Getting started with the X-NUCLEO-IHM15A1 dual brush DC motor driver expansion based on STSPIN840 for STM32Nucleo

Introduction

The X-NUCLEO-IHM15A1 dual brush DC motor driver expansion board is based on the STSPIN840 for STM32 Nucleo.

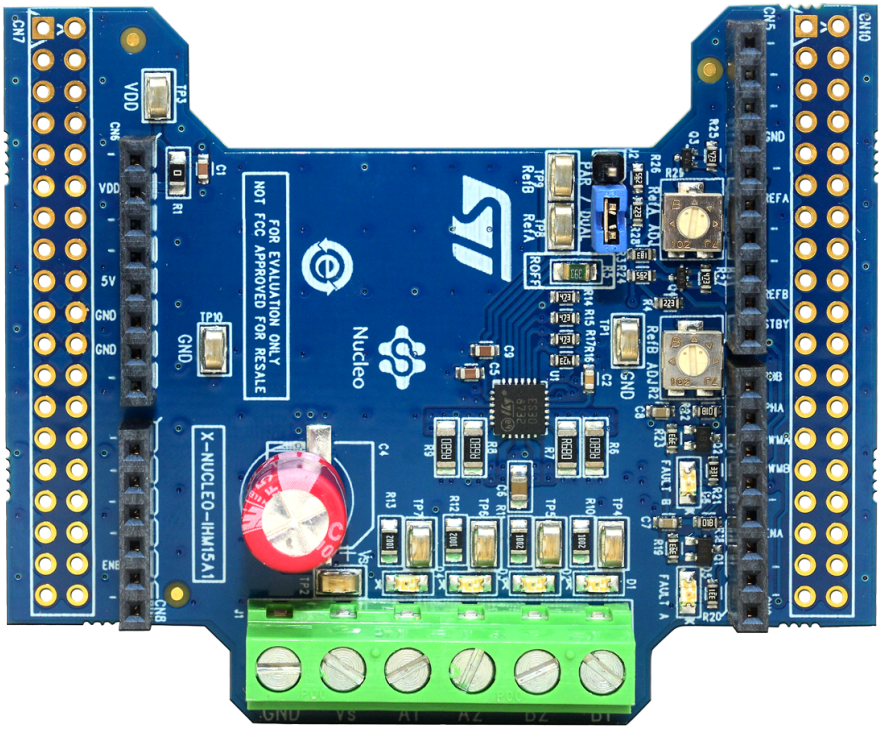
It provides an affordable and easy-to-use solution for the implementation of compact motor driving applications such as thermal printers, robotics and toys.

Thanks to the parallel operation, it can be easily converted to a single brush DC driver with double current capability.

The current limiters and complete set of protection features make it suitable for rugged applications.

The X-NUCLEO-IHM15A1 is compatible with the Arduino UNO R3 connector and most STM32 Nucleo boards.

Figure 1. X-NUCLEO-IHM15A1 expansion board



1 Hardware and software requirements

The main features of the X-NUCLEO-IHM15A1 expansion board are:

- Voltage range from 7 to 45 V
- Output current up to 1.5 A_{rms} for each motor
- Two independent current limiters with adjustable OFF time
- Full protection set including: overcurrent, short-circuit, under voltage lock out and thermal shutdown
- Parallel operation
- Compatible with Arduino UNO R3 connector
- Compatible with STM32 Nucleo boards

To use the STM32 Nucleo development boards with the X-NUCLEO-IHM15A1 expansion board, the following software and hardware specifications are required:

- an STM32 Nucleo development board (NUCLEO-F401RE, NUCLEO-F334R8 or NUCLEO-F030R8)
- an X-NUCLEO-IHM15A1 expansion board
- the X-CUBE-SPN15 software package (available on www.st.com)
- a PC/laptop with Microsoft Windows (7 and above) to install the software package (X-CUBE-SPN15)
- a type A USB to mini-B USB cable to connect the STM32 Nucleo board to the PC/laptop
- an IDE chosen from among IAR Embedded Workbench for ARM (EWARM), Keil microcontroller development kit (MDK-ARM) and system workbench for STM32 Nucleo project
- up to two dual brush DC motors with compatible voltage and current ratings for the STSPIN840 driver
- an external power supply able to provide the right voltage for the DC motor used

2 Safety precautions

Danger:

Some of the components mounted on the board could reach hazardous temperature during operation.

While using the board:

- Do not touch the components
- 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

3 Getting started

The X-NUCLEO-IHM15A1 expansion board is a dual brush DC motor driver covering a wide range of applications.

The maximum ratings of the expansion board are:

- power stage supply voltage (VS) from 7 to 45 V
- motor phase current up to 1.5 A_{rms}

To start your project with the expansion board:

Step 1. Check the jumper position based on your configuration.

Step 2. Connect the X-NUCLEO-IHM15A1 to the STM32 Nucleo board through Arduino UNO R3 connectors (CN5, CN6, CN8 and CN9).

Step 3. Supply the board through the input 5 (Vin) and 6 (GND) of the connector J1.

The D5 and D6 LEDs (red) turn on.

Step 4. Develop your application using the examples provided with the firmware library (X-CUBE-SPN15).

Visit www.st.com for supporting material regarding the STSPIN840 dual brush DC motor driver and www.st.com/stm32nucleo.

4 Hardware description and configuration

Figure 2. **X-NUCLEO-IHM15A1 switch and connector positions**

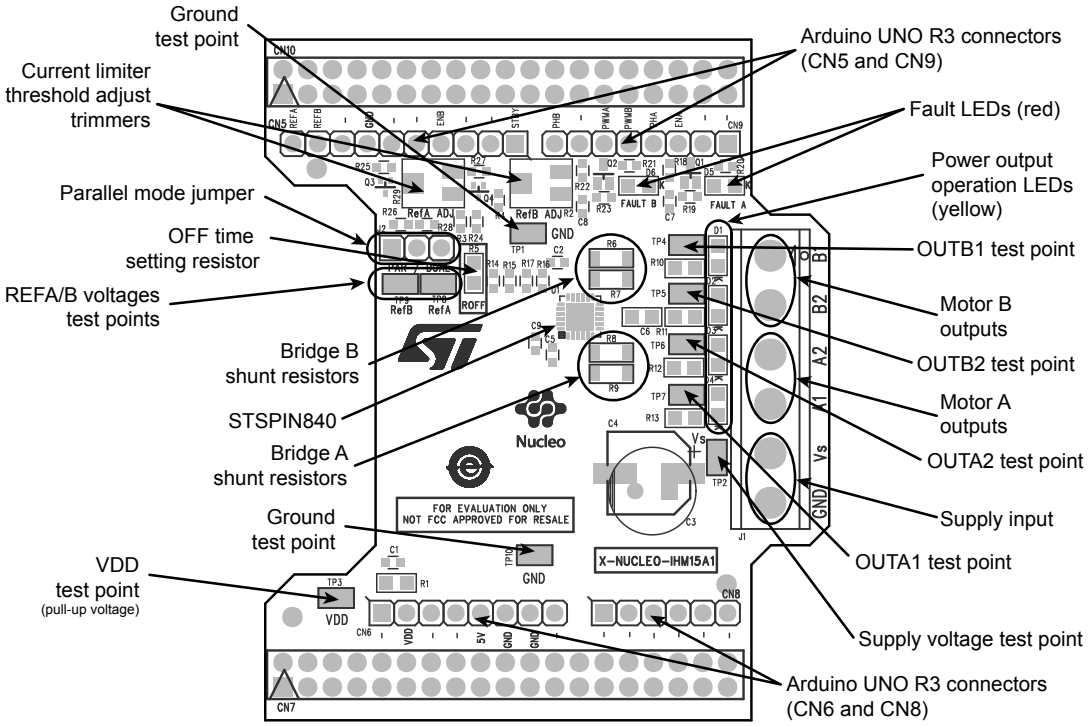


Table 1. **Arduino UNO R3 connector table**

Connector	Pin(1)	Signal	Description
CN5	1	STBY	Active low standby signal
	4	EN/FAULTB	Enable/Fault signal for motor B
	7	Ground	
	9	REF_PWM_B	PWM reference signal for current limiter B
	10	REF_PWM_A	PWM reference signal for current limiter A
CN6	2	VDD	Pull-up voltage from Nucleo board (3.3 V)
	6	Ground	
	7	Ground	
CN9	3	EN/FAULTA	Enable/Fault signal for motor A
	4	PHA	Phase (direction) signal for motor A
	5	PWMB	PWM signal for motor B
	6	PWMA	PWM signal for motor A
	8	PHB	Phase (direction) signal for motor B

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

Table 2. **J1 connector, switches and test points**

Name	Pin	Label	Description
J1	5-6	VIN-GND	Motor power supply
	1-2	B+, B-	Motor B phase connection
	3-4	A-, A+	Motor A phase connection
TP1, TP10	-	GND	Ground
TP2	-	VIN	Motor power supply
TP3	-	VDD	Digital power supply (by default 3.3 V coming from STM32 Nucleo board)
TP4, TP5, TP6, TP7	–	-	OUTB1, OUTB2, OUTA2, OUTA1 power outputs
TP8	-	REFA	Threshold of current limiter A
TP9	-	REFB	Threshold of current limiter B

4.1 Selecting the STM32 Nucleo board

The X-NUCLEO-IHM15A1 expansion board offers native support for the following STM32 Nucleo development boards:

- NUCLEO-F401RE
- NUCLEO-F334R8
- NUCLEO-F030R8

4.2 Adjusting the off-time and the thresholds of the current limiters

The STSPIN840 integrates two current limiters, one for each full bridge.

The bridge current is sensed through the voltage drop across an external shunt resistor connected between the source of the low side power MOSFET (SENSEx pins) and the ground.

The current limiter compares the voltage of the SNSA and SNSB pins to the respective reference voltage pin (REFA and REFB). When VSNSX > VREFX, the control logic turns on both the low-side MOSFETs of the power stage for a period adjusted through the pull-down resistor connected to the TOFF pin.

In the X-NUCLEO-IHM15A1 board, both a trimmer and a PWM signal from the Nucleo board adjust the current limit thresholds:

$$I_{peak} = \frac{V_{REF}}{R_{SHUNT}} = \frac{V_{DD} \times \left(\frac{R_{trim}}{R_{trim} + 5.6\ k\Omega}\right) \times PWMDC}{0.34\ \Omega} \quad (1)$$

The R5 resistor adjusts the off-time of both limiters; the value mounted by default on the board sets a duration of about 40 µs.

5 Bill of materials

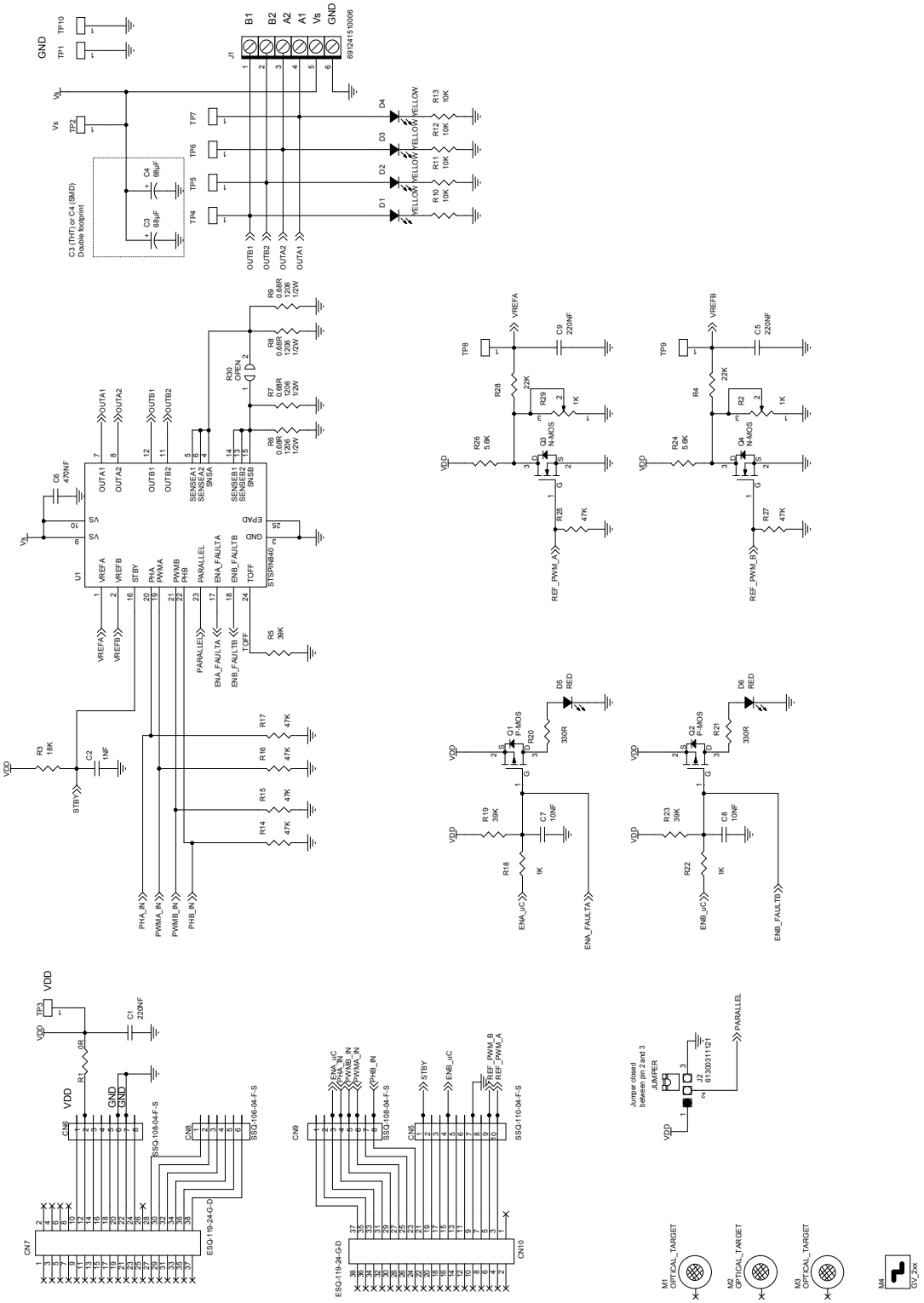
Table 3. **X-NUCLEO-IHM15A1 bill of materials**

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	CN5	SSQ-110-04-F-S	Header	Samtec	SSQ-110-04-F-S
2	2	CN6, CN9	SSQ-108-04-F-S	Header	Samtec	SSQ-108-04-F-S
3	2	CN7, CN10	ESQ-119-24-G-D	Header (D.N.M)	Samtec	ESQ-119-24-G-D
4	1	CN8	SSQ-106-04-F-S	Header	Samtec	SSQ-106-04-F-S
5	1	C1	220 NF 50 V ±10% 0603 X7R	Ceramic capacitor	Any	Any
6	1	C2	1 NF 50 V ±15% 0603 X5R	Ceramic capacitor	Any	Any
7	1	C3	68 µF 50 V ±20% D8_H11.5_P3	Capacitor (D.N.M)	Wurth Elektronik	860080674007
8	1	C4	68 µF 50 V ±20% D8_H10.5	ALU CMS	Wurth Elektronik	865080653015
9	2	C5, C9	220 NF 35 V ±15% 0603 X7R	Ceramic capacitors	Any	Any
10	1	C6	470 NF 100 V ±15% 0805 X7R	Ceramic capacitor	Any	Any
11	2	C7,C8	10 NF 50 V ±15% 0603 X7R	Ceramic capacitors	Any	Any
12	4	D1, D2, D3, D4	YELLOW 0805	LED	Wurth Elektronik	150080YS75000
13	2	D5, D6	RED 0805	LED	Wurth Elektronik	150080RS75000
14	1	JUMPER	BLACK	Jumper	Wurth Elektronik	60900213621
15	1	J1	691241510006	Screw	Wurth Elektronik	691241510006
16	1	J2	61300311121	Header (closed 2-3)	Wurth Elektronik	61300311121
17	2	Q1, Q2	P-MOS SOT323	CMS	NXP	NX3008PBKW
18	2	Q3, Q4	N-MOS SOT416	CMS	Onsemi	NTA4001NT1G
19	1	R1	0 R 1/8 W ±5% 0805	Resistor	Any	Any
20	2	R2, R29	1 K 1/4 W ±20% L5_W5_H2.55	Trimmer	Bourns	3314J-1-102E
21	1	R3	18 K 1/10 W ±5% 0603	Resistor	Any	Any
22	2	R4, R28	22 K 1/10 W ±5% 0603	Resistors	Any	Any
23	1	R5	39 K 1/8 W ±5% 0805	Resistor	Any	Any
24	4	R6, R7, R8, R9	0.68 R 1/2 W ±1% 1206	Resistors	Yageo (Phycomp)	RL1206FR-7W0R68 L
25	4	R10, R11, R12, R13	10 K 1/2 W ±5% 0805	Resistors	Any	Any

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
26	6	R14, R15, R16, R17, R25, R27	47 K 1/10 W ±5% 0603	Resistors	Any	Any
27	2	R18, R22	1 K 1/10 W ±5% 0603	Resistors	Any	Any
28	2	R19, R23	39 K 1/10 W ±5% 0603	Resistors	Any	Any
29	2	R20, R21	330 R 1/10 W ± 5% 0603	Resistors	Any	Any
30	2	R24, R26	5.6 K 1/10 W ±5% 0603	Resistors	Any	Any
31	1	R30	OPEN SOLDER_BRIDGE	Resistor	Any	Any
32	10	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10	S1751-46R	Test poiints	Harwin	S1751-46R
33	1	U1	STSPIN840	Dual brush DC motor driver	ST	STSPIN840

6 X-NUCLEO-IHM15A1 schematic diagram

Figure 3. **X-NUCLEO-IHM15A1 circuit schematic**



Revision history

Table 4. **Document revision history**

Date	Revision	Changes
16-May-2018	1	Initial release.

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