

CS-35 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.

To make a true difference, we split our power amplifier schematics in a voltage- and a current stage board 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.

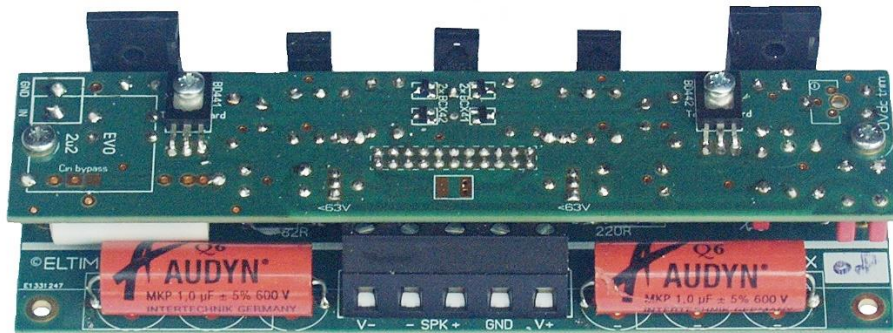
Most of the VS-tracks are in a 90° angle to the CS-module tracks, preventing electromagnetic interference.

This cooperation works very well indeed as many indicated as a “tube like” sound, added with solid bass.

While using large TO-247 or even TO-263 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 (2x35um), tinned isles, text on both sides, etc.

The module is L-mounted to a heatsink.



For ultra-compact solutions you even can sandwich mount our [matching VS-5](#) input stage module (picture).

This [CS-35](#) power (current) stage PCB highlights:

- Versions for GSD (mostly Mosfets) and GDS (mostly Hexfets) oriented types, TO-247 or TO-263.
- 2x3 Ø12,5mm elco's or 2x serious quality MKP capacitors (both optional) locations over the voltage rails.
- WIMA MKS4 1,0uF in the idle network. Quality MKP capacitors optional.
- Current driven feedback in the centre of PCB by 2W or 3W MOX resistors (induction free SMD optional).
- Speaker output at the professional centre connector, 20A, 4mm², pitch 7,5mm.
- No coil in the output line resulting in way better impulse behaviour (>60V/us @ ±30Vdc).
- Separate tracks for Power-, VS-stage and input ground.
- All grounds are leading to the centre front area of the PCB.
- Wide and thick (>8mm/35um) speaker-, ground- and power rails tracks.
- Highly efficient at average/low power due to low idle current, better than class-D at low levels.
- Width matches our new and [compact VS-5 input module](#), also mountable as sandwich for lowest height.
- CS-35ps (with power supply part) can be sandwiched for compact multichannel and bridged operations.
- Even four modules fit in f.e. a MODU Dissipante cabinet, 80mm high, 300mm deep.
- Size 149x50mm, Effective height depends on Fets/power capacitors used.

Basically, all CS-35 modules we supply are the same, except for the types of Power Fets. Due to the specifications and price of the power Hexfets/Mosfets used, their data and pricing is different as well.

Quite unique is that you can decide yourself which quality of sound influencing parts we mount for you. So, even while buying ELTIM built modules, you will get them as bespoke versions all the time.

Shared Power Supply

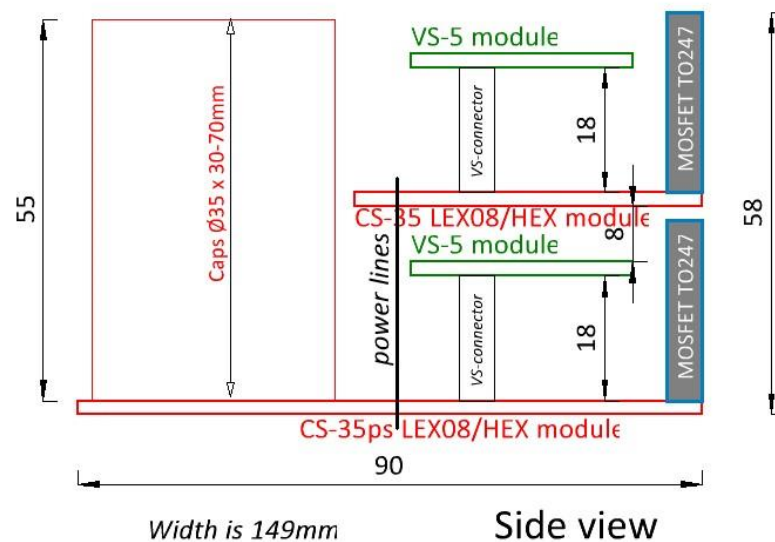
The schematics and PCB layout of this CS-35 is the same as a CS-35ps, but on a CS-35ps PCB there is also a rectifier and space for a pair of supply capacitors, together forming a basic symmetrical power supply. Both module types can be sandwiched, sharing the power supply of CS-35ps and you only need one dual sec. windings transformer to feed it. An example is shown at the last page.

Instead of the central 5-pole screw terminal (not installed, but supplied) you can feed through 3x 1,5mm² copper rods to the power supply part of a CS-35ps under it. This makes it a very compact multichannel setup in f.e. active speaker, bi-amped or bridged systems.

In that case use a 2-pole, pitch 7,5mm screw connector as speaker terminal.

You only have to connect a suitable (Pout total x 1,5) dual secondary windings transformer to this pack. Also, the power supply capacitance needs to match. We recommend using >4700uF/100Wrms output. The elco's rated voltage has to be higher than the voltages supplied, otherwise they blow in your face!

If you use a switching power supply, we also recommend to mount 2x3 supply capacitors on this CS-35. The total ESR of the power supply will then significantly drop, resulting in a more solid bass response.



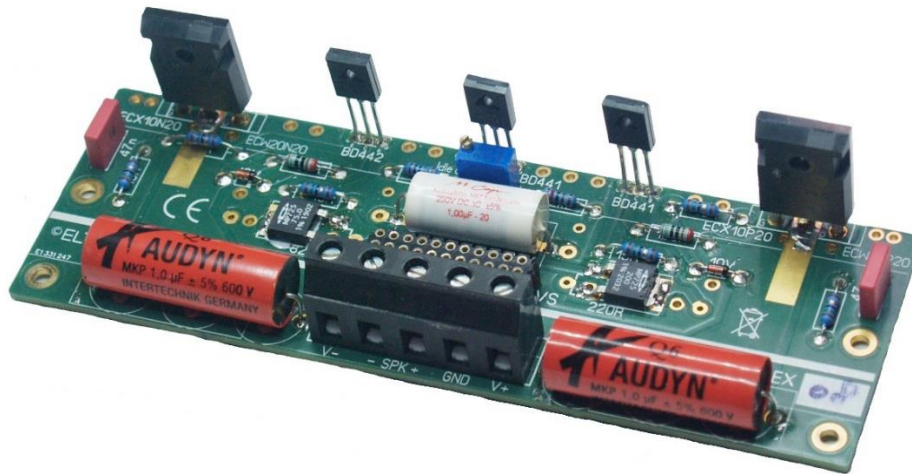
Type of Fets.

In the beginning we only used HEXFETS in our designs, later we started to use EXICON Mosfets only. Besides the price, characteristics, etc. the most important difference in using them is their pinning. Hexfets are GDS oriented, where EXICON Mosfets have a GSD layout. This CS-35 (and brother CS-35ps) are the only modules left where we provide PCB's for both pinning layouts. Marked HEX is GDS, where LEX is GSD oriented.

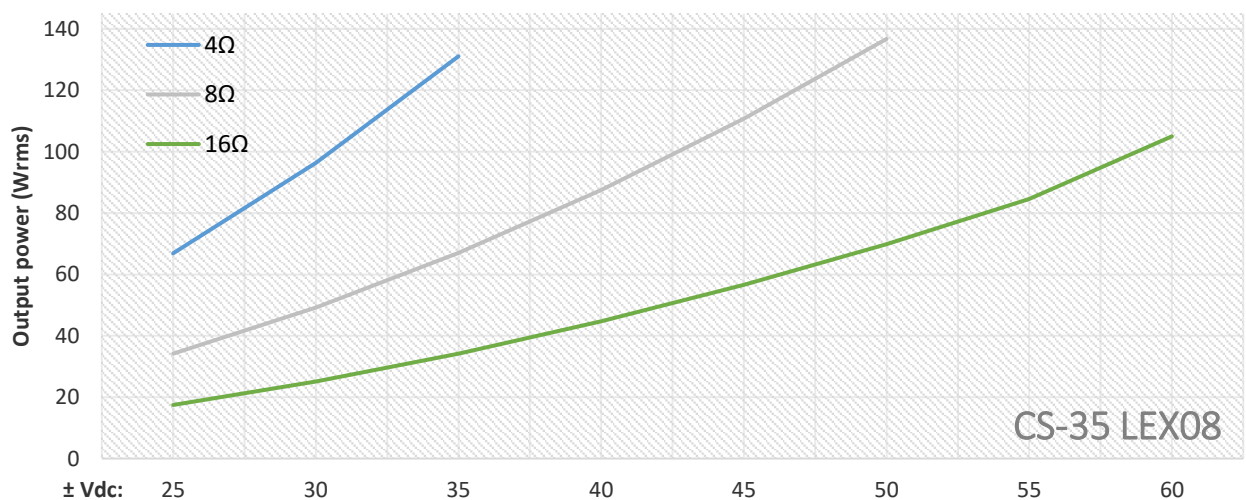
For rugged PA or cost-effective applications we recommend to use HEXFETs (International Rectifier). These can withstand abuse and at high power have a higher efficiency and output power compared to lateral Mosfets.

For High-End or even better applications we suggest to use the unique [EXICON Mosfets](http://www.eltim.eu). They have a slightly lower efficiency but have a conversion characteristic straight as a ruler, even with a low idle current of around 30-50mA only. They function that linear from that set point on, that it even doesn't make sense to apply more idle current as done with classic transistor class-A setting! They will only dissipate more heat actually.

Another thing is that while "clipping" these Exicons, only the tops of the signal run flat to the power rails. Hexfets will show a quite harmless high frequency oscillation just after the signal drops again. However, this effect is totally harmless compared to transistor designs, where mostly a huge and high frequency (outside audible range) oscillation occurs, reason why a lot of tweeters died actually. Since they are connected via a high-pass filter, these high frequencies will reach the tweeter VC and cause a lot of heat built up in them, the more because they won't move any more on these frequencies. Energy = movement + heat.....

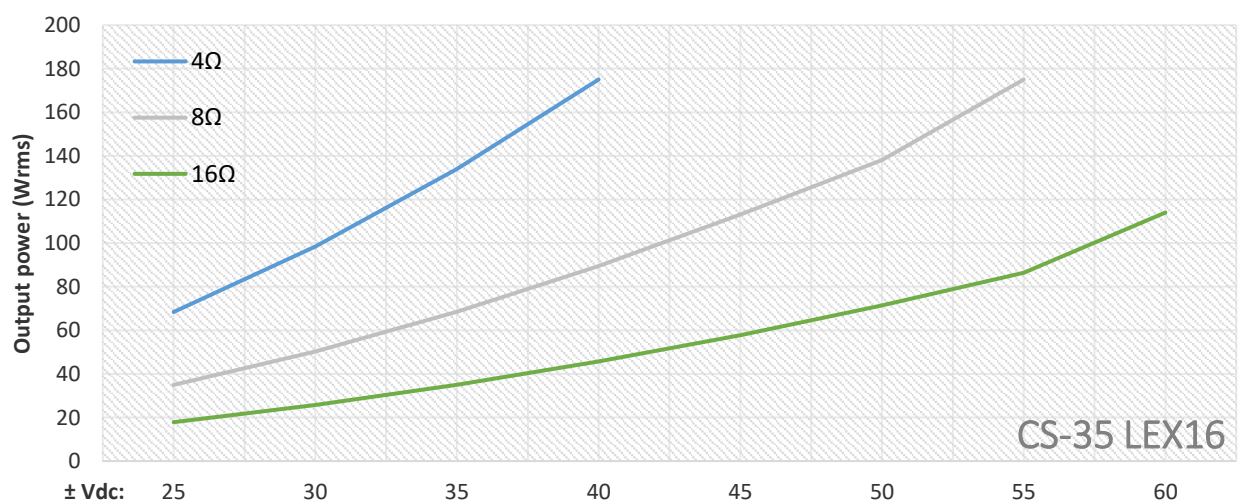


CS-35 LEX08 current Stage module. Extra's: Q6 MKP's over the power rails and induction free (and expensive) Caddock MP725 resistors in the feedback circuitry.



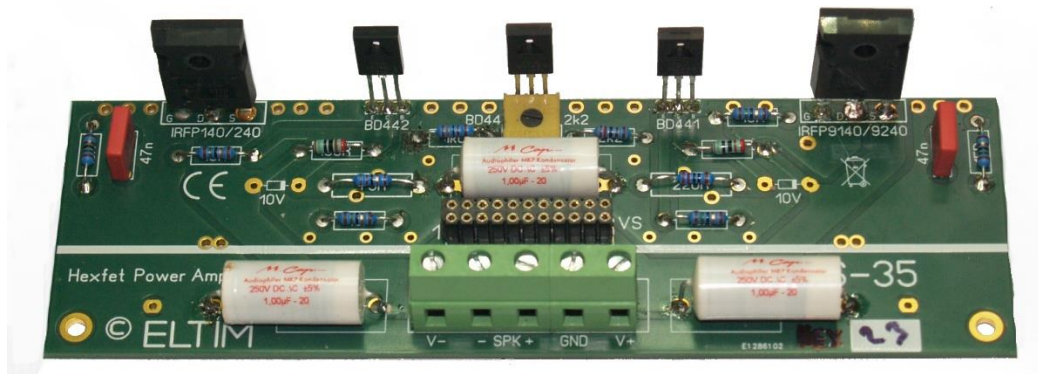
CS-35 LEX08, with EXICON 8A/200V/125W , TO-247 lateral Mosfets (ECX10N20 / ECX10P20)

The power is limited to around 125Wrms due to the Mosfets characteristics.

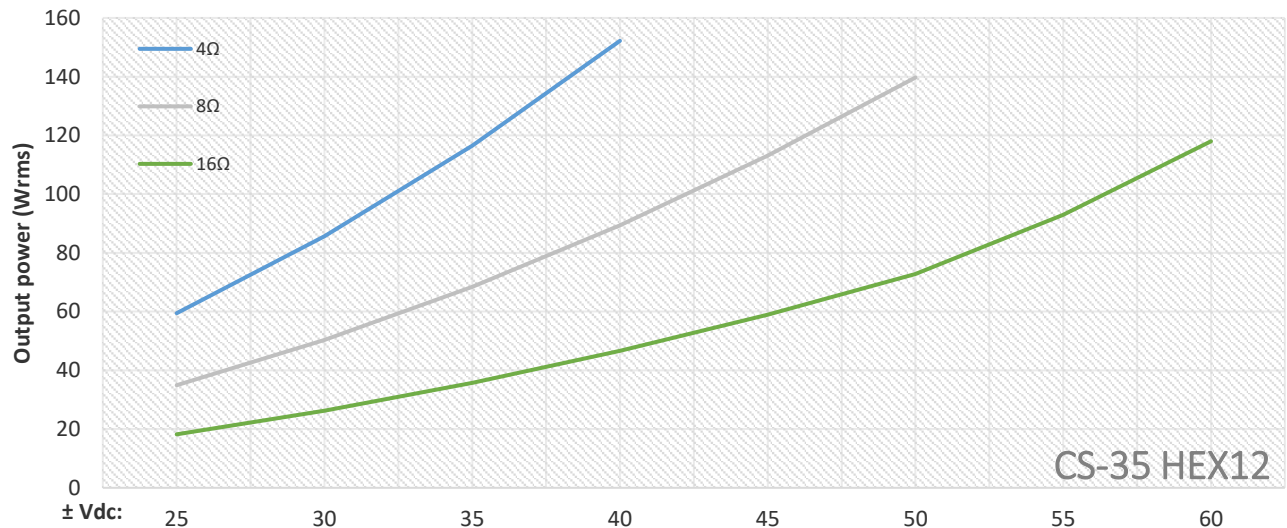


CS-35 LEX16, with EXICON 16A/200V/250W, TO-263 lateral Mosfets (ECW20N20 / ECW20P20)

The power is limited to around 170Wrms due to the Power supply limits of 200W and while using this unit mostly a relatively small heatsink. Use as large as possible.

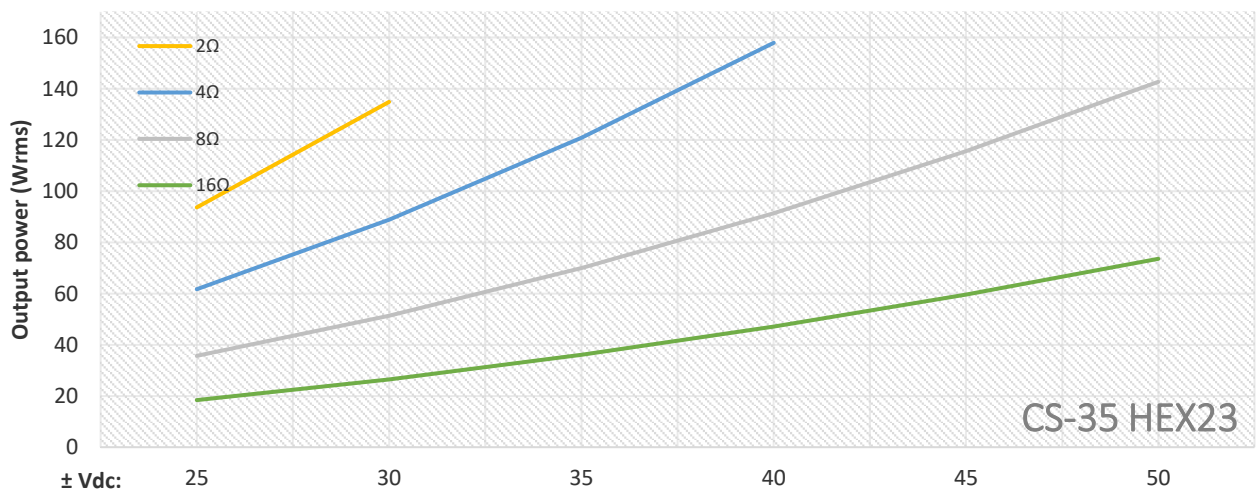


CS-35 HEX23 current Stage module. Extra's: MCAP250 MKP's over the power rails.
Regular MOX resistors (1%) mounted in the feedback circuitry.



CS-35 HEX12, with IR 12A/200V/150W, TO-247 Hexfets (IRFP240 / IRFP9240)

The power is limited to around 140Wrms due to the Hexfets characteristics.
This model is specialist in driving high ohmic loads, up to 120Wrms in 16ohms loads.



CS-35 HEX23, with IR 23A/100V/150W, TO-247 Hexfets (IRFP140 / IRFP9140)

The power is limited to around 150Wrms due to the Hexfets characteristics.

Vdc max = ±50V due to the Hexfet characteristics!!

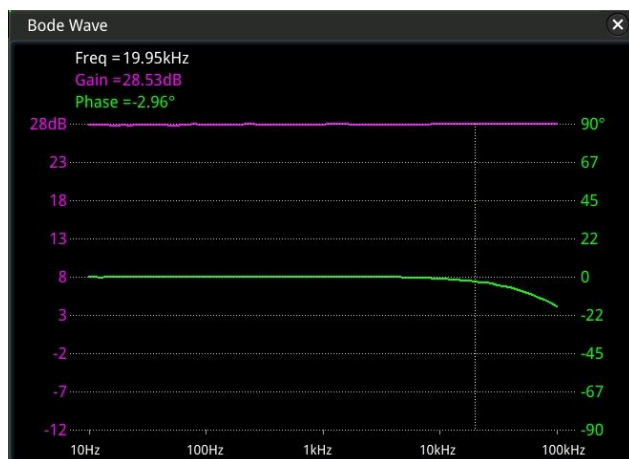
This is our most practical/cost effective ELTIM CS-module. A prototype model of it already performed very well years ago and resulted in many nicer ELTIM products.
135Wrms @ 2ohms load capable with < ±30Vdc supply max. and sufficient cooling!

Technical specifications:

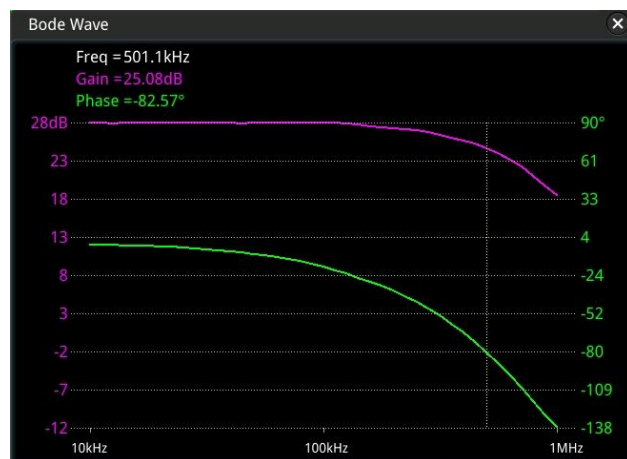
Frequency range:	DC - 170kHz within $\pm 0,2\text{dB}$
-3dB point:	> 400kHz
Audio band phase shift:	< -3° (20-20000Hz)
Distortion figure (THD):	< 0,005% (1W/1kHz/8ohm) < 0,01% (80W/1kHz/8ohm)
Slew rate:	> 40V/ μs (@ $\pm 30\text{V}$). Limited by AC-input filter on VS-module used.
Harmonics:	< -65dB, NONE specific, see graph right below. Actually well below noticeable.
Damping factor:	> 100 - 200 (strongly depending on power Mosfets and supply capacitors used)
Gain:	28dB
Recc. input voltage:	1 Volt
Input impedance:	47kOhm
Output load:	depending on model and supplied voltages, see graphs
DC Supply voltage:	depending on the model, see graphs
Output power:	depending on the model and supplied voltages, see graphs.
Dimensions:	149x50x28mm.

Some measurement data

We ourselves prefer listening over measuring, since our ears and senses are way better instruments than any other equipment. However, since a lot of DIYers want to see figures (acknowledging our senses) instead:



Wide audio bandwidth graph 10-100.000Hz with the marker set on 20kHz.
At this 20kHz the input to output phase error is at a minor -3° .



Extended bandwidth graph 10kHz – 1MHz with the marker on the -3dB point. Nice and clean roll offs.
This -3dB point as mostly given is just over 500kHz here.



1kHz square wave signal without any significant irregularities like swing in/outs. It also shows a slew rate of around 40V/ μs .
Please note that high quality opamps hardly reach 12V/ μs ...



Frequency domain (50kHz wide). Harmonics < -65dB (13+53).
The irritating 3rd harmonics (3kHz) is at this low level.
Even more irritating 5th is below the scale actually.

Measurement setup:

CS-35 LEX08 with CADDOCK MP725 resistors in feedback and INTERTECHNIK Q6-1,0uF over the power lines
+ VS-20 input module. Supply voltage $\pm 30\text{Vdc}$, load 8ohms dummy. Idle current 50mA.
Measuring equipment [RIGOL MSO5074](http://www.rigol.com) all in one instrument, all options included.

All the above looks impressive indeed, but we also wanted to show a graph nobody else shows:

Here we show the amplification factor for four frequencies with input levels from 50mV – 2,2V with 50mV interval measured steps. The corresponding output level is vertical.

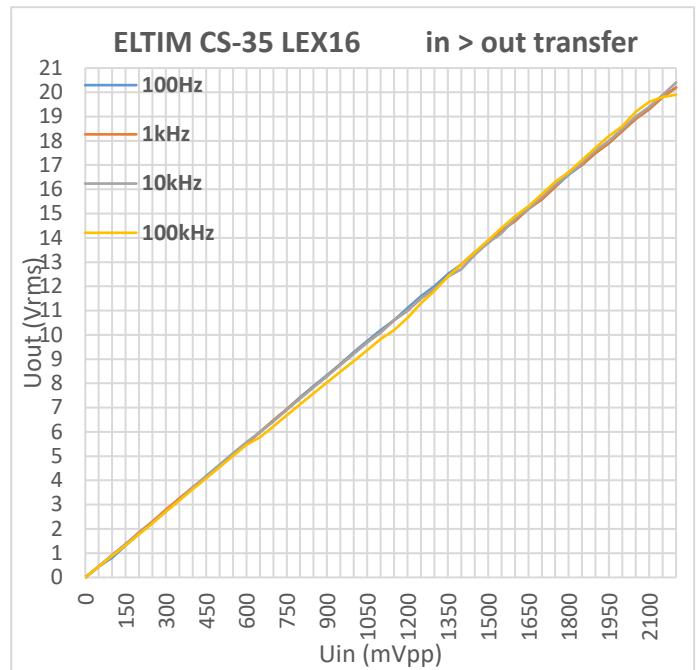
At best all four lines are as straight at a ruler and overlapping each other exactly. The blue 100Hz line is completely covered by the others in our designs.

If straight, at all levels and all frequencies the amplifier will neither increase nor decrease any instrument or voice character details (harmonics) at certain levels or frequencies, nor start to “scream” or sounding “dull” at certain levels. We believe ours is close enough, even at a 2V/100kHz level which normally never occurs, nor translated in sound: it will never “scream”. In all cases the gain is 28,3dB to be exactly.

Please, do this measurement with other designs and especially Class-D setups as well..... Hmmmm.

Customers already stated, “there is no amplifier”, meaning that it does not affect the sound character of voices and instruments, regardless the power it is set as proved in this and the other measurements.

Measured at $\pm 30\text{Vdc}$ and an 8 ohms dummy load. Idle current set at a ridiculous low 100mA > cool amp. Actually, at practical, reasonable levels they dissipate around the same as a class-D amp.

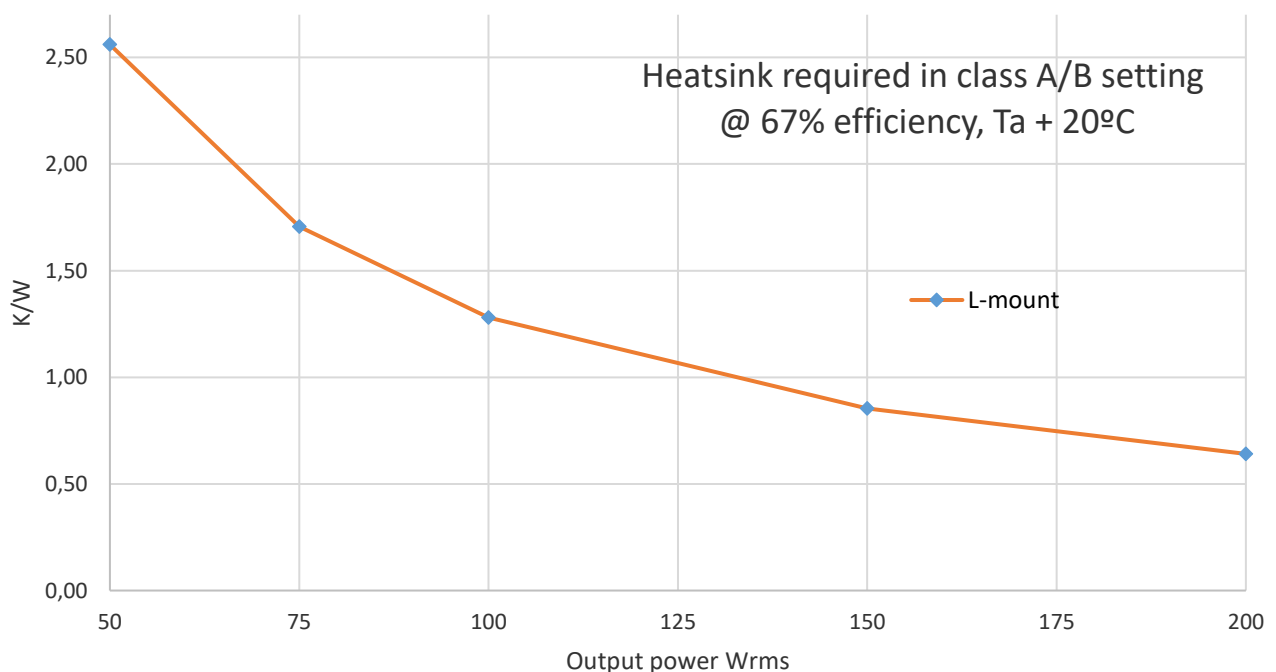


Heatsink data

In this graph you can read the required cooling capacity (K/W) of a heatsink with a certain output power.

The graph is recalculated where 33% of power (as always in class A/B) is transferred into heat.

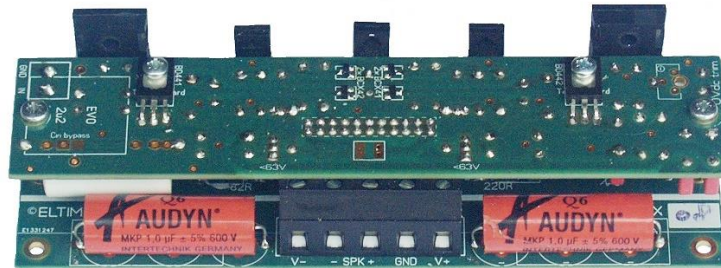
We also subtracted a 20°C ambient temperature already. With shown values the heatsink will become around 100°C. If you want it cooler, use a heatsink with a lower K/W rate = temperature rise per Watt heat added.



CONNECTOR FUNCTIONS

The central 5-pole screw connector is where a suitable power supply and the speakers are connected. Unlike as in many Chinese crap, the max. load of this professional connector is 20A (as our tracks can), pitch 7,5mm, 4mm² wiring. It makes no sense to combine 4 pairs of 16A Mosfets with a 10A screw connector! Instead of this connector you could mount a 2-pole speaker screw terminal and 3x 1,5mm copper rods to a CS-35ps beneath it, sharing its power supply and make a stereo or bridged amplifier this way.

We split up a power amplifier schematic into a Voltage Stage (input, small voltages) and a Current Stage (output, large currents) and due to a way simpler PCB layout get significantly improved sound quality results. The centre connector is where one of our [Voltage Stage modules](#) is connected, L-mounted or sandwiched. This last option makes the pack a compact version of around 30mm in height. Our VS-5 has the same width.



Please note that only a set of a CS and VS module is a working amplifier! So, you need both.

The input signal is connected to the 2-pole screw terminal on the VS-module. The input capacitor right behind it can be bypassed by connecting two solder pads at the back side.

Note that our new VS-5 exactly matches this CS-35 module.

DIY remarks

Unfortunately, we found out that to many DIYers overestimate themselves and fail to complete their DIY project. The unfinished projects sent to us about all show bad soldering's, misplaced components, etc. After correcting these errors, all modules were working as they supposed to do.

Even though there are hundreds properly working and highly regarded ELTIM modules around the world today, some talk about "poorly functioning modules" on fora, in reviews, etc. without telling or even realising perhaps they made mistakes themselves.

Since these kind of messages are read over and over for many years to come, we decided to drop this DIY delivery and only sell properly soldered, tested and very well-functioning High-End ELTIM built modules now. Unfortunately, in their "wisdom of truth" these people are harming our and our products good name and the DIY community itself. A pity, the more because they most probably don't even realise that or don't care.

Several enthusiasts were ahead of you already and built their nice ELTIM based amplifier.

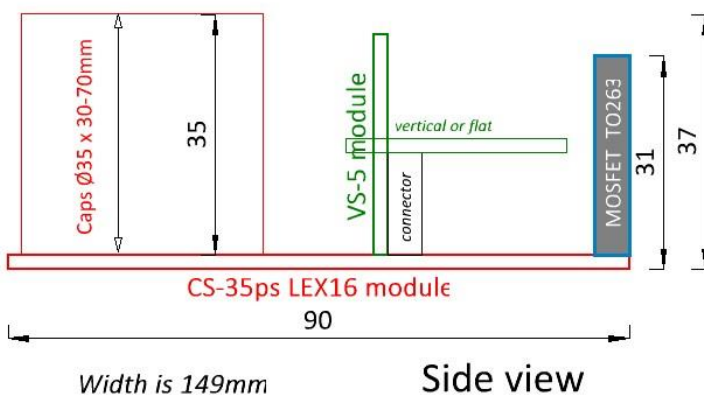
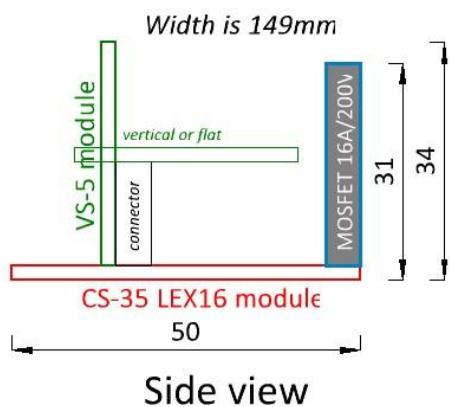
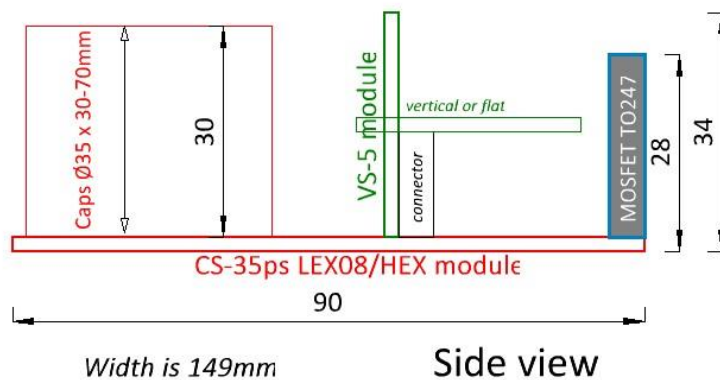
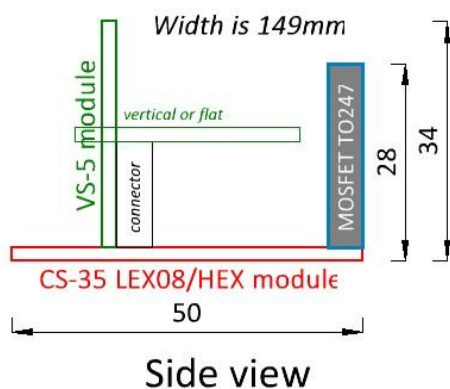
Some even sent us [pictures](#) and/or a [brief review](#).

[Send us](#) pictures of your project as well!

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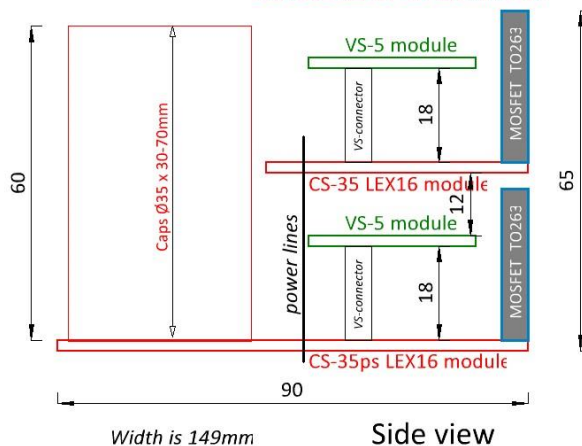
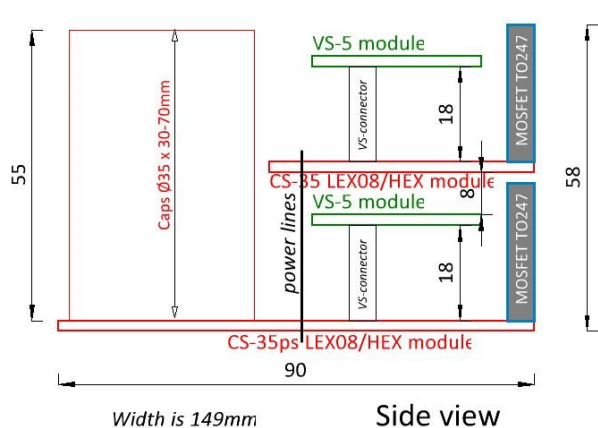
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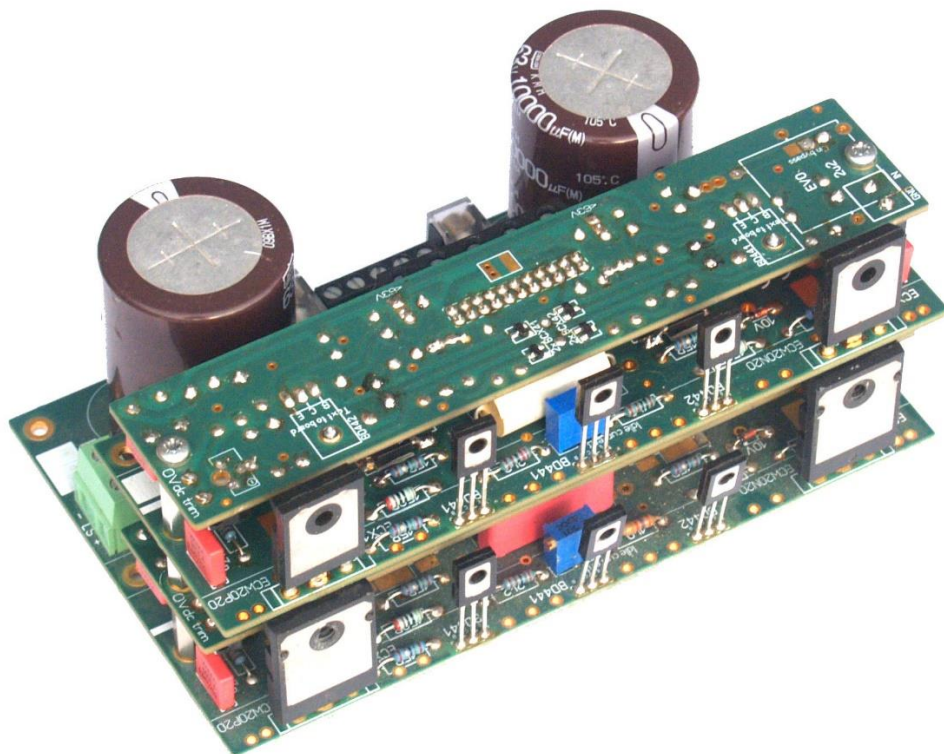
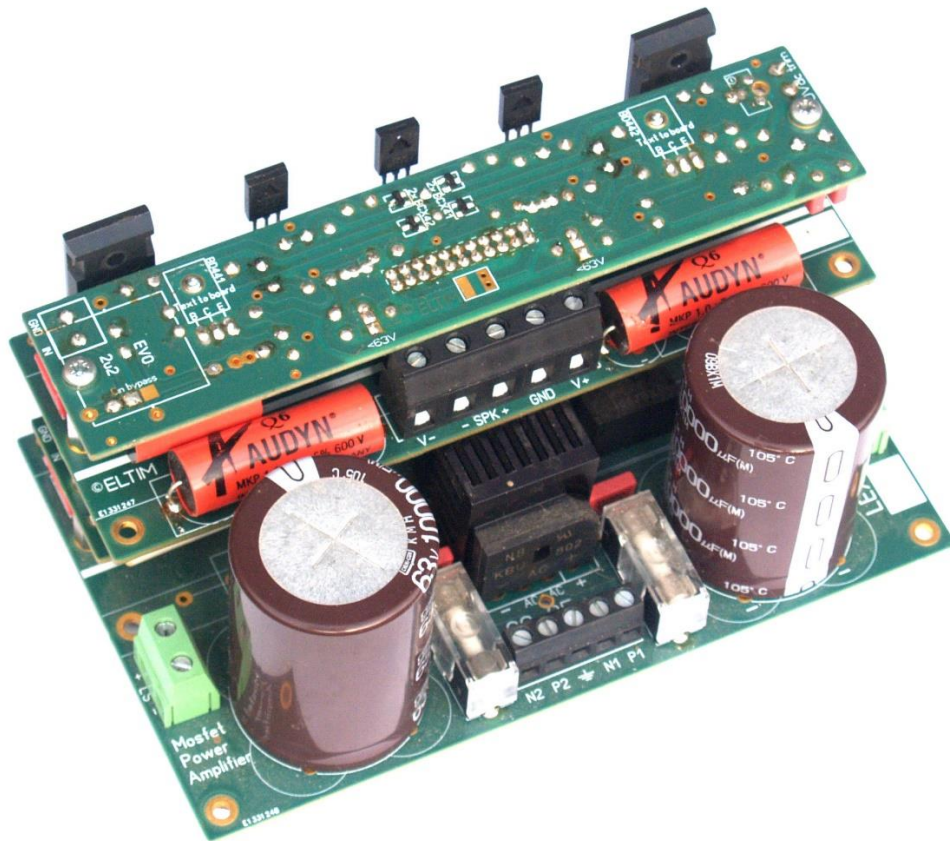
VS-35 module(s) also fit on top of a CS-35ps with integrated power supply, so you can make a very compact stereo, multi-channel or bridged amp:

For active multiway setups you also can use CS-35 LEX08 for mid- and high range



***Supply capacitor lengths are given as just below max. height of the modules.
For multichannel setups use a CS-35ps LEX16 for the bass and CS-35 LEX08 for mid/high.***

With our PS-35 and CS-35ps you could build a very compact two-channel amplifier for stereo, bi-amp, active or even bridged mode use:



Both channels use the Power Supply of the CS-35ps module, so you only require a single, double secondary windings transformer to complete it. This example is with a 16A CS-35ps (woofer) and an 8A CS-35 (tweeter) active setup. You could feed it with an active filtering system like a DSP.