UM2082
User manual

Getting started with X-NUCLEO-IHM06A1 low voltage stepper motor driver expansion board based on STSPIN220 for STM32 Nucleo
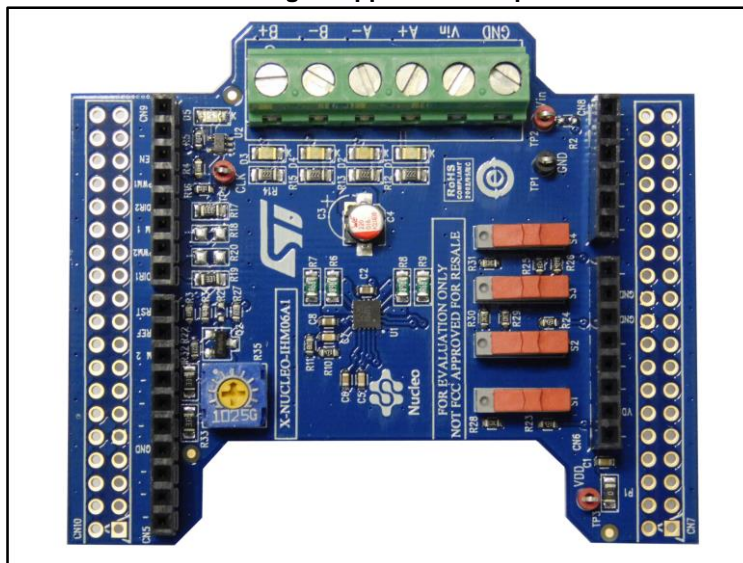
Introduction

The X-NUCLEO-IHM06A1 is a low voltage stepper motor driver expansion board based on the STSPIN220 monolithic low voltage driver for low voltage stepper motors. It represents an affordable, easy-to-use solution for driving low voltage stepper motors in your STM32 Nucleo project, implementing portable motor driving applications such as thermal printers, robotics and toys.

It includes a stepper driver able to operate in low voltage (battery) scenarios, allowing zero consumption states. The device implements current control with fixed OFF time and a maximum 1/256 microstep resolution.

The X-NUCLEO-IHM06A1 is compatible with the Arduino UNO R3 connector and supports the addition of other STM32 expansion boards with a single STM32 Nucleo board. You can also mount the ST morpho connector.

Figure 1: X-NUCLEO-IHM06A1 low voltage stepper motor expansion board based on STSPIN220

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1 X-NUCLEO-IHM06A1 board overview

The X-NUCLEO-IHM06A1 expansion board for STM32 Nucleo is a low voltage stepper motor driver covering a wide range of applications.

The key features are:

- Low voltage range: 1.8 to 10 V
- Microstep adjustment up to the 256th step
- Phase current: up to 1.3 A$_{RMS}$
- Current control with adjustable off-time
- Full protection overcurrent and short circuit protection
- Thermal shutdown
- Compatible with Arduino UNO R3 connector
- Compatible with STM32 Nucleo boards
- RoHS compliant

2 Getting started

2.1 Hardware and software requirements

Using STM32 Nucleo boards with the X-NUCLEO-IHM06A1 expansion board requires the following software and hardware:

- 1 x Windows PC (XP, Vista 7 ,Win 8, Win 10) to install the software package
- 1 x Low voltage stepper motor driver expansion board (X-NUCLEO-IHM06A1)
- 1 x STM32 Nucleo development board (NUCLEO-F401RE or NUCLEO-F334R8 or NUCLEO-F030R8 or NUCLEO-L053R8)
- 1 x USB type A to mini-B USB cable to connect the STM32 Nucleo board to the PC
- X-CUBE-SPN6 software package (available on www.st.com)
- 1 x IDE among:
    - IAR Embedded Workbench for ARM (EWARM)
    - Keil microcontroller development kit (MDK-ARM)
    - system workbench for STM32 Nucleo project
- 1 x stepper motor with compatible voltage and current ratings for the STSPIN220 driver
- 1 x external power supply or external battery suitable for the stepper motor used.

2.2 Using the X-NUCLEO-IHM06A1 expansion board with the STM32 Nucleo board

The X-NUCLEO-IHM06A1 board is compatible with following STM32 Nucleo development boards:

- NUCLEO-F401RE
- NUCLEO-F334R8
- NUCLEO-F030R8
- NUCLEO-L053R8

To start your project:

1. Check the jumper position based on your configuration (see *Section 5: "Hardware description and configuration"*).
2. Connect the X-NUCLEO-IHM06A1 with the STM32 Nucleo board through Arduino UNO R3 Connectors (CN5, CN6, CN8, CN9).
3. Supply the board through the input 5 (Vin) and 6 (ground) of the J1 connector. The D5 (red) LED turns on.
4. Develop your application using the sample applications bundled with the X-CUBE-SPN6 software package.

Further STSPIN220 and STM32 Nucleo support material is available on *www.st.com*.

2.3 Using the X-NUCLEO-IHM06A1 expansion board alone

The X-NUCLEO-IHM06A1 expansion board is able to drive a low voltage stepper motor without an STM32 Nucleo board.

2.3.1 Hardware connections and equipment

- A suitable external power supply or external battery for the stepper motor used, connected between J1 connector pin 5 (Vin) and pin6 (ground)
- A secondary supply from one of the following sources:
  - An external power supply providing 3.3 V (recommended), connected between TP3 (+VDD) and TP1 (ground).
  - If a secondary power supply is not available, you can connect the VDD net to the Vin supply voltage by adding the R2 resistor (not mounted by default); in this configuration, Vin must be lower than 5 V.

> In both cases, the R4 resistor must be replaced with a 10 kΩ resistor (recommended value) for a VDD below 2.5 V.

- A waveform generator providing the signal step clock, connected between TP4 (CLK test point) and TP1 (GND); refer to the STSPIN220 datasheet for amplitude and frequency limits
- Stepper motor connect to J1 motor phase connector (A+, A-, B+, B-).

2.3.2 Operating mode

You can adjust the following parameters:

- **Step mode**: set the desired step mode via the S1, S2, S3 and S4 switches (refer to the step mode selection table in the STSPIN220 datasheet)
- **Motor torque** (according motor requirements): using the R35 trimmer, you can set the voltage value at REF input of STSPIN220 (the maximum value is 0.5 V with VDD = 3.3 V).
- **Motor speed**: you can change this parameter through the step clock signal frequency.

3 Hardware description and configuration

The PCB silkscreen image below shows the position of the connectors and the configuration switches of the board.

Figure 2: Switch and connector positions
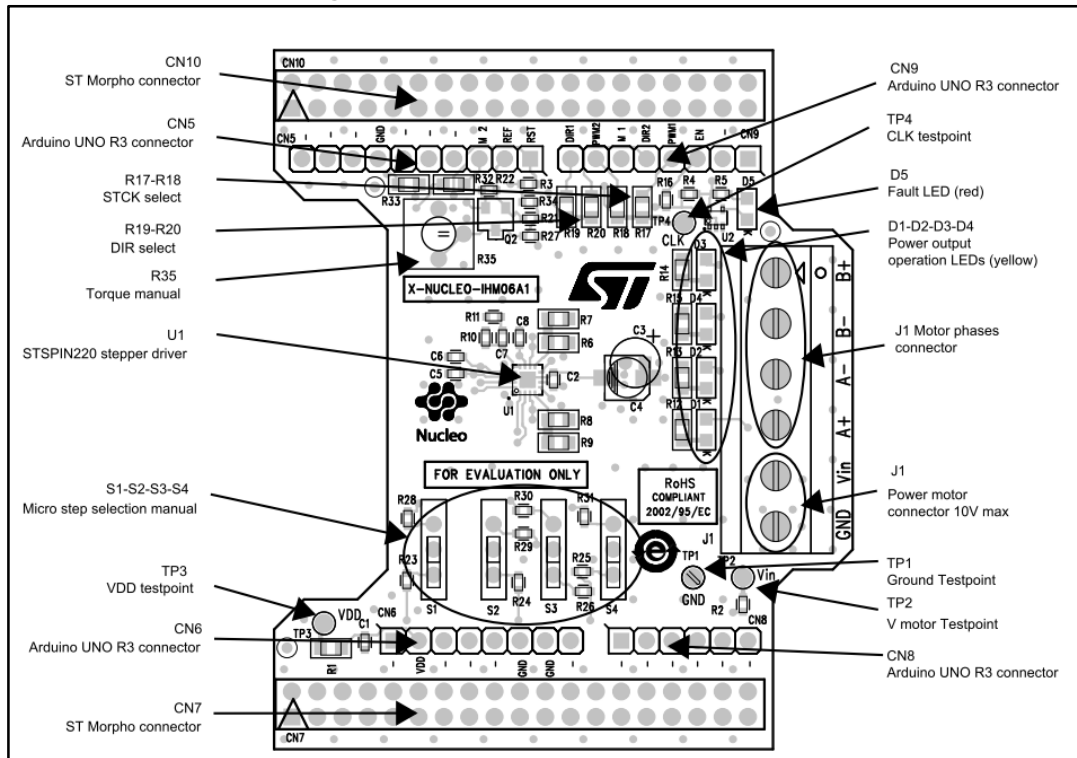
The following table provides the detailed pinout of the Arduino UNO R3 and ST morpho connectors.

Table 1: Arduino UNO R3 connector table

Connector	Pin[1]	Signal	Remarks
CN5	1	RESET	
	2	REF	
	3	MODE 2	
	7	Ground	
CN9	3	ENABLE	
	4	PWM1	See *Section 5.1: "Selecting direction and step clock lines"*
	5	DIR 2	See *Section 5.1: "Selecting direction and step clock lines"*
	6	MODE 1	
	7	PWM2	See *Section 5.1: "Selecting direction and step clock lines"*
	8	DIR 1	See *Section 5.1: "Selecting direction and step clock lines"*
CN6	2	VDD	
	6	Ground	
	7	Ground	

Notes:

[1]unlisted pins are not connected

Table 2: ST morpho connector table

Connector	Pin[1]	Signal	Remarks
CN10	9	Ground	
	17	MODE 2	
	19	REF	
	21	RESET	
	23	DIR 1	See *Section 5.1: "Selecting direction and step clock lines"*
	25	PWM2	See *Section 5.1: "Selecting direction and step clock lines"*
	27	MODE 1	
	29	DIR 2	See *Section 5.1: "Selecting direction and step clock lines"*
	31	PWM1	See *Section 5.1: "Selecting direction and step clock lines"*
	33	ENABLE	
CN7	12	VDD	
	20	Ground	
	22	Ground	

Notes:

[1]unlisted pins are not connected

Table 3: J1 connector, switches and test point descriptions

Name	Pin	Label	Description
J1	5 - 6	Vin - GND	Motor power supply
	1 - 4	A+, A-, B+, B-	Motor phases connection
S1, S2, S3, S4	-	MODE1, 2, 3, 4	Step mode selection (stand-alone operation)
TP1	-	GND	Ground
TP2	-	VIN	Motor power supply
TP3	-	VDD	Digital power supply (by default 3.3 V coming from STM32 Nucleo board)
TP4	-	CLK	Step clock line

3.1 Selecting direction and step clock lines

The direction and the step clock lines of STSPIN220 can be selected through dedicated resistors indicated in the following tables.

Table 4: Direction selection

Signal	R19	R20	Connector	Remarks
DIR1	330 Ω	Not mounted	CN9 pin8	Default
DIR2	Not mounted	330 Ω	CN9 pin5	

Table 5: Step clock selection

Signal	R17	R18	Connector	Remarks
PWM1	330 Ω	Not mounted	CN9 pin4	Default
PWM2	Not mounted	330 Ω	CN9 pin6	

Ensure that these signals are used by all the stacked X-NUCLEO-IHM06A1 boards

4   Bill of materials

Table 6: Bill of materials

Part reference	Part value	Part description
CN5	CONN10	10 pin elevated socket, female, straight two part board connector
CN6, CN9	CONN8	8 pin elevated socket, female, straight two part board connector
CN7, CN10	N.M.	Elevated Socket MORPHO connector 19x2, TH pitch 2.54 mm
CN8	CONN6	6 pin elevated socket, female, straight two part board connector
C1	3.3 nF, 50 V, 15 %	Ceramic Capacitor, SMD 0603
C2	2.2 µF, 16 V 20 %	Ceramic Capacitor, SMD 0603
C3	N. M.	Electrolytic capacitor, TH D5xH11xP2 mm
C4	22 µF, 16 V, 20 %	Aluminum Electrolytic capacitor, SMD L4.5xW4.5 mm
C5	1 nF, 50 V, 15 %	Ceramic Capacitor, SMD 0603
C6	10 nF, 50 V, 15 %	Ceramic Capacitor, SMD 0603
C7	22 nF, 50 V, 5 %	Ceramic Capacitor, SMD 0603
C8	220 Nf, 35 V, 15 %	Ceramic Capacitor, SMD 0603
D1, D2 ,D3, D4	LED	SMD LED (yellow)
D5	LED	SMD LED (red)
J1	Motor Connector	Screw PCB terminal block 1x6
Q2	N-MOS	2N7002 or similar
R1	0 Ω, 5 %, 0.125 W	Resistor, SMD 0805
R2,R21	N.M.	Resistor, SMD 0603
R3	18 kΩ, 5%, 0.1 W	Resistor, SMD 0603
R4	39 kΩ, 5 %, 0.1 W	Resistor, SMD 0603
R5, R16	330 Ω, 5%, 0.1 W	Resistor, SMD 0603
R6, R7, R8, R9	680 mΩ, 1%, 0.33 W	Resistor, SMD 0805
R10, R23, R24, R25, R26	47 kΩ, 5 %, 0.1 W	Resistor, SMD 0603
R11	1 kΩ, 5 %, 0.1 W	Resistor, SMD 0603
R12, R13, R14, R15	2.2 kΩ, 5 %, 0.125 W	Resistor, SMD 0805
R17, R19, R32, R33	330 Ω, 5 %, 0.125 W	Resistor, SMD 0805
R18, R20	N. M.	Resistor, SMD 0805
R22	22 kΩ, 5 %, 0.1 W	Resistor, SMD 0603
R27	22 kΩ, 1 %, 0.1 W	Resistor, SMD 0603
R28, R29, R30, R31	10 kΩ, 5 %, 0.1 W	Resistor, SMD 0603

Part reference	Part value	Part description
R34	5.6 kΩ, 5 %, 0.1 W	Resistor, SMD 0603
R35	1 kΩ, 10 %, 0.5 W	Trimmer, TH L7xW7xH5.8 mm Copal Electronics CT-6EP102 or similar
S1, S2, S3, S4	Slide Switch	2-position switch, L10xW2.5xH6.4 mm
TP1	TPTH-ANELLO-1MM	PCB Test terminal 1 mm (black)
TP2, TP3, TP4	TPTH-ANELLO-1MM	PCB Test terminal 1 mm (red)
U1	STSPIN220	Low voltage stepper motor driver, QFN 3x3 16L
U2	SN74LVC1G125DCKR	Single bus buffer gate with 3-state output, SOT-353

5 Revision history

Table 7: Document revision history

Date	Version	Changes
04-Jul-2016	1	Initial release.

IMPORTANT NOTICE – PLEASE READ CAREFULLY