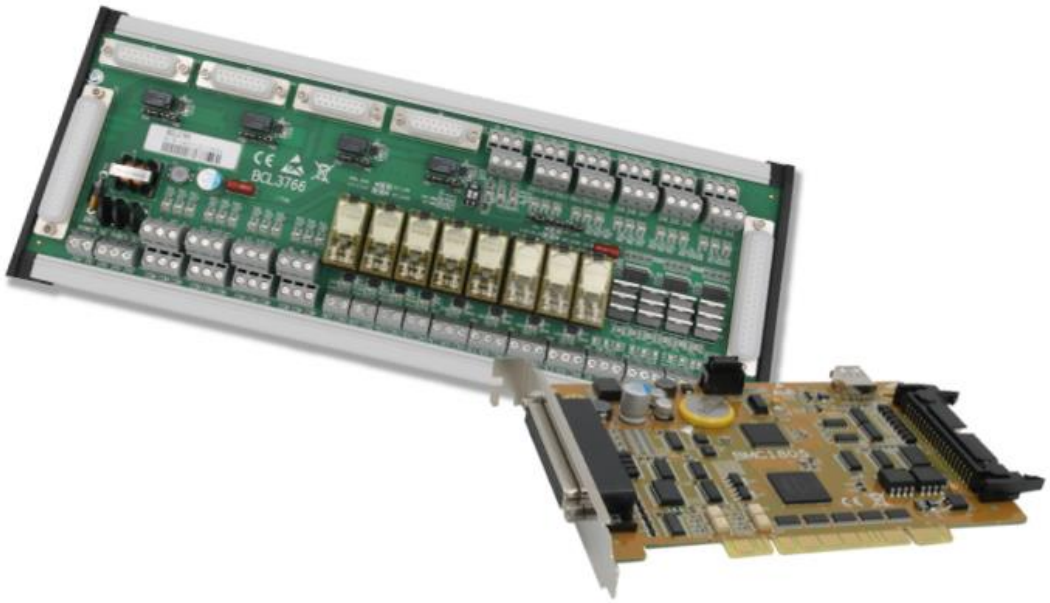
FSCUT3000S Laser Cutting System
User Manual



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Thank you for choosing our products!

This manual gives a detailed introduction to the use of FSCUT3000S laser cutting control system, including technical features and installation instructions, etc. If you want to know more information about TubePro cutting control software, TubesT/TubesT-Lite 3D nesting software and BCS100 height controller which are used in FSCUT3000S system, please refer to related manual. For other matters you can contact us directly.

Operating personnel should read the manual in detail which will be helpful for a better use of the product.

Due to the continuous updating of product functions, the products you receive may differ from the statement in this manual in some respects. We apologize for any inconvenience may cause.

You can download the latest software on official web site www.fscut.com to get function update and application solutions.

1. Product introduction

1.1 Brief introduction

FSCUT3000S is an open loop laser cutting control system of high performance developed by Shanghai Friendess Company. It is widely used in the field of metal and non-metal laser cutting area and gained popularity among the customers at home and abroad for its outstanding performance in medium power laser cutting application.

Please read through this manual carefully before operation.

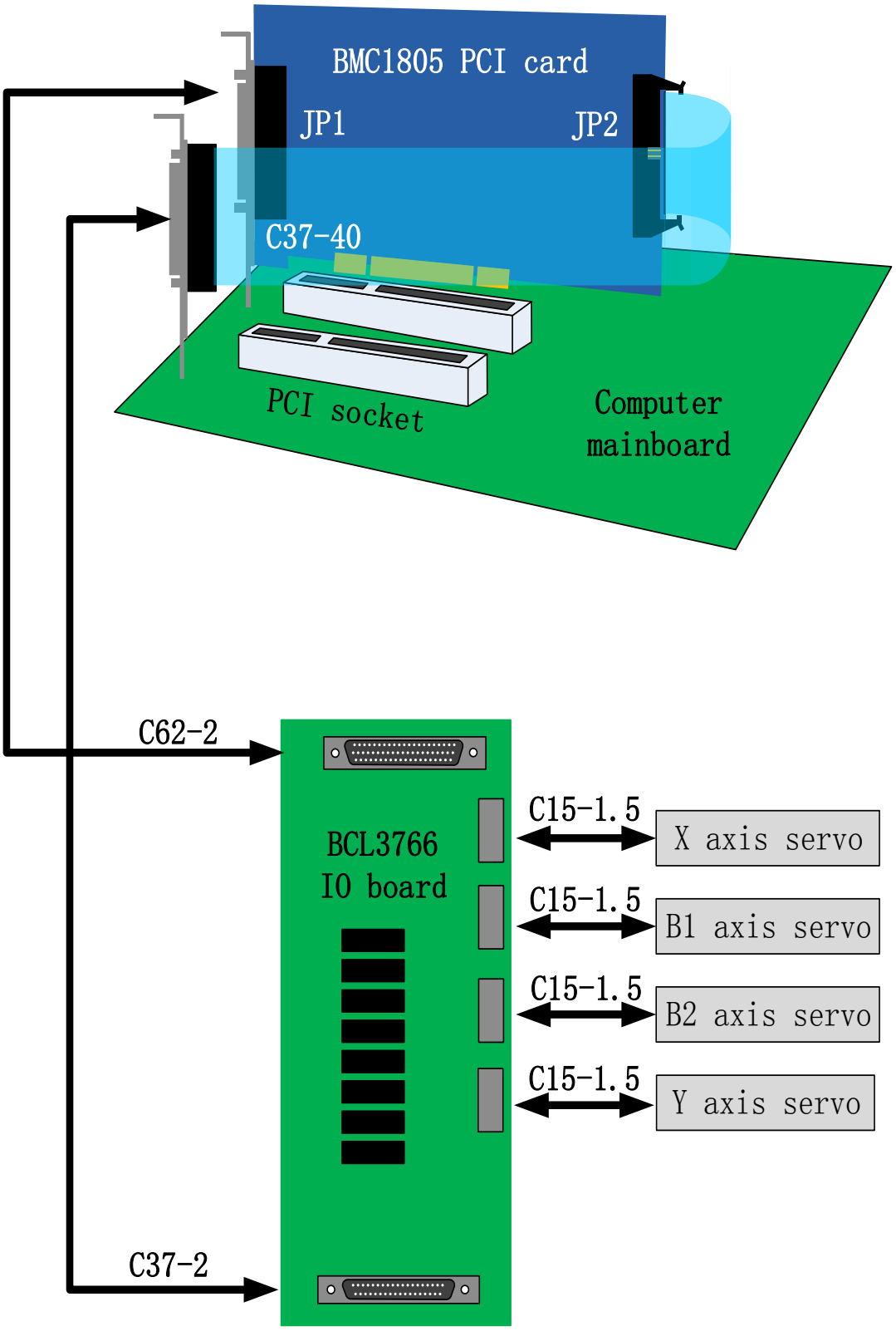
FSCUT3000S Laser Cutting System contains the following accessories:

Name	Model	Qty.
Motion control card	BMC1805	1 pcs
I/O terminal board	BCL3766	1 pcs
Flat cable	C37-40	1 pcs
37-core cable(2 meters)	C37-2	1 pcs
62-core cable (2 meters)	C62-2	1 pcs
Servo cable(1.5 meters)	C15-1.5	4 pcs
Cutting control software	TubePro	1 pcs
Nesting software(optional)	TubesT/TubesT-Lite	1 pcs
Wireless remote	WKB	1 pcs
Control panel(optional)	BCP5045	1 pcs

1.2 System Connection Diagram

BMC1805 card adopts PCI interface. Dimension:213mm*112mm.There are 2 sockets on control card, JP1 is type DB62M socket connected by C62-2 cable to BCL3766 IO terminal board ; JP2 is extension socket connected with flat cable to the back of the computer case first then connected to BCL3766 IO terminal board by C37-2 cable.

Wiring diagram shown below:



1.3 Technical Reference

Motion Control	**Motor Control Signal**	4 servo axes ports with high speed pulse output of
		3 servo axes ports with encoder feedback channel, quadruple frequency can reach to 8MHz.
		Positive, negative limit and servo alarm signal input for each axis.
		Servo enable and alarm reset output for each axis port
	Motion Control Performance	Control cycle 1ms.
		S type acceleration and deceleration with filter function
		Velocity look-ahead strategy, intelligent speed control at turning point.
		Trajectory accuracy 0.02 mm, positioning accuracy 0.001 mm, repetitive positioning accuracy 0.003 mm.
		Local curvature analysis and speed limitation at small curves.
		Tube corner technique.
Laser Control Signal		1 PWM output: 5V/24V for optional, 5khz accuracy.
		2 analog signal outputs of 0~10V.
I/O function	**General Input**	15 inputs: 12 low level active inputs, among which 3 inputs can jump setting the active level.
	General Output	8 relay outputs: Load capacity AC 250V/5A、DC 30V/5A 12 thyristor emitter outputs: Load capacity DC 24V/500mA.
Work Environment		Temperature: 0-55 degrees Celsius.
		Humidity: 5%~90% without condensation.
Power Supply Requirements		DC 24V/2A.

1.4 Control Card Installation

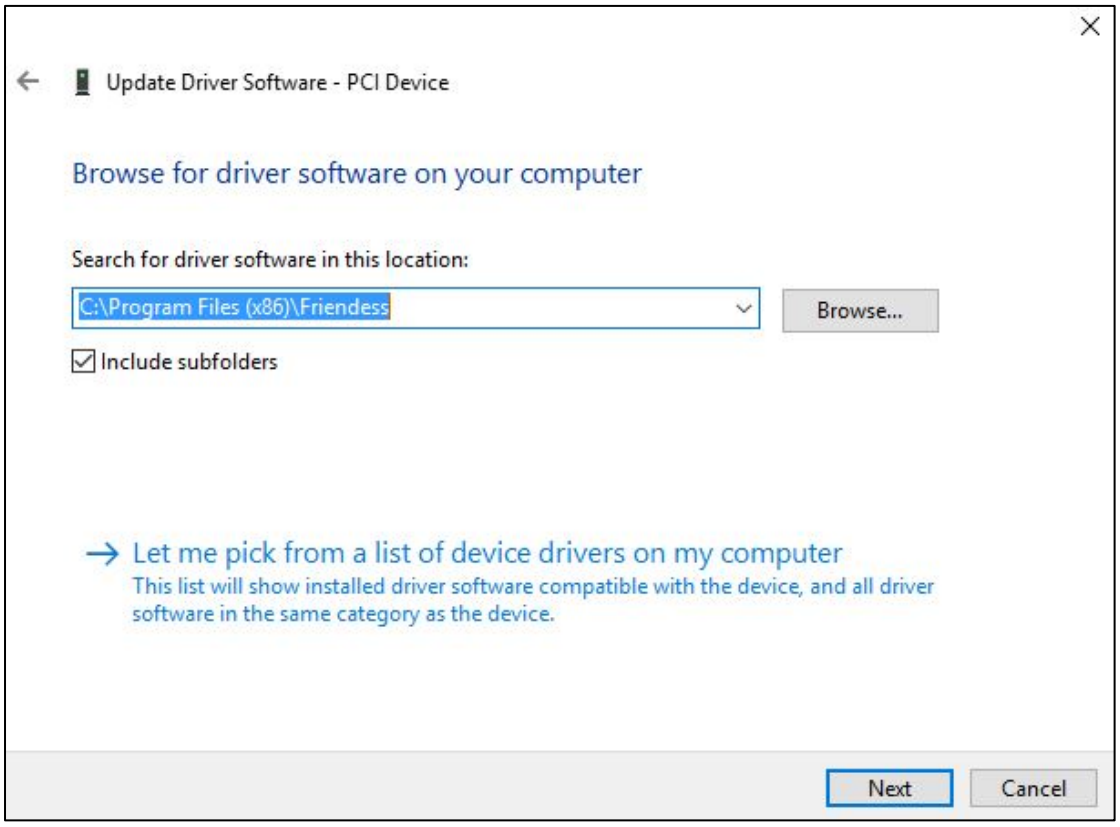
1.4.1 Install steps

	Please wear anti-static gloves to prevent possible electrostatic damage to the motion control card.

(1) Turn off computer, insert the control card into PCI slot, and fix the control

with screw;

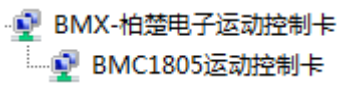
(2) After start up computer, "Find New Hardware Wizard" pops out and click "Cancel" button, as shown below. If this dialog box does not appear, indicating that the card is not inserted properly, please repeat the first step.



(3) Install TubePro software, meantime the driver of BMC1805 card and softdog will be installed automatically.

(4) Close the anti-virus software during installation in case it's misdiagnosed as virus and fail the installation process. Pass all the message box during the installation.

(5) Open device manager to confirm installation is succeed. If the following image appears:

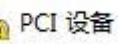


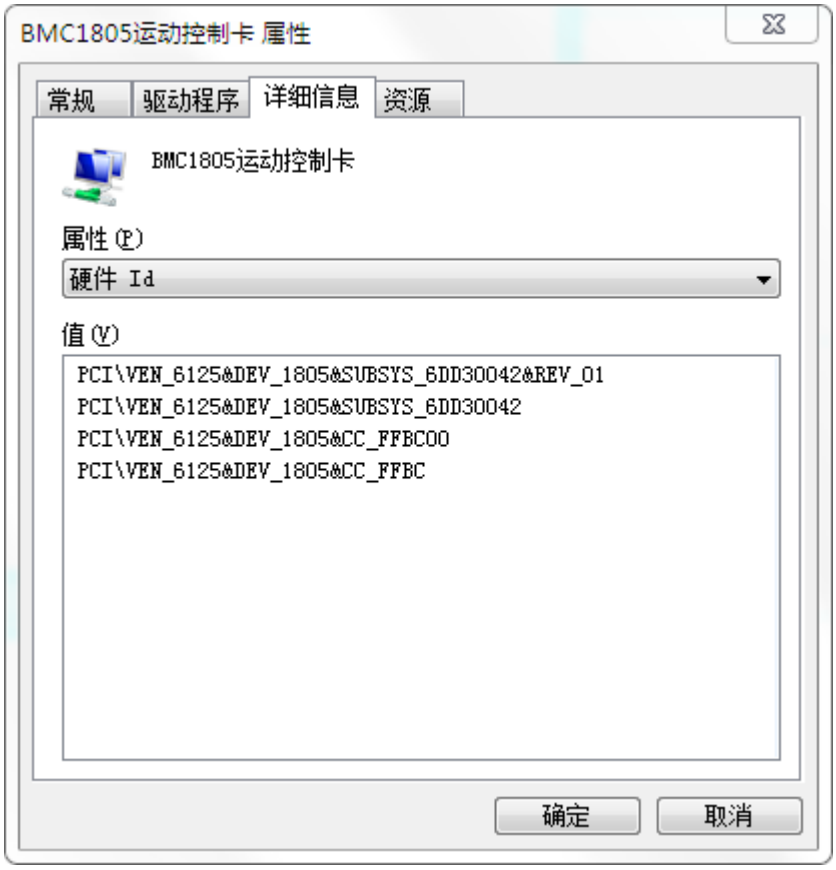
It indicates that installation succeed.

1.4.2 Troubleshooting

（1） If "Find New Hardware" dialog box does not pop out after start up computer or

control card does not shown in device manager, indicating that the control card is not inserted properly. Please replace the PCI socket or computer, insert the control card and reinstall software.

（2） If the device has a yellow exclamation mark, double-click to open its attributes page, and select "Detail Information" as shown below: 



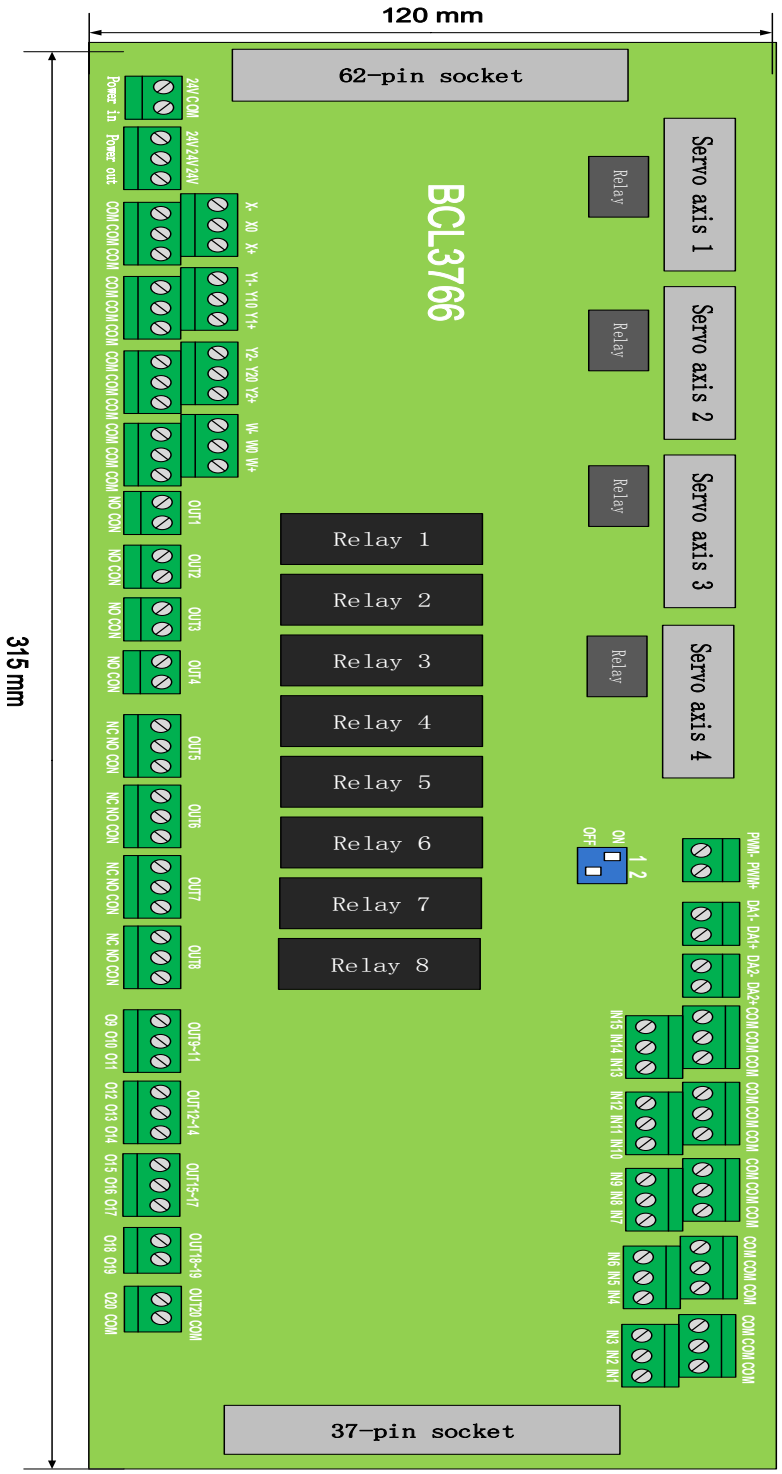
（3） If the first half of the "hardware ID" shows: PCI\VEN_6125&DEV_1805&CC_FFBC00 means computer recognize the card properly, software installation might fail. Please re-install TubePro software. If it still fails, please contact our

（4） The first half of the "Hardware ID" does not shown as: PCI\VEN_6125&DEV_1805&CC_FFBC00, indicating that the computer failed to recognize the control card. Shut down computer and replace PCI socket, insert control card and reinstall the software.

（5） If step (4) still fails, the control card might be damaged please contact our technicians.

2. BCL3766 Connection

2.1 BCL3766 Connection Instructions



BCL3766 can be mounted by guide rail or fixed form, dimension 315mm*120mm. The DB62M socket and DB37 socket at both ends on the IO board are connected to JP1 and IP2 plugs of BMC1805 card. Connect DB62 socket with JP1 plug by C62-2 cable. Lead JP2 socket by C37-40 flat cable from back of the computer case, then connect to DB37 socket on BCL3766 board by C37-2 cable.

Four DB15M sockets at the top corner from left to right is for X axis, B1 axis, B2 axis and Y axis.B1 and B2 are rotate axes.

At the left bottom are signal terminals of limit switch and origin switch for X, Y and W axes. At the top right are terminals of input signal, all lower terminals are COM earth end, 0V.

At the bottom right are 16 general outputs, of which 8 are relay outputs and 8 are thyristor outputs. The first 4 relay outputs are only with normally-open contact, the last 4 relay outputs has both normally-open and normally-closed contacts.8 thyristor outputs are 24V common cathode output.

At center top are 1 PWM and 2 DA analog outputs.

DIP switch:

Below the PWM there are one DIP switch.

Switch P1 and P2 to set PWM voltage

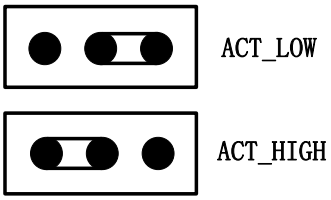
P1	P2	Description
On	Off	PWM voltage is 24V
Off	On	PWM voltage is 5V

2.2 Signal Type

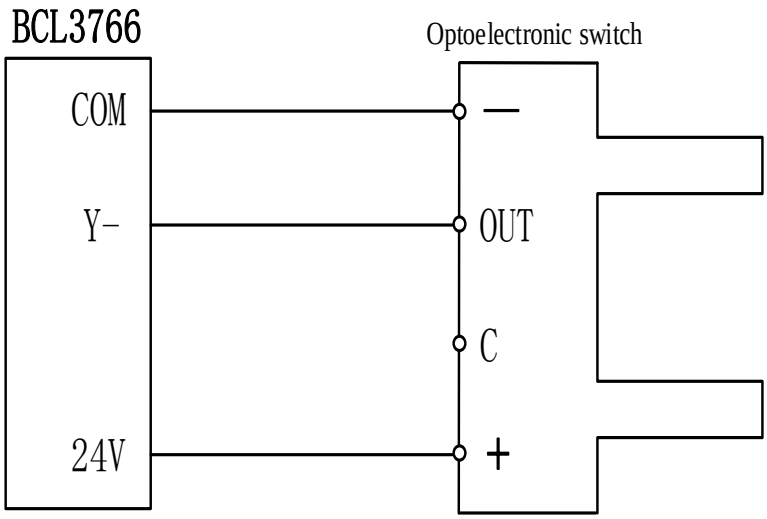
2.2.1 Input Signals

The input signal includes: Positive and negative limit switch, origin switch, general input signal. Input signal to BMC1805 card is low level active: It supports normally open and normally close input patterns (signal logic setting is in TubePro 'config tool'). When set as normally open, input is valid when conducting with 0V. When set as normally closed, input signal is valid when disconnected with 0V.

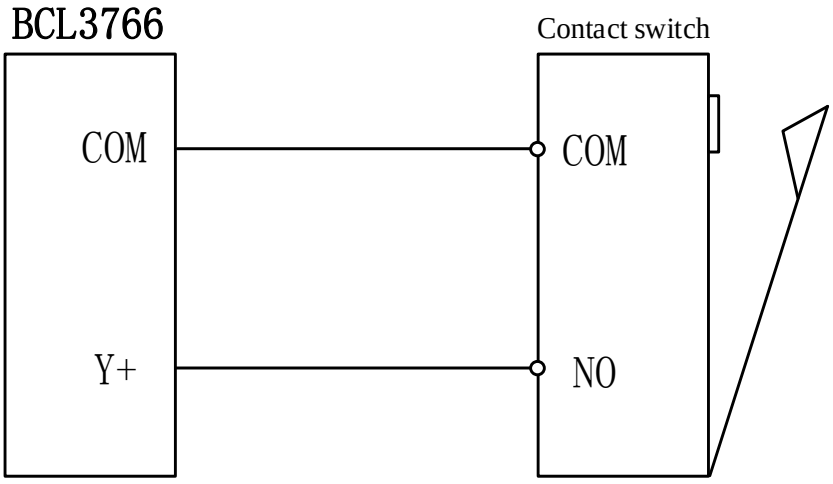
The input logic can be switched by jump wire, supported by IN13, IN14, IN15 inputs. There are 2 states of jumper, ACT_LOW state shown in image, indicates low level active; ACT_HIGH state shown in image, indicates high level active. Default state is ACT_LOW.



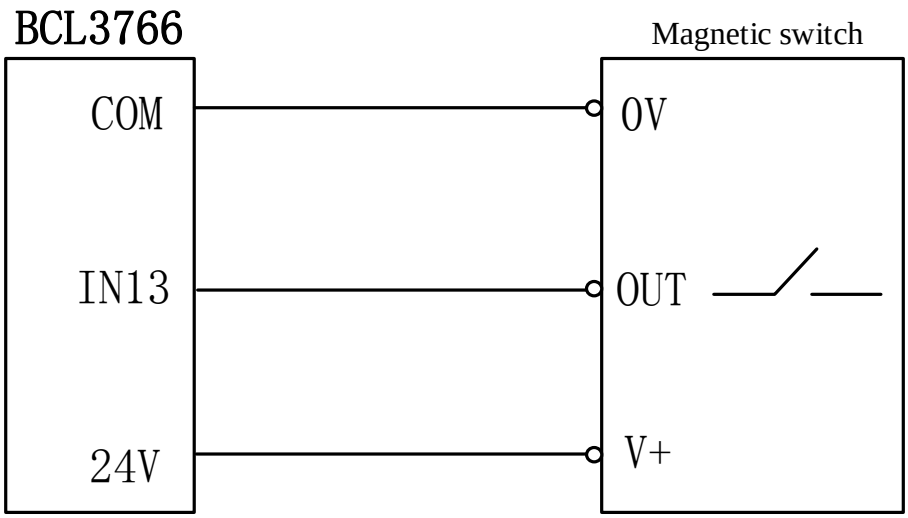
The typical wiring of optoelectronic switch shown below, it must be NPN type 24V switch.



The typical wiring of contact switch shown below.



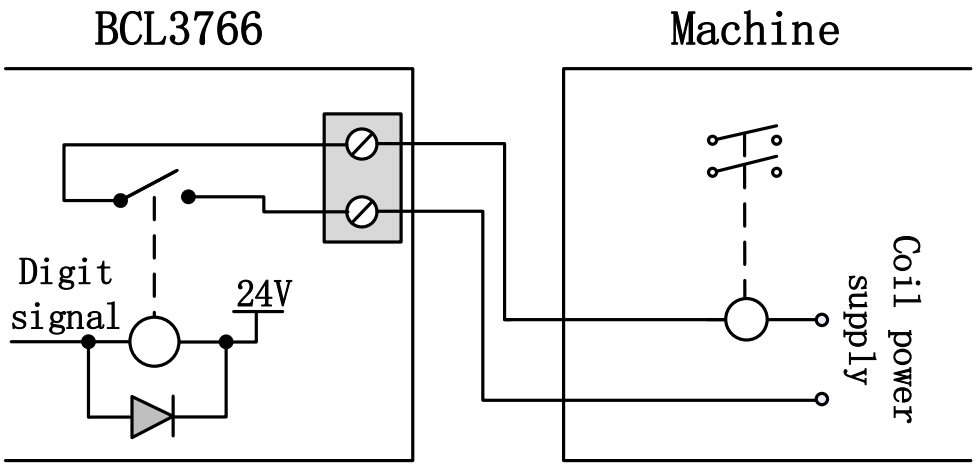
The typical wiring of magnetic switch shown below, it must be NPN type 24V switch.



2.2.2 Relay Output

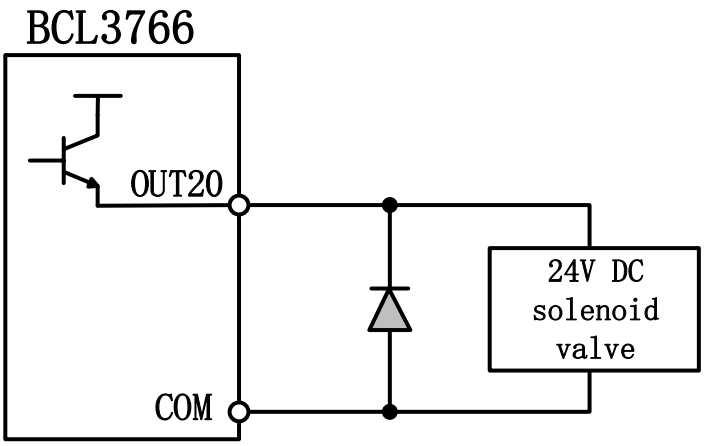
The load capability of the relay outputs in BCL3766 are: AC 250V/5A、DC 30V/5A。 Support to control AC 220V load of small power. If you need to carry high power load, please connect external contactor.

The wiring between relay output and contactor as shown below:



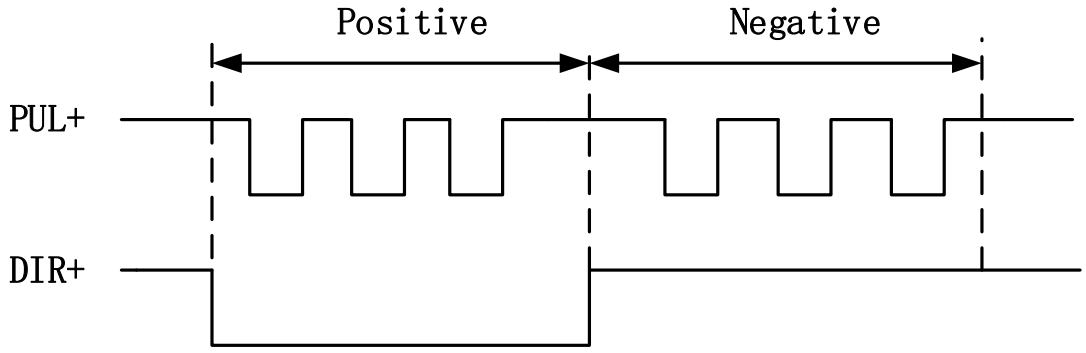
2.2.3 Thyristor Output

There are 12 thyristor outputs OUT9~OUT20 on BCL3766 IO terminal board which can directly drive DC 24V device, capacity of each output is 500mA.Wiring diagram shown below:

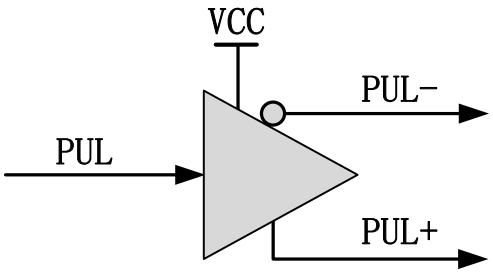


2.2.4 Differential Output

The pulse instruction form send to servo driver is "pulse + direction, negative logic". Highest pulse frequency:3MHz。 Pulse pattern shown below:



The differential signal output pattern shown below:



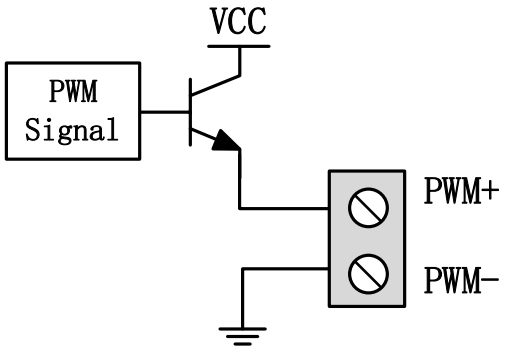
2.2.5 Analog Output

2 analog outputs of 0~10V.

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

2.2.6 PWM Output

There is one PWM output on the BCL3766 terminal board, which can be used to control laser average power output. PWM signal level is 24V or 5V as option. The duty cycle is adjustable from 0%~100%, the highest carrier frequency 50KHz.The output of the signal is shown in the following figure:



It's highly recommended that connect PWM+/- with relay in series to prevent laser leakage by interference. See details in section 2.5.In addition, set the right voltage of PWM signal. Select 5V or 24V by DIP switch.

2.3 BCL3766 Instructions

2.3.1 External Power Supply

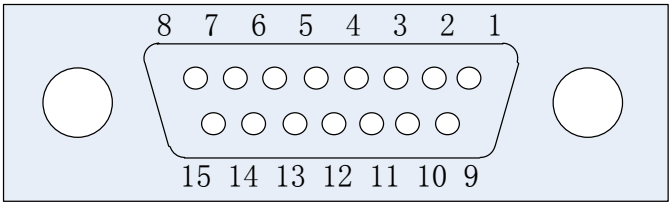
BCL3766 requires 24V DC external power supply. 24V and COM input terminal connect with switch power supply 24V and OV output.

Power terminal		Function description and parameters
POWER IN	24V	DC 24V power input, maximum input current 1A
	GND	DC 0V power input
POWER OUT	24V 24V 24V	The maximum power output of BCL3766 is 0.2A (note: these 3 power output ports of 24V are mainly for switch sensor and total current less than 0.2A)

Note: If output current overload will cause IO board work abnormally.

2.3.2 Servo Control Port

Four servo control ports on BCL3766 are DB15 socket.



The signal pin description listed below:

15-core servo control signal cable					
Signal Pin	Cable color	Signal name	Signal Pin	Cable color	Signal name
1	Yellow	PUL+	9	Yellow-black	PUL-
2	Blue	DIR+	10	Blue-black	DIR-
3	Black	A+	11	Black-white	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	Dark-brown	0V
8	Brown	24V			

+24V、0V： Supply 24V DC power for servo driver.

SON： Servo ON, output servo drive enable signal;

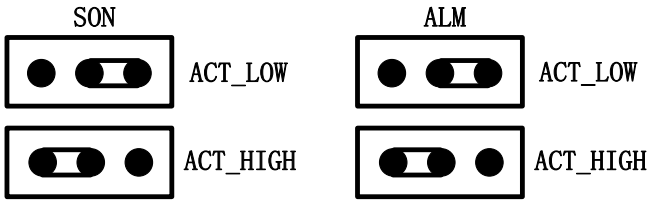
ALM： Alarm, receiving servo driver alarm signal;

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

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

A+、A-、B+、B-、Z+、Z-： Encoder three-phase, input signal.

You can switch active level of SON and Alarm signal by jump wire;



When SON signal is ACT_LOW, low level output(0V) is valid; When SON signal is ACT_HIGH, high level output(24V) is valid; ACT_LOW is default status;

When ALM signal is ACT_LOW, low level input(0V) is valid; When ALM signal is ACT_HIGH, high level input(24V) is valid; ACT_LOW is default status;

For wiring diagram with Panasonic, Yaskawa, Mitsubishi, Fuji, Delta and other

servo drivers, please refer to the "2.3.3 Servo Driver Control Signal Wiring".

Please note the following terms:

(1) Make sure SON signal of servo is active-low type (when conducted with 24V GND turns ON);

(2) Set the signal type "pulse +direction" in servo;

(3) Check if there is external emergency input to the servo, and the signal logic;

(4) Before operating trial run of driver, provide 24V power supply to IO terminal board, which will transfer power supply to driver;

(5) If driver still can't run, check if the parameter "positive/negative direction drive inhibit" in driver set invalid.

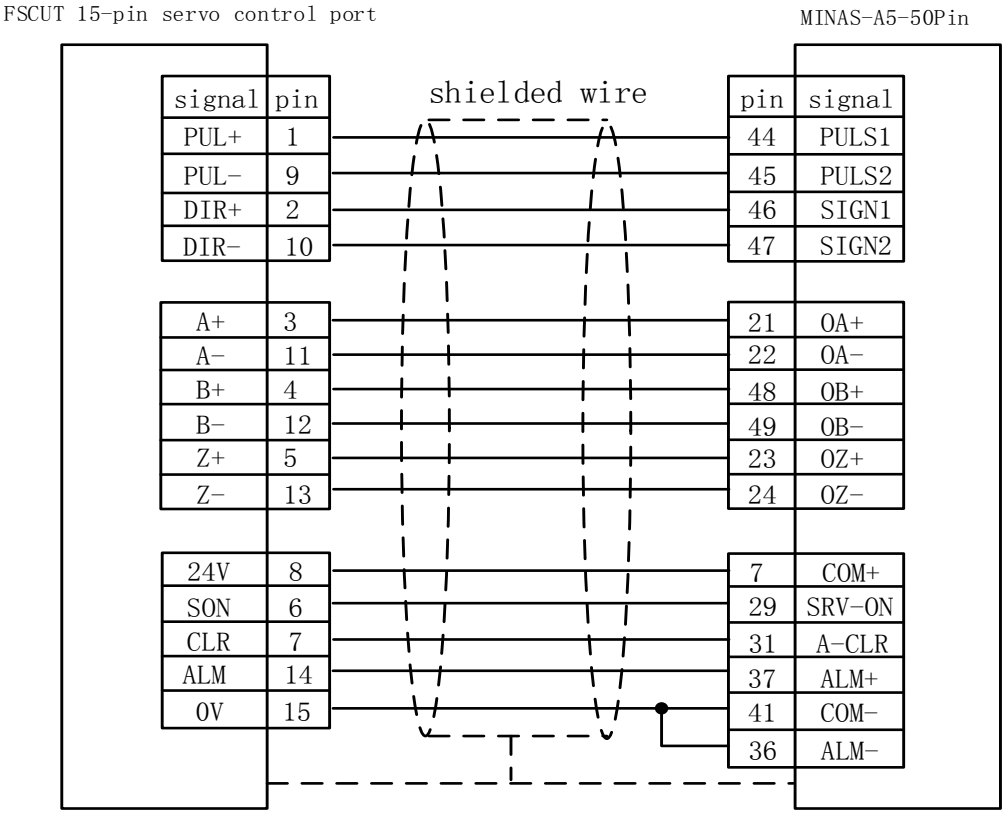
(6) Make sure the shielded layer of signal cable connected with servo shell.

2.3.3 Servo Control Signal Pin Wiring

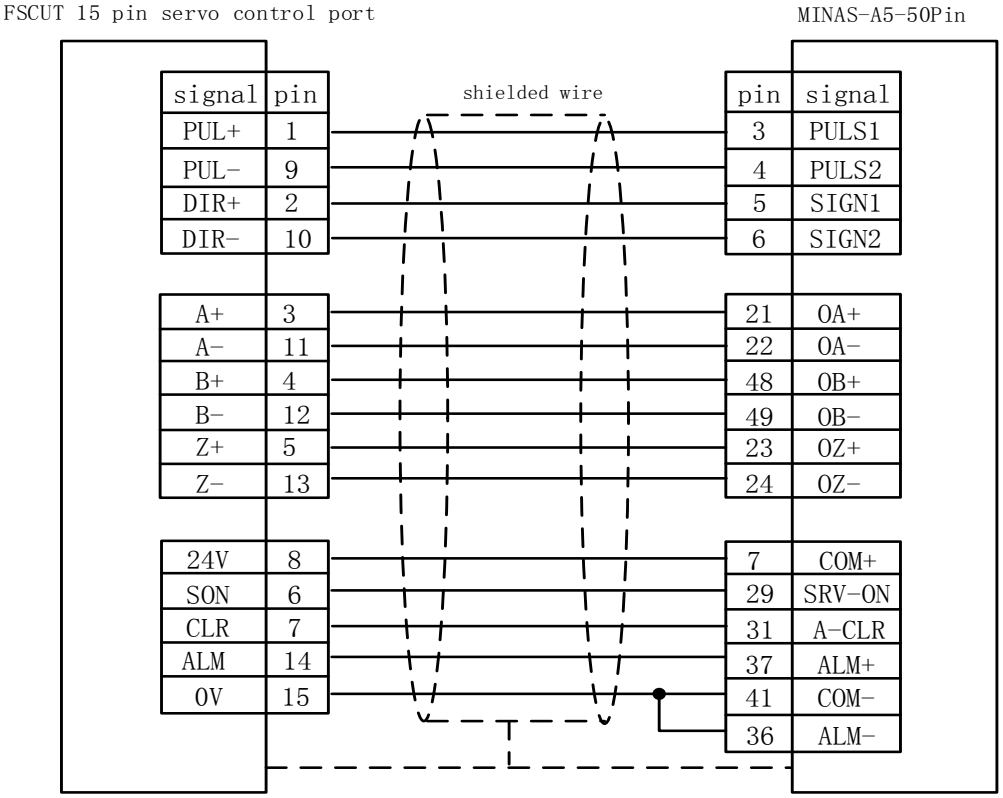
FSCUT3000S motion control system adopts 'pulse+ direction' signal pattern to control servo driver. The highest signal frequency can reach to 3Mpps.

It's recommended that select high speed differential signal. Set pulse equivalent within 1000~2000 to improve the interpolation precision.

Panasonic A5 High Speed Pulse Wiring Diagram



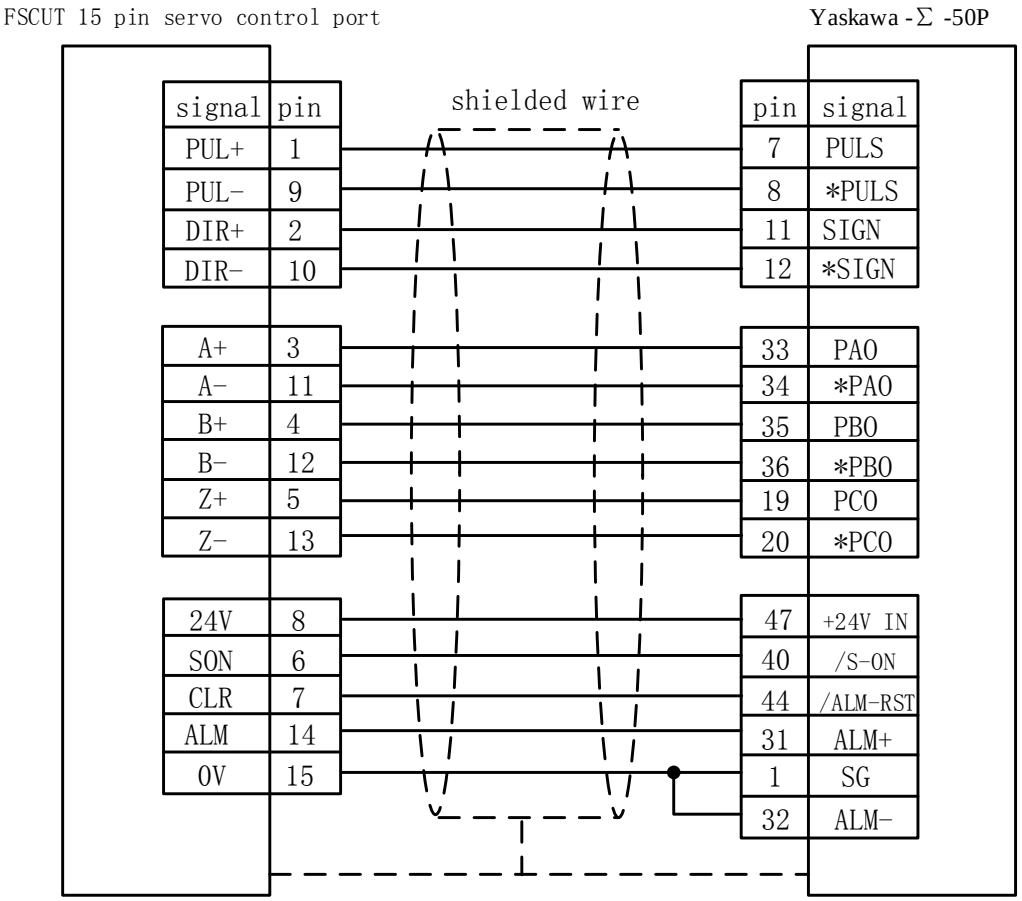
Panasonic A5 Low Speed Pulse Wiring Diagram



Panasonic A5 Series Basic Setting

Parameter	Recommended value	Description
Pr001	0	Control mode must be position mode.
Pr007	3	Must select "Pulse + Direction" mode
Pr005	1	When using high speed pulse wiring, the parameter setting is 1, and highest pulse frequency supports to 3Mpps; When using low speed pulse wiring, the parameter setting is 0, and highest pulse frequency supports to 500Kpps.

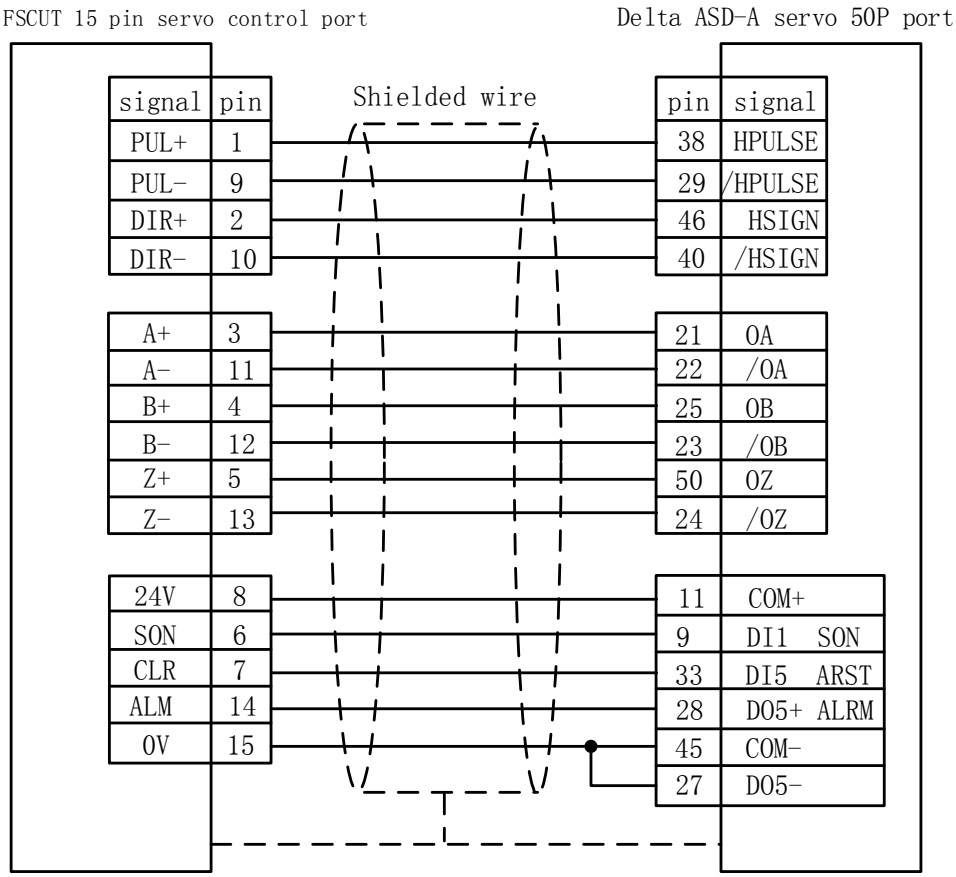
Yaskawa Servo Wiring Diagram



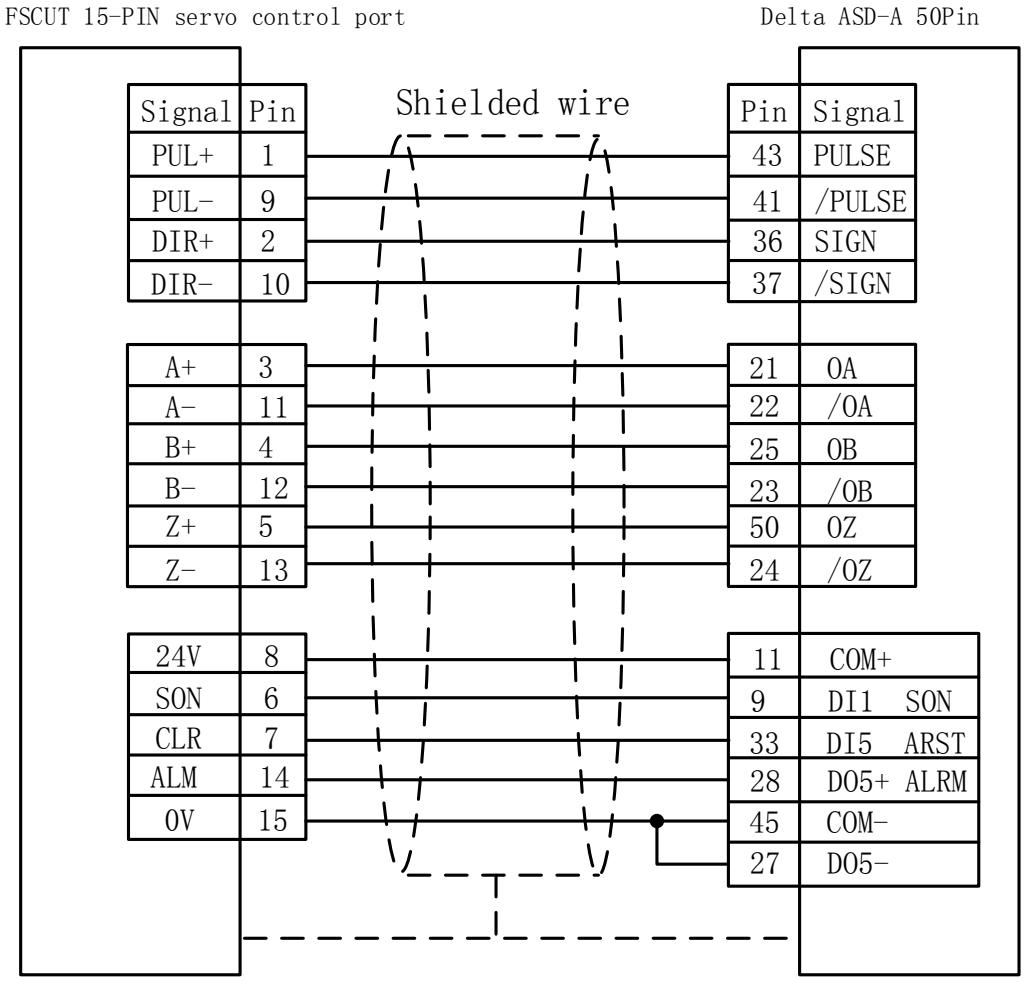
Yaskawa Σ Series Basic Setting

Parameter	Recommended value	Description
Pn000	001X	Select position mode
Pn00B	None	When use single-phase power supply, set the value to 0100.
Pn200	2000H	Positive logic: Pulse + direction;0005H negative logic: Pulse + Direction When pulse frequency is smaller than 1 Mpps select mode 0000H When pulse frequency reaches 1Mpps~4Mpps select mode 2000H
Pn50A	8100	Positive turn side can be driven.
Pn50B	6548	Reverse turn side can be driven.

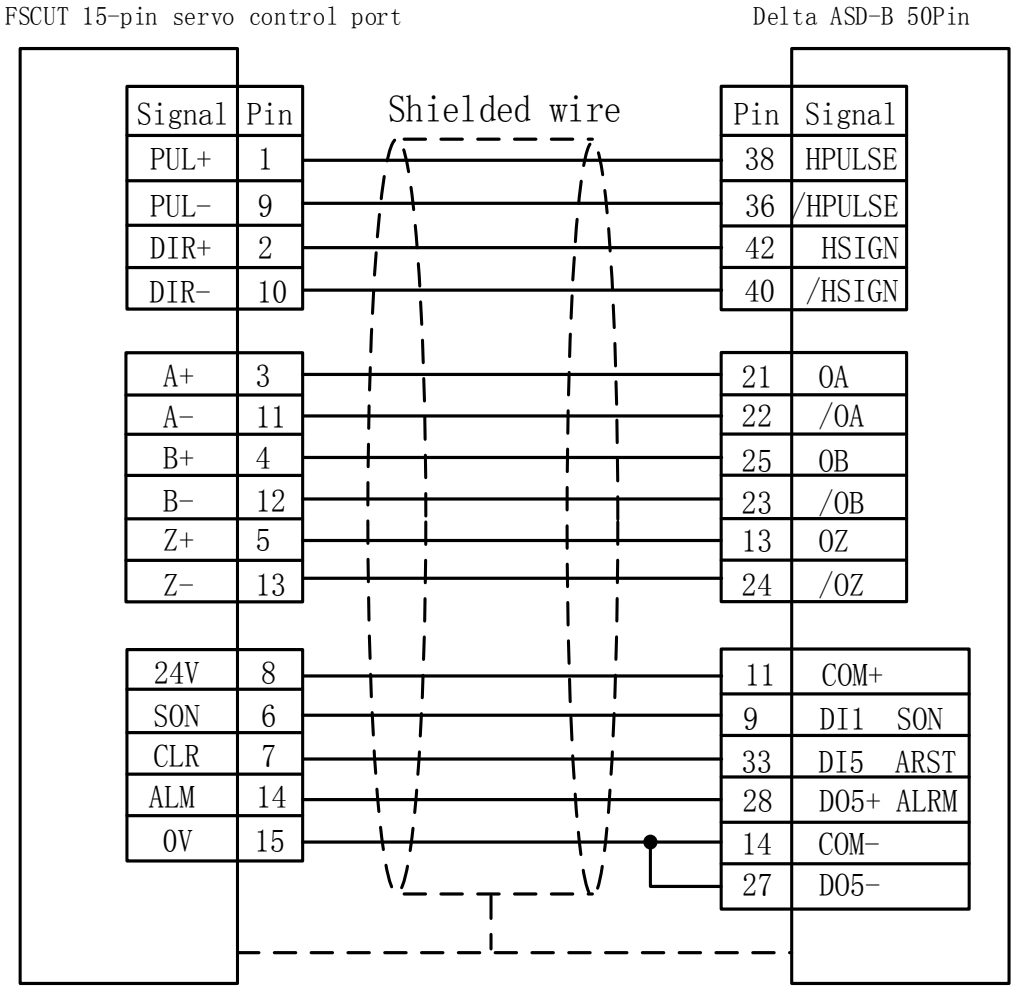
Delta A Series High Speed Pulse Wiring Diagram



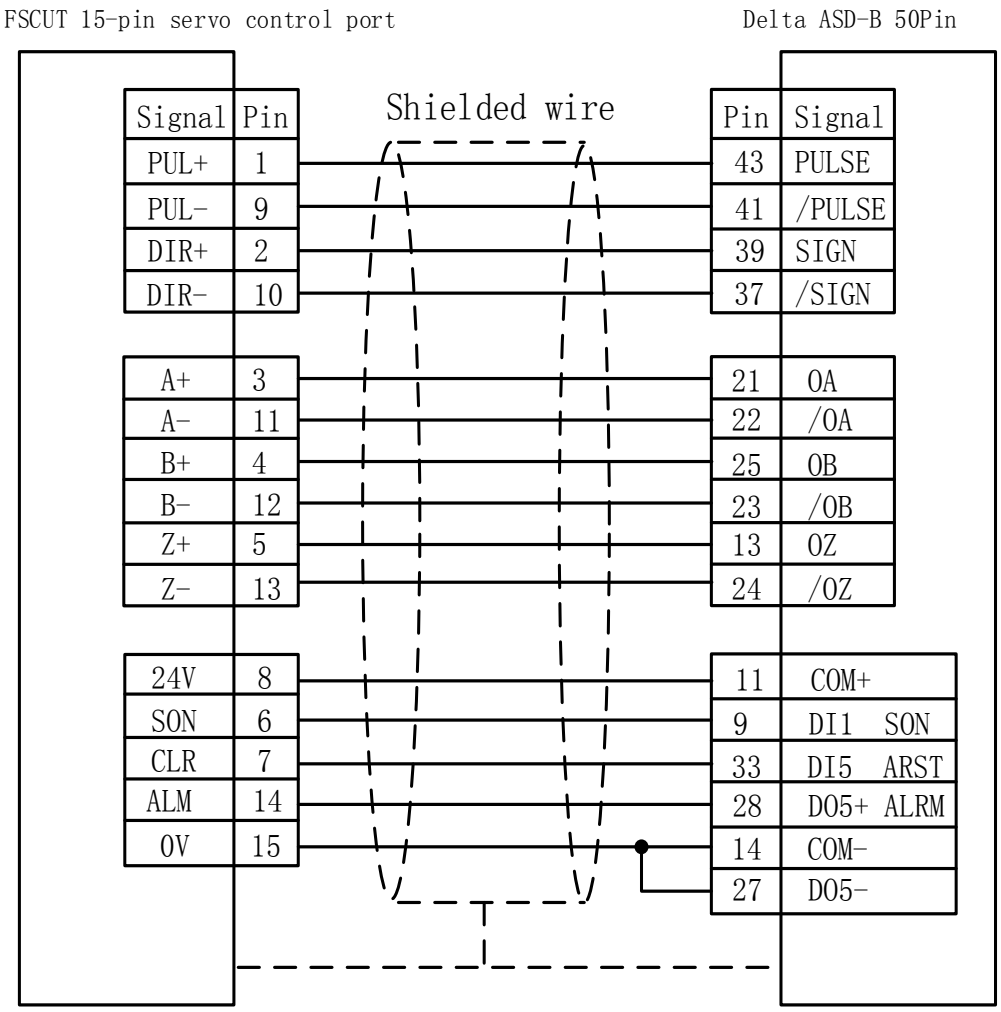
Delta A Series Low Speed Pulse Wiring Diagram



Delta B Series High Speed Pulse Wiring Diagram



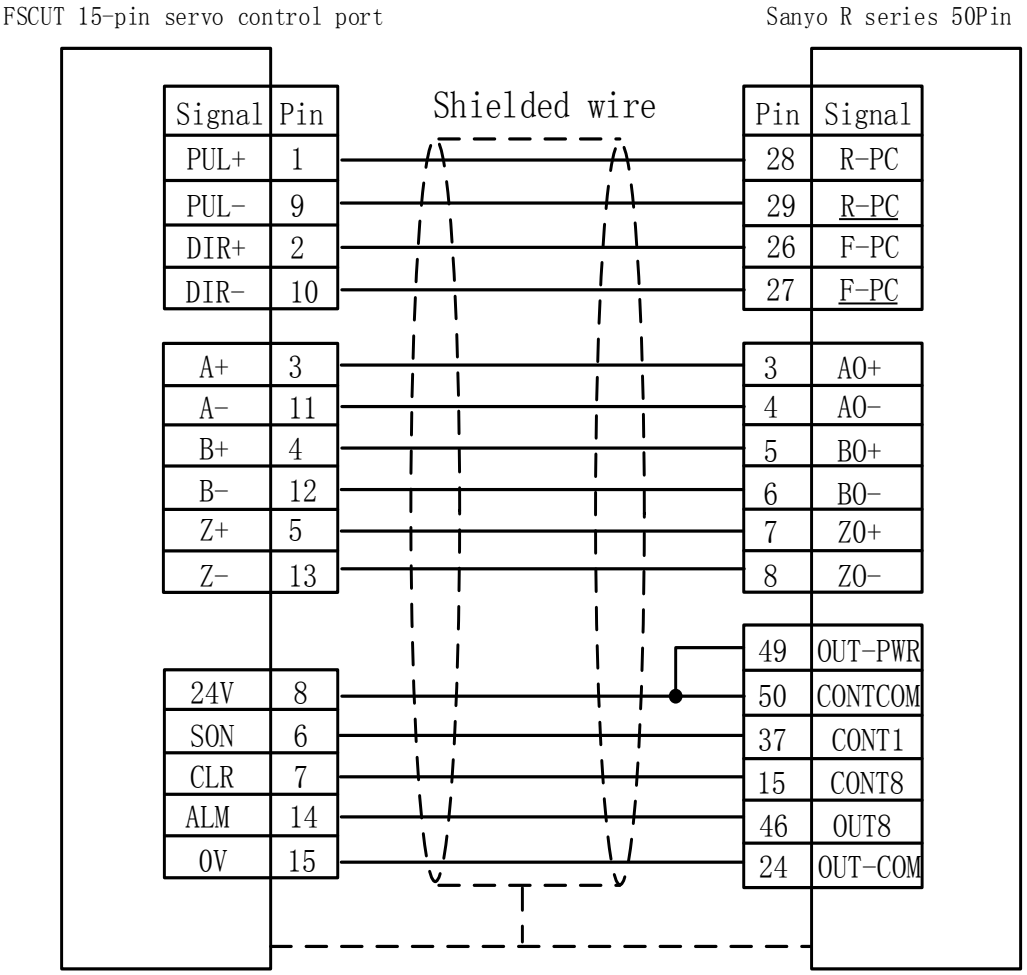
Delta B Series Low Speed Pulse Wiring Diagram



Delta ASD Series Basic Setting

Parameter	**Recommended value**	**Description**
P1-00	**1102H**	Position control mode, negative logic, pulse + direction. Setting is 1102H open high speed differential signal mode, the highest pulse frequency can reach to 4Mpps; Setting is 0102H open low speed pulse signal mode, the highest pulse frequency up to 500Kpps.
P1-01	00	Select position mode controlled by external instructions.
P2-10	101	DI1 set as SON, logic is normally open
P2-14	102	DI5 set as ARST, logic is normally open.
P2-22	007	DO5 set as alarm, logic is normally close

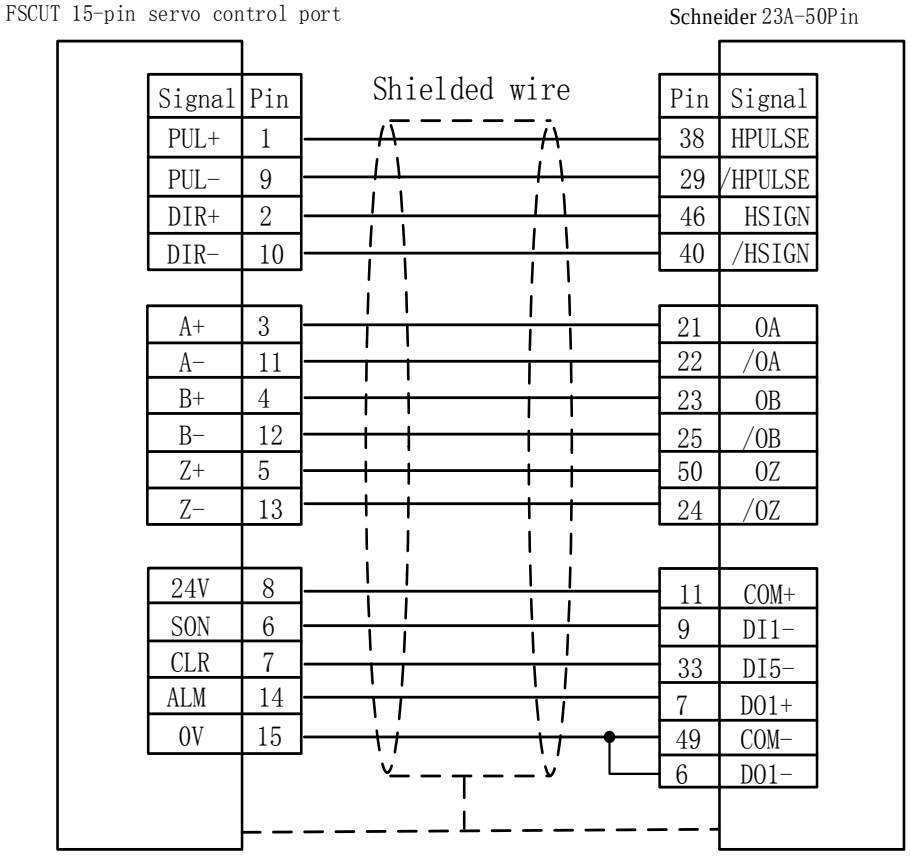
Sanyo R Series Servo Wiring Diagram



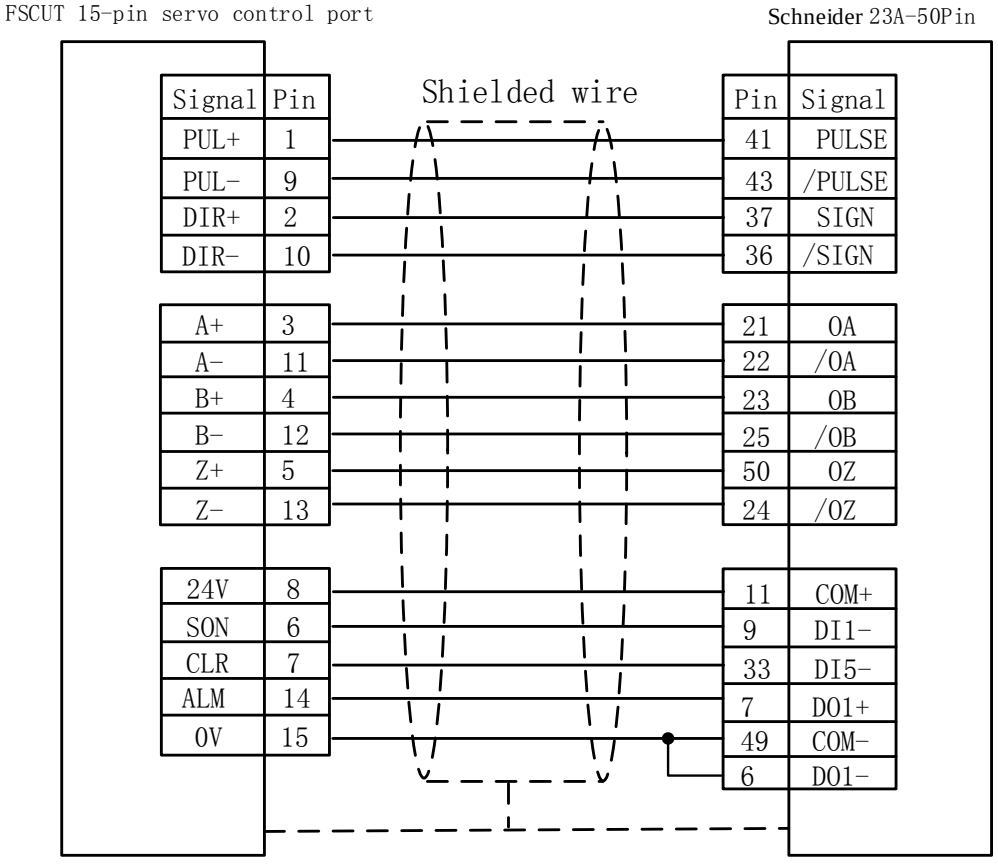
Sanyo R Series Basic Setting

Parameter	Recommended value	Description
SY08	00	Select position mode
Gr8.11	02	Select pulse signal type: Pulse + direction;
Gr9.00	00	Positive turn side can be driven.
Gr9.01	00	Reverse turn side can be driven.

Schneider 23A High Speed Pulse Wiring Diagram



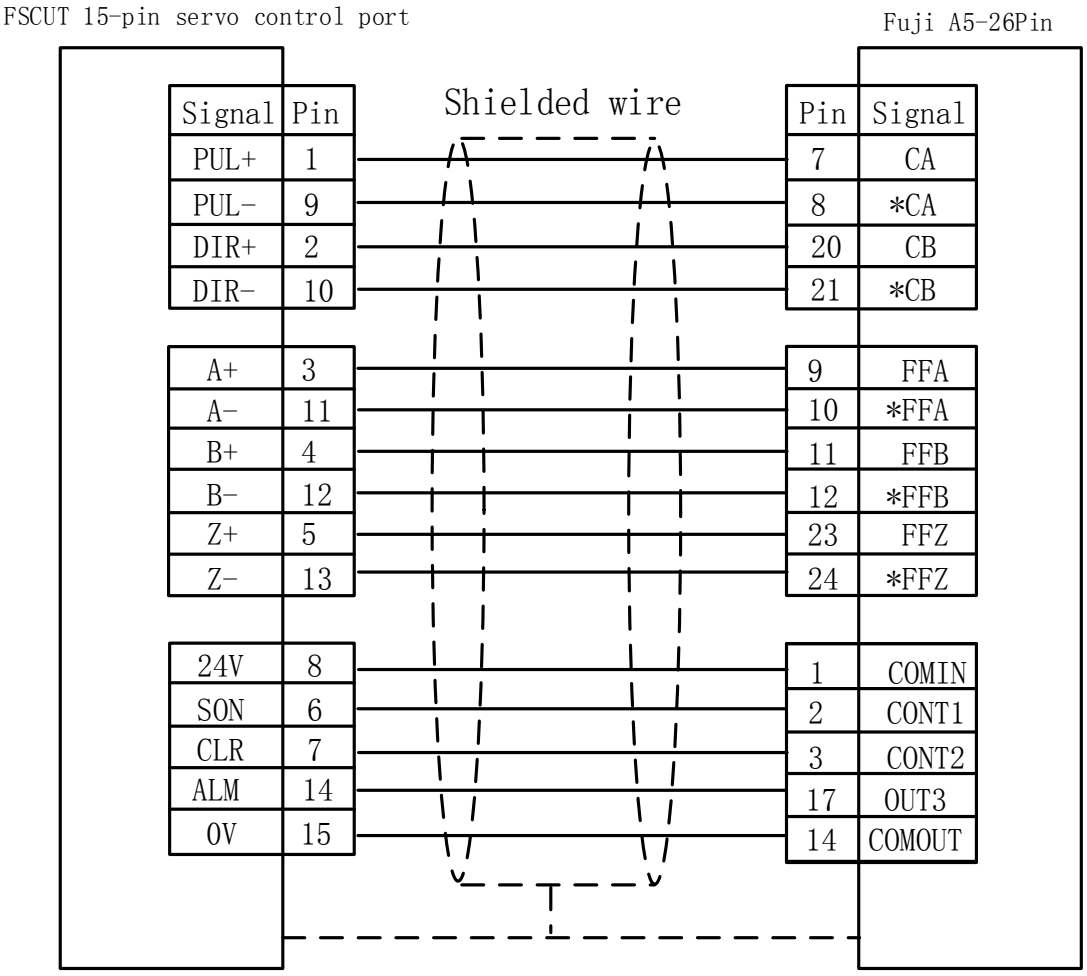
Schneider 23A Low Speed Pulse Wiring Diagram



Schneider Lexium 23D Series Basic Setting

Parameter	Recommended value	Description
P1-00	**1102H**	Position control mode, negative logic, pulse + direction. Setting is 1102H open high speed differential signal mode, the highest pulse frequency can reach to 4Mpps; Setting is 0102H open low speed pulse signal mode, the highest pulse frequency up to 500Kpps.
P1-01	X00	Select position mode controlled by external instructions.
P2-10	101	Set IN1 as SON function.
P2-11	0	IN2 invalid
P2-13~P2-17	0	IN4~IN8 invalid

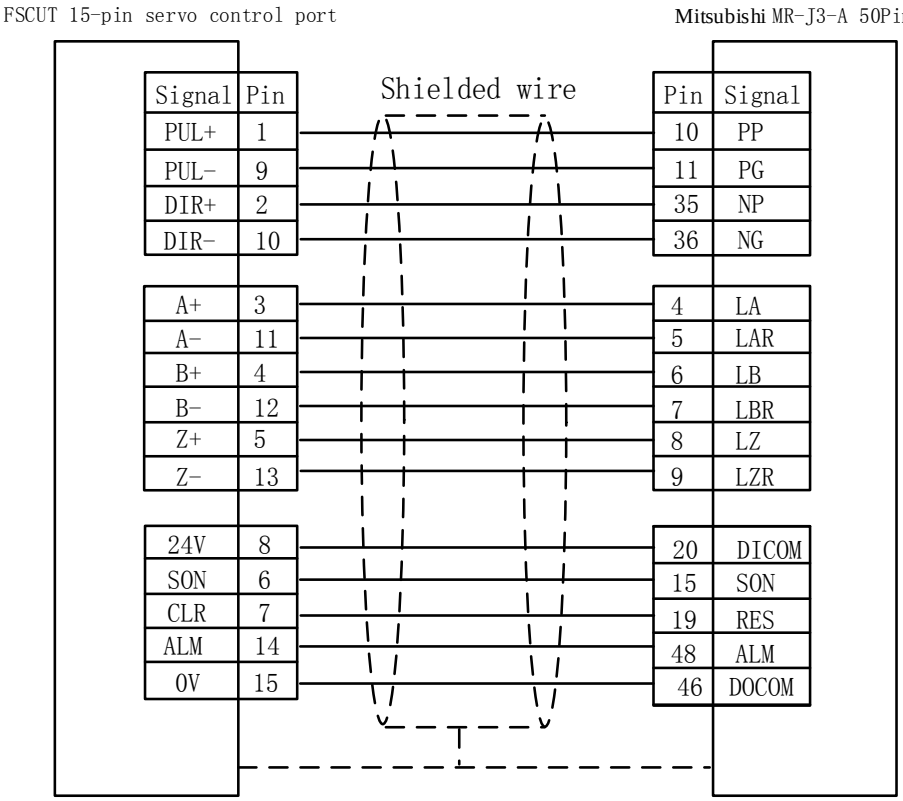
Fuji A5 Series Wiring Diagram



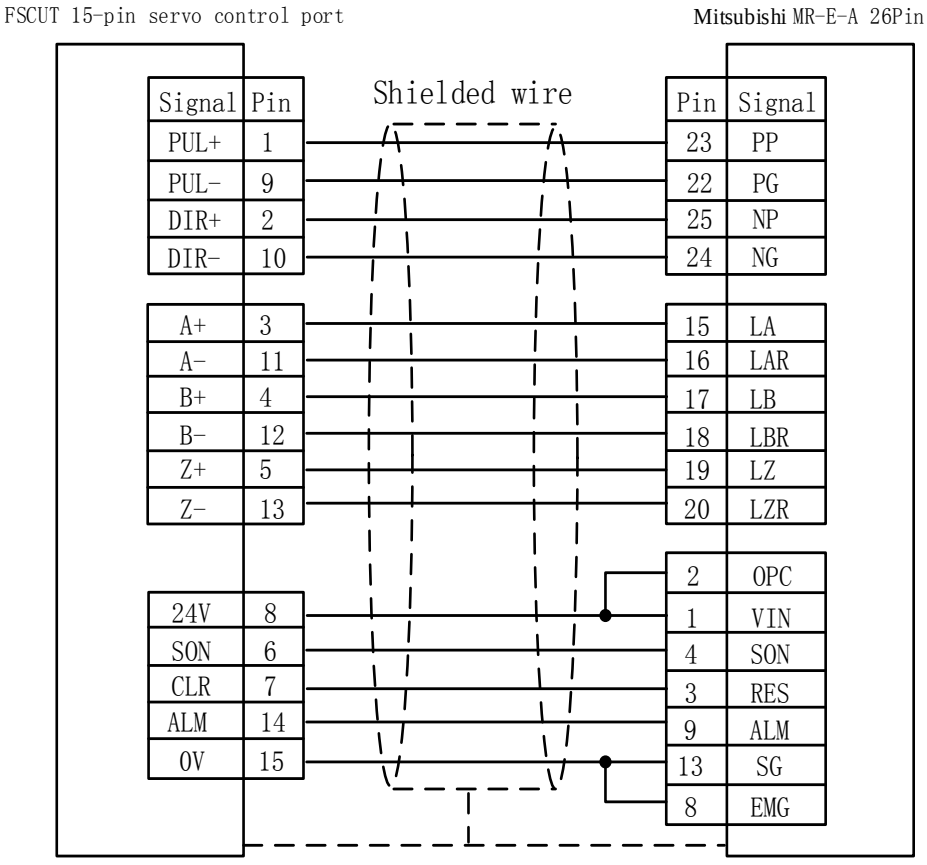
Fuji ALPHA 5 Series

Parameter	Recommended value	Description
PA-101	0	Position control mode
PA-103	0	Pulse + Direction highest frequency 1 Mpps

Mitsubishi J3 Series Wiring Diagram



Mitsubishi E Series Wiring Diagram



Mitsubishi MR-J3-A Series Basic Setting

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

Highest pulse frequency is 1Mpps.

Note:

The above basic parameters setup and correct wiring can only guarantee the basic motion function cannot ensure the control accuracy. To optimize motion performance, please adjust rigidity, gain, inertia ratio and other parameters.

2.3.4 Limit Input

X, Y1, Y2 and W axis respectively correspond to the 4 axis ports on top left of the BCL3766 board;

X-： X - Limit, dedicated input port, low level effective;

X0： X origin, dedicated input port, low level effective;

X+： X + Limit, dedicated input port, low level effective;

COM： Ground, the common end of the above three signals.

Y1-： B1 - Limit, dedicated input port, low level effective;

Y10： B1 origin, dedicated input port, low level effective;

Y1+： B1 +Limit, dedicated input port, low level effective;

COM： Ground, the common end of the above three signals.

Y2-： B2 - Limit, dedicated input port, low level effective;

Y20： B2 origin, dedicated input port, low level effective;

Y2+： B2 + Limit, dedicated input port, low level effective;

COM： Ground, the common end of the above three signals.

W-： Y - Limit, dedicated input port, low level effective;

W0： Y origin, dedicated input port, low level effective;

W+： Y+ Limit, dedicated input port, low level effective;

COM： Ground, the common end of the above three signals.

Users can select NO and NC logic of limit and origin switch in 'Config Tool' of Tubepro. See details in chapter 3 Configuration Tool.

2.3.5 General Input

There are 15 inputs from IN1~IN15. Users can customize the input as alarm or other function in TubePro-Configuration tool. See details in chapter 3 Configuration Tool.

2.3.6 General Output

There are 8 relay outputs OUT1~OUT8.You can assign 8 relay outputs controlling laser, cutting gas etc., in TubePro- Configuration tool. See details in chapter 3 Configuration Tool.

12 thyristor outputs on BCL3766 can directly use to drive 24V DC device.

2.3.7 Analog Output

DA1 and DA2 analog output of 0~10V. You can set DA1 and DA2 for controlling laser peak power and proportional valve in config tool.

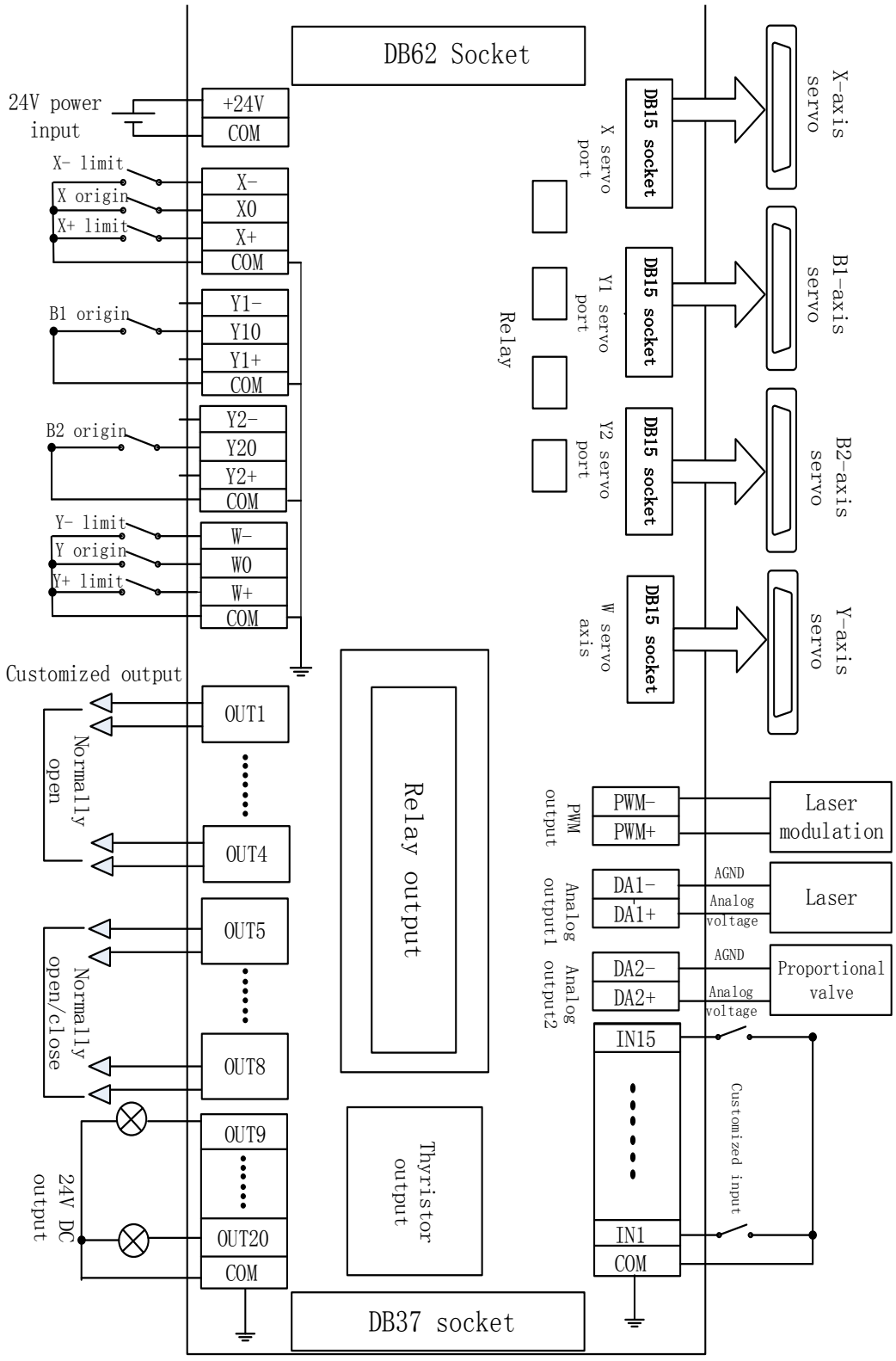
2.3.8 PWM Output

When you select laser type as fiber laser in TubePro-Config tool, PWM output will be activated for controlling average laser power.

PWM requires 5V, PIN1 OFF, PIN2 ON.

PWM requires 24V, PIN1 ON, pin2 OFF.

2.4 Wiring Diagram



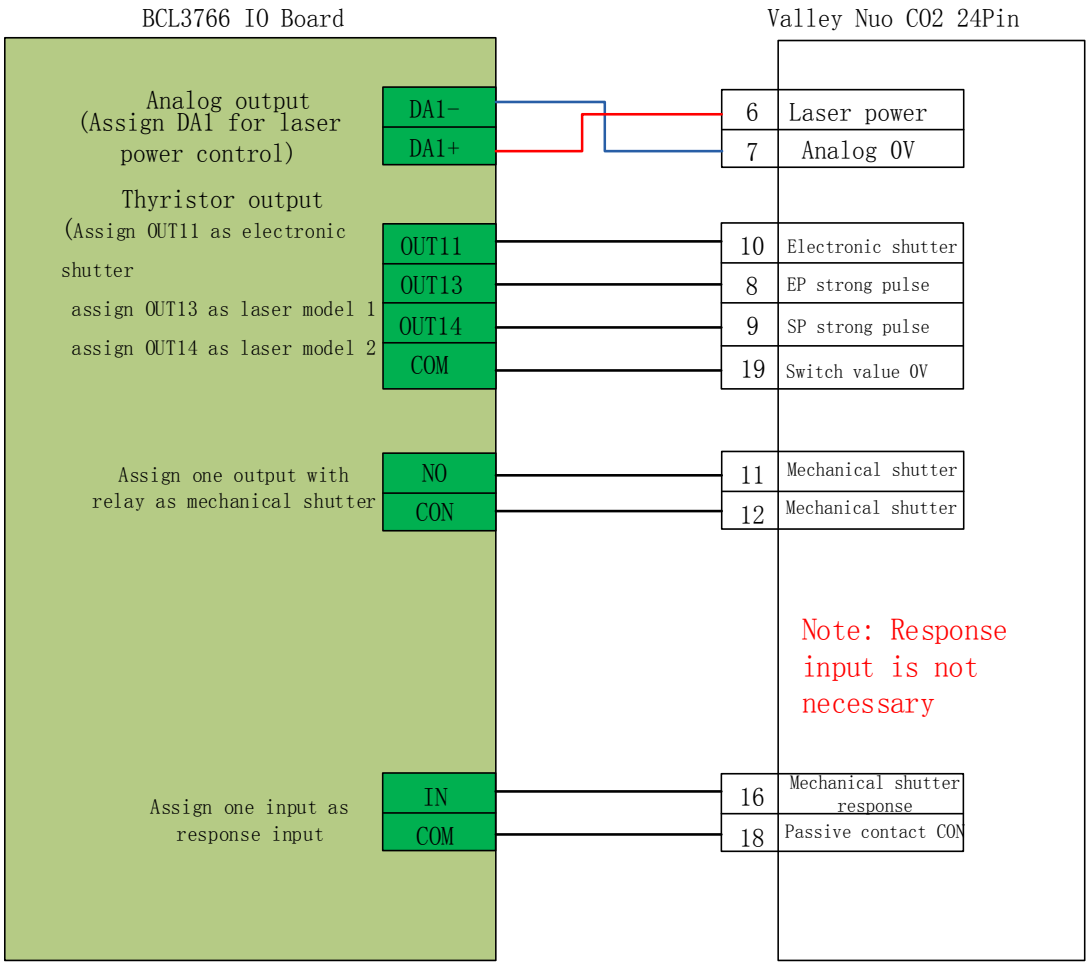
2.5 Laser Wiring Diagram

2.5.1 YAG Laser Connection

Directly connect assigned laser output to laser, no details described here.

2.5.2 CO2 Laser Connection

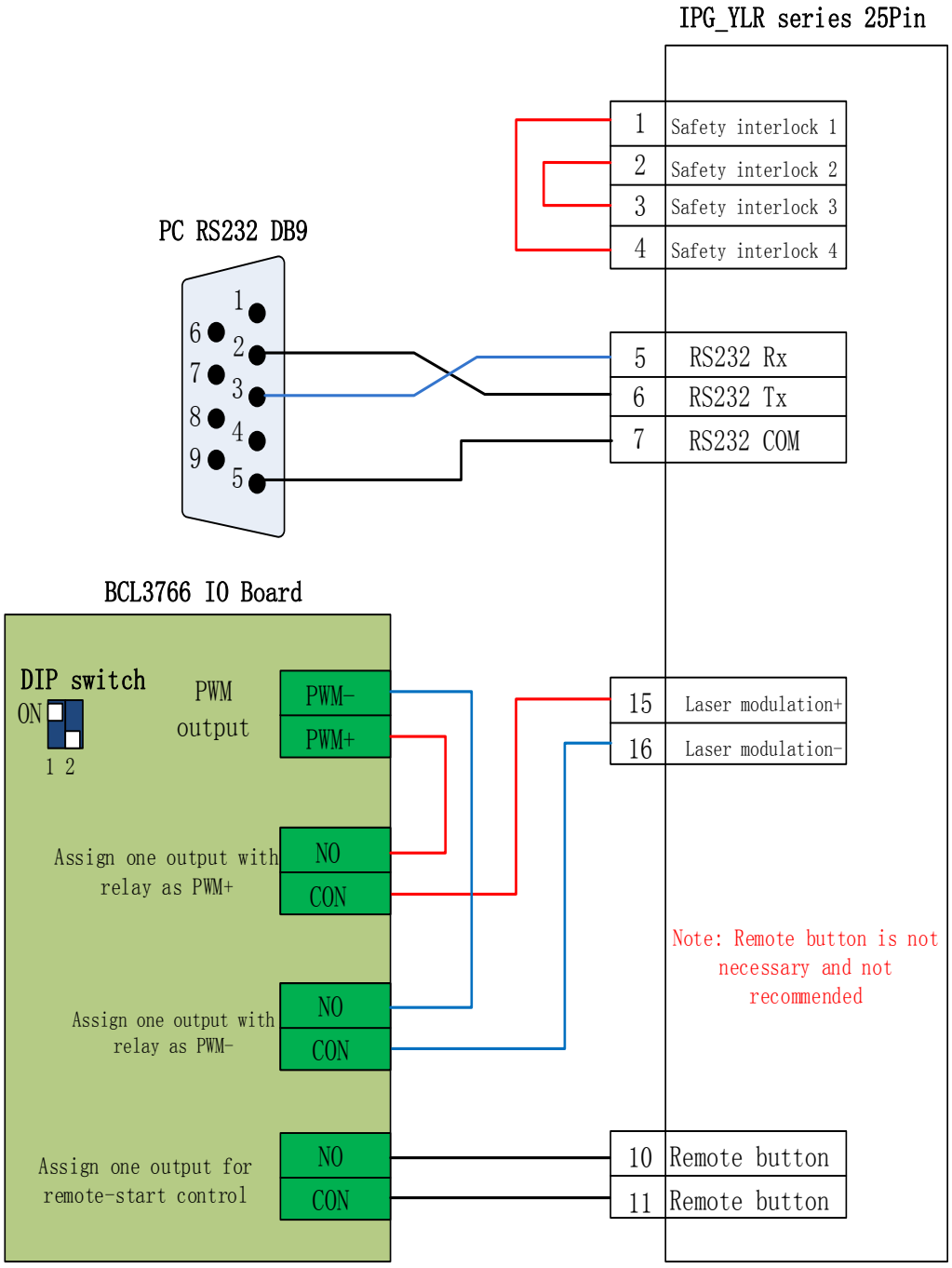
Here take the example of NT-3200SM model of Valley Nuo.



Note:

Part of CO2 laser also supports PWM control mode, wiring can take reference from Max laser.

2.5.3 IPG-YLR series wiring diagram



We recommend you choose RS232 or network control if laser supports this communication mode. When use serial or network communication for laser control, TubePro software will monitor laser state in real time. And to realize the functions including turn on and off laser shutter (Emission), aiming (guide beam), and set laser peak power (Current) etc., no analog port required.

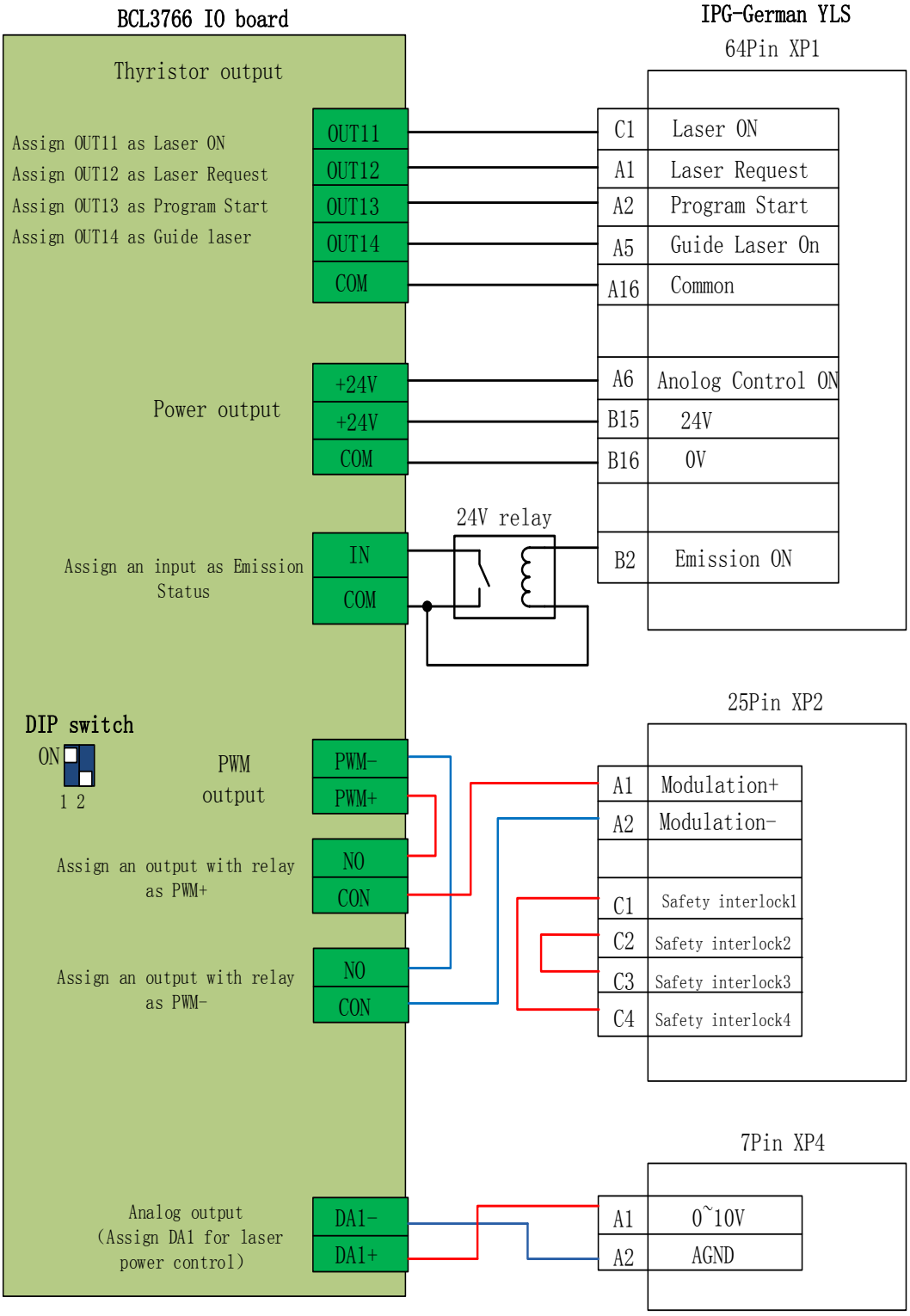
Recommend to use network communication for IPG-YLR series.

Note:

1. Remote start-up button is not necessary, it might cause laser error when laser device is not well grounded.

2. PWM 24V control (DIP switch: P1 on, P2 off).

2.5.4 German IPG_YLS Series Wiring Diagram

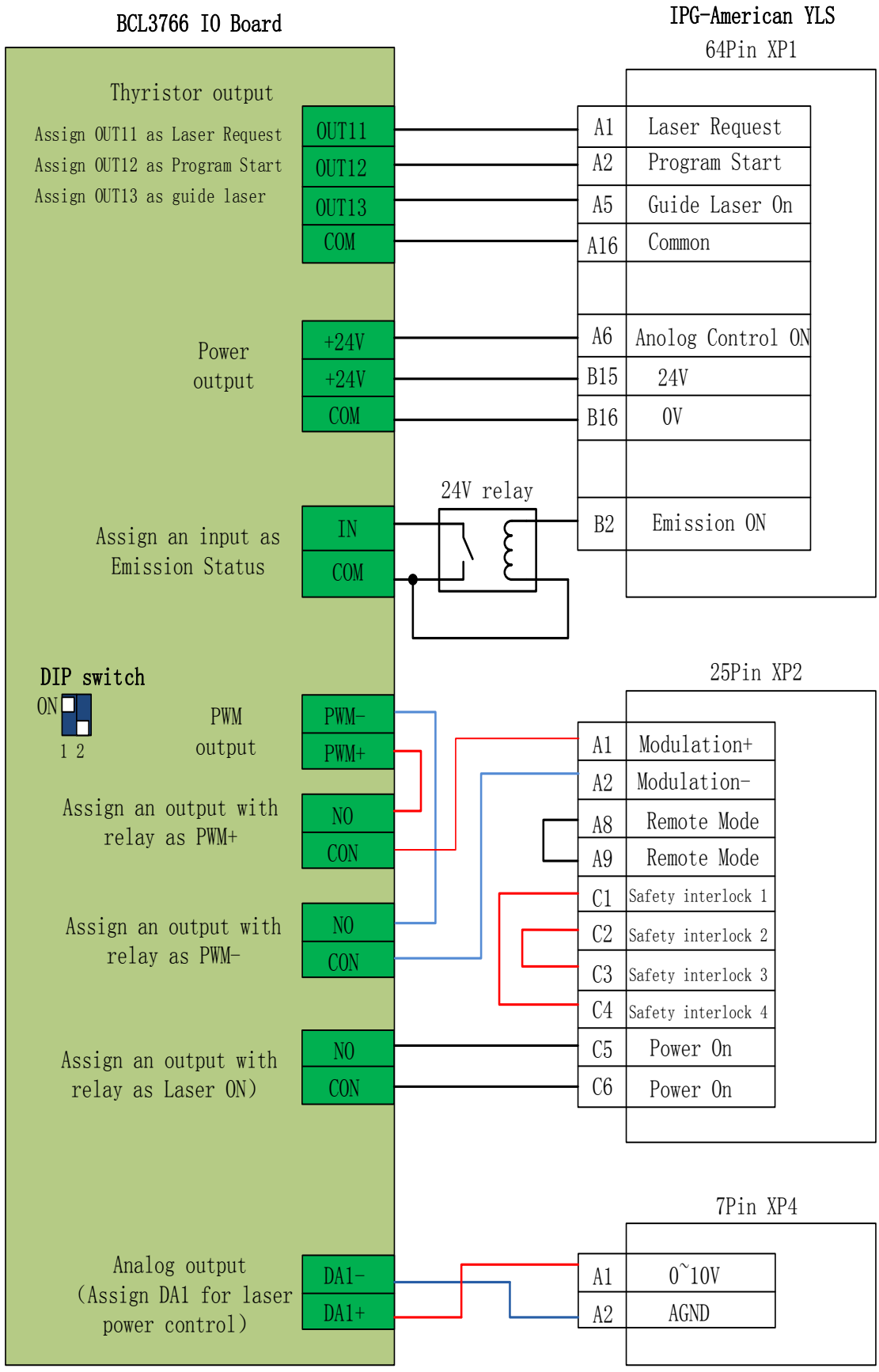


Note:

1.Emission On of XP1 is not necessary, meantime set Emission Status in configuration tool as 0, this indicating that software will not detect the emission status feedback.

2. PWM 24V control (DIP switch: P1 on, P2 off).

2.5.5 American IPG_YLS Series wiring diagram

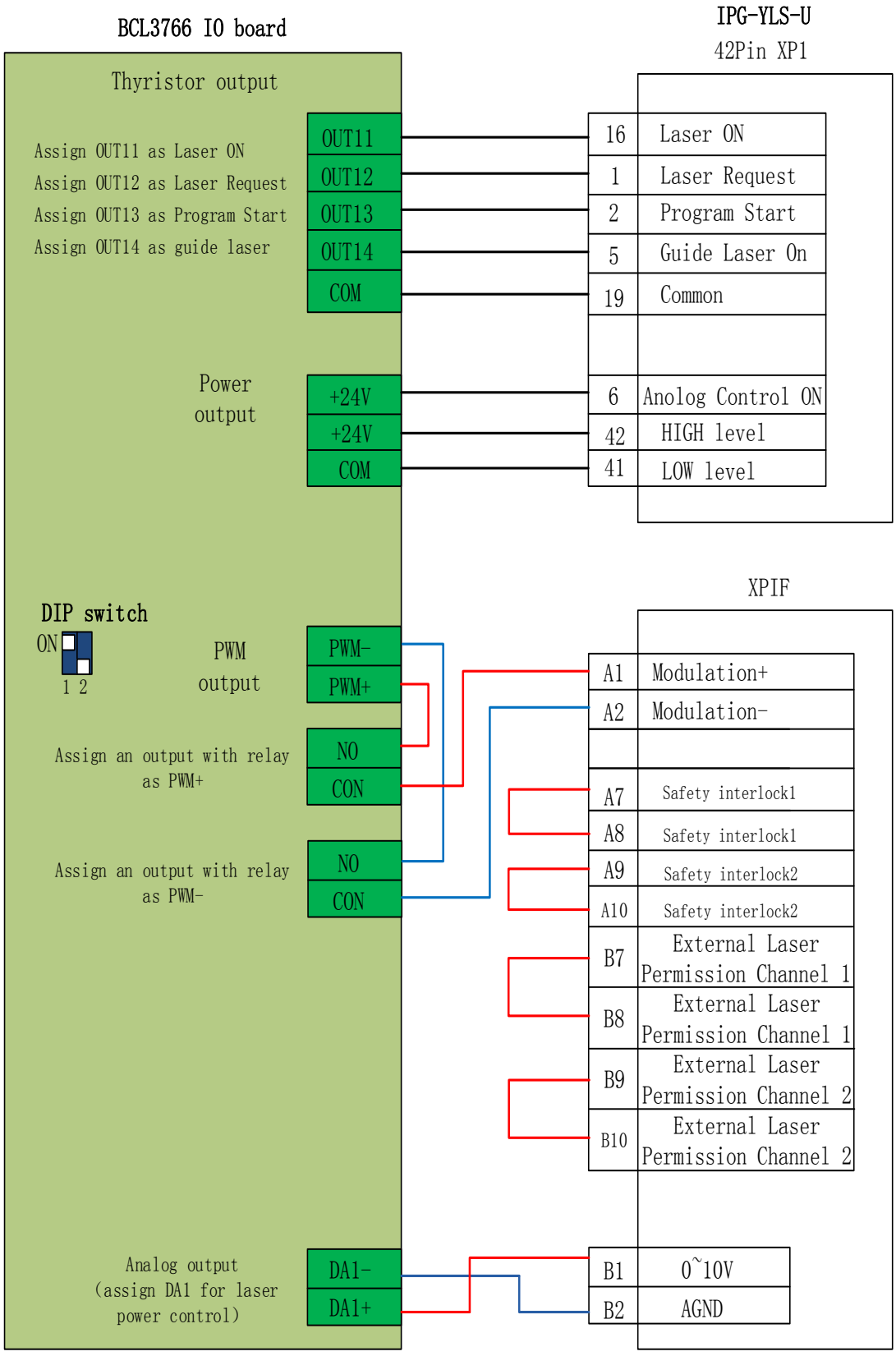


注：

1. Emission On of XP1 is not necessary, meantime set Emission Status in configuration tool as 0, this indicating that software will not detect the emission status feedback.

2. PWM 24V control (DIP switch: P1 on, P2 off).

2.5.6 IPG-YLR-U series wiring diagram

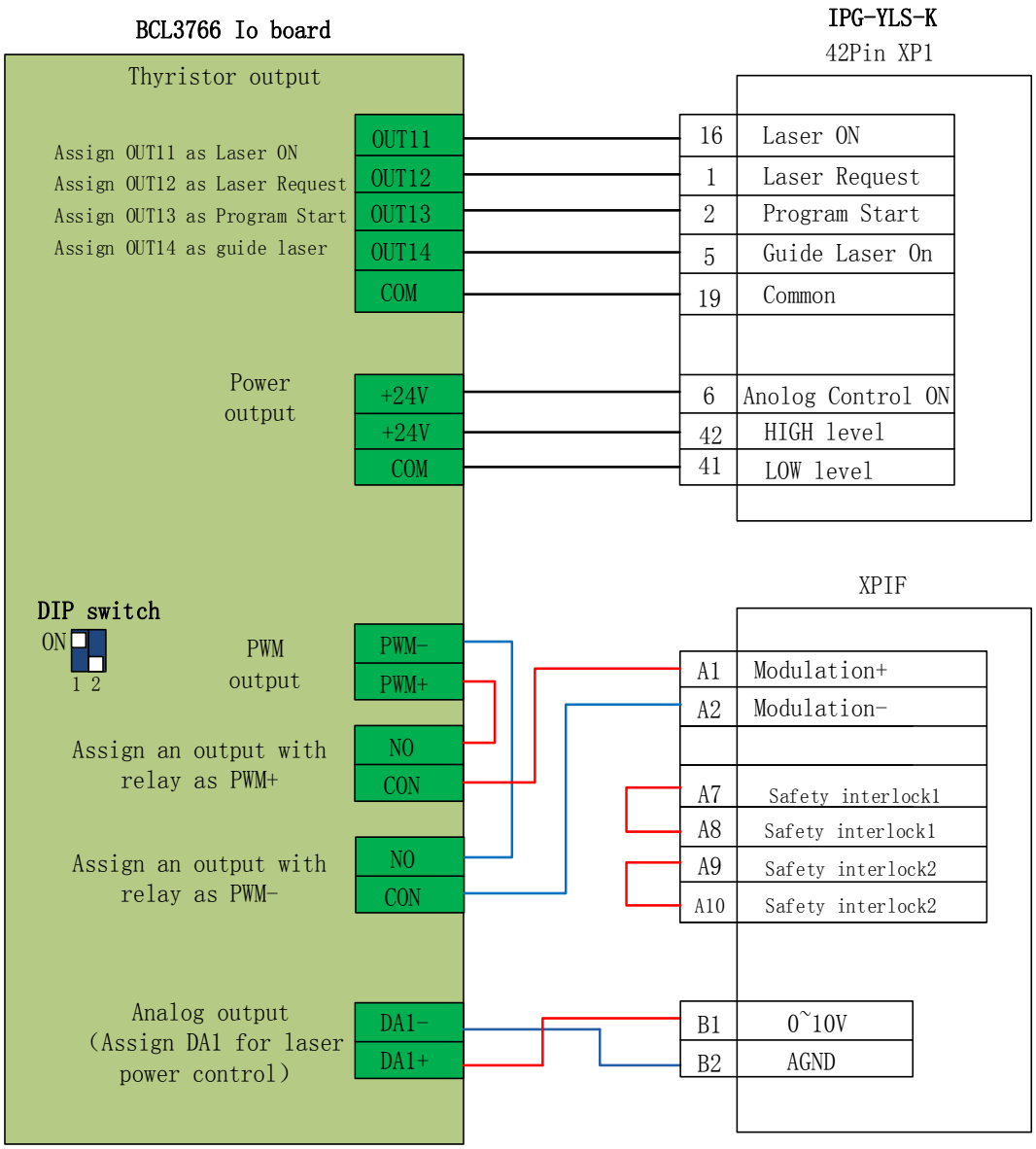


Note:

1. Select YLS-German in configuration tool.

2. PWM selects 24V(DIP switch:P1 ON, P2 OFF)

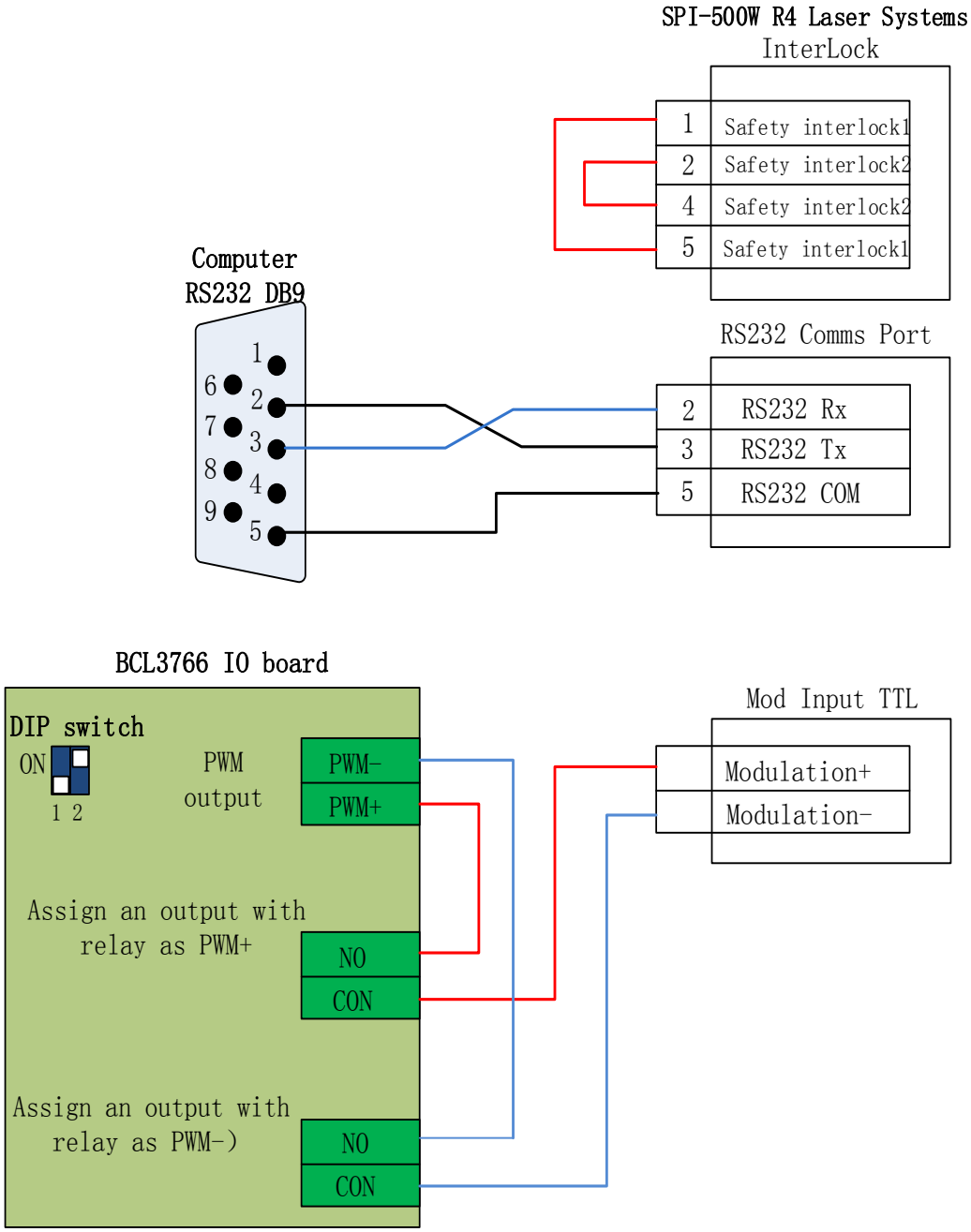
2.5.7 IPG-YLR-K series wiring diagram



Note:

1. Select YLS-German in configuration tool.
2. PWM selects 24V(DIP switch:P1 ON, P2 OFF)

2.5.8 SPI-500W-R4 Wiring Diagram

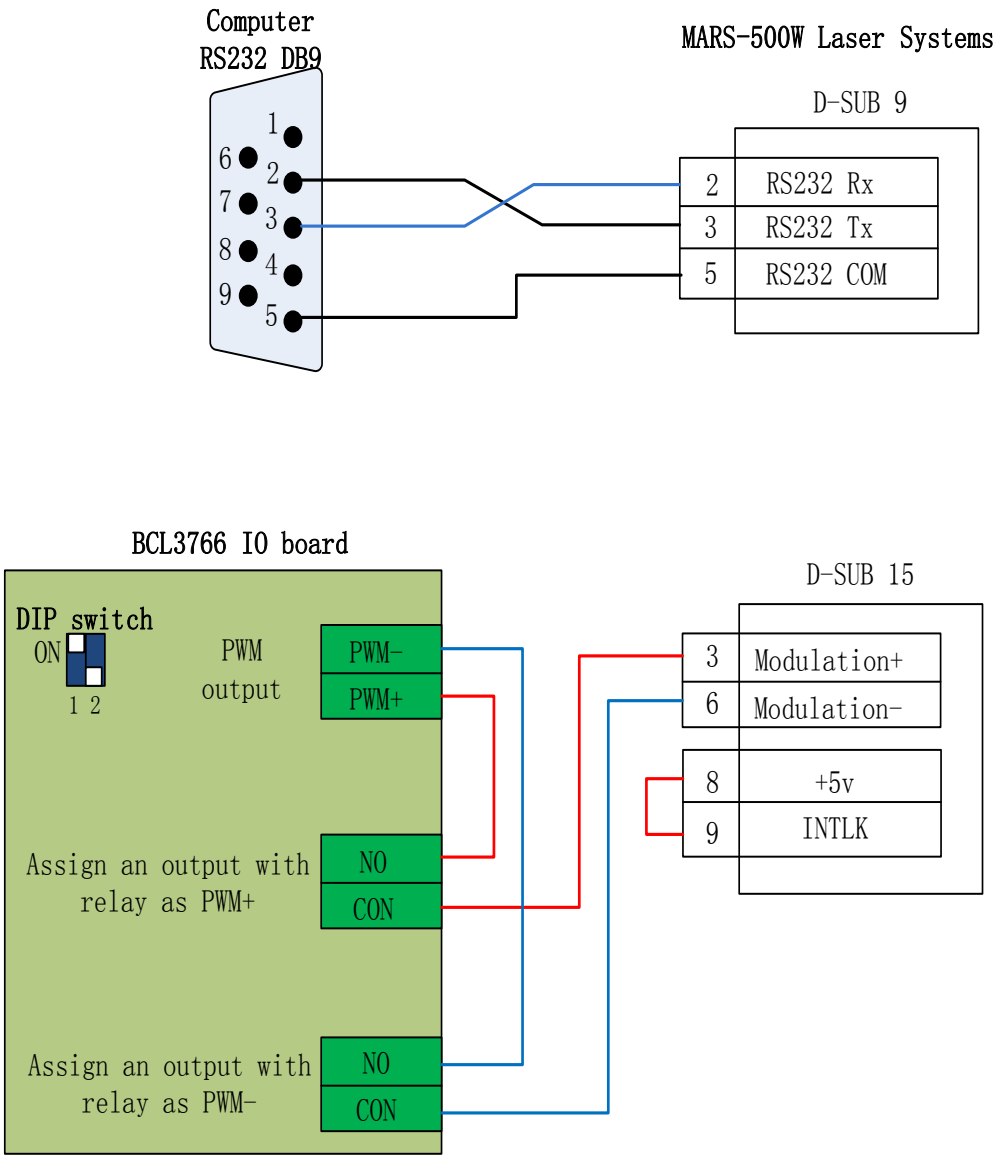


Note:

1. When modulation signal selects MODINPUTTTL, PWM selects 5V (DIP switch:P1 off, P2 ON).

2. When modulation signal selects IO pin1, PWM selects 24V (DIP switch:P1 off, P2 ON).

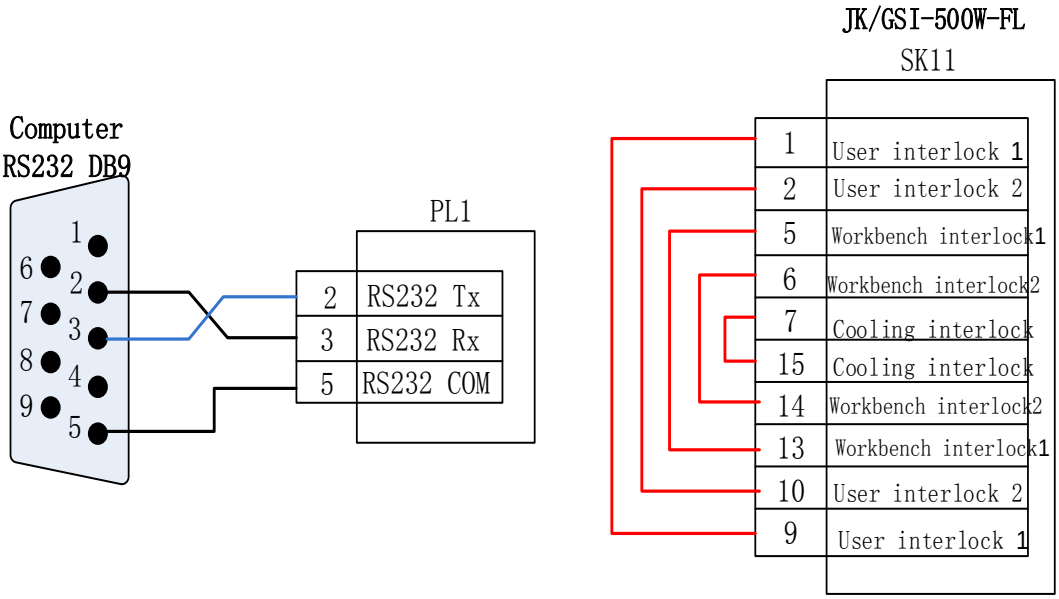
2.5.9 MARS series wiring diagram

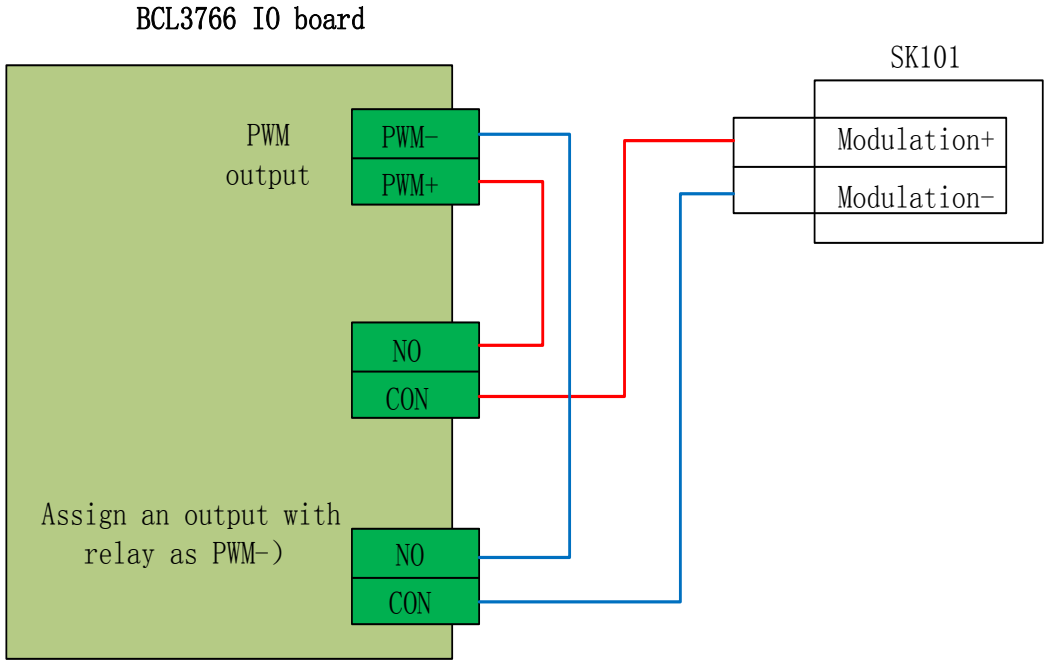


Note:

PWM selects 24V control (DIP switch:P1ON, P2 OFF).

2.5.10 JK/GSI-FL Series wiring diagram

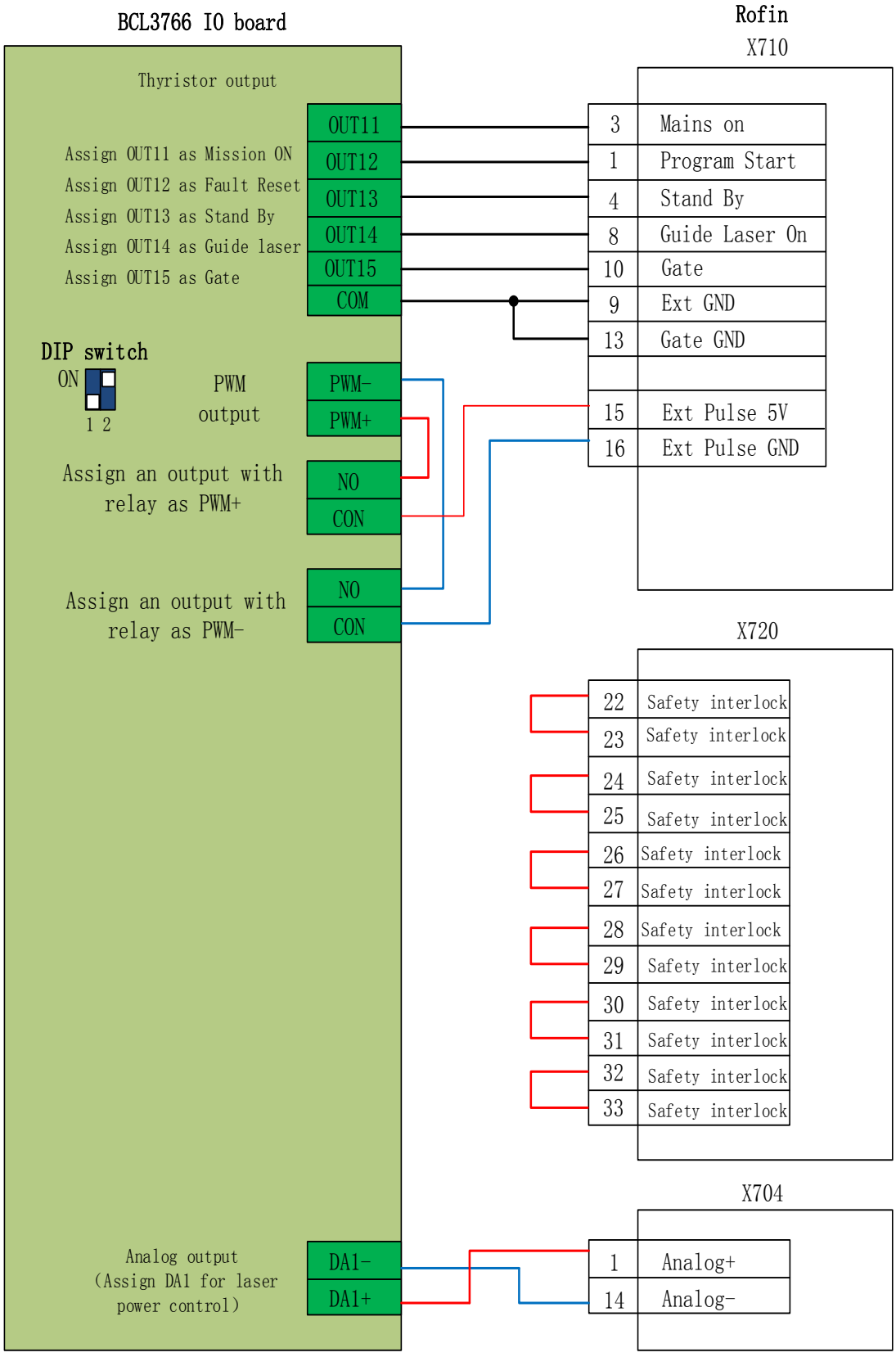




Note:

1. Interlocks in SK11 connect with proper device to confirm safety chain lock;
2. When modulating signal selects SK101, PWM choose 5V (DIP switch: P1 OFF, P2 ON);
3. When modulating signal selects PIN16 of PL5, PWM choose 24V (DIP switch: P1 ON, P2 OFF).

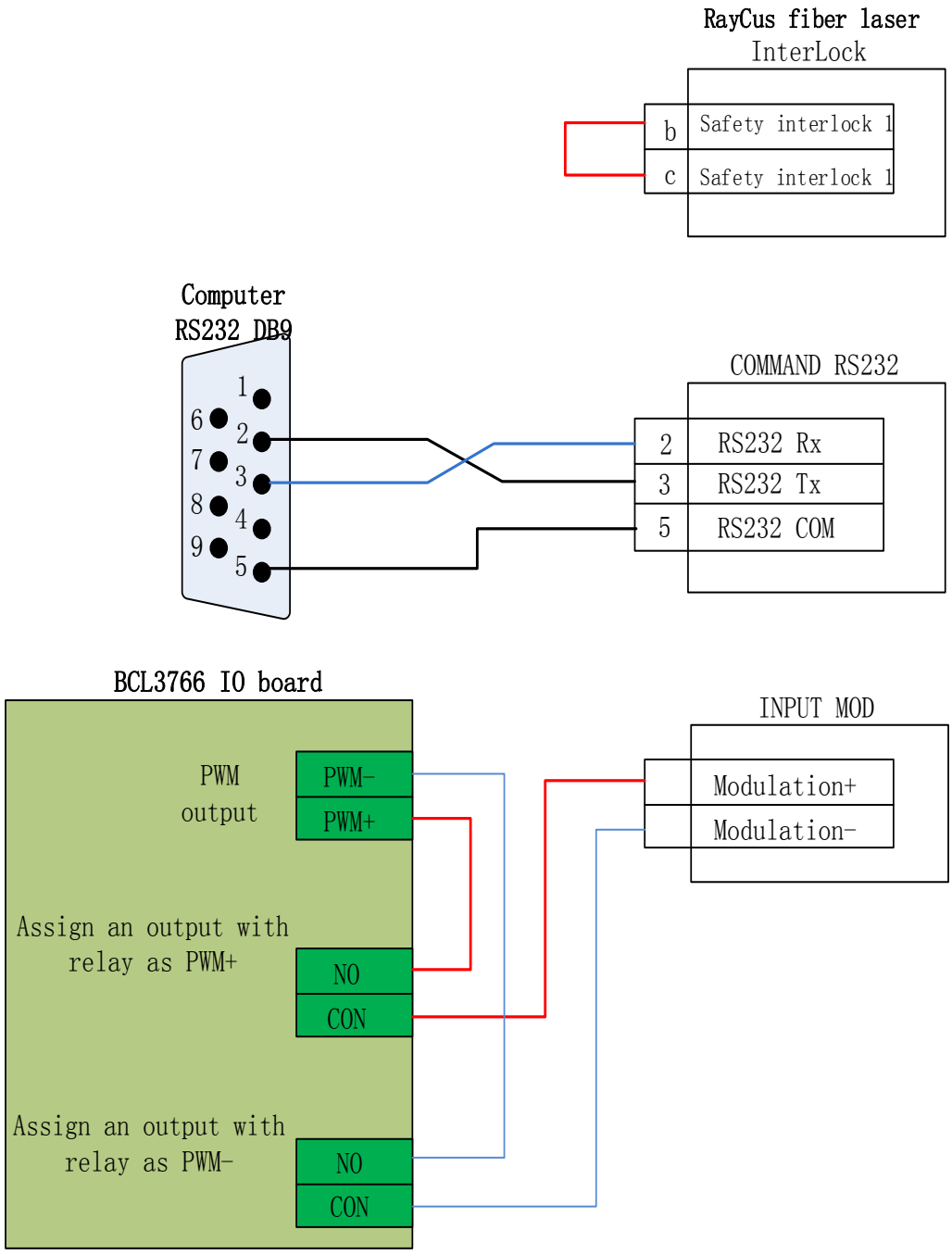
2.5.11 Rofin Wiring diagram



Note:

1. Interlocks in X720 connect to proper device confirm safety chain lock;
2. PWM select 5V control (DIP switch: P1 OFF, P2 ON).

2.5.12 RayCus fiber laser wiring diagram



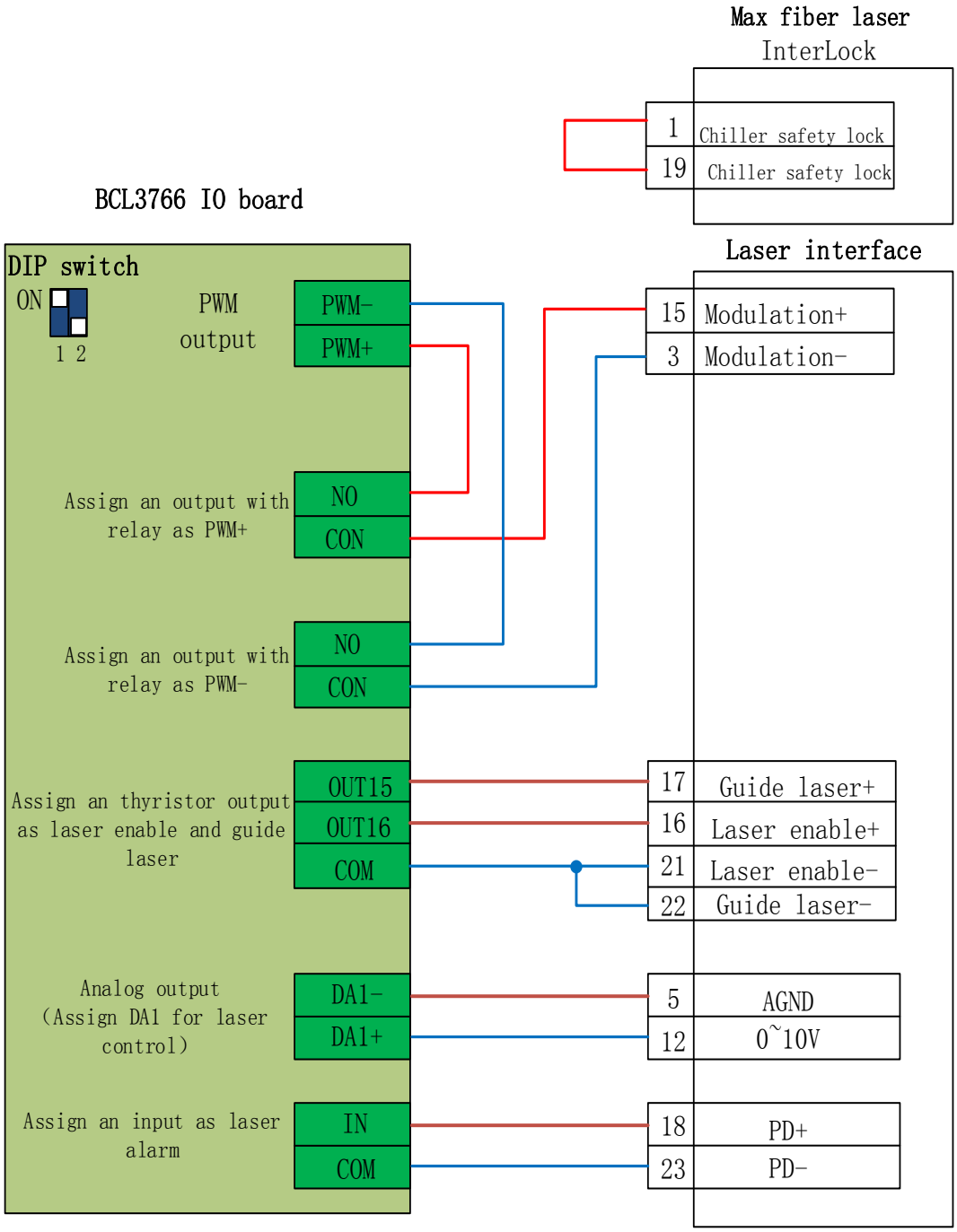
Note:

1. RayCus latest products use 24V PWM, the old version use 5V PWM. And the key switch to REM then RS232 is available in latest version, while the old version switch to ON. Laser PWM port will indicate 24V or 5V control; No sign indicating voltage means using 5V.

2. PWM 5V control (DIP switch: P1 off, P2 on).

3. PWM 24V control (DIP switch: P1 on, P2 off).

2.5.13 Max Laser Wiring Diagram



Note:

1. PD+, PD- are laser alarm outputs, connect to input port in BCL3766 and assign a customized laser alarm input in "Config tool-- alarm--custom alarm";

2. The grounding foot of guide laser and laser enable signal can connect to COM foot on BCL3766.

2. PWM selects 24V control (DIP switch: P1 ON, P2 OFF)

3. Platform Configuration Tool

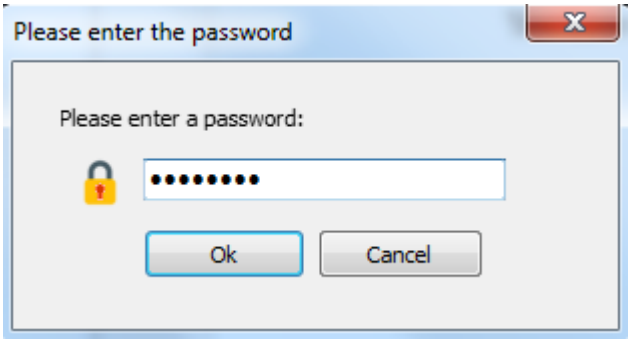
3.1 Installation

Configuration tool will be installed automatically in TubePro software installation.

In Windows 'Start' menu-'All programs'-'TubePro Laser Cutting Control System' click 'Machine config tool' the icon is .

3.2 Password

You have to input password to start config tool.



Initial password 61259023 click Ok open the config tool.

Note:

Parameter setup must accord with the actual mechanism structure, wrong setting will cause unknown serious consequences! In config tool, input ports are in yellow color, output ports are in green color.

3.3 User interface

Click buttons at the top of the screen you can enter in different parameter page like picture above.

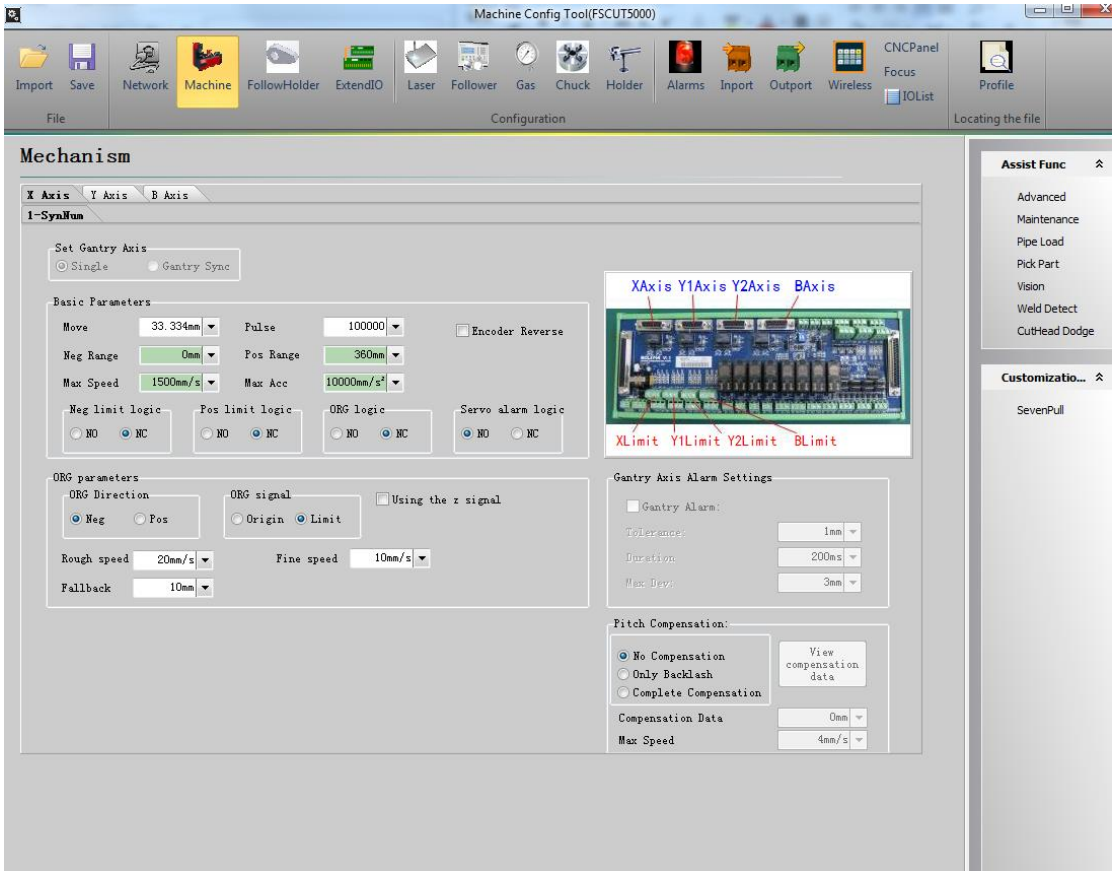
For example: Click 'Machine' enter into the mechanism parameter setting page.

Users can click 'Import' to directly load the configuration file; Click 'Save' preserve the setting.

Note:

1. Data folder contains all configuration information of TubePro.
2. You can backup file in config tool-file-parameter backup.

3.4 Machine Mechanism Configuration



Select the drive pattern of each axis (single drive or dual-drive). Set the parameters of rotate axis (input right pulse equivalent and reduction ratio).

Negative Travel range: When enable the soft limit protection, this is the range axis can reach in negative direction.

Positive Travel range: When enable the soft limit protection, this is the range axis can reach in positive direction.

Pulse Equivalent: Command pulses controller send to servo every 1mm linear distance on machine bed. The linear distance can set to 4 decimal places, pulse equivalent= pulses/linear distance.

Dual-drive axis deviation too large: In machine structure if any of X, Y or B is dual-drive structure, you can set alarm to alert the deviation. If the error of dual-drive reaches a certain value (Tolerance) and lasts a certain time (Duration), it will produce alarm 'Dual-drive axis deviation too large". If the error of dual drive reaches up limit (Max deviation) it will produce alarm immediately.

Servo alarm logic: Select the signal logic as normally open or normally close.

Speed: The maximum speed and acceleration allowed.

Return origin direction: You can set different return origin direction according the axis structure.

Origin signal: If user selects limit switch, it will sample limit signal when execute return axis to origin function. Note: B axis must separate limit switch and origin switch, and sampling origin signal when execute return origin process.

Z phase signal: Whether use Z phase signal decide the two different process of return origin. The corresponding process image will be displayed at lower position.

Rough speed: Axis will find origin switch 2 times. The first time to find origin signal at fast speed, recommended value of XY is 50mm/s, B axis is 30RPM.

Fine speed: Axis will find origin the second times at fine speed, recommended value is 10mm/s, B axis is 3RPM.

Fallback: The distance can keep machine origin not too close to limit switch.

Limit logic: The signal logic of X, Y, B axis limit and origin switch. Limit switch is not necessary for B axis.

B axes return origin separately: B axes decoupled then return origin separately.

3.5 Laser Configuration

TubePro supports most of the laser in market includes YAG, CO2, IPG, Raycus, SPI etc., there are different parameter settings for each type laser.

3.5.1 CO2 laser configuration

Mechanical shutter: Output port to control mechanical shutter.

Electronic shutter: Output port to control electronic shutter.

Response input: After mechanical shutter open will send a response signal to this port.

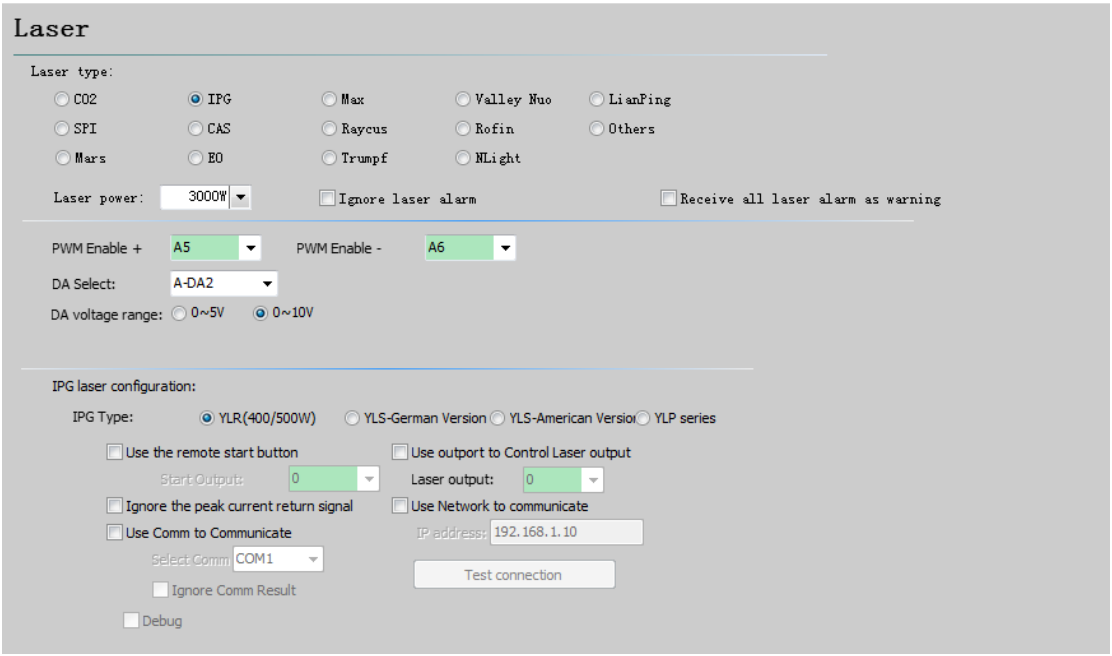
Laser model: Laser model 1 and model 2 will form the laser as continuous wave, gate or strong pulse.

DA port: There are 2 analog DA ports on BCL3766 terminal board, choose either of them to control laser peak power.

DA voltage range: The analog voltage range to control laser power.

Minimum power: The minimum power of the laser.

3.5.2 IPG Laser configuration



PWM Enable: Assign any of the relay output to switch PWM signal on and off. This can prevent laser leakage or false triggering.

DA port selection: There are 2 analog DA ports on BCL3766 terminal board, choose either of them to control laser peak power. When use RS232 or network control doesn't use DA port.

IPG Fiber Laser Configuration:

Remote start-up button:

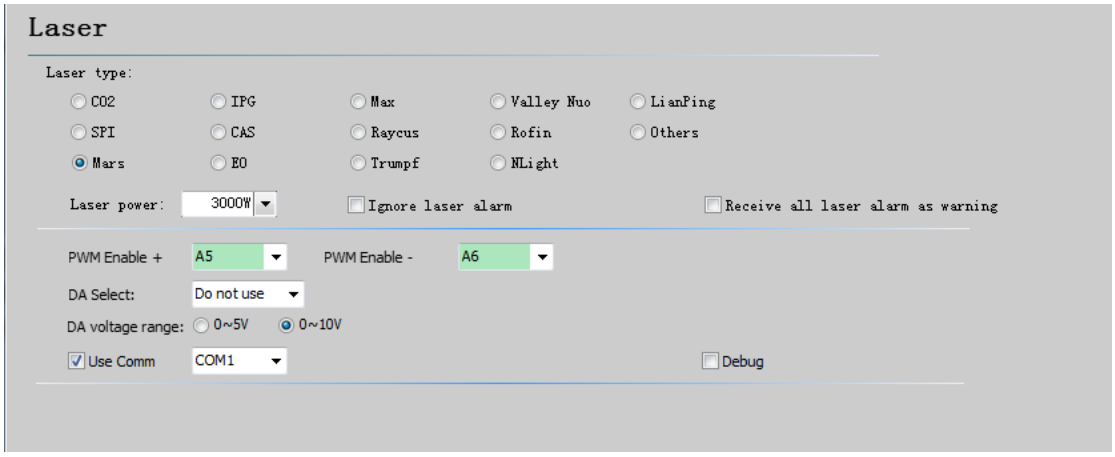
When switch key to remote control mode, you can startup laser by remote button. Select this option you have to assign an output port for remote control button. (It is not recommended to use this function, which might cause laser error)

IPG remote control:

When enable IPG remote control mode, TubePro will monitor the laser status in real time and realize the functions including laser emission control, guide beam and set laser peak power etc. When you use network or RS232 control laser, DA setting won't take effect.

IPG provides serial and network communication methods, users can set serial port or IP address under the circumstances. If the communication between PC with laser and PC with BCS100 both choose network communication, the network segment cannot be repetitive. For example, the segment of BCS100 is 10.1.1.x. Laser can set 192.168.1.x. It's recommended to use network communication control laser. If use serial communication the serial cable shielded layer must be well grounded.

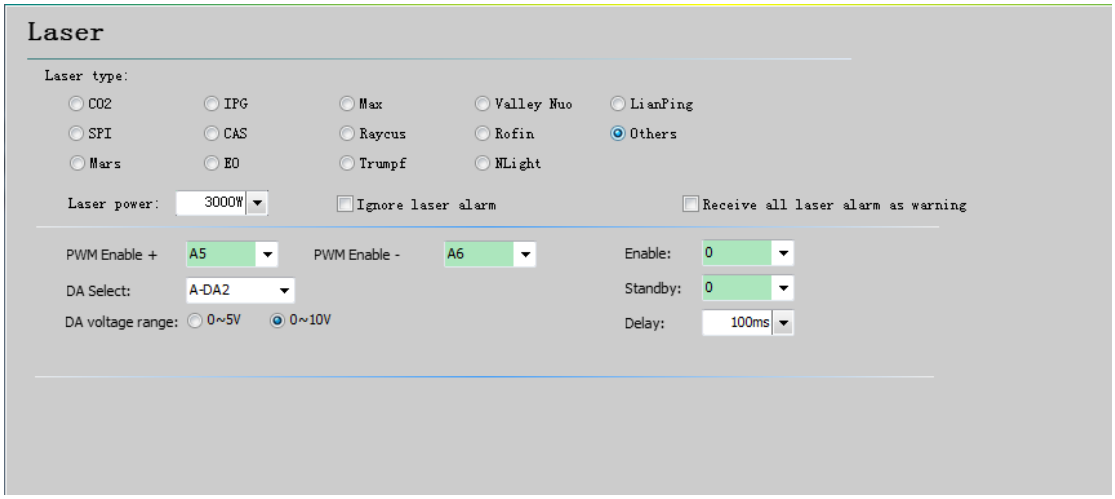
3.5.3 Mars/Rofin/RayCus/SPI/GSI/JK laser configuration



The configuration of Mars, Raycus and SPI are similar and support serial communication.

Debug mode: Enable debug mode, it will show communication code on TubePro message window at bottom of screen.

3.5.4 Other Brand of Laser

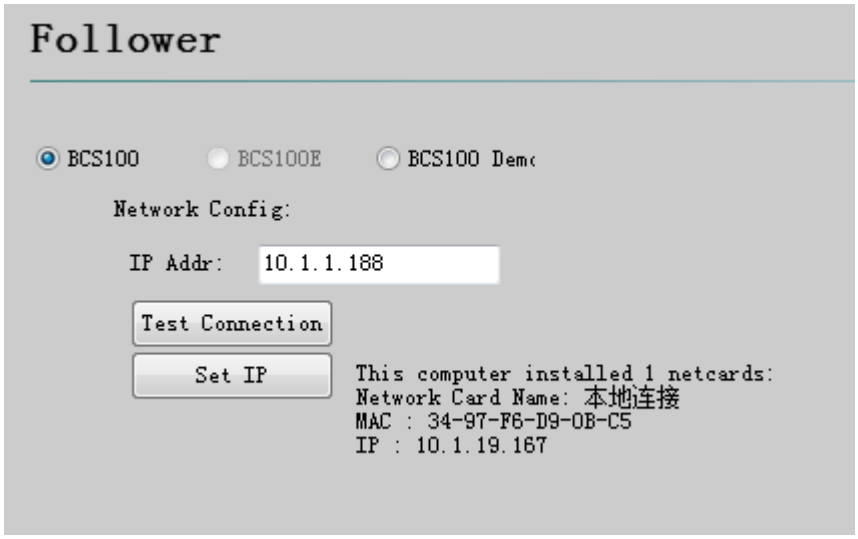


Laser enable: This related with the Emission button in TubePro control panel.

Standby: This related with the Emission button in TubePro, assign this signal there will be an extra output to open shutter.

Delay: This related with the Emission button in TubePro, the delay of enabling laser.

3.6 BCS100 Configuration

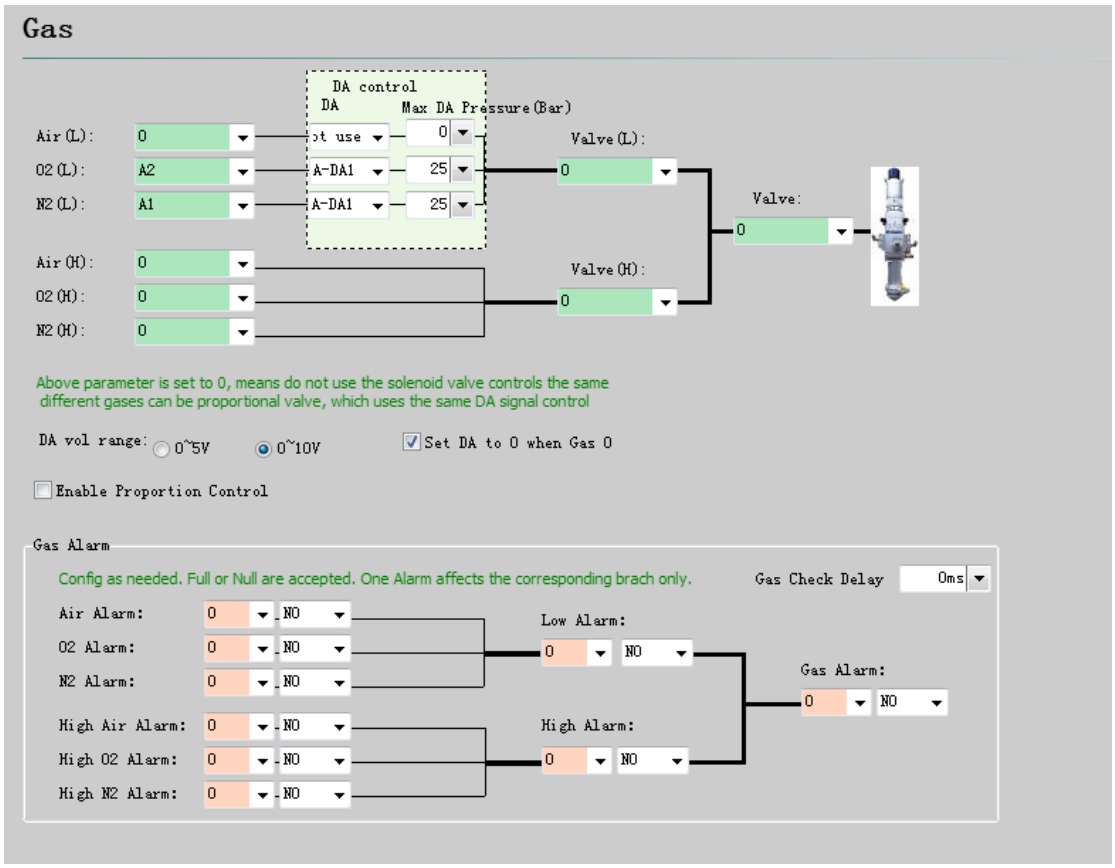


If you choose to use BCS100, only need to set IP address in TubePro config tool, which must be the same with the network address in BCS100.

Details setting IP see in BCS100 manual P2.5.6.

BCS100 demo: When select this mode, users can set related parameters in TubePro without connect with BCS100.

3.7 Gas Configuration



Master Valve: Output to turn on/off cutting gas.

Air (High pressure): Output to turn on/off air.

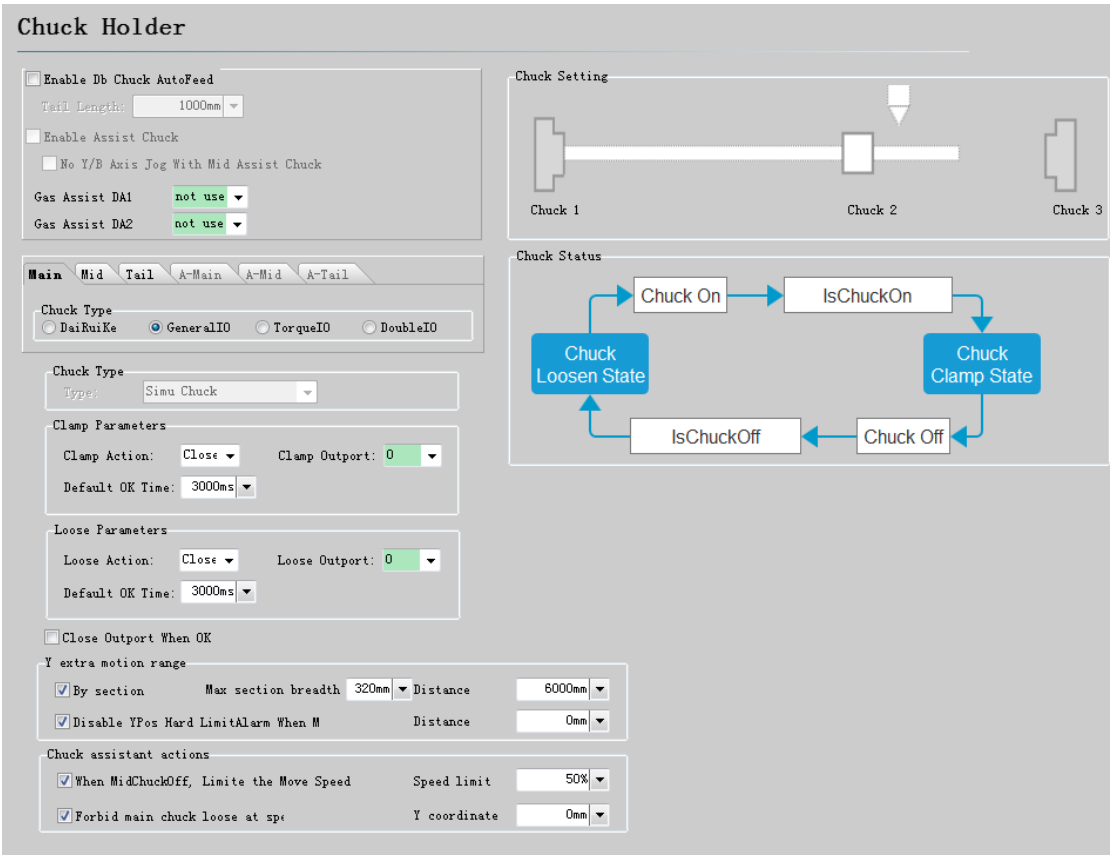
O2 (High pressure): Output to turn on/off O2.

N2 (High pressure): Output to turn on/off N2.

DA Gas Control: Users can choose one of the DA ports on BCL3766 for gas control.

Max DA pressure: The maximum gas pressure pass proportional valve.

3.8 Chuck



Enable Double chucks auto-feed: the solution that to cut longer tube in short motion range. Require mechanical structure that mid-chuck is hollow structure and mounted with assist chuck with clamp jaws.

Assist chuck: To assist-clamp the tube in chuck center. It's recommended that select 'No Y/B axis Jog with Mid assist chuck' in case of chuck damage. It means when mid-chuck jaws clamped tube, forbid Y and B axis motion functions.

Gas Assist DA: Assign one of the DA ports on BCL3766 to control gas pressure of chuck.

Chuck Type: Chuck types that FSCUT3000S system supports contain electric chuck and pneumatic chuck, from which pneumatic chuck divides into ordinary structure chuck and DaiRuiKe chuck with seal pin structure.

Seal Pin: The DaiRuiKe chuck with seal pin structure can only be used as mid-chuck in 3000S system. One thing to note about DaiRuiKe seal pin structure is that after B axis (chuck) return origin the seal pin must aim at inlet on the rotate body of chuck. After seal pin inserted in air inlet, chuck is not allowed to rotate until seal pin pulls out in case of chuck damage.

Clamp action: Select 'open', program will consider the initial status of the output is close.

Clamp outport: This output will send command of clamp signal.

Default ok time: The time required to complete clamping actions.

Loose action: Select 'open', program will consider the initial status of the output is close.

Loose output: This output will send command of un-clamp signal.

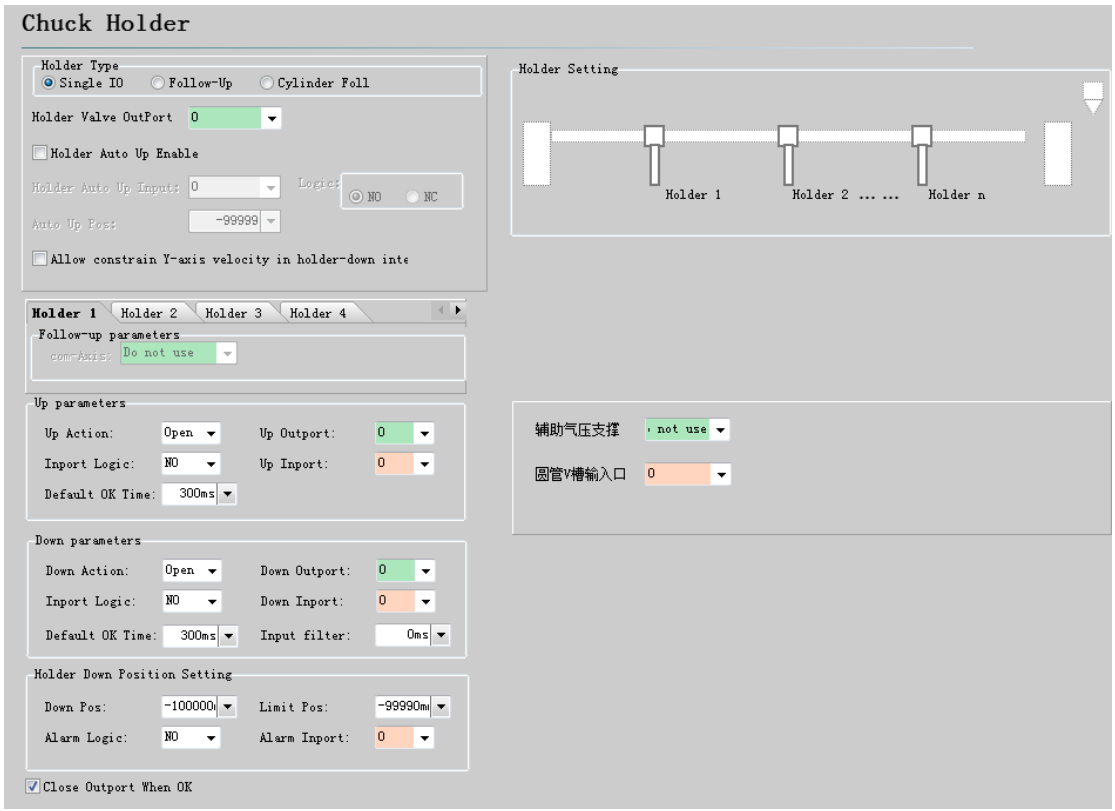
Default ok time: The time required to complete un-clamping actions.

Close output when ok: Program sent clamp and un-clamp output signal then close the output after this time interval.

Y extra motion range: When the tube cross section or mid-chuck status match the condition, Y axis extra motion range will be available.

Chuck assistant actions: Limit Y speed when mid-chuck loose: this function applied in the case that main chuck cannot drag the tube in high motion speed when mid-chuck in loose state. Forbid main chuck loose at specified position: this applied in the case that clamping jaws of main chuck hit the mid-chuck.

3.9 Holder



Holder Type: The holder driven by cylinder defined as 'IO holder', driven by servo motor defined as 'Follow up holder', driven by servo motor and cylinder defined as 'Cylinder follow type' in TubePro program.

Holder auto-up enable: Holder can lift up automatically when user enable this function and set lift up position. When Y axis coordinate smaller than this position holder will lift up. When assign a 'holder auto up' input, only when this input signal

activate and Y axis coordinate smaller than auto up position that holder will lift up automatically.

Limit Y speed in holder-down range: Program will limit Y axis dry-run speed in the range of holder drops down. Limited speed ≈ 0.9 *(limit position - down position)/default Ok time.

Up parameters

Up action: Choose open or close this signal port to control holder lift up.

Up outport: Assign the output port to control holder lift up.

Up inport: When this signal port valid, program will consider holder has reached position.

Inport logic: The signal logic of up-inport.

Default ok time: Controller sent holder lift command, after this time interval it will consider holder has reached position.

Down parameters:

Down action: Choose open or close signal port to control holder drop down.

Down outport: Assign the output port to control holder drop down.

Down inport: When this signal port valid, program will consider holder has reached position.

Inport logic: The signal logic of down-inport.

Default ok time: Controller sent holder drop down command, after this time interval it will consider holder has reached position.

Holder down position setting:

Down position: When Y axis reached this position, program will send holder drop down signal.

Limit position: The limiting position Y axis can reach when holder not drop down in position.

Alarm inport: When this signal port active, program will generate holder alarm.

Alarm logic: Signal logic of alarm.

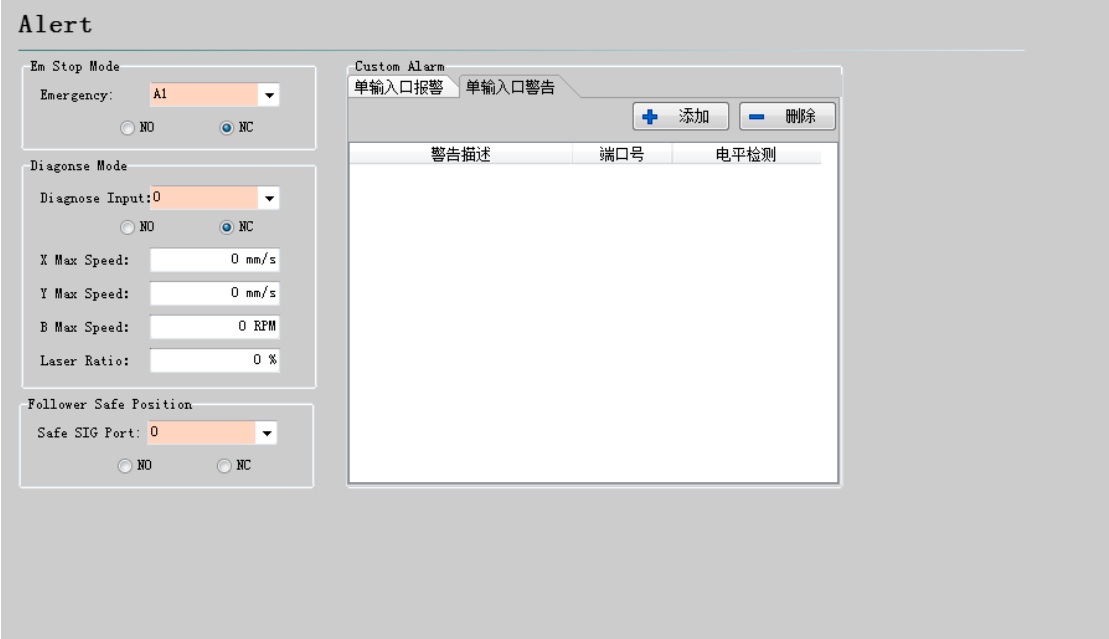
Close output when ok: When holder lift up or drop down reached position, close

the output port automatically.

Note:

1. If enable soft limit function and set 'auto up position' as 0, holder will not lift up at Y=0 position.
2. If use single output to control holder up and down, output will not close when holder has reached position.

3.10 Alarms



3.10.1 Warning message

Display the warning message in yellow color when machine is running. You can customize the warning message.

3.10.2 Emergency stop button

Assign an emergency input port, when this signal port turns active program will generate emergency stop alarm.

3.10.3 Diagnose mode

When diagnose input port turns active, program will enter in diagnose mode, under which it will limit Z/Y/X axis speed and laser burst PWM.

3.10.4 Safe SIG port

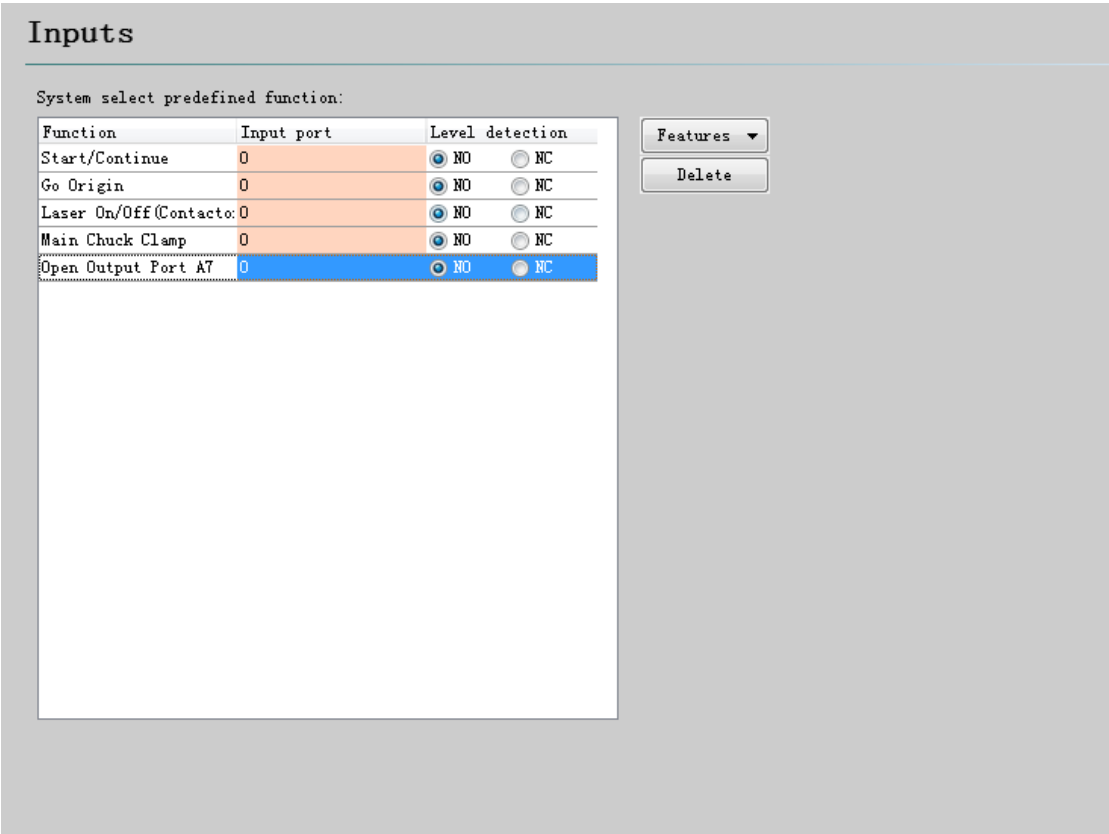
When this signal port turns active, program will consider Z axis is in safe position. Otherwise program will generate 'Z axis not in safe position' alarm and disable Z axis motion function.

3.10.5 Custom alarm:

Users can add customized alarm and edit alarm name, assign signal pin and select signal logic. Commonly used alarms are gas low-pressure, water temperature too high, and laser head collision etc.

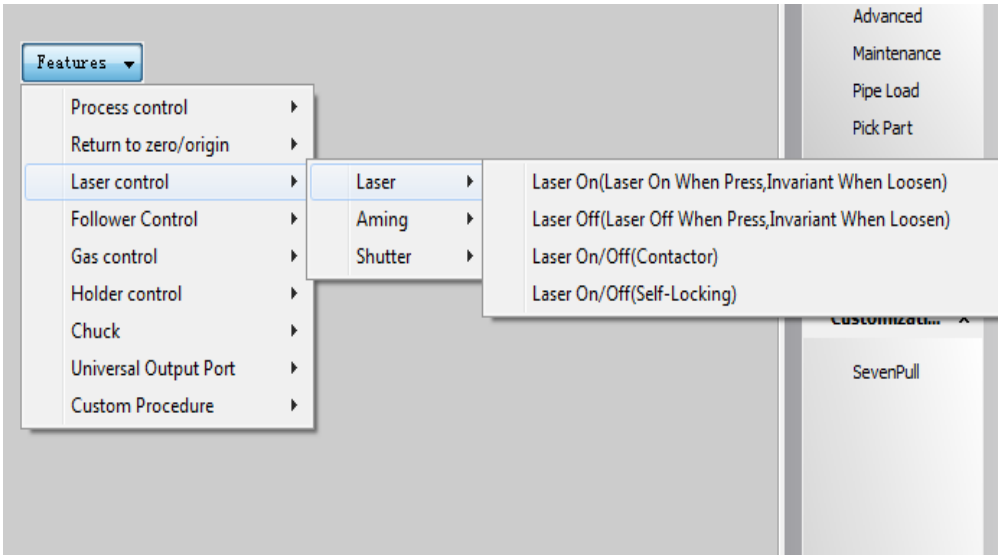
Note: All alarm status will be released in 2 seconds automatically after alarm signal eliminated.

3.11 General input



Click 'Features' button, users can select function item and assign an input port to the function.

Part of the function items have sub-function items, take 'Laser control' for example:

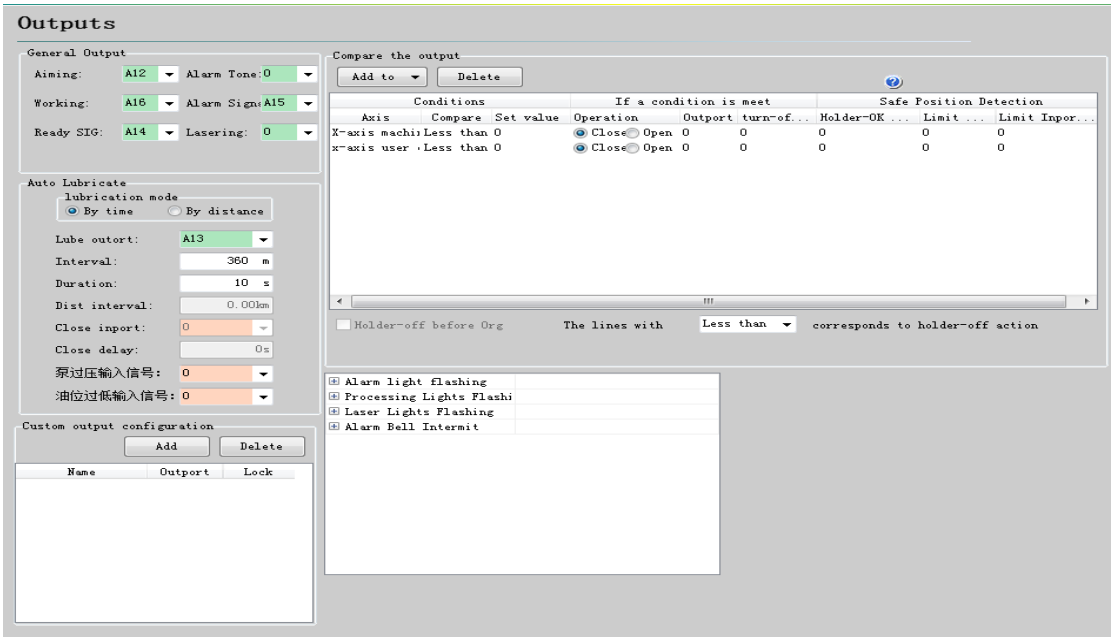


Select the function item as needed.

As shown below.

Function item	Description
Laser on(laser on when press)	Press the button enable the function.
Laser off(laser off when press)	Press the button enable the function.
Laser on/off(Contact)	Press the button enable the function, release the button disable the function.
Laser on/off(Self-lock)	Press the button enable the function, press again disable the function.

3.12 General output



3.12.1 Output Assignment

Aiming: Output to control guide /pilot laser.

Working: Assign this port as indicator light of machining status. The indicator will be flashing when machine is in machining status.

Alarm Signal: Assign this port as indicator light of alarm, the indicator will be flashing when there is alarm.

Lasering: Assign this port as indicator light of laser firing status, the indicator will be flashing when laser is firing.

Alarm Tone: Assign this port as alarm bell, when there is alarm detected alarm bell will be ringing.

Light flashing: Enable this function users can customize the interval of indicator light turns on and off to realize the flashing effect.

3.12.2 Auto Lubricate

Select 'Lubrication by time' mode, it will start time counting since TubePro software opened and open the signal output at each cycle and maintain a pre-set 'duration' time; Select 'Lubrication by distance' mode, it will start counting running

distance since TubePro software opened and open the signal output at each cycle and maintain a pre-set 'duration' time;

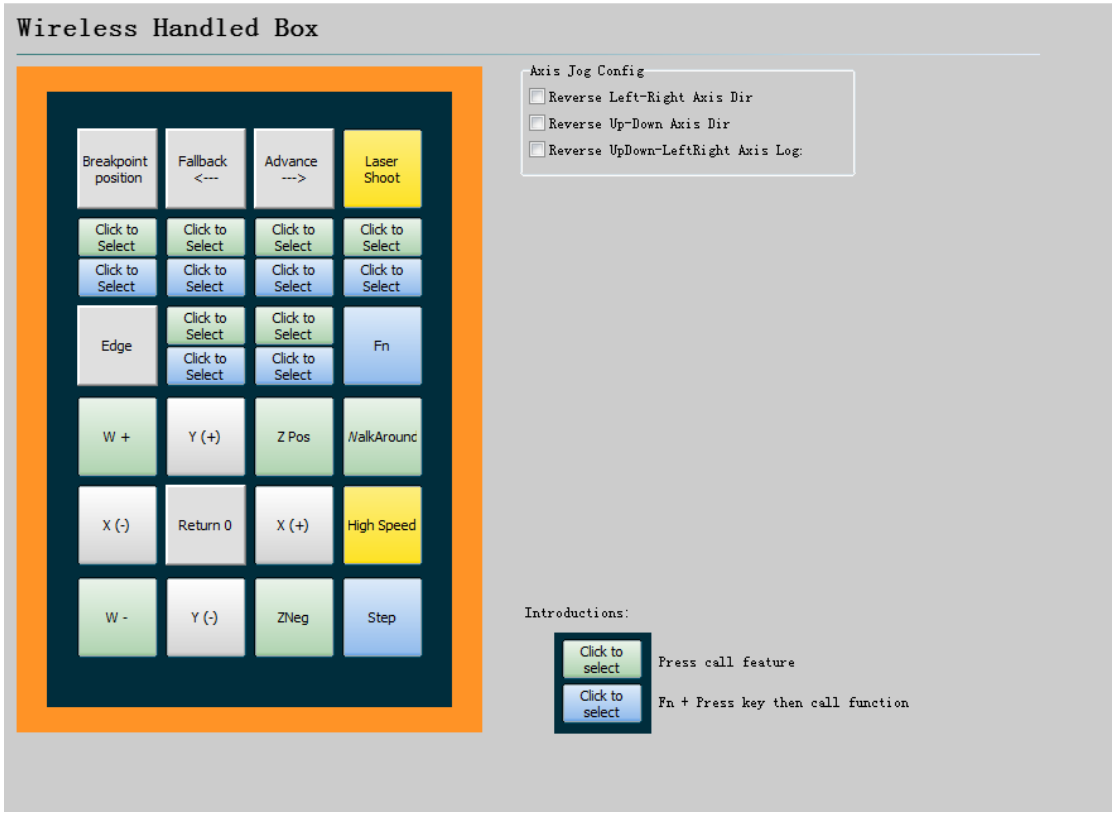
3.12.3 Custom Output

Customize the output port. Assign an output port there will be a control button of the same displayed in TubePro CNC page. The control mode of the button can be contact or self-lock.

3.12.4 Position-compare Output

Used in automatic application, when axes mechanical/program coordinates meet the specified conditions it will open the output port to realize some automatic actions.

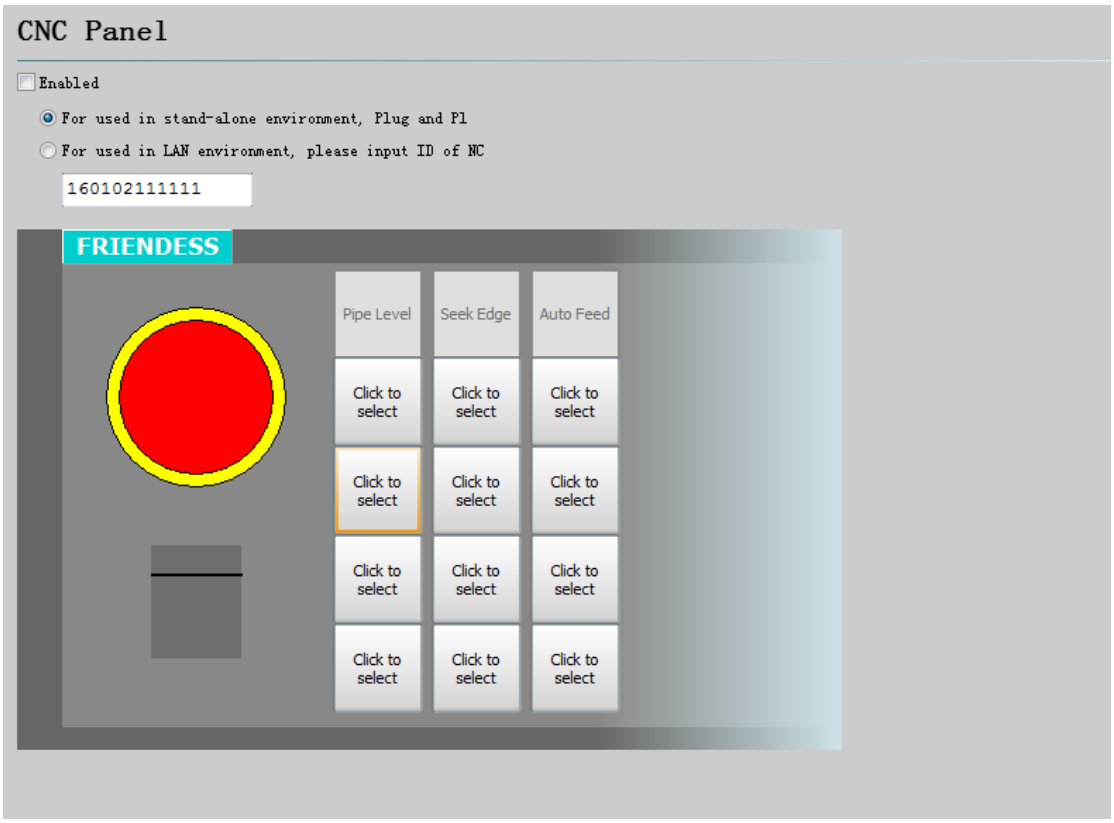
3.13 Wireless Remote



In FSCUT3000S system, direction of Y axis defined as positive when move towards laser head and linked with ↑ button on WKB remote. In TubePro config tool-WKB select 'Reverse left-right' press ↑on WKB Y axis will move to the opposite of laser head.

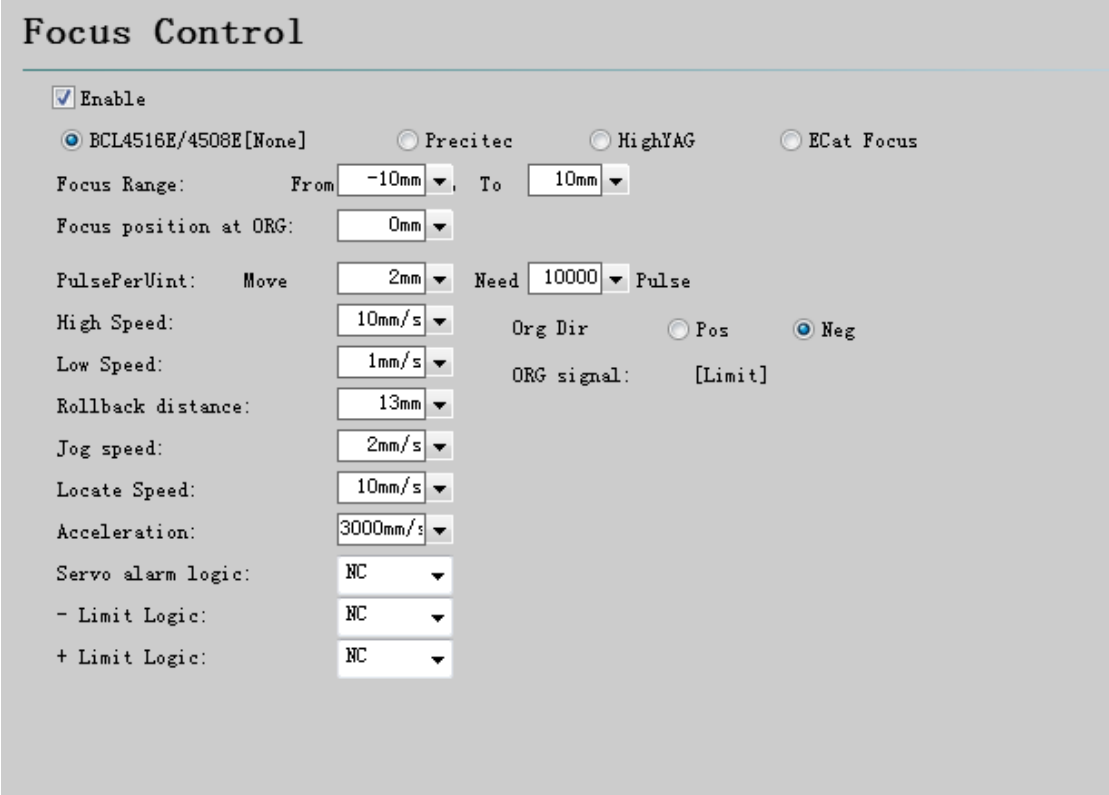
In this page you can set functions of 6 compound buttons. Press K button only, it will execute the function set in green zone. Press Fn+K together, it will execute the function set in blue zone.

3.14 CNC Panel



In TubePro config tool- CNC Panel you can activate BCP5045 panel. When use BCP5045 in standalone environment, TubePro program will pair BCP5045 Mac address automatically. When use BCP5045 in LAN environment, please enter the device ID number of BCP5045.There are 12 custom buttons on BCP5045 which can be assigned for pallet changer control or other PLC control.

3.15 Focus Control



Focus range: Set software limit and travel range.

Focus position at ORG: The focus scale at origin position.

Pulse per unit: Command pulses send to servo correspond with focus moving distance.

High speed: The speed to find origin switch.

Low speed: The speed to relocate the origin switch after find the origin in high speed.

Return origin direction: Negative direction is upward, positive direction is downward.

Origin signal: Use limit switch to sample the origin signal.

Rollback distance: After find the origin switch it will move backwards a distance.

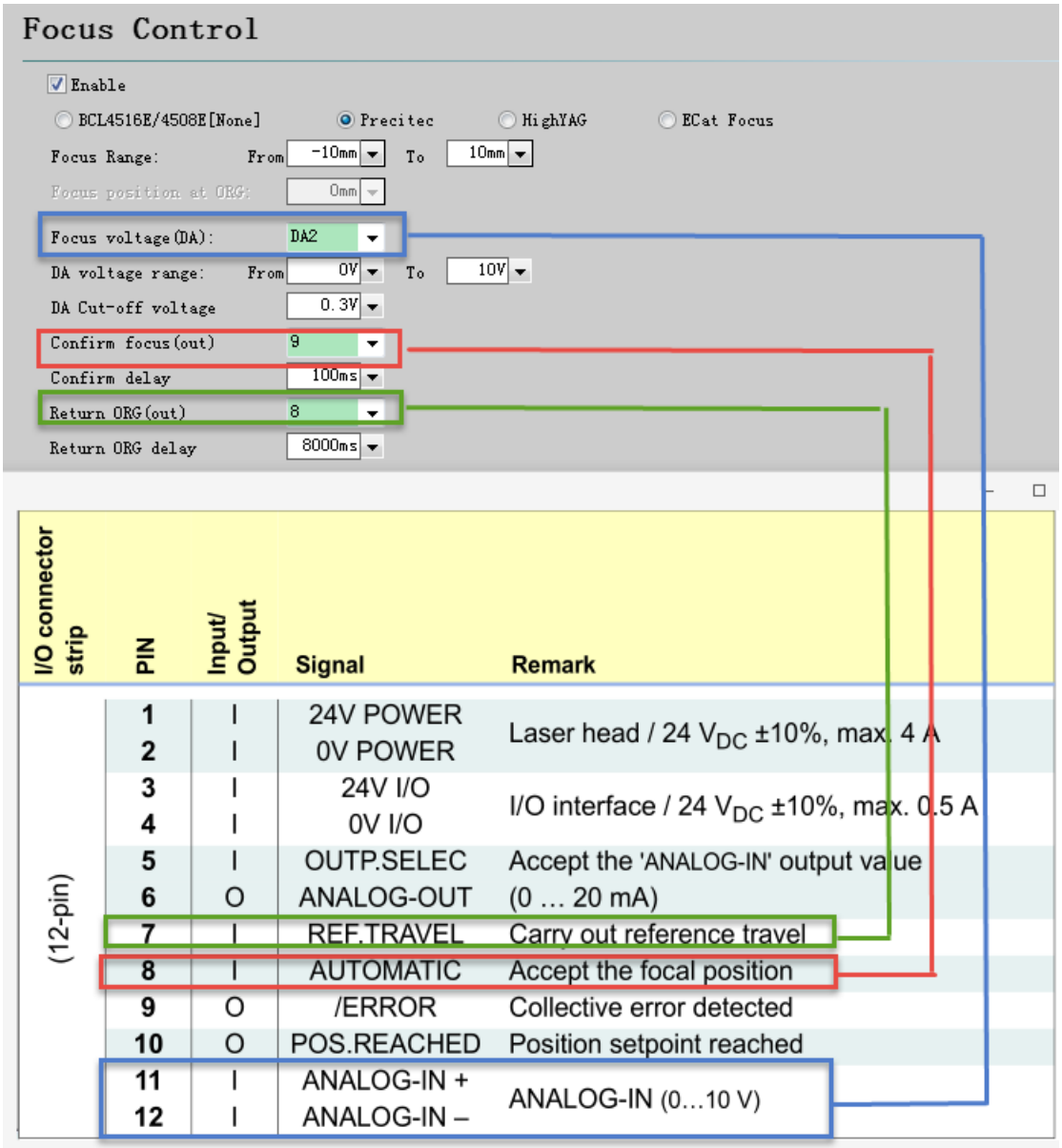
Jog speed: Speed of jogging axis driving focus.

Locate speed: The speed of axis driving focus.

Acceleration: The acceleration of axis driving focus.

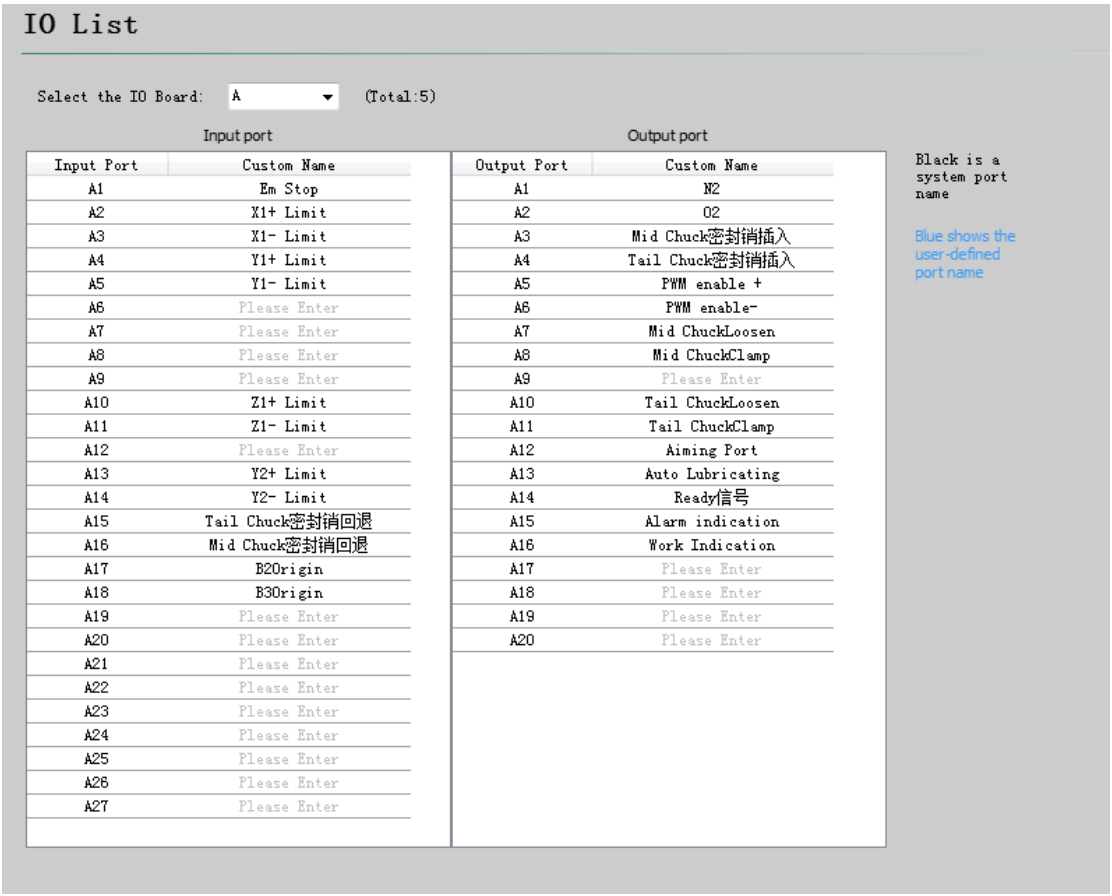
3.15.1 Precitec-ProCutter

Cypcut with BCS 100-pro can support ProCutter perfectly. Setting is recommended as below: One DA and one 24V output required to control focus position; One 24V output required to execute return origin action. Provide 24V power supply to pin 1, 2 and pin 3, 4.



I/O connector strip	PIN	Input/ Output	Signal	Remark
(12-pin)	1	I	24V POWER	Laser head / 24 V_{DC} ±10%, max. 4 A
	2	I	0V POWER	
	3	I	24V I/O	I/O interface / 24 V_{DC} ±10%, max. 0.5 A
	4	I	0V I/O	
	5	I	OUTP.SELEC	Accept the 'ANALOG-IN' output value
	6	O	ANALOG-OUT	(0 … 20 mA)
	7	I	REF.TRAVEL	Carry out reference travel
	8	I	AUTOMATIC	Accept the focal position
	9	O	/ERROR	Collective error detected
	10	O	POS.REACHED	Position setpoint reached
	11	I	ANALOG-IN +	ANALOG-IN (0…10 V)
	12	I	ANALOG-IN –	

3.16 IO list



Input Port	Custom Name
A1	Em Stop
A2	X1+ Limit
A3	X1- Limit
A4	Y1+ Limit
A5	Y1- Limit
A6	Please Enter
A7	Please Enter
A8	Please Enter
A9	Please Enter
A10	Z1+ Limit
A11	Z1- Limit
A12	Please Enter
A13	Y2+ Limit
A14	Y2- Limit
A15	Tail Chuck密封销回退
A16	Mid Chuck密封销回退
A17	B2Origin
A18	B3Origin
A19	Please Enter
A20	Please Enter
A21	Please Enter
A22	Please Enter
A23	Please Enter
A24	Please Enter
A25	Please Enter
A26	Please Enter
A27	Please Enter

Output Port	Custom Name
A1	N2
A2	O2
A3	Mid Chuck密封销插入
A4	Tail Chuck密封销插入
A5	PWM enable +
A6	PWM enable-
A7	Mid ChuckLoosen
A8	Mid ChuckClamp
A9	Please Enter
A10	Tail ChuckLoosen
A11	Tail ChuckClamp
A12	Aiming Port
A13	Auto Lubricating
A14	Ready信号
A15	Alarm indication
A16	Work Indication
A17	Please Enter
A18	Please Enter
A19	Please Enter
A20	Please Enter

You can check all input and output assignment in this page and customize the port name. Customized name will be shown in blue color.

4. Electrical System Debug

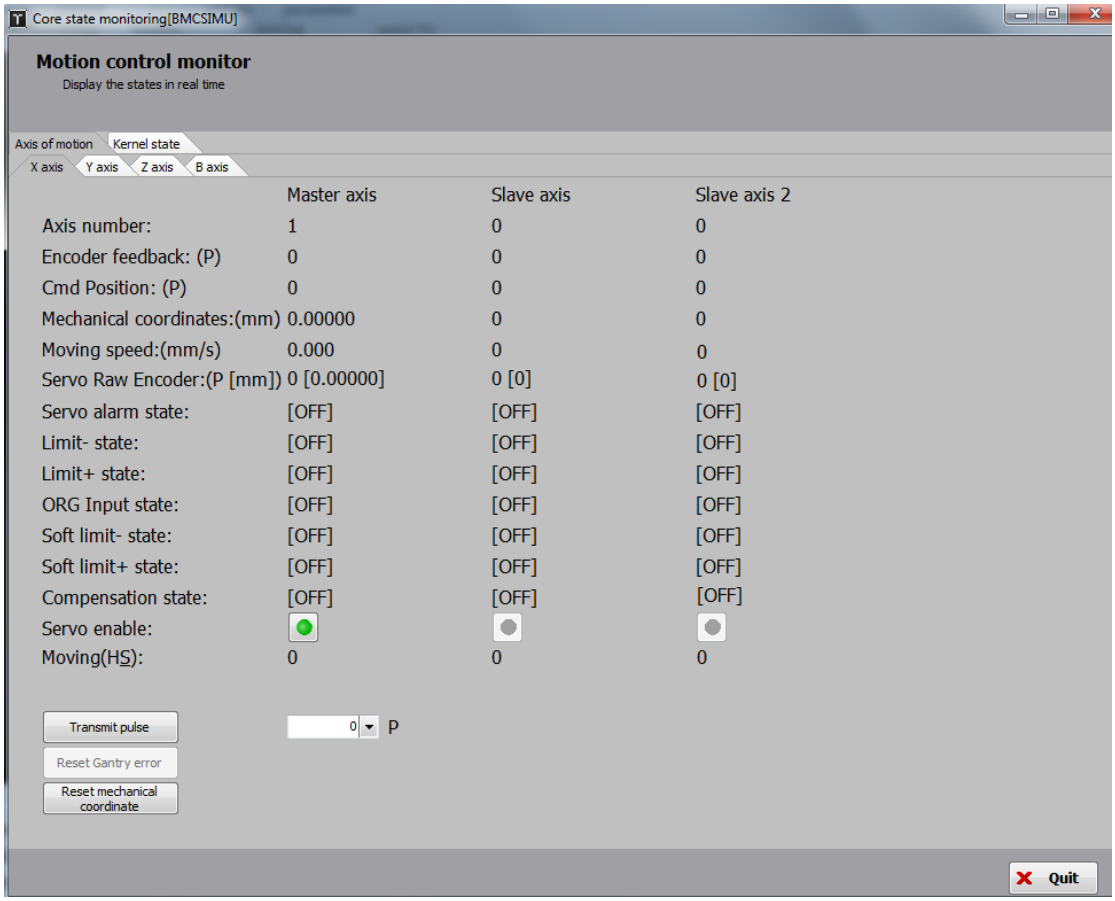
4.1 Power Supply Debug

Connect BCL3766 with BMC1805 card by C62 and C37 cable, provide 24V power supply to BCL3766 IO terminal board. Before provide power supply to the system, make sure power line correctly connected.

Note: It's forbidden hot plug BMC1805 card from C62 or C37 cable.

4.2 Hardware Signal Debug

Startup computer and run TubePro software. At TubePro top menu-Tool- Motion control monitoring.



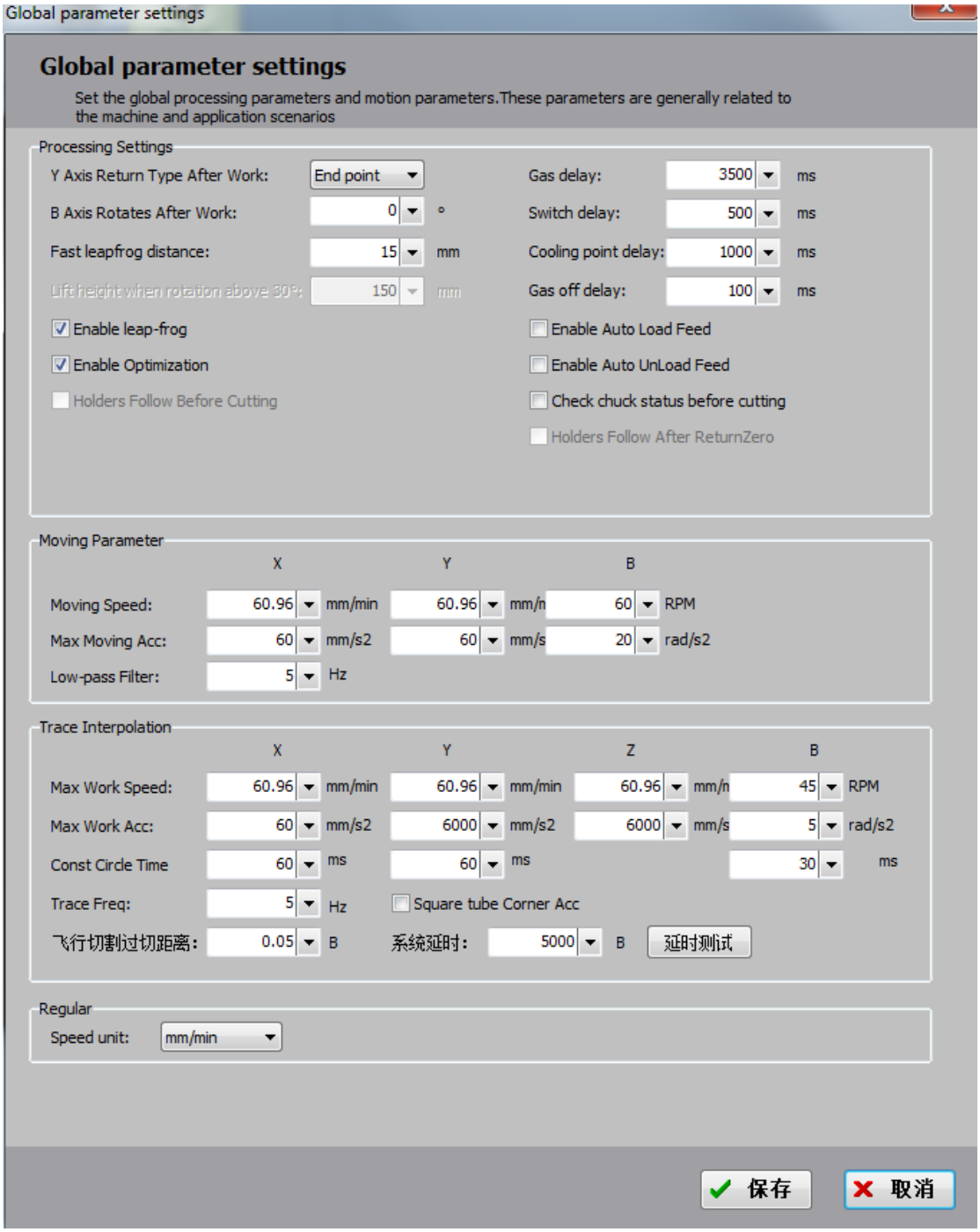
Check the positive/negative/origin switch signal, input/output, DA signal, PWM signal and servo enable signal make sure they are all valid.

For dual-drive axes, you can 'Reset gantry error' and 'Reset mechanical coordinate' to clear the encoder count. Then send 1000 command pulses to each axis test the motion performance and encoder feedback.

4.3 Motion Performance Debug

Set conservative parameters in servo driver. Also set conservative values related with motion parameters in TubePro. Open global parameter page in TubePro main

program. As shown below:



Test each axis if it will move in right distance and direction.

Make sure limit and origin switch can work normally then execute axes return mechanical origin to build coordinate.

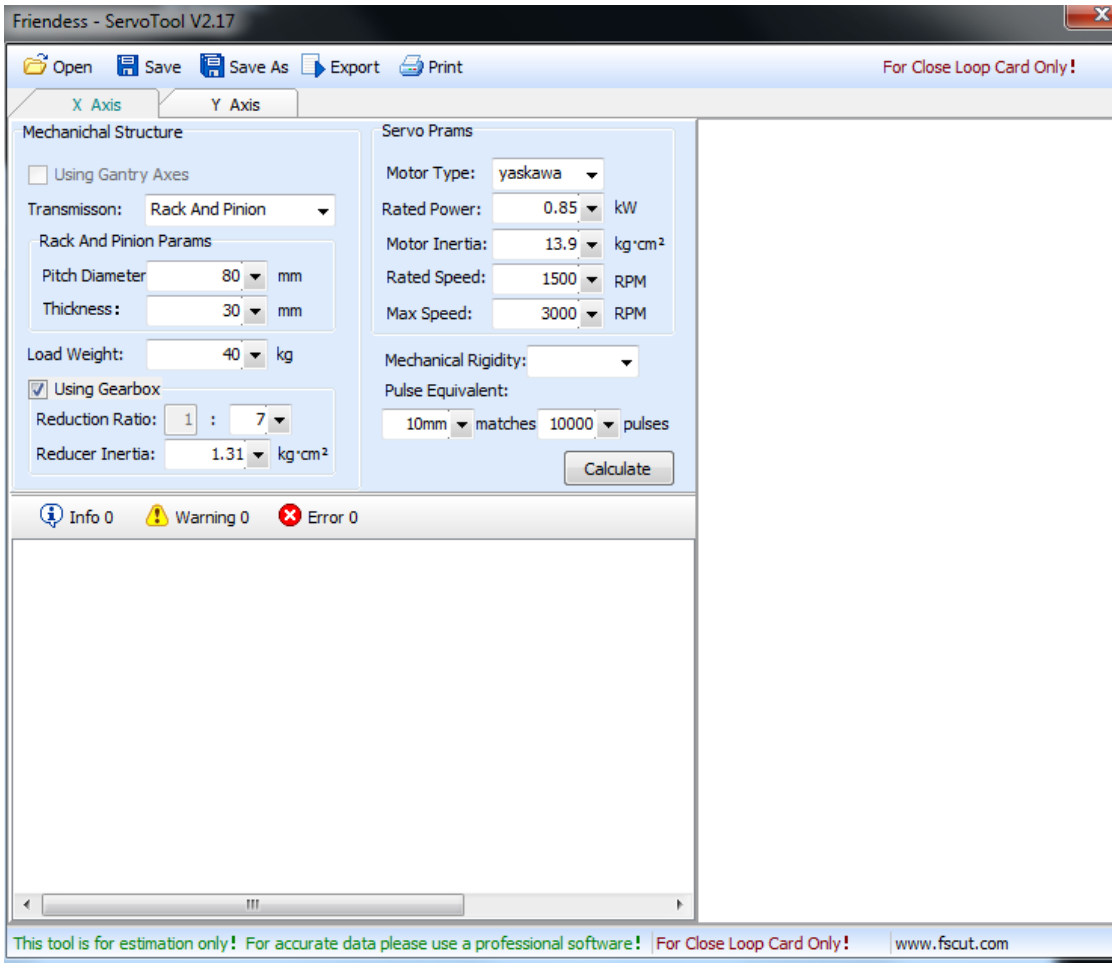
4.4 TubePro Function Test

Press Jog, Gas, Laser, Aiming and other buttons in control panel on TubePro main program check if functions work normal. Make sure system can normally control peripherals including laser, BCS100, gas valve etc.

5. Motion Performance Optimization

5.1 Calculate Inertia Ratio and Machine Performance Features

The inertia ratio is a key indicator of machine performance features. You can calculate the inertia ratio of each axis by a Servo Tool provided by Friendess Company. You can download Servo Tool on http://downloads.fscut.com/.As shown in the following figure:



The inertia ratio is smaller than 200% indicating machine in light load that can reach high speed cutting.

The inertia ratio within 200% to 300% indicating machine in medium load, cutting precision is declined compared with light load in high speed, you need to lower the cutting speed and low pass filter.

The inertia ratio is in 300% to 500% indicating machine in heavy load that cannot reach high speed cutting performance.

Inertia ratio is bigger than 500%. There are serious design defects. It's difficult for servo tuning.

You can calculate the max cutting speed, max running speed and max acceleration which can be directly set in CypOne motion control parameters. Experienced users can also calculate inertia ratio accurately through servo adjust tool.

Note: The servo parameters calculated in ServoTool can only be reference value for FSCUT4000 close-loop system. FSCUT2000 and FSCUT3000S system users should set the servo parameters of position mode.

5.2 Servo Gain Adjustment

5.2.1 Requirements

It requires professionals who are experienced with servo tuning tools: PANATERM servo tuning tool for Panasonic servo, SigmaWin+ for Yaskawa servo, experienced with servo tool can simplify the process.

5.2.2 Panasonic Servo Gain Adjustment

Step 1: Open PANATERM [Gain tuning] page. Open the [Real time auto-gain tuning] to calculate the inertia ratio.

Step 2: Set rigidity in a conservative value. For example, start from level 13. Then Jog the axis in high speed. Watch if there are abnormal noise or vibration. Then slowly rise the rigidity level. When axis started to have noise and vibration, lower the rigidity 1~2 level to ensure axis motion stability. The final rigidity recommended within 10~20. For dual-drive axes you need to change the parameters of both axes then test the motion function.

Step 3: When you finish measuring the servo rigidity of X/Y axis, recommend set the same rigidity to both X/Y axes to make sure XY axes response is uniform. The final rigidity should take the smaller level. For example, X axis servo rigidity is level 19, Y axis 16, final level should be 16.And set servo rigidity as 16 to both XY axes.

Step 4: Close [Real time auto-gain tuning] and save the setting.

5.2.3 Yaskawa Servo Gain Adjustment

Yaskawa servo adjustment process is similar with the Panasonic, the difference is: No inertia ratio and auto-gain tuning function in SigmaWin+.You can calculate the inertia ratio by Servo Tool download in our web www.fscut.com.Experienced users can manually calculate the inertia ratio by the torque variation and acceleration time during an acceleration motion.

- It is recommended to close Pn140 function.
- It is recommended to close Pn170 function.
- There is no concept of servo rigidity in Yaskawa servo. You can set the parameter take reference in Panasonic servo rigidity level table:

  Pn102 --correspond with Panasonic Pr100

  Pn100 --correspond with Panasonic Pr101

  Pn101 --correspond with Panasonic Pr102

  Pn401 -correspond with Panasonic Pr104
- The table as below please notice the unit and decimal point. The unit of Pn101 parameter in Yaskawa is 0.01ms, while in Panasonic Pr102 unit is 0.1ms.

Pr0.03	Pr1.00/ Pr1.05	Pr1.01/ Pr1.06	Pr1.02/ Pr1.07	Pr1.04/ Pr1.09
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 adjustment

Delta servo adjustment can also refer to Panasonic servo rigid table. Reference methods are as follows:

P2-00 KPP is equivalent to Panasonic Pr100.For example, when P2-00 = 90, it is equivalent to Panasonic Pr100 = 900.

5.3 Motion Control Parameter Adjustment

5.3.1 Motion Control Parameter

FSCUT3000S open the parameters setting to users including speed and acceleration etc., which will take effect to the working stability, machining performance and efficiency. Program will optimize the other motion related parameters automatically. The description of parameter is shown in below table:

Name	Description
Moving speed	The dry run speed of each axis.
Move acceleration	The maximum acceleration axis can reach in dry run. Usually set 1.2~2 times larger than machining acceleration.
Work acceleration	The max speed axis can reach in machining.

5.3.2 Adjust Cutting Acceleration

Jog axis at a high speed, 500mm/s for example, make sure axis move a long distance and reach the set speed.

Monitor the torque curve in servo tool when jog the axis, increase the work acceleration if peak torque under 80% or reduce work acceleration if peak torque larger than 80%.

Adjust the acceleration until top torque reaches to 80%.The acceleration lead screw structure can bear is usually no more than 0.5G. And usually no more than 2G for rack gear structure.

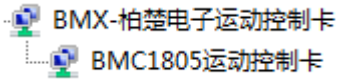
5.3.3 Adjust running acceleration

You can set this value according the result calculated by the ServoTool. Or set a value larger than work acceleration by 1.5~2 times of it. When axis running without load, servo torque should be within 150%, and there is no mechanical deformation and vibration under this acceleration. The acceleration lead screw can bear usually no more than 0.5G.And usually no more than 2G for rack gear structure.

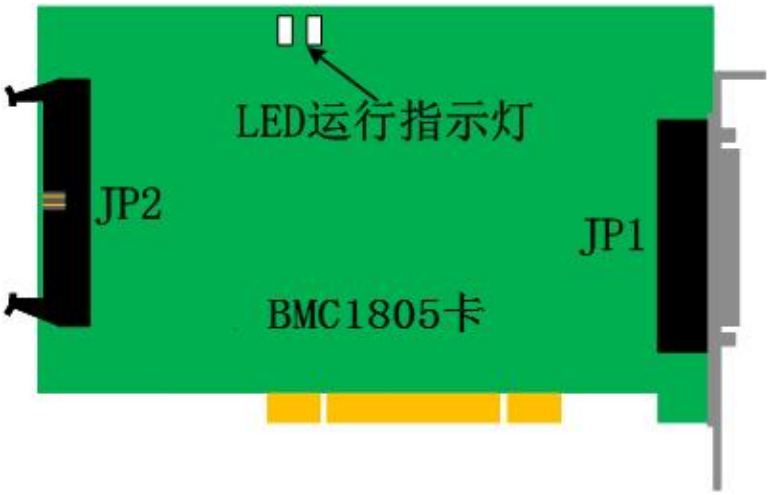
6. Common Problems

6.1 'Motion control card initialization failed' when open TubePro

1. In windows 'Device Manager' execute 'Scan for hardware changes'. If found BMC1805 motion control card in Device Manager, re-start TubePro software.



2. Watch 2 LED lights flashing status (LED7 and LED8) on BMC1805 control card. The position of the LED lights shown below:



LED flashing patterns indicates the following status:

Flashing pattern	Status	Solutions
Flash 1 flash 1	Normal	Normal
Flash 1 flash 2	Communication error between BMC1805 and BCL3766	Check the cable connection
Flash 1 flash 3	Unsupported USB device	Send back to supplier for repair
Flash 1 flash 4	FPGA BOOT data transmission error	Send back to supplier for repair
Flash 1 flash 5	FPGA BOOT initialization error	Send back to supplier for repair
Flash 1 flash 6	FPGA BOOT failed	Send back to supplier for repair
Flash 2 flash 3	ARM upgrade failed	Send back to supplier for repair

Flash 2 flash 4	System initialization error	Send back to supplier for repair

3. If LED lights are in flash 1 flash 1 pattern it means BMC1805 card works normally. PCI socket might in bad contact. It recommended that cut off computer power and re-insert PCI card or replace PCI socket.

6.2 Pulse Equivalent

Pulse equivalent is moving distance of load or rotation degree of rotary axis corresponding to one pulse sent by CNC controller.

The maximum pulse frequency system supports is 3Mpps. If the highest running speed of the machine is 1000mm/s. Then the pulse equivalent of each axis should not exceed 3Mpps/1000 = 3000 Pulse/mm.

It suggested that set the pulse equivalent within 1mm corresponds 1000~2000 pulses. It better not set pulse equivalent under 200Pulse/mm.

Set similar pulse equivalent to X and Y axes to reduce the truncation error caused by system calculation.

6.3 Machining speed is too slow or not smooth with pauses

- Check if set improper delay or misread the unit, for example set 200s while it should be 200ms.
- If there are pauses in Z axis lifting motion, please check the BCS100 firmware version. If BCS100 is V2.0, please update to V1112 and above.
- If it takes a long interval after gassing finished then laser starts emitting, check the laser serial communication.

6.4 Corner Burning

- Rise the corner precision parameter to smooth the corner path.
- Edit power-speed curve, lower the power at low speed area.
- Add cooling point to the corner.

6.5 No laser emission

1. Check the laser configuration

- Check the laser configuration in config tool (IPG YLS series contain American version and Germany version).
- If using serial communication or network communication check if communication port set correctly.
- Check if using DA control laser peak power and if select correct DA port in config tool.
- Check if PWM and laser enable port are set correctly.

2. Check PWM and DA output

- In TubePro-Tool-Card monitor set DA and PWM output value. Measure the voltage value on DA and PWM port on BCL3766 board by multimeter.
- If PWM or DA port output voltage too low or even no output, change to the other PWM and DA port.
- You can contact our technicians for hardware malfunctions.

3. Check the wiring

- Check the wiring of PWM, DA, serial cable and laser control cables.
- Serial port cable must have shielded layer.Pin2 and pin3 must be crossed.

4. Check laser unit

- Examine the laser emitting by laser software check if laser works properly.
- When use serial communication, not allowed to open more than one laser software to communicate with laser unit.
- If serial communication failed, enable debug mode in config tool check the command and feedback message from laser in log window of TubePro main program.