

LAB 2002

SERVICE MANUAL

1999 EMC

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LAB 2002

Theory of function

Power supply

AC-power is coming in to terminal K1. The voltage is rectified by D1 and filtered by C10, C11. This gives 310V DC to the transformer TR1. The PWM-controller U1 controls the switch Q1-Q3 to give the correct output voltage at terminal J17, J19. When the switch Q1-Q3 is closed, current flows through transformer, TR1, storing energy. Because of the voltage polarity, diode D3, D4 are reverse-biased, thus no voltage present at the load. When the switch is open, transformer TR1 reverses polarity because of the collapsing magnetic field, forward-biasing diode D3, D4, and inducing a current flow into the capacitors C12, C14. The reversed voltage is sensed by a winding in TR1 and rectified by diode D8. The PWM-controller adjusts the on-time of the switch, by comparing the voltage across C14 with an internal reference, to give a rail voltage of $\pm 155V$ across the capacitors C12, C14. The voltage can be adjusted by potentiometer TP2. The maximum current in the transformer is sensed over the resistor R6-R8. The voltage across R6-R8 is compared with a reference-voltage, set by TP3, which makes it possible to adjust the maximum output power from the power supply. Normally TP3 is in maximum position, but if something has to be repaired in the amplifier, TP3 is used for "slow starting" the amplifier.

Amplifier

The input signal is connected to the balanced amplifier U1. The gain in this amplifier can be reduced by opto resistor LDR1 to prevent clipping in the output amplifier. From amplifier U1 signal is going to limiter U2, Q1, Q2 passing gain control P1. This limiter together with the phase linear lowpassfilter U3, U4 limits the slewrates of the signal going to the output amplifier 4KLF, preventing from intermodulation in this amplifier if signals of too high frequencies are presented on the input terminal.

The output amplifier 4KLF works as an ordinary power amplifier with the difference that the collector voltage to the output transistors is supplied from the switch mode amplifier 4KHF.

The base voltage on the output transistors Q26-Q28, Q31-Q33 is sensed by voltage divider R36-R38 and is then sent to the adjustable limiter U3, U4 on the input board, before it reaches the input on the switch mode amplifier. Limit level is set by the minimum load select-switches (MLS-sv.) to give correct output power in different loads. These switches also change the sensitivity for the led bars on the front panel.

The amplifier U1 (U2) on the HF-board makes sure that the output signal on terminal J4 (J8) is a copy of the input signal on terminal J12, by giving correct control voltage to pulse width modulator U3. U3 compares this voltage with a 614Khz triangular wave giving a pulse wide modulated output signal from Q1 (Q7) which is filtered by L1, C1 (L4, C10). The gain from the base of the output transistors in the LF-amplifier to the output of the HF-amplifier is equal to one. TP1 (TP2) is used to add a DC-offset on the input of U1 (U2) giving +7,5V (J4) -7,5V (J8) relative output of the LF-amplifier (J6), which is the same as collector-emitter voltage for the output transistors Q26-Q28, Q31-Q33.

REPAIRING INSTRUCTIONS

REQUIRED MEASUREMENT EQUIPMENT:

- Audio generator
- AC-voltmeter/THD-meter
- 2 digital voltmeters
- Two channel oscilloscope for audio
- Variac 0-280V, 6A
- 50Mhz oscilloscope, ex. Tek 2225
with 100x probe ex. Tek P6009

AMPLIFIER

1. Without changing any fuses check the power supply +136V, -136V,+16V, -16V,+30V. If these aren't OK go to section for repairing power supply.
2. If all fuses are OK, follow the signal from input to output, and repair in normal way. The best way is to place the amplifier on the front handles, loosen the rear panel, and mount it back on distances (delivered with this manual) to make it possible to measure.
3. If there is a fault in the power amplifier stage do as follows:
 - 3:1 Turn TP1, TP2 on the HF-board, TP3 on the power supply board counter clockwise.
 - 3:2 Short-circuit R38 on LF-board.
 - 3:3 Disconnect cables from Q28, and Q32 collectors on the LF-board.
 - 3:4 Replace broken fuses. (only for the channel you repair)
 - 3:5 Connect DC-voltmeter (200V) to the positive (negative) rail voltage.
 - 3:6 Connect another DC-voltmeter (20V) to the cable disconnected from Q28 (Q32).
 - 3:7 Turn TP3 (PSU) slowly clockwise, TP1 and watch the voltmeters. Rail voltage should increase rapidly, "collector voltage" should read 0. After turning TP3 maximum 30°, rail voltage should be 136V.
 - a. If the rail voltage is zero or very low, check Q1, D1 (Q7, D5) (shorted) on the HF-board..
If Q1 (Q7) is broken, also replace R3 (R16) and D2 (D6).
 - b. If OK (155V) turn TP1 (TP2) slowly maximum clockwise. Voltage measured on the disconnected collector cable should stop at about 7,5V.

c. If OK turn TP1 (TP2) and TP3 counter clockwise.

3:8 Repeat from 3:5 for the negative side (xx).

3:9 Reconnect cable to Q28 collector.

3:10 Connect dummy load 16Ω to output, and connect an oscilloscope (10V/div) across the load.

3:11 Slowly turn TP3 (PSU) for 136V (-136V) rail voltage.

3:12 Slowly turn TP1 (TP2) clockwise and look at the oscilloscope. There should be no DC on the oscilloscope. If there is DC ($\approx 1V$) repair the positive (negative) output section on the LF-board.

3:13 Turn back TP1 (TP2) and TP3, and disconnect Q28 collector.

3:14 Reconnect Q32 collector and repeat from 3:11 for the negative side.

3:15 Reconnect cables to Q28 and Q32 collector. Turn TP3 for 136V rail voltage. Turn TP1 clockwise, no DC on the oscilloscope. Then slowly turn TP2 clockwise. There can be some oscillation with TP2 in middle position, but it will stop at further turning.

3:16 Connect 1KHz sine wave to the input of the amplifier. Adjust gain until there is signal on the output. It should be a 7V PK sine wave with no distortion.

3:17 Disconnect short circuit from R38, and the amplifier will work.

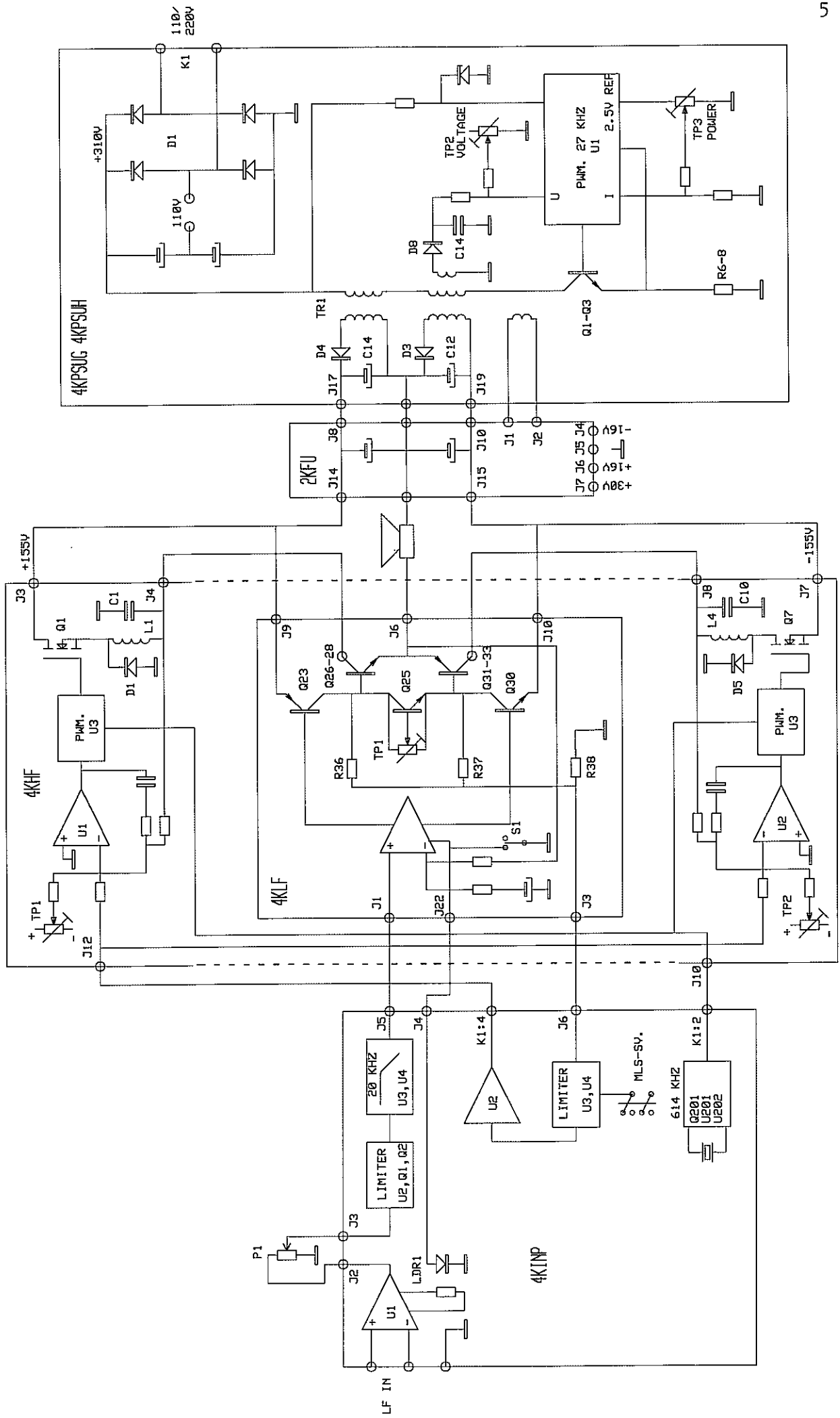
POWER SUPPLY

| | |
|------------------------------------|---|
| Required measurement equipment | -Isolation transformer for the mains, 1:1 |
| -Audio generator | -Variac 0-280V, 6A |
| -DVM | (-Two channel oscilloscope for audio) |
| -50 MHz oscilloscope, ex. Tek 2225 | (-AC Voltmeter/ THD-meter) |
| with 100x probe ex. Tek P6009 | |

- 1) Turn TP2 and TP3 fully counter clockwise.
- 2) Change F1 on the PSUG.
- 3) Increase the main voltage slowly by the variac.
- 4) Measure the voltage across C1 on PSUH.
 - a) No voltage: -change R1 PSUG.
 - b) The current increases quickly: -check D1- PSUG-check Q1, Q2, Q3 PSUH.
- 5) It is now possible to increase the voltage across C1 on PSUH to approx. 300 V without current inrush.

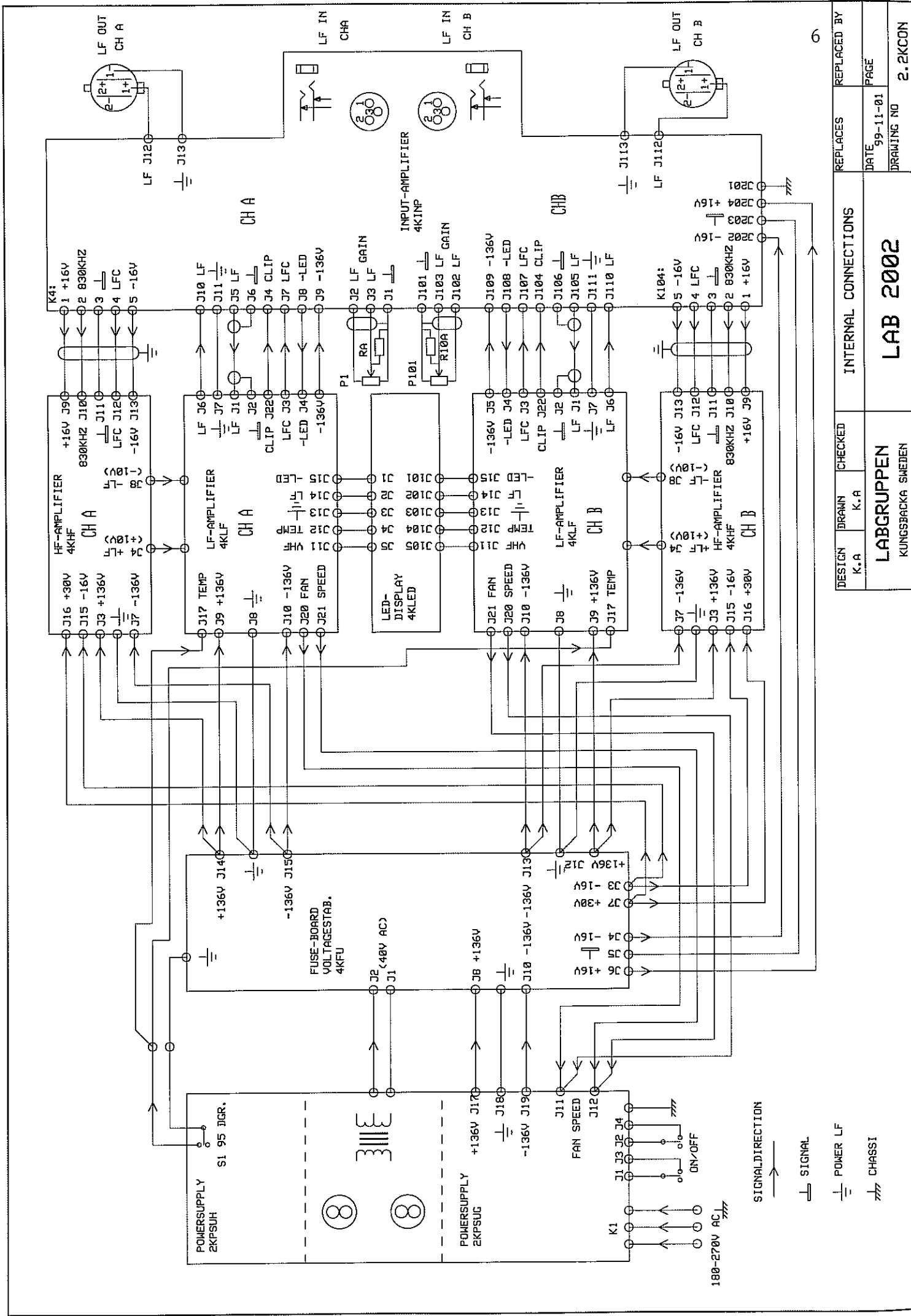
- 6) Connect an oscilloscope to mains voltage via an isolation transformer.
Then measure across Q1 collector and emitter.
- 7) Turn TP3 slowly clockwise until a pulse is visible on the scope. The frequency is approx. 27 kHz (see figure1). If the graph is seen, go to item 9).
- 8) If nothing is seen check:
 - a) U1:15 >14V
 - b) U1:16 5V
 - c) U1:3 < 3V
 - d) U1:2 > 3V
 - e) U1:8 > 5V
 - f) U1:10 54KHz ramp
- 8) If only narrow spikes are seen, check the following components.
 - a) D3, D4 - PSUH or the output circuits.
 - b) D1, D2 -makes U1 goes into over voltage protection.
- 9) Turn TP3 fully clockwise:
 - a) Check the output voltage on C22, C23 – PSUG for correct voltage.
Adjust with TP2. Correct voltage is found in the schematics (see below).
 - b) Check the soft start circuit by turn on and off the main switch and look at the oscilloscope.
 - c) Increase the power by applying an audio signal to the amplifier and turn up the gain controls. -The pulse width will increase.
 - d) Check the over/ under voltage protection circuits by turning the variac up to 280 VAC and down to 130 VAC. (No load).

Fig. 1

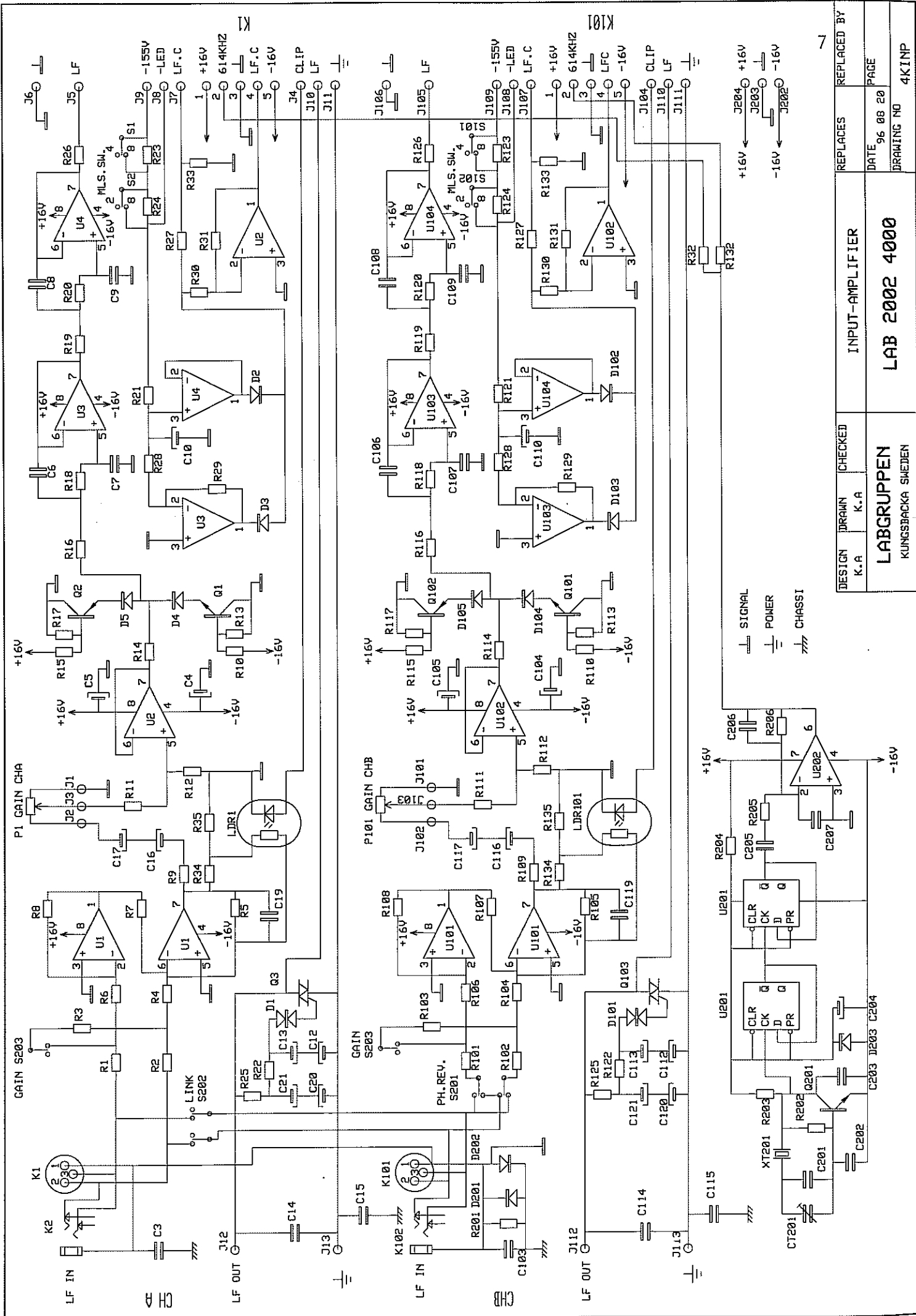


U

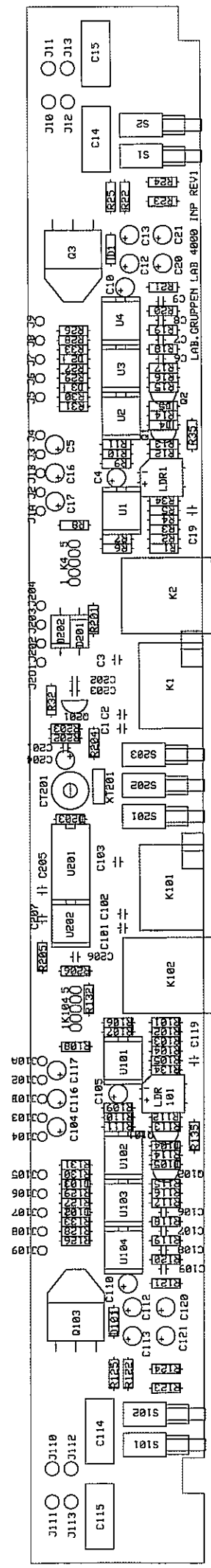
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| DESIGN | DRAWN | CHECKED | THEORI OF FUNCTION | REPLACES | REPLACED BY |
| K.A | K.A | | LAB 2002 4000 | | |
| LABGRUPPEN | | | LAB 2002 4000 | DATE | PAGE |
| KUNGSBACKA SWEDEN | | | | 96 08 20 | 4KFUN |



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| DESIGN K.A | DRAWN K.A | CHECKED K.A | INTERNAL CONNECTIONS | REPLACES | REPLACED BY |
| LABGRUPPEN KUNGSBACKA SWEDEN | | | LAB 2002 | DATE 99-11-01 | PAGE |
| | | | | DRAWING NO 2.2KCON | |



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| K.A | K.A | | INPUT-AMPLIFIER | |
| LABGRUPPEN | | | DATE | PAGE |
| KUNGSBACKA SWEDEN | | | 96 08 20 | |
| | | | DRAWING NO | 4K1NP |



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| K.A | K.A | | INPUT AMPLIFIER | |
| LABGRUPPEN | | | DATE | PAGE |
| KUNGSBACKA SWEDEN | | | 99 09 18 | |
| | | | DRAWING NO | 4KINPR1-P |

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INPUT AMPLIFIER AND INTERNAL CONNECTIONS

Component-list

LAB 2002 INPUT AMPLIFIER

Component-list Channel A

(Ch. B; add 100, Ch. A+B add 200)

Resistors

| | |
|-----|-------------------------------|
| R1 | 10 k Ω 1% |
| R2 | 10 k Ω 1% |
| R3 | 5,36 k Ω 1% 29 dB gain |
| R3 | 9,76 k Ω 1% 32 dB gain |
| R4 | 10 k Ω 1% |
| R5 | 66 k Ω 1% |
| R6 | 10 k Ω 1% |
| R7 | 22 k Ω 1% |
| R8 | 22 k Ω 1% |
| R9 | 100 Ω |
| R10 | 47 k Ω 1% |
| R11 | 1 k Ω 1% |
| R12 | 47 k Ω 1% |
| R13 | 18 k Ω 1% |
| R14 | 1 k Ω 1% |
| R15 | 47 k Ω 1% |
| R16 | 10 k Ω 1% |
| R17 | 18 k Ω 1% |
| R18 | 10 k Ω 1% |
| R19 | 10 k Ω 1% |
| R20 | 10 k Ω 1% |
| R21 | 715 k Ω 1% |
| R22 | 27 k Ω 1% |
| R23 | 2,4 k Ω 1% long legs |
| R24 | 6,2 k Ω 1W long legs |
| R25 | 27 k Ω 1% |
| R26 | 100 Ω |
| R27 | 10 k Ω 1% |
| R28 | 47 k Ω 1% |
| R29 | 47 k Ω 1% |
| R30 | 10 k Ω 1% |
| R31 | 10 k Ω 1% |
| R32 | 100 Ω |
| R33 | 12,4 k Ω 1% |
| R34 | 10 k Ω 1% |
| R35 | 1 k Ω 1% |
| R36 | 47 k Ω 1% |

Optoresistor

LDR1 VTL5C4

Transistors

| | |
|----|----------|
| Q1 | BC 547 |
| Q2 | BC 557 |
| Q3 | Q 4015R6 |

Capacitors

| | |
|-----|-------------------|
| C1 | - |
| C2 | - |
| C3 | 330 nF 50V |
| C4 | 10 μ F 50V |
| C5 | 10 μ F 50V |
| C6 | 220 pF 5% |
| C7 | 220 pF 5% |
| C8 | 330 pF 5% |
| C9 | 100 pF 5% |
| C10 | 0.47 μ F 50V |
| C11 | - |
| C12 | 22 μ F 50V |
| C13 | 22 μ F 50V |
| C14 | 0.47 μ F 250V |
| C15 | 2.2 μ F 63V |
| C16 | 22 μ F 50V |
| C17 | 22 μ F 50V |
| C18 | - |
| C19 | 22 pF |
| C20 | 22 uF 50V |
| C21 | 22 uF 50V |

Diodes

| | |
|----|---------|
| D1 | DB 3 |
| D2 | 1N 4148 |
| D3 | 1N 4148 |
| D4 | 1N 4148 |
| D5 | 1N 4148 |

Switches

| | |
|----|------------|
| S1 | Alps SPPJ3 |
| S2 | Alps " |

Integrated circuits

| | |
|----|---------|
| U1 | NE 5532 |
| U2 | NE 5532 |
| U3 | LF 353 |
| U4 | LF 353 |

Connectors

| | |
|----|-----------------------|
| K1 | 3-pole XLR chassie |
| K2 | 3-pole Telejack |
| K4 | 5-pole pinheader |

Resistors

| | |
|------|-------------------|
| R201 | 10 Ω |
| R202 | 220 k Ω |
| R203 | 1 k Ω 1% |
| R204 | 2.2 k Ω |
| R205 | 2,2 k Ω 1% |
| R206 | 22 k Ω 1% |

Capacitors

| | |
|------|----------------|
| C201 | 22 pF |
| C202 | 220 pF |
| C203 | 68 pF |
| C204 | 10 μ F 25V |
| C205 | 1 nF |
| C206 | 68 pF 5% |
| C207 | 220 pF |

Trim capacitors

CT201 2-22pF

Diodes

| | |
|------|---------------|
| D201 | 1N 5404 |
| D202 | 1N 5404 |
| D203 | 5.6V Zener 2% |

Transistors

Q201 BC 547

Integrated circuits

| | |
|------|--------|
| U201 | 74HC74 |
| U202 | LM 318 |

Crystals

X201 2,4576 mHz

Switches

| | |
|------|------------|
| S201 | Alps SPPJ3 |
| S202 | Alps " |
| S203 | Alps " |

INTERNAL CONNECTIONS

| | |
|----|-------------------------|
| RA | 10 k Ω 1% |
| P1 | 10 k Ω lin Tokos |
| K3 | Speak-on NL-4MP |

Inductors

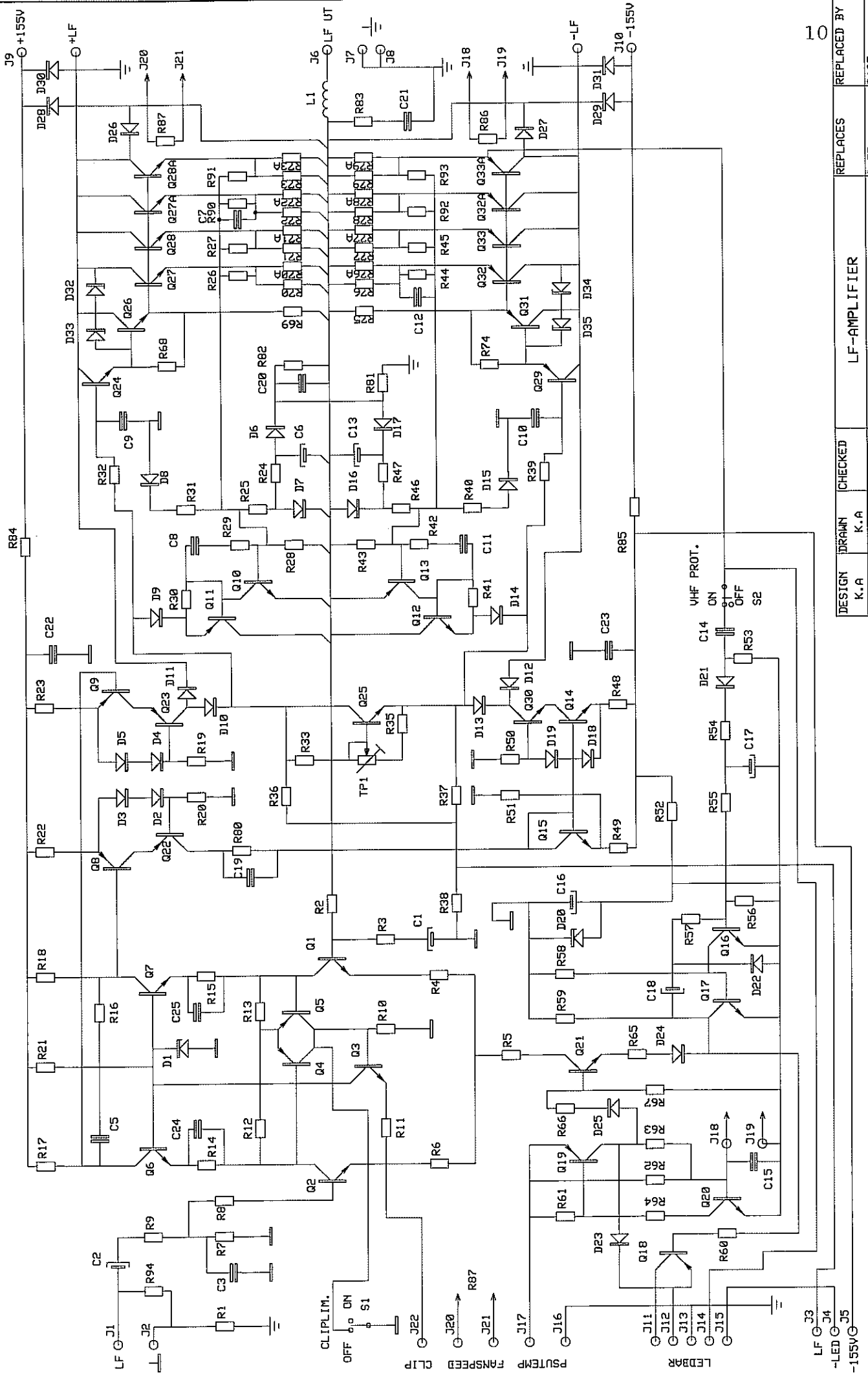
L1 9.5 μ H (2 core)
L2 9.5 μ H (2 core)

***Until 9902**

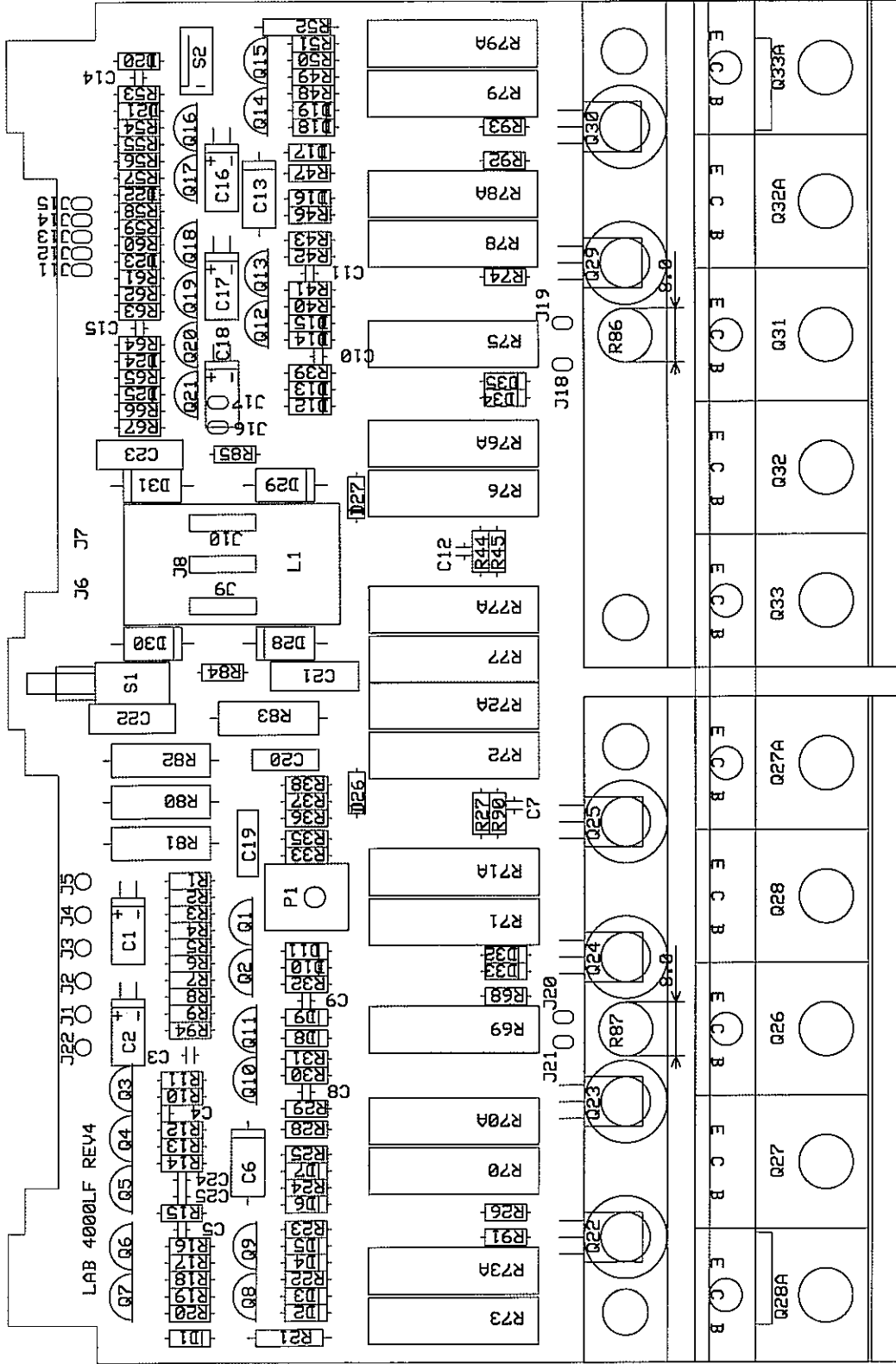
C6 470pF 5%
C7 470pF 5%
C8 680pF 5%
C9 220pF 5%

***Until 2001-06**

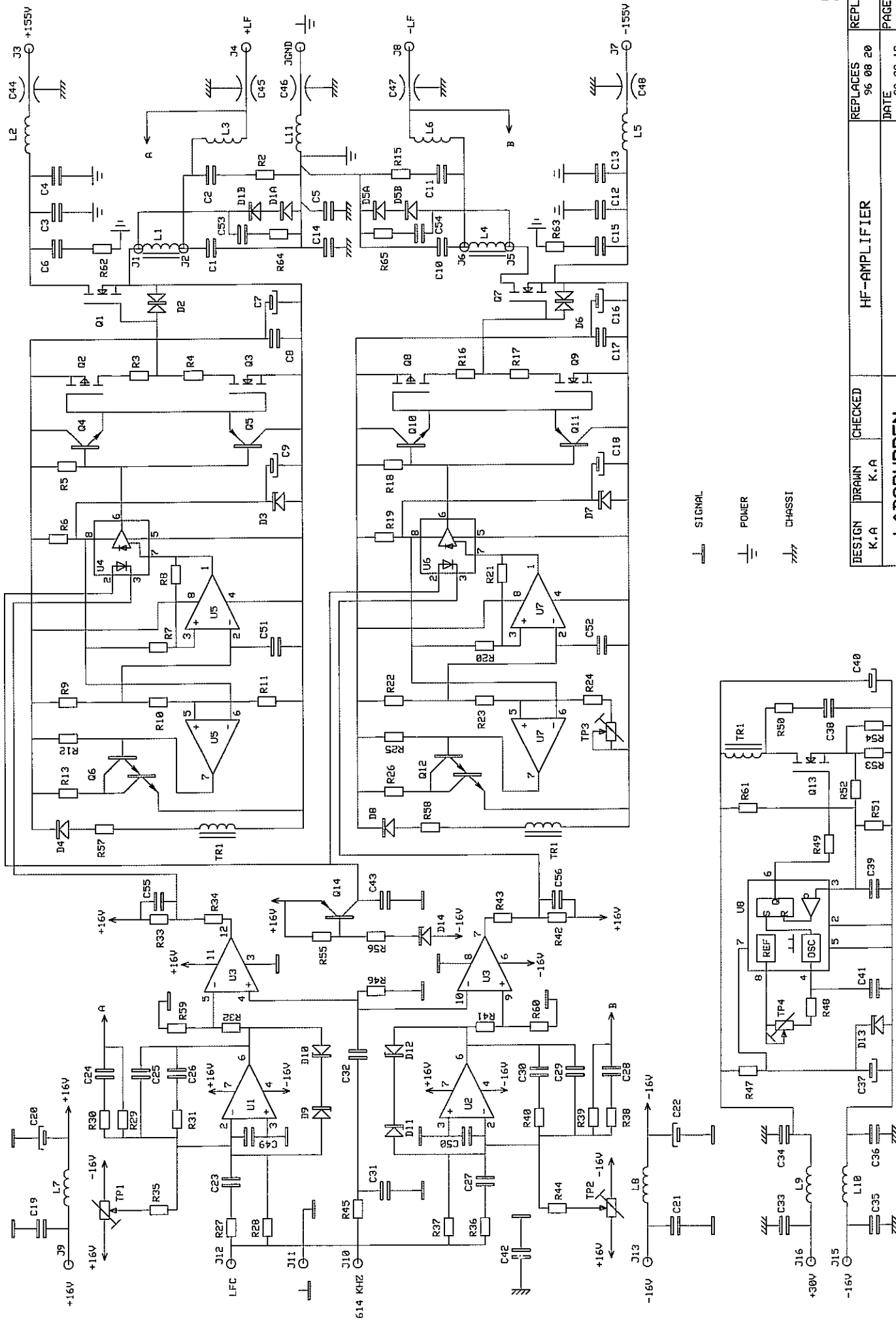
D1 HS10
R22 47 k Ω 1%
R25 47 k Ω 1%



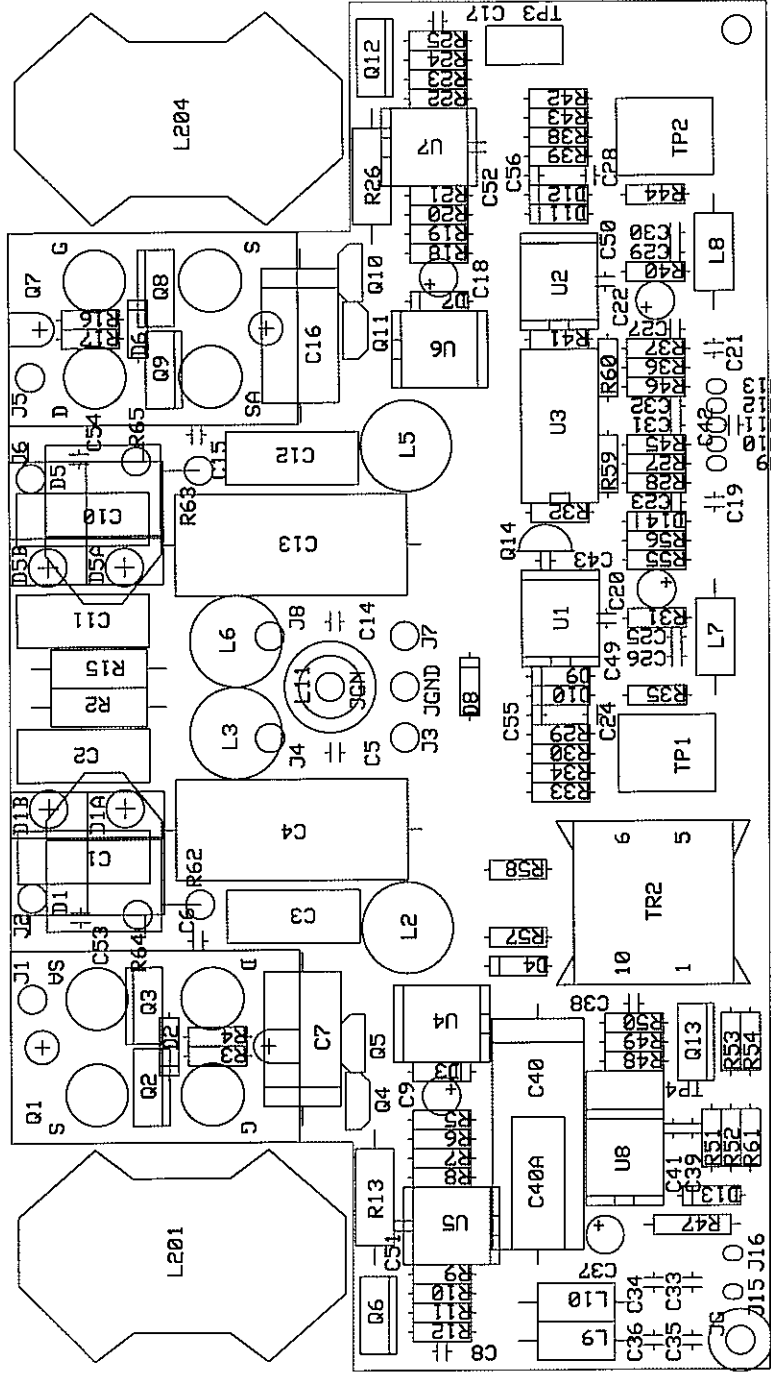
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| DESIGN | DRAWN | CHECKED | REPLACES | REPLACED BY |
| K.A | K.A | | LF-AMPLIFIER | |
| LABGRUPPEN | | | DATE | PAGE |
| KUNGSBACKA SWEDEN | | | 96 08 16 | |
| | | | DRAWING NO | 4KLF |



| | | | | | |
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| DESIGN | DRAWN | CHECKED | REPLACES | | REPLACED BY |
| K.A | K.A | K.A | LF AMPLIFIER | | |
| LABGRUPPEN | | | LAB2002 LAB4000 | | |
| KUNGSBACKA SWEDEN | | | DATE | 99 09 18 | PAGE |
| | | | DRAWING NO | | 4KLF4-P |



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| LABGRUPPEN KUNGSBACKA SMEDEN | | | DATE 99 09 18 | PAGE 4KHF |
| LAB 2002 4000 | | | DRAWING NO | |



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| DESIGN K.A | DRAWN K.A | CHECKED | HF AMPLIFIER | REPLACES | REPLACED BY |
| LABGRUPPEN KUNGSBACKA SWEDEN | | | LAB2002 LAB4000 | DATE 99 09 18 | PAGE |
| | | | | DRAWING NO | 4KHFR1-P |

LAB 4000

HF-AMPLIFIER

Component-list

Resistors

R1 -
 R2 2,2 Ω 2W on legs
 R3 4.7 Ω
 R4 1 Ω 1W on legs
 R5 680 Ω
 R6 47 Ω
 R7 2.2 kΩ 1%
 R8 22 kΩ
 R9 820 Ω
 R10 47 Ω
 R11 2.2 kΩ 1%
 R12 4.7 kΩ 1%
 R13 15 Ω 6W on legs
 R14 -
 R15 2,2 Ω 2W on legs
 R16 4.7 Ω
 R17 1 Ω 1W on legs
 R18 680 Ω
 R19 47 Ω
 R20 2.2 kΩ 1%
 R21 22 kΩ
 R22 820 Ω
 R23 47 Ω
 R24 1.8 kΩ 1%
 R25 4.7 kΩ 1%
 R26 15 Ω 6W on legs
 R27 1,5 kΩ 1%
 R28 1.8 kΩ 1%
 R29 27 kΩ 1%
 R30 2,2 kΩ 1%
 R31 6,8 kΩ 1%
 R32 4.7 kΩ
 R33 330 Ω
 R34 1.2 kΩ
 R35 56 kΩ 1%
 R36 1,5 kΩ 1%
 R37 1.8 kΩ 1%
 R38 2,2 kΩ 1%
 R39 27 kΩ 1%
 R40 6,8 kΩ 1%
 R41 4.7 kΩ 1%
 R42 330 Ω
 R43 1.2 kΩ
 R44 56 kΩ 1%
 R45 2.2 kΩ 1%
 R46 2.2 kΩ 1%
 R47 1,2 kΩ 3W
 R48 12 kΩ
 R49 47 Ω
 R50 27 Ω 1% on legs
 R51 1 kΩ 1%
 R52 1 kΩ 1%

R53 2.2 Ω
 R54 2.2 Ω
 R55 2.2 kΩ 1%
 R56 2.2 kΩ 1%
 R57 1 Ω 1W on legs
 R58 1 Ω 1W on legs
 R59 2.2 kΩ 1%
 R60 2.2 kΩ 1%
 R61 120 kΩ 1%
 R62 2.2 Ω 2W on legs
 R63 2.2 Ω 2W on legs
 R64 2.2 Ω 2W on legs
 R65 2.2 Ω 2W on legs

Trim potentiometers

TP1 25 kΩ
 TP2 25 kΩ
 TP3 1 kΩ
 TP4 10 kΩ

Capacitors

C1 0.33 μF 250V
 C2 0.33 μF 250V
 C3 0.33 μF 250V
 C4 4.7 μF 160V
 C5 1 μF 63V
 C6 4,7 nF 200V NPO
 C7 470 μF 10V
 C8 0.1 μF 63V
 C9 10 μF 50V
 C10 0.33 μF 250V
 C11 0.33 μF 250V
 C12 0.33 μF 250V
 C13 4.7 μF 160V
 C14 1 μF 63V
 C15 4,7 nF 200V NPO
 C16 470 μF 10V
 C17 0.1 μF 63V
 C18 10 μF 50V
 C19 0.1 μF 63V
 C20 10 μF 50V
 C21 0.1 μF 63V
 C22 10 μF 50V
 C23 2,2 nF 5%
 C24 100 pF 5%
 C25 39 pF 5%
 C26 270 pF 5%
 C27 2,2 nF 5%
 C28 100 pF 5%
 C29 39 pF 5%
 C30 270 pF 5%
 C31 68 pF

C32 1 nF
 C33 0.1 μF 63V
 C34 0.1 μF 63V
 C35 0.1 μF 63V
 C36 0.1 μF 63V
 C37 10 μF 50V
 C38 1 nF/100V/5/NPO
 C39 220 pF
 C40 2,2 μF 100V
 C41 1 nF NPO
 C42 0.1 μF 63V ker
 C43 -
 C44 1.5 nF feed
 through
 C45 1.5 nF feed
 through
 C46 1.5 nF feed
 through
 C47 1.5 nF feed
 through
 C48 1.5 nF feed
 through
 C49 220 pF
 C50 220 pF
 C51 1 nF
 C52 1 nF
 C53 470 pF 200V NPO
 C54 470 pF 200V NPO

Diodes

D1a BYW 81PI200
 D1b BYW 81PI200
 D2 BZW 06P15B
 D3 5.6V Zener 2%
 D4 BYV 100-100
 D5a BYW 81PI200
 D5b BYW 81PI200
 D6 BZW 06P15B
 D7 5.6V Zener 2%
 D8 BYV 100-100
 D9 12V Zener
 D10 12V Zener
 D11 12V Zener
 D12 12V Zener
 D13 18V Zener 1.3W
 D14 27V Zener

Transistors

Q1 IXFN 73N30
 Q2 MTP2955V
 Q3 BUZ 71
 Q4 ZTX 650
 Q5 ZTX 750
 Q6 Tip 120

Q7 IXFN 73N30
 Q8 MTP2955V
 Q9 BUZ 71
 Q10 ZTX 650
 Q11 ZTX 750
 Q12 Tip 120
 Q13 IRF 730
 Q14 BC 557

Integrated circuits

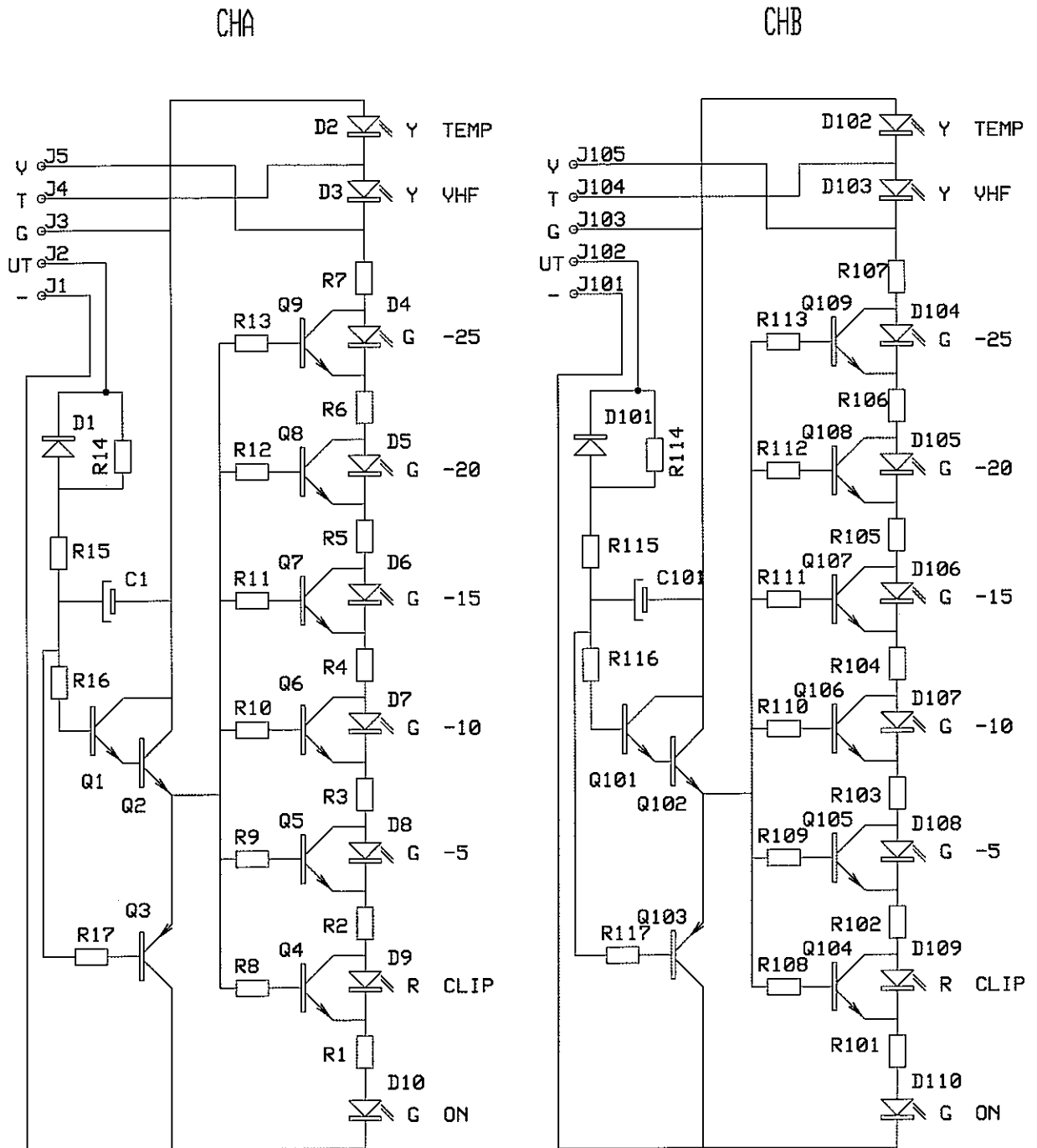
U1 LM 318
 U2 LM 318
 U3 LM 319
 U4 HCPL 2400
 U5 LM 393
 U6 HCPL 2400
 U7 LM 393
 U8 UC 3843

Inductors

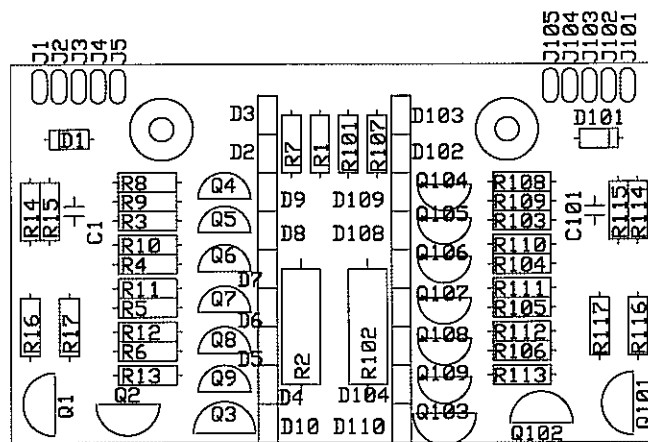
L1 14 μH
 L2 1 μH
 L3 1 μH
 L4 14 μH
 L5 1 μH
 L6 1 μH
 L7 47 μH
 L8 47 μH
 L9 47 μH
 L10 47 μH
 L11 1 μH

Transformers

TR1 EF20 N27



| DESIGN | DRAWN | CHECKED | LED.DISPLAY | REPLACES | REPLACED BY |
|---------------------------------|-------|---------|------------------------------------|------------|-------------|
| K.A | K.A | | | | |
| LABGRUPPEN KUNGSBACKA SWEDEN | | | LAB500 1000 1300 1600 2000 4000 | DATE | PAGE |
| | | | | 90 12 01 | |
| | | | | DRAWING NO | 2KLED |



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|---------------------------------|--------------|---------|------------------------------------|------------------|-------------|
| DESIGN K.A | DRAWN K.A | CHECKED | LED DISPLAY | REPLACES | REPLACED BY |
| LABGRUPPEN KUNGSBACKA SWEDEN | | | | DATE 99 09 18 | PAGE |
| | | | LAB500 1000 1300 1600 2000 4000 | DRAWING NO | LEDRA-P |

LAB 500 – 2002C

LED DISPLAY

Component-list

Channel A
(Ch. B add 100)

Resistors

R1 see below
 R2 2.7 k Ω 3W
 R3 1.2 k Ω 1W
 R4 680 Ω
 R5 330 Ω
 R6 120 Ω
 R7 220 Ω
 R8 33 k Ω
 R9 33 k Ω
 R10 33 k Ω
 R11 33 k Ω
 R12 33 k Ω
 R13 33 k Ω
 R14 33 k Ω
 R15 100 Ω 1%
 R16 2.7 k Ω
 R17 2.7 k Ω

Capacitors

C1 4.7 μ F 100V

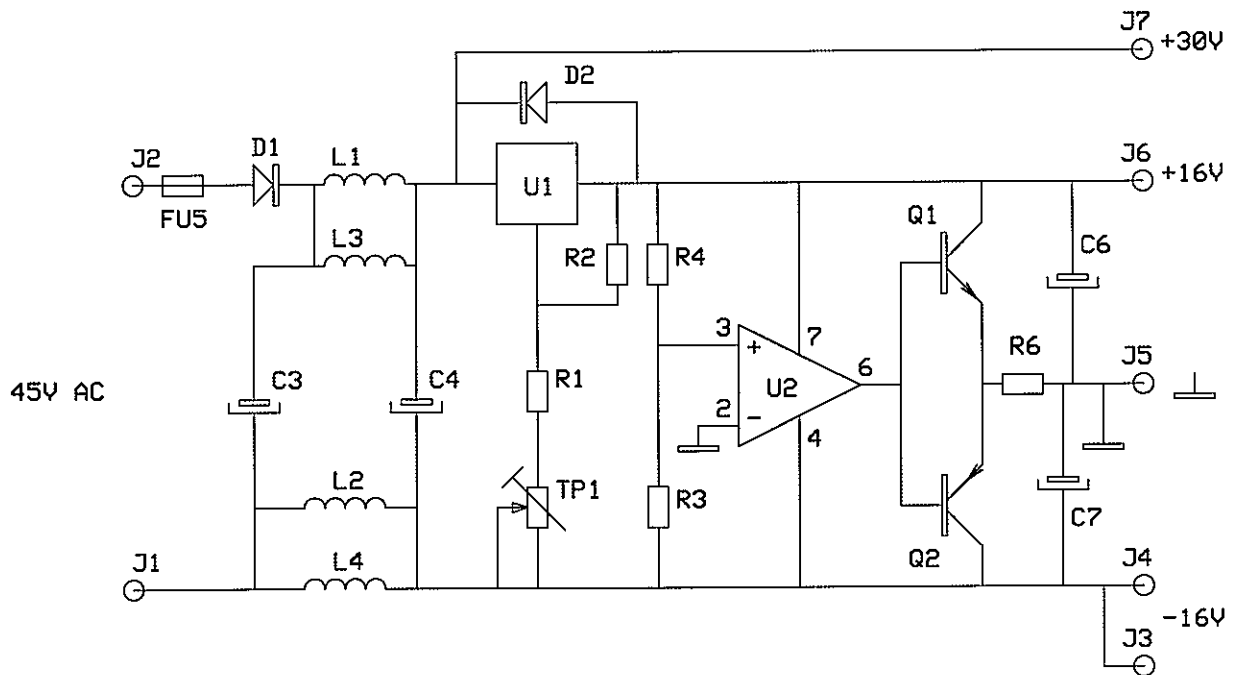
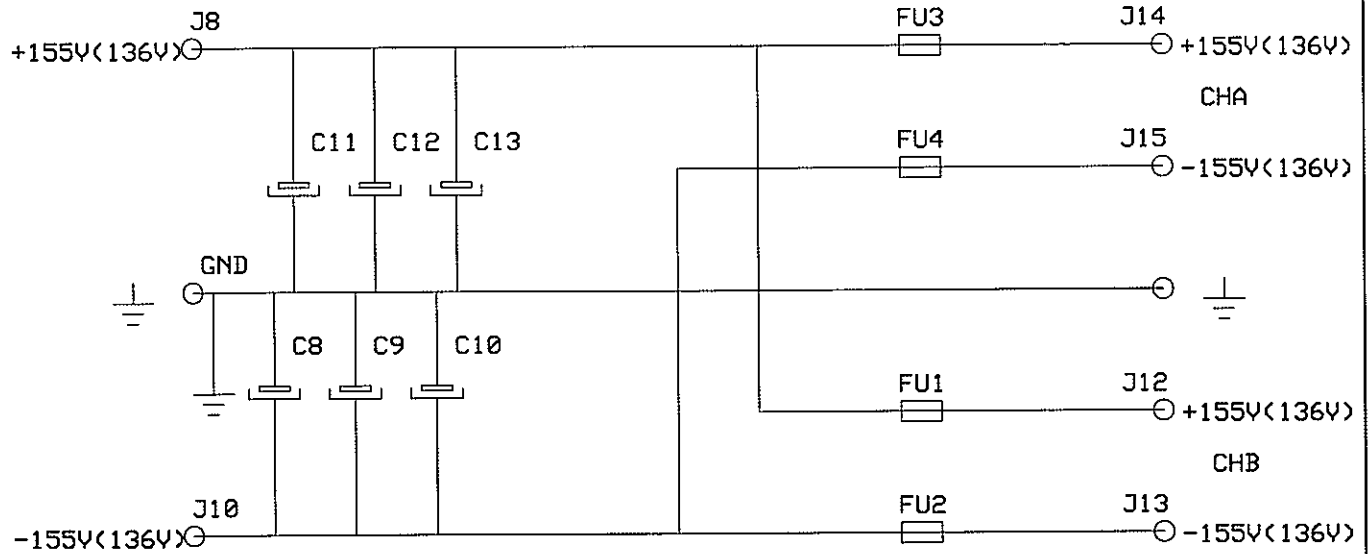
Diodes

D1 1N 4004
 D2 Led Y
 D3 Led Y
 D4 Led G
 D5 Led G
 D6 Led G
 D7 Led G
 D8 Led G
 D9 Led R
 D10 Led G

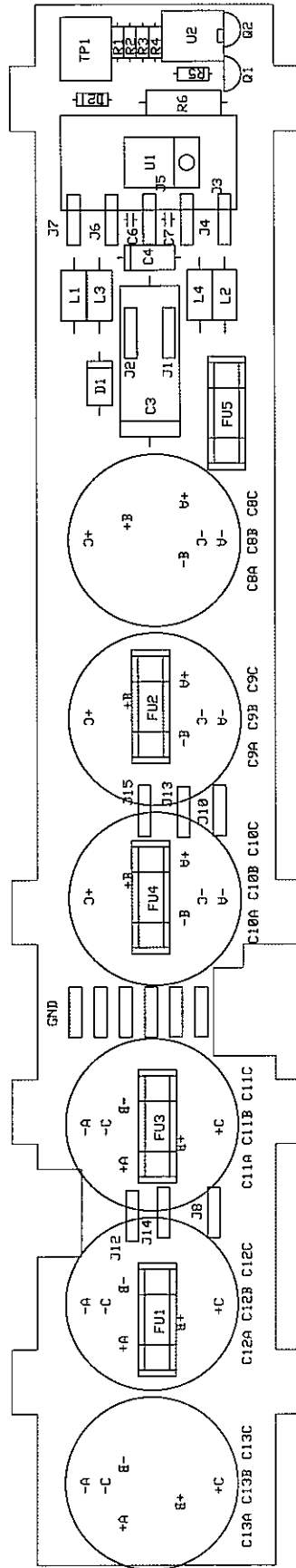
Transistors

Q1 MPSA 42
 Q2 MPSA 42
 Q3 MPSA 92
 Q4 BC 547
 Q5 BC 547
 Q6 BC 547
 Q7 BC 547
 Q8 BC 547
 Q9 BC 547

| | 500 | 1000 | 1300C | 1600 | 2000 |
|----|----------------|--------------|--------------|--------------|---------------------------|
| R1 | 1,5 k Ω | 820 Ω | 680 Ω | 680 Ω | 680 Ω 1% long legs |



| | | | | | |
|---------------------------------|--------------|---------|--------------------------------|------------------|-------------|
| DESIGN K.A | DRAWN K.A | CHECKED | FUSE-BOARD VOLTAGESTABB.-BOARD | REPLACES | REPLACED BY |
| LABGRUPPEN KUNGSBACKA SWEDEN | | | LAB 2002 4000 | DATE 96 08 01 | PAGE |
| | | | | DRAWING NO | 4KFU |



| | | | | |
|---------------------------------|--------------|---------|--|-------------|
| DESIGN K.A | DRAWN K.A | CHECKED | REPLACES FUSE BOARD, VOLTAGE STABB. BOARD | REPLACED BY |
| LABGRUPPEN KUNGSBACKA SWEDEN | | | DATE 99 09 18 | PAGE |
| | | | DRAWING NO LAB2000 2002 4000 | 2KFUC-P |

LAB 2002 4000

FUSE, VOLTAGESTABB. BOARD

component-list

Resistors

R1 5.6 k Ω
 R2 270 Ω
 R3 10 k Ω 1%
 R4 10 k Ω 1%
 R5 1 k Ω
 R6 150 Ω 3W

Trim potentiometers

TP1 2.5 k Ω

Capacitors

C1 -
 C2 -
 C3 470 μ F 100V (ASM021)
 C4 22 μ F 100V (ASM021)
 C5 -
 C6 22 μ F 50V
 C7 22 μ F 50V
 C8 2200 μ F 160V
 C9 2200 μ F 160V
 C10 2200 μ F 160V
 C11 2200 μ F 160V
 C12 2200 μ F 160V
 C13 2200 μ F 160V

Diodes

D1 BYW 98-200
 D2 1N 4004

Transistors

Q1 BC 337
 Q2 BC 327

Integrated circuits

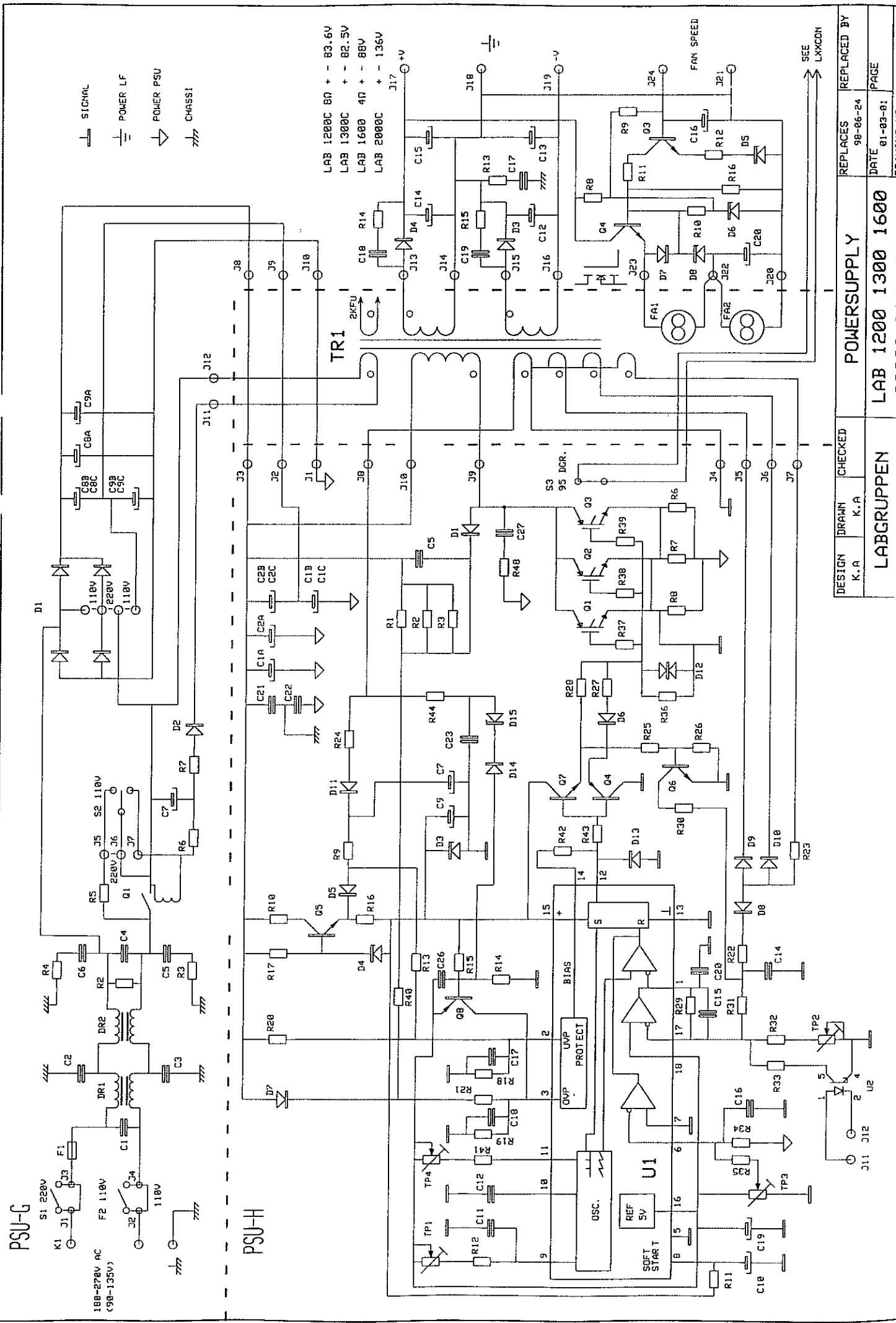
U1 LM 317
 U2 UA 741

Fuses

FU1 F 15A
 FU2 F 15A
 FU3 F 15A
 FU4 F 15A

Inductors

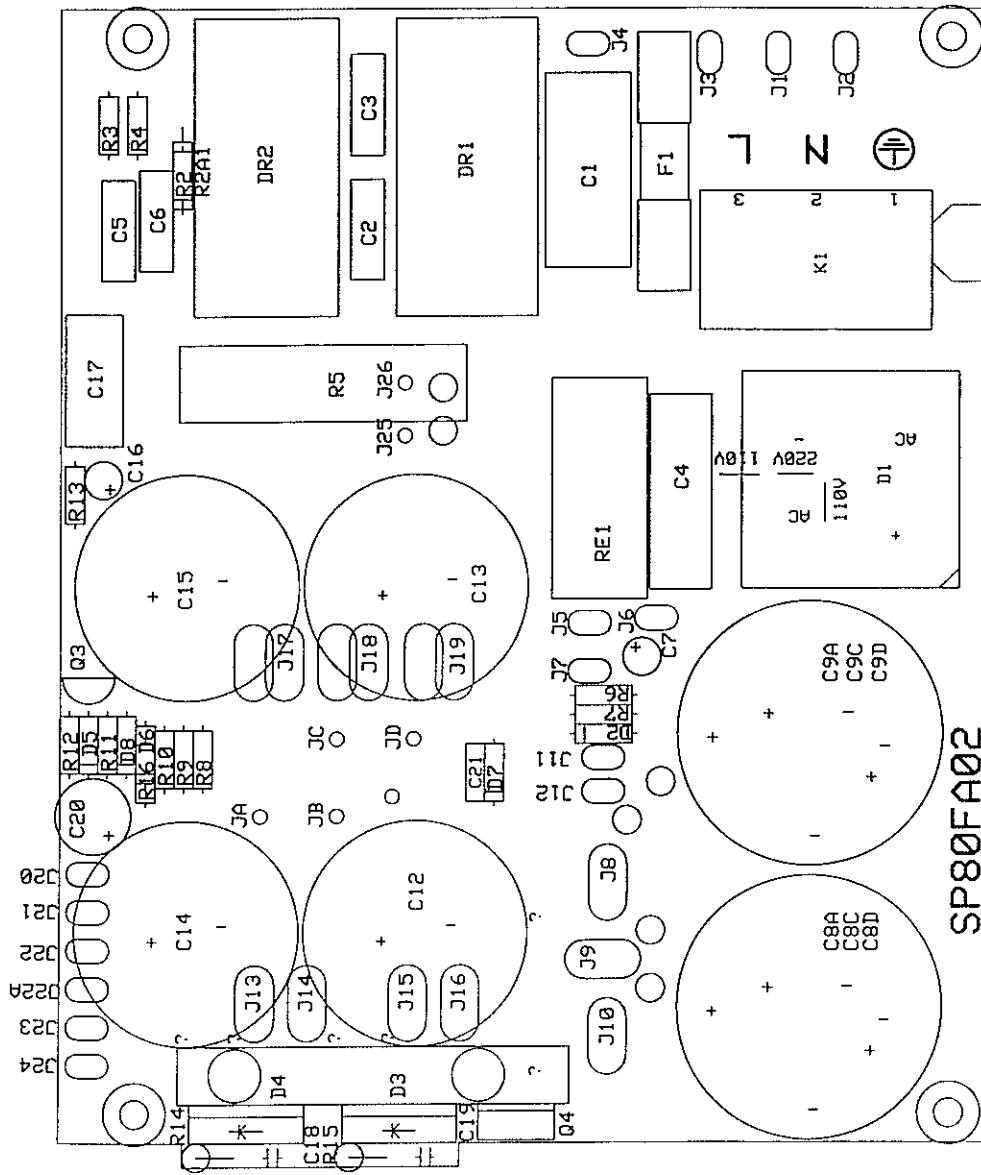
L1 47 μ H
 L2 47 μ H
 L3 47 μ H
 L4 47 μ H



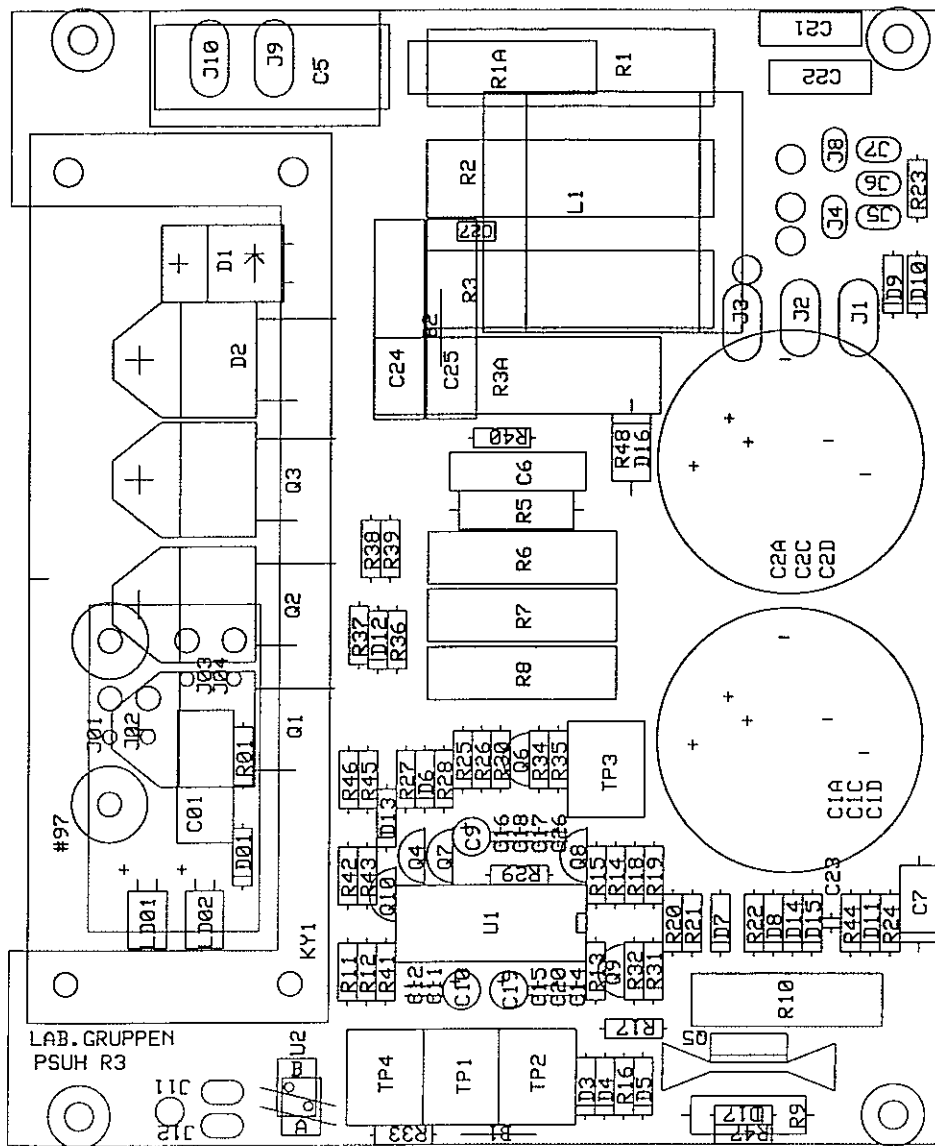
┌ SIGNAL
 ┆ POWER LF
 ▸ POWER PSU
 ┕ CHASSI

LAB 1200C 80 + - 83.6V
 LAB 1300C + - 82.5V
 LAB 1600 40 + - 88V
 LAB 2000C + - 135V

| | | | | | |
|------------|-------|---------|--------------|--------------------|-------------|
| DESIGN | DRAMM | CHECKED | POWER SUPPLY | REPLACES | REPLACED BY |
| K.A | K.A | | | 98-06-24 | |
| LABGRUPPEN | | | | LAB 1200 1300 1600 | DATE |
| | | | | 01-03-01 | PAGE |
| | | | | | 1/1 |



| | | | | | |
|---------------------------------|--------------|---------|---|----------------------|-------------|
| DESIGN K.A | DRAWN K.A | CHECKED | POWER SUPPLY SP80FA | REPLACES 01 04 13 | REPLACED BY |
| LABGRUPPEN KUNGSBACKA SWEDEN | | | LAB 1200 1300 1600 2000C 2002 4000 PSU48 | DATE 01 05 04 | PAGE |
| | | | | DRAWING NO | SP80FA02-P |



LAB. GRUPPEN
PSUH R3

| | | | | | | |
|-------------------|-------|---------|-----------------------|--|------------|-------------|
| DESIGN | DRAWN | CHECKED | POWER SUPPLY H | | REPLACES | REPLACED BY |
| K.A | K.A | | LAB 1200 1300 1600 | | 99 09 18 | |
| LABGRUPPEN | | | 2000C 2002 4000 PSU48 | | DATE | PAGE |
| KUNGSBACKA SWEDEN | | | | | 00 03 02 | |
| | | | | | DRAWING NO | PSUHR3-P |

POWER SUPPLY, BOARD PSUG

component-list

Resistors

R1-
 R2 1 M Ω 1%
 R3 33 Ω
 R4 33 Ω
 R5# 47 Ω 9W
 R6 33 Ω
 R7 2.2 Ω 1W
 R8 See below
 R9 See below
 R10 See below
 R11 See below
 R12 See below
 R13 4.7 Ω
 R14 See below
 R15 See below
 R16 See below

Capacitors

C1 0.47 μ F
 C2# 1.5 nF Y
 C3# 1.5 nF Y
 C4 0.22 μ F
 C5# 1.5 nF Y
 C6# 1.5 nF Y
 C7 100 μ F 50V
 C8a# See below
 C9a# See below

C12 See below
 C13 See below
 C14 See below
 C15 See below
 C16 22 μ F 16V
 C17 2.2 μ F 63V
 C18 See below
 C19 See below
 C20 See below
 C21 See below

Diodes

D1 600V 35A
 D2 BYW26C
 D3 STTB3006PI
 D4 STTB3006PI
 D5 5.6V Zener
 D6 See below
 D7 See below
 D8 See below

Transistors

Q3 BC 546
 Q4 See below

Relays

RE1 FEME MZF 0014816

Fuses

FU1 See below

Coils

DR1# See below
 DR2# See below

Switches

S1# See below
 S2# See below
 S3 Comepa 4JT95 ARIUI 95 $^{\circ}$ C

Relays

RE1 FEME MZF 0014816

Socket

K1 MKDSP10/3-10,16

110V AC

R5 22 Ω 9W
 C2 2,2 nF Y
 C3 2,2 nF Y
 C5 2,2 nF Y
 C6 2,2 nF Y

* Until 9708
 Q4 BDX53F
 D7 -
 D8 -

POWER SUPPLY, BOARD PSUG

| | LAB 1200C | LAB 1300C | LAB 1600 | LAB 2000C | LAB 4000 | PSU48-8 |
|-----|---------------------|----------------------------|---------------------|--------------------|---------------------------|-------------------|
| R8 | 4.7 k Ω 1% | Jumper | 8.2 k Ω 1% | Jumper | 27 k Ω 1% long leg | 4,7 k Ω 1% |
| R9 | 1 M Ω | 470 k Ω | 150 k Ω | 390 k Ω | 180 k Ω 1% | 470 k Ω |
| R10 | 39 k Ω 1% | 4.7 k Ω 1% long leg | 39 k Ω 1% | 47 k Ω 1% | 39 k Ω 1% | 10 k Ω 1% |
| R11 | 18 k Ω 1% | 1.8 k Ω | 18 k Ω 1% | 6.8 k Ω | 18 k Ω 1% | 4,7 k Ω 1% |
| R12 | 4.7 k Ω 1% | Jumper | 4.7 k Ω | 1.8 k Ω | 4.7 k Ω 1% | Jumper |
| R14 | 2.2 Ω 2W | - | 2.2 Ω 2W | - | - | - |
| R15 | 2.2 Ω 2W | - | 2.2 Ω 2W | - | - | - |
| R16 | - | 18 k Ω 1% | - | 39 k Ω 1% | - | - |
| C8a | 220uF 385V | 220uF 385V | 220uF 385V | 220uF 385V | - | 220uF 385V |
| C9a | 220uF 385V | 220uF 385V | 220uF 385V | 220uF 385V | - | 220uF 385V |
| C8b | - | - | - | - | 1500 uF 200V | - |
| C9b | - | - | - | - | 1500 uF 200V | - |
| C12 | 3900 uF 100V | 3900 uF 100V | 3900 uF 100V | 1800 uF 160V | 1800 uF 160V | 3900 uF 100V |
| C13 | 3900 uF 100V | 3900 uF 100V | 3900 uF 100V | 1800 uF 160V | 1800 uF 160V | 3900 uF 100V |
| C14 | 3900 uF 100V | 3900 uF 100V | 3900 uF 100V | 1800 uF 160V | 1800 uF 160V | 3900 uF 100V |
| C15 | 3900 uF 100V | 3900 uF 100V | 3900 uF 100V | 1800 uF 160V | 1800 uF 160V | 3900 uF 100V |
| C18 | 4.7 nF 400V | - | 4.7 nF 400V | - | - | - |
| C19 | 4.7 nF 400V | - | 4.7 nF 400V | - | - | - |
| C20 | 100 uF 50V | 100 uF 50V | 100 uF 50V | 100 uF 50V | 100 uF 50V | - |
| C21 | - | - | - | 680 pF/400V | 680 pF/400V | - |
| D6 | 62 V \pm 2% Zener | - | 62 V \pm 2% Zener | - | 62 V \pm 2% Zener | 27V Zener |
| D7 | - | - | - | 15V Zener | 15V Zener | - |
| D8 | - | - | - | 39V \pm 2% Zener | 39V \pm 2% Zener | - |
| Q4 | TIP132 | TIP41 | TIP132 | *IRF730 | *IRF730 | BDX53F |
| F1 | T10AH250V | T8AH250V | T10AH250V | T10AH250V | T15AH250V | T10AH250V |
| DR1 | 2.7mH 8A 220V | 2.7mH 8A 220V | 2.7mH 8A 220V | 2.7mH 8A 220V | 1.4mH 16A 110V | 2.7mH 8A 220V |
| DR2 | 2.7mH 8A 220V | 2.7mH 8A 220V | 2.7mH 8A 220V | 2.7mH 8A 220V | 1.4mH 16A 110V | 2.7mH 8A 220V |
| S1 | 8550VB | 8550VB | 8550VB | 8550VB | Jumper | 8550VB |
| S2 | - | - | - | - | H8610VBBB | - |
| B1 | JB-JC, D1,2 | - | - | - | - | - |
| B2 | - | - | - | - | - | JA-JB, D1,2 |
| B3 | - | - | - | - | - | JC-JD, D1,2 |
| B4 | J5-J6 | J5-J6 | J5-J6 | J5-J6 | - | J5-J6 |
| B5# | Rectifier 220V | Rectifier 220V | Rectifier 220V | Rectifier 220V | Rectifier 220V | Rectifier 220V |

110V

| | | | | | | |
|------|----------------|----------------|----------------|----------------|----------------|----------------|
| C8b# | 1500 uF 200V | 1500 uF 200V | 1500 uF 200V | 1500 uF 200V | - | 1500 uF 200V |
| C9b# | 1500 uF 200V | 1500 uF 200V | 1500 uF 200V | 1500 uF 200V | - | 1500 uF 200V |
| C8d# | - | - | - | - | 2200 uF 200V | - |
| C9d# | - | - | - | - | 2200 uF 200V | - |
| F1# | T20A | T20A | T20A | T20A | T30A | T20A |
| DR1# | 1.4mH16A110V | 1.4mH16A110V | 1.4mH16A110V | 1.4mH16A110V | 1.4mH25A110V | 1.4mH16A110V |
| DR2# | 1.4mH25A110V | 1.4mH16A110V | 1.4mH16A110V | 1.4mH16A110V | 1.4mH25A110V | 1.4mH16A110V |
| S1 | Jumper | Jumper | Jumper | Jumper | Jumper | Jumper |
| S2# | H8610VBBB | H8610VBBB | H8610VBBB | H8610VBBB | H8610VBBB | H8610VBBB |
| B5 | Rectifier 110V | Rectifier 110V | Rectifier 110V | Rectifier 110V | Rectifier 110V | Rectifier 110V |
| B6 | Rectifier 110V | Rectifier 110V | Rectifier 110V | Rectifier 110V | Rectifier 110V | Rectifier 110V |

POWER SUPPLY, BOARD PSUH

component-list

Resistors

R1 See below
 R2 See below
 R3 See below
 R4 -
 R5 See below
 R6 0.1 Ω 4W
 R7 0.1 Ω 4W
 R8 0.1 Ω 4W
 R9 See below
 R10 4.7 k Ω 5W
 R11 680 k Ω 5%
 R12 33 k Ω 1%
 R13 100 k Ω 1%
 R14 10 k Ω 1%
 R15 18 k Ω 1%
 R16 180 Ω 1%
 R17 120 k Ω 2W
 R18# 8.2 k Ω 1% (110V see below)
 R19 See below
 R20 432 k Ω 1% highvolt
 R21 750 k Ω 1%
 R22 4.7 Ω
 R23 See below
 R24 4.7 Ω
 R25 15 k Ω 1%
 R26 1 k Ω 1%
 R27 See below
 R28 82 Ω
 R29 4.7 M Ω
 R30 See below
 R31 220 k Ω 1%
 R32 See below
 R33 See below
 R34 See below
 R35 See below
 R36 15 k Ω 1%
 R37 See below
 R38 See below
 R39 See below
 R40 See below
 R41 18 k Ω 1%
 R42* -
 R43* Jumper
 R44 See below
 R45 See below
 R46 See below
 R47 See below
 R48 See Below

Capacitors

C1a# See below
 C2a# See below
 C5 0.68 μ F 250V
 C6 -
 C7 10 μ F 63V
 C8 -
 C9 10 μ F 50V
 C10 22 μ F 50V
 C11* 470 pF NPO
 C12 1 nF
 C13 -
 C14 10 nF
 C15 See below
 C16 330 pF
 C17 -
 C18 1 nF
 C19 10 μ F 50V
 C20 -
 C21# 1.5 nF Y
 C22# 1.5 nF Y
 C23 1 nF
 C24 See below
 C25 See below
 C26 1 nF
 C27 See Below

Diodes

D1 BYT 12PI 1000
 D2 See below
 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
 D13 BAT 85
 D14 1N 4148
 D15 See below
 D16 See below
 D17 See below

Trim potentiometers

TP1 10 k Ω
 TP2 25 k Ω
 TP3 10 k Ω
 TP4* 15 k Ω Resistor

Integrated circuits

U1 UC 3851 alt. UC 3841
 U2 See below

Transistors

Q1 See below
 Q2 See below
 Q3 See below
 Q4 BC 327
 Q5 TIP 50
 Q6 BC 547
 Q7* Jumper b-e
 Q8 BC 557
 Q9 See below
 Q10 See below

Switches

S2 Temp switch 95°

Inductors

L1 See below

Jumpers

B1 See below
 B2 See below

110V

C1b See below
 C2b See below
 C21 2,2nF Y
 C22 2,2nF Y
 R18 10k Ω 1%

* UC3841

R42 4.7 k Ω
 R43 82 Ω
 TP4 10 k Ω
 C11 1 nF
 Q7 BC 337

POWER SUPPLY, BOARD PSUH

| | LAB 1200C | LAB 1300C | LAB 1600 | LAB 2000C | LAB 4000 | PSU 48-8 |
|-----------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| R1 | 18 k Ω 9W | 18 k Ω 9W | 18 k Ω 9W | 18 k Ω 9W | 33 k Ω 9W | 18 k Ω 9W |
| R2 | 18 k Ω 9W | 18 k Ω 9W | 18 k Ω 9W | 18 k Ω 9W | - | 18 k Ω 9W |
| R3 | 18 k Ω 9W | 18 k Ω 9W | 18 k Ω 9W | 18 k Ω 9W | - | 18 k Ω 9W |
| R5 | - | - | - | - | 330 Ω 2W | - |
| R9 | 1.5 k Ω 2W | 1.5 k Ω 2W | 1.5 k Ω 2W | 1.5 k Ω 2W | 1 k Ω 3W | 1.5 k Ω 2W |
| R19 | 5.62 k Ω 1% | 5.62 k Ω 1% | 5.62 k Ω 1% | 5.62 k Ω 1% | 5.9 k Ω 1% | 5.62 k Ω 1% |
| R23 | 8,2 k Ω 1% | 6.8 k Ω 1% | 6.8 k Ω 1% | 6.8 k Ω 1% | 6.8 k Ω 1% | 10 k Ω 1% |
| R27 | 4.7 Ω | 4.7 Ω | 4.7 Ω | 4.7 Ω | jumper | 4.7 Ω |
| R30 | 56 k Ω 1% | 56 k Ω 1% | 56 k Ω 1% | 56 k Ω 1% | 180 k Ω 1% | 56 k Ω 1% |
| R32 | 133 k Ω 1% | 88.7 k Ω 1% | 169 k Ω 1% | 88.7 k Ω 1% | 88.7 k Ω 1% | - |
| R33 | 270 k Ω 1% | - | 330 k Ω 1% | - | 1 k Ω 1% | - |
| R34 | 2,2 k Ω 1% | 2,0 k Ω 1% | 2,2 k Ω 1% | 2,2 k Ω 1% | 2,4 k Ω 1% | - |
| R35 | 4.7 k Ω 1% | 4.7 k Ω 1% | 4.7 k Ω 1% | 4.7 k Ω 1% | 3,3 k Ω 1% | 4.7 k Ω 1% |
| R37 | 4.7 Ω | 4.7 Ω | 4.7 Ω | 4.7 Ω | 2.2 Ω | - |
| R38 | 4.7 Ω | 4.7 Ω | 4.7 Ω | 4.7 Ω | 2.2 Ω | 4.7 Ω |
| R39 | 4.7 Ω | 4.7 Ω | 4.7 Ω | 4.7 Ω | 2.2 Ω | 4.7 Ω |
| R40 | 1 M Ω 1% | 1 M Ω 1% | 1 M Ω 1% | 1 M Ω 1% | 1,2 M Ω 1% | 1 M Ω 1% |
| R44 | 470 Ω | 470 Ω | 470 Ω | 470 Ω | 560 Ω | 470 Ω |
| R45 | - | - | - | - | 698 Ω 1% | - |
| R46 | - | - | - | - | 196 Ω 1% | - |
| R47 | - | - | - | - | 820 Ω | - |
| R48 | 2,2 Ω 2W | 2,2 Ω 2W | 2,2 Ω 2W | 2,2 Ω 2W | - | 2,2 Ω 2W |
| C1a# | 220 uF 385V | 220 uF 385V | 220 uF 385V | 220 uF 385V | - | 220 uF 385V |
| C2a# | 220 uF 385V | 220 uF 385V | 220 uF 385V | 220 uF 385V | - | 220 uF 385V |
| C1b# | - | - | - | - | 1500 uF 200V | - |
| C2b# | - | - | - | - | 1500 uF 200V | - |
| C6 | - | - | - | - | 1 nF 1.5 kV | - |
| C15 | 330 pF | 330 pF | 330 pF | 330 pF | 330 pF | 1 nF |
| C24 | - | - | - | - | 22 nF 1kV | - |
| C25 | - | - | - | - | 22 nF 1kV | - |
| C27 | 100pF/1600V | 100pF/1600V | 100pF/1600V | 100pF/1600V | - | 100pF/1600V |
| D2 | - | - | - | - | STTA 1512PI | - |
| D15 | 43V 2% Zener | 43V 2% Zener | 39V 2% Zener | 43V 2% Zener | 43V 2% Zener | 30V 2% Zener |
| D16 | - | - | - | - | BYM 26E | - |
| D17 | - | - | - | - | 1N4148 | - |
| Q1 | BUP 307 | BUP 307 | BUP 307 | BUP 307 | BUP 314S | BUP 307 |
| Q2 | BUP 307 | BUP 307 | BUP 307 | BUP 307 | BUP 314S | - |
| Q3 | BUP 307 | BUP 307 | BUP 307 | BUP 307 | BUP 314S | - |
| Q9 | Jumper b-c | - | Jumper b-c | - | BC557 | - |
| Q10 | - | - | - | - | BC547 | - |
| U2 | PC 113 | - | PC 113 | - | Jumper 1-5 | PC 113 |
| U2 | - | - | - | - | Jumper 2-4 | - |
| L1 | - | - | - | - | 400 uH LAB | - |
| B1 | - | - | - | - | - | jumper |
| B2 | - | - | - | - | - | jumper |
| # 110V | | | | | | |
| C1b# | 1500 uF 200V | 1500 uF 200V | 1500 uF 200V | 1500 uF 200V | - | 1500 uF 200V |
| C2b# | 1500 uF 200V | 1500 uF 200V | 1500 uF 200V | 1500 uF 200V | - | 1500 uF 200V |
| C1d# | - | - | - | - | 2200 uF 200V | - |
| C2d# | - | - | - | - | 2200 uF 200V | - |
| R18 | 10 k Ω 1% | 10 k Ω 1% | 10 k Ω 1% | 10 k Ω 1% | - | - |
| AFS IND. | | | | | | |
| R01 | - | - | - | - | 4,7 k Ω 1% | - |
| C01 | - | - | - | - | 0,1uF 400V | - |
| D01 | - | - | - | - | 1N4148 | - |
| LD01 | - | - | - | - | green 2,5x5mm | red 2,5x5mm |
| LD02 | - | - | - | - | red 2,5x5mm | green 2,5x5mm |