Application Note

DC-DC Over-Current Protection

AN-CM-293

Abstract

This application note is a user guide, which explains how to use the SLG46585 DC/DC OCP feature if output voltage is 3 V or 3.3 V.
This application note comes complete with design files which can be found in the References section.

Contents

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1 Terms and Definitions

DC/DC	direct current to direct current
OCP	over current protection
DLY	delay
CNT	counter
MOSFET	metal-oxide-semiconductor field-effect transistor

2 References

For related documents and software, please visit:

https://www.dialog-semiconductor.com/configurable-mixed-signal.

Download our free GreenPAK Designer software [1] to open the .gp files [2] and view the proposed circuit design. Use the GreenPAK development tools [3] to freeze the design into your own customized IC in a matter of minutes. Dialog Semiconductor provides a complete library of application notes [4] featuring design examples as well as explanations of features and blocks within the Dialog IC.

[1] GreenPAK Designer Software, Software Download and User Guide, Dialog Semiconductor

[2] AN-CM-293 DC-DC Over-Current Protection.gp, GreenPAK Design File, Dialog Semiconductor

[3] GreenPAK Development Tools, GreenPAK Development Tools Webpage, Dialog Semiconductor

[4] GreenPAK Application Notes, GreenPAK Application Notes Webpage, Dialog Semiconductor

3 Background

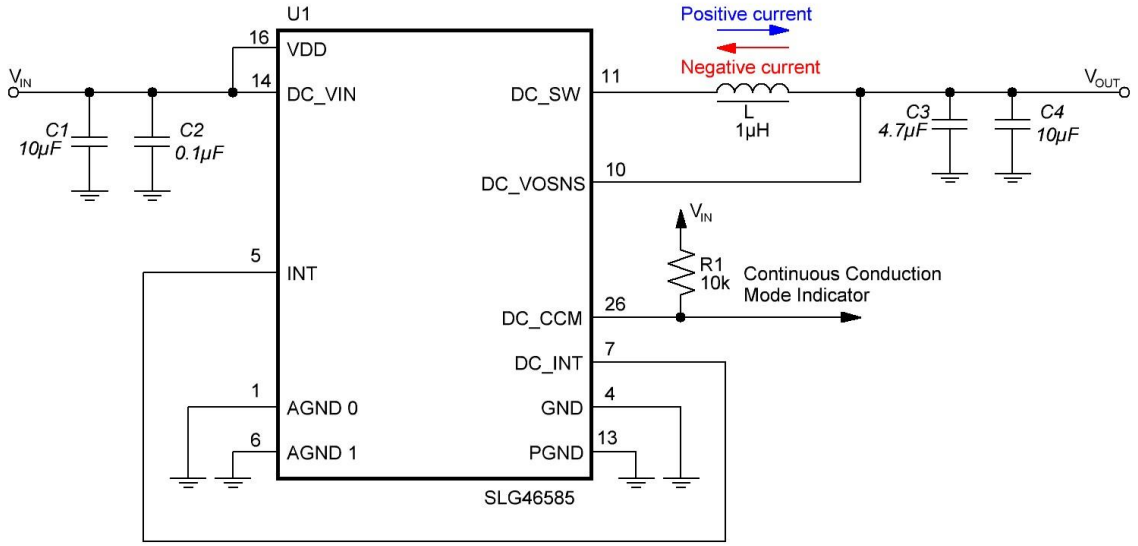

Figure 1: Circuit

When output voltage of DC/DC is 3 V or 3.3 V and the over current protection feature is enabled, there is a specific application circuit that is recommended. During operation, if the inductor current exceeds the OCP threshold, then internally, a high side MOSFET will turn off for 2 us, and the INT output becomes HIGH during the same 2 us.

2us after the high-side MOSFET is turned off and if the VOUT is below the target output voltage, the high side MOSFET will turn on again. At this point, If the inductor current is still greater than the OCP threshold, the high side MOSFET will turn off. This loop will repeat until the OCP event is removed (when the inductor current drops below the OCP threshold), then DC/DC output voltage will finally recover.

However, if DC/DC output voltage is set 3 V or 3.3 V, the DC/DC cannot recover. This happens because of the internal low-side MOSFET. During operation, the low side MOSFET is opened during INT and a capacitor discharges through this MOSFET, meaning the inductor current becomes negative (the inductor's current flows from the output capacitor, C3 and C4, to the power supply). See Figure 2 channel 2 for an example. Due to this, the DC/DC can't recover even if there is no output load. For a given input of 5V, the output will become stuck at 2.5 V and the DC/DC consumes approximately 200 mA.

The recommended workaround is to use the typical application circuit shown in Figure 1 and the internal design circuitry shown in Figure 3.

Channel 1 (yellow/top line) – V_OUT

Channel 2 (light blue/2nd line) – PIN#11 (DC_SW)

Channel 3 (magenta /3rd line) – PIN#7 (DC_INT)

Figure 2: DC/DC Stuck

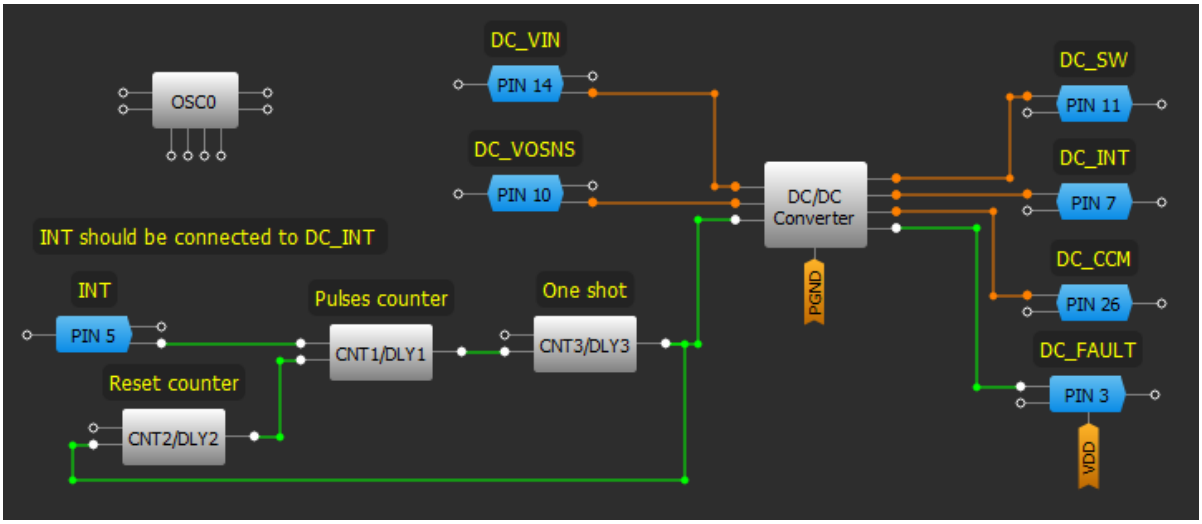

Figure 3: Circuit of the Design

If DC/DC output voltage is set to 3 V or 3.3 V, it is recommended to use the application circuit shown in Figure 1 and Figure 3. When the over current condition occurs, CNT1 will start to detect INT edges. If CNT1 counts more than eight interrupts (CNT1 counter data + 2) within a period of time set by CNT 2, the CNT1 will generate a pulse which launches DLY3. DLY3 will generate a one-shot

pulse, which turns off the DC/DC. This one-shot pulse also resets CNT2, which, in turn, resets the CNT1. The purpose of CNT2 is to create a window. It will periodically reset CNT1.

When the DC/DC is turned on or a load transient occurs, there can be a few interrupt pulses (usually 1 or 2). Therefore, CNT1 should have a count of at least 3 to filter out false over current conditions. The time of one-shot (DLY3), periodical reset (CNT2) and number of counted interrupts (CNT1) can be adjusted.

Since PIN#7(DC_INT) is open drain, add a pull up resistor. In the design PIN#5(INT) is configured with 10k pull up resistor and the two pins PIN#7(DC_INT) and PIN#5(INT) are tied together.

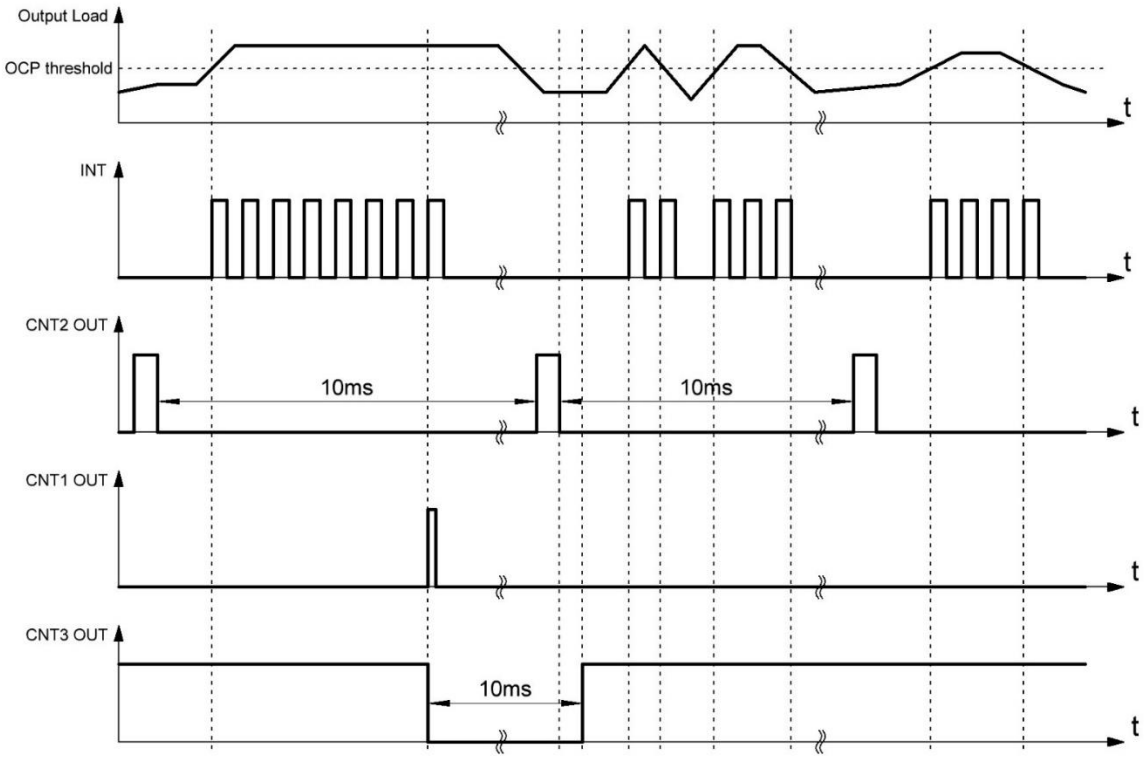

Figure 4: Timing Diagram of Design Functionality

Channel 1 (yellow/top line) – PIN#11 (DC_SW)

Channel 2 (light blue/2nd line) – CNT3 OUT/DC-DC ENABLE

Channel 3 (magenta /3rd line) – PIN#7 (DC_INT)

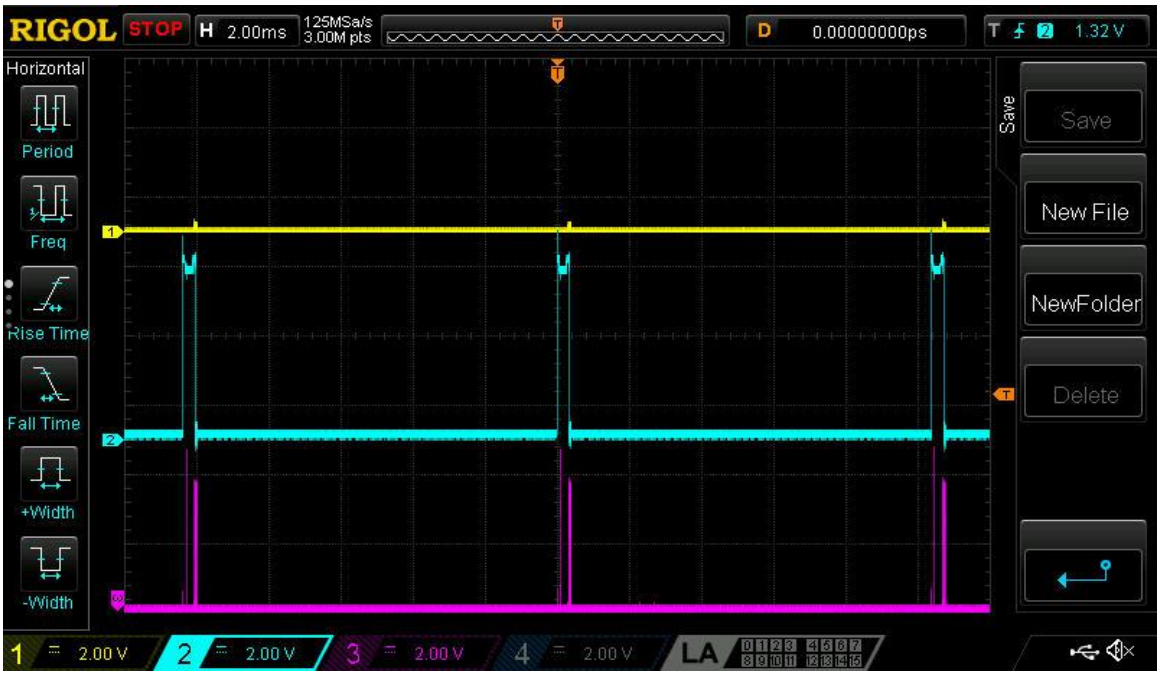

Figure 5: The Design Functionality

Figure 6: Zoomed the Design Functionality

4 Conclusion

This application note explains how to use the OCP in SLG46585's DC/DC, when DC/DC output voltage is set to 3 V or 3.3 V. Here is a typical circuit which is recommended to use with the DC/DC.

Revision History

Revision	Date	Description
1.0	31-Mar-2020	Initial Version

Status Definitions

Status	Definition
DRAFT	The content of this document is under review and subject to formal approval, which may result in modifications or additions.
APPROVED or unmarked	The content of this document has been approved for publication.

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Contacting Dialog Semiconductor

United Kingdom (Headquarters)
Dialog Semiconductor (UK) LTD
Phone: +44 1793 757700

Germany
Dialog Semiconductor GmbH
Phone: +49 7021 805-0

The Netherlands
Dialog Semiconductor B.V.
Phone: +31 73 640 8822

Email:
enquiry@diasemi.com

North America
Dialog Semiconductor Inc.
Phone: +1 408 845 8500

Japan
Dialog Semiconductor K. K.
Phone: +81 3 5769 5100

Taiwan
Dialog Semiconductor Taiwan
Phone: +886 281 786 222

Web site:
www.dialog-semiconductor.com

Hong Kong
Dialog Semiconductor Hong Kong
Phone: +852 2607 4271

Korea
Dialog Semiconductor Korea
Phone: +82 2 3469 8200

China (Shenzhen)
Dialog Semiconductor China
Phone: +86 755 2981 3669

China (Shanghai)
Dialog Semiconductor China
Phone: +86 21 5424 9058