

EVAL_ISO_4DIR1400H user manual

Evaluation board for Infineon ISOFACE™ quad-channel digital isolators

About this document

Scope and purpose

This document introduces the Infineon ISOFACE™ quad-channel digital isolators and describes how to evaluate their performance by using the evaluation board EVAL_ISO_4DIR1400H.

Intended audience

This document is intended for design engineers who want to design high-voltage (HV) applications with Infineon digital isolators for isolation purposes.

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1 Introduction to Infineon ISOFACE™ quad-channel digital isolators

Isolation provides safety in HV applications and improves electrical noise immunity. To meet the continually growing requirements for isolation products, Infineon Technologies offers ISOFACE™ quad-channel digital isolators with the highest robustness, most accurate timing performance and lowest power consumption. This product family, based on coreless transformer (CT) technology, uses two coils stacked on top of each other with SiO₂ as insulation material in between, and has the following features:

- RoHS-compliant PG-DSO-16 wide-body 300 mil package
- High common-mode transient immunity, greater than 100 kV/μs
- Wide supply voltage range, from 2.7 to 6.5 V (absolute maximum 7.5 V)
- Accurate timing, with 26 ns typical propagation delay and -6/+7 ns spread
- Lower power consumption with maximum 6.2 mA at 3.3 V and 1 Mbps
- CMOS variable input thresholds
- Pin-to-pin compatible with all quad-channel digital isolator products in SOIC-16 wide-body package (300 mil) available on the market

This digital isolator family includes the following product variants:

Table 1 Product variants in Infineon's ISOFACE™ quad-channel digital isolator family

Part number	Channel configuration	Default output state	Output enable	Isolation rating	Package
4DIR0400H	4 forward 0 reverse (4+0)	Low	Active high	$V_{ISO} = 5700 V_{RMS7}$ (UL1577 Ed. 5)	PG-DSO-16 300 mil 10.3 x 10.3 mm
4DIR0401H		High			
4DIR1400H	3 forward 1 reverse (3+1)	Low			
4DIR1401H		High			
4DIR2400H	2 forward 2 reverse (2+2)	Low			
4DIR2401H		High			
4DIR1420H	3 forward 1 reverse (3+1)	Low	Active low		
4DIR1421H		High			

The target applications are:

- AC-DC converter in telecom and server power supply systems
- High-side floating pulse-width modulation (PWM) signal transfer for GaN with integrated power stage (GaN-IPS)
- Isolated SPI communication

2 Evaluation board EVAL_ISO_4DIR1400H

To make the evaluation of ISOFACE™ quad-channel digital isolators easier, Infineon offers the evaluation board EVAL_ISO_4DIR1400H, as shown in [Figure 1](#).

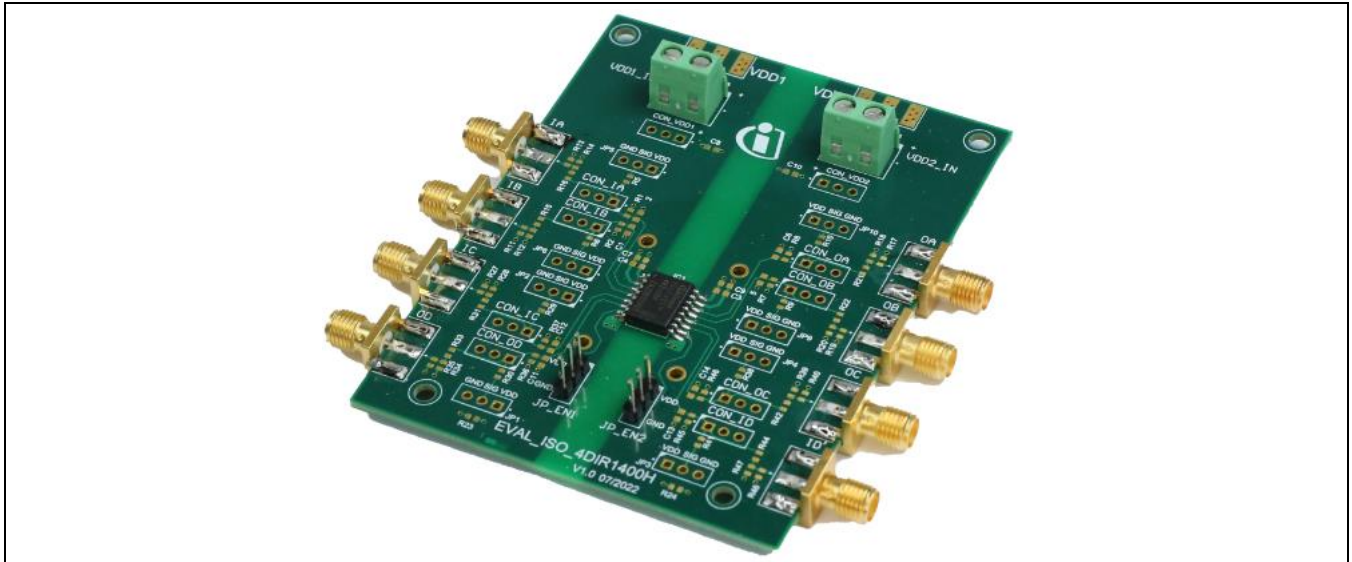


Figure 1 Evaluation board EVAL_ISO_4DIR1400H

This board is designed with a four-layer stack to achieve high EMC performance even at high data-speed operation. Standard FR-4 class epoxy is used as the PCB material. For a more detailed stack specification, please see [chapter 2.1](#).

It comes with the digital isolator ISOFACE™ 4DIR1400H (3+1, CMOS input threshold, default output low) variant assembled by default. But it can also be used to evaluate other product variants of the quad-channel digital isolator family. However, they are not supplied with the board and must be ordered separately. The evaluation board provides the following features:

- Support for high-speed probes to measure all power supply, input and output signals. The connectors are not supplied with the board and must be assembled separately.
- Support for edge-mounted coaxial (SMA) connectors. The SMA connectors are not supplied with the board and must be assembled separately.
- Easy accessibility of input and output pins, e.g., connection of additional filters, load, and pull-up and pull-down resistors. The components must be assembled separately.

For a more detailed description of the features listed above, please see [chapter 3](#).

2.1 Board layer stack

To achieve a low-EMI performance even at a high data rate of up to 40 Mbit/s, the board uses a four-layer PCB design:

- Layer 1: high-speed layer
This layer is intended for high-speed signal traces, for example signal inputs and signal outputs.
- Layer 2: ground layer
One ground layer is placed in between to provide the shielding effect.
- Layer 3: power layer
This layer is intended for all power supply traces for the digital isolator.
- Layer 4: ground layer
As there are no low-speed signal traces available, this layer is designed as the ground layer for better shielding.

The layer stacking is shown in [Figure 2](#).

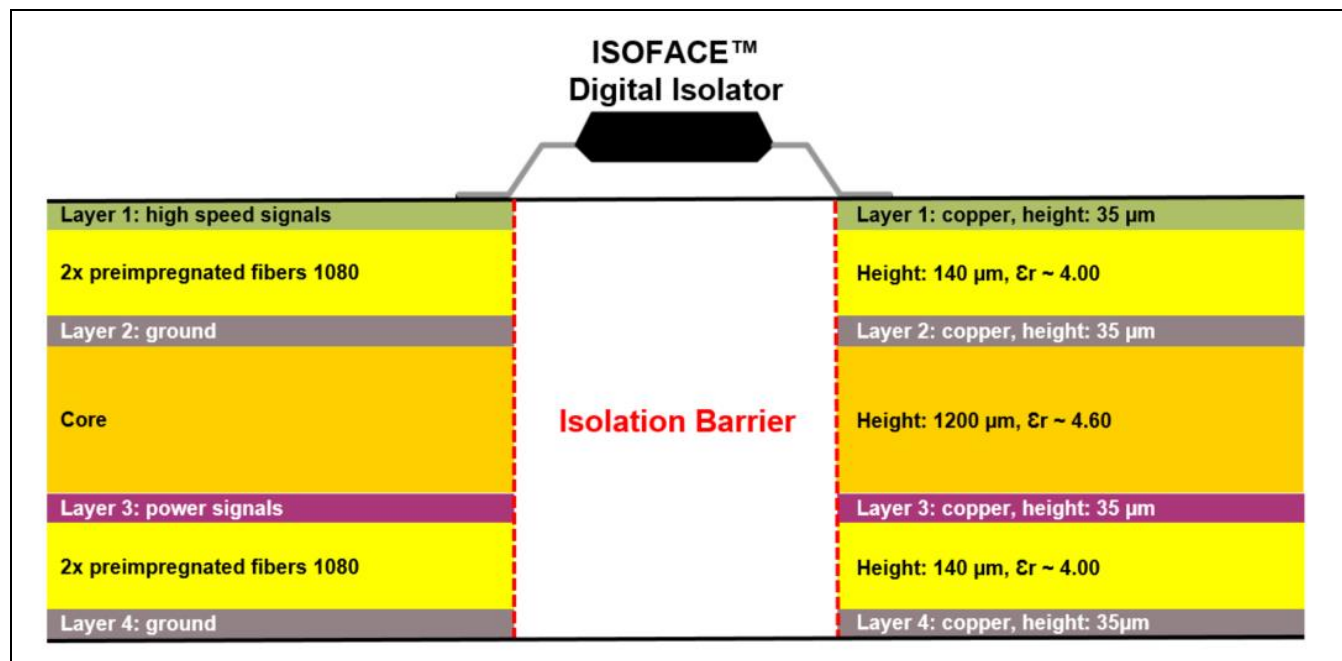


Figure 2 Layer stack of EVAL_ISO_4DIR1400H

2.2 Board schematic

The schematic of the evaluation board EVAL_ISO_4DIR1400H is provided in [Figure 3](#).

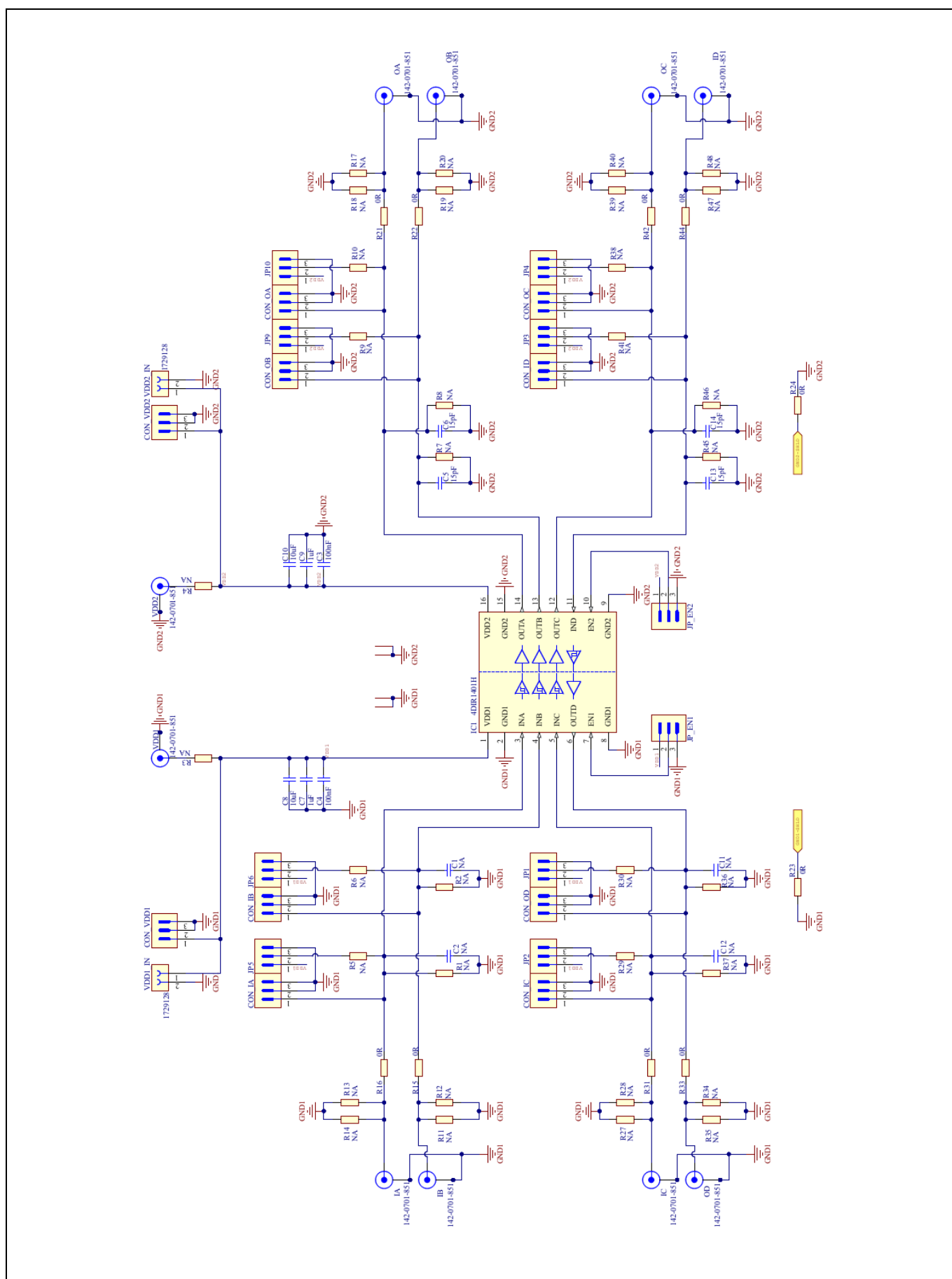


Figure 3 Schematic of EVAL_ISO_4DIR1400H

2.3 Board layout

The layout of the evaluation board EVAL_ISO_4DIR1400H is provided in [Figure 4](#). Please note that the isolation barrier in the middle is placed in each layer and has a width of 8 mm. There are no traces, pads or vias placed within this isolation barrier.

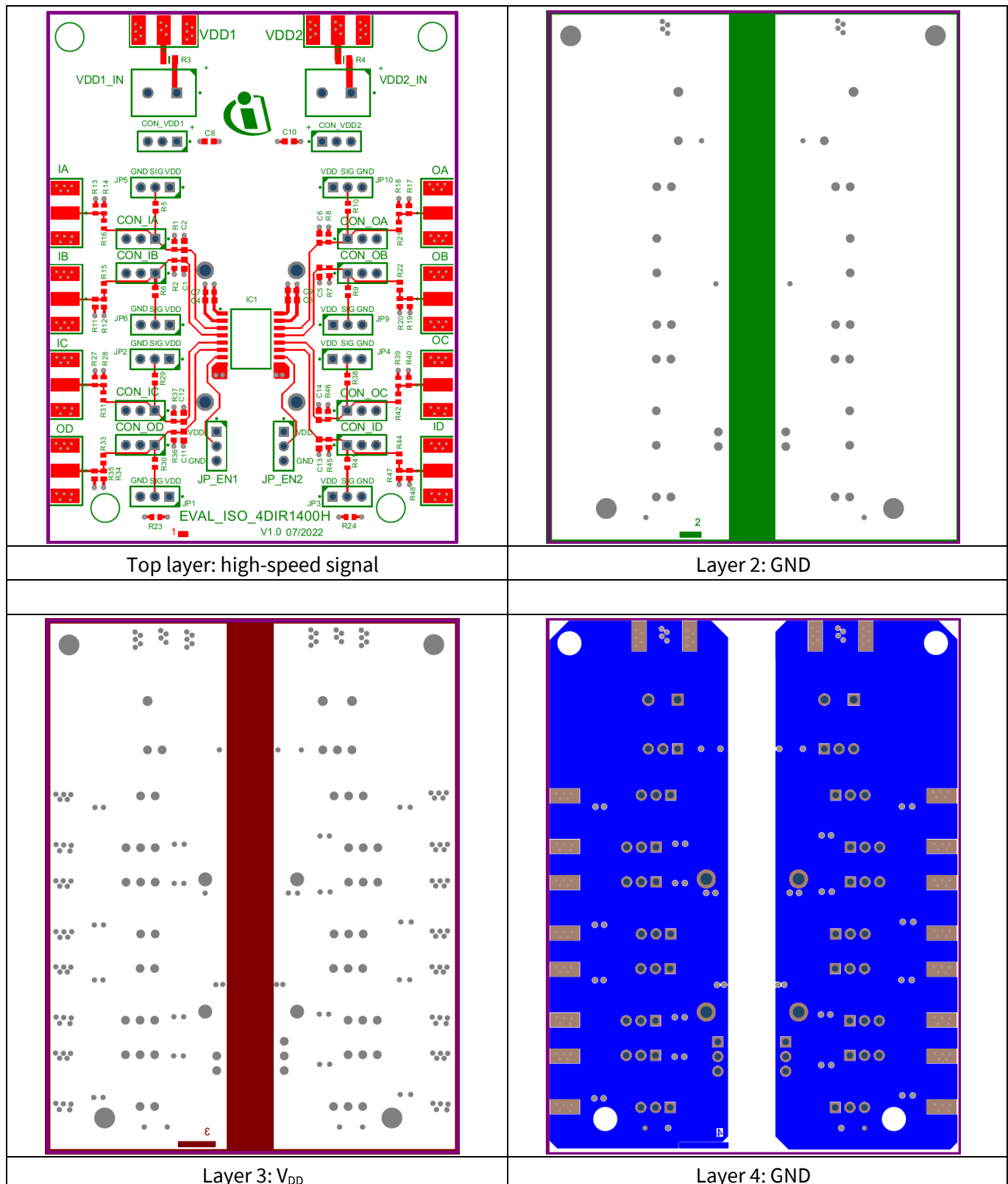


Figure 4 PCB layout of EVAL_ISO_4DIR1400H

3 Functional description

3.1 Connections

The board offers two power supply connections (VDD1 and VDD2) and four input/output connections for the dual-channel digital isolator 4DIR1400H.

3.1.1 Power connections

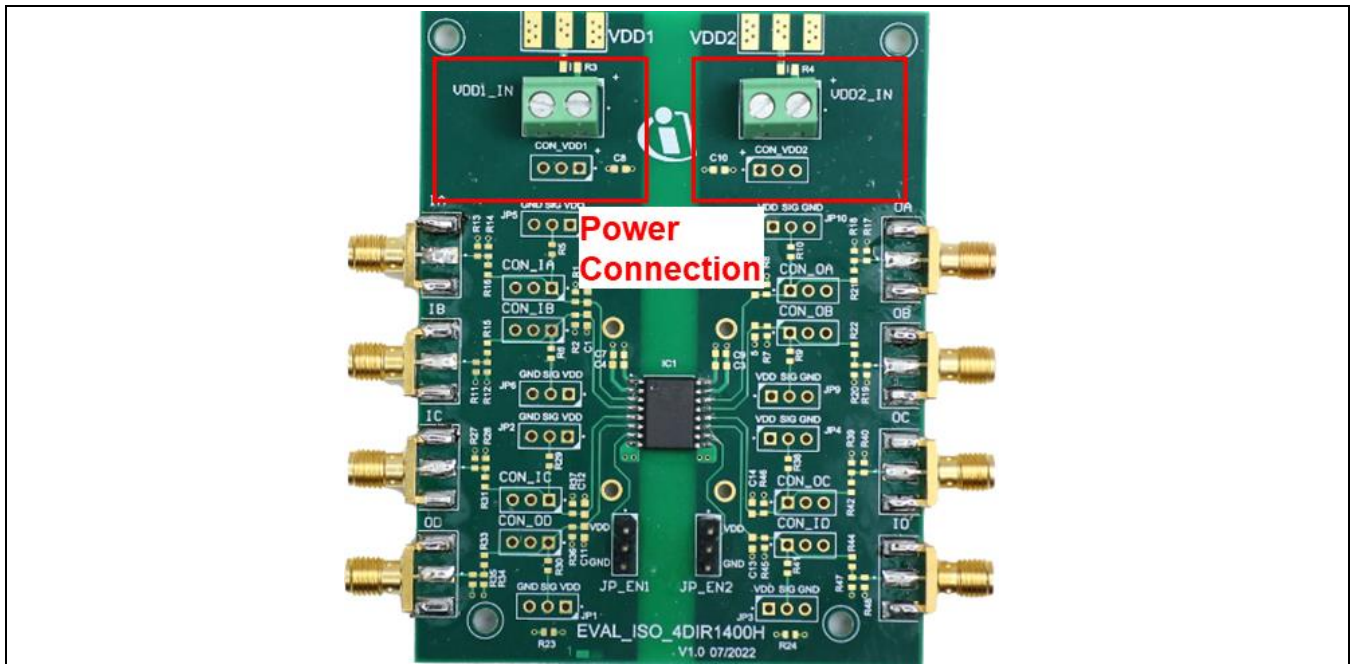


Figure 5 Power connections of EVAL_ISO_4DIR1400H

- **Power connection VDD1**

This connection provides the V_{DD} supply for side 1 of the digital isolator. The operating supply voltage range is 2.7 to 6.5 V. For this connection, there is one edge-mounted SMA connector (VDD1) and one terminal block (VDD1_IN) available. To use the SMA connector, jumper R3 needs to be assembled. To measure the power supply signal on side 1 with a high-speed probe, there is a header block (CON_VDD1) designed.

- **Power connection VDD2**

This connection provides the V_{DD} supply for side 2 of the digital isolator. The operating supply voltage range is 2.7 to 6.5 V. For this connection, there is one edge-mounted SMA connector (VDD2) and one terminal block (VDD2_IN) available. To use the SMA connector, jumper R4 needs to be assembled. To measure the power supply signal on side 2 with a high-speed probe, there is a header block (CON_VDD2) designed.

- **Bypass capacitors for power supply**

There are three bypass capacitors designed on each side of the digital isolator to reduce noise on the power supply line. C8 and C10 (10 μ F) are placed close to the terminal block to compensate for the long power supply cable. C4, C7 and C3, C9 (100 nF and 1 μ F) are placed directly next to the digital isolator so that a stable V_{DD} supply is guaranteed.

3.1.2 Signal connections

There are two signal connections for each side of the digital isolator planned: two input and two output connections. Depending on which product variant is assembled on the board, there are different configurations of input and output connections. **Figure 6** gives an example using 3+1 digital isolator ISOFACE™ 4DIR1400H.

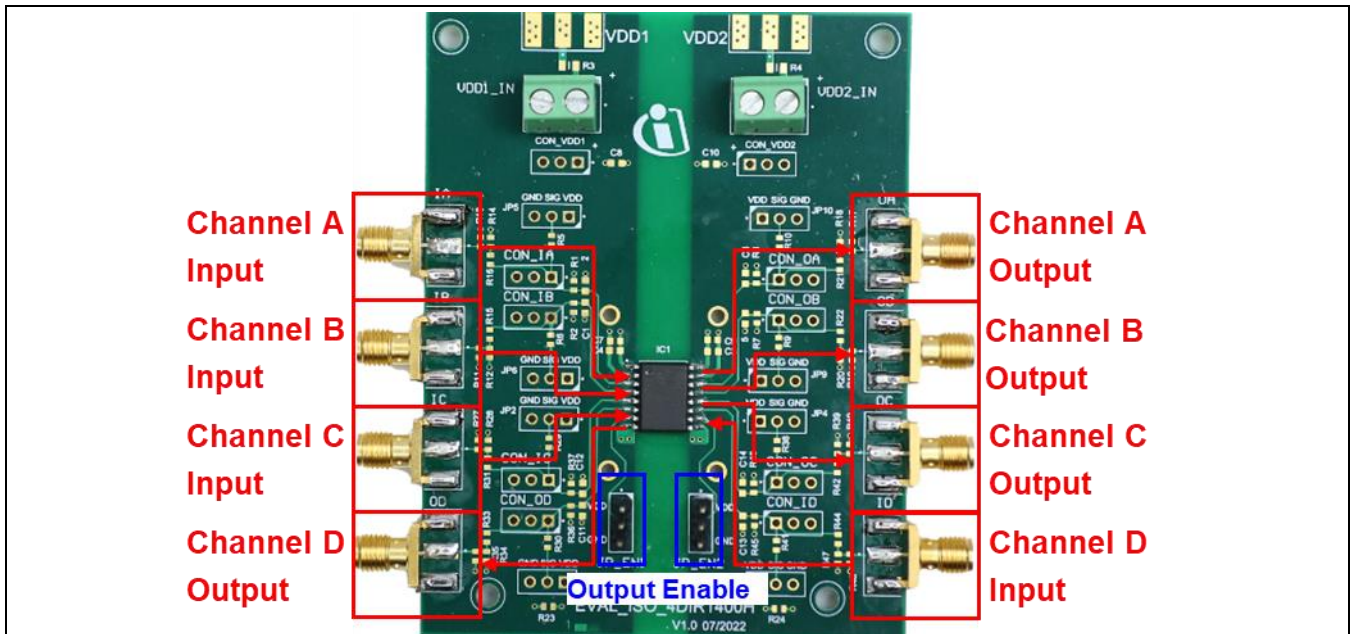


Figure 6 Signal connections of EVAL_ISO_4DIR1400H

- **Signal connections IA, IB, IC and ID**

For a 3+1 digital isolator they are the inputs of channels A to D. Inputs A, B and C are on the left side. Input D is on the right side. There is one edge-mounted SMA connector (IA, IB, IC and ID) and one terminal block (CON_IA, CON_IB, CON_IC and CON_ID) available for each data channel. To use the SMA connector, jumper R12, R16, R31 and R44 must be assembled. CON_IA, CON_IB, CON_IC and CON_ID can also be used to connect the high-speed probe for monitoring.

- **Signal connections OA, OB, OC and OD**

For a 3+1 digital isolator they are the outputs of channels A to D. Outputs A, B and C are on the right side. Output D is on the left side. There is one edge-mounted SMA connector (OA, OB, OC and OD) and one terminal block (CON_OA, CON_OB, CON_OC and CON_OD) available for each data channel. To use the SMA connector, jumper 21, R22, R33 and R42 must be assembled. CON_OA, CON_OB, CON_OC and CON_OD can also be used to connect the high-speed probe for monitoring.

- **Signal connections JP_EN1 and JP_EN2**

The quad-channel digital isolator has one enable input signal on each side, which is used to enable the output signals.

Functional description

3.2 Configuration

As shown in **Figure 7**, to ease the evaluation, the input and output connections of each data channel of the digital isolator can be configured individually: for example, impedance match, load and pull-up/-down possibility.

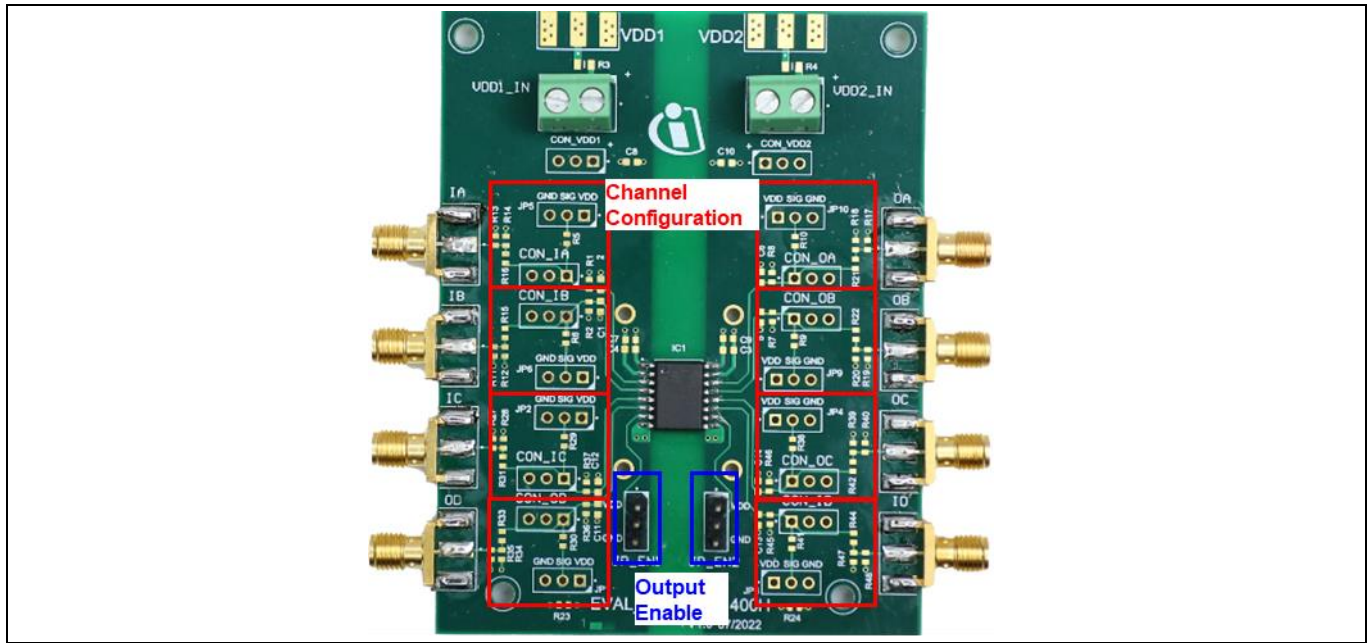


Figure 7 Additional configuration of EVAL_ISO_4DIR1400H

- Each data channel (A, B, C and D) has three pull-down resistors and one pull-up resistor on each side (input and output). Together with the jumpers for SMA connectors (R15, R16, R31 and R33 on the left side, R21, R22, R42 and R44 on the right side), impedance matching can be made individually for input and output.
- Input filter capacitors (C1, C2, C12 and C13) can be assembled for each input data channel.
- Output load capacitors (C5, C6, C11 and C14) can be assembled for each output data channel.
- Terminal blocks CON_IA, CON_IB, CON_IC, CON_ID, and CON_OA, CON_OB, CON_OC, CON_OD are designed to conveniently short the input/output channels to V_{DD} or GND if required. They can also be used as signal input/output terminals.
- Jumpers EN1 and EN2 are designed to input the enable signals for each side. They can be easily shorted to GND or pulled up to V_{DD} .
- Jumpers R23 and R24 are used to connect ground layers 2 and 4.

3.3 Operation and typical waveforms

Figure 8 shows the typical configuration to operate the evaluation board EVAL_ISO_4DIR1400H using two isolated DC power supplies.

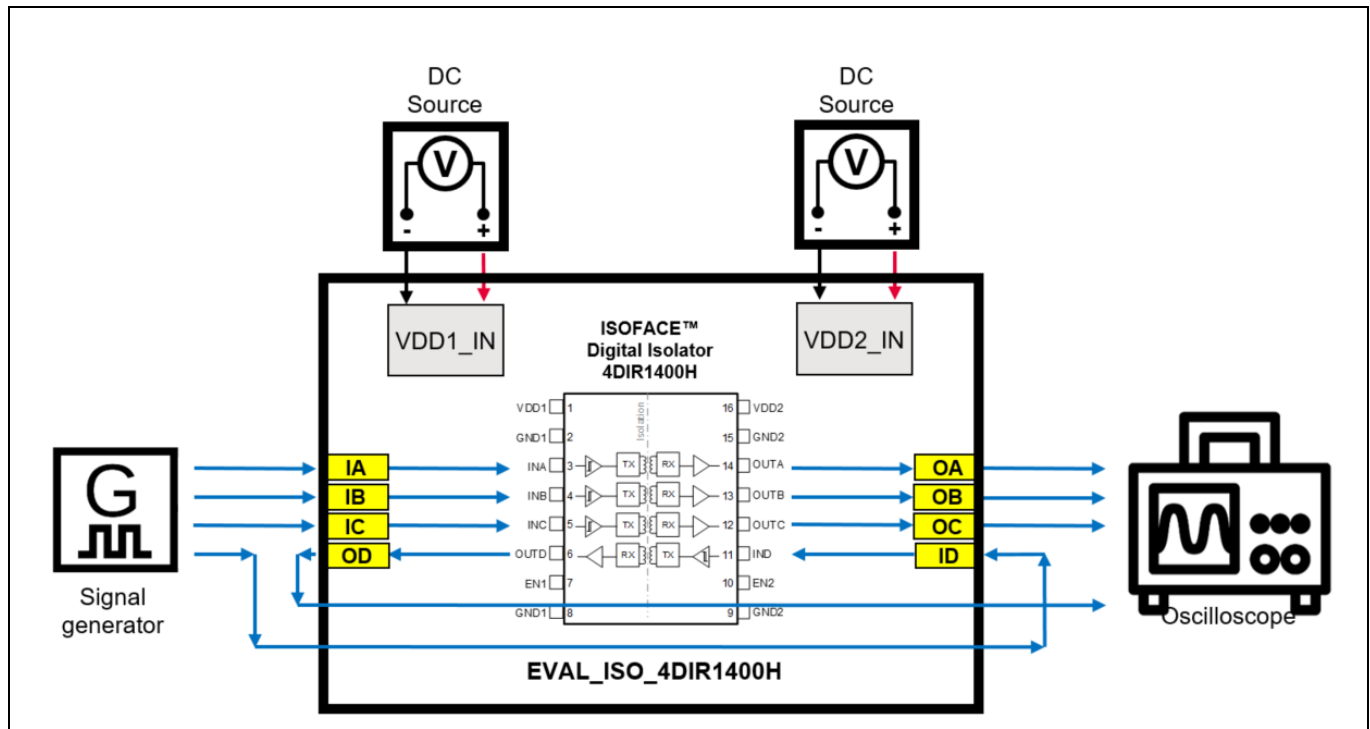


Figure 8 Typical operation of EVAL_ISO_4DIR1400H

Figure 9 shows the input and output waveforms of both channels measured at 200 kHz and 1 MHz PWM.

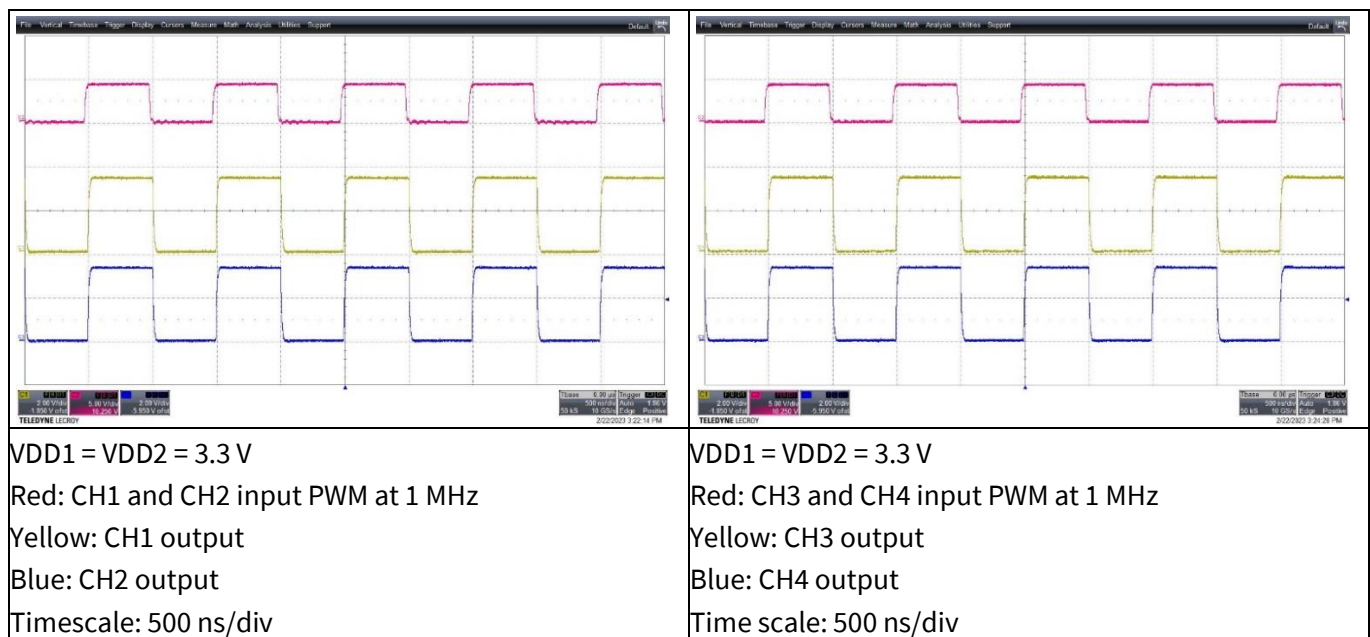


Figure 9 Typical input and output waveforms of EVAL_ISO_4DIR1400H

3.4 High-voltage capability

This evaluation board is designed in compliance with 5700 V_{RMS} reinforced isolation practices. HV testing over 5700 V_{RMS} is not recommended.

Warning: *This board is not designed for evaluation of any HV safety function. This could result in personal injury or death, or property damage.*

4 Bill of materials

Table 2 Bill of materials of EVAL_ISO_4DIR1400H

Quantity	Designator	Description	Part number	Manufacturer
8	C1, C2, C11, C12, C5, C6, C13, C14	Capacitor 15 pF/50 V/0603/C0G/5% Not assembled	885012006052	Würth Elektronik
2	C3, C4	Capacitor 100 nF/50 V/0603/X7R/5%	885012206095	Würth Elektronik
2	C7, C9	Capacitor 1 µF/25 V/0603/X7R/10%	885012206076	Würth Elektronik
2	C8, C10	Capacitor 10 µF/16 V/0603/X5R/20%	885012106031	Würth Elektronik
1	IC1	4DIR1400H/SOIC-8	4DIR1400H	Infineon Technologies
12	R3, R4, R15, R16, R21, R22, R23, R24, R31, R33, R43, R44	Resistor 0 R/75 V/0603/0 R	CRCW06030000Z0	Vishay
2	R25, R26	Resistor 0 R/75 V/0603/0 R Not assembled	CRCW06030000Z0	Vishay
6	IA, IB, OA, OB, VDD1, VDD2	SMA PCB end launch jack flat tab for 1.6 mm PCB WR-SMA	60312202114514	Würth Elektronik
2	VDD1_IN, VDD2_IN	Connector 1729128/ CON-TER-THT-MKDSN 1.5-2-5.08	691213510002	Würth Elektronik
10	CON_IA, CON_IB, CON_IC, CON_ID, CON_OA, CON_OB, CON_OC, CON_OD, JP_EN1, JP_EN2	Connector HTSW-103-07-G-S/ CON-THT-2.54-3-1-8.38	61300311121	Würth Elektronik
10	CON_VDD1, CON_VDD2, JP1, JP2, JP3, JP4, JP5, JP6, JP9, JP10	Connector HTSW-103-07-G-S/ CON-THT-2.54-3-1-8.38 Not assembled	61300311121	Würth Elektronik
32	R1, R2, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R17, R18, R19, R20, R27, R28, R29, R30, R34, R35, R36, R37, R38, R39, R40, R41, R45, R46, R47, R48	Not assembled	N/A	N/A

Revision history

Document version	Date of release	Description of changes
V 1.0	2023-03-06	First release

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