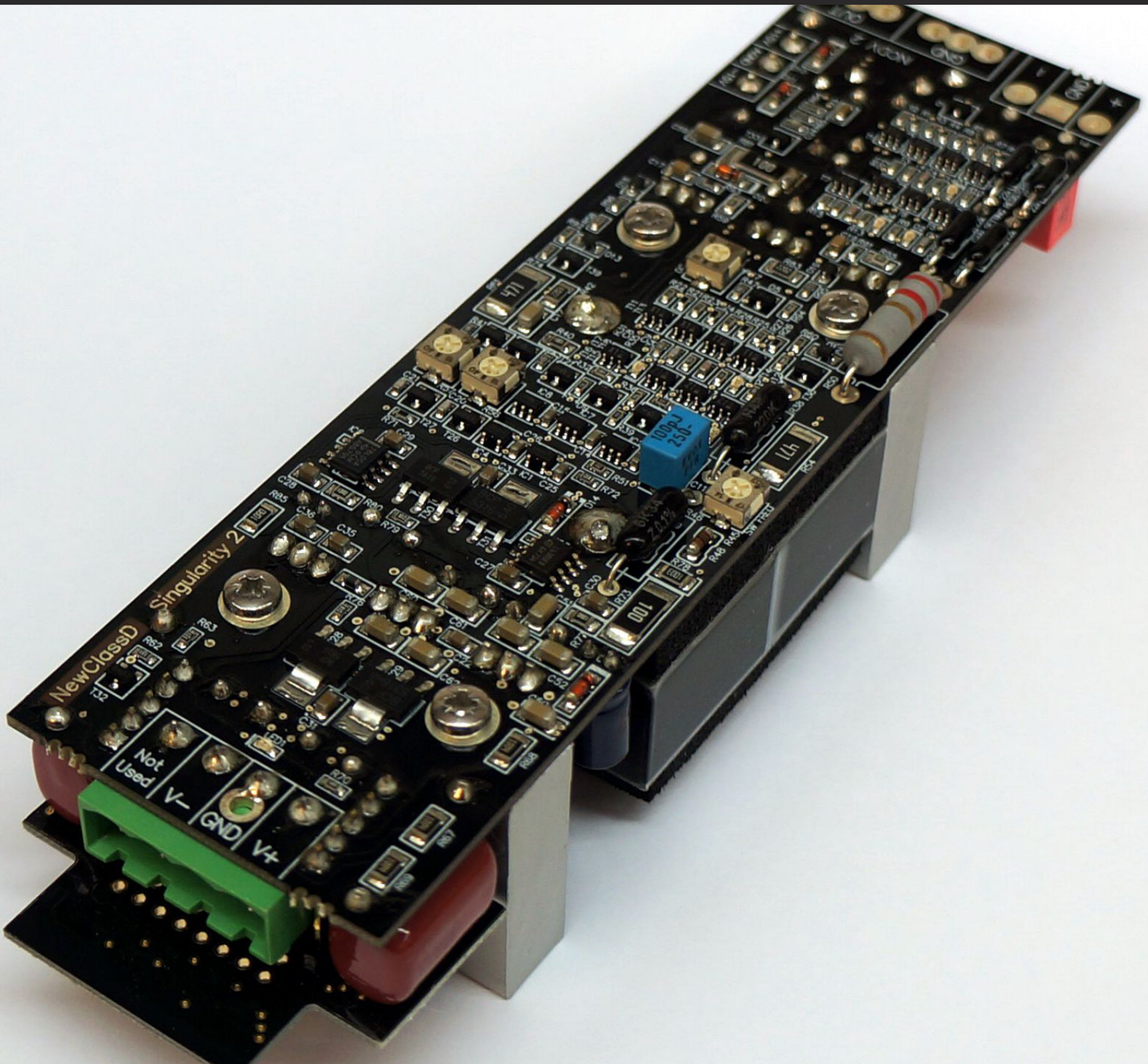


NewClassD

Singularity 2



Cookbook

ver 3.01 - 2018

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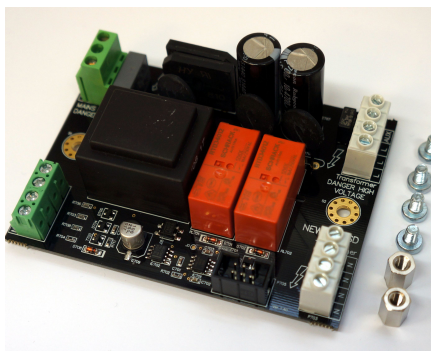
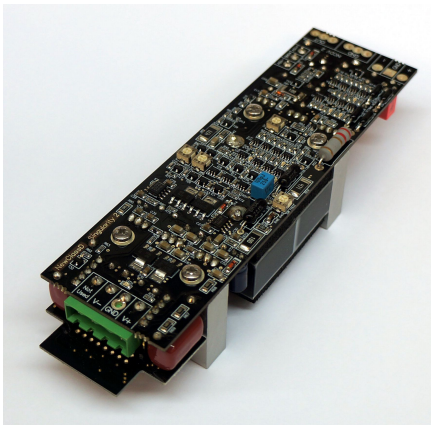
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This booklet released June 2018

Shopping list for building a working amplifier.

2	Singularity 2 modules.	NewClassD product
1	Big Cap Power Supply module.	NewClassD product
1	Soft Start module.	NewClassD product
1	Transformer 500 - 1000 VA.	User Source
1	Enclosure with aluminium bottom plate	NewClassD can source
1	Pushbutton switch with LED light	NewClassD can source
4	Speaker Binding Post	NewClassD can source
2	RCA jack chassis connector	NewClassD can source
2	XLR 3 pin Female Neutrik NC3FD-LX-B	NewClassD can source
2	IEC Mains inlet with fuse holder	NewClassD can source
4	m. 12 AWG silver plated wire with teflon	NewClassD can source
2	m. 20-22 AWG silver plated wire with teflon	NewClassD can source
1	m. Hookup wire 2.5mm or 14 AWG.	NewClassD can source
15	cm. Hookup wire 1.5mm yellow/green.	NewClassD can source



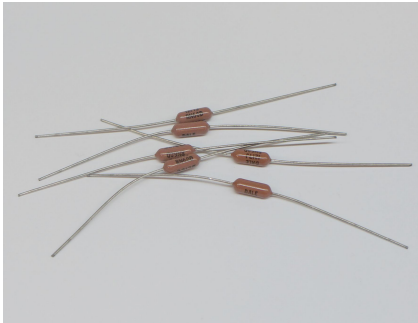
This is for a basic build, and since this is DIY you can expand the features any way you like, and options will be covered later in this cook book.

Choose the right modules.

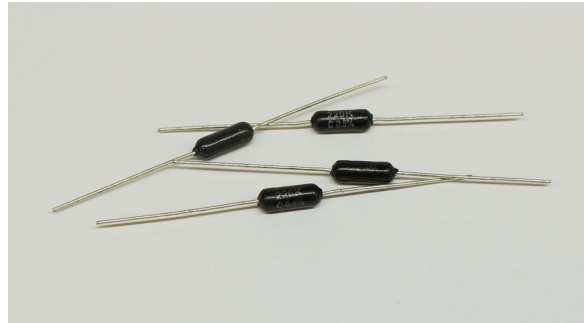
There are three different versions of the Singularity 2 module, and two different versions of the Big Cap power supply module.

Choosing the Singularity module.

The difference between the three version lies in the grading of the audio handling resistors. Those are the two feedback resistors, and the four gain setting resistors. The **Standard** version uses Vishay Dale RN60 or CMF55 style resistors, a good quality 1% resistor, as found in many high end amplifiers.

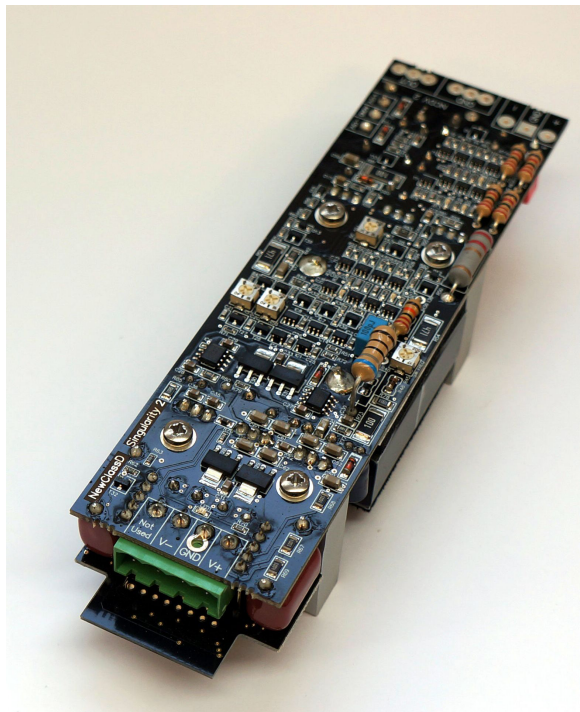


RN60



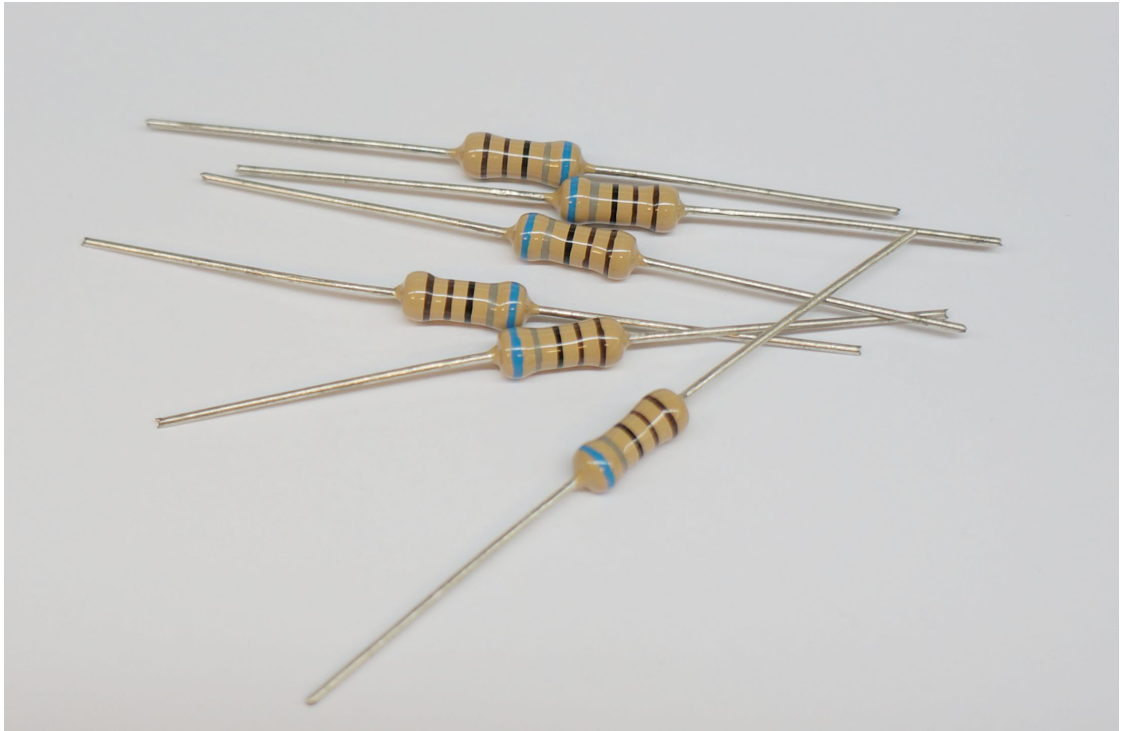
HOLCO H4

Taking it up to the next level we have the **High Grade** version, which uses HOLCO H4, and H8 or Welwyn RC55 resistors, in tolerance of 0.5% and 0.1%. These have much better resolution in the top frequencies, and the depth perspective is clearer. Great sounding resistors.



For the ultimate performance we have a version of Singularity using original Audio Note (r) tantalum resistors. These have all the precision of sound stage like the High Grade version, but add a big spoon of musicality.

The flow is just amazing, and they are very easy to listen to, while not sacrificing a mm of precision and perspective. One surprising property of these resistors is that the bass region will have resolution to an unheard of degree, you can start to hear details in 100 Hz area and up, like never before. But they come at a hefty price tag.



Audio Note (r) Tantalum resistors

Choosing the right power supply module.

The difference of the two modules offered is the size of capacitance. Both use the outstanding United Chemicon US made U36D series 3" cans. They have a warm bass and lower mid, while the electrolytic will not interfere too much in the tops, letting the on board Panasonic MKP capacitor ensure a smooth, and clear, ultra detailed and airy top.

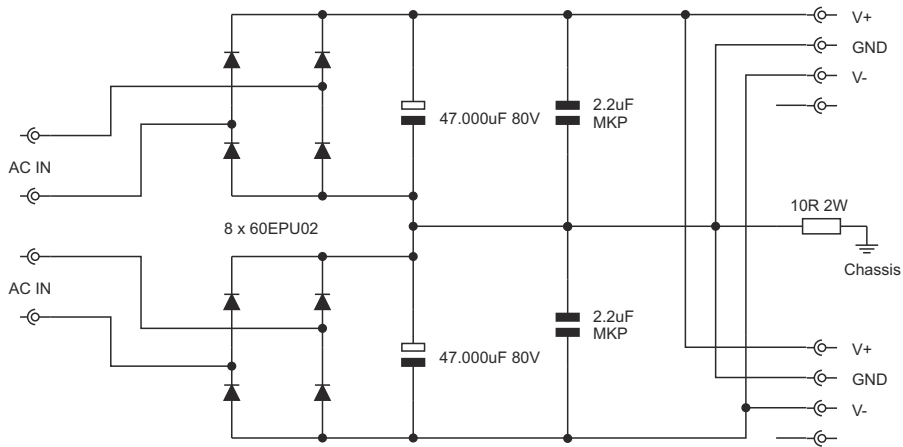


There is a big difference in physical size, the bigger 100.000uF per can version is rather large, with a total length of almost 200mm. See the exact dimensions on www.newclassd.com/index.php?page=116. The smaller 47.000uF per can offering is the universal solution fitting perfectly with most speakers. Even it's the smaller of the two options, it's still bigger than you will find in most amplifiers up to the \$10.000 price range. It has a good balanced bass performance.



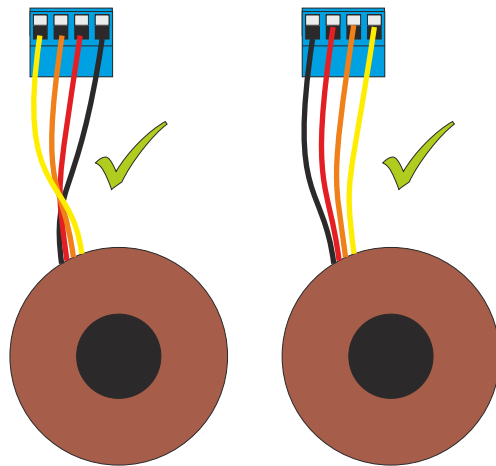
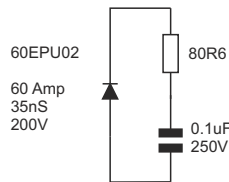
Should you require a more tight control and a bit slimmer bass, then you can opt for the big 100.000uF version. It has plenty of muscle to control even the most difficult speaker loads, and will take control over boomy bass boxes. However if your speakers are leaning towards undersize compared to the installed room, the big capacitors will make the bass even slimmer, so in that case we recommend the smaller 47.000uF version. The U36D cans are carefully chosen, and in numerous comparison with other capacitor brands, have shown themselves to win sound quality hands down.

Both power supply versions will fit inside an 80 mm enclosure, and both are capable of 80V per rail.

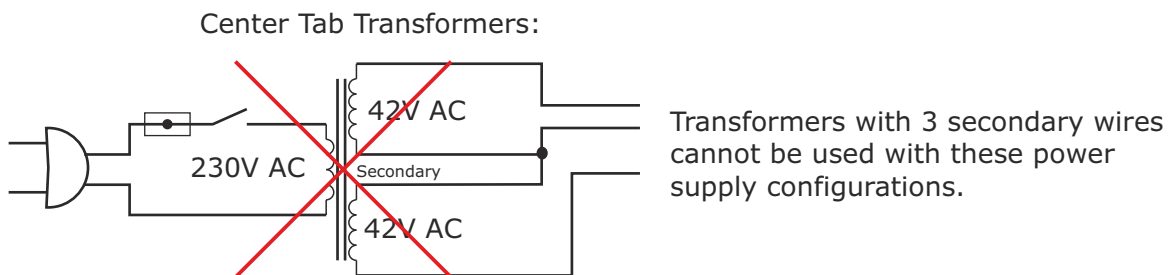


Schematic of the NewClassD Big Cap power supply module model 2018. It is suitable for a standard transformer with 4 secondary wires. You can interchange the two secondary windings as you please, so assemble the secondary wires from dark to light colors, or from light to dark colors it makes no difference.

We use the Vishay 60EPU02 ultra fast soft recovery diode, as it will give a better level of details in the top frequencies compared to a standard bulk recitifier.



Each diode has a noise reducing snubber network consisting of a 80R6 resistor and a 0.1uF 250V WIMA capacitor.



The Singularity 2 modules require only + and - 60V, so you can also build your own version of the perfect power supply.

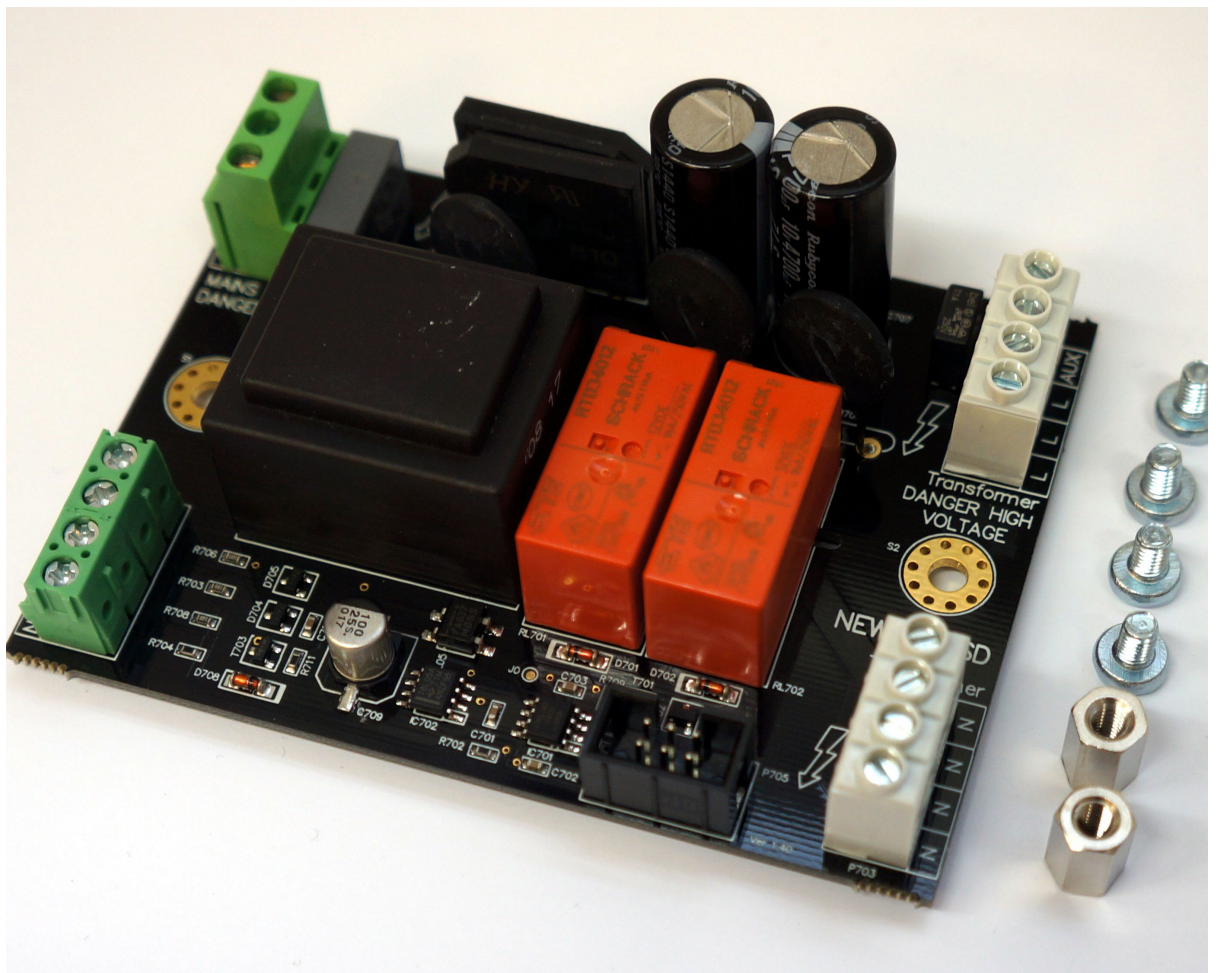
Soft Start Module.

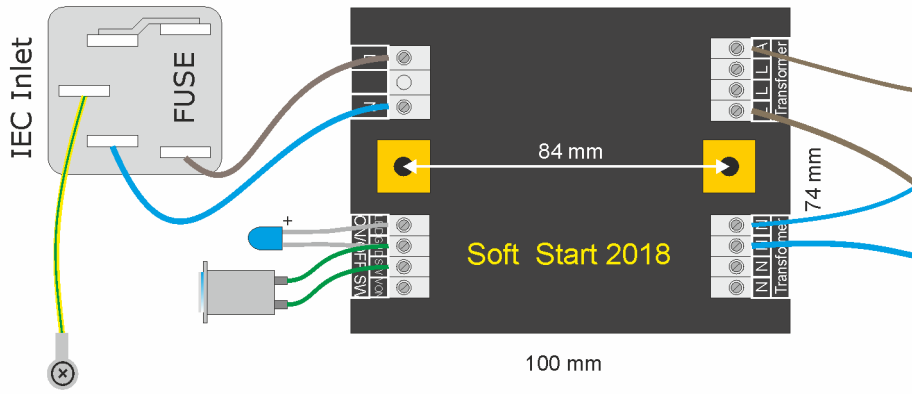
A soft start module slowly charges the mains capacitors and magnetizes the mains transformer, to avoid heavy current surges on the mains, and thus preserve the fuses and switches. The full mains power is switched in after a 2 second delay. Our soft start module has microprocessor control, and will also double as an offline switch, so you can use a nice pushbutton switch with LED indicator for mains switch.

Just a small signal switch is fine, and it is isolated from the mains by a class 2 safety barrier. You can use either a pushbutton type, with momentary action, or a stable switch, like a rocker switch, which ever you prefer. See the connections on the next page. You can even add an external 12V signal, from your preamplifier, which can remotely switch your amplifier on or off.

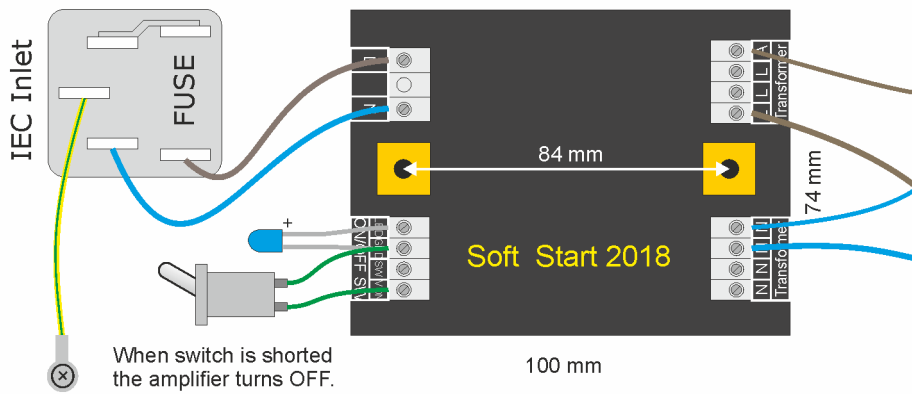
DC Filter.

If your transformer receives a small DC voltage from the mains it will make mechanical noise, which we like to avoid, That is why a DC filter is a must in any high end amplifier. So we placed one on the soft start module.





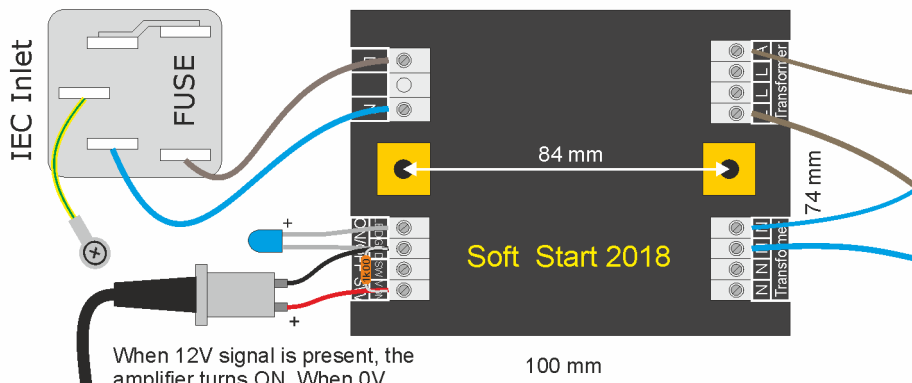
Connection of the Soft Start Module with a momentary on/off switch.



When switch is shorted the amplifier turns OFF.

(The toggle function should initially be set to ON - connect SW to GND momentarily in case nothing happens).

Connection of the Soft Start Module with a stable on/off switch.



When 12V signal is present, the amplifier turns ON. When 0V (or less than 0,7V) is applied then the amplifier turns OFF.

(The toggle function should initially be set to ON - connect SW to GND momentarily in case nothing happens).

Connection of the Soft Start Module with a 12V signal.

In some cases you may have to connect a 1k resistor from VON to GND.

Selection of power transformer.

From a strict loading perspective the transformer does not have to be very big to produce a significant audio output. We usually recommend the transformer should at least be of the same power that you want out of your amplifier. This will keep everything safe. For ex. if you want 2 x 250 Watt RMS out, you can get by with a 500 VA transformer for 2 channels. Mind the rating of the transformer is a thermal long term rating, so it's what it can put out continuously. But in short bursts, the transformer can deliver 3-4 times as much power. So for bare necessities, you do not need to overdo your mains transformer.

However a bigger transformer will give you sound improvements, unexpectedly mostly in the top mids and high frequencies.

So if you have no limitation on space, weight and budget, we recommend using a 630-800VA per channel, or a 1000 VA for a 2 channel amplifier. But remember when you venture over 800 VA the problem with mechanical noise from the transformer will start to be significant. In some cases it's better to use two 500 VA's instead of one 1000 VA, just because they are more quiet.

If your speakers are 4 Ohm, use a 2x40V AC secondary voltage, giving you 400W RMS per channel of audio power. if your speakers are 8 Ohms you can go up to 2x50V AC, but think about the added heat dissipation, making your amplifier run hotter or demanding more focus on the heat sink design.

So if you can get by with 200 Watt RMS in 8 Ohm, you should go for the 2x40V AC secondary also in 8 Ohms.

With old school Class A/B amplifiers the cost increases when you increase the output power, that's why many think of a 200 Watt amplifier being 'worth' more than a 100 Watt amplifier. We are used to pay 1000 bucks for the 60W amplifier, and 1500 for the 100W version.

In Class D the only difference is the voltage of the transformer, and possibly the power rating of the transformer as well, that makes the difference.

So almost no added cost when going from 100W to 200W output power, just to take two random numbers.

The 100W Class D amplifier is rationally not 'worth' less than the 200W.

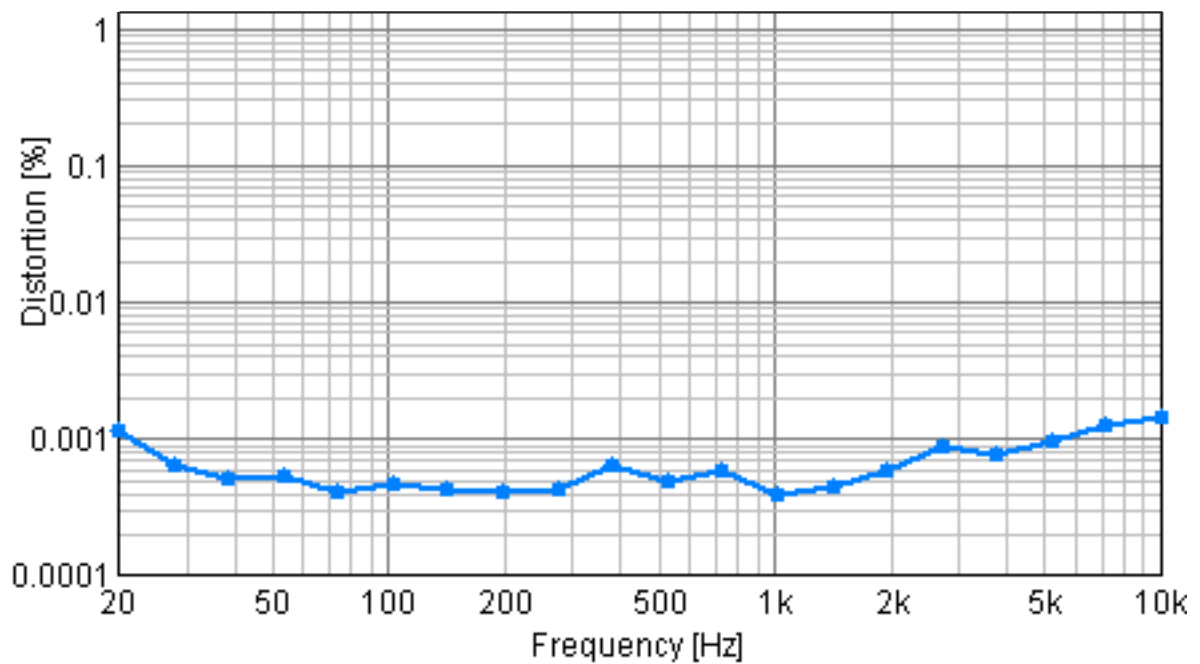
A factor that will push many to go for max. power is that in old traditional amplifiers, a 100W amplifier will usually sound better than a 30W amplifier, even when just playing at 1W. This is because the 1W signal will take up a smaller portion of the linear working span, in the 100W amp compared to the smaller amp. So the distortion at 1W is naturally lower. In a Class D amplifier though, there are no linear working spans, as the amplification is done with 1's and 0's. So in other words one of the great benefits of Class D is, that the 30W will sound every bit as good as the 100W when playing at 1W (The typical high end listening level).

Switched Mode Power Supplies.

The use of Switched Mode is supported, and will work fine, however not recommended, as the old school power supply has a significant better sound quality.

Technical data.

Typical Output power in 8 Ohms	200	Watts RMS
Typical Output power in 4 Ohms	400	Watts RMS
Typical Output power in 2 Ohms	n/a	(safety)
Maximum continous power in 8 Ohms	300	Watts RMS
Maximum continous power in 4 Ohms	600	Watts RMS
Frequency range -3dB 8 Ohms	2-160.000	Hz
Frequency range -3dB 8 Ohms	2-80.000	Hz
THD + N 1W in 8 Ohms typ.	0.0005%	
THD + N 40W in 8 Ohms typ.	0.01%	
Dynamic range	140	dB
Minimum load resistance	3.2	Ohms
Maximum rail voltage	75	Volts
Gain unbalanced	10 (20)	x (dB)
Gain balanced	20 (40)	x (dB)
Output current, RMS	13.3	Ampere
Output current, peak	130	Ampere



The Build!

We assume that you now have all the parts you need handy for assembling your new amplifier.

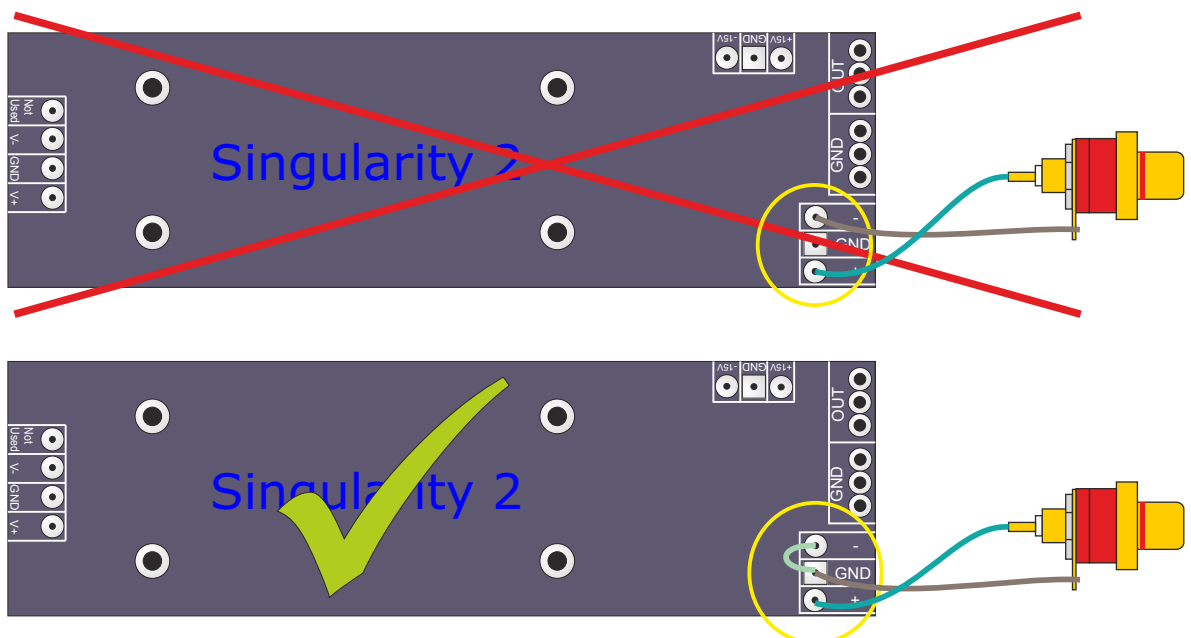
Before you begin.

We provide first some 'Dont's. These are provided to give you a short and sweet of things you should avoid doing to your NewClassD modules during the construction of your new amplifier. We have placed these in the beginning of the cookbook only to make sure you see them, in case you should decide not to read the entire booklet.

Warranty Notice.

NewClassD modules are covered by a limited warranty. In case a module malfunctions, your warranty will cover replacement of the module and other parts delivered by NewClassD, providing the instructions are regarded. No parts which are not delivered by NewClassD are covered by warranty, insurance or other in other way can become liability to NewClassD, it's holding company Lars Clausen Technologies Ltd, or it's insurance companies. However for the parts we deliver, you are well covered in case of any difficulties.

Never do this.



Never use the minus input terminal as GND for your input wire. If you are running unbalanced, short the minus input directly to the square GND terminal right next to it, and connect the screen to GND.

Never re-adjust the trimmers on the module, unless you are absolutely sure what you are doing. There are user adjustments of switching frequency and DC Offset, which are fully user adjustable. But other trimmers are for dead time, and unauthorised readjustment may do damage to the module.

Never use the module without proper heat sink for more than a few minutes.

Never let metallic parts or liquids of any kind come in contact with the module's circuits, other than the connectors. Even when power is turned off.

Never connect more than +/- 80V rail voltage to the module.

If connecting more than 60V DC rail voltage (40 V AC transformer) always use the wet mount option, see later in this chapter.

Never drill holes in the module, anywhere. It will destroy the module.

Bridge load is highly **discouraged**, as the sound quality will suffer.

It is good practice to **always have a 4 - 8 Ohms load** connected to the output, when ever you switch the module on. So in other words it is NOT recommended to start the modules without any load. If you don't like starting up on your expensive high end speakers, that's only human. In that case maybe use a pair of old speakers, or simply a 1W 8 Ohms resistor. When you feel confident that everything is working perfectly, it's time to turn off, and connect your real speakers.

Tools required.

Wire Cutter.

Small Blade Screwdriver.

Medium sized Pozidrive screwdriver.

Full size Caliper.

Solder Iron and solder, we use and recommend 3% silver lead free solder.

Drill machine, and drills. (Maybe also a file for cleaning holes).

Fast on crimper, available at any gas station.

Sandpaper reasonable fine grain.

Vacuum cleaner for removing metal scraps.

Mechanical layout.

First lay down the components of your amplifier in your enclosure, to see how everything can be best fitted inside.

Take the following into consideration, in prioritized order: (If you don't follow these rules, you will not get an optimal result of your amplifier).

1..The module must be bolted onto an aluminium base plate. If the enclosure is made of steel, use an internal aluminium plate or heat sink.

2..Wire distance between PSU and amplifiers must be SHORT! up to 30cm is ok! The PSU wires should be fitted with a ferrite clamp (included).

3..Keep the transformer away for signal wires, speaker wires and the modules. Some people even place the transformer in a separate enclosure, with the rectifiers and extra set of capacitors also placed in that external box.

4..Wire distance of input signal and speaker cables should be as short as possible.

5..Make some space between the modules, 50-100mm is fine, to allow the dissipated heat to spread out easily.

Use a pointy tool to mark up the position of the holes, also see later in this section to find the physical size and hole placement of each module, if required. A caliper is just fantastic for this work.

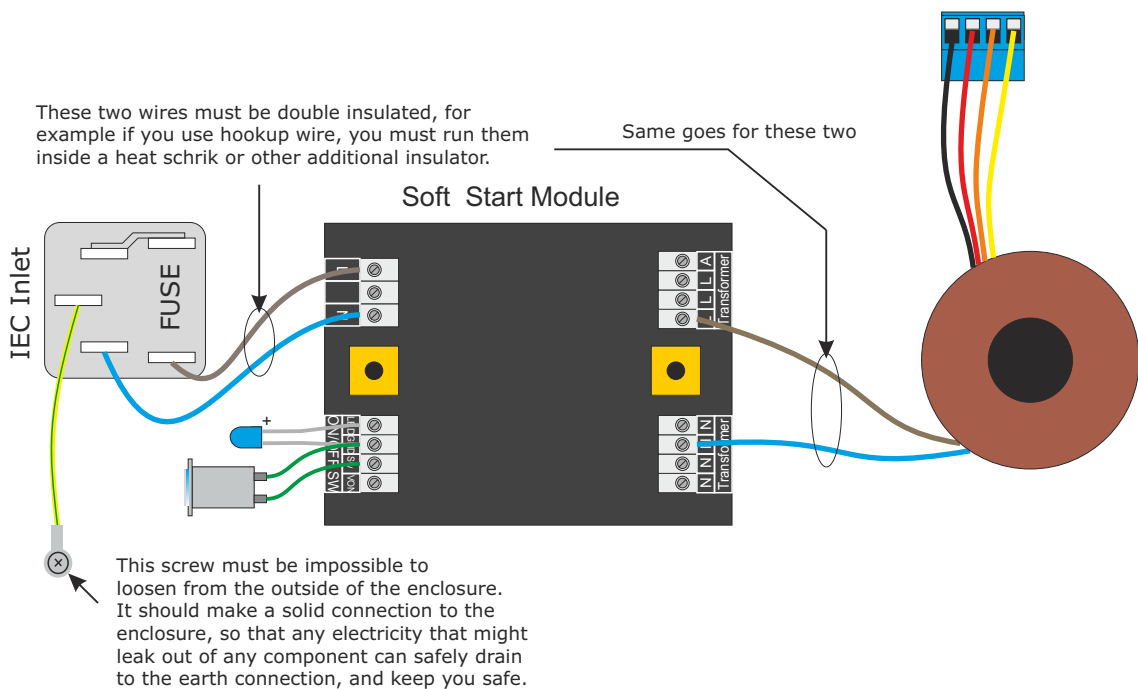
Don't forget the holes for the rubber feet of the enclosure, now is the easiest to drill them. And careful to not place a rubber foot under the transformer.

Then remove all the electronics modules from the enclosure, and drill the holes for fixing the modules. Mark up for the IEC inlet, and drill holes for that. You should also clean the hole up with a file before fixing the IEC inlet. Remember in all holes remove scraps, and make the hole surface smooth, for good thermal contact.

Electrical Safety.

Mainly an issue for the mains side of the transformer. Use only double insulated wiring, or single insulated wire with heatshrink. Crimp terminals / spades should be isolated, and also have heatshrink on top of that, after crimping them on the wire. Ensure all wires are securely fastened (by pulling ALL of them). Make sure you have AT ALL TIMES a mains fuse connected, when the amplifier is on. No bypassing. FUSE size typically 6.3AT.

Make sure your mains wire is DISCONNECTED when ever you work on the amplifier assembly.



Important if your IEC inlet has a safety earth pin (if it has 3 pins total), then your amplifier is in electrical safety terms, a Class 1 apparatus, and then you MUST connect the earth pin to a safety earth in your mains outlet. It is not a audio related option, but a safety issue. The wire from the IEC inlet to the chassis MUST be yellow color with green stripe.

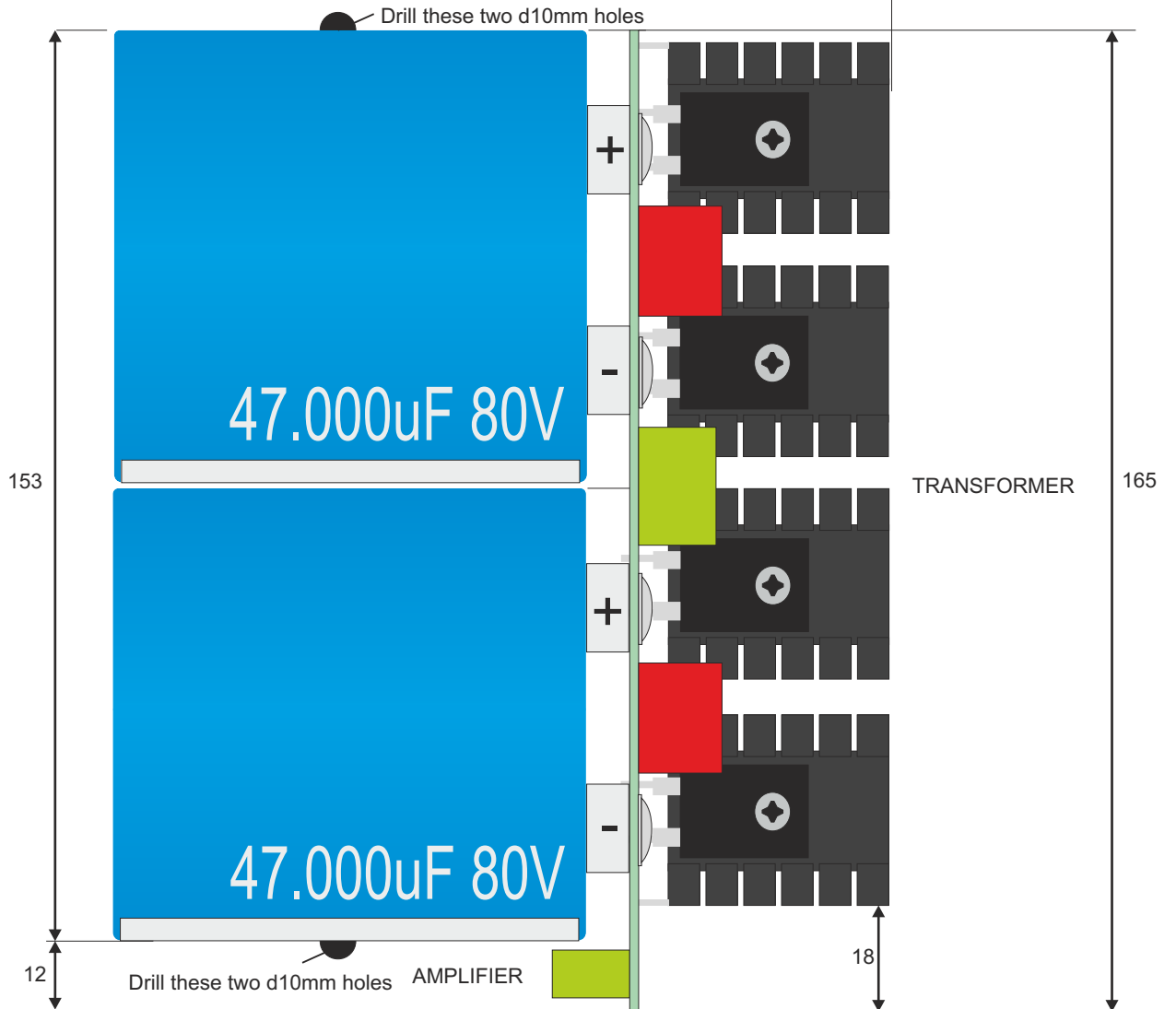
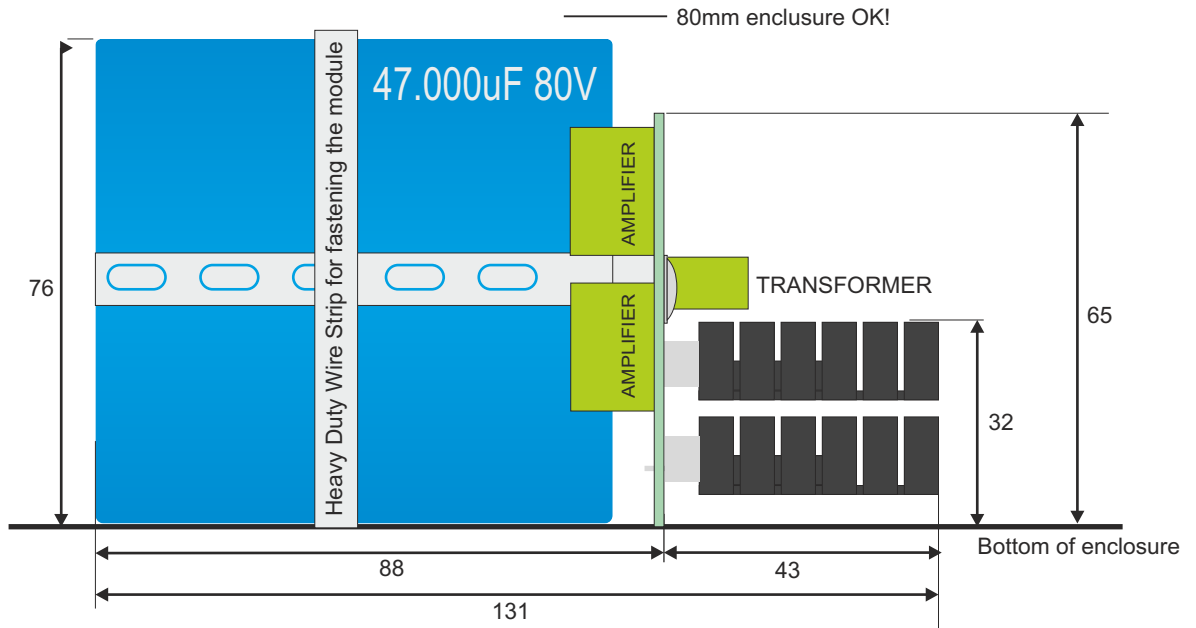
If you don't have the option of safety earth in your house, then we recommend making your amplifier a safety Class 2 appartus instead.

Going Class 2.

Class 2 is now supported by our soft start module. (Version 1.40 and newer). If you have an older version, then only Safety Class 1 is supported, but you can get the module upgraded for free (recommended).

In that case your IEC inlet should must have 2 pins, and then of course no earth connection. Your transformer should have a isolation barrier of 4.2kV and no shield.

Most hifi equipment however is Safety Class 1.

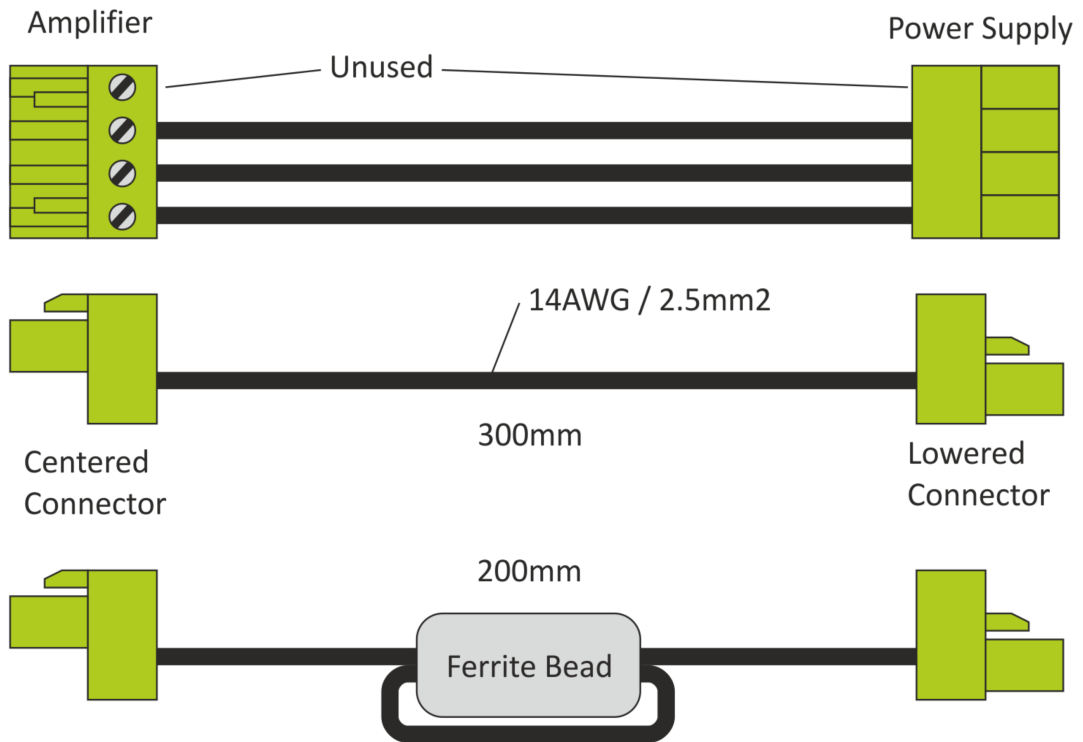


Dimensions of the 47.000uF power supply module.

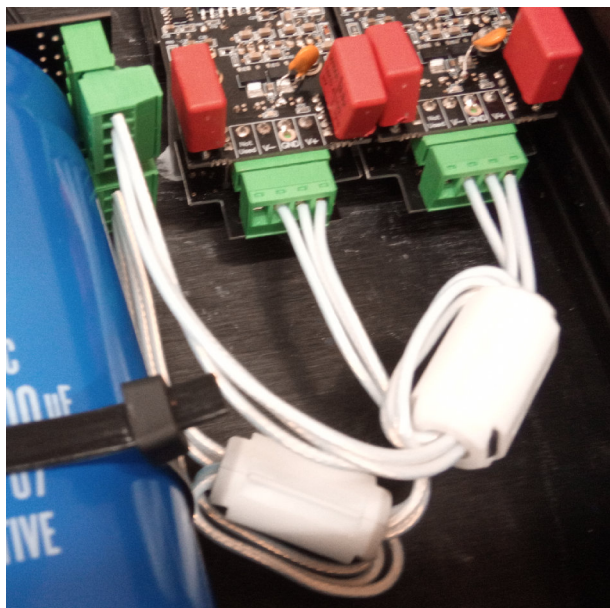
Connection of Modules to Power Supply.

This is the cable between the power supply and the modules, we recommend up to 300mm length. The wires should be of good audio quality, we recommend silver plated copper, and teflon isolation. 12 - 14 AWG is suitable. NOTE the two connectors are different, one fits in the amplifier, while the other only fits in the power supply.

Check from time to time that the screws are still tight.



For low RF emission, run the power supply cables through a set of ferrite clamps. You may have to cut the small plastic spring in each end of the clamp to make the cable fit. If possible run the wires through twice as shown here:

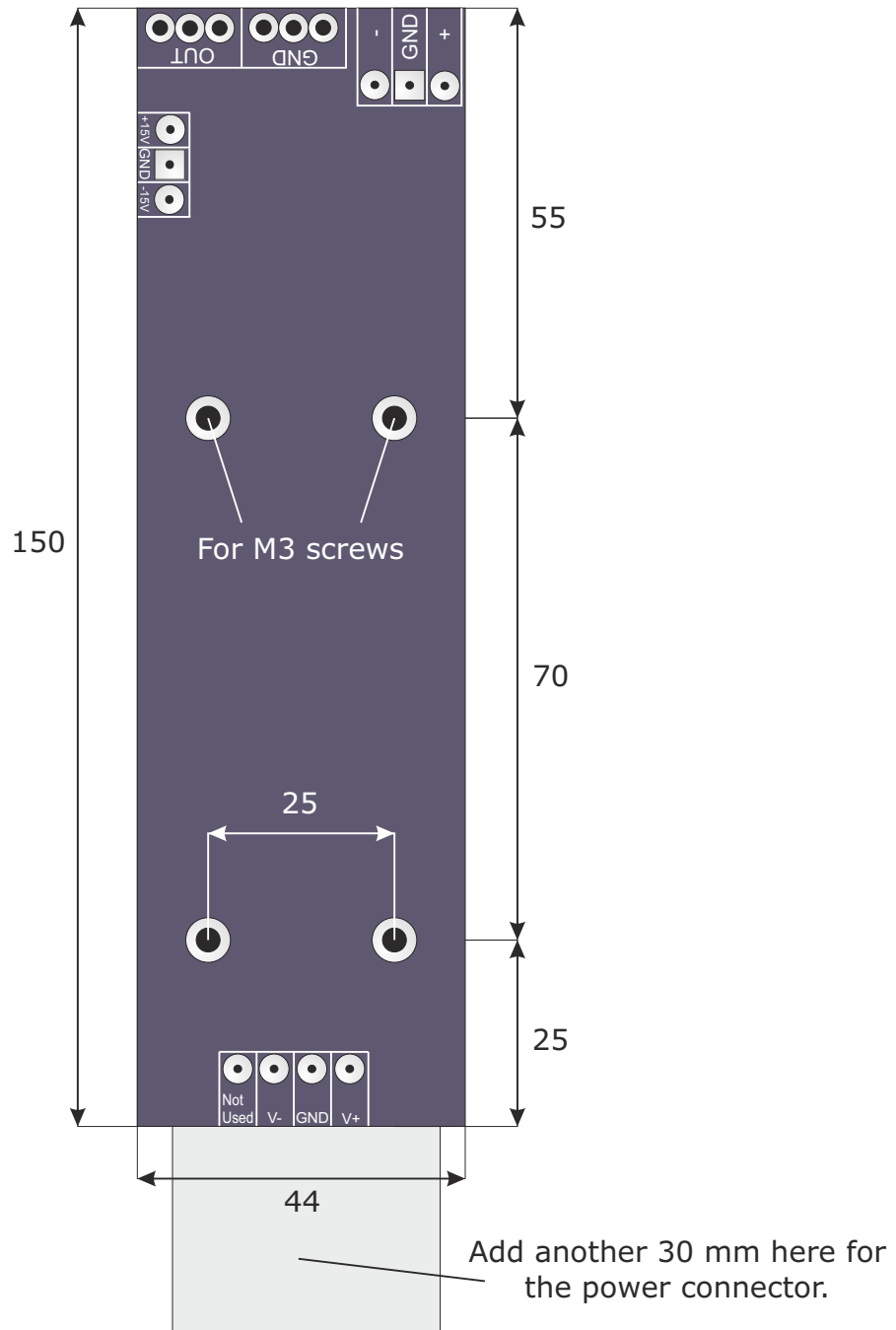


Mounting the two Singularity modules.

The two Singularity modules should be fixed on the bottom plate or heat sink using 4 M3 stainless unmagnetic machine screws. Drill holes as shown here, and place the modules a bit apart, maybe 50 - 100 mm to allow a good distribution of heat, if your bottom plate is 3 mm aluminium.

IMPORTANT! Always use all four screws!

After drilling the holes, use sandpaper to grind down micro scraps, so the bottom plate is absolutely smooth.

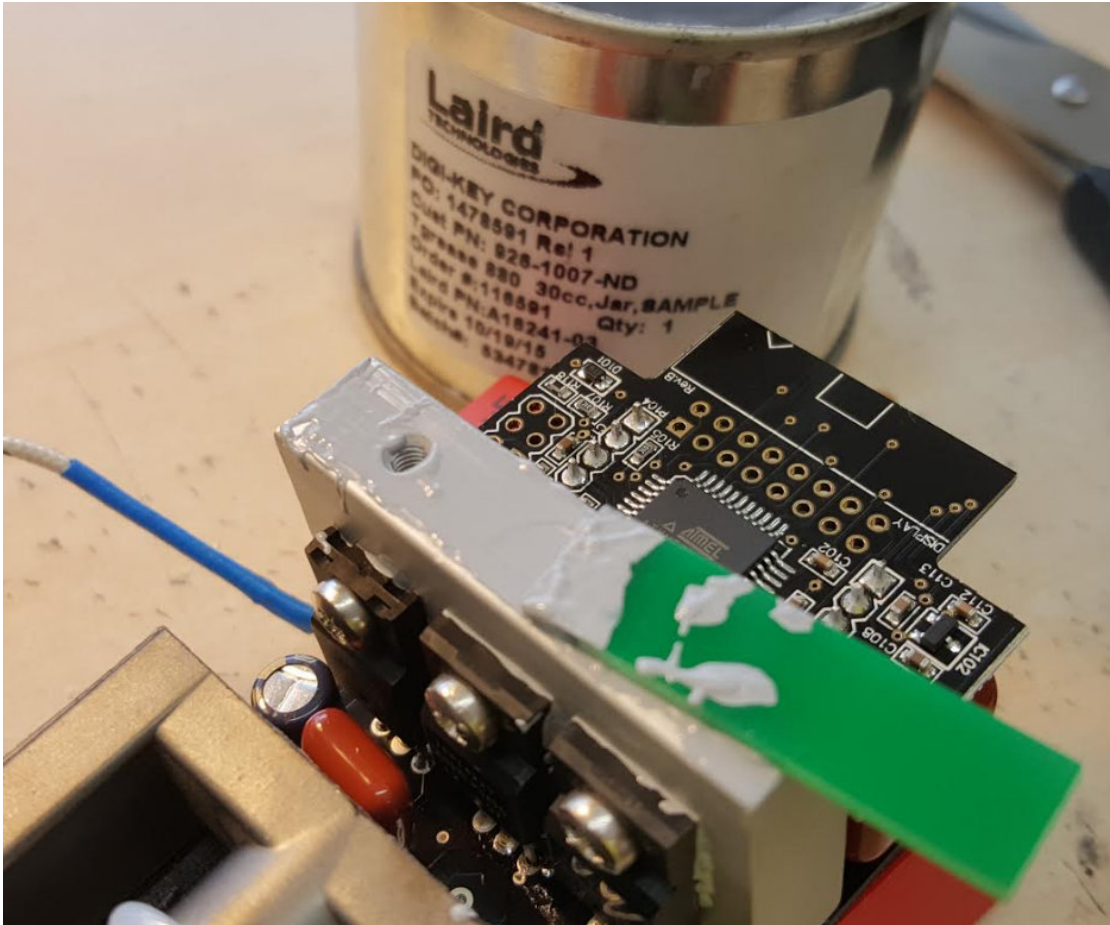


Highest Point over the bottom plate: 38 mm

Dry mount or wet mount?

If you intend to run your amplifier with a max. power output of 2-300 Watts, you can get away with simply fastening the modules with 4 screws each. (ALWAYS use all 4 screws).

However, if you have plans to get the most out of your amplifier, with 400 Watts or up to 600 Watts, it is crucial to mount the modules using a good thermal paste. There is a lot of difference in performance of thermal greases, we recommend the Laird Tgrease 880.

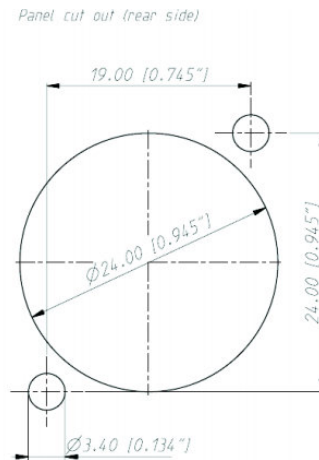


Warning some thermal greases are unsafe to handle, (The Tgrease 880 is safe though), but just to be safe use disposable gloves when handling the grease.

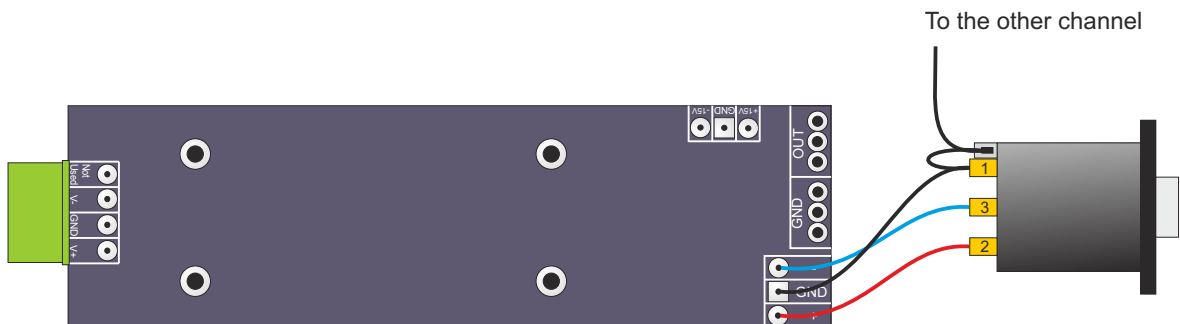
After fitting the modules to the baseplate, double check to make sure the modules aluminium surface is flush with the baseplate, on both blocks. In case a fixing hole is slightly off, the aluminium block may not become fully flush, and thus will not be able to transfer the heat properly.

Connecting the INPUTS.

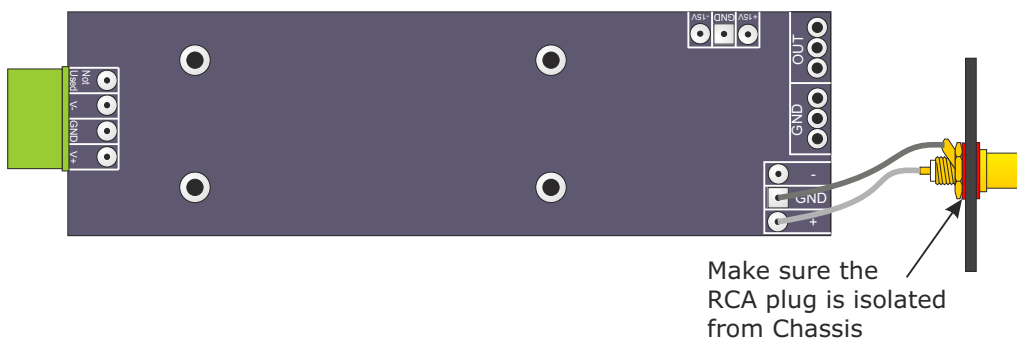
Your Singularity 2 module will directly interface to a balanced input signal. Connect a female XLR receptacle (for example Neutrik Nc3-FD-H-B) to the amplifier's three input terminals.



Connect pin 2 of the XLR plug to the + input pin of the amplifier.
Connect pin 3 of the XLR plug to the - input of the amplifier.
Connect the GND vane to pin 1, and also connect the 2 channel's pin 1's together with a short and solid piece of wire. This way you avoid external hum loops.



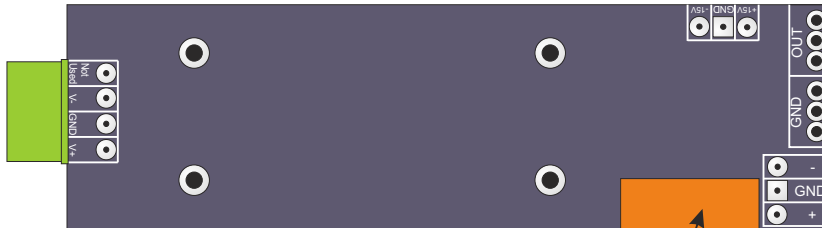
You may connect both balanced XLR input and RCA Line input to the module simultaneously, just make sure both sets of plugs are not used at the same time.



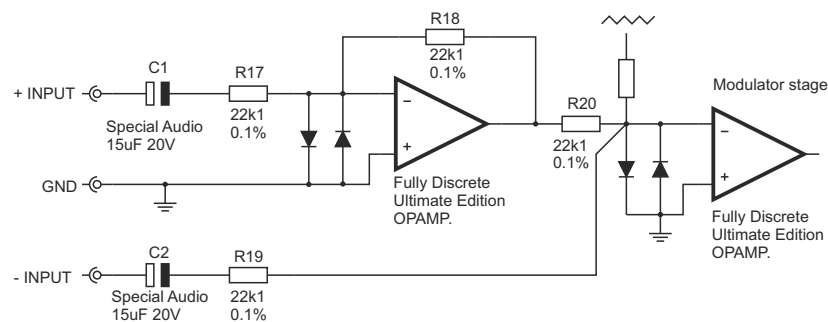
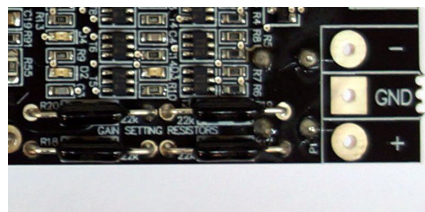
If you encounter any background noises, even very low level, you can mitigate it by trying out different additional GND wires, see the instruction on www.newclassd.com for details.

Gain Setting.

The factory gain of the module is 20dB or 10 times, which is adequate for most cases. If you want to increase the gain to about twice that, replace R17 and R19 to 10k. If you wish to reduce the gain, simply replace R17 and R19 to 47k. Always use ultra high grade resistors, such as Welwyn RC55Y.



Gain setting resistors are found on your module HERE.



Schematic of the Singularity 2 input stage. (Simplified)

The input stage is built with two fully discrete OPAMP's (Ultimate Edition). They are actually built with japanese low noise transistors and precision resistors, and not IC's.

A specialty is the virtual ground coupling, which has the great advantage of keeping the OPAMP's common mode voltage at zero, and thus eliminating distortion from common mode voltage. The common mode rejection of a regular OPAMP may be 100dB, but hey we are looking at distortion figures lower than that on the Singularity 2.

Another advantage is that it's possible to add protection diodes, which have exactly zero mV across them, so they will not affect the sound quality, but still keep the inputs safe, even if several kV is discharged on the input terminals.

Connection of Amplifiers to Output Terminals.

Before connecting the speaker cable, it's a good idea to check the speaker terminal for continuity to the case. All 4 binding posts must be isolated from chassis! If there is any connection, you MUST take the terminal out, and remove the debris that is shorting the terminal to the case.

Use good quality loudspeaker cable, and do not strip them together with input wires or transformer wires. Be careful to get the polarity of the output and GND right. Output goes to the RED speaker terminal, while GND goes to the black or white terminal.

EMC / RFI prevention.

The NewClassD modules will normally not cause any disturbances to your radio or TV reception, even without RFI blockers. However to meet the requirements of the CE marking, we include a RFI blocker kit, which is designed to not impact the sound quality in any way. The blockers are ferrite tubes which clamp on to the power supply and speaker wires. IMPORTANT, both output wires MUST go through the same ferrite clamp, or else the sound quality will be compromised. Small RFI capacitors, clamps and copper tape as shown here, is included with your amplifier modules.



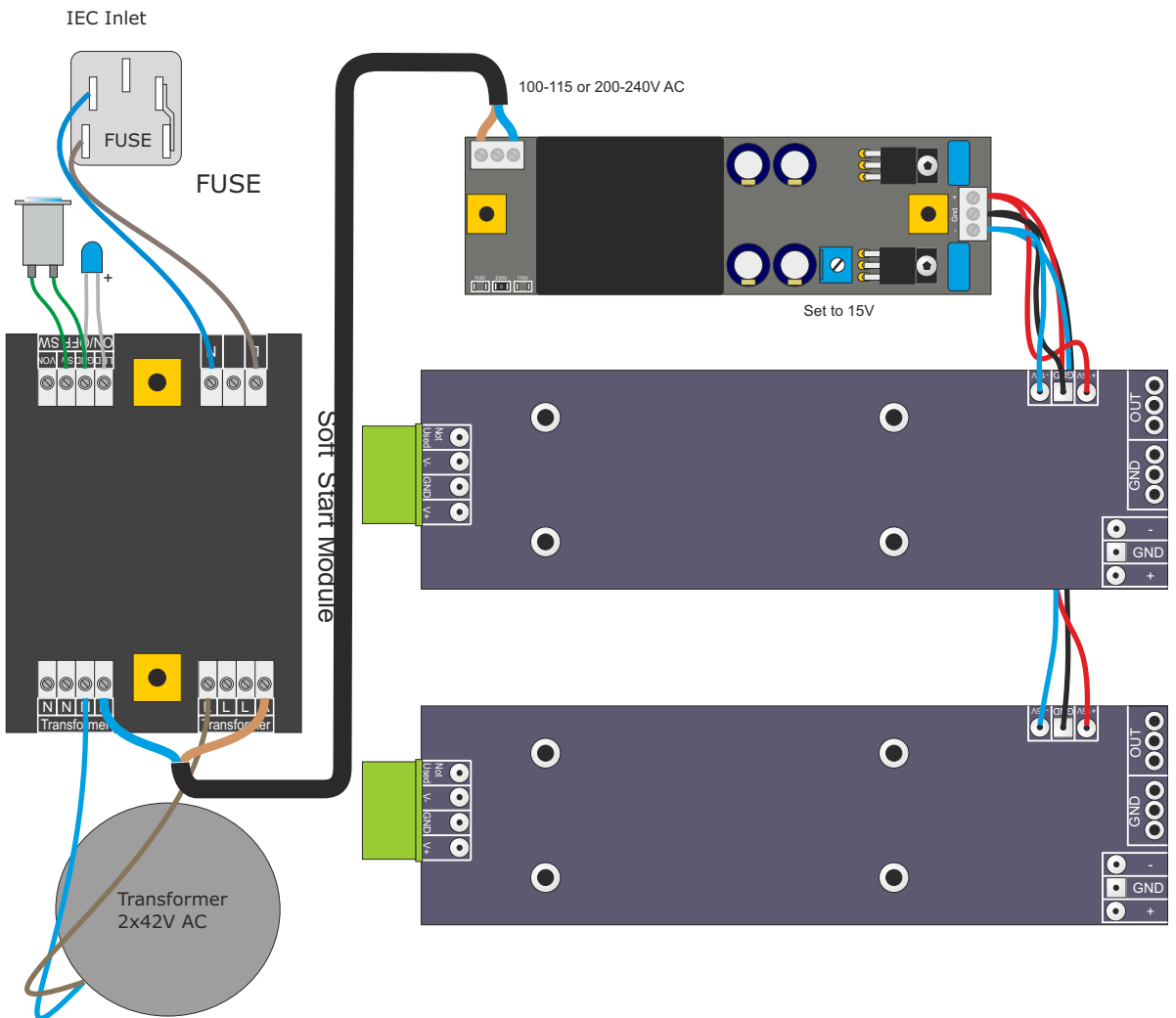
External power supply for the input stage. [OPTIONAL]

This is a modification for the more advanced Audio DIY'er. Whether it has any positive effect on the performance can not be determined technically, since the module already has onboard precision power supply regulators for the input stage. Never the less we are aware that some audio constructors have had positive results from this modification.

The effect of the external power supply is similar to that of placing spikes on your speakers, and letting them dive deep into your wooden floor. Tighter bass, and more definition of the sound stage.

First you need a stable low noise power supply source of +/- 15.0 Volts. The operational limits are 14.8 - 16 V per rail. Do not attempt to change the power supply voltage beyond the below limits, to see if the sound changes. .

We recommend using our Dual Tracking Regulator for this purpose, it is perfect both in performance and specification, and now also supports safety Class 2.



Dual Mono setup. [OPTIONAL]

You can build your Singularity 2 amplifier in Dual Mono if you prefer. The effect in terms of sound quality is normally not overwhelming, however you do get one undeniable improvement. The channel separation will improve significantly, so even the one channel is working at full power, the other channel will be totally unaffected. Also of course you have the opportunity to double your power supply's total capacitance, or muscle.

NOTE! In a dual mono setup we recommend connecting the GND of the two channels together with a 14 AWG wire, in order to control the coupling between the two channels, and avoid noise. See drawing on the next page.

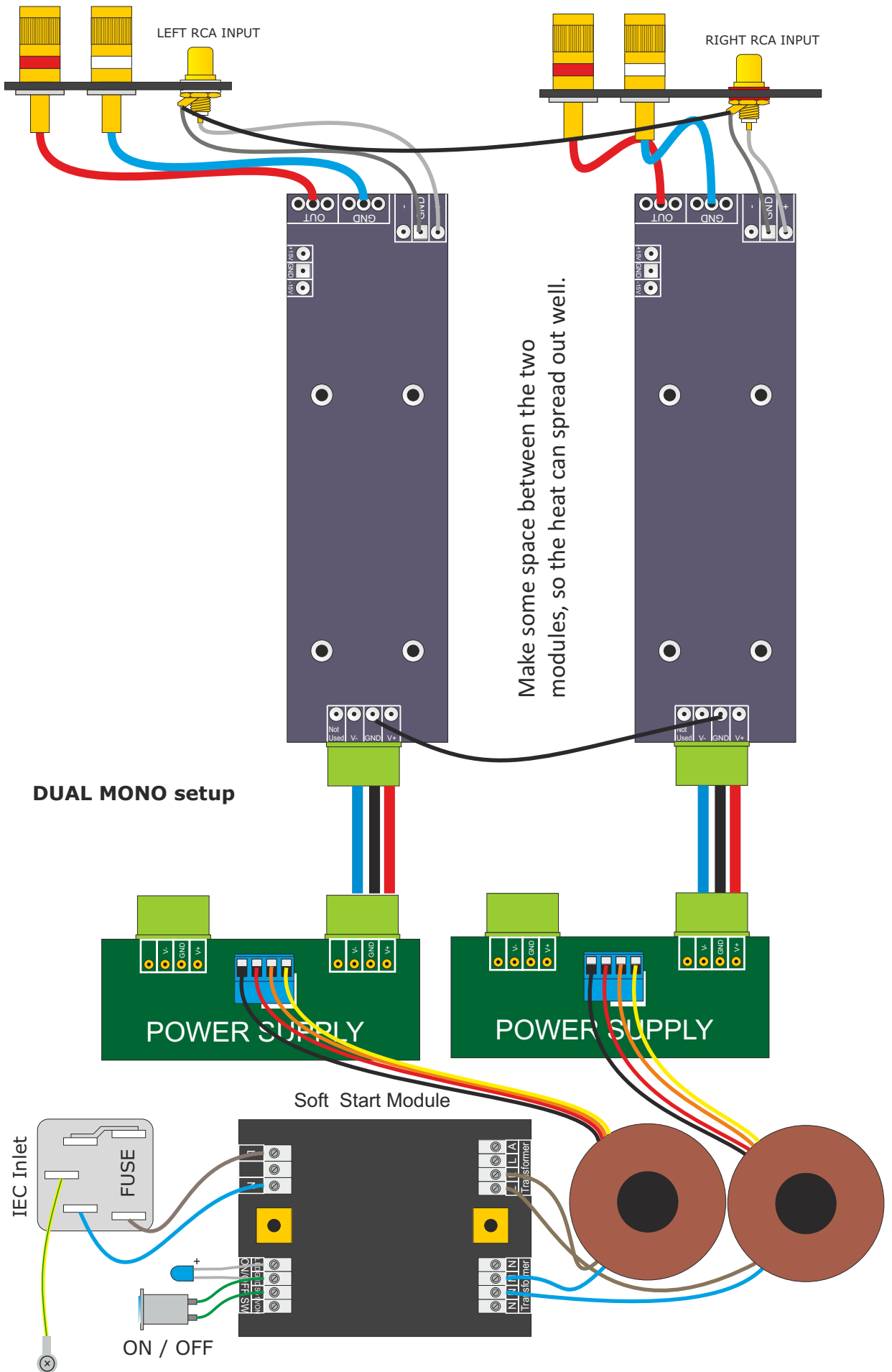
You need two mains transformers, or a special mains transformer with 4 secondary windings. Such a transformer is not standard, so you'd have to get one specially made. Anyway using two separate mains transformers is recommended. This way you also get to reduce the size of each transformer making them more quiet.

You also need two identical power supplies, one for LEFT and one for RIGHT.

There is no way of reducing the circuit by feed two power supplies with the same mains transformer, you will end up with a lot of noise, or even destroying the power supplies, in case you try this.

Another option for ultimate sound performance, is to combine the DUAL MONO setup with a 15V power supply for each channel, as shown on the previous page.

The DUAL MONO setup can also be separated into two enclosures, which will give you actual mono blocks. This option works very well, but you may have to still connect the two mono blocks with the GND wire to completely eliminate background noise.



External main power supply. [OPTIONAL]

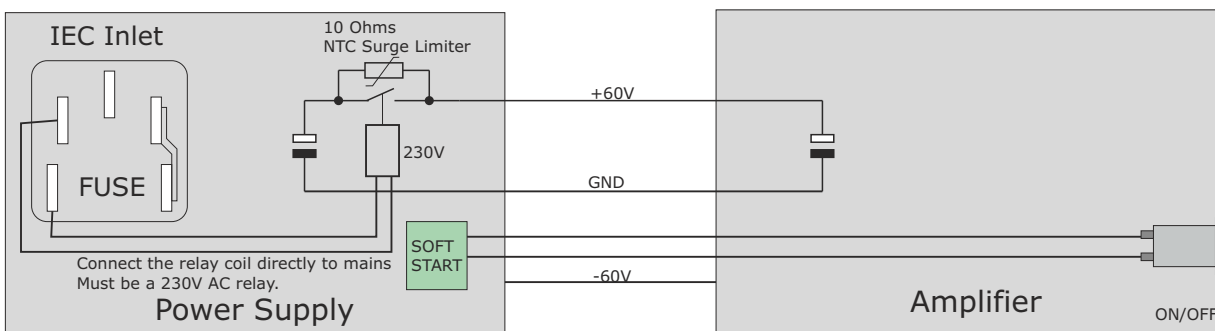
This option can trim the sound quality, to give slightly more calm sound stage, and easy flowing dynamics, but it's also somewhat complicated to implement. The idea is to place the mains transformer and softstart in one enclosure, with a power supply module, and then connect the +/- 60V rails to another enclosure with a power supply unit, and the two modules.

It's important that you have capacitor bank in both the power supply box and the amplifier box. The amplifier box needs capacitors close to the outputs to achieve the best sound quality, and the power supply box needs to have local capacitors, because you cannot send AC voltage with charge spikes out in an external cable. It will produce humming noise into your other cables.

The BIG problem.

If you assemble this, and run it, it's straight forward, and will work fine. But if you ever separate the two units, and try to reconnect them, that's where the big risk is. If the power supply unit has 60V charge on the capacitors, and the amplifier has 0V, then at the moment of connection, the whole charge will try to move from the power supply to the amplifier immediately. And there is nothing to limit the current, so it will jump sky high, hundreds of Amperes. This will fry the connectors, and possible the wires as well. So we need a circuit to secure the units when they are re-connected.

Ideally it should be done with a realy circuit and sensors with micro processor control, however there is also a simpler implementation, which only requires that there is no mains power on, at time of reconnection. So in other words it is not 100% fool proof.



This is just a schematic representation, if you fully understand the circuit, you can use this as inspiration for your build, however since it is an advanced option, we recommend, in case you want the separate cases, that you contact us for further information.



Checklist.

Let's go through the connections step by step, either at this point double check the wires you did before, or fit them now.

1..Yellow/green wire from IEC inlet Earth to chassis screw.

2..Live and Neutral wires from IEC inlet to the soft start module.

3..Transformer Live and Neutral wires connect to the soft start module. Blue is always Neutral (N), and Brown is always Live (L).

4..Transformer secondary wires to the 4 pin power connector. Usually in colors from darker in one side, to lighter in the other side, for ex. Black-Red-Orange-Yellow. Your transformer may have other colors. Check the label on the transformer. One secondary winding pair should connect to pins 1 and 2 on the connector, while the other secondary pair should connect to 3 and 4.

5..Earth wire on the power supply module, connecting to chassis. The purpose of this wire is only to avoid a weak humming sound when somebody touches the enclosure.

6..Power wires from the power supply to each Singularity 2 module.

7..Speaker output wires.

8..Signal input wires, either two wires for RCA unbalanced signal, or 3 wires for XLR balanced signal, or both.

9..Wires for the front panel switch and LED, depending on your preferred setup.

That's it, connect the speakers, and your preamp, or CD player with volume controlled output. before you turn on the amplifier for the first time, remember that we have already been playing on your modules for an hour or more, so they are going to work for sure.

Should you however hear a noise or humming in your speakers, **turn off the power immediately.** While turning on, the singularity will make no more noise than a minute click, as the modulator is going active.

Enjoy one of the best power amplifiers in the world!