DM8010tm

Hardware Reference Manual

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MICROKINETICS CORPORATION
3380 Town Point Drive
Suite 330
Kennesaw, Georgia 30144
Tel: (770) 422-7845
Fax: (770) 422-7854

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1 The DM8010 Driver

1.1 Features

The DM8010 is a single axis microstepping motor driver. It can drive motors with up to 80 volts for excellent high speed performance. The DM8010 can be used in conjunction with our OptiStep Plus[tm] motion controller or with any controller capable of producing TTL compatible step and direction signals. Phase current is resistor settable and ranges from 2 to 10 Amps.

Features of the DM8010 include:

- 14 user selectable step resolutions (on-the-fly switching capable)
- Anti-resonance circuitry for smooth operation
- Full over-current, overvoltage and over-temperature protection
- Opto-isolation for the input signals keeps high power noise from interfering with motion controller logic
- Bipolar chopper circuit provides the highest efficiency and motor performance
- Exact phase current is set with a resistor
- Automatic inverse-speed-proportional current reduction down to programmable current at standstill flattens motor torque response curve
- Fault and On-Full-Step output signals provided for intelligent feedback to motion controller
- Compact design for ease of placement

1.2 Specifications

Drive circuit	Constant current bipolar chopper
Chopping rate	20 KHz nominal
Maximum step rate	300 KHz
Operating voltage range	24 ~ 80 VDC
Output Current	2 - 10 amps peak per phase (selectable)
Stepping Mode	14 selectable binary & decimal resolutions
Current cutback	Resistor selectable idle current
Step input signal	TTL compatible positive edge trigger
Direction input signal	TTL compatible
Fault and On-Full-Step output signals	Open collector type (50 mA max sink)
Motor control connections	4 screw terminals for 2 motor windings
Physical dimensions	6.325" x 2.650" x 1.50"
Working temperature range	32° F ~ 158° F (0° C ~ 70° C)

2 General Information

2.1 Installation

The DM8010 driver was manufactured with ease-of-installation in mind (refer to Appendix B).

1) Mount the DM8010 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 3.5).
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 resolution, phase current and idle current cutback resistor (refer to Sections 3.1 and 3.2).
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^{o} F (80^{o} 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^{o} F (40^{o} 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 during idle, you should observe the idle current. (When no idle resistor is used, the full current will be indicated).

3 Configuration

3.1 Microstep Selection

The 8 pin right angle header on the DM8010 is used to configure the microstep resolution. The resolution for the DM8010 is configured by installing or removing jumpers on headers P0, P1, P2, and P3. The resolution is set according to Table 1:

Table 1 - Microstep Jumper Settings

P3	P2	P1	P0	Microsteps / Step	Steps / Rev 1.8 deg / Step
IN	IN	IN	IN	2	400
IN	IN	IN	OUT	4	800
IN	IN	OUT	IN	5	1000
IN	IN	OUT	OUT	8	1600
IN	OUT	IN	IN	10	2000
IN	OUT	IN	OUT	16	3200
IN	OUT	OUT	IN	25	5000
IN	OUT	OUT	OUT	32	6400
OUT	IN	IN	IN	50	10000
OUT	IN	IN	OUT	64	12800
OUT	IN	OUT	IN	125	25000
OUT	IN	OUT	OUT	128	25600
OUT	OUT	IN	IN	250	50000
OUT	OUT	IN	OUT	256	51200

The resolution can alternatively be set by digital outputs from your OptiStep card or other digital I/O card (these can be either open-collector or TTL compatible). Connect the outputs to the bottom pin on P0, P1, P2, and P3. If the jumper is installed then the input to the pin is a logic '0'. If the jumper is removed then the input to the pin is a logic '1'.

3.2 Current Adjust Resistor

The output current for the driver is determined by a single fixed resistor that sets the Peak output current. **The peak output current for the driver is calculated by multiplying the rated motor current by 1.4.** The value of the Current Adjust Resistor is determined from Table 2. The values in the table are actual values, however, some of the values may not be available. Therefore you should choose the closest available 1% resistor.

The resistor is connected between pins 6 and 7 of connector J1 (see Appendix A). The resistor should be 1/8 Watt or higher and the leads should be as short as possible to minimize the electrical noise coupled into the driver. Table 2 shows the resistor value required for each current setting.

Peak Output Current	Resistor Value 1%
2.0	320
2.2	355
2.4	380
2.6	415
2.8	440
3.0	475
3.2	525
3.4	555
3.6	585
3.8	615
4.0	645
4.2	665
4.4	700
4.6	725
4.8	760
5.0	790
5.2	820
5.4	850
5.6	885
5.8	920

Peak Output Current	Resistor Value 1%
6.0	945
6.2	975
6.4	1000
6.6	1030
6.8	1060
7.0	1100
7.2	1135
7.4	1155
7.6	1175
7.8	1215
8.0	1245
8.2	1280
8.4	1310
8.6	1340
8.8	1365
9.0	1400
9.2	1425
9.4	1455
9.6	1485
9.8	1505
10.0	1535

Table 2

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: *Do not operate this drive without a current adjustment resistor. Insure proper air circulation in the enclosure. Never allow liquids or machining debris in the vicinity of an unenclosed driver.*

3.3 Dynamic Current Reduction

If the idle current resistor is installed the current applied will be proportional to the motor speed. At idle the current is equal to the idle current as determined by R_{adj} and R_{idle}. As the motor is ramped up to speed the current increases proportionally until full current is achieved. For a 50% current reduction the ramp rate is set such that full current will be reached at a step rate of 6000 half-steps/second. The step rate at which the maximum current level is attained will decrease with higher values of idle current and increase with lower values of idle current.

The value of the Idle Current Reduction resistor (R_{idle}) is related to the value of the Current Adjust Resistor (R_{adj}). The current reduction resistor (R_{idle}) sets the current when the driver is at idle. The current reduction resistor is installed between pins 7 and 8 of connector J1 (see Appendix A). Use the following equation to calculate the value for the current reduction resistor:

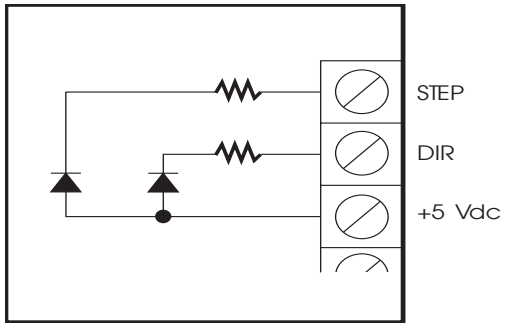
$$R_{idle} = \frac{I_{idle} * R_{adj}}{0.00654 * R_{adj} - I_{idle}}$$

Note: The resistor leads should be kept as short as possible to minimize electrical noise.

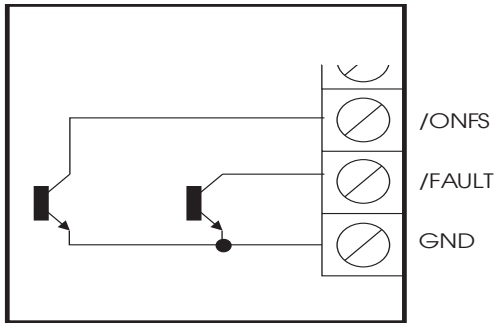
3.4 Control Inputs and Outputs (Connector J2)

Optoisolation

The DM8010 drive system interface contains optoisolators to prevent the electrical noise produced by the drive 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 ground on the +5 Vdc source (see Appendix A).

Step - used to step the motor. The stepping frequency range is from 0 to 300 KHz. The driver updates the motor position after a LO-to-HI transition occurs. The minimum pulse width (LO level) should be 2uS.

Direction - used to set 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 A).

/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.

/ONFS - used to indicate the "on-full-step" condition. The On-Full-Step output signal is a reference indicator that occurs when the driver is at a full step position. When this output is on, the driver can be switched to a different resolution remotely without any loss in position.

3.5 Power Input and Outputs (Connector J1)

Power Supply Input

A 24 ~ 80 Vdc linear power supply should be connected to the +VDC and ⏚ screw terminals of J1. The supply should be a dc linear type (consisting of a transformer, bridge, and a large filter cap). Regulated and switching power supplies should be avoided. When selecting an unregulated power supply, make sure the output voltage under no load does not exceed 80VDC.

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 DM8010 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 3.6 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.

3.6 Stepper Motor Wiring Diagrams

3.6.1 4 Lead motor connection

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

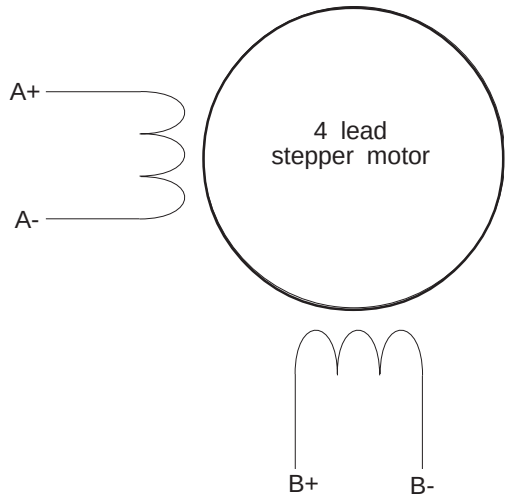


Figure 3.1 - 4 Lead Motor Connection

3.6.2 6 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.

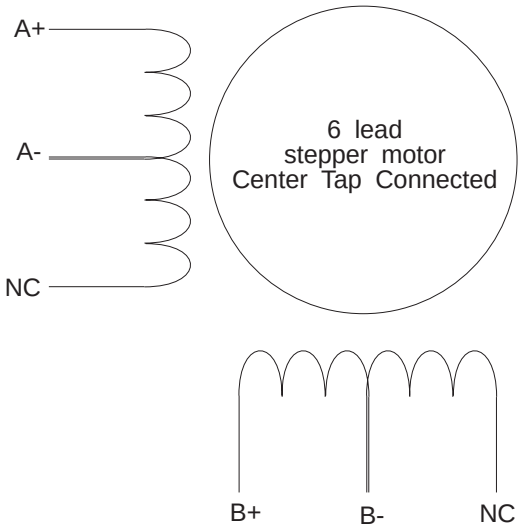


Figure 3.2 - 6 Lead Center Tapped

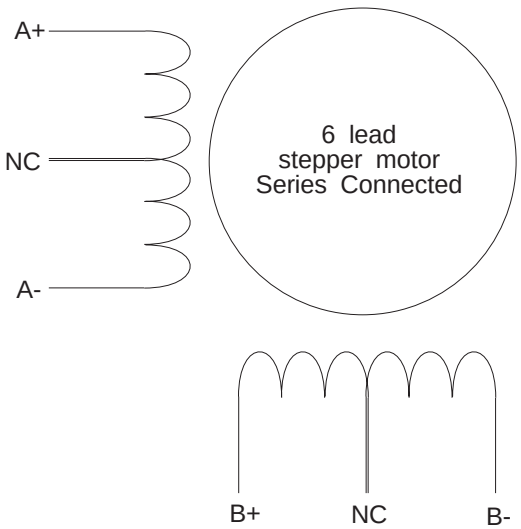
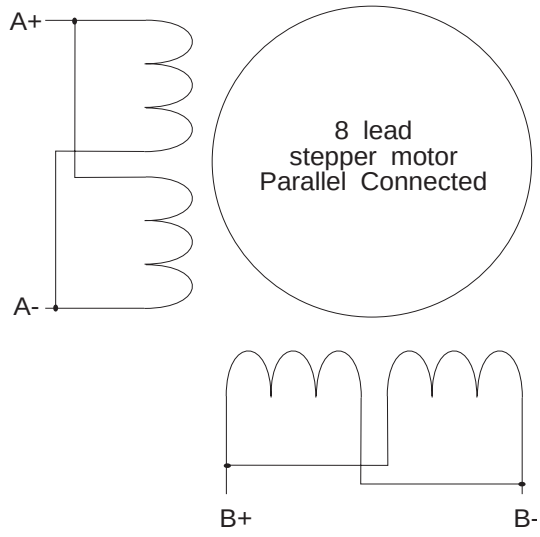


Figure 3.3 - 6 Lead Series

3.6.3 8 Lead motor connection

Eight lead motors can be connected in three configurations, parallel, series, and two of four windings. In parallel mode (Figure 3.4), the motor will run at 140% of its normal current rating, and will provide higher torque at higher speeds.



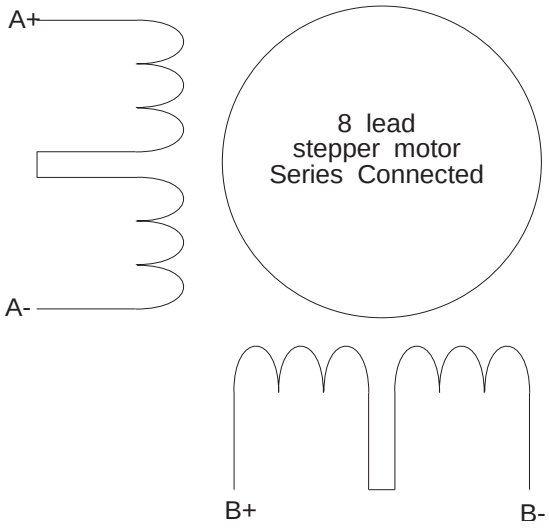


Figure 3.4 - 8 Lead Parallel Connected

Figure 3.5 - 8 Lead Series Connected

In series mode (Figure 3.5), 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 3.6) uses only half of the windings available on the motor and should be driven at the rated current for the motor.

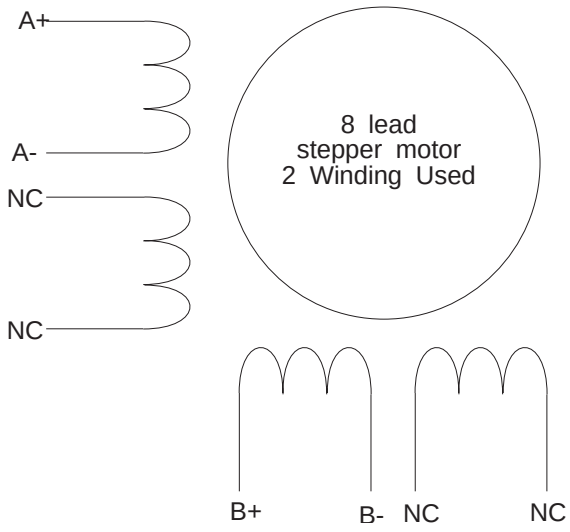


Figure 3.6 - 8 Lead Half Coil

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 helpdesk@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.

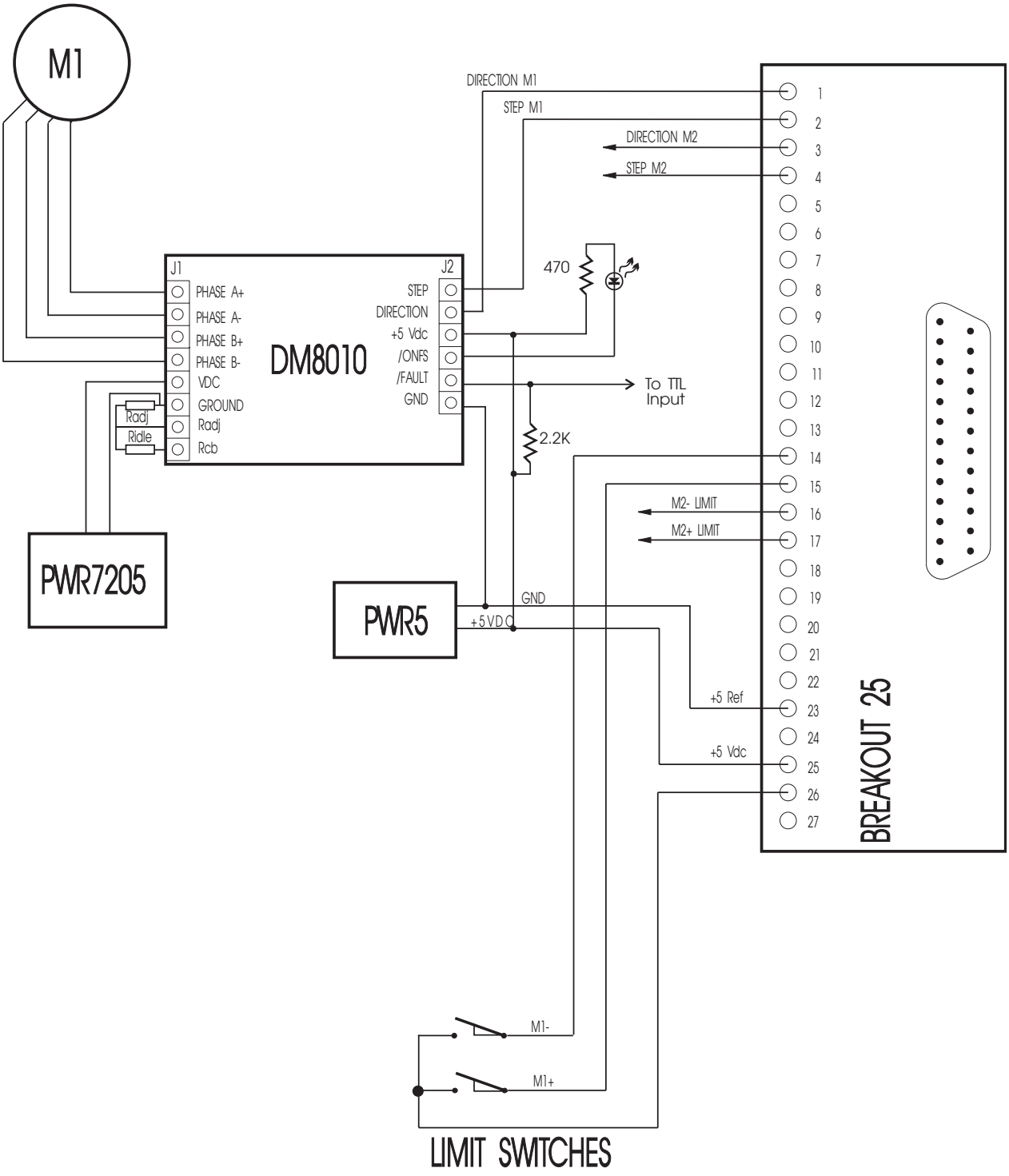
4.2 Product Return Procedure

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.

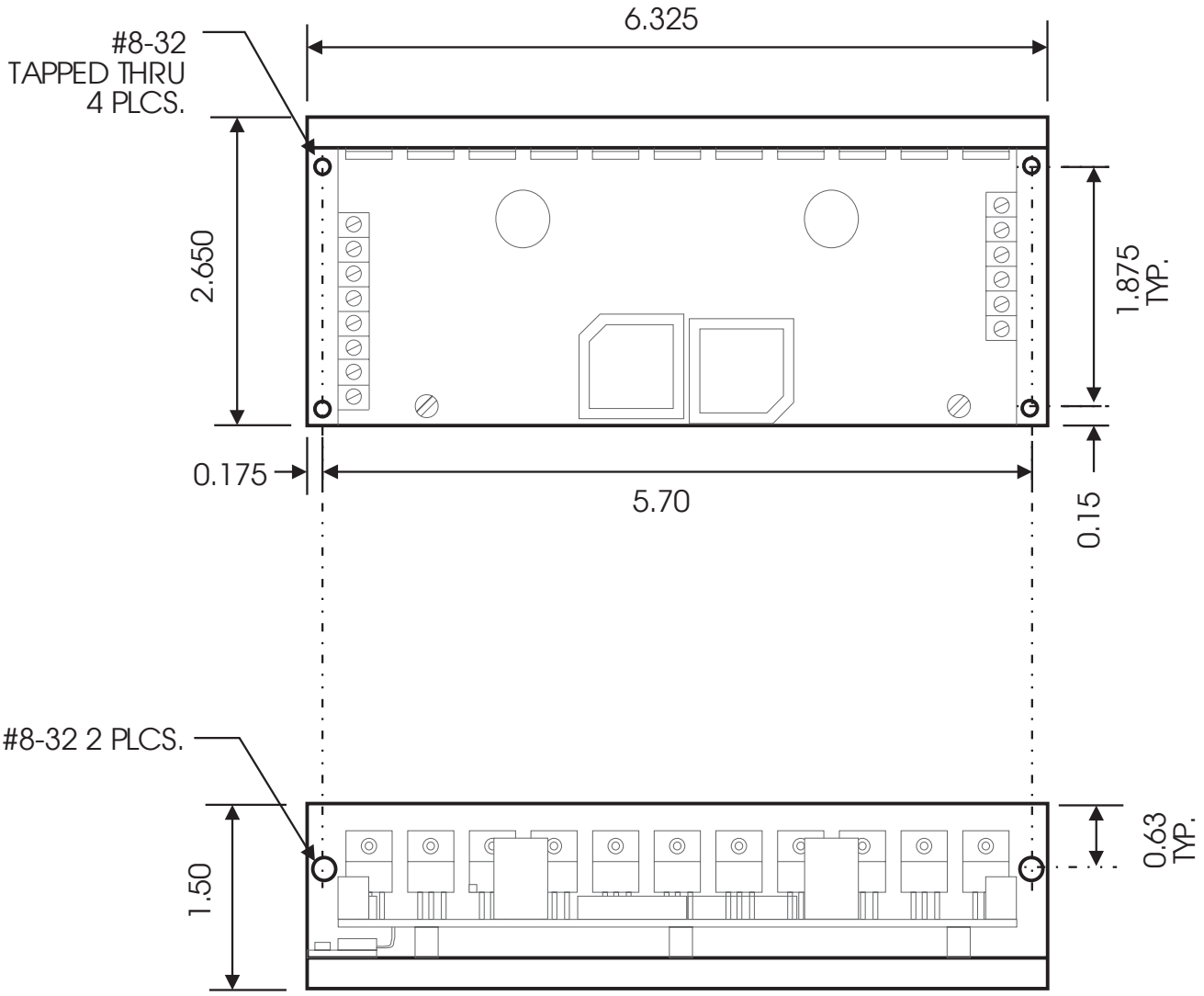
When returning an electronic product, always pack in the original antistatic bag. If original packaging is not available, wrap in aluminum foil and place in container to withstand shipping and handling. Always insure product with shipping company for full value.

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



MEASUREMENTS IN INCHES