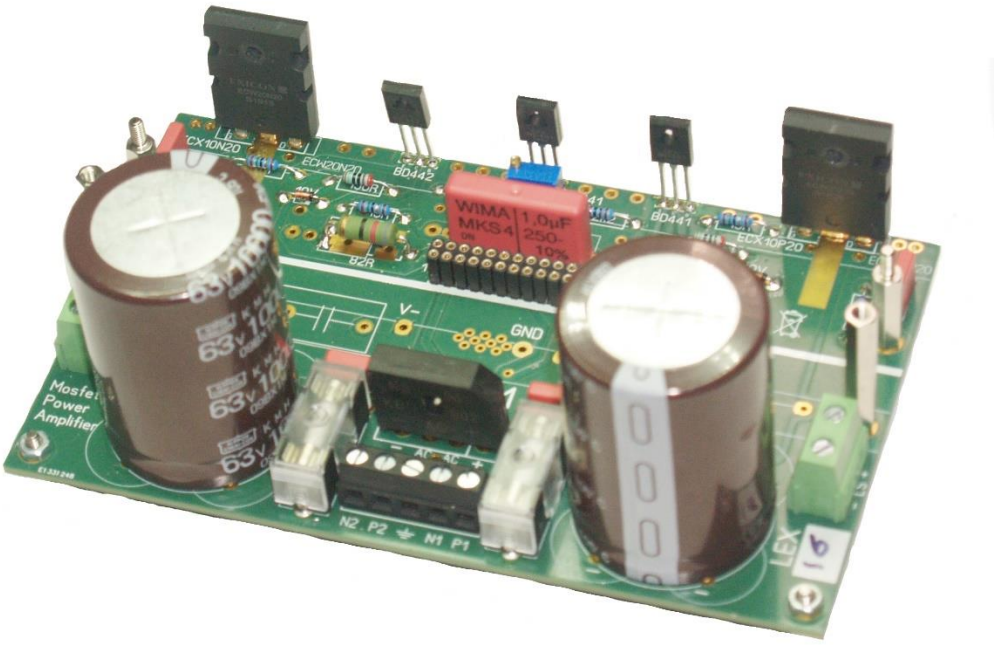
CS-35ps Current Stage module with power supply

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 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.
Most of the VS-tracks are in a 90º 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-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 (2x35um), tinned isles, text on both sides, etc.
On this CS-35ps module we also integrated a symmetrical power supply. Just connect a transformer.



Example of a CS-35ps LEX16 with integrated power supply.

This CS-35ps module can be sandwiched with a CS-35 module, sharing the same power supply of CS-35ps.
While leaving out the central screw connector on CS-35, the V-, GND and V+ connections can be fed through the PCB to the matching locations on the CS-35ps module, forming it a nice and compact stereo, multichannel, active speaker or bridged mode powertrain.
Only three straight and solid copper rods 1,5mm² make the supply connections. Nice, compact, and clean.
While sandwiching both (or more), you still can use long, high capacitance supply capacitors!

For ultra-compact solutions you even can sandwich mount our matching VS-5 input stage modules.

This **CS-35ps** power (current) stage PCB highlights:

- Versions for GSD (mostly Mosfets) and GDS (mostly Hexfets) oriented types, TO-247 or TO-263.
- Integrated, symmetrical power supply with sufficient space for serious supply capacitors.
- 8A/140Vac rectifier, can be cooled by 2x finger/IC coolers while highly loaded.
- 2x 4 Ø18mm, pitch 7,5mm or 2x Ø30/35mm, pitch 10mm electrolytic supply capacitors fit.
- With a mounted CS-35 on top you still can use any length of supply capacitors.
- 2x serious quality MKP capacitors over the voltage rails (option).
- WIMA MKS4 1,0uF in the idle current network. Quality MKP capacitor optional.
- Current driven feedback in the centre of PCB by 2W or 3W MOX resistors (induction free SMD optional).
- Speaker output available both left and right (20A, pitch 7,5mm, 4mm² cable) .
- No coil in the output line resulting in a way better impulse behaviour (>40V/us @ ±30Vdc).
- Separate tracks for Power-, VS-stage and input ground.
- All grounds are leading to the centre front area of the PCB.
- Wide (>8mm) and thick (35um) speaker-, ground- and power rails tracks.
- Highly efficient at average/low power due to low idle current, actually way better than class-D at low levels.
- CS-35 (without power supply) can be sandwiched for stereo, multichannel (active!) or bridged operation.
- Width matching our new and compact VS-5 input module, also mountable as sandwich for lowest height.
- Size 149x90mm. Effective height depends on Fets and power supply capacitors used.

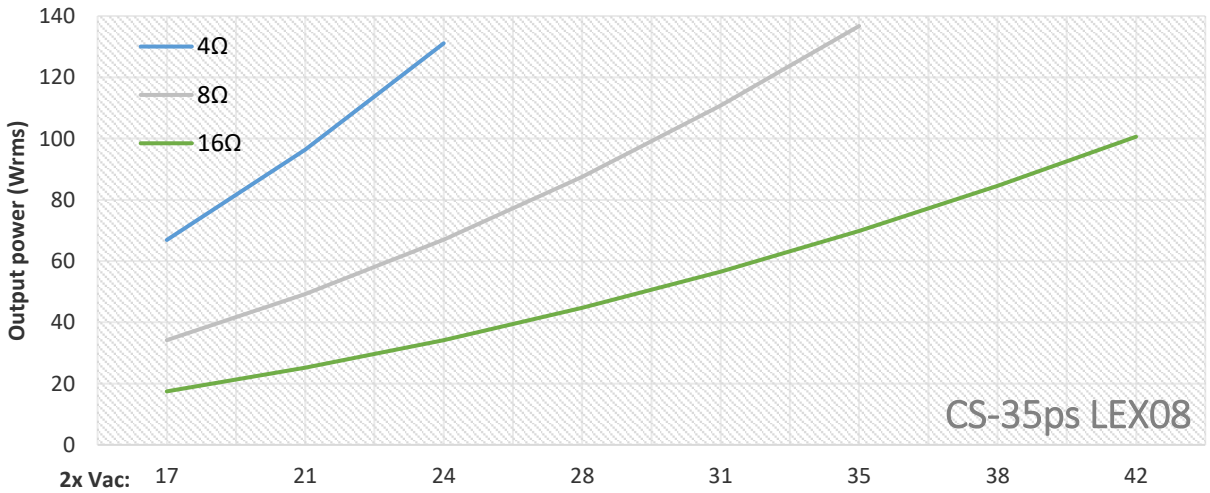
Basically, all our CS-35ps modules are the same, except for the types of Power Fets and supply caps mounted. Due to the specifications of the power transistors and capacitors max. voltage, the “figures”, their data, and pricing is different and based on the max. voltage/current they can handle while mounted in an optimal way.

Integrated symmetrical Power Supply

The schematics and PCB layout of this CS-35ps is exactly the same as a CS-35, but on this CS-35ps PCB there is a 8A/140Vac rectifier and space for electrolytic supply capacitors, together forming a basic symmetrical power supply with a max. capacity of around 200Wrms total output. At high loads use finger/IC coolers!
Instead of the central screw terminal on CS-35 (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.
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/100W output.
The elco’s rated voltage must be higher than the voltages supplied, otherwise they will blow in your face!

Type of Fets.

For rugged PA or low-cost 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 Mosfets.
For High-End or even better applications we suggest using the unique EXICON Mosfets. They have a slightly lower efficiency but have a conversion characteristic straight as a ruler, even with a low idle current of around 30-100mA 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.



CS-35ps LEX08, with EXICON 8A/200V/125W, TO-247 lateral Mosfets (ECX10N20 / ECX10P20)
The power is limited to around 125Wrms due to the Mosfets characteristics.

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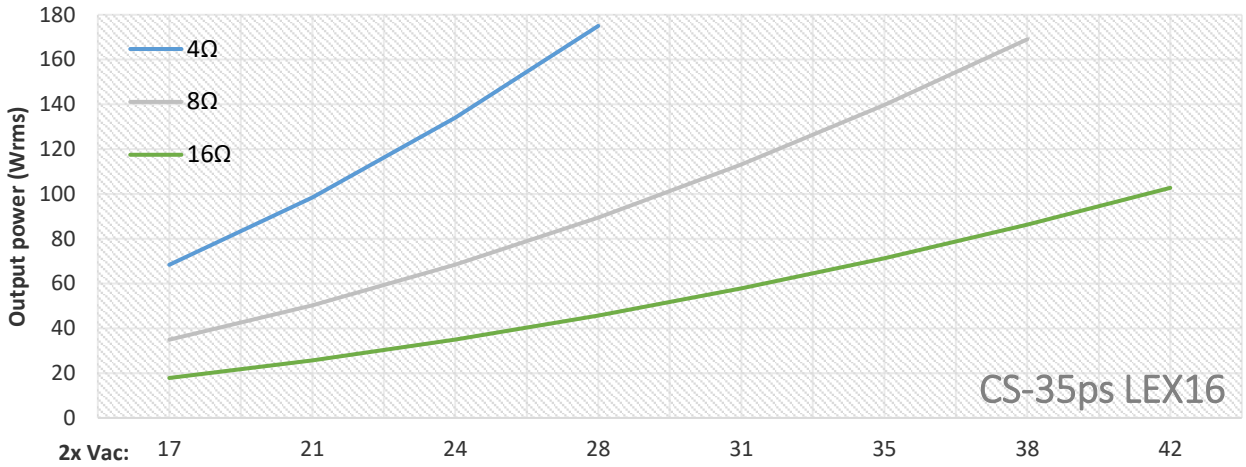
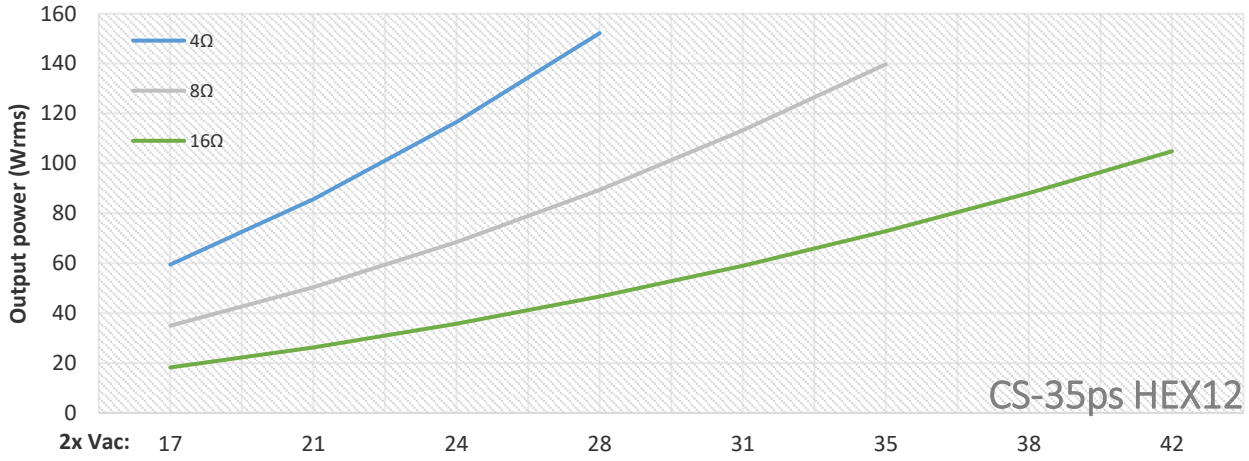


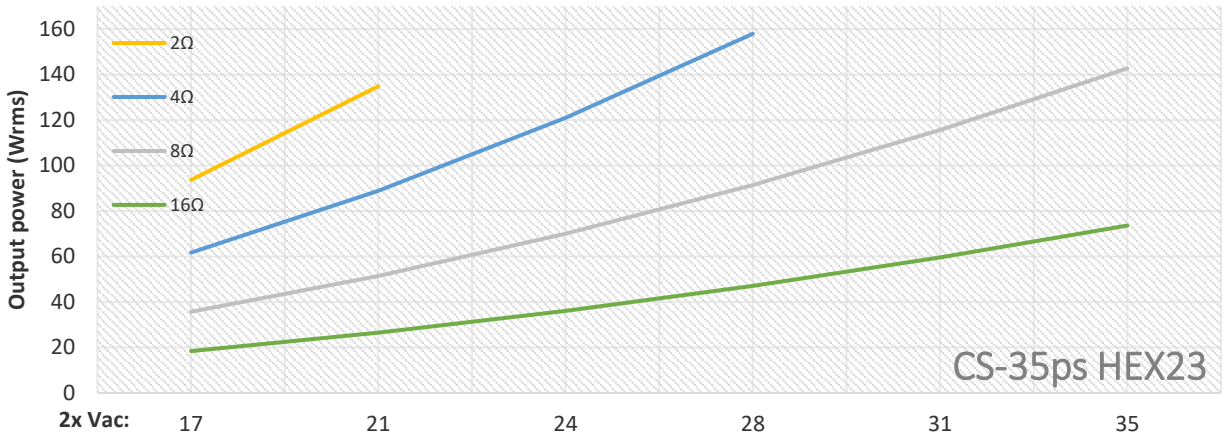
CS-35ps LEX16, *with EXICON 16A/200V/250W, TO-264 lateral Mosfets* (ECW20N20 / ECW20P20)

The power supply capability of around 200W limits the 4/8ohms output of this module!



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

The power is limited to around 150Wrms due to the Hexfets characteristics. Specialist in high ohmic loads.



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

The power is limited to around 150Wrms (2x 35Vac max.) due to the Hexfets characteristics.

Note that the horizontal listed voltages are transformer voltages (Vac)

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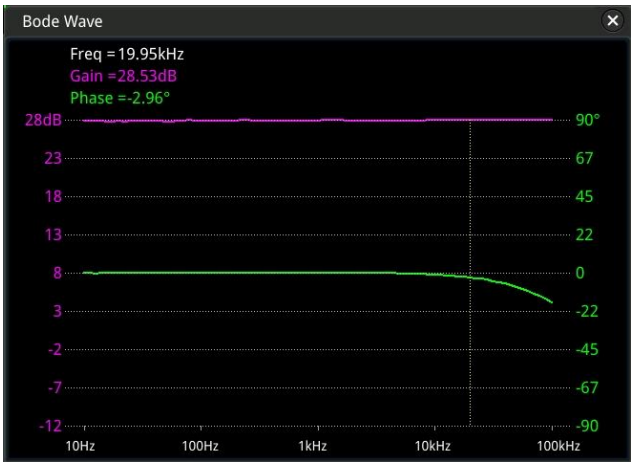
Technical specifications:

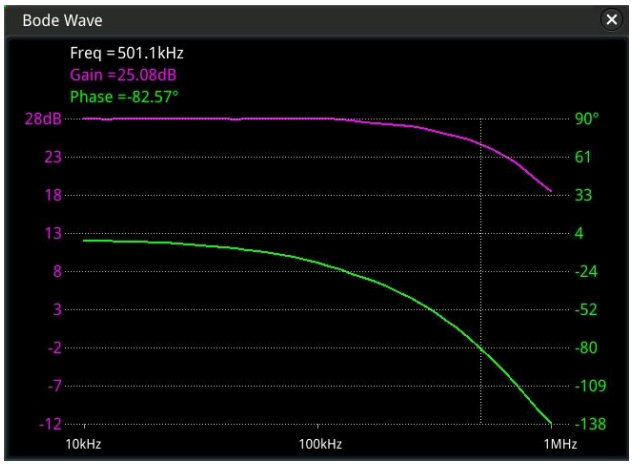
Frequency range:	DC - 170kHz within 0,2dB
-3dB point:	> 500kHz
Audio band phase shift:	< -3º (20-20000Hz)
Distortion figure (THD):	< 0,005% (1W/1kHz/8ohm)
	< 0,01% (80W/1kHz/8ohm)
Slew rate:	> 40V/uS (@ +/- 30V). Limited by AC-input filter on VS-module used.
Harmonics:	< -65dB, nonspecific, see graph right below. 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
Supply voltage:	Dual secondary windings transformer, depending on the model, see graphs
Output power:	depending on the model and supplied voltages, see graphs.
Dimensions:	149x90mm, height depends on type of supply capacitors used.

Some measurement data

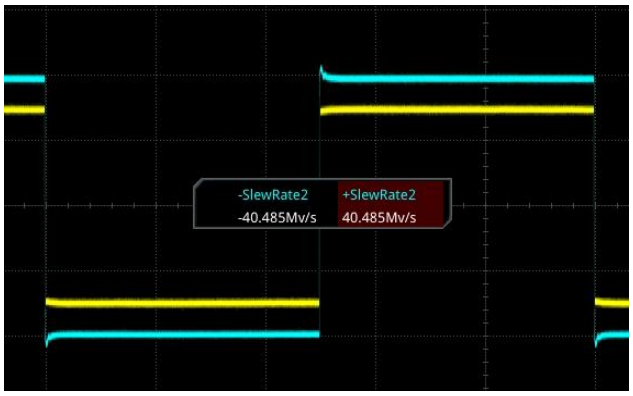
We ourselves prefer listening over measuring, since our ears and senses are way better instruments than any other equipment. However, since a lot of DIYers want to see figures (acknowledging our senses) instead:



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 -3º,
meaning that the 3D staging is phenomenal.



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/uS.
Please note that high quality opamps hardly reach 12V/us…

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 ±30Vdc, load 8ohms dummy. Idle current 50mA.
Measuring equipment RIGOL MSO5074 all in one instrument, all options included.

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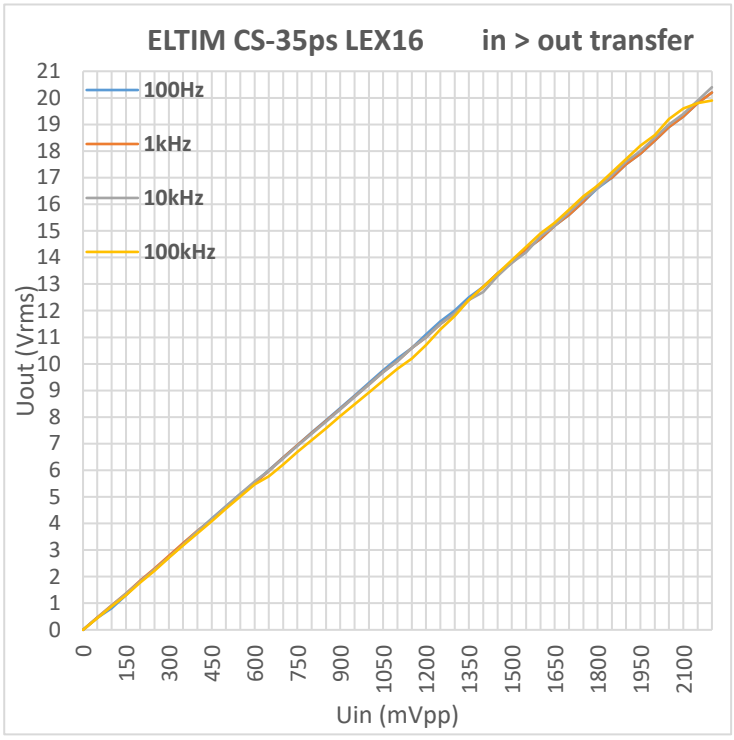
All the above looks impressive indeed, but we also wanted to show a graph nobody else shows:

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.

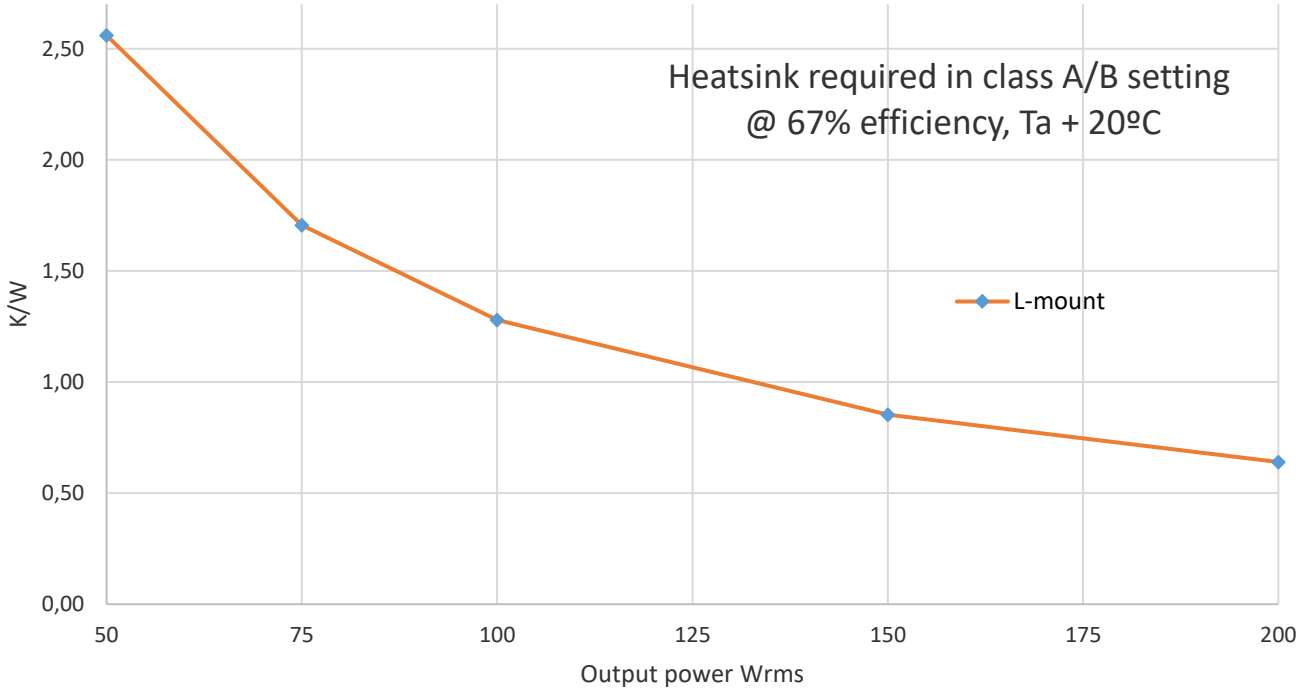


At best all four lines are as straight at a ruler and overlapping each other exactly. Actually, the blue 100Hz line is completely covered by the others in our designs.

If straight, at all levels and all frequencies the amplifier will neither increase nor decrease any instrument or voice character details (their 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.

Customers already stated, “there is no amplifier”, meaning that it does not affect the sound character of voices and instruments as proved in this and the other measurements.
This graph is an acknowledgement of that.
Do this measurement with your existing amplifier setup and be surprised, especially if it is a Class0D setup….
Measured at ±30Vdc and an 8 ohms dummy load. Idle current set at a ridiculous low 100mA > cool 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 20ºC ambient temperature already. With shown values the heatsink will become around 100ºC. If you want it cooler, use a heatsink with a lower K/W rate = temperature rise per Watt heat added.



Connector functions
The 5-pole screw connector is where the two secondary windings of a suitable transformer is connected. Connect a type with aprox. 1,5x the power of the total Prms output will be.

Just behind the rectifier V-, GND and V+ are available for sandwiched CS-35 module(s).

We split up a power amplifier schematic into a Voltage Stage (input, small voltages) and a Current Stage (output, large currents) in order to get the significantly different results compared to all the rest.
The centre connector is where one of our VS-5/10/20 Voltage Stage input modules is connected, L-mounted or sandwiched. This last option makes the pack a compact version of around 30mm in height. VS-5 has the same width and is perfectly matching this CS-35ps output module. While sandwiched its secured by 2x M3 bolts.
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 of the VS-5 input module. The input capacitor right behind this connector can by bypassed by connecting two solder pads at the back side.

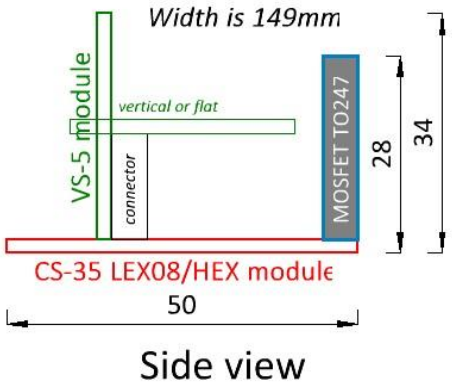
At the left or right connectors (20A, pitch 7,5mm) the speaker leads are to be connected. Use the one closest to the speaker terminals. Since with us it are serious connectors, you can connect up to 4mm² cable to it.

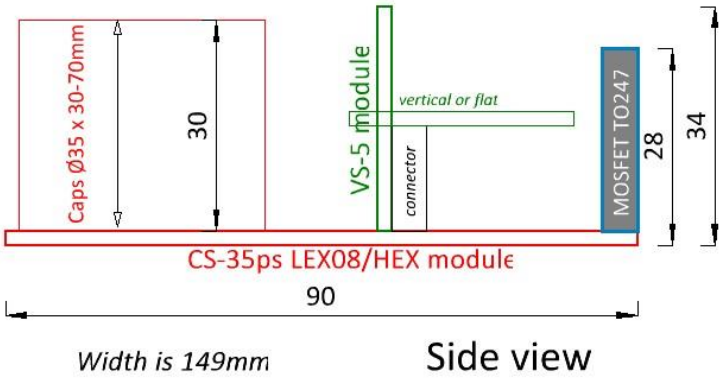
DIY remarks
Unfortunately, we found out that to many DIYers overestimate themselves and fail to complete their DIY project. The unfinished projects sent to us about all show bad soldering's, misplaced components, bad mechanical work, etc. After correcting these errors, all modules were working as they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

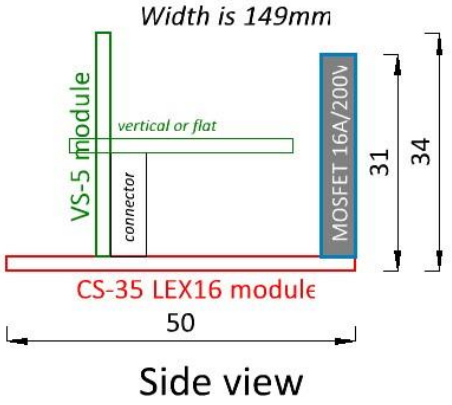
Even though there are hundreds properly working and highly regarded ELTIM modules around the world today, some talk about "poorly functioning modules" on fora, in reviews, etc. without telling or even realising perhaps they made mistakes themselves.
Unfortunately, in their "wisdom of truth" these people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

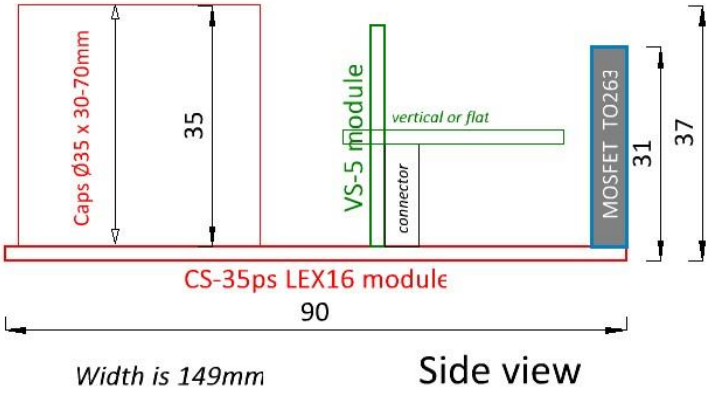
We decided to drop this DIY delivery and only sell properly soldered, tested and very well-functioning High-End ELTIM handbuilt modules now.

Several enthusiasts were ahead of you already and built their nice ELTIM based amplifier.
Some even sent us pictures and/or a brief review.

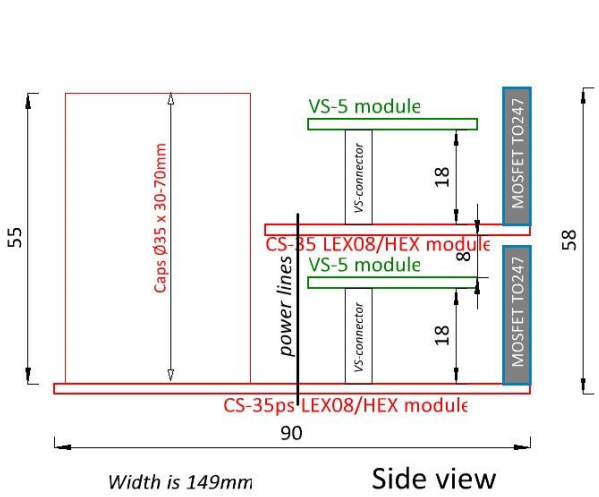


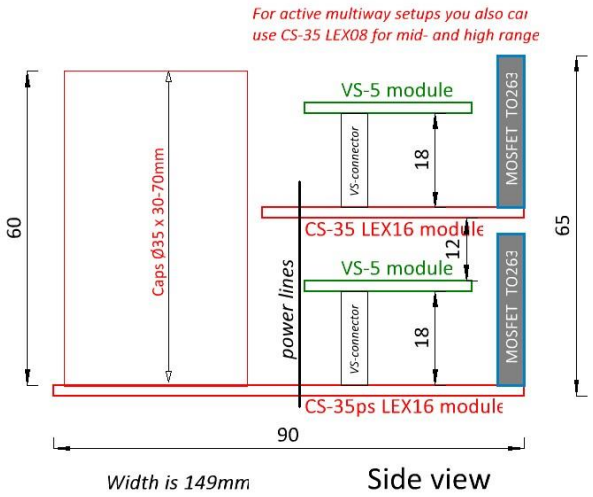






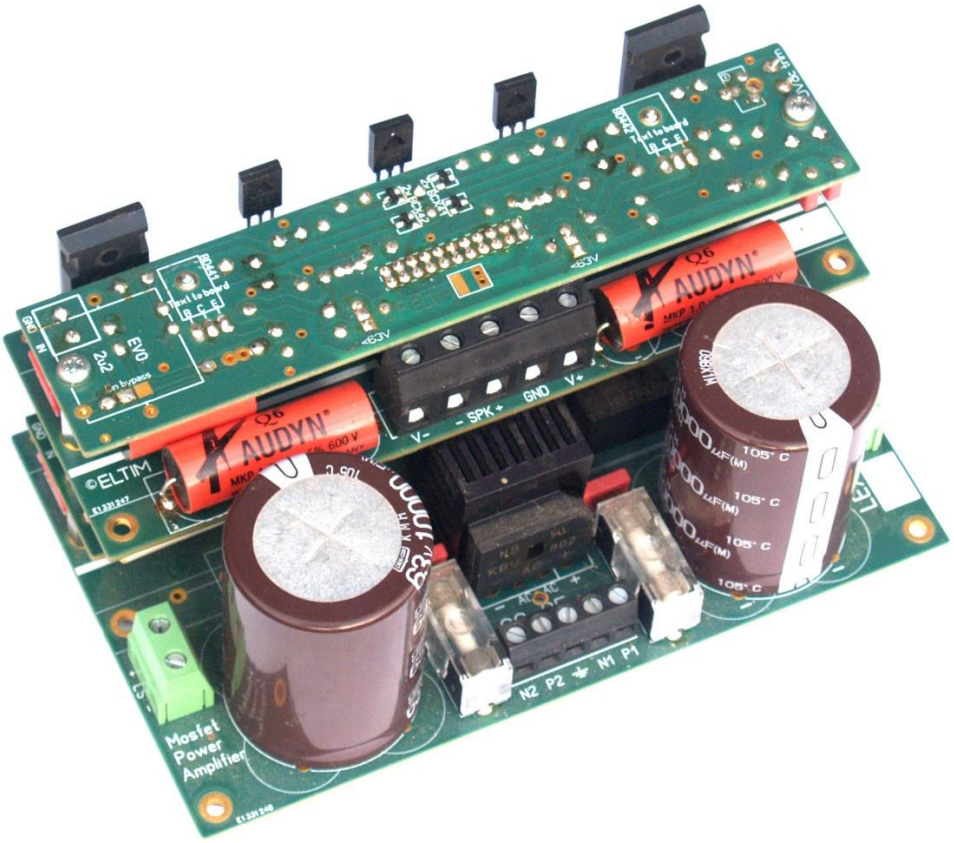
VS-35 module(s) also fit on top of a CS-35ps with integrated power supply, so you can make a very compact stereo, multi-channel or bridged amp:

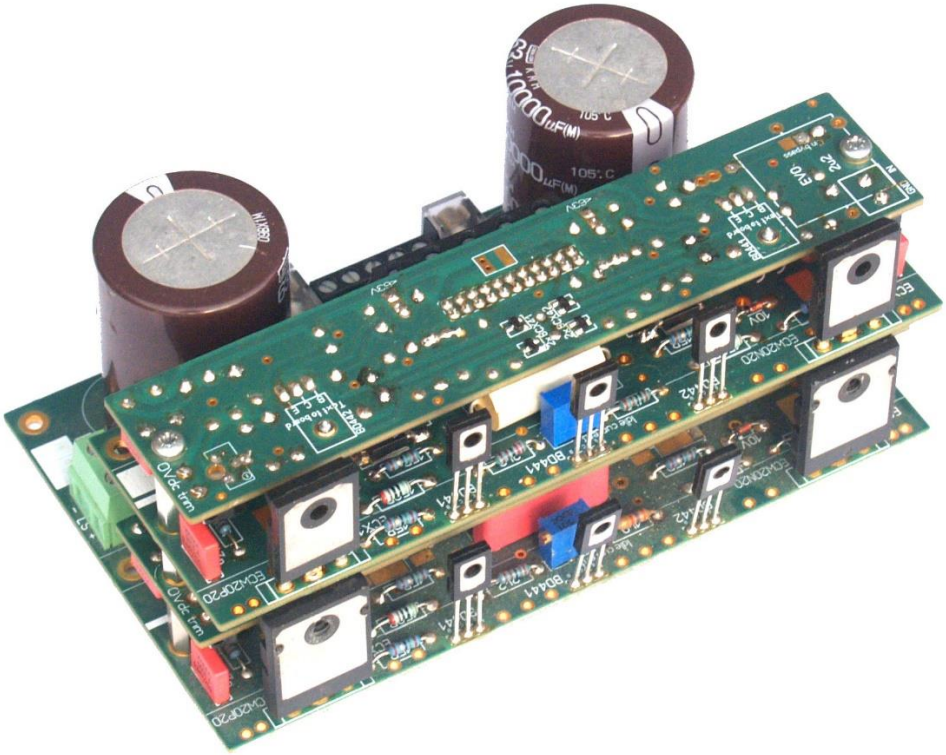




Supply capacitor lengths are given as just below max. height of the modules.

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.