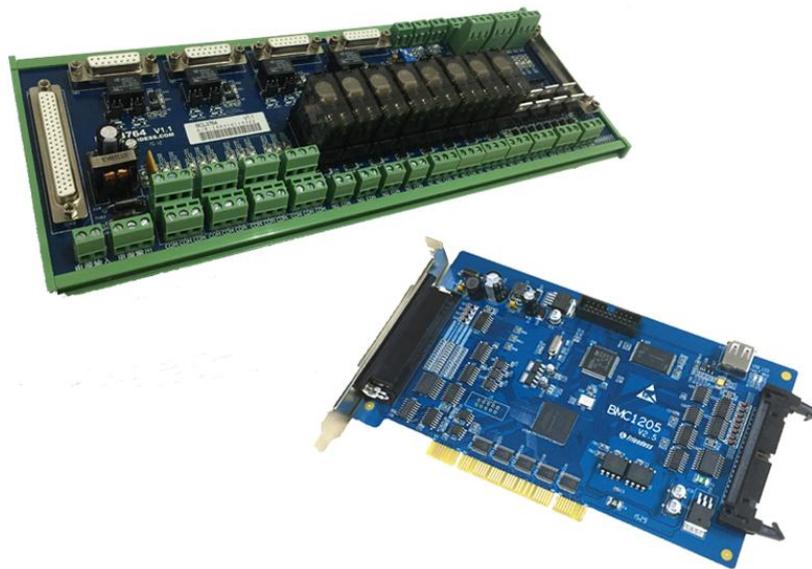# РУКОВОДСТВО ПО ЭКСПЛУАТАЦИИ

ЧПУ контроллера
FSCUT 3000

FSCUT3000

Laser Cutting Control System

User Manual

Shanghai Friendess Electronic Technology Co., Ltd

www.fscut.com

Version 1.0

Thank you for using our products!

This Manual describes FSCUT3000 laser cutting control system in details, including system features, installation instructions etc. If you want to know more about CypTube laser cutting software that can improve the performance of BCS100 height controller while using together, please refer to the relevant help documents. For any other information, please contact us directly.

Please read the Manual carefully before using the BMC1205 controller card and relevant devices, so that you can make better use of it in future.

Along with continuous updating of product functions, there may be some differences between that you received and the Manual. Herein, we apologize for any inconvenience!

The function information and application scheme of the latest product can be queried and downloaded, when you log on the official website www.fscut.com.

Contents

Chapter 1 Product Introduction

1.1 Introduction

FSCUT3000 is a high-performance open loop laser control system developed independently by Shanghai Friendess Electronic Technology Co., Ltd. It is widely used in the field of metal and non-metal laser cutting. Because of its outstanding performance in the field of medium power fiber laser cutting, it is favored by a large number of high quality customers.

When you buy the FSCUT3000 laser cutting control system, please read the manual carefully before using the controller and relevant devices.

FSCUT3000 laser cutting control system is composed of standard accessories as shown below:

Name	Model	Number
Motion control card	BMC1205	1
External IO board	BCL3764	1
Extension wire (with a guard sheet)	C37-40	1
37-pin cable (2metres)	C37-2	1
62-pin cable (2metres)	C62-2	1
Servo cable (1.5metres)	C15-1.5	4
Dongle	Elite IV	1
Laser software	CypTube	1
Wireless handheld box	WKB	1
Numerical control panel (Optional)	BCP5045	1

1.2 System Connection Schematic Diagram

BMC1205 card applies PCI interface whose external size is 213mm*112mm. A control card has two sockets: JP1 is a DB62M socket with matched C62-02 cable connected to BCL3764 external IO board; JP2 is an external expansion cavel socket, with C40-37 expansion winding displacement (with a guard sheet) connected to the back of computer case firstly, and then with

C37-02 cable connected to BCL3764 external IO board.

The system wire is shown as below:

BMC1205 Motion control card

JP1 JP2

C37-40

PCI Slot

Computer Mainboard

C62-2

BCL3764 terminal board

C37-2

C15-1.5   X axis servo drive

C15-1.5   Y1 axis servo drive

C15-1.5   Y2 axis servo drive

C15-1.5   W axis servo drive
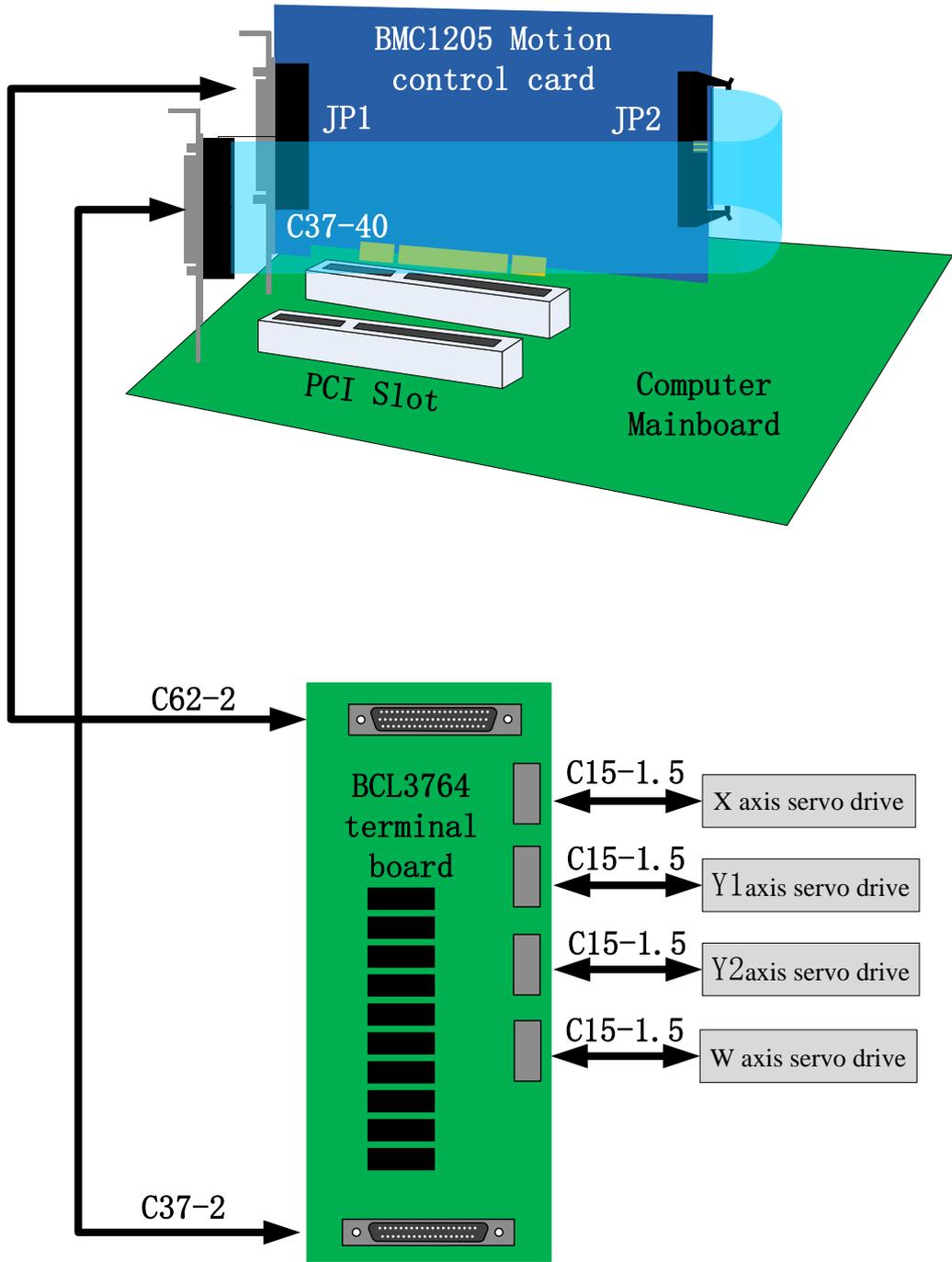
1.3 Technical parameters

Motion control	Motor control signal	4 axis with high-speed pulse output and maximum frequency 3MHz
		4 axis with encoder feedback channel and four times frequency up to 8MHz
		The original point of every axis with limit signal, servo alarm special input signal.
		The servo performance of every axis, alarm clear special output signal.
	Motion control performance	Control cycle is 1ms.
		"S" speed-up and speed-down with wave filtering.
		Velocity look-ahead, inflection point with intelligent speed-up and speed-down.
		The speed limit of small circular arc, Local curvature analysis
		The smoothing of turning
Laser control signal		Output 1 is PWM signal, with dip switch choosing 24V or 5V.
		Output 2 is 0~10V analog signal.
I/O Function		8 general inputs.
		16 general outputs, thereto, 8 interfaces are relay outputs, 8 interfaces are thyristor emitter outputs.
Work environment		Temperature: 0~55℃
		humidity: 5%~90%, no condensation
Power requirement		24V，2A

1.4 Control card installation

1.4.1 Installation Steps

> Please carefully handle them, and effectively touch grounded metal parts before touching control card system or inserting/removing control card, in order to prevent static electricity from damaging motion control card, and please wear electricity-proof gloves.

(1) Shut down computer, insert control card into PCI slot, and fix control card and catch screw of expansion winding displacement.

(2) After start the compute, the window of "Found New Hardware Wizard" pops up; click "Cancel" button as shown below. If this window does not pop up, it means control card is not inserted correctly. So please repeat step one

(3) Install CypTube software, while automatically install BMC 1205 card driver and soft-dog driver.

(4) Open the device manager to confirm the success of installation. If the following icon appeared:
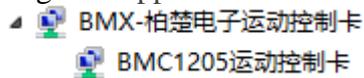
▲ 🖳 BMX-柏楚电子运动控制卡
　　🖳 BMC1205运动控制卡　It shows that the installation was successful.

1.4.2 Recovery processing

(1) If after starting the computer, the widow of "Found New Hardware Wizard" does not pop up, or control card cannot be found in device manager, which means control card is not inserted correctly. Please replace PCI slot or computer, insert and fix control card, and then reinstall the software.

(2) If there is yellow exclamation mark in the device, please double click 🖳❗PCI Device ., open attribute page and select "details", as shown below.
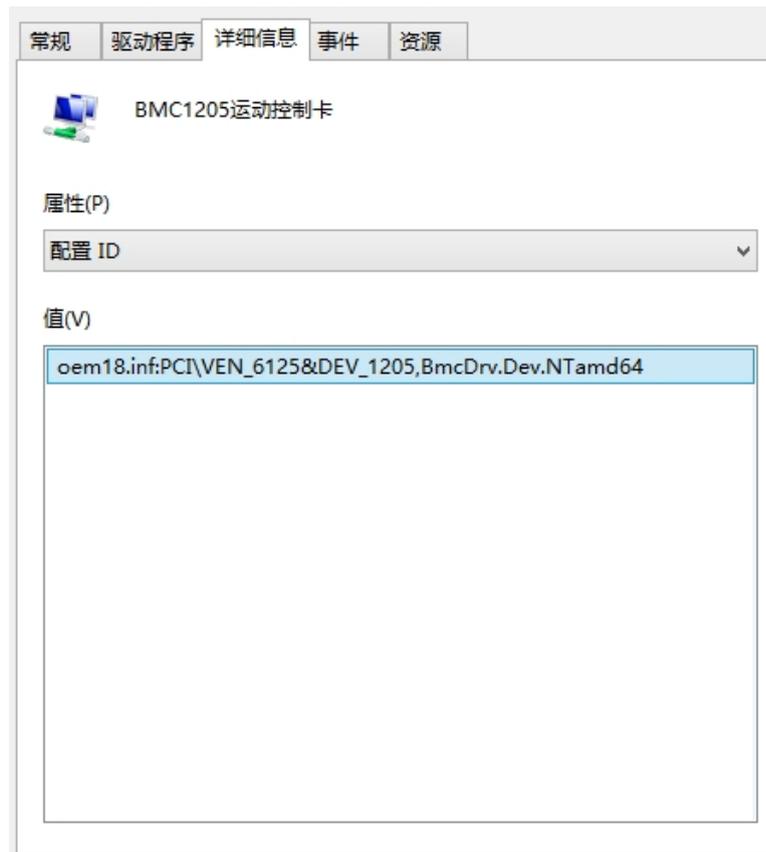
(3) The first half of "Configuration ID" attribute is PCI\VEN_6125&DEV_1205, , which means the computer correctly identifies motion control card and software installation may fail. Please reinstall CypTube software. If it fails again, please contact our technician.

(4) The first half of "Configuration ID" attribute is not " PCI\VEN_6125&DEV_1205, ", which means the computer doesn't identify motion control card successfully. Please shut down the computer, replace the PCI slot, fix the control card again, and then reinstall the software.

(5) If step four still fails, control card may have be damaged. Please contact our technician.

Chapter 2 Port Instructions

2.1 External IO board instruction

BCL3764-V1.1 external IO board is installed by rail and also can be installed permanently. Its external size is 315mm*107mm with DM62M and DB37M interface

in two sides, corresponding to JP1 and JP2 of BMC1204. C62-2 cable is used to connect external IO board DB62 interface with JP1 port on the back of control card. JP2 interface is linked by C37-40 baffle wire and then is fixed on erection fixture of computer with bolts. And C37-2 cable is used to connect DB37 socket on external IO board.

The four DB15M interfaces on the top left corner are servo control signals, which are X axis, Y1 axis, Y2 axis and W axis, respectively, from left to right. When being used as gantry dual drive, Y1 axis and Y2 axis are the axis of gantry dual drive. When being used as Tube cutting, W axis is as rotation axis.

High-low terminals on bottom left are respectively limit signal and origin signal of X axis, Y axis and W axis. High-low terminals on upper right are origin and limit input of W axis and general input interface, with all the low terminals break-over, as COM ground, namely 0 V.

The interface on bottom right is 16 general outputs interface, thereto, 8 interfaces as relay outputs, 8 interfaces as thyristor outputs. The first 4 ones of the 8 relay outputs only have normally open contacts and the second 4 outputs have normally open contacts and normally closed contacts. The thyristor output 8 is 24 V general cathode output.

The three 2--pin terminals over right above are 1 PWM and 2 DA analog signal.

Dip switch:

There is a 2-bit dip switch below the PWM and DA analog signal. Its usage is shown as below:

The interface P1 and P2 of 4-bit dip switch choose PWM voltage.

P1	P2	Implication
On	Off	PWM voltage is 24V
Off	On	PWM voltage is 5V

2.2 Signal type

2.2.1 Input signals

Input signals include:limit signal, origin and general input. The input of BMC1205 card is active low level: support normally open and normally closed mode (The polarity of input port can be modified by "platform configuration tool" of CypTube software). When the setting is normally open, input port and 0 V break-over are active; when the setting is normally closed, disconnection of 0 V is active.

Input port polarity can be modified through the hardware jumper. Now IN6, IN7 and IN8 input ports support this function. Jumper has two states, ACT_LOW as shown in the figure, which means low level is active (inputting 0V voltage is active); ACT_HIGH as shown in the figure, which means high level is active (inputting 24V voltage is active). Default state is ACT_LOW.
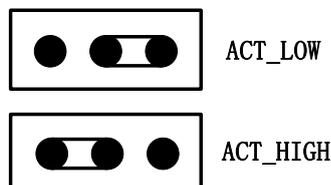
Typical connection of optoelectronic switch is shown as below, which must use 24V switch of the NPN type (low level is active).

```
BCL3764              optoelectronic switch
  COM ──────────────── ─
  Y- ───────────────── OUT
                       C
  24V ──────────────── +
```
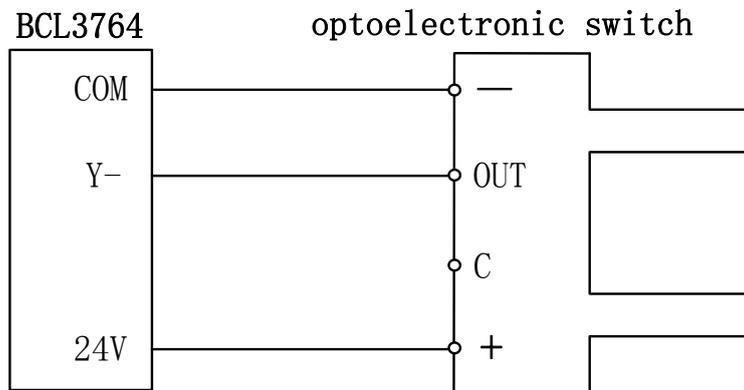
Typical connection of contact switch is shown as below:

```
BCL3764              Contact Switch
  COM ──────────────── COM
  Y+ ───────────────── NO
```
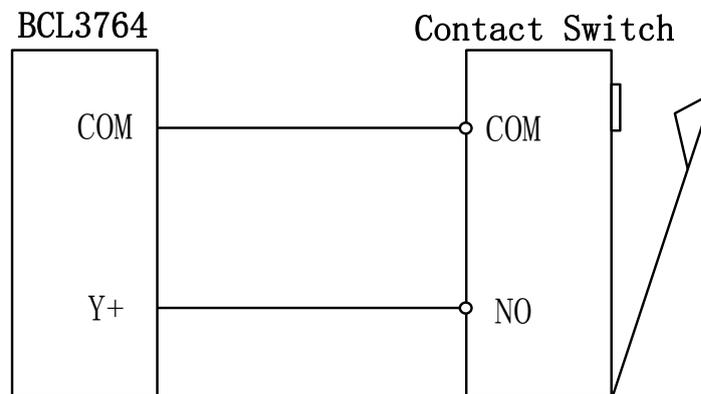
Typical connection of magnetic switch is shown as below, which must use 24V switch of the NPN type.

```
BCL3764              Magnetic Switch
  COM ──────────────── 0V
  IN6 ───────────────── OUT
  24V ──────────────── V+
```
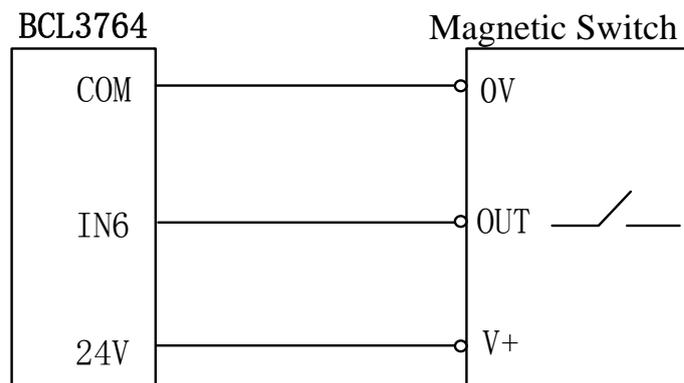
2.2.2 Relay output signal

Load capacity of relay output contact on external IO board is: 240VAC/5A, 30VDC/10A. Controllable small power is 220 V alternating load. Please connect contactor externally if connected with big power load.

The connection of relay output and contactor is shown as below:

BCL3764   Machine side
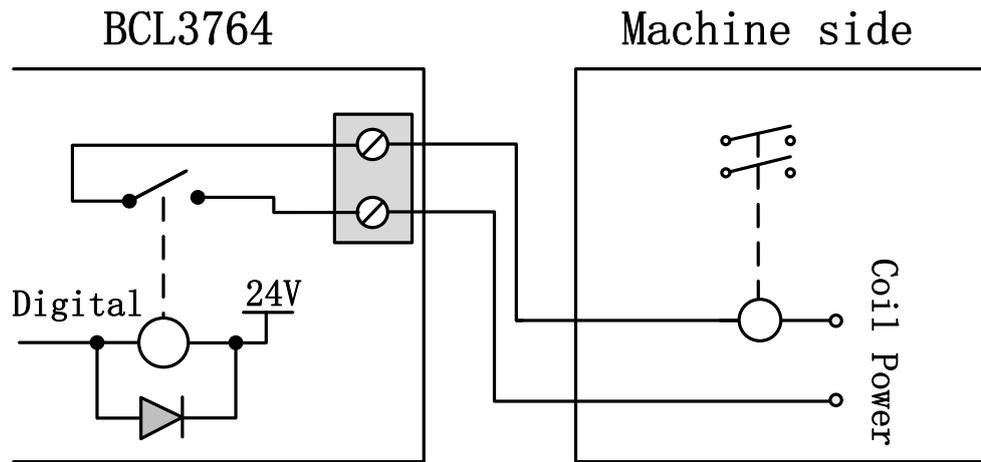
2.2.3 Thyristor output signal

There are OUT9~OUT16, total 8 interfaces, mosfet emitter outputon BCL3764-V1.1 external IO board and it can directly drive 24V direct current device. Each current supply capacity is 500mA. Typical connection is shown as below:

BCL3764

OUT16

24VCurrent solenoid valve

COM
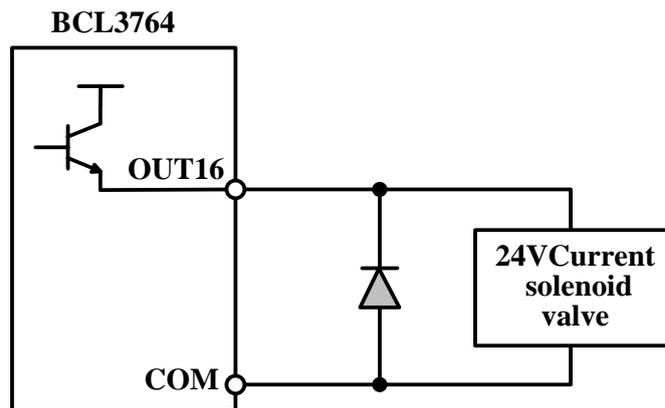
2.2.4 Differential output signal

Pulse command state of control driver is "pulse+direction, negative logic". The highest pulse frequency: 3MHZ. The pulse mode is shown as below:

Forward   **Backward**

PUL+

DIR+
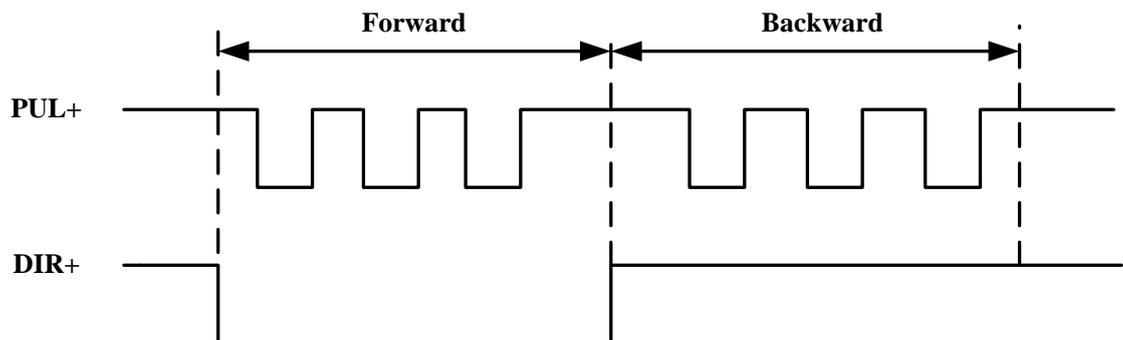
The output way of differential signal is shown as below :
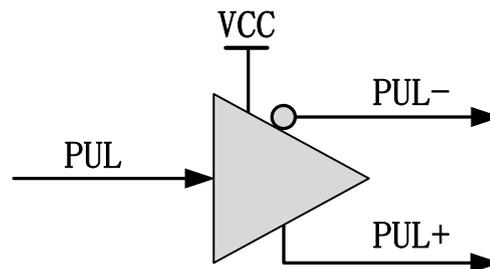
2.2.5 Analog output signal

There are 2 0~10V analog signal in the external IO board.

Range of output signal	0V~+10V
Maximum output current load	50mA
Maximum output capacitive load	350pF
Input impedance	100KΩ
Maximum bipolar error	+/-50mV
Resolution ratio	10mV
Conversion speed	400us

2.2.6 PWM output signal

BCL3764 external IO board has 1 PWM pulse width modulating signal which can be used for controlling average power of fiber laser. PWM signal level is 5 V or 24 V for selection. Duty cycle is 0%~100% and the highest carrier frequency is 50 KHz. The output way of PWM signal is shown as below:
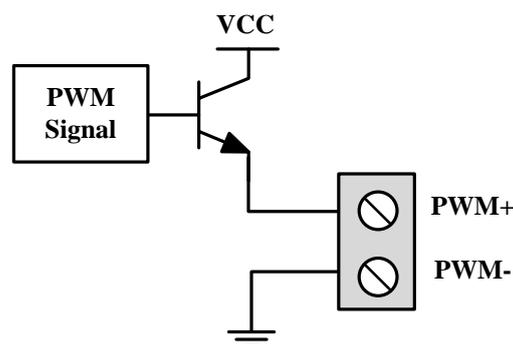
We strongly recommend that users install PWM+/- signal to a relay output port in series (PWM+/- enabled), then access to the laser, which can avoid laser light leakage in modulation mode. Please refer to "2.5 Laser Connection" for more details. Furthermore, please adjust PWM signal level. 24 V or 5 V level can be selected through dip switch.

2.3 Terminal Instructions

2.3.1 External power source

External power source provide direct current 24 V for BCL3764 external IO board. 24 V and COM of power input terminal are connected to 24 V and 0V of power output interface, respectively.

2.3.2 Servo control interface

The four servo control interfaces on BCL3764 are DB15 two-row bores, and pin definition is as below:
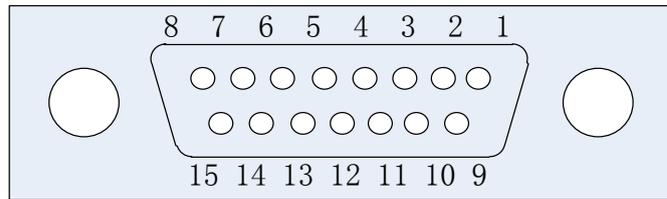
The signal definition of matched servo cables is shown as below:

15-pin servo control signal Line					
Pin	Line color	Signal Name	Pin	Line color	Signal Name
1	Yellow	PUL+	9	Yellow-Black	PUL-
2	Blue	DIR+	10	Blue-Black	DIR-
3	Black	A+	11	White-Black	A-
4	Orange	B+	12	Orange-Black	B-
5	Red	Z+	13	Red-Black	Z-
6	Green	SON	14	Purple	ALM
7	Green-Black	CLR	15	Brown-Black	0V
8	Brown	24V			

+24V,0V: Supply 24V DC power for servo drive;

SON: The output is servo enable signal when servo on;

ALM: Alarm, receive servo alarm signal;

PUL+, PUL-: Pulse (PULS), differential output signal;

DIR+,DIR-: Direction (DIR), differential output signal;

A+, A-, B+, B-, Z+, Z-: Three phase of encoder, input signal;

The polarity of SON and ALM signal can be modified through the hardware jumper.
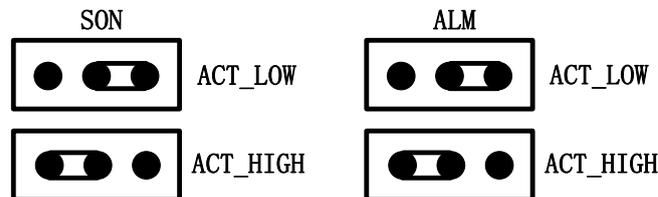
When the SON signal jump to ACT_LOW state, low level is active (inputting 0V voltage is active); When the SON signal jump to ACT_HIGH state, high level is active (inputting 24V voltage is active). Default state is ACT_LOW.

When the ALM signal jump to ACT_LOW state, low level is active (inputting 0V voltage is active); When the ALM signal jump to ACT_HIGH state, high level is active (inputting 24V voltage is active). Default state is ACT_LOW.

Please refer to "2.3.3 The wiring diagram of servo drive control signal" for connection of Panasonic, Yaskawa, Mitsubishi and Delta servo drivers.

Please pay attention to the following information when connect servo driver of other brands:

(1) Please confirm the type of servo driver SON signal you select whether low level is active or not. (That is, It is ON when connecting with 24V GND.)

(2) Confirm the parameters of servo driver are set as: the type of received pulse signal is "pulse + direction"

(3) Confirm whether the servo driver input terminal has external crash stopping signal input or not, and which logic the signal is.

(4) Before the trial operation of servo driver, 24 V power must be provided for external IO board, for 24 V power servo driver needs is provided by external IO board.

(5) If driver still cannot run, confirm that driver parameter is set as not using "positive & negative input inhibit".

(6) Connect shielding layer of signal line with servo driver case.

2.3.3 The wiring diagram of servo drive control signal

FSCUT3000 motion control system apply the signal of "Pulse+Direction" to control servo driver. The pulse sending frequency cap is 3Mpps.

Recommend using high-speed differential pulse signal, and setting the pulse equivalent of servo driver in 1000 ~2000, in order to improve the interpolation accuracy.

The wiring diagram of Panasonic A5 high-speed pulse

DB15 servo control interface of Friendess

MINAS-A servo 50P interface of Panasonic

Signal Name	Pin		Pin	Signal Name
PUL+	1		44	PULSH1
PUL−	9		45	PULSH2
DIR+	2		46	SIGNH1
DIR−	10		47	SIGNH2
A+	3		21	OA+
A−	11		22	OA−
B+	4		48	OB+
B−	12		49	OB−
Z+	5		23	OZ+
Z−	13		24	OZ−
24V	8		7	COM+
SON	6		29	SRV−ON
CLR	7		31	A−CLR
ALM	14		37	ALM+
0V	15		41	COM−
			36	ALM−

Shielded wire
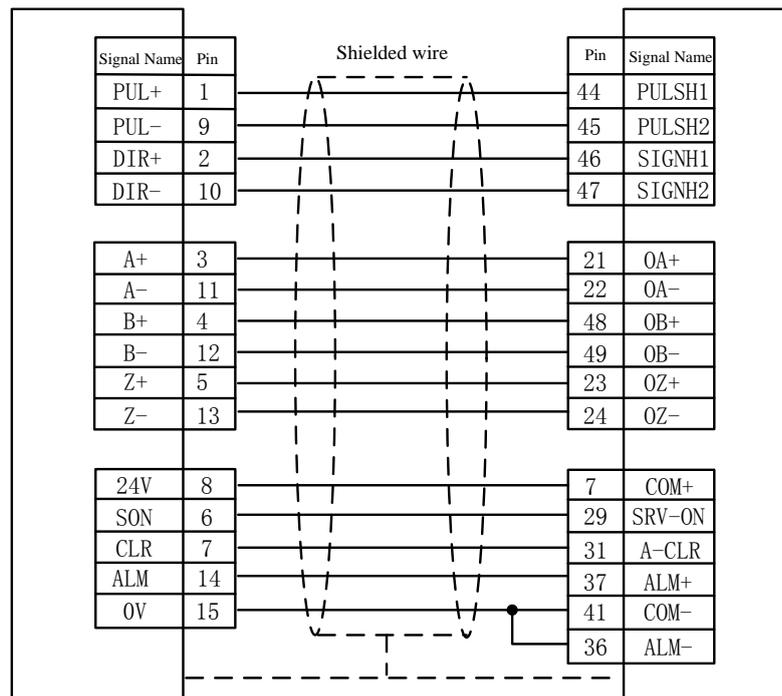
The wiring diagram of Panasonic A5 low-speed pulse

DB15 servo control interface of Friendess

MINAS-A servo 50P interface of Yaskawa
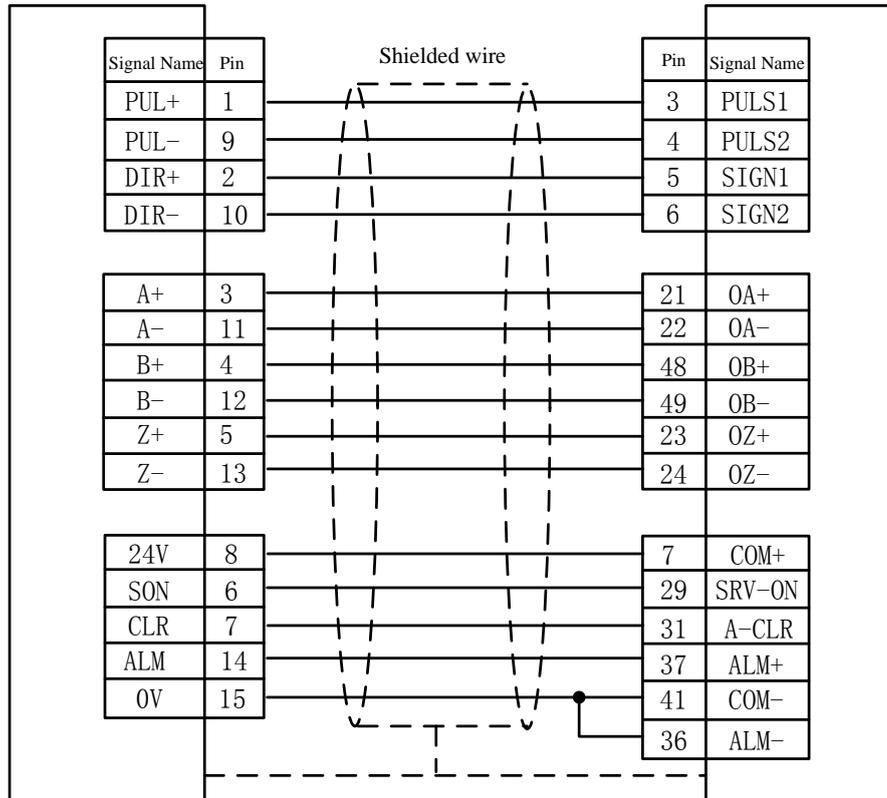
Basic setting parameters of Panasonic A5 series

Parameter Type	Recommended value	Implication
Pr001	0	Control mode must be set as location mode.
Pr007	3	Have to select "Pulse+Direction" mode
Pr005	1	When using high-speed pulse connection mode, this parameter is set as 1, and the maximum supported pulse frequency is 3Mpps; When using low-speed pulse connection mode, this parameter is set as 0, and the maximum supported pulse frequency is 500Kpps;

The wiring diagram of Yaskawa servo

DB15 servo control interface of Friendess

Σ series servo 50P interface of Panasonic

Signal Name	Pin		Pin	Signal Name
PUL+	1		7	PULS
PUL−	9		8	∗PULS
DIR+	2		11	SIGN
DIR−	10		12	∗SIGN
A+	3		33	PAO
A−	11		34	∗PAO
B+	4		35	PBO
B−	12		36	∗PBO
Z+	5		19	PCO
Z−	13		20	∗PCO
24V	8		47	+24V IN
SON	6		40	/S−ON
CLR	7		44	/ALM−RST
ALM	14		31	ALM+
0V	15		1	SG
			32	ALM−

Shielded wire
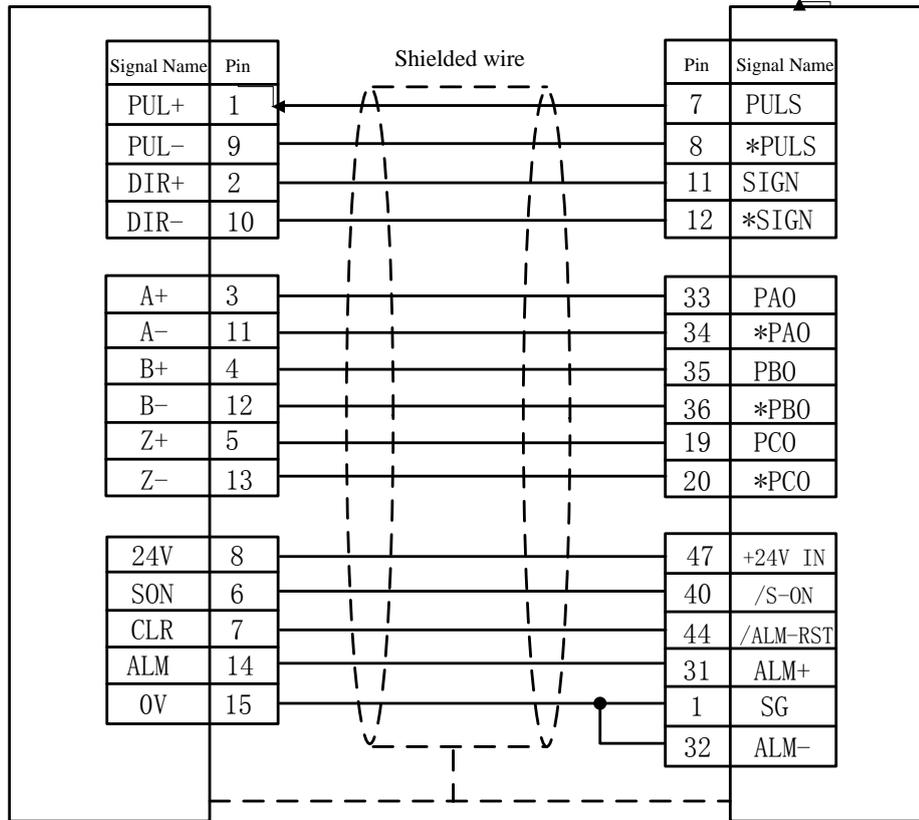
Basic setting parameters of Yaskawa Σ series

Parameter Type	Recommended value	Implication
Pn000	001X	Set as location mode
Pn00B	No	When the input is single-phase power, modify into 0100
Pn200	2000H	Positive logic: pulse + direction; 0005H negative logic: Pulse + direction When the pulse frequency is lower than 1Mpps, please select 0000H mode; When the pulse frequency is up to 1Mpps ~ 4Mpps, please select 2000H mode.
Pn50A	8100	Can be driven in co-rotation side
Pn50B	6548	Can be driven in reverse side

The high-speed pulse wiring diagram of Delta A series

DB15 servo control interface of Friendess   ASD-A servo 50P interface of Delta

Signal Name	Pin			Pin	Signal Name	
PUL+	1			38	HPULSE	
PUL−	9			29	/HPULSE	
DIR+	2			46	HSIGN	
DIR−	10			40	/HSIGN	
A+	3			21	0A	
A−	11			22	/0A	
B+	4			25	0B	
B−	12			23	/0B	
Z+	5			50	0Z	
Z−	13			24	/0Z	
24V	8			11	COM+	
SON	6			9	DI1	SON
CLR	7			33	DI5	ARST
ALM	14			28	DO5+	ALRM
0V	15			45	COM−	
				27	DO5−	

Shielded wire

The low-speed pulse wiring diagram of Delta A series

DB15 servo control interface of Friendess   ASD-A servo 50P interface of Delta

Signal Name	Pin			Pin	Signal Name	
PUL+	1			43	PULSE	
PUL−	9			41	/PULSE	
DIR+	2			36	SIGN	
DIR−	10			37	/SIGN	
A+	3			21	0A	
A−	11			22	/0A	
B+	4			25	0B	
B−	12			23	/0B	
Z+	5			50	0Z	
Z−	13			24	/0Z	
24V	8			11	COM+	
SON	6			9	DI1	SON
CLR	7			33	DI5	ARST
ALM	14			28	DO5+	ALRM
0V	15			45	COM−	
				27	DO5−	

Shielded wire
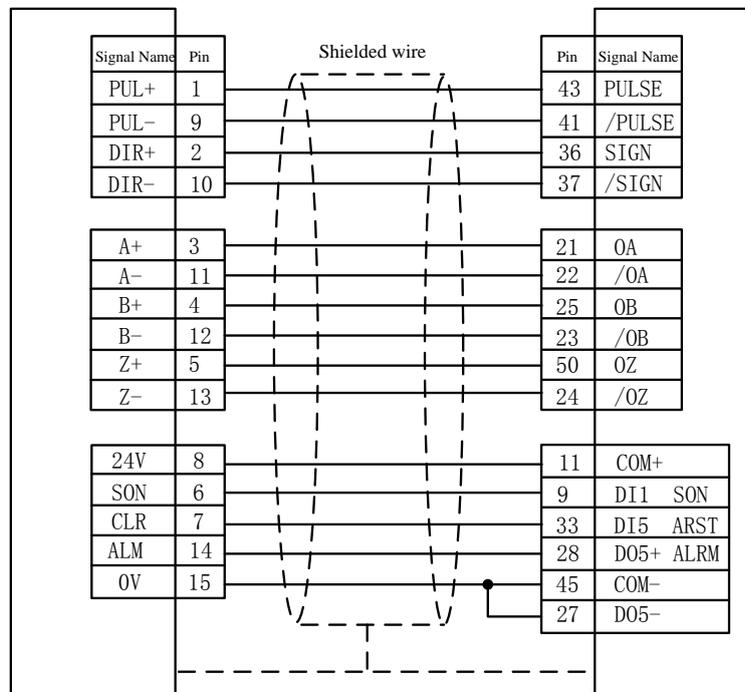
Basic setting parameters of Delta A series

Paramete r Type	Recommended value	Implication
P1-00	1102H	Control mode, position control mode Negative logic pulse + direction. Set parameters as: 1102H start the high speed differential signal, the maximum pulse frequency is 4Mpps; Set the parameters as: 0102H is low-speed pulse signal, the maximum pulse frequency is 500K.
P1-01	00	Select a position mode of external command control
P2-10	101	DI1 is set a SON servo enabling, logic is normally open.
P2-14	102	DI5 is set as ARST clear alarm function, logic is normally open.
P2-22	007	DO5 is set as ALRM Servo alarm function, logic is normally closed.

The servo wiring diagram of Sanyo R series

DB15 servo control interface of Friendess   R series servo 50P interface of Sanyo
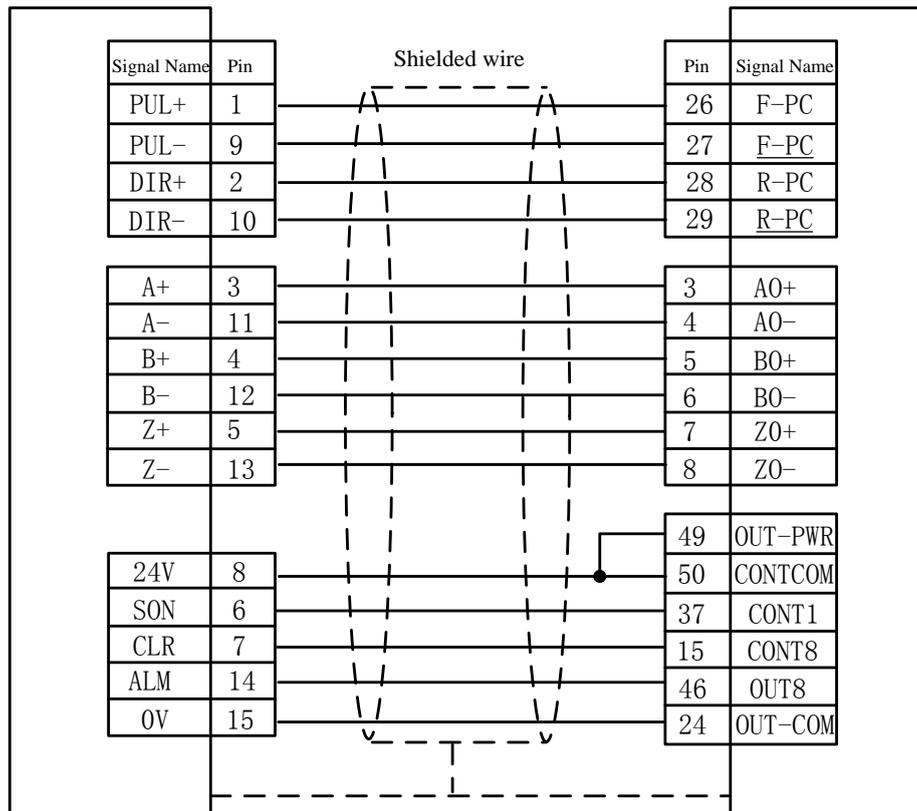
Basic setting parameters of Sanyo R series

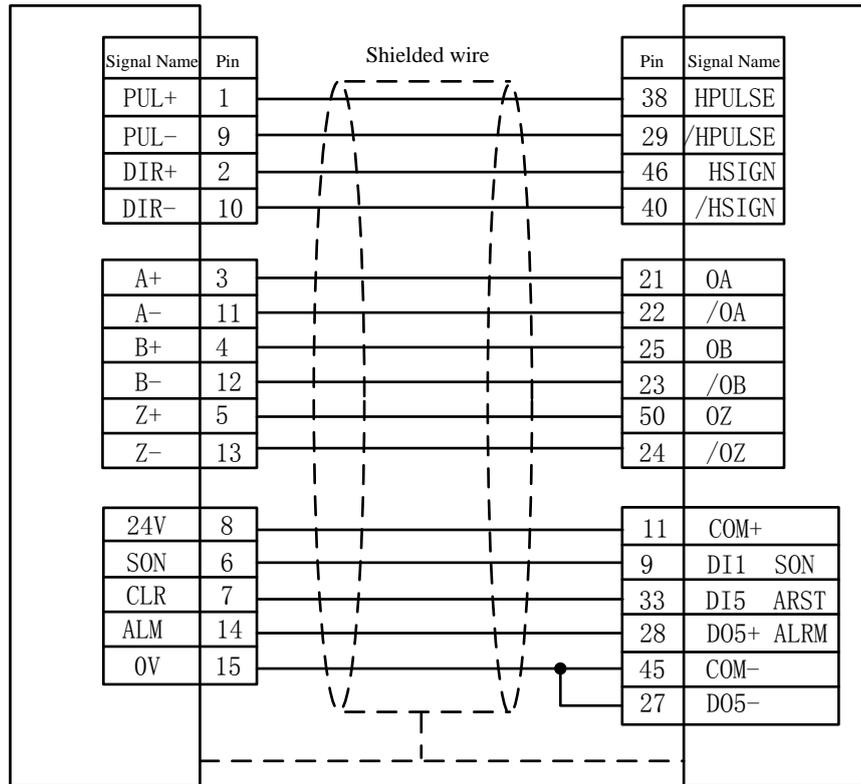| Parameter Type	Recommended value	Implication
SY08	00	Set as position mode
Gr8.11	02	Select pulse signal input type: Pulse + direction;
Gr9.00	00	Can be driven in co-rotation side
Gr9.01	00	Can be driven in reverse side

The wiring diagram Schneider 23A high-speed pulse

DB15 servo control interface of Friendess

23A-50P interface of Schneider

Signal Name	Pin		Pin	Signal Name
PUL+	1	Shielded wire	38	HPULSE
PUL−	9		29	/HPULSE
DIR+	2		46	HSIGN
DIR−	10		40	/HSIGN
A+	3		21	0A
A−	11		22	/0A
B+	4		23	0B
B−	12		25	/0B
Z+	5		50	0Z
Z−	13		24	/0Z
24V	8		11	COM+
SON	6		9	DI1−
CLR	7		33	DI5−
ALM	14		7	D01+
0V	15		49	COM−
			6	D01−
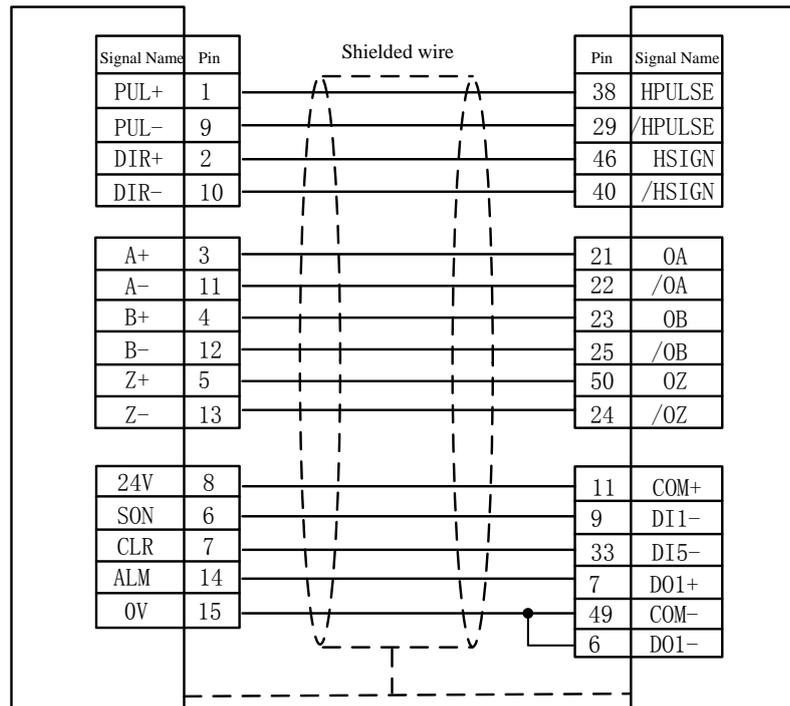
The wiring diagram Schneider 23A low-speed pulse

DB15 servo control interface of Friendess

23A-50P interface of Schneider

Signal Name	Pin		Pin	Signal Name
PUL+	1	Shielded wire	41	PULSE
PUL−	9		43	/PULSE
DIR+	2		37	SIGN
DIR−	10		36	/SIGN
A+	3		21	OA
A−	11		22	/OA
B+	4		23	OB
B−	12		25	/OB
Z+	5		50	OZ
Z−	13		24	/OZ
24V	8		11	COM+
SON	6		9	DI1−
CLR	7		33	DI5−
ALM	14		7	DO1+
0V	15		49	COM−
			6	DO1−
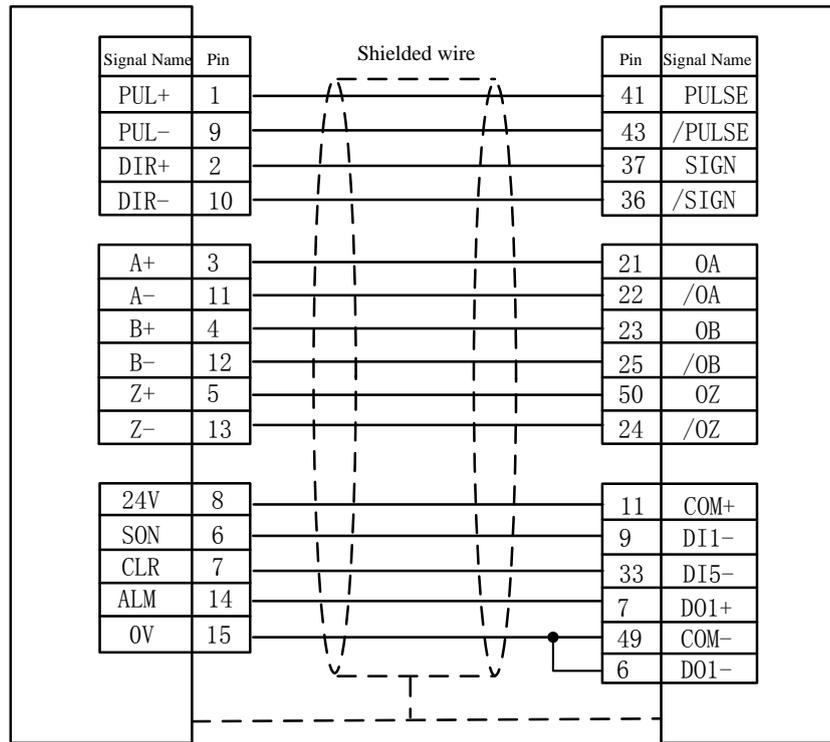
Basic setting parameters of Schneider Lexium 23D series

Parameter Type	Recommended value	Implication
P1-00	1102H	Control mode, position control mode Negative logic pulse + direction. Set parameters as: 1102H starts the high speed differential signal, the maximum pulse frequency is 4Mpps; Set the parameters as: 0102H is low-speed pulse signal, the maximum pulse frequency is 500K.
P1-01	X00	Set as: position mode of external signal control
P2-10	101	IN1 of servo is modified to SON function.
P2-11	0	No using IN2
P2-13~P2-17	0	No using IN4~IN8

The wiring diagram of Fuji A5 series

DB15 servo control interface of Friendess

A5-26P interface of Fuji

Signal Name	Pin		Pin	Signal Name
PUL+	1	Shielded wire	7	CA
PUL−	9		8	∗CA
DIR+	2		20	CB
DIR−	10		21	∗CB
A+	3		9	FFA
A−	11		10	∗FFA
B+	4		11	FFB
B−	12		12	∗FFB
Z+	5		23	FFZ
Z−	13		24	∗FFZ
24V	8		1	COMIN
SON	6		2	CONT1
CLR	7		3	CONT2
ALM	14		17	OUT3
0V	15		14	COMOUT
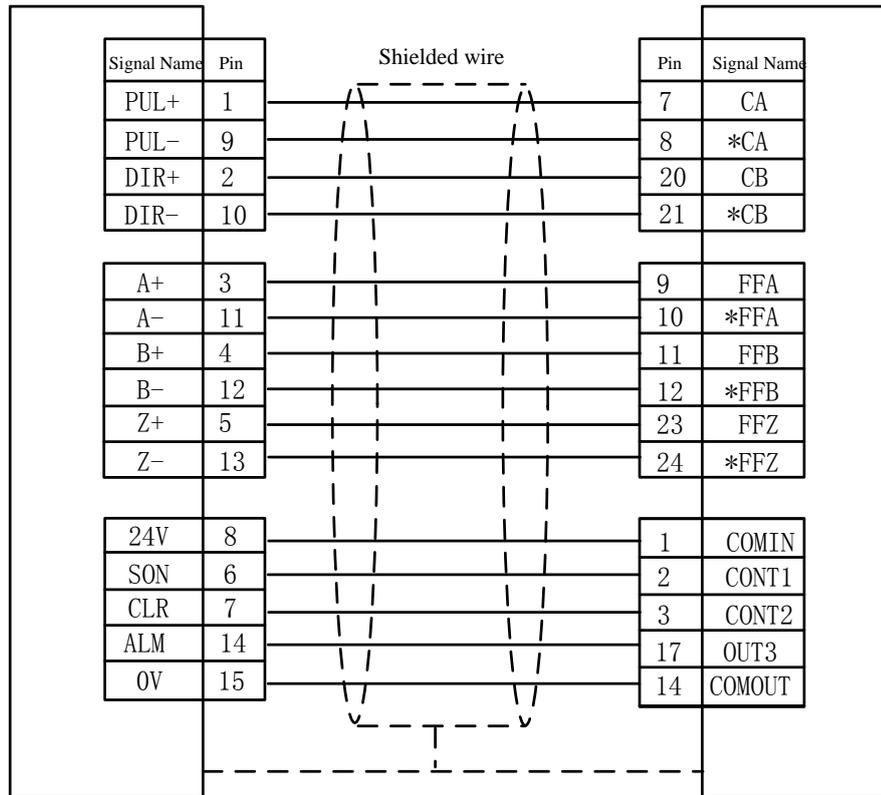
Fuji ALPHA 5 series

Parameter Type	Recommended value	Implication
PA-101	0	Position control mode
PA-103	0	Pulse + direction, the highest frequency is 1Mpps

The wiring diagram of Mitsubishi J3 Series

DB15 servo control interface of Friendess

MR-J3-A servo 50P interface of Mitsubishi

Shielded wire

Signal Name	Pin		Pin	Signal Name
PUL+	1		10	PP
PUL−	9		11	PG
DIR+	2		35	NP
DIR−	10		36	NG
A+	3		4	LA
A−	11		5	LAR
B+	4		6	LB
B−	12		7	LBR
Z+	5		8	LZ
Z−	13		9	LZR
24V	8		20	DICOM
SON	6		15	SON
CLR	7		19	RES
ALM	14		48	ALM
0V	15		46	DOCOM
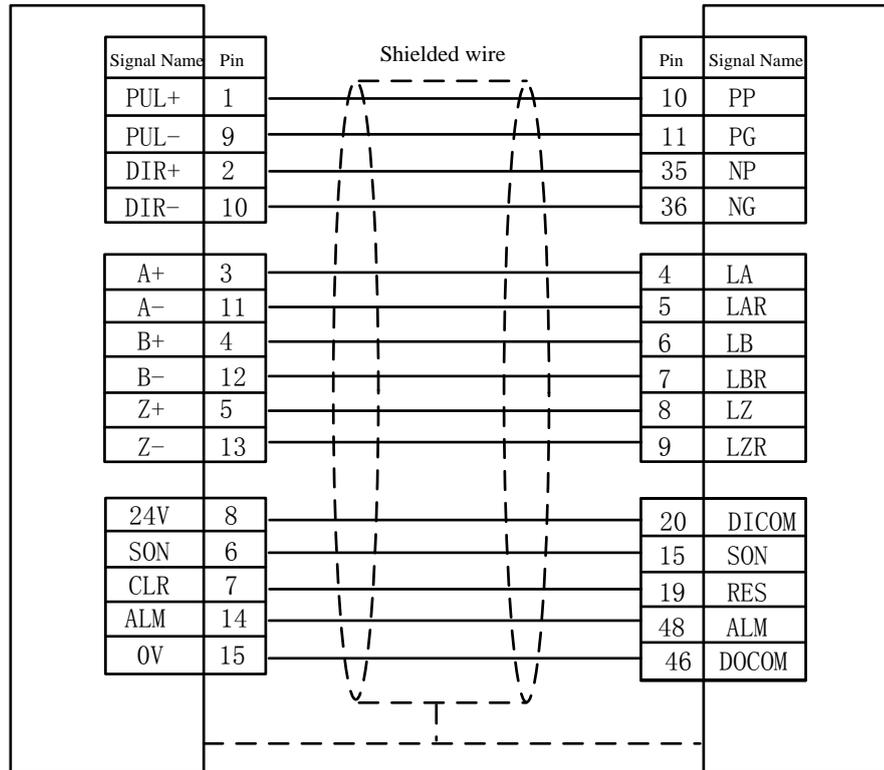
The wiring diagram of Mitsubishi E Series

DB15 servo control interface of Friendess

MR-E-A servo 26P interface of Mitsubishi

Shielded wire

Signal Name	Pin		Pin	Signal Name
PUL+	1		23	PP
PUL−	9		22	PG
DIR+	2		25	NP
DIR−	10		24	NG
A+	3		15	LA
A−	11		16	LAR
B+	4		17	LB
B−	12		18	LBR
Z+	5		19	LZ
Z−	13		20	LZR
			2	OPC
24V	8		1	VIN
SON	6		4	SON
CLR	7		3	RES
ALM	14		9	ALM
0V	15		13	SG
			8	EMG
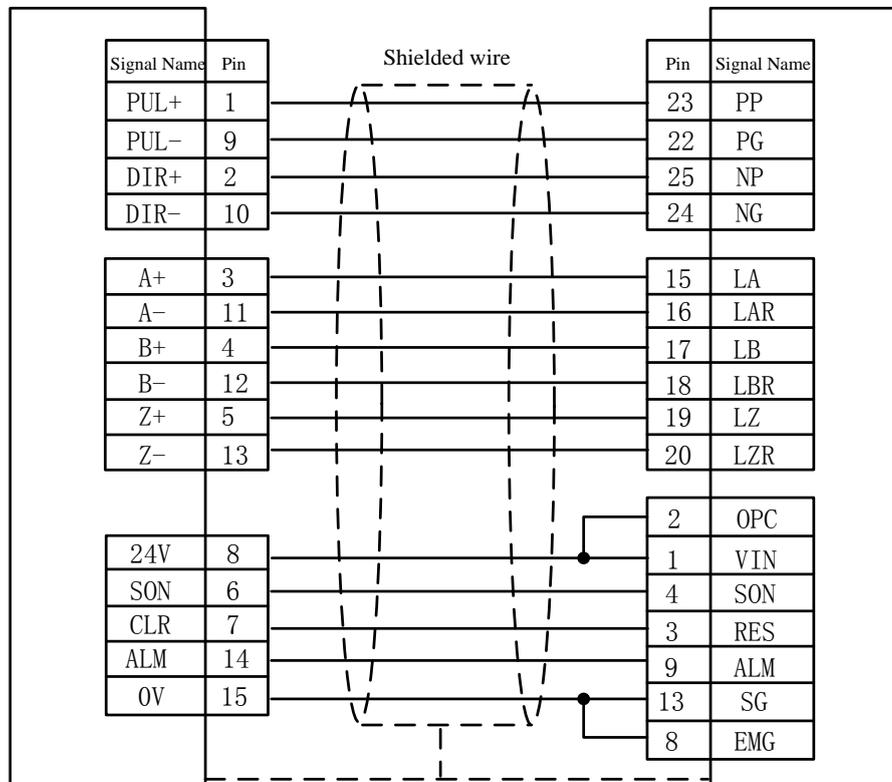
Basic setting parameters of Mitsubishi MR-J3 - A series

Parameter Type	Recommended value	Implication
PA01	0	Control mode-Position mode
PA13	0011	Negative logic: Pulse+Direction

The maximum pulse frequency of Mitsubishi J3 series is 1Mpps.

Note:

Parameter settings above can guarantee basic sports only under the circumstances of the right wiring connection, not ensure control precision. And if you need to further optimize campaign results, please adjust the rigidity, gain, inertia ratio and other parameters.

2.3.4 Origin and limit input

X-: the limit of minus X direction, dedicated input signal and low level is active;
X0: the origin signal, dedicated input signal and low level is active;
X+: the limit of positive X direction, dedicated input signal and low level is active;
COM: GND, the general circuit of the above three signals;

Y-: the limit of minus X direction, dedicated input signal and low level is active;
Y0: the origin signal, dedicated input signal and low level is active;
Y+: the limit of positive X direction, dedicated input signal and low level is active;
COM: GND, the general circuit of the above three signals;

W-: the limit of minus X direction, dedicated input signal and low level is active;
W0: the origin signal, dedicated input signal and low level is active;
W+: the limit of positive X direction, dedicated input signal and low level is active;
COM: GND, the general circuit of the above three signals;
The input logic of limit and origin signal can be modified through "platform configuration tool" coming with the CypTube software. Please refer to **chapter *3* platform configuration tool** for more details.

2.3.5 General input

There are 8 circuits of general input with IN1~IN8. 8 circuits of general input can be configured as various custom buttons or alarm input through "platform configuration tool" coming with the CypTube software. Please refer to **chapter *3* platform configuration tool** for more details.

2.3.6 General output

There are 8 circuits of relay output with OUT1~OUT8. 8 circuits of relay output can be configured as the control port corresponding to "laser", "auxiliary gas", "height controller", "indicator light" through "platform configuration tool" coming with the CypTube software. Please refer to **chapter *3* platform**

configuration tool for more details.

When BCL3764-V1.1 external IO board is selected, besides 8 circuits of relay output, there are also 8 circuits of thyristor output interfaces, which can directly drive 24V direct current device.

2.3.7 Analog output

DA1 and DA2 are 2 circuits of 0~10V analog signal output. DA1 and DA2 can be configured as a control signal of controlling the laser peak power and proportional valve through "platform configuration tool" coming with the CypTube software.

2.3.8 PWM output

When the laser type is configured as "fiber laser" through "platform configuration tool" coming with the software, PWM output port will be activated and used for controlling fiber laser average power.

When PWM is controlled needing to use 5V, 1 pin of two-bit dip switch is OFF, and 2 pin of two-bit dip switch is ON.

When PWM is controlled needing to use 24V, 1 pin of two-bit dip switch is ON, and 2 pin of two-bit dip switch is OFF.
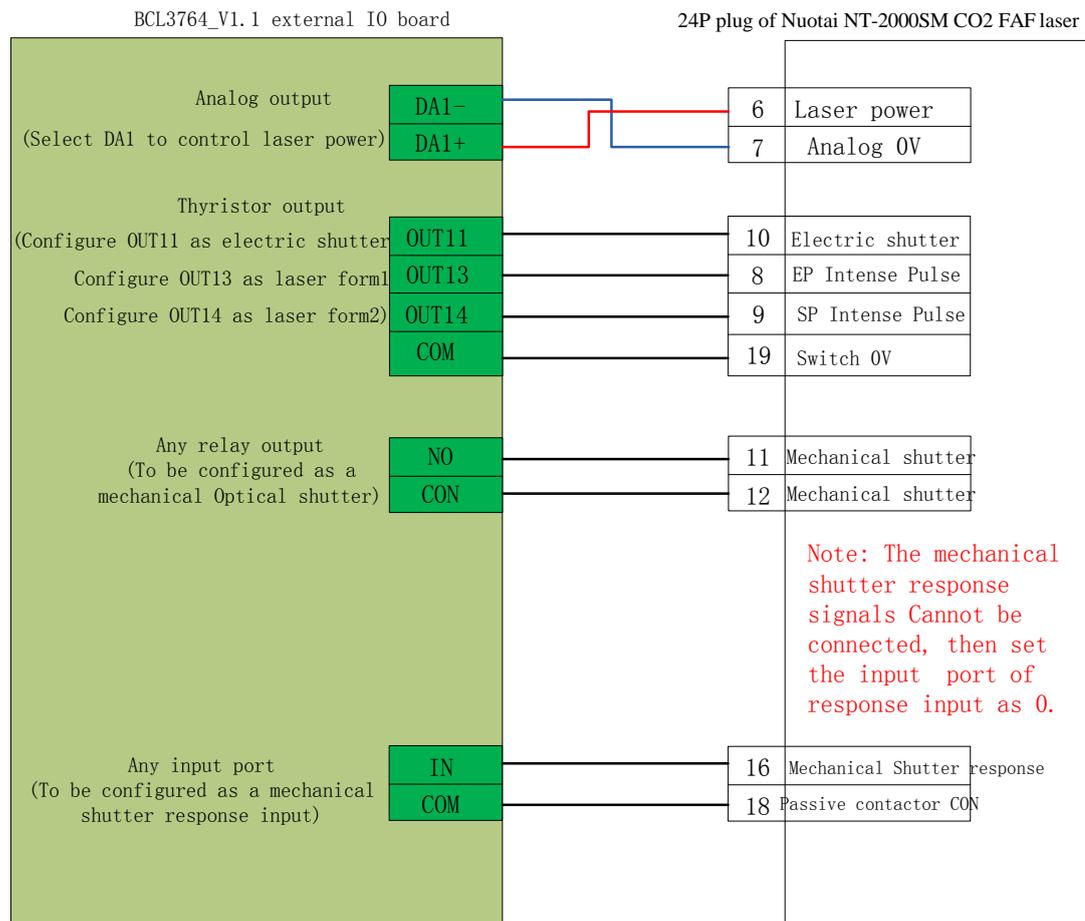
2.4 Connection Diagram
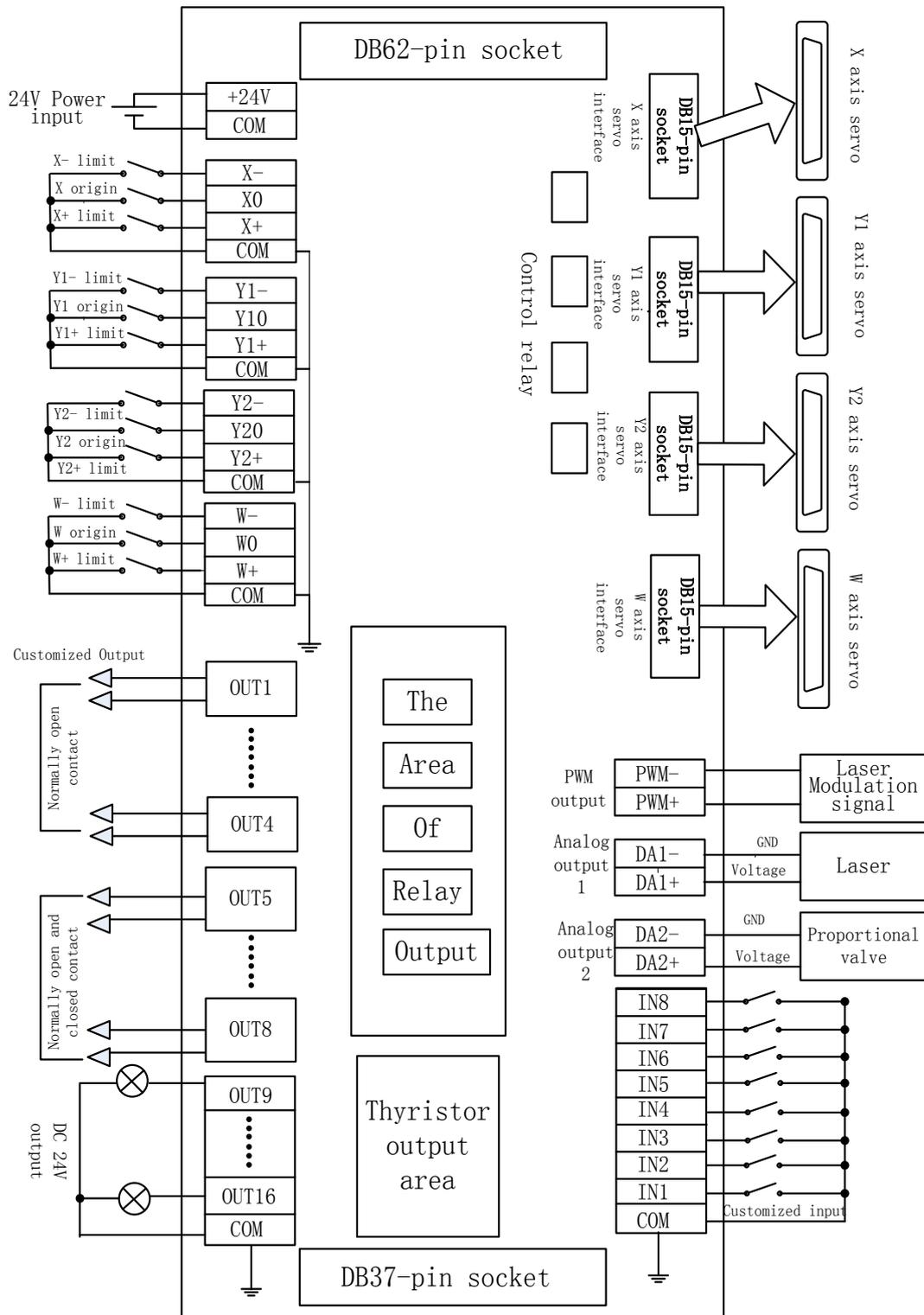
2.5 Laser connection

2.5.1 YAG laser connection

Directly connect output port whose configuration is laser output signal to laser, which will not be covered here.

2.5.2 CO2 laser connection

Herein, Nanjing Optical Valley Nuotai NT-2000SM CO2 FAF laser is included as an example, and lasers of other brands are similar

BCL3764_V1.1 external IO board

24P plug of Nuotai NT-2000SM CO2 FAF laser

Analog output (Select DA1 to control laser power)	DA1-		6	Laser power
	DA1+		7	Analog 0V
Thyristor output (Configure OUT11 as electric shutter	OUT11		10	Electric shutter
Configure OUT13 as laser form1	OUT13		8	EP Intense Pulse
Configure OUT14 as laser form2)	OUT14		9	SP Intense Pulse
	COM		19	Switch 0V
Any relay output (To be configured as a mechanical Optical shutter)	NO		11	Mechanical shutter
	CON		12	Mechanical shutter

Note: The mechanical shutter response signals Cannot be connected, then set the input port of response input as 0.

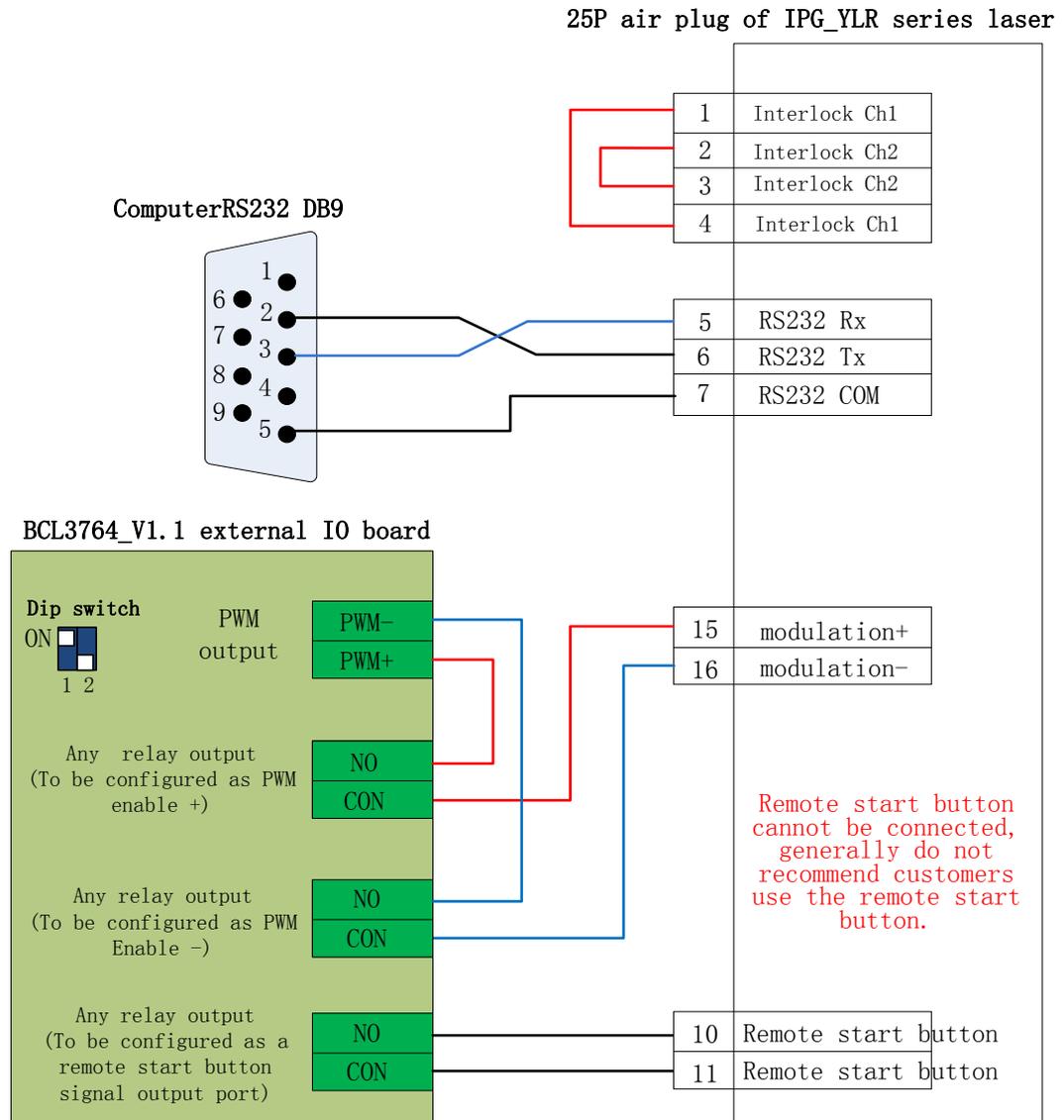|				
Any input port (To be configured as a mechanical shutter response input)	IN		16	Mechanical Shutter response
	COM		18	Passive contactor CON

Note:
Part of the CO2 laser also supports PWM control mode, and specific wiring connection can refer to ChuangXin laser wiring diagram.

2.5.3 IPG-YLR series wiring diagram

25P air plug of IPG_YLR series laser

1	Interlock Ch1
2	Interlock Ch2
3	Interlock Ch2
4	Interlock Ch1

ComputerRS232 DB9

5	RS232 Rx
6	RS232 Tx
7	RS232 COM

BCL3764_V1.1 external IO board

Dip switch
ON
1 2

PWM output

| PWM- |
| PWM+ |

15	modulation+
16	modulation-

Any relay output
(To be configured as PWM enable +)

| NO |
| CON |

Remote start button cannot be connected, generally do not recommend customers use the remote start button.

Any relay output
(To be configured as PWM Enable -)

| NO |
| CON |

Any relay output
(To be configured as a remote start button signal output port)

| NO |
| CON |

10	Remote start button
11	Remote start button

When the laser you are using supports serial or Ethernet communications control, we strongly recommend that you connect communication ports (serial or network interface). Using serial or Ethernet communication, CypTube software will monitor laser status in real-time, and can operate lasers by means of communication. Implementation including switch shutter (Emission), switch red (Guide beam), set the peak power (Current) and other actions, no longer need to connect the analog interface to control the laser peak power.

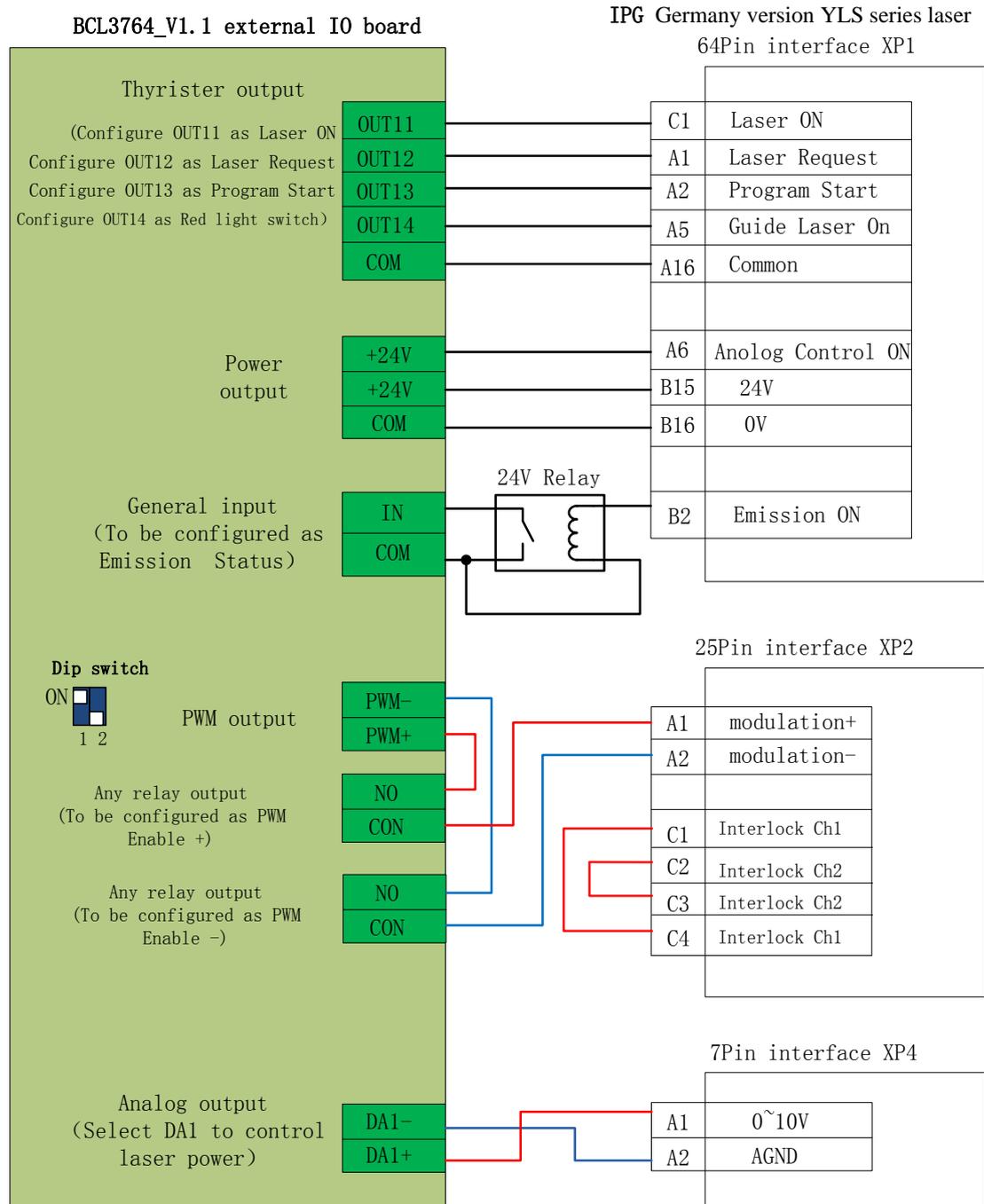Recommended network interface of IPG-YLR series.

Notes

1. remote start button cannot be connected, especially when the laser is not in a good grounding , we do not recommend users to add remote start button, which is easy to cause the laser to produce failure.

2. PWM select 24V control (Dip switch: 1 pin is ON, 2 pin is OFF.

2.5.4 Germany version IPG_YLS series wiring diagram

BCL3764_V1.1 external IO board

IPG Germany version YLS series laser
64Pin interface XP1

Thyrister output

(Configure OUT11 as Laser ON
Configure OUT12 as Laser Request
Configure OUT13 as Program Start
Configure OUT14 as Red light switch)

OUT11	C1	Laser ON
OUT12	A1	Laser Request
OUT13	A2	Program Start
OUT14	A5	Guide Laser On
COM	A16	Common

Power output

+24V	A6	Anolog Control ON
+24V	B15	24V
COM	B16	0V

General input
(To be configured as
Emission Status)

IN	
COM	

24V Relay

B2 — Emission ON

25Pin interface XP2

Dip switch

ON
1 2

PWM output

PWM-	A1	modulation+
PWM+	A2	modulation-

Any relay output
(To be configured as PWM
Enable +)

NO	C1	Interlock Ch1
CON	C2	Interlock Ch2

Any relay output
(To be configured as PWM
Enable -)

NO	C3	Interlock Ch2
CON	C4	Interlock Ch1

7Pin interface XP4

Analog output
(Select DA1 to control
laser power)

DA1-	A1	0~10V
DA1+	A2	AGND

Note：
1. B2 pin of XP1 interface cannot connect Emission ON, then make sure that the Emission Status input port is set as 0 in "platform configuration tool", which means do not detect whether the shutter has been open or not.
2. PWM select 24V control (Dip switch: 1 pin is ON, 2 pin is OFF.
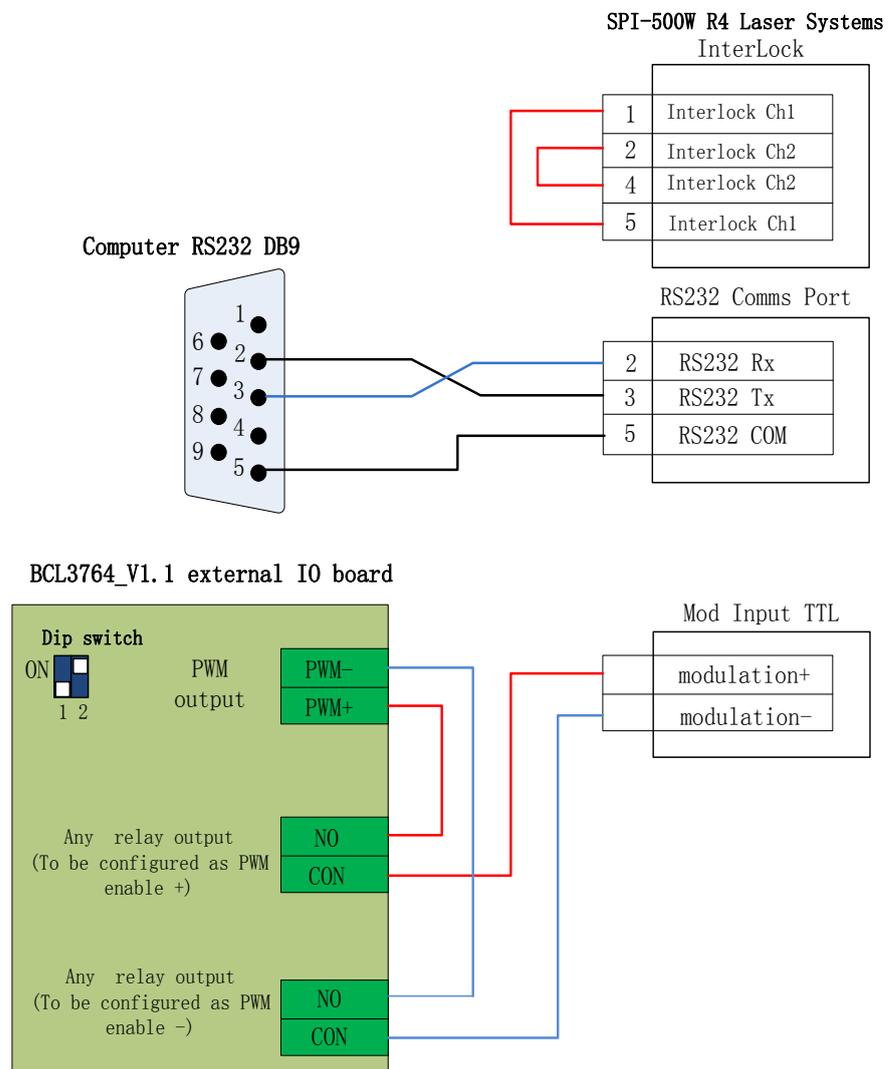
2.5.5 America version IPG_YLS series wiring diagram
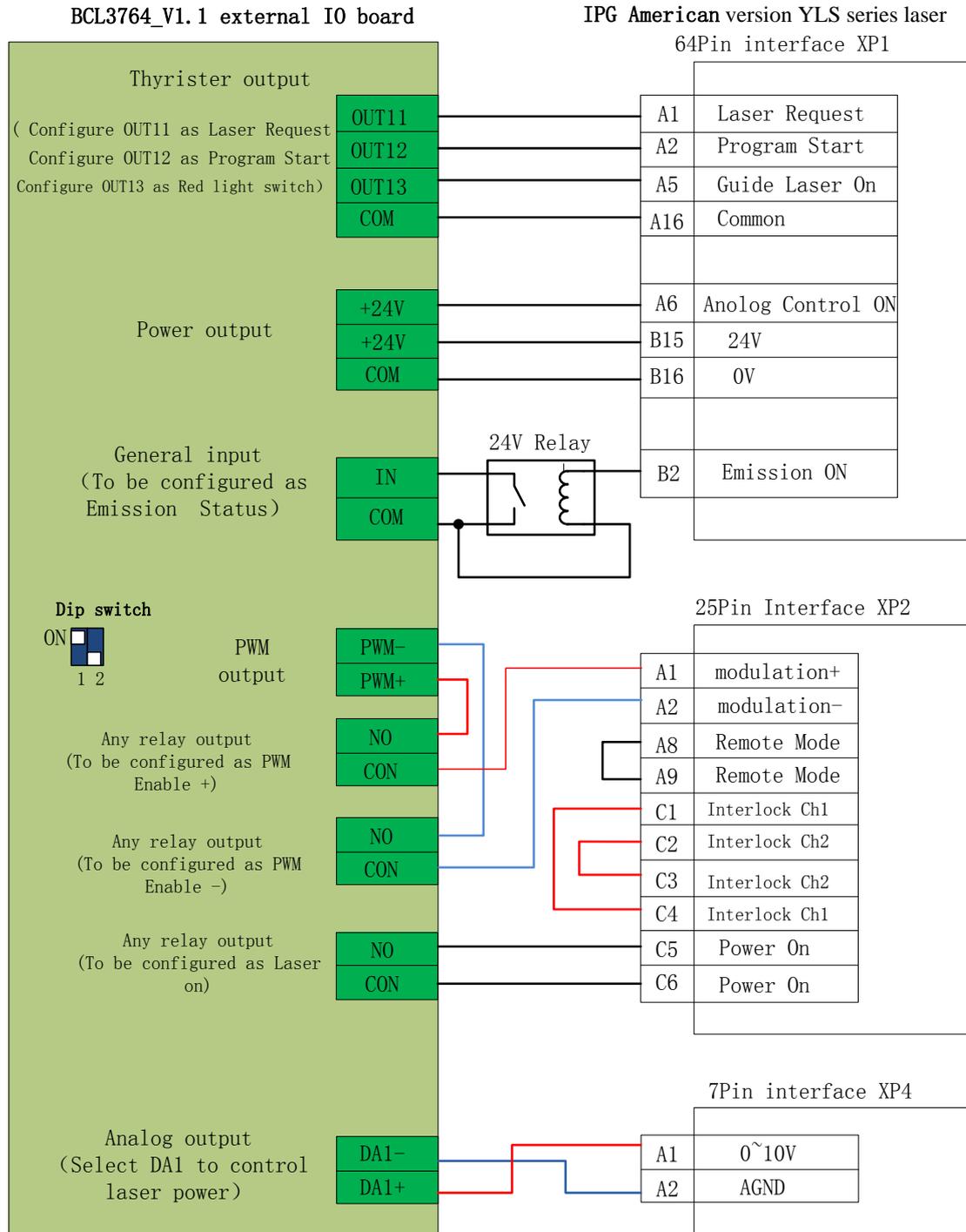
Note：

    1. B2 pin of XP1 interface cannot connect Emission ON, then make sure that the Emission Status input port is set as 0 in "platform configuration tool", which means do not detect whether the shutter has been open or not.

    2. PWM select 24V control (Dip switch: 1 pin is ON, 2 pin is OFF.
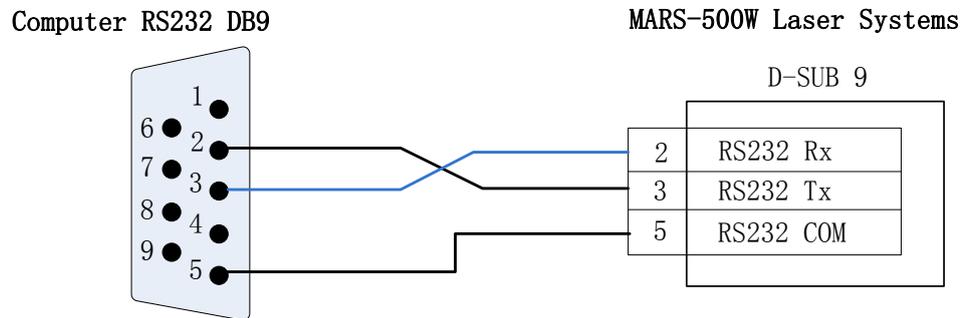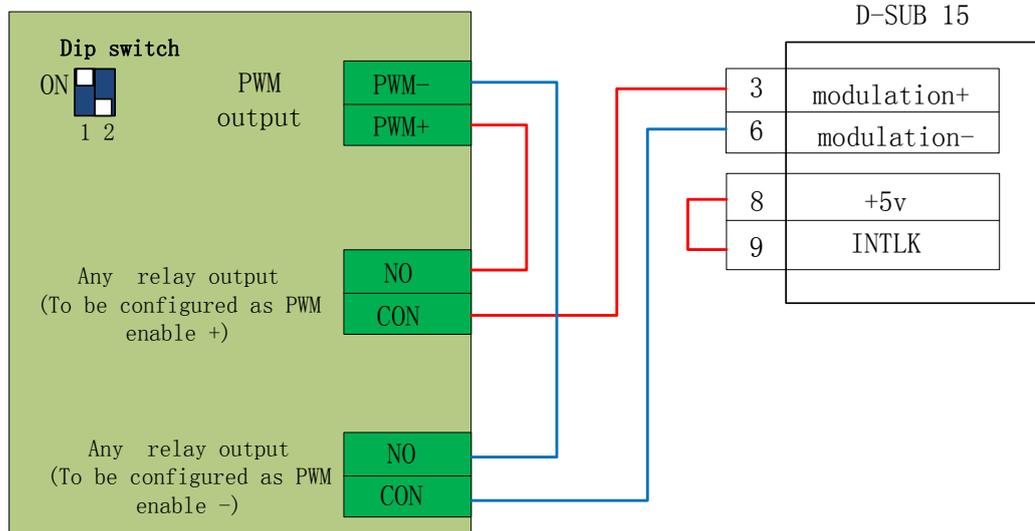
2.5.6 SPI-500W-R4 wiring diagram

SPI-500W R4 Laser Systems
InterLock

1	Interlock Ch1
2	Interlock Ch2
4	Interlock Ch2
5	Interlock Ch1

Computer RS232 DB9

RS232 Comms Port

2	RS232 Rx
3	RS232 Tx
5	RS232 COM

BCL3764_V1.1 external IO board

Dip switch

PWM output

| PWM- |
| PWM+ |

Any relay output
(To be configured as PWM enable +)

| NO |
| CON |

Any relay output
(To be configured as PWM enable -)

| NO |
| CON |

Mod Input TTL

| modulation+ |
| modulation- |

Note：

1. When the modulation signal select MODINPUTTTL interface, PWM select 5V control (Dip switch: 1 pin is OFF, 2 pin is ON.

2. When the modulation signal select 1 pin of I / O interface, PWM select 24V control (Dip switch: 1 pin is ON, 2 pin is OFF.

2.5.7 Bowflex MARS Series wiring diagram

Computer RS232 DB9   MARS-500W Laser Systems

D-SUB 9

2	RS232 Rx
3	RS232 Tx
5	RS232 COM

BCL3764_V1.1 external IO board

D-SUB 15

3	modulation+
6	modulation-
8	+5v
9	INTLK

Dip switch

ON
1 2

PWM
output

PWM-
PWM+

Any relay output
(To be configured as PWM
enable +)

NO
CON

Any relay output
(To be configured as PWM
enable -)

NO
CON

Note:
PWM of **Bowflex** laser select 24V control (Dip switch: 1 pin is ON, 2 pin is OFF.)

2.5.8 JK/GSI-FL Series wiring diagram
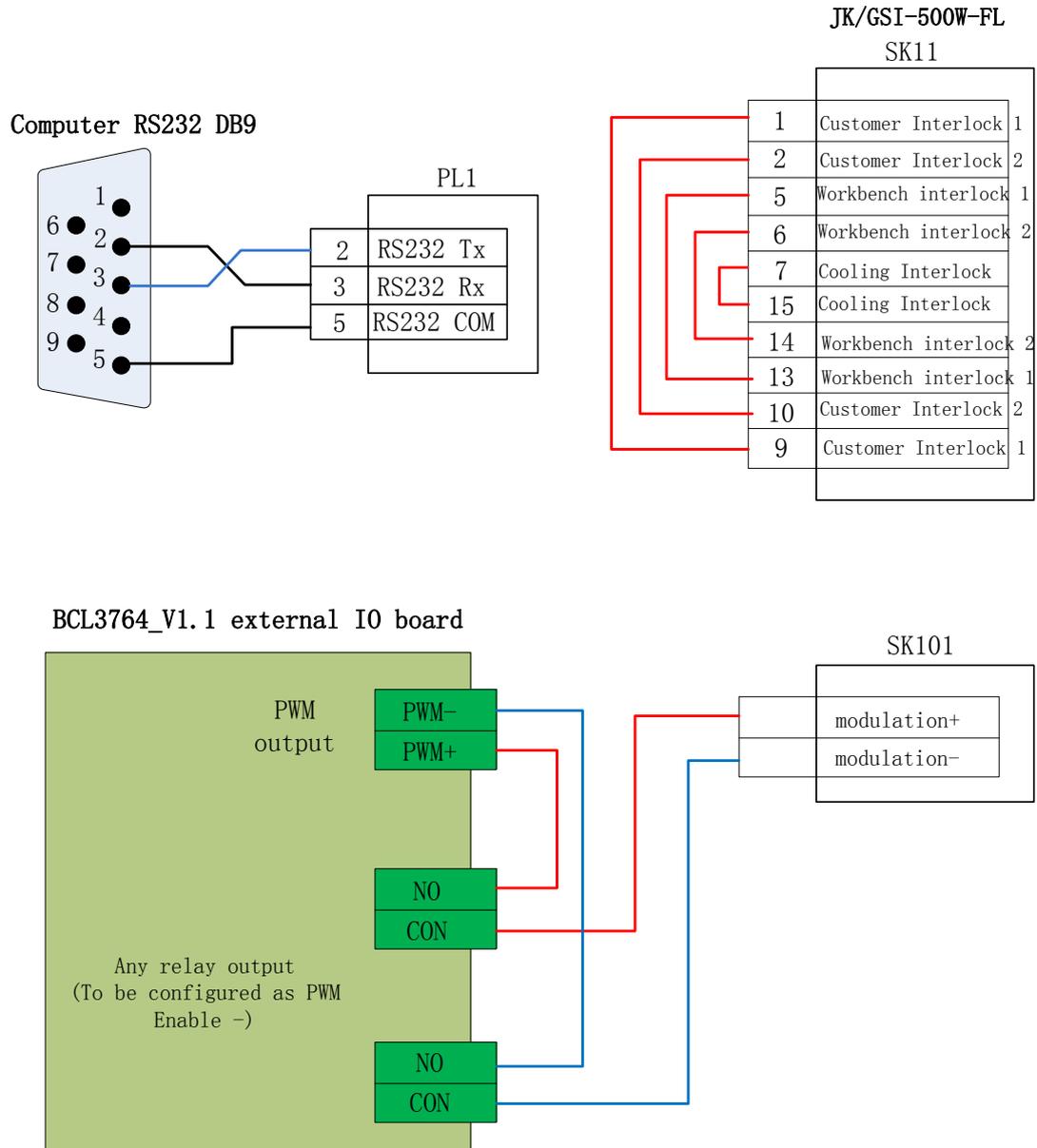
JK/GSI-500W-FL

SK11

1	Customer Interlock	1
2	Customer Interlock	2
5	Workbench interlock	1
6	Workbench interlock	2
7	Cooling Interlock	
15	Cooling Interlock	
14	Workbench interlock	2
13	Workbench interlock	1
10	Customer Interlock	2
9	Customer Interlock	1

Computer RS232 DB9

PL1

2	RS232 Tx
3	RS232 Rx
5	RS232 COM

BCL3764_V1.1 external IO board

SK101

modulation+
modulation-

PWM output

PWM-
PWM+

Any relay output
(To be configured as PWM Enable -)

NO
CON

NO
CON

Note:

1.Several wires on SK11 which need to be interlocked, can connect the appropriate equipment to ensure safety interlock in accordance with the corresponding interpretation.

2.When the modulation signal select SK101 interface, PWM select 5V control (Dip switch: 1 pin is OFF, 2 pin is ON.

3.When the modulation signal select 16 pin of PL5 interface, PWM select 24V control (Dip switch: 1 pin is ON, 2 pin is OFF.)

2.5.9 Rofin fiber laser wiring diagram

BCL3764_V1.1 external IO board

Thyristor output

(Configure OUT11 as Mission ON
Configure OUT12 as Fault Reset
Configure OUT13 as Stand By
Configure OUT14 as Red light switch
Configure OUT15 as Gate)

OUT11	3	Mains on
OUT12	1	Program Start
OUT13	4	Stand By
OUT14	8	Guide Laser On
OUT15	10	Gate
COM	9	Ext GND
	13	Gate GND

Rofin fiber laser
X710 interface

Dip switch

ON
1 2

PWM output

PWM−		
PWM+	15	Ext Pulse 5V
	16	Ext Pulse GND

Any relay output
(To be configured as PWM Enable +)

NO
CON

Any relay output
(To be configured as PWM Enable −)

NO
CON

X720 interface

22	Interlock Ch1
23	Interlock Ch1
24	Interlock Ch1
25	Interlock Ch1
26	Interlock Ch1
27	Interlock Ch1
28	Interlock Ch1
29	Interlock Ch1
30	Interlock Ch1
31	Interlock Ch1
32	Interlock Ch1
33	Interlock Ch1

X704 interface

Analog Output
(Select DA1 To control the laser power)

DA1−	1	Analog+
DA1+	14	Analog−

Note:

1. Several wires on SK11 which need to be interlocked, can connect the appropriate equipment to ensure safety interlock in accordance with the corresponding interpretation.

2. PWM of Rofin laser select 5V control (Dip switch: 1 pin is OFF, 2 pin is ON.)

2.5.10 Raycus fiber laser wiring diagram
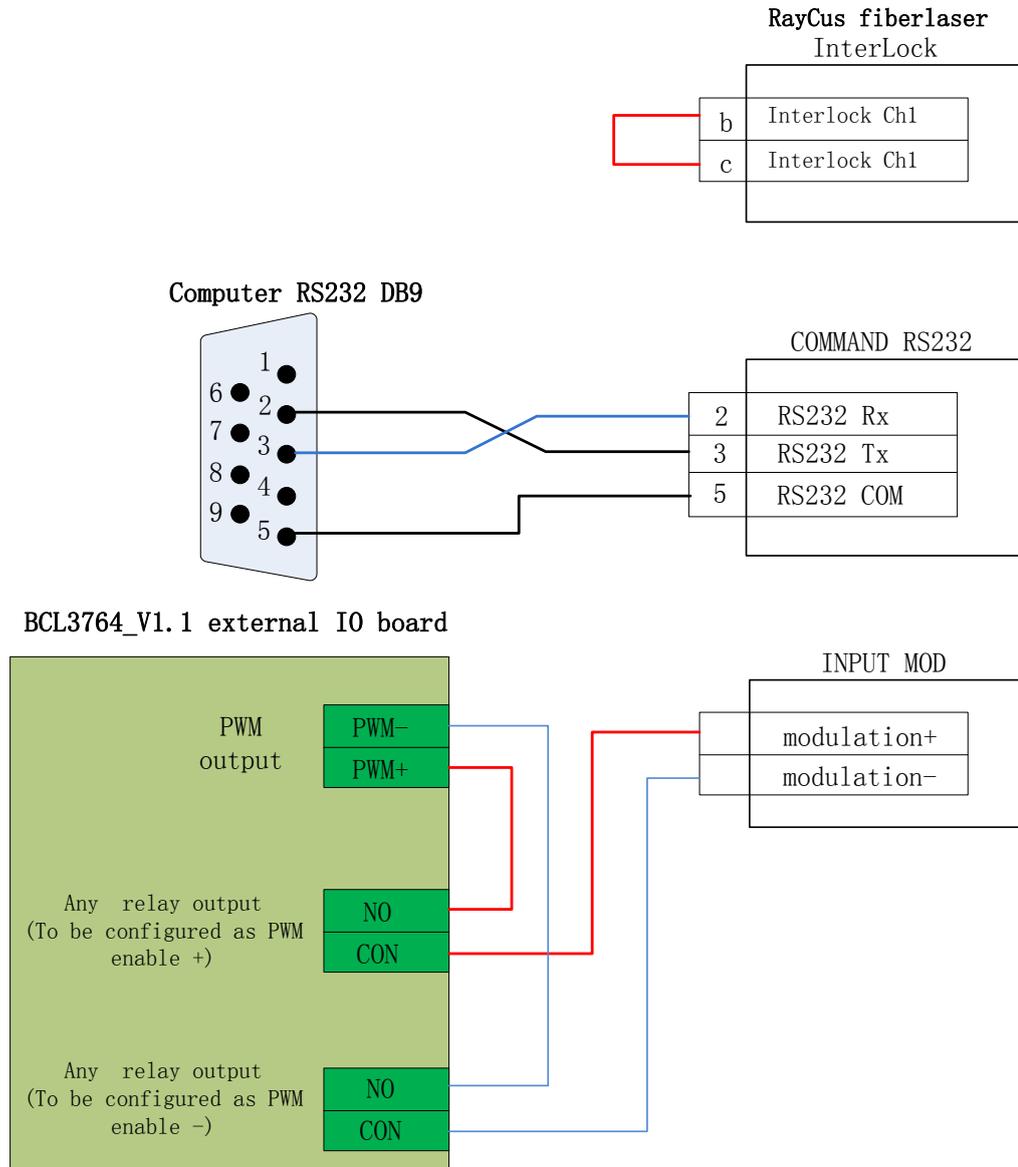
Note:

1. Raycus new lasers need to use 24VPWM signal control, while the old ones use 5V PWM signal. And new lasers can use the serial port control only before the key switch is in the REM state, while key switch of the old ones is in the ON state. It will indicate whether the laser is 24V PWM interface control or not; when it's not indicated or marked with 5V, 5V control mode can be applied totally.

2. PWM select 5V control (Dip switch: 1 pin is OFF, 2 pin is ON.)

3. PWM select 24V control (Dip switch: 1 pin is ON, 2 pin is OFF.)

2.5.11 Max laser wiring diagram

Max fiber laser
InterLock

1	Water Chiller safety interlock
19	Water Chiller safety interlock

BCL3764_V1.1 external IO board

Max laser interface

Dip switch

ON 〔■□〕
1 2

PWM output	PWM-		15	modulation+
	PWM+		3	modulation-

Any relay output (To be configured as PWM enable +)	NO			
	CON			

Any relay output (To be configured as PWM enable -)	NO			
	CON			

Any thyristor output (To be configured to enable light and red light)	OUT15		17	Redlight+
	OUT16		16	Emission enable+
	COM		21	Emission enable-
			22	Red light-

Analog output (Select DA1 to control laser power)	DA1-		5	AGND
	DA1+		12	0~10V

Any input port (To be configured as a laser alarm)	IN		18	PD+
	COM		23	PD-

Note:

1. PD+PD- is a laser alarm output, connected to the input of BCL3764 External IO board any circuit, and with setting a custom laser warning (normally open) in "Platform Configuration - Alarm - Custom Alarm".

2. Red and Emission enable GND can be incorporated together into any COM port of BCL3764.

3. PWM of Max laser select 24V control (Dip switch: 1 pin is ON, 2 pin is OFF.)

Chapter 3 Platform Configuration

3.1 Installation and operation

When you install CypTube software, your default selection is platform configuration tool.

Click "start"- "all programs"- "CypTube software for laser cutting"- "platform configuration tool" (the icon is) to operate platform configuration tool software. "CypTube software for laser cutting" in the path is the name of software. Different customers have different software names.

3.2 Password Input

Before operate platform configuration tool, password box will appear as shown below:
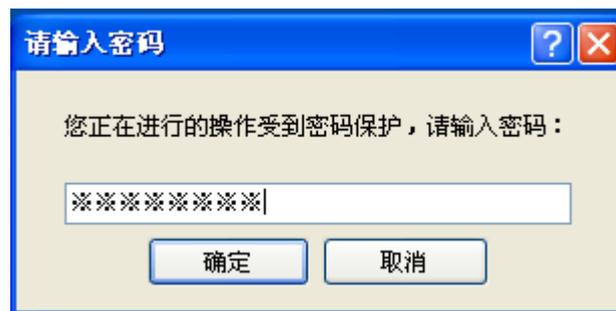
Input password 61259023 and click "OK", and you can start configuration of platform parameters.

Notes:

Users should do parameter configuration based on actual configuration of cutting platform and wrong configuration may lead to unpredictable consequence! In the platform configuration, the orange background color represents the input port configuration, the green background color represents the output port configuration.

3.3 User interface

Top platform configuration tools are shortcut buttons to enter various parameter setting interface, such as machineand shortcut buttons of restoring origin setting as shown in Figure on the left; shortcut buttons of lasers during controlling the device, height controller and auxiliary gas as shown on the central; shortcut buttons of alarm, general input and output and numerical control panel as shown on the right.

Click any button to enter into parameters setting page for current information, such as: click "machine tool" to enter machinesetting page.

Click "Open" button to open existing configuration files; Click "save" button to save information.

Notes:
1. Data files include various configuration information of CypTube soft-ware.
2. Data files backup function is in CypTube software ---- "File" ---- "parameter backup".

3.4 Mechanical structure configuration
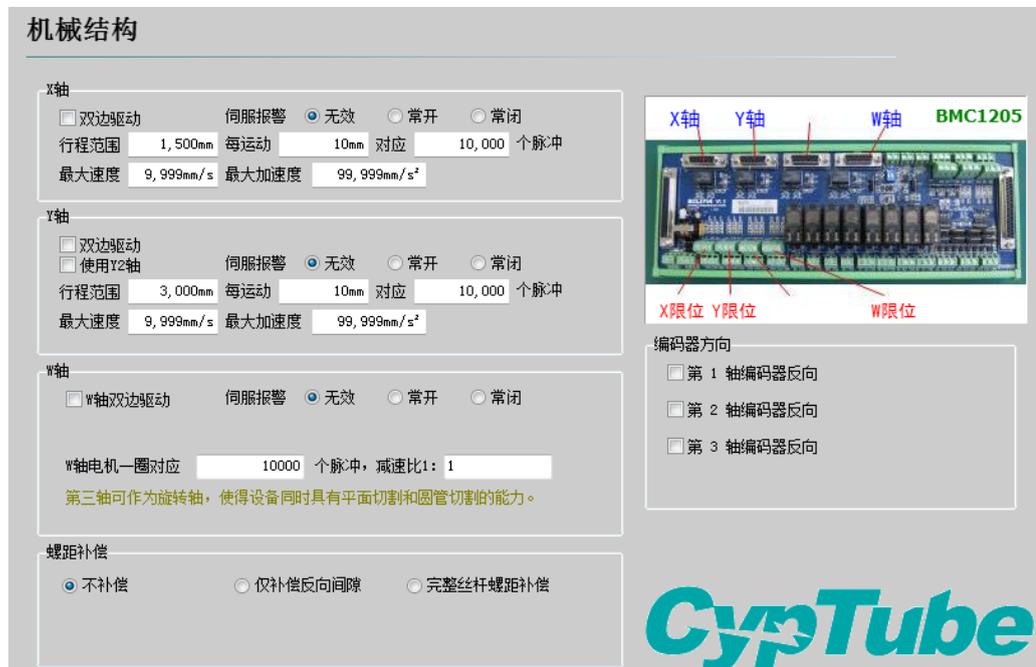
Select drive mode for each axis (whether it's double drive and that Y axis on applies Y2 or not), based on mechanical structure, and then configure information of rotation axis (Strictly input the command pulse of motor per rotation and reduction ratio of decelerator).

X axis range: After opening CypTube software, start soft limit protection. It's

the max motion range for X axis.

Y axis range: After opening CypTube software, start soft limit protection. It's the max motion range for Y axis.

Pulse equivalent: Pulse count sent for 1 mm motion. Count automatically by actual motion distance and pulse count, and millimeter value can be set as four digits after the decimal point. Pulse equivalent= pulse count/ millimeter value.

Servo alarm: Select servo alarm signal logic, or close servo alarm feedback.

Speed limit: limit max speed and acceleration for CypTube software.

Pitch Compensation: Error compensation for Interferometer data.

3.5 Return to origin configuration

Forced open software limit: Enforce to Open soft limit function, and prevent users from manually switching the soft limit in the master interface of CypTube.

Fixed rotation center: After recording the rotation center in CypTube software, select a coordinate which can fix rotation center. The modification of the rotation center can no longer be recorded in the master interface of CypTube.

Origin direction: Different type can select different back to origin direction. Back to origin direction determines which quadrant tool coordinate is in. For example, if X axis and Y axis select negative back to the origin, tool motion is in the first quadrant.

Sampled signal for back to origin: if users select limitation signal, origin switch can be replaced by limitation switch in the process of back to origin to realize

coarse positioning. Note: W axis can only apply origin signal as signal for back to origin.

Z direction signal: whether to use Z direction signal and sampled signal determines specific process of back to origin. The system will show a whole process on an image based on different back to origin way.

Precise positioning speed: As shown in the green section of the figure, approach the origin switch slowly. And It's recommended setting XY as 10 mm/s and setting W axis as 1 RPM.

Coarse positioning speed: As shown in the blue section of the figure, approach the origin switch fast. And It's recommended setting XY as 50 mm/s and setting W axis as 10 RPM.

Rollback distance/angle: A distance/angle for back in the motions of back to origin can ensure distance/angle of mechanical origin leaving a distance/angle from position limit switch.

3.6 Laser configuration

CypTube provides different lasers configuration for YAG, CO2, IPG, Raycus, and SPI, other fibers, and different fiber types correspond to different parameters.

3.6.1 CO2 laser configuration

Mechanical shutter: Set output port for controlling mechanical shutter.

Electrical shutter: Set output port for controlling electrical shutter.

Response input: Set output port for response signal after opening mechanical shutter.

Laser form: Set laser form as continuous wave, gate pulse and strong pulse through laser form 1 and laser form 2.

DA port: 1205 card provides 2 circuits of analog quantity and any circuit

o f output power controlling laser.

    DA voltage range: Set analog quantity range of controlling laser power.

    Minimum power: Set minimum limit for pulse power.

3.6.2 IPG laser configuration

    PWM-enabled signal: Select a relay output port as PWM-enabled switch, which can avoid laser leakage or wrong trigger under modulation mode.

    DA port selection: 1205 card provides 2 circuits of analog quantity. Any circuit can control laser peak power. Don't use this port when using serial port or n e t w o r k remote control.

    IPG fiber laser configuration: Remote start button:

    After starting IPG remote control, CypTube software will monitor the state of lasers in real time and can operate lasers by means of communication. Motions, such as Emission, Guide beam, Current, etc, are realized. After selecting this option, DA port will be not available.

    IPG remote control provides serial port and network, so users can set serial port or network IP address based on actual condition. If communication of PC, laser and BCS 100 applies network communication, please pay attention to don't repeat segment. For example, if height controller segment is 10.1.1.x, and then laser can be set as 192.168.1.x. From the perspective of system stability, network is recommended. If using serial port communication, please pay attention to shell and shielding layer of serial port connector must be ground connection.

3.6.3 Mars/Rofin/Raycus/SPI/GSI/JK laser configuration

Except remote control, the configuration of Mars, Raycus and SPI fiber laser is the same as IPG fiber laser, and supports serial port communication.

Debug mode: After opening this mode, CypTube run record column shows the code of communication between the software and lasers.

3.6.4 Other lasers

Emission Enable: Correspond to the shutter button on software, this signal can open shutter of the laser.

Emission preparation: Correspond to the shutter button on software, and can output one more circuit of output port to open the shutter after configuration.

Delay time: Correspond to the shutter button on software, and open the delay of Emission enable after in preparation of output Emission.

3.7 Height controller configuration

3.7.1 Use BCS100 network height controller

If use network height controller matched by our company (Abbreviation as BCS100), please set IP address which should be s the same as the network address in the BCS 100 parameters.

IP address setting, please refer to instructions P2.5.6 of BCS100 for more detail.

Analog BCS100: under the premise of absent BCS100, freely set the related parameters in CypTube.

3.7.2 Not use BCS100 network height controller (IO mode)

CypTube also supports input/output port to control height controller of other brands. Users can set the output port of following, rise (close following), stop (Hold), move up and down by clicking, and input port of following signal, by themselves.

Start following: open the input port for following.

Raise/finish following: set output port for raise(close following).

Stop/ Hold: Set output port for stopping Z axis motion.

Click to raise: Set output port for manually controlled Z axis raising.

Click to decline: Set output port for manually controlled Z axis declining.

Follow signal: Set input port for collecting and following signal.

Tracking in place signal: Set effective mode for signal controlling level.

Notes: if port is set as "0", it means it is not available. If there is no this signal, please don't set randomly, otherwise it may cause logical error!

3.8 Auxiliary gas configuration

High and low pressure valve: Set the total output port for auxiliary gas correspond to switch.

Air switch (high pressure): Set output port for air selection.

**Oxygen switch (high pressure):** Set output port for oxygen selection.

Nitrogen switch (high pressure): Set output port for nitrogen selection.

DA gas control: Users can select two circuits of analog of 1205 card to regulate auxiliary gas pressure.

The maximum pressure of proportional valve: Set the maximum pressure passed through the proportional valve.

3.9 Alarm configuration
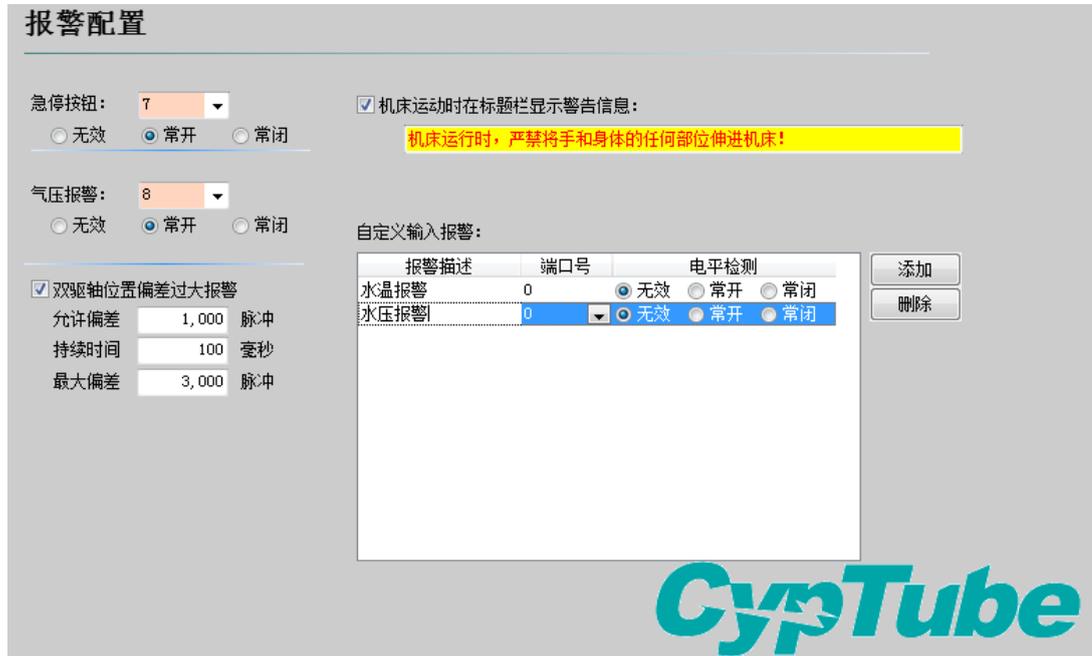
3.9.1 Operating warning

When the machine operates, the title bar will display a yellow warning message. You can customize the display.

3.9.2 Dual-drive excessive deviation alarm

If X or Y axis of the platform structure apply a bilateral drive, you can set up a dual-drive shaft position excessive deviation alarm. If the dual-drive error reaches a certain value (allowable deviation) and continues for a certain period of time (duration time), the system will generate a "dual-drive shaft position excessive deviation alarm". If the deviation reached the maximum deviation value (maximum deviation) in a moment, the system will immediately generate an alarm.

3.9.3 Emergent stop button

Configure input port for emergent stop button, and here emergent stop is an input signal. If input port is active, emergent stop alarm will be generated.

3.9.4 Pressure alarm

Configure input port for pressure alarm, and here alarm is an input signal. If input port is active, pressure alarm will be generated.

3.9.5 Customized input alarm

Users can add other types of alarm in "customized input alarm" and input alarm name in alarm description. Select port number and level detection type corresponding to alarm. General customized alarms include lack-voltage alarm, excessive temperature alarm, laser head collision alarm, etc.

Notes: All the alarm states will be automatically eliminated within 2 seconds after eliminating alarm signal.

3.10 General input
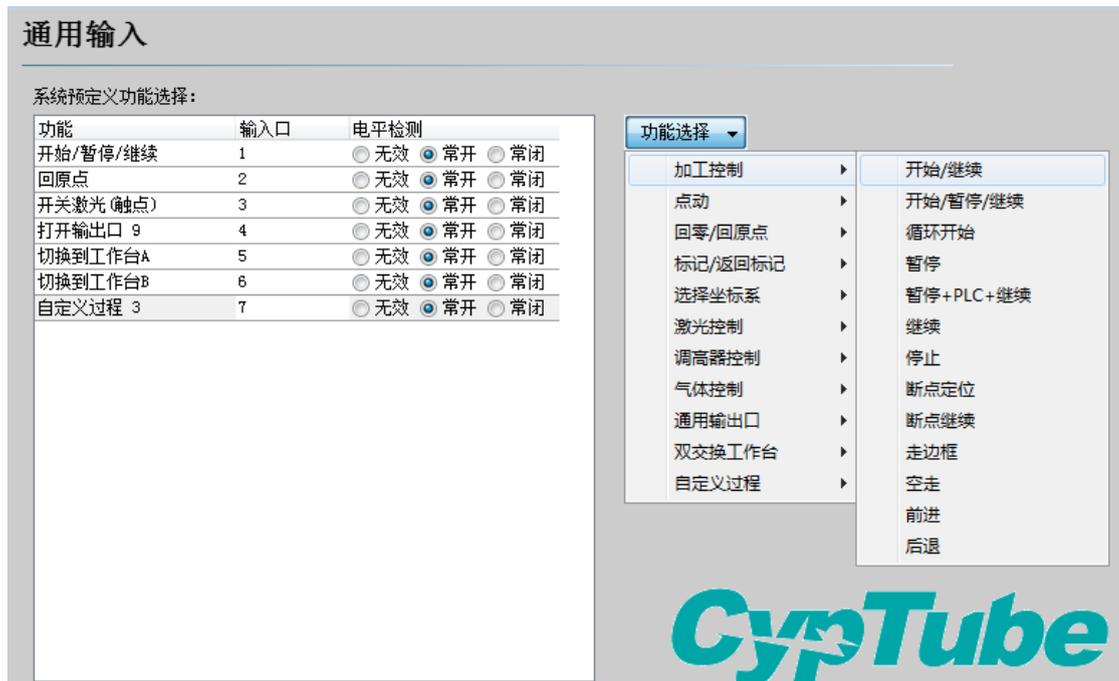
Click on the "Function select" button, users can select the function name of the input port in the drop-down list, and then configure the corresponding input port and level detection.

Some functions of switching are divided into four sub-items, such as a laser switch, as shown below:
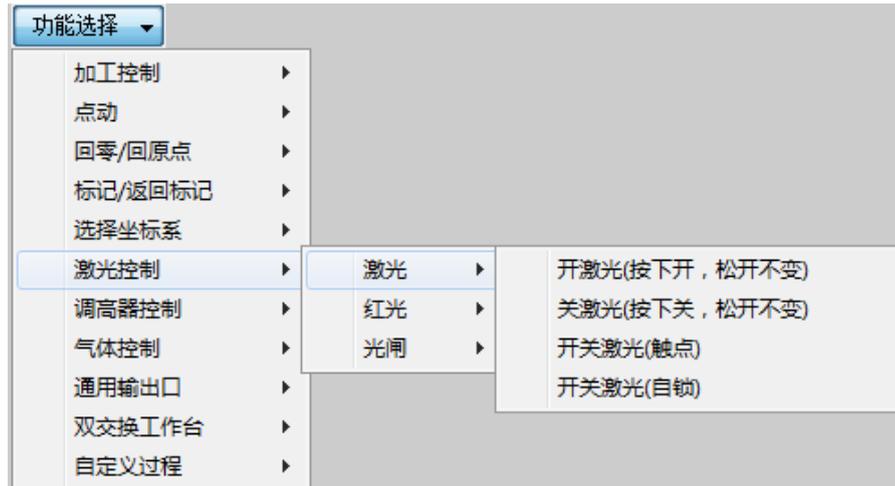
Each instruction is shown as below, please select according to your needs.
It's in the following table.

Function Name	**Instructions**
It's on when press, and loose without changing.	Press the button: Open the corresponding function; Loose the button: Not perform any action.
It's off when press, and loose without changing.	Press the button: Close the corresponding function; Loose the button: Not perform any action.
Contactor	Press the button: Open the corresponding function; press again: close the function.
Self-locking	Press the button: open the corresponding function; press again: close the function.

3.11 General output
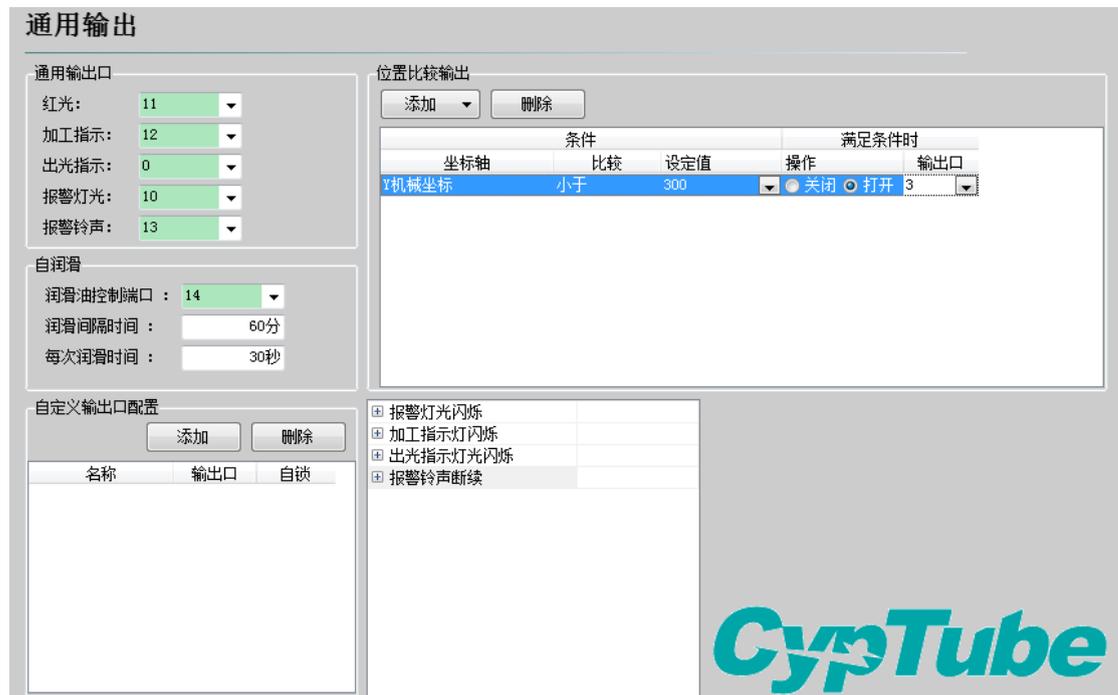
3.11.1 Output port configuration

Red Beam: Set output port for beam switch.

Processing indication: After port configuration, corresponding indicator light will blink when processing.

Alarm indication: After port configuration, corresponding indicator light will blink during alarming.

Light indication: After port configuration, corresponding indicator light will blink during lightening.

Alarm bell: After port configuration, corresponding bell will ring during alarming.

Light blinking: After this series function is enabled, you can customize the time of corresponding port to be open and closed, in order to achieve flicker effect.

3.11.2 Self-lubricating

After the port is configured, start time from opening the CypTube software. And then close, after opening the corresponding output port during each interval period and maintaining the setting output time.

3.11.3 Customize the output

Configure custom output port. The control buttons of custom port is displayed at the numerical control page of CypTube software. This custom port can choose the control mode of self-locking or contactor.

3.11.4 Position compare output

Position output is mainly used to lift and descend the pipe bracket. When the movable card machine move to the machine coordinate less than 300 (as shown above), then the corresponding **"output 3"** will open, thereby descending the pipe bracket.

3.12 Numerical control panel
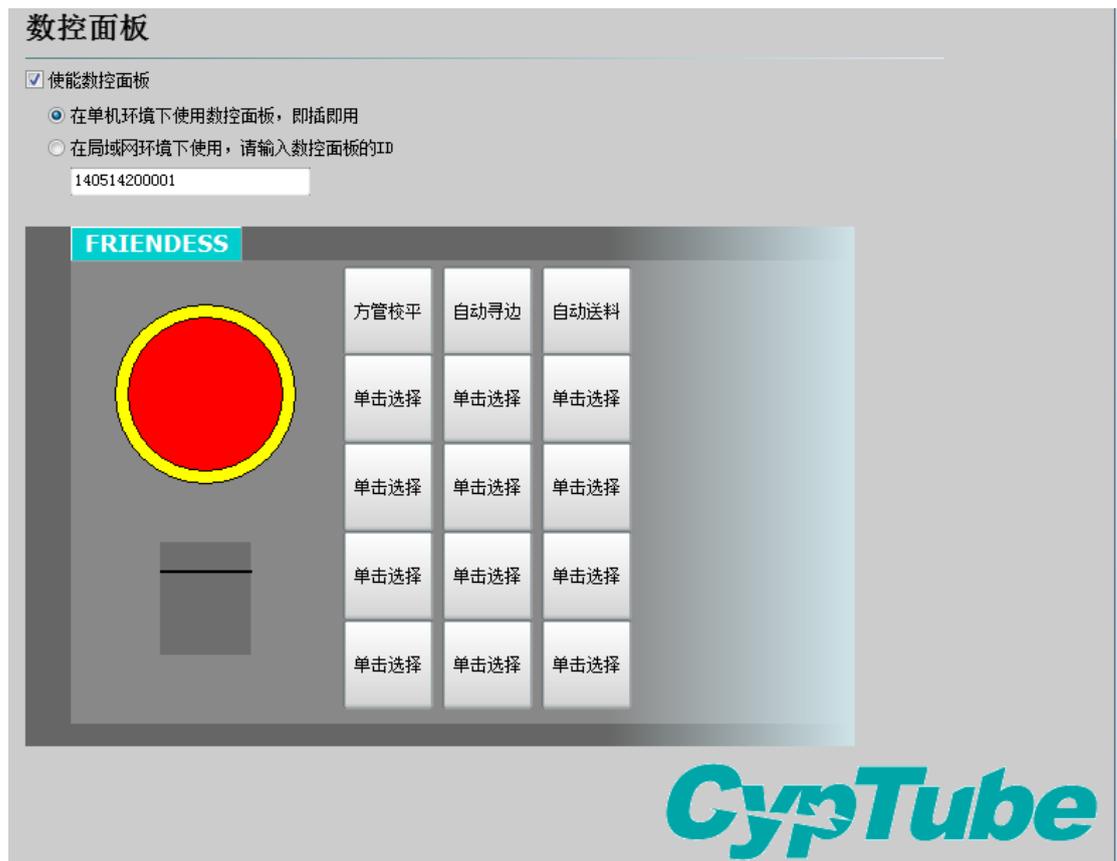
BCP5045 numerical control panel can be activated in numerical control panel interface. When used in a stand-alone environment, CypTube software will adaptively match the Mac address of BCP5045 numerical control panel, and automatically connect the control. When BCP5045 is used in the LAN environment, please enter BCP5045 device ID number. BCP5045 is in total of 12 custom keys, which can be configured as a control button of double exchange workbench or other custom PLC.

Chapter 4 Electrical System Debugging

4.1 Power test

Connect BCL3764 external IO board and BMC1205 control card with C62-2 and C37-2 cables, and provide 24V power for BCL3764 external IO board. Before turn on system power, please confirm whether power connection is correct or not and whether positive and negative polarity of power is short circuit or not.

Notes: Prohibit plugging BMC1205 card, C62 and C37 cable with electric heating!

4.2 All the hardware signal test

Start computer and CypTube software. Click "file" in menu above→"interrogation windows".
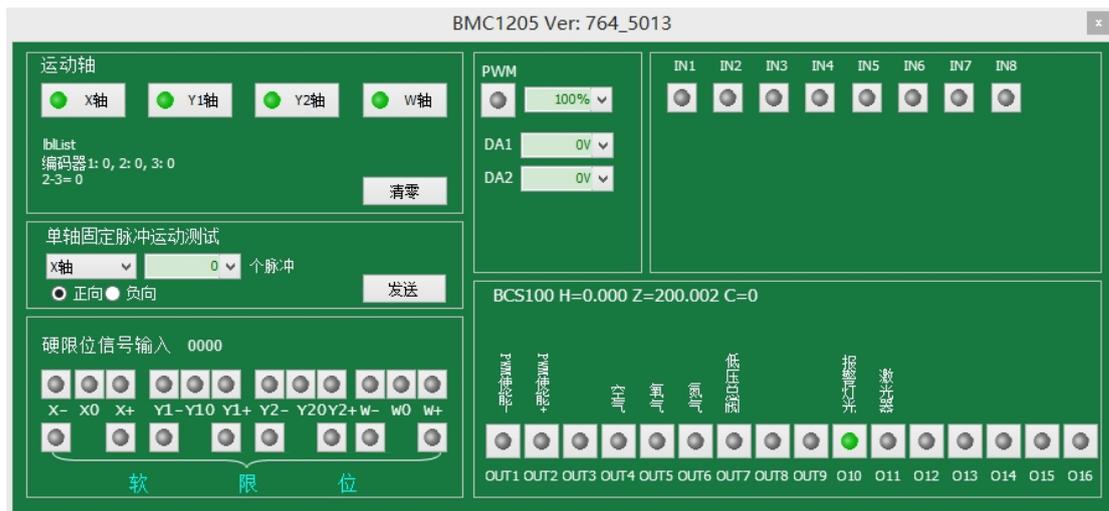
Please check in sequence positive/negative/origin switch of each axis, input signal, output signal, DA signal, PWM signal and servo-enabled signal.

For machines of double shaft drive, count value of encoders of two axes can be reset through 【reset】 button. Then send 1000 test campaign about the status of each axis, and ensure feedback pulse value and sent pulse value of encoder is in accord. Setting method can refer to Appendix 7.1 "Scan cut" introduction file in "FSCUT2000 laser cutting control system User Manual" for more details.

4.3 Basic motion test

First, recommend setting servo driver parameters as conservative values. Also set the parameters of CypTube as conservative values. Click "process" → "Global parameter" on CypTube. Parameter setting is shown as below:

Use pulse test function, test whether pulse equivalent of the system is set correctly or not, click to test whether the direction and motion of each axis is normal or not.

Dual-drive machines do not install the electric motor at first, with no-load operation. Be sure to confirm the rotation direction and mechanical installation method of electric motor is well, and then install the motor.

When have confirmed the limit origin signal is normal, make each axes of the machine home origin and build machine coordinate system.

4.4 CypTube basic functional test

Use control panel on the right of CypTube software to click manually,rise and fall cutting head, switch gas, switch shutter, switch beam, laser on, and conduct each test by the operation of changing fixed fire power etc. Confirm the system can normally control laser, height controller, gas, etc.

Chapter 5 Motion effect optimization

5.1 Infer inertia ratio and machine characteristics

Machine inertia ratio is a key indicator we measure the machine characteristics. Using Servo Tools of Friendess, we can very easily calculate the inertia ratio of the machine for each axis. Servo Tools can be downloaded in http://downloads.fscut.com/. As shown below:

When inertia ratio is less than 200 percent, the device is light loaded, and enables high-speed cutting.

When inertia ratio is greater than 200% but less than 300 percent, the device is medium loaded, lose some precision during high-speed cutting, and need to appropriately reduce processing acceleration and FIR frequency.

When inertia ratio is greater than 300% but less than 500 percent, the device is overloaded, unable to achieve high-speed cutting.

When inertia ratio is greater than 500%, there are serious design flaws, servo is difficult to complete setting in a short time.

The maximum supported machine cutting speed, the maximum air shift speed, and the maximum acceleration can also be simply calculated by Servo Tools. These three parameters can be directly applied to control parameters in the software. Experienced users can also accurately calculate the inertia ratio through testing software coming with servo.

Notes: the servo parameters calculated by Servo Tool is only used for BMC1214 closed-loop control system. Users of BMC1204 open-loop control system and BMC1205 pipe cutting system, please set servo parameters based on position mode.

5.2 Servo gain adjustment

5.2.1 Basic requirement

First, debuggers should be familiar with servo and can use professional servo software to debug servo. For example, Panasonic servo comes with PANATERM testing software and Yaskawa servo comes with SigmaWin+ testing software. This can simplify debugging.

5.2.2 Panasonic servo gain adjustment

STEP1: Open 【gain adjustment】 interface in PANATERM software. Open 【real time automatic adjustment】 function of target axis, to automatically estimate inertia ratio.

STEP2: Rigidity is set as conservative value. For example, it can be set as level 13 first. Then click to move this high-speed axis with CypTube software. Observe whether axis is with abnormal sound and vibration, etc. Raise rigidity slowly. When the axis is with abnormal sound or vibration, level 1~2 should be declined to guarantee system stability. The final level should not be level 10 and more than level 20. If it's dual-drive shaft, it starts moving only after modify two pairs of drive shaft parameters.

STEP3: After rigidity of X axis and Y axis is tested, set rigidity level as the same level to guarantee response of two axes are the same. The smaller rigidity is standard. For example, X axis is level 19 and Y axis is level 16. Finally, set X axis and Y axis as level 16.

STEP4: Close 【real time automatic adjustment】 and save parameters.

5.2.3 Yaskawa servo gain adjustment

Yaskawa servo debugging is similar with the Panasonic. However, there is some difference. The difference is as below:

● SigmaWin+ cannot be used to dual-drive axle ratio estimation, and advanced auto-tuning. Inertia ratio calculation tool, Servo Tool can be downloaded from the official website of Friendess to roughly calculate the inertia ratio for each axis. Advanced users may also accurately calculate the inertia ratio, based on a change of acceleration torque and acceleration time, by themselves.

● We suggest closing Pn140 model tracking function.

● We suggest closing Pn170 free adjustment function.

● Yaskawa servo does not introduce rigidity and can set the following parameters based on Panasonic servo rigidity.

Pn102 position loop gain: Correspond to pr100 of Panasonic.

Pn100 speed loop gain: Correspond to pr101 of Panasonic.

Pn101 speed loop integral time constant: Correspond to pr102 of Panasonic.

Pn401 Torque filter time constant: Correspond to pr104 of Panasonic.

● The table is as below, and you should pay attention to unit and decimal point. The unit of Yaskawa speed loop integral time constant, Pn101, is 0101 ms, while the one of Panasonic is 0.1 millisecond.

Rigidity	Pr1.00 Position loop gain [0.1/s]	Pr1.01 Speed loop gain [0.1Hz]	Pr1.02 Speed loop integral time constant [0.1 ms]	Pr1.04[*2] Torque filter [0.01 ms]
10	175	140	400	200
11	320	180	310	126
12	390	220	250	103
13	480	270	210	84
14	630	350	160	65
15	720	400	140	57
16	900	500	120	45
17	1080	600	110	38
18	1350	750	90	30
19	1620	900	80	25
20	2060	1150	70	20

5.2.4 DELTA servo debugging experience

Delta servo debugging can also refer to the rigidity table of Panasonic. The reference method is shown as below:

The parameter P2-00 KPP is the equal of the position loop gain of Panasonic. Though its unit is rad/s, actually, It's 1/s. For example, when the P2-00 KPP= 90, it's the same as Pr100=900 of the position loop gain of Panasonic.

5.3 Motion Control parameter adjustment

5.3.1 Motion control parameter introduction

FSCUT3000 system mainly opens the parameters, such as speed, acceleration, and to adjust these parameters can affect stability, processing effectiveness and efficiency during mechanical operating. Other sports-related parameters have been optimized internally without needing user settings. The meanings of some parameters are shown as below:

Name	Introduction
Move speed XY	The speed of plane axis Move (not processing speed).
Move speed W	The rotational speed of rotation axis move (not processing speed).
Maximum rotational speed of rotation axis during processing	Please calculate an appropriate value based on your maximum rotational speed of the servo motor and reduction ratio. For example, the maximum motor rotational speed is 3000r / min, the reduction ratio is 1:60. And then the maximum rotational speed of rotation axis during processing = 3000/60 = 50r / min.
Move acceleration	The maximum acceleration of each axis during move is generally set as 1.2~ 2 times of the processing acceleration.
Processing acceleration	The maximum acceleration of each axis when the track processing, used in conjunction with the processing speed.
Turning acceleration	When the track processing, the maximum acceleration in corner, allowed for restricting the turning speed with corner angle greater than 90 degrees. And all of the angular speed less than or equal to 90 degrees will be reduced to zero.
10mm reference circle speed	Used for limiting speed of small arc and small curvature graphics.

5.3.2 Adjust processing acceleration

The speed of high-clicking can be set as high as possible, such as 500mm / s. When complete a click, moving distance is required to be long enough, in order to ensure that speed can be accelerated to the setting value.

Observe the torque curve of click movement by the servo debugging software. For example, if the maximum torque is less than 80%, appropriately increase the processing acceleration; if the maximum torque is higher than 80%, appropriately reduce the processing acceleration.

Adjust the acceleration, until the maximum torque nearly is 80%. Generally, the processing acceleration withstood by lead screw is not more than 0.5G. Rack and pinion generally is not more than 2G.

5.3.3 Adjust move acceleration

Directly fill the maximum acceleration calculated by ServoTool software, or

appropriately increase the move acceleration on the basis of processing acceleration, for example, set as 1.5 to 2 times of the processing acceleration. It's required that the maximum torque of the servo is not more than 150%, and the mechanical structure does not occure significant deformation and vibration under this acceleration. Screw affordable air movement acceleration generally is not more than 0.5G. Rack and pinion generally is not more than 2G.

5.3.4 Adjust 10mm reference circle speed

Generally, it's not recommended that users modify the parameters of 10mm reference circle speed. Under special circumstances, the parameters can be fine-tuned in the vicinity of the range of default parameters.

If you are not satisfied with the accuracy of the arc, you can modify the parameters of 10mm reference circle speed to be smaller. And then the speed will be limited during processing the arc. The smaller the value is, the more obvious the speed will be limited.

Chapter 6 General Problems

6.1 "Motion control card initialization fails" pops up when open Cypcut

1. "desktop" of computer→ click right in "my computer" →"attributes" → "hardware" → "device manager". Click "operation" → "Scan for hardware changes". See whether there is motion control card, as shown below: If BMC1205 motion control card can be found in device manager, please try reopening CypTube software

⊿ 💇 BMX-柏楚电子运动控制卡
　　💇 BMC1205运动控制卡
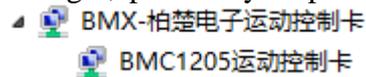
2. Observe the blinking state of 2 small lights on top of BMC1205. The position of lights is shown as below:
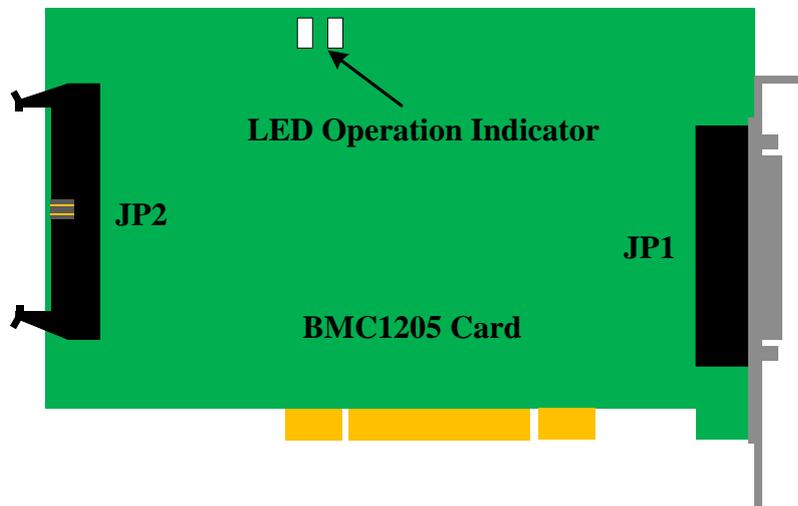
The representative state of LED blinking is shown as below:

Blinking State	Meaning	Solution
1 blink 1 blink	running normally	normal
1 blink 2 blink	not available	/
1 blink 3 blink	unsupported USB	replace USB flash disk to upgrade
1 blink 4 blink	FPGA BOOT data transmission error	use USB flash disk to upgrade
1 blink 5 blink	FPGA BOOT initialization error	use USB flash disk to upgrade
1 blink 6 blink	FPGA BOOT unable to complete	use USB flash disk to upgrade
2 blink 3 blink	ARM upgrade failed	use USB flash disk to upgrade
2 blink 4 blink	file system formatting error	back to repair

3. If LED is one flash and one flash (alternately flashes), which indicates BMC 1205 card is normal. Maybe PCI slot is bad contact. We suggest reinserting board card or replacing PCI slot after computer switches off.

6.2 Pulse equivalent setting

The system defines that pulse equivalent is the pulse count sent after 1mm movement.

The maximum pulse frequency of BMC1205 motion control card is 3Mpps. Assume the maximum operating speed designed by the system is 1000mm / s. Then the pulse equivalent for each axis should not exceed 3Mpps / 1000 = 3000 Pulse / mm.

Under the permitted circumstances, we suggest set the pulse equivalent in 1000 ~ 2000 Pulse corresponding to per 1mm, and thus pulse sequence can be more continuous. Please try not to set the pulse equivalent as 200Pulse / mm or less.

Set pulse equivalent of X axis and Y axis as the same as possible, which is helpful to reduce truncation error calculated by the system..

6.3 How to use USB flash disk to upgrade BMC1205

After CypTube upgrades new functions, sometimes firm-wares of BMC 1205 card will be upgraded. In the case of interference, static, etc, firm-wares of control card may be lost. Using USB flash disk to upgrade is a fast and effective solution. The steps are shown as below:

STEP1: find a USB flash disk, formatting is FAT/FAT32.

STEP2: under CypTube installation directory (default: C:/ ProgramFiles

/Friendess/CypTube), there is a drivers directory. Copy BM5.AFM and BM5.FFM to USB flash disk.

STEP3: Unplug USB flash disk and turn off PC. Open rear cover of PC, insert USB flash disk into USB slot of BMC1205 card, and then turn on PC. At this time, BMC1204 card will be upgraded automatically, in which LED will not blink. After upgrade, the two LED will blink at the same time. It takes less than one minute to upgrade.

STEP4: Unplug USB flash disk and turn off PC. And then turn on PC. Please pay attention to don't restart computer directly.

STEP5: After start PC, observe that whether LED is one flash and one flash (alternately flashes). If it is, it means upgrade is successful.

6.4 Graphics processing is quite slow or pause

● Check whether the unreasonable delay is set or not, or the unit is misread, for example, set 200ms as 200s.

● If the Z-axis has pause during the movement of lifting and descending, please check the program version of BCS100 height controller. If It's BCS100 V2.0 height controller, please make sure the program was upgraded to the version of V964 or later.

● Opening laser after blowing for a long time, please check the serial communication of laser is available.

6.5 Corner burning

● Properly increase turning precise parameters, and make high-speed smooth transition in sharp corner with Bezier curve

● Modify the mapping way, processing the circle overcut by the example as shown below.

● Modify power curve, turn down laser power when speed declines.

● Add cooling points on the corner, further processing after blow to cool for a period with light off.

6.6 Laser not emitting light

1. Check whether the laser setting is correct or not

① Determine correct laser configuration in the platform configuration tool (YLS series of IPG has difference between German version and American version)

② Determine whether serial port or Ethernet communications is applied and communications port is configured correctly.

③ Determine whether the DA signal control is applied to control the peak

power, DA is selected correctly.

④ PWM-enabled and light-enabled is configured correctly.

2. Check the output signal of PWM and DA

① Modify the output value of DA and PWM in the interrogation window of CypTube software (file—interrogation window). Use multi-meter to test whether DA of BCL3764 terminal block and voltage of PWM output port is normal or not.

② If PWM output voltage is too low or the DA signal has no output, try to replace another circuit of PWM or DA.

③ If it's hardware failure, please contact our technical support or apply for repair.

3. Check connection

① Check the connection of PWM, serial cable and laser control signal lines.

② Make sure serial cable use a shielded cable. 2 pin and 3 pin need to be cross.

4. Check laser

① Use the matching software coming with laser to do self-checking and to check light change, and to judge whether laser is working normally.

② In the case of serial communication, not allow to open multiple software to communicate with lasers at one moment.

③ In the case of no serial port communication, you can click debug mode to view the sent instructions and the response of the laser.

Chapter 7 Appendix

7.1 Screw pitch compensation

7.1.1 Brief introduction of pitch compensation

Since the unevenness of screw, rack and other mechanical components exists, there is often a bias the actual characteristic and nominal features. When high precision is required, the actual deviations is required to be measured by a laser interferometer and other precision instruments, and then be compensated by the numerical control system, so as to achieve the purpose of reducing the deviation.

CypTube laser cutting system provides a complete and easy to use screw pitch compensation function, can easily control the machine to run in accordance with the requirements of the laser interferometer, and can directly read the data files outputted by laser interferometers, such as Renishaw, API, Agilent, OptoDyne. Even in the absence of laser interferometer supporting, reverse error compensation can also be set separately.

7.1.2 Determine the machine origin

Before measurement error, we must first determine the machine origin. Screw pitch compensation is compensated by the machine origin as a reference. If the origin used by error measurement is different from the origin operating after machine compensation, then the screw pitch compensation will become meaningless. The machine homing origin can be set in the platform configuration tool of CypTube, as shown below:

As long as conditions allow, be sure to select "Use Z-phase signal", which will greatly enhance the accuracy of homing origin. BMC1205 motion control card matched with CypTube provides encoder input to each axis, to extremely ensure accuracy.

Please select the direction X and Y axes home origin based on machine actual design. The direction of homing origin directly determines in which quadrant of the coordinate system the machine will run. If you select the "negative direction" to home origin, then the machine will run in the range of positive coordinates, otherwise the machine will run in the range of negative coordinates.

If possible, please repeatedly home origin by CypTube, then measure the accuracy of homing origin by laser interferometer. Usually, the position of every homing origin does not differ more than 5 microns.

7.1.3 Determine pulse equivalent

Due to the processing precision and assembly errors, often, there's difference between the pulse equivalent calculated by theory and the actual machine pulse equivalent. The pulse equivalent can be accurately measured by laser interferometer.

Specific measurement methods, please refer to Appendix 7.2.3 documentation of "Determine pulse equivalent" in "FSCUT2000 laser cutting control system User Manual".

7.1.4 Error measurement

The error is measured by the interferometer, commonly known as "Open interferometer." Generally, control the machine to stay for some time at an interval distance by the numerical control system, and then laser interferometer can measure the actual position of each point. The correspondence table of the theoretical position and the actual position can be obtained after all location measurement has been completed.

The error measurement through the interferometer of FSCUT3000 system, please refer to Appendix 7.2.4 documentation of "Error measurement" in "FSCUT2000 laser cutting control system User Manual".

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