

Getting started with STM32 Motor Control Nucleo Packs P-NUCLEO-IHM001 and P-NUCLEO-IHM002

Introduction

The Nucleo Packs P-NUCLEO-IHM001 and P-NUCLEO-IHM002 are motor control kits based on X-NUCLEO-IHM07M1 and NUCLEO-F302R8 boards. The power board with ST L6230 DMOS driver, belonging to STPIN family, provides a motor control solution for low-voltage, 3-phase, DC brushless motor with the addition of the STM32 NUCLEO-F302R8 board, connected through the ST morpho connectors (see [Figure 1](#)). The P-NUCLEO-IHM002 Packs comes with a power supply unit (see [Figure 2](#)).

This document describes the hardware environment to build the system and run an application, based on the P-NUCLEO-IHM001 and P-NUCLEO-IHM002 Nucleo Packs.

Figure 1. P-NUCLEO-IHM001 Pack

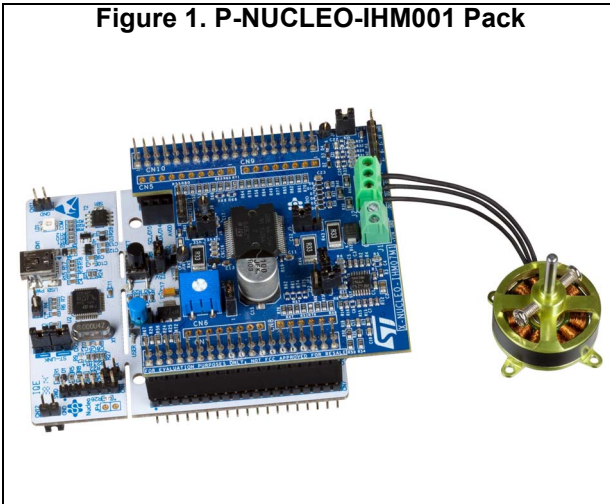


Figure 2. P-NUCLEO-IHM002 Pack



1. Pictures are not contractual.



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1 Getting started

1.1 System architecture

A generic motor control system as the P-Nucleo-IHM001 or the P-Nucleo-IHM002 can be basically schematized as the arrangement of three main blocks (see [Figure 3](#) and [Figure 4](#)):

- **Control block:** its main task is to accept user commands and configuration parameters to drive a motor. The P-Nucleo-IHM001 and the P-NUCLEO-IHM002 Nucleo Packs are based on the NUCLEO-F302R8 board, that provides all digital signals to perform the proper motor driving control algorithm (for instance 6-step or FOC):
 - The original firmware demonstration to reprogram the STM32 MCU of the P-NUCLEO-IHM001, is available in binary file format from the www.st.com website and it is called P-NUCLEO-IHM001.bin.
 - FOC solution is based on the STM32 PMSM FOC SDK software development kit (SDK): STSW-STM32100.
 - 6-step solution is based on 6-step motor control library: X-CUBE-SPN7.
- **Power block:** the X-NUCLEO-IHM07M1 is based on 3-phase inverter topology. The core of the power block embedded on board, is the driver STSPIN L6230, which contains all the necessary active power and analog components, to perform a low- voltage PMSM motor control.
- **PMSM Motor:** low-voltage, 3-phase, brushless motor.

The P-Nucleo-IHM002 has a fourth block:

- **DC Power supply unit:** it provides the power for this Nucleo Pack (12 V, 2 A).

Figure 3. P-NUCLEO-IHM001 Pack main blocks

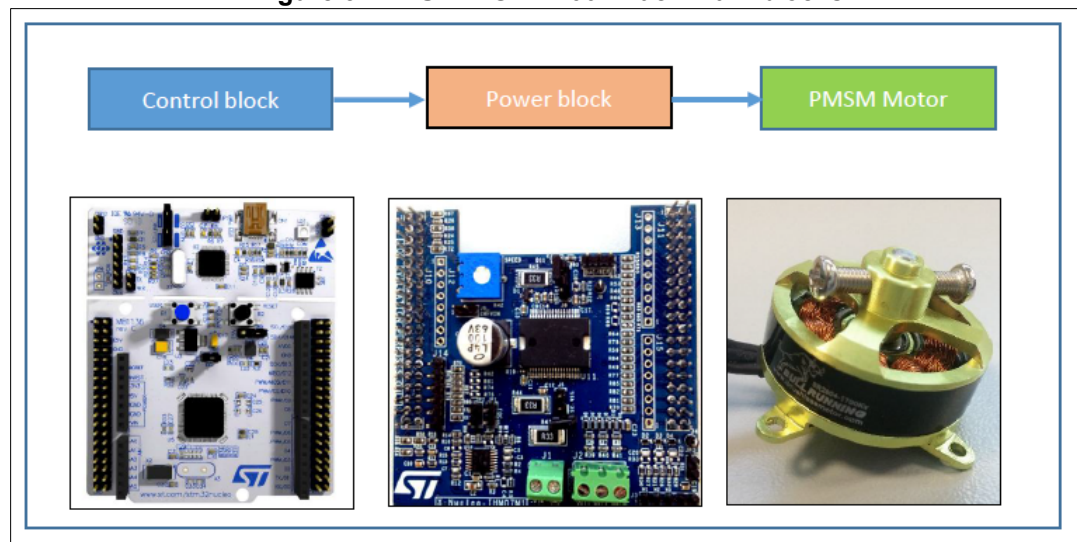
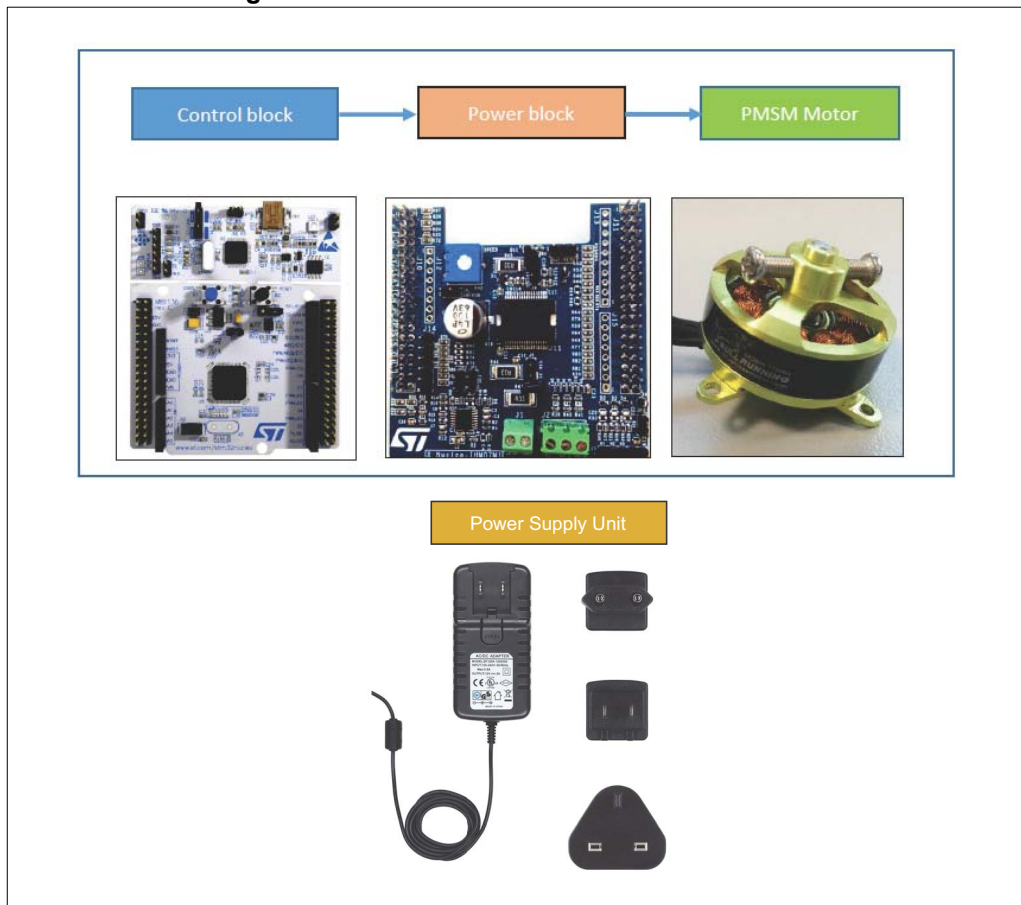


Figure 4. P-NUCLEO-IHM002 Pack main blocks



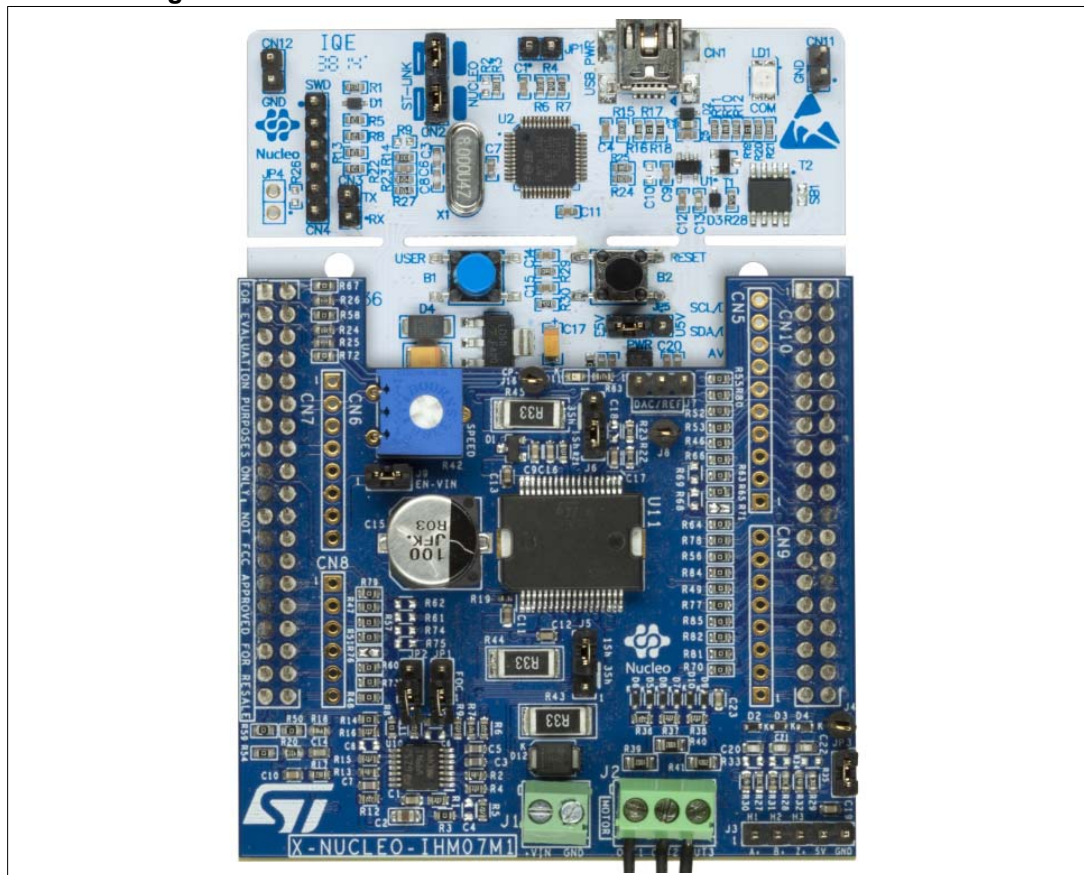
1.2 How to build and run the motor control for the STM32 Nucleo Packs

The Nucleo Packs are complete hardware development platforms for the STM32 Nucleo ecosystem, to evaluate a motor control solution for single motor.

For a regular board operating, follow the hardware configuration explained below:

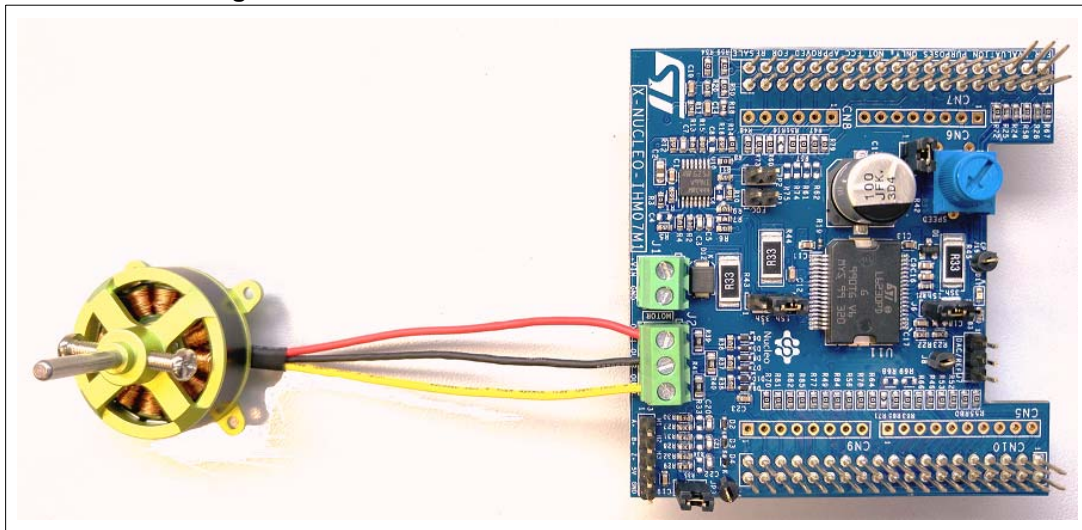
1. The X-NUCLEO-IHM07M1 board must be stacked on the NUCLEO-F302R8 board through the ST morpho connectors. There is only one position allowed for this connection, in particular the two buttons on the NUCLEO-F302R8 board (the blue B1 and the black B2) must be kept out, as shown in [Figure 5](#).

Figure 5. X-NUCLEO-IHM07M1 and NUCLEO-F302R8 assembled



1. The interconnection between the X-NUCLEO-IHM07M1 and the NUCLEO-F302R8 boards has been designed for a full-compatibility with a lot of control board and no modification of solder bridges is required
2. Connect the three motor wires U,V,W at J2 connector as shown in the [Figure 6: Motor connection with X-NUCLEO-IHM07M1](#): it is mandatory to connect the yellow wire to OUT3, the black one to OUT2 and the red one to OUT1, to respect clockwise and counterclockwise motor rotation, according to the firmware implementation.

Figure 6. Motor connection with X-NUCLEO-IHM07M1



3. Select the jumper configuration on the power board to choose the desired control algorithm (6-step or FOC) as described below:
 - a) On the NUCLEO-F302R8 board, check jumper settings: JP1 open, JP5 (PWR) on E5V side, JP6 (IDD) closed.
 - b) On the X-NUCLEO-IHM07M1 expansion board:
 - Check jumper settings: J9^(a) closed, JP3 closed
 - For 6-step control, set jumpers as: JP1 and JP2 open, J5 and J6 on 1Sh side^(a)
 - For FOC control, set jumpers as: JP1 and JP2 closed, J5 and J6 on 3Sh side^(a)

For details refer to [Figure 7: X-NUCLEO-IHM07M1 – top layer with silk-screen](#) and [Figure 8: X-NUCLEO-IHM07M1 connectors](#).

Note: FOC algorithm gives better performance than 6-step.

a. Supply voltage has to be off before changing the control mode.

Figure 7. X-NUCLEO-IHM07M1 – top layer with silk-screen

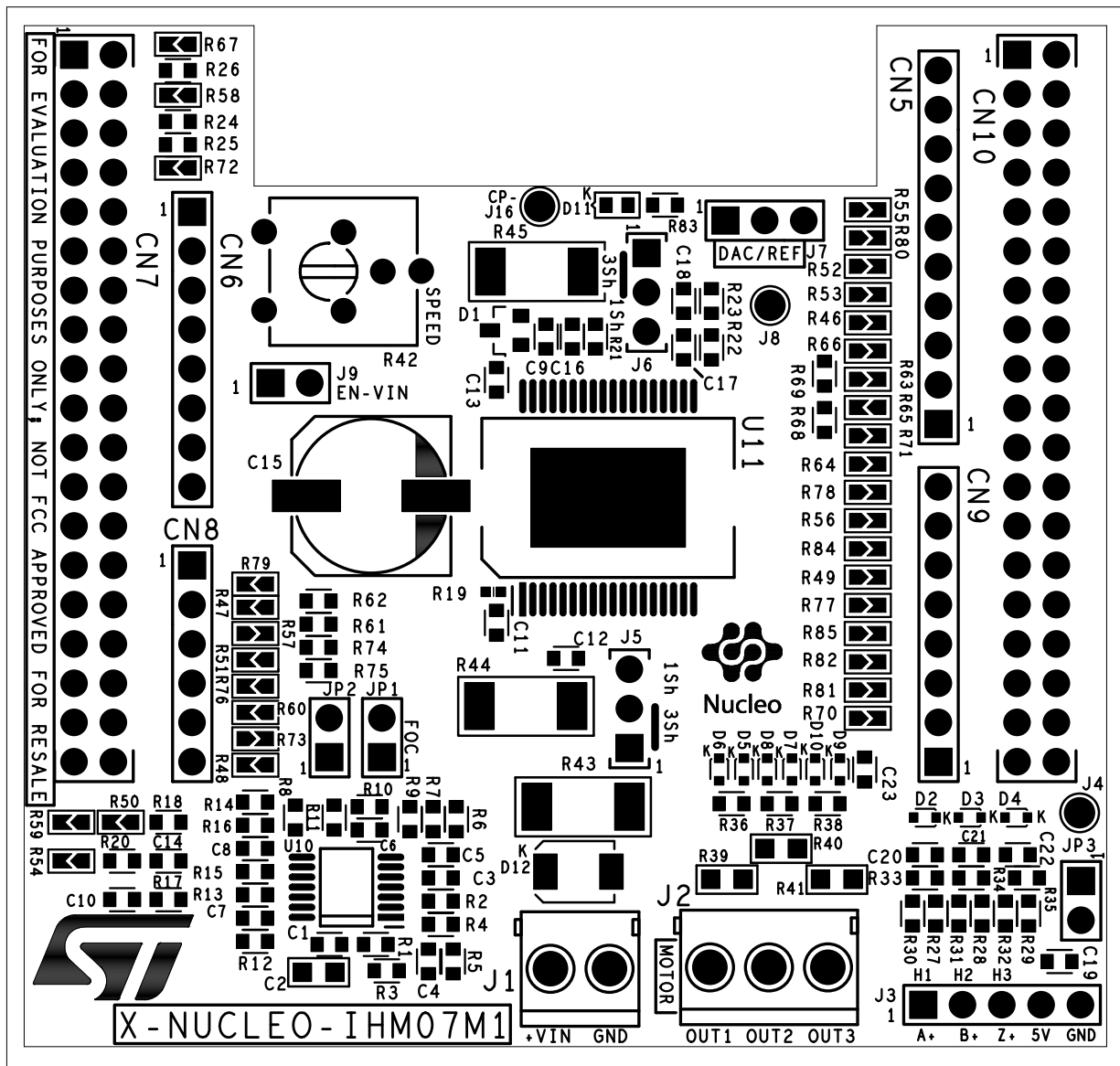


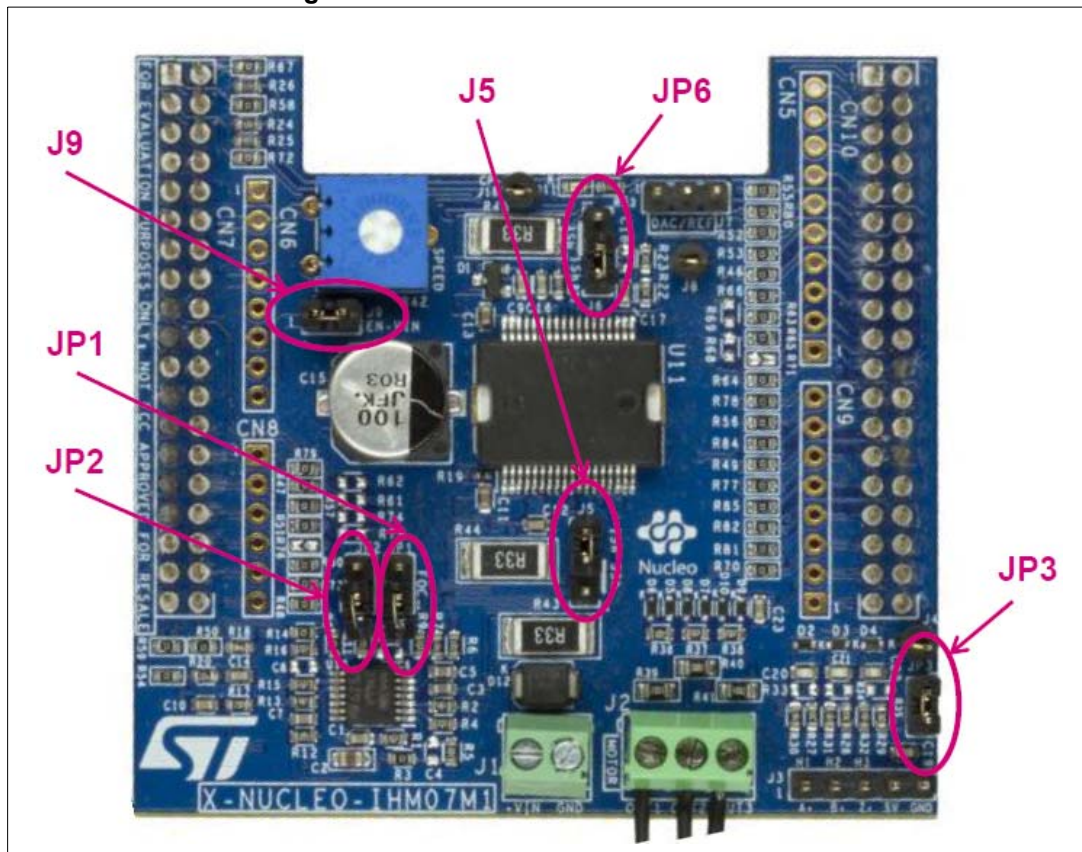
Table 1. Description of the connectors

Part reference	Description
CN7	ST morpho connector
CN6	Arduino UNO connector
CN8	Arduino UNO connector
U11	L6230 driver
U10	TSV994IPT op. amp.
J1	Power supply connector

Table 1. Description of the connectors (continued)

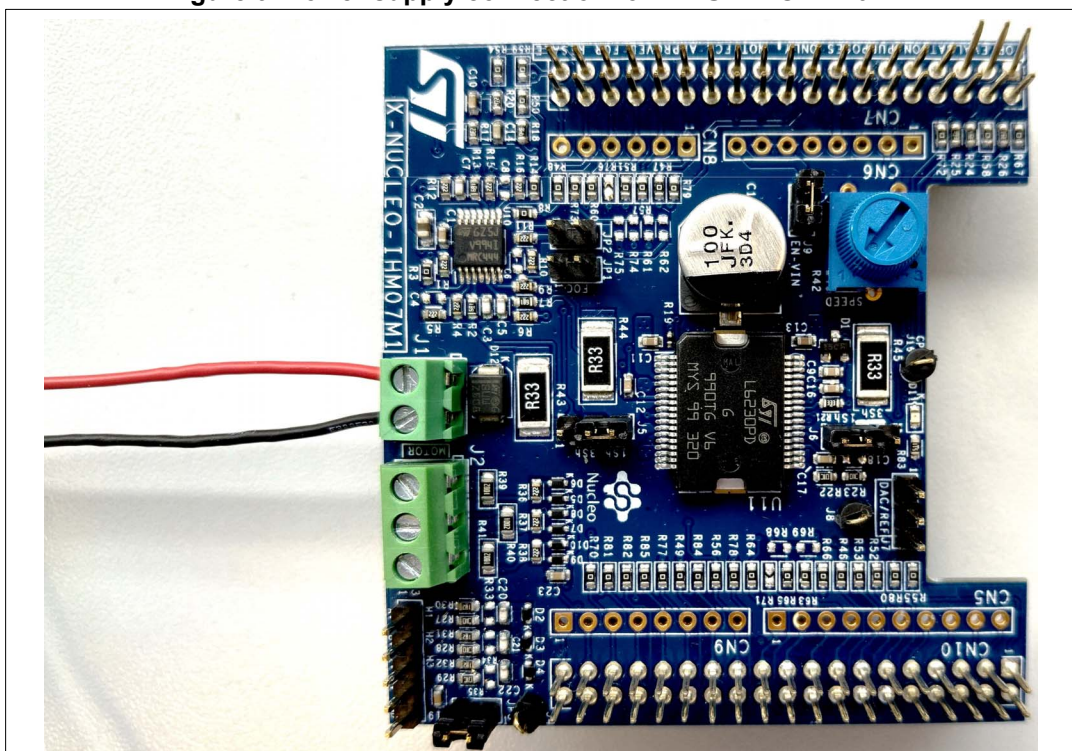
Part reference	Description
J9	Enable VIN supply voltage
JP1, JP2	Jumpers for FOC
SPEED	Potentiometer
CN10	ST morpho connector
CN5	Arduino UNO Connector
CN9	Arduino UNO Connector
J2	Motor connector
J3	Hall/Encoder sensor connector
J7	Debug connector
JP3	External pull-up for sensors
J5, J6	Current measure mode (1Sh/3Sh)
D11	LED status indicator

Figure 8. X-NUCLEO-IHM07M1 connectors



4. Connect the DC power supply on J1^(b) connector and power-on, as shown in [Figure 9: Power supply connection for X-NUCLEO-IHM07M1](#).

Figure 9. Power supply connection for X-NUCLEO-IHM07M1



1. The red cable is VCC, the black one is GND.
5. At power-on (or reset) led D11 on X-NUCLEO-IHM07M1 board starts to blink, according to the control algorithm choice:
 - twice for FOC control mode
 - 4 times for 6-step control mode

After the confirmation of the control algorithm selected, the system is ready to start.

6. Press the blue button (B1) on the NUCLEO-F302R8 board and the motor starts spinning.
7. Rotate the potentiometer on the X-NUCLEO-IHM07M1 board to regulate the motor speed.

For more details refer to “*STM32 Nucleo Packs - Motor Control FOC and 6-step solutions for three-phase, low-voltage and low-current motors*” User manual (UM1945) at the www.st.com website.

- b. For a different motor (>12V) it is mandatory to remove the jumper J9 on power board, before the power-on, to avoid damaging the NUCLEO-F302R8 board. To supply the STM32-NUCLEO from USB, the jumper JP5 must be connected between Pin 1 and Pin 2. For further details on Nucleo settings refer to “*STM32 Nucleo-64 boards*” User manual (UM1724) available from ST web site www.st.com.

2 Revision history

Table 2. Revision history

Date	Revision	Changes
22-Sep-2015	1	Initial version
08-Sep-2016	2	Updated <i>Introduction, Section 1.1: System architecture, Section 1.2: How to build and run the motor control for the STM32 Nucleo Packs</i> to introduce the power supply unit.

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