

Getting started with PROFET™ + 48V devices

Application note

About this document

Scope and purpose

This application note explains how to configure the Infineon PROFET™ + 48V devices. Furthermore, it describes the set-up of external components, based on practical considerations, using the datasheet parameters, and provides insights on how to use these flexible smart high-side switches.

Intended audience

The document is intended for all electrical and electronic engineers who need to replace relays and fuses effectively and simply, so that they make a reliable and self-protected solid-state switch, based on MOSFETs.

Note: *The values shown in this application note are measured under lab conditions and vary for different cooling conditions and setups.*

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1 Generic overview

1 Generic overview

Note: The following information is only an example for the implementation of the device and shall not be regarded as a description or warranty of certain functionality, condition, or quality of the device. This is a simplified example of an application circuit. The function must be verified in the real application.

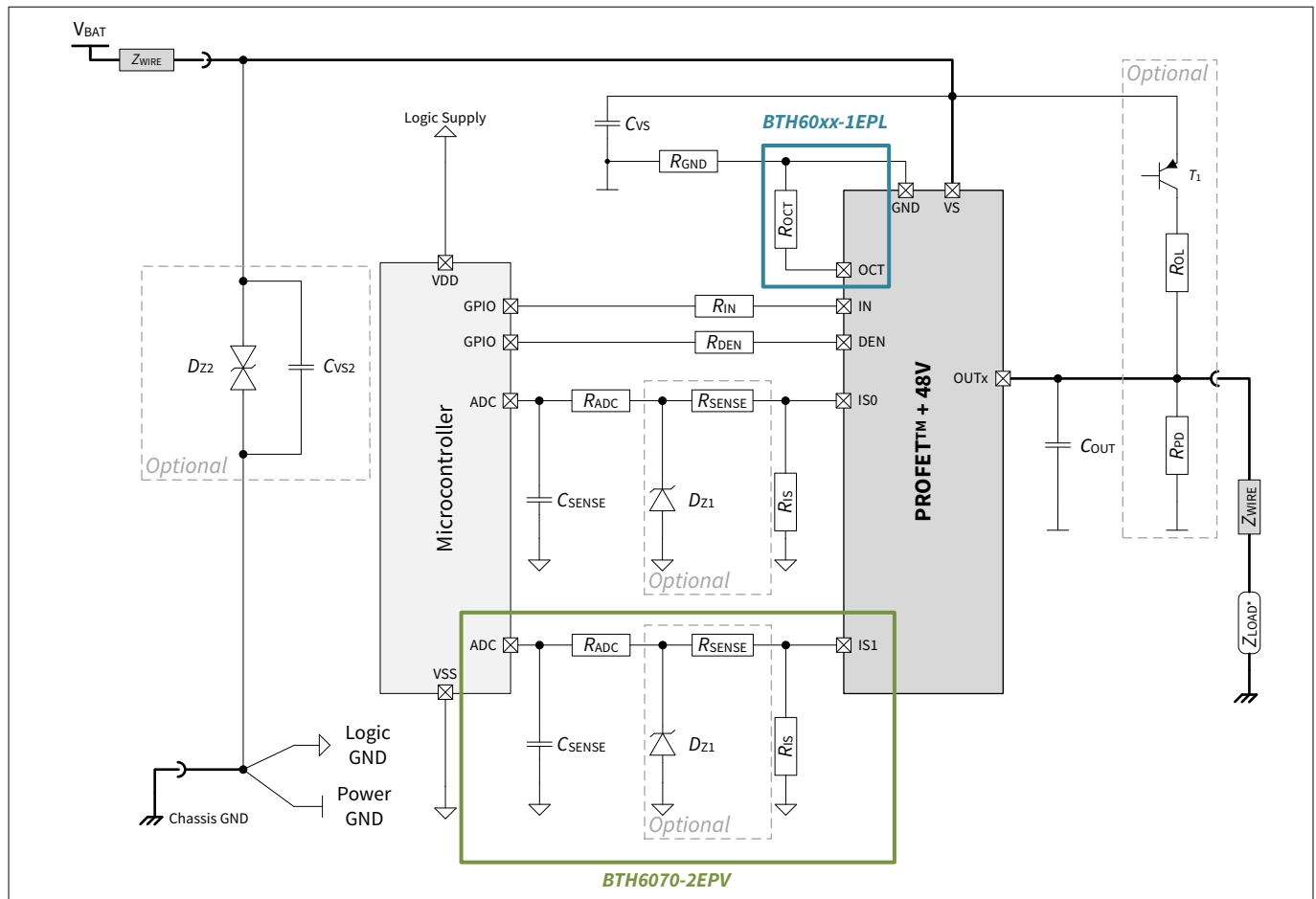


Figure 1 Application diagram

For the *bill of materials (BOM)* table, refer to the datasheet chapter "Application Information".

Table 1

Device	Package	Number of channels	$I_{L(NOM)}$ [A]	Outstanding feature
BTH6035-1EPL	TSDSO-14	1	5	Adjustable overcurrent protection, capacitive load switching capability
BTH6080-1EPL	TSDSO-14	1	2.5	Adjustable overcurrent protection, capacitive load switching capability

(table continues...)

1 Generic overview

Table 1 (continued)

Device	Package	Number of channels	$I_{L(NOM)}$ [A]	Outstanding feature
BTF6070-2EPV	TSDSO-14	2	2.17	Two current sense pins
BTH6200-1ENA	TDSO-8	1	1.74	
BTH6100-2EPA	TSDSO-14	2	2.03	
BTH6200-4ESA	TSDSO-24	4	1	

2 Adjustable current threshold

2 Adjustable current threshold

The following chapter describes the overload protection feature "adjustable overcurrent protection". This feature is available on the following components:

- BTH6035-1EPL
- BTH6080-1EPL

2.1 Formula for adjustable overcurrent threshold

This feature offers protection in the cases of overload and short circuit to ground. To calculate the *overcurrent threshold (OCT)*, use the following equation:

$$I_{LIM} = k_{ILIOCT} \cdot I_{OCT} + \Delta I_{LIM}$$

Where:

$$I_{OCT} = (I_{LIM} - \Delta I_{LIM}) / k_{ILIOCT}$$

To select the applicable I_{OCT} , choose the resistor value R_{OCT} . The value of the R_{OCT} can be calculated with the following equation:

$$R_{OCT} = (V_{OCT} \cdot k_{ILIOCT}) / (I_{LIM} - \Delta I_{LIM})$$

Additionally, add a required safety margin $I_{LIMx_fraction}$ between the adjusted current limitation I_{LIM} and the expected load current of the application $I_{L(APP),MAX}$:

$$I_{L(APP),MAX} = I_{LIMx_fraction} \cdot I_{LIM}$$

2.2 R_{OCT} calculation example

This chapter provides a calculation example of the R_{OCT} resistance that sets the current limitation at 6 A for the BTH6035-1EPL.

V_{OCT} :

The analog overcurrent threshold voltage V_{OCT} is parameter PRQ-386 in "Electrical characteristics diagnostic functions" of the datasheet. For simplification, the value for $V_{OCT,TYP}$ is 0.51 V.

k_{ILIOCT} and ΔI_{LIM} :

The k_{ILIOCT} and ΔI_{LIM} depend on the limitation ranges that are set. The values are given in the datasheet parameters, numbered from 01 to 04, as shown in the figure below. The parameters can be found in "Electrical characteristics power stage" of the datasheet. Because the target current limitation threshold is 6 A, $k_{ILIOCT02}$ provides the fitting I_{LIM} range, and provides a typical value of 101.6 k. Parameter ΔI_{LIM02} gives a value of 2.14 A.

2 Adjustable current threshold

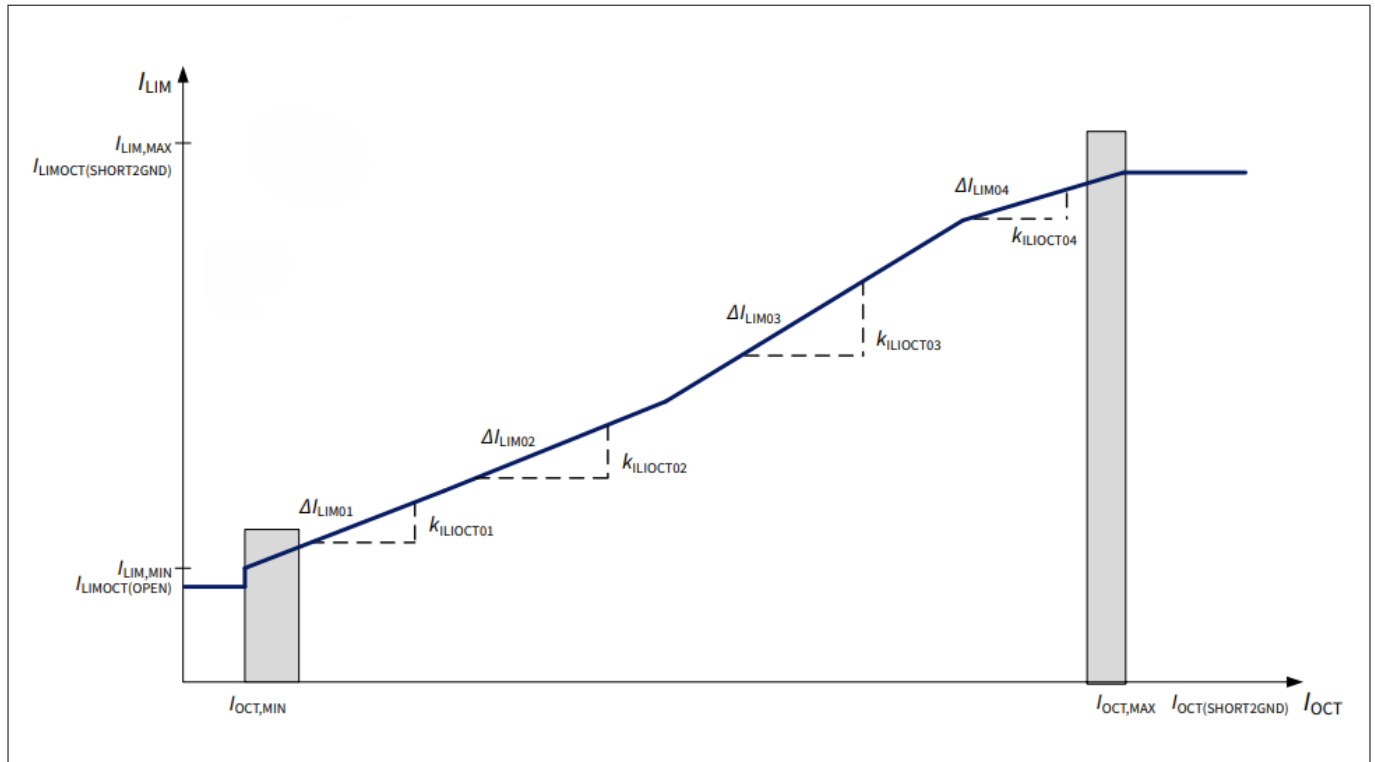


Figure 2 Adjustable overcurrent threshold behavior

I_{LIM} :

The defined current limit is set to 6 A.

Calculation result:

$$R_{OCT} = (V_{OCT} \cdot k_{ILIOCT02}) / (I_{LIM} - \Delta I_{LIM02})$$

$$R_{OCT} = (0.51 \cdot 101.6 \text{ k}) / (6 - 2.14) = 13424 \text{ } \Omega = 13.42 \text{ k}\Omega$$

$I_{LIM0x_fraction}$ describes the safety margin between the adjustable current limitation and the expected load current of the application. The safety margin is essential for preventing the unintentional activation of the current limitation circuit during normal operation.

$$I_{L(APP),MAX} = I_{LIM02_fraction} \cdot I_{LIM}$$

$$I_{L(APP),MAX} = 0.83 \cdot 6 = 4.98 \text{ A}$$

In summary, if the resistor value R_{OCT} is 13.42 k Ω , the maximum allowed application load capability is 4.98 A, resulting in a current limit of around 6 A.

3 Design-in

3.1 Infineon Automotive Power Explorer

The Infineon Automotive Power Explorer is a powerful tool designed to provide a comprehensive and detailed analysis of Infineon products, enabling users to make informed decisions and optimize their designs. It offers a range of analysis features that enable users to evaluate and compare the performance of different products under various operating conditions.

- kILIS analysis: Calculating and visualizing the digital range of the sense current for specific load currents on the respective selected product. Taking the kILIS rate, sense resistor and ADC tolerances into account
- Thermal Transient Multisource analysis: Calculating and visualizing of various important electrical and thermal parameters for specific PCB cooling scenarios, based on the selected products and assigned loads
- Power dissipation analysis: Power dissipation calculation of the most important electrical parameters for selected products and assigned loads to evaluate the best fitting products

The software can be downloaded from the [Infineon Developer Center \(IDC\)](#) or directly via our [homepage](#).

3.2 Evaluation kit and Infineon Smart Power Switches Configuration Wizard

For fast first evaluation of devices, an evaluation kit for Smart Power Switches is available. This kit consists of a [motherboard \(MB\)](#) and a [daughterboard \(DB\)](#), as shown in the figures below. The MB provides the connectivity and the required circuitry. The DB mainly provides the device itself and the resistors for setting the current limitation. The device uses a dip-switch with various resistor values to facilitate the easy exchange of the device and the evaluation of various current limits. We offer two motherboard options for use with the daughterboard: One MB with a microcontroller for use with our configuration wizard software (Smart Power Switches Motherboard, SP006041408).

One MB without a microcontroller but with connectivity to control the device with lab equipment, such as power supplies and signal generators (Smart Power Switch Motherboard Lite, SP006136123).

These options provide flexibility and allow users to choose the setup that best suits their evaluation needs.

3 Design-in

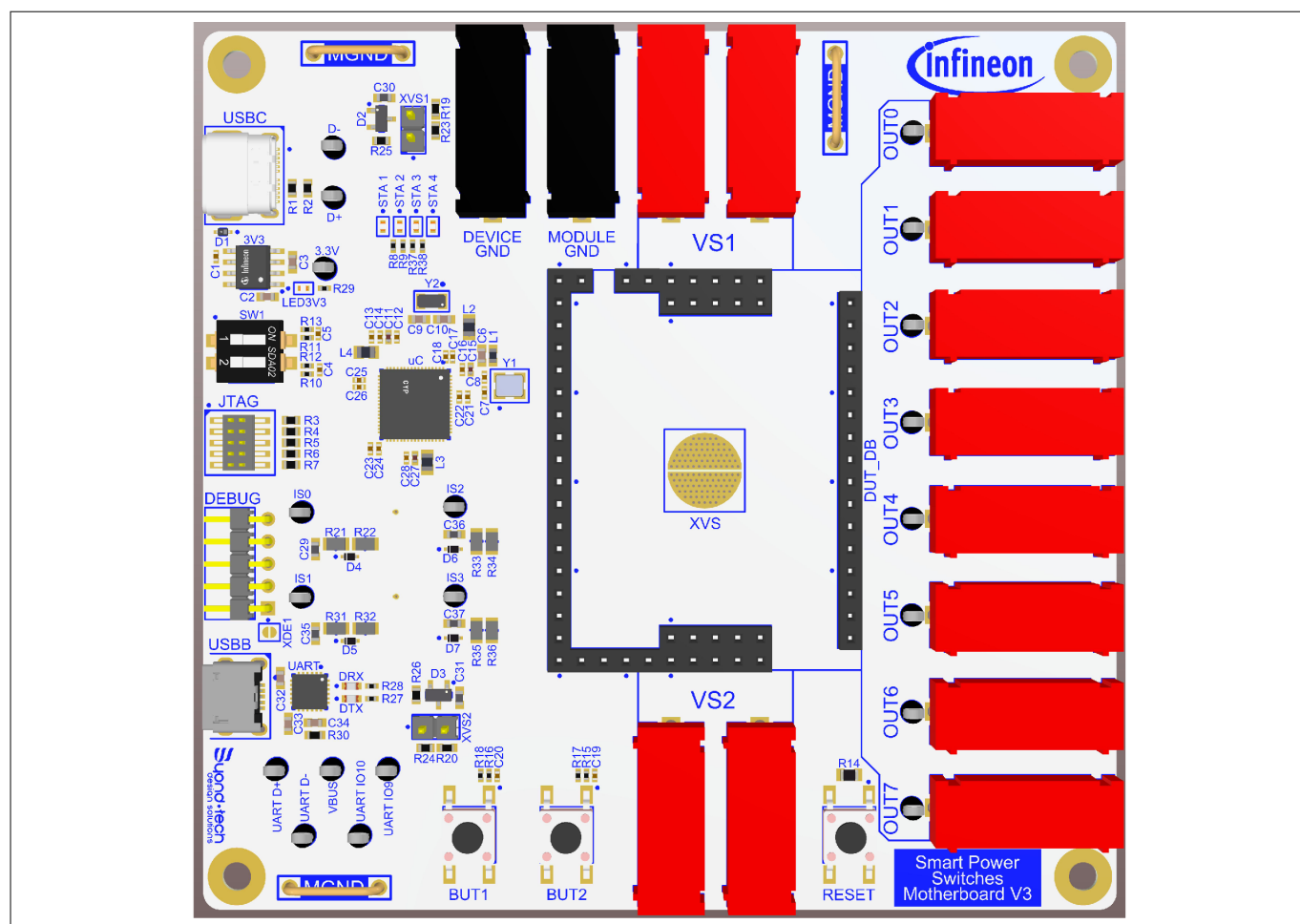


Figure 3 Smart Power Switches Motherboard

3 Design-in

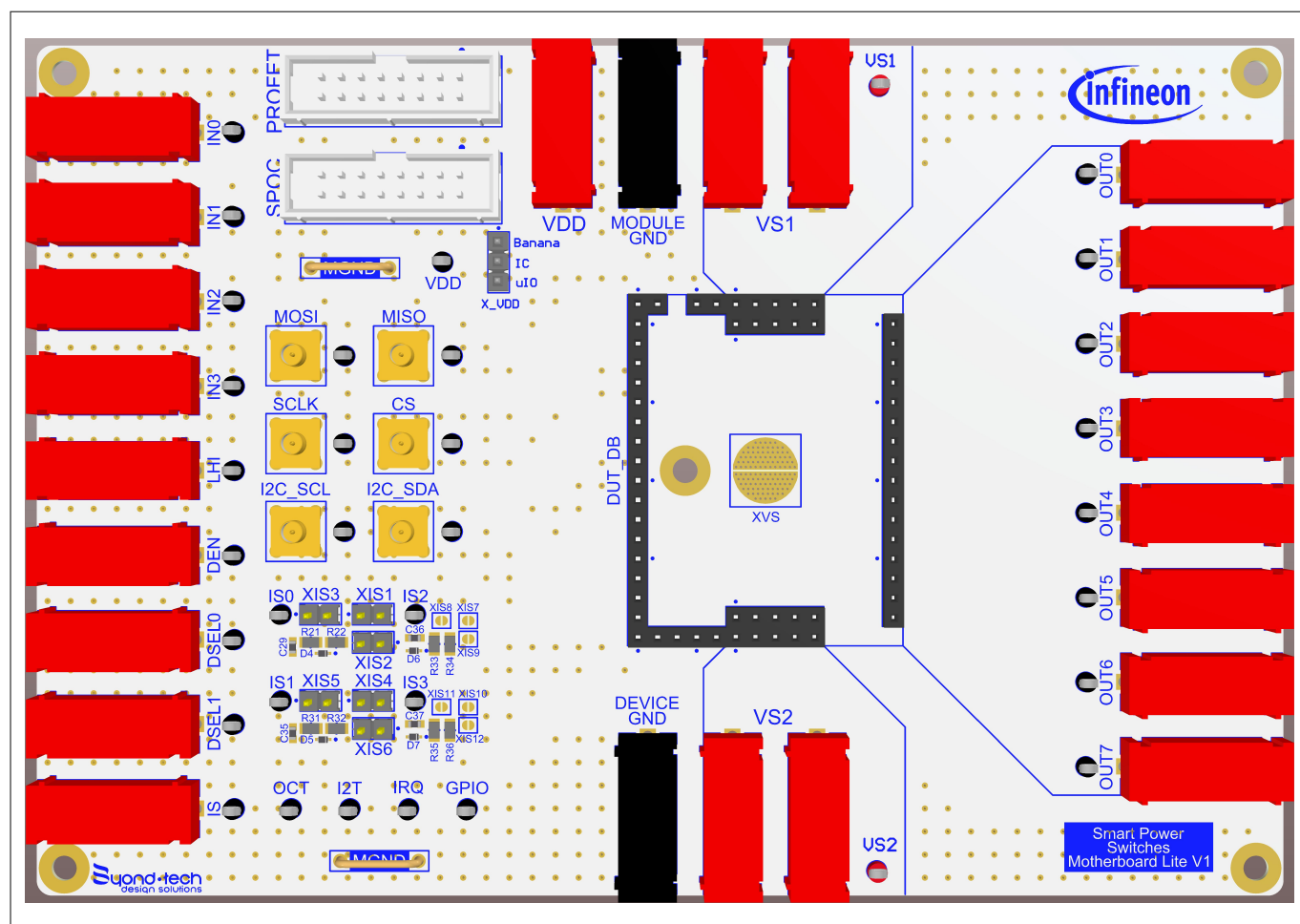


Figure 4 Smart Power Switch Motherboard Lite

3 Design-in

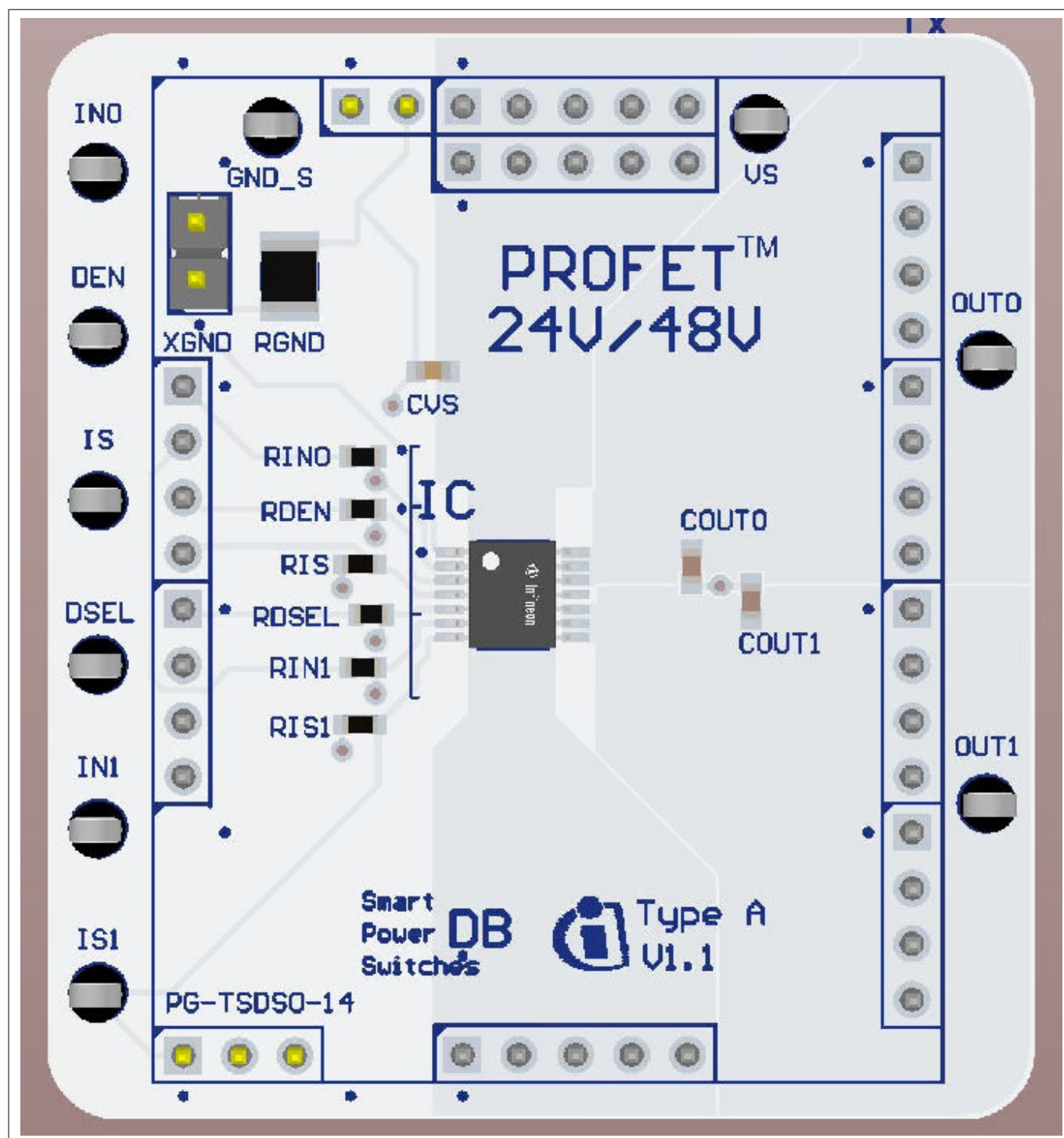


Figure 5 Daughterboard (DB)

Table 2 Board ordering information

Evaluation kit part	Naming	SP number
Smart Power Switch Motherboard	M-SMART-POWER-SWT-5	SP006041408
Smart Power Switch Motherboard Lite	M-SMART-POWER-LITE-5	SP006136123

(table continues...)

3 Design-in

Table 2 (continued) Board ordering information

Evaluation kit part	Naming	SP number
Daughterboard	D-BTH6035-1EPL-4	SP006149044
Daughterboard	D-BTH6080-1EPL-4	SP006149048
Daughterboard	D-BTH6070-2EPV-4	SP006149046
Daughterboard	D-BTH6100-2EPA-4	SP006149050
Daughterboard	D-BTH6200-1ENA-4	SP006149052
Daughterboard	D-BTH6200-4ESA-4	SP006149054

The Infineon Smart Power Switches Configuration Wizard is a [graphical user interface \(GUI\)](#)-based tool for the evaluation of our Smart Power Switches. It demonstrates the functionality of smart power products by providing a fast and easy approach to assess various features. The Configuration Wizard is available in the [Infineon Developer Center](#) or directly from the [tool homepage](#).

For the following devices, the DB has a dip-switch with various values provided for evaluation:

- BTH6035-1EPL
- BTH6080-1EPL

As shown in the figure below, the resistor values are numbered according to the dip-switch, from left to right.

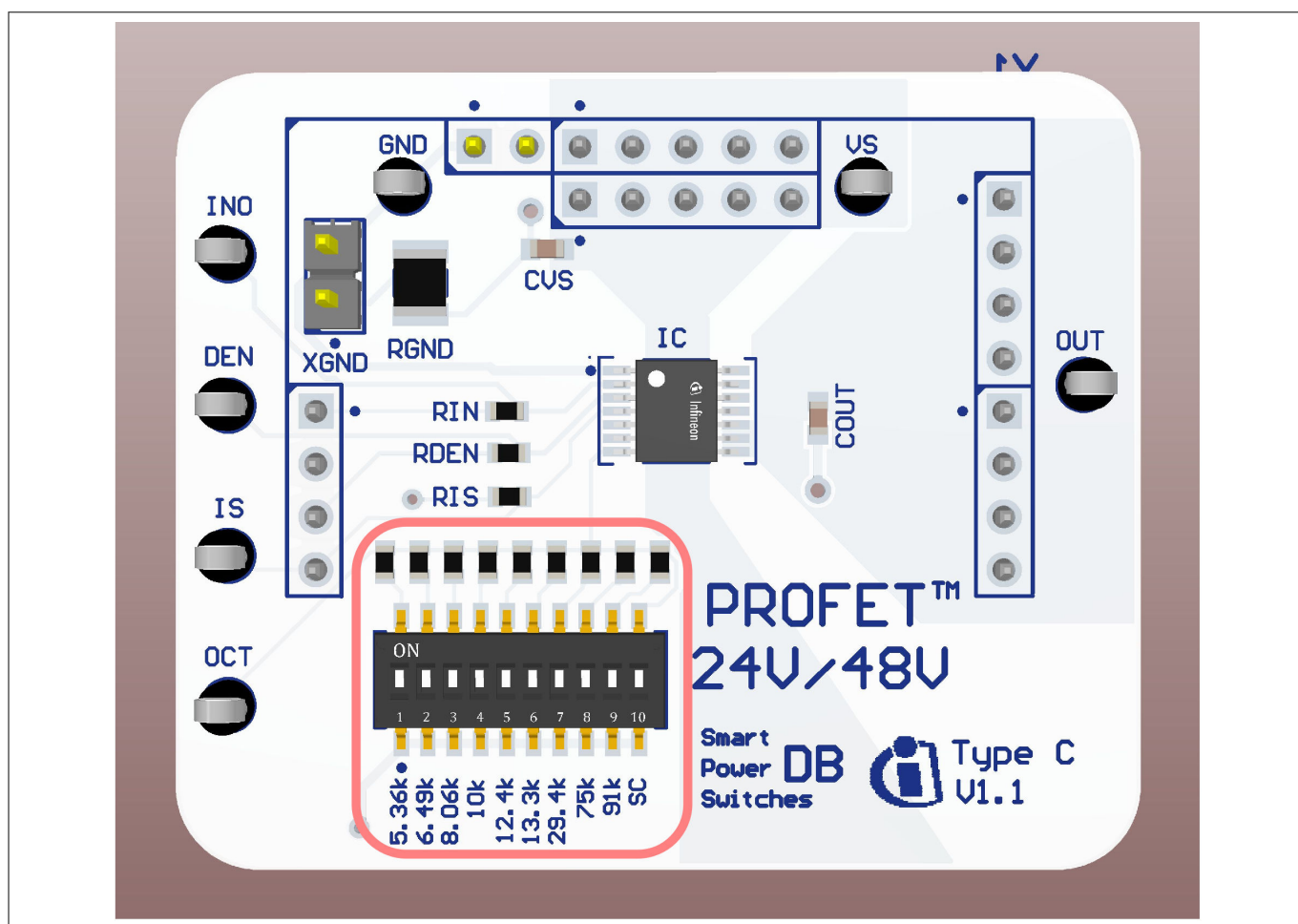


Figure 6 R_{OCT} dip-switch

3 Design-in

Table 3 BTH6035-1EPL daughterboard R_{OCT} values

Designator	R_{OCT} value [kΩ]	$I_{LIM,TYP}$ [A]
R1	5.3	13.06
R2	8	9.43
R3	10	7.38
R4	12.3	5.84
R5	13.4	6.01
R6	18.1	5.00
R7	29	4.05
R8	75	3.09
R9	Short to device <i>ground (GND)</i>	
R10	Not mounted	

Table 4 BTH6080-1EPL daughterboard R_{OCT} values

Designator	R_{OCT} value [kΩ]	$I_{LIM,TYP}$ [A]
R1	5.3	5.37
R2	6.5	3.90
R3	8	3.06
R4	10	2.33
R5	12.3	2.00
R6	13.3	1.87
R7	29.4	1.16
R8	75	0.81
R9	Short to device GND	
R10	Not mounted	

3.3 Current sense

The IS pin of the device provides a sense current, unless a hard failure mode occurs. The DEN pin (diagnosis enable) controls the diagnosis circuitry. When the DEN pin is set to high, the diagnosis is enabled.

The following events are hard failure modes:

- Short to *GND*
- *OCT* short to device GND
- Current limitation
- Overtemperature
- Open load in OFF-state

During normal operation, the IS pin provides an IS current, which is proportional to the load current in the following ratio:

$$k_{ILIS} = I_{LOAD} / I_{IS}$$

3 Design-in

A specific sense circuit is recommended, as shown in the figure below. Depending on the application, other component values should be considered. Therefore, Infineon provides the Infineon Smart Power Switches k_{ILIS} Tool (k_{ILIS} Tool). You can evaluate all components of the sense circuit in this tool. This enables you to find the most appropriate device values for the application. The k_{ILIS} Tool is available in the [Infineon Developer Center](#).

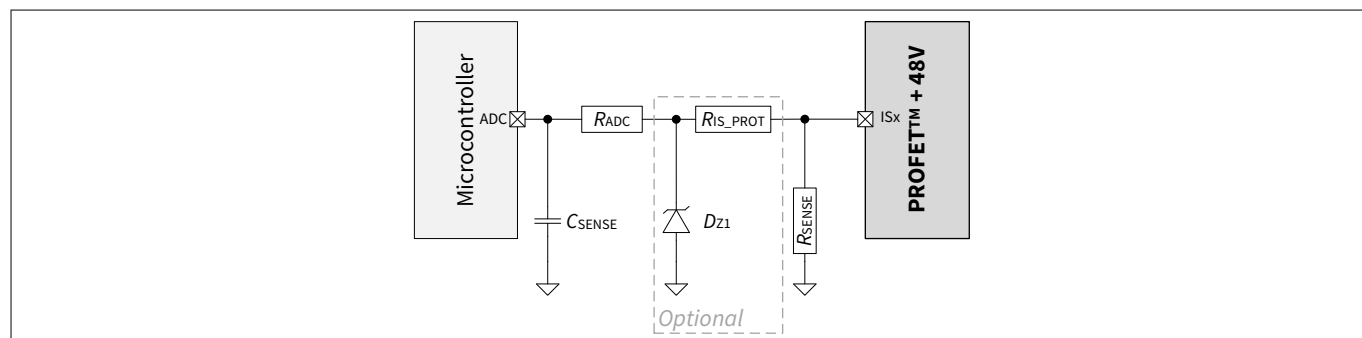


Figure 7 **Sense circuit**

Glossary

BOM

bill of materials (BOM)

A list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, parts, and the quantities of each that are needed to manufacture an end product.

DB

daughterboard (DB)

An expansion circuit card connected to a motherboard.

GND

ground (GND)

GUI

graphical user interface (GUI)

An interface that enables users to interact with electronic devices through icons and visual indicators.

MB

motherboard (MB)

The main printed circuit board (PCB) in general-purpose computers and other expandable systems. It holds and allows communication between many of the crucial electronic components of a system, such as the central processing unit (CPU) and memory, and provides connectors for other peripherals.

OCT

overcurrent threshold (OCT)

Revision history

Document revision	Date of release	Description of changes
Rev. 1.10	2025-12-04	Table 3 , Table 4 updated
Rev. 1.00	2025-10-17	Initial document release

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