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做最好用的运动控制
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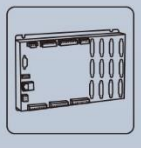
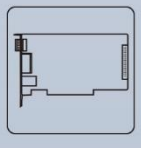
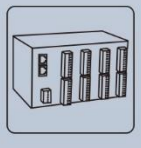
Vision Motion Controller

VPLC710 Series


Vision Motion Controller


Motion Controller


Motion Control Card


IO Expansion Module


HMI

Copyright statement

PCIE controller software involved in details as well as the introduction and routines of each instruction, please refer to ZBASIC software manual.

Information contained in this manual is only for reference. Due to improvements in design and functions and other aspects, Zmotion Technology reserves the final interpretation! Subject to change without notice!

Pay attention to safety when debug the machine! Be sure to design effective safety devices in the machine, and add error handling procedures in software. Zmotion has no obligation or responsibility for the loss.

Foreword

Introduction

VPLC710 is a kind of IPC type product based on X86. And it can make use of system of extensible, inheritable, multi-domain, information, openness and visualization through PC - based. EtherCAT bus is configured. In addition, the linkage axes can reach 16 axes. For motion period, the minimal is 500us. Therefore, high-speed and high-precision requirements in motion control areas can be achieved through powerful motion control functions of VPLC710. What's more, it supports many functions for automation industry, such as, DI / DO, pulse control, handwheel acquisition, etc.

This manual mainly introduces VPLC710 basic specification, wiring and installment, debug and maintain.

For Readers

Mechanical Engineer + Electrical Engineer + Software Engineer + Systems Engineer

Use First Time

For users who use VPLC710 firstly, please read this manual seriously. If there is any question on function and performance, please contact ZMotion engineers, which is good for use this product correctly.

Get this manual

This manual won't brought with product, and there is no notification if updated. Please check in "ZMotion Technologh – Download" for the latest version.

Content

Chapter I Production Information

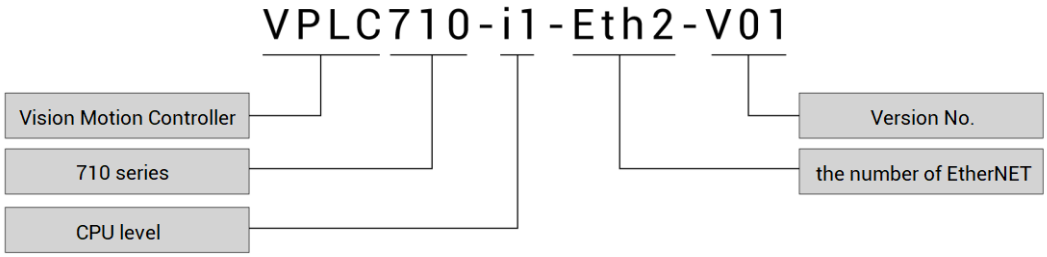
1.1. Product Information

VPLC710 is a kind of IPC type product based on X86. It is matched with MotionRT software to achieve motion control functions, machine vision algorithm and powerful communication ability on one VPLC710 vision motion controller.

MotionRT is Zmotion motion control real-time kernel software. Now, it has developed to generation 7 "MotionRT7". This software is one independent PC software, it has high compatibility to transplant to Linux or Windows conveniently. And MotionRT is with real-time Basic language, ladder diagram, configuration (HMI) that are easy to use. Whether it is a remote application or a local application (VS, QT and other software development), MotionRT provides a unified standard function interface (zmotion.dll/zmotion.so) to facilitate the transplantation of various external programs.

It is matched with RtSys (ZDevelop) development software to realize real-time one-stop-shop development of real-time BASIC, ladder diagram, configuration, machine vision, in this way, development time can be saved.

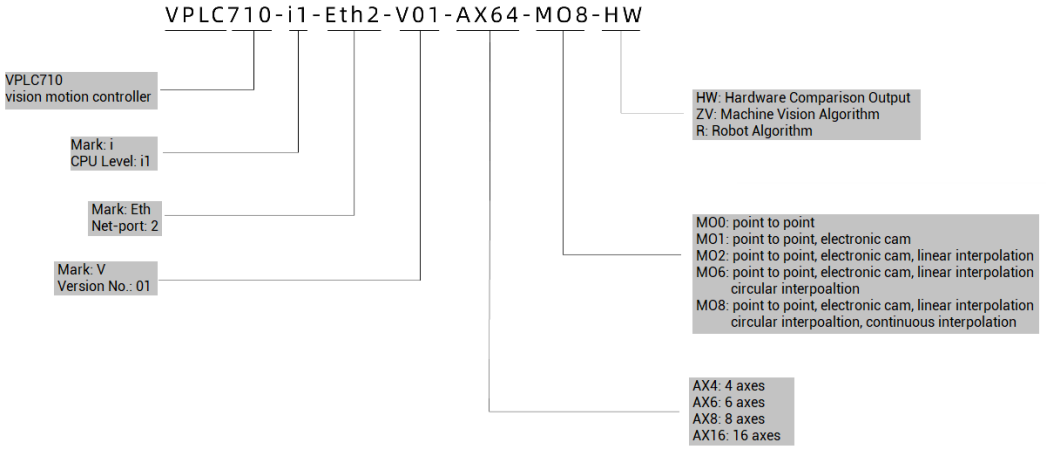
1.2. Nameplate & Models



1.3. Optional Configuration

You can select below to configurate for software, such as, axis numbers, motion control functions, other functions (PSO, vision, robot, etc.).

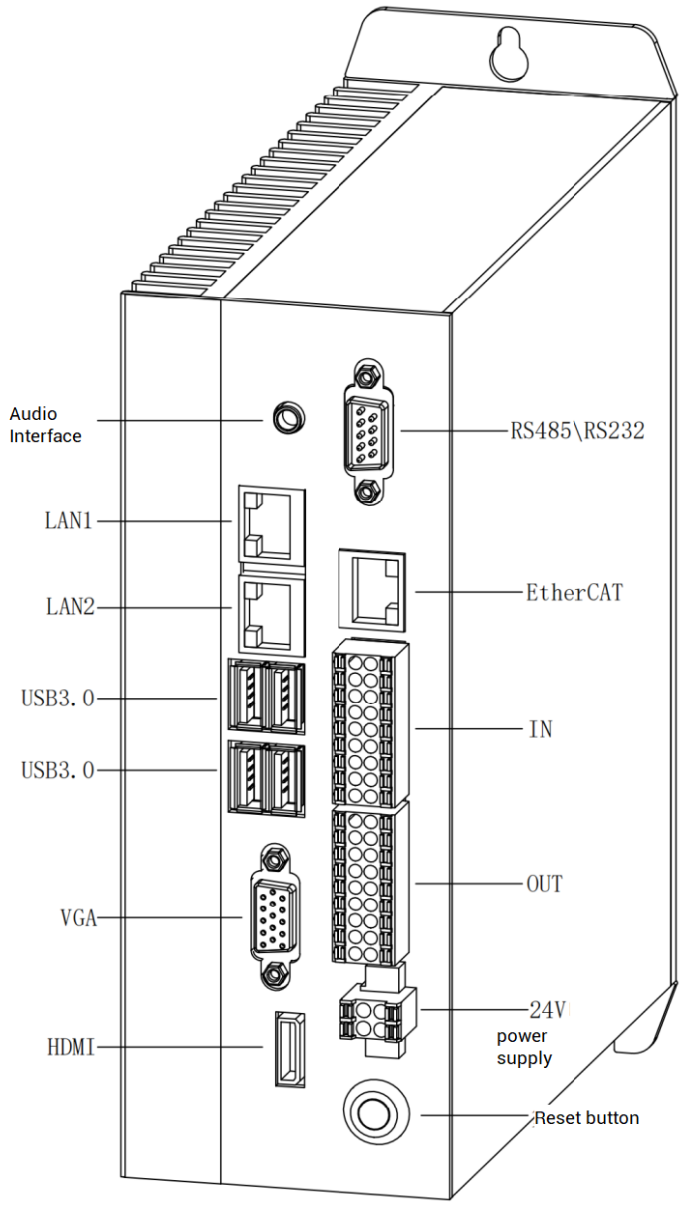
64 axes versions can be customized, please contact us.



No.	Configuration	Specification description
1	VPLC710-i1-ETH2-V01-AX4-MO8	Maximum 4 axes are used. MO0: point to point MO1: point to point, electronic cam MO2: point to point, electronic cam, linear interpolation MO6: point to point, electronic cam, linear interpolation, circular interpolation MO8: point to point, electronic cam, linear interpolation, circular interpolation, continuous interpolation
2	VPLC710-i1-ETH2-V01-AX6-MO8	Maximum 6 axes are used. MO0: point to point MO1: point to point, electronic cam MO2: point to point, electronic cam, linear interpolation MO6: point to point, electronic cam, linear interpolation, circular interpolation MO8: point to point, electronic cam, linear interpolation, circular interpolation, continuous interpolation
3	VPLC710-i1-ETH2-V01-AX8-MO8	Maximum 8 axes are used. MO0: point to point MO1: point to point, electronic cam

		MO2: point to point, electronic cam, linear interpolation MO6: point to point, electronic cam, linear interpolation, circular interpolation MO8: point to point, electronic cam, linear interpolation, circular interpolation, continuous interpolation
4	VPLC710-i1-ETH2-V01-AX16-MO8	Maximum 16 axes are used. MO0: point to point MO1: point to point, electronic cam MO2: point to point, electronic cam, linear interpolation MO6: point to point, electronic cam, linear interpolation, circular interpolation MO8: point to point, electronic cam, linear interpolation, circular interpolation, continuous interpolation

1.4. Production Appearance



Appearance Description:

No.	Name	Numbers	Details
1	Audio interface	1	Output audio
2	LAN1	1	Net port 1, can be configured as EtherCAT
3	LAN2	1	Net port 2, can be configured as EtherCAT
4	USB3.0	2	USB3.0

5	USB3.0	2	USB3.0
6	VGA	1	VGA display interface
7	HDMI	1	HDMI display interface
8	RS485 / RS232	1	RS485 (port1) & RS232 (port0)
9	EtherCAT	1	EtherCAT Bus interface
10	IN	16	Digital inputs
11	OUT	16	Digital outputs
12	24V power supply	2	Power inputs
13	Reset button	1	ON / OFF button

1.5. Specification Parameter

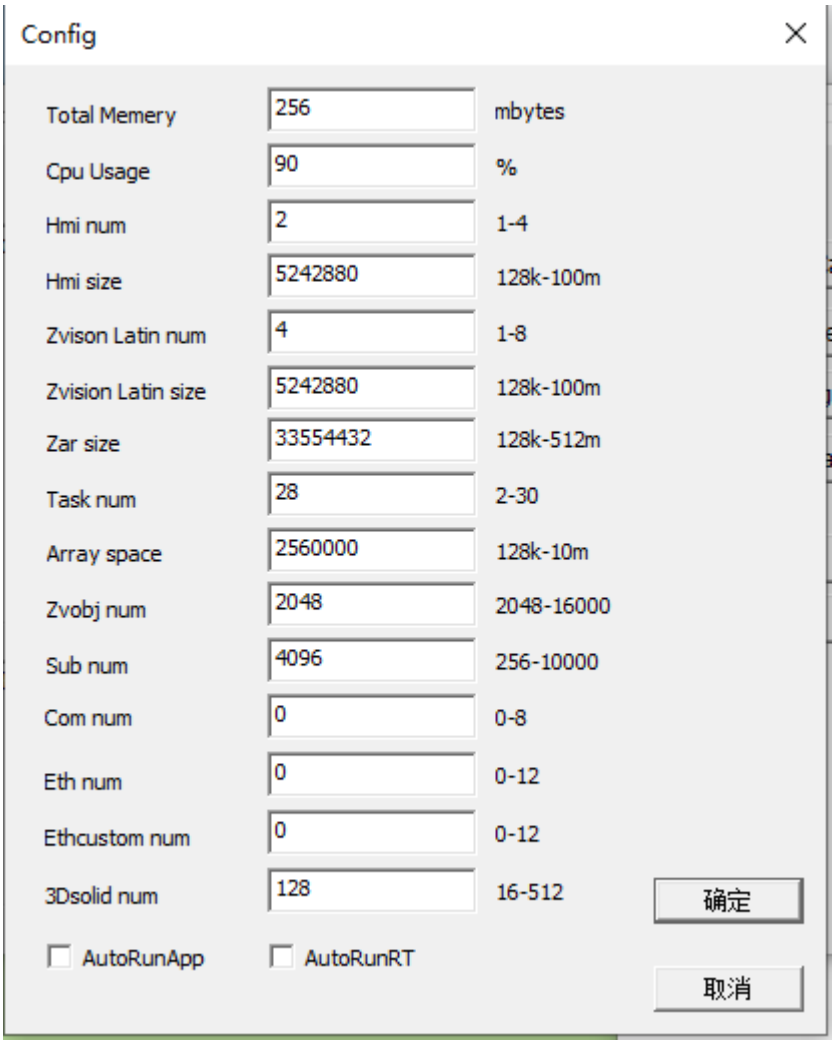
1.5.1. General Specification

Item	Specification	Details
Name	VPLC710-i1-ETH2-V01	/
CPU	Intel CPU	Pentium 5405U
Storage	SSD solid state disk is built-in	128G (others can be selected)
Memory	DDR4	8G
Main Power	24V*3A	Power should be more than 70W, voltage is -15%~+20%
Axes	16	EtherCAT bus and 4 local pulse axes
Max Expanded Axes	16	For more axes, please contact us
Basic Axes Type	16	EtherCAT bus axes, pulse axes, encoder axes, virtual axes
High-Speed Out IO Frequency	500k	/
High-Speed In IO Frequency	500k	/
Normal In IO Frequency	10k	/

Controller Period	1ms by default	Support SERVO_PERIOD to check and adjust period
VR Save Size when Power Off	2048	Ferroelectric memory stores power failure data for about 10 years
heat-dissipating method	Cooling fin	/
Storage Temperature	/	-40℃-80℃
Work Temperature	/	-20℃-60℃
Work Humidity	/	10% ~ 95% (non-condensation)
Volume	178mm*186mm*69mm	About 2.277dm^3
Weight	2KG	/

1.5.2. Config Parameter Specification

Turn on MotionRT software, it can configure parameters specification according to requirements, please see below image, it shows default parameters, behind indicates supported parameters range, after configurated, click (确认) to save.



Parameter Description:

Item	Default Specification	Details
Total Memory	256MB	Total memory, including all memories that can save data, such as, array space, Zar file size, channel size, hmi resolution, etc., it is better to set the value that is above 200.
Cpu Usage	90%	CPU usage limit
Hmi num	2	Valid Hmi numbers
Hmi size	5242880KB	Resolution of one hmi
ZVision Latin num	4	Vision channel numbers
ZVision Latin size	5242880KB	One vision channel size
Zar size	33554432KB	Zar file size

Task num	28	Max tasks can be executed
Array Space	25600000KB	Distributed array space
Zvobj num	2048	The number of vision object Avobject
Sub num	4096	Max sub functions
Com num	0	Serial ports
Eth num	0	The number of PORT net-port, set value should be less than the max value
Ethcustom num	0	The number of customized Ethernet
3Dsolid num	128	3D solid numbers
AutoRunApp	/	Open software automatically when power on
AutoRunRT	/	Run RT software automatically when power on

1.5.3. IO Interface Specification

Item	Specification	Details
Inner IOs	16+16	16 inputs and 16 outputs (with overcurrent protection), and 8 of them are high-speed inputs to be configured as encoder inputs. 16 outputs are high-speed outputs to be configured as pulse outputs.
Max extended IOs	1024 inputs + 1024 outputs	It is matched with expansion module to expand IO.
Latches	4	4 inputs can be configured as latch input, number is IN0-3.
Encoder	2	Reuse input, number is IN0-2, IN4-6
PWM	4	4 outputs can be configured as PWM, number is OUT0-3.
Hardware comparison output	4	4 outputs can be configured as hardware comparison output (PSO function), which are compatible with precision output, number is OUT0-3.

Pulse output	4	Reuse output, number is OUT8-15.
IO power input	24V DC input	IO needs to be supplied by external power independently.

1.5.4. Communication Interface Specification

Item	Specification	Details
LAN	Communication speed 1000Mbps	Standard 1000M Ethernet interface RJ45, it can be configured as EtherCAT. LAN1 Ethernet Factory IP Address: 192.168.0.11 LAN2 Ethernet Factory IP Address: 192.168.1.11
EtherCAT	Communication speed 1000Mbps	Industrial communication EtherCAT master station interface, standard Ethernet interface RJ45.
RS232/ RS485	Several kinds of Baud rate	Support MODBUS_RTU standard protocol, master station and slave station are valid, default is slave station. And default communication parameters are Baud rate 38400, data bit 8, no parity.
VGA	Standard interface	Connect VGA interface externally to show equipment.
HDMI	Standard interface	Connect HDMI interface externally to show equipment.
USB3.0	Standard interface	Both support “plug and then use immediately” and “hot plug in and out”, it is below compatible with USB2.0.

Note:

- EtherCAT specialized minimal communication period is 500us, the maximum period is 4000us, the accumulative is 500us, and the max equipment number is 16, EtherCAT bus drive and EtherCAT bus expansion module can be connected.
- LAN Ethernet both can be configured as EtherCAT custom port, the minimal communication period of EtherCAT custom port is 1000us, the maximum is 4000us, the accumulative is 500us, and the max equipment number is 16.

1.6. Interface Definition

1.6.1. Standard Interface

The USB3.0 interface, VGA interface, HDMI interface, LAN interface, audio interface, and EtherCAT interface are all standard interfaces, which can be connected and used through standard wiring cables.

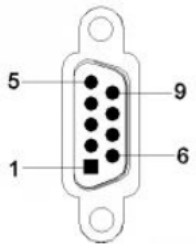
1.6.2. RS485/RS232

VPLC710 series support RS485 protocol local IO communication and RS232 protocol local debug.

Before use, it needs to configure the number of "com num" and related parameters on the "Config Window" of the MotionRT software.

By default, the MODBUS_RTU standard protocol is adopted, and at the same time, it supports configuration as no-protocol mode, and adopts custom communication.

Both support configuration as master or slave.



PIN	Name	Description
2	RS232-RXD	RS232, receive data
3	RS232-TXD	RS232, send data
4	RS485A	RS485 + communication
5	GND	Power ground
7	RS485B	RS485 - communication
9	DC5V	5V power output
1, 6, 8	NC	Spare

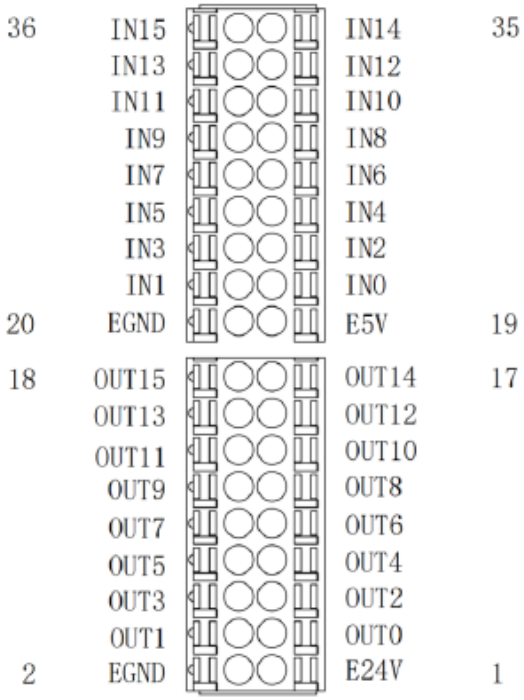
Serial port communication specification:

Item	RS232 (port0)	RS485 (port1)
Maximum Communication Rate	115200(bps)	115200(bps)
Terminal Resistor	No	No
Topological Structure	1 to 1	Daisy Chain Topology
The number of nodes can be extended	1	127
Communication Distance	The longer communication distance is, the lower communication rate is, and maximum of 10m is recommended.	The longer communication distance is, the lower communication rate is, and maximum of 100m is recommended.

1.6.3. Input & Output

General IO includes 16 inputs and 16 outputs (both are NPN type), when the number is not enough, expansion is valid.

IO needs to connect 24V DC externally, following shows IO terminal distribution:



IO terminal definition form:

PIN	Signal	Description	Note
1	E24V	External power 24V input	IO Power terminal
2	EGND	External power ground	
3	OUT0	Output 0, PWM0	1. Outputs all are high-speed outputs, but they are general outputs by default. 2. OUT0-3 can be configured as PWM output or pulse output in ZDevelop, at the same time, hardware comparison output or precision output are valid. 3. OUT8-15 can be configured as 4 pulse outputs.
4	OUT1	Output 1, PWM1	
5	OUT2	Output 2, PWM2	
6	OUT3	Output 3, PWM3	
7	OUT4	Output 4	
8	OUT5	Output 5	
9	OUT6	Output 6	
10	OUT7	Output 7	
11	OUT8	Output 8, single-ended DIR3	
12	OUT9	Output 9, single-ended PUL3	
13	OUT10	Output 10, single-ended DIR2	
14	OUT11	Output 11, single-ended PUL2	
15	OUT12	Output 12, single-ended DIR1	
16	OUT13	Output 13, single-ended PUL1	
17	OUT14	Output 14, single-ended DIR0	
18	OUT15	Output 15, single-ended PUL0	
19	E5V	5V power output	Supply power for external equipment
20	EGND	External power ground	
21	IN0	Input 0, latch R0, encoder EA0	1. IN0-7 are all high-speed inputs, but they are general inputs by default. 2. IN0-3 can be configured as latch input in ZDevelop. 3. IN0-2 and IN4-6 can be configured as 2 encoder inputs.
22	IN1	Input 1, latch R1, encoder EA0	
23	IN2	Input 2, latch R2, encoder EA0	
24	IN3	Input 3, latch R3	
25	IN4	Input 4, encoder EA1	
26	IN5	Input 5, encoder EB1	
27	IN6	Input 6, encoder EZ1	
28	IN7	Input 7	
29	IN8	Input 8	
30	IN9	Input 9	
31	IN10	Input 10	
32	IN11	Input 11	

33	IN12	Input 12	
34	IN13	Input 13	
35	IN14	Input 14	
36	IN15	Input 15	

Only 24V encoders can be used, and the pulse input frequency of encoder 0 and encoder 1 is up to 500kHz, which can be connected to high-speed encoders, the others are ordinary inputs, and the pulse input frequency is up to 10kHz.

The frequency of the high-speed output port is 500KHz.

The number after the pulse output and encoder input is the default axis number, and the ATYPE command is used to switch whether the IO port is a general-purpose IO (ATYPE=0 of the target axis is general-purpose IO, ATYPE=1 is pulse output, ATYPE=3 is encoder input, ATYPE=4 is pulse output + encoder input).

→High-speed Digital Output Specification

Item	Specification
Channel	16 (OUT0-OUT15)
Mode	Transistor NPN type, OD output
Voltage level	Local power ≤ 36V
Max output current	+300mA
Max leakage current when off	25μA
Respond time to conduct	1μs (resistive load typical value)
Respond time to close	3μs
Isolation method	Capacitive isolation
Overcurrent protection	Support, action current is 600mA
Respond time	Below 0.5ms

→High-speed Digital Input Specification

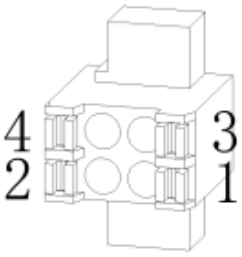
Item	Specification
Channel	8 (OUT0-OUT7)
Mode	NPN type
Voltage level	DC24V (-15%~+20%)
Current to input (typical value)	6.8mA

The voltage to open	<15V
Minimal current	2.3mA
Impedance	3.3KΩ
Overcurrent protection	Capacitive isolation
Respond time	Below 10ms

→General Digital Input Specification

Item	Specification
Channel	8 (OUT0-OUT15)
Mode	NPN type
Voltage level	DC24V (-15%~+20%)
Current to input (typical value)	4.8mA
The voltage to open	<14.5V
Minimal current	1.8mA
Impedance	4.7KΩ
Overcurrent protection	Capacitive isolation
Respond time	Below 10ms

1.6.4. Power Supply



PIN	Description	
1	DC24V input	It can use 24V*3A to 36V*2A, total power should be above 70W.
2	DC24V input	
3	GND	
4	GND	

Chapter II System Configuration

2.1. Connection Configuration

External equipment & Software configuration:

1. Wired mouse and keyboard.
2. Displayer.
3. WIN10 operation system (technical version), ZDevelop development platform, all kinds of operation systems of machine tool industries.

Note: ZDevelop development platform can be downloaded from our website, or contact us. For host computer development, please contact us for function library file.

There is MotionRT software built in this product, there is no operation system, users need to install the operation system by yourselves.

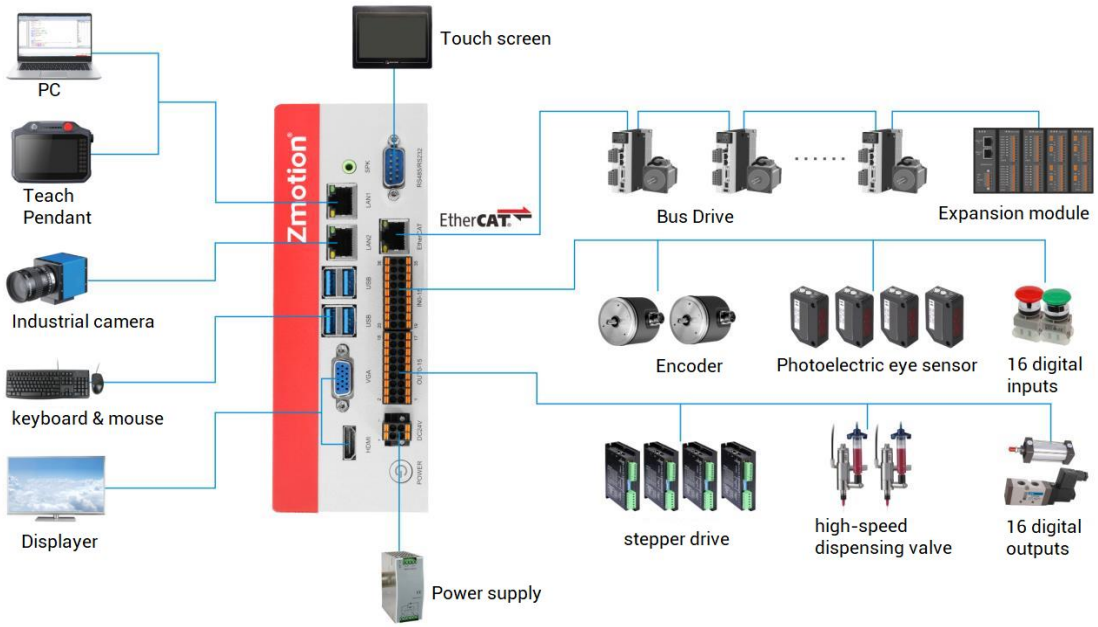
2.2. Main Properties

- Support motion control function and machine vision function.
- Up to 16 axes motion control (EthercCAT axis / encoder axis / pulse axis / virtual axis)
- Encoder interface supports encoder position measurement, which can be configured as handwheel input mode.
- 16 NPN outputs, some outputs can be configured as hardware comparison output, PWM, pulse axis and other functions. The output current can reach 300mA, which can drive sone valve solenoid directly.
- 16 NPN inputs, some high-speed inputs can be configured as latch and encoder.
- There is one 100M EtherCAT interface, and 1024 isolated inputs and 1024 isolated outputs can be extended through EtherCAT bus.
- There are four USB3.0 interfaces, it is compatible below with USB2.0 and USB1.0 interfaces, which can be connected to camera, mouse, keyboard, U disk and other USB external equipment.

- There is one RS485/RS232 interface.
- There are two 1000M Ethernet interfaces that support multiple kinds of expansion applications, which can connect computer, camera or other network equipment.
- There is one HDMI interface that supports high-definition display.
- There is one VGA interface that supports standard displayers.
- Supports x86 system platform.
- Up to 16 axes linear interpolation, any space circular interpolation, helical interpolation, spline interpolation, etc.
- Support electronic cam, electronic gear, position latch, synchronous follow, virtual axis, etc.
- Support hardware comparison output (HW_PSWITCH2), hardware timer, precision output in motion.
- Support pulse closed-loop, pitch compensation, etc.
- Support ZBasic multi-file and multi-task programming.
- A variety of program encryption methods to protect the intellectual property rights of customers.
- Support power failure detection.

2.3. System Framework

The VPLC710 series enters the general machine tool in the form of an industrial computer. The specific application requires an external displayer for display, a keyboard and mouse for interaction, an IO module is for general IO input and output functions, and an EtherCAT bus is to connect the servo drive and remote IO modules. LAN interface is to connect network, camera, etc.

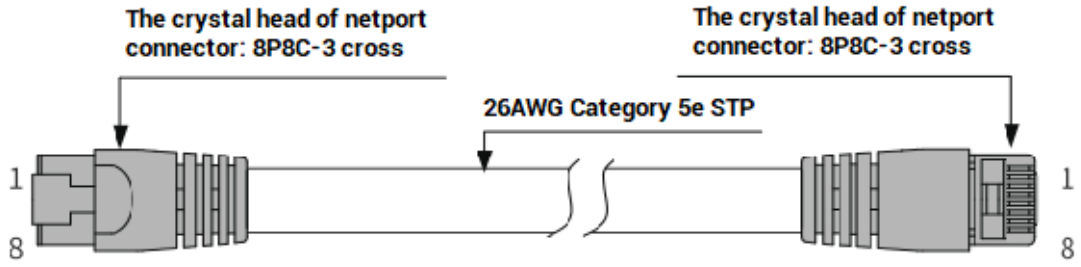

Touch screen
PC
Teach Pendant
Industrial camera
keyboard & mouse
Displayer
Zmotion
EtherCAT
Power supply
Bus Drive
Expansion module
Encoder
Photoelectric eye sensor
16 digital inputs
stepper drive
high-speed dispensing valve
16 digital outputs

Chapter III Wiring Reference

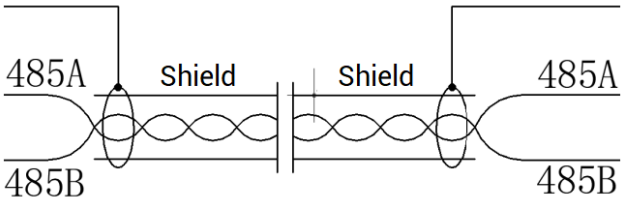
3.1. Basic Requirements

3.1.1. Cable Requirements

1. The network cable adopts Category 5e STP, and the crystal head has a metal shell to reduce interference and to prevent information from being eavesdropped.

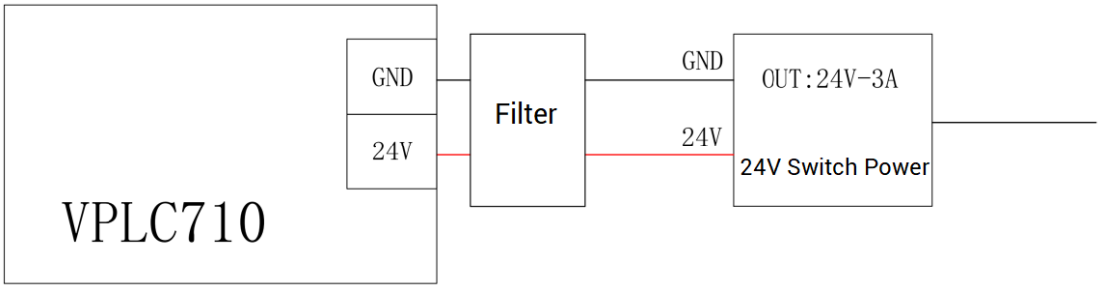


2. RS485 must be twisted pair with shield.



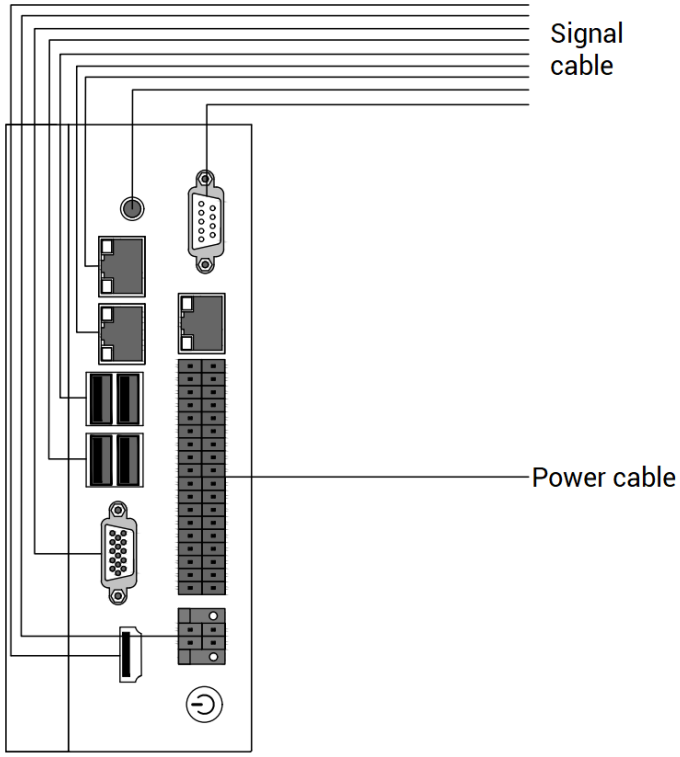
3. HDMI and VGA should be with good quality to avoid display problem in running proess.

4. The power cable is made of high-power wire. In a harsh environment, a filter or a magnetic ring should be added between the power supply and the controller, which is close to the power supply of the controller.

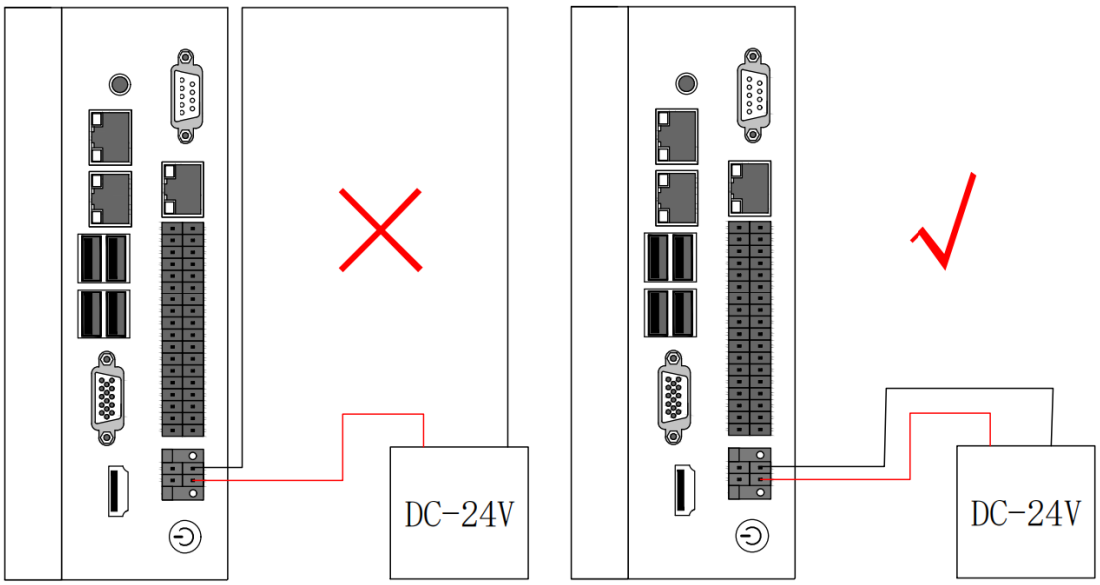


3.1.2. Cable-Arrangment Requirements

1. Signal lines and power lines should be routed separately, try to adjust the position of controllers and drivers in the cabinet, and distribute signal lines and power lines in different areas.



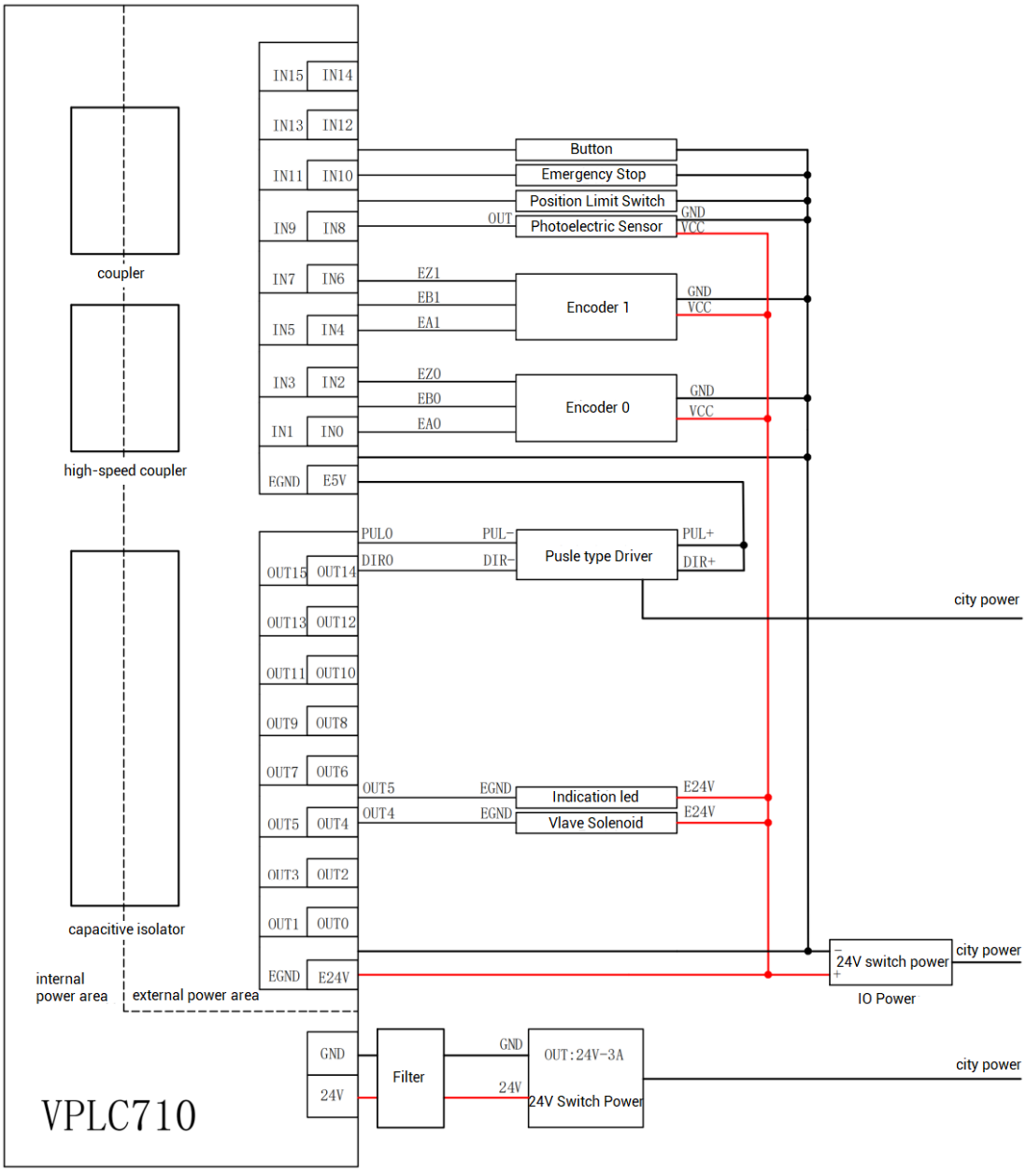
2. The positive and negative lines of the power line are routed side by side to avoid interference caused by a large loop area.



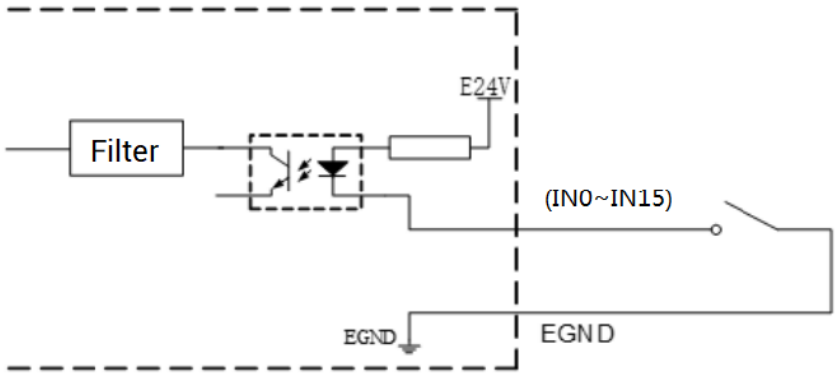
3.1.3. Wiring Requirements

1. The cable that is with shield should connect two sides of shield layer to GND.
2. Power that supplies the power should connect to the grounding cable.

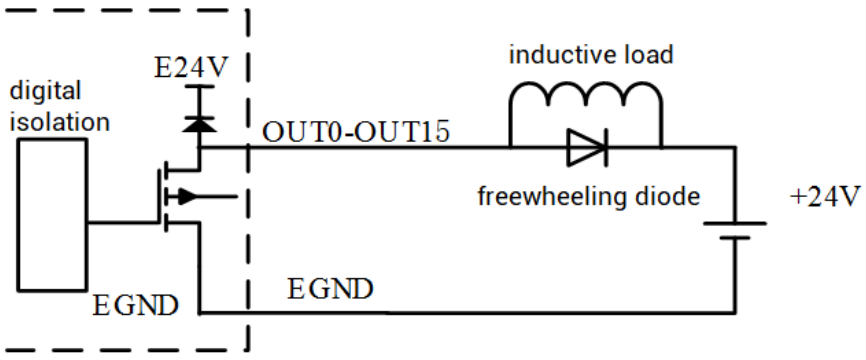
3.2. Terminal Wiring



3.2.1. General Input Wiring



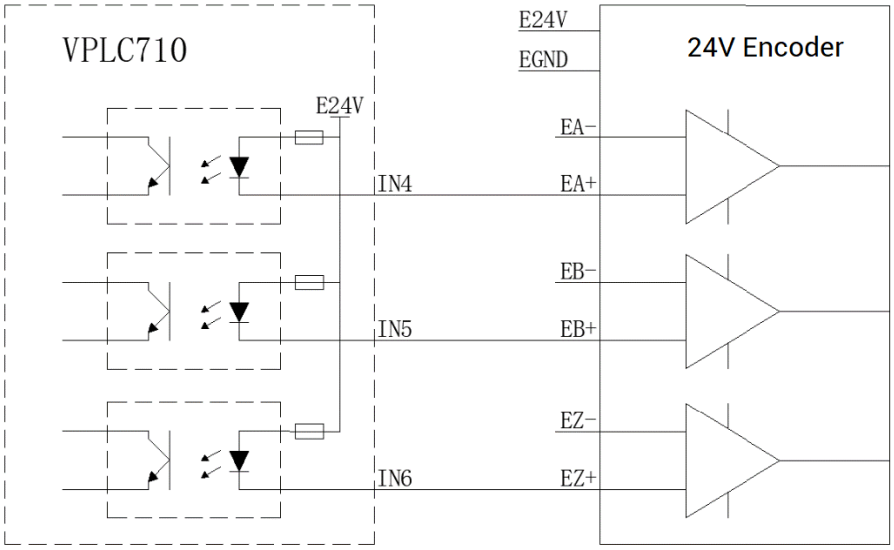
3.2.2. General Output Wiring



3.2.3. Wiring: Input as Encoder

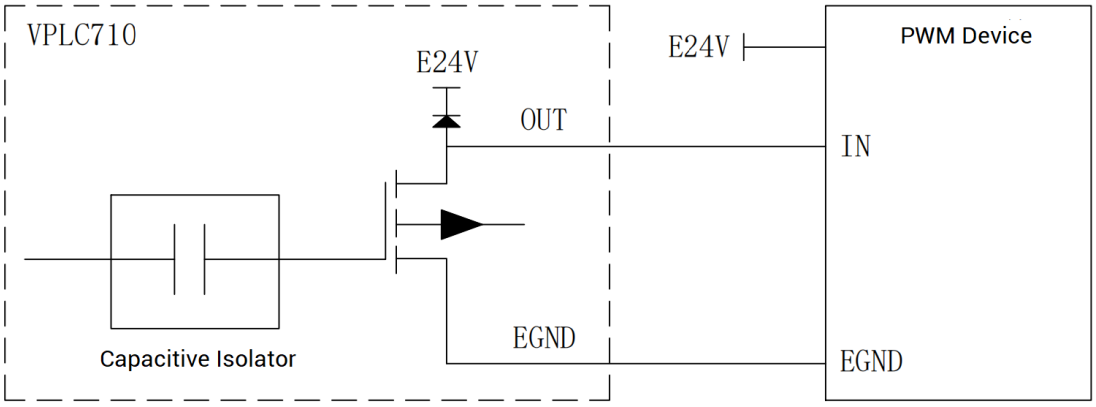
VPLC710 has two 24V single-ended encoder inputs on board.

This example uses IN4-6 to connect the encoder for illustration. After the wiring is completed and configured with ATYPE(1)=3, IN4 is EA1, IN5 is EB1, IN6 is EZ1, and the corresponding encoder axis number is 1.



3.2.4. Wiring: Output ad PWM

Pay attention to select the OUT ports that support PWM function, OUT0~OUT3.

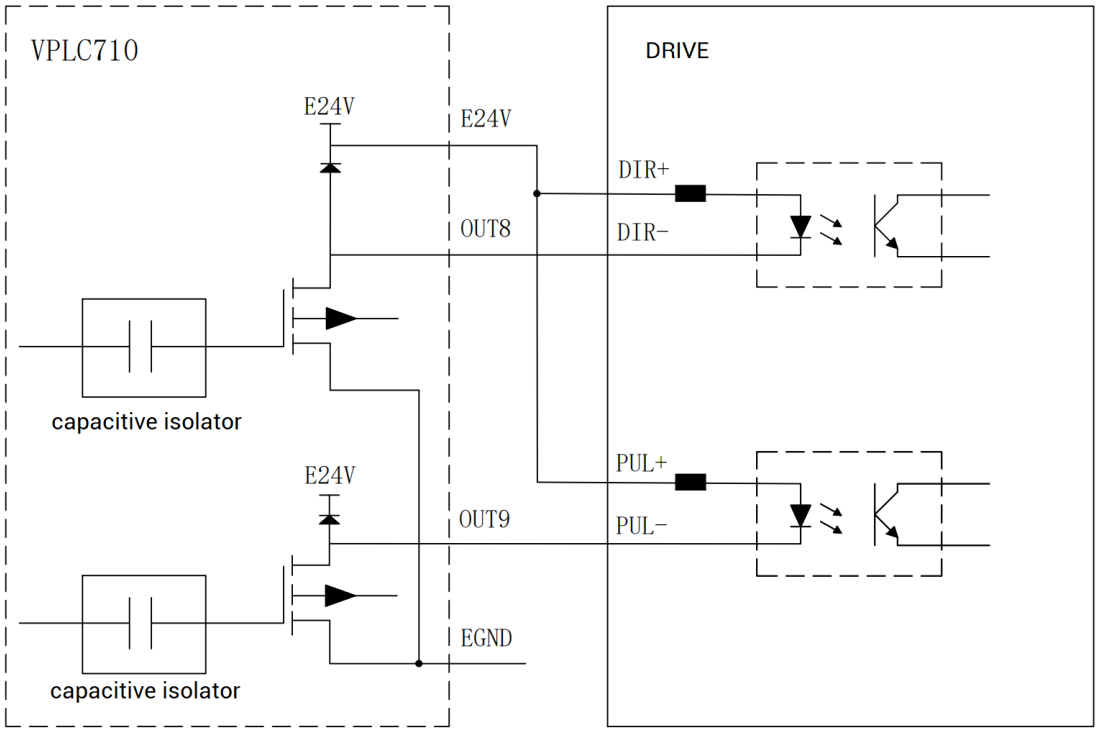


3.2.5. Wiring: Output as Pulse

VPLC710 has 4 single-ended pulse outputs on board.

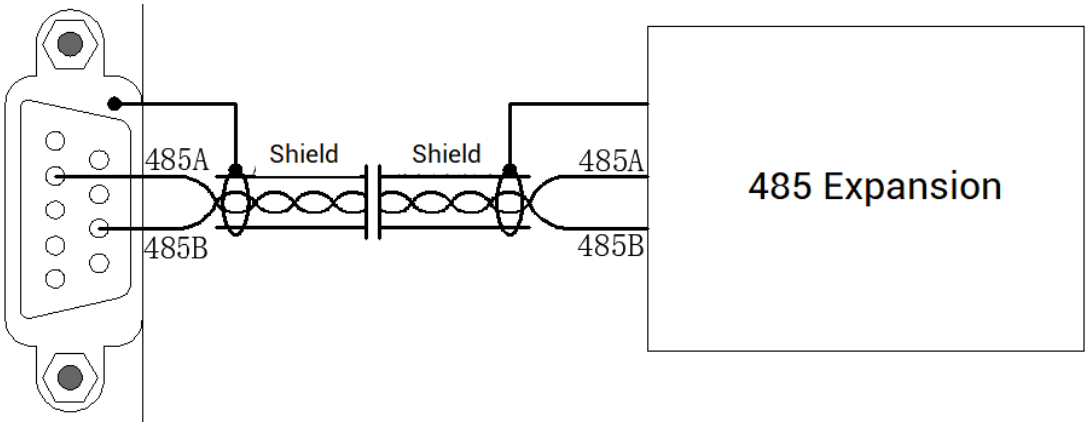
This example uses OUT8 and OUT9 to connect the driver to illustrate. After OUT8 and OUT9 are configured with ATYPE(3)=1, OUT8 is DIR3, OUT9 is PUL3, and the corresponding pulse driver axis number is 3.

For drivers, E24V or E5V can be connected according to specific specification.



3.2.6. Wiring: RS485

485A is connected to 485A, 485B is connected to 485B, shield layer is connected to external shell.



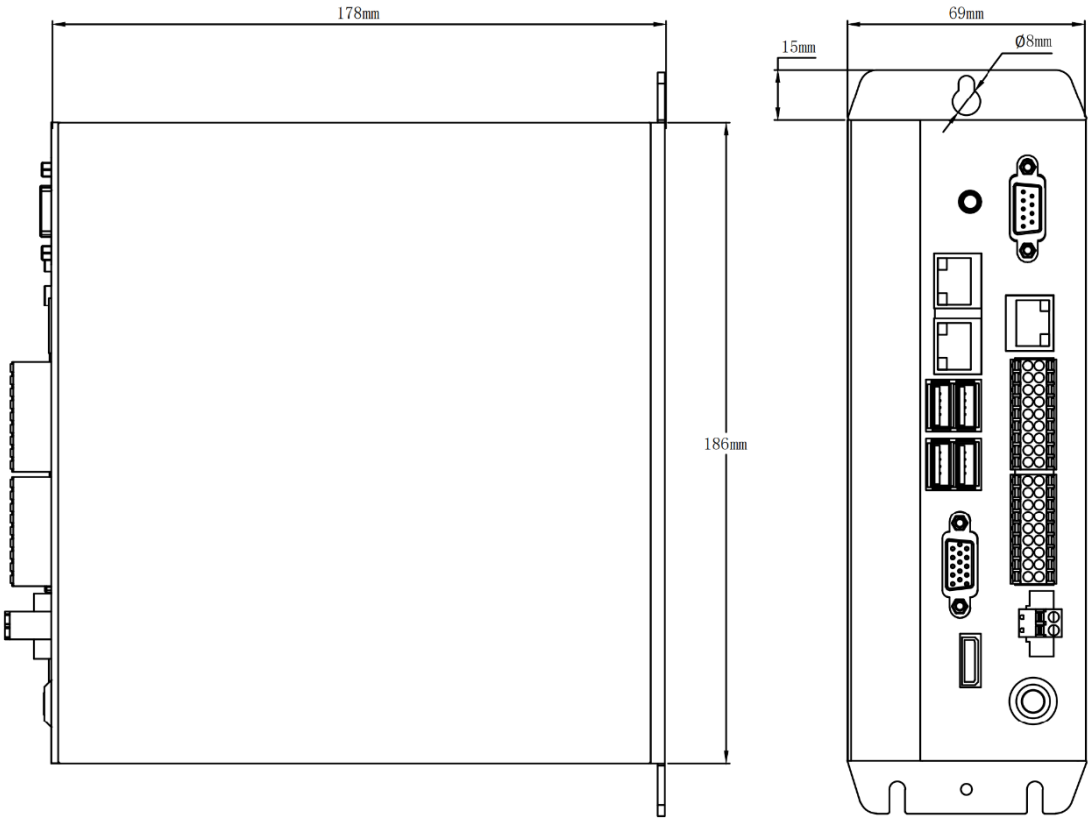
Chapter IV Installment Wiring

4.1. Installment Environment

- Ambient temperature: The ambient temperature has a great influence on the life of the controller, and the operating environment temperature of the controller is not allowed to exceed the allowable temperature range (0°C to 55°C).
- Install the controller vertically on the surface of the flame-retardant object in the installation cabinet, and there must be enough space around it for heat dissipation.
- Please install it in a place that is not easy to vibrate. Vibration should not be greater than 4.9m/s^2. Take special care to stay away from equipment such as punch presses.
- Avoid placing in direct sunlight, humidity, and water droplets.
- Avoid installing in places with corrosive, flammable and explosive gases in the air.
- Avoid installing in places with oil and dust, and the pollution level of the installation place is PD2.
- This product is installed in the cabinet and needs to be installed in the final system. The final system should provide corresponding fireproof enclosures, electrical protection enclosures, and mechanical protection enclosures, etc., in compliance with relevant IEC standards.

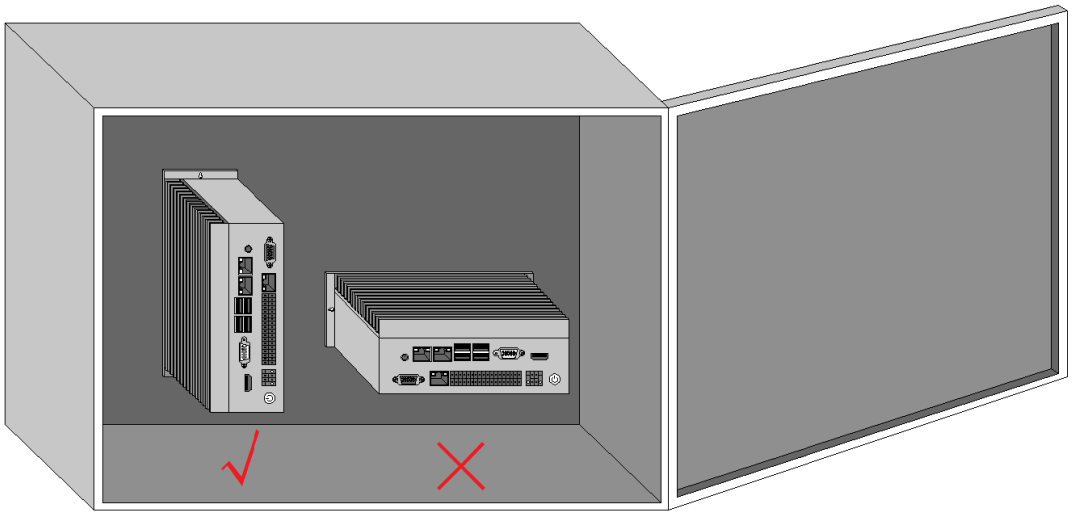
Item	Parameters
Work Temperature	-20℃-60℃
Work relative Humidity	10%-95%RH non-condensing
Storage Temperature	-40℃ ~ 70℃ (not frozen)
Storage Humidity	Below 90%RH (no frost)
Vibration	Below 4.9m/s^2
Shock	Below 19.6m/s^2
Degree of Protection	IP20

4.2. Installment Size

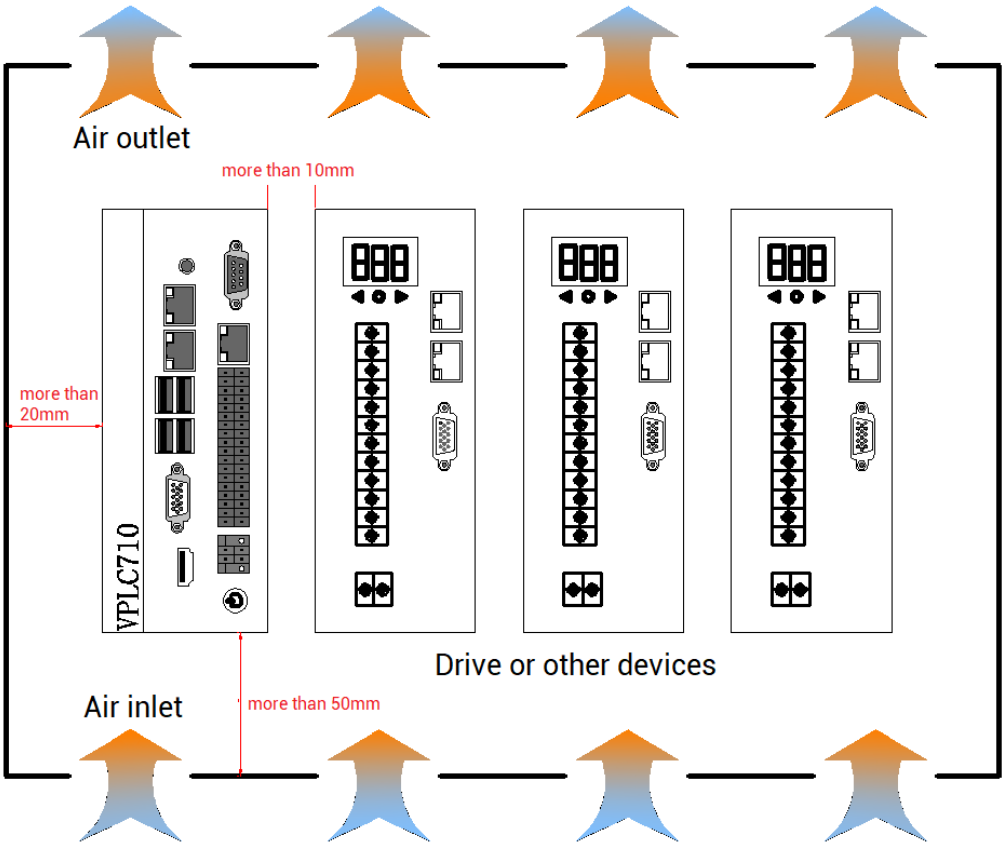


4.3. Installment Method

Secure the controller to the mounting surface with two M5 screws. When installing, please pay attention to the installation position. Please face the front of the controller (the actual installation surface of the operator) to the operator and make it perpendicular to the wall.



Due to the large power consumption and volume of this product, in order to facilitate ventilation and heat dissipation and easy module replacement, a corresponding distance should be reserved between the upper and lower parts of the module and the building and surrounding components, as shown in the figure:



Chapter V Maintain & Problem Processing

5.1. Maintain Regularly

Please regularly check the places that are difficult to check during operation. Always keep the controller in a clean state, effectively remove the dust on the surface of the product, and prevent the dust from entering the product, especially metal dust.

Check item	Check content	Inspection standards
Whole machine	Whether there is accumulation of garbage, dirt and dust on the surface.	1. Check whether the power distribution cabinet is powered off. 2. Vacuum away trash or dust from touching parts. 3. When the surface dirt cannot be removed, wipe it with alcohol and let it dry and evaporate completely.
Cable	Check whether the power line and connection are discolored. Whether the insulation layer is aged or cracked.	1. Replace cracked cables. 2. Replace damaged connection terminals.
Outside of solenoid connector	Whether the suction is not firm or makes abnormal noise during the action. Whether there is a short circuit, water pollution, expansion, rupture of peripheral devices	1. Replace abnormal components.
Fan channel port	Whether the air duct and heat sink are blocked. Whether the fan is damaged.	1. Clean the air duct. 2. Change the fan.
Control circuit	Whether the control components have poor contact.	1. Clean the foreign objects on the surface of control lines and connection terminals.

	whether the terminal screws are loose. Check whether the insulation of the control cable is cracked.	2. Replace damaged and corroded control cables.

5.2. Common Problems

Problems	Suggestions
Motor does not rotate.	➢ Check whether the ATYPE of the controller is correct. ➢ Check whether hardware position limit, software position limit, alarm signal work, and whether axis states are normal. ➢ Check whether pulse mode and pulse mode of drive are matched. ➢ Confirm whether controller sends pulses normally through software test.
The controller works normally, the pulse is sent out normally, but the motor does not rotate.	➢ Check the connection between the drive and the motor are correct, or their communication signal is good ➢ Ensure drive works normally, no alarm.
The motor can be rotated, but in malfunction	➢ Check deceleration and speed exceeds the equipment limit ➢ Check the output pulse frequency exceeds the limitation of drive receive. ➢ Check the controller and the drive is properly grounded, anti-jamming measures are good. ➢ On the pulse and direction signal output port, current-limit resistance used in photoelectrical isolation circuit is too large, operating current is small
Motor can be controlled, but appears oscillation or exceed limit.	➢ Check drive parameter setting. ➢ In the application software, acceleration and deceleration time and motion speed are set improperly.

The output does not work.	1. Check whether IO power is needed. 2. Check whether the output number matches the ID of the IO board.
No signals detected for input.	➢ Check whether IO power supply is normal. ➢ Check whether signal electricity level is matched with input or not. ➢ Check whether input number is matched with IO board ID or not.
No reactions when operating outputs	➢ Check whether IO power supply is normal, IO power also is needed for IO board. ➢ Check whether output number is matched with IO board ID or not
Fail to connect through Ethernet.	➢ Check whether the light of Ethernet is ON? ➢ Check whether direct connection of cable is used and computer doesn't support auto-cross. ➢ Check whether controller IP address is modified. ➢ Check whether PC net card IP address and controller IP are in the same net segment.
Fail to connect through serial port.	➢ Check whether serial port parameters are modified by running program. It can check all current serial port configuration through "?*SETCOM".