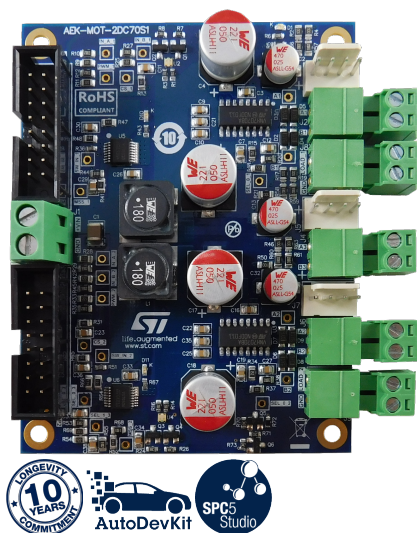


## Automotive-grade Dual DC motor driver up to 15 A each



### Features

- Dual DC motor driver
  - Parallel driving
  - Bi-directional
  - Output current up to 15A each device
- Three DC motor drivers
  - Up to two in parallel
  - Bi-directional
- Dual high-side driver
  - Parallel driving
  - Suitable for DC unidirectional driving
  - One channel up to 85 A and the other up to 25 A
- Optional encoder input
  - Three separated connectors
- Size 65 mm x 83 mm
- Included in AutoDevKit initiative
- RoHS compliant

### Description

The **AEK-MOT-2DC70S1** is a very compact solution for multi DC motor driving applications, embedding all the driver and signal decoding functions on the same board.

Together with current sensing capability, the AEK-MOT-2DC70S1 features three independent encoder inputs. The DC motor drivers have separate half-bridge driving which allows up to three separate motors with only two devices, using an appropriate driving sequence.

The motor driver is ideal for two-wheel applications and allows engineers to build highly compact motor control solutions. The two high-side drivers facilitate additional driving for system actuators (unidirectional DC motor, LED, pump, etc.).

Product summary	
Automotive-grade Dual DC motor driver up to 15A each	<b>AEK-MOT-2DC70S1</b>
High-side driver with MultiSense analog feedback for automotive applications	<b>VN7050AJ</b>
High-side driver with MultiSense analog feedback for automotive applications	<b>VN7E010AJ</b>
Automotive fully integrated H-bridge motor driver	<b>VNH7070BAS</b>
AutoDevKit library plugin for SPC5-STUDIO	<b>STSW-AUTODEVKIT</b>
AutoDevKit library plugin for SPC5-STUDIO	<b>SPC5-STUDIO</b>
Applications	<b>Motor Control</b>

# 1 Block diagram

Figure 1. AEK-MOT-2DC70S1 block diagram

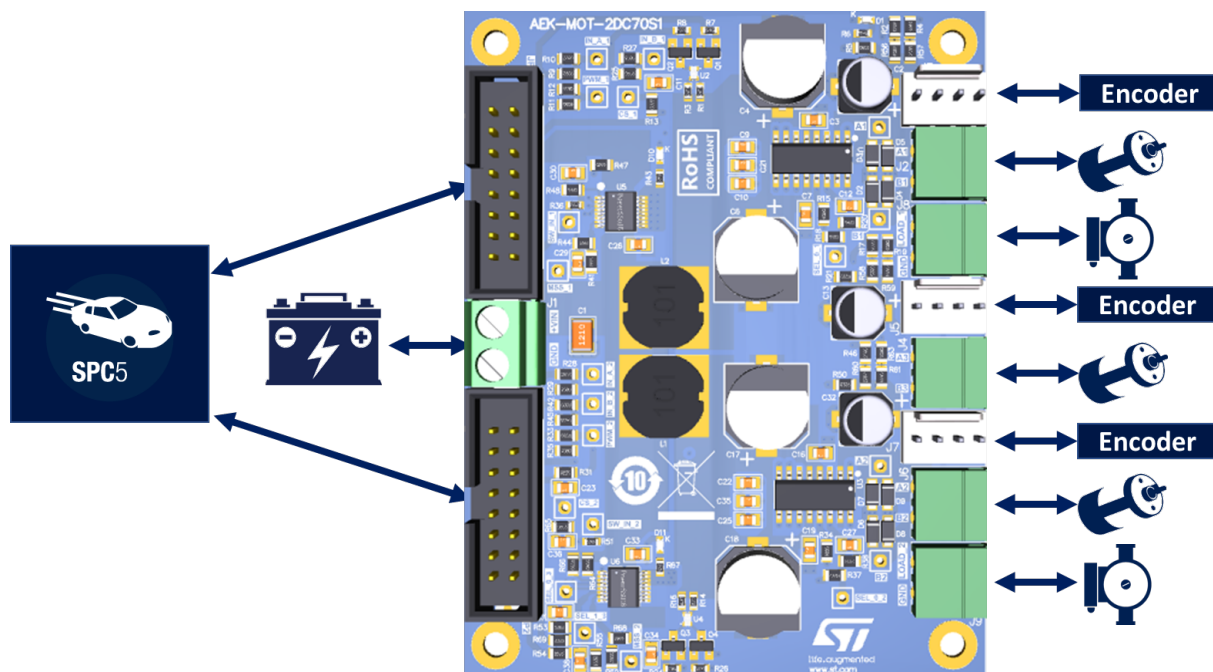
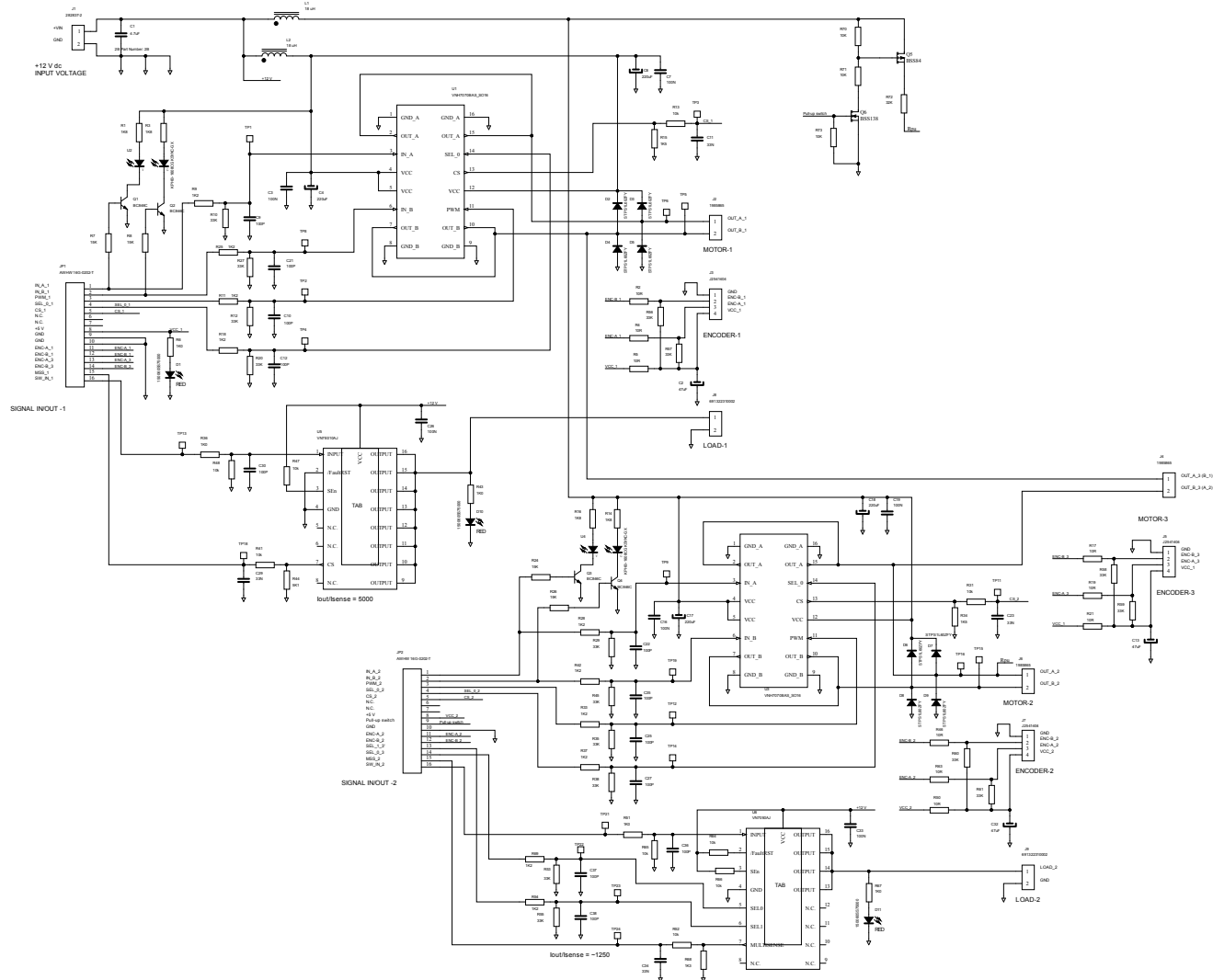


Figure 2. AEK-MOT-2DC70S1 board schematic



### 3 Key IC device features

**Table 1.** Key IC device features

Product	Features	Max transient supply voltage	Operating voltage range		Typ on-state resistance per CH $R_{DS(on)}$ (mΩ)	Current limitation (I <sub>lim</sub> ) typ (A)	Stand-by current (max) I <sub>stby</sub> (uA)
			Min (V)	Max (V)			
VNH7070BAS	H-bridge motor driver	40 V	4	28	70	15	1
VN7E010AJ	High-side driver	40 V	4	28	10.5	88	0.5
VN7050AJ	High-side driver	40 V	4	28	50	30	0.5

## 4 Connector pin-out

**Table 2. Connector pin-out**

Pin name	Pin number	Connector	Pin function
IN_A_1, IN_A_2	1	JP1, JP2	Clockwise input for H-bridge motor driver
IN_B_1, IN_B_2	2	JP1, JP2	Counter-clockwise input for H-bridge motor driver
PWM_1, PWM_2	3	JP1, JP2	A square wave signal up to 20 kHz can be used on this pin for motor speed control (H-bridge motor driver)
SEL_0_1, SEL_0_2	4	JP1, JP2	In combination with INA and INB, it addresses the CurrentSense information delivered to the micro according to the truth table (H-bridge motor driver)
CS_1, CS_2	5	JP1, JP2	Multiplexed analog sense output pin for H-bridge motor driver. It delivers a current proportional to the HSA output current if SEL0 is set high; and to the HSB if SEL0 is set low. It develops a voltage flag for a failure on the relevant output in the ON-state as well as the OFF-state
N.C.	6,7	JP1, JP2	Not connected
+5V	8	JP1, JP2	5V voltage supply Voltage for Encoder
GND	9	JP1	Ground
Pull-up switch	9	JP2	Enable pull-up resistor for open load detection in OFF-state for H-bridge motor driver
GND	10	JP1, JP2	Ground
ENC-A_1, ENC-B_1	11,12	JP1	Encoder output 1
ENC-A_2, ENC-B_2	11,12	JP2	Encoder output 2
ENC-A_3, ENC-B_3	13,14	JP1	Encoder output 3
SEL_1_3, SEL_0_3	13,14	JP2	Address the MultiSense multiplexer for VN7050AJ High side driver
MSS_1, MSS_2	15	JP1, JP2	Analog current sense output pin; it delivers a current proportional to the selected load current for High side driver
SW_IN_1, SW_IN_2	16	JP1, JP2	Controls output switch state for High side driver

## 5 AEK-MOT-2DC70S1 dedicated software component

Through the dedicated [AutoDevKit](#) component, motors can be selectively activated according to the application requirements.

The dedicated GUI allows intuitive management of three motors directly connected to the VNHxxx devices (MOTOR 1, MOTOR 3, MOTOR 5). For each motor, it is possible to set the rotation direction and to connect an encoder for precise positioning. MOTOR/LOAD 2 and MOTOR/LOAD 4 are connected onto the VNxxx devices and are therefore uni-directionally driven. MOTOR 1, MOTOR/LOAD 2, MOTOR 3, MOTOR/LOAD 4 can be driven in parallel, while MOTOR 5 should be activated separately to avoid improper driving of MOTOR 1 and MOTOR 3.

[AutoDevKit](#) high-level drivers are very straightforward and a comprehensive API support is available through online help in [SPC5-STUDIO](#). The user can invoke the desired functions, such as starting a DC motor, increasing or decreasing the DC rotation speed, and braking by simply transmitting the motor parameters (e.g., MOTOR 1, MOTOR 2, ... MOTOR 5) to them.

The API set includes diagnostic functions which indicate if the device is in *Fault* or *Operative* mode. Moreover, it is possible to monitor the device even when it is switched off, to avoid starting the application when a fault occurs.

In the [AutoDevKit](#) plug-in, there are several examples of API usage, including one using an encoder which has a *K* factor that should be set in the appropriate `#DEFINE` in the encoder driver according to the specific motor model.

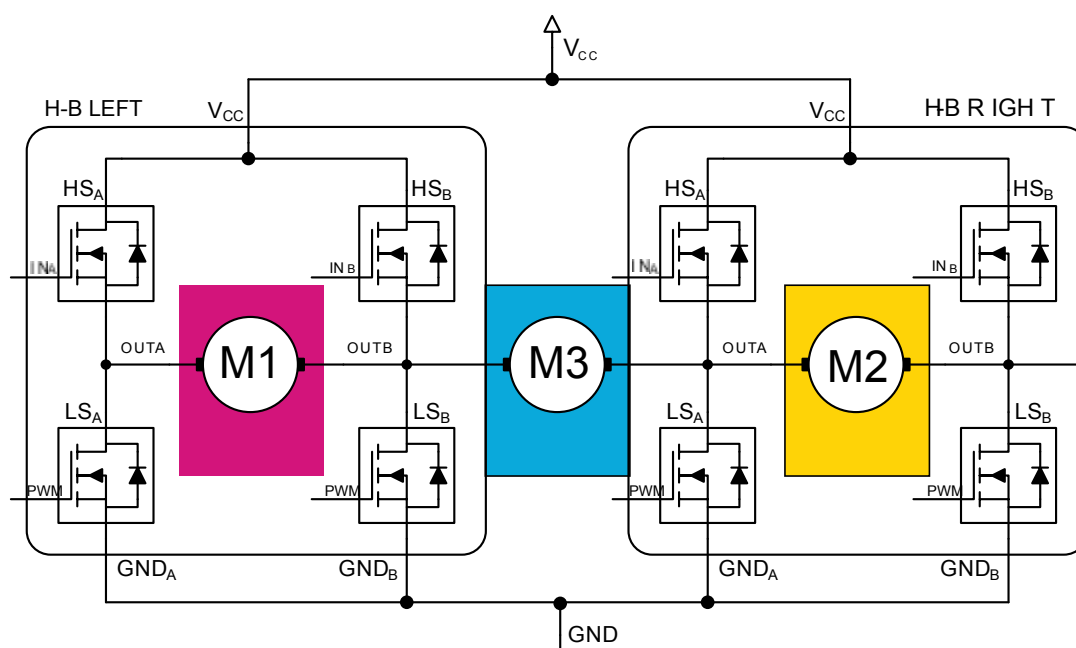
The [AutoDevKit](#) also allows you to implement custom PID control, useful for negative feedback systems, by modifying the relevant `#DEFINE` statements in the PID driver code.

## 6 Multi-motor configurations

To drive multiple loads (motors), it is possible to combine H-bridges in a cascaded configuration that requires less H-bridges than the actual number of motors. The figure below shows a multi-motor configuration based on three motors that can be driven in both directions by two full H-bridges.

Each motor can be independently controlled through specific combinations of INA, INB and PWM on the dedicated H-bridges.

**Figure 3. Multi-motor configuration for three motors**

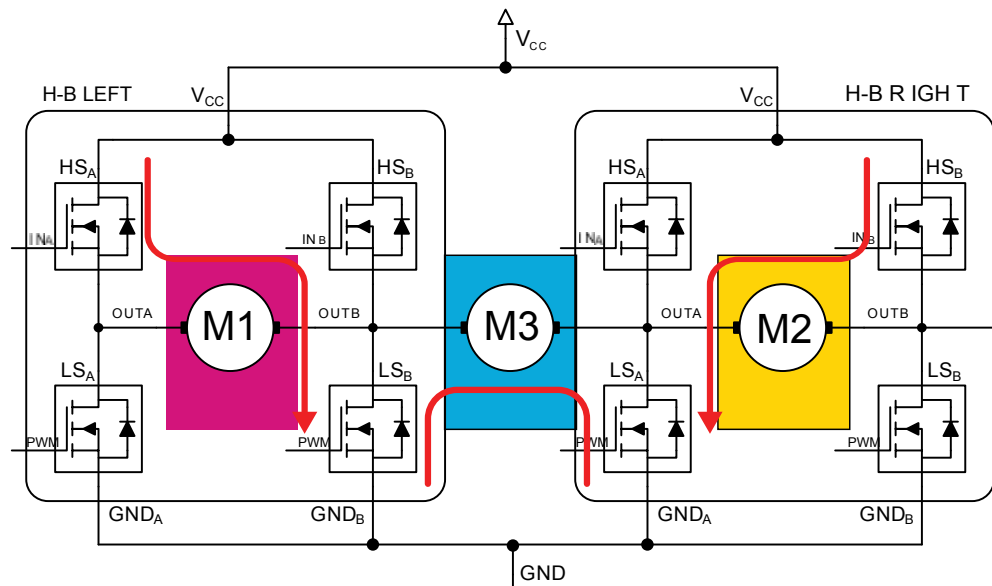


## 6.1 Motor activation sequences

**Step 1.** Set INA=H, INB=L and PWM=H on H-B LEFT to activate M1 motor in clockwise direction and, at the same time, set INA=L, INB=H and PWM=H on H-B RIGHT to activate M2 motor in counterclockwise direction.

M3 motor is braked to GND.

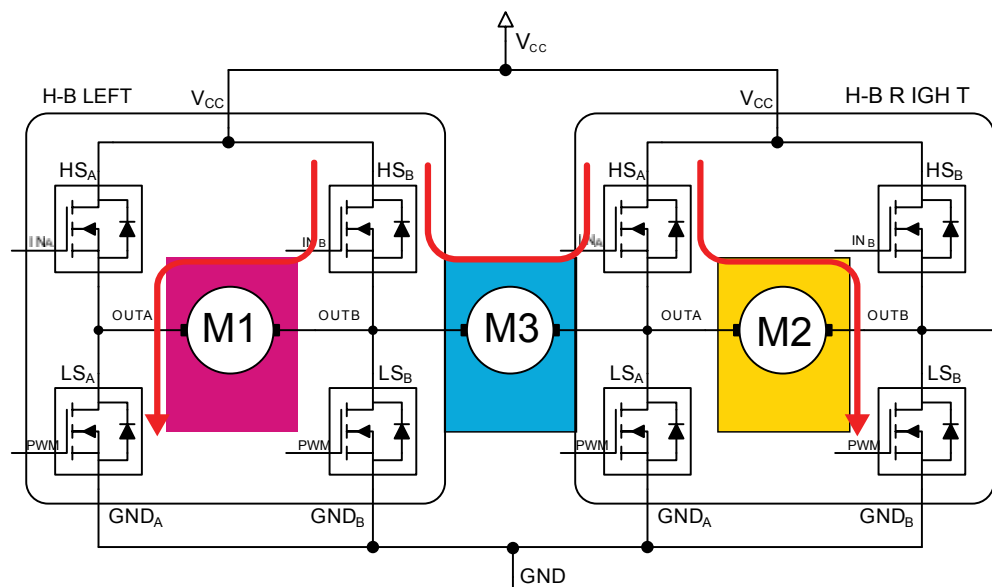
**Figure 4. Motor activation sequence 1**



**Step 2.** Set INA=L, INB=H and PWM=H on H-B LEFT to activate M1 motor in counterclockwise direction and, at the same time, set INA=H, INB=L and PWM=H on H-B RIGHT to activate M2 motor in clockwise direction.

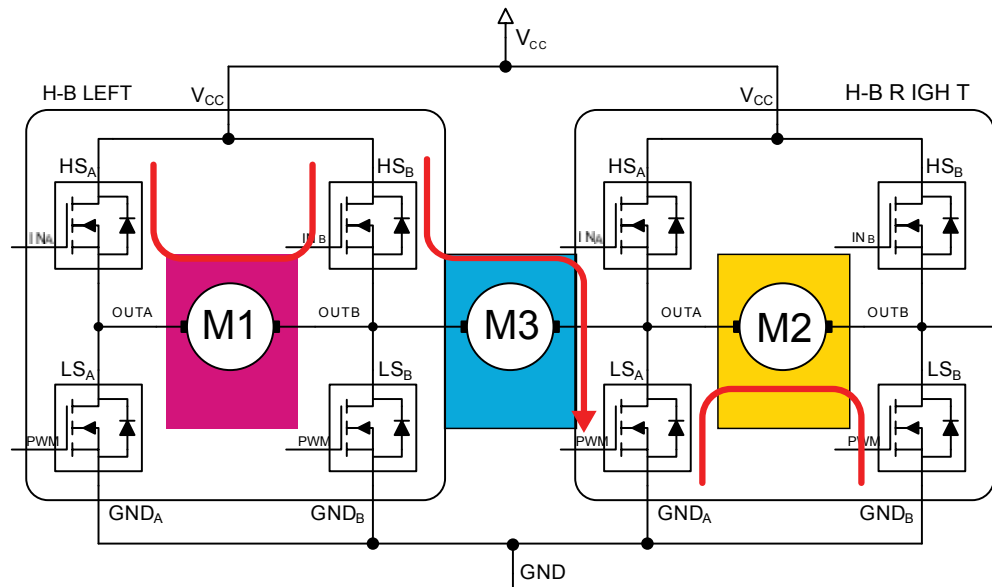
M3 motor is braked to VCC.

**Figure 5. Motor activation sequence 2**



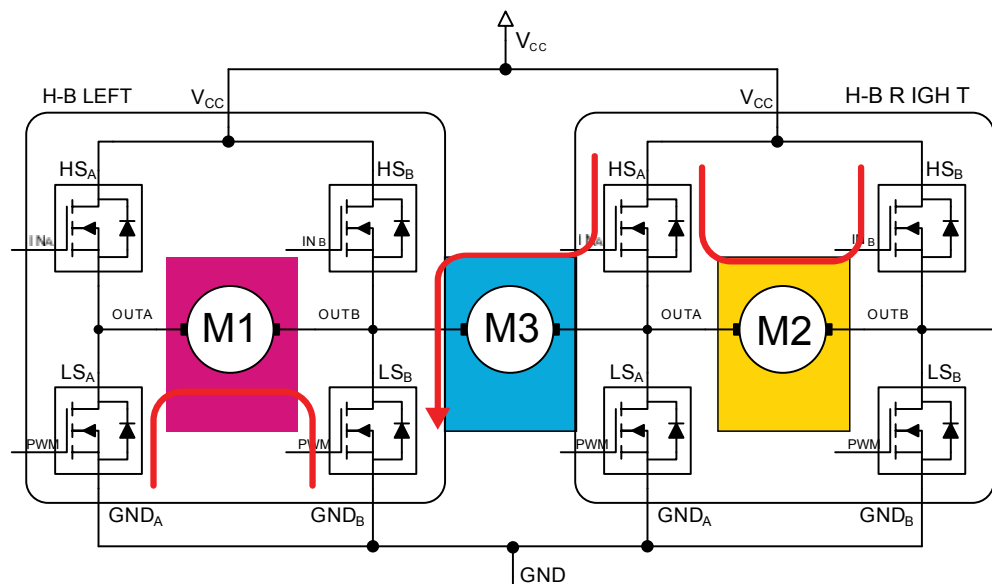
- Step 3.** Set  $INA=H$ ,  $INB=H$  and  $PWM=L$  on H-B LEFT to brake M1 motor to  $V_{CC}$  and, at the same time, set  $INA=L$ ,  $INB=L$  and  $PWM=H$  on H-B RIGHT to brake M2 motor to GND. M3 motor is activated in clockwise direction.

**Figure 6. Motor activation sequence 3**



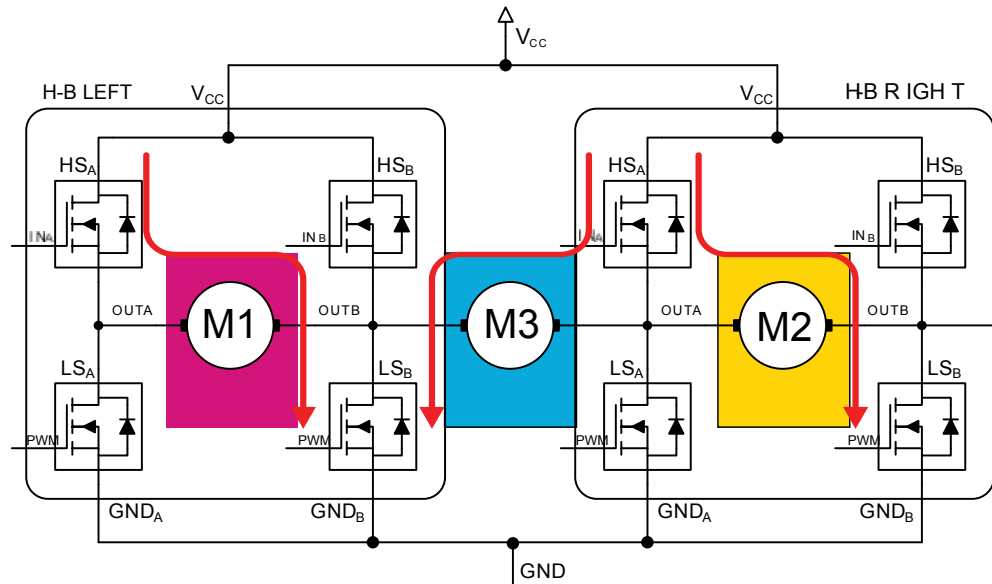
- Step 4.** Set  $INA=L$ ,  $INB=L$  and  $PWM=H$  on H-B LEFT to brake M1 motor to GND and, at the same time, set  $INA=H$ ,  $INB=H$  and  $PWM=L$  on H-B RIGHT to brake M2 motor to  $V_{CC}$ . M3 motor is activated in counterclockwise direction.

**Figure 7. Motor activation sequence 4**



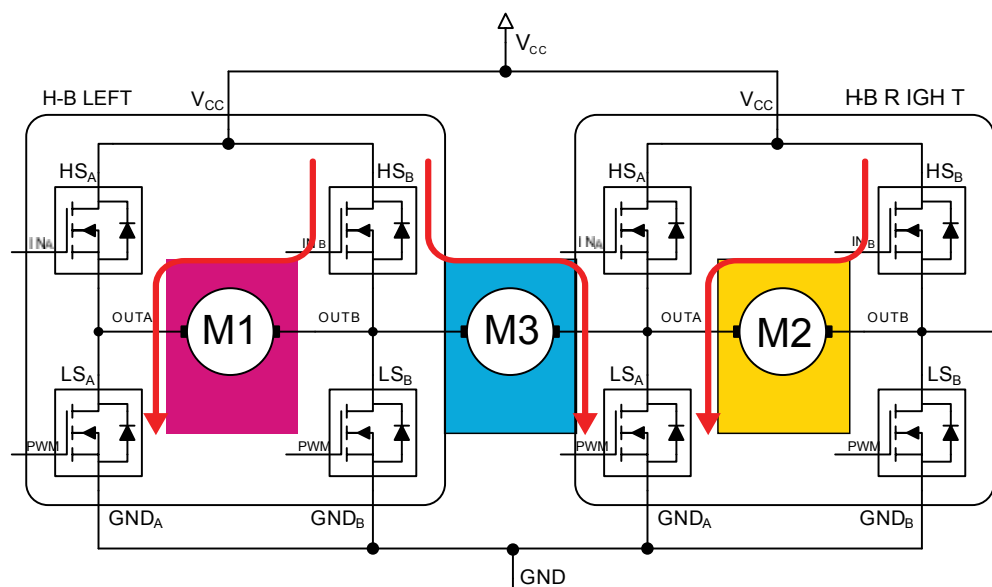
- Step 5.** Set  $INA=H$ ,  $INB=L$  and  $PWM=H$  on H-B LEFT to activate M1 motor in clockwise direction and, at the same time, set  $INA=H$ ,  $INB=L$  and  $PWM=H$  on H-B RIGHT to activate M2 motor in clockwise direction . M3 motor is activated in counterclockwise direction.

**Figure 8. Motor activation sequence 5**



- Step 6.** Set  $INA=L$ ,  $INB=H$  and  $PWM=H$  on H-B LEFT to activate M1 motor in counterclockwise direction and, at the same time, set  $INA=L$ ,  $INB=H$  and  $PWM=H$  on H-B RIGHT to activate M2 motor in counterclockwise direction . M3 motor is activated in clockwise direction.

**Figure 9. Motor activation sequence 6**

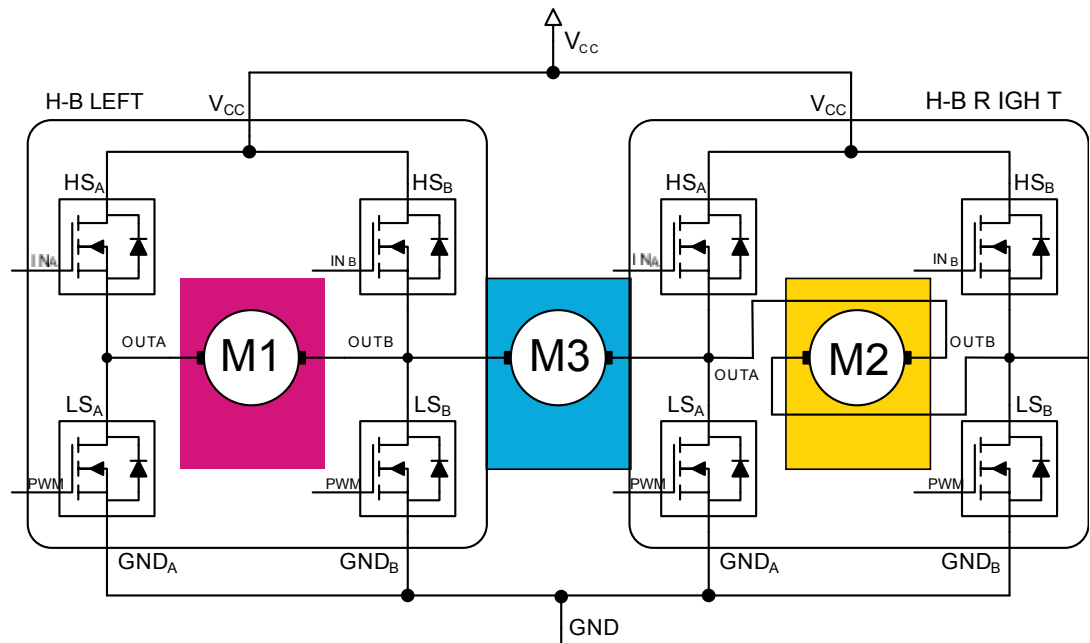


## 7 Synchronized motor configuration

When using three motors, it is possible to create a configuration where the two external motors (M1 and M2) can be synchronized to rotate in the same direction while the central motor (M3) remains blocked.

The figure below shows a synchronized motor configuration that can be properly controlled through specific combinations of INA, INB and PWM on dedicated H-bridges.

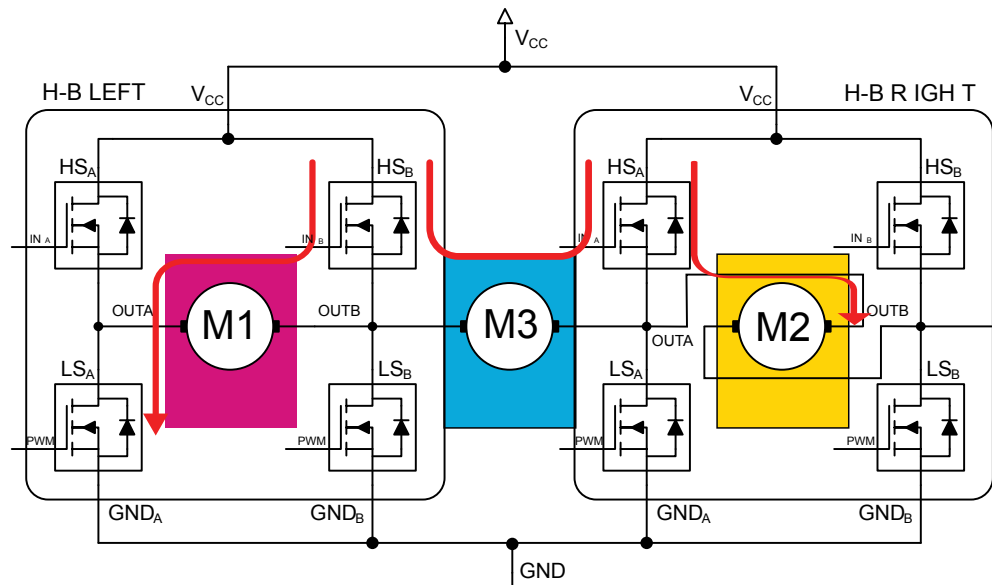
**Figure 10. Example of synchronized motor configuration**



## 7.1 Synchronized motor activation sequences

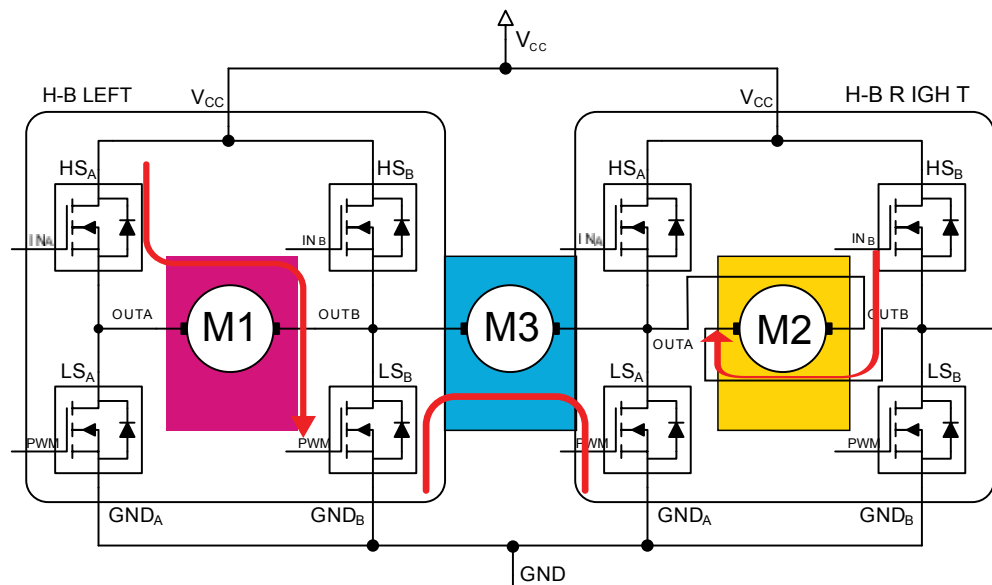
- Step 1.** Set  $INA=L$ ,  $INB=H$  and  $PWM=H$  on H-B LEFT to activate M1 motor in counterclockwise direction and, at the same time, set  $INA=H$ ,  $INB=L$  and  $PWM=H$  on H-B RIGHT to activate M2 motor in counterclockwise direction.  
M3 motor is braked to  $V_{CC}$ .

**Figure 11. Synchronized motor activation sequence 1**



- Step 2.** Set  $INA=H$ ,  $INB=L$  and  $PWM=H$  on H-B LEFT to activate M1 motor in clockwise direction and, at the same time, set  $INA=L$ ,  $INB=H$  and  $PWM=H$  on H-B RIGHT to activate M2 motor in clockwise direction.  
M3 motor is braked to GND.

**Figure 12. Synchronized motor activation sequence 2**



### RELATED LINKS

For further details, configurations and current sensing options, refer to AN5026.

## Revision history

**Table 3. Document revision history**

Date	Version	Changes
14-Oct-2020	1	Initial release.
17-Nov-2020	2	Updated part number in the cover page product summary table.
26-Mar-2021	3	Updated cover page product summary table. Added <a href="#">Section 6 Multi-motor configurations</a> , <a href="#">Section 6.1 Motor activation sequences</a> , <a href="#">Section 7 Synchronized motor configuration</a> and <a href="#">Section 7.1 Synchronized motor activation sequences</a> . Minor text changes.

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