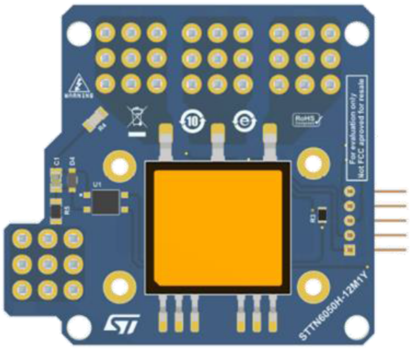
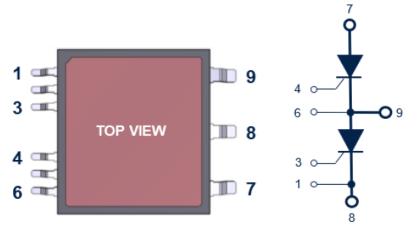
STDES-SSR002V1

Data brief

60 A 1200 V solid state relay



STDES-SSR002V1



STTN6050H-12M1Y

Product summary
STDES-SSR002V1

Key product
STTN6050H-12M1Y

Features

- 60 A 1200 V Thyristor module STTN6050H-12M1Y
- Package with top side cooling and optimized thermal management
- Insulated gate driver included
- Ready to test controlled half bridge module
- Direct connection to STM32 interface

Applications

- Single and tri-phase controller rectifier bridge
- OBC and charging stations
- Solid state relay in heating control and motor starter
- AC/DC converter for motor drive, UPS and SMPS
- Energy storage

Description

The STDES-SSR002V1 is a ready to use reference design that features SCR module STTN6050H-12M1Y. The reference design allows the evaluation of the module as a 60 A switch for automotive and industrial AC applications.

The reference design includes a driving circuit featuring a pulse transformer.

The key product STTN6050H-12M1Y is an automotive qualified 60 A 1200 V thyristor controlled half-bridge module assembled in the top side-cooled package ACEPACK SMIT.

It offers higher specified noise immunity of 1000 V/μs and overvoltage robustness V_{DSM} up to 1400 V. It also has optimized thermal management.

1 Pinout and recommendation

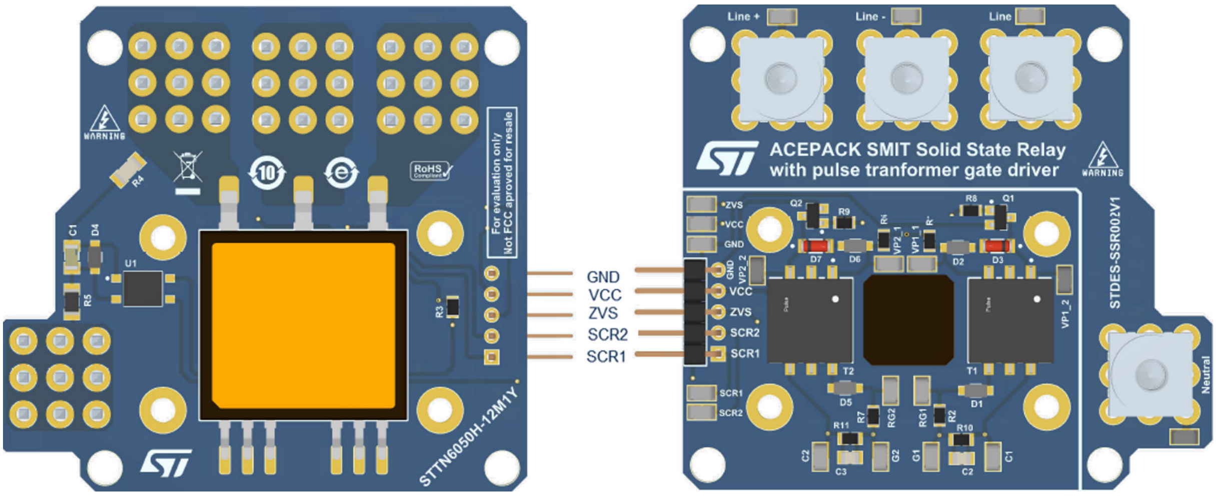


Figure 1. **STDES-SSR002V1 2D view**

The connectors line, line+, line– and neutral should be connected as needed in the AC application.

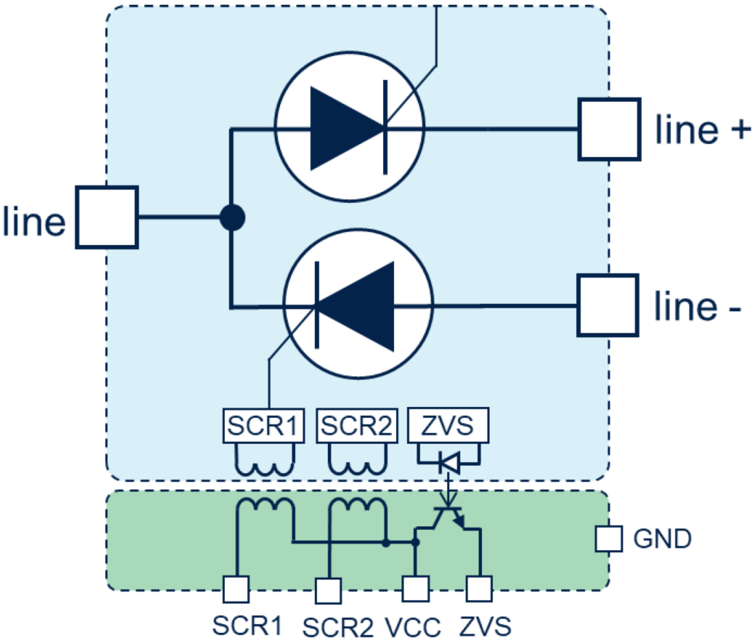


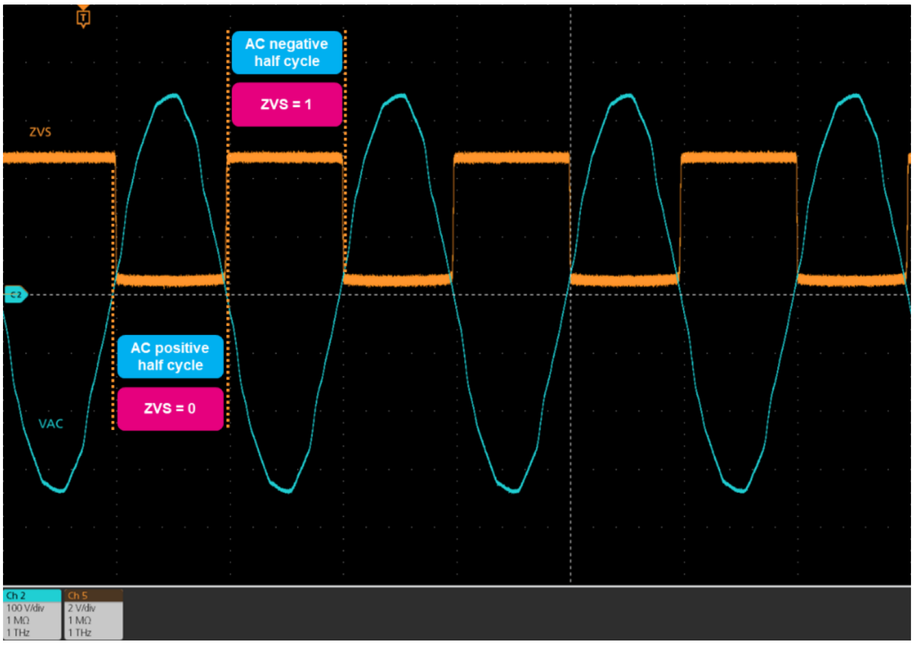
Figure 2. **STDES-SSR002V1 pinout**

To test the reference design, two signals are to be provided from the microcontroller to drive the two Thyristors of the module SCR1 and SCR2. GND and V_{CC} are to be connected as well. ZVS is an output of the board and could be visualized if needed. ZVS signal provides the AC voltage polarity information to the MCU in order to synchronize the SCR driving signal on SCR1 and SCR2 pins.

Figure 3 features a visual of the ZVS signal. The AC voltage is represented in light blue and the ZVS output signal is shown in orange:

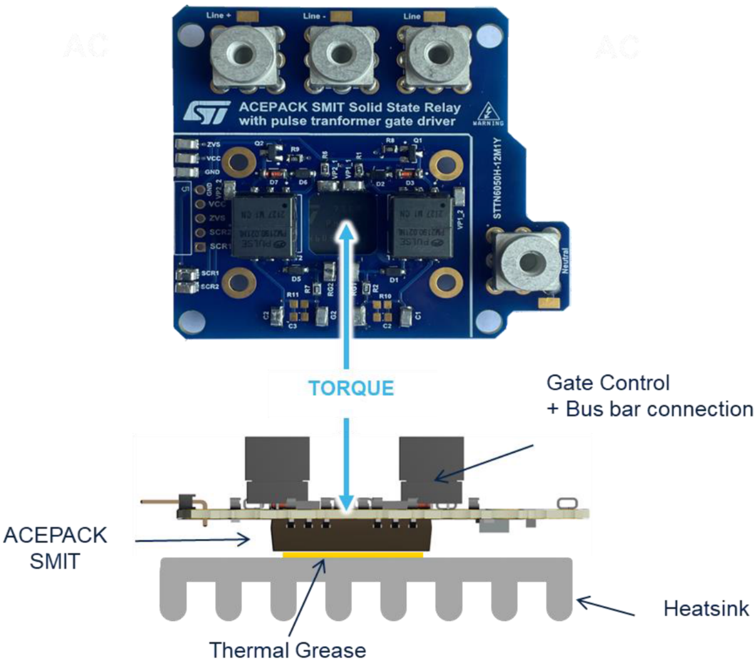
- ZVS level is low during AC positive half cycle
- ZVS level is high during AC negative half cycle.

Figure 3. **ZVS output signal on STDES-SSR002V1**



The reference design PCB features an opening underneath the module STTN6050H-12M1Y that we recommend. To attach the module to a heatsink, torque is applied (refer to AN5384 : ACEPACK SMIT module package guidelines for mounting and thermal management). Having the opening allows the torque to be applied directly on the module and thus protecting the PCB and contact with component pins from mechanical risks that might result from the force applied.

Figure 4. **STDES-SSR002V1 view on the PCB opening**



2 Schematics

Figure 5. Power connectors of the board and STTN6050H-12M1Y

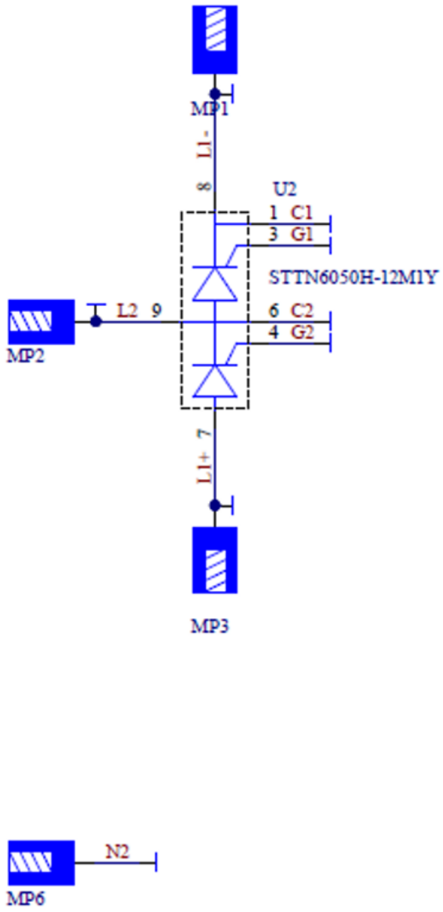


Figure 6. External connectors of STDES-SSR002V1

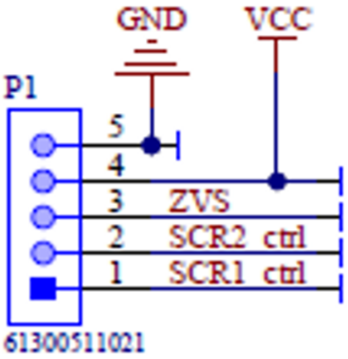


Figure 7. **ZVS detection circuit of STDES-SSR002V1**

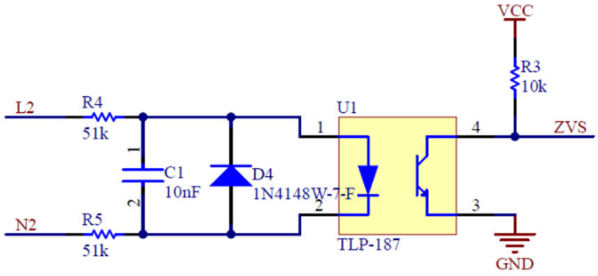
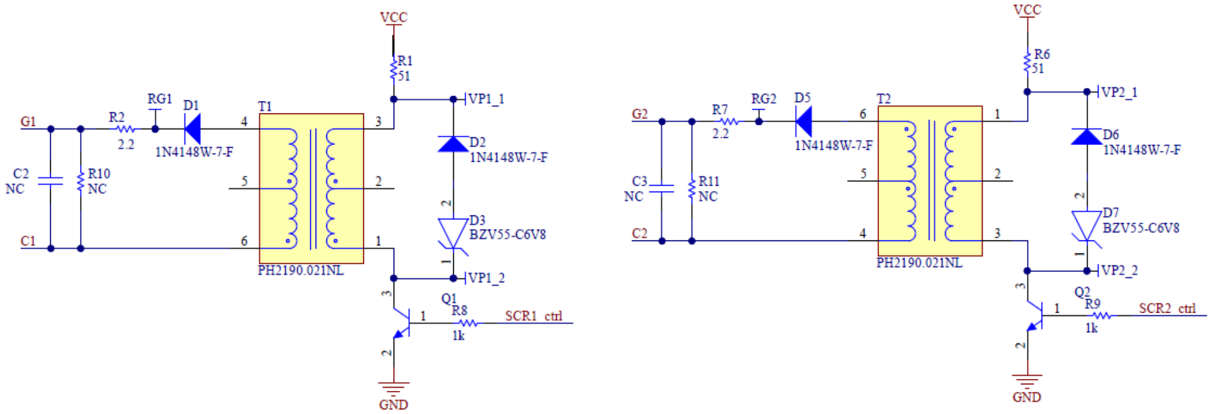


Figure 8. **SCR pulse transformer gate drivers**



3 Use case: 60 A AC switch

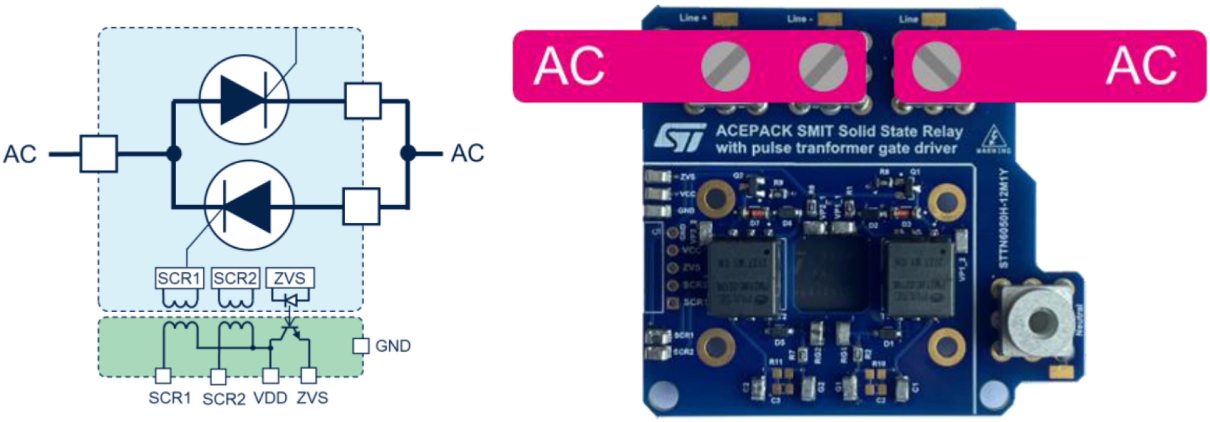


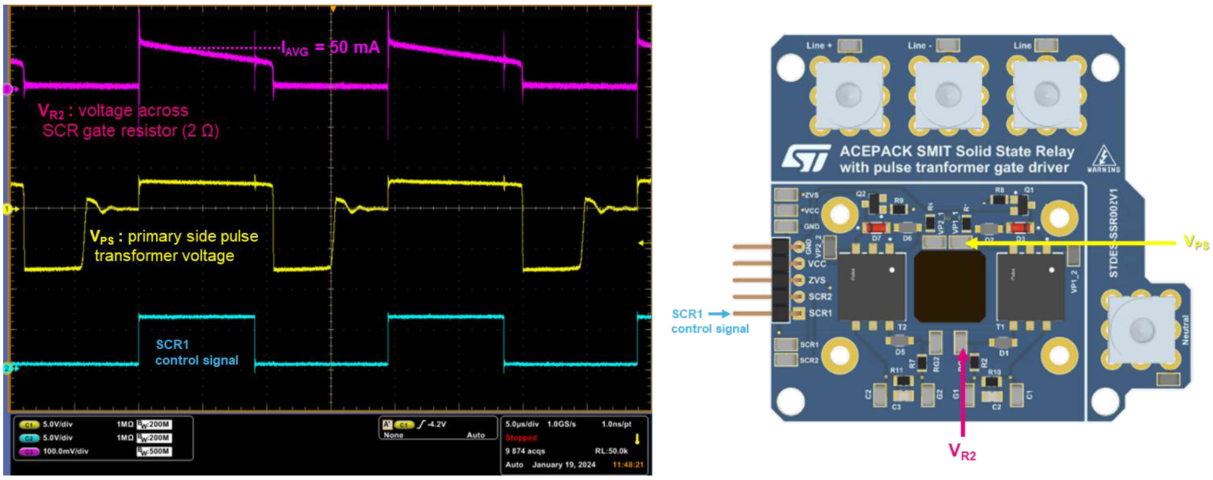
Figure 9. Pinout of 60 A AC switch using STDES-SSR002V1

By shortcutting the two AC connectors as shown in Figure 9, we obtain a 60 A AC switch, ready to use for different types of applications.

Figure 10 shows signals on the oscilloscope in an example of driving the 60 A AC switch. Through the microcontroller we provide a driving signal at 50 kHz, with a 50% duty cycle for both SCR1 and SCR2. The driving signal is in light blue. Other voltages are measured and viewed.

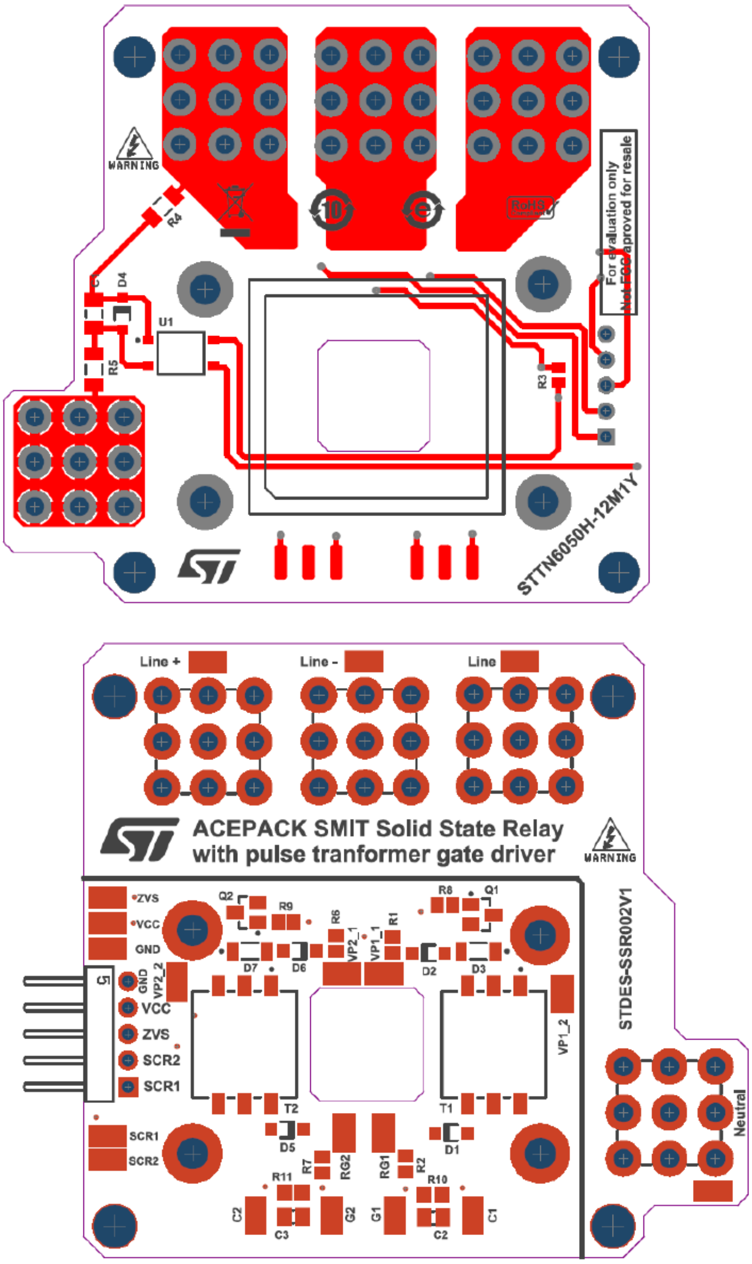
Yellow signal is the voltage at the primary winding of the pulse transformer used for driving in this reference design. The pink color shows the voltage around resistor R2 (featured on 2 Schematics). We can see that 50 mA is the current sent through the gate of each SCR.

Figure 10. Example of driving signal of the 60 A AC switch



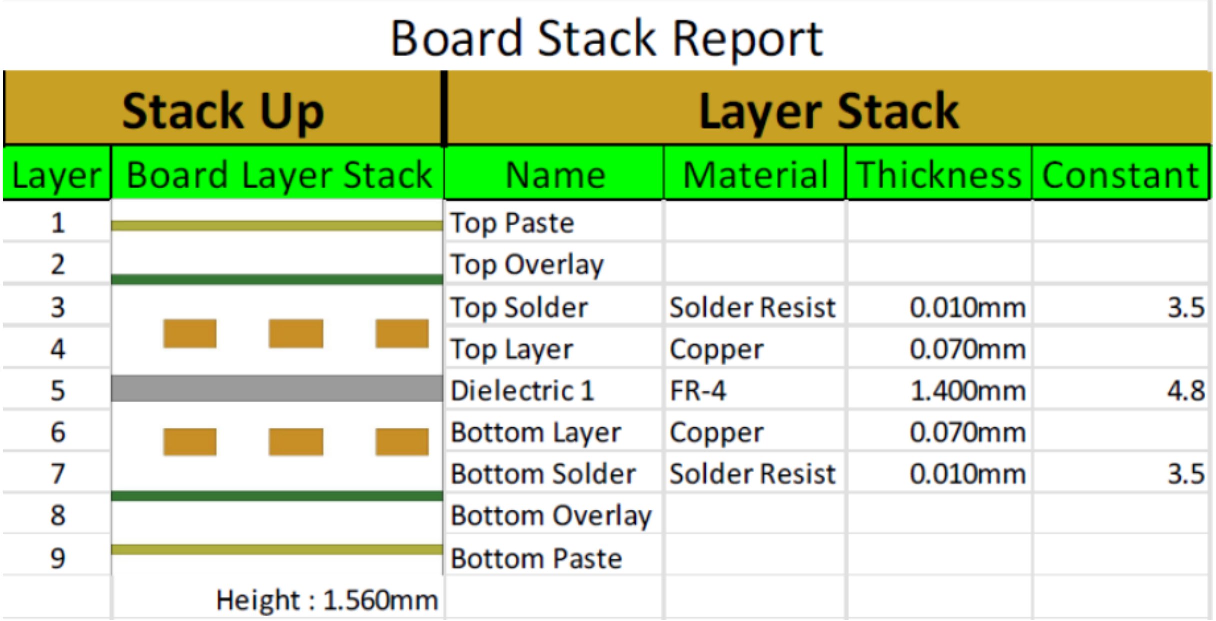
4 Layout

Figure 11. **STDES-SSR002V1 layout**



5 PCB stack-up

Figure 12. PCB stackup

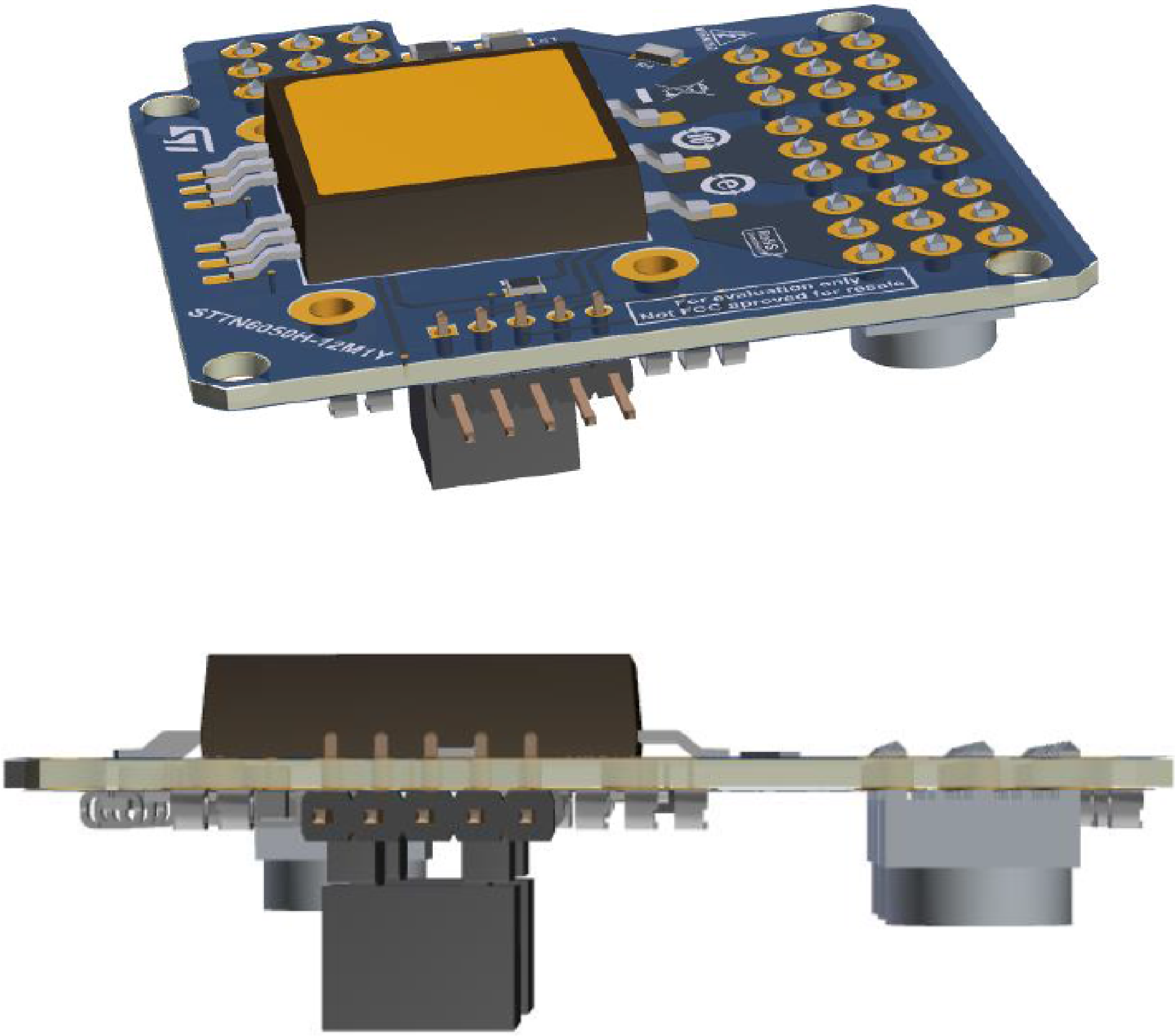


Board Stack Report

Stack Up		Layer Stack			
Layer	Board Layer Stack	Name	Material	Thickness	Constant
1		Top Paste			
2		Top Overlay			
3		Top Solder	Solder Resist	0.010mm	3.5
4		Top Layer	Copper	0.070mm	
5		Dielectric 1	FR-4	1.400mm	4.8
6		Bottom Layer	Copper	0.070mm	
7		Bottom Solder	Solder Resist	0.010mm	3.5
8		Bottom Overlay			
9		Bottom Paste			
	Height : 1.560mm				

6 3D views

Figure 13. STDES-SSR002V1 3D view



7 BOM

Table 1. **STDES-SSR002V1 bill of materials**

Designator	Part / Values	Description
C1	10 nF	Ceramic capacitor, 10 nF X7R / 50 V
C2, G1, G2, L1-, L1+, L2, N,'C1, GND, RG1, RG2, SCR1_ctrl, SCR2_ctrl, VCC, VP1_1, VP1_2, VP2_1, VP2_2, ZVS	N/A	SMD test points
D1, D2, D4, D5, D6	1N4148W-7-F	Fast switching diode, 100 V, 0.15 A, SOD123
D3, D7	BZV55-C6V8	Diode zener 6.8 V, 500 MW
MP1, MP2, MP3, MP6	M4 x 4 mm	WP-THRBU REDCUBE THR internal blind-hole thread, M4 x 4 mm, 85 A
P1	61300511021	THT Angled pin header WR-PHD, pitch 2.54 mm, single row, 5 pins
Q1, Q2	MMBT4401	NPN general-purpose amplifier, 0.6 A, 40 V, -55 to 150 °C, 3-pin SOT-23
R1, R6	51 R	Metal film chip resistor, 0.125 W, +/- 0.1%, 0805 (2012 metric)
R2, R7	2.2 R	Metal film chip resistor, 0.125 W, +/- 0.1%, 0805 (2012 metric)
R3	10 k	Metal film chip resistor, 0.125 W, +/- 0.1%, 0805 (2012 metric)
R8, R9	1 k	Metal film chip resistor, 0.125 W, +/- 0.1%, 0805 (2012 metric)
R4, R5	51 k	Metal chip resistor, 51 kΩ, 0.25 W, +/- 0.1%, 0.25 W, 1206 (3216 metric)
T1, T2	PH2190.021NL	High isolation power transformers - 1800 µH - 2:1
U1	TLP-187	Optocoupler DC-IN darlington output 4-pin mini-flat
U2	STTN6050H-12M1Y	60 A 1200 V thyristor controlled half bridge in ACEPACK SMIT module

Revision history

Table 2. **Document revision history**

Date	Revision	Changes
26-Feb-2024	1	Initial release.

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