Application Note

BTF6070-2EKV use in parallel

About this document

Scope and purpose

In automotive systems high-side switches are very common. In this application note Infineon high-side protected switches (PROFET™) are described, which are also developed for the 24 V boardnet truck application (PROFET™+ 24 V). The PROFET™+ 24 V device was tested for 20 and 40 meter cable, which can be found in trailers and big construction machines.

The device under test BTF6070-2EKV is one of the family members of the PROFET™+ 24 V family. This fast switching device has two channels. Both channels of the device BTF6070-2EKV are not synchronized, especially in the switching-off phase, one channel is always faster and the other channel has to regulate the energy itself. The result of this application note is the testing of the two channels in parallel with 20 and 40 meter cable.

The reference standard for short circuit testing is **AEC-Q100-012** which is defined for 12 V systems (24 V systems do not have an equivalent norm). The test was performed with 28 V which which resembles 24 V boardnets.

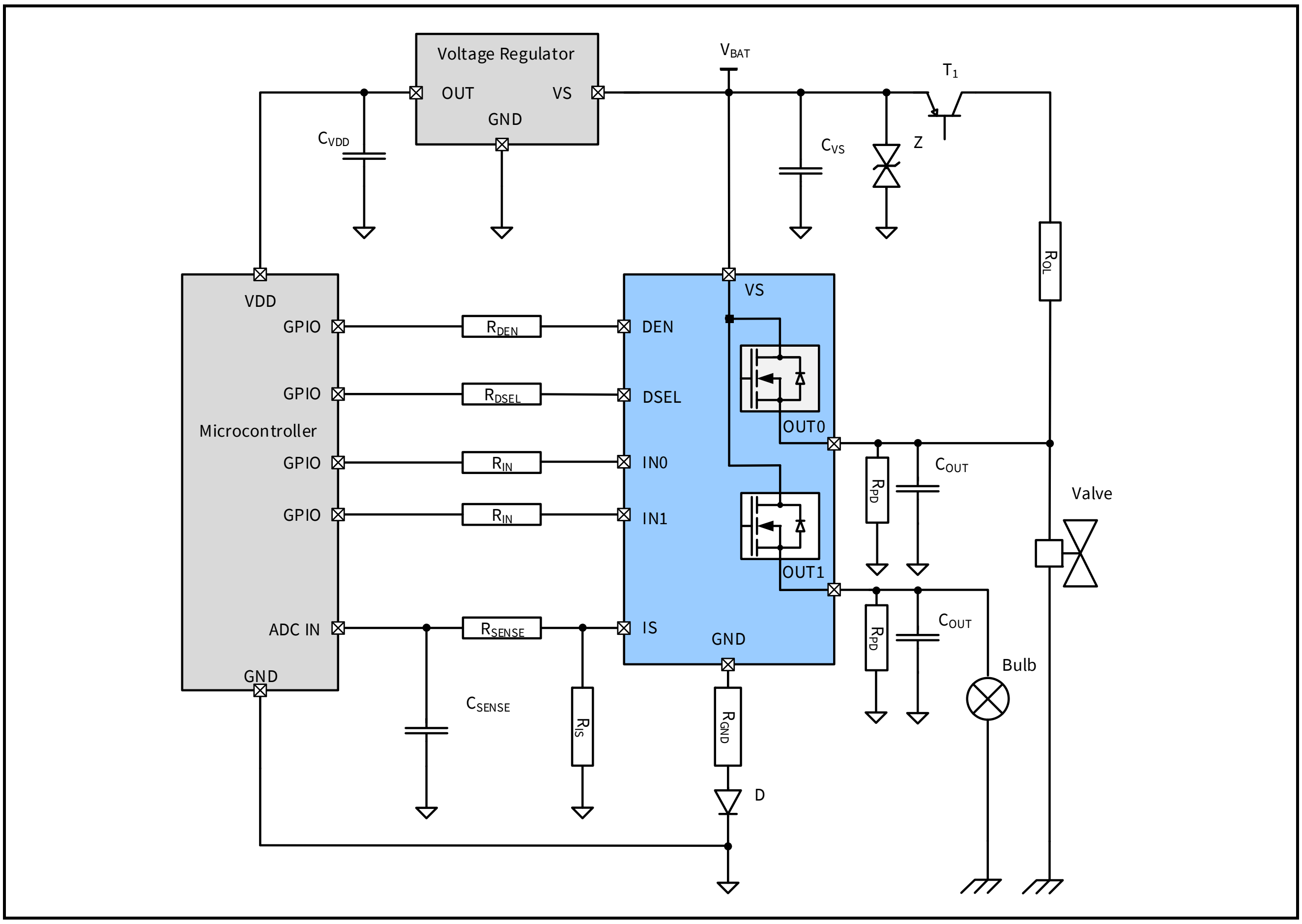

Figure 1 Standard application diagram with BTF6070-2EKV as shown in datasheet

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1 Test setup

In the AEC standard, the description of the short circuit system is detailled. For details on test setup, test procedure and statistical data analysis, please refer to the application note “Repetitive Short Circuit Operation”, March 2006.

In **Figure 2** the circuit with the device under test is depicted. The impedance on the left side represents the connection cable to the battery. The impedance; not only the connector to the load, as well as the return from the load with the cable, is presented with L_{short} and R_{short}. The **AEC_Q100-012** uses the maximum load cable length of 5 m however, the following tests were done with 20 and 40 m cable lengths since truck applications require longer cables than car applications.

Table 1 Extended cable length values

Test setup	Cable length	L_{short}	R_{short}
TP3_20µH	20 m	20 µH	135 mΩ
TP3_40µH	40 m	40 µH	270 mΩ

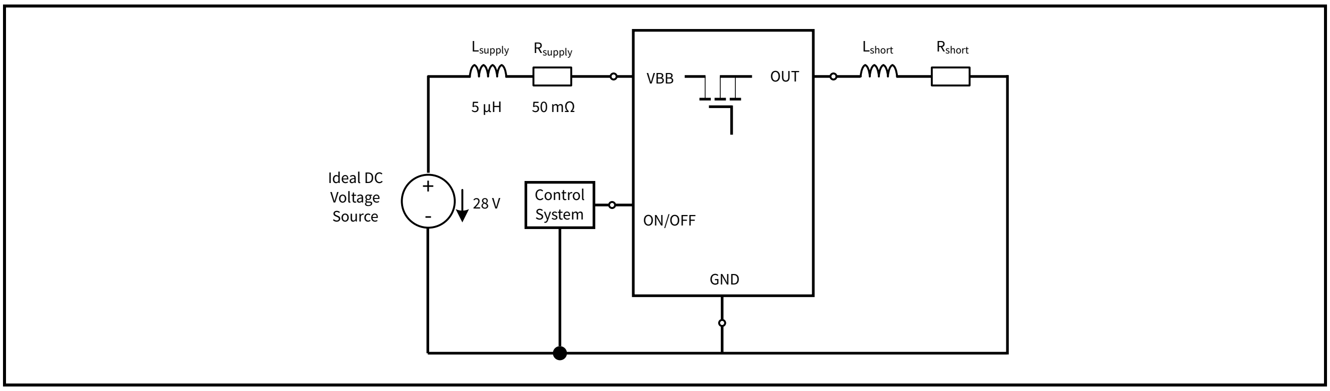

Figure 2 Device circuit

1.1 Application with suggested external components

A possible application schematic is illustrated in **Figure 3**, **Figure 4** and **Figure 5**, when the short circuit occurs at the load.

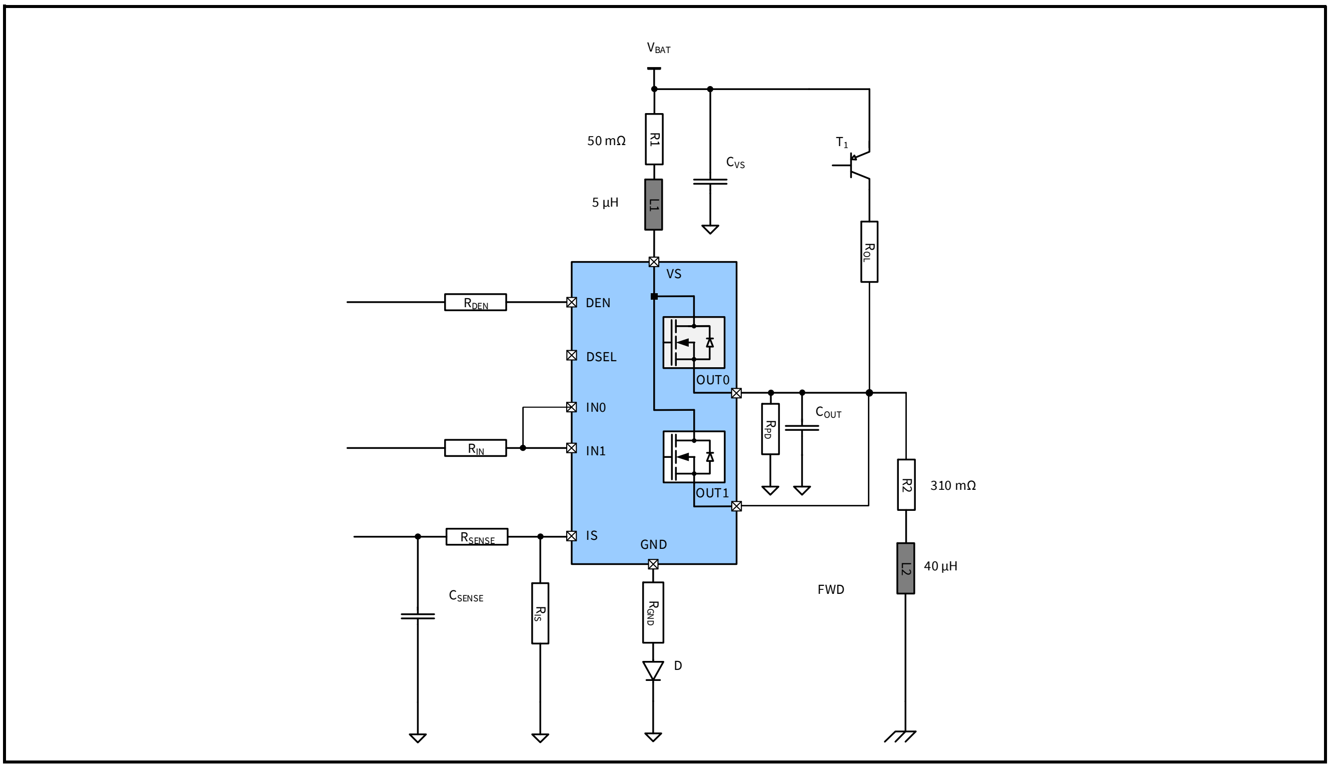

Figure 3 Parallel switching without external protection

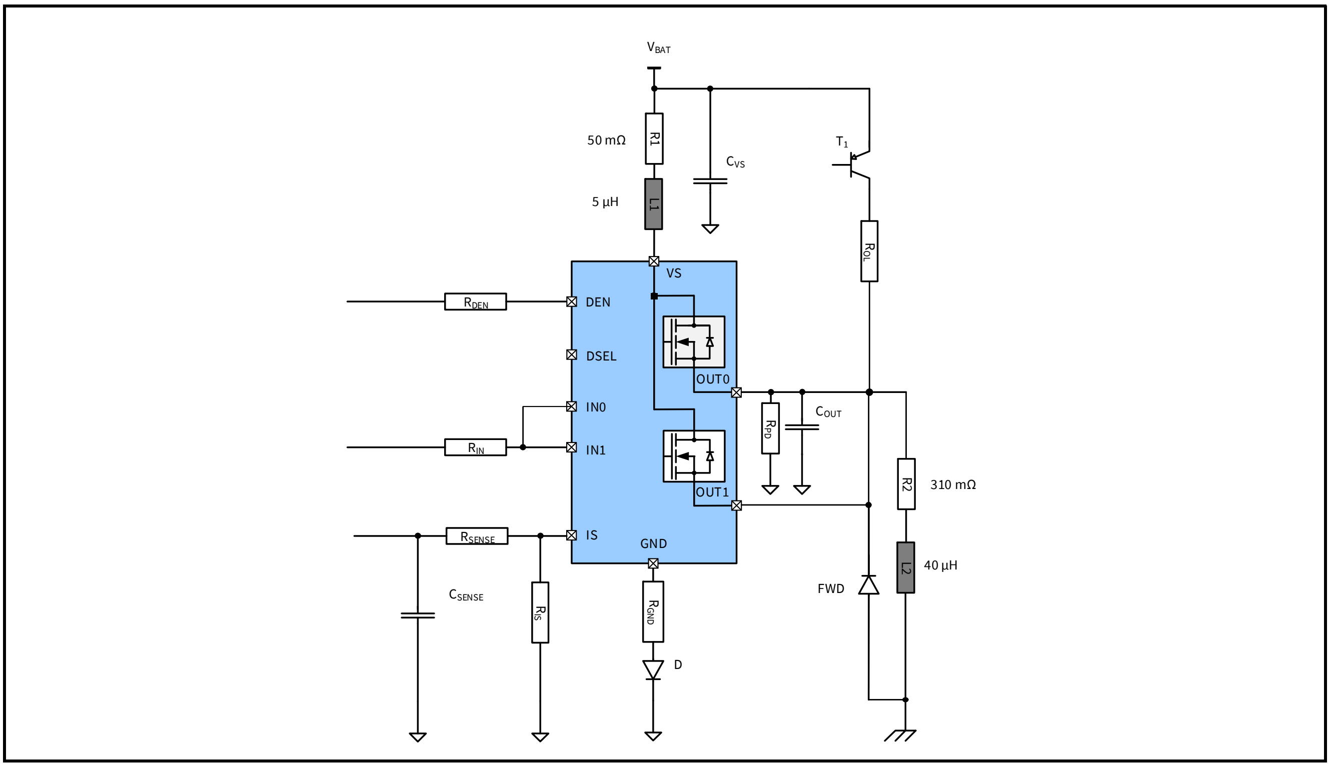

Figure 4 Parallel switching with free wheeling diode

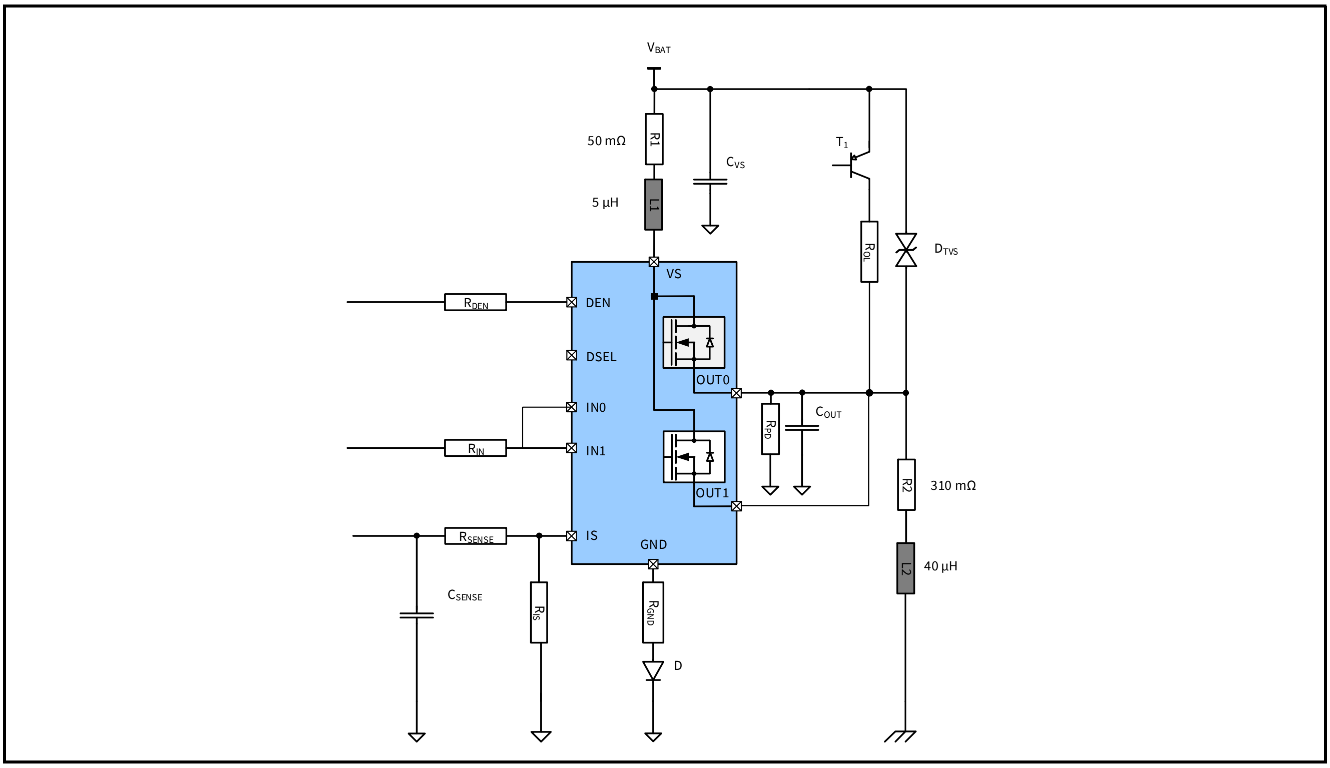

Figure 5 Parallel switching with TVS-diode

1.2 Measurement during normal switching behaviour with short circuit

The measurement results include the resistor load, both channels activated in parallel without external protection (see **Figure 3**).

Measurement Condition: T_A= 25°C; V_S= 28 V; R_L= 5 Ω; R_{SENSE}= 1.2 kΩ; DEN = 5 V

Signals:

- Yellow: *IN0* [V]
- Pink: I_{DS} [A]
- Blue: *IS0* (R_{SENSE}= 1.2 kΩ)
- Green: V_{DS} [V]
- Red: Power dissipation on the output DMOS [calculated W]

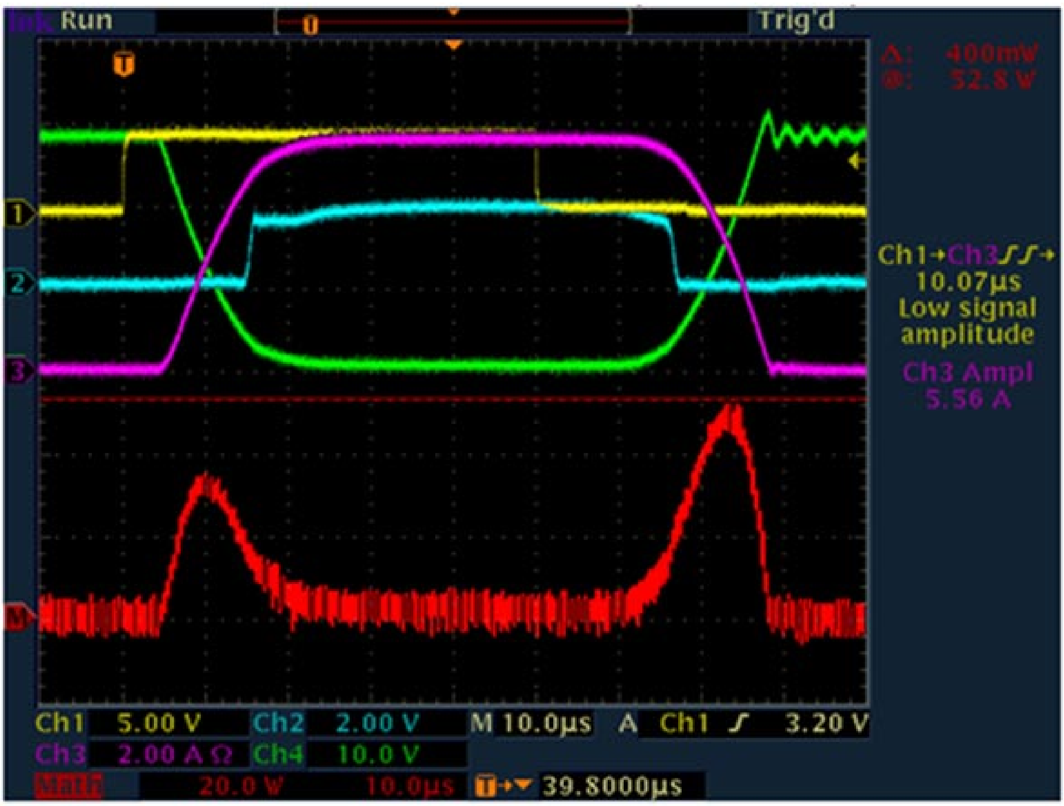

Figure 6 Measurement results

1.3 Measurement results of short circuit testing

The results of the short circuit test for 20 and 40 meter cables with (**Figure 5**) and without TVS-diode (**Figure 3**) are shown in **Table 2** and **Table 3**. The test is done with 28 V supply voltage.

Table 2 Repetitive short circuit results with external protection (TVS) - overview

Test Procedure	Test Setup	Sample Size	T_{AMB}	Cycles to Non-Conformance
High current cold short test result	TP3_20µH	16 1[1)] Lot	85°C	The test was discontinued after 1,000,000 cycles. See **Table 4** to find the number of devices which were found to be non-conforming before the conclusion of testing. First Non-Conformance: N/A Additionally, **no devices** were found after the conclusion of testing to be outside of specification values.
High current cold short test result	TP3_40µH	16 1[1)] Lot	85°C	The test was discontinued after 1,000,000 cycles. See **Table 4** to find the number of devices which were found to be non-conforming before the conclusion of testing. First Non-Conformance: N/A Additionally, **no devices** were found after the conclusion of testing to be outside of specification values.

1) The AEC Q100-012 specification would require the usage of 3 lots. For this investigation only devices from 1 lot were used.

Table 3 Repetitive short circuit results without external protection- overview

Test Procedure	Test Setup	Sample Size	T_{AMB}	Cycles to Non-Conformance
High current cold short test result	TP3_20µH	16 1[1)] Lot	85°C	The test was discontinued after 1,000,000 cycles. See **Table 4** to find the number of devices which were found to be non-conforming before the conclusion of testing. First Non-Conformance: N/A Additionally, **no devices** were found after the conclusion of testing to be outside of specification values.
High current cold short test result	TP3_40µH	15 1[1)] Lot	85°C	The test was discontinued after 1,000,000 cycles. See **Table 4** to find the number of devices which were found to be non-conforming before the conclusion of testing. First Non-Conformance: N/A Additionally, **no devices** were found after the conclusion of testing to be outside of specification values.

1) The AEC Q100-012 specification would require the usage of 3 lots. For this investigation only devices from 1 lot were used.

Table 4 Test results - Cold repetitive short (TP3_20µH and TP3_40µH)

Grade	#Cycles	Lot	#Fails
A	> 1,000,000	1	0
B	> 300,000 - 1,000,000	1	0
C	> 100,000 - 300,000	1	0
D	> 30,000 - 100,000	1	0
E	> 10,000 - 30,000	1	0
F	> 3,000 - 10,000	1	0
G	> 1,000 - 3,000	1	0
H	300 - 1,000	1	0
O	< 300	1	0

2 Conclusion

In spite of the lack of synchronization between the protection mechanism of the two channels, the test results show that the device can reach 1 million short circuit cycles with no defects.

In these tests it is not possible to show a trendline with ppm, because no non-conformance occured.

The results are obtained for a very limited number of typical devices, therefore, is not representative of the complete production spread. In case the application requires the usage of both channels in parallel, the following limitations should be observed:

- The EAR is the same as the specified EAR for one channel (P_4.1.24)
- The current limitation is the same as for one channel (P_6.6.4)

Please check datasheet limits of BTF6070-2EKV at **www.infineon.com**.

3 Revision History

Version	Date	Changes
1.00	2018-05-22	Creation of App Note

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Edition 2018-05-22

Published by

Infineon Technologies AG

81726 Munich, Germany

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Document reference
BTF6070-2EKV-AN