Why does a DC Power Supply need a Power Sink

Modern Loads and Test-Systems become more demanding

In the past a DC power supply only needed to *deliver* power, now loads can *return* power. The only way to cope with this new challenge is integrating an electronic load in the power supply, called a Power Sink. Without the sink-capability the output voltage will start rising and get out of control.

Reverse Current

DC Motors are more and more controlled by a PWM (Pulse Width Modulation) circuit; the advantage is a flexible loss-less speed control. Car makers make use of this technique to make new solutions possible for pumps, electric steering, brakes, windscreen wipers, hybrid cars and more. Also energy is conserved, this means less heat dissipation. The special behaviour of a PWM controlled motor is the return of power during a braking action. In fig. 1 you can see the typical load current, in phase I the motor accelerates; in phase II it has constant speed with a certain load and in phase III the motor brakes and the current becomes negative.

Output under control

Normally the output circuit of a power supply is not designed to absorb current returned by the load; see the simplified circuit in fig. 2. The only path left for the negative load current is into the output capacitor C_o, so it will charge and the voltage will rise without any control from the power supply, following the formula $dv/dt = i/C$. To solve this problem a Power Sink is added, symbolised by the transistor in fig. 3, and integrated in the voltage control of the power supply. So the output voltage is kept to the desired voltage, whether the operation mode is sink or source. Dynamically the system reacts fast, see fig. 5. In this example the load current is switched between positive and negative (a harsh condition). On the output voltage only a slight variation is visible (upper trace). On a normal unit the voltage would rise uncontrolled, see fig. 4.
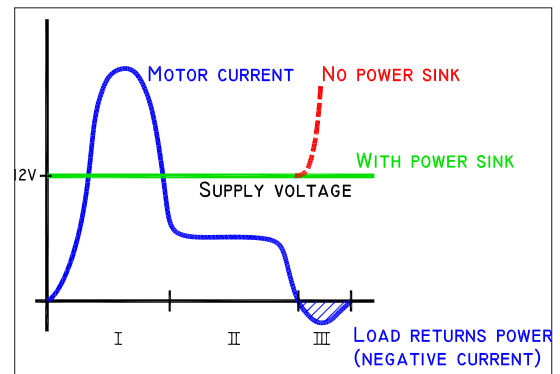

Fig. 1
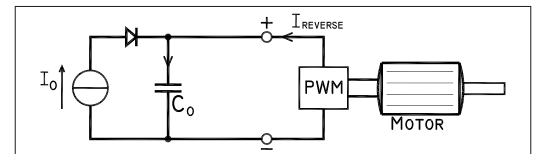Typical load current
PWM - controlled DC motor

Fig. 2
Simplified output circuit normal power supply.
Braking power of motor charges
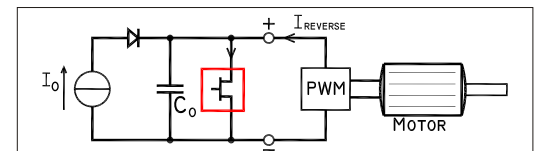output-capacitor

Fig. 3
Braking power of motor absorbed by power sink
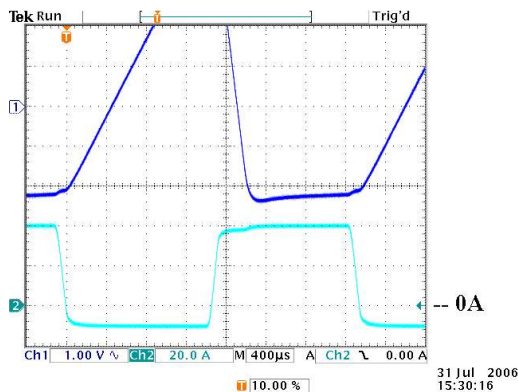equipped power supply.
No voltage rise

Fig. 4
Without power sink
Uncontrolled voltage rise when the load current
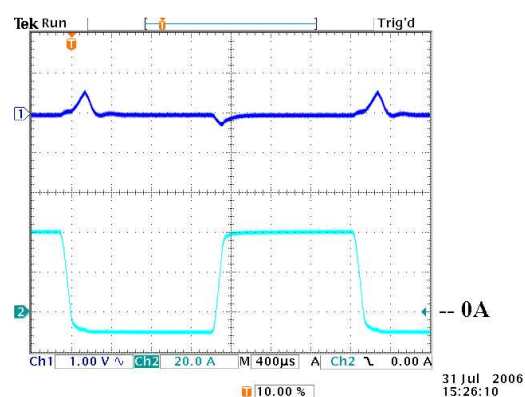goes negative

Fig. 5
Dynamic reaction of power sink
Load current switches between positive and
negative

Fast Down Programming & Automotive

Test Systems require a test-time as short as possible. For each new item to be tested the voltage often has to be programmed down to zero. A normal power supply has a problem because it cannot quickly discharge the output capacitor Co. The circuit in fig. 6 shows that only the load can discharge Co.

A Power Sink as in fig. 7 will make it possible to do fast down-programming at light or no-load conditions. See fig. 8 and 9 to compare the results. Also for generating fast simulation voltages, like the battery voltage of a starting car (ISO7637), a Power Sink is indispensable.
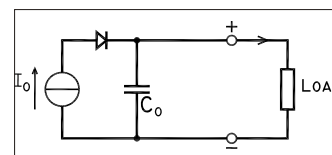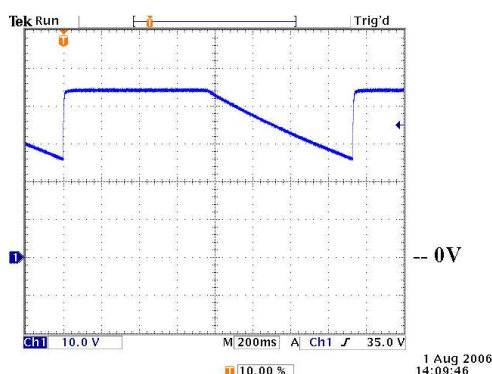
Fig. 6
Simplified output circuit
Normal power supply

Fig. 8
Down programming at no load
Normal power supply
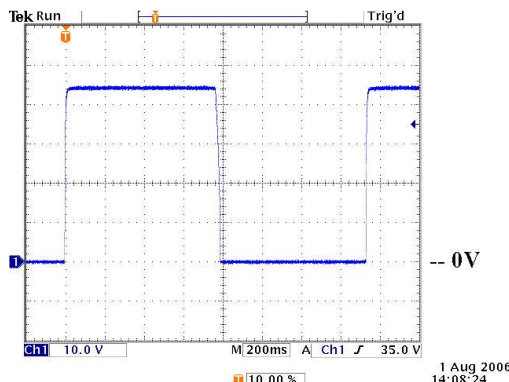*Voltage falls very slowly*

Fig. 9
Down programming at no load
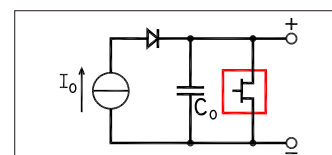*Power sink equipped power supply*
Short fall-time

Fig. 7
Simplified output circuit
Power sink equipped power

Delta Elektronika Power Sinks

See table below for available Delta Elektronika Power Supplies with Power Sink option. All Power Sinks have electronically limited peak power and maximum current. The module shuts down in case of thermal overload (the unit itself continues operation). The overload condition is indicated with a LED on the front panel and with a status output.

SM700 - series Power Sink Peak Power / Maximum current	**SM1540-D** option P140 70W / 18A	**SM7020-D** option P141 70W / 18A	-	-	-
SM800 - series Power Sink * NEW NEW Peak Power / Maximum current	**SM7.5-80** option P245 140W / 36A	**SM18-50** option P246 140W / 36A	**SM70-AR-24** option P247 140W / 25A	**SM400-AR-4** option P248 140W / 5A	-
SM1500 - series Power Sink Peak Power / Maximum current	**SM15-100** option P202 200W / 40A	**SM35-45** option P203 200W / 40A	**SM52-30** option P204 200W / 30A	**SM52-AR-60** option P205 200W / 40A	**SM70-22** option P206 200W / 30A
SM3000 - series Power Sink Peak Power / Maximum current	**SM15-200D** option P127 300W / 70A	**SM30-100D** option P128 300W / 70A	**SM45-70D** option P129 300W / 70A	**SM70-45D** option P130 300W / 45A	-
SM6000 - series Power Sink ** NEW NEW Peak Power / Maximum current	**SM15-400** option P230 700W / 140A	**SM30-200** option P231 700W / 140A	**SM45-140** option P232 700W / 140A	**SM60-100** option P233 700W / 100A	**SM70-90** option P234 700W / 100A

* = available mid 2007   ** = available first quarter 2007

SM52-AR-60, 1500W power supply from Delta Elektronika, with optional Power Sink