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 IC products 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.
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 EVALKT: 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

- μIO stick

![μIO stick](image)

Figure 1  μIO stick

- TLE92108 Evaluation Board (EVALKIT) or TLE9210x Application Kit (APPKIT), see Figure 2 and Figure 3
1.3 Connections

Please prepare the setup as instructed:

- Connect the μIO 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 μIO 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

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

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 μIO 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)
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 μIO-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

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

USB Status LED:
Green: indicates that the communication between the μIO 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 μIO-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):
3 Getting started

CSA selection: CSA1 or CSA2
Define $R_{\text{shunt}}$ 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
3 Getting started

**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
3 Getting started

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

USB status LED:
- Green: indicates that the communication between the µIO 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 µIO-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 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

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

(table continues...)
### 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

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
<th>Unit</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vs</td>
<td>Nominal application supply voltage</td>
<td>V</td>
<td>Vs = 14 V in this document</td>
</tr>
<tr>
<td>Vgh</td>
<td>MOSFET driver gate-source voltage when the gate is fully charged</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Vplateau</td>
<td>Vgs plateau in the application conditions</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>trise_target</td>
<td>Active MOSFET target rise time</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tfall_target</td>
<td>Active MOSFET target fall time</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>toff_fw_target</td>
<td>FW MOSFET target turn-off time</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tdon_min_margin</td>
<td>Additional delay between the end of the pre-charge phase and the moment when Vgs reaches Vgs_th</td>
<td>ns</td>
<td>300 ns in the examples</td>
</tr>
<tr>
<td>toff_min_margin</td>
<td>Additional delay between the end of the pre-discharge phase and the moment when Vds decreases (Vgs reaches Vplateau)</td>
<td>ns</td>
<td>300 ns in the examples</td>
</tr>
</tbody>
</table>
Table 2 (continued) List of input parameters in the application conditions

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

3.4.3 Calculated MOSFET parameters

This section displays calculated parameters with given MOSFET parameters. As is shown in Figure 29.

![Calculated MOSFET parameters]

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)
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: Vds = Vs and Vgs = 0 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 dIdS / 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 Vds 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 Vds 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.
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:
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

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 Kgfc.m. 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.
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](image-url)

**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

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

<table>
<thead>
<tr>
<th>Document version</th>
<th>Date of release</th>
<th>Description of changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.10</td>
<td>2022-09-30</td>
<td>Graphical user interface (GUI) for TLE92108 Register Settings added</td>
</tr>
<tr>
<td>01.00</td>
<td>2022-06-03</td>
<td>Initial document release</td>
</tr>
</tbody>
</table>

Figure 34 Overview of measurement result with default configuration
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