装机手册

FSCUT2000E User Manual

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Chapter 1 Overview

1.1   Introduction

FSCUT2000E is a cost-effective CNC system for laser cutting. It is based on EtherCAT bus technology and capable of motion control, laser control, and cutting gas control. It is common used in sheet metal, kitchen ware, lamps and such industries. This user manual is only for installation guidance.

1.2   System Diagram

FSCUT2000E includes the bus BMC228A Control Card, the bus IO board, and the bus height controller, among which the BMC228A control card integrates the EtherCAT master protocol stack.

The wiring diagram of non-BLT cutting head is shown in Figure 2.
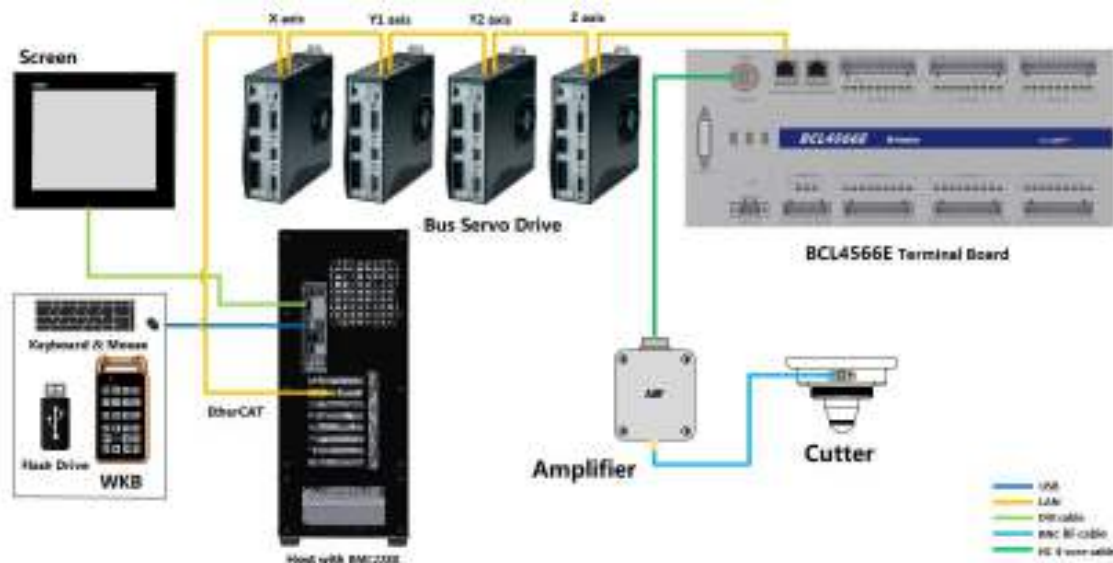
Figure   2 Wiring diagram of FSCUT4000E - non-BLT cutter

1.3   Product Details

FSCUT2000E bus CNC system includes BMC228A Control Card, BCL4566E terminal board, WKB V6, amplifier and related cables.

FSCUT2000E packages contain hardwares and quantity that might be slightly different. Please consult Friendess customer support if any questions.

BMC228A Control Card (1)	WKB V6 (1)	BCL4566E Terminal Board (1)
SPC RF cable (2)	**Amplifier (1)**	**HC four-core cable (1)**
LAN Cables **LAN-0 3X(3)** **LAN-1X (1)** **LAN-3X (1)**		

Table 1-2 FSCUT4000E - non-BLT cutter details

Chapter 2 Wiring Instruction

2.1   BMC228A Installation

BMC228A Control Card is a motion control card based on the EtherCAT Its 1.0Ghz main chip provides excellent overall performance and has passed Friendess stringent testing standards.
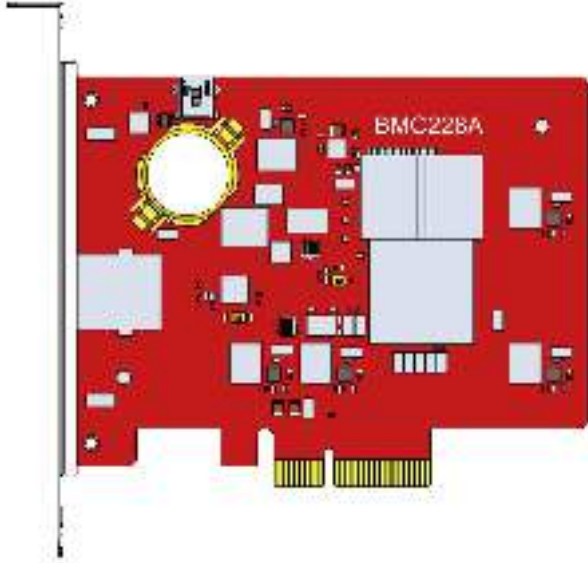
BMC228A EtherCAT Control Card	
Bus Protocol	EtherCAT Master Protocol
PCI Express	PCI Express2.0 (Gen2)
Power Supply	Powered by PCIe motherboard, max 12V/1A, no hot plug
Anti-interference Level	ESD 3 (6kV contact, 8kV air), EFT 4 (4kV power supply, 2kV signal), Surge international 2 (2kV AC line, 1kV DC line)
Dimension and Weight	
Dimension	(L x W x H) 127.6mm x121.0mm x21.45mm
Weight	80g
Feature	
Cooling	Nature Cooling
Operating Environment	0~+60°C
Storage temperature	-20~+70°C
Humidity	0% to 90% (non-condensation
Certification	CE
Environment Requirement	
The waterproof and dustproof grade of the Control Card is IP00, unprotected. Please place the computer in a clean, dust-free environment.	

Table 2-1 BMC228A Technical Data

2.1.1 Dimension Diagram

BMC228A Control Card dimension (mm) is shown in Figure 3.
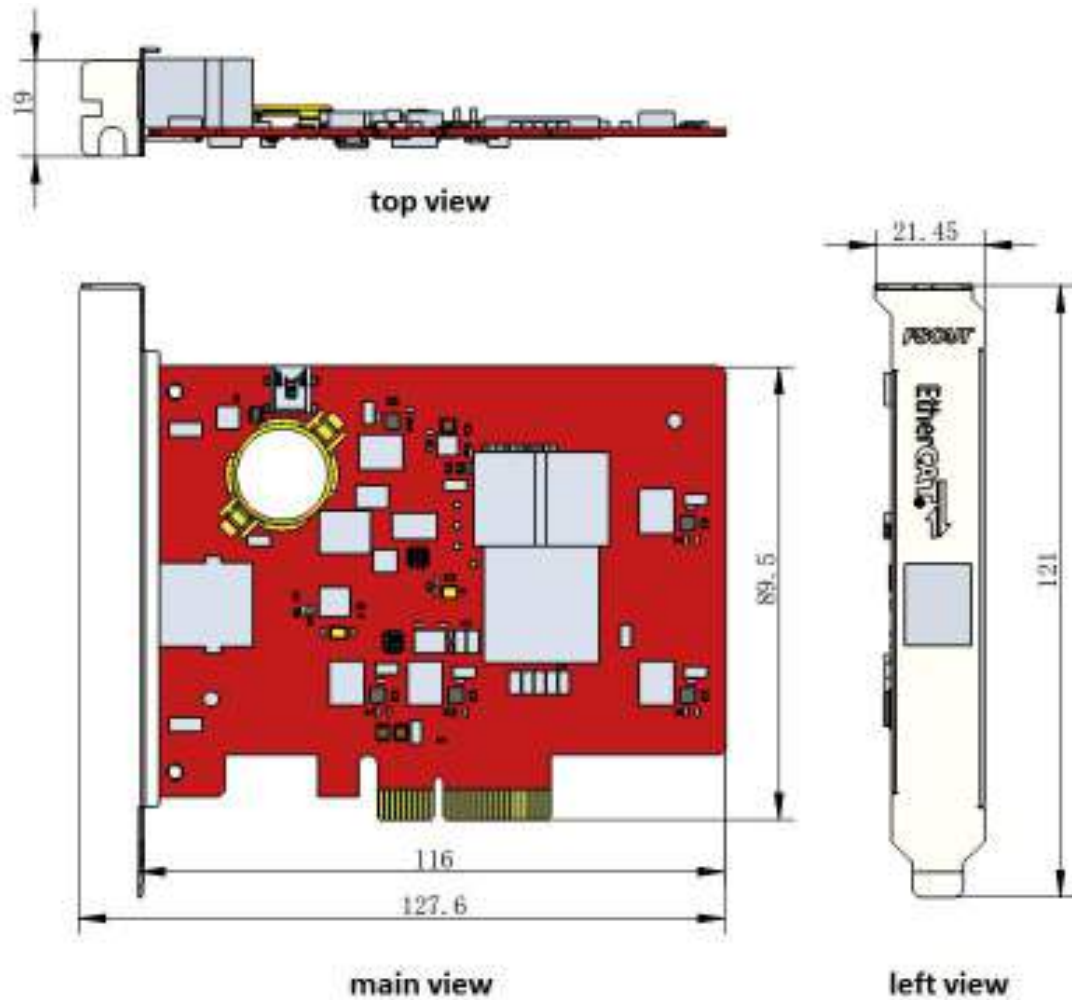
Figure 3 BMC228A Dimension

2.1.2   Installation Diagram

Install BMC228A in the socket of PCIE X4 and up with even force (refer to ②),   and secure its blank screw (refer to ①). Be aware of the heat dissipation for BMC228X and keep it away from other cards as far away as possible. Refer to the diagram below.
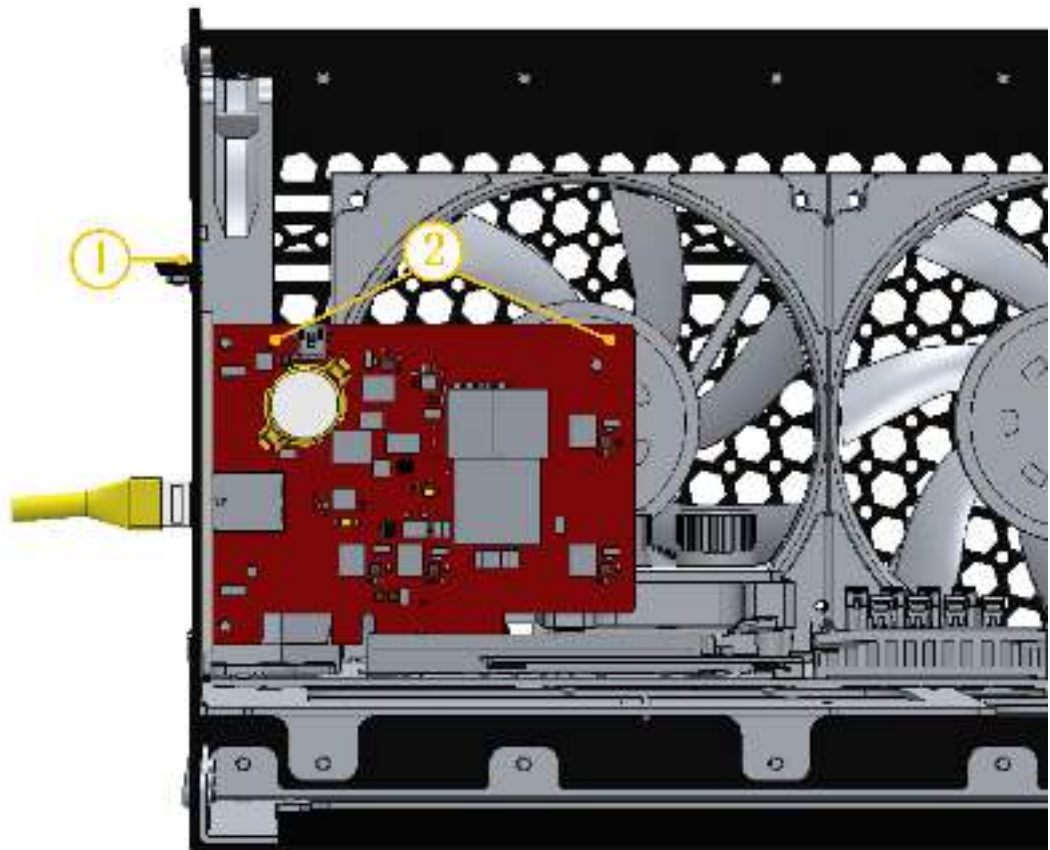
Figure 4 BMC228A Control Card Installation

BMC228X installed is shown below.

Figure 5 BMC228A Control Card After Installation

2.1.3   Ethernet Terminal

The standard socket of BMC228A is RJ45 that can be used to connect EtherCAT slave devices(servo drives, BCS100E, BCL2720E, etc.)
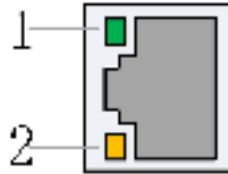
Label	Description	LED Color	Status	Description
1: Speed	Ethernet communication connection speed	Green	Off	10 Mbps connection
			Solid	100 Mbps conection
2: Link	Ethernet communication link status	Yellow	Off	No connection
			Flashes	Communicating
			Solid	Connected

Table 2-2 Description of   RJ45 connection status

2.1.4 PCIE Socket

BMC228A PCIE socket is X4 (Figure 6①)and can be used for X4, X8, X16. Its PCI Express Protocol standard is V2.0 (Gen2) and the BMC228A motherboard requirements are as shown in Table 2-3.

Figure 6 Gold Fingers

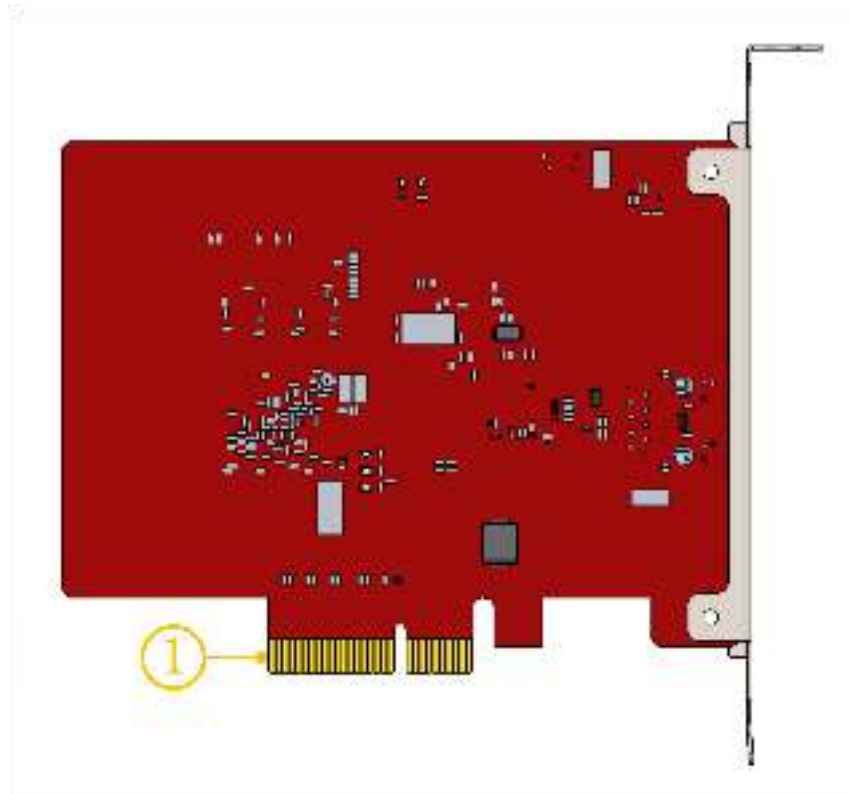| System	64-Bit Win7/10
CPU	Intel i3 8100 and up
Memory	4GB and up
PCIE Socket	X4 and up
PCI Express	PCI Express2.0 (Gen2) and up
Motherboard PCIE power supply	12V/1A and up

Table 2-3 Motherboard Requirements

2.2 BCL4566E Wiring

The BCL4566E bus height controller uses the EtherCAT bus to control the laser cutting capacitive follower. It is a high-performance capacitive height controller.

BCL4566E Terminal Board	

Module	Qty	Description
Power Supply	/	24V DC /3.5A
DA	2	0-10V, 12bit, ±50mV
PWM	2	5V and24V, ±50KHz 0.3%
Common Output	24	24V active high 1) The current of single output ≤ 0.7A 2) The current of all outputs ≤ 2.5A
Axis	1	Pulse digital quantity, PUL±/DIR± output, up to 600KHz
Dedicated Input	27	IN1-IN24, active low, 0~ 15V IN25-IN27, active high, 24~ 8V
Capacitance Sensor	1	Capacitance frequency 2Mhz~4Mhz
Working Environment	/	Temperature: 0℃~60℃
		Humidity: 10%~90%Rh(no(no condensation)
Dimension	/	300mm×123×34mm
Weight	/	640g

Table 2-6 BCL4566E Technical Data

2.2.1　Interface Layout

BCL4566E interface layout of terminals
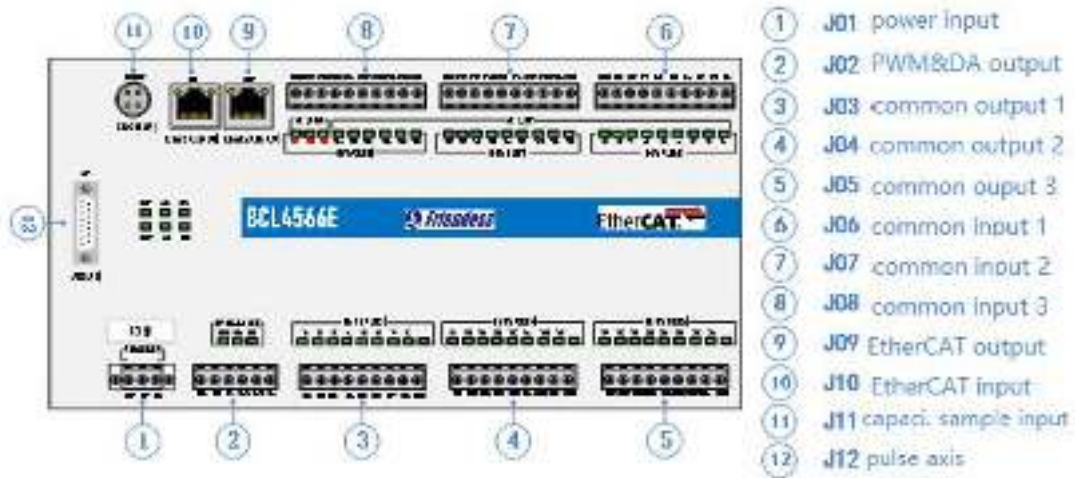
Figure 2 BCL4566E interface terminals

2.2.2　J01 Power Supply
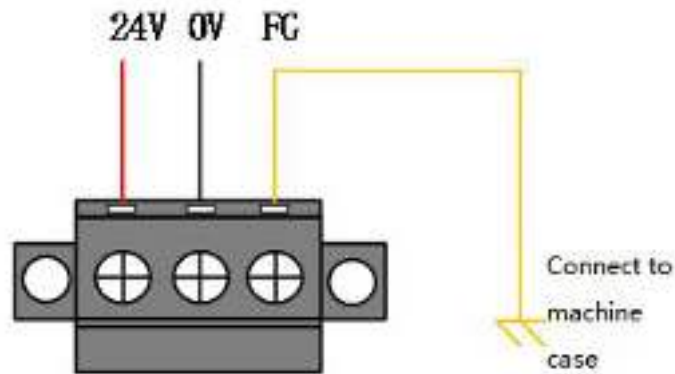
Figure 3 Power Supply Terminal

　　The machine case is the negative pole of the measured capacitance. In order to ensure the stable operation of the measurement circuit, the "FG pin" of the power interface must be reliably connected to the machine case (that is, it is in good conduction with the machine case). The case of the preamplifier of BCL4566E must also be connected with the machine case well. The specific index is that the DC impedance is always less than 10 ohms, otherwise the EMC effect may not be good.

2.2.3 J02PWM/DA Terminals
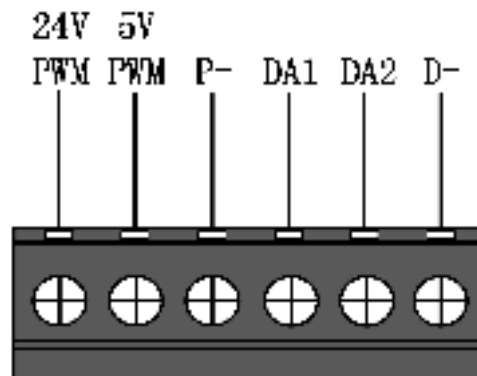
Figutr 4   PWM/DA Terminals

BCL4566E has 2 channels of PWM pulse width modulation signal, the left channel is 24V level PWM. The right channel is 5V level PWM, and P- is the negative terminal of the PWM signal. The duty cycle is adjustable from 0% to 100%, and the highest carrier frequency is 50KHz. The signal output mode is shown in the figure below.
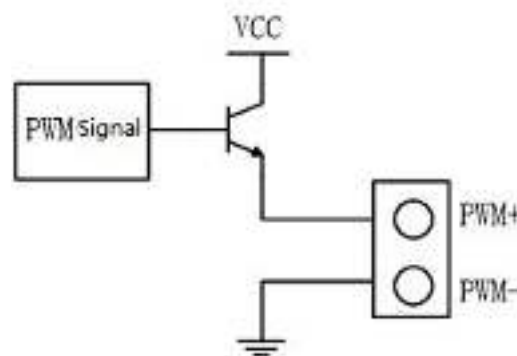
Figure 5 PWM Output Circuit

Note: 1) There are dedicated enabling relays for PWM+ and PWM- signals, and there is no need for external relay isolation.

2) Wrong connection of 5V/24V PWM signal may cause damage to the laser.

BCL4566E has 2 channels of 0~10V analog output. DA1/DA2 is the positive terminal of analog quantity, and D- is the negative terminal of analog quantity. DA1/DA2 can be configured as the control signal of laser peak power and gas proportional valve in the "Cypfig" that comes with CypcutE software.

Output signal	0V~+10V
Max Output	50mA
Max Error	+/-10mV
Resolution	2.7mV
Conversion	400us

2.2.4 J03/J04/J05 Output Terminal

Take J03 as an example, the interface diagram is as follows.

Figure 6 Output Terminal

J03-J05 has a total of 24 high-level (24V level) outputs. The above figure is the wiring diagram of J03. O1-O8 are the positive terminals of the output port, and COM is the negative terminal 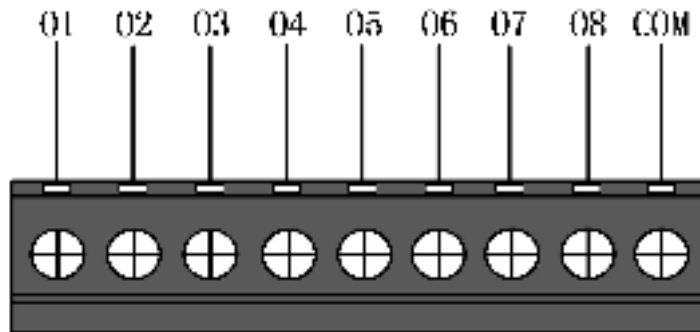of the output port. The 24 output ports can be configured as control interfaces，e.g."laser", "cutting head", "auxiliary gas", "alarm" and "pallet changer" etc. in the "Cypfig" that comes with CypcutE software.

Note: 1) The maximum current of one output port is 0.7A, otherwise the short circuit protection will be triggered.

2) The total current of the output ports cannot exceed 2.5A, otherwise the short circuit protection will be triggered.

2.2.5 J06/J07/J08 Input Terminal

Take J06 as an example, the interface diagram is as follows.
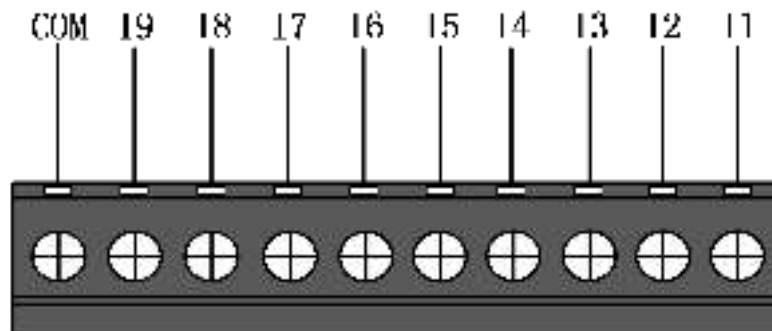
Figure 7 Input Terminal

J06-J08 has a total of 27 input ports. IN1-IN24: active low (0~15V), high level (19-24V) has no conduction; IN25-IN27: active high(24~8V conduction), low level (0~4V) has no conduction. Take J06 as an example, I1-I9 are the positive terminals of the input port signal, and COM is the negative terminal of the input port.

The typical connection of the photoelectric switch is as shown in the figure below. An NPN 24V photoelectric switch should be used.
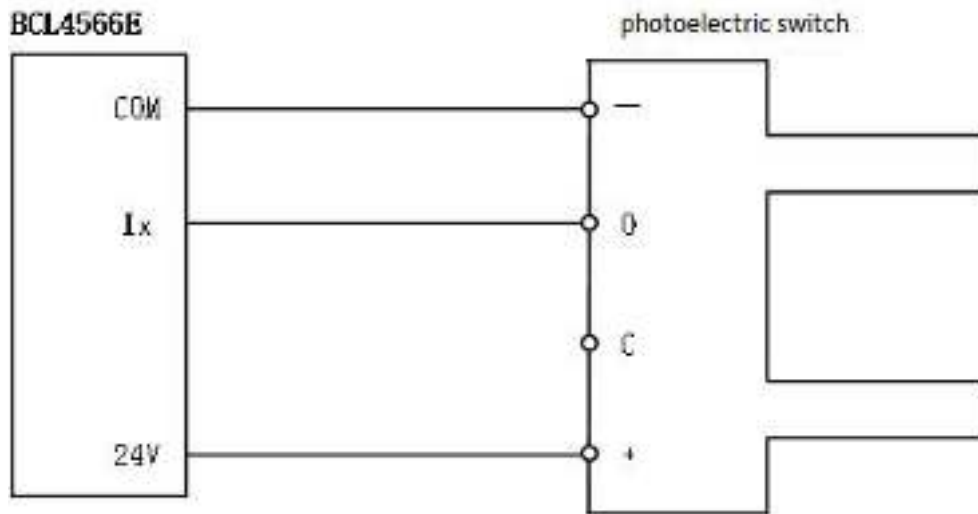
The typical connection of the contact switch is shown in the figure below.
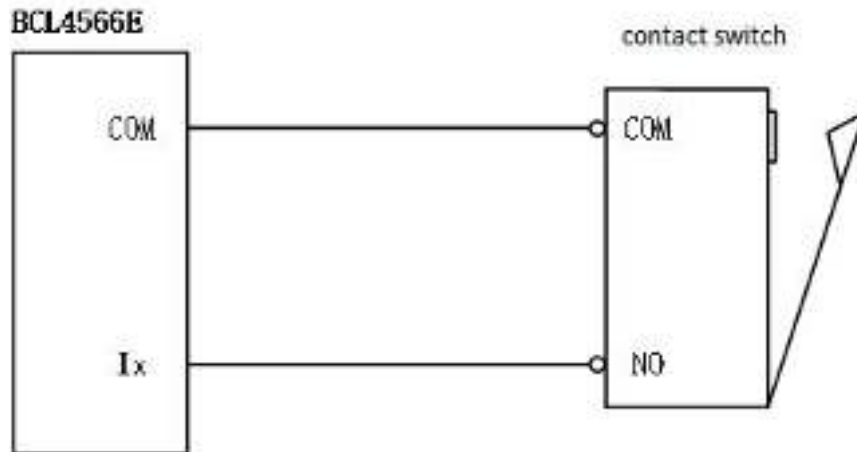
The typical connection of the magnetic induction input switch is shown in the figure below. An NPN 24V magnetic induction switch should be used.

2.2.6　J09/J10 Network Interface

J09 is the EtherCAT network output interface, and J10 is the EtherCAT network input interface, supporting 100Mbps network communication. It is recommended to use standard RJ45 network cables in CAT5E or up　for bus communication

Description of RJ45 connection status of network terminal

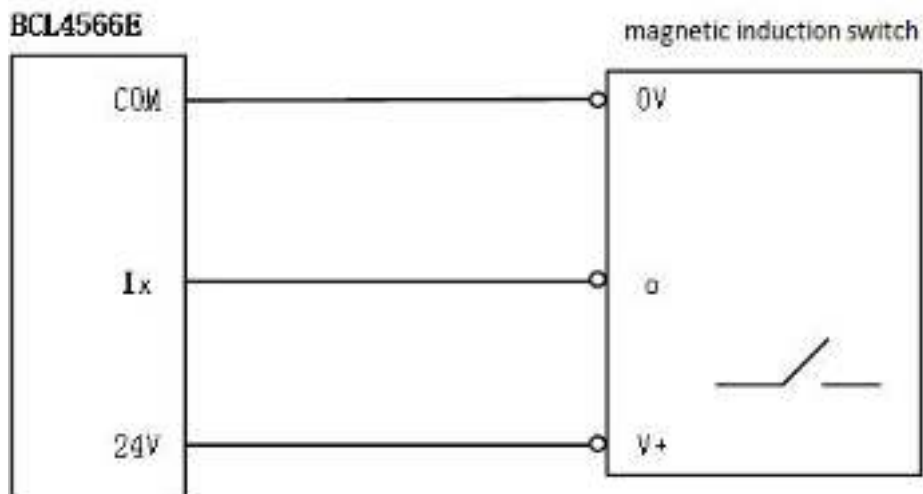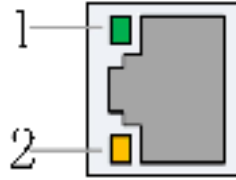| Label	Description	LED Color	Status	Description
1: Link	EtherCAT Bus Connection and Communication Status	Green	Off	No connection
			Solid	Connected, without communication
			Flashes	Connected, with communication
2: Status	EtherCAT Bus Link Status	Yellow	Off/Flashes	Not in the OP state
			Solid	in the OP state

2.2.7　J11 Sensor Interface

1. Connect to the other terminal 1
2. Connect to the other terminal 2
3. Connect to the other terminal 3
4. Connect to shielding layer

Figure 8 Sensor interface

The 4-core signal transmission cable of the sensor can be made by yourself with a 3-core shielded cable and two 4-pin plugs. 1, 2, and 3 cores are connected in pairs, and the 4th core must be connected with a shielding layer. It is recommended to use the original cable to ensure stability.

2.2.8　J12DB15 Servo Axis Interface

The control interface of BCL4566E focusing servo driver is double-row female DB15F, and the pin definition of the corresponding wire is shown in the figure below:
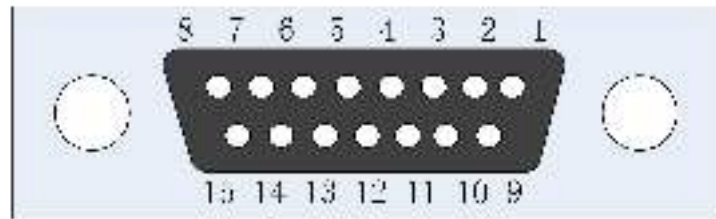
Figure 9 Servo drive interface

Axes are defined in the table below.

Servo Axis Interface Definition

15-pin Female Servo Control Interface			
Pin	**Signal name**	**Pin**	**Signal name**
1 yellow	PUL+	9 yellow black	PUL-
2 blue	DIR+	10 blue black	DIR-
3 black	A+(encoder)	11 black white	A-(encoder)
4 orange	B+(Encoder)	12 orange black	B-(encoder)
5 red	Z+(encoder)	13 red black	Z-(encoder)
6 green	SON(servo enable)	14 purple	ALM(alarm)
7 green black	-	15 brown black	0V(power ground)
8 brown	24V(power output)		

+24V, 0V: 24VDC power for the servo driver.

PUL: digital signal, pulse signal for the driver.

DIR: digital signal, direction signal for the driver.

SON: output servo drive enable signal.

ALM: Receive the alarm signal of the servo drive.

A+, A-, B+, B-, Z+, Z-: three phases of the encoder, input signal.

Please refer to the figure below for the wiring with the Yaskawa servo drive.

Yaskawa Servo Wiring
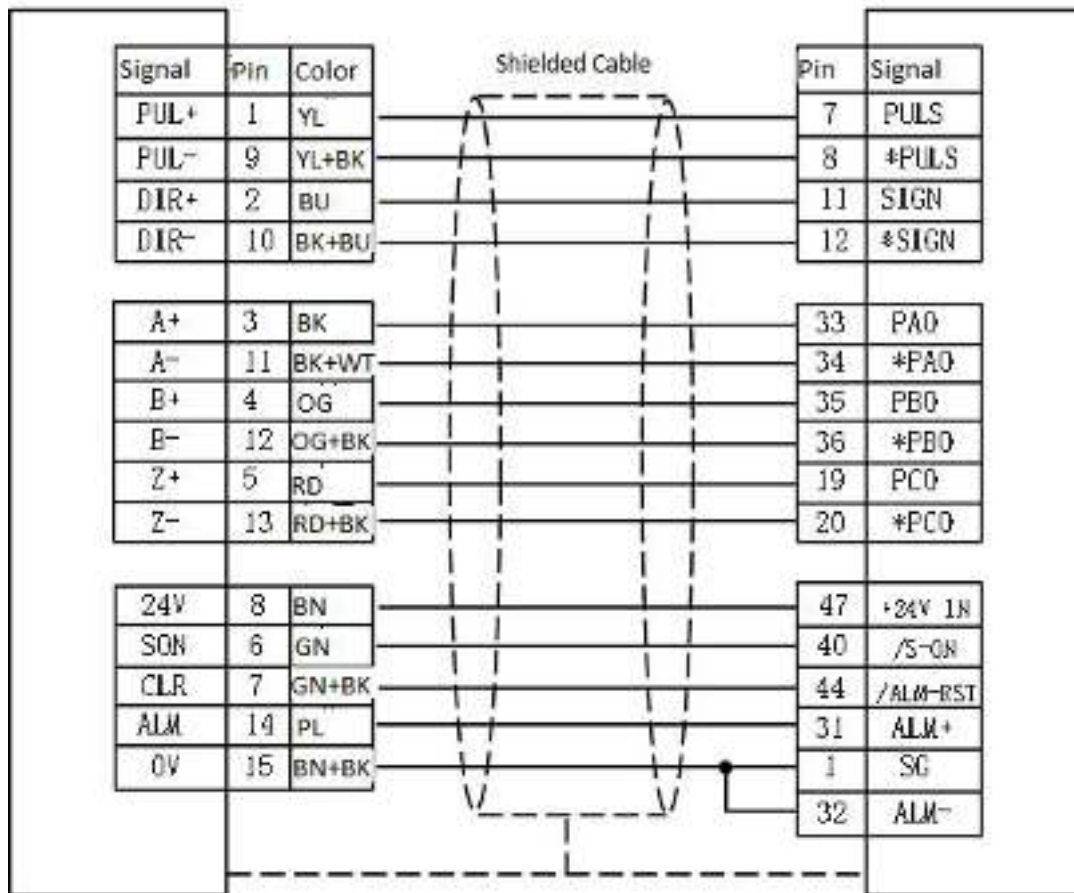
Figure 10 Yaskawa Servo Wiring Diagram

Pay attention to the following when connecting drives in other brands:

1. Please first confirm the type of SON signal of the servo drive you choose and whether it is active low (that is, it is ON when it is connected to the GND of the 24V power supply).

2. Make sure the parameter of the servo drive: the pulse signal received is "pulse + direction".

3. Confirm whether there is an external emergency stop signal input in the input terminal of the servo drive, and its logic.

4. Before the test run of the driver, 24V power must be supplied to the terminal board first, because the 24V power required by the servo is transferred through the terminal board.

5. If the drive still cannot run, make sure that the parameter is set to not use "POT/NOT".
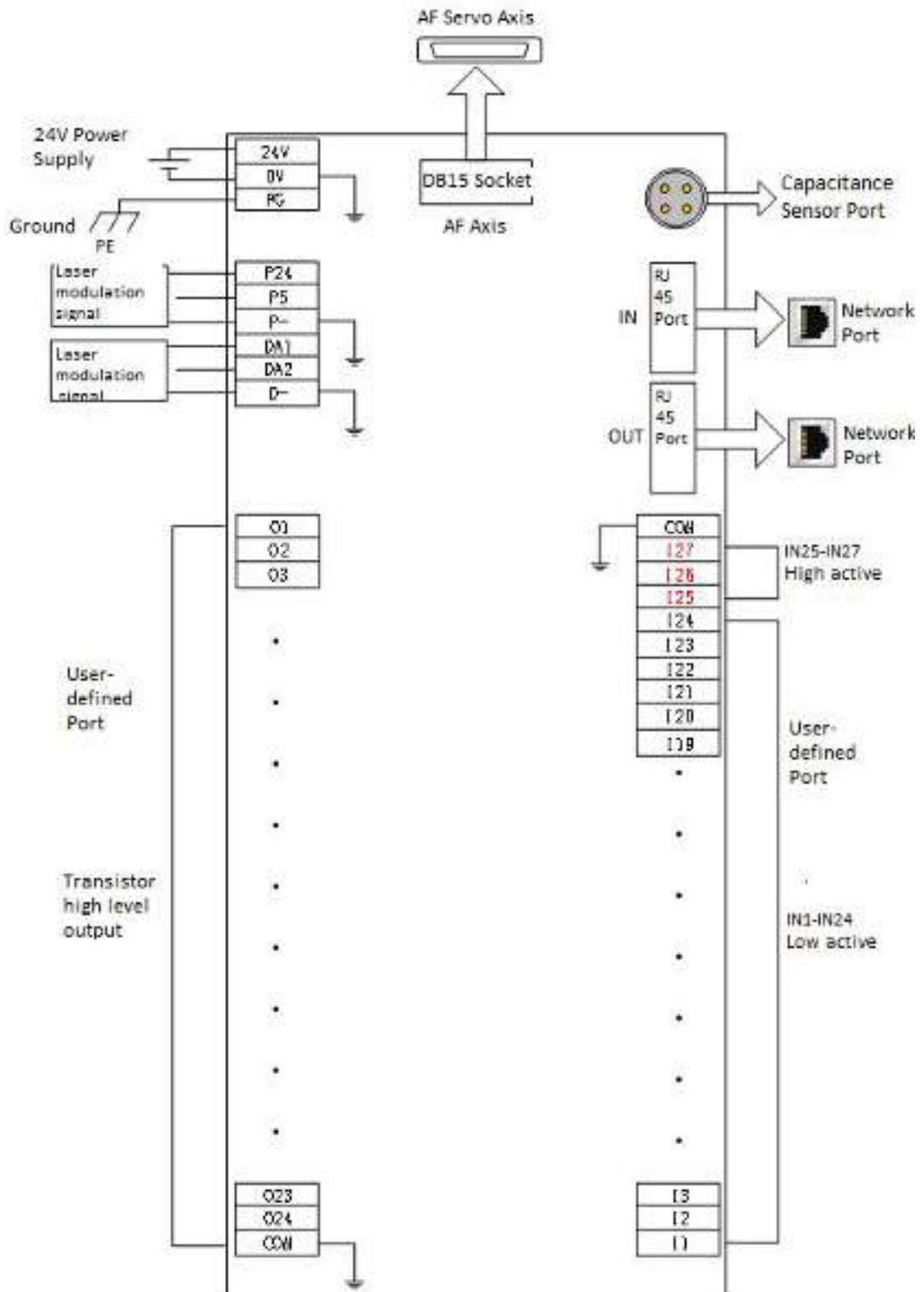
Figure 11 BCL4566E Wiring Diagram

2.3 Cutter Wiring

2.3.1 ProCutter Wiring

The connection of ProCutter cutting head is shown in the figure below.
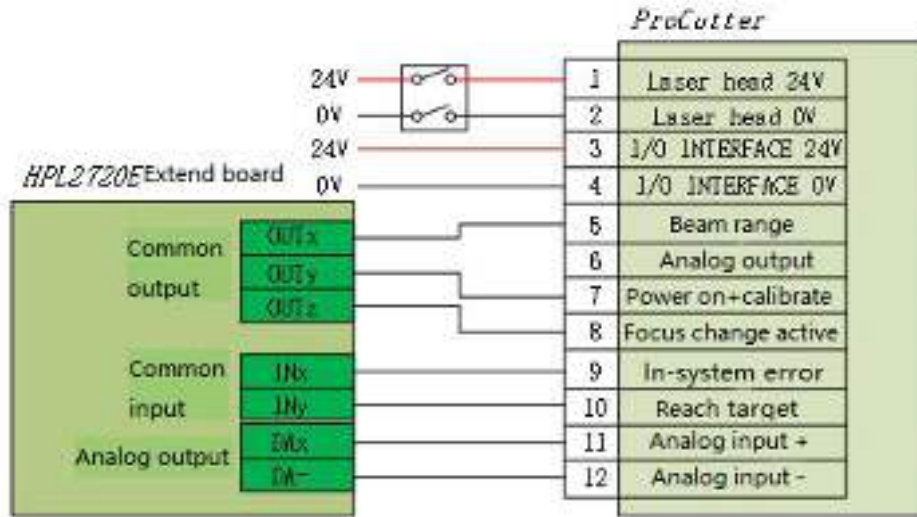
2.4　Laser Wiring

2.4.1　IPG_ YLS Germany

HPL2720EExtend board

IPG German YLS Laser
64Pinport XP1

C1	Laser ON
A1	Laser Request
A2	Program Start
A5	Guide Laser On
A16	Common

Aiming Control — OUT 1, OUT 2, OUT 3, OUT 4, COM

24V power — +24V, +24V, COM

A6	Analog Control ON
B15	24V
B16	0V

Common input (Configured Emission Status) — IN, COM

24V Relay

B2	Emission ON

DIP Switch
ON
1 2

25Pinport XP2

PWM output — PWM+, PWM-

A1	Laser modulate+
A2	Laser modulate-
C1	Safety interlock 1
C2	Safety interlock 2
C3	Safety interlock 2
C4	Safety interlock 1

7Pinport XP4

Analog output (Select DA1 to control laser power) — DA 1+, DA 1-

A1	0~10V
A2	AGND

2.4.2 IPG American

2.4.3 RayCus

Raycus Laser
InterLock

b	Safety interlock1
c	Safety interlock1

Computer RS232 DB9

COMMAND RS232

2	RS232 Rx
3	RS232 Tx
5	RS232 COM

HPL2720E Terminal Board

DIP Switch

ON
1 2

PWM output

PWM+
PWM-

INPUT MOD

Laser modulate+
Laser modulate -
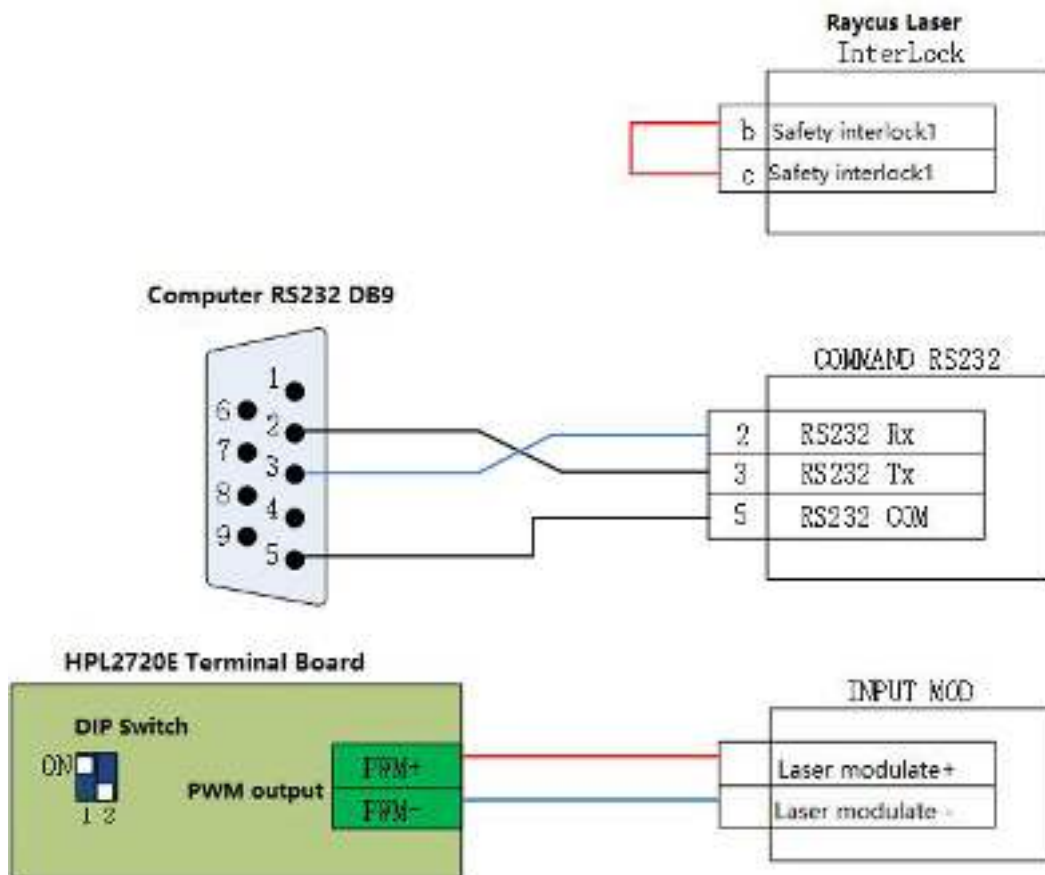
2.4.4   Trumpf

Chapter 3 Installation

3.1   Installation Steps

3.1.1   Step 1. Install BMC228A Control Card

（1）   Power off the host.

（2）   Open the host case, select a free PCIE slot, and use a screwdriver to remove its slat.

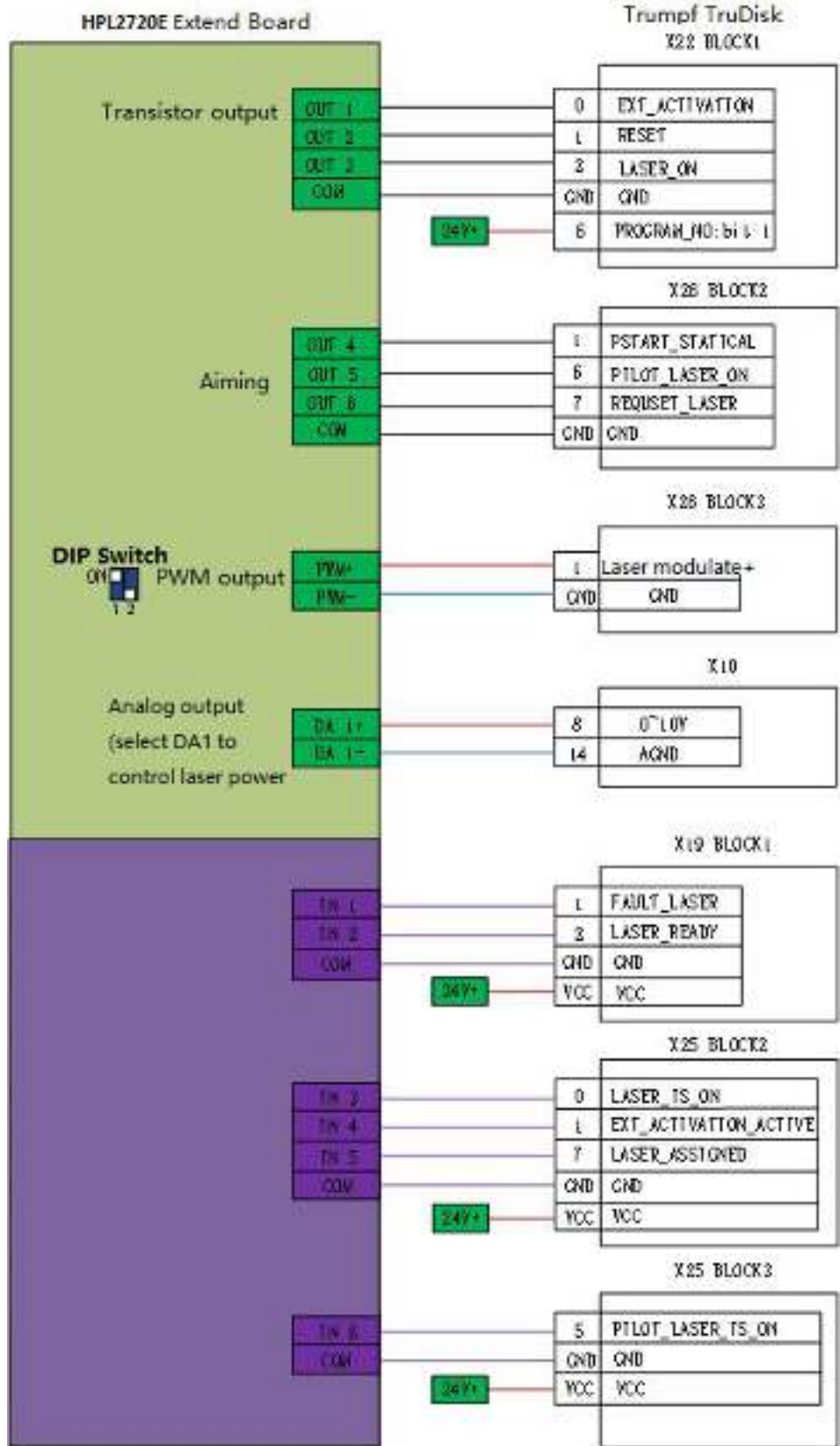（3）   Insert BMC228A into the slot. The installation is shown in 2.1.2.

（4）   Tighten the screws of the BMC228A block with a screwdriver.

（5）   Cover the case, turn on the power of the host PC, and start the host.

3.1.2   Step 2. Install BMC228A Driver

2 ways to install BMC228A driver.

1.   Use CypCutE to install the driver, check the driver when installing CypCutE, as shown in Figure 7.   The BMC228A driver will be automatically installed.
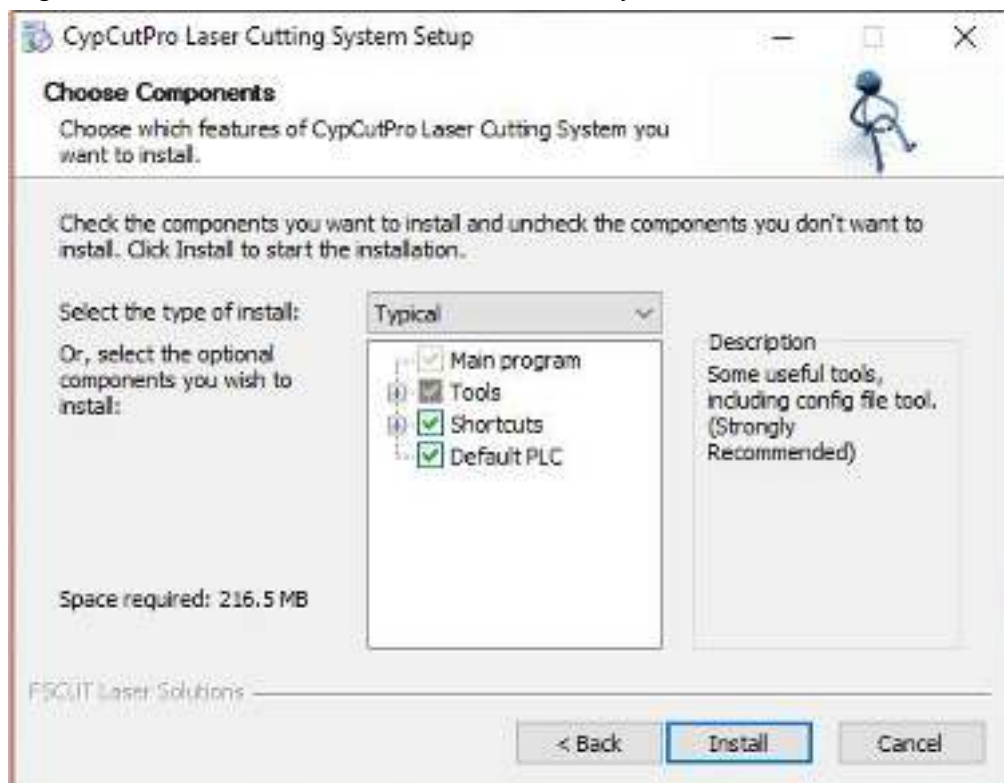

Figure 7 Check Driver Program

2. Open the "Device Manager", it will display "Other Devices" as shown in Figure 8, if its driver is not installed.
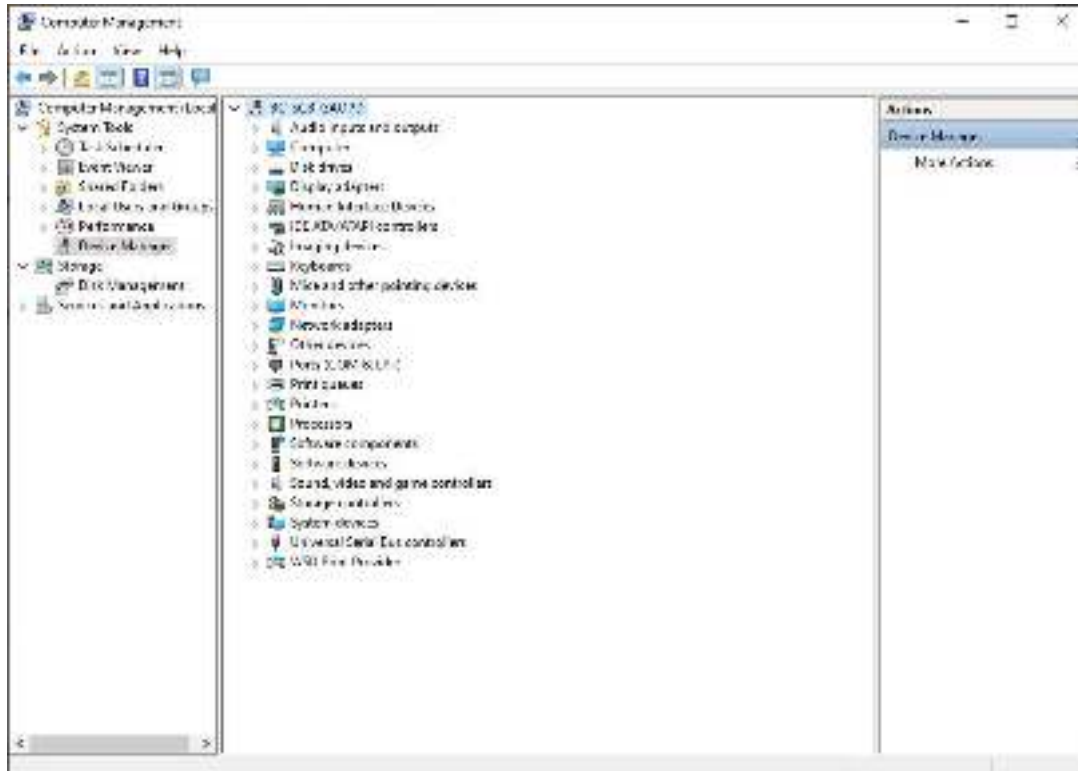
Figure 8 Unknown Device

Right click on "PCI FLASH Memory" and select "Update Driver Software".

Select CypCutE and find the default location of driver files: C:\Program Files (x86)\Friendess\CypCutE\Drivers, then click Next.

The driver installation is complete, if "BMC228A DMA" is displayed.

3.1.3 Step 3. Connect Slave

Use CAT5E or above standard network cable (Friendess network cable recommended) to connect the slave   the wiring diagrams of BLT series cutting head and other cutting heads are shown in section 1.2.

3.1.4 Step 4. Scan in Cypfig

Open "Cypfig" and click "BUS Scan"-"Start". The system will scan the connected slave information.

3.1.5 Step 5. Use CypCutE

After setting the parameters in the "Cypfig", open CypCutE, import the graphics, and set the process parameters, then it can be processed See the software manual for details.

Chapter 4 Precautions

4.1   Wiring Precautions

4.1.1   Drag Chain Wiring

1. When releasing the 4-pin cable from the coil, it is necessary to prevent the cable from twisting (the cable must be released along the tangential direction) and the cable must be laid straight. This work should be done before laying the cables, to give the cables time for stress relief. Because the manufacturing process cannot completely guarantee that the cable is straight and free of distortion, the printed logo on the surface of the cable rotates in a tiny spiral.

Correct	Wrong
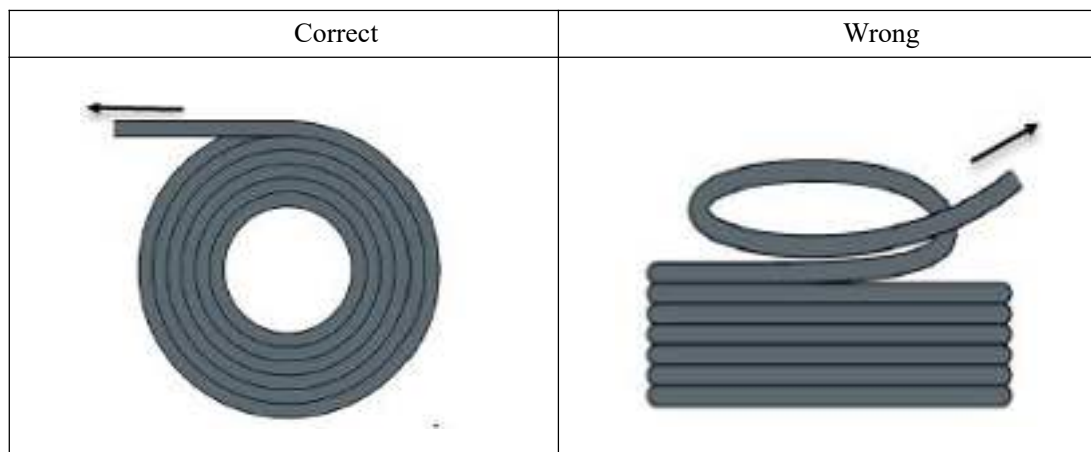
2. Cables are not allowed to be twisted when installed in a closed space, and twisting during installation may cause damage to the core wire stranding. This effect is gradually strengthened during the operation of the cable, resulting in back-twisting, which eventually leads to the breakage of the core wire and failure.

3. The cables must be laid loosely next to each other in the drag chain support. Spacers should be used to separate the cables as much as possible. The space between the cable and the spacer, separator and the cable adjacent to it, shall be at least 10% of the diameter.

Correct	Wrong
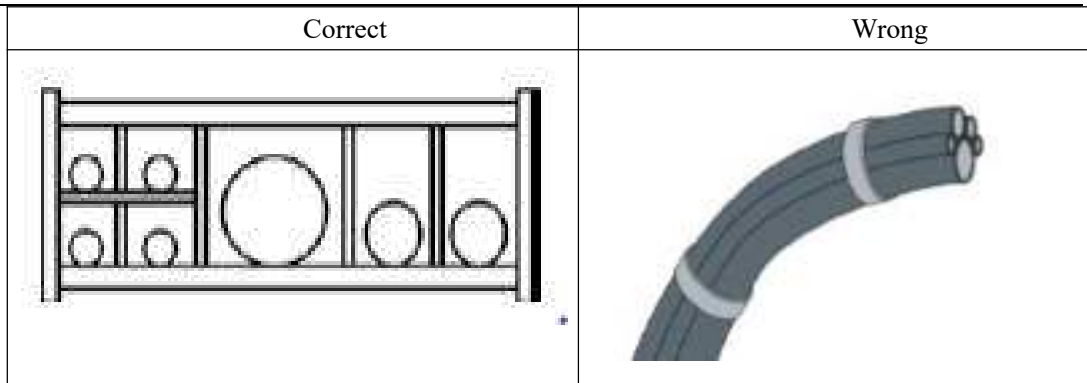
4. The cables should be installed according to the weight and size of the cables. The larger diameter and heavier cables should be placed outside; the smaller diameter and lighter cables should be placed inside. The cables can also be placed from the inside to the outside descendingly by size. Do not place one cable on top of another without using a spacer.

5. For vertically suspended drag chains, keep more free space for the vertical support, because the cables will be stretched during operation. After a short run, it is necessary to check that the cables run along the center area and adjust them if necessary.

6. For self-supporting drag chain, cables are fastened to moving and fixed points. Suitable cable supports from the supplier are required. Cable ties have very limited applicability when operating at high accelerations. So you should not bundle multiple cables together. Cables should not be fixed or tied to any moving parts of the drag chain. The gap between the fixed point and the bending area should be wide enough.

self-supporting

sliding

7. It is recommended to fix the cable on the moving point for sliding drag chains. A small cable protection zone is required at the fixing point. (Refer to the instructions from the drag chain supplier)

8. Please ensure that the cable runs along the center area with the desired bending radius. Do not apply tension to the cable (do not pull it too tightly), otherwise the friction inside the drag chain will cause the cable sheath to wear; do not let the cable be too loose in the drag chain, otherwise it will easily cause abrasion of the cable and the inner wall of the drag chain, or tangled with other cables.

Correct	Wrong
Correct	Wrong
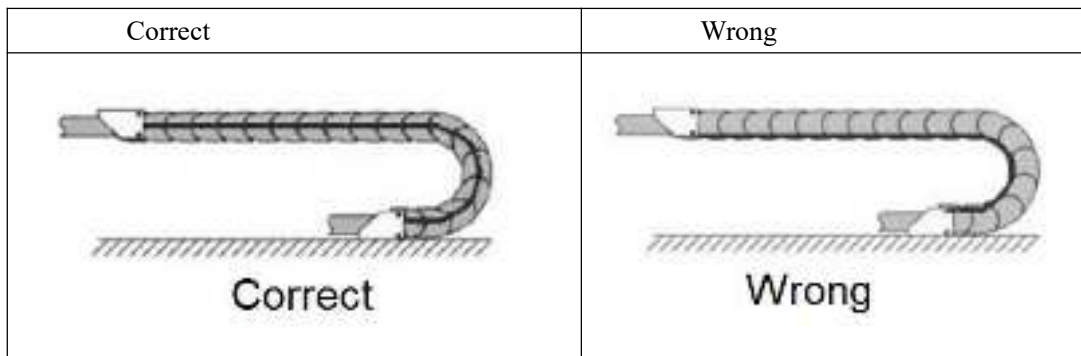
9. If the cable does not run smoothly, check whether it is twisted along the longitudinal axis during operation. The cable should slowly rotate at a certain fixed point until it runs freely.

10. Given the size of cables and drag chains, their length characteristics vary considerably. During the first few hours, the cable naturally elongated. For drag chains, it takes more hours for this to happen. Such a large discrepancy can be remedied by regularly checking the cable installation locations. It is recommended to do regular inspections, every three months for the first year and at every maintenance thereafter. This includes checking that the cables are completely free to move within the intended bending radius and making adjustments if necessary.

4.1.2　Machine Tool Wiring

1. Power Supply（Power) Wiring

（1）　　Strong Electricity

■　Strict separation of strong and weak electricity

Select the appropriate diameter for the power cable according to the power. The table below is the cable diameter and its corressponding power.

Cable Spec(mm^2)	Cross Section(mm2)	25℃ Copper Wire Ampacity (A)	Single-phase 220v load power (W)	Three-phase 380v load power (W)
1.5	1.38	15	3300	9476.8
2.5	1.78	25	5500	13163.2
4	2.25	32	7040	16848.8
6	2.85	45	9900	23693.6
10	7*1.35	60	13200	31591.2
16	7*1.7	80	17600	42121.6
25	7*2.14	110	24200	57917.6

■　Add auxiliary devices such as short-circuit protectors and filters for strong electricity.

（2）　　Weak Electricity (DC24V for example)

■ Distinguish the positive and negative wires of the power supply in color, e.g.,the red wire is connected to the positive pole, and the blue wire is connected to the negative pole

■ Loads with relatively large interference (e.g. servos and solenoid valves) are powered separately from the controller.

2. Grounding

■ **The ground wiring adopts the standard two-color, yellow and green, wires.**

■ It is recommended to use multi-point grounding, for some high-frequency signals (PWM, pulse, encoder, capacitance, etc.) in the laser cutting machines.

■ The machine tool uses galvanized grounding screws and a special grounding wire for grounding. The resistance between the grounded metal body and the main grounding point should be ≤ 0.1Ω.

3. Signal (Control)

■ Signal wire color, e.g. black.

■ Choose the signal wire according to the power.

■ DC 24V solenoid valve is recommended. Add absorption circuits at both ends of the solenoid valve, that is, connect a freewheeling diode in parallel at both ends of the solenoid valve (pay attention to the direction, withstand current, and withstand voltage), as shown in the figure below.
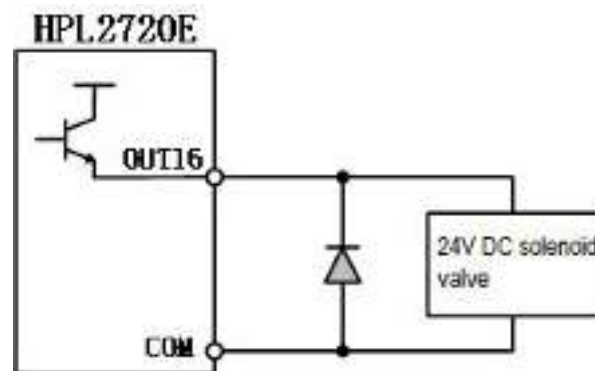

■ It is recommended that the digital signal (PWM) shielding layer be grounded at both ends, and the analog signal (DA) shielding layer be grounded at one end. Single-ended grounding can avoid low-frequency current noise on the shielding layer; double-ended grounding can effectively eliminate high-frequency interference. If the transmission cable is very long, it is recommended to ground at multiple points to ensure that the shielding layer is at the same potential.

■ The resistance from the cutting head connected to the amplifier to the shell of the machine tool is ≤ 1Ω, and the resistance to the grounding point of the electrical cabinet is ≤ 6Ω.

4. Notes

- Each cable is marked clearly and accurately.
- Cables are in parallel and not crossed, and the harnesses should be straight and leveled.
- If using the cables from Friendess, choose the appropriate cable according to the layout space, and do not pile up and circle it.
- All wiring must be firm to prevent sparking.
- Wiring should avoid loops and antenna effects. The current loop composed of signal source---transmission line---load is equivalent to a magnetic field antenna. As shown in the figure below, the wrong connection is on the left, and the correct connection is on the right.
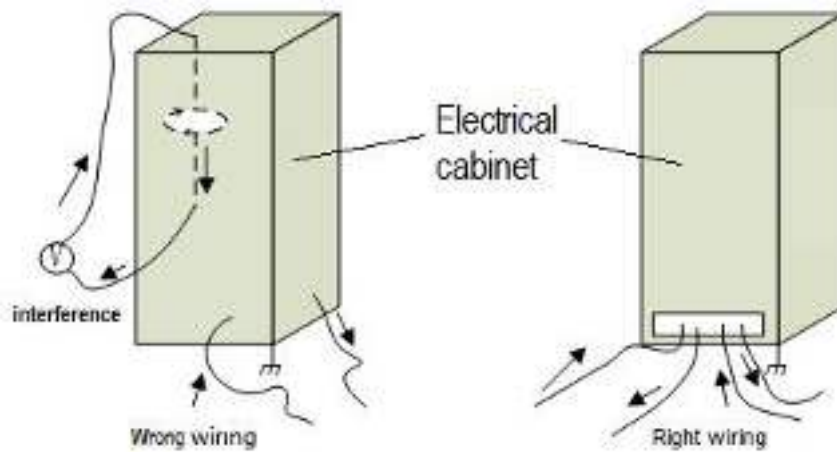
4.1.3 Assembly Requirements

⚠	**Handle with care. Please wear anti-static gloves or touch a grounded metal object to prevent static electricity from damaging the motion control card before touching the control card circuit or inserting/pulling the control card.**
⚠	**Except for the USB interface, plugging and unplugging with power is prohibited for other interfaces, which may cause internal components damaged.**
⚠	**Handle with care. Do not press the card. Pressing might cause the card to bend and its function damaged.**

4.2 Troubleshooting

4.2.1 Device Manager cannot find PCIe devices

If the device manager cannot find any PCIe devices:

1. Check the status of the indicators on BMC228A. The positions of the power indicator and system status indicator are shown in Figure 14
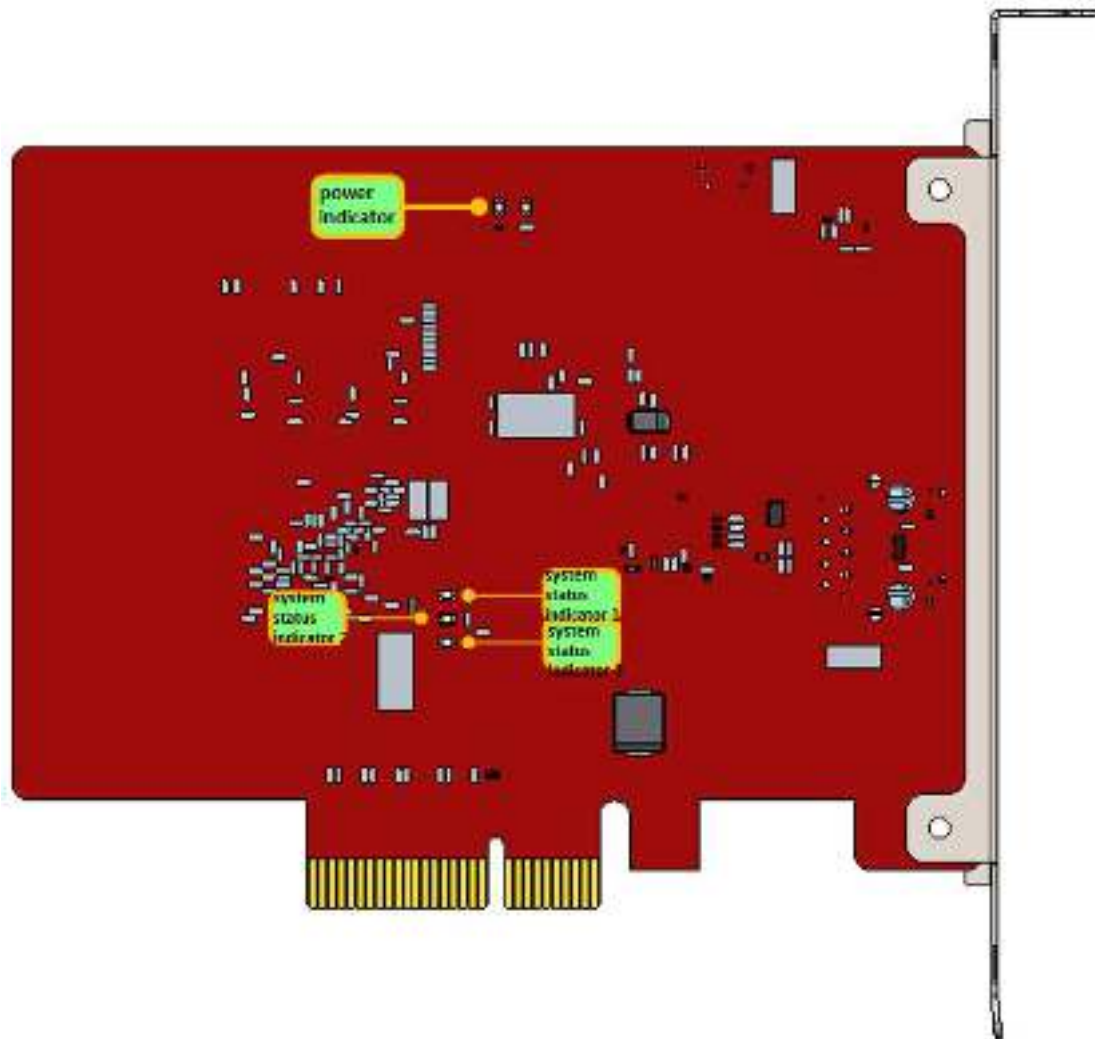
Figure 14 BMC228A Indicators

If it is not in the OP state, the power indicator is always on, both the system status indicator 1 and the system status indicator 2 flash at 1 Hz at the same time, and the system status indicator 3 is always on.

If it is in the OP state, the power indicator is always on, the system status indicator 1 and system status indicator 2 flash alternately at 1 Hz, and the system status indicator 3 is always on.

If the BMC228A status indicator is abnormal, change the card and try again.

2. If the BMC228A status indicator is normal, change a card slot or host computer to scan again

3. If the PCIe device still cannot be found, contact our customer service.

4.2.2　Device Manager cannot install driver

If PCIE devices　are in the device manager, but the BMC228A driver is not recognized:

1. Please manually install the driver again according to section 3.1.2.

2. If the driver is still not installed, change a card slot or install the driver on the host.

3.　If the driver is still not installed, contact our customer service.

4.2.3　Bus Scan failed

If the Cypfig failed to scan the slaves:

1. Check whether the EtherCAT bus servo and slaves are powered on.

2. Check whether the network cable installed securely.

3. Check whether the slave device is supported. If not,   contact customer service If yes, change the slave device and scan again.

4.   If still failed,   contact customer service

4.2.4   Bus network alarm

Common Bus Network Alarms and Solutions

Alarm	Reason	Solution
Bus network alarm, the network cable is not connected 0x9811002D	The slave device is not powered on or the network port is connected incorrectly	Check the power supply of the slave device and the wiring of the network port
Watchdog timeout alarm	Communication between CypCutPro and BMC228A timed out	If it is automatically released, it can be ignored; if it occurs during processing, record the operation steps and give feedback to our customer service.
Bus network alarm, network mismatch 0x9811001E	The network cable between the EtherCAT network port of the computer and the slave is loose or the power supply of the slave is disconnected	1. Check the wiring of the EtherCAT network port 2. Sort out the wiring and check for interference 3. Check the power supply of the slave
Bus network alarm frame lost 0x98110025	EtherCAT network communication data frame loss	1. Check the wiring of the EtherCAT network port 2. Sort out the wiring and check for interference 3. Check the power supply of the slave
Bus network alarm, the slave is not in OP state	The Nth slave is abnormal, the network cable between the N-1 slave and the Nth slave is loose or interfered	1. Check the wiring of the EtherCAT network port 2. Sort out the wiring and check for interference 3. Check the power supply of the slave
Bus network alarm, network timeout 0x98110010	EtherCAT network communication data frames are lost continuously	1. Check the wiring of the EtherCAT network port 2. Sort out the wiring and check for interference 3. Check the power supply of the slave

Table 2-1 Master card bus alarm and solution