

# **Eclipse Series**

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## **PA 150 Amplifier** **Operation and Maintenance Manual**

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**WARNING**

Changes or modifications not expressly approved by RF Technology could void your authority to operate this equipment. Specifications may vary from those given in this document in accordance with requirements of local authorities. RF Technology equipment is subject to continual improvement and RF Technology reserve the right to change performance and specification without further notice.

## **1 Operating Instructions**

### **1.1 Front Panel Indicators**

#### **PWR LED**

The Power LED shows that the dc supply is connected to the transmitter.

#### **RFO LED**

The RF Output LED indicates that the amplifier is being driven and that the forward output power is above a preset level. The indication level is set by RV1 which is accessible through the side of the case. (After removing 20 screws)

#### **TEMP LED**

The Temperature LED indicates when the amplifier temperature is too high. The power is automatically reduced if the output transistors temperature rises above safe limits.

### **1.2 Internal Adjustments**

All internal adjustments are factory set and should not need readjustment under normal conditions.

### **1.3 Output Power**

The output power is set to the desired level watts by RV2. It determines the threshold of the ALC voltage which is fed back to the transmitter module to regulate the power. The output power of standard amplifiers can be set to any level between 25 and 75 watts. The high power versions with “H” suffix model numbers can be set between 50 and 100 watts.

### 1.4 RF Level Detector

The RF Detector threshold for the RFO LED on the amplifier front panel is set by RV1. This is normally set at half the rated output power.

**WARNING**

Ensure that the output power setting complies with the equipment's licence requirements. Failure to do so may result in penalties being imposed by the licensing authority.

### PA150 Amplifier I/O Connections

#### 25 Pin Connector

Function/Signal	Pins	Specification
DC Power +12Vdc - 0Vdc	1,2,14,15 12,13,24,25	+11.4 to 16Vdc
ALC Output	8	Approx 7Vdc decreasing with increasing power or temperature
RF Input BNC Connector		25 Watts max
RF Output N Connector		120 Watts Max

## 2 Circuit Description

The following descriptions should be read as an aid to understanding the block and schematic diagrams at the rear of this manual.

### 2.1 Amplifiers

The RF power amplification is provided by one or two transistors, Q4 and Q5. The standard power version uses one transistor (Q4) and the high power version uses two. Each transistor is rated at 75 watts output. The input and output impedances of the transistors are matched to 50Ω by microstrip matching networks.

## *2 CIRCUIT DESCRIPTION*

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The amplifiers are broad band and do not have any tuning adjustments. The “A” versions are optimized for the frequency range 136-156 MHz while the “B” versions cover 154-174 MHz.

The dc supply is fed to the amplifiers through resistors R21 and R22. This allows the collector current of each amplifier to be measured at the test socket.

### **2.2 Power Splitter/Combiners**

The high power versions use zero degree power splitters and combiners. They consist of lumped element 1/4 wave 700 pi networks and 1000 RF resistors (C43-50, L17-20, R19-20). This configuration provides wider bandwidth and better balance than lower cost 90 degree hybrids.

### **2.3 Directional Coupler**

The forward and reverse power components are measured through a coupled line directional coupler. The output of the coupled line is frequency compensated by R1-4 and C51-52 before being detected by D1 and D3.

The voltage output of the detectors is proportional to the forward and reflected power.

### **2.4 Low Pass Filter**

A low pass filter consisting of L12-16 and C39-42 reduces the harmonic components to less than -80dBc. The filter uses a combination of lumped elements and printed microstrips to obtain the required harmonic attenuation.

### **2.5 Power Control Circuits**

The forward and reverse voltages from the directional coupler are amplified and inverted by U2a and U2b. The amplified voltages are combined before connecting to the input of error amplifier U2d.

Error amplifier U2d compares the detected voltage with the dc reference voltage from output power trimpot RV2. The amplified difference at the output U2d is supplied to the rear panel system connector for connection to the T150 ALC input.

### **2.6 RF Output Indicator**

The forward power voltage is compared with the pre-set dc reference voltage from RV1 and U2c. The output of U2c is used to turn on the RFO LED and provide an output power logic signal to the test connector.

### 3 ALIGNMENT PROCEDURE

RV1 is normally set so that the RFO LED comes ON at 1-3 db below the normal power output.

#### **2.7 Over Temperature Protection**

Thermistor RT1 is mounted to the case of output transistor Q4. If the transistor case temperature rises above 90 degrees C the resistance of RT1 increases and Q2 is turned ON.

This causes the TEMP LED to come on and also reduces the dc reference voltage to the output power error amplifier U2d. The input power will then be reduced by the transmitter ALC circuits and the output transistors are kept within safe operating limits.

### **3 Alignment Procedure**

The following procedures may be used to align the amplifier for optimum performance.

#### **Standard Test Conditions**

<b>RF Input Source</b>	<b>Power Supply</b>	<b>Load</b>
T150 Series transmitter 25 watts maximum	13.8 Vdc at 15 A	50Ω 150 watts VSWR < 1.2:1

#### **Set RFO Level**

<b>Step</b>	<b>Input</b>	<b>Measure</b>	<b>Adjust</b>
1	None	Set RV1 and R2	Fully counter clockwise
2	Centre channel frequency from the T150, 25W max threshold	RF output power at J2	Key transmitter adjust RV2 for desired output
3	As above	RFO LED	Key transmitter adjust RV1 to where the RFO LED just goes OFF

## 4 SPECIFICATIONS

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### Set Output Power

Step	Input	Measure	Adjust
4	As above	RF output power at J2	Key transmitter. Adjust RV2 for the desired power

## 4 Specifications

### 4.1 Description

The power amplifiers are designed for use with the T150 series transmitters to provide 50-150 watts output.

Output power regulation is provided by connecting the output of the directional coupler to the ALC input of the T150. The drive from the transmitter is then automatically adjusted to maintain the required output.

The regulated power level can be preset over a wide range from 25 to 150 watts depending on the available driver power.

Sensing circuits are provided to protect the output transistors from excessive temperatures. If the output transistor case temperature rises to 90 degrees C, the input drive will be reduced to prevent damage.

### 4.2 Physical Configuration

The power amplifier is designed to fit in a 19 inch rack mounted frame. The installed height is 4RU (178mm) and the depth is 350mm. The amplifier is 95.25mm or three Elclipse modules wide.

An extruded aluminium heat sink with vertical fins is used. The temperature rise is normally less than 30 degrees at 50 watts output.

### 4.3 Front Indicators and Test Points

#### 4.3.1 Indicators

Power ON - Green LED  
RF Power Output - Yellow LED  
Over Temperature - Red LED

## 5 ELECTRICAL SPECIFICATIONS

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### 4.3.2 Test Points (DB9 Connector)

Forward Power	Pin 8 + Gnd (pin 1)
Reverse Power	Pin 4 + Gnd (pin 1)
Collector Current	Pin 6, Pin 2 + Vcc 13.2Vdc

## 5 Electrical Specifications

### 5.1 Power Requirements

Operating Voltage - 10.5 to 16 Vdc with output power reduced below 12.5 Vdc.  
Current Drain @ 13.2 Vdc - 10 Amps Max at 50 watts. 100 mA Max standby  
Polarity - Negative Ground

### 5.2 Frequency Range

Frequency	50 Watt	100 Watt
136-156MHz	PA150A	PA150AH
154-174 MHz	PA150B	PA150BH

### 5.3 Nominal Antenna Impedance

500

### 5.4 Output Power

25 to 100 watts adjustable

### 5.5 Transmit Duty Cycle

With Free Air Circulation

50 Watts - 100% to 40 deg. C  
100 Watts - 50% to 40 deg. C

With Fan Module

50-100 Watts - 100% to 50 deg. C

### 5.6 Spurious and Harmonics

Less than 0.25uW

**5.7 Maximum Heatsink Temperature**

90 degrees C.

**5.8 ALC Output**

The ALC is intended for connection to the T150. It supplies a voltage which decreases with increasing power or temperature.

**5.9 Mis-Match Protection**

The amplifier is protected from damage when operating into a VSWR of 10/1 at all phase angles.

**6 Connectors**

**6.1 Antenna Connector**

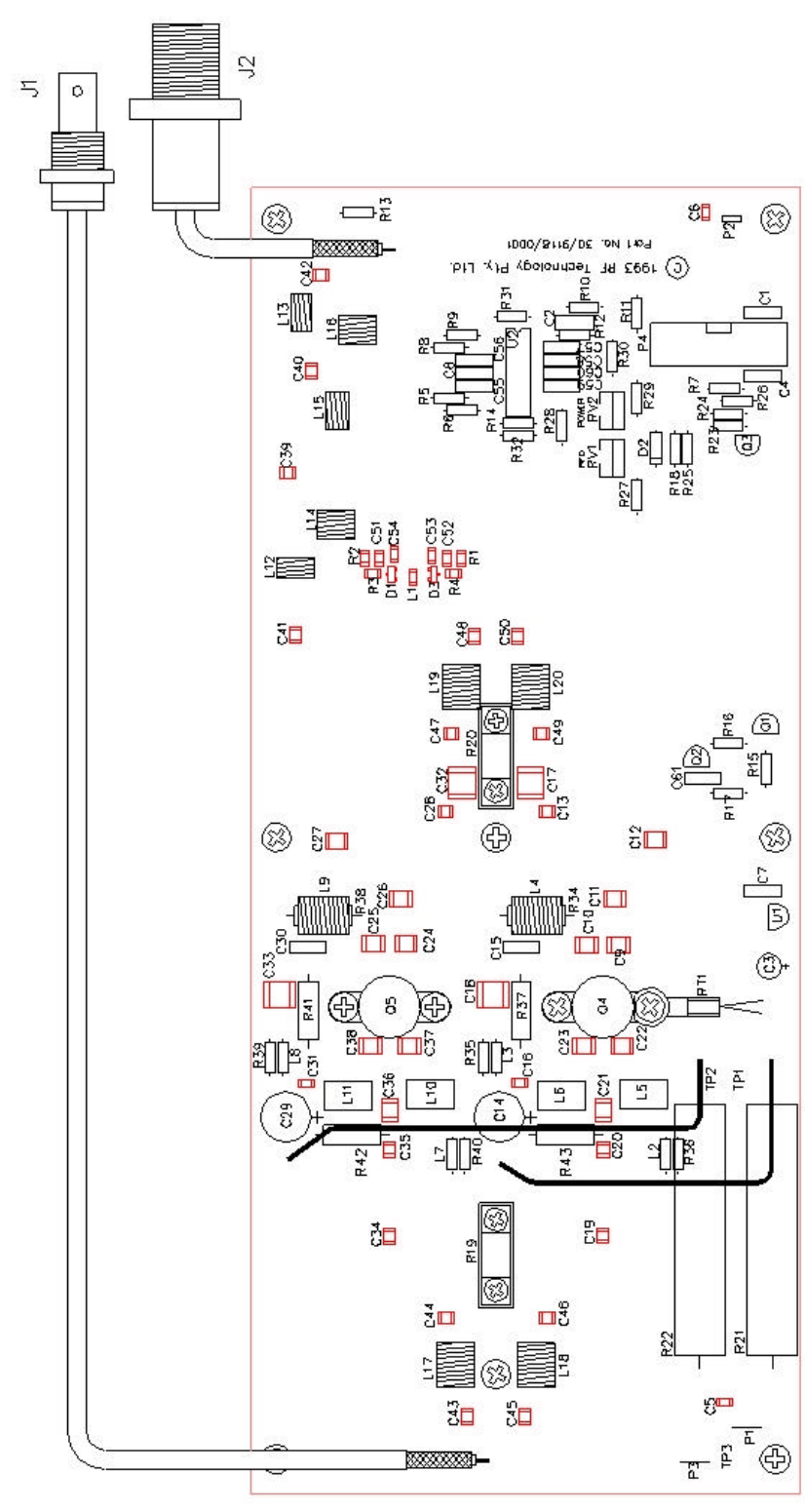
Type N Female mounted on the module rear panel

**6.2 Power and I/O Connector**

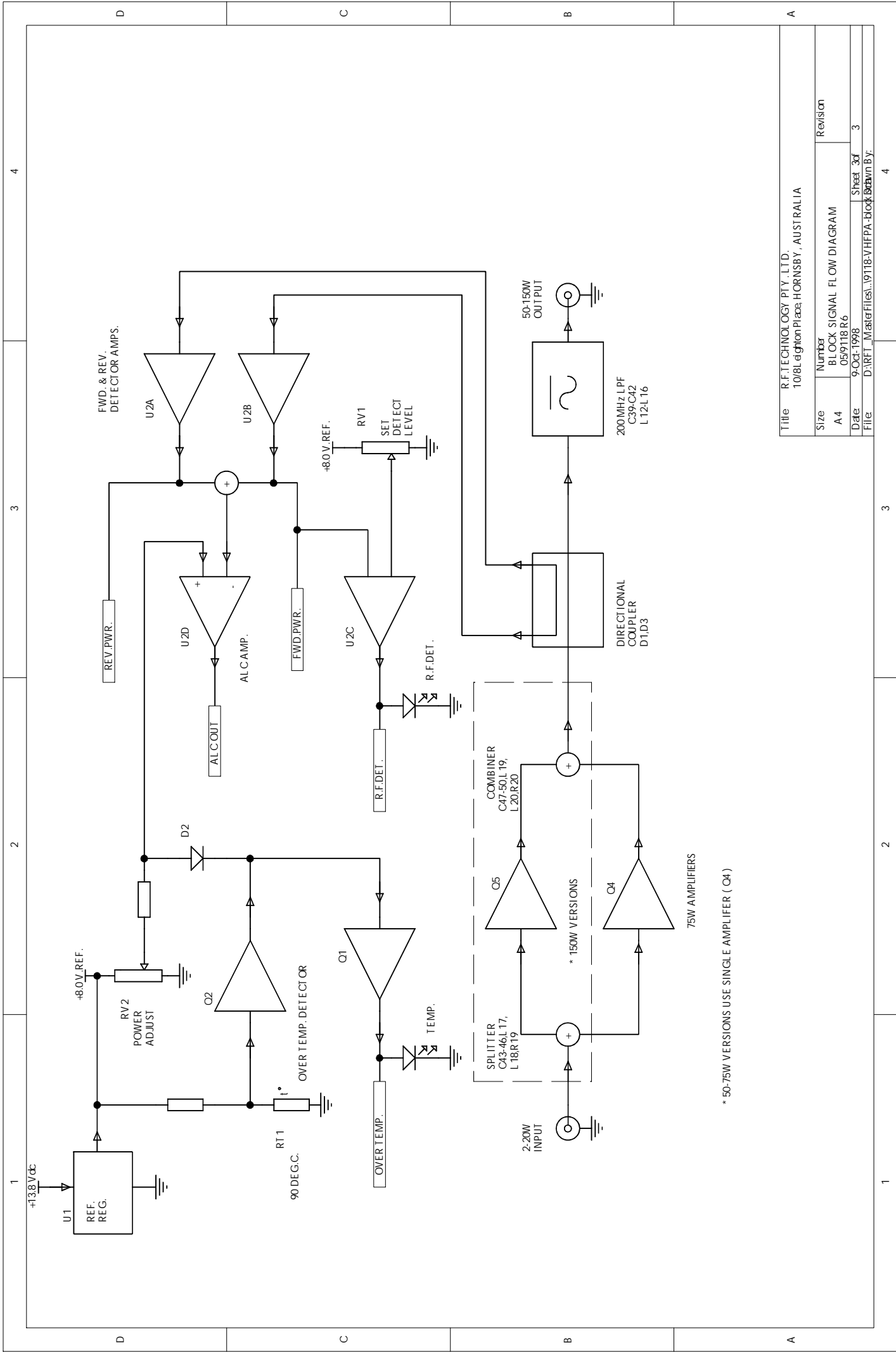
25 pin "D" Male mounted on the rear panel

**6.3 Test Connector**

9 pin "D" Female mounted on the front panel.



POWER AMPLIFIER COMPONENT LAYOUT



\* 50-75W VERSIONS USE SINGLE AMPLIFIER ( O4 )

Title		R.F. TECHNOLOGY PTY. LTD.	
Size		10/81 eighton Place, HORNSBY, AUSTRALIA	
Number	Revision		
A4	BLOCK SIGNAL FLOW DIAGRAM		
Date	05/9118 R6		
9-Oct-1998	Sheet 3 of 3		
File	D:\RFI_MarkFiles\197118-VHFA-block.dwg	Drawn By:	

1

2

3

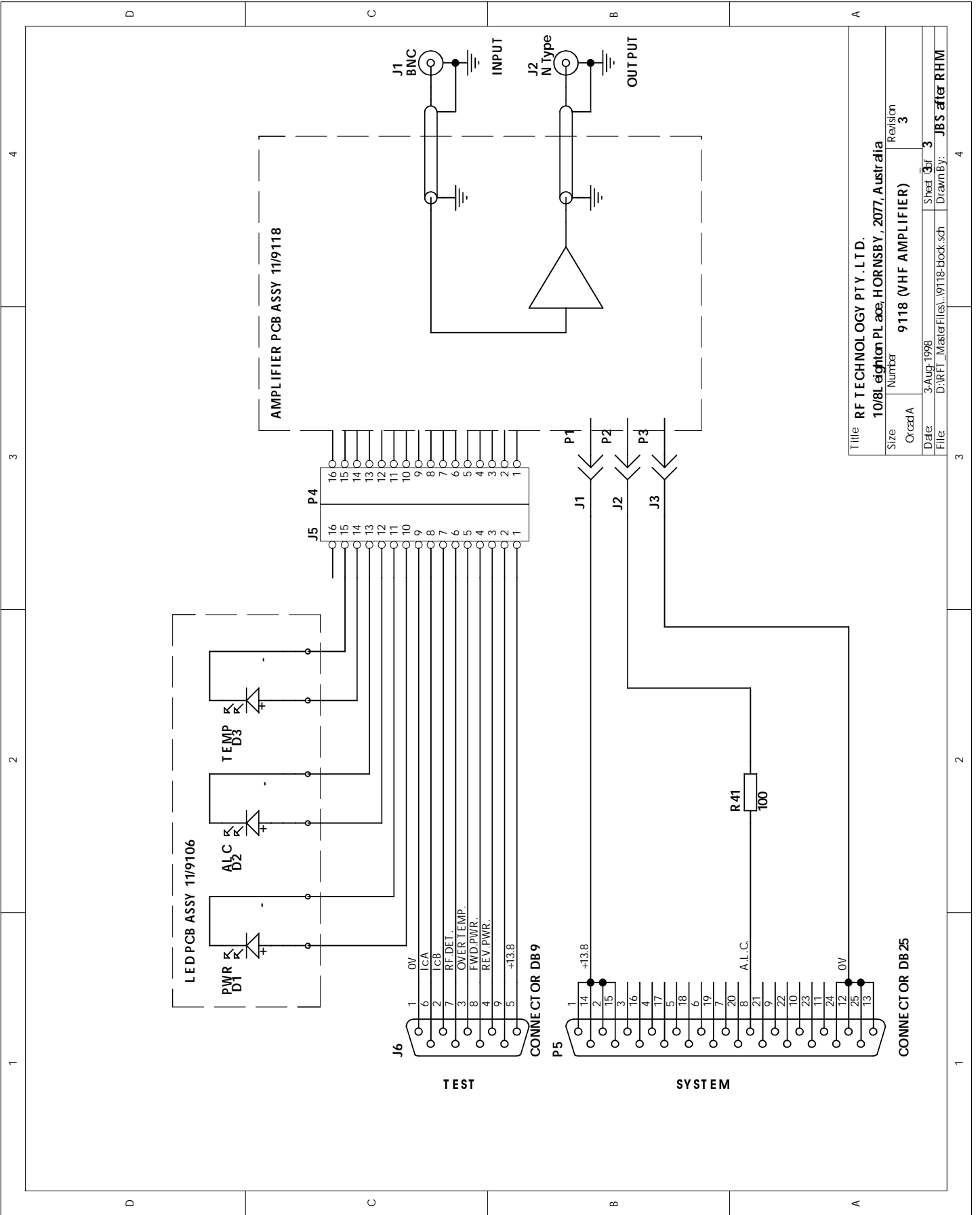
4

A

B

C

D



Title		RF TECHNOLOGY PTY. LTD.	
Size		10/8L eighton PL ace, HORNSBY, 2077, Australia	
Number	91118 (VHF AMPLIFIER)	Revision	3
Date	3-AUG-1998	Sheet	3 of 3
File	D:\RFT_MasterFiles\19118-book.sch	Drawn By:	JBS after RHM

## B PA150 PARTS LIST

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Ref.	Description	Part Number
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**NOTE - ALL COMPONENTS FOR WHICH REF IS ACCOMPANIED WITH AN ASTERIX (\*) ARE USED ONLY IN HIGH POWER MODELS (PA150XH)**

C1	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C2	CAP 4N7 5% 400V MKT RAD.2	47/2040/04N7
C3	CAP 10U 35V RAD ELECTRO	41/2001/010U
C4	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C5	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C6	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C7	CAP 100N 10% 50V X7R RAD.2	46/2001/100N
C8	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C14	CAP 6.8U 20% 25V SOLID AL	41/2225/06U8
C15	CAP 100N 10% 50V X7R RAD.2	46/2001/100N
C16	CAP 100N 10% 63V X7R 1206	46/3310/100N
C17	CAP 1N0 500V MICA SM2220	48/3003/01N0
C18	CAP 1N0 500V MICA SM2220	48/3003/01N0
C29*	CAP 6.8U 20% 25V SOLID AL	41/2225/06U8
C30*	CAP 100N 10% 50V X7R RAD.2	46/2001/100N
C31*	CAP 100N 10% 63V X7R 1206	46/3310/100N
C32*	CAP 1N0 500V MICA SM2220	48/3003/01N0
C33*	CAP 1N0 500V MICA SM2220	48/3003/01N0
C43*	CAP 12P 500V MICA SM1210	48/3003/012P
C44*	CAP 12P 500V MICA SM1210	48/3003/012P
C45*	CAP 12P 500V MICA SM1210	48/3003/012P
C46*	CAP 12P 500V MICA SM1210	48/3003/012P
C47*	CAP 12P 500V MICA SM1210	48/3003/012P
C48*	CAP 12P 500V MICA SM1210	48/3003/012P
C49*	CAP 12P 500V MICA SM1210	48/3003/012P
C50*	CAP 12P 500V MICA SM1210	48/3003/012P
C51	CAP 10P 5% 63V NPO SM 1206	46/3300/010P
C52	CAP 10P 5% 63V NPO SM1206	46/3300/010P
C53	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C54	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C55	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C56	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C57	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C58	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C59	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C60	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C61	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
D1	DIODE SHTKY BAT17 SOT23	21/3030/0017
D2	DIODE SILICON 1N4148	21/1010/4148
D3	DIODE SHTKY BAT17 SOT23	21/3030/0017
L1	IND 1U0 10% CHOKE SM1206	37/3320/01U0
L2	INDUCTOR 1UH AXIAL	37/2021/001U
L3	FERRITE BEAD 3x4x1 4S2	37/1022/0001
L4	COIL AIR COR 7T 1.5P 6.35ID	37/1635/1507
L5	IND MOLDED 6.5 TURN	37/2021/0006
L6	IND MOLDED 6.5 TURN	37/2021/0006
L7*	INDUCTOR 1UH AXIAL	37/2021/001U
L8*	FERRITE BEAD 3x4x14S2	37/1022/0001

B PA150 PARTS LIST

Ref.	Description	Part Number
L9*	COIL AIR CORE 7T 1.5P 6.35ID	37/1635/1507
L10*	IND MOLDED 6.5 TURN	37/2021/0006
L11*	IND MOLDED 6.5 TURN	37/2021/0006
L12	COIL AIR CORE 2T 2P 6.35ID	37/1400/1002
L13	COIL AIR CORE 2T 2P 6.35ID	37/1400/1002
L14	COIL AIR CORE 3T 2P 6.35ID	37/1635/2003
L15	COIL AIR CORE 3T 5P 6.35ID	37/1635/1503
L16	COIL AIR CORE 3T 2P 6.35ID	37/1635/2003
L17	INDUCTOR, MOULDED 7.5T	37/2021/0007
L18	INDUCTOR, MOULDED 7.5T	37/2021/0007
L19*	COIL AIR CORE 6T 1.5P 4D	37/1400/1006
L20*	COIL AIR CORE 6T 1.5P 4D	37/1400/1006
P1	6.35mm QC TAB VERT PCB MT	35/0635/0001
P3	6.35mm QC TAB VERT PCB MT	35/0635/0001
P4	CON 16WAY SHR'D HEADER	35/2502/0016
Q1	TRSTR GP PNP 2N3906 TO92	27/2010/3906
Q2	TRSTR GP NPN 2N3904 TO92	27/2020/3904
Q3	TRSTR GP NPN 2N3904 TO92	27/2020/3904
Q4	TRSTR NPN VHF RF MRF247	27/3020/MRF247
Q5*	TRSTR NPN VHF RF MRF247	27/3020/MRF247
R1	RES 220 5% 0.25W SM1206	51/3380/0220
R2	RES 220 5% 0.25W SM1206	51/3380/0220
R3	RES 220 5% 0.25W SM1206	51/3380/0220
R4	RES 220 5% 0.25W SM1206	51/3380/0220
R5	RES 47K 5% 0.25W AXIAL	51/1040/047K
R6	RES 100K 5% 0.25W AXIAL	51/1040/100K
R7	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R8	RES 47K 5% 0.25W AXIAL	51/1040/047K
R9	RES 100K 5% 0.25W AXIAL	51/1040/100K
R10	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R11	RES 100 5% 0.25W AXIAL	51/1040/0100
R12	RES 1M0 5% 0.25W AXIAL	51/1040/01M0
R13	RES 100K 5% 0.25W AXIAL	51/1040/100K
R14	RES 10K 5% 0.25W AXIAL	51/1040/010K
R15	RES 10K 5% 0.25W AXIAL	51/1040/010K
R16	RES 2K2 5% 0.25W AXIAL	51/1040/2K2
R17	RES 10K 5% 0.25W AXIAL	51/1040/010K
R18	RES 10K 5% 0.25W AXIAL	51/1040/010K
R19*	RES 100 OHM 40W RF	51/RF40/0100
R20*	RES 100 OHM 40W RF	51/RF40/0100
R21	RES 0.1 5% 10W ASW 10	51/0010/00R1
R22*	RES 0.1 5% 10W ASW 10	51/0010/00R1
R23	RES 10K 5% 0.25W AXIAL	51/1040/010K
R24	RES 270 5% 0.25W AXIAL	51/1040/0270
R25	RES 270 5% 0.25W AXIAL	51/1040/0270
R26	RES 680 5% 0.25W AXIAL	51/1040/0680
R27	RES 10K 5% 0.25W AXIAL	51/1040/010K
R28	RES 10K 5% 0.25W AXIAL	51/1040/010K
R29	RES 10K 5% 0.25W AXIAL	51/1040/010K
R30	RES 47K 5% 0.25W AXIAL	51/1040/047K
R31	RES 33K 5% 0.25W AXIAL	51/1040/033K

## B PA150 Parts List

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<b>Ref</b>	<b>Description</b>	<b>Part Number</b>
R32	RES 33K 5% 0.25W AXIAL	51/1040/033K
R34	RES 220 5% 2W AXIAL	51/1052/0220
R35	RES 10 5% 0.25W AXIAL	51/1040/0010
R36	RES 10 5% 0.25W AXIAL	51/1040/0010
R37	RES 220 5% 2W AXIAL	51/1052/0220
R38*	RES 220 5% 2W AXIAL	51/1052/0220
R39*	RES 10 5% 0.25W AXIAL	51/1040/0010
R40*	RES 10 5% 0.25W AXIAL	51/1040/0010
R41*	RES 220 5% 2W AXIAL	51/1052/0220
R42*	RES 12R 5% 2W AXIAL	51/1052/0012
R43	RES 12R 5% 2W AXIAL	51/1052/0012
R50(P2)	RES 100 5% 0.25W AXIAL	51/1040/0100
RT1	THERMISTOR	54/0400/0080
RV1	TRIMPOT 10K 1 TURN VERT	53/1020/010K
RV2	TRIMPOT 10K 1 TURN VERT	53/1020/010K
U1	IC VOLT REG 78L08 TO 92M	25/2040/78L08
U2	IC QUAD OP AMP TLC274	25/2050/274C

### PA150A 135-156 MHz Parts

#### These parts fitted to PA150A & AH

C9	CAP 160P 500V MICA SM1812	48/3003/160P
C10	CAP 160P 500V MICA SM1812	48/3003/160P
C12	CAP 120P 500V MICA SM1812	48/3003/120P
C13	CAP 27P 500V MICA SM1210	48/3003/027P
C19	CAP 68P 500V MICA SM1210	48/3003/068P
C20	CAP 68P 500V MICA SM1210	48/3003/068P
C21	CAP 510P 500V MICA SM1812	48/3003/510P
C22	CAP 330P 500V MICA SM1812	48/3003/330P
C23	CAP 270P 500V MICA SM1812	48/3003/270P
C39	CAP 39P 500V MICA SM1210	48/3003/039P
C40	CAP 39P 500V MICA SM1210	48/3003/039P
C41	CAP 10P 500V MICA SM1210	48/3003/010P
C42	CAP 12P 500V MICA SM1210	48/3003/012P

#### These additional parts used on PA150AH ONLY

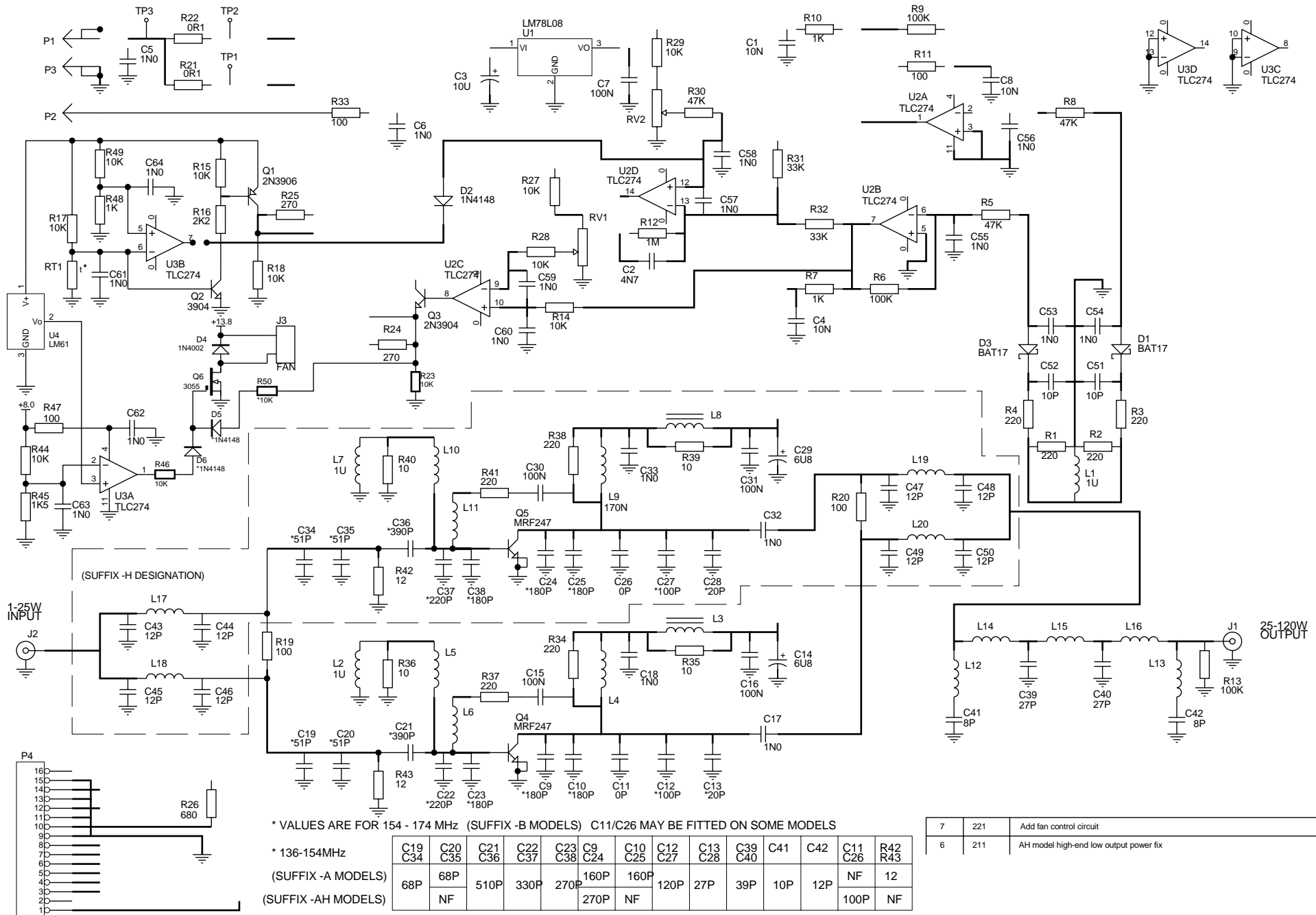
C24*	CAP 160P 500V MICA SM1812	48/3003/160P
C25*	CAP 160P 500V MICA SM1812	48/3003/160P
C27*	CAP 120P 500V MICA SM1812	48/3003/120P
C28*	CAP 27P 500V MICA SM1210	48/3003/027P
C34*	CAP 68P 500V MICA SM1210	48/3003/068P
C35*	CAP 68P 500V MICA SM1210	48/3003/068P
C36*	CAP 510P 500V MICA SM1812	48/3003/510P
C37*	CAP 330P 500V MICA SM1812	48/3003/330P
C38*	CAP 270P 500V MICA SM1812	48/3003/270P

<b>Ref</b>	<b>Description</b>	<b>Part Number</b>
<b>PA150B 154-174 MHz Parts</b>		
<b>These parts fitted to PA150B &amp; BH</b>		
C9	CAP 180P 500V MICA SM1812	48/3003/180P
C10	CAP 180P 500V MICA SM1812	48/3003/180P
C12	CAP 100P 500V MICA SM1812	48/3003/100P
C13	CAP 20P 500V MICA SM1210	48/3003/020P
C19	CAP 51P 500V MICA SM1210	48/3003/051P
C20	CAP 51P 500V MICA SM1210	48/3003/051P
C21	CAP 390P 500V MICA SM1812	48/3003/390P
C22	CAP 220P 500V MICA SM1812	48/3003/220P
C23	CAP 180P 500V MICA SM1812	48/3003/180P
C39	CAP 27P 500V MICA SM1210	48/3003/027P
C40	CAP 27P 500V MICA SM1210	48/3003/027P
C41	CAP 8P 500V MICA SM1210	48/3003/008P
C42	CAP 8P 500V MICA SM1210	48/3003/008P

**These additional parts used on PA150BH ONLY**

C11	CAP 160P 500V MICA SM1812	48/3003/160P
C24*	CAP 180P 500V MICA SM1812	48/3003/180P
C25*	CAP 180P 500V MICA SM1812	48/3003/180P
C26	CAP 160P 500V MICA SM1812	48/3003/160P
C27*	CAP 100P 500V MICA SM1812	48/3003/100P
C28*	CAP 20P 500V MICA SM1210	48/3003/020P
C34*	CAP 51P 500V MICA SM1210	48/3003/051P
C35*	CAP 51P 500V MICA SM1210	48/3003/051P
C36*	CAP 390P 500V MICA SM1812	48/3003/390P
C37*	CAP 220P 500V MICA SM1812	48/3003/220P
C38*	CAP 180P 500V MICA SM1812	48/3003/180P

End parts list



\* VALUES ARE FOR 154 - 174 MHz (SUFFIX -B MODELS) C11/C26 MAY BE FITTED ON SOME MODELS

* 136-154MHz (SUFFIX -A MODELS)		C19 C34	C20 C35	C21 C36	C22 C37	C23 C38	C9 C24	C10 C25	C12 C27	C13 C28	C39 C40	C41	C42	C11 C26	R42 R43
(SUFFIX -AH MODELS)		68P	68P	510P	330P	270P	160P	160P	120P	27P	39P	10P	12P	100P	NF
			NF				270P	NF							NF

7	221	Add fan control circuit
6	211	AH model high-end low output power fix