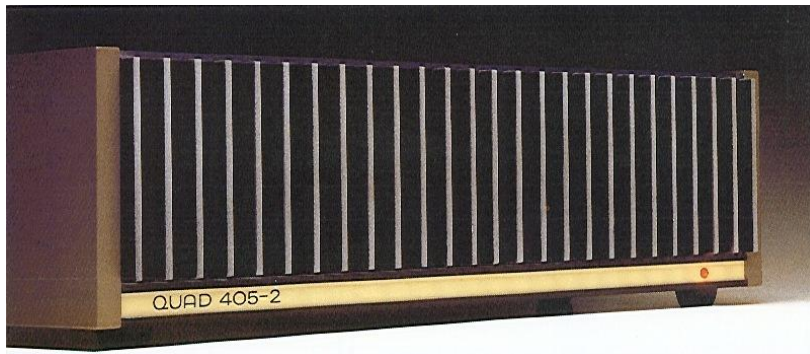


Quad 405 DIY upgrade illustrated guidelines V2.0



These are the illustrated step-by-step guidelines for upgrading your Quad 405 or 405-2 with the Dada Electronics upgrade-kit.

Depending on the version of the 405 you are upgrading, some components or options may be different. This will be mentioned in the text below.

We will replace all electrolytic capacitors, the input Op Amp chip, the zeners who determine the Psu voltages of the Op Amp chip, the in/output connectors and the cabling.

We will also adapt the input-sensitivity (as an option) by adjusting the feedback in the input-circuit. This increases signal-to-noise ratio and makes the amplifier better adapted to modern sources.

We will do the upgrade step-by-step. This is important because some steps are more difficult once other steps are taken. For every step these guidelines will tell you what to do (in Underline) and give you some tips, tricks and advice (*in Italics*).

You should have some soldering-experience for bringing this project to a good end but you don't have to be an electronics-expert.

If there are any problems, send an e-mail to info@dadaelectronics.eu with a good description of the problem. Some pictures may help. We will do our best to answer within 24 hours 7/7.

Read this manual before you start working on the amplifier. It gives you better understanding and will reduce the chance of failures.

When the project is a success you will be listening to one of the best high-end amplifiers ever made with a better-than-original Quad-sound.

For better understanding of the circuit, general construction and layout and as a reference for versions and diagrams, downloading of the following document is mandatory:

[Quad 405 and 405-2 Service Manual](#)

Information from the Service Manual is not repeated in this manual.

Stefaan and Joost, January 2016

www.dadaelectronics.eu

Components and values may change without notice (a higher voltage rating is no problem); always download the latest upgrade manual and service manual. If you buy a kit and plan the upgrade in the future, store the upgrade manual and service manual with the kit. We don't keep older versions of the manuals online! Before you start, read this manual first, to get an idea of the work, tools and skills needed to do the job.

Step 1 – The tools & the Components

The tools you need:

- A good quality soldering iron with a fine point (max 30) Watt or a soldering-station.
- A desoldering-pump or desoldering station
- A micro cutting nipper, a wire-stripper and a miniature pliers
- A Philips n° 2 screwdriver and a small flat screwdriver
- Tin/lead solder wire
- A digital multimeter

If you don't have these tools you can order them in the [Dada Electronics Webshop](#).

The components in the 405 upgrade-kit:

Cables & connectors & mechanical components:

- 2x Insulated LS-chassis connectors with red markings
- 2x Insulated LS-chassis connectors with black markings
 - Or two double LS chassis parts
- 2x Gold-plated RCA-sockets with White (or Black) and Red markings
- 5x 60cm flexible 0,75mm cable for internal wiring (Green for mass, Yellow for AC-current, Blue for the LS-outputs, Black for – DC-current, and Red for + DC current).
- Shielded audio-cable, 50cm (mono or stereo)
- 10x Faston PCB-connectors, female
- Thermal insulation-gain, 30cm
- Thermal compound

Components to be mounted in the chassis:

- 2x capacitors 10.000 μ F 63V (or 100V) for the power-supply. If you ordered the kit without the PSU capacitors or if you will use the dual mono power supply the PSU capacitors are not included.

Components to be mounted on the driver-boards:

Don't replace R6, R4 and C4 if you want the sensitivity to stay at 0.5V

- 2x Op Amp chips OPA604 (or OPA627 as an option)
- 2x R 100K 1% for R6 (Brown-Black-Black-Orange-Brown) (for 1.5 V Sensitivity)
- 2x R 220K 1% for R6 (Red-Red-Black-Orange-Brown) (for 0.775 V Sensitivity)
- 2x R 6K8 1% for R4 (Blue-Grey-Black-Brown-Brown) (for 1.5 V Sensitivity)
- 2x R 15K 1% for R4 (Brown-Green-Black-Red-Brown) (for 0.775 V Sensitivity)
- 4x R 3K for R7and R8 (Orange-Black-Black-Brown-Brown)
- 2x R 2K7 for decoupling D2 (Red-Violet-Black-Brown-Brown)
- 4x Zener diode 15V 1.3 W for D1/D2
- 2x C 100nF decoupling-capacitors for D1
- 2x C 100 μ F 16V for C2
- 2x C 150nF 10mm pin spacing for C4 (for 1.5 V Sensitivity)
- 2x C 68nF 10mm pin spacing for C4 (for 0.775 V Sensitivity)
- 2x C 100 μ F 25V for C5
- 2x C 100 μ F 63V for C10

- 2x C 10 μ F 35V Bipolar for C17 (for the clamp-circuit, which can be on the main Pcb, or on a separate Pcb connected to the output terminals, or absent). See the service manual for information concerning the serial numbers and the modifications.

Extra components for the 405-2:

- 4x 47 μ F 16V for C18 and C19

To reduce the switch off noise of the amplifier we decouple (**after we replaced D1 and D2 with the new zeners!**) D2 with a 2K7 resistor. The decouple resistor is soldered parallel to D2 at the copper side. We decouple D1 with 100nF (soldered parallel to D1), also on the copper side of the Pcb.

C2 must be connected with the + to signal ground! To maintain 0V DC at the speaker output, the output voltage of the Op Amp is +1.2 or +1.5V DC (depending on the version of the 405). The DC voltage at the negative input terminal of the Op Amp must be negative to accomplish this. This is the result of Quad's choice of using an inverting Op Amp circuit. In practice this negative voltage is very low, but not zero. Quad "solved" the problem by using a non-polar electrolyte for C2 in later versions of the 405. But a polarized electrolyte is better suited for the job. That's why we advise a polarized cap but placed in the right way.

Options (you can order these options from our [Webshop](#))

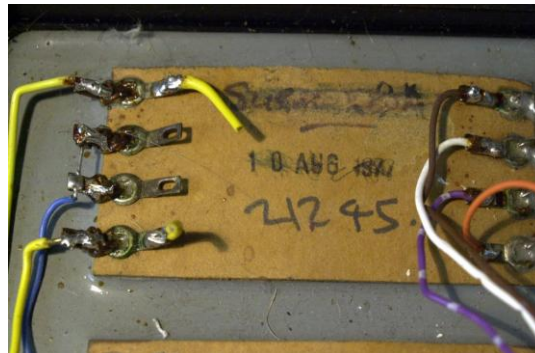
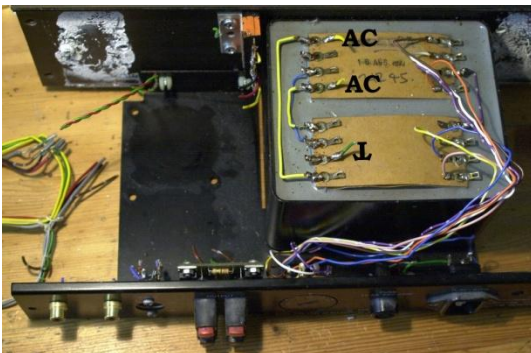
- OPA627AP Op Amps instead of OPA604AP
- Capacitor mounting rings
- Dada Electronics Delay / DC Protection with opt coupler – mono (two needed)
- Dual mono power-supply board standard
- Dual mono power supply board with BHC Aerovox
- 300VA Toroid transformer with mounting-plate
- MJ15003 power-transistors

All other 405-components are also available in the [Webshop](#)

Step 2 – Dismantling the 405



- Remove the top-cover (Philips n°2, 2 screws)
- Remove the bottom-cover (4 screws)
- Remove the side-panels (2x 3 screws)
- Remove the wires from the 2 driver-boards (5 wires per board)
- Remove the driver-boards (2x 4 screws)
- Remove the heat-sink compound from the driver-boards with kitchen-roll paper (don't use cleaning-products)
- Remove the 2 PSU-capacitors and mounting-rings.
- Disassemble the cable-beam. Remove all cables **except** the cables between the power-socket, fuse, voltage-selector and the primary side of the transformer. Also leave the three link wires on the secondary windings in place.
- In most 405-1 the clamp-circuit is soldered to the LS-connectors. Desolder it and keep it apart. In some 405-1's and the 405-2 the clamp-circuit is integrated on the driver-boards.



The first step is to remove the top- bottom- and side panels. Sometimes, after 30 years, the screws are hard to remove. The best screwdriver to use is a Philips n°2 with a length of at least 20 cm. We now understand why Quad made 4 holes on the left- and the right side of the back panel: they were intended to facilitate manipulation of the screws of the circuit-boards. I don't need to mention it's useful to keep the screws apart.

They can be replaced (they are 4mmx14mm - which is a standard-size) but of course there is not much use in replacing the screws.

The first impression of a newly opened 405 is usually a dusty one. This doesn't matter (in this stage ;-). On the 405 on my table the voltage-selector is at 240 Volt. Set the voltage according

to the voltage in your country. In later models the voltage selector is omitted. See the service manual on how to adapt the unit for different mains voltages.

The connectors will have to be replaced (except the DIN-connector). The original LS-connectors were not that good in the first place; they are due to aging, oxidized and will give a bad contact in most cases.

The PCB-connectors also have to be replaced as they are oxidized and we will use new cabling. Don't spend time desoldering the cables, cut them off. They will have to be replaced anyway. The cable-beam of the 230V-side of the transformer can stay in place, there is no improvement in replacing it as there is only +/-1 Amp max going through it.

On the secondary side of the transformer we'll deal with up to 10 Amp so we will replace the cabling here (not the three links!).

About the clamp-circuit. If you will use a Dada Electronics DC-protection/delay you can remove the clamp-circuit. Otherwise you should re-use it. There must be some kind of DC-protection for the outputs; otherwise your speakers risk damage if something goes wrong.

Step 3 - Upgrading the circuit boards.



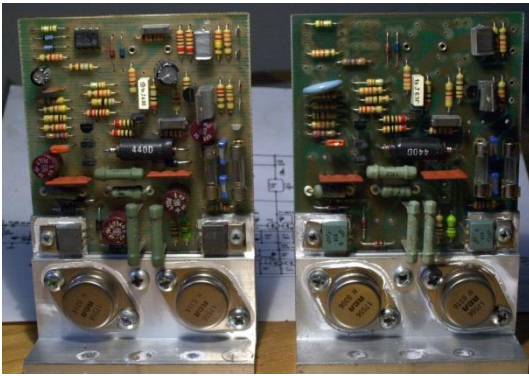
Depending on the version of the circuit boards there will be some differences in the layout of the boards.

In the 405-1 from board number M12565 iss 3 and the later 405-2 the clamp-circuit was integrated on the circuit board, instead of a separate board connected to the output terminals, and some extra 47uF caps (405-2) were added to the current-limiters. Prior to serial 9000 there was no clamp circuit, but a lot of units are converted at a later stage.

On the picture above we see a 405-2 circuit board with the integrated clamp-circuit.

If you have a stabilized power-supply (+ and – 50 Volt), a function-generator and a scope you might test the boards before upgrading them. If you don't, no problem, you can upgrade the boards without them.

When you connect a dual power supply to the board (+ and – voltage to the PCB-connectors, mass to the aluminum heat-sink (don't use the input mass for this!), you should read about 110 mA in the – power-line and 80 mA in the + power-line. This means the power- and driver-transistors are OK. It is a good practice to upgrade the boards one by one. So we can compare between the boards if we want to see the polarity of capacitors or diode's or if something goes wrong.



Replace the other components before you replace the Op Amp chip. This way we avoid static discharges.

- *Remove R4, R6, R7, R8, D1, D2, C2, C3 (from board M12565.5 omitted), C4, C5, C10 and IC1.*
 - *Leave R4, R6 and C4 in place for 0.5V sensitivity*
- *Remove C17 from the board or from the separate clamp circuit on the output terminals, prior serial 9000 there was no clamp circuit. But some units are converted at a later stage*
- *Remove the old PCB-connectors*
- *Replace R6 with 100K for 1,5V sensitivity*
- *Replace R4 by 6K8 for 1.5V sensitivity*
- *Replace R6 with 220K for 0.775 V sensitivity*
- *Replace R4 by 15K for 0.775V sensitivity*
- *Replace R7 & R8 with 3K*
- *Replace D1 & D2 with Zener 15V 1,3W (watch the position of the stripe!)*
- *To reduce the switch off noise of the amplifier we decouple D2 with a 2K7 resistor. The decouple resistor is placed at the copper side.*
- *Decouple the Zener-diode D1 on the copper side of the board with a 100nF capacitor.*
- *Replace C2 with 100μF (watch polarity!)*
- *Replace C4 with 150nF 10mm pin spacing, in combination with R6 is 100K*
- *Replace C4 with 68nF 10mm pin spacing, in combination with R6 is 220K*
- *Replace C5 with 100μF (watch the polarity!)*
- *Replace C10 with 100μF (watch the polarity!)*
- *Replace C17 with 10uF bipolar, on the board or on the separate clamp Pcb, if present*
- *In the 405-2 also replace C18 & C19 with 47μF (watch the polarity!)*
- *Replace the Op Amp with OPA604 (or OPA627). Avoid touching the chips with your fingers, use pliers.*

By changing the input-circuit feedback we reduced the sensitivity of the input to 1.5 V (Line-voltage) or 0.775 V (0 dBm) which is better suited for modern input-sources. This also reduces noise & distortion with another 9 or 4.5 dB.

We did this by adjusting local feedback and DC feedback.

Step 4 - Testing the circuit boards

When both boards are upgraded we'll connect them to a sinus-generator and to the scope. We'll connect + and - 50 Volt with our lab power-supply and connect a true-RMS multimeter to check the input- and output voltages.

Following measurements are OK: Max 0,01 Volt DC on the outputs, 30 .. 32 Volt AC on the outputs before clipping. This corresponds with 110 .. 125 Watt into 8 Ohm, 1,5 Volt AC (or 0.775V or 0.5V), depending on the chosen sensitivity) on the input before clipping. *If you don't have all this lab-equipment, skip this step. We will make sure later that there is 0 VDC on the output and that the power-consumption in the power-lines is 200 .. 300 mA maximum when the amplifier is standby.*

Re-check both sides of the boards to make sure that the polarity of the electrolyte capacitors and the diodes is correct and that there are no soldering short-circuits between the PCB leads. Also re-check all the new soldering joints.

Step 5 - Fitting in the Power Supply capacitors, clamp circuit and the connectors

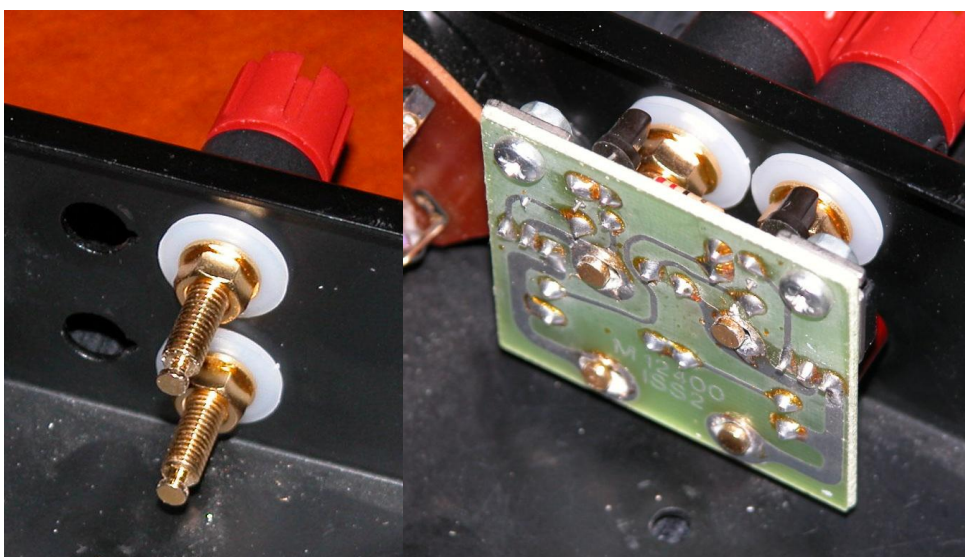
It is important to do these steps in the correct order as it makes it more practical to reach certain components.

In the Dada Electronics 405 upgrade-kit new mounting-rings for the PSU-capacitors are optional. You should drill 2 new holes in the bottom-plate to fit them. Drill those holes on the transformer-side at the right distance. Use a 4mm drill.

If you don't use the mounting rings you can fit the capacitors in the old rings with transparent Silicone. Make sure it dries for 24 hours. See the picture below for the correct placement of the capacitors. Watch the position of the positive and negative terminals. As an alternative you can use a piece of bicycle inner tire or some duct tape around the capacitors to fit them.

Installing the separated Clamp circuit board (depends on version)

First we have to install the LS connectors with the insulating washers in place. Lock them firmly without any play, but do not over tight them! Enlarge the holes in the PCB with a good quality 4mm drill; be careful not to damage the PCB. Solder the wires as explained in the following steps, and the PCB to the end of the LS connectors.



We'll mount the LS-outputs and the RCA-inputs and a part of the wires before we fit in the capacitors. This makes working on the back-panel and soldering easier. Double-check the isolation with a multimeter. The new RCA-inputs are isolated from the chassis as well but the mass is connected to the chassis via the DIN-input socket. The left and right channels and the masses are connected with bell wire to the DIN connector. So the DIN connection and the RCA sockets are connected in parallel. In some cases the holes for the RCA connectors should be enlarged with the right size drill. Sometimes the removal of the insulating rings of the RCA connectors will solve this problem, because the mass of the RCA connectors is also connected to the mass of the DIN connector and to the chassis, removal of the insulating rings is no problem.



- Mount the (Black) mass LS-connectors, or the supplied double connectors
- Connect a Green wire from the mass LS connectors towards the central mass-point on the front panel (these wires will be connected to the central mass-point later). We already put these wires in because it is easier to solder them to the LS connector or clamp Pcb when the capacitors are not in place.
- Mount the (Red) hot LS-connectors above the Black ones. They need to be isolated from the chassis. Make sure that the holes in the connectors (on the outside) are in a horizontal line (**not a vertical line**) otherwise Hot & Cold wires could touch each other causing the amplifier to break down.

Step 6 – Cabling & Re-assembly

We start by cabling the power-supply. For internal cabling counts: the shorter the better. We'll use high-quality flexible 0,75 mm in 5 colors for everything except the 230 Volt lines. :

We'll use the following colors:

- Yellow for AC power-lines (between the transformer and the rectifier bridge)
- Red for the +50 Volt line
- Black for the -50 Volt line
- Green for the output-mass
- Blue for the LS-output lines



For the inputs we'll use shielded cable between the RCA-connectors and the driver-circuits. It is better to twist all cables that have to be soldered to the same point together before tinning them, it makes soldering a lot easier. See the drawing on page 12 for reference.

- *Connect the "+" and the "-" connection of the Psu capacitors on the left-side (seen from behind) to the central mass-point with green wire*
- *Connect the "+" of the front-capacitor (closest to the heat sink) to the "+" of the rectifier bridge with red wire and add 2 cables from the capacitor to the amplifier boards (don't connect them yet to the boards)*
- *Connect the "-" of the second capacitor to the "-" of the rectifier bridge with black wire and add 2 cables from the capacitor to the amplifier boards (don't connect them yet to the boards)*
- *Connect both AC-inputs of the rectifier bridge to the secondary circuit of the transformer with yellow wire*
- *Connect the "neutral" (middle) secondary connection of the transformer to the central mass-point with green wire, so in total 4 wires to this mass point! (2 from the speaker connectors, 1 from the transformer and 1 from the capacitors)*

See also the picture on page 4 for the AC and mass connections.

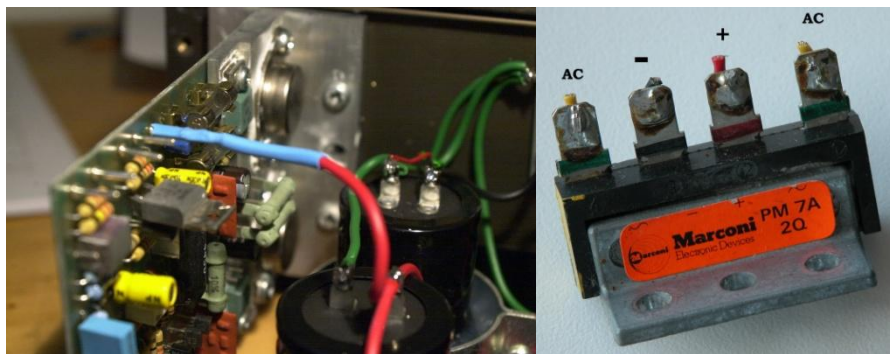
Before connecting the mains power re-check the polarity of the caps and the rectifier-bridge. Compare with the schematics.

Warning If the polarity of the caps is wrong they will explode!

We test the Psu voltages first. They should be around + and – 50 Volt DC. Once the capacitors are charged, the voltage will be there for a long time, so discharge the capacitors with a 1k resistor. Check the voltage of the capacitors with the multimeter. A few volts are acceptable. When the amplifier boards are connected, discharging will be done automatically.

Once the power-supply is OK, we mount both boards adding thermal paste to ensure maximum heat-conduction with the chassis.

We can now connect the + and - power-lines to the boards (don't switch them or you'll kill the output-transistors!) as well as the LS-output cables to the red LS output-plugs.



It is no luxury to use some Raychem (or other) Heat Shrinkable Tubing for insulating the +, - and output connections, as there are large voltages between them.

- *Connect the "+" and "-" leads from the power-supply to the boards*
- *Connect the LS-outputs of the boards to the clamp-circuit, the LS-connectors (for a 405-2) or the DaDa LS-protection*
- *Connect the inputs to the RCA-plugs with shielded cable*
- *Install the boards using new Heat Sink compound*

- *Re-assemble the amplifier is reverse order*

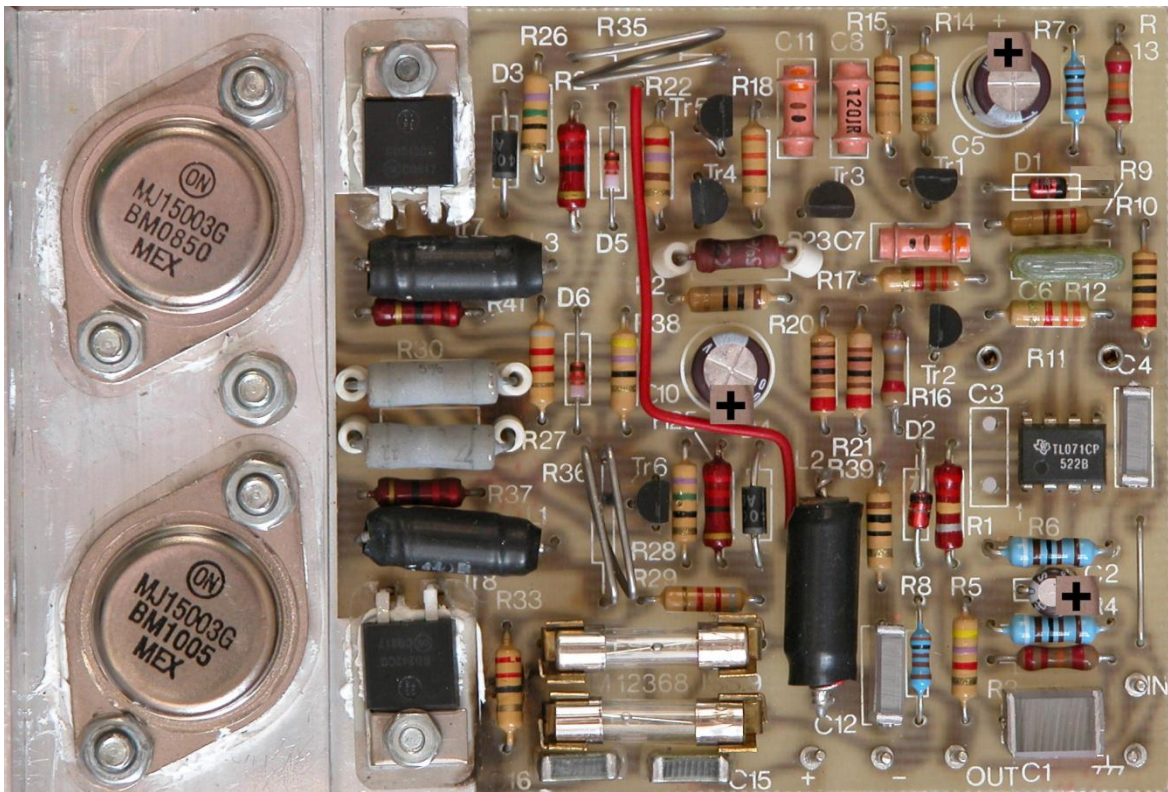
Before connecting mains-voltage we should check all cabling again with the Ohm-meter. We should also re-check that each channel uses around 120 mA in the + and 80 mA in the - power-line and that there is less than 0.1 Volt DC on the outputs (typically 0,01 Volt). If it passes these final tests we can now connect the speakers and the preamp and... enjoy the music ;-)

If there is any problem don't hesitate to send me an e-mail (info@dadaelectronics.eu). A picture and a good description will help us to solve the problem.

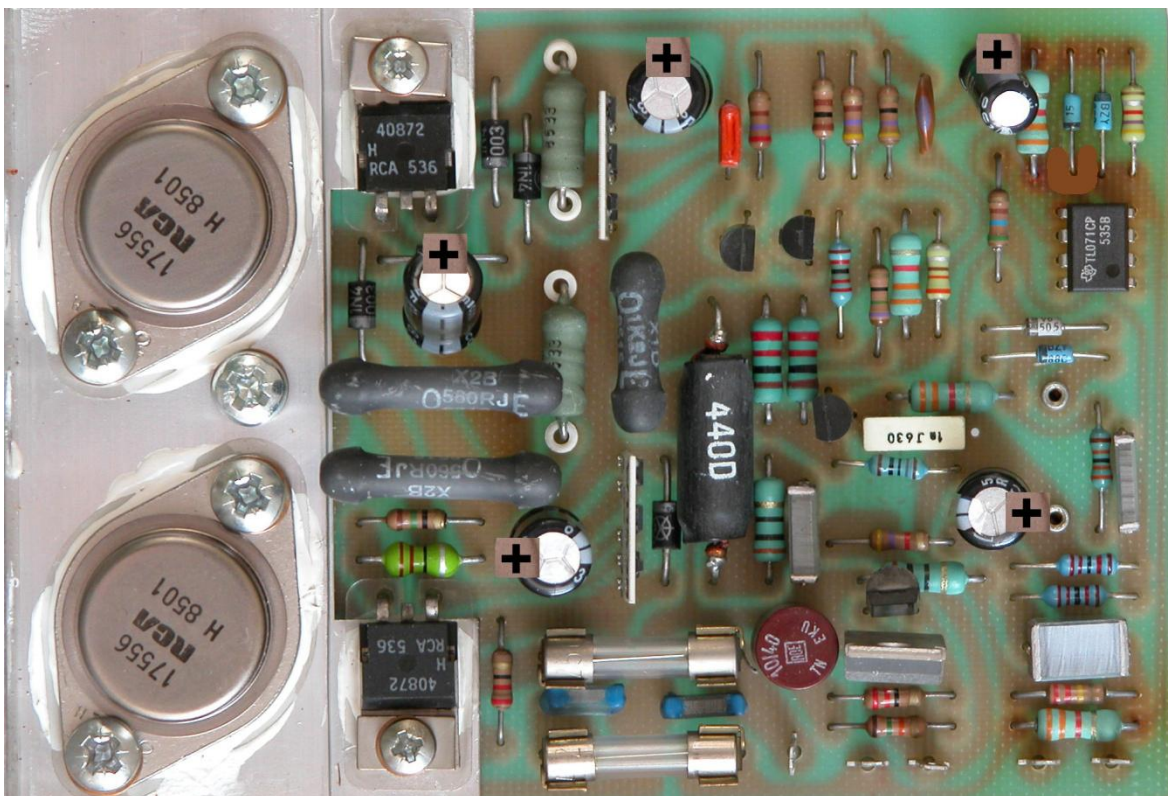
Stefaan and Joost

Appendix 1 Photo's with the polarity of the capacitors

Decouple caps for D1 and D2 are soldered at copper side, only the decouple cap for D1 is polarized.

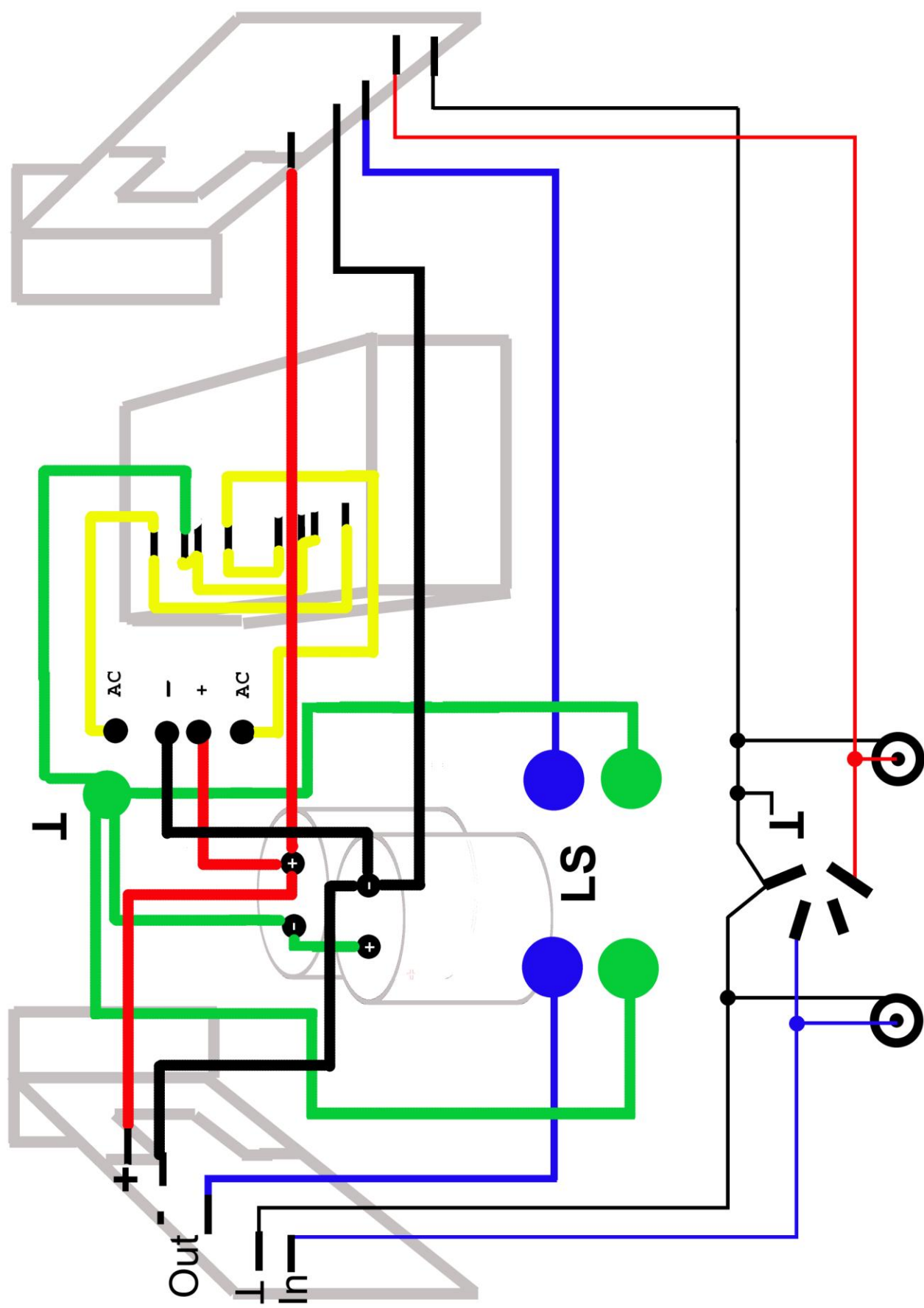


405-1



405-2

Wiring the 405



Color coding of resistors.



To distinguish left from right there is a larger gap between the D and E bands.

- band **A** is the first significant figure of component value (left side)
- band **B** is the second significant figure
- band **C** is the third significant figure
- band **D** is the decimal multiplier
- band **E** indicates tolerance of value in percent

Color	A First figure	B Second figure	C Third figure	D Multiplier		E Tolerance
Black	0	0	0	×1		–
Brown	1	1	1	×10		±1%
Red	2	2	2	×100		±2%
Orange	3	3	3	×1K		–
Yellow	4	4	4	×10K		–
Green	5	5	5	×100K		±0.5%
Blue	6	6	6	×1M		±0.25%
Violet	7	7	7	×10M		±0.1%
Gray	8	8	8	×100M		±0.05%
White	9	9	9	×1G		–
Gold	–	–	–	×0.1		±5%
Silver	–	–	–	×0.01		±10%
None	–	–	–	–		±20%

Example: Red, Red, Black, Red, Brown

220 X 100 = 22Kohm and 1% tolerance

The identification of the plus and minus of electrolyte capacitors.

In almost all cases the minus is indicated with a long stripe with symbols at the side of the can in the color of the printed text.



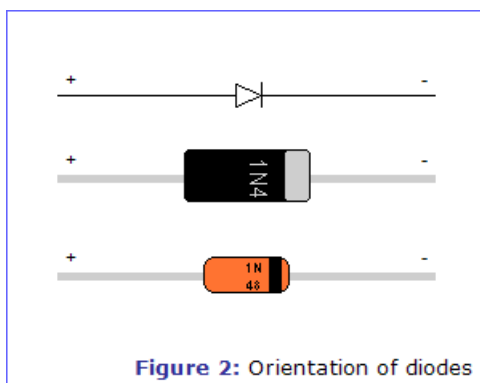
Also if the capacitor has wires, the minus wire is the shortest one!

Capacitors with screw terminals will have sometimes the stripe indication or have indications on top of the capacitor, if any doubts, contact us! Connecting capacitors in the wrong way could give a lot of damage.



With axial capacitors there is an extra arrow indicating the minus wire, or there is a printed small ring around the body indicating the minus wire. Also the minus wire is direct connected to the aluminum body. The plus wire is sticking through the black plastic cap.

Indication of the cathode of diodes and zener diodes



The cathode will be indicated by a white, silver or black line on the body of the diode.