

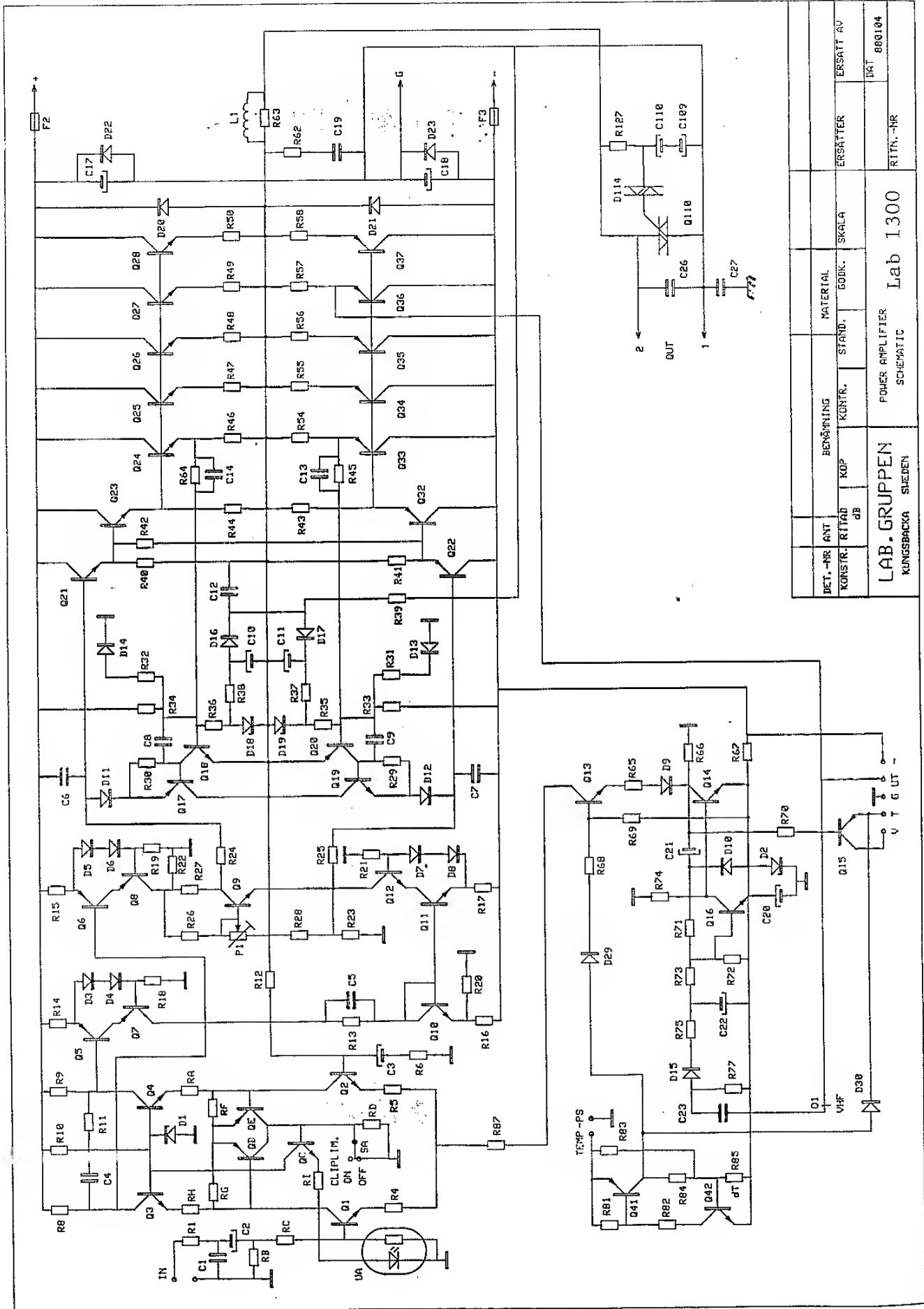
# **SS 1300 LAB 1300**

## **SERVICEMANUAL**

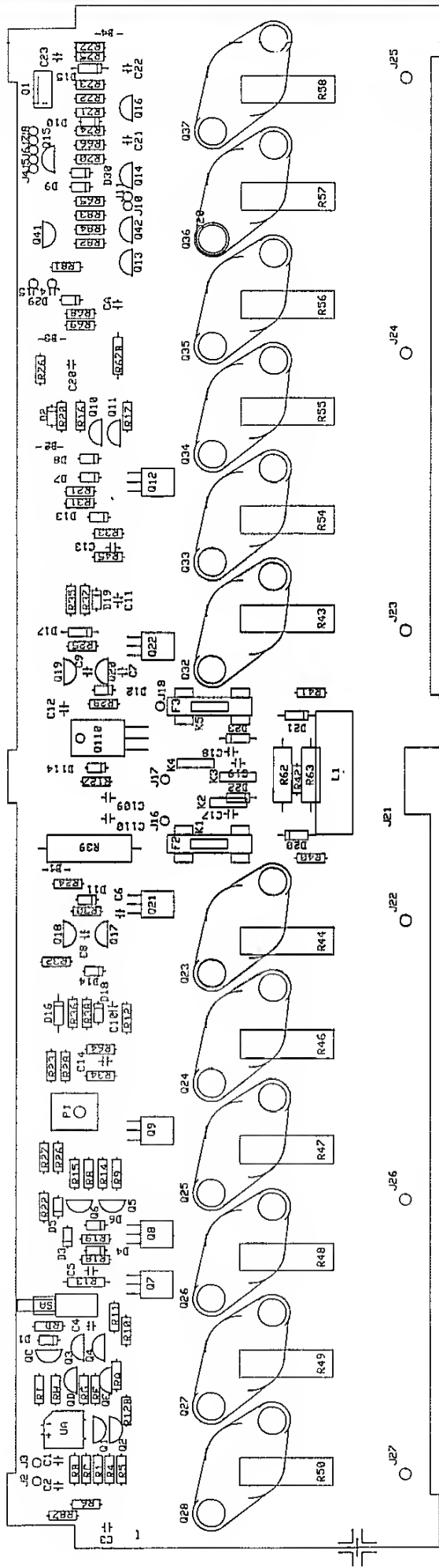
### **LAB.GRUPPEN**

Andersson & Bävholm AB  
Gullregnsvägen 16  
S-434 44 KUNGSBACKA  
SWEDEN

Tel. + 46 300 - 168 23 Fax. + 46 300 - 142 46



DET.-NR	ANT	BENÄMNING	MATERIAL	ERSÄTT AV
KONSTR.	RITAD	KOP.	STAND.	ERSÄTT
	DB	KONTR.	GOVK.	SKALA
LAB. GRUPPEN			Lab 1300	
KUNGSBACKA SVEDEVEN			POWER AMPLIFIER SCHEMATIC	
			RITN.-NR	
			DAT 880104	



KONSTR.	RI TAD	KOP	KONTR.	STAND.	GODK.	SKALA	ERSÄTT AV
LABGRUPPEN KUNGSBACKA SVEDEN			LAB1000	LAB1500		LAB1300	ERSÄTT AV
						POWER AMPLIFIER	ERSÄTT AV
							DAT
							RITN. -NR

Resistors

R1, R87	2.2 kOhms	0.25 W
R2, R8, R9	1 kOhm	1 %
R3, R12, R70	33 kOhms	1 %
R4, R5	47 Ohms	
R6	422 Ohms	1 %
R10, R22, R23	27 kOhms	
R11, R28	1.8 kOhms	
R13, R67	12 kOhms	1 W
R14, R15, R16,		
R17	100 Ohms	1 %
R18, R19, R20, R21	82 kOhms	
R24	120 Ohms	
R25	220 Ohms	
R26, R37, R38,		
R75, R77	10 kOhms	
R29, R30	4.7 kOhms	
R31, R32, R35,		
R36, R68, R72	100 kOhms	
R33, R34	1 MOhm	
R39	820 Ohms	5 W
R40, R41	150 Ohms	0.25 W
R42	100 Ohms	0.25 W
R43, R44	4.7 Ohms	5 W
R45, R64	2.2 kOhms	0.25 W
R46-R58	0.33 Ohm	5 W
R62, R63, R78	10 Ohms	4 W
R65	1.5 kOhm	0.25 W
R66, R74, R69	56 kOhms	
R71, R73	220 kOhms	
R76	10 Ohms	
R82	22 kOhms	
R81	3.3 kOhms	
R27	82 Ohms	
R83	120 kOhms	
R85	150 kOhms (NTC)	
R127	220 kOhms	

Diodes

D1, D2	15V Zener 0.4W
D3, D4, D5, D6,	
D7, D8, D9, D10,	
D11, D12, D24, D30	1 N 4148
D13, D14	BAV 21
D15, D16, D17,	
D20, D21, D22, D23	1 N 4004
D18, D19	27V Zener 0.4W
D25, D26	1 N 5404
D114	HS 10, diac 10 V

Capacitors

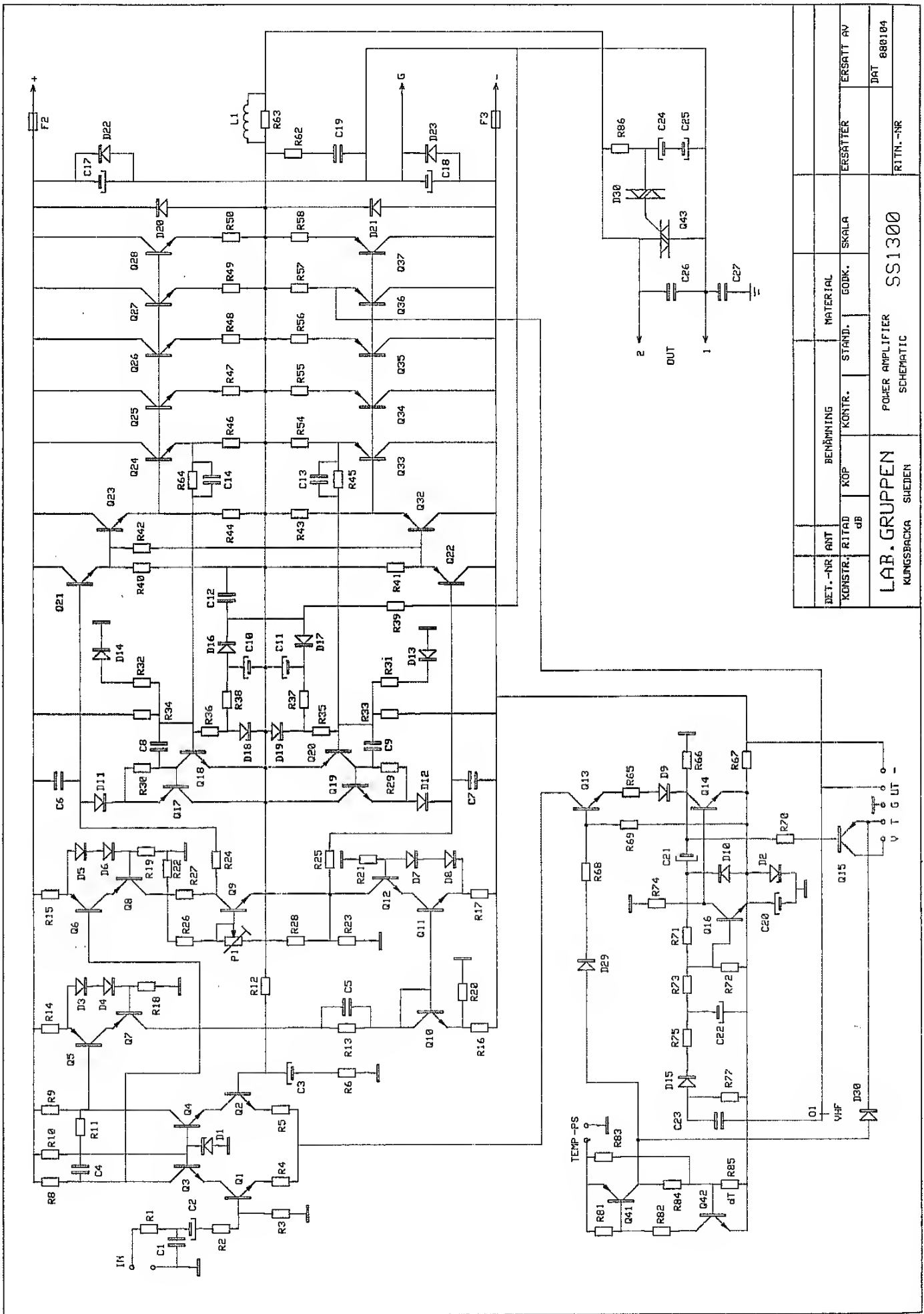
C1	150 pF ker
C2	4.7 $\mu$ F/35 V
C3	100 $\mu$ F/10V
C4	680 pF ker
C5	22 nF
C6, C7	150 pF ker
C8, C9	470 pF ker
C10, C11	1 $\mu$ F/100V
C12	22 nF/400V
C13, C14	1 nF
C17, C18, C109, C110	4.7 $\mu$ F/100V
C19	0.1 $\mu$ F/400V
C20	220 $\mu$ F/16V
C21	10 $\mu$ F/50V
C22	4.7 $\mu$ F/50V
C23	39 pF ker
C26 SS1300	1 nF/400V
C27 SS1300	100 nF ker
C26 Lab1300	0,22 uF 200V
C27 Lab1300	2,2 uF 50V
<u>Transistors</u>	
Q1, Q2	BC 547B, selected
Q3, Q4	MPSA 42
Q5, Q6, Q15	
Q17, Q20, Q41	BC 557B
Q7, Q8, Q22	MJE 350
Q9, Q10, Q11,	
Q13, Q14, Q16,	
Q18, Q19, Q42	BC 547B
Q12, Q21	MJE 340
Q23-Q28	MJ 15022
Q32-Q37	MJ15023
Q110	Q 6015, triac

Miscellaneous

F1, F2	T 6.3A
P1	1 kOhm, trimpot

Cliplimiter LAB 1000 / SS 1300 / LAB 1500

RA,RH,RI	1.5Kohm 1%
RB,RC	15 Kohm
RD	270 Kohm
RF,RG	27 Kohm
R2,R3	Should be removed
R10	Change to 10 Kohm 1% 0.7W
CA	4.7uF/50V OBS. Only LAB 1500
QC	BC 547
QD,QE	BC 557
UA	VTC5C4 (Vactec)
SA	Switch

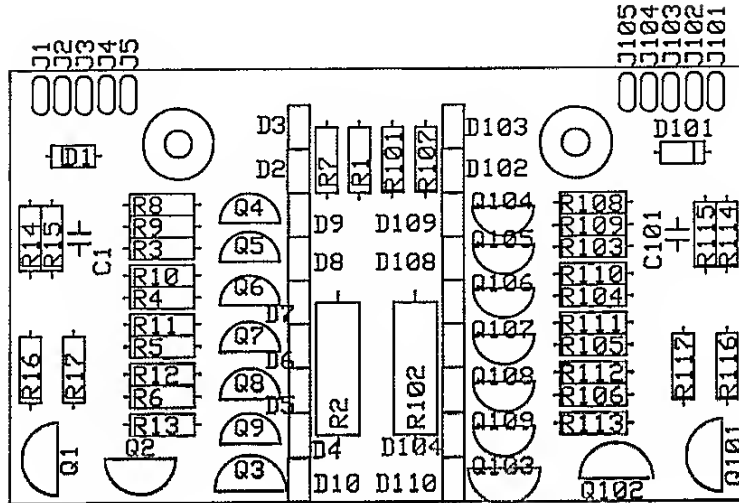


DET.-NR	ANT	BEHÄRNING	MATERIAL	ERSÄTT	ERSÄTT AV
KONSTR.	RITAD	KONTR.	STAND.	SKALA	
	dB	KOP			
LAR.GRUPPEN			POWER AMPLIFIER		SS1300
KUNGSBACKA SVEDEN			SCHEMATIC		
			RITN.-NR		880104

# LAB.GRUPPEN

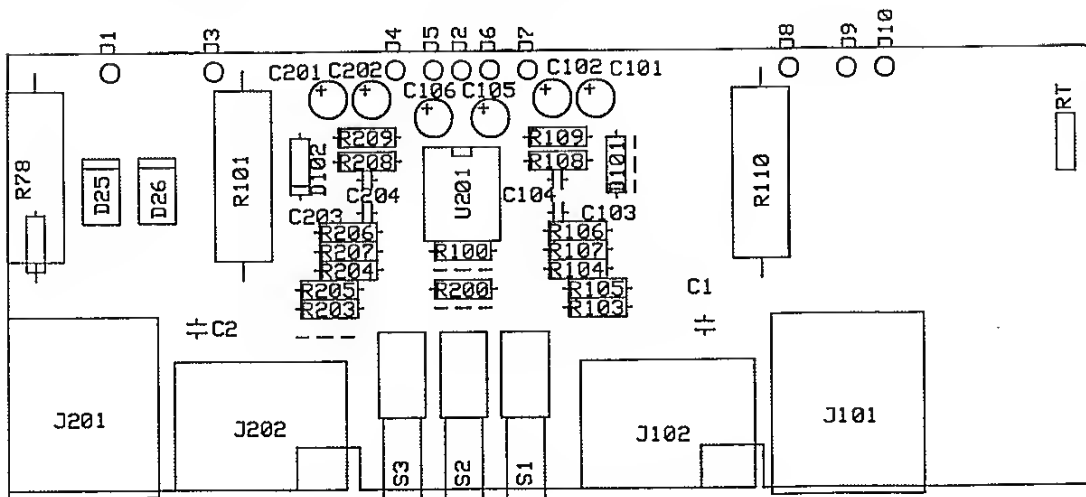
## LAB 1300C POWER AMPLIFIER

### LED DISPLAY



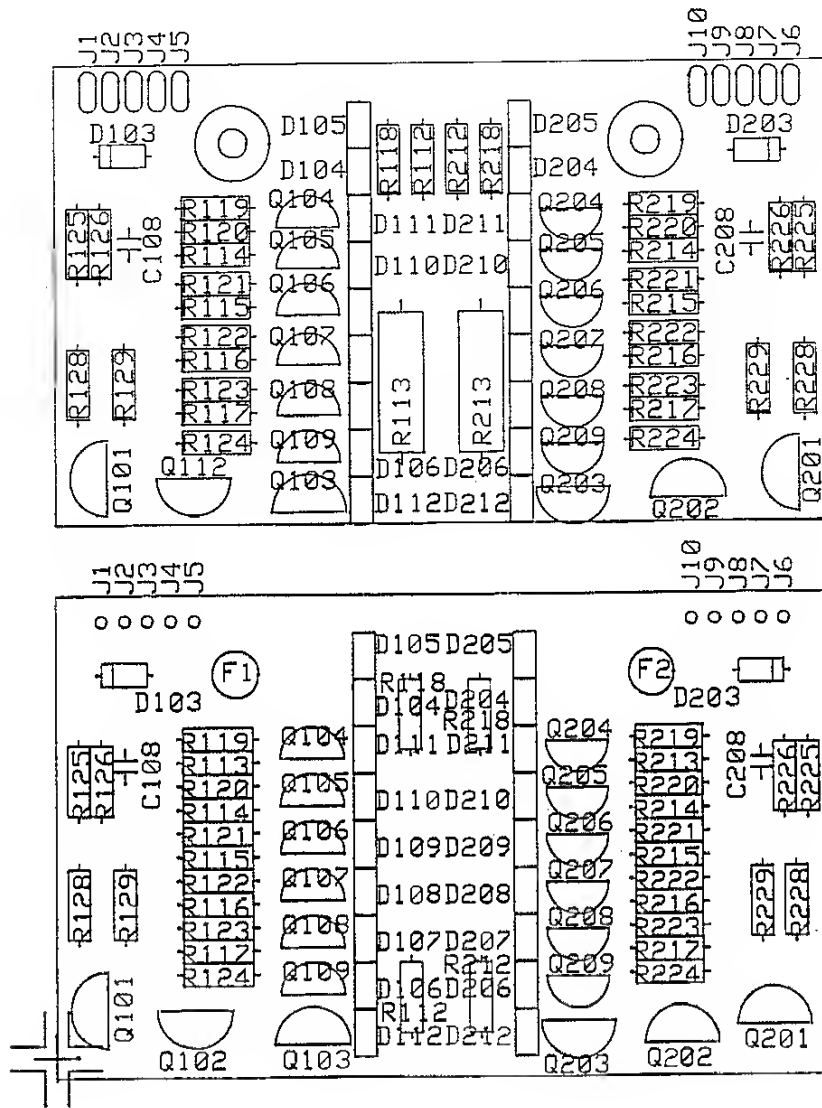
## LAB 1300C POWER AMPLIFIER

### INPUT BUFFER & FAN SPEED CONTROL



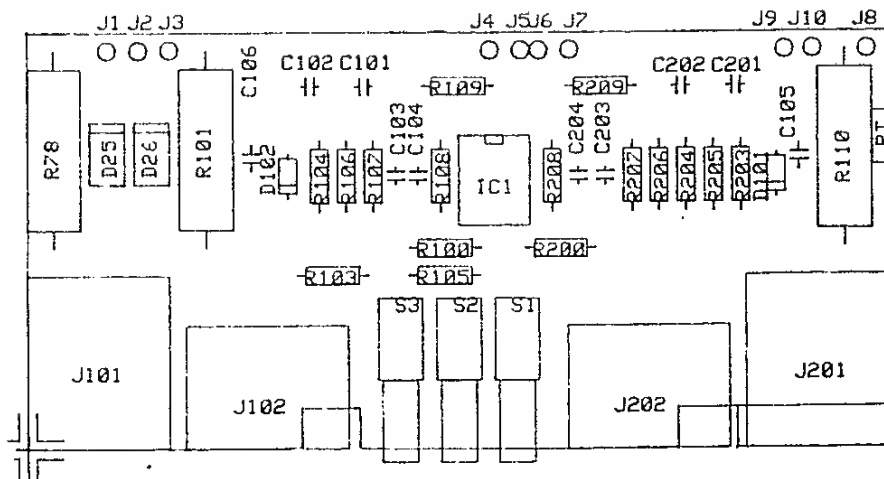






SS 1300/LAB 1300 POWER AMPLIFIER

INPUT BUFFER & FAN SPEED CONTROL



Active Input

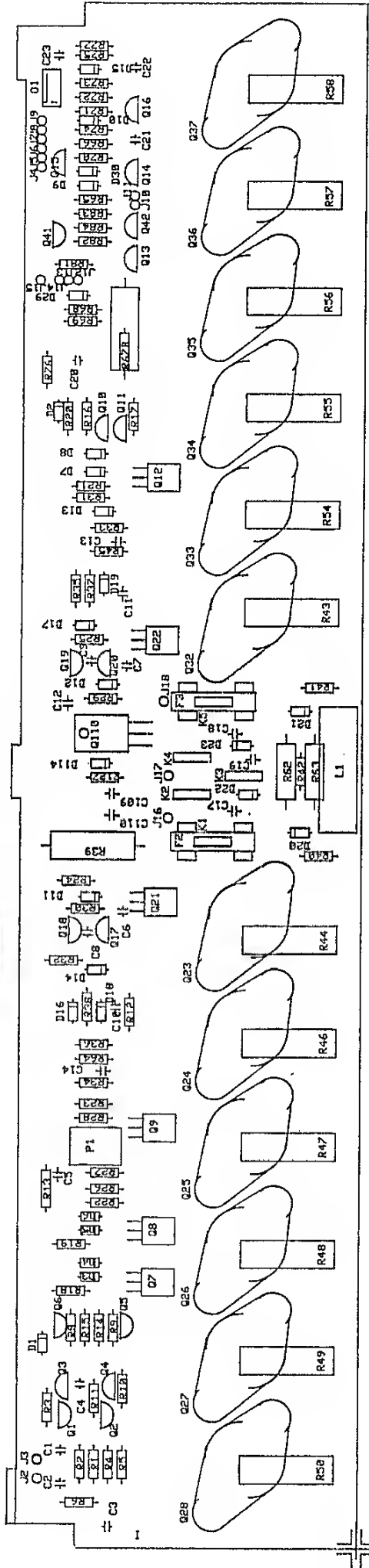
R100, R200	7.5 kOhms 1% =29dB	2,67kohms 1% =23dB
R105, R106, R203, R204, R205, R206	10 kOhms 1%	.
R107, R108, R207, R208	20 kOhms 1%	
R109, R209	100 Ohms	
R101, R110	4.7 kOhms 5W	
C101, C102, C201, C202	47 $\mu$ F/50V	
C103, C104, C203, C204	150 pF ker	
C105, C106,	47 $\mu$ F/25V	
D101, D102	15V Zener 0.4W	
IC1	LF 353 or TL 072	
P2, P3	47 kOhms log pot	

LED-display

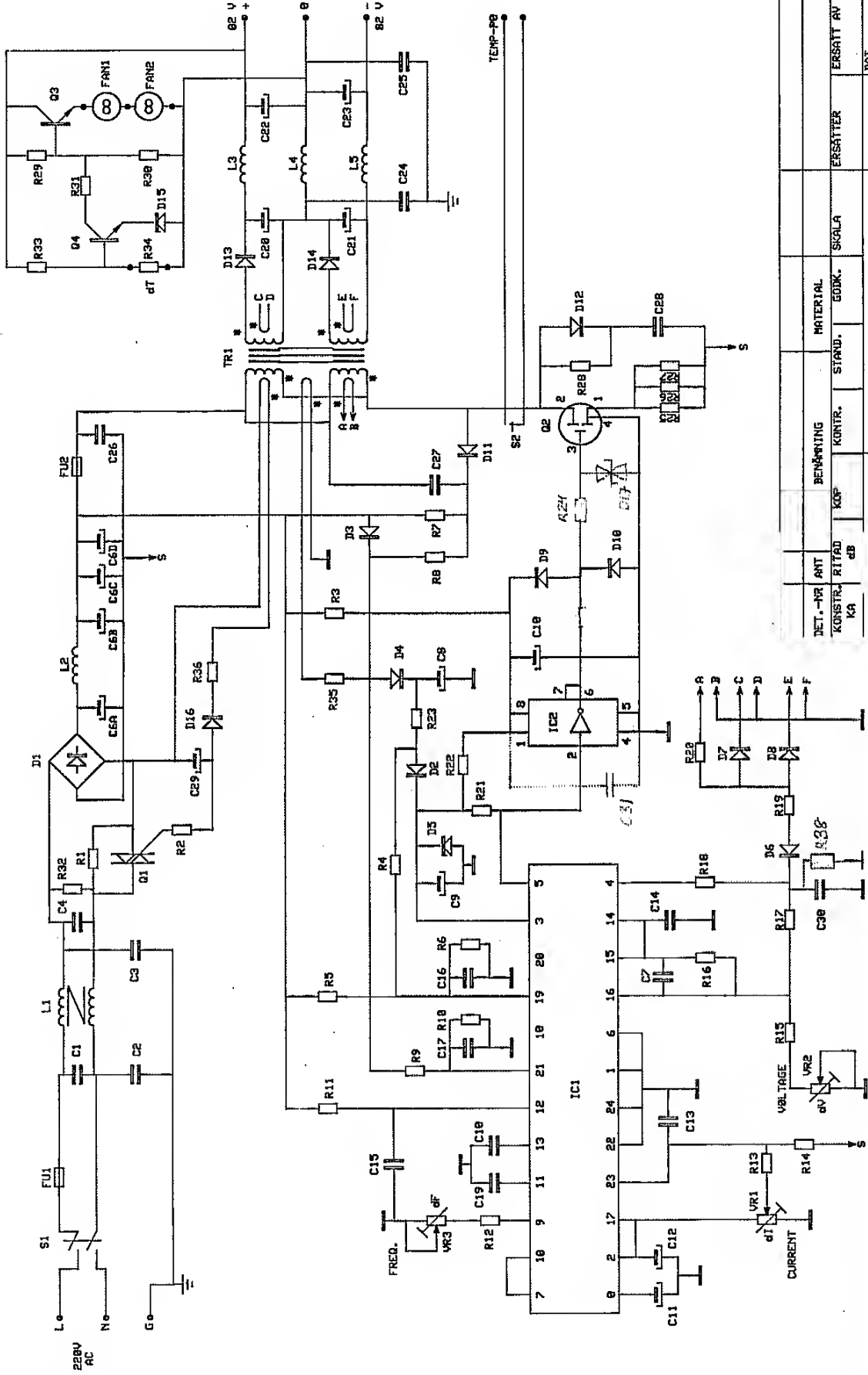
R112	680 kOhms 0.25W
R113	2.7 kOhms
R114	1.2 kOhms
R115	680 Ohms
R116	330 Ohms
R117	120 Ohms
R119, R120, R121, R122, R123, R124,	
R125	33 kOhms
R126	100 Ohms 1W
R128, R129, R118	2.7 kOhms 220 Ohms
C108	4.7 $\mu$ F/100V
D103	1 N 4004
D104, D105	LED, Yel
D106-D113	LED, Green
D111	LED, Red
Q101, Q102	MPSA 42
Q103	MPSA 92
Q104-Q109	BC 547 B

Channel B: Same as above,  
except that it starts with  
no. 200

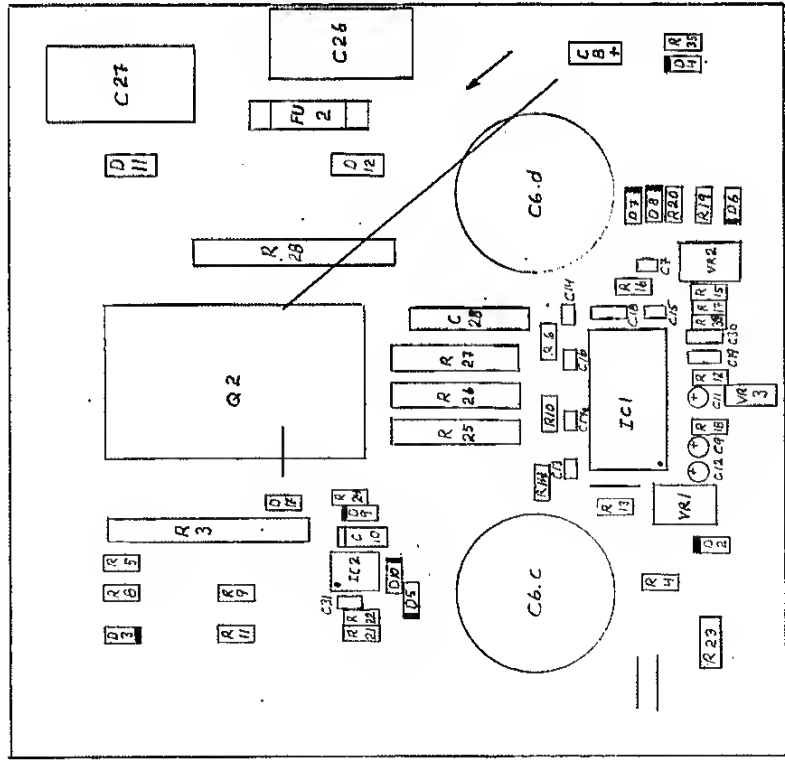
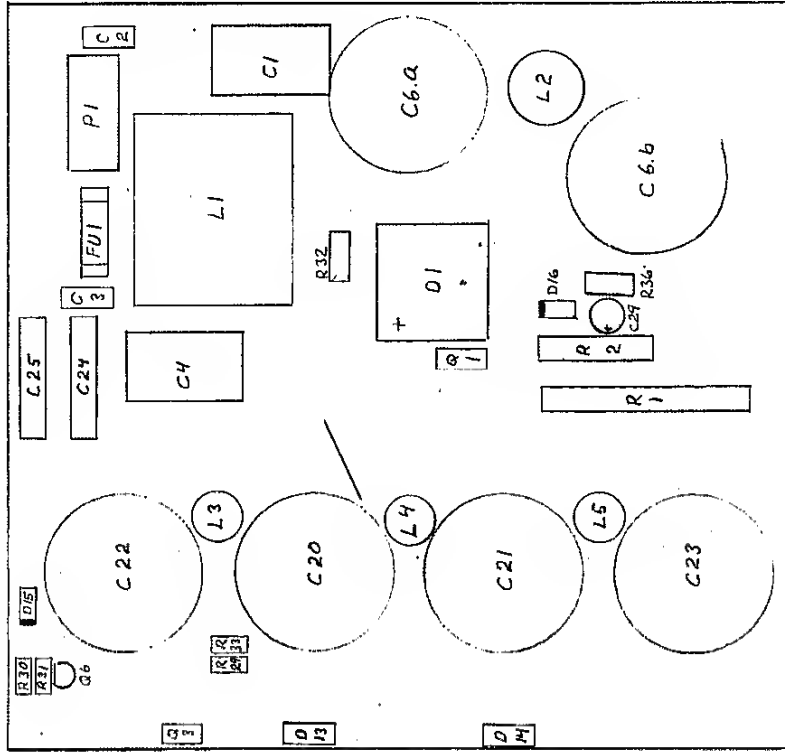
# SS1300 POWER AMPLIFIER



# FAN SPEED CONTROL



DET.-NR ANT	BENÄMNING	MATERIAL	ERSÄTT AV
KONSTR. RITAD	KOP	STAND.	ERSÄTT
KA	KB	SKALA	DAT
LAF. GRUPPEN		POKER SUPPLY	SS 1300
KUNNSBACKA SÄMDEN		SCHEMATIC	
		ERSÄTT	888486
		RITN.-NR	



Det.nr	Ant.	Benämning	Material	Mod.nr Anne Dimension	Antm.
Kompl	Risad	Kont.	Stand.	Skala	Erstat av
L07	1	NÄTDEL SS1300	Godk.		S90424
LAB. GRUPPEN					Ant.
KOMPONENT PLACERING					Run nr.
					Dat. 870629

Nr	Ant.	Ändring och/eller medd.nr	Datum	Inf.	Godk.
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Resistors

R1	47 Ohms	9 W
R2	220 Ohms	4 W
R3	12 kOhms	9 W
R4	22 kOhms	0.25 W
R5, R17	220 kOhms	0.7 W
R6, R10, R20, R21	2.2 kOhms	0.25 W
R7	3.3 kOhms	50 W
R8	270 kOhms	0.7 W
R9, R35	330 kOhms	"
R11	8.2 MOhms	400 V
R12	15 kOhms	0.25 W
R13	1.2 kOhm	"
R14	1 kOhm	"
R15	36 kOhms	"
R16	1 MOhm	"
R18	39 kOhms	"
R19	470 Ohms	"
R22, R24,	3.9 Ohms	"
R23	390 Ohms	4 W
R25-R27	0.1 Ohm	4 W
R28	220 Ohms	9 W
R32	1.5 MOhm	400 V
R36	2.2 Ohms	1 W
VR1	trimpot	2.5 kOhms
VR2, VR3	"	10 kOhms

Capacitors

C1, C4	0.22 $\mu$ F/250 V, RIFA PME 271
C2, C3	4.7 nF/250 V, RIFA PME 265
C6A-C6D	220 $\mu$ F/385 V
C7, C14	390 pF ker.
C8, C10	10 $\mu$ F/63 V
C9, C12	10 $\mu$ F/16 V
C11	1 $\mu$ F/50 V
C13, C17	560 pF ker.
C15, C16	10 nF ker.
C18, C19	1 nF
C20-C23	2200 $\mu$ F/100 V
C24, C25	2.2 $\mu$ F/100 V
C26, C27	0.6 $\mu$ F
C28	4.7 nF/2 kV
C29	100 $\mu$ F/50 V
C30	10 nF
C31	0.1 $\mu$ F ker

Transistors

Q1	Triac Q6025W6
Q2	BSM 181
IC1	TDA 4700 A
IC2	TSC 429 CPA

Diodes

D1	Rectifier Bridge, 35 A / 600 V
D2, D6-D8	1N 4148
D3	1N 4004
D4, D16	BYV 26 C
D5	12 V Zener 1 W
D11, D12	BYR 29-800, alt. BYT 12PI-1000
D13, D14	BYT 30P-300
D9, D10	1N 5818
D17	BZW 06P15B

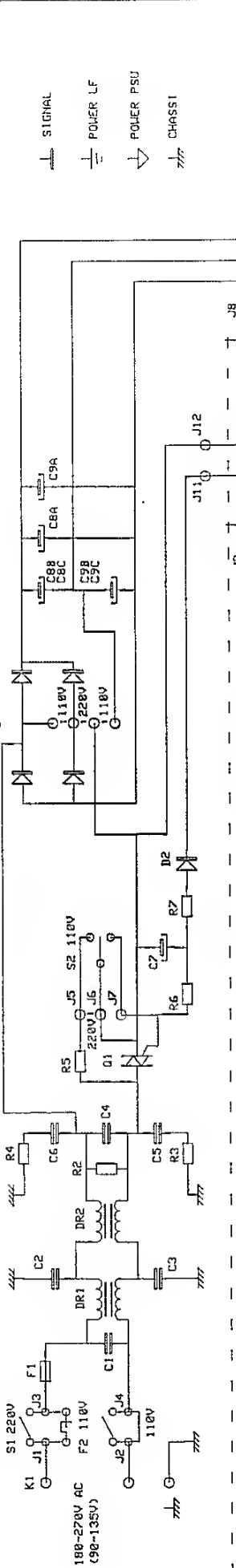
Fan Speed Control

R29	4.7kOhms	0.7 W
R30	18 kOhms	0.25 W
R31	1 kOhm	"
R33	470 kOhms	"
R34	220 kOhms	NTC
D15	5.6 V Zener	0.4 W
Q3	TIP 41 C	
Q4	MPSA 06	
Fan 1, Fan 2	80 x 80 mm,	24 V DC

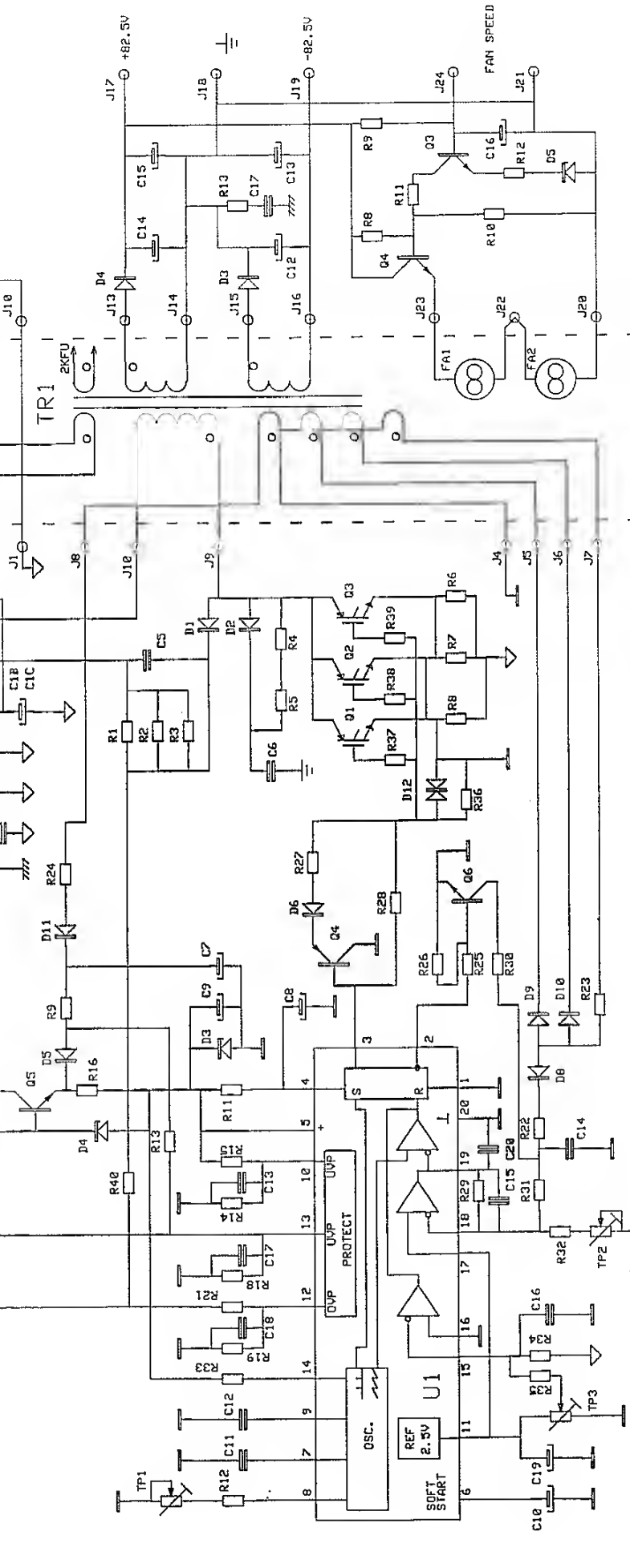
Miscellaneous

TR1	Transformer, Ferrite N 27
L1	LAB. Mains filter
L2	2 layer choke
L3-L5	1 layer choke
FU1	T6.3A Fuse
FU2	F10A Fuse
S1	Power Switch, Marquardt 1802.0102
S2	Temp switch open 80° C

# PSU-A

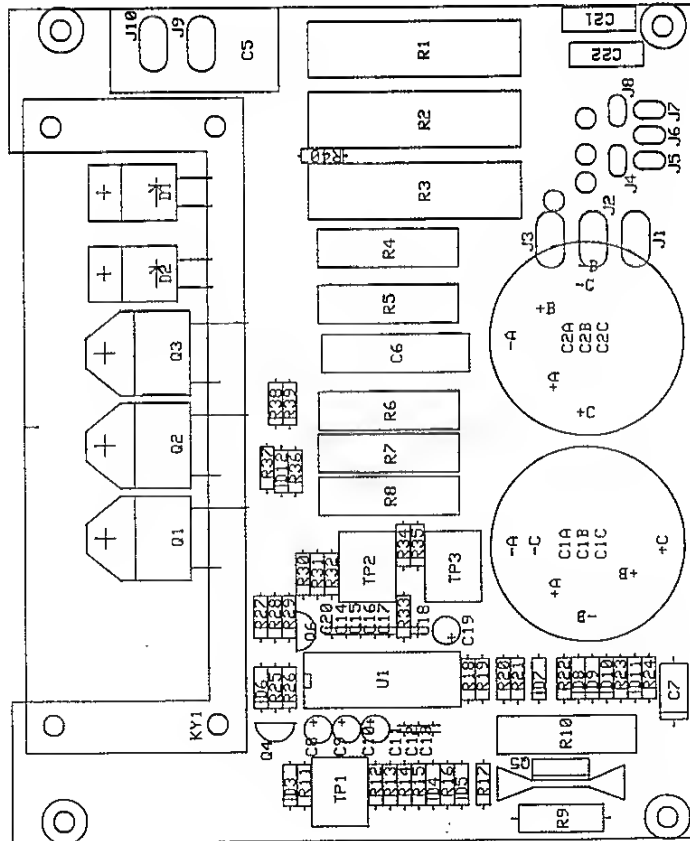
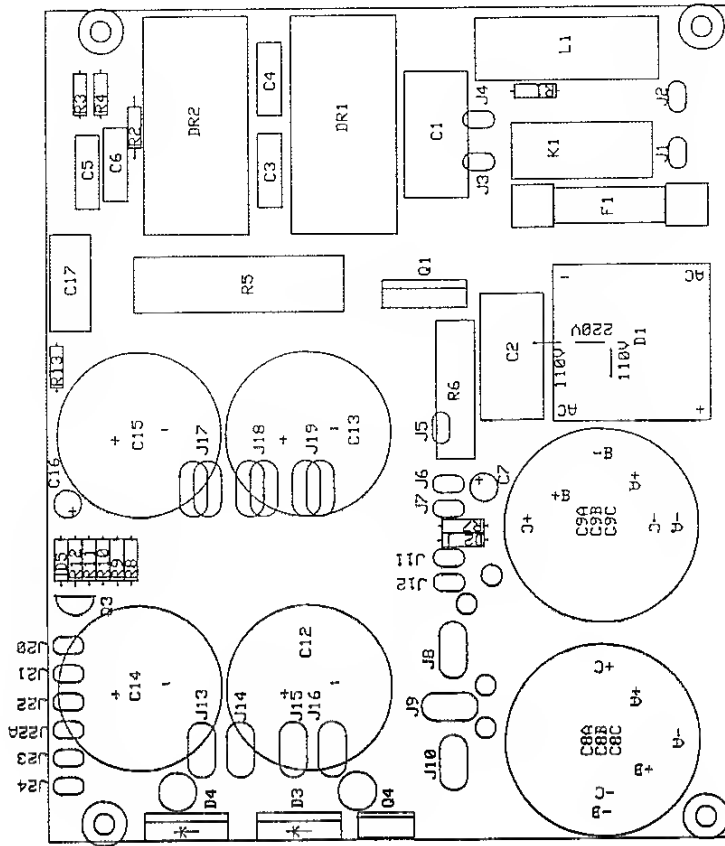


# PSU-B



- SIGNAL
- POWER LF
- POWER PSU
- CHASSI

KONSTR. K.A.	RITAD K.A	KOP	KONTR.	STAND.	GÖDK.	SKALA	ERSÄTT	ERSÄTT AV	
LABGRUPPEN KUNGSBACKA SHEDEN							LAB 1300C POWERSUPPLY	RITN.-NR 2KFSU-A 2KFSU-B	DAT 90-12-01



KONSTR. K.A	RIKTAD K.A	KOP	KONTR.	STAND.	GOBK.	SKALA	ERSÄTT AV
						LAB 1300C POWERSUPPLY	ERSÄTT AV
							DA: 90-12-01
							RIKTN. -NR 2KPSU-A-P 2KPSU-B-P



# LAB 1300 RECTIFIER BOARD

## PSUA Component-list 930201

### 230V AC

#### Resistors

R1	-
R2	1 M $\Omega$ 500V
R3	33 $\Omega$
R4	33 $\Omega$
R5 <sup>x</sup>	47 $\Omega$ 9W
R6	180 $\Omega$ 5W
R7	2.2 $\Omega$ 1W
R8	4.7 k $\Omega$ 1% 1W (long leg)
R9	470 k $\Omega$
R10	18 k $\Omega$ 1%
R11	1.8 k $\Omega$
R12	0 $\Omega$
R13	4.7 $\Omega$

#### Capacitors

C1	0.47 $\mu$ F X
C2 <sup>x</sup>	2.2 nF Y
C3 <sup>x</sup>	2.2 nF Y
C4	0.22 $\mu$ F X
C5 <sup>x</sup>	2.2 nF Y
C6 <sup>x</sup>	2.2 nF Y
C7	100 $\mu$ F 50V
C8a	220 $\mu$ F 385V
C9a	220 $\mu$ F 385V
C8b <sup>x</sup>	-
C9b <sup>x</sup>	-
C8c	1800 $\mu$ F 200V
C9c	1800 $\mu$ F 200V
C12	3300 $\mu$ F 100V
C13	3300 $\mu$ F 100V
C14	3300 $\mu$ F 100V
C15	3300 $\mu$ F 100V
C16	22 $\mu$ F 16V
C17	2.2 $\mu$ F 63V

#### Diodes

D1	600V 35A
D2	BYW26C
D3	BYT30PI400
D4	BYT30PI400
D5	5.6V Zener

#### Transistors

Q1	Q6025J6
Q2	-
Q3	BC 546
Q4	TIP 41 C

#### Fuse

F1 <sup>x</sup>	Fuse T8A H250V
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#### Switch

S1 <sup>x</sup>	Marquart 1552.3102
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#### Chokes

DR1 <sup>x</sup>	2.7mH 8A 220V
DR2 <sup>x</sup>	2.7mH 8A 220V

### 110V AC

R5	22 $\Omega$ 9W
C2	4.7 nF Y
C3	4.7 nF Y
C5	4.7 nF Y
C6	4.7 nF Y
C8b	1500 $\mu$ F 200V
C9b	1500 $\mu$ F 200V
F1	F30A
F2	Circuit Breaker
S2	Marquart 1803.0102
DR1	1.4mH 16A 110V
DR2	1.4mH 16A 110V

# LAB 1300 SWITCH-TRANSISTOR BOARD

## PSUB Component-list 921030

### Resistors

R1	18 k $\Omega$ 9W
R2	18 k $\Omega$ 9W
R3	18 k $\Omega$ 9W
R4	100 $\Omega$ 5W
R5	100 $\Omega$ 5W
R6	0.1 $\Omega$ 4W
R7	0.1 $\Omega$ 4W
R8	0.1 $\Omega$ 4W
R9	1.5 k $\Omega$ 2W
R10	4.7 k $\Omega$ 5W
R11	4.7 $\Omega$
R12	15 k $\Omega$ 1%
R13	82 k $\Omega$ 1%
R14	36.5 k $\Omega$ 1%
R15	15 k $\Omega$ 1%
R16	180 $\Omega$
R17	220 k $\Omega$ 1% (long legs)
R18	4.7 k $\Omega$ 1%
R19	4.7 k $\Omega$ 1%
R20	432 k $\Omega$ 1%
R21	750 k $\Omega$ 1%
R22*	470 $\Omega$
R23*	2.2 k $\Omega$
R24	4.7 $\Omega$
R25	15 k $\Omega$ 1%
R26	1 k $\Omega$ 1%
R27	4.7 $\Omega$
R28	33 $\Omega$
R29	1 M $\Omega$ 1%
R30*	22 k $\Omega$
R31	220 k $\Omega$ 1%
R32	36.5 k $\Omega$ 1%
R33	270 k $\Omega$ 1%
R34	1 k $\Omega$ 1%
R35	1 k $\Omega$ 1%
R36	15 k $\Omega$ 1%
R37	4.7 $\Omega$
R38	4.7 $\Omega$
R39	4.7 $\Omega$
R40	1 M $\Omega$ 1%

### Trim potentiometers

TP1	10 k $\Omega$
TP2	10 k $\Omega$
TP3	2.5 k $\Omega$

### Capacitors

C1a	220 $\mu$ F 385V
C2a	220 $\mu$ F 385V
C1b	220 $\mu$ F 385V
C2b	220 $\mu$ F 385V
C1c	1800 $\mu$ F 200V
C2c	1800 $\mu$ F 200V
C5	0.6 $\mu$ F 500V
C6	2.2 nF 1.5 kV
C7	10 $\mu$ F 63V
C8	10 $\mu$ F 50V
C9	10 $\mu$ F 50V
C10	4.7 $\mu$ F 50V
C11	1 nF
C12	330 pF
C13	10 nF
C14	10 nF
C15	330 pF
C16	1 nF
C17	10 nF
C18	1 nF
C19	10 $\mu$ F 50V
C20	1 nF
C21	2.2 nF Y
C22	2.2 nF Y

### Diodes

D1	BYT 12PI 1000
D2	BYR 29-800F (BYT 12PI 1000)
D3	15V 1.3W Zener
D4	5.6V 0.4W Zener
D5	1N 4148
D6	BYW 26C
D7	1N 4004
D8	1N 4148
D9	1N 4148
D10	1N 4148
D11	BYW 26C
D12	BZW 06P15B

### Integrated circuits

U1	TDA 4718A
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### Transistors

Q1	BUP 307
Q2	BUP 307
Q3	BUP 307
Q4	BC 327
Q5	TIP 50
Q6	BC547

### Switches

S2	Tempswitch 95°C
----	-----------------

\* from 931101

R22	4.7 $\Omega$
R23	6.8 k $\Omega$
R30	30 k $\Omega$ 1%

# SERVICEKIT KEY FOR

## Switch transistor board PSUB

	<b>LAB 1200</b>	<b>LAB 1300C</b>	<b>LAB 2000C</b>
R22	680 $\Omega$	4.7 $\Omega$	82 $\Omega$
R23	2.2 K $\Omega$	6.8 K $\Omega$	2.2 K $\Omega$
R28	82 $\Omega$	33 $\Omega$	33 $\Omega$
R30	22 K $\Omega$ 1%	30 K $\Omega$ 1%	30 K $\Omega$ 1%
R32	50 K $\Omega$ 1%	36.5 K $\Omega$ 1%	36.5 K $\Omega$ 1%

## Rectifier board PSUA

	<b>LAB 1200</b>	<b>LAB 1300C</b>	<b>LAB 2000C</b>
R8	4.7 K $\Omega$ 1% on leg	4.7 K $\Omega$ 1% on leg	47 K $\Omega$ 1%
R9	470 K $\Omega$	470 K $\Omega$	390 K $\Omega$
R10	Not connected	18 K $\Omega$	39 K $\Omega$ 1%
R11	1.5 K $\Omega$	1.8 K $\Omega$	6.8 K $\Omega$
R12	330 $\Omega$	0 $\Omega$	1.8 K $\Omega$
C12-15	3900 $\mu$ F/100V	3900 $\mu$ F/100V	1800 $\mu$ F/100V
Q4	TIP 41	TIP 41	BDX 53

## **WARNING : HIGH VOLTAGE !**

320 V DC potential and 1200 V AC peak-to-peak voltage

The power supply is a primary switchmode unit, which means that the electronic components conduct AC-line voltage.

The "earth-symbol" in the schematic diagram is at line potential, also cooling-fins and inductors are at line potential.

### Service and measurement of the power supply

- 1/ Please contact the Manufacturer, to get more information, before you do any service of the power supply,
- 2/ All warranty service is done exclusively by the Manufacturer.
- 3/ Bearing personal security in mind, and to avoid short-circuit during measurement, all instruments must be isolated with the help of independent 1:1 isolation transformers.
- 4/ The switching time is very short (nano seconds), and the switch period is 35  $\mu$ s. A condition for correct measurement and service, is the use of a 100 MHz oscilloscope (for ex. Tektronix 2215 or better).

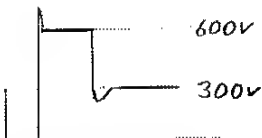
## Service in SS 1300 power supplies.

( VALID FOR UNITS WITH PSA, ALT. PSUA AND PSUB BOARDS. )

Required measurement equipment:

- Audiogenerator
- AC-voltmeter/ THD-meter
- DVM
- Two channel oscilloscope for audio
- Variac 0-280V, 6A
- 50 MHz oscilloscope, ex. Tek 2225  
with 100x probe ex. Tek P6009
- Isolationtransformer for the mains, 1:1

- 1) Turn TP3 fully counter clockwise.
- 2) Change F1 on the PSA ( PSUA ).
- 3) Increase the main voltage slowly by the variac.
- 4) Measure the voltage across C1.
  - a) No voltage: -change R1 ( R5 PSUA ).
  - b) The current increase quickly: -check D1-PSA  
-check Q1, Q2, Q3.
- 5) It is now possible to increase the voltage across C1 to approx. 300 V without currentrush.
- 6) Connect an oscilloscope via a isolation transformer across Q1 collector and emitter
- 7) Turn TP3 slowly until a pulse is visible on the scope. The frequency is approx. 27 kHz.  
If the graph is seen, go to item 10).
 


- 8) If only narrow spikes is seen, check the following components.
  - a) D13, D14 -PSA (D3, D4 PSUA) or the output circuits.
  - b) D1 ( C5 ,R1, R2, R3 ) -makes U1 go into over voltage protection.
  - c) Q1-PSA -the softstart circuit will not deliver enough power.
  - d) U1 -the output will remain low all the time.
- 9) If ringing occur after the flyback pulse, it depends on broken D2 or R4, R5/C6.
- 10) Turn TP3 fully clockwise:
  - a) Check the outputvoltage on C22, C23 -PSA (C13, C15 PSUA) for 82.5V DC -  
Adjust with TP2.
  - b) Check the softstart circuit by turn on and off the mainswitch and look at  
the oscilloscope.
  - c) Increase the power by applying a audiosignal to the amplifier and turn up  
the gaincontrols.-The pulsewidth will increase.
  - d) Check the over-/ undervoltage protection circuits by turning the variac up  
to 280 VAC and down to 130 VAC. (No load ).

## Service in the SS 1300 output-circuits.

Required measurement equipment:

- Audiogenerator
- AC-voltmeter/ THD-meter
- DVM
- Two channel oscilloscope for audio

- 1)
  - a) Identify which channel, A or B, which is broken, by checking if the fuse(s) F2 and/or F3 are melt.
  - b) Take away the F2 and the F3 on the other channel.
  - c) Replace F2 and F3 with two resistors  $47\ \Omega / 5W$  on the broken channel.
- 2) Turn the TP3 on switchtransistor board PSUB fully counter clockwise and turn on the main switch on the amplifier.
- 3) Turn TP3 slowly clockwise until the voltage across C17 and C18 is 1-2V. (TP3 is the current limit adjustment, and act like a variac in this case.)
- 4) If the voltage across C17 or C18 won't reach 1V without high heat disipation in the  $47\Omega / 5W$ -resistors, change D22 or D23.
- 5) Measure the outputvoltage refered to ground at R62.  
 If the voltage is positive: Someone of the transistors Q21, Q23-Q28 is broken.  
 If the voltage is negative: Someone of the transistors Q22, Q32-Q37 is broken.  
 If the voltage is below  $\pm 20mV$ : The output circuits are probably ok.  
 In that case go further to item 7).
- 6) To determine which output transistor(s) which are defect, proceed as follow:
  - a) Connect the DVM with the referens to point R62/ R63.
  - b) Measure the voltage across the emitter-resistors R46-R50 and R54-R58.
  - c) Those emitter-resistors with the highest voltage indicate corrsponding defect outputdevice.
  - d) Desolder and unscrew the defect transistor(s).
  - e) Increase the railvoltage by turning TP3 clockwise and measure the output voltage in accordance to item 5).
- 7) If the railvoltage can be increased (with TP3 ) without any high heatdisipation in the  $47\Omega / 5W$ -resistors, the amplifier can be connected to a sinewawe source at the input. The output will be checked by an oscolloscope. ( The amplifier can run without or with reduced load.)  
 If there still is a DC-potential at the output, check the drivertransistors Q7-Q9 and Q12 and their mica insulations. If there still is DC, go to item 9).  
 If the sinewawe is distorted, check the DC-protection triac Q110, if it still distortion go to item 9).

8)

**Final check:**

Then the signal is undistorted; replace the two 47 $\Omega$ -resistors with fuses, T 6.3A.

- a) Adjust the railvoltage by TP2 to 82.5V on the PSUB.
- b) Check the quiescent current by measuring the current thru the F2, adjust to 200 mA by P1.
- c) Check output by a sinewave up to full swing into 4 $\Omega$  load.
- d) Check of short-circuit protection:
  - Adjust outputvoltage to 10 V AC.
  - Short the output by a resistor 0.3 -0.5 $\Omega$ / 5W.
  - Check symmetry of the shortcircuitvoltage across the 0.3 $\Omega$ -resistor by the scope.

9)

**SERVICE IN DRIVER CIRCUITS**

- a) Desolder R12, R24 and R25.
- b) Connect a resistor 33 k $\Omega$  between point R22/ R27 and R12/ C3.
- c) Connect a scope at R22/ R27.
- d) Apply a sinewave to the amplifier, and the drivercircuits can be checked separately without the outputcircuits.

10)

**Check of DC- voltages:**

- |                 |       |                        |
|-----------------|-------|------------------------|
| a) D1           | +15V  | ref. to ground.        |
| b) D2           | -15V  | "                      |
| c) Q3 collector | -14V  | "                      |
| d) R4, R5       | -0.5V | "                      |
| e) R8, R9       | -1.2V | ref. to + Railvoltage. |
| f) R14, R15     | -0.5V | "                      |
| g) R16, R17     | +0.5V | ref. to - Railvoltage. |