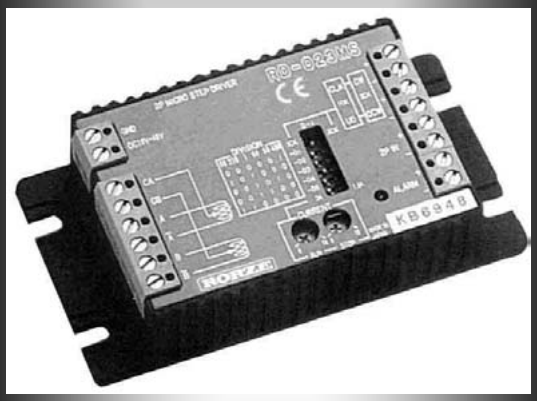
RORZE

RORZE

Instruction Manual



Selectable Microstep
2-ph Stepping Motor Driver

RD-023MS

RORZE RORZE CORPORATION

Be sure to read the following precautions for your safety.

This section describes safety precautions to avoid danger to you or someone else, to avoid damage of your property, and to use this product safely.

Precautions before using this product

This product is designed to be incorporated into general industrial machinery, and is NOT developed to be used in devices such as aerospace machines, security equipment, or other safety devices where a failure or malfunction of this product may directly threaten human lives or health.

Even if you use this product in a general device, make sure that you establish a sufficient level of safety in your device by incorporating a protection function into your machine and guarantee your products based on safety tests on the whole set.

If you will use this product in devices like the above, please contact us. It should be noted that RORZE will not be responsible for any damage caused by using a product in such a device without the consent of RORZE.

⚠ WARNING

Ignoring the following warnings may cause a death or a serious injury.

◇Use this product at places where no explosive or flammable stuff exist nearby and no water is splashed on the product. Otherwise it may cause a fire and/or an injury.
◇Turn off the power before moving or wiring the product. Otherwise you may suffer injuries or electric shocks.
◇Do not forcibly bend, pull, or nip lead wires. Otherwise they may cause an electric shock, fire, and/or failure.
◇Do not use lead wires with their sheath damaged. Otherwise they may cause an electric shock, fire, and/or failure.
◇Make sure that wires are correctly and securely connected at electrical terminals. Otherwise they may cause an electric shock, fire, and/or failure.
◇Do not touch the internal parts of this product.
◇Do not disassemble or modify this product.
◇Do not wire or operate a product with wet hands. Otherwise it may causes electric shocks.
◇Assign a qualified person to transport, install, connect, operate, maintenance, or check this product. Otherwise it may cause an electrical shock, a fire and/or an injury.

⚠ CAUTION

Ignoring the following cautions may result in personal injuries and/or property damages.

◇Make sure that the delivered product is the one you ordered. Installing the wrong product may cause a fire and/or a failure.

Check the following items before turning on the power.

◇The output voltage of the power supply is as described in the specifications.
◇The voltage/current of the input/output terminals conforms to the ratings in the specifications.
◇Input/output terminals are not incorrectly wired or accidentally short-circuited.
◇Do not use with the motor except the stepping motor.
◇Operate the rated current of stepping motor within the specified input current limits only.
◇Please use the wire rod with the cross-section area corresponding to current value.
◇Because this product generates heat, please make it stick to metal board etc. or put the fan and radiate enough.
◇When connecting with terminal block, use a screwdriver whose tip fits an adjustment slot. Tighten the screw in the torque of less than 3.5kgf･cm(0.35N･m)(proper torque is 2.5kgf･cm(0.25N･m)).
◇When you run a product for the first time, make sure that the operation can be stopped immediately under an emergency situation.

Ignoring the above cautions may cause a fire and/or a failure.

◇Immediately turn off the power, if you hear an unusual noise. Otherwise it may cause a fire and/or an injury.
◇Do not touch this product when it is in operation, as a malfunction may occur.
◇Do not carry this product by holding its terminal blocks or lead wires. When the product is accidentally dropped, it may cause a personal injury.
◇Do not place this product in unstable positions. When the product is accidentally dropped, it may cause a personal injury.

Under some circumstances, ignoring the precaution described in the CAUTION section may also result in a death or a severe injury.
Follow the above precautions described in both the WARNING and the CAUTION section.

Table of Contents

INSTRUCTION MANUAL FOR RD-023MS

1. Description

Custom LSI and hybrid circuitry makes this driver ultracompact and power efficient. Therefore, by utilizing a DC power supply of 24V or 36V (as is common to solenoid valves, etc.), several units can be connected to a simple programmable controller or personal computer with great economy of wiring.

The RD-023MS is a high resolution stepping motor driver featuring selectable microstep. Microstep drive is the drive method to resolve a basic step angle of motor by controlling the current applying to the motor. The user can select from 1 to 400 microsteps/step.

Steps for 1.8° motor in full step mode is 200 steps/revolution (1.8°/pulse), but if you select 400 microsteps/step in microstep mode, it can be 80,000 steps/revolution (0.0045°/pulse). Microstepping can provide low speed drive and accurate positioning.
Also, a significant weakness of full step driving is the vibration and resonance but microstepping can reduce amplitude of resonance. 2-phase motor will produce vibration than 5-phase motor in half step mode.

2. Features

- RD-023MS carries out the CE Marking
- High power (3A/phase max.)
- Large supply voltage range (18 to 40VDC)
- Selectable microstep (22 selections) using dip switches
- Photo-isolated inputs and outputs
- Circuitry to protect against overheating, over current, and low supply voltage
- Selectable current range - 1.5A max. or 3A max.
- Selectable clock – 1clk. or 2clk. Input
- Auto current down circuit to reduce heat generation when motor is stationary

3. Specifications

Supply voltage	Single 18 to 40VDC (including ripple)
Supply current	Approx. 1.2 times rated coil current of motor (max.)
Motor current	0.3 to 3A/phase (Adjustable by Run Current Adjustment Trimmer)
Drive method	Unipolar, constant current chopper method
Excitation method	Microstep
Microstep resolution	Up to 400 microsteps/step
Position repeatability	±1 microstep with no load in one direction (with 50 microsteps/step)
Auto. current down	0 to 80% of the run current after about 0.3 seconds of inactivity according to stop current setting. (Setting at shipment is 50 %) Even if the motor rotation is stationary, the auto. current down doesn't work under the condition applying voltage between clock input terminals.
Protective circuitry	Overheat, over current and low supply voltage protection
Response frequency	500 kpps max. (at 4.5V to 5.5V)
Weight	Approx. 250g (8.8oz.)
Outside dimensions	27.5H x 105W x 56Dmm (1.1"H x 4.1"W x 2.2"D)

4. Part Name

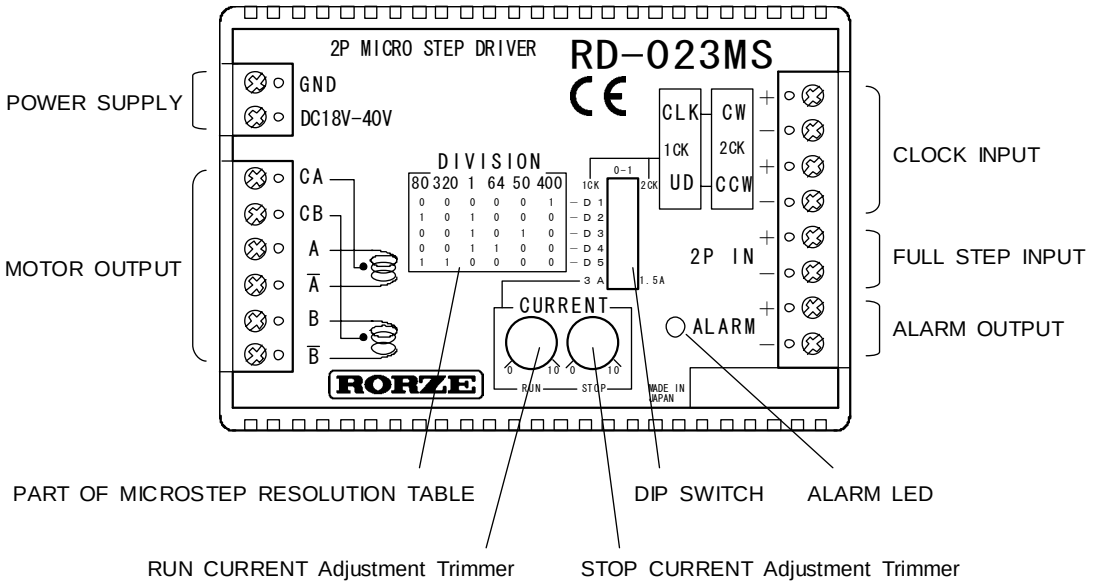


Fig.1. Name Plate

5. Current Adjustment

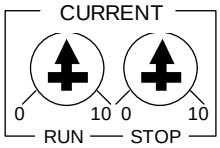


Fig.2. Current Setting Trimmers

5-1 Run Current Adjustment Trimmer

! Caution

Please use after adjusting the current within the motor rated current.
Exceeding the rated current causes the failure of motor or fire.

This is used to adjust the stepping motor drive current and in general it makes equal to the rated current. (Setting at shipment is 0A.)
If a motor is used at a high rpm with a lower-than-rated torque, better efficiency and less temperature rise can be obtained by using the motor with a current lower than the rated value.
(Note: As the current decreases, the torque will lower.)
The drive current changes relative to the dial. The value of the setting will be ±10 % of the set value. (Use 1.5A setting when the motor rating is less than 1.5A. Set the amp. dip switch to 1.5A side, because it makes current adjustment easier.)

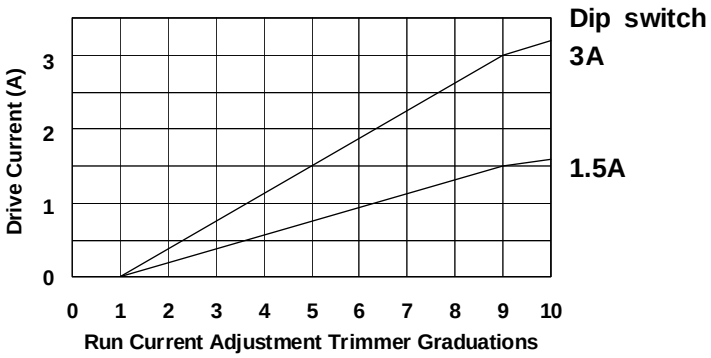


Fig.3. Run Current Setting

5-2 Stop Current Adjustment Trimmer

This trimmer can adjust holding current when the motor is stationary. (Current after auto. current down works.) You can set the stop current to any value between 0 and 80% of the run current by adjusting Stop Current Adjustment Trimmer. (Setting at shipment is 50 %.)

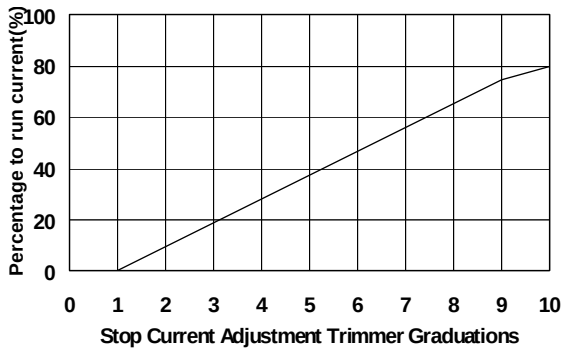


Fig.4. Stop Current Setting

6. Terminals

6-1 Clock Input and Direction Input (CW/CLK, CCW/UD)

⚠ Caution

Please set the current between clock input terminals in the range of 8 to 20mA.
Do not exceed 20mA because of the danger of failure.
Do not set the current to 8mA or less because of the danger of malfunction.

Two Clock Input (2CK)
(Inputs two clock pulses - CW clock pulse and CCW clock pulse)

CW+/-
Motor rotates in CW direction with a pulse current of 8 to 20mA from CW+ to CW- terminal.

CCW+/-
Motor rotates in CCW direction with a pulse current of 8 to 20mA from CCW+ to CCW- terminal.

One Clock Input (1CK)
(Inputs clock pulse and direction (CW, CCW))

CLK+/-
Motor rotates in CW direction with a pulse current of 8 to 20mA from CLK+ to CLK- terminal and UD input off.

UD+/-
Motor rotates in CCW direction with a pulse current of 8 to 20mA from CLK+ to CLK- terminal and UD input turned ON.

The current at 4.5 to 5.5V is 10 to 15mA.

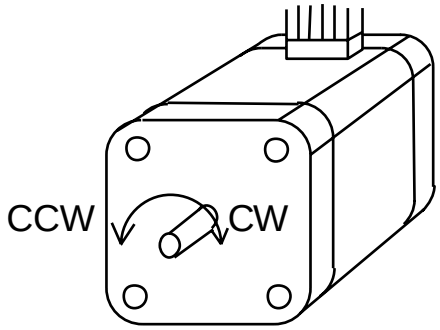


Fig.5. Direction of Rotation

6-2 Full Step Input (2P IN +/-)

Motor rotates in full step mode with a pulse current of 2 to 10mA (approx. 3.8mA at 5V) from "2P IN +" to "2P IN –".

6-3 Alarm Output (ALARM +/-)

Overheating protection circuit intervenes turning ALARM output ON. (Open collector output ON)

7. ALARM LED

This will light when Overheating protection circuit is in operation.

8. Dip Switches

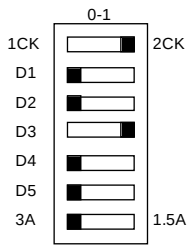


Fig.6. Dip switches

8-1 Clock Input Selection Switch (1CK/2CK)

Selects clock input, Two clock input method (2CK) or Pulse & Direction input method (1CK).

8-2 Microstep Resolution Selection Switch (D1 to D5)

! Caution

Do not set the dip switches except the below table.
It causes malfunction or failure.

You can select microstep resolution from among 22 selections using dip switch D1 to D5.

$$\text{Step angle} = \text{Motor basic step angle} \times \frac{1}{\text{Microstep resolution}}$$

Dip switch setting table:

D5	D4	D3	D2	D1	Microstep Resolution(M)
0	0	0	0	1	400
0	0	0	1	0	200
0	0	0	1	1	100
0	0	1	0	0	50
0	0	1	0	1	25
0	0	1	1	0	12.5
0	0	1	1	1	6.25

D5	D4	D3	D2	D1	Microstep Resolution(M)
0	1	0	0	0	64
0	1	0	0	1	32
0	1	0	1	0	16
0	1	0	1	1	8
0	1	1	0	0	4
0	1	1	0	1	2
0	1	1	1	0	1

D5	D4	D3	D2	D1	Microstep Resolution(M)
1	0	0	0	0	320
1	0	0	0	1	160
1	0	0	1	0	80
1	0	0	1	1	40
1	0	1	0	0	20
1	0	1	0	1	10
1	0	1	1	0	5
1	0	1	1	1	2.5

8-3 Current Range Switch (3A/1.5A)

Sets the motor run current range when setting the run current adjustment trimmer to the max. value. (See Fig.3)

9. Timing Diagrams

Switching Direction of Rotation

Two clock input (2CK):

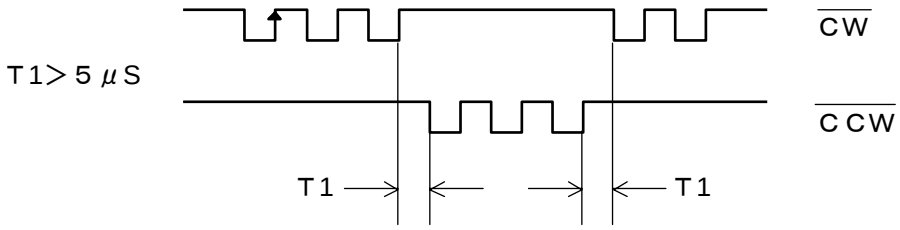


Fig.7. Two Clock Timing Diagram

One clock input (1CK):

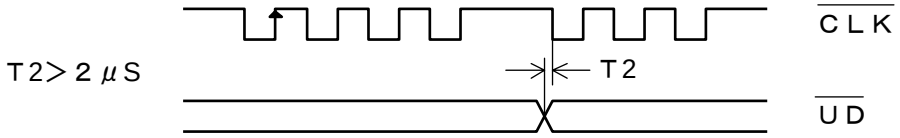


Fig.8. One Clock Timing Diagram

Switching between microstep and full step or vice versa

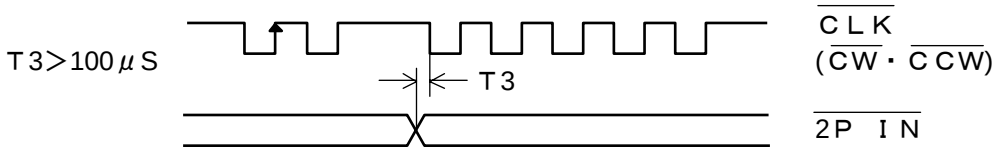


Fig.9. Micro/Full step Switching Timing Diagram

Note1: The above diagrams indicate voltage waveform of "－" terminal (negative logic) in case of connecting external power supply to each "＋" terminal, and open-collector output of external controller to "－" terminal.

Note2: The pulse count will not be lost as long as parameters T1 to T3 are within the spec.

Note3: Motor will rotate 1 step at the rising edge of pulse ($\overline{CW}$・$\overline{CCW}$・$\overline{CLK}$).
(When the clock current will change from ON to OFF)

１０. Input/Output Circuits

Caution

Do not exceed max. rated current･voltage of each I/O circuit.
It causes failure or malfunction.

10-1 Clock Input Circuits (CW/CLK, CCW/UD)

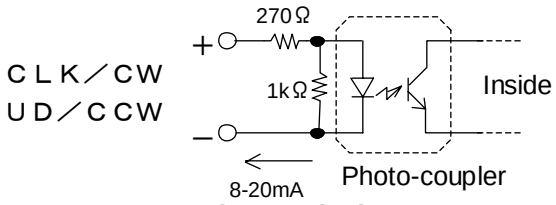


Fig.10. Clock Inputs

Please operate with a pulse current of 8 to 20mA. (10 to15mA at 4.5 to 5.5VDC)
If the current exceeds 20mA by connecting with power supply of high voltage (24V etc.) directly, please place resistor in series so that current can be set to 8 to 20mA.

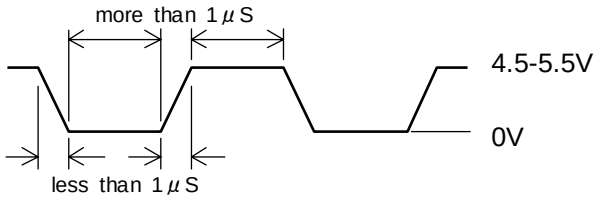


Fig.11. Pulse Specification

10-2 2P IN Input Circuit (2P IN +/-)

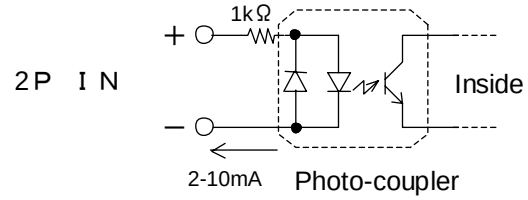


Fig.12. 2P IN Input

Please operate with a pulse current of 2 to 10mA. (Approx. 3.8mA at 5VDC)
If the current exceeds 10mA by connecting with power supply of high voltage (24V etc.) directly, please place resistor in series so that current can be set to 2 to 10mA.

10-3 Output Circuit (ALARM +/-)

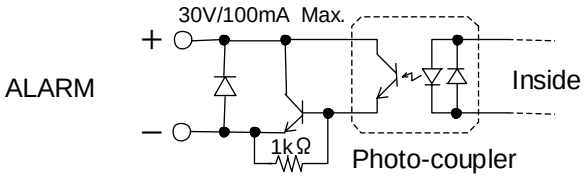


Fig.13. ALARM Output

Do not supply the voltage more than 30V and the current more than 100mA between terminals.

11. Wiring Diagram

⚠ Caution

Make sure that there are no mis-wiring and short-circuiting and do not turn power on before wiring correctly. There is danger of fire or failure.
Please tighten the terminals with the torque of less than 3.5kgf·cm (0.35N·m).

Please use the wire rod with the cross-section area corresponding to current value.

※In microstep mode, a sine curve current which made effective value the run current value set by run current adjustment trimmer flows. The maximum current value which runs on the lead wire of motor is run current × $\sqrt{2}$.

ex.) Run current: 3A → Max. current value is 4.2A. ($3(\mathrm{A})\times\sqrt{2}=4.2(\mathrm{A})$)

Use twisted wire pair for the signal input wiring. Please tighten the terminals less than 3.5kgf·cm (0.35N·m). (Proper torque is 2.5kgf·cm (0.25N·m))

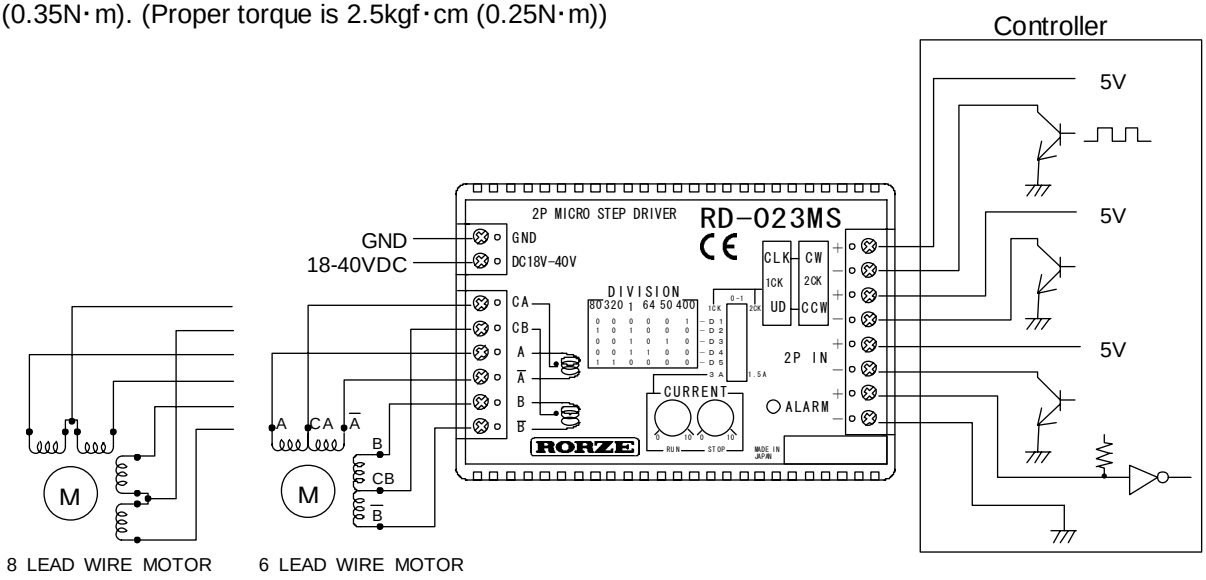


Fig.14. Wiring Diagram

11-1 Suitable Motor

You can use any HB(hybrid) or PM(permanent magnet) stepping motor with rating of 0.3 to 3A/ph. Select motors with rating of less than supply voltage × 0.7(V).

RORZE 2-Ph Stepping Motors (Torque -- 1kgf·cm = 13.9oz·in Inertia -- 1g·cm² = 5.46745×10^{-3}oz·in²)

Model No.	Holding Torque		FullStep Angle	Rated Current	Rotor Inertia	Resistance (Ω)	Inductance (mH)
	(kgf·cm)	(N·m)	(Degree)	(A/phase)	(g·cm²)		
RM2414S/D	1.4	0.14	1.8	1.5	30	1.3	0.96
RM2424S/D	2.4	0.24	1.8	1.5	53	1.75	2.2
RM2621S/D	2.1	0.21	1.8	3.0	57	0.36	0.48
RM2640S/D	4.0	0.39	1.8	3.0	100	0.6	0.8
RM2690S/D	8.0	0.78	1.8	3.0	210	0.77	1.58
RM26A3S/D	13.0	1.3	1.8	3.0	360	0.9	2.2

Color of RORZE motor's wire

	Terminal					
	CA	CB	A	$\overline{A}$	B	$\overline{B}$
RORZE MOTOR	Black	White	Red	Yellow	Blue	Orange

１２. Heat Dissipation

Caution

Please dissipate heat generated by driver and motor enough.
If it is insufficient, temperature rise causes malfunction, failure or fire.

Keep the motor's maximum case temperature below 100℃ and driver's below 60℃ by adjusting the drive current or by installing a cooling fin, fan, etc.

１３. Other Functions

13-1 Auto. current down

This works after about 0.3 seconds of inactivity. Setting stop current lower to run current will prevent heat generation. However, if stop current is high, position gap will decreases. (See fig. 4) Also even if the motor rotation is stationary, the auto. current down doesn't work under the condition applying the voltage between clock input terminals.

13-2 Over heating protection circuit

This works when the internal temperature of the driver reaches about 70℃. It turns ALARM output ON and ALARM LED will be turned ON. Furthermore, if the temperature keeps on rising, it stops motor compulsively and works auto. current down. If the body temperature drops about 10℃ below the triggered temperature, the driver will restore automatically.

13-3 Over current protection circuit

This works when abnormal current inside the driver occurred by mis-wiring or short-circuiting etc. has been detected.

13-4 Low supply voltage protection circuit

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

１４. Consumption Current

The current consumed by driver and motor varies, depending on the supply voltage, pulse (clock) frequency, motor's inductance, rated current and holding torque. Also, the ripple according to the cycle of PWM (50kHz) and RPM is added into the consumption current. Please use the power supply which current is more than 1.2 times the rated current of the motor as a standard.

If other devices share the same power supply and voltage change can't be allowed, then use the power supply which can flow 1.7 times of the max value of the supply current, or incorporate a large capacitor.

１５. Relationship between Frequency(pps) and Motor speed(rpm)

"pps" is about pulse speed and stands for the number of pulses per second.
Formula to calculate rpm:

$$\text{Motor speed(rpm)} = \frac{\text{Step Angle} / \text{Microstep resolution(M)} \times \text{Frequency} \times 60}{360\text{(degree)}}$$

Example

Step Angle: 1.8degree, Microstep resolution(M): 10, Frequency: 10,000pps

$$\text{Motor speed(rpm)} = \frac{1.8 / 10 \times 10{,}000 \times 60}{360} = \underline{300 \text{ rpm}}$$

１６. Dimensions

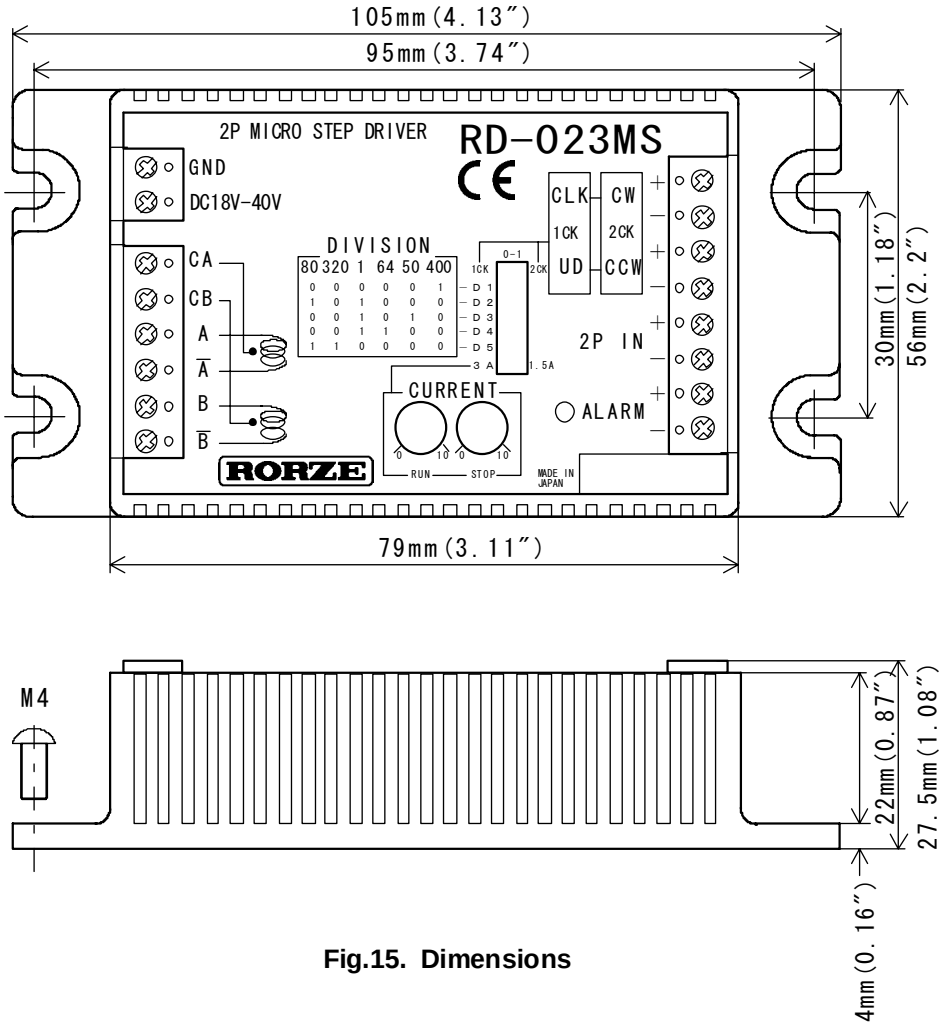


Fig.15. Dimensions

RD-023MS carries out the CE Marking

CE

■ CE Marking

It is obliged for manufacturers to append the CE Conformity Marking to the machine and the electric product which are sold in the sphere of EU in order to display that those apparatus conform to safety, a quality control, and environmental-destruction prevention.
As for the details of this regulation, a lot of EC council Directives (or European Standards) are issued, and the above-mentioned apparatus needs to conform corresponding EC directives.
And manufacturers themselves need to create the self-declaration, which declares that the equipment conforms to EC Directives, and to carry out the CE Marking pasting.

■ Standards of Conformity

Product Name	Application Directive	Application Standards	Certification File No
RD-023MS	EMC	EN 50081-2 EN 50082-2	AE 9951219 03

● **The use conditions for suiting EMC Directive**

(1) A shield cable should be used for power supply line and signal line.
(2) Please put a ferrite core into each line.

In case of the CE Marking to a product, we perform the self-conformity declaration after receiving the attestation of the third party certification body (TÜV Rheinland) in EU area.
Moreover, since RD-023MSs do not have the movable part which may do damage in a human body and are used in the range of less than 40V DC, they do not correspond to Machinery Directive and Low Voltage Directive.

The entire system including RD-023MS and all the control device and electric parts, is subject to EMC Directive. Therefore, please make sure of the final EMC conformity of your system or machinery into which those units are incorporated.

RORZE CORPORATION

◆**Head Office** (Japan)
1588 Michinoue, Kannabe-cho, Fukayasu-gun, Hiroshima 720-2104, Japan
Phone: +81-84-960-0001
Fax: +81-84-960-0200
E-mail address: sales@rorze.com
Home page address: http://www.rorze.com

* All RORZE products come with a 24-month guarantee.
* Specifications and products are subject to change without any obligation on the part of the manufacturer.

RCD 020201