C-DR86A

MISUMI Economy Series Stepper Motor Drivers, 86 Series Operating Instructions

I. Product Introduction

1. Overview

C-DR86A is a new digital stepper motor driver from MISUMI, which adopts the latest 32-bit DSP digital processing technology and a driver control algorithm that combines advanced variable current technology and frequency conversion technology to realize less heat generation, low motor vibration and smooth operation. The driver enables the user to set any subdivision within the range of 400-51200 and any current value within the rated current range, meeting the needs of most application scenarios. With the built-in micro-step subdivision technology, the driver can achieve the effect of high subdivision even under the condition of low subdivision, ensuring smooth operation at low, medium and high speeds with ultra low noise. The driver integrates the power-on parameter auto-tuning function, which can automatically generate optimal operating parameters for different motors and maximize the motor's performance.

2. Features

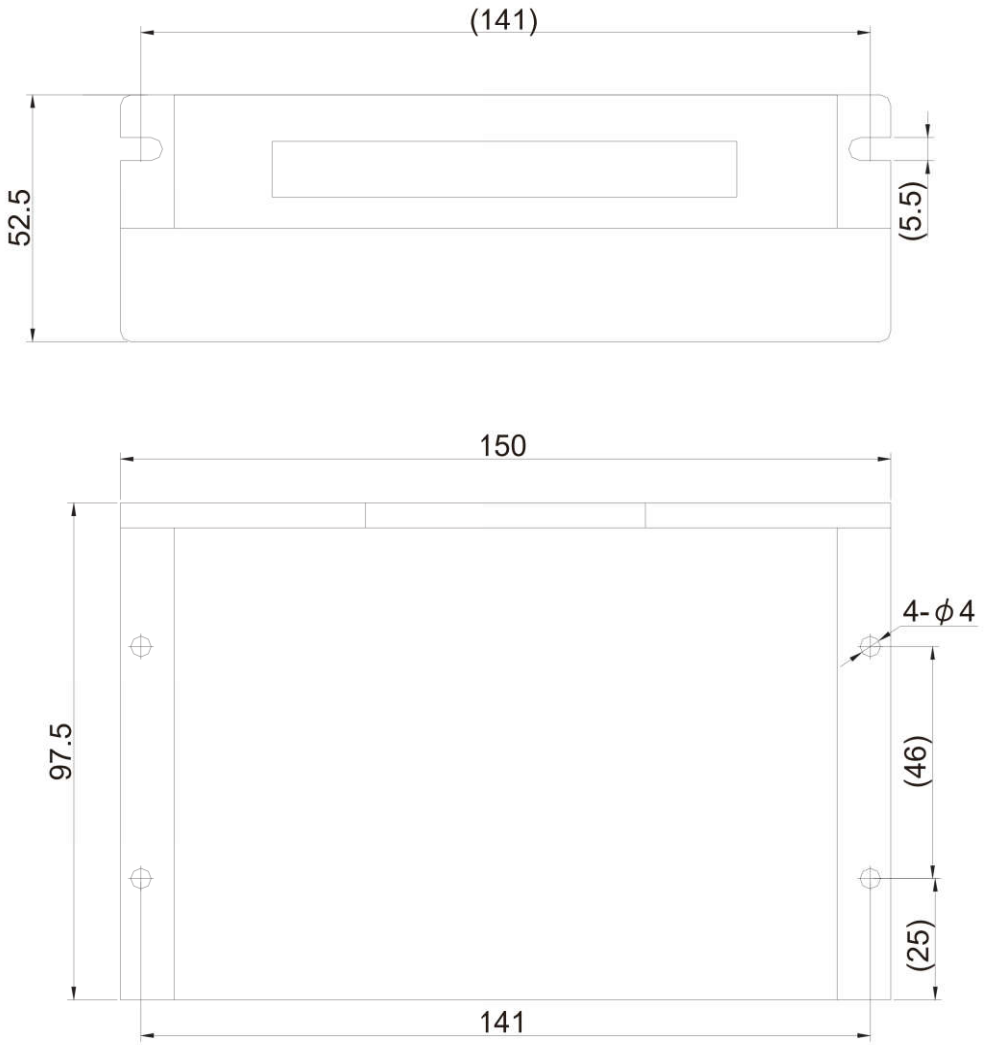
- New 32-bit DSP technology
- Ultra low vibration noise
- Built-in high subdivision
- Power-on parameter auto-tuning function
- Significant reduction of motor heating by variable current control
- Automatic current reduction by half at standstill
- Optically isolated differential signal input
- Impulse response frequency up to 500KHz (factory default: 200KHz)
- Convenient current setting in the range of 2.0-6A
- Subdivision setting in the range of 400-51200
- Overvoltage, undervoltage, overcurrent and other protection functions

II. Environmental Indicators and Dimensions

1. Operating Environment and Parameters

Cooling method		Forced air cooling
Operating environment	Application	Do not place the driver near other heat generating equipment, keep it away from places with dust, oil mist, corrosive gases, high humidity or strong vibration, and prohibit flammable gases or conductive dust.
	Temperature	-5°C ～ +50°C
	Humidity	40 ～ 90%RH
	Vibration	5.9m/s2MAX
Storage temperature		-20°C ～ 80°C
Operating altitude		1000m or less
Weight		Approx. 0.4g

2. Mechanical Installation Diagram



※ Side mounting is recommended for better heat dissipation. When designing the mounting dimensions, pay attention to the terminal size and wiring!

3. Measures for Improving Heat Dissipation

1) The reliable operating temperature of the driver is usually within 66°C, and the operating temperature of the motor is within 85°C;
2) When using the driver, it is recommended to select the automatic half-current mode, in which the current is automatically halved when the motor stops, thereby reducing the heat generation in the motor and the driver;
3) Install the driver sideways and vertically so that the heat sink fins can provide strong air convection; if necessary, install a fan near the driver for forced cooling, ensuring that the driver operates within the reliable operating temperature range.

III. Driver Interface and Wiring Introduction

1. Interface Description

1) Control Signal Interface

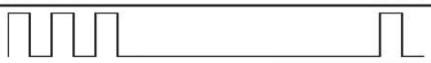
Name	Function
PUL+	Pulse signal: pulse rising edge is valid; PUL is 4.5-28Vdc at high level and 0-0.5V at low level. To respond reliably to pulse signals, the pulse width should be greater than 1.5μs.
PUL-	
DIR+	Direction signal: high/low level signal. To ensure reliable commutation of the motor, the direction signal should be established at least 2μs before the pulse signal. The initial running direction of the motor is related to its wiring. Interchanging any phase winding (e.g. interchanging A+ and A-) can change the initial running direction of the motor. DIR is 4.5-28Vdc at high level and 0-0.5V at low level.
DIR-	
ENA+	Enable signal: This input signal is used to enable or disable. When ENA+ is connected to 4.5-28Vdc and ENA- is connected to low level (or the internal optocoupler is turned on), the driver will cut off the current on each of the motor phases to make the motor free, and the stepping pulse will not be responded. When this function is not needed, the enable signal is recommended to be suspended.
ENA-	

2) Strong Current Interface

Name	Function
AC	AC input for power supply, 20-80VAC (24-110VDC); AC/DC universal, allowing for connection with straight or reversed polarity
AC	AC input for power supply, 20-80VAC (24-110VDC); AC/DC universal, allowing for connection with straight or reversed polarity
A+、A-	Motor phase A coil interface.
B+、B-	Motor phase B coil interface.

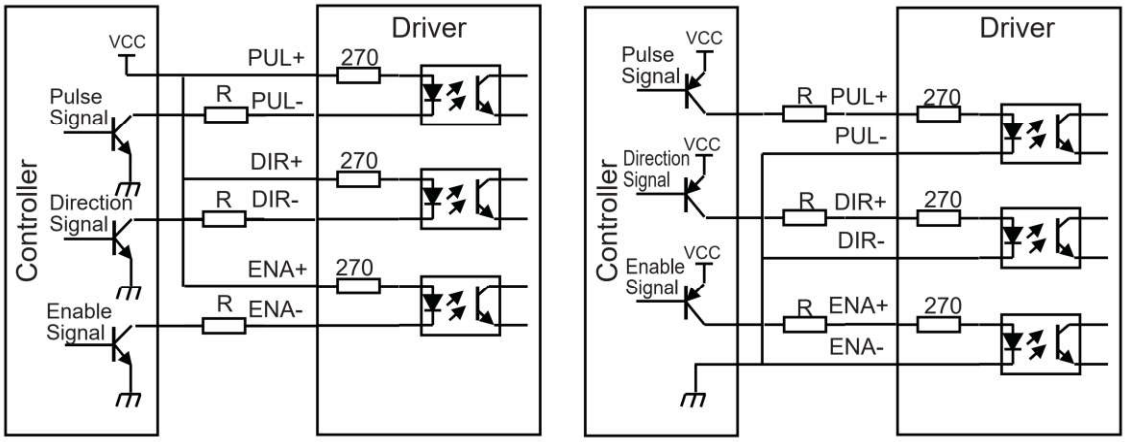
3) Status Indication

The green LED is the power indicator. When the driver is powered on, the LED is always on; when the driver is powered off, the LED is off. The red LED is the fault indicator. When a fault occurs, the indicator flashes in a cycle of 3 seconds. When the fault is cleared by the user, the red LED is always off. The number of flashes of the red LED in 3 seconds represents different fault information, as shown in the table below:

Serial No.	Number of Flashes	Flashing Waveform of Red LED	Fault Description
1	1		Overcurrent or phase-to-phase short circuit fault
2	2		Overvoltage fault
3	3		No definition

2. Control Signal Interface Circuit

C-DR86A driver adopts a differential interface circuit, which is applicable to differential signals, single-ended common cathode and single-ended common anode interfaces, etc. The driver has a built-in high-speed photocoupler, allowing it to receive signals from long-line drivers, open collectors, and PNP output circuits. In harsh environments, it is recommended to use long-line driver circuits to provide strong protection against interference. Now take the open collector and PNP output as an example, the interface circuit diagram is as follows:

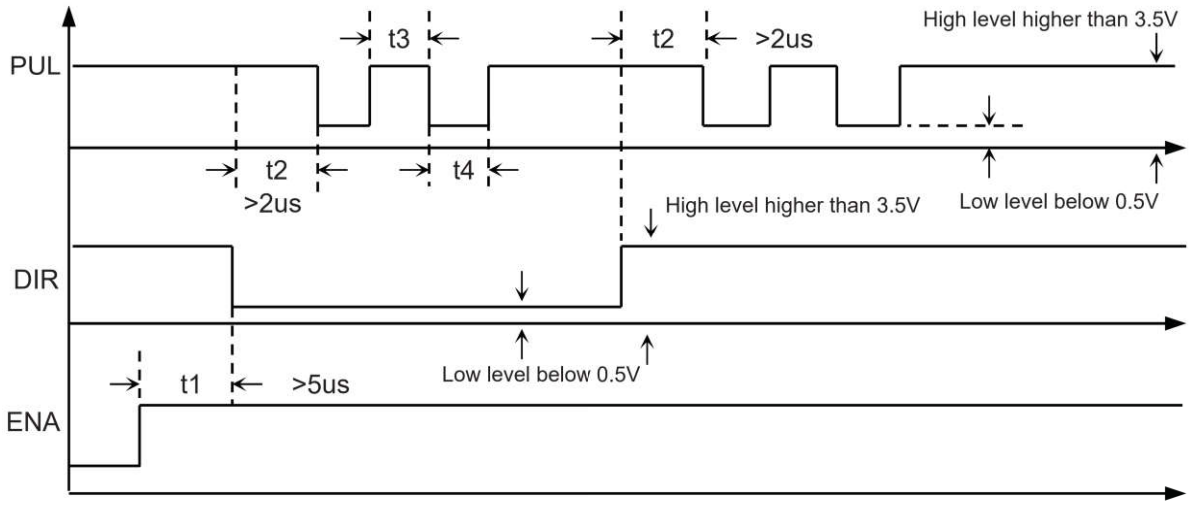


Common anode connection　　Common cathode connection

Note: When the VCC value is 4.5-28Vdc, R is shorted or not connected;

3. Control Signal Timing Diagram

To avoid some malfunctions and deviations, PUL, DIR and ENA should meet certain requirements, as shown in the following figure:



Notes:

1) t1: ENA (Enable Signal) should be at least 5μs ahead of DIR, and it is determined as high. Generally, ENA+ and ENA- are recommended to be suspended.
2) t2: DIR determines its state to be high or low at least 2μs ahead of the falling edge of PUL.
3) t3: The pulse width should be at least 2μs.
4) t4: The low level width should be no less than 2μs.

4. Control Signal Mode Setting

Selection of single/dual pulse: The single pulse mode or dual pulse mode can be set. In the dual pulse mode, the signal at the direction control end must be kept at high level or suspended.

5. Wiring Requirements

1) To prevent interference to the driver, it is recommended to use shielded cables for the control signal and short-circuit the shielding layer with the ground wire. Except for special requirements, the shielding wire of the control signal cable should be grounded at one end: the host computer end of the shielding wire is grounded, and the driver end of the shielding wire is suspended. It is only allowed to ground to the same point within the same machine. If the ground wire is not real, interference may be serious, in which case the shielding layer should not be connected.
2) The pulse and direction signal wires and the motor wires are not allowed to be wrapped side by side, preferably separated by at least 10cm, otherwise the motor noise will easily interfere with the pulse and direction signals, resulting in malfunctions such as inaccurate motor positioning and unstable system operation.
3) When multiple drivers are powered from one power source, the drivers should be connected in parallel at the power source, and it is not allowed to connect to one driver first and then to the other in a chain.
4) It is strictly prohibited to plug and unplug the strong current terminal P2 of the driver with the power turned on. When an energized motor stops, there is still a large current flowing through the coil, and plugging and unplugging the terminal P2 will result in a huge momentary induced electromotive force and cause the driver to burn out.
5) It is strictly prohibited to connect a tinned conductor tip to a terminal, otherwise the terminal may be damaged by overheating due to an increase of contact resistance.

IV. Current, Subdivision DIP Switch Setting and Parameter Auto-tuning

C-DR86A driver adopts an eight-position DIP switch to set the subdivision accuracy, dynamic current, static half current and realize the auto-tuning of motor parameters and internal adjustment parameters.

1. Current Setting

Refer to the driver panel.

2. Subdivision Setting

Refer to the driver panel.

3. Parameter Auto-tuning Function

If SW4 is toggled back and forth once within 1 second, the driver can automatically complete the auto-tuning of motor parameters and internal adjustment parameters. Auto-tuning should be performed following any changes to the conditions of the motor, power supply voltage, etc., otherwise the motor may operate abnormally.

Note that there should be no input of pluses and no change in the direction signal at this time.

Implementation method 1) Toggle SW4 from on to off and then toggle it from off back to on within 1 second;

Implementation method 2) Toggle SW4 from off to on and then toggle it from on back to off within 1 second.

Note: This driver model has the power-on parameter auto-tuning function.

V. Power Supply Selection

The driver can operate normally as long as the power supply voltage is within the specified range. If the C-DR86A driver adopts a DC power supply, it is preferable to use an unregulated DC power supply, or a transformer buck + bridge rectifier + capacitor filter. Note, however, that the peak ripple of the rectified voltage should not exceed its specified maximum voltage. It is recommended that the user supply power with a DC voltage lower than the maximum voltage to prevent the grid from fluctuating beyond the operating range of the driver voltage.

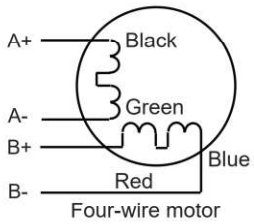
When using a regulated power supply, be aware that the output current range of the switching power supply must be set to maximum.

Please note:

1) Connect the power supply correctly when wiring;
2) It is preferable to use an unregulated power supply;
3) When using an unregulated power supply, the current output capacity of the power supply is recommended to be greater than 60% of the set current of the driver;
4) If a regulated switching power supply is used, the output current of the power supply should be greater than or equal to the operating current of the driver;
5) To reduce cost, two or three drivers may share one power supply, but the power supply should be large enough.

VI. Motor Matching

1. Motor Wiring



Four-wire motor

2. Input Voltage and Output Current Selection

1) Supply Voltage Setting

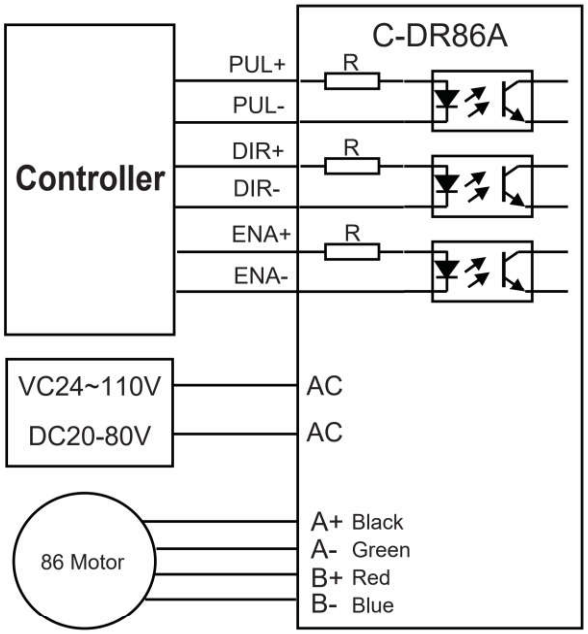
In general, the higher the supply voltage, the greater the motor torque at high speeds and the greater the chance that the step loss at high speeds can be avoided. On the other hand, if the voltage is too high, overvoltage protection will be triggered, and the motor will generate more heat, which may even damage the driver. When operating at a high voltage, the motor will have greater vibration at low speeds.

2) Output Current Setting Value

For the same motor, the higher the current setting value, the greater the motor output torque, but the motor and driver will generate more heat when the current is high. The amount of heat generated is not only related to the current setting value, but also to the type of motion and the dwell time. The following setting method uses the rated current value of the stepper motor as a reference, but the optimum value in practical applications should be adjusted based on this. In principle, if the temperature is very low (<40°C), the current setting value can be appropriately increased to increase the motor output power (torque and high-speed response).

- Four-wire motor: Set the output current to be equal to or slightly smaller than the rated current of the motor.

△ Note: Run the motor for 15-30 minutes after setting the current. If the temperature rise of the motor is too high (>70°C), the current setting value should be reduced. Therefore, the current is generally set to a value at which the motor gets warm but not overheated during long-term operation.



VII. Protective Functions

1) Short Circuit Protection

When a phase-to-phase short circuit occurs or there is overcurrent in the driver, the red light of the driver flashes once, and flashes repeatedly within 3 seconds. In this case, the fault must be cleared and the power-on reset must be performed.

2) Overvoltage Protection

When the input voltage of C-DR86A is higher than 100VAC, the red light of the driver flashes twice, and flashes repeatedly within 3 seconds. In this case, the fault must be cleared and the power-on reset must be performed.

3) Motor Open Circuit Protection

When the motor is open-circuited or not connected, the red light of the driver flashes 4 times, and flashes repeatedly within 3 seconds. In this case, the fault must be cleared and the power-on reset must be performed.

VIII. Common Problems

1. Common Problems and Solutions in Applications

Phenomenon	Possible Problem	Solutions
Motor does not rotate	Power light is not on	Check the power supply circuit and ensure normal power supply
	Motor shaft is under force	As the pulse signal is weak, increase the signal current to 7-16mA
	Subdivision is too small	Select the correct subdivision
	Current setting is too small	Select the correct current
	Driver is under protection	Power on again
	Enable signal is low	This signal is pulled high or not connected
	No response to control signals	Not powered on
Motor steering error	Wrong connection of motor wires	Interchange any two wires on the same phase of the motor (e.g. interchange the wiring positions of A+ and A-)
	Motor wires have an open circuit	Check and connect correctly
Alarm indicator is on	Wrong connection of motor wires	Check the wiring
	Voltage is too high or too low	Check the power supply
	Motor or driver is damaged	Replace the motor or driver
Inaccurate position	Signal interference	Eliminate interference
	Shield ground is not connected or not properly connected	Reliable grounding
	Motor wires have an open circuit	Check and connect correctly
	Subdivision error	Set the subdivision correctly
	Small current	Increase the current
Motor stall when accelerating	Acceleration time is too short	Increase the acceleration time
	Motor torque is too small	Select a large torque motor
	Low voltage or too small current	Increase the voltage or current appropriately

2. Frequently Asked Questions on Driver

1) What is a stepper motor and a stepper driver?

A stepper motor is a special motor designed for precise control of speed and position. It rotates step by step at a fixed angle (known as "step angle"), so it is called stepper motor. Its feature is that there is no accumulated error, and every pulse signal from the controller is received. The motor rotates at a fixed angle under the drive of the driver, so it is widely used in various open-loop control applications.
A stepper driver is a power amplifier that can drive the stepper motor to run. It can convert the pulse signal from the controller into the power signal of the stepper motor. The speed of the motor is proportional to the pulse frequency, so the speed can be accurately adjusted by controlling the pulse frequency, and accurate positioning can be achieved by controlling the number of pulses.

2) What is the subdivision of the driver? What is the relationship between the speed of the stepper motor and the pulse frequency?

Each stepper motor, depending on its own unique structure, is marked at the factory with the "inherent step angle of the motor" (e.g. 0.9°/1.8°, meaning that the motor rotates 0.9° for each step in half-step operation and 1.8° in full-step operation). However, in many precision control applications, the angle of a full step is too large, affecting the control accuracy and causing excessive vibration, so it is required to complete an inherent step angle of a motor in many steps. This is called subdivision driving, and the electronic device that can realize this function is called subdivision driver.

$$V = \frac{P*\theta e}{360*m}$$

V: motor speed (r/s) P: pulse frequency (Hz)
θe: inherent step angle of the motor m: subdivision number (1 for full step and 2 for half step)

3) What are the advantages of a subdivision driver?

- The step uniformity is improved by reducing the step angle of each step, thereby improving the control accuracy.
- It can reduce motor vibration significantly, and subdivision is the best way to eliminate low-frequency oscillation, which is an inherent characteristic of stepper motors.
- It can effectively reduce torque fluctuations and increase output torque.

These advantages are generally recognized by users and bring them benefits, so it is recommended to use a subdivision driver.

4) Why does my motor only run in one direction?

- Maybe the direction signal is too weak, or the wiring polarity is wrong, or the signal voltage is too high, causing burnout of the directional current limiting resistor.
- The pulse mode does not match. If the signal is pulse/direction, the driver must be set to this mode; if the signal is CW/CCW (dual pulse mode), the driver must also be set to this mode, otherwise the motor will run in only one direction.