

Evaluation Board user guide for generic power board for 12 V applications

OptiMOS™ 7 40V in mTOLG & MOTIX™ MCU TLE9879QXA40

About this document

Scope and purpose

This document outlines the Generic Power Board for 12 V applications, suitable for automotive inverter applications to control fans or pumps driven by BLDC motors. The system is controlled by a system- on-chip MOTIX™ MCU, which features integrated MOSFET drivers in combination with OptiMOS™ 7 40 V mTOLG MOSFETs. The design is capable of driving loads up to 400 W, powered by a 12 V battery. This manual includes a detailed description of the design, along with schematics and measurement reports.

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 arises from usage of an evaluation board connected to an electric motor.

About this product group

Target applications

- Automotive fans and pumps
- Radiator fans, water pumps
- 400 W BLDC Motor for 12 V application

Product family

mTOLG with OptiMOS™ 7, MOTIX™ MCU | 32-bit motor control SoC

Evaluation Board (Optional)

This board is to be used during the design-in process for evaluating and measuring characteristic curves, and for comparing different packages on similar PCB.

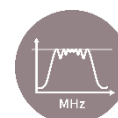
Note: PCB and auxiliary circuits are NOT optimized for final customer design.

Highlighted Components & Design Aspects

- TLE9879QXA40
- IAUMN04S7N011G
- IAUMN04S7N006G



P_{out}
400 W



EMC
optimized



Thermally
optimized

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Important notice

Important notice

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Safety precautions

Safety precautions

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

Table 1 Safety precautions

	<p>Warning: Remove or disconnect power from the drive before you disconnect or reconnect wires or perform maintenance work. Wait five minutes after removing power to discharge the bus capacitors. Do not attempt to service the drive until the bus capacitors have been discharged to zero. Failure to do so may result in personal injury or death.</p>
	<p>Caution: 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.</p>
	<p>Caution: Only personnel familiar with the drive, power electronics and associated machinery should plan, install, commission and subsequently service the system. Failure to comply may result in personal injury and/or equipment damage.</p>
	<p>Caution: The evaluation or reference board contains parts and assembly's 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.</p>
	<p>Caution: A drive that is incorrectly applied or installed can lead to component damage or reduction in product lifetime. Wiring or application errors such as undersizing the motor, supplying an incorrect or inadequate AC supply, or excessive ambient temperatures may result in system malfunction.</p>
	<p>Caution: 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.</p>

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1 The board at a glance

The inverter design described in this document presents a solution for

- an engine cooling fan with power capability up to 400 W or
- similar systems with equal or lower power requirements, such as
 - Automotive fans and pumps
 - Radiator fans,
 - Water pumps or
 - A BLDC Motor for 12 V application.

The circuit features a 3-phase motor control solution with an integrated microcontroller and MOSFET driver. This solution is designed to provide a compact and efficient way to control motors in automotive applications.

Some key features of this solution include:

- Integrated 3-phase MOSFET driver
- Power supply and LIN-transceiver
- Arm Cortex-M3 microcontroller
- OptiMOS™-7 40 V MOSFETs in PG-HSOG-4 package (mTOLG)
- Compact design for minimal PCB size

The OptiMOS™-7 technology is the latest Infineon silicon technology for automotive MOSFETs, offering a wide portfolio in 40 V, 80 V and 100 V. This technology features:

- Low on-state resistance
- Reduced switching losses
- Robust mTOLG package with gullwings for best TCoB performance
- High reliability and excellent quality necessary for automotive applications

This solution is ideal for motor drives up to 400 W within the engine compartment, thanks to its small form factor and high performance.

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The board at a glance

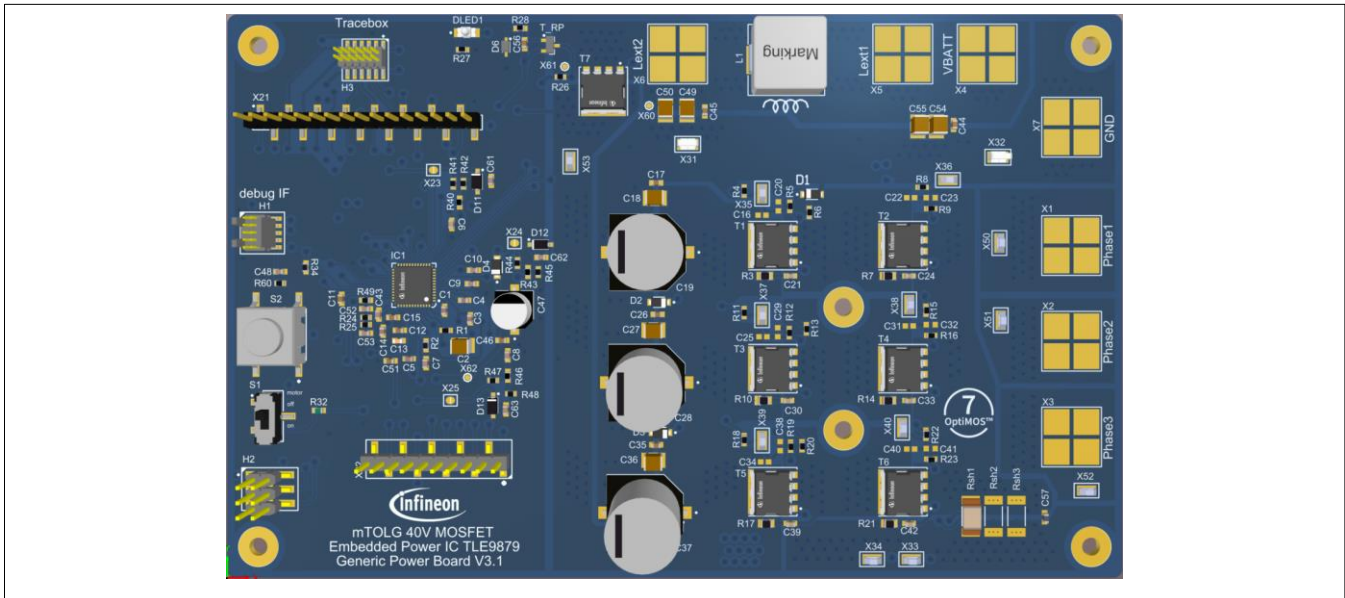


Figure 1 Generic Power Board: Top View

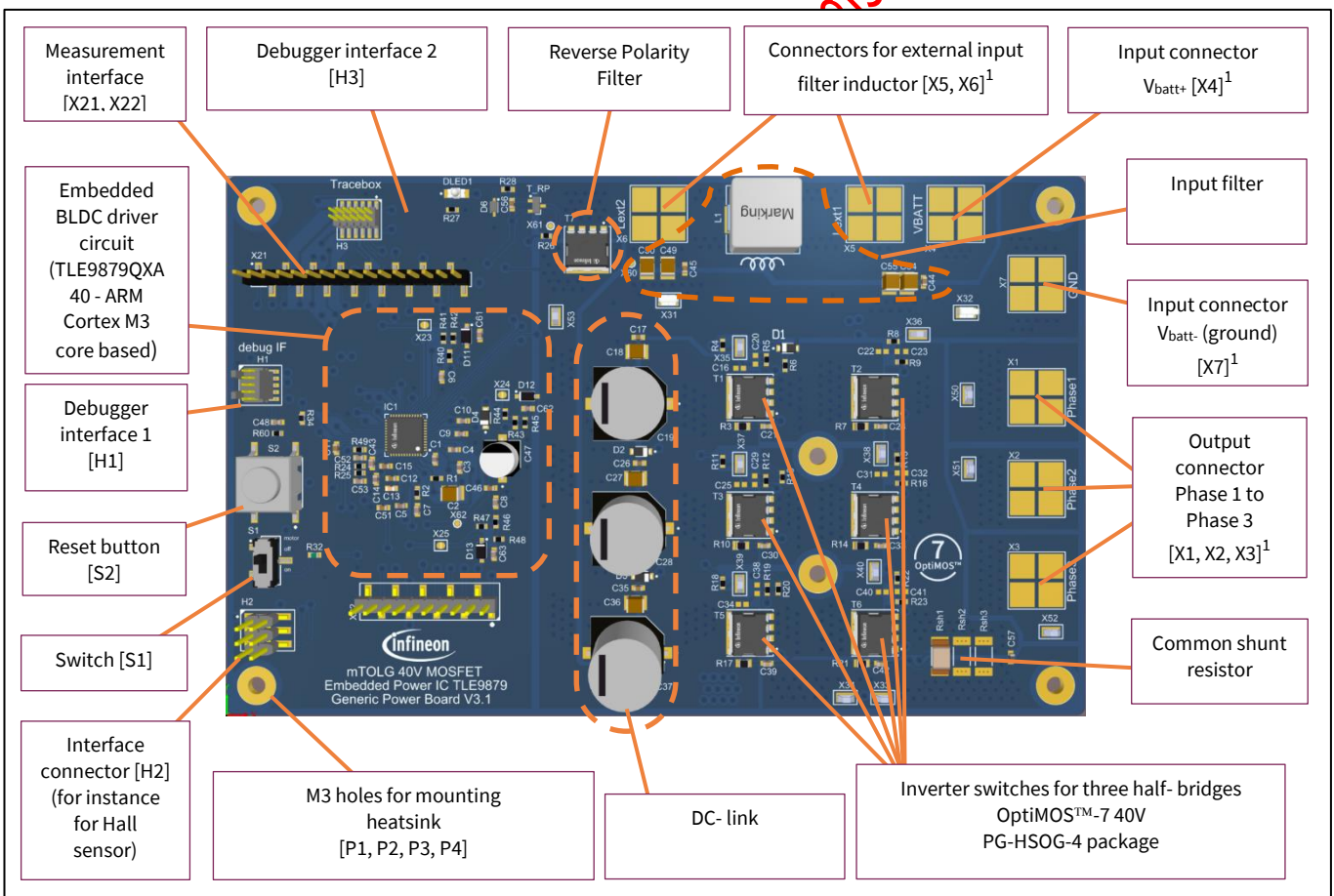


Figure 2 Generic Power Board: Overview¹

¹ Component no. 49 of the BOM (Table 8) can be connected to the pads X1, X2, X3, X4, X5, X6, X7 (not populated nor provided).

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The board at a glance

1.1 Scope of supply

- Generic Power Board with OptiMOS™7 40 V mTOLG MOSFETs and MOTIX™ MCU TLE9879QXA40
- Heatsink for Generic Power Board
- Excluded:
 - Debugger [2]: KIT_XMC_LINK_SEGGER_V1

<https://www.infineon.com/evaluation-board/KIT-XMC-LINK-SEGGER-V1>

1.2 Block diagram

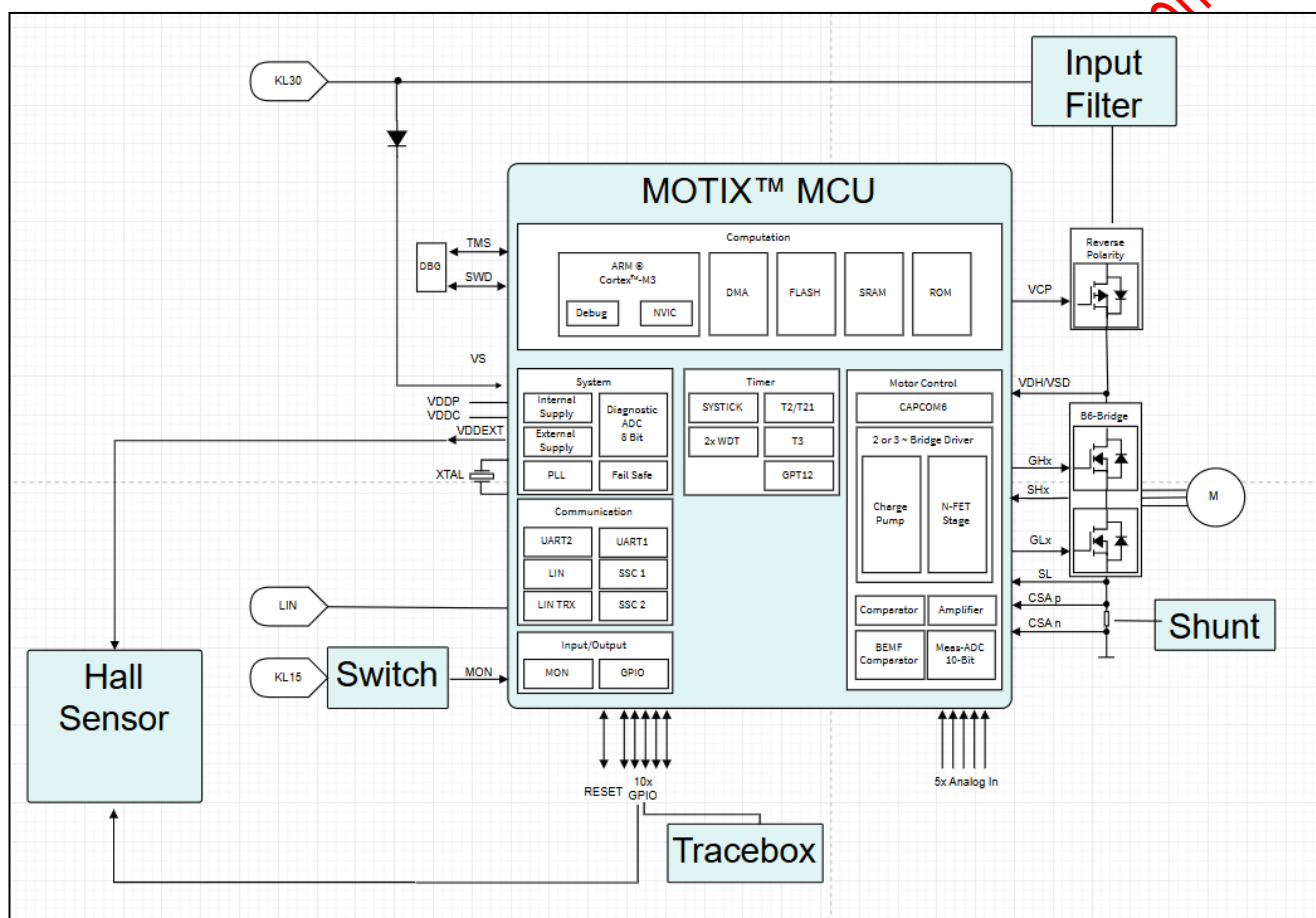


Figure 3 System block diagram

1.3 Main features

- The two main active components are:
 - • 3-Phase Bridge Driver IC with Integrated Arm® Cortex®-M3 (TLE9879QXA40) [1] [12]
 - • OptiMOS™7 MOSFET in mTOLG package (IAUMN04S7N011G) [4]

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The board at a glance

1.3.1 OptiMOS™-7 40 V mTOLG (PG-HSOG-4) MOSFET

The mTOLG package features footprint of 64 mm². In the leading edge power MOSFET technology OptiMOS™-7 40 V, this package offers a drain-to-source on-state resistance ($R_{DS(on)}$) that typically ranges from 0.5 mΩ to 1.14 mΩ.

Table 1 Automotive mTOLG MOSFET with 40 V OptiMOS™-7

Package	Silicon Technology	Product	Max $R_{DS(on)}$ [mΩ]
mTOLG (PG-HSOG-4)	OptiMOS™-7	IAUMN04S7N005G	0.5
		IAUMN04S7N006G	0.6
		IAUMN04S7N009G	0.86
		IAUMN04S7N011G	1.14

1.3.2 3-Phase Bridge Driver IC with Integrated Arm® Cortex®-M3

The TLE987x family is designed for 3-phase brushless DC motor control applications, such as auxiliary pumps and fans. It offers a high level of integration, low system cost, and scalability with varying flash memory sizes and MCU system clock frequencies. This enables support for a wide range of motor control algorithms, including both sensor-based and sensor-less options.

The TLE987x combines a 3-phase bridge driver with a 32-bit Arm Cortex M3 core and various peripherals, including [3]:

- Timer modules
- ADCs
- Double stage charge pump
- Voltage regulators
- External sensor supply
- RAM and flash memory
- LIN communication module

This integration enables advanced motor control capabilities, such as sensor-less FOC with current-controlled gate driving, while minimizing the need for external components.

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The board at a glance

Table 2 Product Family of 3-Phase Bridge Driver IC with Integrated Arm® Cortex®-M3

Grade	Product	Flash	RAM	Frequency	Interface	Tjmax
Grade-0	TLE9873QXW40	48 kByte	3 kByte	40 MHz	PWM + LIN	175 °C
	TLE9877QXW40	64 kByte	6 kByte	40 MHz	PWM + LIN	175 °C
	TLE9879QXW40	128 kByte	6 kByte	40 MHz	PWM + LIN	175 °C
Grade-1	TLE9871QXA20	36 kByte	3 kByte	24 MHz	PWM	150 °C
	TLE9872QXA40	256 kByte	8 kByte	40 MHz	PWM + LIN	150 °C
	TLE9872-2QXA40	256 kByte	8 kByte	40 MHz	PWM + LIN	150 °C
	TLE9877QXA20	64 kByte	6 kByte	24 MHz	PWM + LIN	150 °C
	TLE9877QXA40	64 kByte	6 kByte	40 MHz	PWM + LIN	150 °C
	TLE9879QXA20	128 kByte	6 kByte	24 MHz	PWM + LIN	150 °C
	TLE9879-2QXA40	128 kByte	6 kByte	40 MHz	PWM + LIN	150 °C
	TLE9879QXA40	128 kByte	6 kByte	40 MHz	PWM + LIN	150 °C

Full content available after board serial number registration on Infineon Website

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The board at a glance

1.4 Board parameters and technical data

The design specifications correspond to the components used and related design considerations. These specifications should align with the values provided in the product datasheets. In case of discrepancies, the values in the data sheets shall take precedence.

Table 3 Design Specifications

Parameter	Symbol	Values at T _j =25°C			Unit	Comment
		Min.	Typ.	Max.		
System Parameters						
Input voltage	V _{IN}	-0.3	12	40	V	P_1.1.1 (TLE9879QXA40)
Functional input voltage	V _{IN}	7	12	18	V	Specified for Design
Output current peak	I _{OUT}	-	-	44	A	Peak current (<10 s), air cooling attached (>1.3 m/s)
Output current continuous	I _{OUT}	-	20	35	A	Specified for Design
Hall Sensor Inputs	V _{HALL}	-0.3	5	5.5	V	Specification related to GPIO Port 0,1
LIN interface	V _{LIN}	-28	12	40	V	P_1.1.7 (TLE9879QXA40)
ADC Inputs	V _{ADC}	-0.3	5	5.5	V	Specification related to GPIO Port 2
Phase 1, 2, 3	V _{SH}	-8.0	12	48	V	P_1.1.11 (TLE9879QXA40)
Thermal						
Operating temperature	T _A	-40	25	105	°C	Specified for Design
Mechanical Specification						
Dimensions	159 mm x 100 mm x 30 mm (L x W x H), with heatsink 159 mm x 100 mm x 15 mm (L x W x H) without heatsink ²					
PCB	6-layer, top/bottom layer 2 oz, inner layers 1 oz, standard FR4, 159 mm x 100 mm (L x W), thickness 1.6 mm					

² The overall high is given by the height of C19, C28 and C37 and the heatsink (15 mm).

2 System and functional description

2.1 Getting started

For the hardware setup the following parts are required:

- Generic Power Board
- Debug probe XMC™ Link
- Individual application, e.g. motor, fan or pump
 - Incl. power supply for e.g. electronic brake
- Power Supply 1

Connect the hardware parts as shown in Figure 4.

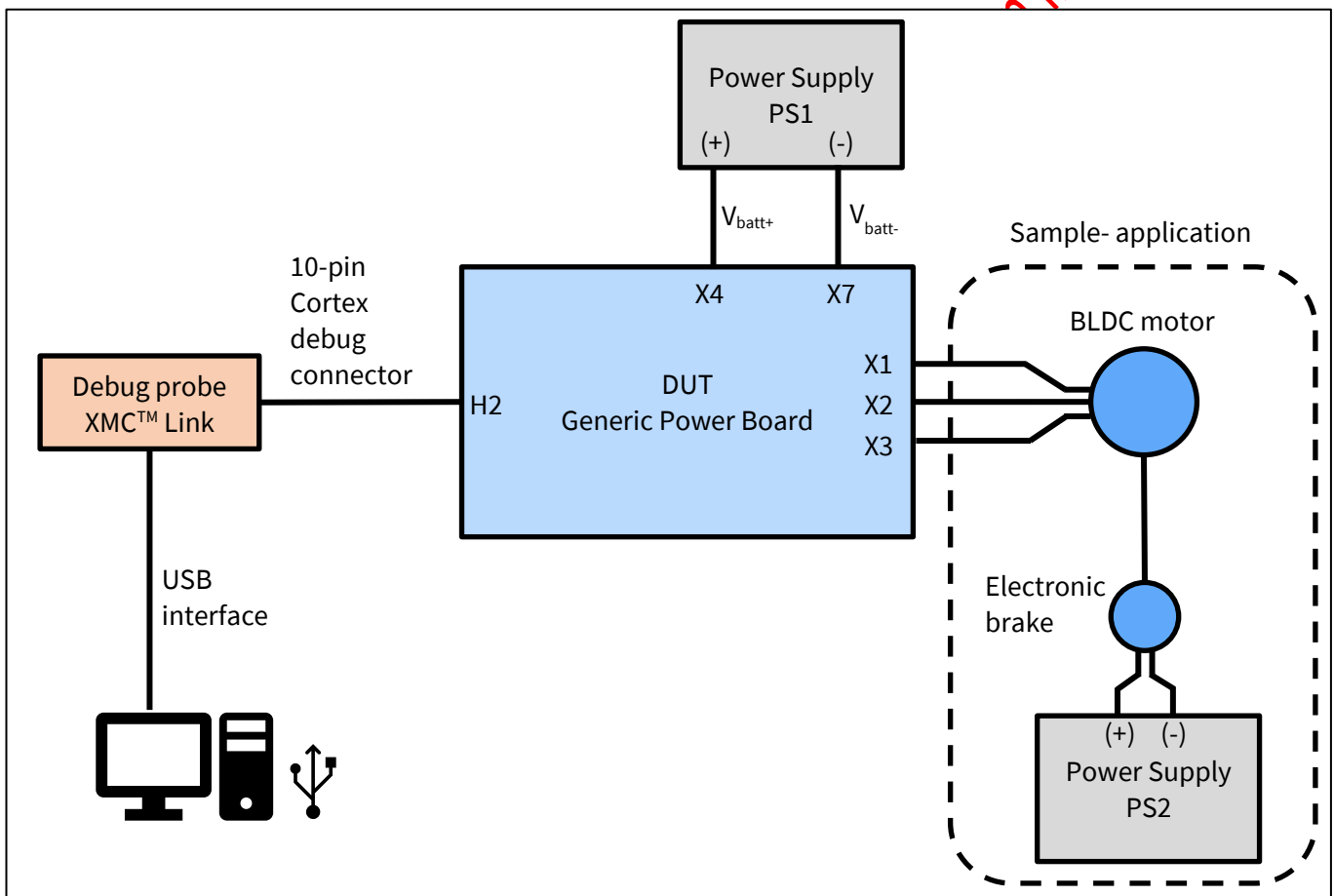


Figure 4 Setup overview

Further details about a sample application are available in the demonstration software's user manual [17].

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System and functional description

2.1.1 3-Toolchain Installation

To prepare the board for operation, the software listed in Table 4 must be installed. The μ Vision software is a development tool provided by Arm® Keil®. Although the shareware version of μ Vision has a code length limitation, it still allows for editing, compiling and debugging. The Infineon Config Wizard is used to configure the peripherals of the Embedded Power IC. This tool can be accessed from the μ Vision pull-down menu, enabling users to adjust parameters through its user interface and subsequently generate the corresponding software code. Infineon also provides standard motor drive software codes for the Embedded Power IC, which can be downloaded via the Pack Installer within the μ Vision software.

Table 4 Software Toolchain Installation Guide

Steps	Company	Description
STEP1 Download and Install Keil® μVision5	Arm® Keil®	<ul style="list-style-type: none"> Arm® Keil® μVision is an integrated development environment which consists of code editor, compiler and debugger. To learn how to use Arm® Keil® μVision 5, check out our video "Get your motor spinning".
STEP2 Download Config Wizard	Infineon Technologies	<ul style="list-style-type: none"> Infineon provides the Config Wizard free of charge, which is designed for configuration of chip modules. 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	<ul style="list-style-type: none"> 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 μ Vision5 Pack Installer	Infineon Technologies	<ul style="list-style-type: none"> The Embedded Power Software Development Kit (SDK) is a low-level driver library which can be downloaded within Keil® μVision via the "Pack Installer"

For the toolchain installation and free motor drive software, please visit the website at the link below.

[Getting Started - Toolchain Installation Guide for TLE987X EVALB](#)

For more information about the tool chain installation steps, please watch the video at the link below.

[Getting Started - Toolchain Installation Guide for TLE987X EVALB - Video](#)

2.1.2 Configuration

To configure the system, follow these steps: open a motor drive code project in μ Vision5, then navigate to "Tools" and select "Config Wizard". Next, set up the parameters for the motor, speed/current controller and the TLE987x peripherals. Given that the Embedded Power IC employs a current-source gate driving scheme, the switching speed is set by the "Gate Charge/Discharge" parameters in the BDRV tap of the peripherals, rather than by the gate resistors. For further configuration details, please visit the Infineon website for Embedded Power ICs.

2.2 Description of the functional blocks

2.2.1 Input Filter

Full content available after board serial number registration on Infineon website

2.2.2 Reverse Polarity Protection

Full content available after board serial number registration on Infineon website

2.2.3 DC-link Electrolytic Capacitor

2.2.4 Shunt Resistor

Full content available after board serial number registration on Infineon website

2.2.5 Snubber

2.2.6 Gate Driver

Full content available after board serial number registration on Infineon website

Full content available after board serial number registration on Infineon website

2.2.8 Heatsink

Full content available after board serial number registration on Infineon website

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System and functional description

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2.3 Basic operation – switching modes

Full content available after board serial number registration on Infineon website

2.3.1 Switching performance

Full content available after board serial number registration on Infineon website

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System and functional description

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System and functional description

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3 System design

3.1 Schematics

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System design



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System design



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3.2 Layout

3.2.1 PCB Stack

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3.2.1 Layout Printing

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System design



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3.3 Bill of material

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System design



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3.4 Connector details

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System design



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4 Related resources

- Product family
 - OptiMOS™-7 40V in mTOLG 8x8
<https://www.infineon.com/assets/row/public/documents/10/158/infineon-afet7-40v-mtolg-npi-newproductintroduction-en.pdf?fileId=8ac78c8c956a0a4701957ee3f2ca0ca3>
- Reference board
 - Generic Power Board: OptiMOS™ -6 40 V SSO8 MOSFET, MOTIX™ MCU (SoC) TLE987x [14]
<https://www.infineon.com/evaluation-board/MOS-GENERIC-POW-BOARD>
 - Generic Power Board: OptiMOS™ 7 40 V SSO8 MOSFET, MOTIX™ MCU (SoC) TLE987x [15]
<https://www.infineon.com/evaluation-board/MOS7-GENERIC-POW-BOARD>
 - Generic Power Board: OptiMOS™ 7 40 V sTOLL MOSFET, MOTIX™ MCU (SoC) TLE987x [16]
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Glossary

Glossary

AC

Alternating Current

ARM

Advanced RISK Machine

ADC

Analogue-to-Digital Conversion

BDRV

Bridge Driver Module of Embedded Power IC

BLCD

Brushless Direct Current

BOM

Bill of Materials

DC

Direct Current

DIL

Dual-In-Line

EMC

Electromagnetic Compatibility

GPIO

General Purpose Input/Output

IC

Integrated Circuit

LIN

Local Interconnect Network

MCU

Microcontroller Unit

MI

Bridge Driver Module of Embedded Power IC

MLCC

Modulation Index

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

mTOLG

8 x 8 medium size TO-Leaded with Gullwings

PCB

Printed Circuit Board

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Glossary

PWM

Pulse Width Modulation

RAM

Random Access Memory

RC

Resistor-Capacitor

RMS

Root-Mean-Square value

SDK

Software Development Kit

SMD

Surface-Mounted Device

SMT

Surface-Mounted Technology

TIM

Thermal Interface Material

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Evaluation Board user guide for generic power board for 12 V applications



OptiMOS™ 7 40V in mTOLG & MOTIX™ MCU TLE9879QXA40

Revision history

Revision history

Document revision	Date	Description of changes
V1.0	2025-12-16	Frist revision

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