EVAL-F3L8MXTR12C2M2_P

A single-phase evaluation board for active front end

About this document

Scope and purpose

EVAL-F3L8MXTR12C2M2_P is a single-phase evaluation board for active front end. It enables hardware developers to evaluate the newest Infineon products quickly. As a fully functional hardware building block with measurement features, EVAL-F3L8MXTR12C2M2_P can be integrated into any system for evaluation purposes.

Intended audience

The intended audiences for this user guide are hardware developers and test engineers.

About this product group

Target applications

- EV charging
- Active front end for motor drives and energy storage systems

Product family

- EasyPACK™ F3L8MXTR12C2M2_H11: EasyPACK™ 2C with CoolSiC™ MOSFET M2 .XT 3-level module, 1200 V
- EiceDRIVER™ 1ED3491MC12M: 9 A, 5.7 kV single-channel flexible isolated gate driver with active Miller clamp, adjustable DESAT and Soft-off. UL 1577 and VDE 0884-11 certified
- EiceDRIVER™ AUIR2085S: Automotive grade, high speed, 100 V, self-oscillating, 50% duty cycle, half-bridge driver in an SO-8 package
- OPTIREG™ switcher TLE8386-2EL: Low-side-sense boost controller with built in protection features

Evaluation board

This evaluation board should 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 the final customer design.

Safety precautions

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

Table 1 Safety precautions

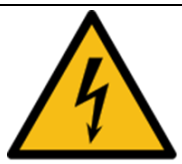	**Warning:** *The DC link potential of this board is up to 1000 VDC. When measuring voltage waveforms by oscilloscope, high-voltage differential probes must be used. Failure to do so may result in personal injury or death.*
	**Warning**: *The evaluation or reference board contains DC bus capacitors, which take time to discharge after removal of the main supply. Before working on the drive system, wait five minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.*
	**Warning:** *The evaluation or reference board is connected to the grid input during testing. Hence, high-voltage differential probes must be used when measuring voltage waveforms by oscilloscope. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.*
	**Warning:** *Remove or disconnect power from the drive before you disconnect or reconnect wires, or perform maintenance work. Wait five minutes after removing power to discharge the bus capacitors. Do not attempt to service the drive until the bus capacitors have discharged to zero. Failure to do so may result in personal injury or death.*
	**Caution:** *The heat sink and device surfaces of the evaluation or reference board may become hot during testing. Hence, necessary precautions are required while handling the board. Failure to comply may cause injury.*
	**Caution:** *Only personnel familiar with the drive, power electronics and associated machinery should plan, install, commission and subsequently service the system. Failure to comply may result in personal injury and/or equipment damage.*
	**Caution:** *The evaluation or reference board contains parts and assemblies sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing, or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.*
	**Caution:** *A drive that is incorrectly applied or installed can lead to component damage or reduction in product lifetime. Wiring or application errors such as undersizing the motor, supplying an incorrect or inadequate AC supply, or excessive ambient temperatures may result in system malfunction.*
	**Caution:** *The evaluation or reference board is shipped with packing materials that need to be removed prior to installation. Failure to remove all packing materials that are unnecessary for system installation may result in overheating or abnormal operating conditions.*

Table of contents

1 The board at a glance

Figure 1 shows the evaluation board with a press-fit EasyPACK™ 2C CoolSiC™ MOSFET power module, four single-channel EiceDRIVER™ devices, and an AUIR2085S half-bridge driver for low-voltage power supply. It provides AC and DC load connectors for flexible connection between the DC-link busbars and between the AC line inductors. An AC-grid measurement connection is implemented for grid synchronization.

Through an isolated low-voltage power supply, which requires +24 V, an independent supply is provided to generate stable supply voltages for measurement functions and the gate drivers. The high-voltage gate driver side comes with fully reinforced isolation against the input signals of the power module. These signals are routed to the main signal connector. At the main signal connector, users can implement a custom control interface for PWM, to enable signals, and for analog measurement functions (DC-link voltage, AC grid measurement, NTC temperature, and load current).

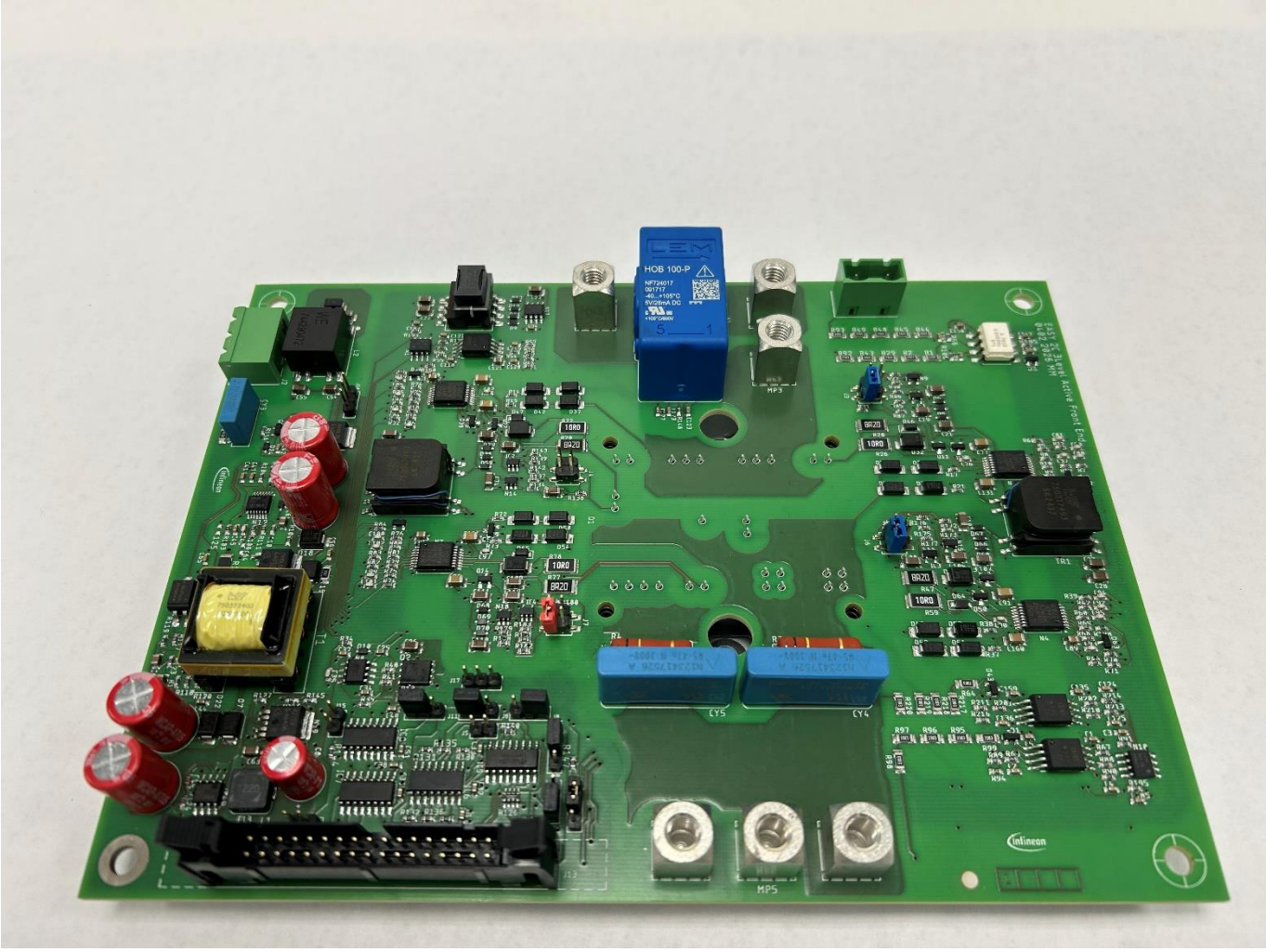

Figure 1 The evaluation board at a glance

1.1 Scope of supply

The kit includes a printed circuit board with a press-fit EasyPACK™ power module.

1.2 Block diagram

Figure 2 shows the block diagram of the evaluation board' architecture. Analog measurement functions are shown in orange blocks and the power functions are shown in blue blocks. The power connections and the signal connections routed to the main connector are also shown. The DC link and inductor are not part of the design and are shown only as an example of the application architecture.

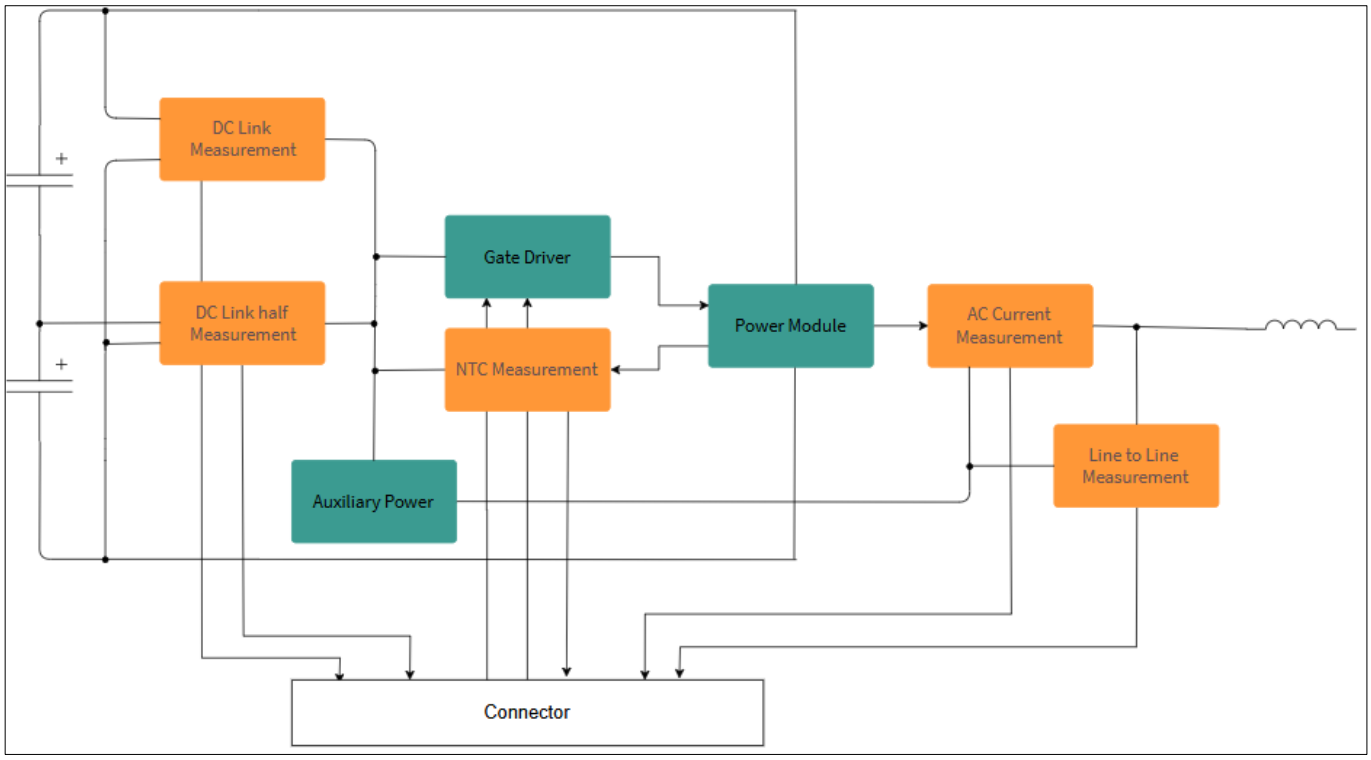

Figure 2 Block diagram of the evaluation board

1.3 Main features

- Variable gate driver supply: +15 V/+18 V and -3 V/-5 V
- Reinforced analog measurement functions
- Reinforced power-stage control
- Independent low-voltage supply

1.4 Board parameters and technical data

Table 2 summarizes the key technical parameters of the evaluation board.

Table 2 Key parameters

Parameter	Symbol	Conditions	Value	Unit
Low-voltage supply	V_{SUP}	External low-power supply	+24	V
Positive gate-driver supply	V_{GS}	Jumper setting	+15/+18	V
Negative gate-driver supply	V_{GS}	Jumper setting	-3/-5	V
DC-link voltage	V_{DC}	3-level topology	800	V
Pulse current	I_d	Double-pulse setup	0 – 150	A
Grid voltage	V_{LL}	Line-to-line measurement	230 – 480	V
Grid frequency	f_{GRID}	Stable grid frequency	50 or 60	Hz

2 System and functional description

This chapter provides an overview of all the available functions. The main functions of the evaluation board are explained using individual functional block diagrams.

2.1 Getting started

Provide +24 V of supply voltage to the evaluation board. Through the switching power supply, the secondary-side voltages of +18 V and, based on the LDOs, +15 V and +5 V are generated. Checking all the supply voltages is recommended to ensure a stable operation.

Users can connect a self-designed 3-level DC link to the screw terminals. In addition, a filter inductor for the grid connection must be connected to the screw terminals between the current sensor and the grid connection.

A detailed description of the digital control signals and analog measurement signals is provided in the connector details section (section 2.4).

2.2 Description of the functional blocks

This section contains all the circuit diagrams for analog measurement and gate driver control in functional blocks.

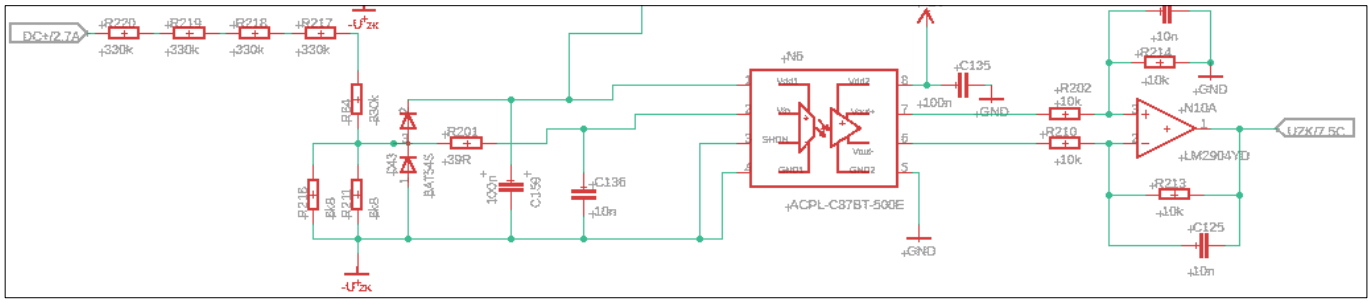

Figure 3 DC-link measurement

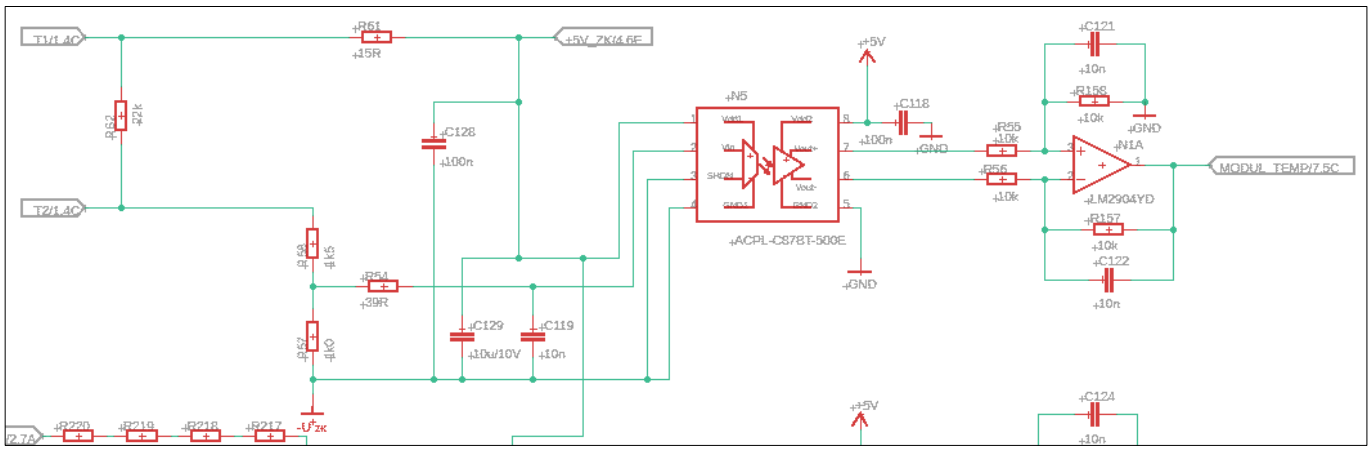

Figure 4 NTC-module measurement

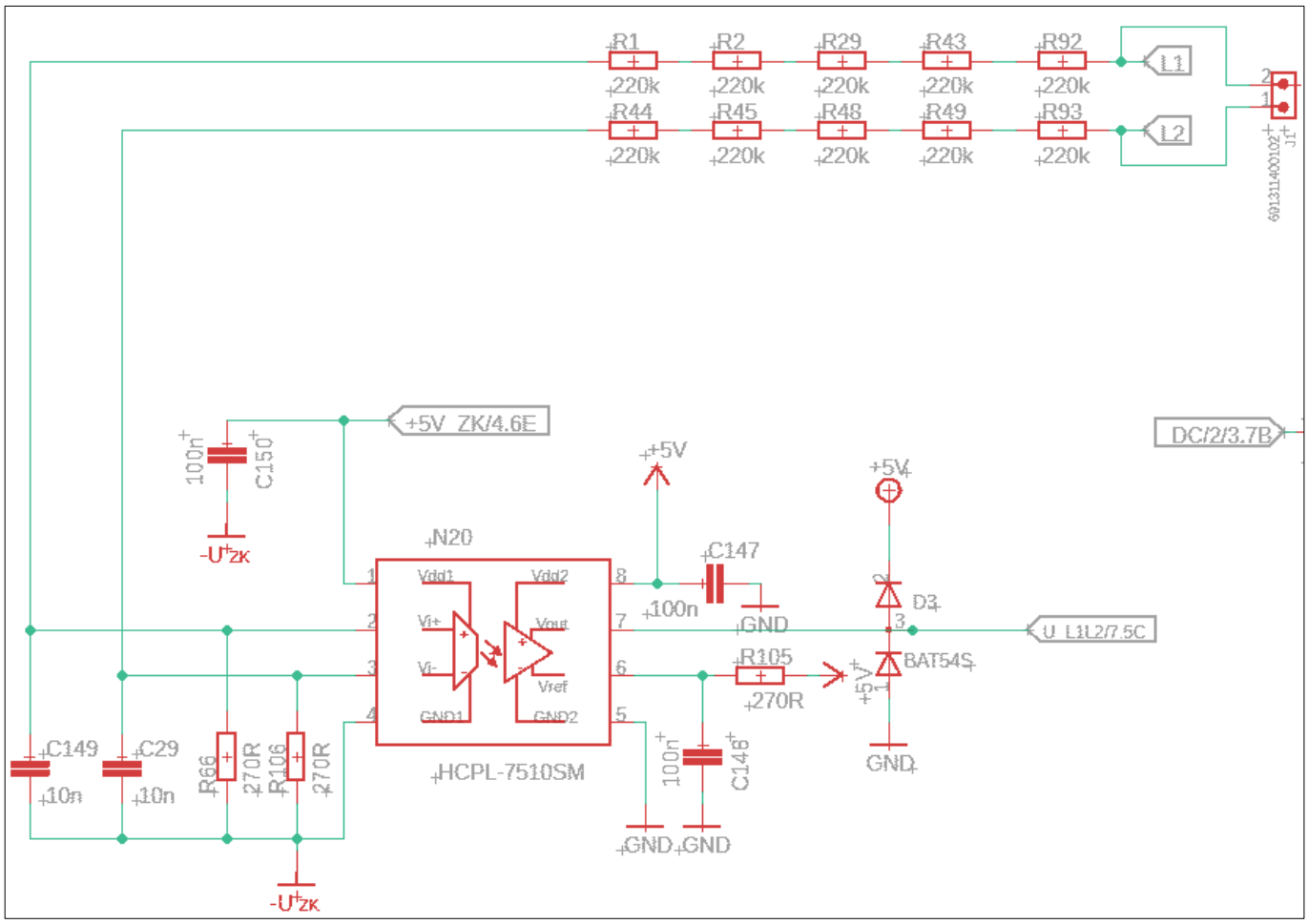

Figure 5 Grid voltage: Line-to-line measurement

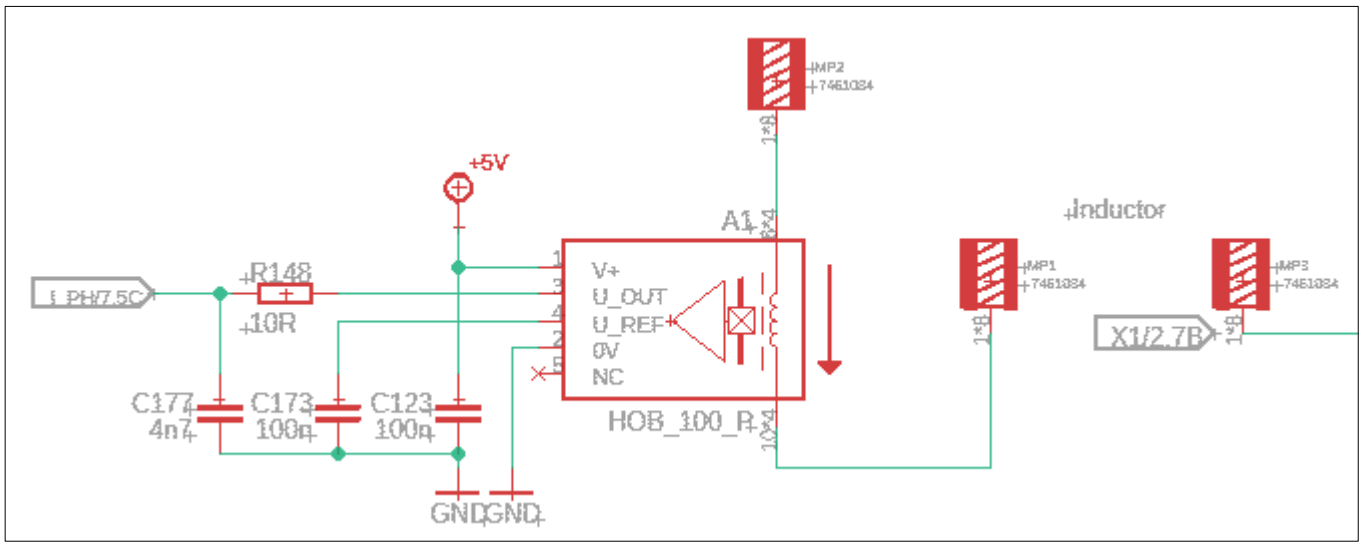

Figure 6 Load-current measurement

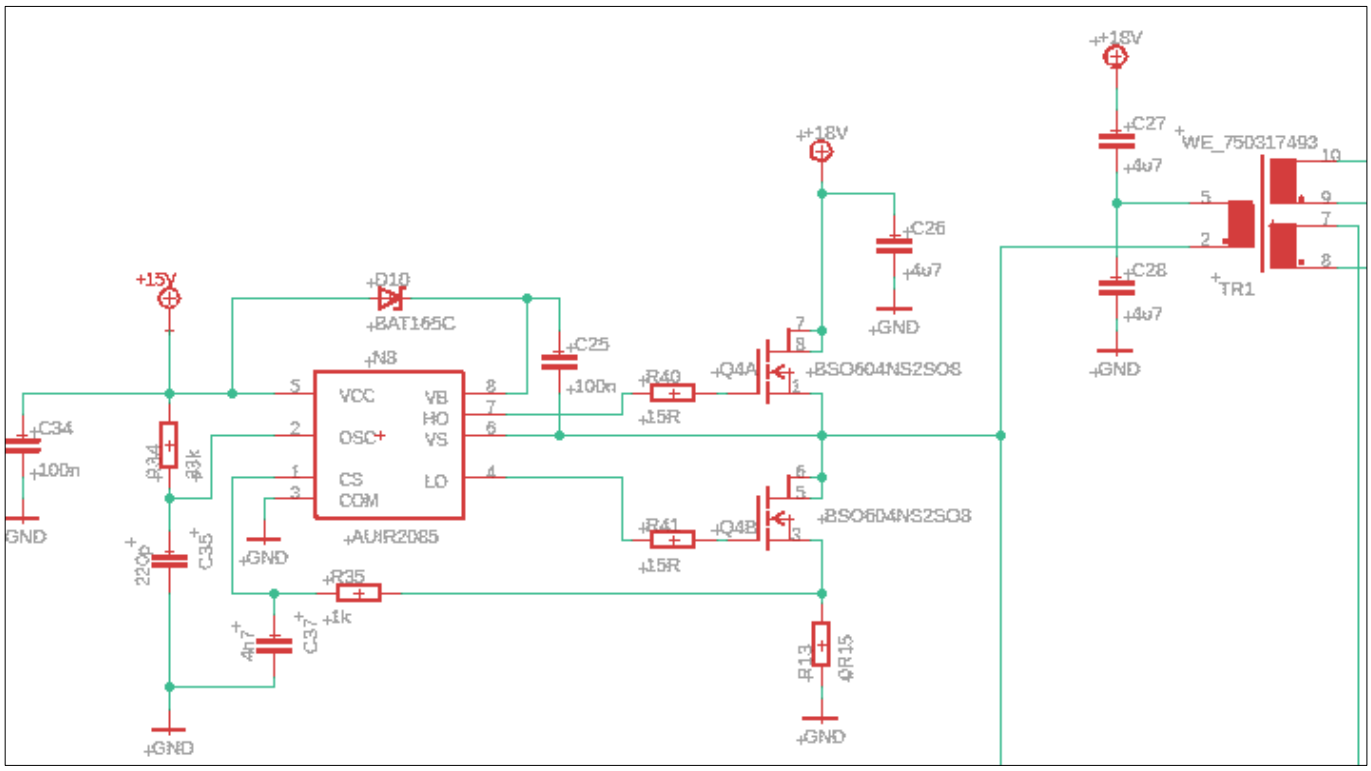

Figure 7 Gate driver supply

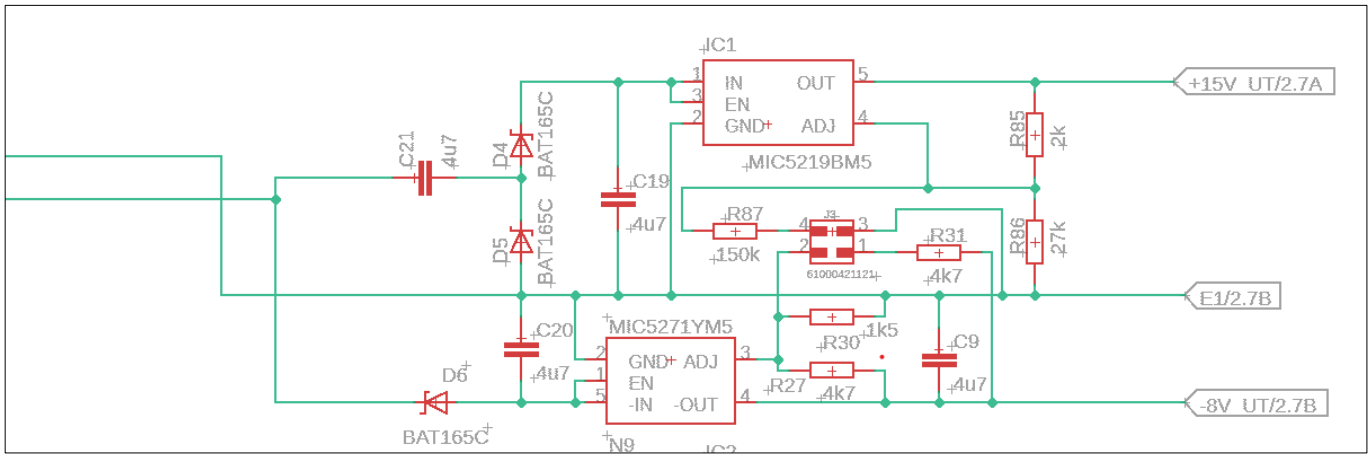

Figure 8 Adjustable gate driver supply

The secondary gate driver power supply can be adjusted via a jumper. Without the jumper, a voltage of +18 V is applied to the gate when the device is on, and -5 V when it is off. By setting the jumper from position 4 to position 3, the positive gate voltage is scaled down to +15 V via a voltage divider. The negative gate voltage can be adjusted to -3 V by setting the jumper from position 1 to position 2.

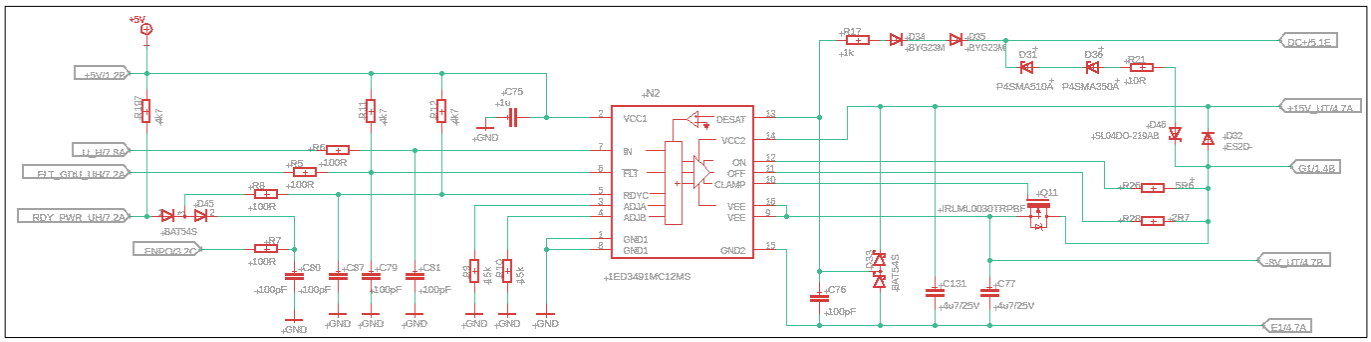

Figure 9 Gate driver

2.3 EasyPACK™ 2C press in process

Figure 10 shows the force-path diagram of an EasyPACK™ 2C power module. The press-in process is acceptable based on the maximum measured press-in force of 1.6 kN. The maximum press-in force was calculated using the following equations [1]:

Equation 1: Maximum total press-in force

$$F_{max,PressIn} = Number\ of\ Pins * F_{max,PressIn/pin} * 1,X$$

Equation 2: Calculation of maximum total press-in force

$$F_{max,PressIn} = 29 * 80\ \frac{N}{Pin} * 1{,}10 = 2{,}55\ kN$$

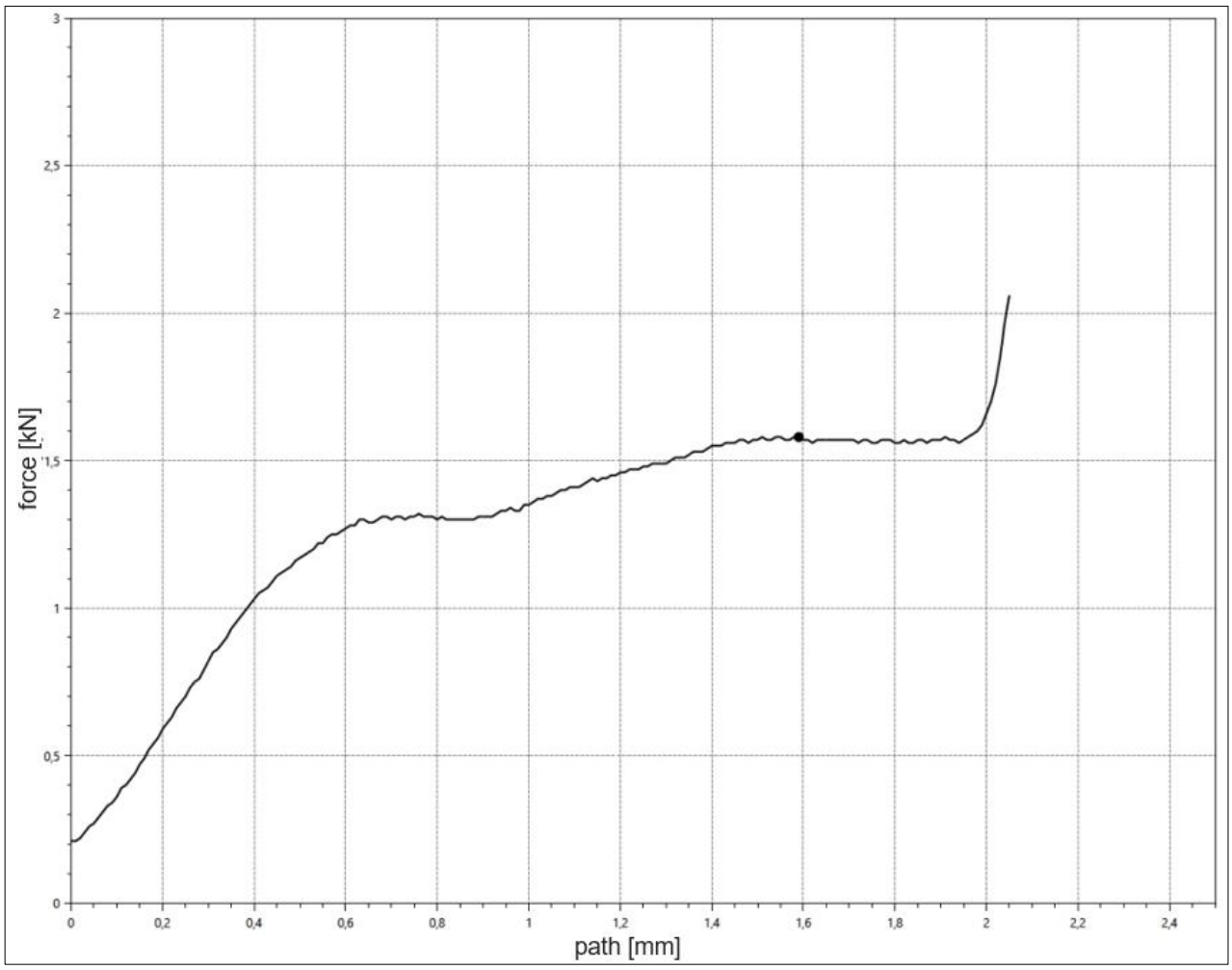

Figure 10 Force-path diagram of an EasyPACK™ 2C power module

2.4 Connector details

Table 3 lists the connector details for EVAL-F3L8MXTR12C2M2_P.

Table 3 Connectors

PIN	Label	Function
1	ENPO	Enable gate-driver stage
2	$G4_{DIFF}$	PWM gate 4 differential
3	$G4_{SINGLE\ ENDED}$	PWM gate 4 single ended
4	$G4_{DIFF}$	PWM gate 4 differential
5	$G3_{SINGLE\ ENDED}$	PWM gate 3 single ended
6	$G3_{DIFF}$	PWM gate 3 differential
7	$G2_{SINGLE\ ENDED}$	PWM gate 2 single ended

PIN	Label	Function
8	$G3_{DIFF}$	PWM gate 3 differential
9	$G1_{SINGLE\ ENDED}$	PWM gate 1 single ended
10	$G2_{DIFF}$	PWM gate 2 differential
11	FLT GD G1	Fault gate driver G1
12	$G2_{DIFF}$	PWM gate 2 differential
13	RDY PWR GD G1	Ready power gate driver G1
14	$G1_{DIFF}$	PWM gate 1 differential
15	FLT GD G2	Fault gate driver G2
16	$G1_{DIFF}$	PWM gate 1 differential
17	RDY PWR GD G2	Ready power gate driver G2
18	GND	Ground
19	FLT GD G3	Fault gate driver G3
20	I_{PHASE}	Analog measurement: Phase current
21	RDY PWR GD G3	Ready power gate driver G3
22	V_{LL}	Analog measurement: Phase-to-phase voltage
23	FLT GD G4	Fault gate driver G4
24	DC LINK	Analog measurement: DC-link voltage
25	RDY PWR GD G4	Ready power gate driver G4
26	DC LINK half	Analog measurement: DC-link half voltage
27	+5 V	Low-voltage supply
28	MODUL TEMP	Analog measurement: NTC power module
29	+15 V	Low-voltage supply
30	GND	Ground
31	-	-
32	GND	Ground
33	+24 V	Supply voltage
34	GND 24 V	Ground 24 V supply voltage

3 Double-pulse test for system performance

For the double-pulse test, the setup shown in Figure 11 was chosen. Through the commutation control in the application, a double-pulse test was carried out between systems T3 and T2. For this, a DC link was short-circuited and pulsed with half the DC-link voltage of 400 V. System T4 was constantly kept on. For active rectification before the second pulse from system T3, system T2 was actively switched in the freewheeling mode to minimize the recovery losses over the body diode. As shown in the figure, the gate-source voltages of systems T3 and T2, the drain-source voltage across T3, and the drain current in the DC path were measured.

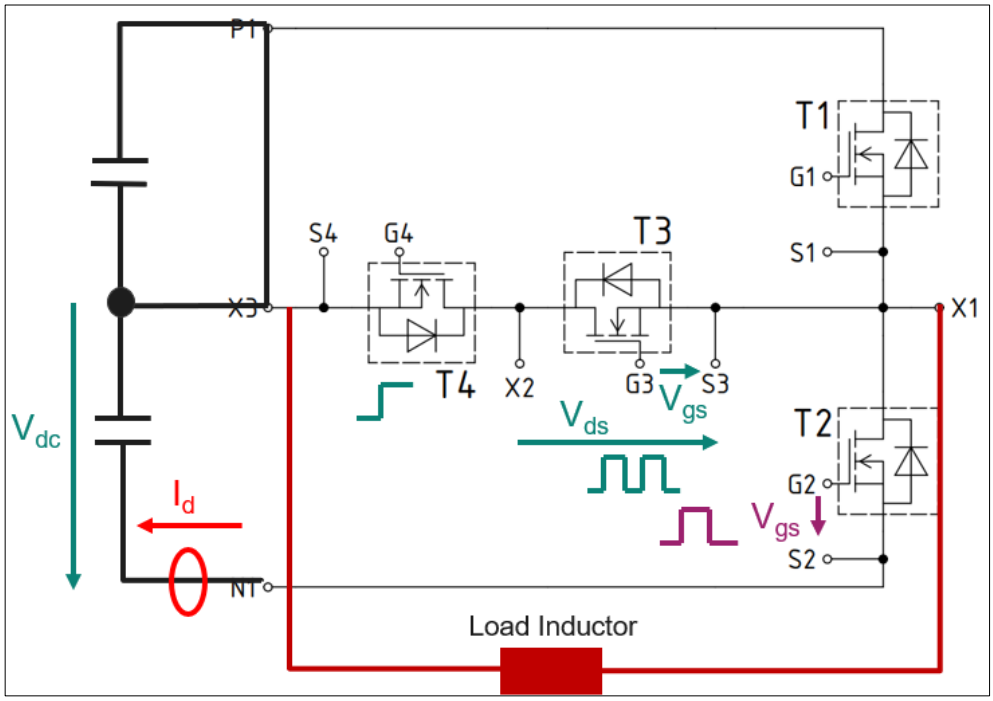

Figure 11 Double-pulse test setup

Table 4 Double-pulse test parameters

Parameter	Value
V_{dc}	400 V
$R_{g,on}$	5.6 Ω
$R_{g,off}$	2.7 Ω
Positive gate supply voltage	+18 V
Negative gate supply voltage	-3 V
Dead time	200 ns

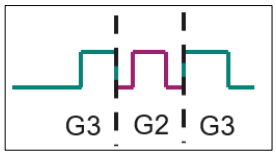

Figure 12 Double-pulse test sequence

3.1 Measurement results of the double-pulse test

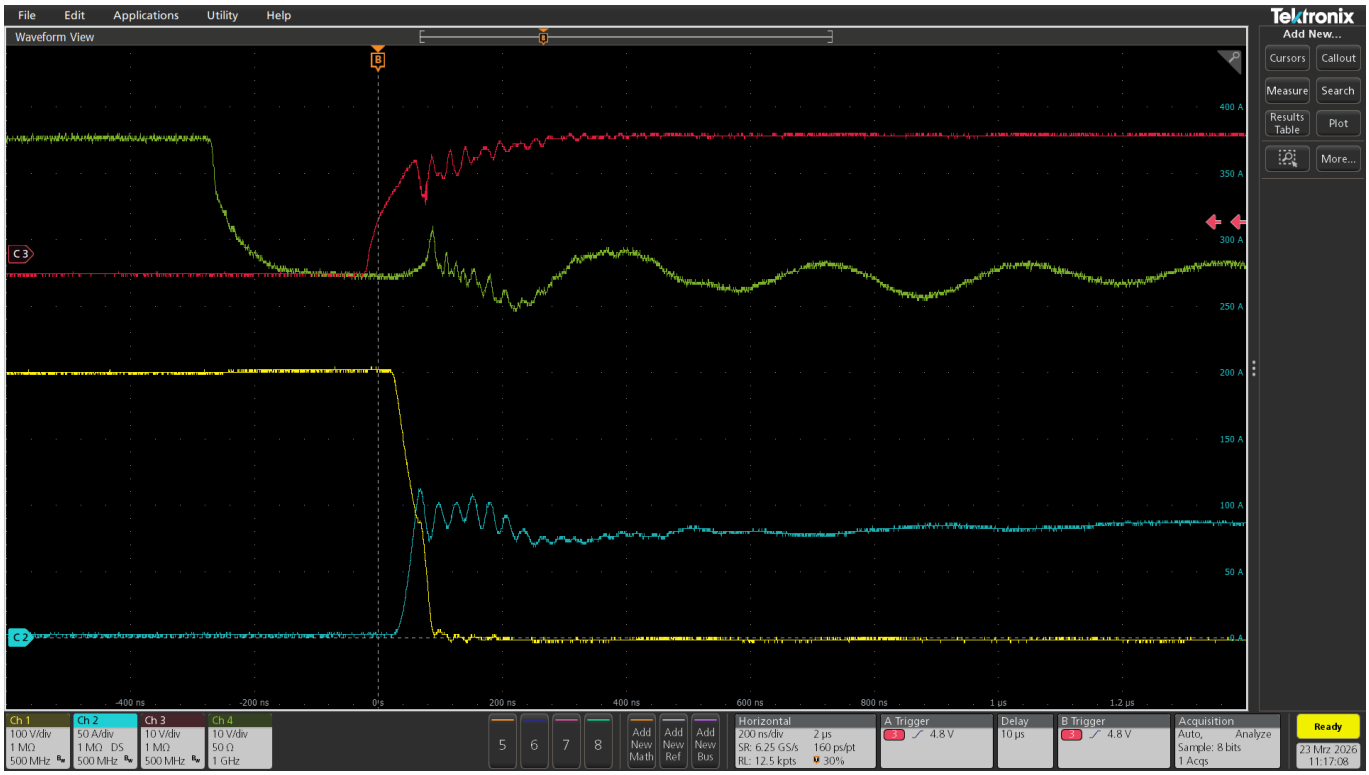

Figure 13 Turn-on event at nominal module current

Table 5 Turn-on event at nominal module current in the double-pulse test

Channel	Description	Channel scaling
1	V_{ds}	200 V/div
2	I_d	50 A/div
3	$V_{gs,G3}$	10 V/div
4	$V_{gs,G2}$	10 V/div
Horizontal	Time scaling	200 ns/div

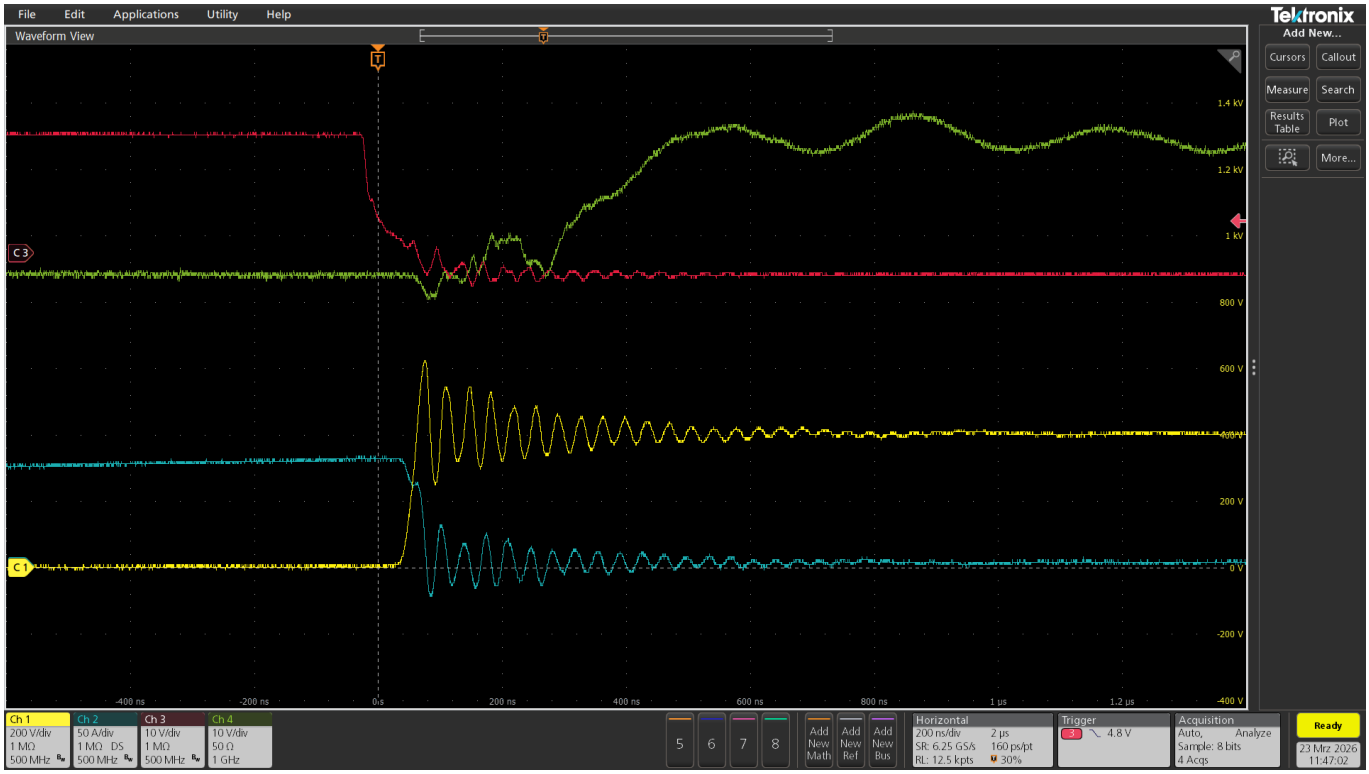

Figure 14 Turn-off event at nominal module current

Table 6 Turn-off event at nominal module current in the double-pulse test

Channel	Description	Channel scaling
1	V_{ds}	200 V/div
2	I_d	50 A/div
3	$V_{gs,G3}$	10 V/div
4	$V_{gs,G2}$	10 V/div
Horizontal	Time scaling	200 ns/div

3.2 Results of analog measurement

In this section, the five analog measurement functions, current measurement, grid-voltage measurement, DC-link measurement, and NTC measurement are presented. All measurement functions are routed back to the connection interface that was presented in chapter 2 and have a voltage range between 0 and +5 V. For the current and grid-voltage measurements, the voltage levelwas set to +2.5 V so that both positive and negative values can be displayed. This enables developers to use a self-designed control card for evaluating the analog measurements. All analog measurement signals are safely isolated from the high-voltage side.

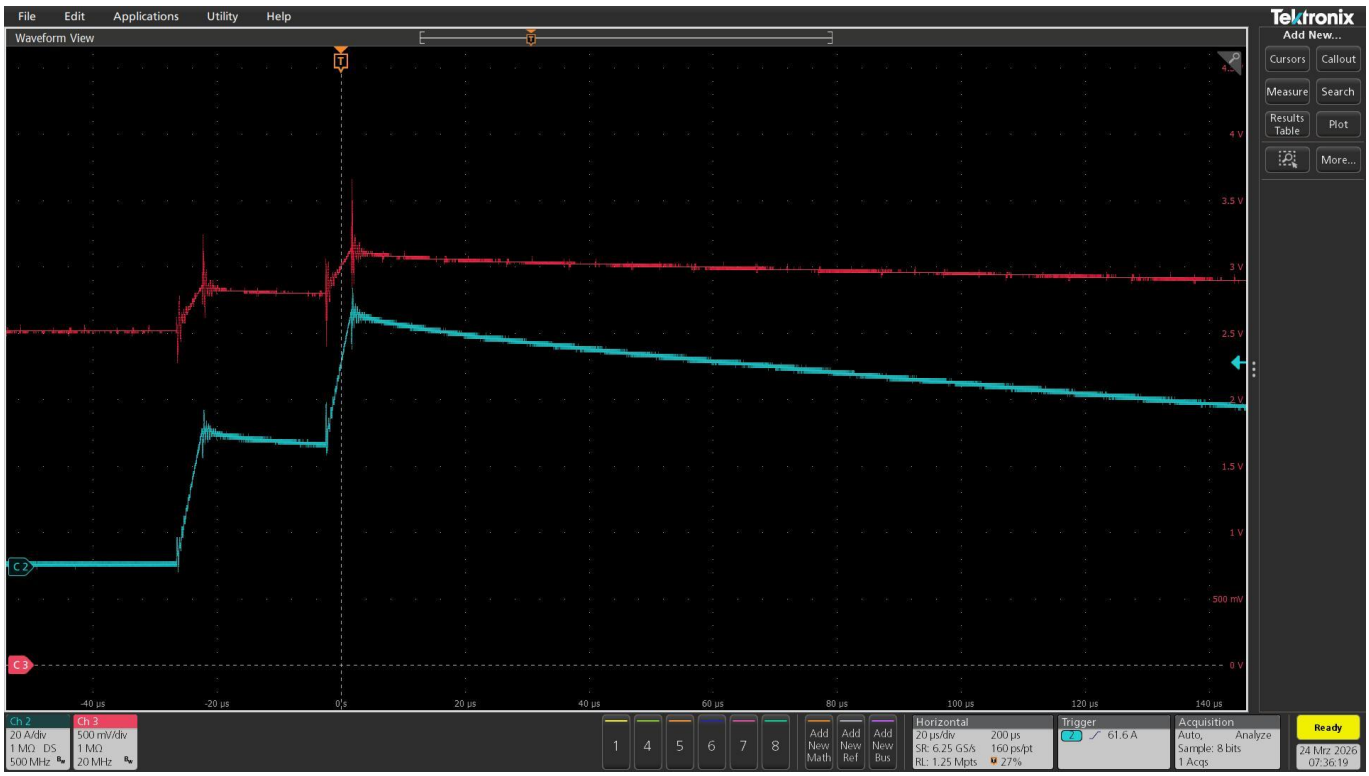

Figure 15 Double-pulse measurement: Load current

Table 7 Analog measurement current sensor

Channel	Description	Channel scaling
1	I_{load} (Rogowski)	20 A/div
2	I_{load} (Current Sensor)	500 mV/div
Horizontal	Time scaling	20 µs/div

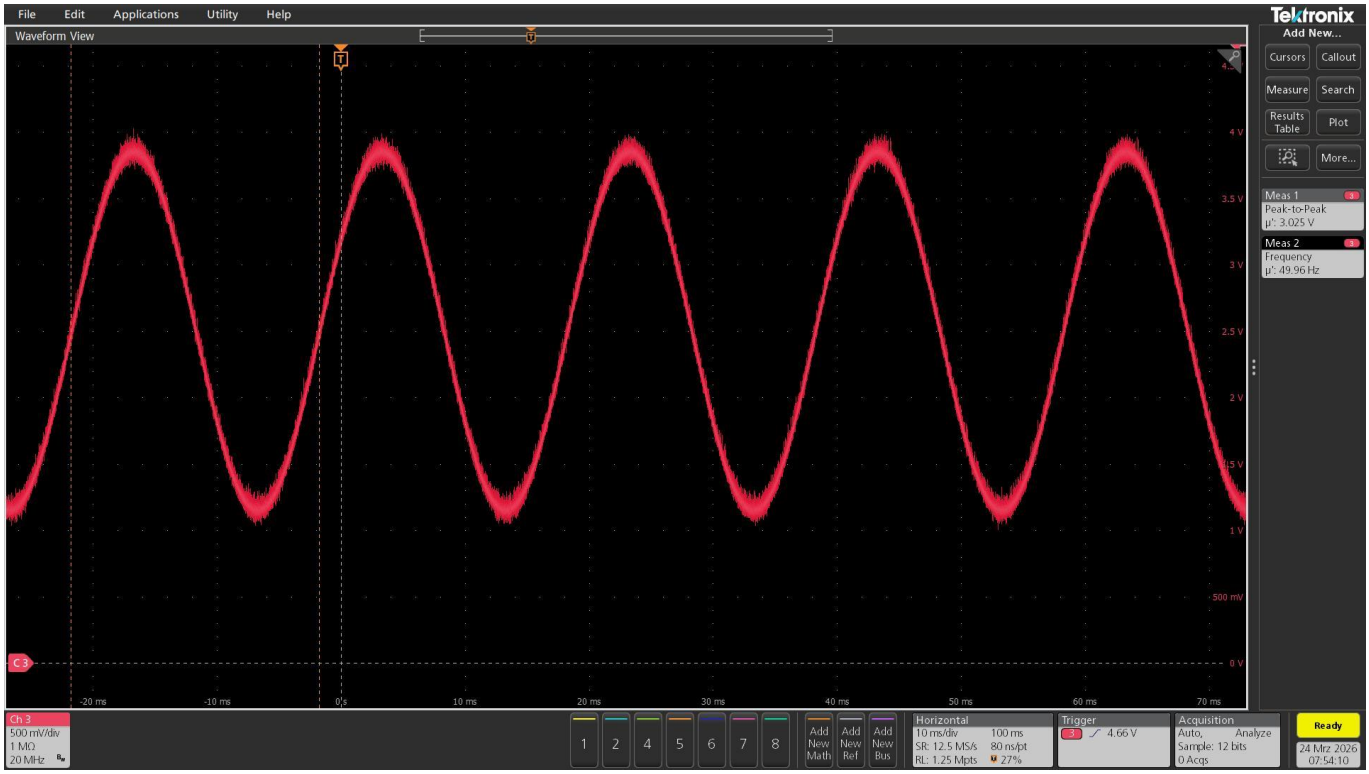

Figure 16 Grid voltage 400 V, 50 Hz line to line

Table 8 Analog measurement for line-to-line grid voltage

Channel	Description	Channel scaling
1	V_{LL}	500 mV/div
Horizontal	Time scaling	10 ms/div

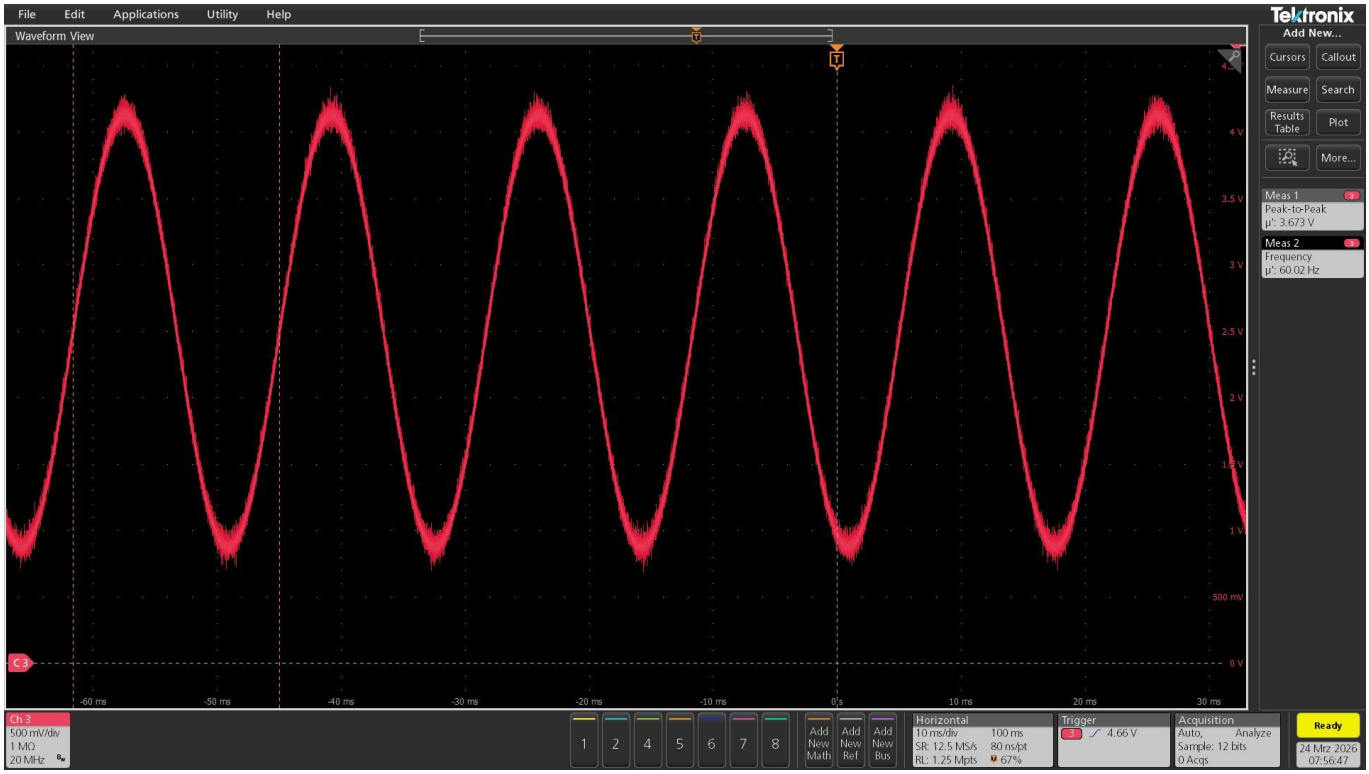

Figure 17 Grid voltage 480 V, 60 Hz line to line

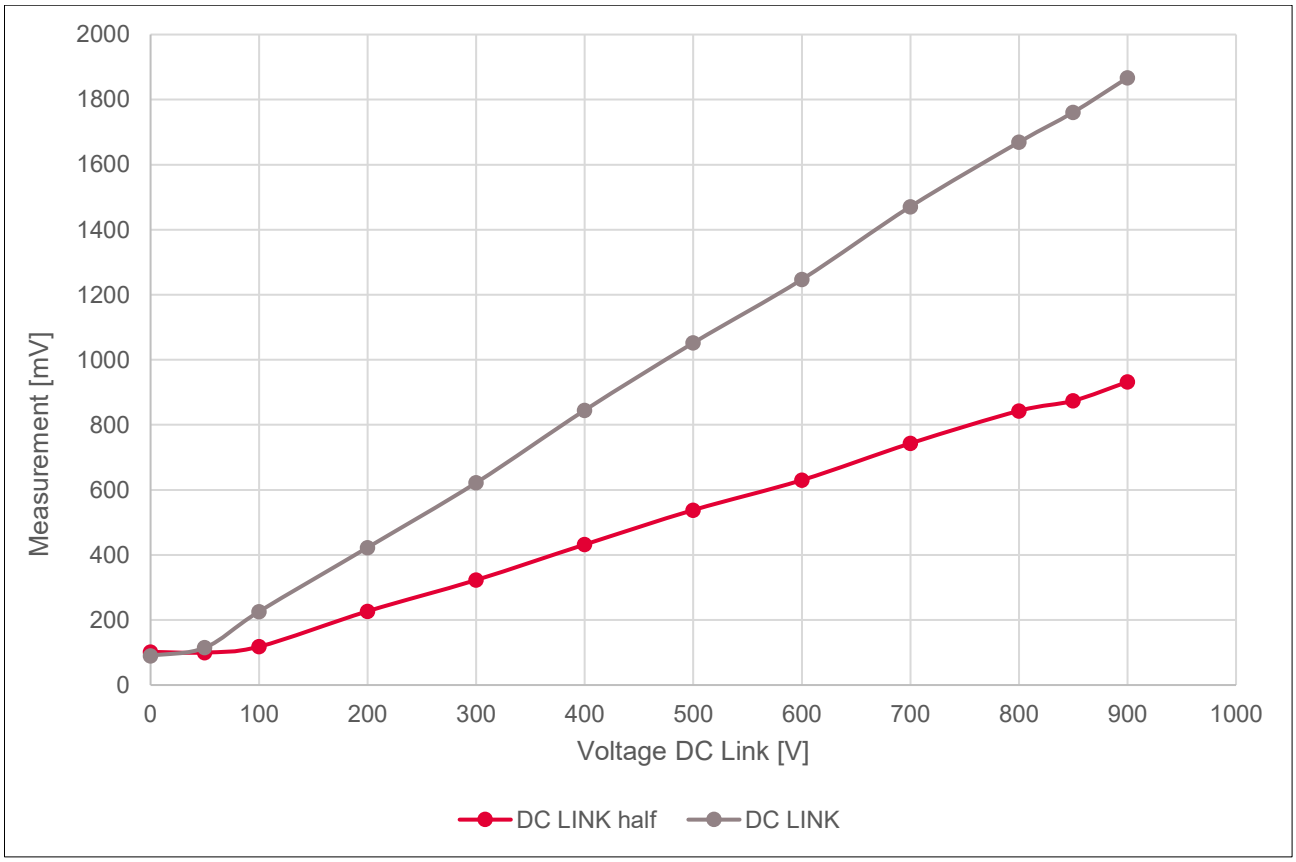

Figure 18 Analog measurement: DC-link

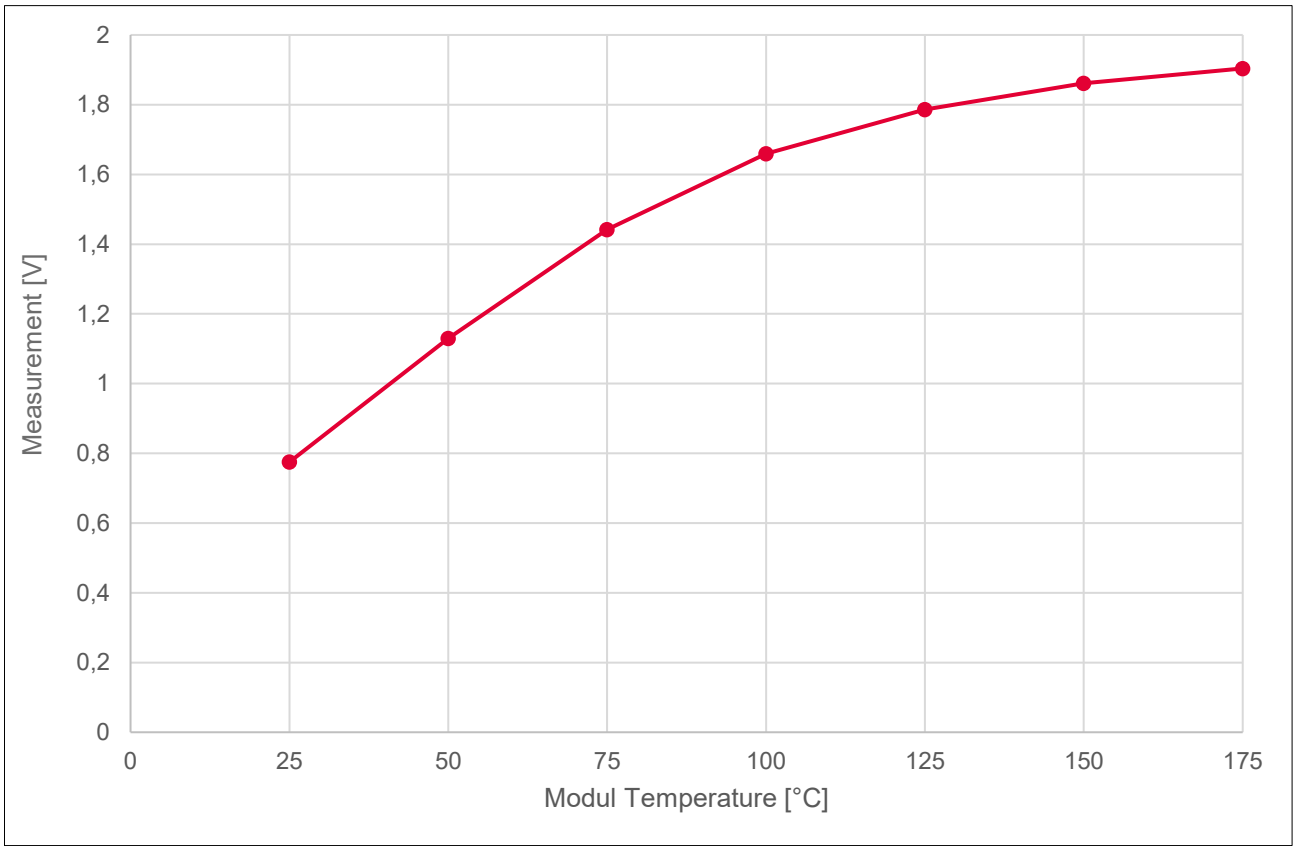

Figure 19 Analog measurement: NTC

4 Related resources

- https://www.infineon.com/part/TLE8386-2EL
- https://www.infineon.com/part/F3L8MXTR12C2M2-H11
- https://www.infineon.com/part/1ED3491MC12M
- https://www.infineon.com/part/AUIR2085S

Appendix

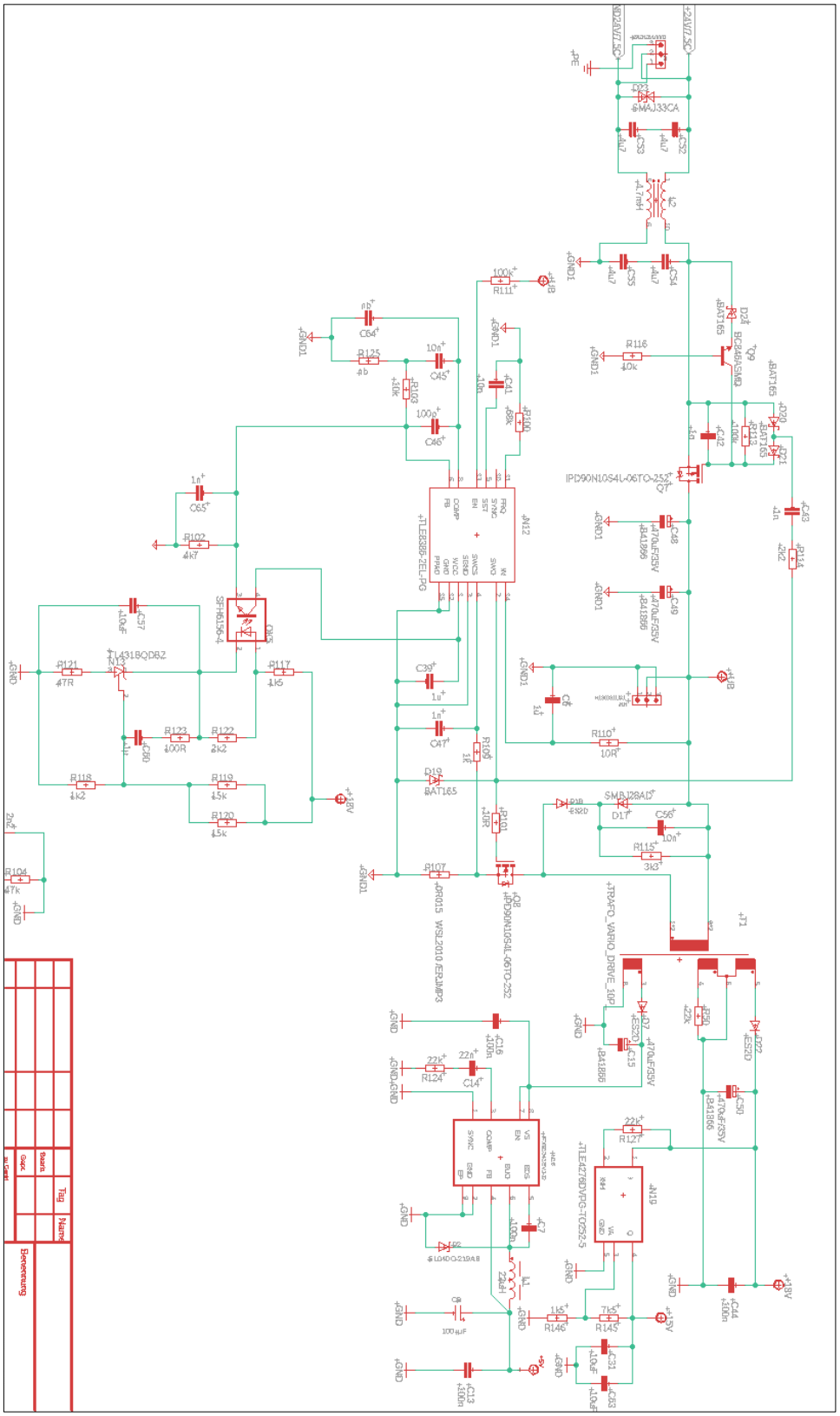

Figure 20 Flyback power supply

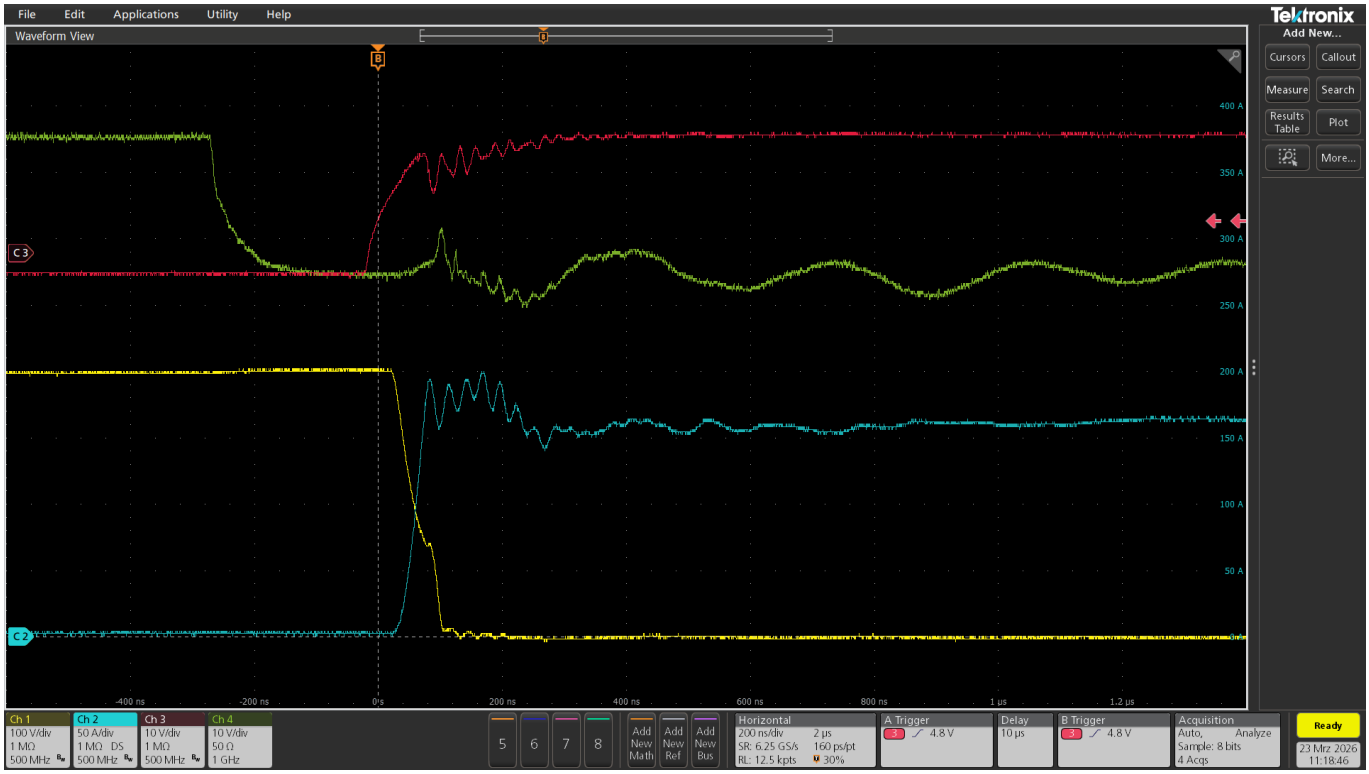

Figure 21 Turn-on event at twice the nominal module current

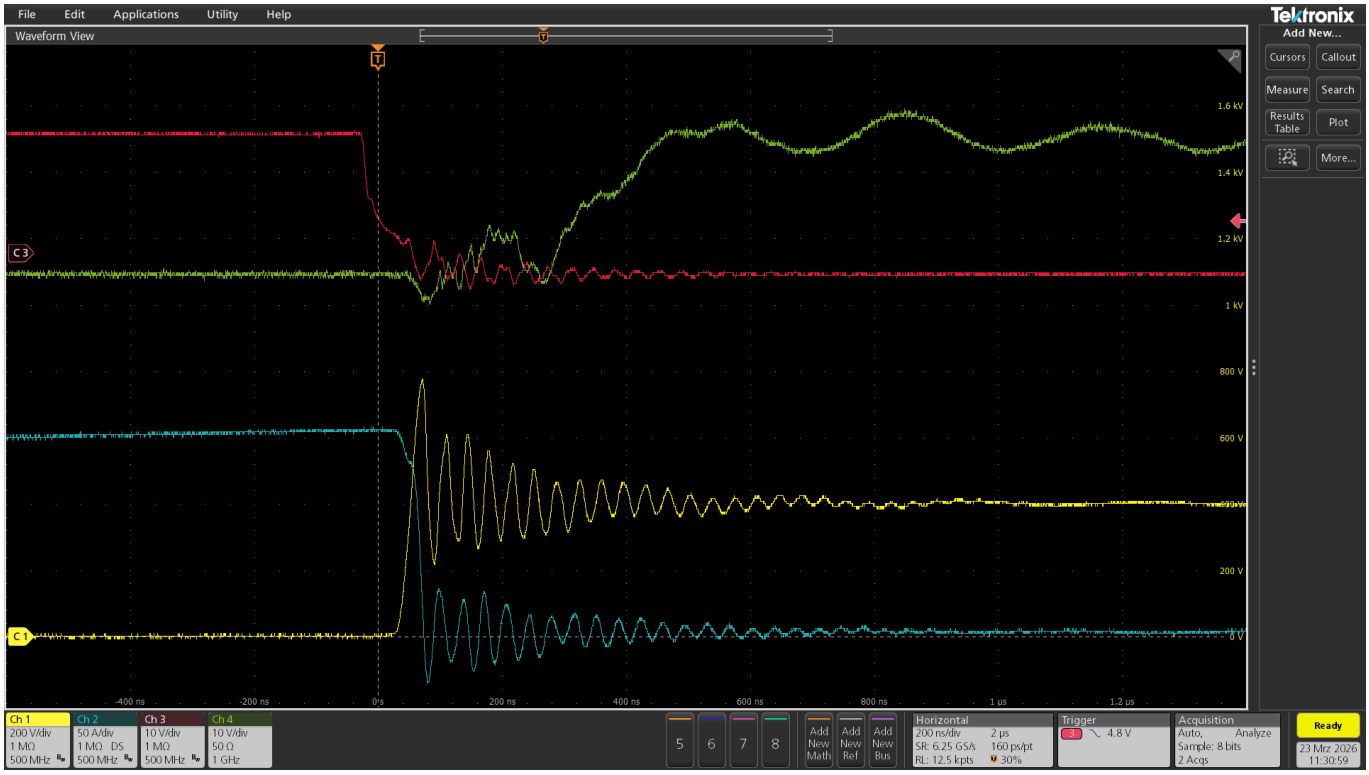

Figure 22 Turn-off event at twice the nominal module current

References

[1] Infineon Technologies AG. AN2009-01 (2025): Assembly Instructions for the Easy Modules. V1.1
https://www.infineon.com/assets/row/public/documents/60/42/infineon-an2023-07-assembly-instructions-for-the-easy-modules-applicationnotes-en.pdf

[2] Infineon Technologies AG. Datasheet: F3L8MXTR12C2M2Q_H11 EasyPACK™ module. V1.0
https://www.infineon.com/assets/row/public/documents/60/49/infineon-f3l8mxtr12c2m2q-h11-datasheet-en.pdf

Revision history

Document revision	Date	Description of changes
1.0	15.06.2026	First version

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Safety & Operating Instructions:
Customer shall check the Evaluation Board for any physical damage which may have occurred during transport. If customer detects any damages or defects in the Evaluation Board, customer shall not connect the Evaluation Board to a power source. Customer shall contact Infineon for further support. If customer observes unusual operating behavior during the evaluation process, customer shall immediately shut off the power supply to the Evaluation Board and consult Infineon for support.
Customer shall not touch the Evaluation Board during operation and keep a safe distance.
Customer shall not touch the Evaluation Board after disconnecting the power supply, several components may still store electrical voltage and can discharge through physical contact. Several parts, like heat sinks and transformers, may still be very hot. Allow the components to cool before touching or servicing.
The electrical installation must be completed in accordance with the appropriate safety requirements.