# EVAL-6EDL04I065PR User Guide

## 650 V SOI gate driver 6EDL04I065PR evaluation board

## About this document

### Scope and purpose

This application note provides an overview of the evaluation board EVAL-6EDL04I065PR concerning its main features, hardware description, thermal performance, typical waveforms, etc.

The EVAL-6EDL04I065PR board is a power drive board including driver ICs, IGBTs and signal interface. The board is intended to drive a brushless direct current (BLDC) motor by connecting it to an external controller board such as iMOTION™ EVAL-M1-101T.

The board aims to boost Infineon's newly promoted 650 V three-phase gate driver with Over Current Protection (OCP), Enable (EN), Fault and Integrated Bootstrap Diode (BSD) 6EDL04I065PR using the silicon-on-isolator (SOI) technology.

### Intended audience

This application note is intended for all technical specialists likely to evaluate the 650 V SOI gate drivers for general applications. The board must be used only under laboratory conditions by technical specialist who have a knowledge of motor control and are capable to handle high voltage tests.

### Evaluation Board

EVAL-6EDL04I065PR is designed to evaluate the 650V SOI three-phase gate driver 6EDL04I065PR along with six Trenchstop™ IGBTs IKD06N60RC2.

This board is to be used during the design-in process for evaluating and measuring characteristic curves, and for checking datasheet specifications.

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

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## Safety precautions

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

**Table 1 Safety precautions**

| | |
|---|---|
|  | **Warning:** *The DC link potential of this board is up to 650 VDC. When measuring voltage waveforms by oscilloscope, high voltage differential probes must be used. Failure to do so may result in personal injury or death.* |
|  | **Warning***: The evaluation or reference board contains DC bus capacitors which take time to discharge after removal of the main supply. Before working on the drive system, wait five minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.* |
|  | **Warning:** *The evaluation or reference board is connected to the grid input during testing. Hence, high-voltage differential probes must be used when measuring voltage waveforms by oscilloscope. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.* |
|  | **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 discharged to zero. Failure to do so may result in personal injury or death.* |
|  | **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.* |
|  | **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.* |
|  | **Caution:** *The evaluation or reference board contains parts and assemblies 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.* |
|  | **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 DC supply, or excessive ambient temperatures may result in system malfunction.* |
|  | **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.* |

# Table of contents

# 1 The board at a glance

The evaluation board EVAL-6EDL04I065PR provides a DC input and a three-phase output power for motors. It contains the gate driver IC 6EDL04I065PR, the TRENCHSTOP™ IKD06N60RC2 IGBTs, bus capacitors, a single shunt for current sensing, a voltage divider for DC-link voltage measurement, and other peripherical circuits.

## 1.1 Scope of supply

The EVAL-6EDL04I065PR evaluation board is delivered along with six TRENCHSTOP™ IKD06N60RC2 IGBTs and an iMOTION™ 2.0 M1 interface connector.

The package also contains an auxiliary power supply to provide 15V; a Low Dropout Linear Voltage Regulator (TLE42744) to provide 3.3V; a voltage divider for DC-link voltage measurement; a single shunt for current sensing and overcurrent protection.

## 1.2 Block diagram

Figure 1 shows a typical application diagram of EVAL-6EDL04I065PR for driving a BLDC motor. The system adopts a single-shunt configuration, which is prevalent for current BLDC motor drive applications.

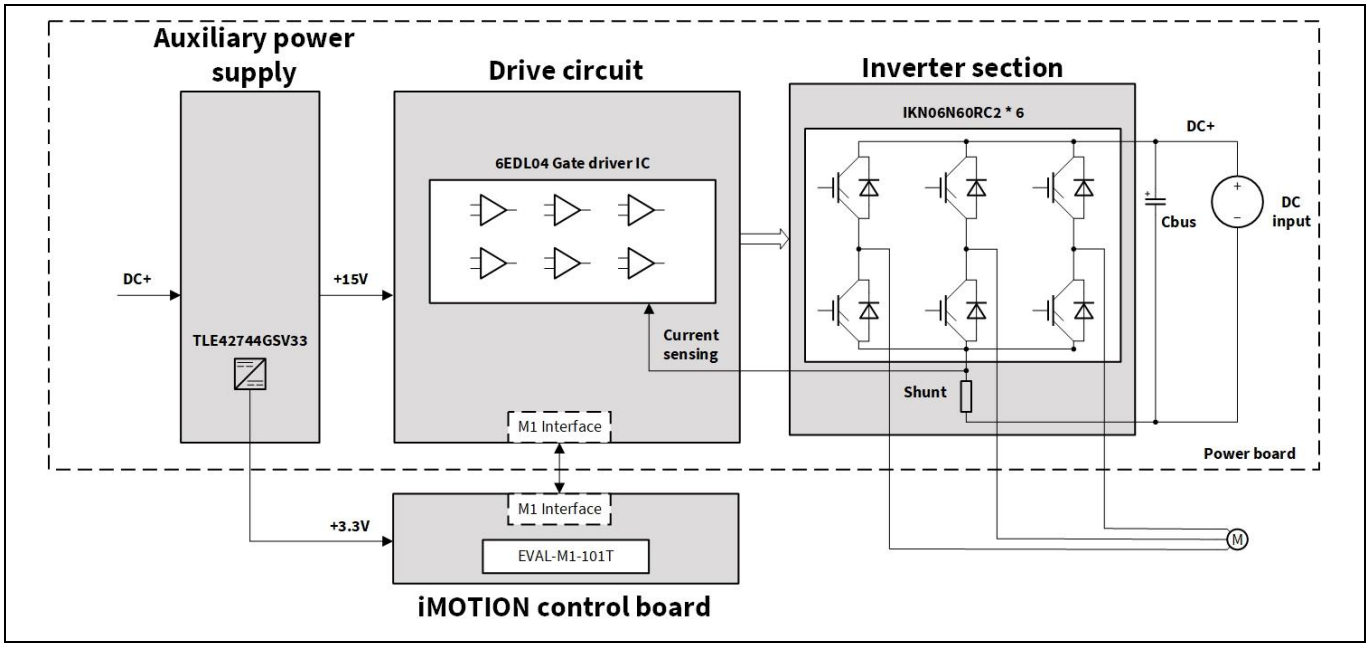


**Figure 1 Typical application block diagram of EVAL-6EDL04I065PR**

The functional blocks of EVAL-6EDL04I065PR are presented in Figure 2.

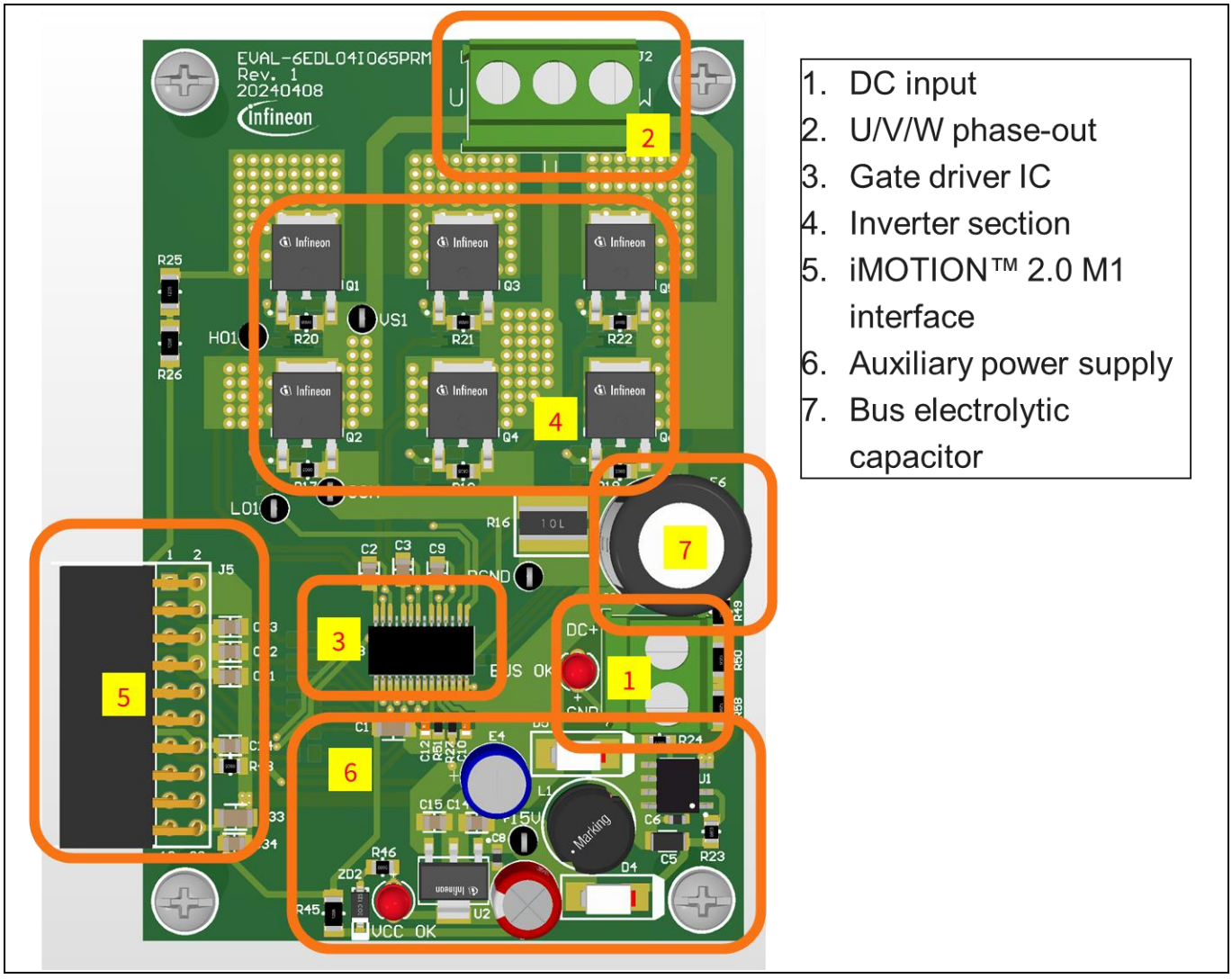


**Figure 2 Functional blocks of EVAL-6EDL04I065PR (top view)**

## 1.3 Main features

The main features of EVAL-6EDL04I065PR includes:

- 6EDL04I065PR gate driver IC
- Nominal DC input voltage of 300V
- Design for maximum 380W motor power output
- Single shunt for current sensing
- Sensing of DC-link voltage
- +15 V and +3.3 V auxiliary power supplies on the board
- M1 interface compatible with the iMOTION™ control board
- 6 x TRENCHSTOP™ IKD06N60RC2 IGBTs

## 1.4 Board parameters and technical data

The key specifications of EVAL-6EDL04I065PR are listed in Table 1.

**Table 1 Specification of EVAL-6EDL04I065PR**

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Nom. | Max. | |
| **Input** | | | | | | |
| Input voltage | $V_{IN}$ | DC voltage | – | 300 | 400 | V |
| Input current | $I_{IN}$ | Input current | – | 1.2 | – | A |
| **Output** | | | | | | |
| Output current | $I_{OUT}$ | RMS current | – | – | 1.2 | A |
| Output power | $P_{OUT}$ | | – | – | 380 | W |
| Overcurrent protection | $I_{OCP}$ | | – | 2.9 | – | A |
| **Switching frequency** | | | | | | |
| Inverter carrier frequency | $F_{SW}$ | | – | – | 25 | kHz |
| **Auxiliary power supply** | | | | | | |
| Gate driver power supply | $V_{CC}$ | | – | 15 | – | V |
| Controller power supply | | | – | 3.3 | – | V |
| **System environment** | | | | | | |
| Ambient temperature | | With adequate cooling method | – | 25 | – | °C |
| **PCB characteristics** | | | | | | |
| Dimensions | L | Length | – | 84 | – | mm |
| | W | Width | – | 55 | – | mm |
| | H | Height | – | 30 | – | mm |
| Layer | | | – | 2 | – | |
| PCB thickness | | | – | 1.5 | – | mm |
| Copper thickness | | | – | 1 | – | oz. |
| Material | | FR-4, RoHS-compliant | | | | |

# 2 System and functional description

## 2.1 Getting started with EVAL-6EDL04I065PR

To run the motor system, a combination of the power board EVAL-6EDL04I065PR and a matching iMOTION™ control board (EVAL-M1-101T) are required. This chapter explains how to set up the system and get started with the iMOTION™ development platform.

The power board EVAL-6EDL04I065PR can run a BLDC motor by connecting to the iMOTION™ 2.0 control board EVAL-M1-101T through an M1 interface. The system is shown in Figure 3, and the results are listed in Section 4.

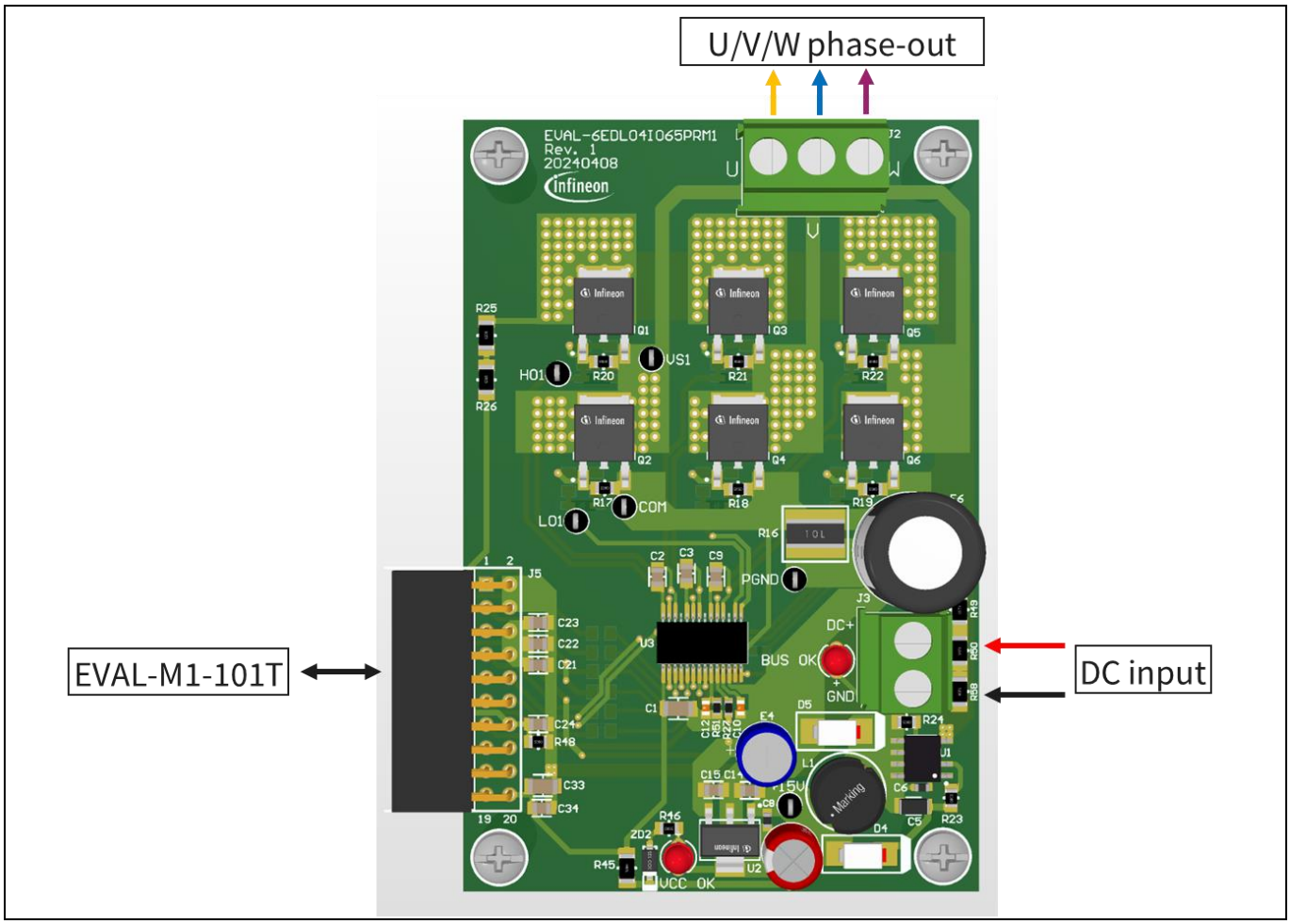


**Figure 3 The system connection for running a BLDC motor**

### 2.1.1 The iMOTION™ control board

You can order the Infineon control board EVAL-M1-101T from https://www.infineon.com/cms/en/product/evaluation-boards/eval-m1-101t/ and download the latest IMC101T-T038 MCE software package from www.infineon.com/imotion-software.

After obtaining EVAL-M1-101T and the latest software, connect your PC to the control board via a USB cable to program and tune it.

1. Connect EVAL-M1-101T's M1 20-pin interface connector J2 to the power board connector J5.

2. In the MCEWizard, enter the system and operating parameters of the target motor and the hardware parameters of the evaluation board. This data is used for calculating the digital parameter set of the controller, representing the complete motor drive system.

3. Go to the Verify & Save page and click **Calculate Parameters**. Then, save the drive parameter set into your project directory by clicking **Export to MCEDesigner file (.txt)** (see Figure 5). This saved drive system parameter file will be used later by the MCEDesigner. Refer to Section 2.1.4 or the MCEWizard user guide for more information.

4. Connect motor phase outputs (J2 on the power board) to the motor.

5. Connect AC input to the power input connector (J3 on the power board), then power on the system.

6. Start the MCEDesigner tool.

7. Click **File > Open** to open the MCEDesigner default configuration file (.irc) for the IMC101T-T038 controller (IMC101T_Vxxx.irc). The IMC101T_Vxxx.irc file is included in the IMC101T-T038 MCE software package.

8. The MCEDesigner should automatically connect to the EVAL-M1-101T control board using the default COM port (indicated by a green circle next to the “COMx Up” status in the bottom frame of the MCEDesigner GUI). If the connection cannot be established, change the COM port as follows:

   a) Open the System Page window.
   b) Click **Preferences>Connection>Connect using**.
   c) Choose one of the other available COM ports from the drop-down list.

9. Program the system parameters into the internal SRAM of the iMOTION™ IC using the following steps:

   a) Click **Tools>Programmer** and select **Program Parameters**
   b) Browse and select the System Drive Parameters file created in step 3. See section 2.1.4 for more information.

10. Start the motor by clicking the green traffic light button in the control bar. To stop the motor, click the red traffic light button in the control bar.

### 2.1.2 iMOTION™ development tools and software

The EVAL-6EDL04I065PR evaluation board can run a BLDC motor when connected to an external control board EVAL-M1-101T. Users must configure the iMOTION™ development tool and software according to the system and BLDC motor parameters.

The MCEDesigner and MCEWizard are based on MCEDesigner v2.3.1 and MCEWizard v2.3.1, and can be downloaded together with supported files from http://www.infineon.com/imotion-software.

### 2.1.3 MCEWizard setup overview

Use the MCEWizard to configure the parameters for the evaluation board or motor. Figure 4 shows the Welcome page of the MCEWizard. Here, users can select the control board or power board from a drop-down list. Infineon releases new control and power boards regularly. Therefore, it is possible that some of the latest power boards have not been pre-configured in the MCEWizard tool and cannot be selected from the drop-down menu. In that case, users can select another power board (as similar as possible) and follow the setup steps in the MCEWizard by entering parameters specific to the power board chosen. Please refer to the application note of the corresponding power board for additional information.

After selecting the modular application design kit (MADK) control board and the power board, click Next in the right-hand bottom corner of the Welcome page to start the MCEWizard system setup process.


**Figure 4 Welcome page of the MCEWizard**

The iMOTION™ system enables users to easily test different combinations of control and power boards with their motors. Users should be familiar with system-level parameters related to the motor used. There are a limited number of parameters specific to the control board or power board hardware. Table 2 lists the hardware parameters specific to the EVAL-6EDL04I065PR power board for MCEWizard setup. Similar tables are available for each control board in its application note. A combination of data in this table and the corresponding table of the control board provides sufficient information to set up the motor drive system quickly.

**Table 2 MCEWizard setup overview table**

| Parameters | Value |
|---|---|
| Control board selecting | EVAL-M1-101T (for example) |
| Motor 1 shunt configuration | Single shunt |
| Controller supply voltage | +3.3V |
| Max DC bus voltage | 400V |
| DC bus sensing high resistor | 2000kΩ |
| DC bus sensing low resistor | 13.3kΩ (mounted on iMOTION™ board) |
| Gate sense low-side devices | High is true |
| Gate sense high-side devices | High is true |
| Motor1 current input scaling | Calculated in the corresponding section of the control board [4] |

After all the MCEWizard questions are answered, the Verify & Save page opens (see Figure 5.).

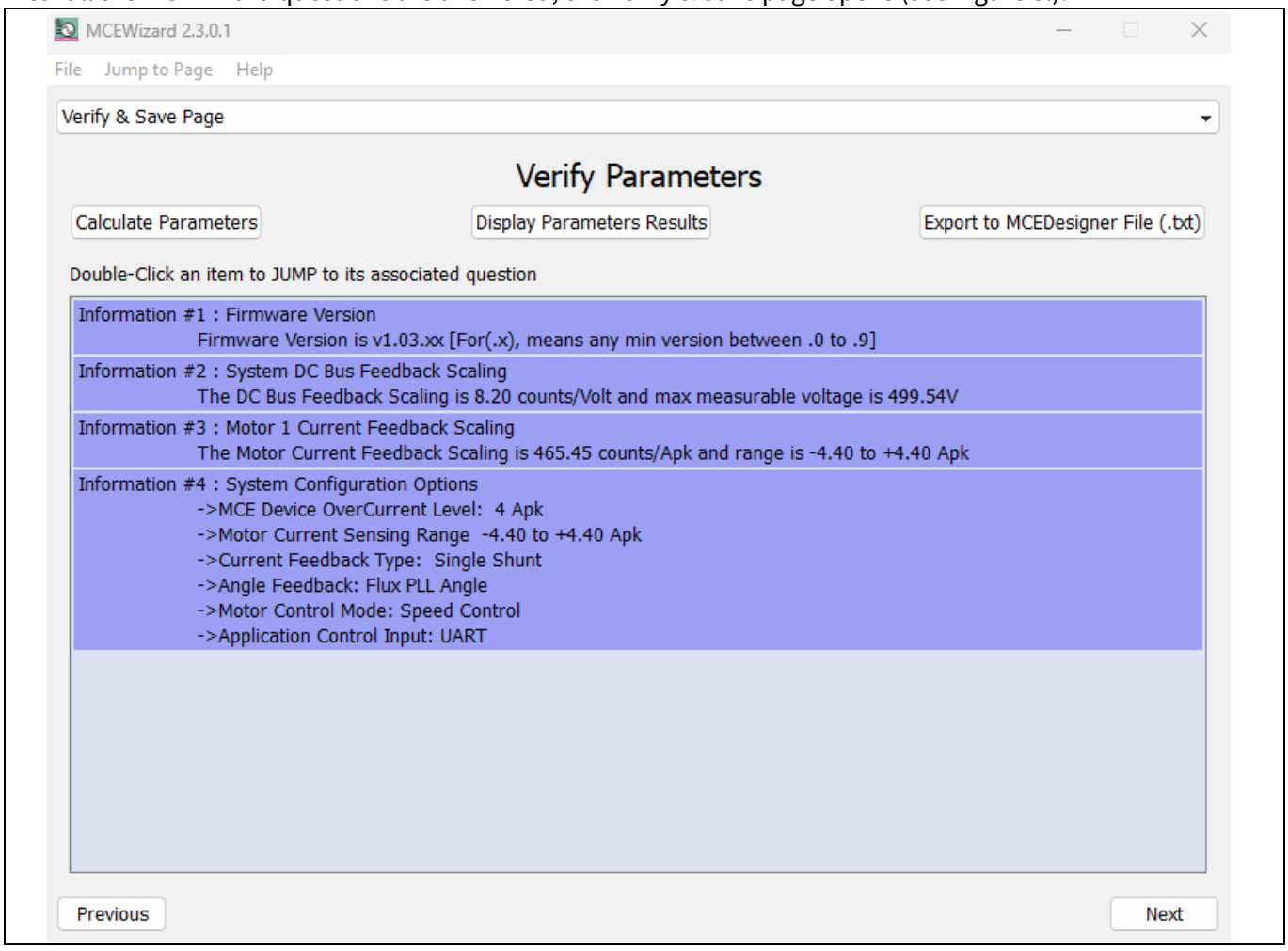


**Figure 5 Verify & Save page of the MCEWizard**

Click **Calculate Parameters** and then **Export to MCEDesigner File (.txt)** to save parameter file. This file will be used by the MCEDesigner in the next steps.

### 2.1.4 MCEDesigner setup overview

The MCEDesigner is a user interface to access or debug the control board. Open the MCEDesigner and then open the IMC101T_xx.irc file. The main display page for EVAL-M1-101T opens, as shown in Figure 6.

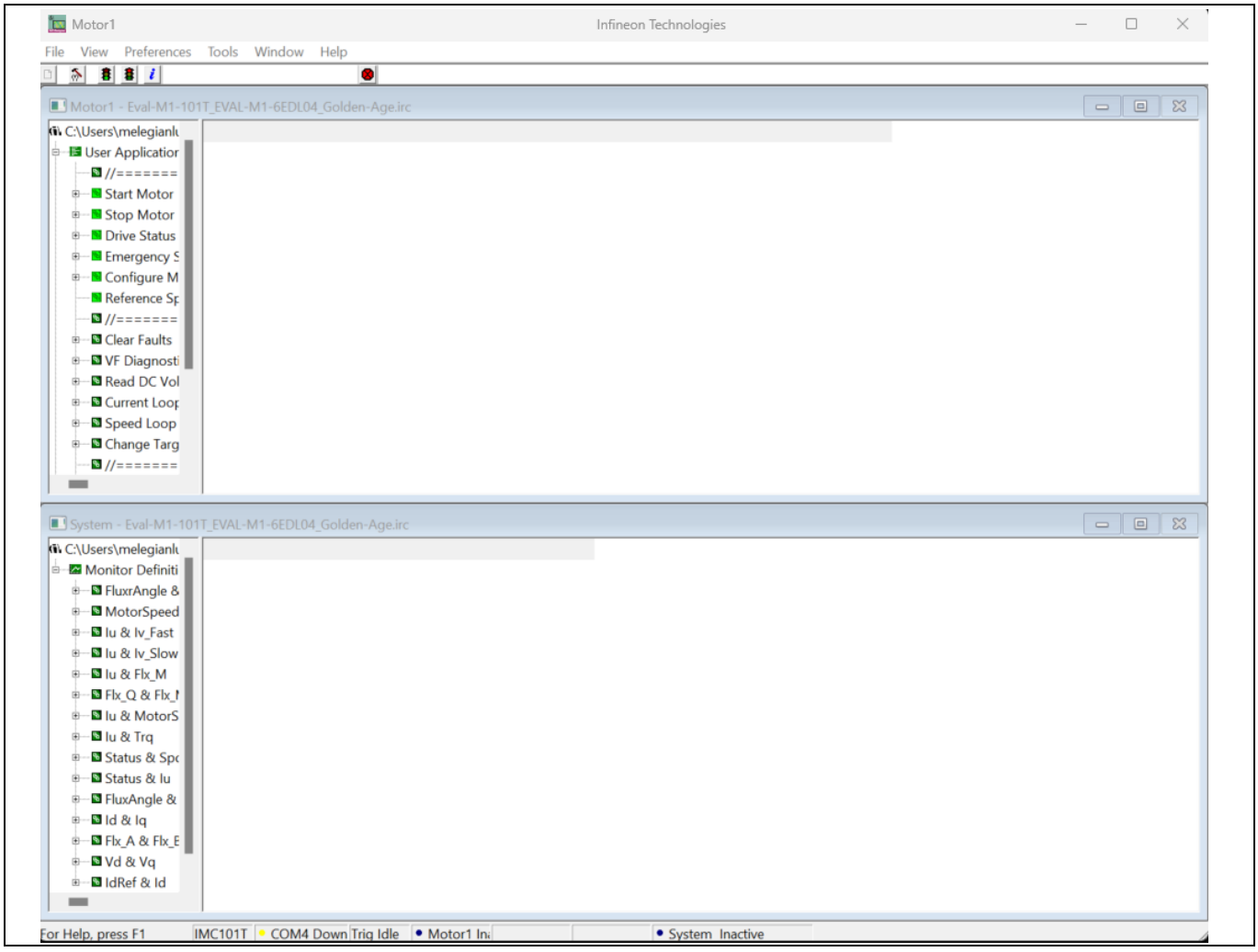


**Figure 6 MCEDesigner's main display for EVAL-M1-101T**

After the drive system parameter file has been programmed into the IMC101 controller, and the motor drive system powered, the MCEDesigner can be used to start/stop the motor, display motor current traces, change the motor speed, modify drive parameters, and perform many other functions. Please refer to the MCEDesigner documentation [6] for more details.

## 2.2 Description of the functional blocks

The motor inverter in EVAL-6EDL04I065PR hardware design is implemented by one 650V SOI three-phase gate driver 6EDL04I065PR and six cost effective monolithically integrated IGBTs IKD06N60RC2. The auxiliary power supply adopts a monolithic integrated low dropout voltage regulator TLE42744GDV33.

### 2.2.1 Overview of 6EDL04I065PR

Figure 7 shows the functional block diagram of 6EDL04I065PR. For more information such as static and dynamic electrical characteristics of the gate driver, please refer to the datasheet of 6EDL04I065PR.

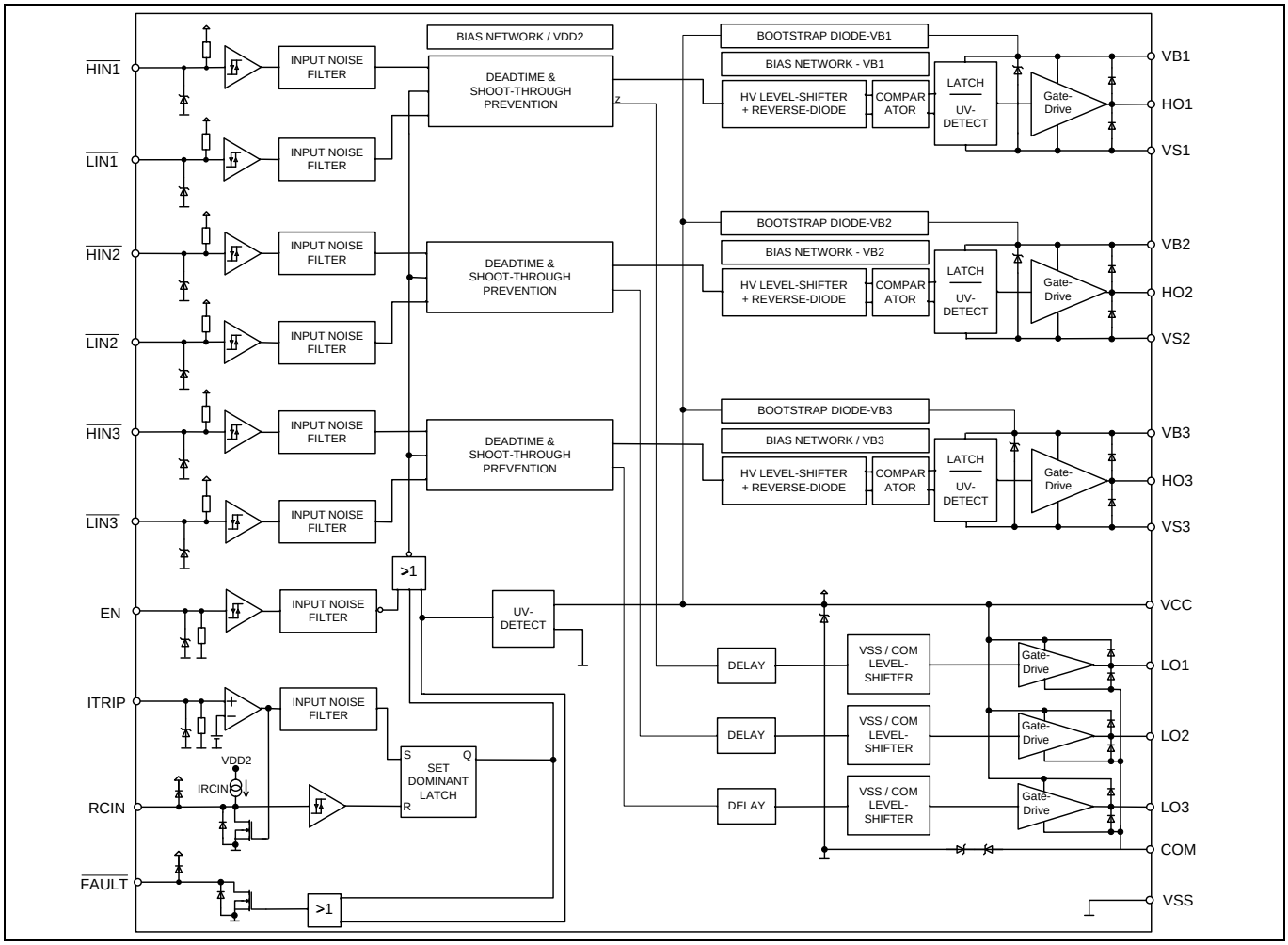


**Figure 7 Functional block diagram of 6EDL04I065PR**

The main features of 6EDL04I065PR include:

- Infineon thin-film-SOI-technology
- Maximum blocking voltage +650 V
- Output source/sink current +0.165 A/-0.375 A
- Integrated ultra-fast, low $R_{DS(ON)}$ Bootstrap Diode
- Insensitivity of the bridge output to negative transient voltages up to -50 V given by SOI-technology
- Separate control circuits for all six drivers
- Detection of over current and under voltage supply
- Externally programmable delay for fault clear after over current detection
- 'Shut down' of all switches during error conditions
- CMOS and LSTTL compatible input (negative logic)
- Signal interlocking of every phase to prevent cross-conduction

**Table 3 Absolute maximum rating**

| Parameter | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| High side offset voltage[1] | $V_S$ | $V_{CC}$ – $V_{BS}$ -1 | 650 | V |
| High side floating supply voltage ($V_B$ vs. $V_S$) (internally clamped) | $V_{BS}$ | -1 | 20 | |
| High side output voltage ($V_{HO}$ vs. $V_S$) | $V_{HO}$ | -0.5 | $V_B$ + 0.5 | |
| Low side supply voltage (internally clamped) | $V_{CC}$ | -1 | 20 | |
| Low side supply voltage ($V_{CC}$ vs. $V_{COM}$) | $V_{CCOM}$ | -0.5 | 25 | |
| Gate driver ground | $V_{COM}$ | -5.7 | 5.7 | |
| Low side output voltage ($V_{LO}$ vs. $V_{COM}$) | $V_{LO}$ | -0.5 | $V_{CCOM}$ + 0.5 | |
| Input voltage LIN,HIN,EN,ITRIP | $V_{IN}$ | -1 | 10 | |
| FAULT output voltage | $V_{FLT}$ | -0.5 | $V_{CC}$ + 0.5 | |
| RCIN output voltage | $V_{RCIN}$ | -0.5 | $V_{CC}$ + 0.5 | |
| Power dissipation (to package)[2] | $P_D$ | – | 0.6 | W |
| Thermal resistance (junction to ambient) | $R_{th(j-a)}$ | – | 165 | K/W |
| Junction temperature | $T_J$ | – | 150 | °C |
| Storage temperature | $T_S$ | - 40 | 150 | |
| Offset voltage slew rate[3] | $dV_S/dt$ | | 50 | V/ns |

[1] In case $V_{CC} > V_B$ there is an additional power dissipation in the internal bootstrap diode between pins VCC and VBx. Insensitivity of bridge output to negative transient voltage up to –50 V is not subject to production test – verified by design / characterization.

[2] Consistent power dissipation of all outputs. All parameters inside operating range.

[3] Not subject of production test, verified by characterization.

### 2.2.2 Overview of IKD06N60RC2

The IKD06N60RC2 is a cost effective monolithically integrated IGBT with diode for hard switching applications from the TRENCHSTOP™ RC-Series.

Figure 8 shows the IKD06N60RC2's package and symbol. For more information about the IGBT, please refer to datasheet of IKD06N60RC2.

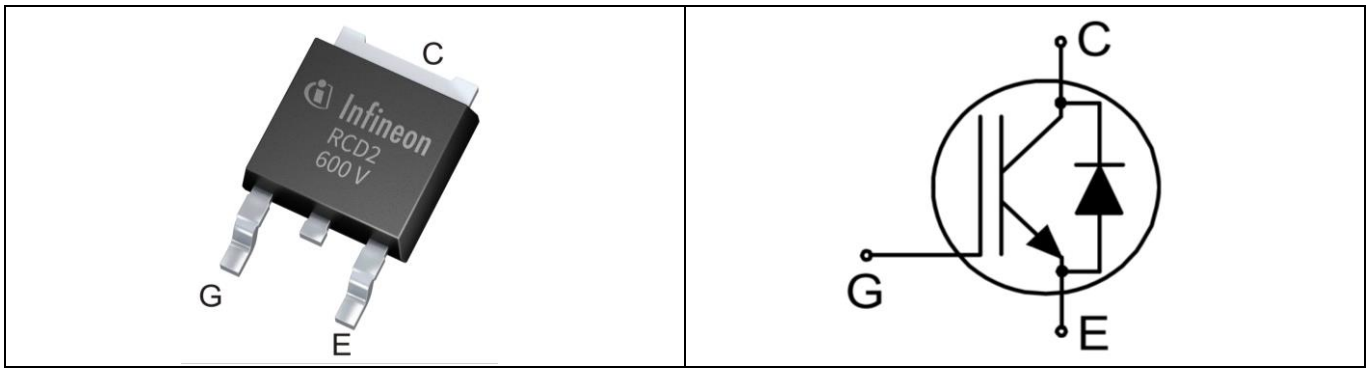


**Figure 8 Package and symbol of IKD06N60RC2**

The main features of IKD04N60RC2 include:

- TRENCHSTOP™ Reverse Conducting (RC) technology for 600V applications
- Very tight parameter distribution
- Operating range up to 20kHz
- Maximum junction temperature 175°C
- Short circuit capability of 3µs
- Humidity robust design
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: http://www.infineon.com/rc-d2

### 2.2.3 Overview of TLE42744GSV33

The TLE42744GDV33 is a monolithic integrated low dropout voltage regulator for load current up to 400mA.

Figure 9 shows the TLE42744GSV33 block diagram. For more information about the device, please refer to datasheet of TLE42744GSV33.

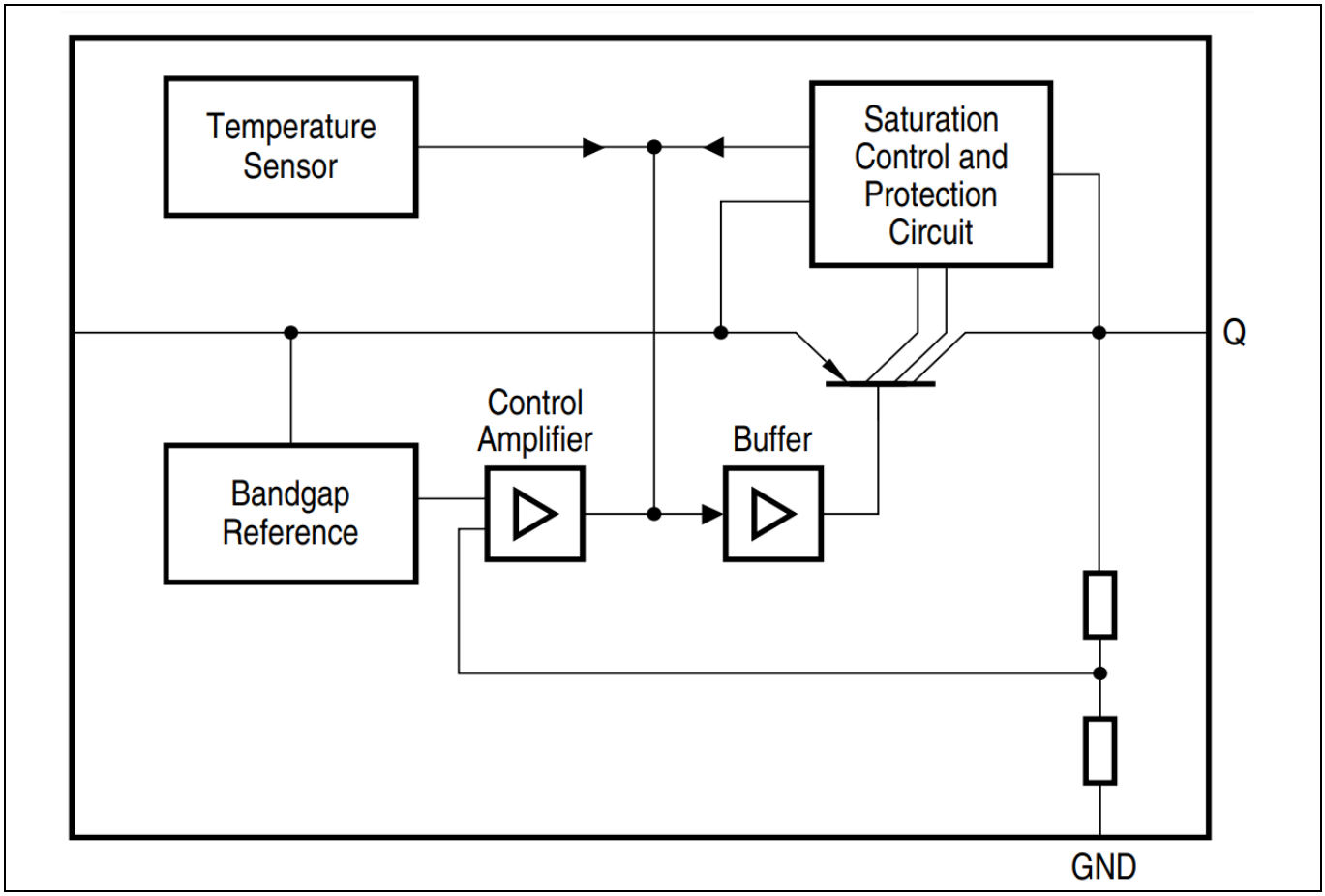


**Figure 9 Block diagram of TLE42744GSV33**

The main features of TLE42744GSV33 include:

- Very low Current Consumption
- Output Voltages 5V and 3.3V ±2%
- Output current up to 400mA
- Very Low Dropout Voltage
- Output Current Limitation
- Reverse Polarity Protection
- Overtemperature Shutdown
- Wide Temperature Range from -40°C up to 150°C
- Green Product (RoHS compliant)
- AEC Qualified

# 3 System design

This chapter covers the hardware design of EVAL-6EDL04I065PR in detail. Users can modify the circuit or reselect the components values based on actual applications in the field.

## 3.1 Schematics

The schematic of EVAL-6EDL04I065PR is shown in Figure 10.

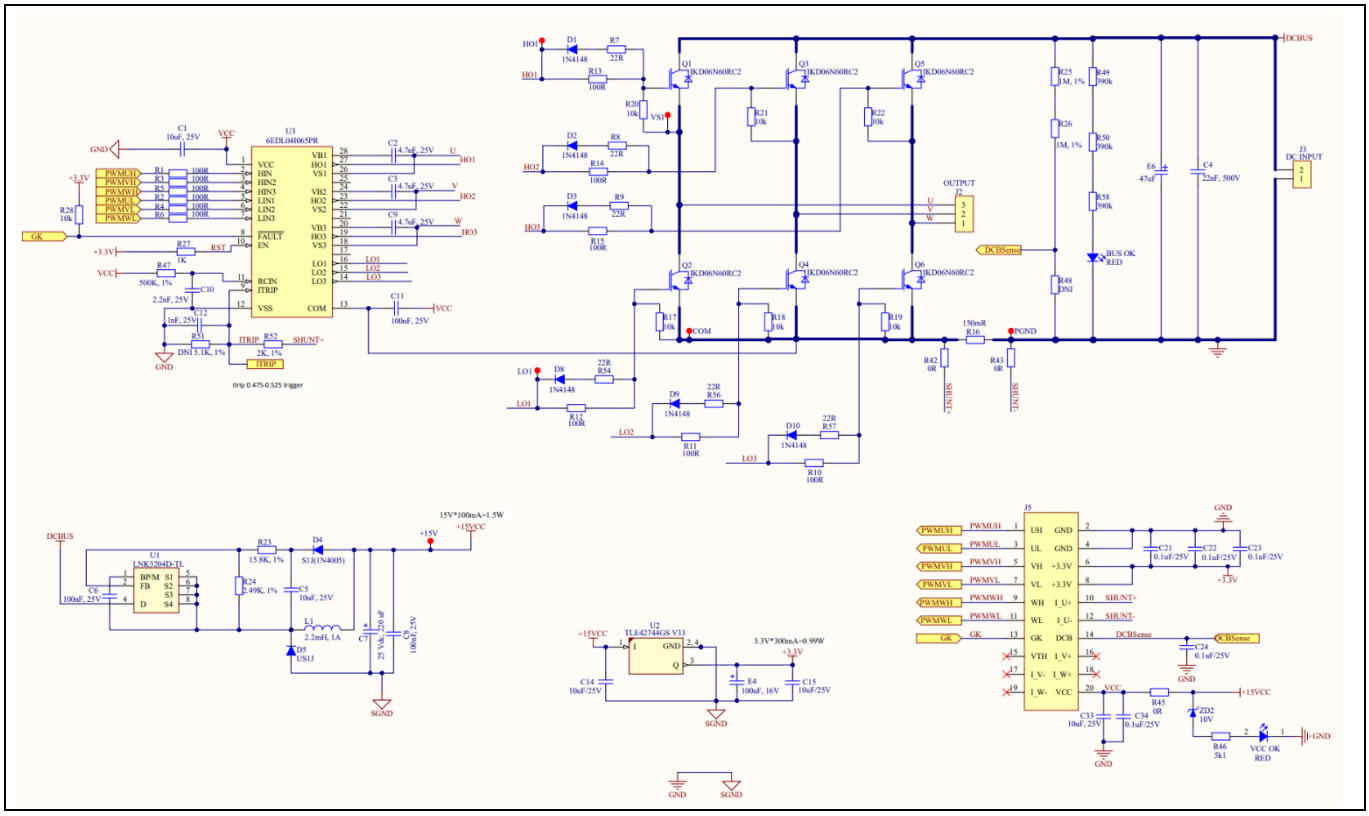

**Figure 10 EVAL-6EDL04I065PR schematic**

For more information about every block included in the schematic refer to the next sections.

### 3.1.1 Drive circuit with 6EDL04I065PR

6EDL04I065PR gate driver IC is used to drive the six IKD06N60RC2 IGBTs mounted on the board. The configuration of 6EDL04I065PR is shown in Figure 11.

The capacitor C2 (C3, C9) is used as bootstrap capacitor to provide necessary floating supply voltage $V_{BS}$. Thanks to the 6EDL04I065PR integrated bootstrap diode, an external bootstrap diode is not needed.

6EDL04I065PR (high-voltage integrated circuit) HVIC is equipped with ITRIP input pin. This functionality can be used to detect overcurrent events in DC bus. When the HVIC detects an overcurrent event through the ITRIP pin for one of the three phases, the output (as well as the outputs of the other two phases) is shut down and the FAULT pin is pulled to VSS to report the fault condition. The FAULT can also be used as the fault-clear time programmable pin.

The fault-clear time setup is based on the datasheet of 6EDL04I065PR. The main feature of 6EDL04I065PR designed with Infineon's SOI technology is its tolerance in terms of negative transient voltage in inductive load applications. The device can tolerate repetitive negative transient voltage of up to 100V.

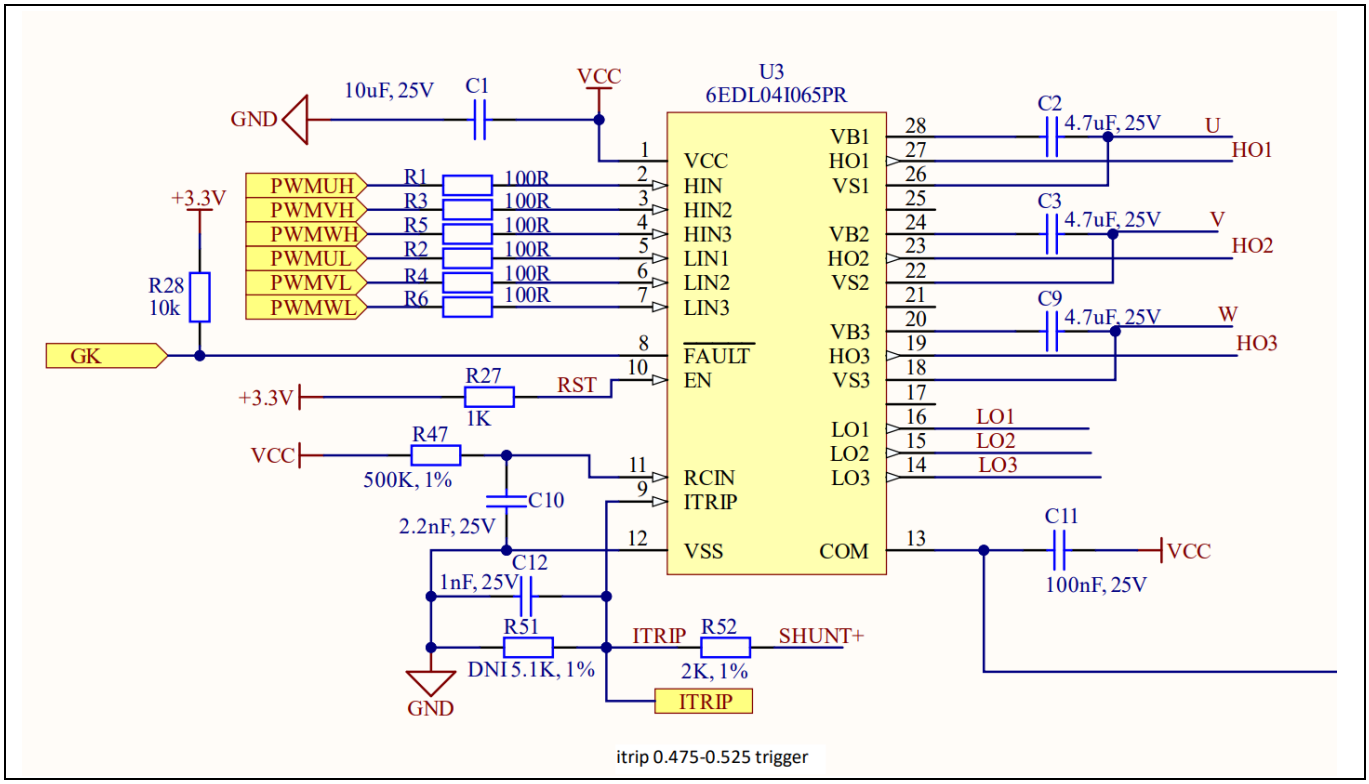


**Figure 11 Drive circuit design with 6EDL04I065PR**

### 3.1.2 Inverter section using IKD06N60RC2

IKD06N60RC2 TRENCHSTOP™ IGBTs are mounted on the power board to implement the three-phase inverter bridge section as shown in Figure 12.

R16 is single shunt for current sensing.

The inverter section slew rate and self heating performances can be seen in the corresponding paragraphs 4.3 and 4.4 respectively.

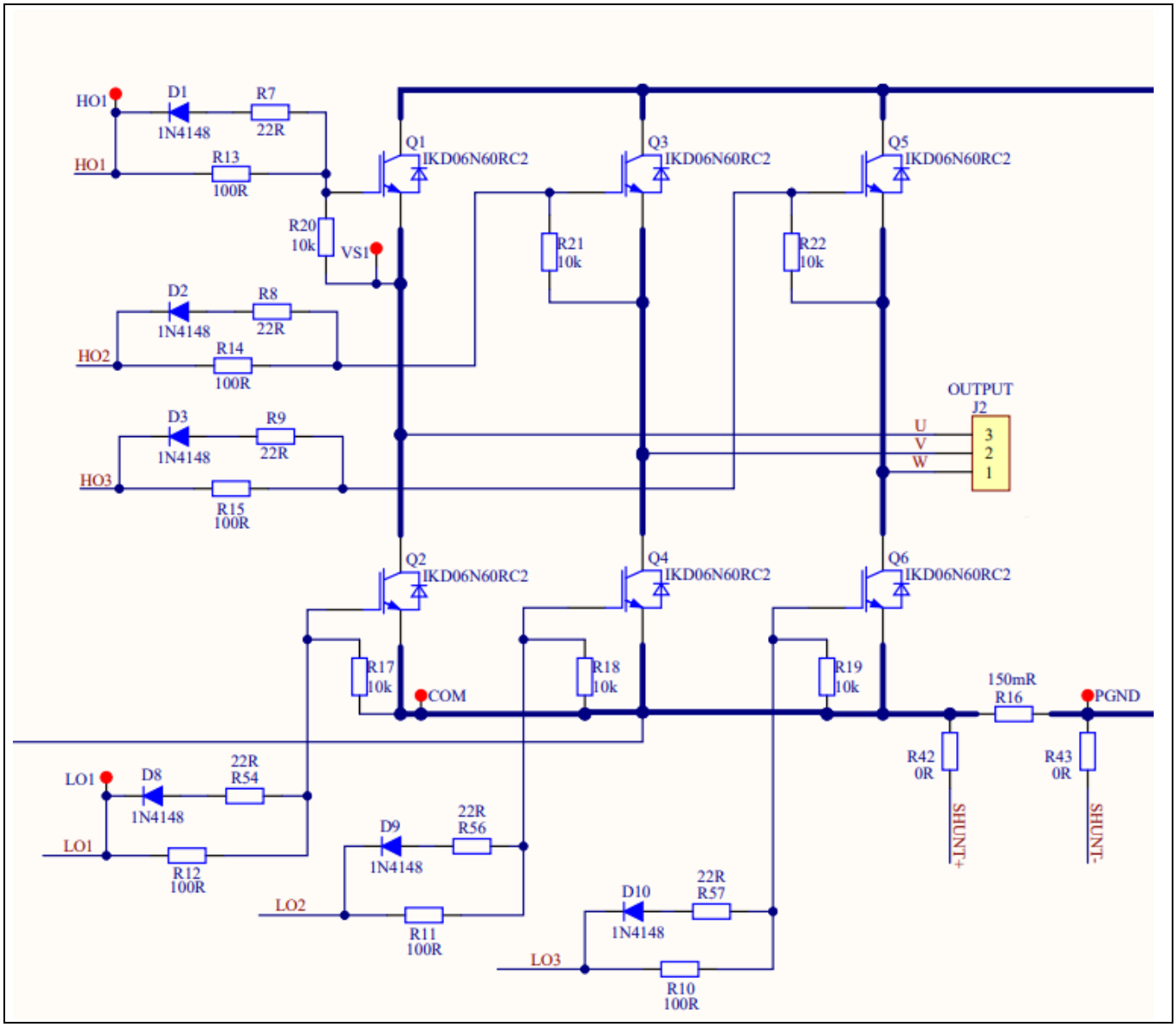


**Figure 12 Inverter section diagram**

### 3.1.3 Overcurrent protection

The overcurrent circuit is shown in Figure 11 and Figure 12.

To save power loss of the shunt resistor, the $R_{Shunt}$ value is set as 150mΩ (R16). In the design, the target for overcurrent protection ($I_{OCP}$) is 2.9A. The overcurrent threshold of the ITRIP pin is 0.445V (typical).

Considering the resistor $R_{51}$ is not mounted, the $I_{OCP}$ is calculated using the following simplified formula:

$$I_{OCP} = \frac{V_{ITRIP}}{R_{Shunt}} = \frac{0.445V}{0.150\Omega} = 2.9A$$

**Equation 1 Simplified equation to calculate the $I_{OCP}$**

If the $R_{51}$ would be mounted the $I_{OCP}$ can be calculated with the following formula:

$$I_{OCP} = V_{ITRIP} \cdot \frac{R_{16} + R_{42} + R_{51} + R_{52}}{R_{16} \cdot R_{51}} = 0.445V \cdot \frac{(0.150 + 0 + 5100 + 2000)\Omega}{(0.150 \cdot 5100)\Omega} = 0.445V \cdot \frac{7100.15\Omega}{765\Omega} = 4.1A$$

**Equation 2 Complete equation to calculate the $I_{OCP}$**

### 3.1.4 DC-link voltage measurement

Bus capacitors (E6, C4) should be large enough to stabilize the bus voltage. A LED is mounted to flag when the DC-link is applied to the board. The iMOTION™ controller can sense the DC-link voltage through the resistor divider (R25, R26 and an additional pull-down resistor mounted on the iMOTION™ control board).

*Note: The resistor R48 is not mounted on the power board EVAL-6EDL04I065PR because a pull-down resistor is already soldered on the iMOTION™ EVAL-M1-101T control board.*

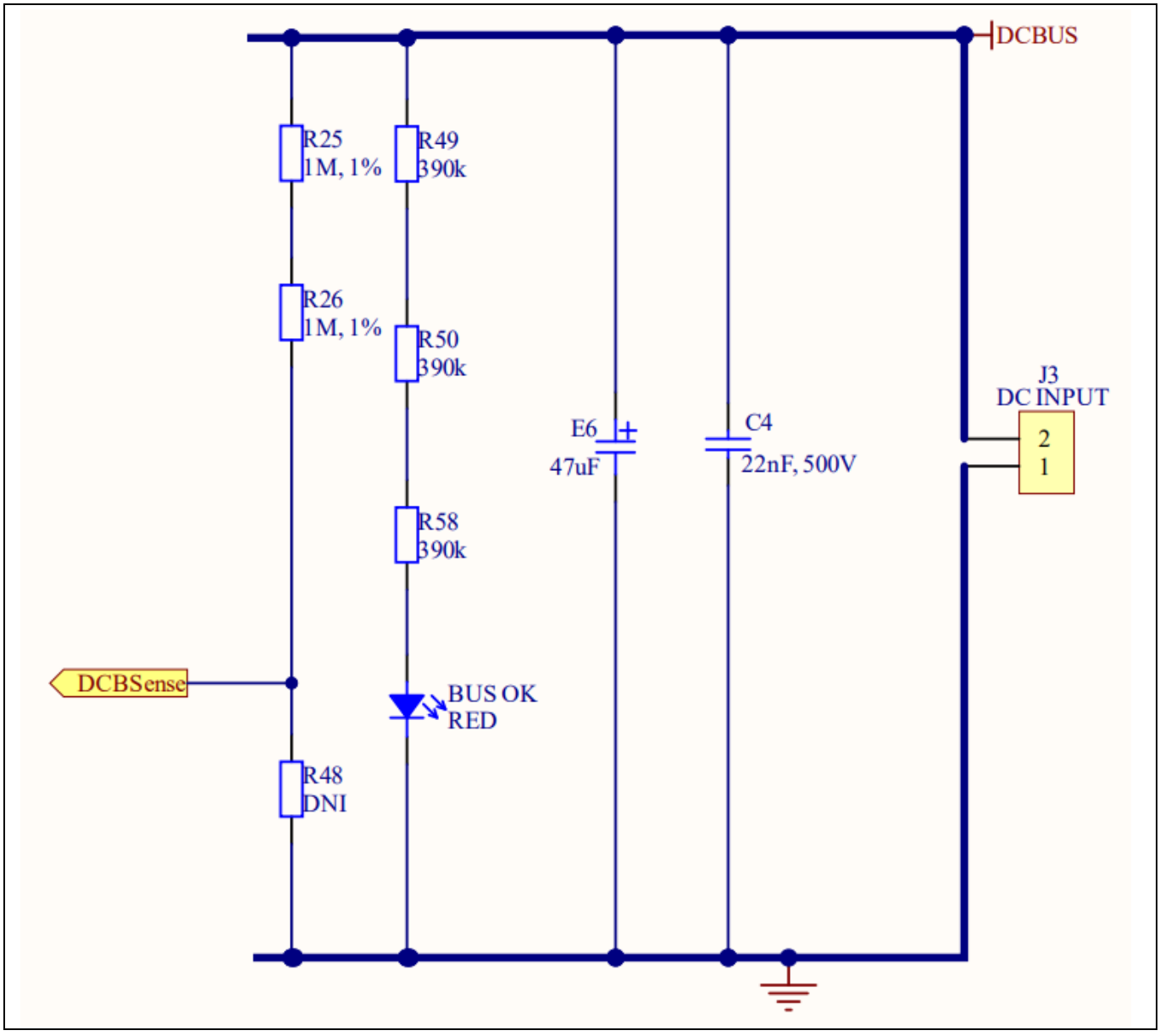


**Figure 13 DC-Link schematic**

### 3.1.5 Auxiliary power supply

The auxiliary power supply circuit adopt a DC/DC converter to step down the DC-Link from 300V to 15V. Moreover, an additional Low Dropout Linear Voltage Regulator (TLE42744GSV33) is added to provide a 3.3V reference from 15V.

## 3.2 Layout

### 3.2.1 Layout details

Detailed layouts of the power inverter board are shown in Figure 14 and Figure 15.

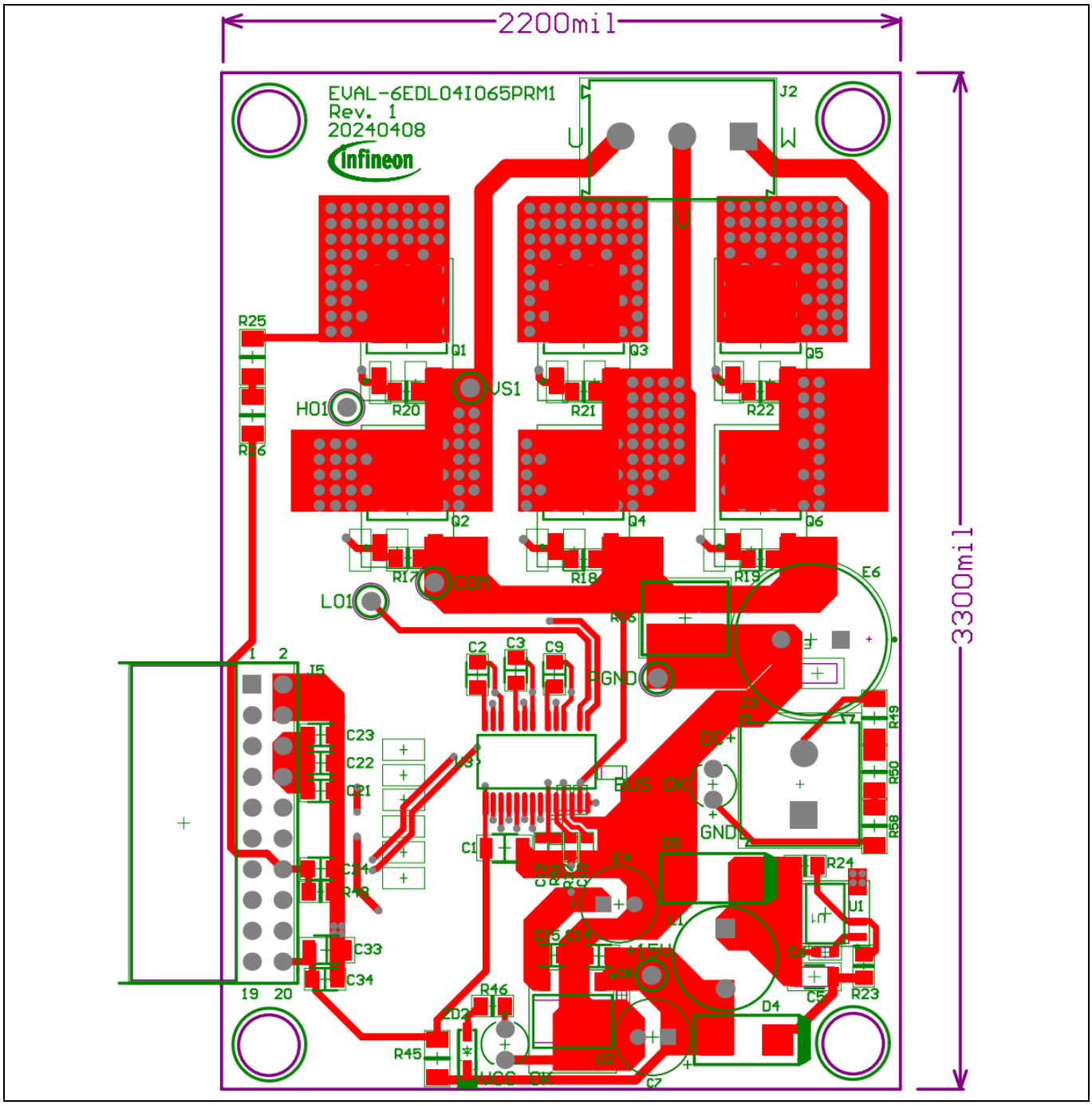


**Figure 14 Power inverter board layout (top view)**

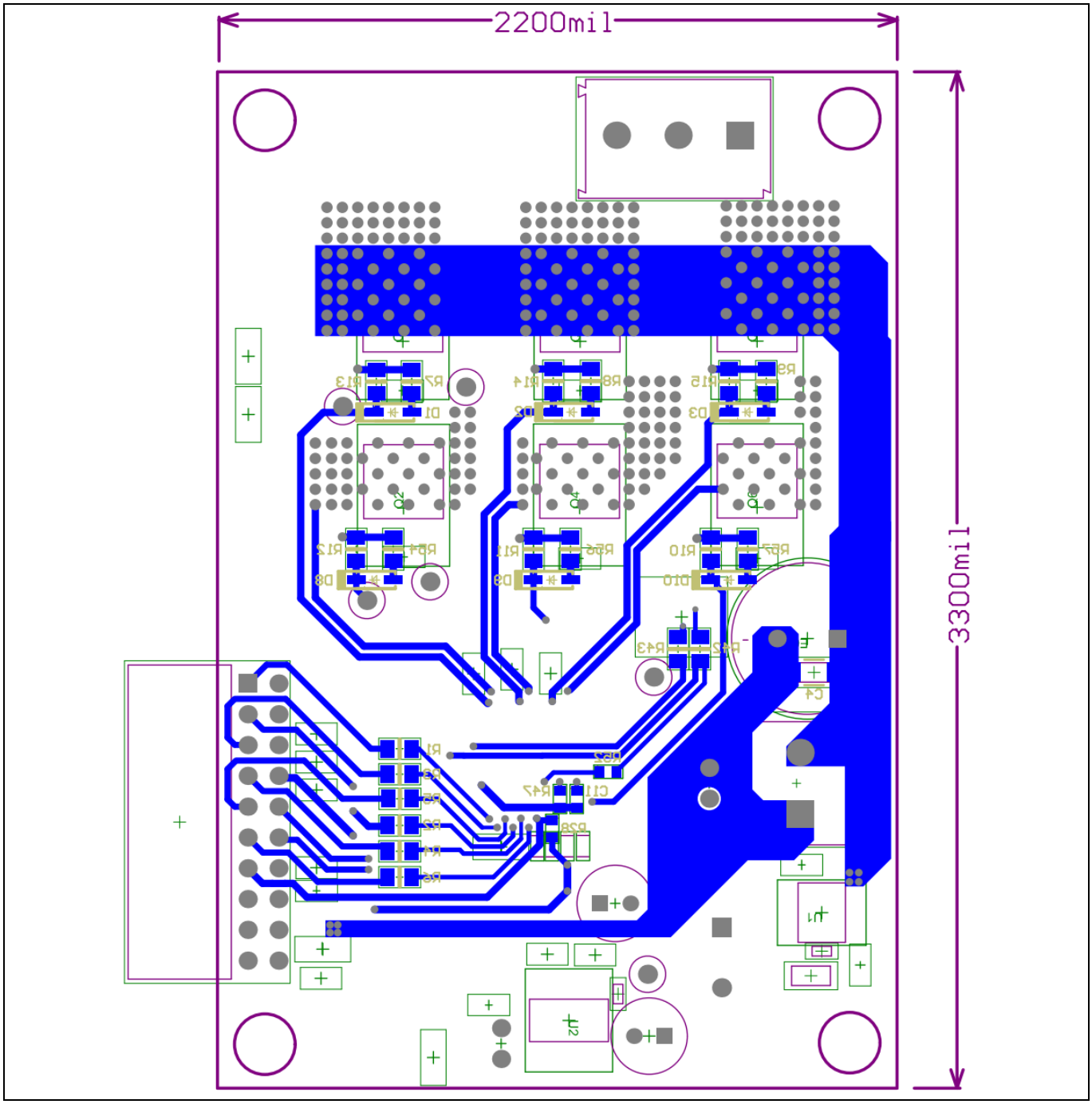


**Figure 15 Power inverter board layout (bottom view)**

### 3.2.2 Layout guidelines

Some basic layout guidelines are as follow:

- The $V_{CC}$ and $V_{BS}$ bypass capacitors should be close to the IC
- The drive loop should be as small as possible
- The loop of $V_{SS}$ and COM should be made as small as possible by connecting the $V_{SS}$ and COM directly at the shunt-resistor terminals
- The two current-sensing traces should be started from the shunt terminals and placed close to each other

## 3.3 Bill of material

The complete bill of material is available on the download section of the Infineon homepage. A log-in is required to download this material.

**Table 4 BOM of the most important/critical parts of the evaluation or reference board**

| S. No. | Ref Designator | Description | Manufacturer | Manufacturer P/N | Populated |
|---|---|---|---|---|---|
| 1 | U3 | Three-phase gate driver with overcurrent protection | Infineon Technologies | 6EDL04I065PR | Yes |
| 2 | Q1, Q2, Q3, Q4, Q5, Q6 | Cost effective monolithically integrated IGBT with diode | Infienon Technologies | IKD06N60RC2 | Yes |
| 3 | U2 | Monolithic integrated low dropout voltage regulator | Infineon Technologies | TLE42744GDV33 | Yes |

## 3.4 Connector details

**Table 5 Connectors**

| PIN | Label | Function |
|---|---|---|
| DC+, DC- | J3 | DC power supply input |
| U,V,W | J2 | Three phase-outs (U/V/W) to the motor |
| | J5 | iMOTION™ MADK-M1 20-pin interface connector |

**Table 6 iMOTION™ MADK-M1 20-pin interface connector for controller board**

| Pin | Name | Pin name connectors |
|---|---|---|
| 1 | PWMUH | 3.3V compatible logic input for high side gate driver-Phase U |
| 2 | GND | Ground |
| 3 | PWMUL | 3.3V compatible logic input for low side gate driver-Phase U |
| 4 | GND | GND ground |
| 5 | PWMVH | 3.3V compatible logic input for high side driver-Phase V |
| 6 | +3.3V | On board 3.3V supply |
| 7 | PWMVL | 3.3V compatible logic input for low side gate driver-Phase V |
| 8 | +3.3V | On board 3.3V supply |
| 9 | PWMWH | 3.3V compatible logic input for high side gate driver-Phase W |
| 10 | I_U | Positive current sense output |
| 11 | PWMWL | 3.3V compatible logic input for low side gate driver-Phase W |
| 12 | I_U- | Negative currente sense output or ground |
| 13 | GK | Gatekill signal – active low when overcurrent is detected |
| 14 | DCBSense | DC bus positive voltage, scaled in 0-3.3V range by a voltage divider |
| 15 | VTH | Thermistor output |
| 16 | I_V | Not used |
| 17 | I_V- | Not used |
| 18 | I_W | Not used |
| 19 | I_W- | Not used |
| 20 | VCC | 15V power supply |

# 4 System performance

EVAL-6EDL04I065PR is tested while running a BLDC motor in the setup shown in Figure 16.

Test conditions:

- Input $V_{IN}$=300VAC
- Phase-out current: $I_{PHASE}$=714mA rms (@200rpm)
- Room temperature
- BLDC motor: Golden Age GK6040-6AC31-WE, test at speed = 200r/min
- Three-phase sinusoidal modulation

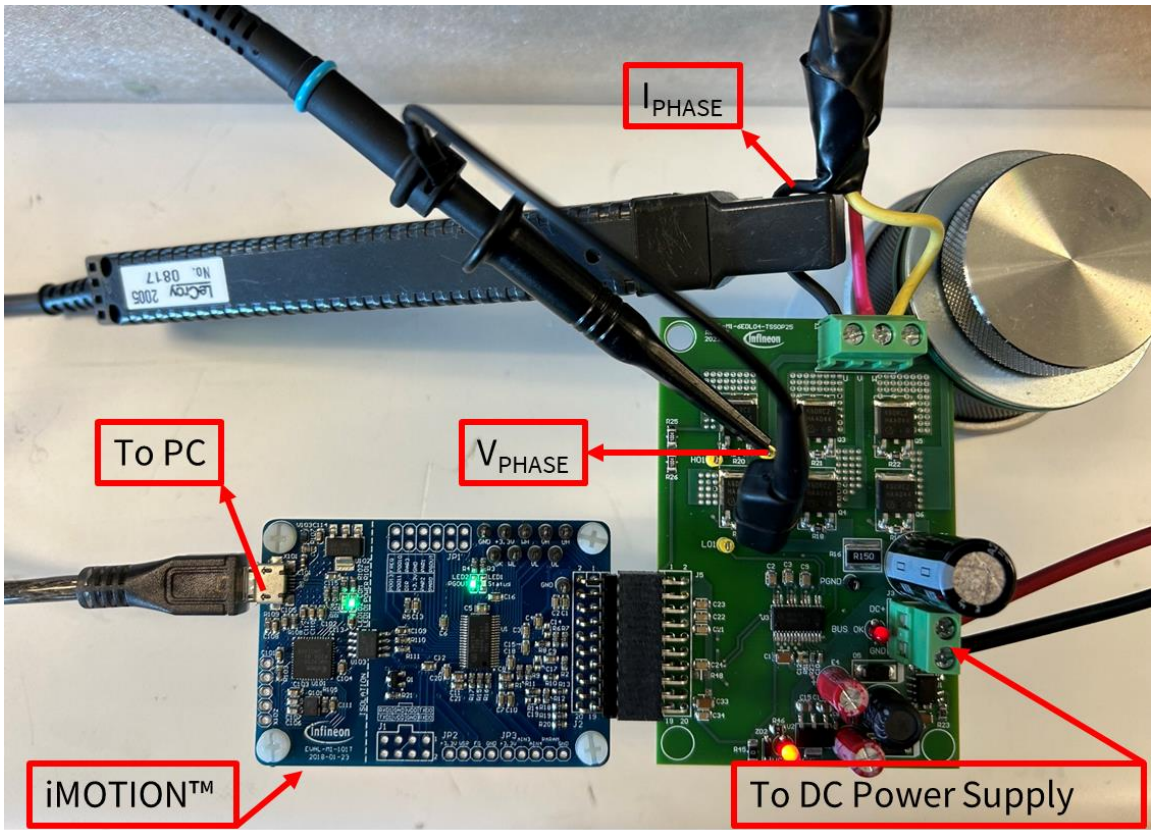


**Figure 16 System setup for running a BLDC motor**

## 4.1 The output phase current

Figure 17 shows the waveforms when running a BLDC motor.

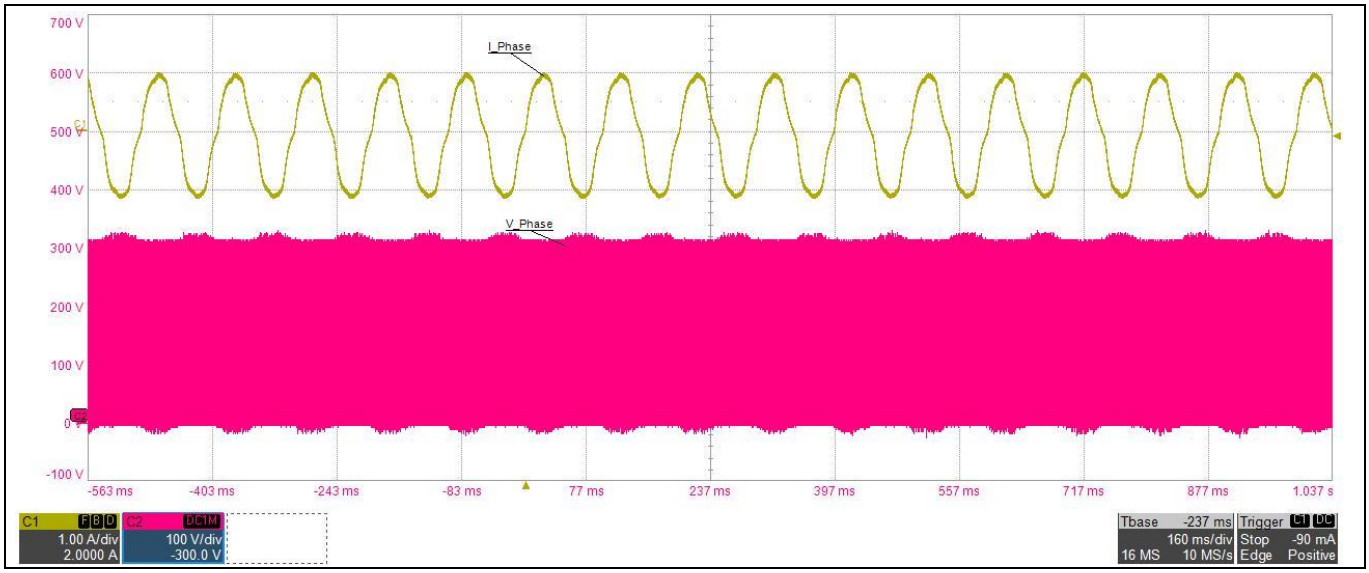


**Figure 17 Phase U output current 714mA rms waveform at $V_{IN}$=300VDC, $F_{SW}$=7kHz**

## 4.2 Test result for short-circuit protection

Figure 18 shows the short-circuit protection of EVAL-6EDL04I065PR. The total short-circuit protection delay time (including external RC filter, 2kΩ/1nF) is less than 1 microseconds when the input voltage $V_{IN}$ is 300V and the maximum current is about 29A.

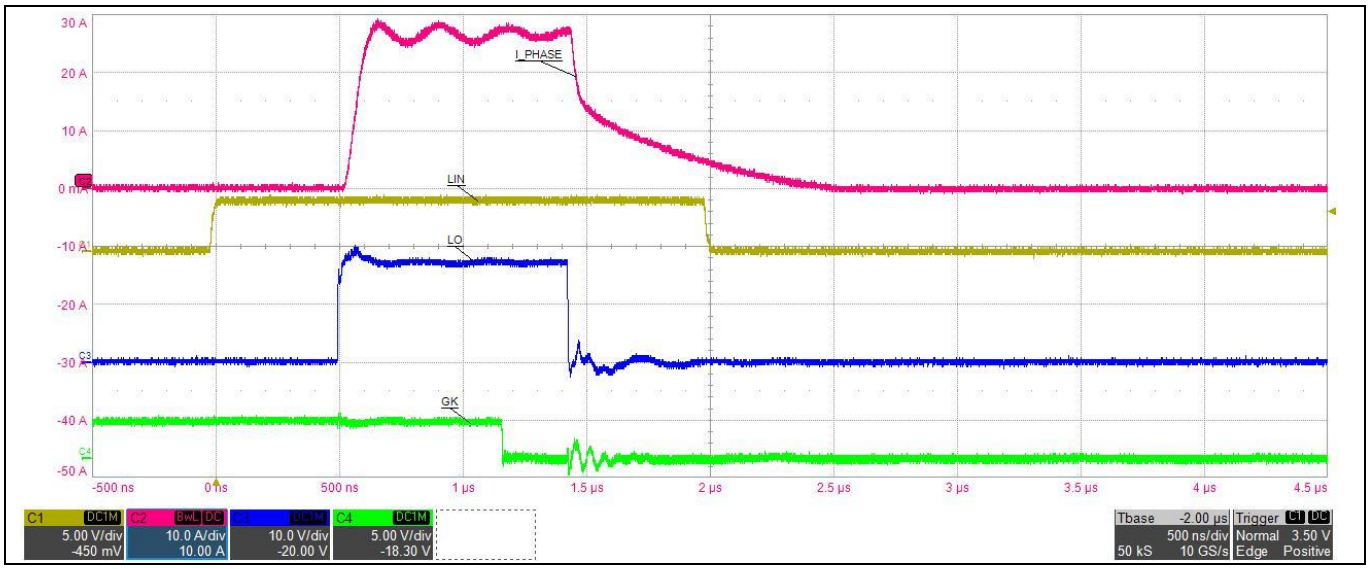


**Figure 18 Short-circuit protection at $V_{IN}$=300V**

## 4.3 Slew rate performances (butterfly diagram)

Figure 19 shows the EVAL-6EDL04I065PR slew rate performances over phase current. The butterfly diagram takes into consideration both High-side and Low-side, turn-on and turn-off conditions.

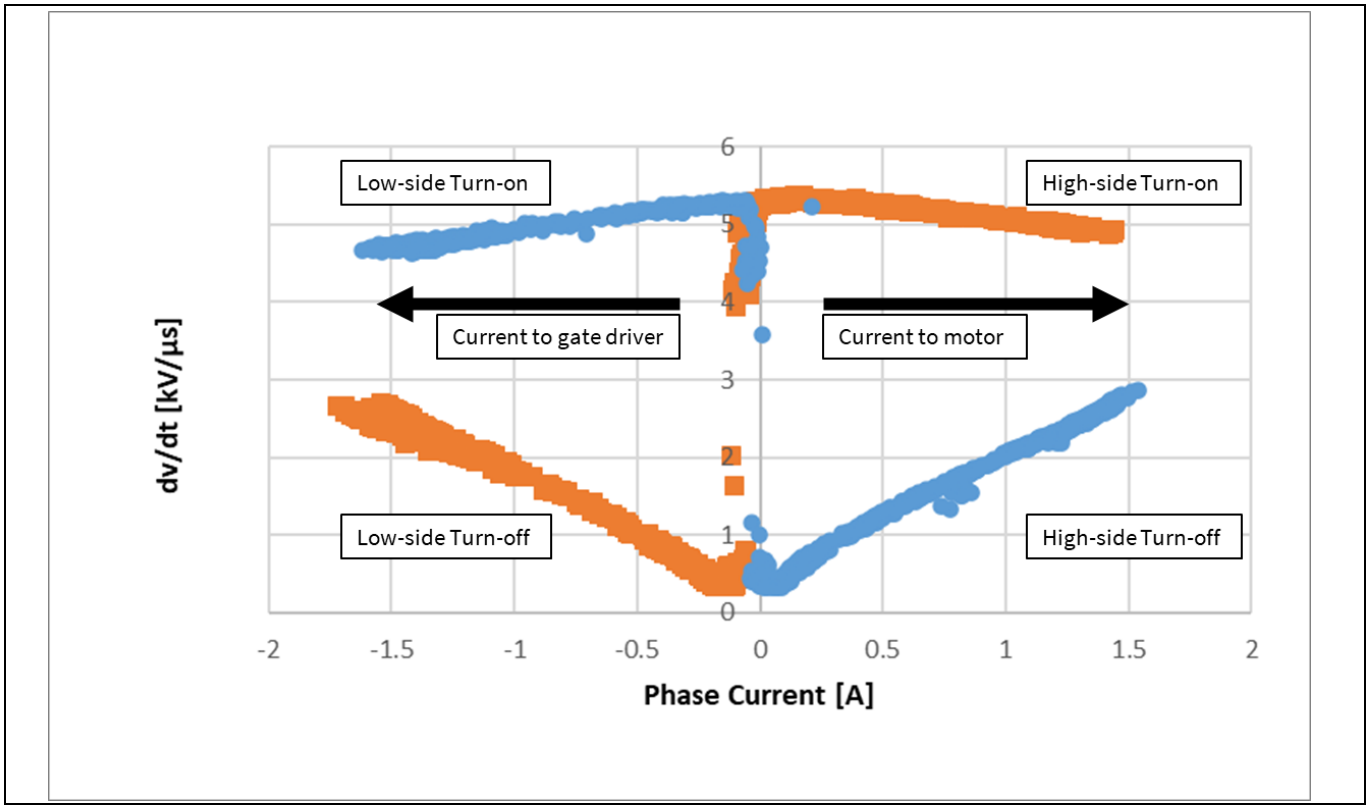


**Figure 19 EVAL-6EDL04I065PR butterfly diagram**

## 4.4 Self heating performances

Figure 20 shows the 6EDL04I065PR gate driver and IKD06N60RC2 IGBTs self heating during motor control operations.

The measurement refers to 200rpm motor target speed (7kHz PWM frequency) at room temperature. 6EDL04I065PR gate driver reaches 50°C while IKD06N60RC2 IGBTs reach less than 75°C as maximum temperature.

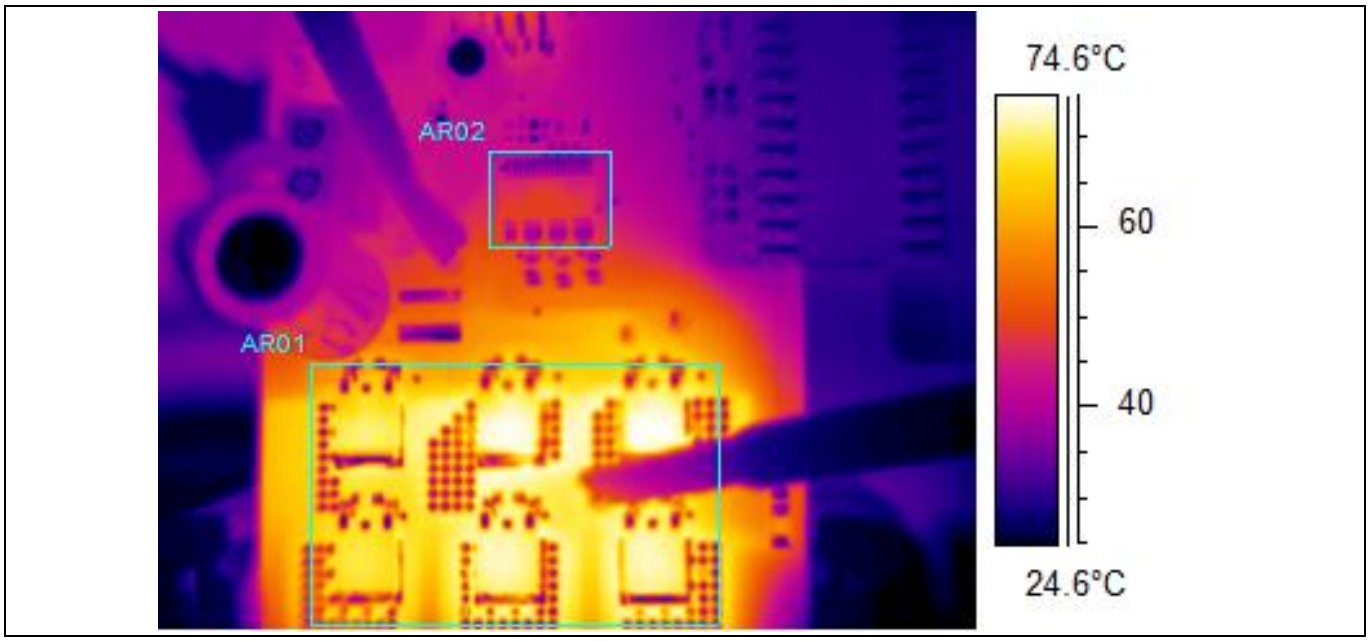


**Figure 20 EVAL-6EDL04I065PR self heating performances**

# Appendices

## A Abbreviations and definitions

**Table 7 Abbrevations**

| Abbrevation | Meaning |
|---|---|
| IC | Integrated circuit |
| IGBT | Insulated gate bipolar transistor |
| DC | Direct current |
| BLDC | Brushless direct current |
| PWM | Pulse width modulation |
| EVAL | Evaluation board |
| PCB | Printed circuit board |
| SOI | Silicon on insulator |

# References

[1] Infineon Technologies AG.: Datasheet of 6EDL04I065PR (2024) V.2.0; Infineon Technologies

[2] Infineon Technologies AG.: Datasheet of IKD06N60RC2 (2020) V.2.1; Infineon Technologies

[3] Infineon Technologies AG.: Datasheet of TLE42744GSV33 (2018) V.1.3; Infineon Technologies

[4] Infineon Technologies AG.: User manual of EVAL-M1-101T (2018) V.1.6; Infineon technologies

[5] Infineon Technologies AG.: Application note “Managing transients in control IC driven power stages (2017) V.1.0; Infineon Technologies

[6] Infineon Technologies AG.: iMOTION™ - MCE – Software Reference Manual (2020) V.1.3; Infineon Technologies

## Revision history

| Document revision | Date | Description of changes |
|---|---|---|
| 1.0 | 4th April 2024 | Final revision after review |
| 1.2 | 28th August 2024 | Updated the gate resistors and related figures 11 and 12 |
| | | |

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