

Unit 5

UHF 50W

Amplifier

1. UHF 100W Amplifier:

1.1. Introduction:

This module amplifies the signal that comes from the channel converter, to the 100 W level, maintaining its characteristics and the same bandwidth.

1.2. +32V 14A switched power supply:

Its function is to supply the 2 W and 100W modules and also the protection circuits that compose the unit.

It is necessary a 220VCA transformer with 35V 15 A output to supply it.

Its efficiency is about $\eta = 80\%$.

1.3. 100W Amplifier protections:

For these functions, we have:

VSWR Circuit: it protects the amplifier module transistors, when the output stationary wave is superior to 4%. This circuit acts in the output transistors gate.

Temperature Circuit: it acts in the output transistors gate when the heat sink temperature is above 56°C.

Over voltage Circuit: this circuit avoids that voltages upper than 32V supply the amplifier modules. When this circuit starts operating the 15 A F1 and F2 fuses damage.

1.4. Power detecting and power limiting protection:

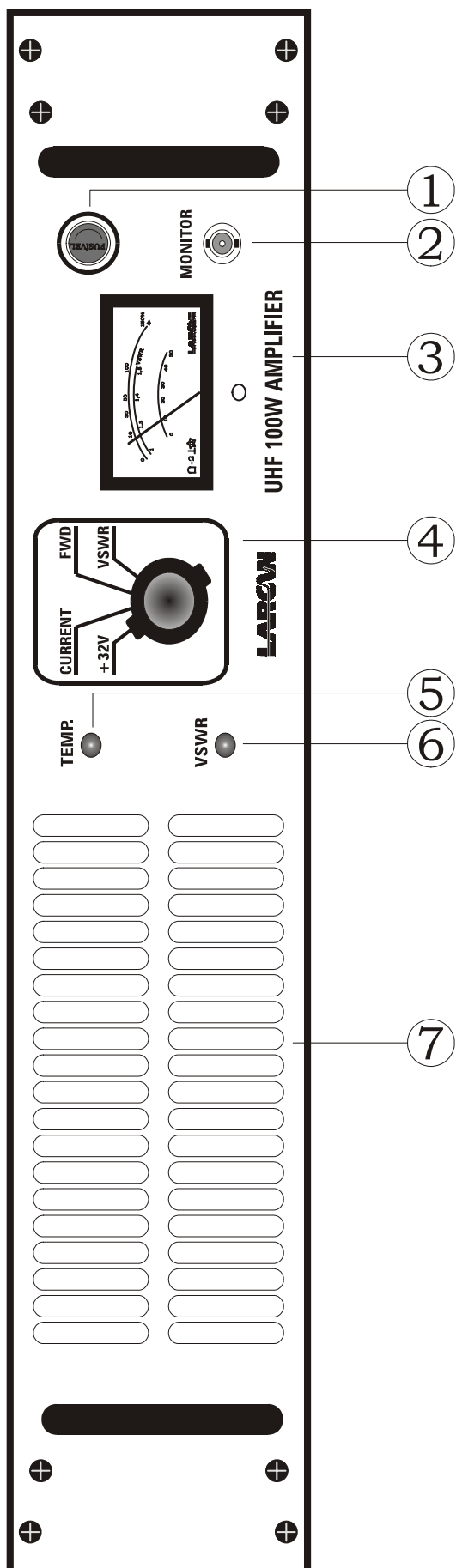
This detector function is to transform a RF signal sample in voltage DC. This voltage, that is proportional to the RF signal, reaches the power limiting circuit to protect the amplifier modules.

1.5. Amplifier stages:

2 W and 100W amplifier modules are used. For this amplifier stages, we use 1 transistor MRF373A for 2W and 4 transistors MRF 373A for 100W. Its gain is about 50 dB in class AB.

2. Frontal and back panel:

2.1. Frontal Panel:



Each element in the panel has the following function:

1. Circuit Breaker: Protection circuit breaker 7 A.

2. Monitor: Connector (BCN) is used to monitoring the RF output signal in the spectrum analyzer.

3. Meter: it allows visualizing +32V measurements, current, forward power and VSWR, according the selector switch position.

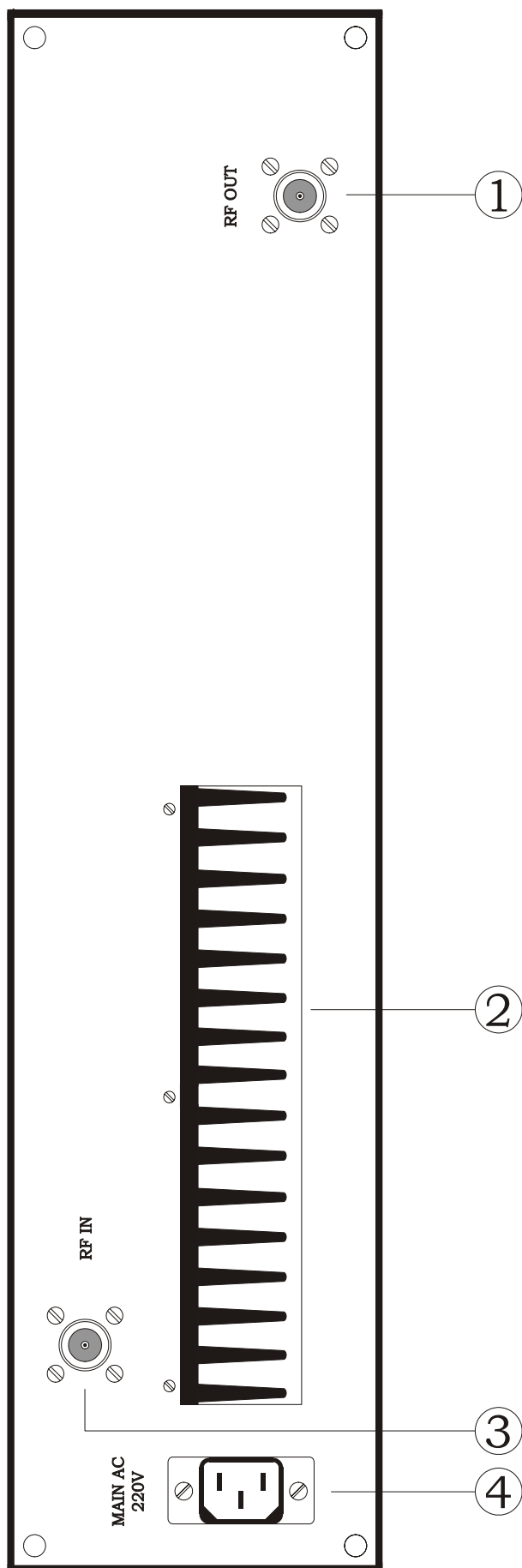
4. Selector switch: according to the switch position, the values are indicated in the meter.

5. Temperature Led alarm: When the led lights, it indicates an over temperature.

6. VSWR Led alarm: When the led lights, it indicates an exceeding VSWR.

7. Air input: there is a fan inside it, which cools the final amplifier heat sink.

2.2. Back Panel:



Each element in the panel has the following function:

- 1. RF OUT:** RF signal output by via connector N.
- 2. AIR OUT:** The air enters through the frontal panel, cools the heat sink and the hot air leaves by the back panel.
- 3. RF IN:** RF signal input by connector N.
- 4. MAIN AC 220V:** main AC power supply 220V.

3. Switched power supply +32V 14A:

3.1. Function

The function of this is to provide 32Vdc with 14 A to the 100W amplifier module.

3.2. Technical characteristics:

Input voltage: _____ 35Vca $\pm$ 10% to 15 A

Output voltage: _____ 32Vdc to 14 A maximum

3.3. Technical description:

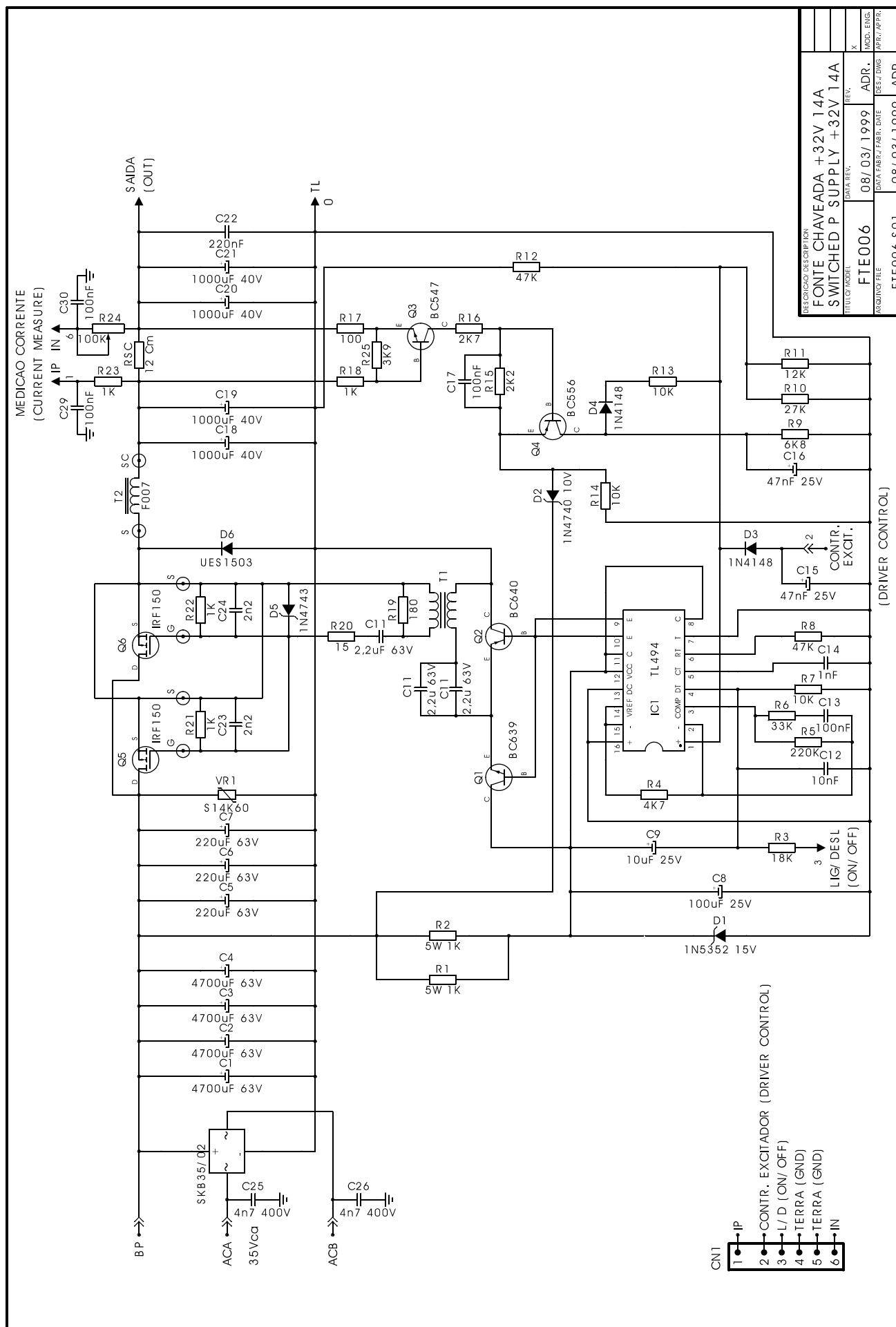
The integrated circuit IC1 operates as PWM (Pulse Width modulator).

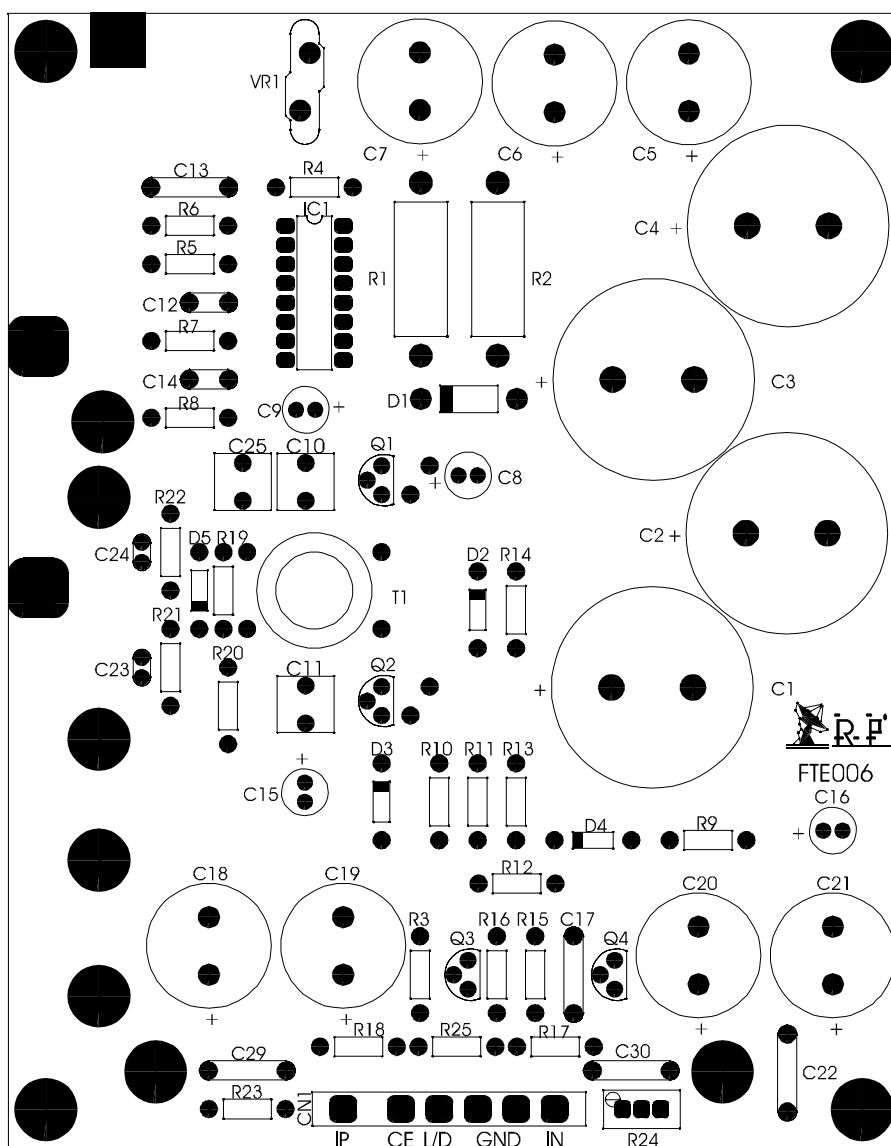
In the IC1 pins 11 and 12, we have the IC supply voltage that comes from zener D1. The power supply Soft Start is effected by capacitor C9 1 μ F with resistor R7 10K, acting in pin 4 of IC1. The power supply oscillation is determined by capacitor C14 and by resistor R8. In pin 9 and 10 from integrated circuit TL494 we have pulses that will activate the current drivers Q1 and Q2.

This sample is transferred to transformer T1 that will activate, through its secondary, the FET's Q5 and Q6. D6 is a fast diode used in switching to avoid reverse voltages in the FET's. T2 function is to isolate switched power supply from the continuing voltage and also, with capacitors C18, C19, C20, C21 and C22 form the filter LC from the power supply. The Shunt RSC is a resistor of low ohm value, made of nickel/chrome which value does not vary due to the circulating current. The power supply module formed by R12 and R11//R10 determines the power supply voltage. The sample of this voltage acts in pin 1 from integrated circuit TL494. Any variation in the output voltage is compensated in pin 1 that acts in the pulse width or shut in pins 9 and 10. The resistors R5 and R6 and capacitor C13 act in the power supply loop. This means the quickness with which the output maintain constant due to the current sudden variation. The over current circuit is formed by Q3, Q4, D4, R13 and associated parts, that act in pin 1 from IC1, decreasing the output voltage to currents upper than 23 A.

The capacitors C1 to C4 and C5 to C7 form an input filter CA after the rectification, and C5 to C7 are 220 μ F capacitors of special manufacture (HFC). These capacitors are used for switching and cannot be substituted for any other type of capacitors.

3.4. Circuit Diagram FTE006:





3.6. Parts list FTE006:

Quant.	Description	Position	Code
1	INTEGRATED CIRCUIT TL 494 CN	IC1	60074
4	CAPACITOR ELCO RADIAL 4700 μ F 63V	C1,C2,C3,C4	71031
1	VARISTOR S14K60	VR1	71037
1	CAPAC. ELCO RADIAL 100 μ F 25V	C8	74010
4	CAPAC. ELCO RADIAL 1000 μ F 40V	C18,C19,C20,C21	74020
1	CAPAC. ELCO RADIAL 1 μ F X 100V	C11	74026
2	CAPAC. ELCO RADIAL 10 μ F X 25V	C9,C10	74028
2	CAPAC. ELCO RADIAL 47 μ F X 25V	C15,C16	74029
3	CAPAC. ELCO RADIAL 220 μ F X 63V	C5,C6,C7	74037
4	CAPAC. POLYESTER METAL. 100 η F	C3,C17,C29,C30	75004
2	CAPAC. POLYESTER METAL. 4 η 7	C25,C26	75008
1	CAPAC. POLYESTER METAL. 220 η F	C22	75016
1	CAPAC. CER. MULTILAYER 1 η F	C14	79501
1	CAPAC. CER. MULTILAYER 10 η F	C12	79510
2	CAPAC. CER. MULTILAYER 2 η 2	C23,C24	79512
2	DIODE 1N 4148	D3,D4	82011
1	DIODE 1N 4740 A 10V	D2	82020
1	DIODE 1N 4743 A 13V	D5	82021
1	DIODE 1N 5352 15V	D1	82074
1	FERRITE TOROID NT15	T1	83005
1	TRIMPOT 100 K	R24	90025
1	RESISTOR 1/8W 15 Ohms	R20	100009
1	RESISTOR 1/8W 100 Ohms	R17	100017
1	RESISTOR 1/8W 180 Ohms	R19	100020
4	RESISTOR 1/8W 1 K	R18,R21,R22,R23	100028
1	RESISTOR 1/8W 2 K 2	R15	100032
1	RESISTOR 1/8W 2 K 7	R16	100033
1	RESISTOR 1/8W 3 K 9	R25	100036
1	RESISTOR 1/8W 4 K 7	R4	100037
1	RESISTOR 1/8W 6 K 8	R9	100039
3	RESISTOR 1/8W 10 K	R7,R13,R14	100041
1	RESISTOR 1/8W 12 K	R11	100042
1	RESISTOR 1/8W 18 K	R3	100044

2	RESISTOR 1/8W 33 K	R6,R10	100047
2	RESISTOR 1/8W 47 K	R8	100048
2	RESISTOR 1/8W 220 K	R5,R10	100056
2	RESISTOR 5W 1 K Ohms	R1,R2	105016
1	SHOCK TRANSFORMER F007	T2	118776
1	TRANSISTOR BC 547 A	Q3	120003
1	TRANSISTOR BC 556 A	Q4	120006
1	TRANSISTOR BC 639	Q1	120007
1	TRANSISTOR BC 640	Q2	120008
1	BRIDGE RECTIFIER 35MB40A	PD1	IMPD00032
1	DIODE UES 1503	D6	IMPD00037
2	TRANSISTOR IRF 150	Q5,Q6	IMPT00069
1	PCB SWITCHED POWER +32V 14 A	PCI1	PCIFTE006

4. 100W UHF amplifier protection:

4.1. Function:

The function of this module is to protect the 100W module, which is formed by VSWR, temperature, over voltage and the power supply limiting circuits.

4.2. Technical Description:

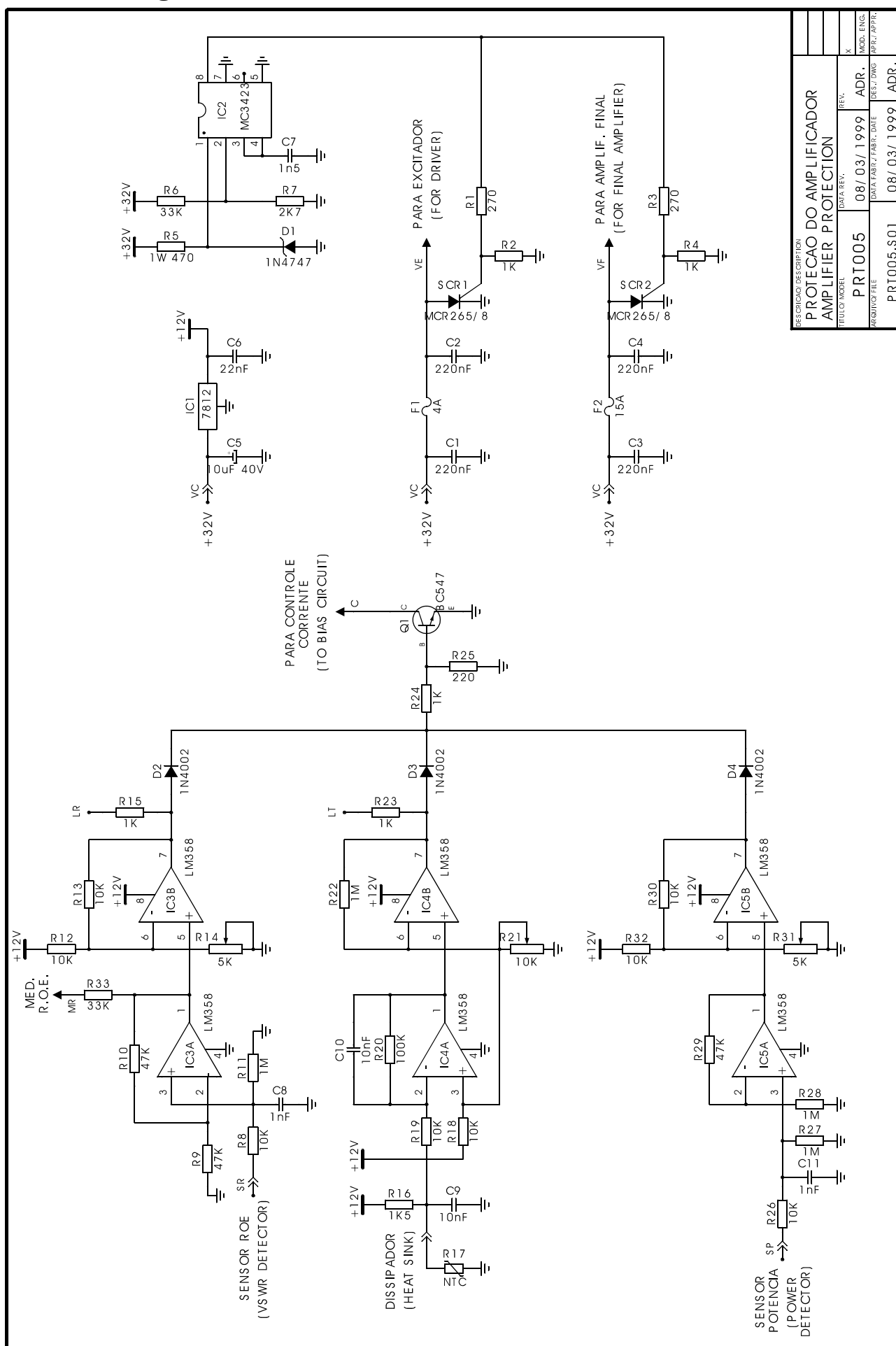
The VWSR sensor protection is calibrated in the plant to be put in action when 4% of stationary wave occurs. The voltage that comes from the VSWR detector acts in the IC3B comparator, through pin 5. Pin 6 has its voltage calibrated previously in the plant for 4% of VSWR, acting in the FET's gates.

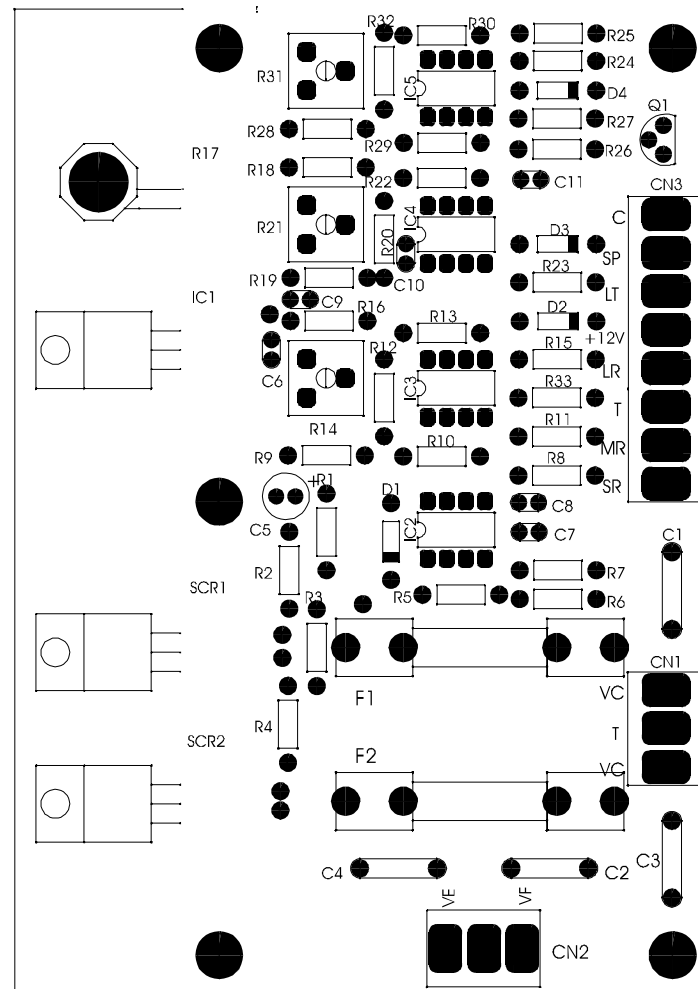
NTC, R17, also acts in the IC4B comparator, through pin 5 with a voltage that comes from the power module through R18 and R21. Q1 puts in action the IC output, as well as it indicates the TL (Temperature Led) when it is turned on.

The power supply over voltage is produced by IC2, SCR1, SCR2, F1 and F2. When any anomaly occurs, IC2 pin 8 has a high level that discharges SCR1 and SCR2, burning the 15A F1 and F2 fuses.

The RF power limiting compares the DC voltage that comes from the Protection detector and the voltage limitat by IC5 pin 5 with a fixed calibrated voltage in the plant IC5 pin 6, acting in the FET's bias gates when the output voltage reaches nominal +10% (similar to the VSWR protection). The comparing voltage happens from the rectification from a final module RF sample, which is always proportional to the output power.

4.3. Circuit Diagram PRT005:





4.5. Parts list PRT005:

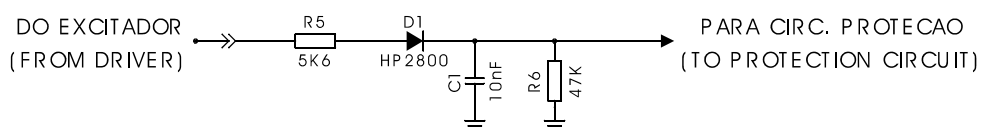
Quant.	Description	Position	Code
3	INTEGRATED CIRCUIT LM 358	IC3,IC4,IC5	60052
1	CAPAC. ELCO RADIAL 10 μ F 50V	C5	74024
4	CAPAC. POLYESTER METAL. 220 η F	C1,C2,C3,C4	75016
1	CAPAC. PLATE 22 η F	C6	76045
2	CAPAC. PLATE 1 η F	C8,C11	79501
1	CAPAC. PLATE 1 η 5	C7	79502
2	CAPAC. PLATE 10 η F	C9,C10	79510
3	DIODE 1N 4002	D2,D3,D4	82001
1	DIODE 1N 4747 A 20V	D1	82056
2	FUSE 15 A	F1,F2	86008
2	TRIMPOT 5 K	R14,R31	90004
1	TRIMPOT 10 K	R21	90005
1	RESISTOR 1/8W 220 Ohms	R25	100021
2	RESISTOR 1/8W 270 Ohms	R1,R3	100022
5	RESISTOR 1/8W 1 K	R2,R4,R22,R23,R24	100028
1	RESISTOR 1/8W 1 K 5	R16	100030
1	RESISTOR 1/8W 2 K 7	R7	100033
8	RESISTOR 1/8W 10 K	R8,R12,R13,R18,R19,R26,R30,R32	100041
1	RESISTOR 1/8W 27 K	R6	100046
1	RESISTOR 1/8W 33 K	R23	100047
3	RESISTOR 1/8W 47 K	R9,R10,R29	100048
1	RESISTOR 1/8W 100 K	R20	100051
4	RESISTOR 1/8W 1 M	R11,R22,R27,R28	100059
1	RESISTOR 1W 470 Ohms	R5	103012
1	THERMISTOR 2 K 2	R17	118749
1	TRANSISTOR BC 547 A	Q1	120003
1	VOLTAGE REGULATOR 7812	IC1	126019
1	INTEGRATED CIRCUIT MC 3423	IC2	IMPCI0025
2	DIODE THERMISTOR MCR 265-10	SCR1	IMPD00033
1	PCB UHF 100W AMPLIFIER PROT	PC11	PCIPRT005

5. Power detecting and power limiting protection:

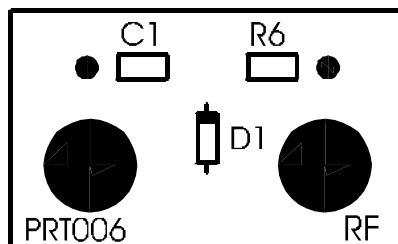
5.1 Function:

Its function is to protect the output transistors from the excessive signal applied to the input.

5.2. Circuit Diagram PRT006:



DESCRICAO/ DESCRIPTION			
PROTECAO DET. E LIMIT. POT. (LIMITING POWER DETECTOR)			
TITULO/ MODEL	DATA REV.	REV.	ME: 148/ 02
PRT006	23/ 05/ 2002	ADR.	MOD. ENG.
ARQUIVO/ FILE	DATA FABR./ FABR. DATE	DES./ DWG	APR./ APPR.
PRT006.S01	08/ 03/ 1999	ADR.	



5.4. Parts List PRT006:

Quant.	Description	Position	Code
1	RESISTOR 1/8W 1 K	R5	100028
1	DIODE HP2800 (5082)	D1	IMPD00001
1	CAPACITOR SMD 1206 - 10 η F	C1	ISMCAP103
1	RESISTOR SMD 1206 - 47 K	R6	ISMRES473
1	PCB DET AND LIM POT PROTEC	PCI1	PCIPRT006

6. 2W UHF Amplifier:

6.1. Function:

The 2W UHF amplifier stage amplifies the channel converted to 2W maximum level.

6.2. Technical characteristics:

Gain: _____ 30 dB
Supply: _____ +32Vdc
Total current: _____ 1 A

6.3. Technical Description:

This module is composed of driver amplifier IC1 and the final amplifier Q1.

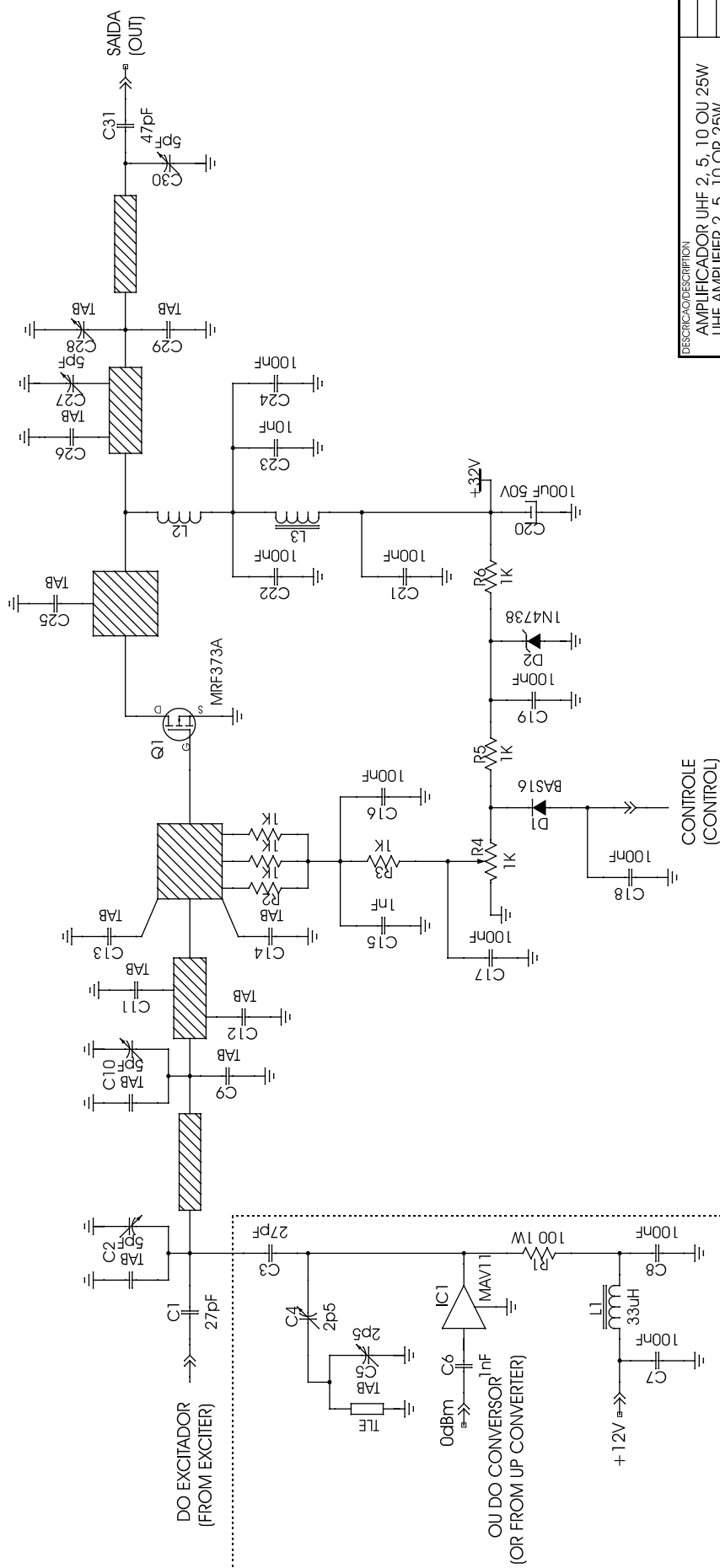
Trimpot R4 sets the quiescent current of Q1 and D1 and allows controlling the output power for protection purposes.

At the input, there is a local oscillator filter TLE, C4 and C5.

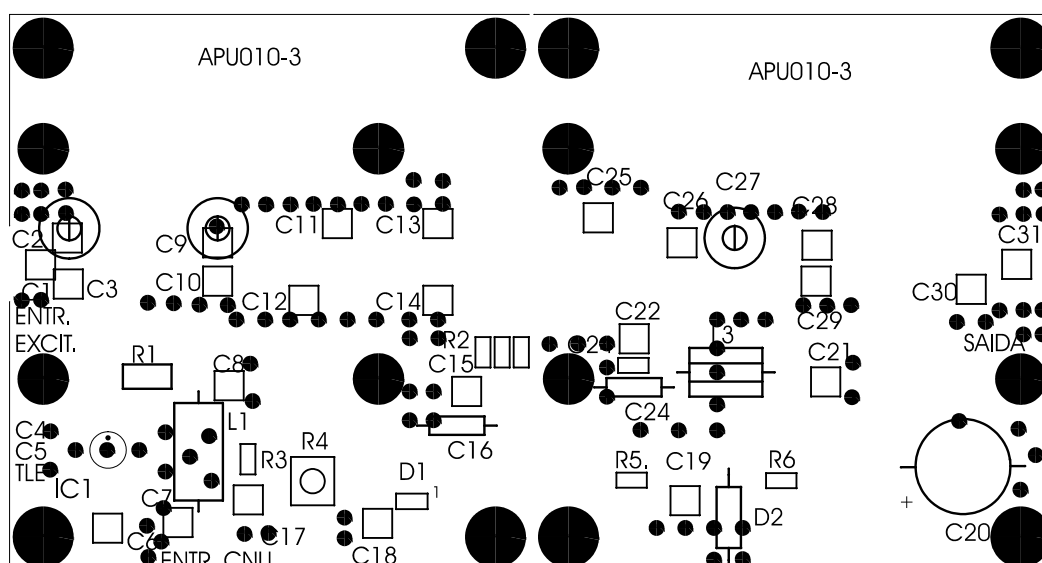
6.4. Circuit Diagram APU010:

CANAL (CHANNEL)	C2	C9	C10	C11	C12	C13	C14	C25	C26	C27	C28	C29
14 - 20	10pF	33pF	10pF	-	-	33pF	47pF	47pF	33pF	-	-	22pF
21 - 40	-	33pF	-	10pF	33pF	33pF	47pF	47pF	33pF	-	-	22pF
41 - 69	-	-	-	-	-	10pF	27pF	-	-	TRIMER 2p5	TRIMER 2p5	-

CANAL (CHANNEL)	TLE
14 - 29	700MHz
30 - 49	900MHz
50 - 69	1100MHz



DESCRIPTION	AMPLIFICADOR UHF 2, 5, 10 O 25W		MOD. ENG.
	UHF AMPLIFIER 2, 5, 10 OR 25W		APR/APPR.
TITLE/NO. MODEL	DATA REV./REV. DATE	REV.	
APIU10	20/03/2003	ADR.	
ARCHIVO FILE	DATA FABR/PABR. DATE	DESIG/IMG	
TM-APIU10 SCH	20/03/2003	ADP	



6.6. Parts list APU010:

Quant.	Description	Position	Code
1	SHOCK 30 μ H	L1	50001
4	CAPAC. POL. META. 100 η F	C16,C24	75019
1	CAPAC. MULTILAYER 22 η F	C29 (TAB)	76045
1	DIODE 1N 4738 8,2V	D2	82029
1	SHOCK 3 6007	L3	95052
1	CAPAC. MONOLITIC 27 pF	C14 (TAB)	IMPCI00088
2	CAPAC. MONOLITIC 47 pF	C14 (TAB),C15 (TAB)	IMPCI00096
5	CAPAC. TRIMMER JMC 9671 2 p 5	C4,C5,C27 (TAB),C28 (TAB)	IMPC00102
1	DIODE SMD BAS16T	D1	ISM DIOS16
1	TRANSISTOR MRF373A	Q1	IMPT00131
7	CAPAC. SMD 1206 - 100 η F	C7,C8,C17,C18,C19,C21,C22	ISM CAP104
1	RESISTOR SMD 1206 – 100 Ohms	R1	ISM RES101
5	RESISTOR SMD 1206 – 1 K	R2 (3x),R5,R6	ISM RES102
1	TRIMPOT 3314G-1-102E – 1 K	R4	ISM TRP102
1	PCB UHF 2W AMPLIFIER	PCI1	PCIAPU010

7. 100W Output amplifier:

7.1. Function:

Its function is to amplify the power that comes from the 2W amplifier to 100W output level.

7.2. Technical characteristics:

Power supply: _____ 32Vdc 11 A maximum
Input power: _____ 2W (Peak Sync)
Output power: _____ 100W (Peak Sync)
Gain: _____ 18.8 dB
Setting Temperature: _____ 56°C

7.3. Technical Description:

The UHF 100W amplifier is formed by the combination of two 50W amplifiers.

At the input and output there are two 3 dB hybrid couplers with the rejection loads R1 and R14.

The signal splitted by the 3 dB coupler input feeds the two 50W amplifiers through C1 and C2.

At the input of each 50W amplifier there is a balun L1 and L2 that splits the signal again for two transistor Q1, Q2 and Q3, Q4 respectively.

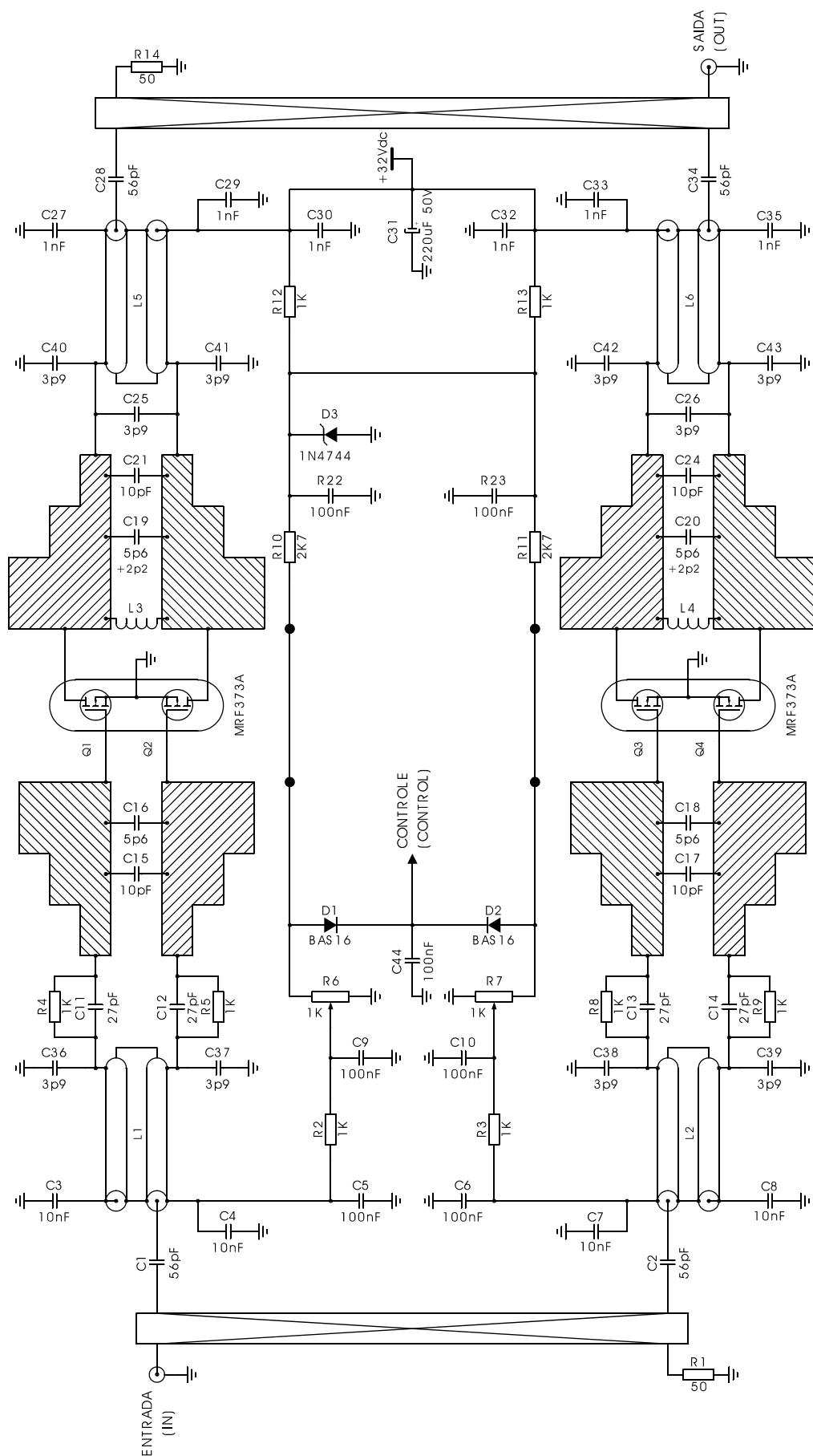
The amplified signals through the baluns L5 and L6 are combined in the final 3 dB coupler with the coupling capacitors C28 and C34.

The bias circuit is formed by resistores R12, R13 and zener diode D3 that generates a +15Vdc.

Through trimpot's R6 and R7 the bias voltage for the transistor's gate are adjusted.

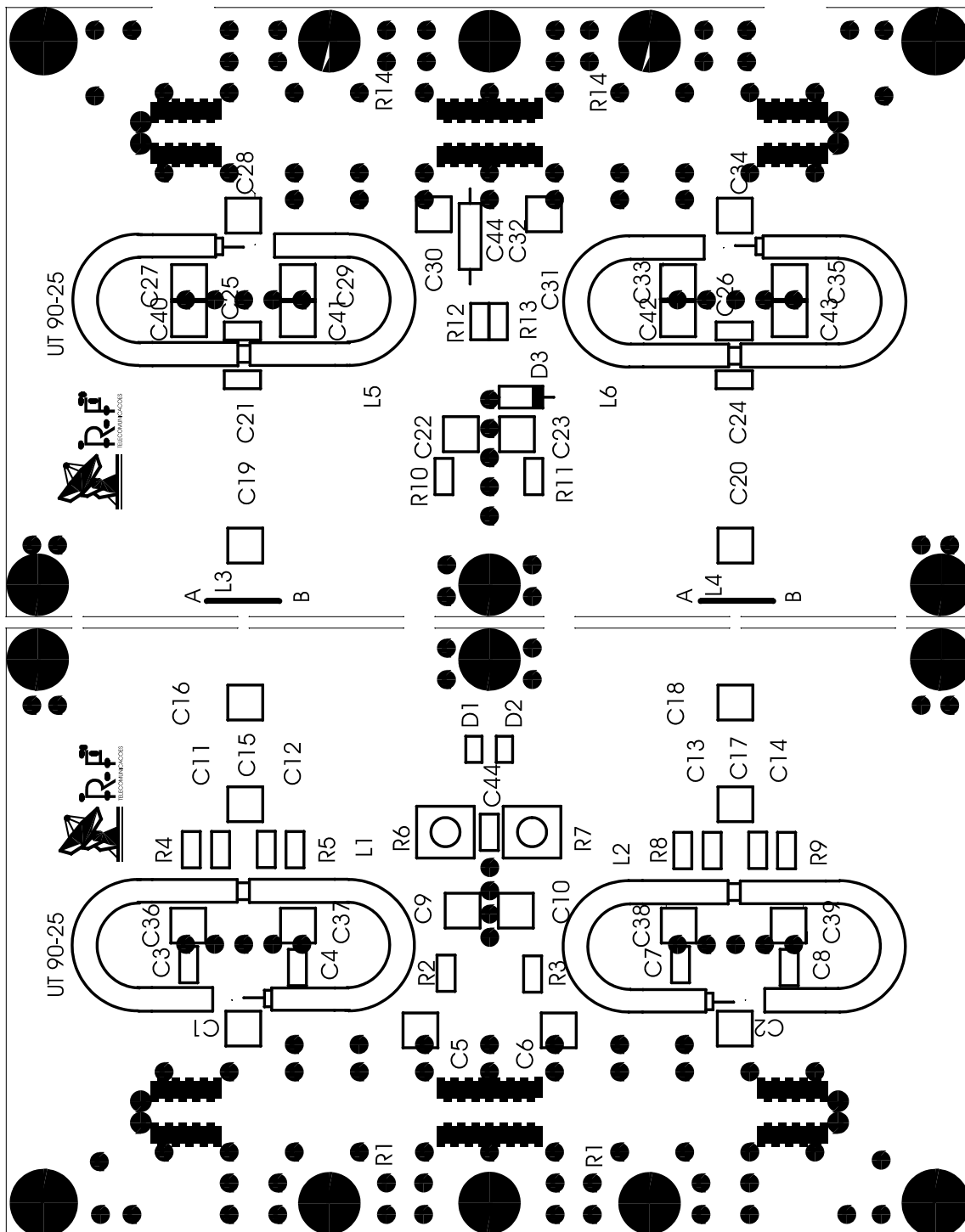
The diode D1 and D2 allow a protection, for the amplifier, reducing the bias voltage and the gain of the amplifier.

7.4. Circuit Diagram APU006:



DESCRICAO DE DESCRICAO			
AMPLIFICADOR 100W UHF			
(100W UHF AMPLIFIER)			
TITULO DO TABELA	DATA REV.	REV.	ADR.
APU006	28/08/2002	1	ADR.
ARQUIVO FILE	DATA FABR./FABR. DATE	DES./ DWG	ADR.
APU006A.S01	11/08/1999		

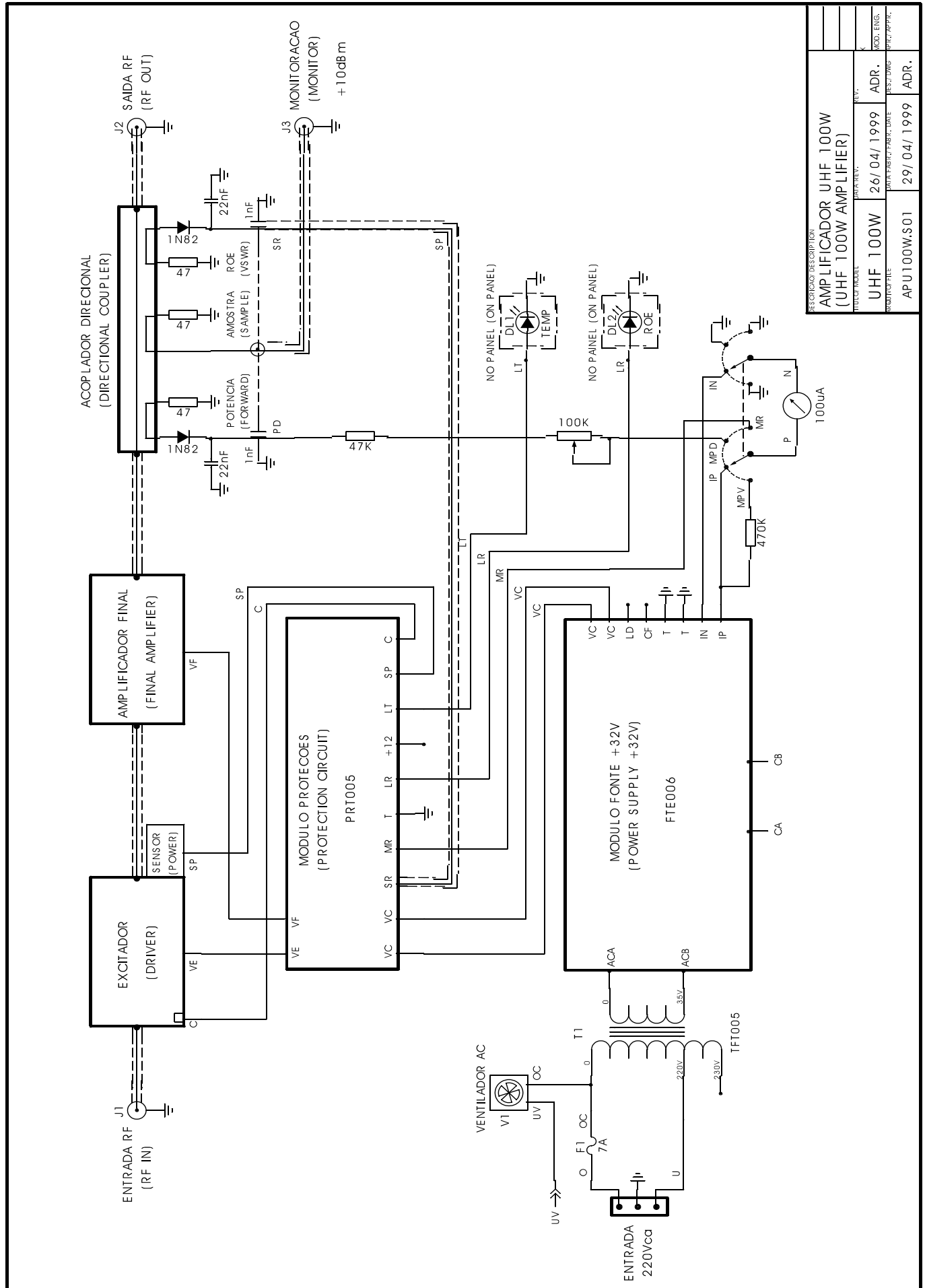
APU006MED



7.6. Parts list APU006:

Quant.	Description	Position	Code
1	CAPAC. ELCO. RADIAL 220 μ F 63V HFC	C31	74037
1	DIODES 1N 4733 A 5V1	D3	82018
1	DIODES 1N 4735 A 6V2	D4	82022
4	CAPAC. MONOL. 27 ρ F	C11,C12,C13,C14	IMPC00088
6	CAPAC. MONOL. 10 ρ F	C15,C17,C21,C24,C25,C26	IMPC00092
2	CAPAC. MONOL. 5 ρ 6	C19,C20	IMPC00093
2	CAPAC. MONOL. 22 ρ F	C16,C18	IMPC00091
4	CAPAC. MONOL. 56 ρ F	C1,C2,C28,C34	IMPC00101
30 Cm	CABLE COAXIAL UT 90-25	L1,L2,L5,L6	IMPCX0008
2	RESISTOR RF CBT-20-5 50 Ohms	R1,R14	IMPR00011
4	TRANSISTOR LDMOS MRF 373 A	Q1,Q2,Q3,Q4	IMPT00131
8	CAPACITOR SMD 1206 10 η F	C3,C4,C7,C8,C27,C29,C33,C35	ISMCA103
8	CAPACITOR SMD 1206 100 η F	C5,C6,C9,C10	ISMCA104
2	DIODE SMD BAS16	D1,D2	ISMDIOS16
10	RESISTOR SMD 1206 1K	R2,R3,R4,R5,R8,R9,R10,R11, R12,R13	ISMRES102
2	TRIMPOT SMD 1K	R6,R7	ISMTRP102
1	PCB 100W UHF AMPLIFIER LDMOS	PCI1	PCIAPU006

8. 100W UHF Amplifier Circuit Diagram:



REVISAO DESCRICAO			
AMPLIFICADOR UHF 100W (UHF 100W AMPLIFIER)			
TITULO MODELO	UHF 100W	DATA REV.	26/04/1999
PRODUTO FILE	APU100W.S01	RES. DWG	ADR.
DATA PROJ. FICHA, DATE	29/04/1999	DATA PROJ. FICHA, DATE	29/04/1999
DATA PROJ. FICHA, DATE	29/04/1999	DATA PROJ. FICHA, DATE	29/04/1999