output matching transformer connected to transformer T5 which feeds an elliptic function low pass filter designed to attenuate any harmonic or spurious frequencies above 400 MHz.

155 When the UHF Power Amplifier circuit is operating in the FM mode the +18 volt dc supply to TR3, TR4 and TR5 is a steady voltage. When the AM mode is selected, the +18 volts varies in amplitude with the modulating signal and this causes amplitude modulation of the output signal.

156 There is no requirement to adjust any components once the equipment leaves the factory, unless any of the active devices are replaced. Should this occur the dc bias controls should be set for optimum performance.

Chassis Assembly Type ATR-36

157 The Chassis Assembly Type ATR-36 contains all the circuitry not fitted to the six modules already described. This circuitry includes the following:-

157.1. Front Panel Hardware
157.2. Rear Panel Hardware
157.3. Power Supplies
157.4. Interconnection wiring
157.5. Reference Frequency Oscillator

158 Figures 55 and 56 are applicable to the Chassis Assembly. Figure 55 provides details of the interconnections between the modules and front/rear panel hardware. Figure 56 shows the circuit of the power supply arrangements.

159 The bulk of the interconnection wiring is loomed and utilises grey ptfe insulated multistranded equipment type wire, with pink pvc insulated multistranded equipment wire being used for external connector wires. For radio frequency signals, miniature coaxial cables with plug/sockets are used, these are routed to maintain minimum lengths and to optimise performance in terms of cross talk and/or interference.

160 Figure 56 shows the circuit diagram of the power supply arrangement. Much of the circuitry is located on a small printed circuit board identified as the Power Supply Board Type ATR-35. This circuitry is shown on Figure 56 as bounded by the dotted lines. Figure 57 shows the layout of the printed circuit board.

161 Mains power is connected via a 1 amp anti-surge (slow blow) fuse F2 and the power on/off switch S1, to the primary of a toroidal mains transformer T1. Simultaneously a second part of S1 connects the 24 volt external battery via a 5 amp fuse F1.

162 After transformation the mains is full wave rectified by the diode bridge rectifier DB1 and smoothed by C4. A rear panel mounted voltage regulator VR3 regulates the voltage to 27 volts and this is used to charge the external battery via D1 if the "Disable Charge" link is fitted. At the same time, D4 provides the 27 volts to two further rear panel mounted voltage regulators.

163 VR4 reduces the output of VR3, (nominally 27.5 volts), to +12 volts dc for use as one of the unit supply rails, whilst VR5 provides a second unit supply rail at +18 volts dc.

164 The Battery Charge Voltage is set by R3. Protection against wrongly connecting the battery is given by D6 and F1.

165 The output from the diode bridge rectifier DB1 is applied across the potential divider formed by R4 and R7. The voltage at the junction of these resistors is applied via R8 as one input to IC1 which is a voltage comparator.

166 The second input to IC1 is derived from the battery supply rail via a potentiometer formed by R5 and R6. When both mains and battery supplies are available IC1 output is such that TR1 and TR2 are switched on. TR1 switched on turns off TR3. Thus the "Mains" LED on the front panel is illuminated while the "Battery" LED is extinguished.

167 The PCB mounted D4 ensures that the mains derived +27 volts dc is connected to the +18 and +12 volt regulators VR4 and VR5.

168 Diodes D4 and D5 isolate the mains and battery derived voltages from each other. In the event of a mains failure, the battery voltage is connected to the two main regulators thereby maintaining unit dc supplies. IC1 output toggles switching off TR1 and TR2. TR2 being off extinguishes the 'Mains' LED. TR3 being switched on illuminates the 'Battery' LED providing the operator with an indication that mains has failed and the unit is functioning from the external battery supply.

169 The Chassis Assembly also contains the Reference Oscillator Module Type ATR-42. Figures 58 & 59 show the layout of the two sides of the printed circuit board fitted in the Module. Figure 60 provides circuit details.

170. The Reference oscillator creates an accurate and stable 5.25 MHz frequency used as a reference for the three receiver local oscillators and the transmitter. XTAL 1 is a temperature compensated crystal oscillator (TCXO) supplied by 5 volts dc from regulator VR1. Frequency is set by R4 and the output of XTAL 1 is buffered by IC1A and simultaneously applied to IC1B, C, D & E. These provide further isolation and drive the four frequency generating circuits fitted in the Oscillator & Transmitter Drive Modules.

171 Table 11 shows the pin outs of the rear panel mounted connectors.

TABLE 11 - REAR PANEL CONNECTOR PIN OUTS

CONNECTOR	PIN OUT DATA
BATTERY INPUT	PIN A = 24V positive PIN B = 24V negative (Ground)

(continued)

TABLE 11 - REAR PANEL CONNECTOR PIN OUTS (continued)

CONNECTOR	PIN OUT DATA
LINE I/P & O/P	PIN 1)= Line Input PIN 2) PIN 3)= Line Output PIN 4) PIN 5 = NOT USED PIN 6 (Centre) = NOT USED NOTE: Pin Numbering is Pin 1 to the right of locating key facing the rear panel, then clockwise with incrementing numbers.

172 Front panel connectors are conventional wired .ith colour coded connections as follows:-

172.1 Monitor Phones:- Red = Signal, Green = Ground

172.2 Microphone:- Yellow = Signal, Blue = Signal Ground
Red & Green = PTT.

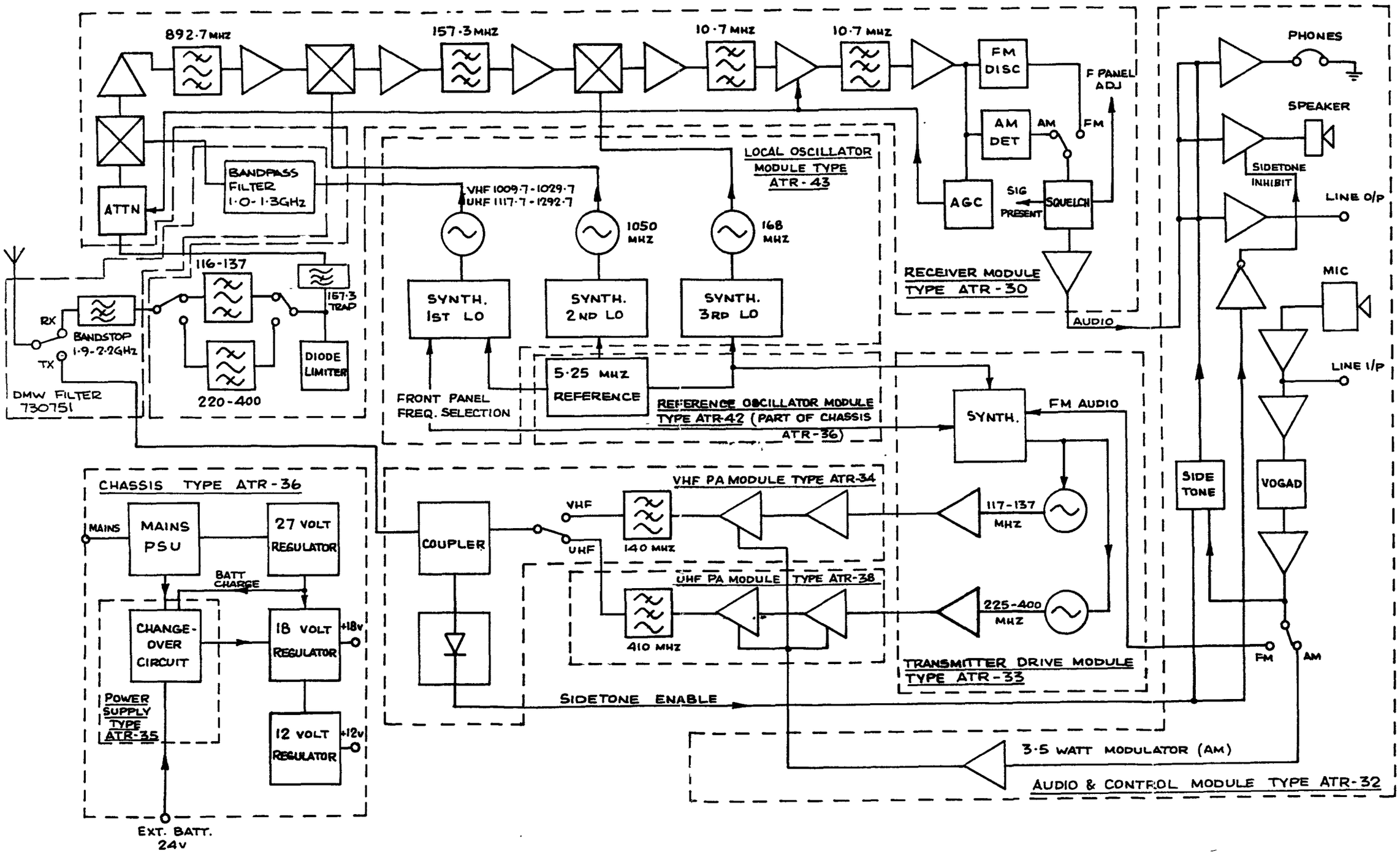


Figure 1 3- Channel V/UHF Radio - Block Diagram

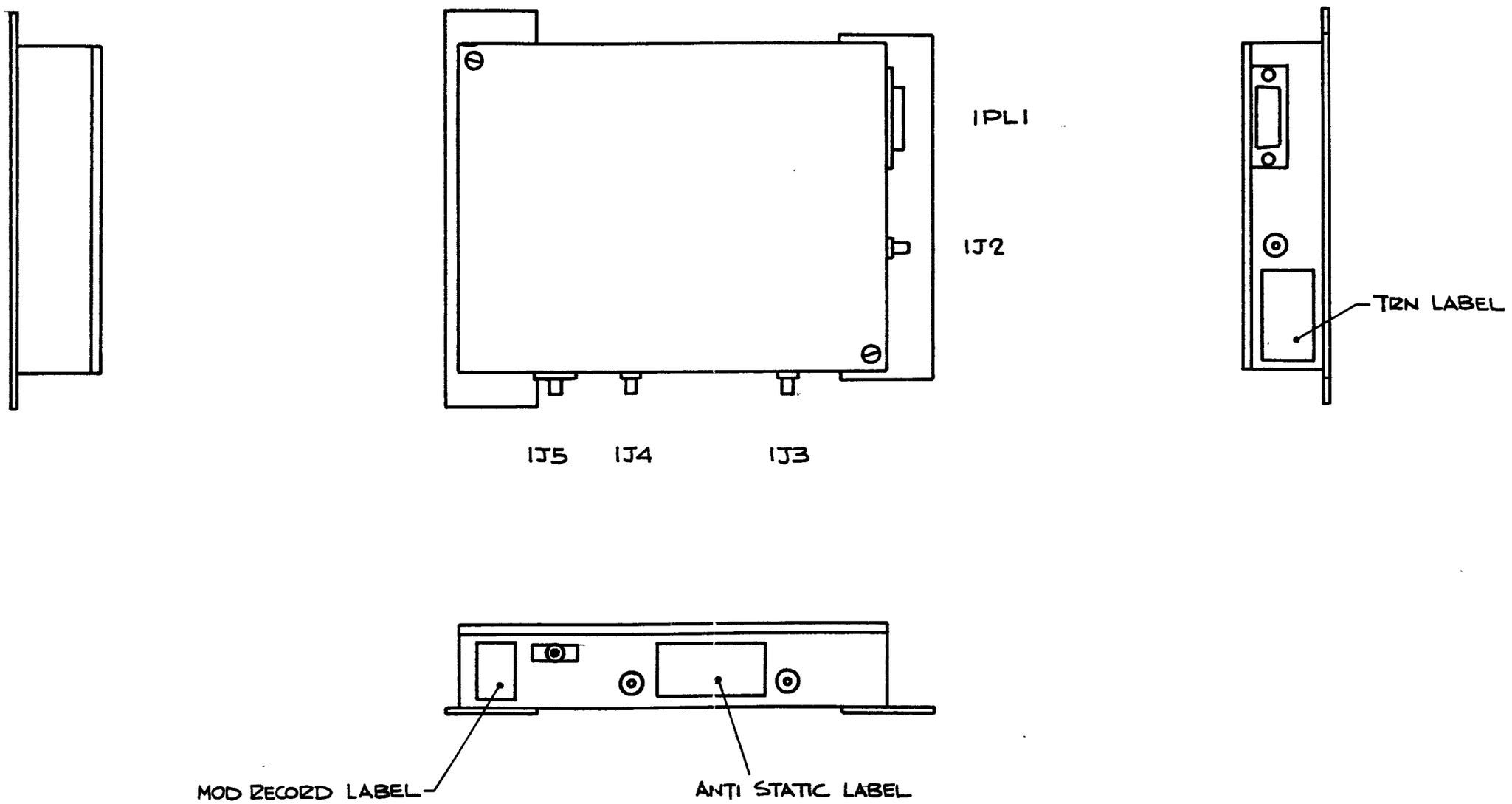


Figure 2 Receiver Module: Outline Detail

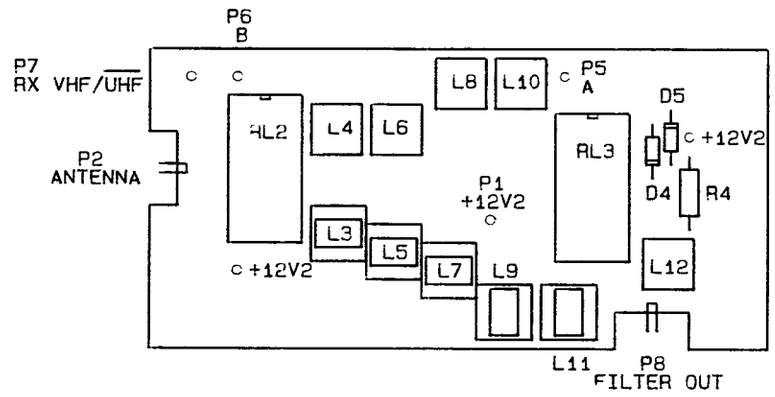


Figure 3 Receiver Module: Filter Board Side A Layout

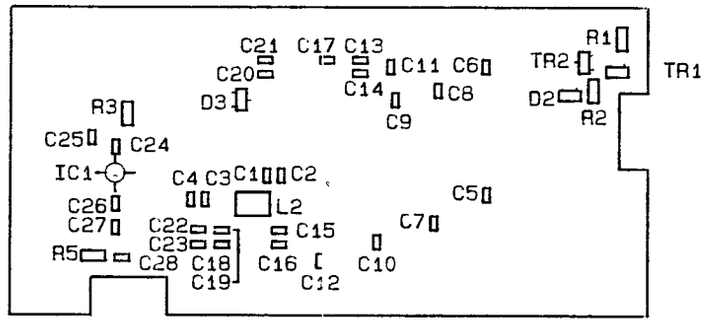


Figure 4 Receiver Module: Filter Board Side B Layout

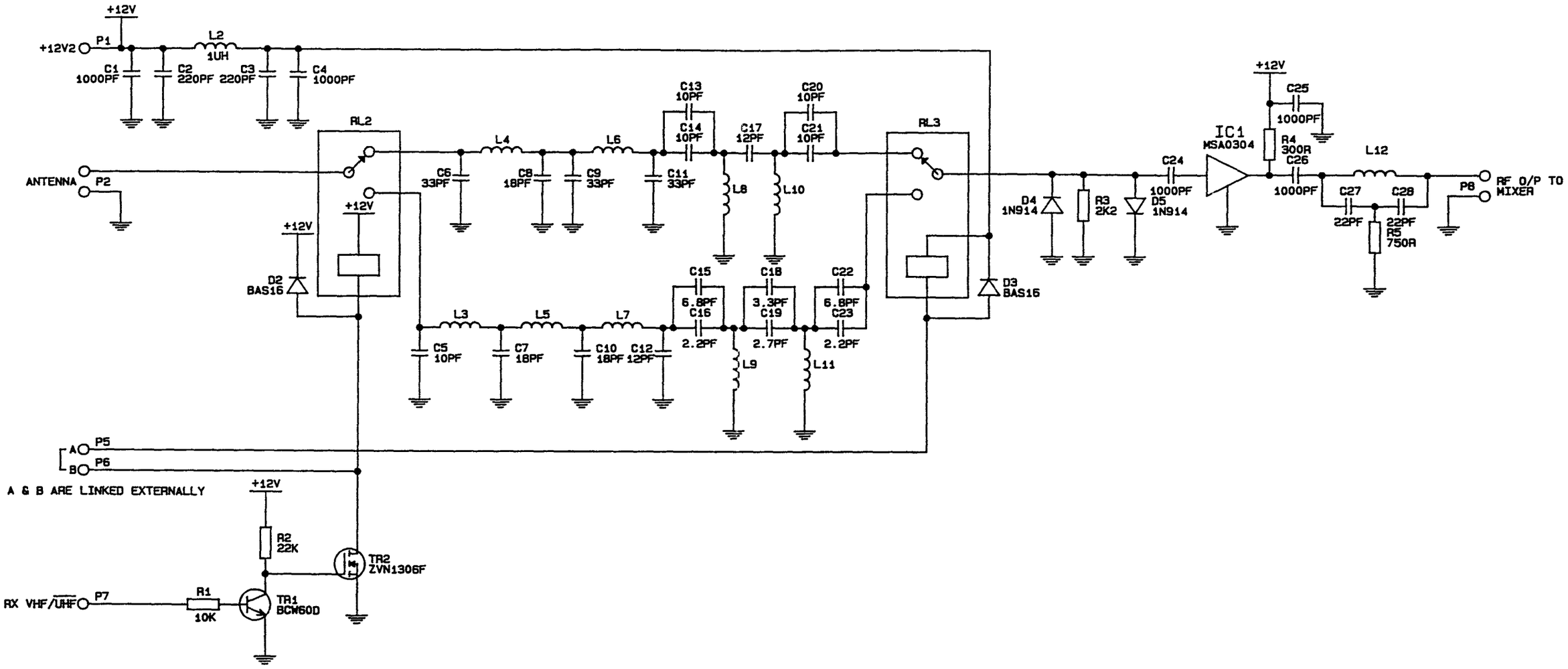


Figure 5 Receiver Module Filter Board Circuit Diagram

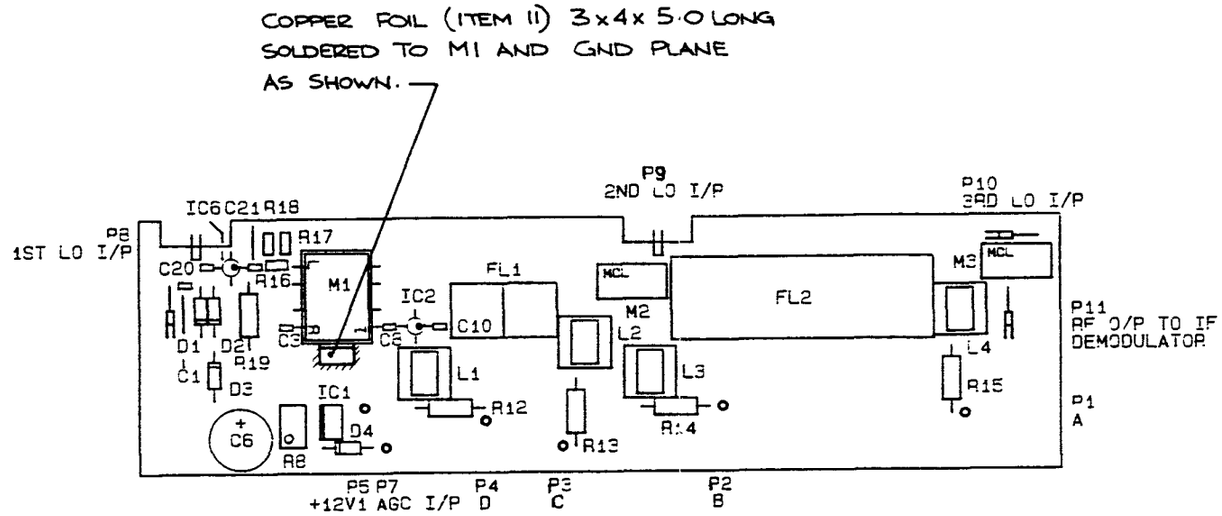


Figure 6 Receiver Module: Mixer Board Side A Layout

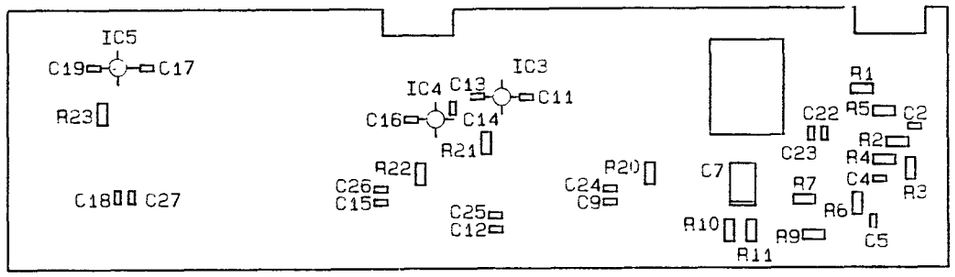


Figure 7 Receiver Module: Mixer Board Side B Layout

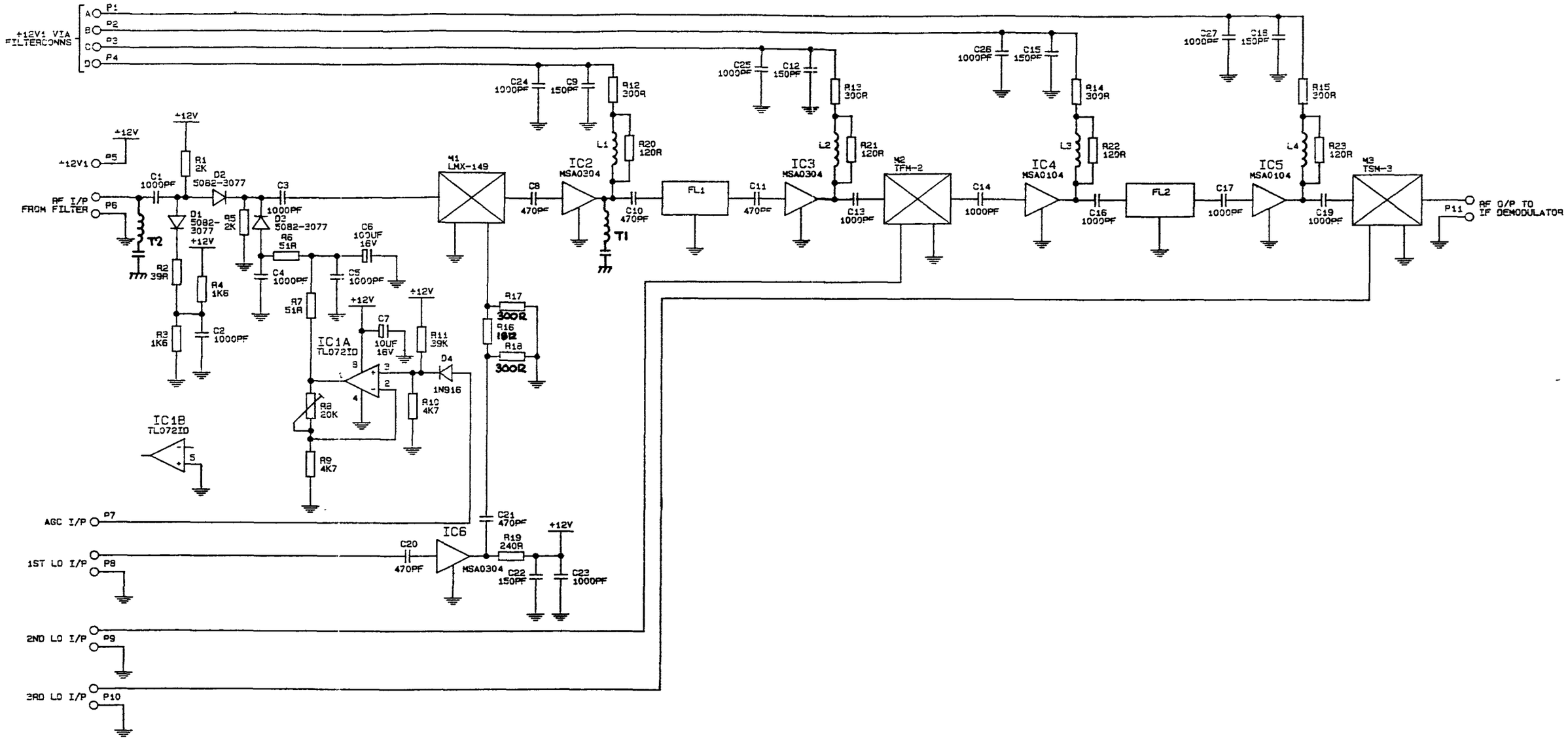


Figure 8 Receiver Module: Mixer Board Circuit Diagram

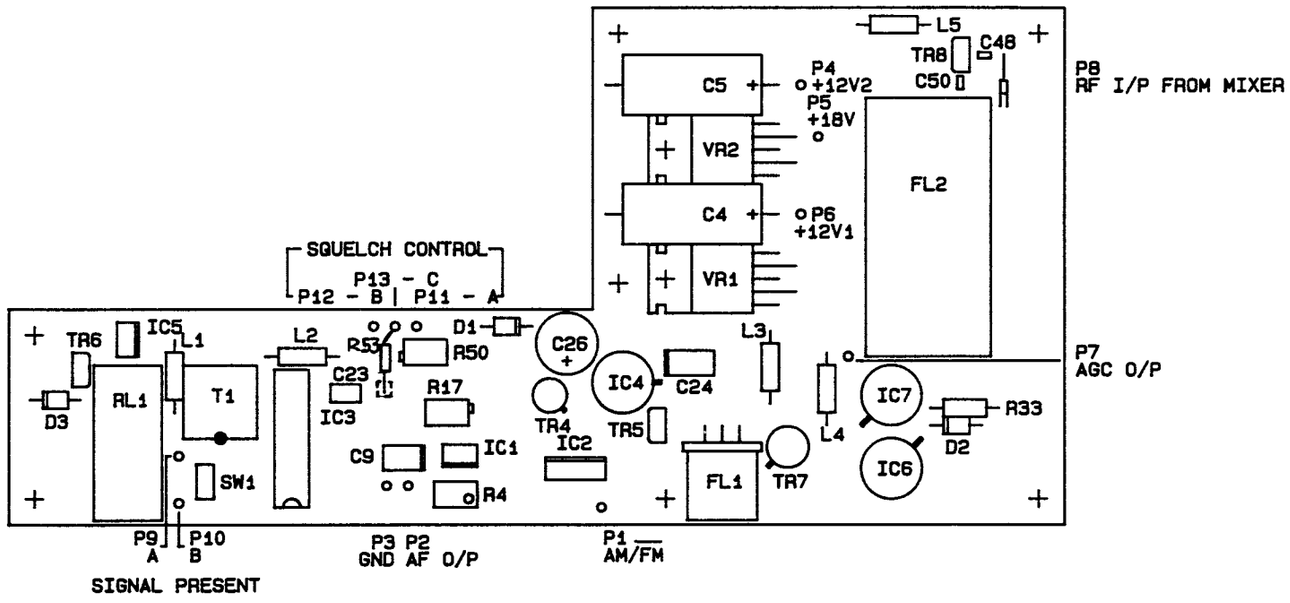


Figure 9 Receiver Module: IF Demodulator Board Side A Layout

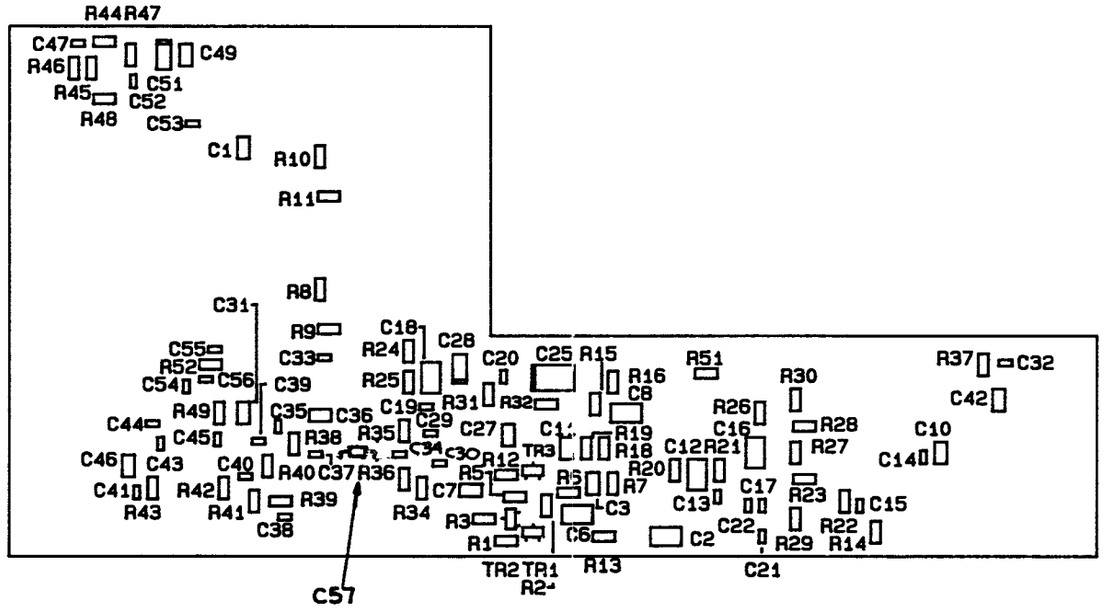


Figure 10 Receiver Module: IF Demodulator Board Side B Layout

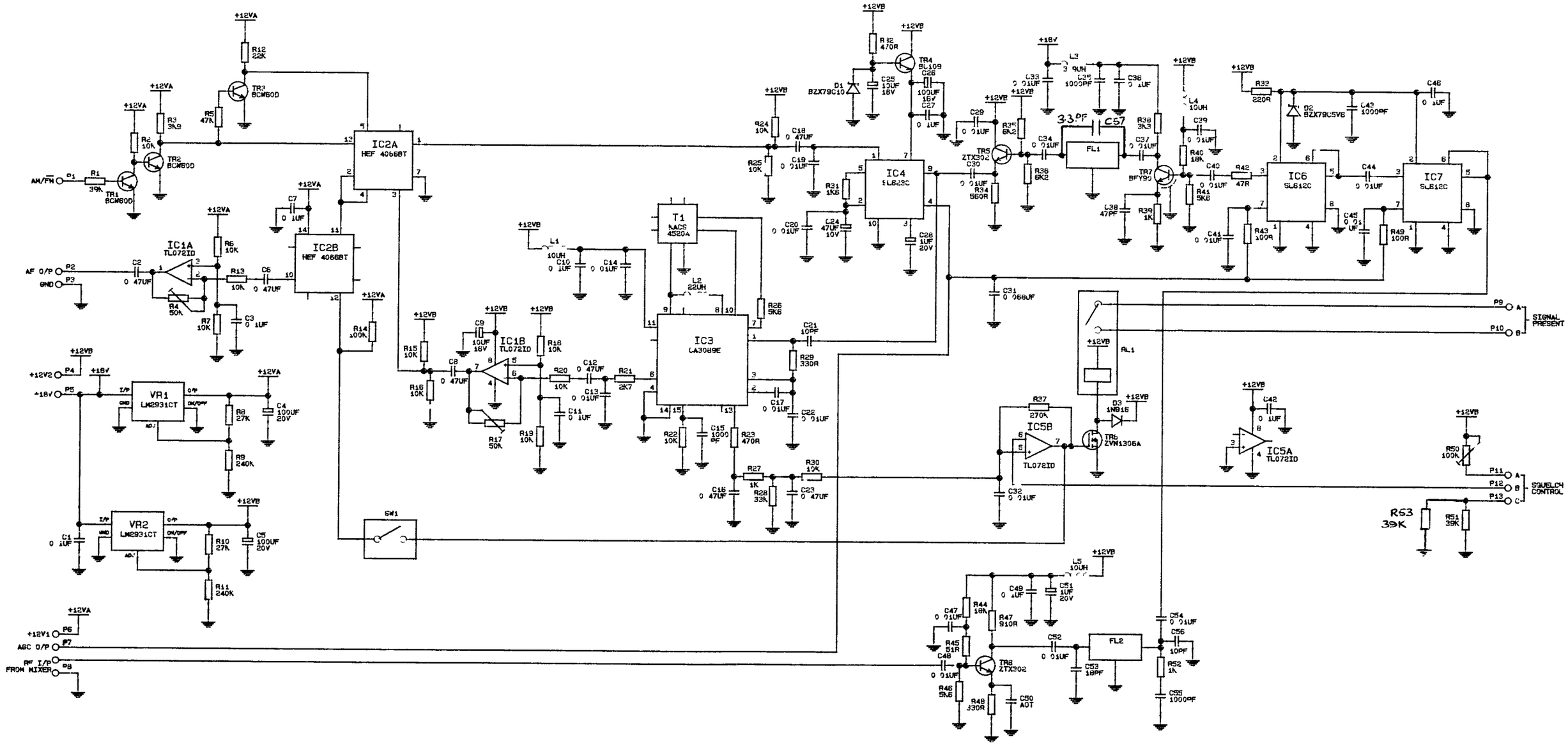


Figure 11 Receiver Module: IF Demodulator Board Circuit Diagram

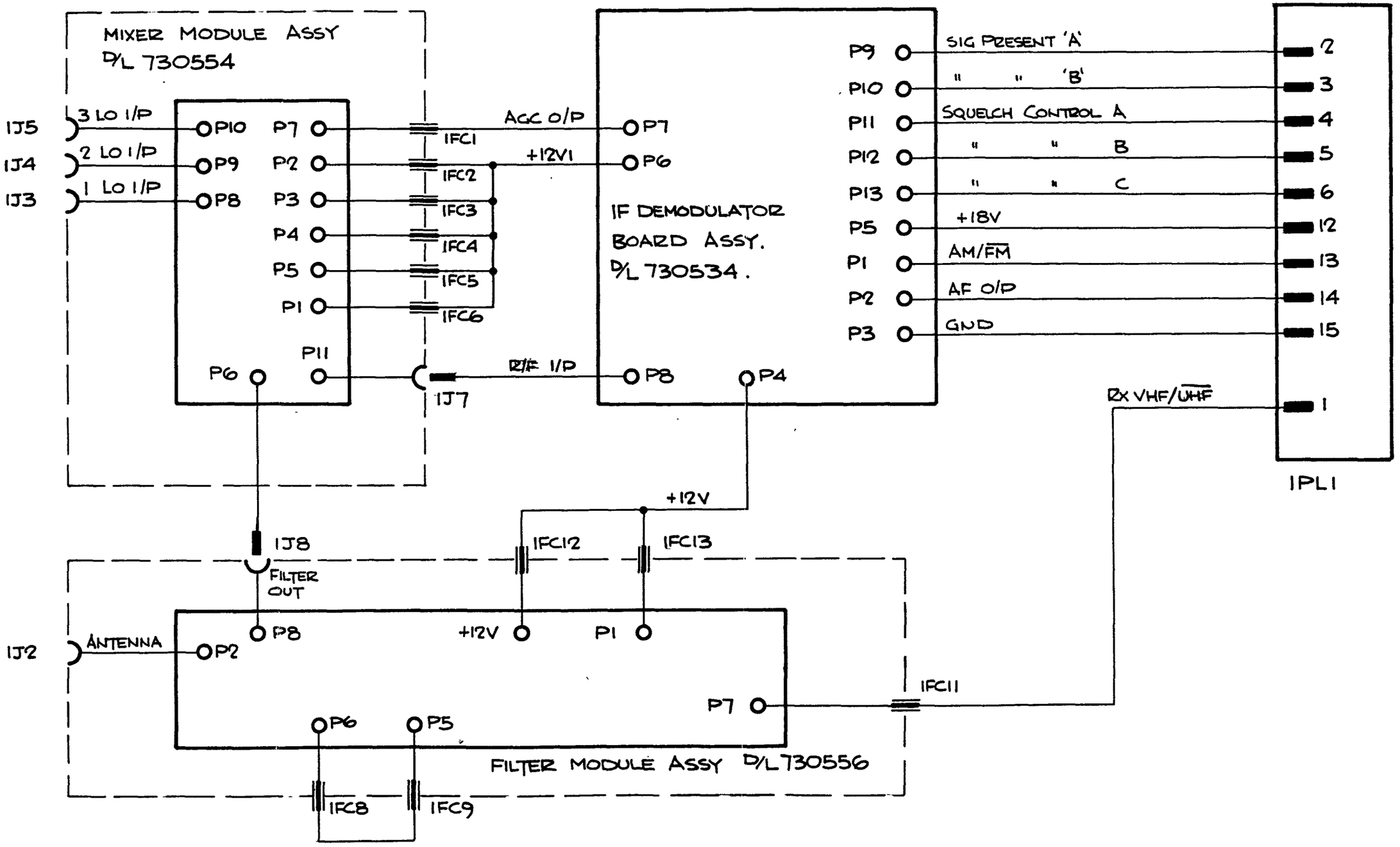


Figure 12 Receiver Module: Interconnection Diagram

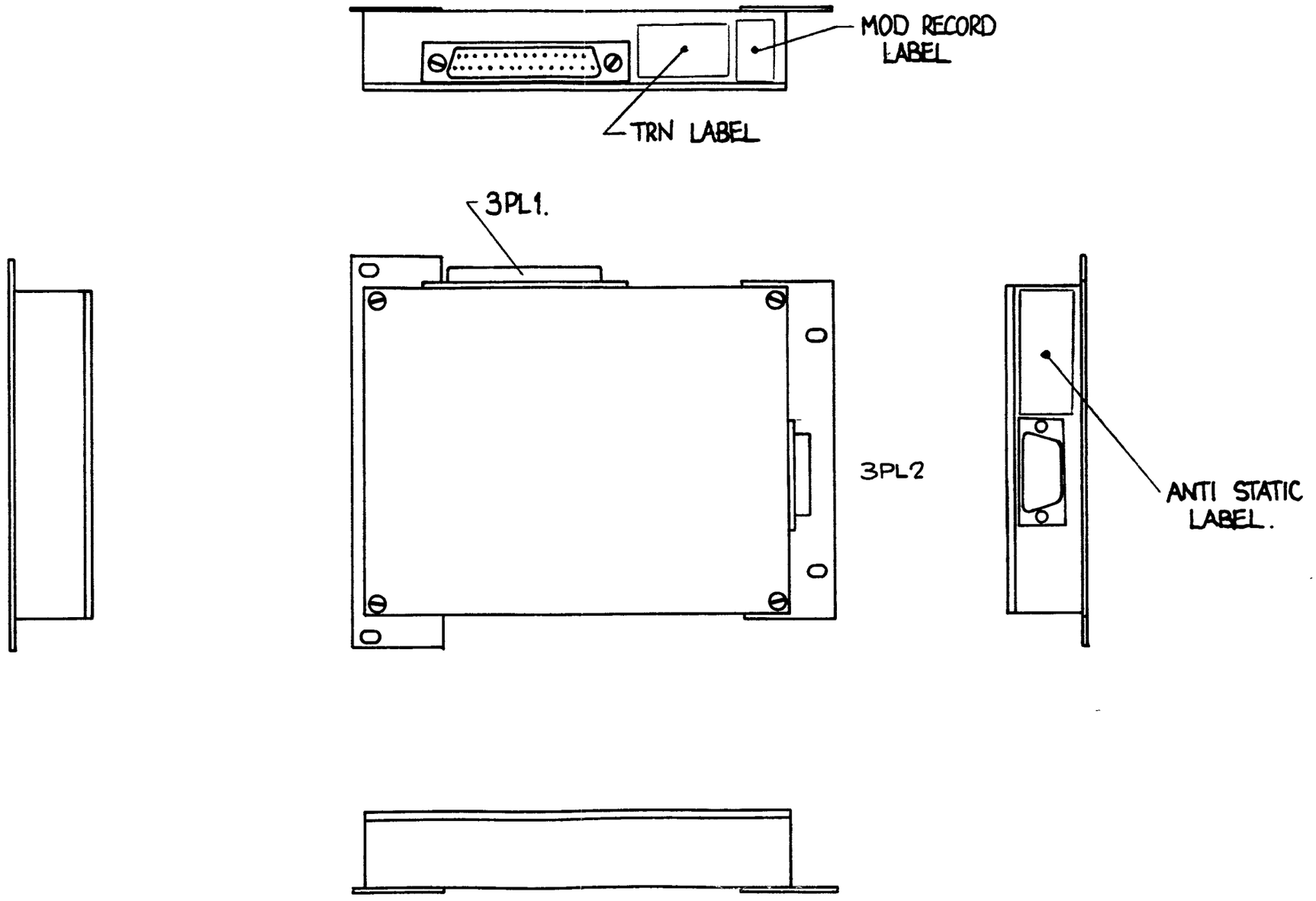
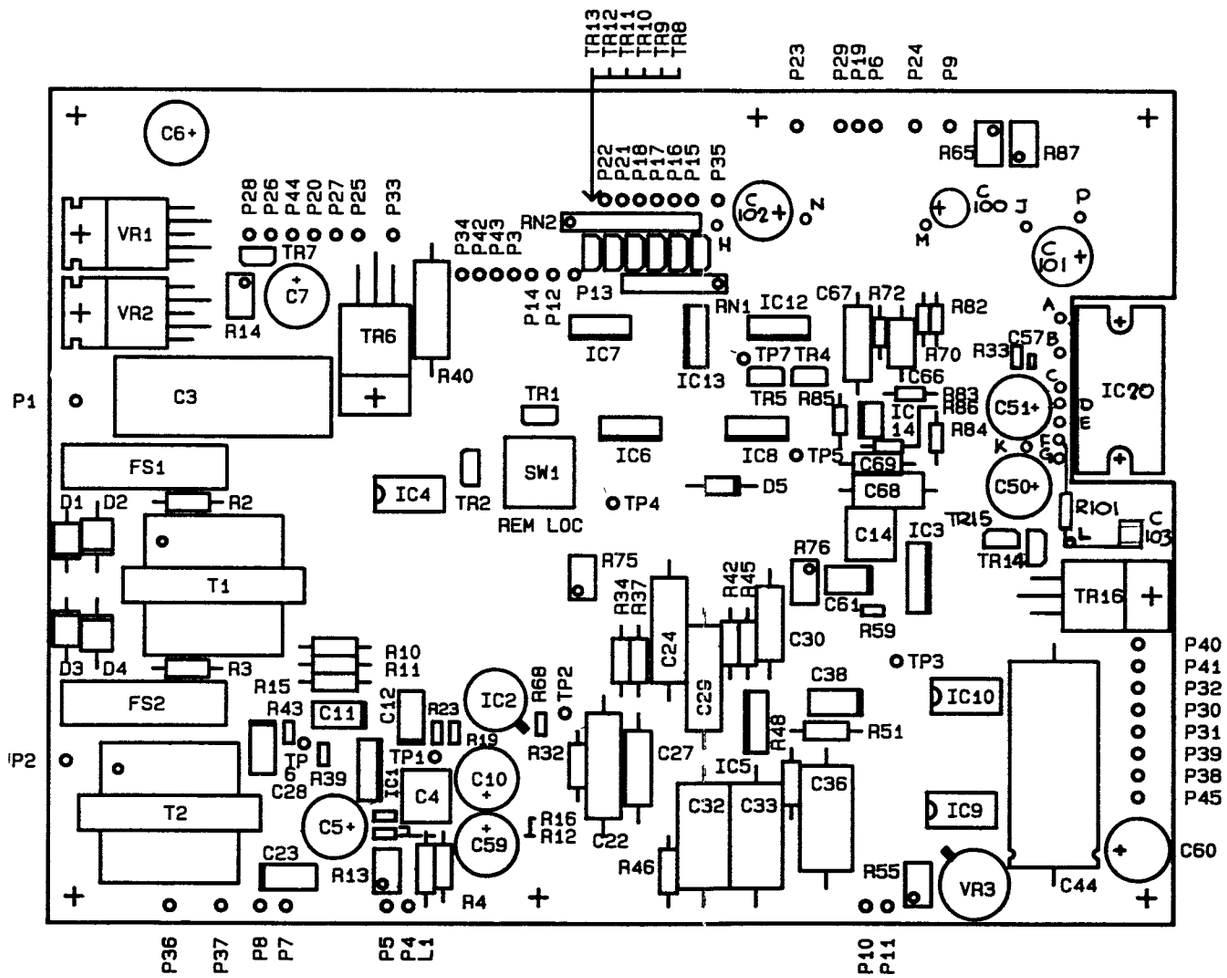


Figure 13 Audio & Control Module - Outline Detail



PIN REFERENCES.

P1 - LINE I/P A
P2 - LINE I/P B
P3 - PTT B
P4 - MIC I/P
P5 - GND
P6 - AF I/P
P7 - LINE LEVEL A
P8 - LINE LEVEL B
P9 - +18V I/P
P10 - MONITOR LEVEL A
P11 - MONITOR LEVEL B
P12 - VHF PA ON/$\overline{\text{OFF}}$
P13 - $\overline{\text{UHF}}$ PA ON/$\overline{\text{OFF}}$
P14 - T/R
P15 - $\overline{\text{OOL4}}$
P16 - $\overline{\text{OOL3}}$
P17 - $\overline{\text{OOL2}}$
P18 - $\overline{\text{OOL1}}$
P19 - FAULT LED A
P20 - FAULT LED $\overline{\text{B}}$
P21 - RX VHF/$\overline{\text{UHF}}$
P22 - TX VHF/$\overline{\text{UHF}}$
P23 - FM LED C
P24 - FM LED A
P25 - FM LED B
P26 - AM LED A
P27 - AM LED B
P28 - B
P29 - DET $\overline{\text{I/P}}$
P30 - AM/FM
P31 - A
P32 - FM MOD O/P
P33 - LED DIM A
P34 - LED DIM B
P35 - O/P TO MODULATION TRANSFORMER
P36 - LINE O/P A
P37 - LINE O/P B
P38 - PHONES O/P
P39 - GND
P40 - 8OHM SPEAKER O/P
P41 - GND
P42 - GND
P43 - PTT A
P44 - LED SOURCE
P45 - +18V I/P
J - O/P TO MOD TRANS'R

Figure 14 Audio & Control Board: Side A Layout

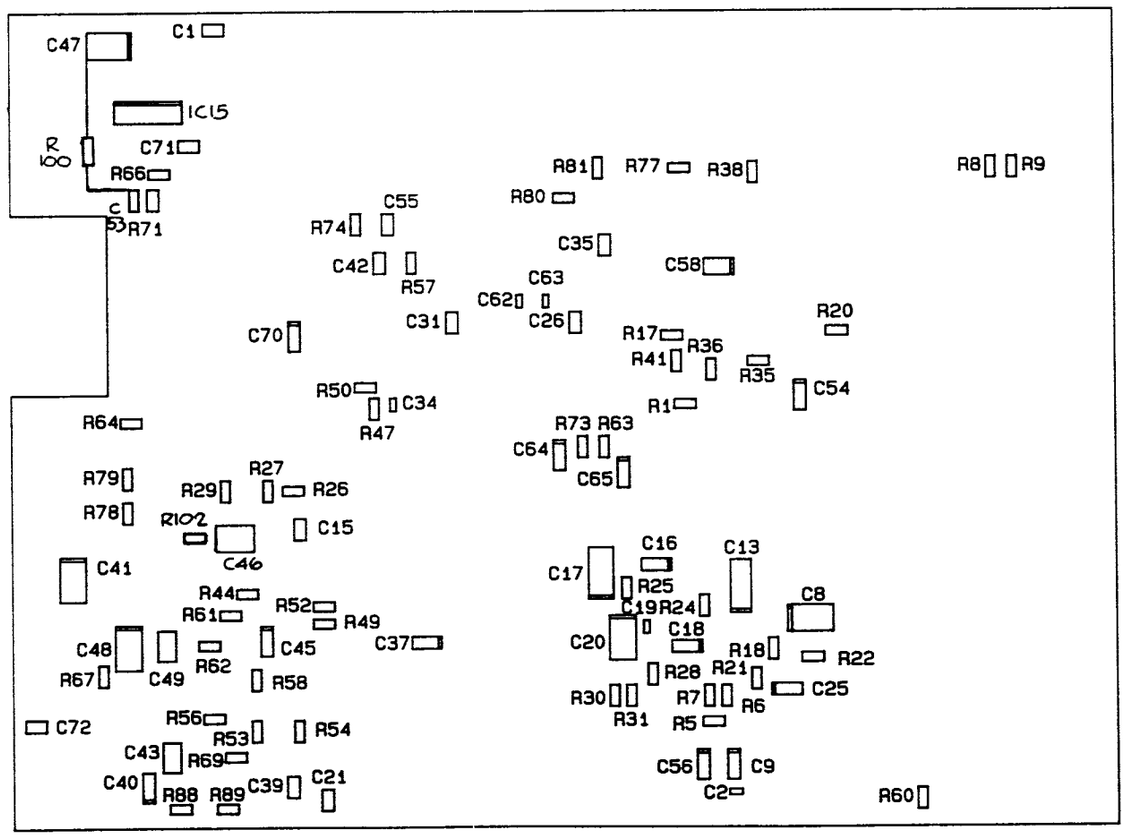


Figure 15 Audio & Control Board: Side B Layout

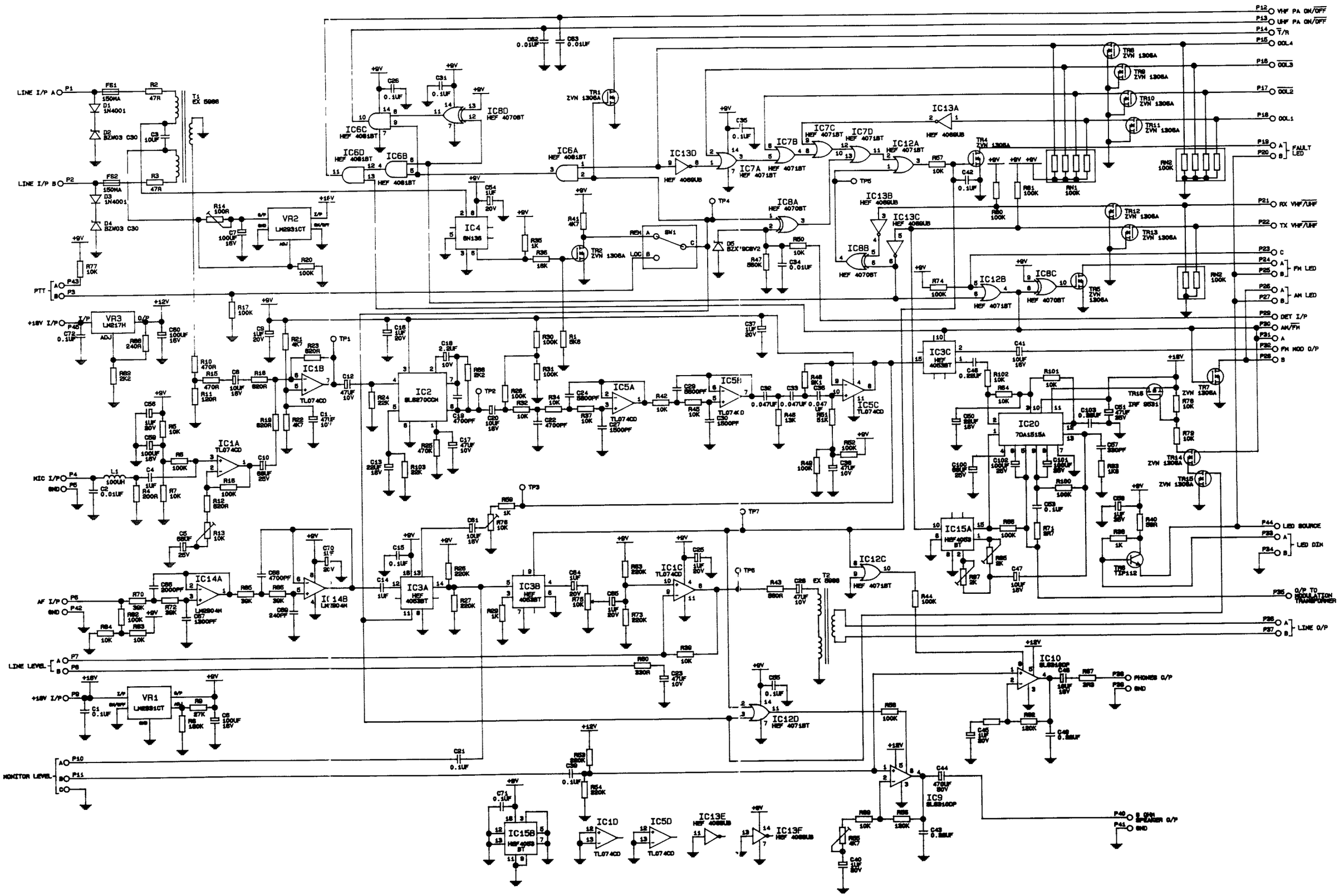


Figure 16 Audio & Control Board: Circuit Diagram

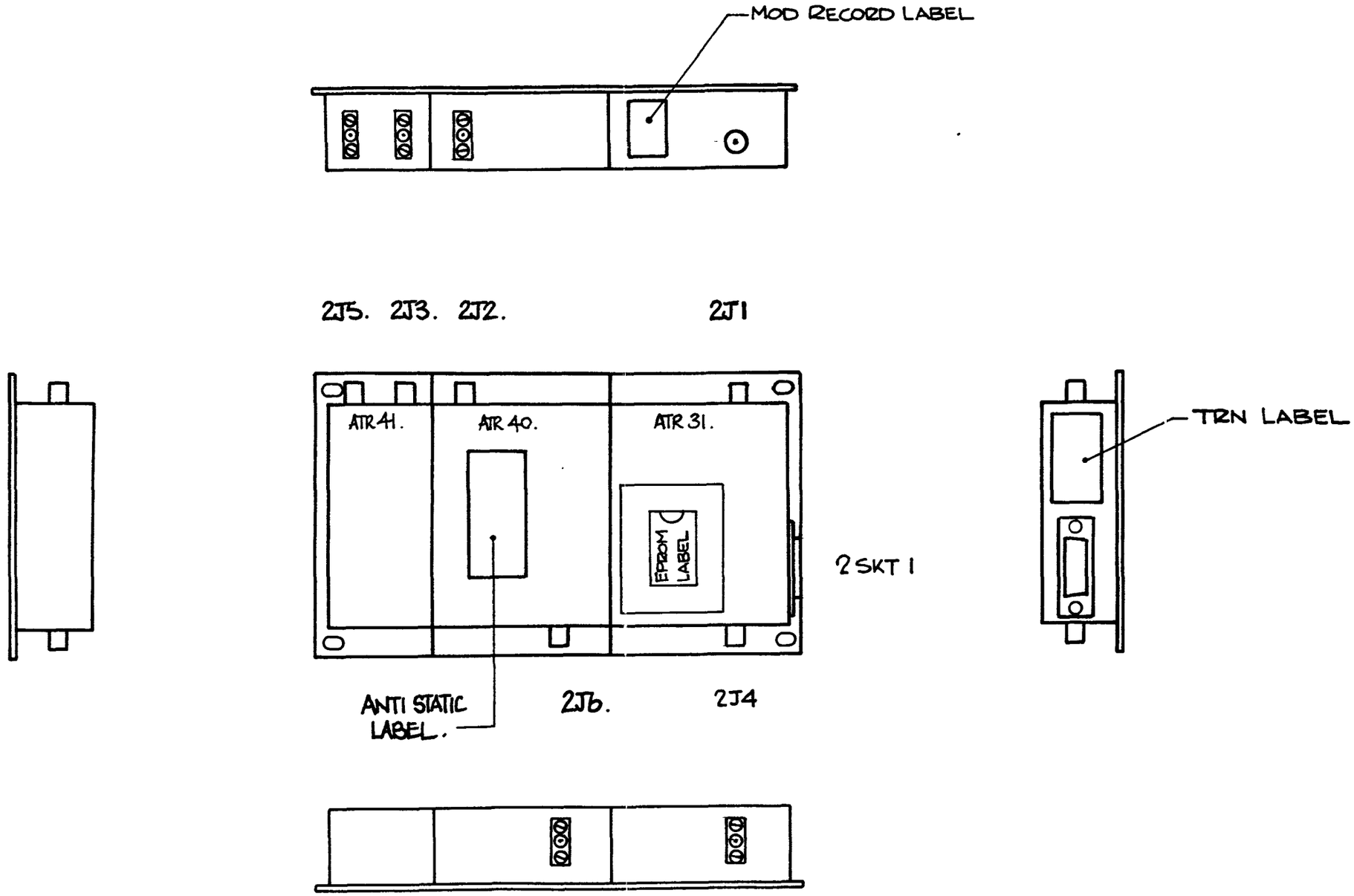


Figure 17 Oscillator Module: Outline Detail

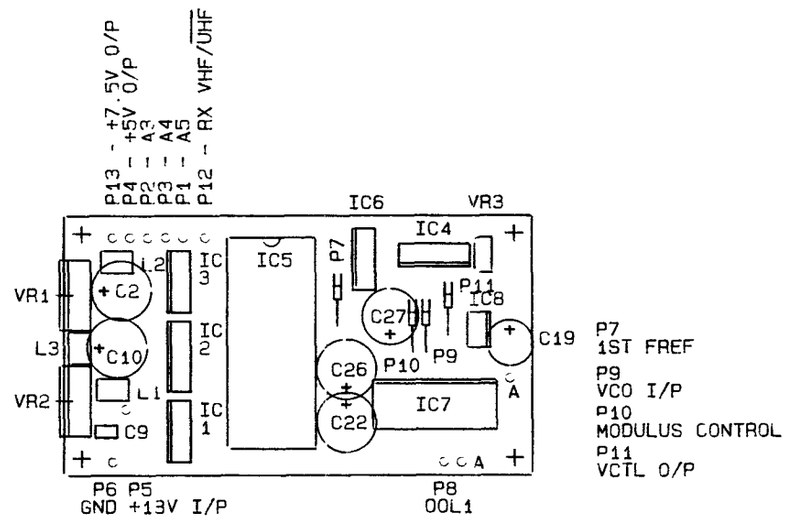


Figure 18 Oscillator Module: 1st L.O. Logic Board Side A Layout

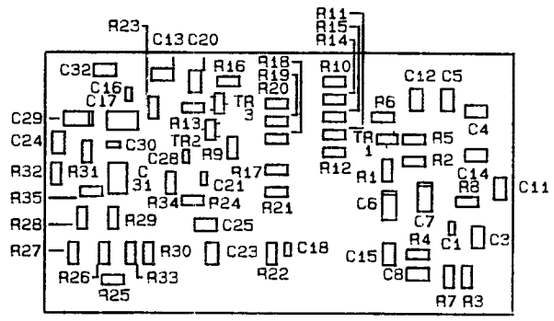


Figure 19 Oscillator Module: 1st L.O. Logic Board Side B Layout

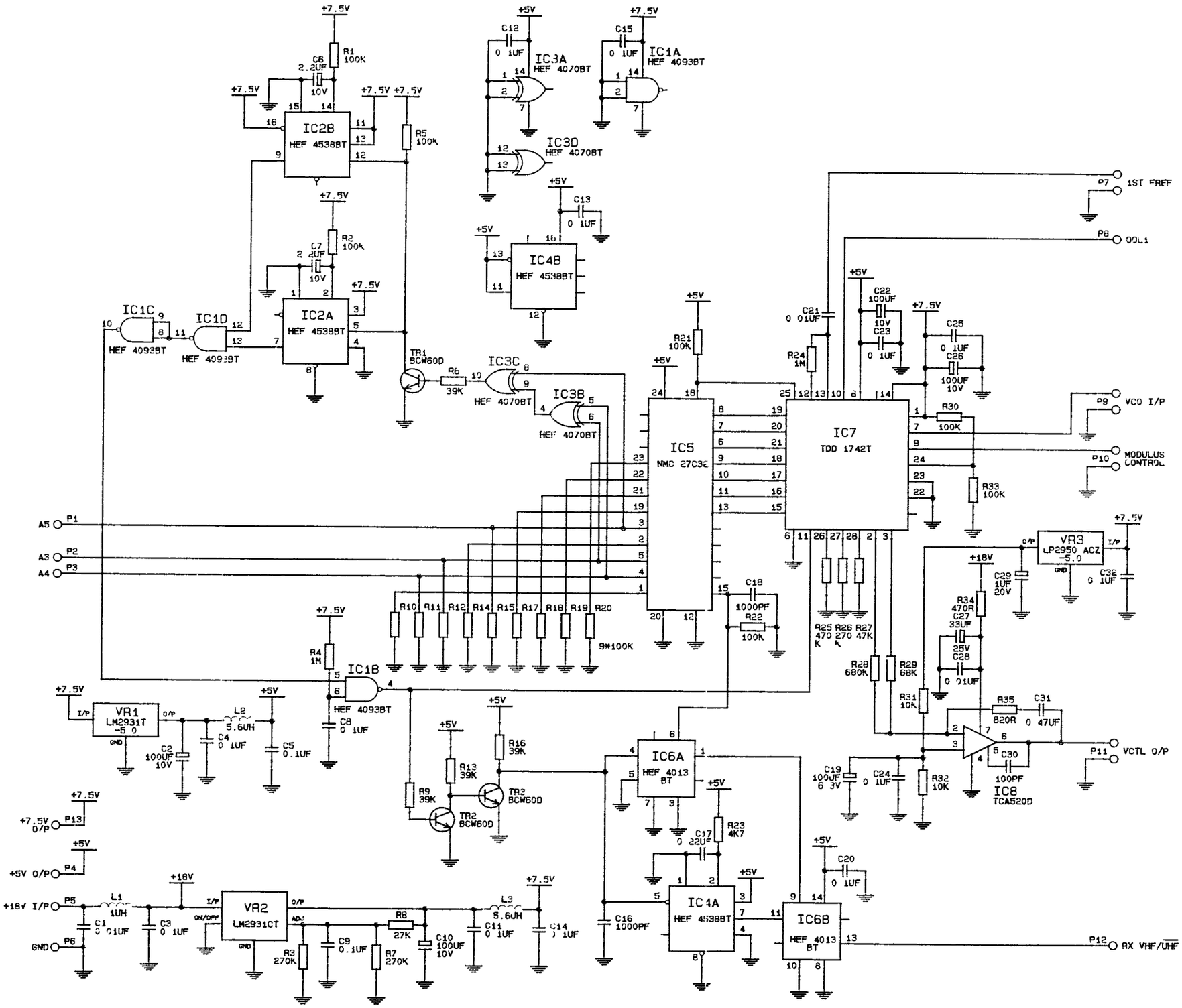


Figure 20 Oscillator Module: 1st L.O. Logic Board Circuit Diagram

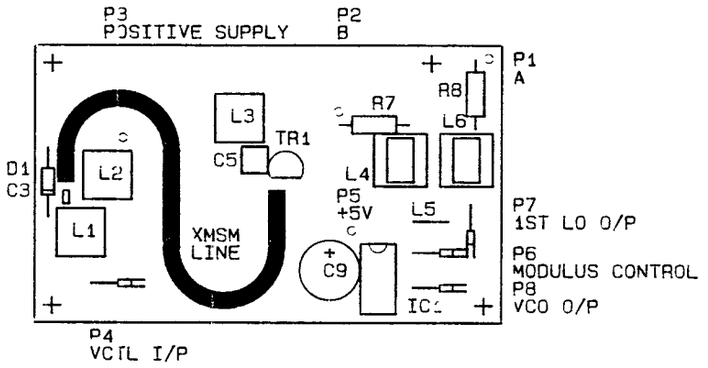


Figure 21 Oscillator Module: 1st L.O. VCO Board Side A Layout

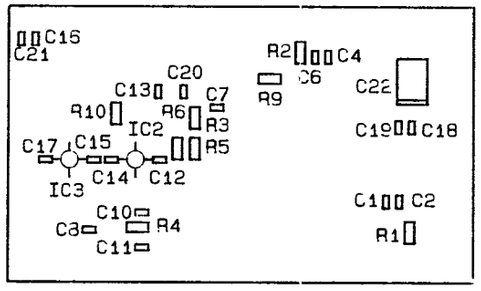


Figure 22 Oscillator Module: 1st L.O. VCO Board Side B Layout

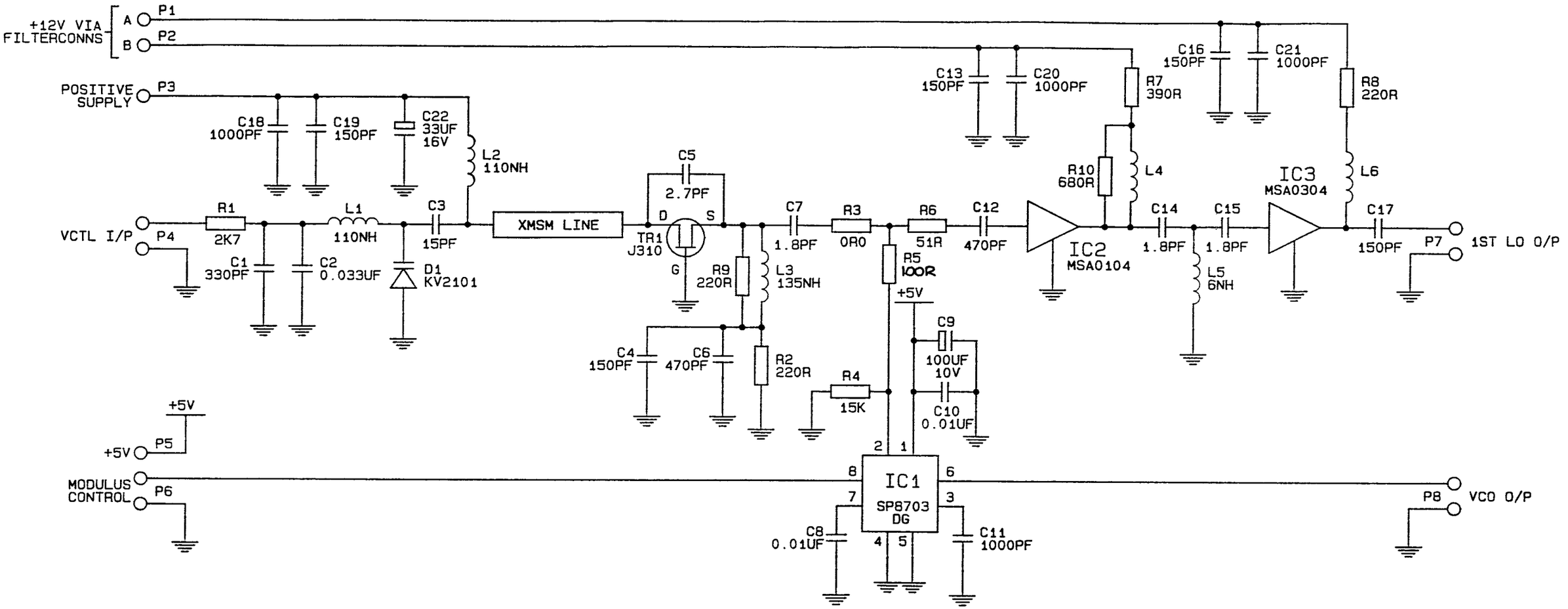


Figure 23 Oscillator Module: 1st L.O. VCO Board Circuit Diagram

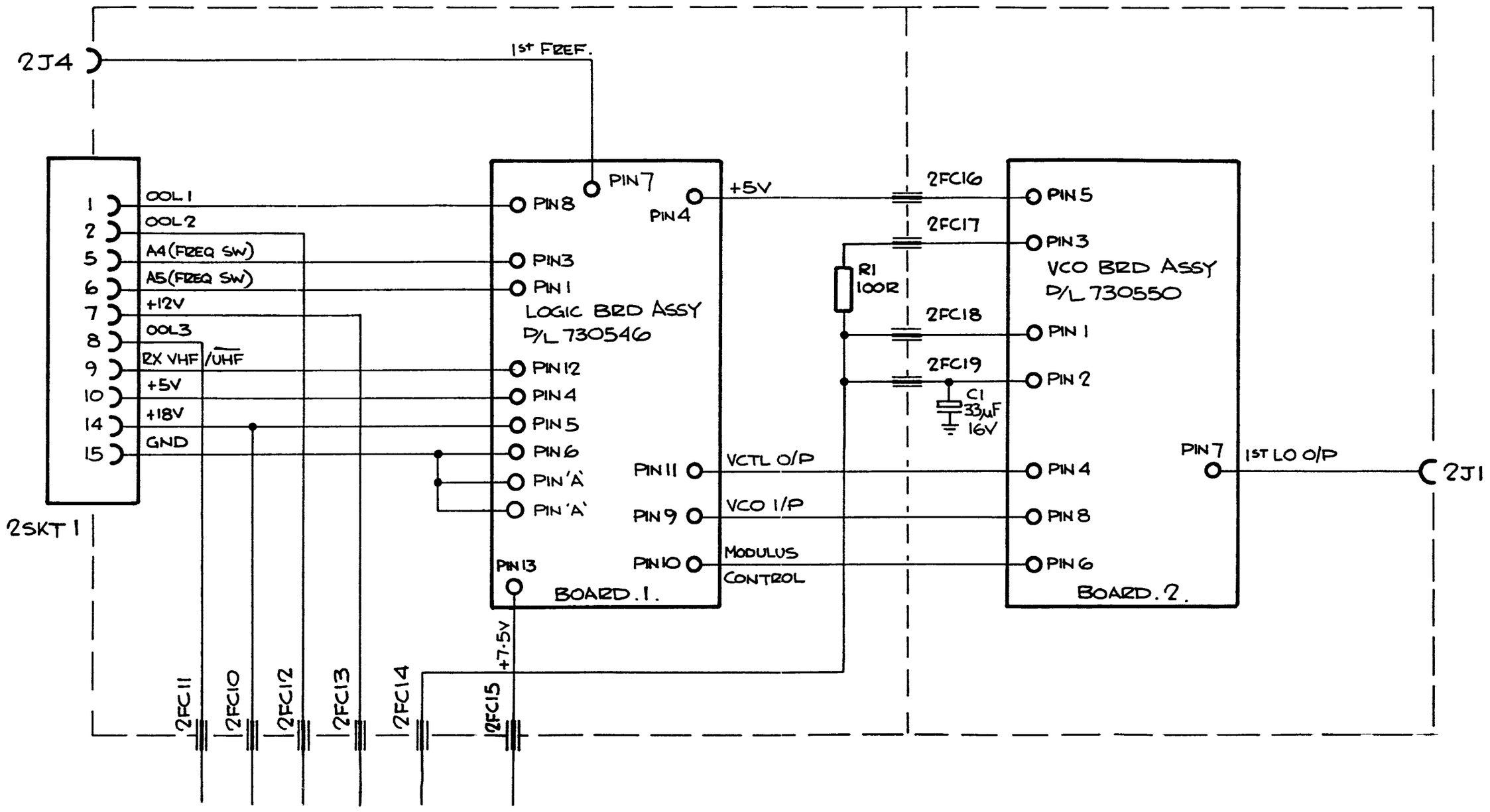


Figure 24 Oscillator Module: 1st L.O. Interconnection Diagram

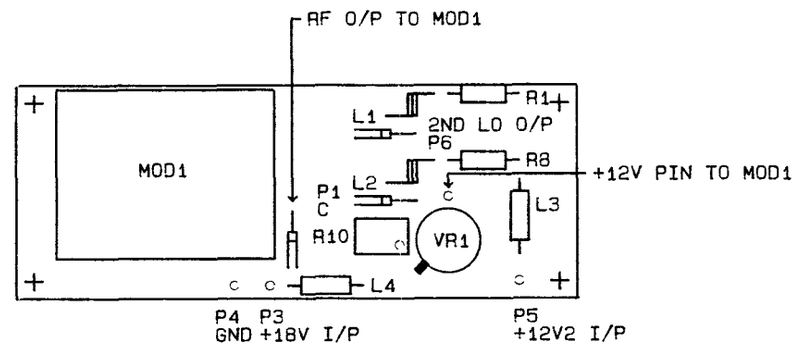


Figure 26 Oscillator Module - 2nd Local Oscillator VCO Board - Side A layout

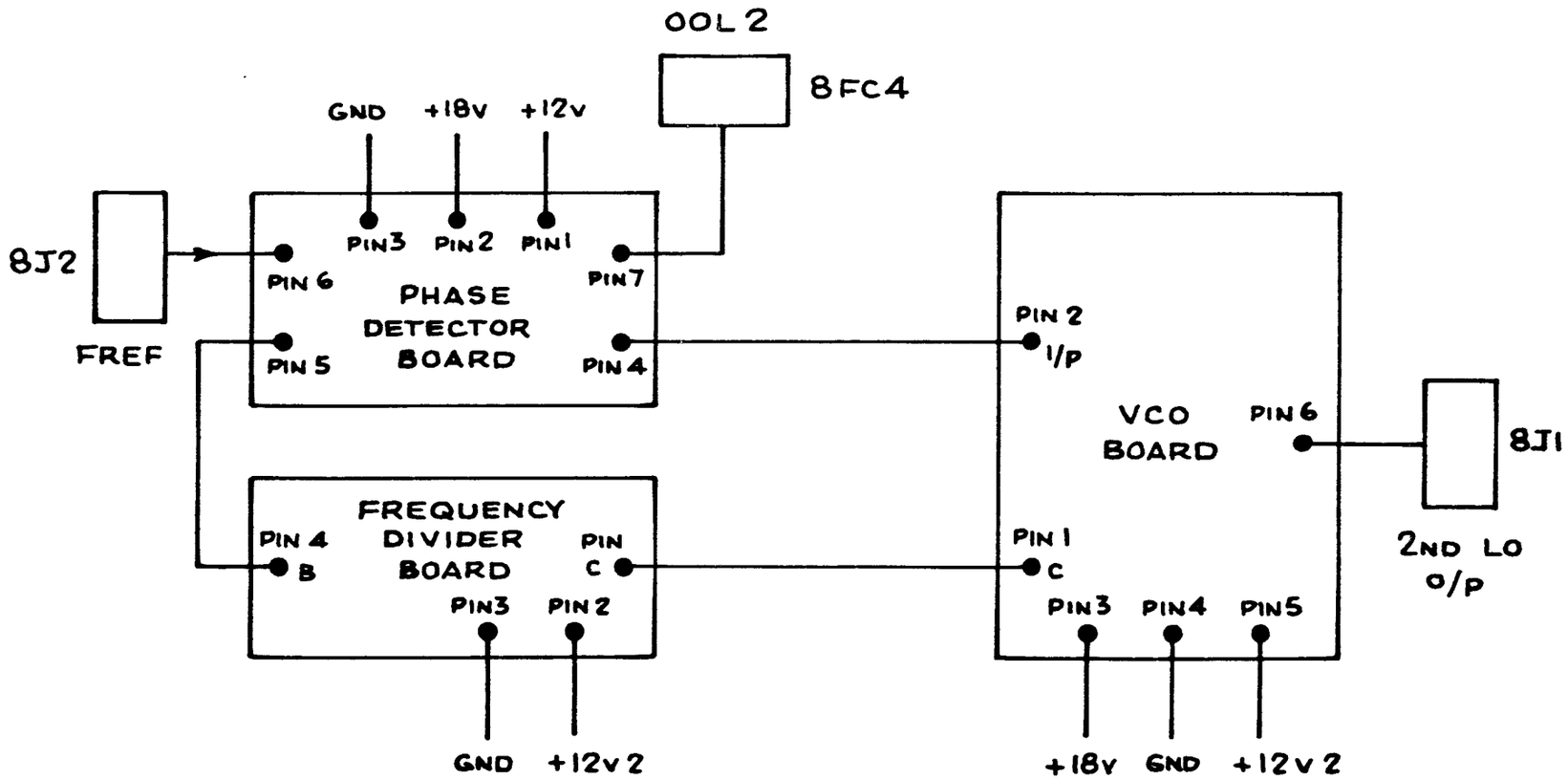


Figure 25 Oscillator Module - 2nd Local Oscillator Interconnection Diagram

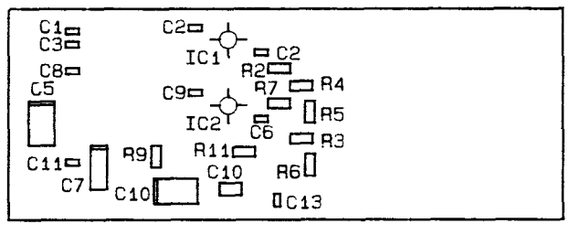


Figure 27 Oscillator Module - 2nd Local Oscillator VCO Board - Side B layout

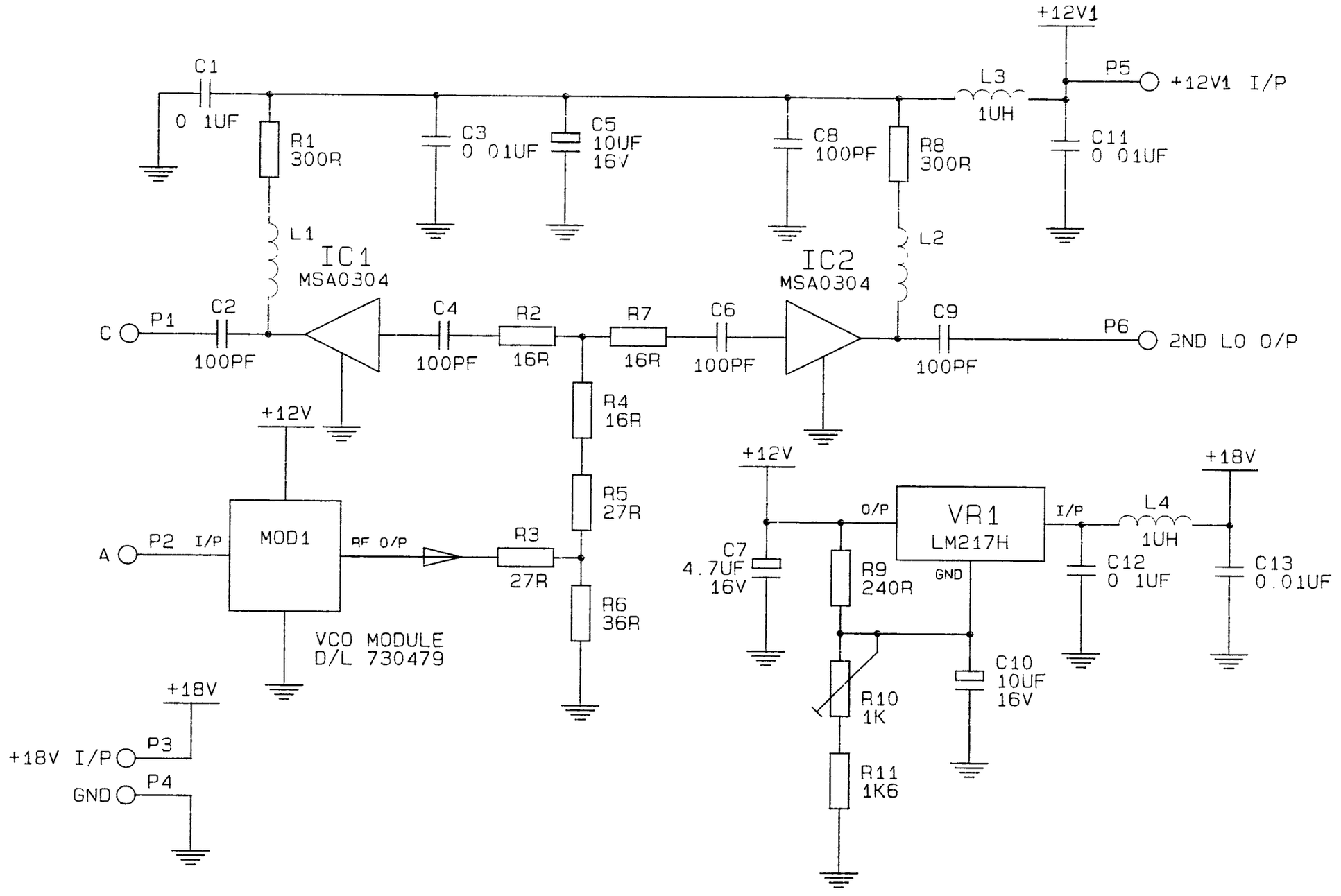


Figure 28 Oscillator Module - 2nd Local Oscillator VCO Board - Circuit Diagram

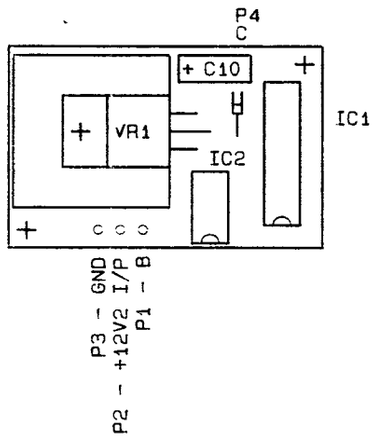


Figure 29 Oscillator Module - 2nd Local Oscillator Frequency Divider - Side A layout

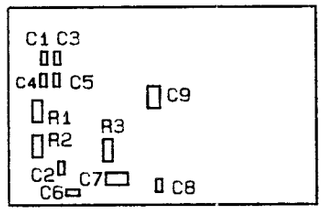


Figure 30 Oscillator Module - 2nd Local Oscillator Frequency Divider - Side B layout

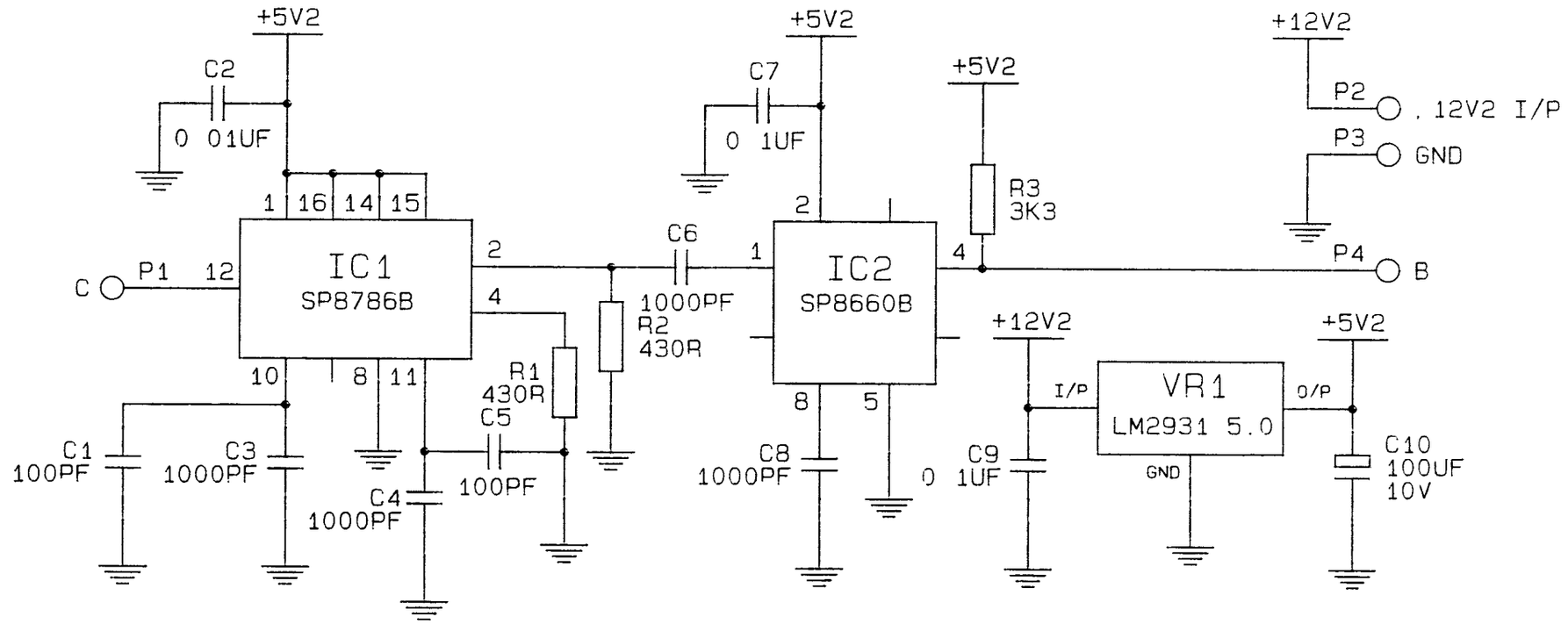


Figure 31 Oscillator Module - 2nd Local Oscillator Frequency Divider - Circuit Diagram

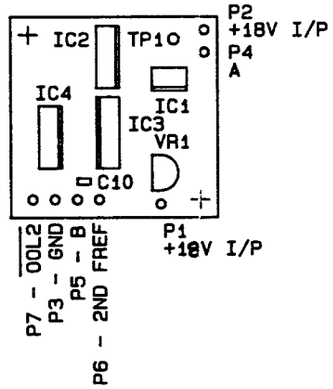


Figure 32 Oscillator Module - 2nd Local Oscillator Phase Detector - Side A layout

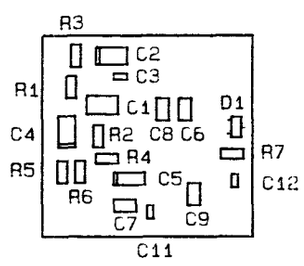


Figure 33 Oscillator Module - 2nd Local Oscillator Phase Detector - Side B layout

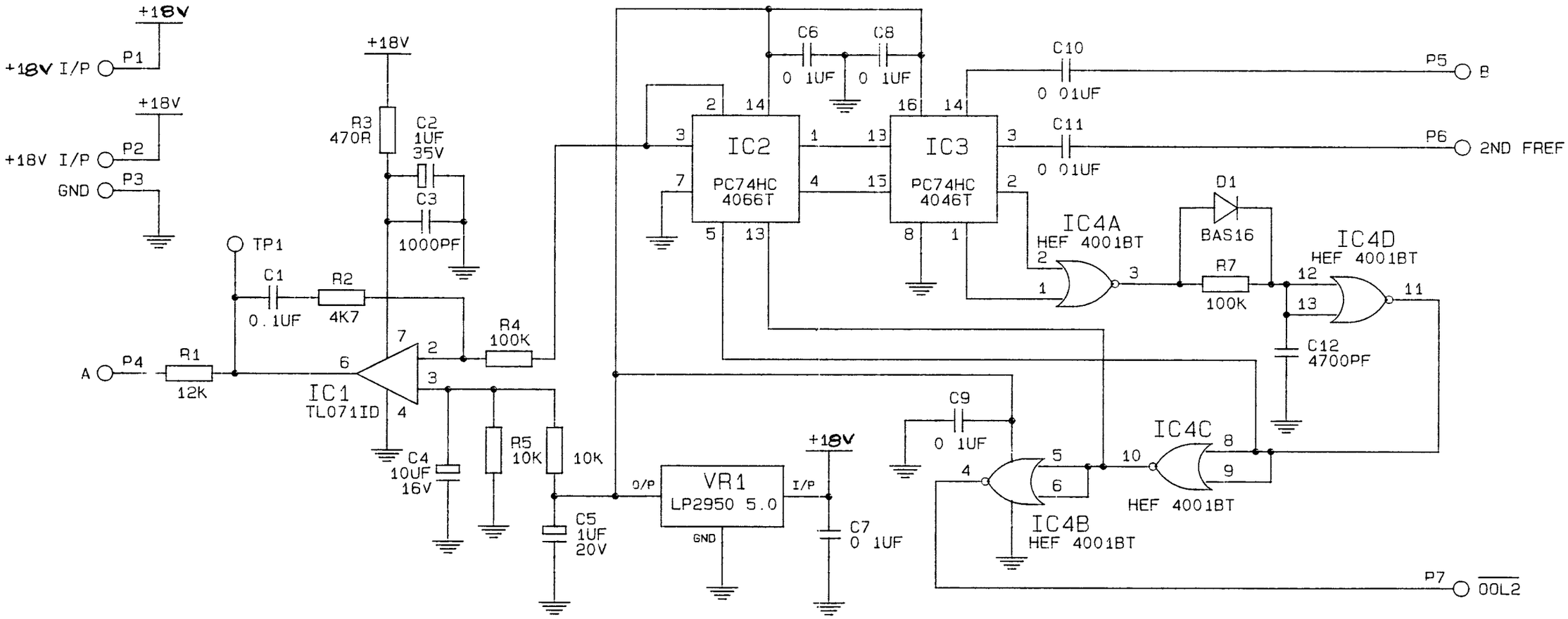


Figure 34 Oscillator Module - 2nd Local Oscillator Phase Detector - Circuit Diagram

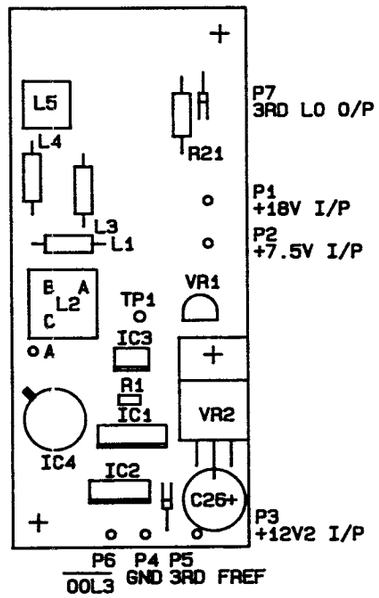


Figure 35 Oscillator Module - 3rd Local Oscillator - Side A layout

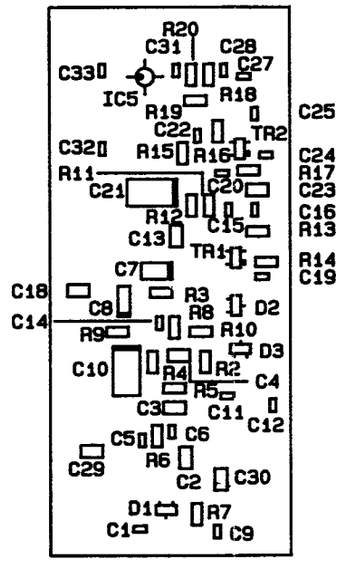


Figure 36 Oscillator Module - 3rd Local Oscillator - Side B layout

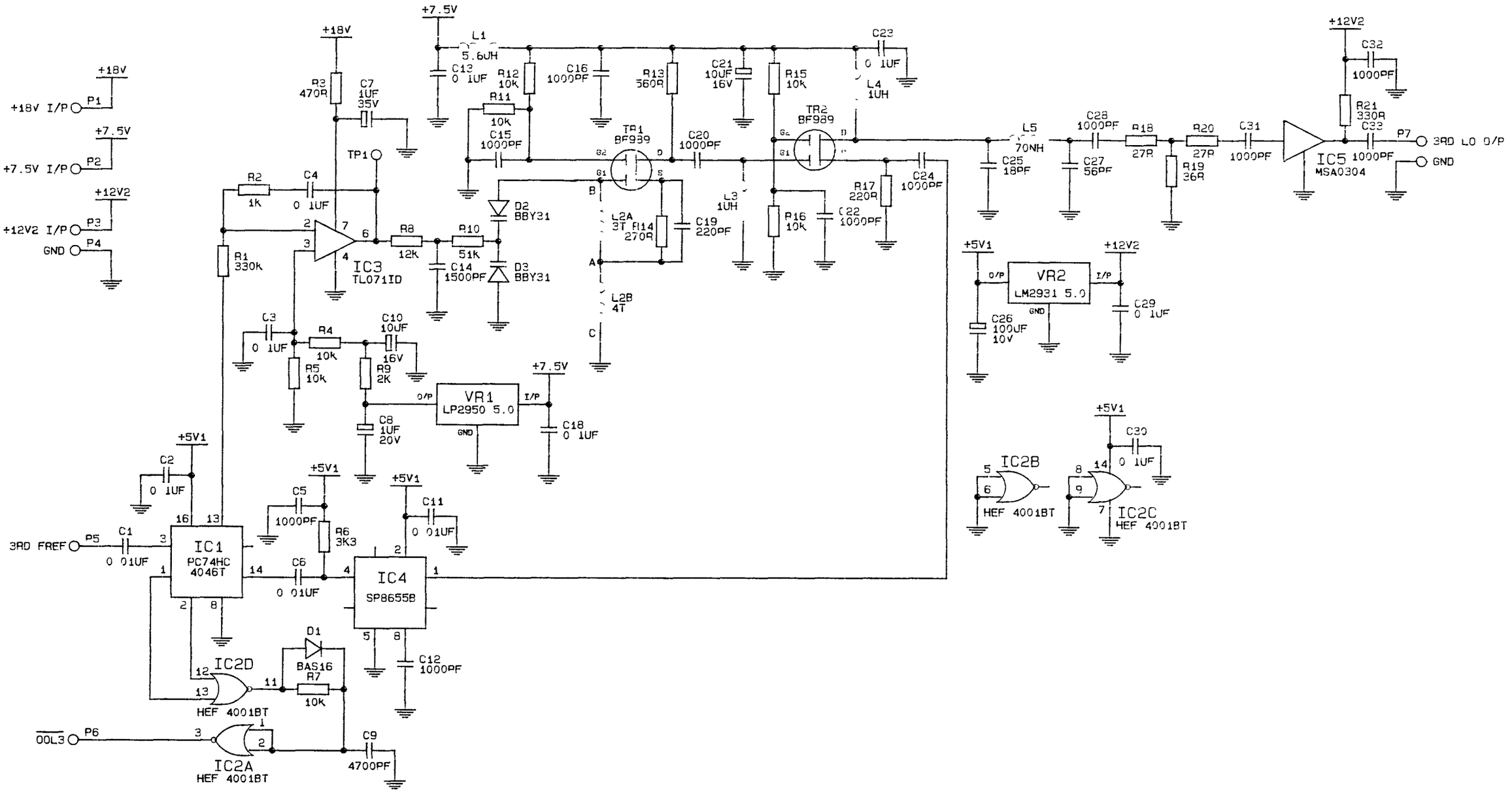


Figure 37 Oscillator Module - 3rd Local Oscillator - Circuit Diagram

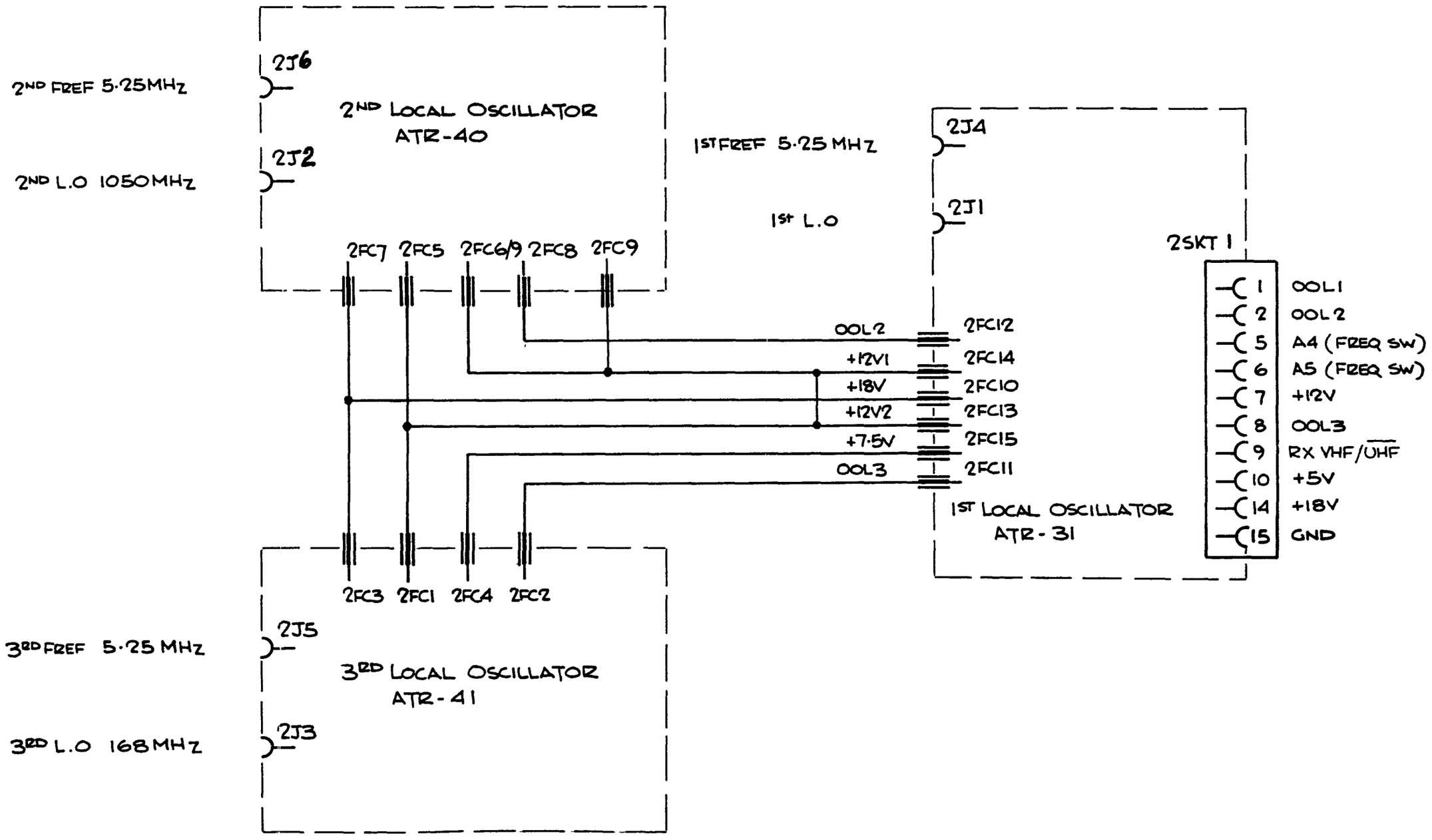


Figure 38 Oscillator Module: Interconnection Diagram

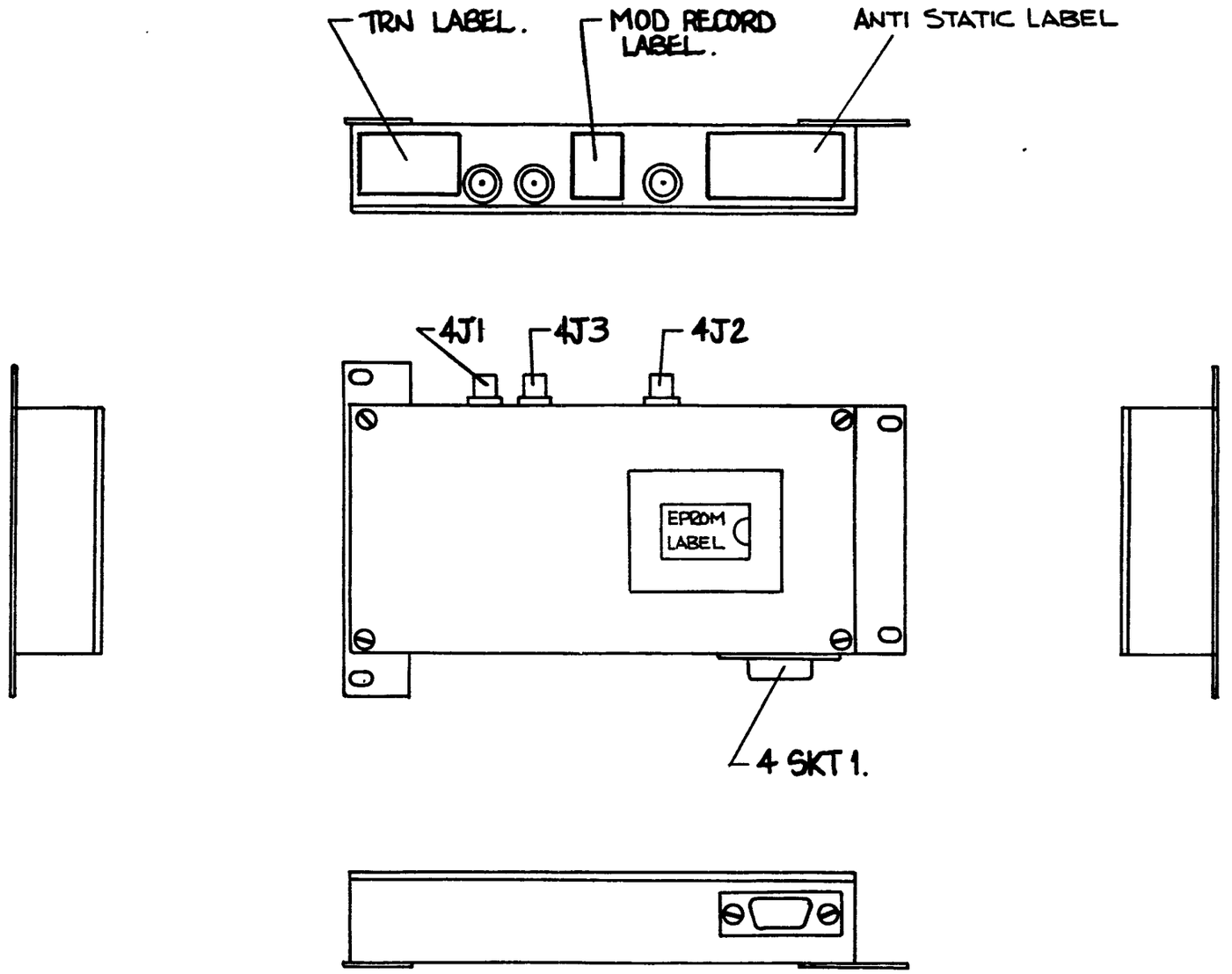


Figure 39 Transmitter Drive Module: Outline Detail

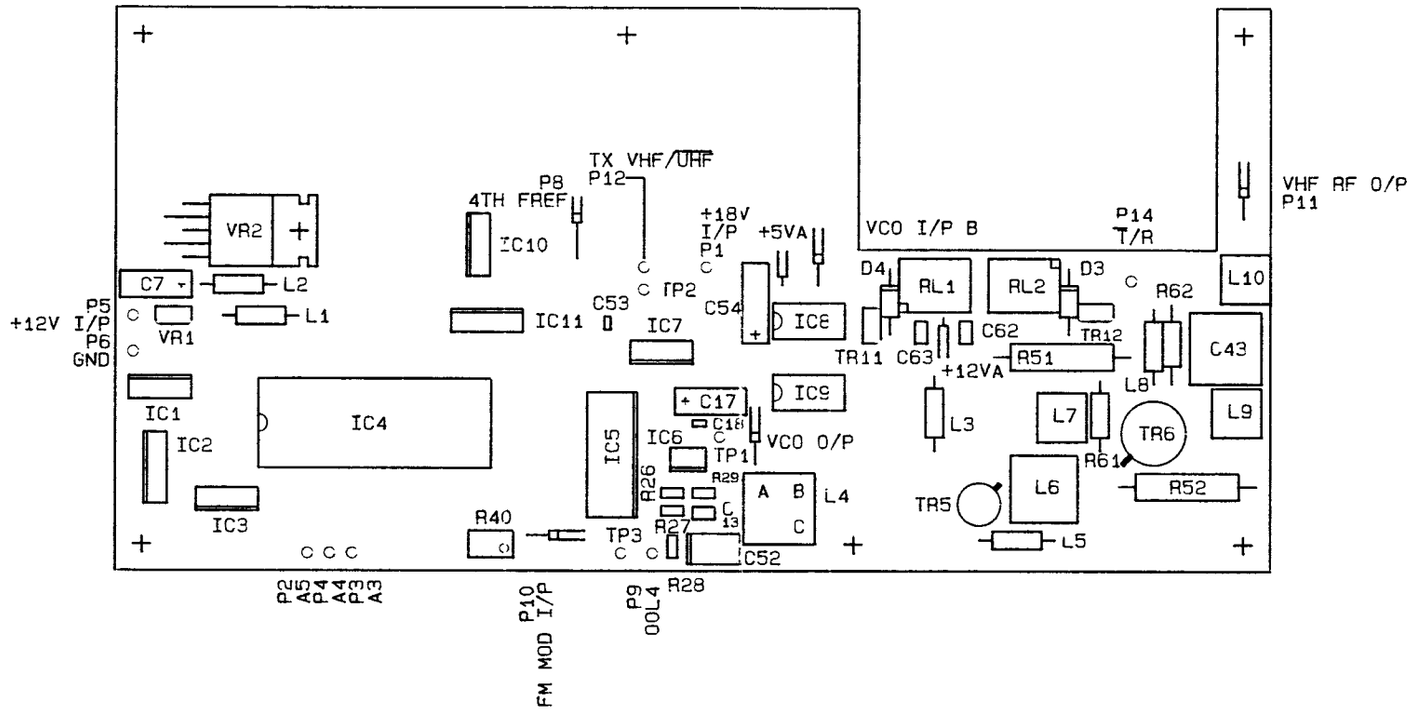


Figure 40 Transmitter Drive Board - Side A Layout

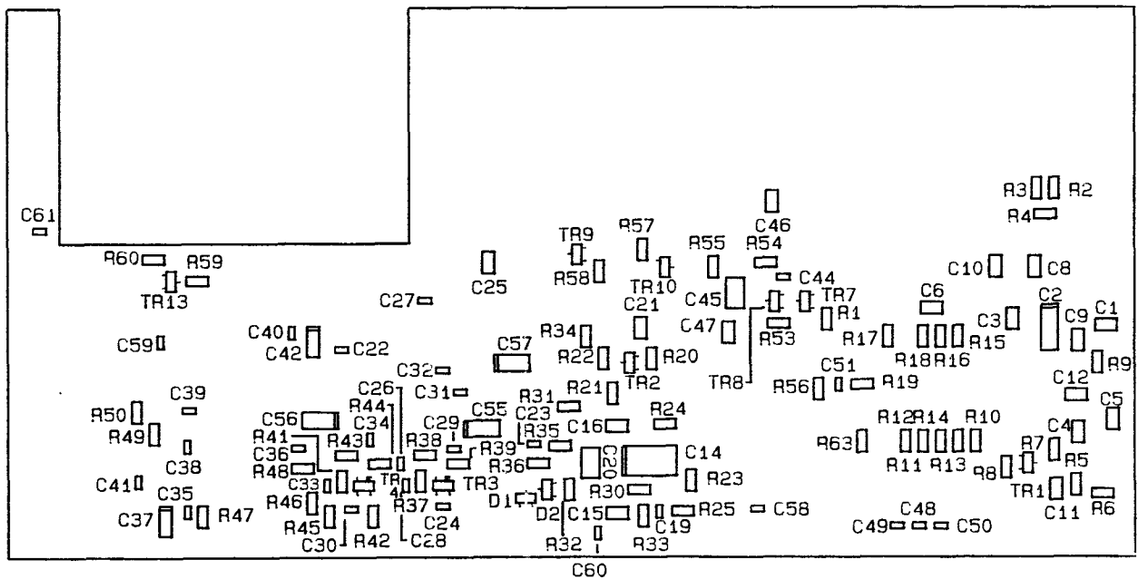


Figure 41 Transmitter Drive Board - Side B Layout

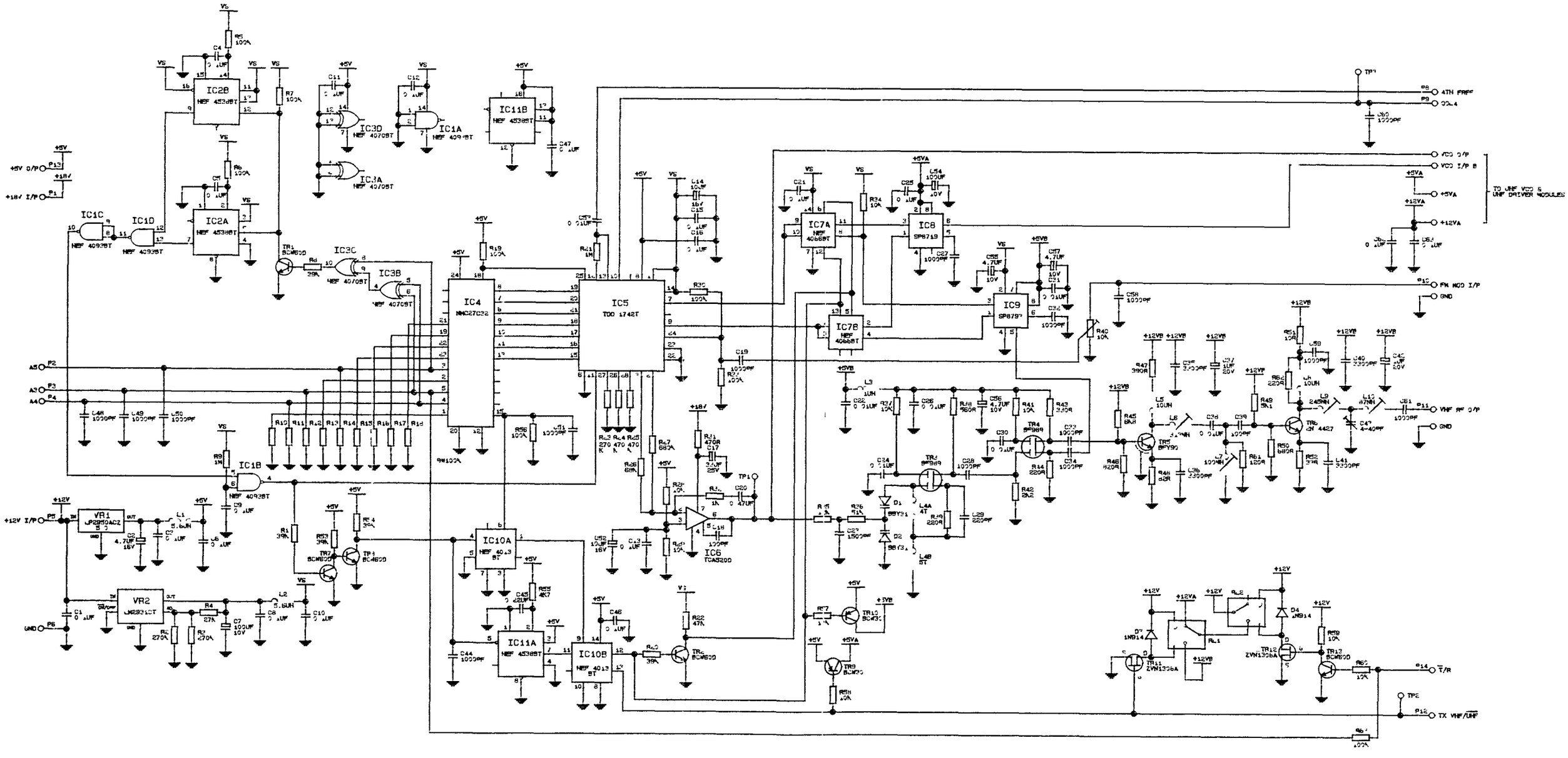


Figure 42 Transmitter Drive Board - Circuit Diagram

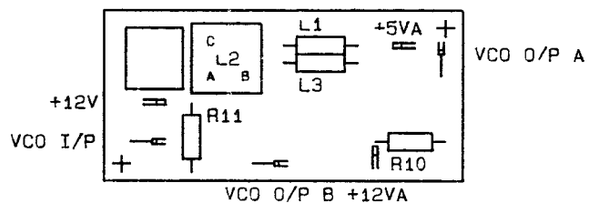


Figure 43 UHF VCO Board: Side A Layout

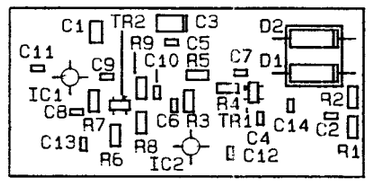


Figure 44 UHF VCO Board: Side B Layout

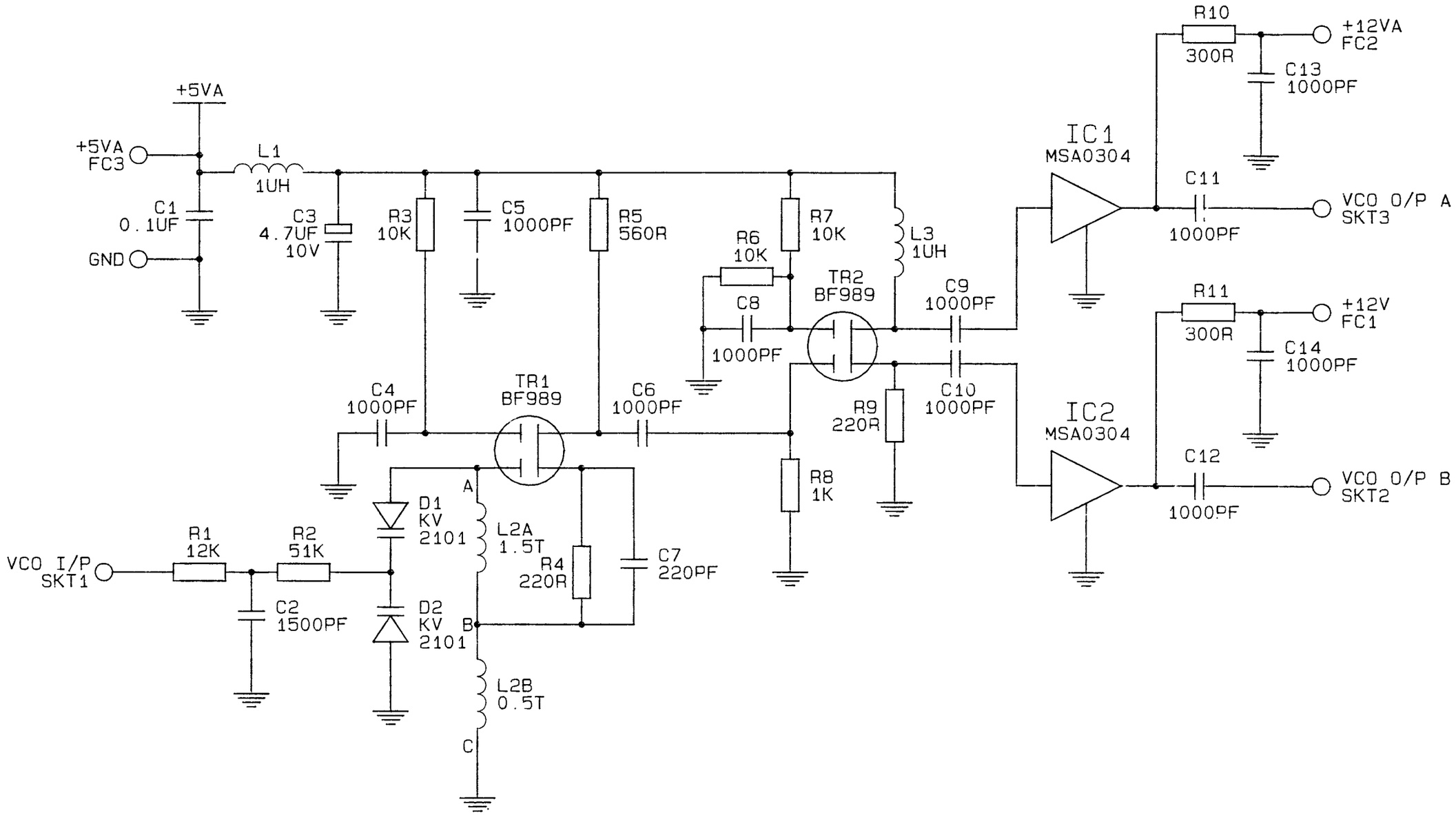


Figure 45 UHF VCO Board: Circuit Diagram

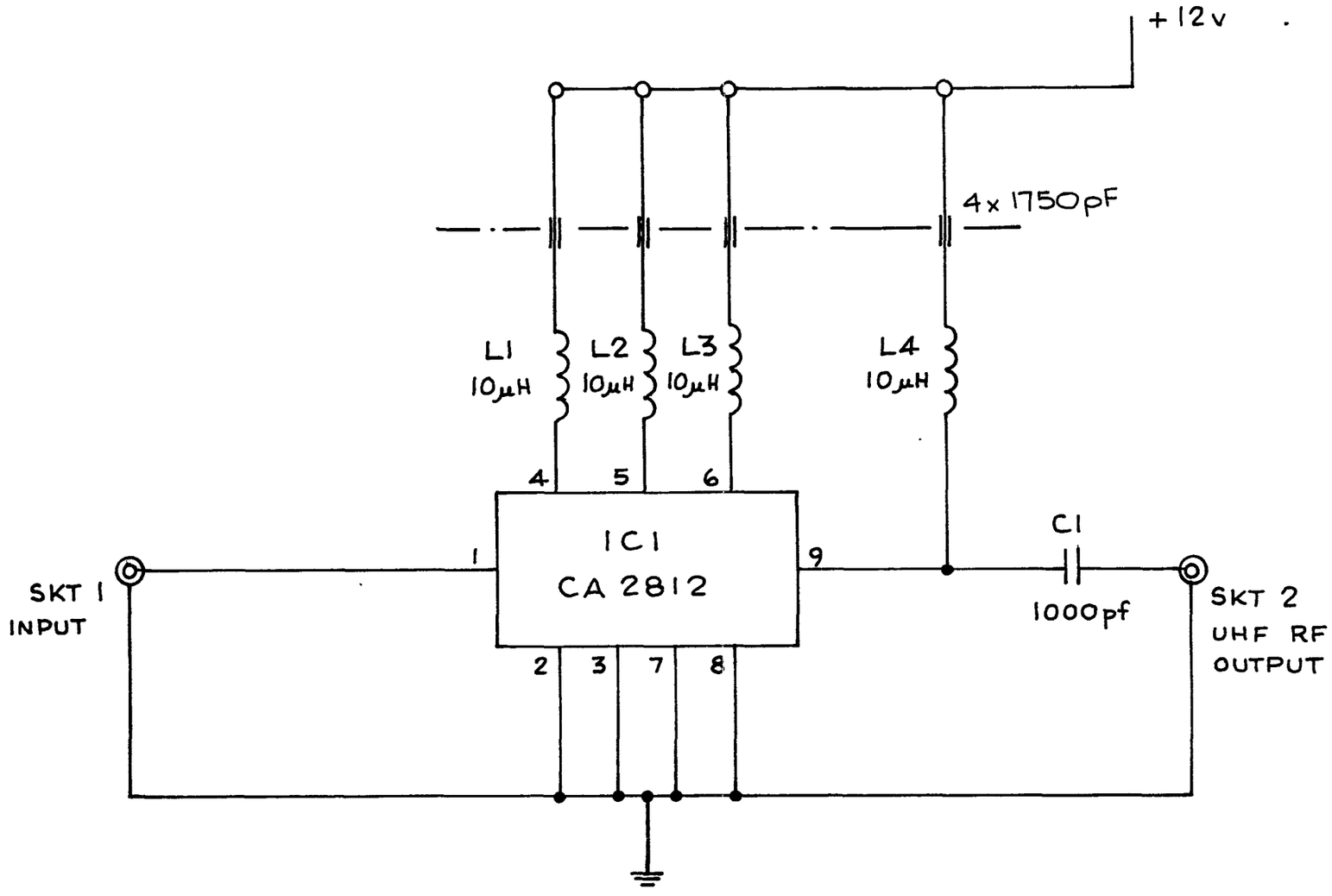


Figure 46 UHF Driver - Circuit Diagram

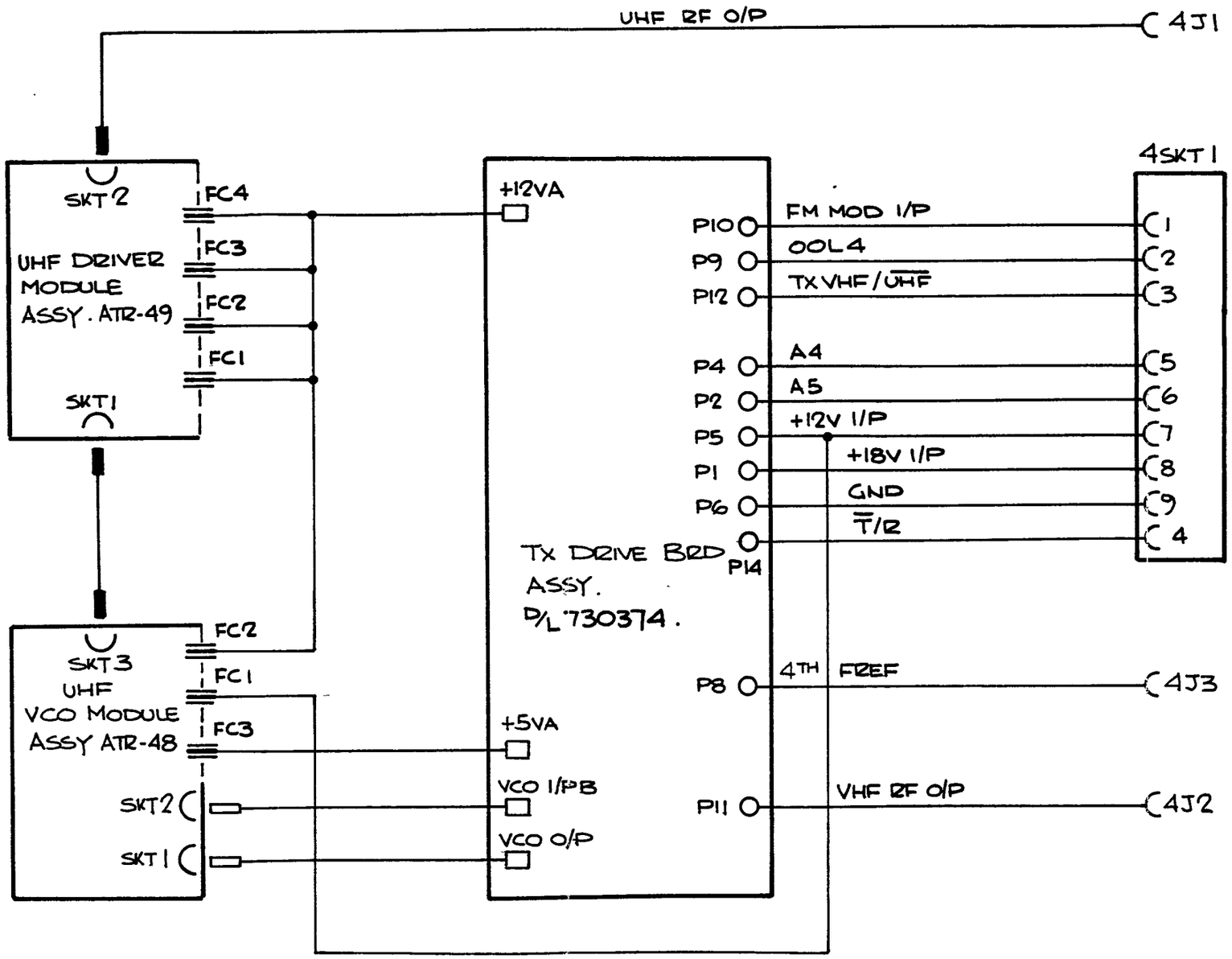


Figure 47 Transmitter Drive Module: Interconnection Diagram

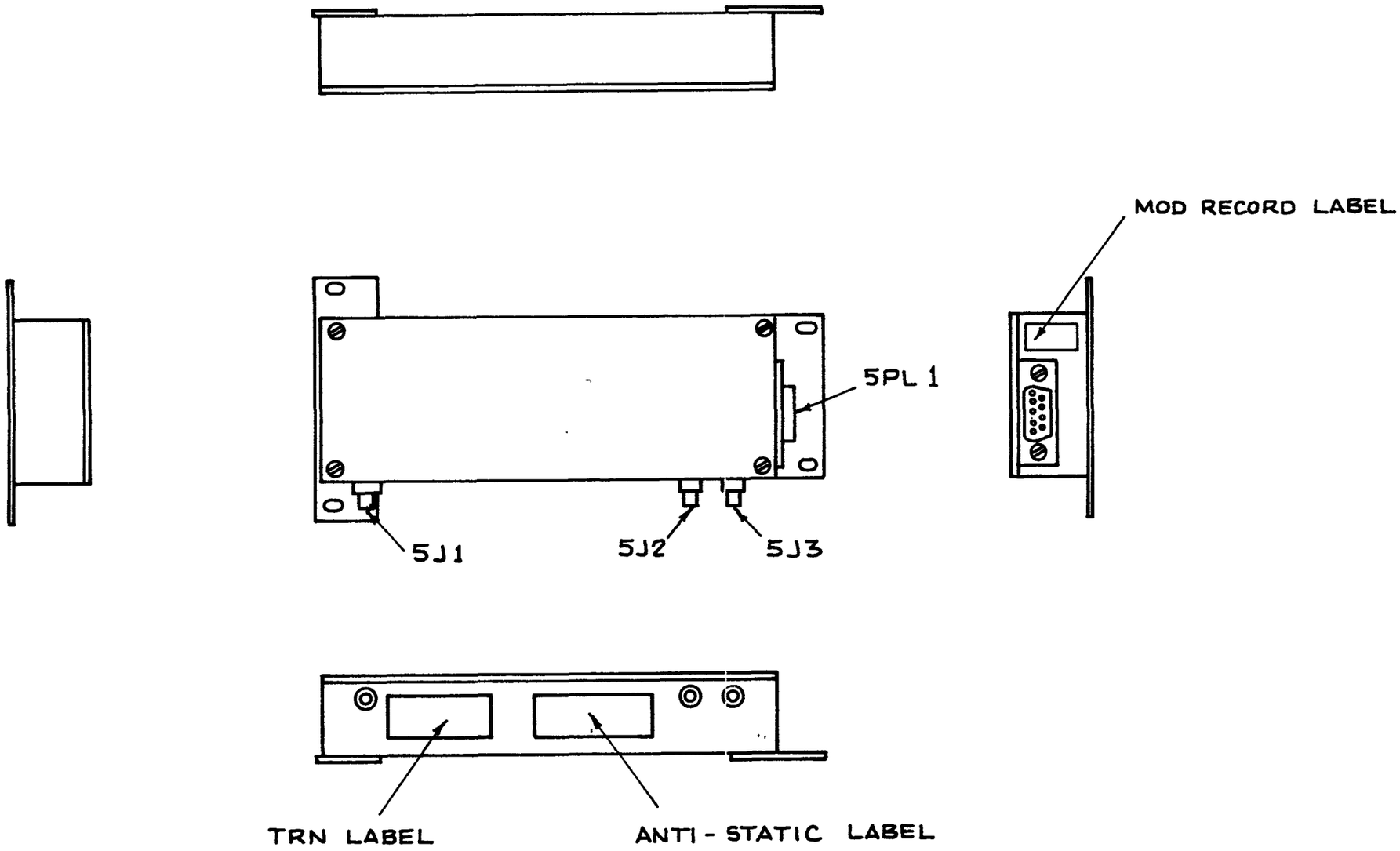


Figure 48 VHF Power Amplifier Module: Outline Detail

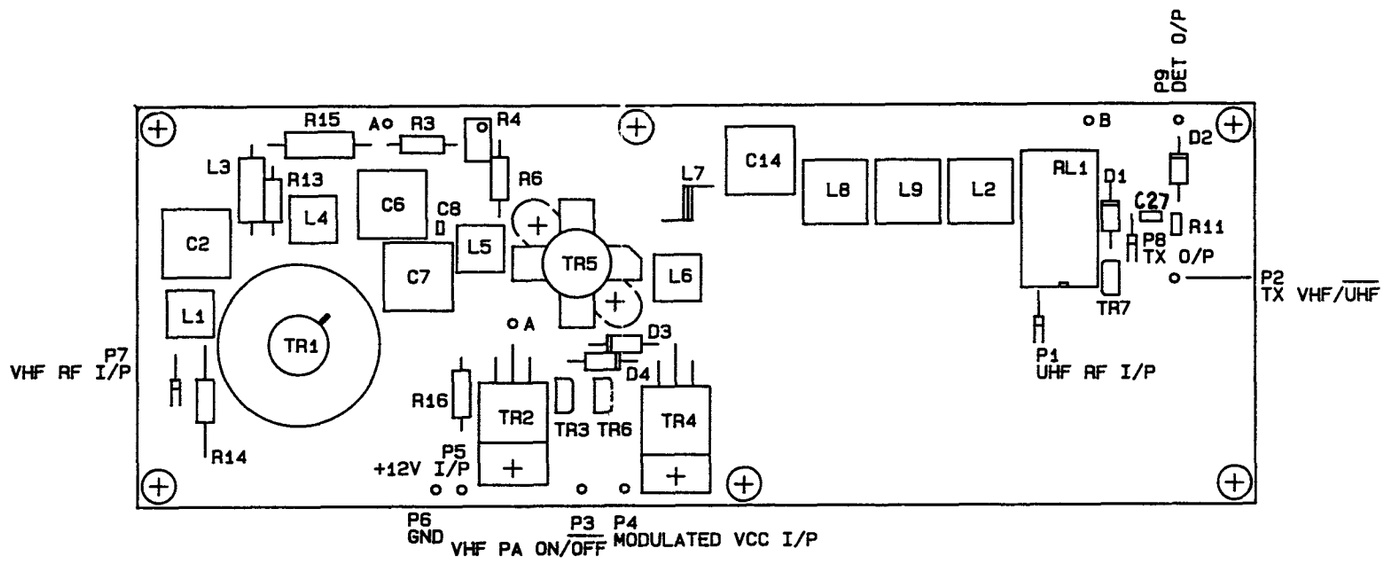


Figure 49 VHF Power Amplifier Board: Side A Layout

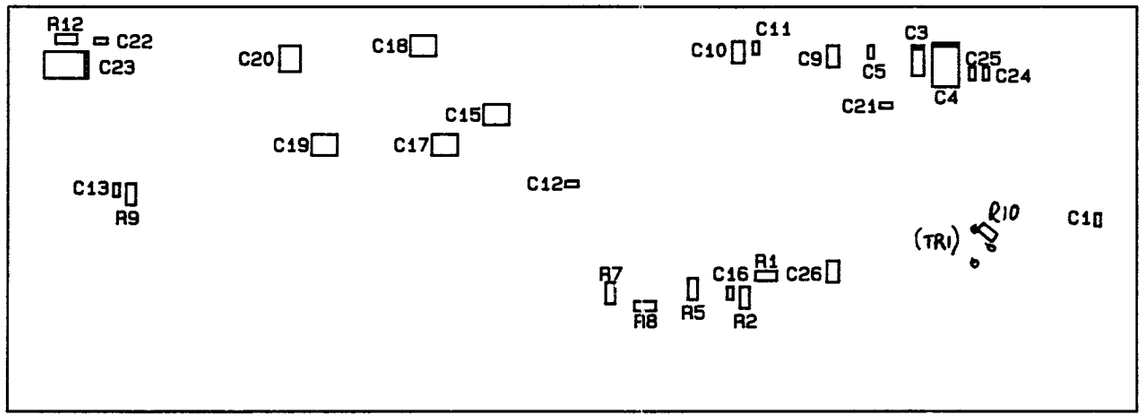


Figure 50 VHF Power Amplifier Board: Side B Layout

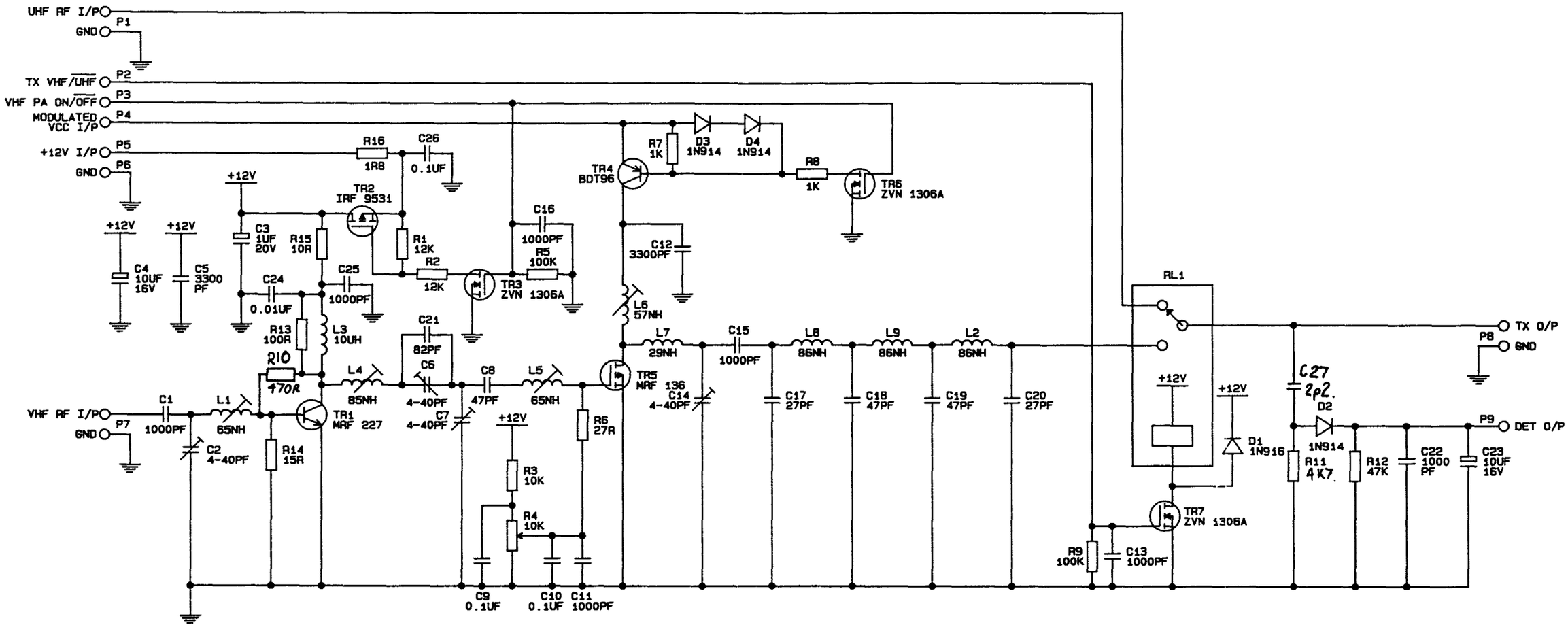


Figure 51 VHF Power Amplifier Board: Circuit Diagram

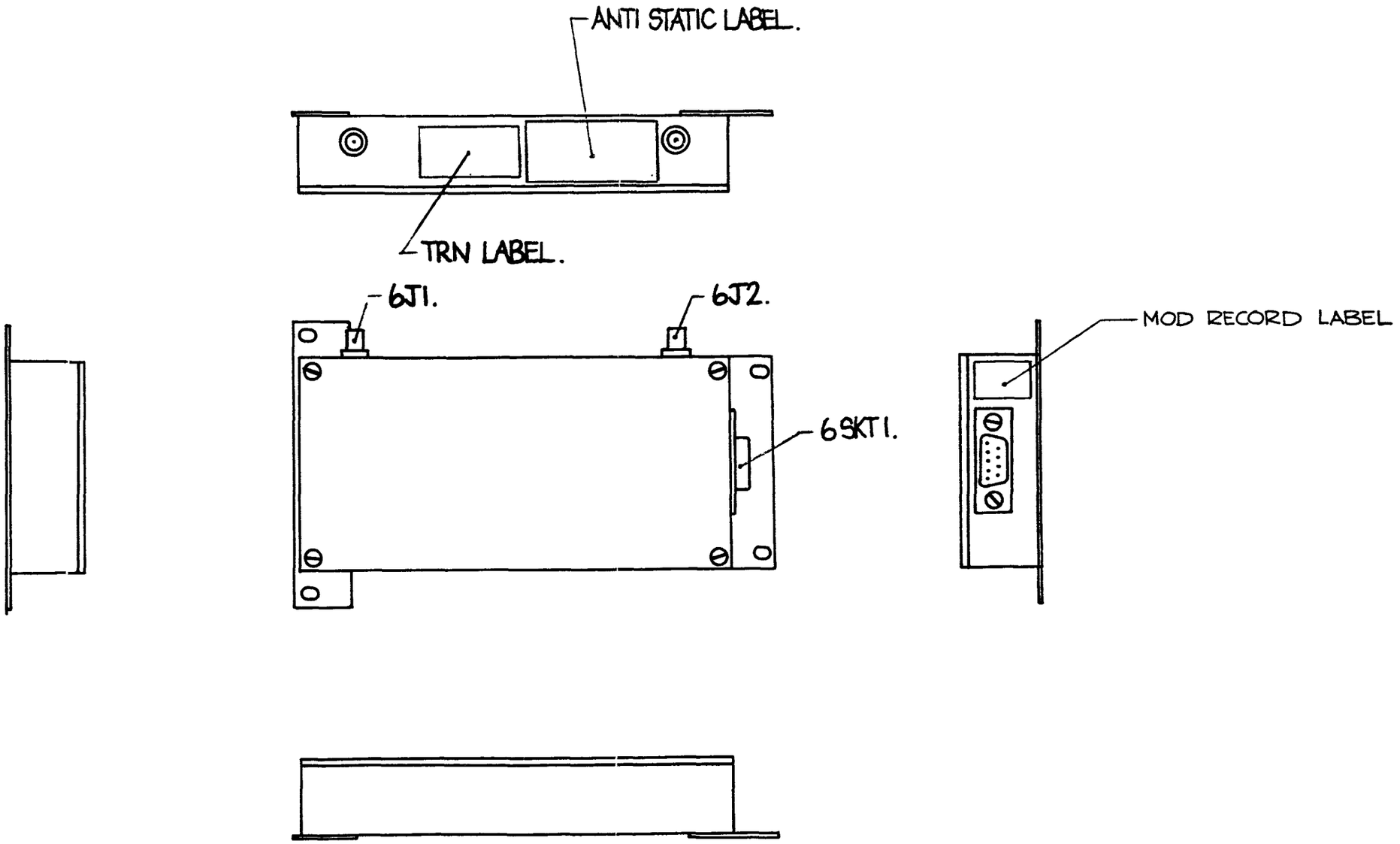
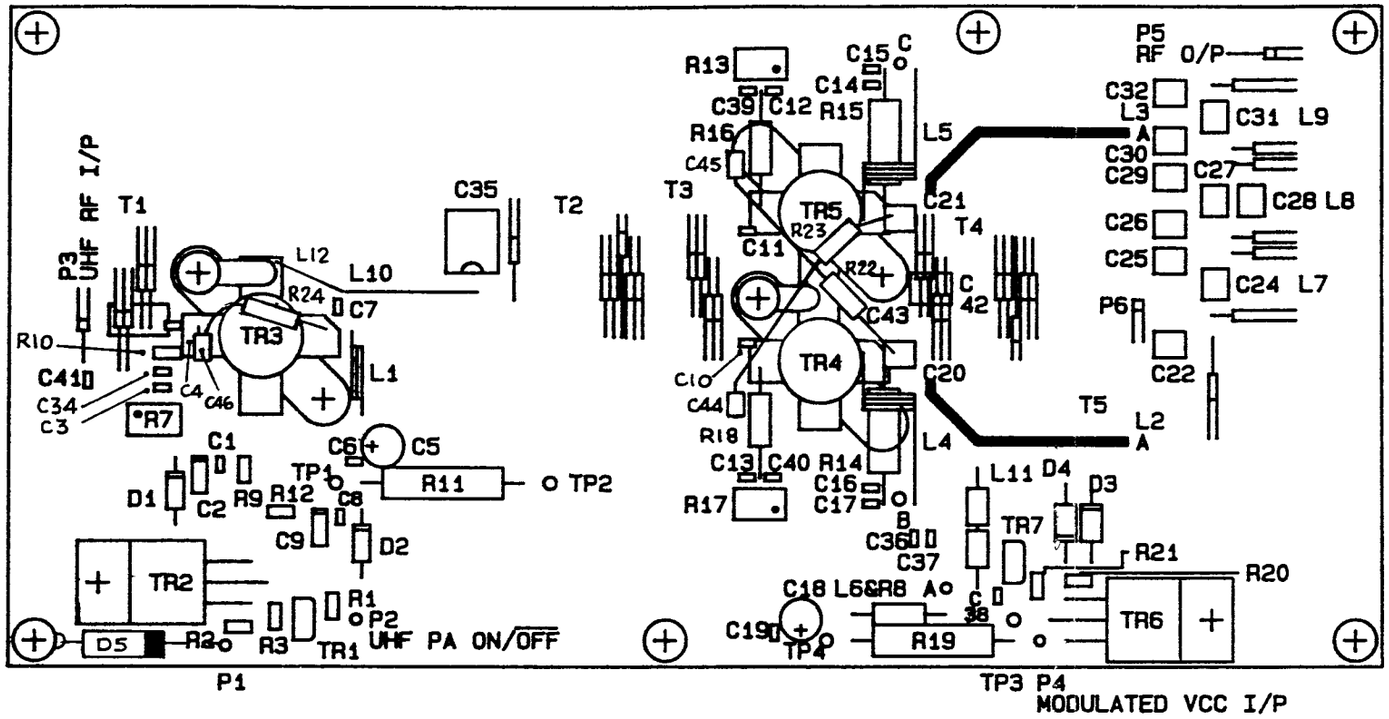
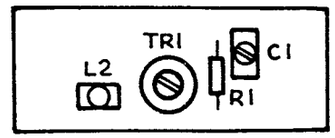


Figure 52 UHF Power Amplifier Module - Outline Detail





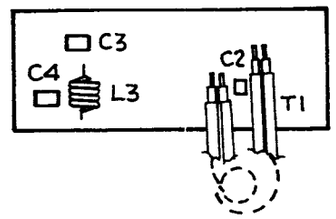


Figure 53 UHF Power Amplifier Board: Layout

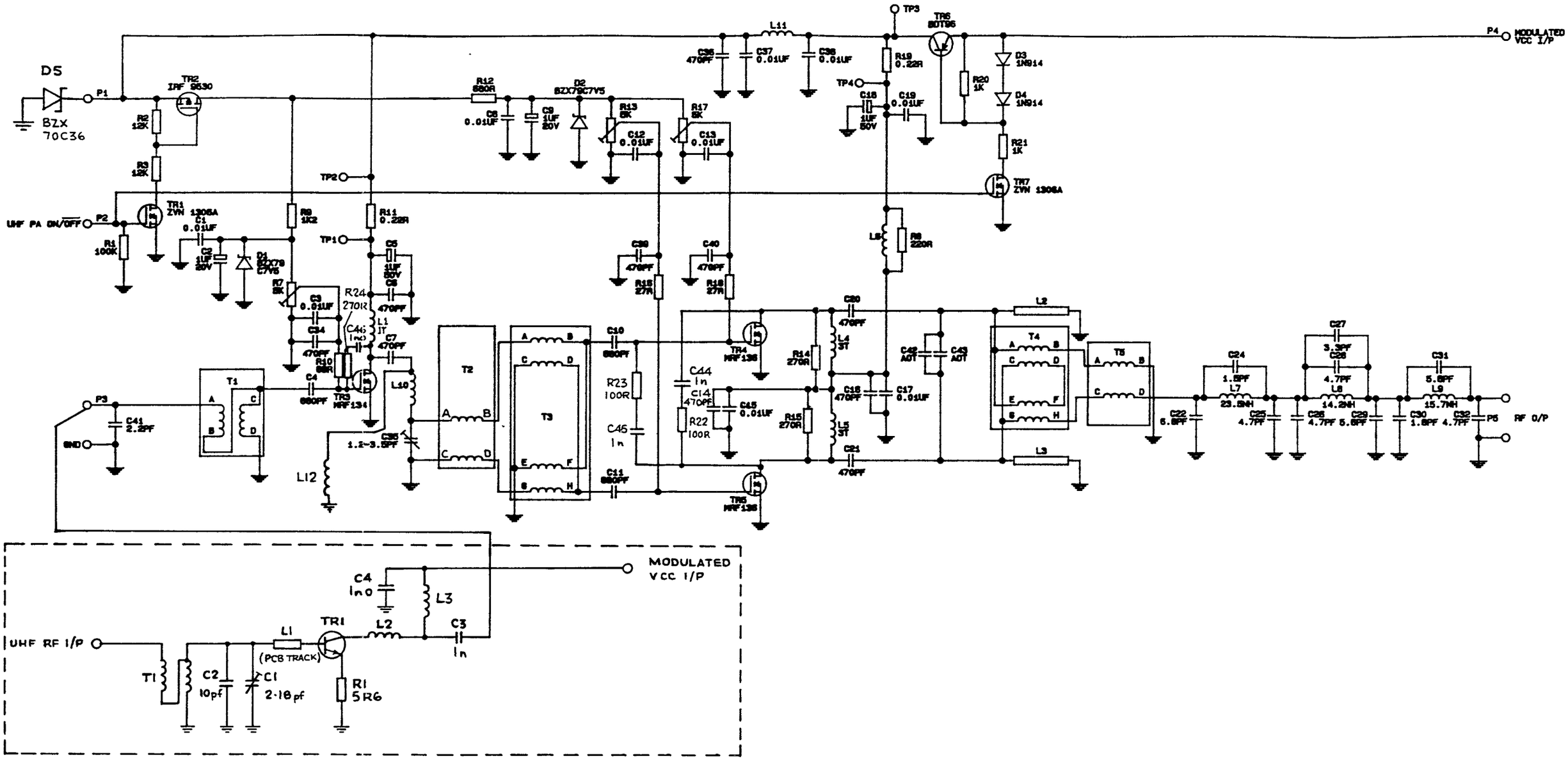


Figure 54 UHF Power Amplifier Board: Circuit Diagram

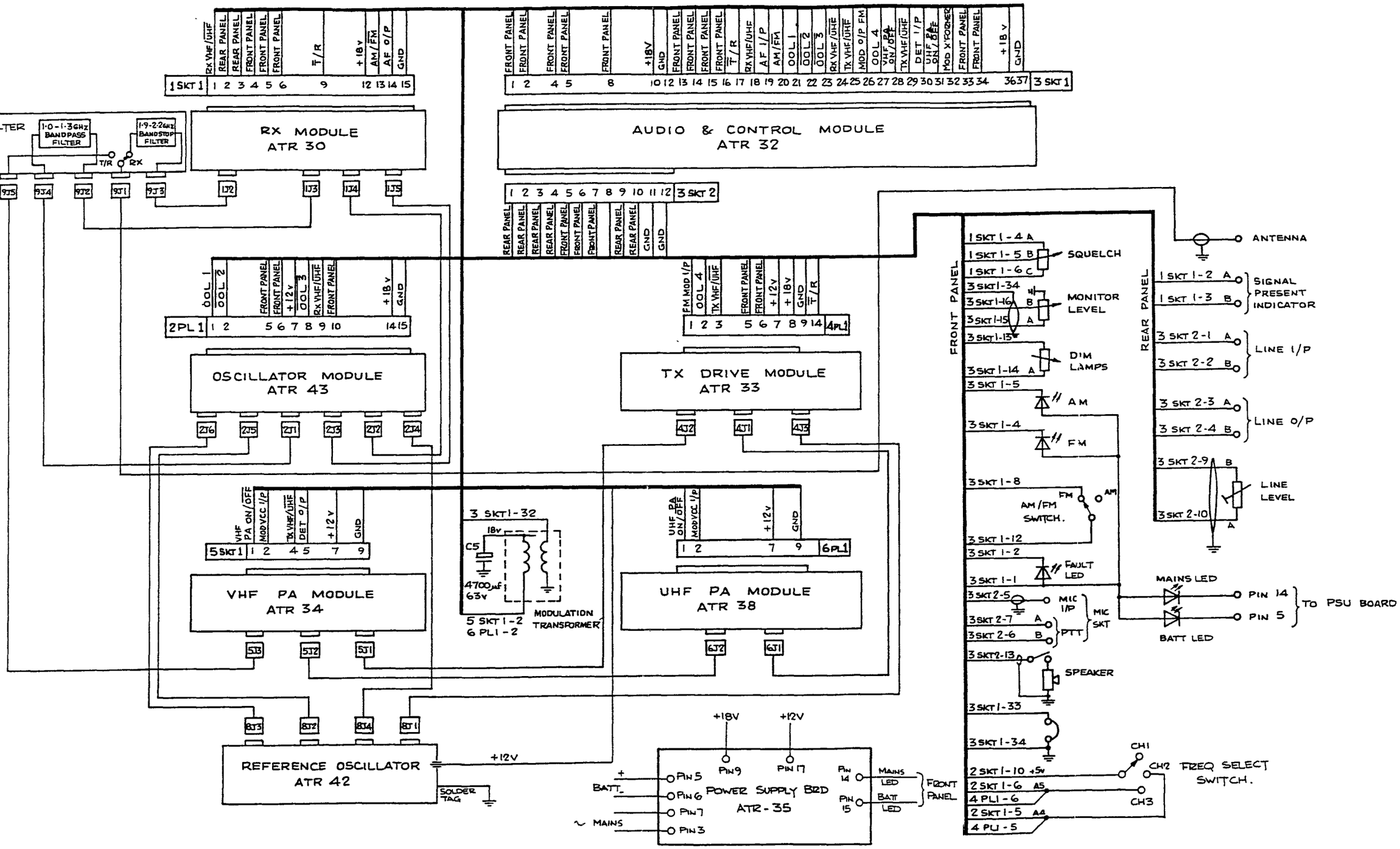


Figure 55 Chassis Assembly: Interconnection Diagram

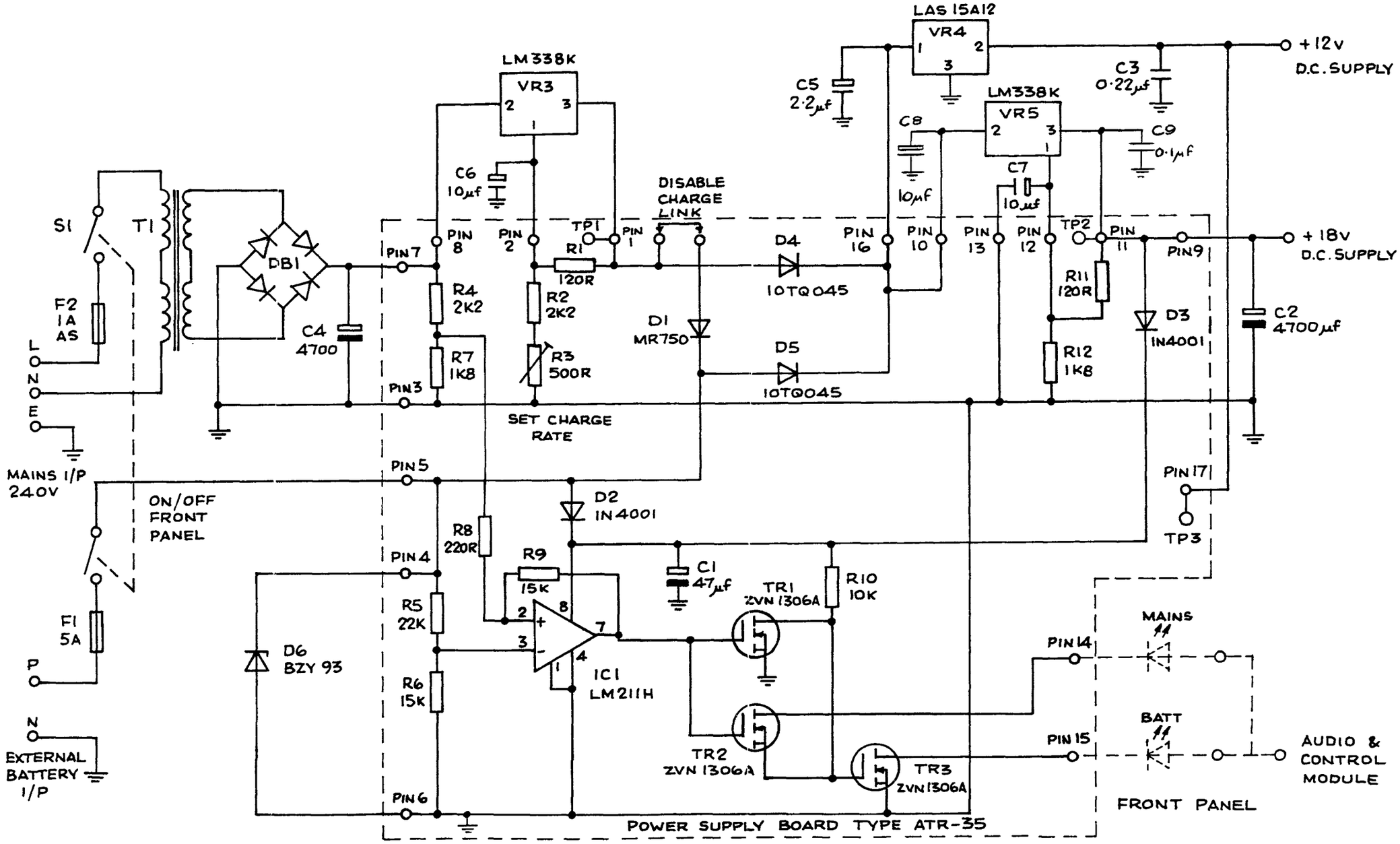


Figure 56 Chassis Assembly - Power Supply Circuit Diagram

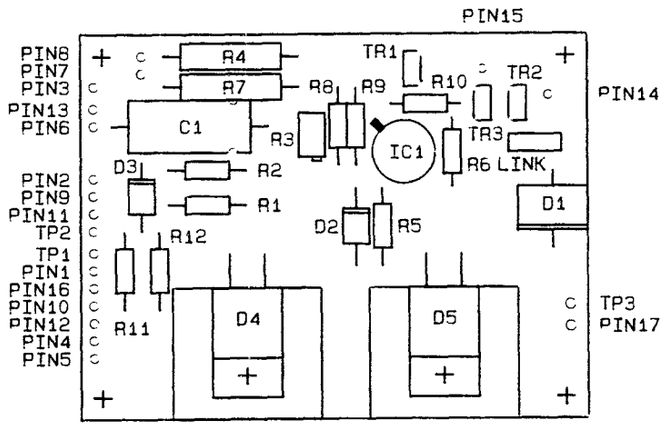


Figure 57 Chassis Assembly - Power Supply Board layout

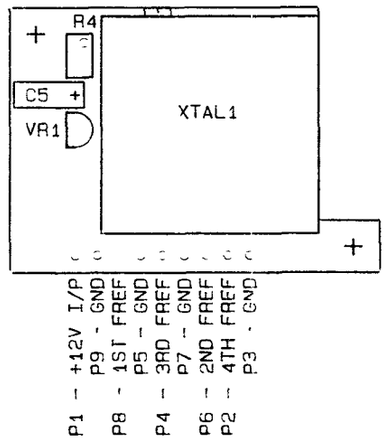


Figure 58 Chassis Assembly: Reference Oscillator Side A Layout

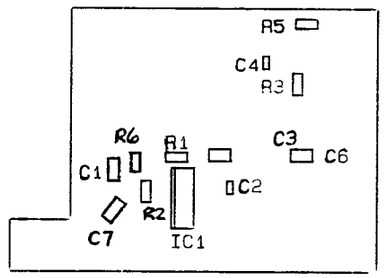


Figure 59 Chassis Assembly: Reference Oscillator Side B Layout

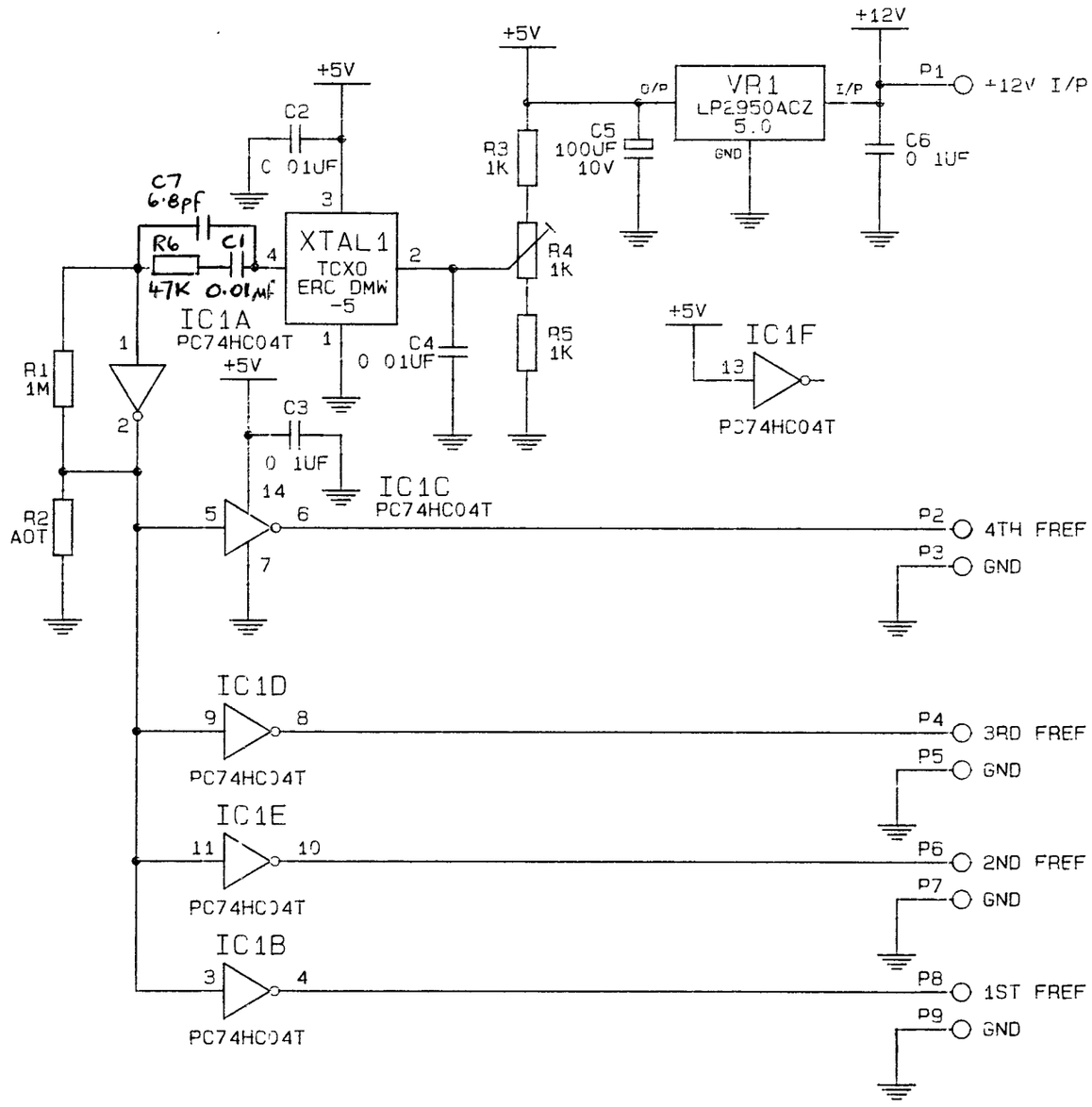


Figure 60 Chassis Assembly: Reference Oscillator Circuit Diagram

Chapter 3

MAINTENANCE INFORMATION

CONTENTS

INTRODUCTION, SAFETY PRECAUTIONS, MAINTENANCE NOTES AND GLOSSARY

INTRODUCTION

1 This section has been written to a format which details the minimum amount of maintenance necessary to ensure serviceability of the equipment It is intended to be used:

(a) On acceptance checks
(b) For functional testing after defect rectification
(c) To confirm serviceability after incorporation of modifications or STI's.
(d) When electronic alignment is judged necessary.

2 The setting-up of items of common user radio test equipment is not included in this schedule since this information is given in the appropriate AP.

3 There are no "lifed" components or moving parts fitted to the equipment and therefore there is no requirement for routine or periodic maintenance in the recognised sense.

Safety Precautions and Maintenance Notes

4 During servicing, the equipment is to be examined and any cleaning necessary is to be carried out.

5 Do not remove or disconnect modules without first ensuring that all power, (Mains and Battery), is removed from the equipment.

6 Voltages which are lethal are present in the equipment.

7 Static sensitive devices are utilised within the equipment.

8 Components containing Beryllium and/or its oxide Beryllia are utilised within the equipment.

CAUTION: Before keying on the equipment, (transmitting), ensure that the antenna connector on the ATR-3 is not directly connected to any equipment incapable of accepting 10 watts of RF energy without damage. 30 dB of attenuation will normally protect Counters, Signal Generators etc.

Glossary

9 The servicing operations detailed in this schedule have the meaning given in the Concise Oxford Dictionary except for the following:-

(a) Inspect - Review the work carried out by tradesman to ensure it has been performed satisfactorily.

(b) Check - Make a comparison of a measurement of time, pressure, temperature, resistance, dimension or other quantity with a known figure for that measurement.

(c) Test - Ascertain, by using the appropriate test equipment, that a component or system functions correctly.

(d) Examine - Carry out survey of the condition of an item. For example the condition of an item may be impaired by one or more of the following:-

(1) Insecurity of attachment.
(2) Cracks or fractures.
(3) Corrosion, contamination or deterioration.
(4) Distortion.

(5) Loose or missing rivets.
(6) Chafing, fraying, scoring or wear.
(7) Faulty or broken locking devices.
(8) Loose clips or packing, obstruction of, or leaks from pipelines.
(9) External damage due to birds, vehicles, stones, wind etc.
(10) Discolouration due to overheating, or leaking of fluids etc.

(e) Fit - Correctly attach one item to another.

(f) Refit - Fit an item which has previously been removed.

(g) Replace - Remove an item and fit a new or serviced item.

(h) Disconnect - Uncouple or detach cables.

(j) Reconnect- Reverse of sub para h.

(k) Operate - Ensure an item or system functions correctly, as far as can be ascertained without the use of test equipment or reference to measurement.

STANDARD SERVICEABILITY TEST (SST)

EQUIPMENT LIST

10 Table 1 lists the equipment required to carry out the Standard Serviceability Test (SST).

TABLE 1 EQUIPMENT LIST

ITEM	DESCRIPTION	QTY
1	Multimeter (AVO Model 8 or similar)	1
2	Signal Generator (HP 8657 or equivalent)	1
3	Frequency Counter (Philips PM6668 or equivalent)	1
4	Spectrum Analyser (Marconi TF2380 or equivalent)	1
5	RMS Voltmeter (Hewlett Packard 403B or equivalent)	1
6	Through line Wattmeter (Bird Type 43)	1
7	Inserts for Item 6 covering frequency ranges 117-137 MHz and 220 to 400 MHz at 10 watts)	As Req'd
8	RF Attenuator (30dB Bird 5052 Tenuline or similar)	1
9	Distortion Meter (Marconi TF 2337A or equivalent)	1
10	Battery, Lead Acid 24 volts 5 amp minimum capability.	1
11	Microphone (Tone Dynamics TD201 or equivalent)	1
12	Headphones (Standard NATO 600 Ohms)	1
13	Test Rx UHF Eprom (DMW programme A113)	1
14	Test Tx UHF Eprom (DMW programme A112)	1
15	Test Box (DMW Type ATR-310)	1
16	Cable Assembly Mains (DMW Type ATR-39)	1

(continued)

TABLE 1 EQUIPMENT LIST(continued)

ITEM	DESCRIPTION	QTY
17	Cable Assembly Test (DMW Type ATR-311)	1
18	Coaxial Cable Assemblies N (DMW Type ATR-312)	3
19	Coaxial Cable Assemblies BNC (DMW Type ATR-314)	3
20	Adaptor 'T' BNC	1
21	Adaptor 'N' to BNC	1
22	Cable Assembly Test (DMW Type ATR-313)	1
23	Cable Assembly Test (DMW Type ATR-315)	1
24	Audio Signal Generator (Farnell Type ESG1 or equivalent)	1
25	Test Rx VHF EPROM (DMW Programme A114)	1
26	Test Tx VHF EPROM (DMW Programme A111)	1
27	Extractor Tool (24 Pin IC)	1
28	Audio Wattmeter (Marconic TF893A or equivalent)	1
29	Adaptor BNC to Banana Twin	2
30	Modulation Meter (Racal Dana 9008 or similar)	1

SST PARAMETERS

11 Table 2 lists the specific parameters tested during the implementation of the SST.

TABLE 2 SST PARAMETERS

PARAMETER TESTED	SST REFERENCE
VHF AM Sensitivity Check	Item 4
Quieting Check & Line Output Level Check	Item 5
Squelch Control Check	Item 6
Monitor Audio Output Check	Item 7
Monitor Audio Frequency Response Check	Item 8
Audio Distortion Check	Item 9
AGC Check	Item 10
IF Selectivity Check	Item 11
IF Rejection Check	Item 12
Adjacent Channel Check	Item 13
Transmitter Frequency Accuracy Checks	Item 14
VHF Power Output Check	Item 15
Sidetone Check	Item 16
Modulation Depth Checks	Item 17
Modulation Distortion Checks	Item 18
Spurious Output Checks	Item 19
UHF & FM Check Preliminaries	Item 20
Deviation Checks	Item 21
Occupied Bandwidth Check	Item 22
UHF Power Output Check	Item 23
FM Sensitivity Check	Item 24
FM Audio Distortion Check	Item 25
Battery Take-Over Check	Item 26
Conclusion	Item 27

SST PROCEDURES

12 The SST is provided in tabular form with each parameter checked being allocated a specific item number.

TABLE 3 STANDARD SERVICEABILITY TEST

Item No	Equipment	Operation
1.0	Chapters 1 & 2	Read
2.0	Servicing Forms	Enter details of unit under test (UUT).
3.0	Preparation	
3.1.	General Purpose Test Equipment.	) Connect as) shown in
3.2.	Special-to-type Test Equipment.	) Figure 1.)
3.3.	ATR-3	)
3.4.	Battery	Ensure charged
3.5.	Test Equipment	Switch on and allow a warm up period.
3.6.	ATR-3	(i) Ensure fitted with Test EPROMS A114 & A111 (A114=Rx A111=Tx). (ii) Ensure set for "Remote" operation.(Switch SW1 in Audio and Control Module).
3.6.1.	Power Switch	Depress to 'ON'
3.6.2.	AM/FM Switch	Set to 'AM'
3.6.3.	Speaker ON/OFF switch	Set to 'ON'
3.6.4.	Dim Lamps Control	Set fully clockwise
3.6.5.	Frequency Select switch	Set for CH.2
3.6.6.	Squelch Control	)Set for comfortable level of
3.6.7.	Monitor Level Control	)noise background with squelch)just lifted.
3.6.8.	Mains LED	Ensure illuminated.
3.6.9.	Fault LED	Ensure extinguished.
3.7.	RMS Voltmeter	Connect to Test Box ATR-310 Output Socket. (AF O/P 2).
3.8.	RF Wattmeter	Ensure fitted with VHF 10 watt insert to measure forward power
	NOTE: Standard RF Input definition is:- An emf from a 50 ohm source, amplitude modulated by 1 KHz sine wave to 30 % depth at a level of 1 mV at the ATR-3 antenna connector unless otherwise specified. For FM, standard deviation is ± 2.5 KHz.	
4.0.	VHF AM Sensitivity Check	
4.1.	Signal Generator	Set to CH.2 frequency (127.0 MHz) with 80 % AM, 1 kHz sine wave modulation. (continued)

TABLE 3 STANDARD SERVICEABILITY TEST (continued)

Item No	Equipment	Operation
4.2.	ATR-3	Ensure sensitivity is better than 5 microvolts emf at the ATR-3 antenna connector for a 10 dB S+N/N ratio.
4.3.	Signal Generator	)Repeat 4.1 & 4.2 for Channels
4.4.	ATR-3	)1 & 3. (117 & 136.975 MHz)respectively).
5.0.	Quieting Check & Line Output Level Check	
5.1.	ATR-3	Select Channel 2
5.2.	Signal Generator	(i) Set to Channel 2 frequency (ii) Set for Standard input.
5.3.	RMS Voltmeter	(i) Connect to Test Box ATR-310 A/F O/P 1 socket. (ii) Ensure indicating 0 dBm ±2 dB. (iii)Note indication.
5.4.	Signal Generator	)(i) Switch off modulation and
5.5.	RMS Voltmeter	)ensure indication falls by at)least 40 dB.)(ii) Restore modulation and)ensure that indication returns)to 0 dBm (±2 dB). (iii) Switch off carrier.
6.0.	Squelch Control Check	
6.1.	Signal Generator)	(i) Set Squelch control to just mute audio.
6.2.	ATR-3)	(ii) Restore carrier
6.3.	RMS Voltmeter)	(iii) Ensure that with squelch lifted, (signal present), the two rear panel 'SIG PRESENT'
6.4.	Multimeter)	terminals are short circuit, & with no signal present,(carrier off),terminals are open circuit. iv) Using the Squelch control, ensure that squelch operation is possible over the range of S+N/N ratios 8 to 13 dB. (v) Leave Squelch control positioned to just mute audio with no signal input.
7.0.	Monitor Audio Output Check	
7.1.	Audio Wattmeter)	Connect to phones jack on ATR-3
7.2.	Cable Test ATR-15)	
7.3.	ATR-3 Monitor Level Control.	Set fully clockwise.
7.4.	Signal Generator	Inject standard input
7.5.	Audio Wattmeter	Ensure indication is 15 milliwatts or greater
7.6.	ATR-3 Monitor Level Control.	Set for comfortable level.
8.0.	Monitor Audio Frequency Response Check	(continued)

TABLE 3 STANDARD SERVICEBILITY TEST (continued)

ITEM No	Equipment	Operation
8.1.	Signal Generator)	Set for standard input but with
8.2.	Audio Generator)	external modulation frequency.
8.3.	Audio Wattmeter)	Sweep from 300 to 3000 Hz and
8.4.	Audio Generator)	ensure that Wattmeter indications are not less than 3 dB below & not more than 1 dB above the indication obtained at 1 kHz.
8.5.	Audio Generator	Reconnect to Test Box ATR-310 I/P Connector.
9.0.	Audio Distortion Check	
9.1.	Signal Generator	Set for standard input.
9.2.	RMS Voltmeter	Disconnect from Test Box ATR-310
9.3.	Distortion Meter	(i) Connect to Test Box ATR-310 O/P Connector. (A/F O/P 1). (ii) Ensure indication is 5 % or less. (iii)Disconnect from Test Box ATR-310.
9.4.	RMS Voltmeter	Reconnect to Test Box ATR-310 O/P Connector. (A/F O/P 1).
10.0.	AGC Check	
10.1.	Signal Generator	Set for standard input but with 10 microvolts emf at ATR-3 antenna connector (-63 dBm at the Signal Generator).
10.2.	Audio Wattmeter)	(i) Note Wattmeter indication.
10.3.	Signal Generator)	(ii) Ensure wattmeter indication remains within 3 dB of noted value for all signal levels up to 200 millivolts at ATR-3 Antenna connector (+23 dBm at Signal Generator.)
11.0.	IF Selectivity Check	
11.1.	Signal Generator	Set for standard input but with a level of 5 microvolts (-99 dBm) at the ATR-3 antenna. (160 microvolts or -69 dBm at the Signal Generator).
11.2.	RMS Voltmeter	Note indication.
11.3.	Signal Generator)	(i) Change carrier frequency
11.4.	RMS Voltmeter)	first up & then down until indication is 6 dB below that noted at 11.2. (ii) Ensure total Carrier frequency difference is 18 kHz $\pm$ 3 kHz.
12.0.	IF Rejection Check	

(continued)

TABLE 3 STANDARD SERVICEABILITY TEST (continued)

Item No	Equipment	Operation
12.1.	Signal Generator	Set for standard input but with level at 5 microvolts (-99 dBm) at the ATR-3 antenna connector (160 microvolts or -69 dBm at the Signal Generator).
12.2.	RMS Voltmeter	Note indication.
12.3.	Signal Generator)	(i) Set for 10.7 MHz and
	)	increase output level until
12.4.	RMS Voltmeter)	indication noted in 12.2 is achieved (if possible).
		(ii) Ensure level is greater than 5 millivolts (-39 dBm) at the ATR-3 antenna (160 millivolts or -9 dBm at the Signal Generator).
		(iii) Repeat 12.1 to 12.4 incl. for carrier frequencies of 157.3 MHz & 892.7 MHz.
13.0.	Adjacent Channel Check	
13.1.	Signal Generator)	Set for standard input but with
	)	level set to give an indication
13.2.	RMS Voltmeter)	of -5 dBm on the RMS Voltmeter.
13.3.	Signal Generator	(i) Increase carrier frequency by 25 kHz (Adjacent channel).
		(ii) Increase level until indication noted in 13.2 is achieved.
		(iii) Ensure Signal Generator output is at least 60 dB above initial level.
		(iv) Disconnect from 30 dB Attenuator.
	NOTE: Ensure 30 dB Attenuator is in circuit during following checks.	
14.0.	Transmitter Frequency Accuracy Checks	
14.1.	Frequency Counter	Connect to output of 30 dB Attenuator.
14.2.	Test Box ATR-310	Key-on
14.3.	Frequency Counter	Ensure frequency is 127 MHz +1 kHz.
14.4.	Test Box ATR-310	Key off.
15.0.	VHF Power Output Check	
15.1.	Test Box ATR-310	Key on.
15.2.	RF Wattmeter	Ensure indication is 5 watts or greater.
15.3.	Test Box ATR-310	Key off.
15.4.	ATR-3)	(i)Repeat 15.1 to 15.3 inclusive
15.5.	RF Wattmeter)	for channels 1 and 3.
15.6.	Test Box ATR-310)	(ii) Re-select channel 2.
		(continued)

TABLE 3 STANDARD SERVICEABILITY TEST(continued)

Item No	Equipment	Operation
16.0.	Sidetone Check	
16.1.	Microphone)	Ensure connected
16.2.	Headphones)	
16.3.	Test Box ATR-310	(i) Key on (ii)Ensure microphone signals are available in Headphones and on loudspeaker. (iii)Key off.
16.4.	Microphone.	Disconnect.
17.0.	Modulation Depth Checks	
17.1.	Audio Generator	(i) Ensure connected to ATR-310 I/P connector. (ii)Set for 1 kHz at -10 dBm level
17.2.	Test Box ATR-310	Key on.
17.3.	Modulation Meter	(i)Connect to 30 dB Attenuator O/P (ii)Ensure Modulation depth is less than 95 %.
17.4.	Test Box ATR-310	Key off.
17.5.	Audio Generator	Reset for -30 dBm level.
17.6.	Test Box ATR-310	Key on.
17.7.	Modulation Meter	(i) Ensure modulation depth is greater than 75 %. (ii)Disconnect.
17.8.	Test Box ATR-310	Key off.
18.0.	Modulation Distortion Checks	
18.1.	Test Box ATR-310	Key on.
18.2.	Spectrum Analyser	Check that distortion is less than 15 % using sidebands.
18.3.	Test Box ATR-310	Key off.
19.0.	Spurious Output Checks	
19.1.	Test Box ATR-310	Key on
19.2.	Spectrum Analyser	Check that: (i) No signals are present which are within 50 dB of the wanted signal level. (ii) The noise floor does not exceed -100 dBm/Hz.
19.3.	Test Box ATR-310	Key off.
19.4.	Spectrum Analyser	Ensure that Key up output from Transmitter does not exceed -77dBm
20.0.	UHF & FM Check Preliminaries	
20.1.	ATR-3	(i) Remove covers. (ii)Remove Test EPROMS A114 & A111 (iii)Fit Test EPROMS A113 & A112 (A113=Rx, A112=Tx) (iv) Refit covers. (v) Select FM (vi) Select Channel 2

(continued)

TABLE 3 STANDARD SERVICEABILITY TEST(continued)

Item No	Equipment	Operation
20.2.	Audio Generator	Set for 1 kHz -10 dBm.
21.0.	Deviation Checks	
21.1.	Test Box ATR-310	Key on.
21.2.	Spectrum Analyser	Check deviation is between 4 and 7 kHz.
21.3.	Test Box ATR-310	Key off.
22.0.	Occupied Bandwidth Check	
22.1.	Test Box ATR-310	Key on
22.2.	Spectrum Analyser	Check all radiated power, outside 25 kHz bandwidth round the carrier frequency, is at least 20 dB down on the carrier frequency level.
22.3.	Test Box ATR-310	Key off
22.4.	Spectrum Analyser	Disconnect from Attenuator.
23.0.	UHF Power Output Check	
23.1.	RF Wattmeter	(i) Remove VHF insert. (ii) Fit UHF (200-400 MHz) insert.
23.2.	Test Box ATR-310	Key on.
23.3.	RF Wattmeter	Check indicates at least 5 watts.
23.4.	Test Box ATR-310	Key off.
23.5.	ATR-3)	(i) Repeat 23.2 to 23.4 inclusive
23.6.	RF Wattmeter)	for Channels 1 & 3.
23.7.	Test Box ATR-310	(ii) Set to channel 2.
24.0.	FM Sensitivity Check	
24.1.	Signal Generator)	(i) Re-connect to 30 dB Attenuator
24.2.	RMS Voltmeter)	(ii) Set for standard FM input. (iii)Ensure output level necessary to obtain S+N/N ratio of 12 dB is less than 2 microvolts (-107 dBm) at the ATR-3 antenna (63.2 microvolts or -77 dBm at the Signal Generator.) (iv) Disconnect RMS Voltmeter from Test Box ATR-310.
24.3.	Distortion Meter	Connect to Test Box ATR-310. A/F O/P 1.
25.0.	FM Audio Distortion Check	
25.1.	Signal Generator	Set for standard input.
25.2.	Distortion Meter	Check indicates 5 % distortion or less.
26.0.	Battery Take-Over Check	
26.1.	ATR-3	(i) Remove mains supply at source (do not use on/off switch). (ii) Ensure Mains LED extinguishes (iii) " Battery LED illuminates (iv) Ensure normal ATR-3 operation (v) Restore mains & check normal operations.

(continued)

TABLE 3 STANDARD SERVICEABILITY TEST(continued)

Item No	Equipment	Operation
27.0.	Conclusion	
27.1.	ATR-3	(i) Switch off (ii)Remove covers. (iii)Remove Test EPROMS. (iv) Fit operational EPROMS. (v) If required, set LOC/REM switch (SW1) in Audio & Control module to 'LOCAL'. (vi) Refit Covers. (vii)Switch on. (viii)Ensure fault lamp is extinguished. (ix) Switch off.
27.2.	Test Equipment	(i) Switch off. (ii) Disconnect. (iii)Stow
27.3.	Servicing Forms	Sign.

REPAIR PROCEDURES

GENERAL

13 The 3-Channel V/UHF Radio Type ATR-3 is designed to provide for repair to module level at user locations, with deeper level repairs being effected at either a central depot or within industry.

73 Figure 2 provides a breakdown of the equipment to sub-unit or level. All sub-units which include the word 'Module' in the description are designed for physical removal and refitting within a period of five minutes each, without the use of specialised tools. The Chassis includes all the wiring, front and rear panel controls, and the power supply circuits and is considered as a sub-unit. The Power Supply Board Type ATR-35, which is hard-wired, into the chassis, should not be considered a replaceable sub-unit at user location level, but is shown as a sub-unit of the chassis for clarity reasons.

15 Two further items are included with each equipment. These are a Cable Assembly (Mains) Type ATR-39. Thus is used to interconnect the Radio to the domestic 250 volt 50 Hz mains power supply. A Free Standing Enclosure Type ATR-37 is also provided. This will only be used when the Radio is operated in a 'desk-top' application or similar.

16 To assist the user in removing and refitting modules, a convention of marking has been used in which each module securing screw has a small green dot marked in an immediately adjacent position. No other screws are marked in this way.

Dismantling Procedures

17 To remove one or more of the modules the following procedures are necessary:-

17.1. Switch off all power to the Radio.

17.2. Disconnect all rear panel connectors.

17.3. Disconnect Headphones/Microphone (if applicable).

17.4. Remove from free standing enclosure (if applicable).

17.5. Remove top and bottom lids by removing and retaining the two screwing screws for each, and sliding the lid towards the rear to disengage the lid from the chassis members.

17.6. Release and move clear electrical plug/socket connections on the module(s) to be removed.

17.7. Remove and retain the module(s) securing screws (identified by adjacent green dot).

17.8. Lift module clear of chassis.

18 No further dismantling procedures are considered necessary.

Assembly Procedures

19 The procedure for assembly of the equipment is simply the reverse of the dismantling procedure. Modules being fitted, secured and connected, followed by refitting and securing of bottom and top lids, replacement into the free standing enclosure, (if applicable), and reconnection of the external equipment and power sources.

20 Whenever, the equipment has been disturbed, for example by the removal and refitting of a module, a full standard serviceability test should be carried out to prove the equipment is fully functional.

FAULT DIAGNOSIS

GENERAL

21 The 3-Channel V/UHF Radio Type ATR-3 has been designed such that many of the modules contain circuitry which is functionally specific. This provides for a high degree of fault diagnosis and localisation to module level by analysis of the reported fault symptom and reference to the overall equipment block diagram. (Chap.2 Figure 1).

22 Additionally, each module is fitted with plug/socket connectors which are readily accessible and which can be easily removed to allow monitoring of outputs or simulation, by connecting external test equipment. Furthermore, because the replacement of modules is so readily accomplished, the equipment lends itself to repair by module substitution techniques in situations where rapid turn round times are of the essence.

23 An example of using the logical fault diagnosis and localisation techniques might be where a symptom is given, say, of 'No transmission on

UHF FM'. In this instance a technician would verify that transmissions on 'VHF' and 'UHF AM' are satisfactory and, if so, reference to the block diagram would reveal that the Transmitter Drive Module Type ATR-33 almost certainly contains the faulty circuit.

24 The reasoning behind this statement being as follows:-

24.1. UHF Power Amplifier Module Type ATR-38 is operating satisfactorily on AM mode and is therefore unlikely to be a causal factor in the reported fault.

24.2. All FM modulation circuitry and the frequency synthesiser used on UHF FM is housed in the Transmitter Drive Module.

24.3. Because VHF operation is satisfactory it is unlikely that the antenna changeover relay, power supplies, control facilities or audio signal circuitry is defective.

25 Using similar reasoning, many reported defects can be diagnosed and localised to a specific module by judicious use of symptom analysis, checking other design features of the equipment and reference to the block diagram.

26 To assist in the fault diagnosis process a number of Fault Charts are provided. Each begins with a likely reported symptom and provides a logical set of checks or tests which have a high probability of leading to accurate fault diagnosis and location. It is emphasised that the charts are not exhaustive or all embracing, neither do they infer that only one method of localisation technique should be adopted.

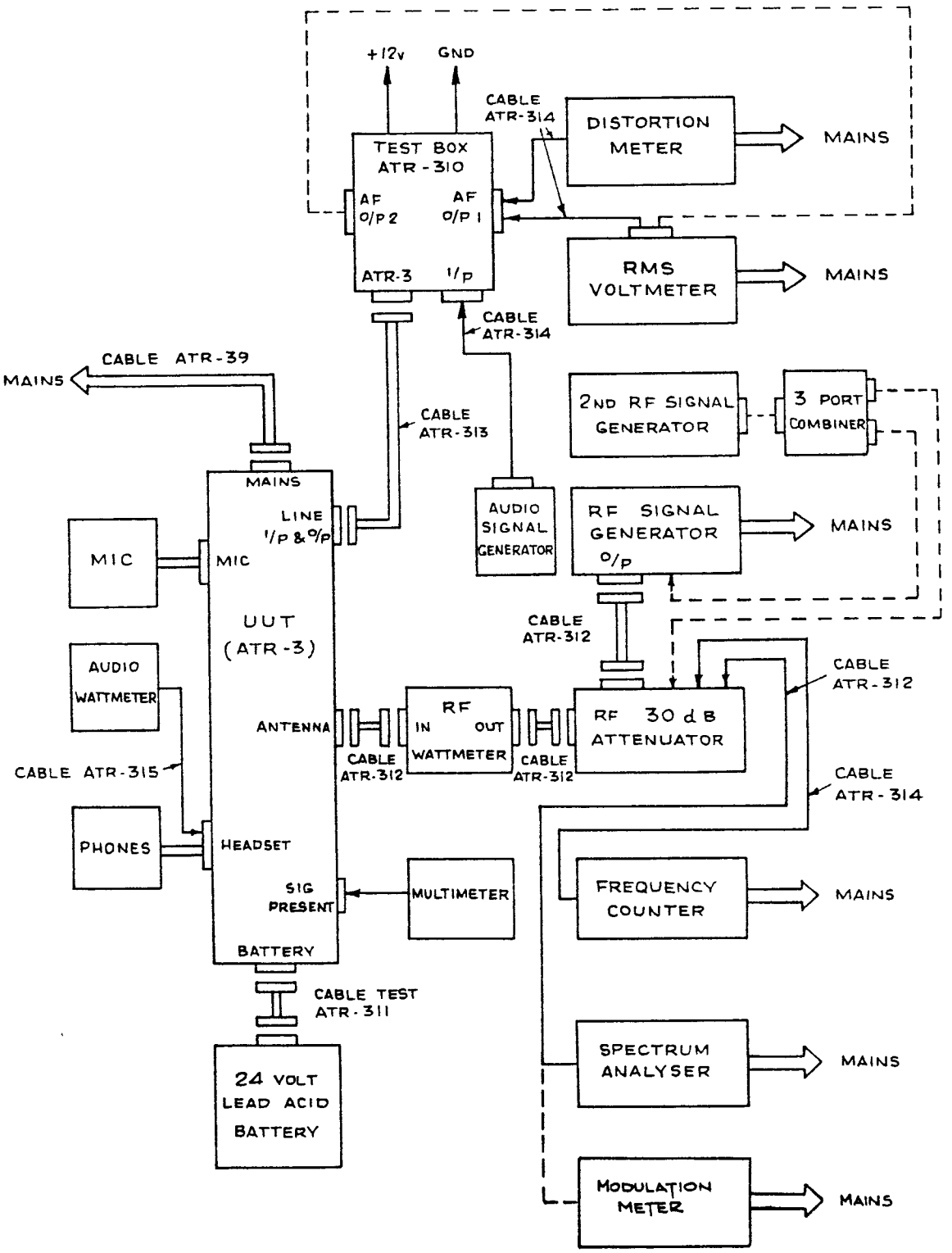


Figure 1 Test Arrangement

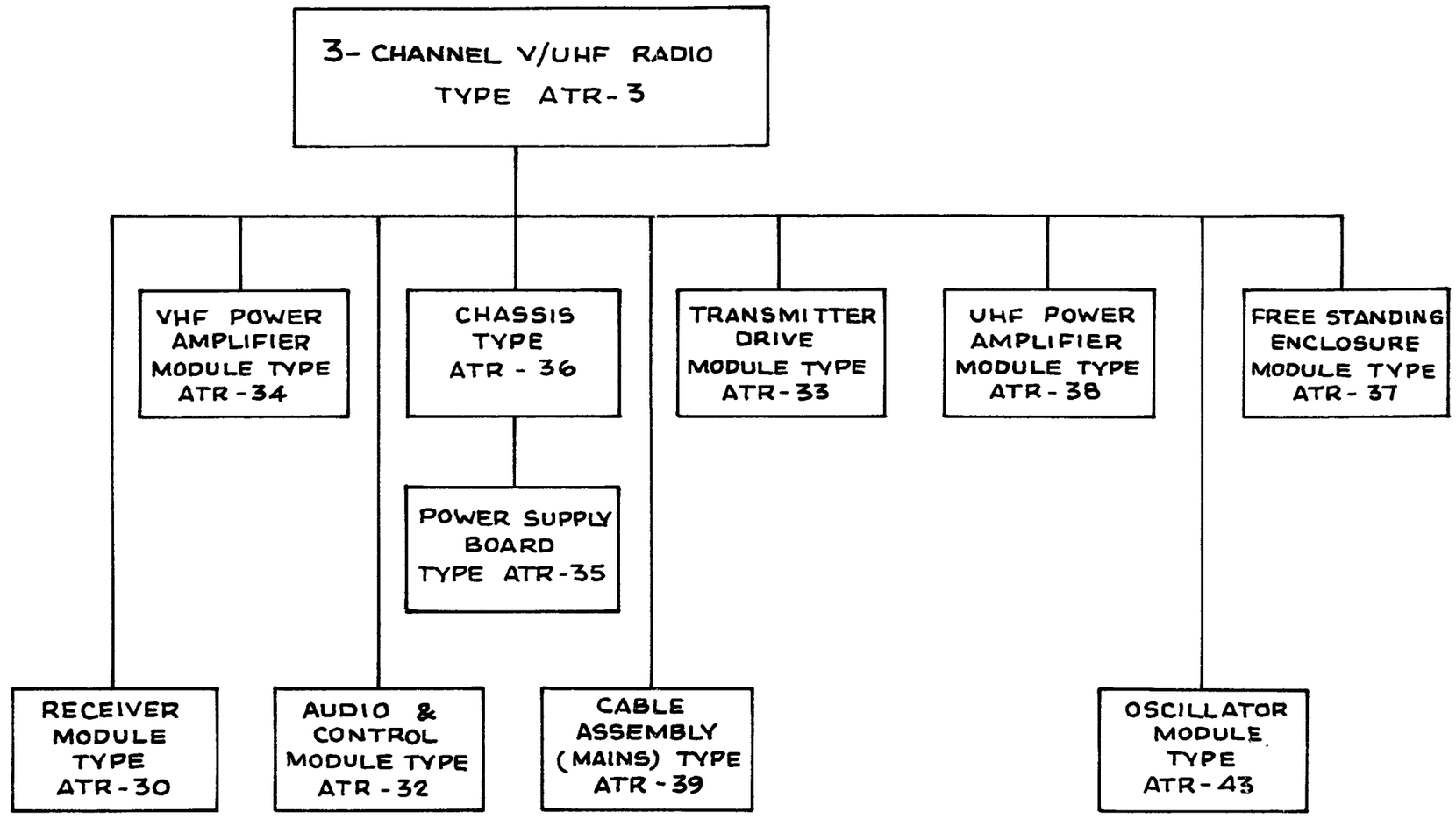


Figure 2 3-Channel V/UHF Radio Type ATR-3 - Brakdown to Sub-unit Level

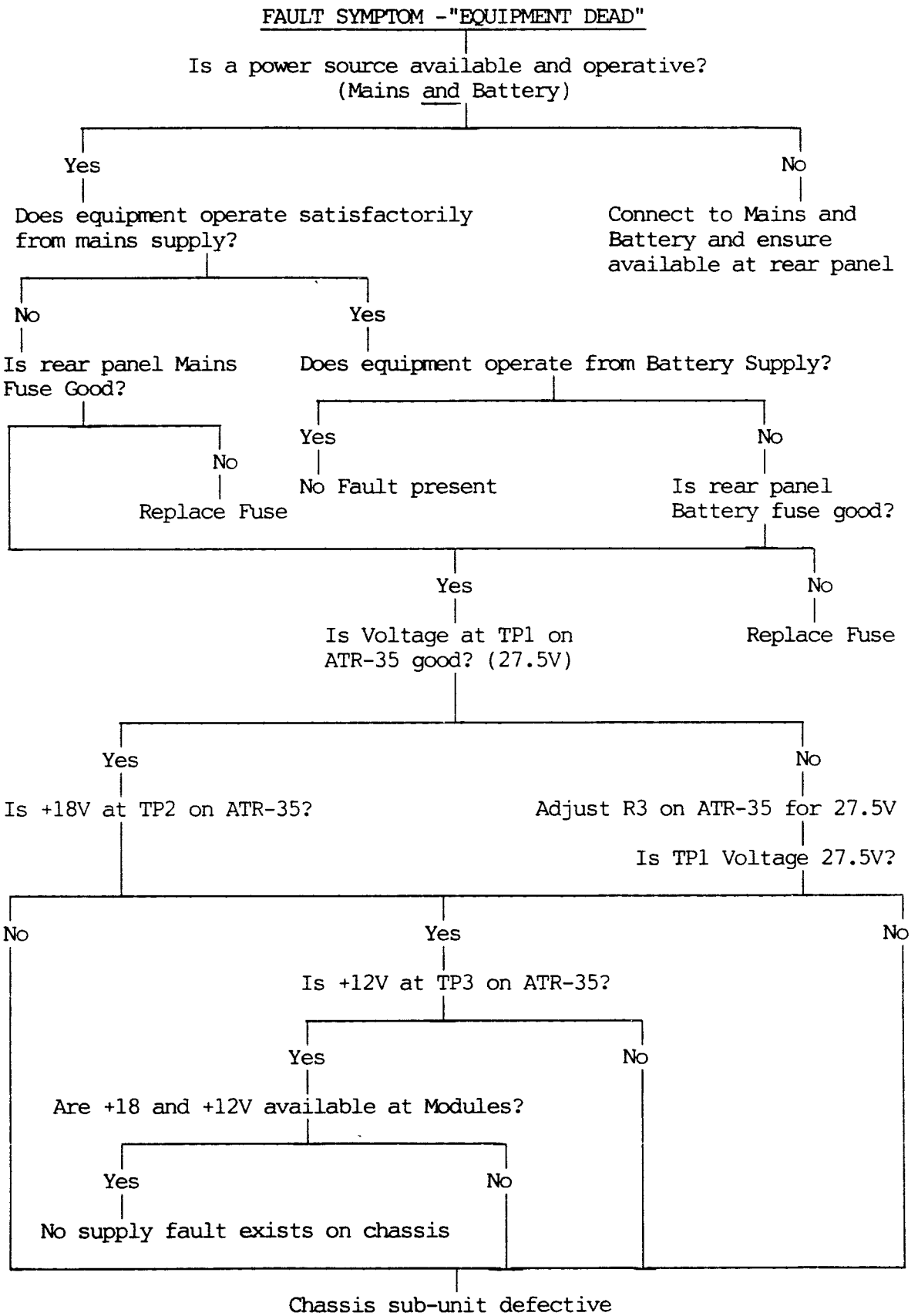


Figure 3 Fault Chart 1

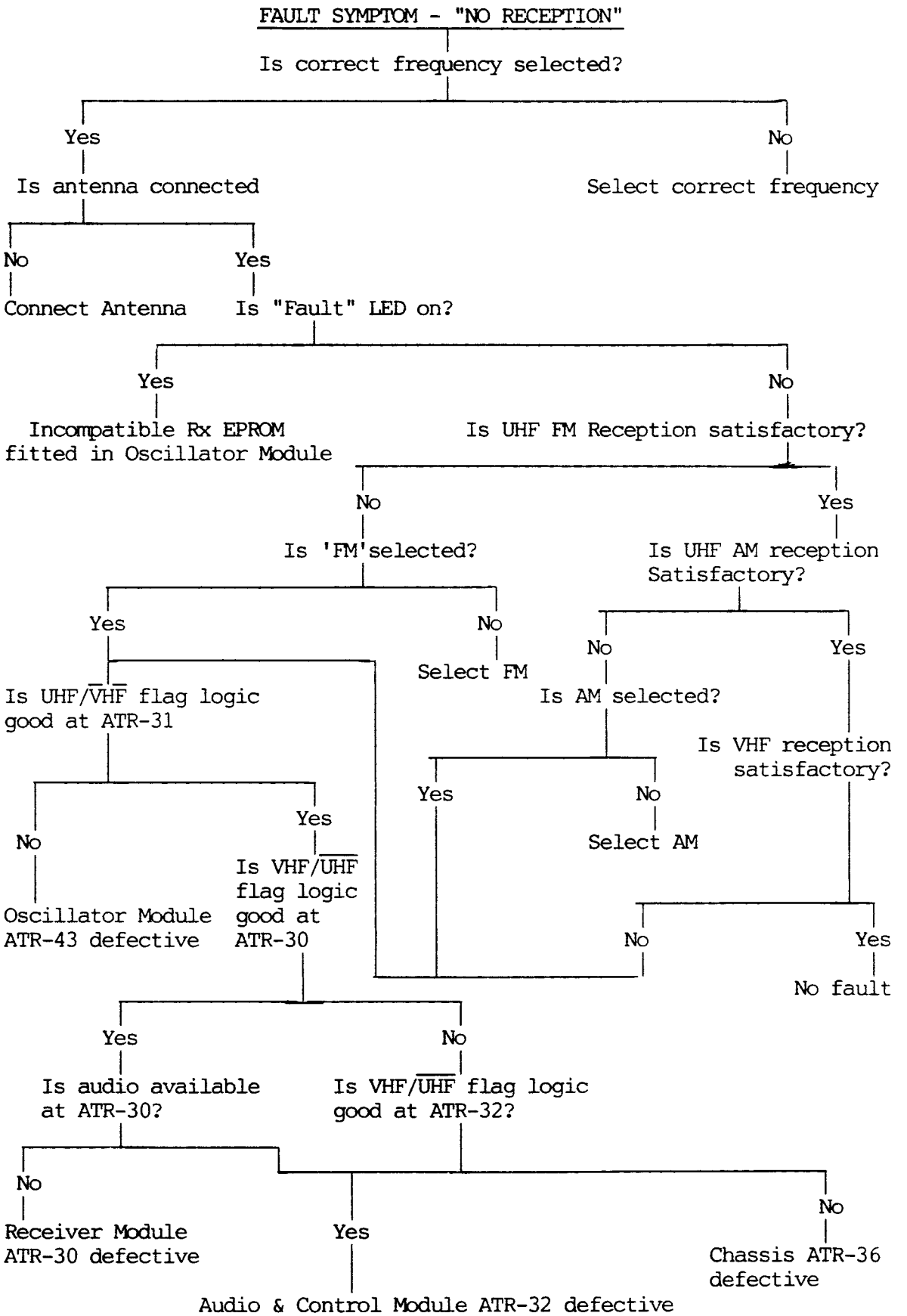


Figure 4 Fault Chart 2

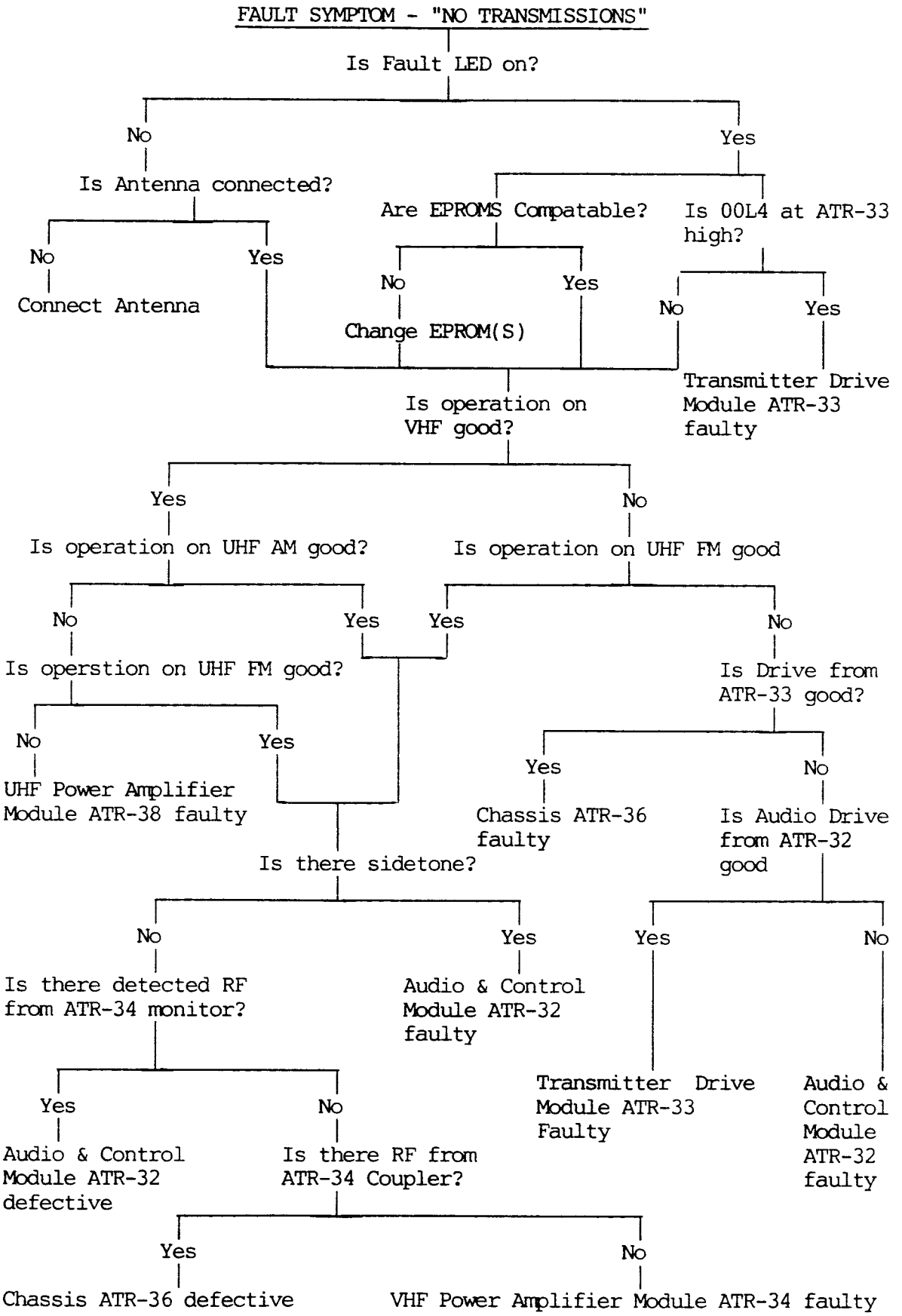


Figure 5 Fault Chart 3

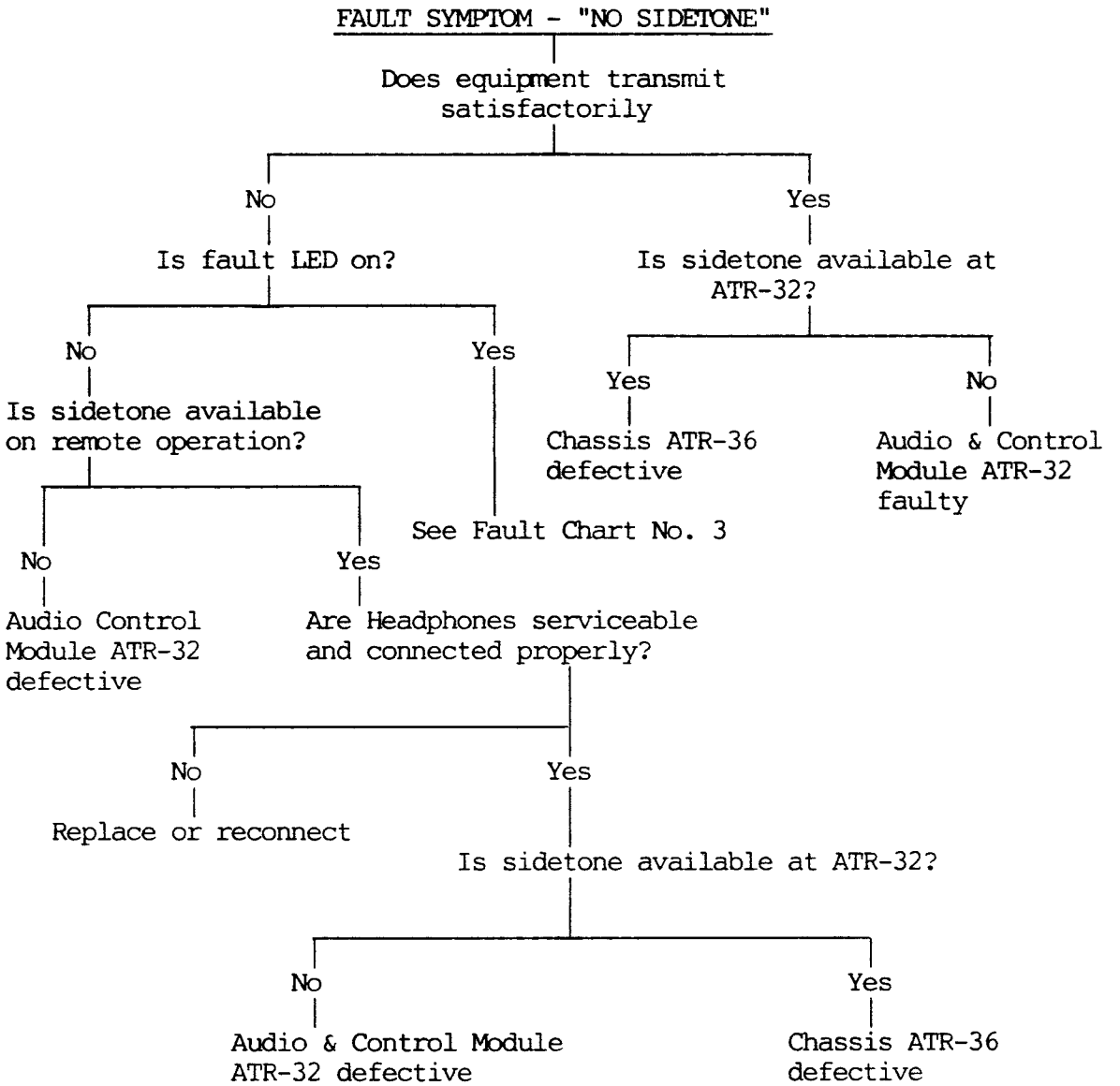


Figure 6 Fault Chart 4

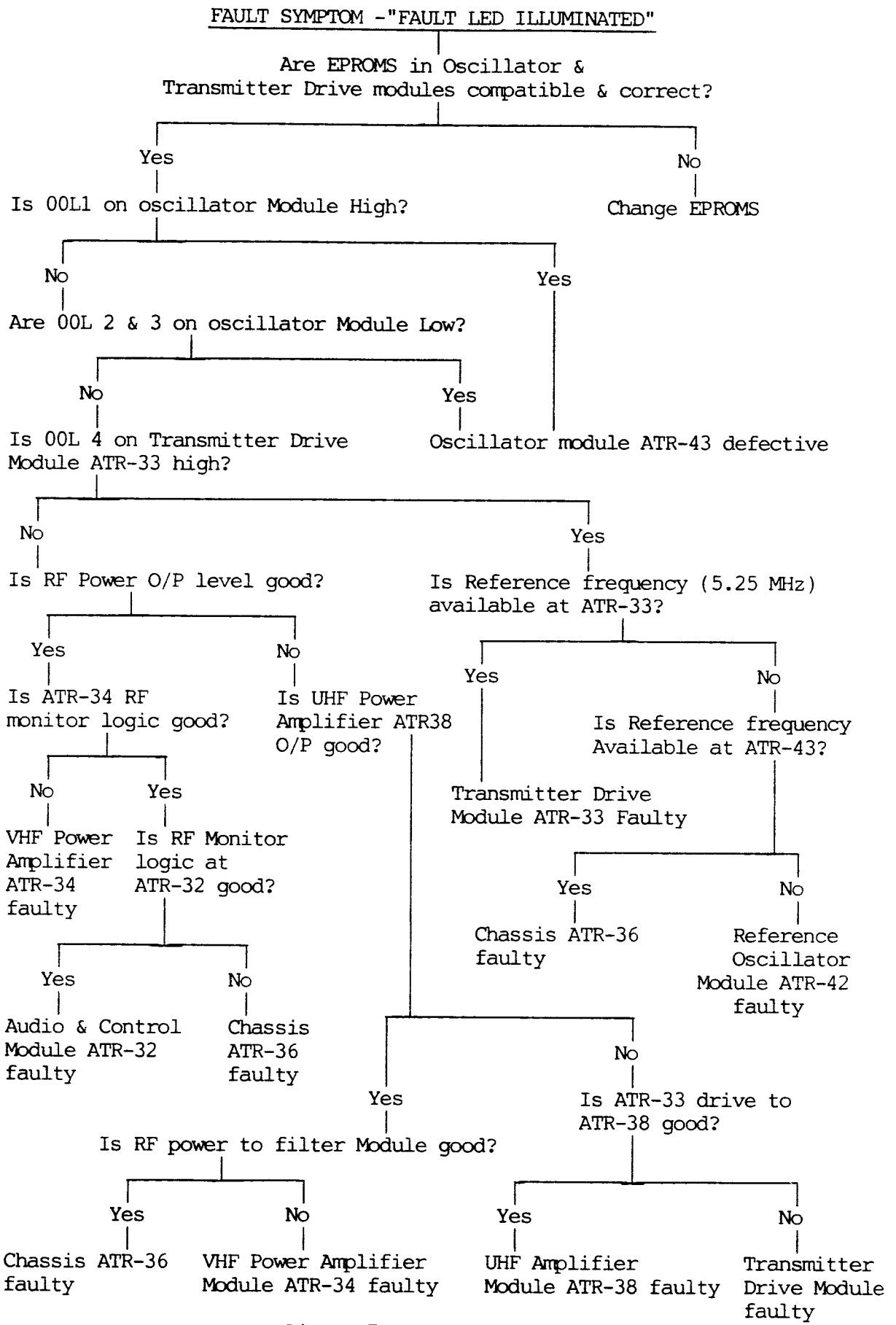


Figure 7 Fault Chart 5

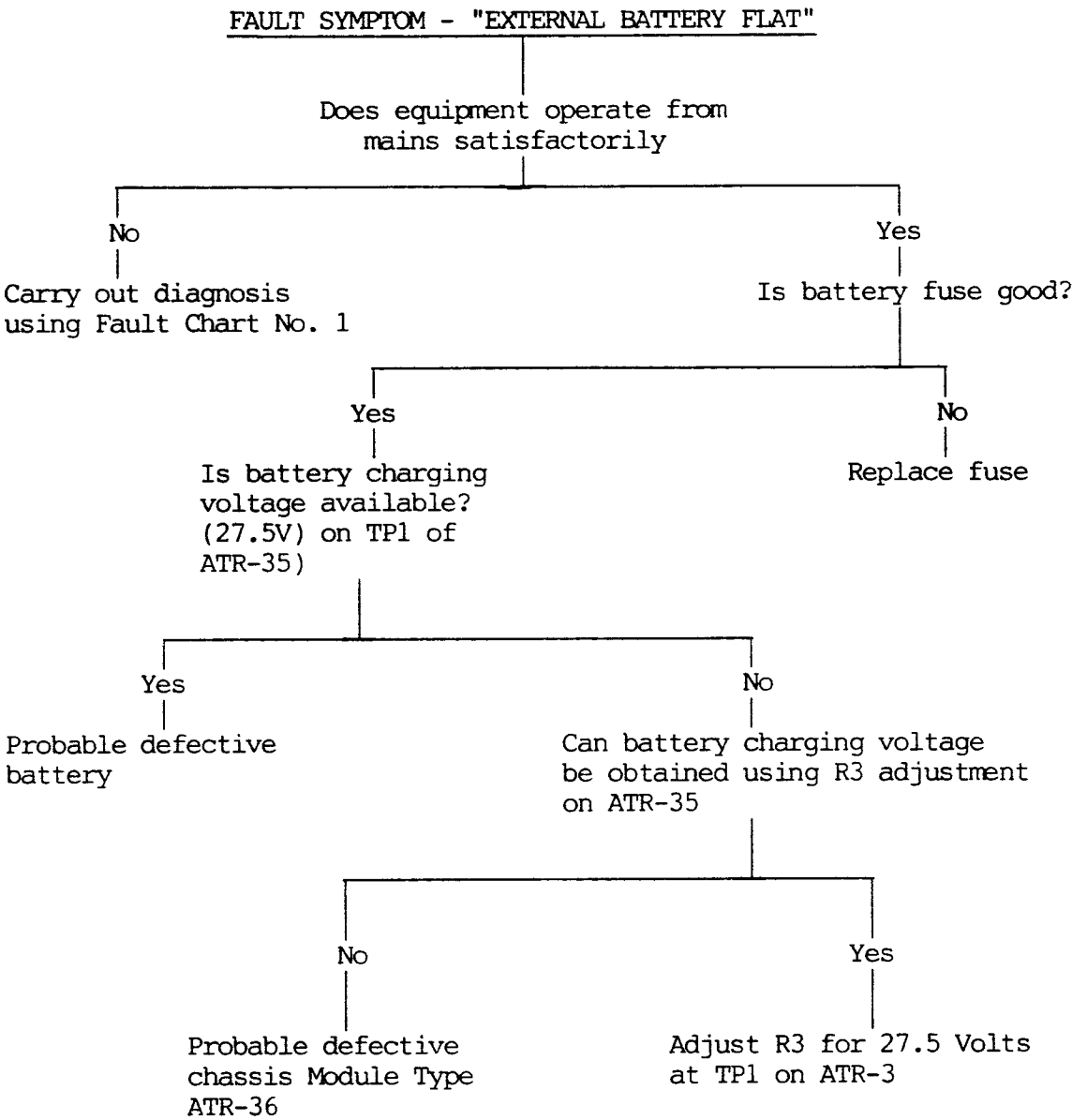


Figure 8 Fault Chart 6

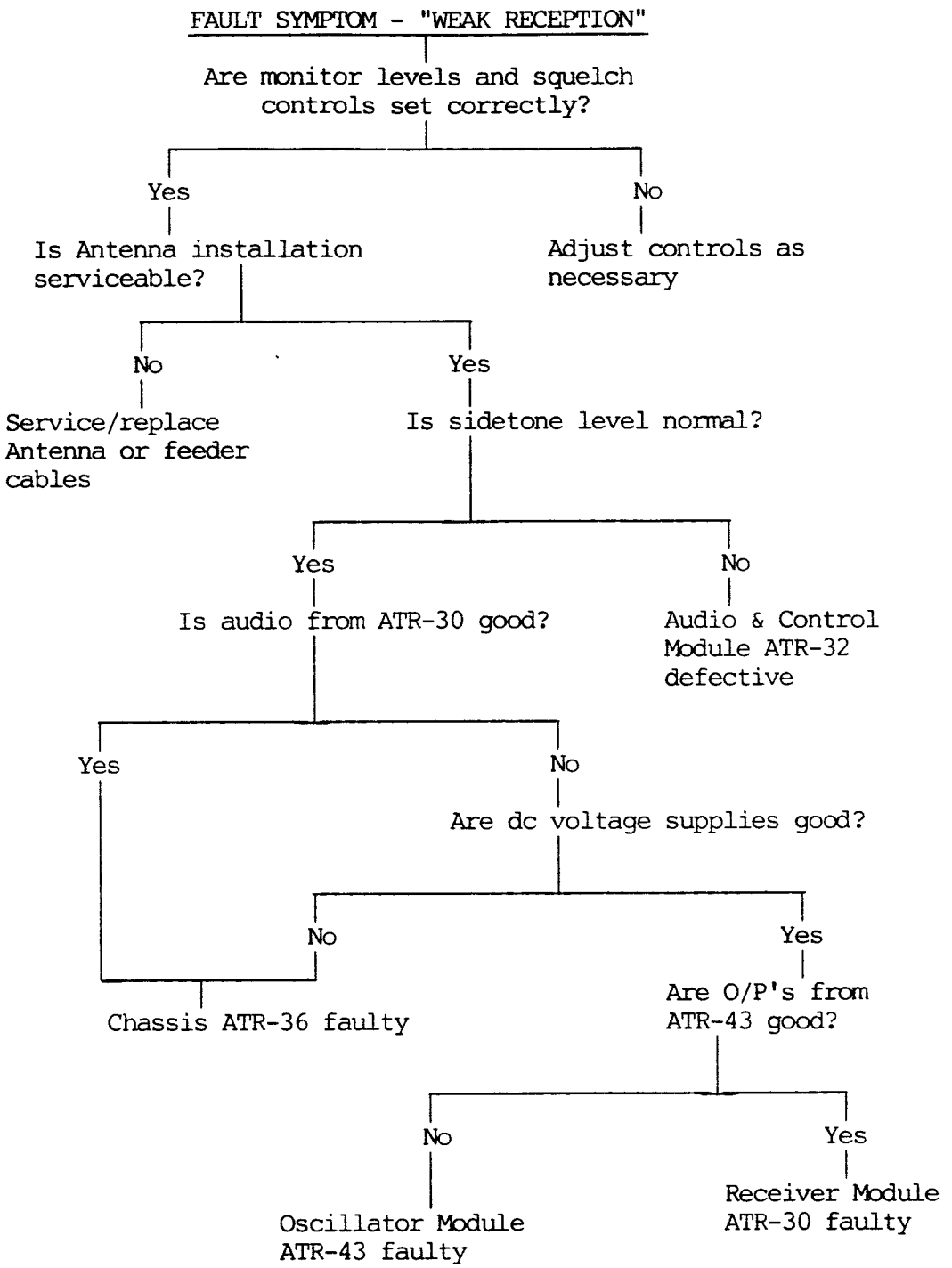


Figure 9 Fault Chart 7

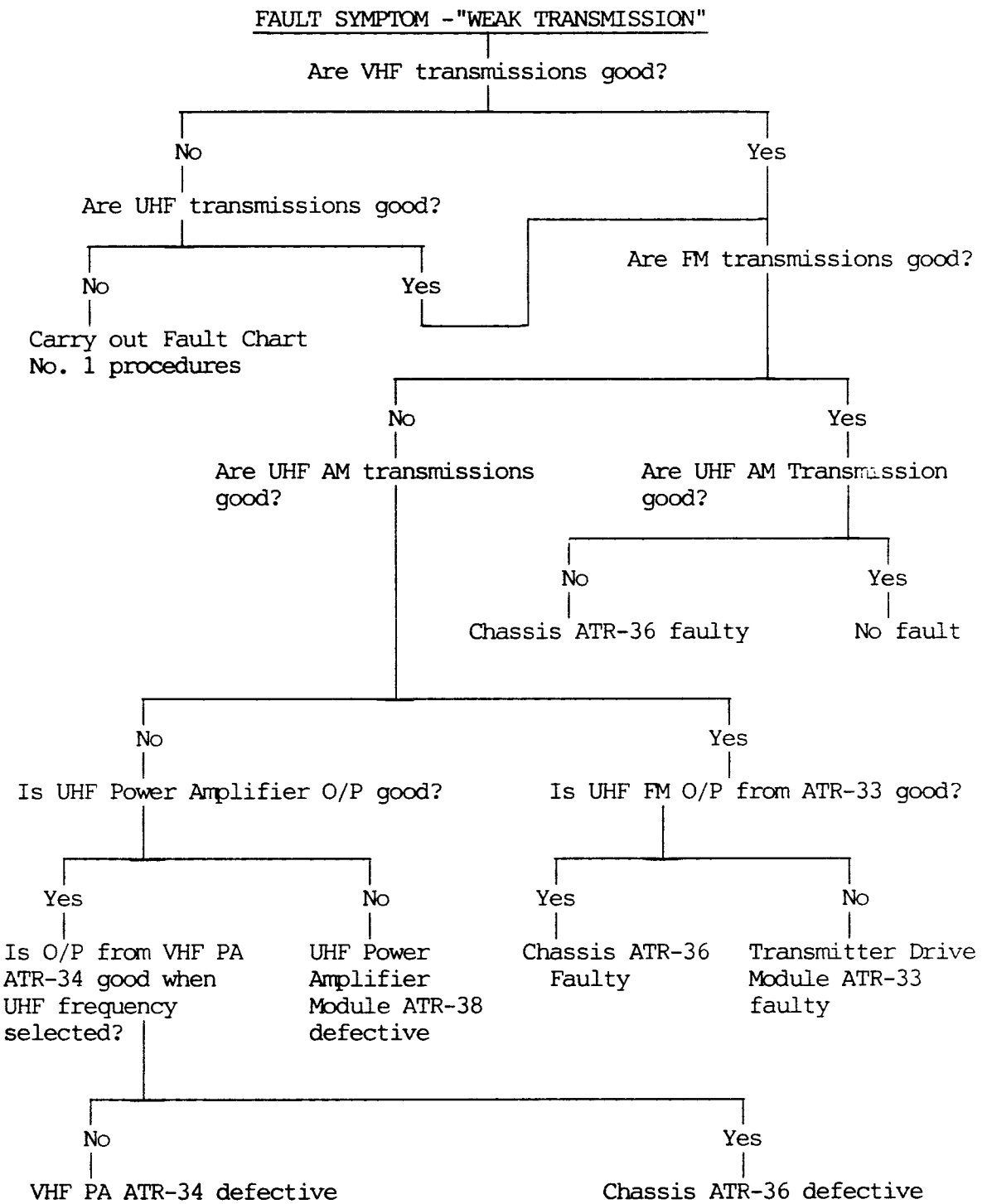


FIGURE 10 FAULT CHART 8