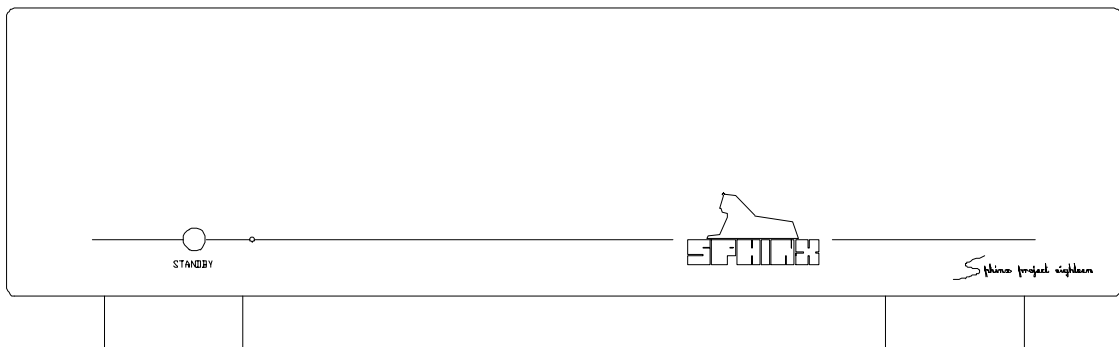


SERVICE MANUAL

PROJECT EIGHTEEN

TRUE DUAL MONO POWER AMPLIFIER



SPHINX Project Eighteen Service Manual

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The Sphinx Project Eighteen design

The Sphinx Project Eighteen was designed for the ever-increasing group of quality-conscious audiophiles.

We are very proud of the tradition connected with the SPHINX name, especially concerning audio quality perfection.

This service manual will help you to optimally service and repair the Sphinx Project Eighteen True Dual Mono Power Amplifier.

The power amp handles the largest signal peaks and transients with ease, and has no problem with any size and type of loudspeaker load: even the most demanding.

These characteristics are the result of several new technologies and components. For instance the unique power supply which assures a stable and noise free operation. The special toroidal transformer (one for each channel!) of 650 VA has the size of a 1000 VA model: safely over-specified. Thanks to the generous energy reserve of 66,000 μF (formed by 30 capacitors in parallel), unlimited power is available for the largest signal peaks.

Furthermore there are three completely separate power supplies for the input section, driver section and the logic and indicator section.

Much attention has also been paid to the physical layout, the positioning of components and the internal grounding. This results in a equivalent input noise value of $<1 \mu\text{V}$ ($<-120 \text{ dBV}$): remarkable for a pre-amp, but really astounding for a big power amp with two transformers.

All of this means that the Project Eighteen can work with all kind of loads from every loudspeaker: even the most difficult ones like electrostatic and magnetostatic...

To obtain the maximum quality from this power amp it is necessary to use it with top quality audio components preferably with other Sphinx components.

Please also refer to the User Manual of the Project Eighteen for information about functions not described in this manual. It is important to familiarise yourself with the special functions, operation and possibilities of the Sphinx Project Eighteen.

1. UNPACKING

Before leaving the factory every Project Eighteen is subjected to stringent and extensive technical and exterior quality inspections. This ensures the user many years of high quality audio from a perfect-looking product.

Attention: The power amp weighs over 24 kg! Never lift it out of the box without someone helping you.

We recommend owners to ship the Project Eighteen in its original carton.

After unpacking the Project Eighteen we therefore recommend you carefully check it for any transport damage.

If you find any damage and the product has not been shipped in the original carton the ensuing repair costs will not be covered by the warranty.

2. SPHINX WARRANTY CARD

To be entitled to any warranty repairs the owner must have send the filled out warranty card to Sphinx or a distributor where it has been registered. Other regulations may apply in your specific country: when in doubt, please consult the proper authorities.

3. CONTACTING THE MANUFACTURER

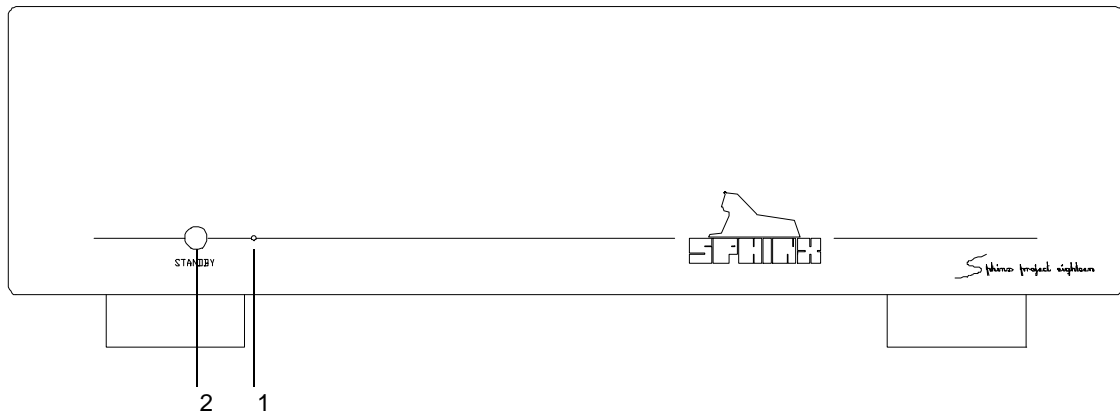
In case of any problem not covered in this manual or if you have other questions you may contact the **Sphinx International Service Department** in The Netherlands (local time: GMT +1h) during office hours at the following numbers:

Telephone	(+31) 35 602 0302
Fax	(+31) 35 602 2806
E-mail	audionl@euronet.nl

It is always very helpful and efficient if you have all relevant information about the specific product and the problem ready.

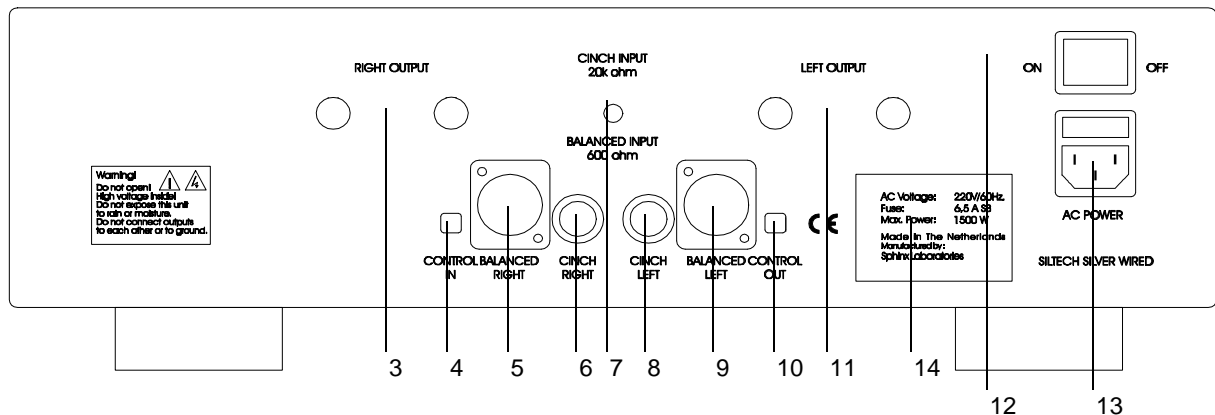
4. THE POWER AMP AT A GLANCE

Front panel



1. **LED:** Indicates the selected function:
stand-by red
on green
2. **STANDBY:** To switch the component on and off.

Rear panel



3. **RIGHT OUTPUT:** To connect the cable from the right loudspeaker:
red +
white -
4. **CONTROL IN:** To connect the optical cable from another Sphinx component like a pre-amp.
5. **BALANCED RIGHT:** To connect the XLR cable (balanced cable) from the right output of the signal source.
6. **CINCH RIGHT:** To connect the cinch cable from the right output of the signal source.
7. **CINCH/BALANCED INPUT:** With this switch you may select between the inputs:
up unbalanced (6 and 8)
down balanced (5 and 9)
8. **CINCH LEFT:** To connect the cinch cable from the left output of the signal source.
9. **BALANCED LEFT:** To connect the XLR cable (balanced cable) from the left output of the signal source.
10. **CONTROL OUT:** To connect the optical cable going to another Sphinx component.
11. **LEFT OUTPUT:** To connect the cable from the left loudspeaker:
red +
white -
12. **ON/OFF:** This is the mains power switch.
13. **AC POWER:** Connect the power amp to a mains outlet (230 - 240 VAC).
The mains fuse is placed behind the cover.
14. **Manufacturer's label:** This shows important data for the component, such as serial number and mains power voltage.

5. TECHNICAL SPECIFICATIONS

Bandwidth	0 – 100,000 Hz (+0/-1 dB)
Phase response error	<1° (0 - 20,000 Hz)
Gain	30 dB max.
Minimum Power Output (1 - 20,000 Hz, 1 W = 0 dBW)	>2x 160 W into 8 ohm (22.0 dBW), THD <0.01% >2x 280 W into 4 ohm (24.5 dBW), THD <0.01% >2x 420 W into 2 ohm (26.2 dBW), THD <0.01%
Output voltage / current, max.	36 V / 43 A
THD+N (IHF-A)	<0.01% (@ 1 W into 8 ohm, 1 - 20,000 Hz)
IMD	<0.01% (@ 100 W into 8 ohm)
S/N ratio (IHF-A)	>120 dB
Common Mode Rejection Ratio	>80 dB (@ 100 Hz)
Slew rate	>50 V/ μ s
Damping factor	>2000 (1 – 20,000 Hz)
Input level, nominal impedance	XLR balanced / cinch WBT unbalanced 1.25 V (1.9 dBV) / 1.25 V (1.9 dBV) 600 ohm / 20 kohm
Supply capacitance	132,000 μ F total
Power consumption	1500 W max. (70 W standby)
Power transformer, primary	230 VAC / 115 VAC
secondary 1 & 2	42.5 V / 7.1 A
secondary 3 & 4	15 V / 1 A
secondary 5 & 6	60 V / 0.1 A
Maximum DC-offset	+0.5 V and –0.5 V
Short circuit protection	Fuse per channel
Dimensions (h x w x d)	143 x 482 x 452 mm
Weight	24 kg

This unit conforms to the EMC interference regulations issued by the EU and to the CE standards.
This unit complies with safety regulation VDE 0860 and therefore with international safety regulation IEC 65.

Technical specifications may be changed by SPHINX without prior notice if technical developments make this necessary.

6. GENERAL CHECKLIST

Before you test or service the Project Eighteen please check the following items. They will give information about the current status of the amplifier.

Note: The Project Eighteen will become warm, so correct placement is critical. Do *not* position it on top of or close to other heat-radiating equipment (such as other power amps) or in direct sunlight.

Please ensure unrestricted ventilation around the component.

Optical connections

The optical CONTROL IN (4.) is light-sensitive. A strong light source might therefore activate the CONTROL function and switch the Project Eighteen to Standby.

While this mode has priority the amplifier can not be activated with the Standby switch at the front panel.

Before you start connecting equipment it is always wise to check whether all the mains cables of all components are disconnected from the mains outlets!

This will prevent any damage to the loudspeakers and amplifiers caused by incorrect wiring or settings.

Connect the mains cable after you have connected all other components in the system and have double-checked all connections.

Switching the amp on

Before you switch the power amp on you should always first:

- connect a pre-amp
- connect the pre-amp's Control Out to the power amp's Control In
- or place the dummy plug in the Control IN connector

After switching the amplifier ON it will select Standby mode and the following will happen:

1. The output relays are disconnected.
2. The input relays are disconnected.
3. The Control Out will show a red light.
4. The biasing relays reset the bias current to standby level.
5. The red LED (1.) will light.

Pressing the Standby-button (2.) will activate the amplifier and the LED turns to green.

Protection mode

If at any time the output DC-offset exceeds 500 mV the protection mode will activate.

This will reset the amp to Standby mode and the green LED (1.) will change to red.

Note: Externally there is no way of telling whether the amp is in protection or standby mode!

This can only be checked inside the housing: LED LD 102 will be illuminated in protection mode.

The protection mode can only be deactivated by readjustment of the DC offset voltage (according to the procedure "Offset" at page 9).

Shorted output

If one of the outputs is shorted the fuse F203, F204, F403 or F404 will blow.

Cables

Always use loudspeaker and audio cables and connectors of the highest quality.

Siltech cable is used throughout internally and we recommend using this same cable for all external connections.

If you have the choice between longer loudspeaker cables or longer audio cables, choose the latter (cables between pre-amp and power amp will cause the least signal quality loss).

7. ADJUSTMENT PROCEDURES

The Project Eighteen has eight adjustable settings, meaning four adjustment procedures per channel:

1. **High Bias:** to set the bias current of the power-transistors for normal use
2. **Low Bias:** to set the bias current of the power-transistors for standby mode
3. **Offset:** to set the minimal DC voltage for the output
4. **Common Mode:** to maximise the common mode rejection of the balanced input

Re-adjustment of one or more might be necessary due to ageing or when parts have been replaced or repaired.

Attention:

When re-adjusting any setting please ensure that there is no loudspeaker connected to the output! Otherwise the loudspeaker may be seriously damaged.

Attention:

The amplifier is able to generate high output voltages of over + or -60 V.

Please be very careful during the adjustments!

After removing the top cover plate you will clearly see the two separate channel sections.

High Bias

With this procedure you set the proper bias level for the power transistors. This ensures their Class A operation at low power levels.

Connect the amplifier according to the drawing "Connecting diagram for testing the project 18" (page 13).

The input of the amplifier must be shorted (by way of the MUTE function of the oscillator).

- Switch the amplifier ON (**not in Standby Mode!**) and wait until it has reached the proper operating temperature (this takes an hour).
- Set the millivolt-meter to the DC-range.
- Place the two measuring clips of the meter across one of the emitter resistors
Left Channel: R468, R469, R472, R473, R476, R477, R480 and R481.
Right Channel: R268, R269, R272, R273, R276, R277, R280 and R281 (see schematic at page 15).
- The level should be 60 mV DC (± 3 mV).
If not: adjust potmeter P402 (Left) or P202 (Right) until the level is 60 mV.

Attention:

All emitter resistors should show the same 60 mV value. If not, the corresponding power transistor may be defective.

- Switch the oscillator on and set it to 1 kHz and a level of 0 dBu.
- Check the distortion with a THD analyser: it should be at the specified value (0.01% IHF-A @ 1 kHz).
- If this is correct the procedure is finished.
- You may now switch off the amplifier or continue with another adjustment procedure.

Low Bias

With this procedure you set the proper bias level so the power transistors will remain at operating temperature during standby mode.

If this setting is too low, the operating temperature will drop too much causing an unnecessary increased warm-up period after switching the amp on.

If this setting is too high the amplifier will consume more electrical power than necessary.

Connect the amplifier according to the drawing "Connecting diagram for testing the project 18" (page 13).

The input of the amplifier must be shorted (by way of the MUTE function of the oscillator).

- Switch the amplifier ON (**but in Standby Mode!**) and wait until it has reached the proper operating temperature (this takes an hour).
- Set the millivolt-meter to the DC-range.
- Place the two measuring clips of the meter across one of the emitter resistors
Left Channel: R468, R469, R472, R473, R476, R477, R480 and R481.
Right Channel: R268, R269, R272, R273, R276, R277, R280 and R281 (see schematic at page 15).
- The level across *each* resistor should be 5 mV DC (± 0.25 mV).
If not: adjust potmeter P403 (Left) or P203 (Right) until the level is 5 mV.
- Then switch the amplifier ON (LED is green).
- Switch the oscillator on and set it to 1 kHz and a level of 0 dBu.
- Check the distortion with a THD analyser: it should be at the specified value (0.01% IHF-A @ 1 kHz).
- If this is correct the procedure is finished.
- You may now switch off the amplifier or continue with another adjustment procedure.

Offset

The Offset adjustment procedure minimises the DC offset value of the amplifier output. This DC offset is important when capacitive loads are used, such as electrostatic loudspeakers. These loudspeakers often use a very low-impedance step-up transformer. The amplifier 'sees' this load as a short to the DC voltage.

Connect the amplifier according to the drawing "Connecting diagram for testing the project 18" (page 13).

The input of the amplifier must be shorted (by way of the MUTE function of the oscillator).

Attention:

Be careful not to trip the offset protection mode. It will activate when the output DC offset exceeds +/-500 mV.

This is indicated by Internal LED LD 102.

This mode will be reset if the DC offset is adjusted to within the proper limits.

Please be careful during the adjustments!

- Switch the amplifier ON (**not in Standby Mode!**) and wait until it has reached the proper operating temperature (this takes an hour).
- Set the millivolt-meter to the DC-range.
- Place the measurement clips of the meter over the output terminal.
- The level should not exceed +5 or -5 mV DC.
If not: adjust potmeter P404 (Left) or P204 (Right) until the level is within this range.
- Switch the oscillator on and set it to 1 kHz and a level of 0 dBu.
- Check the distortion with a THD analyser: it should be at the specified value (0.01% IHF-A @ 1 kHz).
- If this is correct the procedure is finished.
- You may now switch off the amplifier or continue with another adjustment procedure.

Common Mode

The Common Mode adjustment procedure minimises the amplification error of the (internal) differential amplifier.

If the balanced input amplifier receives an identical signal at the normal (+) and inverted (-) inputs the output signal will be zero. This helps to reduce the effect of external noise signals while these will be induced at the same level in both signal conductors.

The Common Mode adjustment is optimally set during manufacturing (the error is as low as possible).

Connect the amplifier according to the drawing "**Connection diagram for common mode adjustment**" (page 14) and use the special input connector. This connector supplies both the plus (+) and minus (-) input pins of the XLR with the same signal.

If there is no signal analyser available you may use an oscilloscope at the output to view the waveform.

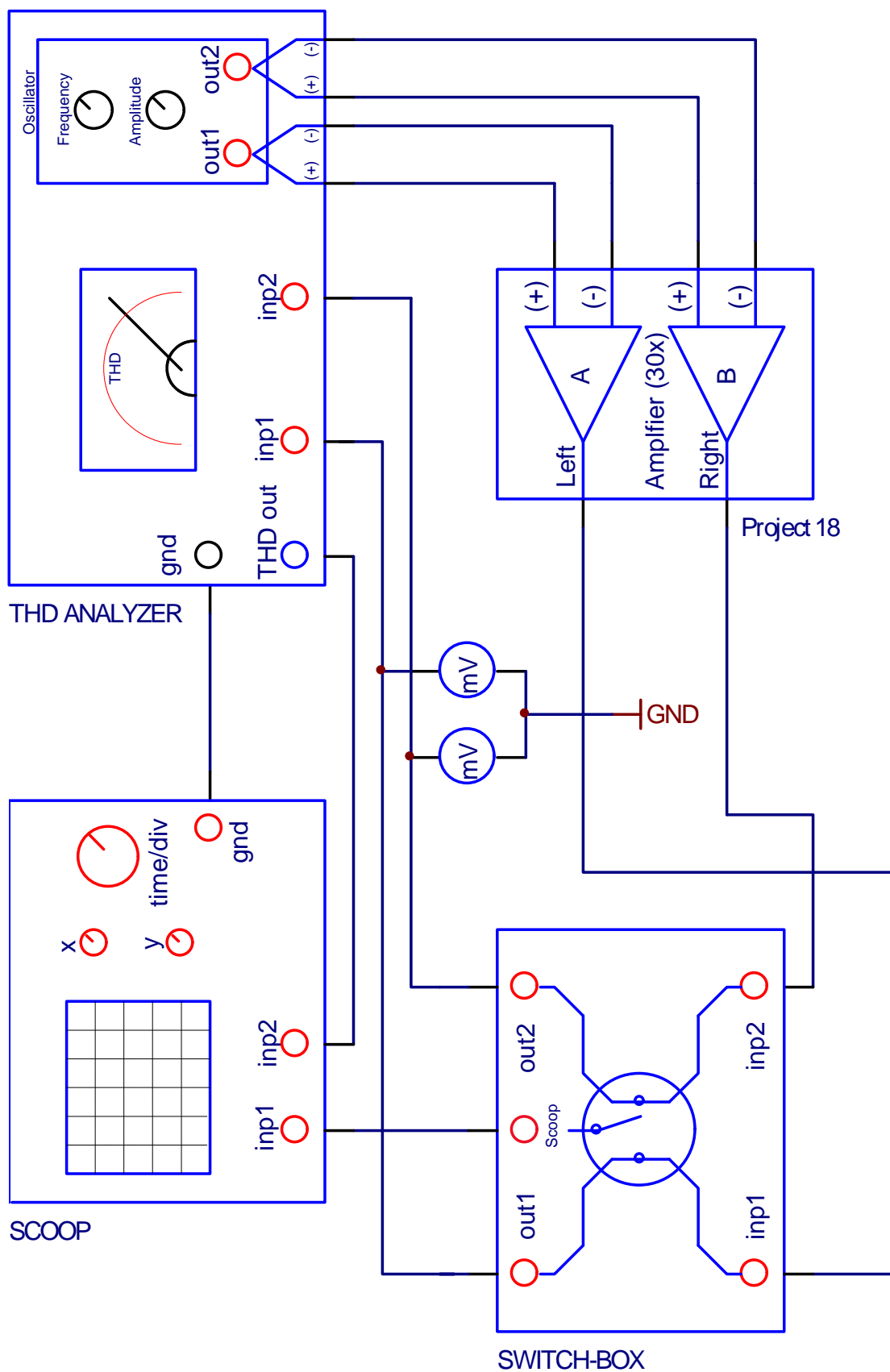
- Switch the amplifier ON (**not in Standby Mode!**) and wait until it has reached the proper operating temperature (this takes an hour).
- Switch the oscillator on and set it to 1 kHz and a level of 0 dBu.
- Adjust potmeter P401 (Left) or P201 (Right) until the minimum level is set.
When using a phase meter the minimum point is reached when the output phase is at 180° re. the input.
- Also check the setting at 10 Hz, 100 Hz and 10 kHz. Readjust when necessary.
- If the common mode is at minimum level at all frequencies the adjustment is completed.
- You may now switch off the amplifier or continue with another adjustment procedure.

9. DIAGRAMS AND PARTS LISTS

The next pages contain a complete set of schematic drawings including the associated parts lists (if applicable).

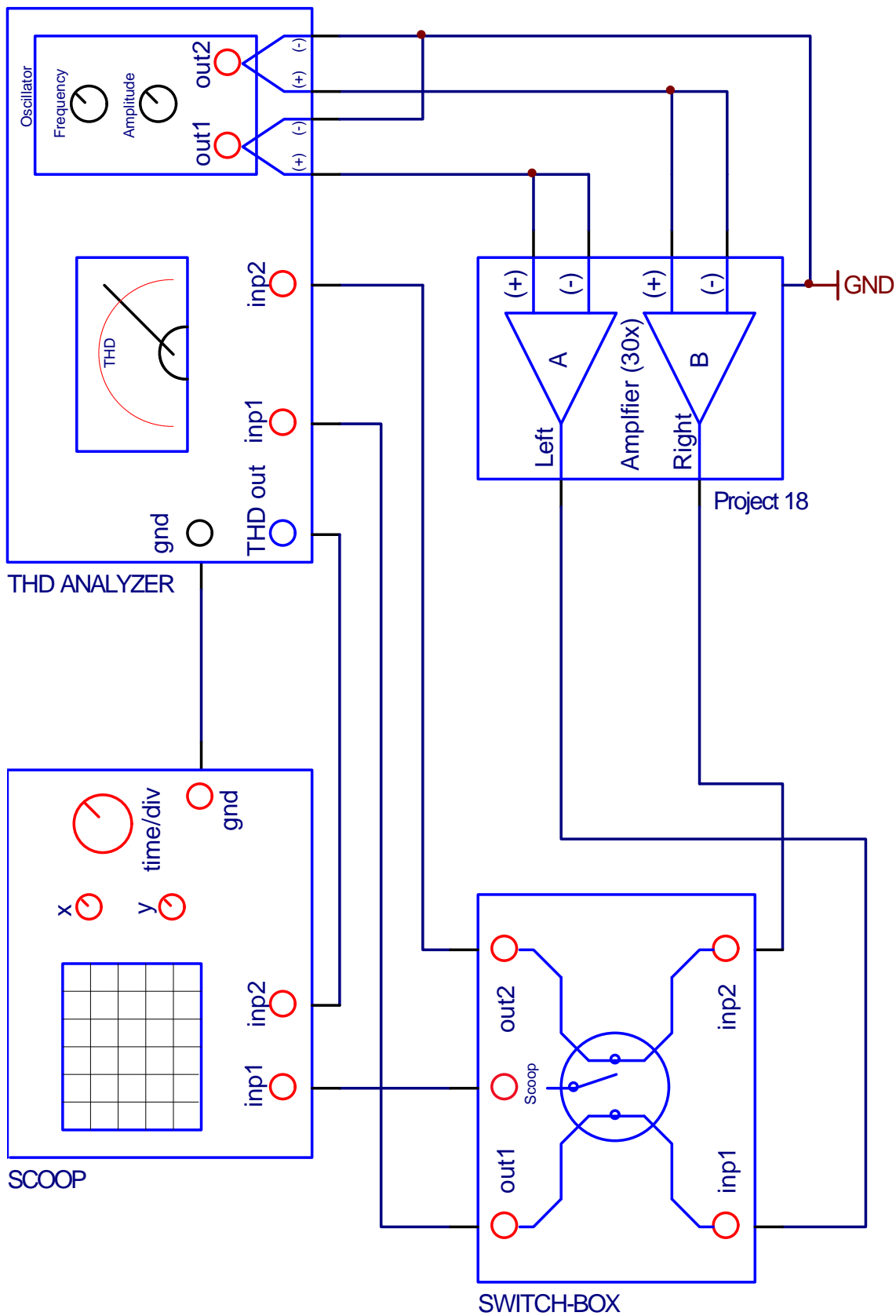
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Connecting diagram for testing the project 18



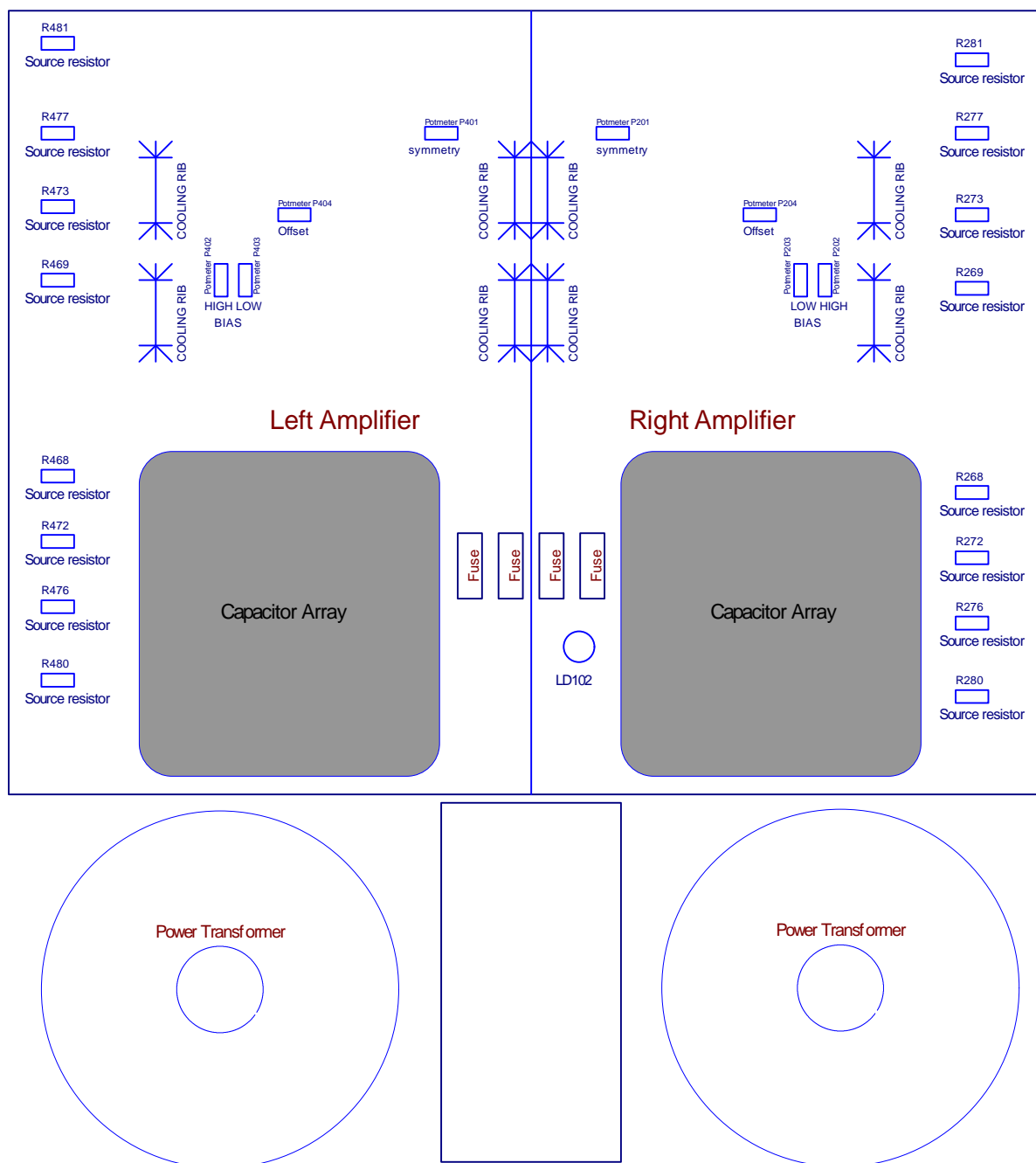
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Connection diagram for common mode adjustment



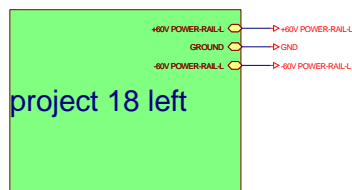
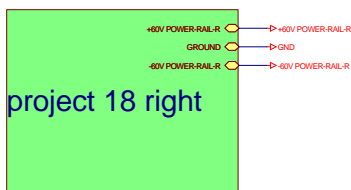
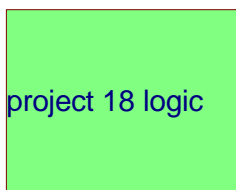
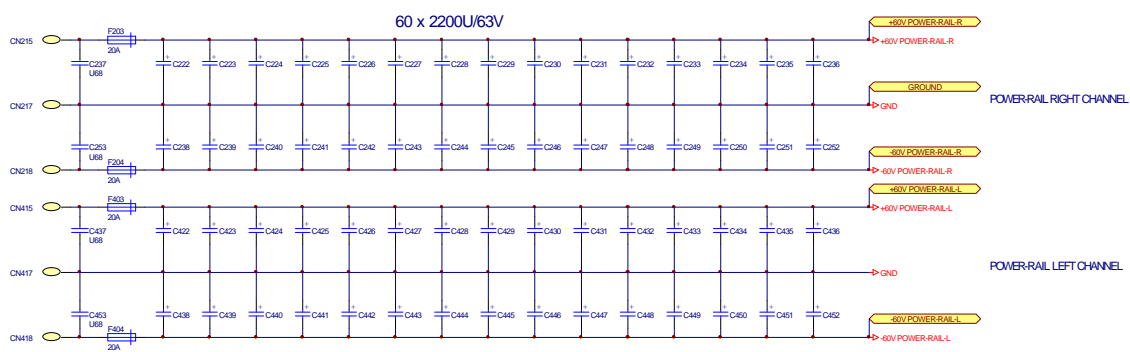
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Schematic layout of all relevant parts



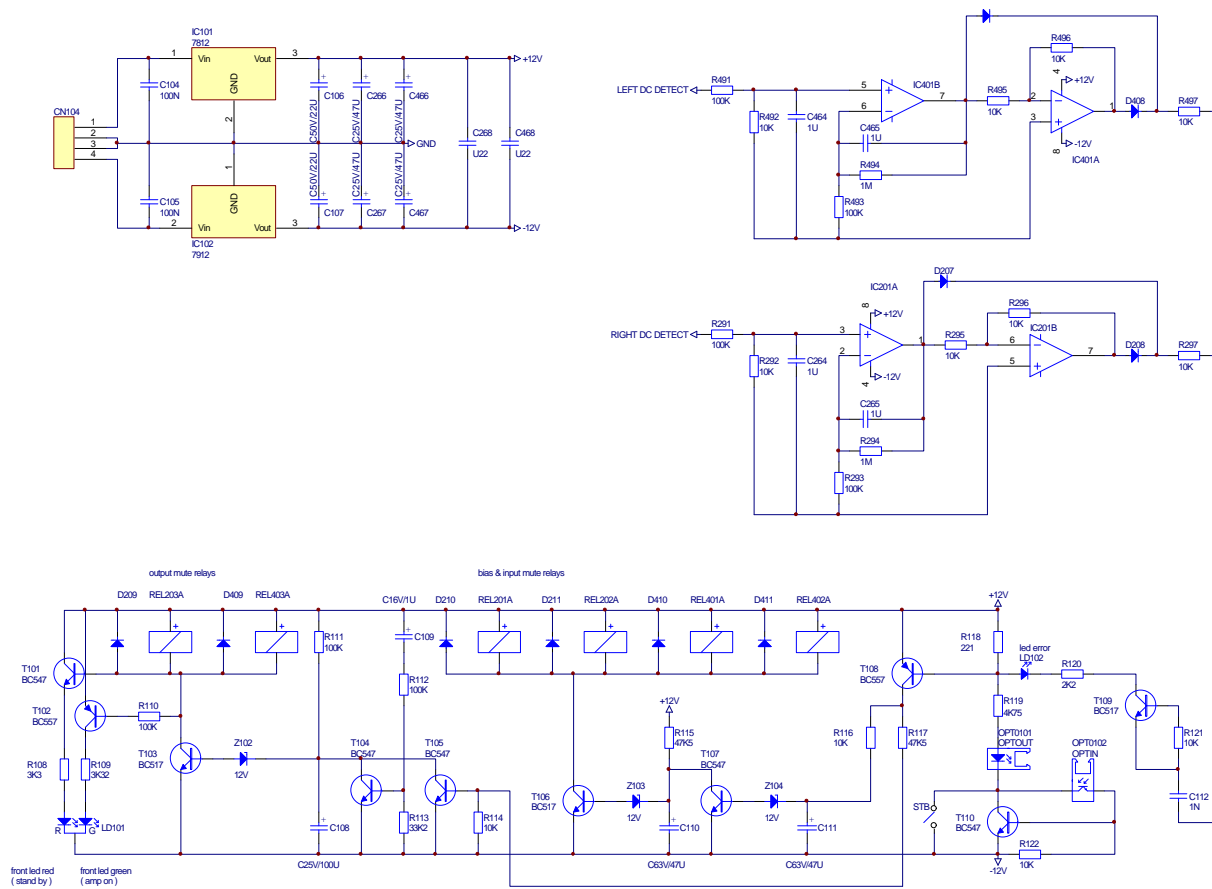
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Schematic overview of the Project 18 mainboard



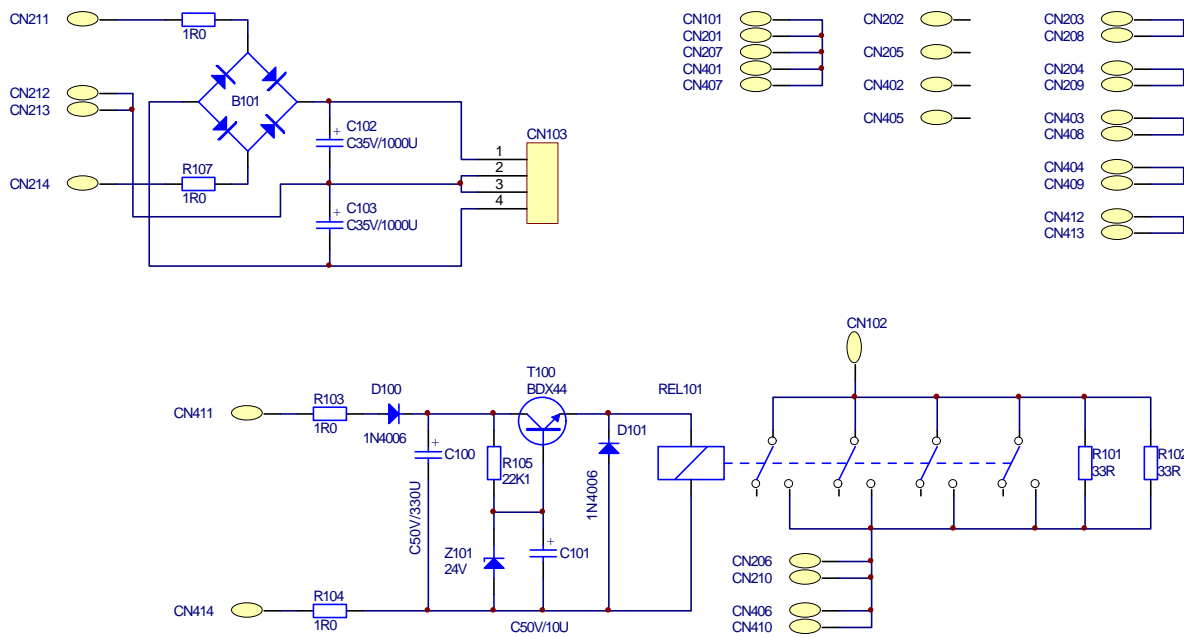
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Project 18 logic



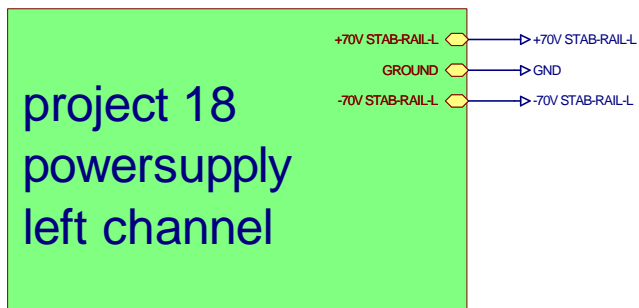
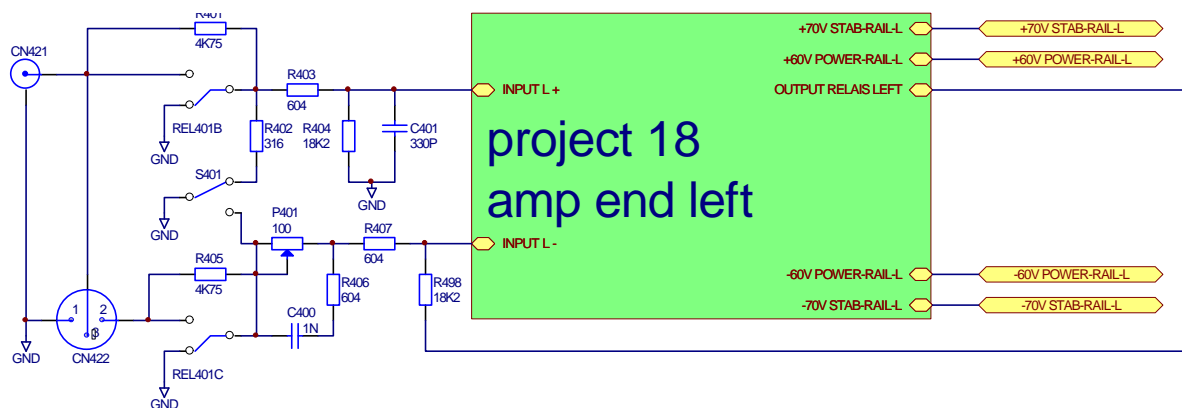
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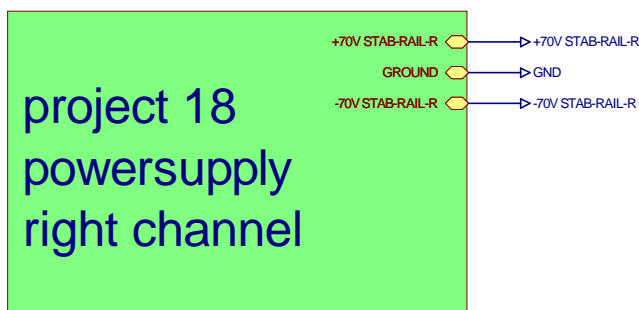
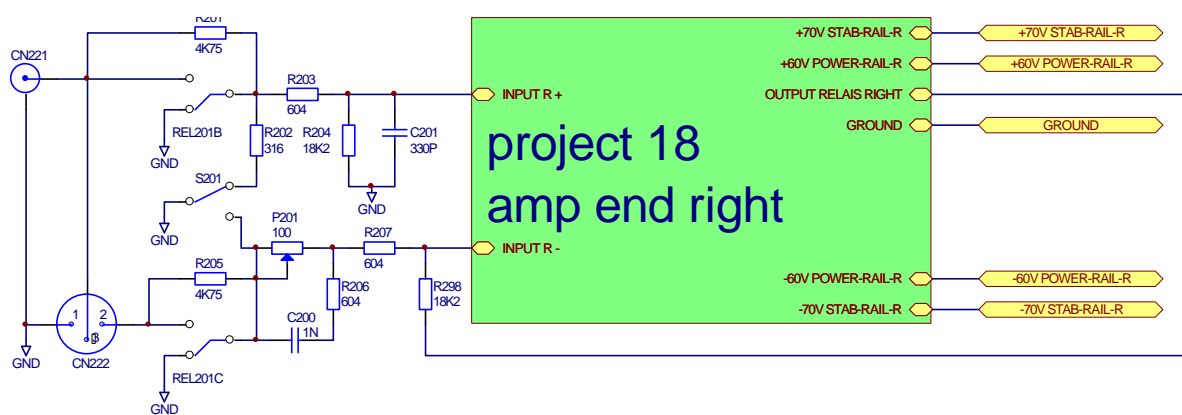
Project 18 supply & relay control schematic



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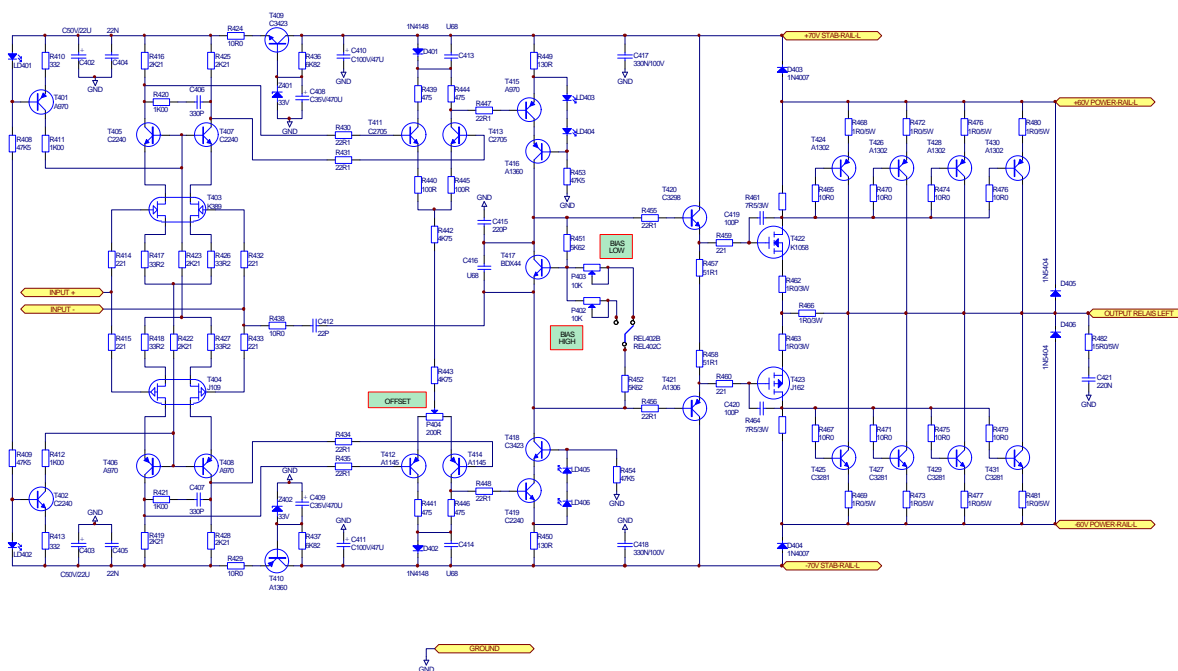
Project 18 blockdiagram left





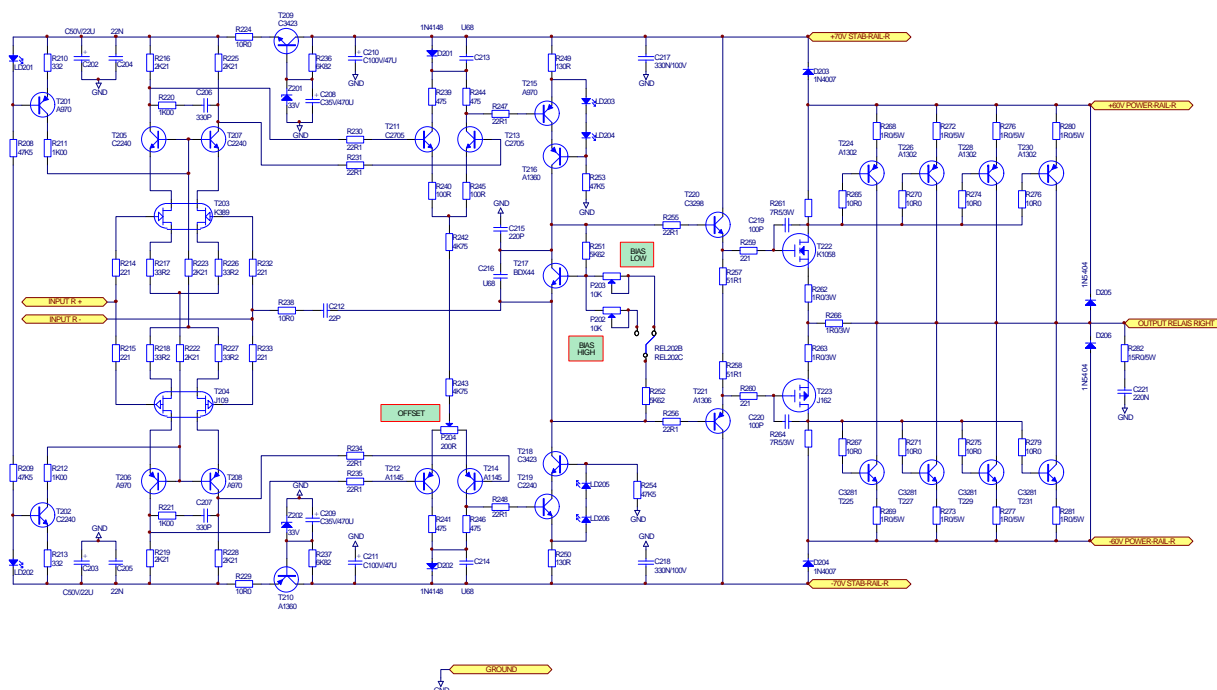
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Project 18 amplifier diagram left



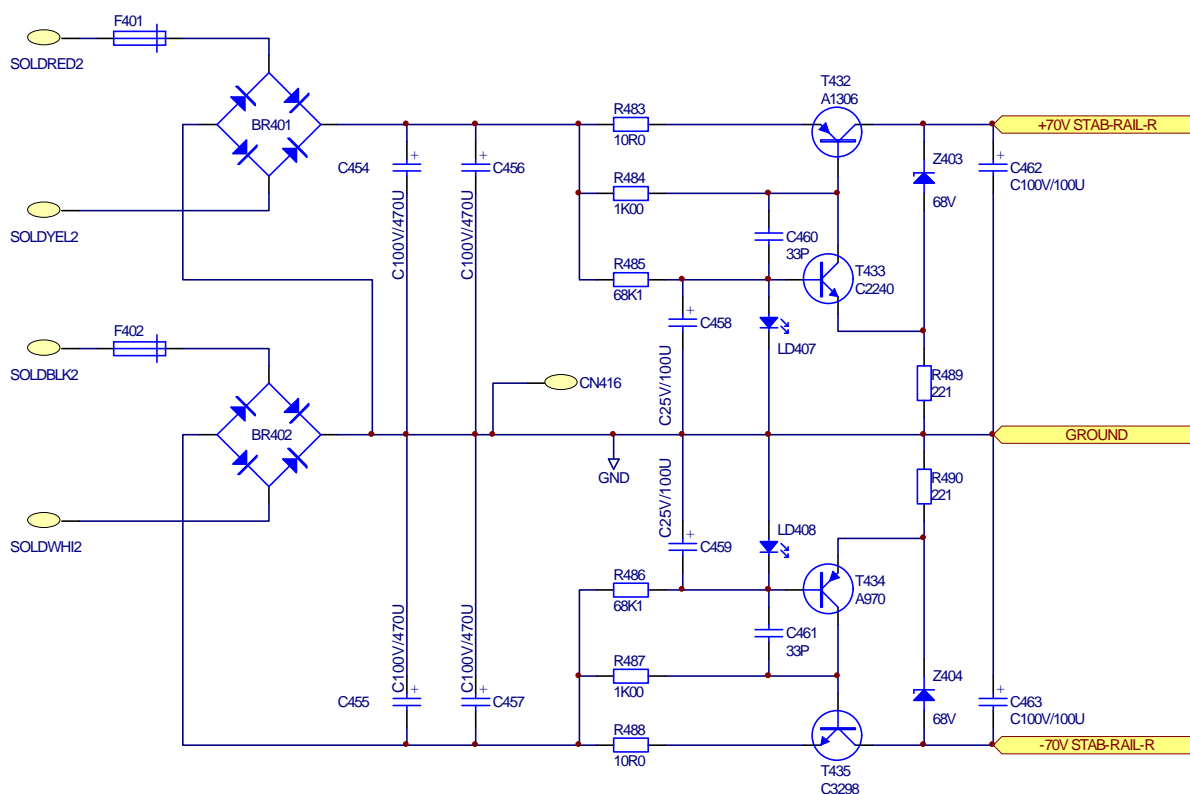
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Project 18 amplifier diagram right



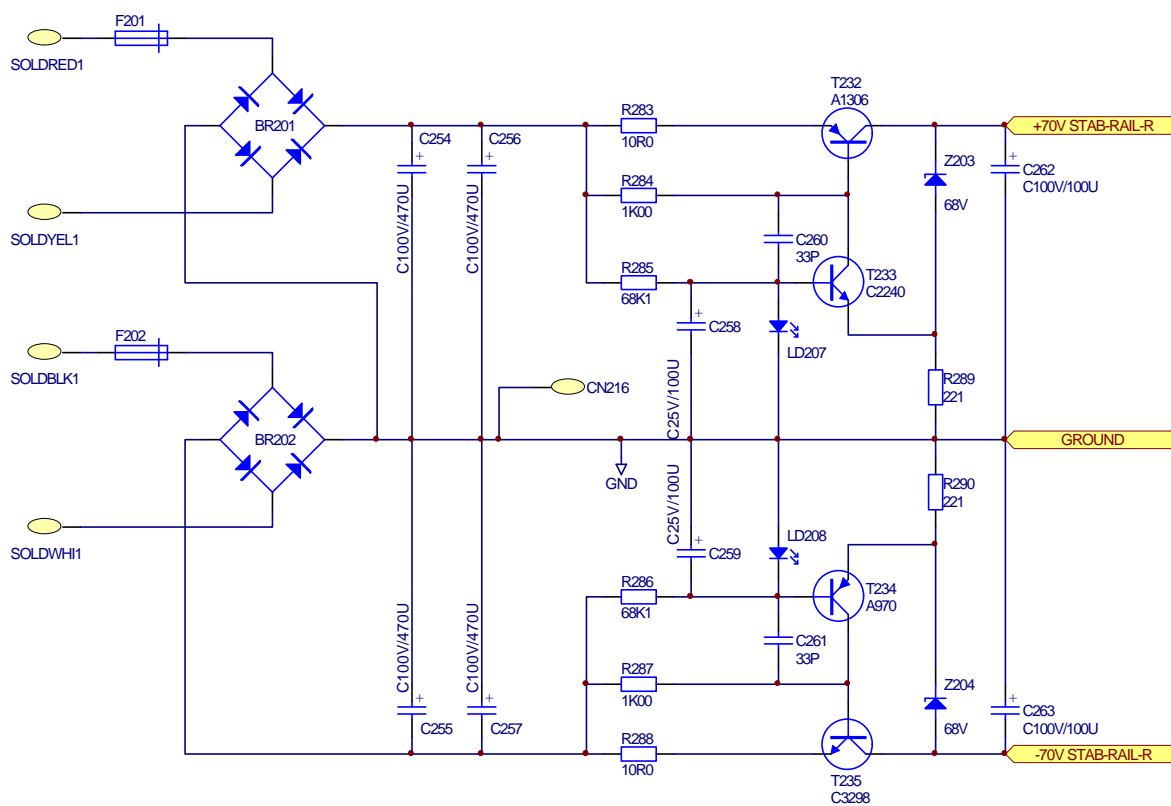
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Project 18 power supply left



SPHINX Project Eighteen Service Manual

Project 18 power supply right



PCB drawings of Project 18

Because there is a significant image-quality loss during the conversion of the drawing, the PCB-drawing is located in a separate file.

This file is in PDF-format (Adobe Acrobat 3.0 Reader).

- Pj18Main.PDF for Mainboard

SPHINX Project Eighteen Service Manual

Partlist

Designator	Part Type	Description
B101	WO2M	Bridge rectifier
BR201	KBPC602	Bridge rectifier
BR202	KBPC602	Bridge rectifier
BR401	KBPC602	Bridge rectifier
BR402	KBPC602	Bridge rectifier
C100	330uF/50V	Electrolytic capacitor
C101	10uF/50V	Electrolytic capacitor
C102	1000uF/35V	Electrolytic capacitor
C103	1000uF/35V	Electrolytic capacitor
C104	100nF	MKT capacitor
C105	100nF	MKT capacitor
C106	22uF/50V	Electrolytic capacitor
C107	22uF/50V	Electrolytic capacitor
C108	100uF/25V	Electrolytic capacitor
C109	1uF/16V	Electrolytic capacitor
C110	47uF/63V	Electrolytic capacitor
C111	47uF/63V	Electrolytic capacitor
C112	1nF	MKT capacitor
C200	1nF	MKT capacitor
C201	330pF	Styroflex capacitor
C202	22uF/50V	Electrolytic capacitor
C203	22uF/50V	Electrolytic capacitor
C204	22nF	MKT capacitor
C205	22nF	MKT capacitor
C206	330pF	Styroflex capacitor
C207	330pF	Styroflex capacitor
C208	470uF/35V	Electrolytic capacitor
C209	470uF/35V	Electrolytic capacitor
C210	47uF/100V	Electrolytic capacitor
C211	47uF/100V	Electrolytic capacitor
C212	22pF	Ceramic capacitor
C213	68nF	MKT capacitor
C214	68nF	MKT capacitor
C215	220pF	Styroflex capacitor
C216	68nF	MKT capacitor
C217	330nF/100V	MKT capacitor
C218	330nF/100V	MKT capacitor
C219	100pF	Styroflex capacitor
C220	100pF	Styroflex capacitor
C221	220nF	MKT capacitor
C222	2200uF/63V	Electrolytic capacitor
C223	2200uF/63V	Electrolytic capacitor
C224	2200uF/63V	Electrolytic capacitor
C225	2200uF/63V	Electrolytic capacitor
C226	2200uF/63V	Electrolytic capacitor
C227	2200uF/63V	Electrolytic capacitor
C228	2200uF/63V	Electrolytic capacitor

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Designator	Part Type	Description
C229	2200uF/63V	Electrolytic capacitor
C230	2200uF/63V	Electrolytic capacitor
C231	2200uF/63V	Electrolytic capacitor
C232	2200uF/63V	Electrolytic capacitor
C233	2200uF/63V	Electrolytic capacitor
C234	2200uF/63V	Electrolytic capacitor
C235	2200uF/63V	Electrolytic capacitor
C236	2200uF/63V	Electrolytic capacitor
C237	68nF	MKT capacitor
C238	2200uF/63V	Electrolytic capacitor
C239	2200uF/63V	Electrolytic capacitor
C240	2200uF/63V	Electrolytic capacitor
C241	2200uF/63V	Electrolytic capacitor
C242	2200uF/63V	Electrolytic capacitor
C243	2200uF/63V	Electrolytic capacitor
C244	2200uF/63V	Electrolytic capacitor
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C247	2200uF/63V	Electrolytic capacitor
C248	2200uF/63V	Electrolytic capacitor
C249	2200uF/63V	Electrolytic capacitor
C250	2200uF/63V	Electrolytic capacitor
C251	2200uF/63V	Electrolytic capacitor
C252	2200uF/63V	Electrolytic capacitor
C253	68nF	MKT capacitor
C254	470uF/100V	Electrolytic capacitor
C255	470uF/100V	Electrolytic capacitor
C256	470uF/100V	Electrolytic capacitor
C257	470uF/100V	Electrolytic capacitor
C258	100uF/25V	Electrolytic capacitor
C259	100uF/25V	Electrolytic capacitor
C260	33pF	Ceramic capacitor
C261	33pF	Ceramic capacitor
C262	100uF/100V	Electrolytic capacitor
C263	100uF/100V	Electrolytic capacitor
C264	1uF	MKT capacitor
C265	1uF	MKT capacitor
C266	47uF/25V	Electrolytic capacitor
C267	47uF/25V	Electrolytic capacitor
C268	22nF	MKT capacitor
C400	1nF	MKT capacitor
C401	330pF	Styroflex capacitor
C402	22uF/50V	Electrolytic capacitor
C403	22uF/50V	Electrolytic capacitor
C404	22nF	MKT capacitor
C405	22nF	MKT capacitor
C406	330pF	Styroflex capacitor
C407	330pF	Styroflex capacitor
C408	470uF/35V	Electrolytic capacitor

SPHINX Project Eighteen Service Manual

Designator	Part Type	Description
C409	470uF/35V	Electrolytic capacitor
C410	47uF/100V	Electrolytic capacitor
C411	47uF/100V	Electrolytic capacitor
C412	22pF	Ceramic capacitor
C413	68nF	MKT capacitor
C414	68nF	MKT capacitor
C415	220pF	Styroflex capacitor
C416	68nF	MKT capacitor
C417	330nF/100V	MKT capacitor
C418	330nF/100V	MKT capacitor
C419	100pF	Styroflex capacitor
C420	100pF	Styroflex capacitor
C421	220nF	MKT capacitor
C422	2200uF/63V	Electrolytic capacitor
C423	2200uF/63V	Electrolytic capacitor
C424	2200uF/63V	Electrolytic capacitor
C425	2200uF/63V	Electrolytic capacitor
C426	2200uF/63V	Electrolytic capacitor
C427	2200uF/63V	Electrolytic capacitor
C428	2200uF/63V	Electrolytic capacitor
C429	2200uF/63V	Electrolytic capacitor
C430	2200uF/63V	Electrolytic capacitor
C431	2200uF/63V	Electrolytic capacitor
C432	2200uF/63V	Electrolytic capacitor
C433	2200uF/63V	Electrolytic capacitor
C434	2200uF/63V	Electrolytic capacitor
C435	2200uF/63V	Electrolytic capacitor
C436	2200uF/63V	Electrolytic capacitor
C437	68nF	MKT capacitor
C438	2200uF/63V	Electrolytic capacitor
C439	2200uF/63V	Electrolytic capacitor
C440	2200uF/63V	Electrolytic capacitor
C441	2200uF/63V	Electrolytic capacitor
C442	2200uF/63V	Electrolytic capacitor
C443	2200uF/63V	Electrolytic capacitor
C444	2200uF/63V	Electrolytic capacitor
C445	2200uF/63V	Electrolytic capacitor
C446	2200uF/63V	Electrolytic capacitor
C447	2200uF/63V	Electrolytic capacitor
C448	2200uF/63V	Electrolytic capacitor
C449	2200uF/63V	Electrolytic capacitor
C450	2200uF/63V	Electrolytic capacitor
C451	2200uF/63V	Electrolytic capacitor
C452	2200uF/63V	Electrolytic capacitor
C453	68nF	MKT capacitor
C454	470uF/100V	Electrolytic capacitor
C455	470uF/100V	Electrolytic capacitor
C456	470uF/100V	Electrolytic capacitor
C457	470uF/100V	Electrolytic capacitor

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Designator	Part Type	Description
C458	100uF/25V	Electrolytic capacitor
C459	100uF/25V	Electrolytic capacitor
C460	33pF	Ceramic capacitor
C461	33pF	Ceramic capacitor
C462	100uF/100V	Electrolytic capacitor
C463	100uF/100V	Electrolytic capacitor
C464	1uF	MKT capacitor
C465	1uF	MKT capacitor
C466	47uF/25V	Electrolytic capacitor
C467	47uF/25V	Electrolytic capacitor
C468	22nF	MKT capacitor
D100	1N4006	Diode
D101	1N4006	Diode
D201	1N4148	Diode
D202	1N4148	Diode
D203	1N4007	Diode
D204	1N4007	Diode
D205	1N5404	Diode
D206	1N5404	Diode
D210	1N4148	Diode
D211	1N4148	Diode
D401	1N4148	Diode
D402	1N4148	Diode
D403	1N4007	Diode
D404	1N4007	Diode
D405	1N5404	Diode
D406	1N5404	Diode
D410	1N4148	Diode
D411	1N4148	Diode
F201	T1A	Fuse
F202	T1A	Fuse
F203	T20A	Fuse
F204	T20A	Fuse
F401	T1A	Fuse
F402	T1A	Fuse
F403	T20A	Fuse
F404	T20A	Fuse
IC101	L7812CV	Voltage regulator
IC102	L7912CV	Voltage regulator
IC201	AD712	Dual OPAMP
IC401	AD712	Dual OPAMP
LD101	L29EGW	Duo LED
LD102	LO5R3000F3	LED red
LD201	LO5R3000F3	LED red
LD202	LO5R3000F3	LED red

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Designator	Part Type	Description
LD203	LO5R3000F3	LED red
LD204	LO5R3000F3	LED red
LD205	LO5R3000F3	LED red
LD206	LO5R3000F3	LED red
LD207	LO5R3000F3	LED red
LD208	LO5R3000F3	LED red
LD401	LO5R3000F3	LED red
LD402	LO5R3000F3	LED red
LD403	LO5R3000F3	LED red
LD404	LO5R3000F3	LED red
LD405	LO5R3000F3	LED red
LD406	LO5R3000F3	LED red
LD407	LO5R3000F3	LED red
LD408	LO5R3000F3	LED red
OPT0101	173298-2	Optical output
OPT0102	173298-1	Optical input
P201	100R	Adjustable pot.
P202	10K	Adjustable pot.
P203	10K	Adjustable pot.
P204	200R	Adjustable pot.
P401	100R	Adjustable pot.
P402	10K	Adjustable pot.
P403	10K	Adjustable pot.
P404	200R	Adjustable pot.
R101	33R	Resistor MRS25
R102	33R	Resistor MRS25
R103	1R0	Resistor MRS25
R104	1R0	Resistor MRS25
R105	22K1	Resistor MRS25
R106	1R0	Resistor MRS25
R107	1R0	Resistor MRS25
R108	3K3	Resistor MRS25
R109	3K32	Resistor MRS25
R110	100K	Resistor MRS25
R111	100K	Resistor MRS25
R112	100K	Resistor MRS25
R113	33K2	Resistor MRS25
R114	10K	Resistor MRS25
R115	47K5	Resistor MRS25
R116	10K	Resistor MRS25
R117	47K5	Resistor MRS25
R118	221R	Resistor MRS25
R119	4K75	Resistor MRS25
R120	2K2	Resistor MRS25
R121	10K	Resistor MRS25
R122	10K	Resistor MRS25

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Designator	Part Type	Description
R201	4K75	Resistor MRS25
R202	316R	Resistor MRS25
R203	604R	Resistor MRS25
R204	18K2	Resistor MRS25
R205	4K75	Resistor MRS25
R206	604R	Resistor MRS25
R207	604R	Resistor MRS25
R208	47K5	Resistor MRS25
R209	47K5	Resistor MRS25
R210	332R	Resistor MRS25
R211	1K00	Resistor MRS25
R212	1K00	Resistor MRS25
R213	332R	Resistor MRS25
R214	221R	Resistor MRS25
R215	221R	Resistor MRS25
R216	2K21	Resistor MRS25
R217	33R2	Resistor MRS25
R218	33R2	Resistor MRS25
R219	2K21	Resistor MRS25
R220	1K00	Resistor MRS25
R221	1K00	Resistor MRS25
R222	2K21	Resistor MRS25
R223	2K21	Resistor MRS25
R224	10R0	Resistor MRS25
R225	2K21	Resistor MRS25
R226	33R2	Resistor MRS25
R227	33R2	Resistor MRS25
R228	2K21	Resistor MRS25
R229	10R0	Resistor MRS25
R230	22R1	Resistor MRS25
R231	22R1	Resistor MRS25
R232	221R	Resistor MRS25
R233	221R	Resistor MRS25
R234	22R1	Resistor MRS25
R235	22R1	Resistor MRS25
R236	6K82	Resistor MRS25
R237	6K82	Resistor MRS25
R238	10R0	Resistor MRS25
R239	475R	Resistor MRS25
R240	100R	Resistor MRS25
R241	475R	Resistor MRS25
R242	4K75	Resistor MRS25
R243	4K75	Resistor MRS25
R244	475R	Resistor MRS25
R245	100R	Resistor MRS25
R246	475R	Resistor MRS25
R247	22R1	Resistor MRS25
R248	22R1	Resistor MRS25
R249	130R	Resistor MRS25

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Designator	Part Type	Description
R250	130R	Resistor MRS25
R251	5K62	Resistor MRS25
R252	5K62	Resistor MRS25
R253	47K5	Resistor MRS25
R254	47K5	Resistor MRS25
R255	22R1	Resistor MRS25
R256	22R1	Resistor MRS25
R257	51R1	Resistor MRS25
R258	51R1	Resistor MRS25
R259	221R	Resistor MRS25
R260	221R	Resistor MRS25
R261	7R5/3W	Resistor MRS25
R262	1R0/3W	Resistor MRS25
R263	1R0/3W	Resistor MRS25
R264	7R5/3W	Resistor MRS25
R265	10R0	Resistor MRS25
R266	1R0/3W	Resistor MRS25
R267	10R0	Resistor MRS25
R268	1R0/5W	Resistor MRS25
R269	1R0/5W	Resistor MRS25
R270	10R0	Resistor MRS25
R271	10R0	Resistor MRS25
R272	1R0/5W	Resistor MRS25
R273	1R0/5W	Resistor MRS25
R274	10R0	Resistor MRS25
R275	10R0	Resistor MRS25
R276	10R0	Resistor MRS25
R276	1R0/5W	Resistor MRS25
R277	1R0/5W	Resistor MRS25
R279	10R0	Resistor MRS25
R280	1R0/5W	Resistor MRS25
R281	1R0/5W	Resistor MRS25
R282	15R0/5W	Resistor MRS25
R283	10R0	Resistor MRS25
R284	1K00	Resistor MRS25
R285	68K1	Resistor MRS25
R286	68K1	Resistor MRS25
R287	1K00	Resistor MRS25
R288	10R0	Resistor MRS25
R289	221R	Resistor MRS25
R290	221R	Resistor MRS25
R291	100K	Resistor MRS25
R292	10K	Resistor MRS25
R293	100K	Resistor MRS25
R294	1M	Resistor MRS25
R295	10K	Resistor MRS25
R296	10K	Resistor MRS25
R297	10K	Resistor MRS25
R298	18K2	Resistor MRS25

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Designator	Part Type	Description
R401	4K75	Resistor MRS25
R402	316R	Resistor MRS25
R403	604R	Resistor MRS25
R404	18K2	Resistor MRS25
R405	4K75	Resistor MRS25
R406	604R	Resistor MRS25
R407	604R	Resistor MRS25
R408	47K5	Resistor MRS25
R409	47K5	Resistor MRS25
R410	332R	Resistor MRS25
R411	1K00	Resistor MRS25
R412	1K00	Resistor MRS25
R413	332R	Resistor MRS25
R414	221R	Resistor MRS25
R415	221R	Resistor MRS25
R416	2K21	Resistor MRS25
R417	33R2	Resistor MRS25
R418	33R2	Resistor MRS25
R419	2K21	Resistor MRS25
R420	1K00	Resistor MRS25
R421	1K00	Resistor MRS25
R422	2K21	Resistor MRS25
R423	2K21	Resistor MRS25
R424	10R0	Resistor MRS25
R425	2K21	Resistor MRS25
R426	33R2	Resistor MRS25
R427	33R2	Resistor MRS25
R428	2K21	Resistor MRS25
R429	10R0	Resistor MRS25
R430	22R1	Resistor MRS25
R431	22R1	Resistor MRS25
R432	221R	Resistor MRS25
R433	221R	Resistor MRS25
R434	22R1	Resistor MRS25
R435	22R1	Resistor MRS25
R436	6K82	Resistor MRS25
R437	6K82	Resistor MRS25
R438	10R0	Resistor MRS25
R439	475R	Resistor MRS25
R440	100R	Resistor MRS25
R441	475R	Resistor MRS25
R442	4K75	Resistor MRS25
R443	4K75	Resistor MRS25
R444	475R	Resistor MRS25
R445	100R	Resistor MRS25
R446	475R	Resistor MRS25
R447	22R1	Resistor MRS25
R448	22R1	Resistor MRS25
R449	130R	Resistor MRS25

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Designator	Part Type	Description
R450	130R	Resistor MRS25
R451	5K62	Resistor MRS25
R452	5K62	Resistor MRS25
R453	47K5	Resistor MRS25
R454	47K5	Resistor MRS25
R455	22R1	Resistor MRS25
R456	22R1	Resistor MRS25
R457	51R1	Resistor MRS25
R458	51R1	Resistor MRS25
R459	221R	Resistor MRS25
R460	221R	Resistor MRS25
R461	7R5/3W	Resistor MRS25
R462	1R0/3W	Resistor MRS25
R463	1R0/3W	Resistor MRS25
R464	7R5/3W	Resistor MRS25
R465	10R0	Resistor MRS25
R466	1R0/3W	Resistor MRS25
R467	10R0	Resistor MRS25
R468	1R0/5W	Resistor MRS25
R469	1R0/5W	Resistor MRS25
R470	10R0	Resistor MRS25
R471	10R0	Resistor MRS25
R472	1R0/5W	Resistor MRS25
R473	1R0/5W	Resistor MRS25
R474	10R0	Resistor MRS25
R475	10R0	Resistor MRS25
R476	10R0	Resistor MRS25
R476	1R0/5W	Resistor MRS25
R477	1R0/5W	Resistor MRS25
R479	10R0	Resistor MRS25
R480	1R0/5W	Resistor MRS25
R481	1R0/5W	Resistor MRS25
R482	15R0/5W	Resistor MRS25
R483	10R0	Resistor MRS25
R484	1K00	Resistor MRS25
R485	68K1	Resistor MRS25
R486	68K1	Resistor MRS25
R487	1K00	Resistor MRS25
R488	10R0	Resistor MRS25
R489	221R	Resistor MRS25
R490	221R	Resistor MRS25
R491	100K	Resistor MRS25
R492	10K	Resistor MRS25
R493	100K	Resistor MRS25
R494	1M	Resistor MRS25
R495	10K	Resistor MRS25
R496	10K	Resistor MRS25
R497	10K	Resistor MRS25
R498	18K2	Resistor MRS25

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Designator	Part Type	Description
REL201	RELAY DPDT	Relay
REL202	RELAY DPDT	Relay
REL203	RELAY DPDT	Relay
REL401	RELAY DPDT	Relay
REL402	RELAY DPDT	Relay
REL403	RELAY DPDT	Relay
T100	BDX44	Transistor
T101	BC547	Transistor
T102	BC557	Transistor
T103	BC517	Transistor
T104	BC547	Transistor
T105	BC547	Transistor
T106	BC517	Transistor
T107	BC547	Transistor
T108	BC557	Transistor
T109	BC517	Transistor
T110	BC547	Transistor
T201	2SA970	Transistor
T202	2SC2240	Transistor
T203	K389	Dual N-JFET
T204	J109	Dual P-JFET
T205	2SC2240	Transistor
T206	2SA970	Transistor
T207	2SC2240	Transistor
T208	2SA970	Transistor
T209	2SC3423	Transistor
T210	2SA1360	Transistor
T211	2SC2705	Transistor
T212	2SA1145	Transistor
T213	2SC2705	Transistor
T214	2SA1145	Transistor
T215	2SA970	Transistor
T216	2SA1360	Transistor
T217	BDX44	Transistor
T218	2SC3423	Transistor
T219	2SC2240	Transistor
T220	2SC3298	Transistor
T221	2SA1306	Transistor
T222	K1058	Transistor
T223	J162	Transistor
T224	2SA1302	Transistor
T225	2SC3281	Transistor
T226	2SA1302	Transistor
T227	2SC3281	Transistor
T228	2SA1302	Transistor
T229	2SC3281	Transistor
T230	2SA1302	Transistor
T231	2SC3281	Transistor

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Designator	Part Type	Description
T232	2SA1306	Transistor
T233	2SC2240	Transistor
T234	2SA970	Transistor
T235	2SC3298	Transistor
T401	2SA970	Transistor
T402	2SC2240	Transistor
T403	K389	Dual N-JFET
T404	J109	Dual P-JFET
T405	2SC2240	Transistor
T406	2SA970	Transistor
T407	2SC2240	Transistor
T408	2SA970	Transistor
T409	2SC3423	Transistor
T410	2SA1360	Transistor
T411	2SC2705	Transistor
T412	2SA1145	Transistor
T413	2SC2705	Transistor
T414	2SA1145	Transistor
T415	2SA970	Transistor
T416	2SA1360	Transistor
T417	BDX44	Transistor
T418	2SC3423	Transistor
T419	2SC2240	Transistor
T420	2SC3298	Transistor
T421	2SA1306	Transistor
T422	K1058	Transistor
T423	J162	Transistor
T424	2SA1302	Transistor
T425	2SC3281	Transistor
T426	2SA1302	Transistor
T427	2SC3281	Transistor
T428	2SA1302	Transistor
T429	2SC3281	Transistor
T430	2SA1302	Transistor
T431	2SC3281	Transistor
T432	2SA1306	Transistor
T433	2SC2240	Transistor
T434	2SA970	Transistor
T435	2SC3298	Transistor
Z101	24V	Zener diode
Z102	12V	Zener diode
Z103	12V	Zener diode
Z104	12V	Zener diode
Z201	33V	Zener diode
Z202	33V	Zener diode
Z203	68V	Zener diode
Z204	68V	Zener diode
Z401	33V	Zener diode

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Designator	Part Type	Description
Z402	33V	Zener diode
Z403	68V	Zener diode
Z404	68V	Zener diode

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