DB elettronica telecomunicazioni S.p.A.

KA 1000

1 kW VHF FM Power Amplifier

User Manual

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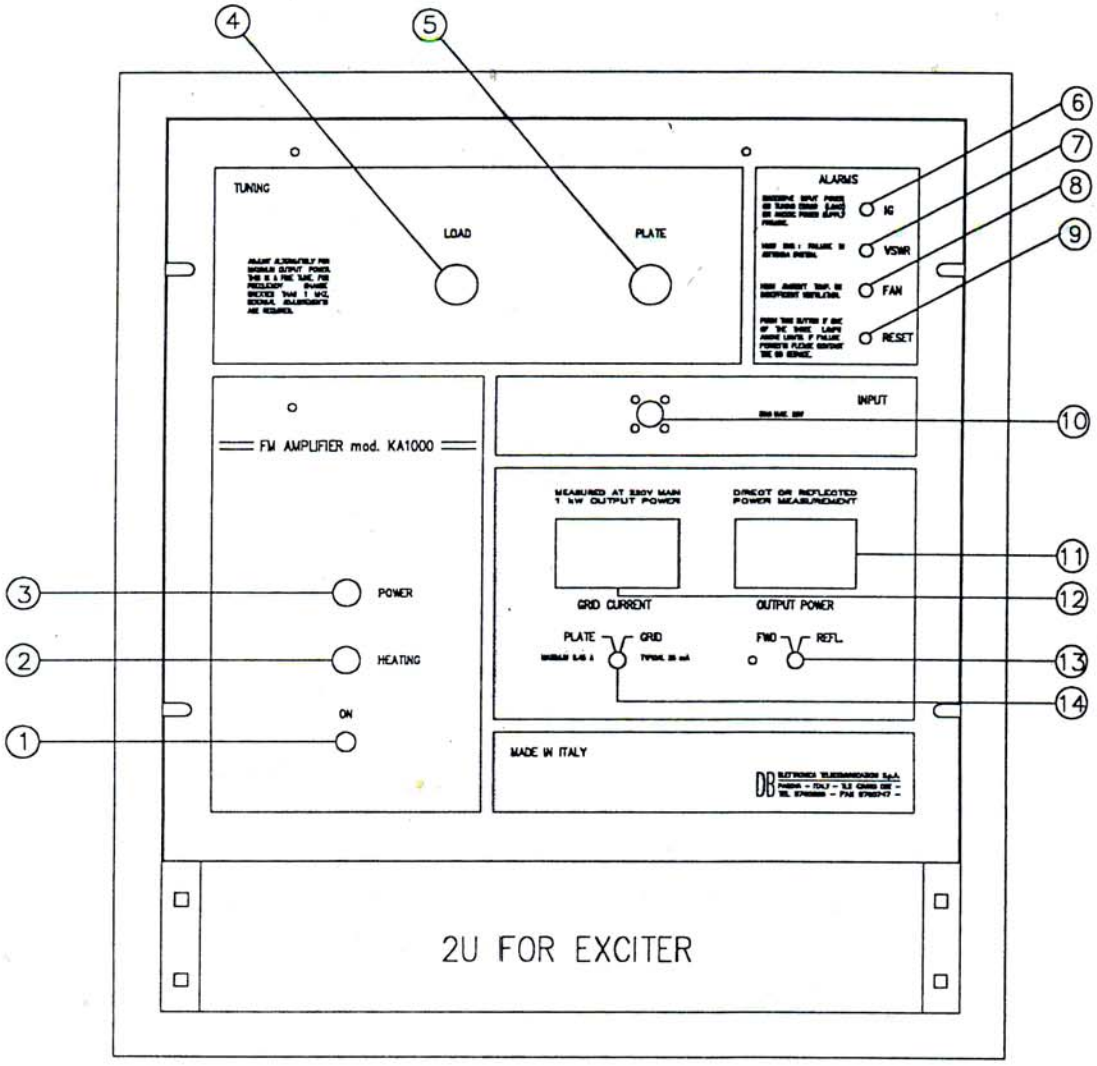
fig.1 - KA 1000 amplifier



1) ON/OFF switch
2) HEATING lamp (filament pre-heating)
3) POWER lamp (amplifier turn-on)
4) LOAD knob
5) PLATE knob
6) Overdriver and GRID current allarm
7) V.S.W.R. allarm
8) Overheating or blower stop allarm
9) Control logic reset
10) Input R.F. connector
11) Power meter
12) Current meter
13) Power switch
14) Current switch

1.3 END USER FACILITIES

1.31 External settings and adjustment

OFF/ON (switch): this switch (see. fig.1) in *OFF* position means that the amplifier is turned-off; on the contrary when this switch is in *ON* position means that cooling system, tube filament , control and logic unit, timer (which gives authorization to close the high voltage anodic circuit) are powered.

FWD/REFL (switch): it permits to select (see fig.1) the kind of signal the *OUTPUT POWER* meter will show: in *FWD* position it is possible read the direct output power while in *REFL* position shall have the reflected power coming from the load (antenna system).

RESET (pushbutton): it permits to reset the logic and control unit when an internal or external drawback may happen in the device, and the relative LED indication. (see fig.1).

PLATE/GRID (switch): it permits to select (see fig.1) the current value indicate by *CURRENT* meter: in *PLATE* position it will indicate the PLATE current, while in *GRID* position it will indicate the GRID current.

PLATE (knob): it needs to make the fine transmitting frequency adjustment (0.8 MHz); this is possible turning left or right the knob (see fig.1) in order to have the maximum output power.

LOAD (knob): it needs to optimize the coupling of final power stage with the connected load; this is possible turning the knob (see fig.1) in order to have the maximum indication of *OUTPUT POWER* meter when it is in *FWD* position.

1.32 Warning and led indications (see fig. 1)

HEATING (red lamp): it shows the start of pre-heating cycle (filament, cooling and control logic unit are powered).

POWER (red lamp): it shows the end of pre-heating cycle and that the anodic circuit is powered.

IG (green led): it shows the intervention of logic and control unit due to overdriving given to the amplifier input or an higher grid current value absorbed by tube.

VSWR (red led): it shows the intervention of control and logic unit due to an excessive power return coming from antenna system connected (mismatching or short circuit).

FAN (yellow led): it shows the intervention of control and logic unit due to a no-functioning of cooling system or on enviromental air over-heating, not due to the air cooling system malfunction.

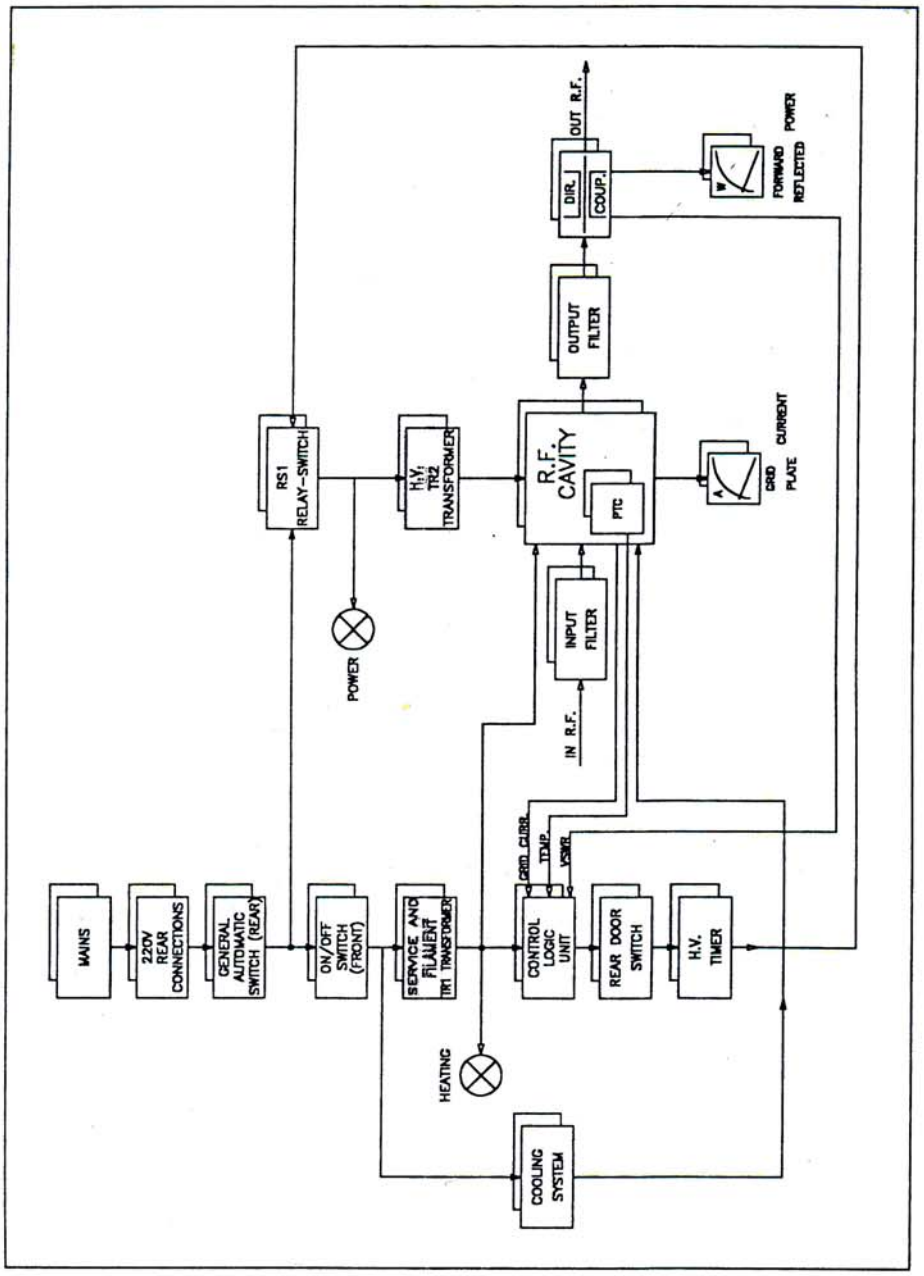
1.33 Meters

These meters (see fig.1) have been developed in order to furnish to the end user a continous general information of amplifier status, with indication of main important parameters and values. As above said, these indications are general only, so it is necessary use external measurement devices to have more precise indications, above all when forwarding and reflected power are taken into consideration.

CURRENT (100 mA/1 A max. indication): it permits to show the values of grid current and plate current absorbed by the tube. The choise what show is made by the means of *PLATE/GRID* switch above mentioned.

OUTPUT POWER (1.5 kW max. indication): it permits to show the forwarding power given to the load and the reflected power coming from this last one due to a mismatching. The choice what show is made by the means of *FWD/REFL* switch above mentioned. Up to a 5% reflected power indication has to be consider correct.

fig.2 - KA 1000 block diagram



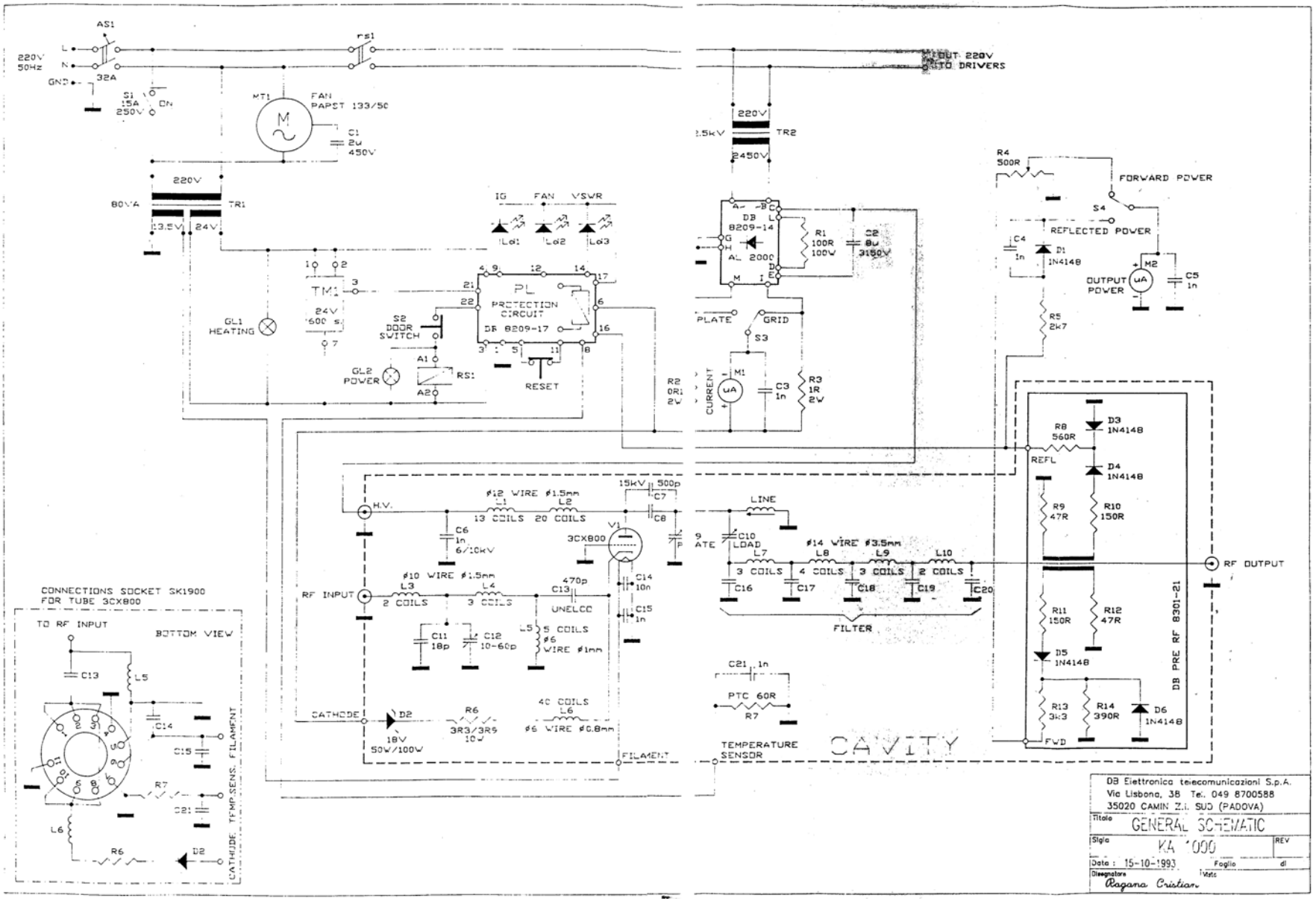
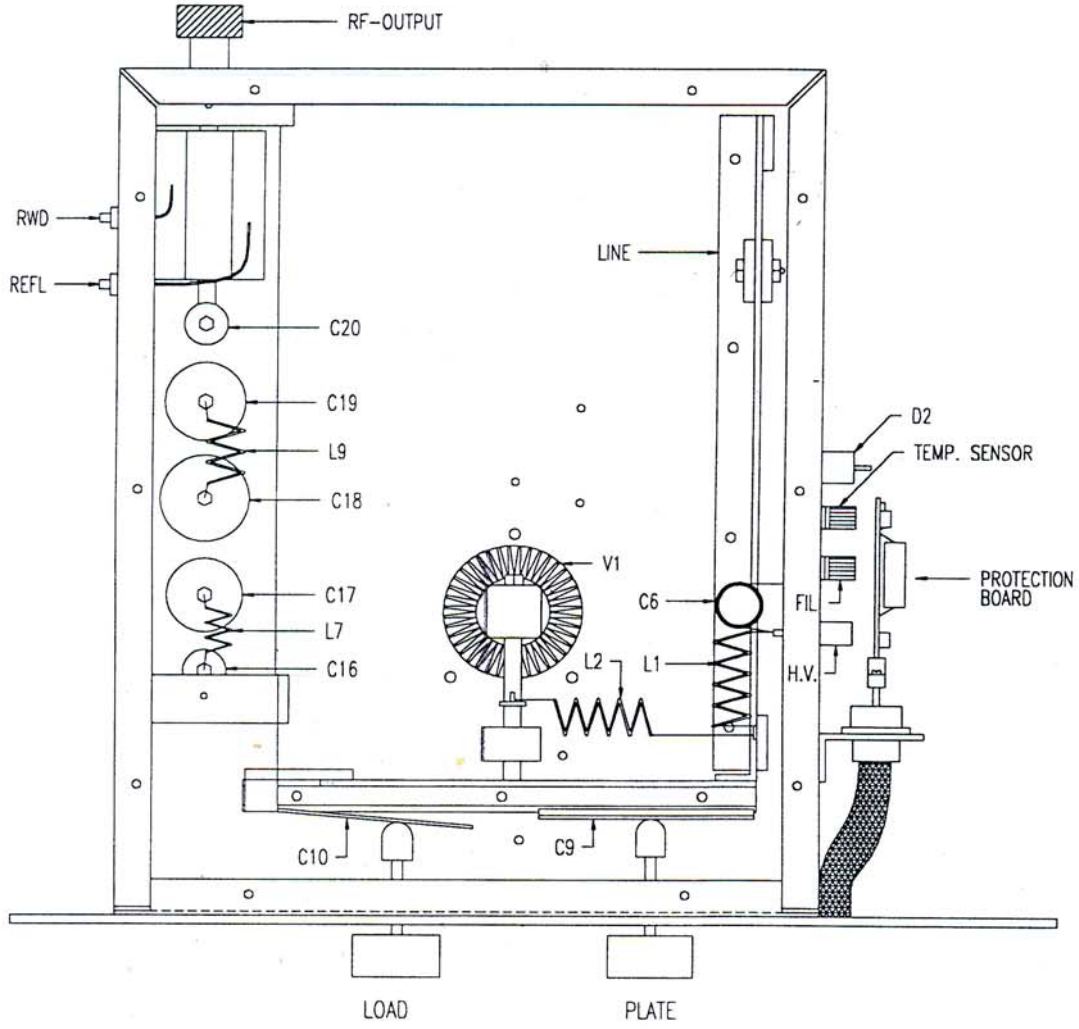

AS1
220V 50Hz
L
N
GND
32A
S1 15A 250V ON
MT1
FAN PAPST 133/50
C1 2u 450V
220V
80VA
TR1
13.5V
24V
IG
FAN
VSWR
Ld1
Ld2
Ld3
TM1
24V 600 s
GL1 HEATING
S2 DOOR SWITCH
PL
PROTECTION CIRCUIT
DB 8209-14
GL2 POWER
A1
A2
RS1
RESET
R2 0R1 2W
OUT 220V TO DRIVERS
220V
2450V
TR2
DB 8209-14
AL 2000
R1 100R 100W
C2 8u 3150V
PLATE
GRID
S3
CURRENT
M1
C3 1n
R3 1R 2W
R4 500R
FORWARD POWER
S4
REFLECTED POWER
C4 1n
D1 1N4148
OUTPUT POWER
M2
C5 1n
R5 2K7
R8 560R
D3 1N4148
REFL
D4 1N4148
R9 47R
R10 150R
R11 150R
R12 47R
D5 1N4148
R13 3K3
R14 390R
D6 1N4148
FWD
DB PRE RF 8301-21
H.V.
15KV
500p
C7
C8
ø12 WIRE ø1.5mm
L1
L2
13 COILS
20 COILS
C6 1n 6/10KV
3CX800
V1
LINE
C10 LOAD
ø14 WIRE ø3.5mm
L7
L8
L9
L10
3 COILS
4 COILS
3 COILS
2 COILS
C16
C17
C18
C19
C20
RF OUTPUT
FILTER
RF INPUT
ø10 WIRE ø1.5mm
L3
L4
2 COILS
3 COILS
C13 470p UNELCO
C14 10n
C15 1n
C11 18p
C12 10-60p
L5
5 COILS ø6 WIRE ø1mm
CATHODE
D2 18V 50W/100V
R6 3R3/3R5 10W
40 COILS
L6
ø6 WIRE ø0.8mm
FILAMENT
C21 1n
PTC 60R
R7
TEMPERATURE SENSOR
CAVITY
CONNECTIONS SOCKET SK1900 FOR TUBE 3CX800
TO RF INPUT
BOTTOM VIEW
CATHODE TEMP.SENS. FILAMENT
DB Elettronica telecomunicazioni S.p.A.
Via Lisbona, 38 Tel.: 049 8700588
35020 CAMIN Z.I. SUD (PADOVA)
Titolo
GENERAL SCHEMATIC
Sigla
KA 1000
REV
Data : 15-10-1993
Foglio
di
Disegnatore
Pagana Cristian
Visto

fig.6 - Cavity internal view



4.3 SUGGESTION FOR A LONGER LIFE OF TUBE

In order to have the longer possible life of tube, it is necessary follow these suggestions:

➲ avoid mains fluctuations greater than 5%;

4.6 TUNING INSTRUCTIONS

Here are described operation apply in case of tuning a new cavity, greater repairs or changing of the operating frequency, transport, and even in case of following regular replacement of the tube, which required retuning, of all the slight shifting of sliding and rotary contacts needs to be performed.

For tuning, polyscope is used. The goal is to achieve maximum output power together with minimum grid current, both visible on protection and control front panel meters.

❶ Make sure the exiter is off or that the driver of the output power exiter indicate 0 (zero).

❷ Give tension moving the switch power *AS1* in ON and the one of STAND-BY (*S1*); afterwards waiting for the tube preheating period (about 2 min.); after that, the STAND-BY lighten indicats the equipment is able to be in POWER from that moment the equipment is able to be located in POWER through the exciter (please check the modulator is switched on).

❸ Arrange the deviator in *FWD* position.

❹ Take pilot power to a value of 5W; work on driver *PLATE* and *LOAD* getting the higher indication you can, on instrument *POWER*.

❺ Increase pilotage power to the maximum value (20÷25W); in output you will have 1000W. If this wouln't happen, work on knobs *PLATE* and *LOAD*.

❻ Check on *GRID* current instrument that the grid current does not pass over 30mA; if that would happen, proceed like point **4**).

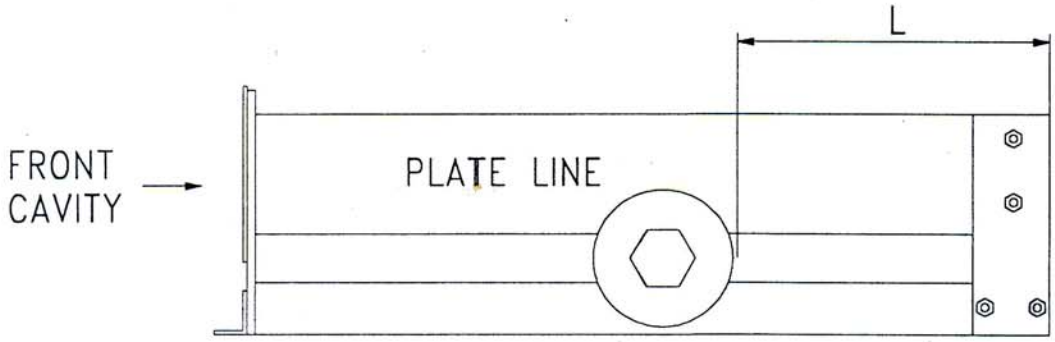
❼ Check on *PLATE* current instrument the anodic currents doesn't exceed value of 450mA; if that would happend, proceed like point **4**).

4.7 HOW TO CHANGE FREQUENCY

The amplifier can be tuned in trasmission on the whole FM band. For short frequency shifting (max. 0.8MHz) it's enough working on driver *PLATE* and *LOAD*, so that you have the maximum sign on instrument *POWER*.

For bigger shifting (*LOAD* driver completely close or open), it's necessary to work directly on *PLATE LINE* (see fig.6-8), moving the metallic record and considering that to higher frequences corresponds shorter lines and vice versa. Every time you do this last kind of intervention is good to repeat again the whole calibration proceedings.

fig.8 - Change frequency



frequenza in MHz

88 - 89 - 90 - 91 - 92 - 93 - 94 - 95 - 96 - 97 - 98 - 99 - 100 - 101 - 102 - 103 - 104 - 105 - 106 - 107 - 108

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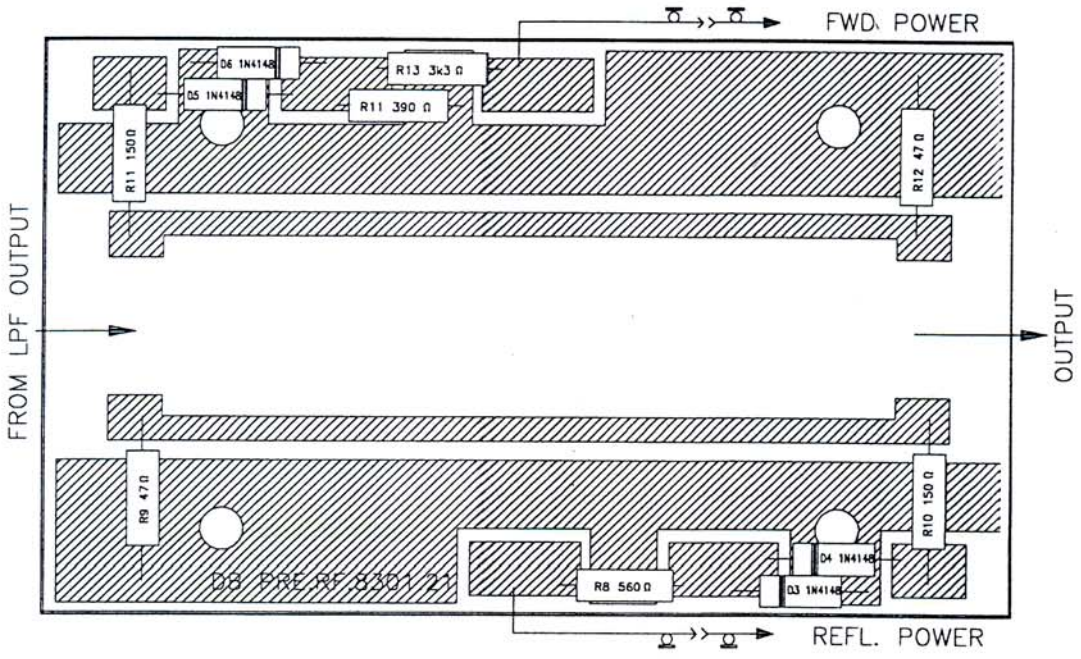
25 - 30 - 36 - 42 - 47 - 52 - 57 - 61 - 64 - 69 - 75 - 79 - 84 - 89 - 94 - 100 - 105 - 110 - 115 - 120 - 125

distanza L in mm

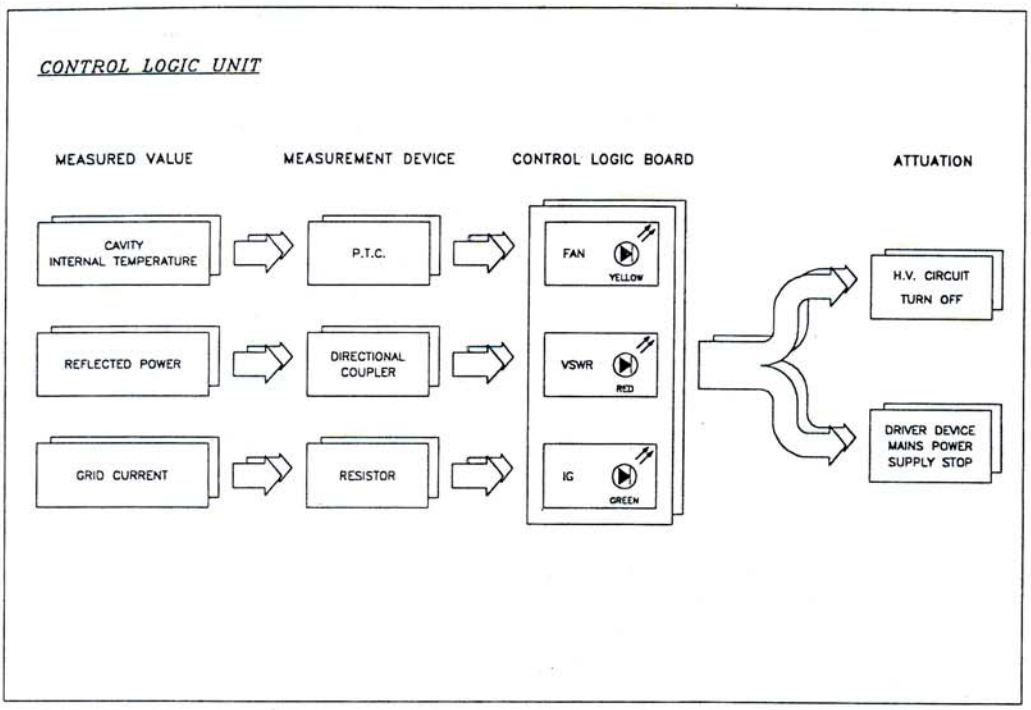
fig.10 - Component layout (DB PRE RF 8301-21)



5.2 RF POWER MEASUREMENT CIRCUIT PARTS LIST

Item	Quantity	Reference	Part
1	4	D3,D4,D5,D6	1N4148
2	1	R8	560R
3	2	R9,R12	47R
4	2	R10,R11	150R
5	1	R13	3k3
6	1	R14	390R

fig.11 - CONTROL LOGIC unit block diagram



6.2 STOP FUNCTIONING CONDITIONS

The amplifier stop functioning conditions can happen for:

- excessive grid current caused by a wrong cavity tuning, a tube discharge (defective), or overdriving (> 20÷25W);
- obstruction or broken fan or enviromental air over-heating;
- excessive V.S.W.R. caused by antenna system or feeder cable.

fig.12 - CONTROL LOGIC unit electric diagram

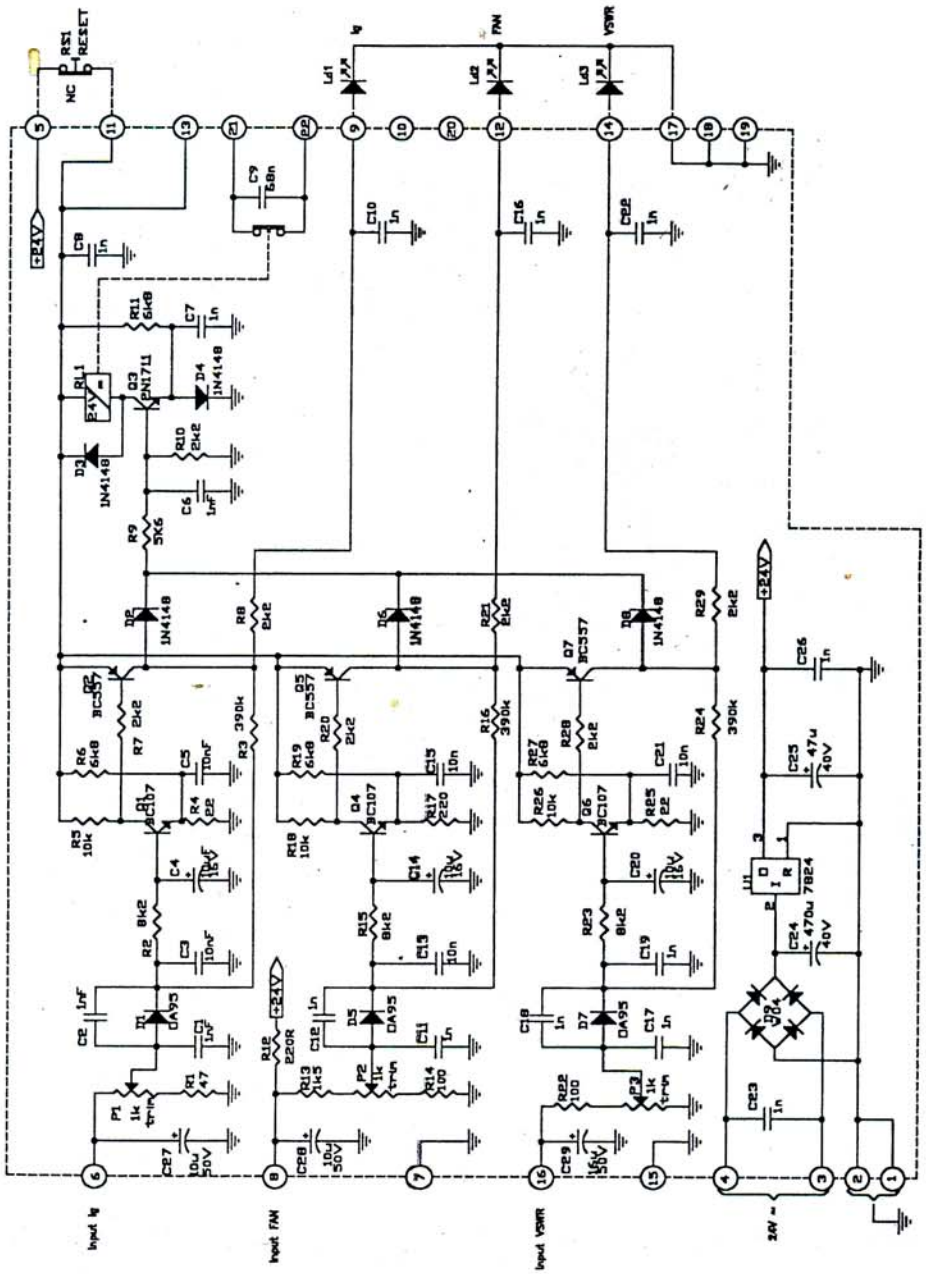
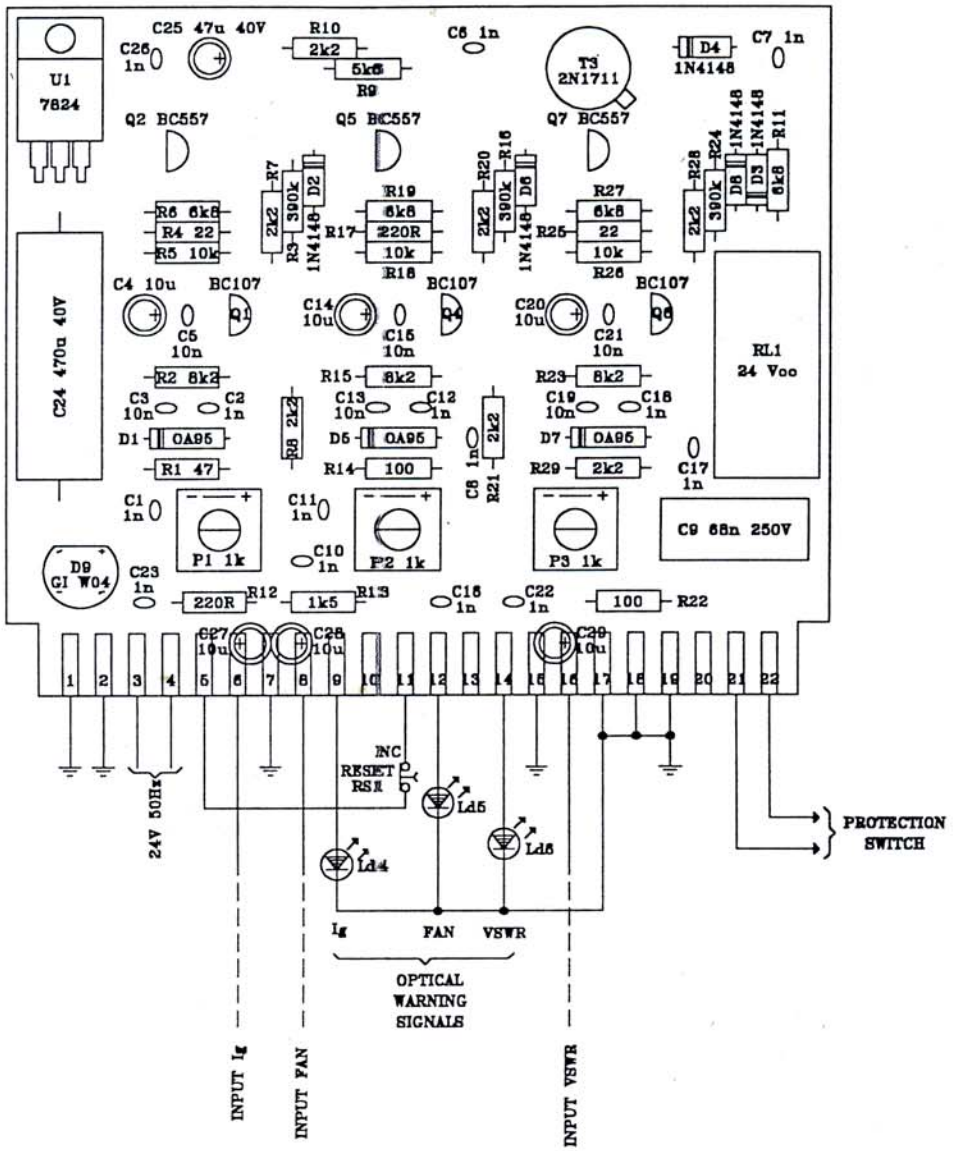


fig.13 - CONTROL LOGIC unit component layout (DB 8209-17)



PN: C27-C28-C29=10μF 50VCONNECTED BETWEEN INPUT Ig-FAN-VSWR AND GROUND

6.3 CONTROL LOGIC UNIT PARTS LIST

Item	Quantity	Reference	Part
1	14	C1,C2,C6,C7,C8,C10,C11, C12,C16,C17,C18,C22, C23,C26	1n cer
2	6	C3,C5,C13,C15,C19,C21	10n cer
3	1	C9	68n 400/600V cer
4	6	C4,C14,C20,C27,C29,C28	10µ 50V
5	1	C24	470µ 40V
6	1	C25	47µ 40V
7	3	D1,D5,D7	DA95
8	5	D2,D3,D4,D6,D8	1N4148
9	3	Q1,Q4,Q6	BC107/547/237 npn
10	3	Q2,Q5,Q7	BC557/307 pnp
11	1	Q3	2N1711 npn
12	1	U1	µA7824
13	1	RL1	24V relais
14	1	D9	GIW04
15	1	R1	47R 1/4W
16	3	R2,R15,R23	8k2 1/4W
17	3	R3,R16,R24	390k 1/4W
18	2	R4,R25	22R 1/4W
19	3	R5,R18,R26	10k 1/4W
20	4	R6,R11,R19,R27	6k8 1/4W
21	7	R7,R8,R10,R20,R21,R28,R29	2k2 1/4W
22	1	R9	5k6 1/4W
23	1	R12	220R 1W
24	1	R13	1k5 1/4W
25	1	R14,R22	100R 1/4W
26	1	R17	220R 1/4W
27	3	P1,P2,P3	1k trim

7.2 HIGH VOLTAGE UNIT

It has a 2.5 kVA transformer (*TR2*) with 2450 Vac secondary circuit voltage .The primary circuit has three different connectors (220 Vac ± 8%) that permit to compensate non nominal mains value but costant, in order to have always the same value at the secondary circuit (in any case it is necessary use voltage stabilizer if there are voltage fluctuations daily).

The 2450 Vac rectifier is obtained by the means of 24 BY228/255 diodes rectifier bridge (AL 2000 8209-14 board), and leveling by the means of capacitive filter (*C2*).

This system permits a good compromise between ripple level and reliability.

Tube discharge limitation is made by the means of *R1*.

R25-26-27-28 resistors (see fig.15-16) discharge the residual high voltage presents on *C2* when the amplifier is off.

18 Vdc voltage necessary to power the cathode is obtained by the means of *D2* zener diode (see general electric diagram).

7.3 LOW VOLTAGE UNIT

The *TR1* transformer is the component that permits to have the two voltages of 13.5 Vac and 24 Vac.

The 13.5 Vac primary voltage is used to power the tube filament (see fig.14).

The 24 Vca secondary voltage is used to power the control and logic unit, *RS1* automatic switch, which contacts give power to the High Voltage Unit, and to the automatic turn-on cycle timer (see fig.14).

When *S1* switch is closed gives power to this unit , and also gives voltage to the *MT1* blower used to cool the heat produced by the tube functioning.

fig.15 - H.V. RECTIFIER board electric diagram

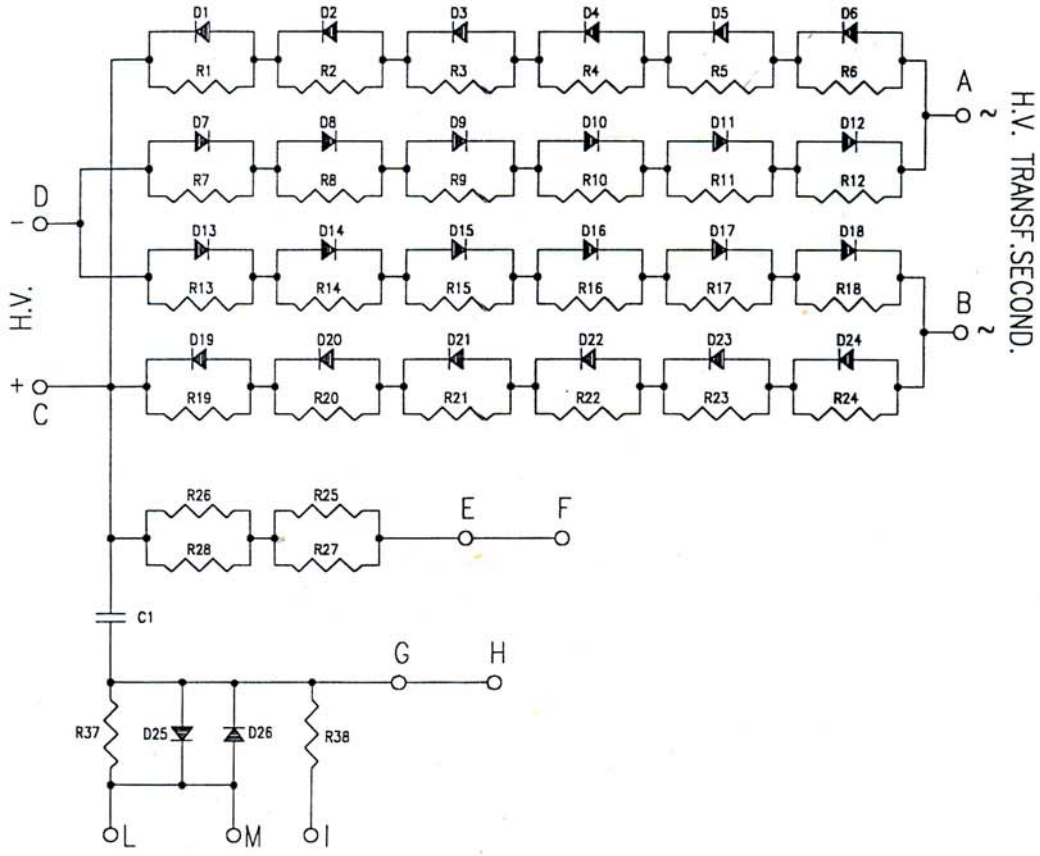
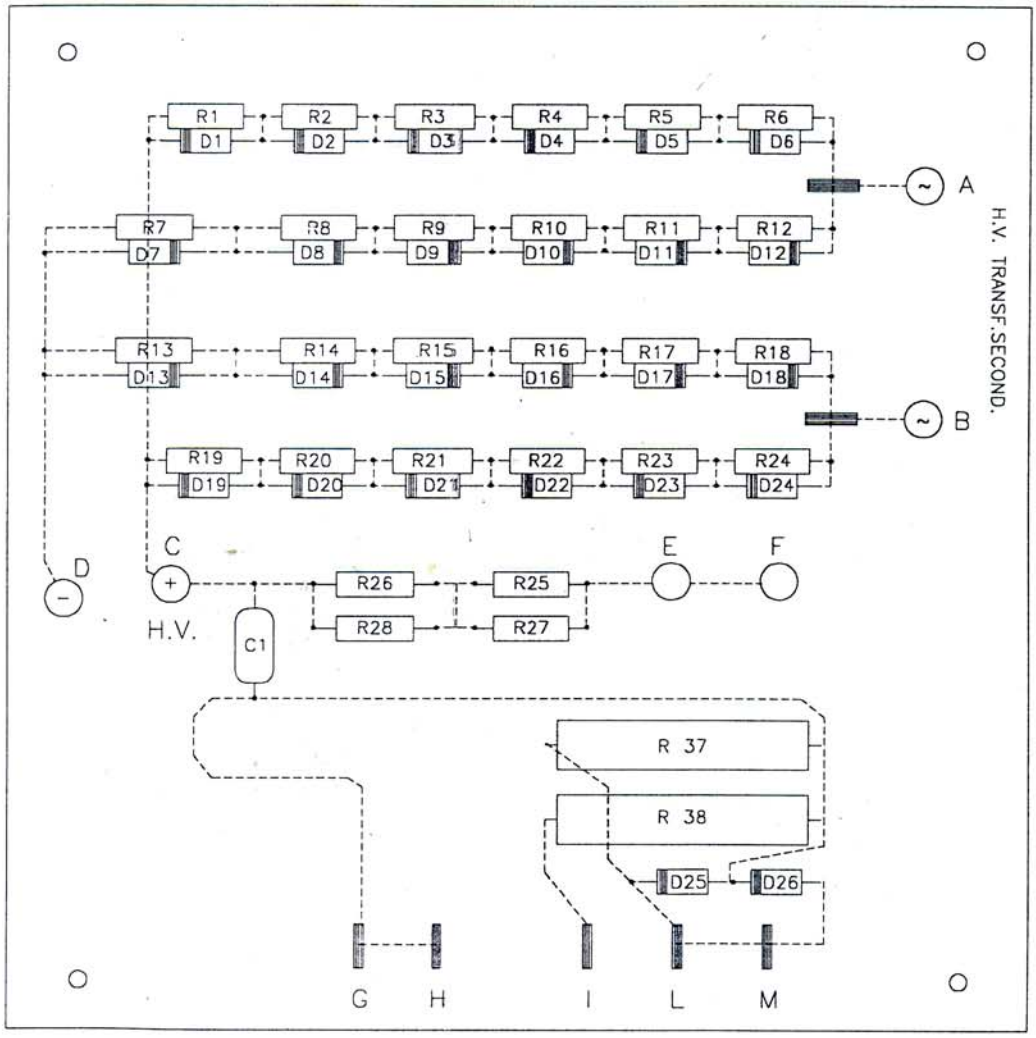


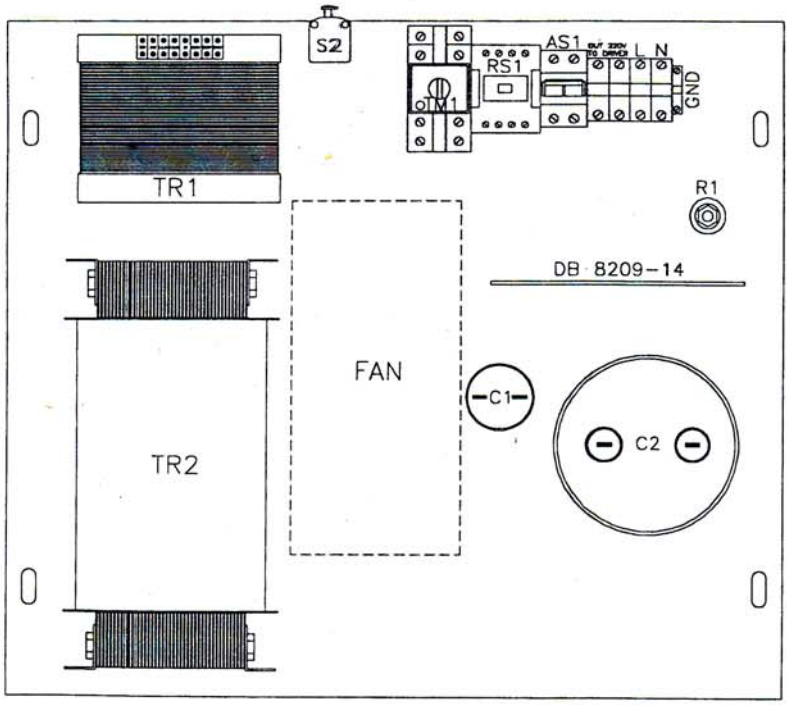
fig.16 - H.V. RECTIFIER board component layout (AL 2000 DB 8209-14)



7.4 H.V. RECTIFIER PARTS LIST

Item	Quantity	Reference	Part
1	1	C1	1n 6/10kV
2	24	D1,D2,D3,D4,D5,D6,D7,D8, D9,D10,D11,D12,D13,D14, D15,D16,D17,D18,D19,D20, D21,D22,D23,D24	BY228/255
3	2	D25,D26	1N4007
4	24	R1,R2,R3,R4,R5,R6,R7,R8 R9,R10,R11,R12,R13,R14, R15,R16,R17,R18,R19,R20, R21,R22,R23,R24	470k/1M 1W
5	4	R25,R26,R27,R28	10M 4W
6	1	R37	220R 11W
13	1	R38	6R8 11W

fig.17 - Mains power supply



CHAP. 8
COOLING SYSTEM

A forced air flow serves as cooling for tube and cavity. This system is automatically controlled by a PTC (*R7*) the protective logic (see general electric diagram).

The blower used is self-lubricate on ball bearing and warranty by its manufacturere for a life of more than 20000 working hours.

Fan - Technical data:

Type	PAPST RV133/50-200
Revolutions/min.	2100
Air delivery	290 m3/h
Pressure	300 Pa

CHAP. 9
AMPLIFIER FUNCTIONING

To the AC 220V connectors (L, N, GND) must be connected the mains. Switching the *AS1* automatic switch it is given the voltage to the device, but it is still turn-off.

Closing *S1* (ON) switch it is given the voltage to the blower and to *TR1* transformer, which with its two secondary circuits has two functions:

1 - to power the filament (13.5 Vac);

2 - to power the services and the logic and control unit (24 Vac).

In these conditions *GL1* lamp is on and the *TM1* timer is excited in order to start with the preheating cycle (~ 120 sec.). At the end of this cycle will turn-on the contact of *TM1* timer, which excite the *RS1* (in case of rear pannel is present this close *S2* contact).

Turned-on *RS1* switch that power the anodic circuit and the driver will be excited, light-on the *GL2* lamp.

At this stage the amplifier is able to work.

The *TR2* transformer gives 2450 Vac to the H.V. rectifier board, where it is taken the anodic voltage leveled by *C2* capacitor.

The *M2* meter takes from the directional coupler (PRE RF 8301-21), placed on filter, voltages relative to forward and reflected power.

The *C3* and *C5* capacitors protect *M1* and *M2* meters against the radiofrequency components.

CHAP. 10
SERVICE AND MAINTENANCE INSTRUCTIONS

10.1 MEASUREMENT TEST

Timely (any week or after working period) a test record with the main measurements values of amplifier, such as forward and reflected power, mains voltage, is raccomemned.

10.2 MAINTENANCE GENERAL INSTRUCTIONS

If the transmitter is placed into a clean and not humid enviroment, the maintenance procedures can be made twice per year.

Moreover the transformers and the other power supply components must be clean to avoid over heating. To do that use dry clothes, brushes, vacuum cleaner or compressed air (max. 1 bar).

Particular care shall be done for H.V. insulators.

Conductive and ceramic parts can be cleaned with alcool.

☠ **DANGEROUS** ☠

Before start with maintenance procedure, disconnect mains power supply by the means of *ASI* automatic switch.

CHAP. 11

TUBE CARACTERISTICS

3CX800A7:

- Plate dissipation (max.) ..... 1000 W
- Grid dissipation (max.) ..... 4 W
- Frequency for max. ratings (CW) ..... 350 MHz
- Cooling ..... Forced air
- Cathode ..... Oxide-coated Unipot.
  - Voltage ..... 13.5 V
  - Current ..... 1.5 A
- Capacitances (Gnd. Grid. connection):
  - Input ..... 26 pF
  - Output ..... 6.1 pF
  - Feed-through ..... 0.05 pF
- Amplification factor 200
- Base ..... Special, coaxial
- Maximum Seal & Anode Core Temperature ..... 250 °C

Operating condition:

- Plate voltage ..... 2800 V
- Plate current ..... 0.45÷0.50 A
- Grid current ..... 20÷25 mA
- Drive power ..... 20÷25 W
- Output power ..... 1000 W

CHAP. 4
TRIODE CAVITY

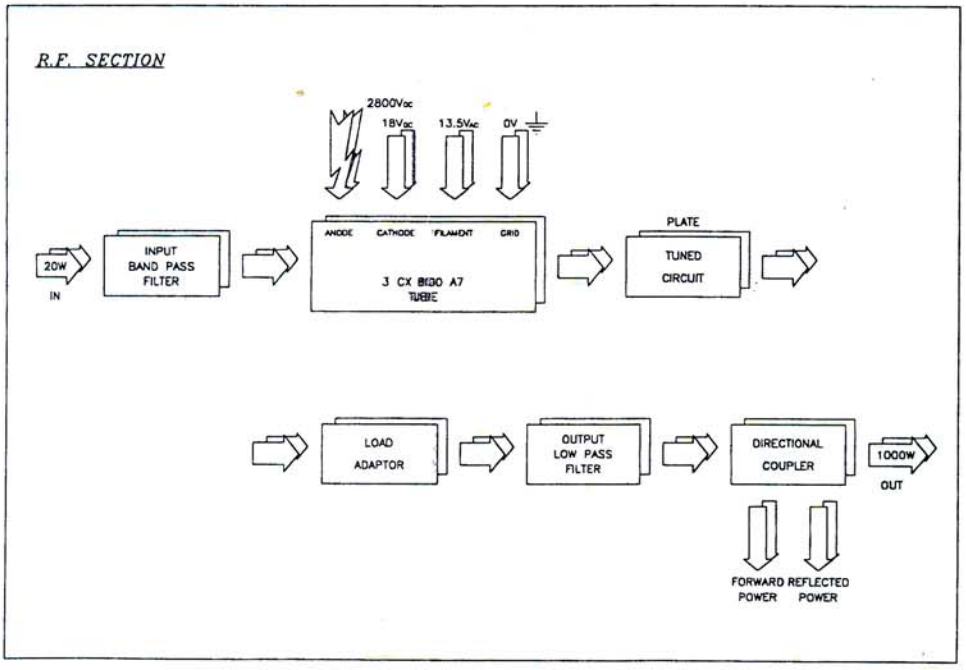
4.1 DESCRIPTION

The VHF cavity is designed to incorporate the tube 3CX800A7 EIMAC device.

It consists of the input section, in which the input impedance of 50 Ω is trasformed to the impedance of the tube and the output section, which transforms tube impedance of 50 Ω.

At the same time, the output section is a lowpass filter. In this section there are the *PLATE* and *LOAD* adjustments.

fig.5 - Cavity block diagram



4.2 R.F. UNIT

The R.F. unit is completelly contained into an extractable rack and connected to the power supply by the means of multi pin pannel connector, HV coaxial connector and fan connecting cable.

The 3CX800A7 EIMAC tube is polarized with grounded grid and cathode excited. The input circuit is realized with a broadband (85÷110 MHz) adaptive impedance net, so no tuning operations are required; then the signal is given to the tube cathode connected in common grid configuration with positive polarization of cathode (by the means of *ZENER D2* diode) so that the grid (grounded) is negative respect to this last one.

The parallel resonant circuit composed by *C9* (PLATE) and *LINEA* (LINE) (see fig.6) gives the tuning frequency; *C9* permits a maximum tuning of 0.8 MHz, while for greater variations shall be necessary move the grounding points of *LINEA* (LINE).

The amplified signal present on the tube anode it is drawn through *C10* (LOAD) which variation permits to adapt the output impedance to that of load (see general electric diagram).

The output low pass filter, composed by four cells in Π configuration, keeps the harmonic components within the international normative requirements ("C" class amplification).

Between this low pass filter and output connector there is a directional coupler that permits, taking a little amount of forwarding and reflected power, to show them on *M2* meter.