

# **DR8010<sup>tm</sup>**

## **Hardware Reference Manual**

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# 1 The DR8010 Driver

## 1.1 Features

The DR8010 is a single axis stepper motor driver. It can drive motors with up to 80 volts for excellent high speed performance. The DR8010 driver can be used in conjunction with our OPTISTEP PLUS™ products or with any controller capable of producing TTL compatible step and direction signals. Phase current is switch selectable from 32 different levels ranging from 0.7 to 10.0 amps in 0.3 amp increments.

The features of the DR8010 include:

- Selectable full-step or half-step operation
- Equalized half-step mode for smooth operation
- Full over-current, over-voltage and over-temperature protection
- Optical isolation for the control logic
- Switch selectable current levels
- Bipolar chopper circuit provides the highest efficiency and motor performance
- Fault and Home signal outputs for feedback circuits
- Current cutback (50% current after ½ second of idle when enabled)
- Compact design for ease of placement

## 1.2 Specifications

Drive circuit.....	Constant current bipolar chopper
Chopping rate .....	21 KHz nominal
Operating voltage range .....	24 ~ 80 VDC
Output current .....	0.7 - 10.0 Amps in 0.3 A increments
Stepping modes .....	Half / Full step selectable
Current cutback .....	50 % of full current when enabled.
Step input signal.....	TTL compatible positive edge trigger
Direction input signal .....	TTL compatible
Fault and Home output signals .....	Open collector type (50 mA max sink)
Motor control outputs .....	4 screw terminal motor connections
Current capability .....	10.0 amps per phase continuous
Physical dimensions .....	6.00" x 2.50" x 1.50"
Working temperature range .....	32° F ~ 158° F (0° C ~ 70° C)

## 2 General Information

### 2.1 Installation

The DR8010 driver was manufactured with ease-of-installation in mind (refer to Appendix B).

- 1) Mount the DR8010 driver to any clean metal surface in an area where air is able to circulate. Forced air cooling is recommended if the driver is operating over 5 amps peak.
- 2) Connect the motor to the phase outputs (refer to Section 3.4).
- 3) Connect a PWR7205 or other suitable unregulated dc power supply to the power input ensuring correct polarity.
- 4) Connect a +5 Vdc power source, step, and direction signals to the logic inputs.
- 5) Set the phase current (refer to Section 3.1).
- 6) Turn power on.

### 2.2 Safety Features

#### **Over-Current Protection**

If an accidental short occurs between PHASE-to-GROUND, PHASE-to-PHASE, or PHASE to VDC, the driver will shutdown immediately, the FAULT LED will light, and the /FAULT output will turn on. Normal driver operation will automatically resume when the short is removed.

#### **Over-Temperature Protection**

If the heatsink temperature rises above 175° F (80° C), the driver will shutdown automatically and the TEMP LED will come on. Normal driver operation will automatically resume when the heatsink temperature returns to 100° F (40° C).

#### **Over-Voltage Protection**

If the power supply voltage exceeds +83 Vdc, the driver will shutdown and the POWER LED will turn off. The power fuse must be replaced for normal operation to continue.

#### **Normal Operation**

When none of the above conditions are in effect, the driver is functioning normally, the POWER LED will be lit and the programmed current will be delivered to the motor. To measure the current in a phase, put an Amp meter in the path of phase A or Phase B outputs and pulse the step input once and observe the current value. The "idle" dip switch should be turned off for this measurement.

## 3 Configuration

### 3.1 Dip Switch Settings

The DR8010 dip switch block is used to configure various functions on the board. To activate the function, slide the indicated switch toward its respective label.

**Switch #1** - selects the stepping mode operation of the DR8010. As shipped, the DR8010 is set for halfstep operation (This results in 0.9° steps on a standard 1.8° step motor).

**Switch #2** - enables/disables current cutback at idle. When enabled, the phase current is cutback to 50 percent ½ second after no step pulses are detected. Under normal circumstances, current cutback at idle should be enabled. Both the driver and motor run cooler and you save energy with no loss of position.

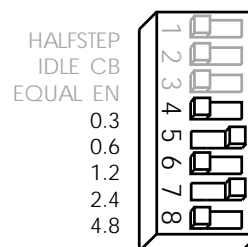
**Switch #3** - selects equalized half-step mode (available only when halfstep mode is enabled). Equalized half-step produces equal torque on every step. Use this feature to reduce vibration.

**Switches #4 - #8** - select the amount of phase current. These switches come set for minimum power (0.7 amps) and should be changed to suit the application. Each switch controls the amount of current, in amperes, that its label indicates. There is always a base of current of 0.7 Amps. To add to that base current, simply slide the appropriate switches toward their labels.

Example:

To set the driver for 7.0 amps per phase, you need to set the slide switches #4, #6, and #8 toward their respective labels.

$$7.0 \text{ A} = 4.8 + 1.2 + 0.3 + 0.7 \text{ (base)}$$



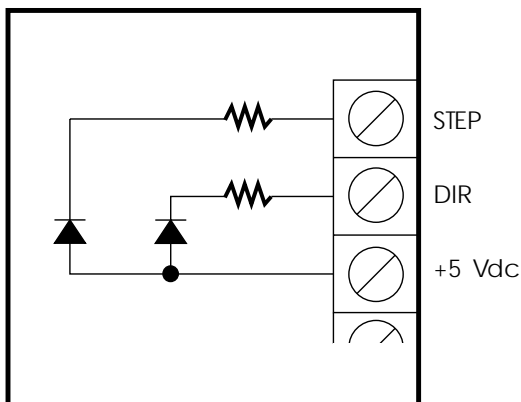
A heat sink and/or forced air cooling may be needed when set at 5 Amps or above. This requirement depends on the application's expected environmental temperature. To operate the drive continuously at or near maximum power you must properly mount it on a heat sink with a thermal constant of no more than 4° C/watt.

**CAUTION:** *Never allow liquids or machining debris in the vicinity of an unenclosed driver.*

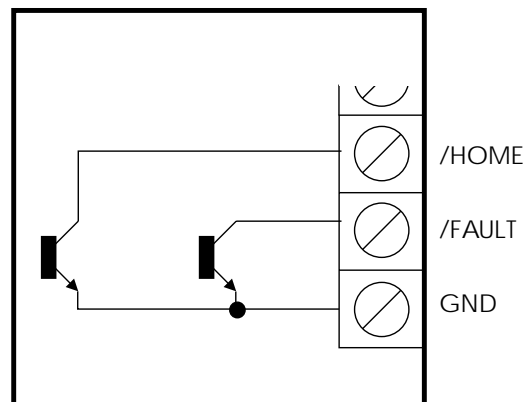
## 3.2 Control Inputs and Outputs (Connector J2)

### Optoisolation

The DR8010 interface contains optoisolators to prevent the electrical noise produced by the drive's high currents from interfering with your controlling circuits. Below are schematic diagrams showing the internal circuitry of the inputs and outputs.



Typical Input



Typical Output

### Logic Inputs

The inputs are TTL and open-collector compatible. By default, the inputs are setup to be driven by an external +5 VDC capable of at least 30 mA. If TTL signals are used, simply connect the outputs of the logic gates to the step and dir inputs; the +5 VDC source should be the same one used to power the control logic. If open-collector outputs are used to drive the inputs, connect the collectors to the inputs and a +5 VDC source to the +5V input. The emitters of the outputs should be connected to +5 VDC source reference.

- |           |  |
|-----------|--|
| Step      | - used to step the motor. The stepping frequency range is from 0 to 16 KHz. The driver updates the motor position after a LO-to-HI transition occurs. The minimum pulse width (LO level) should be 50uS.   |
| Direction | - used to indicate direction of rotation. When HI, counterclockwise rotation (as viewed from the rear of the motor) will occur and when LO, a clockwise rotation. Since phase labels (ie: A+, B-,...) vary between motor manufacturers, your motor direction could be different. Simply swap Phase A wires to change the direction of your motors (ie: if your motor rotates CCW when DIR is HI, it will rotate CW if you swap the phase A-wire with the A+ wire). |

### **Logic Outputs**

The outputs are open-collector type and are capable of sinking up to 50 mA each. The emitters of each output transistor are connected internally to the GND screw terminal. To use these outputs, the external power source reference should be connected to the GND terminal and the outputs connected to their respective loads (see Appendix I).

- /FAULT - used to indicate that an overcurrent condition has occurred on the driver. This output can be used for feedback to the control circuitry to inform the operator of the cause of the malfunction.
- /HOME - used to indicate the *HOME* step. The home step is a reference indicator that occurs once every 8 step pulses. This may be used to qualify a home limit sensor.

## **3.3 Power Input and Outputs (Connector J1)**

### **Power Supply Input**

A 24 ~ 80 VDC linear power supply should be connected to the +VDC and  $\underline{\underline{\text{GND}}}$  screw terminals of J1. The supply should be a dc linear type (basically a transformer, bridge, and a large filter cap). Regulated and switching types should be avoided.

**Warning:** *Care should be taken when connecting the power supply. Reversing the polarity of the power supply connections WILL destroy the drive and is not covered under the warranty.*

### **Motor Driver Outputs**

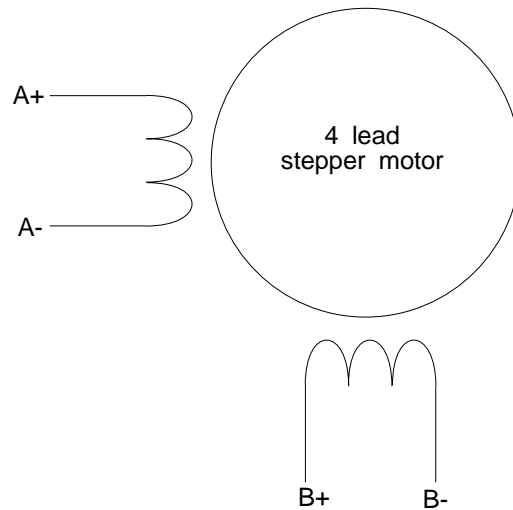
The motor driver outputs (A+, A-, B+, and B-) are used to connect the motors to the drive. The DR8010 is a bipolar current chopper type drive so 4, 6, and 8 lead stepper motors can be used: **5 lead motors can not be used.** Refer to Section 3.4 for all the possible wiring combinations and choose the one that best suits your needs.

Special Note: You can easily change the direction of rotation of any wiring scheme by swapping Phase A or Phase B connections, BUT NOT BOTH.

### 3.4 Stepper Motor Wiring Diagrams

#### 3.4.1 4 Lead motor connection

Four lead motors must be connected as shown in Figure 3.1.



#### 3.4.2 6 Lead motor connection

Figure 3.1 - 4 Lead Motor Connection

Six lead motors can be connected in two configurations, center tap and series. In center tap mode (Figure 3.2), the motors will run at their normal current and torque ratings. In series mode (Figure 3.3), the motors will have greater low end torque ratings but will not run as fast as center tapped motors. In series mode, the motors should also be run at only 70% of their rated current to prevent over heating.

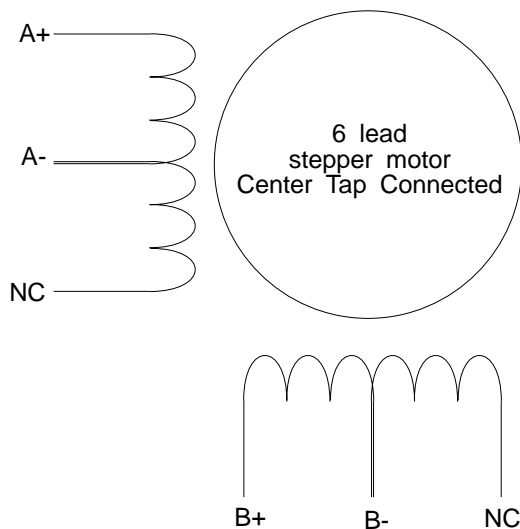


Figure 3.2 - 6 Lead Center Tapped

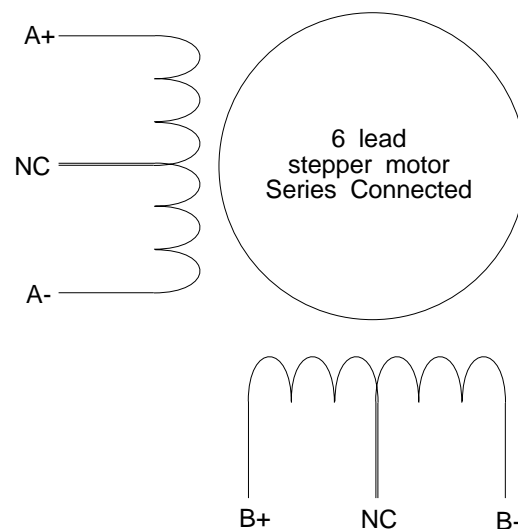
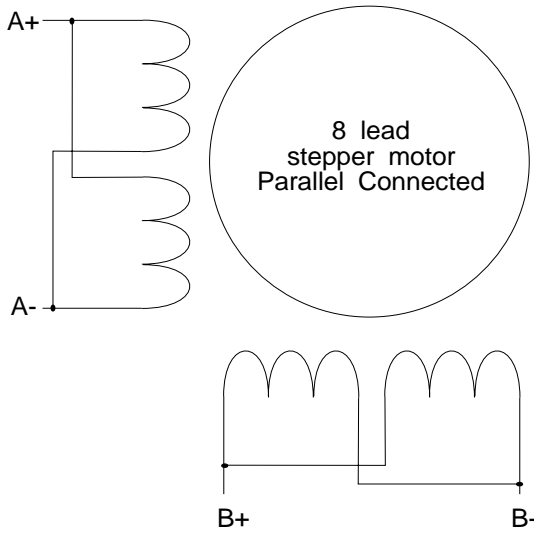


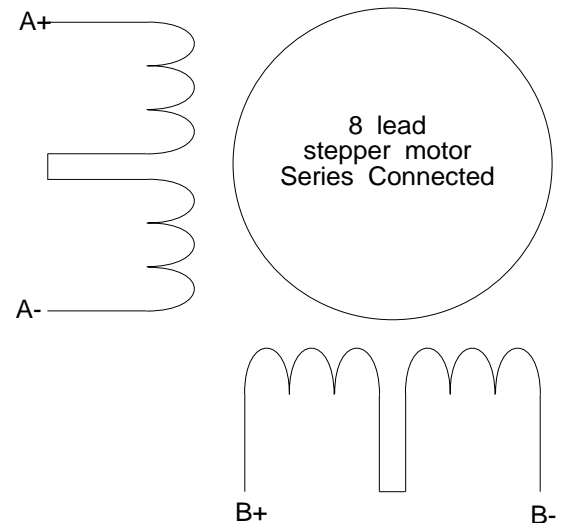
Figure 3.3 - 6 Lead Series

### 3.4.3 8 Lead motor connection

Eight lead motors can be connected in three configurations, parallel, series, and two of four windings. In parallel mode (Figure 3.5), the motor will run at 140% of its normal current rating, and will provide higher torque at higher speeds.

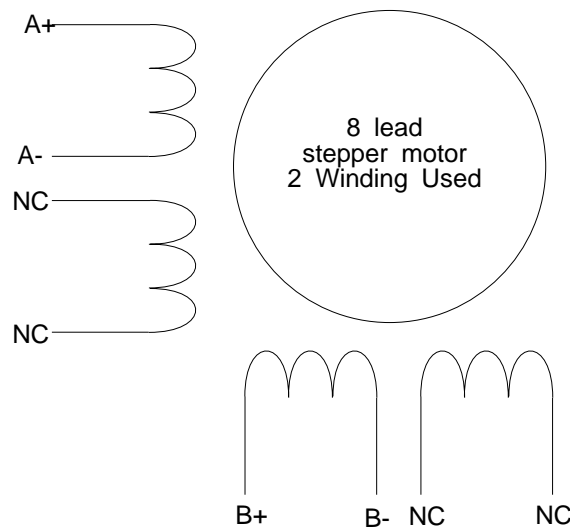


**Figure 3.5 - 8 Lead Parallel**



**Figure 3.6 - 8 Lead Series**

In series mode (Figure 3.6), the motor will have greater torque capability at low speeds but the torque will drop off sharply as speed increases. In series mode, the motors should be run at only 70% of their rated current to prevent over heating. The half coil method (Figure 3.7) uses only half of the windings available on the motor and should be driven at the rated current for the motor.



**Figure 3.7 - 8 Lead Half Coil**

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## **4 Technical Support**

Should you need help in identifying and correcting a problem, the MicroKinetics engineering staff is ready to assist you during business hours. You should refer to the documentation and verify any described adjustments before calling. Be prepared to supply the model number of all components and any software and/or dip switch or jumper settings.

### **4.1 How to Obtain Technical Support**

Technical support is available as follows:

#### Via Email

Email MicroKinetics with a description of problem symptoms to [engineering@microkinetics.com](mailto:engineering@microkinetics.com) where it is reviewed and answered daily.

#### Via Fax

Fax a detailed description of the problem to 770-422-7854 including your fax and voice number. An engineer will call to help you.

#### Via Telephone

Call our main line directly and request Hardware Tech Support. The number is 770-422-7845.

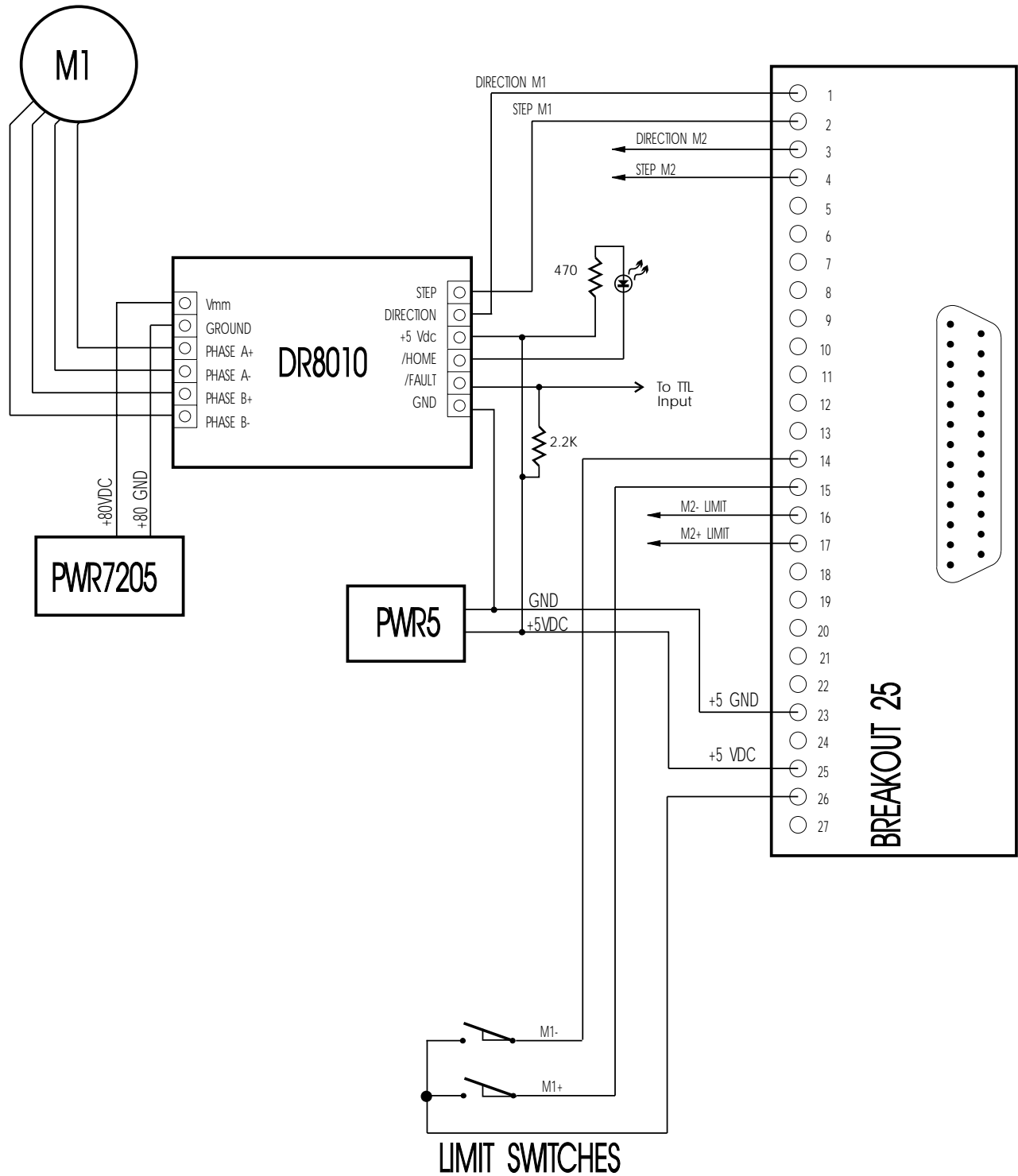
### **4.2 Product Return Procedure**

The technical support staff can determine if the problem requires returning the product for testing and can give you an RMA (Return Merchandise Authorization) number to write on the outside of the package for proper routing. This improves repair turnaround time.

When returning an electronic product, always pack in the original antistatic bag. If original packaging is not available, wrap in aluminum foil and place in container to withstand shipping and handling. Always insure product with shipping company for full value.

If a product is returned to us for repair, is tested and found to operate within the rated specifications, a nominal testing fee will apply. Please inquire as to the testing charge at the time you obtain the RMA number.

### Appendix A - Typical Wiring Diagram



### Appendix B - Mechanical Specifications

