SMdump documentation

This document describes an accessory to the Simplex Motion line of servo motors. This accessory is used to convert electrical energy to heat, and this is necessary in dynamic motion control applications where the motor brakes high inertia mechanical loads and thus produces electrical power that has nowhere to go.

Index

1. Change notes 1
2. General description 2
3. Hardware description 3
4. Software description 4
5. Notes 5
6. Example application 6
7. Availability 6

1. Change notes

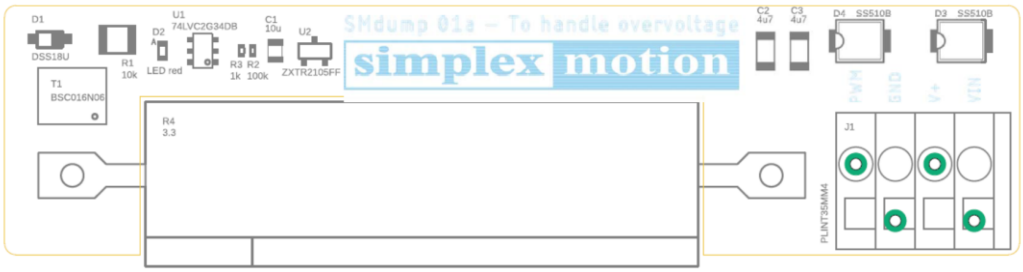
Change date	By	Change
240104	Pär Jalbin	Added example

2. General description

In applications with dynamic motion control, where a mechanical load is both accelerated and decelerated, the motor operates as both a motor and generator. When the high inertia load is decelerated the motor converts mechanical energy into electrical energy, producing an electric current out from the motor. In battery supplied applications this feedback power can be used for battery charging.
But in applications supplied by a mains connected power supply there is usually nowhere this energy can be consumed, and instead the system capacitance is charged and the supply voltage increases. Potentially the supply voltage can reach levels that are higher than the components connected to the supply line can handle, and damage may occur.
The most common solution to this problem is to convert the excess electrical energy into heat by using some sort of ‘braking resistor’.
This document describes the SMdump accessory that performs this conversion from electrical energy to heat.

3. Hardware description

The hardware of this unit is quite simple and relies on control performed by the motor. The motor has a register for configuration of the power dump feature. And the motor monitors the supply voltage level and controls the amount of power to convert into heat.
Basically, the SMdump hardware consists of a large power resistor and a mosfet transistor switch that can turn on/off quickly. The switch is controlled by a pulse width modulated (PWM) signal from the motor.
The resistor is capable of sinking 50W of power continuously, and up to 500W for short bursts when properly mounted to a good thermal conductor for proper cooling.



The connections to the SMdump board are according to the following table:

Signal name	Description
VIN	In cases where it is needed to guarantee that no energy at all is supplied back to the supply source, this connection should be used for the power supply. The supply to the motor should then be connected to the V+ connection point. There is a diode on the SMdump board connected from the VIN to the V+ connection to make sure that no current can flow back to the supply.
V+	Normal connection of power supply and supply to the motor. Power can flow from the motor to the power source, which may be beneficial if there are other consumers or a battery supply system.
GND	Ground connection for supply and motor.
PWM	PWM control signal from motor that will control the amount of power sinking.

Absolute maximum ratings:

Parameter	Value	Comments
Maximum voltage	60V	
Maximum peak current	20A	
Maximum continuous power	50W	Requires mounting to a large metallic structure/heatsink.
Maximum peak power	500W	

4. Software description

The control of power sinking is done by the motor. The motor monitors the measured supply voltage and starts sinking power into the resistor when the supply voltage gets above the set threshold voltage. The control uses pulse width modulation (PWM) control of the power resistor at a constant frequency of 10kHz. The PWM duty cycle is controlled in a linear fashion with 0-100% across a voltage span of 5 volts. Thus, if the threshold is configured to 26V (a reasonable level for a 24V supply system) the duty cycle is linearly increased from 0 till 100% for voltages between 26 and 31V.
The configuration is done using the <OverVoltage> register, which can be accessed with the SMtool PC software.

Definition of <OverVoltage> register:

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Mode					Auto voltage	Voltage limit									

Voltage limit

Bits	Voltage limit
0..9	The threshold at which to activate the voltage protection feature. The unit is in 0.1V 0 = The default motor maximum voltage rating is used.

Auto voltage

Bits	Auto voltage
10	Not implemented yet.

Mode

The Mode bit field configures what should happen when the voltage limit is reached.

Bits	Mode
12..15	0 = Turn off motor 1 = Engage external brake resistor on OUT1 2 = Engage external brake resistor on OUT2 3 = Engage external brake resistor on OUT3 4 = Engage external brake resistor on OUT4

Example:
To activate an external resistor circuit connected to OUT1 at 26V, the following data should be entered:
Voltage limit: 26V converted to the unit of the voltage limit field is 260. 260 is
01 0000 0100 in 10 bit binary (bits 0..9).
Mode = 1 which is 0001 in 4 bit binary (bits 12..15)
Combine the binary digits together in the bitfields:

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Mode					Auto voltage	Voltage limit									
0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0

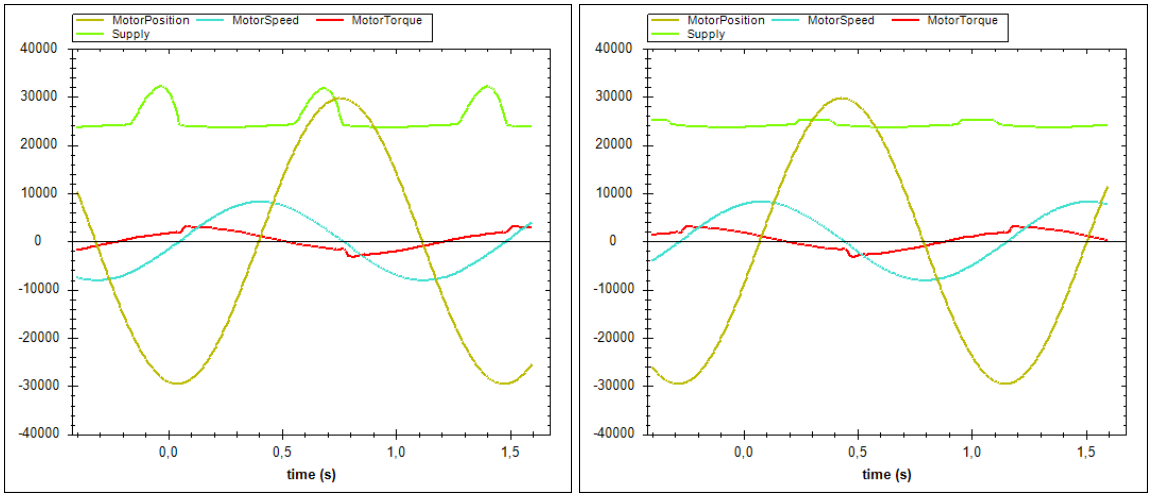
0001 0001 0000 0100 equals 4356 in decimal, which is written to <110>.

5. Notes

In applications with several motors there may be sufficient to have one SMdump board to handle overvoltage conditions for all the motors if the share the same power supply line.
The SMdump board should be connected close to the motor with short cables in cases with larger power sinking requirements.
For short deceleration intervals that are infrequent, there is typically no heatsink required as the average sinking power is low.

6. Example application

A simple application has a large weight connected to the motor shaft, causing a large rotational inertia. The motor is controlled in a sinusoidal movement with +/-8 revolutions. When the period time of this movement is decreased, we can see that power feedback is caused by the fast deceleration of the mechanical load.
The following graphs shows the supply voltage as a green curve. The left graph is without the SMdump accessory, and the right graph is using the SMdump with a threshold setting of 25V.



As can be seen the voltage rises above 30V in the case without the SMdump board connected, and this can typically lead to damages in a 24V supply system.

7. Availability

At the moment the SMdump control support is implemented in the SE range of servomotors from firmware revision 01.08.