Eval-iSSR60V4A0R1H user guide

Infineon coreless-transformer advanced solid-state relay

About this document

Scope and purpose

This user guide describes the functionalities and key features of Infineon's coreless-transformer advanced solid-state relays.

The Infineon solid-state relay (SSR) evaluation board EVAL-iSSR60V4A0R1H features an integrated solid-state relay ISSR60V4A0R1H. The solid-state relay ISSR60V4A0R1H integrates a coreless-transformer based solid-state isolator with CoolMOS™ S7 T-sense technology MOSFETs in a single package.

The product iSSR60V4A0R1H is planned for certification as per UL 1577 and reinforced isolation (IEC 60747-17, planned).

Intended audience

- Engineers who want to learn how to use iSSR iSSR60V4A0R1H
- Experienced design engineers who design circuits with photovoltaic isolators (PVI), IGBTs, and MOSFETs or electromagnetic relays
- Design engineers who develop solid-state relays

About this product group

Target applications

- Solid-state relay (SSR) modules
- Home and building automation
- Laboratory power supplies
- Industrial automation - PLC I/O
- Test and measurement systems
- Photovoltaic relay replacement

Product family

Infineon's iSSR60V4A0R1H solid-state relays are galvanically isolated solid-state relays in PG-DSO-22-3 package based on Infineon's benchmark CoolMOS™ transistors. They provide a typical output current of up to 4 A. The input logic pin operates on a wide input voltage range of 3 V to 15 V using CMOS threshold levels to support 3.3 V microcontrollers and come with undervoltage lockout (UVLO) protection.

Energy transfer across the isolation barrier is realized using Infineon's coreless transformer technology. The devices come with ultra-fast acting protection features to protect against overcurrent and overtemperature. Active shutdown and dynamic Miller clamping enable to keep the relay in off state even under demanding situations, such as electric fast transients.

About this document

Evaluation board

The evaluation board EVAL-iSSR60V4A0R1H is designed based on the environmental conditions described in this document. It has been tested as described in this document, but not qualified regarding manufacturing, lifetime, or over the full range of ambient operating conditions. The boards provided by Infineon are not subject to full production tests.

Evaluation 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 are intended to be used under laboratory conditions and by trained specialists only.

Note: The printed circuit board (PCB) and auxiliary circuits are NOT optimized for final customer design.

Safety precautions

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 5 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 an 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.*

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1 Overview and key features

EVAL-iSSR60V4A0R1H is intended for evaluating the product featuring Infineon's solid-state relay, iSSR60V4A0R1H, in an application circuit. The key features of the board and iSSR60V4A0R1H are as follows:

- Evaluation board with iSSR60V4A0R1H as an AC switch
- Ultra-fast overcurrent detection that is triggered at the typical peak current of 9.1 A
- Direct-chip temperature measurement of CoolMOS™ with shutdown at 155°C
- Fast turn-on
- Fast turn-off after overcurrent and overtemperature protection
- Dynamic Miller clamping
- Clamping of inductive energy by a TVS diode and MOV

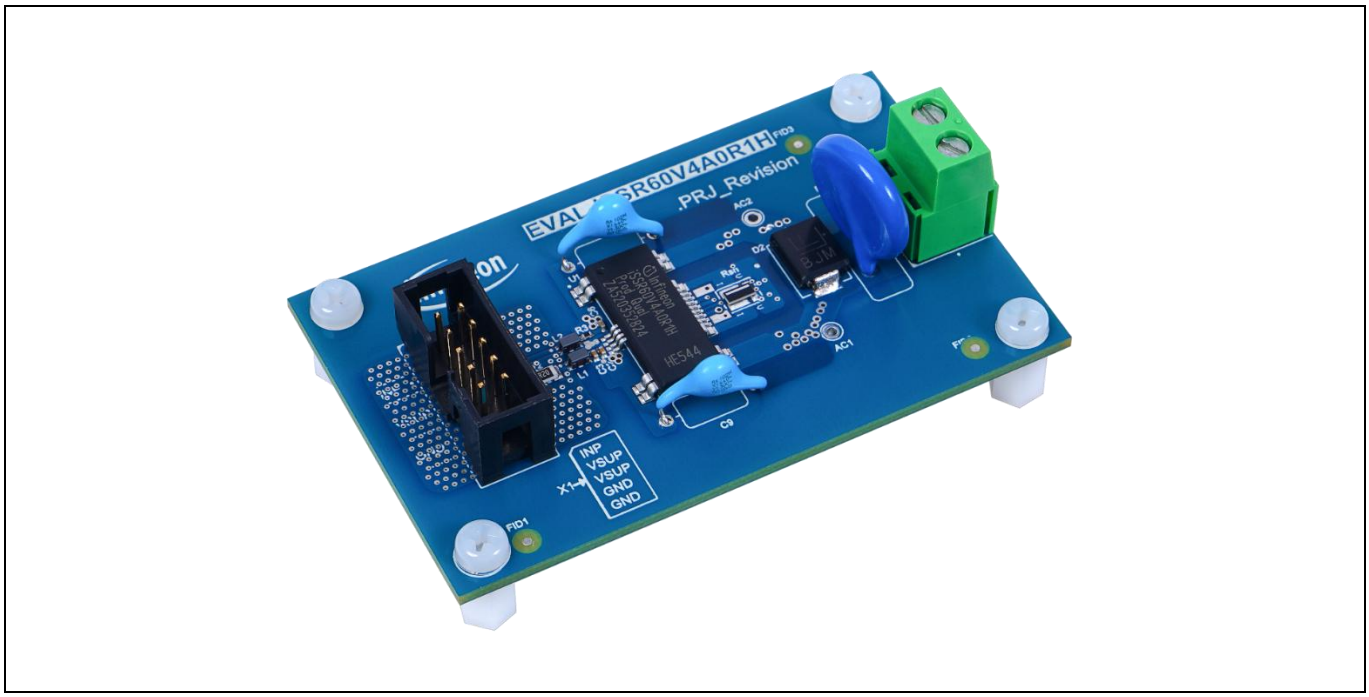


Figure 1 EVAL- iSSR60V4A0R1H Evaluation Board

This board is best suited for testing switching, as described in Section 3. It requires additional considerations about thermal and power balance for continuous operation.

The control interface can be connected to a pulse generator, a microcontroller, or other digital circuits with appropriate driving capability of at least 25 mA.

2 Absolute maximum ratings, operating conditions, and supply voltages

Some components on the evaluation boards as well as the Infineon SSR solid-state isolator have defined operating conditions and maximum ratings to avoid damage to individual parts and the overall evaluation board.

Table 2 Absolute maximum ratings (T_a = 25°C)

Pin/parameter name	Connector	Min.	Max.	Unit	Note
VSUP	*X1.3, X1.4, X1.5, X1.6*	-10	3.5	V	Input, Infineon solid-state relay voltage supply
INP	*X1.1, X1.2*	-10	15	V	Input, digital signal
HV-AC1 *HV-AC2*	*X2.1* *X2.2*	-320	320	V	Input, high-voltage power supply. For 42 V and above, a special high-voltage lab environment is strongly recommended
RMS current	*X2.1/ X2.2*	–	4	A	–
DC current	*X2.1/ X2.2*	–	4	A	–
f_{sw}	–	–	1	Hz	Maximum switching frequency for continuous operation. Power dissipation required for power transistor and Infineon SSR has been carefully considered

The printed circuit board (PCB) assembly is optimized for a *VSUP* voltage supply of 3.3 V. Higher supply voltages may require adjustments to the current limiting resistor, R2.

Table 3 Recommended operating conditions and supply voltages

Pin name	Min.	Typ.	Max.	Unit	Note
VSUP	2.85	3.3	3.5	V	Input voltage supply
INP	0	–	3.3	V	Input, digital signal
HV-AC1	-320	–	320	V	Input, high-voltage power supply, referenced to *HV-AC2*. For 42 V and above, special high-voltage lab environment is strongly recommended

3 Getting started with EVAL-iSSR60V4A0R1H

Follow the steps given to set up and power up the board, and to perform initial evaluations.

Prerequisites

- Have low voltage power supply ready for the input supply voltage (*VSUP)*, with a current capability of at least 25 mA for *VSUP*
- Have a power supply (V_{HV}), in series with a suitable load (Z_{Load}), ready to connect *HV-AC1* and *HV-AC2*
- Have a function generator ready for control signal input (*INP)*

To adapt the circuit to application requirements, resistor or capacitor values can be changed to optimize performance.

Steps to power up the board

1. Connect the VSUP to connector X1.3 (or equivalent) with +3.3 V and GND to connector X1.7
2. Connect the digital pulse-width modulation (PWM) generator to input signal connector X1.1 (or equivalent) and GND to connector X1.8. Make sure that the outputs of the PWM generator are disabled, or the signals are set to low
3. Connect the V_{HV} to connector HV-AC1
4. Connect the ground of V_{HV} to one end of the Z_{Load}, and the other end to connector HV-AC2

The board is now ready to evaluate switching.

Steps to safely power down the board

1. Turn off V_{HV}
2. Discharge the DC-link capacitor (if available) and check the DC-link voltage with, for example, a digital multimeter or an oscilloscope (for DC operation)
3. Turn off the low voltage supply

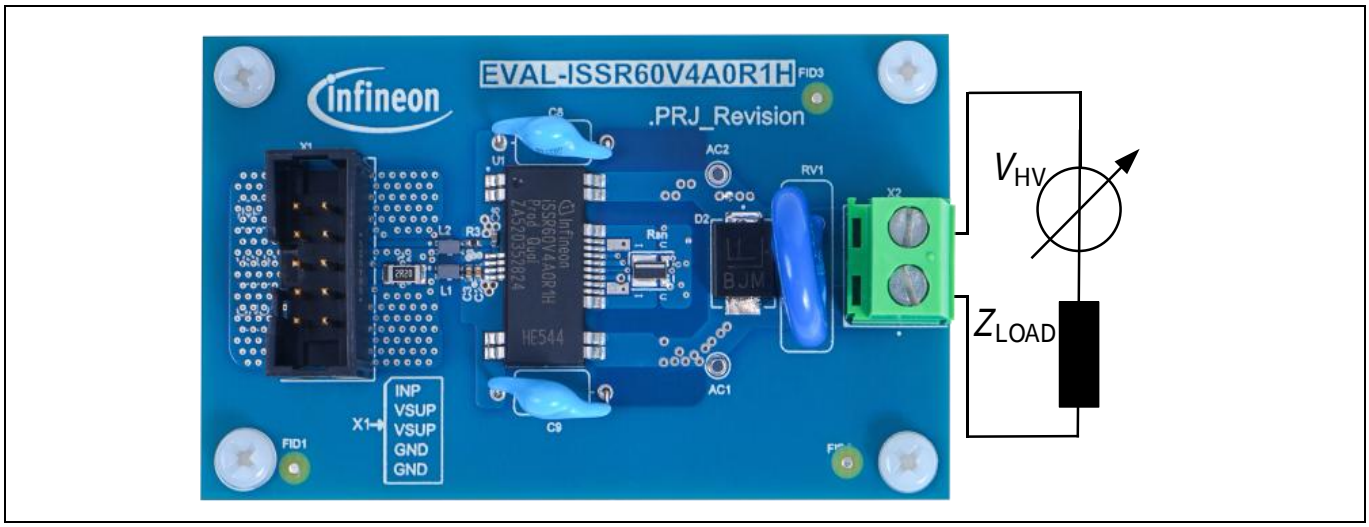


Figure 2 Connection of Z_{Load} for tests

3.1 Overcurrent protection

The detection circuit monitors the voltage across shunt resistor, R_{sh}. This signal passes a noise RC filter, consisting of R4 and C7. The integrated comparator of the Infineon SSR compares it to a fixed threshold voltage $|V_{CS,th}|$ at terminal *CS* of iSSR60V4A0R1H . The maximum peak current can be adapted to application requirements by changing the shunt resistor R_{sh}, using the following equation:

$$I_{pk,max} = \frac{V_{CS,th}}{Rsh} = 9.1\ A$$

Equation 1 Overcurrent protection

Once triggered, the protection reacts quickly and can turn off the iSSR60V4A0R1H in a very short time.

The triggering of overcurrent protection leads to the latched turn-off, of the power switch. To return to normal operation, applying either 0 V to *VSUP* or a low signal at the logic control input *INP*, is required.

3.2 Overtemperature protection

iSSR60V4A0R1H provides a constant bias current, $I_{TS,bias}$, for the temperature sense diodes inside the integrated power transistors. The constant current generates a temperature-dependent forward voltage at the diodes. The diode voltage is connected to the terminal TS, and the terminal voltage is compared to the threshold voltage $V_{TS,th}$. The integrated comparator includes a noise filter of duration $t_{TS,filter}$ for safely detecting the sensor signal.

Once triggered, the protection reacts quickly and can turn off iSSR60V4A0R1H in a very short time. The triggering of the overtemperature protection leads to the latched turn-off of the power switch. To return to normal operation, applying either 0 V to *VSUP* or a low signal at the logic control input, *INP,* is required.

The triggering of the overtemperature protection can be forced by external heating of the temperature sensor.

3.3 Connectors and pin assignment

Table 4 Connectors and pin assignment

Connector	Pin	Marking/function	Note
X1	1, 2	*INP*	Infineon solid-state relay voltage supply
	3, 4, 5, 6	*VSUP*	Infineon solid-state relay input signal/INF
	7, 8, 9, 10	*GND1*	Infineon solid-state relay voltage supply reference
X2	1	*AC1*	High-voltage connector
	2	*AC2*	High-voltage connector

3.4 EMI options

Different EMI mitigation schemes can be applied to the evaluation board to meet the EMC standards under test. Standalone or a combination of the mitigation techniques usually work together to meet EMI.

Capacitive return paths: Use a discrete Y capacitor between the primary ground and secondary ground. The board offers options for surface-mount components (SMD) and for through-hole (THT). Sometimes the system design requires a Y capacitor for safety purposes as a capacitive return path. For functional isolation a normal capacitor with sufficient voltage rating can be used. In practice only one of both options, SMD or THT, will be used in the design.

Inductive components: A CM choke with a high frequency impedance is assembled on the input side. Alternatively, a pair of ferrite beads may be placed on the same footprint for the supply or ground system. A similar arrangement can be placed on the control signal input or ground system if a separate control signal is used.

4 Schematic diagram

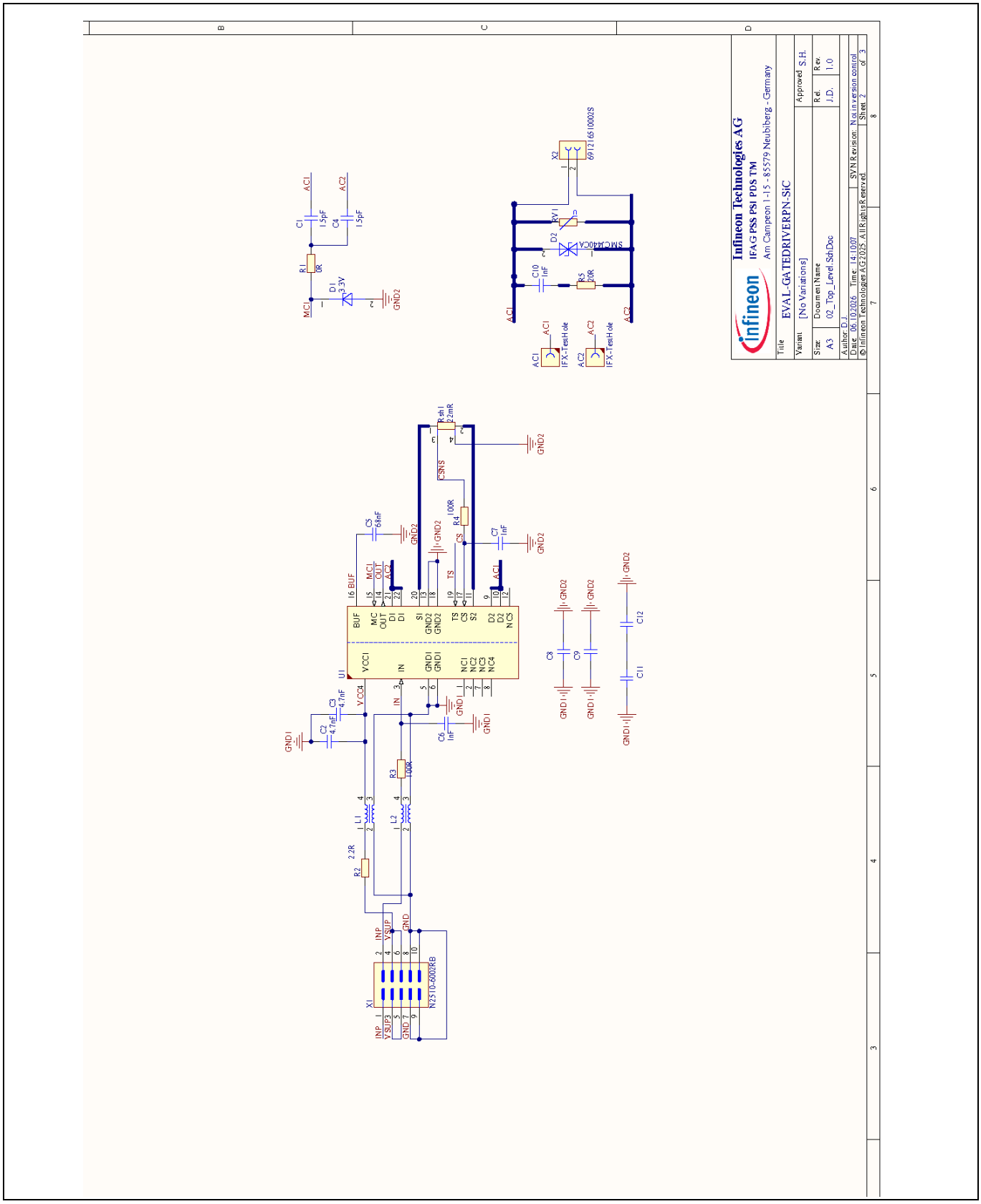


Figure 3 Eval-iSSR60V4A0R1H schematic (assembled components only)

5 Layout

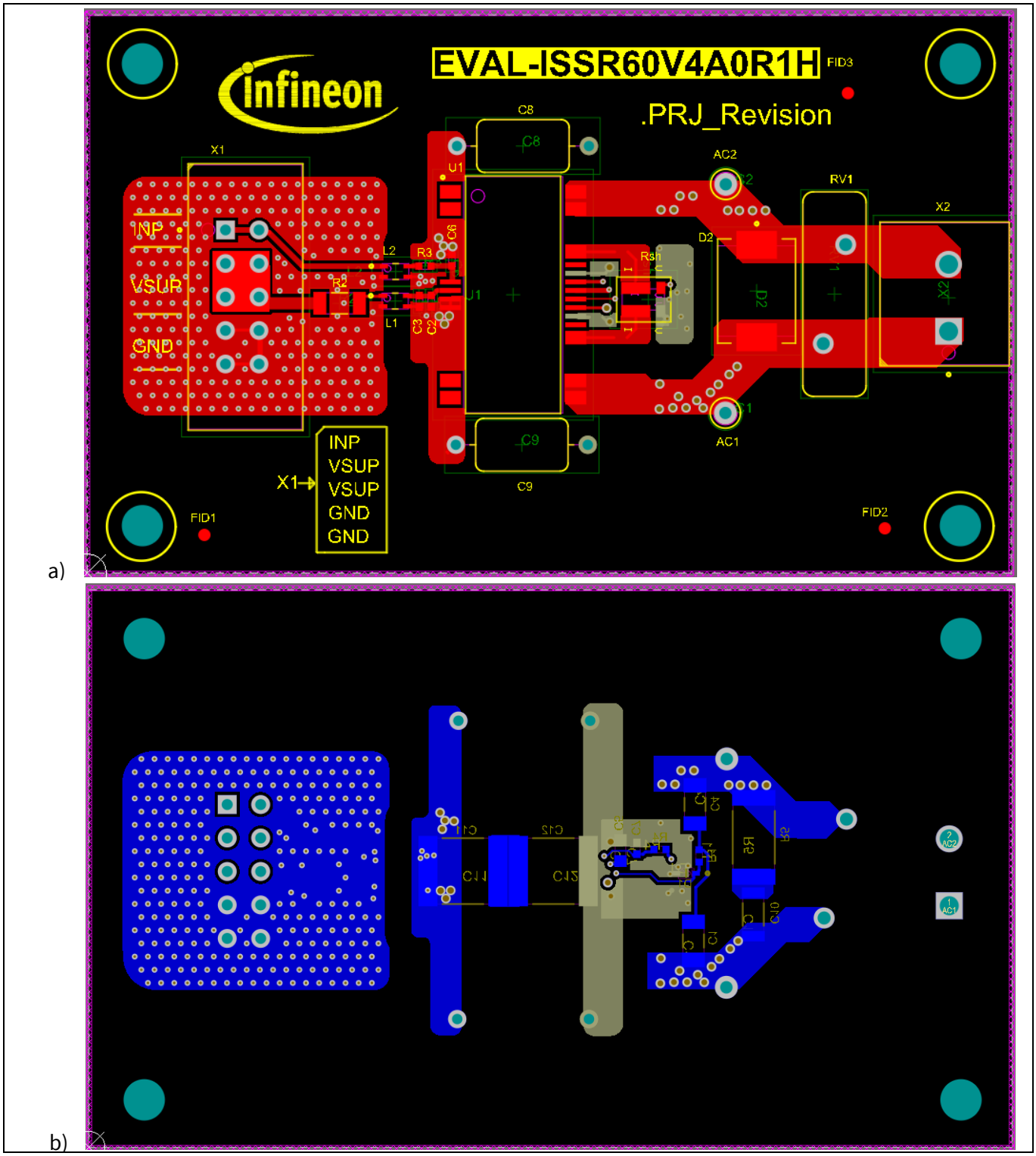


Figure 4 Top (a) and bottom (b) layers of Eval-iSSR60V4A0R1H

6 Bill of materials

Table 5 Eval-iSSR60V4A0R1H bill of materials

Component	Value	Description	Manufacturer	Part number
C1, C4	1.5 pF	CAP/CERA/1.5pF/2kV/0.1%/C0G (EIA)/NP0/-55°C to 125°C / 1206(3216)/SMD/-	–	1206N1R5B202CT
C2, C3	4.7 nF	CAP/CERA/4.7nF/25V/5%/X7R (EIA)/ -55°C to 125°C / 0402(1005)/SMD/-	MuRata	GRM155R71E472JA01
C5	68 nF	CAP/CERA/68nF/50V / 10%/X7R (EIA)/-55°C to 125°C / 0603(1608)/SMD/-	MuRata	GCM188R71H683KA57
C6, C7	1 nF	CAP/CERA/1nF/16V / 10%/X7R (EIA)/ -55°C to 125°C / 0402(1005)/SMD/-	MuRata	GRM155R71C102KA01
C8, C9	1 nF	CAP/CERA/1nF/ / 20%/E (JIS)/-40°C to 125°C/10.00mm C × 0.60mm W 7.00mm L × 4.00mm T × 10.00mm H/THT/-	MuRata	DE1E3RA102MA4BP01F
C10	1 nF	CAP/CERA/1nF/1kV / 10%/X7R (EIA)/ -55°C to 125°C / 1206(3216)/SMD/-	MuRata	GRM31BR73A102KW01
C11, C12	4.7 nF	CAP/CERA/4.7nF/ / 10%/X7R (EIA)/ -55°C to 125°C / 2220(5750)/SMD/-	Würth Elektronik	8853522140011
D1	3.3 V	DIODE ZENER 3.3V 500MW SOD523	ON Semiconductor	SZMM5Z3V3T1G
D2	SMCJ440CA	Surface Mount TVS Diode, 440V, 2kW	Littelfuse	SMCJ440CA
L1, L2	ACM2012-222-2P-T001	Inductor; Common Mode Choke; Standard; Core; 4 Pins	TDK Corporation	ACM2012-222-2P-T001
R1	0R	RES/-/0R/100mW/-/-/-/0402(1005)/SMD/-	Panasonic	ERJ2GE0R00X
R2	2.2R	RES/STD/2.2R/250mW/1%/100ppm/K/-55°C to 155°C / 1206(3216)/SMD/-	Vishay	CRCW12062R20FK
R3, R4	100R	RES/STD/100R/63mW/1%/100ppm/K/-55°C to 155°C / 0402(1005)/SMD/-	Yageo	RC0402FR-07100RL
R5	20R	RES/STD/20R/1W/1%/100ppm/K/ -55°C to 155°C / 2512(6432)/SMD/-	Vishay	CRCW251220R0FK
R_{sh}	22mR	RES/STD/22mR/1W/1%/35ppm/K/ -55°C to 155°C / 1206(3216)/SMD/-	Susumu	KRL3216T4A-M-R022-F-T1
RV1		RES/STD/-/-/-/-/-40°C to 105°C/7.50mm C × 0.80mm W	TDK Corporation	B72214S0251K101

6 Bill of materials

Component	Value	Description	Manufacturer	Part number
		15.50mm L × 4.80mm T × 18.50mm H/THT/-		
U1	iSSR60V4A0R1H	Infineon coreless-transformer advanced solid-state relay	Infineon Technologies	iSSR60V4A0R1H
X1	N2510-6002RB	Header, 4-Wall Lo-PRO, .100, Straight, 10Pins, 2.54mm Pitch	3M	N2510-6002RB
X2	691216510002S	Horizontal Cable Entry With Rising Cage Clamp - WR-TBL, 2 Pins	Würth Elektronik	691216510002S

7 Related resources

- Solid state relays

References

[1] Infineon Technologies AG: *iSSR60V4A0R1H, iSSR60V2A5R1H datasheet*; Available online

Revision history

Document revision	Date	Description of changes
1.0	2026-10-13	Initial 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.