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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



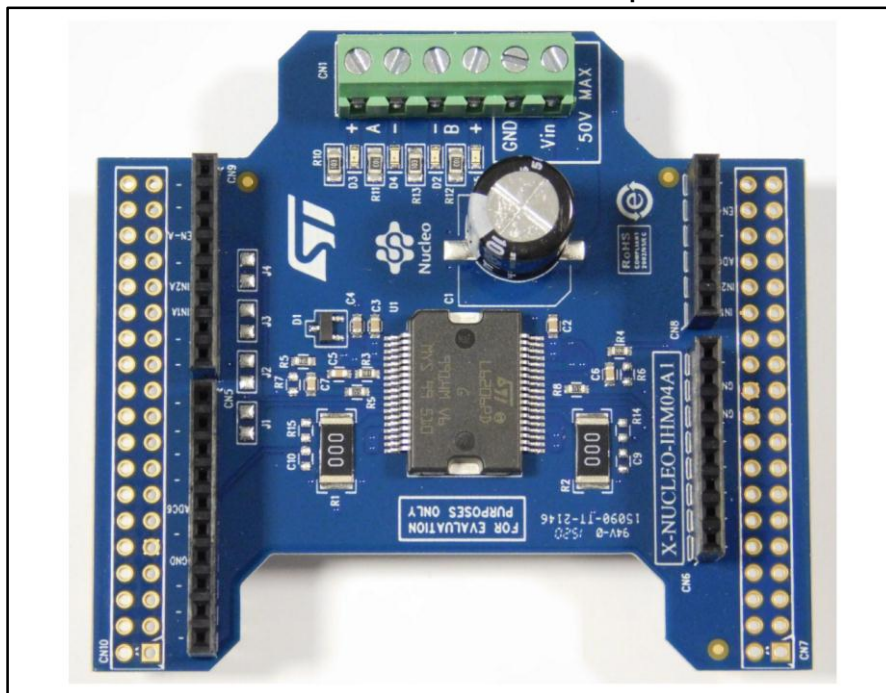
### Getting started with the X-NUCLEO-IHM04A1 dual brush DC motor driver expansion board for STM32 Nucleo

## Introduction

The X-NUCLEO-IHM04A1 is a dual brush DC motor drive expansion board based on L6206 (DMOS dual full bridge driver) to drive dual bipolar DC or quad unipolar DC motors. It provides a low cost, robust and easy-to-use solution for driving DC motors in your STM32 Nucleo project. A flexible solution for driving 1 to 4 DC motors is implemented via jumpers.

The X-NUCLEO-IHM04A1 is compatible with the Arduino UNO R3 connector, and supports the addition of other expansion boards with a single STM32 Nucleo board. The user can also mount the ST Morpho connector.

Figure 1: X-NUCLEO-IHM04A1: Dual brush DC motor driver expansion board based on L6206



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# 1 Getting started

The X-NUCLEO-IHM04A1 expansion board is a dual brush DC motor driver covering a wide range of applications. The maximum ratings of the board are the following:

- Power stage supply voltage (VS) from 8 V to 50 V
- Motor phase current up to 2.8 A r.m.s.

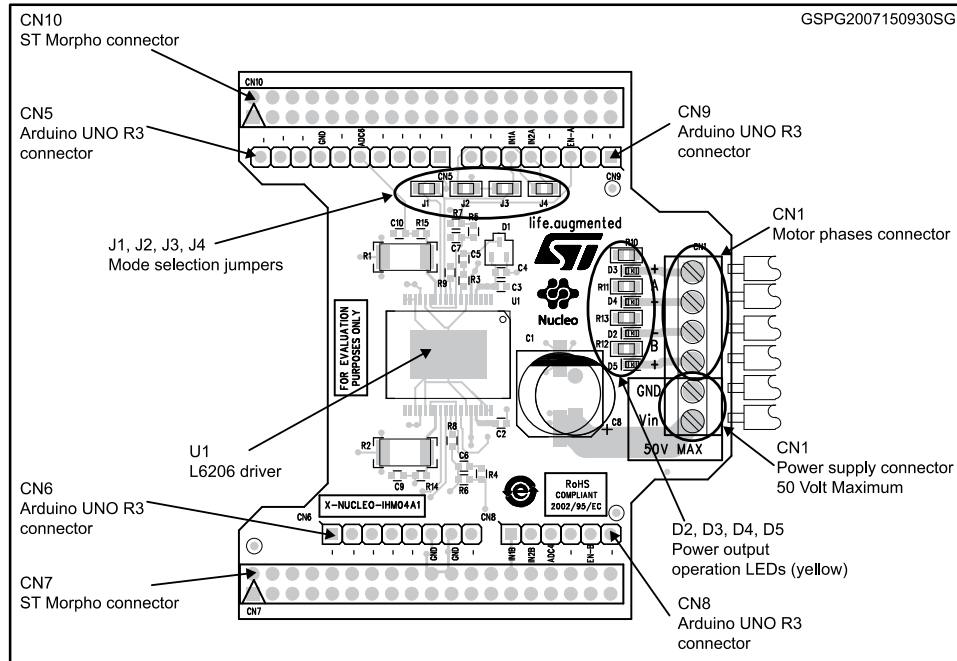
Follow this sequence to start your project with the board:

1. Check the jumper position based on your configuration (see [Section 2: "Hardware description and configuration"](#))
2. Connect the board with the STM32 Nucleo board through Arduino UNO R3 for the X-NUCLEO-IHM04A1
3. Supply the board through the input 6 (VS) and 5 (ground) of the connector CN1
4. Develop your application using the examples provided with the firmware library, X-CUBE-SPN4

Further support material is available on the L6206 and the STM32 Nucleo web pages on [www.st.com](http://www.st.com)

## 2 Hardware description and configuration

Figure 2: Jumper and connector position



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 <sup>(1)</sup>	Signal	Remarks
CN5	5	ADC-6	
	7	Ground	
CN9	3	EN-A	
	5	IN2A	See <a href="#">Section 2.1: "overcurrent (OCD) threshold setting"</a>
CN6	6	IN1A	See <a href="#">Section 2.1: "overcurrent (OCD) threshold setting"</a>
	7	Ground	
CN8	1	Ground	See <a href="#">Section 2.1: "overcurrent (OCD) threshold setting"</a>
	2	IN2B	See <a href="#">Section 2.1: "overcurrent (OCD) threshold setting"</a>
	3	ADC-4	
	5	Ground	

**Notes:**

<sup>(1)</sup>All the non-listed pins are not connected.

Table 2: ST Morpho connector table

Connector	Pin <sup>(1)</sup>	Signal	Remarks
CN10	9	Ground	
	13	ADC-6	
	27	IN1A	See <a href="#">Section 2.1: "overcurrent (OCD) threshold setting"</a>
	29	IN2A	See <a href="#">Section 2.1: "overcurrent (OCD) threshold setting"</a>
	33	EN-A	
CN7	20	Ground	
	22	Ground	
	28	IN1B	See <a href="#">Section 2.1: "overcurrent (OCD) threshold setting"</a>
	30	IN2B	See <a href="#">Section 2.1: "overcurrent (OCD) threshold setting"</a>
	32	ADC-4	
	36	EN-B	

**Notes:**

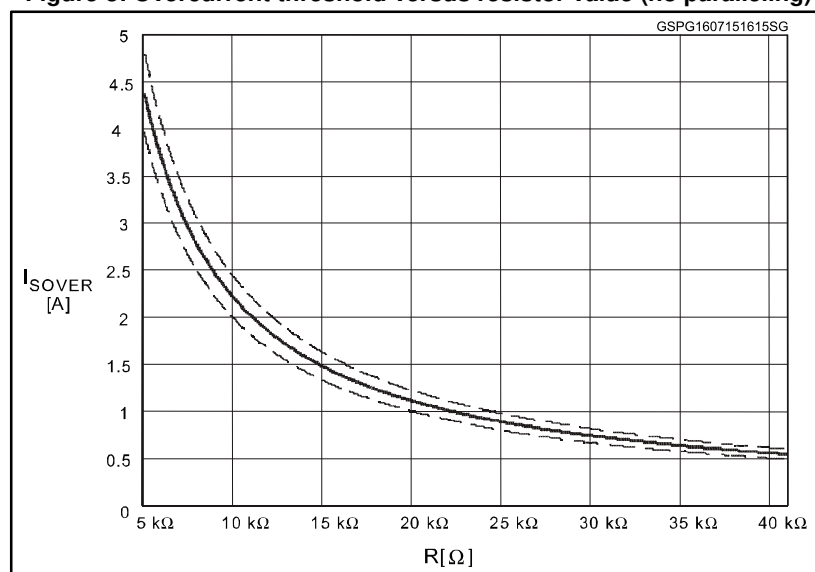
<sup>(1)</sup>All the non-listed pins are not connected.

## 2.1 overcurrent (OCD) threshold setting

The device integrates two overcurrent protection circuits with adjustable threshold, one for each full bridge.

The overcurrent threshold is set through the R9 (bridge A) and R8 (bridge B) resistors, as indicated in [Figure 3: "Overcurrent threshold versus resistor value \(no paralleling\)"](#).

Figure 3: Overcurrent threshold versus resistor value (no paralleling)



When one of the paralleling modes is used (see [Section 2.2: "Selecting the mode"](#)), the actual OCD threshold value may be scaled as indicated in [Table 1: "Arduino UNO R3 connector table"](#).

## 2.2 Selecting the mode

This board can drive 1 to 4 DC motors with several configurations.

The selection is done by Jumper J1 - J2 - J3 and J4, by default: all jumpers are not populated.

The table below briefly summarizes the possible configurations:

Table 3: Board configuration summary

Mode	Max output current	Output $R_{DS(on)}$	OCD threshold scaling	J1	J2	J3	J4
Two bidirectional DC motors	2.8 A rms	0.3 $\Omega$	$\times 1$	Disconnect ed	Disconnect ed	Disconnect ed	Disconnect ed
Four unidirectional DC motors	2.8 A rms <sup>(1)</sup>	0.3 $\Omega$	$\times 1$ <sup>(1)</sup>	Disconnect ed	Disconnect ed	Disconnect ed	Disconnect ed
High current parallel one bidirectional DC motor	5.6 A rms	0.15 $\Omega$	$\times 2$	Disconnect ed	Disconnect ed	Connected	Connected
High current parallel two unidirectional DC motors	5.6 A rms	0.15 $\Omega$	$\times 2$	Disconnect ed	Disconnect ed	Connected	Connected
Low current parallel one DC motors bidirectional	2.8 A rms	0.15 $\Omega$	$\times 1$	Connected	Connected	Disconnect ed	Disconnect ed
Low current parallel two unidirectional DC motors	2.8 A rms	0.15 $\Omega$	$\times 1$	Connected	Connected	Disconnect ed	Disconnect ed

Mode	Max output current	Output $R_{DS(on)}$	OCD threshold scaling	J1	J2	J3	J4
Parallel all bridges one unidirectional DC motor	11.2 A rms	0.075 $\Omega$	$\times 4$	Connected	Connected	Connected	Connected

**Notes:**

<sup>(1)</sup>The current limit is shared between the two motors connected on the same full-bridge (A or B).

**2.2.1 Mode no. 1: two bidirectional DC motors**

Two independent DC motors are driven by the board.

The supply voltage of both motors is connected to J1 pin 5 and 6 with a maximum voltage at 50 V DC.

Maximum current is 2.8 A rms and the output  $R_{DS(on)}$  is equal to 0.3 W ( $T_J = 25\text{ }^\circ\text{C}$ ).

The maximum overcurrent detection threshold is set to 5.6 A.

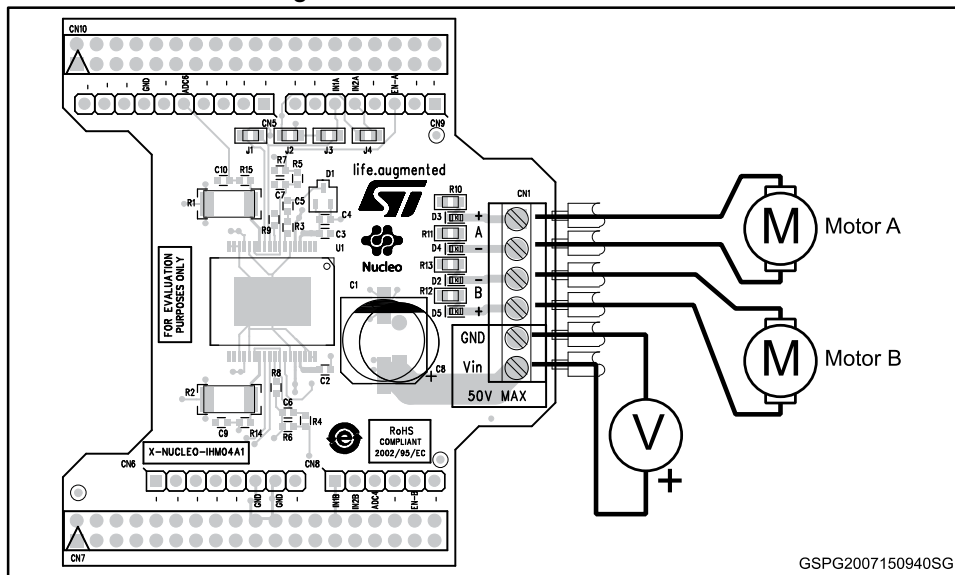
Motor A connected between A+ (CN1 pin1) and A- (CN1 pin2)

Motor B connected between B+ (CN1 pin4) and B- (CN1 pin3)

**Table 4: Jumper selection**

J1	J2	J3	J4
Disconnected	Disconnected	Disconnected	Disconnected

**Figure 4: two bidirectional DC motors**



**2.2.2 Mode no. 2: four DC motors unidirectional**

Four independent DC motors are driven by the board.

The supply voltage of both motors is connected to J1 pin 5 and 6 with a maximum voltage of 50 V DC.



Maximum current is 2.8 A rms and the output  $R_{DS(on)}$  is equal to 0.3 W ( $T_J = 25\text{ }^\circ\text{C}$ ).

The maximum overcurrent detection threshold is set to 5.6 A.



The total rms current flowing in A+ and A- DC motor must be below the 2.8 A rms limit. The OCD threshold is also triggered when the sum of the two output currents exceeds the programmed threshold.



The same for the B+ and B- outputs.

Motor A connected between A+ (CN1 pin1) and GND

Motor B connected between A- (CN1 pin2) and GND

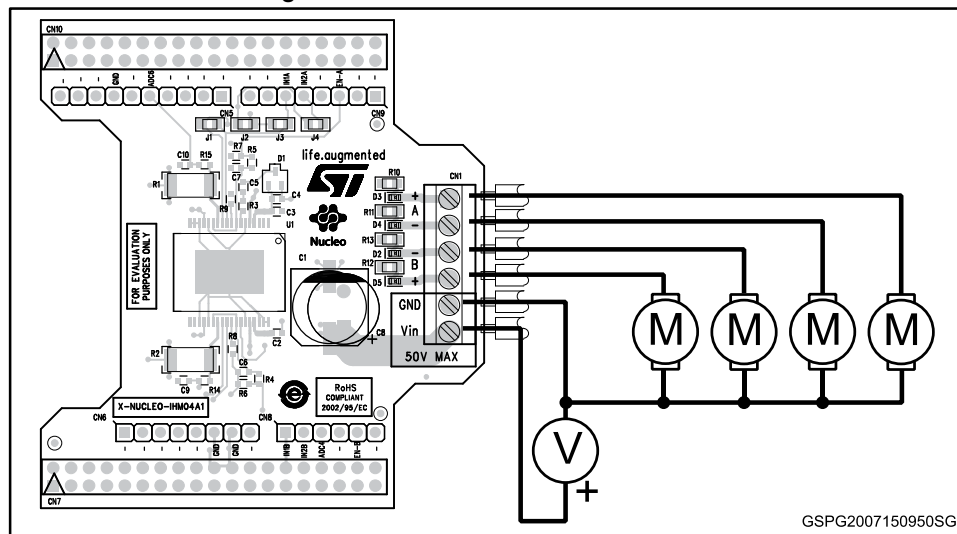
Motor C connected between B+ (CN1 pin4) and GND

Motor D connected between B- (CN1 pin3) and GND

Table 5: Jumper selection

J1	J2	J3	J4
Disconnected	Disconnected	Disconnected	Disconnected

Figure 5: Four unidirectional DC motors



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### 2.2.3 Mode no. 3: parallel connection for higher current - one DC motor bidirectional

This mode, with output power in parallel, increases the output current capability.

The motor supply voltage is connected to J1 pin 5 and 6 with a maximum voltage of 50 V DC.

Maximum current is 5.6 A rms and the output  $R_{DS(on)}$  is equal to 0.15 W ( $T_J = 25\text{ }^\circ\text{C}$ ).

The maximum overcurrent detection threshold is set to 11.2 A.

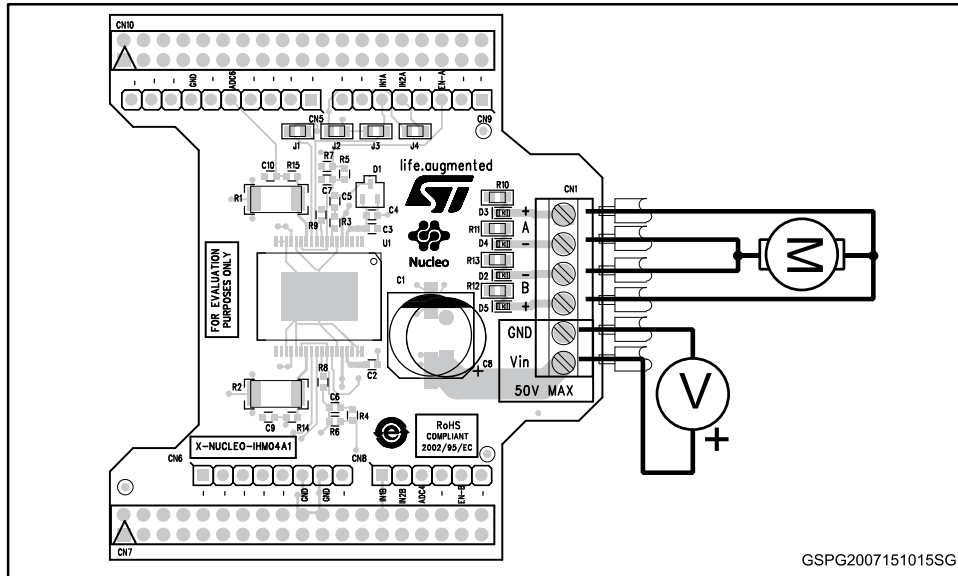
Motor A connected between

- Both A+ (CN1 pin1) B+ (CN1 pin4)
- Both A- (CN1 pin2) B- (CN1 pin3)

**Table 6: Jumper selection**

J1	J2	J3	J4
Disconnected	Disconnected	Connected	Connected

**Figure 6: One DC motor bidirectional - higher current**



**2.2.4 Mode n°4: parallel connection for higher current - two unidirectional DC motors**

This mode is similar to mode 3 - the bidirectional DC motor is replaced by two unidirectional DC motors

Motor A connected between

- Both A+ (CN1 pin1) B+ (CN1 pin4)
- GND

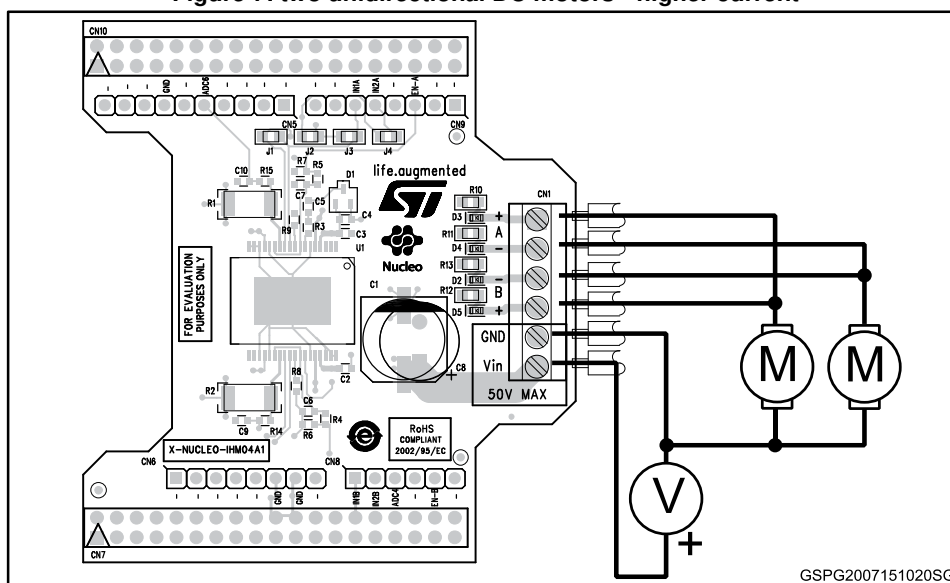
Motor B connected between

- Both A- (CN1 pin2) B- (CN1 pin3)
- GND

**Table 7: Jumper selection**

J1	J2	J3	J4
Disconnected	Disconnected	Connected	Connected

Figure 7: two unidirectional DC motors - higher current



**2.2.5 Mode no. 5: parallel connection for lower overcurrent - one DC motor bidirectional**

This mode, with output power in parallel, maintains a lower operating current compared to the solution in mode 3, but power dissipation is reduced.

The motor supply voltage is connected to J1 pin 5 and 6 with a maximum voltage of 50 V DC.

Maximum current is 2.8 A RMS and the output  $R_{DS(on)}$  is equal to 0.15 W ( $T_h = 25\text{ }^\circ\text{C}$ ).

The maximum overcurrent detection threshold is set to 5.6 A.

Motor A connected between

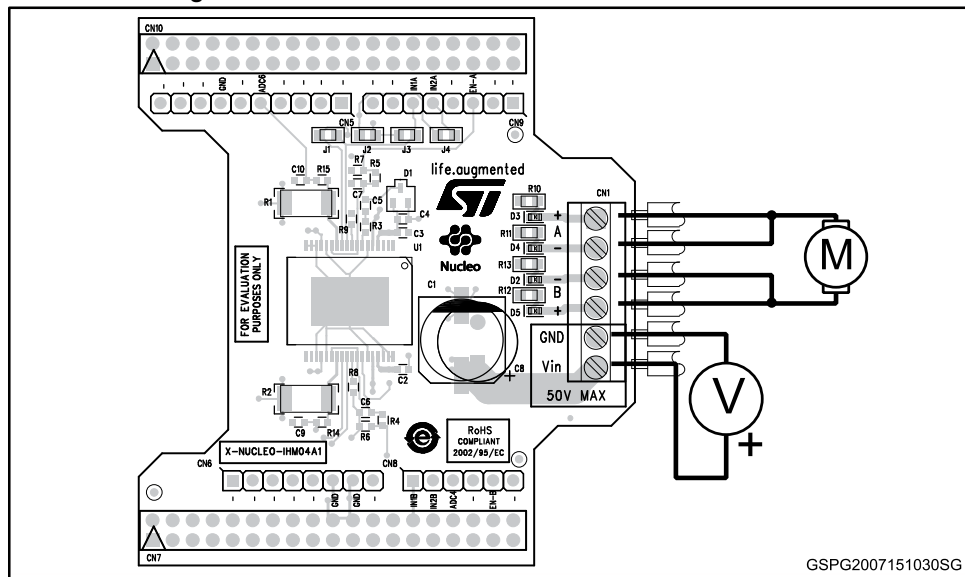
Both A+ (CN1 pin1) A- (CN1 pin2)

Both B+ (CN1 pin4) B- (CN1 pin3)

**Table 8: Jumper selection**

J1	J2	J3	J4
Connected	Connected	Disconnected	Disconnected

Figure 8: One bidirectional DC motor - lower overcurrent



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### 2.2.6 Mode n °6: parallel connection for lower overcurrent - two unidirectional DC motors

This mode is similar to the mode 5 - the bidirectional DC motor is replaced by two unidirectional DC motors.

Motor A connected between

- Both A+ (CN1 pin1) A- (CN1 pin2)
- GND

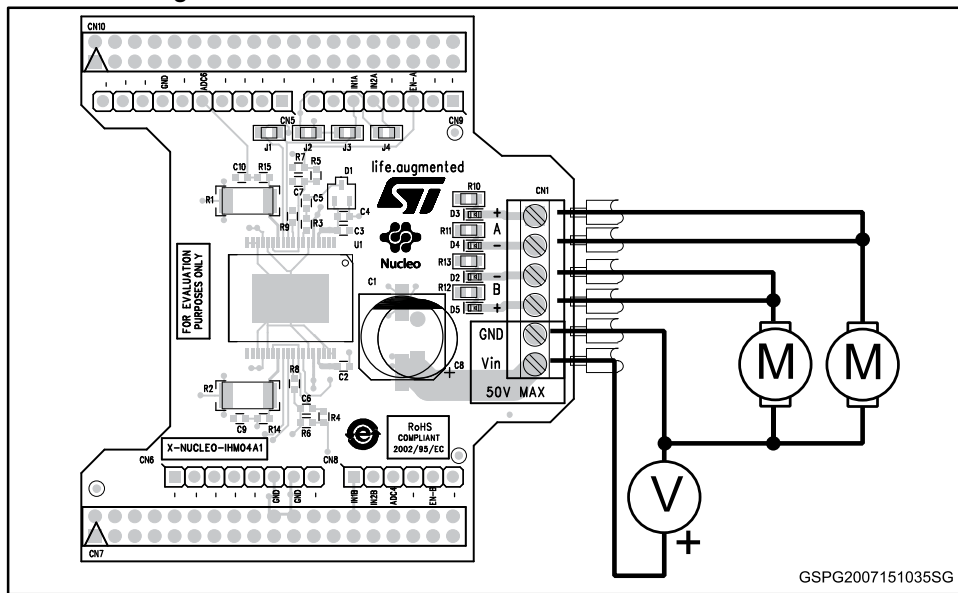
Motor B connected between

- Both B+ (CN1 pin4) B- (CN1 pin3)
- GND

Table 9: Jumper selection change

J1	J2	J3	J4
Connected	Connected	Disconnected	Disconnected

Figure 9: two unidirectional DC motors - lower overcurrent



2.2.7 Mode no. 7: parallel all bridges - one unidirectional DC motor

This mode, with all output power in parallel, allows driving a single-brush unidirectional DC motor.

The motor supply voltage is connected to J1 pin 5 and 6 with a maximum voltage of 50 V DC.

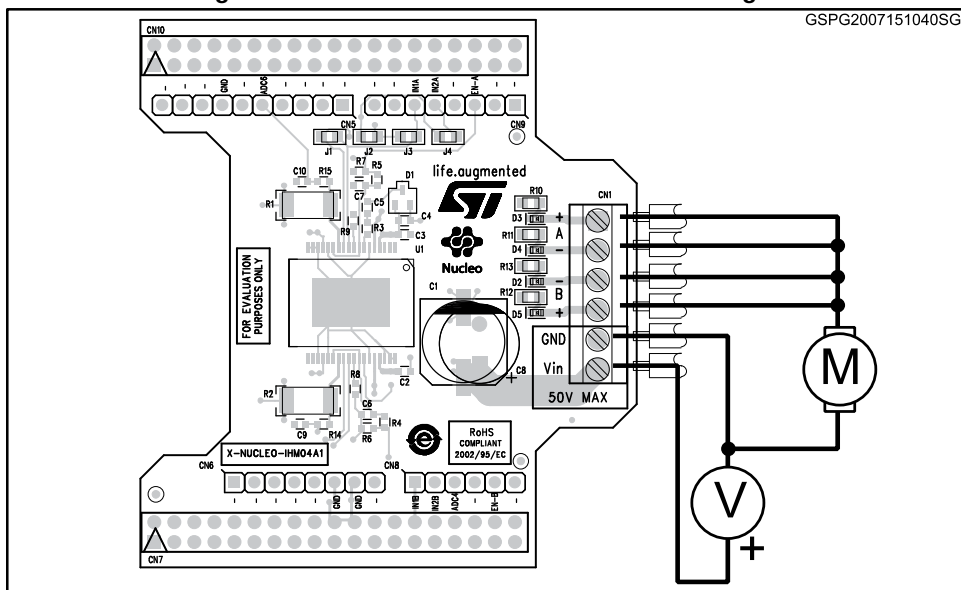
Maximum current is 11.2 A rms and the output  $R_{DS(on)}$  is equal to  $0.075 \Omega$  ( $T_J = 25^\circ C$ ).

The maximum overcurrent detection threshold is set to 22.4 A.

Motor A connected between

- Both A+ (CN1 pin1) A- (CN1 pin2) B+ (CN1 pin4) B- (CN1 pin3)
- GND

Figure 10: One unidirectional DC motor - all bridges





## 4 Bill of material

Table 10: Bill of material (Part 1)

Item no.	Description	Q.ty	Part reference	Value	Voltage	Part type
1	CAP ALU 100µF 63V SMD-PACK-G 10x10.2 mm	1		100UF	63V	ALUMINIUM
2	CAP CER 100nF 50V X7R 0603	2	C2 C3	100NF	50V	CERAMIC
3	CAP CER 220nF 35V X7R 0603	1	C4	220NF	35V	CERAMIC
4	CAP CER 10nF 50V X7R 0603	1	C5	10NF	50V	CERAMIC
5	CAP CER 5.6nF 50V X7R 0603	2	C6 C7	5.6NF	50V	CERAMIC
6	CAP ALU 100µF 63V Radial 10x6-P5	1	C8	100UF	63V	ALUMINIUM
7	CAP NP 0603	2	C9 C10	NP		NP
8	Screw connector 6 poles MKDS 1/6- 3.81	1	CN1	MKDS1/6- 3.81		SCREW CONNECTOR
9	THOUGH-HOLE-1x10-Pin height 14.8 - Body 8.5mn - pitch 2.54	1	CN5	CON-1x10		HEADER
10	THOUGH-HOLE-1x8-Pin height 14.8 - Body 8.5mn - pitch 2.54	2	CN6 CN9	CON-1x8		HEADER
11	THOUGH-HOLE-2x19-Pin height 14.8 - Body 8.5mn - pitch 2.54	2	NOT POPULATED	CON-2x19		HEADER
12	THOUGH-HOLE-1x6-Pin height 14.8 - Body 8.5mn - pitch 2.54	1	CN8	CON-1x6		HEADER
13	Double Diode high speed switching Diode	1	D1	BAR43		DIODE
14	LED YELLOW - 0603	4	D2-D5	YELLOW		LED
15	TIN DROP OPEN	4	J1-J4	OPEN	NOT POPULATE	CMS
16	OPTICAL_TARGET	3	MIRE1-MIRE3	OPTICAL_ TARGET		OPTICAL_ TARGET
17	RES 0 Ω 1.5W 2512	2	R1 R2	0R		CMS
18	RES 100 Ω 5% 1/10W	1	R3	100R		CMS
19	RES 100 kΩ 5% 1/10W 0603 SMD	2	R4 R5	100K		CMS
20	RES NP 0603	4	R6 R7 R14 R15	NP		CMS
21	RES 5.1 kΩ 1% 1/10W 0603 SMD	2	R8 R9	5.1K		CMS
22	RES 10 kΩ 5% 1/2W 0805 SMD	4	R10-R13	10K		CMS
23	DMOS dual full bridge driver	1	U1	L6206PD		MOTOR DRIVER

Table 11: Bill of material (Part 2)

Item no.	Toler.	Package type	Manufacturer	Manufacturer Part number	Distributor	Distributor Part num.
1	20%	EEEFK1J101P	PANASONIC	EEEFK1J101P	FARNELL	9696040RL
2	15%	C0603				
3	15%	C0603				
4	15%	C0603				
5	15%	C0603				
6	20%		NICHICON	UVR1J101MPD		
7		C0603				
8		MKDS1/6-3.81	PHOENIX CONTACT	MKDS1/6-3.81	RS	220-4377
9		SSQ110-03	SAMTEC	SSQ-110-04-F-S		
10		SSQ108-03	SAMTEC	SSQ-108-04-F-S		
11		SSQ119-04D	SAMTEC	SSQ-119-04-L-D		
12		SSQ106-03	SAMTEC	SSQ-106-04-F-S		
13		BAR43	STMICROELECTRONICS	BAR43SFILM	RS	714-0470
14		LEDC-0603				
15		R0805				
16		OPTICAL_TARGET				
17		R2512	VISHAY DALE	CRCW25120000Z0EG HP	FARNELL	2099593
18	5%	R0603				
19	5%	R0603				
20		R0603				
21	1%	R0603				
22	5%	R0805				
23		L6206PD	STMICROELECTRONICS	L6206PD		



## 5 Revision history

Table 12: Document revision history

Date	Revision	Changes
06-Aug-2015	1	Initial release.

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