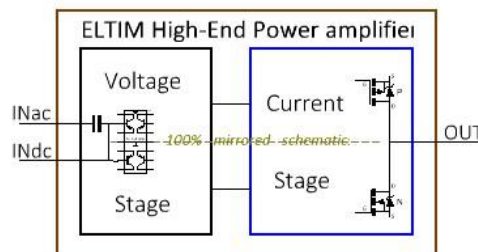


CS-150 Current Stage module

Updated: December 1st, 2023

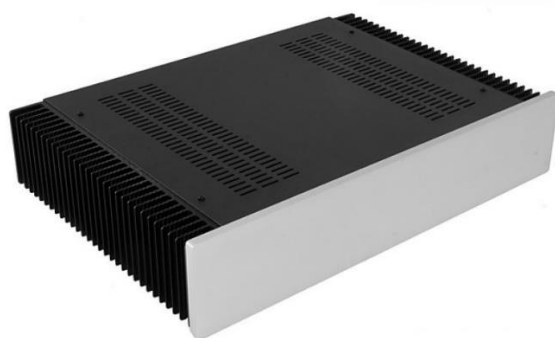
With ELTIM High-End amplifier modules we split up the amplifier schematics in a Voltage Stage (VS-module) processing the small input voltages and a Current Stage (CS-module) which processes the large and transient rich speaker currents. While doing so, the PCB layouts can be made way simpler, symmetrical, 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-150 REF module with one pair of 8A EXICON Mosfets. Size 240x75mm.
Expected rated power: 150Wrms. Successor of our [respected](#) CS-80 module.

2x three NICHICON UKA High Audio Grade 3300uF/50V electrolytic capacitors are mounted most close to the Mosfets, assisting our PS-2 or PS-3 Power Supply module or your own PS.



It fits nice in MODU Dissipante 300x80mm and exactly in MODU Mini Dissipante 250x80mm cabinets or larger and can make around 150Wrms in these cabinets.

There is no space to mount chassis plates in 80mm MODU (Mini) Dissipante cabinets. Then you need a higher cabinet.



CS-150 exactly fits the flanks (and slides) of MODU Slimline/Galaxy 280/350x80mm. You do not need to drill holes in the flanks!

The output power in a 280mm deep version is limited to around 100Wrms due to the flanks heat dissipation limits.

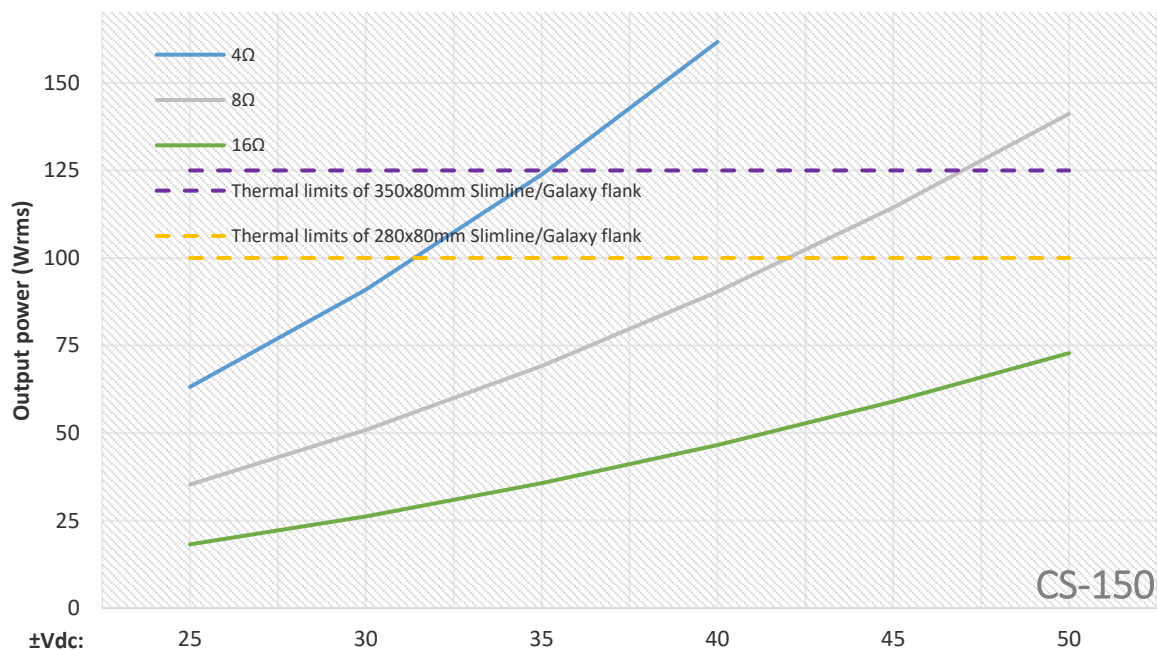
You could use our [PRE-230 preamplifier](#) to give it two line and an MM/MC phono input.

CS-150 General technical specifications (still PRELIMINARY DATA):

Frequency range:	DC - >200kHz within $\pm 0,1\text{dB}$
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-150 runs >2MHz....)
In > Out Phase shift:	-0,2° constant @ 10Hz - 18kHz, -3,6°@20kHz
Max. output current:	8A constant (dependant on the heatsink dissipation rate, for max. power < 0,75K/W!)
Distortion figure (THD):	< 0,0005% (1W/1kHz/8ohm) < 0,001% (80W/1kHz/8ohm)
Slew rate:	> 65V/ μs (@ full power). Limited by RF-input filter on VS-module used.
Harmonics:	< -60dB, nonspecific
Noise floor:	<-120dB
Damping factor:	> 100
Input sensitivity:	1 Volt
Gain:	28dB (i.c.w. any required VS-module)
Input impedance:	10kOhm (lower on request)
Output load:	4 – 16 ohms (see load graph)
Supply voltage:	$\pm 25 - \pm 40\text{Vdc}$ (4/8/16ohms load) $\pm 25 - \pm 50\text{Vdc}$ (8/16 ohms load only!)
Max. output power:	160Wrms @ 4ohms (with $\pm 40\text{Vdc}$ supply voltages). 140Wrms @ 8ohms (with $\pm 50\text{Vdc}$ supply voltages, then 4ohms is not allowed!).

Dimensions: 240x75x42mm (fits a 250/300x80mm MODU heatsink with mounting braces).
It also fits in the slides of a MODU Slimline 280/350x80mm flank, no drilling required !

Output power versus \pm Supply voltage diagram.



Calculated power with 8A EXICON lateral Mosfets. Select the supply voltage matching your power requirements.
With the power of 160Wrms @ 4ohms the max supply voltage is $\pm 40\text{Vdc}$. It produces 85Wrms @ 8ohms then.
Only if you are sure you only use 8/16 ohms speakers, you can increase the supply voltage
up to $\pm 50\text{Vdc}$ where this CS-150 makes 140Wrms @ 8ohms only!

The Standard version with 24A Hexfets will produce slightly more power due to less losses in the Power Fets.
While clipping, Hexfets will produce some HF signals, EXICON Mosfets are about clean then.
The International Rectifier Hexfets also require more idle current than the EXICON Mosfets and operate less linear.
This 24A Hexfet version will work fine as a small bridged 250W Monoblock amplifier as well.

FREQUENCY and PHASE BEHAVIOUR (for now CS-250 with 2x 8A Mosfets shown, CS-150 is probably “faster”)

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.

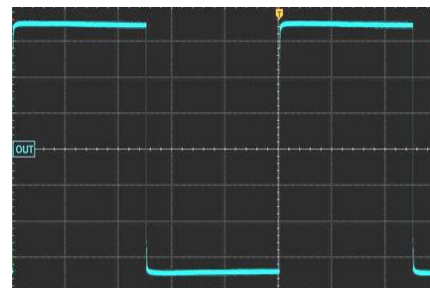
In this CS-250 (+ modified VS-20) this error is a constant -0,2° in the audio band, only -4,3°@20kHz which is ignorable. In order to obtain this flat phase response, meaning that high frequencies require the same transfer time as low frequencies do, the frequency range must be at least 20x the audible 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??

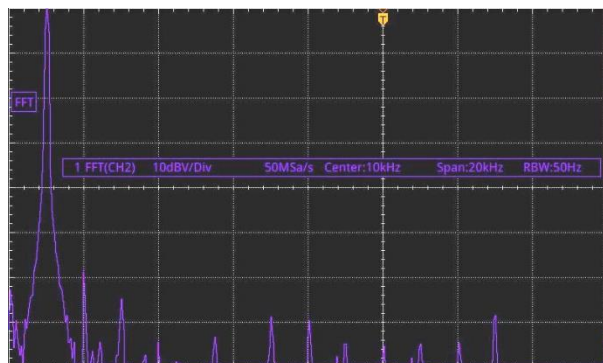
The impulse response with a 1kHz/150mV square wave input signal is “by the book”, no over- nor undershoot.

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.



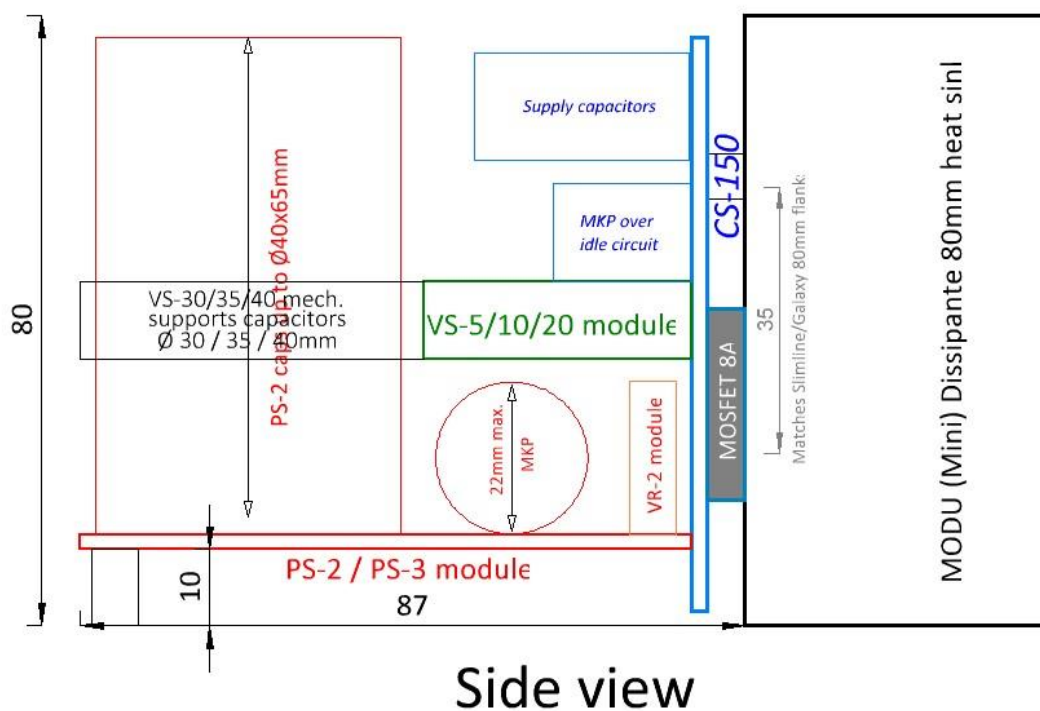
1kHz/1V sine wave input tone (left peak) with the resulting multi frequency harmonics peaks in purple.

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-150 / VS-xx / VRxx and PS-2/3 combination:



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

In blue the CS-150 mounted to a 80mm high heat sink like in MODU 2U (Mini) Dissipante cabinets.
There is NO space to mount a chassis plate!

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.

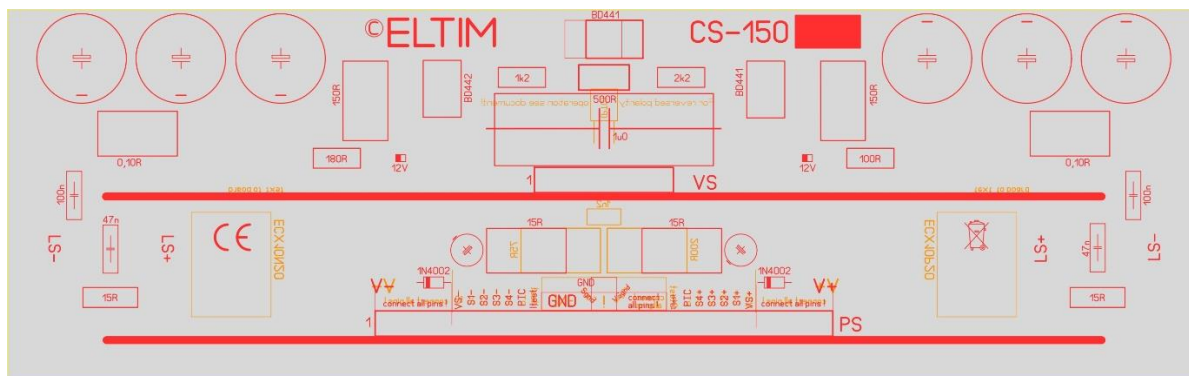
They are the same as VS-20 (green), but are "stretched" in length, allowing for Ø30, Ø35 or Ø40mm holes exactly surrounding the large supply capacitors on the PS-2 or PS-3 power supply modules.

Largest fitting capacitor size is Ø40x65mm.

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 > ±35V i.c.w. VS-20, also improving sound quality.



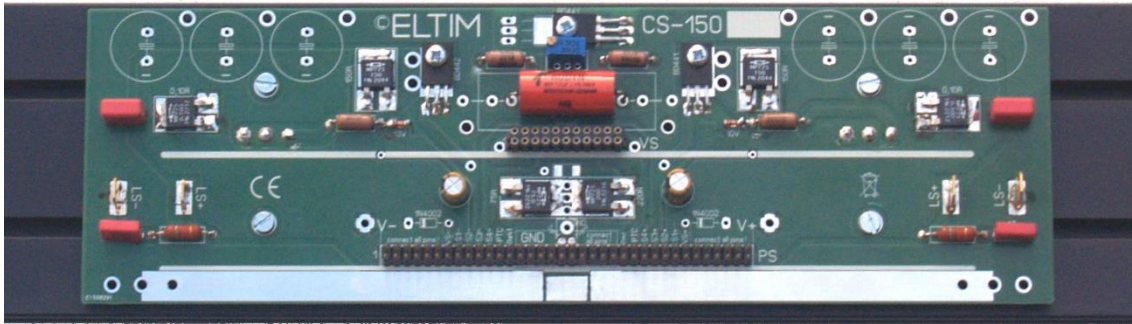
Final PCB layout, in production 22/11/2023

VERSIONS

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

CS-150	Standard (ST)	High-End (HE)	Reference (REF)
Power Mosfets	1 pair IR HEXFETS IRFP140/IRFP9140 23A/100V, TO247	1 pair EXICON lateral Mosfets, ECX10N20 / ECX10P20, 8A/200V, TO247	
Electrolytic capacitors	6x NICHICON UVZ 3300uF/50V, 105° Standard Grade	6x NICHICON UKW 3300uF/50V, 105° Audio Grade	6x NICHICON UKA 3300uF/50V, 105° High Audio Grade
Idle current capacitor	PANASONIC ECW	MUNDORF MCAP400	VH-Audio ODAM300
Power resistors	8x BOURNS PWR163 , 5%, low induction	8x BOURNS PWR163 , 1%, low induction	8x CADDOCK MP725 1%, induction free
Other resistors	Standard MOX 0,6W, 1%		DALE RN60 , 1%, military grade
PCB	Eurocircuits (EU), FR4+, double sided 2x35um, tin plated solder isles		
Solder	Any lead-free solder	MUNDORF MSOL.SG Sn95,5Cu0,7Ag3,8Au	MUNDORF MSOL.SUP Sn88,6Cu1,8Ag9,5Au0,1

We produce completely by hand, so we can mount other parts if you like.
Just mention it in the comment line of the order form or send an [email](#).
We will respond with a modified offer.



CS-150 exactly fits the flanks of 80mm high MODU Slimline/Galaxy 280/350mm deep variants.
For mounting we use 4x M3, fitting the slides of the profiles, where no drilling is required!
The back side mounted Mosfets also act as 5mm distance holders.
In this prototype of CS-150 REF we used a different type of idle current capacitor at centre.

We make *MUSIC* again, not just **power**

“LESS IS MORE!”

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