POLOLU TB9051FTG SINGLE BRUSHED DC MOTOR DRIVER CARRIER

USER'S GUIDE

USING THE MOTOR DRIVER

Motor and power connections are made on one side of the board and control connections are made on the other. The driver requires an operating voltage between 4.5 V and 28 V to be supplied to the reverse-protected power input, VIN, and a 5 V regulated logic voltage to be supplied to VCC. The VM pin provides convenient access to the reverse-protected motor voltage.

For drive-brake operation (also known as slow decay) with two PWM-capable control lines, the enable pins' default states can be overridden (EN tied high and ENB tied low) to enable the driver; the adjacent VCC and GND pins provide convenient places to make these connections. The two PWM pins then control the state of the corresponding outputs, as shown in the following simplified truth table:

TB9051FTG simplified truth table (PWM1 + PWM2)						
Inputs				Outputs		Operation
EN	ENB	PWM1	PWM2	OUT1	OUT2	
1	0	PWM	0	PWM (H/L)	L	forward/brake at speed *PWM %*
		0	PWM	L	PWM (H/L)	reverse/brake at speed *PWM %*
		0	0	L	L	brake low (outputs shorted to ground)
		1	1	L	L	
0	X	X	X	Z	Z	coast (outputs floating/disconnected)
X	1	X	X	Z	Z	

Alternatively, you can hold PWM1 and PWM2 at fixed levels to set the motor direction and apply a PWM signal to EN (or an inverted PWM signal to ENB) to set the speed, which results in drive-coast operation (also known as fast decay). This increases the number of I/O lines to three, but only one of them needs to be PWM-capable, as shown in this simplified truth table:

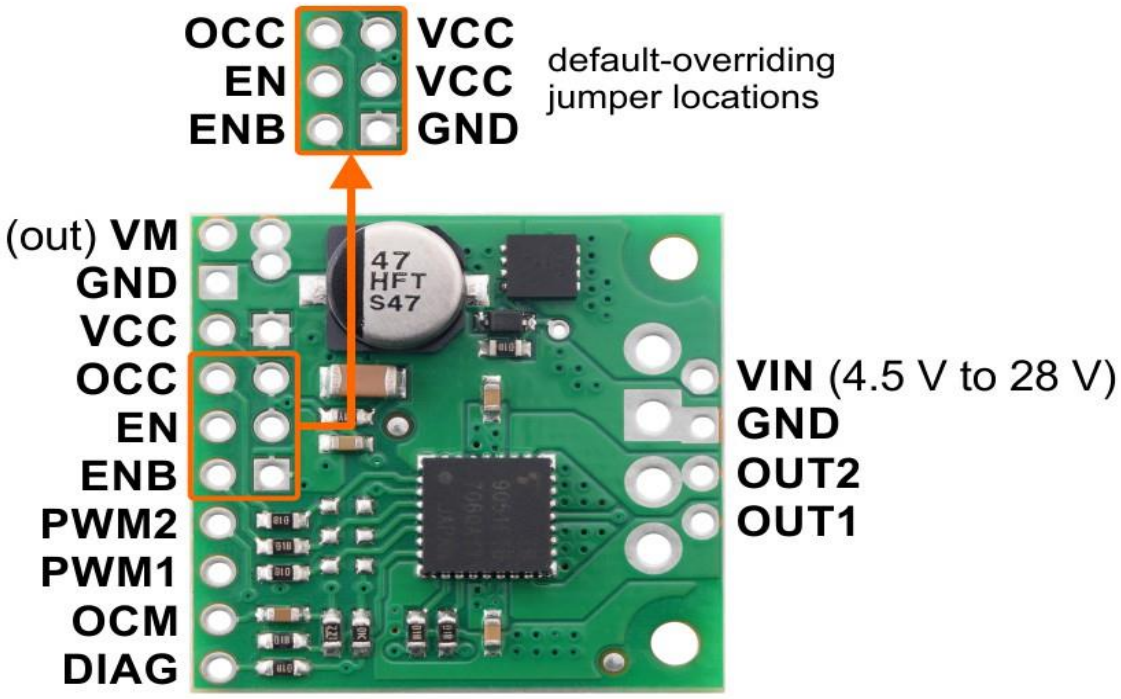
TB9051FTG simplified truth table (PWM1 + PWM2 + EN)						
Inputs				Outputs		Operation
EN	ENB	PWM1	PWM2	OUT1	OUT2	
PWM	0	1	0	PWM (H/Z)	PWM (L/Z)	forward/coast at speed *PWM %*
		0	1	PWM (L/Z)	PWM (H/Z)	reverse/coast at speed *PWM %*
0	X	X	X	Z	Z	coast (outputs floating/disconnected)
X	1	X	X	Z	Z	

The TB9051FTG drives its DIAG pin low whenever an under-voltage, VCC over-voltage, over-temperature, or over-current condition occurs. DIAG will also be low whenever either of the enable pins is disabling the driver (they both disable the driver by default). Otherwise, during normal operation, the board pulls DIAG up to VCC.

Over-temperature errors are latched, so the motor outputs will stay off and the DIAG pin will stay asserted until the fault is cleared by toggling one of the enable pins or disconnecting power to the driver. After an over-current error, the driver's behavior depends on the state of the OCC pin: if OCC is low (default), the outputs remain disabled until the fault is cleared, but if OCC is high, the driver will automatically try to resume operation after a fixed off-time (typically 500 ms). Regardless of the state of OCC, the DIAG pin remains asserted after an over-current error until the fault is cleared.

Under-voltage and VCC over-voltage errors are not latched (the driver will release the DIAG pin and resume operating as soon as the voltage is corrected). An exception is if the driver detects an abnormal voltage on start-up; in this case, it will continue asserting DIAG until the fault is cleared, although it will still allow normal operation in the meantime if there are no other active fault conditions.

PINOUT



Pinout diagram of the TB9051FTG Single Brushed DC Motor Driver Carrier.

The default states of some of the TB9051FTG logic input pins requires that external connections be made to use this motor driver. To reduce the number of necessary external connections, the board has three locations where an input can be jumpered to an adjacent pin to override the default. The OCC and EN default-overriding jumpers provide connections to VCC, while the ENB jumper provides a connection to GND. The VCC jumper pads are circles; the ground jumper pad is square.

PIN	Default State	Description
VIN		Reverse-protected 4.5 V to 28 V board power supply input.
GND		Ground connection points for the motor and logic supplies. The control source and the motor driver must share a common ground.
VM		These pins give access to the motor power supply after the reverse-voltage protection MOSFET (see the board schematic below). They can be used to supply reverse-protected power to other components in the system. VM is generally intended as an output, but it can also be used to supply board power, and some of the VM and GND holes are spaced for the addition of an optional through-hole capacitor.
OUT1		Motor output 1.
OUT2		Motor output 2.
VCC		5 V logic supply input.
OCC	LOW	Over-current response configuration input: by default, the driver remains disabled after an over-current condition, but if OCC is high, it automatically tries to resume driving after a short delay instead.
EN	LOW	Enable input: when EN is low, OUT1 and OUT2 are set to high impedance. PWM can be applied to this pin (typically done with ENB low and either PWM1 or PWM2 high). The default is for both enable pins to be disabling the driver.
ENB	HIGH	Inverted enable input: when ENB is high, OUT1 and OUT2 are set to high impedance. Inverted PWM can be applied to this pin (typically done with EN high and either PWM1 or PWM2 high). The default is for both enable pins to be disabling the driver.
PWM1	LOW	Control/PWM input for OUT1.
PWM2	LOW	Control/PWM input for OUT2.
OCM		Current monitor output: this pin provides an analog current-sense feedback voltage of approximately 500 mV per amp (only active while H-bridge is driving) through an on-board RC filter.
DIAG	HIGH	Diagnostic error output: driven low when certain faults have occurred or when the driver is disabled by the EN or ENB inputs. Otherwise, the board pulls this pin up to VCC.

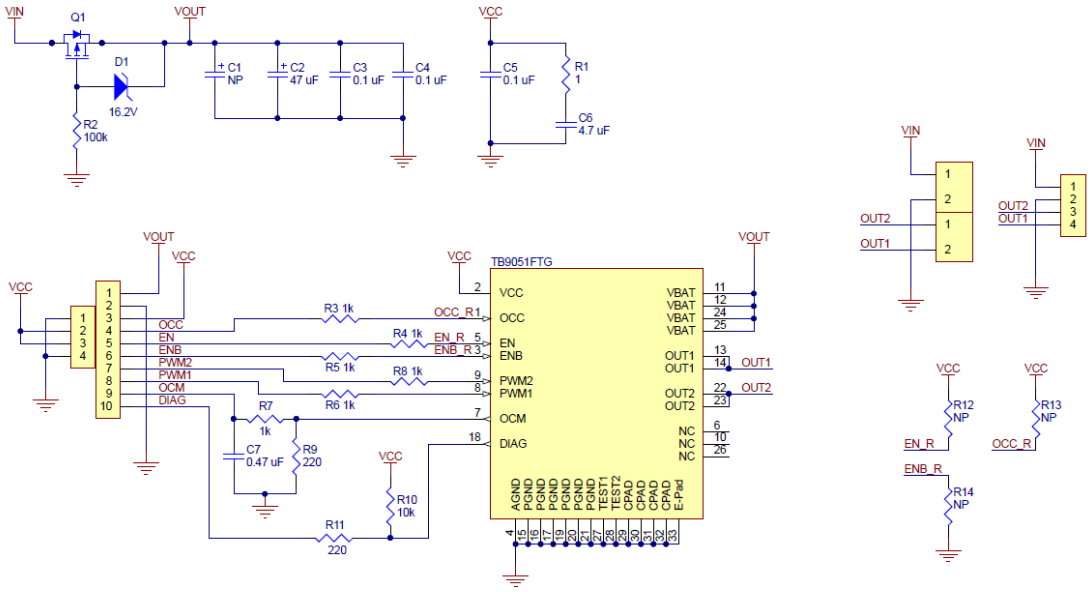
REAL-WORLD POWER DISSIPATION CONSIDERATIONS

The TB9051FTG will start chopping its output current at a typical threshold of 6.5 A. However, the chip by itself will typically overheat at lower currents. In our tests, we found that the chip was able to deliver 5 A for only a few seconds before the chip's thermal protection kicked in; a continuous current of about 2.6 A per channel was sustainable for many minutes without triggering thermal current limiting or an over-temperature shutdown. The actual current you can deliver will depend on how well you can keep the motor driver cool. The carrier's printed circuit board is designed to help with this by drawing heat out of the motor driver chip. PWMing the motor will introduce additional heating proportional to the frequency.

Unlike typical H-Bridges, the TB9051FTG has a feature that allows it to gracefully reduce the maximum current limit when the chip temperature approaches its limit. This means that if you push the chip close to its limit, you will see less power to the motor, but it might allow you to avoid a complete shutdown.

This product can get hot enough to burn you long before the chip overheats. Take care when handling this product and other components connected to it.

SCHEMATIC



Schematic diagram of the TB9051FTG Single Brushed DC Motor Driver Carrier