Getting started with the X-NUCLEO-IHM14A1 stepper motor driver expansion board based on STSPIN820 for STM32 Nucleo
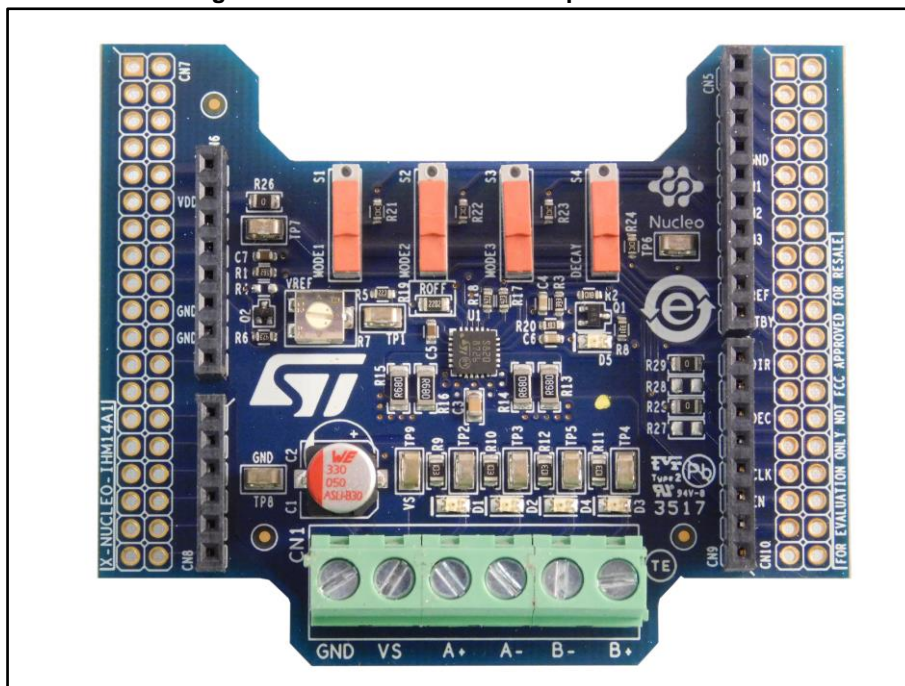
Introduction

The X-NUCLEO-IHM14A1 motor driver expansion board is based on the STSPIN820 monolithic driver for stepper motors.

It represents an affordable, easy-to-use solution for driving stepper motors in your STM32 Nucleo project, implementing motor driving applications such as 2D/3D printers, robotics and security cameras.

The STSPIN820 implements a PWM current control with constant OFF time adjustable via an external resistor and a microstepping resolution up to the 256th step.

The X-NUCLEO-IHM14A1 expansion board is compatible with the Arduino UNO R3 connector and the ST morpho connector, so it can be plugged to the STM32 Nucleo development board and stacked with additional X-NUCLEO expansion boards.

Figure 1: X-NUCLEO-IHM14A1 expansion board

Contents

List of tables

List of figures

1 Getting started

1.1 Board overview

The X-NUCLEO-IHM14A1 expansion board for STM32 Nucleo is a stepper motor driver covering a wide range of applications.

The key features are:

- Operating voltage: 7 to 45 V
- Output current up to 1.5 A$_{rms}$
- Fine tuning microstepping up to the 256th step
- Current control with adjustable OFF time
- Full protection set:
  - Overcurrent protection
  - Short-circuit protection
  - Under voltage lock out
  - Thermal shutdown
- Compatible with Arduino UNO R3 connector
- Compatible with STM32 Nucleo boards
- RoHS compliant

1.2 Hardware and software requirements

To use the STM32 Nucleo development boards with the X-NUCLEO-IHM14A1 expansion board, the following software and hardware specifications are required:

- a PC with Microsoft Windows ® (XP, Vista, 7, 8 and 10) to install the software package (X-CUBE-SPN4)
- an STM32 Nucleo development board
- a type A to Mini-B USB cable to connect the STM32 Nucleo board to the PC
- the X-CUBE-SPN4 software package (available on *www.st.com*)
- an IDE among:
  - IAR Embedded Workbench for ARM (EWARM)
  - Keil microcontroller development kit (MDK-ARM)
  - System Workbench for STM32 (SW4STM32)
- a stepper motor with compatible and current ratings for the STSPIN820 driver
- an external power supply or external battery suitable for the stepper motor used

1.3 Board setup

1.3.1 Using the X-NUCLEO-IHM14A1 expansion board with an STM32 Nucleo

When used with an STM32 Nucleo board, to set up the X-NUCLEO-IHM14A1 expansion board:

1   Check the jumper position on the basis of your configuration (refer to *Section 2.1: "X-NUCLEO-IHM14A1 expansion board switches, connectors and pins"*)

2   Connect the X-NUCLEO-IHM14A1 to the STM32 Nucleo board via the Arduino UNO R3 connectors (CN5, CN6, CN8 and CN9).

3   Power the board through the CN1 connector inputs 5 (VS) and 6 (GND).

The D5 (red) LED turns on.

4   Develop your project using the sample applications bundled with the X-CUBE-SPN14 software package.[a]

1.3.2   Using the X-NUCLEO-IHM14A1 expansion board alone

The X-NUCLEO-IHM14A1 expansion board is able to drive a stepper motor without an STM32 Nucleo board. The following equipment is required:

- a suitable external power supply (or battery) for the stepper motor used, connected between CN1 connector pins 5 (VS) and 6 (GND)
- a secondary power supply providing 3.3 V (recommended) or 5 V, connected between TP3 (VDD) and TP6 or TP8 (GND)
- a waveform generator providing the signal step clock, connected between CN9 (CLK line) connector pin 4 and TP6 or TP8 (GND)[b]
- a stepper motor connected to the motor phase CN1 connector (A+, A-, B+, B-)

1.3.2.1   Operating mode

You can adjust the following application parameters:

- **Step mode**: to set the desired step mode through the position of S1, S2 and S3 switches as listed in *Table 1: "S1, S2, S3 step mode switches"*[c]
- **Decay mode** and **OFF time**: to set the decay mode current recirculation through the position of switch S4 *Table 2: "S4 step mode switches"* and the OFF time changing the R9 resistor value[d]
- **Motor torque** (according to the motor requirements): to set the voltage value at the STSPIN820 REF input using the R7 trimmer (the maximum value is 0.5 V with VDD = 3.3 V).
- **Motor speed**: to be adjusted through the step clock signal frequency

---

[a] Further details on the STSPIN820 and other STM32 Nucleo support material are available on *www.st.com*.

[b] Refer to the STSPIN820 datasheet for amplitude and frequency limits.

[c] Refer to the step mode selection table in the STSPIN820 datasheet.

[d] Refer to the PWM current control section in the STSPIN820 datasheet.

Table 1: S1, S2, S3 step mode switches

S1 - MODE1	S2 - MODE2	S3 - MODE3	Step mode
			Full step
			½ step
			¼ step
			1/8th step
			1/16th step
			1/32nd step
			1/128th step
			1/256th step

Table 2: S4 step mode switches

S4	Decay mode
	Mixed decay
	Slow decay

2 Hardware description and configuration

2.1 X-NUCLEO-IHM14A1 expansion board switches, connectors and pins

Figure 2: X-NUCLEO-IHM14A1 expansion board: switches and connectors
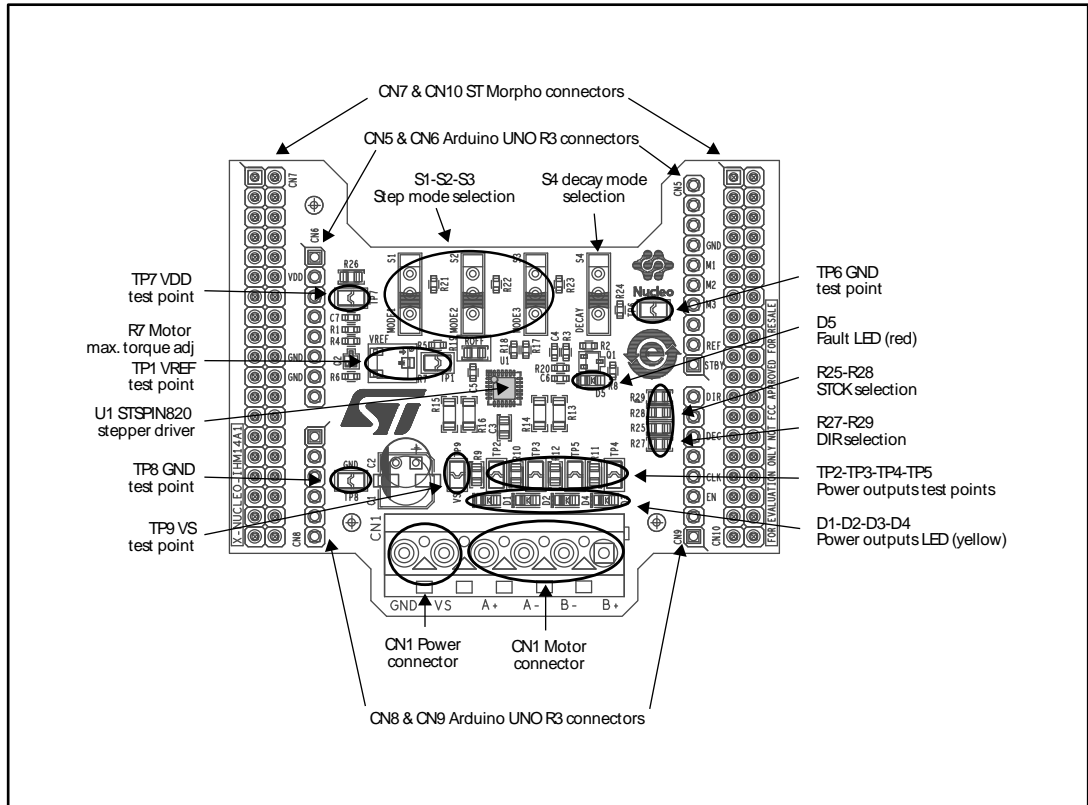
Table 3: Arduino UNO R3 connector description

Connector	Pin	Signal
CN5	1	STBY
	2	REF
	4	MODE3
	5	MODE2
	6	MODE1
	7	Ground
CN9	3	EN_FAULT
	4[1]	STCK1
	5[1]	DIR2
	6	DECAY
	7[1]	STCK1
	8[1]	DIR1

Connector	Pin	Signal
CN6	2	VDD
	6	Ground
	7	Ground

Notes:

[1] Refer to *Section 2.2: "Selecting the STSPIN820 direction and step clock lines"*

All the non-listed pins are not connected.

Table 4: ST morpho connector description

Connector	Pin	Signal
CN10	9	Ground
	11	MODE1
	13	MODE2
	15	MODE3
	19	REF
	21	STBY
	23[1]	DIR1
	25[1]	STCK2
	27	DECAY
	29[1]	DIR2
	31[1]	STCK1
	33	EN_FAULT
CN7	12	VDD
	20	Ground
	22	Ground

Notes:

[1] Refer to *Section 2.2: "Selecting the STSPIN820 direction and step clock lines"*

All the non-listed pins are not connected.

Table 5: CN1 connector, switches and test point description

Name	Pin	Label	Description
CN1	5 - 6	VS - GND	Motor power supply
	1 ÷ 4	B+, B-, A-, A+	Motor phases connection
S1, S2, S3	-	MODE1, 2, 3, 4	Step mode selection (stand-alone operation)
S4	-	DECAY	Decay mode current recirculation (stand-alone operation)
TP1	-	VREF	Reference voltage
TP2, TP3, TP4, TP5	-	OUT A+, A-, B+, B-	Power bridge outputs
TP6, TP8		GND	Ground
TP7		VDD	Digital power supply (by default 3.3 V coming from the STM32 Nucleo board)
TP9	-	VS	Motor power supply

2.2 Selecting the STSPIN820 direction and step clock lines

The STSPIN820 direction and step clock lines can be selected via dedicated resistors as listed in the following tables.

Table 6: Direction selection

Signal	R29	R27	Connector	Remarks
DIR1	0 Ω	Not mounted	CN9 pin 8	Default
DIR2	Not mounted	0 Ω	CN9 pin 5	

Table 7: Step clock selection

Signal	R25	R28	Connector	Remarks
STCK1	0 Ω	Not mounted	CN9 pin 4	Default
STCK2	Not mounted	0 Ω	CN9 pin 7	

3 Schematic diagram

Figure 3: X-NUCLEO-IHM14A1 circuit schematic
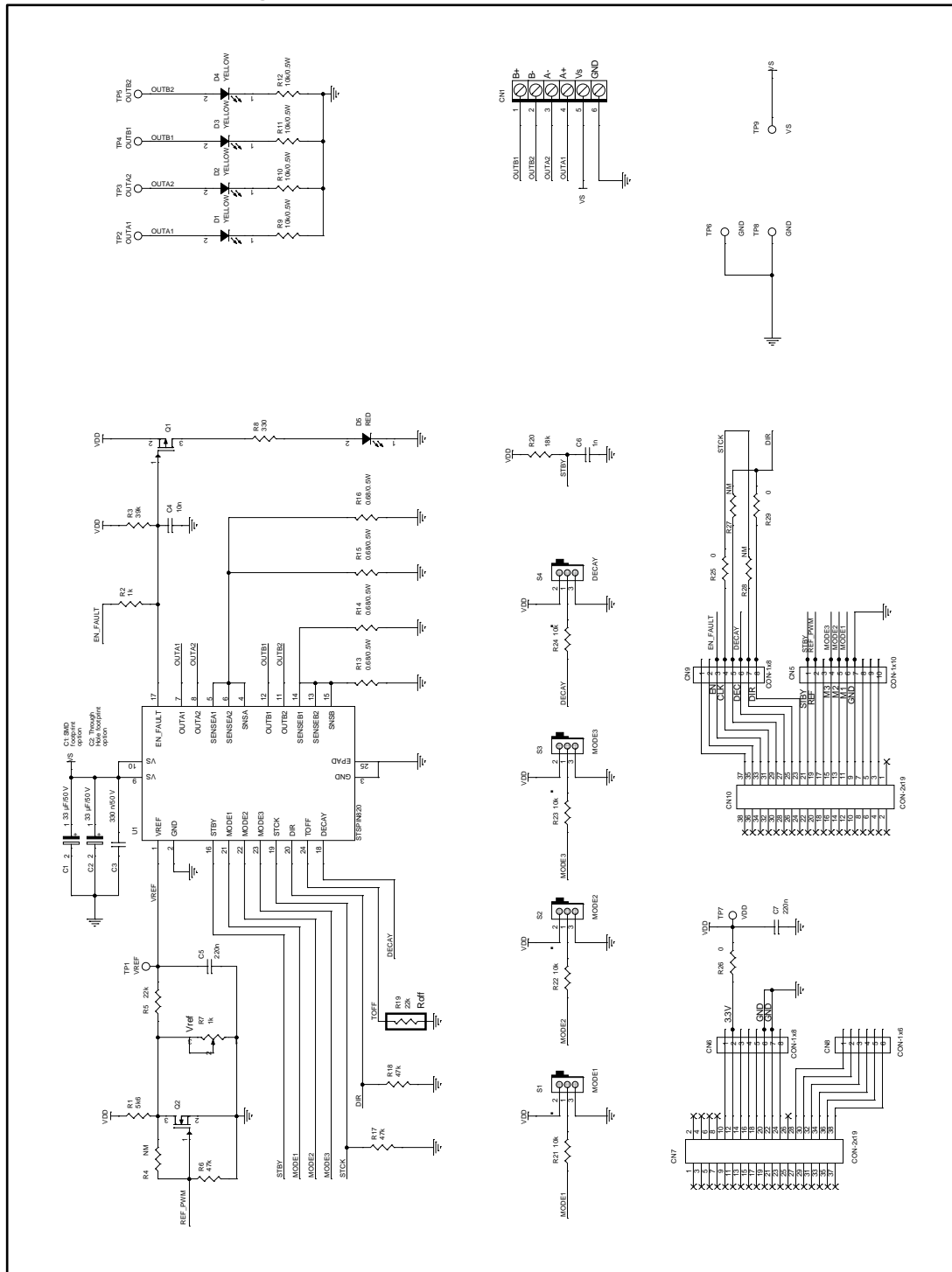
4 Bill of materials

Table 8: X-NUCLEO-IHM14A1 expansion board bill of materials

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	CN1	MKDS1/6-5.08 MORSV-508-6P	Capacitor	Phoenix Contact	
2	2	CN7, CN10	CON-2x19 STRIP254P-M-19X2	Capacitors	Samtec	SSQ-119-04-L-D (Do not mount)
3	2	CN6, CN9	CON-1x8 STRIP254P-F-8	Capacitors	Samtec	SSQ-108-04-F-S
4	1	CN5	CON-1x10 STRIP254P-F-10	Capacitor	Samtec	SSQ-110-04-F-S
5	1	CN8	CON-1x6 STRIP254P-F-6	Capacitor	Samtec	SSQ-106-04-F-S
6	1	C1	33 µF/50 V SMD	Capacitor	Wurth Elektronik	865080645010
7	1	C2	33 µF/50 V - DNM	Capacitor		
8	1	C3	330 n/50 V 0805	Capacitor		
9	1	C4	10 n 0603	Capacitor		
10	2	C5, C7	220 n 0603	Capacitors		
11	1	C6	1 n 0603	Capacitor		
12	4	D1, D2, D3, D4	805	Yellow LEDs	Wurth Elektronik	150080YS75000
13	1	D5	805	Red LED	Wurth Elektronik	150080RS75000
14	1	Q1	NX3008PBKW		NPX	
15	1	Q2	NTA4001N		ONSemiconductors	
16	1	R1	5k6 0603	Resistor		
17	1	R2	1 k 0603	Resistor		
18	1	R3	39 k 0603	Resistor		
19	1	R4	DNM	Resistor		
20	1	R5	22 k 0603	Resistor		
21	3	R6, R17, R18	47 k 0603	Resistors		
22	1	R7	1 k	Resistor	Bourns	3223J
23	1	R8	330, 0603	Resistor		
24	4	R9, R10, R11, R12	10 k/0.5 W 0805	Resistors		

25	4	R13, R14, R15, R16	0.68/0.5 W 1206	Resistors	Yageo	RL1206FR-7W0R68L
26	1	R19	22 k 0805	Resistor		
27	1	R20	18 k 0603	Resistor		
28	4	R21, R22, R23, R24	10 k 0603	Resistors		
29	3	R25, R26, R29	0 0805	Resistors		
30	2	R27, R28	DNM	Resistors		
31	1	S1	MODE1	Switch	Wurth Elektronik	
32	1	S2	MODE2	Switch	Wurth Elektronik	
33	1	S3	MODE3	Switch	Wurth Elektronik	
34	1	S4	DECAY	Switch	Wurth Elektronik	
35	1	TP1	VREF SMD	Test point	Harwin	S1751 Series
36	1	TP2	OUTA1 SMD	Test point	Harwin	S1751 Series
37	1	TP3	OUTA2 SMD	Test point	Harwin	S1751 Series
38	1	TP4	OUTB1 SMD	Test point	Harwin	S1751 Series
39	1	TP5	OUTB2 SMD	Test point	Harwin	S1751 Series
40	2	TP6, TP8	GND SMD	Test points	Harwin	S1751 Series
41	1	TP7	VDD SMD	Test point	Harwin	S1751 Series
42	1	U1	STSPIN820		ST	

5 Revision history

Table 9: Document revision history

Date	Version	Changes
17-Oct-2017	1	Initial release.

IMPORTANT NOTICE – PLEASE READ CAREFULLY