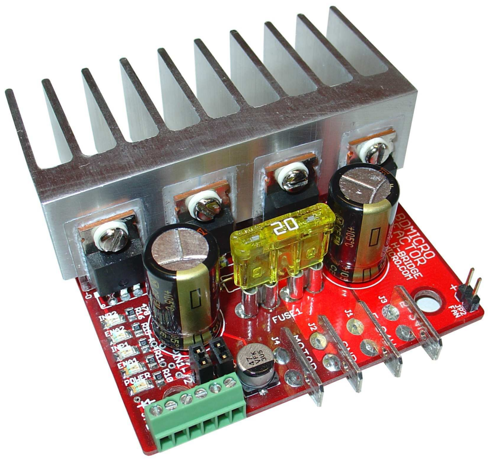


RX50

REACTOR RX50
Technical Manual

BDMICRO
http://www.bdmicro.com/

April 6, 2009

DISCLAIMER

BDMICRO products are designed and assembled with care and all assembled products must pass functional testing to ensure quality before they are shipped. However, our products are not rated for use in medical, life support, or systems where failure could result in the loss of life or have serious life threatening or economic impact.

BDMICRO does not warrant merchantability for any purpose and shall not be liable for any direct, indirect, incidental, special, exemplary, or consequential damages of any kind, however incurred, through the use of our products.

Contents

1 WARNING **4**

2 Introduction and Features **4**

3 Specifications **4**

4 Connections **6**

4.0.1 FAN 6

4.0.2 V+ and GND 6

4.0.3 MOTOR+ and MOTOR- 6

4.0.4 VCC and GND 7

4.0.5 EN1 and IN1 7

4.0.6 EN2 and IN2 7

4.1 Control Input / Truthtable 7

4.2 Locked Anti-Phase Drive 7

4.3 Sign Magnitude Control 8

4.3.1 RX50SM Sign-Magnitued Pinout 9

5 Mounting Instructions **10**

5.1 Using a Fan for Forced Air Cooling 10

1 WARNING

The RX50 device is a high power component capable of carrying large electrical currents and voltages. Use extreme caution when working with the RX50 and double check all connections before applying power. If you see smoke or smell burning, disconnect all power immediately.

2 Introduction and Features

The BDMICRO RX50 is a high performance h-bridge driver circuit designed to drive inductive and resistive loads using mid to high frequency PWM signals. The native drive method is **locked-antiphase**. Other drive methods are possible using external components. An ATO style clip fuse holder is incorporated on-board as a failsafe against over current.

- all MOSFET driver
- high frequency PWM input - over 100 kHz possible
- wide operating load voltage range from 5 to 30V
- adaptive non-overlapping gate drive
- TTL/CMOS control input levels
- 5 LED status indicators
- on-board overload protection using commonly available ATO style fuse
- easy to use screw terminals for control connections
- easy to use FASTON connectors for power and load
- drives resistive and inductive loads
- 60mm fan optional
- on-board connector for optional fan
- native locked-antiphase control logic
- sign-magnitude control available with optional RX50SM logic module

3 Specifications

- Input Voltage:
  Logic: 5V regulated
  Driver: 5V to 24V, 30V absolute max
- Drive Current:
  - No Heatsink: 10 Amps (@ 12V)

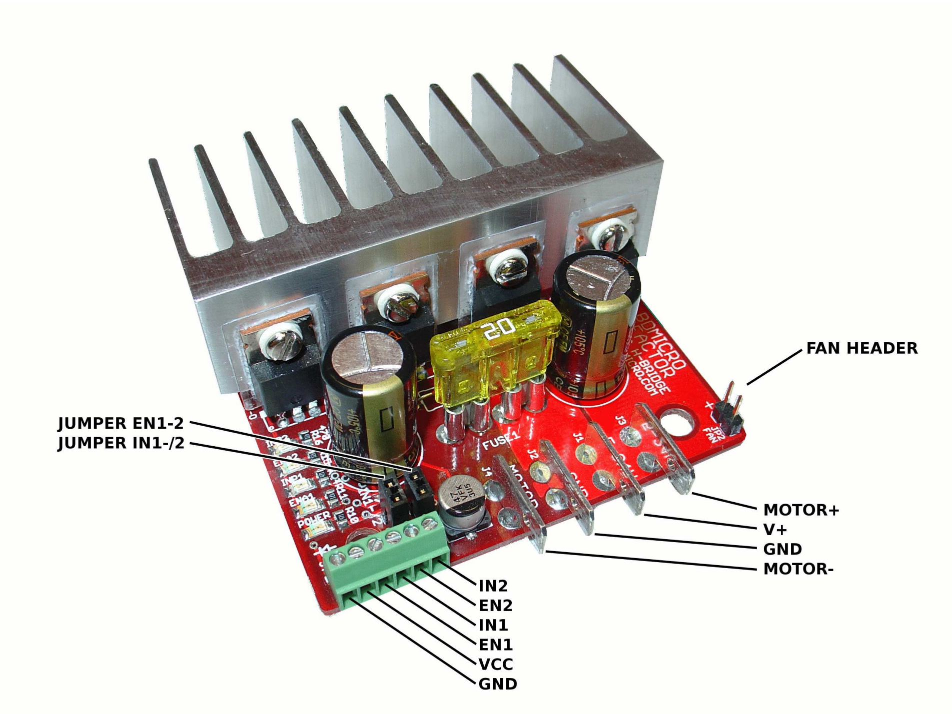
  - Using Optional Heatsink: 30 Amps (@ 12V)

  Note that higher voltages will produce more heating and reduce the current carrying capacity. Active cooling with forced air such as a fan can extend the current carrying capacity.

- PWM Frequency: DC to 150 kHz
- Fuse: common ATO automotive blade style

4 Connections

See the diagram below for the position of each h-bridge connection.



4.0.1 FAN

The FAN header provides two pins for powering a fan for forced air cooling of the h-bridge. The + mark on the PCB silkscreen indicates the positive lead. The other lead is GND. These leads connect to teh V+ and GND supply, therefore, use a fan that is rated for the supply voltage that is powering the h-bridge. For example, if you are using a 12VDC h-bridge supply voltage, choose a fan rated for 12VDC.

4.0.2 V+ and GND

V+ and GND are used to supply power to the driver for driving the load. The load is connected using the `MOTOR+` and `MOTOR-` connections.

4.0.3 MOTOR+ and MOTOR-

MOTOR+ and MOTOR- provide connections for the driver load. These connections are either at the level of GND or V+, depending on the state of teh EN1, IN1, EN2, and IN2 control connections.

4.0.4 VCC and GND

VCC and GND on the .1 inch screw terminal header block supply the control logic power and should be supplied with regulated 5V. This supplies the power necessary to run the LEDs and LAP control intverter.

4.0.5 EN1 and IN1

EN1 and IN1 control one half of the h-bridge. The EN1 control enables the half-bridge, while the IN1 control determines the state of the high-side and low-side MOSFETS which are complementary of each other.

4.0.6 EN2 and IN2

EN2 and IN2 control the other half of the h-bridge. The EN2 control enables the half-bridge, while the IN2 control determines the state of the high-side and low-side MOSFETS which are complementary of each other.

The signals EN1, IN1, EN2, and IN2 are used together to control the state of the h-bridge. See below for how to control the state of the h-bridge with these signal inputs.

4.1 Control Input / Truthtable

The `EN1`, `IN1`, `EN2`, `IN2` signals are used to control the output state of the h-bridge. The `ENx` controls should only be used to enable and disable their respective bridge halves, while the `INx` controls used to supply the PWM signal. The `ENx` are not designed for high-speed PWM and should not be used for that purpose. Using the `ENx` controls for high-speed PWM will result in poor quality output control and could damage the h-bridge and possibly the load. See the following truthtable for the possible control states:

EN1	EN2	IN1	IN2	MOTOR+	MOTOR -	Description
0	0	x	x	OPEN	OPEN	bridge disabled, motor freewheels
1	1	0	0	GND	GND	MOTOR leads brake to GND
1	1	1	1	V+	V+	MOTOR leads brake to V+
1	1	0	1	GND	V+	MOTOR turn CW
1	1	1	0	V+	GND	MOTOR turn CCW

4.2 Locked Anti-Phase Drive

Locked Anti-Phase is a motor drive method where both bridge halves are enabled and the motor's direction is controlled using the PWM duty cycle. At 50% duty, the motor rotor is stationary. At $> 50\%$, the motor rotor rotates in one direction and at $< 50\%$ duty, it rotates in the opposite direction. At 100% duty, the motor is full on and at 0% duty, the motor is full on in the opposite direction.

Some advantages of Locked Anti-Phase Drive are:

- excellent motor response to changes in PWM
- excellent motor speed control w/braking

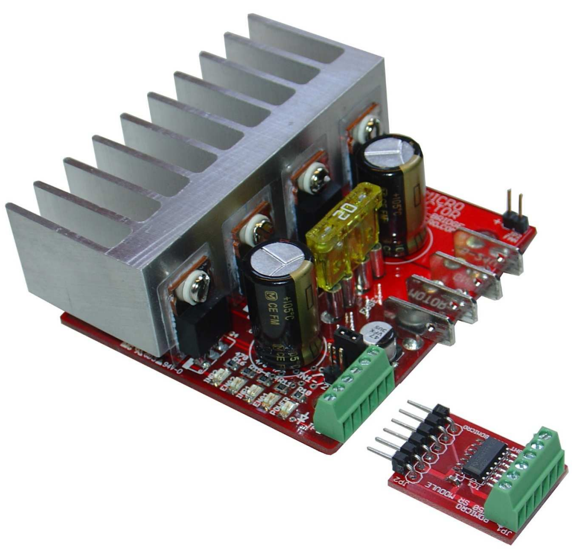
The RX50 h-bridge is designed with LAP drive built-in, no external circuitry is required. To run the RX50 using LAP drive, simply install jumpers EN1-2 and IN1-/2. Connect the h-bridge enable control line to EN1. The RX50's EN2 input is left unconnected - the jumper EN1-2 connects the EN2 control signal to the EN1 control signal so both are driven simultaneously by a single control signal to EN1. Connect the h-bridge PWM control line to IN1. Like EN2, the IN2 control line is left unconnected. The jumper IN1-/2 connects the IN1 control input through an inverter and then to the IN2 control signal. This results in IN2 = /IN1, which is required for locked-antiphase drive control. Enable the bridge by bringing EN1 high. Apply the desired PWM duty cycle to IN1 - 50% for motor stopped, 0% for full-on, 100% for full-on in the opposite direction, or some proportionate duty cycle to acheive speed control.

Note: do not use EN1 nor EN2 control signals for PWM control. These signals are designed to energize and de-energize the h-bridge driver, and are not designed for high-speed PWM control.

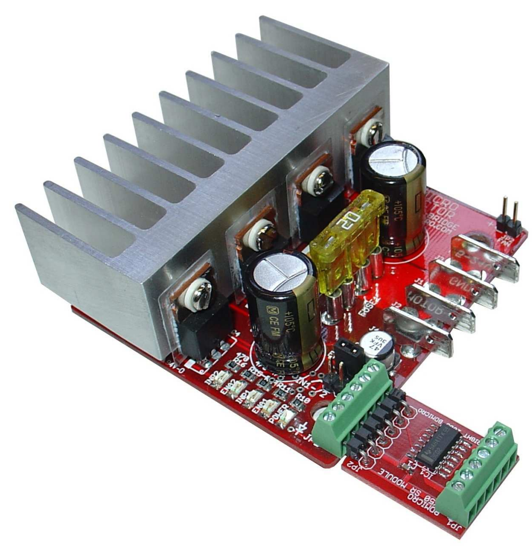
4.3 Sign Magnitude Control

Sign-Magnitude h-bridge control uses a *direction* and a *PWM* control signal. *Direction* controls the rotational direction of the motor, while the *PWM* signal is used to control the duty cycle. A 0% duty cycle stops the motor while a 100% duty cycle runs the motor at full speed. Use a duty cycle proportionally between 0 and 100% to control the motor's speed.

The RX50SM module is required for sign-magnitude control. Connect the sign-magnitude control signals to the screw terminal and connect the right angle pin header directly into the screw terminal control connections on the RX50. Remove the jumper labeled **IN1-/2** and install the jumper labeled **EN1-2**. The RX50SM module becomes an extension to the RX50 - see photo below.



RX50 H-BRIDGE + RX50SM MODULE



RX50SM MODULE INSTALLED

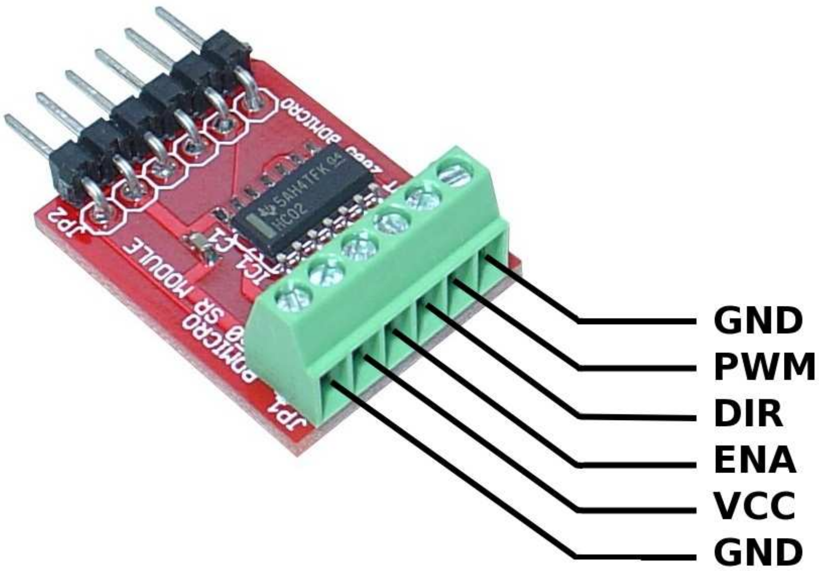
Three signals are used to control the RX50 when using sign-magnitude control. These are:

- ENA - h-bridge enable
- DIR - direction control
- PWM - duty cycle control

The following shows the truth table when using the RX50SM sign-magnitude module.

ENA	DIR	PWD	Description
0	x	x	bridge disabled, motor freewheels
1	0	0	MOTOR shaft stopped, leads shorted for brake
1	0	1	MOTOR shaft spins CW
1	1	0	MOTOR shaft stopped, leads shorted for brake
1	1	1	MOTOR shaft spins CCW

4.3.1 RX50SM Sign-Magnitued Pinout



Note that ENA is optional and can be tied high to continuously enable the h-bridge. This reduces the control signals required from the microcontroller to two. A PWM of 0% stops the motor. However, for full h-bridge control, we recommend using the ENA signal which can be used to de-energize the h-bridge when not in use. Also, with the ENA signal low, the motor can be allowed to freewheel, which is not possible otherwise.

Note: do not use the ENA control signal for PWM control. This signal is designed to energize and de-energize the h-bridge driver, and is not designed for high-speed PWM control.

The sign-magnitude implemention provided by the RX50SM module does not freewheel the motor during the PWM low state. This is a feature which allows for tight motor control and is not typically provided by other sign-magnitude implementations.

5 Mounting Instructions

Four mounting holes are provided for mounting the RX50. **Be sure and choose your wire size to handle your amperage draw. Choosing wire that is too small can result in fire or other hazards.** Use the provided screw terminals to interface to your low-power logic connections. Use 0.25 inch blade style crimp connectors for the power input and motor output connections. Since the wire of the larger sizes for higher currents is typically fairly stiff, be sure and mount the RX50 securely to keep it from moving.

Note that when mounting through the holes under the heat sink, you need to work around the heat sink fins which partially cover the mounting holes.

5.1 Using a Fan for Forced Air Cooling

An optional 60mm fan is available to provide forced air cooling of the RX50. Forced air cooling can extend the operating range of the RX50 by removing heat from the heat sink and MOSFETs more quickly than is possible by ambient convection.

Use the optional RX50FK fan and mounting hardware to mount the fan. Use two of the four mounting holes to mount the fan. Use the remaining two mounting holes to mount the RX50 to the chassis surface.