ELTIM POWER SUPPLY modules

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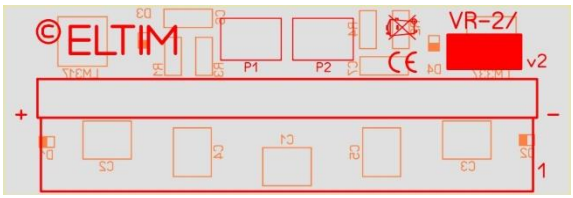
VR-2xx v2 Symmetrical Voltage Regulator module

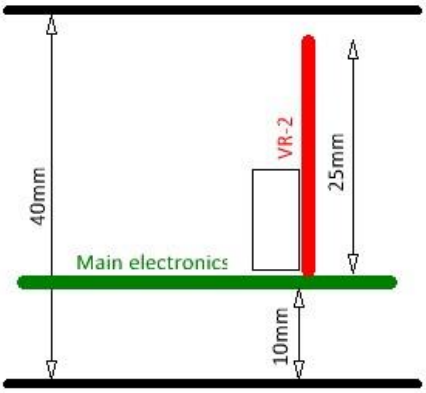
Where high Power rail voltages are used on our VS/CS amplifier modules and/or where even an improvement in sound quality is desired, the supply voltages of our VS-board could be regulated down. For this purpose we developed this extremely compact VR-2 board, fitting on about all our Power Supply And preamplifier modules.

With the v2 version we changed to small versions of LM317 and LM337 IC's, capable to supply ±1,5A.

Since a power supply circuit is part of the AC-signal chain (!) the impedance (AC resistance) of the power supply lines has to be as low as possible AND as constant as possible over the full audio range. Unfortunately, electrolytic power supply capacitors have an increasingly bad behaviour with rising frequencies. On top of that, and especially with the use of small transformers, the internal resistance of this transformer causes a variable supply voltage depending the load and its frequency.
In order to compensate these effects, regulating the power supply voltage f.e. by this module works perfect. Due to the regulating qualities of the circuit, the impedance of the power supply is drastically reduced and unaffected by the preceding main power supply circuitry and load demands. The impedance can be measured partially in a simple way, since the voltage drop while loading the power supply represents the value of this impedance. Check it while driving the amp with different frequencies and you will notice differences.

- Some of the highlights of this VR-2xx Voltage Regulator module:
  - LM317/337 TO252-3 SMD regulated ±V outputs, adjustable by changing a single resistor.
  - "Floating" regulation (no connection to ground), so it can be used even to regulate high voltages.
  - Max. output currents ±1,5A, current limiter, shortcut protected
  - Over-temperature protection, max. dissipation 2x 2,5W, safe side calculated!
  - RF-interference blocking capacitors in strategic positions.
  - Fixed or trimmed (single turn) output voltages.
  - Dimensions: 75x25x12mm.
  - Fits L-mounted even in 1U (40mm) high cabinets.





Mostly 10mm distance holders are used under the main PCB as in the picture. Add 2mm for the main PCB thickness and 25mm for the VR-2. The drawing at the left shows us that there is around 3mm left to spare under the top lid of a 40mm high cabinet. So, it will fit in f.e. a very shallow preamplifier design.

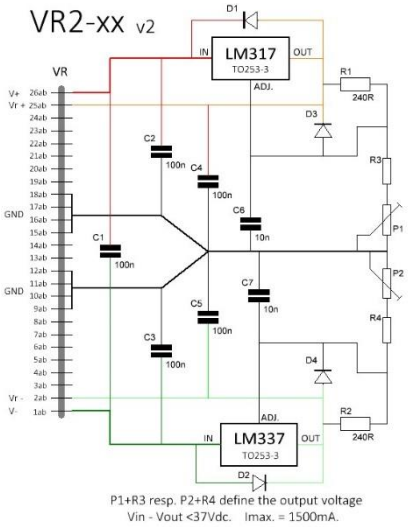
Since we separated the VS-module power lines from the CS-stage power lines in our High-End amplifier modules, we are able to provide a regulated power to the VS-module. This will bring the effects as described above. At next pages more about this.
It can also be mounted on our Preamplifier modules, providing regulated voltages to the audio electronics.

The regulating IC's are mounted at the back side, where as much copper as possible is connected to the IC's. While doing so, the PCB acts a bit as a cooling device, increasing the possible current it can provide.

We supply the modules with specific output voltages: ±5V, ±8V, ±10V, ±12V, ±15V, ±18V, ±24V, ±30V.
On trimmed versions the output voltages can be trimmed by around 10% by a pair of single turn trimmers.
We can supply about any output voltage, but consider that **Vin_{max} = Vout +37V and max. dissipation is 2,5W**.

Circuitry

In this VR-module we use tiny versions of LM317 for positive voltage regulation and the hard to find LM337 negative voltage regulator. They can provide 1,5A each in a tiny TO253-3 SMD case.
With this small case the power dissipation is limited to 2,5W though, to be calculated as **Pdiss = (Vin – Vout) * I** !
We also have the VR-3 model using TO220 SMD types (5W) and a VR-4 model, using TO220's with coolers for higher loads resp. where is a large voltage drop. These can handle 10W+ dissipation.
LM317/337 are way better than 78xx/79xx in dynamic behaviour, etc.!

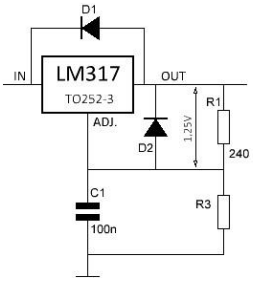


As always and as recommended by TI, strategic RF-decoupling over the power lines is included. 100nF capacitors over both input voltage rails and the output voltage rails reduce noise and prevent any EMI in whatever case you are using our VR-2xx. An extra one is fitted over both input rails. By doing so, we also provide lowest impedance possible at higher frequencies. C1-5 (SMD) capacitors are mounted at the back of the PCB, behind the header connector, most strategic in shortest way. For C6/7 we mounted 10nF capacitors, reducing noise at the regulator adjust pin and so prevent noise passed on amplified to the outputs.

For the same reason of multipurpose use, we added 4 diodes which are normally not necessary. Doing so though, allows you to connect >22uF of output capacitors to this circuit without damaging the LM's, see the datasheets of these. Also inductive loads cannot damage the IC's due to their inductive power off behaviour (neg. peak). So, we used max. schematics as advised by the manufacturers, and more actually.
All on a PCB, just measuring 75x25x12mm.

Output voltage setting

The regulated output voltages can be changed by altering the values of just two resistors, one for each LM. We split R3/R4 up in a fixed R2/R4 and variable resistors P1/P2. Output voltage regulating is achieved by keeping 1,25V over R1 (R2), being 240R usually. Since the Adj. pin hardly takes current, the current through R1 and R3 can be calculated as 1,25/240= 0,0052A (5,2mA).
With this knowledge we understand that the regulated voltage is "lifted" by 1,25V + the voltage over R3+P1 (and R4+P2), which is calculated as ***$V_{R3} = 0{,}0052 \times R3$***.
We simply can set R3 and R4 at a value where the desired output voltage is achieved.



$V_{out} = V_{R3} + 1{,}25$

Below we calculated the output voltage for the different VR-2 versions we provide:

LM317/337 ranges and value table				
TYPE	Range	R3/4	P1/2	Fixed R3/4
±5V	±4,7-5,2V	650R	100R	715
±6V	±5,7-6,2V	845R	100R	909
±8V	±7,6-8,6V	1k2	200R	1300
±10V	±9,6-10,7V	1k6	200R	1690
±12V	±11,5-12,6V	1k91	200R	2050
±15V	±13,9-16,5V	2k4	500R	2700
±18V	±17,0-19,6V	3k0	500R	3160
±24V	±22,9-25,5V	4k12	500R	4320
±30V	±28,6-31,2V	5k2	500R	5490

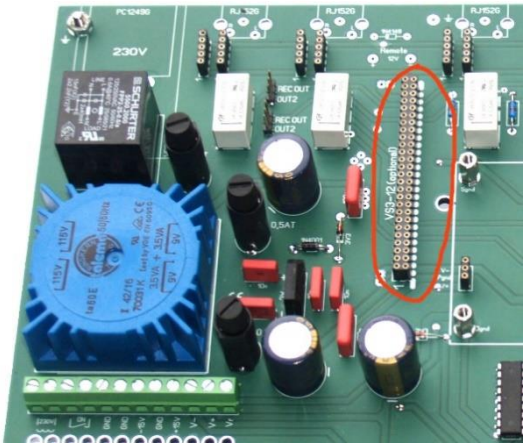
All trimmed variants are using two single turn trimmers, so you can fine tune the output voltages.
For more cost effective purposes we also could mount fixed R3/4 resistors only on this module.

Power On/Off irregularities in power amplifiers
Instead of using an output relay as many do in a power amplifier, you could use one of our VR-modules in our High-End VS/CS amplifier designs in order to prevent any power up/down irregularities in the output.
This solution is way more elegant than a blunt, distorting power relay.
Please note: many believe while seeing a relay it has a protection function. Mostly it's not, it just comes in delayed and switches off fast while powering down! Just masking the unbalance while powering up/down.
Note that most relays distort on low level signals due to the contact material used (mostly Wolfram).

Mostly due to our full symmetrical design, ELTIM VS/CS amps modules hardly get unstable while switching on or off. Switching them on, there could be a tiny "tick" noticeable, but **NO uncontrolled woofer movements** !
While switched off, the woofer also **stays around centre position**, but for a short moment there could be some minor distortion, where the rail voltages dropped to around ±15V and then goes silent without woofer shifts.

While adding our VR-2 module in our amplifier designs, the switch on/off irregularities become even better.
With this module we only feed the VS-module with regulated supply voltages.
First the CS-voltages come in, but without any current flowing. Shortly after, the VS-Stage is fired up by this VR-2 module and setting the CS-module in the adjusted mode. Since the VS voltage stops increasing more early due to the regulating effect of this VR-2 module, the amp becomes stable faster as well.
While powering down, the VS-stage loses power sooner too, resulting in disconnecting the power transistors before the supply voltage becomes too low and so preventing distortion at power down.
This VR-2 directly fits on any CS-40(ps) module and on about all our Power Supply modules.

Use in our Preamplifier designs
In our PRE-230 and PRE-330 preamplifier modules there are relatively small supply transformers used. Law of nature is that these by definition have a relatively high internal resistance, causing a significant supply voltage change, depending the load.
While using this VR-2 module (even fitting in 40mm high cabinets) the supply voltage to ALL audio electronics is regulated linearly in a very good way and more: it has, unlike commonly used 78xx/79xx regulators, a constant character over the full audio range. With all electronics we also mean possible added active input/output modules connected.
The in/output relays and (possible) digital circuits are fed via separate supplies.
On PRE230/330 we provide a header connector for VR-modules:



ELTIM PRE-330 power supply part

We recommend to use VR-2 or VR-3 modules in ±8V or ±10V versions. Both appear to work very satisfactory.

Floating device
About everywhere you read that LM317/337 can handle up to 37V input voltage. This is NOT correct.
Probably this is caused by the fact that most other IC regulators are connected to ground, so having limits.
As f.e. a transistor, the LM317/337 IC's are not directly connected to ground. The 37V everybody parrots is the DIFFERENTIAL voltage between in and output, meaning that the voltage drop over the IC must be <37V.
So, you could regulate about any voltage, just by using the correct R3/R4 value. Read the datasheet.
The only limits are the actual space between supply rails and ground and the max. voltage over the capacitors, which is 300Vmax. **NOTE**: C1 is over V+ and V-. If higher voltage than ±150V used, remove it!

Check our website for ordering

www.eltim.eu