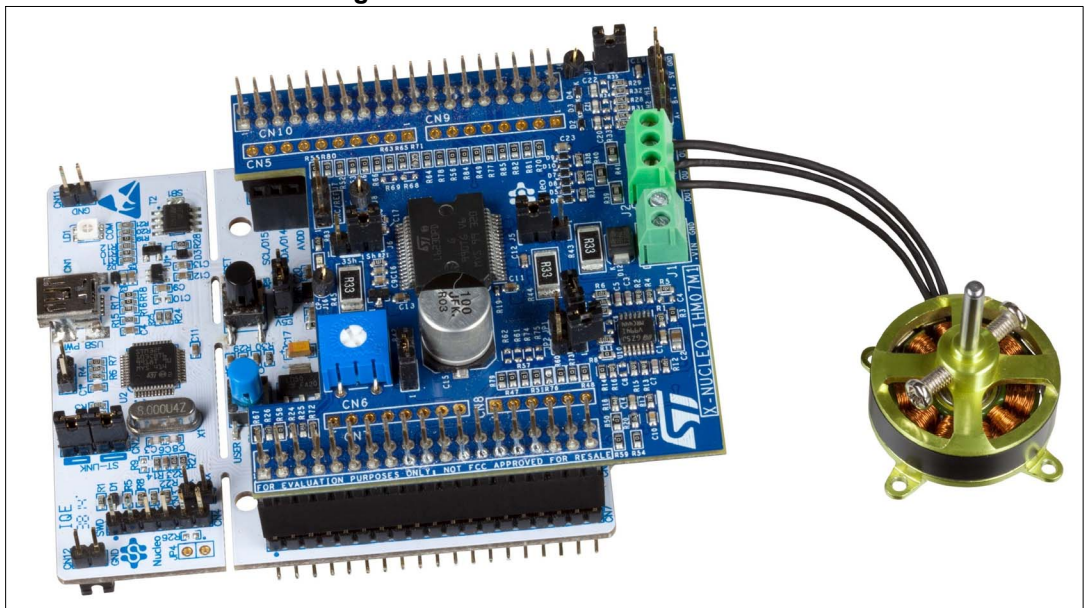


Introduction

The NUCLEO Pack (P-NUCLEO-IHM001) is a motor control kit based on X-NUCLEO-IHM07M1 and NUCLEO-F302R8. 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 STM32 NUCLEO-F302R8 board, connected through ST morpho connectors.

This document describes the hardware environment to build the system and run an application based on the P-NUCLEO-IHM001 motor control kit.

Figure 1. P-NUCLEO-IHM001 Pack



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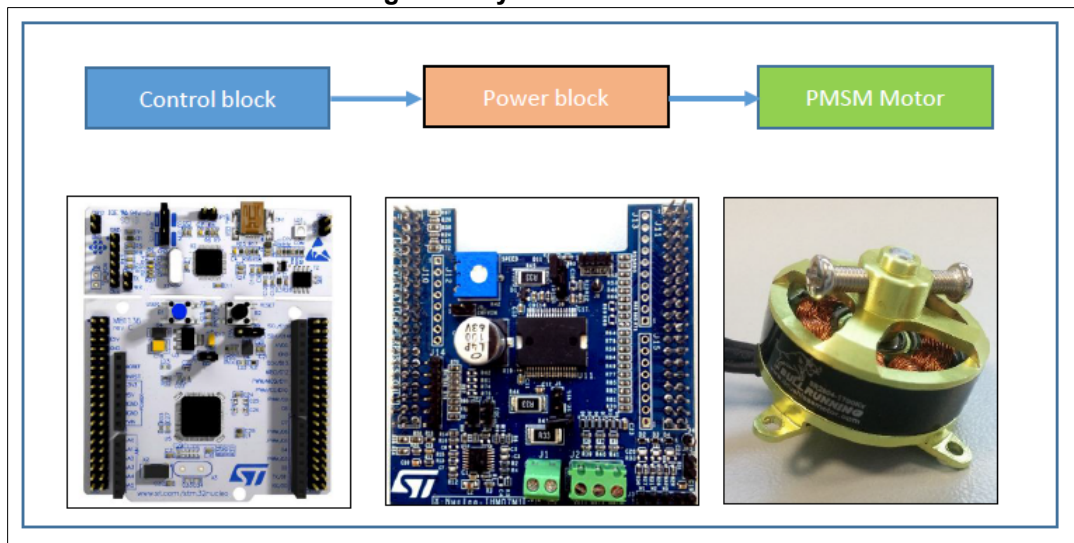
1 Getting started

1.1 System architecture

A generic motor control system can be basically schematized as the arrangement of three main blocks (see [Figure 2: System architecture](#)):

- **Control block:** its main task is to accept user commands and configuration parameters to drive a motor. The P-NUCLEO-IHM001 is based on 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 from ST web site www.st.com, in binary file format 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.

Figure 2. System architecture



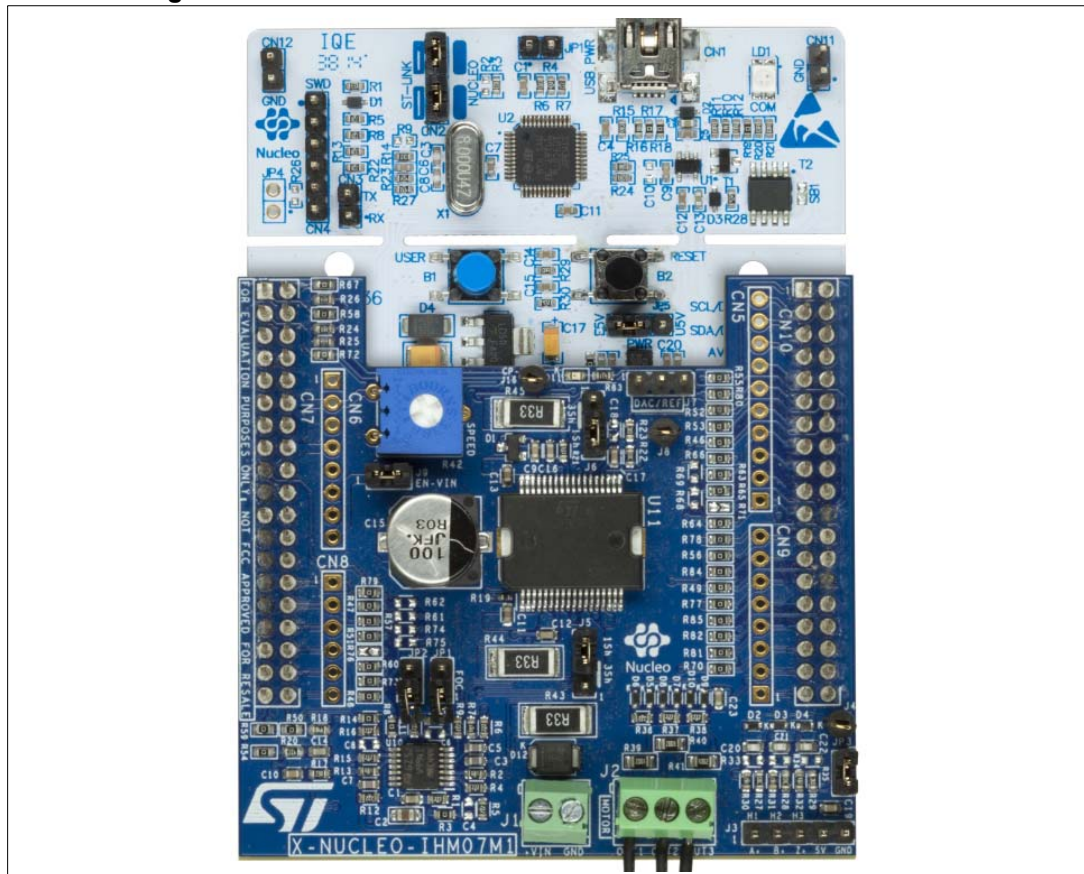
An external power supply (from 8 V min to 12 V max, able to delivered 1 A min) is required to power the kit.

1.2 How to build and run the motor control Nucleo Pack

The P-NUCLEO-IHM001 is a complete hardware development platform (**Power & Control block + Motor**) for STM32 Nucleo ecosystem, to evaluate a motor control solution for single motor. For a regular board operating, follow the hardware configuration shown below:

1. The X-NUCLEO-IHM07M1 must be stacked on the NUCLEO-F302R8^(a) board through the ST morpho connector. There is only one position allowed for this connection, in particular as shown in [Figure 3](#) the two buttons on NUCLEO-F302R8 board (blue B1 and black B2) must be kept out.

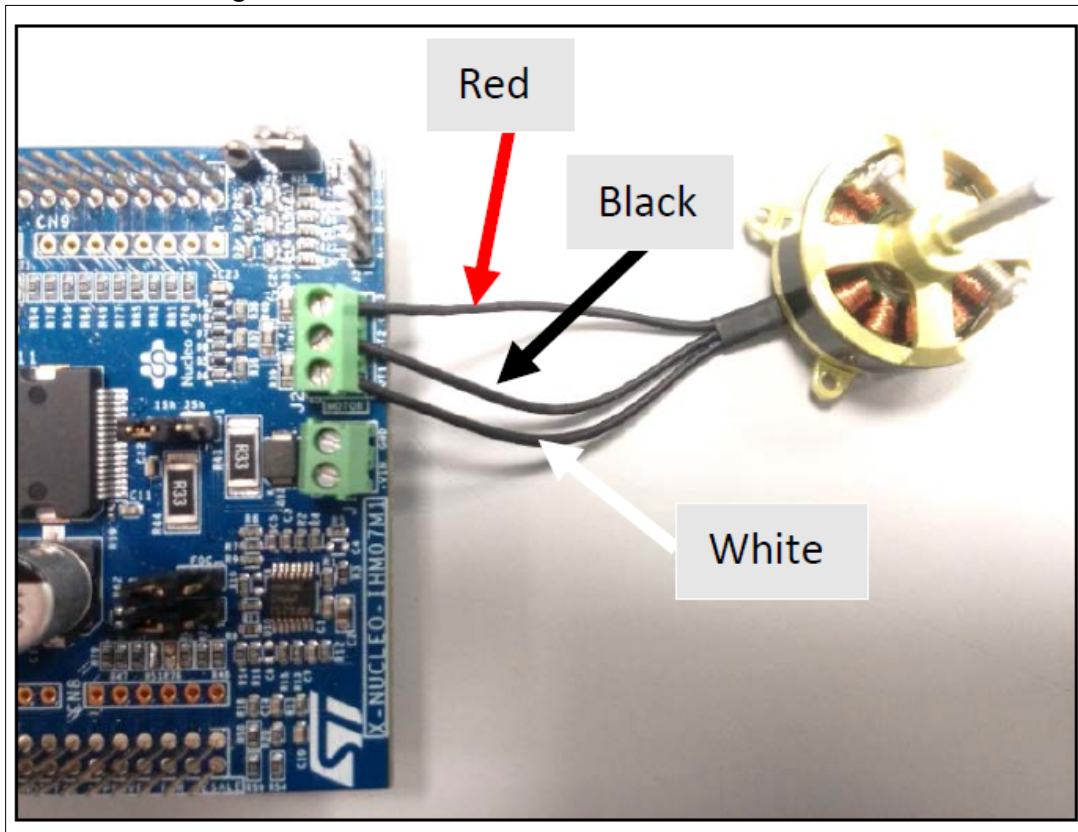
Figure 3. X-NUCLEO-IHM07M1 and NUCLEO-F302R8 assembled



- a. The interconnection between the X-NUCLEO-IHM07M1 and 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 4: Motor connection with X-NUCLEO-IHM07M1](#): it is mandatory to connect the white or yellow wire to OUT1, the black one to OUT2 and the red one to OUT3, to respect clockwise and counterclockwise motor rotation, according to the firmware implementation.

Figure 4. Motor connection with X-NUCLEO-IHM07M1



1. The three motor wires are identified by a colored line, marked on them. The line marked on OUT1 (refer to the white arrow in the above figure) can be white or yellow.
3. Select the jumper configuration on the power board to choose the desired control algorithm (6-step or FOC) as described below:
 - a) On NUCLEO-F302R8 board, check jumper setting: JP1 open, JP5 (PWR) on E5V side, JP6 (IDD) closed.
 - b) On X-NUCLEO-IHM07M1 expansion board:
 - Check jumper settings: J9^(b) closed, JP3 closed
 - For 6-step control, set jumpers as: JP1 and JP2 open, J5&J6 on 1Sh side^(b)
 - For FOC control, set jumpers as: JP1 and JP2 closed, J5&J6 on 3Sh side^(b)

For details refer to [Figure 5: X-NUCLEO-IHM07M1 – top layer with silk-screen](#) and [Figure 6: X-NUCLEO-IHM07M1 connectors view](#).

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

- b. It is important that supply voltage is powered off before control mode changing.

Figure 5. X-NUCLEO-IHM07M1 – top layer with silk-screen

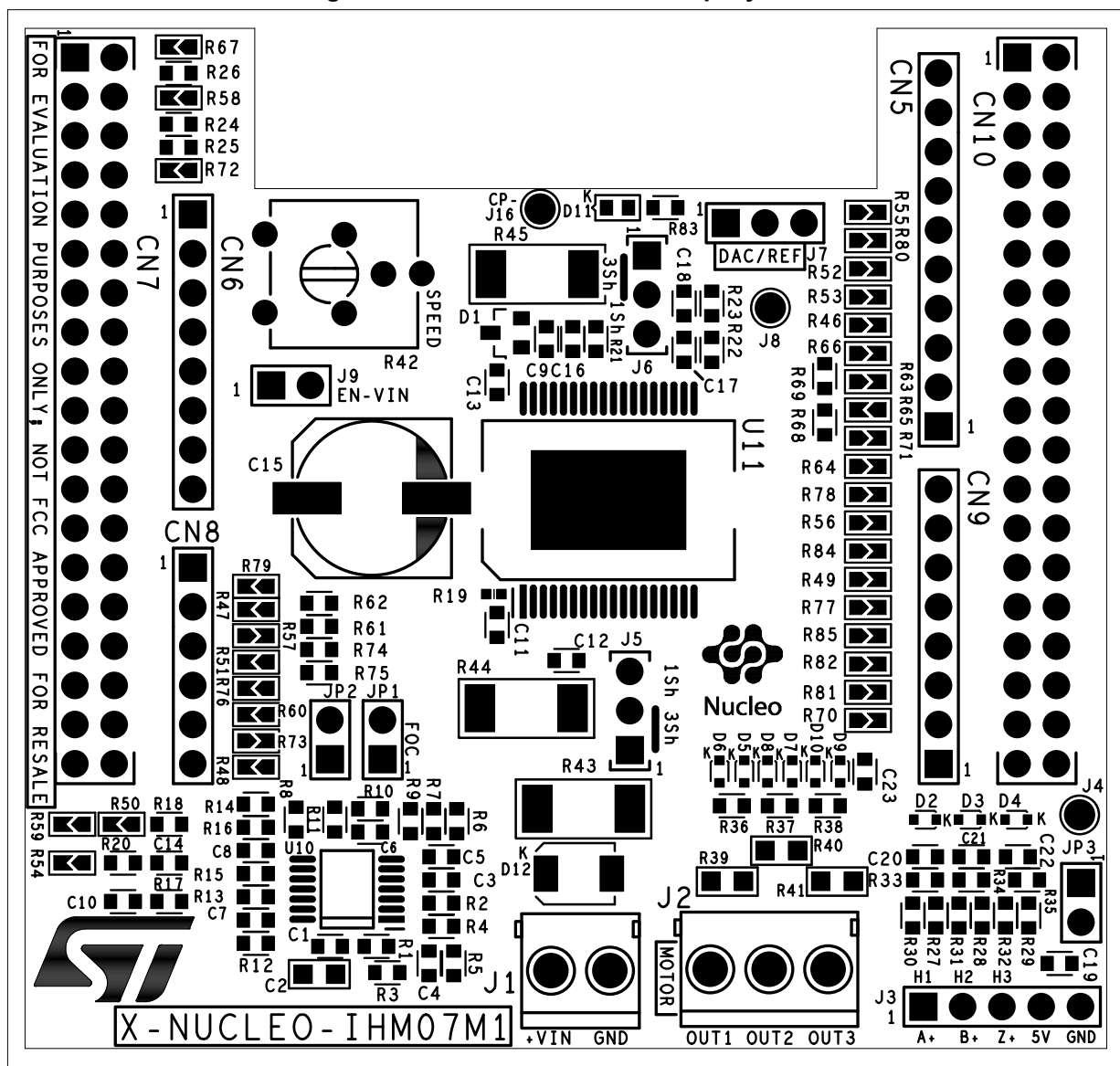


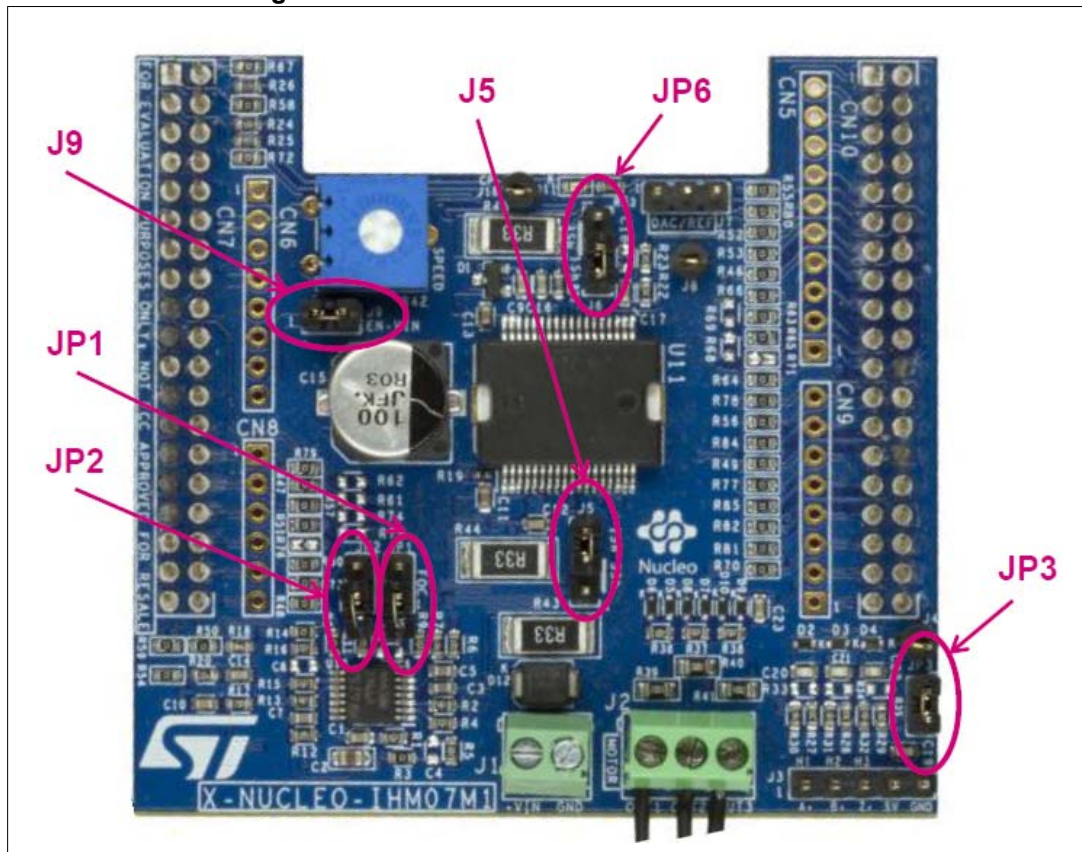
Table 1. Connectors description

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
J9	Enable VIN supply voltage
JP1, JP2	Jumpers for FOC

Table 1. Connectors description (continued)

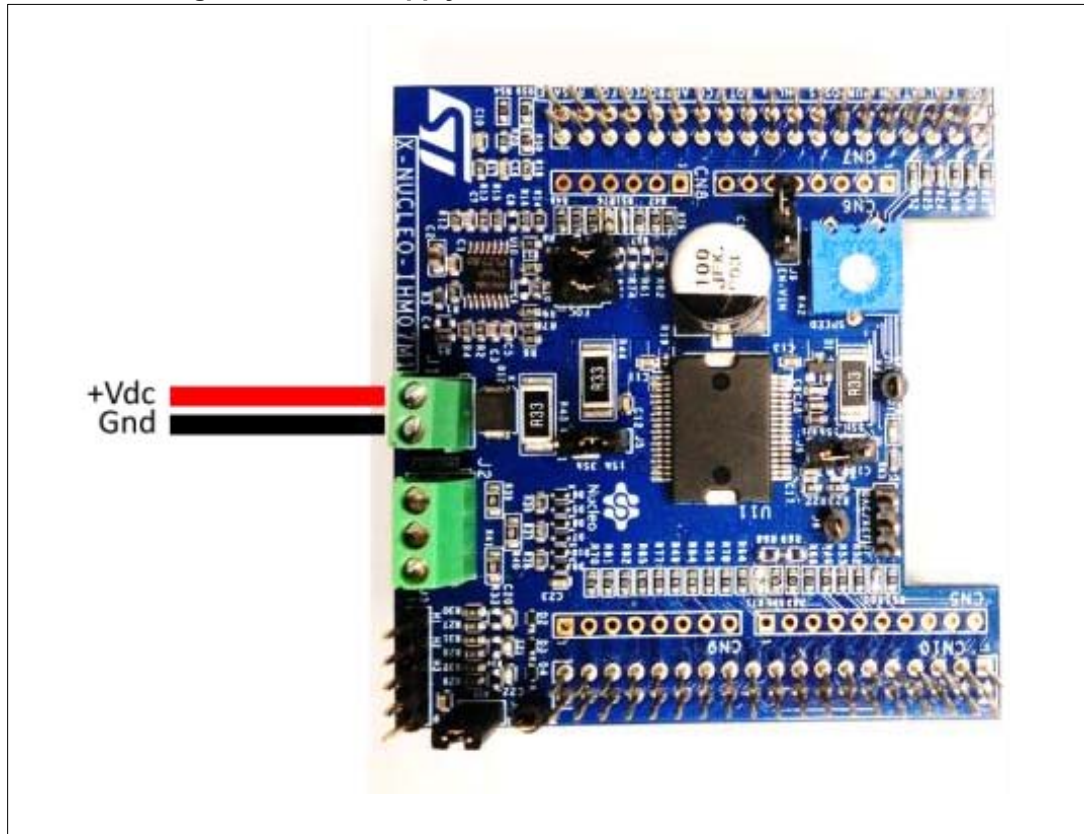
Part reference	Description
SPEED	Potentiometer
CN10	ST morpho connector
CN5	Arduino UNO Connector
CN9	Arduino UNO Connector
J2	Motor connector
J3	Hall/Encoder sensor connector
J7	Debug connector
JP3	External pull-up for sensors
J5, J6	Current measure mode (1Sh/3Sh)
D11	LED status indicator

Figure 6. X-NUCLEO-IHM07M1 connectors view



4. Connect DC supply voltage on J1^(c) connector and power-on (up to 12 V DC for BR2804 motor included in the Pack, as shown in [Figure 7: Power supply connection for X-NUCLEO-IHM07M1](#)).

Figure 7. Power supply connection for X-NUCLEO-IHM07M1



5. At power-on (or reset) led D11 on X-NUCLEO-IHM07M1 board starts to blink, according to the control algorithm choice:
 - 2 times for FOC mode control
 - 4 times for 6-step mode control

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

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

For more details refer to UM1945 at www.st.com website.

-
- c. For a different motor (>12V) it is mandatory to remove the jumper J9 on power board, before the power-on, to avoid to damage the NUCLEO-F302R8 board. To supply the STM32-NUCLEO from USB, the jumper JP5 must be connected between PIN 1 and PIN2. For further details on Nucleo settings refer to 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

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