

# Customer Evaluation kit description

**PROFET™**

Z8F80147930

## About this document

### Scope and purpose

This document provides an overview of the latest high-side switches evaluation boards. This user guide is intended as guidance for the Configuration Wizard and its usage related to the customer evaluation kit. The information given in this document is intended only as an implementation guide and not as a description or warranty of a certain functionality, condition or quality of the device.

### Intended audience

This document is intended for anyone using Smart Power Switches boards with or without the Configuration Wizard.

## **Important notice**

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## Safety precautions

### Safety precautions

#### Reference board/kit




Product(s) embedded on a PCB with a focus on specific applications and defined use cases that may include software. PCB and auxiliary circuits are optimized for the requirements of the target application.

**Note:** Boards do not necessarily meet safety, EMI, or quality standards (e.g., UL, CE) requirements.

#### Safety precautions

**Note:** Please note the following warnings regarding the hazards associated with development systems.

**Table 1** Safety precautions

	<b>Caution:</b> The heat sink and device surfaces of the evaluation or reference board may become hot during testing. Hence, necessary precautions are required while handling the board. Failure to comply may cause injury.
	<b>Caution:</b> The evaluation or reference board contains parts and assemblies sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.
	<b>Caution:</b> The evaluation or reference board is shipped with packing materials that need to be removed prior to installation. Failure to remove all packing materials that are unnecessary for system installation may result in overheating or abnormal operating conditions.

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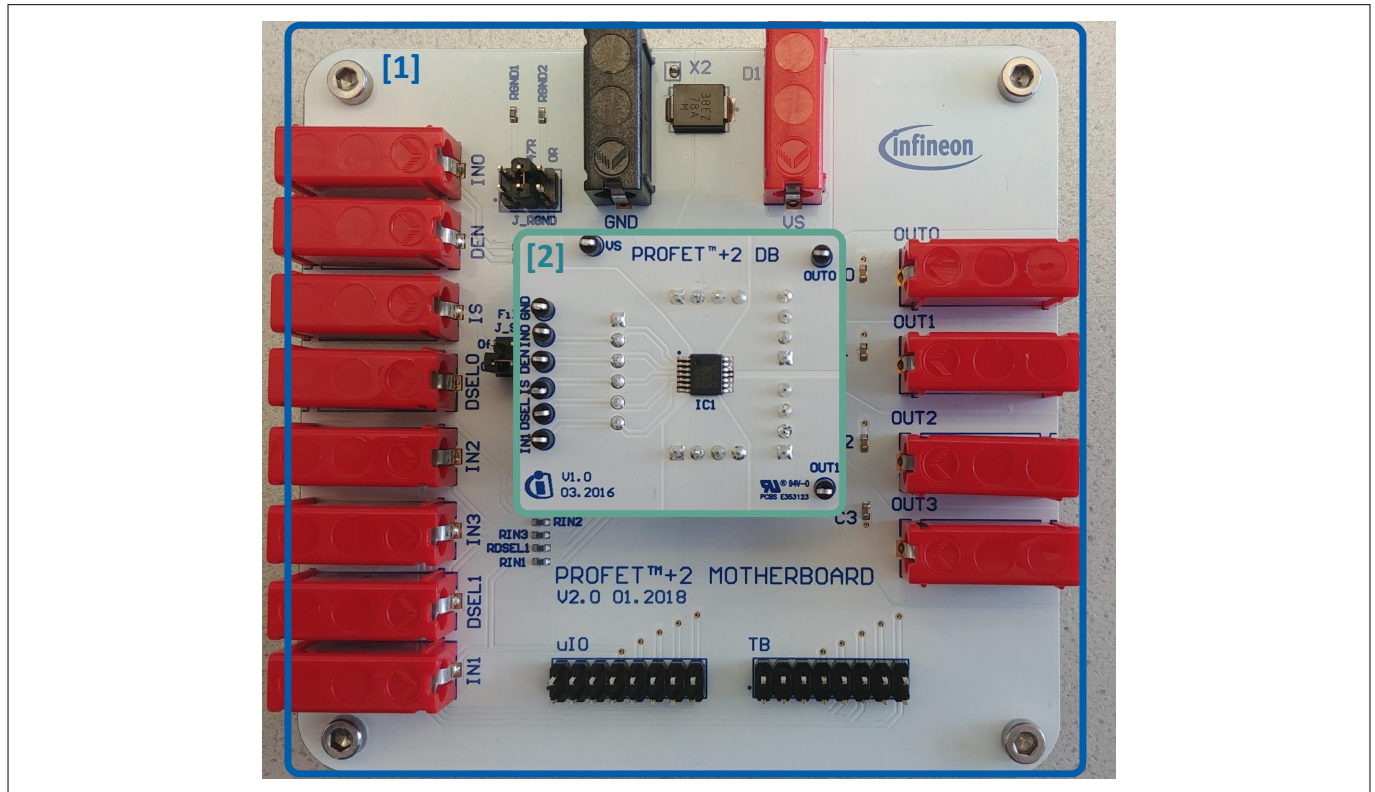


### 1 Evaluation kit overview [MB and DB]

## 1 Evaluation kit overview [MB and DB]

The PROFET™ +2 12V customer evaluation kit consists of a motherboard (MB) and a daughterboard (DB).

Figure 1 below shows the DB [2] plugged onto the MB [1].



**Figure 1** PROFET™ +2 12V MB [1] and DB [2]

### Application description

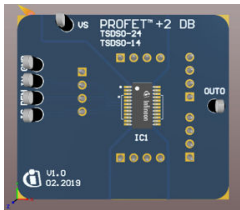
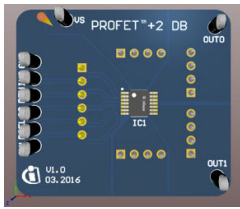
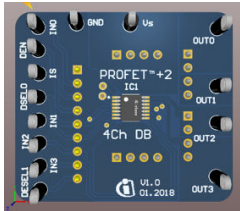
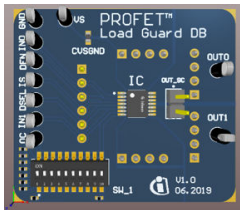
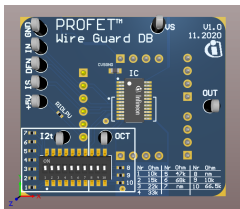
- The MB is designed to handle all devices within the families of PROFET™ +2 12V, PROFET™ Load Guard 12V and, PROFET™ Wire Guard 12V.
  - 1-channel, 2-channel or 4-channel devices (DBs) can be plugged onto the MB
- It is suitable for the evaluation of resistive, capacitive and/or inductive loads
- The evaluation can either be done directly or with the Config Wizard for Smart Power Switches (see [Chapter 5](#))

**Note:**

- The board is **not** designed for **EMC characterization**, including ISO pulses
- The board design is **not** optimized for **thermal performance characterization**

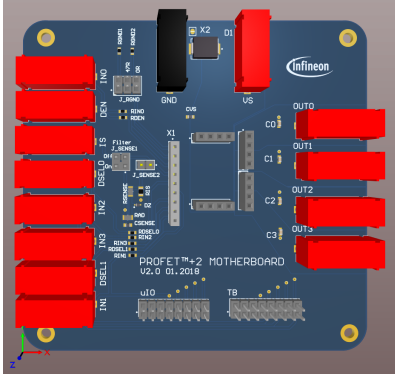
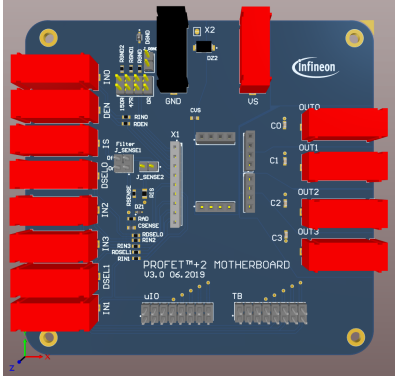
### 1 Evaluation kit overview [MB and DB]

**Table 2 Available daughterboards**

Name	Picture	TSDSO-14: 1-channel	TSDSO-14: 2-channel	TSDSO-14: 4-channel	TSDSO-24: 1-channel	PROFET™ Load Guard or PROFET™ Wire Guard
PROFET™ +2 12V 1-channel 14 and 24 pin		YES	NO	NO	YES	NO
PROFET™ +2 12V 2-channel		YES	YES	NO	NO	NO
PROFET™ +2 12V 4-channel		NO	NO	YES	NO	NO
PROFET™ Load Guard 12V		YES	YES	NO	NO	only PROFET™ Load Guard 12V devices
PROFET™ Wire Guard 12V		YES	NO	NO	YES	only PROFET™ Wire Guard 12V

1 Evaluation kit overview [MB and DB]

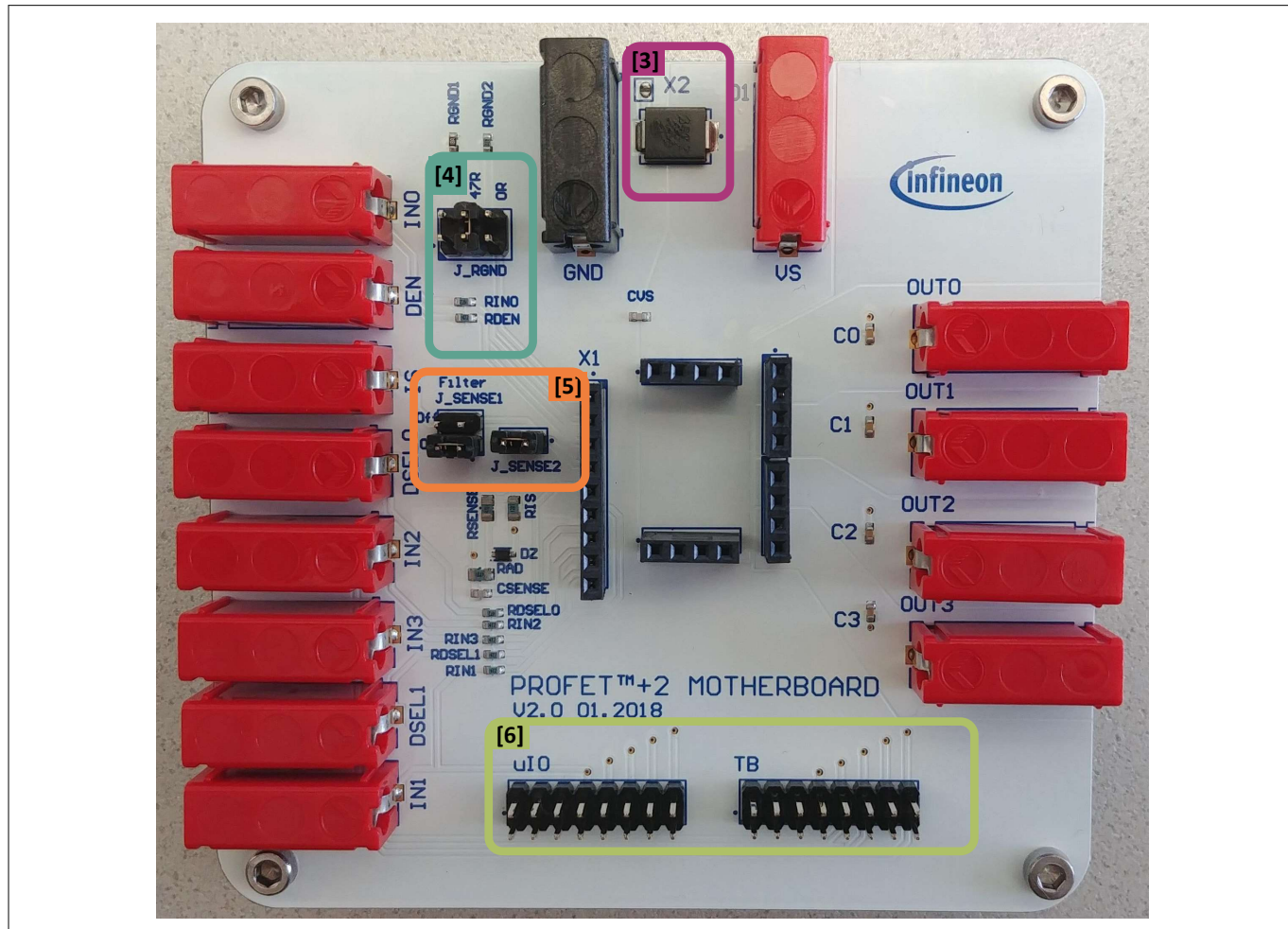
Table 3 Recommended MB depending on DB

Naming	Motherboard V2	Motherboard V3
Figure		
ISAR name	PROFET™ PLUS2 MOTH BRD	PROFET™ ONE4ALL MB V1
PROFET™ +2 12V (1-channel and 2-channel and 4-channel)	YES	YES
PROFET™ Load Guard 12V	NO	YES
PROFET™ Wire Guard 12V	NO	YES

## 2 Motherboards [MB]

## 2 Motherboards [MB]

Figure 2 and Table 4 below illustrate the location of the connectors and jumpers. The names of the jumpers are printed next to them. Chapter 2.1 provides detailed information.



**Figure 2** PROFET™ +2 12V MB - connectors and jumpers

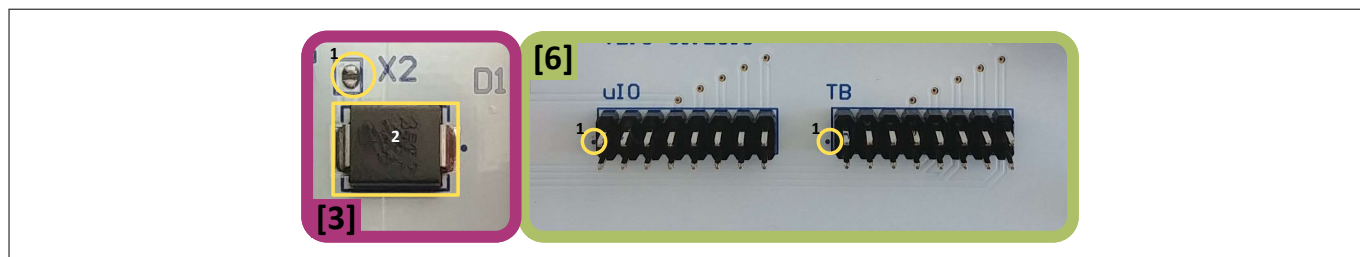
**Table 4** PROFET™ +2 12V MB connectors and jumpers

#	Description
1	PROFET™ +2 12V motherboard (see Figure 1)
2	PROFET™ +2 12V daughterboard (see Figure 1)
3	TVS Diode (device protection)
4	J_RGND (GND resistor selection)
5	J_SENSE1, J_SENSE2 (sense configuration)
6	µIO connectors of the PROFET™ +2 12V MB (optional: microcontroller)

## 2 Motherboards [MB]

### 2.1 Detailed information

The two  $\mu$ IO connectors of the PROFET™ +2 12V MB [6] are used to connect the motherboard with the  $\mu$ IO-Stick<sup>1)</sup> (for further information see Chapter 5). The connector marked as **uIO** can only be used for 1-channel and 2-channel devices, whereas the connector marked with **TB** also can be used for 4-channel devices. The yellow circles illustrated in Figure 3 and Figure 4 indicate the position of the pin 1 indicator. In order to avoid overvoltages on the MB it is possible to close the solder bridge **X2** which connects a TVS diode between VS and GND. Figure 3 and Table 5 show the solder bridge X2, the TVS diode [3] and the two  $\mu$ IO connectors of the PROFET™ +2 12V MB.

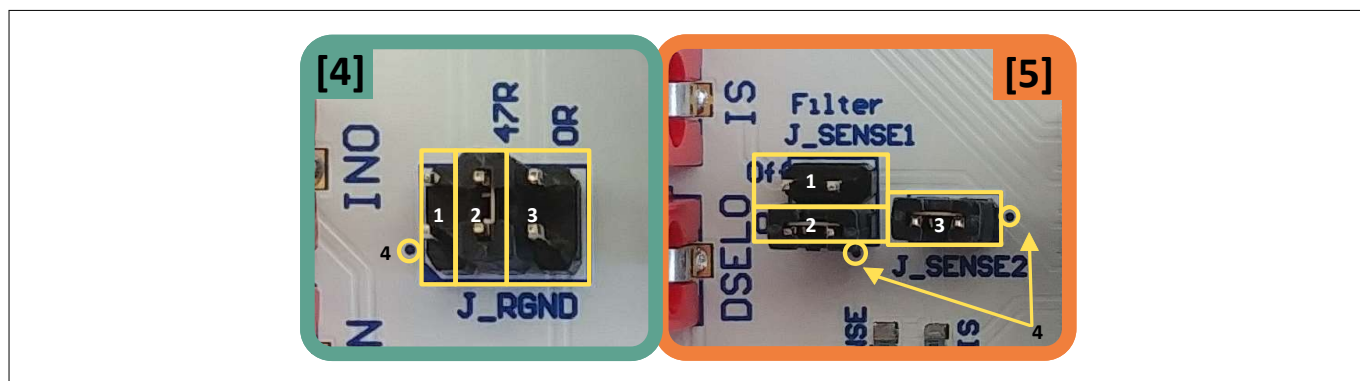


**Figure 3** Position of X2, uIO and TB

**Table 5** TVS diode [3]

Position	Description
yellow circle	Solder bridge X2, opened by default, close to enable overvoltage protection
yellow square	TVS diode

Figure 4 and the tables below illustrate the jumpers, as well as the positions of the jumpers. The description of the positions is given in Table 6 (J\_RGND [4]) and Table 7 (J\_SENSE1, J\_SENSE2 [5]).



**Figure 4** Jumper positions

Table 6 below lists the description of the three jumper positions of J\_RGND [4]. All jumpers are open by default.

**Table 6** J\_RGND [4] jumper positions

#	Description
1	The PROFET™ +2 12V DB ground is connected to the MB module ground via 150 $\Omega$ resistor
2	The PROFET™ +2 12V DB ground is connected to the MB module ground via 47 $\Omega$ resistor
3	The PROFET™ +2 12V DB ground is connected to the MB module ground via 0 $\Omega$ resistor

<sup>1)</sup> The Infineon  $\mu$ IO-Stick can be ordered at <https://www.ehitex.de/en/>.

## 2 Motherboards [MB]

Table 7 below lists the description of J\_SENSE1 and J\_SENSE2 jumpers [5], as well as their positions and the position of pin 1.

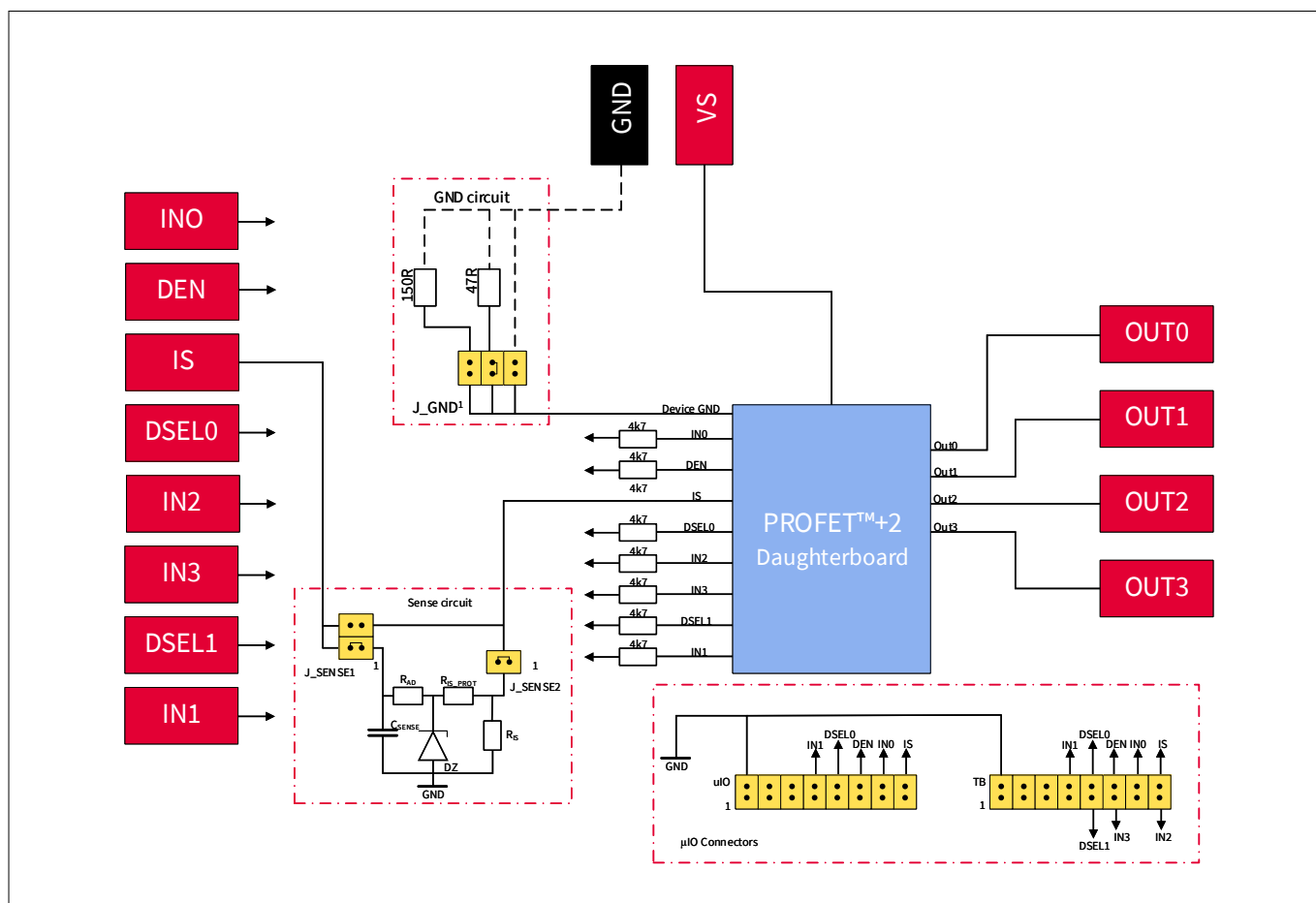
In order to convert the IS current into a voltage, J\_SENSE2 [3] needs to be closed. In case of using a different sense resistor, either replace RIS or use an external resistor. Therefore, remove J\_SENSE2 [3] and close JSENSE [1] to enable a direct path from the IS pin of the device to the banana connector. All jumpers are open by default.

**Table 7 J\_SENSE1/J\_SENSE2 [5] jumper positions**

#	Description
J_SENSE1 [1]	It connects the IS pin of the device directly to the banana connector of the MB and disables the on-board filter of the IS
J_SENSE1 [2]	It connects the IS pin of the device after the on-board filter to the banana connector of the MB
J_SENSE2 [3]	It connects the IS pin of the device to the 1.2 kΩ sense resistor RIS and to the μIO connectors

## 2.2 PROFET™ +2 12V motherboard V2 (PROFET™ PLUS2 MOTH BRD)

Figure 5 shows the block diagram of the PROFET™ +2 12V MB. It provides an overview of the locations of jumpers and connectors.



**Figure 5 Block diagram of the PROFET™ +2 12V MB V2**



## 2 Motherboards [MB]

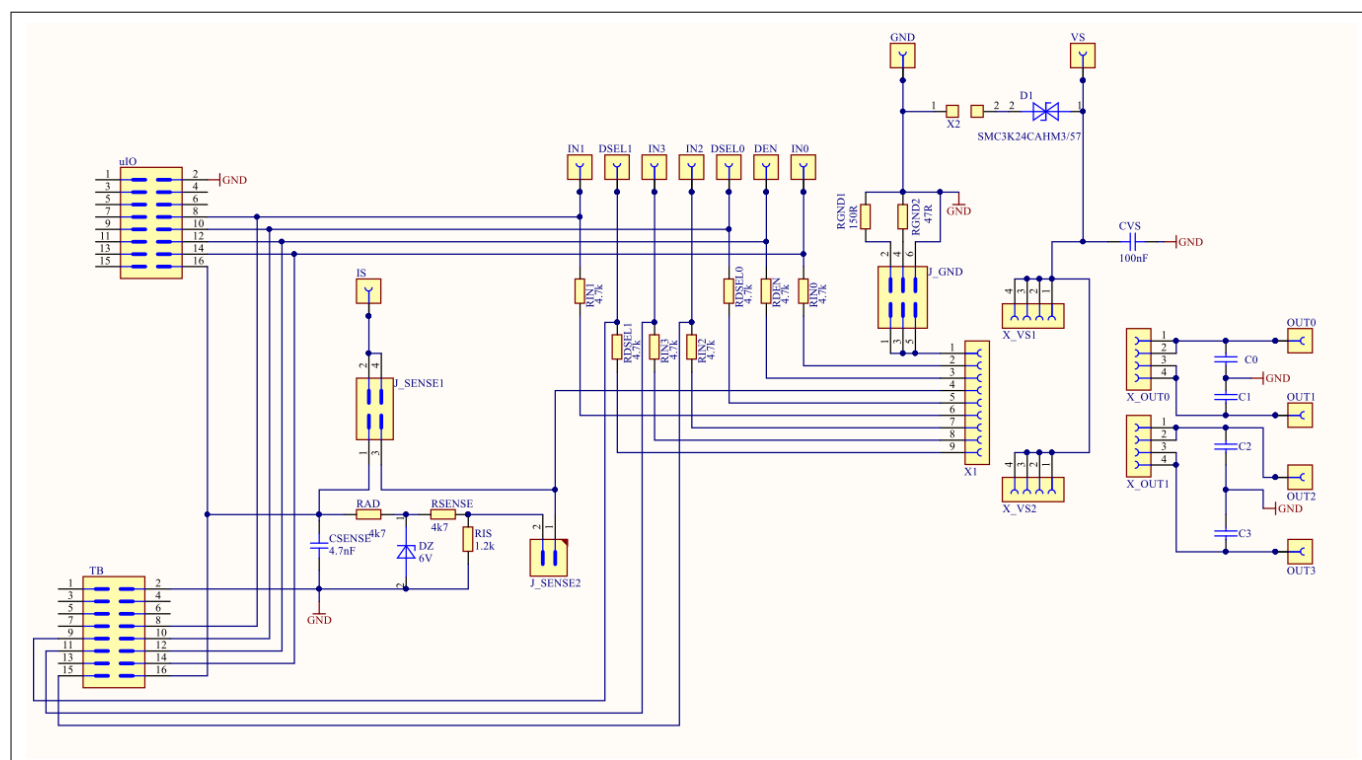
The device can be controlled with or without the  $\mu$ IO-Stick (see [Chapter 2.1](#), [Chapter 5](#)). [Table 8](#) below explains the functionality of all jumpers as well as the purpose of the connectors shown in the block diagram above ([Figure 5](#)).

**Table 8** PROFET™ +2 12V MB connectors and jumpers

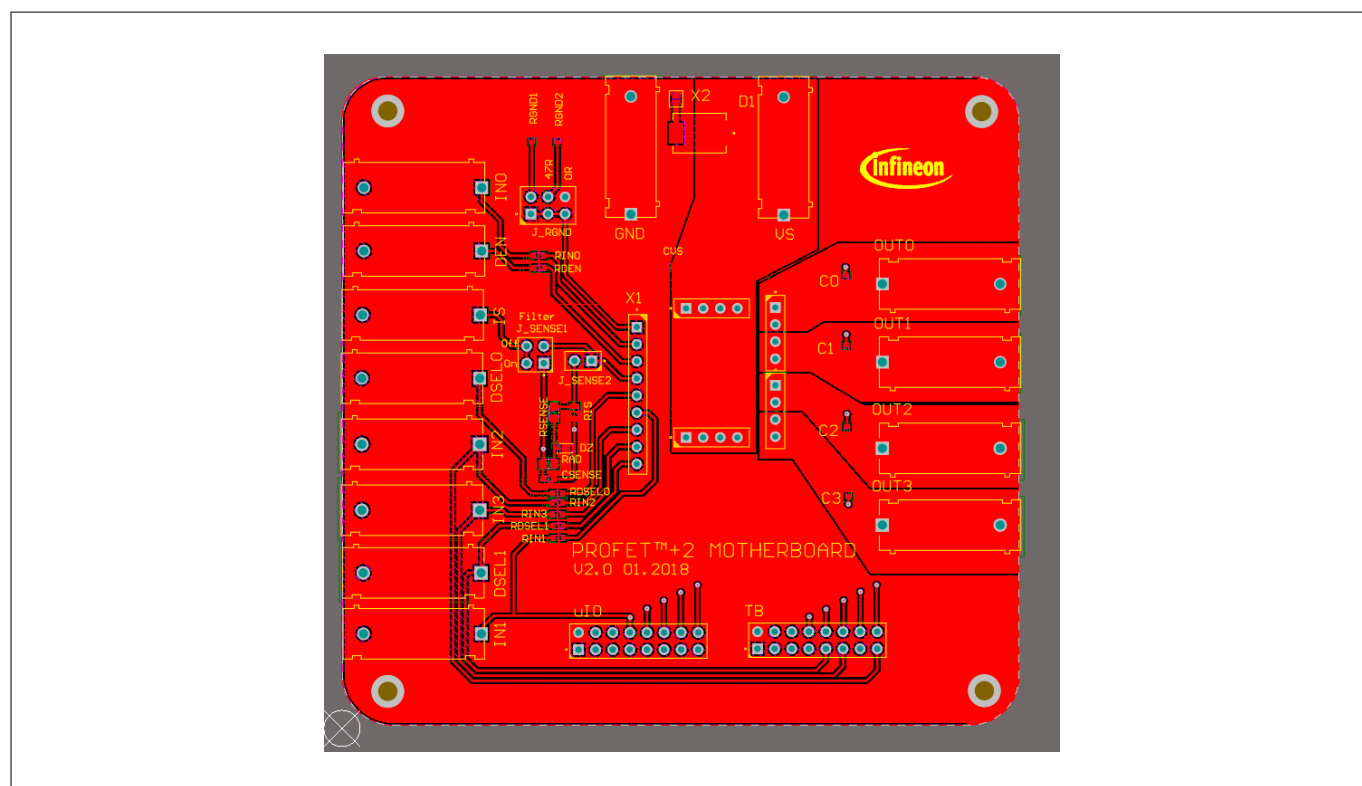
Name	Description
VS	Connection of the supply voltage
GND	Connection of the GND module
OUT0	OUT0 from the PROFET™ +2 12V
OUT1	OUT0/OUT1 <sup>1)</sup> from the PROFET™ +2 12V
OUT2	OUT1/OUT2 <sup>2)</sup> from the PROFET™ +2 12V
OUT3	OUT1/OUT3 <sup>2)</sup> from PROFET™ +2 12V
IN0, IN1, IN2, IN3	External input control of the PROFET™ +2 12V device with serial 4.7 k $\Omega$ resistors
DEN	External control of DEN pin with serial 4.7 k $\Omega$ resistor; enables/disables the diagnosis functions of the device
DSEL0, DSEL1	External control of DSELx pins with serial 4.7 k $\Omega$ resistor to select a dedicated channel for diagnosis feedback
IS	Sense output of the PROFET™ +2 12V (see <a href="#">Chapter 2.1</a> )
J_GND	J_GND is used to connect the PROFET™ +2 12V to the motherboard's GND network. It is also possible to choose between three ground resistors (150 $\Omega$ , 47 $\Omega$ , 0 $\Omega$ ) (see <a href="#">Chapter 2.1</a> )
J_SENSE1	Used to enable/disable the sense filtering (see <a href="#">Chapter 2.1</a> )
J_SENSE2	J_SENSE2 either enables the connection to a 1.2 k $\Omega$ onboard-resistor or a direct connection to the IS connector on the motherboard to add an external RSENSE with different values (see <a href="#">Chapter 2.1</a> )
$\mu$ IO-Connectors	The PROFET™ +2 12V demoboard can either be used with external sources or with the $\mu$ IO-stick by means of the Infineon Config Wizard (see <a href="#">Chapter 2.1</a> , <a href="#">Chapter 5</a> )

- 1) If a 1-channel or 2-channel device is used, OUT0 and OUT1 are connected to OUT0 of the device connector.  
 2) If a 2-channel device is used, OUT3 and OUT4 are connected to OUT1 of the device connector.

## 2 Motherboards [MB]



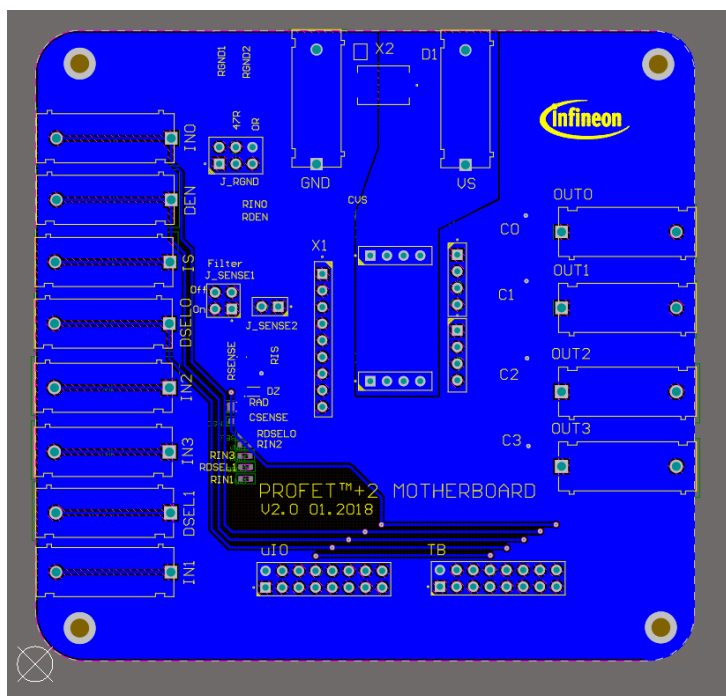
**Figure 6** Motherboard V2 schematic



**Figure 7** Motherboard V2 PCB top view



## 2 Motherboards [MB]

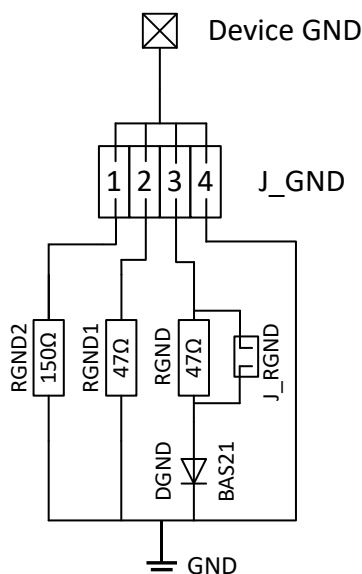


**Figure 8** Motherboard V2 PCB bottom view

### 2.3 PROFET™ +2 12V motherboard V3 (PROFET™ ONE4ALL MB V1)

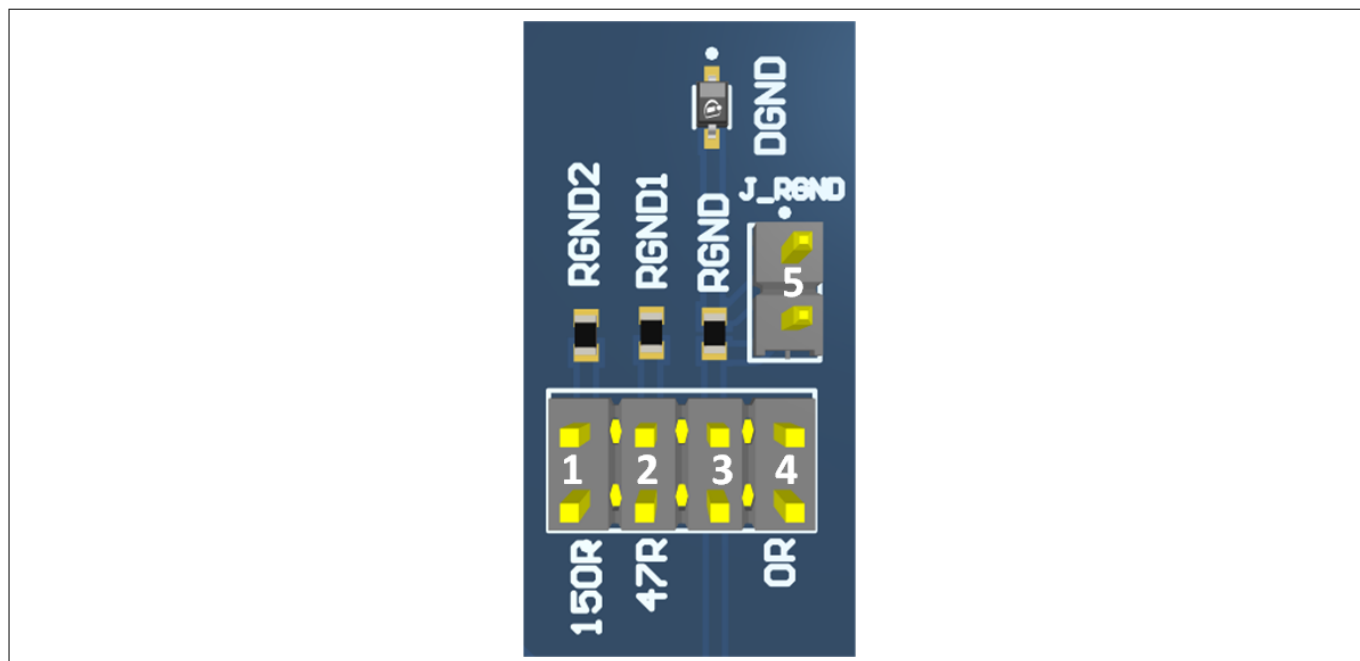
As a new option, the PROFET™ +2 12V motherboard V3 provides the possibility to easily plug in further PROFET™ devices with a DB. Compared to the PROFET™ +2 12V motherboard V2, more PROFET™ devices can be used.

Figure 9 shows the changes of the GND path. There are two jumpers: J\_GND and J\_RGND. Using J\_GND enables modification of the ground resistor value at four different positions. Figure 10 shows the possible jumper positions and Table 9 contains the description of the four possible jumper positions and their values.



**Figure 9** Motherboard V3 GND schematic

## 2 Motherboards [MB]

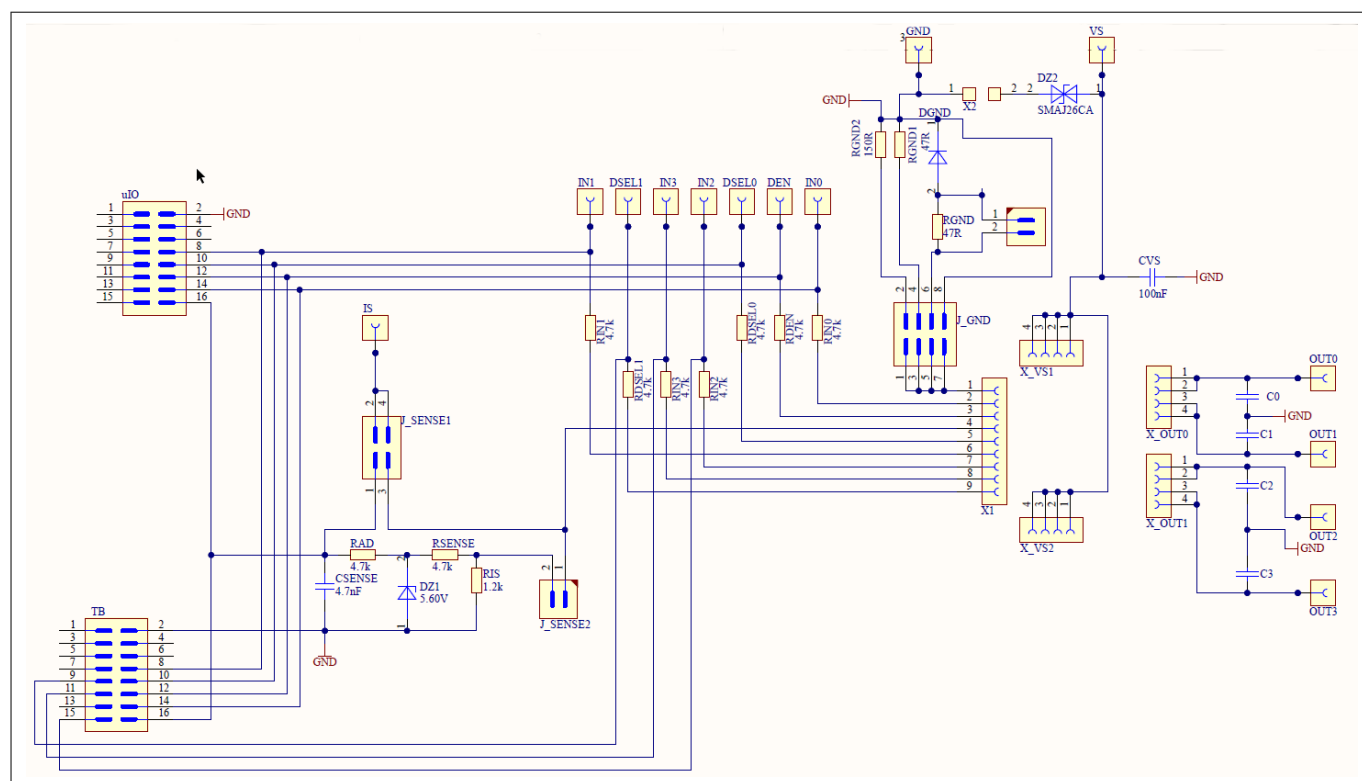


**Figure 10** Motherboard V3 GND path layout

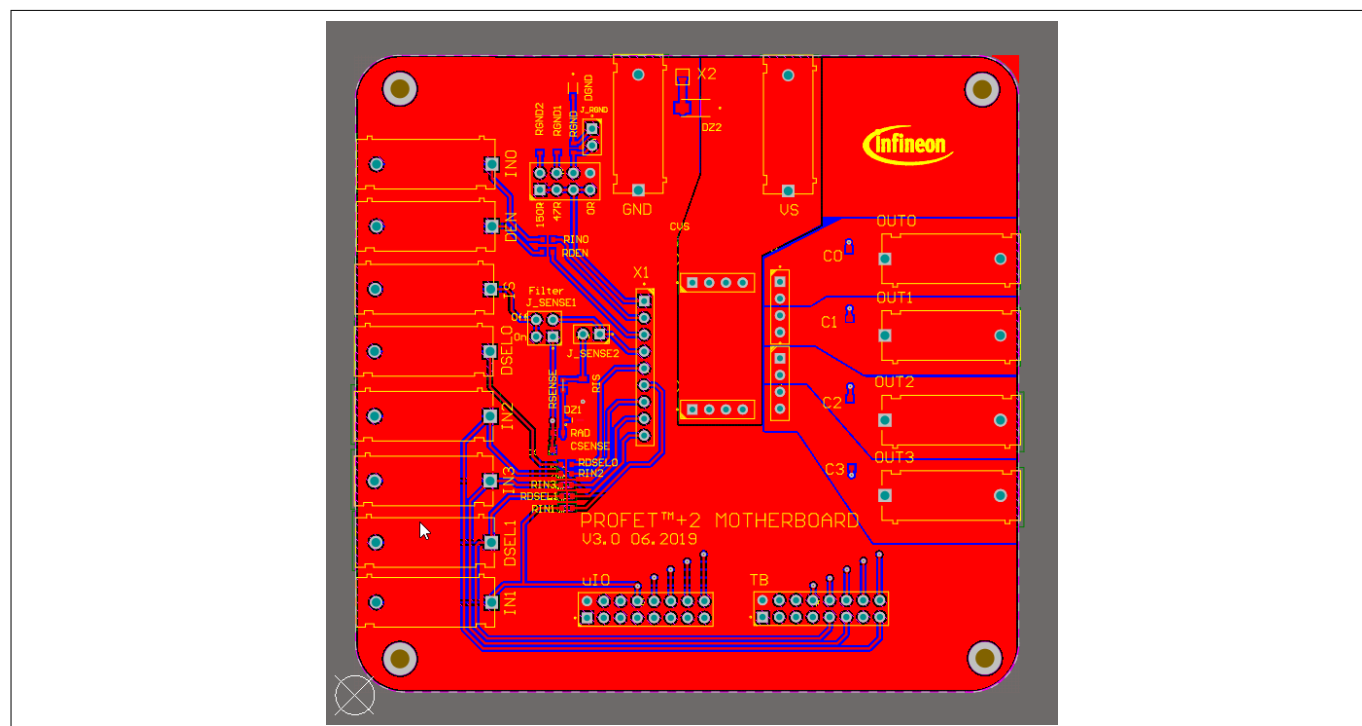
**Table 9** Motherboard V3 J\_GND jumper positions

#	Description
1	The DB ground is connected to the MB module ground via a 150 $\Omega$ resistor
2	The DB ground is connected to the MB module ground via a 47 $\Omega$ resistor
3	The DB ground is connected to the MB module ground via a 47 $\Omega$ resistor and a serial diode (BAS21-03W)
4	The DB ground is connected to the MB module ground via a 0 $\Omega$ resistor
3 + 5	The DB ground is connected to the MB module ground via a serial diode (BAS21-03W)

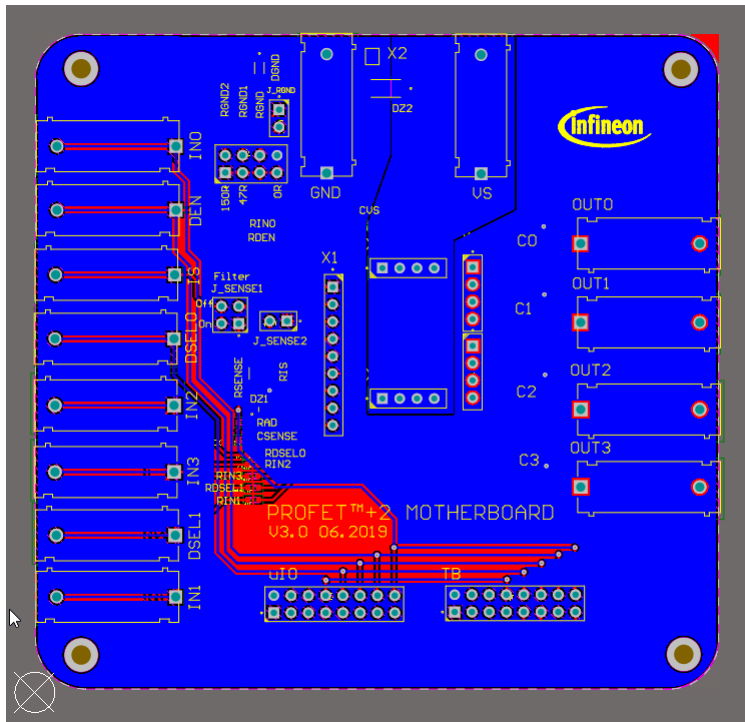
## 2 Motherboards [MB]



**Figure 11**                      **Motherboard V3 schematic**



**Figure 12**                      **Motherboard V3 PCB top view**



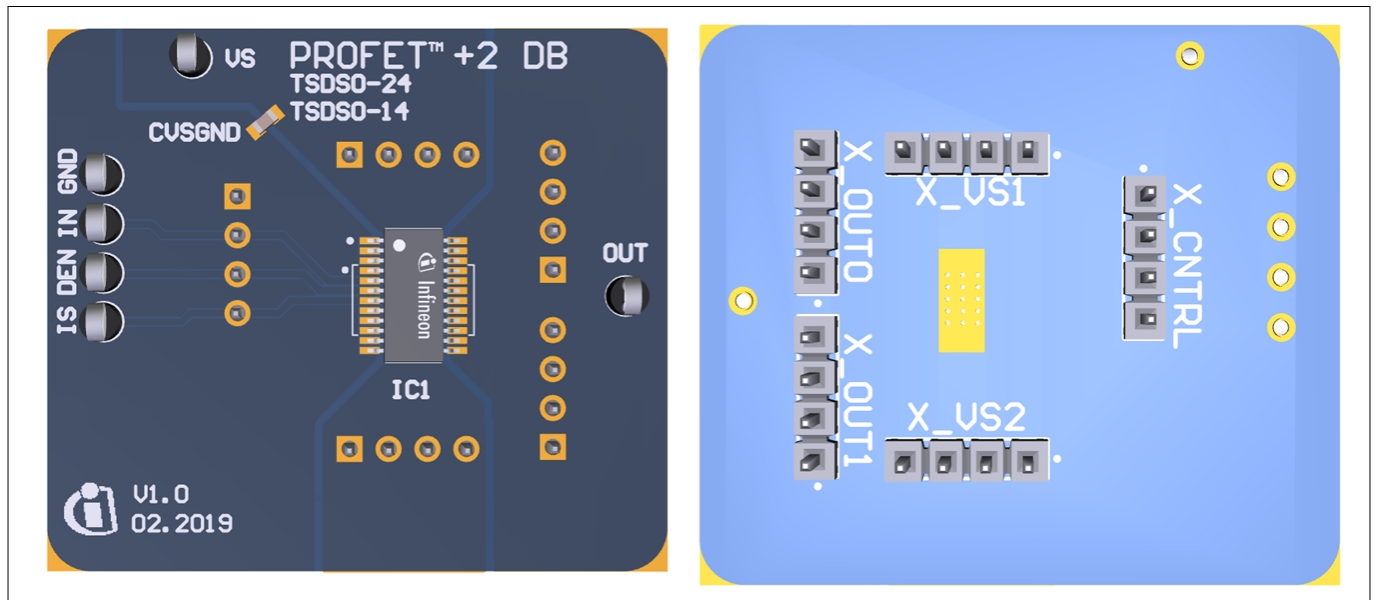
### Figure 13

### 3 Daughterboards [DB]

## 3 Daughterboards [DB]

### 3.1 PROFET™ +2 12V 1-channel daughterboard (14 and 24 pin)

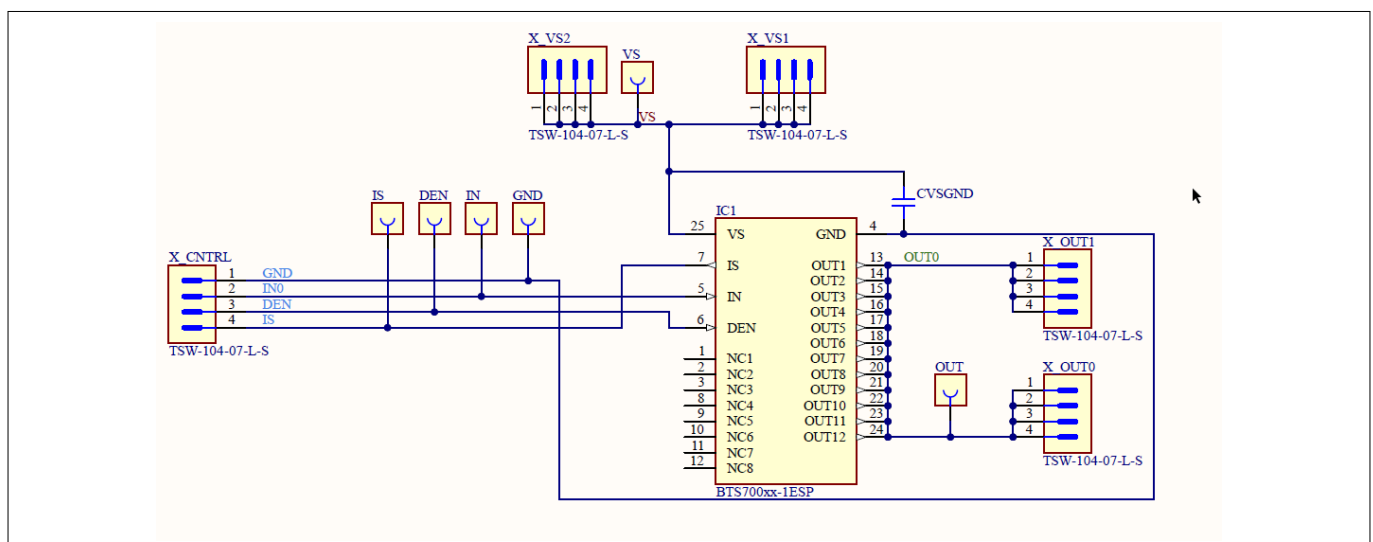
The PROFET™ +2 12V 1-channel daughterboard (14 and 24 pin) includes the device (PROFET™ +2 12V). The DB is plugged onto the MB.



**Figure 14** PROFET™ +2 12V 1-channel daughterboard (14 and 24 pin) top and bottom view

Using the PROFET™ +2 12V 1-channel daughterboard (14 and 24 pin), please note, that the board is designed for 1-channel devices and can only be used in combination with 1-channel devices. Additionally the following points need to be considered:

- The correct position of a 14-pin device is indicated by the white lines on both sides of the footprint and the dot marking the GND pin position
- The correct position of the 24-pin device is marked by the dot in the upper left corner of the footprint for the GND pin
- Between the VS pin and the GND pin of the DB is an additional 100 nF capacitor



**Figure 15** PROFET™ +2 12V 1-channel daughterboard (14 and 24 pin) schematic

### 3 Daughterboards [DB]

#### 3.2 PROFET™ +2 12V 2-channel daughterboard

Figure 16 below shows the PROFET™ +2 12V DB in top and bottom view. As can be seen, depending on the required product (1-channel or 2-channel), this device is located on the DB. The DB is plugged onto the MB.

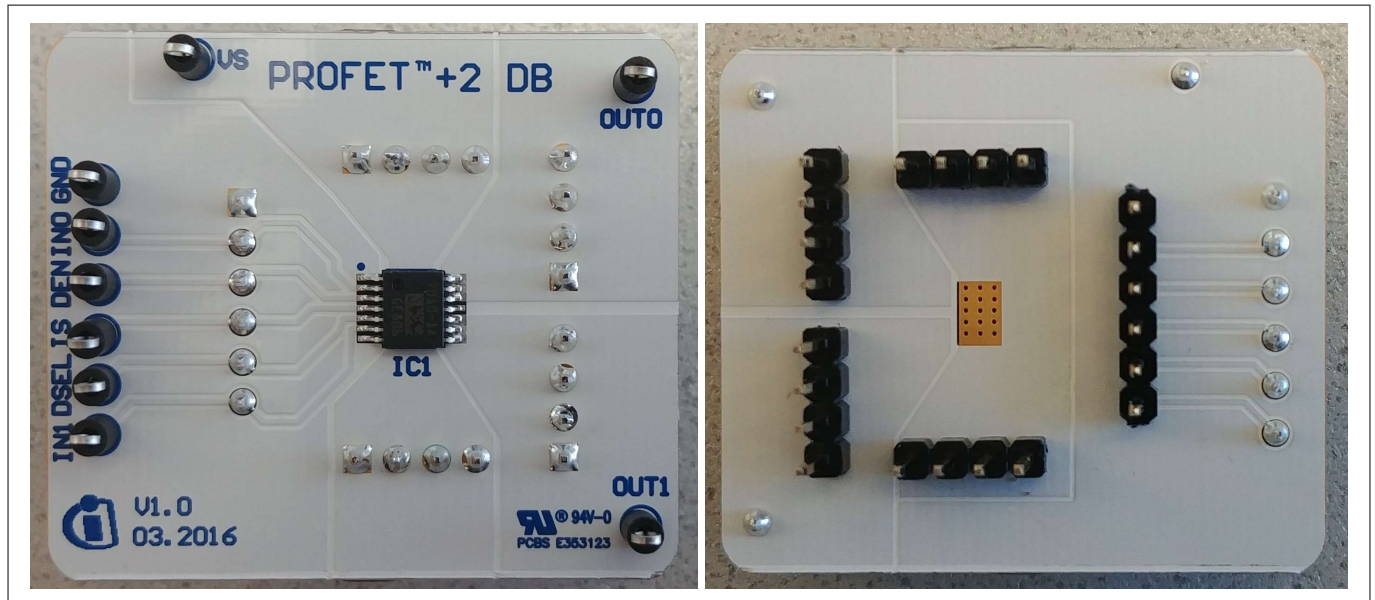


Figure 16 PROFET™ +2 12V 2-channel daughterboard top and bottom view

#### 3.3 PROFET™ +2 12V 4-channel daughterboard

Figure 17 below shows the PROFET™ +2 12V DB in top view. As can be seen, depending on the required product (4-channel), this device is located on the DB. The DB is plugged onto the MB.

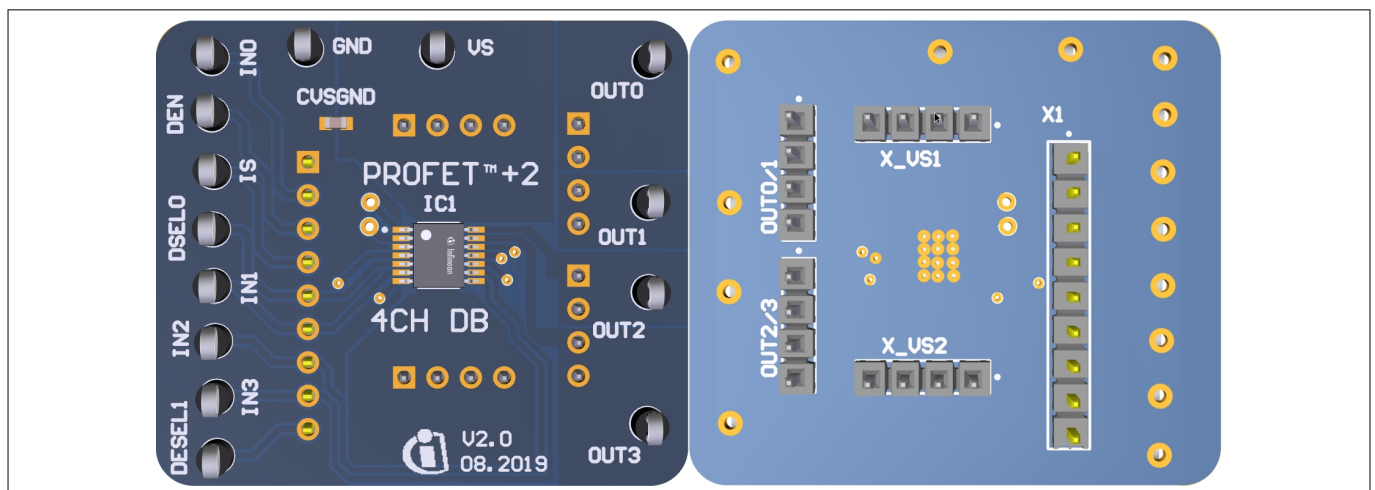
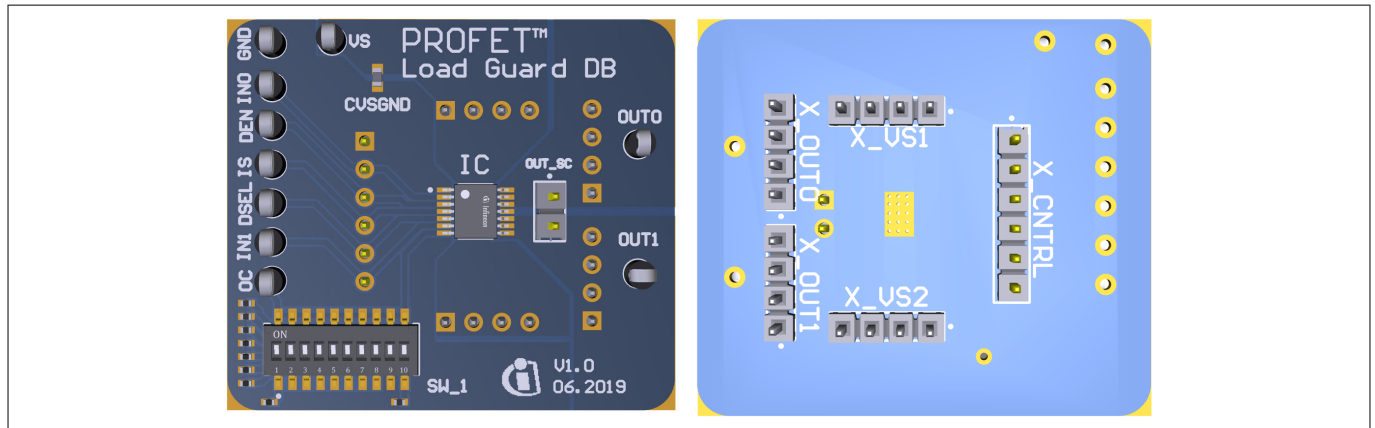


Figure 17 PROFET™ +2 12V 4-channel daughterboard top and bottom view

### 3 Daughterboards [DB]

#### 3.4 PROFET™ Load Guard 12V daughterboard

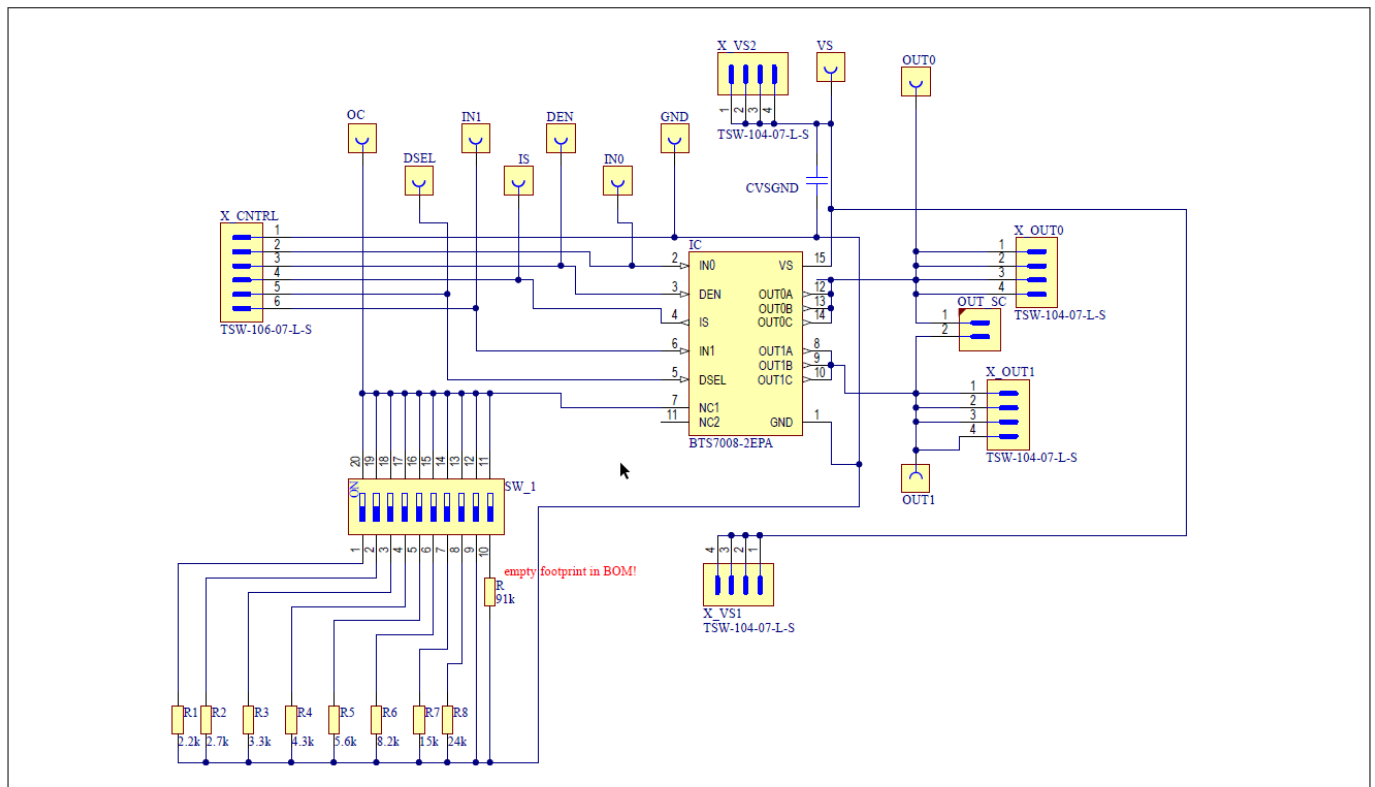
The PROFET™ Load Guard 12V daughterboard includes the device (PROFET™ Load Guard 12V). The DB is plugged onto the MB.



**Figure 18** PROFET™ Load Guard 12V daughterboard top and bottom view

**Note:** Due to redesigns, daughterboards with different dip switch resistor values have been produced. It is recommended to check the resistor values.

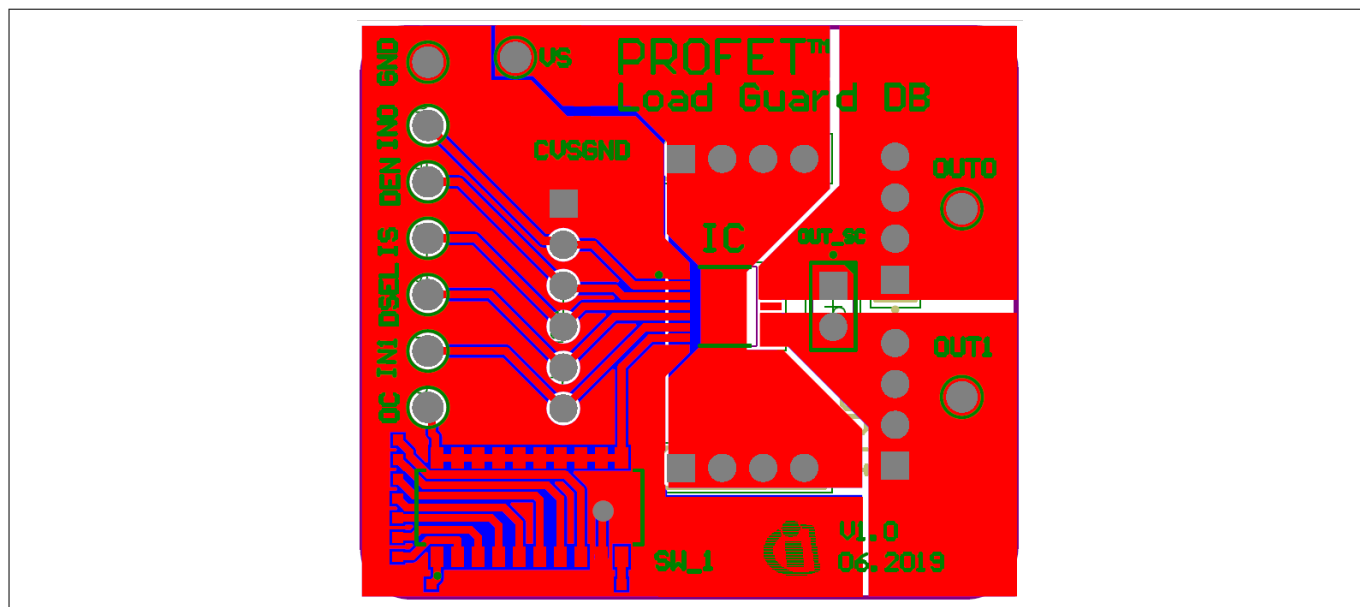
Using the PROFET™ Load Guard 12V daughterboard, please be aware, that the board is designed for and can only be used in combination with 1-channel and 2-channel devices. Additionally pin 7 is connected to the dip switch with different values. See [Figure 19](#).



**Figure 19** PROFET™ Load Guard 12V schematic



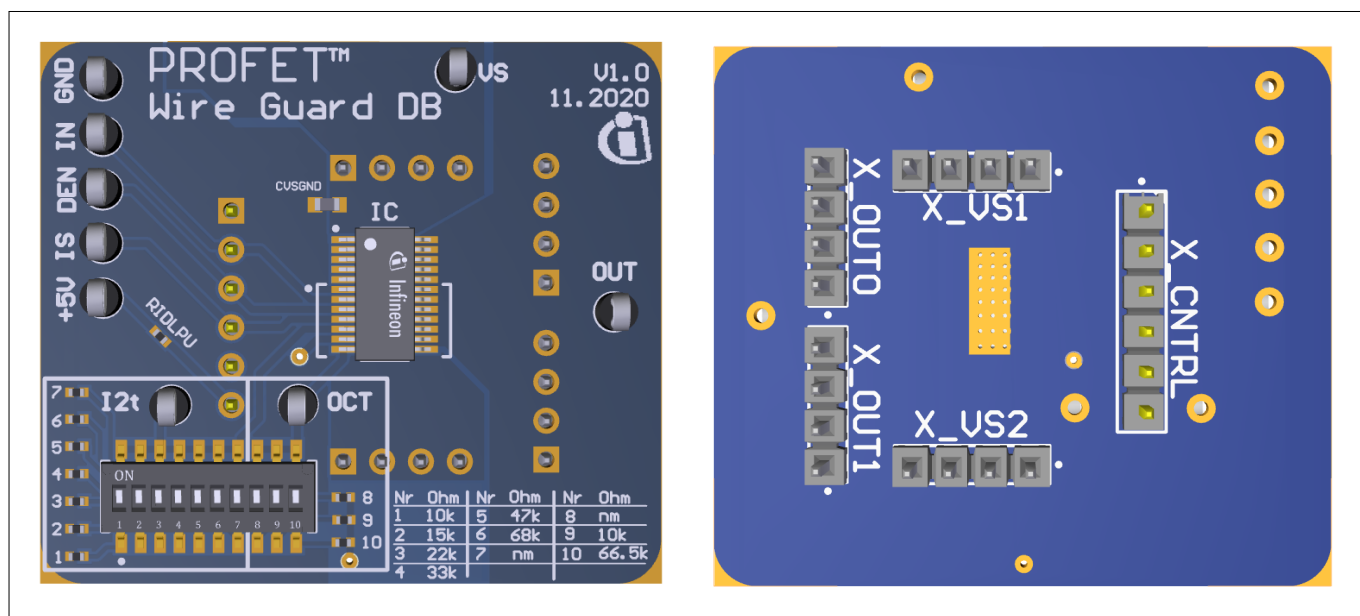
### 3 Daughterboards [DB]



**Figure 20** PROFET™ Load Guard 12V PCB design

### 3.5 PROFET™ Wire Guard 12V daughterboard

PROFET™ Wire Guard 12V daughterboard includes the device (PROFET™ Wire Guard 12V). The DB is plugged onto the MB. [Figure 21](#) below shows the PROFET™ Wire Guard 12V daughterboard in top and bottom view, which can be used with the PROFET™ +2 12V motherboard V2 and with the PROFET™ +2 12V motherboard V3.



**Figure 21** PROFET™ Wire Guard 12V daughterboard top and bottom view

**Note:** It is recommended to check the resistor values.

Using the PROFET™ Wire Guard 12V daughterboard, please note, that the board is designed for 1-channel devices and can only be used in combination with 1-channel devices. In addition the following points need to be considered:

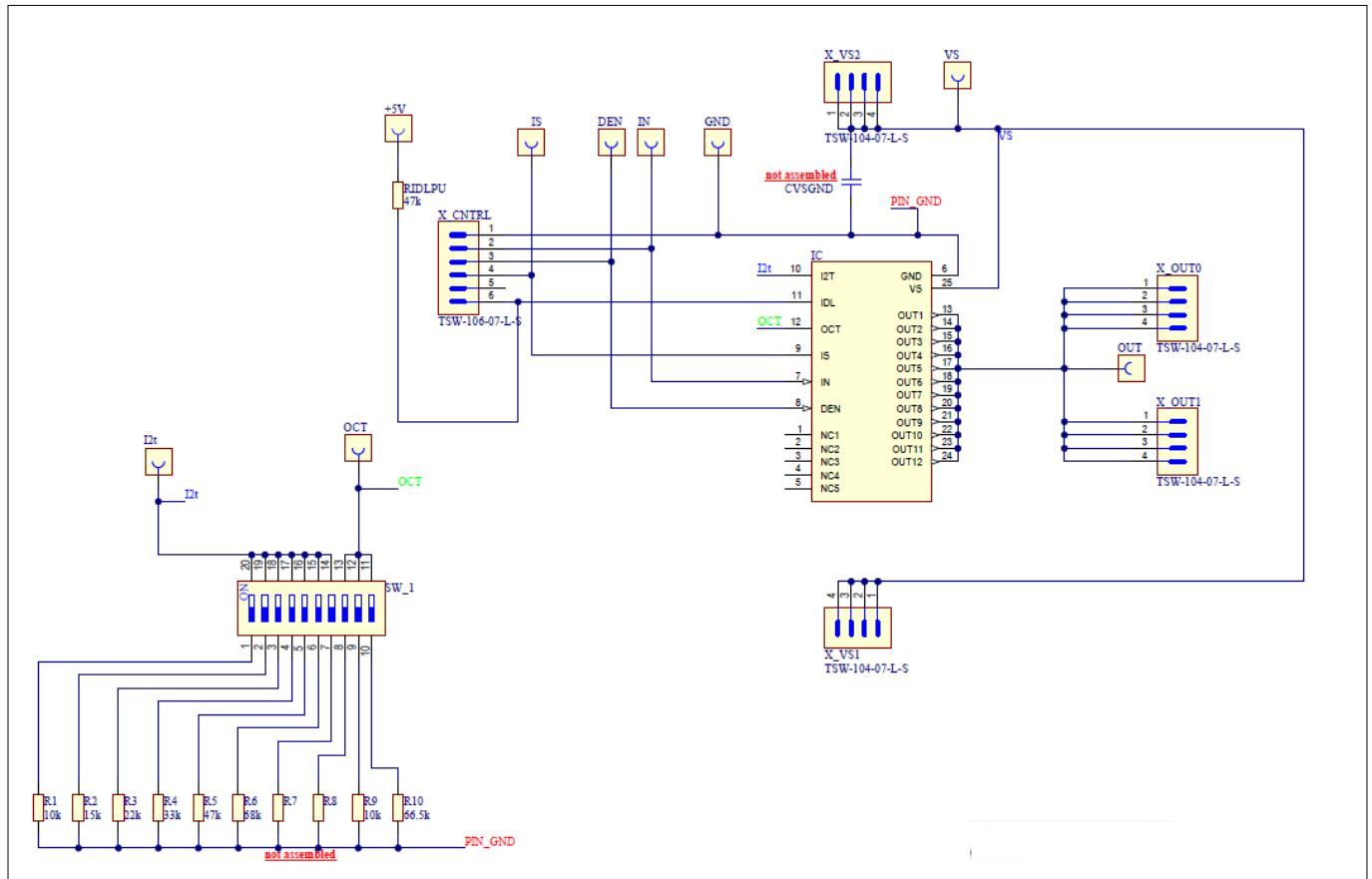
- Pin 10 (I2t) and pin 12 (OCT) is connected to the dip switch with different resistor values (see [Figure 22](#))



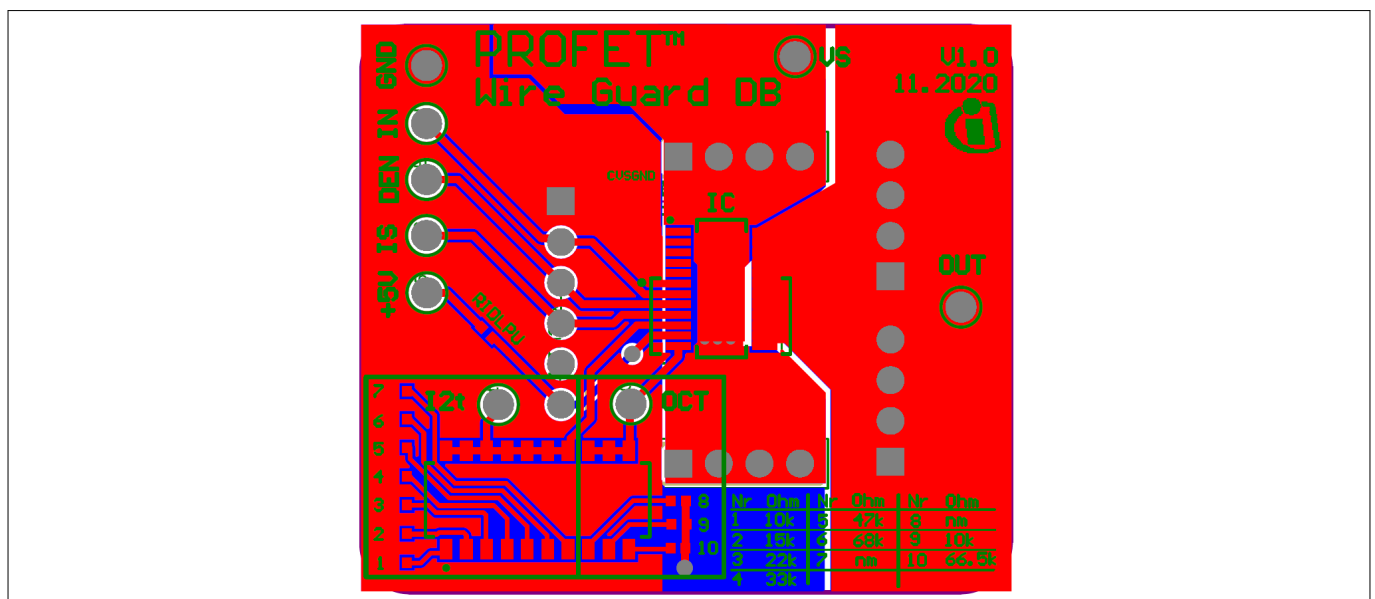
### 3 Daughterboards [DB]

- Resistor R7 and R8 on the dip switch is an empty footprint
- Between the VS pin and the GND pin of the DB is an additional footprint for an 100 nF capacitor (for more information see [Figure 22](#))

**Attention:** Please note that all switches are on by default.



**Figure 22** PROFET™ Wire Guard 12V daughterboard



**Figure 23** PROFET™ Wire Guard 12V PCB design

## 4 Evaluation boards [EB]

### 4 Evaluation boards [EB]

**Note:** Depending on the evaluation board, compatibility with the Infineon Developer Center and Config Wizard can not be guaranteed. Please check the availability of software for each board.

#### 4.1 PROFET™ +2 12V Arduino H-bridge evaluation board

This chapter provides a quick introduction to the Arduino H-bridge evaluation board, which is designed to handle the H-bridge configuration of all 2-channel devices in the PROFET™ +2 12V family. The intention of the evaluation board is to give customers a quick start for lab evaluation of the performance of this board.

**Note:** Its recommended to use the Arduino H-bridge evaluation board with 5 V compatible Arduino microcontroller boards.

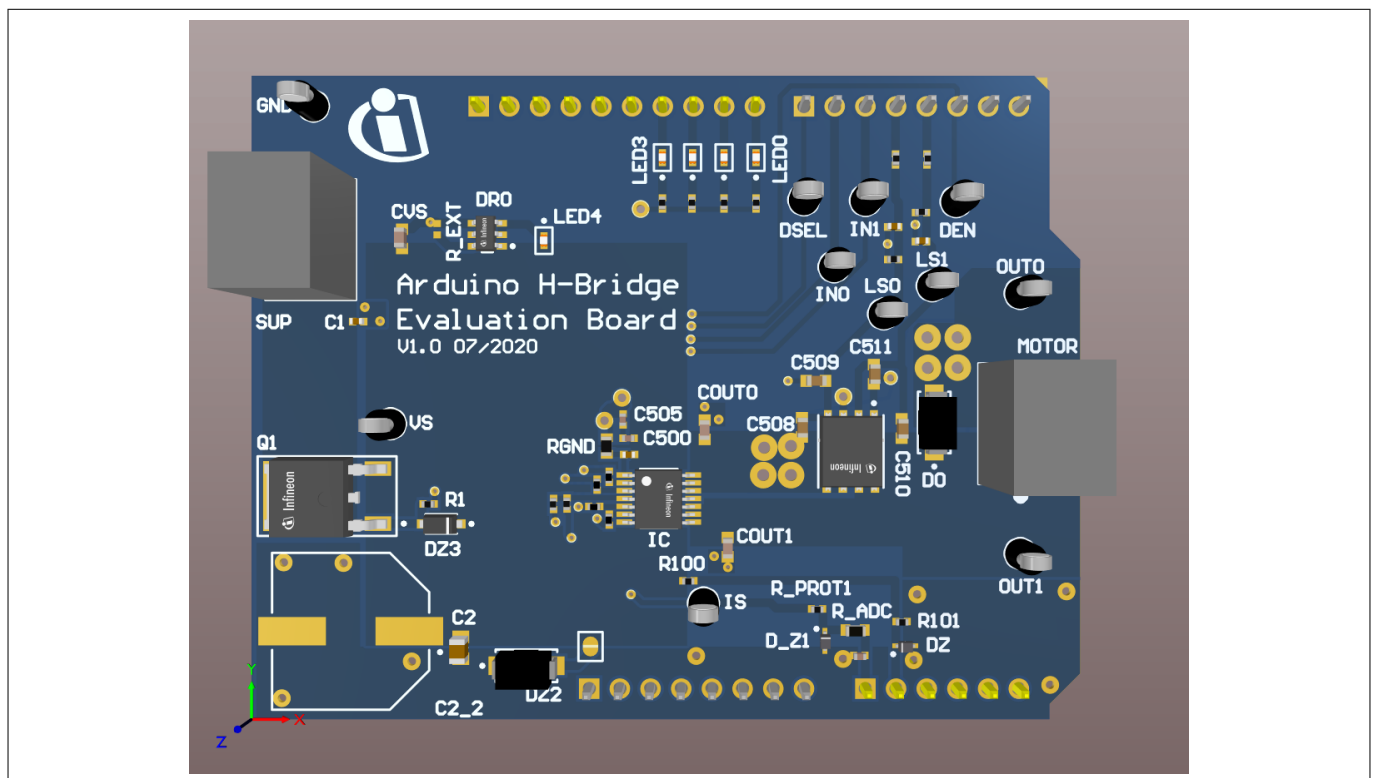


Figure 24 Arduino H-bridge evaluation board

#### Default assembly

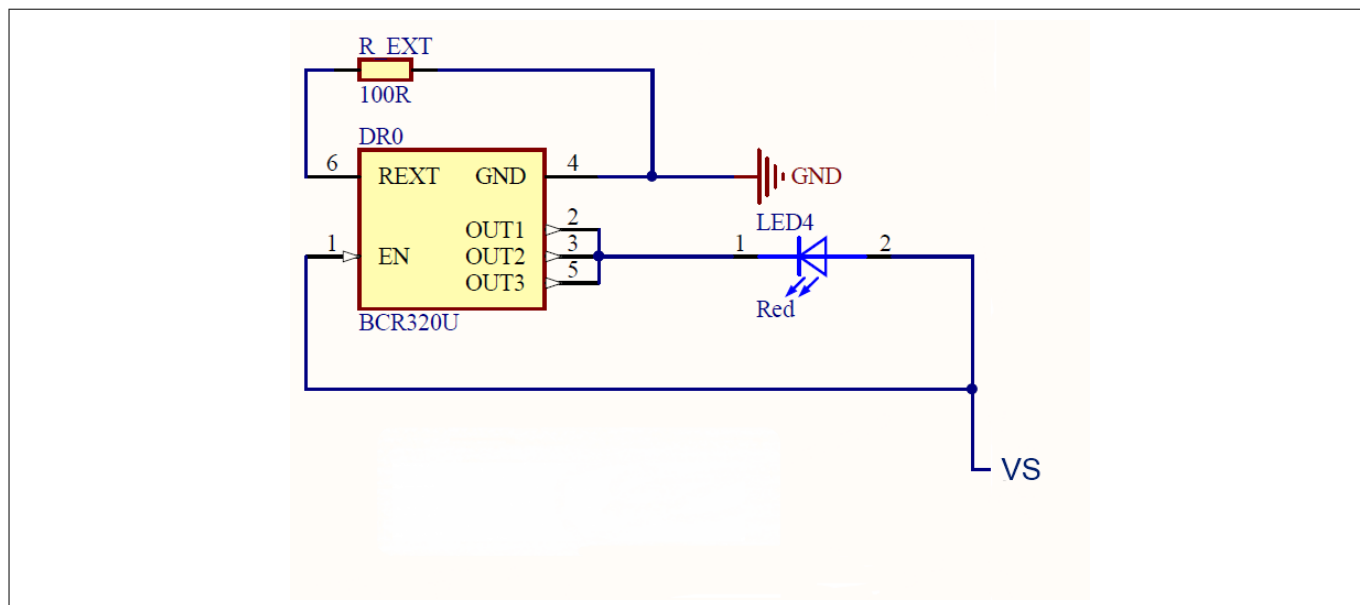
As seen in Figure 24 and Figure 27 some parts are not mounted on default assembling. The following parts are not mounted:

- C2\_2 with 470  $\mu$ F
- R\_EXT of the BCR320U circuit

#### BCR320U circuit

This circuit includes a red LED, an LED driver (BCR320U) and a footprint for the R\_EXT resistor. The BCR320U circuit is placed in parallel to the IC. The LED indicates if the PROFET™ +2 12V device is supplied. With the additional external resistor the current flow can be adjusted. The higher the current flow, the brighter the LED4 shines. For more information see the [datasheet](#) of the BCR320U LED driver.

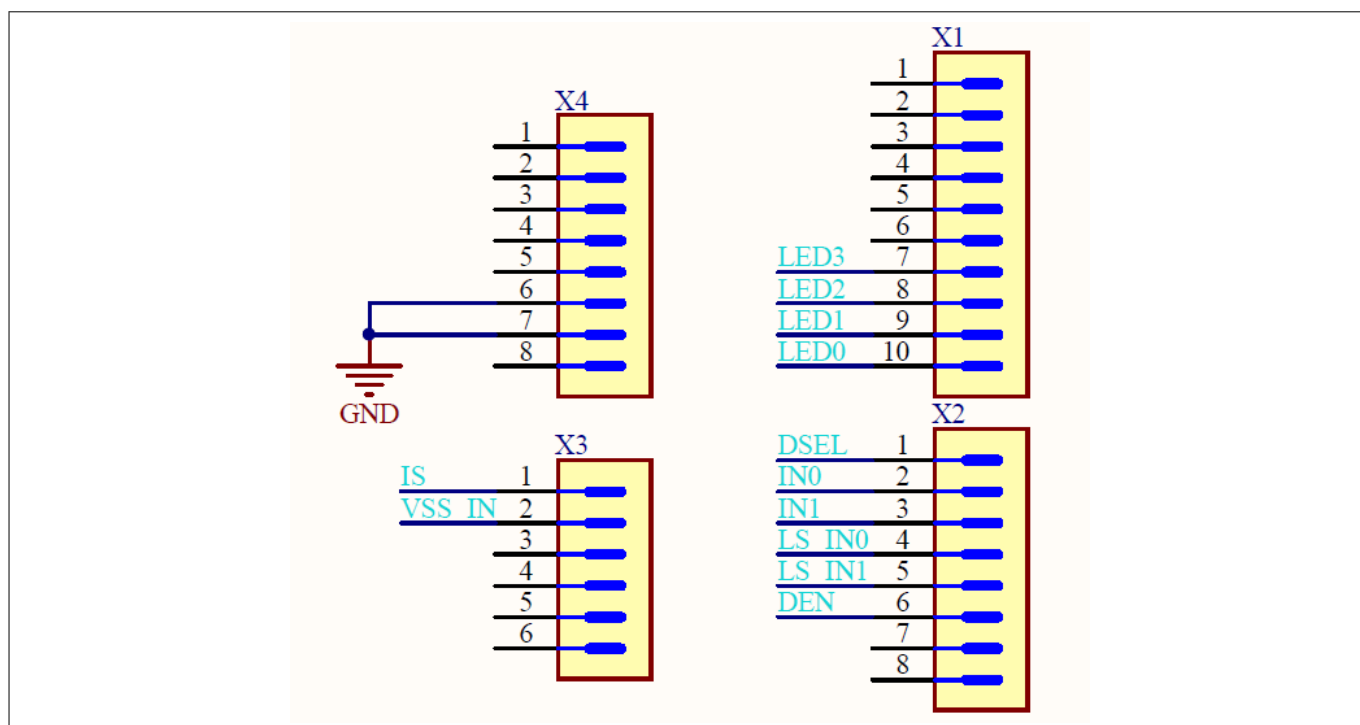
#### 4 Evaluation boards [EB]



**Figure 25** BCR320U circuit

#### Arduino pinout

The Arduino H-bridge evaluation board can be controlled via Arduino board. See [Figure 26](#) and [Figure 27](#) of the pinout for the Arduino board. The Arduino pin connections are written in cyan font color.



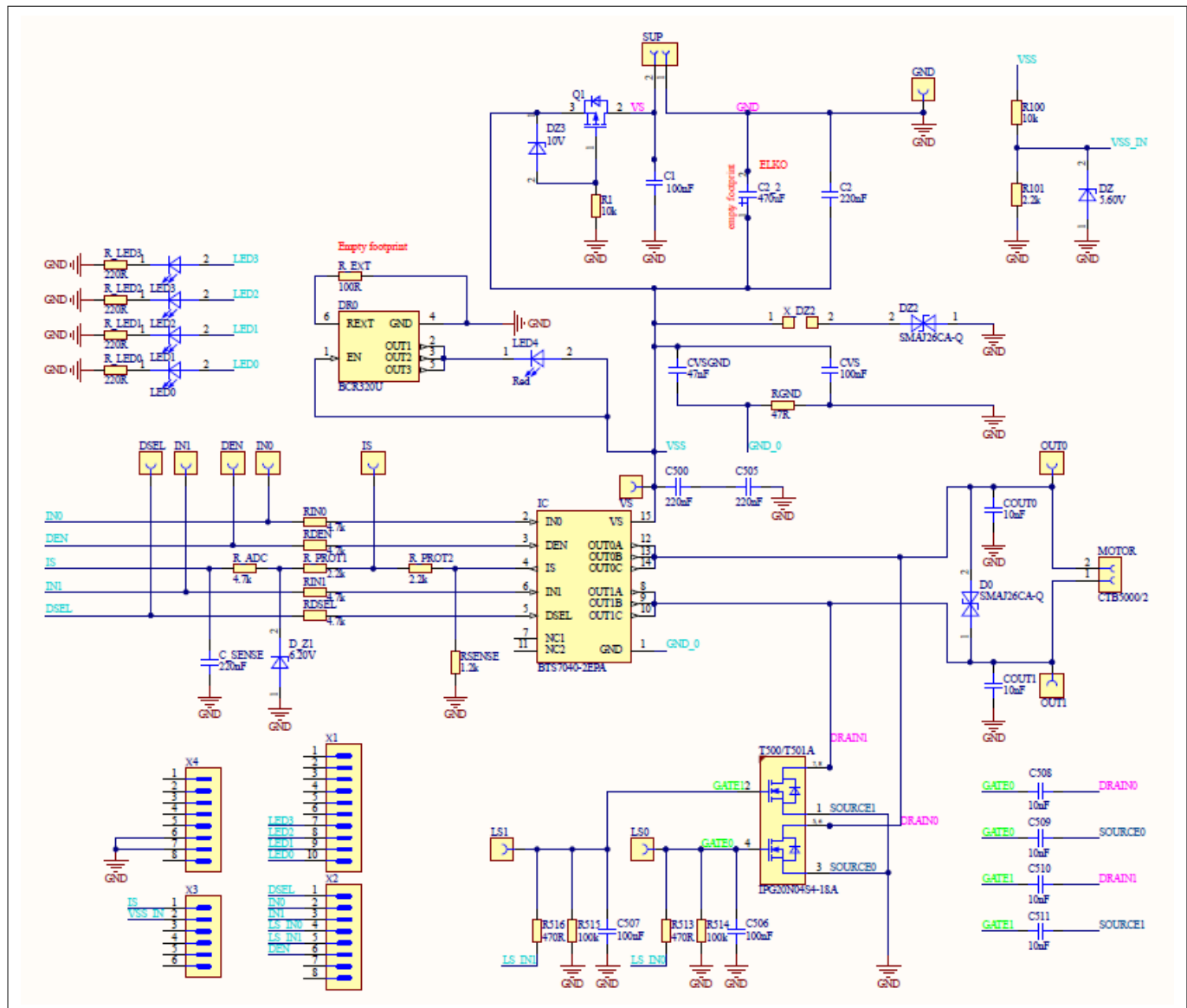
**Figure 26** Arduino H-bridge pinout

#### 4 Evaluation boards [EB]

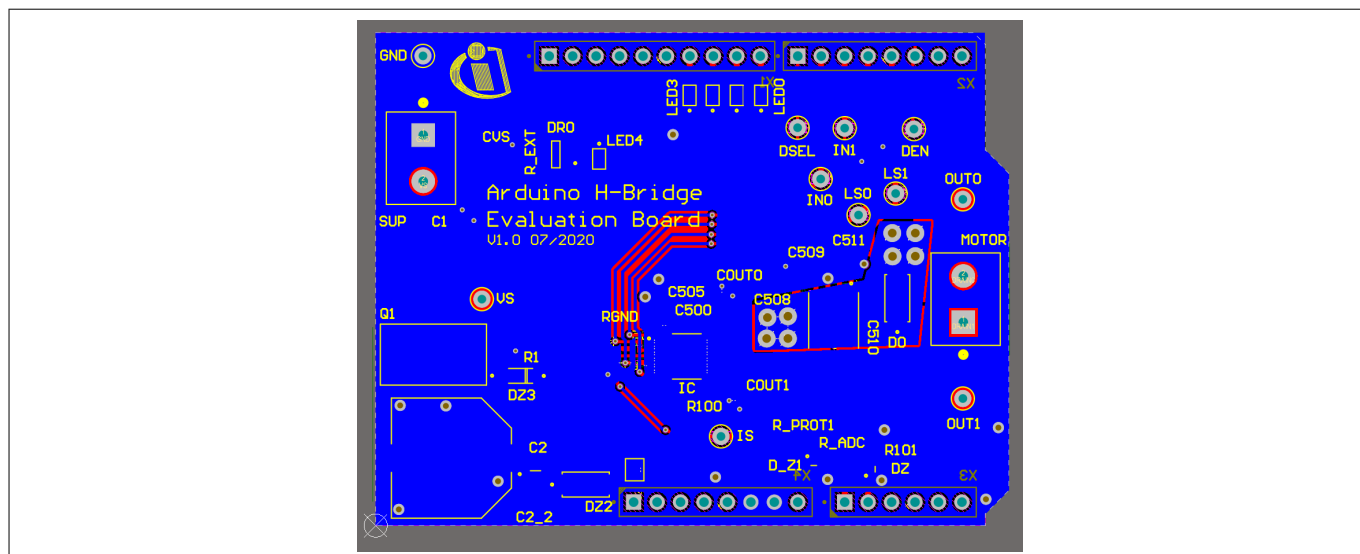
**Table 10**      **Board connectors and functions**

Connector	Function
VS	Supply pin connects the positive supply voltage to this pin
GND	Ground pin connects the supply ground to this pin
IN0	Input signal of channel 0 of IC turns the device on/off and resets the fault if triggered 3.3 V or 5 V logical input
IN1	Input signal of channel 1 of IC turns the device on/off and resets the fault if triggered 3.3 V or 5 V logical input
DEN	Sense enable signal of IC measurements at the IS pin are now possible and in addition it resets the counter if a fault is triggered 3.3 V or 5 V logical input
DSEL	Diagnostic select signal selects the channel to be diagnosed 3.3 V or 5 V logical input
IS	Sense output of IC
OUT0	Output 0 of IC connects a grounded load to this pin, such as a power resistor, a bulb or 12 V heating elements
OUT1	Output 1 of IC connects a grounded load to this pin, such as a power resistor, a bulb or 12 V heating elements
LS0	Low side pin 0 enables the low-side 0, input signal of channel 0 of IC T500/T501
LS1	Low side pin 1 enables the low side 1, input signal of channel 1 of IC T500/T501
MOTOR	2 pins for connecting the motor

### 4 Evaluation boards [EB]



## 4 Evaluation boards [EB]



**Figure 29** Arduino H-bridge bottom layout

### Bill of materials

**Table 11** Arduino H-bridge evaluation board BOM

Designator	Comment	Manufacturer	Manufacturer order number
C1, C506, C507	100 nF	TDK Corporation	C1005X7R1H104K050BE
C2	220 nF	MuRata	GRM21BR71H224KA01
C2_2	470 $\mu$ F	Nippon Chemi-Con	EMHS500ARA471MKG5S
C500, C505, C_SENSE	220 nF	TDK Corporation	CGA2B3X7R1E224K050BB
C508, C509, C510, C511	10 nF	AVX	06035F103K4Z2A
COUT0, COUT1	10 nF	AVX	06035C103K4Z2A
CVS	100 nF	AVX	06035C104K4Z2A
CVSGND	47 nF	MuRata	GRM155R61H473KE19
D0, DZ2		Bourns	SMAJ26CA-Q
D_Z1	6.20 V	Vishay	BZX584C6V2-V-G-08
DEN, DSEL, GND, IN0, IN1, IS, LS0, LS1, OUT0, OUT1, VS	–	Vero Technologies	20-2137
DR0	–	Infineon Technologies	BCR320U
DZ	5.60 V	Vishay	BZX584C5V6-V-G
DZ3	10 V	Nexperia	BZT52H-B10,115
IC	–	Infineon Technologies	BTS7040-2EPA
LED0, LED1, LED2, LED3	Yellowish green	ROHM Semiconductors	SML-P12MTT86R
LED4	Red	ROHM Semiconductors	SML-P12UTT86R

(table continues...)

#### 4 Evaluation boards [EB]

**Table 11** (continued) **Arduino H-bridge evaluation board BOM**

Designator	Comment	Manufacturer	Manufacturer order number
MOTOR, SUP	–	Camden Boss	CTB5000/2
Q1	–	Infineon Technologies	IPD90P03P4L-04
R1, R100	10 kΩ	Vishay	CRCW040210K0FK
R101, R_PROT1, R_PROT2	2.2 kΩ	Vishay	CRCW04022K20FK
R513, R516	470 Ω	Vishay	CRCW0402470RFK
R514, R515	100 kΩ	Vishay	CRCW0402100KFK
R_ADC	4.7 kΩ	Yageo	RC0603FR-074K7L
R_EXT			
R_LED0, R_LED1, R_LED2, R_LED3	220 Ω	Vishay	CRCW0402220RFK
RDEN, RDSEL, RIN0, RIN1	4.7 kΩ	Yageo	RC0402FR-074K7L
RGND	47 Ω	Vishay	CRCW060347R0FK
RSENSE	1.2 kΩ	Vishay	CRCW04021K20FK
T500/T501	–	Infineon Technologies	IPG20N04S4-18A
X1	–	Samtec	TSW-110-07-L-S
X2, X4	–	Samtec	TSW-108-23-F-S
X3	–	Samtec	TSW-106-07-L-S
X_DZ2	Solder jumper 2 pins		

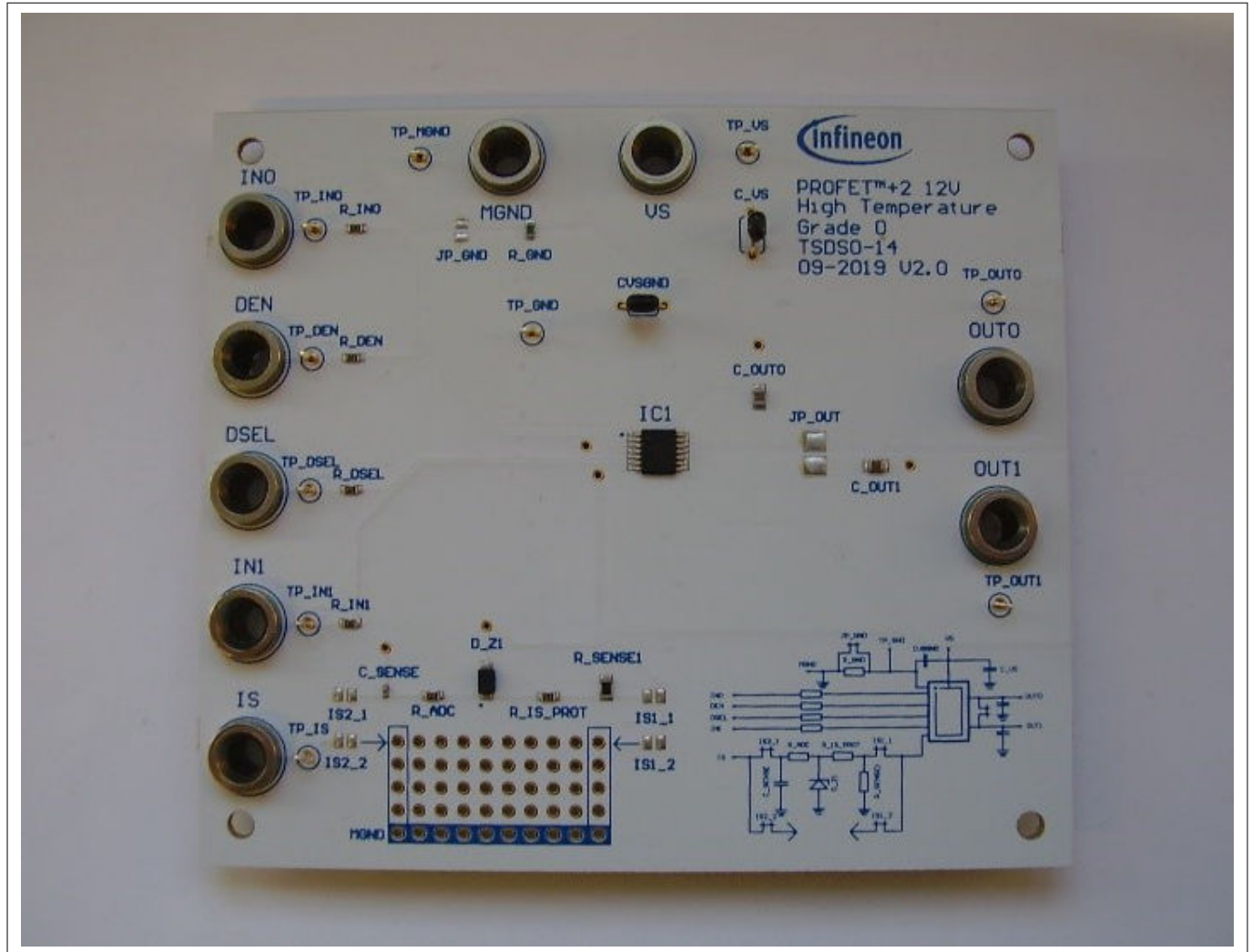
## 4.2 PROFET™ +2 12V Grade0 customer evaluation board

### Scope and purpose

This chapter provides a quick introduction to the Grade0 PROFET™ +2 12V customer evaluation board, which is designed to handle all devices of the PROFET™ +2 12V Grade0 family. The intention of the evaluation board is to provide customers with a quick start for lab evaluation of the performance offered by this product family. PROFET™ +2 12V family consists of six different high-side switches (from 4 mΩ to 80 mΩ) and offers an extended junction temperature range up to 175°C that allows partitioning at high ambient temperature with high ohmic parts.

The PROFET™ +2 12V Grade0 portfolio is designed to provide extended lifetime at elevated temperatures based on the AEC-Q100 Grade0 qualification. The PROFET™ +2 12V Grade0 devices are suitable to drive resistive, inductive and capacitive loads. They are the perfect fit for applications with extended and high temperature mission profiles, such as under the hood, powertrain and transmission applications.

#### 4 Evaluation boards [EB]



**Figure 30** Grade0 customer evaluation board

#### GND resistor selection

The jumper JP\_GND is open by default. If the jumper is open, the integrated 49.9 Ω resistor is selected. If the jumper is closed, no ground resistor is selected within the PCB. It is recommended to use the Grade0 evaluation board with the integrated or an external connected ground resistor.

#### Sense configuration

The Grade0 evaluation board offers two different possibilities for selecting a sense configuration. One is the standard configuration, while the other option is the flexible breadboard.

The standard configuration is identical to the application information given in the datasheet of the Grade0 products. For more information, refer to the datasheets of the device. This sense configuration has to be used by setting the jumpers IS2\_1 and IS2\_2.

The voltage at IS can be measured with a voltmeter. If IN=DEN="high" the load current can be calculated with this formula:

$$I_{LOAD} = \frac{V_{IS} \times k_{ILIS}}{1.2 \text{ k}\Omega} \quad (1)$$



#### 4 Evaluation boards [EB]

The second configuration is a 10 x 5 hole breadboard with a connection to module ground at the blue marked holes in the bottom row. There it is possible to design a custom sense configuration with through-hole devices. To use this sense configuration set the jumpers IS1\_1 and IS1\_2.

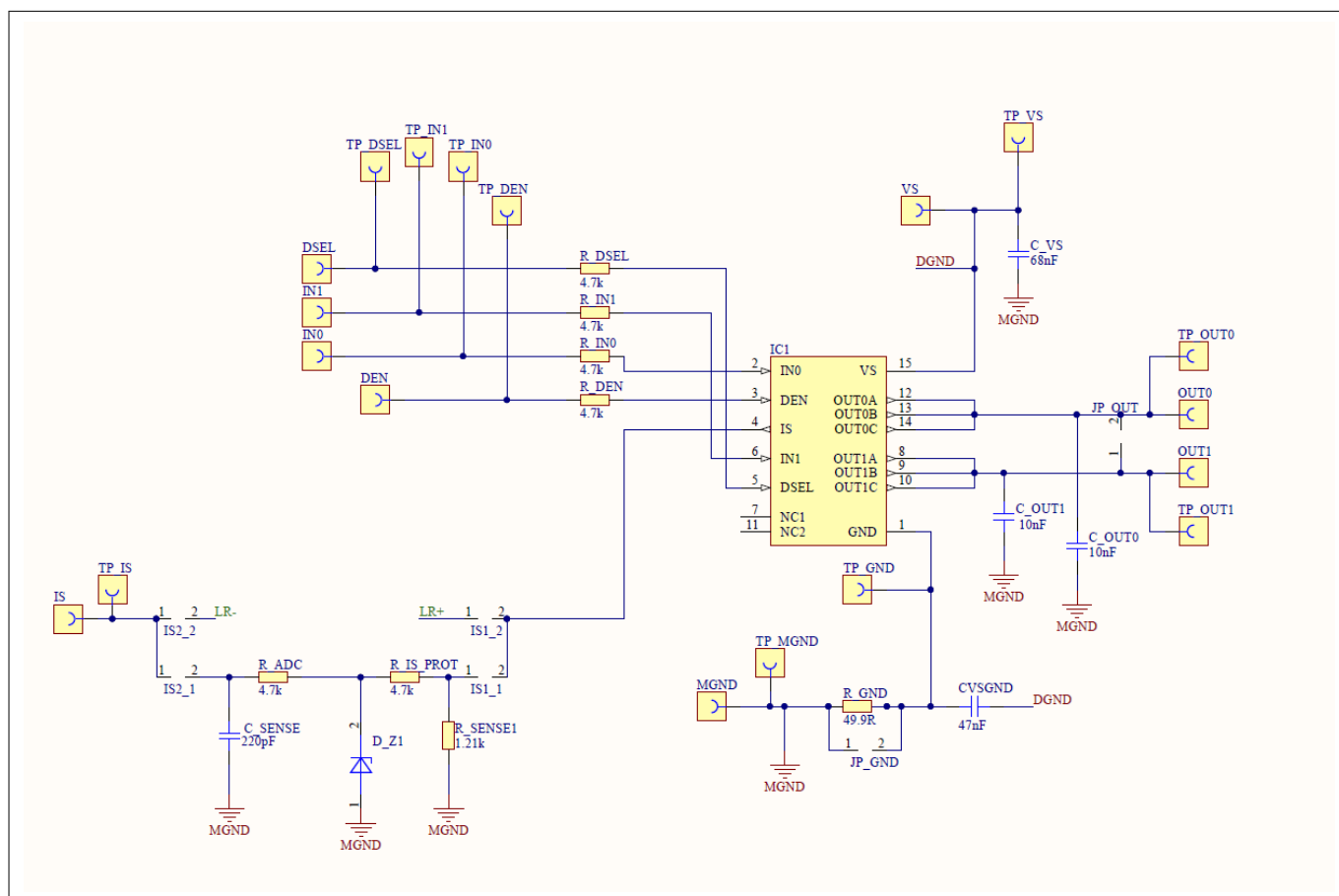
**Table 12 Board connectors and functions**

Connector	Function
VS	Supply pin connects the positive supply voltage to this pin (4.1 V to 28 V, typical 12 V DC)
MGND	Ground pin connects the supply ground to this pin connection for the module X_GND to the device GND
IN0	Input signal of channel 0 of IC turns the device ON/OFF and resets the fault if triggered 3.3 V or 5 V logical input
IN1	Input signal of channel 1 of IC turns the device ON/OFF and resets the fault if triggered 3.3 V or 5 V logical input
DEN	Sense enable signal of IC turns measurements signaled at the IS pin ON/OFF and resets the fault if triggered 3.3 V or 5 V logical input
DSEL	Diagnostic select signal selects the channel to be diagnosed 3.3 V or 5V logical input
IS	Sense output of IC
OUT0	Output 0 of IC connects a grounded load to this pin, such as a bulb, a power resistor or 12 V heating elements
OUT1	Output 1 of IC connects a grounded load to this pin, such as a bulb, a power resistor or 12 V heating elements
JP_GND	Ground resistor closes the jumper to short-circuit the 47 $\Omega$ default ground resistor
JP_OUT	Output connection closes the jumper to increase the current capability performance in case of a single channel device

#### 4 Evaluation boards [EB]

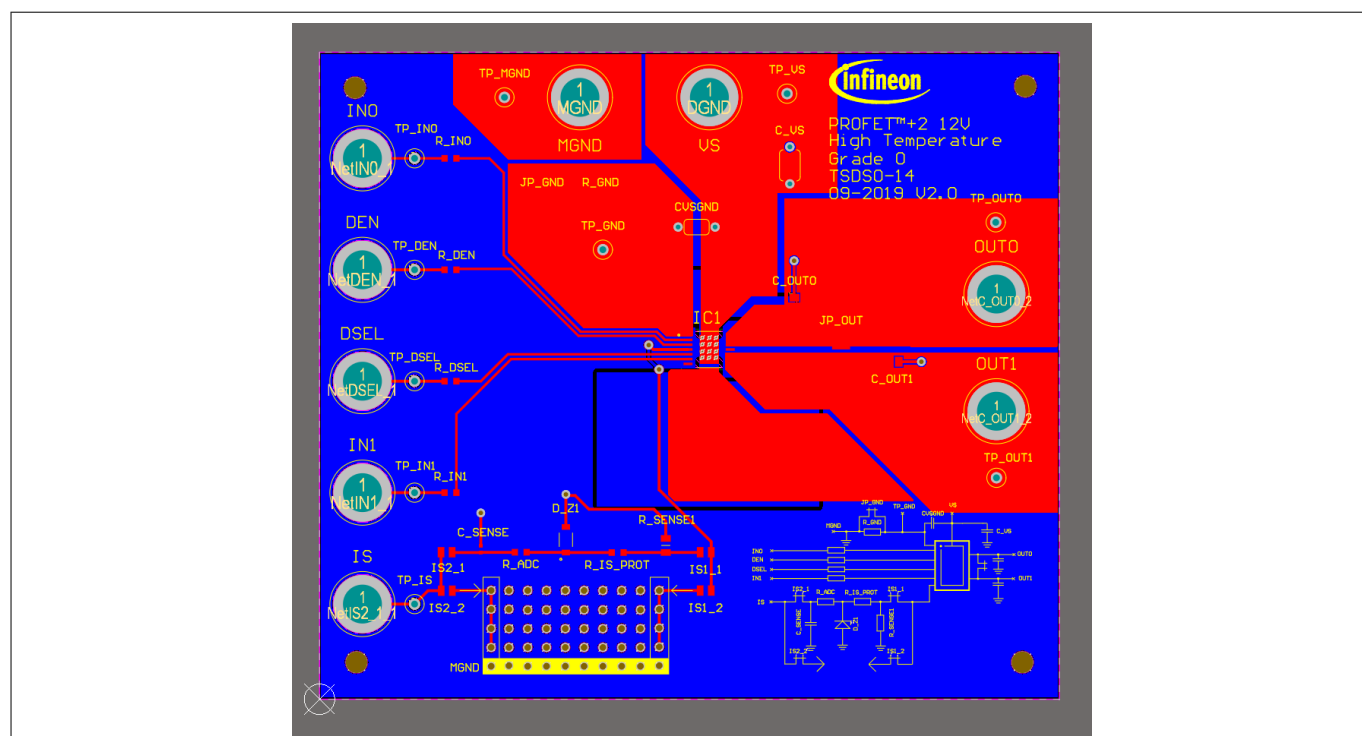
**Table 13** Component values of PROFET™ +2 12V Grade0 customer evaluation board

Designator	Value
C_VSGND	47 nF
R_ADC, R_DEN, R_DSEL, R_IN0, R_IN1, R_IS_PROT	4.7 kΩ
R_SENSE1	1.21 kΩ
C_VS	68 nF
C_SENSE	220 pF
R_GND	49.9 Ω
C_OUT0, C_OUT1	10 nF
D_Z1	VZ = 6.2 V

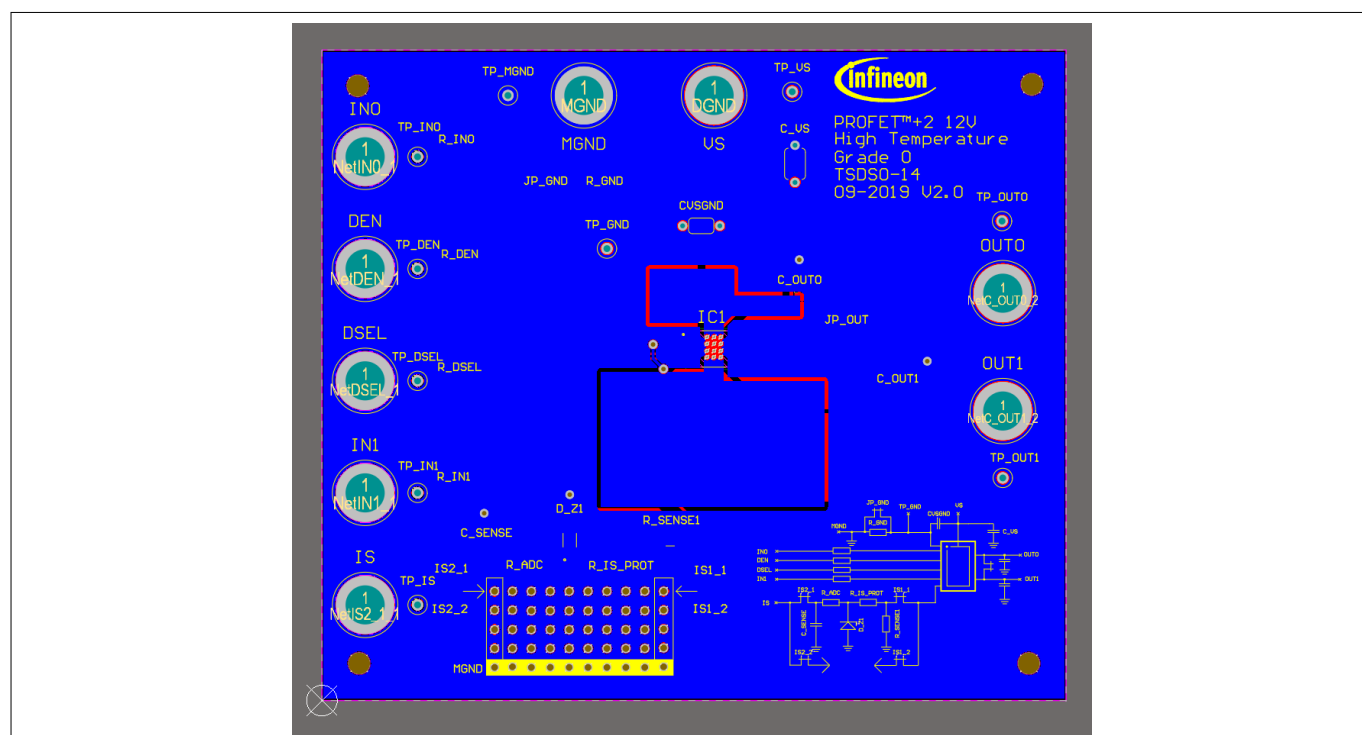


**Figure 31** PROFET™ +2 12V Grade0 customer evaluation board schematic

#### 4 Evaluation boards [EB]



**Figure 32**      **PROFET™ +2 12V Grade0 customer evaluation board top layout**



**Figure 33** PROFET™ +2 12V Grade0 customer evaluation board bottom layout

## 5 Software (optional)

### 5 Software (optional)

The PROFET™ +2 12V MB can either be used directly or with the Configuration Wizard for Smart Power Switches. Accessing the software requires the Infineon Developer Center to be installed. Download the Infineon Developer Center[1].

#### 5.1 Infineon Developer Center and Config Wizard

Access the Infineon Developer Center installation page via the link provided in [Chapter 5](#). Install the Infineon Developer Center by clicking on the highlighted (<version>) **Install via Launcher**. After download, run the file **infineon-developer-center-launcher-setup-win-x64-<version>.exe** and as described in [Chapter 5.1.1](#), proceed by following the instructions of the Installation Wizard.

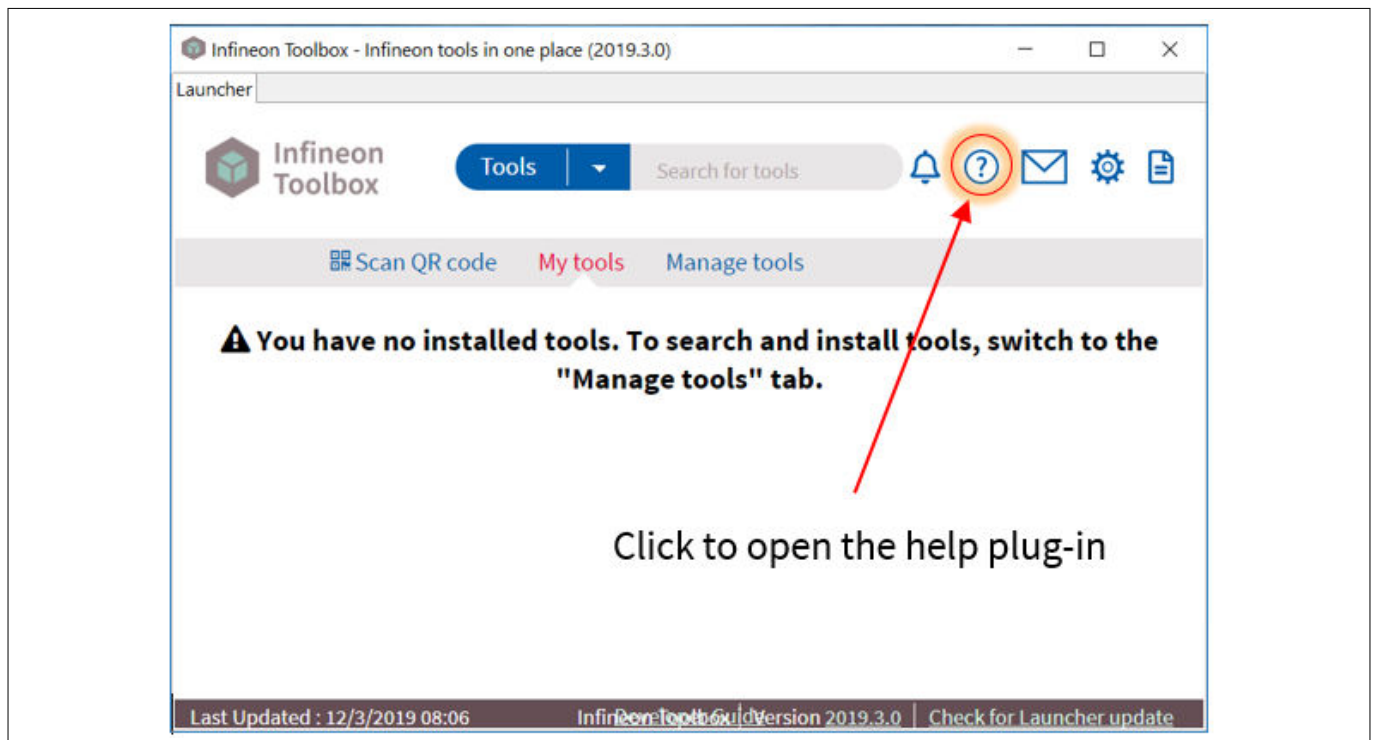
**Note:** The Infineon Developer Center requires installation of **Java 8 32-bit** on the system, otherwise the Infineon Developer Center will not start.

##### 5.1.1 Installation of the Infineon Developer Center

The first step of the installation is to read the license agreement carefully. In the next step, by ticking the check box as recommended, it is possible to allow the installation wizard to create a desktop shortcut. Then, the last step is the installation itself. By clicking **Install**, the Infineon Developer Center will be installed. Finally, click **Finish** to complete the installation process.

To start the Infineon Developer Center directly after the software has been installed, tick the respective check box. After starting it, go to the **Manage tools** tab and install the required tools.

[Figure 34](#) shows the start screen and the location of the Infineon Developer Center **Help** button.



**Figure 34** Startup screen of the Infineon Developer Center

## 5 Software (optional)

### 5.1.2 Installation of the Config Wizard for Smart Power Switches

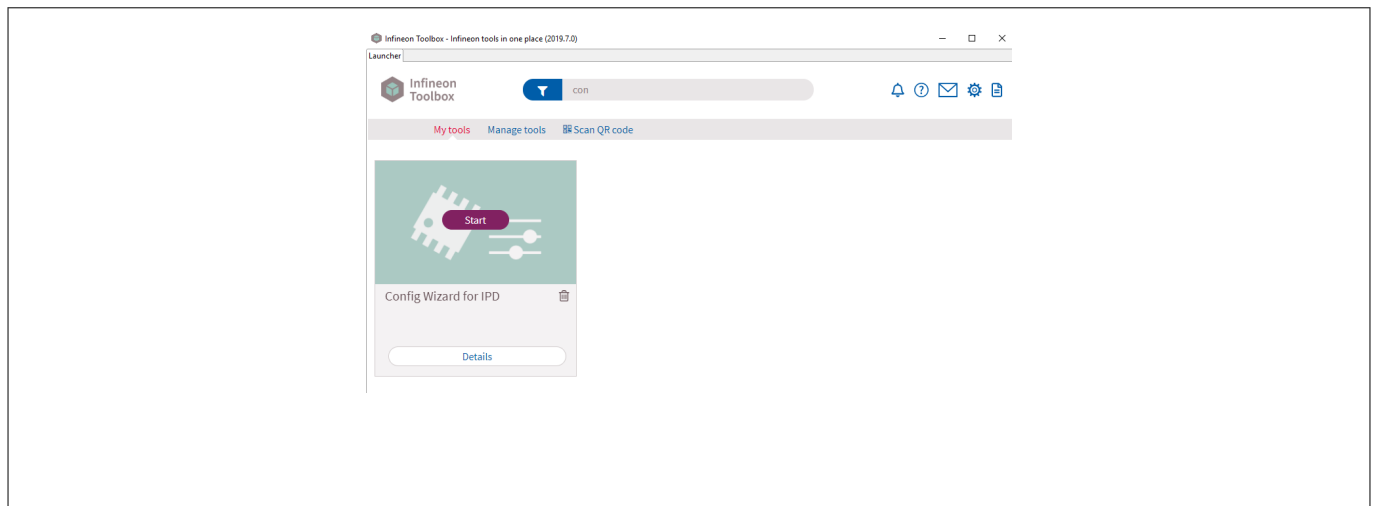
Initially, launch the Infineon Developer Center and go to the **Manage tools** tab. In the search bar, type **Config Wizard for Smart Power Switches** to find the application. [Figure 35](#) shows the requested file. To proceed with the installation, click **Install**.



**Figure 35** Infineon Developer Center - Config Wizard for Smart Power Switches

Click **Install** and accept the license agreement after reading it carefully. A restart of the Infineon Developer Center after the installation process has finished, is required.

[Figure 36](#) shows the **My tools** tab in the Infineon Developer Center. Here, users can find the Config Wizard after restarting. To open it, place the cursor on the Config Wizard icon and click **Start**.



**Figure 36** Infineon Developer Center - start the Config Wizard for Smart Power Switches in My tools

## 5.2 GUI description

The Infineon Config Wizard is designed to support an easy configuration of Infineon devices. configure Infineon devices easily. The graphical user interfaces (GUI) are product specific and not intended for detailed evaluation (use).

### 5.2.1 $\mu$ IO-Stick

The Infineon  $\mu$ IO-Stick is the required tool to connect the Config Wizard to a device. [Figure 37](#) shows the  $\mu$ IO-Stick which is delivered with a 16-pin ribbon cable that enables to connect the  $\mu$ IO-Stick to the MB.

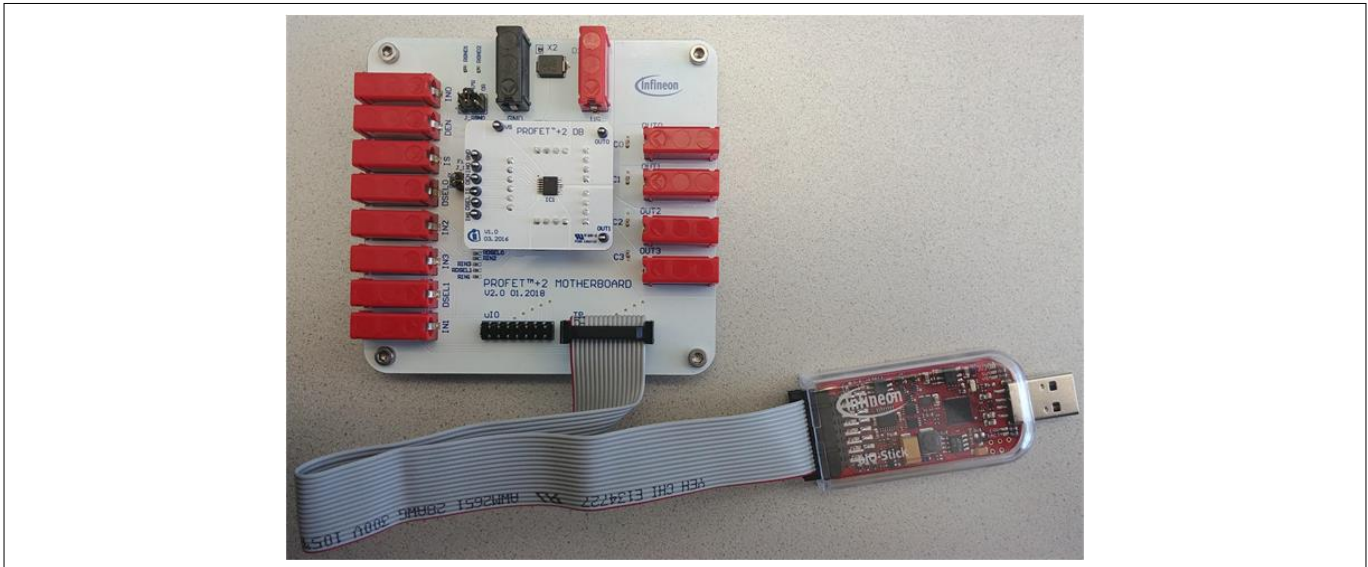
### 5 Software (optional)



**Figure 37** Infineon µIO-Stick with ribbon cable

To connect the MB with the µIO-Stick please refer to µIO connector uIO and µIO connector TB.

[Figure 38](#) below illustrates the µIO-Stick connected to the PROFET™ +2 12V MB.



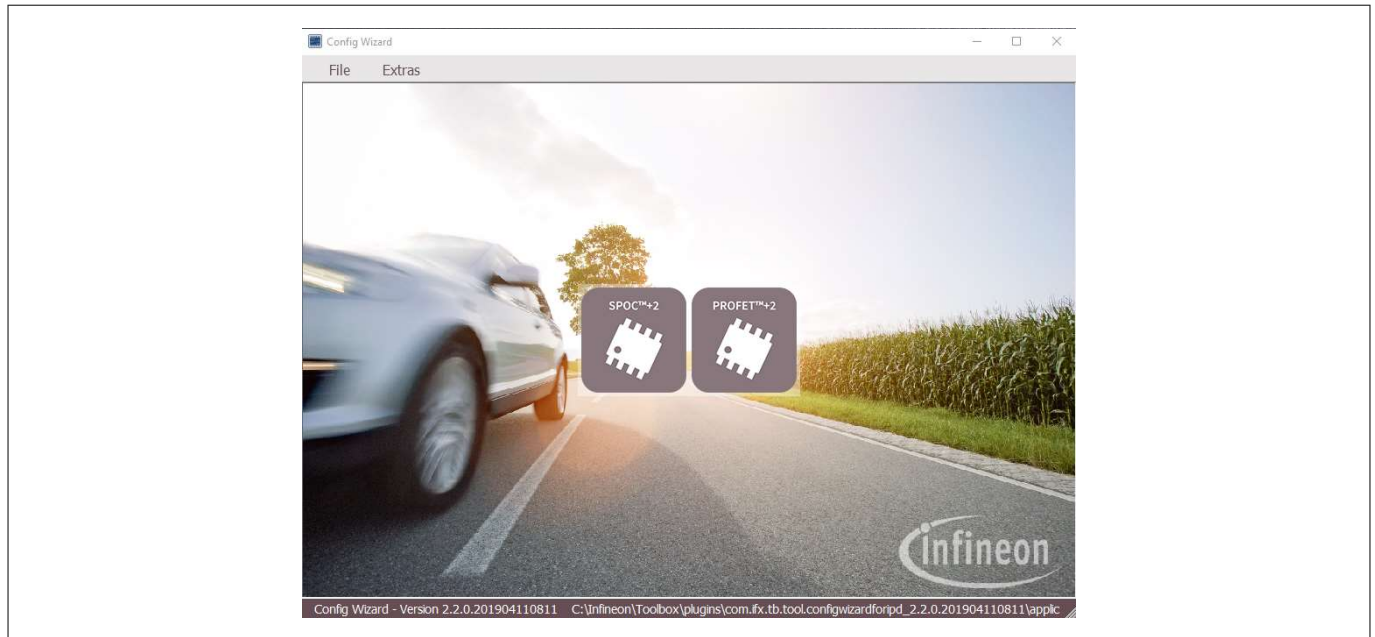
**Figure 38** Infineon µIO-Stick connected to the PROFET™ +2 12V MB

### 5.2.2 Start screen

[Figure 39](#) shows the start screen of the Config Wizard for Smart Power Switches . It provides tile-like buttons named according to the product families.



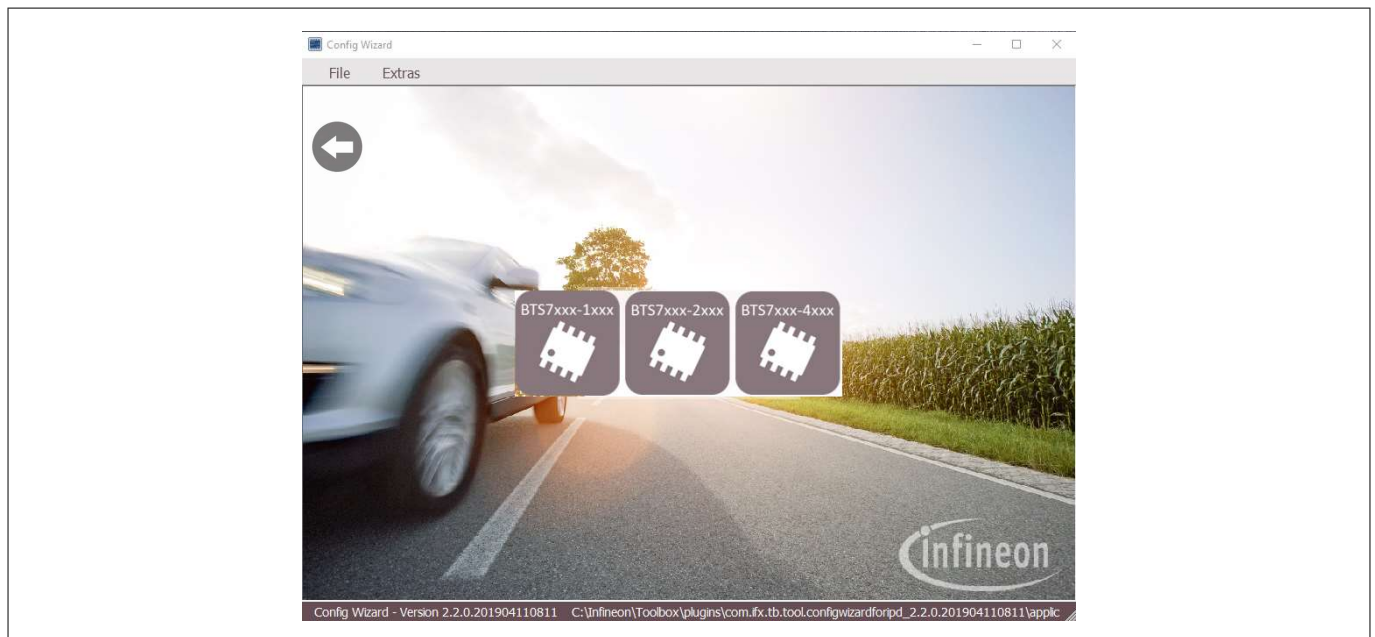
### 5 Software (optional)



**Figure 39** Configuration Wizard for Smart Power Switches start screen

**Note:** The number of tiles shown to users can vary depending on product extensions such as for example new product families or types.

Clicking on the tile with the product family of choice leads to a rearrangement of the GUI, allowing users to select the required type of product. Figure 40 shows the type selection screen for the different product types (1-channel, 2-channel, 4-channel) of the PROFET™ +2 12V family. In the upper left corner a back button is available that enables going one step backwards.



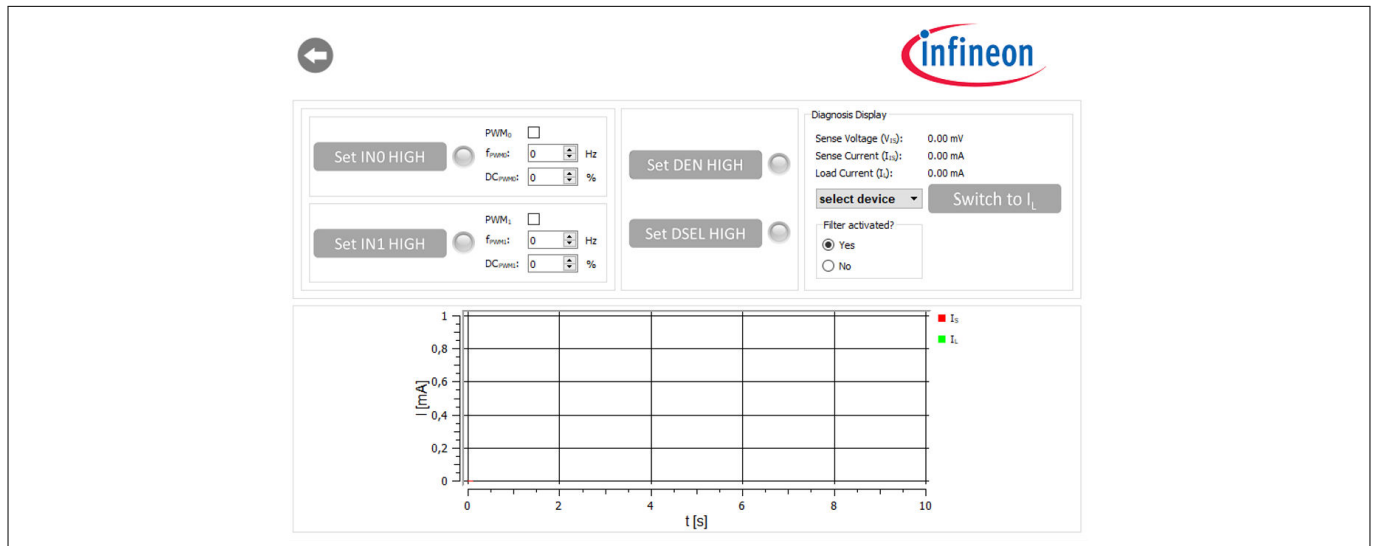
**Figure 40** Configuration Wizard for Smart Power Switches type-selection screen of PROFET™ +2 12V

Clicking on the tile with the product type of choice leads again to a rearrangement of the GUI (see Chapter 5.2.3).

## 5 Software (optional)

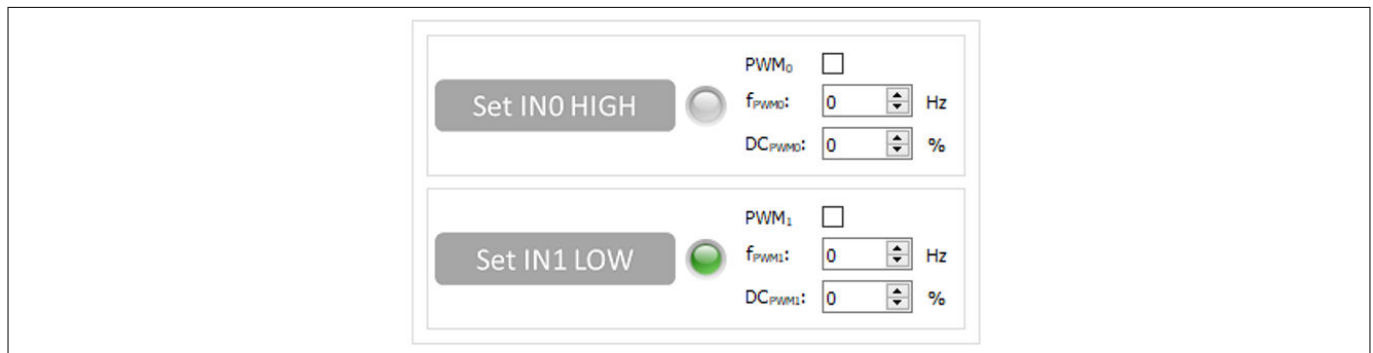
### 5.2.3 PROFET™ +2 12V GUI

The GUI for PROFET™ +2 12V provides buttons to control the GPIOs of the  $\mu$ IO-Stick. The GPIOs are connected to the pins of the device (as INx, DEN and DSELx). As such, the buttons control the logic state applied to the pins of the device. Figure 41 shows the device screen of the PROFET™ +2 12V GUI for a 2-channel device.



**Figure 41** PROFET™ +2 12V device screen (2-channel)

The state of the buttons is visualized by alternating icons and lamp elements. The names of the buttons reflect the actions they perform, such as **Set IN0 HIGH** or once a button has been clicked, **Set IN1 LOW**. In addition, as shown in Figure 42, a lamp element indicates whether a button has been clicked or not. Once the lamp element is green, the corresponding pin is activated.

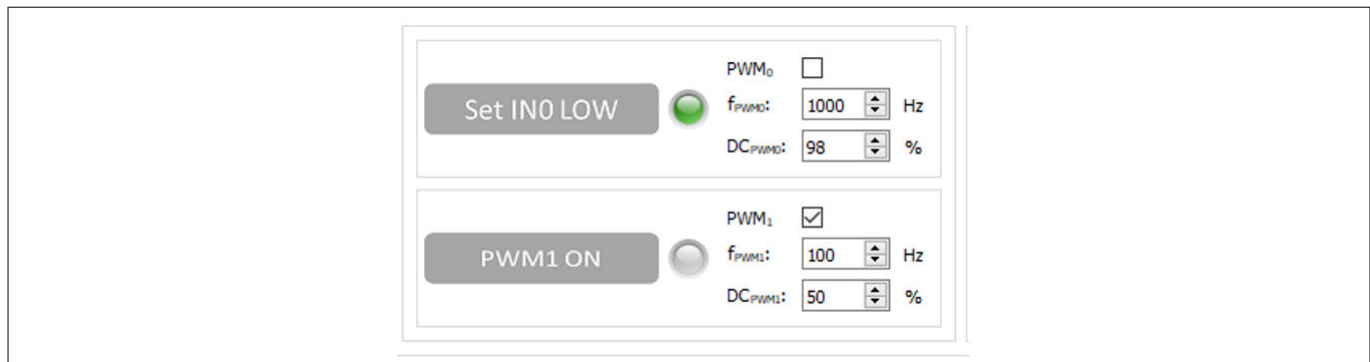


**Figure 42** PROFET™ +2 12V functional view – GPIO controlling toggle-buttons

As seen in Figure 42 and Figure 43, also PWM functionality is given for channels 0 and 1. It can be activated by ticking the PWM checkbox. The button then adapts to **PWM1 ON** and the lamp-element will stay grey. PWM frequency and PWM duty-cycle can be set via the two spinboxes below the checkbox.

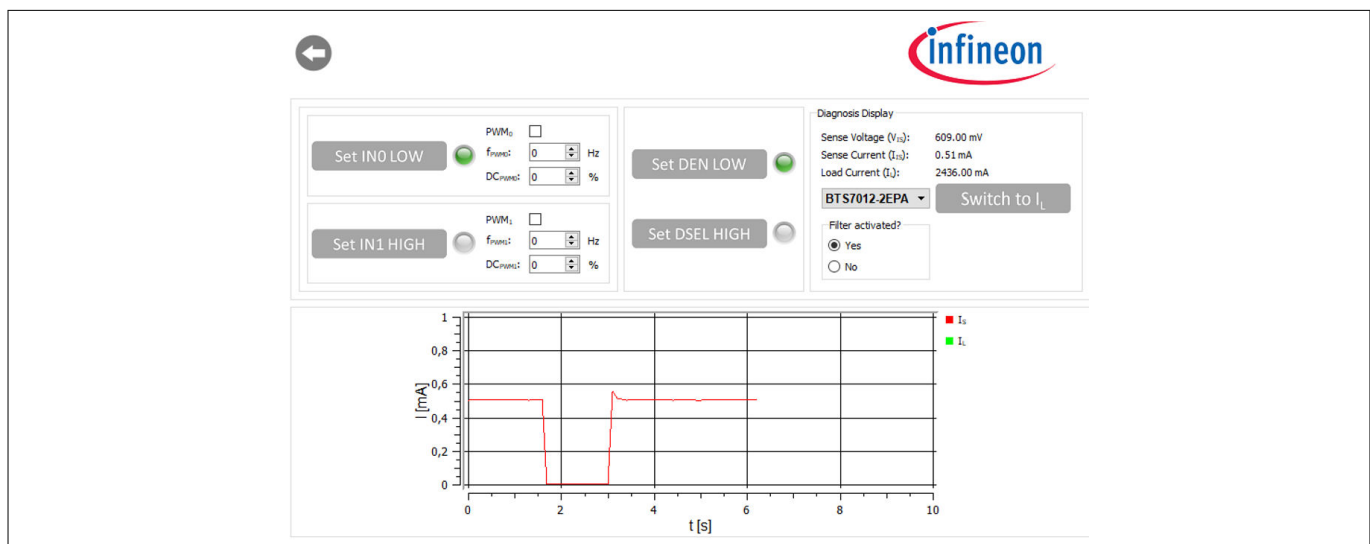


## 5 Software (optional)



**Figure 43** PROFET™ +2 12V functional view: – IN0 as logic input, IN1 as PWM input

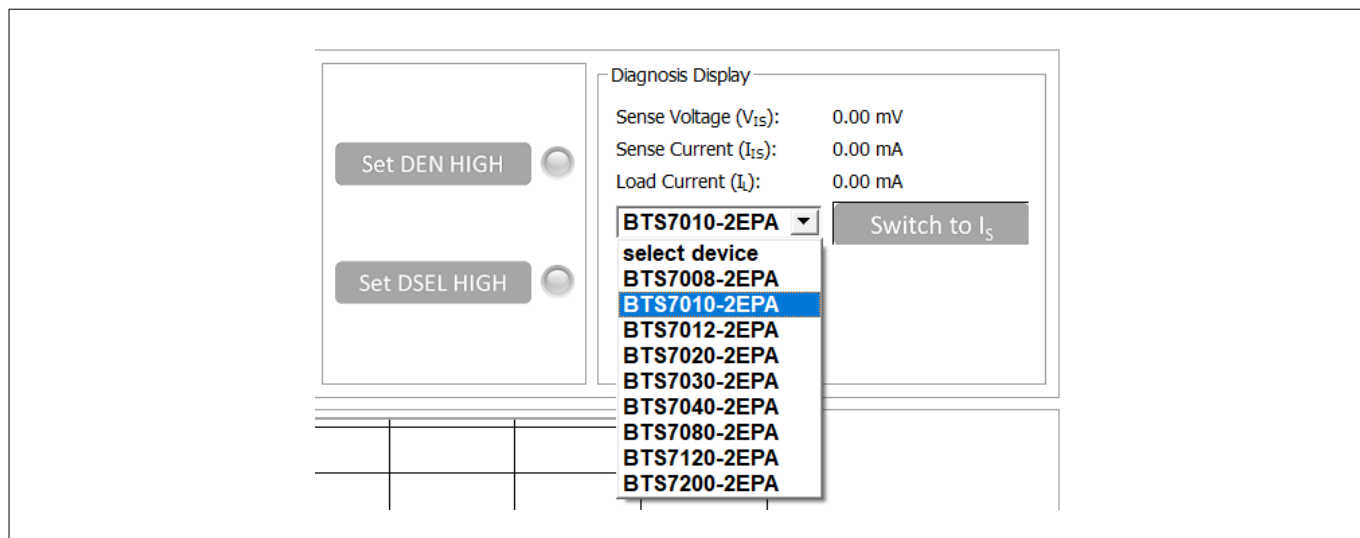
The possibility to display the sense current  $I_S$  is also given, it is converted into a measurable voltage via a resistor. This voltage is measured by an analog-to-digital converter (ADC) on the  $\mu$ IO-stick and visualized by the GUI. Figure 43 displays the GUI plot of the digitalized data set imported. As shown in Figure 44, clicking the **Set DEN HIGH** button, displays the sense current automatically and the button changes to **Set DEN LOW** while the color of the lamp element turns green.



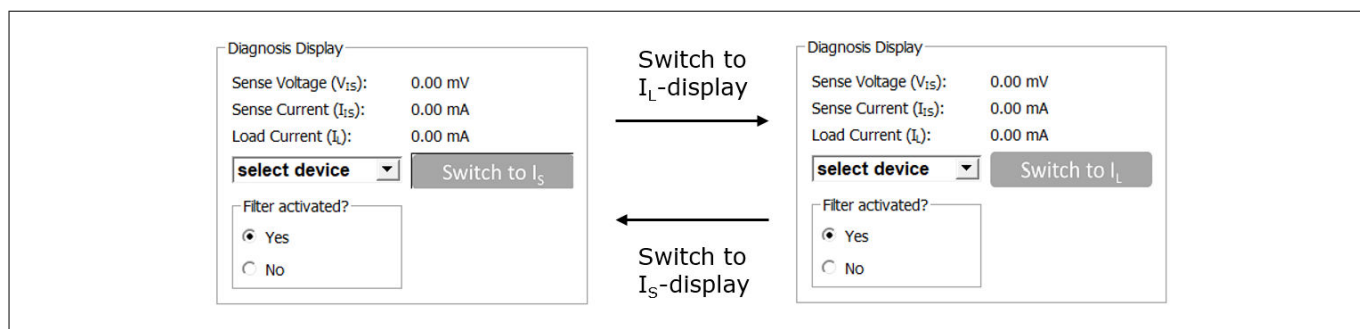
**Figure 44** PROFET™ +2 12V functional view – Sense current display for OUT0

It is also possible to switch between the sense and load current display. As shown in Figure 45, by selecting a device in the display section, the corresponding factor  $k_{ILIS}$  is mapped and the load current is calculated with the defaults of the PROFET™ +2 12V MB. Next to the device selection is the **Switch to  $I_L$** , which can be used to switch between sense and load current. After clicking this button, **Switch to  $I_S$**  is displayed. Figure 44 illustrates this.

## 5 Software (optional)

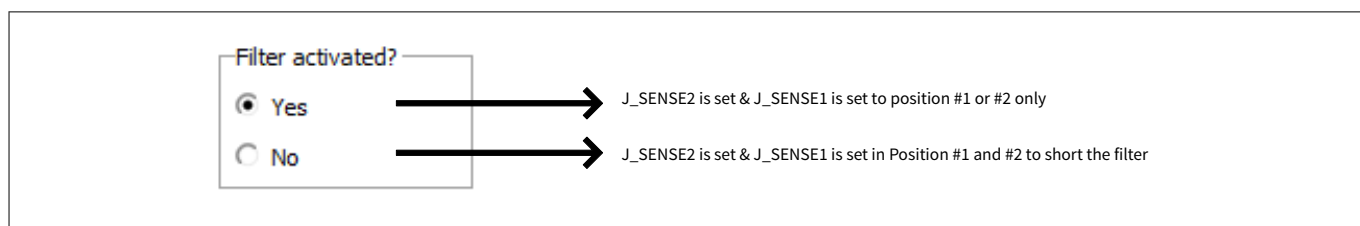


**Figure 45** PROFET™ +2 12V functional view – Device selection



**Figure 46** PROFET™ +2 12V functional view – Switching from  $I_S$  to  $I_L$

Figure 47 shows the small box titled *Filter activated?* included in the diagnosis display section. It is used to specify whether sense filtering on the MB is activated (see [Chapter 2.1](#) for further information). This setting serves to display the sense/load current and the sense voltage correctly.



**Figure 47** Filter activated?- box in diagnosis display section – Meaning of Yes/No

**6 Appendix**

**6 Appendix**

**Table 14 Available daughterboards: PROFET™ +2 12V**

Product	ISaR name	Internet link
BTS70012-1ESP	BTS70012-1ESP DAUGHBD	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/bts70012-1esp-daughbd/">https://www.infineon.com/cms/en/product/evaluation-boards/bts70012-1esp-daughbd/</a>
BTS70015-1ESP	BTS70015-1ESP DAUGHBD	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/bts70015-1esp-daughbd/">https://www.infineon.com/cms/en/product/evaluation-boards/bts70015-1esp-daughbd/</a>
BTS70020-1ESP	BTS70020-1ESP DAUGHBD	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/bts70020-1esp-daughbd/">https://www.infineon.com/cms/en/product/evaluation-boards/bts70020-1esp-daughbd/</a>
BTS7002-1EPP	PROF_2 BTS7002-1EPP DB	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/prof_2-bts7002-1epp-db/">https://www.infineon.com/cms/en/product/evaluation-boards/prof_2-bts7002-1epp-db/</a>
BTS7004-1EPP	PROF_2 BTS7004-1EPP DB	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/prof_2-bts7004-1epp-db/">https://www.infineon.com/cms/en/product/evaluation-boards/prof_2-bts7004-1epp-db/</a>
BTS7004-1EPR	PROF_2 BTS7004-1EPR DB	Page in development
BTS7004-1EPZ	SHIELD_BTS7004-1EPZ	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/shield_bts7004-1epz/">https://www.infineon.com/cms/en/product/evaluation-boards/shield_bts7004-1epz/</a>
BTS7006-1EPP	PROF_2 BTS7006-1EPP DB	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/prof_2-bts7006-1epp-db/">https://www.infineon.com/cms/en/product/evaluation-boards/prof_2-bts7006-1epp-db/</a>
BTS7006-1EPZ	SHIELD_BTS7006-1EPZ	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/shield_bts7006-1epz/">https://www.infineon.com/cms/en/product/evaluation-boards/shield_bts7006-1epz/</a>
BTS7008-1EPA	BTS7008-1EPA DAUGH BRD	<a href="https://www.infineon.com/bts7008-1epa-daugh-brd">https://www.infineon.com/bts7008-1epa-daugh-brd</a>
BTS7008-1EPP	PROF_2 BTS7008-1EPP DB	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/prof_2-bts7008-1epp-db/">https://www.infineon.com/cms/en/product/evaluation-boards/prof_2-bts7008-1epp-db/</a>
BTS7008-1EPZ	SHIELD_BTS7008-1EPZ	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/shield_bts7008-1epz/">https://www.infineon.com/cms/en/product/evaluation-boards/shield_bts7008-1epz/</a>
BTS7008-2EPA	BTS7008-2EPA DAUGH BRD	<a href="https://www.infineon.com/bts7008-2epa-daugh-brd">https://www.infineon.com/bts7008-2epa-daugh-brd</a>
BTS7008-2EPG	BTS7008-2EPG DB	Page in development
BTS7008-2EPZ	SHIELD_BTS7008-2EPZ	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/shield_bts7008-2epz/">https://www.infineon.com/cms/en/product/evaluation-boards/shield_bts7008-2epz/</a>
BTS7010-1EPA	BTS7010-1EPA DAUGH BRD	<a href="https://www.infineon.com/bts7010-1epa-daugh-brd">https://www.infineon.com/bts7010-1epa-daugh-brd</a>
BTS7010-2EPA	BTS7010-2EPA DAUGH BRD	<a href="https://www.infineon.com/bts7010-2epa-daugh-brd">https://www.infineon.com/bts7010-2epa-daugh-brd</a>
BTS7012-1EPA	BTS7012-1EPA DAUGH BRD	<a href="https://www.infineon.com/bts7012-1epa-daugh-brd">https://www.infineon.com/bts7012-1epa-daugh-brd</a>
BTS7012-2EPA	BTS7012-2EPA DAUGH BRD	<a href="https://www.infineon.com/bts7012-2epa-daugh-brd">https://www.infineon.com/bts7012-2epa-daugh-brd</a>
BTS7012-2EPG	BTS7012-2EPG DB	Page in development
BTS7020-2EPA	BTS7020-2EPA DAUGH BRD	<a href="https://www.infineon.com/bts7020-2epa-daugh-brd">https://www.infineon.com/bts7020-2epa-daugh-brd</a>
BTS7030-2EPA	BTS7030-2EPA DAUGH BRD	<a href="https://www.infineon.com/bts7030-2epa-daugh-brd">https://www.infineon.com/bts7030-2epa-daugh-brd</a>
BTS7030-2EPG	BTS7030-2EPG DB	Page in development
BTS7040-1EPA	BTS7040-1EPA DAUGH BRD	<a href="https://www.infineon.com/bts7040-1epa-daugh-brd">https://www.infineon.com/bts7040-1epa-daugh-brd</a>

**(table continues...)**

**6 Appendix**

**Table 14 (continued) Available daughterboards: PROFET™ +2 12V**

Product	ISaR name	Internet link
BTS7040-1EPZ	SHIELD_BTS7040-1EPZ	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/shield_bts7040-1epz/">https://www.infineon.com/cms/en/product/evaluation-boards/shield_bts7040-1epz/</a>
BTS7040-2EPA	BTS7040-2EPA DAUGH BRD	<a href="https://www.infineon.com/bts7040-2epa-daugh-brd">https://www.infineon.com/bts7040-2epa-daugh-brd</a>
BTS7040-2EPG	BTS7040-2EPG DB	Page in development
BTS7050-2EPL	BTS7050-2EPL DAUGH BRD	Page in development
BTS7080-2EPA	BTS7080-2EPA DAUGH BRD	<a href="https://www.infineon.com/bts7080-2epa-daugh-brd">https://www.infineon.com/bts7080-2epa-daugh-brd</a>
BTS7080-2EPZ	SHIELD_BTS7080-2EPZ	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/shield_bts7080-2epz/">https://www.infineon.com/cms/en/product/evaluation-boards/shield_bts7080-2epz/</a>
BTS7090-2EPL	BTS7090-2EPL DAUGH BRD	Page in development
BTS7120-2EPA	BTS7120-2EPA DAUGH BRD	<a href="https://www.infineon.com/bts7120-2epa-daugh-brd">https://www.infineon.com/bts7120-2epa-daugh-brd</a>
BTS7120-2EPG	BTS7120-2EPG DB	Page in development
BTS7200-2EPA	BTS7200-2EPA DAUGH BRD	<a href="https://www.infineon.com/bts7200-2epa-daugh-brd">https://www.infineon.com/bts7200-2epa-daugh-brd</a>
BTS7200-2EPC	BTS7200-2EPC DAUGH BRD	<a href="https://www.infineon.com/bts7200-2epc-daugh-brd">https://www.infineon.com/bts7200-2epc-daugh-brd</a>
BTS7200-4EPA	BTS7200-4EPA DAUGH BRD	<a href="https://www.infineon.com/bts7200-4epa-daugh-brd">https://www.infineon.com/bts7200-4epa-daugh-brd</a>
PROFET™ +2 12V motherboard V2	PROFET™ PLUS2 MOTH BRD	<a href="https://www.infineon.com/profet-plus2-moth-brd">https://www.infineon.com/profet-plus2-moth-brd</a>
PROFET™ +2 12V motherboard V3	PROFET™ ONE4ALL MB V1	<a href="https://www.infineon.com/profet-one4all-mb-v1">https://www.infineon.com/profet-one4all-mb-v1</a>

**Table 15 Available daughterboards: PROFET™ Load Guard 12V**

Product	ISaR name	Internet link
BTG7050-1EPL	BTG7050-1EPL DAUGH BRD	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/btg7050-1epl-daugh-brd/">https://www.infineon.com/cms/en/product/evaluation-boards/btg7050-1epl-daugh-brd/</a>
BTG7050-2EPL	BTG7050-2EPL DAUGH BRD	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/btg7050-2epl-daugh-brd/">https://www.infineon.com/cms/en/product/evaluation-boards/btg7050-2epl-daugh-brd/</a>
BTG7090-1EPL	BTG7090-1EPL DAUGH BRD	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/btg7090-1epl-daugh-brd/">https://www.infineon.com/cms/en/product/evaluation-boards/btg7090-1epl-daugh-brd/</a>
BTG7090-2EPL	BTG7090-2EPL DAUGH BRD	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/btg7090-2epl-daugh-brd/">https://www.infineon.com/cms/en/product/evaluation-boards/btg7090-2epl-daugh-brd/</a>

**Table 16 Available daughterboards: PROFET™ Wire Guard 12V**

Product	ISaR name	Internet link
BTG70013A-1ESW	BTG70013A-1ESW DB	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/btg70013a-1esw-db/">https://www.infineon.com/cms/en/product/evaluation-boards/btg70013a-1esw-db/</a>
BTG70020A-1ESW	BTG70020A-1ESW DB	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/btg70020a-1esw-db/">https://www.infineon.com/cms/en/product/evaluation-boards/btg70020a-1esw-db/</a>
BTG7003A-1EPW	BTG7003A-1EPW DB	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/btg7003a-1epw-db/">https://www.infineon.com/cms/en/product/evaluation-boards/btg7003a-1epw-db/</a>

**(table continues...)**

## 6 Appendix

**Table 16** (continued) Available daughterboards: PROFET™ Wire Guard 12V

Product	ISaR name	Internet link
BTG7007A-1EPW	BTG7007A-1EPW DB	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/btg7007a-1epw-db/">https://www.infineon.com/cms/en/product/evaluation-boards/btg7007a-1epw-db/</a>
BTG7016A-1EPW	BTG7016A-1EPW DB	<a href="https://www.infineon.com/cms/en/product/evaluation-boards/btg7016a-1epw-db/">https://www.infineon.com/cms/en/product/evaluation-boards/btg7016a-1epw-db/</a>

## References

- [1] Infineon Developer Center; Smart Power Switches Configuration Wizard <https://www.infineon.com/cms/de/design-support/tools/utilities/infineon-developer-center-idc-launcher/>

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Revision history

## Revision history

Document version	Date of release	Description of changes
Rev.1.20	2024-01-24	<ul style="list-style-type: none"><li>Editorial changes</li><li>Added PROFET™ Wire Guard 12V daughterboards description</li><li>Updated tables in <a href="#">Appendix</a> with additional devices</li></ul>
Rev.1.10	2022-06-24	Added PROFET™ Load Guard 12V daughterboards
Rev.1.00	2021-05-19	Initial release PROFET™ customer evaluation kit description



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