Application Note

High current PROFET™

BTS50060-1TEA

Example for external circuitry

Application Note

V1.1 2014-01-29

Automotive Power

BTS50060-1TEA	
Revision History: V1.1, 2014-01-29	
Previous Version: V1.0, 2013-07-19	
Page	**Subjects (major changes since last revision)**
6, 7, 9	Table 4, Table 5, Table 6: BCR133S replaced by BCR10PN

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1 Abstract

Note: The following information is given as a hint for the implementation of the device only and shall not be regarded as a description or warranty of a certain functionality, condition or quality of the device.

This application note is intended to give examples for external circuitry for using Infineon® product BTS50060-1TEA.

2 Introduction

Within high current PROFET™ product family, Infineon® offers the BTS50060-1TEA, which is a 6mOhm single channel smart high-side switch. With it's unique feature set, it serves a wide range of automotive heating applications, such as driver for glow plugs, PTC heater, or urea heater.

In this application note, the following abbreviations and symbols are used:

BOM : bill of material

DI/O : digital output pin of a microcontroller

ADC : ADC input pin of a microcontroller; ADC = analog-to-digital converter

RF : radio frequency

3 Basic circuitry

Using circuitry as shown in Figure 1 supports basic functionality of BTS50060-1TEA.

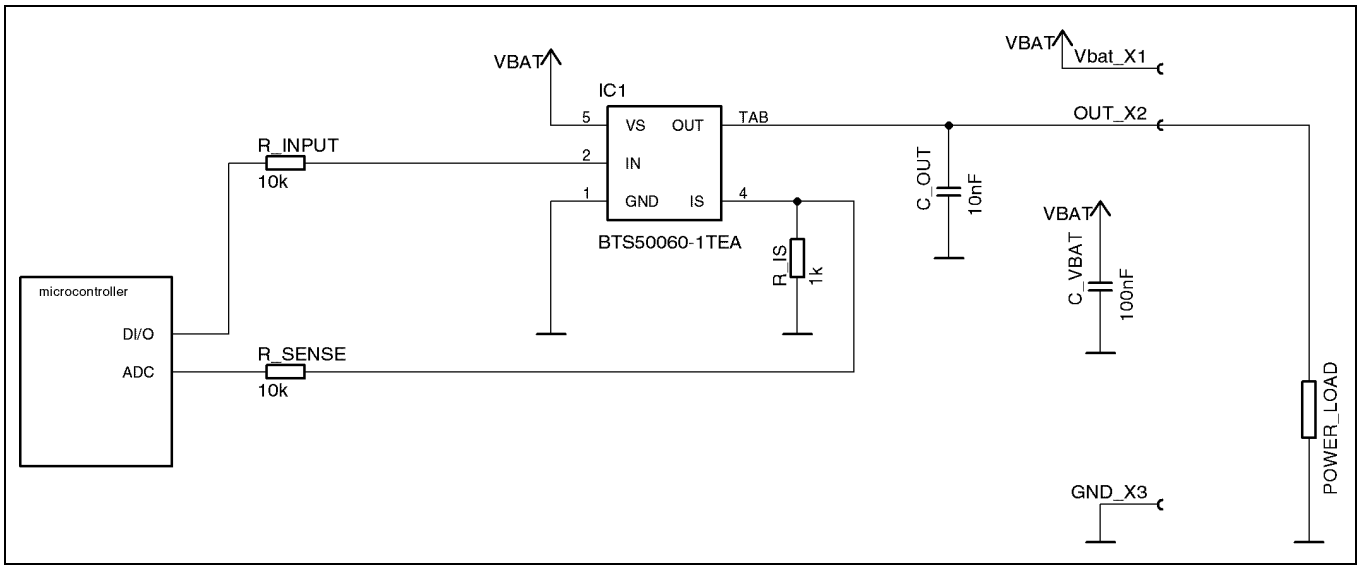

Figure 1 Example for using BTS50060-1TEA basic circuitry

Table 1 BOM single device basic circuitry

Symbol	Value	Count	Comment
IC1	BTS50060-1TEA	1	Smart High-side switch
Microcontroller	e.g. TLE9832	1	-
R_Input	10k	1	-
R_sense	10k	1	-
R_IS	1k	1	-
C_Vbat	100nF	1	-
C_OUT	10nF	1	-
X	Power connectors	3	-
Power Load	e.g. Diesel glow plug	1	Loads to be driven

4 Circuitry for applications requiring accurate load current sensing

The ADVANCED SENSE feature of BTS50060-1TEA allows accurate sensing of the load current. To support this accuracy under severe RF disturbances, it may be necessary to include a resistor R_GND (100R) in the connection for pin 1 of BTS50060-1TEA. See Figure 2. This may cause a shift of voltage at the GND pin, which influences voltage levels and hysteresis behavior for undervoltage lock-off, input voltage thresholds, open load at off detection.

Note: All parameters in datasheet are given only in respect to device pins (if not mentioned differently). Voltage drops on external components are not covered by the device specification.

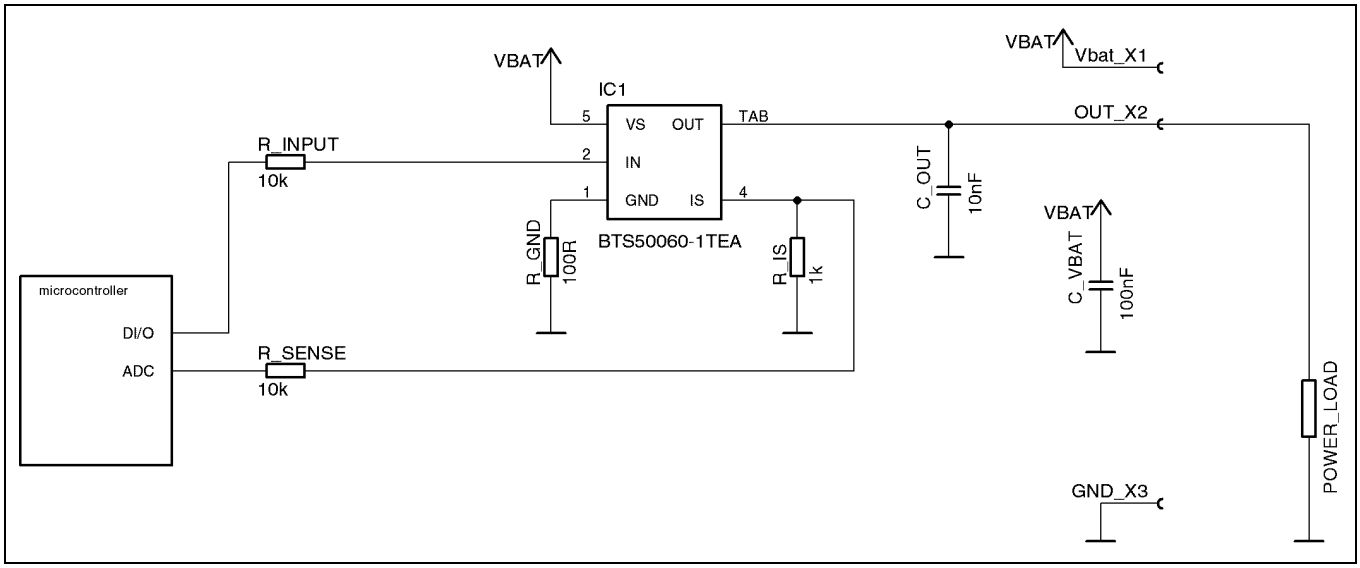

Figure 2 Example for using BTS50060-1TEA basic circuitry with R_GND

Table 2 Change to BOM for robust IS signal

Symbol	Value	Count	Comment
R_GND	100 Ohm	1	-

5 Circuitry for applications sensitive to shift of voltage levels / increased RF robustness of IS signal

The voltage drop across R_GND causes a shift of the voltage levels of the device, such as undervoltage threshold, input threshold, or open load at OFF threshold. For applications which are sensitive to a shift of these

thresholds, it may be necessary to replace R_GND by a chip ferrite L_GND. This will further increase the robustness of IS signal against RF disturbances, especially at low load currents. See Figure 3 for example.

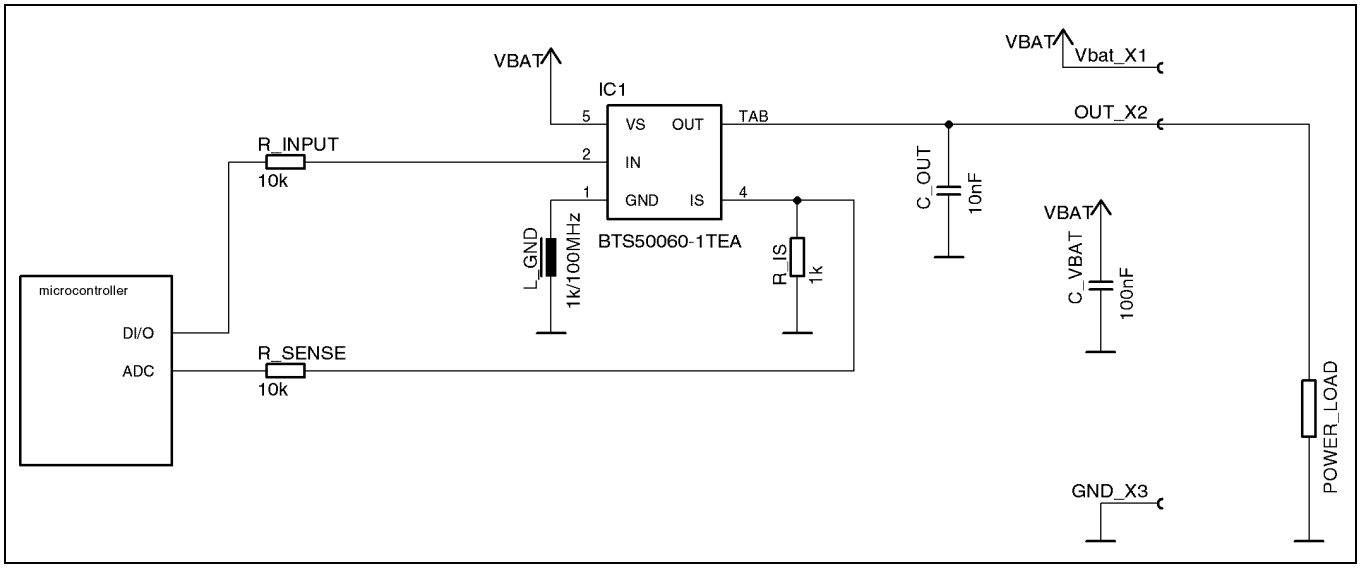

Figure 3 Example for using BTS50060-1TEA circuitry with chip ferrite

Table 3 Change to BOM for chip ferrite

Symbol	Value	Count	Comment
~~R_GND~~	~~100 Ohm~~	0	Replaced by L_GND
L_GND	e.g. WE 74279205	1	1k@100MHz

6 Circuitry with “open load at OFF” detection

BTS50060-1TEA offers easy implementation of diagnosing open loat at OFF (e.g.: detecting broken load wire without activating BTS50060-1TEA). An example for such implementation can be found in Figure 4. This circuitry would allow short-to-battery as well as open load detection in OFF state.

Table 4 Change to BOM for “open load at OFF” detection

Symbol	Value	Count	Comment
T1	NPN bias transistor, e.g. TR1 of BCR10PN	1	-
T2	PNP bias transistor, e.g. TR2 of BCR10PN		
RL_OL	10k	1	-

7 Summary of circuitry for single device

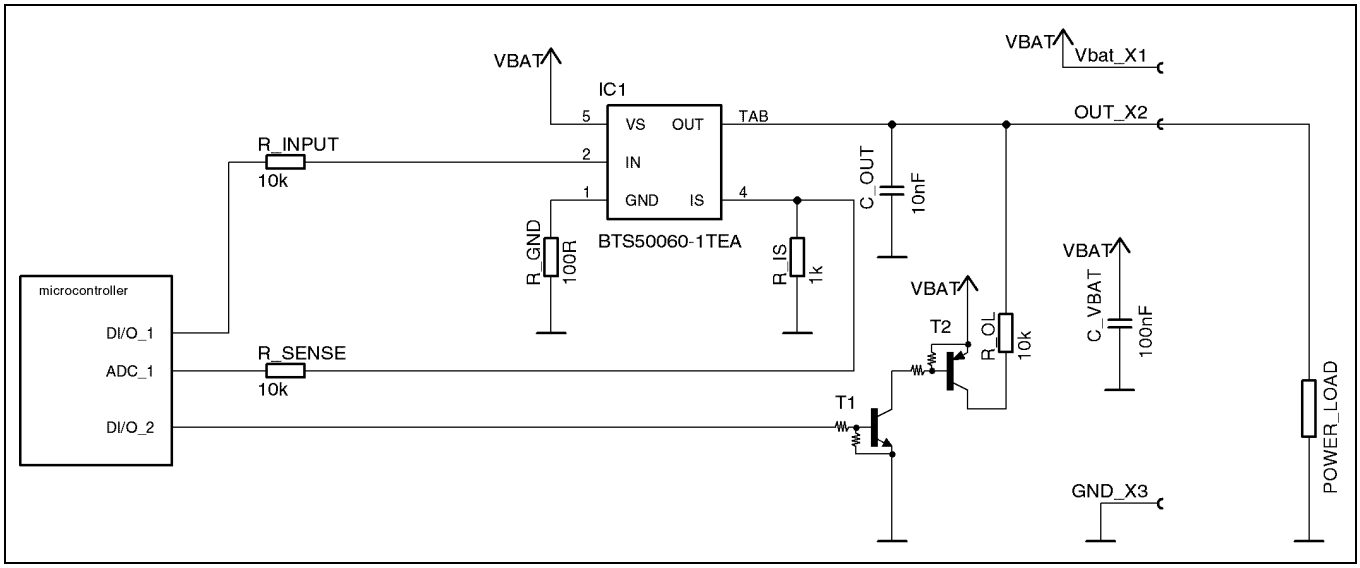

Figure 4 Example for using BTS50060-1TEA, summarizing above circuitry

Table 5 BOM single device

Symbol	Value	Count	Comment
IC1	BTS50060-1TEA	1	Smart High-side switch
Microcontroller	e.g. TLE9832	1	-
R_Input	10k	1	-
R_sense	10k	1	-
R_IS	1k	1	-
R_GND	100 Ohm	1	-
C_Vbat	100nF	1	-
C_OUT	10nF	1	-
X	Power connectors	3	-
Power Load	e.g. Diesel glow plug	1	Loads to be driven
T1	NPN bias transistor, e.g. TR1 of BCR10PN	1	For open load detection
T2	PNP bias transistor, e.g. TR2 of BCR10PN		
RL_OL	10k	1	For open load detection

8 Multiple devices

Using multiple BTS50060-1TEA for independent outputs on a single board, some parts of the circuitry may be necessary only one time, saving components and microcontroller pins. An example for using 2 units BTS50060-1TEA, with open load detection, can be found in Figure 5.

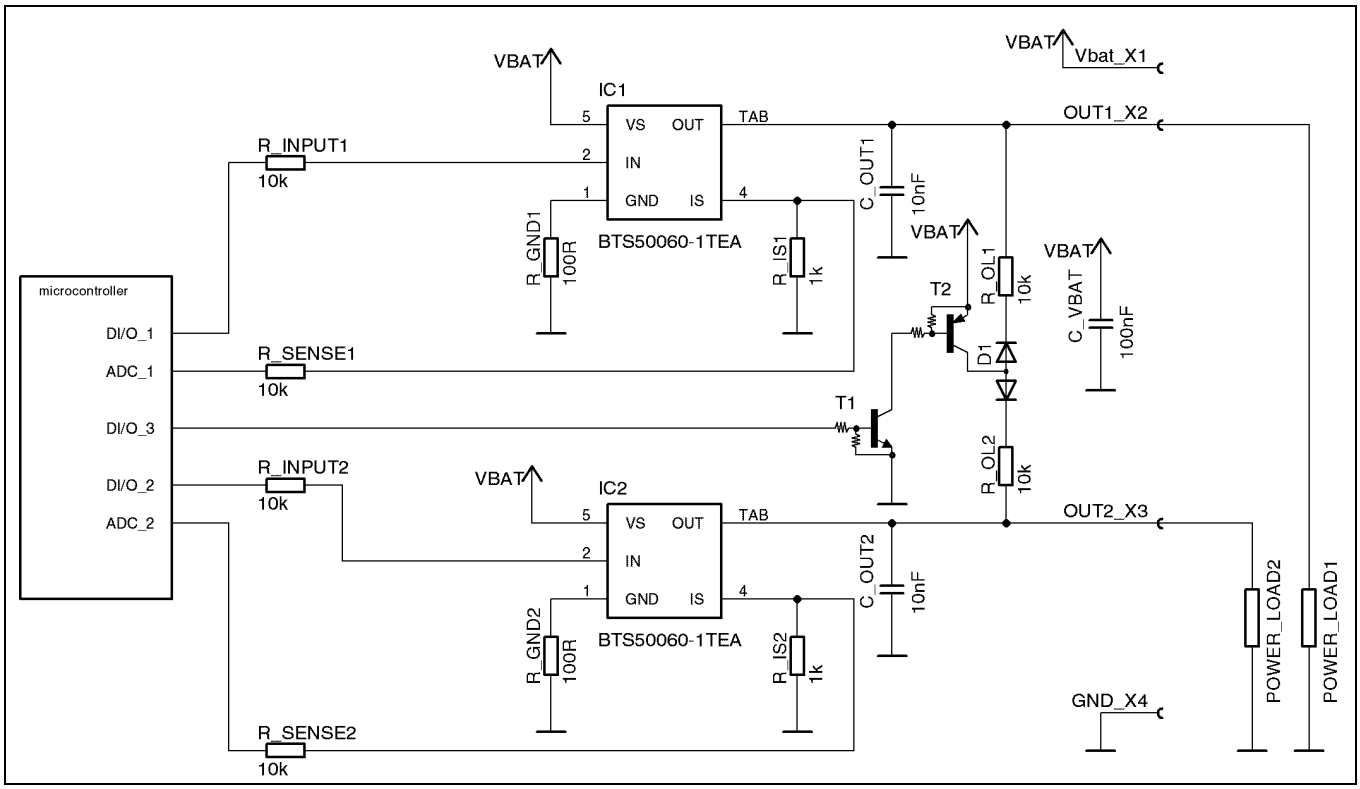

Figure 5 Example for using two BTS50060-1TEA, re-using circuitry and microcontroller pins

Table 6 BOM for two devices, including “open load at OFF” detection

Symbol	Value	Count	Comment
IC1	BTS50060-1TEA	2	Smart High-side switch
Microcontroller	e.g. TLE9832	1	-
R_Input	10k	2	-
R_sense	10k	2	-
R_IS	1k	2	-
R_GND	100 Ohm	2	-
C_Vbat	100nF	1	-
C_OUT	10nF	1	-
X	Power connectors	4	-
Power Load	e.g. Diesel glow plug	2	Loads to be driven
T1	NPN bias transistor, e.g. TR1 of BCR10PN	1	For open load detection
T2	PNP bias transistor, e.g. TR2 of BCR10PN		
RL_OL	10k	2	For “open load at OFF”
D1	e.g. BAW56	1	For “open load at OFF”; double diode with common anode

As shown in Figure 6, instead of using a separate R_GND for each BTS50060-1TEA, using one common L_GND for multiple BTS50060-1TEA may reduce the number of device count on board. Care has to be taken in board layout to avoid RF coupling from BTS50060-1TEA pin 1 (GND) to module board, bypassing L_GND. Using single R_GND for multiple BTS50060-1TEA is not recommended because of voltage drop across R_GND.

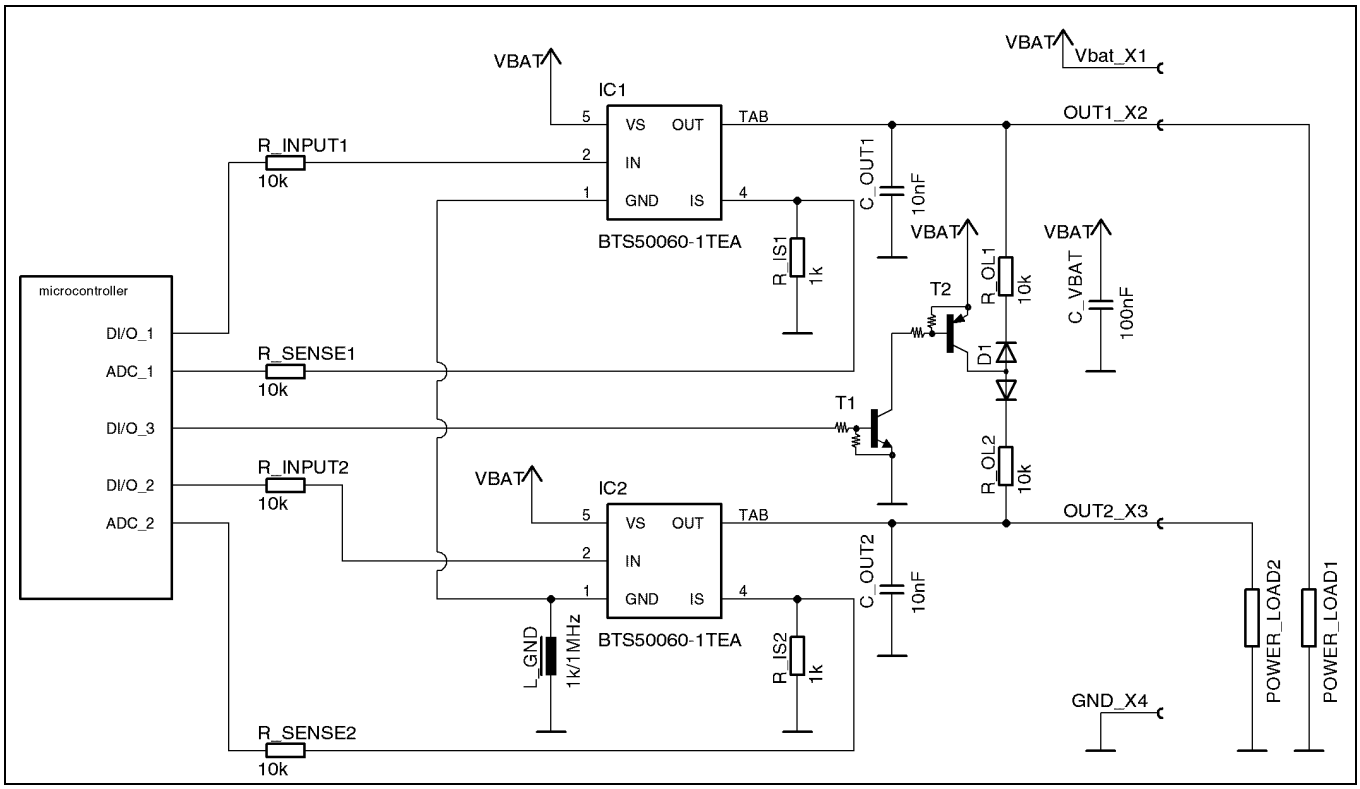

Figure 6 Example for using two BTS50060-1TEA, re-using circuitry and microcontroller pins, with single L_GND

Table 7 Change to BOM for two devices when using single L_GND

Symbol	Value	Count	Comment
~~R_GND~~	~~100 Ohm~~	0	Replaced by L_GND
L_GND	e.g. WE 74279205	1	1k@100MHz

9 Conclusion

The high current PROFET™ BTS50060-1TEA from Infineon® is a smart high-side switch. It offers the high driving capability of a 6mOhm switch in a DPak package with a high number of protection and diagnostic features. It supports high feature set and low count of external components, for a high variety of applications. Examples of how to make use of that in application design were given in this application note.

10 Additional Information

- Data sheet of BTS50060-1TEA can be found at **http://www.infineon.com/PROFET**
- More information on ADVANCED SENSE feature can be found in the application note “ADVANCED SENSE calibration and benefits guide” available at document section of **http://www.infineon.com/PROFET**
- For further information you may contact **http://www.infineon.com**

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