Instruction Manual
For
SEMIX/RORZE
MicroMate
Selectable Microstep Driver
RD-021M8

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1. INTRODUCTION

Thank you for purchasing a SEMIX/RORZE ***MicroMate*** product. This new breakthrough in ideas and technology from SEMIX has brought you an easy-to-use, low cost, selectable microstep motor driver. We hope you will be completely satisfied with your purchase and that it will greatly enhance your automation capabilities.

Please read this manual carefully before installing your ***MicroMate*** driver to get the most from your application. As your motion control needs increase, SEMIX has an ever-increasing number and type of Controllers and Drivers that meet those needs. Keep us in mind for your future automation endeavors.

If you have any questions regarding this product or an application that you would like to discuss with us, direct your questions to:

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2. DESCRIPTION

A significant weakness of full step drivers is the vibration produced at low speeds (700 pps or lower) and thus they cannot be used in applications such as wafer, CD Disk, medical, laser, optical instrumentation. Microstepping has been developed to overcome this problem. It can increase the step resolution, reduce amplitude of resonance, and provide more stable torque.

The RD-021M8 is a high resolution step motor driver featuring selectable microstep. The user can select from 1~8 microsteps/step using dip switches D1~D2. This driver can accept pulse and direction inputs or two clock inputs, one for each direction. Custom LSI and hybrid circuitry makes this driver ultracompact and power efficient.

It is also equipped with high-precision, current regulation circuitry that can be adjusted to 0.1~1.5 for Full step mode or to 0.1~1.0 A/ph for Microstep mode, to provide better current control. Idle current is reduced to 50% of rated current automatically to reduce motor and driver heat generation.

Features

- Hi-tech design
- Aluminum alloy heat sink for heat dissipation
- Anti-loosening connectors
- Selectable microstep - 1~8 microsteps/step
- Automatic idle current (50% of rated current)
- Photo-isolated inputs
- Very low minimum current setting (100mA)
- Low minimum voltage (10VDC)
- Bipolar constant chopper driver
- Circuitry to protect low power supply voltage
- Hybrid, custom LSI circuit, resulting in an ultra compact casing
- High efficiency, power MOSFET circuit to minimize heat generation

3. SPECIFICATIONS

Supply voltage:	Single 10~ 40 VDC (including ripple)
Supply current:	Approx. 1.2 times the rated coil current of motor
Motor current:	0.1 ~ 1.5 A/ph max.for full step
	0.1 ~ 1.0 A/ph max. for microstep mode
Microstep resolution:	2, 4, 8 microstep/step
Excitation method:	Full step or microstep
Drive method:	Bipolar, constant current chopper with standard wiring
Auto. current limiting:	50% of rated motor current
Protection circuitry:	Low power supply voltage
Oscillation frequency:	Max. clock input 100 Kpps
Outside dimensions:	1.25"H x 3.15"L x 1.69"W
	(32 H x 80D x 50W mm.)
Weight:	150 g. (5.28 oz.)

4. TERMINALS

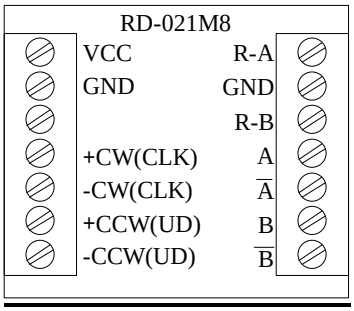

Fig. 1 View of Terminals

Two Clock Input (2ck)

CW +/-

Motor rotates in CW direction with a pulse current of 5 ~ 20 mA (15 mA typically) from CW + to CW- terminal.

CCW +/-

Motor rotates in CCW direction with a pulse current of 5 ~ 20 mA (15 mA typically) from CCW + to CCW- terminal.

One Clock Input (1ck)

CLK +/- & UD +/-

Motor rotates in CW direction with a pulse current of 5 ~ 20 mA (15 mA typically) from CLK + to CLK- terminal and UD input off.

Motor rotates in CCW direction with a pulse current of 5 ~ 20 mA (15 mA typically) from CLK + to CLK- terminal and UD input turned ON (UD + connected 5V).

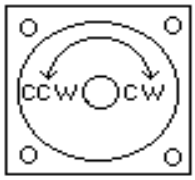

Fig. 2 Direction of Rotation

View of stepper from shaft end (single ended shaft)

5. WIRING DIAGRAM

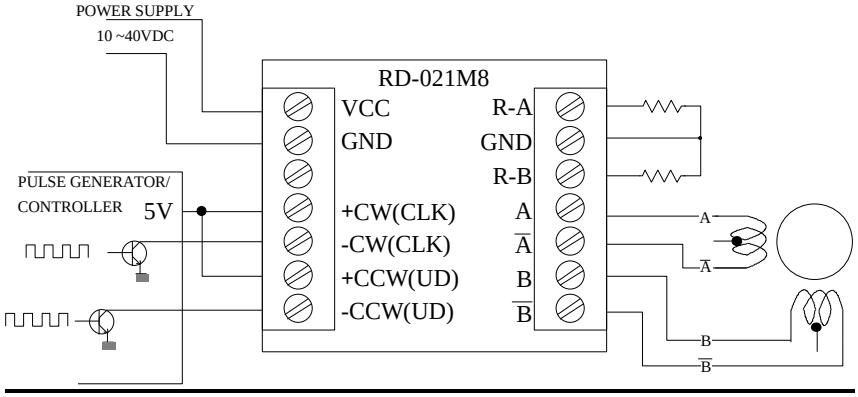

Fig. 3 Wiring Diagram

The driver is constructed with bipolar drive logic.

Note: Use AWG 20 or less (greater than 0.5 mm^2) wire for connecting the driver to the motor and use shielded cable or twisted wire pair for the signal input wiring.

6. PRECAUTIONS FOR WIRING

!CAUTION!

1. ***Do not turn power on without the correct resistor set connected to RA and RB terminal.***
2. ***Do not turn power on without motor wires connected. Follow the motor wiring diagram.***
3. ***Do not switch the microstep or clock input setting with power ON.***
4. ***Do not connect shorted motor coils to the dirver.***
5. ***Do not short the resistor terminal to GND.***

7. DIP SWITCHES

Fig. 4.0 shows the layout of dip switches that are used for selecting clock input and microstep selection.

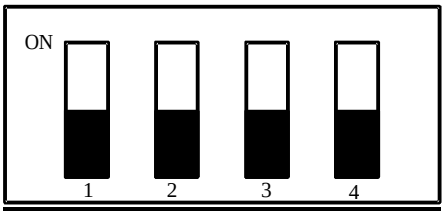

Fig. 4 Dip Switches

Clock Input Selection

Pulse and Direction Input:

Dip Switch #3	Dip Switch #4	Clk Selection
OFF	OFF	X
OFF	ON	1CLK
ON	OFF	2CLK
ON	ON	X

X -- Not a valid selection

Set the dip switches as shown in the table above.

Two Clock Input:

Set the dip switches as shown in the table above.

Microstep Selection

Dip Switch #1	Dip Switch #2	Microstep Selection
OFF	OFF	1/8
OFF	ON	1/4
ON	OFF	Half
ON	ON	Full

8. CURRENT ADJUSTMENT

Set the current range using the resistor set.

RD-021M8 resistor selection formula

Formula that you can use for determining the resistor values based on rated current and rated voltage of the motor.

Unipolar 6 wire motor.

Rated Current	Half coil Full step	Half coil Microstep	Full coil Full step	Full coil Microstep
Ir > 3.0 A	Cannot be used	Cannot be used	Cannot be used	Cannot be used
2.1A<Ir≤3A	Cannot be used	Cannot be used	α =Ir /2	α=I/√2
1.5A<Ir≤2.1A	Cannot be used	Cannot be used	α =Ir /2	α=I/√2
1.0A<Ir≤1.5A	α =Ir	α =√2∗Ir	α =Ir /2	α=I/√2
Ir≤1.0A	α =Ir	α =√2∗Ir	α =Ir /2	α=I/√2

Ir = rated motor current
Vr = rated voltage of the motor

4 Lead wire motor.

Rated Current	Half coil Full step	Half coil Microstep
Ir > 3.0 A	Cannot be used	Cannot be used
2.1A<Ir≤3A	Cannot be used	Cannot be used
1.5A<Ir≤2.1A	Cannot be used	Cannot be used
1.0A<Ir≤1.5A	α =Ir	α =√2∗Ir
Ir≤1.0A	α =Ir	α =√2∗Ir

** Ir for 8 lead converted to 4 leads
4 lead parallel -- Ir = Ir * 1.414
4 lead series -- Ir = Ir /1.414

$$X = \{\alpha/(0.1108*Ir+0.66\}^{\{-1/(0.75+0.023*Vr)\}}$$

$$R = 8.2*X/(8.2-X)\ \Omega \text{ or } K\Omega \text{ for RA and RB}$$

$$Watt = (0.8*0.8/X) * \text{safety factor}$$
$$\text{safety factor} = 2\sim 3$$

Example:

6 wire Full Step Mode Type Half coil connection

V=2, Ir = 1.2A, $\alpha = 1.2$

$X= (1.2/(0.1108*1.2+0.66))^{\{-1 / (0.75 + 0.023* 2)\}}$

$X = (1.5133172)^{\{-1.2562814\}}$

X= 0.5942338

R= 8.2*0.5942338/(8.2-0.5942338)

R= 0.64 Ω @ 3 Watts

Watts = (0.8*0.8/X)* Safety factor

Safety Factor 2 ~ 3

Watts = 1.07*3 = 3 Watts

6 wire Microstep Mode Full coil connection

V=2, Ir = 1.2A, $\alpha = 1.2/1.414$

$X= (\alpha /(0.1108*1.2+0.66))^{\{-1 / (0.75 + 0.023* 4)\}}$

$X = (.8755)^{\{-1.187648\}}$

X= 1.17103

R= 8.2*1.1703/(8.2-1.1703)

R= 1.366 Ω @ 2 Watts

Watts = (0.8*0.8/X)* Safety factor

Safety Factor 2 ~ 3

Watts = 1.6*2 = 3 Watts

6 wire Microstep Mode Full coil connection

V=4, Ir = 0.6A, I = 0.6/1.414

$X= (0.42432/(0.1108*0.6+0.66))^{\{-1 / (0.75 + 0.023* 4)\}}$

X=1.89

R= 8.2*1.89/(8.2-1.89)

R= 2.4 Ω @ 1 Watts

Watts = (0.8*0.8/X)* Safety factor

Safety Factor 2 ~ 3

Watts = (0.8*0.8/1.89)*3 = 1 Watts

Watts selection table

Resistance Ω	Watts
0.33~0.62	3
0.68~1.20	2
1.30~2.40	1
2.7~5.10	0.5
5.60~10.00	0.25
11.00~39.00	0.125

Motor	**Current A/phase**	**Resistance Ω Full step**	**Resistance Ω Microstep**
NetMotion			
RM-2414S/D	1.5	0.56	
RM-2414S/D	1.1		0.56
RM-2424S/D	1.5	0.56	
RM-2424S/D	1.1		0.56
HSI	230 mA	6.2	3.6
20540-05	100 mA	39.0	18.0
20540-12	340mA	3.3	2.2
26440-05	140mA	18.0	7.5
26440-12	340mA	3.3	2.2
26540-05	140mA	18.0	7.5
26540-12	460mA	2.2	1.5
35460-05	190mA	9.1	4.7
36440-12			

9. TIMING DIAGRAM

Switching Direction of Rotation for 1Clk Mode/ 2Clk Mode

In order to change direction, the controller should wait more than 10μs before sending the pulse train.

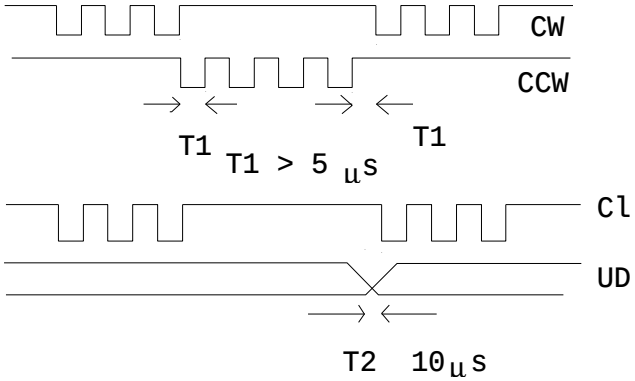

Fig. 5 Timing Diagram

10. INPUT / OUTPUT CIRCUITS

Clk Inputs

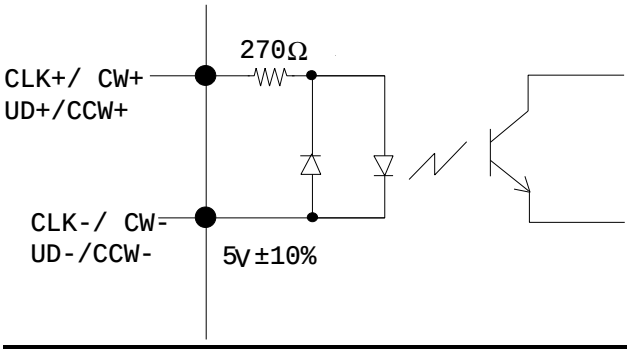

Fig. 6 Clock Inputs

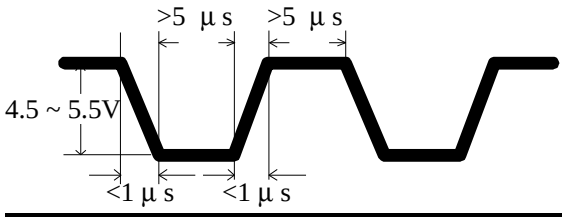

Fig. 7 Pulse Specification

Change the clock setting using the dip switch.

11. MOTOR SELECTION

You can use any hybrid or permanent magnet step motor with rating of 3 A/ph or less. Select motors with less than 12 VDC rated voltage.

SEMIX	Holding Torque (oz-in.)	Amps/ph
RM2414S (single shaft)	19.46	1.5
RM2414D (double shaft)	19.46	1.5
RM2424S	33.36	1.5
RM2424D	33.36	1.5

Refer to SEMIX' motor catalog for more details.

Terminal	**SEMIX/ RORZE Motor**
A	Red
/A	Yellow
B	Blue
/B	Orange

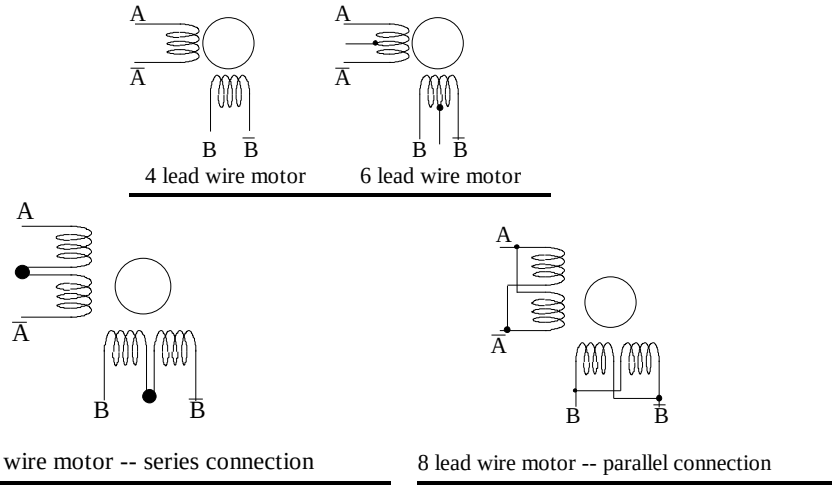

Fig. 8 Motor Wiring

- Driver and motor temperature increases when supply voltage is increased.

- Motor and driver temperature also increases when running current is increased. Never allow the motor temperature to rise above 100°C and driver temperature should not exceed 70°C. To dissipate heat, mount the driver and motor on a metallic board (aluminum plate).

12. RELATIONSHIP BETWEEN FREQUENCY AND MOTOR SPEED (RPM)

rpm = 60 x (freq./steps per revolution)

steps per revolution = ((360 x M)/1.8) for 1.8°motor

M = microsteps/step

Example: Calculate the rpm with a frequency of 10,000 pps and with 8 microstep/step selection.

freq = 10,000 M = 8

steps per revolution = ((360 x 8)/1.8) = 1,600

rpm = 60 x (10,000/1600) = 375 rpm

13. POWER SUPPLY REQUIREMENT

The supply current for driver and motor varies, depending on the input voltage and load torque. In general, you should use 1.2 times the rated current of the motor.

If motor and driver are the only devices connected to the power supply, 110% to 120% rating should be adequate. A ripple of 0.8 volts will be produced whenever the motor is operating. If other devices share the same power supply, then design it to 170% of the rating, or incorporate a large capacitor.

14. PROTECTION CIRCUITS

Automatic Idle Current

After about 0.3 seconds of inactivity, current will be reduced to 50% of the rated current. This reduces driver and motor heat generation during idle periods.

Low Supply Voltage Protection

The driver has a built-in low supply voltage protection circuit to prevent current overload. The low supply voltage condition normally occurs when power is turned ON.

15. DIMENSIONS

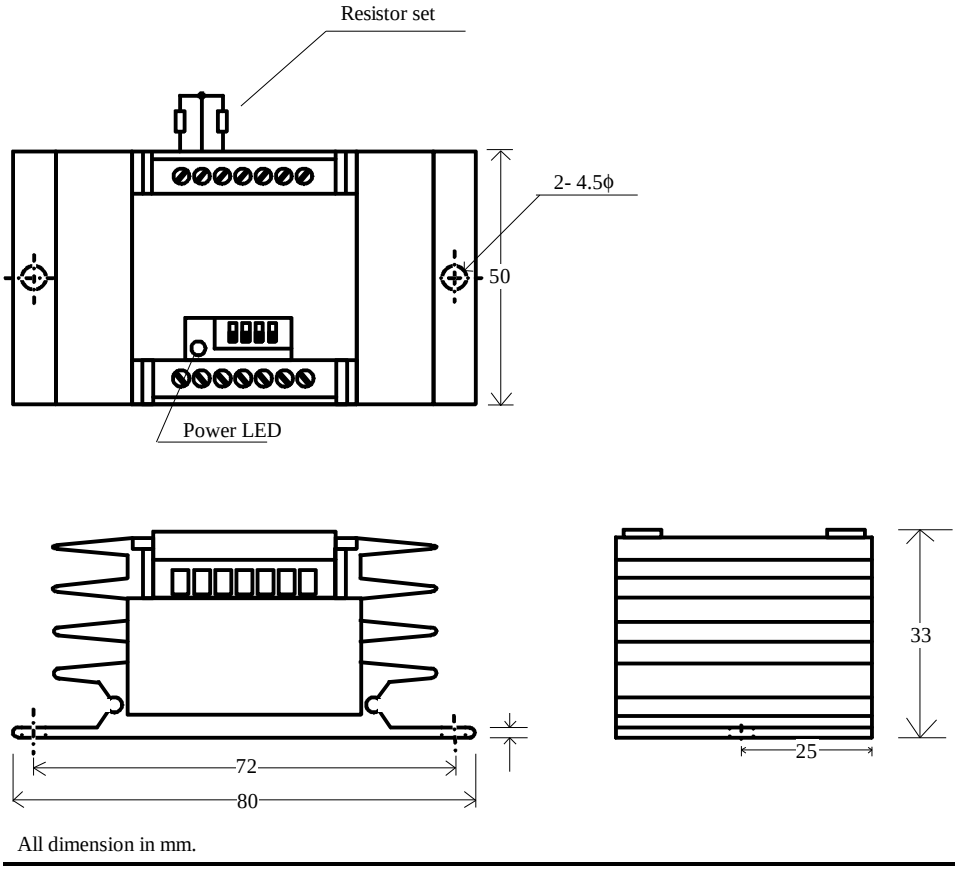

Fig. 9 Dimensions