

# DC Motor Board

## *User Manual*

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# Chapter 1. DC Motor Board

## 1. Overview

The DC Motor Board is a variable speed controller for 12V brushed DC motors at upto 1.0 Amp continuous current. This board offers a high degree of isolation with the use of high speed 10 MBit/s Logic Gate opto-isolators for isolation between low voltage control side and high voltage motor side.

The heart of the board is Si9986, an integrated buffered H-bridge, with TTL compatible inputs and the capability of delivering a continuous 1.0 Amp at 12V with switching rates up to 200kHz. By supporting high-frequency pulse width modulation (PWM), the DC motor can run smoothly and quietly over a wide speed range.

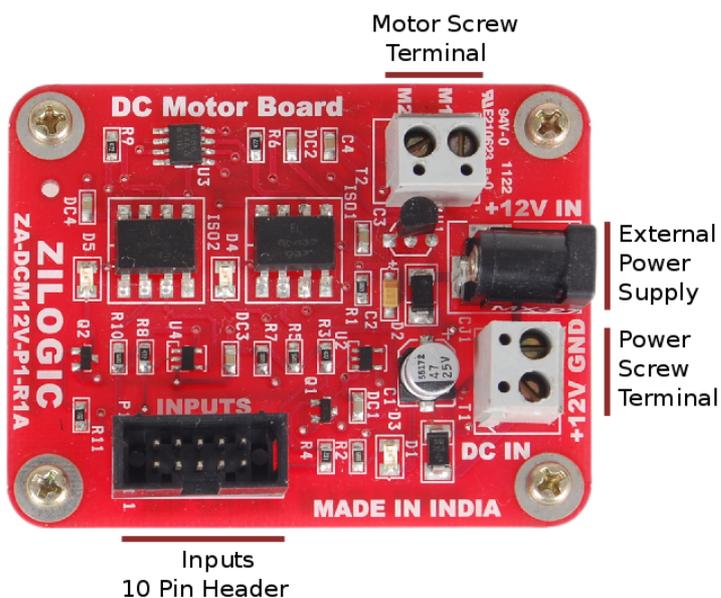
## 2. Board Features

- Controls brushed 12 V DC motors up to 1.0 A continuous.
- High Speed Opto-isolated inputs.
- 200 kHz Switching Rate.
- PWM input signal state indication by LEDs.
- Heavy duty screw terminal blocks for motor connection.
- Standard TTL compatible inputs use with most microcontrollers and control systems.
- 0.1" FRC header for connection to control logic/MCU.
- Ready to go with Zilogic's motherboards.
- Controlled through digital or PWM signals.
- Supports forward, reverse & brake mode.

## 3. Locating Components

The location of the components on the board are indicated in the following diagrams.

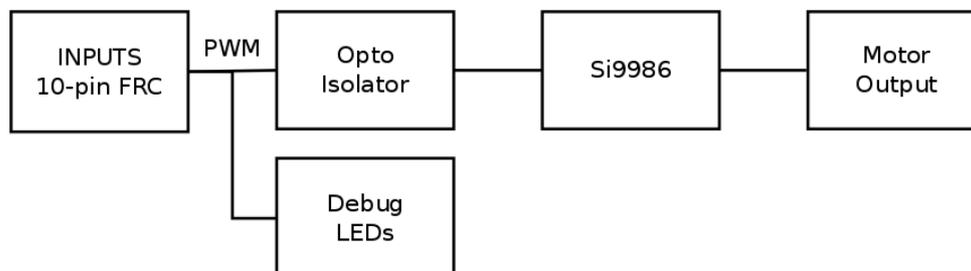
**Figure 1.1. Front View**



## 4. Block Diagram

The devices available on the board, is shown in the following block diagram. Each device is described in details in the following sections.

**Figure 1.2. Block Diagram**



## 5. Power Supply

The DC motor board is powered from the motherboard through the FRC header. The motors are themselves powered from a 12V external power supply, applied through a standard power jack or screw terminal. The external power supply should have the following characteristics.

Output Voltage	12V
Output Current	1A
Polarity	

## 6. Debug LEDs

The Debug LEDs indicate the duty cycle of the PWM signal. If the PWM signal duty cycle is 100%, then the corresponding LED turns ON. If the PWM signal duty cycle is 0%, then the corresponding LED turns OFF. For intermediate duty cycles, the corresponding LED's brightness varies between ON and OFF.

## 7. Connectivity

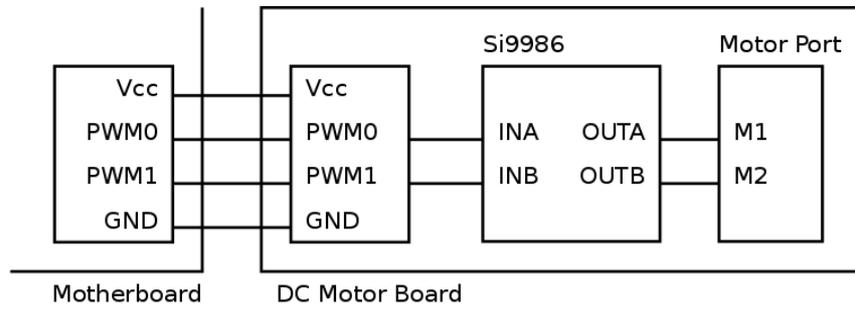
The DC motor board can be interfaced with motherboard through the `INPUTS` 10 pin FRC connector. The signal details are given below.

**Table 1.1. FRC-10 Connector**

Pin #	Signal	Signal Type
1	5V	Supply from motherboard
2	PWM0	TTL In <sup>1</sup>
3	PWM1	TTL In <sup>1</sup>
4	Not Connected	-
5	Not Connected	-
6	Not Connected	-
7	Not Connected	-
8	Not Connected	-
9	Not Connected	-
10	GND	Ground

<sup>1</sup> 5V tolerant Input

**Figure 1.3. Interface**



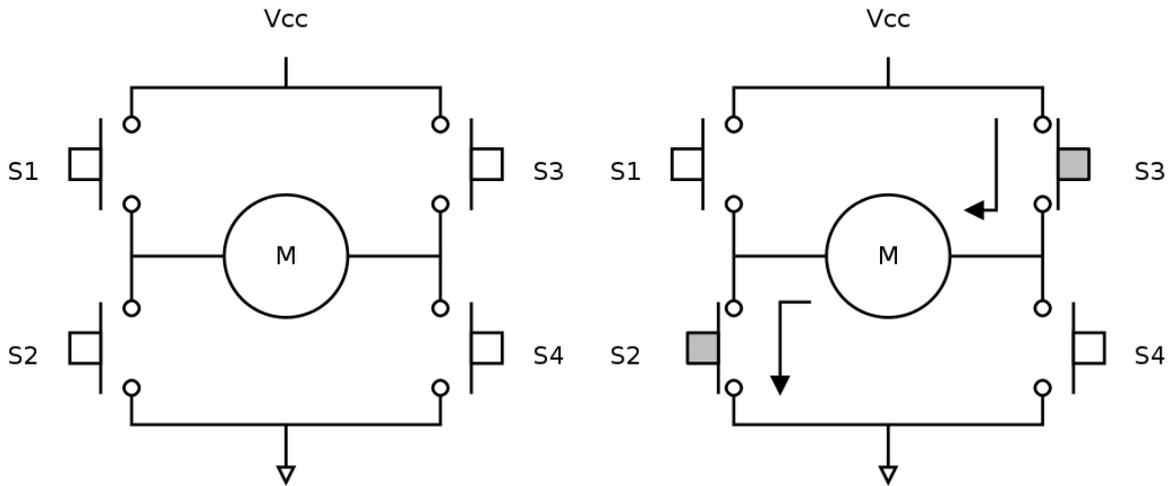
## 8. Specification

Max. output current	1A
Output Voltage	12V
Switching Rate	200KHz

# Chapter 2. Motor Board Usage

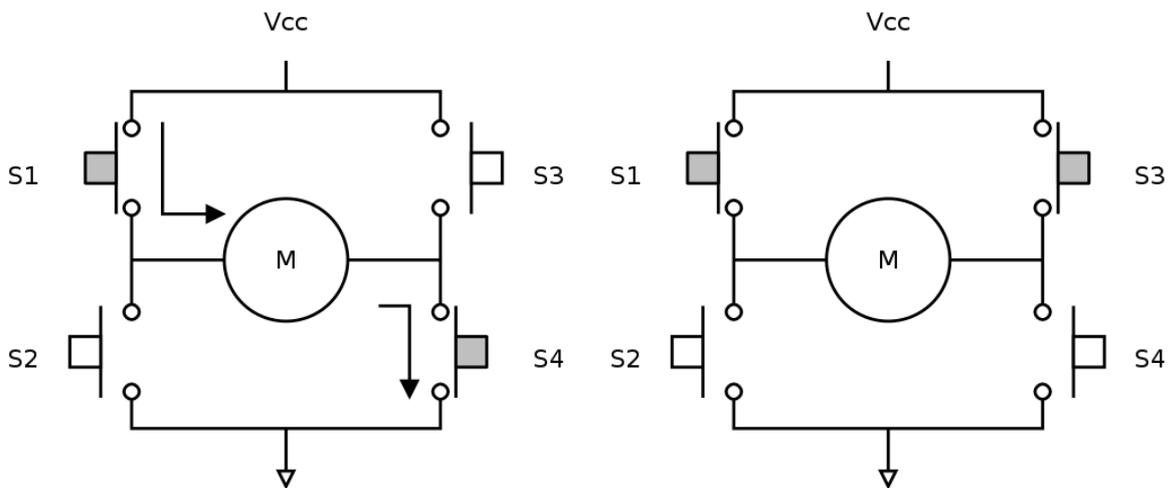
## 1. Basic H-Bridge Operation

The H-Bridge is an electronic circuit that allows voltage to be applied to a motor in either direction, and thus control the direction of rotation of the motor. A simple H-Bridge constructed using switches is shown in the following diagram. By controlling, the switches the motor can be made to rotate forward, reverse, brake, and free run. The various switch states and their effect on the motor is shown in the following table.



(a) Free Running State

(b) Reverse State



(c) Forward State

(d) Brake State

S1	S2	S3	S4	Function
0	0	0	0	Free-run
0	1	1	0	Reverse
1	0	0	1	Forward
0	1	0	1	Brake
1	0	1	0	Brake

Forward      The current to flows in one direction through the motor.

Reverse	The current flows in the opposite direction through the motor.
Brake	Applying same voltage to both the terminals, counters the back EMF produced by the motor, and causes it to come to a sudden stop.
Free-run	Power is cut-off from the motor, and the motor free-runs and eventually stops.

To control the motor through digital / PWM signals, the switches are replaced by transistors / MOSFETs. Driver ICs like the Si9986, A3901, L298, etc. that implement the H-Bridge can also be used for motor control applications.

## 2. Motor Control

The DC motor board has H-bridge motor driver IC, Si9986. By controlling the inputs, various functions can be selected, as shown in the table below.

**Table 2.1. DC Motor**

PWM0	PWM1	Function
0	0	Free-run
1	0	Forward
0	1	Reverse
1	1	Brake

When in Forward state or Reverse state, the speed of the motor can be controlled by driving the inputs with a PWM signal

PWM0 Duty	PWM1 Duty	Function
0%	0%	Brake
100%	100%	Brake
0%	100%	Reverse, full speed
100%	0%	Forward, full speed
0%	X%	Reverse, speed proportional to duty cycle
X%	0%	Forward, speed proportional to duty cycle

# Chapter 3. Legal Information

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