Eclipse Series

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PA70 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 reserves the right to change performance and specifications 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 present 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 re-adjustment unless the operating frequency is changed.

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 can be set to any level between 25 and 70 watts.

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 license requirements. Failure to do so may result in penalties being imposed by the licensing authority.

PA70 Amplifier I/O Connections

25 Pin Connector

Function Signal	Pins	Specification
DC Power +12 Vdc 0 Vdc	1,2,14,15 12,13,24,25	+11.4 to 16 Vdc
ALC Output	8	Approx 7 Vdc decreasing with increasing power or temperature
RF Input BNC Connector		25 Watts Max.
RF Output N Connector		70 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 Amplifier

The RF power amplification is provided by a single transistor, Q4. The transistor provides at least 10dB gain in the 66-88 MHz frequency range.

The input and output impedance of the transistor is matched to 50 O by networks which use printed micro-strips and lumped elements. Variable

capacitors C9, C12, C21 and C22 are used to tune the amplifier for optimum performance on the operating frequency.

Although not a true broad band design, the amplifier provides good gain and efficiency with frequency spreads of up to 5 MHz.

The dc supply is fed to the amplifier through resistor R21. This allows the collector current to be measured at the test socket.

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

2.3 Low Pass Filter

A low pass filter consisting of L8-12 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.

2.4 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 of U2d is supplied to the rear panel system connector for connection to the T70 ALC input.

2.5 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.

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

2.6 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 procedure may be used to align the amplifier for optimum performance.

3.1 Standard Test Conditions

RF Input Source

T70 series transmitter set for 10 Watts maximum output.

The ALC output from the PA70 must be connected to the T70 ALC input.

Power Supply

13.8 Vdc at 15A with a load current meter or a test meter connected to measure the voltage between pins 2 and 5 of the PA70 test connector (0.1 Vdc = 1A)

RF Power Meter and Load

50O 0-70 Watts
VSWR <1.2:1

Directional RF Power Meter

50O 0-10 Watts
Forward and Reverse

OR

A dc test meter connected to measure the forward and reverse voltage at the T70 test connector.

Alignment

Step	Input	Measure	Adjust
1	None		Set RV2 fully clockwise
2	None		SetC11,C12,C20, C21 to the middle of their adjustment range
3	Set T70 to the centre frequency channel	Reflected power at the PA70 input/ T70 output	Key the transmitter and adjust C9 and C12 for minimum reflected power.
4	As above	Output power from the PA70	Key the transmitter and adjust C21 and C22 for maximum output power.
5	As above	Refl. Pwr. = 0 Output > 70W	Repeat 3 and 4 until no further improvement is obtained.
6	As above	Output power from the PA70	Key the transmitter and adjust RV2 to set the power to approximately 10% above the desired level.
7	As above	dc current or voltage at test pins 5-2 and output power	Key the transmitter and adjust C21 in the direction of decreasing dc curent to the point where the output power just starts to drop
8	As above	Output power	Key the transmitter and set RV2 to obtain the desired output power
9	As above	reflected power at the PA70 input/T70 output	Key the transmitter and adjust C9 and C21 for minimum reflected power

Set RFO Level

Step	Input	Measure	Adjust
10	None		Set RV1 and R2 fully counter clockwise
11	Centre channel frequency from T70, 10W max	RF output power at J2	Key transmitter and ajust RV2 for the desired threshold output power
12	As above	RFO LED	Key transmitter and adjust RV1 to where the RFO LED just goes OFF.
13	As above	RF output power at J2	Key transmitter and adjust RV2 for the desired power

4 Specifications

4.1 Description

The power amplifier is designed for use with the T70 series transmitters to provide 25-70 watts output.

Output power regulation is provided by connecting the output of the directional coupler to the ALC input of the T70. The drive from the transmitter module is then automatically adjusted to maintain the required output.

The regulated power level can be preset over a wide range from 25 to 70 watts depending on the available driver power.

Sensing circuits are provided to protect the output transistor 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 Eclipse 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.

5 Front Indicators and Test Points

5.1 Indicators

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

5.2 Test Points

Forward Power –	Pin 8 + Gnd (pin 1)
Reverse Power -	Pin 4 + Gnd (pin 1)
Collector Current –	Pin 2 + 13.2Vdc (pin 5)

6 Electrical Specifications

6.1 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 70 Watts. 100 mA Max. standby
Polarity - Negative Ground

6.2 Frequency Range

Adjustable to cover 66 to 88 MHz with a maximum channel frequency spread of 5 MHz.

6.3 Nominal Antenna Impedance

50O

6.4 Output Power

25 to 70 watts adjustable

6.5 Transmit Duty Cycle

With Free Air Circulation

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

With Fan Module

25-70 Watts - 100% to 50 deg. C

6.6 Spurious and Harmonics

Less than 0.25µW

6.7 Maximum Heatsink Temperature

90 degrees C.

6.8 ALC Output

The ALC is intended for connection to the T70. It supplies a voltage which decreases with increasing power or temperature.

6.9 Mis-Match Protection

The amplifier is protected from damage when operating into a VSWR of 5/1 at all phase angles.

7 Connectors

7.1 Antenna Connector

Type N Female mounted on the module rear panel

7.2 Power and I/O Connector

25 Pin “D” Male mounted on the rear panel

7.3 Test Connector

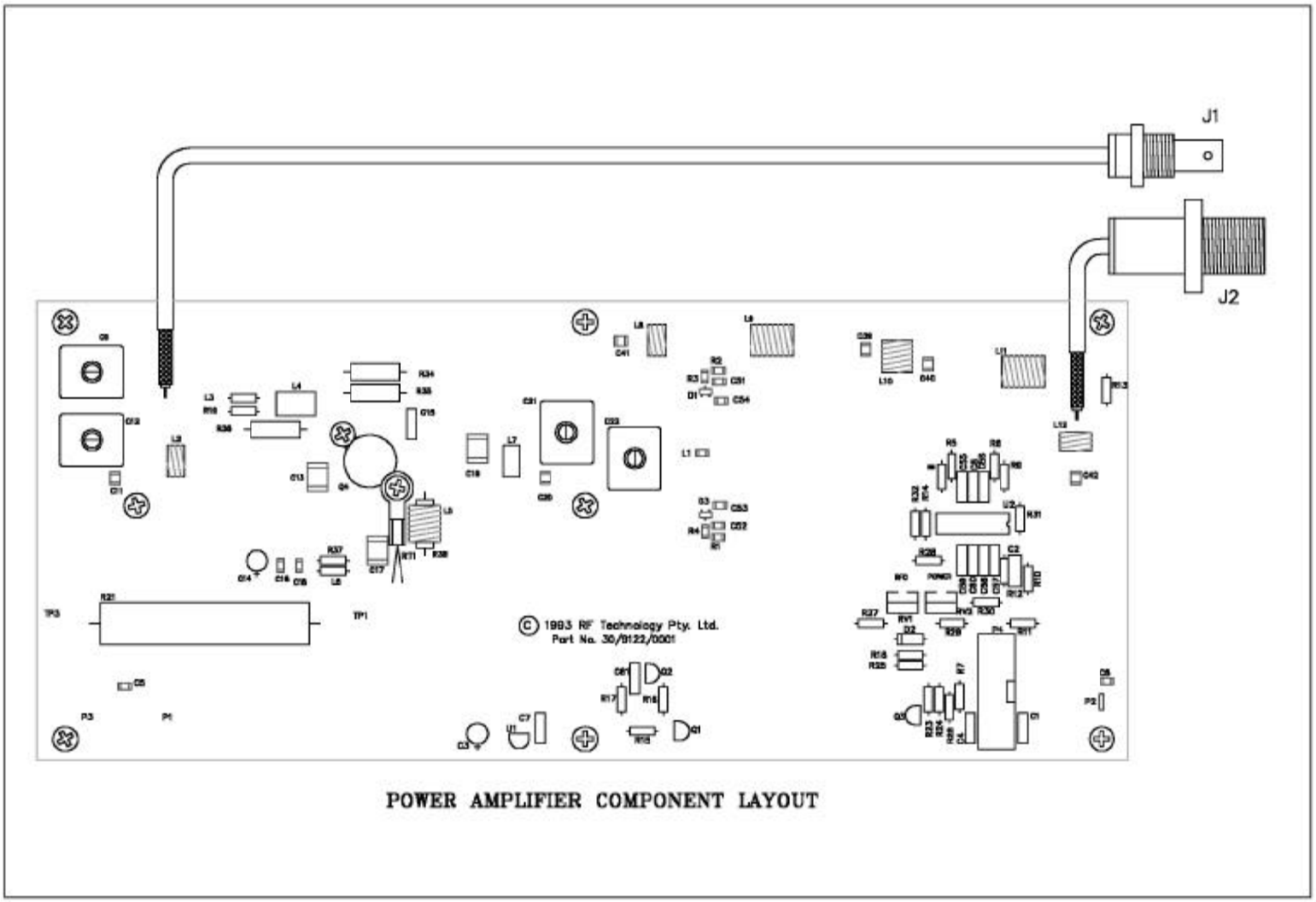
9 Pin “D” Female mounted on the front panel.

Ref.	Description	Part Number
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 1NO 5% 63V NPO SM1206	46/3300/01N0
C6	CAP 1NO 5% 63V NPO SM1206	46/3300/01N0
C7	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C8	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C9	CAP TRIM 7-100P HI TEMP	49/3003/100P
C11	CAP 27P 500V MICA SM1210	48/3003/027P
C12	CAP TRIM 7-100 HI TEMP	49/3003/100P
C13	CAP 1N0 500V MICA SM2220	48/3003/01N0
C14	CAP 6.8U 20% 25V SOLID AL	41/2225/06U8
C15	CAP 100N 10% 50V X7R RD.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 5% 63V NPO SM1206	46/3300/01N0
C19	CAP 510P 500V MICA SM2200	48/3003/510P
C20	CAP 27P 500V MICA SM1210	48/3003/027P
C21	CAP TRIM 7-100P HI TEMP	49/3003/100P
C22	CAP TRIM 7-100P HI TEMP	49/3003/100P
C39	CAP 68P 500V MICA SM1210	48/3003/068P
C40	CAP 68P 500V MICA SM1210	48/3003/068P
C41	CAP 20P 500V MICA SM1210	48/3003/020P
C42	CAP 20P 500V MICA SM1210	48/3003/020P
C51	CAP 27P 5% NPO SM1206	46/3300/027P
C52	CAP 27P 5% NPO SM1206	46/3300/027P
C53	CAP 1NO 5% 63V NPO SM1206	46/3300/01N0
C54	CAP 1NO 5% 63V NPO SM1206	46/3300/01N0
C55	CAP 1NO 5% 100V NPO RAD.2	46/2000/01N0
C56	CAP 1NO 5% 100V NPO RAD.2	46/2000/01N0
C57	CAP 1NO 5% 100V NPO RAD.2	46/2000/01N0
C58	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C59	CAP 1NO 5% 100V NPO RAD.2	46/2000/01N0
C60	CAP 1NO 5% 100V NPO RAD.2	46/2000/01N0
C61	CAP 1NO 5% 100V NPO RAD.2	46/2000/01N0
D1	DIO SHTKY BAT17 SOT23	21/3030/0017
D2	DIODE SILICON IN4148	21/1010/4148
D3	DIO SHTKY BAT17 SOT23	21/3030/0017
L1	IND 1U 10% CHOKE SM1206	37/3320/01U0
L2	COIL AIR CORE 2T 2P 6.35D	37/1635/2002
L3	INDUCTOR 1uH AXIAL	37/2021/001U
L4	IND MOLDED 6.5 TURN	37/2021/0006
L5	COIL AIR CORE 7T 1.5P 6.35ID	37/1635/1507
L6	FERRITE BEAD 3x4x1 4S2	37/1022/0001
L7	COIL AIR CORE 2T 2P 6.35ID	37/1635/2002
L8	COIL AIR CORE 3T 1.5P 6.35ID	37/1635/1503
L9	COIL AIR CORE 5T 1.5P 6.35ID	37/1635/2005
L11	COIL AIR CORE 5T 2P 6.35ID	37/1635/2005
L12	COIL AIR CORE 3T 1.5P 6.35ID	37/1635/1503
P1	6.35mm QC TAB VERT PCB MT	35/0635/0001
P3	6.35mm QCTAB 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 MRF492	27/3020/MRF492

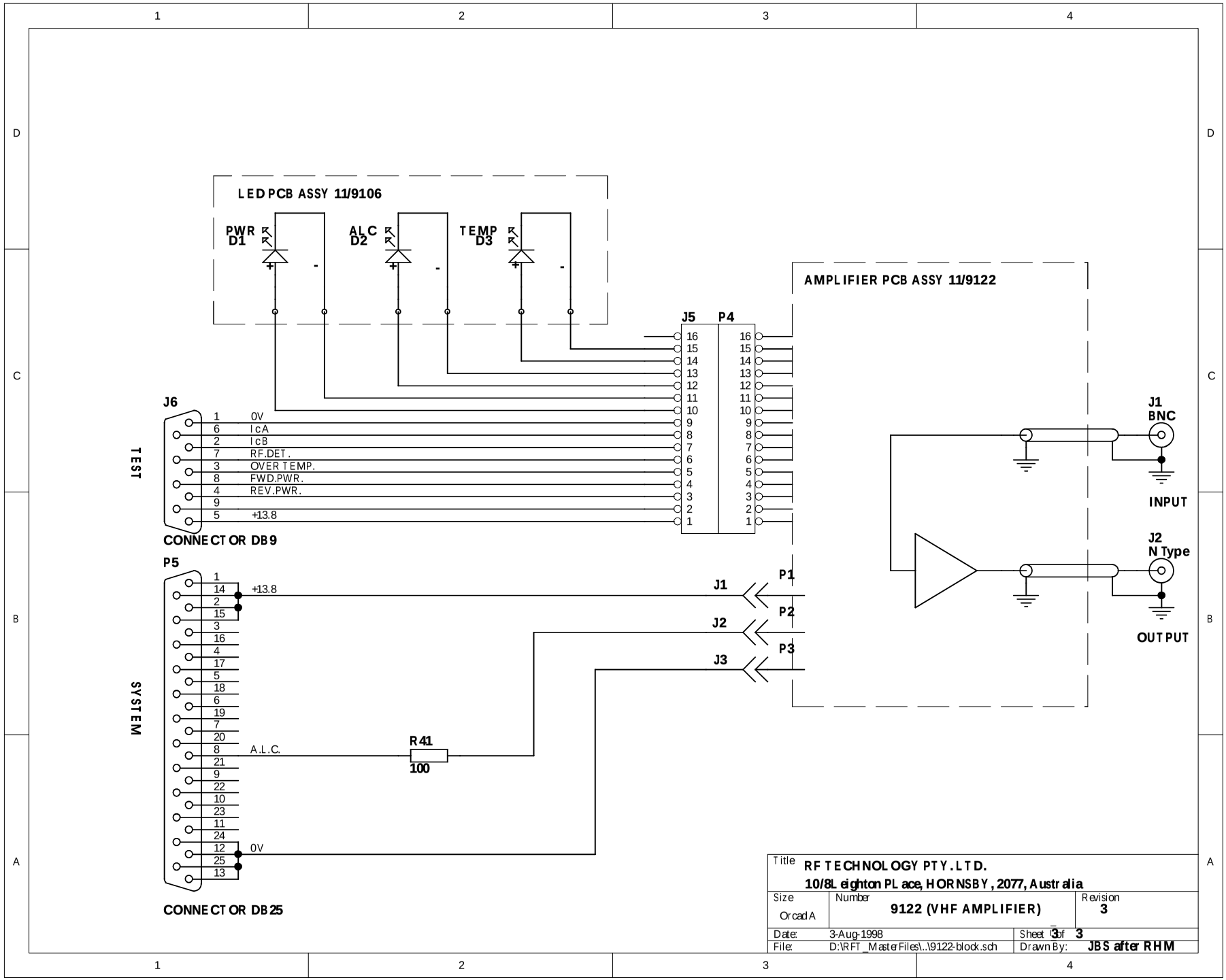
R1	RES 220 5% 0.25W SM1206	51/3380/0220R
R2	RES 220 5% 0.25W SM1206	51/3380/0220R
R3	RES 220 5% 0.25W SM1206	51/3380/0220R
R4	RES 220 5% 0.25W SM1206	51/3380/0220R
R5	RES 47K 5% 0.25W AXIAL	51/1040/047K
R6	RES 100K 5% 0.25W AXIAL	51/1040/100K
R7	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R8	RES 47K 5% 0.25W 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	51/1040/0100R
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	51/1040/02K2
R17	RES 10K 5% 0.25W AXIAL	51/1040/010K
R18	RES 10K 5% 0.25W AXIAL	51/1040/101K
R19	RES 10R 5% 0.25W AXIAL	51/1010/0010
R21	RES 0.1R 5% 10W ASW 10	51/0010/00R1
R23	RES 10K 5% 0.25W AXIAL	51/1040/010K
R24	RES 270R 5% 0.25W AXIAL	51/1040/0270
R25	RES 270R 5% 0.25W AXIAL	51/1040/0270
R26	RES 680R 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
R32	RES 33K 5% 0.25W AXIAL	51/1040/033K
R34	RES 47R 5% 2W AXIAL	51/1052/0047
R35	RES 47R 5% 2W AXIAL	51/1052/0047
R36	RES 4R7 5% 2W AXIAL	51/1052/04R7
R37	RES 2R2 5% 0.25W AXIAL	51/1040/02R2
R38	RES 47R 5% 2W AXIAL	51/1052/0047
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 78LO8 TO92M	25/2040/78LO8
U2	IC QUAD OP AMP TLC274	25/2050/274C

PA70 LED Board Parts

D1	DIODE LED GREEN T1 3/4	21/1010/LEDG
D2	DIODE LED YELLOW T1 3/4	21/1010/LEDY
D3	DIODE LED RED T1 3/4	21/1010/LEDR



POWER AMPLIFIER COMPONENT LAYOUT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ALC D2
TEMP D3
AMPLIFIER PCB ASSY 11/9122
J5
P4
J6
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6 IcA
2 IcB
7 RF.DET.
3 OVER TEMP.
8 FWD.PWR.
4 REV.PWR.
9
5 +13.8
CONNECTOR DB9
TEST
SYSTEM
P5
+13.8
A.L.C.
0V
R41
100
CONNECTOR DB25
J1
P1
J2
P2
J3
P3
J1 BNC
INPUT
J2 N Type
OUTPUT
Title RF TECHNOLOGY PTY.LTD.
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Size OrcadA
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Revision 3
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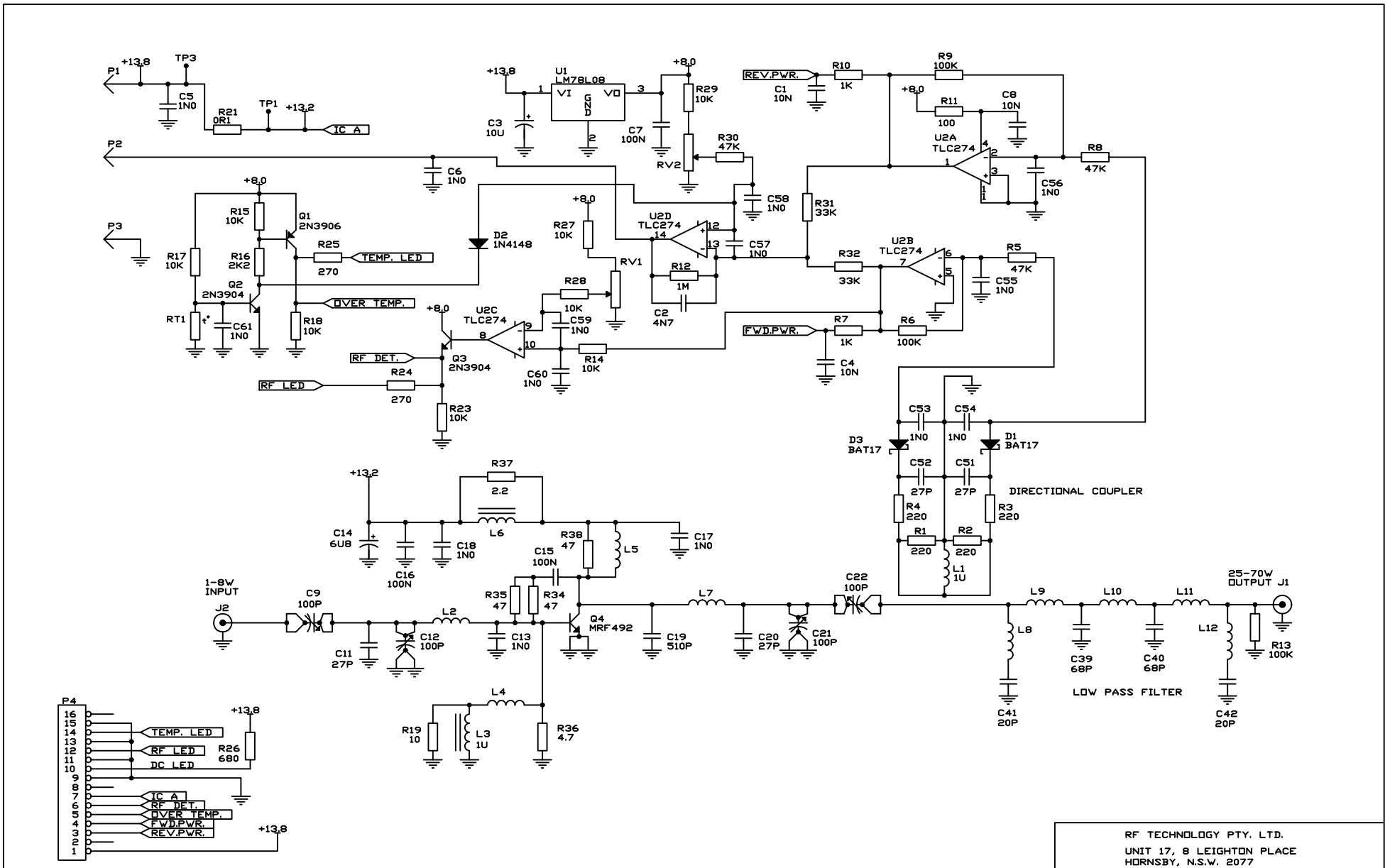

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Title: 70W AMPLIFIER, VHF 66-88 MHZ

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