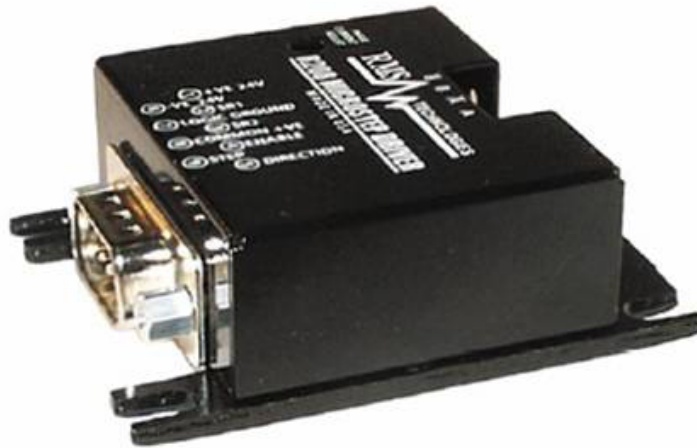


R208 Microstepping Driver



User Manual

Version 1.18

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Thank you for purchasing the R208 driver. This product is warranted to be free of manufacturing defects for one year from the date of purchase.

PLEASE READ BEFORE USING

Before you start, ensure that there is a suitable DC power supply and step motor. In addition, a suitable STEP and DIRECTION pulse source is also required.

DISCLAIMER

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1. FEATURES

- Bipolar Step Motor Driver
- Low Cost
- Small size 2.464" x 1.932" x .848" (62.59 x 49.07 x 21.54 mm)
- Selectable Step Resolutions of: Full Step, Half Step, 4x, 8x Microsteps
- Optically Isolated Step, Direction, and Disable/Enable Inputs
- Automatic Current Reduction With Disable Switch
- Operates on +12 to +24 VDC
- Low Power Dissipation
- Efficient Current Control
- Thermal Shutdown, Under-voltage Protection
- Power-on Indicator
- Power Disable/Enable Control
- Sinusoidal current waveform
- Phase Current Range from 0.35 to 2.0 Amp
- Default Setting is 1.0 Amp RMS or, 1.4 Amp Peak*

* The default current can be preset at different values prior to shipping per customer's request

Automatic Current Cutback Feature

The R208 unit offers the user the option of using the Current Cutback function in the form of a switch. **The default setting is set to the Enabled position.** This means that when pulse input is discontinued, the driver will produce 23% of the Peak running current. When this switch is set to the Disabled position, the driver will produce 100% of the running current. To change the position of the Current Cutback Switch, please refer to Appendix A - Adjusting the Current Cutback Switch. The following formula is used to calculate the Holding Current:

Reduced holding current,

$$I_h = 0.23 \times I_p$$

$I_h = 0.33 \times I_r$, where

$I_r = 0.7 \times I_p$. Therefore,

$I_h = 0.33 \times 0.7 \times I_p$, or

$$I_h = 0.23 \times I_p$$

1. I_h = Reduced Holding Current
2. I_r = Rated Current or RMS Current of the motor
3. I_p = Peak Current

2. ELECTRICAL SPECIFICATIONS

Supply Voltage: +12 to 24 VDC
Peak Current: 0.35 to 2.0 Amps OR 0.25 to 1.4 Amps

3. OPERATING SPECIFICATIONS

Operating Temperature: -20° to 50° Celsius
Humidity Range: 0 to 95% (non-condensing)

Logic Input Timing

(A) Minimum Command Active Time Before Step Pulse (Data Set-up Time)	200 nanoseconds
(B) Minimum Command Active Time After Step Pulse (Data Hold Time)	200 nanoseconds
(C) Minimum Step Pulse Width	20 microseconds
(D) Minimum Step Low Time	20 microseconds
(E) Maximum Power-Down Recovery Time	20 milliseconds
Maximum Step Frequency	30 kHz

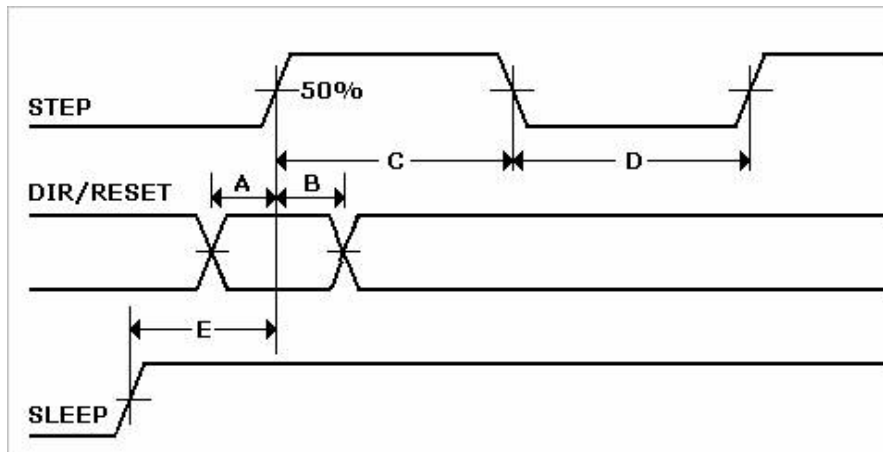


Figure 1: Timing Diagram

The R208 steps on the falling edge into the opto-coupler

4. MECHANICAL SPECIFICATIONS

Size:	2.464" x 1.932" x .848" (62.59 mm x 49.07 mm x 21.54 mm)
Weight:	3.68 oz (104 g)
Mounting:	Four screws, 1.622" x 2.003" (41.20 mm x 50.88 mm)
Cover:	Steel
Plate/Heatsink:	Aluminum, Anodized
Color:	Black Exterior

Dimensions

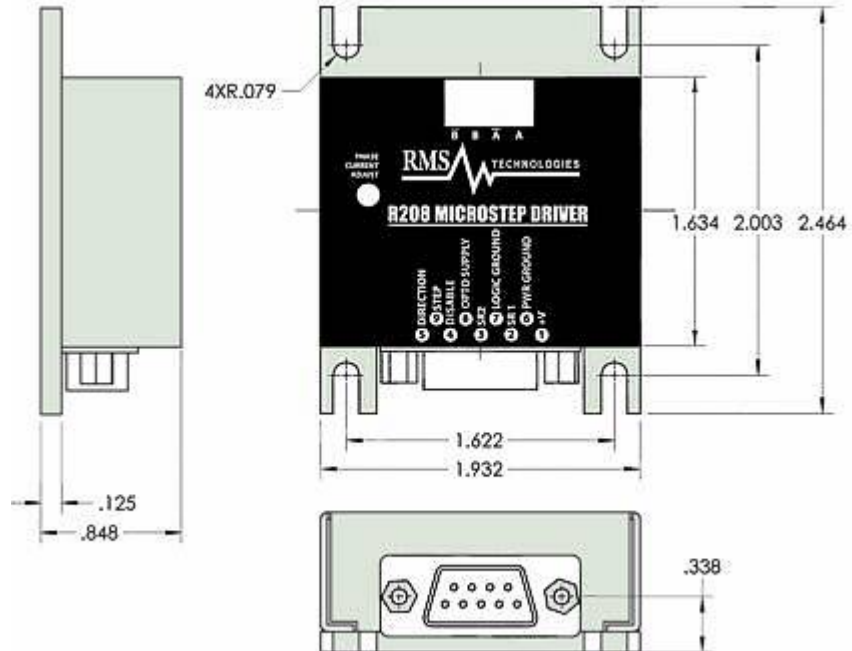


Figure 2: R208 Dimensions Diagram

5. PIN ASSIGNMENTS

A DB-9 female connector cable receives power and provides the control connections for the R208 Driver. Active signals are optically isolated. An open-collector drive is required to provide pulses for Step, levels for Direction and Disable/Enable.

PIN #	COLOR (#26 AWG Lead)	FUNCTION	DESCRIPTION
1	Red	+V	Motor Supply Voltage. +12 to +24 VDC
2	Black	SR1 Input	Step Resolution 1. Pins 2 & 3 are used to preset the step resolution by selective contact to ground (Pin 7)
3	Brown	SR2 Input	Step Resolution 2. Pins 2 & 3 are used to preset the step resolution by selective contact to ground (Pin 7)
4	Black/White	Enable/Disable Input	This input is used to enable/disable the output of the driver
5	Orange	Direction Input	This input is used to change the rotation direction of the motor
6	Green	Power Ground	The ground or return of power supply connects here.
7	White	Logic Ground	Used to ground to the logic functions (i.e. step resolution)
8	Blue	Opto Supply	+5 VDC input used to supply power to the isolated logic inputs. A resistor must be used if the supply is greater than 5 VDC.
9	Yellow	Step Clock	Connects to the open-collector drive.

Table 1: Pin Assignments

WARNING! - Do not apply differential voltage on SR1 and SR2, this will damage the driver.

6. CONNECTION SPECIFICATIONS

List of Parts

Connection of the R208 is simple. Here is what you need:

- External Main Power Supply (+12 to +24 VDC)
- +5 VDC Power Supply used as the Opto Supply (*Table 6*)
- Voltmeter
- Function Generator
- An appropriate Bipolar Step Motor
- Mating Connector Cables that are provided with the R208 Driver

Mating Connectors

A mating DB-9 connector and crimp style connector will be provided.



Adjusting the Output Current

Before connecting a step motor to this driver, use the following procedure to check the output current of the R208 unit. The default output current is set at 1.0 Amp.

WARNING! – To avoid damaging your step motor with the default setting, the output current should be adjusted before connecting the step motor.

1. Ensure that the step motor is not connected to the R208 unit. Do not supply pulse input to the R208 unit while adjusting the Output Current. This will affect the voltage level reading on the voltmeter.
2. Place one probe of the voltmeter through the slot of the cover and attach it to the lead of the potentiometer. The other probe of the voltmeter shall be attached to Pin #7 of the mating connector assembly (Part # 90-019).
3. Apply the appropriate power supply to the R208 unit. (See *Figure 4*)
4. In order to **decrease** the current output, adjust the potentiometer in the **clockwise** direction using a flathead screwdriver. Please use the following formula to obtain the desired current output:
 - Current, $I = 2.22 \times V_{ref}^* + 0.14$ when cutback current function is enabled
 - Current, $I = 0.72 \times V_{ref}^* + 0.14$ when cutback current function is disabled
 - $V_{ref} = (I - 0.14)/2.22$, where **I = Motor's Rated Current (RMS Value)**

To achieve more power when running a motor rated less than 1.4 Amp, use Peak Current, which will multiply the Motor's Rated current by 1.4 Amps. Please use this formula:

$$V_{ref} = (I - 0.14)/1.554 \quad (I \text{ is still the Motor's Rated Current})$$

Currently, the default setting is at $V_{ref} = 0.55 \text{ VDC} = (1.0 \text{ Amp} - 0.14)/1.554$

*Reference Voltage refers to the voltage level across the potentiometer.



Figure 3: Adjusting the output current

How to Connect

To connect the R208 according to *Figure 4*, begin by connecting your step motor to the R208, for details on how to make that connection refer to *Section 8 – Motor Connections*. Next, connect the DB-9 mating connector to the R208.

If using a function generator, take the positive end and connect it to Pin 9 (Step) and connect the negative end of the generator and connect it to the negative of the +5 VDC power supply. Take the positive end of the +5 VDC power supply and connect it to Pin 8, the Opto Supply. (Refer to *Table 6* for Opto supply resistor values)

Finally, connect the external +12 to +24 VDC power supply. Connect Pin 1 (Power) to the positive terminal of the power supply. Connect Pin 6 (Power Ground) to the negative terminal of the power supply.

Remember that the default Current is set to 1.4 Amp. **BE SURE NOT TO BURN YOUR STEP MOTOR WITH THIS DEFAULT CURRENT SETTING.** In order to change this value, please see the section above called "Adjusting the Output Current".

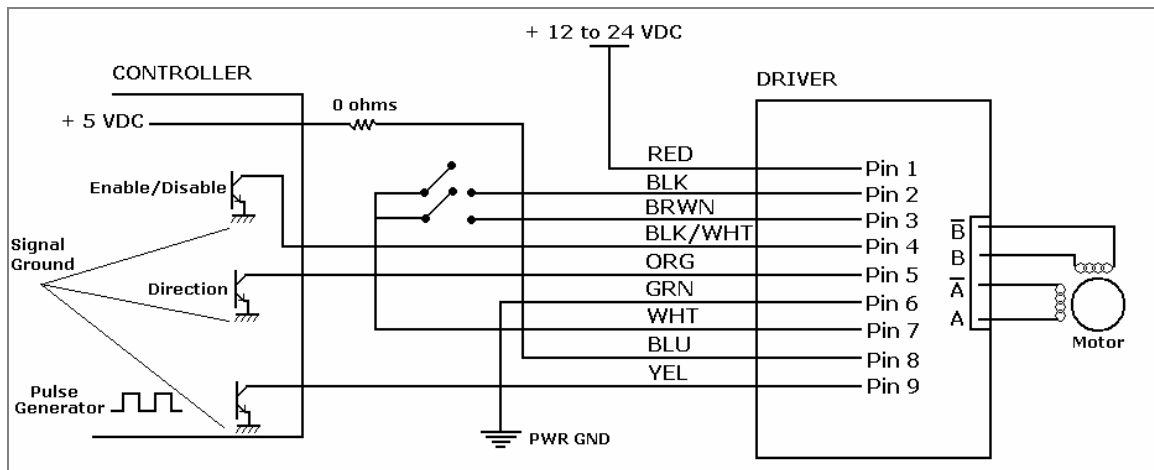


Figure 4: Connections Diagram

WARNING! Avoid touching Pin 1 (+12 to 24 VDC) to Pins 2, 3, 4, or 5. These four pins are connected to optocouplers which can only handle a few milliamps of current.

Alternative Step Resolution Connection

It is possible to change the microstepping resolution by using the signal from the controller.

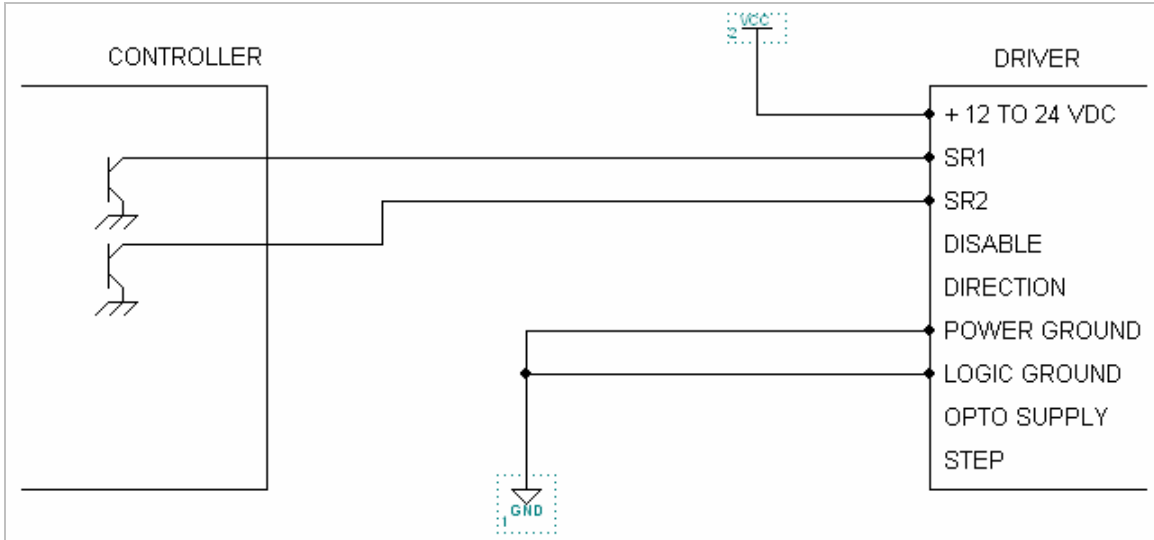


Figure 5: Alternative Step Resolution Connection

By sending a high signal to Pin 2 and/or Pin 3, the connection between these pins will be effectively closed with Pin 7. This will change the microstepping resolution. Please refer to the *Table 3* for Step Resolution Settings.

NOTE: The microstepping resolution should not be changed on the fly, loss of step may occur.

7. CONFIGURING AND CONTROLLING THE R208

Signal Control Specifications

Default Settings	
Current	1.4 Amp
Step Resolution	8x microstep
Direction of rotation	Counterclockwise
Current Cutback Switch	Enabled

Table 2: Default Settings

The R208 is set to these default settings when Pins 2, 3, 4, and 5 are left open and untouched.

Step Resolution	SR1	SR2
Full	Close	Close
Half	Close	Open
1/4	Open	Close
1/8	Open	Open

Table 3: Step Resolution Settings

SR1 (Pin 2) and SR2 (Pin 3) are used to preset the step resolution by selective contact closure to ground (Pin 7).

WARNING: Do not change the Step Resolution on the fly, loss of step will occur.

Enable/Disable

Enable	Open
Disable	Close

Table 4

Disable the Driver by closing the connection between Pin 4 and Signal Ground.

Direction

Clockwise	Close
Counterclockwise	Open

Table 5

Change direction of rotation by closing the connections between Pin 5 and the Signal Ground.

Internal Schematic

The R208 has 3 optically isolated logic inputs. These inputs are isolated to minimize or eliminate electrical noise coupled onto the drive control signals. Each input is internally pulled-up to the level of the optocoupler supply and may be connected to sinking outputs on a controller or a PLC. These inputs are:

- Enable/Disable (Pin 4)
- Direction (Pin 5)
- Step Clock (Pin 9)

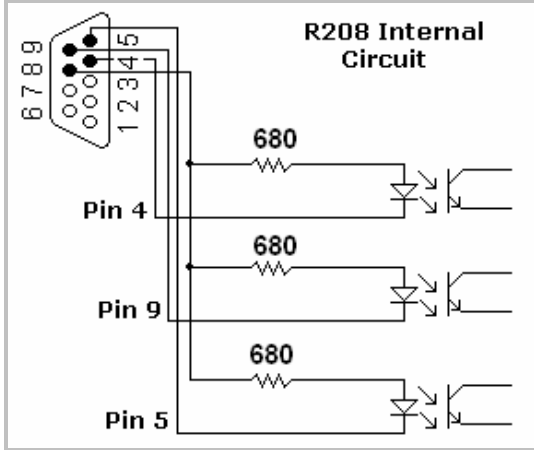


Figure 6: Optically Isolated Inputs

Within the Driver lies three 680 Ω Resistors and three Optocouplers. The current is limited to 7 mA due to these three Opto Couplers.

Resistor Values for the Opto Supply

The optocouplers must be powered by an external power supply to maintain isolation. The Opto Supply for the optocouplers can be between +5 to 24 VDC with respect to the signal input. It is recommended to use a +5 VDC Opto Supply in order to limit the current going into the optocouplers to 7 mA. However, if the supply is greater than +5 VDC then a resistor must be connected in series with each signal line to maintain 7 mA of current running through the optocouplers. **Do NOT provide more than 10 mA or damage may occur to the driver.** Refer to *Table 6* for the corresponding Resistor Values.

The Resistors shall be connected in series with each Input: Pin 4 (Disable), Pin 5 (Direction), and Pin 9 (Step).

Opto Supply	Resistor Value (Ohms 5%)
5 V	-
10 V	750
15 V	1300
20 V	2000
24 V	2700

Table 6: Opto Supply Resistor Values

8. MOTOR CONNECTIONS

Step Motors have 4, 6, or 8 wires. To better understand how to connect your step motor with your R208 Driver, follow the Figures below for the corresponding motor. NOTE: The dots indicate the starting position of the wires when wound.

4 Lead Wire Motor Connection

Connect one set of windings to the A terminals. Connect the other set of windings to the B terminals. If the set of windings is unclear, take a pair of wires; use an ohmmeter to check for continuity. When you find the first two wires that have continuity, connect it to the A terminals. Connect the other two to the B terminals.

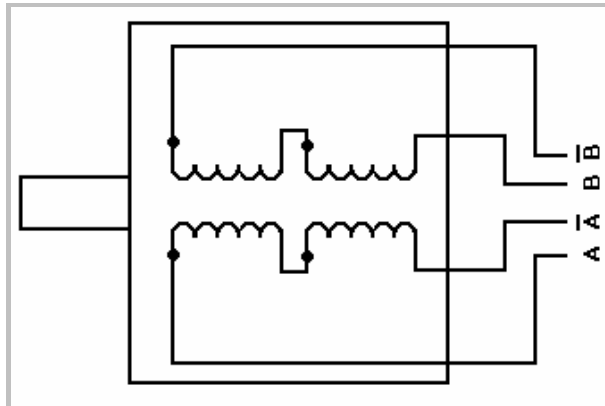


Figure 7.1: 4 Lead Wire Motor Connection

6 Lead Wire Motor Connection (Half Winding)

Six wire motors can be wound in two ways: Half Winding and Full Winding. Six wire motors contain a center tap on each of the two windings. For a half-winding connection, the center tap and one end of the wires are used.

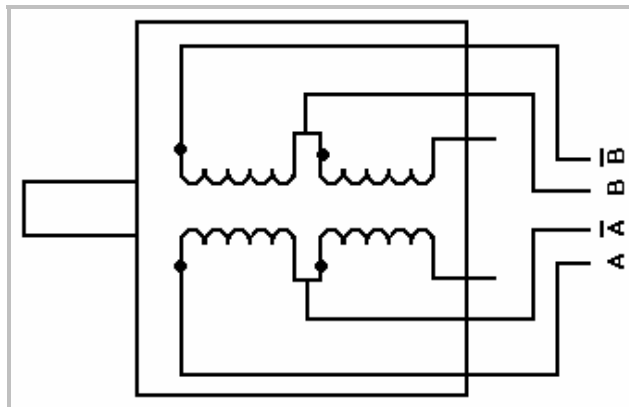


Figure 7.2: 6 Lead Wire Half Winding Connection

6 Lead Wire Motor Connection (Full-Winding)

For a full winding connection, use both end wires, the center tap is ignored. (NC: No Connection).

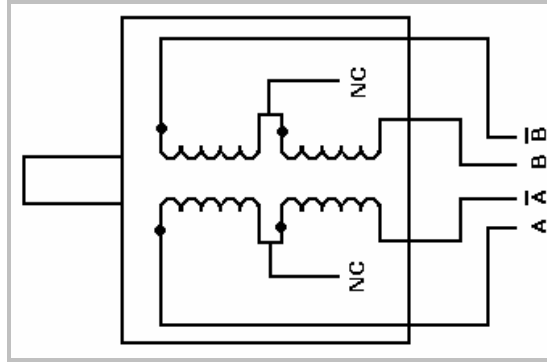


Figure 7.3: 6 Lead Wire Full Winding Connection

8 Lead Wire Motor Connection (Parallel Connection)

Eight wire motors can be connected in two ways: Parallel and Series. When in parallel, the wires are simply connected such that the beginning of each winding are connected together.

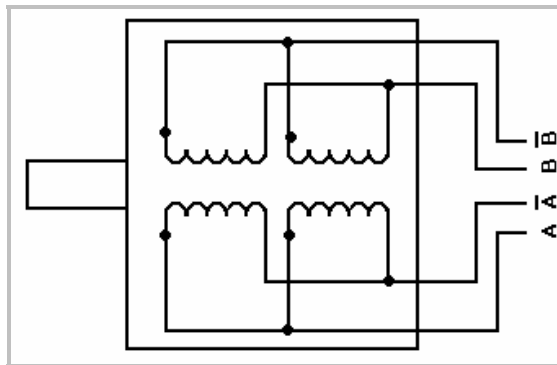


Figure 7.4: 8 Lead Wire Parallel Connection

8 Lead Wire Motor Connection (Series Connection)

Be sure to set the drive current to exactly half of the motor's rated parallel current rating when using the series connection.

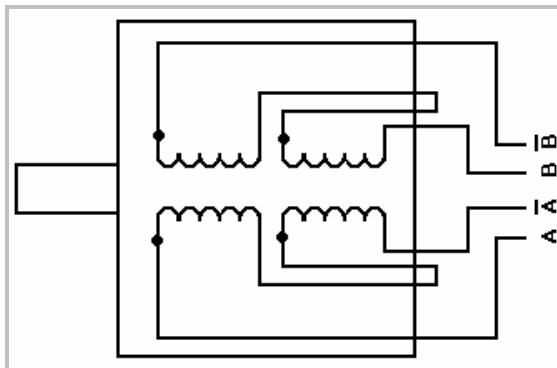


Figure 7.5: 8 Lead Wire Series Connection

9. TROUBLESHOOTING & FAQ

When you first encounter a problem, the first step is to identify which component is the cause of the problem. You can do this by swapping out individual components and verifying if they work independently.

Make sure that you have connected all the wiring correctly, this is a common cause of most problems

Problems and Solutions

- **The Motor is in Holding Position, but does not rotate:**
This means that Power is being supplied to the driver and motor, so the power supply is OK. However, the signal generator might be causing the problem. Try changing the signal to TTL. If this does not help, is the external +5 VDC Power connected? Is Pin 4 (enable/disable) touching Pin 7 (logic ground)? This will disable the driver from running.
- **When setting the current to the R208, the voltmeter never gives a clear reading:**
If the voltmeter is not giving a clear reading, and you are unable to reach the desired value for V, then the driver has been damaged.
- **The Microstepping doesn't always change to the correct step resolution:**
Changing the microstepping "on the fly" might ruin the driver. It is recommended that you disable the motor from running (either turn off the power, or use the disable pin), then change the step resolution

Will potential back-EMF from the step motor damage the R208?

The circuit on the board is protected and it should not be an issue if you are using the driver properly.

How long are the DB-9 mating cable and crimp style motor cable? Are the leads open on the other end?

Both cables are about 12 inches in length. The leads are open at the ends.

How many turns is the output current potentiometer?

The output current potentiometer is multi-turn. We recommend using a voltmeter if you need to adjust the output current.

Is the R208 a logic sourcing or sinking?

The R208 is a Logic sinking driver. The R208 driver requires an external power source - power is put into the driver, whereas a logic sourcing driver can provide a power source.

What is the heat dissipation of the R208?

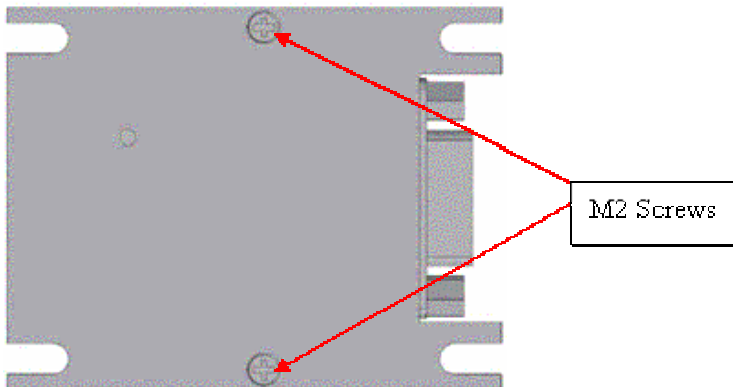
It has 35°C/Watt heat dissipation. Very low compared to other drivers.

APPENDIX A

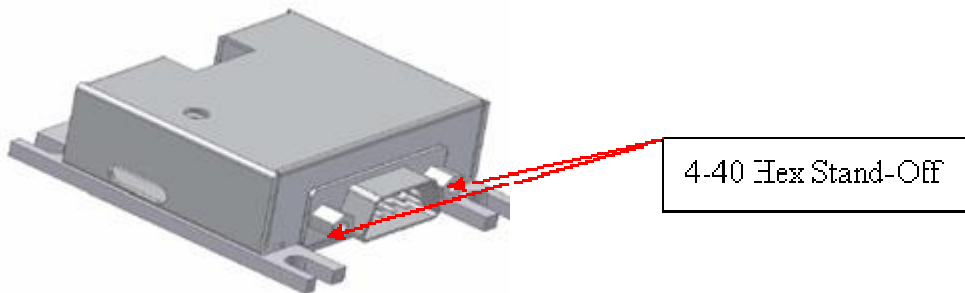
Adjusting the Current Cutback Switch

In order to adjust the Current Cutback Switch position, the cover of the R208 must first be removed. Please use the following procedure:

- Locate and loosen the two M2 screws on the bottom of the base shown below:



- Locate and loosen the two 4-40 Hex Stand-offs on the DB-9 connector using an appropriate sized Hex screwdriver:



- Proceed to carefully lift the cover away from the base.
- To disable the current cutback feature, adjust the position of switch AWAY from the white dot. This will give 100% of the full running current.

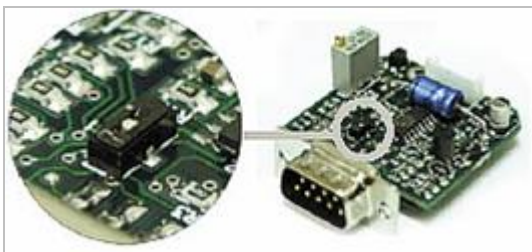


Figure 8: Current Cutback Switch.