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Part I

General Introduction

Chapter I System Overview

This chapter will briefly introduce the Kinco-K5 series micro PLC (Programmable Logic Controller) and focuses on the explanation of the terms related to Kinco-K5 with a purpose of facilitating you to understand the contents in the following part of this manual. The main content of this chapter covers: application scope of the product, explanations on relevant terms, rules for nomenclature, etc.

1.1 Application Scope of the Product

According to the accepted classification rules for PLC, Kinco-K5 series PLC falls into the range of micro PLC. Therefore, it can be used to control machines and small-scale process. Kinco-K5 series PLC can well satisfy the demands in the following application areas (including but not limited to these applications):

Packing machinery   textile machinery   building material machinery

Foodstuff machinery   plastic machinery   numerical control machine

Printing mechanism   central air conditioner

Environmental Machinery   individual process control device

1.2 General Designation in the Manual

1.2.1 Vocabulary of Terms

▪ Micro PLC (Programmable Logic Controller)

According to the general classification rules, micro PLC generally refers to the type of PLC with the control points below 128. This type of PLC usually adopts compact structure, that is, a certain number of I/O channels, output power supply; high-speed output/input and other accessories are integrated on the CPU module.

▪ CPU body

Namely, the CPU module, it's the core of the control system. The user program is stored in the internal storage of the CPU module after being downloaded through the programming software, and will be executed by the CPU. Meanwhile, it also executes the CPU self-test diagnostics: checks for proper operation of the CPU, for memory areas, and for the status of any expansion modules.

▪ Expansion module & expansion bus

The expansion module is used to extend the functions of the CPU body and it is divided into expansion I/O module (to increase the input/output channels of the system) and expansion functional module (to expend the functions of CPU).

The expansion bus connects the CPU and expansion modules, and the 16-core flat cable is adopted as the physical media. The data bus, address bus and the expansion module's working power supply are integrated into the expansion bus.

▪ KincoBuilder

The programming software for Kinco-K5 series PLC, accords with IEC61131-3 standard KincoBuilder, presently provides LD and IL languages for convenience and efficiency in developing the control programs for your applications. KincoBuilder provides a user-friendly environment to develop and debug the programs needed to control your applications.

▪ CPU firmware

It is the "operating system" of the CPU module, and is stored in the Flash memory. At power on, it starts operation to manage and schedule all the tasks of the CPU module.

▪ User program

It's also called user project or application program, the program written by the user to execute some specific control functions. After the user program is downloaded to the CPU module, it is stored in the FRAM. At power on, the CPU module shall read it from FRAM into RAM to execute it.

▪ Main program and Scan Cycle

The CPU module executes a series of tasks continuously and cyclically, and we call this cyclical execution of tasks as *scan*.

The main program is the execution entry of the user program. In the CPU, the main program is executed once per scan cycle. Only one main program is allowed in the user program.

▪ Free-protocol communication

The CPU body provides serial communication ports that support the special programming protocol, Modbus RTU protocol (as a slave) and free protocols. Free-protocol communication mode allows your program to fully control the communication ports of the CPU. You can use free-protocol communication mode to implement user-defined communication protocols to communicate with all kinds of intelligent devices. ASCII and binary protocols are both supported.

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▪ I/O Image Area

Including input image area and output image area. At the beginning of a scan cycle, signal status are transferred from input channels to the input image area; at the end of a scan cycle, the values stored in the output image area are transferred to output channels;

In order to ensure the consistency of data and to accelerate the program execution, the CPU module only access the image area during each scan cycle.

▪ Retentive Ranges

Through "Hardware" configuration in KincoBuilder, you can define four retentive ranges to select the areas of the RAM you want to retain on power loss. In the event that the CPU loses power, the instantaneous data in the RAM will be maintained by the lithium cell, and the retentive ranges will be left unchanged at next power on. The retaining duration is 3 years at normal temperature.

▪ Data backup

Data backup is the activity that PLC writes the data within a particular memory area into E^2PROM or FRAM automatically for permanent storage. *Notice: Every type of permanent memory has its own expected life, for example, E^2PROM allows 100 thousand of times of writing and FRAM provides unlimited read/write endurance.*

1.3 Denomination Rules for the product

1.3.1 Description of the Product Name

The "product name" of Kinco-K5 PLC is used to indicate the main functions and application purpose of the product. The "product name" is not for any individual product but the general term for a type of products. The "product name" is defined according to the following principle:

Product name: *module type + 5 + subtype + serial number*

▪ *Module type* is indicated with the following letters

CPU   CPU module

PM   expansion I/O module

SM   expansion function module

PS   power module

SW   Software

AS   Accessory

▪ *5*   :   Stands for Kinco-K5 series micro PLC

▪ *Subtype:* a one-digit number (0~9) is used to indicate the subtype of the module.

0   CPU module

1   Reserved

2   Digital Input/Output module

3   Analog Input/Output module

4   Communication module

5   Specific function module

6   Software

7   Accessory

8   Power Module

9   Reserved

▪ *Serial number*: A one-digit number (0~9) is used to indicate the sequence number of a subtype. The serial

numbers of subtypes have the following implications.

▪ **CPU module**

4   CPU which provides 14 I/O channels on the CPU body;

6   CPU which provides 24 I/O channels on the CPU body;

8   CPU which provides 40 I/O channels on the CPU body;

Other serial numbers are reserved.

▪ **Digital Input/Output module**

1   DI (digital input) module;

2   DO (digital output) module;

3   DI / DO mixed module;

Other serial numbers are reserved.

▪ **Analog Input/Output module**

1   AI (analog input) module;

2   AO (analog output) module;

3   AI/AO mixed module;

Other serial numbers are retained.

▪ **Communication Module**

0   RS485 communication module;

1   CAN Protocol Interface module;

Other serial numbers are reserved.

▪ **Special Function Module**

These numbers are reserved.

▪ **Software**

0   Programming software;

Other serial numbers are reserved.

▪ **Accessories**

0   Programming cable;

Other serial numbers are reserved.

▪ **Power Module**

0   Power Expansion module;

Other serial numbers are reserved.

▪ **Function Identifier (optional)**

EC   Communication Enhanced CPU Module;

EA   Analog Enhanced CPU Module;

EM   Motion Control Enhanced CPU Module;

EX   Other Enhanced CPU Module.

According to the above principle, *CPU506* indicates a CPU module with 24 I/O channels; *PM521* indicates DI expansion module; *AS360* stands for KincoBuilder programming software, etc.

1.3.2 Description of Order Number

The difference from "product name" is that each product has a unique "order No.", users are merely required to expressly inform us the order number of the demanded product when making an order. The "order number" is confirmed in accordance with the following rule:
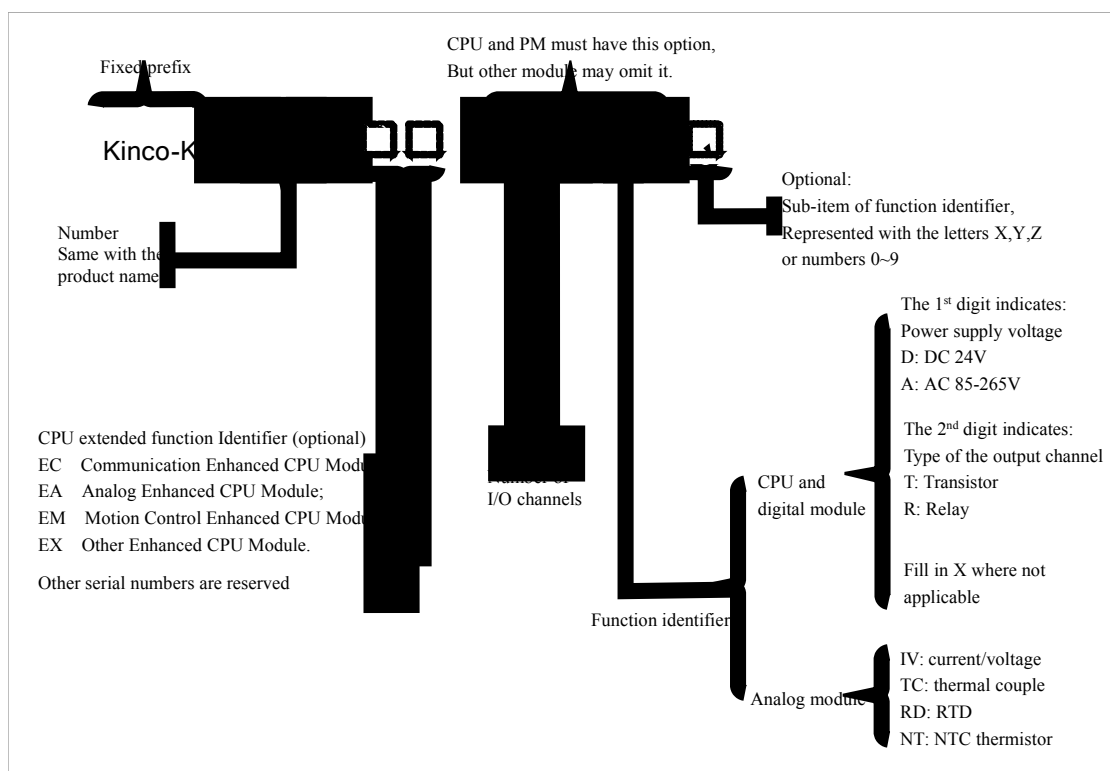
Kinco-K + module code + feature code

Diagram 1-2 Description of the Order Number

According to the above principle, *KINCO-K506-24DT* stands for the CPU module with 24 I/O channels (wherein the output channel is of transistor type) and DC24V power supply; *KINCO-K521-08DX* stands for the

DI expansion module with 8 transistor-type input channels.

1.4 Product list of Kinco-K5

Type	Name	Order no.	Description
CPU module	CPU504	Kinco-K504-14AT	AC85~265V power supply, with 14 I/O, DI 8*DC24V, DO 6*DC24V,1*RS232, non-reconnected extension module
		Kinco-K504-14AR	AC85~265V power supply, with 14 I/O, DI 8*DC24V, DO 6*Relay, 1*RS232, non-reconnected extension module
		Kinco-K504-14DT	DC21.6~28.8V power supply, with 14 I/O, DI 8*DC24V, DO 6*DC24V, 1*RS232, non-reconnected extension module
		Kinco-K504-14DR	DC21.6~28.8Vpower supply,with 14 I/O,DI 8*DC24V,DO 6*Relay, 1*RS232, non-reconnected extension module
	CPU504EX	Kinco-K504EX-14AT	AC85~265V power supply, with 14 I/O, DI 8*DC24V, DO 6*DC24V, 1*RS232,1*RS485
		Kinco-K504EX-14AR	AC85~265V power supply, with 14 I/O, DI 8*DC24V, DO 6*Relay, 1*RS232, 1*RS485
		Kinco-K504EX-14DT	DC21.6~28.8V power supply, with 14 I/O, DI 8*DC24V, DO 6*DC24V, 1*RS232, 1*RS485
		Kinco-K504EX-14DR	DC21.6~28.8V power supply, with 14 I/O, DI 8*DC24V, DO 6*Relay, 1*RS232, 1*RS485
	CPU506	Kinco-K506-24DT	DC24V power supply, with 24 I/O, DI 14*DC24V, DO 10*DC24V, 1*RS232, 2*RS485
		Kinco-K506-24DR	DC24V power supply, with 24 channels, DI 14*DC24V, DO 10*Relay, 1*RS232, 2*RS485
		Kinco-K506-24AR	AC85~265V power supply, with 24 I/O, DI 14*DC24V, DO 10*24V, 1*RS232, 2*RS485
		Kinco-K506-24AT	AC85~265V power supply, with 24 I/O, DI 14*DC24V, DO 10*Relay, 1*RS232, 2*RS485
	CPU506EA	Kinco-K506EA-30AT	AC85~265V power supply, with 30 I/O, DI 14*DC24V, DO 10*24V, AI 4*IV, AO 2*IV, 1*RS232, 2*RS485
		Kinco-K506EA-30DT	DC21.6~28.8V power supply, with 30 I/O, DI 14*DC24V, DO 10*24V, AI 4*IV, AO 2*IV, 1*RS232, 2*RS485
	CPU508	Kinco-K508-40AT	AC85~265V power supply, with 40 I/O, DI 24*DC24V, DO 16*DC24V, max output current per channel 0.75A
		Kinco-K508-40AR	AC85~265V power supply, with 40 I/O, DI 24*DC24V, DO 16*Relay, max output current per channel 3A

		Kinco-K508-40AX	AC85~265V power supply, with 40 I/O, DI 24*DC24V, DO 4*DC24V/12*Relay, max output current per channel 0.75A/3A
		Kinco-K508-40DT	DC21.6~28.8V power supply, with 40 I/O, DI 24*DC24V, DO 16*24V, 1*RS232, 2*RS485
		Kinco-K508-40DR	DC21.6~28.8V power supply, with 40 I/O, DI 24*DC24V, DO 16*Relay, 1*RS232, 2*RS485
Expansion I/O module	PM521	Kinco-K521-08DX	DI 8*DC24V
		Kinco-K521-16DX	DI 16*DC24V
	PM522	Kinco-K522-08DT	DO 8*DC24V
		Kinco-K522-16DT	DO 16*DC24V
		Kinco-K522-08XR	DO 8*Relay
		Kinco-K522-16XR	DO 16*Relay
	PM523	Kinco-K523-08DT	DI 4*DC24V, DO 4*DC24V,
		Kinco-K523-08DR	DI 4*DC24V, DO 4*Relay
		Kinco-K523-16DT	DI 8*DC24V, DO 8*DC24V
		Kinco-K523-16DR	DI 8*DC24V, DO 8*Relay
	PM531	Kinco-K531-04IV	4 analog input channels, 0-20mA/4-20mA/±10V/1-5V optional for each channel
		Kinco-K531-04TC	4 Thermocouple input channels, Type J/K/E/S optional for each channel
		Kinco-K531-04RD	4 RTD input channels, Pt100/Pt1000/Cu50/R, 2/3 wire optional for each channel
	PM532	Kinco-K532-02IV	2 analog output channels, 0-20mA/4-20mA/0-10V/1-5V optional for each channel
	PM533	Kinco-K533-04IV	2 analog input channels, 2 analog output channel, 4-20mA/1-5V/0-10V optional for each channel
Expansion functions module	SM541	Kinco-K541	CAN communication expansion module, supports CANopen master and CAN free protocol.
Expansion Power supply module	PM580	Kinco-K580	Power supply for expansion modules. Rated supply voltage AC85~265V, Max. output current: DC5V 1A and DC24V 250mA.

Table 1-1 Product list

Note: the relay output type of CPU module (the last number is "R", such as K506-24AR) doesn't support high-speed pulse output function!

Part II

Hardware Manual

Chapter I   Application of Kinco-K5 Series Micro PLC

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This chapter will briefly depict the architecture, expansion connection, network interface, etc and the introduction will help you understand and grasp the basics of KINCO-K5 series PLC to correctly use them.

1.1   Architecture of KINCO-K5

1.1.1 Overview

The Kinco-K5 is a kind of high-performance micro PLC (Programmable Logic Controller), and it provides a wide variety of CPU modules and expansion modules. The compact design, flexible configuration and powerful instruction set make Kinco-K5 a perfect solution for a wide variety of applications.

CPU module is the core of Kinco-K5, and it can monitor input channels and change output channels as controlled by the user program, which can include Boolean logic, counting, timing, complex math operations, and communications with other devices. 24VDC sensor supply, communication ports and a certain number of I/O channels are integrated on the CPU body.

Expansion module can add additional functionality to the CPU. The CPU module controls the operation modes of connected expansion modules and exchanges data through the expansion bus with them. Kinco-K5 provides all kinds of expansion modules for you, such as DI, DO, DI/DO, AI, AO, AI/AO, RTD, TC modules, etc.

KincoBuilder is the programming software for Kinco-K5. KincoBuilder accords with IEC61131-3 standard, and presently provides LD and IL languages. KincoBuilder provides you with a variety of useful functions such as programming, hardware configuration, reading diagnostic message, monitoring and forcing output, etc.

1.1.2 Allowable System Scales

The max numbers of points and expansion modules that supported by various CPUs are listed in the following table. Besides, the number of relay-output is restricted because of the limited power supply of the expansion bus.

Notice: All the data in the table refer to the maximum limitations, and each restrictive condition must be satisfied simultaneously!

	DI	DO	AI	AO	Max. number of expansion modules
CPU504	8	6	-	-	-
CPU504EX	8	6	-	-	4
CPU506	14	10	-	-	10
CPU506EA	14	10	4	2	10
CPU508	24	16	-	-	10

Table 1-1 Allowable system scales

1.1.3 Communicating over a Network

Kinco-K5 provides serial communication (RS232 and RS485) and CAN bus to conveniently connect with the 3rd-party equipments and systems. Kinco-K5 can not only meet the requirement of monitoring single equipment but also build up a complex network to satisfy all kinds of demands.
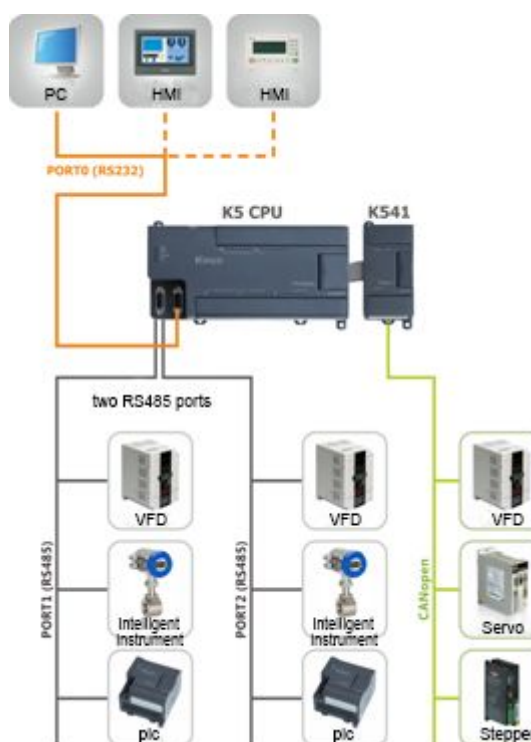
Figure 1-1 Communication Network

▪ Serial communication

The CPU module provides one RS232 port and one or two RS485 ports, and supports the standard Modbus

RTU protocol and free-protocol mode. You can link 32 (max) devices through RS485 port.

Default, all ports act as a Modbus RTU slave. RS485 ports supports Modbus RTU master functions, too.

▪ CAN bus

SM541 is a CAN bus expansion module, and it supports CANOpen mater and CAN free-protocol mode.

While working as a CANOpen master, SM541 supports CAN2.0A, and accords with DS301 V4.2.0.

While working as a CAN free-protocol device, SM541 supports CAN2.0A and CAN2.0B, and Kinco-K5

provides various CAN communication instructions for your application.

1.2 Power supply design

The Kinco-K5 CPU has an internal integrated power supply that provides power for the CPU itself, for all
connected expansion modules, and for other DC24V power requirements.

The integrated power supply of the CPU module, supplies both DC5V power and DC24V power to the connected
expansion modules, thereof, the DC5V power supply serves the internal circuit of each expansion module as
working power supply, and the DC24V power supply is specially designed as the drive supply (DC24V) for the
relay coil in the relay-type DO modules.

In order to facilitate users, DC24V sensor supply is integrated into the CPU module, the terminal labels are *VO+*
and *VO-*.

1.2.1 DC24V Sensor Supply

The DC24V sensor supply can supply DC24V for input channels or other requirements. If the power requirement
exceeds the capacity of the sensor supply, you can add an external DC24V power supply. **Notice: Prohibit
connecting an external DC24V power supply in parallel with the the DC24V Sensor Supply because this can
result in a conflict between the two supplies.**

The capacity of the DC24V sensor supply is shown in the following table.

CPU504/CPU504EX	300 mA
CPU506/CPU506EA/CPU508	AC：500mA；DC：300 mA

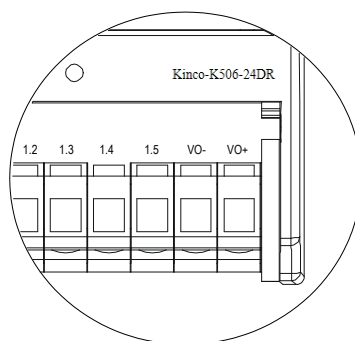Table 1-2 Capacity of the 24VDC Sensor Supply

Diagram 1-1   Wiring of the DC24V Sensor Supply

1.2.2 Expansion Supply

The expansion supply supplies both DC5V power and DC24V power for the connected expansion modules through expansion bus. In a PLC system, the power requirements for all the expansion modules must not exceed the capacity of the CPU's expansion supply, otherwise you have to add a PS580 module to provide extra expansion power, or select a CPU with higher capacity of the expansion supply.

The following tables list the expansion supply capacity of each CPU and the power requirements of each expansion module.

	DC5V	DC24V
CPU504EX	600mA	300mA
CPU506、CPU506EA、CPU508	1500mA	360mA
PS580	1000mA	250mA

Table 1-3 Capacity of expansion supply

	Typical requirement of external DC24V supply (L+ and L-)	Max. requirement of expansion supply	
		DC5V	DC24V
K521-08DX	-	180mA	-
K521-16DX	-	210mA	-
K522-08DT	-	200mA	-
K522-08XR	-	180mA	60mA
K522-16DT	-	240mA	-
K522-16XR	-	210mA	120mA
K523-08DT	-	200mA	-
K523-08DR	-	180mA	30mA
K523-16DT	-	240mA	-

K523-16DR	-	210mA	60mA
K531-04IV	10mA	172mA	-
K531-04RD	10mA	172mA	-
K531-04TC	10mA	172mA	-
K532-02IV	10mA	160mA	-
K533-04IV	10mA	166mA	-
K541	30mA	170mA	-

Table 1-4 Power requirements of expansion module

1.2.2 Input power of the CPU

The input power requirements of the CPU in three different situations are described below:

- Maximum power: This is the required maximum input power while the CPU is in the full load working condition, including the DC24V sensor supply working full load, and the expansion supply working full load, etc.

- Maximum power of a single CPU: This is the required maximum input power while a single CPU (without expansion modules) is in the full load working condition.

- Typical power of a single CPU: This is the required typical input power while a single CPU (without expansion modules) is in the normal working condition.

The following table lists the power values, unit: W.

		Max. power	Max. power of a single CPU	Typical power of a single CPU
CPU504	AC	15.0	15.0	3.0
	DC	15.0	10.0	2.5
CPU504EX	AC	22.5	15.0	3.0
	DC	22.5	10.0	2.5
CPU506	AC	40.0	22.5	3.9
	DC	24.0	10.5	3.0
CPU506EA	AC	40.0	22.8	4.0
	DC	24.0	12	3.5
CPU508	AC	40.0	23.2	4.2
	DC	24.0	11.2	3.0

Table 1-5 Input power values of the CPU

1.3 Environmental Condition

Kinco-K5 accords with GB/T 15969.3-2007（idt IEC61131-2：2007）standard and test specifications.

The following table lists the conditions and requirements for Kinco-K5 to work properly. It is the user's

responsibility to ensure that the service conditions are not exceeded.

Transport and storage		
Ambient conditions	temperature	-40 --- +70 °C
	relative humidity	10%~95%, no condensation
	Altitude	Up to 3000 m
Mechanical conditions	Free falls	within manufacturer's original packaging, 5 falls from 300mm of height.
Normal Operation		
Ambient conditions	air temperature	Open equipment : -10 --- +55°C; Enclosed equipment: -10 --- +40°C
	relative humidity	10%~95%, no condensation
	Altitude	Up to 2000 m
	Pollution degree	for use in pollution degree 2.
Mechanical conditions	Sinusoidal vibrations	5<f<8.4Hz, Occasional: 3.5mm amplitude; Continuous: 1.75mm mplitude. 8.4<f<150, Occasional: 1.0g acceleration; Continuous: 0.5g acceleration.
	Shock	occasional excursions to 15g, 11 ms, half-sine, in each of 3 mutually perpendicular axes.
Electromagnetic compatibility (EMC)	Electrostatic discharge	±4kV Contact, ±8kV Air. Performance criteria B.
	High energy surge	a.c. main power: 2KV CM, 1KV DM; d.c. main power: 0.5KV CM, 0.5KV DM; I/Os and Communication port: 1KVCM. Performance criteria A.
	Fast transient bursts	main power: 2KV, 5KHz. I/Os and Communication port: 1KV, 5KHz. Performance criteria A.
	Voltage drops and interruptions	a.c. supply: at 50Hz, 0% voltage for 1 period; 40% voltage for 10 periods; 75% voltage for 20 periods. Performance criteria A.
Ingress Protection Rating		IP20

Chapter II   CPU Principle and Application

This chapter will describe the CPU module of Kinco-K5.

2.1 Overview

2.1.1 Front view

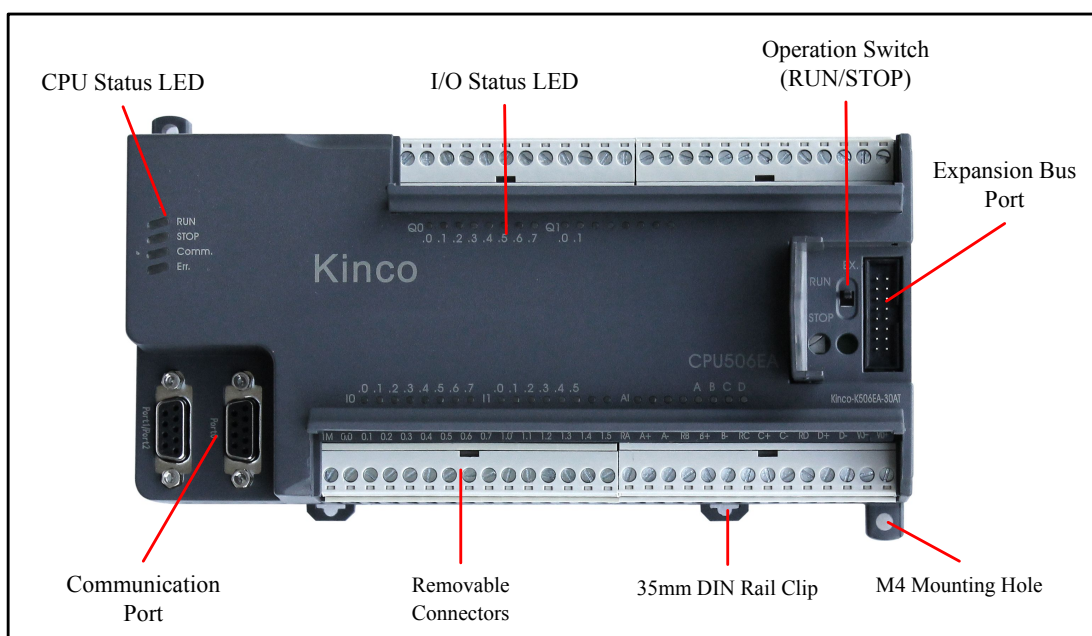The following diagram is the front view of a CPU.

Diagram 2-1 Main components

2.1.2 CPU Types

Kinco-K5 provides different CPU models with a diversity of features and capabilities that help you create effective solutions for your varied applications.

According to the voltage of main power supply, there are two kinds of CPU: one requires DC24V power supply and the other requires AC85V~265V.

According the number of the built-in I/O channels, there are 5 CPU models, including CPU504, CPU504EX, CPU506, CPU506EA and CPU508, and the larger the serial number is, the more integrated I/O channels and the

higher the performance is. The following table describes main technical data of each CPU model.

	CPU504	CPU504EX	CPU506	CPU506EA	CPU508
Built-in I/O and Communication					
Digital channel	8*DI/6*DO	8*DI/6*DO	14*DI/10*DO	14*DI/10*DO	24*DI/16*DO
Analog channel	--	--	--	4*AI / 2*AO	--
Max. expansion modules	--	4	10		
Communication Port	1 (PORT0)	2 (PORT0, PORT1)	3 (PORT0, PORT1, PORT2)		
	PORT0 is RS232,PORT1 and PORT2 are RS485。 PORT0 support the special programming protocol, Modbus RTU protocol (as a slave) and free-protocol communication mode. PORT1 and PORT2 support the special programming protocol, Modbus RTU protocol (as a slave or master) and free-protocol communication mode.				
High-speed counters	2				
Single phase	2, max.60KHz				
Two phase	2, max.20KHz				
High-speed pulse output	2, max. 200KHz. (For 200KHz, load resistance must be less than 1.5 KΩ).				
I/O Interrupts	4 rising/falling edge interrupts				
memory area					
Max. User program	1K instructions	4K instructions			
User Data	M area: 1K bytes; V area: 4K bytes				
DI image area	1 byte	5 bytes	32 bytes		
DO image area	1 byte	5 bytes	32 bytes		
AI image area	--	16 bytes	64 bytes		
AO image area	--	16 bytes	64 bytes		
Data Backup	FRAM, 448 bytes				
Retentive Ranges	--	4K bytes, lithium cell as backup power, 3 years at normal temperature.			
Others					
Timers	256 totally: 1ms time-base: 4 ; 10ms time-base: 16; 100ms time-base: 236				
Timed interrupts	2 with 0.1 ms resolution。				
Counters	256, (retained by lithium cell)				
Real-time clock	--	Yes, deviation less than 2 min/month@25°C			
DC24V Sensor Supply	300mA			500mA	

2.2 Functions

2.2.1 Operation Mode

The CPU has two operation modes: STOP mode and RUN mode.

In RUN mode, the CPU executes the main scan cycle and all interrupt tasks.

In STOP mode, the CPU will set all output channels (including DO and AO) to the known values which are specified in the [**Hardware Configuration**] through Kincobuilder, and process communication requests which comes from KincoBuilder software and other Modbus RTU master device.

➢ **Changing the Operation Mode**

Kinco-K5 provides two ways for manually changing the operation mode: Using the operation switch (RUN/STOP); Executing [Debug] -> [RUN] or [STOP] menu command in Kincobuilder.

The following table lists the combined results of these two ways.

Operation Switch Position	KincoBuilder command	Actual Operation Mode
RUN	[RUN]	RUN
RUN	[STOP]	STOP
STOP	[RUN]	STOP
STOP	[STOP]	STOP

Table 2-2 Changing the operation mode

此外，若 CPU 在运行过程中若检测到严重错误，则会立即进入 STOP 状态。

➢ **CPU Status LED**

The CPU module provides 4 status LEDs: **RUN**, **STOP**, **Comm.** and **Err.**

- The **RUN** LED is green and indicates the CPU is in RUN mode.

- The **STOP** LED is red and indicates the CPU is in STOP mode.

- The **Comm.** LED is green and indicates the CPU is sending or receiving communication data.

- The **Err.** LED is red and indicates that an error occurred and is detected. Common errors just cause **Err.** LDE turning on. Serious errors cause the CPU changing to STOP mode and turning on both the **Err.** LED and the **STOP** LED.
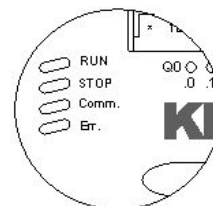
2.2.2 Communication Port

Kinco-K5 provides 1-3 communication ports, which are named as PORT, PORT1 and PORT2. PORT0 is RS232, PORT1 and PORT2 are RS485. RS485 ports are fully isolated in hardware (including their power supply and communication port) to enhance anti-interference ability.

PORT0 supports the special programming protocol, Modbus RTU protocol (as a slave) and free-protocol communication mode. PORT1 and PORT2 support the special programming protocol, Modbus RTU protocol (as a slave or master) and free-protocol communication mode.

Each type of CPU has different number of communication ports. The number and location of the PORTs are as following table.   And please refers to 2.3 Wiring Diagram   to know about their pin assignment.

CPU Type	RS232	RS485	Comment
CPU504	1	-	
CPU504EX	1	1	PORT0 and PORT1 are all in the DB9.
CPU506	1	2	PORT0 and PORT1 are all in the DB9.
			PORT1 is on the left side of the upper connector.
CPU506EA	1	2	PORT0 is in the right DB9.
CPU508	1	2	PORT1 and PORT2 are in the left DB9.

Table 2-3 Communication Ports

2.2.3 User program and data storage

The CPU provides an E^2PROM to store the user program and hardware configuration permanently. At power on, the CPU will restore the program and configuration data from E^2PROM into RAM to execute.

For permanently Data Backup, the CPU provides an FRAM to store the data in the particular range of V area (VB3648—VB4095). If the data change, they shall be written into FRAM at the end of current scan cycle. if the CPU loses power, the data in the FRAM shall be permanently backup for next power on.

Also, the CPU provides a Data Retention method using lithium cell. Through **[Hardware]** configuration in KincoBuilder, you can define four retentive ranges to select the areas of the RAM you want to retain on power loss. In the event that the CPU loses power, the instantaneous data in the RAM will be maintained by the lithium cell, and the retentive ranges will be left unchanged at next power on. The retaining duration is 3 years at normal temperature.

2.2.4 Real-time Clock (RTC)

The real-time clock built in the all CPU modules except CPU504 can provide real-time clock/calendar indication. The real-time clock/calendar adopts BCD-format coding through second to year, automatically conducts leap-year

adjustment and uses the lithium cell as backup power.

KincoBuilder can be used to set/read the RTC online. Besides, KincoBuilder also provides RTC setting/reading instructions to realize the applications related to the clock.

2.2.5 High-speed counter and High-speed pulse output

The CPU provides two high-speed counters, HSC0 and HSC1, and each counter allows the input frequency up to 60kHz. HSC0 and HSC1 support 11 operating modes at most.

Also, The CPU provides two PTO/PWM pulse generators that produce high-speed pulse train output (PTO) or pulse-width modulation (PWM), and the output frequency can reach 200kHz. **Notice: For 200KHz, load resistance must be less than 1.5 KΩ.**

2.2.6 边沿中断

　　CPU 本体的输入点 I0.0—I0.3 支持边沿中断功能，可以利用输入信号的上升沿和下降沿产生中断。利用这一功能够快速捕捉到输入的上升沿或下降沿，对一些脉冲宽度小于 CPU 扫描周期的输入信号实现快速响应。

2.3 Wiring Diagram
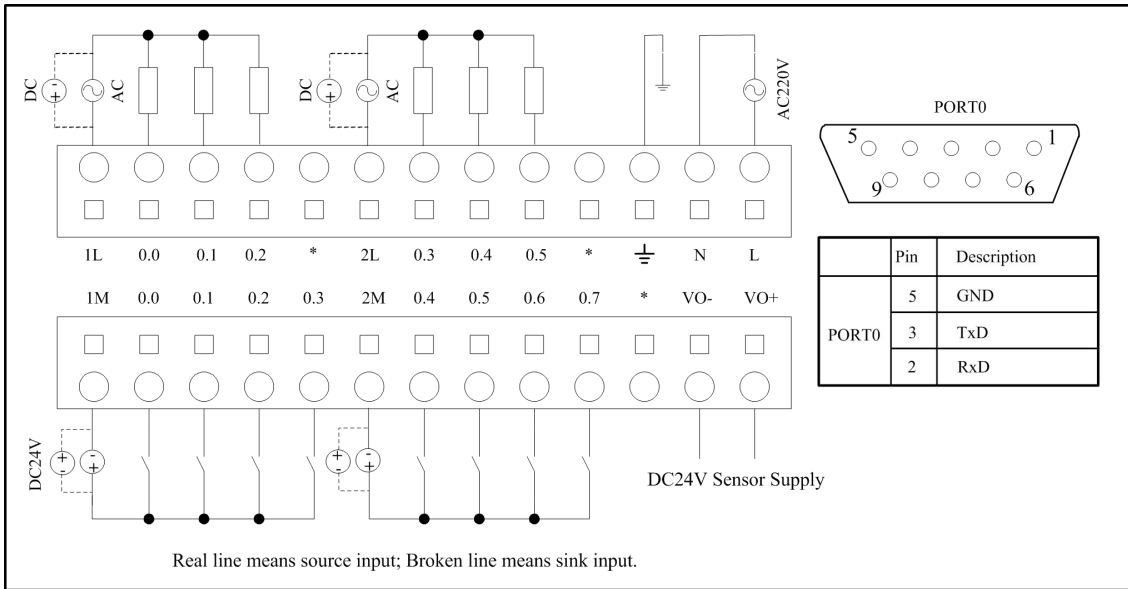
Diagram 2-2 Wiring Diagram of K504-14AR

	Pin	Description
PORT0	5	GND
	3	TxD
	2	RxD

Real line means source input; Broken line means sink input.
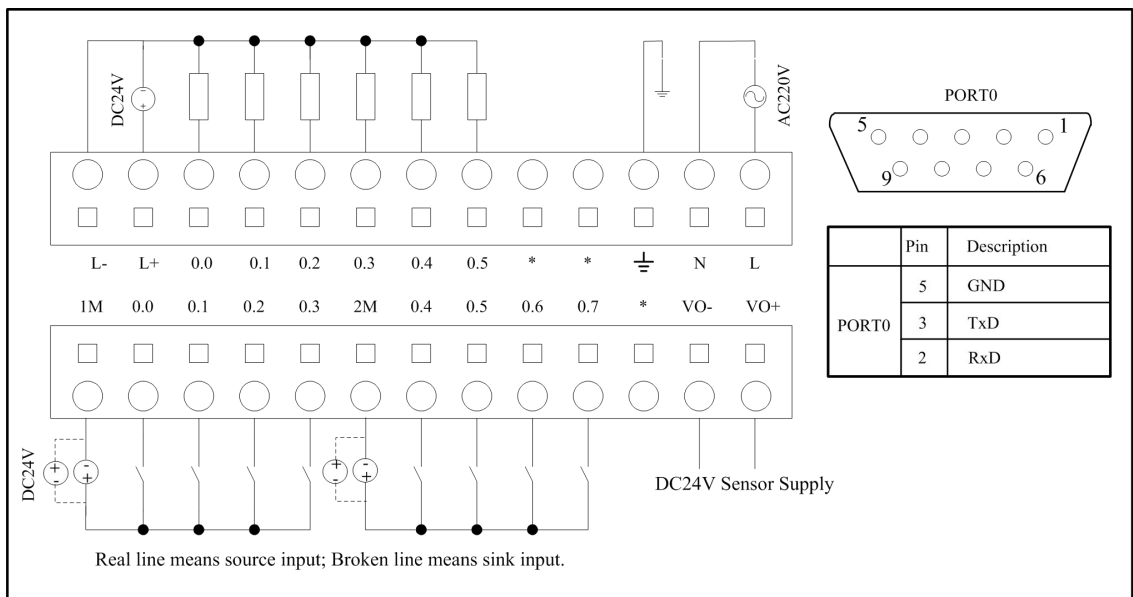
Diagram 2-3 Wiring Diagram of K504-14AT

	Pin	Description
PORT0	5	GND
	3	TxD
	2	RxD

Real line means source input; Broken line means sink input.
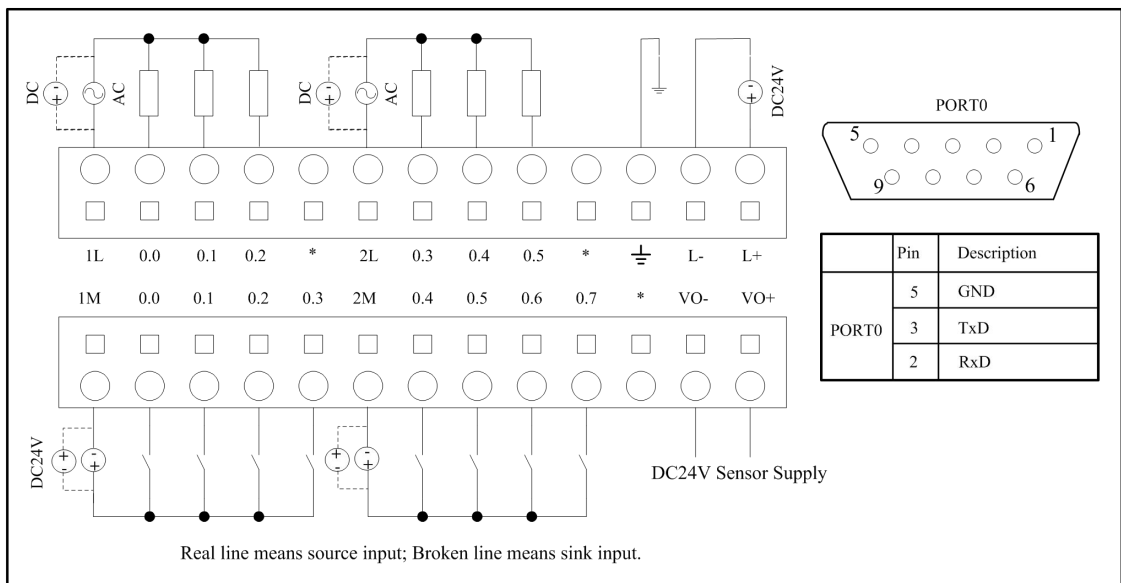
Diagram 2-4 Wiring Diagram of K504-14DR
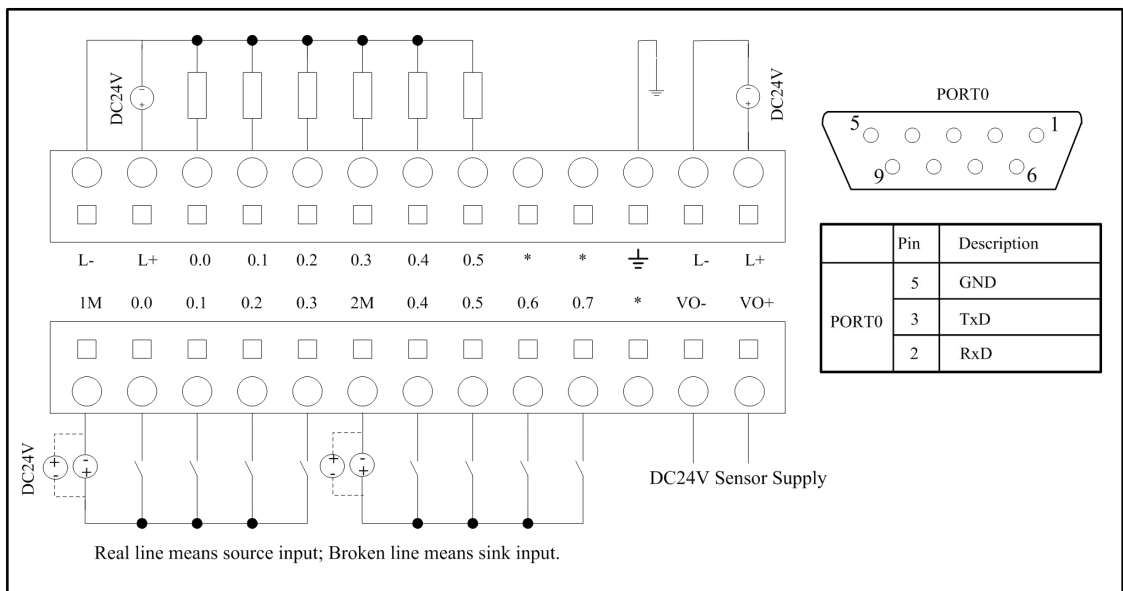
Diagram 2-5 Wiring Diagram of K504-14DT

	Pin	Description
PORT0	5	GND
	3	TxD
	2	RxD
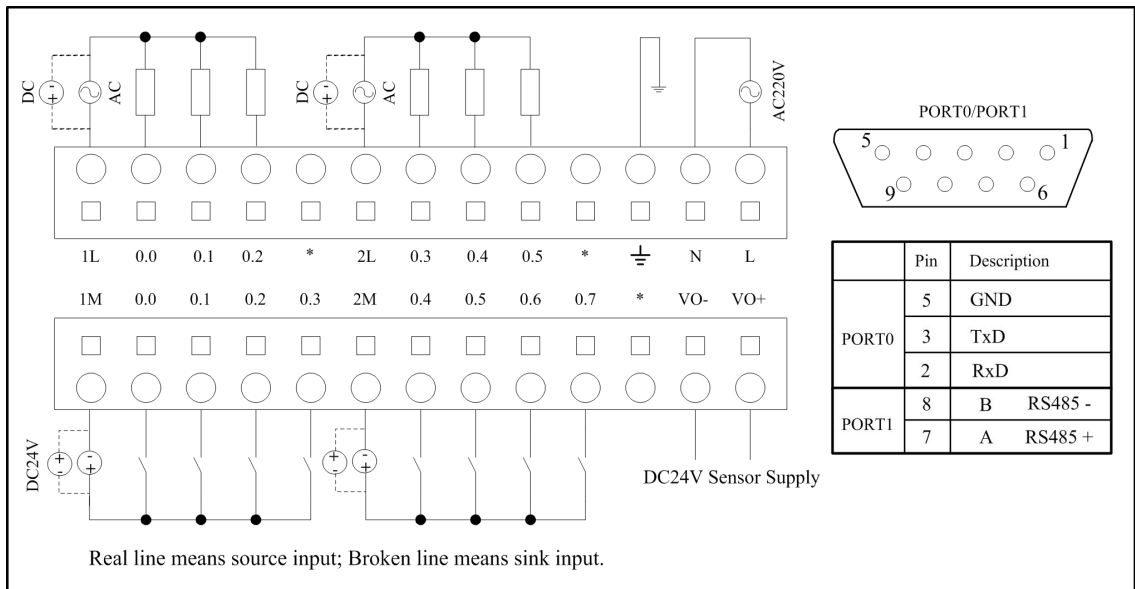
Diagram 2-6 Wiring Diagram of K504EX-14AR

	Pin	Description	
PORT0	5	GND	
	3	TxD	
	2	RxD	
PORT1	8	B	RS485 -
	7	A	RS485 +
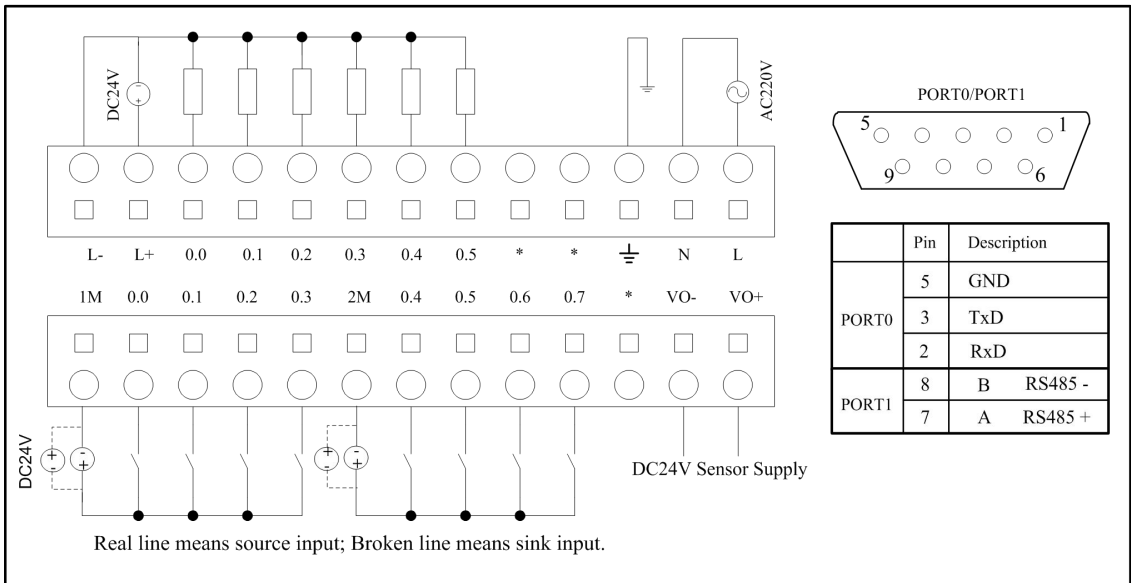
Diagram 2-7 Wiring Diagram of K504EX-14AT

	Pin	Description	
	5	GND	
PORT0	3	TxD	
	2	RxD	
PORT1	8	B	RS485 -
	7	A	RS485 +

Real line means source input; Broken line means sink input.
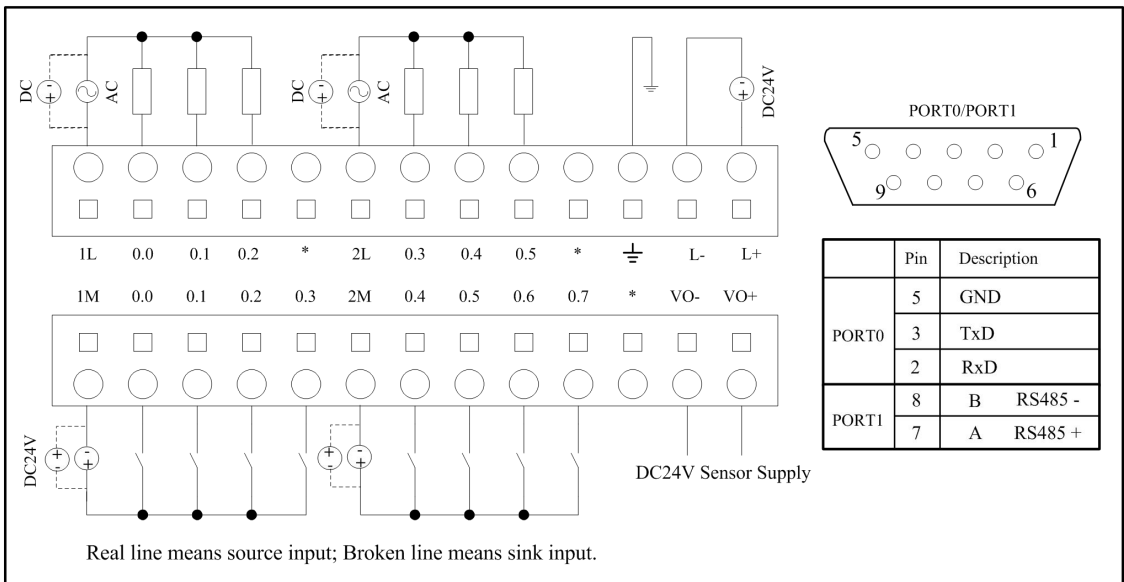
Diagram 2-8 Wiring Diagram of K504EX-14DR

	Pin	Description	
	5	GND	
PORT0	3	TxD	
	2	RxD	
PORT1	8	B	RS485 -
	7	A	RS485 +

Real line means source input; Broken line means sink input.

	Pin	Description	
PORT0	5	GND	
	3	TxD	
	2	RxD	
PORT1	8	B	RS485 -
	7	A	RS485 +

Real line means source input; Broken line means sink input.
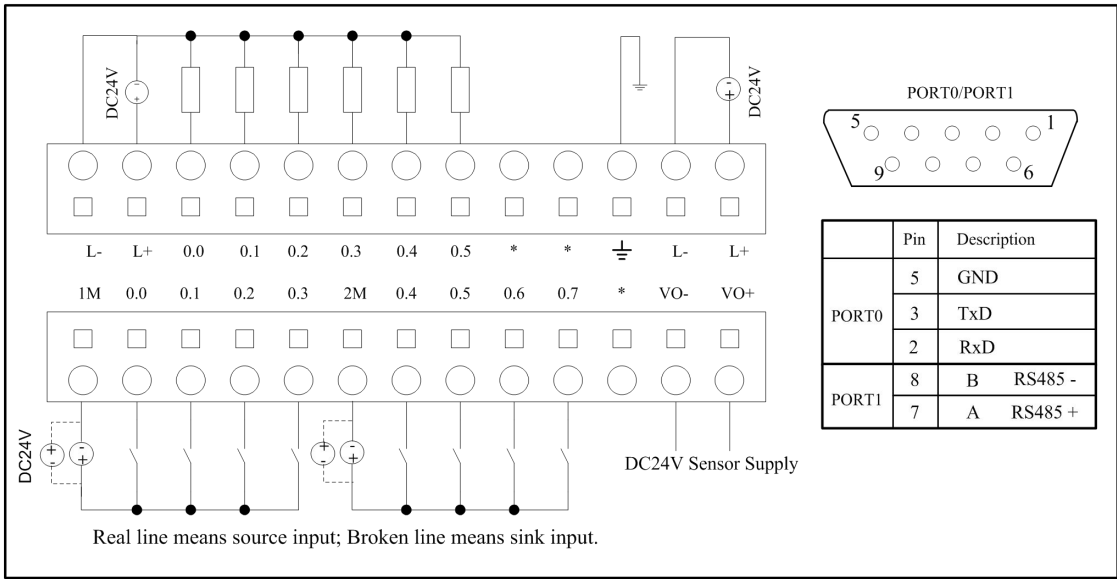
Diagram 2-9 Wiring Diagram of K504EX-14DT

	Pin	Description	
PORT0	5	GND	
	3	TxD	
	2	RxD	
PORT1	8	B	RS485 -
	7	A	RS485 +

Real line means source input; Broken line means sink input.
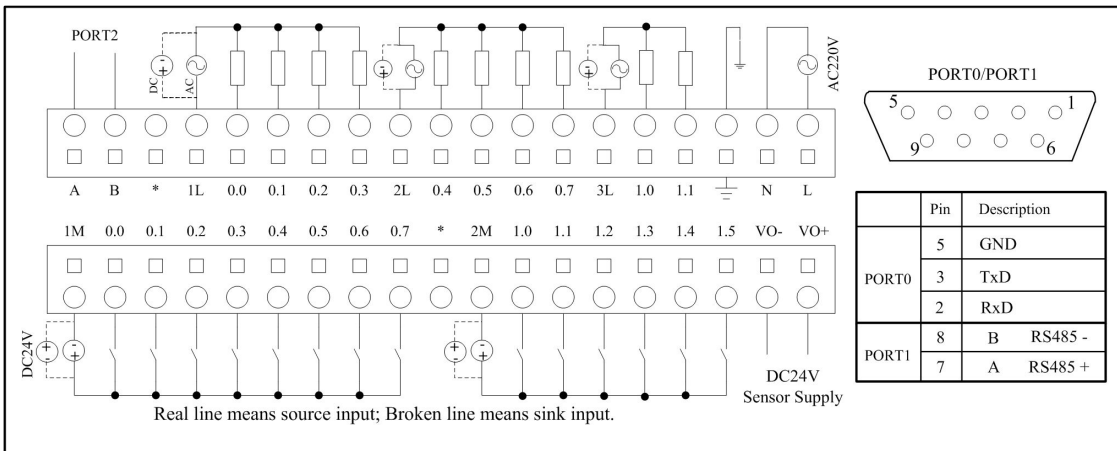
Diagram 2-10 Wiring Diagram of K506-24AR
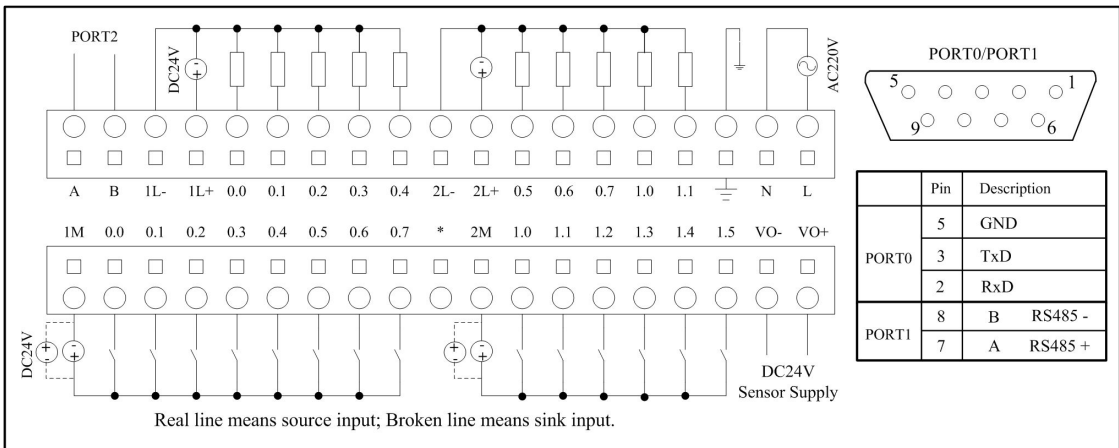
Diagram 2-11 Wiring Diagram of K506-24AT

	Pin	Description
PORT0	5	GND
	3	TxD
	2	RxD
PORT1	8	B RS485 -
	7	A RS485 +

Real line means source input; Broken line means sink input.
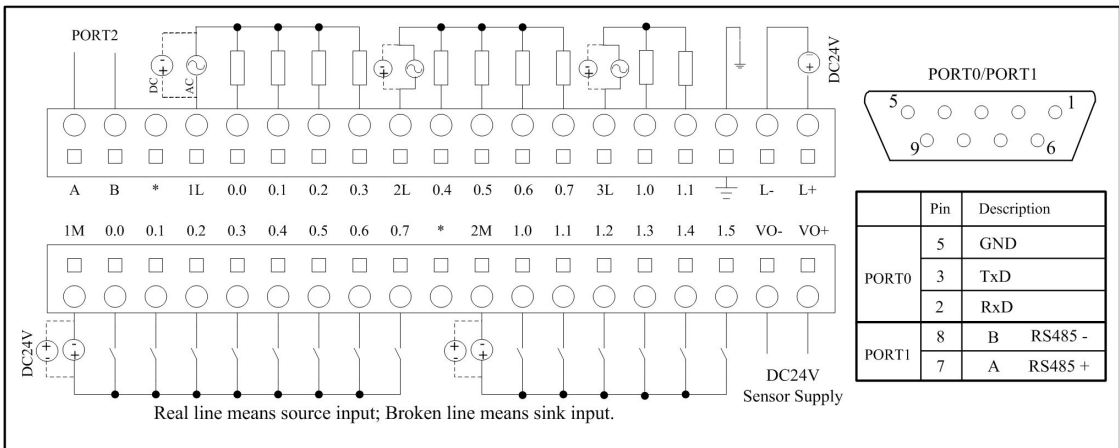
Diagram 2-12 Wiring Diagram of K506-24DR

	Pin	Description
PORT0	5	GND
	3	TxD
	2	RxD
PORT1	8	B RS485 -
	7	A RS485 +

Real line means source input; Broken line means sink input.
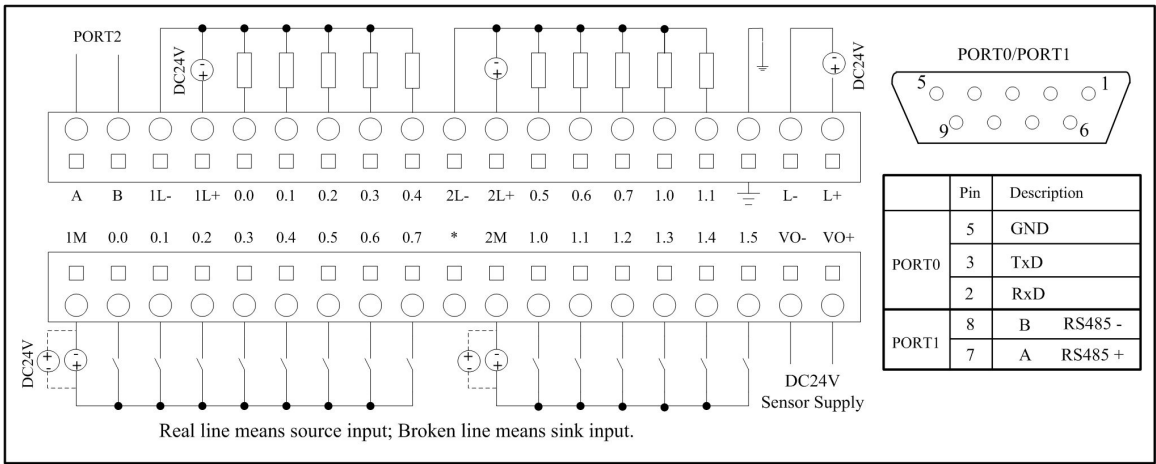
Diagram 2-13 Wiring Diagram of K506-24DT
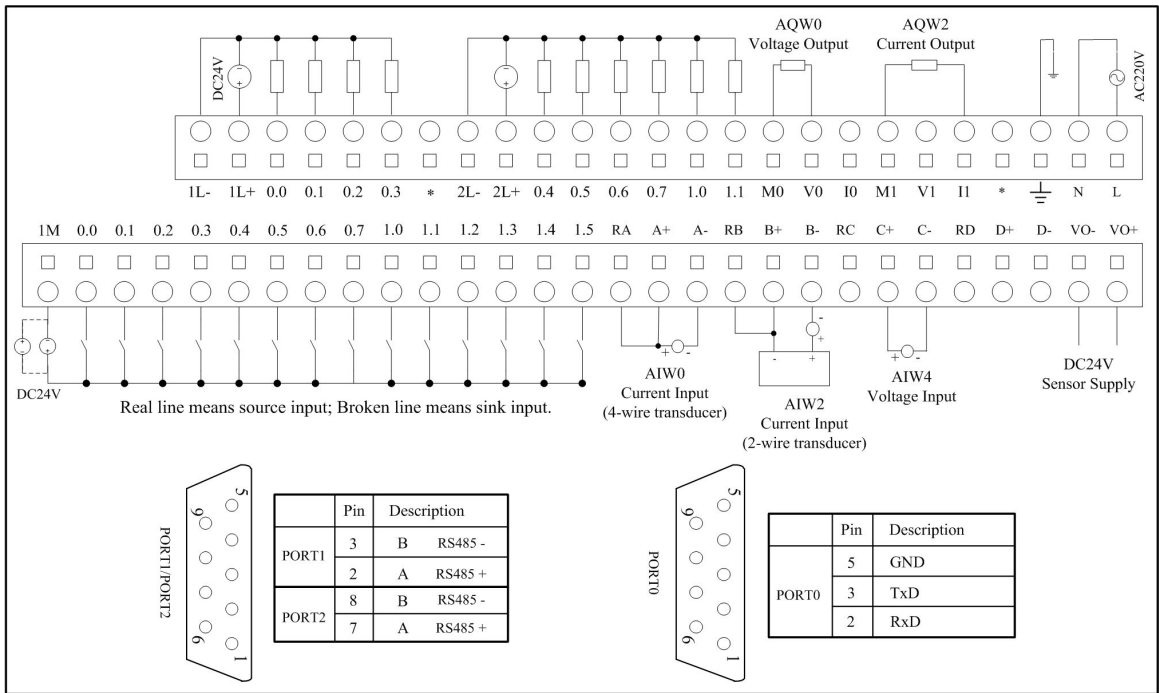
Diagram 2-14 Wiring Diagram of K506EA-30AT
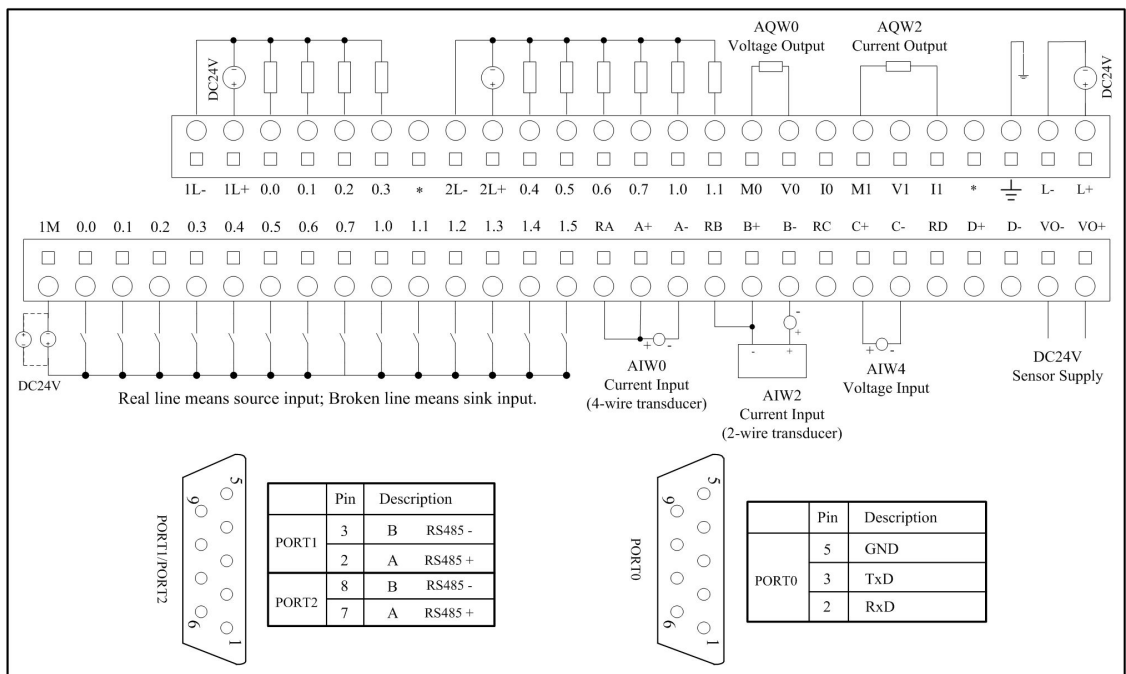
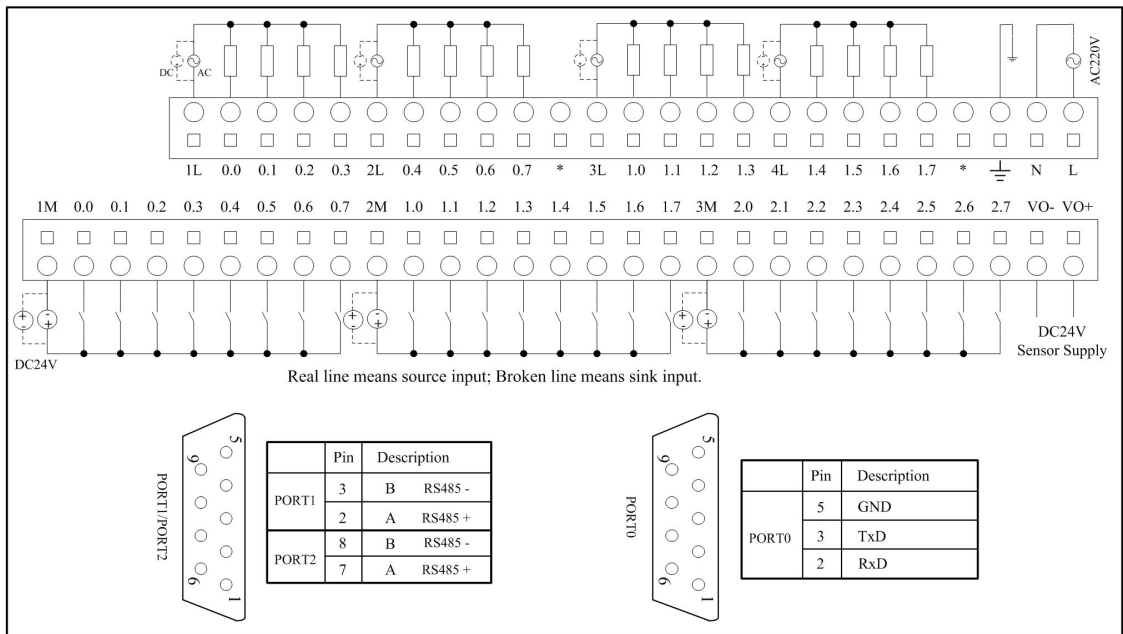Diagram 2-15 Wiring Diagram of K506EA-30DT
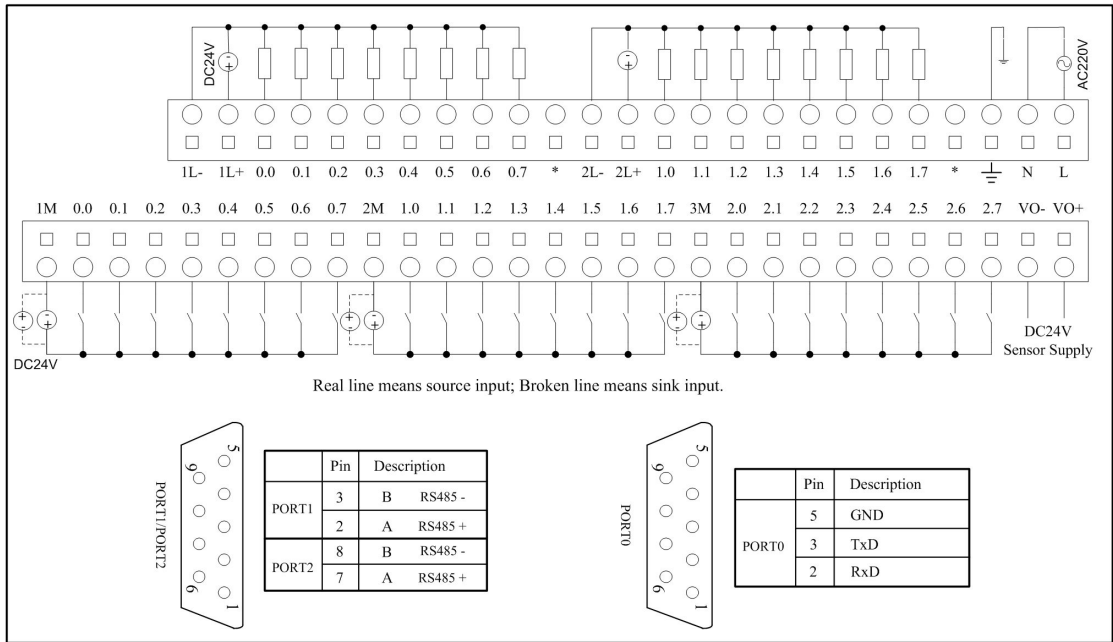

Diagram 2-16 Wiring Diagram of K508-40AR
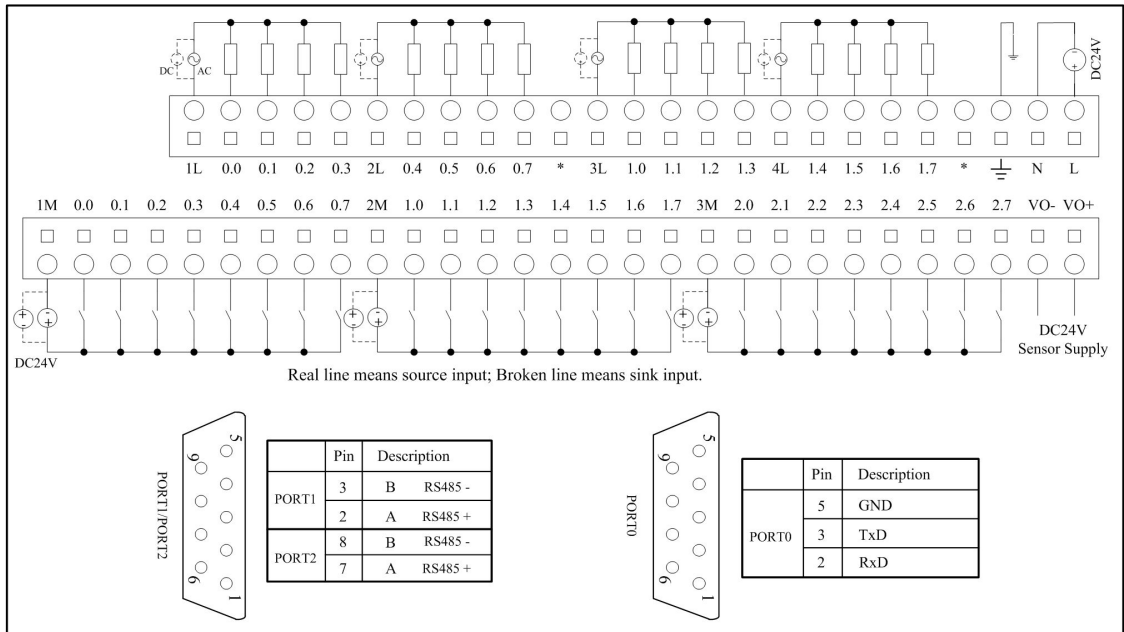
Diagram 2-17 Wiring Diagram of K508-40AT
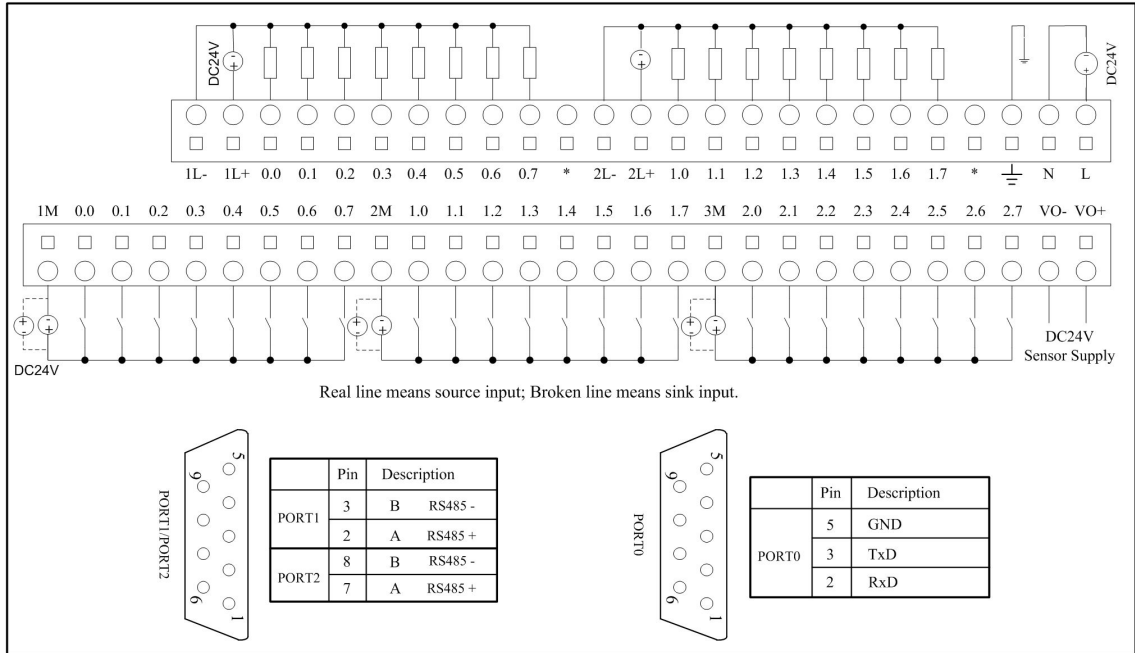

Diagram 2-18 Wiring Diagram of K508-40DR

Diagram 2-19 Wiring Diagram of K508-40DT

2.4 Specifications

2.4.1 CPU Specifications

	CPU504	CPU504EX	CPU506	CPU506EA	CPU508
Built-in I/O and Communication					
Digital channel	8*DI/6*DO	8*DI/6*DO	14*DI/10*DO	14*DI/10*DO	24*DI/16*DO
Analog channel	--	--	--	4*AI / 2*AO	--
Max. expansion modules	--	4	10		
Communication Port	1 (PORT0)	2 (PORT0, PORT1)	3 (PORT0, PORT1, PORT2)		
	PORT0 is RS232,PORT1 andPORT2 are RS485。 PORT0 support the special programming protocol, Modbus RTU protocol (as a slave) and free-protocol communication mode. PORT0 support the special programming protocol, Modbus RTU protocol (as a slave or master) and free-protocol communication mode.				
High-speed counters	2				
Single phase	2, max.60KHz				
Two phase	2, max.20KHz				

High-speed pulse output	2, max. 200KHz. (For 200KHz, load resistance must be less than 1.5 KΩ).		
I/O Interrupts	4 rising/falling edge interrupts		
memory area			
Max. User program	1K instructions	4K instructions	
User Data	M area: 1K bytes; V area: 4K bytes		
DI image area	1 byte	5 bytes	32 bytes
DO image area	1 byte	5 bytes	32 bytes
AI image area	--	16 bytes	64 bytes
AO image area	--	16 bytes	64 bytes
Data Backup	FRAM, 448 bytes		
Retentive Ranges	--	4K bytes, lithium cell as backup power, 3 years at normal temperature.	
Others			
Timers	256 totally: 1ms time-base: 4 ; 10ms time-base: 16; 100ms time-base: 236		
Timed interrupts	2 with 0.1 ms resolution。		
Counters	256, (retained by lithium cell)		
Real-time clock	--	Yes, deviation less than 2 min/month@25°C	
DC24V Sensor Supply	300mA		500mA

2.7.2 DI Specifications

Input type	Source/Sink
Rated input voltage	DC 24V ("1", when DC11~30V)
Rated input current	3.5mA@24VDC
Max input voltage of logic 0	5V@0.7mA
Minimum input voltage of logic 1	Common channel:11V@2.0mA HSC channel: 18V@2.5mA
Input filter time delay · off-to-on · on-to-off	 Common channel: 12μs; HSC channel: 8μs; Common channel: 40μs; HSC channel: 12μs;
Isolation between input and internal circuit · Mode · Voltage	 Opto-electrical isolation 500VAC/1 min
Status indicator	Green LED

2.7.3 DC24V Output Specifications

Output type	Source
Rated power supply voltage	DC 24V
· Reverse polarity protection	Yes
Rated output voltage	DC 24V
Output current per channel	Max 500mA@24VDC
Output leakage current	Max 0.5цA
Output impedance	Max 0.2Ω
Output delay · off-to-on · on-to-off	 0.3--5μs 5μs
Isolation between output and internal circuit · Mode · Voltage	 Opto-electrical isolation 500VAC/1 min
Inductive load protection	Yes
Short-circuit protection	Yes
Inductive load protection	Yes
Parallel connection of outputs	Yes (in the same group)
Status indication	Green LED

2.7.4 Relay Output Specifications

Output type	Relay
Load voltage	DC30V/AC250V
Output current per channel	2A (DC30V/AC250V)
Output current per group	Max 10A
Output off-to-on delay	Max 10ms
Output on-to-off delay	Max 5ms
Contact endurance · No load · Rated load	 20000000 times (12,000 times/min) 100000 times (100 times/min)
Isolation · Mode · Between coil and contact	 Relay 2000Vrms
Status indication	Green LED

2.7.5　本体 AI 通道参数

信号形式	4~20mA、1~5V、0~20mA、0-10V
分辨率	12 位
测量精度	0.3% F.S.
转换速率（每通道）	约 30 次/秒
输入阻抗	电流模式：<=500Ω 电压模式：>4MΩ
抗共模电压	（信号电压＋共模电压）≤12V。超出后通道将处于保护状态。
状态指示	各通道红色 LED 指示输入值超出了所选范围

2.7.6　本体 AO 通道参数

信号形式	4~20mA、1~5V、0~20mA、0~10V
分辨率（含符号位）	12 位
输出信号精度	0.3% F.S.
转换速率（每通道）	约 200 次/秒
外部负载	电流模式：最大 500Ω 电压模式：最小 1KΩ

Chapter III DI (Digital Input) Modules

A DI module accepts digital input signals from the field and writes their status to the CPU's I area through the expansion bus. It provides opto-electrical isolation between the input signal and the internal circuit.All types of DI module are uniformly called PM521.

3.1 DI 8*DC24V

Order No.: Kinco-K521-08DX.

The module has 8 channels, and each channel is equipped with a LED to indicate the input status.
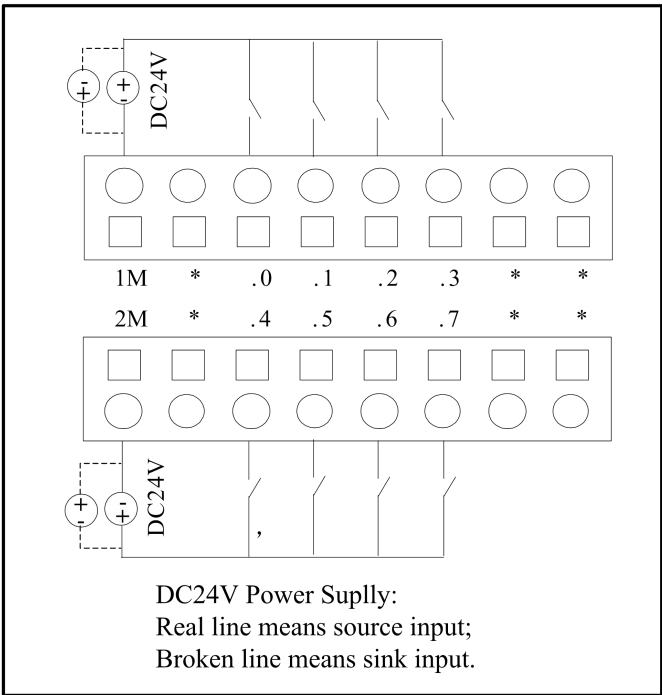
3.1.1 Wiring Diagram

Diagram 3-1 Wiring Diagram

3.1.2 Technical Data

Electrical Data		
Number of channels	8 (4 channels/group)	
Input type	Source/Sink	
Rated input voltage	DC 24V	
Rated input current	3.5mA@24VDC	
Max input voltage of logic 0	5V@0.7mA	
Minimum input voltage of logic 1	11V@2.0mA	
Input filter time delay · off-to-on · on-to-off	12μs 40μS	
Current consumption via expansion bus	5V	< 180mA
	24V	-
Isolation between input and internal circuit · Mode · Voltage	Opto-electrical isolation 500VAC/1 min	
Status indicator	Green LED	
Address occupied		
DI image area	1 byte	
DO image area	-	
Dimension and weight		
Dimension (L×W×H)	114×50×70mm	
Net weight	125g	

3.2 DI 16*DC24V

Order No.: Kinco-K521-16DX

The module has 16 channels, and each channel is equipped with a LED to indicate the input status.
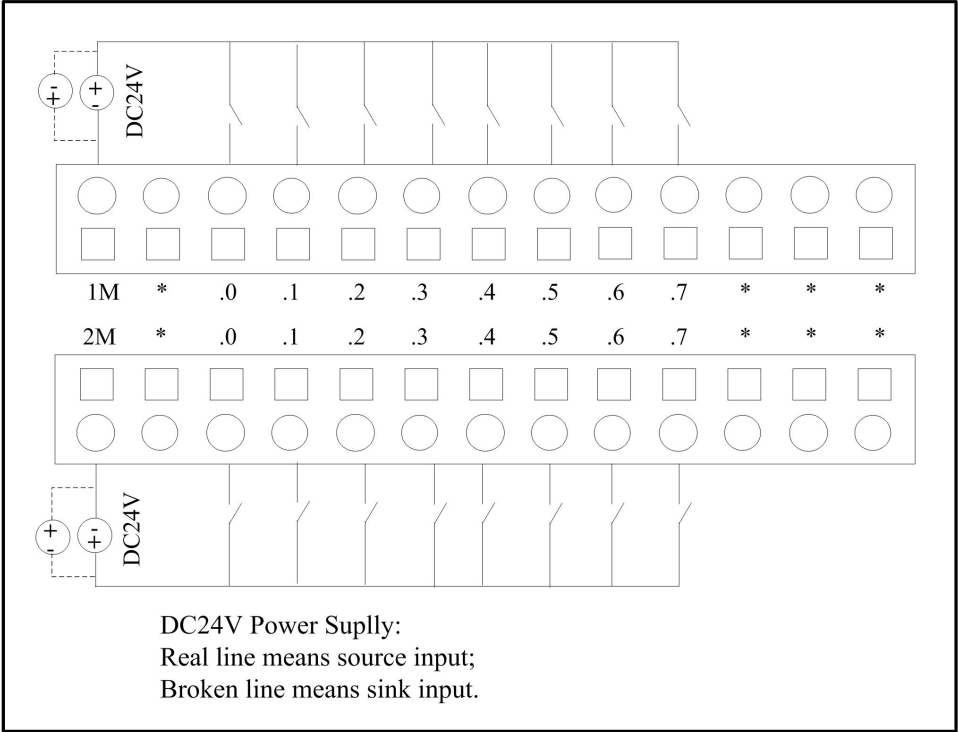
3.2.1 Wiring Diagram

Diagram 3-2 Wiring Diagram

3.2.2 Technical Data

Electrical data	
Number of channels	16 (8 channels/group)
Input type	Source/sink
Rated input voltage	DC 24V
Rated input current	3.5mA@24VDC
Max input voltage of "0"	5V@0.7mA
Minimum input voltage of "1"	11V@2.0mA
Input filter time delay · off-to-on · on-to-off	 12μs 40μS
Current consumption via expansion bus	5V < 210mA 24V -
Isolation between input and internal circuit · Mode · Voltage	 Opto-electrical isolation 500VAC/1 min
Status indication	Green LED
Address occupied	
DI image area	2 bytes
DO image area	-
Dimension and weight	
Dimension (L×W×H)	114×75×70mm
Net weight	150g

Chapter IV DO (Digital Output) Modules

There are two types of DO modules: DC24V output through solid state-MOSFET, and Relay contact output.

All types of DO module are uniformly called PM522.

4.1 DO 8*DC24V

Order No: Kinco-K522-08DT

The module has 8 channels, and each channel is equipped with a LED to indicate the output status. It accepts control data from the expansion bus and converts them to electrical signals by isolation and amplification to output. The module requires a power supply of DC24V via the appropriate terminals.

4.1.1 Wiring Diagram
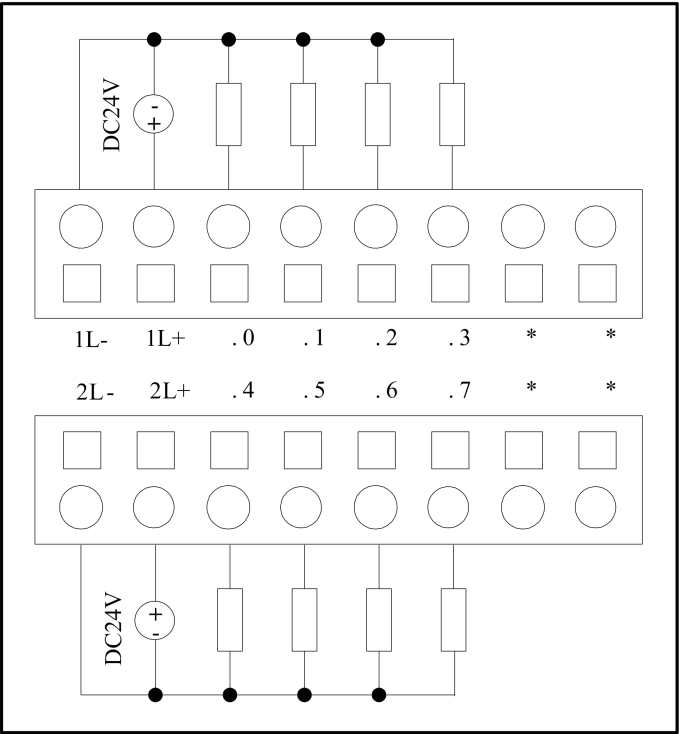
Diagram 4-1 Wiring Diagram

4.1.2 Technical Data

Electrical data		
Number of output channels	8 (4 channels/group)	
Output type	Source	
Rated power supply voltage	DC 24V	
· Reverse polarity protection	Yes	
Rated output voltage	DC 24V	
Output current per channel	Max 500mA@24VDC	
Output leakage current	Max 0.5цA	
Output impedance	Max 0.2Ω	
Output delay · off-to-on · on-to-off	 0.3--5μs 5μs	
Current consumption via expansion bus	5V	<200mA
	24V	-
Isolation between output and internal circuit · Mode · Voltage	 Opto-electrical isolation 500VAC/1 min	
Inductive load protection	Yes	
Short-circuit protection	Yes (when output current per group exceeds 3A)	
Parallel connection of outputs	Yes (in the same group)	
Status indication	Green LED	
Address occupied		
DI image area	-	
DO image area	1 byte	
Dimension and weight		
Dimension (L×W×H)	114×50×70mm	
Net weight	125g	

4.2　DO 8*relay

Order No.: KINCO-K522-08XR

The module has 8 relay-output channels, and each channel is equipped with a LED to indicate the output status.

It accepts control data from the expansion bus and converts to electrical signals to control the connected devices

via relay outputs. The module derives working power from the expansion bus. The load voltage must be

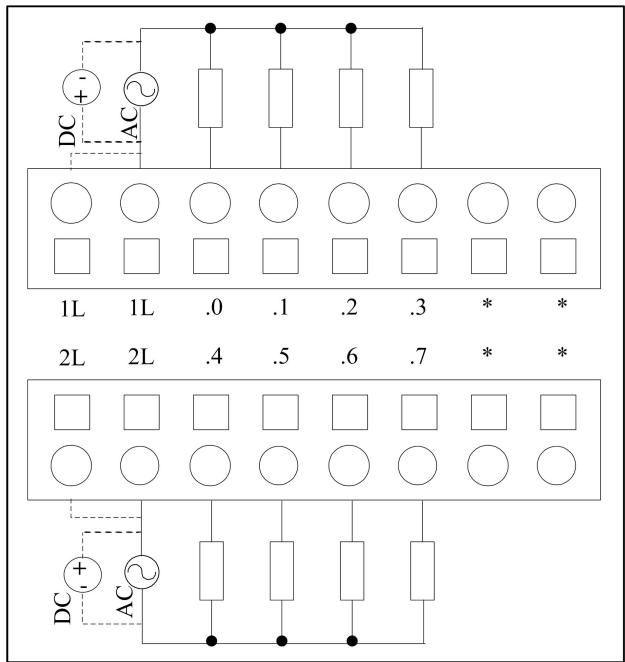connected to the appropriate terminals.

4.2.1 Wiring Diagram

Diagram 4-2 Wiring Diagram

4.2.2 Technical Data

Electrical data		
Number of relay outputs	8 (4 channels/group)	
Load voltage	Max DC 30V/AC250V	
Output current per channel	Max 2A (DC 30V/AC250V)	
Output current per group	Max 10A	
Output off-to-on delay	Max 10ms	
Output on-to-off delay	Max 5ms	
Current consumption via expansion bus	5V	< 180mA
	24V	< 60mA
Max. switching rate · No load · Rated load	12,000 times/min 100 times/min	
Expected life of the contacts · Mechanical life (no-load) · Eectrical life (rated load)	20,000,000 times (1200 times/min) 100,000 times (6 times/min)	
Isolation · Mode · Between coil and contact	Relay 2000Vrms	
Status indication	Green LED	
Address occupied		
DI image area	-	
DO image area	1 byte	
Dimension and weight		
Dimension (L×W×H)	114×50×70mm	
Net weight	150g	

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4.3 DO 16*DC24V

Order No.: KINCO-K522-16DT

The module has 16 channels, and each channel is equipped with a LED to indicate the output status. It accepts control data from the expansion bus and converts to electrical signal by isolation and amplification to control the connected devices. The module requires a power supply of DC24V via the appropriate terminals.
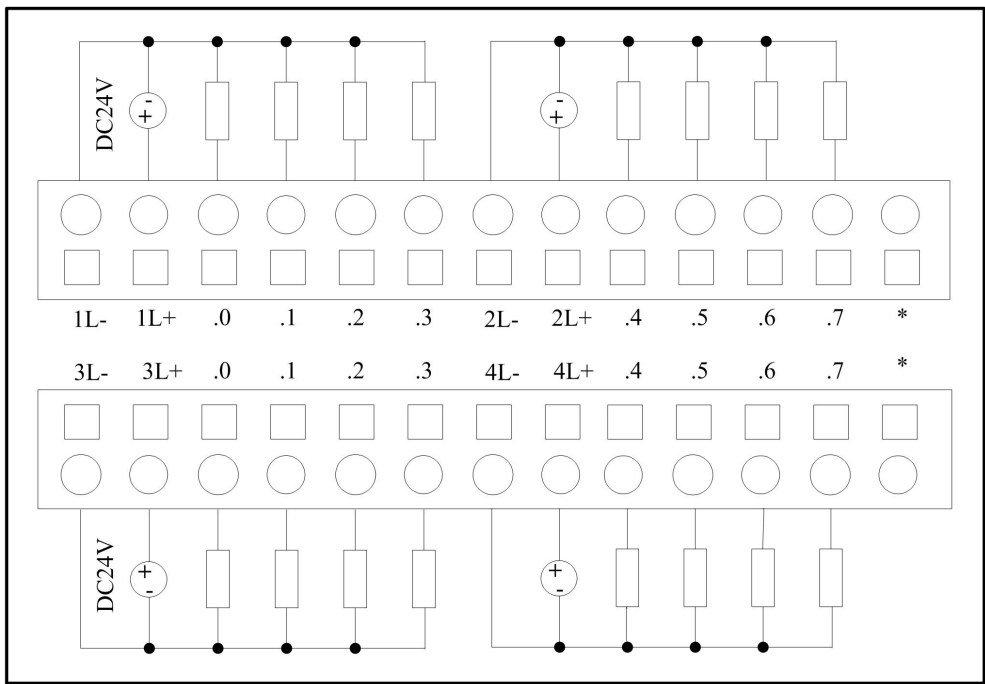
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4.3.1 Wiring Diagram

Diagram 4-3 Wiring Diagram

4.3.2 Technical Data

Electrical data		
Number of output channels	16 (4 channels/group)	
Output type	Source	
Rated power supply voltage	DC 24V	
· Reverse polarity protection	Yes	
Rated output voltage	DC 24V	
Output current per channel	Max 500mA@24VDC	
Output leakage current	Max 0.5цA	
Output impedance	Max 0.2Ω	
Output delay · off-to-on · on-to-off	0.3--5μs 5μs	
Current consumption via expansion bus	5V	< 240mA
	24V	-
Isolation between output and internal circuit · Mode · Voltage	Opto-electrical isolation 500VAC/1 min	
Inductive load protection	Yes	
Short-circuit protection	Yes (when output current per group exceeds 3A)	
Parallel connection of outputs	Yes (in the same group)	
Status indication	Green LED	
Address occupied		
DI image area	-	
DO image area	2 bytes	
Dimension and weight		
Dimension (L×W×H)	114×75×70mm	
Net weight	170g	

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4.4 DO 16*Relay

Order No.: KINCO-K522-16XR

The module has 16 relay-output channels, and each channel is equipped with a LED to indicate the output status.

It accepts control data from the expansion bus and converts to electrical signal to control the connected devices

via relay outputs. The module derives working power from the expansion bus. The load voltage must be

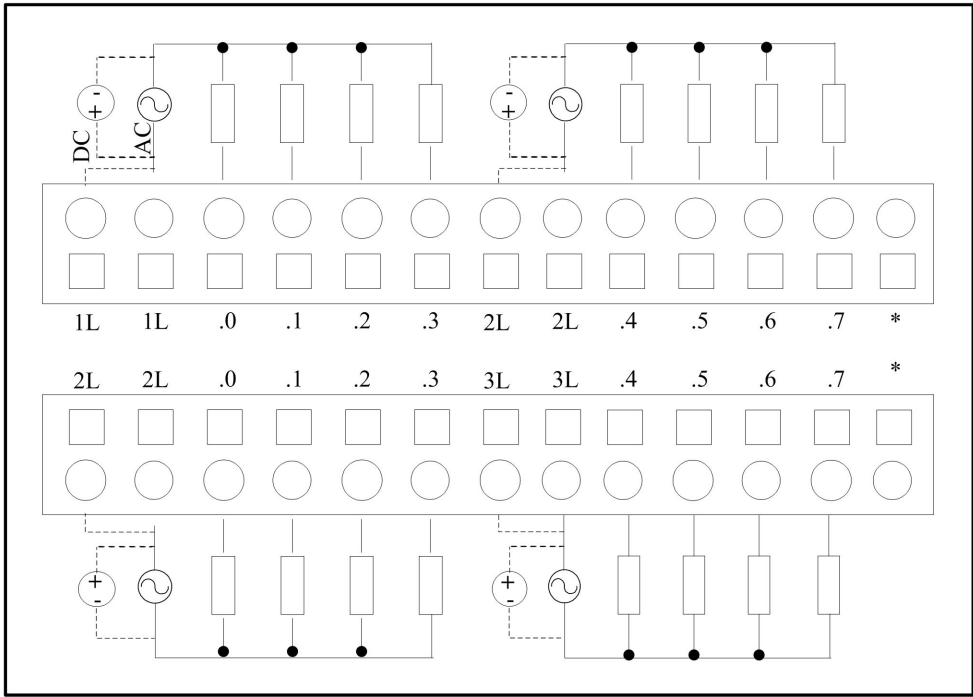connected to the appropriate terminals.

4.4.1 Wiring Diagram

Diagram 4-4 Wiring Diagram

4.4.2 Technical Data

Electrical data		
Number of relay outputs	16 (4 channels/group)	
Load voltage	Max DC 30V/AC250V	
Output current per channel	Max 2A (DC 30V/AC250V)	
Output current per group	Max 10A	
Output off-to-on delay	Max 10ms	
Output on-to-off delay	Max 5ms	
Current consumption via expansion bus	5V	<210mA
	24V	< 120mA
Max. switching rate · No load · Rated load	12,000 times/min 100 times/min	
Expected life of the contacts · Mechanical life (no-load) · Electrical life (rated load)	20,000,000 times (1200 times/min) 100,000 times (6 times/min)	
Isolation · Mode · Between coil and contact	Relay 2000Vrms	
Status indication	Green LED	
Address space occupied		
DI image area	-	
DO image area	2 bytes	
Dimension and weight		
Dimension (L×W×H)	114×75×70mm	
Net weight	235g	

Chapter V   DI/O Modules

DI/O module refers to the module on which a certain number of DI and DO channels are provided. Each channel has the unique function and cannot be used for other purposes.

All types of DI/O module are uniformly called PM523.

5.1 DI/O, DI4*DC24V   DO4*DC24V

Order No.: KINCO-K523-08DT

This module has 8 channels. 4 channels operate as inputs and 4 as outputs.

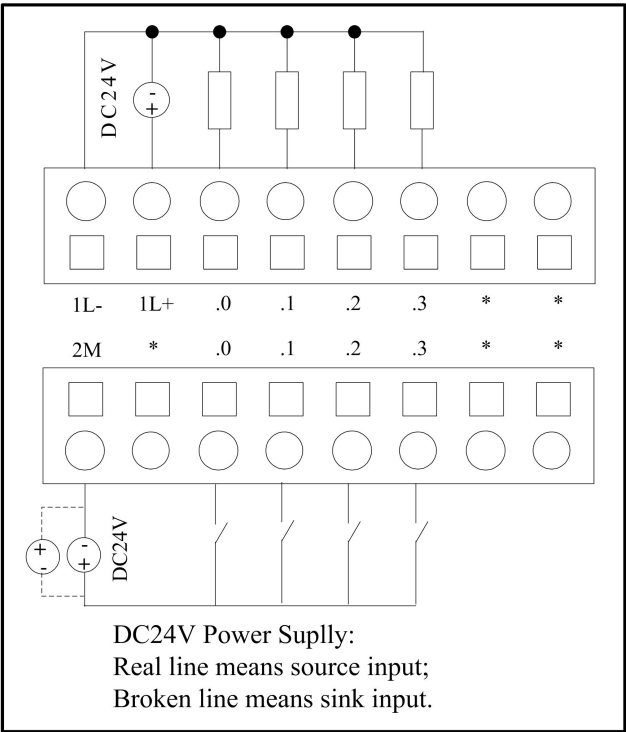Each channel is equipped with a LED to indicate its status.

5.1.1 Wiring Diagram

Diagram 5-1 Wiring Diagram

5.1.2 Technical Data

Electrical data	
Number of inputs	4 (4 channels/group)
Input type	Source/Sink
Rated input voltage	DC 24V
Rated input current	3.5mA@24VDC
Max input voltage of logic 0	5V@0.7mA
Minimum input voltage of logic 1	11V@2.0mA
Input filter time delay	5ms
Isolation between input and internal circuit · Mode · Voltage	 Opto-electrical isolation 500VAC/1 min
Number of output channels	4 (4 channels/group)
Output type	Source
Rated power supply voltage · Reverse polarity protection	DC 24V Yes
Rated output voltage	DC 24V
Output current per channel	Max 500mA@24VDC
Output leakage current	Max 0.5цA
Output impedance	Max 0.2Ω
Output delay · off-to-on · on-to-off	 0.3--5μs 5μs
Isolation between output and internal circuit · Mode · Voltage	 Opto-electrical isolation 500VAC/1 min
Inductive load protection	Yes
Short-circuit protection	Yes (when output current per group exceeds 3A)
Parallel connection of outputs	Yes (in the same group)
Current consumption via expansion bus	5V	< 200mA
	24V	-
Status indication	Green LED
Address occupied	
DI image area	1 byte
DO image area	1 byte

Dimension and weight	
Dimension (L×W×H)	114×50×70mm
Net weight	125g

5.2 DI/O, DI 4*DC24V DO 4*Relay

Order No.: KINCO-K523-08DR

This module has 8 channels. 4 channels operate as inputs and 4 as relay outputs.

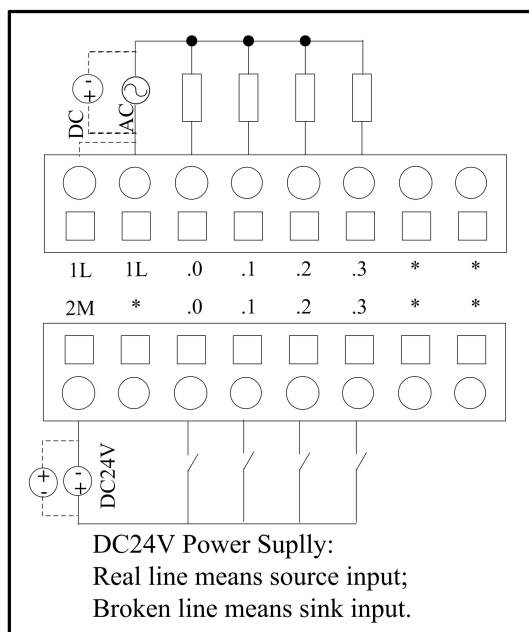Each channel is equipped with a LED to indicate its status.

5.2.1 Wiring Diagram

| 1L | 1L | .0 | .1 | .2 | .3 | * | * |
| 2M | * | .0 | .1 | .2 | .3 | * | * |

DC24V Power Suplly:
Real line means source input;
Broken line means sink input.

Diagram 5-2 Wiring Diagram

5.2.2 Technical Data

Electrical Parameter	
Number of inputs	4 (4 channels/group)
Input type	Source/Sink
Rated input voltage	DC 24V ("1", when DC15~30V)
Rated input current	3.5mA@24VDC
Max input voltage of logic 0	5V@0.7mA
Minimum input voltage of logic 1	11V@2.0mA
Input filter time delay	5ms
Isolation between input and internal circuit · Mode	Opto-electrical isolation

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· Voltage	500VAC/1 min
Number of relay outputs	4 (4 channels/group)
Load voltage	Max DC 30V/AC250V
Output current per channel	Max 2A (DC 30V/AC250V)
Output current per group	Max 10A
Output off-to-on delay	Max 10ms
Output on-to-off delay	Max 5ms
Max. switching rate · No load · Rated load	 12,000 times/min 100 times/min
Expected life of the contacts · Mechanical life (no-load) · Electrical life (rated load)	 20,000,000 times (1200 times/min) 100,000 times (6 times/min)
Isolation · Mode · Between coil and contact	 Relay 2000Vrms
Current consumption via expansion bus	5V	< 180mA
	24V	< 30mA
Status indication	Green LED
Address occupied	
DI image area	1 byte
DO image area	1 byte
Dimension and weight	
Dimension (L×W×H)	114×50×70mm
Net weight	145g

5.3 DI/O, DI 8*DC24V DO 8*DC24V

Order No.: KINCO-K523-16DT

This module has 16 channels. 8 channels operate as inputs and 8 as outputs.

Each channel is equipped with a LED to indicate its status.
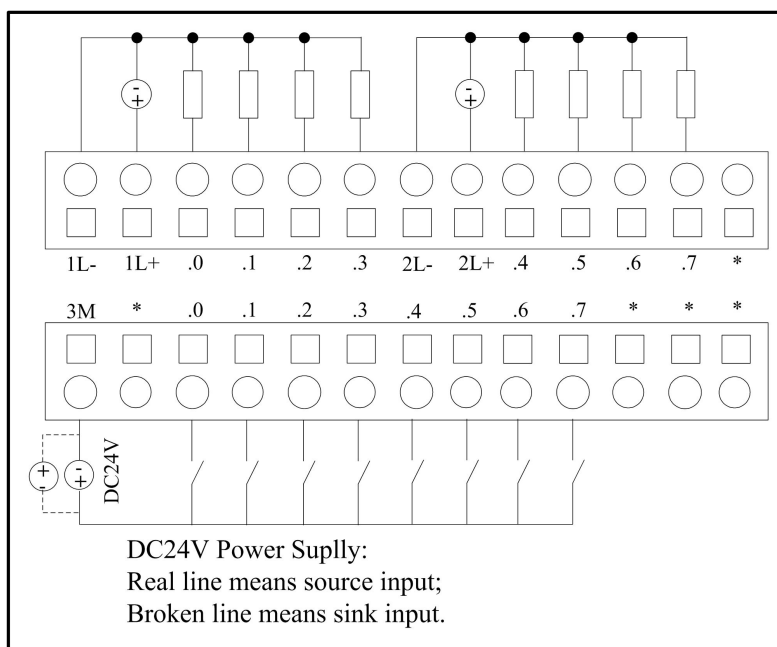
5.3.1 Wiring Diagram

Diagram 5-3 Wiring Diagram

5.3.2 Technical Data

Electrical data	
Number of inputs	8 (8 channels/group)
Input type	Source/Sink
Rated input voltage	DC 24V ("1", when DC15~30V)
Rated input current	3.5mA@24VDC
Max input voltage of logic 0	5V@0.7mA

Minimum input voltage of logic 1	11V@2.0mA
Input filter time delay	5ms
Isolation between input and internal circuit	
· Mode	Opto-electrical isolation
· Voltage	500VAC/1 min
Number of output channels	8 (4 channels/group)
Output type	Source
Rated power supply voltage	DC 24V
· Reverse polarity protection	Yes
Rated output voltage	DC 24V
Output current per channel	Max 500mA@24VDC
Output leakage current	Max 0.5цA
Output impedance	Max 0.2Ω
Output delay	
· off-to-on	0.3--5μs
· on-to-off	5μs
Isolation between output and internal circuit	
· Mode	Opto-electrical isolation
· Voltage	500VAC/1 min
Inductive load protection	Yes
Short-circuit protection	Yes (when output current per group exceeds 3A)
Parallel connection of outputs	Yes (in the same group)
Status indication	Green LED

Current consumption via expansion bus	5V	< 230mA
	24V	-

Address occupied	
DI image area	1 byte
DO image area	1 byte
Dimension and weight	
Dimension (L×W×H)	114×75×70mm
Net weight	165g

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5.4 DI/O, DI 8*DC24V   DO 8*Relay

Order No.: KINCO-K523-16DR

This module has 16 channels. 8 channels operate as inputs and 8 as relay outputs.

Each channel is equipped with a LED to indicate its status.
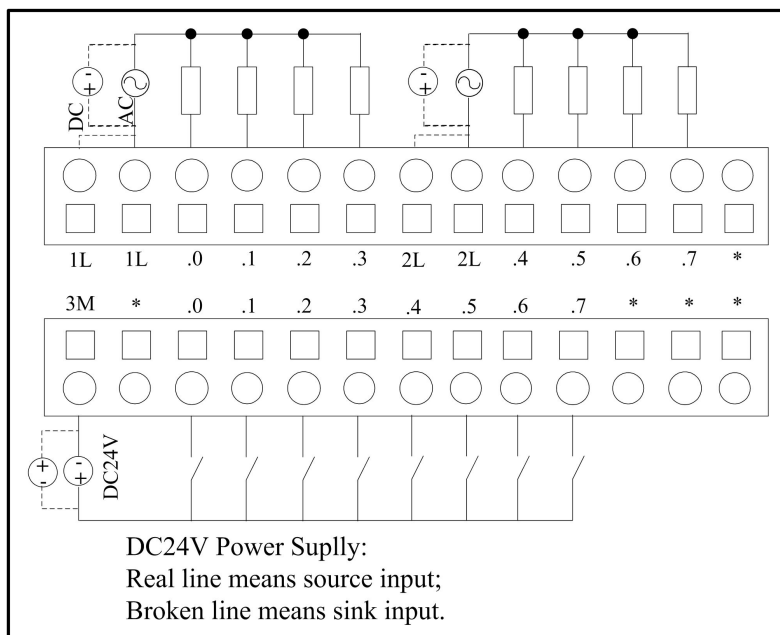
5.4.1 Wiring Diagram

Diagram 5-11 Wiring Diagram

5.4.2 Technical Data

Electrical data	
Number of inputs	8 (8 channels/group)
Input type	Source/Sink
Rated input voltage	DC 24V ("1", when DC15~30V)
Rated input current	3.5mA@24VDC
Max input voltage of logic 0	5V@0.7mA

Minimum input voltage of logic 1	11V@2.0mA
Input filter time delay	5ms
Isolation between input and internal circuit	
· Mode	Opto-electrical isolation
· Voltage	500VAC/1 min
Number of relay outputs	8 (4 channels/group)
Load voltage	Max DC 30V/AC250V
Output current per channel	Max 2A(DC 30V/AC250V)
Output current per group	Max 10A
Output off-to-on delay	Max 10ms
Output on-to-off delay	Max 5ms
Max. switching rate	
· No load	12,000 times/min
· Rated load	100 times/min
Expected life of the contacts	
· Mechanical life (no-load)	20,000,000 times (1200 times/min)
· Electrical life (rated load)	100,000 times (6 times/min)
Isolation	
· Mode	Relay
· Between coil and contact	2000Vrms
Status indication	Green LED
Current consumption via expansion bus	5V < 210mA
	24V < 60mA
Address occupied	
DI image area	1 byte
DO image area	1 byte
Dimension and weight	
Dimension (L×W×H)	114×75×70mm
Net weight	165g

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Chapter VI   AI (Analog input) Modules

All types of AI module are uniformly called PM531.

6.1 AI 4*IV, Multi-signal Input

Order No.: Kinco-K531-04IV

This module has 4 channels for current and voltage measurement, and the measurement type (4-20mA, 1-5V, 0-20mA, 0-10V) is optional for each channel. 16-bit high-performance A/D converter is adopted in the module. The module requires 8 bytes (2 bytes per channel) in the AI image area. The parameters of each channel, such as address, function, filter, etc, can be configured through KincoBuilder individually.

Each channel is equipped with a red LED, which indicates the input signal over-range if the channel's measuring method is configured to 4-20mA or 1-5V

 *Notic***e:** *Unused channel should be shor- circuited between the positive pole and the negative pole!*

6.1.1 Wiring Diagram
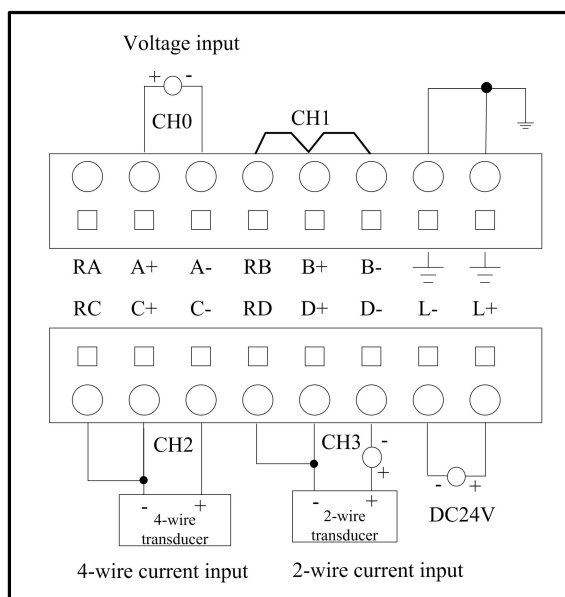
Diagram 6-2 Current Measurement

6.1.2 Measurement Ranges and The measured value Representation

In the following table, I represents input current value, unit mA; V represents input voltage value, unit V.

Measurement Type	Measurement Range	Measured value	Remark
4~20mA[1]	3.92~20.4mA[3]	I×1000	If input signal exceeds the upper limit of measuring range, the measured value will be kept at 32767. If input signal exceeds the lower limit of measuring range, the measured value will be kept at -32767.
1~5V[2]	0.96~5.1V[3]	V×1000	
0~20mA	0~20.4mA[3]	I×1000	
0~10V	0~10.2V[3]	V×1000	

Table 6-1 Measurement Range and The measured value Representation

6.1.3 Technical Data

Electrical data	
Number of channels	4
Measurement types	4~20mA, 1~5V, 0~20mA, 0-10V
Rated power supply	DC 24V, >=100mA
Resolution (including sign)	12 bits
Measurement accuracy	0.3% F.S.
Conversion rate (per channel)	About 20 times/s
Input impedance	Current mode: <500Ω Voltage mode: >4MΩ
Current consumption via expansion bus	5V — < 172mA 24V — -
Status indication	Red LED
Address occupied	
AI image area	8 bytes (2 bytes per channel)
AO image area	-
Dimension and weight	

Dimension (L×W×H)	114×50×70mm
Net weight	136g

6.2 AI 4*RD, RTD Input

Order No.: Kinco-K531-04RD

This module has 4 channels for temperature measurement using RTD, and the measurement type (Pt100, Cu50, Pt1000 and Resistance) is optional for each channel. 24-bit high-performance A/D converter is adopted in the module.

The module requires 8 bytes (2 bytes per channel) in the AI image area. The parameters of each channel, such as address, function, filter, etc, can be configured through KincoBuilder individually.

Each channel is equipped with a red LED that indicates the input signal overruns the measuring range.

Notice: Unused channel should be short-circuited between its terminals!
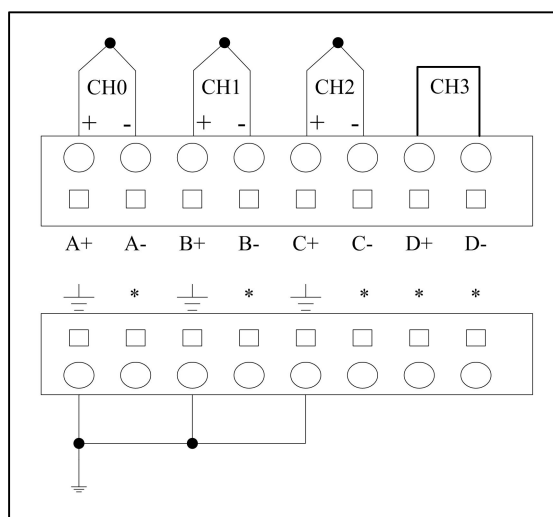
6.2.1 Wiring Diagram
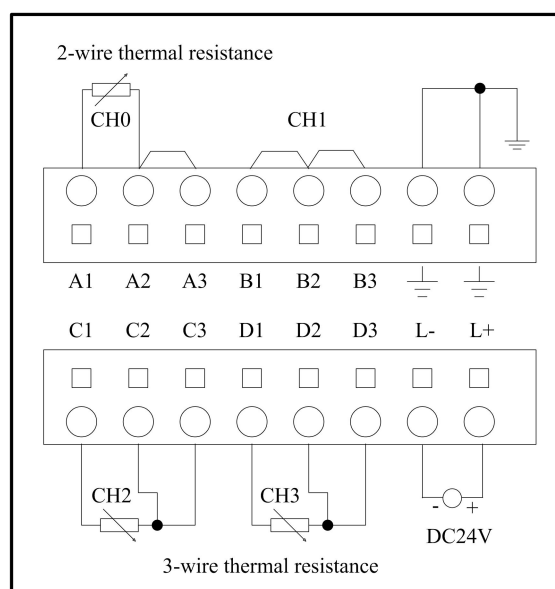
Diagram 6-4 Connection

6.2.2 Measurement Ranges and The measured value Representation

In the following table, T represents measured temperature, unit: °C, R represents measure Resistance, unit: Ω.

Measurement Type	Measurement Range	Measured value
Pt100	-200~850°C	T×10
Cu50	-50~150°C	T×10
Pt1000	-50~300°C	T×10
Resistance	0~2000Ω	R×10

Table 6-2 Measurement Range and The measured value Representation

6.2.3 Technical Data

Electrical data		
Number of channels	4	
Measurement types	Pt100, Cu50, Pt1000, R	
Connection	2-wire or 3-wire	
Rated power supply	DC 24V, >=100mA	
Resolution (including sign)	24 bits	
Measurement accuracy	Temperature: ±0.6℃, Resistance: ±1Ω	
Conversion rate (per channel)	About 1 times/s	
Input impedance	>1MΩ	
Current consumption via expansion bus	5V	< 172mA
	24V	-
Status indication	Red LED	
Address occupied		
AI image area	8 bytes (2 bytes per channel)	
AO image area	-	
Dimension and weight		
Dimension (L×W×H)	114×50×70mm	
Net weight	132g	

6.3 AI 4*TC, thermocouple Input

Order No.: Kinco-K531-04TC

This module has 4 channels for temperature measurement using thermocouples, and the measurement type (Type J, Type K, Type E and Type S) is optional for each channel, additionally cold junction internal compensation or external compensation is optional.24-bit high-performance A/D converter is adopted in the module. ***Notice: if internal compensation is adopted, the internal temperature sensor will acquire the temperature of the module interior and supply a compensation voltage, so the heat generated by the module will affect the measured value. Generally speaking, measured temperature with internal compensation will be 2~4°C higher than the actual temperature.***

The module requires 8 bytes (2 bytes per channel) in the AI image area. The parameters of each channel, such as address, function, filter, etc, can be configured through KincoBuilder individually.

Each channel is equipped with a red LED to indicate wire break.

Notice: Unused channel should be short-circuited between the positive pole and the negative pole!

6.3.1 Wiring Diagram

Diagram 6-6 Wiring Diagram

6.3.2 Measurement Ranges and The measured value Representation

In the following table, T represents measured temperature, unit: °C.

Measurement Method	Measurement Range	Measured value
Type J	-210~1200°C	T×10
Type K	-270~1300°	
Type E	-270~1000°C	
Type S	-50~1600°C	

Table 6-4 Measurement Range and The measured value Representation

6.3.3 Technical Data

Electrical data		
Number of channels	4	
Measurement types	Type J, Type K, Type E, Type S	
Cold junction compensation	Internal/external compensation optional	
Rated power supply	DC 24V, >=100mA	
Resolution (including sign)	24 bits	
Measurement accuracy	0.1% F.S.	
Conversion rate (per channel)	About 1 times/s	
Input impedance	>20kΩ	
Current consumption via expansion bus	5V	< 172mA
	24V	-
Status indication	Red LED to indicate wire break	
Address occupied		
AI image area	8 bytes (2 bytes per channel)	
AO image area	-	
Dimension and weight		
Dimension (L×W×H)	114×50×70mm	
Net weight	132g	

Chapter VII   AO (Analog Output) Modules

All types of AO module are uniformly called PM532.

7.1 AO 2*IV, Multi-signal Output

Order No.: KINCO-K532-02IV

This module has 2 channels, suitable for connecting with actuators requiring standard voltage or current signals (4-20mA, 1-5V, 0-20mA and 0-10V). The module has corresponding output ranges for different outputs, and if the output value specified in the user program exceeds the upper/lower limit of the output range, the actual output value will be kept at the upper/lower limit to prevent the connected equipment from damage. 12-bit high-performance D/A converter is adopted in the module.

The module requires 4 bytes (2 bytes per channel) in the AQ image area. The parameters of each channel, such as address, function, etc, can be configured through KincoBuilder individually.

7.1.1 Wiring Diagram
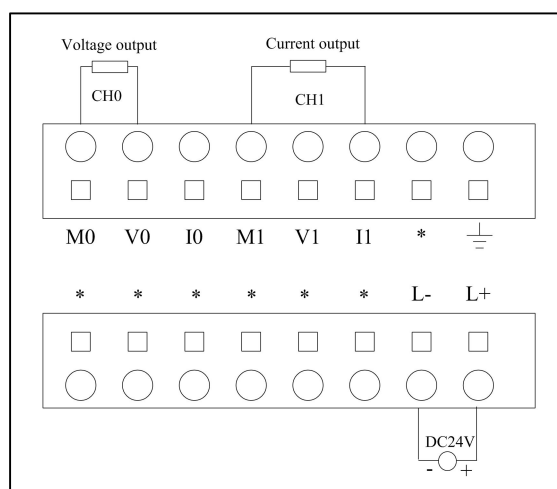
Diagram 7-2 Wiring Diagram

7.1.2 Output Ranges and the Output Value Representation

In the following table, I represents actual output current value, unit mA; V represents actual output voltage value, unit V.

Output Signal	Output Range	Output Value Representation	Remark
4~20mA	3.92~20.4mA	I×1000	If the output value specified in the user program exceeds the upper/lower limit of the output range, the actual output value will be kept at the upper/lower limit.
1~5V	0.96~5.1V	V×1000	
0~20mA	0~20.4mA	I×1000	
0~10V	0~10.2V	V×1000	

Table 7-1 Output Range and the Output Value Representation

7.1.3 Technical Data

Electrical data	
Number of outputs	2
Output signal	4~20mA, 1~5V, 0~20mA,0-10V
Rated power supply	DC 24V
Resolution (including sign)	12 bits
Output Accuracy	0.3% F.S.
Resistance load	Current mode:　max. 500Ω Voltage mode:　min. 1kΩ
Current consumption via expansion bus	5V　　<160mA 24V　　-
Address occupied	
AI image area	-
AO image area	4 bytes (2 bytes per channel)
Dimension and weight	
Dimension (L×W×H)	114×50×70mm
Net weight	125g

Chapter VIII   AI/O (Analog Input/Output) Modules

AI/O 模块是指模块上提供了一定数量的 AI 通道和一定数量的 AO 通道。

All types of AO module are uniformly called PM533.

8.1 AI/O,   AI 2×IV   AO 2×IV, Multi-signal Output

Order No.: KINCO-K533-04IV

This module has 2 channels for current and voltage measurement, and the measurement type (4-20mA, 1-5V, 0-20mA or 0-10V) is optional for each channel. 24-bit high-performance A/D converter is adopted in the module. Each channel is equipped with a red LED, which indicates the input signal over-range if the channel's measuring method is configured to 4-20mA or 1-5V

This module has 2 channels, suitable for connecting with actuators requiring standard voltage or current signals (4-20mA, 1-5V, 0-20mA or 0-10V). The module has corresponding output ranges for different outputs, and if the output value specified in the user program exceeds the upper/lower limit of the output range, the actual output value will be kept at the upper/lower limit to prevent the connected equipment from damage. 12-bit high-performance D/A converter is adopted in the module.

The module requires 4 bytes (2 bytes per channel) in the AI image area and 4 bytes (2 bytes per channel) in the AQ image area. The parameters of each channel, such as address, function, etc, can be configured through KincoBuilder individually.

 *Notic***e: *Unused AI channel should be shor- circuited between the positive pole and the negative pole!***

8.1.1 Wiring Diagram
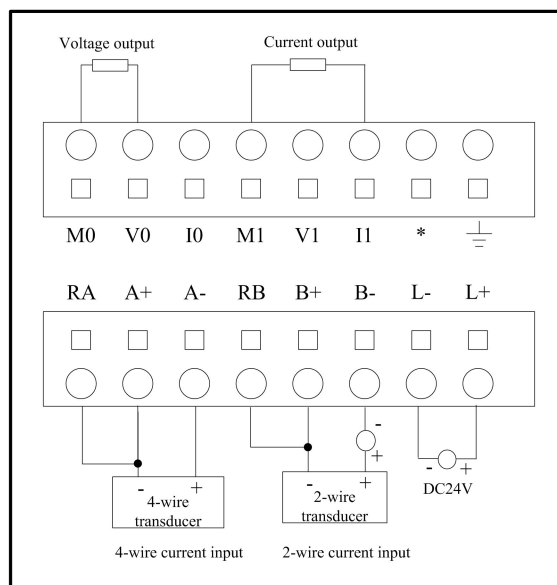
Diagram 8-2 Wiring Diagram

8.1.2 Measurement Ranges and The measured value Representation

In the following table, I represents input current value, unit mA; V represents input voltage value, unit V.

Measurement Type	Measurement Range	Measured value	Remark
4~20mA[1]	3.92~20.4mA[3]	I×1000	If input signal exceeds the upper limit of measuring range, the measured value will be kept at 32767.
1~5V[2]	0.96~10.2V[3]	V×1000	
0~20mA	0~20.4mA[3]	I×1000	If input signal exceeds the lower limit of measuring range, the measured value will be kept at -32767.
0~10V	0~10.2V[3]	V×1000	

Table 8-1 Measurement Range and The measured value Representation

Notice:

(1) If input signal is less than 4mA or greater than 20mA, then the red LED of this channel lights.

(2) If input signal is less than 1V or greater than 5V, then the red LED of this channel lights.

(3) If the input signal is beyond the measuring range, the module may be damaged.

8.1.3 Output Ranges and the Output Value Representation

In the following table, I represents actual output current value, unit mA; V represents actual output voltage value, unit V.

Output Signal	Output Range	Output Value Representation	Remark
4~20mA	3.92-20.4mA	I×1000	If the output value specified in the user program exceeds the upper/lower limit of the output range, the actual output value will be kept at the upper/lower limit.
1~5V	0.96-5.1V	V×1000	
0~20mA	0-20.4mA	I×1000	
0~10V	0-10.2V	V×1000	

Table 8-2 Output Range and the Output Value Representation

8.1.4 Technical Data

Electrical data		
Number of AI channels	2	
Measurement types	4~20mA, 1~5V, 0~20mA, 0~10V	
Rated power supply	DC 24V, >=100mA	
Resolution (including sign)	12 bits	
Measurement accuracy	0.2% F.S.	
Conversion rate (per channel)	About 20 times/s	
Input impedance	Current mode: <500Ω Voltage mode: >4MΩ	
Status indication	Red LED	
Number of AO outputs	2	
Output signal	4~20mA, 1~5V, 0~20mA, 0~10V	
Rated power supply	DC 24V	
Resolution (including sign)	12 bits	
Output Accuracy	0.3% F.S.	
Resistance load	Current mode: max. 500Ω Voltage mode: min. 1kΩ	
Current consumption via expansion bus	5V	< 166mA
	24V	-
Address occupied		

AI image area	4 bytes (2 bytes per channel)
AO image area	4 bytes (2 bytes per channel)
Dimension and weight	
Dimension (L×W×H)	114×50×70mm
Net weight	136g

Chapter IX Expansion Function Modules

Expansion function module provides a certain function and it has no I/O channels.

9.1 K541, CAN bus Module

Order No.: KINCO-K541.

K541 is a CAN bus expansion module. Cooperating with a CPU, it can serve as a CANOpen master, or as a free-protocol CAN bus node.

K541 has two CAN port named as CAN1 and CAN2. CAN1 is internal port and use for communicating with the CPU through the expansion bus. CAN2 is an external port and use for communicating with other CAN devices, including CANOpen slaves. CAN2 port is fully isolated in hardware (including its power supply and communication port) to enhance anti-interference ability.

When using in a Kinco-K5 plc system, K541 must be arranged at the end of all modules, and it does not need to be configured in Kincobuilder.

9.1.1 Main Features

K541 supports CANOpen mater and CAN free-protocol mode.

➢ **As a CANOpen Master**

- Supporting CAN2.0A, and accords with DS301 V4.2.0.
- Supporting NMT (Network ManagemenT) protocol and serving as a NMT master.
- Supporting normal expedited SDO as a client, and providing SDO_READ and SDO_WRITE instructions.
- Supporting for 120 CANOpen slaves.
- At most 8 TPDOs and 8 RPDOs for a slave, and 256 TPDOs and 256 RPDOs for all.
- Supporting Heartbeat protocol and Node-guarding protocol.

➢ **For CAN** free-protocol communication

- Supporting CAN2.0A and CAN2.0B.
- Providing various necessary CAN communication instructions for user application.

9.1.2 Terminals and Status LEDs
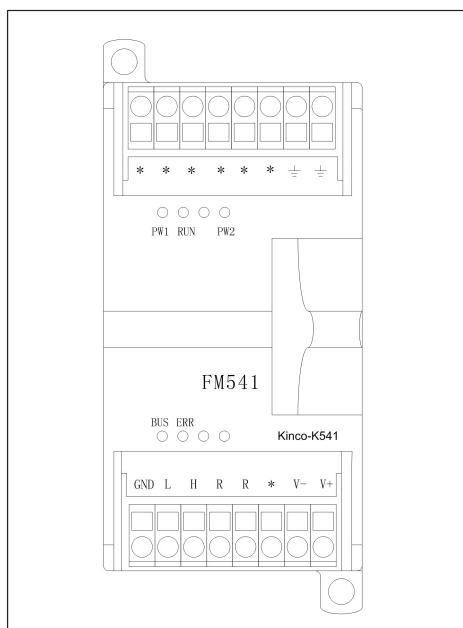
Diagram 9-1 Kinco-K541 Front View

➢ **Status LED**

- PW1: CAN1 power indication. Green LED.

  LED on means CAN1 port is powered on, and off means is powered off.

- PW2: CAN2 power indication. Green LED. LED on means power on, and off means power off.

  LED on means CAN2 port is powered on, and off means is powered off.

- RUN: CANOpen status indication. Green LED.

  LED on means Operational state, flashing means Pre-Operational state, off means .

- BUS: CAN2 communication indication. Green LED.

  Flashing means CAN2 is communicating.

- ERR: CAN2 error indication. Green LED.

  LED on means that CAN controller chip detects CAN errors whose levels are over Error Active.

  Notice: If ERR led is on, there must be some errors on your CAN bus, such as wrong wiring, wrong Baud rate, Terminal resistance mismatching, etc. And these errors have nothing to do with K541.

➢ **Terminals**

- GND、L、H: GND/0V, CAN_L, CAN_H of CAN2 port

- R、R: K541 provides a 120Ω resistance internally.

  Shorting these two terminal means adding this internal resistance into your CAN bus.

- V+、V-: External DC24V power supply for CAN2. '

9.1.3 Wiring and Arranging

When using K541 in a Kinco-K5 plc system, K541 must be arranged at the end of all modules, and it does not need to be configured in Kincobuilder.
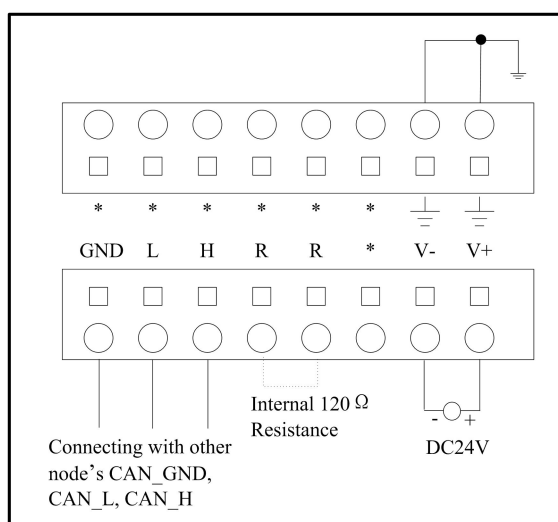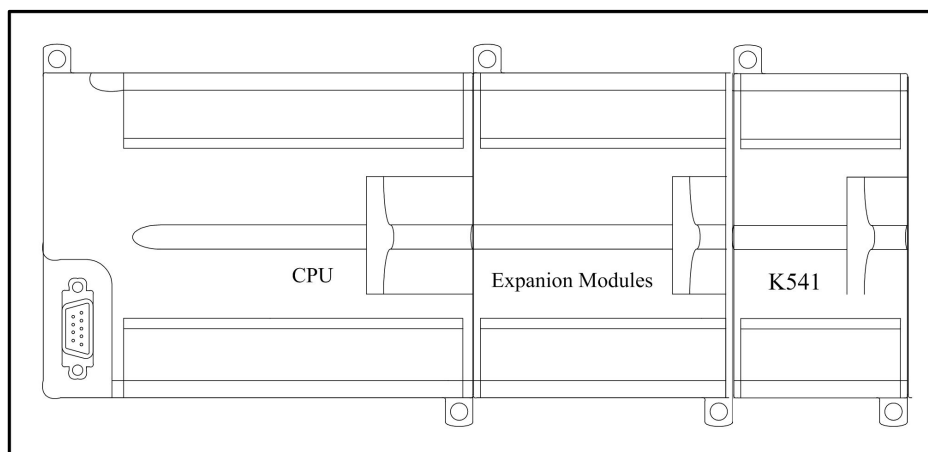

图中虚线表示用户根据实际情况来决定是否在 K541 这一端接入终端电阻。

Diagram 9-2 Kinco-K541 Wiring and Application

9.1.4 Technical data

Electrical data		
Rated power supply	DC24V，≥100mA，tolerance ±5%。	
CAN standard	CAN2.0A, CAN2.0B	
Baud rate	Standard 10K-1Mbps	
Current consumption via expansion bus	5V	< 170mA
	24V	-
Isolation ·power supply ·CAN bus	2500VAC/1 minute Opto-electrical isolation, 500VAC/1 miniute	
Status indication	Various LEDs	
Dimension and weight		
Dimension (L×W×H)	114×50×70mm	
Net weight	136g	

9.2 Expansion Power Module

Order No: Kinco-K580

The expansion power module supplies both DC5V power and DC24V power for the connected expansion modules through expansion bus. In a PLC system, the power requirements for all the expansion modules must not exceed the capacity of the CPU's expansion supply, otherwise you have to add a PS580 module to provide extra expansion power, or select a CPU with higher capacity of the expansion supply. The module supply +5V and +24V to the expansion modules which are after this module. The position of expansion bus power module is decided by calculating the current offered by CPU module and the consumption of the expansion modules. The +5V and +24V of expansion modules which are between the CPU module and PS580 are supplied by CPU module. And the expansion modules after the PS580 are supplied by PS580.

To use the PS580, just plug the expansion cable to the previous module, and connect the next module to PS580. This module does not occupy the I/O image of the CPU. You don't need to configure this module in KincoBuilder. The module requires AC85～265V input via the terminals.

Suggestion：If the number of expansion modules is greater than 7, even the +5V and +24V of expansion bus is enough, Expansion Bus Power Module is needed also.

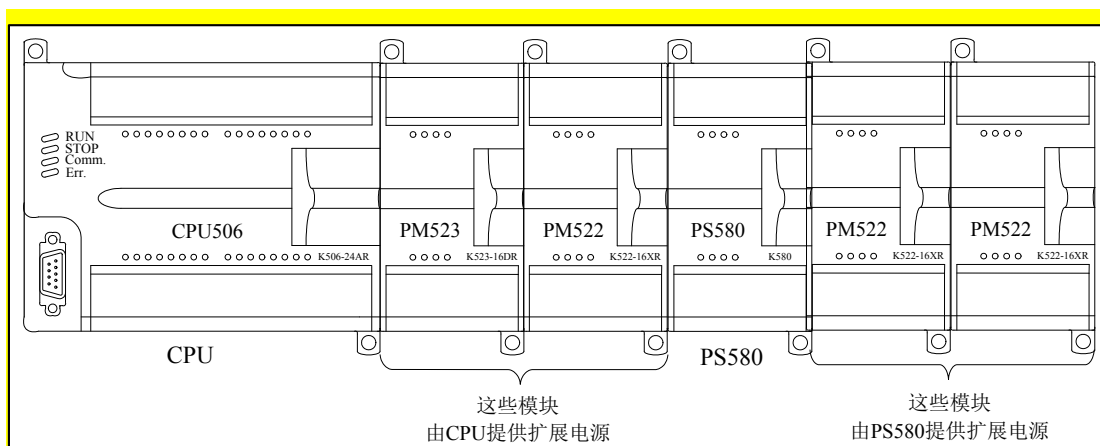该模块不占用 CPU 的 I/O 映像区中的地址，也不需要在 KincoBuilder 中进行配置。

💡 *In the same control system, PS580 and CPU module need the same* **AC85～265V.**

9.2.1 主要特点

• PS580 不需要在 KincoBuilder 中进行配置

• PS580 不占用 CPU 的 I/O 映像区中的地址

• PS580 不计入 CPU 支持的扩展 IO 模块总数

• PS580 供电电源：AC85～265V

• 当供电电源正常时，PW 指示灯亮

• 模块宽度 75mm

9.2.2 PS580 使用示意图

9.2.3 PS580 应用示例

工艺要求：8 个 DI、85 个 DO（继电器输出）、6 路 AI、2 路 AO，请给出 PLC 配置选型。

根据工艺要求，一步步 PLC 选型配置，以下三点是必须考虑的。

1) 先选 CPU 模块，可以从供电电源（DC24V 还是 AC220V）、I/O 点数、通讯口个数、输出点的类型（继电器还是晶体管）等方面考虑；

2) 其次再选扩展模块，可以从数字量 I/O 点数、模拟量点数、输出点的类型（继电器还是晶体管）等方面考虑；

3) 再次就需要考虑电源的问题了，包括扩展+5V、扩展+24V、输出电源（V0+、V0-）24V、模拟量供电电源等等。

具体分析一下本例子。

1) CPU 模块选型：CPU506 本体 14 点 DI 和 10 点 DO；CPU506EA 本体有 4 点 AI 与 2 点 AO，但没有继电器输出的 DO。综合比较，这里选择 CPU506。CPU504EX 的最大 I/O 数只有 78，对于 85 个 DO 来说不够用，因此也不考虑。综合比较，这里选择 CPU506，具体订货号为 Kinco-K506-24AR。

2) 扩展模块选型：DI 只有 8 点，CPU 模块本体就够用，不需要扩展 DI 模块。DO 需要 85 点，减去 CPU 模块本体的 DO 点（10 个 DO）成为 75 点，输出 DO 模块有 8 点和 16 点的，选 16 点的合理，可以计算出 5 个 K522-16XR。6 路 AI 与 4 路 AO，需要 1 个模拟量输入模块 K531-04IV 和 1 个模拟量输入输出模块 K533-04IV。

3）本例电源计算：

扩展+5V 损耗情况：扩展模块中芯片、指示灯、光耦、线路等损耗。

扩展+24V 损耗情况：扩展模块中间继电器线圈、线路损耗。

每一种扩展模块都有这两项指标，可查模块的技术数据中的扩展总线电流损耗项。每款 CPU 模块提供的扩展+5V、扩展+24V 都有指标，可查《表 1-3 扩展电源的最大输出电流》与《表 1-4 扩展模块的功率损耗》。 查表可得

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扩展电源供电：

型号	扩展电源（+5V ）	扩展电源（+24V ）	DC24V 输出电源（V0+、V0−）
Kinco-K506-24AR	1500mA	360mA	500mA
Kinco-K580	1000mA	250mA	无

扩展电源消耗：

型号	数量	扩展电源（+5V ）	扩展电源（+24V ）	DC24V 输出电源（V0+、V0−）
K522-16XR	5	210*5=1050mA	120*5=600mA	–
K531-04IV	1	172mA	–	10mA
K333-04IV	1	166mA	–	10mA
总计		1388	600	48

从上表中可以得出下列结论：

CPU506 提供+5V 扩展电源的容量为 1500mA，而 7 个扩展模块损耗的为 1388mA，因此 CPU 本体提供的+5V 扩展电源就可以满足。

CPU506 的 DC24V 输出电源（V0+、V0−） 容量为 500mA，而 8 个 DI 和模拟量模块损耗 48mA，因此可以用 CPU506 本体集成的 DC24V 输出电源为所有扩展模块供电。

CPU506 提供+24V 扩展电源的容量为 360mA，而所有扩展模块的电源损耗为 600mA，因此需要在系统中增加扩展电源模块 PS580。根据总电流损耗，增加一个 PS580 电源模块即可满足需求，模块可以如下排列：
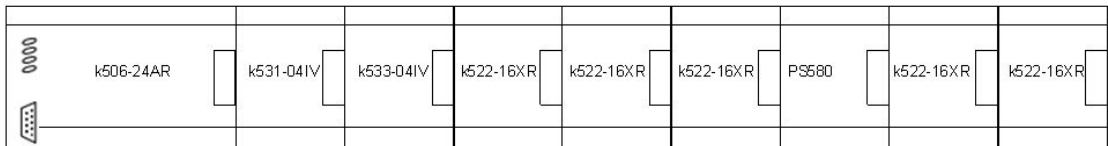
9.2.4 Technical Data

| Electrical data		
Supply voltage	AC85～265V	
Capability for expansion bus	+5V	≤1000mA
	+24V	≤250mA
Status indication	Green LED（PW）	
Dimension and weight		
Dimension (L×W×H)	114×75×70mm	
Net weight	195g	

Chapter X Installation & Wiring Guidelines

This chapter contains the information required to install and wire the KINCO-K5 modules.

10.1 Plastic Case Dimension

There are 5 different types of plastic cases for KINCO-K5 modules with the same length and height; the widths (expansion direction) are 200, 125, 97, 75 and 50mm respectively. The plastic cases of 200mm, 125mm and 97mm width are used for the CPU modules; 75mm and 50mm width are used for the expansion modules. Professional design of the case ensures the system surface flat and exquisite appearance when you combine modules.

Please refer to installation dimension diagrams in the above chapters for details.

若 L= 200mm， L1= 190mm
若 L= 125mm， L1= 115mm
若 L= 97mm， L1= 87mm
若 L= 75mm， L1=65mm
若 L= 50mm， L1=40mm
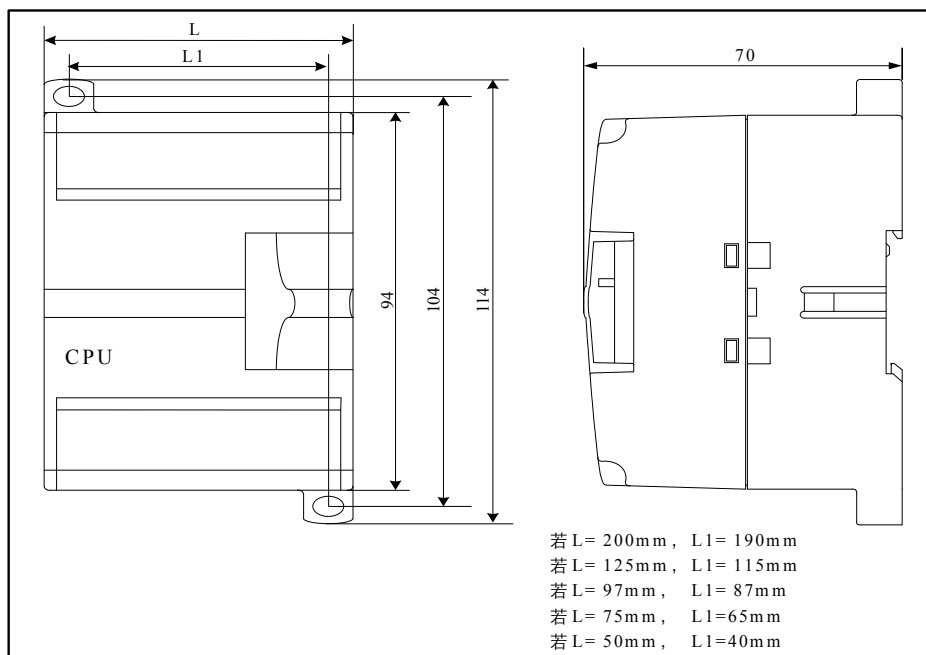
10.2 Installaton Guidlines

10.2.1 模块的连接

在实际的连接中，CPU 模块总是排列在最左端，扩展总线电缆从 CPU 的扩展接口引出，依次向右连接扩展模块，连接步骤为：将第一个扩展模块的 16 针扩展电缆插头接入 CPU 右端扩展接口的插座中，第二个扩展模块的 16 针扩展电缆插头接入第一个扩展模块右端的扩展接口插座，依此类推。扩展模块连接完成后将全部扩展模块推紧，扩展电缆自然滑入模块左侧的蔽线槽中，从正面看模块之间平滑过渡，没有缝隙。

图 10-2　PLC 模块连接后的实际图

注意：

(1) 扩展电缆一定要牢固地插在扩展插口的插座中，否则容易接触不良，导致系统不稳定！

(2) 安装完成后，一定要将所有模块推紧，让扩展电缆自然滑入蔽线槽中，并且要将所有的扩展盖板盖紧。这样能够尽量保护扩展电缆避免受到外来的损伤。

(3) *When CPU connects with too many expansion modules, it's recommended that the 9th and 10th pins of the expansion port of the last module should be short-circuited by placing a jumper!*

10.2.2 Installing the KINCO-K5 modules

You can install the KINCO-K5 modules either on a panel or on a DIN rail; also, you can arrange the modules

either horizontally or vertically. For horizontal mounting, the CPU module shall be located at the leftmost side; for vertical mounting, the CPU shall be at the uppermost side. If the modules need to be installed dispersively because of the limited space, lengthened expansion bus shall be useful. The horizontal installation effect is shown in the following diagram.
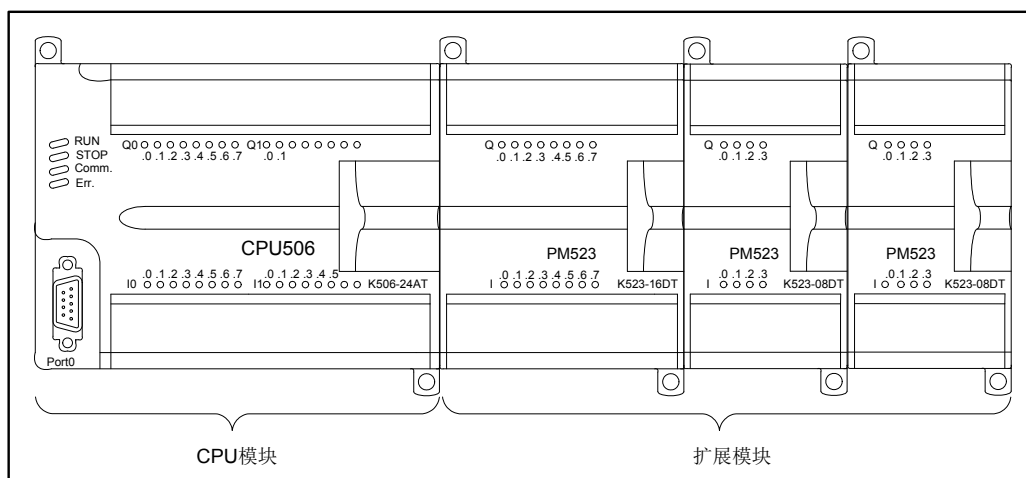

Diagram 8-1 Installation Effect

Notice:

(1) For appropriate cooling, make sure that a clearance of at least 60mm above and below the modules. In addition, at least 100mm of depth should be provided.

(2) For vertical mounting, the maximum ambient temperature in the operating environment is reduced by 10°C.

10.2.2.1 Panel Mounting

(1) Each module has 2 M4 mounting holes, which are respectively located on the top-left corner and the bottom-right corner. Both of the two mounting holes should be secured with bolts.

(2) Locate and drill the M4 mounting holes according to the module's dimension.

(3) Mount the module securely to the panel using M4 bolts. If you are using an expansion module, connect the expansion bus cable into the expansion port of the prior module. Before securing each expansion module, make some adjustments to make the expansion bus slide into the slot on the right side of

the module with a purpose to achieve a more exquisite appearance.

为防止因振动引起的松动，每套螺栓都建议加装弹簧垫圈和垫片。

10.2.2.2 DIN Rail Mounting

(1) Prepare a standard 35mm DIN rail. There are 2 specifications as shown in the following diagram.
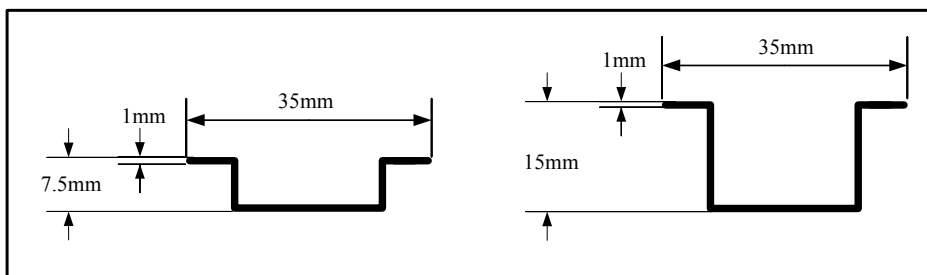
(2) Mount the rail securely to the appropriate position of the mounting panel.

(3) Snap down the DIN clip and hook the back of the module onto the DIN rail; Rotate the module forward until it clings to the rail and then snap the DIN clip back to its original position. Make sure that the clip has fastened the module securely onto the rail, as shown in the following diagram.
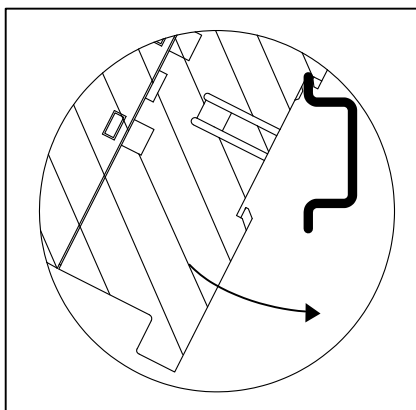

(4) If an expansion module is used, connect its expansion bus cable into the expansion port of the prior module; make some adjustments to make the expansion cable slide into the slot on the right side of the module; push tight all the modules after connection.

10.3 接线端子的拆卸和安装

Kinco-K5 系列 PLC 采用可拆卸的端子排，便于用户更换模块。

10.3.1 端子排的拆卸

① 打开端子排位置的端子盖板。

② 将合适的螺丝刀垂直插入端子块中央的缺口中。

③ 用力向外撬动，将端子排撬出来。

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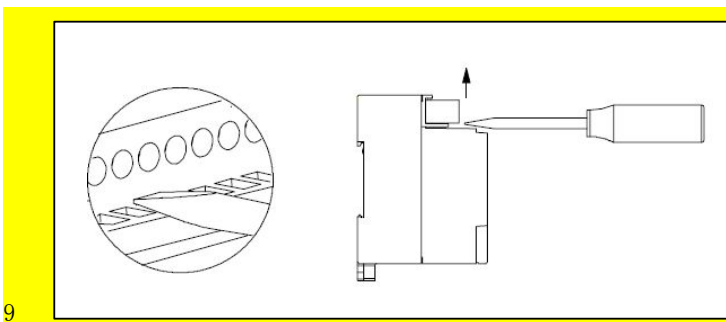
10.3.2 端子排的重新安装

① 打开端子排位置的端子盖板。

② 将端子排后部的凸起置于立板上的定位孔中。

③ 确保模块上插针与端子排边缘的孔都对正，然后向下用力压入端子排。

10.4 保护电路和接地

10.4.1 晶体管型 DO 通道的保护功能

K5 的晶体管型 DO 通道内部提供了短路保护功能，若输出电流超过 3A 则会触发短路保护，短路的通道所在组将被切断输出。另外，内部电路也提供了感性负载保护功能（采用了过电压抑制二极管），可以直接连接感性负载，能够适应大部分应用。

10.4.2 继电器型 DO 通道的外部保护指南

K5 的继电器型 DO 通道允许负载电压在 AC250V/DC30V 以下，负载电流最大可达 3A，因此一般不宜直接驱动大电流负载，建议通过外接中间继电器（或固态继电器）来驱动大负载。另外，继电器触点的使用寿命也有限制。例如，机械寿命（空载）为 2000 万次，电气寿命（额定电压，阻性负载，负载电流 3A，通断频率 6 次/分钟）10 万次。在实际的应用中，触点寿命跟实际的负载情况有关。

继电器型 DO 通道既可以接直流负载，也可以接交流负载，因此在内部没有提供感性负载保护功能。当连接感性负载时，在继电器断开的瞬间，负载两端会产生极高的反向电动势，因此建议在负载两端并联抑制电路以防止继电器触点过快损坏。下面分别介绍直流感性负载和交流感性负载的抑制电路。
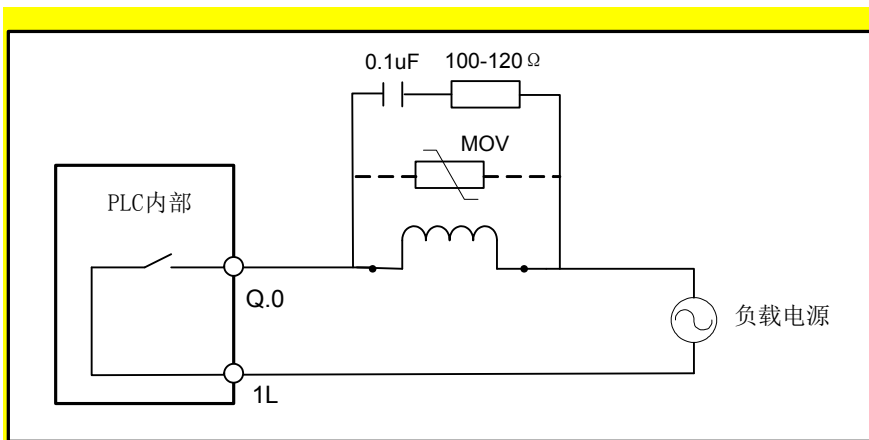
➢ 直流感性负载

下图是直流负载抑制电路的一个实例，在负载两端并联了过电压抑制二极管（需注意二极管极性）。
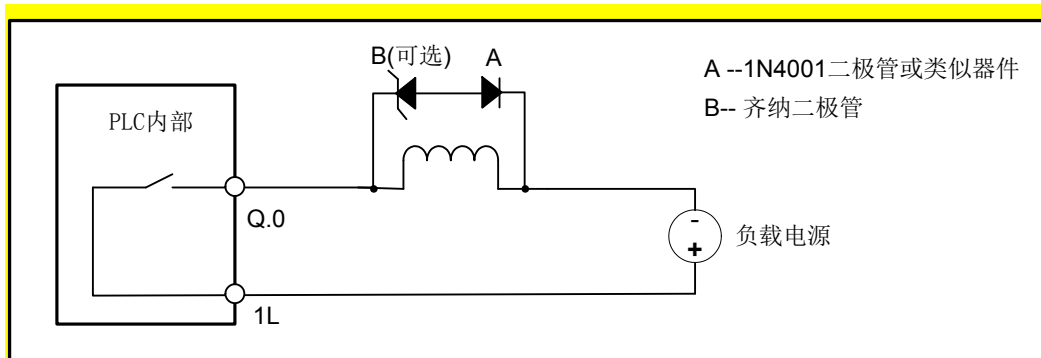
在大多数的应用中，用附加的二极管 A 即可，但如要求更快的关断速度，则推荐加上齐纳二极管 B，要确保齐纳二极管能够满足输出电路的电流和耐压要求。

➢ 交流感性负载

下图是交流负载抑制电路的一个实例，在负载两端并联了阻容网络，此时要确保电阻、电容能够满足输出电路的电流和耐压要求。或者也可以选择并联金属氧化物可变电阻器（MOV），此时要确保 MOV的工作电压比正常的线电压至少高出 20%。

10.4.3 接地

接地总体上分为两类：

- 保护接地（也称为安全接地），是为人身安全和电气设备安全而设置的接地。⏚ 表示保护地。

- 工作接地，用以保证控制系统和仪表设备正确、可靠地运行并保证测量和控制精度。

良好的工作接地是提高 PLC 系统电磁兼容性（EMC）的有效手段之一，一些原则如下：

- 在整个工厂中，PLC 控制系统要单独做工作接地。

- 接地线应尽可能地短且应使用大线径（比如 $2mm^2$ 以上），接地电阻小于 4Ω。

- 建议采用单点接地方法，将 PLC 及其相关设备的所有接地点在一点接入大地。接地方法如下图：

并联单点接地

串联、并联混合单点接地
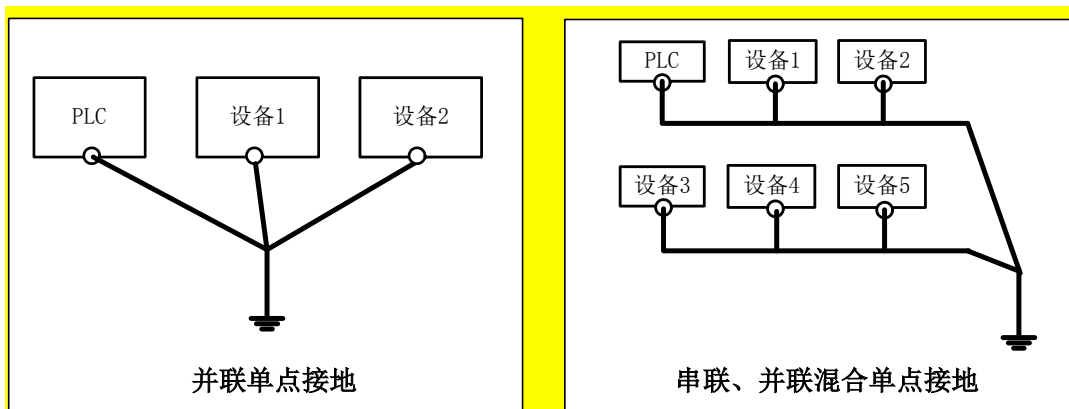
但是若系统中使用了变频器、大功率电机或者其它大功率设备时，应尽量避免 PLC 与这些设备共地。