User manual

EVAL-L9026-YO Evaluation Board

Introduction

The EVAL-L9026-YO is a low-cost tool designed to evaluate L9026, a smart power device designed by STMicroelectronics in advanced BCD technology.

The L9026 is an eight channels IC, with 2 fixed HS drivers and 6 configurable HS/LS drivers designed for Automotive applications (LEDs, solenoid and Relays) and compatible with resistive, inductive and capacitive loads. The device offers advanced diagnostic and protection functionalities such as: short to GND, open load, overcurrent, over-temperature detections. The 8 output channels can be either driven by SPI or by 2 dedicated parallel inputs that can be associated to different output thanks to a programmable internal multiplexer. Limp-Home functionality is also featured, which allows using 2 selected drivers in particular faulty conditions, such as SPI fault, microcontroller fault or supply UV. Daisy chain compatibility even with 8bit SPI is available. The device is able to guarantee operations under cranking scenario down to VBATT = 3 V and guarantees very low quiescent current under RESET condition. A serial peripheral interface (SPI) is used for control and configuration of the loads as well as of the device; besides, status feedback of all diagnostic functions is provided. For direct control and PWM there are two input pins available: these are connected to two defined outputs by default, but additional or different output mapping can be controlled by SPI. L9026 is available in two package versions HTSSOP24 and QFN32. EVAL-L9026-YO is intended for HTSSOP24 package.

Thanks to the expansion connectors, EVAL-L9026-YO allows the complete control of L9026 communication interface (SPI) and parallel input/output. The evaluation board can be also controlled using a Graphical User Interface.

1 Hardware description

The EVAL-L9026-YO is intended as low-cost tool to evaluate all the functionalities of L9026. An optimized BOM has been analyzed:

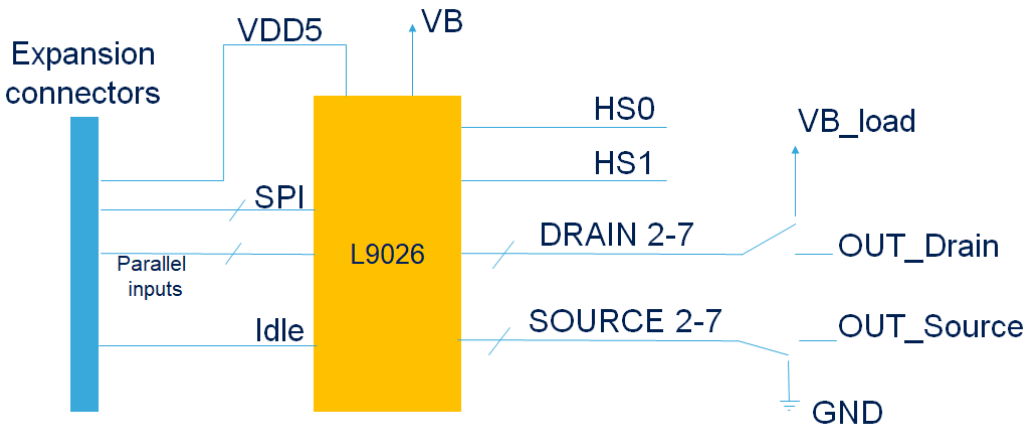
- All components are automotive grade (AEC-Q100)
- Dimensioning has been made considering the real application range and cost

In the following the main electrical characteristic of EVAL-L9026-YO:

- Operative input Voltage: 3 V – 18 V
- Output:
  - 2 fixed HS driver up to 1 A
  - 6 configurable HS/LS driver up to 1 A
- Idle input
- IN0 and IN1 configurable parallel input
- SPI communication interface
- Configurable dip switch for all the L9026 available configuration
- 80x65 mm 4 layers PCB

1.1 Block diagram

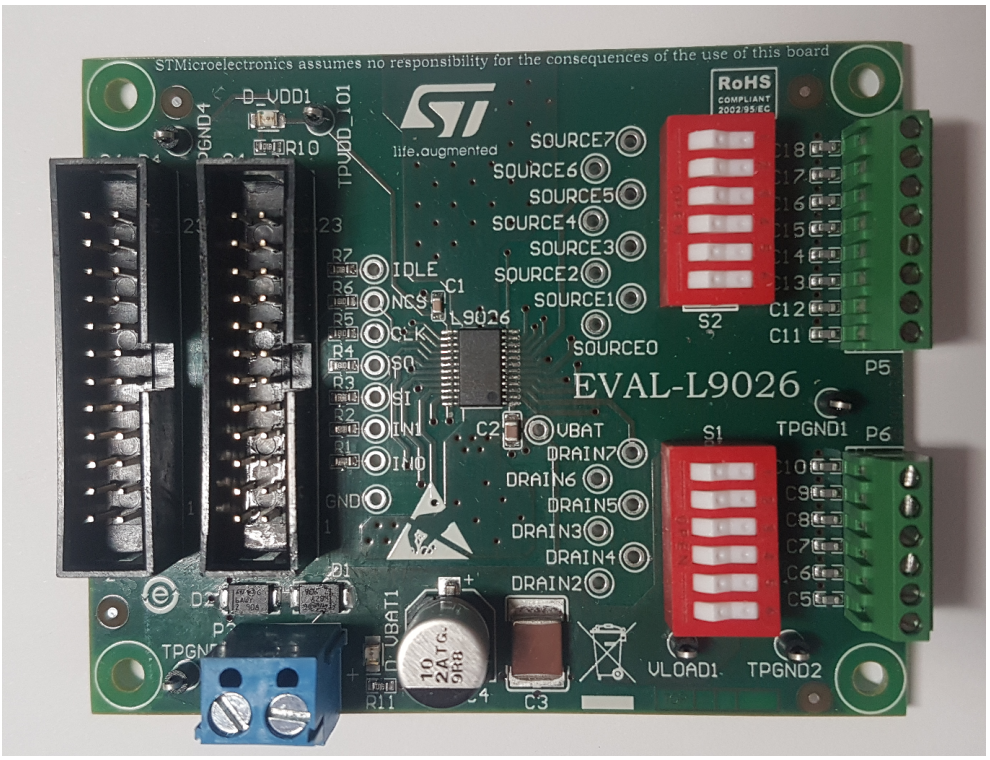
Figure 1. EVAL-L9026-YO Block diagram



2 Board description

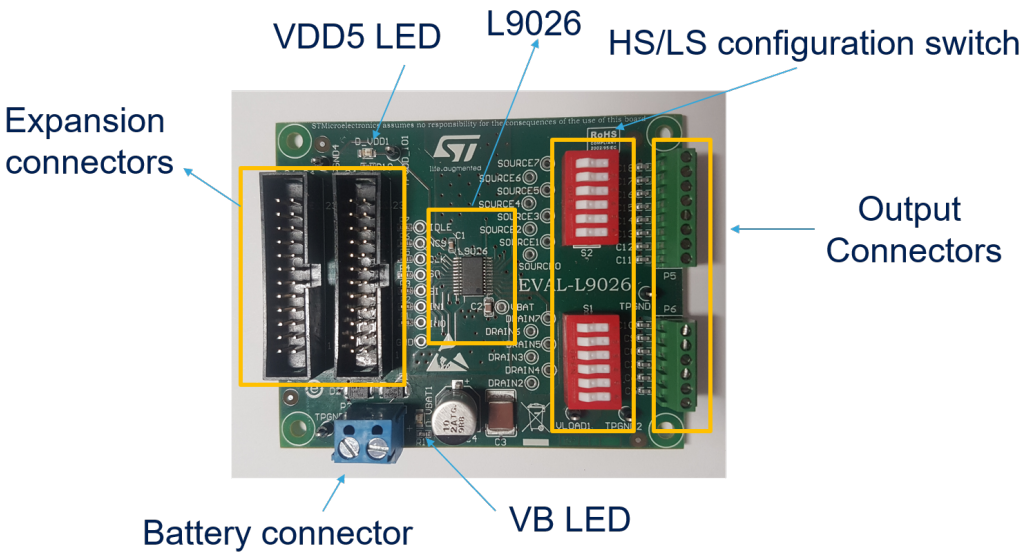
In this paragraph the user will find a brief description of the board and its settings.

Figure 2. Board front view



2.1 Evaluation board main components and connectors

Figure 3. Evaluation board main components and connectors



2.2 Switches and connectors

Table 1. Evaluation board switches and connectors

Name	Description	Type
P2	Expansion connector: Pin 4: IN0 Pin 5: IN1 Pin 6: L9026 SPI input Pin 7: L9026 SPI output Pin 8: SPI Clock Pin 9: SPI Chip Select Pin 14, 16: GND Pin 15: L8026 Idle input All the other pins are unconnected	12 x 2 Header
P4	Expansion connector: Pin 1: 5 V supply Pin 21, 22: GND All the other pins are unconnected	12 x 2 Header
P3	Main battery connector: Pin 1: GND Pin 2: VB	2 x Screw connector
P5	Sources connector: Pin 1: source 0 Pin 2: source 1 Pin 4: source 3 Pin 5: source 4 Pin 6: source 5 Pin 7: source 6 Pin 8: source 7	8 x Screw connector
P6	Drains connector: Pin 1: drain 0 Pin 2: drain 1 Pin 3: drain 2 Pin 4: drain 3 Pin 5: drain 4 Pin 6: drain 5 Pin 7: drain 6 Pin 8: drain 7	8 x Screw connector
S1	High/Low side configuration (Drain): Open: $drain_n$ is connected at P6_$drain_n$; n = 2..7 (LS configuration) Closed: $drain_n$ is connected at Battery; n = 2..7 (HS configuration)	6 x dip switches
S2	High/Low side configuration (Source): Open: $source_n$ is connected at P5_$source_n$; n = 2..7 (HS configuration) Closed: $source_n$ is connected at GND; n = 2..7 (LS configuration)	6 x dip switches

2.3 Default setting

Table 2. Default configuration

Name	Description	Configurtion
S1	High/Low side configuration (Drain)	Open: $drain_n$ is connected at P6_$drain_n$; n = 2..7 (LS configuration)
S2	High/Low side configuration (Source)	Closed: $source_n$ is connected at GND; n = 2..7 (LS configuration)
Out0, Out1	-	High side configuration

3 Getting started

3.1 Minimum setup

In order to operate EVAL-L9026-YO the following tools are necessary:

- Power supply 3 V - 28 V Current capability up to 8 A
- Loads: LED, Relay, LAMP with a rating of 12 V, 1 A
- Oscilloscope and or multimeter
- Optional: PTS-Connect and STSW-L9026 GUI.

3.2 Startup

Before using the board, follow the steps below:

1. Configure S1 and S2 dip switches according to Table 1 or according to your favorite setup;
2. Configure the power supply to 13.5 V and limit the current to *n* x 1 A where *n* is the number of connected loads;
3. Switch on the power supply;
4. Control Idle input and SPI settings according to L9026 Datasheet;
5. Control IN0 and IN1 according to your setup;
6. Check with oscilloscope or multimeter that the expected voltage values are present on outputs.

3.3 Usage example

In this paragraph a usage example will be described. The example configuration is the following:

Table 3. Example configuration

Channel Name	Configuration	Load	Associated Controlled by
CH0	HS	Solenoid actuator	IN0
CH1	HS	Main Relay	SPI
CH2	LS	LED	LED PWM Generator
CH3	HS	Resistive Load	GEN PWM Generator
CH4	LS	Relay	SPI
CH5	LS	Bulb lamp	IN1
CH6	LS	(Unconnected)	SPI
CH7	LS	(Unconnected)	SPI

Table 4. **S1 and S2 configuration**

Switch name	Associated Output	Position	Configuration
S1			
S1.1	Drain2	Open	LS
S1.2	Drain3	Closed (Connected to Vbat)	HS
S1.3	Drain4	Open	LS
S1.4	Drain5	Open	LS
S1.5	Drain6	Open	LS
S1.6	Drain7	Open	LS
S2			
S2.1	Source2	Closed (connected to GND)	LS
S2.2	Source3	Open	HS
S2.3	Source4	Closed (connected to GND)	LS
S2.4	Source5	Closed (connected to GND)	LS
S2.5	Source6	Closed (connected to GND)	LS

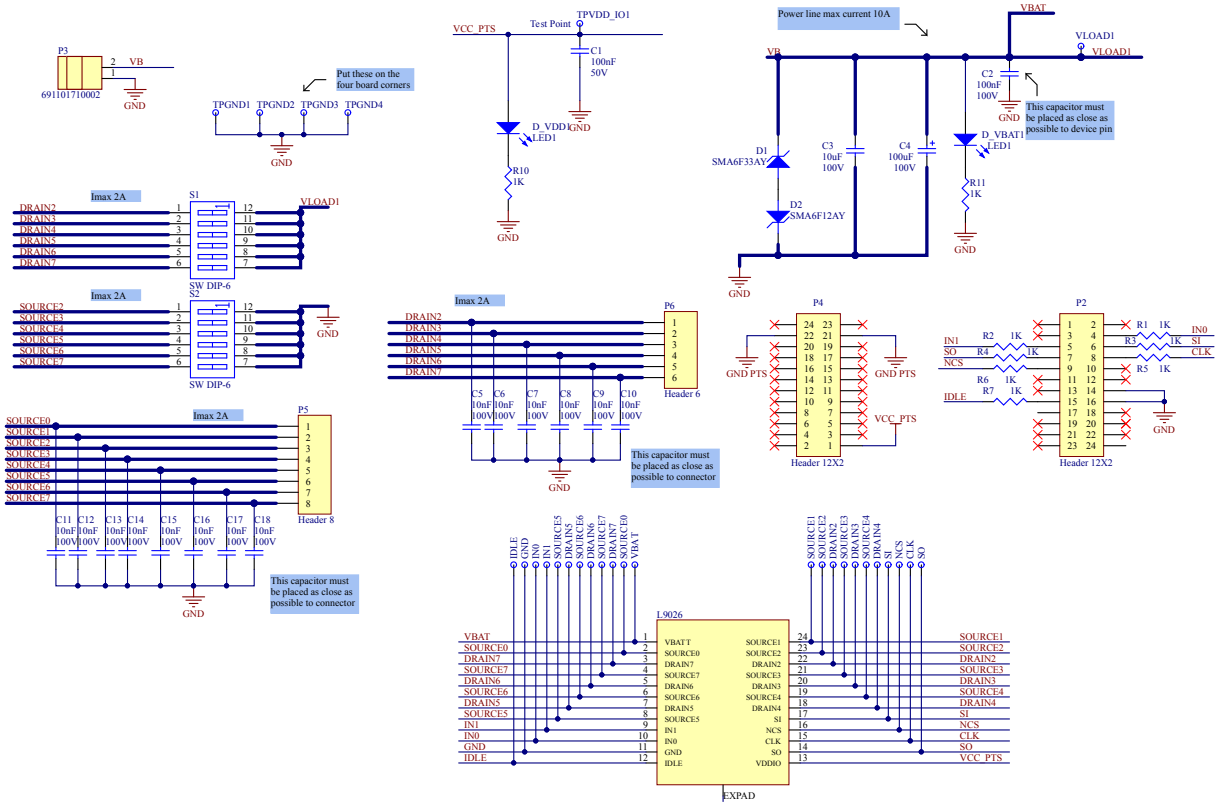
Start-up phase:

1. Power up system
2. IN0 = 0 IN1 = 0 Idle = 0: The device is in ***Sleep mode***
3. IN0 = 0 IN1 = 0 Idle = 1: The device is in ***Idle State***
4. SPI initial configuration:
   - **CFG_0: 0x9822** (configure Out3 as High side, all other outputs are in default state LS, Frame counter = 0)
   - **MAP_IN0: 0x9C05** (Associates IN0 to OUT0, Frame counter = 1)
   - **MAP_IN1: 0xA080** (Associates IN1 to OUT5, Frame counter = 0)
   - **CFG_1: 0x8803** (LED PWM generator freq = 122.5 Hz, Frame counter = 1)
   - **CFG_2: 0x8C00** (GEN PWM generator freq = 122.5 Hz, no adjustment, Frame counter = 0)
   - **PWM_LED_DC: 0xB001** (PWM LED duty cycle 0 %, Frame counter = 1)
   - **PWM_GEN_DC: 0xAC00** (PWM GEN duty cycle 0 %, Frame counter = 0)
   - **MAP_PWM: 0xA431** (OUT2 and OUT3 driven by internal PWM generators, Frame counter = 1)
   - **PWM_SEL: 0xA812** (OUT2 driven by PWM LED and OUT3 driven by PWM GEN, Frame counter = 0)
   - **BIM: 0x9081** (activate Bulb inrush mode on OUT5, Frame counter = 1)
   - **CFG_1: 0x8900** (put the device in ***Active mode***, Frame counter = 0)
   - **STA_1: 0x4403** (read the Status register 1, expected results POR = 0, VDD_UV = 0, VS_UV = 0, MODE = 11: active mode, Frame counter = 1)

5. SPI diagnosis:
   - OFF diagnosis:
     - **DIAG_OFF_EN: 0xB7FE** (enable OFF diagnosis on all channels to detect open load or short circuits, Frame counter = 0)
     - **STA_0: 0x4001** (read Status register0: expected result DIS = 0, NRES = 0, IDLE = 1, IN1 = 0, IN0 = 0, OUT_ON_ERR = 0, OUT_OFF_ERR = 1, Frame counter = 1)
     - **DIAG_OPL_OFF: 0x4C00** (read Open load in OFF diagnostic: expected results OUT6 = 1, OUT7 = 1 because unconnected, Frame counter = 0)
     - **DIAG_SHG: 0x5401** (read short diagnostic, expected results all 0 because no short are present, Frame counter = 1)
   - Switch ON all the loads:
     - IN0 = 1, IN1 = 1 (solenoid actuator and Bulb lamp will be switched ON)
     - **PWM_SPI: 0x9B78** (all channels are switched ON, except CH2 and CH3 because the duty cycles are still 0 %, Frame counter = 0)
     - **PWM_GEN_DC: 0xAFFF** (configure the PWM GEN duty cycle at 100 %, the expected effect is the 100 % Vbat voltage on the resistive load, Frame counter = 1)
     - **PWM_LED_DC: 0xB3FE** (configure the PWM LED duty cycle at 100 %, the expected effect is the LED is 100 % ON, Frame counter = 0)
   - ON diagnosis:
     - **DIAG_OPL_ON_EN: 0xBBFF** (enable open load in ON diagnosis on all channels to detect open load, Frame counter = 1)
     - **STA_0: 0x4000** (read Status register0: expected result DIS = 0, NRES = 0, IDLE = 1, IN1 = 1, IN0 = 1, OUT_ON_ERR = 0, OUT_OFF_ERR = 0, Frame counter = 0)
     - **DIAG_OPL_ON: 0x5003** (read Open load in ON diagnostic: expected results all 0 because all the HS channel are correctly connected, Frame counter = 1)
   - Over current and over temperature diagnosis:
     - **DIAG_OVC_OVT:0x4800** (read the Over Current and Over Temperature diagnosis, expected results OUT5 = 1 depending on the kind of bulb lamp that has been used, please refer to the L9026 Datasheet for further details. Frame counter = 0)
     - **DIAG_OVC_OVT_RLW: 0XBFFF** (clear all the Over Current and Over Temperature diagnosis, expected result reading again DIAG_OVC_OVT all the diagnosis has been cleaned. Frame counter = 1)

4 Evaluation board schematic

Figure 4. Evaluation board schematic



5 PCB Layout

Figure 5. **Assembly Top**

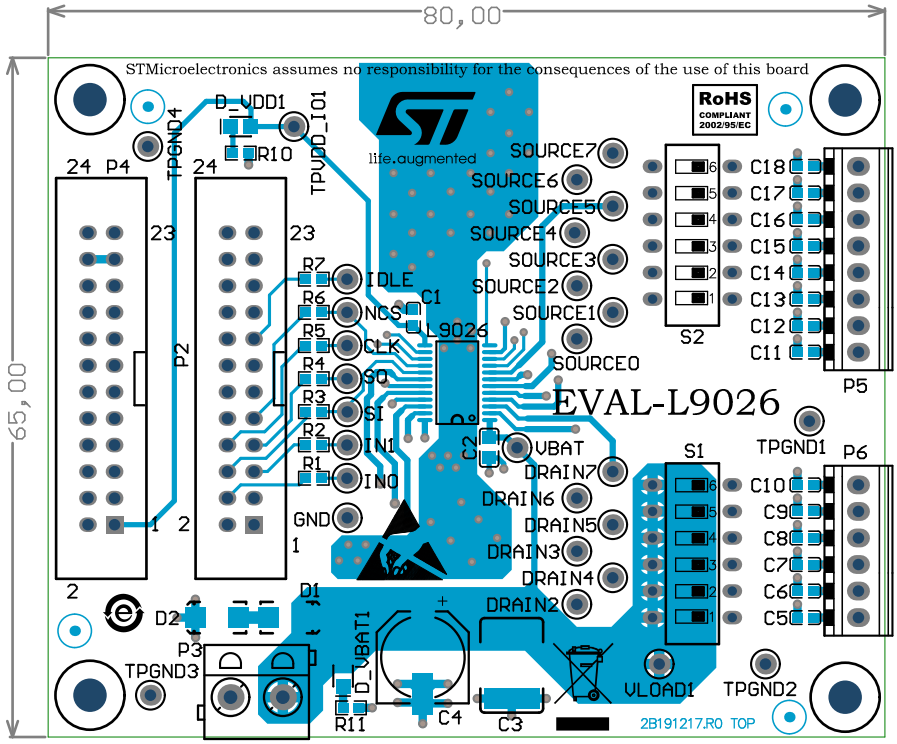


Figure 6. **Inner 1**

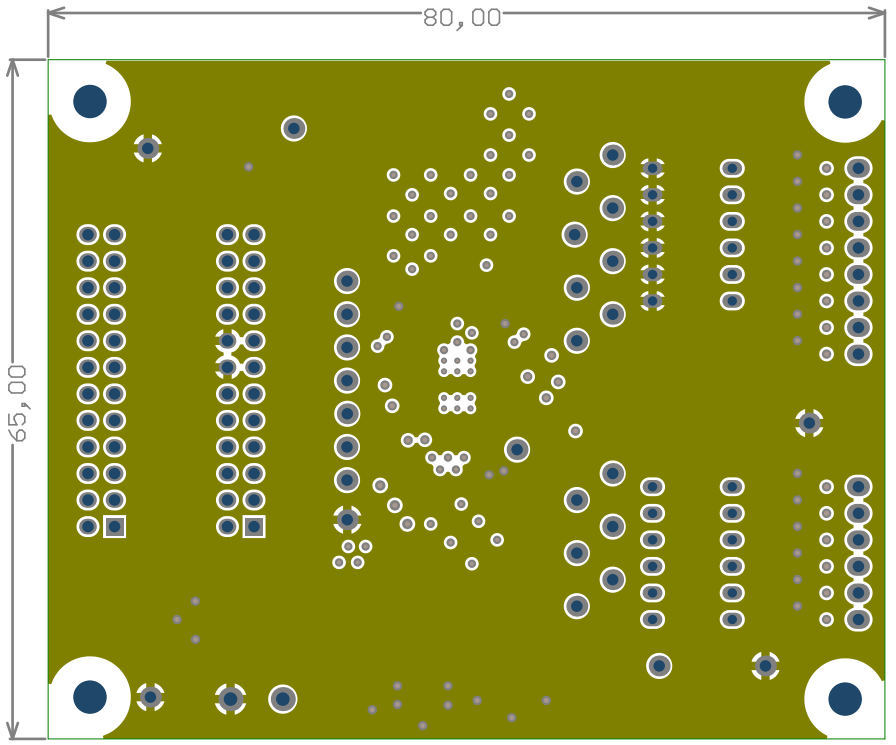


Figure 7. **Inner 2**

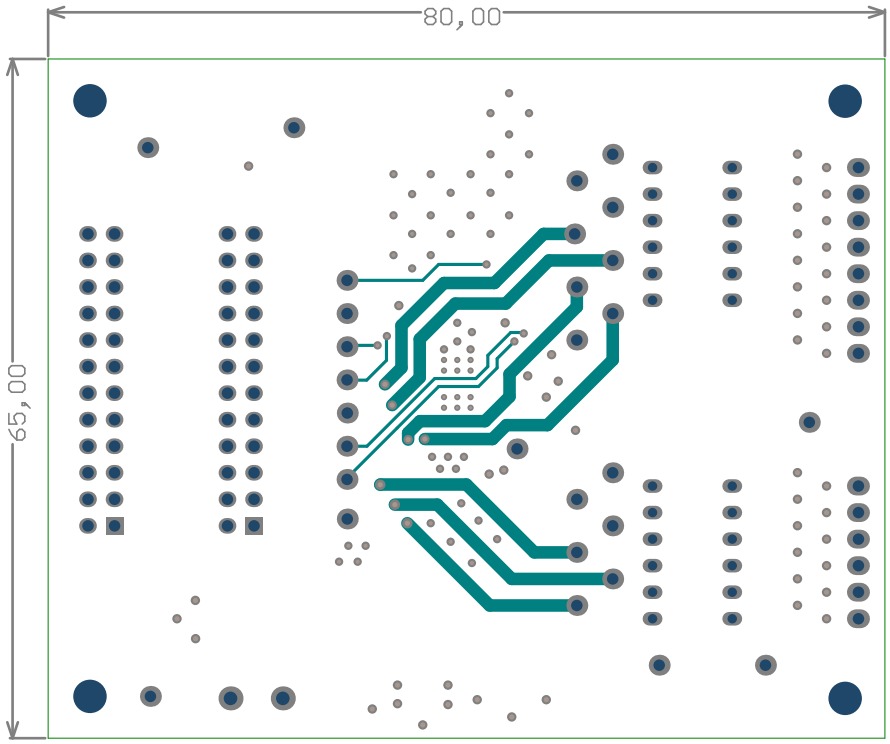
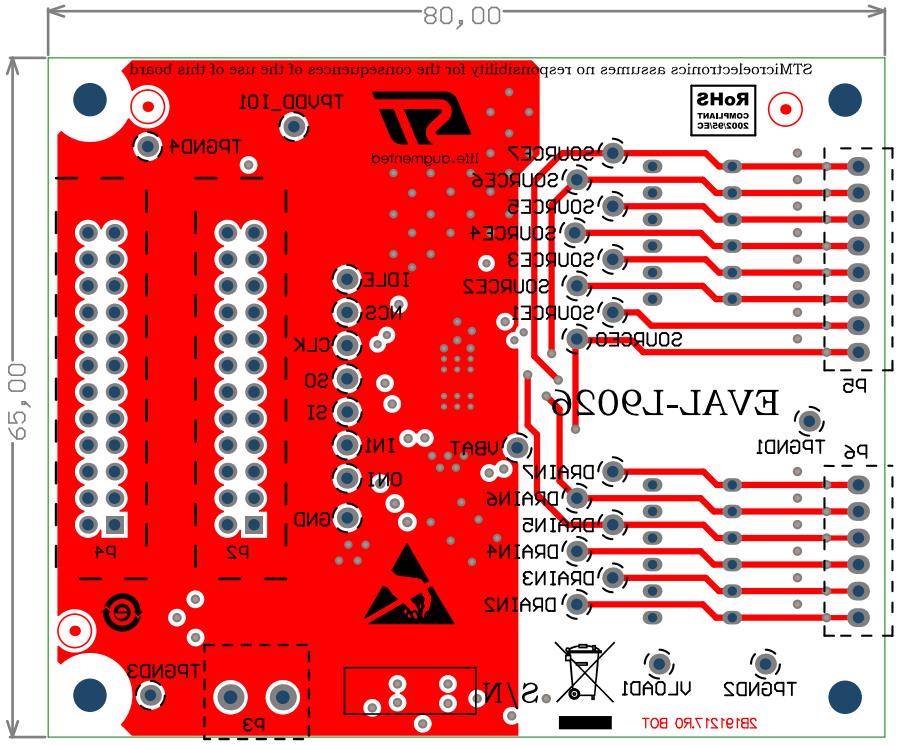


Figure 8. **Assembly Bottom**



Appendix A Reference documents

Table 5. **Reference documents**

Doc Name	ID	Title
DS13397	034478	Configurable multi channel relay driver 2HS + 6HS/LS

Revision history

Table 6. **Document revision history**

Date	Version	Changes
06-Aug-2020	1	Initial release.

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