EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board

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About this document

Scope and purpose

This document describes the EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board. The user is encouraged to refer to the corresponding datasheet and user manual for information on the product features and configurability. The evaluation board also supports a graphical user interface together with an Aurix™ TC375 shield buddy board to provide a simple, easy-to-use tool for getting familiar with the features and for high-voltage tests with power semiconductor devices.

Intended audience

The intended audiences for this document are design engineers, technicians, and developers of electronic systems.

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Safety precautions

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

Table 1 Safety precautions

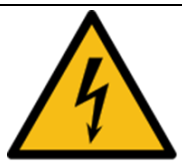	**Warning:** *The DC link potential of this board is up to 1000 VDC. When measuring voltage waveforms by oscilloscope, high voltage differential probes must be used. Failure to do so may result in personal injury or death.*
	**Warning:** *ELECTRIC SHOCK HAZARD Contact can cause an electric shock. If a voltage above 60 V is applied to the evaluation board, then only persons trained in working with voltages above 60 V are allowed to handle the evaluation board. In addition, ensure that hazardous live parts are not accessible and that accessible live parts are not hazardous.*
	**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:** *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 EiceDRIVER™ gate driver 1EDI3040AS overview

The EiceDRIVER™ gate driver 1EDI3040AS is a high-voltage galvanic isolated gate driver for IGBTs and SiC MOSFETs designed for automotive traction inverter applications. The device is based on Infineon's Coreless Transformer (CT) technology, providing reinforced galvanic insulation between low voltage and high voltage domains. The device is designed to drive 600 V, 750 V and 1200 V IGBTs and SiC-MOSFETs directly. Short propagation delays and controlled internal tolerances minimize distortions of the PWM signal.

The device features a split output stage to achieve a slew rate control with an output stage of 20 A peak current capability. In addition, there is an integrated and external Miller clamping available to support highest dV/dT. A large panel of safety-related functions supports functional safety requirements at system level as per ISO 26262.

The fast and configurable desaturation protection in combination with the SOFTOFF pin enables the system to use IGBTs and SiC-MOSFETs to its limits for optimum system efficiency.

The device includes an 11-bit SAR-ADC, which can be multiplexed to two output pins to precisely monitor the DC-link voltage and the power semiconductor temperature. Moreover, the ADC also measures voltages at VCC2, VEE2, DESAT input and others. The gate timing capture functionality enables predictive maintenance of the system.

A flyback controller is integrated to support accurate and on-the-fly configurable secondary side supply voltage generation.

For more details regarding the features and the configurability of the device, the user is encouraged to refer to the product datasheet and user manual.

Type	Package	Marking
1EDI3040AS	PG-LDSO-36	1EDI3040AS

2 EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board

This evaluation board is designed to be compatible with four components – Aurix™ TC375 shield buddy board, adapter board and the HybridPACK™ HD module. The evaluation board can be used as a standalone test board or as a combination with the above four components. When used in combination with the Aurix™ TC375 shield buddy board, a graphical user interface is also available to provide the user an easy-to-use way to configure, control and test the gate drivers.

Each evaluation board consists of two 1EDI3040AS gate drivers connected in a half bridge configuration (further referred to in this document as “HS” and “LS” gate drivers respectively) with each gate driver having its own built-in flyback controller, which is used to generate the corresponding power supplies - VCC2 and VEE2. The system architecture of the EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board together with the Aurix™ TC375 shield buddy board, is shown in Figure 1.

The evaluation boards and interface components can be ordered with your local Infineon sales representative with the corresponding SP order number. **Note that a DC link solution is not available, the DC link needs to be provided by the user.**

Component	SP Order Number
1EDI3040AS HybridPACK™ HD evaluation board with adapter board	SP006185598
Aurix™ TC375 Shieldbuddy board	SP005432164
HybridPACK™ HD module	FF01M2R14A60MA2XT: SP006072078 FF01MR14A60MA2XT: SP006086378 FF01M5R14A60MA2XT: SP006104595

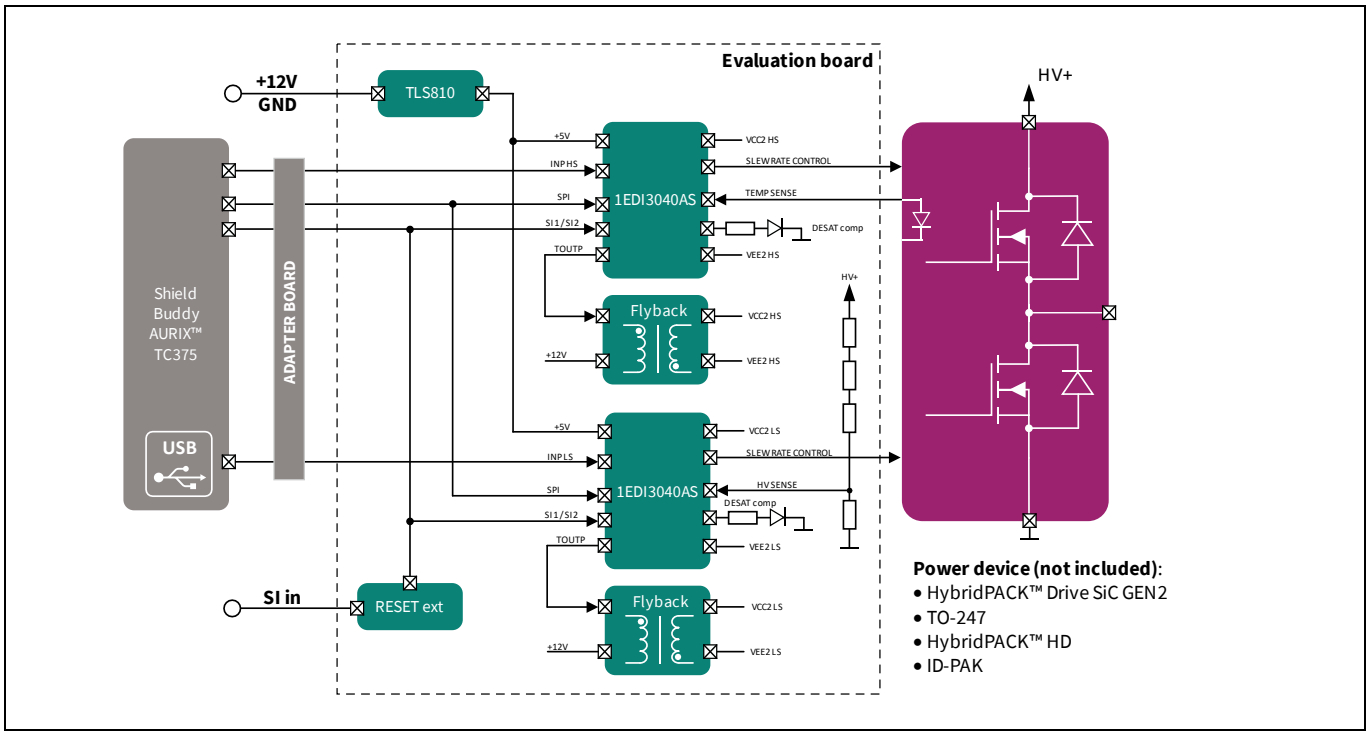

Figure 1 System architecture of 1EDI3040AS evaluation boards

2.1 PCB overview

This section provides an overview of all the connectors, LEDs and jumpers available on the EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board.

2.1.1 Connectors

The EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board has three banana connectors as shown in Figure 2 with the functionalities as mentioned in Table 1. Please see Chapter 0 for operating ranges of the connectors.

Table 1 Connectors

Connector # from Figure 2	Functionality
1	Primary power supply ground
2	+12 V primary power supply
3	Safety inputs (SI) control pin

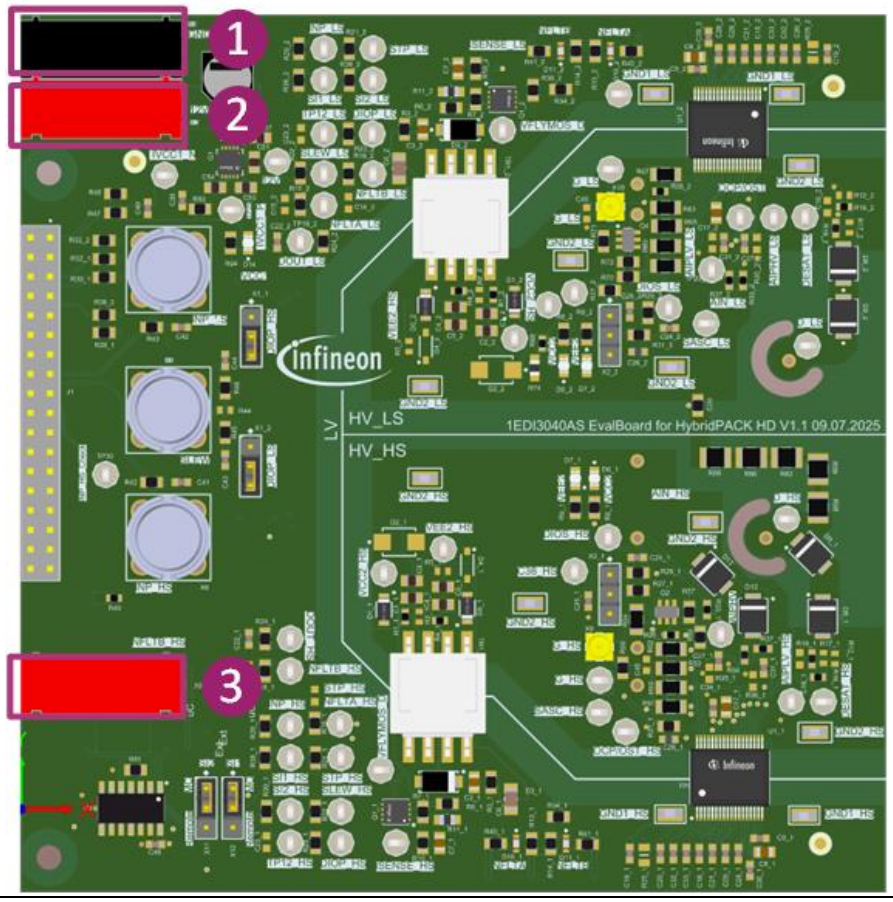

Figure 2 Connectors

2.1.2 LED indicators

The EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board is equipped with the following LEDs to signal important information.

Table 2 LED indicators

LED # from Figure 3	Functionality
1	VCC1 +5 V power supply
2	NFLTB_LS
3	NFLTA_LS
4	VCC2_LS
5	VEE2_LS
6	VEE2_HS
7	VCC2_HS
8	NFLTA_HS
9	NFLTB_HS

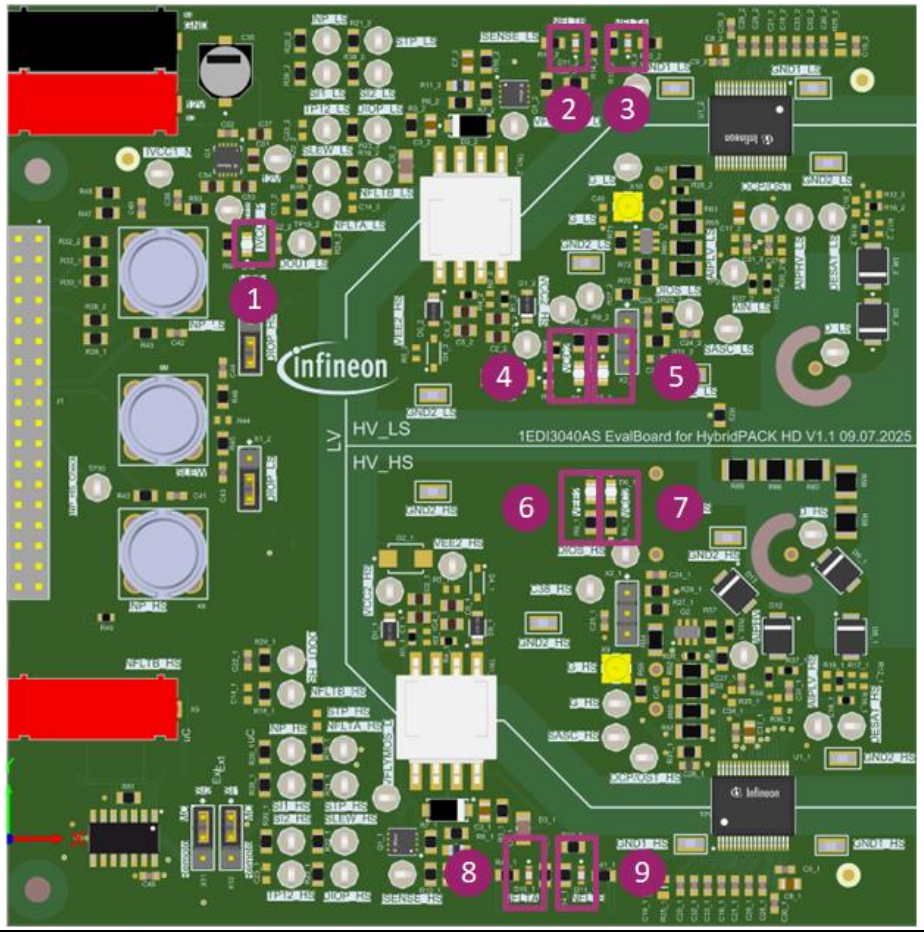

Figure 3 LED indicators

2.1.3 BNC connectors

The 1EDI3040AS evaluation board has the following BNC connectors to connect function generator inputs in case the Aurix™ TC375 shield buddy board and the graphical user interface are not used. Please see Chapter 0 for operating ranges of the BNC connectors.

Table 3 BNC connectors

BNC label from Figure 4	Functionality
1	INP PWM signal for LS gate driver
2	SLEW PWM signal for both LS and HS gate drivers
3	INP PWM for HS gate driver

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EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board

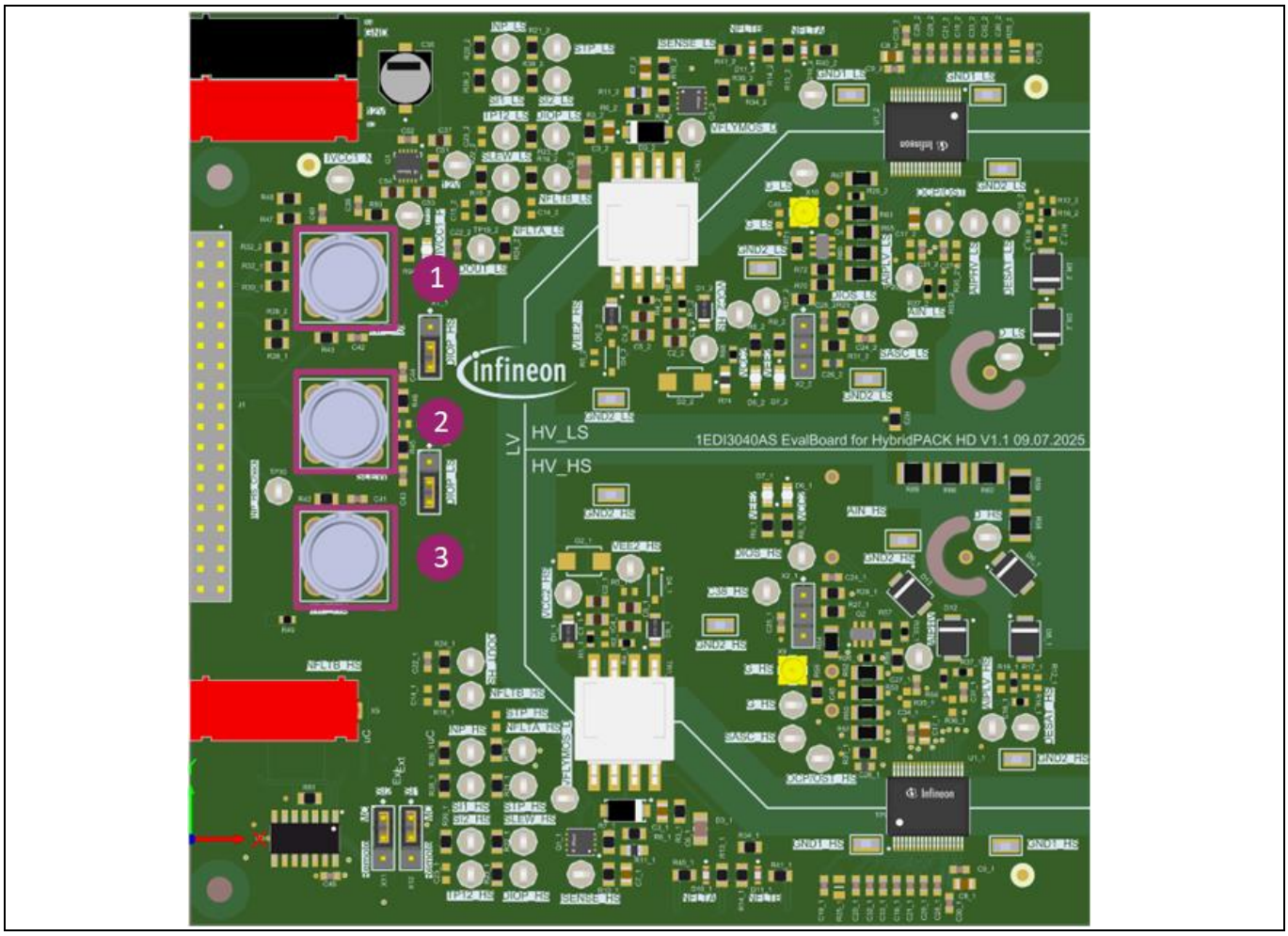

Figure 4 BNC connectors

When driving the PWM and slew rate signals through the external BNC connectors the external driving source needs to provide enough power to override the outputs

2.1.4 Jumper configurations

The 1EDI3040AS evaluation board provides the following configuration options with jumpers:

1. DIOP_HS and DIOP_LS
   - This jumper provides flexibility to use the DIOP pins of both the HS and LS device either as an input or output when using the 1EDI3040AS evaluation board in combination with the Aurix™ shield buddy board and the graphical user interface

Table 4 Jumper configuration options for DIOP_HS and DIOP_LS

Jumper configuration	Functionality
1-2	DIOP used as input
2-3	DIOP used as output

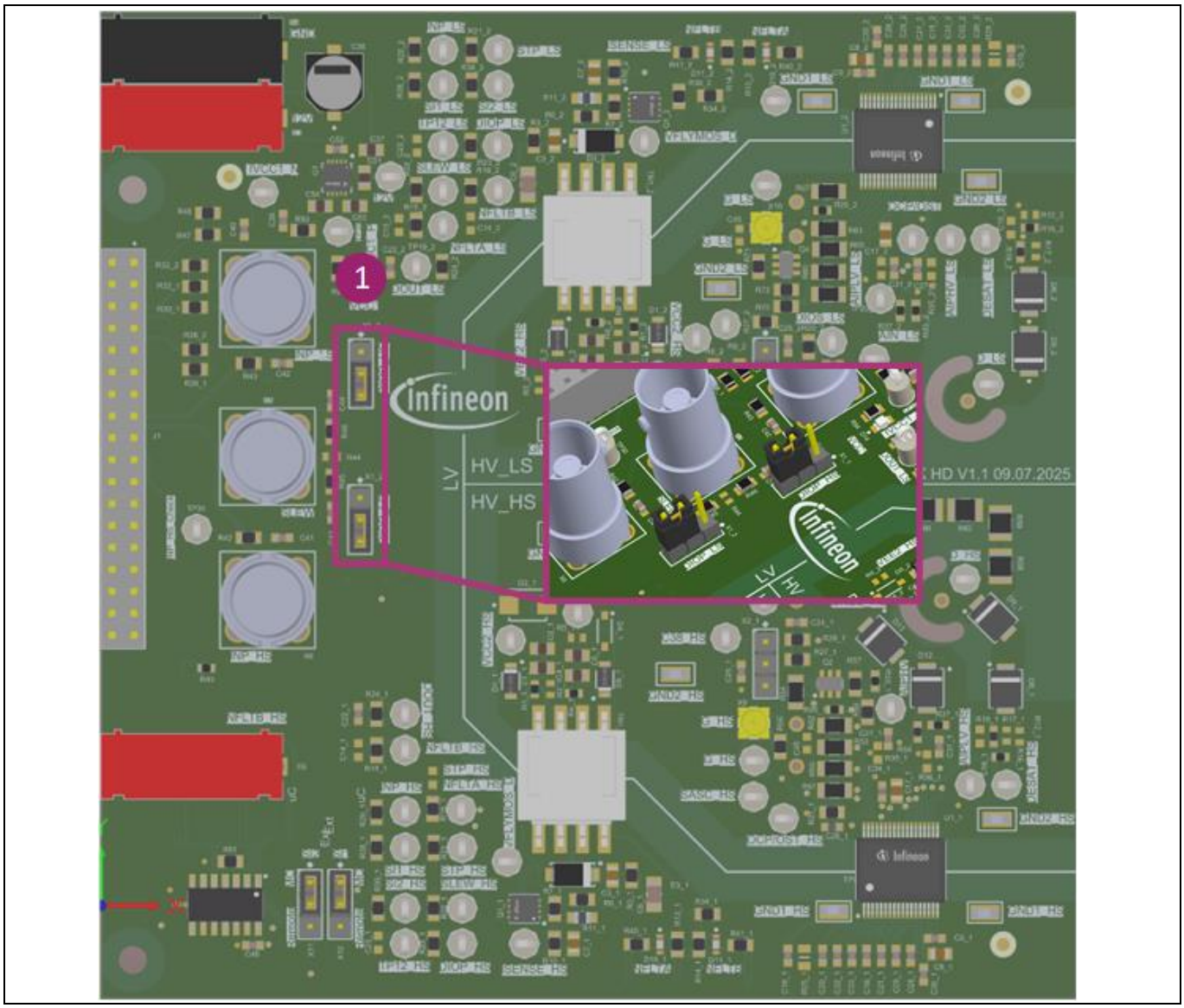

Figure 5 DIOP_HS and DIOP_LS configuration jumpers

2. SASC/DIOS_HS and SASC/DIOS_LS

- This jumper provides the following configuration options:

Table 5 Jumper configuration for SASC/DIOS_HS and SASC/DIOS_LS

Jumper configuration	Functionality
Open – no jumper placed	DIOS: input or output as configured SASC: inactive
1-2	DIOS: output SASC: controlled by DIOS
2-3	DIOS: input or output as configured SASC: connected to VCC2

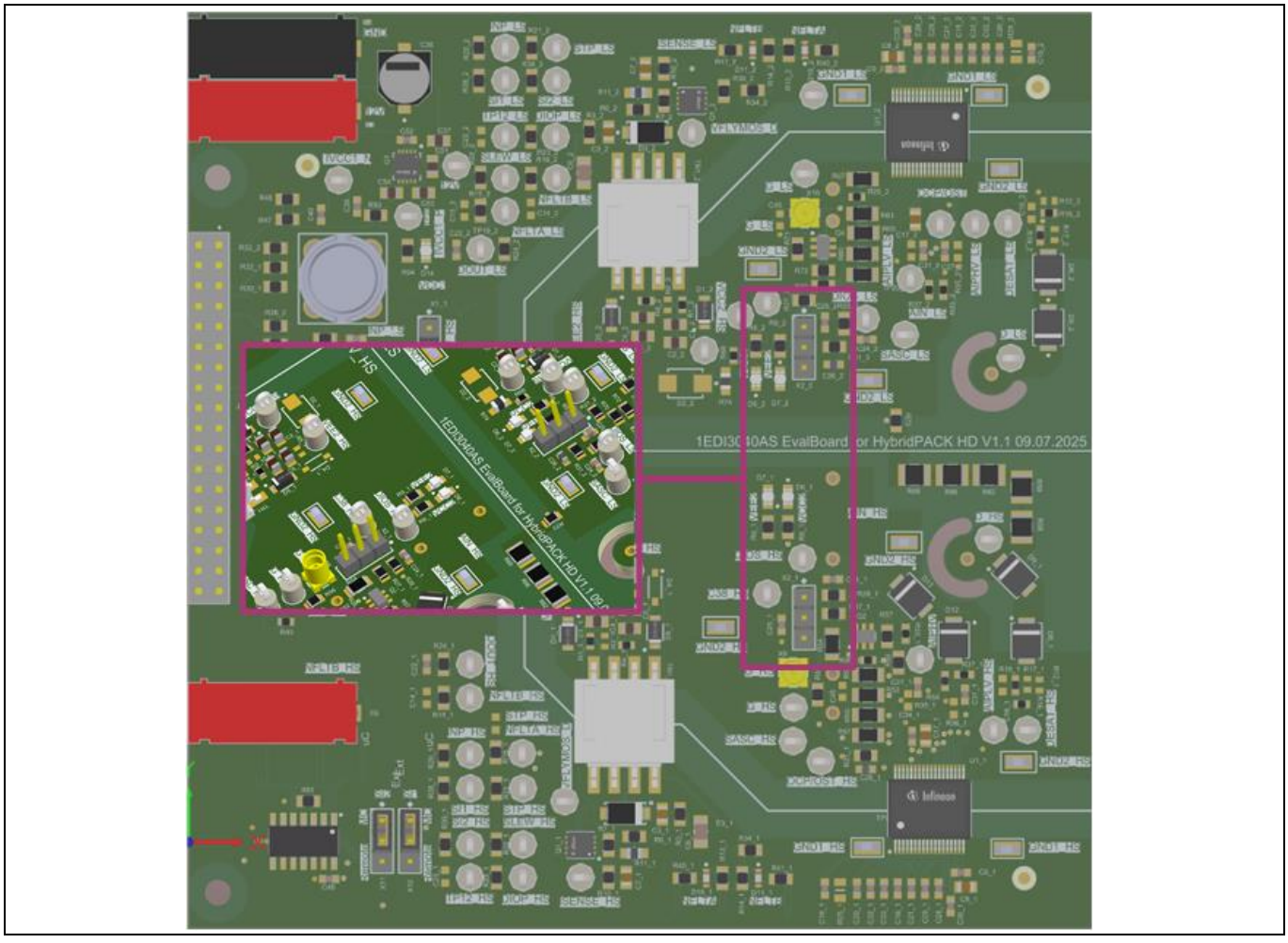

Figure 6 SASC jumpers left open

3. SI1 and SI2

- These jumpers are used to select if the SI1 and SI2 signals are controlled by the Aurix™ TC375 Shieldbuddy board or through the SI reset circuit connected to the banana connector SI_IP

Table 6 Jumper configuration for SI1 and SI2

Jumper configuration	Functionality
1-2	SI1 and SI2 controlled by the micrcontroller
2-3	SI1 and SI2 controlled by banana connector SI_IP

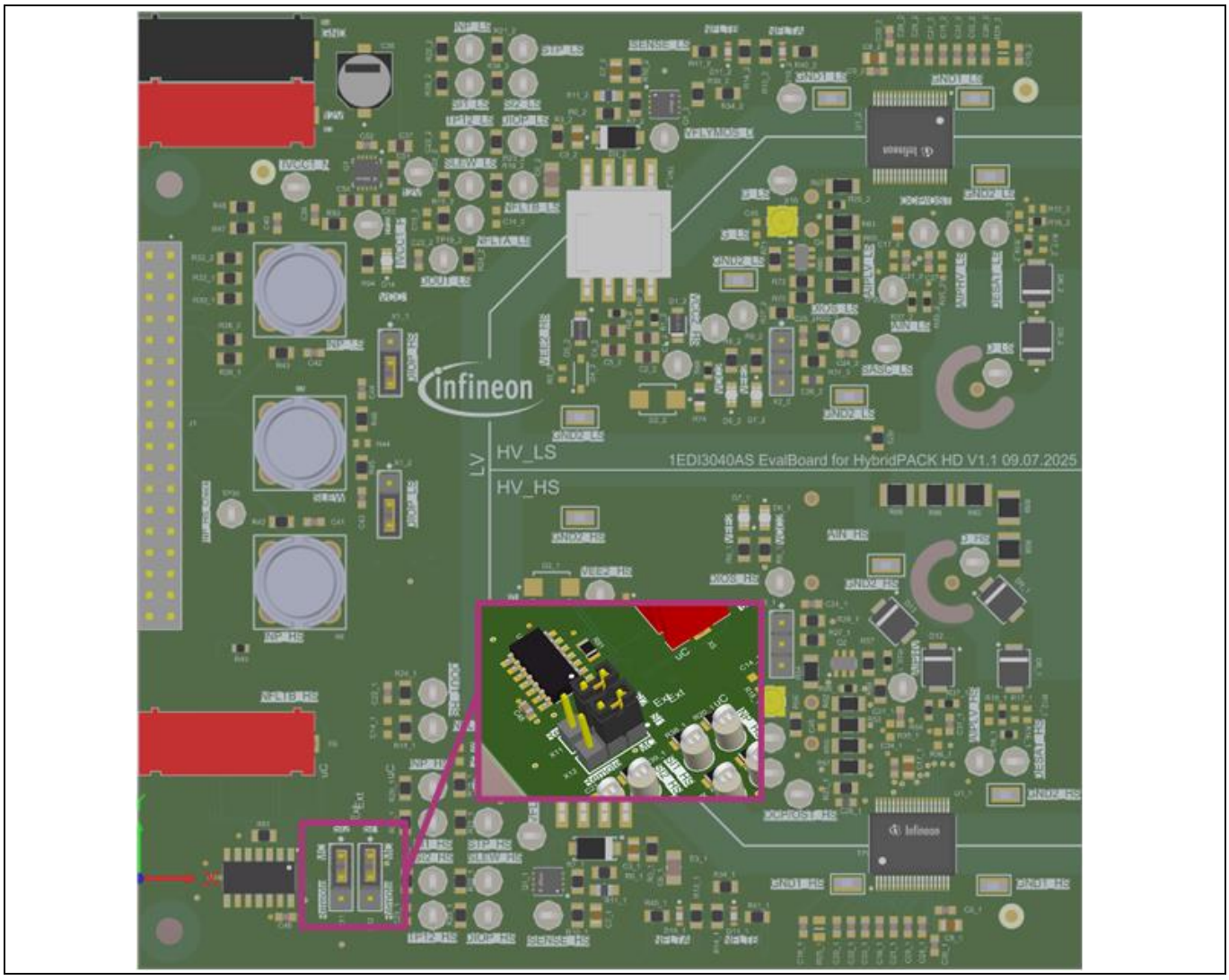

Figure 7 SI1 and SI2 jumpers configured to be controlled by the microcontroller

2.1.5 External SI interface

The safety inputs control pin as shown in Figure 2 can be used to asynchronously control the state machine of the microcontroller through an external function generator. To use this function set the jumper according to Table 6 so that the external SI control is selected.

By applying a voltage in the range as shown below the

Table 7 SI interface voltages

Voltage on SI_IP (Typ)	Operating mode
0 … 1.25 V	Configuration and Error
1.25 …. 2.5 V	PWM enable
2.5 … 3.75 V	ASCP ON
3.75 … 5 V	ASCP OFF

2.1.6 Operating conditions

Please make sure that the operating ranges defined in Table 8 are maintained to avoid electrical damage of the product.

Table 8 Operating conditions

Parameter	Pin	Values		Unit	Note
		Min.	Max.		
$V_{primary}$	Between banana sockets “+12 V” and “GND”	6	26	V	Limited by input voltage requirement from Flyback controller and linear voltage regulator
V_{SI_IP}	Between banana sockets “SI_IP” and “GND”	0	5	V	Limited by SI reset circuitry supplied by VCC1
V_{BNC}	All BNC connectors	-0.3	5	V	Limited by VCC1 voltage
V_{AIPLV}	Voltage nodes NTC_LS and DESAT_COMP_HS	0	3.3	V	Please see schematic of the evaluation board. Limited by internal clamping structure of the gate driver

2.2 Schematic

Figure 8, Figure 9, Figure 10, Figure 11, Figure 12, Figure 13 and Figure 14 show the EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board schematics.

Note: A red cross represents not mounted components

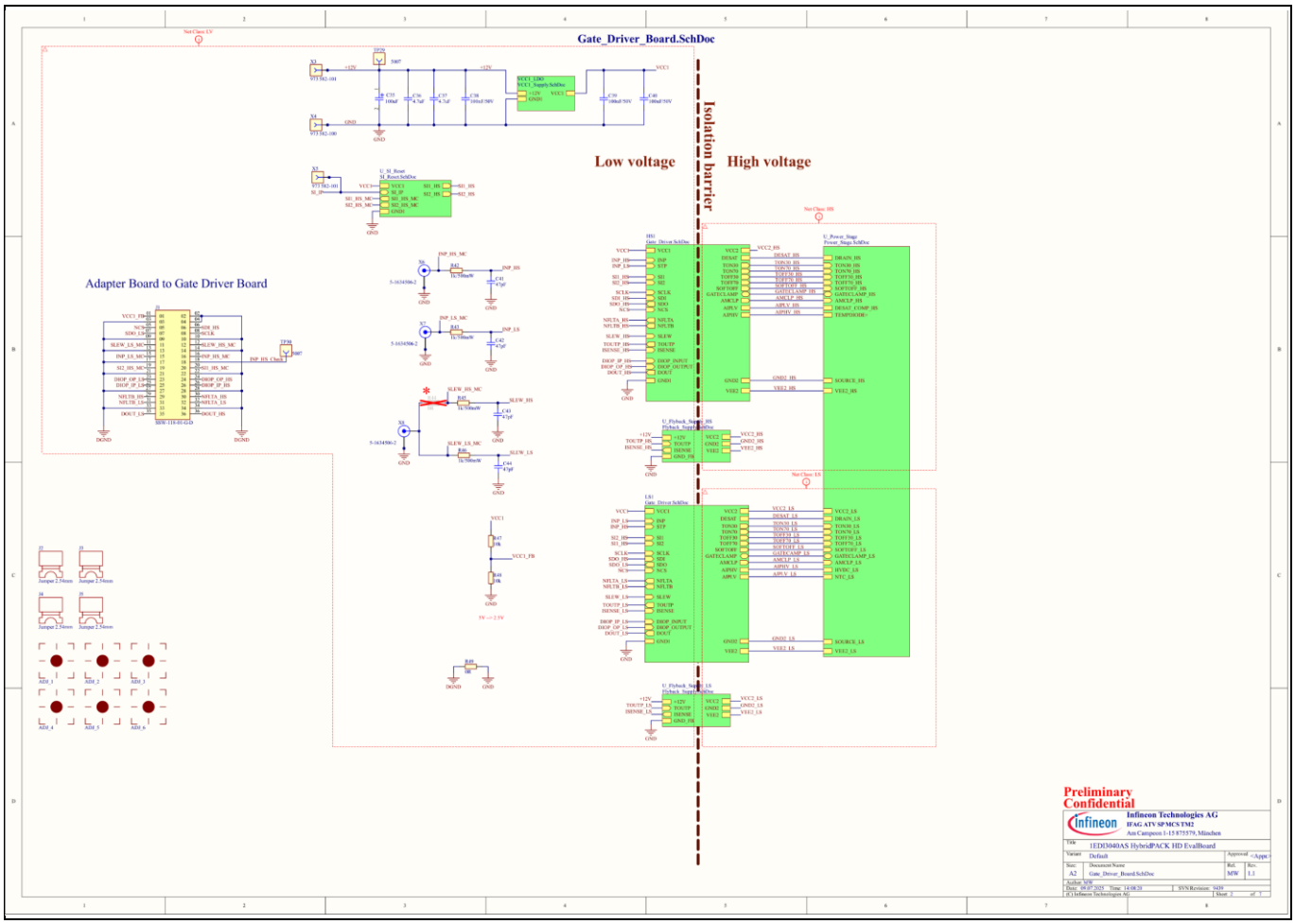

Figure 8 Top-level schematic overview

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EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board

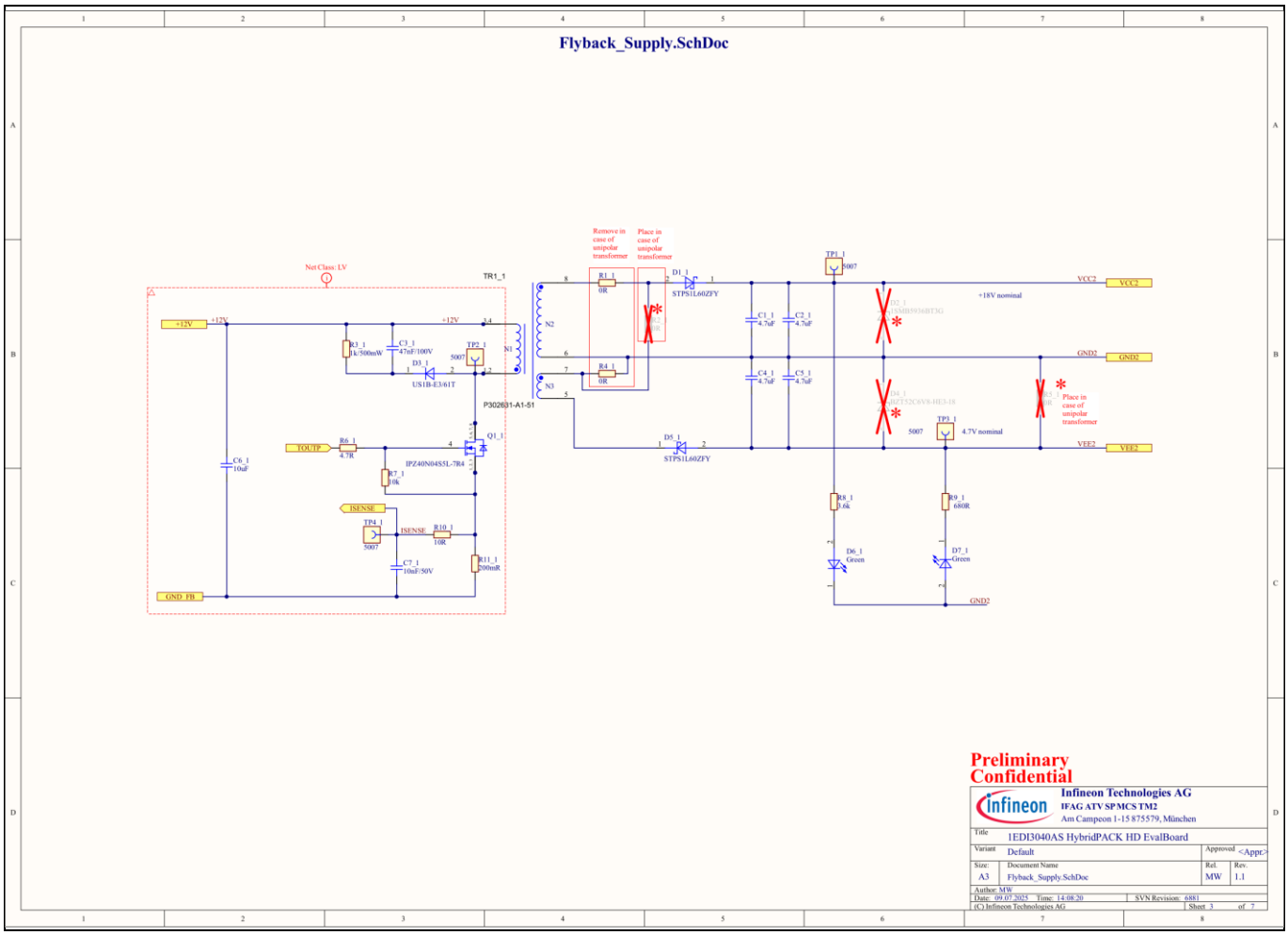

Figure 9 Flyback power supply schematic

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EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board

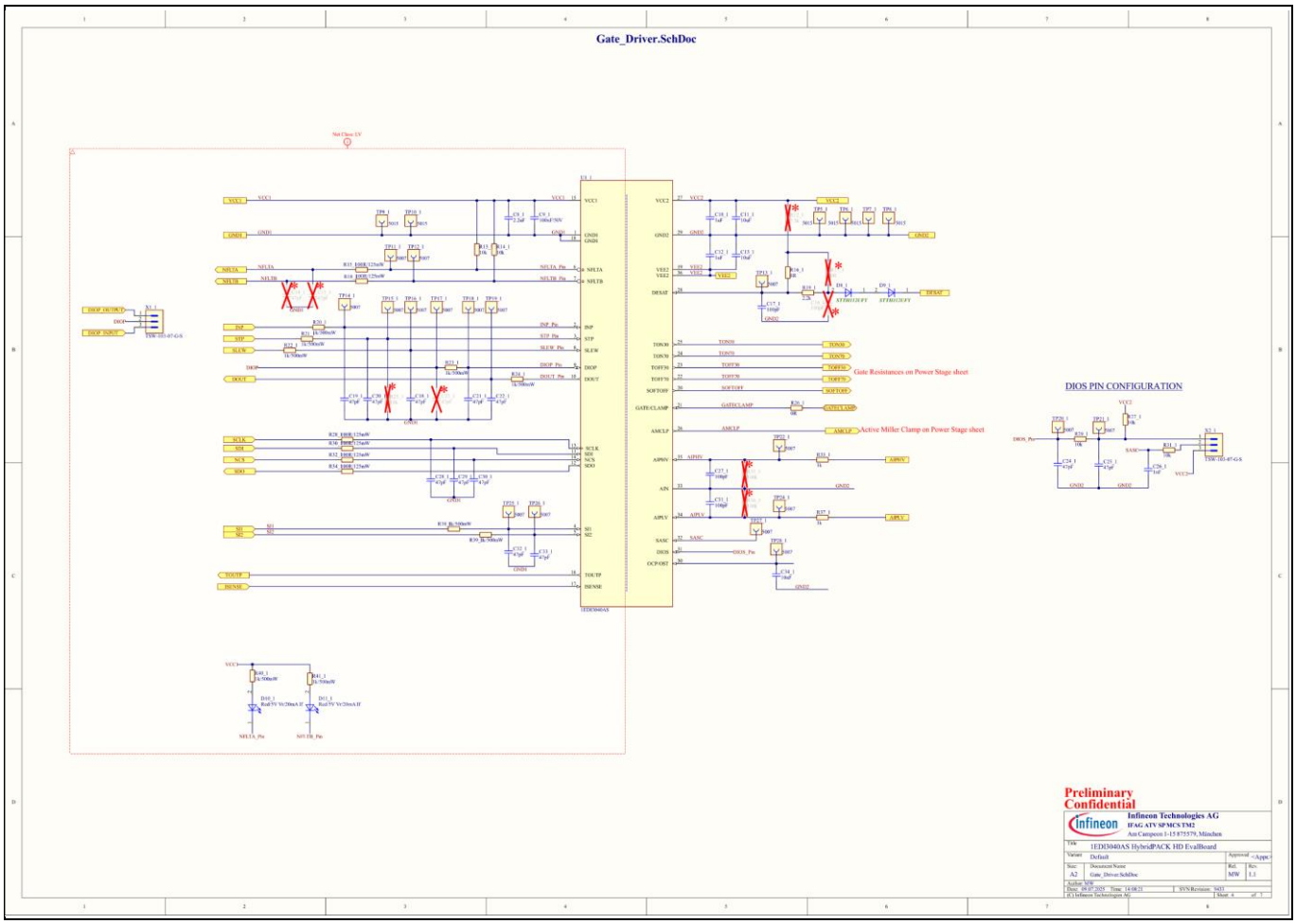

Figure 10 Gate driver schematic

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EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board

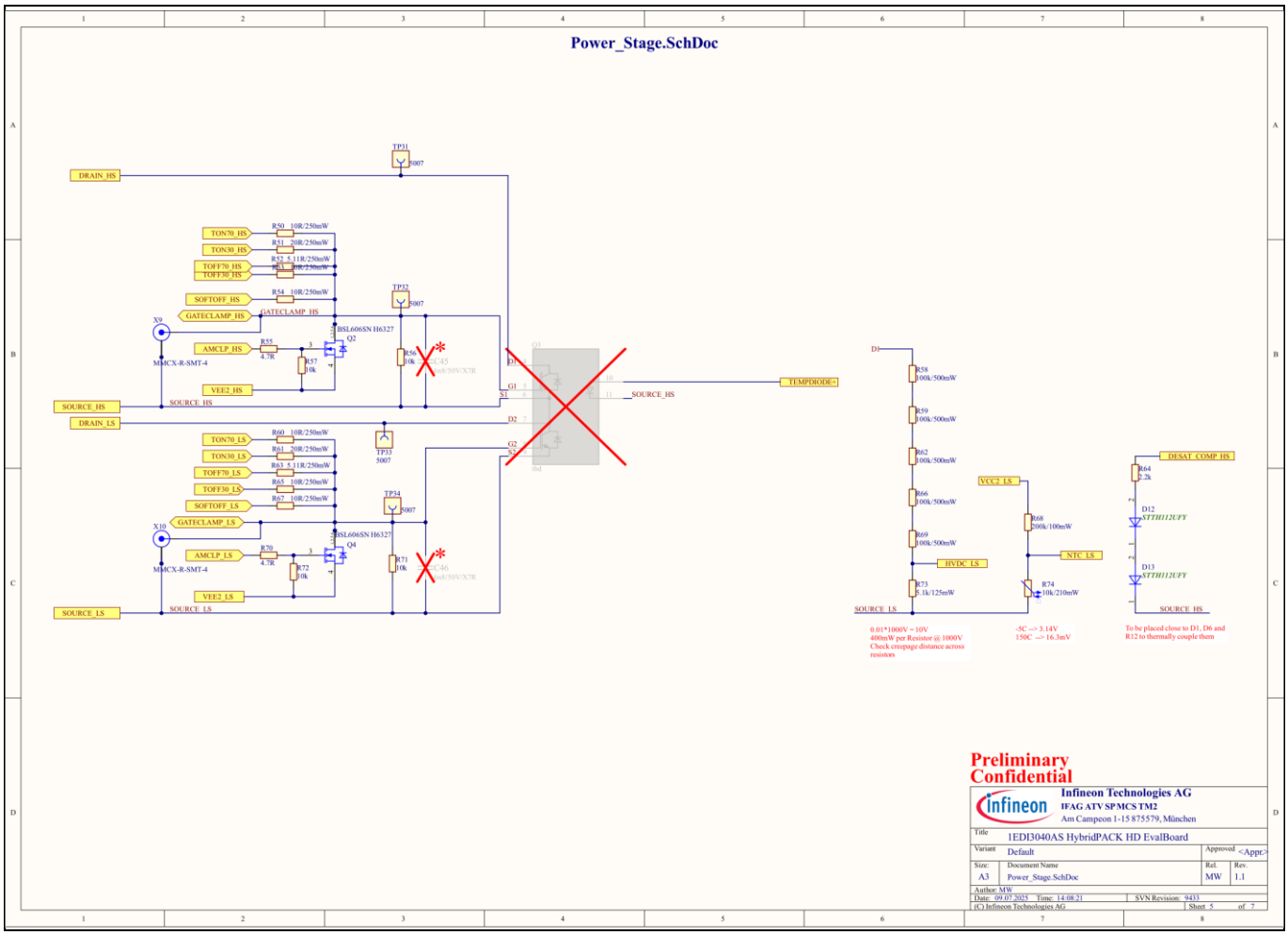

Figure 11 HybridPACK™ Drive power stage schematic

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EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board

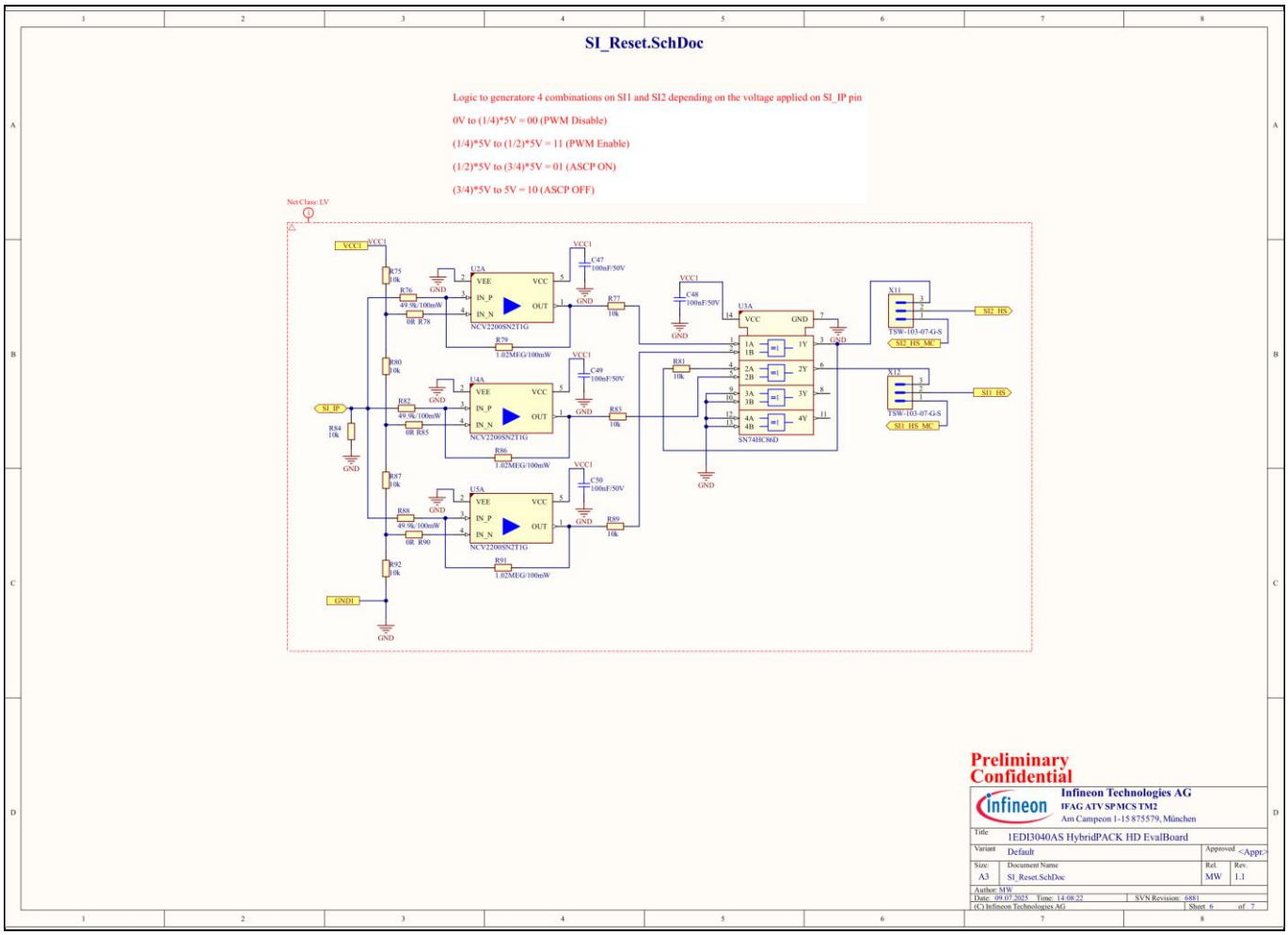

Figure 12 Safety inputs reset schematic

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EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board

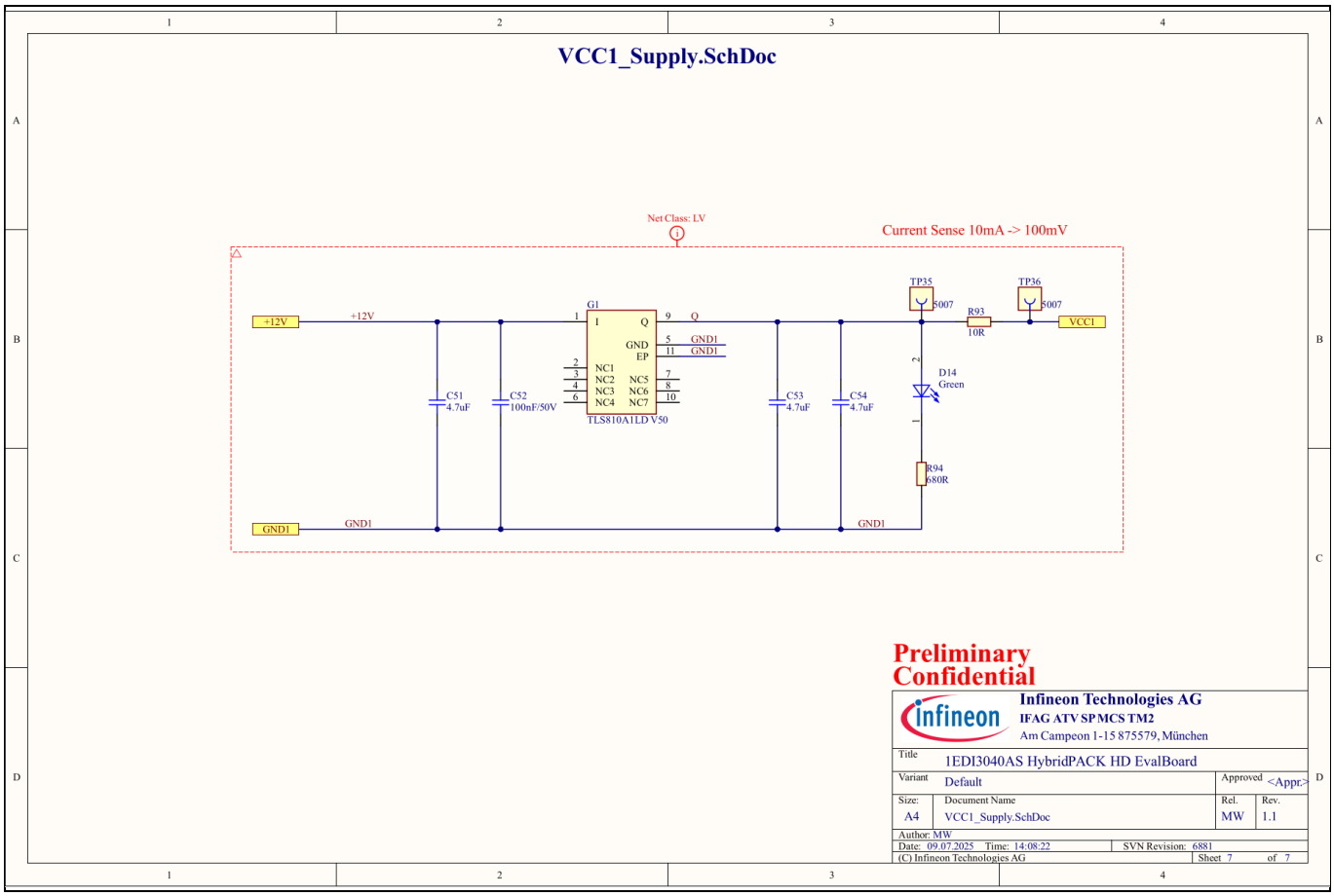

Figure 13 VCC1 power supply schematic

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EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board

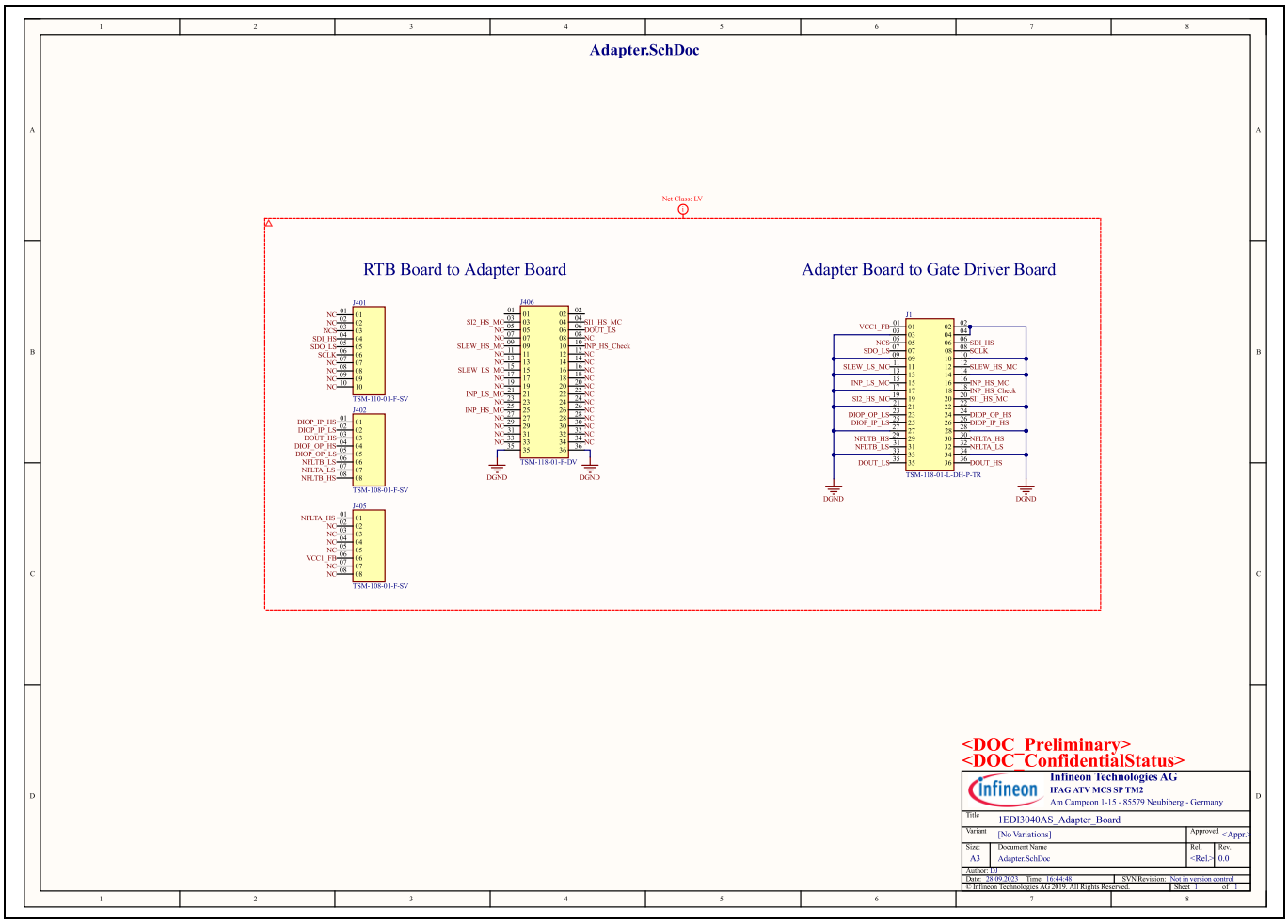

Figure 14 Adapter board schematic

2.3 Layout

The EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board PCB consists of four layers as shown in Figure 15, Figure 16, Figure 17, Figure 18 and Figure 19. Figure 20 shows the assembly overview.

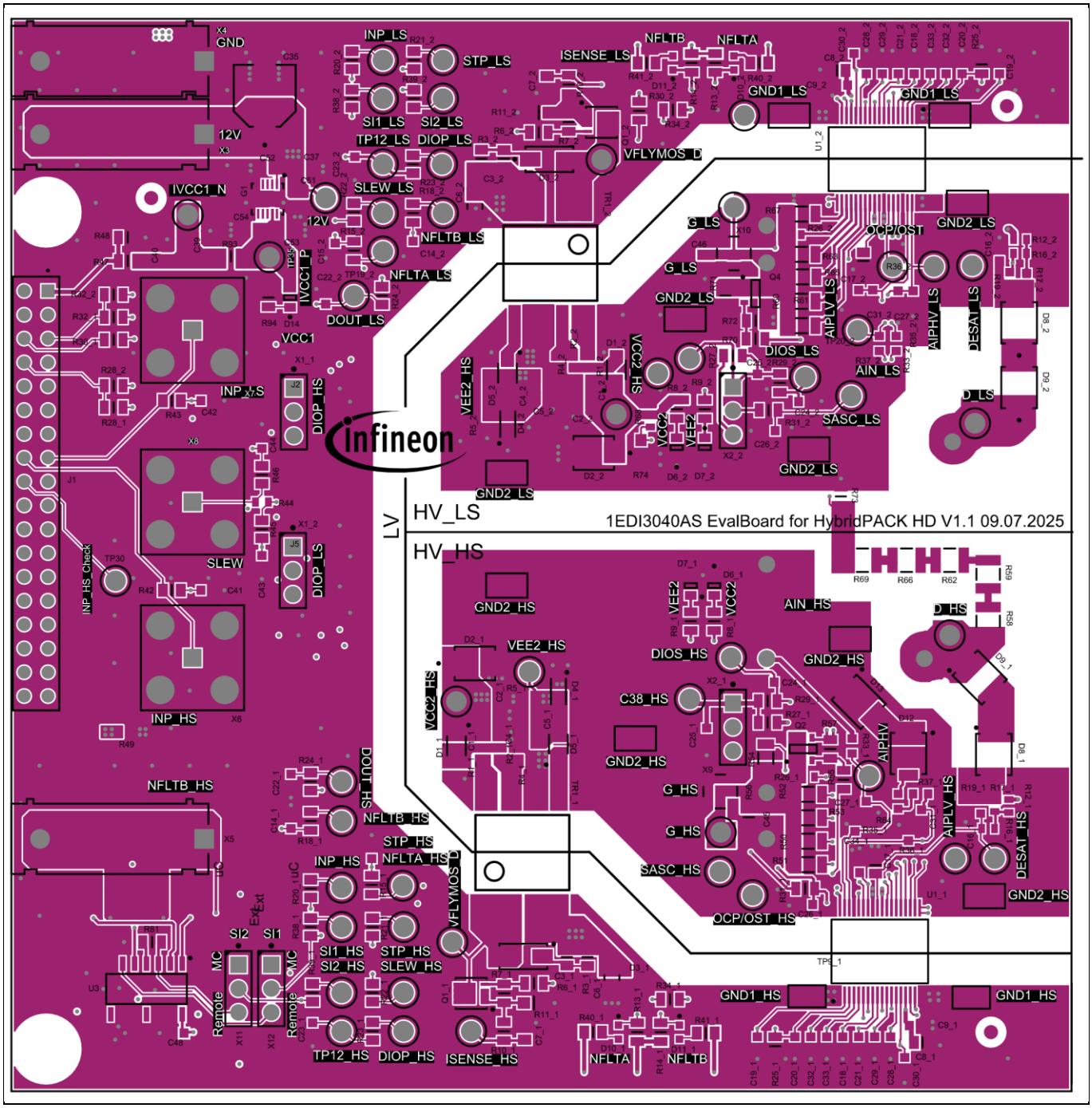

Figure 15 Top layer

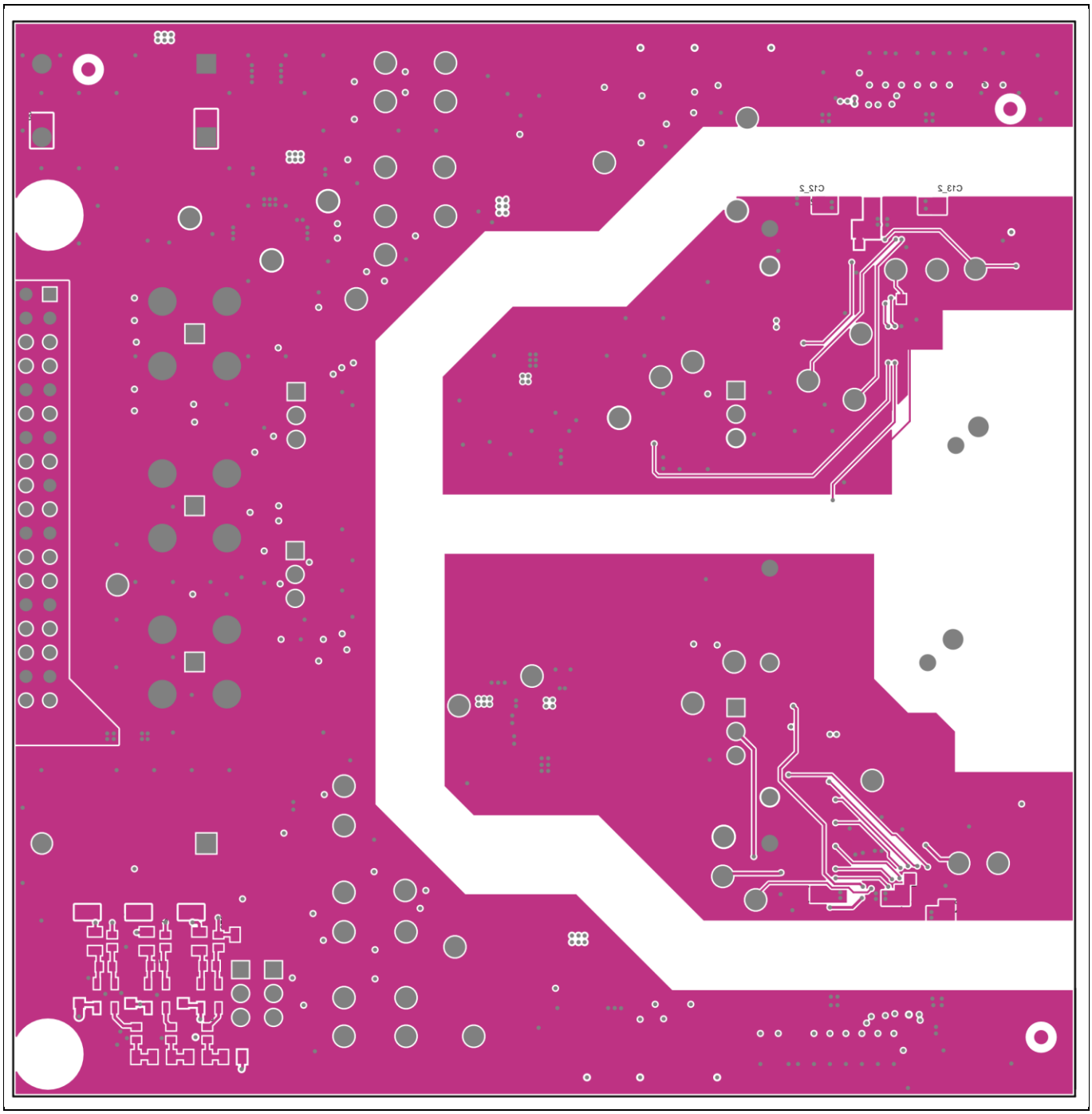

Figure 16 Layer 2

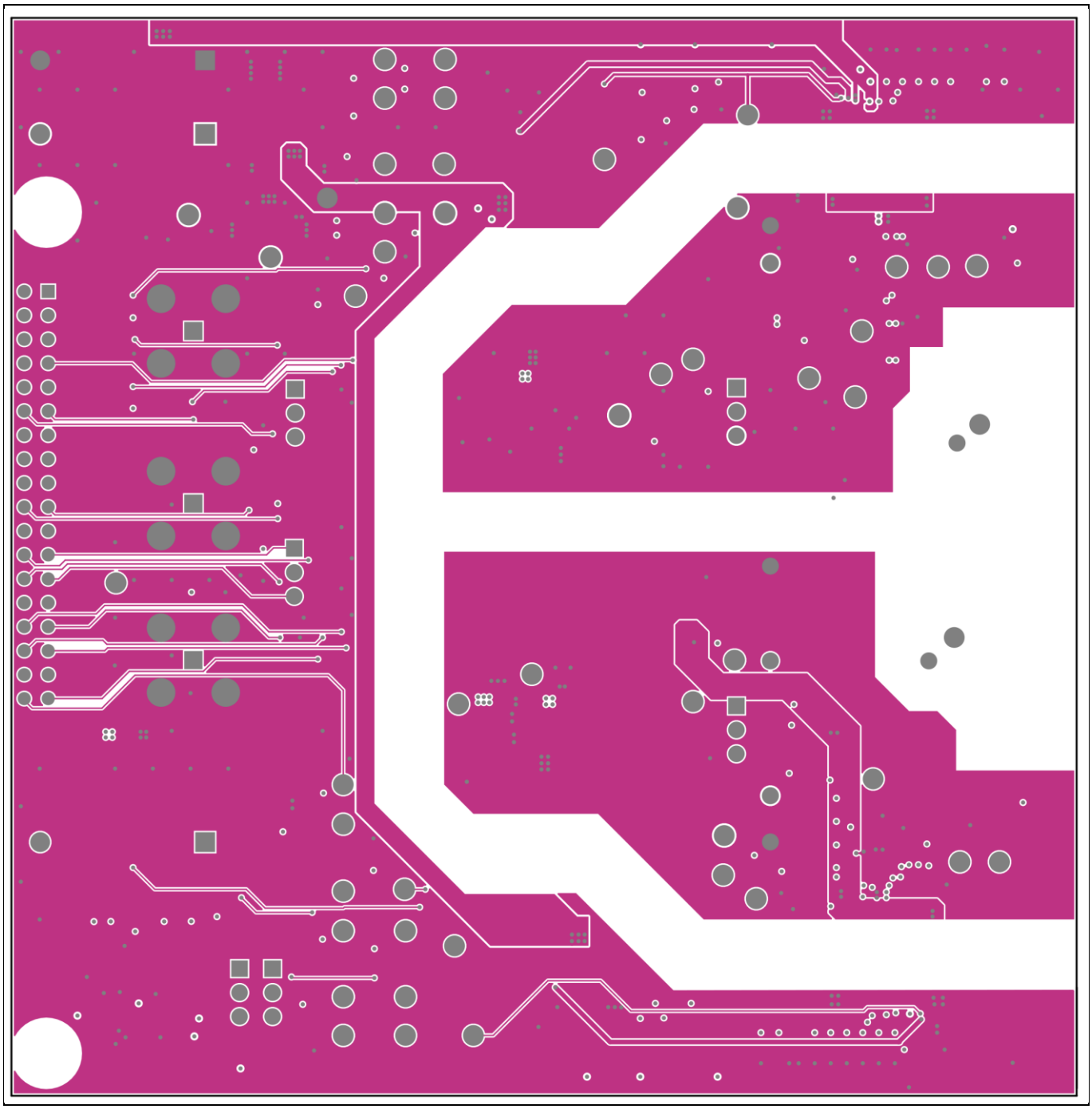

Figure 17 Layer 3

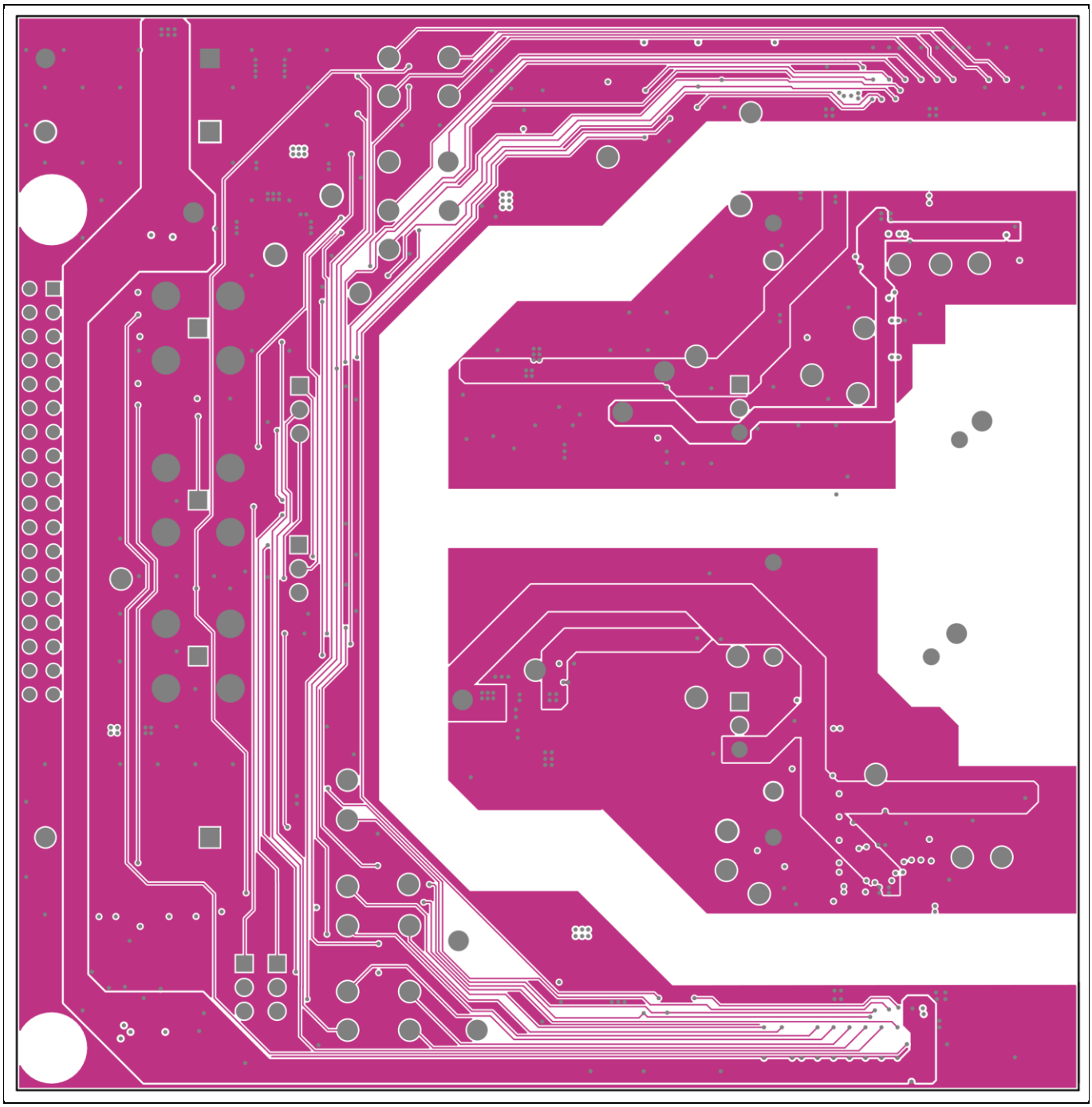

Figure 18 Bottom layer

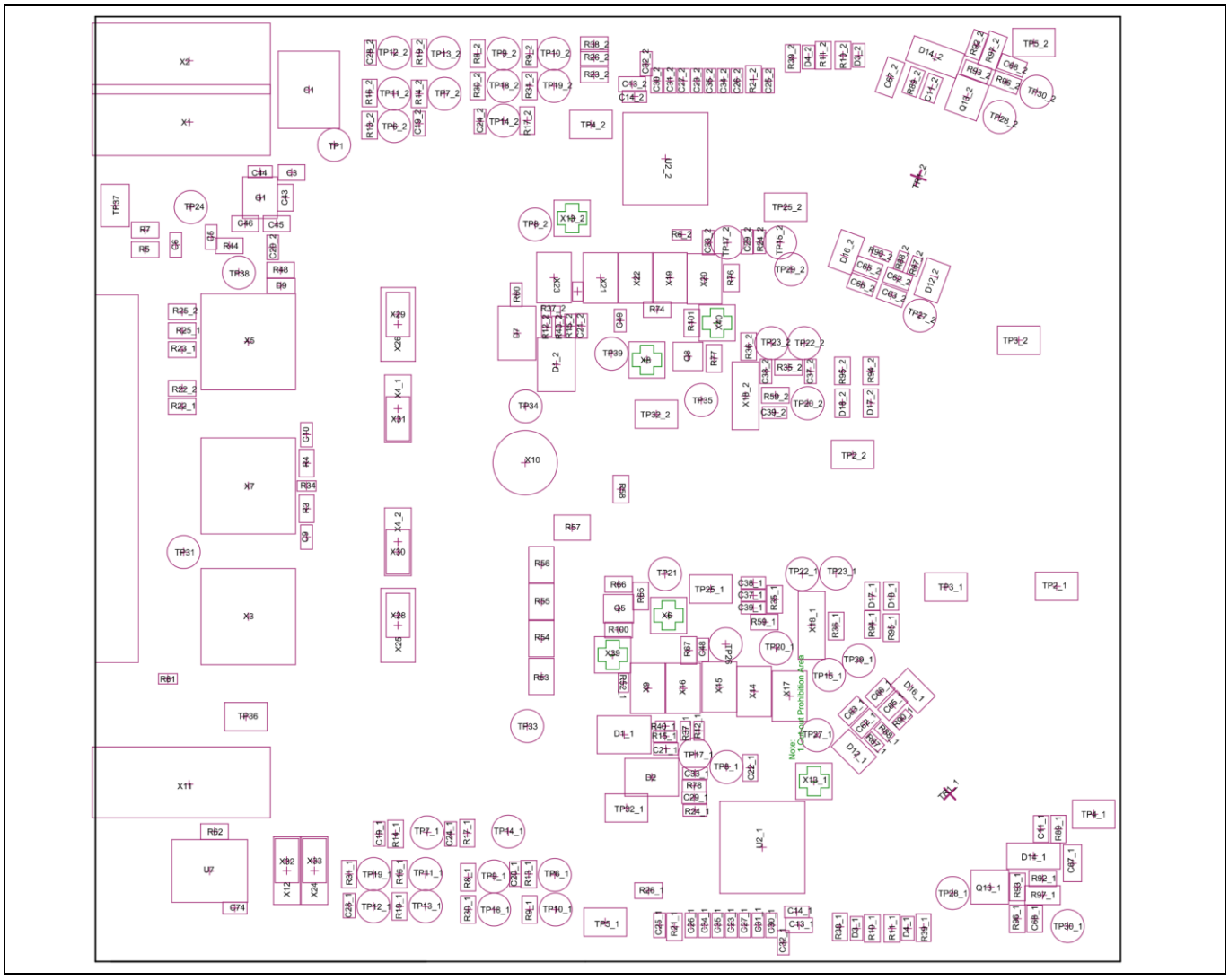

Figure 19 Top assembly

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EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board

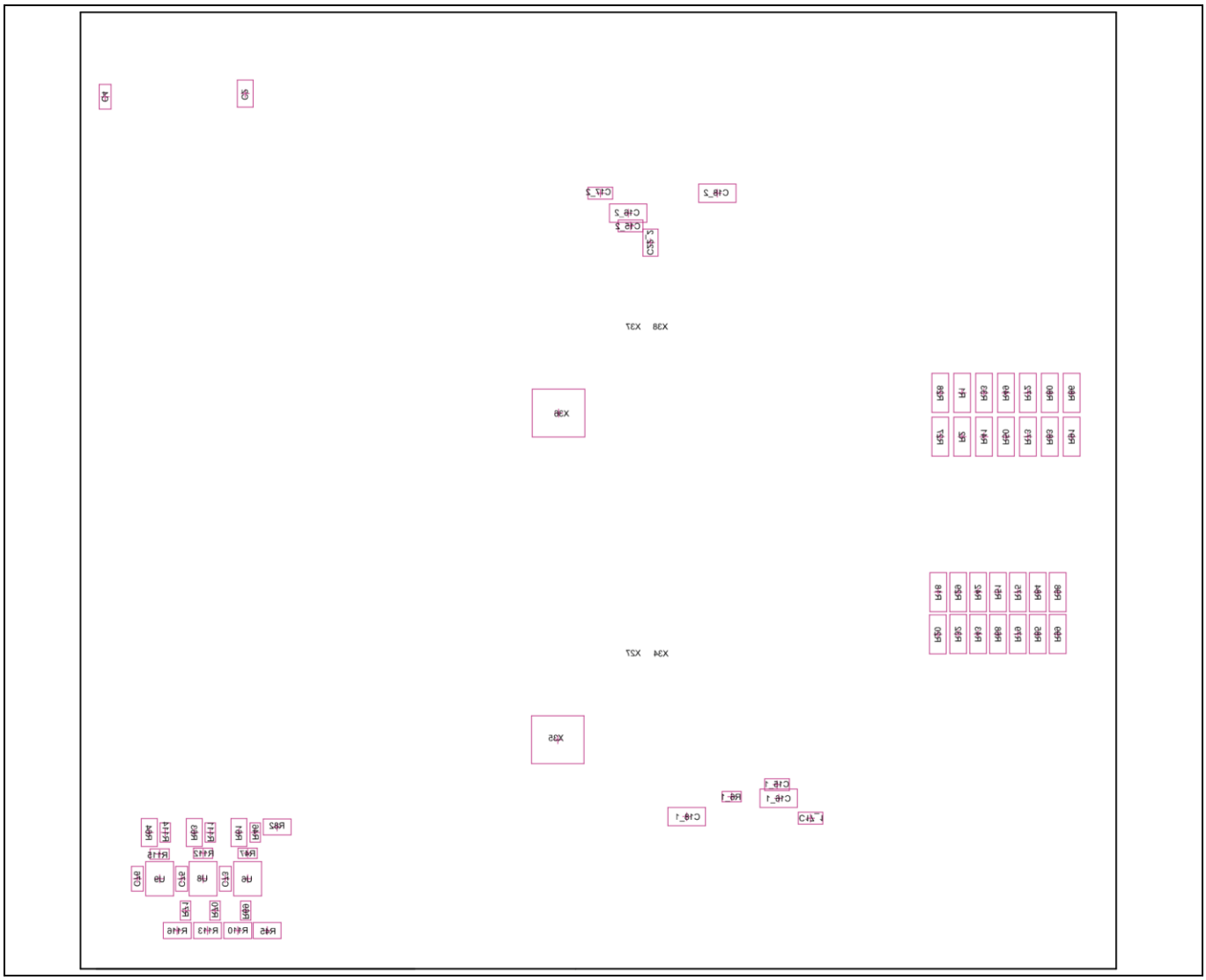

Figure 20 Bottom assembly

2.4 Bill of materials

Table 9 shows the bill of materials for the EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board. The HybridPACK™ Drive SiC Gen2 module is not included.

Table 9 BOM of the most important/critical parts of the evaluation or reference board (example)

Designator	Comment	Quantity	Manufacturer	Manufacturer Order Number
C1_1, C1_2, C2_1, C2_2, C4_1, C4_2, C5_1, C5_2, C36, C37, C51, C53, C54	4.7uF	13	Taiyo Yuden	TMK212AB7475KG-T
C3_1, C3_2	47nF/100V	2	MuRata	GRM21BR72A473KA01
C6_1, C6_2, C11_1, C11_2, C13_1, C13_2	10uF	6	TDK Corporation	C3216X7R1E106K160AB
C7_1, C7_2	10nF/50V	2	MuRata	GCM2195C1H103FA16
C8_1, C8_2	2.2uF	2	MuRata	GRM21BR71C225KA12
C9_1, C9_2, C38, C39, C40, C47, C48, C49, C50, C52	100nF/50V	10	AVX	06035C104K4Z2A
C10_1, C10_2, C12_1, C12_2	1uF	4	MuRata	GRM188R7YA105MA12
C17_1, C17_2	100pF	2	MuRata	GRM2165C1H101GA01
C18_1, C18_2, C19_1, C19_2, C20_1, C20_2, C21_1, C21_2, C22_1, C22_2, C24_1, C24_2, C25_1, C25_2, C28_1, C28_2, C29_1, C29_2, C30_1, C30_2, C32_1, C32_2, C33_1, C33_2, C41, C42, C43, C44	47pF	28	MuRata	GRM1885C1H470GA01
C26_1, C26_2	1nF	2	Kemet	C0603C102G8GAC
C27_1, C27_2, C31_1, C31_2	100pF	4	MuRata	GRM1885C2A101JA01
C34_1, C34_2	10nF	2	TDK Corporation	CGA3EAC0G2A103J080AC
C35	100uF	1	Panasonic	EEEFTH101XAP
D1_1, D1_2, D5_1, D5_2	STPS1L60ZFY	4	ST	STPS1L60ZFY
D3_1, D3_2	US1B-E3/61T	2	Vishay	US1B-E3/61T
D6_1, D6_2, D7_1, D7_2, D14	Green	5	OSRAM Opto Semiconductors	LG R971-KN-1
D8_1, D8_2, D9_1, D9_2, D12, D13	STTH112UFY	6	STMicroelectronics	STTH112UFY

D10_1, D10_2, D11_1, D11_2	Red/5V Vr/20mA If	4	LiteOn Optoelectronics	LTST-C190CKT
G1	TLS810A1LD V50	1	Infineon Technologies	TLS810A1LD V50
J1	SSW-118-01-G-D	1	Samtec	03.13.0348.0
J2, J3, J4, J5	Jumper 2.54mm	4	Harwin Inc.	M7581-05
Q1_1, Q1_2	igfet_n_ch_enh_dio_1s2s3s4g5d6d7d8d_8p	2	Infineon Technologies	IPZ40N04S5L-7R4
Q2, Q4	igfet_n_ch_enh_dio_1d2d3g4s5d6d_6p	2	Infineon Technologies	BSL606SN H6327
R1_1, R1_2, R4_1, R4_2, R16_1, R16_2, R26_1, R26_2, R49, R78, R85, R90	0R	12	Vishay	CRCW06030000Z0EA
R3_1, R3_2, R20_1, R20_2, R21_1, R21_2, R22_1, R22_2, R23_1, R23_2, R24_1, R24_2, R38_1, R38_2, R39_1, R39_2, R40_1, R40_2, R41_1, R41_2, R42, R43, R45, R46	1k/500mW	24	Panasonic	ERJ-P06J102V
R6_1, R6_2, R55, R70	4.7R	4	Vishay	CRCW08054R70FK
R7_1, R7_2, R13_1, R13_2, R14_1, R14_2, R27_1, R27_2, R29_1, R29_2, R31_1, R31_2, R47, R48, R56, R57, R71, R72, R75, R77, R80, R81, R83, R84, R87, R89, R92	10k	27	Vishay	CRCW080510K0FK
R8_1, R8_2	3.6k	2	Vishay	CRCW08053K60FK
R9_1, R9_2, R94	680R	3	Vishay	CRCW0805680RFK
R10_1, R10_2, R93	10R	3	Vishay	CRCW080510R0FK
R11_1, R11_2	200mR	2	Vishay	RCWE0805R200FKEA
R15_1, R15_2, R18_1, R18_2, R28_1, R28_2, R30_1, R30_2, R32_1, R32_2, R34_1, R34_2	100R/125mW	12	Vishay	CRCW0805100RFK
R19_1, R19_2, R64	2.2k	3	ROHM Semiconductors	MCR03EZPFX2201
R33_1, R33_2, R37_1, R37_2	1k	4	Multicomp	MCHP03W8F1001T5E
R50, R53, R54, R60, R65, R67	10R/250mW	6	Vishay	CRCW120610R0FKEA

R51, R61	20R/250mW	2	Vishay	CRCW120620R0FK
R52, R63	5.11R/250mW	2	Vishay	CRCW12065R11FK
R58, R59, R62, R66, R69	100k/500mW	5	Vishay	CRCW1210100KFK
R68	200k/100mW	1	Vishay	CRCW0603200KFK
R73	5.1k/125mW	1	Vishay	CRCW08055K10FK
R74	10k/210mW	1	TDK Corporation	B57421V2103J062
R76, R82, R88	49.9k/100mW	3	Vishay	CRCW060349K9FK
R79, R86, R91	1.02MEG/100mW	3	Vishay	CRCW06031M02FK
TP1_1, TP1_2, TP2_1, TP2_2, TP3_1, TP3_2, TP4_1, TP4_2, TP11_1, TP11_2, TP12_1, TP12_2, TP13_1, TP13_2, TP14_1, TP14_2, TP15_1, TP15_2, TP16_1, TP16_2, TP17_1, TP17_2, TP18_1, TP18_2, TP19_1, TP19_2, TP20_1, TP20_2, TP21_1, TP21_2, TP22_1, TP22_2, TP24_1, TP24_2, TP25_1, TP25_2, TP26_1, TP26_2, TP27_1, TP27_2, TP28_1, TP28_2, TP29, TP30, TP31, TP32, TP33, TP34, TP35, TP36	5007	50	Keystone Electronics Corp.	5007
TP5_1, TP5_2, TP6_1, TP6_2, TP7_1, TP7_2, TP8_1, TP8_2, TP9_1, TP9_2, TP10_1, TP10_2	5015	12	Keystone Electronics Corp.	5015
TR1_1, TR1_2	01.30.0524.0	2	TDK	B78308A2464A003
U1_1, U1_2	1EDI3040AS	2	Infineon Technologies	1EDI3040AS
U2, U4, U5	NCV2200SN2T1G	3	ON Semiconductor	NCV2200SN2T1G
U3	SN74HC86D	1	Texas Instruments	SN74HC86D
X1_1, X1_2, X2_1, X2_2, X11, X12	TSW-103-07-G-S	6	Samtec	TSW-103-07-G-S
X3, X5	973 582-101	2	Hirschmann Test & Measurement	973 582-101
X4	973 582-100	1	Hirschmann Test &	973 582-100

			Measurement	
X6, X7, X8	5-1634506-2	3	TE Connectivity	5-1634506-2
X9, X10	MMCX-R-SMT-4	2	Hirose Connectors	MMCX-R-SMT-4

3 Getting started with the EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board

In this section, details on getting started and operating the evaluation board together with the Aurix™ TC375 Shieldbuddy board is described. Please refer in parallel to the document **Infineon-EiceDRIVER_AMC_gate_driver_Configuration_Wizard-UG** for details on how to use the GUI.

3.1 Step by step instructions

- Connect the HybridPACK™ HD module and the Aurix™ Shiedbuddy to the EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board as shown in Figure 21 .
- Set jumpers SI1 and SI2 to position “1-2” as shown in Figure 7
- When no module is connected to the evaluation board, the device will generate DESAT and RBSOA faults due to floating DESAT pins. To prevent a DESAT or RBSOA error, the errors need to be disabled or set to warning using the corresponding SPSMER.DESATERR and SCPC3.RBSOAERR bits.
- Set the DIOP jumper of Table 4 as desired
- Connect the 12 V supply to the evaluation board through banana connectors “+12V” and “GND”
- Observe the LEDs indicating the board supply voltages as of Table 2
- Connect the evaluation board to the PC through the USB cable
- Start the EiceDRIVER™ AMC 1EDI304xAS Configuration Wizard
- Go to the **Aurix (uC) Shield Buddy** tab page and click **Setup Serial Interface**, select the COM port and select the checkbox **Connect. Aurix Shield Status LED** will turn green
- When using the Aurix™ TC375 Shieldbuddy board for the first time, click **Program Aurix TC375** to ensure that the latest firmware is programmed to the microcontroller. This step only needs to be done only once and can be skipped for subsequent use
- Wait for the programming to be complete and for the **Aurix Shield Status LED** to turn green
- Click **Reset board** and check in tab page **Console** that the board is reset
- Click **Send RTB Board Configuration** to initialize all the peripherals of the microcontroller and wait for the **Evalboard Status LED** to turn green
    - **Note:** If the Evalboard status LED stays orange, the communication between AURIX™ and the 1EDI3040AS is not working. Update the DAS drivers that might have been corrupted during the GUI installation if the AURIX™ development studio was previously installed.
- Configure the registers for each high side and low side gate driver individually under the **1EDI3040AS Gate Driver tab** and under **Register Configuration**
- To write to a register, enter mode **00_ Configuration & Error** and click **SPI Write Enable – HS/LS**. Corresponding LEDs **SPI Config Enabled** should turn green
- Turn on the 12 V power supply
- LED “VCC1” should turn green indicating that VCC1 has successfully powered-up
- LEDs “VCC2” and “VEE2” for both the HS and LS drivers should turn green indicating the VCC2 and VEE2 have powered-up succesfully
- Once the devices have powered-up completely, LEDs “NFLTA” for both HS and LS should turn red indicating that the device is in “Configuration and Error” mode
- Follow the instructions under the tab **Test Mode** to execute the required tests
    - When values such as **PWM Frequency** need to be set, enter the corresponding values in units mentioned and press enter to load the values
    - Upon completion of a test, please click **Stop Test** to ensure that the test is complete

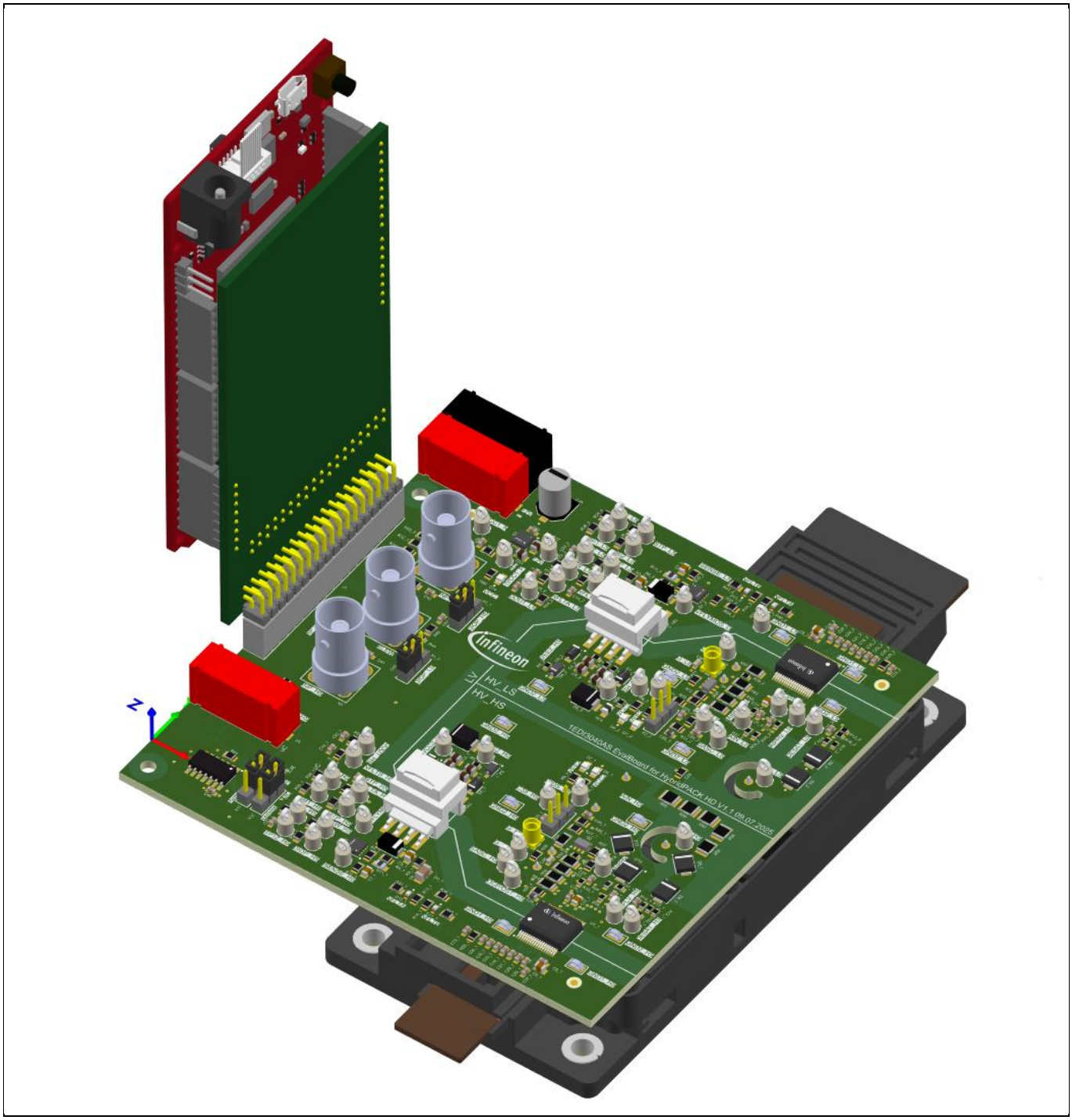

Figure 21 EiceDRIVER™ gate driver 1EDI3040AS HybridPACK™ HD evaluation board with base board

4 Performance measurements

Double pulse measurements were carried out to demonstrate the capabiolities of the evaluation kit. The set-up is shown in Figure 22.

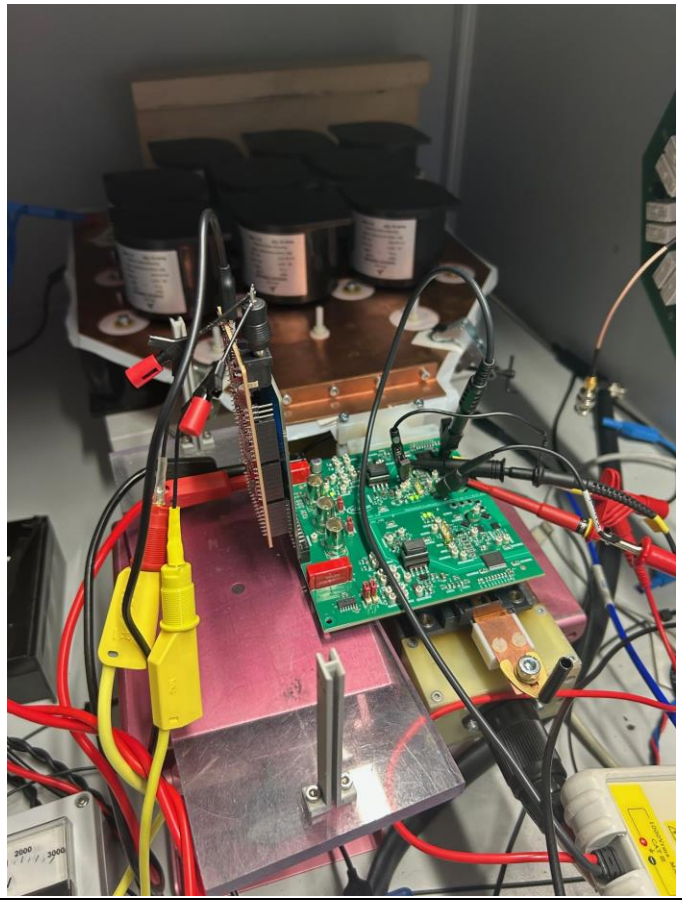

Figure 22 Measurement set-up with evaluation board and HybridPACK™ HD

4.1 Double pulse results

The following conditions where applied:

- 800V DC-link voltage
- 750A peak switched current
- Rgon = 3.6 Ω
- Rgoff = 2.0 Ω

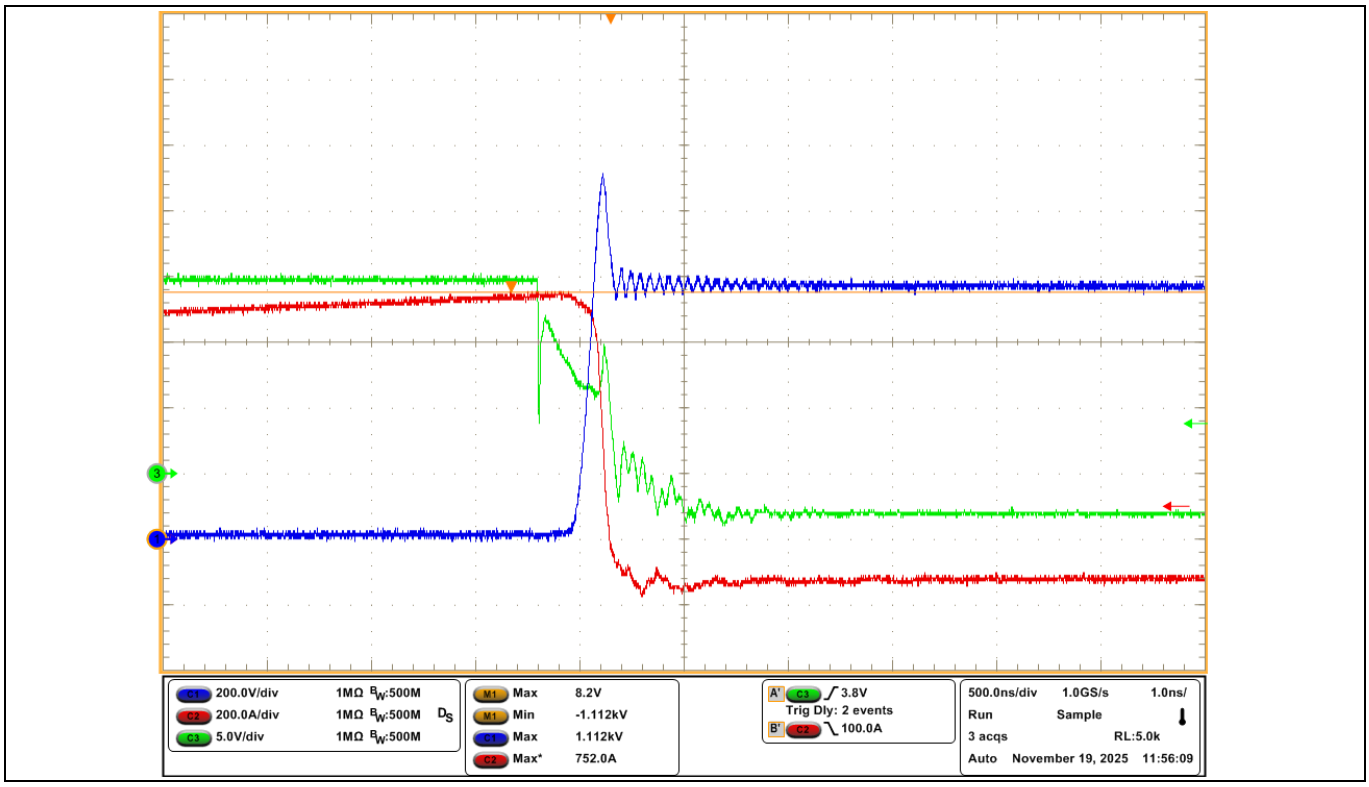

Figure 23 Turn-off @ 750A and 800V

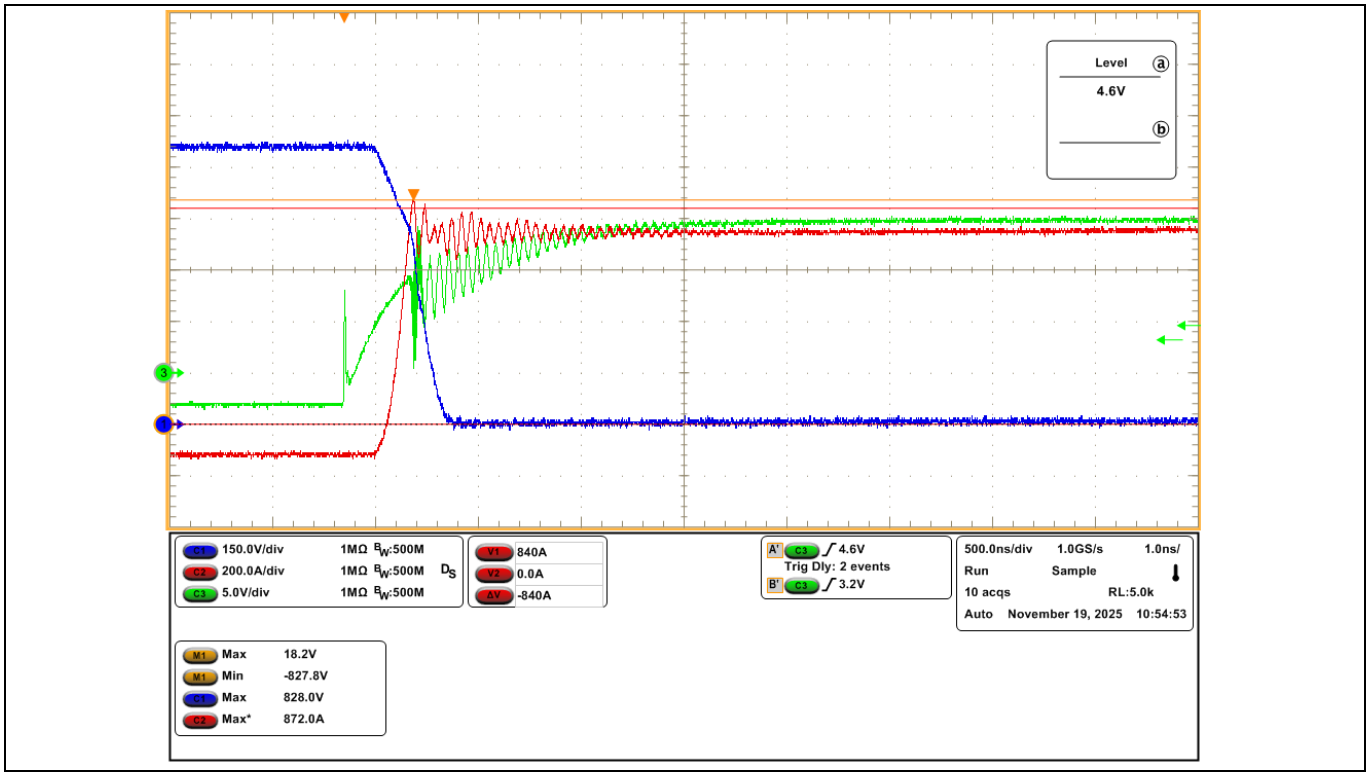

Figure 24 Turn-on @ 870A and 800V

4.2 Short circuit performance

For the short circuit, the same gate resistors as in the double pulse experiment were used. The investigated short circuit is a s called “Type 1” short circuit. For this condition the opposite switch is permanently turned on and the shoot-through protection is disabled. The switch under test is turned on into the already conducting channel.

The following configuration was used for the experiment:

- RSOFTOFF = 6.7 Ω
- Cdesat = 30 pF
- Desat blanking time 175ns
- Desat filter time 80ns

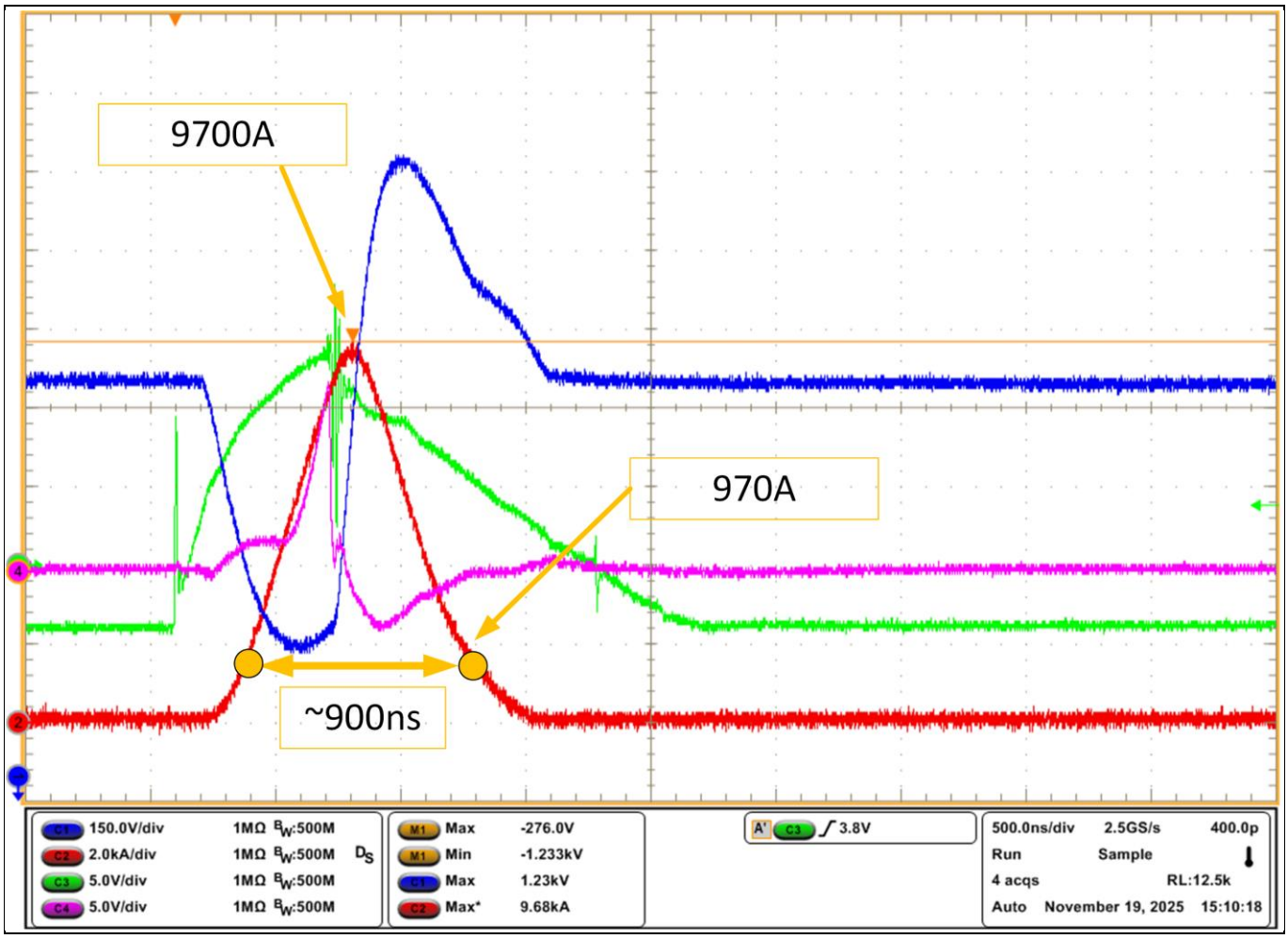

Figure 25 Type 1 short circuit measurement

As can be seen in Figure 25 the achieved short circuit turn-off time is around 900ns. The voltage overshoot maxes out at around 1.2kV, which is within the 1.4kV rating of the HbyridPACK ™ HD rating. The configuration can be used a starting point for further optimization in the application.

Revision history

Document revision	Date	Description of changes
1.0	2025-10-08	Initial version
1.1	2025-10-20	Chapter 2: Added SP numbers for HybridPACK HD modules
1.2	2025-12-10	Chapter 4 added: Performance measurements

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