Isolated Digital Output Reference Board REF-ISOPLCSSR24V

User Guide

About this document

Scope and purpose

The user guide describes the setup and evaluation of the Isolated Digital Output Reference Board REF-ISOPLCSSR24V. It provides a brief overview of the isolated digital output reference board concept, functions, protection and diagnosis implementations.

Intended audience

This document is intended for engineers who want to operate the Isolated Output Reference Board and start developments, perform measurements and check performances of the used components.

Reference Board/Kit

Product(s) embedded on a PCB with a focus on specific applications and defined use cases that may include software. PCB and auxiliary circuits are optimized for the requirements of the target application.

Note: Boards do not necessarily meet safety, EMI, quality standards (for example UL, CE) requirements.

Important notice

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

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

The Evaluation Boards and Reference Boards provided by Infineon Technologies are subject to functional testing only under typical load conditions. Evaluation Boards and Reference Boards are not subject to the same procedures as regular products regarding returned material analysis (RMA), process change notification (PCN) and product discontinuation (PD).

Evaluation Boards and Reference Boards are not commercialized products, and are solely intended for evaluation and testing purposes. In particular, they shall not be used for reliability testing or production. The Evaluation Boards and Reference Boards may therefore not comply with CE or similar standards (including but not limited to the EMC Directive 2004/EC/108 and the EMC Act) and may not fulfill other requirements of the country in which they are operated by the customer. The customer shall ensure that all Evaluation Boards and Reference Boards will be handled in a way which is compliant with the relevant requirements and standards of the country in which they are operated.

The Evaluation Boards and Reference Boards as well as the information provided in this document are addressed only to qualified and skilled technical staff, for laboratory usage, and shall be used and managed according to the terms and conditions set forth in this document and in other related documentation supplied with the respective Evaluation Board or Reference Board.

It is the responsibility of the customer’s technical departments to evaluate the suitability of the Evaluation Boards and Reference Boards for the intended application, and to evaluate the completeness and correctness of the information provided in this document with respect to such application.

The customer is obliged to ensure that the use of the Evaluation Boards and Reference Boards does not cause any harm to persons or third party property.
The Evaluation Boards and Reference Boards and any information in this document is provided "as is" and Infineon Technologies disclaims any warranties, express or implied, including but not limited to warranties of non-infringement of third party rights and implied warranties of fitness for any purpose, or for merchantability.

Infineon Technologies shall not be responsible for any damages resulting from the use of the Evaluation Boards and Reference Boards and/or from any information provided in this document. The customer is obliged to defend, indemnify and hold Infineon Technologies harmless from and against any claims or damages arising out of or resulting from any use thereof.

Infineon Technologies reserves the right to modify this document and/or any information provided herein at any time without further notice.

Safety precautions

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

Table 1 **Safety precautions**

	**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.*

Table of contents

1 The board at a glance

The isolated digital output reference board (REF-ISOPLCSSR24V) is combining a digital isolator and two protected high-side switches and represents an 24V I/O module subsystem in industrial application environment. The typical output voltage is 24 V with different input voltages and an isolation layer between the input and output as well as diagnosis feedback to the control side.

The board combines two Infineon ProFET™ ITS6035S with a digital Isolator 4DIR2400H for two 24 V digital outputs with a current capability up to 4 A DC. The reference board supports two high-side power switches with integrated diagnosis and withstands up to 5700 V_{rms} isolation voltage suitable for safety isolation. In addition to that the board is equipped with a linear voltage regulator TLS810 on the input and output side to enable the power supply for the digital isolator. The User Guide UG-2024-04 gives an overview and operating instructions for the isolated digital output reference board, for more information please visit the application page at www.infineon.com/industrialautomation

1.1 Scope of supply

The Evaluation Kit contains one reference PCB and four cable-PCB connectors which are pre-plugged on the PCB.

1.2 Block diagram

The top-level block diagram of the reference board is shown in Figure 1. The reference board consists of a power supply connector on the input and output side, as well as logic signal on the input and power output connector on the output side. A stable logic supply voltage for the digital isolator is generated from the input and output power supply input respectively.

The input control and status feedback I/O voltage for both channels on the signal connector can be configured with the selection of input resistors (standard I/O voltage: 3.3 V, see chapter 2.2.3). After the control and status feedback signal are isolated from the output side with the 2-input / 2-output digital isolator 4DIR2400H, it is directly connected to the two ProFET ITS6035S inputs. Each high-side output channel is protected against short-circuits and overloads which support DC currents up to 4 A. A picture of the reference board is shown in Figure 2.

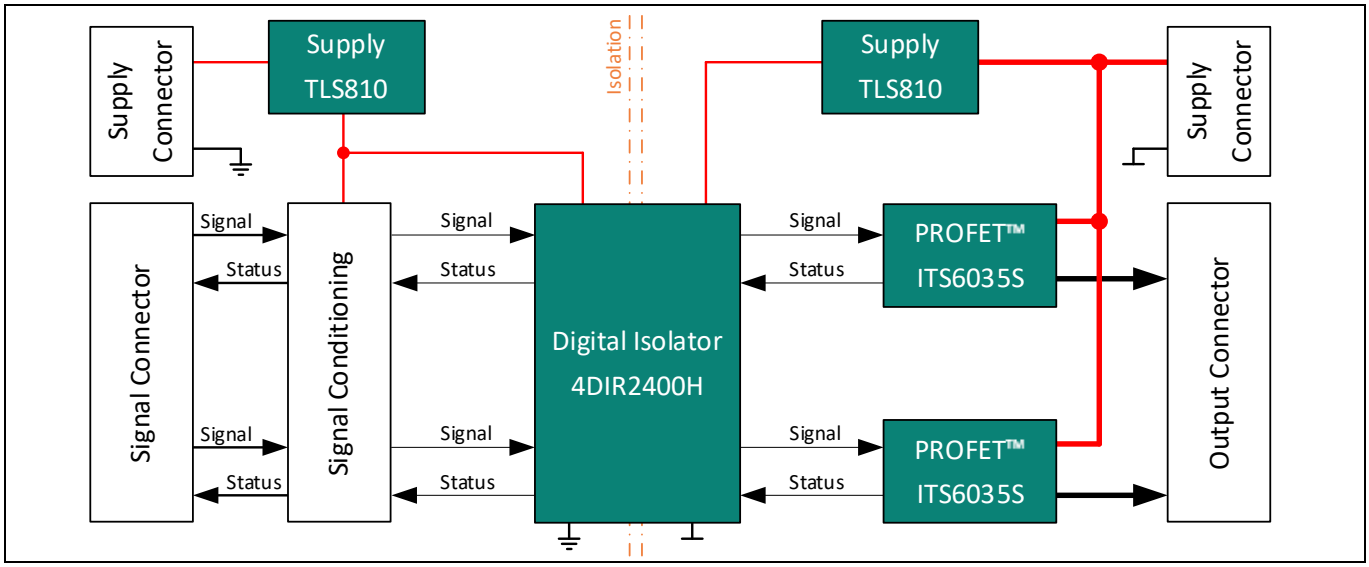


Figure 1 Block diagram

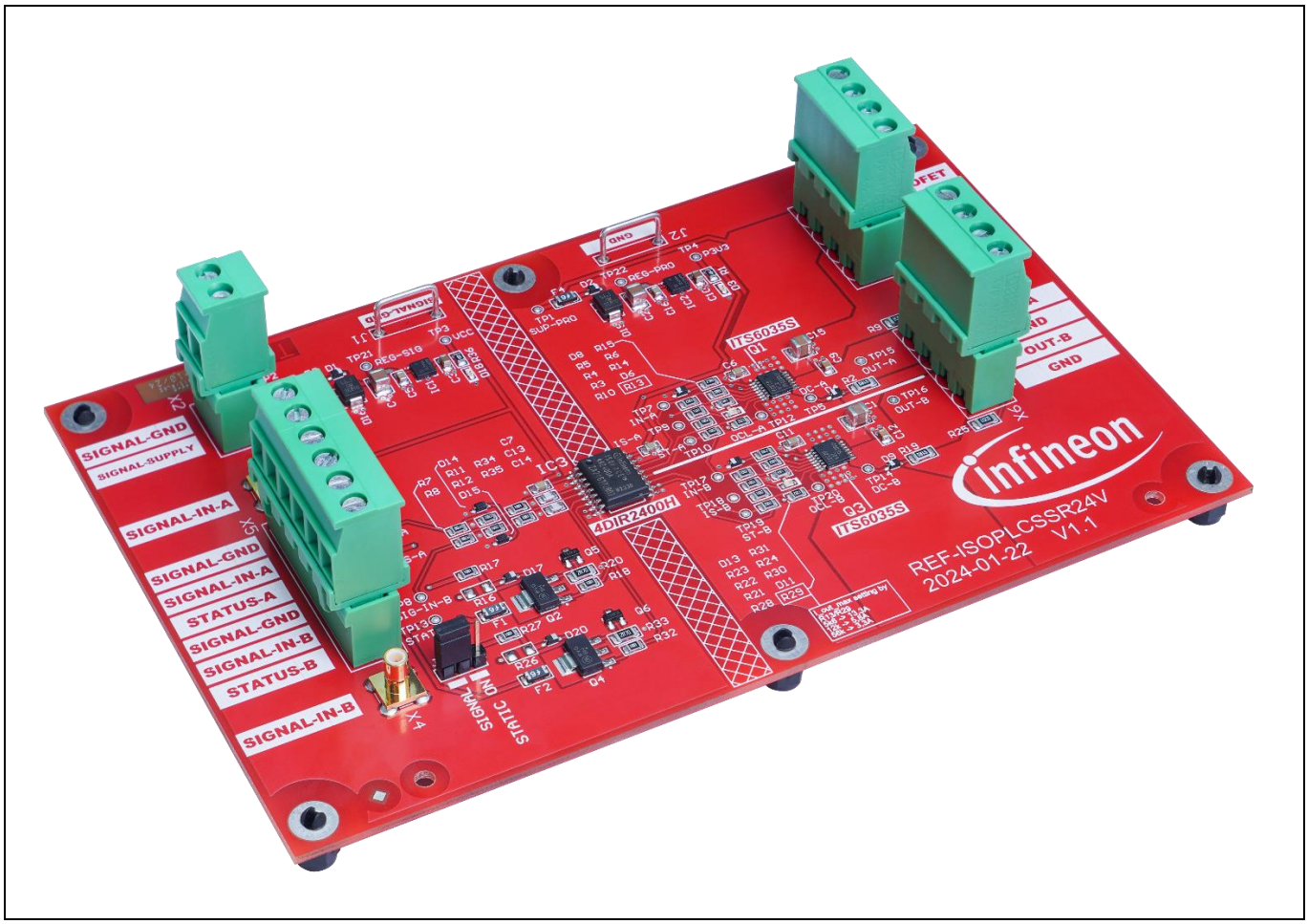


Figure 2 Board view top side

1.3 Main features

The main features of REF-ISOPLCSSR24V - V1.1 include:

- 2-Channel High side switch up to 4 A output current
- Short-circuit / overcurrent protection
- Integrated Overtemperature protection
- Input/Output reinforced galvanic isolation
- Diagnosis feedback to control side
- +3.3V logic supplies for signal and power side on board
- Signal level 3.3 V (24 V-level configurable with input resistances)
- Static ON / OFF with jumper on input side

1.4 Board parameters and technical data

The electrical parameters of the reference board are shown in Table 1. The nominal voltage for control input is 3.3 V and 24 V for the supplies. If other control voltages are required, the input resistors R7 / R8 need to be dimensioned (see chapter 2.2.3).

The status outputs on the signal side are open-collector with a pull-up resistor to 3.3V as standard. Optional the pull-up resistors can be changed to SIGNAL-SUPPLY (see chapter 2.2.3).

Table 1 Electrical parameters

Symbol	Parameter	Min	Max	Unit
SIGNAL-IN_H(3,3V)	Logic “1” input voltage (3,3V-Variant, R7/R8=470 Ω)	3,0	5,5	V
SIGNAL-IN_L(3,3V)	Logic “0” input voltage (3,3V-Variant, R7/R8=470 Ω)	0	0,8	V
SIGNAL-IN_H(24V)	Logic “1” input voltage (24V-Variant, R7/R8=56 kΩ)	19,0	30,0	V
SIGNAL-IN_L(24V)	Logic “0” input voltage (24V-Variant, R7/R8=56 kΩ)	0	5.0	V
SUPPLY-SIG	Supply Voltage signal side (X2)	5.0	30.0	V
VS-PROFET	Supply Voltage PROFET side (X1)	8.0	30.0	V
I-OUT_STATUS	Maximum output current at status Pin (X5-3, X5-6) internal limited		50	mA
V-OUT_STATUS	Maximum output voltage at status Pin (X5-3, X5-6)		30.0	V
I-OUT	Maximum PROFET output current (thermally limited)		5.8	A

2 System and functional description

2.1 Getting started

A typical test-setup for the Isolated digital output reference board is shown in Figure 3. One power supply for the input (X2) and one for the output (X1) is needed if an isolation is required. A function generator for the signal input (X5 or X3/X4) or JP1 and JP2 can be used if a static ON is required to control the outputs. The status outputs are open collector and have an internal pull-up to 3.3V. Both loads can be connected on connector X6 and will be supplied from connector X1.

For simplified measurements, J1 and J2 are the respective GND potential of Input and Output side to be connected to the oscilloscope probe.

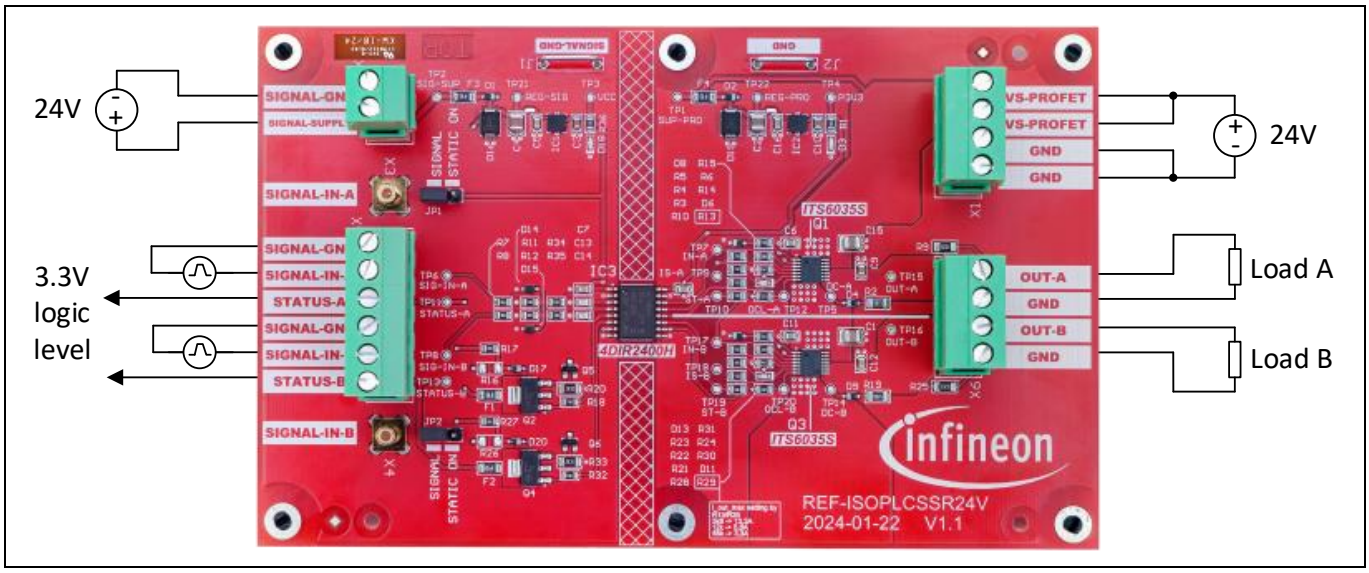


Figure 3 Basic operation with nominal supply voltages

2.2 Description of the functional blocks

Figure 4 is showing the reference board concept with all blocks which will be discussed in the next chapters.

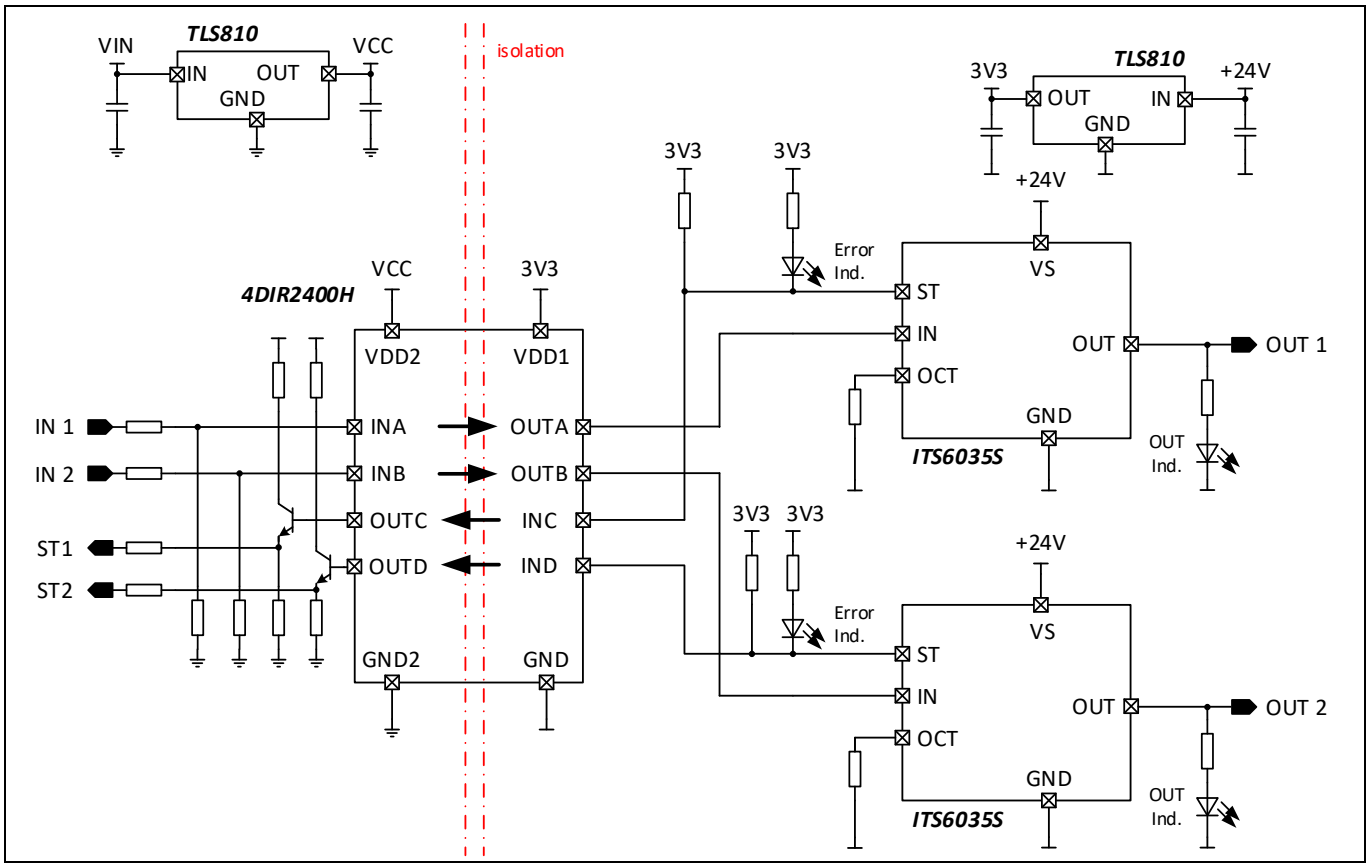


Figure 4 Board concept

2.2.1 Digital supply

Figure 5 shows the digital supply of the signal side. The input supply voltage range is between 5V and 30V. Digital supply is reverse polarity and overload protected. The input side of the galvanic isolator 4DIR2400H is supplied with 3.3 V – VCC.

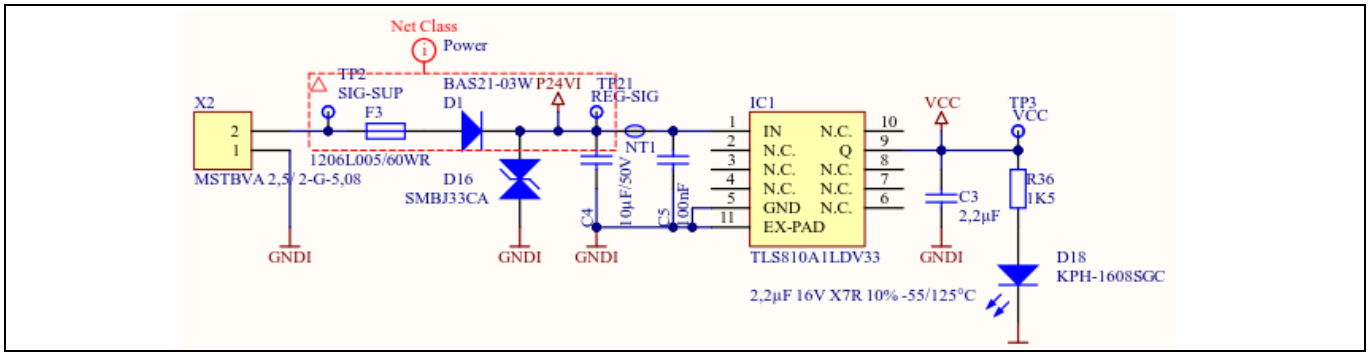


Figure 5 Input side power supply

2.2.2 Digital isolator

In Figure 6 one of the key components of this reference board is shown, the galvanic digital isolator 4DIR2400H. Input signals are transferred to power side and status signals are transferred from power to control side.

To avoid parasitic turn-on due to electrical interferences, the input signals Via and Vib are passive low pass filtered with R34/R35 and C13/C14.

For more information such as static and dynamic characteristics of the digital isolator 4DIR2400H, please refer to the datasheet of 4DIRx4xxH family. [2]

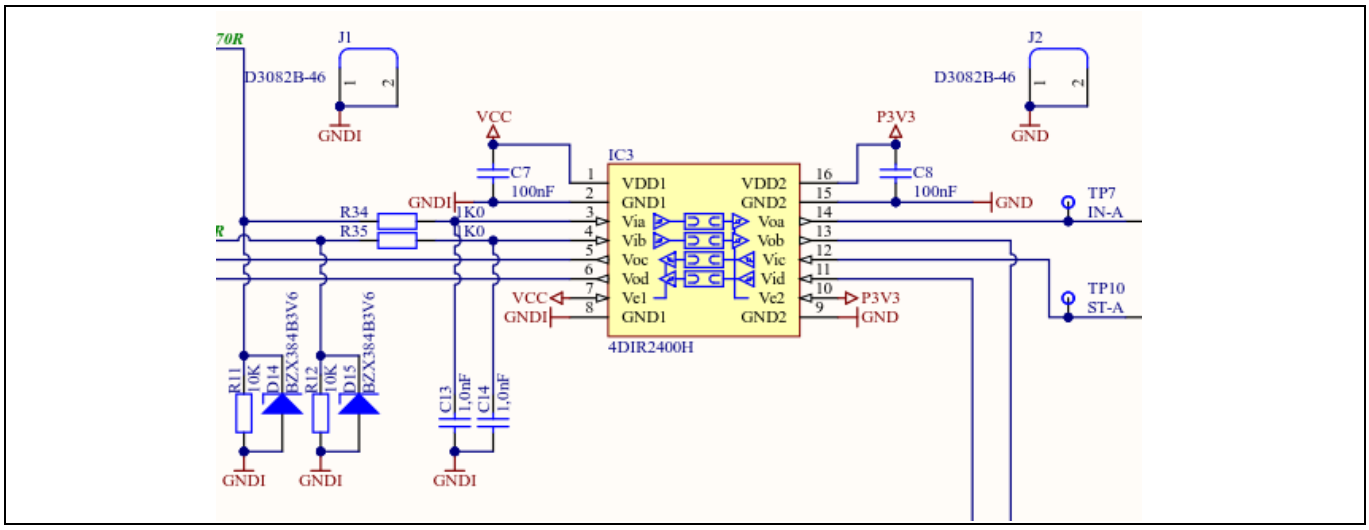


Figure 6 Schematic of digital isolator 4DIR2400H

2.2.3 Control input and status output signal conditioning stage

Figure 7 shows the signal conditioning block of the control input and status output stage of the reference board.

External input signal will be connected to X5 or X3/X4 if SMB connectors are needed. If no external signals will be used, it is possible to set the output power switches static in ON or OFF state by setting JP1/JP2.

Table 2 Jumper JP1/JP2 functions

Jumper	Function
1-2	External signal on X5; X3/X4 active
2-3	Power output static ON
removed	Power output static OFF

Note: In case of input voltages bigger than 3.3 V, R7 and R8 must be dimensioned accordingly. In case of 24V signal level are required, set R7 and R8 to 56 kΩ. In this case the Jumper JP1/JP2 function to set the output to static ON or OFF is not available.

The status output has as a current limited open collector output function. The dynamic current limit is set to 220mA, but static output current is limited to 50mA by resettable fuse F1, F2 in case of overloading.
Status output is designed with a short circuit protection to positive supply.

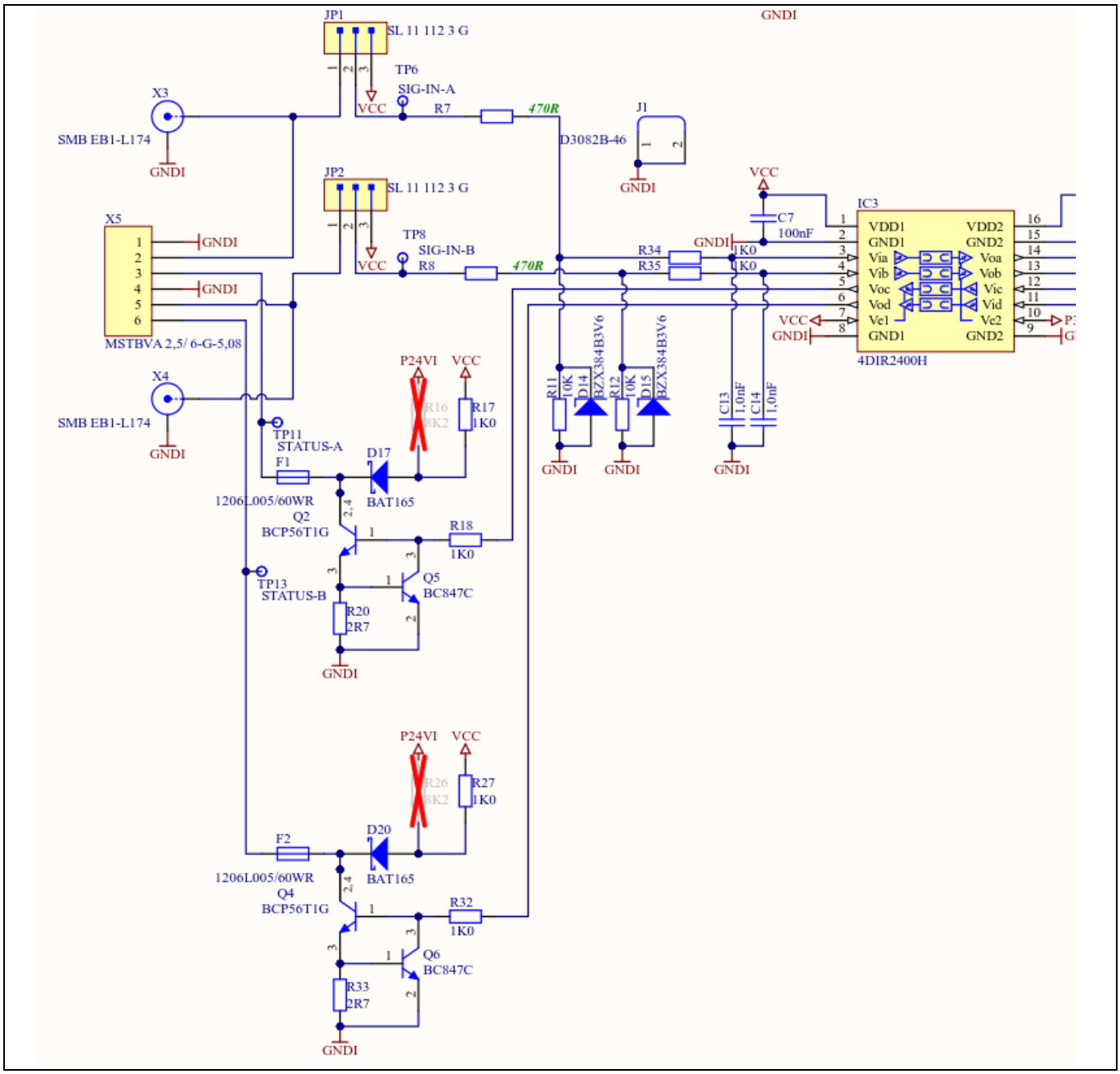


Figure 7 Signal conditioning

2.2.4 Power output stage

Figure 8 shows the PROFET output stage for one output channel. This maximum DC current on the reference board is thermally limited to ~5.8 A by the internal temperature protection of the ITS6035S.

The overcurrent protection level can be set with I_{OCT} which is proportional to R13 according to Figure 8:

$$I_{LIM} \propto I_{OCT} = \frac{V_{OCT}}{R_{13}} = \frac{0.5\ V}{R_{13}}$$

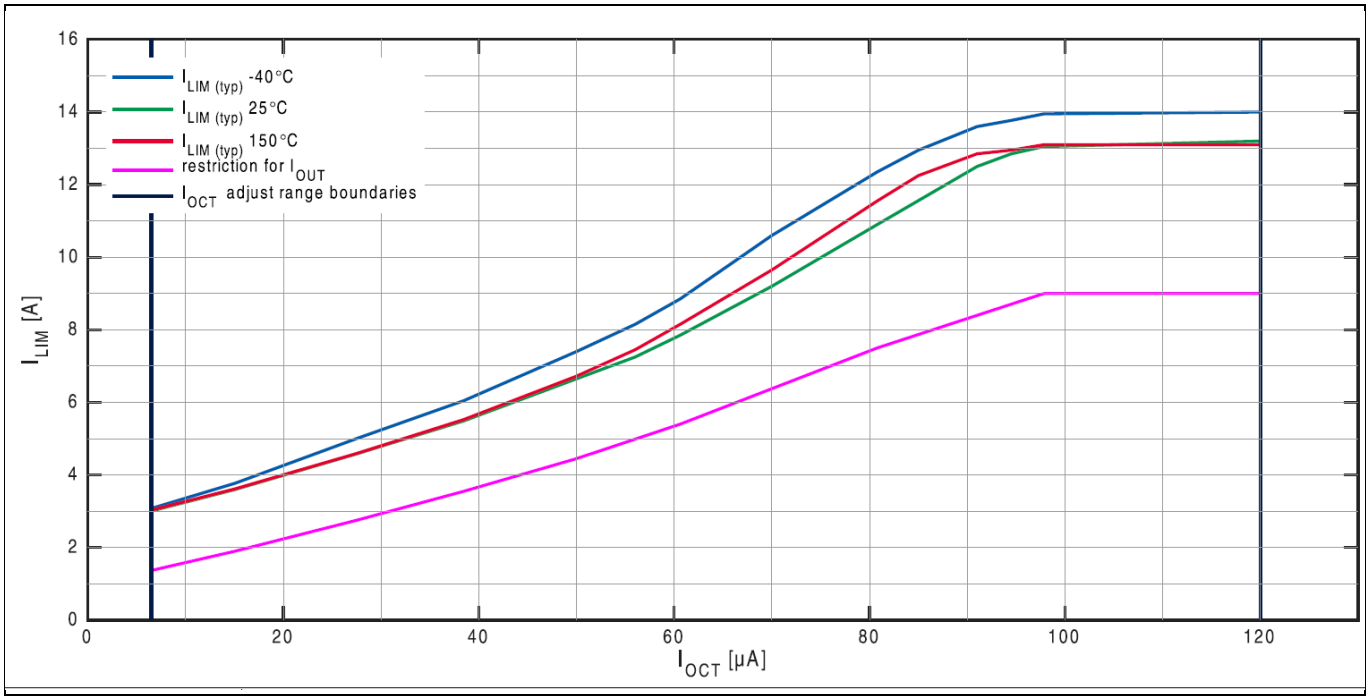


Figure 8 Typical values of the current limitation as function of the adjusted I_{OCT} current

If the switch is in ON state, the current feedback can be measured on TP9 as voltage feedback. The current can be calculated as followed:

$$I_{load}(A) = k_{ILIS} \cdot I_S = k_{ILIS} \cdot \frac{U_{TP9}}{R14} = 1910 \cdot \frac{U_{TP9}}{1200\ \Omega} = 1.592 \cdot U_{TP9}$$

Furthermore, during OFF state, the outputs will be discharged via the DC pin of the ITS6035S with the pull-down circuit and discharge path R2/D4 to GND. If this feature is not needed, R2 and/or D4 should be removed.

To provide a reverse polarity protection of the output stage, the current towards the input side is limited by R6, R10 and R15, D8.

For more information such as static and dynamic characteristics and all protection features of the PROFET, please refer to the datasheet of ITS6035S. [1]

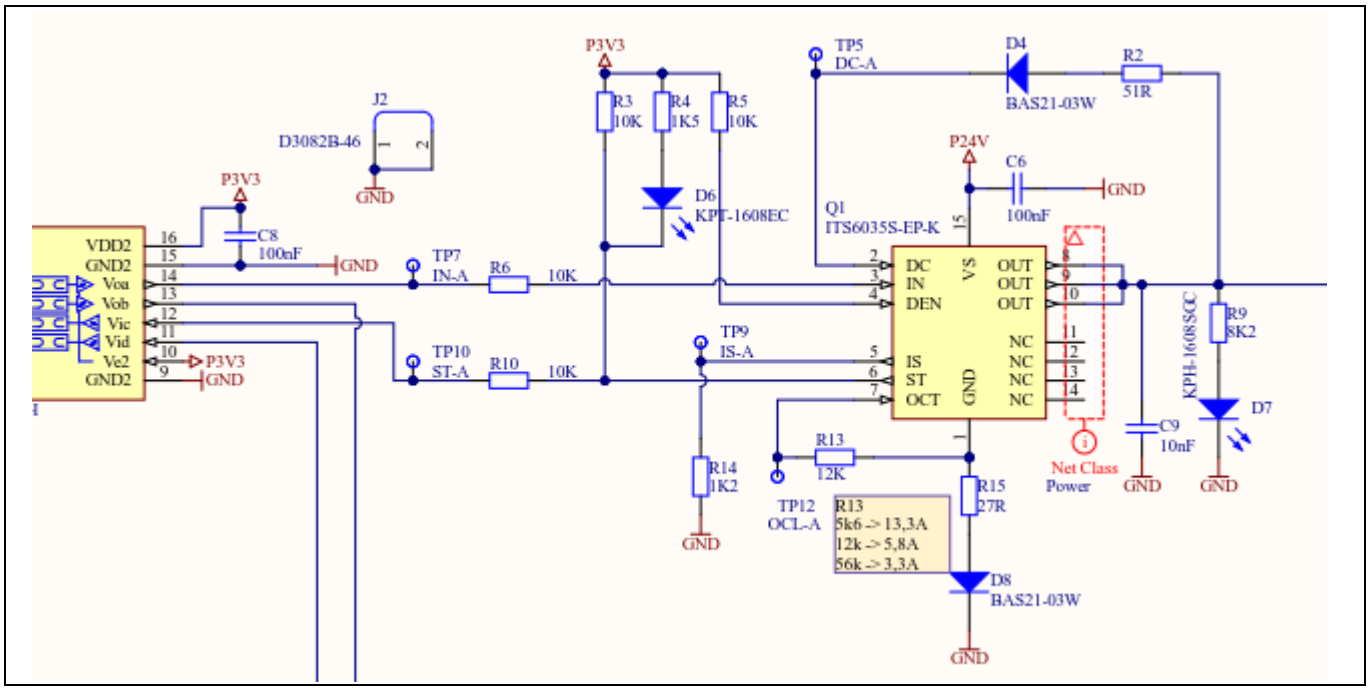


Figure 9 Schematic Power output stage (1 channel)

2.3 Basic operation

If input and output side is supplied, a high signal on one of the signal inputs will enable the corresponding high-side output. If no protection feature of the ITS6035S is activated, the status feedback on the signal side is pulled to GND. In case of a fault condition, this signal is pulled to high.

The LEDs D18 and D3 are indicating if the digital isolator input and output side is supplied. The output state is indicated with LED D7 and D12 and any fault condition of the respective channel with LED D6 and D11. The position of the LEDs is shown in Figure 10.

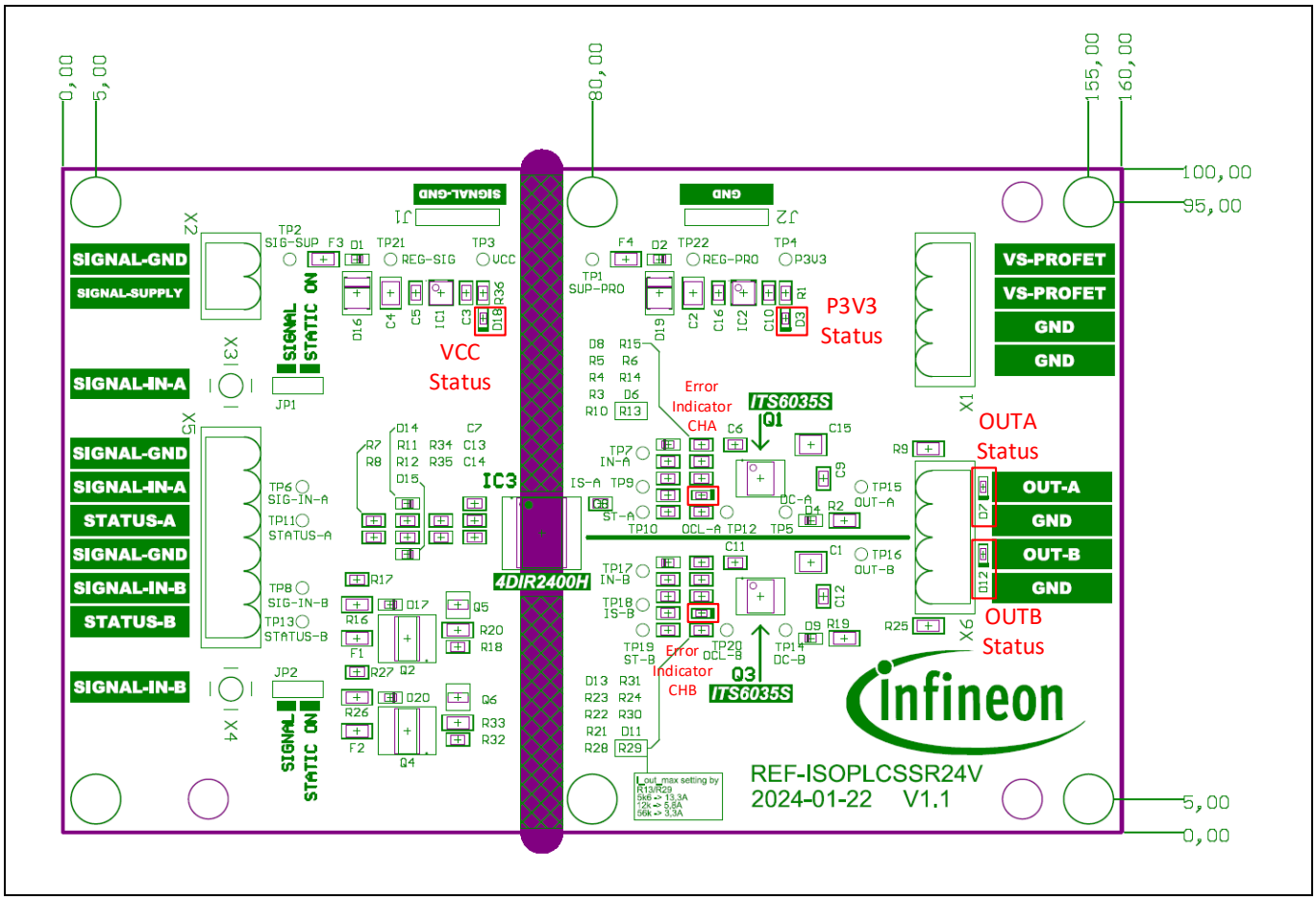


Figure 10 Reference Board - position of the indicators

3 System design

3.1 Schematics

Figure 11 is showing the full schematic of the reference board.

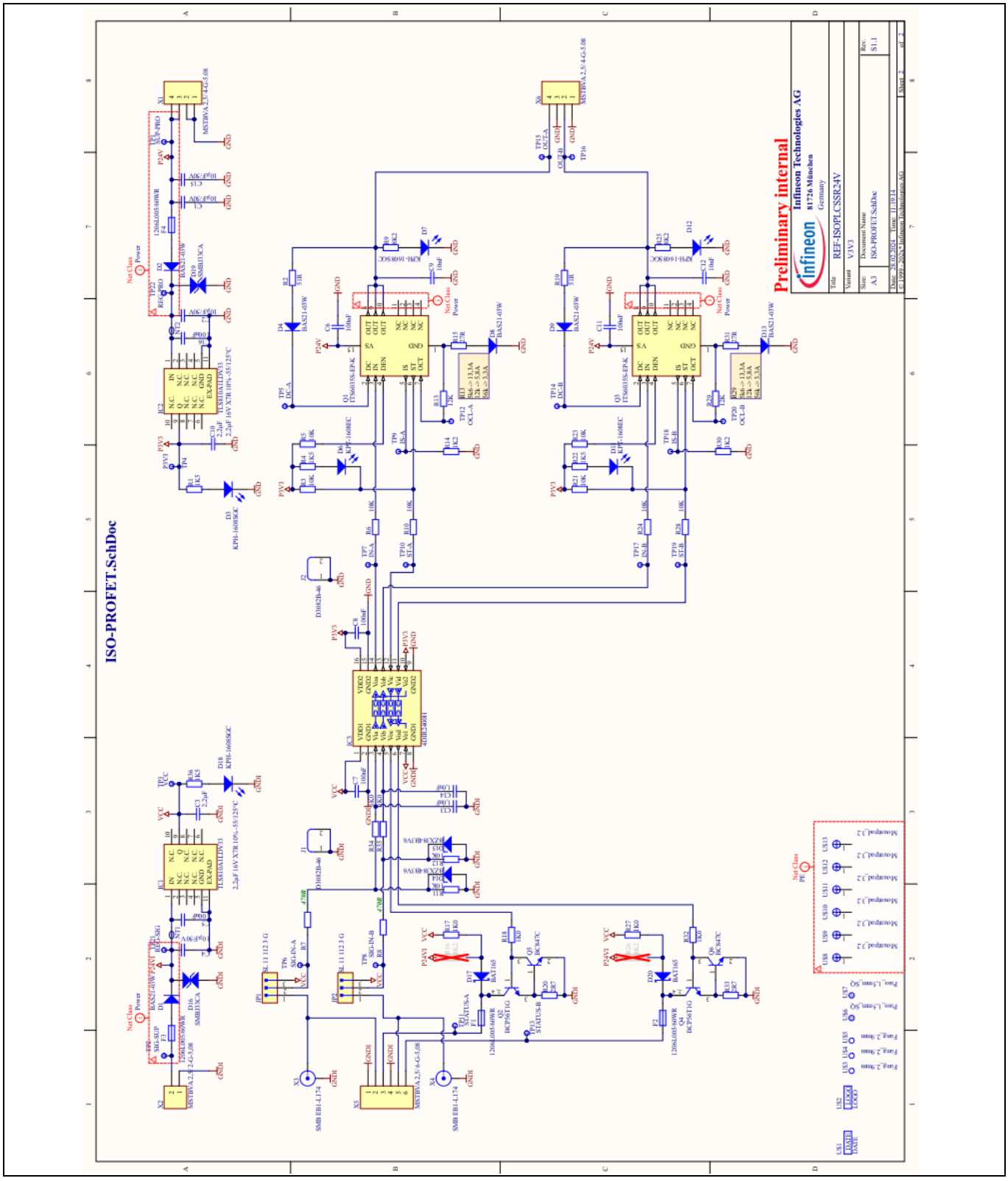


Figure 11 Schematic

3.2 Layout

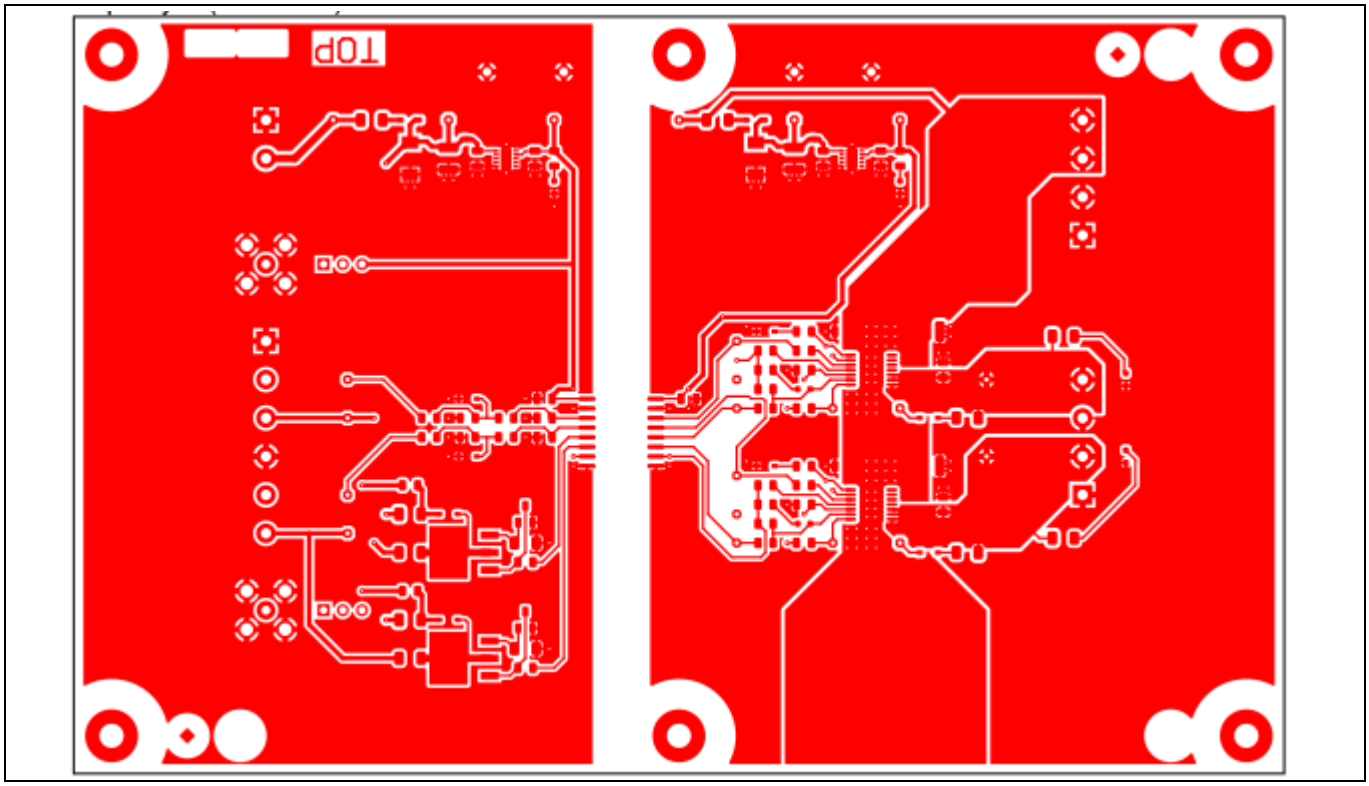


Figure 12 Top Layer

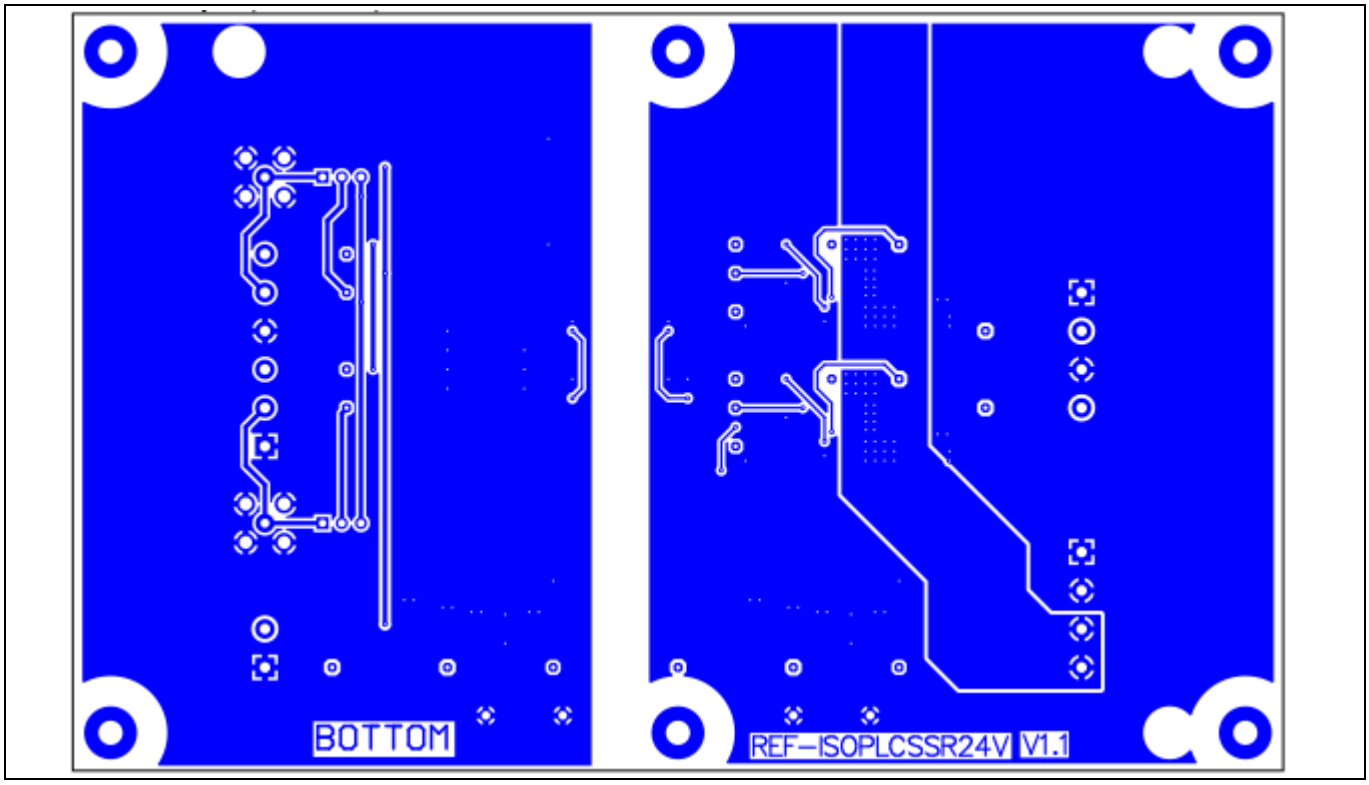


Figure 13 Bottom Layer (Botto View)

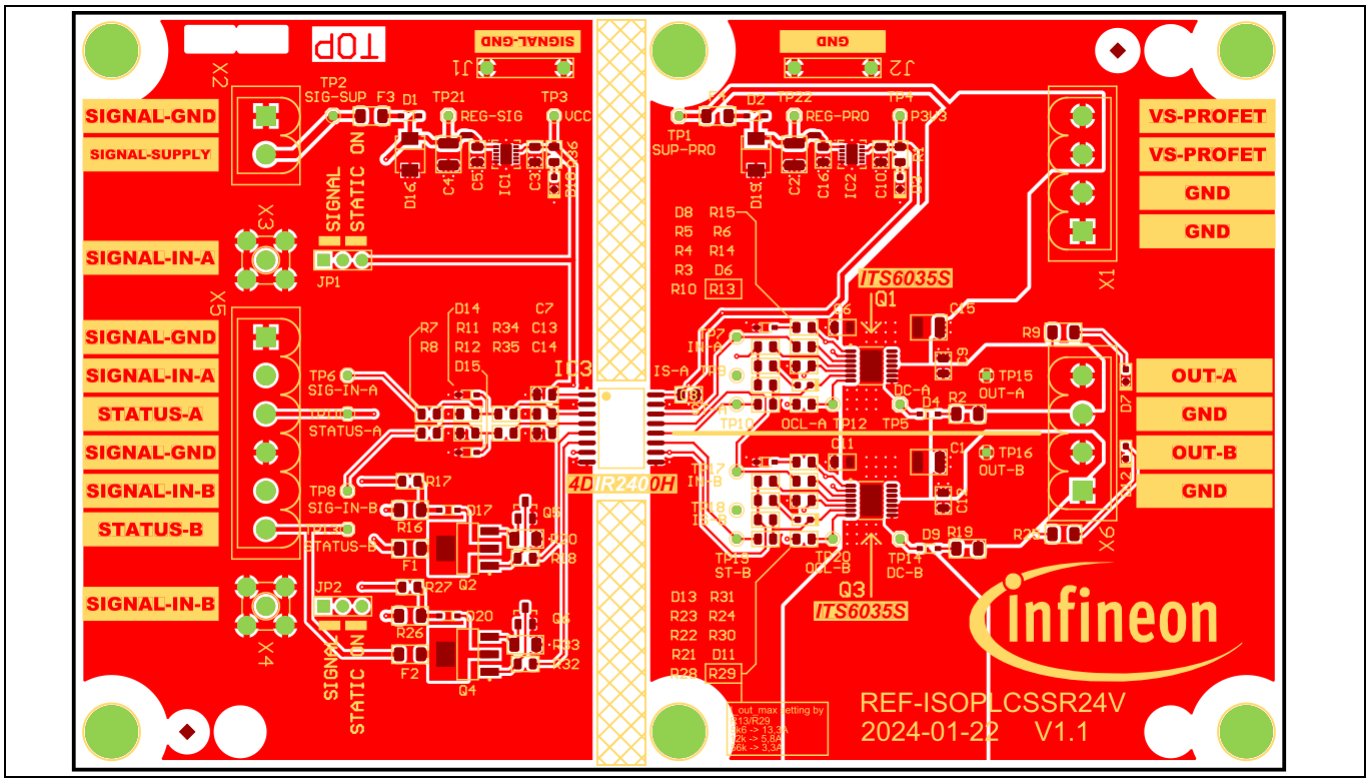


Figure 14 Top assembly view

3.3 Bill of material

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

Table 3 BOM of the most important/critical parts of the reference board

S. No.	Ref Designator	Description	Manufacturer	Manufacturer P/N
1	Q1, Q3	PROFET 60V 35mOhm 13A	Infineon	ITS6035S-EP-K
4	IC3	Digital galvanic Isolator	Infineon	4DIR2400H
20	IC1, IC2	Voltage Regulator 3.3V 100mA Vinmax=42V	Infineon	TLS810A1LDV33
3	Q2, Q4	npn Transistor 80V 1A	ONSemiconductor	BCP56T1G
2	Q5, Q6	npn Transistor	NXP	BC847C,215
5	D14, D15	Diode Zener	Vishay	BZX384B3V6-E3-08
6	D17, D20	Diode Schottky 40V 750mA	Infineon	BAT165
7	D1, D2, D4, D8, D9, D13	Diode 200V 250mA	Infineon	BAS21-03WE6327HTSA1
8	D16, D19	Diode Supressor 33V	Littlefuse	SMBJ33CA
9	F1, F2, F3, F4	PTC Fuse 50mA 60V	Littlefuse	1206L005/60WR
21	X5	PCB header 12A 6 number of rows	Phoenix Contact	MSTBVA 2,5/ 6-G-5,08
22	X1, X6	PCB header 12A 4 number of rows	Phoenix Contact	MSTBVA 2,5/ 4-G-5.08

S. No.	Ref Designator	Description	Manufacturer	Manufacturer P/N
23	X2	PCB header 12A 2 number of rows	Phoenix Contact	MSTBVA 2,5/ 2-G-5,08
26	X3, X4	SMB-Coax-Connector		
25	JP1, JP2	Jumper	Fischer Elektronik	SL 11 112 3 G

3.4 Connector details

Table 4 X2-Connector MSTBVA 2,5/ 2-G-5,08; Pin 1 left

PIN	Label	Function
1	SIGNAL-GND	Negative supply signal side
2	SIGNAL-SUPPLY	Positive supply signal side (5 V…30 V, nominal 24 V)

Table 5 X3-Connector SMB-Coax

PIN	Label	Function
MID	SIGNAL-IN-A	Signal input channel A
Housing	SIGNAL-GND	Signal return

Table 6 X4-Connector SMB-Coax

PIN	Label	Function
MID	SIGNAL-IN-A	Signal input channel A
Housing	SIGNAL-GND	Signal return

Table 7 X5-Connector MSTBVA 2,5/ 6-G-5,08; Pin 1 left

PIN	Label	Function
1	SIGNAL-GND	Signal- and status return
2	SIGNAL-IN-A	Signal input channel A
3	STATUS-A	Status channel A
4	SIGNAL-GND	Signal- and status return
5	SIGNAL-IN-B	Signal input channel B
6	STATUS-B	Status channel B

Table 8 X1-Connector MSTBVA 2,5/ 4-G-5,08; Pin 1 left

PIN	Label	Function
1	GND	Negative supply power output side
2	GND	Negative supply power output side

3	VS-PROFET	Positive supply power output side (8V..30V, nominal 24 V)
4	VS-PROFET	Positive supply power output side (8V..30V, nominal 24 V)

Table 9 X6-Connector MSTBVA 2,5/ 4-G-5,08; Pin 1 left

PIN	Label	Function
1	GND	Power return
2	OUT-B	Power output Channel B
3	GND	Power return
4	OUT-A	Power output Channel A

4 System performance

4.1 Test points

Table 10 Testpoints of Reference Board

Designator	Label	Function
TP1	SUP-PRO	Power Supply Output Side
TP2	SIG-SUP	Power Supply Input Side
TP3	VCC	4DIR2400 logic supply input side
TP4	P3V3	4DIR2400 logic supply output side
TP5	DC-A	ITS6035S DC pin channel A (discharge)
TP6	SIG-IN-A	Signal Input Channel A
TP7	IN-A	ITS6035S IN pin channel A (input)
TP8	SIG-IN-B	Signal Input Channel B
TP9	IS-A	ITS6035S IS pin channel A (current sense)
TP10	ST-A	ITS6035S ST pin channel A (status)
TP11	STATUS-A	Status Feedback Channel A
TP12	OCL-A	ITS6035S OCT pin channel A (overcurrent limit)
TP13	STATUS-B	Status Feedback Channel B
TP14	DC-B	ITS6035S DC pin channel B (discharge)
TP15	OUT-A	ITS6035S OUT pin channel A (Output)
TP16	OUT-B	ITS6035S OUT pin channel B (Output)
TP17	IN-B	ITS6035S IN pin channel B (input)
TP18	IS-B	ITS6035S IS pin channel B (current sense)
TP19	ST-B	ITS6035S ST pin channel B (status)
TP20	OCL-B	ITS6035S OCT pin channel B (overcurrent limit)
TP21	REG-SIG	Voltage regulator IN – Input side
TP22	REG-SIG	Voltage regulator IN – Output side
J1	SIGNAL-GND	Ground – input side
J2	GND	Ground – output side

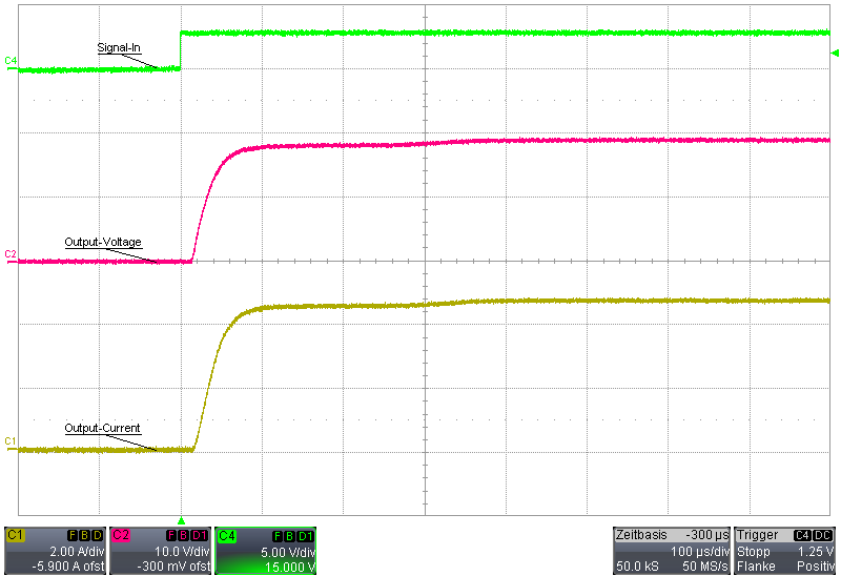
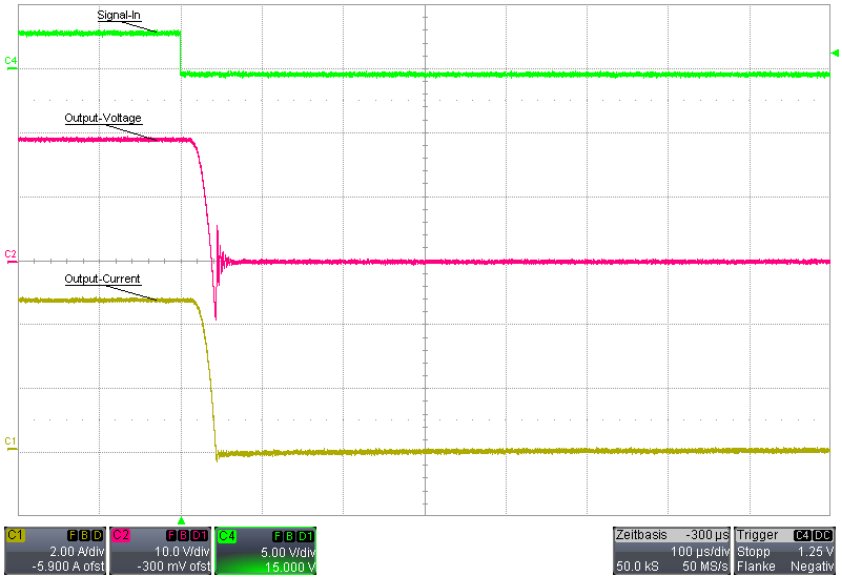
4.2 Test results

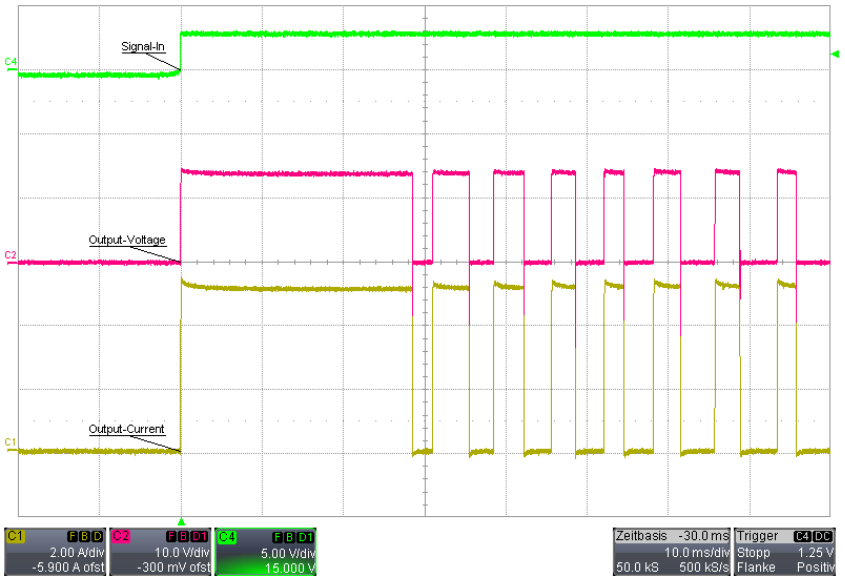
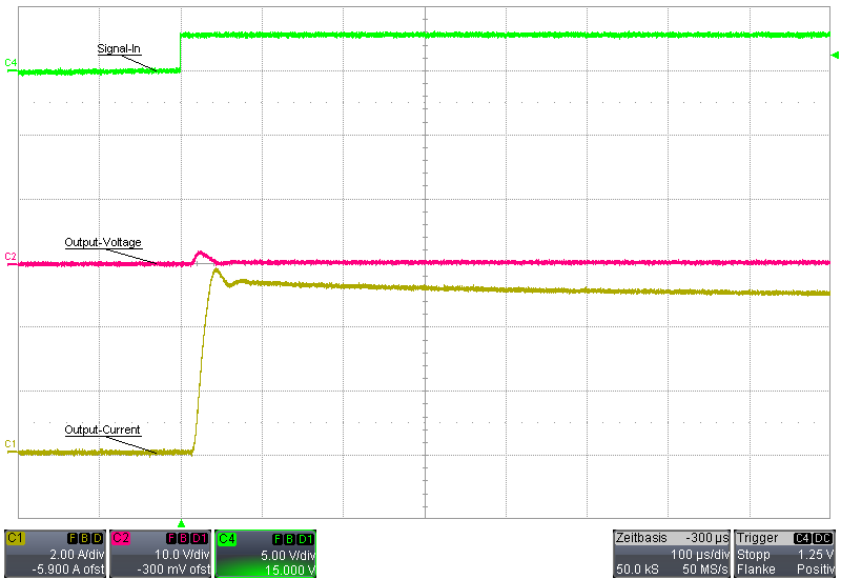
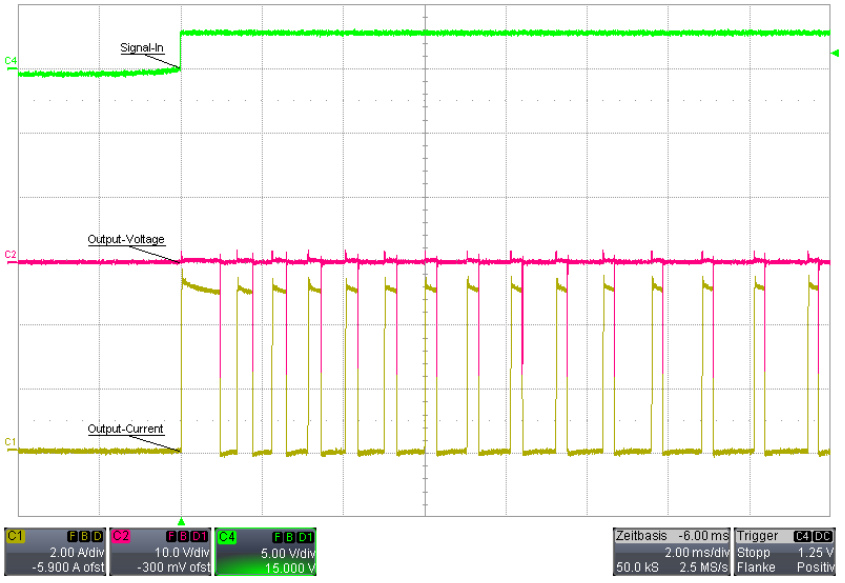
4.2.1 Electrical performance

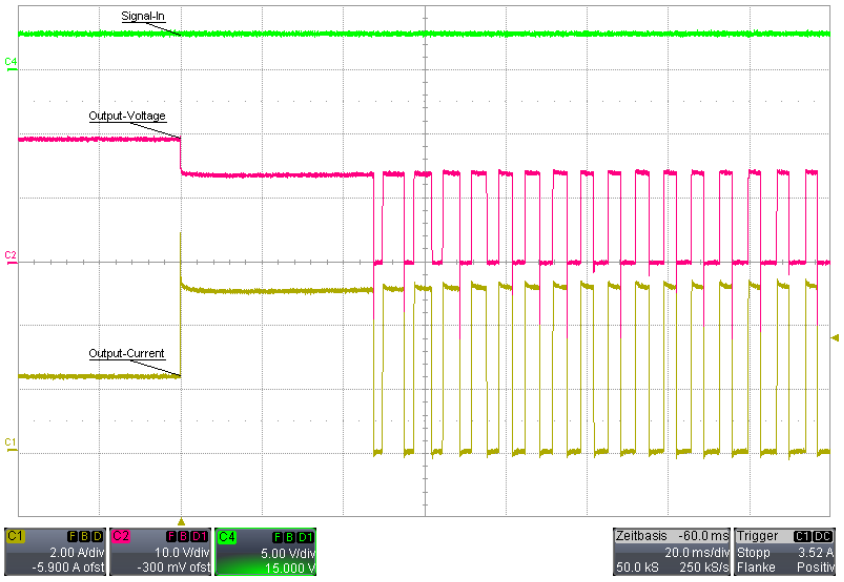
The tests were performed with these parameters:

Supply-Signal: 24 V
Signal level: 3.3 V
VS-PROFET: 20 V
Current limit set point: 5.8 A (R13, R29 = 12 kΩ)

Table 11 Power switching behavior

Description	Scope Image
PROFET Turn On Load resistance: 3.9 Ω Load current: 4.7 A	
PROFET Turn OFF Load resistance: 3.9 Ω Load current: 4.7 A	

Overload Load resistance: 2.6 Ω Current limitation: 5.6A For the first 30 ms after Turn On PROFET current limit is active. After that the thermal protection is working and results in current pulsing.	
Short circuit (100µs/Div) Load resistance: 0 Ω Current limitation: 5.6 A PROFET short circuit protection limits the output current to 5.6 A.	
Short circuit (2ms/Div) Load resistance: 0 Ω Current limitation: 5.6 A For the first 1 ms after turn On PROFET current limit is active. After that the thermal protection is working and results in current pulsing.	

Load dump Input signal in static ON condition Load resistance: 7.8 Ω -> 2.6 Ω Load dump to 2.6 Ω results in current limitation and thermal protection Current Limitation: 5.6 A	

4.2.2 Thermal Results

All thermal evaluations are done with an IR thermal camera on the housing of the ITS6035S. The measured temperatures are not representing the internal T_j and can be different especially in dynamic load conditions. Figure 15 is showing the measurement result with a DC load on channel A of 4.1 A after temperature settled.

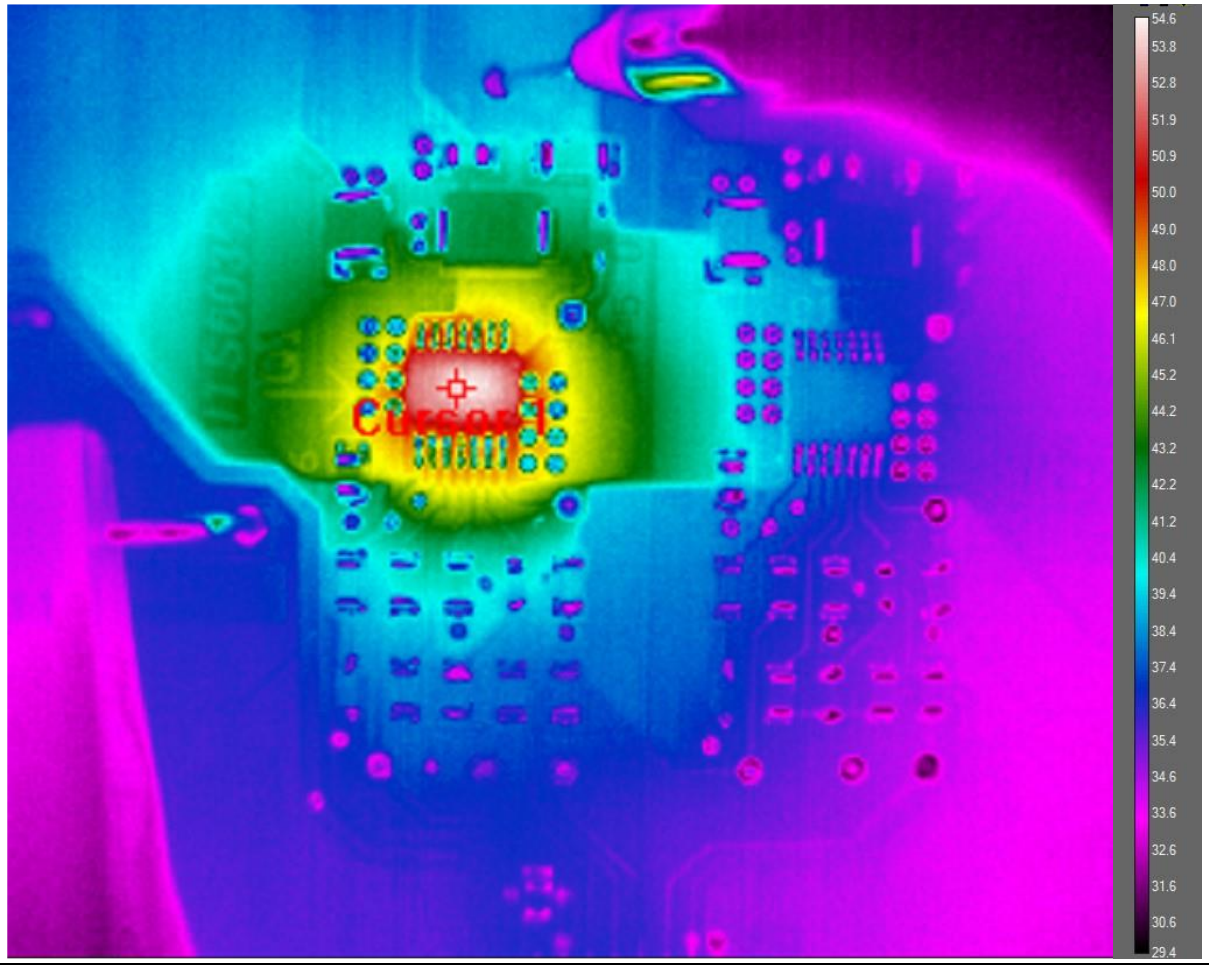


Figure 15 Thermal Measurement with 4.1 A DC load

4 System performance

Figure 16 shows the thermals measurement results of the hotspot temperature on the surface of the package with a DC load current of 2.2 A and 4.1 A. All measurements were taken at room temperature and normalized to a starting temperature of 25°C.

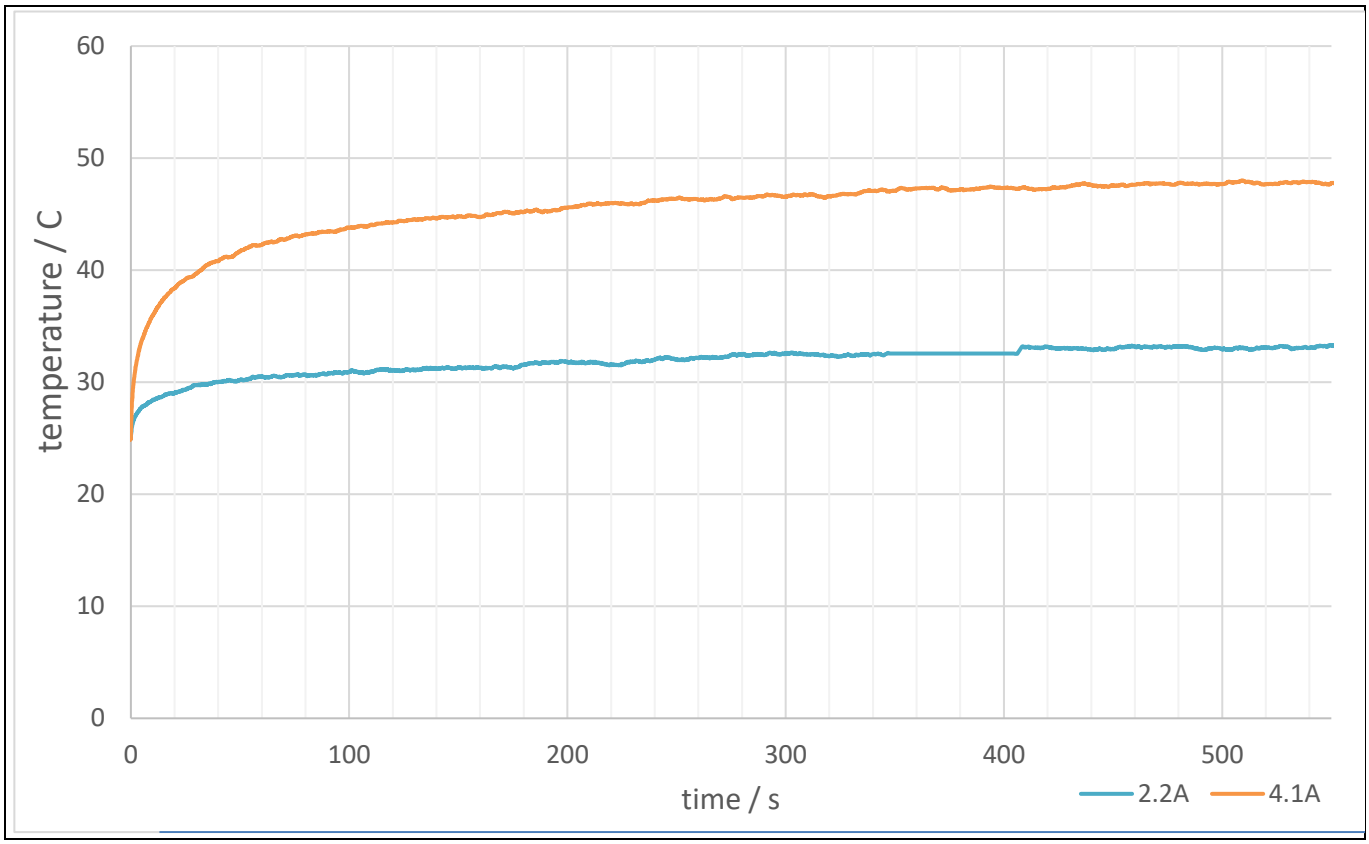


Figure 16 Thermal Measurement hotspot temperature with 4.1 A / 2.2 A DC load

5 Appendices

5.1 Abbreviations and definitions

Table 12 Abbreviations

Abbreviation	Meaning
I/O	Input / Output
PCB	Printed circuit board
AC	Alternating current
DC	Direct current
SMB	SubMiniature version B

5.2 Additional information

Isolated Digital Output Reference Board order number: REF-ISOPLCSSR24V

References

[1] [IFX]: [Datasheet ITS6035S-EP-K - 35 mΩ single channel smart high-side power switch]; [2023]; [https://www.infineon.com/dgdl/Infineon-ITS6035S-EP-K-DataSheet-v01_00-EN.pdf?fileId=8ac78c8c8929aa4d018a21c51e3b2599]

[2] [IFX]: [Datasheet 4DIRx4xxH family - Robust Digital Isolators with precise timing and low power consumption]; [2024]; [https://www.infineon.com/dgdl/Infineon-Datasheet_ISOFACE(TM)_4DIRx4xxH_family-DataSheet-v01_06-EN.pdf?fileId=8ac78c8c8929aa4d01899cc3b5175436]

Revision history

Document version	Date	Description of changes
V1.0	2025-05-24	Initial Release

Trademarks
All referenced product or service names and trademarks are the property of their respective owners.

Edition 2024-05-24

Published by

Infineon Technologies AG

81726 Munich, Germany

Do you have a question about this document?

Email: erratum@infineon.com

Document reference

UG-2024-04

WARNINGS
Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for Interface Development Tools ***category:***

Click to view products by Infineon ***manufacturer:***

Other Similar products are found below :

CY4607M CHA2066-99F XR21B1424IV64-0A-EVB P0551 5346 SI32185ACB10SL1KIT Si32185ACB10SL0EVB 4901 LIME2-SHIELD USB TO TTL USB TO RS485 PL2303 USB UART Board (type A) V2 USB-CAN-A MIKROE-5492 5956 WEBCARDLXE MIKROE-2335 KIT_MINIWIGGLER_3_USB KITXMC4XCOMETH001TOBO1 SI871XSOIC8-KIT 1764 1833 1862 ZSC31010KITV2.1 EVALISO1I811TTOBO1 EVB-USB82514 ATAB663231A-V1.2 ATAB663254A-V1.2 2264 MCP23X17EV PS09-EVA-KIT BOB-13263 ORG4572-R01-UAR XR21B1422IL40-0A-EVB XR21B1420IL28-0A-EVB SKYFR-000982 MIKROE-2750 292 DFR0065 DFR0077 DFR0504 TEL0010 TEL0038 TEL0070 ASI4UEVBV2P1 NCN5193GEVB MIKROE-2517 BOB-13830 MIKROE-2674 DFR0483