Eval-1ED3142MU12F-SiC

Evaluation board description and getting started guide

About this document

Scope and purpose

This user guide is intended to introduce and provide an overview of the gate driver evaluation board Eval-1ED3142MU12F-SiC with the 1ED3142MU12F gate driver integrated circuits (IC), including the functionality and key features of the Infineon EiceDRIVER™ 1ED314xMU12F gate driver IC family.

The Eval-1ED3142MU12F-SiC board is designed to evaluate the functionality and capability of 1ED3142MU12F gate driver ICs.

This user guide presents only key features of the gate driver, and the datasheet should be consulted to ensure the full functionality and flexibility of the 1ED3142MU12F gate driver and Eval-1ED3142MU12F-SiC.

Intended audience

This document is intended for all technical specialists who want to evaluate the functionality, performance and features of 1ED3142MU12F gate driver ICs. The evaluation board is intended to be used under laboratory conditions only by trained specialists.

It is a prerequisite to read the datasheet of the 1ED3142MU12F to become familiar with the parameters of the gate driver.

It is highly recommended to have an EiceDRIVER™ Eval-PSIR2085 power supply board to provide an isolated power supply to the Eval-1ED3142MU12F-SiC evaluation board from a single power supply rail.

Evaluation Board

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

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

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Safety precautions

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

Table 1 Safety precautions

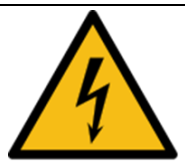	**Warning:** *The DC link potential of this board is up to 900 VDC. When measuring voltage waveforms by oscilloscope, high voltage differential probes must be used. Failure to do so may result in personal injury or death.*
	**Warning***: The evaluation board contains DC bus capacitors which take time to discharge after removal of the main supply. Before working on the 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:** *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 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 board is shipped with packing materials that need to be removed prior to installation. Failure to remove all packing materials that are unnecessary for system installation may result in overheating or abnormal operating conditions.*

Table of contents

1 The board at a glance

The Eval-1ED3142MU12F-SiC evaluation board was designed to be used by design engineers to evaluate the 1ED3142MU12F EiceDRIVER™ isolated gate driver IC in a half-bridge configuration. The evaluation board can be used to evaluate other ICs from the EiceDRIVER™ 1ED314xMU12F gate driver family by replacing the gate driver ICs.

The board comes with two Infineon IMZA120R020M1H CoolSiC™ 1200 V SiC Trench MOSFETs in a TO247-4 package, as seen in Figure 1. The switches can be substituted by any other desired switches, such as Infineon IGBTs, CoolSiC™ or CoolMOS™ transistors.

Details about the EiceDRIVER™ 1ED3142MU12F can be found on our product pages at *https://www.infineon.com/gdisolated* or by using the product search.

The board has a size of 83 × 57 × 28 mm^3 without any power switches assembled. As the board was designed for non-continuous evaluation, such as double-pulse testing, special consideration should be taken regarding the power track's current capabilities and to ensure proper cooling of the power switches. It is also recommended to add additional high-voltage decoupling capacitors at the high-voltage input.

The board is designed to be be supplied using an EiceDRIVER™ Eval-PSIR2085 power supply board, which offers two galvanically isolated power rails for the switch side of the gate driver ICs and a supply rail for the primary side of the gate driver ICs. **It is highly recommended to include an EiceDRIVER™ Eval-PSIR2085 in your initial order.**

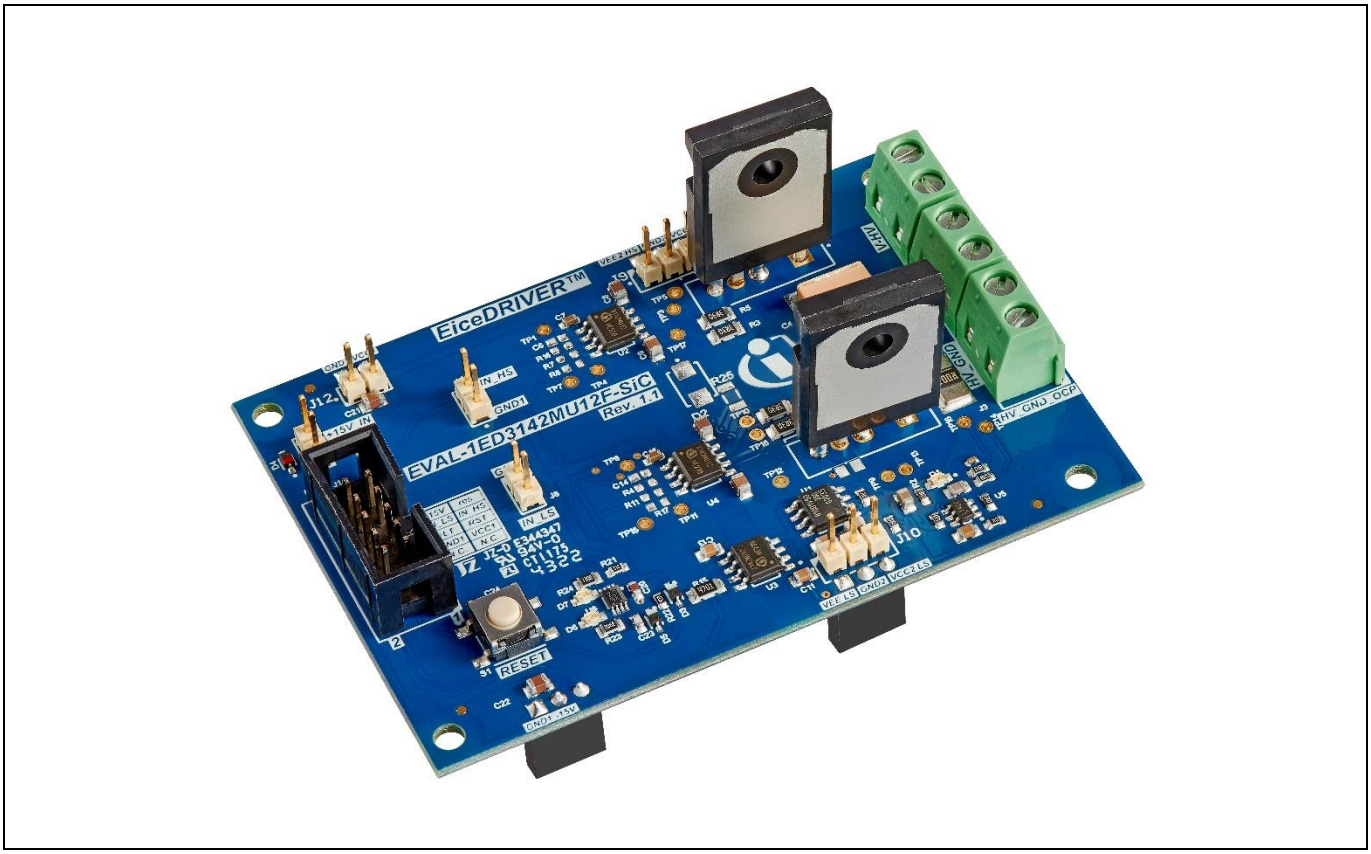

Figure 1 Eval-1ED3142MU12F-SiC evaluation board

1.1 Scope of supply

The delivery contains the evaluation board Eval-1ED3142MU12F-SiC.

1.2 Block diagram

Figure 2 shows the block diagram of the Eval-1ED3142MU12F-SiC evaluation board.

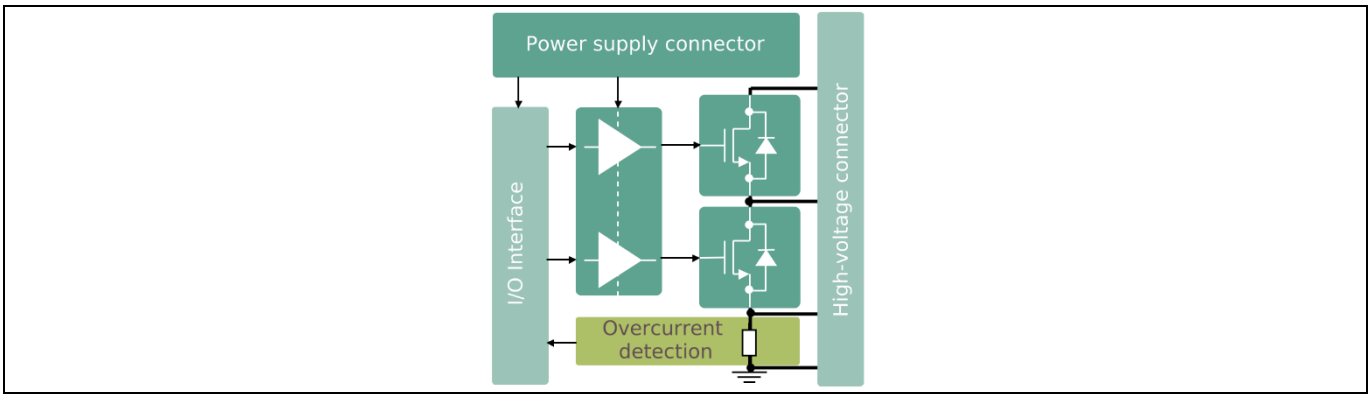

Figure 2 Eval-1ED3142MU12F-SiC evaluation board block diagram

1.3 Main features

The Eval-1ED3142MU12F-SiC is an evaluation board for the 1ED3142MU12F gate driver ICs. It was designed in a half-bridge configuration with a 900 V maximum blocking capability across the power terminals. The board is designed for easy measurement and configuration of the gate driver parameters, and the main features of the board and gate driver include:

- 35 V absolute maximum output supply voltage
- Up to ± 6.5 A typical output current
- Separate source and sink output for optimized gate driving
- Active shutdown
- High common-mode transient immunity CMTI > 300 kV/µs
- 45 ns typical propagation delay
- Tight IC-to-IC propagation delay matching
- 3.3 V and 5 V input supply voltage
- DSO-8 narrow body package with 3 mm creepage
- Gate driver safety certification:
    - UL 1577 recognized with $V_{ISO,test}$ = 3600 V (rms) for 1 s, V_{ISO} = 3000 V (rms) for 60 s
- Infineon IMZA120R020M1H CoolSiC™ 1200 V SiC Trench MOSFETs in TO247-4

1.4 Board parameters and technical data

The absolute maximum ratings are summarized in Table 2.

Table 2 Absolute maximum ratings

Parameter/Pin	Symbol	Conditions/Notes	Value	Unit
Diode protected isolated power supply input voltage	+15V_IN	Referenced to GND1. To be used only with Eval-PSIR2085	-0.3 … 20	V
Isolated power supply input voltage	+15V	Referenced to GND1. To be used only with Eval-PSIR2085	-0.3 … 20	V
Primary side supply voltage	VCC1	Referenced to GND1	-0.3 … 7	V
Positive input for low side gate driver	IN_LS	Referenced to GND1	-0.3 … 7	V
Positive input for high side gate driver	IN_HS	Referenced to GND1	-0.3 … 7	V
Fault output from over current protection circuit	FLT	Referenced to GND1	-0.3 … 7	V
Reset input for over current protection circuit	RST	Referenced to GND1	-0.3 … 7	V
Reserved	.res	Reserved for future use		
DC-link voltage	V-HV	Referenced to HV_GND/HV_GND_OCP power terminal. Limited by component ratings and design clearances. For voltages above 42 V, special safety measures should be taken	-0.2 … 900	V
Half-bridge mid-point connection	PHASE	Mid point connection for the half-bridge	-0.2 … 900	V
High power ground terminal without OCP	HV_GND	Ground connection for the high-power connection bypassing the overcurrent protection circuit	-	-
High power ground terminal with OCP	HV_GND_OCP	Ground connection for the high-power connection with the overcurrent protection circuit in the loop	-	-
Secondary side positive supply voltages	VCC2_HS/ VCC2_LS	Referenced to VEE2H/VEE2L. Not to be used with Eval-PSIR2085	-0.3 … 35	V
Secondary side negative supply voltages	VEE2_HS/ VEE2_LS	Referenced to GND2_HS / GND2_LS. Not to be used with Eval-PSIR2085	-35 … 0.3	V
Phase peak current	I_{out}	With shortcircuit protection circuit	35	A
		Without shortcircuit protection circuit	50	A
	t_{pulse}	Maximum ON pulse length for double-pulse tests. Power dissipation should be considered	100	µs
	f_{sw}	Maximum switching frequency for continuous operation. Power dissipation should be considered	100	kHz

The recommended operating conditions are summarized in Table 3.

Table 3 Recommended operating conditions and supply for 3.3 V

Parameter/Pin	Symbol	Conditions/Notes	Value			Unit
			Min.	Typ.	Max	
Isolated power supply input voltage	+15V	Referenced to SGND. To be used only with Eval-PSIR2085	15	15.5	16	V
Primary side supply voltage	VCC1	Referenced to GND1	3.2	3.3	3.5	V
Positive input for low side gate driver	IN_LS	Referenced to GND1	-0.1	*VCC1*	*VCC1*+0.1	V
Positive input for high side gate driver	INP_P	Referenced to GND1	-0.1	*VCC1*	*VCC1*+0.1	V
Fault output from over current protection circuit	FLT	Referenced to GND1	-0.1	*VCC1*	*VCC1*+0.1	V
Reset input for over current protection circuit	RST	Referenced to GND1	-0.1	*VCC1*	*VCC1*+0.1	V
DC-link voltage	HV+	Referenced to HV_GND/HV_GND_OCP power terminal. Limited by component ratings and design clearances. For voltages above 42 V, special safety measures should be taken	25	-	800	V
Secondary side positive supply voltages	VCC2H/ VCC2L	Referenced to VEE2_HS/VEE2_LS. Not to be used with Eval-PSIR2085	12	17	20	V
Secondary side ground reference supply voltages	GND2H/ GND2L	Referenced to VEE2_HS/VEE2_LS. Not to be used with Eval-PSIR2085	0	7.5	15	V

2 System and functional description

2.1 Getting started

The Eval-1ED3142MU12F-SiC is optimized to be used with both 5 V and 3.3 V VCC1 primary side supply voltages. The threshold values for the primary-side input signals are always proportional to the VCC1 supply voltage.

It is recommended to use the board with the EiceDRIVER™ Eval-PSIR2085 isolated power supply board. For a nominal input voltage, +15V, of 15.5 V, the EiceDRIVER™ Eval-PSIR2085 isolated power supply will provide a bipolar +15 V/-7.5 V supply voltage for the secondary sides for both high-side and low-side gate drivers.

Note: In case separate power supplies will be used for the secondary side, EiceDRIVER™ Eval-PSIR2085 does not have to be connected, and the board can be supplied using connector J12 for the primary-side supply voltage, VCC1, and connectors J9 and J10 for the secondary-sides power voltages: VCC2_HS/VCC2_LS, GND2_HS/GND2_LS, VEE2_HS/VEE2_LS.

2.1.1 Prerequisites

- EiceDRIVER™ Eval-PSIR2085 isolated power supply board
- Assembled external high-voltage decoupling capacitor (100 µF) across the high-voltage power terminals: J1 (V-HV) and J3 (HV_GND/HV_GND_OCP)
- Low-voltage power supply for supplying primary-side power supply circuit, capable of supplying 15 V, 100 mA (+15V, SGND1)
- Suitable function generator for double-pulse pattern generation
- High-voltage power supply for supplying the power stage: J1 (V-HV) and J3 (HV_GND/HV_GND_OCP)
- A suitable inductive load for double-pulse testing

2.1.2 Power-up sequence

Note: It is assumed that the board will be used with the EiceDRIVER™ Eval-PSIR2085 isolated power supply board.

1. Connect Eval-1ED3142MU12F-SiC to the EiceDRIVER™ Eval-PSIR2085 isolated power supply board
2. Connect the double-pulse pattern generator to the Eval-1ED3142MU12F-SiC input pin. For evaluating the low-side switching capability, connect the patter generator to IN_LS and SGND1 and short IN_HS to SGND1. For evaluation of the high-side switching capability, connect the pattern generator to IN_HS and SGND1 and short IN_LS to SGND1
3. Connect one end of the inductive load to terminal J2 (PHASE) and the other end, depending on the double-pulse test requirements, to either J1 (V-HV) for the low side testing or J3 (HV_GND/HV_GND_OCP) for the high side testing
4. Supply the isolated power supply input voltage at connector J13-1 (+15V_IN) and J13-2 (SGND1) with +15.5 V and ground
5. The red LED D7 will turn on at start-up as the overcurrent protection has to be reset before using the board
6. The RESET button has to be preset to un-latch the overcurrent protection circuit and enable it’s operation
7. The green LED D6 will turn on to signal that the overcurrent protection was reset and operation can be started
8. Connect the high-voltage power supply to the connector J1 (V-HV) and J3 (HV_GND/HV_GND_OCP) depending if the overcurrent protection should be used or not

The board is now ready for double-pulse evaluation.

2.2 Example: Normal operation with unipolar power supply

Figure 3 shows the Eval-1ED3142MU12F-SiC in a typical double-pulse test of the low side CoolSiC™ MOSFET. The evaluation board was supplied using the EiceDRIVER™ Eval-PSIR2085 isolated power supply board, whichwas adjusted to output a unipolar power supply of +15 V. The board was supplied with 800 V between terminals J1 (V-HV) and J3-1 (HV_GND). A 200 µH load inductor was connected in parallel with the high side CoolSiC™ MOSFET, between terminals J1 (V-HV) and J2 (PHASE). The gate source signal of the low side CoolSiC™ SiC MOSFET is shown with yellow on channel 1. The PWM input signal for the gate driver is shown in magenta on channel 2. Channel 3 shows with blue the drain source votlage, V_{DS} of the same MOSFET. Lastly, with green the drain current, I_D, is shown on channel 4.

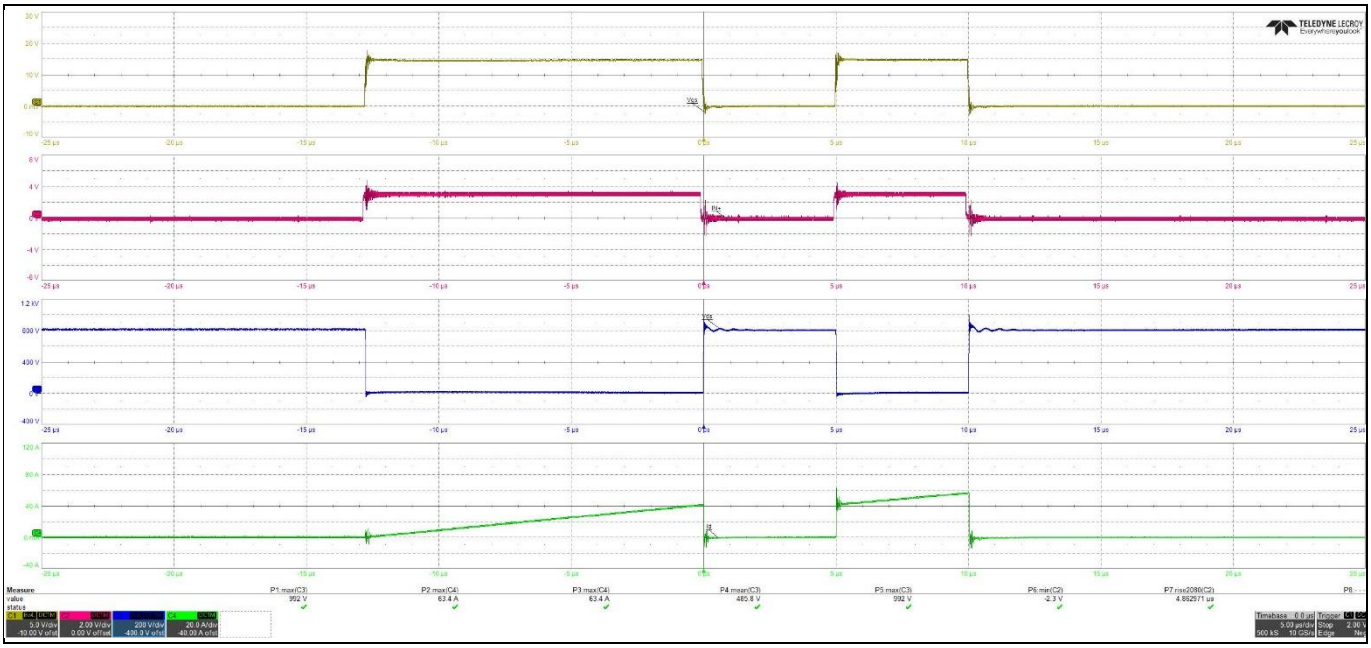

Figure 3 Eval-1ED3142MU12F-SiC – Double-pulse test of the low side CoolSiC™ MOSFET with 15V unipolar power supply

2.3 Example: Normal operation with bipolar power supply

Figure 4 shows the CoolSiC™ MOSFET gates being driven using a bipolar power supply of +18 V/-3V. The board was supplied with 800 V between terminals J1 (V-HV) and J3-1 (HV_GND). A 200 µH load inductor was connected in parallel with the high side CoolSiC™ MOSFET, between terminals J1 (V-HV) and J2 (PHASE). The gate source signal of the low side CoolSiC™ SiC MOSFET is shown with yellow on channel 1. The PWM input signal for the gate driver is shown in magenta on channel 2. Channel 3 shows with blue the drain source votlage, V_{DS} of the same MOSFET. Lastly, with green the drain current, I_D, is shown on channel 4.

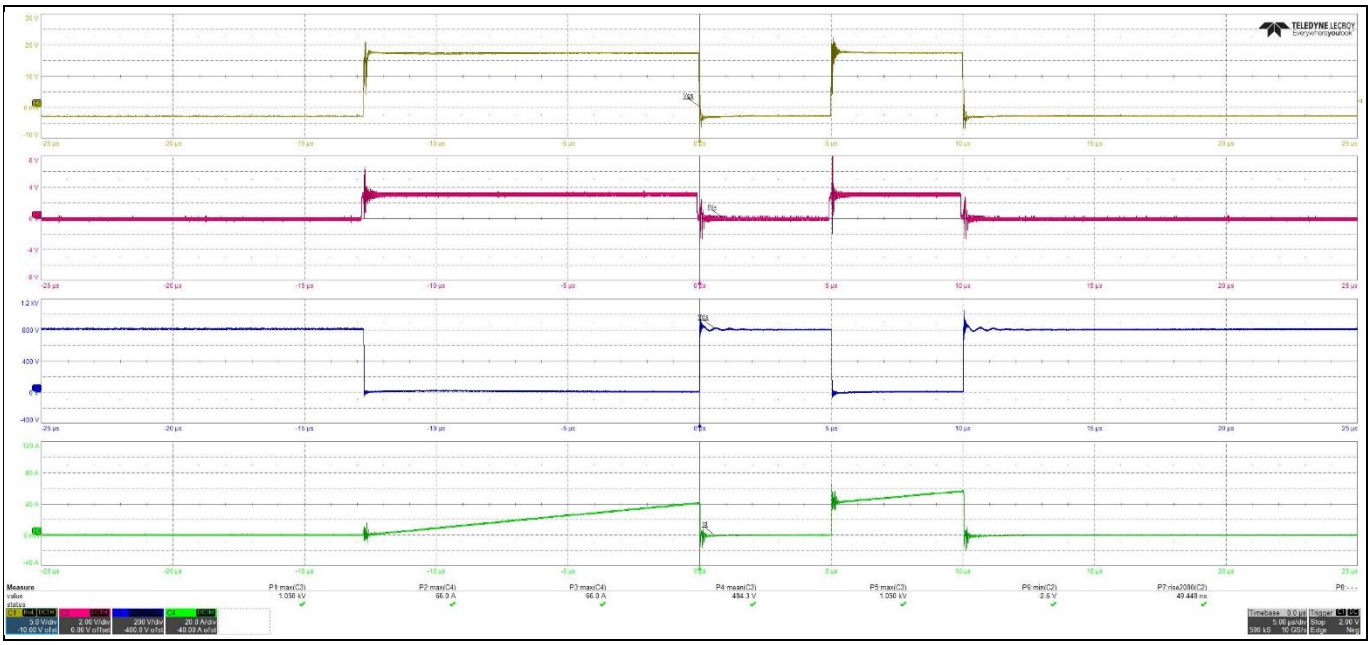

Figure 4 Eval-1ED3142MU12F-SiC – Double-pulse test of the low side CoolSiC™ MOSFET with 18V / -3V bipolar power supply

2.4 Example: Overcurrent protection operation

Figure 5 shows the Eval-1ED3142MU12F-SiC short-circuit protection in action. The board was supplied with 800 V between terminals J1 (V-HV) and J3-2 (HV_GND_OCP). The high CoolSiC™ was kept on, and the low side was turned on, creating a type 1 short circuit. The gate source votlage of the low side MOSFET is shown with yellow on channel 1. The overcurrent protection fault signal, that triggers the disabling of the gate driver is shown with magenta on channel 2. The drain source voltage of the CoolSiC™ is shown in blue on channel 3. Lastly, on channel 4, the short-circuit drain current is shown with green.

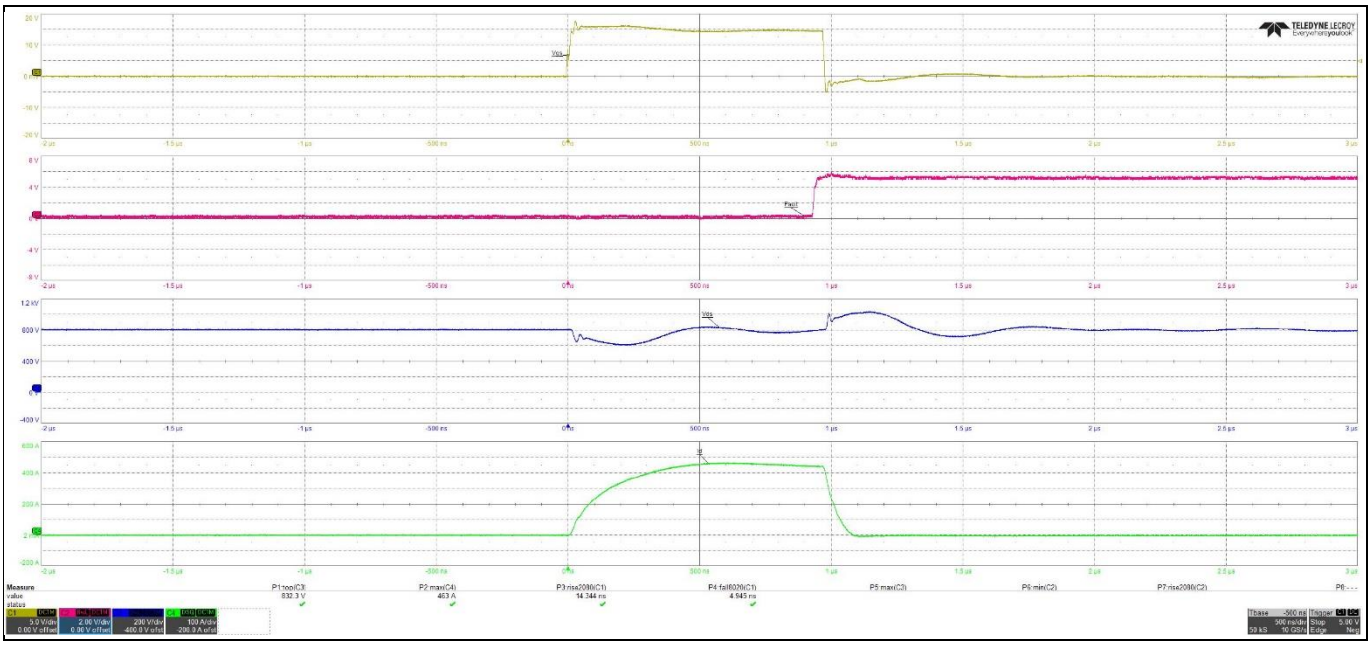

Figure 5 Eval-1ED3142MU12F-SiC – Oercurrent protection in case of short-circuit

3 System design

The Eval-1ED3142MU12F-SiC evaluation board is designed to evaluate the EiceDRIVER™ 1ED314xMU12F X3 compact family gate driver ICs. To support the customer in getting started with the design, the schematics, Gerber data and Altium project files can be found on the Infineon homepage.

3.1 Schematics

The schematic of the evaluation board is shown below.

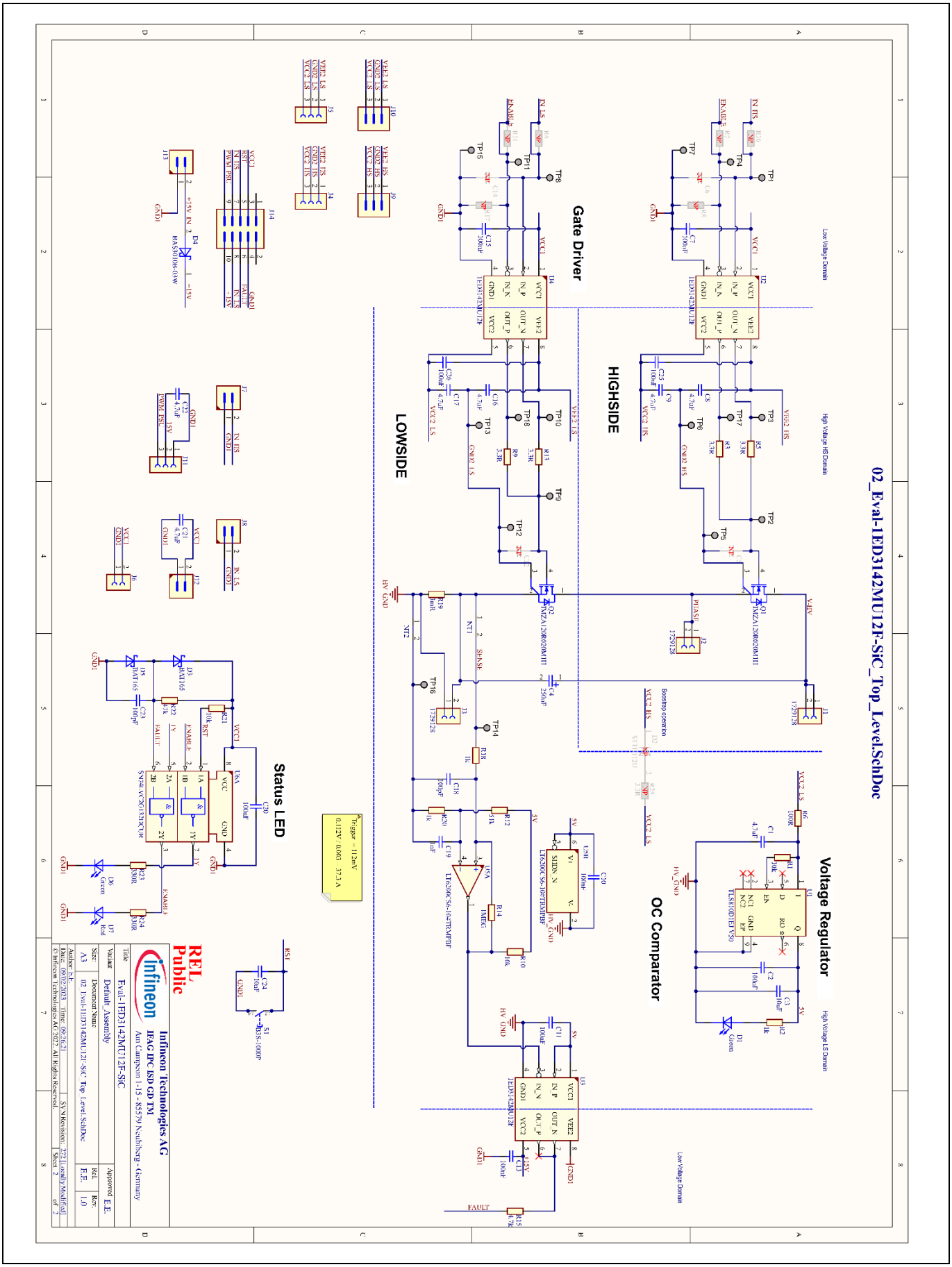

Figure 6 Eval-1ED3142MU12F-SiC - Schematic

3.2 Bill of material

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

Table 4 Bill of materials

Designator	Quantity	Description	Manufacturer	Manufacturer P/N
C1, C8, C9, C16, C17	5	4.7uF	MuRata	GRM21BR61H475ME51
C2, C10, C11, C13	4	100nF	Kemet	C0805C104J5RAC
C3	1	10uF	MuRata	GRM219R61E106KA12
C4	1	250nF	TDK Corporation	B58031I9254M062
C7, C15, C25, C26	4	100nF	Wurth Elektronik	885012206095
C18	1	100pF	MuRata	GRM2165C1H101JA01
C19	1	1nF	MuRata	GRM15XR71H102KA86
C20	1	100nF	TDK Corporation	CGA3E3X7S2A104M080AB
C21, C22	2	4.7uF	Wurth Elektronik	885012107018
C23	1	100pF	TDK Corporation	C1608X7R1H101M
C24	1	10nF	Wurth Elektronik	885012206089
D1, D6	2	Green	Wurth Elektronik	150080VS75000
D3, D5	2	BAT165	Infineon Technologies	BAT165
D4	1	BAS3010B-03W	Infineon Technologies	BAS3010B-03W
D7	1	Red	Wurth Elektronik	150080RS75000
J1, J2, J3	3	1729128	Phoenix Contact	1729128
J4, J5, J11	3	SSW-103-01-G-S	Samtec	SSW-103-01-G-S
J6	1	SSW-102-01-G-S	Samtec	SSW-102-01-G-S
J7, J8, J12, J13	4	HTSW-102-07-G-S	Samtec	HTSW-102-07-G-S
J9, J10	2	HTSW-103-07-G-S	Samtec	HTSW-103-07-G-S
J14	1	T821110A1S100CEU	Amphenol	T821110A1S100CEU
Q1, Q2	2	IMZA120R020M1H	Infineon Technologies	IMZA120R020M1H
R1, R10, R21	3	10k	Yageo	RC0603FR-0710KL
R2, R18, R20	3	1k	Yageo	RC0603FR-071KL
R3, R5, R9, R13	4	3.3R	Vishay	CRCW12063R30FK
R6	1	100R	Yageo	RC0603FR-07100RL
R12	1	51k	Vishay	CRCW060351K0FK
R14	1	1MEG	Yageo	RC0603FR-071ML
R15	1	4.7k	Vishay	CRCW12064K70FK
R19	1	3mR	Bourns	CRE2512-FZ-R003E-3
R22	1	47k	Stackpole Electronics	RMCF0603FT47K0
R23, R24	2	330R	Vishay	CRCW0805330RFK
S1	1	B3S-1000P	Omron	B3S-1000P
U1	1	TLS810D1EJ V50	Infineon Technologies	TLS810D1EJ V50
U2, U3, U4	3	1ED3142MU12F	Infineon Technologies	1ED3142MU12F
U5	1	LT6200CS6-10#TRMPBF	Analog Devices	LT6200CS6-10#TRMPBF
U6	1	SN74LVC2G132DCUR	Texas Instruments	SN74LVC2G132DCUR

3.3 Connector details

General information about the connectors of the Eval-1ED3142MU12F-SiC evaluation board is provided in this section.

Table 5 shows the connection of the high-voltage connector X90.

Table 5 High-voltage connectors

Connector / Pin	Label	Function
J1	V_HV	DC-link high-side connection
J2	PHASE	Half-bridge midpoint connection
J3 (1)	HV_GND	DC-link ground side connection without OCP circuit
J3 (2)	HV_GND_OCP	DC-link ground side connection with OCP circuit

Table 6 shows the connections of the low voltage, input side connectors. This includes all four connectors, X1, X2, X5 and X6.

Table 6 Input side connectors pinout

PIN	Label	Function
J7 (1)	GND1	Ground for the input side of the board
J7 (2)	IN_HS	Noninverting input for the high side gate driver
J8 (1)	GND1	Ground for the input side of the board
J8 (2)	IN_LS	Noninverting input for the low side gate driver
J6/J12 (1)	GND1	Ground for the input side of the board
J6/J12 (2)	VCC1	Supply voltage for the input side of the gate drivers
J13 (1)	GND1	Ground for the input side of the board
J13 (2)	+15V_IN	Reverse polarity protected, supply voltage for the isolated power supply
J14 (1)	N.C.	Not connected
J14 (2)	N.C.	Not connected
J14 (3)	GND1	Ground for the input side of the board
J14 (4)	GND1	Ground for the input side of the board
J14 (5)	FLT	Fault output from the overcurrent protection circuit
J14 (6)	RST	Reset input for the overcurrent protection circuit
J14 (7)	IN_LS	Noninverting input for the low side gate driver
J14 (8)	IN_HS	Noninverting input for the high side gate driver
J14 (9)	+15V	Supply voltage for the isolated power supply
J14 (10)	.res	Not used

2Table 7 shows the connection of the low side supply connectors X3 and X4. This is used to supply the low side gate drive secondary side. If the EiceDRIVER™ Eval-PSIR2085 isolated power supply board is not used, VCC2, GND2, and VEE2 voltage can be supplied here by means of an isolated power supply that allows floating operation of the gate driver as per application.

Table 7 Low side gate driver IC -isolated secondary power supply

PIN	Label	Function
J5/J10 (1)	VEE2_L	Low side gate driver positive supply (VEE2_L) connection
J5/J10 (2)	GND2_L	Low side gate driver supply ground reference (GND2_L) connection
J5/J10 (3)	VCC2_L	Low side gate driver negative supply (VCC2_L) connection

Table 8 shows the connection of the high side supply connectors X13 and X14. This is used to supply the high-side gate drive secondary side. If the EiceDRIVER™ Eval-PSIR2085 isolated power supply board is not used, VCC2, GND2, and VEE2 voltage can be supplied here by means of an isolated power supply that allows floating operation of the gate driver as per application.

Table 8 High side gate driver IC -isolated secondary power supply

PIN	Label	Function
J4/J9 (1)	VEE2_H	High-side gate driver positive supply (VEE2_H) connection
J4/J9 (2)	GND2_H	High-side gate driver supply ground reference (GND2_H) connection
J4/J9 (3)	VCC2_H	High-side gate driver negative supply (VCC2_H) connection

3.4 Test points

The test points used on the board are summarized in the table below.

Table 9 Test points

Test point name	Signal measured	Ground reference for test point
TP1	IN_HS	GND1
TP2	High side (Q1) gate signal	GND2_HS
TP3	High side OUTL	GND2_HS
TP4	ENABLE	GND1
TP5	GND2_HS	GND2_HS
TP6	GND2_HS	GND2_HS
TP7	GND1	GND1
TP8	IN_LS	GND1
TP9	Low side (Q2) gate signal	GND2_LS
TP10	Low side OUTL	GND2_LS
TP11	ENABLE	GND1
TP12	GND2_LS	GND2_LS
TP13	GND2_LS	GND2_LS
TP14	Shunt resistor kelvin sense (+)	HV_GND
TP15	GND1	GND1
TP16	Shunt resistor kelvin sense (-)	HV_GND
TP17	High side OUTH	GND2_HS
TP18	Low side OUTH	GND2_LS

4 References and appendices

4.1 References

[1] Datasheet of Infineon EiceDRIVER™ 1ED3142MU12F

[2] User guide of EiceDRIVER™ Eval-PSIR2085

[3] Datasheet of Infineon IMZA120R020M1H

4.2 Ordering information

Base Part Number	Package	Standard Pack		Orderable Part Number
		Form	Quantity	
Eval-1ED3142MU12F-SiC	-	Boxed	1	EVAL1ED3142MU12FTOBO1
1ED3140MU12F	PG-DSO-8	TAPE & REEL	1000	1ED3140MU12FXUMA1
1ED3141MU12F	PG-DSO-8	TAPE & REEL	1000	1ED3141Mu12FXUMA1
1ED3142MU12F	PG-DSO-8	TAPE & REEL	1000	1ED31D2MU12FXUMA1
IMZA120R020M1H	PG-TO247-7	Tube	240	IMZA120R020M1HXKSA1
EVAL-PSIR2085	-	Boxed	1	EVALPSIR2085TOBO1

Revision history

Document version	Date	Description of changes
V1.0	2022-02-01	Initial release

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