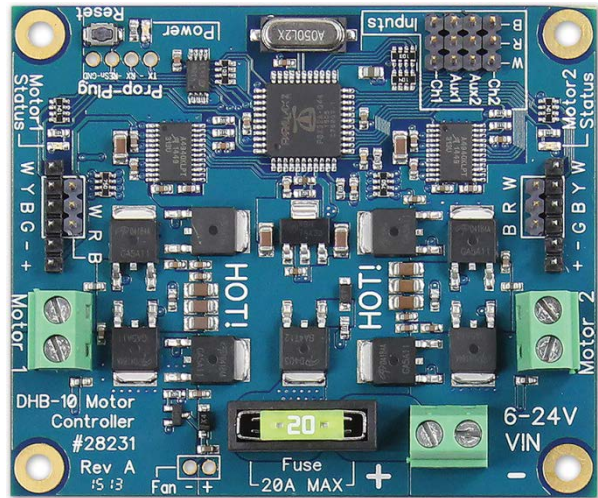


# DHB-10 Dual H-Bridge 10 Amp Motor Controller (#28231)

The DHB-10 is an open-source, 10 amp dual H-bridge motor controller. It features an onboard multicore Propeller microcontroller to provide precise closed-loop or open-loop control for two individual motor channels.

Ready to use, the DHB-10 comes preloaded with open source firmware designed for use with the Arlo robot platform: <http://learn.parallax.com/arlo>.



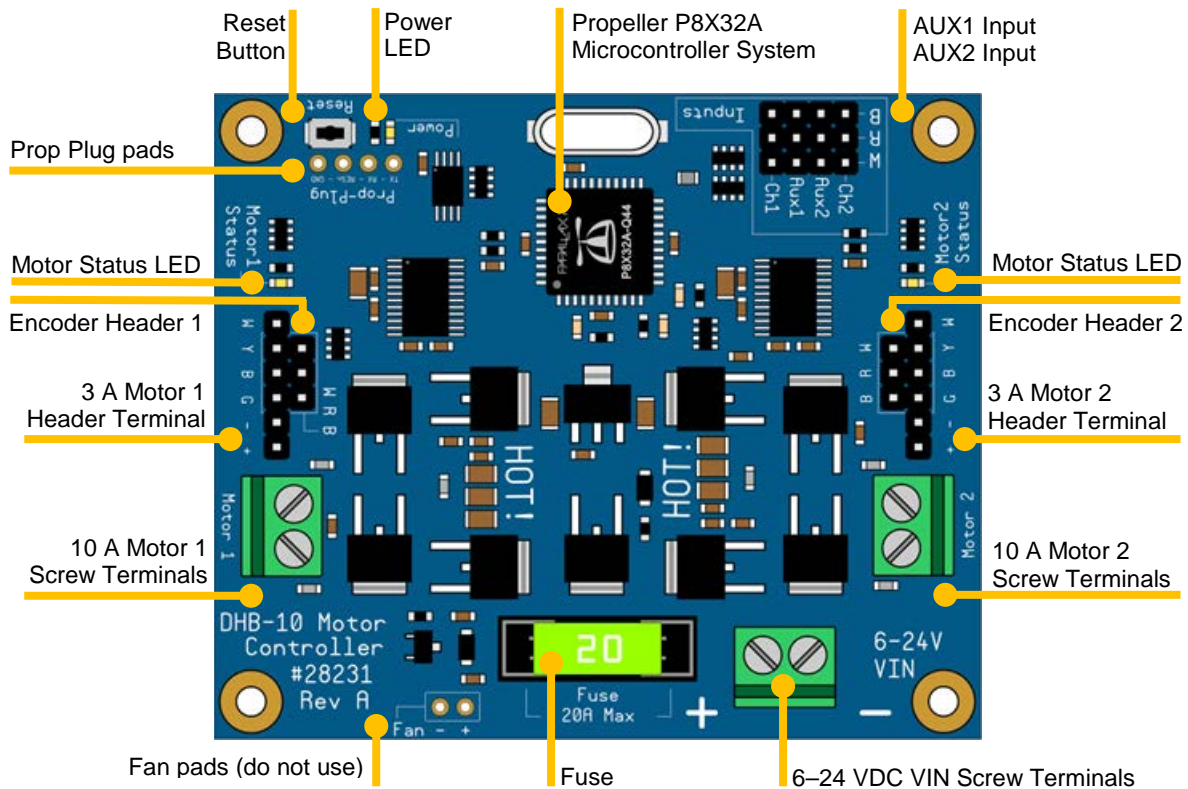
## Features

- Built-in 8-core 80 MHz Propeller P8X32A microcontroller with 64 KB EEPROM and 5 MHz crystal
- Wide 6–24 VDC supply voltage range with reverse polarity protection
- Two independent 10 amp motor control channels
- Pin headers for direct plug-in of standard Parallax encoders
- Screw terminals for large-current motors
- Two flexible input channels allow control of both motors together or individually
- Input channels automatically sense PWM or serial data commands
- Reset button to return to PWM/Serial auto-detect mode or to clear errors
- Power and motor status LEDs
- Four grounded 0.125 inch (3.2 mm) mounting holes
- Accepts mini fuses; 20 amp fuse included and installed
- Pads provided for the Prop Plug (#32201) to load firmware updates

## Specifications

- Power requirements: 6–24 VDC (DHB-10 and motor supply voltage)
- Maximum continuous motor current: 10 A per channel; 13.5 A total
- Maximum surge motor current: 12 A per channel, 24 A total
- Communication: 19,200 to 115,200 baud open-collector non-inverted Serial or PWM
- Dimensions: 3.05 x 2.56 in (77.5 x 65 mm)
- Operating temp range: 32 to 158 °F (0 to 70 °C)

## Functional Description



### Propeller P8X32A Microcontroller System

The multicore Propeller P8X32A Microcontroller System includes a 64K EEPROM and 5 MHz oscillator. The Propeller microcontroller loads firmware and nonvolatile settings from the EEPROM, automatically detects PWM or serial inputs, and drives one or two motors. The firmware is capable of reading encoders and performing advanced closed-loops motor controls for precise navigation of robotics platforms.

### CH1 and CH2 Inputs

The DHB-10 accepts serial and PWM inputs on CH1 and CH2. Note that the center "R" pin on these headers is not connected.

### AUX1 and AUX2 Inputs

If AUX1 the AUX2 I/O pins are shorted on power up, the DHB-10 will return all control and communications settings to factory default, including those that have been saved to EEPROM. These inputs are not otherwise used by the original firmware. Note that the center "R" pin on these headers is not connected. See the Propeller I/O Pin Assignments and the open-source DHB-10 design files for more information about these pins, if desired.

### Encoder Headers

The encoder headers are compatible with the Parallax 36-position Quadrature Encoder Set (#29321) used with the Arlo Robot Platform System. Each encoder uses two 3-pin BRW (Black-Red-White) cables, and these connect to the headers marked BRW and GBY on the DHB-10 board.



**WARNING:** Never plug a 3-pin encoder cable into the pins marked "+ -" because doing so can permanently damage your encoder!

## Motor Status LEDs

At reset, the status LEDs will flash, in sync at a slow rate, to indicate that the board is ready to accept commands. After receiving input, each LED will remain off to indicate valid control input for a given motor, or the LEDs will turn on, after a period of time without a valid PWM input or in the case of a fault condition.

Fault conditions can include an obstruction that prevents the motor turning, power overload, board overheating, under-voltage such as low battery, wiring error, or cable damage.

## 10 Amp Motor Screw Terminals

The screw terminals are suitable for directly connecting motors that have bare cable connections, such as the Parallax Motor Mount & Wheel Kits #28962 (Aluminum) or #28963 (Plastic) supplied with the Arlo platform.

The screw terminals wire sizes in the range 26–16 AWG range (0.14 mm<sup>2</sup> to 1.5 mm<sup>2</sup>). Ensure an appropriate size cable to safely satisfy the power requirements of the motor.

Each channel has a dedicated A4940 H-Bridge MOSFET controller which provides protection against the noise often associated with brushed motors.

## 3 Amp Motor Header Terminals

These header pins with 0.1" spacing provide a secondary connection to the motor outputs for smaller motors, up to 3 amps.



**WARNING:** Do not use the 10 A Motor Header Screw Terminals and the 3 A Motor Header Terminals at the same time.



**WARNING:** Do not connect any motor output to ground. Connect motors directly to the Motor Screw Terminal, or Motor Header Terminal.



**WARNING:** The DHB-10 motor controller is designed to support 2-wire DC motors. DO NOT connect 3-wire motors.

## 6–24 VDC VIN Screw Terminals

The DHB-10 powers the motors, and itself, from a 6–24 VDC input supplied to the VIN terminal. The input voltage should match the voltage required by the attached motors. The polarity is marked on the board with (+) and (–) symbols on either side of the screw terminal block.

The DHB-10 has built in protection against reverse polarity supply to the VIN screw terminal. The DHB-10 will not operate and the power LED will not illuminate if the voltage supply is connected in reverse.

The four 0.125" mounting holes, located on each corner, are electrically connected to the negative VIN terminal ground.



**WARNING:** Ensure the DHB-10 is not installed on a conductive surface which may short out the high-current pins on the bottom of the board.

## Fuse

The DHB-10 is supplied and fitted with a 20 amp fuse, to support up to 10 amps per channel. Install a lower value fuse when using motors that have a low continuous current rating. The fuse holder will accept either mini or low-profile mini automotive fuses.

## Fan Pads

The connections labeled "Fan" are not available for use with Rev A hardware and original firmware. Do not connect anything to these pads.

## Prop Plug Pads

Connect a Prop Plug (#32201) via a 4-pin male-male header to these pads to load updated firmware. The DHB-10 is supplied as a ready-to-run motor controller with pre-programmed firmware for use with the Arlo Robot Platform System, or as a stand-alone motor controller. Any future versions of the firmware would be made available from the DHB-10 Motor Controller product page at [www.parallax.com](http://www.parallax.com).

## Reset Button

The reset button clears some error conditions and resets the input to automatically detect PWM or serial inputs. The reset button may not clear all motor errors and may not return all settings to factory defaults.

The onboard Propeller microcontroller will automatically load and run the preloaded firmware upon power-up or after reset. This process takes about 2 seconds, after which both motor channel LEDs will flash slowly to indicate the DHB-10 is ready for input.

## Power LED

The Power LED remains on when correct polarity voltage is supplied to the 6–24 VDC VIN connector.

## Quick-Start Guide

The DHB-10 comes pre-loaded with firmware so that it is ready to use with the Arlo Robot Platform System or as a standalone motor controller.

To use with the Arlo Robot Platform System, see the tutorials at <http://learn.parallax.com/arlo>.

For additional information, read the sections below and also refer to the DHB-10 Firmware Guide and open-source design files available from the 28231 product page at [www.parallax.com](http://www.parallax.com).

## General Use

Connect a motor to either the Motor header (marked + -), or to the Motor screw terminal.

If you are using an encoder to improve motor position accuracy, then plug that into the 3-pin header marked "BRW" located next to the motor terminal. If your encoder is a dual channel type (and has two cables), then plug the second cable into the 6-pin header parallel to the first encoder plug. These pins are labelled GBY.



**WARNING:** Never plug a 3-pin encoder cable into the pins marked "+ -" because doing so can permanently damage your encoder!

Connect the DHB-10 CH1 and CH2 headers to your robot control board.

Having double checked all your connections, the VIN screw terminal must be supplied with the correct voltage in the range 6–24 VDC, according to the motors you have connected.

In the case of Arlo, that would typically be 12 V connected to the motor screw terminal on the Arlo Power Distribution Board (#28996). You could also connect VIN directly to a battery.



**WARNING:** The cable connecting DHB-10 to your power source must be rated sufficiently to handle the maximum stall current required by your motors, which can be much higher than the operating current! Consult your motors' manufacturer datasheet.

### Input Modes

On startup, or after a default of 250 ms without a valid PWM pulse, each motor's status light will flash slowly. The DHB-10 will respond to PWM pulses until it receives serial data on the CH1 pin, at which point it will halt all motor movement and only respond to serial commands, until it either receives the PULSE command or it is reset or power cycled. While responding to a valid PWM pulse, or waiting for a serial command, the status lights will remain off, unless there is a fault.

### PWM

For PWM controls, use CH1 to control Motor 1, the left motor, and CH2 to control Motor 2, the right motor. Under a default configuration, use a 1 ms pulse for full reverse, a 1.5 ms pulse for no movement, and a 2 ms pulse for full forward. To maintain motor power, send a pulse at least every 250 ms.

For different pulse width ranges or inter-pulse timing, see the SCALE and HOLD commands in the DHB-10 firmware documentation, available for download from the 28231 product page at [www.parallax.com](http://www.parallax.com).

### Serial

Under a default configuration, connect a bidirectional serial port at 19,200 kilobaud, to CH1. For different baud rates or separate transmit and receive pins, see the BAUD and RXPIN commands.

### Factory Defaults

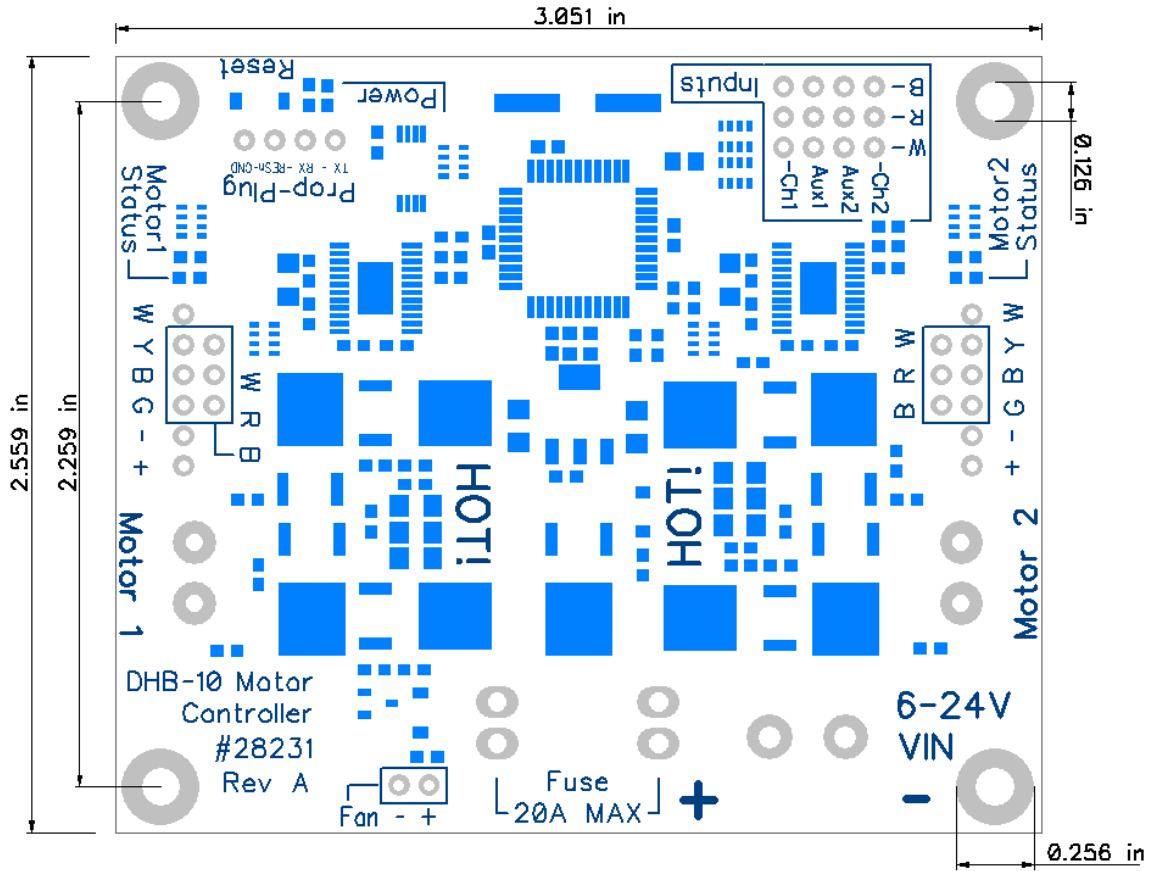
To return all settings to factory defaults, including pulse width ranges, pulse timing, serial pin assignments, and the serial baud rate, short the AUX1 and AUX2, then power on the board. The fault LEDs will light alternately. Remove the short between AUX1 and AUX2, and power cycle or reset the board.

## Propeller I/O Pin Assignments

See the open-source DHB-10 Design Files, available as a download from the 28231 product page at [www.parallax.com](http://www.parallax.com), for more information about the Propeller I/O pin usage.

I/O Pin	Function
P0	Encoder 1A
P1	Encoder 1B
P2	Motor 1 – Status LED
P3	Motor 1 - Fault
P4	Motor 1 - ALO
P5	Motor 1 - BHI
P6	Motor 1 - BLO
P7	Motor 1 - AHI
P8	Not connected
P9	NTC RC Network - Channel 2
P10	NTC RC Network - Channel 1
P11	Motor 2 - Reset
P12	Motor 2 - Fault
P13	Motor 2 - AHI
P14	Motor 2 - ALO
P15	Motor 2 - BHI
P16	Motor 2 - BLO
P17	Motor 2 – Status LED
P18	Encoder 2B
P19	Encoder 2A
P20	Serial 2
P21	Serial 1
P22	Aux 1
P23	Aux 2
P24	Motor 1 - Reset
P25	Not connected
P26	Not connected
P27	Optional Fan PWM control
P28	EEPROM / Accelerometer / I2C clock
P29	EEPROM / Accelerometer / I2C data
P30	TX (USB programming / terminal)
P31	RX (USB programming / terminal)

## Module Dimensions



## Revision History

Version 1.0: original release