

PR-xx Protection/control module

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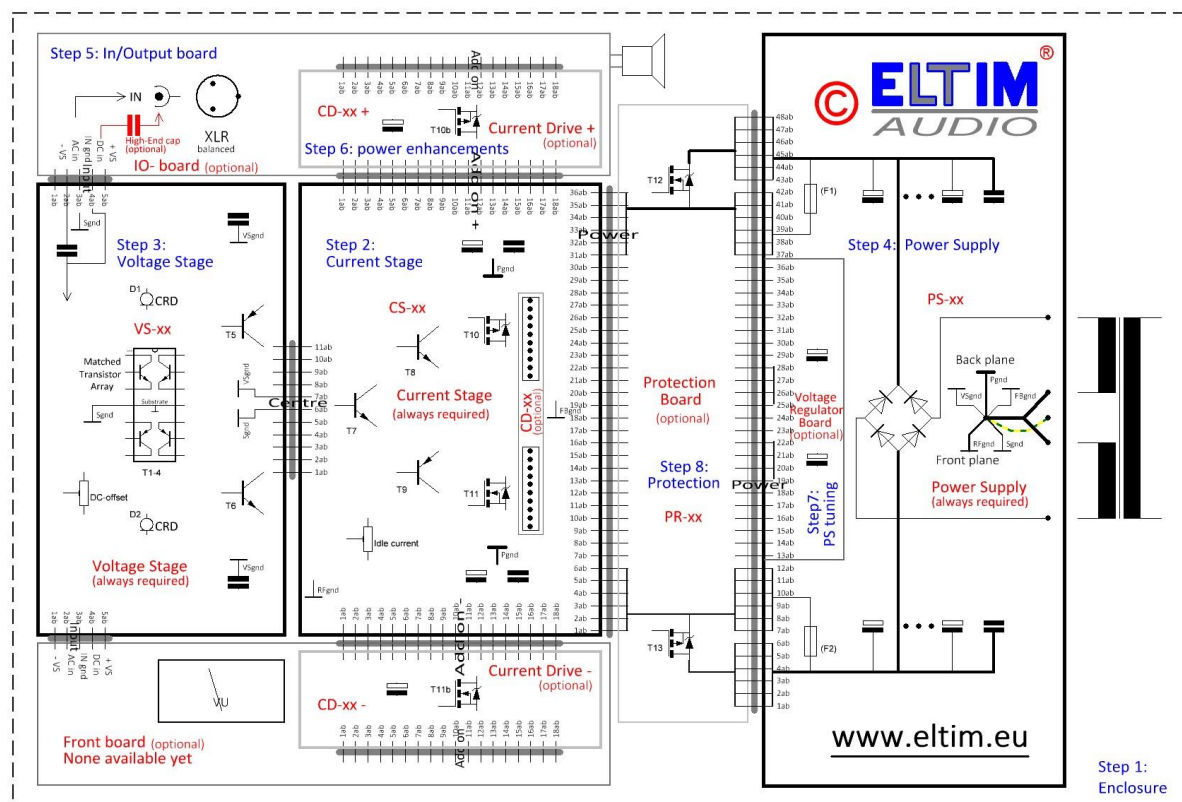
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Since our amplifier modules mostly drive expensive PA- or High End speakers, we believe that using a protection system, controlling the functioning of the Amplifier is a must. This module is controlling about all we could think of and takes proper action if something is wrong.

ELTIM Power amplifiers are split in several modules, each performing its own task. We made them in a way, that an EXTRA module as this Protection module can be mounted on CS-40ps directly or on about any Power Supply board we have in our program. This means that your amplifier is also functioning without it, but with the risk that if something goes wrong, it could damage your amplifier and/or speaker system. It's your decision!

This module will be available in two different versions:

- For our amps fed from +/-25 up to +/- 65 Volts.
- For our amps fed from +/-60 up to +/- 100 Volts.



General description

In about all protection circuits, a relay is disconnecting the speaker from the faulty amplifier. Error detection is mostly very simple and NOT controlling all possible faults! Our protection module checks following faults:

- Distorted output (input and output signal are compared). LED indication
- Overload error (Currents of max. 4 Mosfet pairs are checked, not just a single one). LED indication.
- Over temperature is checked, both heatsink and interior. LED indication

If one or more errors occur a master error LED will flash as well, so you can leave out the other three. We use this master error indication in our High-End amps to blink a red circle around the on/off switch.

In PA-amplifiers we also use the other three, so the technician can decide what to do, before the amp will shut down. F.e. lowering volume, giving it more ventilation, etc.

Protection principle

First note that while detecting a relay in the speaker circuit of an amplifier this is about always just meant to prevent speaker “popping” while firing up/shut down of the amplifier, nothing more! If you detect a relay in the power supply circuit this one mostly just prevents high currents while firing up the amplifier.

If there is really a protection circuit, a high-current relay in the speaker line is disconnecting the speaker when something goes wrong in the amplifier. Unfortunately there are several difficulties with this simple solution. Most difficult is it to use a relay like that in High-End amplifiers, since the high-current Wolfram relay contacts show a low signal distortion similar to that of a class –B amplifier, highly noticed while playing at low volumes.

If a fault is detected, this module is discharging the power supply very fast instead of disconnecting the speaker. With the same electronics we also do a two-step charge while switch on the amplifier.

Main power on/off procedure

This module is switching your ELTIM amplifier module pack on and off in a safely manner, drawing less charge current due to a two-step charge procedure. Immediately after you activated the main power switch (or an input signal sensitive switching unit) the PS-module capacitors are charged. While about 60% charged, a pair of 24A (80A peak) Hexfets connect the PS-board with the CS-board capacitors. While switched on, the Hexfets have a very low rest resistance of 150mΩ. Unlike relays, this will be the same after many years of use. We also didn't use power relays, only one of them already takes 20x more energy than an ELTIM amp itself does in idle state...

Switching off procedure has a double function: switching off in normal, functioning mode AND taking action while the amp is heavily overloaded. For both actions the electronics measures the voltage drop of the positive power rail.

After switching off main power, the switch off procedure is initiated when the voltage of the main positive rail dropped by about 1V. This event also occurs while heavily overloading the amplifier.

In both cases the PS-module will be disconnected from the CS-module by the Hexfets and shortly after, the capacitors on the CS-board will be discharged fast by some power resistors.

So, when a power down is initiated for what reason ever, the CS-module is powerless in fastest way.

Doing so, the only tiny “problem” with our amplifiers is minimised as well. This problem is that while switching off the power amp while there is still an input signal, you hear a disturbed sound for a short moment, just before it switches off when the voltage rails are at about +/- 15V. With these low voltages there is now power available anymore, so it won't damage anything. It just could disturb you. By bringing the power down faster by using this PR-module, this event will be present much shorter or even unnoticeable.

NOTE: our amps show NO ultra-low frequency movements while switching on/off ! Other, especially more complex, designs do though and for that reason they use a speaker relay in order to protect your speaker!

Detection measurements

Just by selecting the right components and their values, the CS-module will be disconnected as explained above when one of the power rails is missing. Otherwise this event could cause DC at the output and this could damage your speaker. Especially the woofer coil becomes far overheated and/or break down mechanically since it would move to the most forward or back position possible with his event.

Also, if the amp is heavily overloaded (or capacitor bank inappropriate...) causing this voltage drop, the amp switches off. By then, we are sure that one or more warning lights blinked already, but you ignored it.....

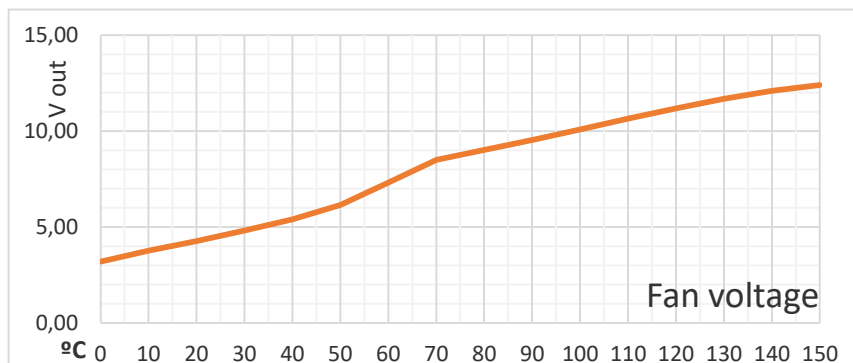
In both cases the **On/off** indicator light (ELTIM logo in ready amps) will be switched off as the amp itself will too.

By measuring the voltage drop over the power resistors in series with the Source lines of the Power Transistors of the CS- and possibly CD-modules, this PR-module will give a warning when the source current of one or more power transistors becomes too high.

Adding extra Power Transistor pairs (CD-modules) will be “detected” and measured accordingly automatically. The value of these resistors differs with the module type. Larger modules allow higher currents due to better cooling, so have lower resistor values, resulting in higher currents before detection occurs. A shortcut in the speaker line will also cause an overload indication since there will be a large current flowing. We measure ALL (max 8) transistors, not just the upper four. So, if f.e. in the unlikely event that any one of the Power Transistors breaks down and shortcuts one of the power lines to the speaker line, this will cause an overcurrent measured and the switch off procedure is initiated in the fastest possible way. Signalling overcurrent by lightning the **OVERLOAD** Led. If you wait too long, power off procedure is initiated.

We also measure a possible distortion in the speaker output line. This distortion could occur when your amplifier has an electronic failure or gets a too high input signal. This distortion could also harm your speaker system, especially your tweeters, so if it stays too long or becomes too bad, the amp will be switched off. This is done by comparing the in- and output signal. A residual sum signal present means that there is distortion on the output. This distortion could be caused by a failure in the amp, too high input signal or some foreign signal is entering the amp, which will hardly happen, due to our PCB layouts. This same circuit also detects that the amp is “clipping”, meaning that the output signal reached the level of the power rails voltages. This effect could damage your speakers, but NOT your amp. This residual signal is rectified by a so called small signal rectifier (double opamp) circuit and if this rectified sum signal becomes large enough, a **DISTORTION** Led will blink with the audio signal distortion. If you wait too long, the PR-module will initiate the power down procedure as well, just to protect your speakers.

With about the most simple circuit one can think off, we make a variable DC-level which is about linear to the heat of the amplifier. We use a tiny, hard to find SMD medium power transistor size LM317 regulator and two silicon PTC elements. Increasing value of the PTC element(s) cause a raise of the output voltage. One PTC is mounted on every CS-board already and so measuring the heatsink temperature. This is allowed to become very hot and will be if you use (too) small heatsinks and/or not venting enough. The other one is on this PR-module and measures the interior temperature. If you don't ventilate the interior enough and/or your grandmother puts a newspaper on top of your amp, this interior could become too hot as well..... In both cases, a DC-voltage is produced like about this:



If this voltage reaches 6V, a 12V fan will start by “nature” and speeding up with temperature rising. While using a correct sized fan, it all will stabilize at an acceptable temperature, since the rotating fan is cooling the amp, the voltage drops, the vent turns slower, etc.....

While using one of our amps in your living room, and working as it will be about 90% of the time, it not even becomes hand warm and the fan won't rotate; it will only work if the amp does too.... Actually you will hardly NEED a fan in most cases, since we designed our systems in a way, that while using the MODU cabinets as we advise, the amps will not reach too high temperatures in a living room. There are also some persisting “[Class A](#)” adepts, who could set our amps in class A, causing heat though. As we mention in our CS-documents, doing so will hardly increase the sound quality due to the modern, very linear functioning components. Class A only has effect while using very non-linear components.

While the FAN output is exceeding about 10V, the **OVERHEAT** Led will be turned on. With a long delay (the amp has to cool down after you took action), power down will be initiated if you didn't take action.

We built in an extra safety feature for the case that the fan is not working, blocked or even not mounted. If the interior temperature rises above a certain temperature, the power down procedure will be initiated. This is done by a Murata Positron (PTC) resistor, available in different activation temperatures in the range of 60-120°C. We believe we have to use a 90°C version since the Power caps don't like to be exceeded above 105°C. Doing so will not damage any other parts than the ones perhaps already are broken and causing this rise of temperature.

Unlike a normal PTC, the resistance of this Positron will rise fast when the temperature is exceeding the given value. Below that temperature the resistance is about stable. It is in series with the power on relay, which will come down if the Positron value gets to high. So, even if the electronics of this protection module has a failure, the relay will come down and shutting the amp off. Even a defect or unintentional fall of the discharge relay is controlled this way. If this one fails, the discharge resistors will become hot and the positron will increase in resistance. The power off relay will shut down the amplifier even in that case.

After these positron actions, the amp will shut down without extra warning lights! We are sure that there will be one or more lights ON already if the amp reaches that temperature though. If you don't want this option, replace the positron by a regular resistor.

Even when this module's power supply shows a failure or is overloaded somehow, regardless if it is the positive or negative side, the power down sequence will start, since the initiating relay automatically comes in rest position due to a too low voltage applied. So, for this function no extra electronics is required. In that case all lights will dim immediately as if there is no grid power supplied.

MASTER WARNING

If one or more of the events listed above occurs and you didn't take action, a **MASTER WARNING** Led wil go on, in order to warn you that shortly after this one is on, the amp WILL shut itself down !

The way it lights indicates the kind of problem:

- Shortly on while a shortcut or overload is detected. The amp shuts down fast.
- Blinks bright with the beat while clipping. Waiting to long, the amps shuts down
- Blinks dimming while a distortion is detected. Shuts down when there is to much distortion.
- Starts glowing more intense with temperature rise. Shuts down while exceeding 100°C somewhere.
- Or any combination of above.

Due to this different way of lightning it is not necessary to use the other warning lights, you also could see what's wrong in the way the master warning light flashes.

In our ready built amps, this warning LED is a red circle surrounding the on/off button, so a red circle around the on/off switch will light up indicating that the amp will switch itself off if you don't take action.....

Due to the design only, one or more signalling light stays on for several seconds after they initiated a power down, so when the speaker stops, you look automatically to the amp and see what's wrong.



Our **ELTIM** logo on our ready built amps is lighted soft blue from the back, showing that the power on procedure was successful and the amp ready for use, so it not only indicates that there is voltage available on one of the power rails only as a normally used On/Off indicator mostly does. We used an LM337 as a constant current source, delivering a 30mA current over the full 25 – 65V range of this PR module, no matter how many LED's you put in series. So you also could light VU-meters, etc.

These Led's are connected to a contact of the discharging relay, so go off immediately when power off procedure is initiated. While switching off the amp manually, the dimming of our logo (or ON light) indicates that the discharge procedure works. If there is some failure detected, the ELTIM logo will also go off, to indicate that the power off procedure was in action, even when the master on/off switch is still on.

Other info

You can leave out any of the warning Led's. This does NOT affect the circuit and its procedures.

F.e while used in a High-End setup, you could decide to use just the MASTER WARNING light.

We can imagine that while used in f.e. a PA-system you want to know what's wrong and so mount all 4 Led's.

All Led's are fed via separate series resistors to +12V. Switching them on is done by a transistor connecting the kathodes of the LED's to ground. Doing so, enables you (and us) to connect as many protection modules as you like to just a single set of lights. The master unit is always fully connected, the slave(s) are just connected to the cathode sides of the Led's then and leave the anode sides open.

The DC level output could feed a Led-bar (LM3914 f.e, presenting the amp's temperature. You also could feed this signal to f.e. the [EVOR04 VU-module](#) we sell and indicate the exact temperature besides of TRUE output power (regardless load impedance), spectral, (peak) bar graph or even analog style VU with peak indicator and even more. All functions/programming are accessible via its own touch screen or PC by USB.

The power on the PS-modules is unaffected and NOT switched off by this PR-module, it is ONLY disconnecting the CS-module from it as described above. Only by activating the master On/Off switch all power goes down.

We managed to make it work over the full working range of our amplifier modules, from +/- 20 up to +/-100V. We only had to make a small compromise: you have to set a jumper when the amplifier is powered by voltages < +/- 65V. Take away the jumper if you use it up to +/- 100V, otherwise a CRD will be blown !!

We used two small relays to (dis)connect some functions. Not only because this works well and saving several components, but also because you can HEAR that the amp takes action after you activated the main power switch.

Remark

Believe it or not, we did NOT use a smart and fast processor to do this all, but used old fashion knowledge of analog components, a 4-opamp IC, two LM317's, two LM337's, a few transistors, some resistors and two relays. That's it.....

This module is in the test phase now. We have to make sure that it works well in every setting!

