Getting started with the EVALSP820-XS evaluation board

Introduction

The EVALSP820-XS is an easy to use evaluation board for the STSPIN820, providing a compact solution to evaluate the performance of the STSPIN820 stepper motor driver with minimal external equipment and without the need for extra components.

The hardware is fully compatible with RepRAp Arduino Mega Poloulo Shield (RAMPS) or other similar Fused Filament Fabrication (FFF) 3D Printing platforms, representing a very fast drop-in replacement of similar solutions. Contrary to most other competitor solutions, the EVALSP820-XS helps customers to really exploit the benefits of working at high microstepping resolution.

1 Board overview

The main characteristics of the board are:

- Supply voltage from 7 V to 45 V
- Output current up to 1.5 A rms for each motor phase
- Peak current regulation through trimmer
- Form factor and connectivity compatible with RAMPS (RepRap Arduino Mega Pololu Shield) or similar boards
- Based on STSPIN820 driver featuring:
  - Stepper motor driving with a microstepping resolution up to 1/256th of step
  - Overcurrent, short-circuit and overtemperature protections

Figure 1. Board overview

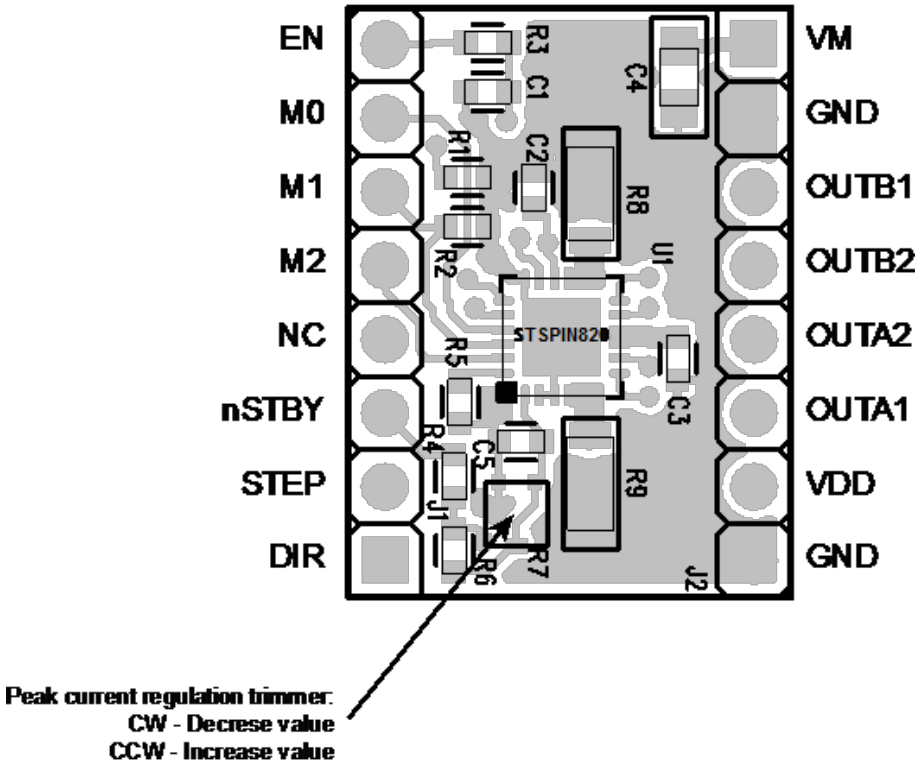


Table 1. Board pinout

J1	Signal	J2	Signal
8	Enable (EN)	1	Motor supply voltage (VM)
7	Step mode selection input (M0)	2	Ground
6	Step mode selection input (M1)	3	Phase B out 1 (OUTB1)
5	Step mode selection input (M2)	4	Phase B out 2 (OUTB2)
4	NC	5	Phase A out 2 (OUTA2)
3	Active low standby (nSTBY)	6	Phase A out 1 (OUTA1)
2	Step-clock input (STEP)	7	Logic supply voltage (VDD)
1	Direction input (DIR)	8	Ground

2 Quick start

2.1 Safety precautions

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

While using the board, please adhere to the following precautions

- Do not touch the components
- Do not cover the board
- Do not put the board in contact with flammable materials of with materials releasing smoke when heated

After operation, allow the board to cool down before touching it.

2.2 Adjusting motor peak current

The R7 trimmer adjusts the reference voltage of the STSPIN820 PWM current controller setting the peak current input to the motor phases.

The R7 trimmer controls the current level. Rotating clockwise increases and rotating counter clockwise decrease the current level.

The range depends on the VDD logic supply voltage (pin 6 of J2) as listed in the table below.

Table 2. Peak current ranges

VDD	Minimum	Maximum
3.3 V	V_{REF} = 0 V I_{peak} = 0 A(1)	V_{REF} = 0.67 V I_{peak} = 4.5 A(2)
5 V	V_{REF} = 0 V I_{peak} = 0 A(1)	V_{REF} = 1 V I_{peak} = 6.8 A(2)

(1) Minimum current could be present due to the PWM current control operation

(2) The overcurrent protection of the STSPIN820 could limit the actual peak current

2.2.1 Modify the peak current range

The trimmer can be adjusted by modifying some board components.

In particular the components contributing to the definition of the peak current are:

- Both the sensing resistors
- Pull-up resistor (R6)
- Sensing resistor (R8 and R9)

The detailed formula is the following:

$$I_{peak,max} = \frac{V_{DD}}{R8} \times \frac{R7}{R6 + R7}$$

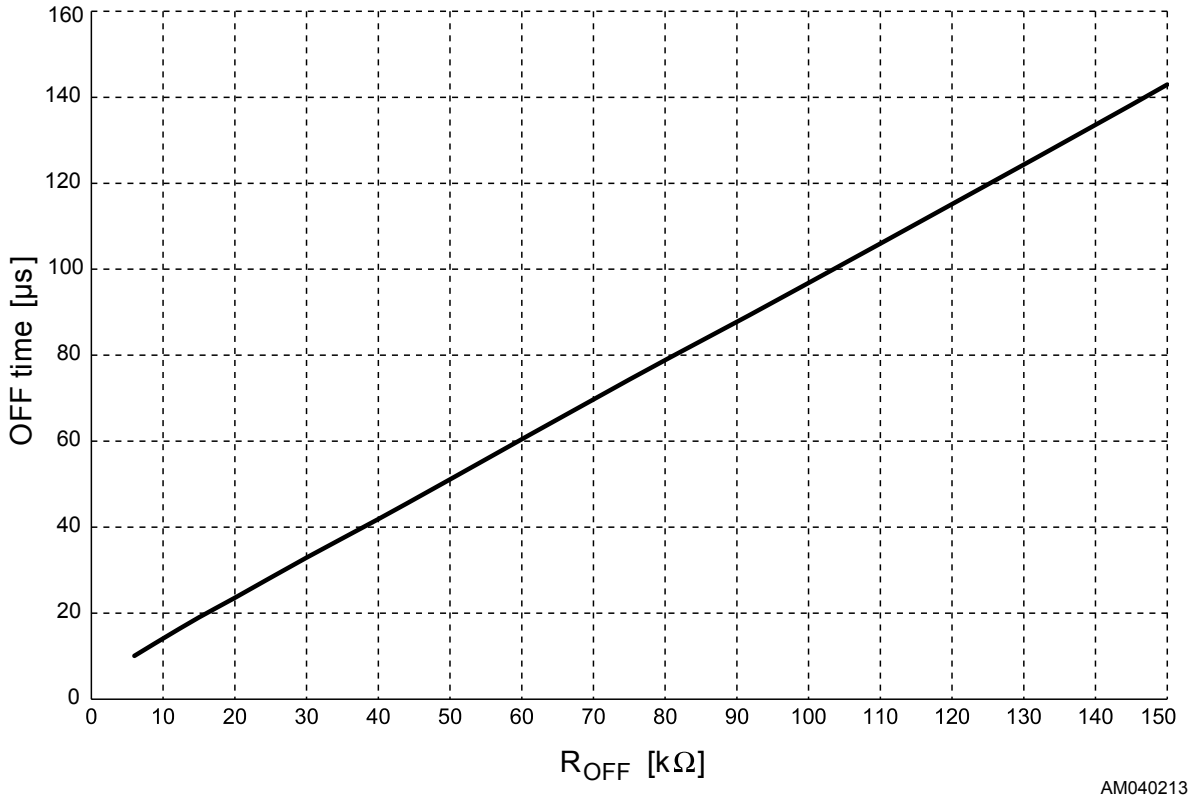
Changing the sensing resistors requires particular attention:

- Bust the sensing resistors must have the same value
- Power dissipation on the resistors is equal to $I_{peak}^2 \times R_{sense}$. The power rating must be selected accordingly.

2.3 Setting off time duration

The R5 resistor sets the off time duration for the PWM current control circuitry as indicated in the figure below. Low resistance value imposes a short off time reducing the current ripple into the motor phases.
The default value is 10 kΩ, corresponding to about 14 µs.

Figure 2. OFF time vs R_{OFF} value



2.4 Setting the step mode

The inputs M0, M1 and M2 sets the step mode of the STSPIN820 driver as listed in the table below.

Table 3. Step mode selection

M2	M1	M0	Mode
LOW	LOW	LOW	Full step
LOW	LOW	HIGH	½ step
LOW	HIGH	LOW	¼ of step
LOW	HIGH	HIGH	1/8th of step
HIGH	LOW	LOW	1/16 th of step
HIGH	LOW	HIGH	1/32 nd of step
HIGH	HIGH	0	1/128 th of step
HIGH	HIGH	HIGH	1/256 th of step

3 Schematic, layout and bill of material

Figure 3. Schematic

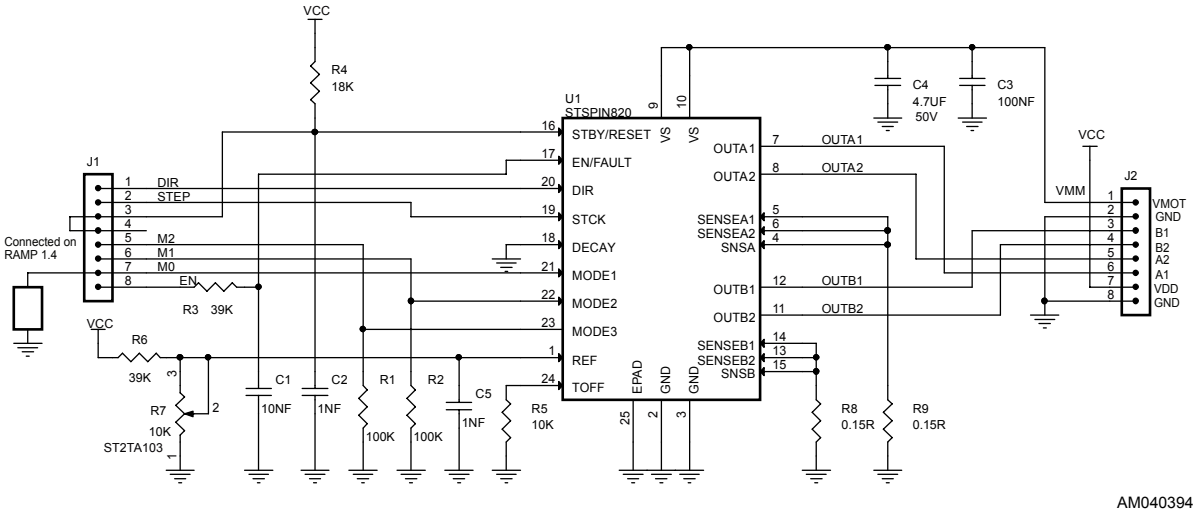


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Figure 4. Layout top

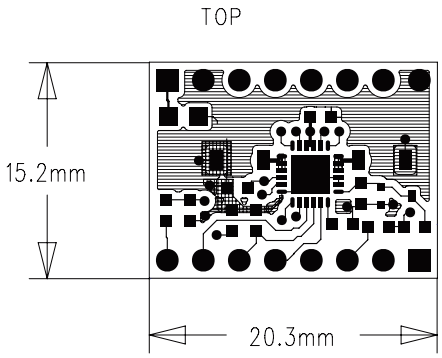

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Figure 5. Layout bottom

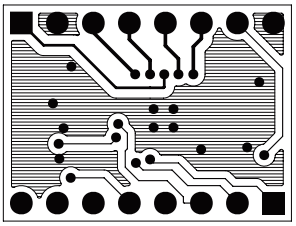

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Table 4. Bill of material

Item	Qty.	Ref.	Part/ value	Voltage/ watt/ ampere	Tolerance	Package	Manufacturer	Orderable part number
1	1	C1	10 NF	50 V	0.15	0603		
2	2	C2, C5	1 NF	50 V	0.15	0603		
3	1	C3	100 NF	100 V	0.15	0603		
4	1	C4	4.7 UF	50 V	0.15	0805		
5	2	J1, J2	61300811121				WURTH ELECTRONIK	61300811121
6	2	R1, R2	100 K	1/10 W	0.05	0603		
7	2	R3, R6	39 K	1/10 W	0.05	0603		
8	1	R4	18 K	1/10 W	0.05	0603		
9	1	R5	10 K	1/10 W	0.05	0603		
10	1	R7	10 K	1/10 W	0.2	L2.75_W2.2_H0.8	BOURNS	TC42X-2-103
11	2	R8, R9	0.15 R	1/2 W	0.01	1206		
12	1	U1	STSPIN820			QFN24_L4_W4_P0.5	ST	STSPIN820

Revision history

Table 5. **Document revision history**

Date	Version	Changes
28-Jun-2018	1	Initial release.

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