Regulated Class-A power pack in battery quality

T.Hartwig-ELEktronik owner Thomas Hartwig
Blumenweg 3a, D-34355 Staufenberg Tel.
05543-3317, email Office hours: Mon-Thu, approx. 10.00-12.00 + 14.00-16.00 VAT.
ID. No.: (VAT) DE 115268023 Privacy Policy

completely crazy exceptional power supply

Black-Pulsar The audiophile master version of a power supply
Current-regulated dual power supply with electronic shunt resistor
for preamps, active crossovers, etc. This is one of the most unusual methods of building a power supply.
All of the energy from a constant current source is wasted in an electronic load resistor, minus the energy drawn by the consumer. The perfect type of circuit for an extremely clean and fast voltage. Noise and other interference are reduced to battery levels.
For audio modules up to max. 500mA !!

since 2013

Waste of energy in its purest form The term **"class A"** is
more common in amplifier technology. Applying it to a power supply hasn't evolved that much. However, this designation is used for a better understanding of how this exceptional power supply works.

The shifting principle is comparable to a car that is driven at full throttle and the speed is only controlled with the brakes (don't copy it!). However, the maximum loss values of our circuit are max. 12 watts per half. Therefore, this principle is still justifiable here. However, given the loss values, it requires that things be done right.

As a reward, a previously unfulfillable wishful thinking seems to have been achieved - a voltage in rechargeable battery quality . Through
the skilful use of MOS-FETs and bipolar transistors, this perfected circuit type is in principle free of any tendency to oscillate and noise.
Even mains disturbances are effectively suppressed, since a power source for alternating current of any kind represents an almost infinitely high resistance. Therefore there are almost no measurable ripple voltages or other interference components. Also, not a single compensation measure is required, as is often the case with voltage-controlled power supplies.

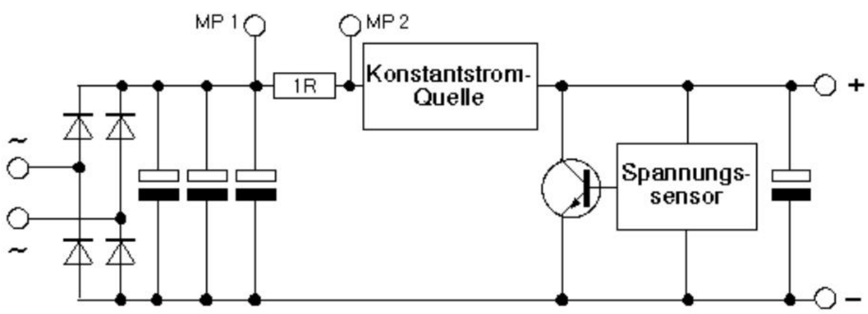
This enables a puristic use of components, which has a corresponding effect on the liveliness of the music reproduction.
In comparison with the car mentioned above, it is easy to imagine how extremely quickly such a power supply responds to load requests, without any tendency to overshoot.
Depending on your needs and preferences, unlimited electrolytic capacitor capacities can also follow.

The increase in performance of the connected high-end audio modules is of such magnitude that the relatively high energy loss seems justified in any case. Preamplifiers, phono preamplifiers, etc. reach their highest level, caused by a voltage purity, as it is only known from **rechargeable batteries ,** and even surpasses it in some values - such as speed.

Discreetly
constructed The control electronics are tried and tested classic analogue circuits without ICs.
Important components are of high audiophile quality: super-fast rectifier diodes, electrolytic capacitors selected according to our own measurement process in terms of loss values, behavior with parallel connection and temperature behavior, as well as a straight layout and easy handling.

Consider that the output voltage of an audio circuit is 100% the supply voltage, only modulated by the input signal. This is the only way to realize how important the quality of the power supply is and what unexpected effects such a crazy power supply has.

Principle of a class A power supply with electronic shunt resistor



Known from Zener diodes. There, a zener diode loads a series resistor and shares the current with the consumer. However, it is only suitable for tiny currents and simple applications.
However, a precise regulation is at work here: If no load is connected, the same current flows through the shunt resistor (the transistor in the picture) as through the current source. When a load is connected, the transistor yields accordingly and thus keeps the voltage constant.
Current and output voltage can be precisely adjusted

The maximum current that can be set depends on the input voltage of the constant current source (rectifier output under load) and should not cause a power loss of more than approx. 10-12 watts (results in a cooler temperature of approx. 55°C above ambient).
Note: The consumer cannot draw more current than the constant current source supplies by its setting. This should be considered in the case of extreme impulse loads, whereby the output electrolytic capacitor can emit a certain excess current at the impulse moment (see also here).

Calculation of power dissipation (heatsink)
Input voltage (MP1 against minus; see above) multiplied by the set current of the constant current source.
Without a load, the shunt current is identical to that of the power source, both stages heat the heat sink proportionally and add up to the power loss.
The consumer current can be subtracted from the shunt current. This proportionally reduces the power loss. The consumer's performance would have to be deducted.
This results from the consumer voltage multiplied by the consumer current.

Setting example 22
volts input voltage (eg for 18V stabilized output) results in a maximum possible current of 450mA (10 watts divided by 22 volts = 450mA). Measured between MP1 and MP2; mV=mA.

The max current of 1A should therefore only be set up to an input voltage of 10-12 volts.
With an input voltage of 35 volts, a maximum of approx. 300mA is possible. see also the table below.

A current that should be at least twice as high as that drawn by the consumer serves as a guide. You can opt for an even higher current if the above calculation and the heat development allow it and another tonal success results.

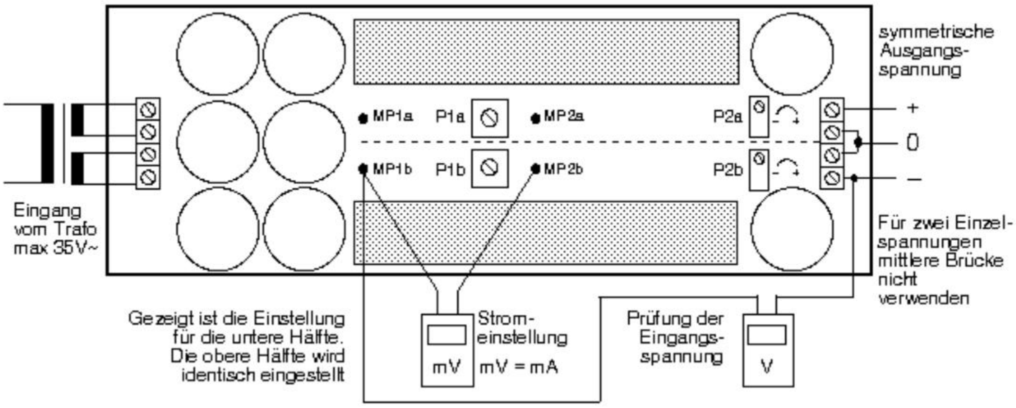
Application example Our
super preamplifier VX-Line draws a current of approx. +/- 60mA at +/- 24 volts. Here you would set the constant current source to around 100-200mA. Max impulse current with low-impedance headphone operation approx. +/- 300mA. Here you would set the constant current source to around 400-500mA.

The power supply has a double structure (two galvanically isolated halves). The two voltages can only be used individually or for a symmetrical arrangement (+/-). The principle of this power supply circuit does not allow the outputs to be connected in parallel.

Housing ventilation
The cooler may reach a temperature of 85°-90° degrees. If the power supply is operated with a power loss of more than 2x6 watts, ventilation may be necessary if the housing is too small. If in doubt, test. Ventilation could be provided by drilling holes in the floor (below or next to the circuit board) and in the back panel.

Information on the electrolytic
capacitor temperature: At a maximum of 85°C cooler temperature (12W in the non-closed housing), the electrolytic capacitor temperature levels off at approx. 45°C.

Short-circuit-proof as a matter of principle - in this case, too, no more than the set current can flow.



Connection
diagram The required effective transformer AC voltage see below.
Transformer nominal voltages apply under full load. See also here: If the voltage potentiometer (P2) is turned higher than the maximum possible voltage, the power pack behaves like a constant current source, ie the maximum set constant current only flows when a correspondingly strong load is connected. In this case, the output voltage adapts to the constant current.

For a symmetrical voltage, the two outputs are connected in series as shown in Fig.
Parallel connection is not possible here.

Dual power supply, galvanically isolated

The output voltage must be set on site according to the requirements.
Prices (incl. VAT)

Type	Electrolytic **capacitors main**	EUR
BLP 10/35	screening 6x10,000µ/	**125.00**
BLP 6.8/50	35V 6x 6,800µ/50V	**129.00**

Dimensions: LxWxH=200x71x54mm
(height from lower edge of circuit board)

Technical data per half Input
voltage: 9-25V AC(~) at 35V electrolytic capacitors.
Input voltage: 9-36V AC(~) at 50V electrolytic capacitors.
Adjustable power source current: 150mA - 1000mA (depending on the input voltage)
Adjustable output voltage: at 35V
electrolytic capacitors approx. 3.5 -
30VDC at 50V electrolytic capacitors
approx. 3.5 - 40VDC Voltage drift at 85°C approx. 1-2%

Important information If the Black-Pulsar is part of a complete system that you have ordered (eg preamplifier with power supply), the Black-Pulsar will be delivered pre-configured so that you can start using it without any further settings.

The current specification refers to the set current of the power source. The consumer should need a maximum of half of this set current.

Note The
height of the Black-Pulsar does not quite fit into our GHX case series ending in -07 (internal height 62mm)
The mounted spacer bolts M3x10 would have to be exchanged for M3x5.

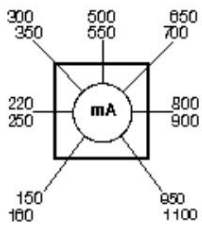
Maximum current settings

The table on the right shows the limit values of the adjustable current (MP1 > MP2) depending on the input voltage (MP1 against minus). The current specification means that of the constant current source. The consumer should need max. half of this set current (110-500mA).

With very good housing ventilation, the maximum current can be increased by up to 20%. Higher currents do not immediately lead to overload, but can also be set briefly for any tests. Eg 3 times the maximum current for a maximum of 1 minute. The power loss of the shunt controller and the constant current source add up to the power loss of the heat sink, which must not exceed approx. 12 watts. You also calculate the power dissipation.

The current can also be set roughly without a measuring device. The respective potentiometer setting can be seen on the graphic on the right. The values take into account the maximum pot tolerances and slight deviations in the case of strong input voltage differences. A very high accuracy of the current setting is not necessary in practice. The purpose of the circuit principle is already achieved when the current is set to at least twice the value of the load current.

10V	1000mA
12V	830mA
15V	670mA
20V	500mA
25V	400mA
30V	330mA
35V	280mA
40V	250mA
45V	220mA



Maximum Voltage Settings

The set output voltage can be set to a maximum of approx. 2-3 volts below the input voltage. Above that, the voltage stabilization no longer works and the power supply unit switches to pure current operation.
The level of the output voltage has no influence on the current limit values. It only changes the distribution of the power loss between the shunt transistor and the current source, which always remains the same in total. Only the current of the consumer reduces the power loss of the shunt transistor accordingly.

The required effective transformer AC voltage in the unloaded state is approx. 0.7 times the input DC voltage. Under load, the transformer AC voltage is reduced accordingly, so that the required DC voltage for the transformer is almost the same value. Therefore, no precise information can be given here for the required transformer voltage. The following reference values can be assumed:
transformer voltage (AC) max output voltage (DC)

9V 5-6V

12V 9-12V

15V	12-16V
18V	16-20V
24V	24-27V
30V	30-36V

This is based on a normally dimensioned transformer with a nominal load. If a transformer is oversized, or if it is loaded well below its nominal current, a slightly higher output voltage than that specified in the table can be set. The information in the table is therefore a guide and may vary slightly in practice.

Recommended transformer module TM50/20

This transformer module is ideally suited to supply the Black Pulsar with AC voltage. Numerous voltage combinations are possible.

Connection examples with the transformer module

TM50/20 The transformer series NT-LN 50... can also be used. The technical data of the transformer module series TM... shows which output voltage can be expected under load after rectification at the Siebelkos.

This voltage is then present on the Blackpulsar in front of the controller. The control losses amount to about 3-4V.

Thus, the output voltage cannot be set higher than 3-4V below the screen voltage.

1.
Connection of the transformer module for a single power pack with high output voltage

2.
Connection of the transformer module for a single power pack with a high output current

3.

Connection of the transformer module for two separate power packs

The typical wiring for a left/ right separate power supply in one audio application