# Driving 650 V CoolGaN™ GIT G5 for Motor Control Applications

## featuring IFX SOI EiceDRIVER™ drivers

## About this document

### Scope and purpose

This document presents the EVAL-2EDGAN-INV-1KW evaluation board, which is a 1000W inverter for home appliance application and general purpose motor drives able to source up to 3 Arms motor current.

This board shows the capability of SOI (Silicon On Insulator) level shifter EiceDRIVER™ 2ED21064S06J to efficiently drive 650 V CoolGaN™ G5 GIT (Gate Injection Transistor) IGLD65R055D2 55 mΩ in a motor drive set up characterized by a three leg shunt configuration.

This document describes the converter system architecture and hardware, with a summary of the experimental results. This board is intended to be used during the design-in process for evaluating and measuring characteristic curves, and for checking datasheet specifications.

| ***Base Part Number*** | ***Package*** | ***OPN (Orderable Part Number)*** |
|---|---|---|
| EVAL-2EDGAN-INV-1KW | EVAL | EVAL2EDGANINV1KWTOBO1 |
| 2ED21064S06J | PG-DSO-14 | 2ED21064S06JXUMA1 |
| IGLD65R055D2 | PG-LSON-8 | IGLD65R055D2 AUMA1 |
| ICE5BR4780BZ | PG-DIP-7 | ICE5BR4780BZXKLA1 |
| TLE42754D | PG-TO252-5 | TLE42754DATMA1 |

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

*Note: Boards do not necessarily meet safety, EMI, quality standards (for example UL, CE) requirements*

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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 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:** *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 AC 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 System and functional description

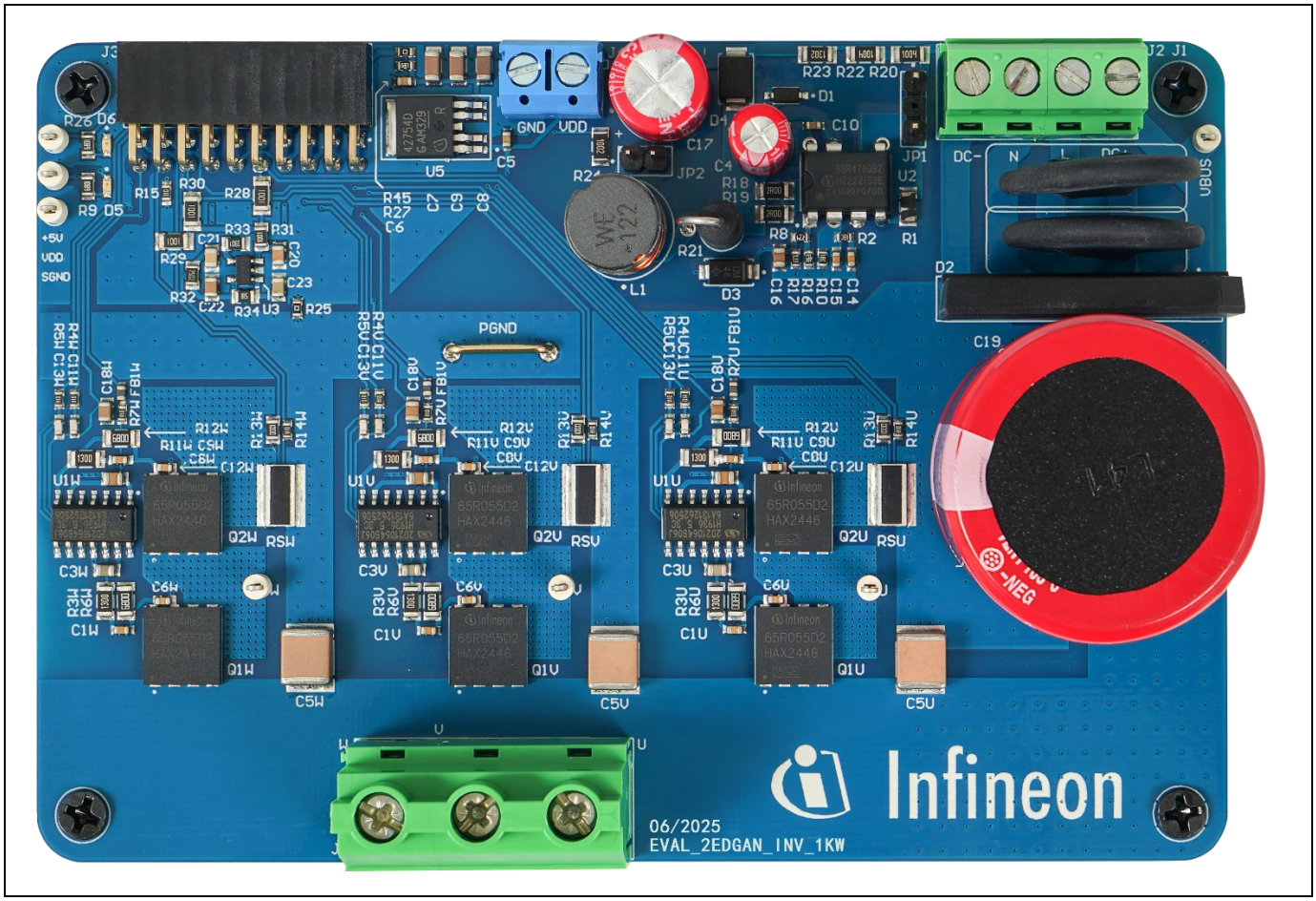



**Figure 1 Evaluation Board EVAL-2EDGAN-INV-1KW**

Figure 1 shows the picture of the EVAL-2EDGAN-INV-1KW evaluation board. A detailed description is given in paragraph 1.3 Board description.

## 1.1 Overview of Block Diagram

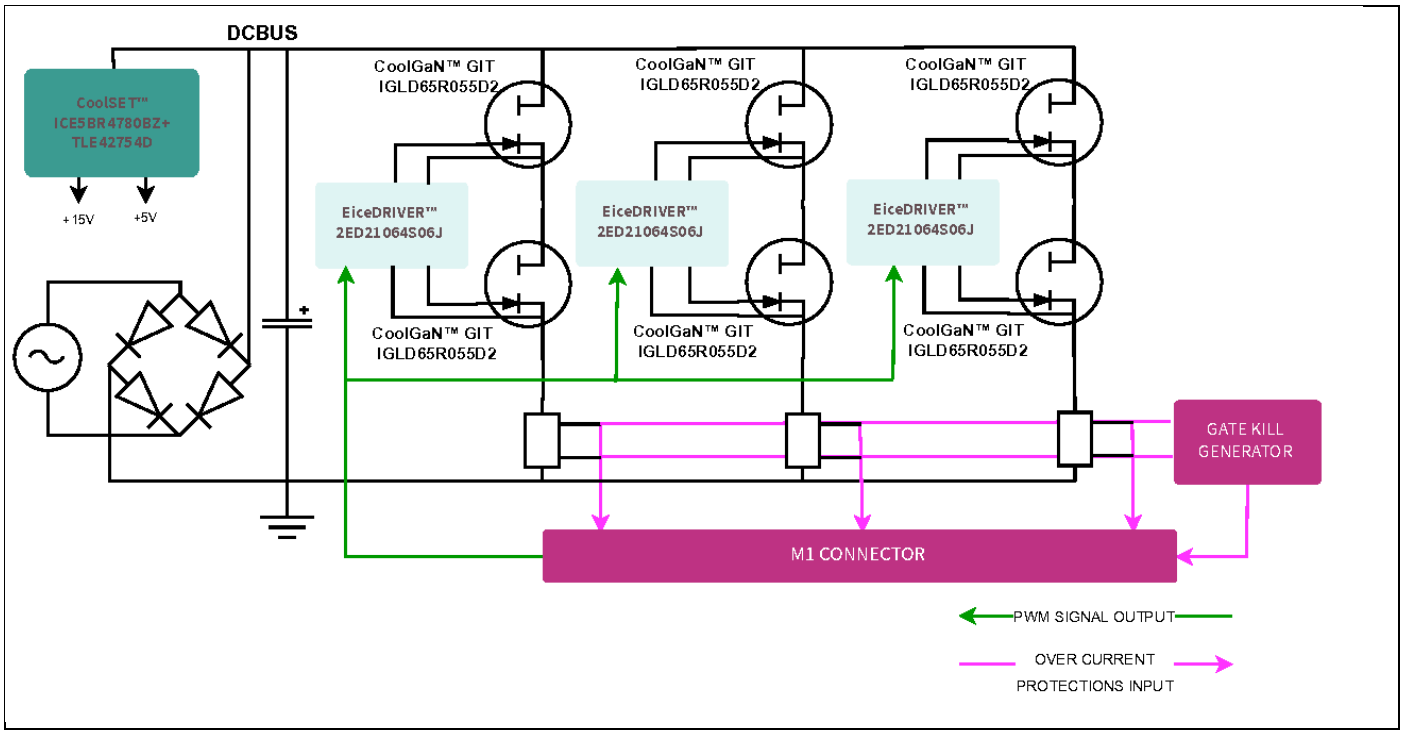



**Figure 2 Functional block of EVAL-2EDGAN-INV-1KW**

Figure 2 depicts the block diagram relative to the EVAL-2EDGAN-INV-1KW. AC source is rectified to establish the VBUS voltage, from which the auxiliary supplies are generated. The VDD aux supplies is sourced from the CoolSET™ ICE5BR4780BZ, and the 5V supply from LDO TLE42754D. VDD supply is needed for Gate Driver 2ED21064S06J, while 5V supply is needed for Gate Kill generator circuit and MCU supply.

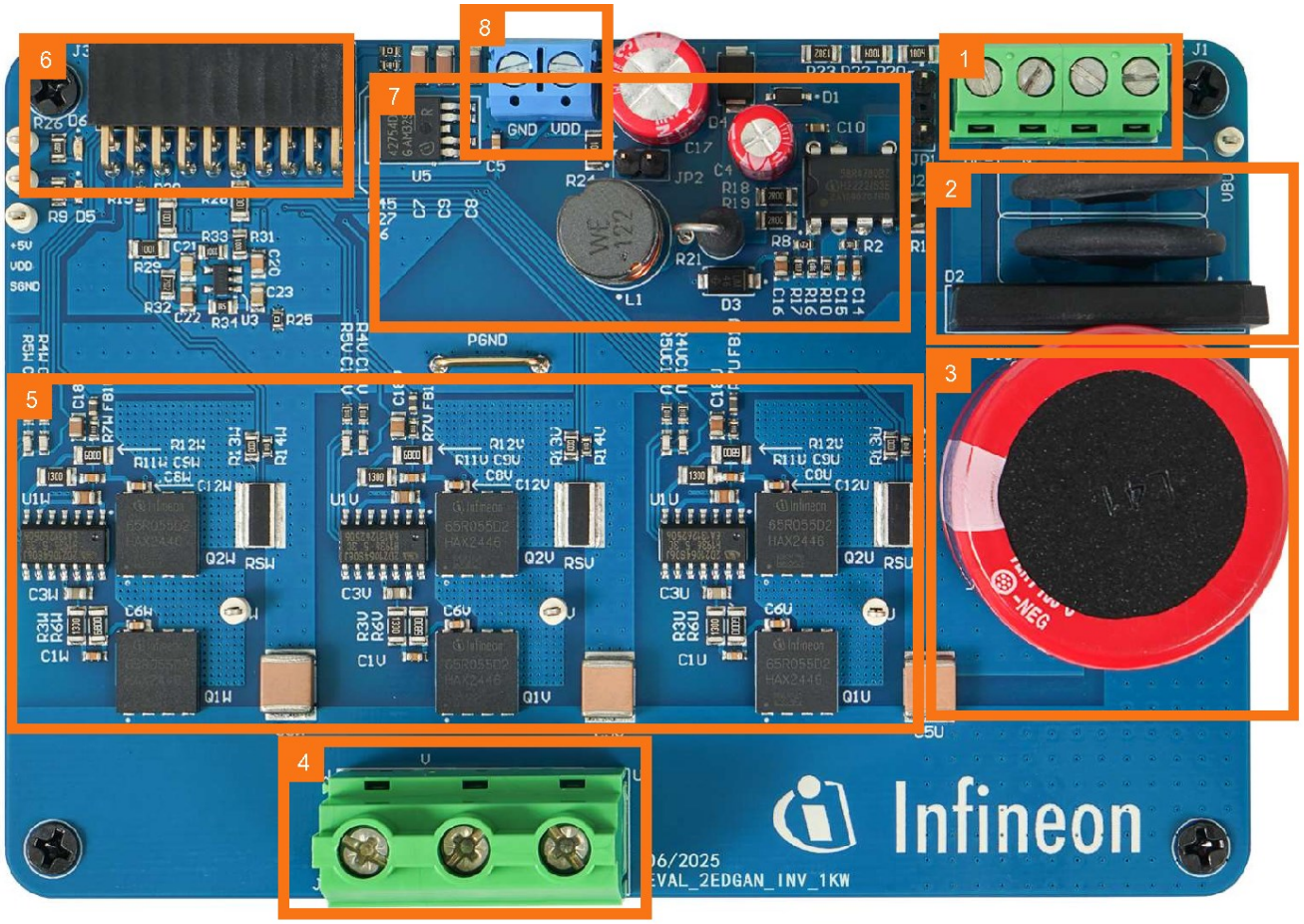
## 1.2 Board parameters and technical data

This paragraph presents the specifications, performance and behavior of the EVAL-2EDGAN-INV-1KW Table 1 shows the specifications for a typical motor control application.

| Parameter | Specification |
|---|---|
| Vin | 180 to 264 VDC |
| POUT | 1000W |
| Output motor current | 3.2 Arms |
| Switching Frequency | 7-16 kHz |
| dVs/dt | Max 10 V/ns @3.2 Arms |

**Table 2 Board Specification at Tvj=25°C, 230 Vrms, 50 Hz/60 Hz**

## 1.3 Board description




1. AC and VBUS input (J1 and J2)
2. Rectifier stage
3. VBUS capacitor
4. Three phase motor (J6)
5. Inverter Stage
6. MCU connector (J3)
7. AUX supply generator (enabled through JP1 and JP2)
8. External VDD Connector (J4)

**Figure 3 Board Description of EVAL-2EDGAN-INV-1KW**

EVAL-2EDGAN-INV-1KW evaluation board is compatible with iMotion™ MADK-M1 connector. For internal test IMC101T-T038 was used, connected to J3 (**Table 3**), the connector on the left upside of .

On the right side of the top, J1 and J2 are the connector to connect the AC or VBUS voltages (more details on **Table 1** and **Table 2**). There is also the possibility to supply gate drivers with an external VDD supply thanks of the connector J4 on the central top part (**Table 4**) and removing the jumper JP1 and JP2.

On the central of the bottom side there is J6 to connect the three phase motor (**Table 5**).

### 1.3.1 Connector and Jumper Description

**Table 1 J1 VBUS connector**

| *Pin* | *Name* | *Pin name connectors* |
|---|---|---|
| 1 | DC+ | BUS |
| 2 | L | Line (AC input) |

**Table 2 J2 AC connector**

| *Pin* | *Name* | *Pin name connectors* |
|---|---|---|
| 1 | N | Neutral (AC input) |
| 2 | DC- | Power Ground |

**Table 3 J3 iMotion MADK M1 20pin interface connector for power board**

| *Pin* | *Name* | *Pin name connectors* |
|---|---|---|
| 1 | PWM H U | 5 V compatible logic input for high-side gate driver, phase U |
| 2 | VSS | Ground |
| 3 | PWM L U | 5 V compatible logic input for low-side gate driver, phase U |
| 4 | VSS | Signal Ground |
| 5 | PWM H V | 5 V compatible logic input for high-side gate driver, phase V |
| 6 | +5 V | 5 V power supply |
| 7 | PWM L V | 5 V compatible logic input for low-side gate driver, phase V |
| 8 | +5 V | 5 V power supply |
| 9 | PWM H W | 5 V compatible logic input for high-side gate driver, phase W |
| 10 | SHUNT IU P | Shunt voltage on leg U |
| 11 | PWM L W | 5 V compatible logic input for low-side gate driver, phase W |
| 12 | SHUNT IU N | Return of Shunt voltage on leg U |
| 13 | GATEKILL | Gatekill |
| 14 | Vbus sns | DC bus voltage sensing after 2 MΩ resistors |
| 15 | VTH | Thermistor sensor |
| 16 | SHUNT IV P | Shunt voltage on leg U |
| 17 | SHUNT IV N | Return of Shunt voltage on leg V |
| 18 | SHUNT IW P | Shunt voltage on leg W |
| 19 | SHUNT IW N | Return of Shunt voltage on leg W |
| 20 | VDD | Gate Driver Supply |

**Table 4 J4 VDD connector**

| *Pin* | *Name* | *Pin name connectors* |
|---|---|---|
| 1 | VDD | Gate Driver Power supply input |

| | | |
|---|---|---|
| 2 | SGND | Signal Ground |

**Table 5 J6 Motor Side connector**

| *Pin* | *Name* | *Pin name connectors* |
|---|---|---|
| 1 | U | Connected to motor phase U |
| 2 | V | Connected to motor phase V |
| 3 | W | Connected to motor phase W |

**Table 6 Jumper Description**

| *Name* | *Pin name connectors* |
|---|---|
| JP1 | Enable internal supply generation, to be removed before applying external VDD |
| JP2 | To be removed before applying external VDD |

### 1.3.2 Gate Driver

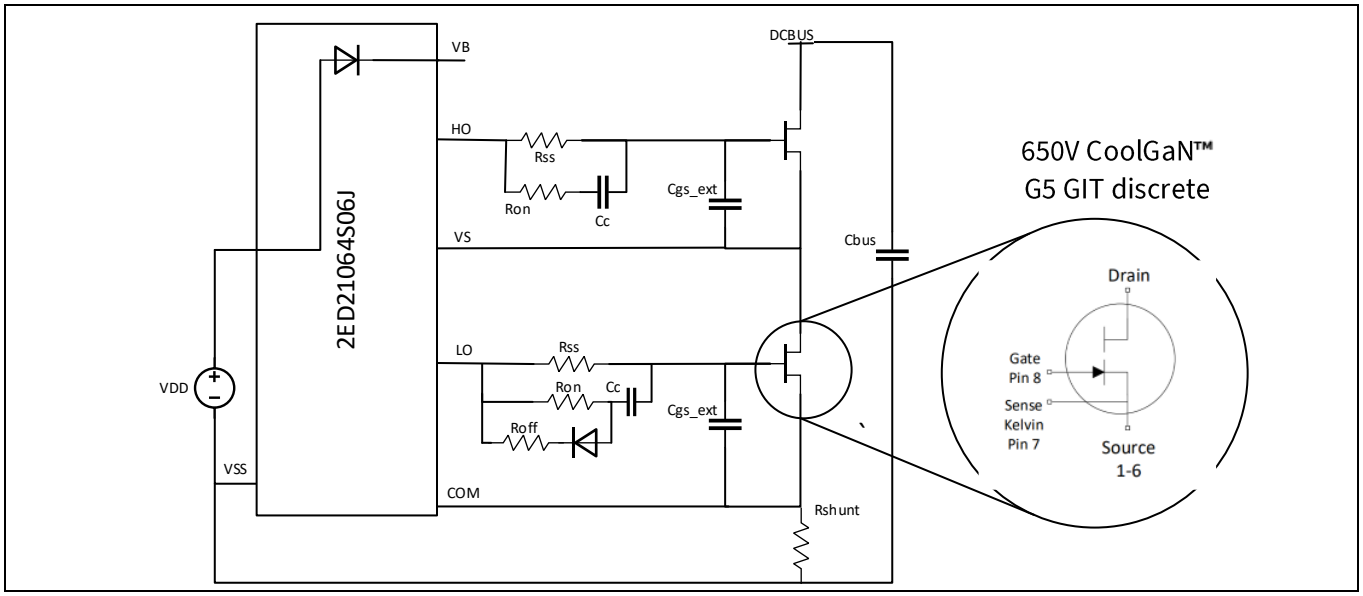



**Figure 4 RC interface for motor control, dVs/dt<10V/ns**

Figure 4 shows a standard solution for a universal CoolGaN™ half-bridge gate drive circuit. The two output stages of the dual-channel EiceDRIVER™ 2ED21064S06J drive the respective switch via the RRC interface.

As the dual-channel gate driver ICs do not provide separate source and sink outputs, a diode must be added to the standard interface if different values for Ron and Roff are required.

In order to optimize the driving loop driver's Vs and COM pins are connected to the Kelvin source SK of the 2 CoolGaN switches.

The dual-channel level shifter EiceDRIVER™ 2ED21064S06J is offered in a DSO14 150 mil package and it has more than 4 mm channel-to-channel creepage.

An ultra-fast bootstrap diode is monolithically integrated for establishing the high side supply.

The absence of dead time in this gate driver provides users with the flexibility to optimize dead time for their specific application, allowing for tailored performance and efficiency.

Furthermore, the DSO14 package features separate signal and power grounds, enabling designers to implement a 2-layer printed circuit board (PCB) design without compromising the gate loop inductance and lowering the manufacturing cost.

### 1.3.3 Gate Kill Generator

This circuitry has been implemented to trigger the MCU with a 5/0V signal in case of an overcurrent event. The voltage across the shunt resistor is detected by a comparator, whose threshold can be set from the user, through the selection of resistors, as explained in Equation (1).

The comparator peak current threshold ($I_{th}^{OCP}$) can be calculated relying on the following formula:

$$I_{th}^{OCP} = 3 * V^{+} \frac{R_{33}}{R_{32}R_{33}} \frac{1}{R_{shunt}} \quad (1)$$

Where $V^{+}$ is the reference voltage connected to the voltage divider composed by $R_{32}$ and $R_{33}$

In some cases, the microcontroller may introduce an offset voltage ($V_{OFF}$) to the shunt resistor's sensed voltage. To ensure proper circuit design, this offset value must be taken into account.

The revised formula for calculating the comparator peak current threshold is defined in Equation (2):

$$I_{th}^{OCP} = 3 * \left(V^{+} \frac{R_{33}}{R_{32}R_{33}} - V_{OFF}\right) \frac{1}{R_{shunt}} \quad (2)$$

In this evaluation board the threshold has been set at 6.8A.

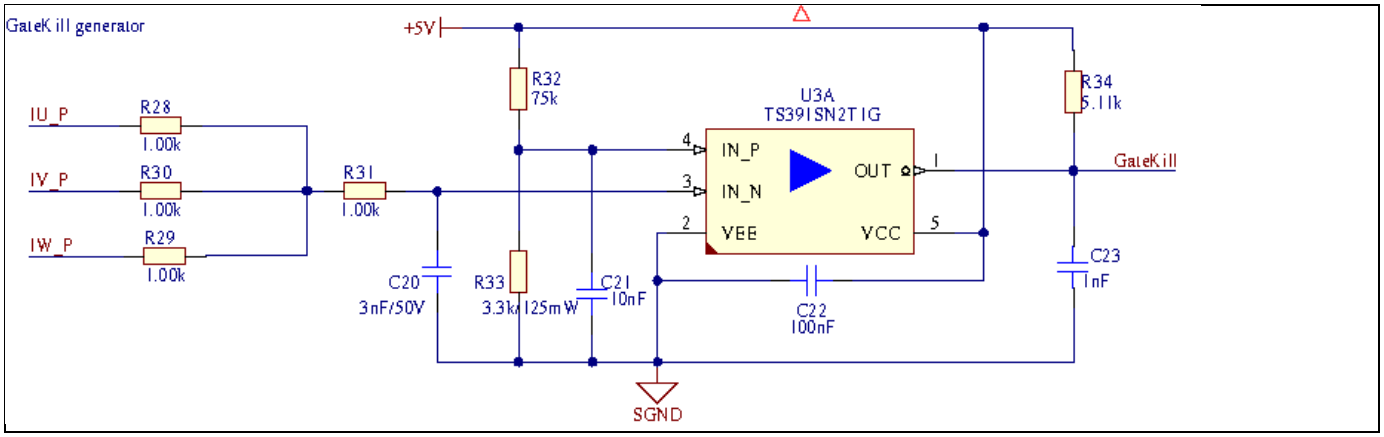



**Figure 5 Overcurrent protection through Gate Kill**

### 1.3.4 Leg Shunt

The EVAL-2EDGAN-INV-1KW has been designed with a three-leg shunt system. So, each phase has in series with the low side transistor, a 75milliohm shunt resistor with a capacitance of 100 pF plus a resistor 1kΩ to filter transient voltage spikes.
Each shunt signal is directly connected to the MCU connector, enabling the detection of overcurrent events during motor operation. Upon receiving this signal, the MCU will process it and terminate PWM output to prevent system damage.

### 1.3.5 Auxiliary supply generator

CoolSET™ ICE5BR4780BZ has been implemented to generate auxiliary power supply (VDD) in EVAL-2EDGAN-INV-1KW.

The ICE5BR4780BZ, part of Infineon's 5th generation fixed frequency CoolSET™ family, is a highly integrated current-mode controller including an 800 V CoolMOS™ superjunction MOSFET.

It supports both isolated and non-isolated topologies such as flyback and buck as typical of biasing and offline auxiliary power supply.

Regulation is made easy thanks to an integrated error amplifier for non-isolated topologies to enable direct feedback while minimizing the external BOM.

Thanks to the integrated MOSFET, the support of a wider input voltage range is possible, and snubber circuitry can be optimized further to enhance the efficiency/standby performance of the converter.

Available in the DIP-7 package, the ICE5BR4780BZ offers a high level of integration that provides a comprehensive suite of protection features, frequency jittering to minimize EMI, frequency reduction in tandem with the decrease of load to improve overall efficiency. On top, the active burst mode improves light-load/standby performance.

#### 1.3.5.1 How to change VDD value on EVAL-2EDGAN-INV-1KW

The EVAL-2EDGAN-INV-1KW generates on board 15 V supply and 5 V supply through LDO TLE42754D. In case the user needs to change the supply value (VDD) there are two options:

1. using the J4 VDD connector, described in Table 4,
2. changing few components on the on board AUX supply circuit. (Figure 8) as described in **Table 7**

**Table 7 components to change for different VDD**

| Component | 15 V 350 mA | 12 V 450 mA |
|---|---|---|
| R18 | 2 Ω (1206) | 1.5 Ω (1206) |
| R19 | 2 Ω (1206) | 1.6 Ω (1206) |
| L1 | 1.2 mH | 180 uH |

More details can be found in this Application Note relative to CoolSET™ ICE5BR4780BZ. The inductor part number can be found in the Bill of Material in **Table 8**.

### 1.3.6 CoolGaN™ Power switch

IGLD65R055D2 CoolGaN™ Transistor 650 V G5 is a highly efficient gallium nitride (GaN) transistor designed for power conversion at 650 V. Housed in a bottom-side cooled DFN package, it is designed for optimal power dissipation in various industrial and consumer applications. Produced using 200 mm (8 inch) wafer technology and fully automated production lines, it features narrow production tolerances and the highest product quality. This makes it suitable for a wide range of applications, from consumer electronics to industrial applications.

Technology benefits:

- Enhancement mode transistor
- Ultra-fast switching
- No reverse-recovery charge
- Capable of reverse conduction
- Low gate and output charge
- Superior commutation ruggedness
- 2 kV HBM ESD standards
- Normally OFF transistor technology ensures safe operation
- Enables rapid and precise power delivery control
- Improves system efficiency and reliability
- Ensures robust performance under challenging conditions

# 2 Schematics

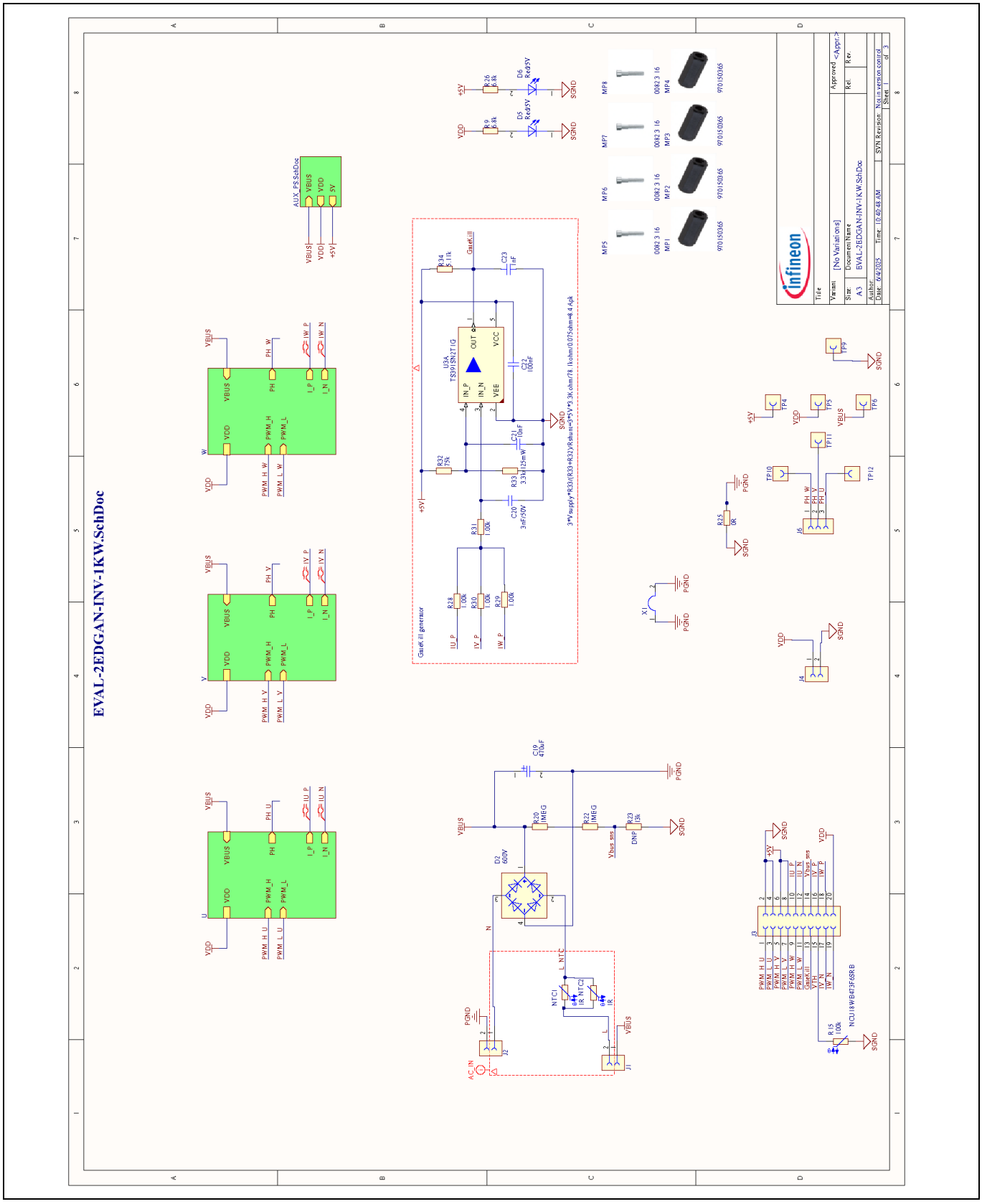



**Figure 6 Connectors, Rectifier and Gate Kill Generator**

## Schematics

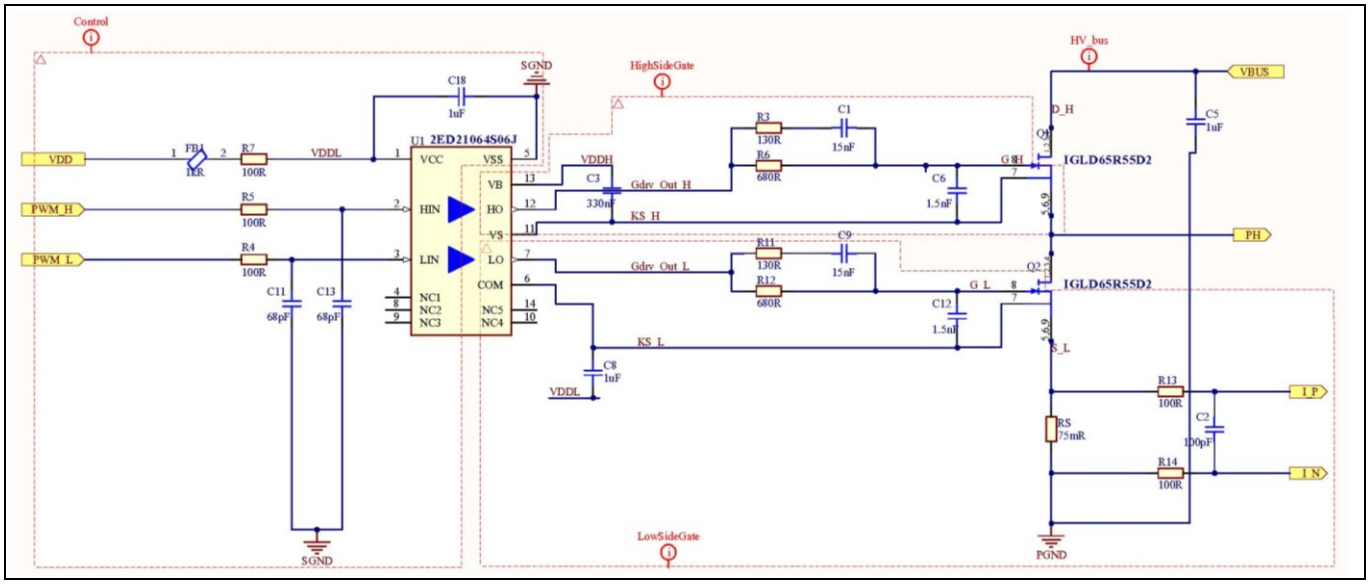



**Figure 7 Half Bridge**

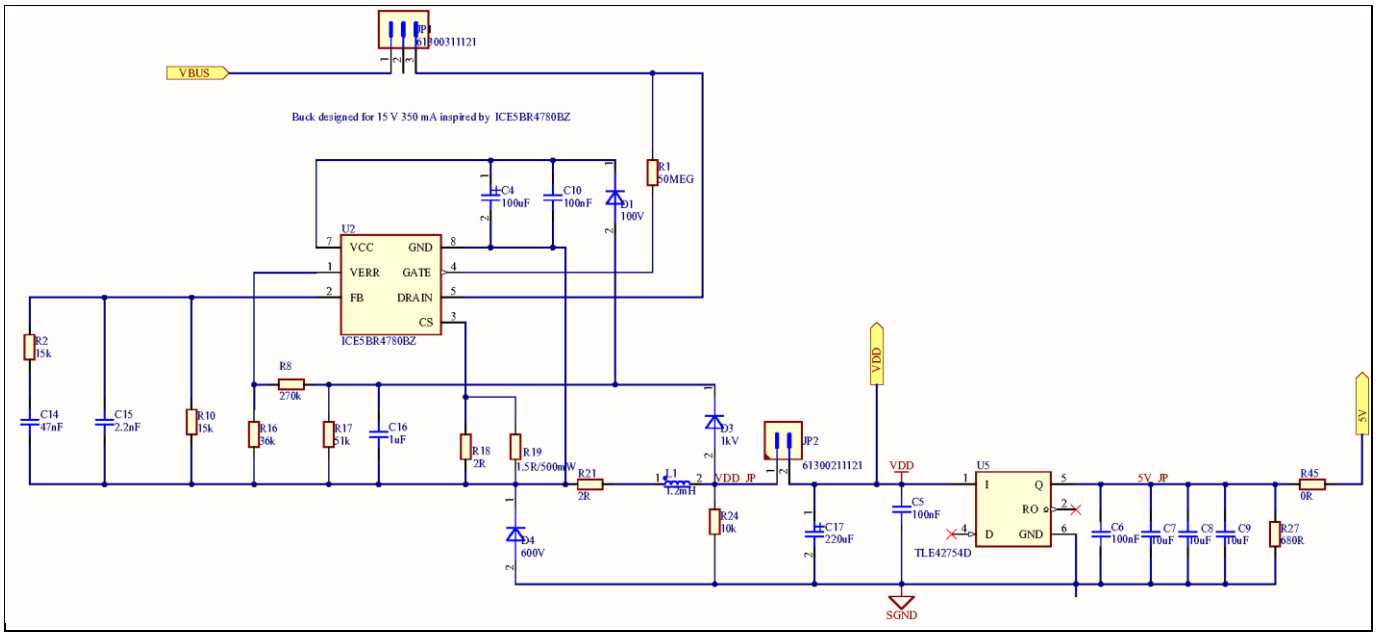



**Figure 8 Aux Supplies**

# 3 Layout

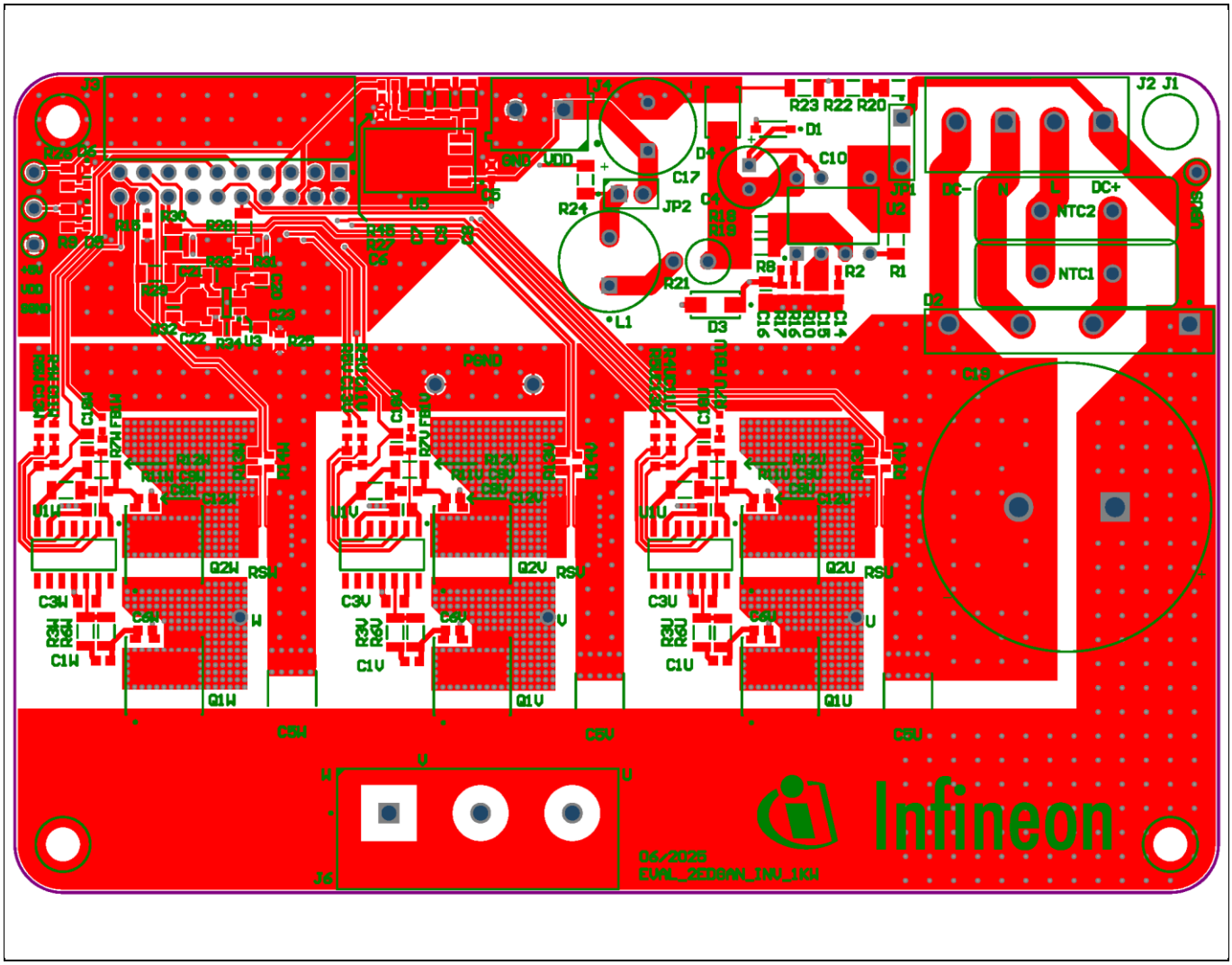



**Figure 9 Top PCB**

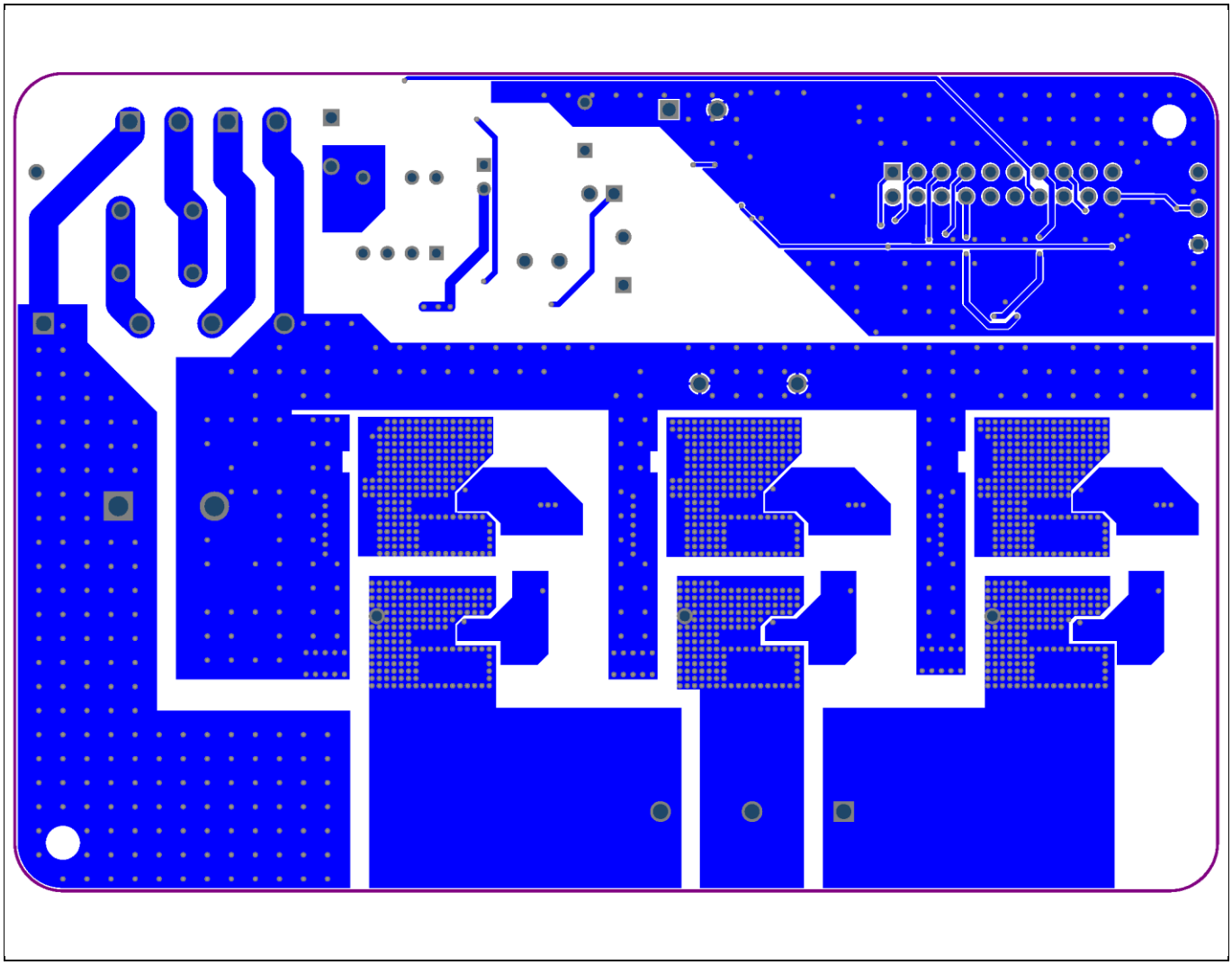


**Figure 10 Bottom PCB**

## 3.1 Bill of material

**Table 8 EVAL-2EDGAN-INV-1KW BOM**

| Comment | Description | Designator |
|---|---|---|
| 15nF | CAP / CERA / 15nF / 25V / 10% / X7R (EIA) / -55°C to 125°C / 0603(1608) / SMD / - | C1U, C1V, C1W |
| 330nF | CAP / CERA / 330nF / 25V / 10% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / - | C3U, C3V, C3W |
| 100uF | CAP / ELCO / 100uF / 25V / 20% / Aluminiumelectrolytic / -40°C to 105°C / 2.50mm C X 0.50mm W 6.30mm Dia X 12.50mm H / THT / - | C4 |
| 100nF | CAP / CERA / 100nF / 50V / 10% / X7R (EIA) / -55°C to 125°C / 0603(1608) / SMD / - | C5, C6, C10 |
| 1uF | CAP / CERA / 1uF / 630V / 10% / X7R (EIA) / -55°C to 125°C / 2220(5750) / SMD / - | C5U, C5V, C5W |
| 1.5nF | CAP / CERA / 1.5nF / 25V / 10% / X7R (EIA) / -55°C to 125°C / 0603(1608) / SMD / - | C6U, C6V, C6W, C12U, C12V, C12W |

## Layout

| | | |
|---|---|---|
| 10uF | CAP / CERA / 10uF / 50V / 10% / X5R (EIA) / -55°C to 85°C / 1206(3216) / SMD / - | C7, C8, C9 |
| 1uF | CAP / CERA / 1uF / 50V / 10% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / - | C8U, C8V, C8W, C16, C18U, C18V, C18W |
| 15nF | CAP / CERA / 15nF / 25V / 10% / X7R (EIA) / -55°C to 125°C / 0603(1608) / SMD / - | C9U, C9V, C9W |
| 68pF | CAP / CERA / 68pF / 25V / 5% / C0G (EIA) / NP0 / -55°C to 125°C / 0603(1608) / SMD / - | C11U, C11V, C11W |
| 68pF | CAP / CERA / 68pF / 25V / 5% / C0G (EIA) / NP0 / -55°C to 125°C / 0603(1608) / SMD / - | C13U, C13V, C13W |
| 47nF | CAP / CERA / 47nF / 25V / 10% / X7R (EIA) / -55°C to 125°C / 0603(1608) / SMD / - | C14 |
| 2.2nF | CAP / CERA / 2.2nF / 25V / 10% / X7R (EIA) / -55°C to 125°C / 0603(1608) / SMD / - | C15 |
| 220uF | CAP / ELCO / 220uF / 35V / 20% / Aluminiumelectrolytic / -55°C to 105°C / 5.00mm C X 0.60mm W 10.00mm Dia X 14.00mm H / THT / - | C17 |
| 470uF | CAP / ELCO / 470uF / 450V / 20% / Aluminiumelectrolytic / -40°C to 105°C / Capacitor, Polarized, Radial, THT, 10.00 mm Pitch, 2 pin, X 30.00 mm Dia X 42.00 mm H / THT / - | C19 |
| 3nF/50V | CAP / CERA / 3nF/50V / 50V / 5% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / - | C20 |
| 10nF | CAP / CERA / 10nF / 50V / 5% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / - | C21 |
| 100nF | CAP / CERA / 100nF / 50V / 5% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / - | C22 |
| 1nF | CAP / CERA / 1nF / 50V / 5% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / - | C23 |
| 100V | Surface Mount Fast Switching Diode | D1 |
| 600V | 25A GLASS PASSIVATED BRIDGE RECTIFIER | D2 |
| 1kV | Surface Mount Ultrafast Rectifier 1.0A/1000V | D3 |
| 600V | 3.0A Surface Mount Super Fast Rectifier, 600V, 10uA | D4 |
| Red/5V | WL SMCD SMT Mono Color Chip LED Diffused, Red, 630nm | D5, D6 |
| 1kR | IND / FERR / 1kR / 50mA / 25% / -55°C to 125°C / 1.8mR / 0603(1608) / Inductor,Chip;1.60mm L X 0.80mm W X 1.00mm H / SMD / - | FB1U, FB1V, FB1W |
| 691216510002S | Horizontal Cable Entry With Rising Cage Clamp - WR-TBL, 2 Pins | J1, J2 |
| 613020243121 | WR-PHD 2.54 mm Angled Dual Socket Header | J3 |
| 691102710002 | Series 102 - 5.0mm Horizontal Entry with Pressure Clamp - 1.5mm² Wires WR-TBL | J4 |
| 691250910003 | Horizontal Cable Entry Rising Cage Clamp WR-TBL,3 Pins | J6 |
| 61300311121 | WR-PHD Pin Header | JP1 |
| MSE-G | SHUNT 2.54MM PITCH | (JP1) |
| 61300211121 | Header, 2.54mm Pitch, 2 pin, Vertical, Single Row | JP2 |
| 60900213421 | JUMPER W/TEST PNT 1X2PINS 2.54MM | (JP2) |

| | | |
|---|---|---|
| 1.2mH | IND / STD / 1.2mH / 620mA / 5% / -40°C to 125°C / 1.15R / THT/Radial / Inductor, 2-Leads, THT, 5.00mm Pitch, 10.5mm D, 14.5mm H / THT / - | L1 |
| 970150365 | WA-SPAII Plastic Spacer Stud | MP1, MP2, MP3, MP4 |
| 0082 3 16 | Cheese Head Screw With Hexagon Socket, DIN 912 (ISO 4762), M3, 16mm length | MP5, MP6, MP7, MP8 |
| 1R | RES / NTC / 1R / 5.1W / 20% / - / -55°C to 170°C / 7.50mm C X 1.00mm W 21.00mm L X 7.00mm T X 28.00mm H / THT / - | NTC1, NTC2 |
| IGLD65R055D2 | CoolGaN Gen2, 650V CoolGaN Enhancement Mode Power Transistor | Q1U, Q1V, Q1W, Q2U, Q2V, Q2W |
| 50MEG | RES / STD / 50MEG / 300mW / 1% / 100ppm/K / -55°C to 155°C / 1206(3216) / SMD / - | R1 |
| 15k | RES / STD / 15k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / - | R2, R10 |
| 130R | RES / STD / 130R / 500mW / - / - / - / 1206(3216) / SMD / - | R3U, R3V, R3W, R11U, R11V, R11W |
| 100R | RES / STD / 100R / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / - | R4U, R4V, R4W, R5U, R5V, R5W, R7U, R7V, R7W, R14U, R14V, R14W |
| 680R | RES / STD / 680R / 500mW / - / - / - / 1206(3216) / SMD / - | R6U, R6V, R6W, R12U, R12V, R12W |
| 270k | RES / STD / 270k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / - | R8 |
| 6.8k | RES / STD / 6.8k / 125mW / 1% / 100ppm/K / -55°C to 155°C / 0805(2012) / SMD / - | R9, R26 |
| 100R | RES / STD / 100R / - / - / - / -55°C to 155°C / 0805(2012) / SMD / - | R13U, R13V, R13W |
| 100k | RES / NTC / 100k / 100mW / 1% / - / -40°C to 125°C / 0603(1608) / SMD / - | R15 |
| 36k | RES / STD / 36k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / - | R16 |
| 51k | RES / STD / 51k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / - | R17 |
| 2R | RES / STD / 2R / 250mW / 1% / 100ppm/K / -55°C to 155°C / 1206(3216) / SMD / - | R18, R19 |
| 1MEG | RES / STD / 1MEG / 250mW / 1% / 100ppm/K / -55°C to 155°C / 1206(3216) / SMD / - | R20, R22 |
| 2R | RES / STD / 2R / 3W / 5% / 50ppm/K / -65°C to 250°C / 20.00mm C X 0.813mm W 12.70mm L X 4.57mm Dia / THT / - | R21 |
| 13k | RES / STD / 13k / 250mW / 1% / 100ppm/K / -55°C to 155°C / 1206(3216) / SMD / - | R23 (DNP) |
| 10k | RES / STD / 10k / 250mW / 0.1% / 25ppm/K / -55°C to 125°C / 1206(3216) / SMD / - | R24 |
| 0R | RES / STD / 0R / 100mW / - / - / -55°C to 155°C / 0603(1608) / SMD / - | R25, R45 |
| 680R | RES / STD / 680R / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / - | R27 |

## Layout

| | | |
|---|---|---|
| 1.00k | RES / STD / 1k/250mW / 250mW / 1% / 100ppm/K / -55°C to 155°C / 1206(3216) / SMD / - | R28, R29, R30 |
| 1.00k | RES / STD / 1.00k/125mW / 125mW / 1% / 100ppm/K / -55°C to 155°C / 0805(2012) / SMD / - | R31 |
| 75k | RES / STD / 75k/125mW / 125mW / 1% / 100ppm/K / -55°C to 155°C / 0805(2012) / SMD / - | R32 |
| 3.3k/125mW | RES / STD / 3.3k/125mW / 125mW / 1% / 100ppm/K / -55°C to 155°C / 0805(2012) / SMD / - | R33 |
| 5.11k | RES / STD / 5.11k/125mW / 125mW / 1% / 100ppm/K / -55°C to 155°C / 0805(2012) / SMD / - | R34 |
| 75mR | RES / STD / 75mR / 4W / 1% / 150ppm/K / -65°C to 155°C / 1225(3264) / SMD / - | RSU, RSV, RSW |
| 5002 | Test Point THT, White | TP4, TP5, TP6, TP9, TP10, TP11, TP12 |
| 2ED21064S06J | A high voltage, high speed power MOSFET and IGBT driver | U1U, U1V, U1W |
| ICE5BR4780BZ | Fixed-frequency 800V/950V CoolSET | U2 |
| TS391SN2T1G | Low Power Single Voltage Comparator | U3 |
| TLE42754D | Monolithic integrated low-dropout voltage regulator designed for automotive applications, Very low Current Consumption, Power-on and Undervoltage Reset with Programmable Delay Time, Reverse Polarity Protection, Output Current Limitation | U5 |

# 4 System performance

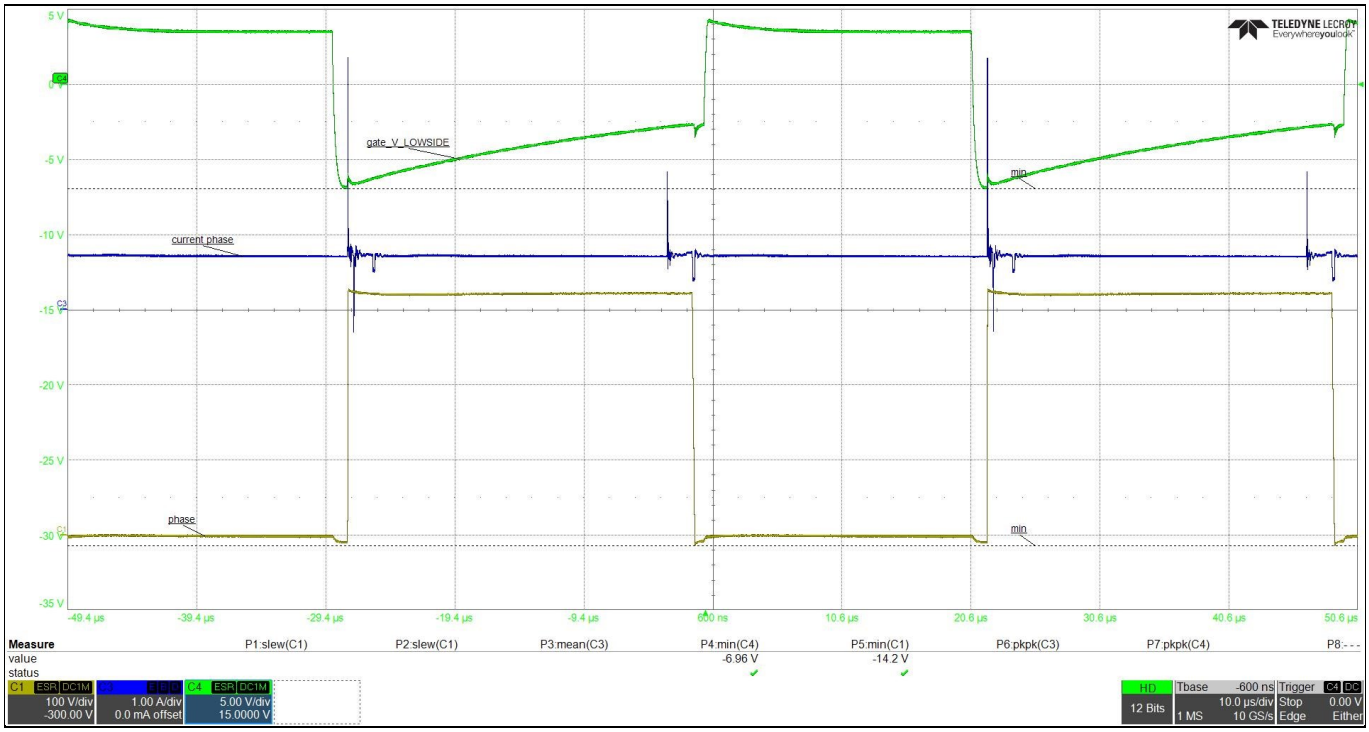



**Figure 11 Low side gate voltage waveform (green channel), current phase (blue channel). Motor phase (yellow channel), VDD=15 V, VBUS=320 V**

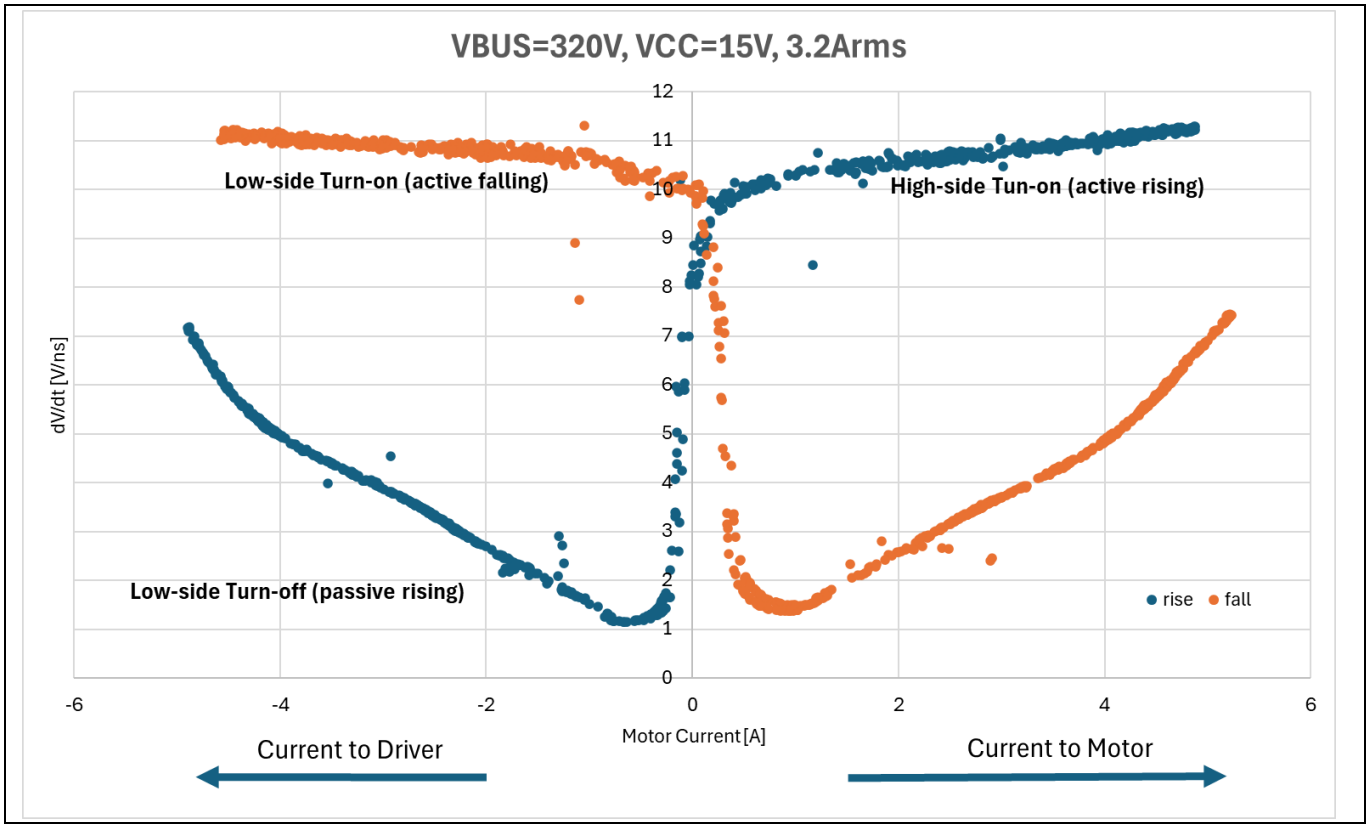



**Figure 12 Butterfly chart: DCBUS=320 V, 3.2 Arms, VDD=15 V, max dvdt= 11V/ns**

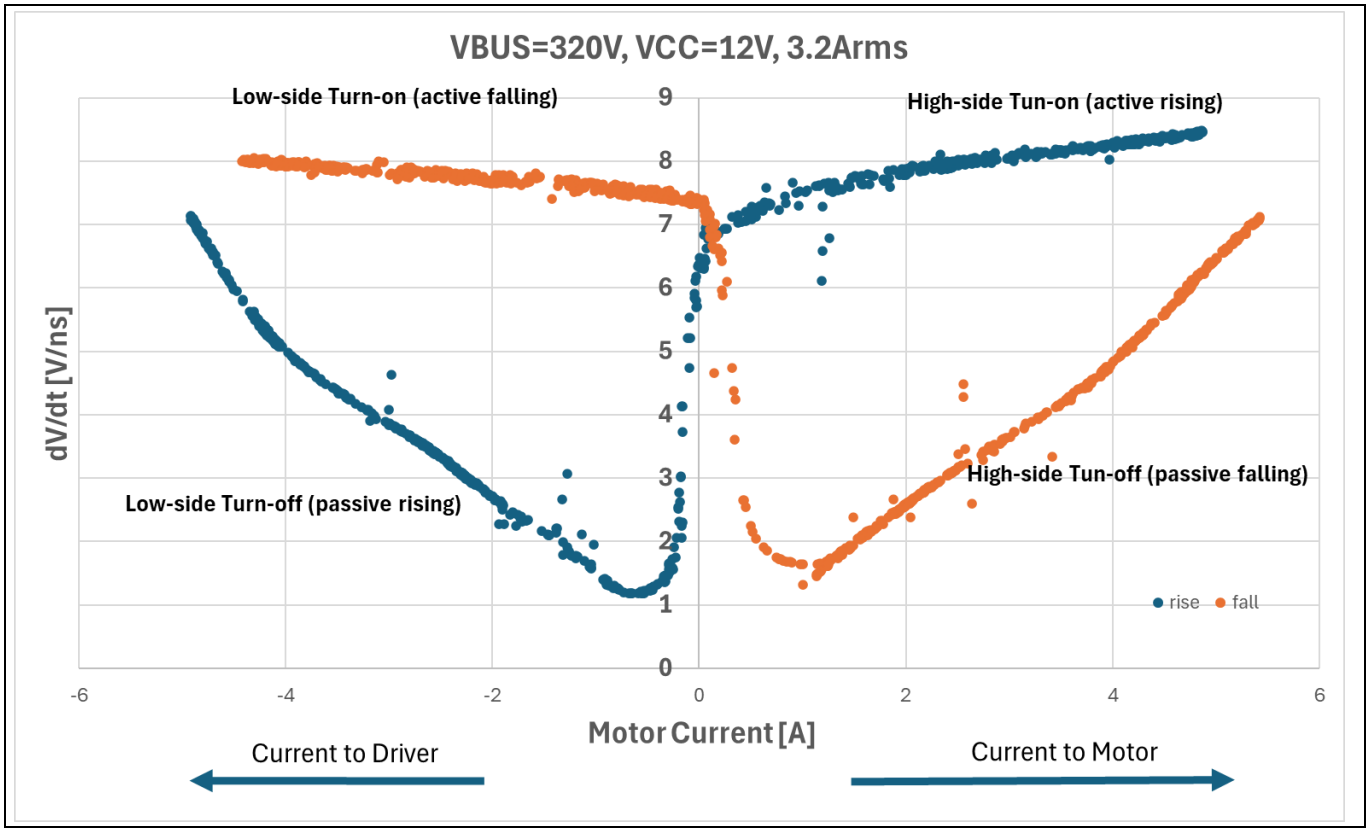
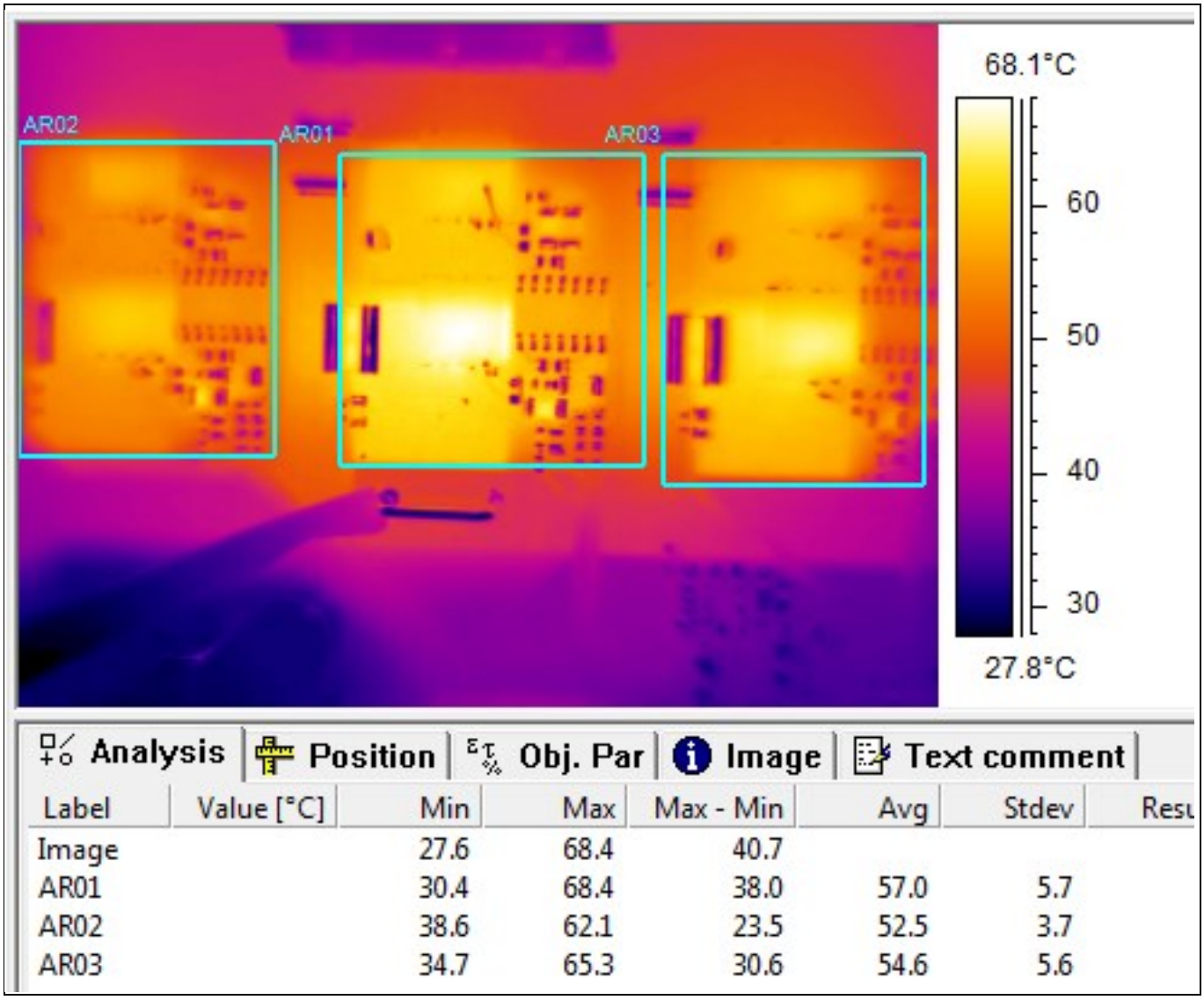
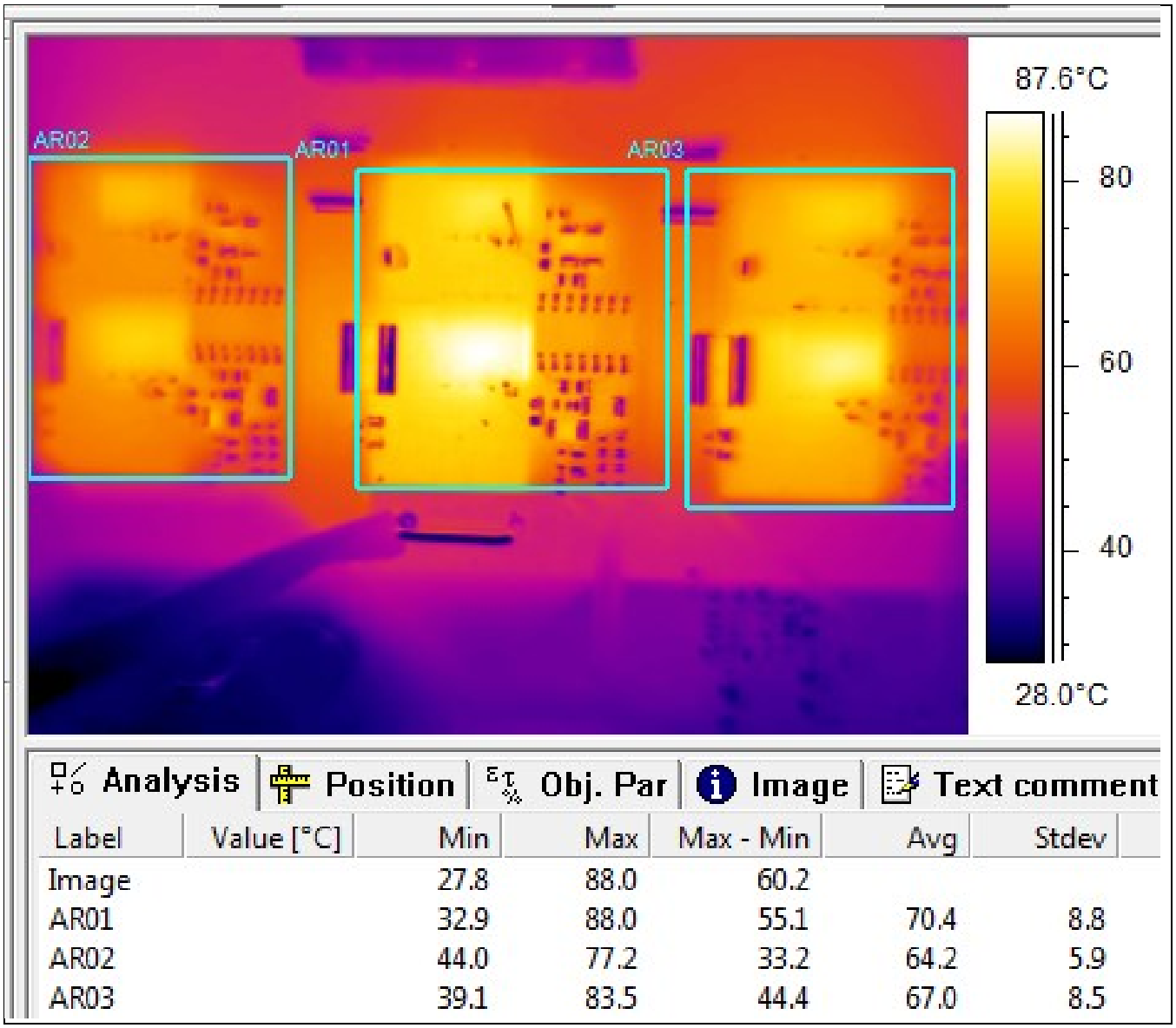



**Figure 13 Butterfly chart: DCBUS=320 V, 3.2 Arms, DT= 500 ns, VDD=12 V, max dvdt= 8V/ns**




| Label | Value [°C] | Min | Max | Max - Min | Avg | Stdev | Resu |
|---|---|---|---|---|---|---|---|
| Image | | 27.6 | 68.4 | 40.7 | | | |
| AR01 | | 30.4 | 68.4 | 38.0 | 57.0 | 5.7 | |
| AR02 | | 38.6 | 62.1 | 23.5 | 52.5 | 3.7 | |
| AR03 | | 34.7 | 65.3 | 30.6 | 54.6 | 5.6 | |

**Figure 14 IGLD65R055D2 CoolGaN™ temperature at 3.2 Arms, 7 kHz, VDD=15 V, VBUS=320 V, DT=500 ns, max temp on board 68 degC with an ambient temperature of 27 degC**




| Label | Value [°C] | Min | Max | Max - Min | Avg | Stdev |
|---|---|---|---|---|---|---|
| Image | | 27.8 | 88.0 | 60.2 | | |
| AR01 | | 32.9 | 88.0 | 55.1 | 70.4 | 8.8 |
| AR02 | | 44.0 | 77.2 | 33.2 | 64.2 | 5.9 |
| AR03 | | 39.1 | 83.5 | 44.4 | 67.0 | 8.5 |

**Figure 15 IGLD65R055D2 CoolGaN™ temperature at 3.2 Arms, 16 kHz, VDD=15 V, VBUS=320 V, DT=500 ns, max temp on board 88 degC with an ambient temperature of 27 degC**

# References

[1] Infineon Technologies AG: Whitepaper, Operation and features of high-voltage CoolGaN™ Transistors, October 2024; Available online

[2] Infineon Technologies AG Whitepaper, Gate drive configurations for CoolGaN™ power transistors, April 2024 Available online

## Revision history

| Document revision | Date | Description of changes |
|---|---|---|
| 1.0 | 06/05/2025 | Initial Release |
| 1.1 | 07/14/2025 | Typo fix: Table 1,Table 2, Figure 15<br>Add 1.3.4 Leg Shunt |
| | | |

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