EVAL-2ED2742S01 GM1 for Battery Powered Applications Evaluation Kit User Guide

Used for Consumer and Outdoor Power Tools, Robotics, Drones, Ebikes

About this document

Scope and purpose

The purpose of this document is to serve as an user guide for evaluating the new 160 V half bridge SOI gate driver from Infineon Technologies – 2ED2742S01G. EVAL-2ED2742S01 GM1 for Battery Powered Applications (BPA) evaluation kit consists of a three-phase inverter power board with the 160 V rated 2ED2742S01G (in 3 x 3 10-Lead DFN package) half bridge gate driver driving six 100 V rated OptiMOS™ MOSFETs IPTC015N10NM5. The power board has a M1 connector that is used to interface with iMotion™ Modular Application Design Kit (MADK) control card – EVAL-M1-101T. This control card is powered by IMC101T-T038 iMOTION™ Motor Control IC featuring advanced Motor Control Engine (MCE), that enables state-of-the-art Sensorless Field Oriented Control (FOC) without need for any coding. IMC101T-T038 is a part of the iMOTION™ IMC100 series, which is the next generation of well established iMOTION™ motor control IC platform dedicated to field-oriented control of PMSM (BLDC) motors. The evaluation kit comes with both EVAL-2ED2742S01 GM1 and EVAL-M1-101T including a USB connector to interface with a laptop having MCE Designer software.

Intended audience

Direct Current (DC) based Motor (BLDC, Servo, Stepper) control system engineers designing battery operated consumer power tools, outdoor power tools, robotics systems, drones, electric bikes and Small Home Appliances such as hair dryers, vacuum cleaners.

Evaluation Board

This board is to be used during the design-in process for evaluating and measuring characteristic curves, and for checking datasheet specifications. This board must be used in laboratory environment by trained power electronic engineers adhering to safety requirements.

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.

Ordering information

Base part number	Package	Standard pack		Orderable part number
		Form	Qty	
EVAL-2ED2742S01GM1	MADK EVAL	Boxed	1	EVAL2ED2742S01G
2ED2742S01G	3 x 3 mm DFN10	Tape and Reel	2,500	2ED2742S01GXUMA1
EVAL-M1-101T	MADK EVAL	Boxed	1	EVALM1101TTOBO2
IPTC015N10NM5	PG-TSON-8	Tape and Reel	5000	IPTC015N10NM5ATMA1
IFX25001 V33	PG-SOT223-4	Tape and Reel	1000	IFX25001 ME V33

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“Evaluation Boards and Reference Boards” shall mean products embedded on a printed circuit board (PCB) for demonstration and/or evaluation purposes, which include, without limitation, demonstration, reference and evaluation boards, kits and design (collectively referred to as “Reference Board”).

Environmental conditions have been considered in the design of the Evaluation Boards and Reference Boards provided by Infineon Technologies. The design of the Evaluation Boards and Reference Boards has been tested by Infineon Technologies only as described in this document. The design is not qualified in terms of safety requirements, manufacturing and operation over the entire operating temperature range or lifetime.

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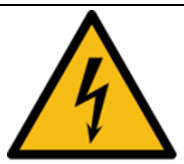
Safety precautions

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 160 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:** *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 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.*

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1 The board at a glance

The evaluation board EVAL-2ED2742S01 GM1 is powered by a DC source in the range of 24 V to 72 V and provides a three-phase output to power upto 500 W (without heat sink) to 1000 W (with heat sink) BLDC motors operating at a nominal 48 V DC bus voltage. It contains the new 160 V, half bridge gate driver IC 2ED2742S01G, the OptiMOS™ IPTC015N10NM5, bus capacitors, a single shunt for current sensing, and other peripheral circuits. The board can also be powered up from a 24 V to 72 V Li-ion battery pack. Before connecting the battery pack, ensure reverse polarity protection and inrush protection is provided to EVAL-2ED2742S01 GM1 board.

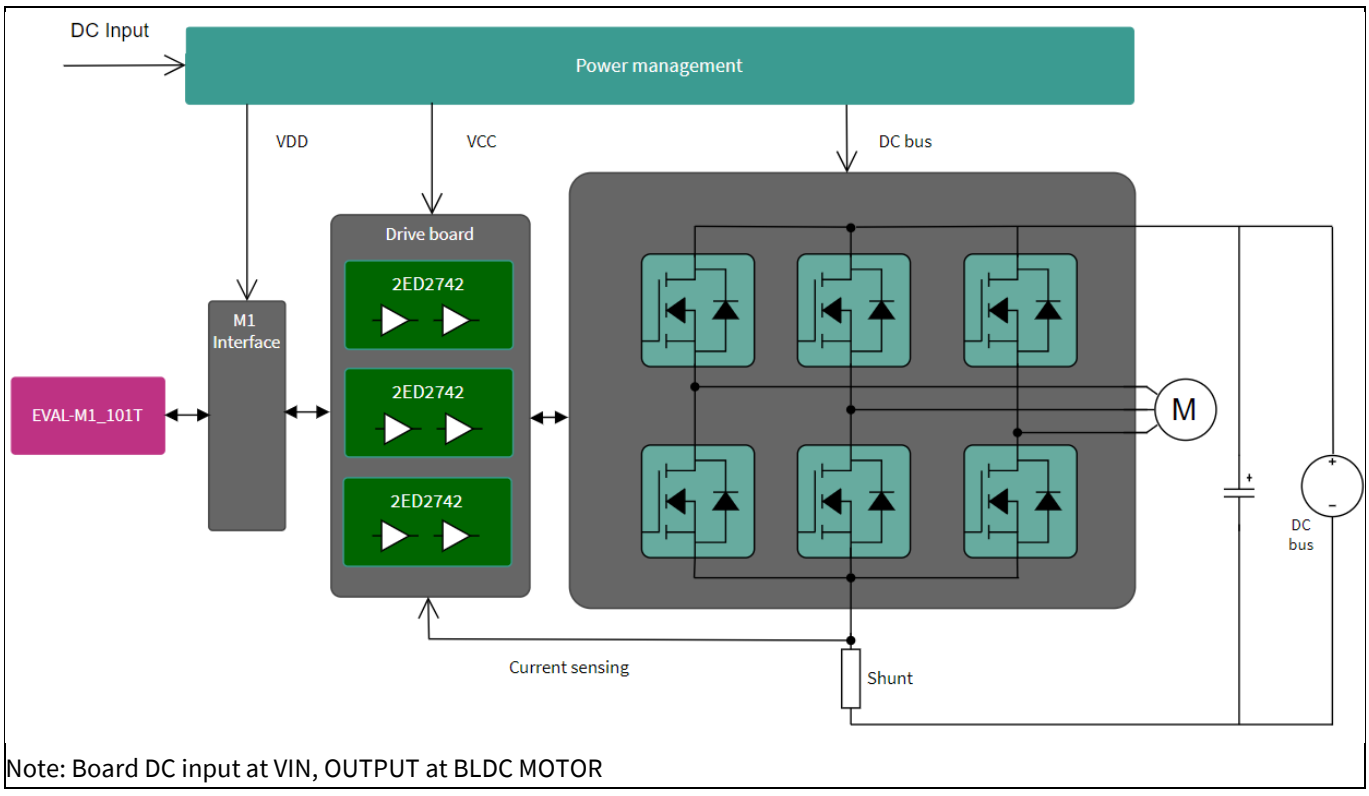
1.1 Scope of delivery

The EVAL-2ED2742S01 GM1 evaluation board is delivered along with an iMOTION™ 2.0 M1 interface connector and EVAL-M1-101T control card.

The package also contains a DC-DC buck converter with integrated MOSFET to provide auxiliary power supply of 12 V and 3.3 V; a single shunt for current sensing and overcurrent protection. The board can be operated directly with the DC power supply without any additional components. An inrush current limiter is recommended if operating directly from a battery source.

1.2 Block diagram

Figure 1 shows a typical application diagram of EVAL-2ED2742S01 GM1 for driving a BLDC motor. The system adopts a single-shunt configuration, which is prevalent for current BLDC motor drive applications.



Note: Board DC input at VIN, OUTPUT at BLDC MOTOR

Figure 1 Simplified application block diagram of EVAL-2ED2742S01 GM1

The 2ED2742S01G is a 160 V SOI based gate driver designed for three phase BLDC motor drive applications. Integrated bootstrap diodes are used to supply the external high sides charging bootstrap capacitors. Protection

features include under voltage lockout, over current protection with configurable threshold, fault communication and automatic fault clear.

The functional blocks of EVAL-2ED2742S01 GM1 BPA Evaluation Kit are presented in Figure 2

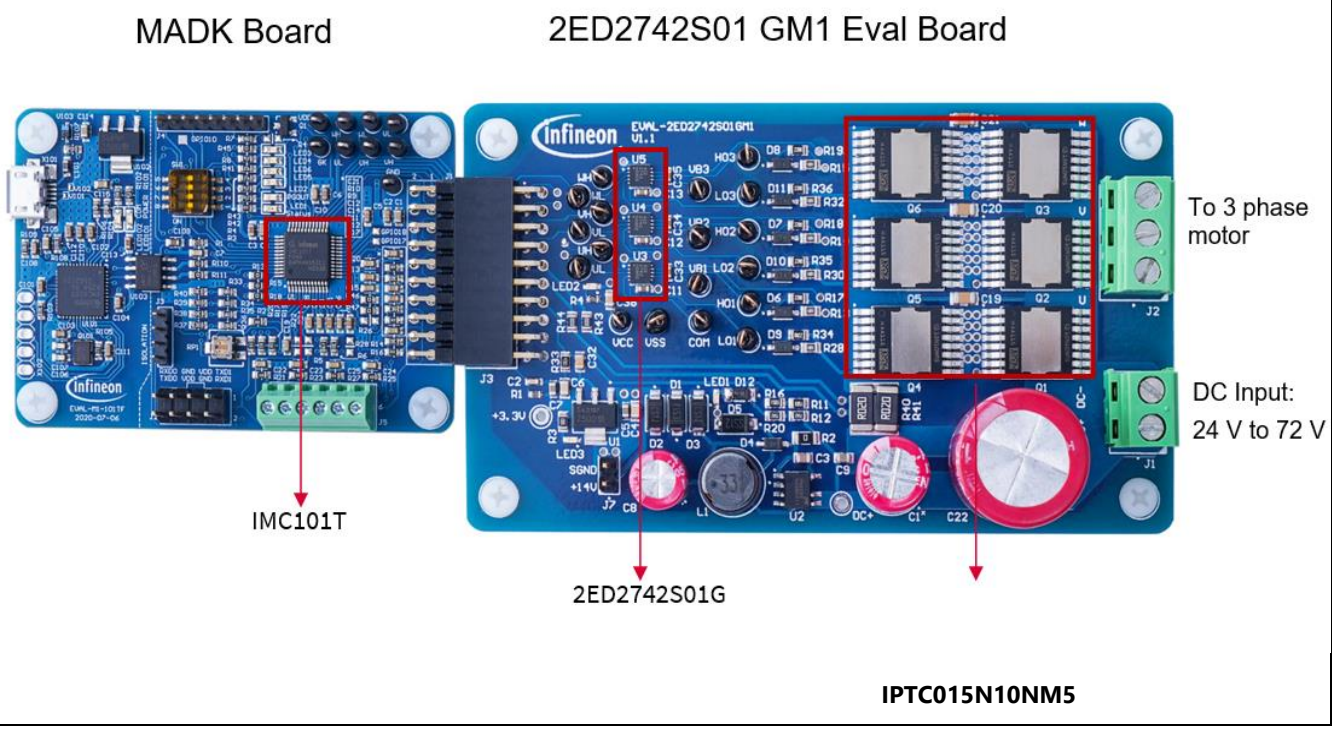


Figure 2 Functional blocks of EVAL-2ED2742S01 GM1 BPA Evaluation Kit (top view) w/o heatsink

1.3 Main features

The main features of EVAL-2ED2742S01 GM1 include:

- Nominal DC input voltage of 48 V
- Design for maximum 500 W motor power output (1000 W with added heatsink / forced air cooling)
- Single shunt for current sensing
- Sensing of DC-link voltage
- +12 V and +3.3 V auxiliary power supplies on the board
- M1 interface compatible with the iMOTION™ control board
- Integrated over-current protection inside 2ED2742S01G with selectable V_{REF} threshold
- Integrated shoot-through protection with built-in dead time

1.4 Board parameters and technical data

The key specifications of EVAL-2ED2742S01 GM1 are listed in Table 2.

Table 2 Specifications of EVAL-2ED2742S01 GM1

Parameter	Symbol	Conditions	Value			Unit
			Min.	Nom.	Max.	
Input						
Input voltage	V_{IN}	DC voltage	24	48	72	V
Input current	I_{IN}	Input current	–	–	25	A
Output						
Output current	I_{OUT}	RMS phase-out current	–	–	20	A
Output power	P_{OUT}	Additional heat dissipation is needed (e.g. heat sink, forced air cooling)	150	500	1000	W
Switching frequency						
Inverter carrier frequency	F_{SW}		–	23	–	kHz
Auxiliary power supply						
Fan power supply			–	12	–	V
Controller power supply			–	3.3	–	V
System environment						
Ambient temperature		With adequate cooling method	–	25	–	°C
PCB characteristics						
Dimensions	L	Length	–	120	–	mm
	W	Width	–	60	–	mm
	H	Height	–	25	–	mm
Layer			–	4	–	
PCB thickness			–	1.6	–	mm
Copper thickness			–	4	–	oz.
Material		FR-4, RoHS-compliant				

Note: The evauation board is designed to evaluate the parameters of 2ED2742S01G half bridge gate driver IC. The board does not have over temperature protection and care should be taken to not to operate the board at full load for maximum 15 minutes only.

1.5 Getting started with EVAL-2ED2742S01G

To run the motor system, a combination of the power board EVAL-2ED2742S01 GM1 and a matching iMOTION™ control board (e.g., 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-2ED2742S01 GM1 can run a BLDC motor by connecting to the iMOTION™ 2.0 control board EVAL-M1-101T through an M1 interface. The system connection is shown in Figure 3, and the test results are listed in Section 3.1.

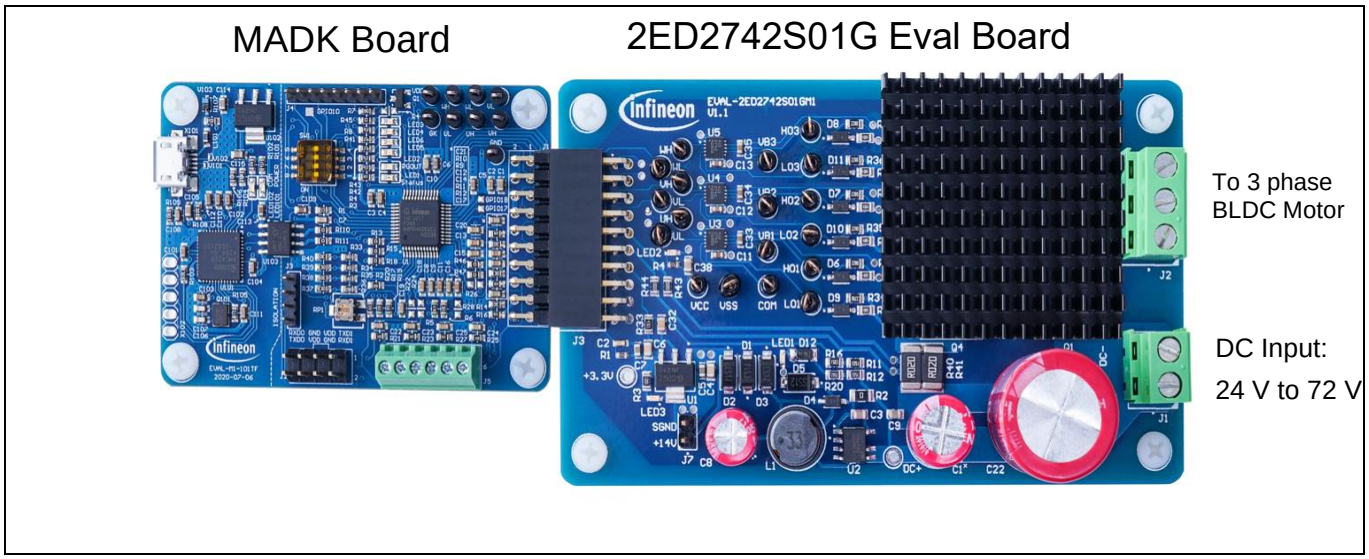


Figure 3 The system connection for running a BLDC motor with Heatsink

1.5.1 The iMOTION™ control board

The latest IMC101T-T038 MCE software package can be downloaded from www.infineon.com/imotion-software.

With 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 EVAL-2ED2742S01 GM1 board connector J3.
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 6). 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 EVAL-2ED2742S01 GM1 board) to the motor.
5. Connect DC input to the power input connector (J1 on the EVAL-2ED2742S01 GM1 board), then power on the system. Note the
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.

1.5.2 iMOTION™ development tools and software

The EVAL-2ED2742S01 GM1 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.

A review of references [10] to [16], on page 45 will provide a deeper understanding of the overall iMotion™ ecosystem.

1.5.3 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 3 lists the hardware parameters specific to the EVAL-2ED2742S01 GM1 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 3 MCEWizard setup overview table

Parameter	Value
Control board selecting	EVAL-M1-101T for example
Motor 1 shunt configuration	Single shunt
Controller supply voltage	+3.3 V
Max DC bus voltage	36 V
DC bus sensing high resistor	300 kΩ
DC bus sensing low resistor	4.7 kΩ
NTC temperature shutdown value	Refer to the control board's application note [6]
Gate sense low-side devices	High is true
Gate sense high-side devices	High is true
Motor 1 current input scaling	Calculated in the corresponding section of the control board's application note [6]

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

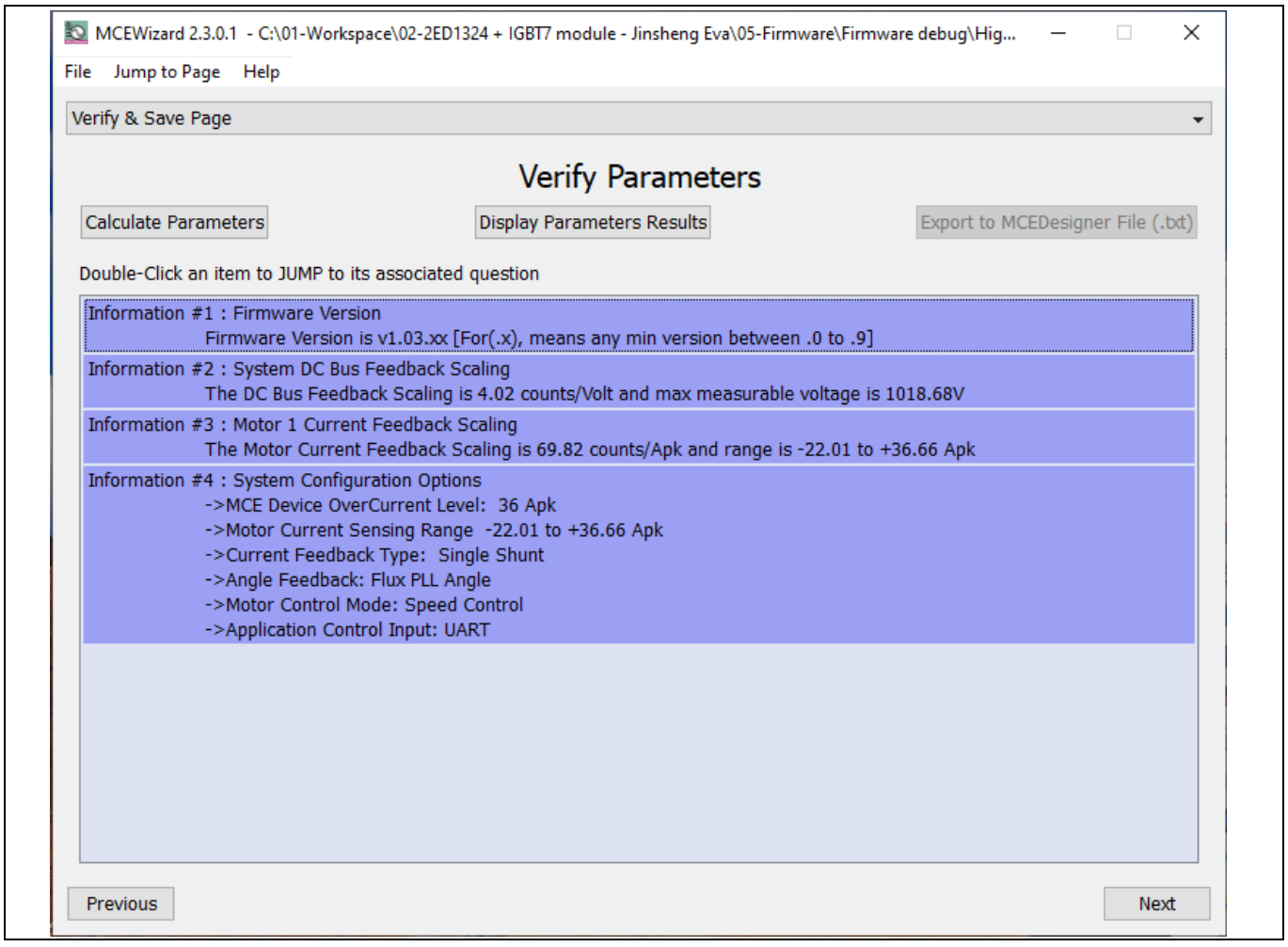


Figure 5 Verify & Save page of the MCEWizard.

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

1.5.4 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.

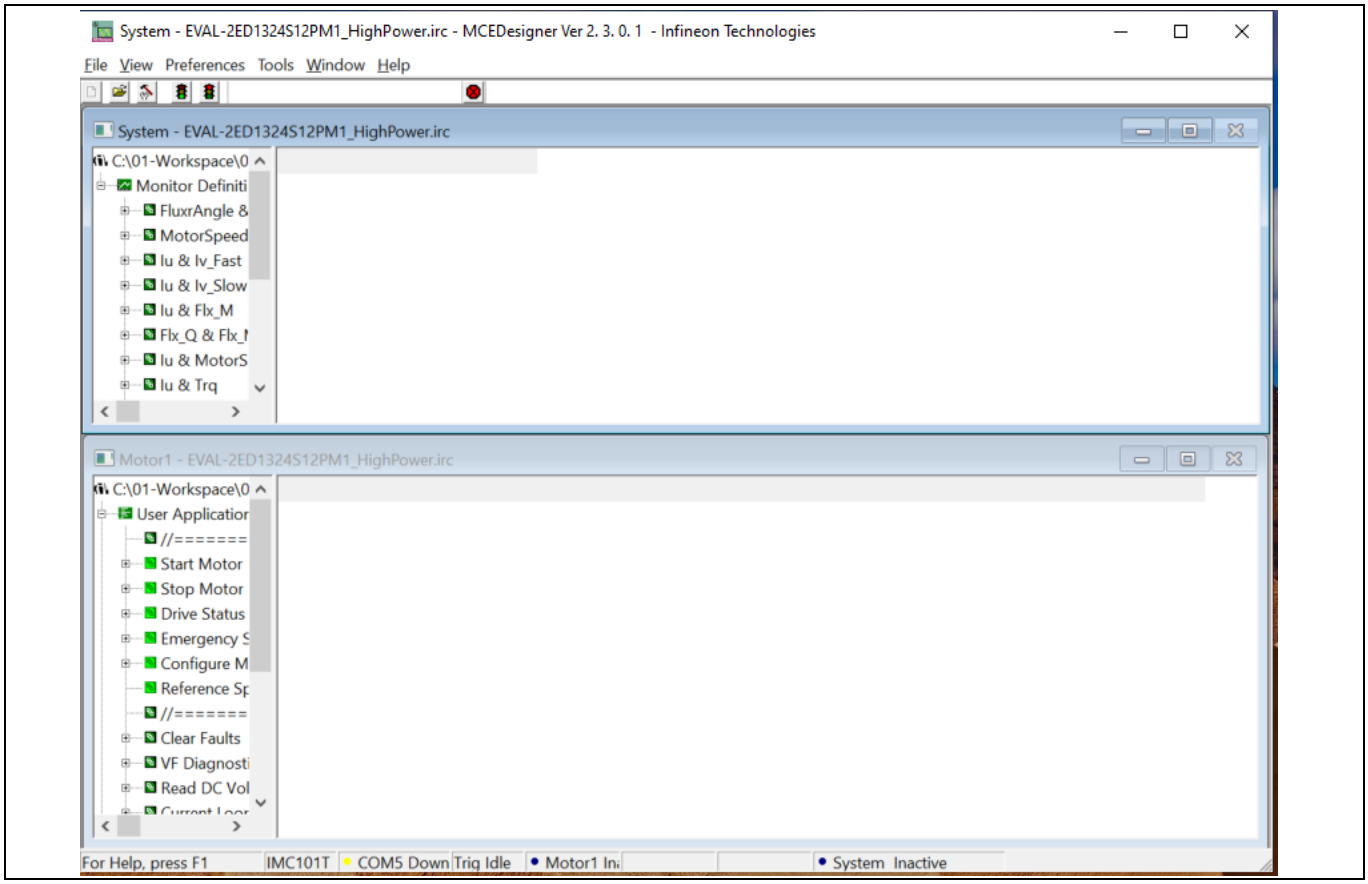


Figure 6 MCEDesigner's main display for EVAL-M1-101T

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 [8] for more details.

1.6 Description of functional blocks

The motor inverter in EVAL-2ED2742S01 GM1 hardware design is implemented by the new 160 V SOI three half bridge gate drivers 2ED2742S01G and six OptiMOS™ 100 V N-Channel MOSFETs - IPTC015N10NM5. The auxiliary power supply is derived from a high voltage DC-DC buck converter providing 12 V followed by a LDO providing the 3.3 V required to power the iMotion™ IMC101T microcontroller.

1.6.1 Overview of 2ED2742S01G

Figure 7 shows the functional block diagram of 2ED2742S01G. For more information such as static and dynamic electrical characteristics of the gate driver, please refer to the datasheet of 2ED2742S01G.

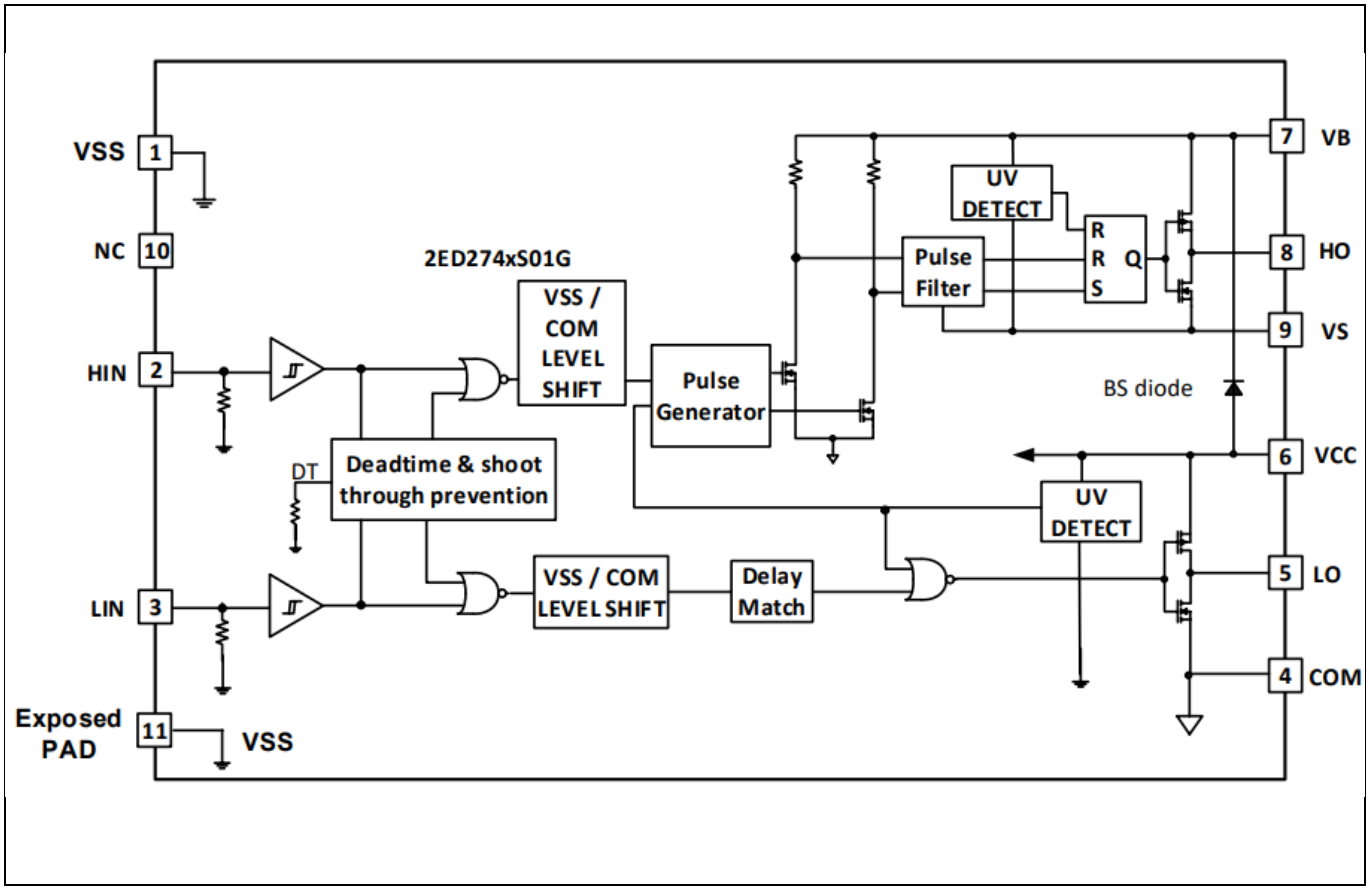


Figure 7 Functional block diagram of 2ED2742S01G

The main features of 2ED2742S01G include:

- Bootstrap voltage (VB node) of +160 V
- Floating channel designed for bootstrap operation
- Integrated low R_{ON}, ultra-fast bootstrap diodes
- Independent under voltage lockout for both high and low side
- Integrated shoot-through protection with built-in dead time
- 3.3 V, 5 V input logic compatible, outputs in phase with inputs
- Available in small footprint DFN 10 lead, 3x3 mm package
- 2.5kV HBM ESD, RoHS compliant

Table 4 Absolute maximum ratings of 2ED2742S01G

Symbol	Definition	Min.	Max.	Units
V_B	High-side floating well supply voltage (Note 1)	-0.3	160	
V_S	High-side floating well supply return voltage	-0.3	140	
V_{BS}	Bootstrap supply range	-0.3	20	
V_{HO}	Floating gate drive output voltage	V_S – 0.3	V_B + 0.3	V
V_{CC}	Low side supply voltage	-0.3	20	
V_{LO}	Low-side output voltage	–0.3	V_{cc} + 0.3	

$V_{LOGIC\ IN}$	Logic input voltage (HIN, LIN)		-0.3	5	
COM	Low side power ground return		-5.0	+5.0	
dV_S/dt	Allowable V_S offset supply transient relative to COM		—	50	V / ns
P_D	Package power dissipation @ $T_A \leq +25°C$	5 x 5mm QFN-32		3	W
Rth_{JA}	Thermal resistance, junction to ambient	5 x 5mm QFN-32		41	°C/W
T_J	Junction temperature		—	150	°C
T_s	Storage temperature		-50	150	
T_L	Lead temperature (soldering, 10 seconds)			260	

Note 1: In case VCC > VB there is an additional power dissipation in the internal bootstrap diode between pins VCC and VB.

1.7 Shoot-through protection

The 2ED2742S01G is equipped with shoot-through protection circuitry (also known as cross-conduction prevention circuitry). Figure 10 shows how this protection circuitry prevents both the high- and low-side switches from conducting at the same time.

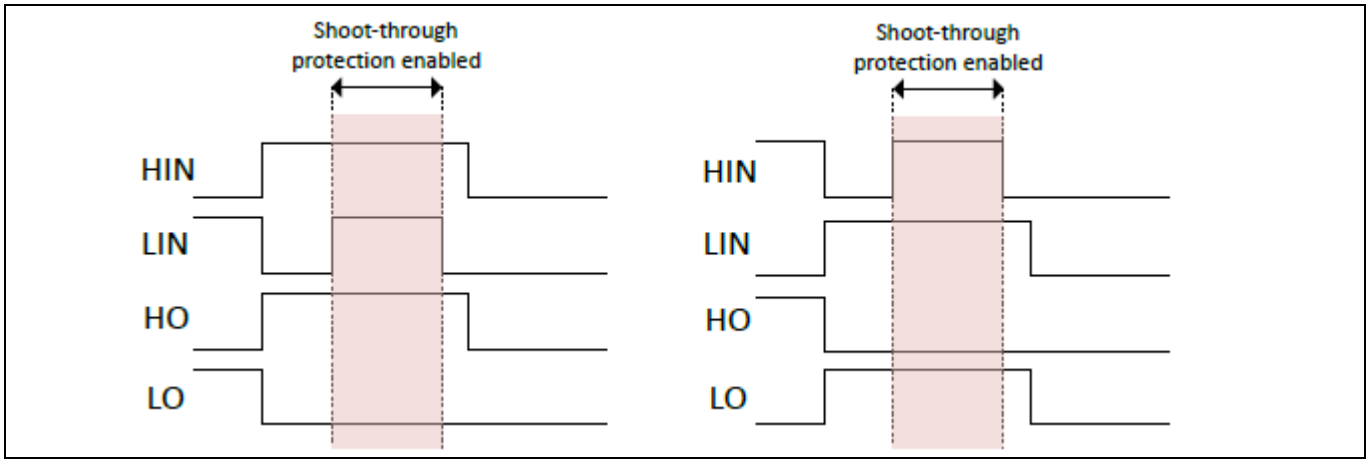


Figure 10 Illustration of shoot-through protection circuitry

1.8 Short-Pulse / Noise rejection filters

This device's input filter provides protection against short pulses (e.g., noise) on the input lines. If the duration of the input signal is less than $t_{FIL,IN}$, the output will not change states. Example 1 of Figure 21 shows the input and output in the low state with positive noise spikes of durations less than $t_{FIL,IN}$; the output does not change states. Example 2 of Figure 21 shows the input and output in the high state with negative noise spikes of durations less than $t_{FIL,IN}$; the output does not change states.

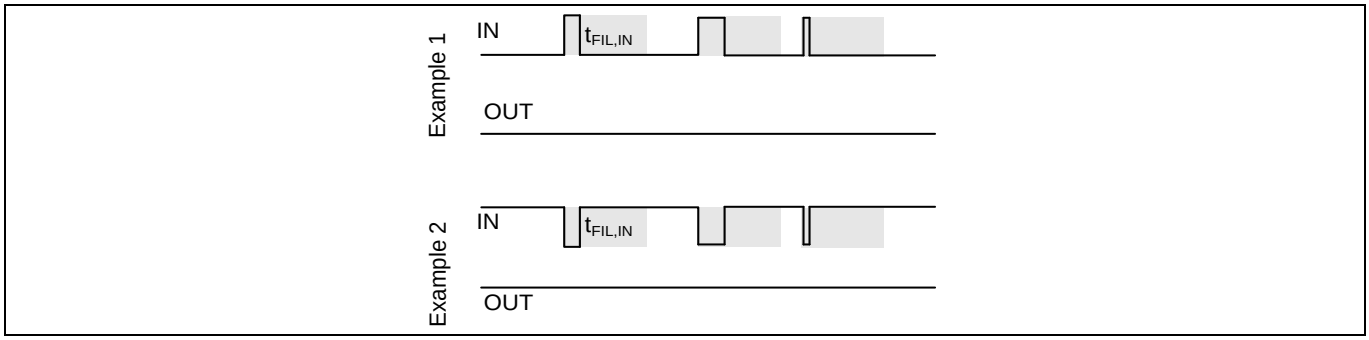
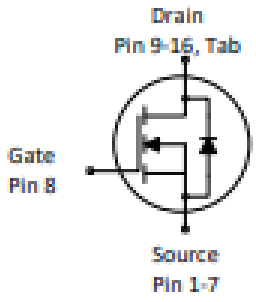


Figure 11 Noise Rejecting Input Filters

1.8.1 Overview of IPTC015N10NM5

The IPTC015N10NM5 is a 100 V rated N-Channel OptiMOS™ 5 power MOSFET. It was mainly chosen for its 5 x 6 Super SO8 package and its excellent gate charge x $R_{DS(on)}$ product Figure of Merit (FOM).

Figure 22 shows the key features of IPTC015N10NM5. For more information about the MOSFET, please refer to the datasheet of IPTC015N10NM5.



Parameter	Value	Unit
V_{DS}	100	V
$R_{DS(on),max}$	1.5	mΩ
I_D	354	A
Q_{oss}	210	nC
Q_G	166	nC

PG-HDSOP-16

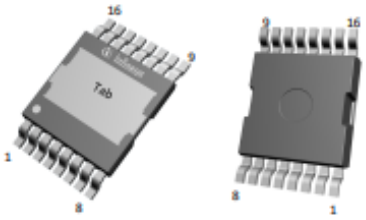


Figure 12 Key features of IPTC015N10NM5

The typical gate charge characteristics and typical capacitances of IPTC015N10NM5 are shown in Figure 23.

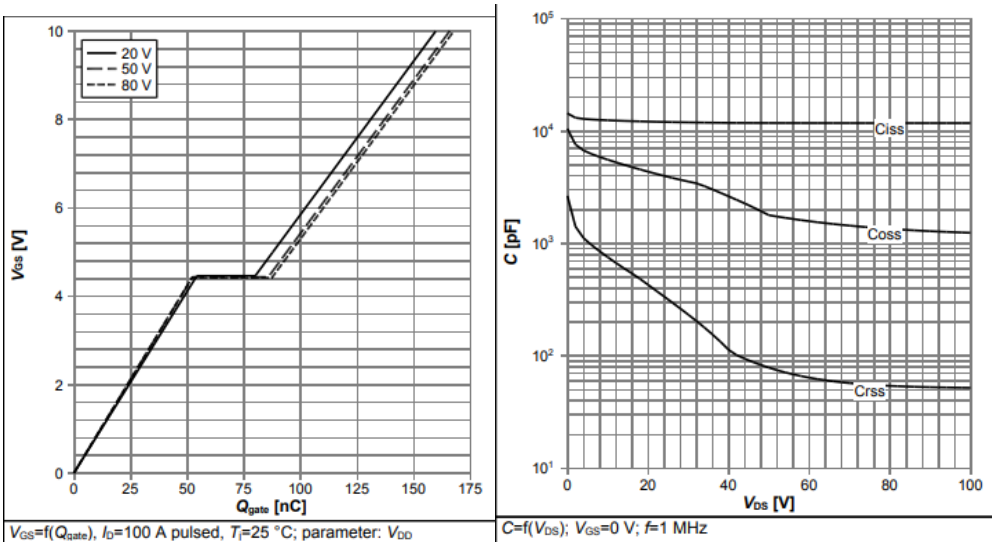


Figure 13 IPTC015N10NM5 typical characteristics

2 System design

This chapter covers the hardware design of EVAL-2ED2742S01 GM1 in detail. Users can modify the circuit or re-select the component values based on actual applications in the field.

2.1.1 DC-link voltage measurement and inrush current limiter

Bus capacitors should be large enough to stabilize the bus voltage.

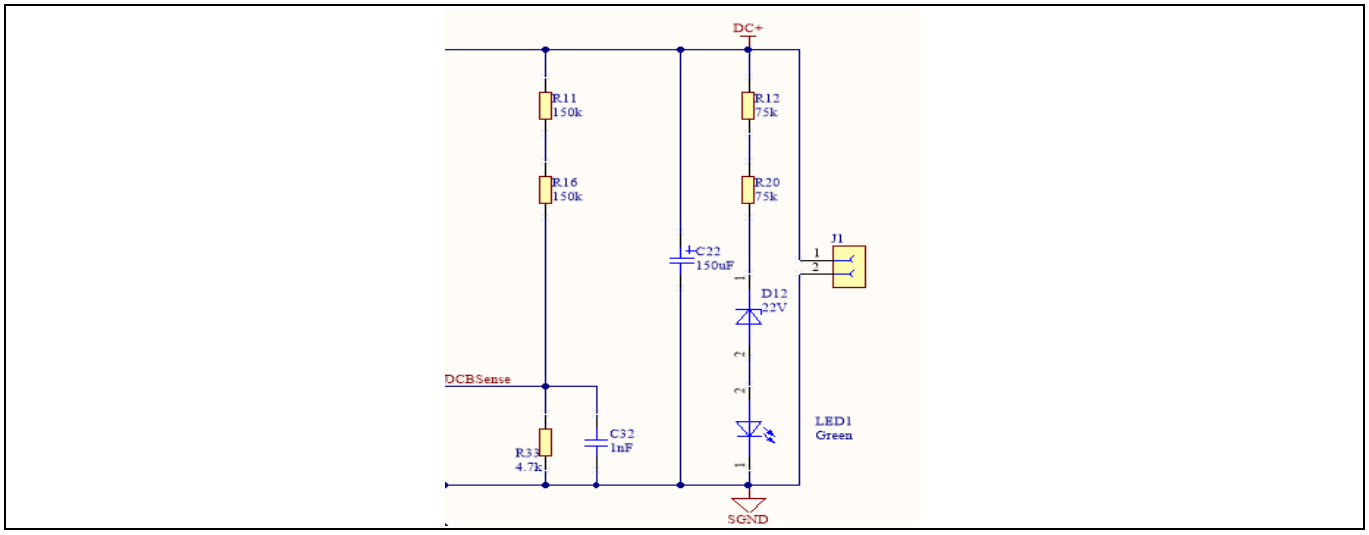


Figure 14 Bus capacitor configuration and DC bus sensing

2.1.2 Inverter section using OptiMOS™ 5 IPTC015N10NM5

The inverter section is implemented using IPTC015N10NM5 as shown in Figure 15. It is a three-phase inverter bridge section with Infineon's OptiMOS™ 5 N-channel MOSFETs. R40/ R41 (in parallel) are single shunt for current sensing.

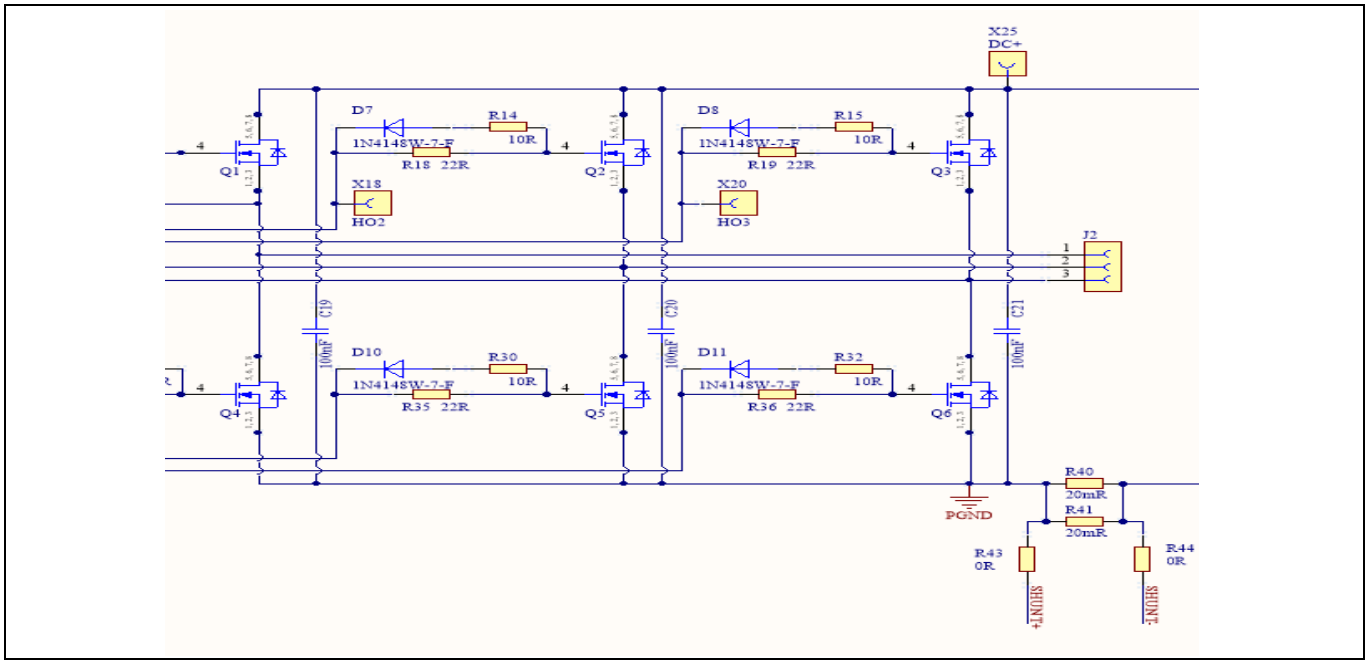


Figure 15 The diagram of the IPTC015N10NM5 based inverter section with single shunt current sense

2.1.3 Drive circuit with 2ED2742S01G

The configuration of 2ED2742S01G is shown in Figure 16.

The capacitor C33 (C34, C35) is used as bootstrap capacitor to provide the necessary floating supply voltage VBS. Thanks to the bootstrap diode integration in 2ED2742S01G, an external bootstrap diode is not needed.

The fault-clear time setup is based on the datasheet of 2ED2742S01G. The main feature of 2ED2742S01G designed with Infineon's SOI technology is its tolerance in terms of negative transient voltage in inductive load applications. 2ED2742S01G can tolerate repetitive negative transient voltage of up to 15 V (pulse width up to 100 ns).

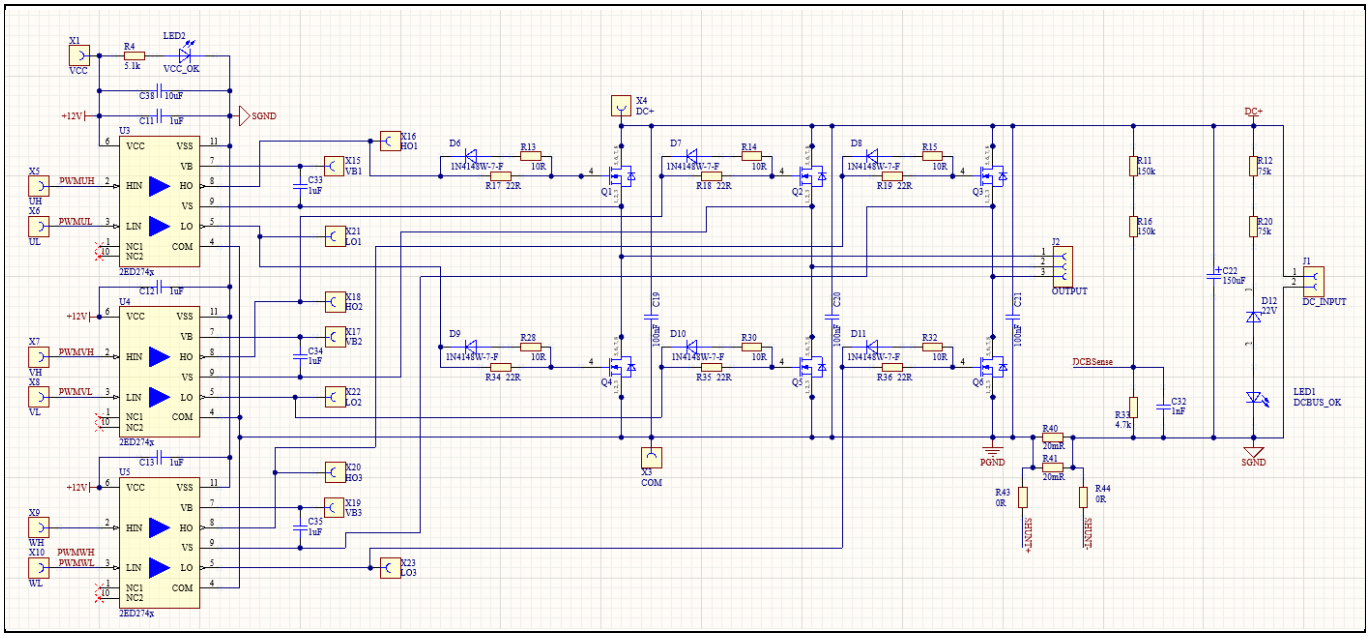


Figure 16 Drive circuit design with 2ED2742S01G

2.1.4 Overcurrent protection

The overcurrent circuit is shown in Figure 15. To save power loss of the shunt resistor, the R_{shunt} value is set as 10 mΩ by using two 20 mΩ / 2 W surface-mounted devices (SMD) resistors (R40/R41) and low equivalent series inductance (ESL) in parallel. In the design, the target current for overcurrent protection (I_{OCP}) is 25 A. The overcurrent threshold of the ITRIP pin is 0.54 V. An additional 0.19 V DC-bias voltage is needed at the ITRIP pin to meet the target current of 25 A. This is achieved by using resistor dividers R19 and R20 with 3.3 V supply.

The I_{OCP} is calculated using:

$$Iocp = \frac{(V_{ITRIP+} - \frac{R19}{R19 + R20} * 3.3V) * (R19 + R20)}{R20 * Rshunt}$$

$$= 24.93\ A$$

Here, V_{ITRIP+} is the positive-going threshold for ITRIP and its typical value is 0.44 V, R19 = 100 Ω, and R20 =1 kΩ.

Note: If EVAL-M1-101T is not used as the controller board, an offset circuit needs to be added.

2.1.5 Auxiliary power supply

The auxiliary power supply is derived from BM0650HV based DC-DC buck converter. The 12 V DC can be connected an external Fan (not provided with the Eval board) for forced air cooling during prolonged testing. The 3.3 V power supply required for the IMC101T based MADK control card is derived from the 12 V DC using the linear regulator IFX25001ME V33. This 3.3 V power supply is also used to bias different circuitry on board such as the ITRIP config and CSO config. The auxiliary supply stage is as shown in the schematic in figure 27.

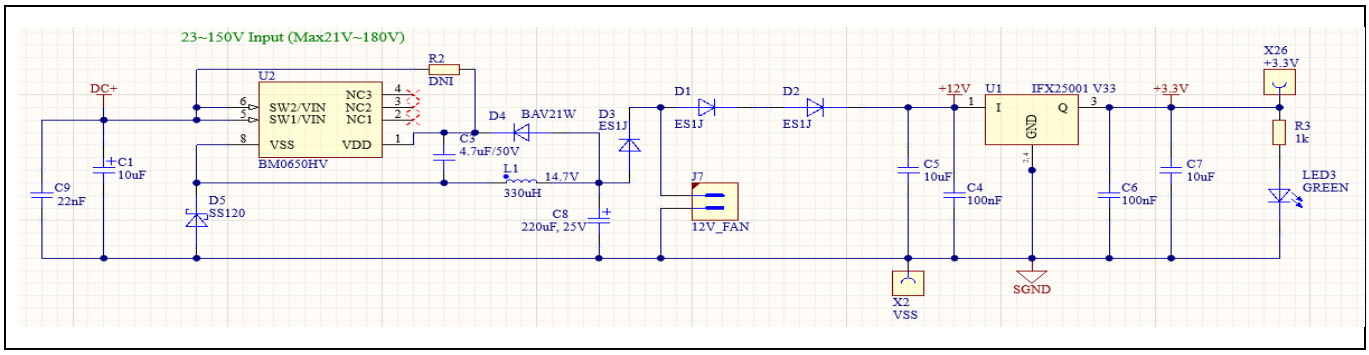


Figure 17 A high voltage DC-DC buck converter provides 12 V followed by a 3.3 V generated from a linear regualtor

2.2 Schematics

The schematics of EVAL-2ED2742S01G are shown in Figure 28

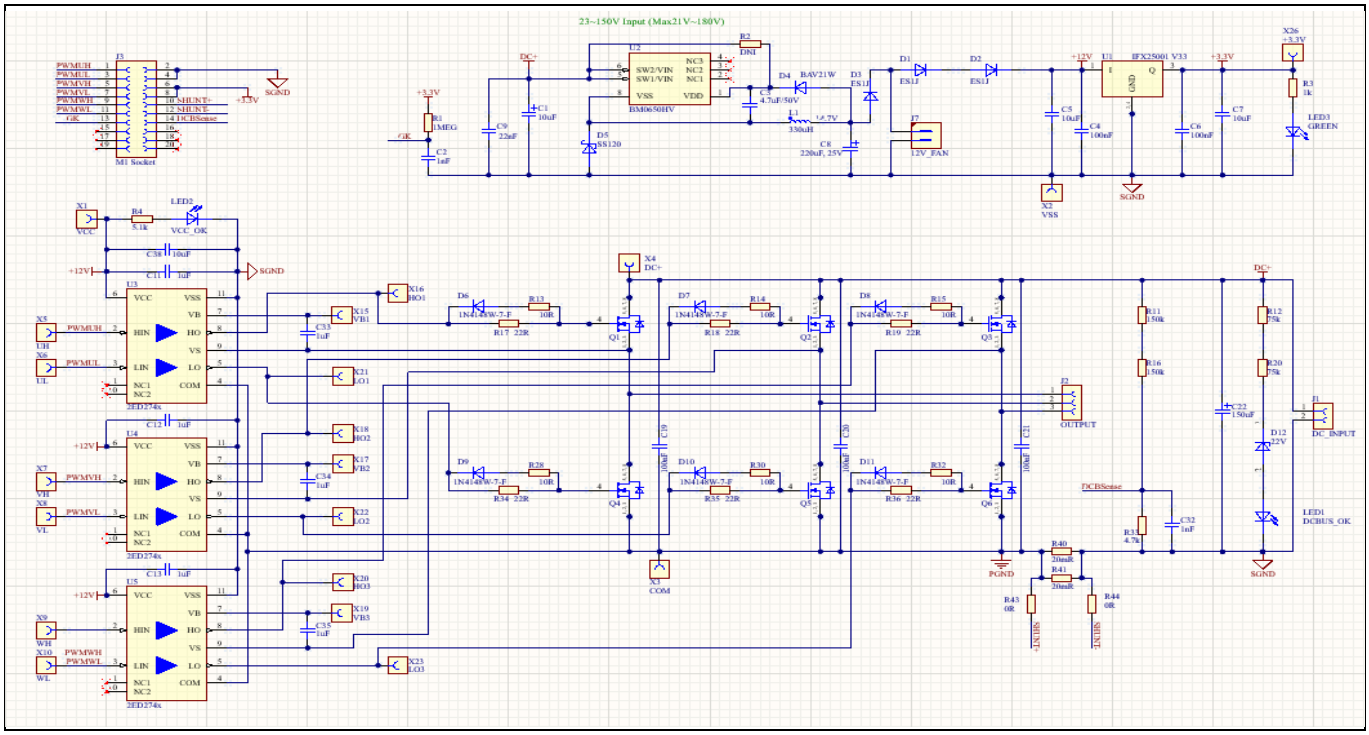


Figure 18 Circuitry of the power inverter board (main board)

2.3 Layout

2.3.1 Layout details

Detailed layouts of the main inverter board are shown in Figure 19 to Figure 22.

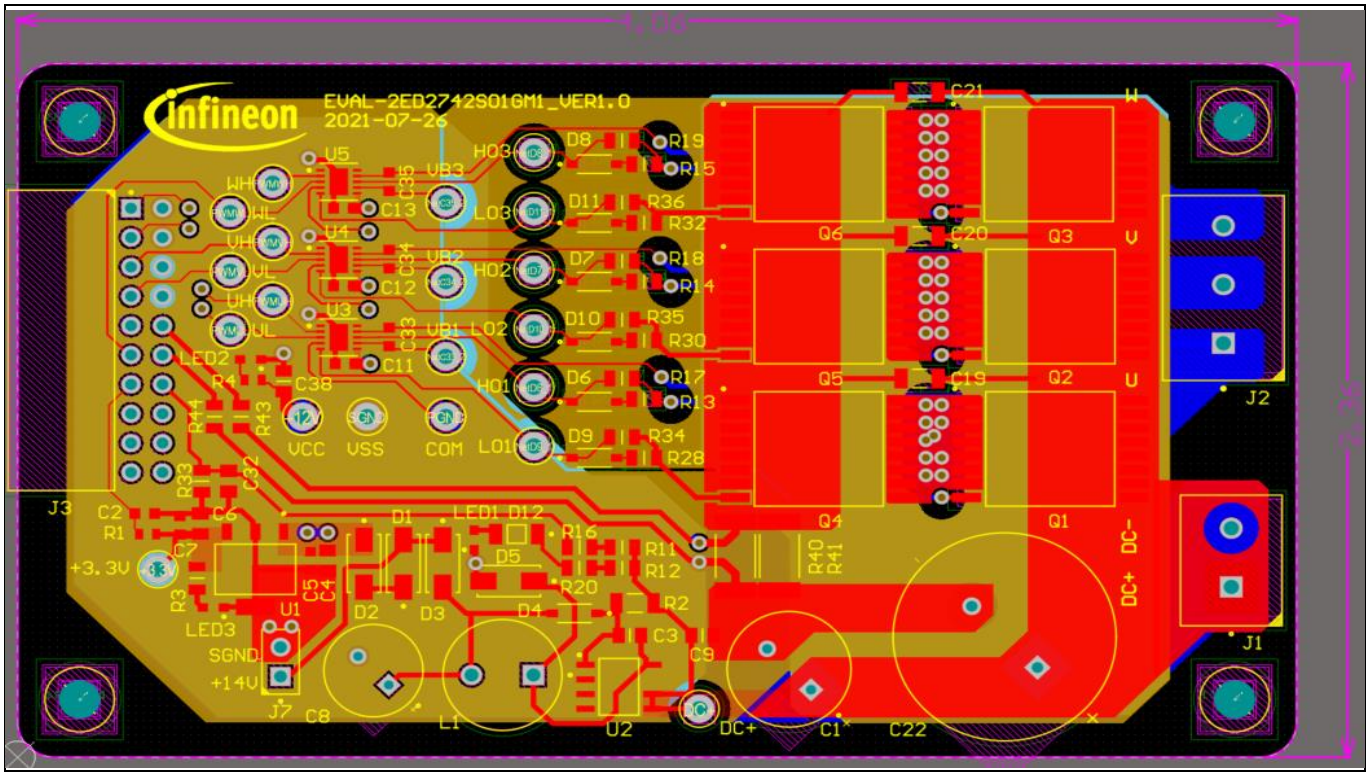


Figure 19 Power inverter board layout (All 4 layers togather)

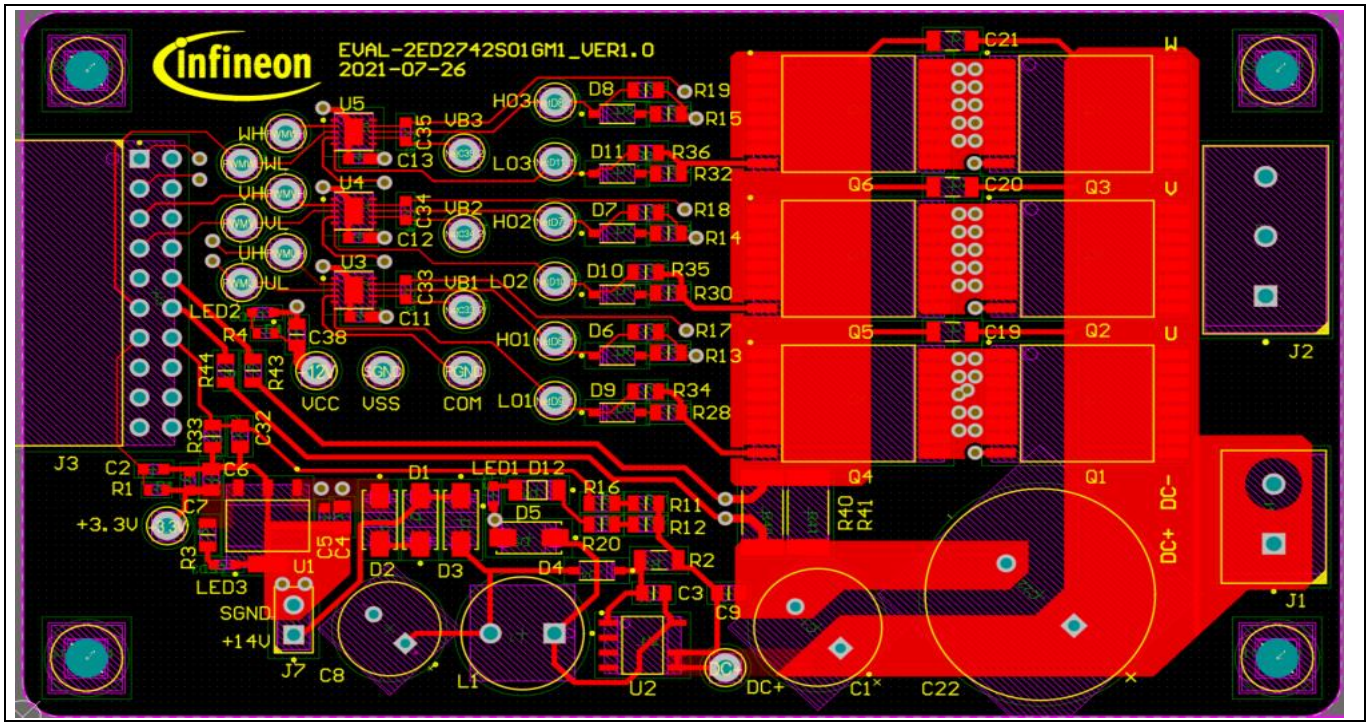


Figure 20 Power inverter board layout (Top view- layer 1)

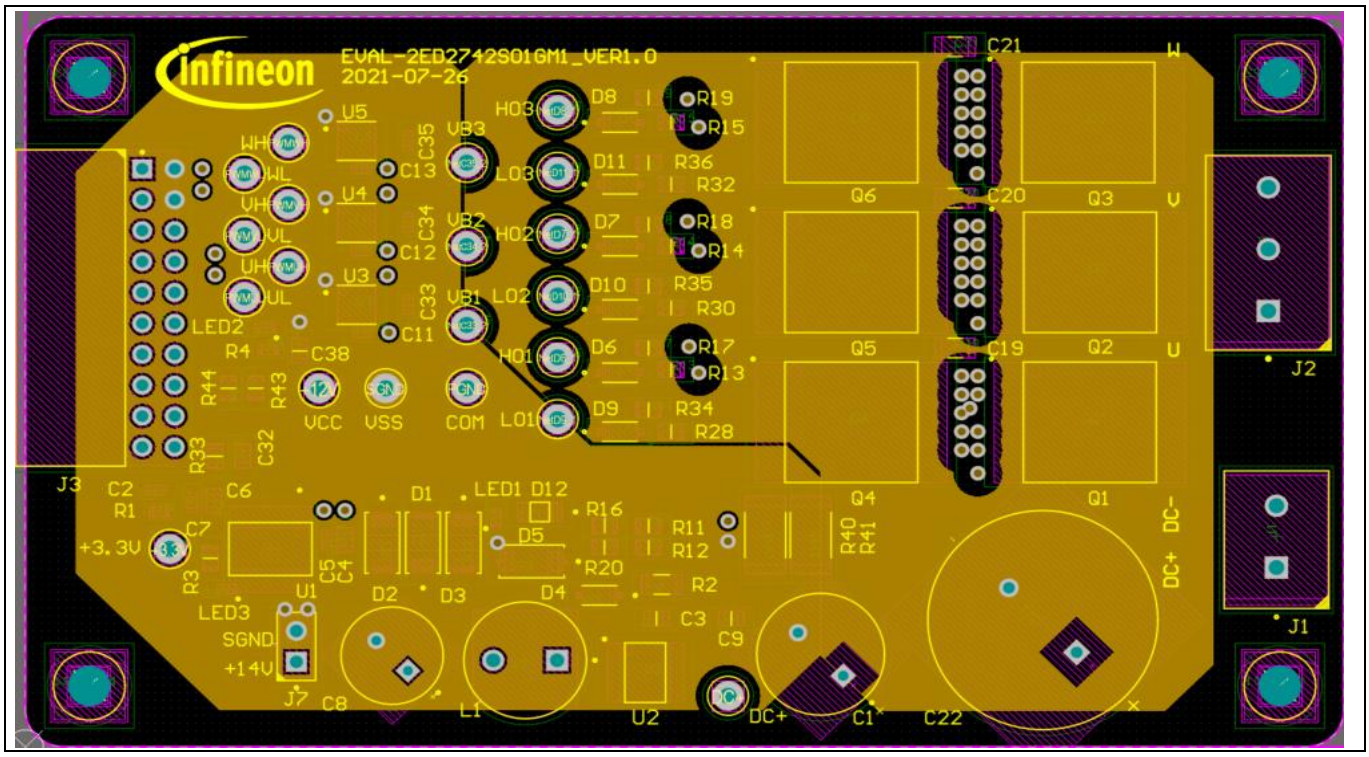


Figure 21 Power inverter board layout (Middle layer- layer 2)

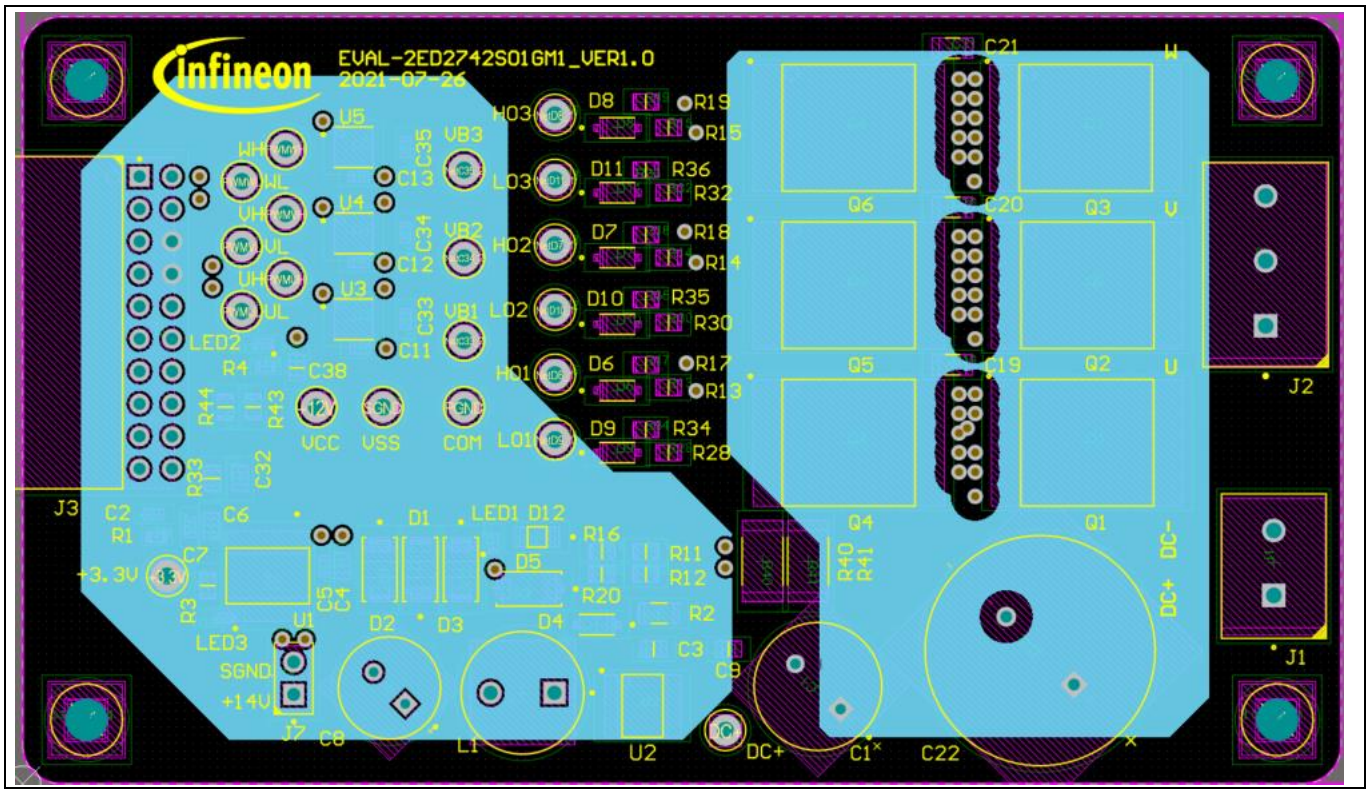


Figure 22 Power inverter board layout (Middle layer- layer 3)

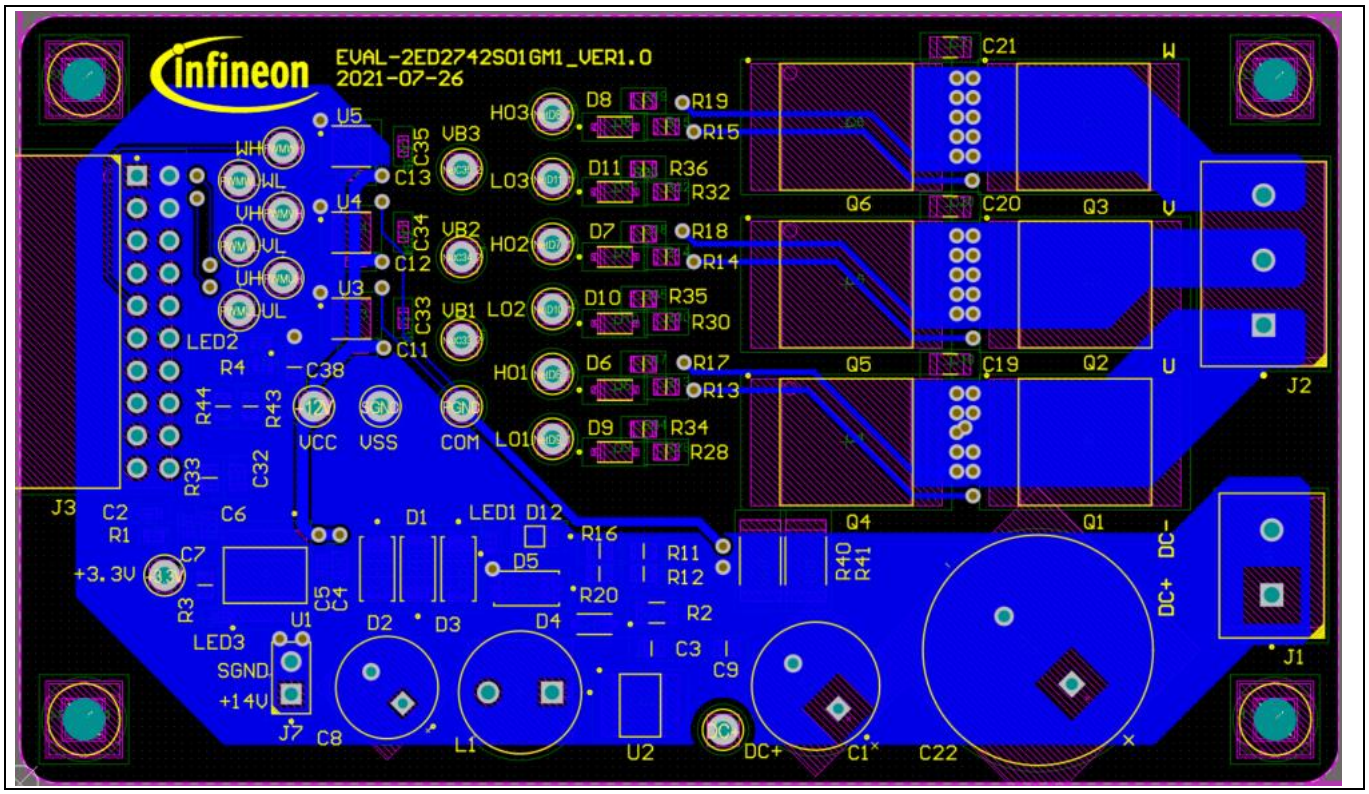


Figure 23 Power inverter board layout (bottom view- layer 4)

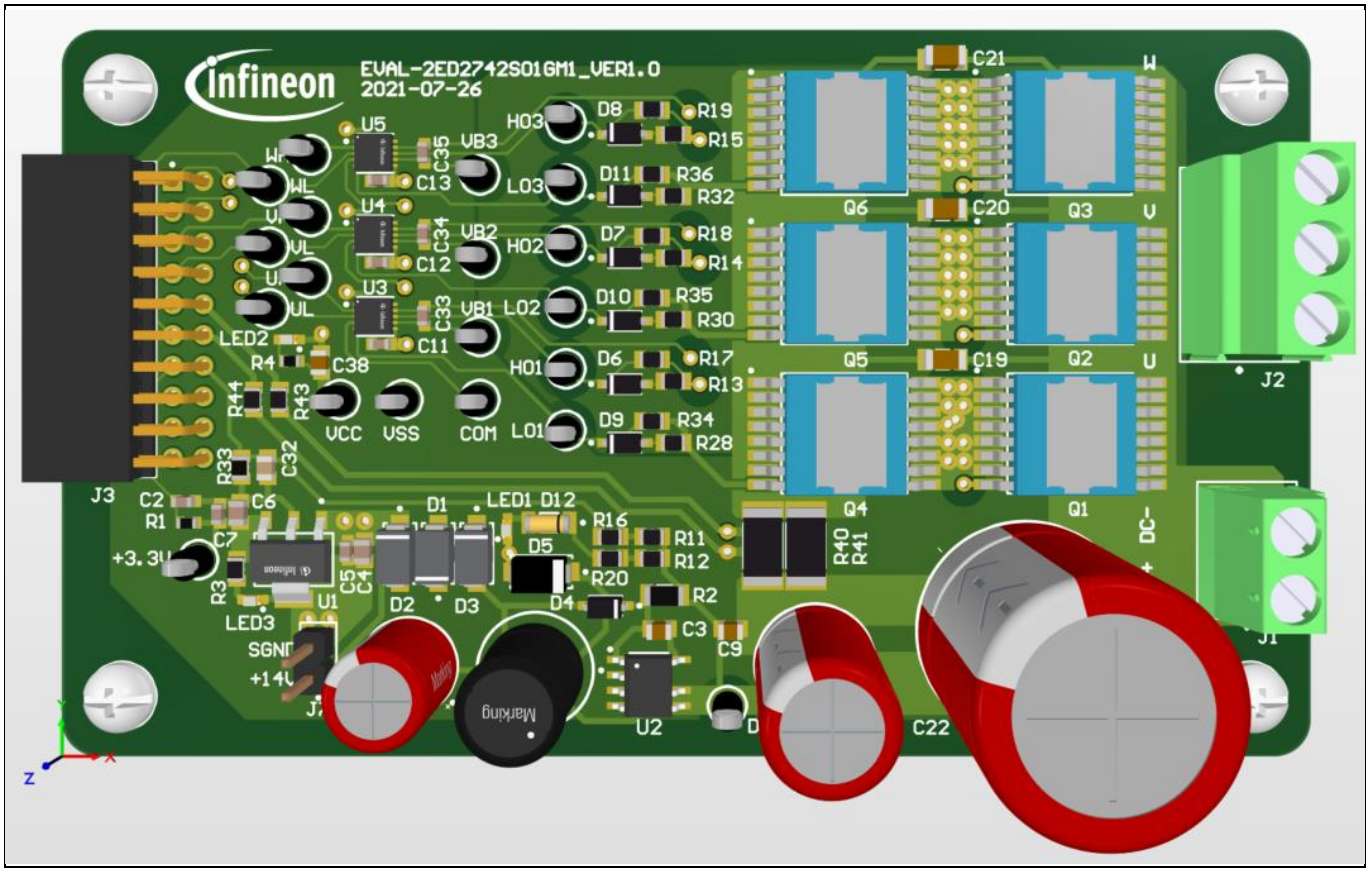


Figure 24 Power inverter assembled board

Both the schematic and layout files in Altium are provided on the 2ED2742S01G webpage online. Users can download the same by logging in with their infineon.com credentials.

2.3.2 Layout guidelines

Some basic layout guidelines are as follows:

- 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 VSS and COM should be made as small as possible by connecting the VSS 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

2.4 Bill of material

The complete bill of material (BOM) is available in the Downloads section of Infineon's homepage. A login is required to download this material.

Table 5 lists the important components used in EVAL-2ED2742S01G.

Table 5 BOM with Infineon components in Bold

Designator	Comment Value	Description	Quantity
C1	10uF	CAP / ELCO / 10uF / 200V / 20% / Aluminiumelectrolytic / -25¡ãC to 105¡ãC / 5.00mm C X 0.60mm W 10.00mm Dia X 21.50mm H / - / -	1
C2	1nF	CAP / - / 1nF / 25V / 10% / X7R (EIA) / -55¡ãC to 125¡ãC / 0603(1608) / SMD / -	1
C3	4.7uF/50V	Chip Monolithic Ceramic Capacitor	1
C4, C6	100nF	Surface Mount Ceramic Capacitor 0.1uF 25V X7R 10%	2
C5, C7	10uF	Chip Monolithic Ceramic Capacitor	2
C8	220uF, 25V	CAP / ELCO / 220uF / 25V / 20% / Aluminiumelectrolytic / -40¡ãC to 105¡ãC / 3.50mm C X 0.60mm W 8.00mm Dia X 13.00mm H / - / -	1
C9	22nF	CAP / - / 22nF / 250V / 10% / X7R (EIA) / -55¡ãC to 125¡ãC / 0805(2012) / SMD / -	1
C11, C12, C13, C33, C34, C35	1uF	CAP / - / 1uF / 25V / 10% / X7R (EIA) / -55¡ãC to 125¡ãC / 0603(1608) / SMD / -	6
C19, C20, C21	100nF	Ceramic Capacitor 0.1uF 250V X7R 10% SMD 1206	3
C22	150uF	CAP / ELCO / 150uF / 200V / 20% / Aluminiumelectrolytic / -25¡ãC to 105¡ãC / 7.50mm C X 0.80mm W 18.00mm Dia X 26.50mm H / - / -	1

C32	1nF	Surface Mount Multilayer Ceramic Chip Capacitor	1
C38	10uF	Chip Monolithic Ceramic Capacitor	1
D1, D2, D3	ES1J	1.0A Ultra Fast Recovery Rectifier	3
D4	BAV21W	Surface Mount Fast Switching Diode	1
D5	SS120	Surface Mount Schottky Barrier Rectifier, 20V	1
D6, D7, D8, D9, D10, D11	1N4148W-7-F	Surface Mount Fast Switching Diode	6
D12	22V	Zener Diode, 5% 22V	1
J1	DC_INPUT	PCB Terminal Block, Vertical, 5.08mm Pitch; 2 pins	1
J2	OUTPUT	PCB Terminal Block, Nominal Current 16A, Nominal Voltage 250V, 5.08mm pitch, 3 pin	1
J3	M1 Socket	WR-PHD 2.54 mm Angled Dual Socket Header	1
J7	12V_FAN	Header, 2.54mm Pitch, 2 pin, Vertical, Single Row	1
L1	330uH	IND / STD / 330uH / 1.1A / 10% / -40¡ãC to 125¡ãC / 470mR / Radial / Inductor, Radial;5.00mm C X 0.65mm W 9.50mm Dia X 13.50mm H / - / -	1
LED1	DCBUS_OK	Surface Mount LED, Green, 570nm	1
LED2	VCC_OK	Surface Mount LED, Green, 570nm	1
LED3	GREEN	Surface Mount LED, Green, 570nm	1
MP1, MP2, MP3, MP4	D00688	M3 X 10mm Pan Head, Cross Head Metric Screw, 5.6mm X 2.4mm Head, Nylon 6,6	4
MP11, MP22, MP33, MP44	05.30.315	Hex-Standoff / Female - Female M3 / 6 x 15 (DxH)	4
Q1, Q2, Q3, Q4, Q5, Q6	IPTC015N10NM5	OptiMOS 5 Power-Transistor, 100 V, N-channel	6
R1	1MEG	RES / STD / 1MEG / 100mW / 1% / 100ppm/K / -55¡ãC to 155¡ãC / 0603 / SMD / -	1
R2	DNI	Standard Thick Film Chip Resistor	1
R3	1k	Standard Thick Film Chip Resistor	1
R4	5.1k	RES / STD / 5.1k / 100mW / 1% / 100ppm/K / -55¡ãC to 155¡ãC / 0603 / SMD / -	1
R11, R16	150k	Standard Thick Film Chip Resistor	2
R12, R20	75k	Standard Thick Film Chip Resistor	2
R13, R14, R15, R28, R30, R32	10R	Standard Thick Film Chip Resistor	6

R17, R18, R19, R34, R35, R36	22R	Standard Thick Film Chip Resistor	6
R33	4.7k	4.7k/150V/1%	1
R40, R41	20mR	Low Value Power Metal Strip Resistor	2
R43, R44	0R	Standard Thick Film Chip Resistor	2
U1	IFX25001 V33	Low Dropout Voltage Regulator, 3.3V Output	1
U2	BM0650HV	PFM Controller and 200V Smart power with high avalanche capability MOSFET	1
U3, U4, U5	2ED274x	160 V half bridge SOI gate driver with integrated bootstrap diode	3

2.5 Connector details

Table 6 Connectors

PIN	Label	Function
Various signal input / output	X1 – X26	Test points for various onboard signals
DC+, DC-	J1	DC power supply input
U/V/W	J2	Three phase-outs (U/V/W) to the motor
M1 connector	J3	M1 Socket - iMOTION™ MADK-M1 20-pin interface connector
12 V Aux output	J7	12V_FAN Header

3 System performance

3.1 System setup for running a BLDC motor

EVAL-2ED2742S01G is tested while running a custom BLDC motor in the setup shown in Figure 25.

Test conditions:

- Input: V_{IN} = 48 VdC
- Phase-out current: I_{PHASE} =25 $A_{rms,}$
- Room temperature
- BLDC motor: Custom, I_{PHASE} = 25 A, test at speed = 52000 r/min
- Maximum heat sink temperature = 85°C after running for 30 min
- MOSFET temperature stable at 100 °C after running for 30 min

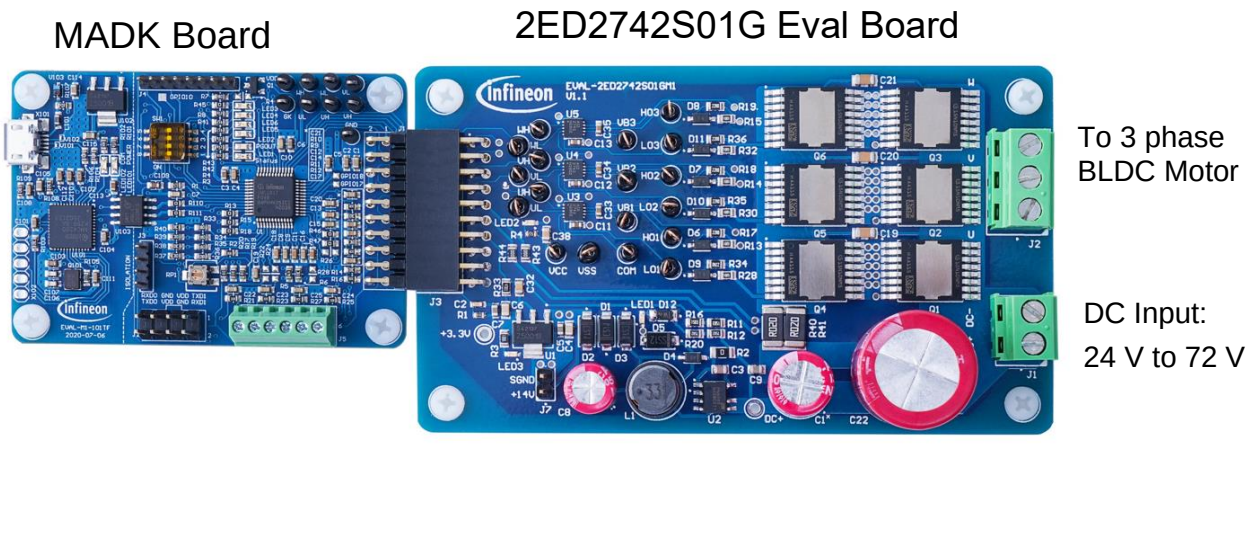


Figure 25 System setup for running a BLDC motor

3.2 The output phase current

Error! Reference source not found. and 39 shows the waveform at light load and full load

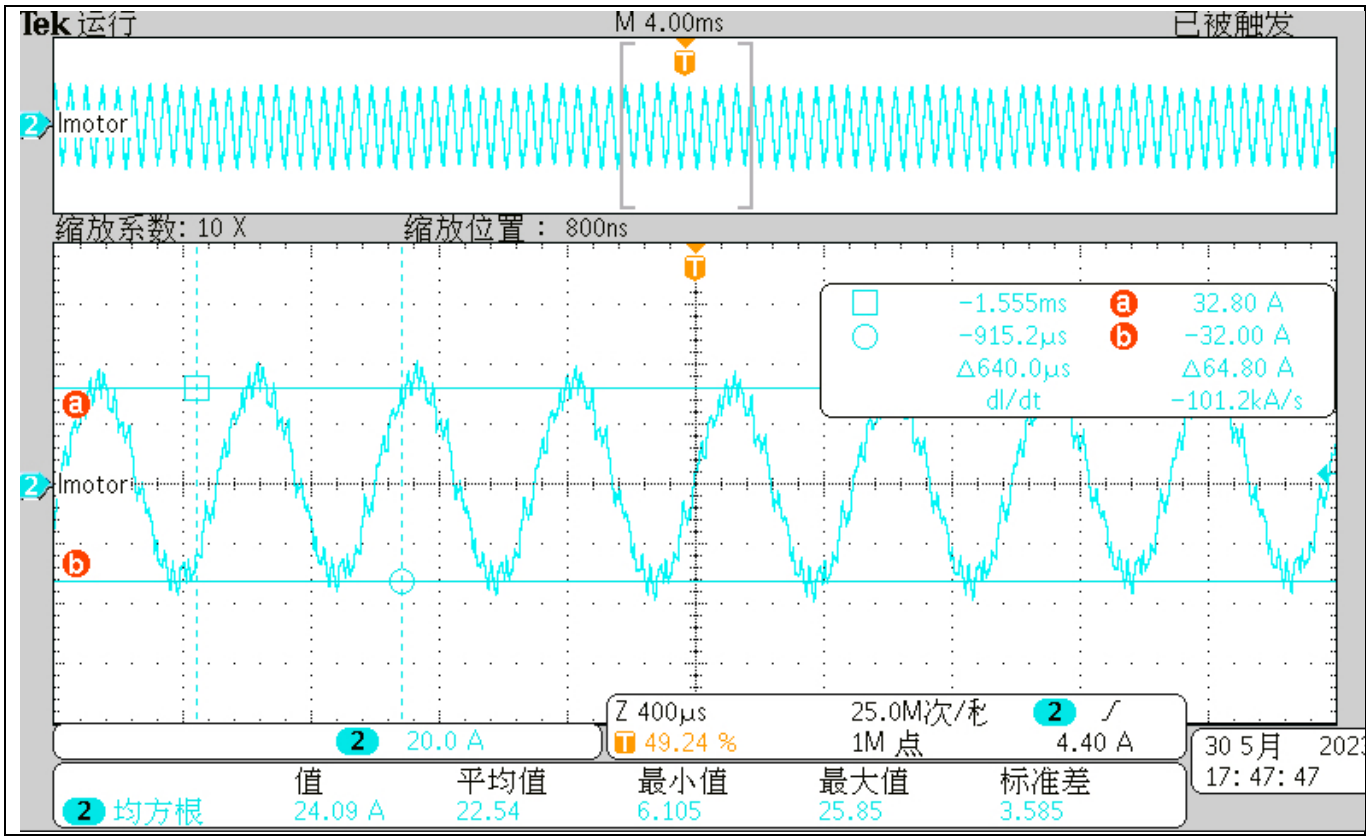


Figure 26 Current at light load

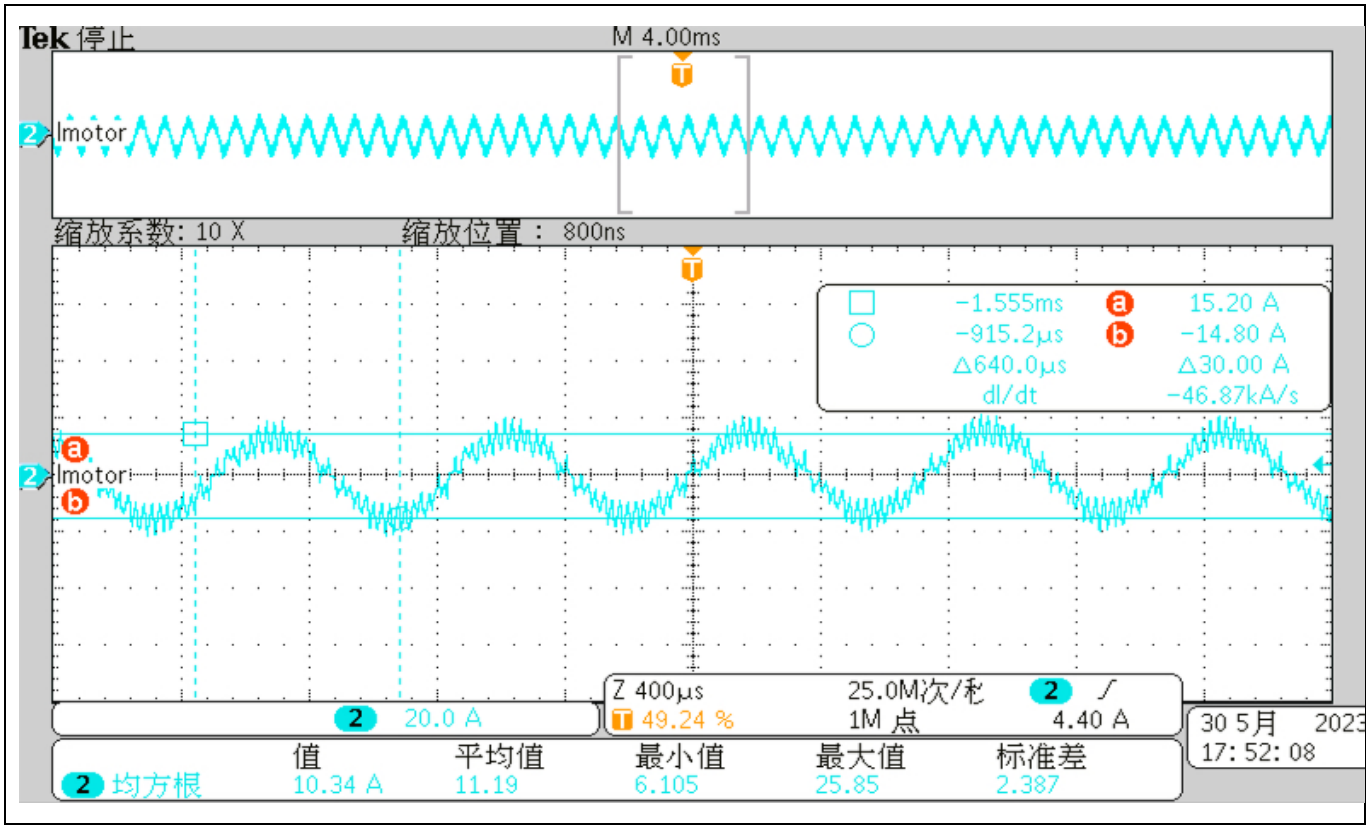


Figure 27 Current at full load

4 References and appendices

4.1 Abbreviations and definitions

Table 7 Abbreviations

Abbreviation	Meaning
IC	Integrated circuit
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
DC	Direct Current
BLDC	Brushless Direct Current
PWM	Pulse Width Modulation
EVAL	Evaluation board
PCB	Printed Circuit Board
SOI	Silicon on Insulator

4.2 References

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