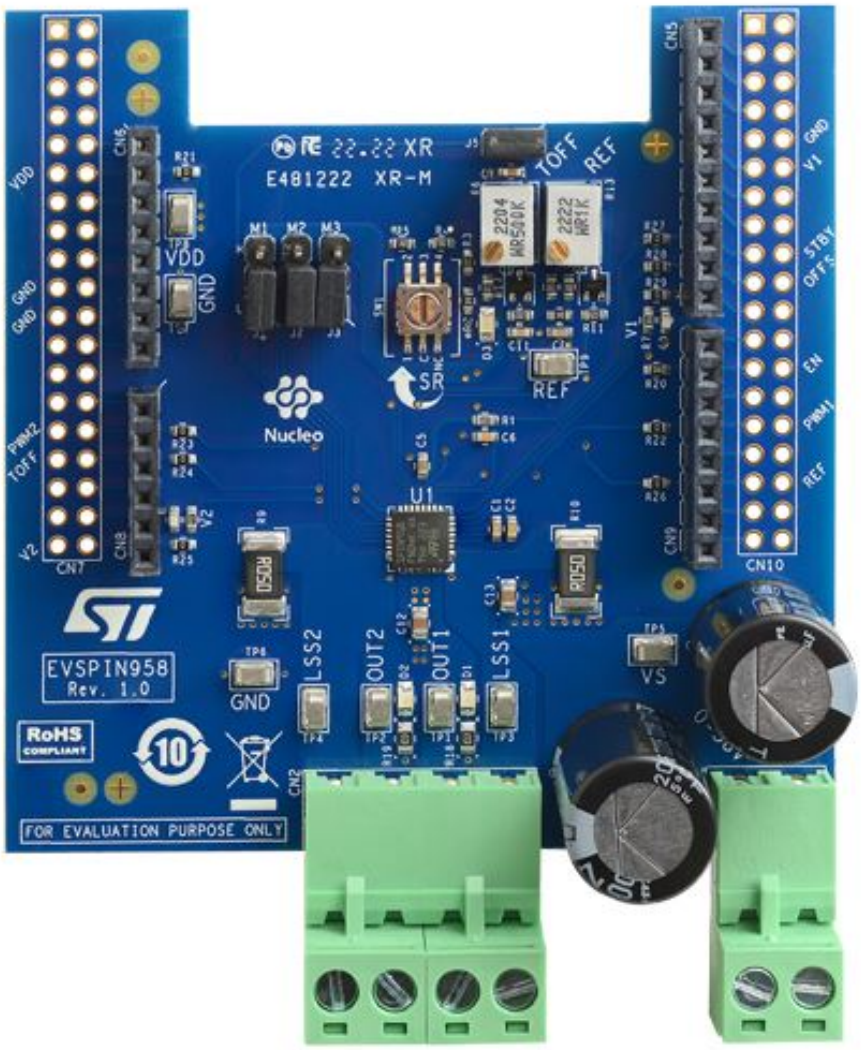
Getting started with the EVSPIN958 brushed DC motor driver expansion board based on the STSPIN958

Introduction

The EVSPIN958 single brushed DC motor driver expansion board is based on the STSPIN958.

It provides an affordable and easy-to-use solution for the implementation of brushed DC motor driving applications. Thanks to the parallel operation, it can be easily converted to a single half-bridge with double current capability. In addition to the internal current limiter, the integrated amplifiers allow it to be used in systems with external current control. The EVSPIN958 is compatible with the Arduino UNO R3 connector and most STM32 Nucleo boards.

Figure 1. EVSPIN958 expansion board



1 Safety precautions

Warning: *Some of the components mounted on the board could reach hazardous temperatures during operation.*

While using the board, please follow the following precautions:

- Do not touch the components or the heatsink.
- Do not cover the board.
- Do not put the board in contact with flammable materials or with materials releasing smoke when heated.
- After operation, allow the board to cool down before touching it.

2 Getting started

The main features of the EVSPIN958 expansion board are:

- Voltage range from 5 V to 58 V
- Phase current up to 5 A r.m.s
- Adjustable output slew rate
- Seven different driving modes
- One current limiter with adjustable OFF time
- Two integrated amplifiers with fixed gain
- Full protection set including: overcurrent, undervoltage lock out and thermal shutdown
- Compatibility with Arduino UNO R3 connector and STM32 Nucleo boards

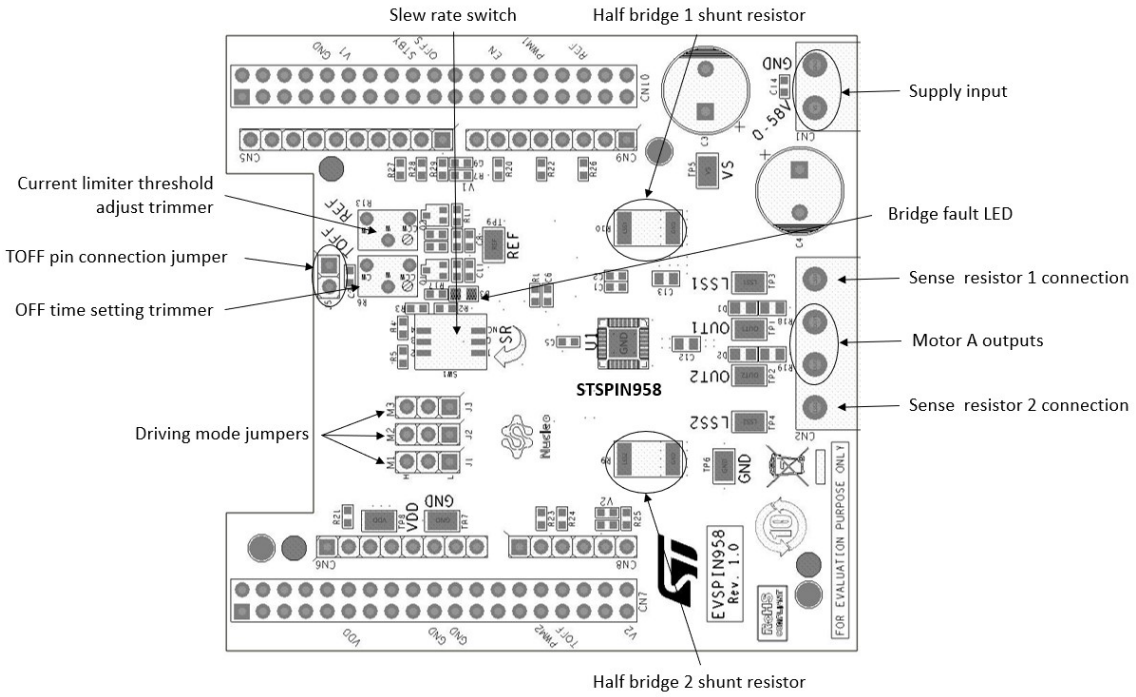
The EVSPIN958 evaluation board is ready to be used in few steps. Follow this procedure to start your evaluation:

1. Check the setting of the jumpers based on your configuration as described in Section 3
2. Connect the board with the STM32 Nucleo board through the Arduino UNO R3
3. Supply the board through the input 2 (VS) and 1 (ground) of the connector CN1

Further support material is available on the STSPIN958 product page www.st.com

3 Hardware description and configuration

Figure 2. EVSPIN958 overview



The following tables provide the detailed pinout of the Arduino UNO R3 and ST Morpho connectors.

Table 1. Arduino UNO R3 connector table

Connector	Pin(1)	Signal	Remarks
CN5	2	Operational amplifiers offset enable	
	3	Standby (active low)	
	6	Operational amplifier 1 output	
	7	Ground	
CN9	3	Voltage reference current limiter	
	5	PWM1 input	
	7	Enable bridge	
CN6	2	VDD	
	6	Ground	
	7	Ground	
CN8	2	PWM2 input	
	3	TOFF signal	Digital output in ***PWM trimming mode***
	6	Operational amplifier 2 output	

1. *All non-listed pins are not connected.*

3.1 Driving mode selection

The EVSPIN958 can drive up to 2 DC motors at the same time.

The driving mode selection is done setting J1 and J2 jumpers (connected to MODE1 and MODE2 pins of the device) on the top of the board.

J6 solder jumper on the bottom of the board must be closed/opened according to the selected driving mode.

The table below briefly summarizes the possible configurations:

Table 2. Driving mode settings

J1	J2	Driving mode	Typical application	J6(1)	Max. output current (each motor)	Output $R_{DS(ON)}$	Minimum OCD threshold
1-2	1-2	Dual half-bridge	2 x unidirectional brushed DC (Figure 3)	open	5 Arms	0.2Ω	7 A
			1 x bidirectional brushed DC (Figure 4)	closed		0.4Ω	
1-2	2-3	Single full-bridge	1 x bidirectional Figure 4	closed	5 Arms	0.4Ω	7 A
2-3	1-2	Single half-bridge	1 x high current unidirectional brushed DC(2) (Figure 5)	closed	10 Arms	0.2Ω	14 A
2-3(3)	2-3(3)	Single full-bridge with mixed decay	1 x bidirectional brushed DC or Half bipolar stepper (Figure 4)	closed	5 Arms	0.4Ω	7 A

1. *When J6 is closed, the removal of the shunt resistor 2 (R9) is recommended for higher precision of the triggering of the current limiter*
2. *The motor can be connected between OUT and either LSS (like in the figure) or VS, paying attention to properly connect PWM2 to GND or to VDD respectively.*
3. *This configuration is only available with current limiter in Fixed OFF time mode (see Section 3.2).*

Figure 3. **Two unidirectional DC motors**

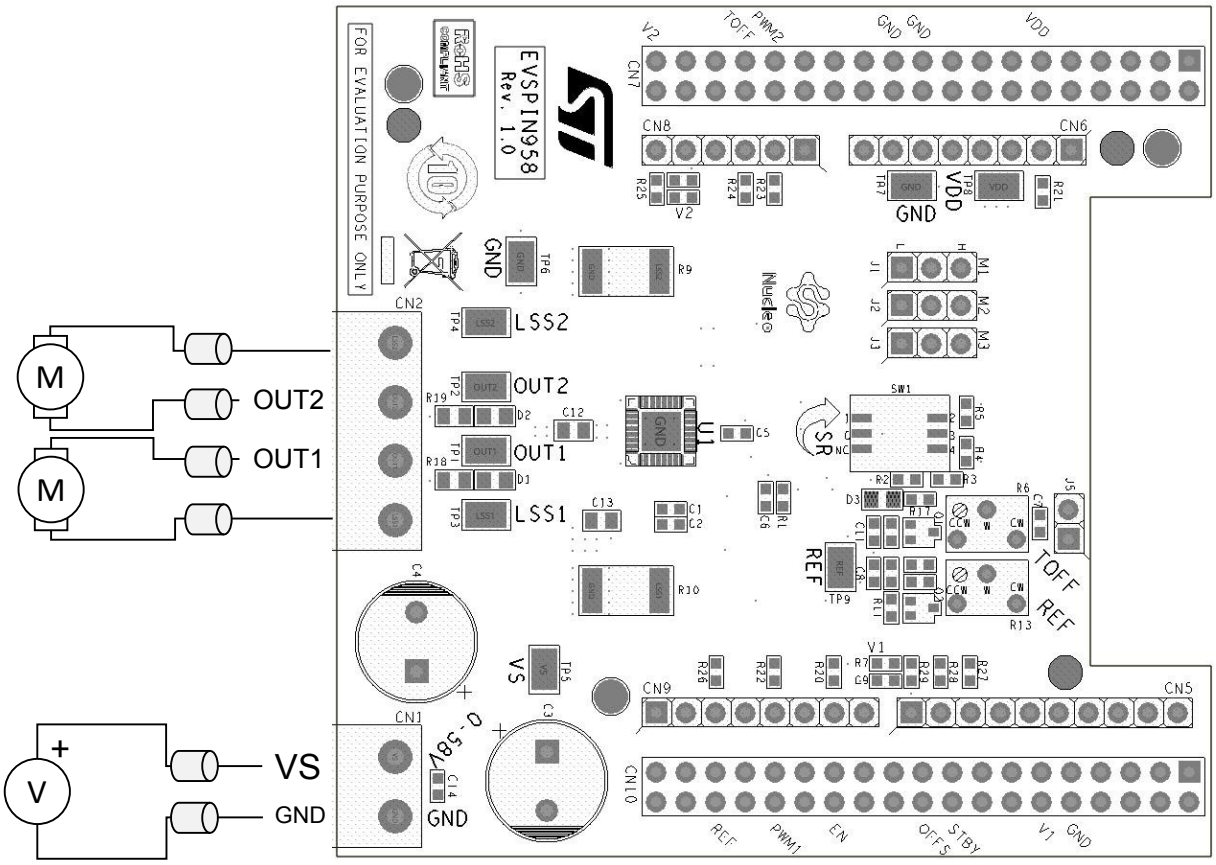


Figure 4. **One bidirectional DC motor**

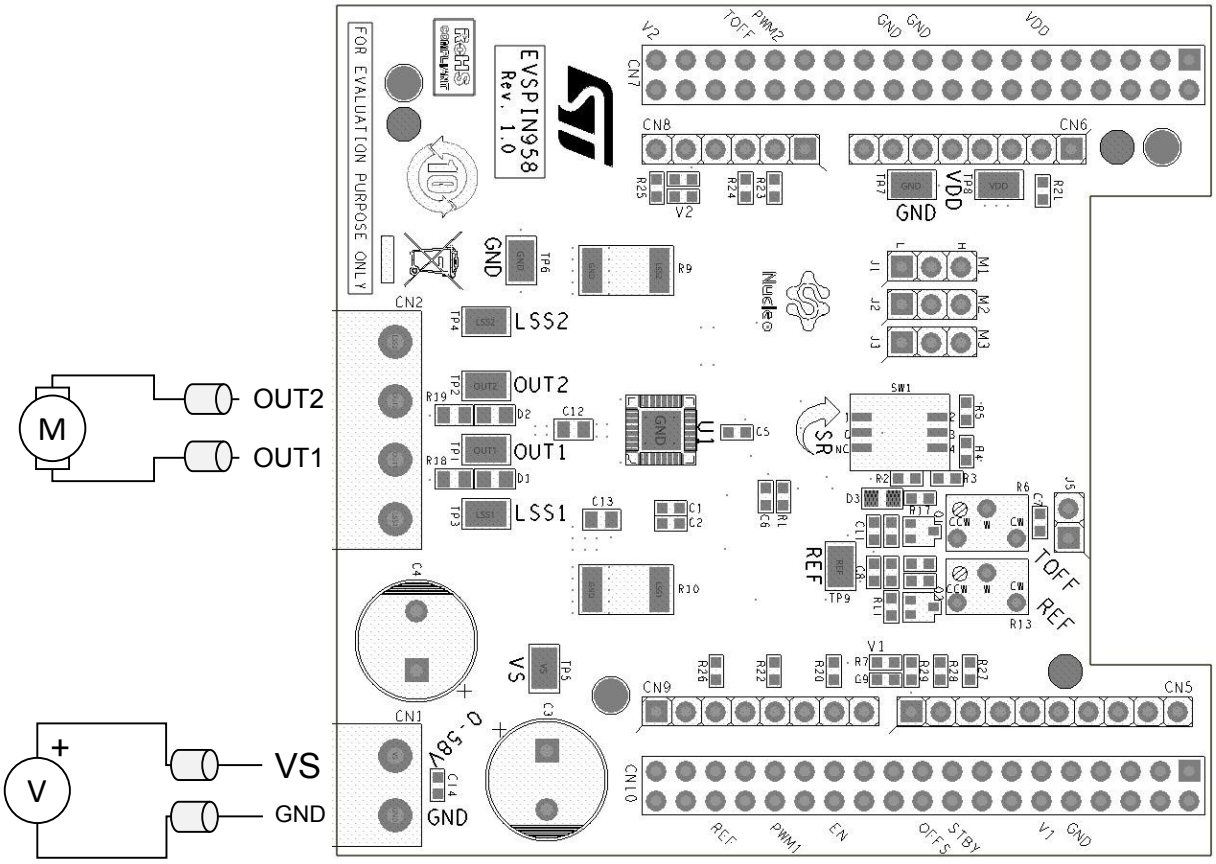
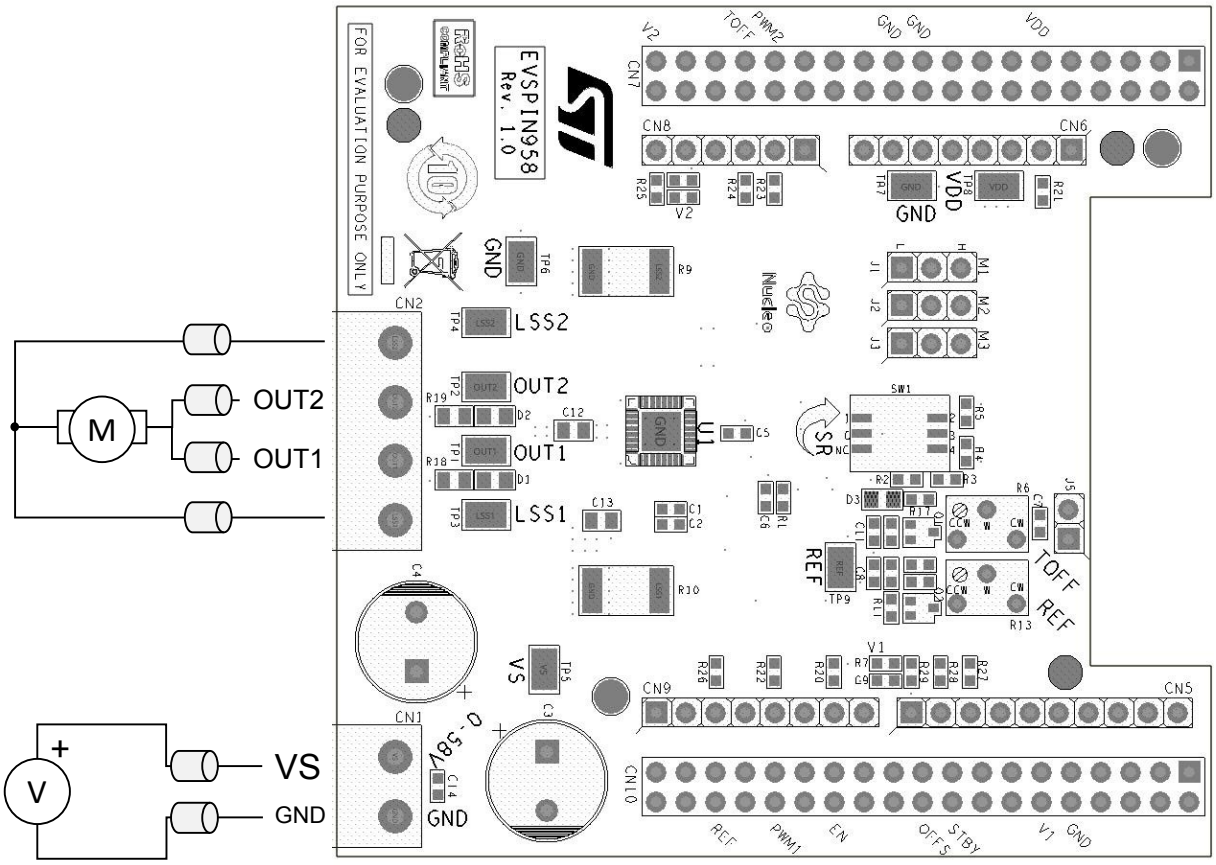


Figure 5. **One unidirectional DC motors – higher current**



3.2 Current limiter mode

The behavior of the current limiter can be changed by setting the J3 jumper (connected to MODE3 of the device) as follows:

Table 3. **Current limiter mode settings**

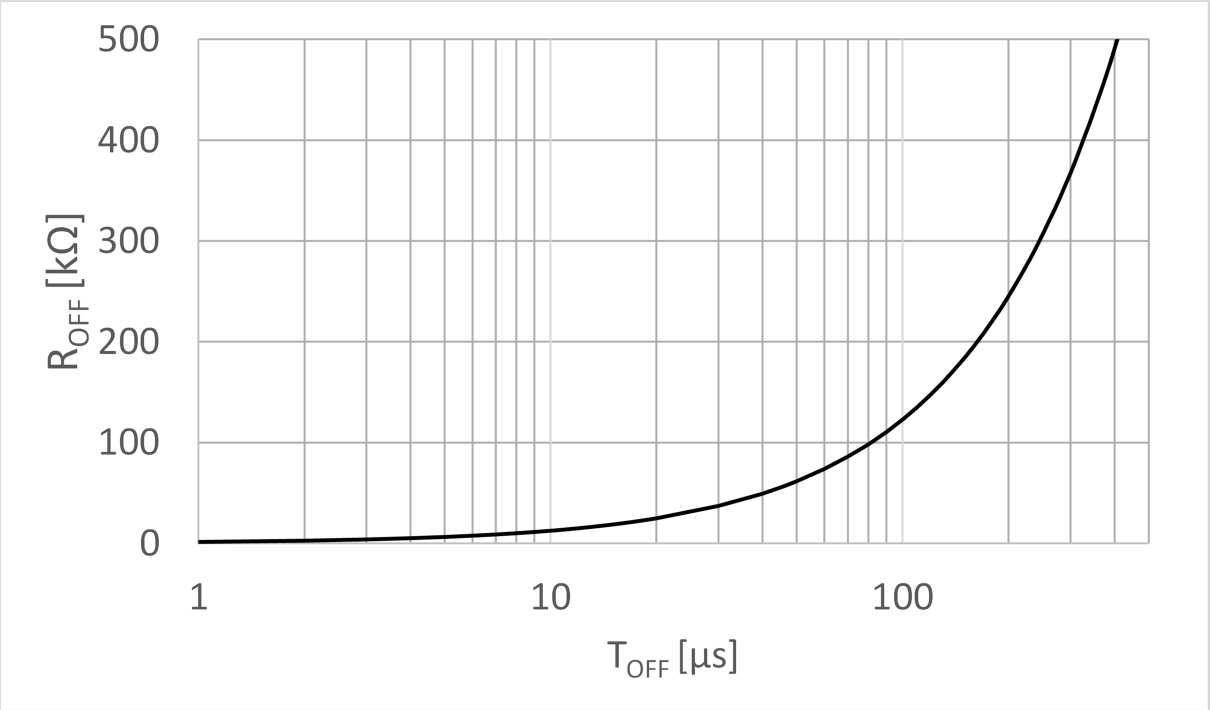
J3	Current limiter mode	J5 and J3	Decay time
1-2	Fixed OFF time	Closed	Depending on R6 resistor (Figure 6)
2-3	PWM trimming	Open	Depending on PWM input signals

In *Fixed OFF time* mode, the current limiter can be disabled by setting R6 to its minimum value.

The current threshold can be set in two different ways:

- Trimming R13 resistor, leaving CN9.3 floating
- Applying a square wave with variable duty cycle to CN9.3, setting R13 to its minimum value

Figure 6. t_{OFF} versus R_{OFF}



3.3 Output slew rate

The output slew rate can be increased moving the rotative switch SW1 clockwise. With the STSPIN958 device, the slew rate value can be chosen from four different values, as shown in Table 4.

Table 4. **Slew rate settings**

SW1	R_{SR}	Slew rate (typ. at VS = 58 V)
C-1 closed	10 kΩ	0.3 V/ns
C-2 closed	5.6 kΩ	0.6 V/ns
C-3 closed	2.2 kΩ	1.2 V/ns
C-4 closed	1 kΩ	2 V/ns

4 Thermal performance

An example of the thermal performances of the EVSPIN958 is provided in Figure 7 . The board is used in full-bridge and parallel half-bridge configuration in a typical application to drive an inductive load with different output currents ranging from 0.5 A to 4 A.

Set-up conditions:

- *Planar orientation of the board and natural convection only*
- *Tambient = 25 °C*
- *PWM frequency = 20 KHz*
- *VS = 30 V*
- *Output slew rate setting = 2 V/ns*

Figure 7. EVSPIN958 - thermal performances

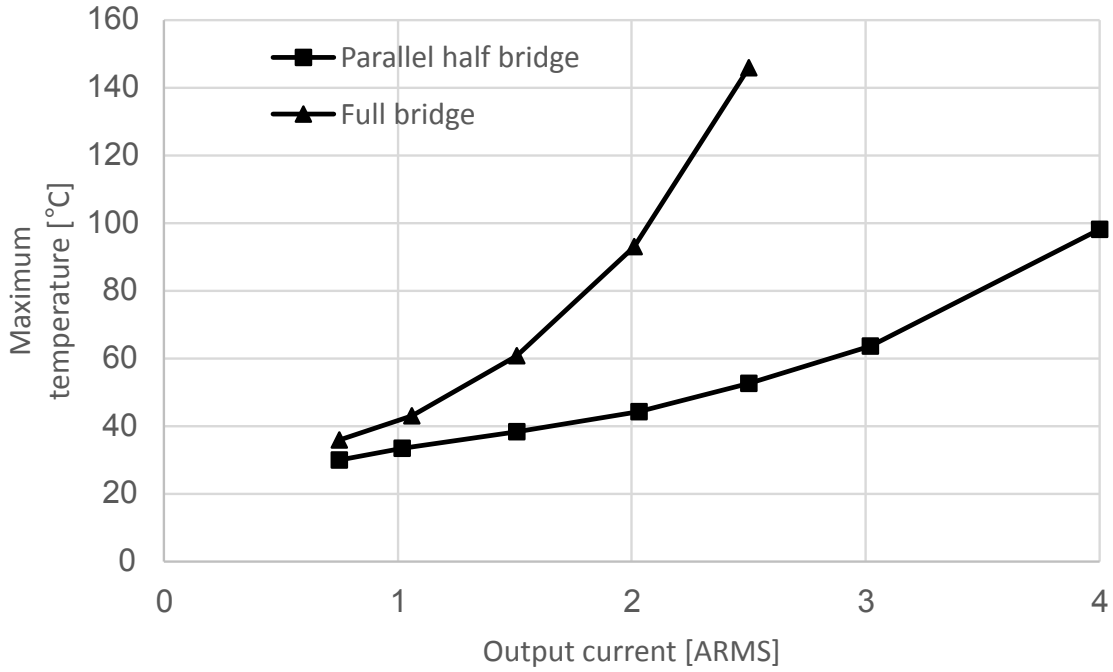
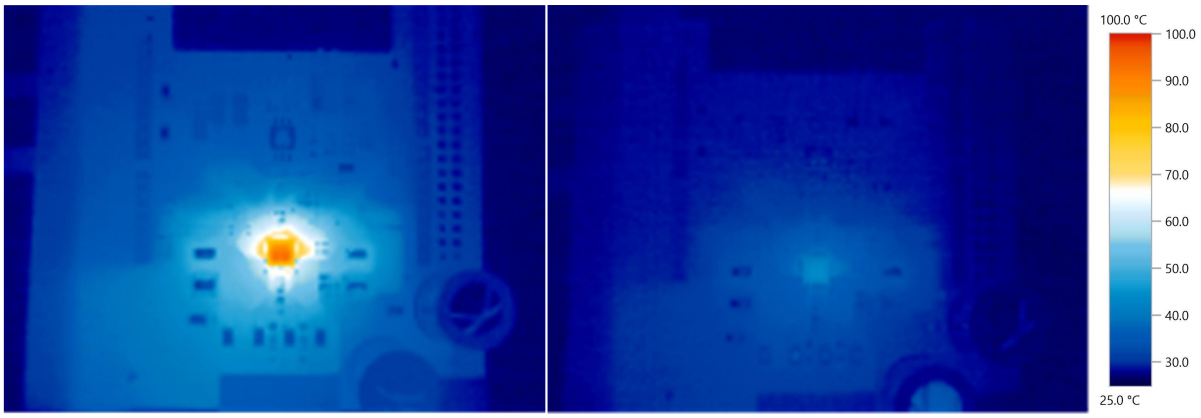


Figure 8. Thermal images (IOUT = 2_{ARMS})

Full-bridge configuration *Parallel half-bridge configuration*



5 Bills of material

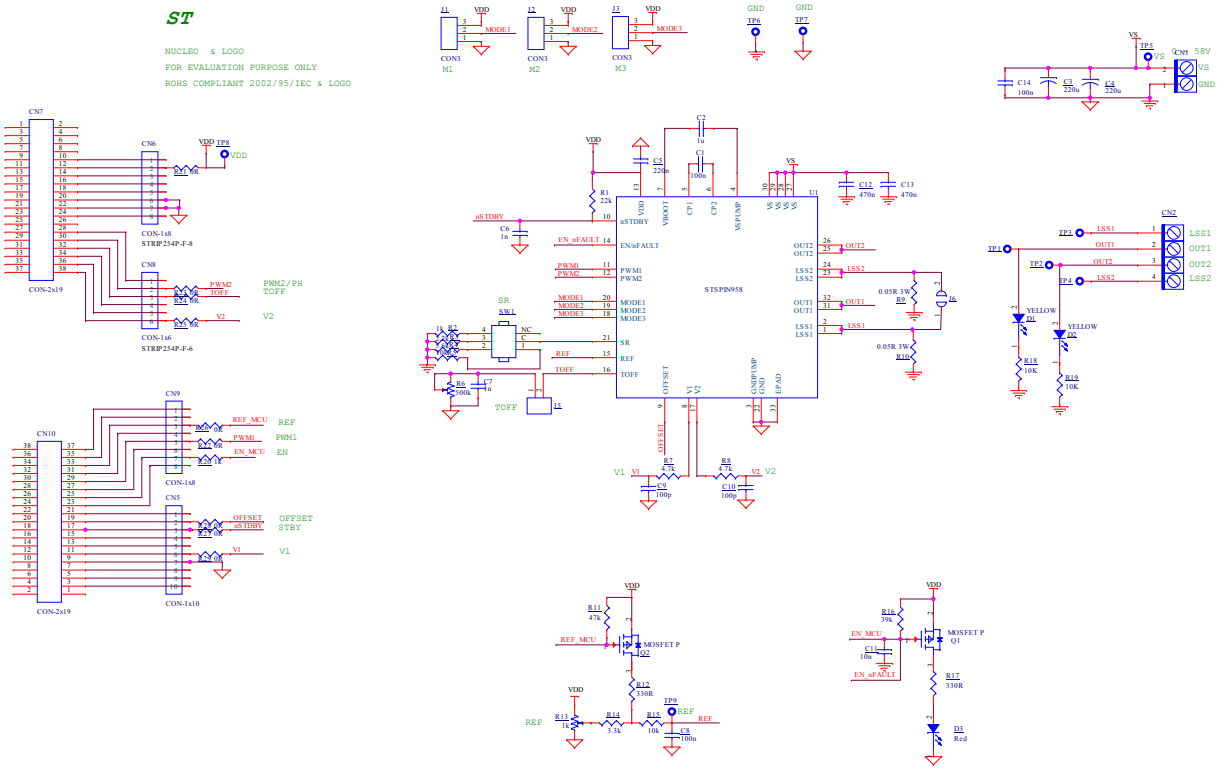
Table 5. **EVSPIN958 bill of material**

Item	Qty.	Ref.	Description	Part/Value	Manufact.	Order code
1	1	CN1	Connector 5.08 mm Close Vertical	MORSV-508-2P_ screw	Wurth Elektronik	691312510002 or equivalent
2	1	CN2	Connector 5.08 mm close vertical	MORSV-508-4P_ screw	Wurth Elektronik	691312510004 or equivalent
3	1	CN5	Connector through-hole-pitch 2.54	CON-1x10	Samtec	SSQ-110-04-F-S
4	2	CN6,CN9	Connector through-hole-pitch 2.54	CON-1x8	Samtec	SSQ-108-04-F-S
5	2	CN7,CN10	Connector through-hole-pitch 2.54	N.M.	Samtec	ESQ-119-24-G-D
6	1	CN8	Connector through-hole-pitch 2.54	CON-1x6	Samtec	SSQ-106-04-F-S
7	2	C1,C8	SMT ceramic capacitor	100 n 15 V		
8	1	C2	SMT ceramic capacitor	1 u 15 V		
9	2	C3,C4	Through-hole aluminum elect. capacitor	220 u 100 V	Panasonic	EEUFS2A221B
10	1	C5	SMT ceramic capacitor	220 n 15 V		
11	2	C6,C7	SMT ceramic capacitor	1 n 15 V		
12	2	C9,C10	SMT ceramic capacitor	100 p 15 V		
13	1	C11	SMT ceramic capacitor	10 n 15 V		
14	2	C12,C13	SMT ceramic capacitor	470 n 100 V		
15	1	C14	SMT ceramic capacitor	100 n 100 V		
16	2	D1,D2	Yellow LED	Yellow		
17	1	D3	Red LED	Red		
18	1	SW1	Rotative switch x4	ROT-SWITCH	Nidec	CS-4-14-NTB or equivalent
19	3	J1,J2,J3	Header connector 1x3 pins	Closed 1-2		
21	1	J5	Header connector 1x2 pins	Closed		
22	1	J6	Solder jumper	Open		
23	2	Q1,Q2	P MOSFET	MOSFET P	NXP	NX3008PBKW
24	1	R1	SMT resistor	22 k 1/10 W		
25	2	R2,R20	SMT resistor	1 k 1/10 W		
26	1	R3	SMT resistor	2.2 k 1/10 W		
27	1	R4	SMT resistor	5.6 k 1/10 W		
28	2	R5,R15	SMT resistor	10 k 1/10 W		
29	1	R6	1/4" square trimpot trimming potentiometer, top adjust	500 k	Bourns	3266W-1-504 LF
30	2	R7,R8	SMT resistor	4.7 k 1/10 W		
31	2	R9,R10	SMT resistor	0.05 1% 3 W	Bourns	CRA2512-FZ-R050ELF
32	1	R11	SMT resistor	47 k 1/10 W		
33	2	R12,R17	SMT resistor	330 R 1/10 W		
34	1	R13	1/4" square trimpot trimming potentiometer, top adjust	1 k	Bourns	3266W-1-102 LF
35	1	R14	SMT resistor	3.3 k 1/10 W		

Item	Qty.	Ref.	Description	Part/Value	Manufact.	Order code
36	1	R16	SMT resistor	39 k 1/10 W		
37	2	R18,R19	SMT resistor	10 k ½ W		
38	9	R21,R22,R23 R24,R25,R26 R27,R28,R29	SMT resistor	0 R 1/10 W		
39	9	TP1,TP2,TP3 TP4,TP5,TP6 TP7,TP8,TP9	Test point	TP-SMD-S1751-46R	Harwin	S1751-46R
40	1	U1	STSPIN958	STSPIN958		

6 Schematic diagrams

Figure 9. **EVSPIN958 schematic diagram**



Revision history

Table 6. **Document revision history**

Date	Version	Changes
14-Sep-2022	1	Initial release.

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