9 Amp Digital Bidirectional PWM Motor Controller with Braking
BIDIR-309-D

The BIDIR-309-D is a fully solid-state motor controller that allows you to control the speed and direction of a brushed DC motor using a potentiometer, a 0-5V voltage level, push buttons or logic pulses. Logic DIR and BRAKE inputs control motor direction and braking. Automatic current limiting protects the controller and motor from overload conditions. Additional safety features include reversed-battery protection, over-temperature protection, and over/under-voltage protection. Optional soft-start ramps up the speed of the motor when starting and reversing to limit stress to mechanical linkages and power supplies. A high efficiency full H-bridge allows for minimal power loss while delivering up to 9 amps to the motor.

Features:

- Forward / Reverse Control
- Braking input (full brake)
- Logic Enable input
- 9 Amps maximum continuous current
- 5k potentiometer or 0-5V control
- Push button speed control option
- Microcontroller input option
- Jumper-selectable soft-start function
- 0 – 100% pulse width output range
- Over-current protection
- Over-temperature protection
- Over/under voltage protection
- Reverse polarity protection
- LED status indicator
- Low ESR, long-life filter capacitors

Absolute Maximum Ratings:

Parameter	Max	Units
Continuous Output Current	9	A
Continuous Input Voltage	30	V
Instantaneous Input Voltage (t<0.1 s)	36	V

Warning – operating at or above the absolute maximum ratings may damage your controller or your equipment under control.

Operating Parameters:

Parameter	Min	Typical	Max	Units
Input Voltage	6	12	26	V
Continuous Output Current	--	--	9*	A
Digital Logic Input Low Level	0	--	1.5	V
Digital Logic Input High Level	3.5	--	5	V
Digital Logic Input Current	-0.2	--	1	mA
Digital Input Capacitance	--	0.1	--	uF
Digital Pulse Frequency (UP, DN lines)	0	--	500	Hz
Analog Voltage Input	0.0	--	5.0	V
Analog Voltage Input Current	0.0	0.05	0.1	mA
Potentiometer Total Resistance	1	5	30	kΩ
Soft Start from Disabled Mode, Ramp Rate**	--	100	--	% / s
PWM Frequency	1.2	1.5	1.8	kHz
Quiescent Current Drain	10	20	25	mA
Temperature	-40	25	+60	°C

* Internally limited
** When soft-start is enabled.

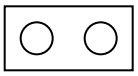
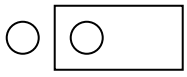
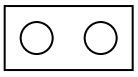
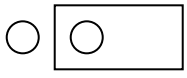
Pin-out:

Pin Label	Function	Active H/L
P-	Lower pin of potentiometer (GND)	--
CN/D	Wiper of potentiometer or Digital Decrease Speed Input	--
P+	Upper pin of potentiometer (5V)	--
EN	PWM output enable (internal pull-up)	H = enable L = disable
DIR	Direction Input	L = forward H = reverse
BRK	Brake Input	H = brake mode L = normal mode
UP	Digital Increase Speed Input	
M-	Negative output to motor	--
M+	Positive output to motor	--
GND	Ground from power supply	--
V+	Positive Power Supply	--

Modes of Operation:

The BIDIR-309-D can be operated in analog or digital mode. The jumper labeled A/D is used to select between analog and digital input modes. Jumper CL/PB is used to select between pulsed digital speed selection (microcontroller mode) and continuous digital speed selection (or push button mode).

Table 1: Jumper Configuration

	Jumper Label	Position	Function
	A/D	Closed	Potentiometer (Analog Mode)
	A/D	Open	Digital Mode
	CL/PB	Closed	Pulsed Digital (Microcontroller Mode)
	CL/PB	Open	Continuous Digital (Push Button Mode)

Note: All jumper setting changes take effect at power-up. Power down the board before changing the jumper settings.

Analog Mode:

When the board is configured for Analog Operation, a varying voltage (0 – 5 V) level is converted to the pulse width at the output (0 – 100%). Any potentiometer from 1kΩ - 30 kΩ may be used for speed control.

There is a built-in dead-band for potentiometer operation that sets the duty cycle to:
0% for any voltage level < 0.10 V.
100% for any voltage level > 4.90 V.

This dead-band along with digital filtering ensures smooth and reliable operation.

Digital Mode:

There are two ways to operate in digital mode: Microcontroller Mode and Push-Button Mode.

Microcontroller Mode:

In microcontroller mode, the UP and DN inputs are used to control the duty cycle. For every rising edge of the UP [DN] line, the output pulse width is increased [decreased] by approximately 0.8%. Once the pulse width reaches 0%, any further inputs on the DN line have no effect. Similarly, when the pulse width reaches 100%, any further inputs on the UP line have no effect.

Push-Button Mode:

In push-button mode, the UP and DN inputs are designed for interfacing to push buttons. When the UP line is brought LOW, the duty cycle is continuously increased at a rate of ~ 33% per second. Similarly, when the DN line is brought low, the duty cycle is decreased at a rate of ~ 33% per second. Any additional increase [decrease] after the pulse width has reached 100% [0%] will have no effect on the output.

Automatic digital de-bouncing of the inputs is implemented in continuous mode.

Output Enable:

The output is enabled by default and the EN pin is internally pulled up. Bringing the EN pin low immediately brings the PWM output to 0%, allowing the motor to coast. Allowing the pin to return high re-enables the PWM output at the previous duty cycle.

Direction:

A switch can be connected between the DIR input and P+ to reverse the direction of the motor. Alternatively, a 5V signal applied to the DIR input will also reverse the motor. While reversing quickly is supported, rapid switching of directions without braking first could result in excessively high currents that may shorten the life of the controller.

Brake:

A switch can be connected between the BRK input and P+ to cause the motor to brake by shorting the motor terminals together. Alternatively, a 5V signal applied to the BRK input will cause the motor to brake. The PWM level does not affect braking intensity - braking is always set to 100% when activated.

Soft Start:

To enable the soft-start feature, install a jumper across the terminals labeled SS. When soft-start is enabled, the output is automatically ramped up back to the original PWM level at a rate of 100% per second when the controller is switched from disabled to enabled. Soft-start is also activated when the direction is switched while the motor is running. This reduces the stress placed on power supplies and mechanical linkages as the motor comes back up to speed.

LED Status Indicators:

During normal operation, the GREEN status LED blinks slowly. During current limiting operation, the RED status LED will light.

Protection Systems:

The controller is protected from a reversed V+ and GND power connection. However, triple check the wiring before applying power to ensure that power is not unintentionally applied to the M+ and M- terminals.

In the event the controller overheats, the controller will shut down until the temperature drops. The maximum H-bridge chip temperature is 150°C. During normal operation, the chip should never reach this temperature.

The controller will shut down if the voltage is too low to sustain proper operation. It will also be disabled if the voltage exceeds the maximum allowable operating voltage of 30 volts. Please note that while the controller will shut down, excessive voltage beyond 33 volts will still cause damage to the unit.

Application Notes:

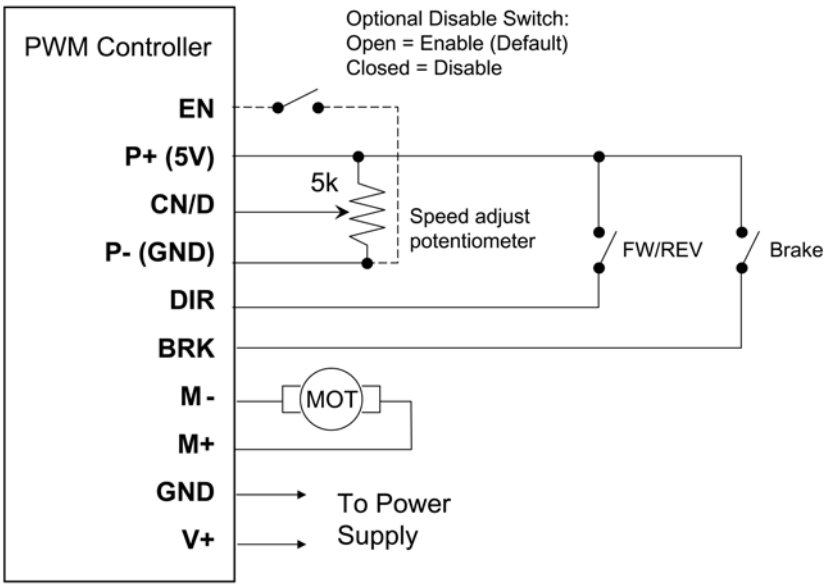
Ensure that the controller is wired correctly before applying power. Always turn off the power supply before making any changes to the wiring.

PWM controllers switch currents at high frequencies to vary the average power to the load. This switching can cause undesirable RF interference. To minimize such interference, it is recommended to twist the input V+ and Ground wire pair as well as the M+ and M- wire pair.

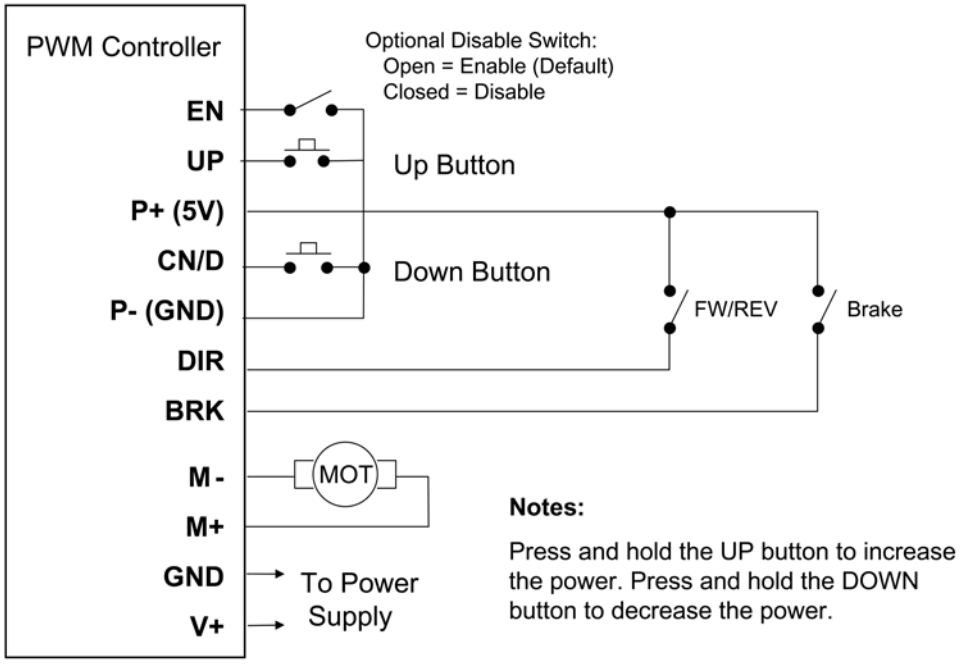
Ensure that the controller has adequate air flow for proper cooling. If operating for extended periods of time in high temperature environments, a cooling fan may be necessary.

Use the shortest possible wiring between the load and controller, and between the controller and the power source. Ensure that the cables carrying the load current are adequately sized. If the wiring from the power source to the controller is more than 12 inches long, a 470 uF 50V filter capacitor should be connected directly to the V+ and GND terminals of the PWM controller. Inadequate power supply filtering or other causes leading to a high impedance path to the power supply will result in higher losses in the filter capacitor and wiring, and may damage the load and/or controller.

Typical Connections – Potentiometer Control Mode:



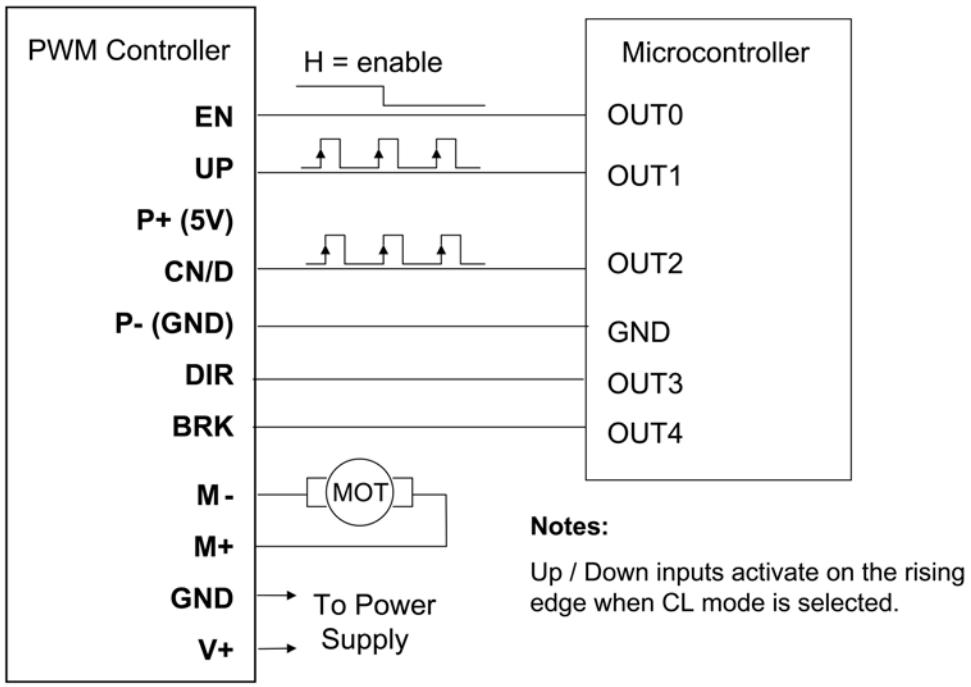
Typical Connections – Push Button Mode:



Notes:

Press and hold the UP button to increase the power. Press and hold the DOWN button to decrease the power.

Typical Connections – Microcontroller Mode:



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