EVAL-1ED3321MC12N-SiC

Evaluation board description and getting started guide

About this document

Scope and purpose

This user guide provides an overview of the EVAL-1ED3321MC12N-SiC gate driver evaluation board featuring the Infineon EiceDRIVER™1ED3321MC12N gate driver IC. It outlines the functionality and highlights the key features of this gate driver IC in a half-bridge topology.

The EVAL-1ED3321MC12N-SiC board is designed to evaluate the functionality and capability of the 1ED3321MC12N gate driver IC. The board is designed with high-frequency decoupling capacitance to provide a low-inductive path in the commutation loop, ensuring optimal switching performance and minimizing the switching noise. While the primary purpose of the decoupling capacitance is to support high-frequency operation, an additional external high-voltage DC link capacitance is strongly recommended for double-pulse testing. To simplify this setup, EVAL-1ED3321MC12N-SiC is designed to be compatible with the EVAL-DCLink-DPT board from the Infineon Infineon modular evaluation platform. Alternatively, users can connect any other suitable high-voltage capacitance externally to meet their specific testing requirements.

Intended audience

This document is intended for all technical specialists who want to evaluate the functionality, performance, and features of 1ED3321MC12N gate driver ICs. The evaluation board is intended to be used under laboratory conditions only by trained specialists. Read the datasheet of the 1ED3321MC12N IC to become familiar with the features and the datasheet parameters of the gate driver.

Evaluation board

This board is to be used during the design-in process for evaluating the functionality and the performance of the gate driver IC.

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

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***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 900 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 board contains DC bus capacitors which take time to discharge after removal of the main supply. Before working on the evaluation board, ensure with measurement on the high-voltage supply terminals that the capacitors are discharged 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 circuit before you disconnect or reconnect wires, or perform maintenance work. Ensure the discharge of the bus capacitors after removing power to the board. Do not attempt to service the circuit 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 circuit, 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 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:** *The evaluation 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 EVAL-1ED3321MC12N-SiC Evaluation Board is designed to be used by engineers to evaluate the 1ED3321MC12N EiceDRIVER™ isolated gate driver ICs and discrete power switches from Infineon in a half-bridge configuration. The evaluation board can be used to evaluate other pin-compatible ICs from the 1ED332xMC12N gate driver family by replacing the gate driver ICs on the board. See the 1ED3321MC12N gate driver product pages for more details.

The board includes two unassembled Infineon IMZC120R017M2H CoolSiC™ 1200 V SiC Trench MOSFETs in a TO247-4 package, as seen in Figure 1. These MOSFETs can be mounted on the board for testing or replaced with other compatible switches, such as Infineon IGBTs, CoolSiC™, or CoolMOS™ transistors with the same TO247-4 package. This flexibility allows users to evaluate various switches based on their specific application requirements.

The board has a size of 100 mm x 60 mm x 32 mm without any power switches assembled. Designed primarily for non-continuous evaluation, such as double-pulse testing (DPT), special consideration must be given to the current-carrying capabilities of the power tracks and proper cooling of the power switches if the board is used in continuous testing mode. Additionally, high-voltage bulk capacitors must be added at the high-voltage input terminal for double-pulse testing.

The board is designed to be compatible with the EVAL-DCLink-DPT board from the Infineon modular evaluation platform, which not only provides the necessary capacitance but also offers connection points to facilitate the setup of a double-pulse test. **Therefore, it is highly recommended to also include an EVAL-DCLink-DPT board in the initial order.**

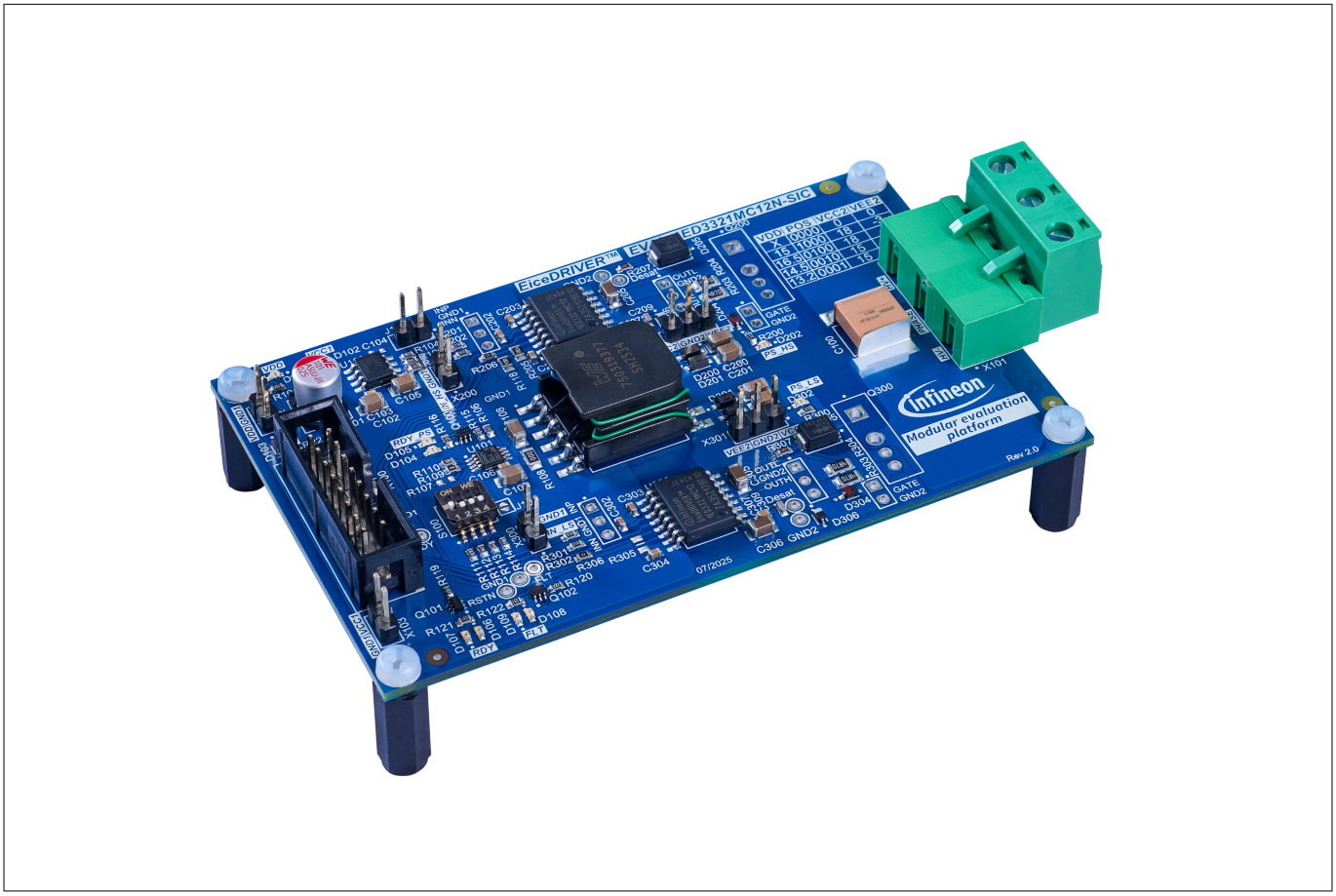


Figure 1 EVAL-1ED3321MC12N-SiC Evaluation Board

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1.1 Scope of supply

The delivery contains:

- The EVAL-1ED3321MC12N-SiC Evaluation Board
- Two IMZC120R017M2H CoolSiC™ 1200 V SiC Trench MOSFETs for assembly
- High-voltage PCB connector (plugged on high-voltage PCB terminal header)

1.2 Block diagram

Figure 2 shows the block diagram of the EVAL-1ED3321MC12N-SiC Evaluation Board.

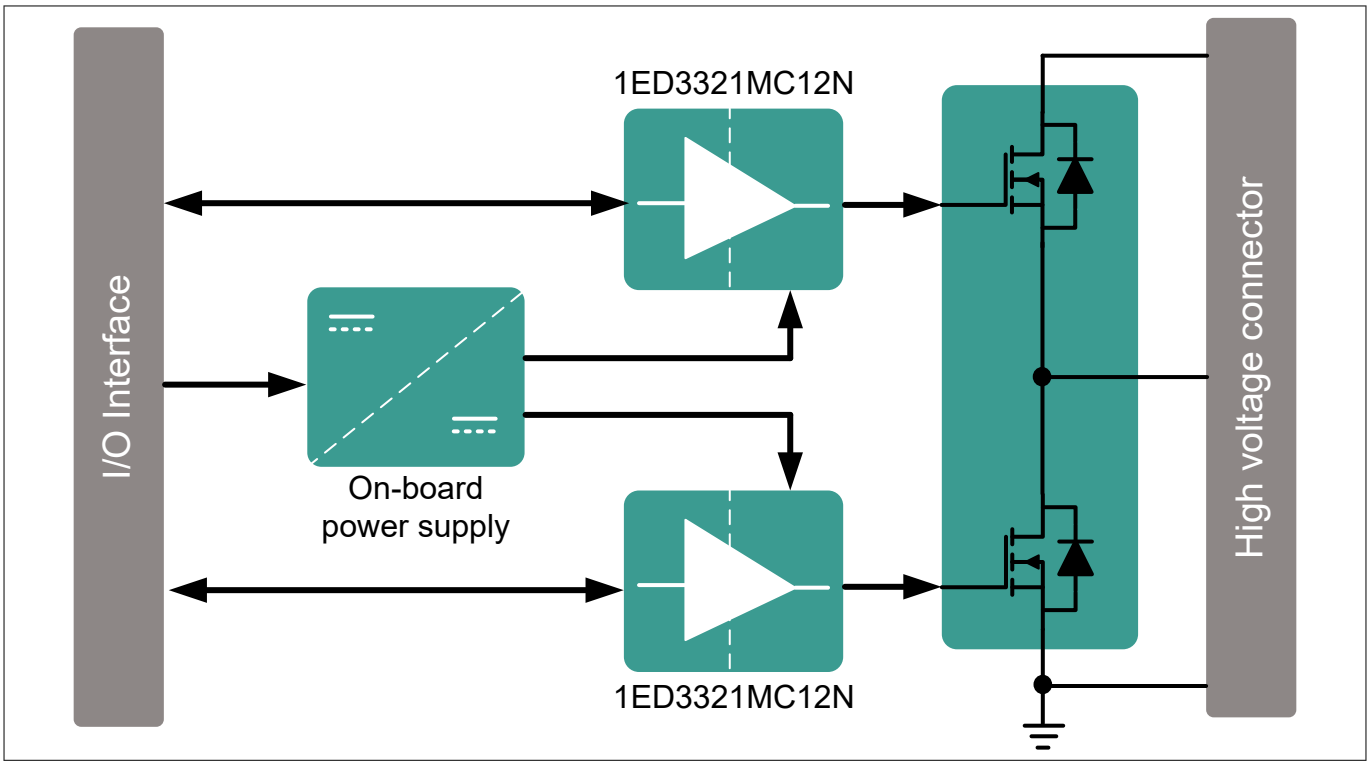


Figure 2 EVAL-1ED3321MC12N-SiC block diagram

1.3 Main features

The EVAL-1ED3321MC12N-SiC is an evaluation board for the 1ED3321MC12N gate driver ICs. It is built in a half-bridge configuration with a maximum DC-link voltage of 900 V. It is optimized for easy measurement and flexible adjustment of the gate driving components and the protection features.

The main features of the evaluation board are:

- Infineon IMZC120R017M2H CoolSiC™ 1200 V SiC Trench MOSFETs in TO247-4 (unassembled) in a half-bridge configuration
- PCB layout designed to ensure optimal switching performance of the half-bridge
- Built-in configurable on-board isolated power supply for the gate driver output side, easily adjustable to generate typical bipolar driving voltages
- Built-in power supply for gate driver input side, easily configurable to generate 3.3 V or 5 V
- Fast short circuit protection and feedback
- UVLO for all the gate driver supply voltages
- Interlocked PWM inputs for shoot-through protection
- Test points for monitoring critical signals

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The main features of the gate driver 1ED3321MC12N IC are:

- Single channel galvanically isolated coreless transformer (CT) gate driver
- Pure-PMOS sourcing stage for optimal turn-on efficiency
- Up to +6 A/ -8.5 A typical peak output current
- Separate source and sink outputs
- Integrated protection features, such as short-circuit protection (DESAT), soft-off fault turn-off, active Miller clamp driver, and active shutdown
- 40 V absolute maximum output supply voltage
- 85 ns short propagation delay (typ.) and tight IC-to-IC propagation delay matching
- High common-mode transient immunity CMTI > 300 kV/µs
- DSO-16 wide body package with 8 mm creepage for optimal PCB footprint
- Gate driver safety certification:
  - UL 1577 with $V_{ISO,test}$ = 6840 V (rms) for 1 s, V_{ISO} = 5700 V (rms) for 60 s
  - Reinforced isolation as per IEC 60747-17 with V_{IORM} = 1767 V

The on-board isolated power supply is designed with the 2EP130R transformer driver IC. The main features of 2EP130R IC are:

- Wide input voltage range 4.5 V to 20 V
- Wide range of switching frequency from 50 kHz to 695 kHz
- High accuracy duty cycle adjustment from 10% to 50%
- Peak-current controlled soft-start
- Over-current and over-temperature protection
- Ready signal to indicate successful completion of soft-start

1.4 Board parameters and technical data

Table 2 Absolute maximum ratings

Parameter/pin	Symbol	Conditions/notes	Value			Unit
			Min.	Typ.	Max.	
Diode protected board input voltage	*VDD*	Referenced to *GND1*	-0.3	-	18	V
Input-side supply voltage	*VCC1*	Referenced to *GND1*	-0.3	-	6.5	V
Non-inverting PWM input for low-side gate driver	*IN_LS*	Referenced to *GND1*	-0.3	-	-	6.5 V
Non-inverting PWM input for high-side gate driver	*IN_HS*	Referenced to *GND1*	-0.3	-	6.5	V
Ready output of the gate drivers	*RDY*	Referenced to *GND1*	-0.3	-	6.5	V
Reset input for the gate drivers	*RSTN*	Referenced to *GND1*	-0.3	-	6.5	V
Fault output of the gate drivers	*FLTN*	Referenced to *GND1*	-0.3	-	6.5	V
Ready output of the power supply	*RDY PSU*	Referenced to *GND1*	-0.3	-	6.5	V

(table continues...)

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Table 2 (continued) Absolute maximum ratings

Parameter/pin	Symbol	Conditions/notes	Value			Unit
			Min.	Typ.	Max.	
Clock signal for bypass mode of power supply	*PWM PSU*	Referenced to *GND1*	-0.3	-	6.5	V
DC link voltage	*HV+*	Referenced to *HV-* power terminal. Limited by component ratings and design clearances. For voltages above 60 V, special safety measures should be taken	-0.2	-	900	V
Half-bridge midpoint connection	*PHASE*	Midpoint connection for the half-bridge. Referenced to *HV-* power terminal	-0.2	-	900	V
Output-side positive supply voltage for high-side gate driver	*VCC2H*	Referenced to high-side *GND2* . To be used only when on-board power supply is deactivated	-0.3	-	35	V
Output-side positive supply voltage for low-side gate driver	*VCC2L*	Referenced to low-side *GND2* . To be used only when on-board power supply is deactivated	-0.3	-	35	V
Output-side negative supply voltages for high-side gate driver	*VEE2H*	Referenced to high-side *GND2* . To be used only when on-board power supply is deactivated	-35	-	0.3	V
Output-side negative supply voltages for low-side gate driver	*VEE2L*	Referenced to low-side *GND2* . To be used only when on-board power supply is deactivated	-35	-	0.3	V
Output-side differential supply voltage for high-side gate driver	*VCC2H*	Referenced to high-side *VEE2* . To be used only when on-board power supply is deactivated	-0.3	-	35	V
Output-side differential supply voltage for low-side gate driver	*VCC2L*	Referenced to low-side *VEE2* . To be used only when on-board power supply is deactivated	-0.3	-	35	V

Table 3 Recommended operating conditions

Parameter/pin	Symbol	Conditions/notes	Value			Unit
			Min.	Typ.	Max.	
Diode protected board input voltage	*VDD*	Referenced to *GND1*	13	15.1	17	V
Input-side supply voltage	*VCC1*	Referenced to *GND1*	3	3.3	5.5	V
Non-inverting PWM input for low-side gate driver	*IN_LS*	Referenced to *GND1*	-0.1	V_{VCC1}	V_{VCC1}+0.1	V
Non-inverting PWM input for high-side gate driver	*IN_HS*	Referenced to *GND1*	-0.1	V_{VCC1}	V_{VCC1}+0.1	V
Reset input for the gate drivers	*RSTN*	Referenced to *GND1*	-0.1	V_{VCC1}	V_{VCC1}+0.1	V
Fault output of the gate drivers	*FLTN*	Referenced to *GND1*	-0.1	V_{VCC1}	V_{VCC1}+0.1	V
DC link voltage	*HV+*	Referenced to *HV-* power terminal.	0	-	800	V

(table continues...)

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Table 3 (continued) Recommended operating conditions

Parameter/pin	Symbol	Conditions/notes	Value			Unit
			Min.	Typ.	Max.	
Half-bridge midpoint connection	*PHASE*	Midpoint connection for the half-bridge. Referenced to *HV*-power terminal	0	-	800	V
Output-side positive supply voltage for high-side gate driver	*VCC2H*	Referenced to high-side *GND2* . To be used only when on-board power supply is deactivated	15	-	18	V
Output-side positive supply voltage for low-side gate driver	*VCC2L*	Referenced to low-side *GND2* . To be used only when on-board power supply is deactivated	15	-	18	V
Output-side negative supply voltages for high-side gate driver	*VEE2H*	Referenced to high-side *GND2* . To be used only when on-board power supply is deactivated	-5	-	-3	V
Output-side negative supply voltages for low-side gate driver	*VEE2L*	Referenced to low-side *GND2* . To be used only when on-board power supply is deactivated	-5	-	-3	V

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2 System and functional description

2.1 Getting started

EVAL-1ED3321MC12N-SiC is designed for convenient testing of the gate driver functionality and switching performance of the gate driver and power transistor in a half-bridge configuration. All the necessary supply voltages required to power the gate driver, including both input-side and output-side voltages, are generated directly on the board. This eliminates the need for multiple external power supplies and reduces setup complexity, allowing users to focus on evaluation and testing.

The board is designed to support both 5 V and 3.3 V for the gate driver input-side supply voltage *VCC1*, featuring a built-in linear power supply circuit to generate the required input voltage. It is important to note that the threshold values for the primary-side input signals are ratiometric, scaling with the *VCC1* supply voltage.

For the output-side supply voltages of the high-side and low-side gate drivers, it is recommended to use the on-board isolated power supply. This configurable power supply is designed to generate the bipolar supply voltages typically used to drive SiC MOSFETs. The output of the on-board power supply can be configured using the DIP switch S100 position and by adjusting the board input voltage, *VDD*.

2.1.1 Prerequisites

- The EVAL-DCLink-DPT decoupling board or alternatively any other external high-voltage decoupling capacitor (>60 µF) connected across the high-voltage power terminals: X101 (*HV+*) and X101 (*HV-*)
- A low-voltage power supply for supplying the input voltage of the board, capable of supplying up to 20 V and 500 mA: X102 (*VDD*) and X102 (*GND1*)
- Suitable pulse generator for double-pulse pattern generation
- High-voltage power supply for supplying the power stage via the EVAL-DCLink-DPT terminal or: X101 (*HV+*) and X101 (*HV-*)
- A suitable inductive load for double-pulse testing

2.1.2 Integration with the Infineon modular evaluation platform

This board is designed to be part of the Infineon modular evaluation platform. Although the evaluation board, EVAL-1ED3321MC12N-SiC is equipped with a small DC link capacitance for high frequency-decoupling, additional bulk capacitance is required for testing high currents in the DPT. In order to enable convenient evaluation, the DC link board EVAL-DCLink-DPT, from the Infineon modular evaluation platform can be used.

The EVAL-DCLink-DPT board is specifically designed to complement the EVAL-1ED3321MC12N-SiC, enabling faster and easier evaluation by providing the necessary capacitance and seamless integration between the two boards. In addition to supplying the required capacitance, the EVAL-DCLink-DPT board also offers dedicated connection points to facilitate the setup of a double-pulse test. The Figure 3 shows the EVAL-DCLink-DPT board. A brief description of the connectors on the EVAL-DCLink-DPT is provided for a quick start. It is strongly recommended to refer to the user guide to become familiar with the DC link board's functionality. To integrate with the EVAL-DCLink-DPT, unplug the connector from the high-voltage PCB terminal, X101 of EVAL-1ED3321MC12N-SiC and connect the two boards together.

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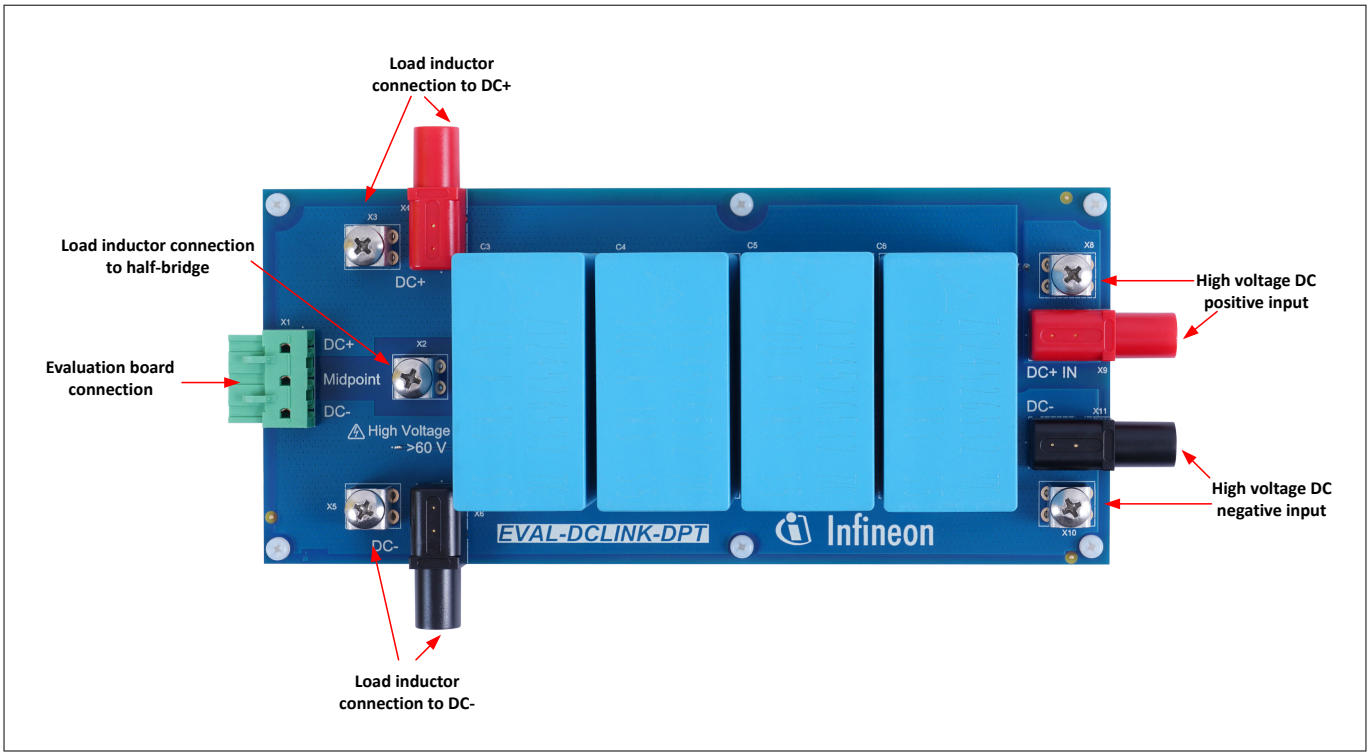


Figure 3 EVAL-DCLink-DPT

2.1.3 Power-up sequence

1. Mount the unassembled IMZC120R017M2H SiC MOSFETs or any other switches with the same package on the EVAL-1ED3321MC12N-SiC board
2. Connect the double-pulse signal generator to the input pins of the board. For evaluating the low-side switching capability, connect the signal generator to the connector X300 (*IN_LS*) and X300 (*GND1*) and short the pins on the connector X200 (*IN_HS*) and X200 (*GND1*). For evaluation of the high-side switching capability, connect the signal generator to X200 (*IN_HS*) and X200 (*GND1*) and short X300 (*IN_LS*) to X300 (*GND1*)
3. High-voltage power supply and load connections:
   a. When used with the optional EVAL-DCLink-DPT board, the high voltage power supply and the load should be connected on the DC link board. For more information, please refer the user guide of the DC link board
   b. When used as stand-alone, connect one end of the inductive load to terminal X101 (*PHASE*) and the other end, depending on the double-pulse test requirements, to either X101 (*HV+*) for the low-side testing or X101 (*HV-*) for the high-side testing. Connect the high-voltage power supply to the X101 (*HV+*) terminal and the power ground to the X101 (*HV-*) terminal
4. Connect the low-voltage input supply for the board, *VDD* at the connector X102, and configure the four pole DIP switch, S100 based on the required gate driver supply voltages. The gate driver output-side power supply voltages can be configured as:

Table 4 Gate driver output-side supply voltage selection

***VDD* [V]**	**DIP switch configuration**	***VCC2* [V]**	***VEE2* [V]**
X	0000 (Deactivated)	0	0

(table continues...)

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Table 4 (continued) Gate driver output-side supply voltage selection

VDD [V]	DIP switch configuration	*VCC2* [V]	*VEE2* [V]
15.1	1000	18	-3
16.5	0100	18	-5
14.5	0010	15	-5
13.2	0001	15	-3

***Note**: The DIP switch configuration 1 implies the pole is in the ON position.*

5. If the gate drivers are to be supplied with external voltages, deactivate the on-board power supply using the DIP switch configuration explained in the previous step and supply the external voltages for the high-side gate driver on connector X201 and the low-side gate driver on the connector X301. Note that the supply voltages for the high-side and the low-side gate drivers should be functionally isolated from each other
6. The internally generated *VCC1* supply can be tailored for different signal and supply voltages by the jumper J100. The default configuration (jumper open) sets *VCC1* to 3.3 V. This can be changed to 5 V by bridging the jumper J100
7. After the board is powered up, the following green LEDs will turn on indicating that the board is ready for operation:

Table 5

LED	Symbol	Indication
D101	*VDD*	Board input-side supply voltage available
D102	*VCC1*	Gate drivers input-side supply voltage available
D202	*PS_HS*	High-side gate driver output-side supply voltage available
D302	*PS_LS*	Low-side gate driver output-side supply voltage available
D104	*RDY_PS*	On-board isolated power supply ready
D106	*RDY*	Gate drivers ready for operation
D108	*FLT*	No DESAT fault in the system

8. The board is now fully configured and ready for double-pulse evaluation

2.2 Sample measurement results

The switches IMZC120R017M2H are assembled on the EVAL-1ED3321MC12N-SiC board which is connected to the DC link board, EVAL-DCLink-DPT. The gate drivers are supplied with the on-board power supply as described in Chapter 2.1.3.

2.2.1 Startup behavior

The board is powered up with the gate drivers in a non-switching state.

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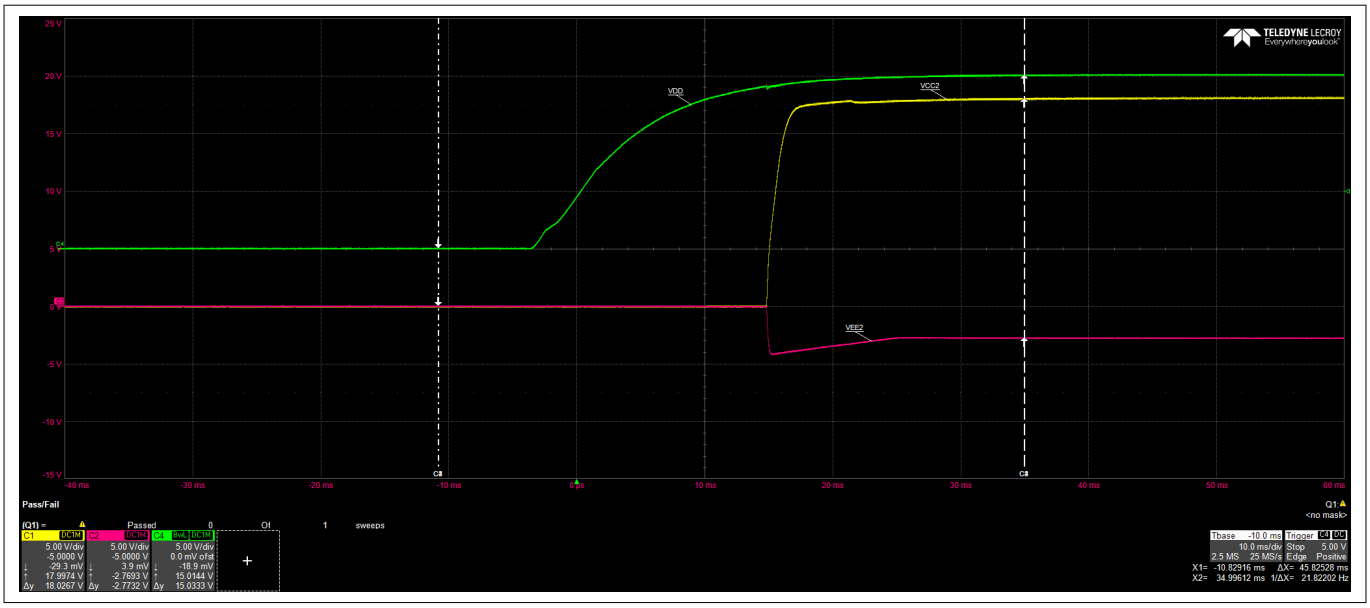


Figure 4 **EVAL-1ED3321MC12N-SiC – Gate driver output-side supply voltages startup**

Table 6 **Measurement signals and scaling**

Channel	Color	Signal	Vertical scale	Horizontal scale
Channel 1	Yellow	V_{VCC2_LS} - V_{GND2_LS}	5 V/div	10 ms/div
Channel 2	Red	V_{VEE2_LS} - V_{GND2_LS}	5 V/div	10 ms/div
Channel 4	Green	*VDD*	5 V/div	10 ms/div

Figure 4 shows the ramp-up of the output-side supply voltages of the low-side gate driver at startup. The positive supply voltage and the negative supply voltage reach 18 V and -2.8 V, respectively after the soft-start.

2.2.2 Double-pulse test

On this evaluation board, the double pulse test is conducted on the low-side switch to evaluate its switching performance and the gate driver's control functionality. The EVAL-DCLink-DPT board is connected to EVAL-1ED3321MC12N-SiC board to provide the bulk capacitance for the testing. The on-board isolated power supply is configured to provide +18 V and -3 V for the output side of the gate drivers. A 201 µH inductor is connected between the terminals X4 (*DC+*) and X2 (*Midpoint)* on the EVAL-DCLink-DPT board to act as the load. During the test, an 800 V DC voltage is applied across the power terminals X9 (*DC+IN*) and the X9 (*DC-*) of the EVAL-DCLink-DPT board. This voltage appears across the X101 (*HV+*) and X101 (*HV-*) terminals. The block diagram of the measurement setup is shown in Figure 5.

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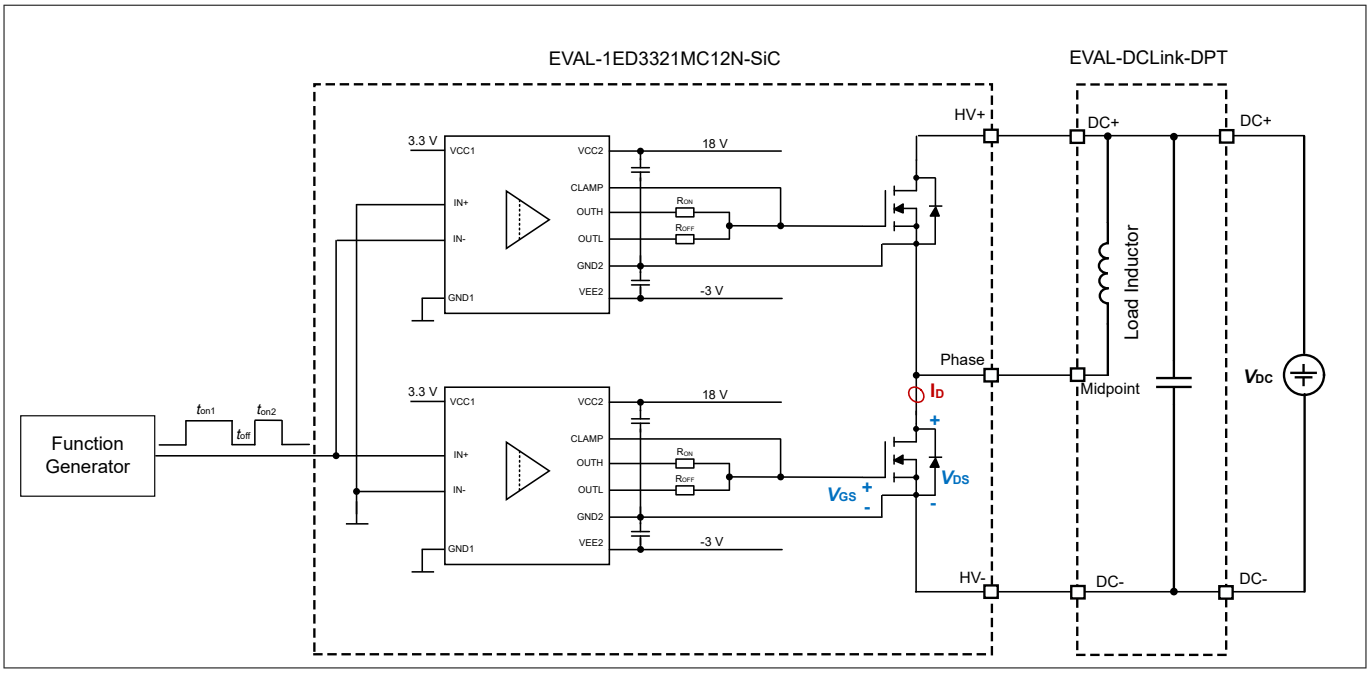


Figure 5 Measurement setup for the double-pulse test

Figure 6, Figure 7, and Figure 8 show the results of the double-pulse test on the EVAL-1ED3321MC12N-SiC board. During the test, the sequence of events is as follows:

1. When the first pulse is applied, the low-side switch turns on, causing the DC voltage to be applied across the load inductor, which leads to a steady ramp-up of the inductor current
2. By the end of the first pulse, the low-side switch reaches the test current level and it is turned off. For this measurement, a test current of 100 A is chosen
3. After the turn-off of the low-side switch, the inductor current commutates to the body diode of the high-side switch, allowing the current to continue freewheeling through the circuit
4. When the low-side switch turns on again, the inductor current commutates from the body diode of the high-side switch back to the low-side switch, enabling the current to continue its natural ramp-up due to the applied DC voltage. At turn-on, the current in the low-side switch is close to the test level of 100 A as a result of the freewheeling process

Therefore, the double-pulse test enables the characterization of the switch's turn-on and turn-off behavior and allows for the evaluation of the gate driver's ability to control high-current switching events.

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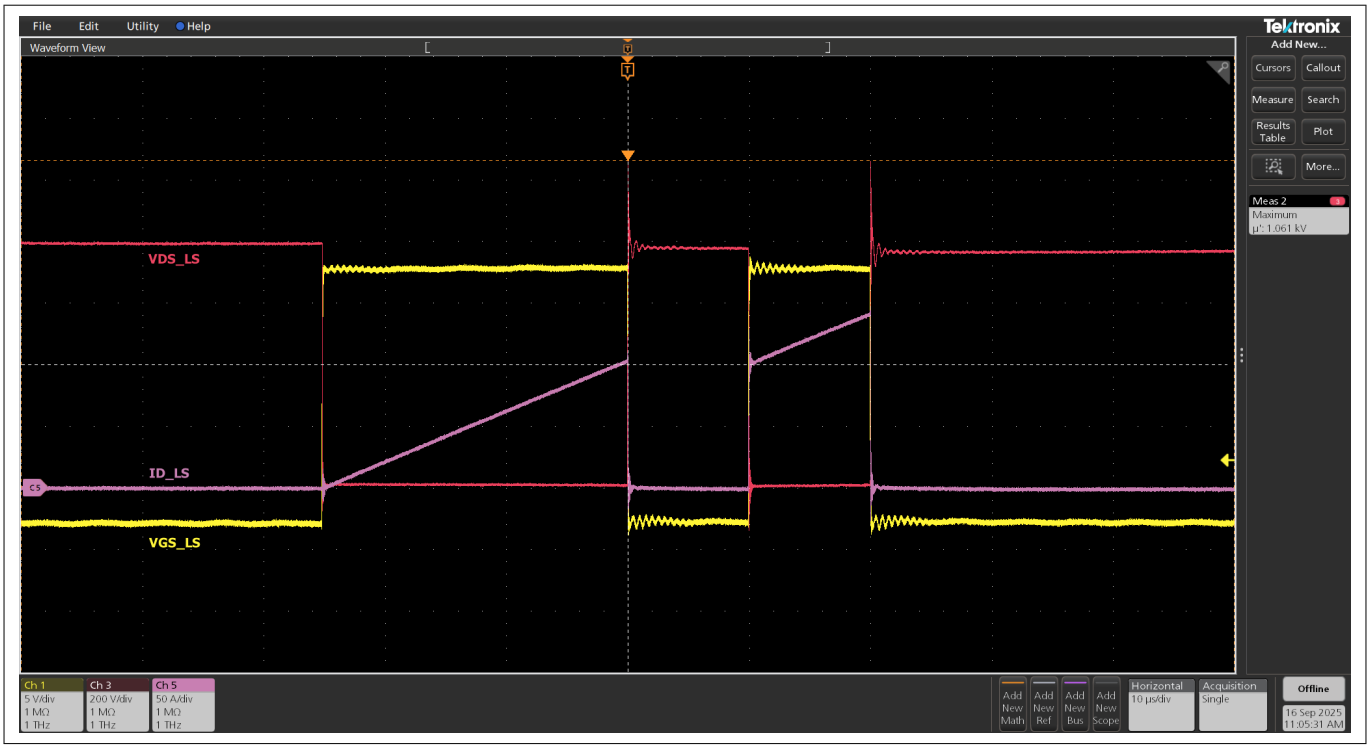


Figure 6 **EVAL-1ED3321MC12N-SiC– Double-pulse test of the low-side switch**

Table 10 **Measurement signals and scaling**

Channel	Color	Signal	Vertical scale	Horizontal scale
Channel 1	Yellow	V_{GS_LS}	5 V/div	10 µs/div
Channel 3	Red	V_{DS_LS}	200 V/div	10 µs/div
Channel 5	Magenta	I_{D_LS}	50 A/div	10 µs/div

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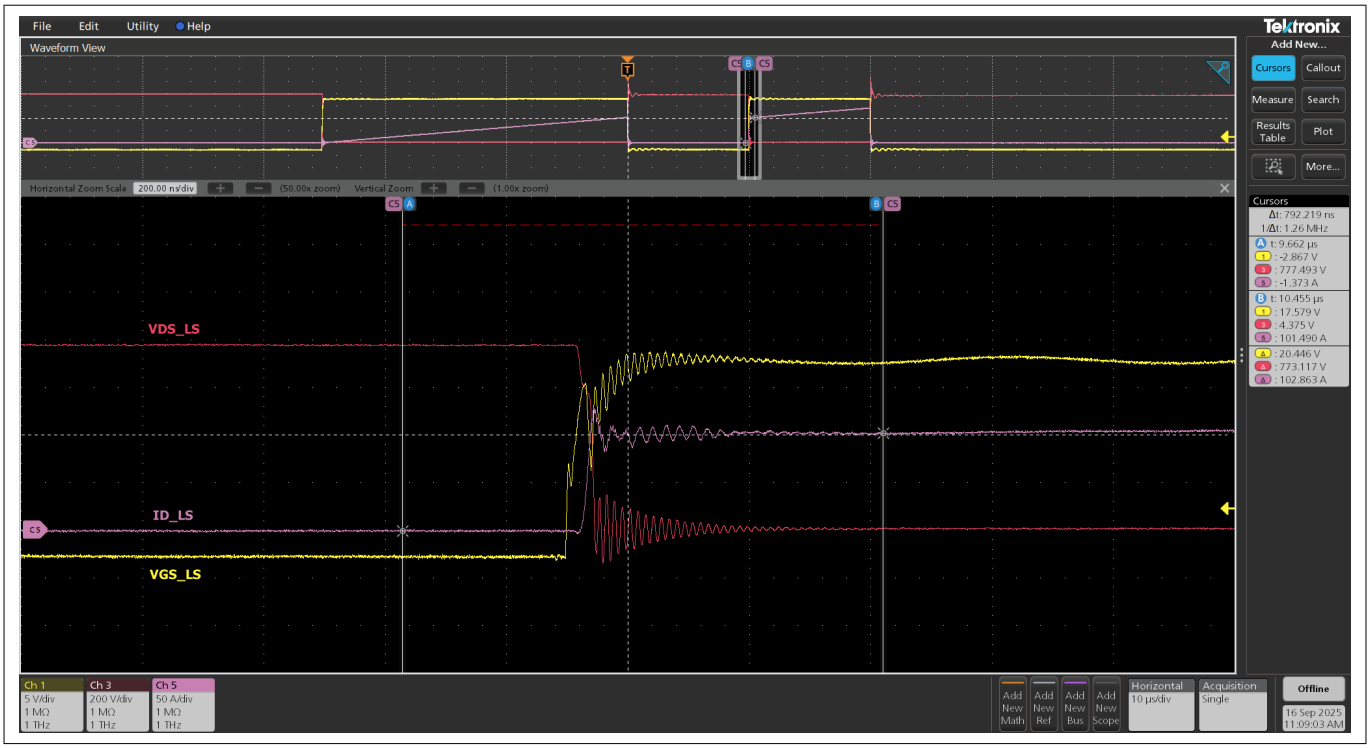


Figure 7 **EVAL-1ED3321MC12N-SiC– Turn-on of the low-side switch**

Table 11 **Measurement signals and scaling**

Channel	Color	Signal	Vertical scale	Horizontal scale
Channel 1	Yellow	V_{GS_LS}	5 V/div	200 ns/div
Channel 3	Red	V_{DS_LS}	200 V/div	200 ns/div
Channel 5	Magenta	I_{D_LS}	50 A/div	200 ns/div

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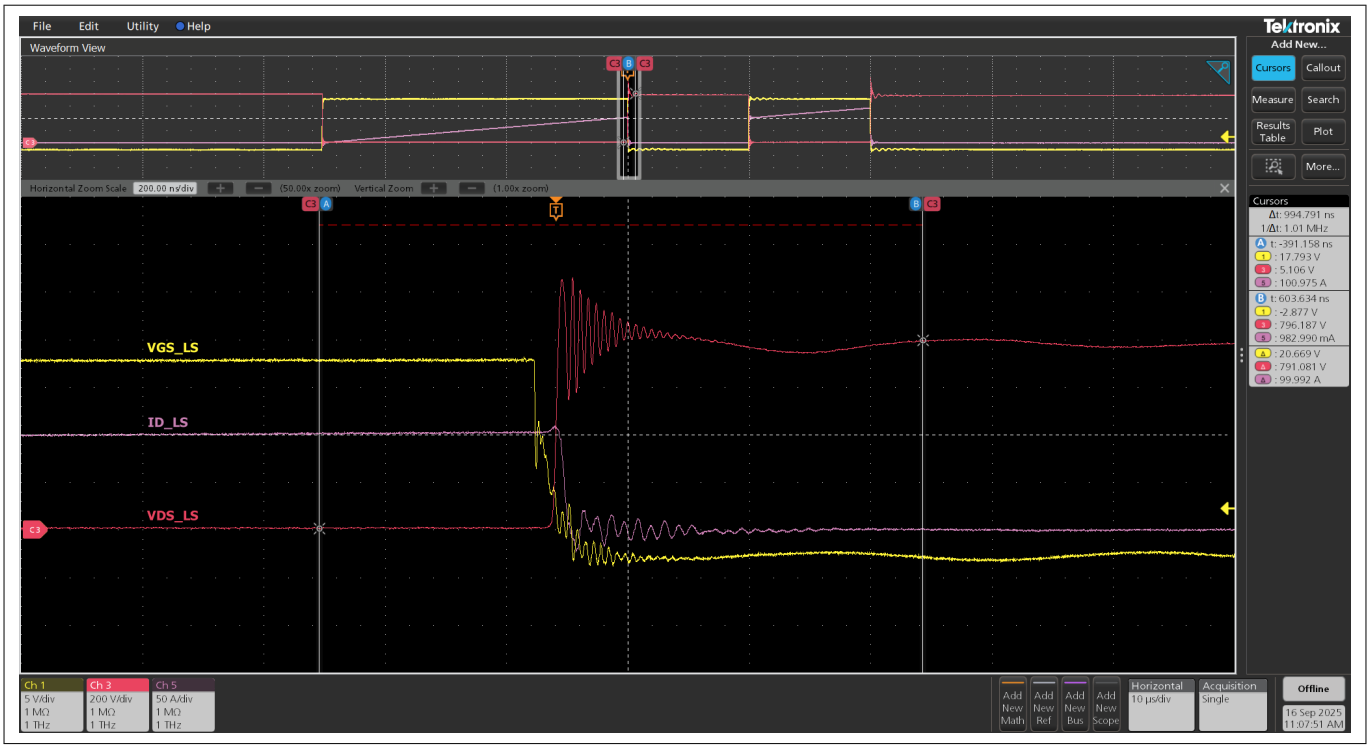


Figure 8 **EVAL-1ED3321MC12N-SiC– Turn-off of the low-side switch**

Table 12 **Measurement signals and scaling**

Channel	Color	Signal	Vertical scale	Horizontal scale
Channel 1	Yellow	V_{GS_LS}	5 V/div	200 ns/div
Channel 3	Red	V_{DS_LS}	200 V/div	200 ns/div
Channel 5	Magenta	I_{D_LS}	50 A/div	200 ns/div

2.2.3 Short circuit test

The type 1 short circuit test demonstrates the functionality and robustness of the gate driver, particularly its DESAT (desaturation) protection mechanism, which protects the switch during fault conditions. On the evaluation board, the type 1 short circuit test is conducted on the low-side switch. In this test, the on-board power supply is configured to generate 15 V and -5 V for the output side of the gate drivers. An 800 V DC voltage is applied to the power terminals of the EVAL-DCLink-DPT board. The short circuit condition on the high-side switch is simulated by directly shorting its drain and source terminals. Under this condition, the low-side switch is actively turned on to allow current to flow through the short circuit. This test replicates the severe electrical and thermal stresses encountered during a fault, allowing evaluation of the gate driver's ability to detect the short circuit and protect the power semiconductor device through DESAT protection.

Figure 9 shows the type 1 short circuit on EVAL-1ED3321MC12N-SiC. When the low-side switch turns on, the drain current through the MOSFET rises rapidly and the drain-to-source voltage falls. After the gate driver's leading-edge blanking time has elapsed, the gate driver's internal DESAT current source begins charging the DESAT capacitor. As the drain current continues to increase, it reaches its maximum value before leveling off due to the saturation of the MOSFET. With the increasing current, the MOSFET's drain-to-source voltage starts to rise again. This rise in the drain-to-source voltage (*dV/dt*) further contributes to the charging of the DESAT capacitor via the junction capacitance of the DESAT diode. Consequently, the voltage on the DESAT capacitor reaches the threshold value, triggering the gate driver's DESAT protection. The gate driver activates the DESAT protection by initiating a soft turn-off at the output. This ensures a controlled turn-off of the switch that

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minimizes the overshoot of the drain to source voltage caused by switching off the short circuit current. Finally, the gate driver latches into a fault state and the *FLTN* signal transitions to a LOW state, indicating the fault condition to the input side of the system.

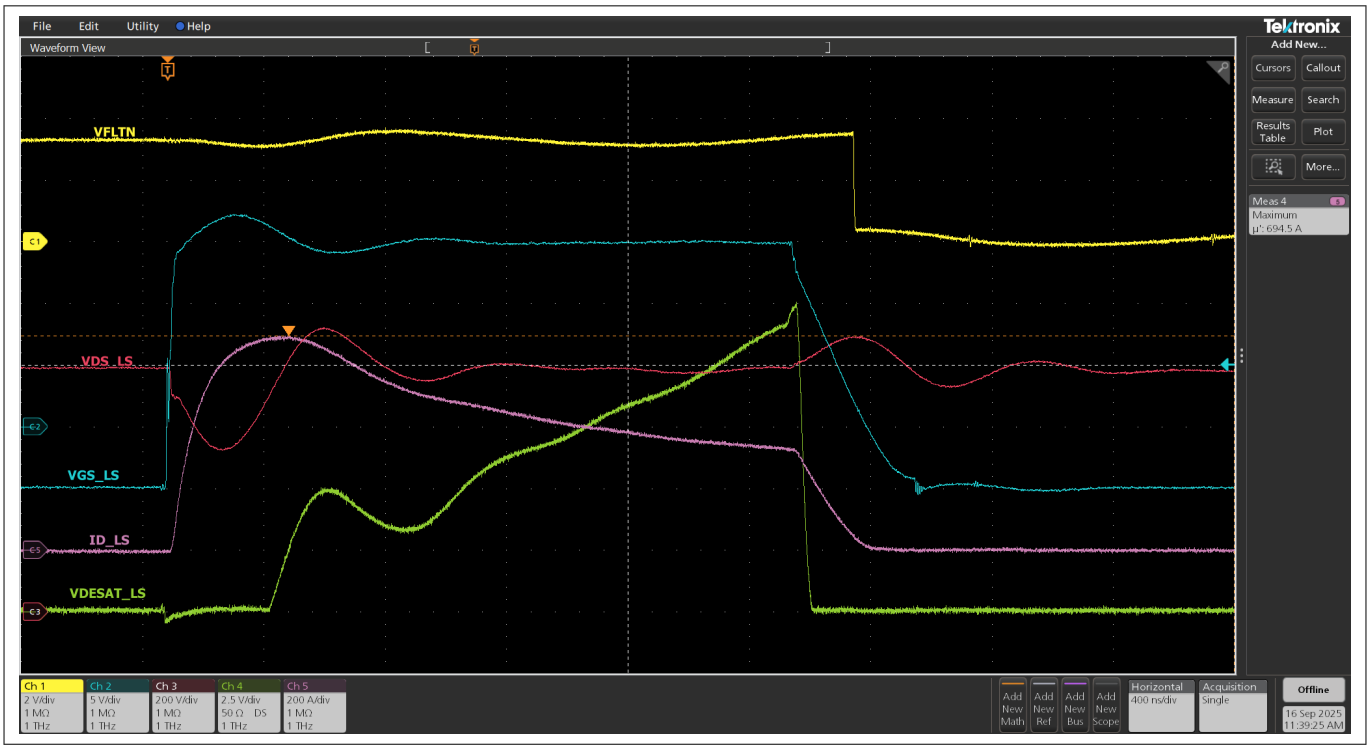


Figure 9 **EVAL-1ED3321MC12N-SiC– Type 1 short circuit test of the low-side switch**

Table 13 **Measurement signals and scaling**

Channel	Color	Signal	Vertical scale	Horizontal scale
Channel 1	Yellow	V_{FLTN}	2 V/div	400 ns/div
Channel 2	Blue	V_{GS_LS}	5 V/div	400 ns/div
Channel 3	Red	V_{DS_LS}	200 V/div	400 ns/div
Channel 4	Green	V_{DESAT_LS}	2.5 V/div	400 ns/div
Channel 5	Magenta	I_{D_LS}	200 A/div	400 ns/div

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3 System design

The EVAL-1ED3321MC12N-SiC Evaluation Board is designed to evaluate the 1ED3321MC12N gate driver IC. To assist the user in quickly getting started with the design, this section provides the schematic, PCB layout details and the bill of materials (BOM). Furthermore, the schematic, the gerber files, the BOM and the complete Altium Designer project files are available for download on the EVAL-1ED3321MC12N-SiC Evaluation Board's homepage for comprehensive design support.

3.1 Schematics

This section presents the schematics of the evaluation board.

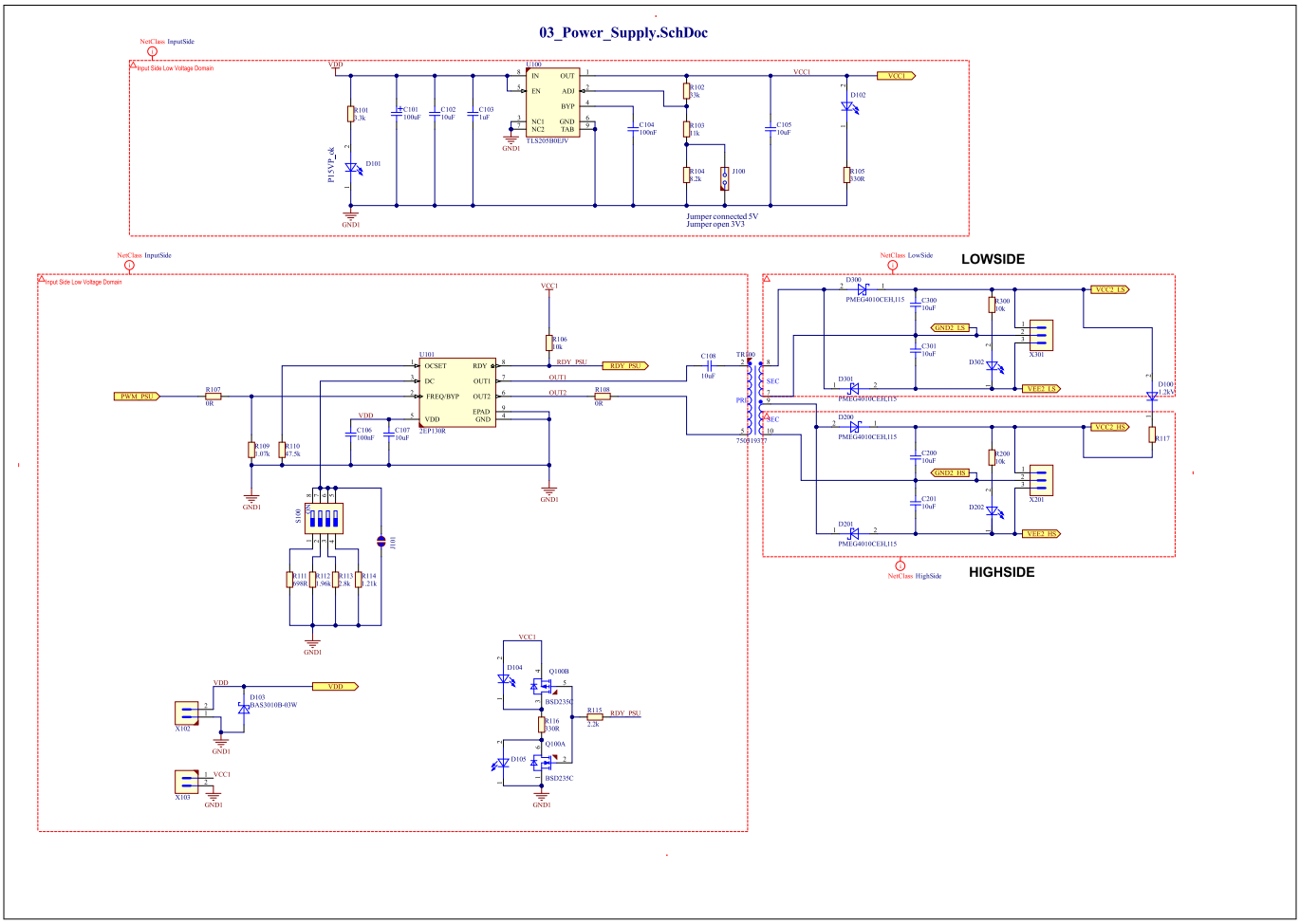


Figure 10 Power supply circuit schematic

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3 System design

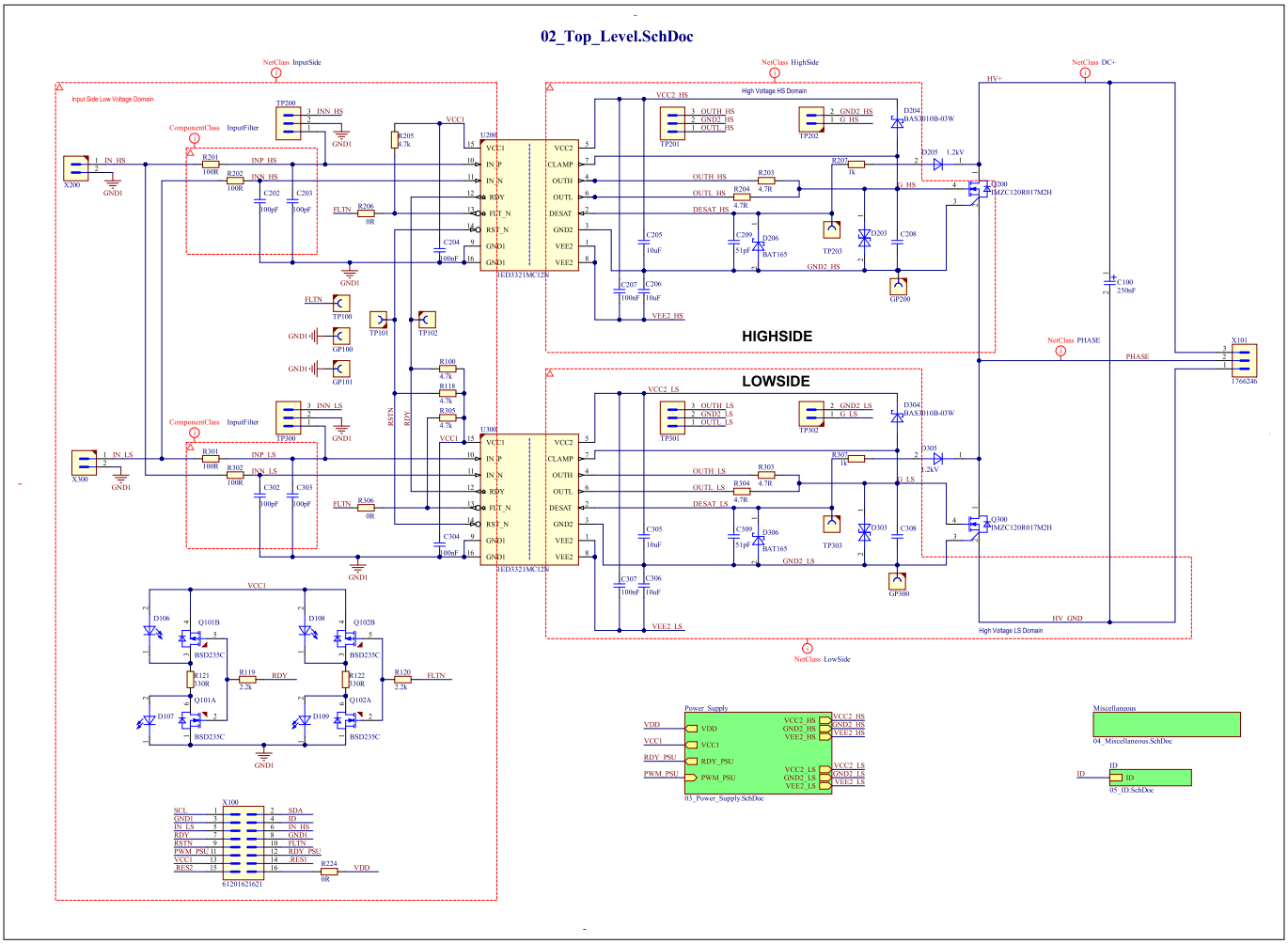


Figure 11 **Circuit schematic of the half-bridge featuring SiC MOSFETs and gate driver circuitry**

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3.2 Layout

The evaluation board EVAL-1ED3321MC12N-SiC is designed on a 4 layer PCB with 35 µm copper thickness. The top and the bottom view of the PCB layout as well as the copper layers of the PCB are shown below.

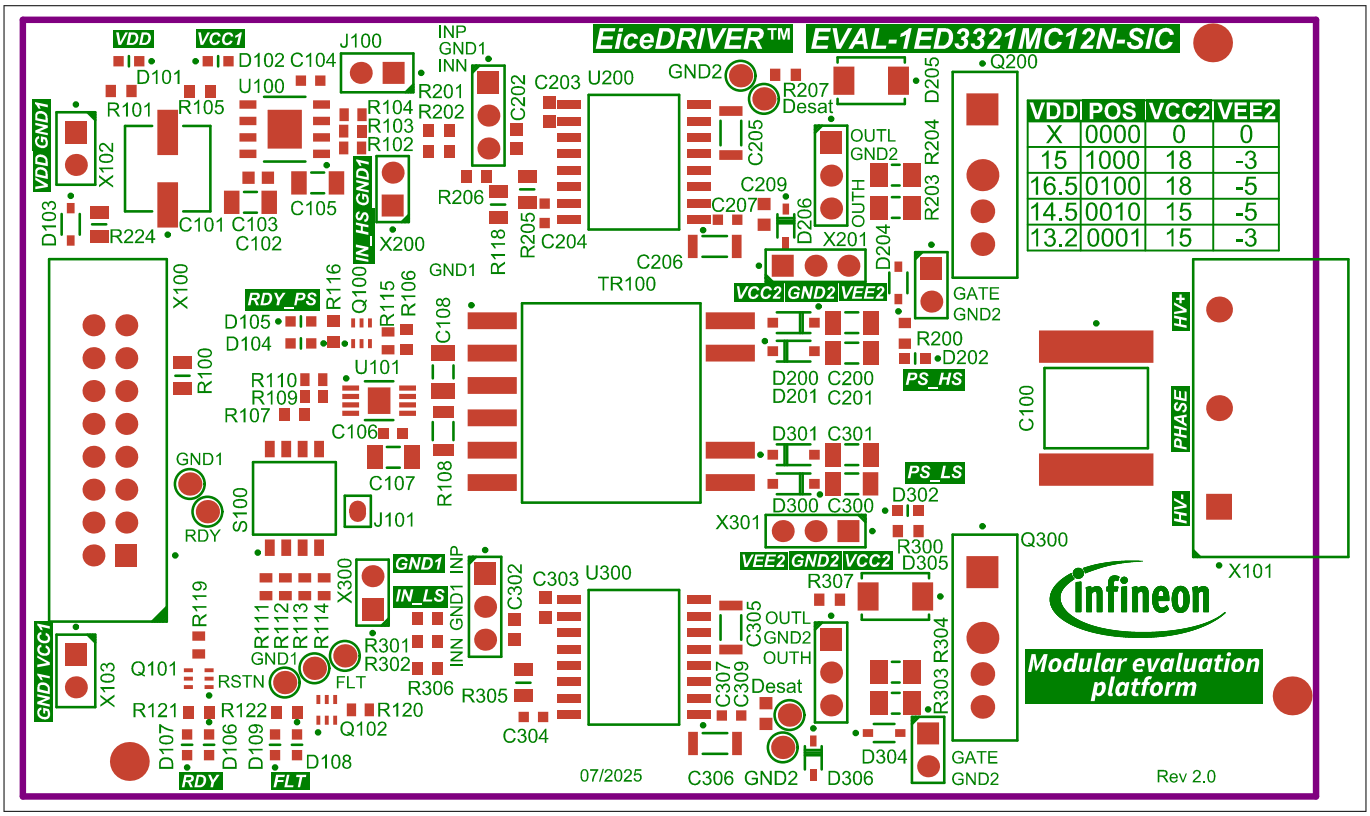


Figure 12 PCB top overlay

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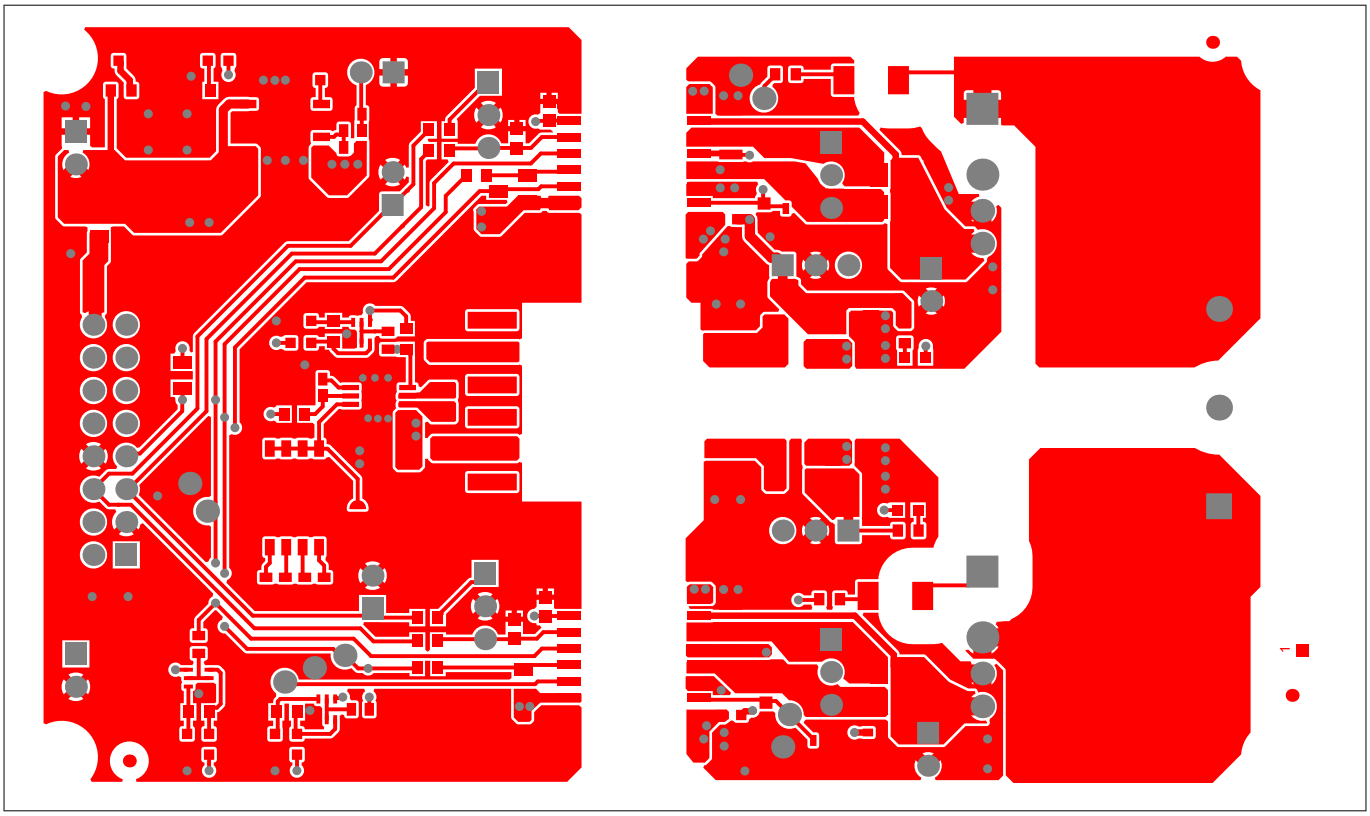


Figure 13 PCB top copper layer

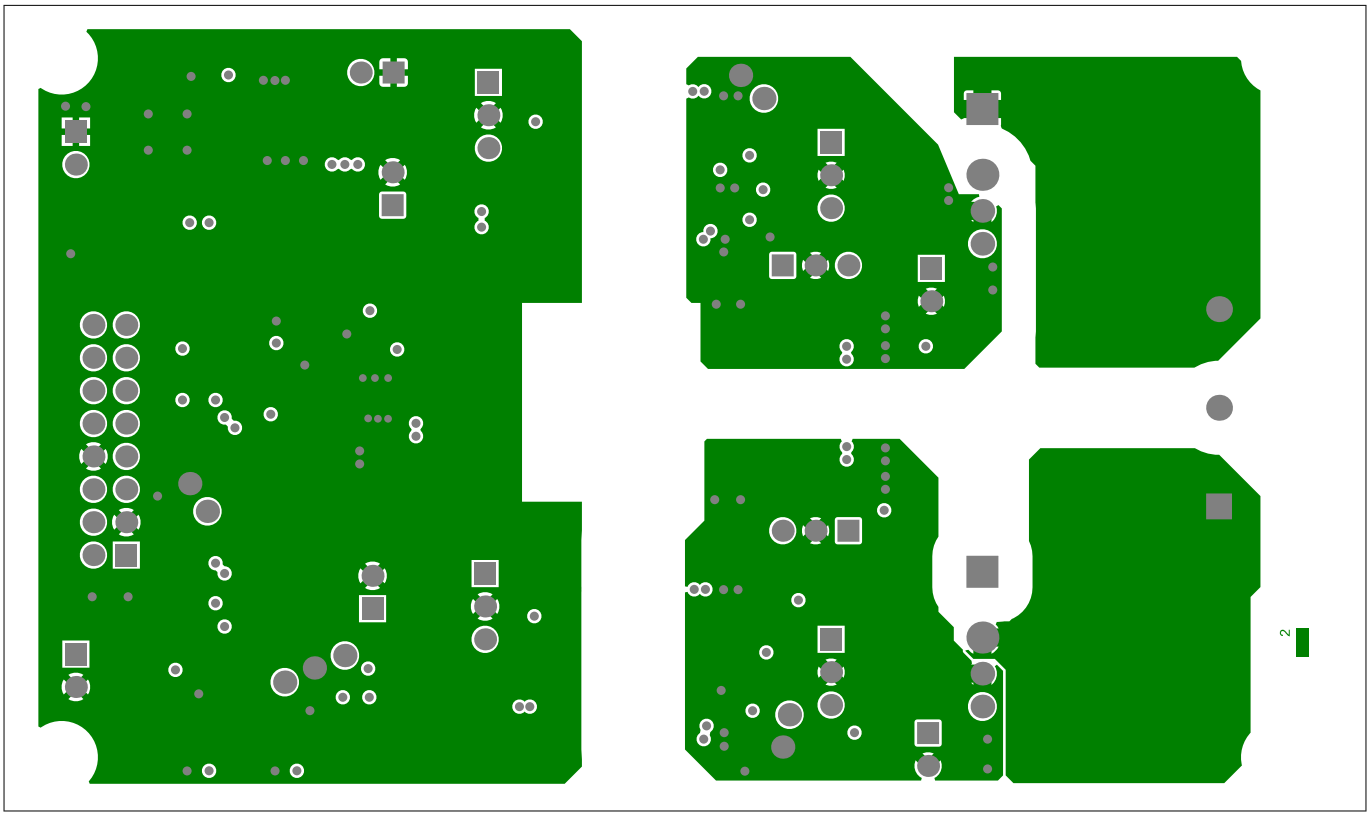


Figure 14 PCB inner copper layer 1

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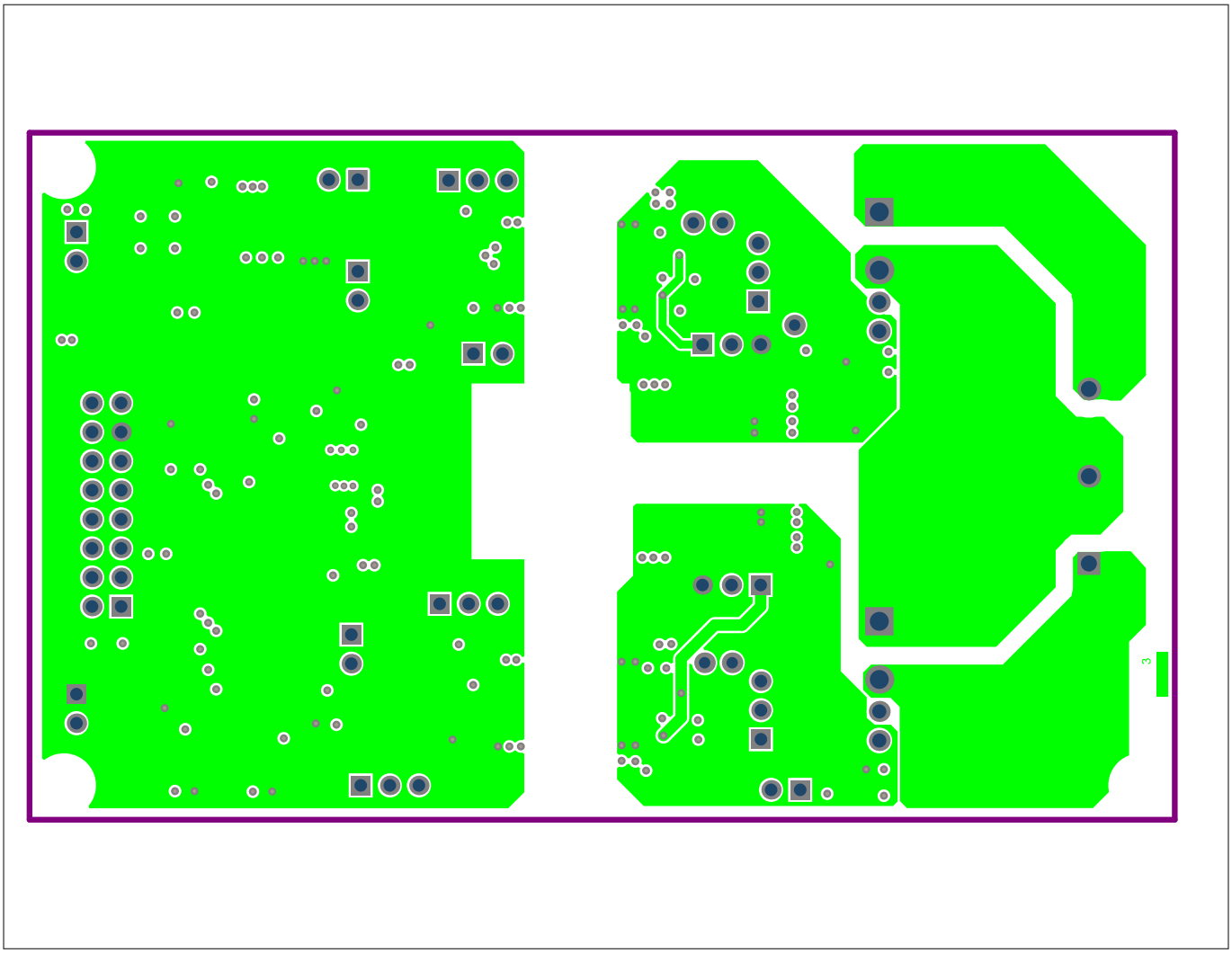


Figure 15 PCB inner copper layer 2

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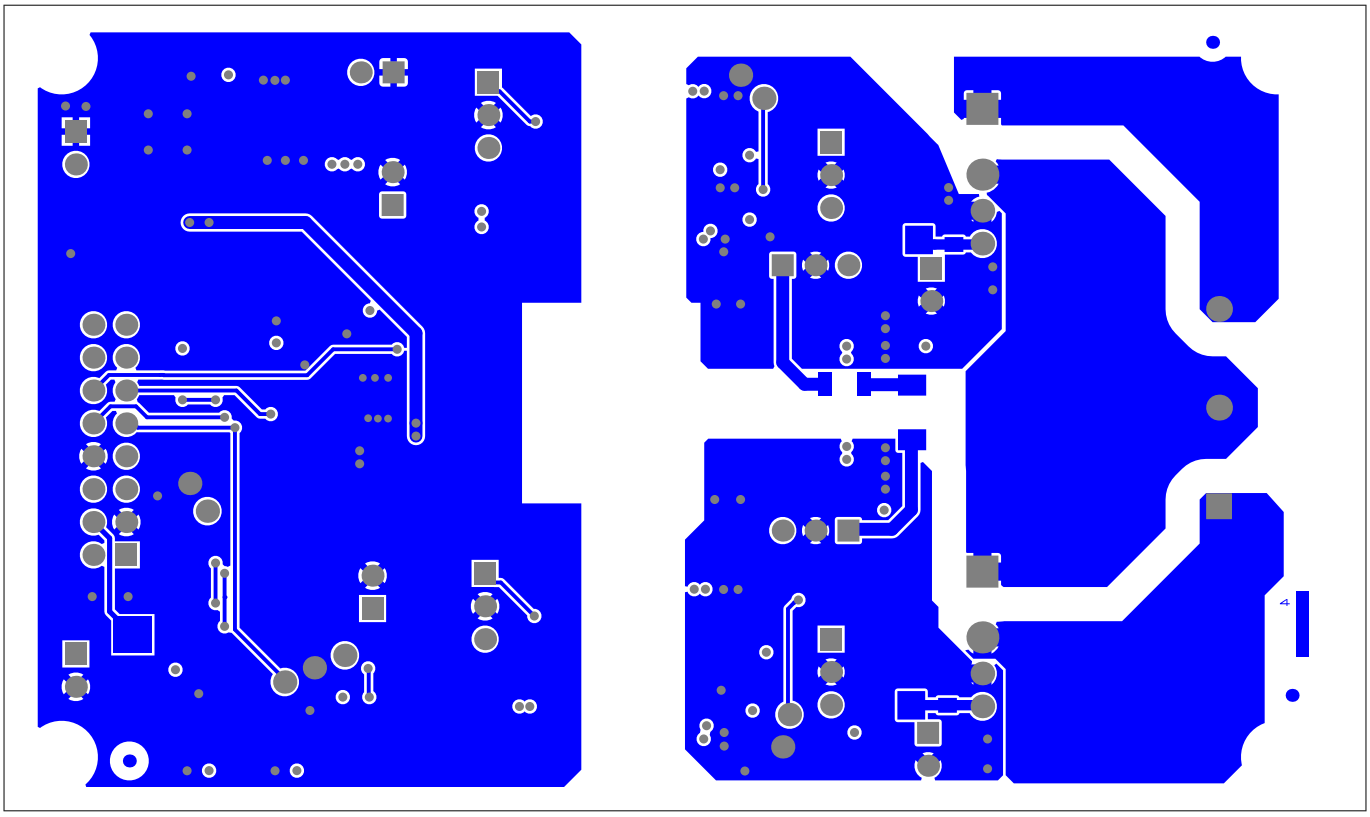


Figure 16 PCB bottom copper layer

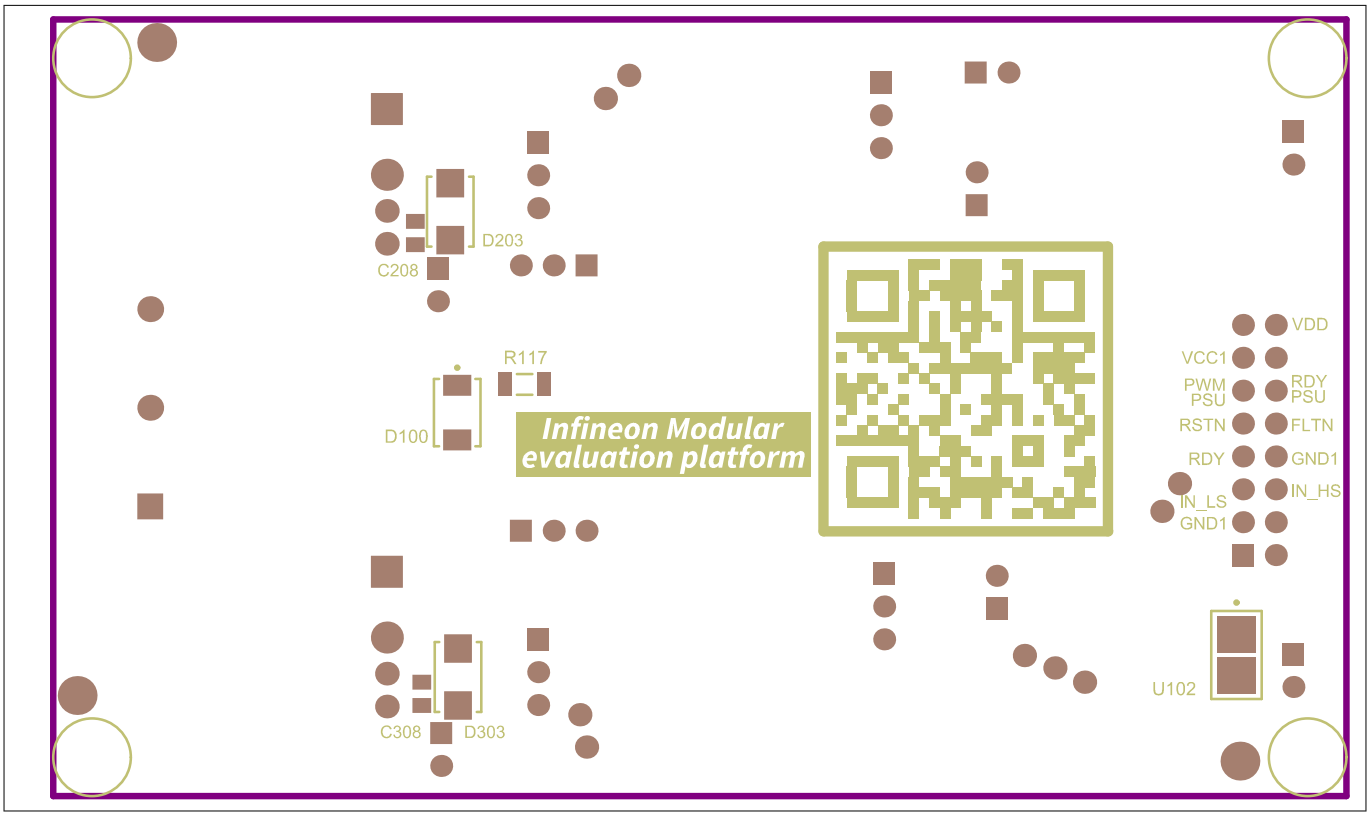


Figure 17 PCB bottom overlay(mirrored)

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3.3 Bill of materials

This chapter provides the bill of materials (BOM) table, detailing all components, part numbers and quantities required for the evaluation board.

Table 14 Bill of materials

Designator	Quantity	Description	Manufacturer	Manufacturer P/N
C100	1	Capacitor, 250nF	TDK Corporation	B58031I9254M062
C101	1	Capacitor, 100uF	Würth Elektronik	865090445008
C102, C105, C107, C108, C200, C201, C300, C301	8	Capacitor, 10uF, 1206 (3216)	Samsung	CL31B106KBHNNNE
C103	1	Capacitor, 1uF, 0603 (1608)	Würth Elektronik	885012106022
C106, C204, C207, C304, C307	5	Capacitor, 100nF, 0603 (1608)	Würth Elektronik	885012206095
C202, C203, C302, C303	4	Capacitor, 100pF, 0603 (1608)	Würth Elektronik	885012206053
C205, C206. C305, C306	4	Capacitor, 10uF, 1206(3216)	TDK Corporation	C3216X7R1H106K160AC
C209, C309	2	Capacitor, 51pF, 0603 (1608)	MuRata	GRM1885C1H510JA01
D101, D102, D104, D106, D108, D202, D302	7	Diode, Green/5V, SMD	Würth Elektronik	150060VS75000
D103, D204, D304	3	Diode, BAS3010B-03W, SOD323	Infineon Technologies	BAS3010B-03W
D105, D107, D109	3	Diode, Red/5V, 0603 (1608)	Würth Elektronik	150060RS75000
D200, D200, D300, D301	4	Diode, PMEG4010CEH,115, SOD123F	Nexperia	PMEG4010CEH,115
D205, D305	2	Diode, 1.2kV, SMB (DO-214AA)	STMicroelectronics	STTH112U
D206, D306	2	Medium Power AF Schottky Diode	Infineon Technologies	BAT165
J100, X102, X103	3	Header, 2.54mm Pitch, 2 pin, Vertical, Single Row	Würth Elektronik	61300211121
MP1, MP2, MP3, MP4	4	Screw, D00688	Duratool	D00688
MP5, MP6, MP7, MP8	4	Standoff, 970150365	Würth Elektronik	970150365
Q100, Q101, Q102	3	OptiMOS™ 2+OptiMOS™-P 2 Complementary P and N Channel Small Signal Transistor	Infineon Technologies	BSD235C
Q998, Q999	2	CoolSiC™ MOSFET, IMZC120R017M2H, PG-TO247-4-17	Infineon Technologies	IMZC120R017M2H
R100, R118, R205	3	Resistor, 4.7k, 0805 (2012)	Vishay	CRCW08054K70FK
R101	1	Resistor, 3.3k, 0603 (1608)	Yageo	RC0603FR-073K3L

(table continues...)

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Table 14 (continued) Bill of materials

Designator	Quantity	Description	Manufacturer	Manufacturer P/N
R102	1	Resistor, 33k, 0603 (1608)	Vishay	CRCW060333K0FK
R103	1	Resistor, 11k, 0603 (1608)	Vishay	CRCW060311K0FK
R104	1	Resistor, 8.2k, 0603 (1608)	Vishay	CRCW06038K20FK
R105, R116, R121, R122	4	Resistor, 330R, 0603 (1608)	Würth Elektronik	560112116020
R106, R200, R300	3	Resistor, 10k, 0603 (1608)	Yageo	RC0603JR-070RL
R108	1	Resistor, 0R, 1206 (3216)	Würth Elektronik	560112132007
R109	1	Resistor, 1.07k, 0603 (1608)	Vishay	CRCW06031K07FK
R110	1	Resistor, 47.5k, 0603 (1608)	Vishay	CRCW060347K5FK
R111	1	Resistor, 698R, 0603 (1608)	Vishay	CRCW0603698RFK
R112	1	Resistor, 1.96k, 0603 (1608)	Vishay	CRCW06031K96FK
R113	1	Resistor, 2.8k, 0603 (1608)	Vishay	CRCW06032K80FK
R114	1	Resistor, 1.21k, 0603 (1608)	Vishay	CRCW06031K21FK
R115, R119, R120	3	Resistor, 2.2k, 0603 (1608)	Vishay	CRCW06032K20FK
R201, R202, R301, R302	4	Resistor, 100R, 0603 (1608)	Würth Elektronik	560112116009
R203, R204, R303, R304	4	Resistor, 4.7R, 1206 (3216)	Vishay	RCS12064R70FKEA
R206, R306	2	Resistor, 0R, 0603 (1608)	Yageo	RC0603JR-070RL
R207, R307	2	Resistor, 1k, 0603 (1608)	Panasonic	ERJ-UP3J102V
R224	1	Resistor, 0R, 0805 (2012)	Keystone Electronics Corp.	5106
S100	1	DIP Switch, 416131160804, SMD	Würth Elektronik	416131160804
TR100	1	Transformer, 750319377, SMD	Würth Elektronik	750319377 R00
U100	1	Power Supply, TLS205B0EJV, PG-DSO-8-52	Infineon Technologies	TLS205B0EJV
U101	1	Full-bridge transformer driver, 2EP130R, PG-TSSOP-8-2	Infineon Technologies	2EP130R
U200, U300	2	Single-Channel Isolated Gate Driver IC with DESAT and Soft-off, 1ED3321MC12N, PG-DSO 16	Infineon Technologies	1ED3321MC12N
X100	1	WR BHD Male Box Header	Würth Elektronik	61201621621
X101	1	PCB Header, 7.62 mm Pitch, 3 Pin, Right Angle, 12A, 630V	Phoenix Contact	1766246
X200, X300	2	Through hole .025 SQ Post Header, 2.54mm pitch, 2 pin, vertical, single row	Samtec	HTSW-102-07-L-S
X201, X301	2	Through hole .025 SQ Post Header, 2.54mm pitch, 3 pin, vertical, single row	Samtec	HTSW-103-07-L-S

(table continues...)

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Table 14 (continued) Bill of materials

Designator	Quantity	Description	Manufacturer	Manufacturer P/N
X999	1	PCB Connector, Screw Connection with Tension Sleeve, 12A, 630V	Phoenix Contact	1767012

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3.4 Connectors

General information about the input and output connectors of the EVAL-1ED3321MC12N-SiC evaluation board is provided in this section.

This table shows the pinout of the input-side low-voltage connectors. It includes the connectors X102, X103, X100, X200, and X300.

Table 15 Input side connectors pinout

Connector	Pin	Symbol	Function
X102	1	*GND1*	Common ground reference for the input side
X102	2	*VDD*	Supply voltage for the input side of the board
X103	1	*VCC1*	Supply voltage for the input side of the gate drivers
X103	2	*GND1*	Common ground reference for the input side
X100	1	-	Not connected
X100	2	-	Not connected
X100	3	*GND1*	Common ground reference for the input side
X100	4	*ID*	ID pin of 1 wire EPROM
X100	5	*IN_LS*	Non-inverting input for the low-side gate driver
X100	6	*IN_HS*	Non-inverting input for the high-side gate driver
X100	7	*RDY*	Ready state of the gate drivers, active high signal
X100	8	*GND1*	Common ground reference for the input side
X100	9	*RSTN*	**1.** Enable/shutdown input signal for the gate drivers **2.** Reset signal for the fault latch state of the gate drivers in case of DESAT protection activation, active low signal
X100	10	*FLTN*	Open drain fault output signal of the gate drivers indicating DESAT fault, active low signal
X100	11	*PWM_PSU*	External PWM signal for bypass mode of the on-board isolated power supply circuit. Remove the resistor R107 and bridge the solder jumper J102 for bypass mode.
X100	12	*RDY_PSU*	Ready state of the transformer driver 2EP130R, active high signal
X100	13	*VCC1*	Supply voltage for the input side of the gate drivers
X100	14	-	Not connected
X100	15	-	Not connected
X100	16	*VDD*	Supply voltage for the input side of the board
X200	1	*IN_HS*	Non-inverting input for the high-side gate driver
X200	2	*GND1*	Common ground reference for the input side
X300	1	*IN_LS*	Non-inverting input for the low-side gate driver
X300	2	*GND1*	Common ground reference for the input side

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This table shows the pinout of the output-side gate driver power supply connectors X201 and X301. Use these connectors only if the on-board isolated power supply circuit is deactivated.

Table 16 Output side power supply connectors pinout

Connector	Pin	Symbol	Function
X201	1	*VCC2*	Positive supply voltage for the high-side gate driver
X201	2	*GND2*	Ground reference for the supply voltage of the high-side gate driver
X201	3	*VEE2*	Negative supply voltage for the high-side gate driver
X301	1	*VCC2*	Positive supply voltage for the low-side gate driver
X301	2	*GND2*	Ground reference for the supply voltage of the low-side gate driver
X301	3	*VEE2*	Negative supply voltage for the low-side gate driver

This table shows the pinout of the high-voltage power terminal connector X101.

Table 17 High-voltage terminal connector pinout

Connector	Pin	Symbol	Function
X101	1	*HV-*	High-voltage DC ground connection
X101	2	*Phase*	Half-bridge midpoint for connecting to the load inductor
X101	3	*HV+*	High-voltage DC positive input

3.5 Test points

This chapter provides an overview of all test points available on the evaluation board, detailing their functions and intended measurements.

This table summarizes all the test points available on the evaluation board for measurement of signals on the input side.

Table 18 Input side test points

Test point	Pin	Symbol	Function
TP100	-	*FLTN*	Common fault output signal of the high-side and low-side gate drivers indicating DESAT fault
TP101	-	*RSTN*	Common reset signal for the high-side and low-side gate drivers
TP102	-	*RDY*	Common ready state of the high-side and low-side gate drivers
TP200	1	*INP*	Non-inverting input for the high-side gate driver
TP200	2	*GND1*	Common input for the high-side ground reference
TP200	3	*INN*	Inverting input for the high-side gate driver
TP300	1	*INP*	Non-inverting input for the low-side gate driver
TP300	2	*GND1*	Common input for the low-side ground reference
TP300	3	*INN*	Inverting input for the low-side gate driver

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This table summarizes all the test points available on the evaluation board for measurement of signals on the output side.

Table 19 Output side test points

Test point	Pin	Symbol	Function
GP200	-	*GND2*	Output-side ground reference for high-side gate driver
TP201	1	*OUTL*	Sourcing output of high-side gate driver
TP201	2	*GND2*	Output-side ground reference for high-side gate driver
TP201	3	*OUTH*	Sinking output of high-side gate driver
TP202	1	*GATE*	Gate voltage of the high-side switch
TP202	2	*GND2*	Output-side ground for high-side gate driver
TP203	-	*Desat*	DESAT signal of the high-side gate driver
GP300	-	*GND2*	Output-side ground reference for low-side gate driver
TP301	1	*OUTL*	Sourcing output of low-side gate driver
TP301	2	*GND2*	Output-side ground reference for low-side gate driver
TP301	3	*OUTH*	Sinking output of low-side gate driver
TP302	1	*GATE*	Gate voltage of the low-side switch
TP302	2	*GND2*	Output-side ground for low-side gate driver
TP303	-	*Desat*	DESAT signal of the low-side gate driver

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4 References and appendices

4.1 References

[1] Datasheet of EiceDRIVER™ 1ED3321MC12N
[2] Datasheet of EiceDRIVER™ Power 2EP130R
[3] User guide of EVAL-2EP130R-PR-SiC
[4] Datasheet of CoolSiC™ IMZC120R017M2H

4.2 Ordering information

Base Part Number	Package	Standard Pack		Orderable Part Number
EVAL-1ED3321MC12N-SiC	-	Boxed	1	-
1ED3321MC12N	DSO-16	TAPE & REEL	1000	1ED3321MC12NXUMA1
2EP130R	PG-TSSOP-8	TAPE & REEL	1000	2EP130RXTMA1
IMZC120R017M2H	PG-TO247-4	Tube	240	IMZC120R017M2HXKSA1

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Revision history

Document Revision	Date	Description of changes
V 1.0	2025-10-29	Initial release

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