Generic power board design for 12 V application - SSO8/sTOLL/S3O8/mTOLG and TLE9879QXA40

Demonstration software - Getting started

About this document

Scope and purpose

This user manual describes the use of the demonstration software V 1.1 for the Generic Power Board equipped with the SoC MOTIX™ MCU TLE9879QXA40 in combination with different automotive power MOSFETs, e.g. in leadless SSO8 package.

Target

The user manual is targeting to the following Generic Power boards:

Table 1

Evaluation board	SP number	comment
MOS_GENERIC_POW_BOARD	SP005875129	TLE9879QXA40 + OptiMOS-6™
MOS7_GENERIC_POW_BOARD	SP006016660	TLE9879QXA40 + OptiMOS-7™
STOLL_MOS_GENERIC	SP006103346	TLE9879QXA40 + OptiMOS-7™
S3O8_MOS_GENERIC	SP006166385	TLE9879QXA40 + OptiMOS-7™
MTOLG_MOS_GENERIC	SP006166389	TLE9879QXA40 + OptiMOS-7™

Intended audience

This document is written for skilled technical staff. The technical staff must be qualified for laboratory usage, sufficient to identify and control any hazard that arise from usage of an evaluation board connected to an electric motor.

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1 Hardware

1.1 Description

The demonstration software refers to the different versions of the Generic Power Board. A block diagram of the reference hardware setup is shown in Figure 1.

The DUT, the Generic Power Board, is biased by the power supply PS2. To cover the complete functional range of input voltage (from 7V to 17V), a 20V power supply supporting 5A current limitation is recommended. The phase outputs X1, X2 and X3 of the DUT are connected to the motor load. As motor load acts the three-phase current synchronous machine DB42S02 from Nanotec® [1]. The rated power of this BLDC motor is 42W. To achieve a defined constant mechanical load to the engine, the current-controlled hysteresis brake HB-50-2DS from Mobac® [2] is mechanically connected to the BLDC motor. The demanded torque furnished by the brake is continuously adjustable via power supply PS1, either current or voltage controlled. A detailed description of how to adjust the brake is available in [3]. To flash the embedded software into the program memory of the SoC MOTIX™ MCU and perform debug sessions, the debugger probe must be connected to the DUT. The XMC™ Link is an isolated debug probe for flashing and debugging the MOTIX™ microcontroller devices via Serial-Wire- Debug (SWD).

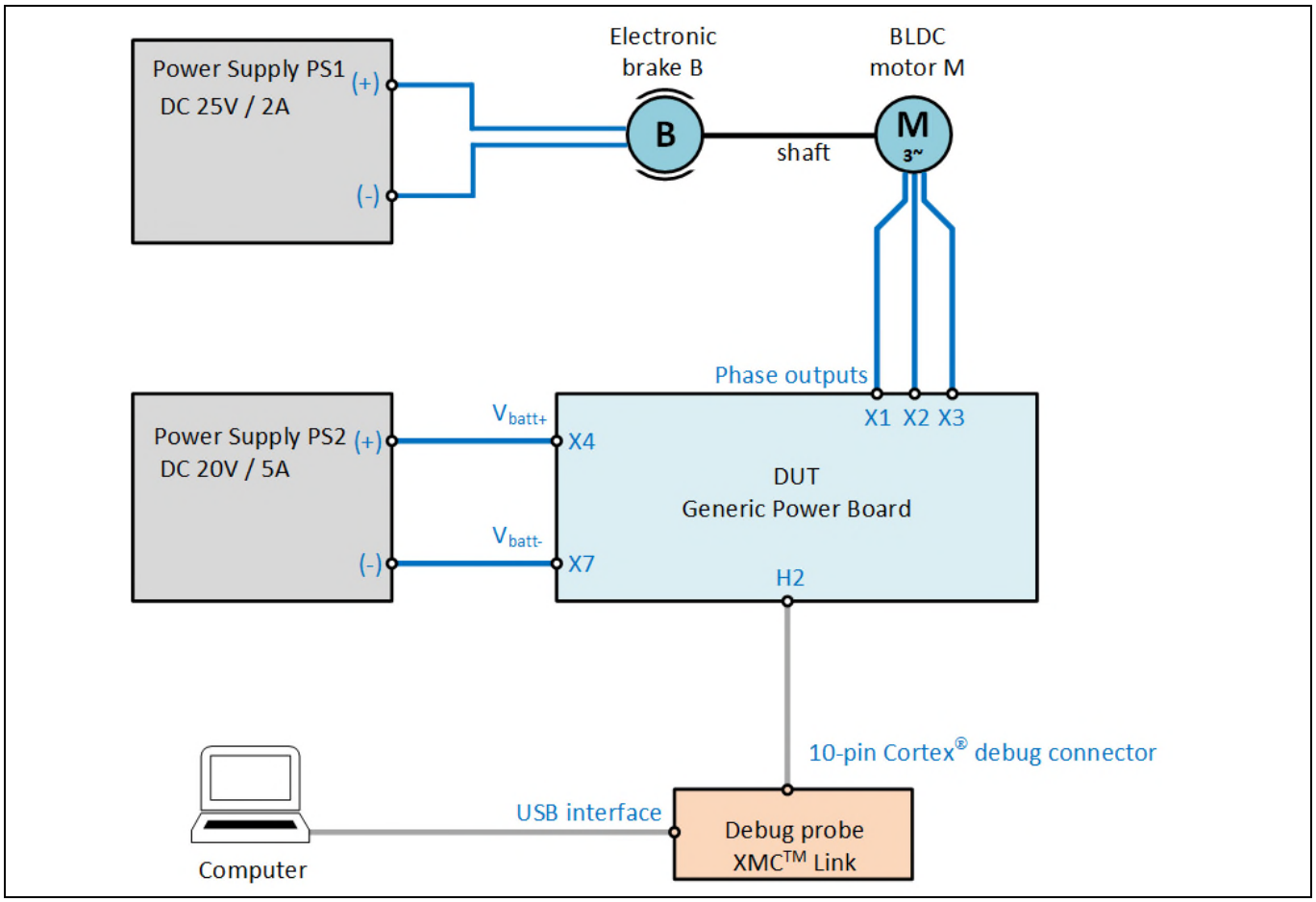


Figure 1 Simplified block diagram of the reference hardware setup

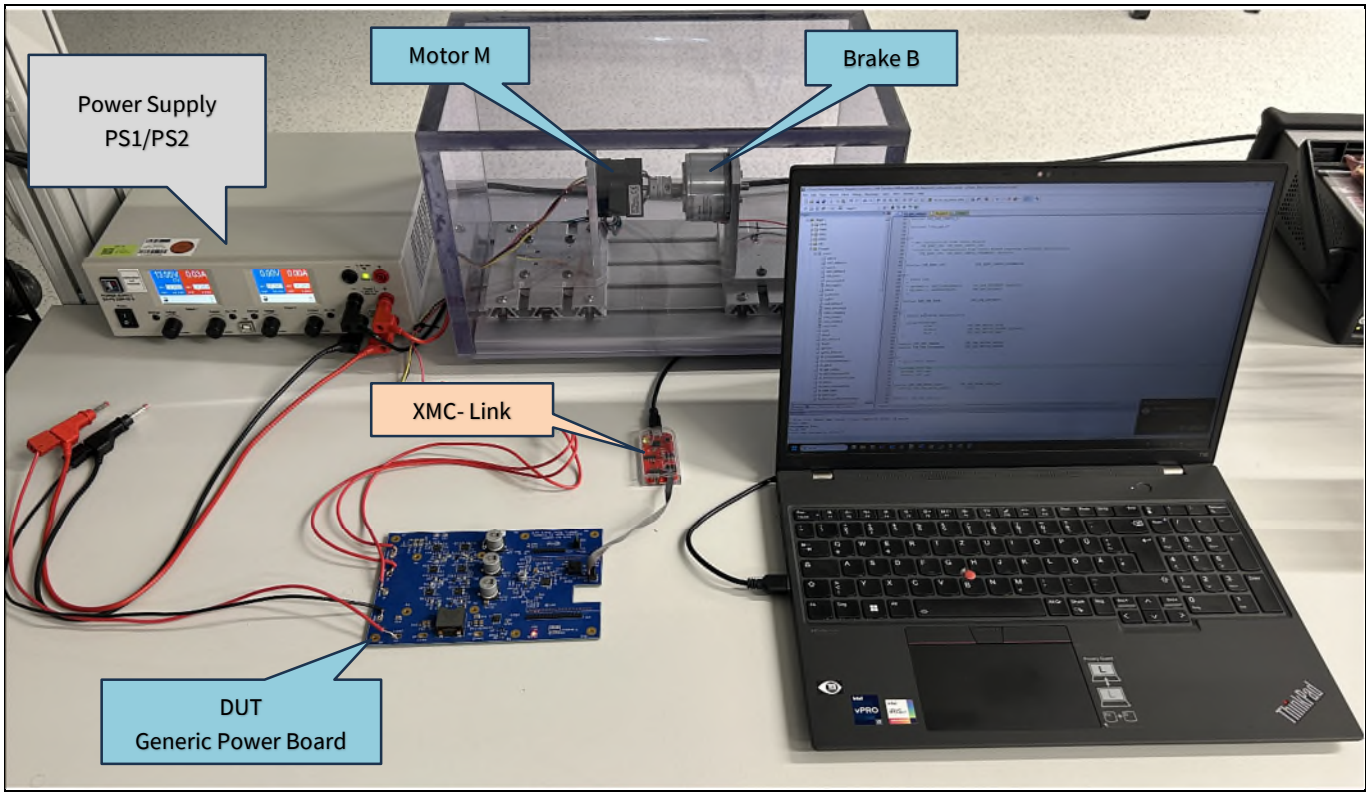


Figure 2 Reference hardware setup

Infineon's BLDC MOTIX™ motor bench in a portable package [11] provides a solution to combine a BLDC motor load with Infineon's evaluation boards or reference designs for BLDC motor control. The BLDC MOTIX™ motor bench is equipped with the synchronous motor DB42S03 from Nanotec [15] and the hysteresis brake HB-50-2DS from Mobac® [2] connected to each other via mechanical link.

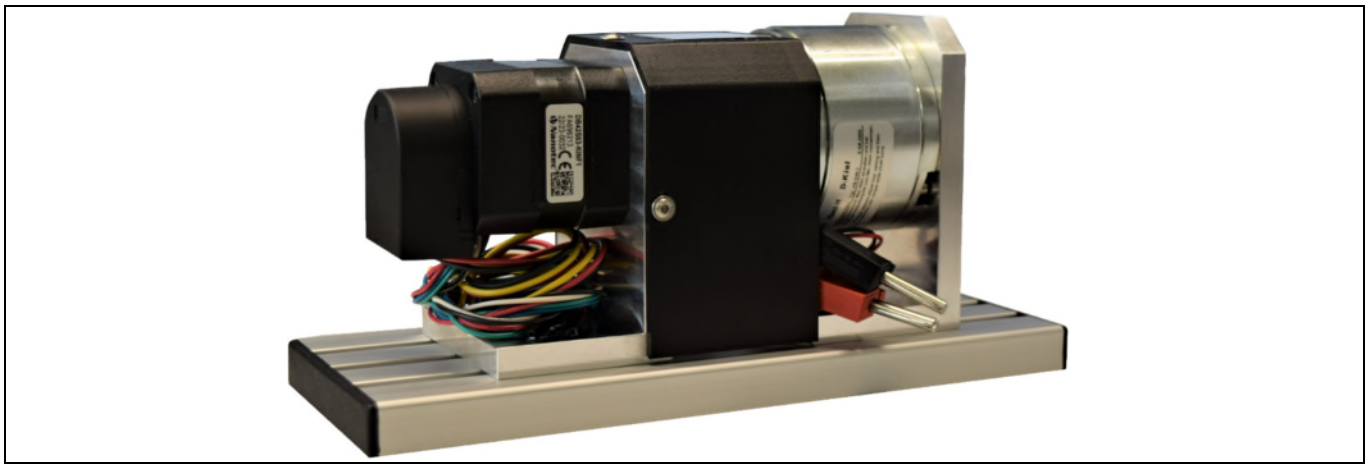


Figure 3 MOTIX™ motor bench

Depending on whether the DB42S02 or DB42S03 motor is used with the Generic Power Board, the parameter set in the Config Wizard must be adjusted as described in the chapter 'Config Wizard'. The demonstration software in delivery state is set up for the motor DB42S03.

1.2 Specific hardware configurations

1.2.1 Shunt resistors

For individual board configurations up to three shunt resistors can be populated (Rsh1, Rsh2, Rsh3). The PCB comes with one 2mΩ shunt resistor assembled (Rsh1). However, the first batch of the Generic Power Boards with OptiMOS™-6 SSO8 is equipped with three shunt resistors each 2W/2mΩ (Rsh1, Rsh2, Rsh3). In that case or if the PCB has more than one shunt resistor due to modifications from individual previous projects, it is strongly recommended to remove and reduce the overall shunt resistor value to only 2mΩ for the use of this demonstration software.

To measure the sum of the current coming from DC- link to all three inverter half-bridges with this demonstration software and its preconfigured settings, an overall shunt resistor value of 2mΩ on the board is recommended. The operation of the board together with the defined motor load is optimized and tested by using an overall shunt resistor value of 2mΩ. Changing the shunt resistor's value would require software changes.

If the Generic Power Board is populated with three shunt resistors, it is strongly recommended to remove two of the three shunt resistors (i.e. Rsh2 & Rsh3) from the PCB to get an overall shunt resistor value of 2mΩ.

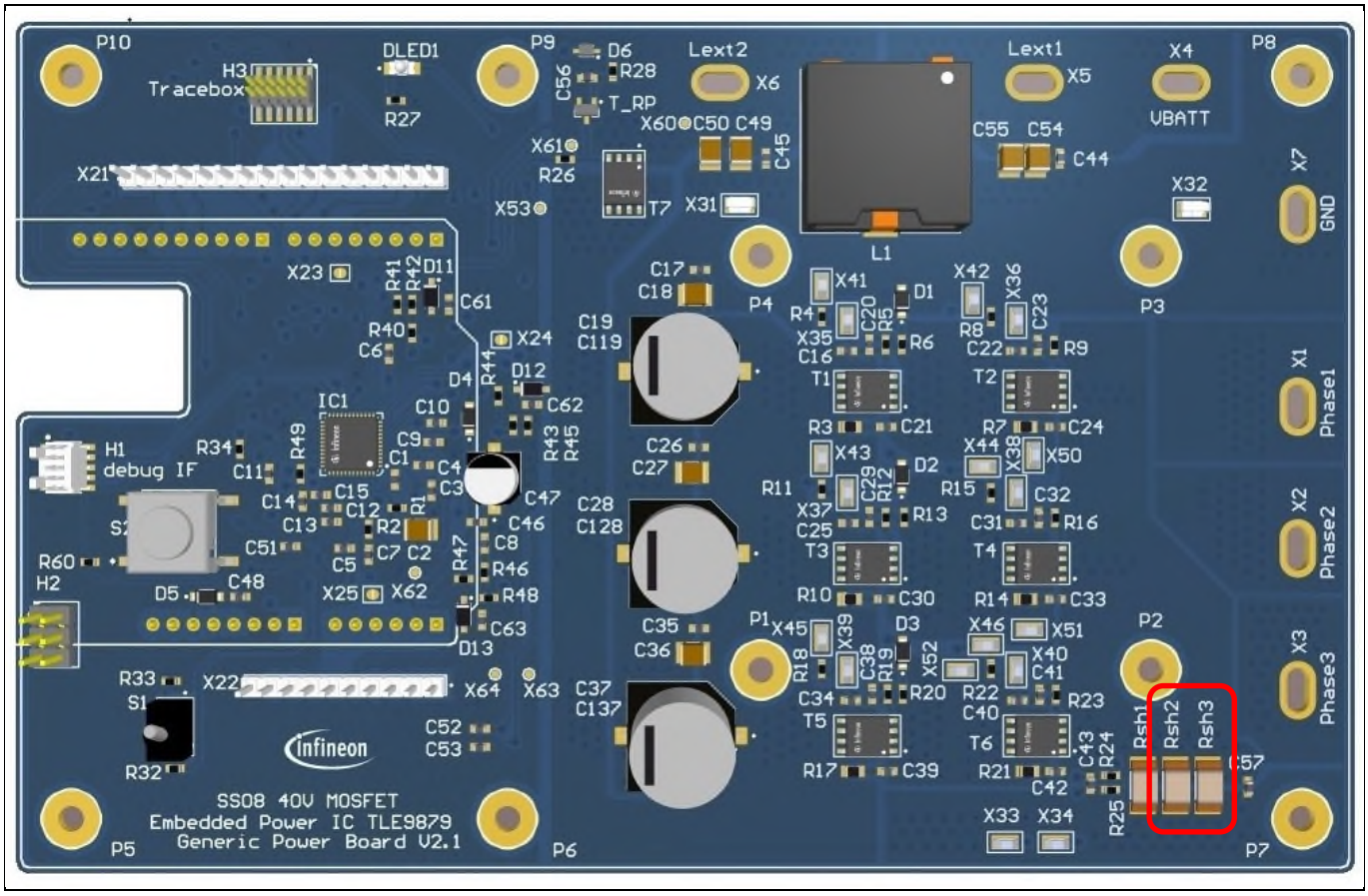


Figure 4 Position of the shunt resistor Rsh2 and Rsh3 - at example of the Generic Power Board OptiMOS™-6 SSO8[1]

[1] Please note that the position could differentiate slightly for other Generic Power Board versions.

1.2.2 External capacitors

Additionally external MLCC capacitors can be added manually between the gate and source (C16/C22/C25/C31/C34/C40) and between gate and drain of each MOSFET (T1, ..., T6) of the B6-bridge inverter (C20/C23/C29/C32/C38/C41). PCBs of the first batch of the Generic Power Boards with OptiMOS™-6 SSO8 have these external MLCC capacitors populated, 1.8nF for C16/C22/C25/C31/C34/C40 and 150pF for C20/C23/C29/C32/C38/C41. In that case or if these capacitors are populated due to own previous individual projects, they should be removed in order to use this demonstration software. They influence the switching characteristics of the MOSFETs and do not match the driver configuration set in the demonstration software.

If the Generic Power Board is populated with the optional capacitors between gate-source and gate-drain of the inverter switches, it is strongly recommended to remove these capacitors.

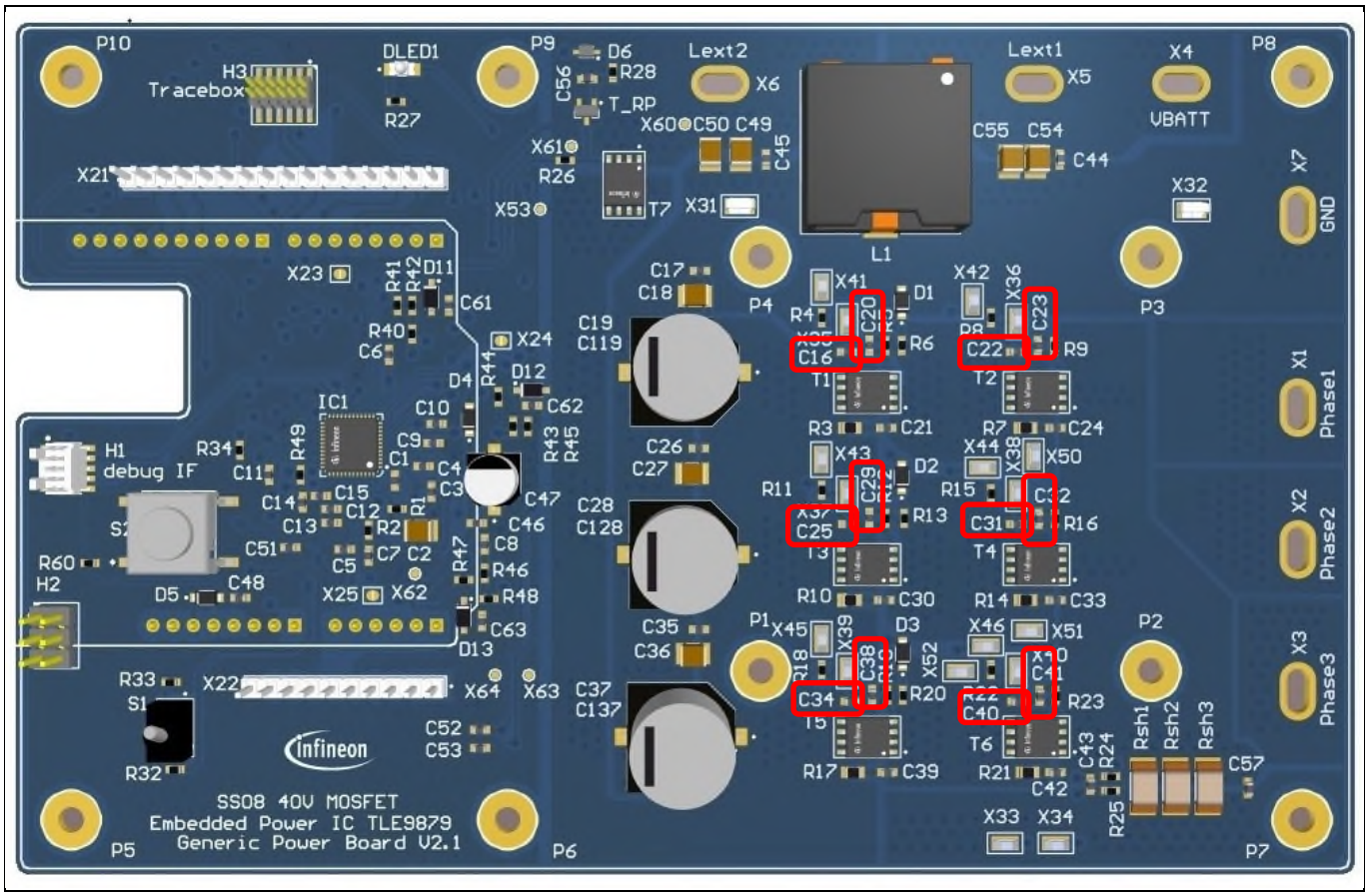


Figure 5 Position of the capacitors C16/C22/C25/C31/C34/C40 and C20/C23/C29/C32/C38/C41 at example of Generic Power Board OptiMOS™-6 SSO8[1]

[1] Please note that the position could differentiate slightly for other Generic Power Board versions.

2 Toolchain

2.1 Overview

Table 2 gives an overview about all software tools which are needed to install.

Table 2 Software Toolchain Installation Guide

Steps	Company	Description
STEP1 Download and Install **KEIL® µVision5**	ARM® Keil®	• ARM® KEIL® µVision is an integrated development environment which consists of code editor, compiler and debugger. • The evaluation version limits the code size to 32 kB • To learn how to use ARM® KEIL® µVision 5, watch our video "**Get your motor spinning**".
STEP2 Download Config Wizard	Infineon Technologies	• Infineon provides the Config Wizard free of charge. The Config Wizard supports easy configuring of Embedded Power IC peripherals. • Config Wizard can be installed via the Infineon Developer Center. If you don't have this Infineon toolbox yet, please go to **Infineon Developer Center Launcher** and enjoy the release management for updates.
STEP3 Download and Install **Segger J-Link Driver**	XMC™ Link based on SEGGER J-Link technology	• XMC™ Link is a debug probe for all XMC™ microcontrollers • The debug probe is based on Segger J-Link debug firmware, which enables use with DAVE and all major third-party compiler/IDEs known from the wide ARM® ecosystem
STEP4 Download the SDK via µVision5 Pack Installer	Infineon Technologies	• The Embedded Power Software Development Kit (SDK) is a low-level driver library which can be downloaded within KEIL® µVision via the "Pack Installer"

2.2 Installation

2.2.1 KEIL® µVision

The first step is the installation of the Integrated Development Environment µVision from KEIL®. Follow the link provided in Table 2, download the installation package and install the program.

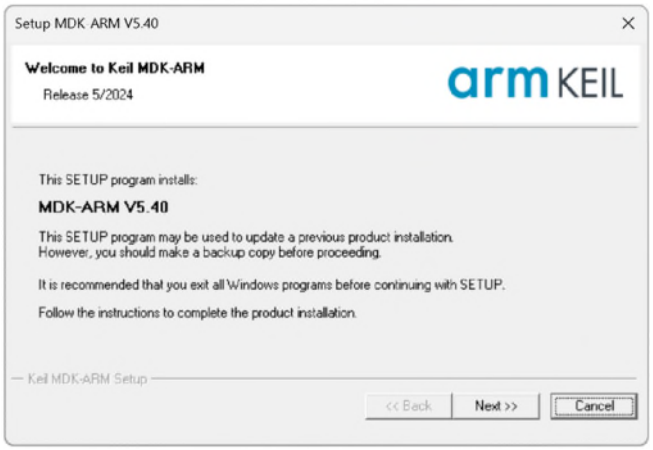


Figure 6 Installation KEIL® µVision IDE

2.2.2 Config Wizard

The installation of the Config Wizard for MOTIX™ MCU is possible using Infineon's Development Center Launcher. Hence, the installation of the program for managing tools for different purposes is required. To download the Development Center Launcher from Infineon's website and to use the integrated services, it is needed to be a registered user at myInfineon.

After installing the program, start the Development Center Launcher and select the tab *Manage Tool*. Type in 'Config Wizard' in the search field on top as shown in Figure 7.

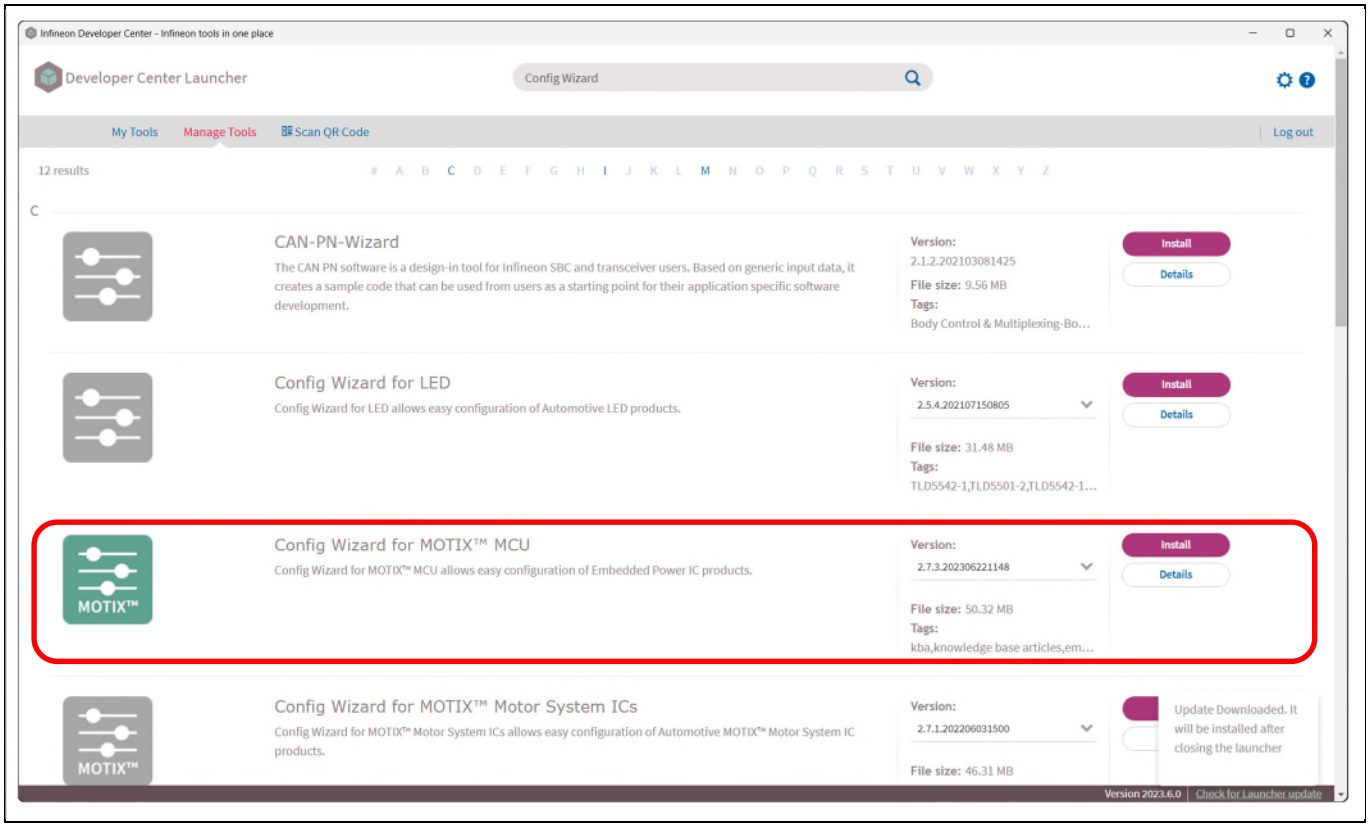


Figure 7 Development Center Launcher

After the installation start the Config Wizard once to force the integration to the µVision IDE.

2.2.3 Driver for XMC™ Link

The debug probe XMC™ Link is an isolated debug probe for all Infineon Cortex®-M based microcontrollers. The probe is based on Segger J-Link debug firmware. Hence, it is usable together with all common third-party compiler/IDEs (i.e. KEIL®) known from wide ARM® ecosystems.

To operate the XMC™ Link the installation of the J-Link driver software is required. The driver software can be downloaded from the link provided in Table 2. Install the driver on your PC/laptop. A restart of the computer after driver installation is recommended.

Connect the XMC™ Link to the computer using the Micro-USB cable. If the DEBUG LED on the PCB of the debug probe XMC™ Link is illuminated constantly, the driver has been installed successfully.

The XMC™ Link debug probe can be acquired here: https://www.infineon.com/evaluation-board/KIT-XMC-LINK-SEGGER-V1

2.2.4 Device database for SoC MOTIX™ MCU

The last step of the toolchain software installation is the installation of the device database for the SoC MOTIX™ MCU TLE9879QXA40 operating on the Generic Power Board.

Start the KEIL® µVision and call the Pack Installer via icon in the file toolbar as shown in Figure 8.

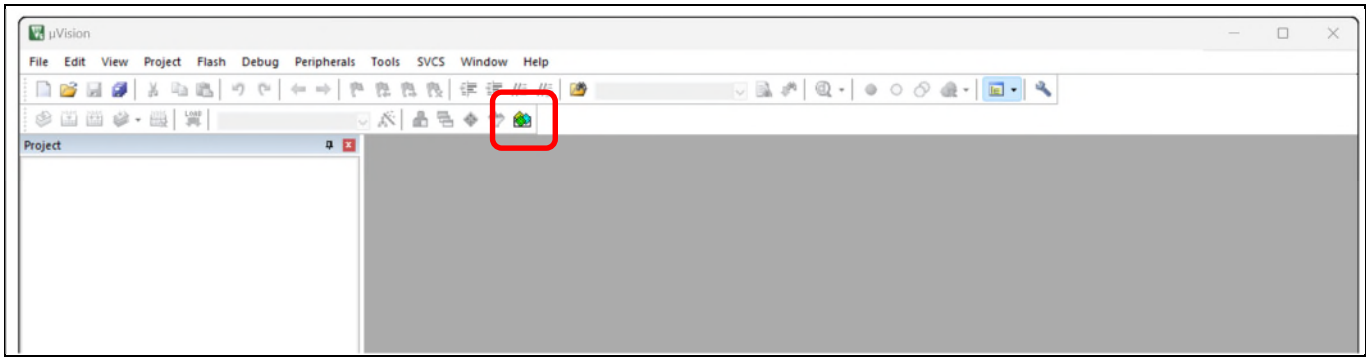


Figure 8 Pack Installer

Type in search field *TLE987*, then unfold the icon for *TLE987x Series* in device explorer left hand side in window tab *'Devices'*. Finally select the controller *TLE9879QXA40*.

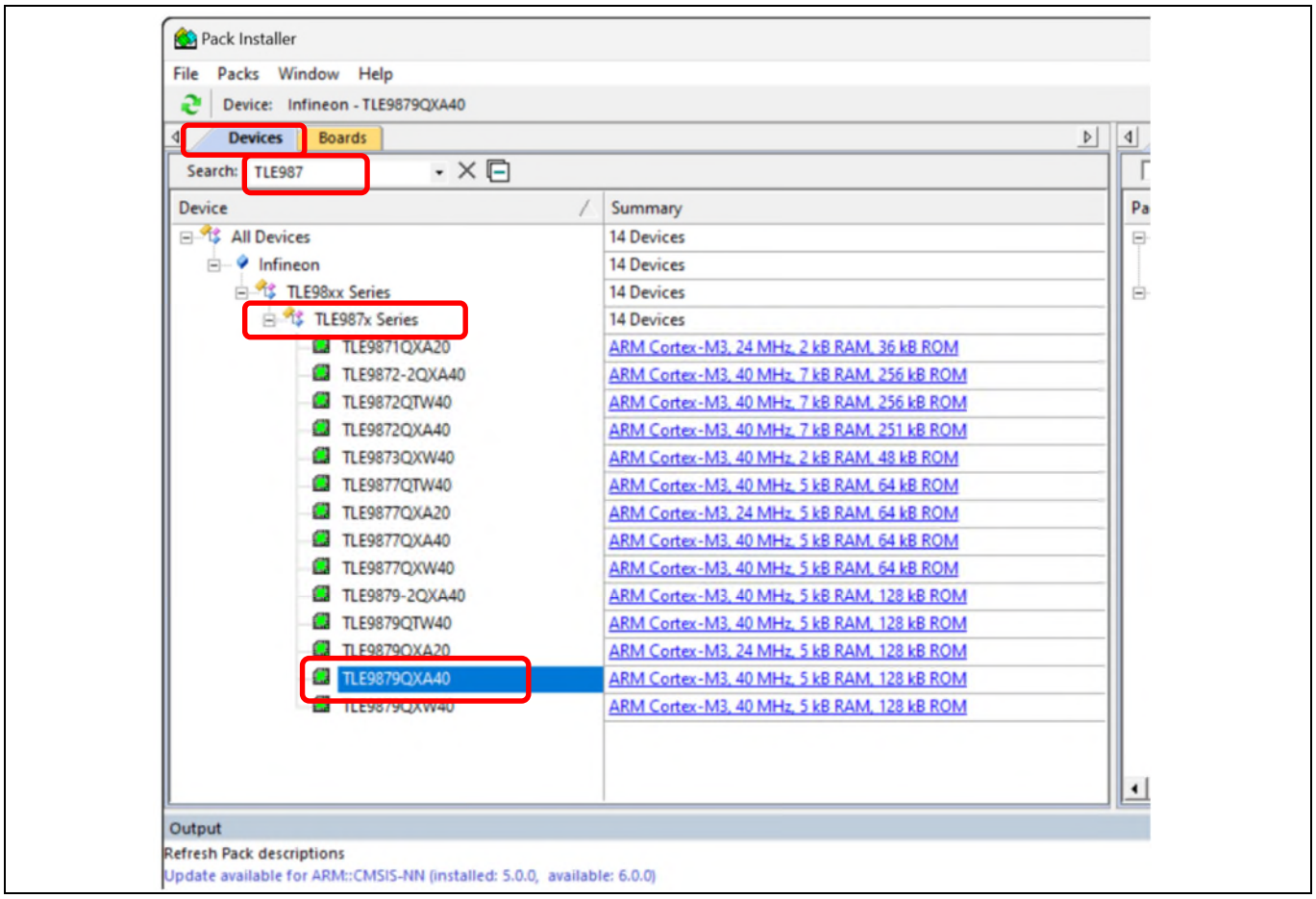


Figure 9 Select controller in Pack Installer in window 'Devices'

Now the installation of the SDK of selected controller can be started by pressing the corresponding button on right hand side window tab *'Packs'*.

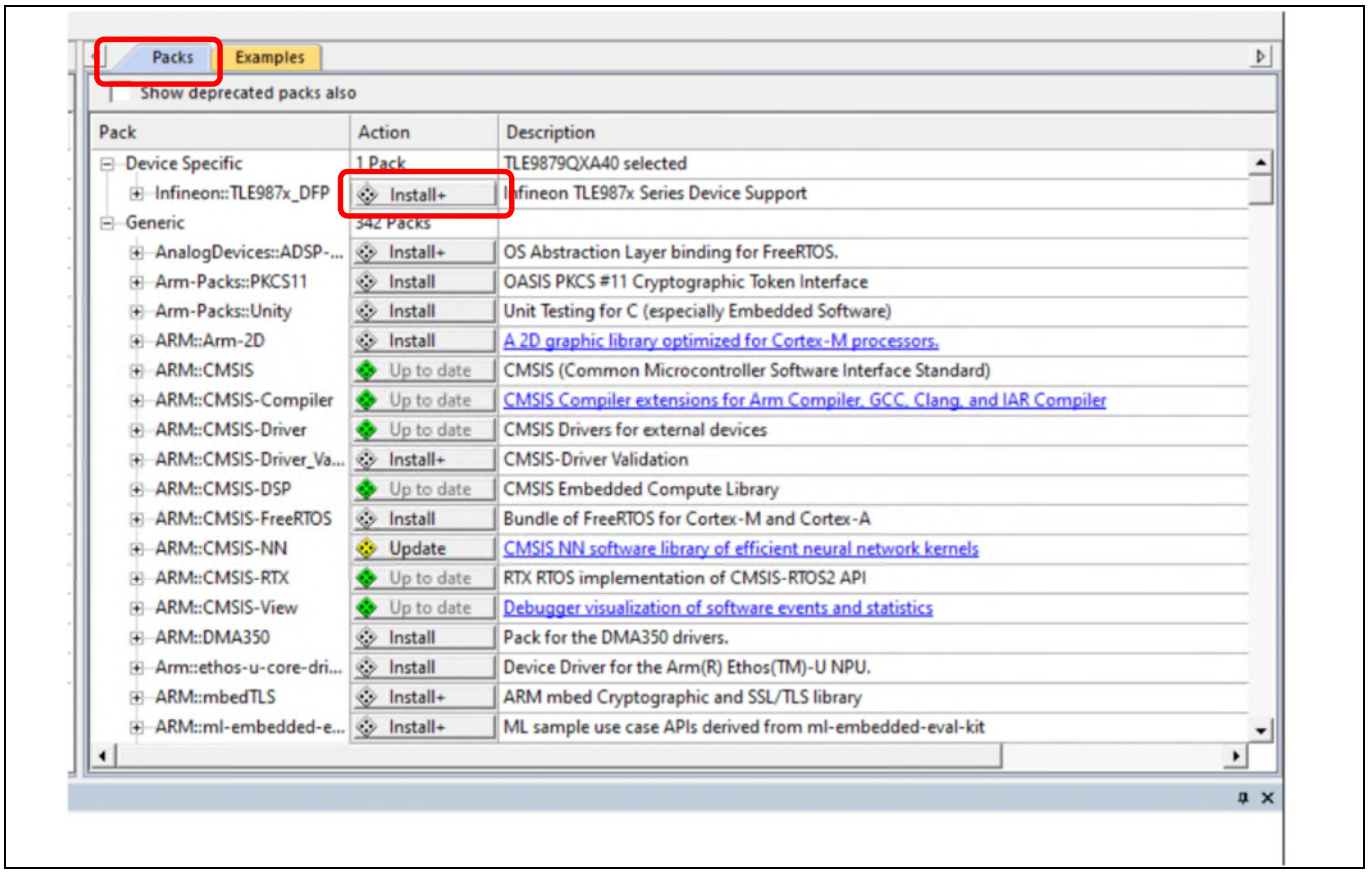


Figure 10 Install SDK of controller in Pack Installer in window 'Packs'

3 Software

3.1 Overview

The software package provides preconfigured settings for all targeted Generic Power boards and intends to run a specific motor load configuration as described in chapter ‘Hardware’. The software shall conduce the users during initial operation of the board and serves as a starting position for their SoC specific software developments.

To control the BLDC-motor the sensor-less Field Oriented Control (FOC) method is implemented in demonstration software. The SoC TLE9879 microcontroller on the Generic Power Board has the required performance to process the trigonometric transformation, the flux and angle estimation, the PI closed-loop-controller, and other functions. Besides other peripheral blocks, the Analogue Digital Conversion ADC module is needed for the current measurement. The Capture Compare Unit CCU6 simplifies the generation of the PWM pattern based on Space Vector Modulation SVM to control the MOSFETs in the B6- bridge of the inverter. The MOSFET drivers are integrated into the SoC microcontroller too, which allows the development of a compact, cost-optimized inverter application. Another benefit is that software reconfiguration of peripheral blocks and functions allows a fast and flexible modification of the application properties in case of changing requirements.

It is not intended to describe all of the demonstration software’s functionalities in this document. To dive deeper into the control methodology of BLDC motors, refer to the technical documentation on the product website of the TLE9879 microcontroller [5].

The Infineon Config Wizard allows the adjustment of the configuration of the functional and peripheral blocks of the software to the setup of the Generic Power Board and its connected motor load. If the motor DB42S03 is used with the Config Wizard, it is not required to modify the software configuration to get the motor running (i.e. modifying of Generic Power Board type dependent software register settings). All software configuration which is required to get motor spinning can be setup in particular header file by setting a few directives (this is described in the following chapter). In case of using the motor type DB42S02 with the Generic Power Board, the parameter setup in the Config Wizard needs to be adjusted as described in chapter ‘Config Wizard’.

The following chapters describe the steps to unpack the software package, to set the required software configuration, to program the firmware from the computer to the SoC controller at the Generic Power Board and finally, to operate the motor.

3.2 Software package

The link for the download of the software package via the Infineon development center can be taken from the websites of the corresponding Generic Power Board [6], [7], [8], [9] or [10]. After downloading the file, unpack the complete content of the ZIP archive to a project folder at your computer. After unpacking ZIP archive the following files and folders are available in the main path as shown in Figure 11.

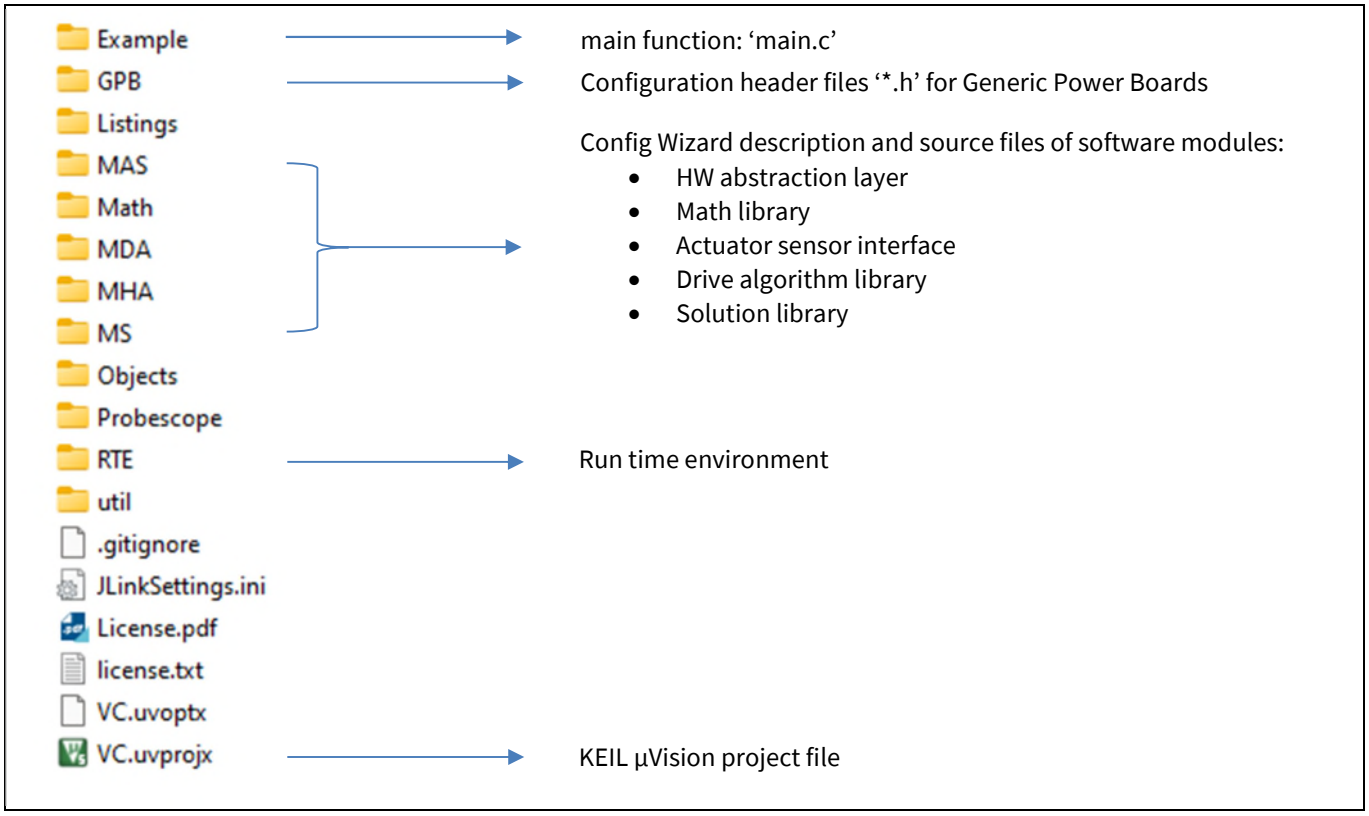


Figure 11 Software Package

3.3 µVision

Open the project file VC.uvprojx in KEIL® µVision (menu ‘Project’/’Open Project’). The project structure is shown in the Project explorer of the µVision IDE.

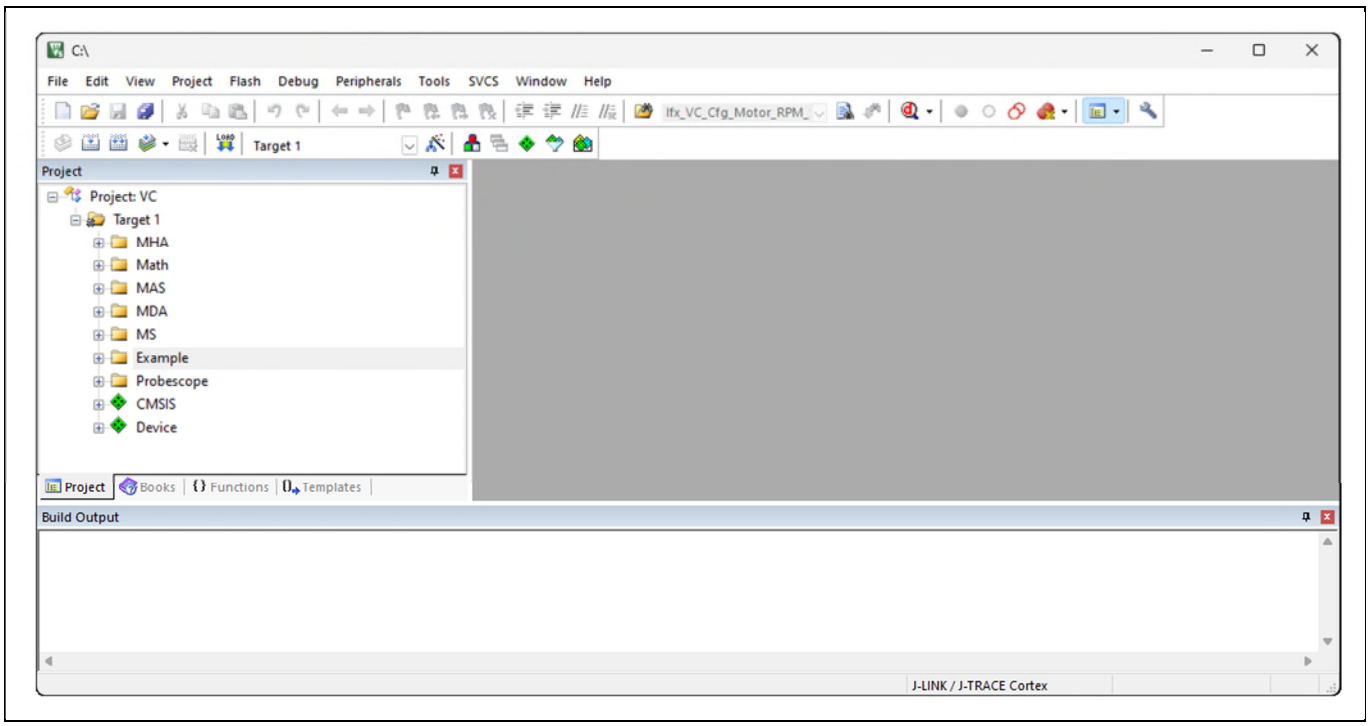


Figure 12 Project VC (Verified Chipset) in KEIL® µVision

3.3.1 Config Wizard setup depending on motor type

Depending on the selected motor type, DB42S02 or DB42S03, some parameters in the Config Wizard must be modified to guarantee faultless operation of the connected motor load. The default Configuration Wizard Description included to the delivered software package refers to the motor type DB42S03. By driving this motor type using the Generic Power Board it is not required to modify the Configuration Wizard Description.

When using the DB42S02 motor type, several parameters must be adjusted. The table below summarizes all parameters depending on the motor type which is controlled by the Power Board.

Table 3

tab main / tab sub /window	Parameter name	Motor type	
		DB42S02	DB42S03
MCTRL Solution / FOC Solution / Base values	System base voltage	17.0 V	24.0 V
	System base current	10.0 A	5.0 A
	System base mechanical speed	8000 rpm	4000 rpm
MCTRL Solution / FOC Solution / PI Controllers	Current control adjustment factor	0.5	0.2
	Proportional gain	0.01 A/rpm	0.0075 A/rpm
	Integral gain	0.1 A/rpm	0.07 A/rpm
	Output lower limit	-9.0 A	-3.0A
	Output upper limit	9.0 A	3.0 A
MCTRL Solution / FOC Solution / System Parameters	Phase resistance	0.095 Ω	0.75 Ω
	Direct phase inductance	0.125 mH	1.05 mH
	Quadrature phase inductance	0.125 mH	1.05 mH
	Start- up current	5.0 A	2.5 A
	Initial Start- up current	0.6 A	0.3 A
	Start- up current ramp up rate	8.0 A/s	4.0 A/s
MCTRL Solution / FOC Solution / General Operation Settings	Merge angle tolerance	15°	10°
	Transition speed	800 rpm	1000 rpm
MCTRL Drive Algorithm / FOC Controller / Structure	Limit voltage vector with D axis prioritization	Set ☑	Cleared ☐

To start the Config Wizard program, open the menu ‘Tools’/’MCU Config Wizard Vx.y’ in KEIL® µVision. The configuration wizard program starts. In Figure 13 the tabs for main category (MCTRL Solution’) and sub category (‘FOC Solution’) as well as the parameter window (‘PI Controllers’) are shown.

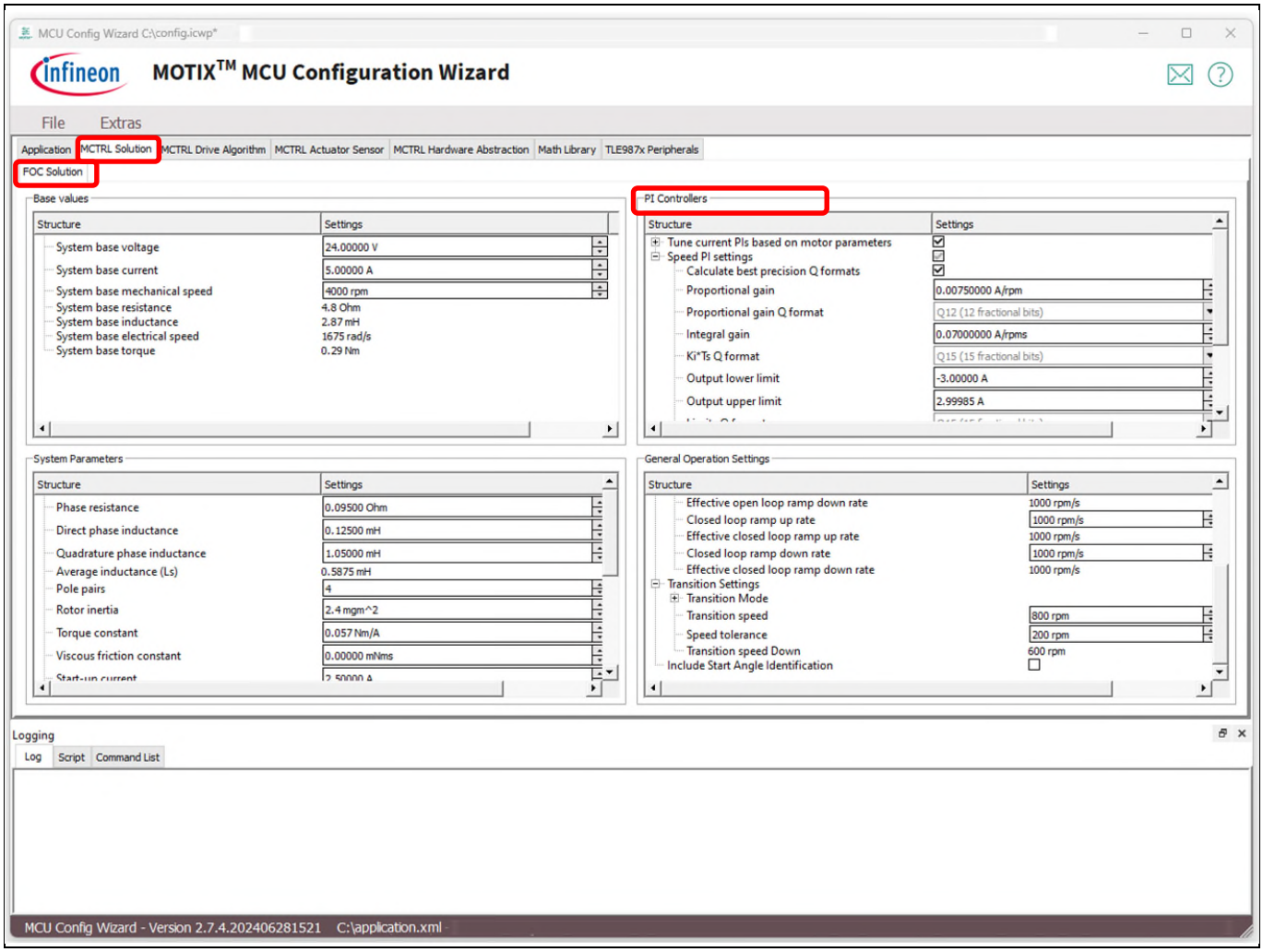


Figure 13 Config Wizard – parameter set in MCTRL Solution / FOC Solution

After modification of all parameters dependent on motor type open the menu ‘File’ and save the modified Config Wizard setup by execution the sub menu ‘Save’. All modifications will be stored then, and the new Config Wizard description is updated in the corresponding software modules of the project.

A further adjustment of the Config Wizard description is required again if the motor type is changed.

3.3.2 Software configuration

Open the configuration header file ‘ifx_gpb_config.h’ in µVision. The file is accessible via the project explorer as shown in Figure 14 .

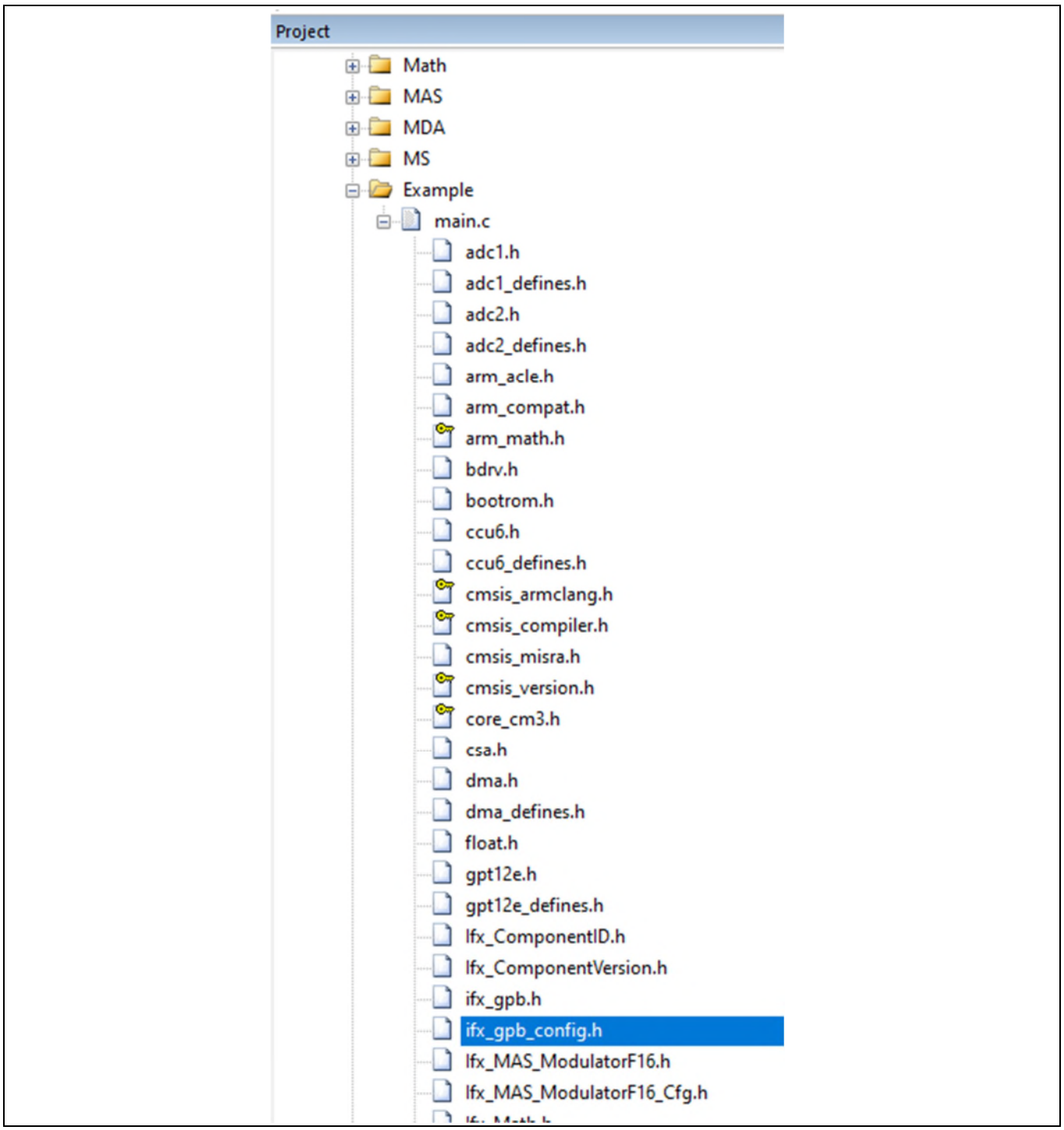


Figure 14 Configuration file ‘ifx_gpb_config.h’

Software

The demonstration software is configured in such a way that almost all register settings are preset. Since the different variants of the Generic Power Boards are equipped with different MOSFET switches, adjustments in setup of the gate drivers in SoC are required. The user must define the type of the Generic Power Board to adjust the MOSFET driver settings accordingly. Besides, the user has the possibility to set up the switching characteristics of the B6- MOSFET switches regarding switching speed, and to define the revolution speed of the motor within predefined limits.

The Config Wizard initializes all concerned setup variables and registers in the source code. Since the specified presets of this demonstration software are defined in the source code as well, the configuration of the directive token FX_BDRV_CFG is set to value 1 (IFX_BDRV_CONFIG_OVERWRITE). This value is the default in this demonstration software and allows overwriting the Config Wizard's values and using the MOSFET-specific variables instead. So that the ifx_pgb_config.h file allows the selection of the provided MOSFET-specific presets in this file easily.
If the Config Wizard shall be used for an individual initialization of corresponding registers and variables, clear the token IFX_BDRV_CFG to value 0 (IFX_BDRV_CONFIG_USE).

```
/*
 * use configuration from Config Wizard:
 *    IFX_BDRV_CFG: IFX_BDRV_CONFIG_USE (default)
 * overwrite the configuration from Config Wizard regarding switching characteristic
 *    IFX_BDRV_CFG: IFX_BDRV_CONFIG_OVERWRITE
 */

#define IFX_BDRV_CFG                IFX_BDRV_CONFIG_OVERWRITE
```

Figure 15 Directive IFX_BDRV_CFG

The next step in the configuration is the definition of the type of the individual Generic Power Board including its equipped MOSFETs. The directive token IFX_GPB_TYPE is intended to define the type of the Generic Power Board which is the target board to execute the demonstration software. The different compatible versions are listed in the comment below the token, see Figure 16. The default value is linked to the OptiMOS™-6 board.

```
/*
 * board type
 *
 * OptiMOS-6:       IAUC120N40S6N010:     IFX_GPB_OPTIMOS6_SSO8 (default)
 * OptiMOS-7:       IAUCN40S7N009:        IFX_GPB_OPTIMOS7_SSO8
 * OptiMOS-7 sTOLL: IAUAN40S7N008:        IFX_GPB_OPTIMOS7_sTOLL
 * OptiMOS-7 S3O8:  IAUZN04S7N013:        IFX_GPB_OPTIMOS7_S3O8
 * OptiMOS-7 mTOLG: IAUMN04S7N011G:       IFX_GPB_OPTIMOS7_mTOLG
 */

#define IFX_GPB_TYPE                IFX_GPB_OPTIMOS6_SSO8
```

Figure 16 Directive IFX_BDRV_CFG

The gate drivers integrated in the MOTIX™ MCU TLE9879QXA40 allow to tune the switching speed of the inverter's MOSFETs by setting the charge and discharge current. The switching characteristics of the MOSFETs influence the efficiency of the inverter, but also affects the EMC in terms of conductive and radiated emission of the control board concurrent, see [11], [12], and [13].

The demonstration software distinguishes between three different switching characteristics: ‘slow’, ‘middle’ and ‘fast’. In Table 4 the corresponding parameter values (in control register CTRL - 3 of the bridge-drivers) are summarized.

Table 4 Charge/Discharge settings in control register CTRL - 3

	OptiMOS™-6 SSO8	OptiMOS™-7 SSO8	OptiMOS™-7 sTOLL	OptiMOS™-7 S3O8	OptiMOS™-7 mTOLG
Switching characteristic	**Charge** (parameter ICHARGE_TRIM)				
Slow	0x05	0x05	0x05	0x03	0x05
Middle	0x08	0x0A	0x0A	0x05	0x08
Fast	0x0B	0x0F	0x0F	0x0F	0x0F
Switching characteristic	**Discharge** (parameter IDISCHARGE_TRIM)				
Slow	0x05	0x07	0x07	0x03	0x05
Middle	0x09	0x0B	0x0B	0x05	0x09
Fast	0x0B	0x0F	0x0F	0x0F	0x0F

To choose the demanded switching characteristic, separately for charge (turn-on MOSFET) and discharge (turn-off MOSFET), the configuration provides the two directives IFX_GPB_CHARGE and IFX_GPB_DISCHARGE. The default value for charge and discharge current limit is ‘middle’ (IFX_GPB_SWITCH_MIDDLE).

```
/*
 * select switching characteristic
 *
 * charge/discharge:
 *           slow   :                IFX_GPB_SWITCH_SLOW
 *           middle:                 IFX_GPB_SWITCH_MIDDLE (default)
 *           fast   :                IFX_GPB_SWITCH_FAST
 */

#define IFX_GPB_CHARGE              IFX_GPB_SWITCH_MIDDLE
#define IFX_GPB_DISCHARGE           IFX_GPB_SWITCH_MIDDLE
```

Figure 17 Directives IFX_GPB_CHARGE and IFX_GPB_DISCHARGE

The last parameter provided to modify the setup outside the Config Wizard is the change of the rotation speed of the BLDC motor. The directive token is IFX_GPB_MOTOR_SPEED. The rotation speed is related to the shaft of the motor. The unit is rounds per minute (rpm). The rotation speed is limited by software in the range from 1000 to 2000 rpm for an usage in closed loop. Additionally, a motor speed of 500 rpm can be set for an operation in open loop in V 1.1 of this demonstration software. The default value of the motor's rotation speed is 1500 rpm (IFX_GPB_MOTOR_SPEED_DEF).

```
/*
 * select motor speed
 *
 * minimum 1000 rpm
 * maximum 2000 rpm
 * default 1500 rpm
 * open loop 500 rpm
 */

#define IFX_GPB_MOTOR_SPEED         IFX_GPB_MOTOR_SPEED_DEF
```

Figure 18 Directive IFX_GPB_MOTOR_SPEED

3.4 Firmware

After configuring all requested parameters by setting the corresponding directives in the header file, save the configuration file ‘ifx_gpb_config.h’.

As a next step rebuild the target files (menu ‘Project’/’Rebuild all target files’). The successful operation shall be shown in ‘Build Output’ window.

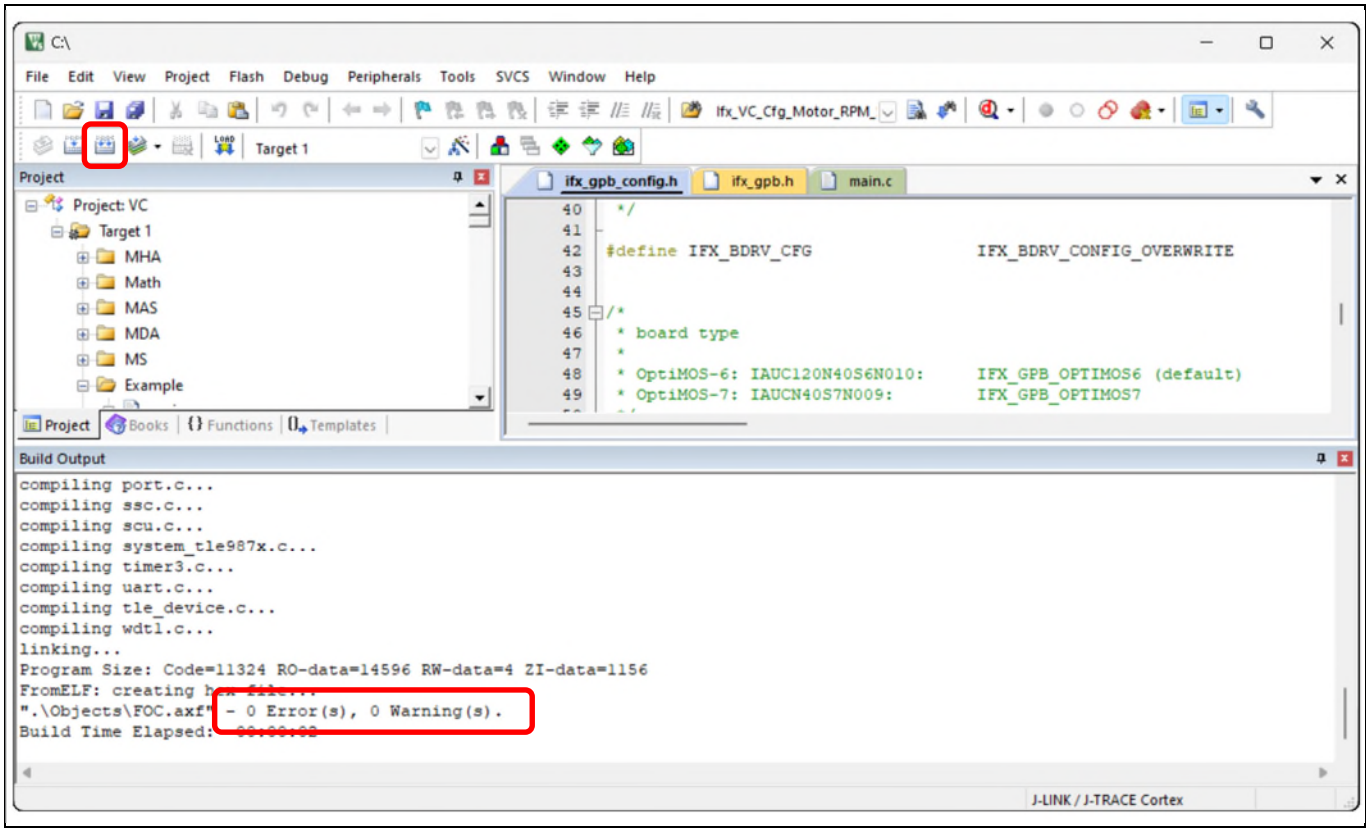


Figure 19 Rebuild all target files

Software

As a last step, program the software to the FLASH memory of the MOTIX™ MCU on the Generic Power Board. The DUT must be biased by power supply PS2 (i.e. 13.5V / current limit Imax = 5A) before starting the programming software file. The XMC™ Link must be connected to the computer via USB and to the Generic Power Board as described in chapter ‘Description’. In the project options the correct debug probe must be set (menu ‘Project’/’Options for Target …’, see Figure 20).

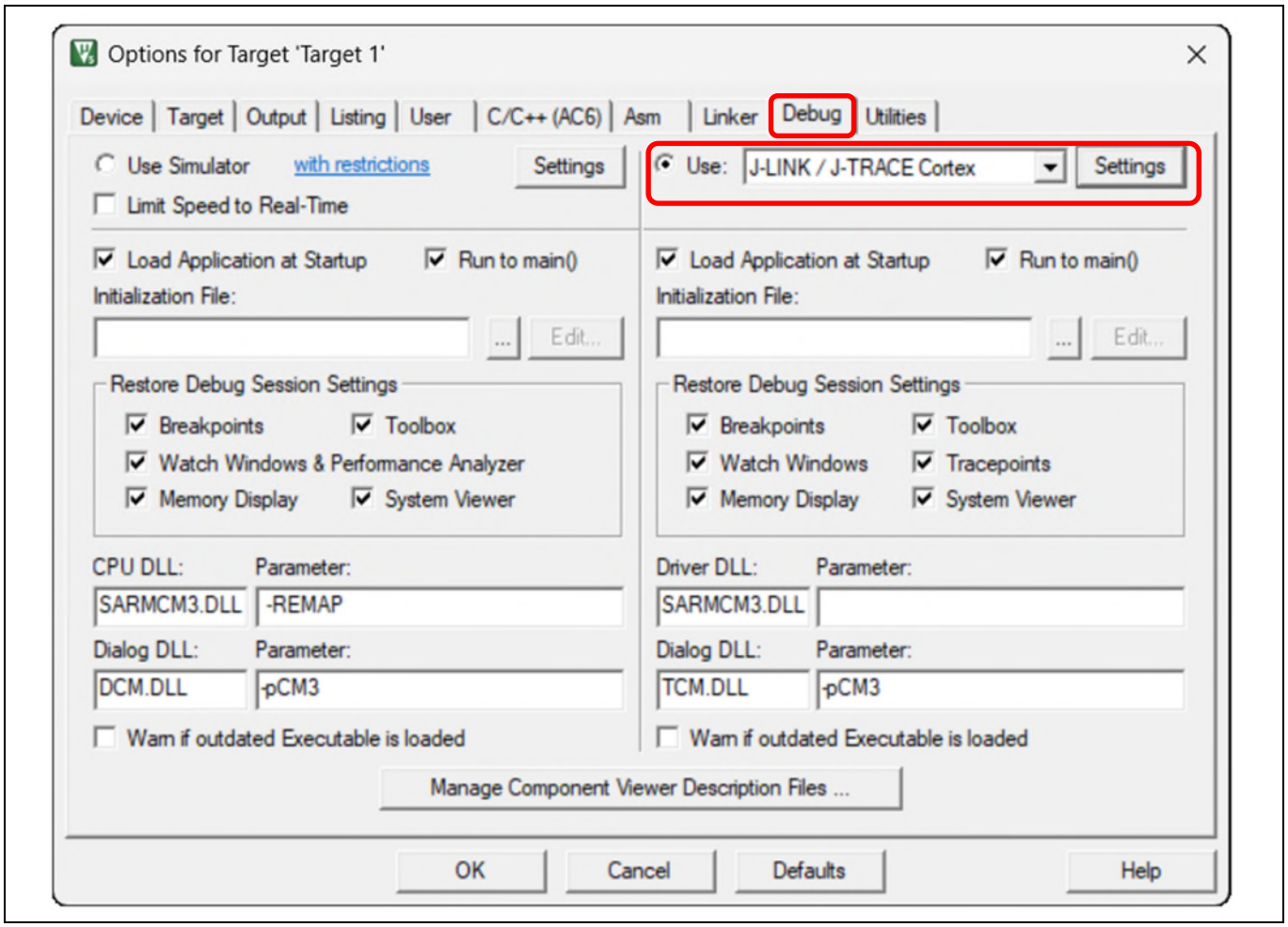


Figure 20 Project options – debug probe

Download the program file to SoC via menu ‘Flash’/’Download’ (short key F8). The successful program operation is shown in ‘Build Output’ window.

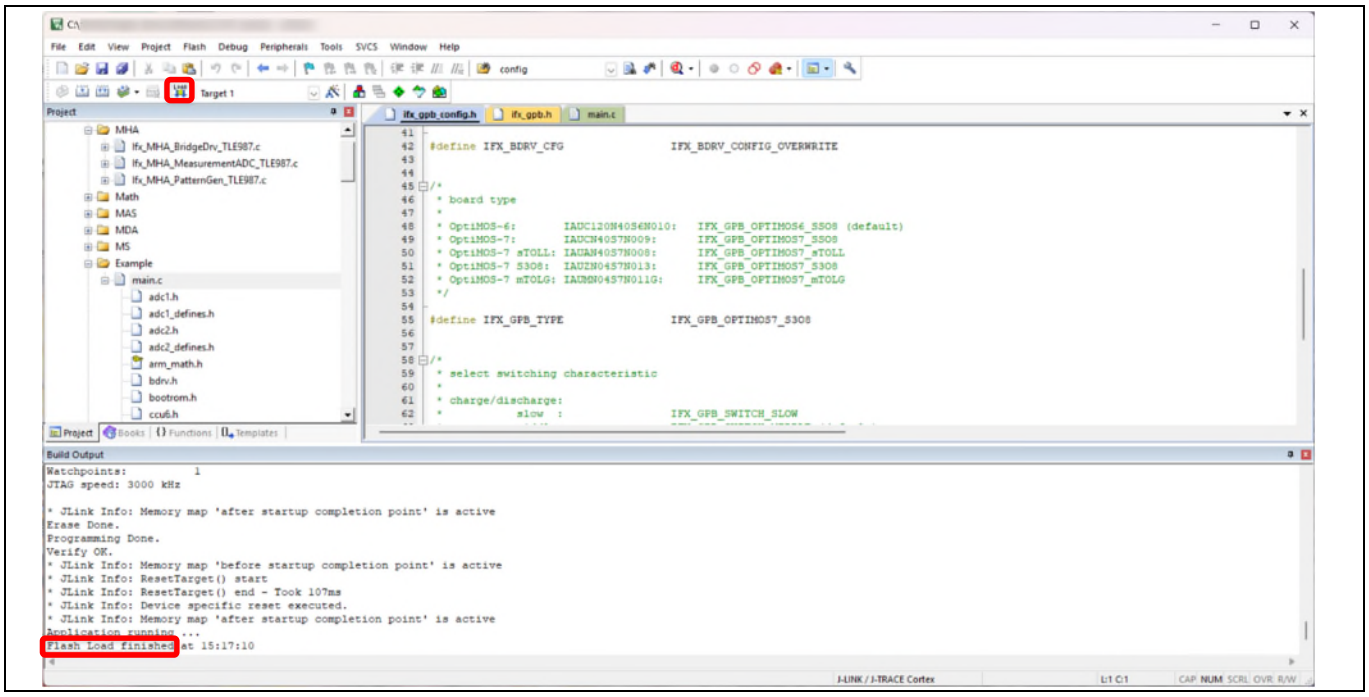


Figure 21 Flash/Download program files

4 Operation of Generic Power Board

After programming the firmware to the SoC a reset of the MCU (IC1) on Generic Power Board is required to start the new firmware. To perform the Reset press button S2. The toggle switch S1 on board is used to start or stop the motor drive operation.

The motor is intended to stop briefly immediately after releasing the triggered switch S2 before it starts a short movement into restarting the continuous operation again. This is needed to place the rotor in a defined start position in relation to the stator of the motor to ensure optimal FOC regulation during ramp up.

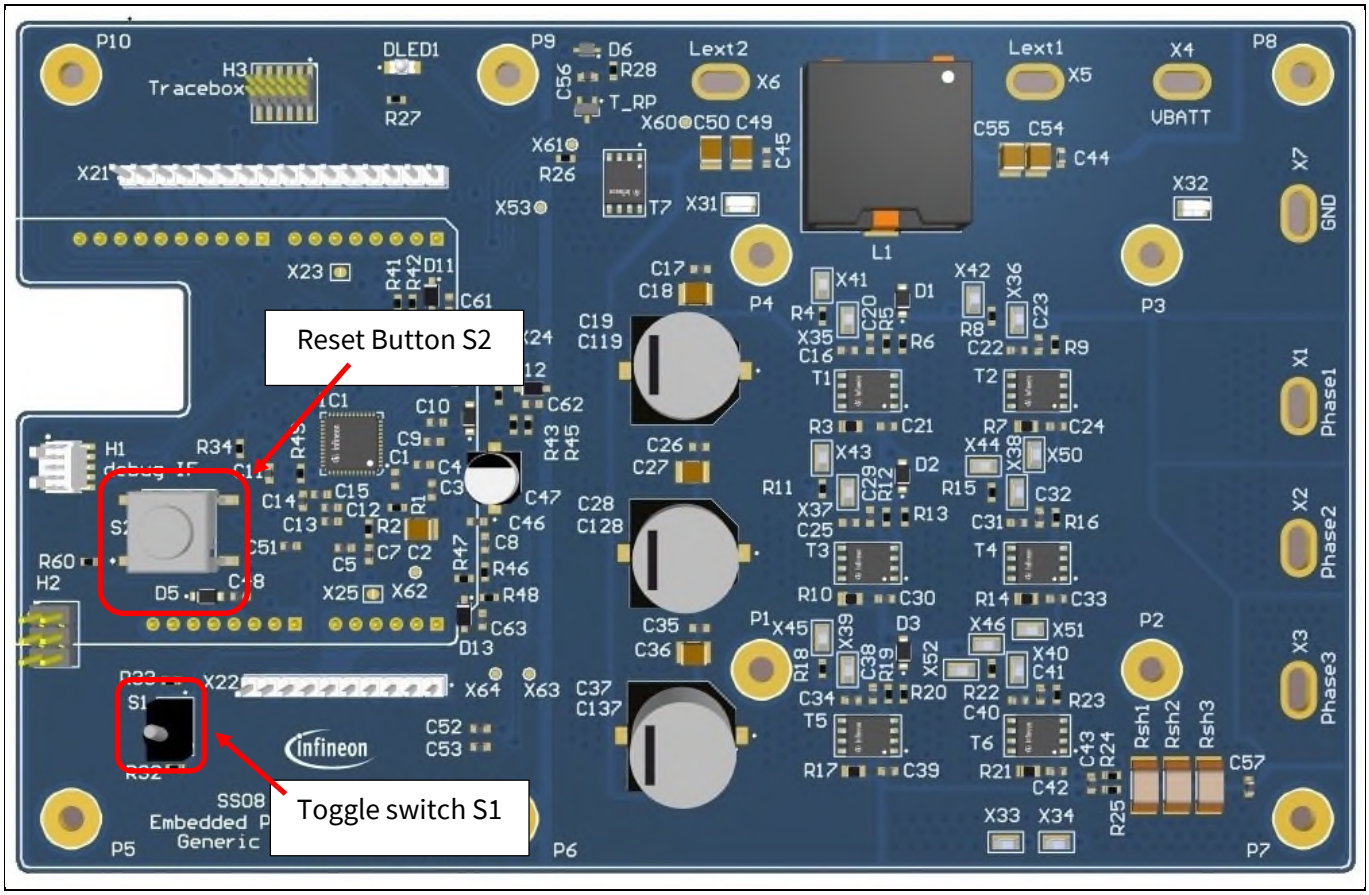


Figure 22 Control interface S1/S2 at example of Generic Power Board OptiMOS™-6 SSO8[1]

[1] Please note that the position could differentiate slightly for other Generic Power Board versions.

5 Abbreviations and definitions

Table 5 Abbreviations

Abbreviation	Definition
ARM	Advanced RISC Machine
ADC	Analogue-to-Digital Conversion
BDRV	Bridge Driver Module of Embedded Power IC
BLDC	Brushless Direct Current
DC	Direct Current
DUT	Device Under Test
EMC	Electromagnetic Compatibility
FOC	Field Oriented Control
IC	Integrated Circuit
IDE	Integrated Development Environment
LED	Light Emitting Diode
MCU	Microcontroller Unit
MLCC	Multi-Layer-Ceramic Capacitor
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
PC	Personal Computer
PCB	Printed Circuit Board
PG-TDSON	Plastic Green- Thin Dual Small-Outline Non-leaded
PWM	Pulse Width Modulation
RISC	Reduced Instruction Set Computer
rpm	Rounds per minute
SDK	Software Development Kit
SoC	System On a Chip
SSO8	Super Small-Outline 8 pin
SVM	Space Vector Modulation
SWD	Serial- Wire- Debug
USB	Universal Serial Bus
XMC	Cross-market Micro Controller

6 Reference documents

This document should be read in conjunction with the following documents:

[1] Motor load, Nanotec DB42S02, https://en.nanotec.com/products/635-db42s02

[2] Current controlled hysteresis brake, Mobac HB-50-2DS, https://www.mobac.de/fileadmin/user_upload/Mobac/PDF/strom/strom-stand-bs.pdf

[3] Installation and operating instructions for hysteresis brake, https://www.mobac.de/fileadmin/user_upload/Mobac/PDF/strom/Strom-Hysteresebremse-Englisch-Neu-aktuell_01.pdf

[4] XMC™ Link user manual, Infineon Technologies AG, https://www.infineon.com/dgdl/Infineon-XMC_Link_Board_Users_Manual.pdf-UserManual-v01_00-EN.pdf?fileId=5546d462518ffd850152451695e45edc

[5] TLE9879QXA40 product page , Infineon Technologies AG, https://www.infineon.com/cms/en/product/microcontroller/embedded-power-ics-system-on-chip-/3-phase-bridge-driver-integrated-arm-cortex-m3/

[6] Generic Power Board OptiMOS-6™ – SSO8, Infineon Technologies AG, https://www.infineon.com/cms/en/product/evaluation-boards/mos_generic_pow_board/

[7] Generic Power Board OptiMOS-7™ SSO8, Infineon Technologies AG, https://www.infineon.com/cms/en/product/evaluation-boards/mos7_generic_pow_board/

[8] Generic Power Board OptiMOS-7™ – sTOLL, Infineon Technologies AG, https://www.infineon.com/evaluation-board/STOLL-MOS-GENERIC

[9] Generic Power Board OptiMOS-7™ – S3O8, Infineon Technologies AG, https://www.infineon.com/evaluation-board/S3O8-MOS-GENERIC

[10] Generic Power Board OptiMOS-7™ – mTOLG, Infineon Technologies AG, https://www.infineon.com/evaluation-board/MTOLG-MOS-GENERIC

[11] MOTIX™ Motor Bench, Infineon Technology AG, https://www.infineon.com/cms/en/product/evaluation-boards/motix_motor_bench/

[12] TLE9879QXA40 data sheet, Infineon Technologies AG, https://www.infineon.com/dgdl/Infineon-TLE9879QXA40-DataSheet-v02_00-EN.pdf?fileId=8ac78c8c81ae03fc0181d840096a3c2f

[13] TLE986x_TLE987x Bridge Driver Application Note, 2022-05-02, Infineon Technologies AG, Rev 1.03 https://www.infineon.com/dgdl/Infineon-AppNote-TLE986x-TLE987x-FAQ-Application-Hints_3-ApplicationNotes-v01_03-EN.pdf?fileId=5546d4625b62cd8a015ba9870bd91373

[14] User Manual TLE987x Microcontroller with LIN and BLDC MOSFET driver for automotive applications https://www.infineon.com/dgdl/Infineon-TLE987x_UM-UserManual-v01_08-EN.pdf?fileId=8ac78c8c81ae03fc0181d38669525fab

[15] Motor load, Nanotec DB42S03, https://www.nanotec.com/eu/en/products/636-db42s03

Revision history

Document version	Date of release	Description of changes
1.01	12.12.2024	First release (SW V 1.0)
1.02	31.07.2026	Update to SW V 1.1 (includes more Generic Power Board versions)

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Edition 2024-12-12
Published by
Infineon Technologies AG
81726 Munich, Germany

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Document reference
Z8F80651251

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