

Arduino Shield Power PROFET™ + 12V

User guide

About this document

Scope and purpose

This document describes how to use the high-side switch Arduino shield with the Power PROFET™ + 12V.

Intended audience

Engineers, hobbyists and students who want to use powerful protected high-side switches for Arduino projects.

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User guide

Getting started

1 Getting started

The BTS500xx-1LUA Arduino shield from Infineon Technologies is a flexible evaluation board dedicated to drive loads. This board is compatible with Infineon's XMC1100 Boot Kit, the Arduino UNO, the Arduino DUE and all the other boards which comply with the Arduino form factor.

The shield can be controlled either with the general logic IO-Ports of a microcontroller or with a PWM signal generated by a waveform generator.

The board is designed with the typical circuit to control one BTS50005-1LUA and one BTS50010-1LUA. This shield offers a quick evaluation of features like the analog current feedback and all the different protection functions.

1.1 Shield overview

The **Figure 1** shows and describes the board. With this board, users are able to drive loads by adding power connectors on BAT, OUT1 and OUT2. All the pins of the two devices are accessible by test points. If a user does not want to use a microcontroller, it is possible to connect the inputs of the two devices to a low frequency generator and do the measurements with an oscilloscope. The demoboard can also be easily connected to any Arduino UNO board or Infineon board which has the Arduino UNO form factor through headers.

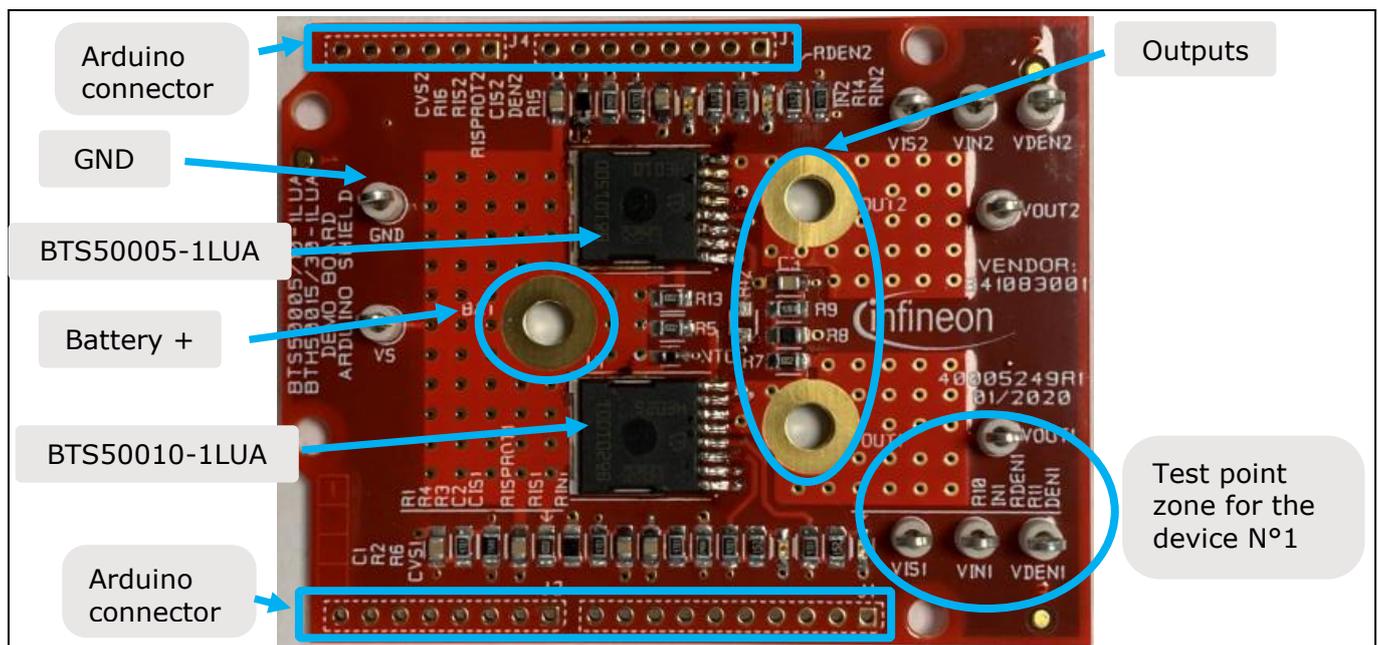


Figure 1 Arduino compatible evaluation board for the Power PROFET™ + 12V

This shield offers a quick evaluation of the product:

- the latch functionality
- the current sensing functionality
- and all protections, e.g. “over temperature shut down” and “over current shut down”

WARNING: Refer to the datasheet for details on functionalities and parameters values. This user guide does not replace the datasheet and the user must be aware of limitations before turning on any supply.

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1.2 Typical connection

In **Figure 2**, the evaluation board is connected to an Arduino UNO board, this pinout connection works with all microcontrollers using an Arduino pinout.

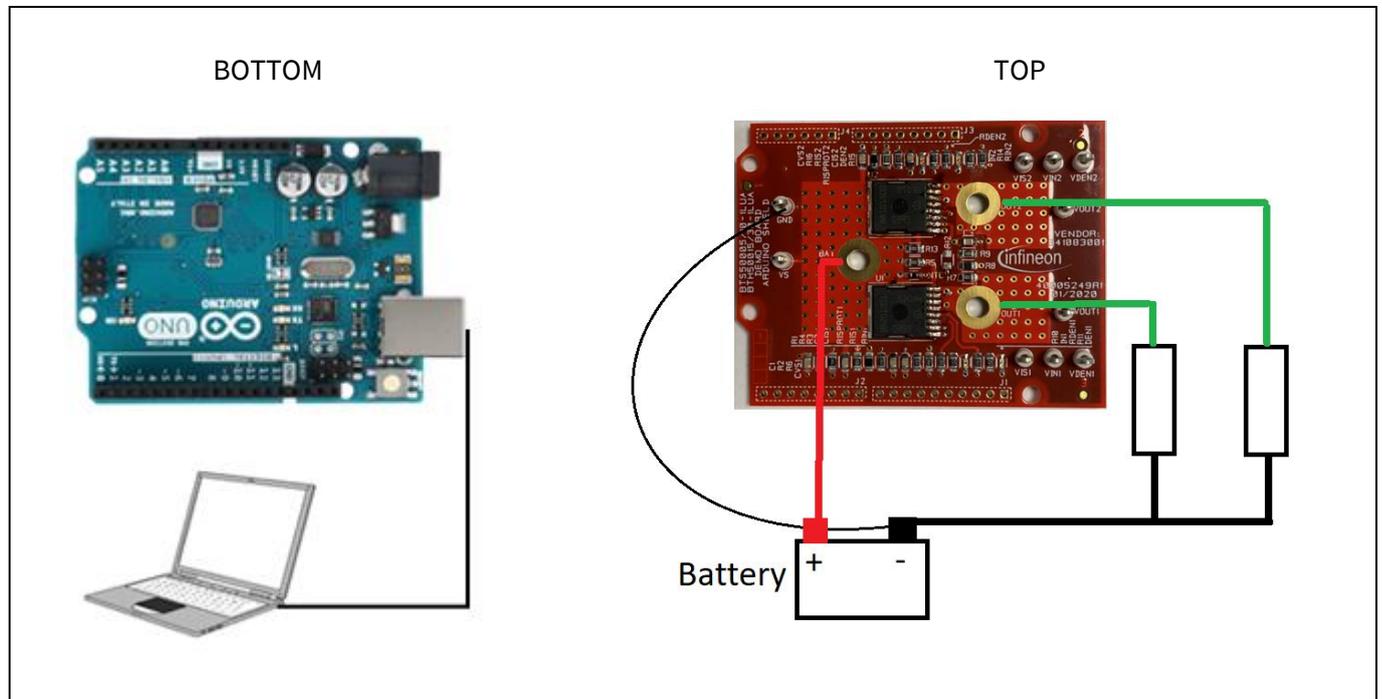


Figure 2 Evaluation board connected to the Arduino UNO board

In **Figure 3**, the evaluation board is connected to a waveform generator, driving the IN and DEN pin.

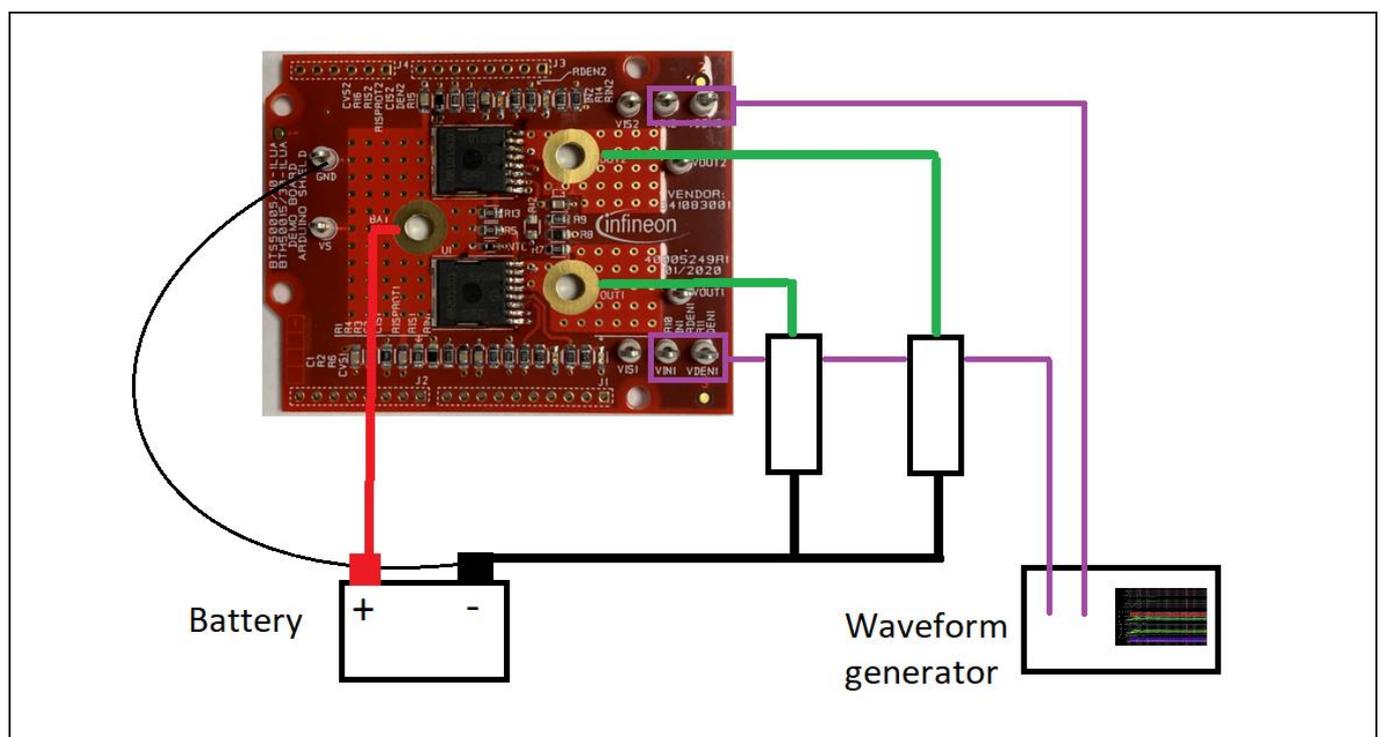


Figure 3 Evaluation board connected to a waveform generator

1.3 Key features

- The demoboard is able to provide continuous load current (12V-50A) between V_OUT and BAT.
- A green LED will turn on when the logic supply voltage is connected and turned on.
- A red LED will turn on when the logic supply voltage is connected and only if the referred device is latched.
- Output voltage, battery voltage, input and DEN logic, output current sense IS voltage can be measured externaly with test points.
- Output voltage, battery voltage, input and DEN logic, output current sense IS can be monitored with the Arduino shield and also throught the GitHub library.
- The board temperature can be measured with an NTC, which is populated on the board.

2 How to drive the evaluation board

2.1 Without any Arduino board connected

Users can connect a waveform generator in order to drive the evaluation board manually. The IN pin has to be driven to turn the device on. The DEN pin has to be driven to enable the diagnosis ability.

2.2 Using a microcontroller

Users are able to connect any microcontroller which is compliant with the Arduino UNO form factor. Source code for microcontroller can be written and implemented according the schematic and the pinout of the evaluation board provided in chapter 3.

2.3 With the GitHub library

Users have the possibility to use the Arduino Shield Power PROFET™ + 12V GitHub library. The procedure is described step by step below.

- 1- Open the Arduino IDE.
- 2- Select “Manage library”, search for “High-Side-Switch” and install it.
- 3- Choose an example inside the “High-Side-Switch” library. For the Power PROFET™ + 12V, there are three examples. The first one is about switching one single channel, the second is about switching the two channels and the third is about switching the two channels separately and measuring the available parameters like the battery voltage, the temperature and the current sense voltage of the two channels.

Many functions are available with the GitHub library. All functions are described below.

The source file can be found following this link: <https://github.com/Infineon/high-side-switch>

Public Functions

```
Bts500xxShield(Hss *sw1, Hss *sw2, ADCPAL *vs, ADCPAL *vOut, ADCPAL *temp, BtxVariants_t *btxVariant1, BtxVariants_t *btxVariant2)
```

Power PROFET™ +12V BTS500xx Shield constructor.

Parameters

- **sw1** – [in] High-side switch instance 1
- **sw2** – [in] High-side switch instance 2
- **vs** – [in] ADC instance to measure the supply voltage
- **vOut** – [in] ADC instance to measure the output voltage of the high-side switch 1
- **temp** – [in] ADC instance to measure the temperature of the PCB

```
~Bts500xxShield()
```

Destructor of the PROFET +12V BTS500xx Shield.

***virtual Error_t* init()**

Initialize all necessary objects of the high-side switch board. This function initializes all necessary objects of the high-side switch board. It returns an error code to see if everything was initialized correctly.

Returns: hss::Error_t

***virtual Error_t* deinit()**

Deinitialize all necessary objects of the high-side switch board. This function de-initializes all necessary objects of the high-side switch board. It returns an error code to see if everything was de-initialized correctly.

Returns: hss::Error_t

***virtual Error_t* switchHxOn(uint8_t x)**

Switch on the selected high-side switch. This function turns on the desired high-side switch.

Parameters

x – [in] Number of the switch that should be turned on (1-2). Can be either SWITCH1 or SWITCH2.

Returns: hss::Error_t

***virtual Error_t* switchHxOff(uint8_t x)**

Switch off the selected high-side switch. This function turns off the desired high-side switch.

Parameters

x – [in] Number of the switch the should be turned off (1-2) Can be either SWITCH1 or SWITCH2.

Returns: hss::Error_t

***virtual DiagStatus_t* readDiagx(uint8_t x)**

Read the diagnosis output of the chosen switch. This function uses the current signal of the chosen switch to diagnose the switch. It returns the different states depending on the switch's condition.

Parameters

x – [in] Desired switch for the diagnosis (1-2) Can be either SWITCH1 or SWITCH2.

Returns: DiagStatus_t

Returns

- **-1** – Diagnosis read error (chosen channel not valid)
- **0** – Switch is working fine
- **2** – Short circuit to ground
- **4** – Short circuit to Vs

- 5 – Open load detected

virtual float readIsx(uint8_t x)

Read the desired current value of the chosen switch. This function reads the IS pin of the chosen high-side switch and calculates the current which is flowing through the switch with the acquired ADC value.

Parameters: x – [in] Number of the desired switch (1-2)

Returns: The value of the current in [A]

Returns: -1.2345 – Invalid channel was chosen

Error_t switchesHxOn(bool h1 = false, bool h2 = false)

Switches on high-side switches. This function can switch on several high-side switches at once, but is also possible to only switch on the first or second one.

Parameters

- **h1** – [in] Bool value for the first switch. *true* means turn on, *false* means keep it as is.
- **h2** – [in] Bool value for the second switch. *true* means turn on, *false* means keep it as is.

Returns: hss::Error_t

Error_t switchesHxOff(bool h1 = false, bool h2 = false)

Switches off high-side switches. This function can switch off several high-side switches at once. But is also possible to only switch off the first or second one.

Parameters

- **h1** – [in] Bool value for the first switch. *true* means turn off, *false* means keep it as is.
- **h2** – [in] Bool value for the second switch. *true* means turn off, *false* means keep it as is.

Returns: hss::Error_t

float readVs()

Read the supply voltage. This function is reading the supply voltage of the high-side switch board.

Returns: Value of the supply voltage in [V]

float readVOut()

Read the output voltage. This function is reading the output voltage of high-side switch one.

Returns: Value of the output voltage in [V]

float readTemperature()

Read the PCB temperature. This function is reading the temperature of the high-side switch board PCB.

Returns: Value of the temperature in [°C]

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Board connectors description

3 Board connectors description

3.1 Power connectors

| Name | Type | Description |
|------|--------------|---------------------------|
| BAT | Power supply | Positive power supply 12V |
| GND | Ground power | Ground |
| OUT1 | Power output | Output 1 |
| OUT2 | Power output | Output 2 |

3.2 Arduino connector

Connector J1

| Name | Pin | Type | Description / Arduino pin name |
|-------|-----|----------------|------------------------------------|
| - | 1 | No connected | - |
| - | 2 | No connected | - |
| - | 3 | No connected | - |
| Gnd | 4 | Digital Ground | Ground |
| - | 5 | No connected | - |
| IN1 | 6 | Digital Input | IN activation for U1 / Digital 12 |
| DEN1 | 7 | Digital Input | DEN activation for U1 / Digital 11 |
| IN2 | 8 | Digital Input | IN activation for U2 / Digital 10 |
| DEN23 | 9 | Digital Input | DEN activation for U2 / Digital 9 |
| - | 10 | No connected | - |

Connector J2

| Name | Pin | Type | Description |
|------|-----|--------------|-------------|
| - | 1 | No connected | - |
| - | 2 | No connected | - |
| - | 3 | No connected | - |
| - | 4 | No connected | - |
| - | 5 | No connected | - |
| - | 6 | No connected | - |
| - | 7 | No connected | - |
| - | 8 | No connected | - |

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Board connectors description

Connector J3

| Name | Pin | Type | Description |
|------|-----|----------------|-------------|
| - | 1 | No connected | - |
| - | 2 | No connected | - |
| - | 3 | No connected | - |
| - | 4 | No connected | - |
| - | 5 | No connected | - |
| Gnd | 6 | Digital Ground | Ground |
| Gnd | 7 | Digital Ground | Ground |
| - | 8 | No connected | - |

Connector J4

| Name | Pin | Type | Description/ Arduino pin name |
|----------|-----|--------------|---|
| IS_adc1 | 1 | Analog input | Analog measurement for the current sense U1 / A0 |
| VS_adc | 2 | Analog input | Analog measurement for the Vs voltage 2 / A1 |
| Temp_adc | 3 | Analog input | Analog measurement for the temperature / A2 |
| VOUT_adc | 4 | Analog input | Analog measurement for the output voltage U2 / A3 |
| IS_adc2 | 5 | Analog input | Analog measurement for the current sense U2 / A4 |
| - | 6 | No connected | - |

Test points

| Name | Type | Description |
|-------|---------------------|---|
| VIN1 | Digital Input | IN activation for U1 |
| VIN2 | Digital Input | IN activation for U2 |
| VDEN1 | Digital Input | DEN activation for U1 |
| VDEN2 | Digital Input | DEN activation for U2 |
| VIS1 | Analog output | Analog measurement for the current sense U1 |
| VIS2 | Analog output | Analog measurement for the current sense U2 |
| VS | Analog output | Analog measurement for the VS voltage |
| Out1 | Analog power output | Analog power output from U1 |
| Out2 | Analog power output | Analog power output from U2 |

3.3 Schematic

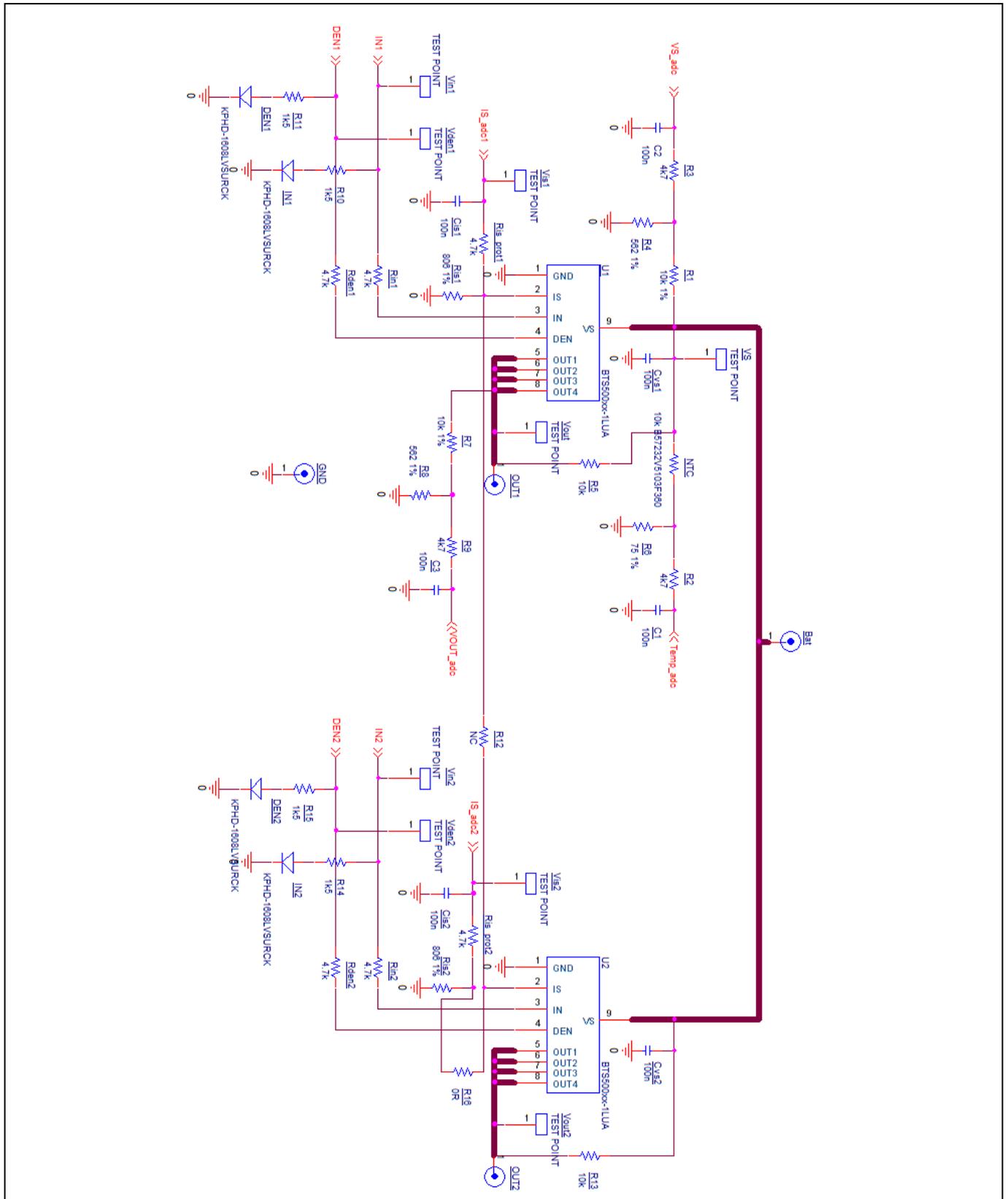


Figure 4 Schematic

Revision history

| Document revision | Date | Description of changes |
|-------------------|------------|--------------------------|
| 1.0 | 2023-01-30 | Initial version released |
| | | |
| | | |

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