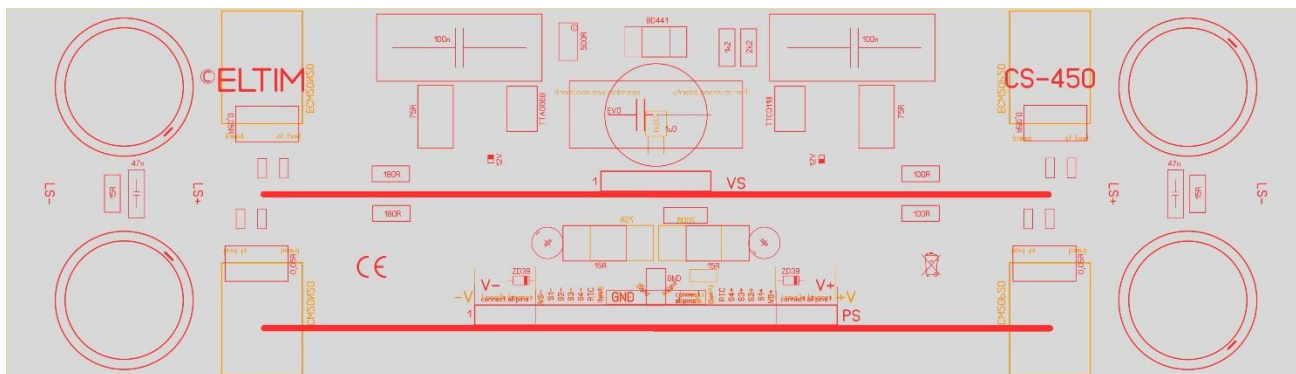
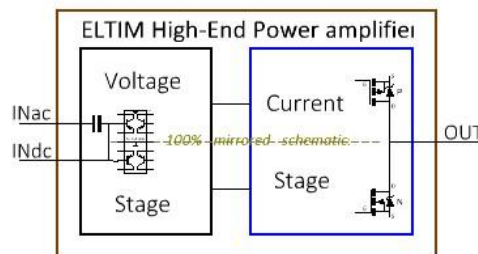


CS-450 Current Stage module

 Updated: November 23rd, 2023

With ELTIM High-End amplifier modules we split the amplifier schematics up in a Voltage Stage (VS-module) processing the small input voltages and a Current Stage (CS-module) which processes the large and transient rich speaker currents. While doing so, the PCB layouts can be made way simpler, symmetrical, and designed for their specific task. F.e. CS-modules have unusual wide tracks. Due to this totally different and symmetrical design of our schematics and PCB layout with unusual wide tracks, they sound “tubelike” clean, yet have better and deeper control over your speaker system compared to most other amplifier designs as noticed immediately after the first bass drum or guitar note you hear.

Both a VS-module and a Power Supply (PS) module are connected by high quality milled headers, no wiring!



CS-450 (2024) with two pairs of 16A EXICON Mosfets (32A total) at the back side. 390x94mm

This 2024 model fits in a MODU Dissipante casings, with a size of 400x120mm.

There is space for 2x two Ø30/35mm, pitch 10mm or 4-pin electrolytic capacitors (not included), assisting our PS-2 or PS-3 Power Supply module or your own PS. You can select several types or none in the order process.

Due to the wide variety of values/quality/prices we don't mount them standard.

We strongly advice to use some in any case, preventing possible oscillations and increased bass quality!



It exactly fits in MODU Dissipante 400x120mm and can make around 450W in this cabinet.

There is space to mount chassis plates both on top and bottom at the same time.



It exactly fits in MODU Mini Dissipante 400x120mm and can make around 400W in this cabinet.

There is space to mount chassis plates both on top and bottom at the same time.

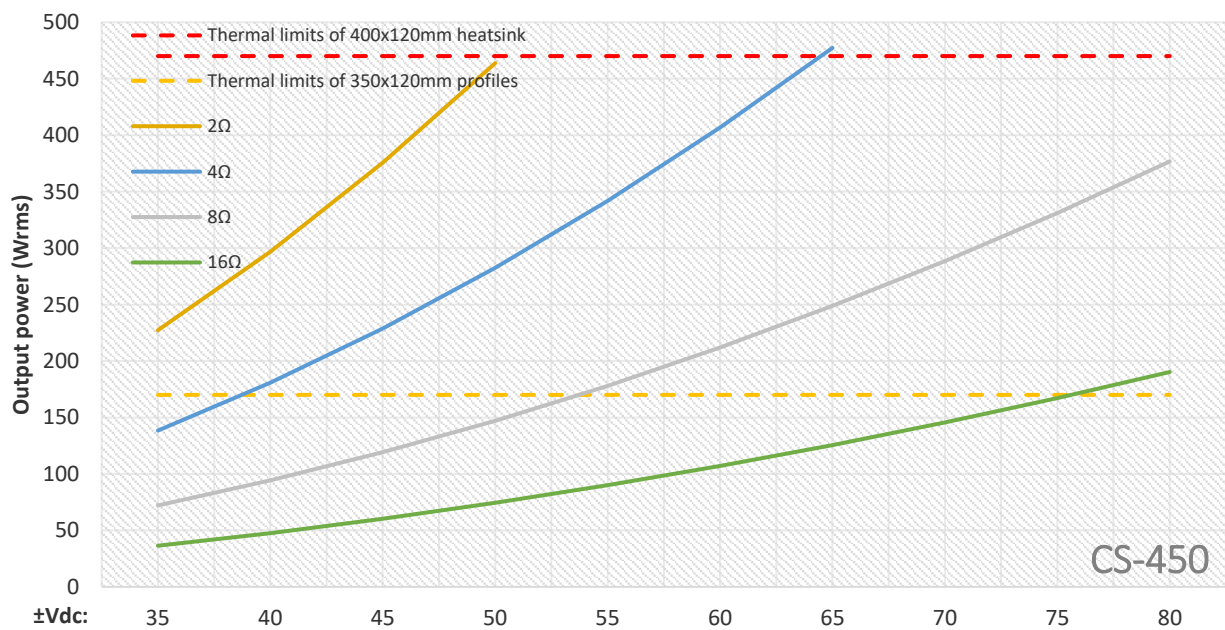
CS-450 stays even cooler in MODU Dissipante and Monoblock versions, both 400x165mm.

CS-450 also fits in Slimline side profile slides 350x120mm, only with restricted power due to limited heat transfer!

CS-450 General technical specifications (PRELIMINARY):

Frequency range:	DC - >200kHz within $\pm 0,1$ dB
Frequency limit (-3dB):	limited and defined by VS-module used: VS-10: 350kHz, VS-20: 450kHz, VS-50/60: 600kHz)
Frequency limit (-10dB):	700-900kHz (unlimited this CS-450 runs >2MHz....)
In > Out Phase shift:	-0,2° constant @ 10Hz - 18kHz, -3,6°@20kHz
Max. output current:	32A constant (dependant on the heatsink dissipation rate, for max. power < 0,6K/W!)
Distortion figure (THD):	< 0,0005% (1W/1kHz/8ohm) < 0,001% (150W/1kHz/8ohm)
Slew rate:	> 60V/ μ S (@ full power). Limited by RF-input filter on VS-module used.
Harmonics:	< -60dB, nonspecific
Noise floor:	<-120dB
Damping factor:	> 500
Input sensitivity:	1 Volt
Gain:	34dB (i.c.w. any required VS-module)
Input impedance:	10kOhm (lower on request)
Output load:	2 – 16 ohms (see load graph)
Supply voltage:	± 35 - ± 50 Vdc (2/4/8/16ohms load) ± 35 - ± 65 Vdc (4/8/16 ohms load only!) ± 35 - ± 80 Vdc (4/8/16 ohms load only!)
Max. output power:	450Wrms @ 2ohms (with ± 50 Vdc supply voltages). 450Wrms @ 4ohms (with ± 60 Vdc supply voltages, then 2ohms is not allowed!). 380Wrms @ 8ohms (with ± 80 Vdc supply voltages, then 2/4ohms is not allowed!).
Dimensions:	390x94x20mm (exactly fits a double 200x120mm MODU heatsink with mounting braces).

Output power versus \pm Supply voltage diagram.



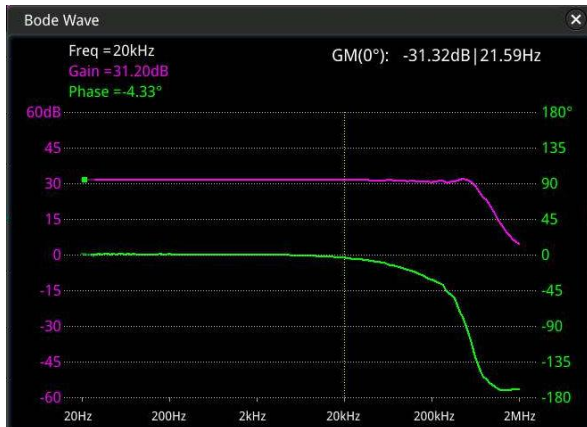
Select the supply voltage matching your power requirements.
With the power of aprox. 450Wrms @ 2ohms the max supply voltage is ± 50 Vdc.
It produces 280Wrms @ 4ohms or 150Wrms @ 8ohms then.
With no 2ohms capability you can increase the supply voltage to 65V,
resulting in 470Wrms into 4ohms and 250Wrms in 8ohms.
Only if you are sure you only use 8/16 ohms speakers, you can increase the supply voltage
up to ± 80 Vdc where this CS-450 makes 380Wrms @ 8ohms.

You could use it in Slimline 350x120mm where it fits without drilling. Power is limited to around 170Wrms then.

FREQUENCY and PHASE BEHAVIOUR (for now CS-250 with 2x 8A Mosfets shown)

In the [Bode graph](#) below we show the gain and frequency graph (purple) as well as the input to output transfer delay given in phase error degrees (green). We used 30 measurements/decade.

The values of the yellow, dotted line at 20kHz are shown at left top.



The purple line in the picture is the frequency graph, straight as a ruler from DC to >200kHz.

The -3dB point is around 600kHz, -10dB around 900kHz and limited by us on VS-modules.

Without this safety (possible external caused oscillation) precautions CS-250 runs over 2MHz.

It could work from DC up while using the INdc input at the VS-module.

Very important, yet hardly ever shown is the green line representing the phase (=time delay) between the input- and output signal at different frequencies. This graph simply shows the staging (3D) performance. A flat line would be perfect.

While watching the measurement one can see at the oscilloscope ([RIGOL MSO5000 series](#), all options) that the higher the measuring frequency the more the output comes behind the input signal.

The time shift difference in both signals is presented as the phase.

In this CS-250 (+ modified VS-20) this error is a constant -0,2° in the audio band, only -4,3°@20kHz which is ignorable. In order to obtain this flat phase response, meaning that high frequencies require the same transfer time as low frequencies do, the frequency range must be at least 20x the audible band. So we did, is not easy. Unlike as with most bandwidth limited systems you will not think all the time “something is wrong here” !

STEP RESPONSE

To present “fast” instruments like cymbals, triangle, bells, snare drums, etc. correctly, the step response needs to be as vertical as possible. Basically, this is easily done, but mostly the vertical graph as shown below shows “overshoot” (passing the horizontal line) and “undershoot”, making it a “tssjj” like sound as we hear about everywhere today. Some even believe it must be that way > High-End??

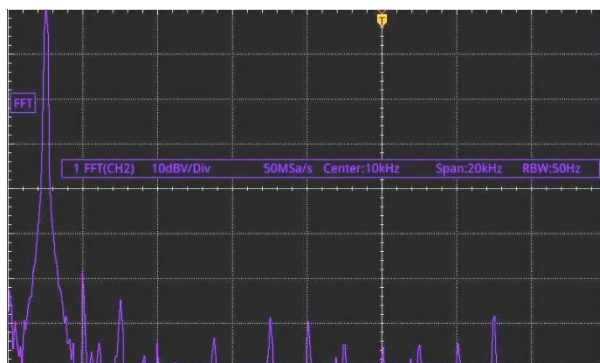
The impulse response with a 1kHz/150mV square wave input signal is “by the book”, no over- nor undershoot.

With the extremely wide frequency response of 600kHz, preventing over/undershoot is very difficult to achieve and mostly simply accepted. The “speed” of the vertical incline is measured in V/us, with us >65V/us @ full power, being >3x faster than best quality opamps used in studio mastering sets.



HARMONICS

Harmonics are frequencies of multiple base tone made by the circuit itself and can be represented in a FFT ([Fast Fourier Transformation](#)) diagram. Their effect is part of many discussions. Fact is that this combination of added tones partly gives the amplifier its “sound character”. The less harmonics produces, the cleaner the sound. Some of our customers stated that with our (more simple) amps “there is no amplifier present”. Nice.



1kHz/1V sine wave input tone (left peak) with the resulting multi frequency harmonics peaks in purple.

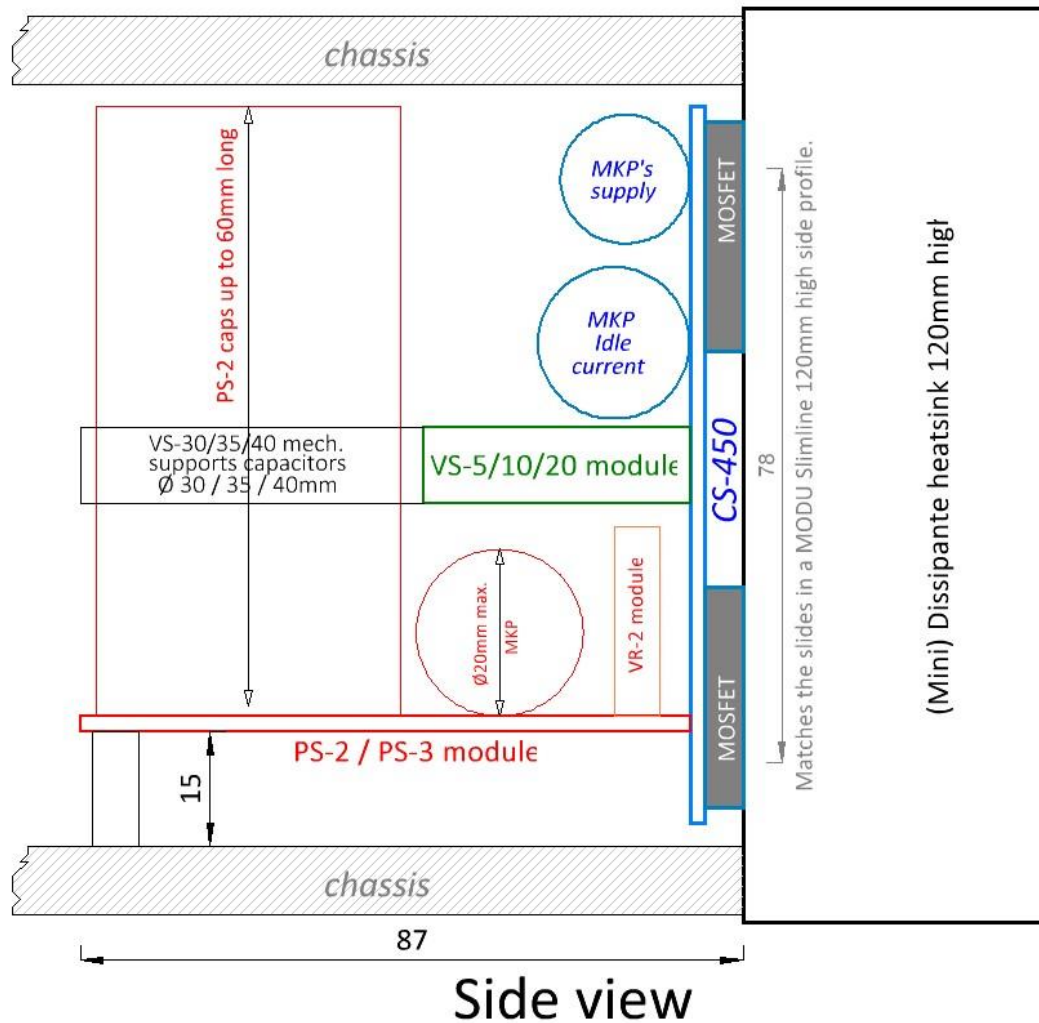
FFT transformation shows that the only few harmonics are way below audible level, <<65dBv. All are similar in size, nonspecific present and way below critical level.

The largest one is the second harmonics, 2kHz @ -60dB.

Second harmonics (as many tube amps show) are experienced as pleasant. Most solid-state systems show an as unpleasant experienced third harmonics (so 3kHz) here.

The noise floor is < 120dB and cannot be heard.

Full scale (1:1) view of a CS-450 / VS-xx / VRxx and PS-2/3 combination:



Scaled 1:1 if your printer is set to 100%

In blue the CS-450 mounted to a 120mm high heat sink like in MODU 3U (Mini) Dissipante cabinets.
There is space to mount a chassis plate both at top and bottom at the same time!

In green we show a connected VS-5, VS-10 or VS-20 input stage module.

In black the VS-30/35/40 input module.

They are the same as VS-20 (green), but are "stretched" in length, allowing for \varnothing 30, \varnothing 35 or \varnothing 40mm holes exactly surrounding the large supply capacitors on the PS-2 or PS-3 power supply modules.

Largest fitting capacitor size is \varnothing 40x60mm.

While doing so, these large and heavy capacitors are mounted free from vibrations and mechanical stress to especially their soldering's, being limited to about zero then.
If your amp is transported a lot, we recommend this option to prevent "cold" soldering's!

In purple we show the position of a VR2-30 Voltage Regulator module, providing regulated voltages to VS-xx.
This module is required while operating at $> \pm 35V$ i.c.w. VS-20, also improving sound quality.

VERSIONS

In our new 2024 series CS-modules we introduce two quality levels, using different quality parts, resulting in sound differences and (as always) a serious price difference....

CS-450	High-End (HE)	Reference (REF)
Power Mosfets	2 pairs EXICON lateral Mosfets, ECW20N20 / ECW20P20, 16A/200V, TO264	
Electrolytic capacitors recommended types (not included!)	2x two NICHICON UKW 4700uF/63V, 105° Audio Grade	2x two MUNDORF MLGO 4700uF/63V, 125° Audio Grade, long life
Capacitors	3x MUNDORF MCAP400	3x MUNDORF SUP8
Power resistors	10x BOURNS PWR163, 5%, Low induction	10x CADDOCK MP725 1%, Induction free
Other resistors	MOX 0,6W, 1%	DALE RN60, 1%, Military grade
PCB	Eurocircuits (EU), FR4+, double sided 2x35um, tin plated solder isles	

**We produce by hand, so we can mount other parts if you like.
Just mention it in the comment line of the order form.
We will respond with a modified offer.**

For example, we could mount 80V electrolytic capacitors where the max supply voltage becomes $\pm 80V$. This results in 380Wrms power @ 8ohms only.
We could even make the PCB full gold plated and solder it with MUNDORF MSOL.SUPREME with high gold content.

We make *MUSIC* again, not just **power**
“LESS IS MORE!”

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