

## CS-165 Current Stage module

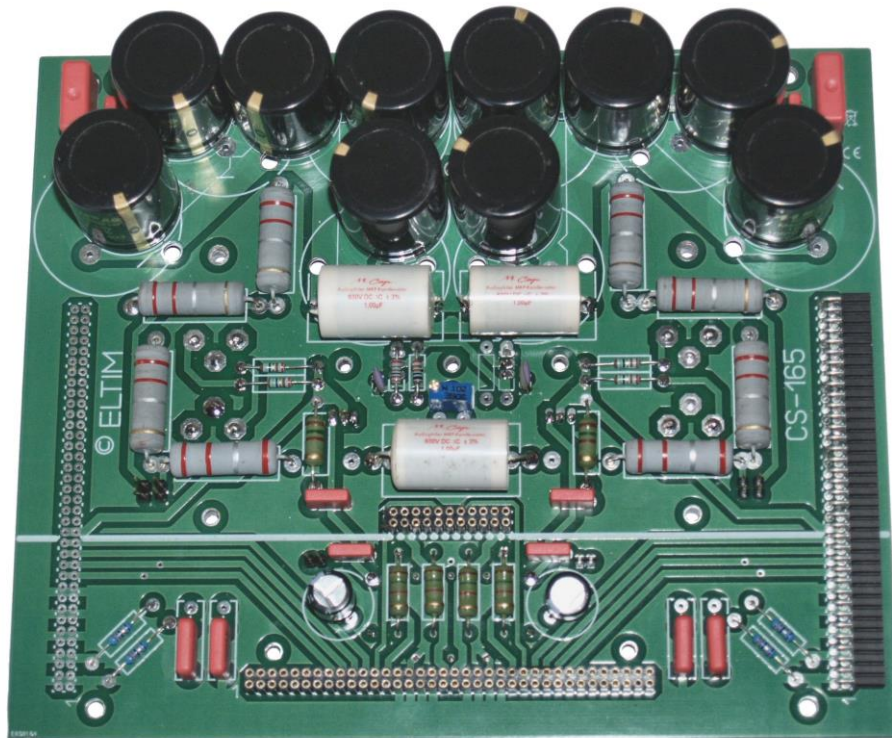
Due to our completely different way of thinking when it comes to PCB design and layout, mechanical and thermal stress, magnetic interference, EMI, etc., an ELTIM amplifier built with these modules looks and acts a bit different, which is [confirmed by our customers](#). According to them they make *MUSIC*, not just power ! And that for a (very) long period of time due to the stress free setup and quality components.

In order to make a true difference, we split our power amplifier schematics in a voltage- and a current stage board in order to obtain the maximum possible sound quality. This means that an ELTIM amplifier is based on these two (VS + CS) modules. A VS-input stage processes the sensitive and often small signal voltages and transfers it into signals powering a CS-module, which is leading the transient rich high currents.

This cooperation works very well indeed as many indicated as a “tube like” sound.

While using large TO-247 or even TO-264 sized power Fets, our amplifier systems are extremely stable, can deliver lots of power and more important, together with our totally different pcb setup, they have way better control over your speaker system compared to most other amplifier designs.

We only use very high quality materials lasting for 20 years and heat resistant, double sided FR4+ PCB's made by a highly regarded European manufacturer, double sided (2x70um), tinned isles, text on both sides, etc.



Example of a CS-165 HEX12 with extra Ø25mm supply capacitors mounted, which is an option!  
Extra power supply capacitors (not included) close to the power transistors can be added by you (or us).  
Per 2019 we no longer mount preselected caps on our modules in order to give you freedom of choice.

Left or right of this CS-165 you can connect the speaker lines.

A Power Supply board (f.e. [PS-120](#) or PS-80) can be connected to the large horizontal connector.

The module is mounted directly to a heatsink, making it very rigid, dissipating heat in a most optimal way. Many note that our amplifiers only become hand warm, even at high power. Also, no microphonic effects.

We like to refer to our [special document](#) where we explain all the details we implemented in our designs.

This [CS-165](#) power (current) stage PCB highlights:

- PCB's for two pairs of GDS (mostly Hexfets) types, TO-247 or TO-264.
- Microphonic free mounted to a heat sink, which is electrically separated from the PCB.
- Power transistors located in the heart of the heat sink for optimal dissipation rate.
- Multiple positions power supply capacitor bank very close to the power Fets:
  - 2x2 Ø22x42mm axial capacitors for low cost purposes.
  - 2x5 Ø25mm, pitch 10mm affordable or high/audio grade radial capacitors.
  - 2x4 Ø30mm, pitch 10mm, low ESR, classy or high value capacitors + MKP's.
- Quality MKP capacitor in the idle current network.
- Current driven feedback in the centre of PCB with multiple paralleled resistors, reducing noise.
- Speaker output and extra Mosfet/Hexfet connector both left and right.
- The absence of a coil in the output line results in way better impulse behaviour.
- Separate Current stage (CS) and Voltage stage (VS) voltage rails.
- Separate tracks for Power-, speaker-, RF-ground, feedback, VS-stage and input ground.
- All grounds are leading to the centre area of the bottom connector.
- Wide and thick (70um) speaker-, ground- and power rails tracks.
- Milled, gold plated beryllium copper connectors, with multiple pin (12x 3A for supply) connections. Way higher quality than regular (1A) headers.
- Speaker signal for signalling/protection purposes at all connectors.
- PCB position to mount an NTC/PTC at centre, connected to both horizontal connectors. Will be connected to a Protection module if mounted.
- Fits exactly to MODU 3PD04200 heatsink.
- Dimensions: 200x165x12mm. Effective height depends on power capacitors used.



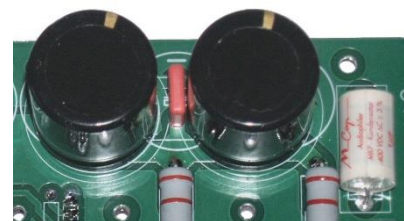
At following pages we list the data of the different CS-165 modules as we have in our program. After some years of selling them, we decided to change the way we supply and offer them. Basically all these modules are the same, except for the types of Power Fets, which are mounted at the back side. Due to the specifications of these power transistors, the “figures” of the two remaining base modules are different and based on the max. voltage/current they can handle while mounted in an optimal way. These Hexfet versions are only available as a kit from now on, see more info below.



CS-120 backside shown.

On a CS-165 PCB there is space to mount extra supply capacitors close to the power transistors. Doing so will improve the overall sound quality and especially improve the “punch” response due to the fact that there is energy available very close to the power transistors. Before we had a wide range, based on power transistor / supply capacitor differences. This appeared to be confusing for a lot of customers and we got many questions. Now we offer them without supply capacitors, as all other manufacturers do. Actually, with those you can't even mount extra caps. As listed above, three capacitor types fit in the left and right top corners:

New pictures soon



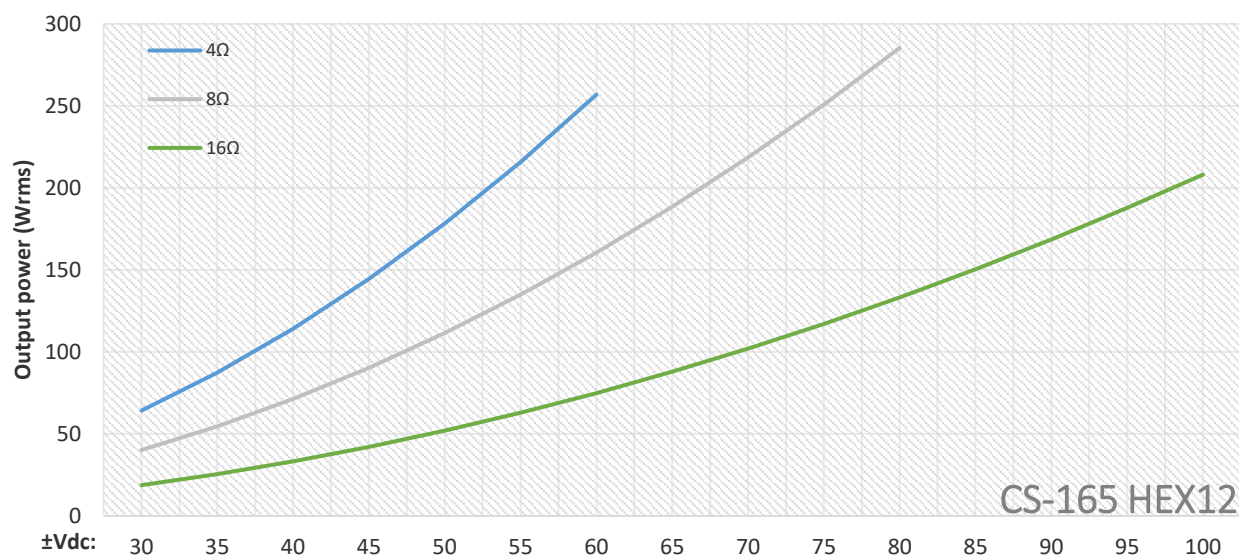
2x Ø22 x 48mm axial

2x3 Ø25mm radial

2x2 Ø30/35mm radial + 2x MKP

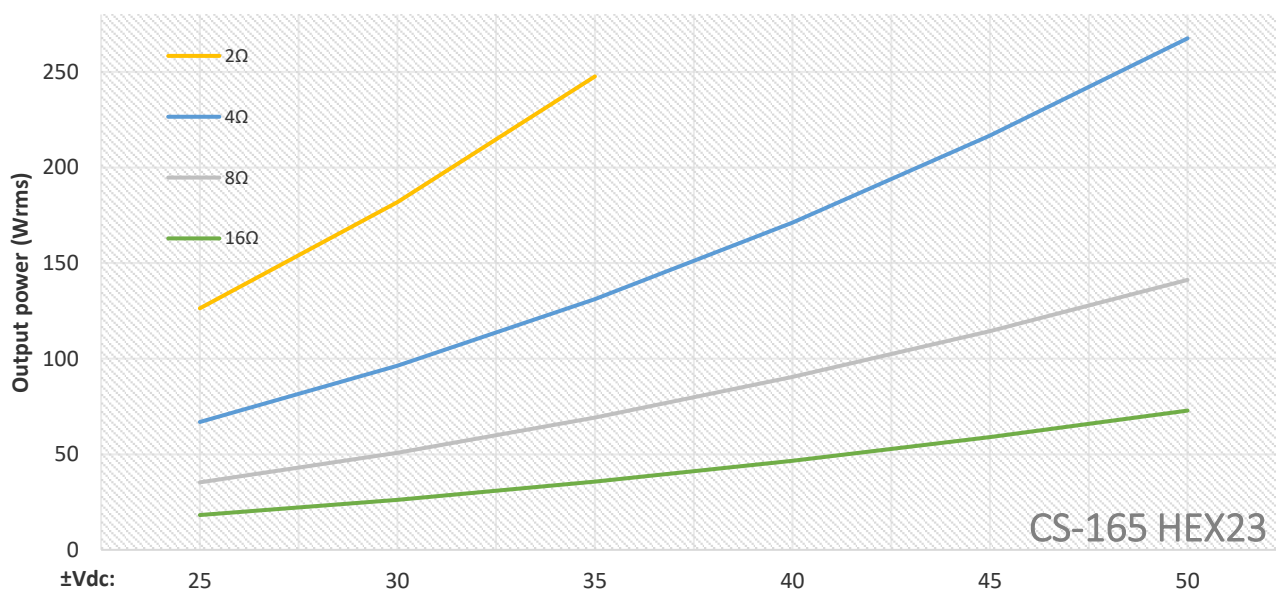
They are connected in the shortest and thickest possible way to the power transistors and due to that, they will increase peak power and transient response.

## Output power for models with rugged and cost effective [Hexfets](#):



**CS-165 HEX12**, with 12A/200V/140W, TO-247 Hexfets (2x IRFP240 / IRFP9240)

The power is limited to around 250Wrms due to the limits of the Hexfets used.



**CS-165 HEX23**, with 23A/100V/140W, TO-247 Hexfets (2x IRFP140 / IRFP9140)

The power is limited to around 250Wrms @ 4ohms due to the limits of the Hexfets used.

Due to the high current/low voltage Hexfets, recommended for low ohmic loads.

### Technical specifications:

Frequency range:	DC - >2MHz within 2dB (limited and defined by VS-module used, 270kHz/450kHz)
Distortion figure (THD):	< 0,001% (1W/1kHz/8ohm with Hexfets, Exicon's are even far better) < 0,002% (80W/1kHz/8ohm with Hexfets, Exicon's are even far better)
Slew rate:	> 18V/uS (@ +/- 30V). Limited by AC-input filter on VS-module used.
Harmonics:	<< -55dB, NONE specific, see graph right below. With Exicon's unmeasurable.
Damping factor:	> 200 (strongly depending on power Mosfets and supply used)
Input voltage:	1 Volt
Input impedance:	47kOhm
Output load:	depending on model and supplied voltages, see graphs
Supply voltage:	depending on the model, see graphs
Output power:	depending on the model and supplied voltages, see graphs.
Dimensions:	200x120x35mm

## Bridged mode

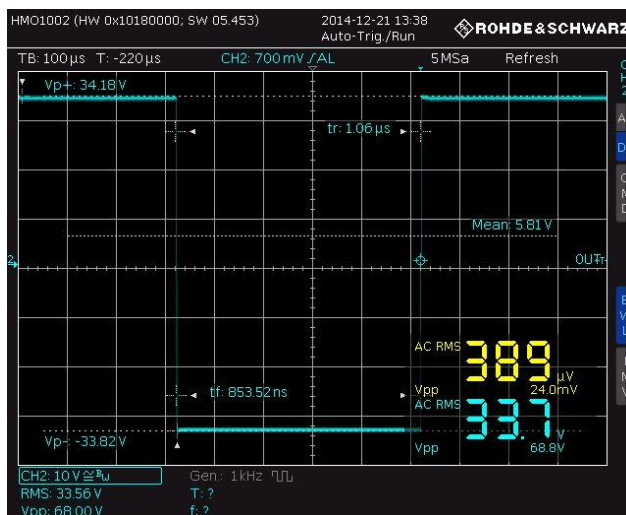
With this CS-165 module, it is most easy to make a bridged mode monoblock amplifier. On our request MODU developed a series of cabinets, a mix of Dissipante and Galaxy series. We made a special power supply module fitting between both CS-165's. Just connect a transformer. To make this work, one of the CS- AND VS-modules has to be made in reversed supply mode, which can be done without serious modifications. We just need the switch all transistors and rotate electrolytic capacitors by 180°, that's all.



Some drive a bridged amp by just feeding a balanced signal to both modules. Doing so, you forget that the Interfering signals are passed 100%, and so the advantage of a balanced line is down the drain.

If you want to drive this bridge mode amplifier as you should, we also provide an input module with line- and balanced input, and has an in phase and out of phase signal to drive both amp modules. All signals go through the same electronics, avoiding phase errors. This module can be stacked to the side connectors, without any wiring. Then just connect a transformer and the in/out connectors.

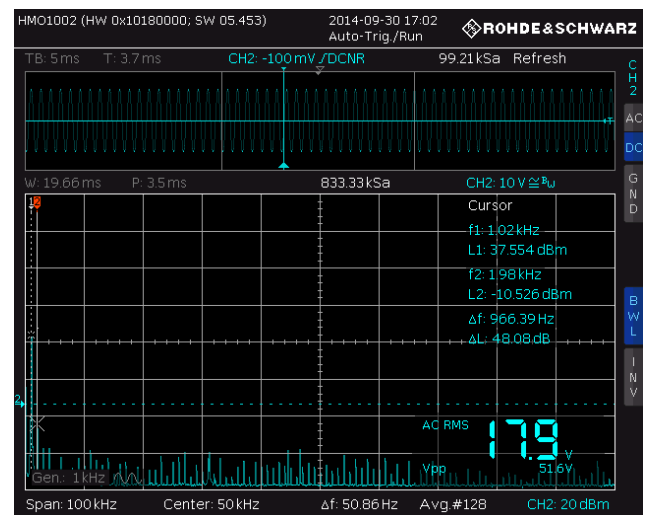
## Some measurement data:



Square wave signal without ANY irregularities

It also shows a slew rate of around 60V/µs.

Limiting factor is the low-pass network in the input circuit!



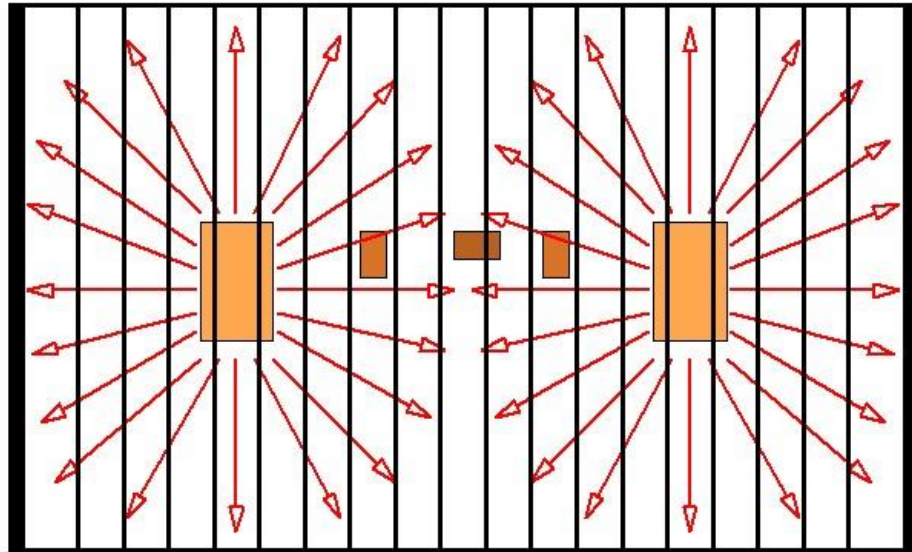
Frequency domain (100kHz wide) without any significant harmonics.

Please note that we run on 40W/8ohms here, not 1W as others do!



## HEAT SINK data

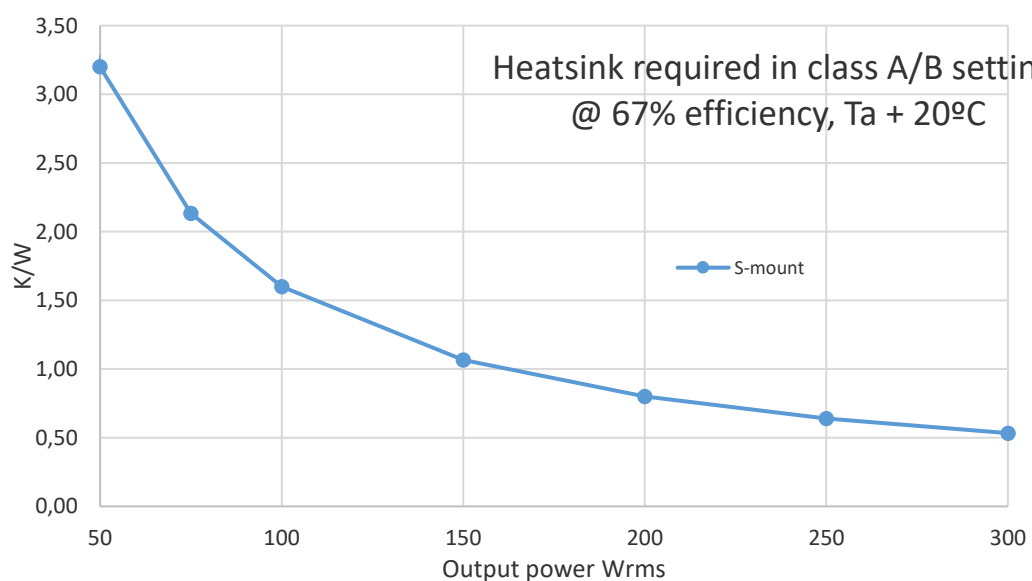
Unlike most amplifier modules available today, in this design heat is spread symmetrical over the heat sink by spreading the transistors over the heat sink symmetrically. Doing so increases effective thermal load of the power transistors. In practise, with us the amps will become only handwarm.



Mounted on the exactly fitting MODU [3PD04200](#), 200x165x40mm heat sink (0,38K/W), it is a nice solid and exactly fitting combination, but the module cannot be used at full potential due to the limited heat dissipation of this heatsink. For more than around 150Wrms, you need a larger heat sink.

With CD-120 add-ons use [3PD04300](#) (300x165x40mm, 0,31K/W). This combination also fits exactly and increases the power load to about 200Wrms. But: with the extra CD-120 pair you won't reach the electrical limits, since it all would become too hot. For max. power you need a larger heat sink.

While used in f.e. a MODU [Pesante Dissipante 4U](#) (300x 165mm, 031K/W) cabinet, the full potential of a CS-165 module can be shown. The module exactly fits, where the PCB fits between the construction L-bars, see picture below with PS-120 power supply. Use a MODU inner pierced base as well if you want to use a L-mounted power supply as well ! A 400mm deep model will fully fit a CS-165 + CD-120 pair at full potential.



## CONNECTOR FUNCTIONS

The bottom connector of our CS-modules are meant to connect a symmetrical power supply to it. CS-165 is standard NOT equipped with some power supply capacitors, but you could mount some close to the power transistors. The possible capacitance will mostly not be enough though to bring this module to full potential. A power supply with some extra capacitor value and rectification has to be connected at the bottom connector. We provide several Power Supply modules with different size, functions and/or different power capacitor banks, which all will fit to this connector. Our [PS-120 range](#) is especially made for CS-165. Matched fix. Of course you also could connect a hardwired or universal power supply here.

The centre connector is where one of our [VS10/20 Voltage Stage modules](#) is connected, L-mounted or sandwiched. This last option sets the total height at a minimum of around 30mm.

**Please note that only a set of a CS and VS module is a working amplifier!**

Besides the needed connections for basic amplifier function, there are also connections for a PTC and the centre contact leads to the idle current potmeter. With later VS-modules you could adjust idle current, f.e. to switch to class A mode automatically when only low power is used or to class B when NO power is used ..... The PTC leads via the header connectors to our Protection module which can be mounted optionally.

At the left and right connectors the speaker leads are to be connected.

Connector signals: Ground, Speaker output, Hexfet drive signal, + or - power voltage and four extra paths for random use or power measurement.

At these connectors you also can stack an input/output board where the connectors, extra filtering like better quality input capacitor, etc. can fit. Also, our Current Drive module pair CD-120 can be connected here.

At the last page we give a block diagram of how our modules are connected.

## INPUT / OUTPUT add on

In order to make connections required most easy, we also developed special I/O modules for these CS-165 modules. We have boards with a line input and with XLR balanced input, using the unique [InGenius](#) technology by

**THAT** Corporation

You just need to bring some straight, short wires from this board to the connectors of the back of the amplifier.

### “Wireless” connecting

At the right the result of a full mounted pack:

CS-80 + VS-20 (not visible) + PS-80(v1) + VR-3 + IO-80bal.

CS-165 is assembled in the same way, except for the height, being 120mm instead of 80mm.

Five modules connected without a centimetre of wire. Just connect a transformer and the in/out connectors with short wires. A nice and clean amplifier setup.

## Protection

If you want to protect your speaker, you need one of our [Protection modules](#). This module detects differences between in- and output signals and acts if this event occurs, f.e. overloading it or if the amp has a fault.

The protection module separates the power supply from the electronics and/or discharges them very fast, instead of a relay with unsuitable nickel/wolfram contacts causing distortion, especially with small signals.

This board is mounted on one of our Power Supply boards.

However, the Hex/Mosfets we use show NO irregularities as many other Mosfets (easy breakdown) and regular transistors (thermal runaway and oscillations at high power) tend to show.

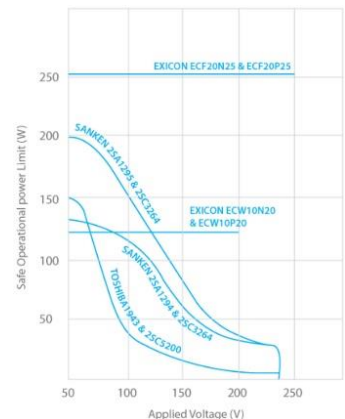
So far we nor any of our customers experienced breakdown of power Fets in our designs.

## THE MISSING PARTS, or less is more....

While using the Hex/Mosfets we do, the schematics can be kept very simple. We don't need to feed the power transistors with a lot of current and they show a negative temperature characteristic. Due to this effect we also don't need to take precautions avoiding a so called "thermal runaway" effect as regular transistor based amps tend to show. We also don't need rows of Mosfets as seen everywhere and required to keep the Mosfets inside their Safe Operating Area (SOA). The ones we use have no SOA and so need only one pair.

By using a fully symmetrical design, electrical AND mechanical, there are no DC-irregularities in the output while switching the amp on or off, there is NO speaker "anti-plop" protection needed, mostly a (distorting) relay in the speaker line. With this amp module there is just a tiny "tick", without any woofer DC shifts when power comes on and about 1,5 secs. some minor distortion when power goes down (@ around 15Vdc) before signal stops, also without slow and far moving around of the woofer cone.

If this short period of distortion disturbs you, take away the input signal with power off or use our protection module, which prevents this event by discharging the power supply fast, instead of a relay in the speaker line.



There is also no output coil in the output line, meant to prevent current peaks. As a matter of fact, especially short impulse peaks make the music more real and this network is killing it..... So, we left this out.

The Fets we use can easily handle these peaks, don't worry.

We did about all possible, 24 hours of clipping them, short circuit (unintentionally of course....), etc.

This coil comes from ancient times where the power transistors (f.e. famous mother of all 2N3055) just barely could handle the power even without serious peak currents..... And still they blew out even while rows of them were mounted. The same counts for older Mosfet based amplifiers giving power Mosfets a bad name.

## Answers to comments and questions we received

**Q:** The lengths of our pcb tracks would cause parasitic capacities, resulting in poor frequency response.

**A:** [We made a video](#) of our new CS-150, having exactly the same schematics as all our CS-modules, just more space for wider tracks and more power Mosfets. In this case even four pairs are working.

Even with these four pairs of Mosfets and the relatively large gate capacitance it appears to run > 450kHz, flat as a ruler and with a slew rate of >65V/us. What "parasitic"? In/output phase error < 5°.

With our different PCB design we explicitly try to avoid parasitic capacitances and magnetic interferences as seen in all the overcrowded PCB's we see everywhere. And obviously it works, heard by the "spacy" sound.

**Q:** The "huge" amount of header pins would cause severe contact problems over time.

**A:** We don't use just one header pin (normally tinned 1A) for power/speaker, we use 12/10x 3A (so 36/30A) gold plated, beryllium copper headers which is something else, yet cost way more.

With us no problems over time with connections. All is over calculated.

**Q:** Our amps can't work, since "the Mosfets" are exchanged, see the arrows" pointing in the wrong direction.

**A:** The datasheets show that Mosfets symbols indeed point in the "wrong" direction compared to regular transistors. So, of course we mounted them correctly as proven by many working amps.

Unlike many anonymous commenting fora members we are electronics technicians for over 40 years, officially licenced by degree to repair all kinds of electronics, from a coffee machine up to an F16 actually and all between.

We are allowed to hang a shield on our building "official audio-/video repair centre" as well.

Actually, the very first Dutch NOKIA GSM phone was approved by me for sales; you know where it ended....

I threw away this phone with serial number "prototype", stupid.

Over the years we also developed and built all kinds of electronics. We are even a licenced radio amateur (PE1LTM), meaning that we can and are allowed by Dutch government to build and use our own radio transmitter equipment without anybody checking before operating them.

So, we are not some Chinese guys, [grasping some junk together](#) and (re)sell it for a nice price.

Obviously we know what we are doing and only buy new and original parts from well-known distributors and manufacturers. Hopefully you will appreciate that.

## CABINET tips

Since [ELTIM audio BV](#) also represents Italian [MODU cabinets](#) our designs were adjusted in size to these cabinet dimensions. This way, we get remarkable High-End cabinet looks as well. Some idea's where this CS-165 fits:

- All MODU Dissipante 5U models, leaving room for one or even two max. Ø150mm toroidal transformer(s). See picture at right (MODU 1NPD03300) with CS-80 modules in a 3U cabinet: With CS-165 is similar, but higher.



- MODU Slimline 4U (165mm) models fit exactly top to bottom. You could use side profiles if only modest power (<200Wrms) is required. Since there is NO top/bottom space for connecting a transformer to a CS-165 /PS-120 combinations, one of our L-mounted power supplies recommended!

TIP: in order to reduce the significant amount of inrush current, switch the primary sides in series in power activating mode and then parallel them in operating mode. The supply capacitors will also charge slower then and your amplifier will have a longer life cycle.

With a supply like this, you make sure that you know what you are doing !

## LISTENING

We listened to our modules for a real long time and simply forgot that it's there. We used it as anyone else would do, listening to music, watch the news, series and movies. Unlike our [Accuphase P-450](#) there are NO irregularities, especially noticed with spoken voices. Bass fundament is simply fantastic and correct and makes you smile. The "air" around voices and instruments is amazingly beautiful..... Cymbals sing g g g g g g g g g g. Even non-audiophile visitors got tears in their eyes ! Actually, we don't use our P-450 (€ 10k) any more.

Our experiences are [confirmed by several true audiophile](#) listeners. They all are amazed about the natural sound and fantastic 3D presentation. The "air" around voices and instruments amazes all, incl. us -)  
We also got some replies mentioning that the bass is deep and very well under control.  
Some confirmed that it sounds better than the high-end stuff (even expensive, regarded brands) they use.....  
One word came up more than once: **EMOTIONAL**. Just as we wanted it.  
Right, marketing bla, bla. NO, we are audiophile technicians hating this as you do.

We had a demo amplifier available, which we sent out to EU citizens and experience it yourself.  
Believe it or not, some actually "modified" this demo amp as if it was their own.  
After receiving it and rebuild it the way we made it (...) it could be shipped out again.  
In the end we stopped this service, sorry.

**More specific info of every separate module you can find at [our website](#).**

[Check our website for ordering or check our dealers list](#)

For bespoke built amps: [www.eltimaudio.com](http://www.eltimaudio.com)

We are setting up a dealer network of our modules program. Want to join us? [MAIL](#).

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In a basic configuration you just mount a VS-module to the centre connector and the speaker leads left or right of the board.  
The input signal is fed into the VS-module used, see the specific info of the module in question.



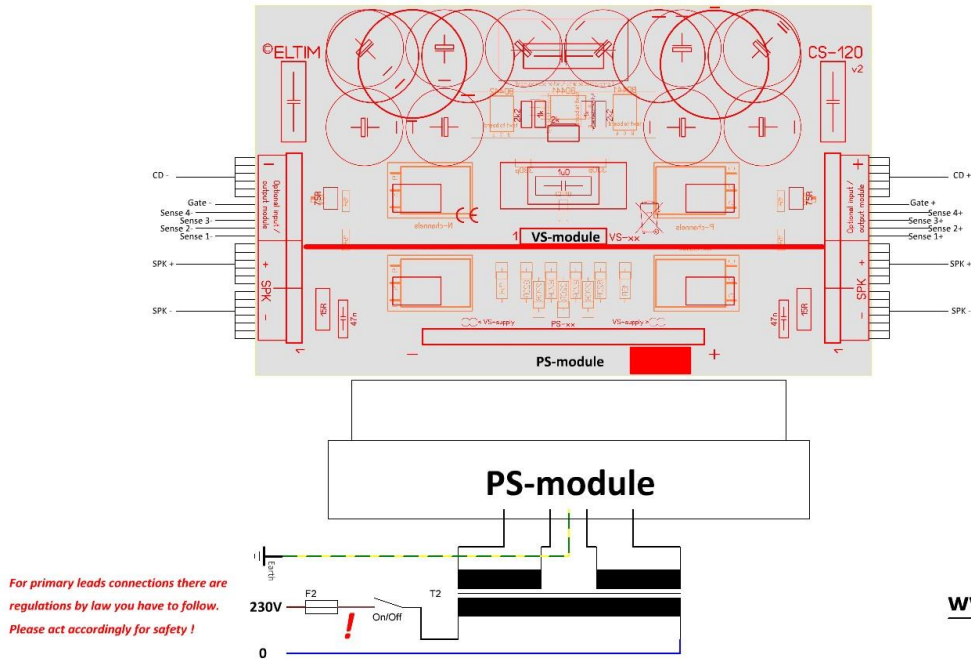
If a Protection Module is mounted on a PS-module, you have to shortcut both jumpers close to the power transistors.

In that case, the voltage drop of these resistors is available at the Sense 1+ resp. Sense 1- lines. Our PR-modules measure this and take action if required.

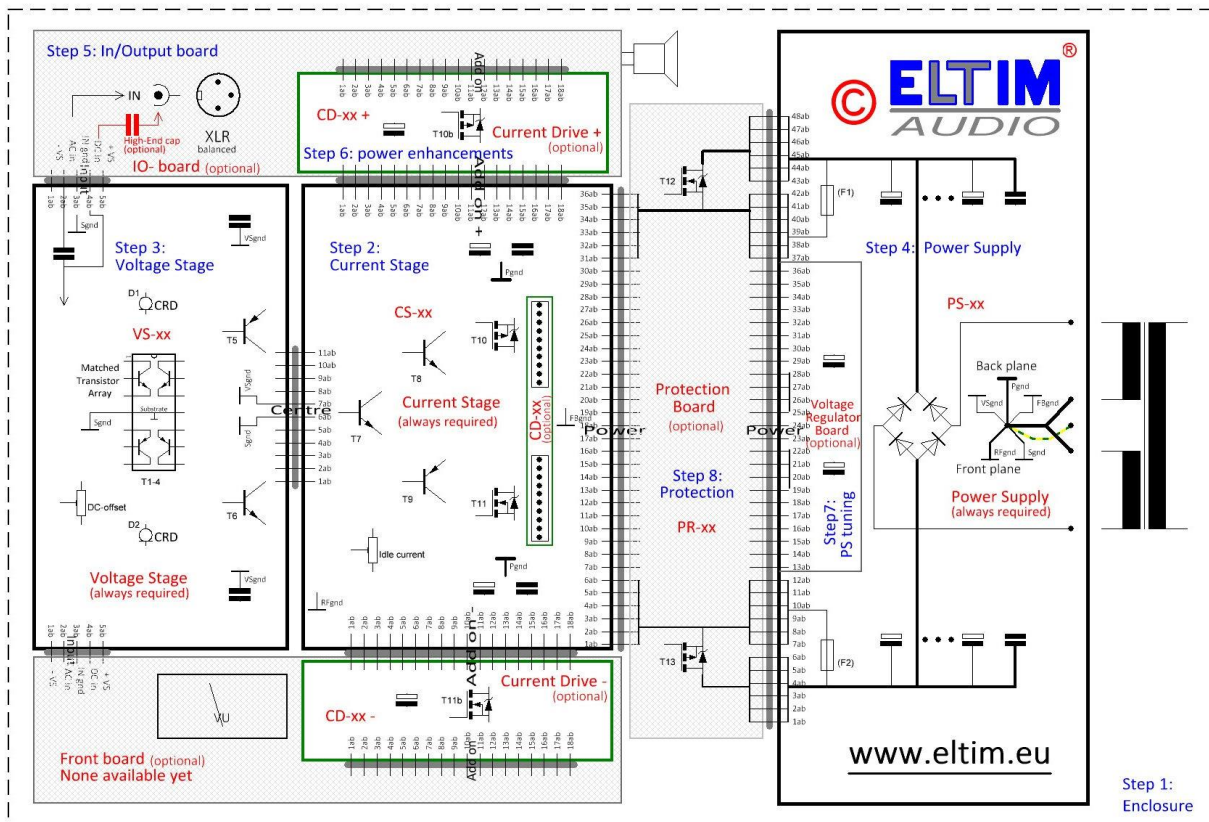
While using a protection module the jumpers near to the power transistors have to be positioned.

The 2x36 pin horizontal connector leads to one of our Power Supply modules, like PS-120 which is stacked onto this CS-120. Together they form a compact power pack.

If the power supply rails exceed +63V, you might need to mount a Voltage Regulator board on the Power Supply module, because f.e. a VS-20 input module can't handle higher voltages.  
If there is no Voltage Regulator board mounted (nor needed), shortcut the two jumpers close to the PS-connector; then the VS module gets unregulated supply.



[www.eltim.eu](http://www.eltim.eu)



**Here our functional layout of our modules program.**  
Just define the way you want to build your amp and follow the steps 1 thru 8.

[www.eltim.eu](http://www.eltim.eu)