15 Amp Bidirectional Digital PWM Motor Speed Controller

BIDIR-115D and BIDIR-115DS

The BIDIR-115D(S) allows you to control the speed and direction of a motor using an analog voltage input, push buttons, or digital logic pulses. Use of PWM and low on-resistance MOSFETs allows for high efficiency control with minimal loss of power.

Absolute Maximum Ratings:

Parameter	Max	Units
Continuous Output Current	15	A
Instantaneous Output Current	20	A
Input Voltage	30	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	10	12	26	V
Continuous Output Current	--	--	15	A
Digital Logic Input Low Level	0	--	1.5	V
Digital Logic Input High Level	3.5	--	5	V
Digital Input Capacitance	--	0.1	--	uF
Analog Voltage Input	0	--	5	V
Potentiometer Total Resistance	1	10	30	kΩ
Digital Continuous Mode Change Rate	--	33	--	% / s
Soft Start from Disabled Mode, Ramp Rate	--	100	--	% / s
PWM Frequency	150	200	250	Hz
Quiescent Current Drain	70	75	80	mA
Temperature	-40	25	+60	°C

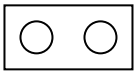
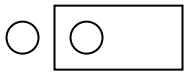
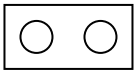
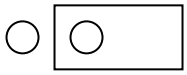
Pin-out:

Pin Label	Function	Active H/L	Mode
P-	Lower pin of potentiometer (GND)	--	Analog
DN/CN	Wiper of potentiometer (analog) Decrease Pulse Width (digital) (internal pull-up in digital mode)	L = decrease (digital)	Both
P+	Upper pin of potentiometer (5V)	--	Both
UP	Increase Pulse Width (internal pull-up)	L = increase	Digital
DIR	Direction	L = forward H = reverse	Both
EN	PWM output enable (internal pull-up)	H = enable L = disable	Both
M -	Negative output to LOAD	--	Both
M +	Positive output to LOAD	--	Both
GND	Ground from power supply	--	Both
V+	Positive Power Supply	--	Both

Modes of Operation:

The Analog/Digital PWM Controller can be operated in analog or digital mode. The jumper labeled P/D (JP1) is used to select between analog and digital inputs. Jumper CLKED is used to select between clocked digital speed selection and continuous digital speed selection (or push button mode).

Table 1: Jumper Configuration

	Jumper Label	Position	Function
	P/D (JP1)	Closed	Potentiometer (Analog Mode)
	P/D (JP1)	Open	Digital Mode
	CLKED (JP2)	Closed	Clocked Digital
	CLKED (JP2)	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 using the jumper, 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 even with dirty potentiometers.

A switch can be connected between the DIR input and P+ to reverse the direction of the motor. Ensure that the motor is completely stopped before reversing direction. The onboard fuse protects the motor in the event of an accidental reverse when the motor is still rotating. Replace only with a fuse of the same type and rating.

Digital Mode:

There are two ways to operate in digital mode: Clocked Mode and Continuous Mode.

Clocked Mode:

In clocked 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.

Continuous Mode:

In continuous 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. Spurious inputs are ignored.

Output Enable:

The output is enabled by default and is internally pulled up. Bringing this pin low immediately brings the PWM output to 0%. Allowing the pin to go back to high re-enables the PWM output at the previous duty cycle.

When in digital mode, the duty cycle may be changed by the UP and DN pins at all times, even in PWM output disabled mode. Thus, it is possible to turn off the output, change the duty cycle, and turn on the output again, but at the new duty cycle.

Reversing:

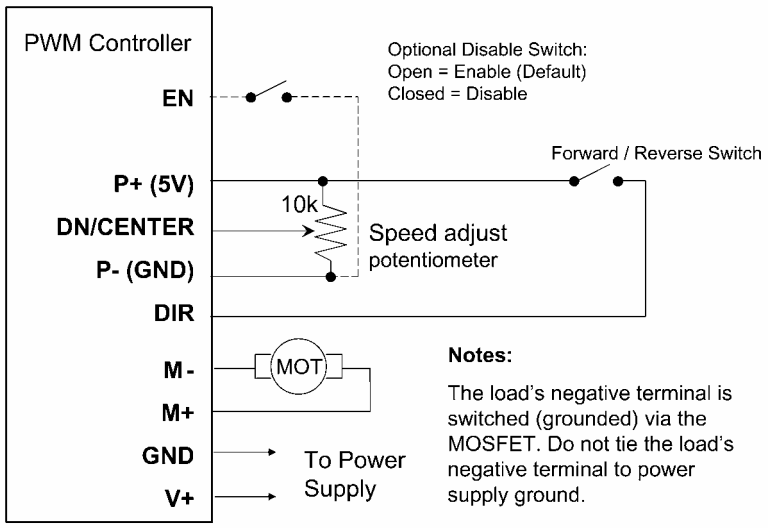
A 0-5V digital signal can be sent to the DIR input to reverse the direction of the motor. If using continuous mode, a switch can be connected between P+ and DIR instead for reversing control. Ensure that the motor is completely stopped before reversing direction. The onboard fuse protects the motor in the event of an accidental reverse when the motor is still rotating. Replace only with a fuse of the same type and rating.

Soft Start (BIDIR-115DS only):

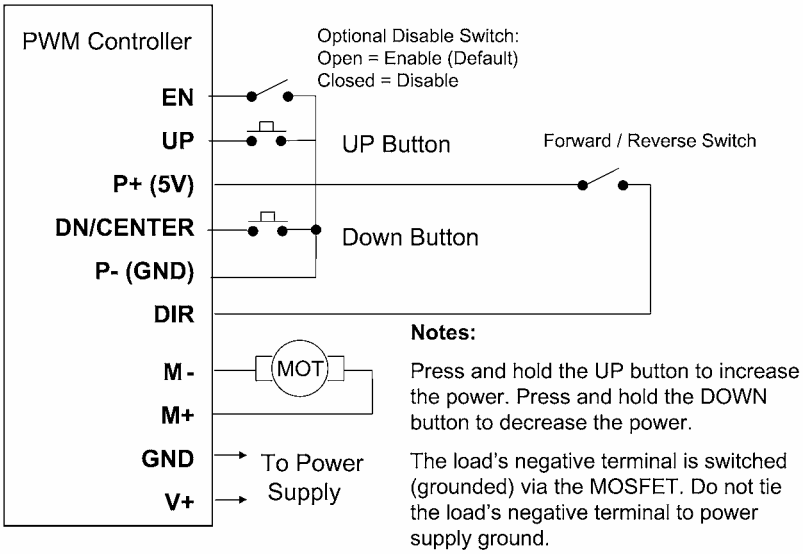
The output is automatically ramped up back to the full PWM level at a rate of 100% per second. This reduces the stress placed on power supplies and mechanical linkages as motors come back up to speed.

Connection Diagrams:

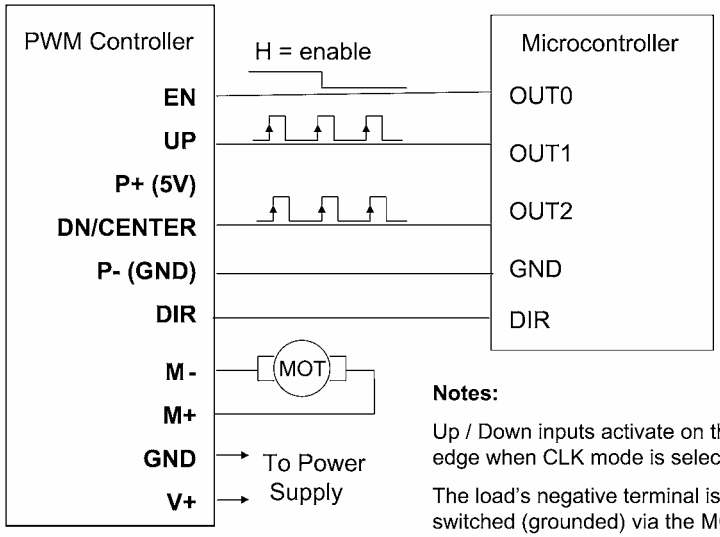
Analog Control Mode



Digital Control Mode: Push-button interface



Digital Control Mode : Microcontroller interface



Notes:

Up / Down inputs activate on the rising edge when CLK mode is selected.

The load's negative terminal is switched (grounded) via the MOSFET. Do not tie the load's negative terminal to power supply ground.

Application Notes:

The controller automatically puts the motor into braking mode when power is removed. Please be aware that if the motor is still spinning when the power is removed, the motor will brake suddenly.

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 Out+ and Out- wire pair. In addition, installation of a small capacitor from each of the two motor terminals to the metal case may reduce noise emission.

A fuse appropriately rated for the load device can help enhance safety.

This controller is not reverse-polarity protected. Ensure that it is wired correctly before applying power. Always turn off the power supply before making any changes to the wiring.

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 wires between the motor and controller, and between the controller and the power source. Ensure that the wires carrying the load current are adequately sized. If operating heavy inductive loads, it may be advisable to add an appropriately rated filter capacitor at the input to 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, reducing overall system efficiency.

30-Day Limited Warranty:

Subject to the provisions described below, CRITICAL VELOCITY ENTERPRISES, LLC ("Critical Velocity") warrants this product to be free from defects in material and workmanship for thirty (30) days from the date of purchase by the original consumer. If any part is found to be defective during the warranted period, it will be repaired or replaced with the same or functionally equivalent product by Critical Velocity, at its discretion, free of charge provided you: (1) return the failed product to Critical Velocity with shipping prepaid, and (2) provide Critical Velocity with proof of the original date of purchase. Repaired or replacement products will be returned to you with shipping charges prepaid.

Replacement products may be refurbished or contain refurbished materials. If Critical Velocity, by its sole determination, is unable to repair or replace the defective product, it will refund the purchase price of the product. This warranty does not apply if, in the judgment of Critical Velocity, the product fails due to damage from shipment, handling, storage, accident, abuse or misuse, or if it has been used or maintained in a manner not conforming to product manual instructions or has been modified in any way. Repair by anyone other than Critical Velocity will void this warranty. The maximum liability of Critical Velocity under this warranty is limited to the purchase price of the product covered by the warranty.

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1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.

2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.