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POW503/POW505
Technical manual

RCSL Nr. 46-F 0089

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af 1979

Keywords:

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Power supply

Abstract:

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1. General description

POW 503 and POW 505 are series resonant switch mode power supplies for use in RC750 and RC755 respectively.

POW 503 can supply up to 135 W continuously and 150 W during startup of motors in disc drives. It needs fan cooling and includes a fan regulator that adjusts the fan speed after how much cooling is needed. It also requires some additional mains filtering as seen on the interconnection diagram sect. 2.1.

POW 505 is a low power version of POW 503 intended to supply up to 50 W. It is a complete unit with all components from mains input to DC output on a single PCB.

1.1 Principle of operation

A simplified diagram of the power supply is shown in sect. 1.2. The power supply mainly consists of:

- input rectifier and filter
- 160 kHz FET square wave generator driven by a VCO
- Low pass LC-filter
- 160 kHz power transformer
- Low voltage rectifiers and regulators.

The mains voltage is rectified and filtered to obtain an unregulated DC voltage around 300 V.

This voltage is converted to a 300 Vpp square wave by the power MOSFET transistor switches. The low pass LC filter filters the square wave and converts it to a sine wave. The amplitude of this sine wave is controlled by varying the switch frequency above the series resonant frequency of the LC-filter.

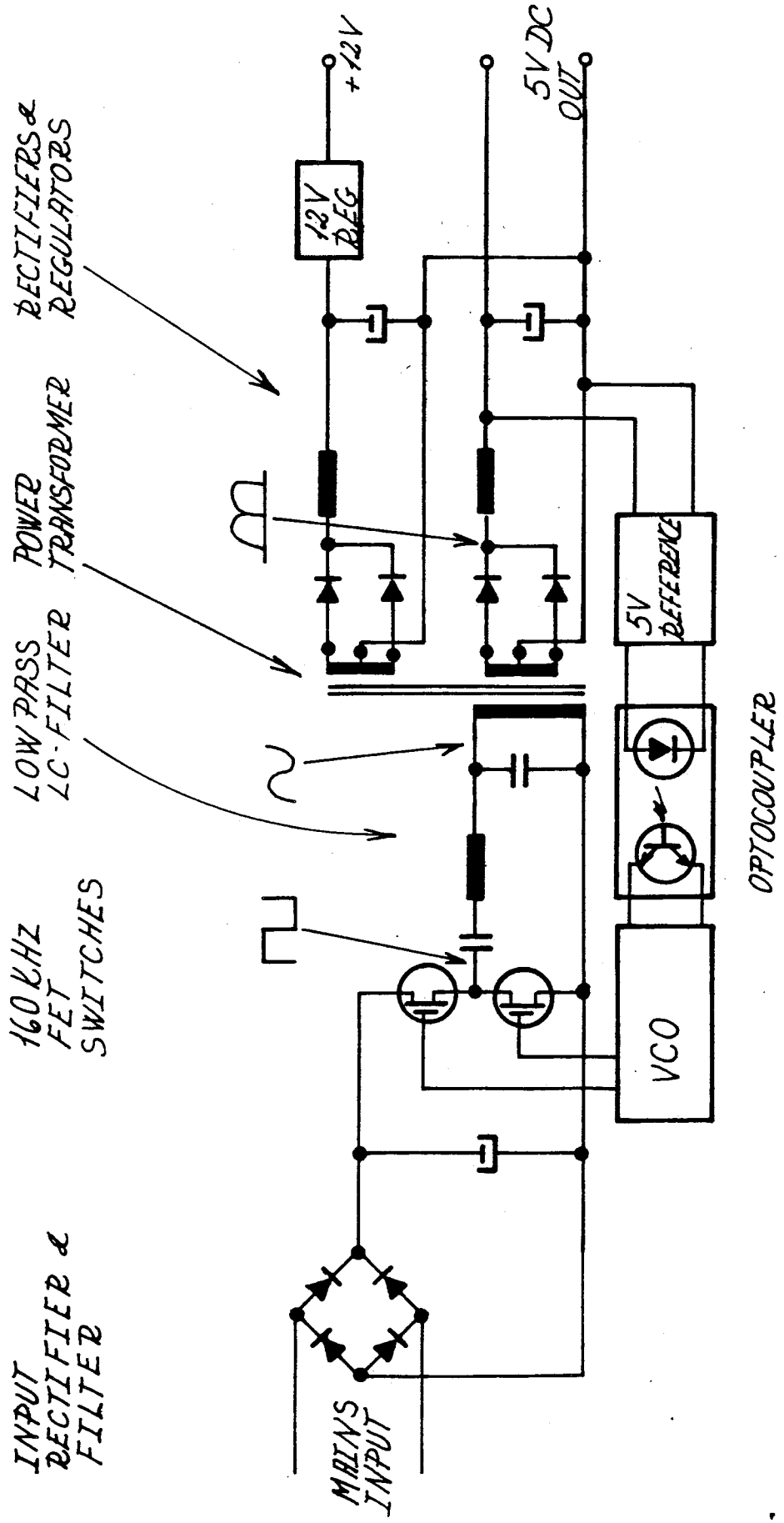
In this way maximum output is obtained at the resonance frequency. The output voltage is reduced by increasing the switch frequency.

The 5V output voltage is compared to a 5V reference voltage and controls the current in the optocoupler.

An increase in 5V output voltage increases the current in the optocoupler which in turn increases the VCO switch frequency and thus reduces the voltage amplitude into the power transformer.

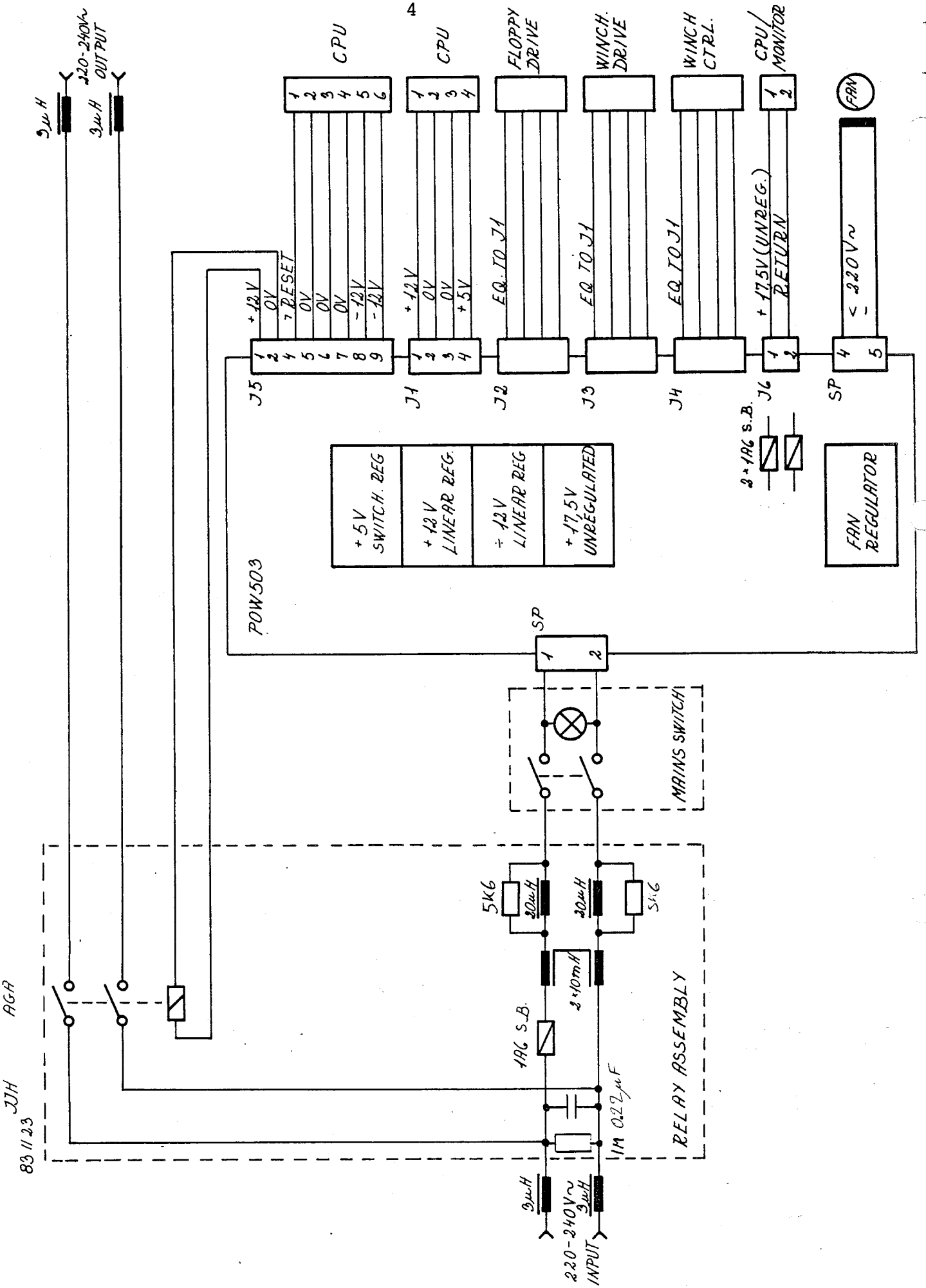
The + and - 12V are stabilized by series pass regulators. The + 17.5V output is unregulated with respect to load variations, but variations in mains voltage are regulated by the 5V main feedback loop.

1.2 Block diagram



2. POW 503

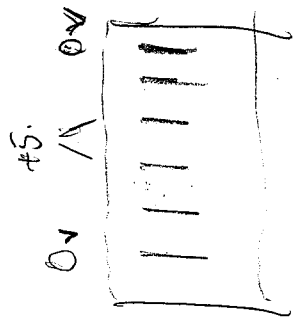
2.1 POW 503 interconnection diagram

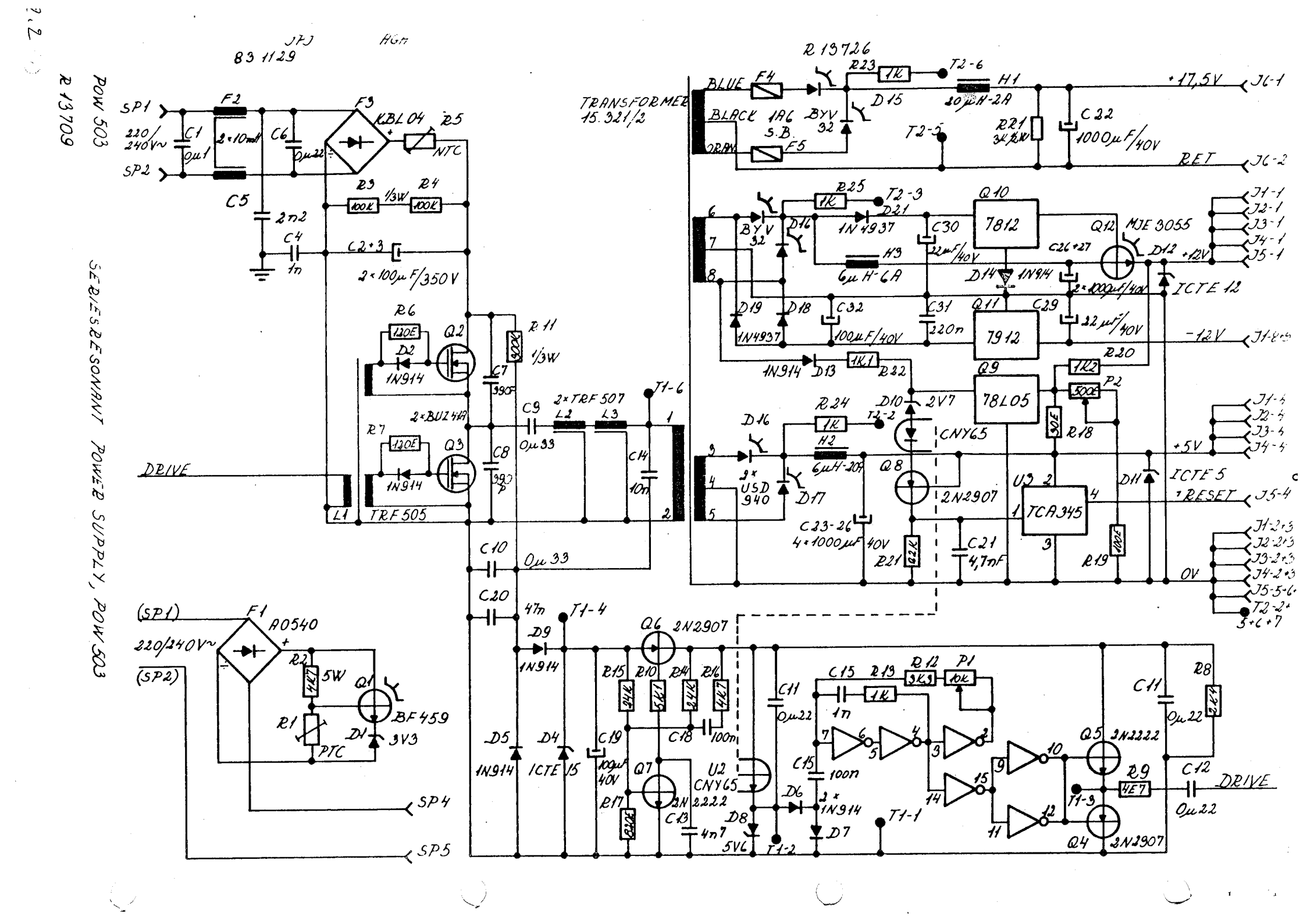


POWER SECTION, RC 750

R 13710

2.2 POW 503A Circuit diagram

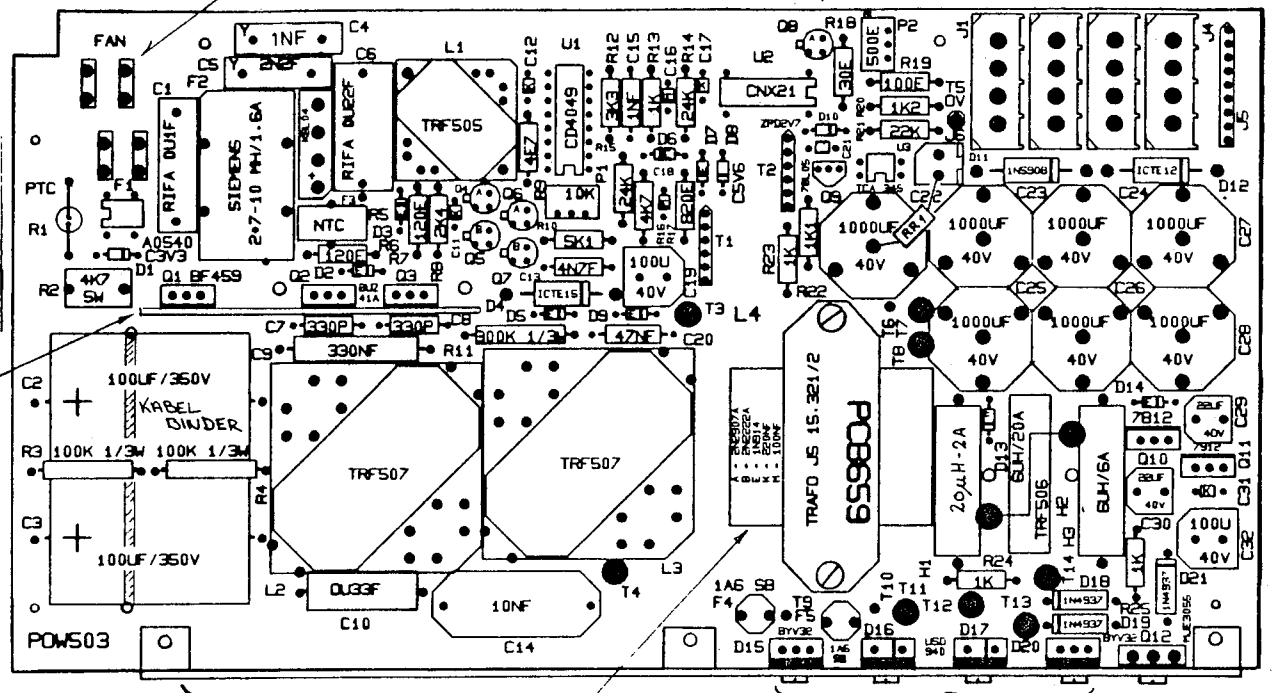



POW 503
R 13709
SELF RESONANT POWER SUPPLY, POW 503
83 1129
R 13726
TRANSFORMER 15.321/2
BLUE
BLACK
ORAN
F4
F5
F2
F3
KBL04
R5
NTC
SP1
SP2
220/240V~
C1
0µ1
2×10mH
C6
0µ22
C5
2n2
C4
1n
R3
1/3W
100K
R4
100K
C2+3
2×100µF/350V
R23
1K
T2-6
H1
20µH-2A
+17,5V
J6-1
D15
BYV 32
T2-5
R21
3K3 2W
C22
1000µF/40V
RET
J6-2
R25
1K
T2-3
D21
1N4937
Q10
7812
Q12
MJE 3055
D12
+12V
J1-1
J2-1
J3-1
J4-1
J5-1
D16
BYV 32
C30
22µF/40V
H3
6µH-6A
C26+27
2×100nF/40V
ICTE 12
D14
1N914
D19
1N4937
D18
C32
100µF/40V
C31
220n
Q11
7912
C29
22µF/40V
-12V
J1-8-5
1N914
D13
1K1
R22
R20
1K2
Q9
78L05
P2
500R
R24
1K
T2-2
D10
2V7
CNY65
H2
6µH-20T
3×
USD
940
D17
Q8
2N2907
50E
R18
+5V
J1-4
J2-4
J3-4
J4-4
D11
ICTE 5
U3
TCA345
*RESET
J5-4
C23-26
4×1000µF
40V
R21
82K
C21
4,7nF
R19
100R
OV
J1-2-3
J2-2-3
J3-2-3
J4-2-3
J5-5-6-
T2-2-
3-C-7
DRIVE
R6
120E
Q2
D2
1N914
R11
470K
1/3W
C7
390P
R7
120E
Q3
1N914
2×BUZ48A
C9
0µ33
2×TRF 507
L2
L3
T1-6
C14
10n
C8
390P
L1
TRF 505
C10
0µ33
C20
47n
T1-4
D9
1N914
Q6
2N2907
R15
24K
R10
5K1
R4
24K
R16
4K7
C18
100n
C19
100µF
40V
D5
1N914
D4
ICTE 15
Q7
2N2222
R17
82R
C13
4n7
U2
CNY65
D8
5V6
T1-2
D6
2×
1N914
D7
T1-1
C11
0µ22
C15
1n
R13
1K
R12
3K3
P1
10K
C15
100n
T1-3
Q4
2N2907
Q5
2N2222
R9
4E7
C12
0µ22
DRIVE
C11
0µ22
R8
2K2
(SP1)
(SP2)
F1
A0540
220/240V~
R2
4K7
5W
Q1
BF459
R1
PTC
D1
3V3
SP4
SP5

RR1 , 3K ½ W på loddeside

C21 = 4,7nF / 63V

4 STK SPADEMALE



KOMP. SIDE

PTC MODSTAND SKUBBES IGENNEM HOLDER FOR LYSDIODE

KØLEPLADE FOR Q1-3 , SE TGN. 76053460

3STK SKRUE ¼ x 6 PHPX-B

TRAFO FASTGØRES MED:

2 STK TRANSF. BESLAG
2 STK SKRUE M3x50
2 STK SELVLÅSENDE MØTR.

SKRUE
611004 - GLIMMERSKIVE, SILICONE PÅ BEGGE FLADER.
611003 - ISOLATIONE SØSNING
STJERNESKIVE
MØTRIK, M3

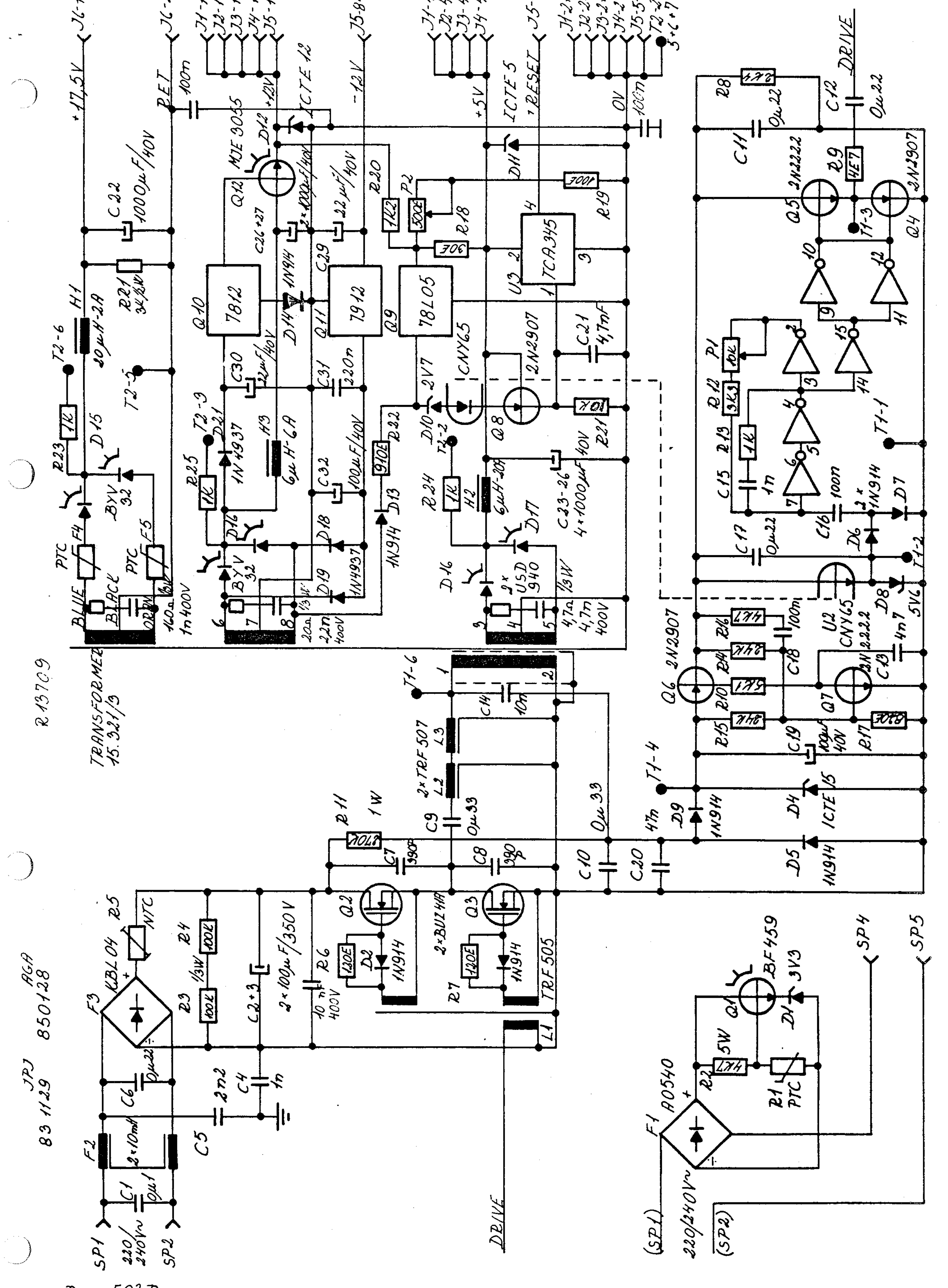
MONTAGE AF TRAFO TILLEDNINGER.

TRAFO JS 15.321/2		PCB659
1		T3
2		T4
3		T11
4		T7
5		T12
6		T13
7		T8
8		T14
9	BLÅ	T9
10	SORT	T6
11	ORANGE	T10

I T3 OG T4 MONTERES LODDETÅRNE. TILLEDNINGERNE TIL DISSE SKOES GODT INDEN LODNING.

BETEGNELSE	POW503 MONTAGETEGNING PCB659	UDGAVE	
		02 840104 JJH	07
		03 840114 JJH	08
		04 840223 HC	09
PA PART NR	PA TEGN PART NR	05	10
		06	11
DESIGN HC	MONTAGE	TEGN NR	76053510
01 UDGAVE 831216			

2.3 POW 503B Circuit diagram

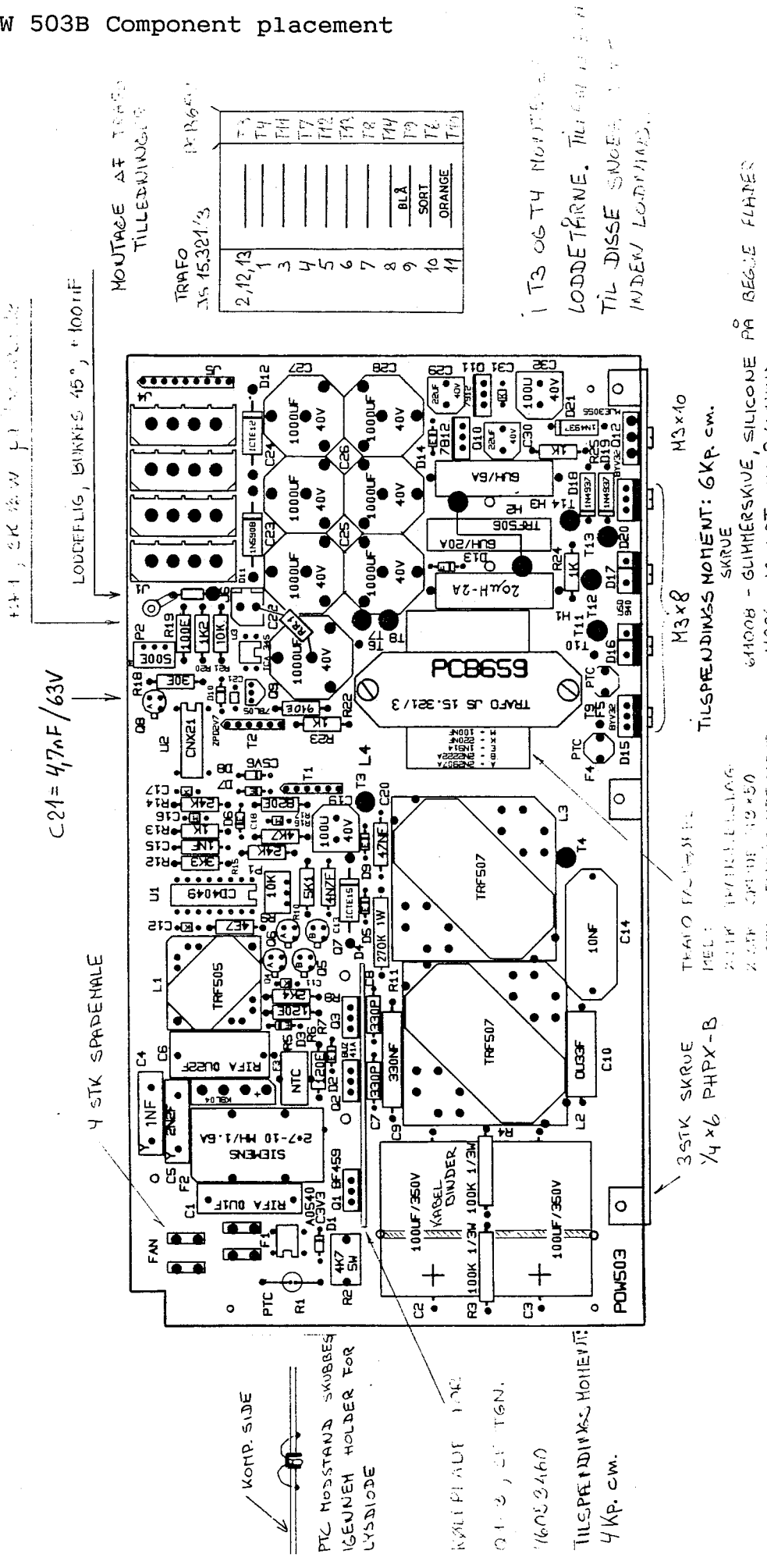


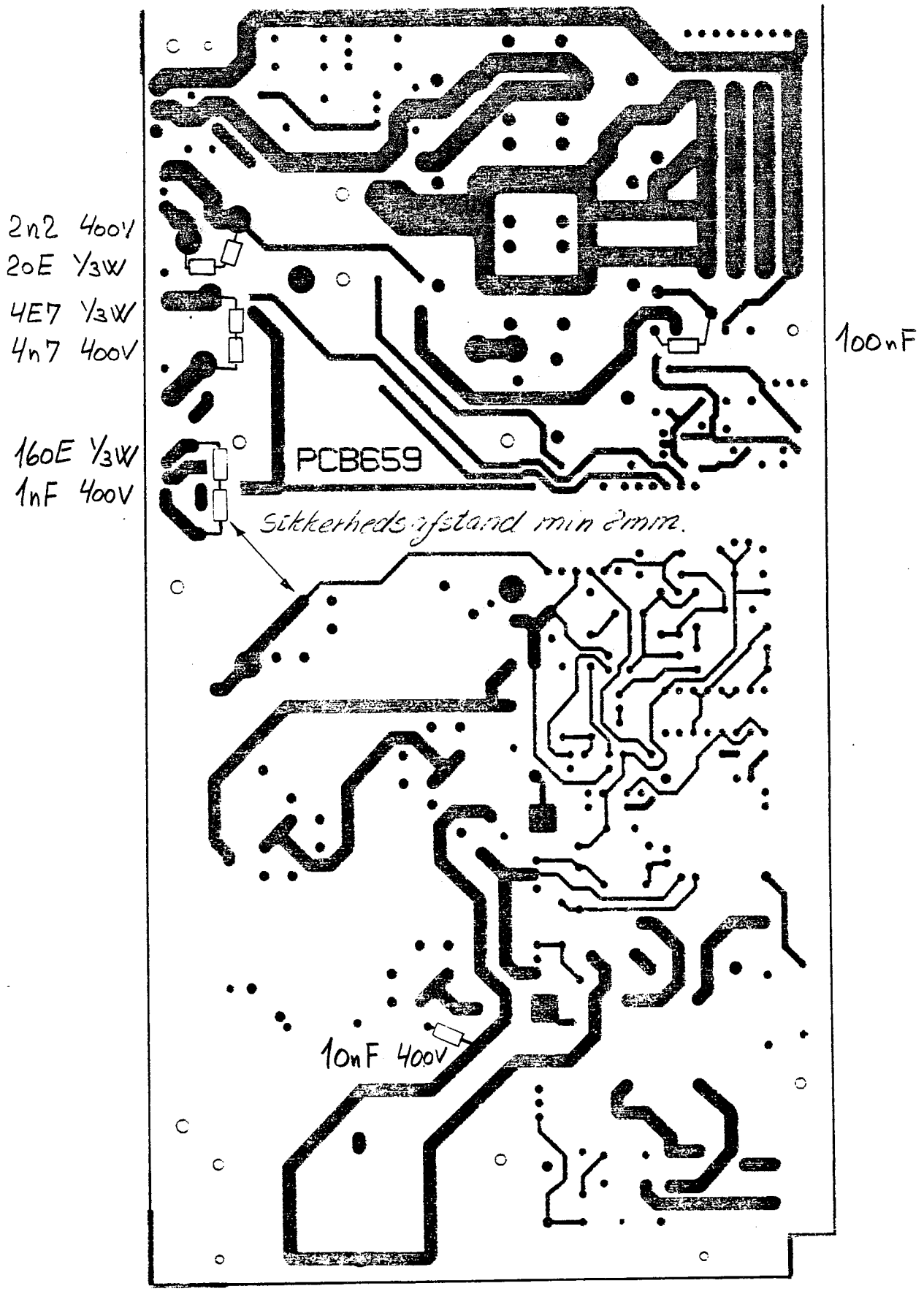
POW 503B

SERIESRESONANT POWER SUPPLY, POW 503 B

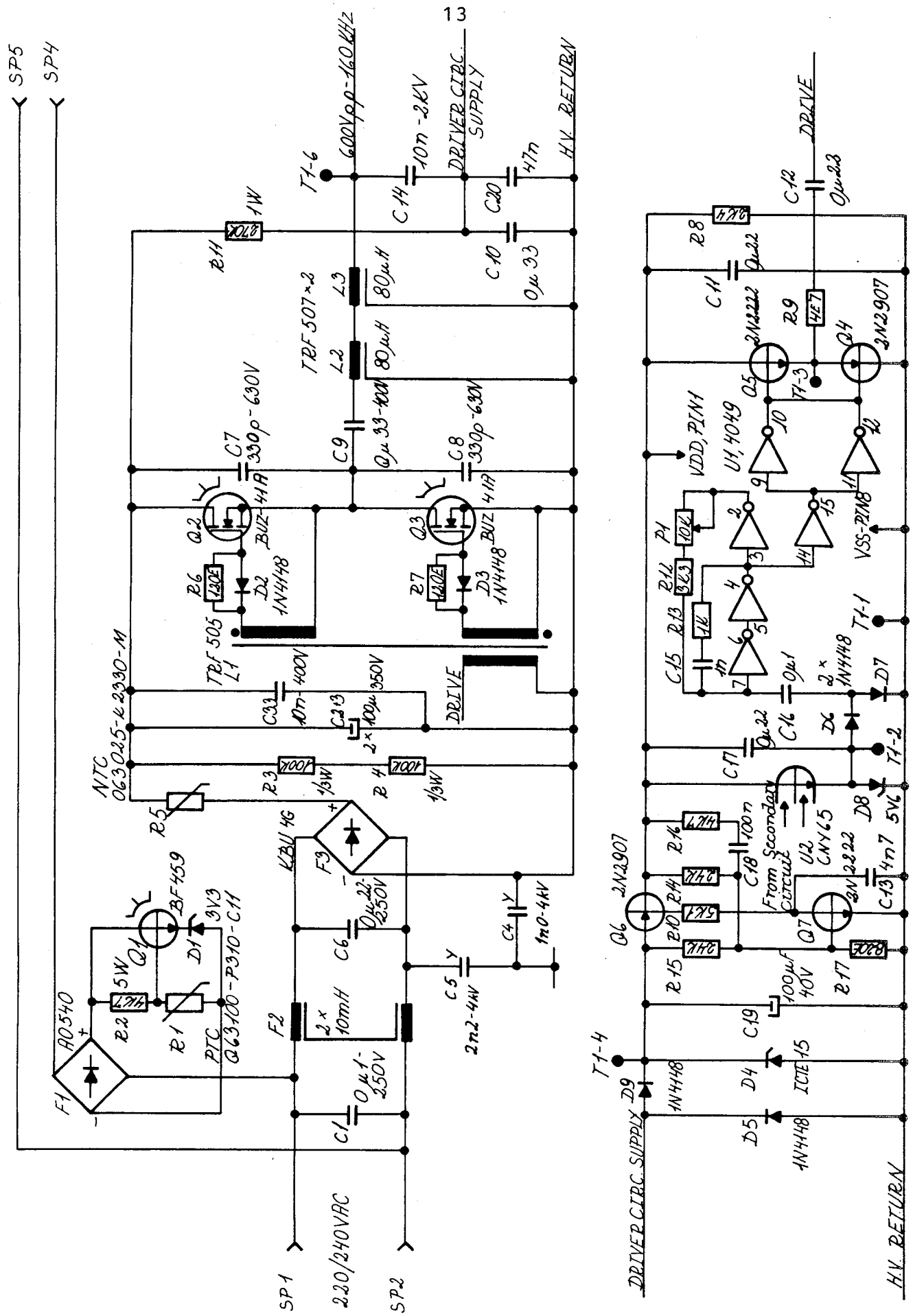
R 13726

POW 503B Component placement

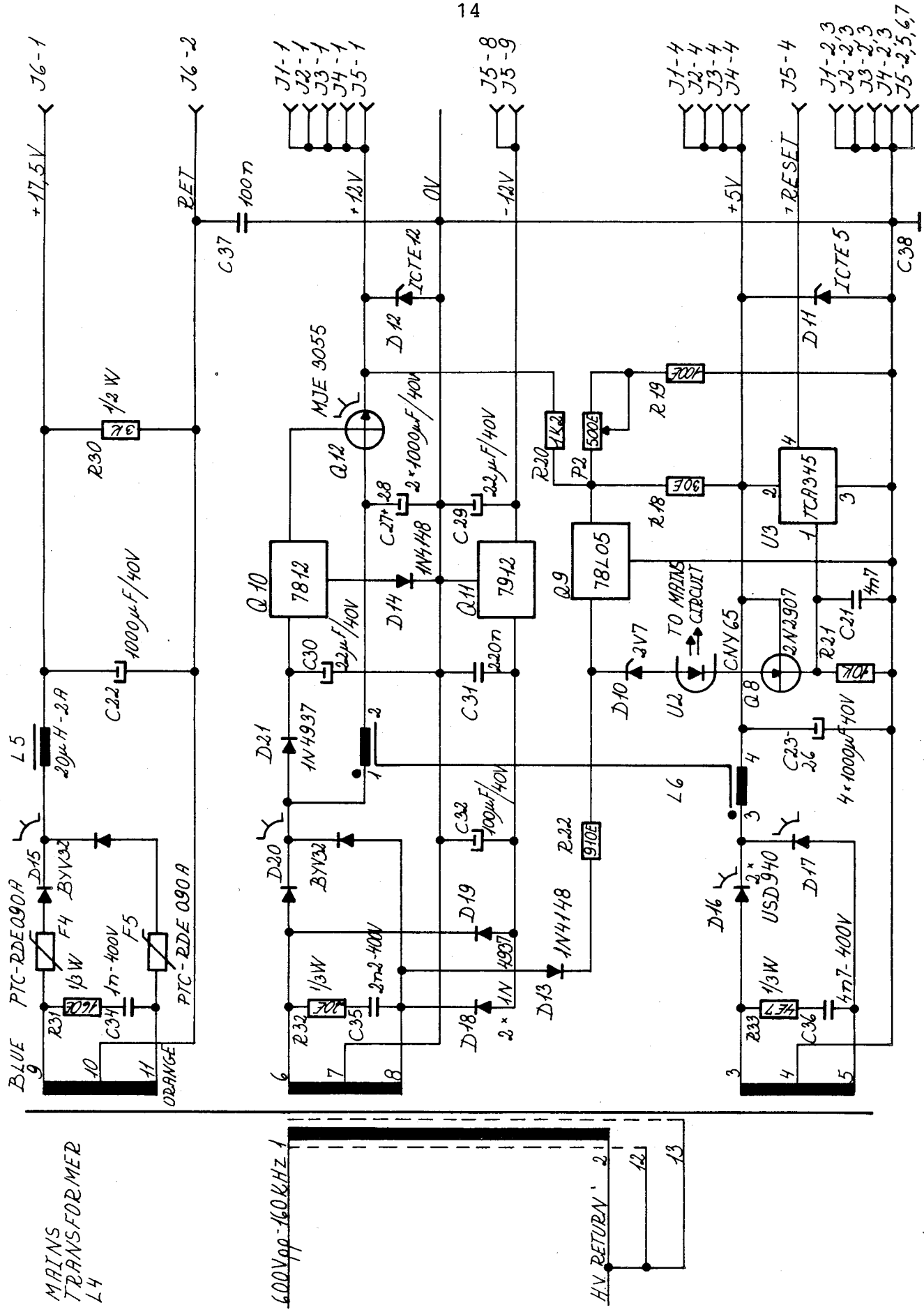



2n2 400V
20E 1/3W
4E7 1/3W
4n7 400V
160E 1/3W
1nF 400V
100nF
PCB659
Sikkerheds-afstand min 2mm.
10nF 400V

2.4 POW 503C Circuit diagram

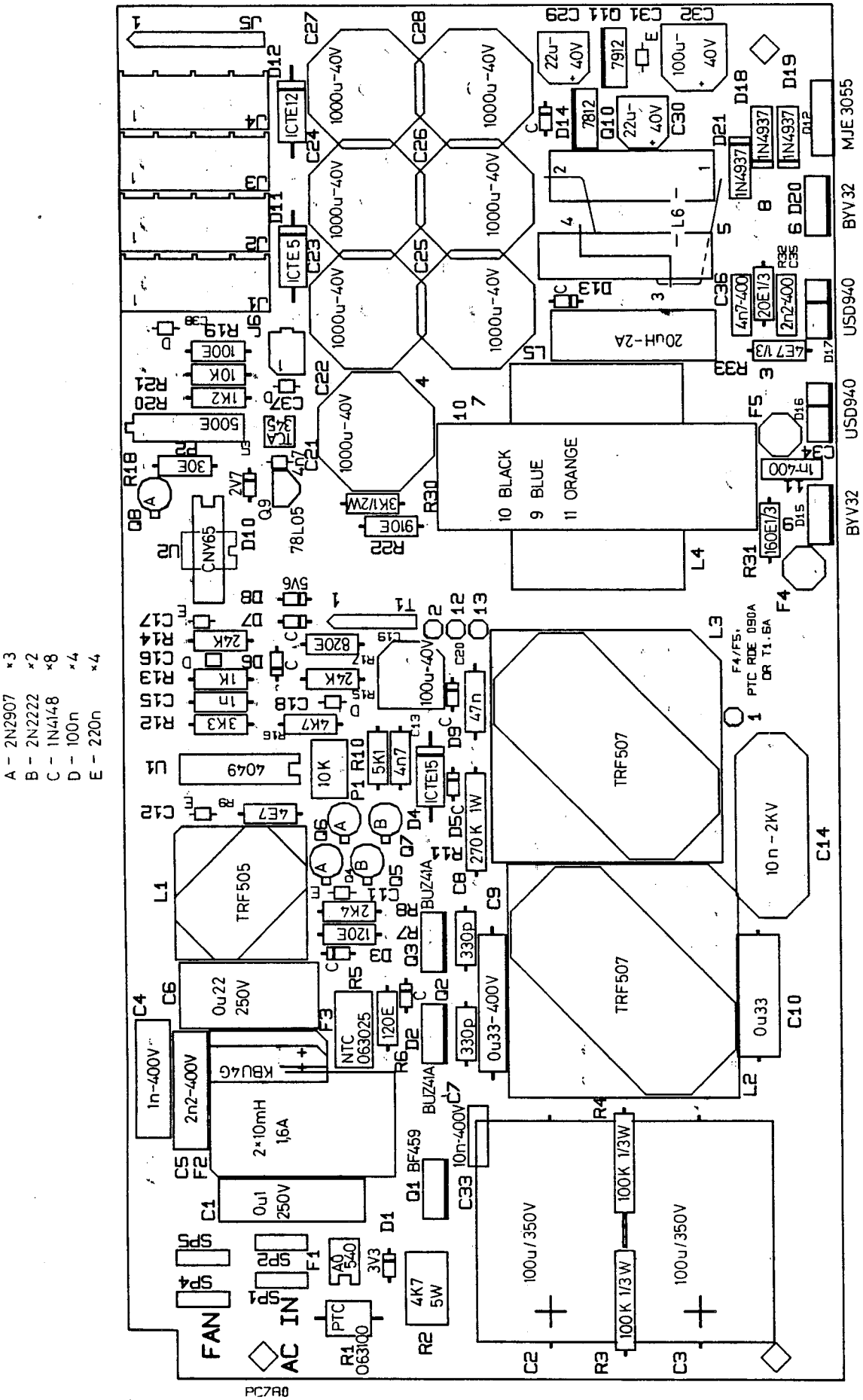


POW 503 C SR. SMPS MAINS CIRCUIT



POW503C S.R.SMPS. SECONDARY CIRCUIT

POW 503C Component placement



2.5 Adjustment procedure, POW 503

Necessary equipment

- Isolation transformer
- Variable mains transformer 180V - 264V
- Variable DC power supply 0 - 15V, 0,5A
- Oscilloscope
- Digital voltmeter (R in = 10 Mohm min.)
- Dummy loads:

for	+ 5V	5A and 12A (2 steps)
	+12V	3.5A and 5.5A (2 steps)
	-12V	0.1A (120E, 2W)
	+17.5V	1.6A (11E, 30W)

Testconnector on primary side (T1)

PIN NO	Signal
1	0V - Primary
2	VCO control voltage
3	Drive signal for Power FET's
4	Control circuit Supply voltage
5	No Connection
6	Power transformer input voltage

Testconnector on secondary side (T2)

PIN NO	Signal
1	0V - Secondary
2	8V peak (+)
3	19V peak (+)
4	No Connection
5	0V return for pin 6-signal
6	25V peak (+)

2.5.1 Step by step adjustment procedure

A) Prelininary adjustment of VCO. Connect the DC-power supply to T1-1 (0V) and T1-4 (+).

Connect the oscilloscope to T1-3. Increase the DC-supply voltage slowly and check that oscillator starts at a voltage of appr. 12.5V and max. 14V. Then lower the voltage to 10V and adjust the oscillator period time to 8.5 us at P1.

B) Connect the variable mains transformer to SP1 and SP2 and adjust mains voltage to 187 V AC.

Connect the following dummy-loads:

-12V	0.1A
+17.5V	1.6A
+5V	5A
+12V	3.5A

Then adjust P2 (+5V adjust) until 5.1 ± 0.1V is measured on J1.

C) With the same loads as above connect the voltmeter to the primary VCO-control voltage (T1-2 and T1-1) and adjust to -1.25V with P1 (POW503C must be adjusted to -3.6V)

D) Check all output voltages at both 187V AC and 264V AC mains voltage. The following voltages should be measured:

+5V ± 0.25V

+12V ± 0.6V

+12V ± 0.6V

+17.5V ± 2V

E) Increase the loads on +5V to 12A and on +12V to 5.5A.

Check that the power supply can start with this max. load at 187V AC mains voltage. The output voltages need not be within limits, but when the +12V load is reduced to 3.5A the output voltages should increase to their normal levels.

F) Fan regulator. Check that the fan runs faster when the PTC resistor is heated.

2.6 Power specifications, POW 503

Input voltage	220V to 240V +10% -15% 50Hz
Mains frequency	47Hz to 63Hz
Power consumption	200 W max.

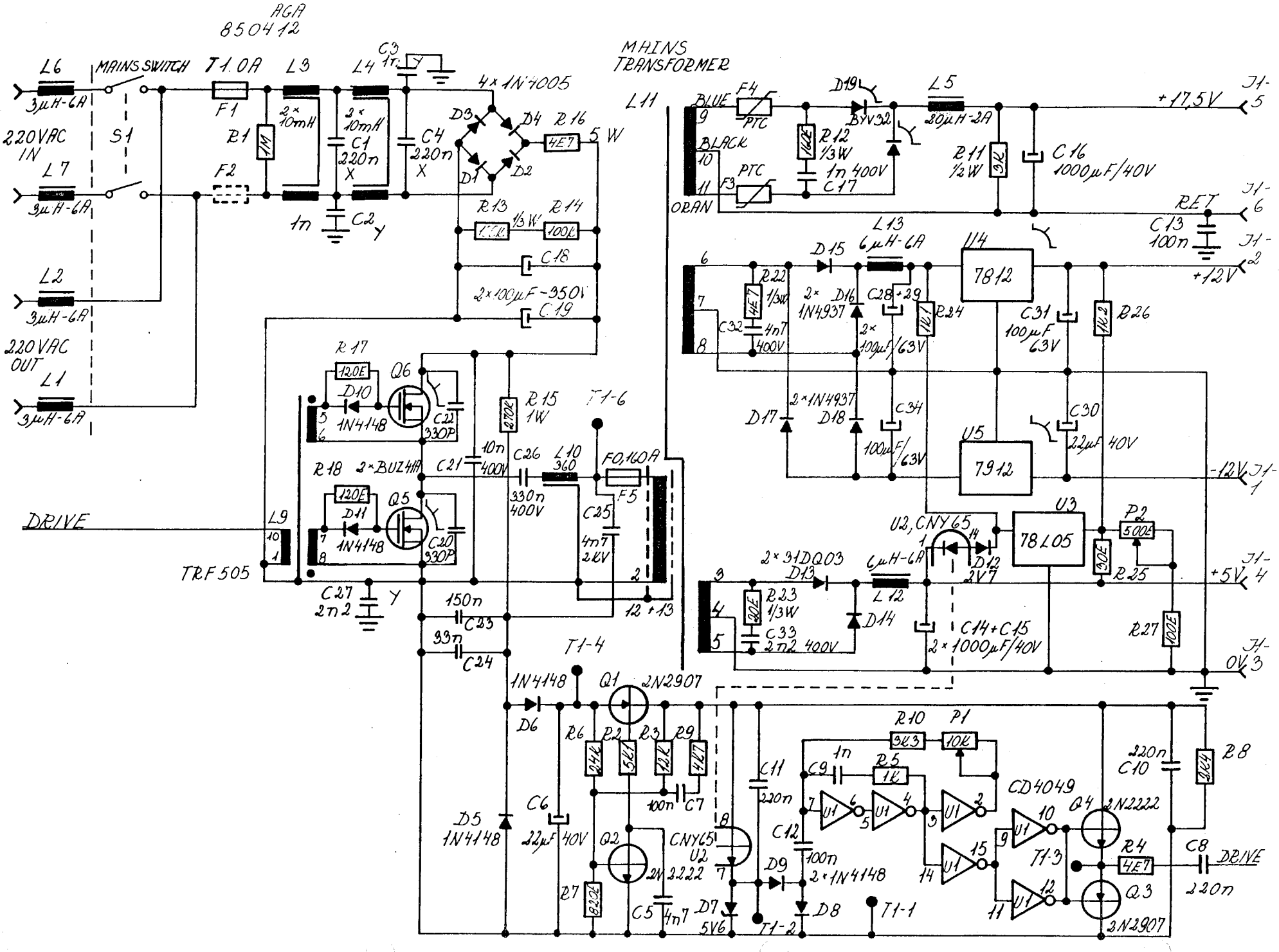
Output voltages

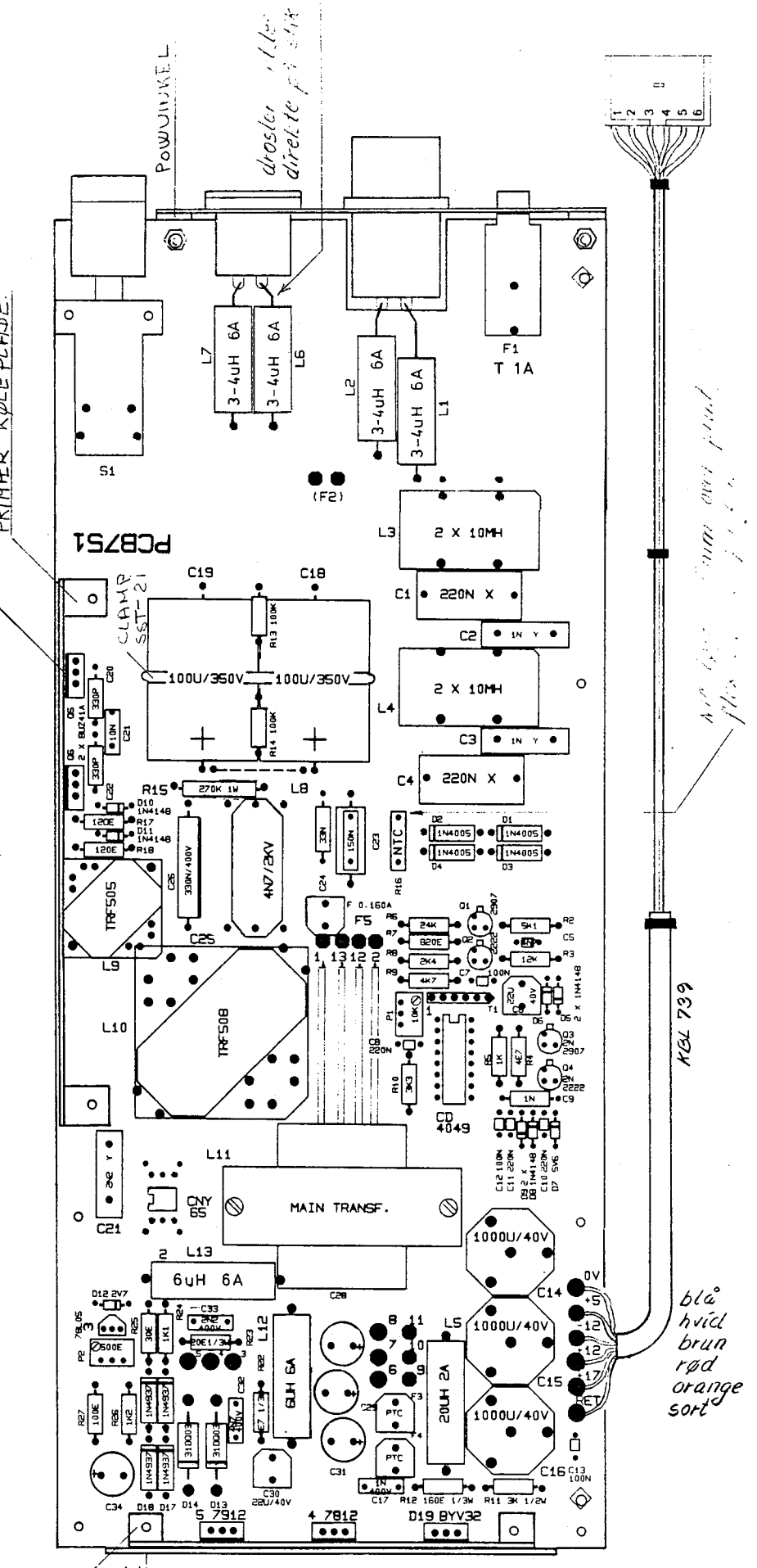
Voltage	Tol.	I max.
+17.5V	±2V	1.6A
+12 V	±0.6V	3.5A const. 5.5A intermittent (+0.6V -1.5V)
+5 V	±0.25V	12A
-12 V	±0.6V	0.2A

Fan regulator range: 0-1600 RPM.

3. POW 505

3.1 Circuit diagram


AGA
850412
MAINS TRANSFORMER
L6
MAINS SWITCH
T1.0A
L3
L4
C3
4x 1N4005
220VAC IN
L7
S1
F1
F2
R1
1M
2x 10mH
2x 10mH
C1 220n X
C4 220n X
1n
C2 Y
D3
D4
D1
D2
R16 4E7 5 W
L11
BLUE
BLACK
ORAN
F4 PTC
F3 PTC
D19
BYV32
L5
30µH-2A
+17,5V
J1-5
R12 1/3W 1n 400V C17
R11 1/2W 3K
C16 1000µF/40V
RET
J1-6
C13 100n
J1-2
+12V
R13 1/3W
R14 100E
C18
2x 100µF-350V C19
L2
3µH-6A
220VAC OUT
L1
3µH-6A
L13 6µH-6A
D15
U4
7812
R22 1/3W 4E7
C32 4n7 400V
2x D16 1N4937
2x 100µF/63V
C28 C29
1K2
R24
C31 100µF 63V
1K2
R26
R17 120E
Q6
D10 1N4148
C22 330P
R15 1W 270E
T1-6
10n C21 400V
C26 330n 400V
L10 360
FO,160A F5
C25 4n7 2KV
R18 2xBUZ41A
120E
Q5
D11 1N4148
C20 330P
DRIVE
L9
TRF505
C27 2n2 Y
2
12 + 13
2x 1N4937 D17
D18
C34 100µF/63V
U5
7912
C30 22µF 40V
-12V
J1-1
U2, CNY65
U3
78L05
P2 500R
30E
R25
+5V
J1-4
2x 31DQ03 D13
6µH-6A
L12
D14
R23 1/3W 10E
C33 2n2 400V
D12 2V7
C14+C15 2x 1000µF/40V
R27 100E
0V
J1-3
150n C23
33n C24
T1-4
1N4148 D6
Q1 2N2907
R6 27K
P2 5K1
R3 12K
R9 4K7
100n C7
D5 1N4148
C6 22µF 40V
Q2
CNY65 U2
2N2222
R7 332E
C5 4n7
D7 5V6
T1-2
D9
2x 1N4148
D8
T1-1
R10 3K3
P1 10K
1n C9
R5 1K
CD4049
220n C10
R8 3K4
C11 220n
C12 100n
T1-3
Q4 2N2222
R4 4E7
C8 220n
DRIVE
Q3 2N2907



ENHED / BETEGNELSE	POW 505B MONTAGETEGNING PCB 751						6
							5
							4
							3
			851015HC	760 [illegible]			2
							1
		DATO / SIGN	850816 HC	TEGN NR	760 [illegible]		0

3.2 Adjustment procedure, POW 505

Necessary equipment

- Isolation transformer
- Variable mains transformer 180V-264V
- Variable DC power supply 0-15V, 0.5A
- Oscilloscope
- Digital voltmeter (R in = 10 Mohm min.)
- Dummy loads:

  for +5V 0.5A and 2A (2 steps)

  +12V 0.3A

  -12V 0.1A (120E, 2W)

  +17.5V 1.6A (11E, 30W)

Testconnector on primary side (T1)

PIN NO	Signal
1	0V - Primary
2	VCO control voltage
3	Drive signal for Power FET's
4	Control circuit Supply voltage
5	No Connection
6	Power transformer input voltage

DC power connector on secondary side (J1)

PIN NO	Signal
1	-12V
2	+12V
3	0V
4	+5V
5	+17.5V
6	17.5V return

3.2.1 Step by step adjustment procedure

A) Preliminary adjustment of VCO. Connect the DC-power supply to T1-1 (0V) and T1-4 (+).

Connect the oscilloscope to T1-3. Increase the DC-supply voltage slowly and check that oscillator starts at a voltage of appr. 12.5V and max. 14V. Then lower the voltage to 10V and adjust the oscillator period time to 7.5 us at P1.

B) Connect the variable mains transformer to the mains input and adjust the voltage to 187V AC.

Connect the following dummy-loads:

-12V	0.1A
+17.5V	1.6A
+5V	2A
+12V	0.3A

Then adjust P2 (+5V adjust) until 5.1V $\pm$ 0.1V is measured on J1.

C) With the same loads as above connect the voltmeter to the primary VCO-control voltage (T1-2 and T1-1) and adjust to -2V with P1.

D) Check all output voltages at both 187V AC and 264V AC mains voltage.

The following voltages should be measured:

+5V $\pm$ 0.25V

+12V $\pm$ 0.6V

-12V $\pm$ 0.6V

+17.5V $\pm$2V

E) Check that the power supply is able to start with full load at 187V mains voltage.

F) Remove all loads except a +5V load of 0.5A and check that the +5V output is within limits.

3.3 Power specifications, POW 505

Input voltage 220V to 240V +10% -15% 50 Hz

Mains frequency 47 Hz to 63 Hz

Power consumption: 65 W max.

Output voltages

Voltage	Tol.	I max.
+17.5V	±2V	1.6A
+12V	±0.6V	0.3
+5V	±0.25V	3A
-12V	±0.6V	0.1A

4. Safety Components

IMPORTANT

To protect the user against voltage and fire hazards, the components listed below must not be replaced by other types than specified.

4.1 POW 503 Components

NOTE: Component numbers refer to POW 503C-diagram.

Component	Type, manufacturer
C4	1nF-400V (4kV), ROEDERSTEIN RKP 615 1nF (5kV), FERROPERM 9/0138.9 D
C5	2n2-400V (4kV), ROEDERSTEIN RKP 619 2n2 (5kV), FERROPERM 9/0138.9 D
C1	0,1uF-250V, RIFA PME271
F2	2x10mH-1,6A, SIEMENS B82723-G2-B9
C6	0,22uF-250V, RIFA PME 271
F3	KBU4G, GENERAL INSTRUMENTS BY224-600, PHILIPS
R5	NTC-resistor, SIEMENS Q63023-K2330-M
C33	10nF-400V, SIEMENS B32510-D6103-K SIEMENS B32520-A6103-K PHILIPS 2222 368 55103
C7+8	330pF-630V, SIEMENS B33063-B6331-H6
C9	0,33uF-400V, PHILIPS 2222 341 29334
L2+3	80uH, TRF 507
C14	10nF-2KVDC, WIMA FKP1 5%
U2	Optocoupler, AEG CNY 65
L4	Mains transf., FT 14321003-2
F4+5	PTC, RAYCHEM RDE 090A FUSE T1,6A, WICKMANN TR-5 (T)

C34	1nF-400V,	SIEMENS B32510-D6102-K SIEMENS B32520-A6102-K PHILIPS 2222 368 55102
C35	2,2nF-400V,	SIEMENS B32510-D6222-K SIEMENS B32520-A6222-K PHILIPS 2222368 55222
C36	4,7nF-400V,	SIEMENS B32510-D6472-K SIEMENS B32520-A6472-K PHILIPS 2222 368 55472

4.2 POW 505 Components

Component	Type, manufacturer
F1	T1,0A-250V 5x20, IEC 127-111 specified
R1	1MOHM, BEYSCHLAG MBB027
L3,L4	2x10mH-1,6A, SIEMENS B82723-G2-B9
C1,C4	0.22uF-250V, RIFA PME 271
C2,C3	1nF-400VAC (4KV),RODERSTEIN RKP 615 1nF (5KV),FERROPERM 9/0138.9 (D)
D1+2+3+4	1N4005, MOTOROLA
R16	4E7-5W
C20+22	330pF-630V, SIEMENS B33063-B6331-H6
C21	10nF-400V, SIEMENS B32510-D6103-K SIEMENS B32520-A6103-K PHILIPS 2222 368 55103
L10	360uH, TRF 508
C25	4,7nF-2KV, WIMA FKP1 5% 2x10nF-2KV, WIMA FKP1 5%
F5	F 0.16 A, WICKMANN tr-5 (F)
L11	Mains transf., FT14321003-2
U2	Optocoupler, AEG CNY65
F3+4	PTC-RDE135A, RAYCHEM T1,6A, WICKMANN RE-5 (T)
C17	1n-400V, SIEMENS B32510-D6102-K SIEMENS B32520-A6102-K PHILIPS 2222 368 55102
C32	4n7-400V, SIEMENS B32510-A6472-K SIEMENS B32520-A6472-K PHILIPS 2222 368 55472
C33	2n2-400V, SIEMENS B32510-D6222-K SIEMENS B32520-A6222-K PHILIPS 2222 368 55222
C27	2n2-400VAC (4KV),ROEDERSTEIN RKP 619 2n2 (5KV),FERROPERM 9/0138.9 (D)

RETURN LETTER

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