

User guide Config Wizard Tool for MOTIX™ Multi MOSFET Driver ICs

About this document

Scope and purpose

This tool is a graphical user interface to control the motor control shields of Infineon's MOTIX™ Multi MOSFET Driver ICs for TLE92108 EVALKIT, TLE92108 APPKIT and TLE92104 APPKIT, and to support parameter definition with TLE9210x GATE DRIVER SETTINGS or register design with TLE9210x Register Setting Tool.

Config Wizard for MOTIX™ Multi MOSFET Driver ICs allows easy configuration of Automotive Multi MOSFET Driver IC products.

Intended audience

This document is addressed to embedded hardware and/or software developers which are familiar with motor control schemes and intend to evaluate the named ICs.

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1 Introduction to Config Wizard for MOTIX™ Multi MOSFET Driver ICs

1 Introduction to Config Wizard for MOTIX™ Multi MOSFET Driver ICs

1.1 Tool overview

The Config Wizard for MOTIX™ Multi MOSFET Driver ICs is a tool within Infineon Developer Center and allows easy configuration of Multi MOSFET Driver IC products.

The download link and installation instructions can be found [here](#)

This tool consists of:

- TLE92108 EVALKIT: a graphical user interface (GUI) to control Infineon's MOTIX™ Multi MOSFET Driver ICs for TLE92108 EVALKIT
- TLE92108 APPKIT: a graphical user interface (GUI) to control Infineon's MOTIX™ Multi MOSFET Driver ICs for TLE92108 APPKIT
- TLE92104 APPKIT: a graphical user interface (GUI) to control Infineon's MOTIX™ Multi MOSFET Driver ICs for TLE92104 APPKIT
- TLE9210x GATE DRIVER SETTINGS: a calculator for the settings of the gate drivers for the DC Motor System ICs (TLE9210x)
- TLE92108 REGISTER SETTINGS: a graphical user interface (GUI) for register setting for TLE92108

1.2 Required hardware

- μ IO stick

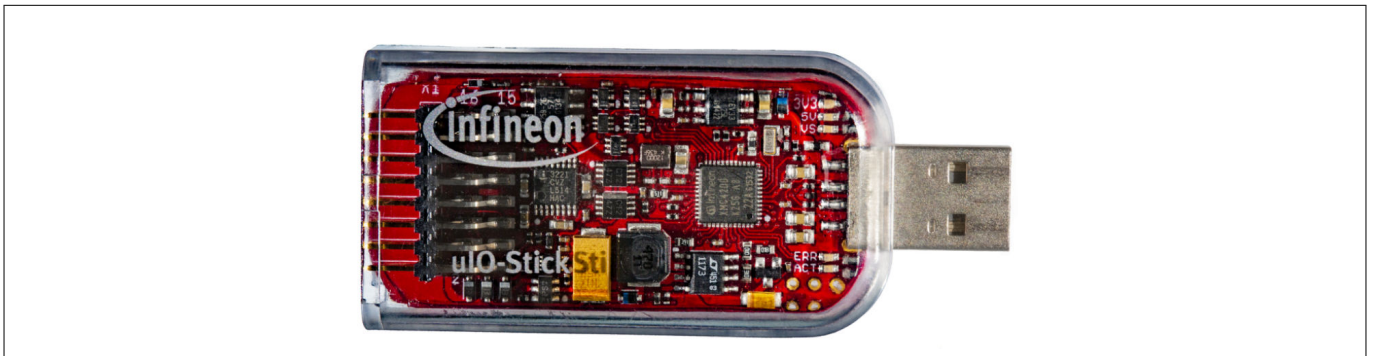


Figure 1 μ IO stick

- TLE92108 Evaluation Board (EVALKIT) or TLE9210x Application Kit (APPKIT), see [Figure 2](#) and [Figure 3](#)

1 Introduction to Config Wizard for MOTIX™ Multi MOSFET Driver ICs

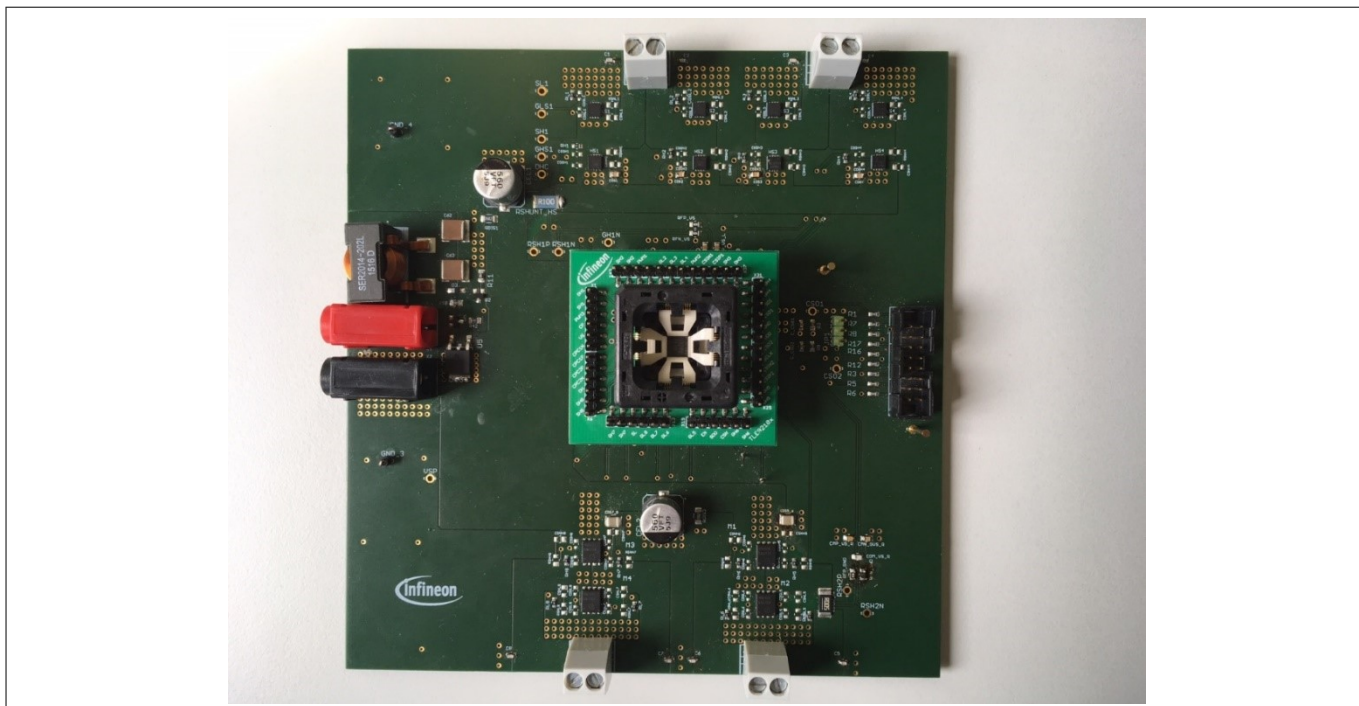


Figure 2 TLE92108 Evaluation Board



Figure 3 TLE9210x Application Kit

1 Introduction to Config Wizard for MOTIX™ Multi MOSFET Driver ICs

- 12 V DC power supply, which is able to provide sufficient current for the motor load. For evaluation purpose motor loads with less than 10 A current consumption are recommended
- DC motor as load

1.3 Connections

Please prepare the set up as instructed:

- Connect the μ IO Stick to the device. Check the connection of cable to the 16-pin header. Red wire should be at the cable indicates pin 1
- Connect a motor as a load between the ports OUT1 and OUT2
- Connect the μ IO Stick to a PC or a laptop through a free USB port
- Connect a 12V DC power supply to the ports VBAT and GND

Finally, connections are built, as is shown in [Figure 4](#).

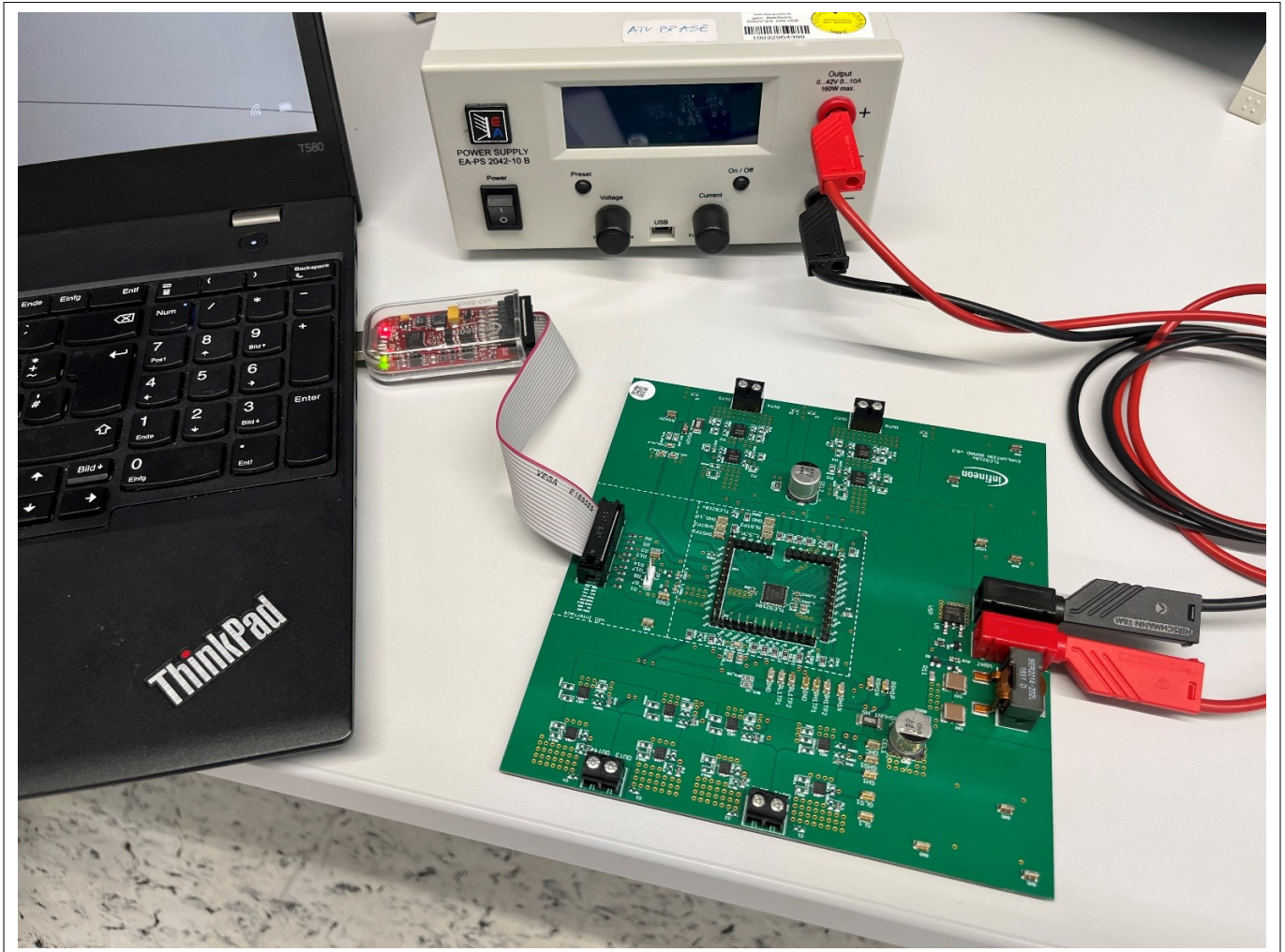


Figure 4 Test environment

1.4 Starting the tool

After successful installation of Config Wizard for MOTIX™ Multi MOSFET Driver ICs, the installed tool can be found in the Infineon Developer Center Launcher. Click on the corresponding **Start** button to launch the tool.

1 Introduction to Config Wizard for MOTIX™ Multi MOSFET Driver ICs

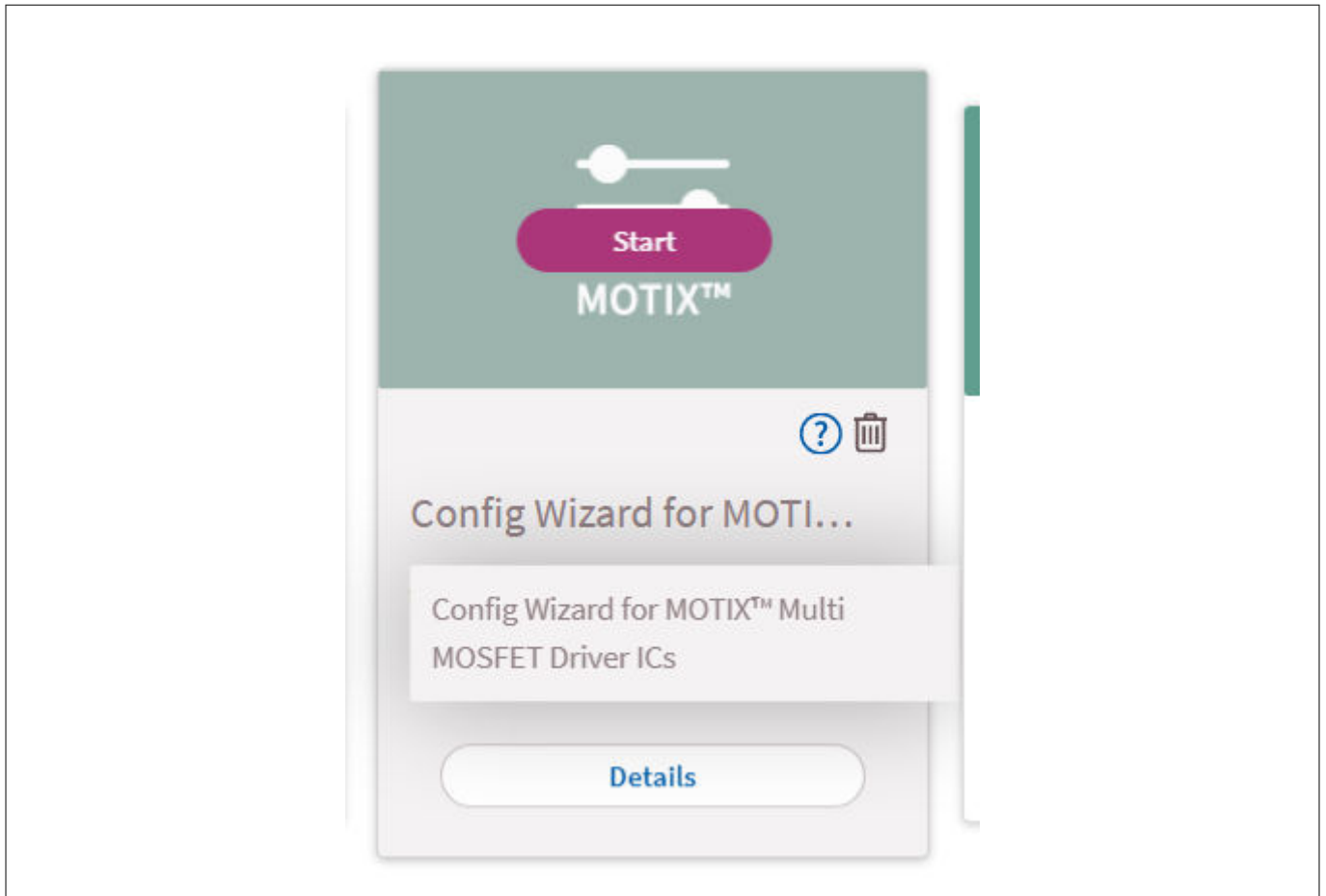


Figure 5 Starting the Config Wizard for MOTIX™ Multi MOSFET Driver ICs

Select the desired product and board from provided options in the tool.

2 GUI explanation

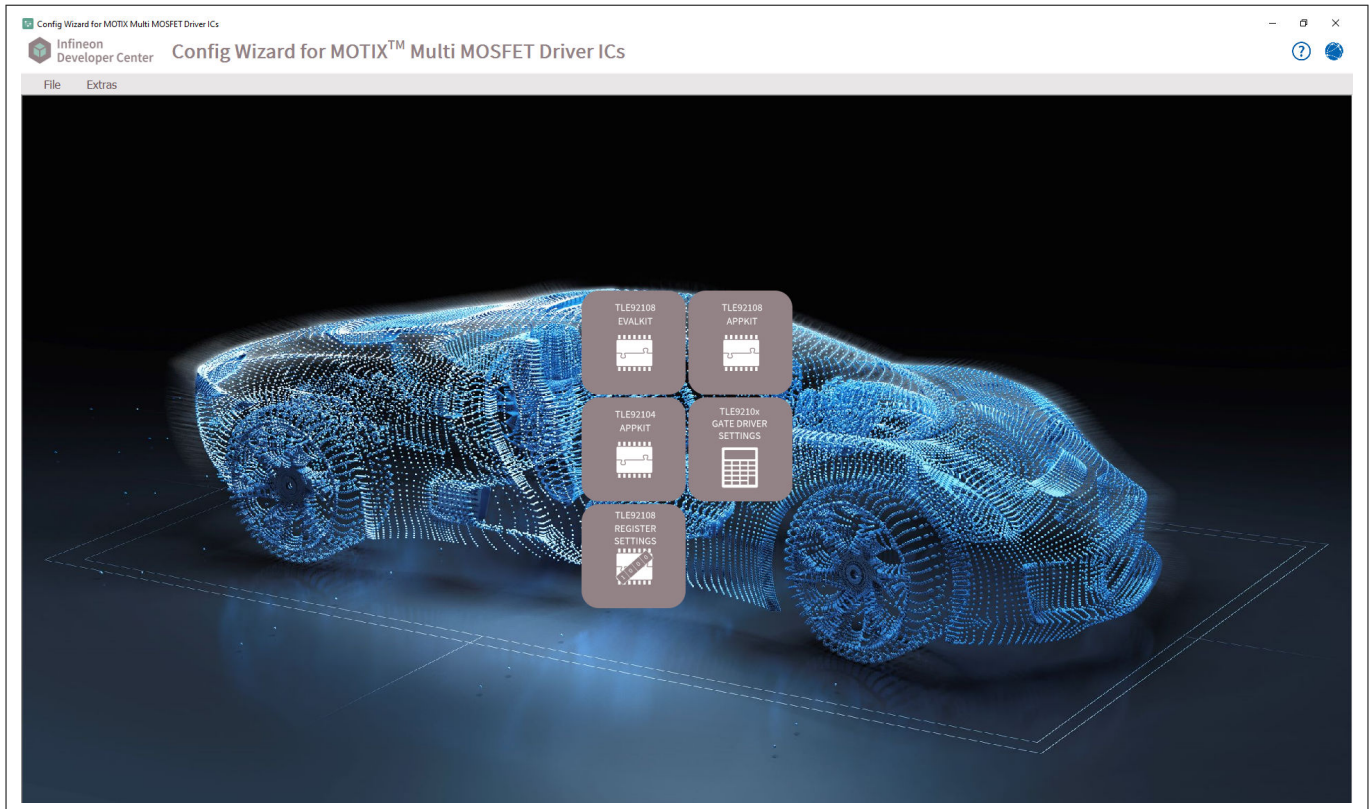


Figure 6 Product selection in the Config Wizard for MOTIX™ Multi MOSFET Driver ICs

1.5 User guide and forum

Click on the question mark icon to open the user guide and find a GUI explanation, configuration examples, general information and recommendations here.



Figure 7 Opening the user guide

Click on the world icon to open the forum for MOTIX™ Driver. In the forum you can find discussions on the products, gain access to the community as well as further information.



Figure 8 Accessing the forum

2 GUI explanation

2.1 Open Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE92108 EVALKIT

Select icon below to open the product view.

2 GUI explanation



Figure 9 Starting the GUI for the TLE92108 EVALKIT

The following view will be displayed. Refer to [Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE92108 EVALKIT](#) for further information on the configuration options.

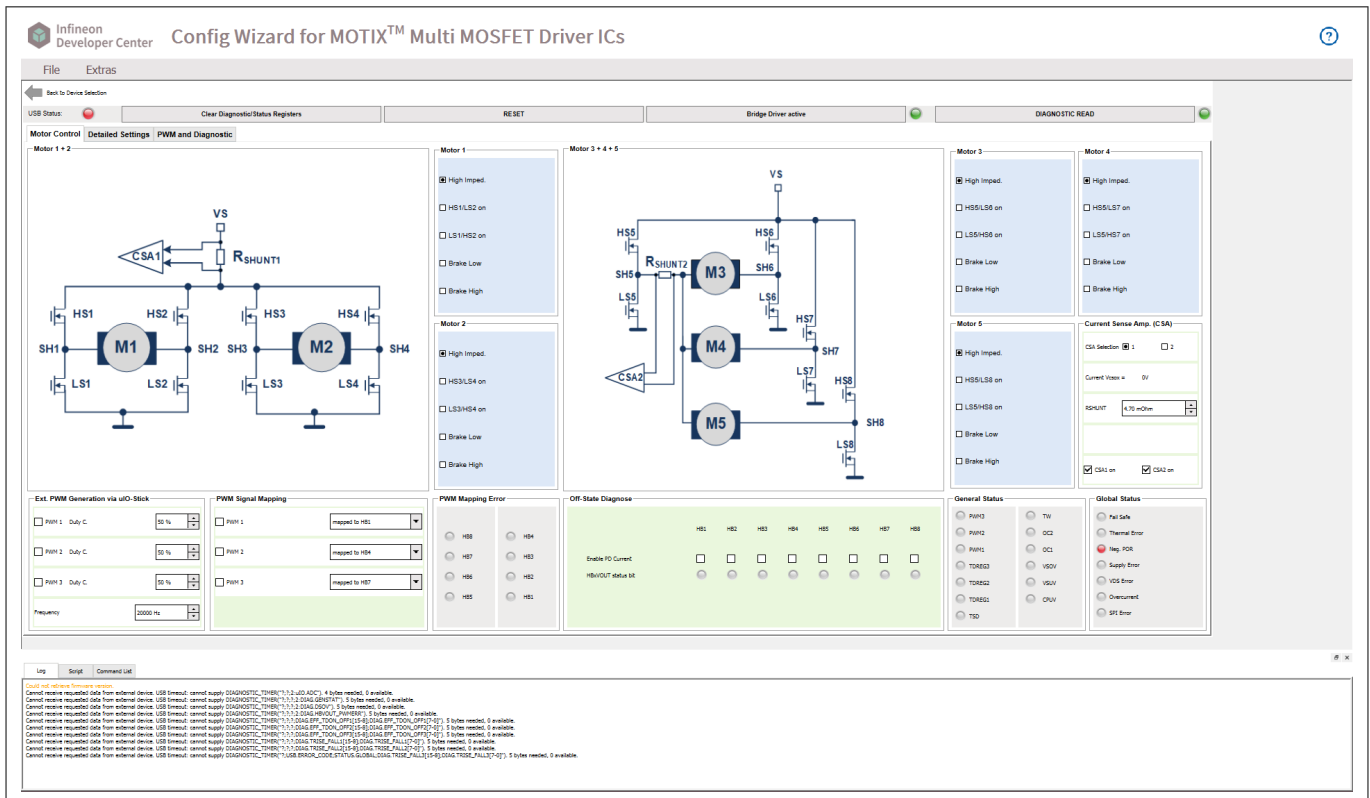


Figure 10 Starting view of the GUI for the TLE92108 EVALKIT

2.2 Open Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE92108 APPKIT

Select icon below to open the product view.

2 GUI explanation

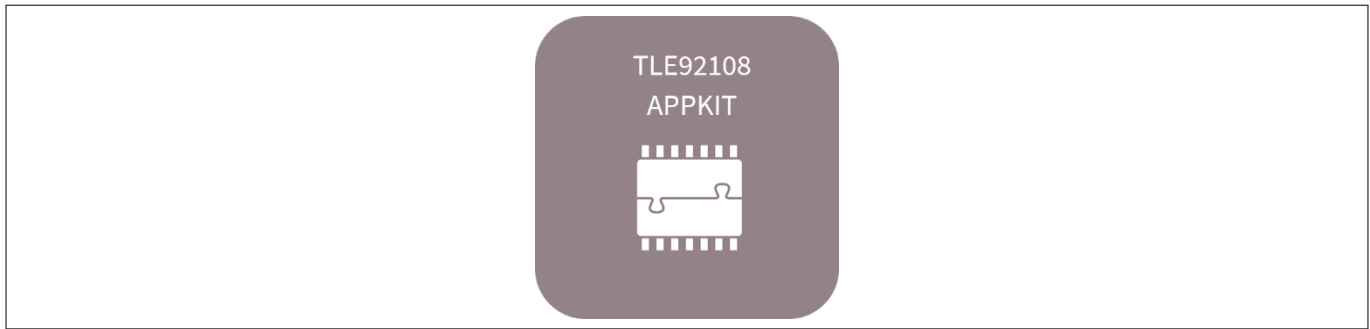


Figure 11 Starting the GUI for the TLE92108 APPKIT

The following view will be displayed. Refer to [Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE92108 APPKIT](#) for further information on the configuration options.

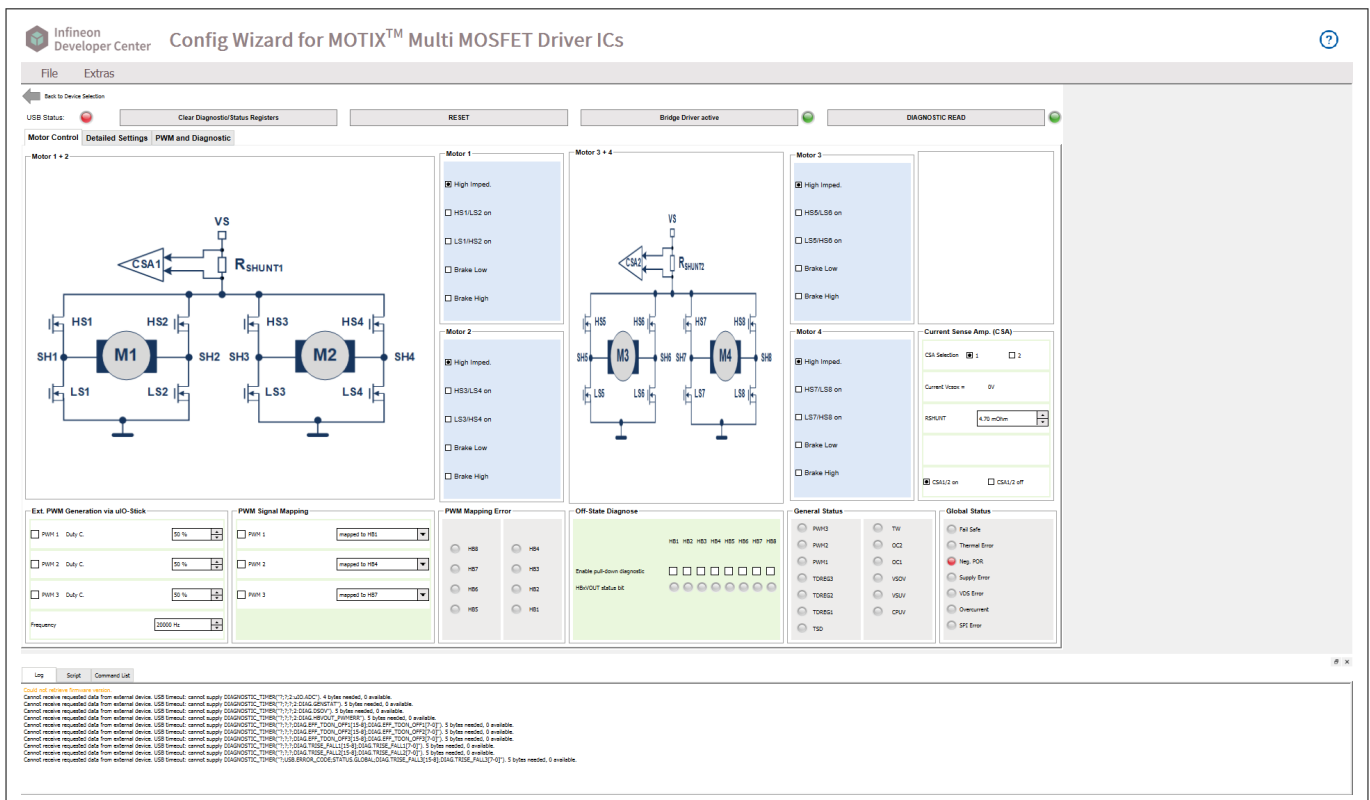


Figure 12 Starting view of the GUI for the TLE92108 APPKIT

2.3 Open Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE92104 APPKIT

Select icon below to open the product view.

2 GUI explanation

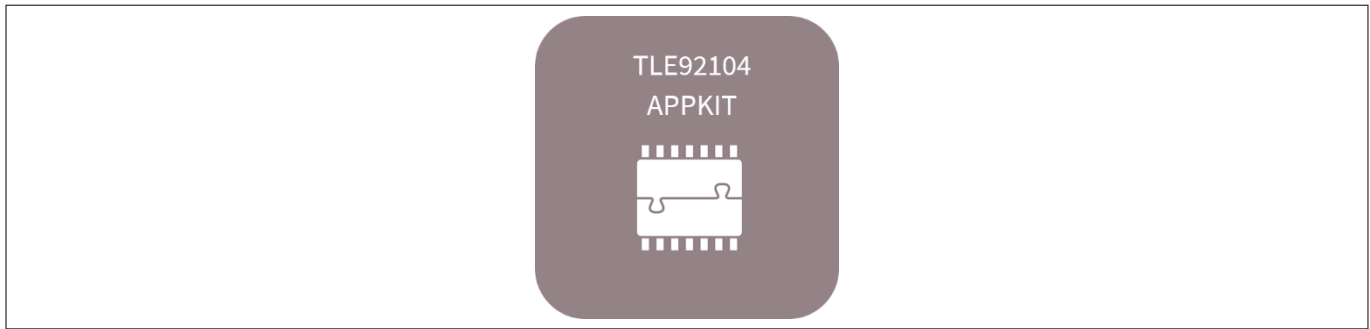


Figure 13 Starting the GUI for the TLE92104 APPKIT

The following view will be displayed. Refer to [Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE92104 APPKIT](#) for further information on the configuration options.

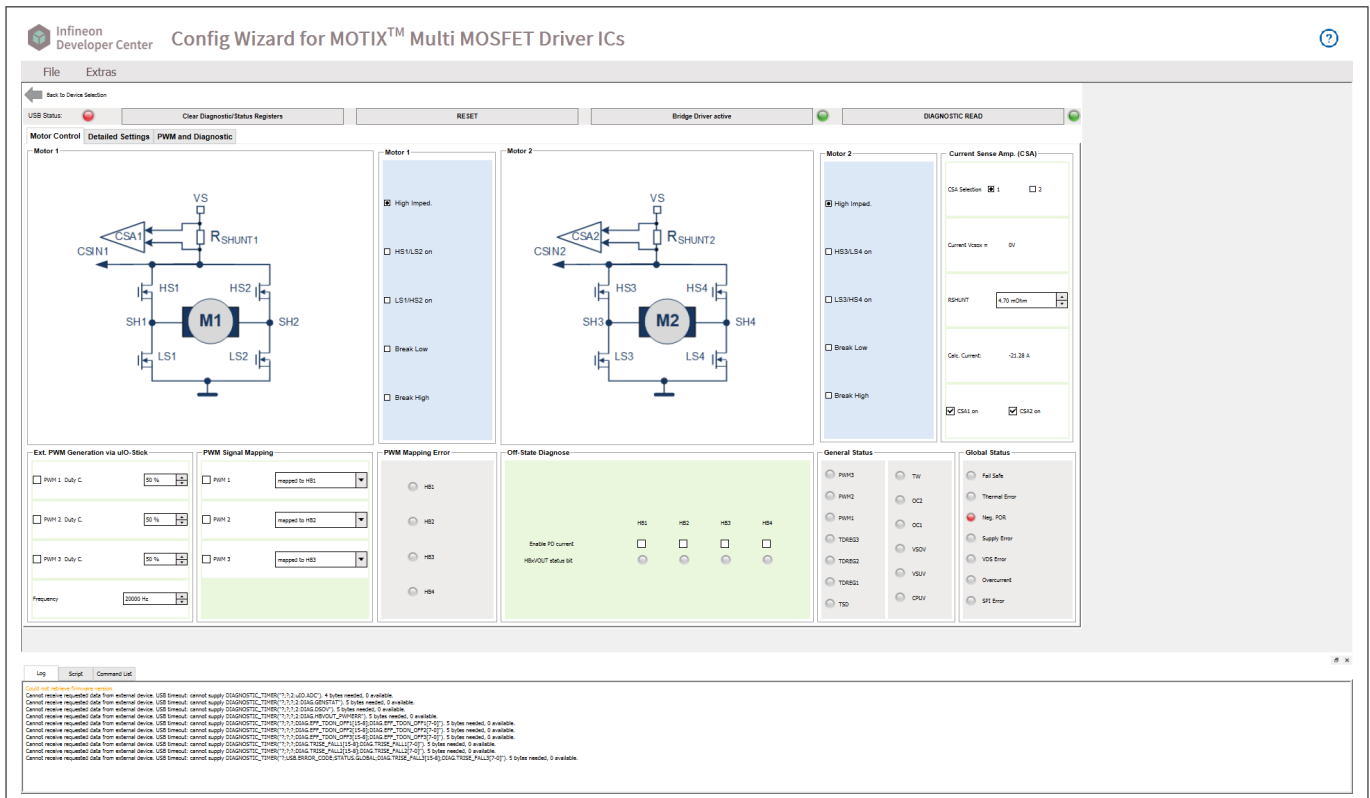


Figure 14 Starting view of the GUI for the TLE92104 APPKIT

2.4 Open Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE9210x GATE DRIVER SETTINGS

Select icon below to open the product view.

2 GUI explanation



Figure 15 Starting the GUI for the gate driver settings for the TLE9210x

The following view will be displayed. Refer to [Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE9210x GATE DRIVER SETTINGS](#) for further information on the configuration options.

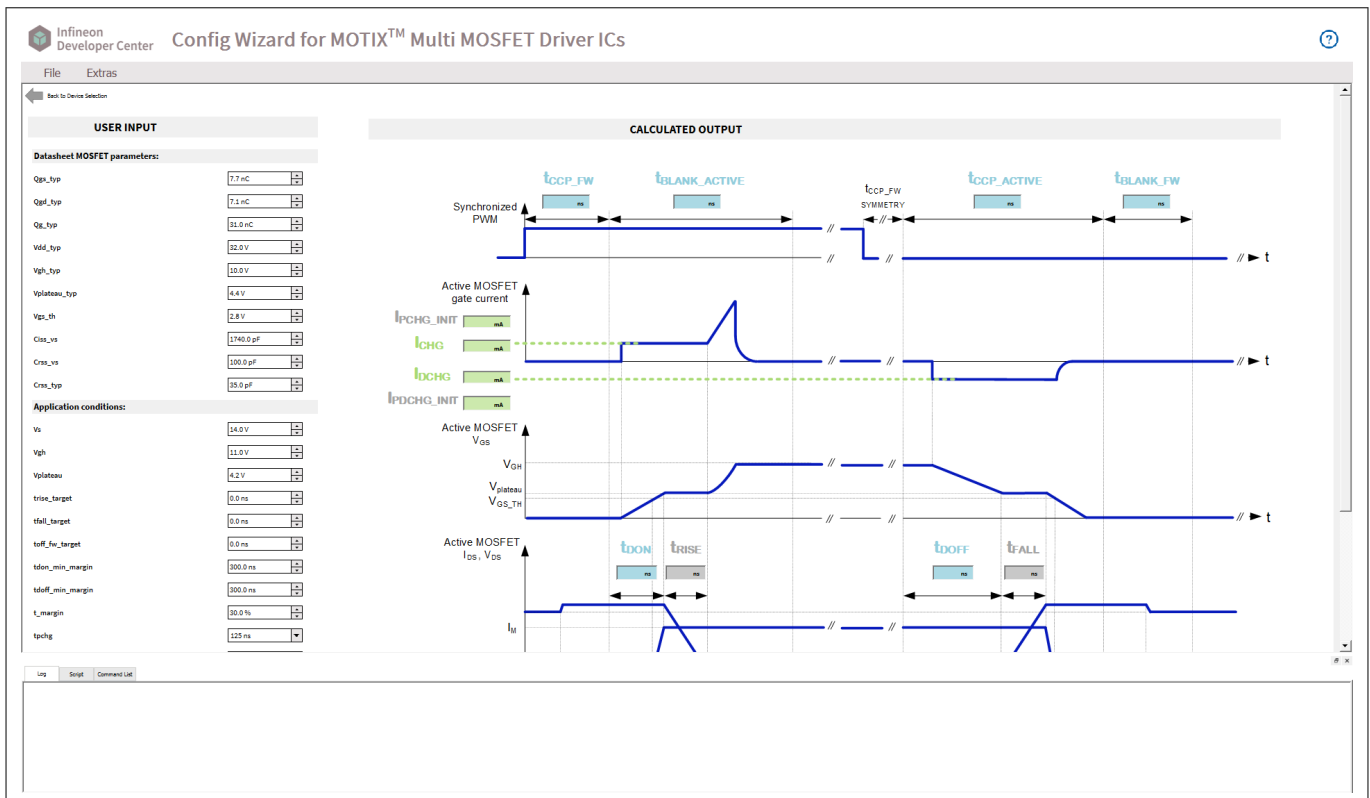


Figure 16 Starting view of the TLE9210x gate driver settings

2.5 Open Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE92108 REGISTER SETTING TOOL

Select icon below to open the product view.

3 Getting started



Figure 17 Starting the GUI for the register setting tool for the TLE92108

The following view will be displayed. Refer to [Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE92108 Register Setting Tool](#) for further information on the configuration options.

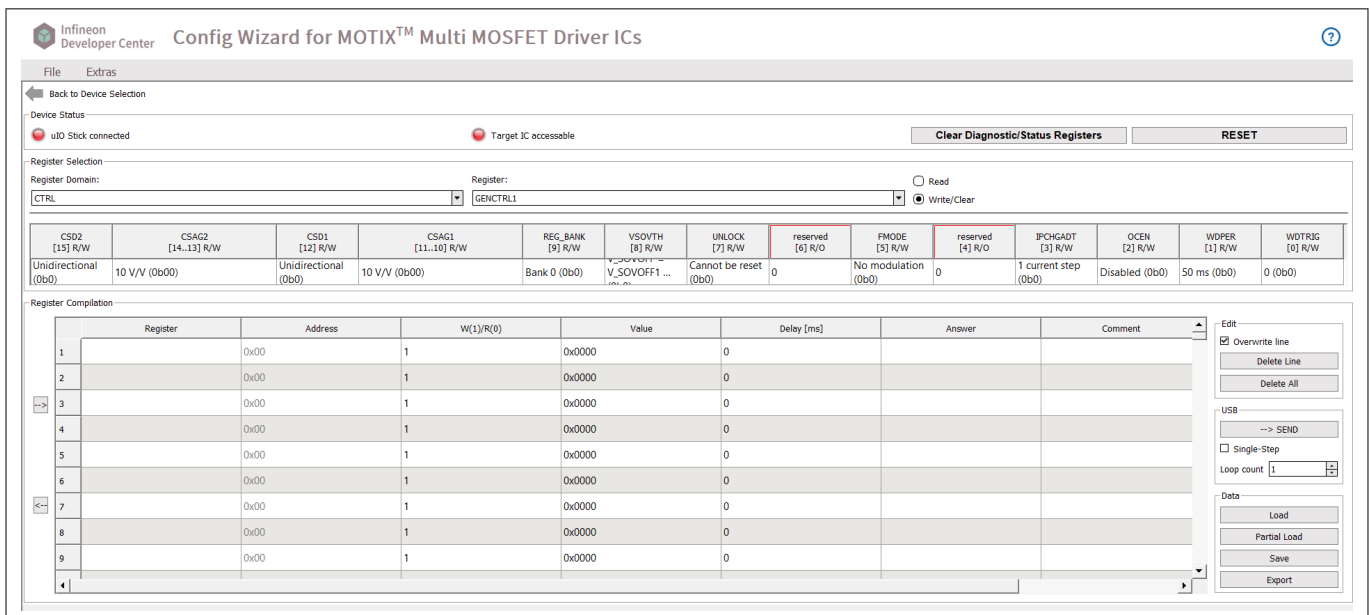


Figure 18 Starting view of the TLE92108 register setting tool

3 Getting started

3.1 Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE92108 EVALKIT

USB Status LED:

Green: indicates that the communication between the μ IO stick and the TLE92108-23QX is working

Red: indicates that the communication is not working

Clear diagnostic/status registers:

all of the diagnostic/status register should be cleared

Reset:

reset the graphic user interface and of the TLE92108 device (EN pin is toggled resulting in a device power-on reset)

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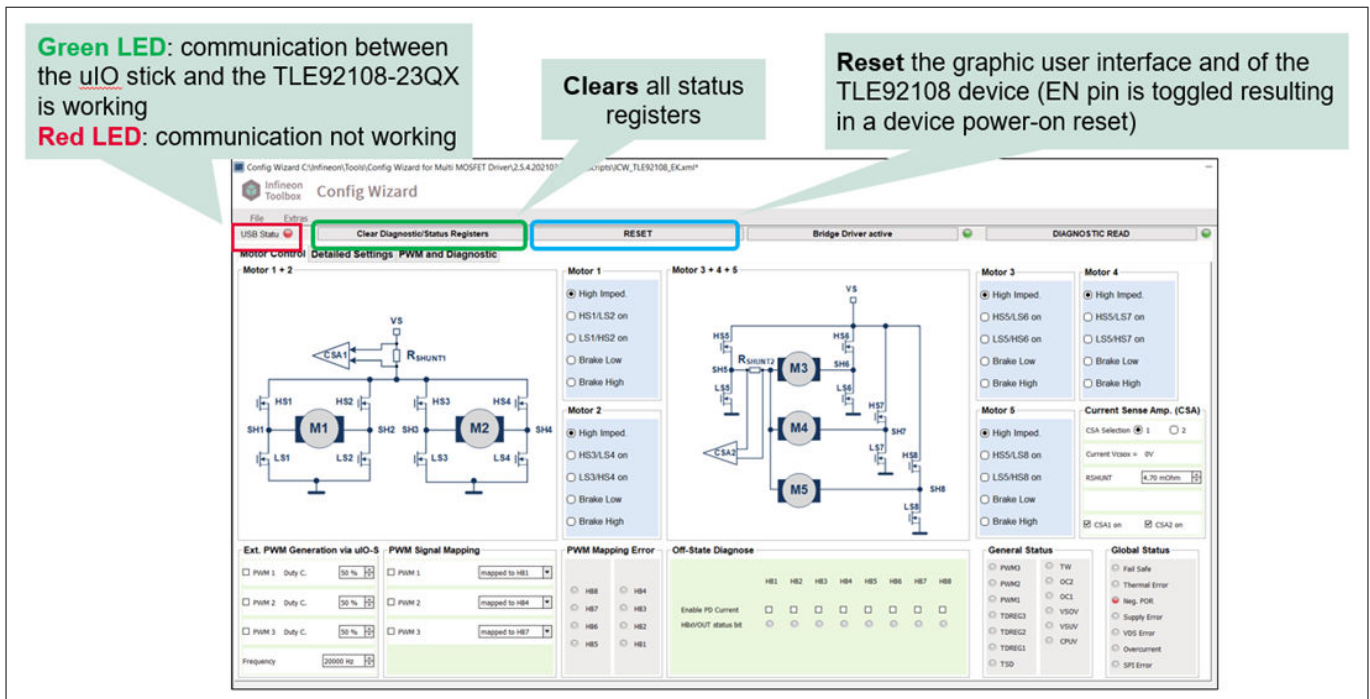


Figure 19 TLE92108 EVALKIT motor control panel

- Motor 1/2/3/4/5:
- Select motor and define state and half bridge settings
- Ext. PWM generation via μ IO-stick:
- Define PWM duty cycle and frequency
- PWM signal mapping:
- Map PWM channel to specific half bridge
- PWM mapping error:
- LED lights showing error in PWM channel
- Off-state diagnose:
- Enable PD current and check HBxVOUT status bits from LED
- General status:
- LED lights showing state of general status register
- Current sense amp. (CSA):
- CSA selection: CSA1 or CSA2
- Define R_{shunt} value
- Enable/disable CSA1 and CSA2
- Global status:
- LED lights showing global status byte

3 Getting started

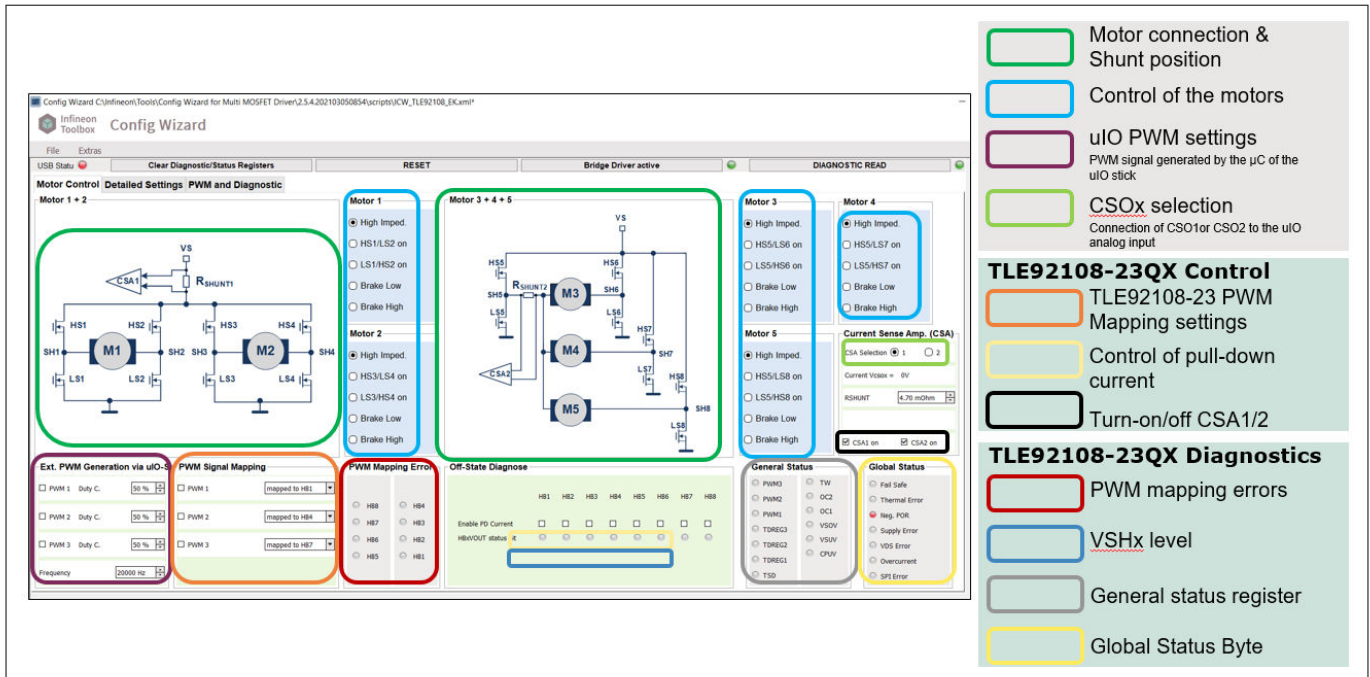


Figure 20 TLE92108 EVALKIT motor control panel and details

Detailed settings:

Configure general control parameters, bridge driver passive settings, current sense specifications and gate driver parameters

Set thresholds, blank time and charge/discharge current for each HB

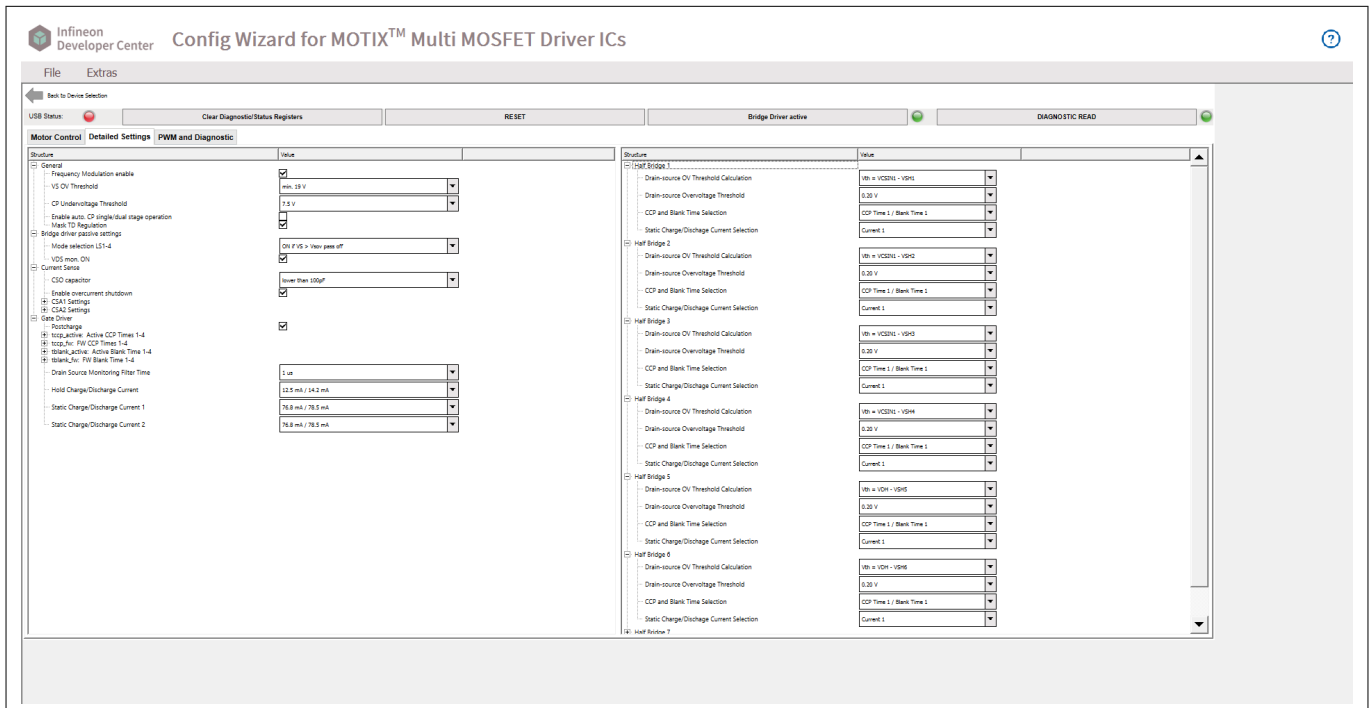


Figure 21 TLE92108 EVALKIT detailed settings panel

PWM and diagnostic:

Set detailed information of PWM

Display PWM switching characteristics in real time

3 Getting started

Display global status byte, general status register, PWM mapping error and drain-source over-voltage error

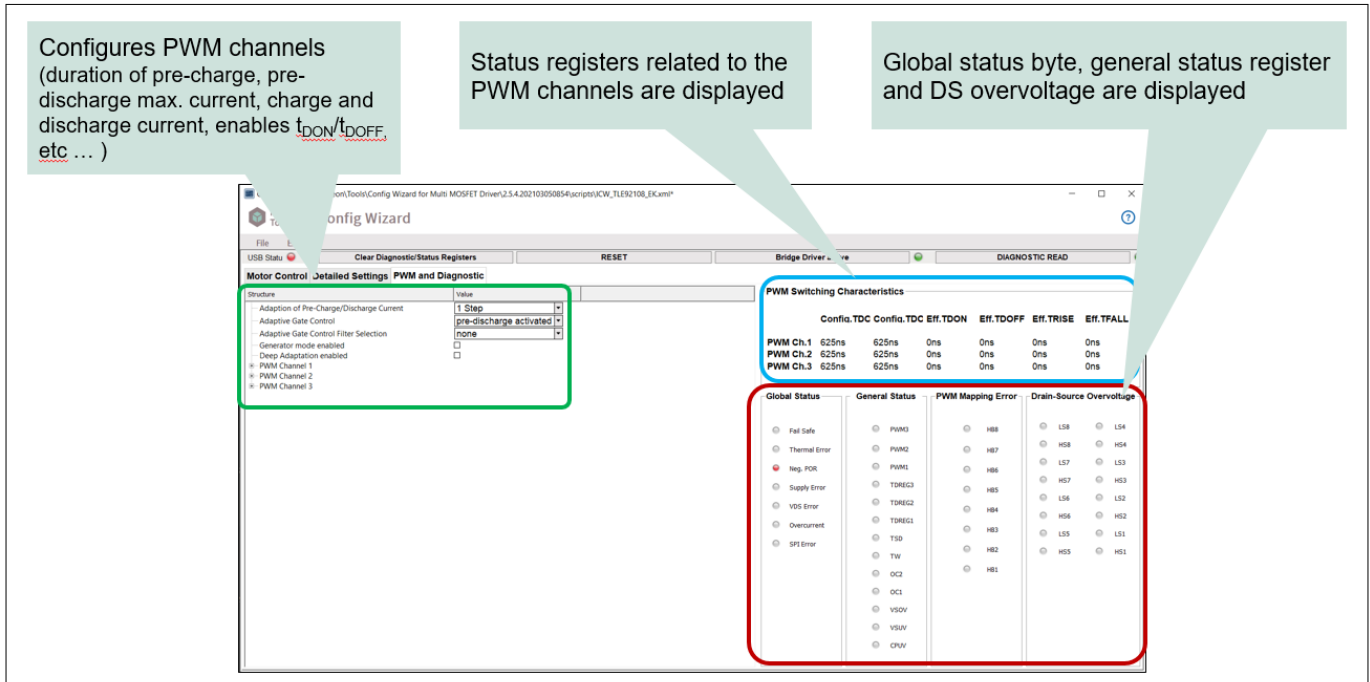


Figure 22 TLE92108 EVALKIT PWM and diagnostic pane

3.2 Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE92108 APPKIT

USB Status LED:

Green: indicates that the communication between the μ IO stick and the TLE92108-23QX is working

Red: indicates that the communication not working

Clear Diagnostic/Status Registers:

All of the diagnostic/status register should be cleared

Reset:

Reset the graphic user interface and of the TLE92108 device (EN pin is toggled resulting in a device power-on reset)

Motor 1/2/3/4:

Select motor and define state and half bridge settings

Ext. PWM generation via μ IO-stick:

Define PWM duty cycle and frequency

PWM signal mapping:

Map PWM channel to specific half bridge

PWM mapping error:

LED lights showing error in PWM channel

Off-state diagnose:

Enable PD current and check HBxVOUT status bits from LED

General status:

LED lights showing state of general status register

Current sense amp. (CSA):

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CSA selection: CSA1 or CSA2

Define R_{shunt} value

Enable/disable CSA1 and CSA2

Global status:

LED lights showing global status byte

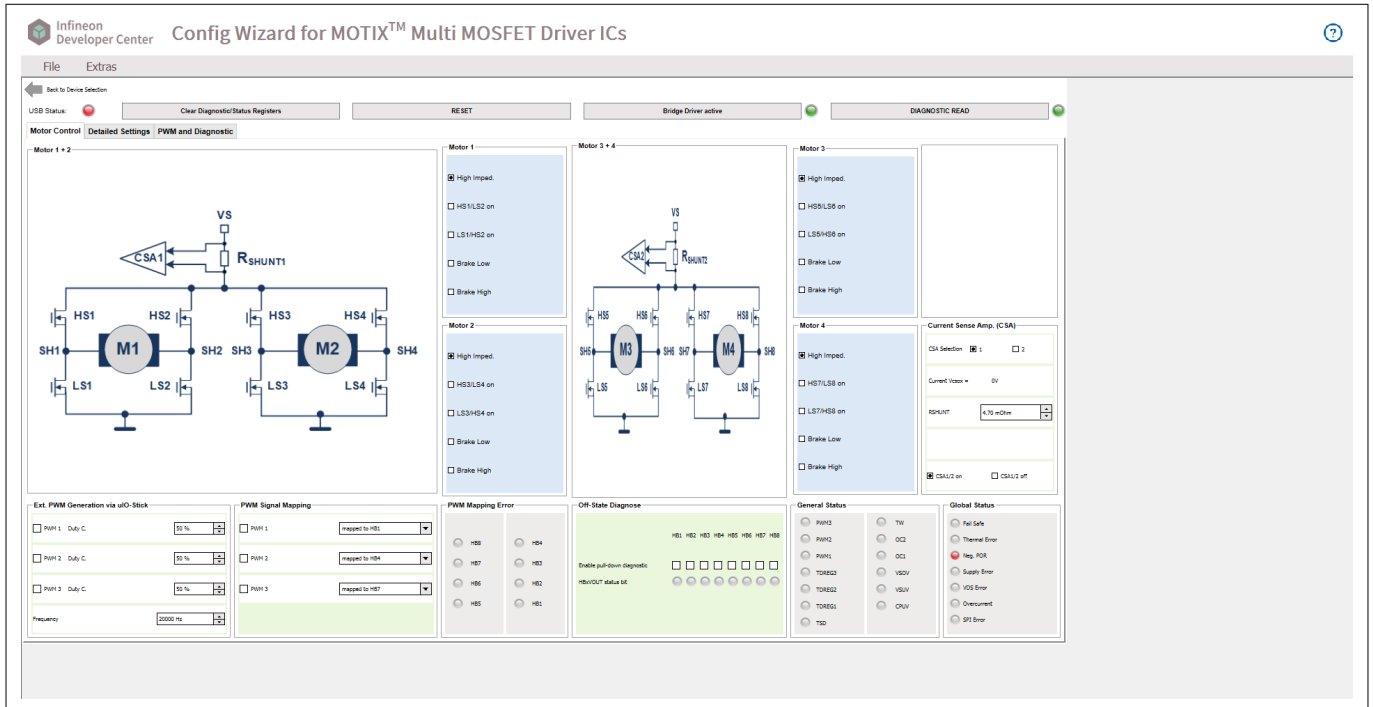


Figure 23 TLE92108 APPKIT motor control panel

Detailed settings:

Configure general control parameters, bridge driver passive settings, current sense specifications and gate driver parameters

Set thresholds, blank time and charge/discharge current for each HB

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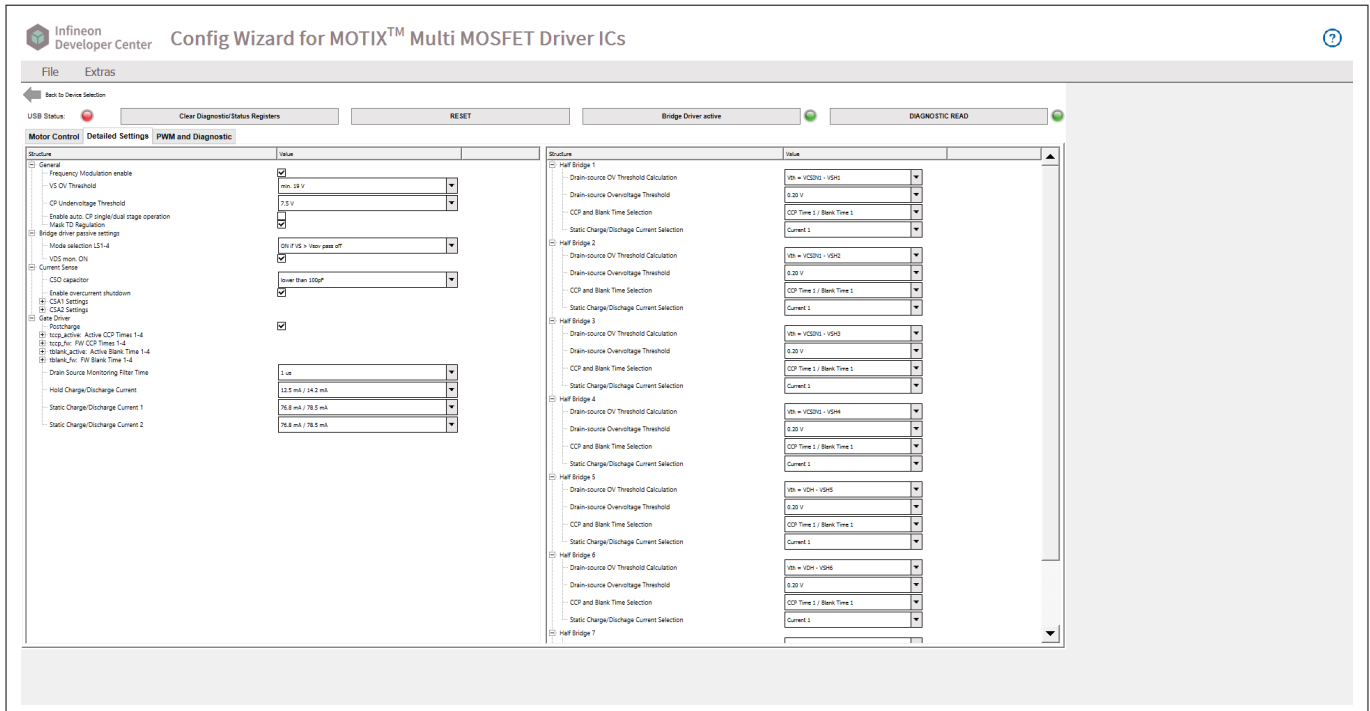


Figure 24 TLE92108 APPKIT detailed settings panel

PWM and diagnostic:

Set detailed information of PWM

Display PWM switching characteristics in real time

Display global status byte, general status register, PWM mapping error and drain-source over-voltage error

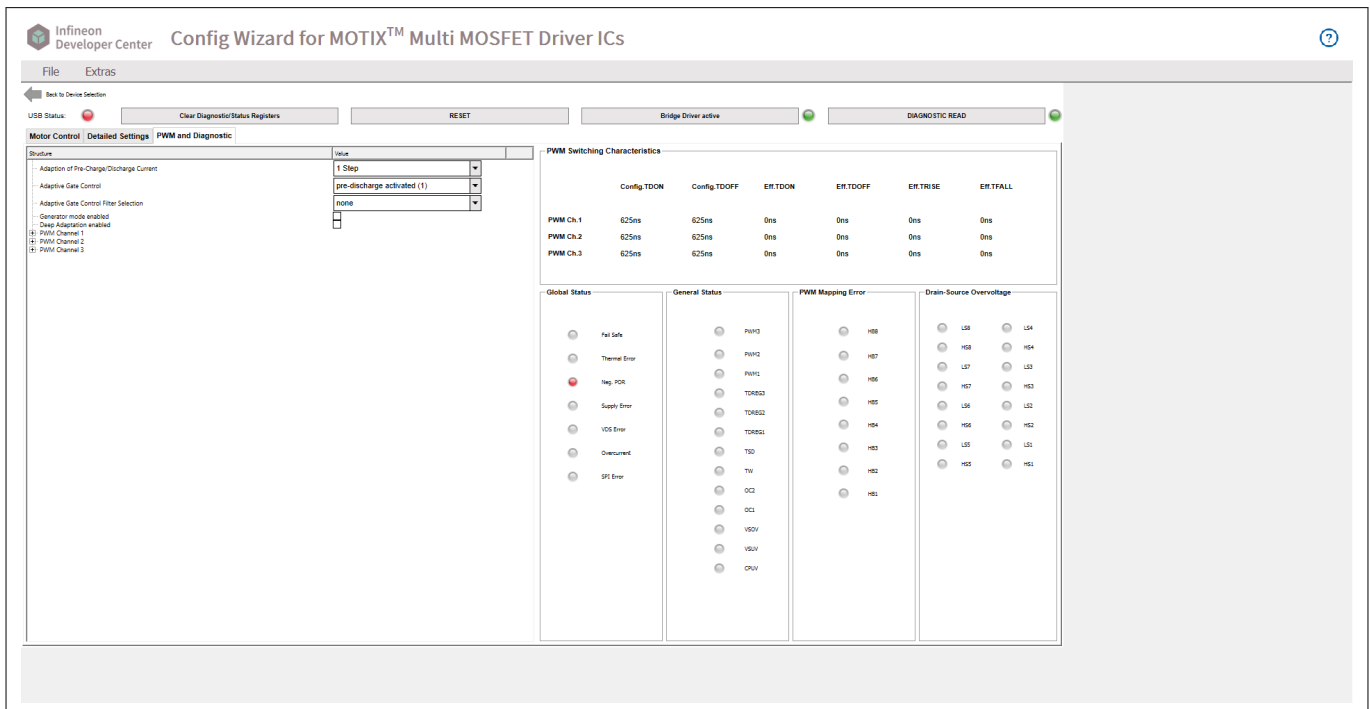


Figure 25 TLE92108 APPKIT PWM and diagnostic panel

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3.3 Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE92104 APPKIT

USB status LED:

Green: indicates that the communication between the μ IO stick and the TLE92104-23QX is working

Red: indicates that the communication not working

Clear diagnostic/status registers:

All of the diagnostic/status register should be cleared

Reset:

Reset the graphic user interface and of the TLE92104 device (EN pin is toggled resulting in a device power-on reset)

Motor 1/2:

Select motor and define state and half bridge settings

Ext. PWM generation via μ IO-Stick:

Define PWM duty cycle and frequency

PWM signal mapping:

Map PWM channel to specific half bridge

PWM mapping error:

LED lights showing error in PWM channel

Off-state diagnose:

Enable PD current and check HBxVOUT status bits from LED

General status:

LED lights showing state of general status register

Current sense amp. (CSA):

CSA selection: CSA1 or CSA2

Define R_{Bshunt} value

Enable/disable CSA1 and CSA2

Global status:

LED lights showing global status byte

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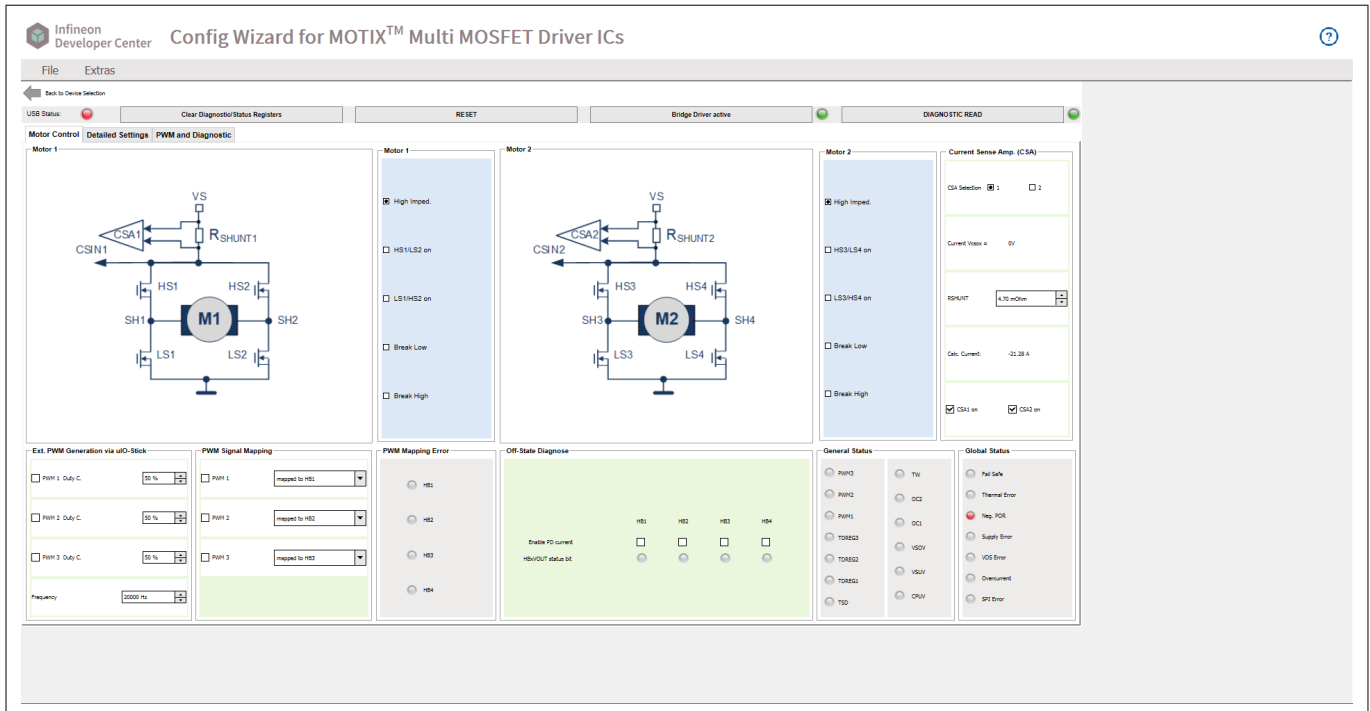


Figure 26 TLE92104 APPKIT motor control panel

Detailed settings:

Configure general control parameters, bridge driver passive settings, current sense specifications and gate driver parameters

Set thresholds, blank time and charge/discharge current for each HB

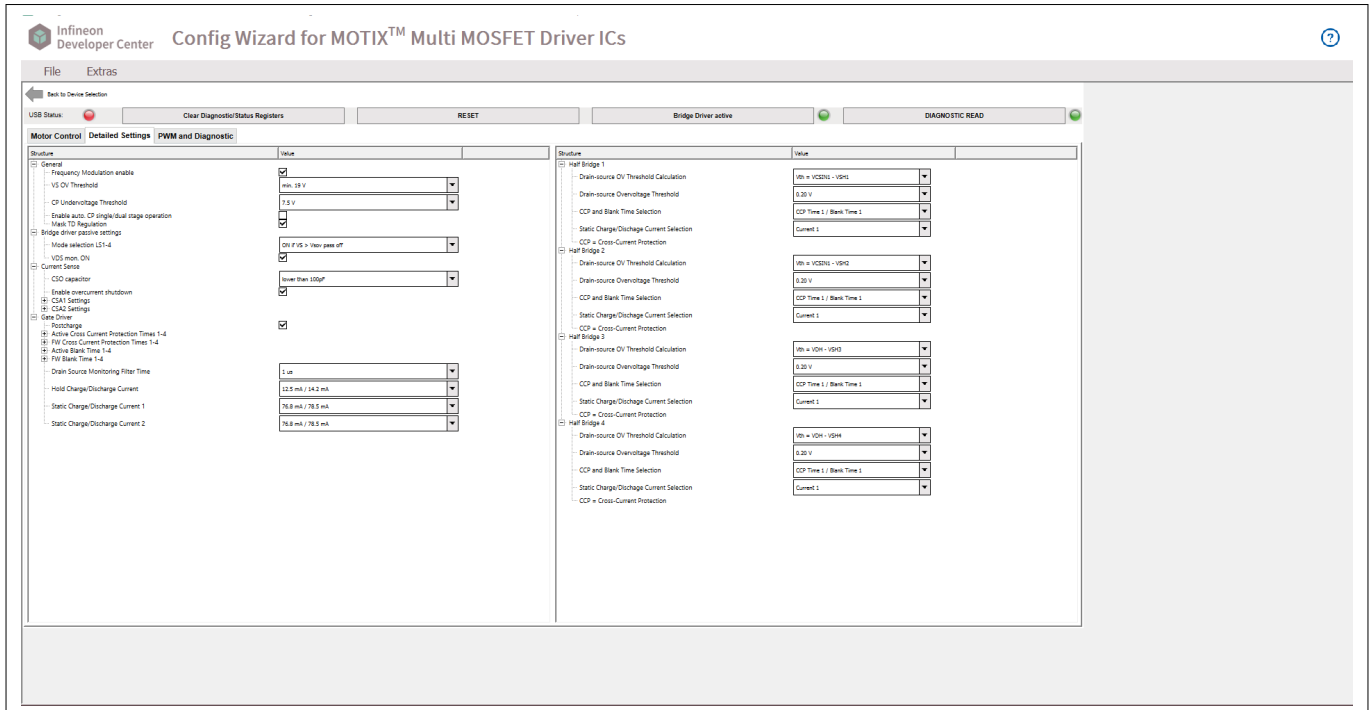


Figure 27 TLE92104 APPKIT detailed settings panel

PWM and diagnostic:

Set detailed information of PWM

Display PWM switching characteristics in real time

3 Getting started

Display global status byte, general status register, PWM mapping error and drain-source overvoltage error

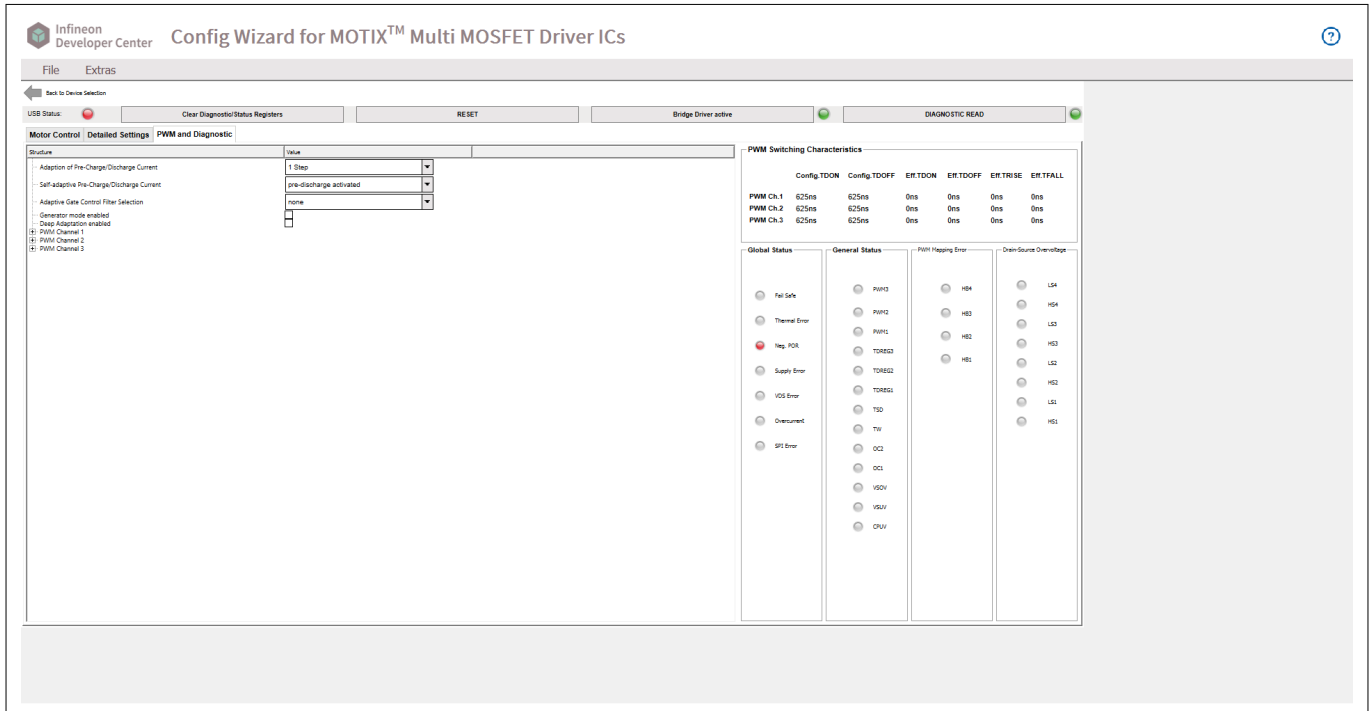


Figure 28 TLE92104 APPKIT PWM and diagnostic panel

3.4 Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE9210x GATE DRIVER SETTINGS

3.4.1 Datasheet MOSFET parameters

Configure parameters of MOSFET to be controlled by the MOSFET driver in this section.

Table 1 List of MOSFET input parameters

Abbreviation	Definition	Unit	Comment
Qgs_typ	Typical MOSFET gate-source charge	nC	According to the datasheet conditions
Qgd_typ	Typical MOSFET gate-drain charge	nC	According to the datasheet conditions
Qg_typ	Typical MOSFET total gate charge	nC	According to the datasheet conditions (in general @Vgs = 10 V)
Vdd_typ	Vds at which Qgd_typ is specified	V	e.g. For IPZ40N04S5-3R1: Vdd_typ = 32 V
Vgh_typ	Vgs at which Qg_typ is specified for full turn-on	V	e.g. For IPZ40N04S5-3R1: Vgh_typ = 10 V
Vplateau_typ	Vgs plateau at which Qgs_typ is specified	V	For IPZ40N04S5-3R1: Vplateau_typ=4.4 V @ Ids=40A

(table continues...)

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Table 1 (continued) List of MOSFET input parameters

Abbreviation	Definition	Unit	Comment
Vgs_th	Vgs threshold according to the typical application conditions (Ids, etc...)	V	According to the datasheet conditions
Ciss_vs	MOSFET input capacitance for drain-source voltage with Vds = Vs	pF	Corresponding to the nominal application conditions (Vs = 14 V in this application note)
Crss_vs	MOSFET reverse transfer capacitance with Vds = Vs	pF	
Crss_typ	MOSFET reverse transfer capacitance at Vds = Vdd_typ	pF	

3.4.2 Application conditions

This section specifies the application parameters: voltage level, timing and adaptive gate control. For detailed information of each parameter, please check [Table 2](#).

Table 2 List of input parameters in the application conditions

Abbreviation	Definition	Unit	Comment
Vs	Nominal application supply voltage	V	Vs = 14 V in this document
Vgh	MOSFET driver gate-source voltage when the gate is fully charged	V	
Vplateau	Vgs plateau in the application conditions	V	
trise_target	Active MOSFET target rise time	ns	
tfall_target	Active MOSFET target fall time	ns	
toff_fw_target	FW MOSFET target turn-off time	ns	
tdon_min_margin	Additional delay between the end of the pre-charge phase and the moment when Vgs reaches Vgs_th	ns	300 ns in the examples
tdoff_min_margin	Additional delay between the end of the pre-discharge phase and the moment when Vds decreases (Vgs reaches Vplateau)	ns	300 ns in the examples

(table continues...)
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Table 2 (continued) List of input parameters in the application conditions

Abbreviation	Definition	Unit	Comment
t_margin	Margin in % added to the min. required cross-current protection time and blank time	%	30 % in the examples
tpchg	Gate driver pre-charge time	ns	TPRECHG register
tpdchg	Gate driver pre-discharge time	ns	TPRECHG register
AGC	Adaptive gate control bit		GENTCTRL register

3.4.3 Calculated MOSFET parameters

This section displays calculated parameters with given MOSFET parameters. As is shown in [Figure 29](#).

Calculated MOSFET parameters:		
Qgs	7.308	nC
Qgd	5.885	nC
Qg	33	nC
Ciss_0V	2893	pF

Figure 29 Calculated MOSFET parameters

Qg, Qgd, Qg are required parameters for the control of the switching times of the active MOSFET. Refer to [Figure 30](#) for the definition.

These parameters depend on the working point of the active MOSFET. Indeed, these gate charges vary (among others) with:

- The applied drain-source voltage
- The MOSFET Ids current
- The applied gate-source voltage, when the MOSFET is turned on (Vgh)

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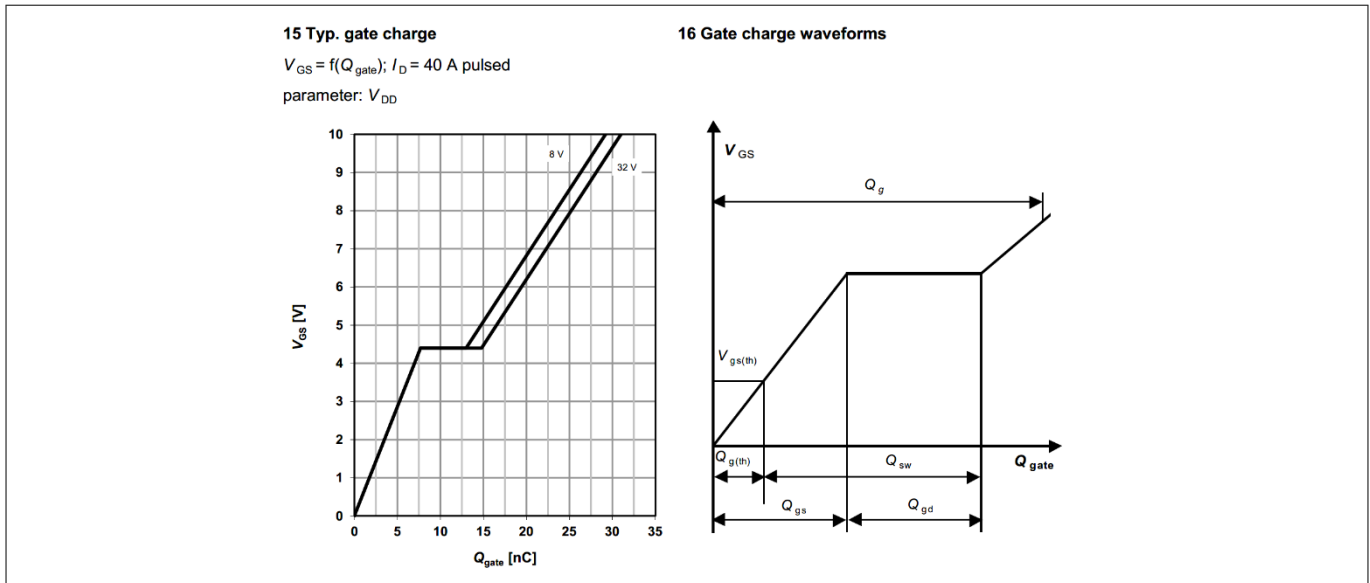


Figure 30 Definition of gate charge

For a more accurate control of the switching times, the gate charges must be adapted to the specific application conditions.

Ciss_vs is the input capacitance under the following conditions: $V_{ds} = V_s$ and $V_{gs} = 0 \text{ V}$. Ciss_vs is needed to set conditions on the gate driver configurations for the pre-charge phase (AGC = 1 or 2), in order to avoid a too fast current increase of Ids (i.e. high dI_{ds} / dt) during the turn-on of the MOSFET.

3.4.4 Calculated Output

Curves showing the switching of MOSFET with given MOSFET parameters and application settings

For details of this calculation tool, please check the application note ‘Step-by-step MOSFET driver setting guide and calculator description’.

tRISE: is the target rise time of the active MOSFET. This parameter is defined as the duration of the V_{ds} slope at the turn-on of the active MOSFET (refer to Figure 31).

tFALL: is the target fall time of the active MOSFET. This parameter is defined as the duration of the V_{ds} slope at the turn-off of the active MOSFET (refer to Figure 31).

tDON: is the turn-on delay time.

tDOFF: is the turn-off delay time.

toff_fw: is the target switch-off time of the FW MOSFET.

ton_fw: is the target switch-on time of the FW MOSFET.

tCCP_ACTIVE: is the cross-current protection time of the active MOSFET. The gate driver must be configured so that active MOSFET is off before the end of the tCCP_ACTIVE

tCCP_FW: is the cross-current protection time of the FW MOSFET. The gate driver must be configured so that the FW MOSFET is off before the end of the tCCP_FW.

tBLANK_ACTIVE: is the blank time of the active MOSFET.

tBLANK_FW: is the blank time of the FW MOSFET.

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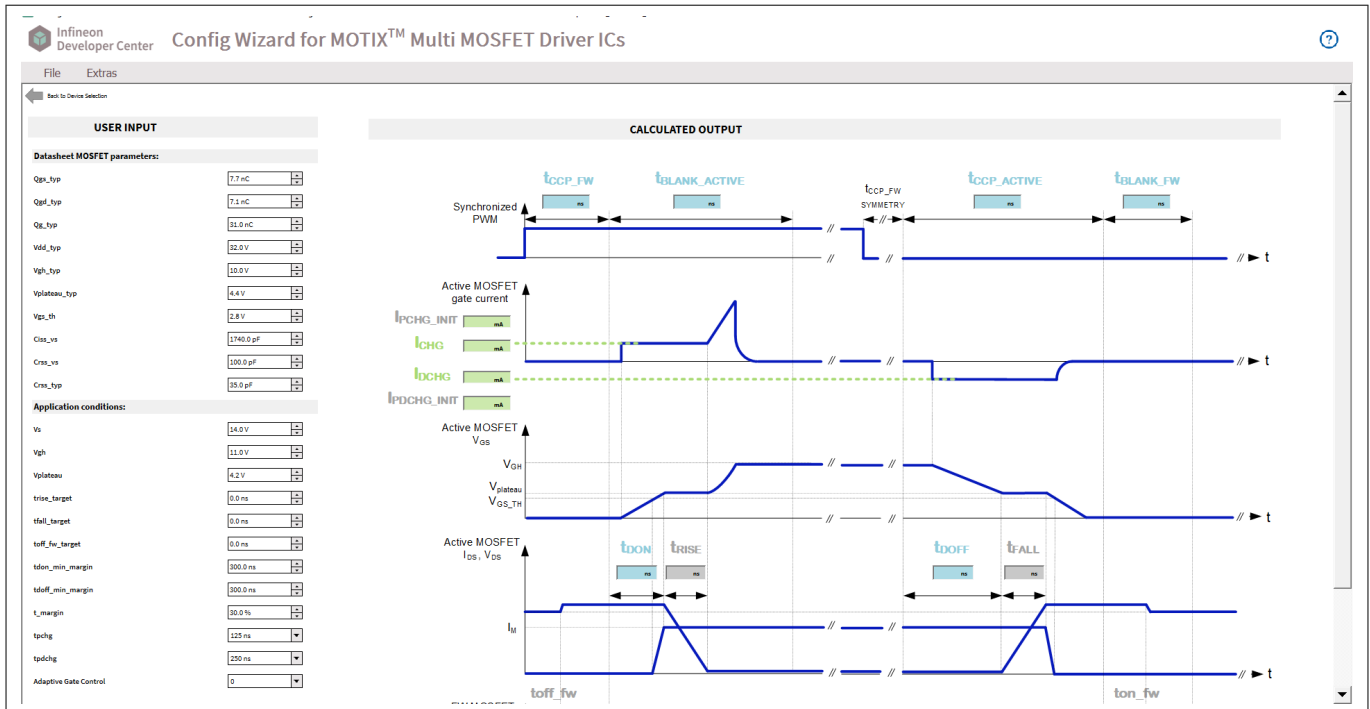


Figure 31 Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE9210x gate driver settings panel

3.5 Config Wizard for MOTIX™ Multi MOSFET Driver ICs for TLE92108 Register Setting Tool

µIO stick connected LED:

Green: indicates that the communication between the µIO stick and the TLE92108-23QX is working

Red: indicates that the communication not working

Target IC accessible:

The device is accessible and ready for read or write

Clear diagnostic/status registers:

Clear all status registers

RESET:

Reset the graphic user interface and of the TLE92108 device (EN pin is toggled resulting in a device power-on reset)

Register domain:

Set the domain of register (CTRL register or STAT register) to be written or read

Register:

Set the register of specific register domain to be written or read

Read:

Read the value from selected register

Write/clear:

Write or clear the value in selected register

Right arrow:

Write the defined value to a temporary list

Left arrow:

4 Example of Config Wizard for MOTIX™ Multi MOSFET Driver ICs configuration with TLE92108 EVALKIT

Read the register value from a loaded list

Overwrite line:

Overwrite the lines in the list from selected line onwards

Delete Line:

Delete the selected line in the list

Delete all:

Delete all of the selected lines in the list

SEND:

Send the list of settings to the device

Single-step:

Execute the settings in the list line by line

Loop count:

Define how many times the settings in the list should be repeated

Load:

Load settings from an existing file

Partial load:

Load the setting partially from an existing file

Save:

Save the settings to an .icwp file

Export:

Export register settings to a .c file

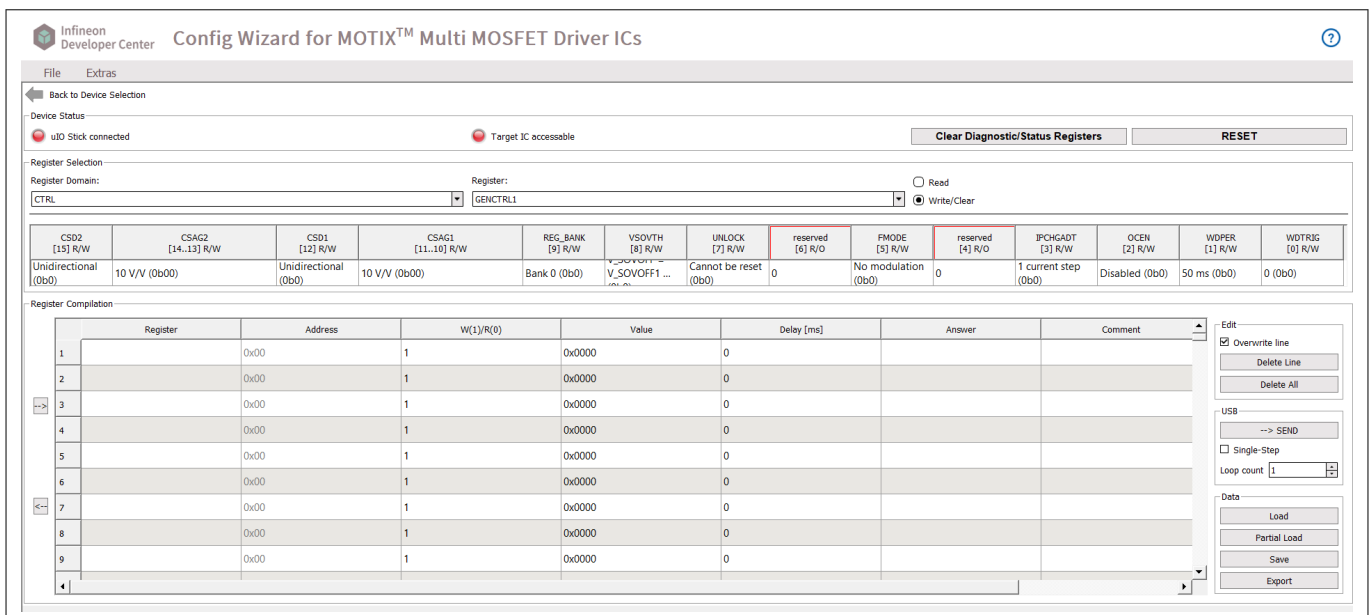


Figure 32 TLE92108 Register Setting Tool control panel

4 Example of Config Wizard for MOTIX™ Multi MOSFET Driver ICs configuration with TLE92108 EVALKIT

The motor implemented for this test is a 12 V brush DC motor with 2 pole pairs. This motor features with high speed of rotation and large moment of force, which is 1 Kgf.cm. The motor is powered with a 12 V DC voltage source. At this voltage level, the rated speed of the motor is 3500 RPM, and the rated power is 30 W.

4 Example of Config Wizard for MOTIX™ Multi MOSFET Driver ICs configuration with TLE92108 EVALKIT

As is shown in Figure 33, half bridge 1 and half bridge 2 are enabled, where LS1 is the active MOSFET controlled by PWM1 with a defined duty cycle. In this case, HS1 is the freewheeling MOSFET. All other configurations are from default settings defined in Config Wizard for MOTIX™ Multi MOSFET Driver ICs provided as reference. Please note that the Config Wizard for MOTIX™ Multi MOSFET Driver ICs pre-configures the control registers of TLE92108/4 and optimized the settings for the IPZ40N04S5-3R1 MOSFET.

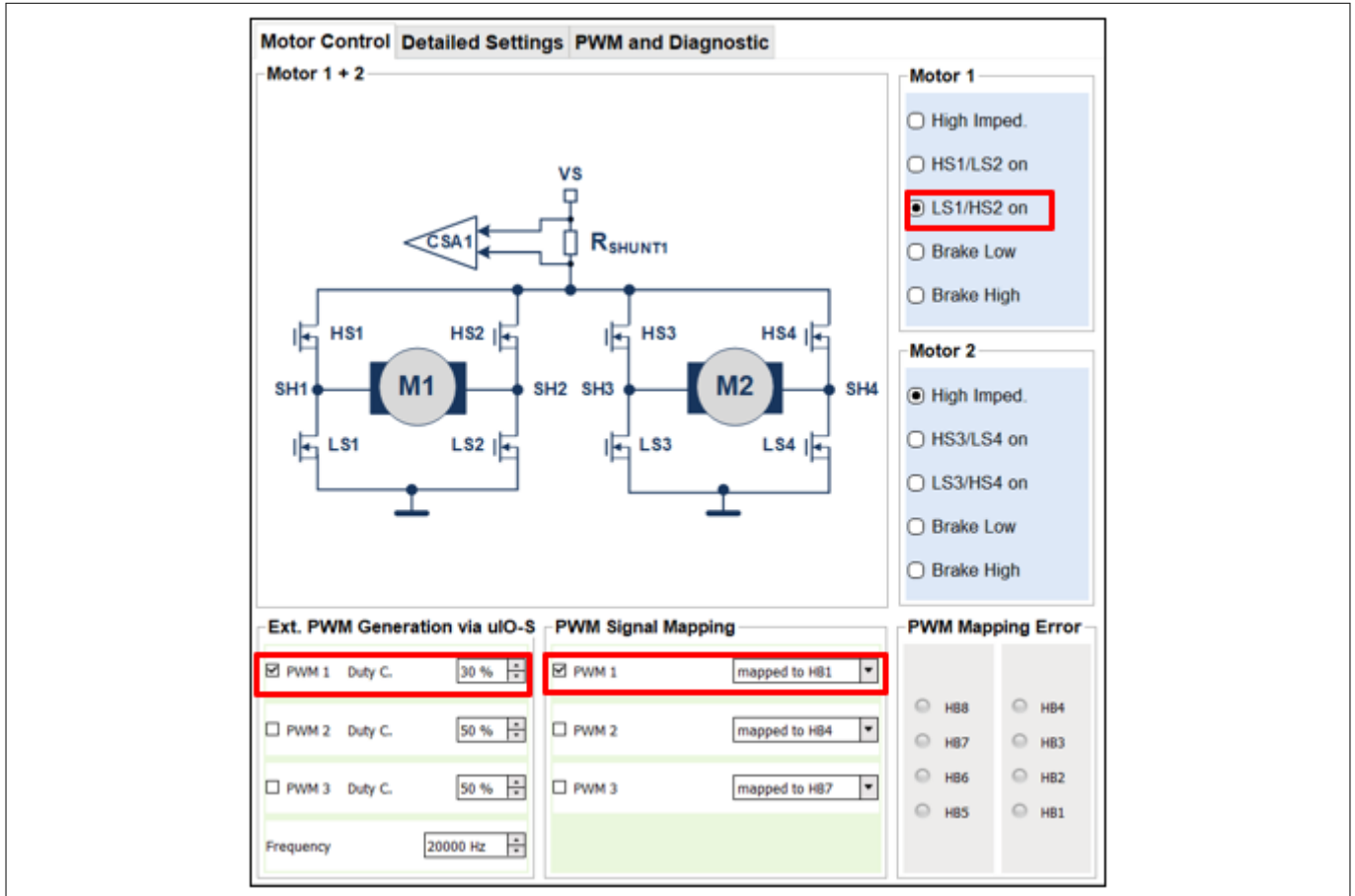


Figure 33 Configuration with LS1/HS2 on and PWM1 mapped to HB1

To better understand the switching behavior of the device, following pins of EVALKIT are measured:

- PWM1: PWM signal applied to PWM 1
- V_{GLS1} : voltage of low side 1 gate
- V_{SH1} : voltage of junction point between high side 1 and low side 1
- I_G : gate current of low side 1

As is shown in Figure 34, the gate driver is switched on and off with the control of PWM signal.

5 Disclaimer

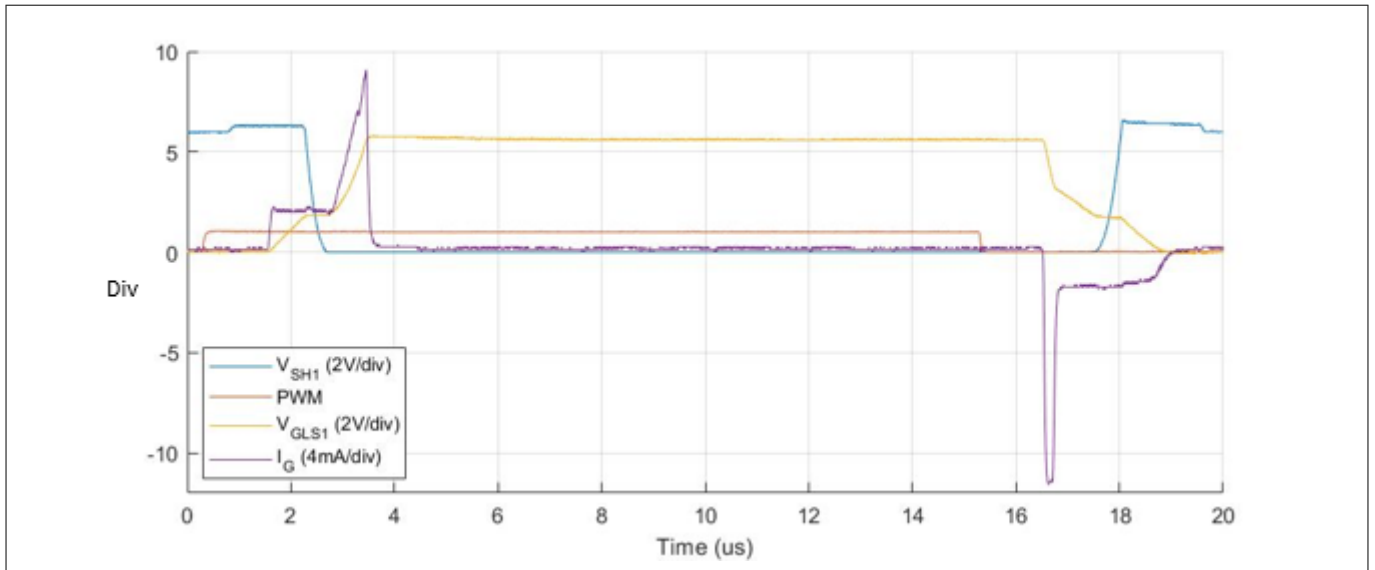


Figure 34 Overview of measurement result with default configuration

5 Disclaimer

Config Wizard for MOTIX™ Multi MOSFET Driver ICs is based in part on the work of the Qwt project (<http://qwt.sf.net>).

The following LGPL/GPLv3 are used in our software and can be found in the license folder:

- QuaZip
- qt 5.12.2
- libiconv 1.14
- PythonQt

Revision history

Document version	Date of release	Description of changes
01.10	2022-09-30	Graphical user interface (GUI) for TLE92108 Register Settings added
01.00	2022-06-03	Initial document release

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