Power supply soft-start analysis

Soft-start verification is becoming a major concern for modern switching mode power supplies due to the increasing use of digital controllers. The R&S®RTM3000 and R&S®RTA4000 oscilloscopes offer pulse width modulation (PWM) track analysis functionality, which is a great feature for verifying and optimizing soft start during development.

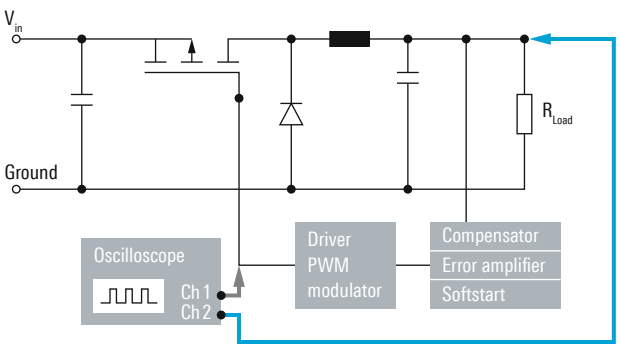
Your task

Modern switching mode power supplies provide soft-start functionality to limit the stress on the power driver section and prevent overshoot when the power supply enters the steady state condition. In battery applications followed by a switching mode power supply (SMPS) converter, the lifetime of the battery may be reduced if the soft start does not limit the input current. The soft-start functionality is usually provided in the controller integrated circuit and can be configured by a number of external components. Nowadays, more innovative power supply designs are based on digital control circuits and the user has to develop the soft-start function. That makes the verification of the soft start an important factor for the designer.

Rohde&Schwarz solution

The R&S®RTM3000 and R&S®RTA4000 oscilloscopes offer PWM track analysis functionality to track the measured duty cycle information during the power supply start-up time. The designer obtains detailed information about the control signal of the switch device cycle by cycle. With this track functionality, it is not necessary to connect the power stage in order to implement and verify the soft-start algorithm. This makes it very easy to develop and test the software section practically independently from the power stage design. Tracking the PWM signal will also give the user more confidence in the implemented soft-start algorithm before connecting the power stage. This approach may help prevent overstressing of the power stage components.

Measurement setup for tracking a PWM



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Measurement setup

All that is needed to set up the soft-start measurement is a voltage probe at the switching element of the power supply. In a simple buck converter design, the gate of the switching element is the preferred choice.

Device setup

After connecting the probe to the circuit under test, the measurement can be started according the following instructions:

- Set the trigger mode to normal mode and activate single trigger acquisition
- Set the acquisition time to a sufficient value
- Set the horizontal scale to a sufficient value
- Set the trigger level to a sufficient level
- In the Math menu, activate “track pulse width” with the use of the PWM control signal
- Configure channel 2 to measure the output voltage. This is only a reference signal
- Start the power supply by switching on the input voltage

Measurement result

Channel 1 displays the connected PWM control signal. The Math channel shows the duty cycle of the control signal. Channel 2 displays the output voltage of the converter and is only measured to compare the output voltage with the math signal.

It is remarkable that the rise time of the output voltage curve is very close to the timing of the tracking graph.

However, the great advantage of this tracking measurement is that for each switch on/off cycle, the duty cycle is visible in the track curve. The soft-start algorithm in the controller limits the rise time of the duty cycle graph. The output current follows the duty cycle graph. But unlike with the direct output voltage measurement, the user is able to easily observe any single erroneously generated duty cycle. In the output voltage graph, it may be difficult to observe any spikes in the slope because the output filter may suppress short events.

Summary

The tracking functionality of the R&S®RTM3000 and R&S®RTA4000 oscilloscopes is a great feature that lets the designer verify the soft start of the power supply converter during the start-up process. It provides detailed information about the PWM signal for each cycle, making it easy to observe any spikes or other anamolies. When the soft-start feature is based on a digital design, the tracking function can help the designer during the design process before the power stage is developed. The mature algorithm will also prevent any damage to the power stage elements.

The tracking functionality is an excellent feature for displaying any varying PWM modulated signal over time in different power electronic applications.

See also

www.rohde-schwarz.com/oscilloscopes

Soft-start measurement

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PD 3609.4861.92 | Version 01.00 | July 2019 (ch)
Power supply soft-start analysis
Data without tolerance limits is not binding | Subject to change

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3609.4861.92 01.00 PDP 1 en