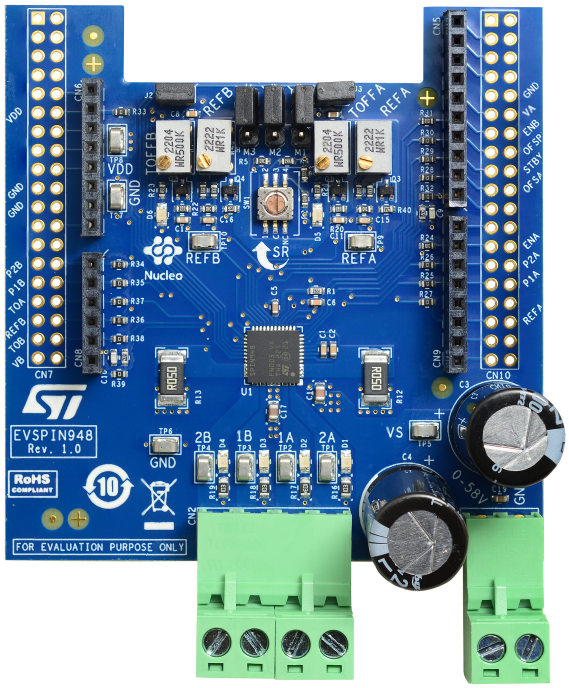
Getting started with the EVSPIN948 dual brushed DC motor driver expansion board based on the STSPIN948

Introduction

The EVSPIN948 dual brushed DC motor driver expansion board is based on the STSPIN948.

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 brushed DC motor driver with double current capability. In addition to the internal current limiters, the integrated amplifiers allow it to be used in systems with external current control. The EVSPIN948 is compatible with the Arduino UNO R3 connector and most STM32 Nucleo boards.

Figure 1. EVSPIN948 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 EVSPIN948 expansion board are:

- Voltage range from 5 V to 58 V
- Phase current up to 5 A r.m.s for each motor
- Adjustable output slew rate
- Five different driving modes
- Two independent current limiters 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

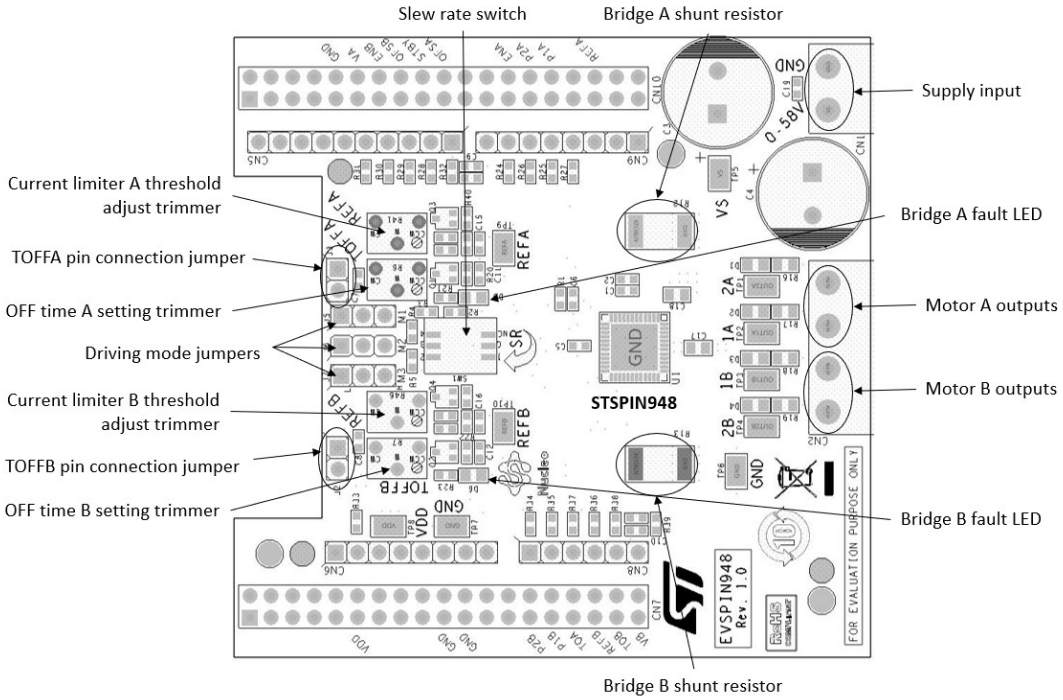
The EVSPIN948 evaluation board is ready to be used in few steps. Follow this procedure to start your evaluation:

1. Check the setting of the jumpers based on your configuration as described in Section 3 Hardware description and configuration
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 STSPIN948 product page www.st.com

3 Hardware description and configuration

Figure 2. EVSPIN948 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	Offset enable (operational amplifier A)	
	3	Standby (active low)	
	4	Offset enable (operational amplifier B)	
	5	Enable bridge B	
	6	Operational amplifier A output	
	7	Ground	
CN9	3	Voltage reference current limiter A	
	5	PWM1A input	
	6	PHA input	
	7	Enable bridge A	
CN6	2	VDD	
	6	Ground	
	7	Ground	
CN8	1	PHB input	
	2	PWM1B input	
	3	TOFFA signal	Digital output in ***PWM trimming mode***

Connector	Pin(1)	Signal	Remarks
CN8	4	Voltage reference current limiter B	
	5	TOFFB signal	Digital output in ***PWM trimming mode***
	6	Operational amplifier B output	

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

3.1 Driving mode selection

The EVSPIN948 can drive up to 2 DC motors at the same time.

The driving mode selection is done setting J5 and J6 jumpers (connected to MODE1 and MODE2 pins of the device) on the top of the boards.

The table below briefly summarizes the possible configurations:

J5	J6	Driving mode	Typical application	Max output current (each motor)	Output $R_{DS(ON)}$	Minimum OCD threshold
1-2	1-2	Reserved				
1-2	2-3	Dual full bridge	2 x bidirectional brushed DC (Figure 3)	5 Arms	0.4 Ω	7 A
2-3	1-2	Dual half bridge	2 x high current unidirectional brushed DC(1) (Figure 4)	10 Arms	0.2 Ω	14 A
			1 x high current bidirectional brushed DC (Figure 5)		0.4 Ω	
2-3(2)	2-3(2)	Dual full bridge with mixed decay	2 x bidirectional brushed DC or Bipolar stepper (Figure 3)	5 Arms	0.4 Ω	7 A

1. *The motors can be connected between OUT and either VS (like in the figure) or GND. In the latter case, the current limiter must be disabled. Motors can also be connected between OUT and LSS (without the need of disabling the current limiter), soldering one of the motor cables directly to R12 or R13.*
2. *This configuration is only available with current limiter in Fixed OFF time mode (see Section 3.2)*

Figure 3. **Two bidirectional DC motors**

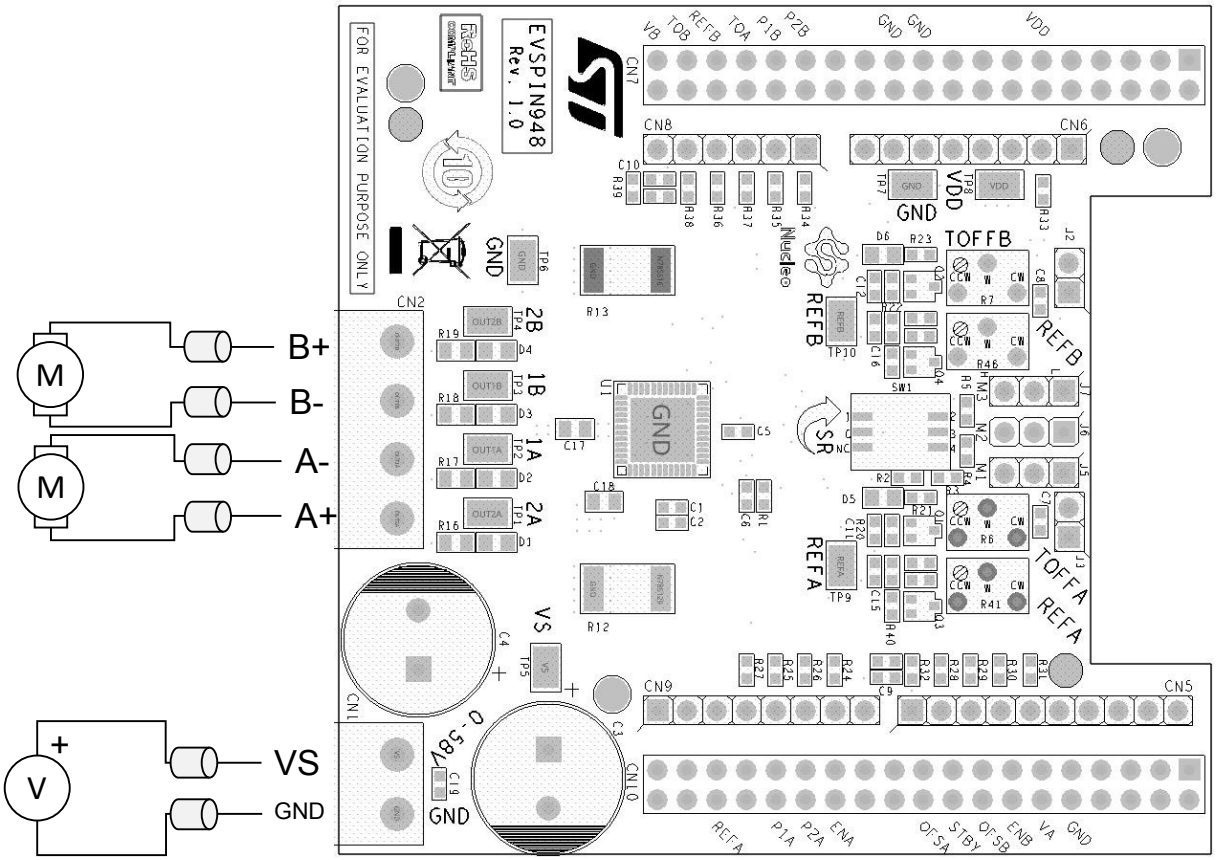


Figure 4. **Two unidirectional DC motors – higher current**

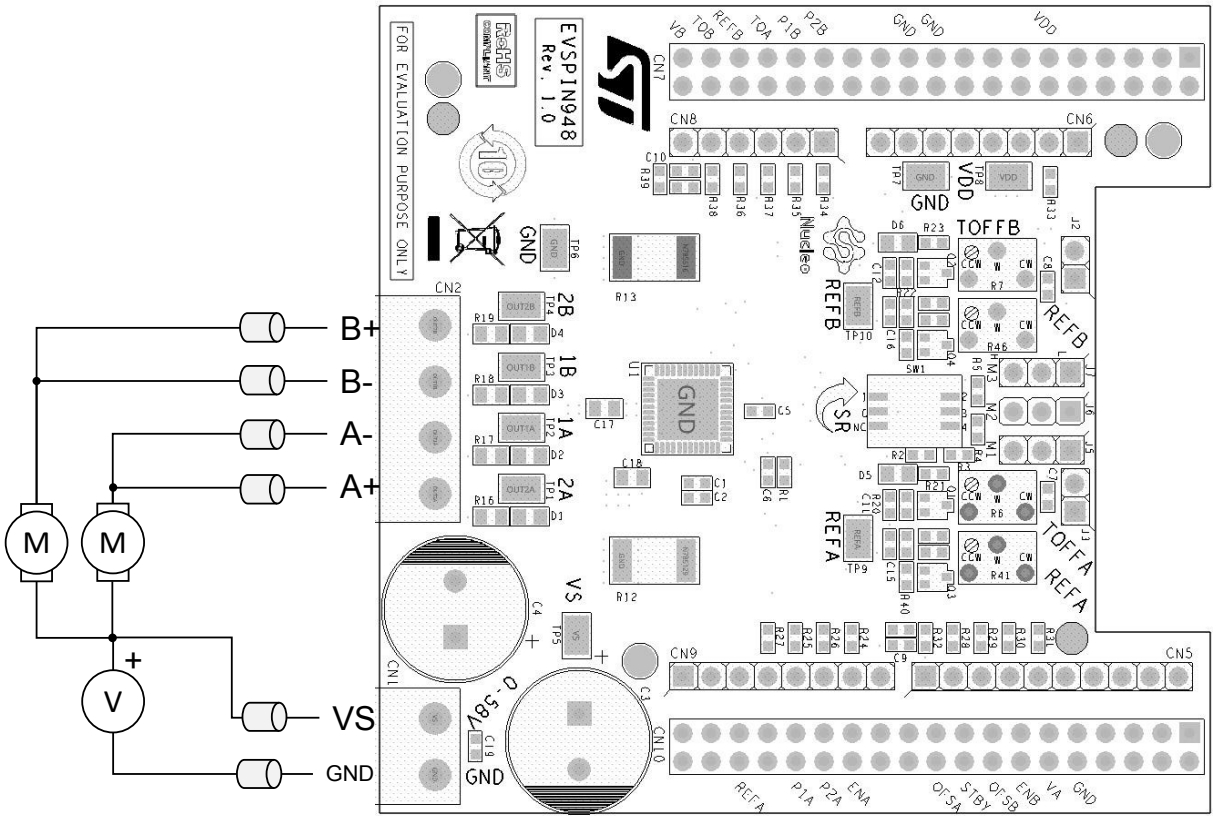
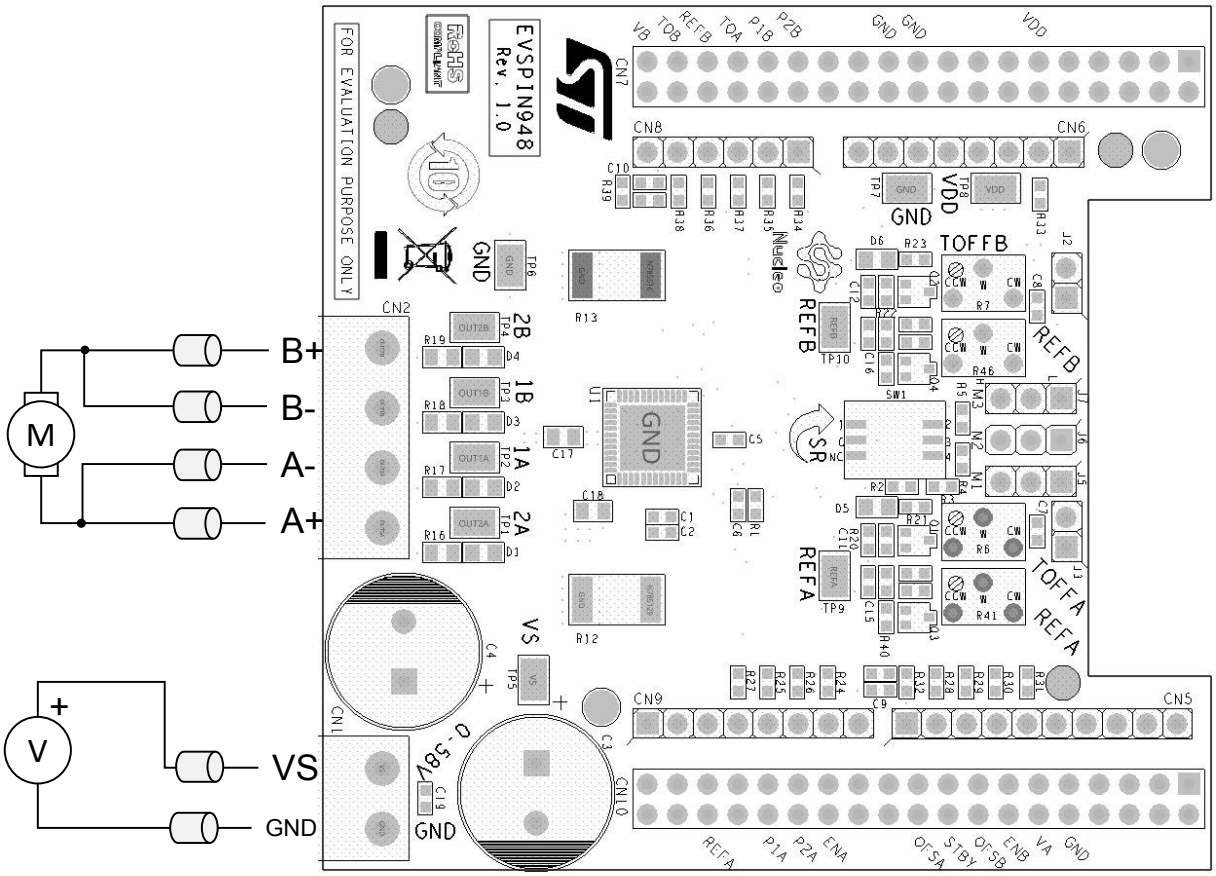


Figure 5. **One bidirectional DC motor - higher current**



3.2 Current limiter mode

The behavior of the current limiter can be changed by setting the J7 jumper (connected to MODE3 of the device) as follows:

Table 2. **Current limiter mode settings**

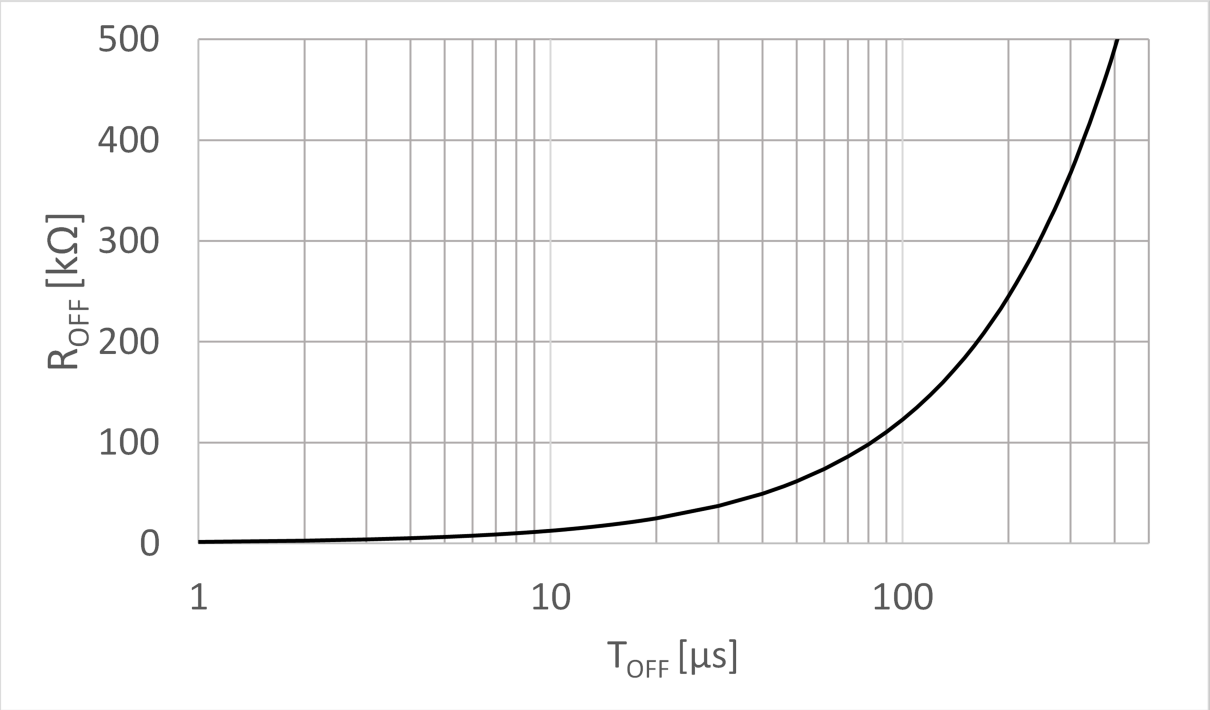
J7	Current limiter mode	J2 and J3	Decay time
1-2	Fixed OFF time	Closed	Depending on R6 and R7 resistors (Figure 6)
2-3	PWM trimming	Open	Depending on PWM input signals

In *Fixed OFF time* mode, the current limiter A and current limiter B can be disabled by setting R6 and R7 to their minimum value respectively.

The current threshold can be set in two different ways:

- Trimming R41 and R46 resistors, leaving CN9.3 and CN8.4 floating
- Applying a square wave with variable duty cycle to CN9.3 and CN8.4, setting R41 and R46 to their 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 STSPIN948 device, the slew rate value can be chosen from four different values, as shown in Table 3.

Table 3. **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 EVSPIN948 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 3 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. EVSPIN948 - thermal performances

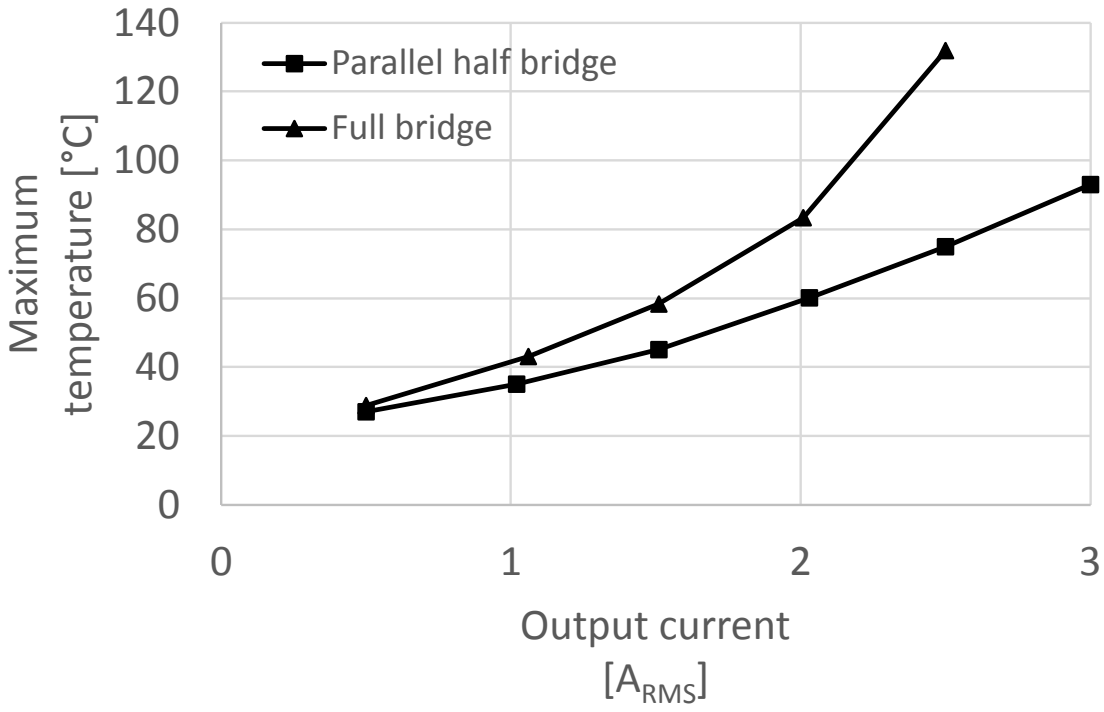
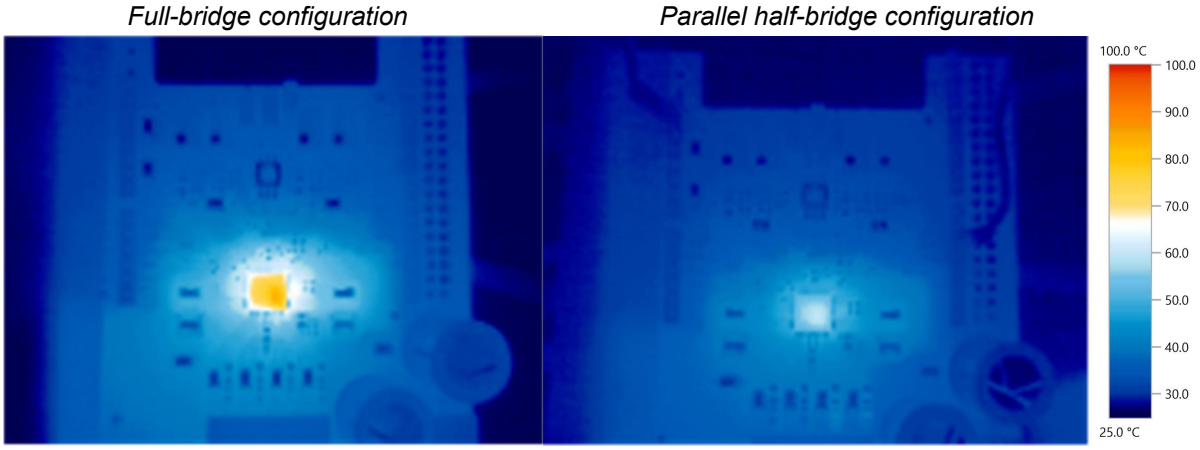


Figure 8. Thermal images (IOUT = 2_{ARMS})



5 Bills of material

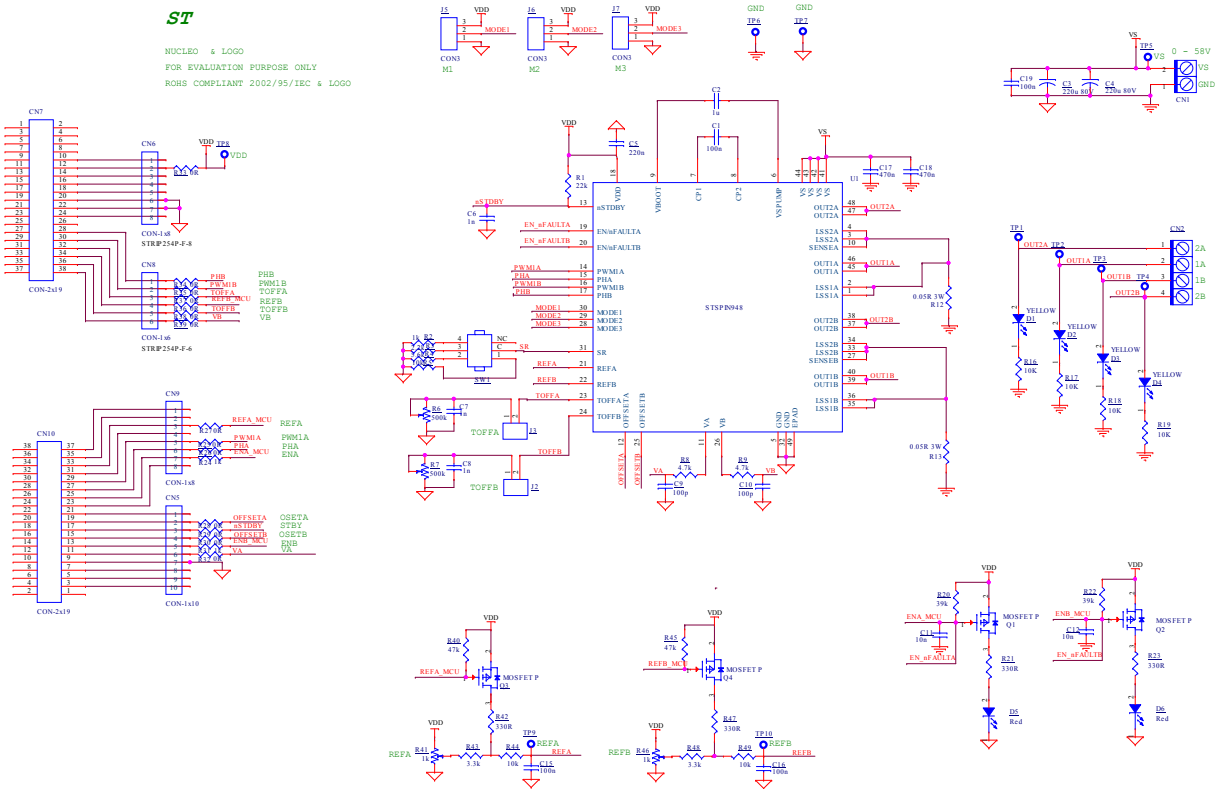
Table 4. EVSPIN948 bill of material

Item	Qty.	Ref.	Description	Part/Value	Manufact.	Order code
1	1	CN1	Connector 5.08 mm close vertical	MORSV-508-2P_screw	Wurth Elektronic	691312510002 or equivalent
2	1	CN2	Connector 5.08 mm close vertical	MORSV-508-4P_screw	Wurth Elektronic	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	3	C1,C15,C16	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	3	C6,C7,C8	SMT ceramic capacitor	1 n 15 V		
12	2	C9,C10	SMT ceramic capacitor	100 p 15 V		
13	2	C11,C12	SMT ceramic capacitor	10 n 15 V		
14	2	C17,C18	SMT ceramic capacitor	470 n 100 V		
15	1	C19	SMT ceramic capacitor	100 n 100 V		
16	4	D1,D2,D3,D4	Yellow LED	Yellow		
17	2	D5,D6	Red LED	Red		
18	1	SW1	Rotative switch x4	ROT-SWITCH	Nidec	CS-4-14-NTB or equivalent
19	2	J2,J3	Header connector 1x2 pins	Closed		
20	3	J5,J6,J7	Header connector 1x3 pins	Closed 1-2		
21	2	Q1,Q2,Q3,Q4	P MOSFET	MOSFET P	NXP	NX3008PBKW
22	1	R1	SMT resistor	22 k 1/10 W		
23	3	R2,R24,R31	SMT resistor	1 k 1/10 W		
24	1	R3	SMT resistor	2.2 k 1/10 W		
25	1	R4	SMT resistor	5.6 k 1/10 W		
26	3	R5,R44,R49	SMT resistor	10 k 1/10 W		
27	2	R6,R7	1/4" square trimpot trimming potentiometer, top adjust	500 k	Bourns	3266W-1-504 LF
28	4	R8,R9	SMT resistor	4.7 k 1/10 W		
29	4	R12,R13,R14, R15	SMT resistor	0.05 1% 3 W	Bourns	CRA2512-FZ-R050ELF
30	4	R16,R17,R18, R19	SMT resistor	10 k 1/2 W		
31	2	R20,R22	SMT resistor	39 k 1/10 W		
32	4	R21,R23,R42, R47	SMT resistor	330 R 1/10 W		
33	14	R25,R26,R27, R28,R29,R30, R32,R33,R34, R35,R36,R37, R38,R39	SMT resistor	0 R 1/10 W		
34	2	R40,R45	SMT resistor	47 k 1/10 W		
35	2	R41,R46	1/4" square trimpot trimming potentiometer, top adjust	1 k	Bourns	3266W-1-102 LF

Item	Qty.	Ref.	Description	Part/Value	Manufact.	Order code
36	2	R43,R48	SMT resistor	3.3 k 1/10 W		
37	10	TP1,TP2,TP3, TP4,TP5,TP6, TP7,TP8,TP9, TP10	Test point	TP-SMD-S1751-46R	Harwin	S1751-46R
38	1	U1	STSPIN948	STSPIN948		

6 Schematic diagrams

Figure 9. **EVSPIN948 schematic diagram**



Revision history

Table 5. **Document revision history**

Date	Version	Changes
07-Jul-2023	1	Initial release.

Contents

List of tables

List of figures