

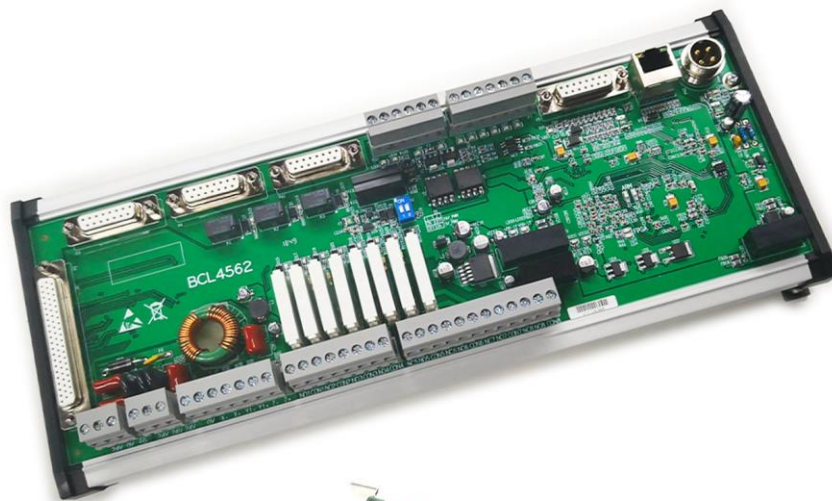


РУКОВОДСТВО ПО  
ЭКСПЛУАТАЦИИ  
ЧПУ контроллер  
FSCUT1000S



**柏楚电子**  
Friendess Co., Ltd.

# **FSCUT1000S Laser Cutting Control System User Manual**



**Shanghai Friendess Electronic Technology Corporation., Ltd.**

**[www.fscut.com](http://www.fscut.com)**

**Ver 1.1**



Thank you for choosing our products!

This manual gives a detailed introduction to the usage of FSCUT1000S laser cutting controller, including technical features, installation instructions, etc. For CypOne laser cutting software operation, please refer to the Help documentation in the software. Other matters you can contact us directly.

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

Due to 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.



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## 1.1 Brief introduction

**FSCUT1000S 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 which has gained widespread popularity among the vast number of customers.

Please read through this manual carefully before operation.

**FSCUT1000S Laser Cutting System contains the following accessories:**

| Item                                    | Model          | Qty. | Standard | Optional |
|---|----------------|------|----------|----------|
| <b>Motion control card</b>              | BMC1603        | 1    | √        |          |
| <b>I/O terminal board</b>               | BCL4562        | 1    | √        |          |
| <b>Preamplifier</b>                     | BCL_AMP        | 1    | √        |          |
| <b>Handheld operator</b>                | WKB V6         | 1    | √        |          |
| <b>62-pin cable</b>                     | C62-2(2m)      | 1    | √        |          |
|   | C62-5(5m)      |      |          | √        |
|   | C62-10(10m)    |      |          | √        |
| <b>Servo cable (one end not welded)</b> | C15-1.5(1.5m)  | 4    | √        |          |
|   | C15-2.5(2.5m)  |      |          | √        |
|   | C15-4(4m)      |      |          | √        |
| <b>Radio frequency cable</b>            | SPC-140(140mm) | 2    | √        |          |
|   | SPC-180(180mm) |      |          | √        |
| <b>Aviation plug cable</b>              | HC-15(15m)     | 1    | √        |          |
|   | HC-5(5m)       |      |          | √        |
|   | HC-20(20m)     |      |          | √        |
| <b>Network cable</b>                    | LAN-3X(3m)     | 1    | √        |          |
|   | LAN-7X(7m)     |      |          | √        |
|   | LAN-17X(17m)   |      |          | √        |

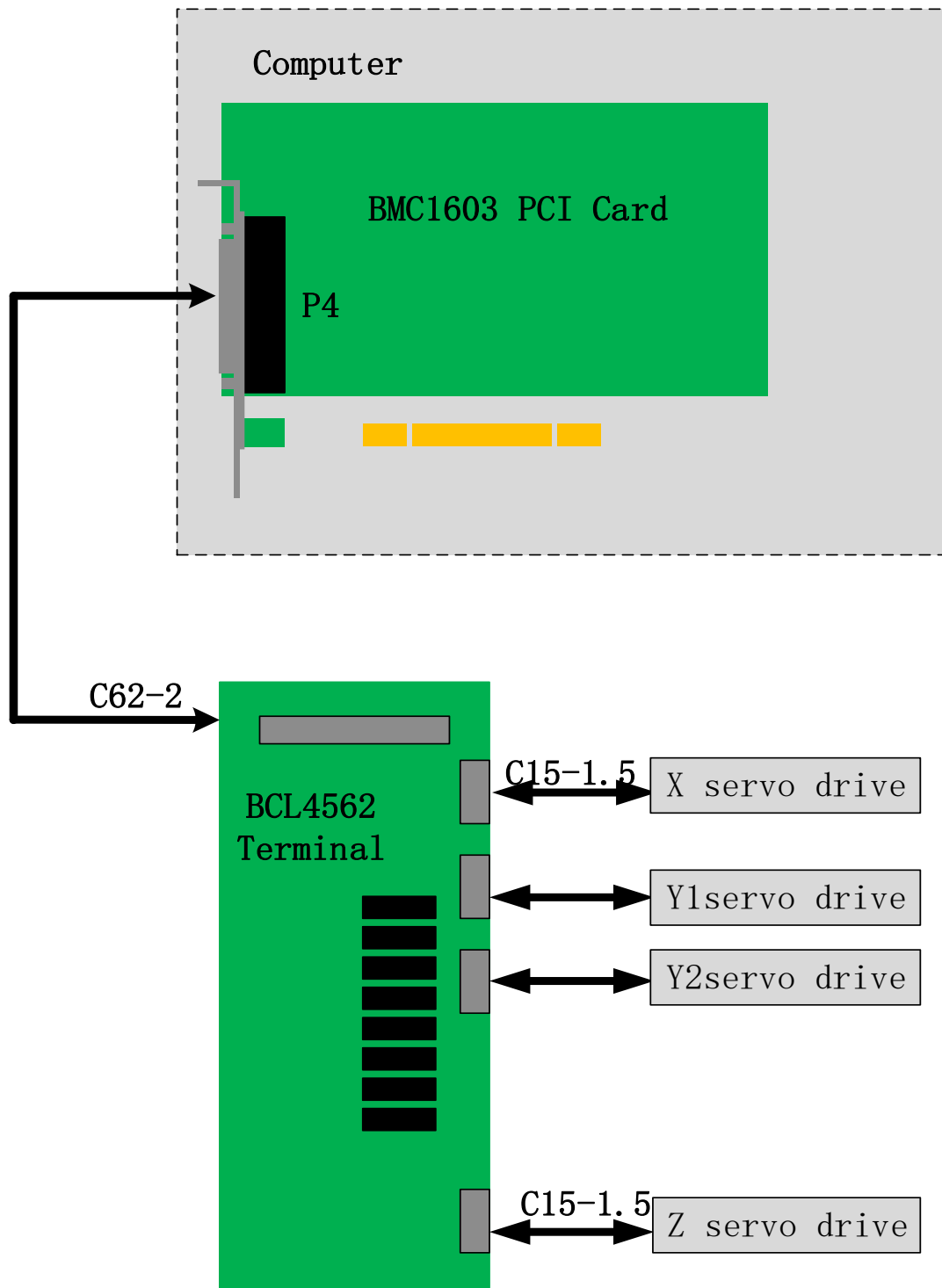
## 1.2 System Connection Diagram

BMC1603 card uses PCI interface. Dimension: 213mm\*112mm. Motion control



card BMC1603 connected with IO terminal board BCL4562 by a C62-2 cable;

Wiring diagram shown below:







### 1.3 Technical Reference

|                                  |                                    |  |
|----------------------------------|------------------------------------|--|
| <b>Motion Control</b>            | <b>Motor Control Signal</b>        | 3 servo axis ports with high frequency pulse output of 2MHz, 1 servo axis with analog output |
|                                  |                                    | 3 servo axis ports with encoder feedback channel, quadruple frequency can reach to 8MHz      |
|                                  |                                    | Positive& negative limit and servo alarm signal input for each axis                          |
|                                  |                                    | Servo enable function  |
|                                  | <b>Motion Control Performance</b>  | Control cycle 1ms  |
|                                  |                                    | S-type acceleration and deceleration   |
|                                  |                                    | Velocity look-ahead strategy, intelligent speed control at turning point                     |
|                                  |                                    | Local curvature analysis and speed limitation at small curves.                               |
|                                  |                                    | Smoothing process at small graphics  |
|                                  | <b>Laser Control Signal</b>        | 1 PWM signal, DIP switch 24V and 5V for option   |
| 2 DA 0-10V analog signal         |                                    |  |
| <b>I/O Function</b>              | 6 general inputs                   |  |
|                                  | 8 general relay outputs            |  |
| <b>Work Environment</b>          | Temperature:0-60 degrees Celsius   |  |
|                                  | Humidity:10%~90% (no condensation) |  |
| <b>Power Supply Requirements</b> | 24V, 2A                            |  |

### 1.4 Control Card Installation

#### 1.4.1 Install Steps

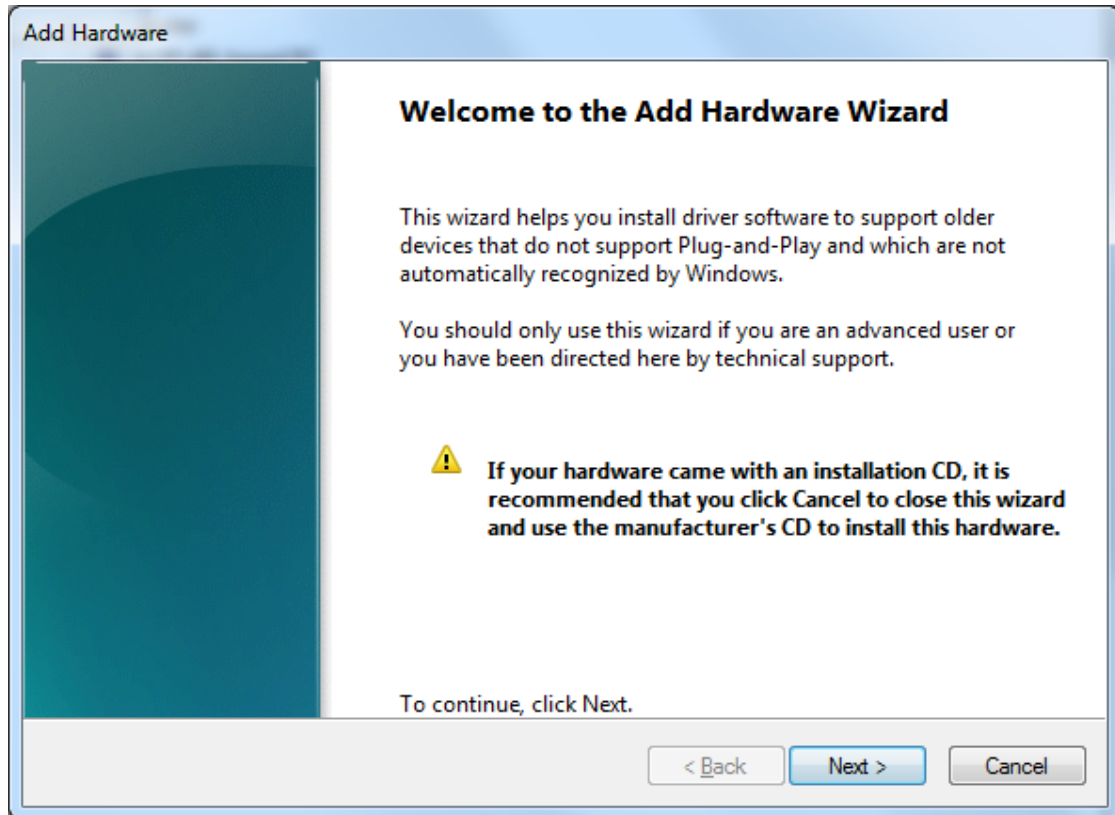


**Please wear anti-static gloves to prevent possible electrostatic damage to the motion control card.**

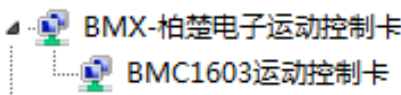
- (1) Turn off computer, insert the control card into PCI slot, and fix the control card with screw;
- (2) After start up computer, "Find New Hardware Wizard" pops out and click "Cancel" button, as shown below. If this dialog box does not appear, indicating



that the card is not inserted properly, please repeat the first step.

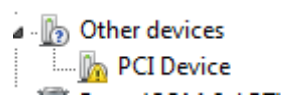


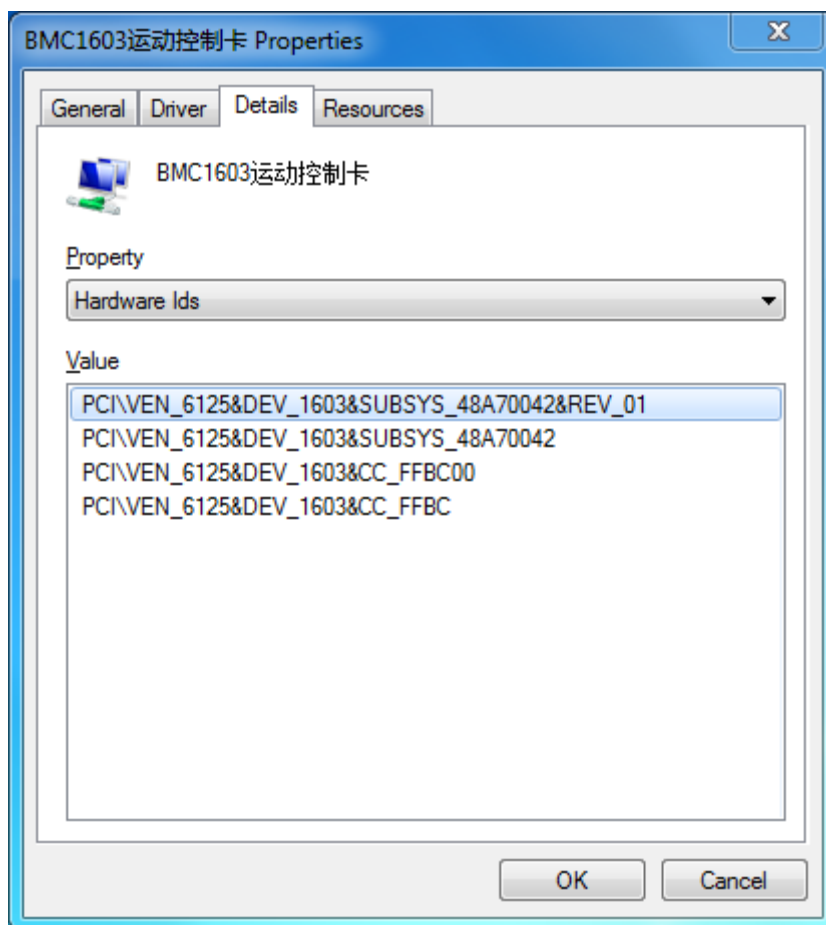
- (3) Install CypOne software. BMC1603 card driver and dongle driver will be installed automatically in CypOne installation.
- (4) Turn off antivirus software during installation to prevent CypOne identified as virus and installation failed. Pass all pop-out windows during installation.
- (5) Open device manager to confirm installation succeed. If the following image

appears  means 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 slot 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:



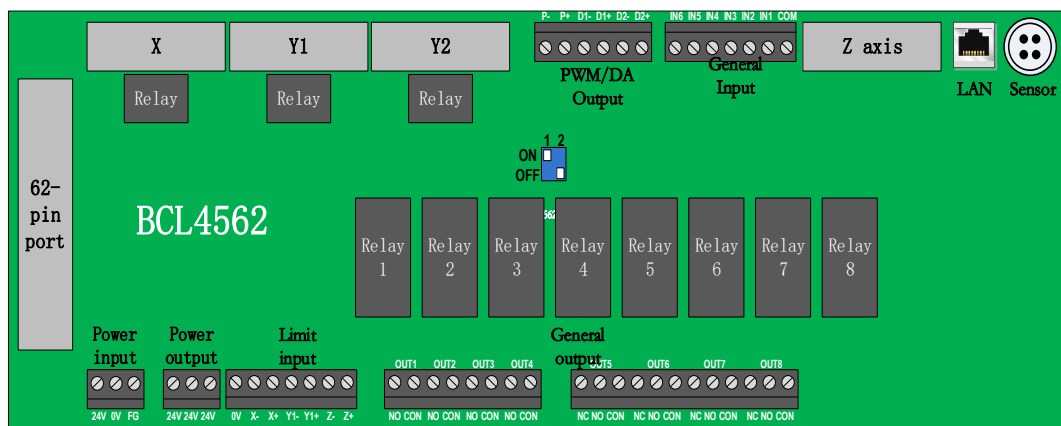
- (3) If the first half of the "hardware ID" shows: " `PCI\VEN_6125&DEV_1603&`" means computer recognize the card properly, software installation might fail. Please re-install CypOne software. If it still fails, please contact our technicians.
- (4) The first half of the "Hardware ID" does not shown as: " `PCI\VEN_6125&DEV_1603&`", indicating that the computer failed to recognize the control card. Shut down computer and replace PCI slot, insert control card and reinstall the software.
- (5) If step (4) still fails, the control card might be damaged please contact our technicians.



## 2.1 Interface description

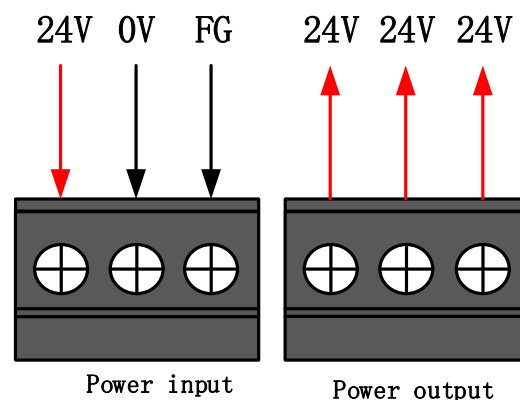
### 2.1.1 Interface layout

BMC1603 card compatible with BCL4562 IO terminal board. The detailed signal port layout as shown below:



BCL4562 terminal board uses guide rail or fixed install form. The old version dimension is 315 mm\*120 mm\*54 mm and the new version dimension is 315 mm\*127.8\*60 mm.

### 2.1.2 Power interface specification



The outer shell of the machine is the negative pole of the capacitance to be measured. In order to ensure the stable operation of the measuring circuit, the FG foot



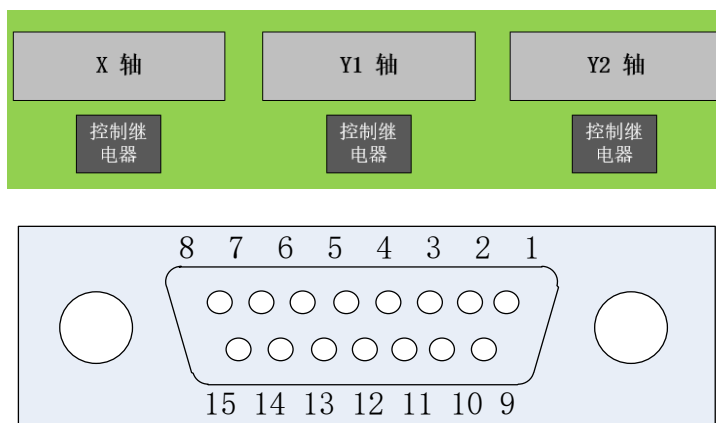
of the power interface must be reliably connected to the outer shell of the machine. The outer shell of the preamplifier must also be well connected to the outer shell of the machine. The specific index is DC impedance less than 4 ohms, otherwise the actual follow up performance may be poor.

**The power output can only be supplied to limit switch.**

### 2.1.3 Servo control port

There are 4 servo control ports in BCL4562 IO terminal board, 3 ports send pulses and 1 send analog output.

Pulse control ports use DB15 connector, signal pin described as below:



Signal pin description of C15-1.5 cable shown as below:

| Pin      | Signal name                   | Pin             | Signal name                   |
|----------|-------------------------------|-----------------|-------------------------------|
| 1 Yellow | PUL+ (positive pulse)         | 9 Yellow-black  | PUL- (negative pulse)         |
| 2 Blue   | DIR+ (positive direction)     | 10 Blue-black   | DIR- (negative direction)     |
| 3 Black  | A+ (Encoder A phase positive) | 11 Black-white  | A- (Encoder A phase negative) |
| 4 Orange | B+ (Encoder B phase positive) | 12 Orange-black | B- (Encoder B phase negative) |
| 5 Red    | Z+ (Encoder Z phase positive) | 13 Red-black    | Z- (Encoder Z phase negative) |
| 6 Green  | SON (Servo enable)            | 14 Purple       | ALM (Alarm signal)            |



|               |                    |                |                   |
|---------------|--------------------|----------------|-------------------|
| 7 Green-black | CLR (Alarm clear)  | 15 Brown-black | 0V (Power ground) |
| 8 Brown       | 24V (power output) |                |                   |

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

SON: Servo ON, output servo drive enabling 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.

The servo wiring diagram with Fuji, Panasonic, Yaskawa, Delta etc., shown as below, recommend to use high frequency pulse connection.

Notes regarding wiring other servo:

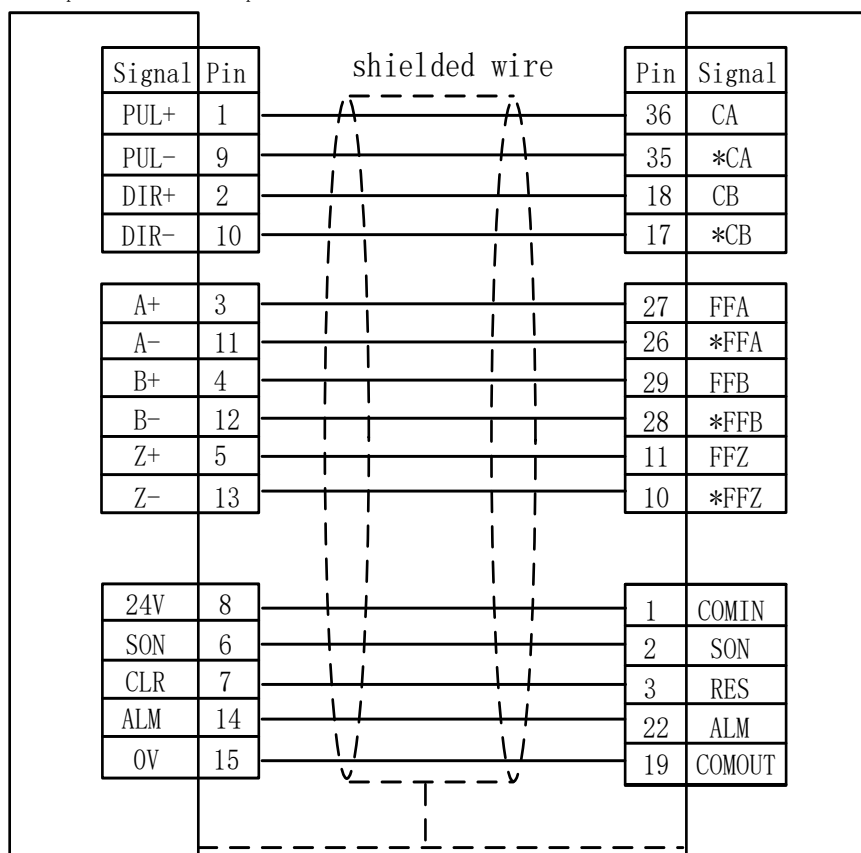
- (1) Check the SON signal type of the servo if it's active-low (when conducted with 24V GND turns active);
- (2) Make sure set the signal type "pulse +direction" in servo;
- (3) Check input of servo if there is external emergency signal, and the active logic of it;
- (4) Before trial run of driver, provide 24V power supply to IO terminal board, which required by driver;
- (5) If driver still can't run, check if the parameter "positive/negative direction drive inhibit" in driver invalid.



## Fuji ALPHA5 SMART PLUS High Frequency Pulse

FSCUT 15-pin servo control port

Fuji WSK-D36P servo 36 pin port



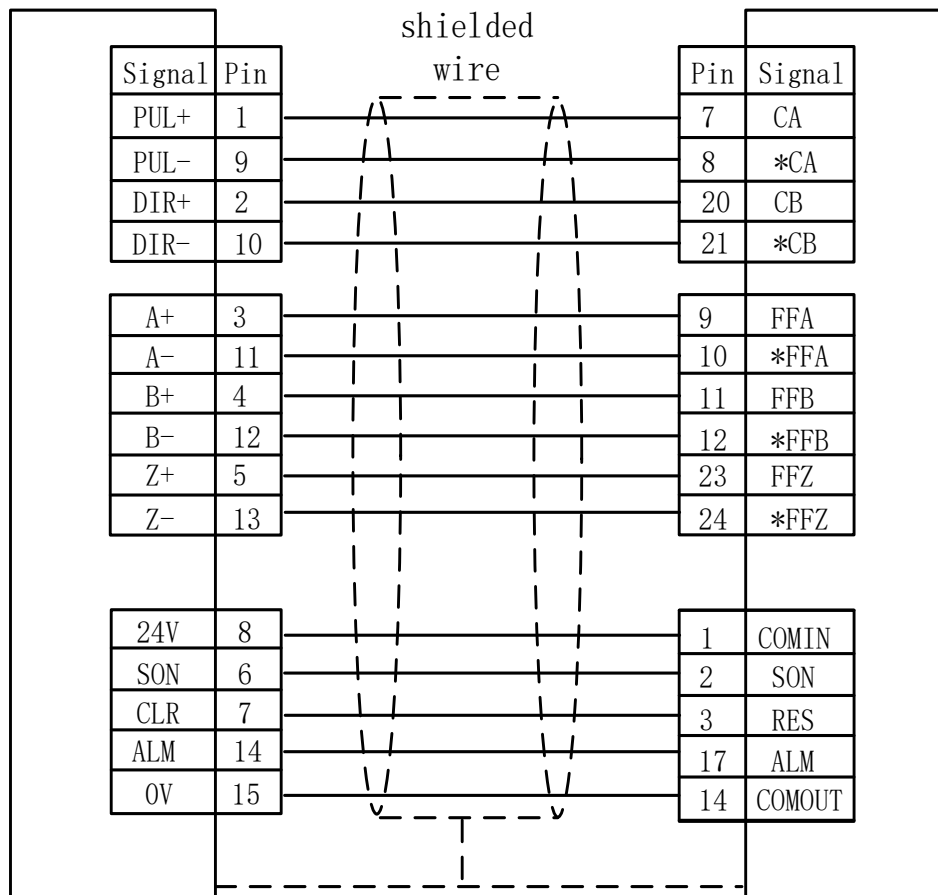
| Parameter | Recommended Setting | Description                                    |
|-----------|---------------------|--|
| PA1.01    | 0                   | Control mode must select position mode.        |
| PA1.03    | 0                   | Select command pulse/direction, 500kHz-4.0MHz. |
| PA1.04    |                     | Motor rotation direction                       |
| PA1.05    |                     | Number of command input pulses per revolution  |
| PA1.08    |                     | Number of output pulses per revolution         |
| PA1.13    | 13                  | Recommend to use interpolation operation mode  |
| PA1.14    |                     | Inertia ratio                                  |
| PA1.15    |                     | Auto tuning gain (rigidity)                    |
| PA1.54    |                     | Position command response time constant        |



### Fuji ALPHA5 SMART Series Wiring Diagram

FSCUT 15 pin servo control port

Fuji WSK-D26P servo 26 pin port



#### Fuji ALPHA 5 Series

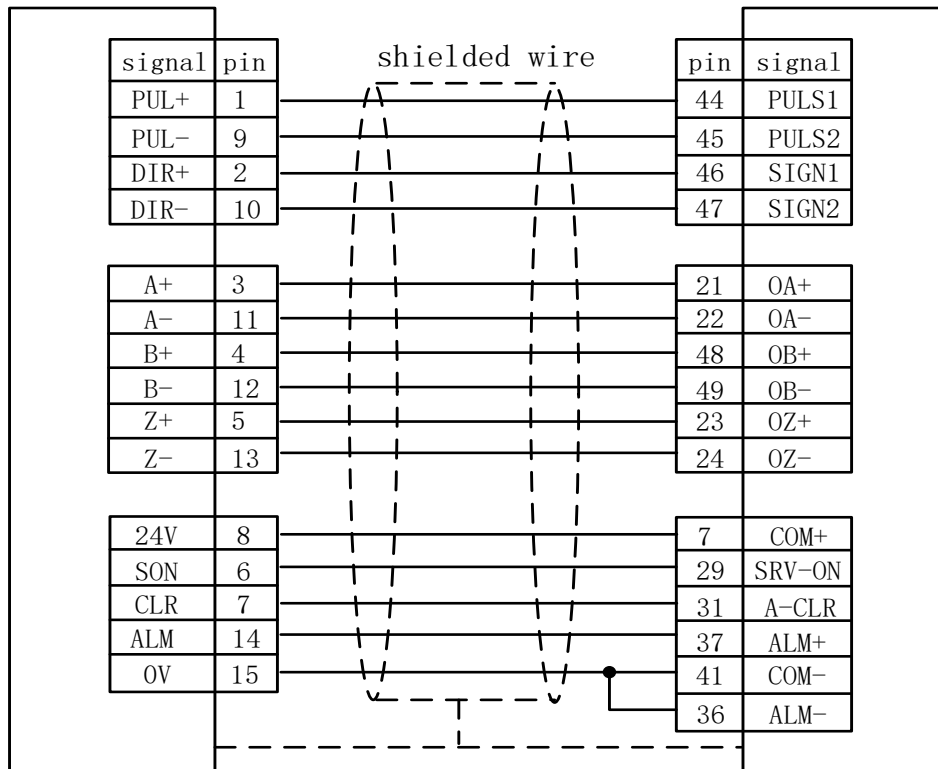
| Parameter | Recommended Setting | Description                                |
|-----------|---------------------|--|
| PA-101    | 0                   | Position control mode                      |
| PA-103    | 0                   | Pulse + Direction highest frequency 1 Mpps |



**Panasonic A5 High Frequency Pulse Wiring Diagram**

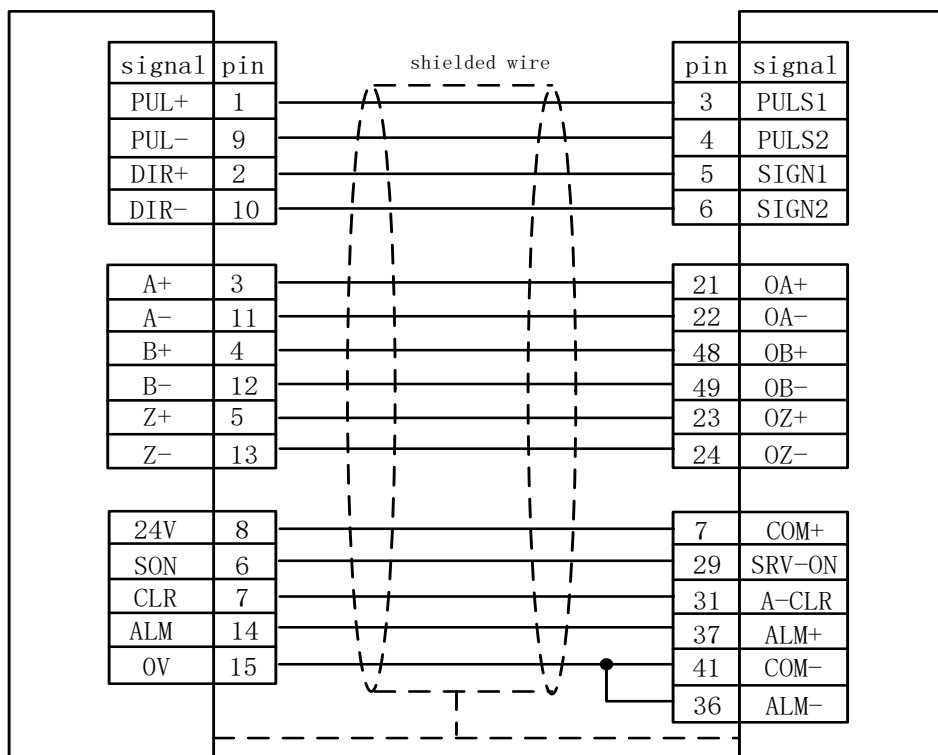
FSCUT 15 pin servo control port

MINAS-A5-50Pin

**Panasonic A5 Low Frequency Pulse Wiring Diagram**

FSCUT 15 pin servo control port

MINAS-A5-50Pin





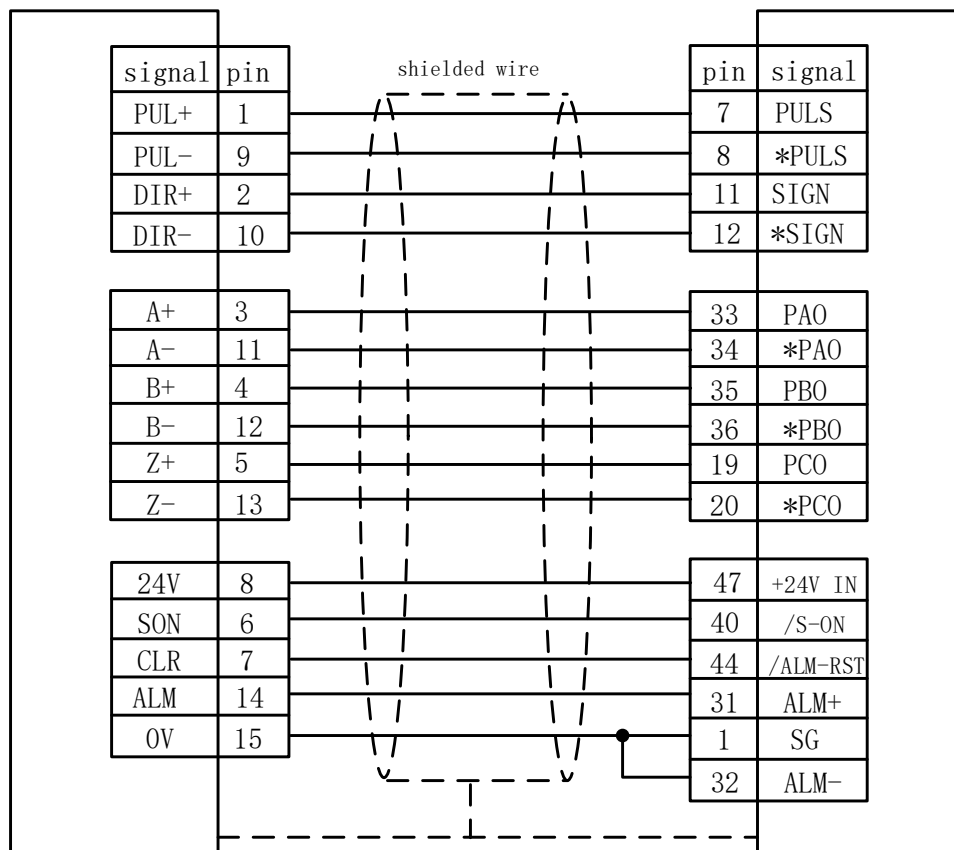
## Panasonic A5 Series basic setting

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

## Yaskawa servo wiring diagram

FSCUT 15 pin servo control port

Yaskawa -Σ -50P



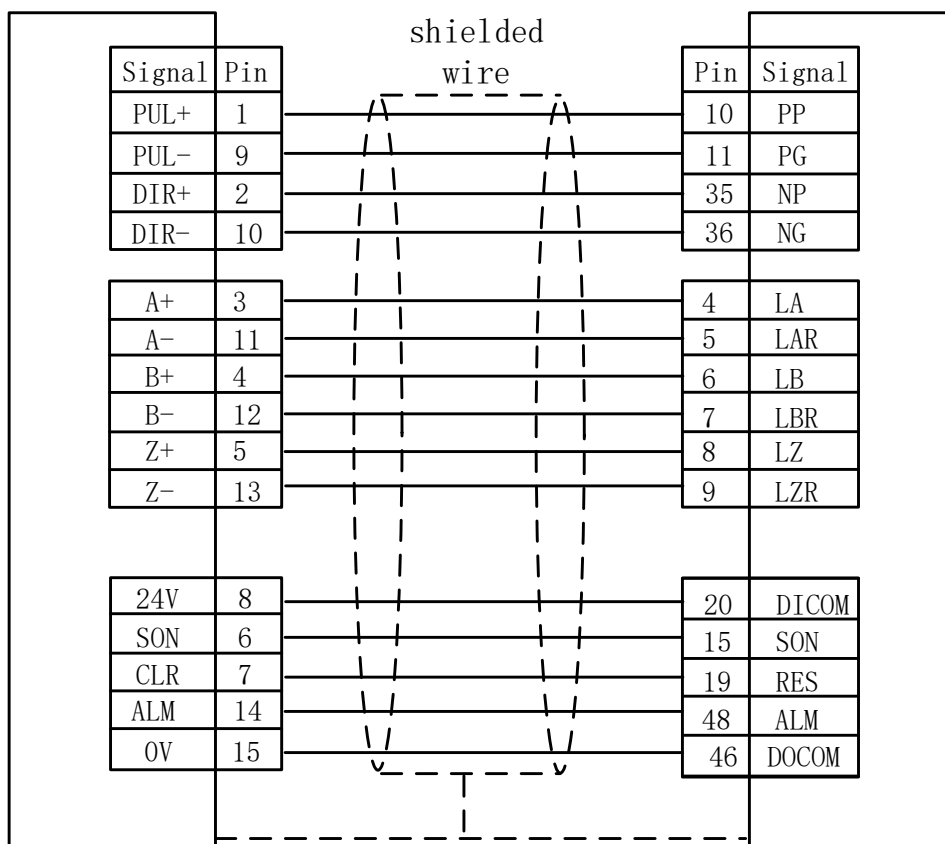
Yaskawa  $\Sigma$  series basic setting

| Parameter | Recommended Setting | Description  |
|-----------|---------------------|--|
| Pn000     | 001X                | Set position mode  |
| Pn00B     |                     | The setting is 0100 when use single phase power input  |
| Pn200     | 2000H               | Positive logic: Pulse + direction;0005H<br>negative logic: Pulse + direction<br>When pulse frequency is less than 1 Mpps<br>select mode 0000H<br>When pulse frequency reaches 1Mpps~4Mpps<br>select mode 2000H |
| Pn50A     | 8100                | Forward run allowed  |
| Pn50B     | 6548                | Reverse run allowed  |

## Mitsubishi J3 series wiring diagram

FSCUT 15 pin servo control port

Mitsubishi MR-J3-A50P

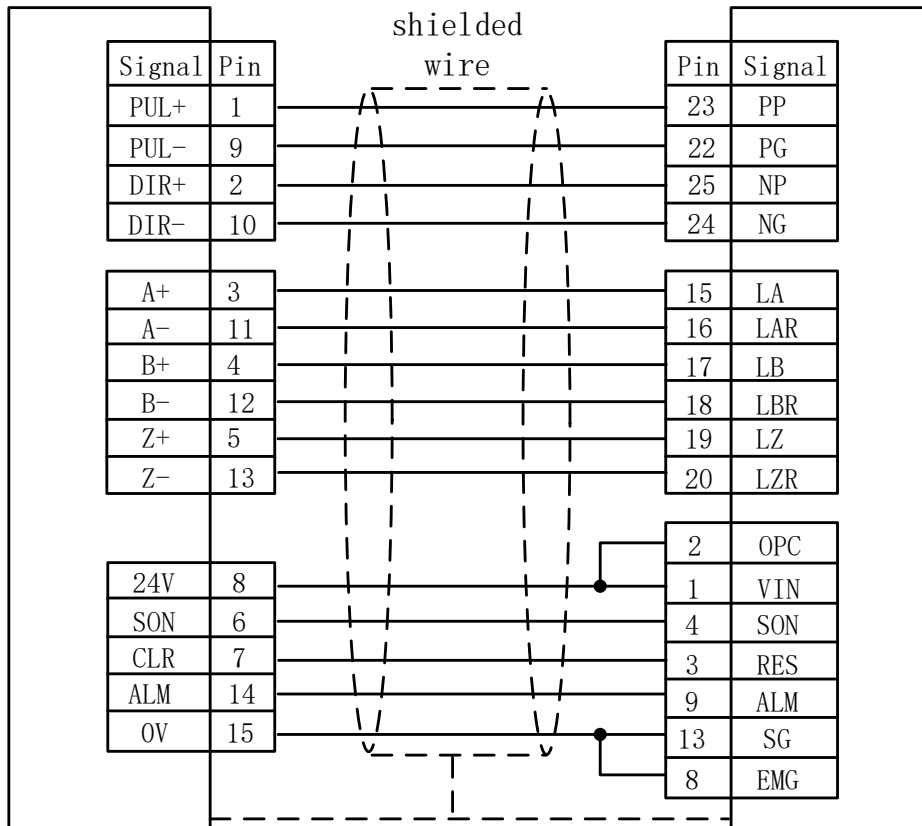




### Mitsubishi E Series wiring diagram

FSCUT 15 pin servo control port

Mitsubishi MR-E-A 26P



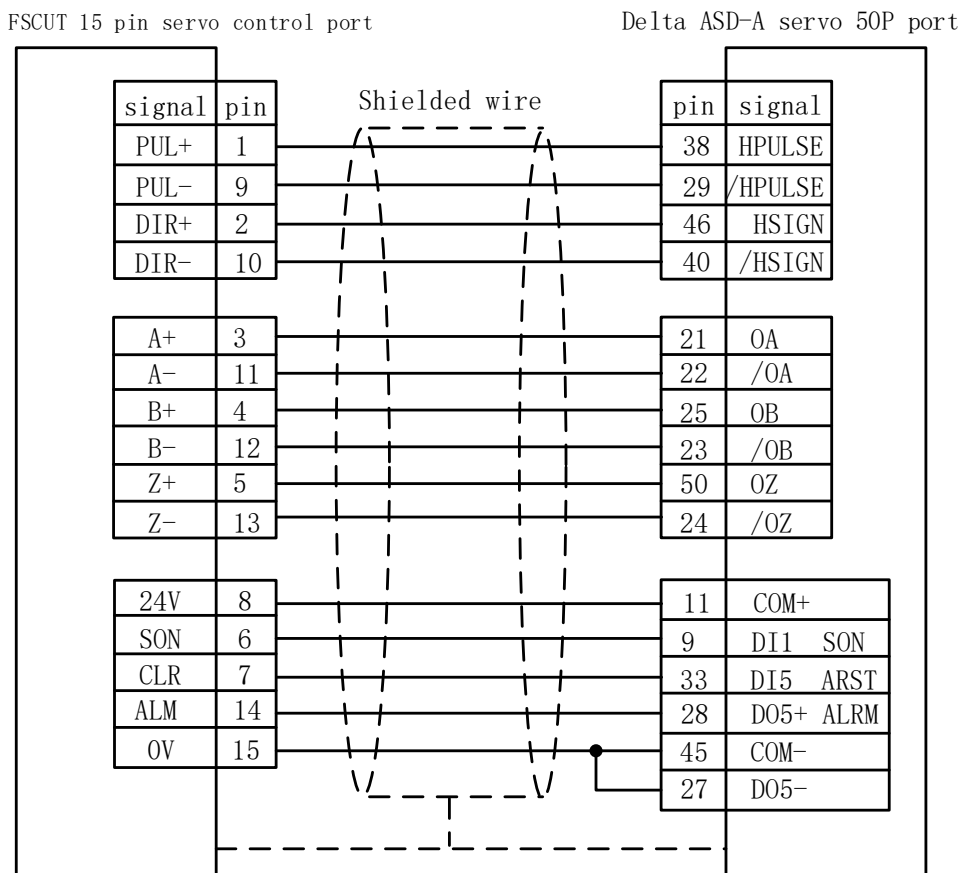
#### Mitsubishi MR-J3-A series basic setting

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

For Mitsubishi J3 series highest pulse frequency is 1Mpps.



### Delta A Series High Frequency Pulse Wiring Diagram



#### Delta ASD-A series basic setting

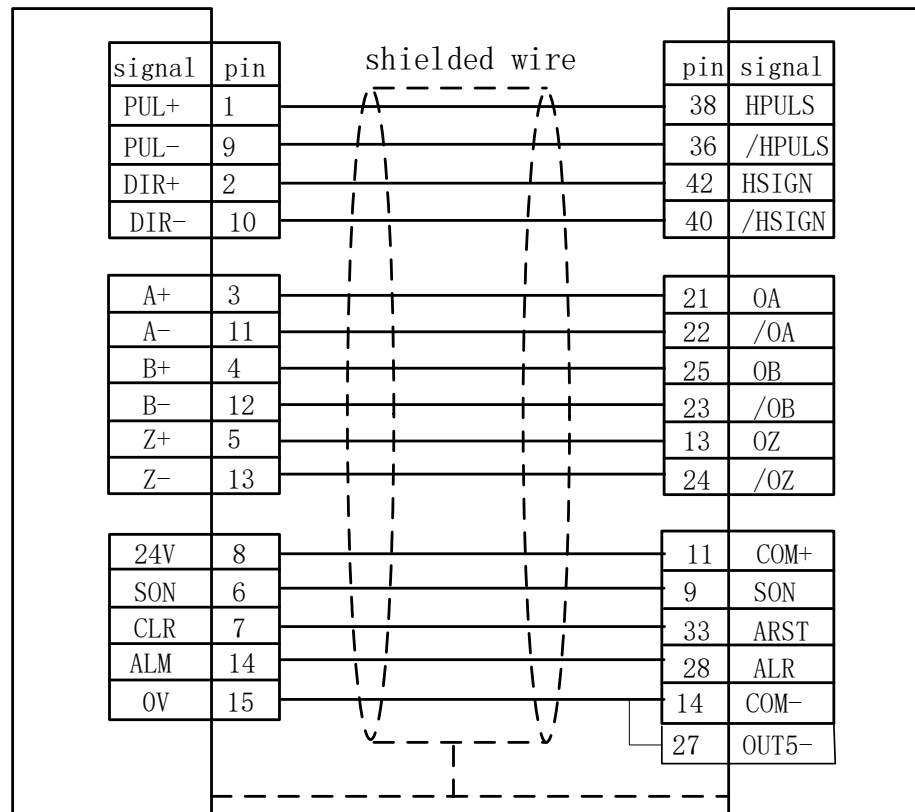
| Parameter | Recommended Setting | Description   |
|-----------|---------------------|---|
| P1-00     | 1102H               | Position control mode, negative logic pulse + direction.<br>Setting is 1102H unlocks high speed differential signal mode, the highest pulse frequency can reach to 4Mpps;<br>Setting is 0102H unlocks low speed pulse signal mode, the highest pulse frequency up to 500Kpps. |
| P1-01     | 00                  | Position control mode controlled by external instructions.  |
| P2-10     | 101                 | DI1 select SON servo enable, logic is normally open.  |
| P2-14     | 102                 | DI5 set ARST alarm reset, logic is normally open.   |
| P2-22     | 007                 | DO5 set Alarm, logic is normally open.  |



### Delta B Series High Frequency Pulse Wiring Diagram

FSCUT 15 pin servo control port

Delta ASD-B 44P port



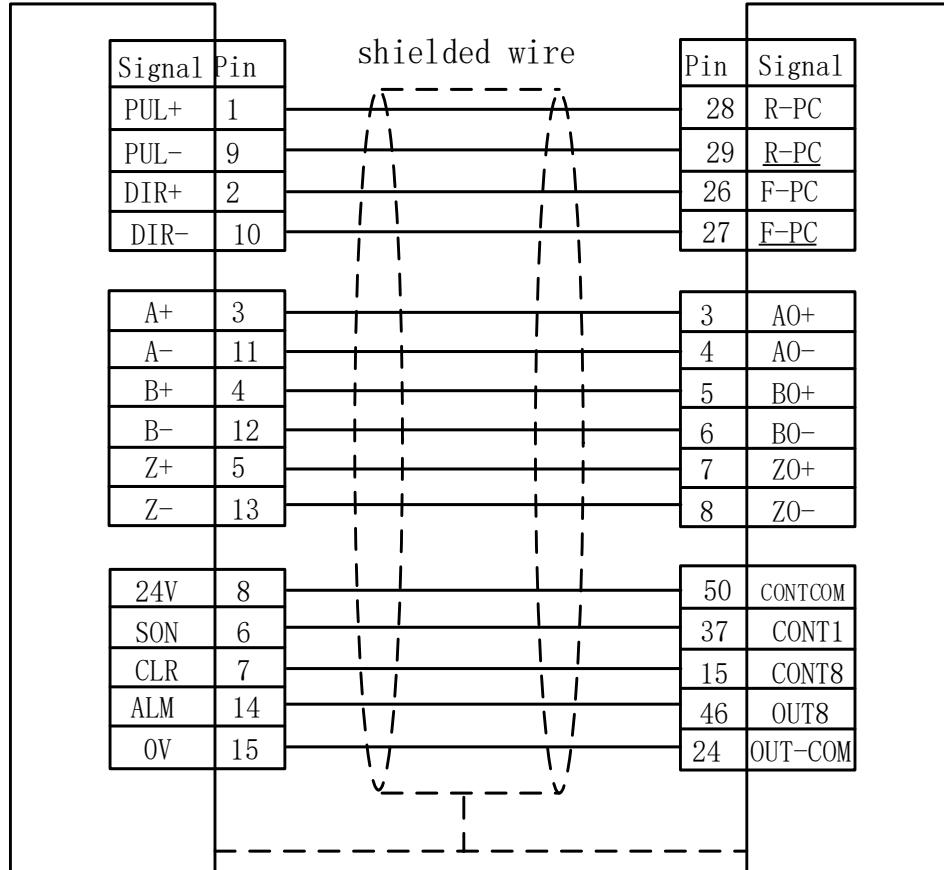
| Parameter | Recommended Setting | Description   |
|-----------|---------------------|---|
| P1-00     | <b>1102H</b>        | Position control mode, negative logic pulse + direction.<br>Setting is 1102H unlocks high speed differential signal mode, the highest pulse frequency can reach to 4Mpps;<br>Setting is 0102H unlocks low speed pulse signal mode, the highest pulse frequency up to 500Kpps. |
| P1-01     | 00                  | Position control mode controlled by external instructions.  |
| P2-10     | 101                 | DI1 select SON servo enable, logic is normally open.  |
| P2-14     | 102                 | DI5 set ARST alarm reset, logic is normally open.   |
| P2-22     | 007                 | DO5 set Alarm, logic is normally open.  |



### Sanyo R Series Servo Wiring Diagram

FSCUT 15 pin servo control port

Sanyo R series 50P



#### Sanyo R Series Basic Setting

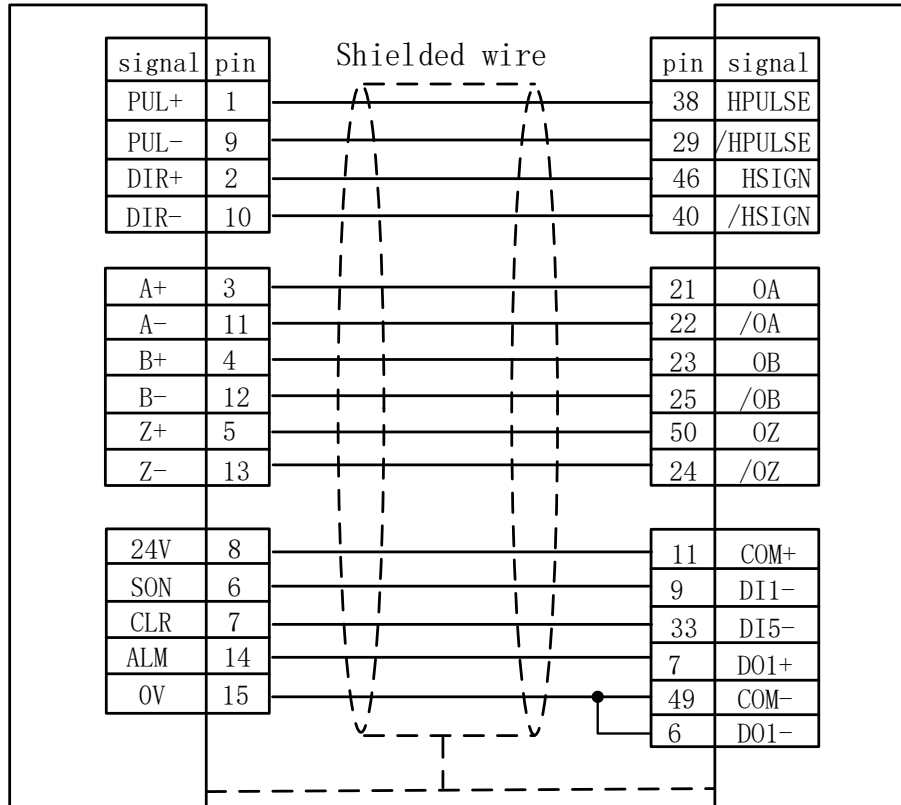
| Parameter | Recommended Setting | Description                                  |
|-----------|---------------------|--|
| SY08      | 00                  | Set position mode                            |
| Gr8.11    | 02                  | Select pulse signal type: Pulse + direction; |
| Gr9.00    | 00                  | Forward run allowed                          |
| Gr9.01    | 00                  | Reverse run allowed                          |



### Schneider 23D High Frequency Pulse Wiring Diagram

FSCUT 15 pin servo control port

Schneider 23A-50Pin



### Schneider Lexium 23D Series Basic Setting

| Parameter   | Recommended Setting | Description   |
|-------------|---------------------|---|
| P1-00       | 1102H               | Position control mode, negative logic pulse + direction.<br>Setting is 1102H unlocks high speed differential signal mode, the highest pulse frequency can reach to 4Mpps;<br>Setting is 0102H unlocks 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 in servo   |
| P2-11       | 0                   | IN2 invalid   |
| P2-13~P2-17 | 0                   | IN4~IN8 invalid   |

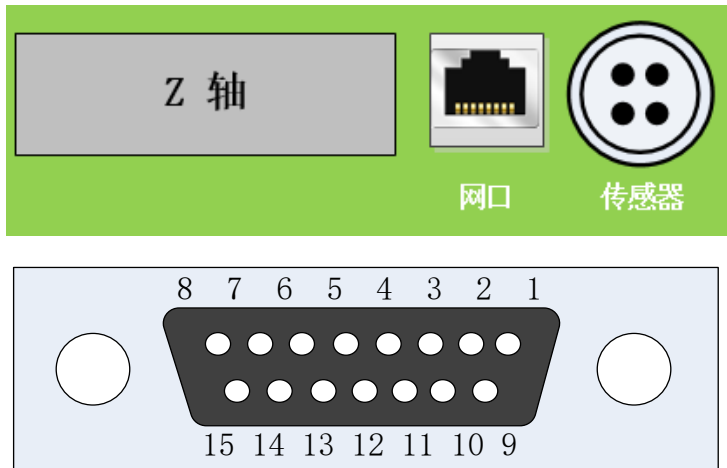
#### Notice:

The above parameters setup and correct wiring can only guarantee the basic



motion function cannot ensure the control accuracy. To optimize motion effect, please adjust rigidity, gain, Inertia ratio and other parameters.

Servo control terminal and PIN description on BCL4562 as shown below:



Signal pin description of C15-1.5 cable shown as below:

| Pin           | Signal name                   | Pin             | Signal name                   |
|---------------|-------------------------------|-----------------|-------------------------------|
| 1 Yellow      | DA (-10~10V analog)           | 9 Yellow-black  | AGND (analog ground)          |
| 2 Blue        | 0S (ZEROSPD)                  | 10 Blue-black   | 0V (Power ground)             |
| 3 Black       | A+ (Encoder A phase positive) | 11 Black-white  | A- (Encoder A phase negative) |
| 4 Orange      | B+ (Encoder B phase positive) | 12 Orange-black | B- (Encoder B phase negative) |
| 5 Red         | Z+ (Encoder Z phase positive) | 13 Red-black    | Z- (Encoder Z phase negative) |
| 6 Green       | SON (Servo enable)            | 14 Purple       | ALM (Alarm signal)            |
| 7 Green-black | CLR (Alarm clear)             | 15 Brown-black  | 0V (Power ground)             |
| 8 Brown       | 24V (power output)            |                 |                               |

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

DA、AGND: Analog output provides speed signal for the driver.

0S: Zero-speed clamp is used to suppress zero drift of servo system.

SON: Output signal enable servo



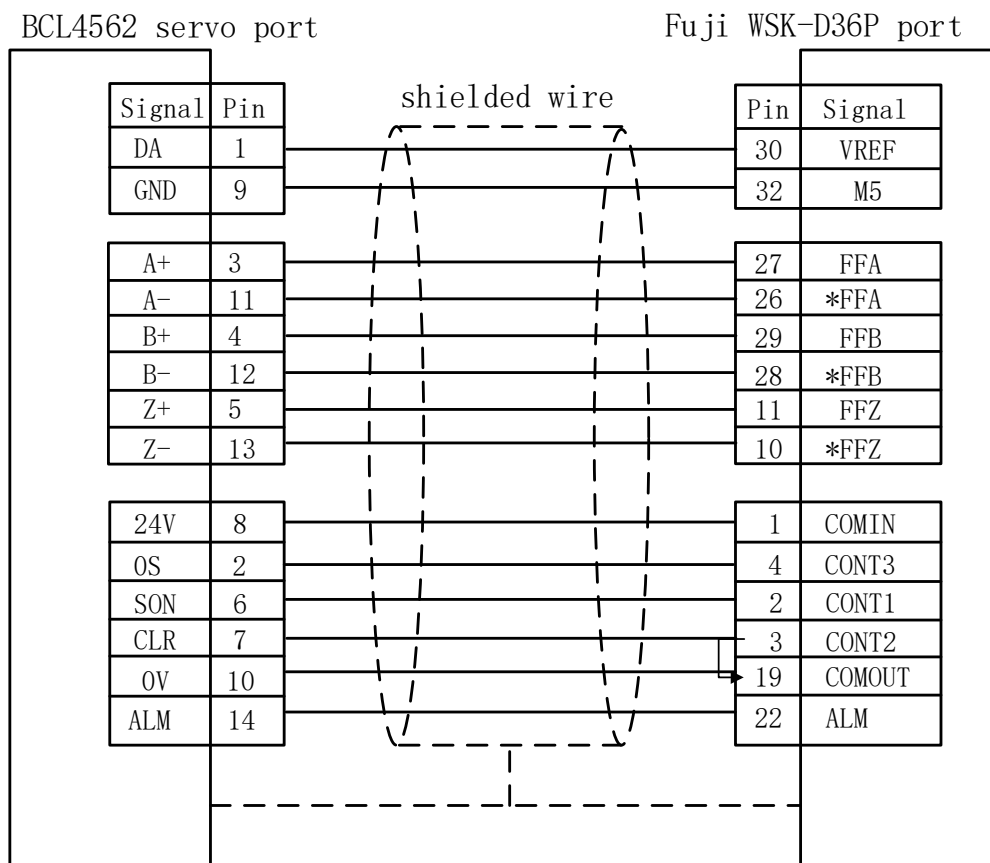
ALM: Receive servo driver alarm signal.

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

Precautions when connecting the driver:

- (1) Make sure the servo supports velocity control mode. For example, Panasonic A5 series servo must choose full-function type, not pulse type.
- (2) All IO ports in BCL4562 are active-low type, servo should be active-low.
- (3) Check if servo equipped with motor brake. Strictly connect the signal pin and set parameters as user manual instructions.
- (4) The shielding layer of servo cable connect with servo shell and make sure servo unit well grounded.

### Fuji ALPHA 5 SMART PLUS Series Wiring Diagram



### Fuji ALPHA 5 SMART PLUS Series Servo Parameters

| Parameter | Recommended Setting | Description           |
|-----------|---------------------|-----------------------|
| PA1.01    | 1                   | Velocity control mode |

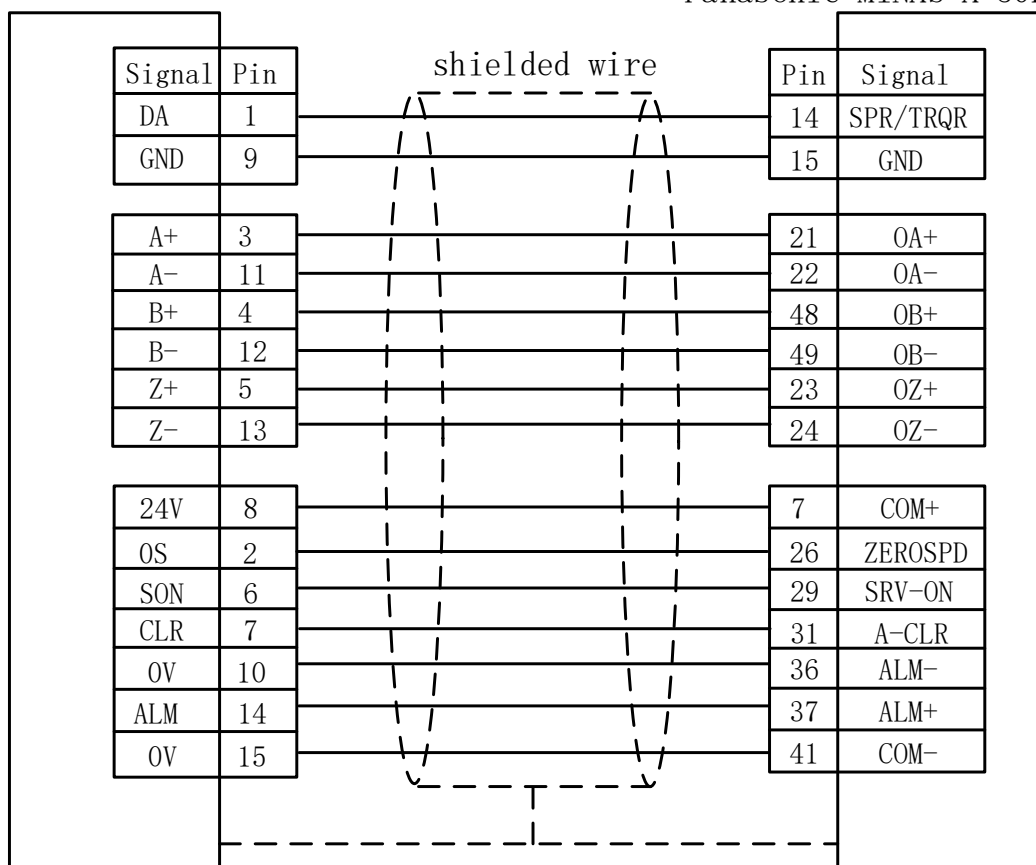


|        |      |  |
|--------|------|--|
| PA1.04 |      | Motor rotate direction   |
| PA1.08 | 2500 | Number of output pulses per revolution                           |
| PA1.15 | 20   | Auto tuning gain   |
| PA3.03 | 2    | Zero clamp   |
| PA3.31 | 6    | Speed command scale matches with 500r/v/min in BCS100 controller |
| PA3.51 | 14   | Brake timing   |

### Panasonic servo wiring diagram

BCL4562 servo port

Panasonic MINAS-A 50P



Panasonic A5 servo parameter set

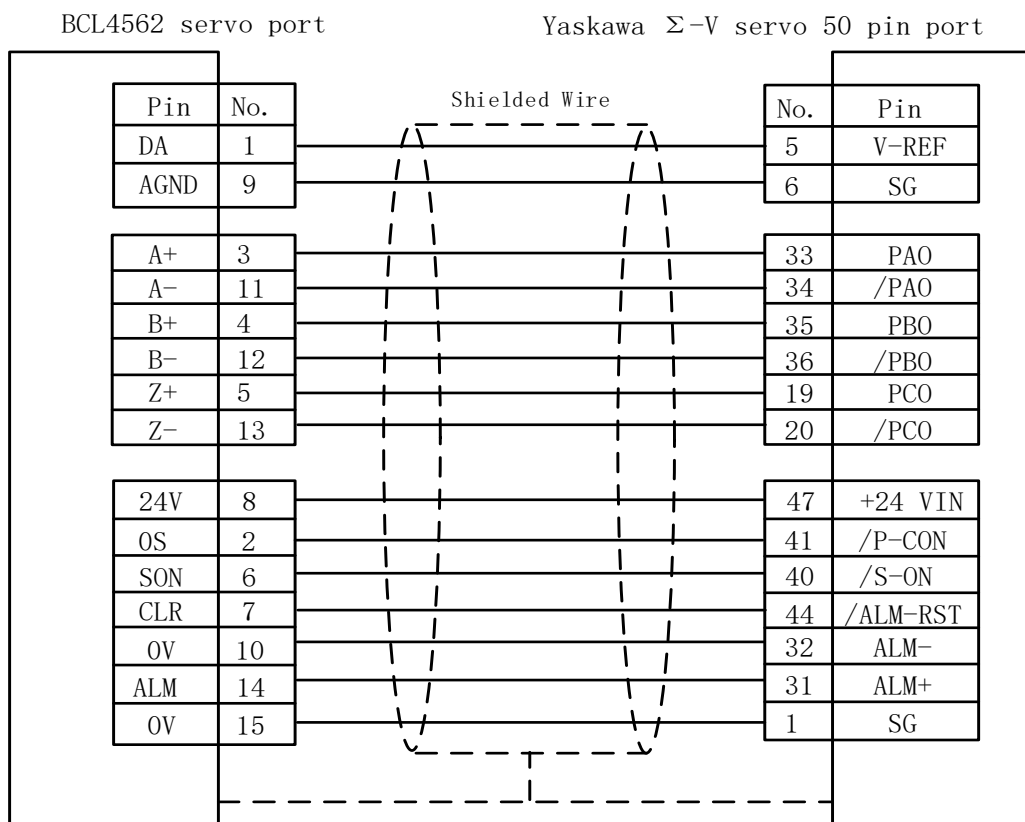
| Parameter | Recommended Setting | Description  |
|-----------|---------------------|--|
| Pr001     | 1                   | Control mode must be velocity mode.                        |
| Pr002     | 3                   | Real-time auto-gain tuning setup select vertical axis mode |



|       |     |   |
|-------|-----|---|
| Pr003 | 17  | Servo stiffness, recommended range 14-20. |
| Pr302 | 500 | Input gain of speed command               |
| Pr315 | 1   | Enable speed zero-clamp function          |
| Pr504 | 1   | Setup of over-travel inhibition input     |

#### Panasonic A4 series servo parameter setup

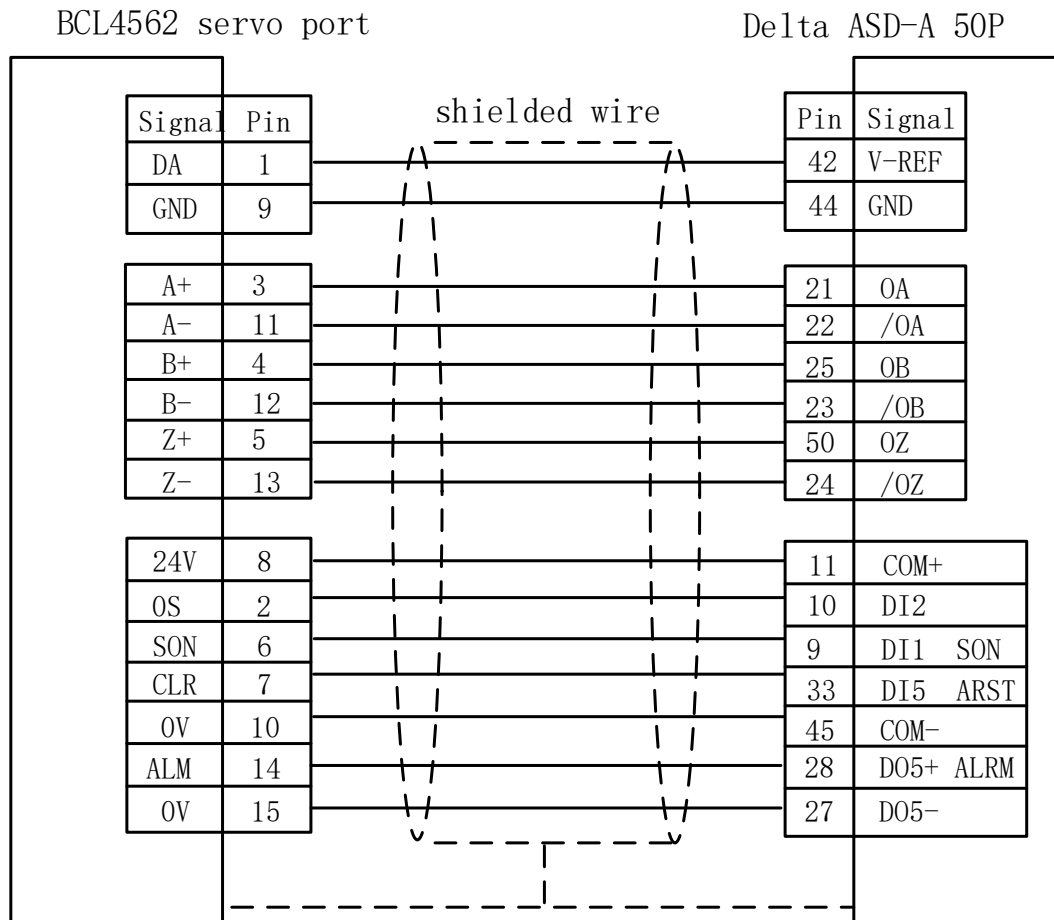
| <b>Parameter</b> | <b>Recommended Setting</b> | <b>Description</b>   |
|------------------|----------------------------|--|
| Pr02             | 1                          | Control mode must be velocity mode.                        |
| Pr21             | 4                          | Real-time auto-gain tuning setup select vertical axis mode |
| Pr22             | 7                          | Servo stiffness, recommended range 5-10.                   |
| Pr50             | 500                        | Input gain of speed command                                |
| Pr06             | 1                          | Enable speed zero-clamp function                           |
| Pr04             | 1                          | Setup of travel limit inhibition input                     |

**Yaskawa servo wiring diagram****Yaswaka  $\Sigma$ -V series servo parameter setup**

| Parameter | Recommended Setting | Description  |
|-----------|---------------------|--|
| Pn000     | 00A0                | Speed control mode with zero-clamp function  |
| Pn00B     | Null                | The setting is 0100 when use single phase power input  |
| Pn212     | 2500                | The number of output pulses per motor revolution, match the parameter "pulses per rev 10000" in BCS100 |
| Pn300     | 6.00                | Correspond to the speed gain 500r/v/min in BCS100.   |
| Pn501     | 10000               | Zero-clamp value   |
| Pn50A     | 8100                | Forward run allowed  |
| Pn50B     | 6548                | Reverse run allowed  |



### Delta A Series servo wiring diagram



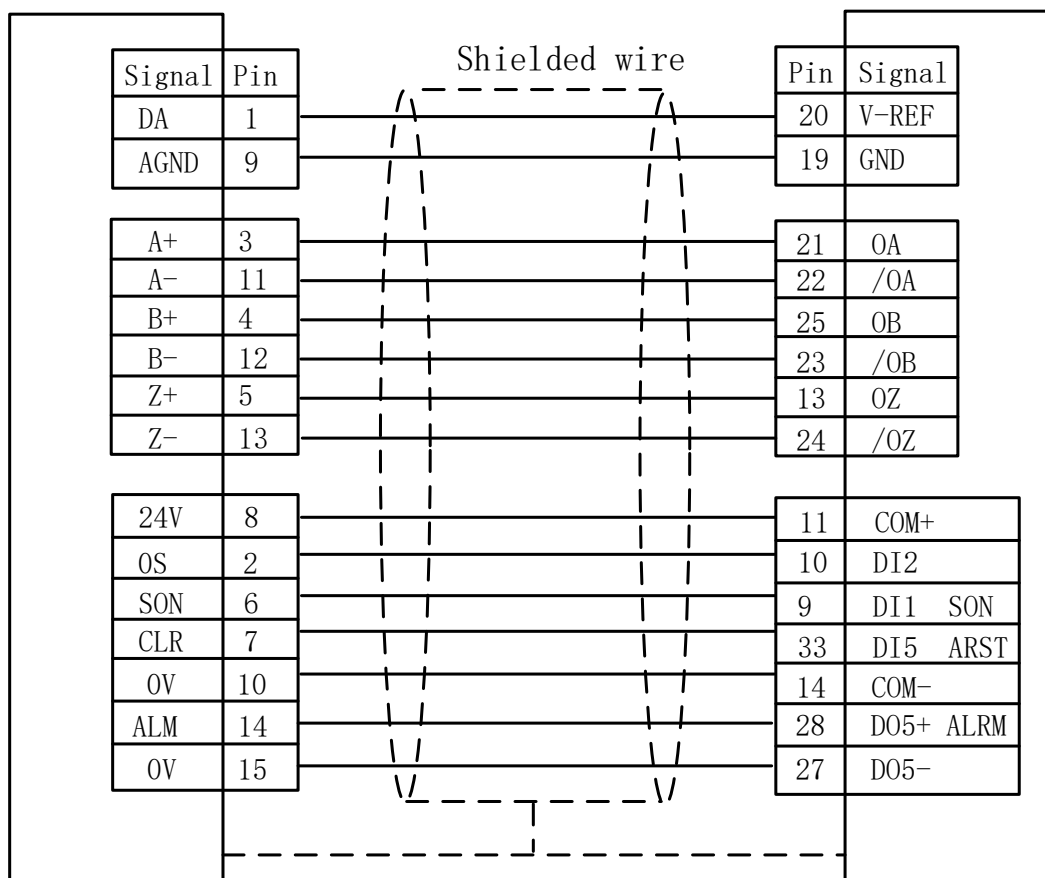
### Delta ASD-A series servo parameter setup

| Parameter | Recommended Setting | Description  |
|-----------|---------------------|--|
| P1-01     | 0002                | Control mode must select velocity control mode.      |
| P1-38     | 2000                | Set the largest value of zero-clamp                  |
| P1-40     | 5000                | Match the "speed gain 500 r/v/min" in BCS100         |
| P2-10     | 101                 | DI1 select SON servo enable, logic is normally open. |
| P2-11     | 105                 | DI2 set CLAMP, logic is normally open.               |
| P2-12     | 114                 | Set speed command as external analog control         |
| P2-13     | 115                 | Set speed command as external analog control         |
| P2-14     | 102                 | DI5 set ARST alarm reset, logic is normally open.    |
| P2-22     | 007                 | DO5 set Alarm, logic is normally open.               |

**Delta B series servo wiring diagram**

BCL4562 servo port

Delta ASD-B servo 44P



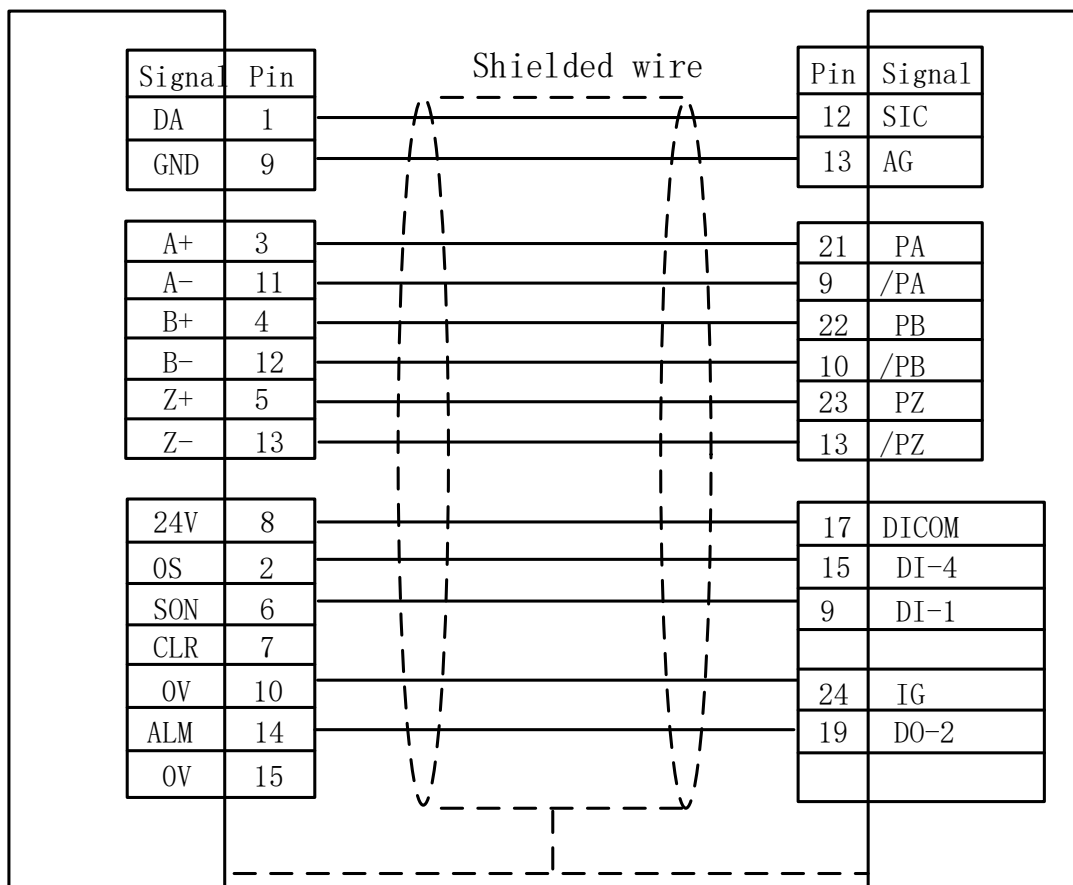
| Parameter | Recommended Setting | Description   |
|-----------|---------------------|---|
| P1-01     | 0002                | Control mode must select velocity control mode.       |
| P1-38     | 2000                | Set the max value                                     |
| P1-40     | 5000                | Match the parameter speed gain 500 r/min/v in BCS100. |
| P2-10     | 101                 | DI1 select SON servo enable, logic is normally open.  |
| P2-11     | 105                 | DI2 set CLAMP, logic is normally open.                |
| P2-12     | 114                 | Set speed command as external analog control          |
| P2-13     | 115                 | Set speed command as external analog control          |
| P2-14     | 102                 | DI5 set ARST alarm reset, logic is normally open.     |
| P2-22     | 007                 | DO5 set Alarm, logic is normally open.                |



### TECO servo wiring diagram

BCL4562 servo port

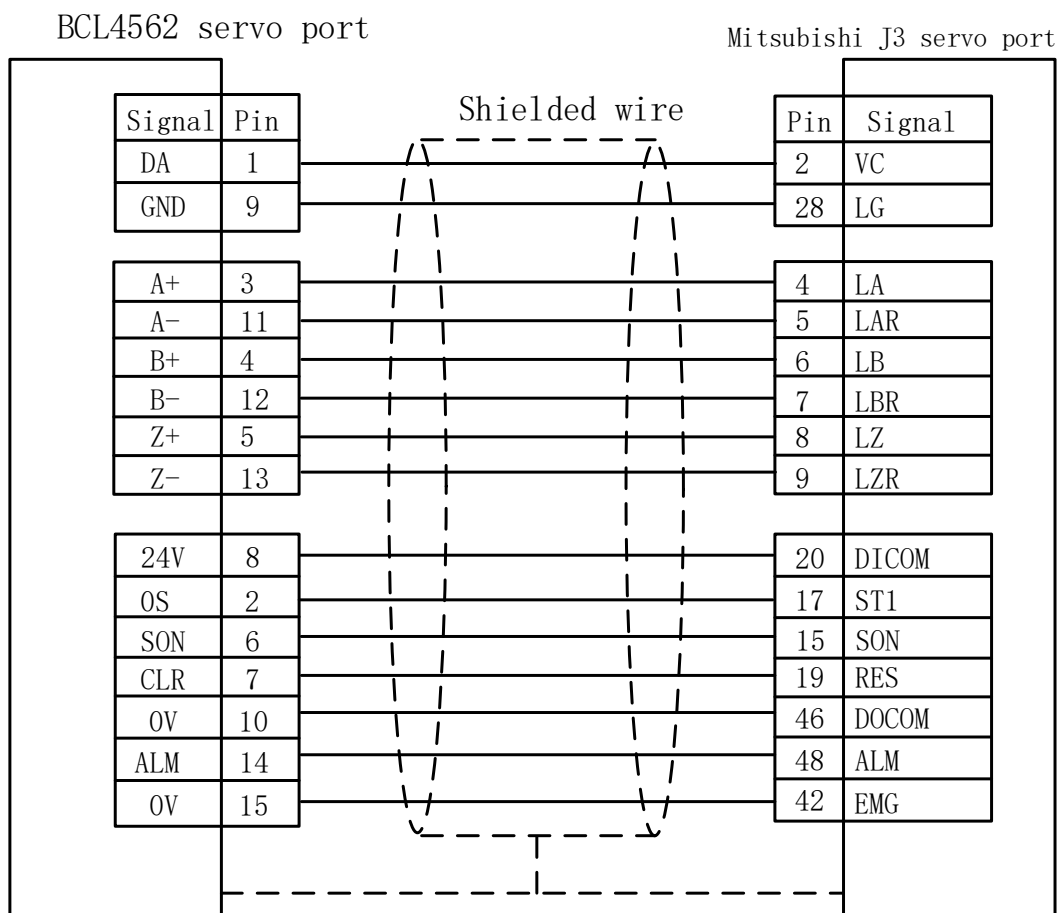
TECO JSDEP servo port



#### TECO JSDEP Servo parameter setup

| Parameter | Recommended Setting | Description   |
|-----------|---------------------|---|
| Cn001     | 1                   | Control mode must select velocity control mode.   |
| Cn002.2   | 1                   | Auto-tuning gain (Note: This is parameter no. 2 of Cn002.)  |
| Cn005     | 2500                | The number of output pulses per motor revolution, match the parameter "pulses per rev 10000" in BCS100. |
| Cn026     | 4                   | Rigidity, you can sue default level 4.  |
| Sn216     | 4000                | Speed gain, match with 500r/v/min in BCS100 controller  |



**Mitsubishi servo MR-J30A wiring diagram****Mitsubishi MR-J30A Series**

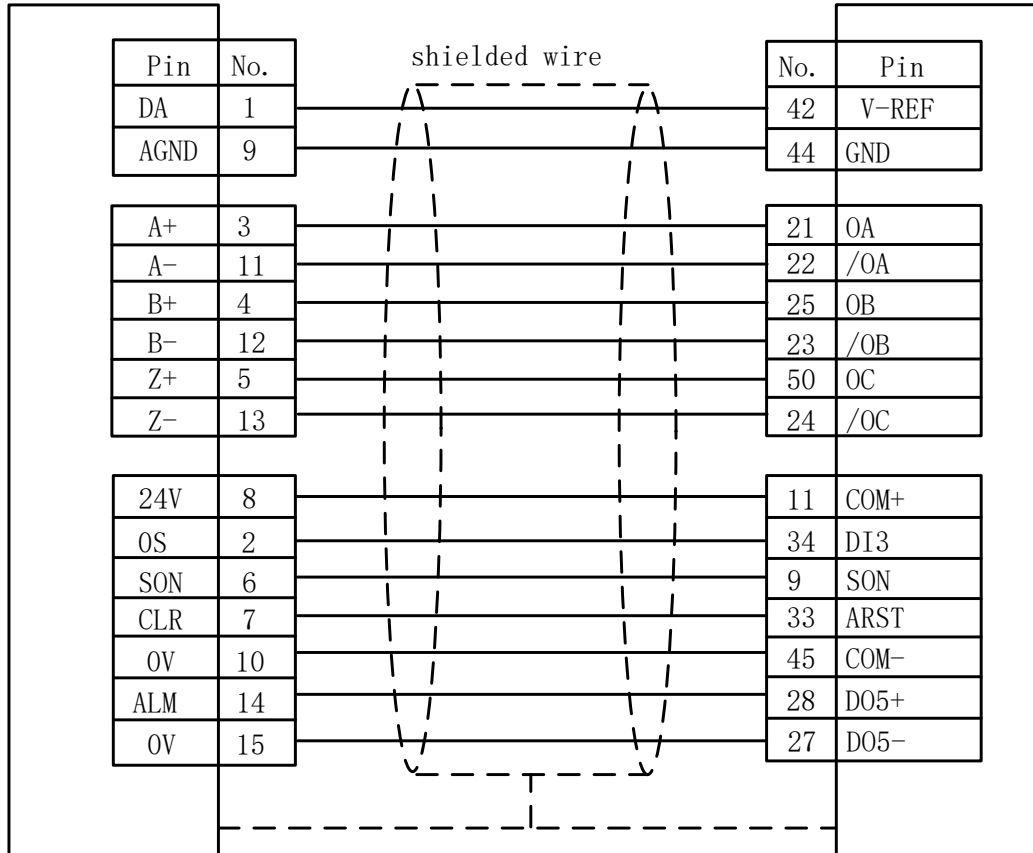
| Parameter | Recommended Setting | Description   |
|-----------|---------------------|---|
| PA01      | 2                   | Control mode is speed mode                            |
| PA15      | 10000               | Number of encoder pulses per revolution x 4           |
| PC12      | 5000                | Corresponding to the speed gain in BCS100 500r/v/min. |
| PC17      | 0                   | Not use zero-clamp function(use ST1 port)             |



### Schneider Servo Lexium 23D Wiring Diagram

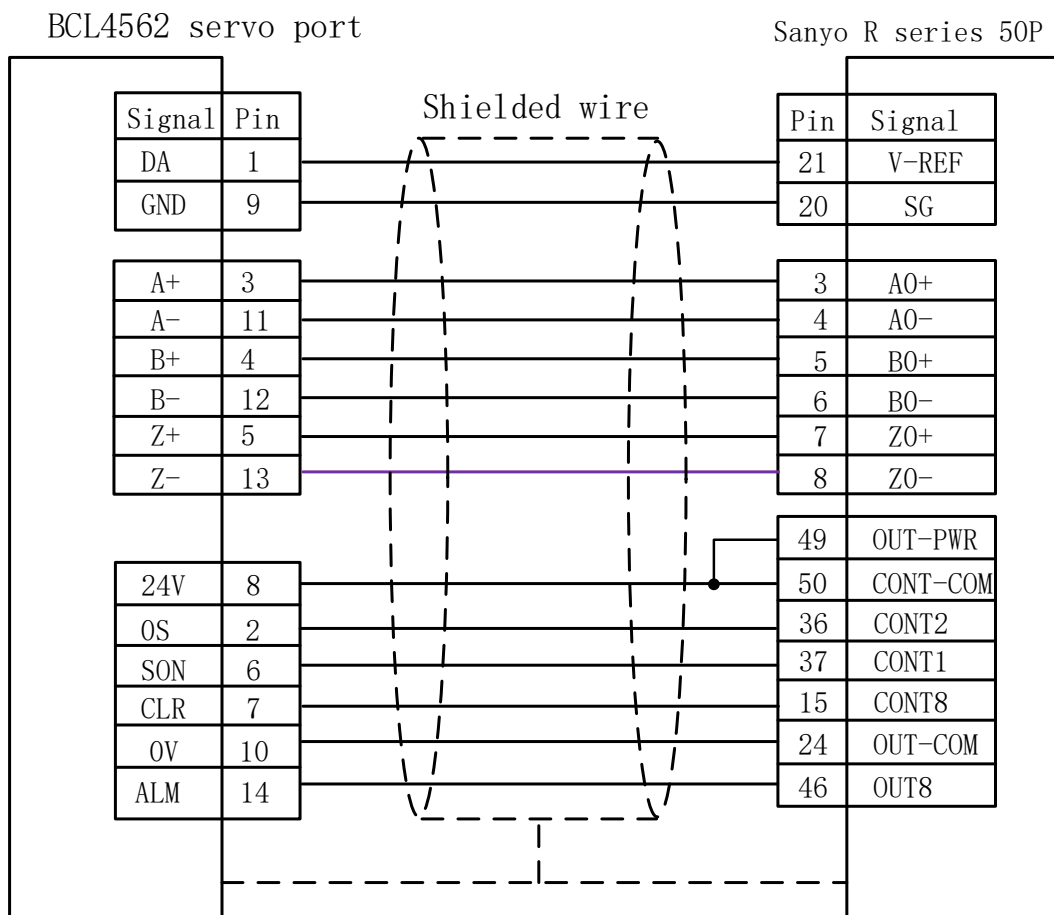
BCL4562 servo port

Schneider Lexium 23D



Schneider Lexium 23D servo parameter setup

| Parameter   | Recommended Setting | Description  |
|-------------|---------------------|--|
| P2-10       | 101                 | Set IN1 as SON in servo  |
| P2-11       | 0                   | IN2 invalid  |
| P2-12       | 5                   | Servo IN3 set as zero speed signal.                              |
| P2-13~P2-17 | 0                   | IN4~IN8 invalid  |
| P1-38       | 2000                | Zero speed range setting is 200rpm.                              |
| P1-01       | 2                   | Set speed mode   |
| P1-40       | 5000                | Speed command scale matches with 500r/v/min in BCS100 controller |
| P1-46       | 2500                | Match with pulses per rev 10000 in BCS100                        |
| P2-68       | 1                   | User does not need to re-trigger SON to enable motor             |

**Sanyo R Series Wiring Diagram****Sanyo R Series Servo parameter setup**

| Parameter | Recommended Setting | Description   |
|-----------|---------------------|---|
| SY08      | 01                  | Velocity control mode   |
| Gr0.00    | 00                  | Self-tuning   |
| Gr8.25    | 5000                | Maximum speed (r/min) of motor correspond to 10V analog output. |
| Gr9.00    | 00                  | Positive side allowed turn                                      |
| Gr9.01    | 00                  | Negative side allowed turn                                      |
| Gr9.26    | 00                  | Disable gain switch   |
| GrB.13    | 0                   | Brake delay from servo on switch to servo off state             |
| GrB.14    | 0                   | Brake loosen delay from servo on switch to servo off state      |
| GrC.05    | 2500/32768          | Match with pulses per rev 10000 in BCS100                       |



### 2.1.4 Limit signal

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

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

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

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

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

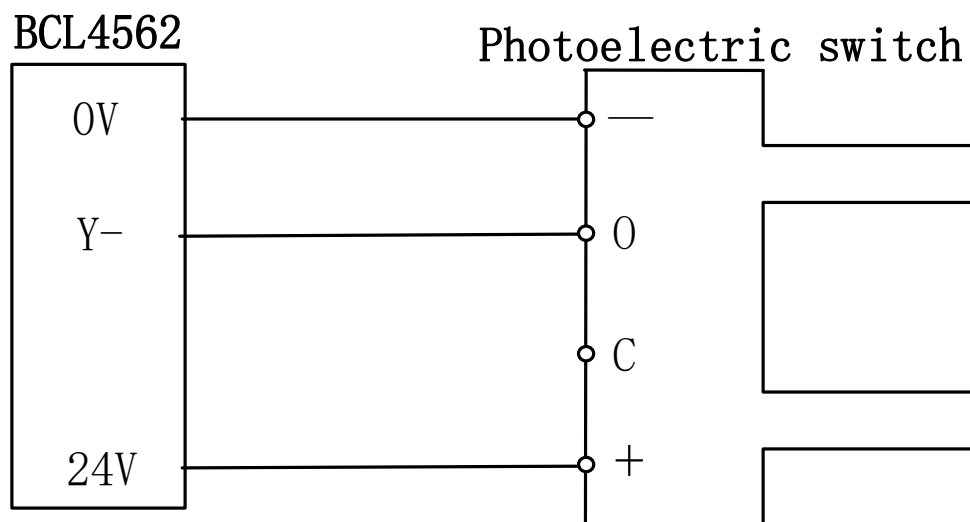
Z+: Z+ Limit, dedicated input port, low level effective;

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

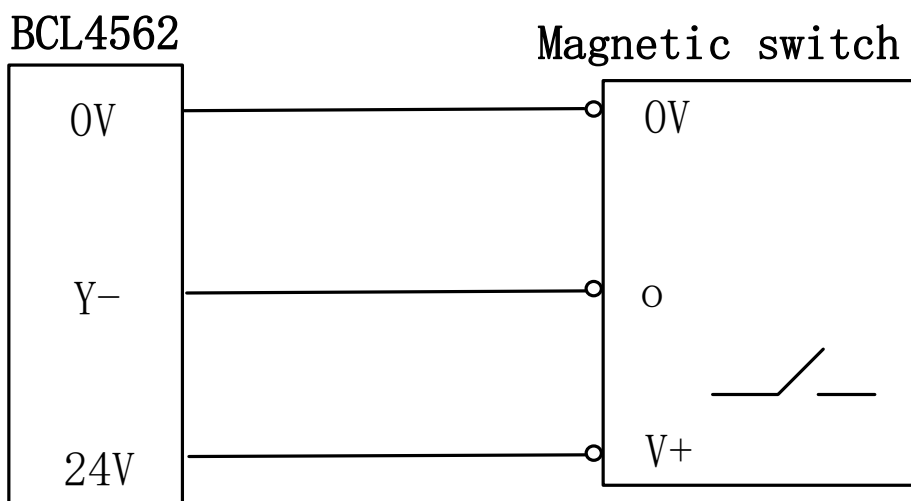
Limit input logic can be switched in config tool. If set limit input normally open, Input signal is valid in conduction with 0V if set limit input normally closed, input signal is valid when disconnected with 0V.

See details in chapter 4 configuration tool.

The typical wiring diagram of optoelectronic switch as shown below, required NPN 24V type.



The typical wiring diagram of magnetic switch as shown below, required NPN 24V type.

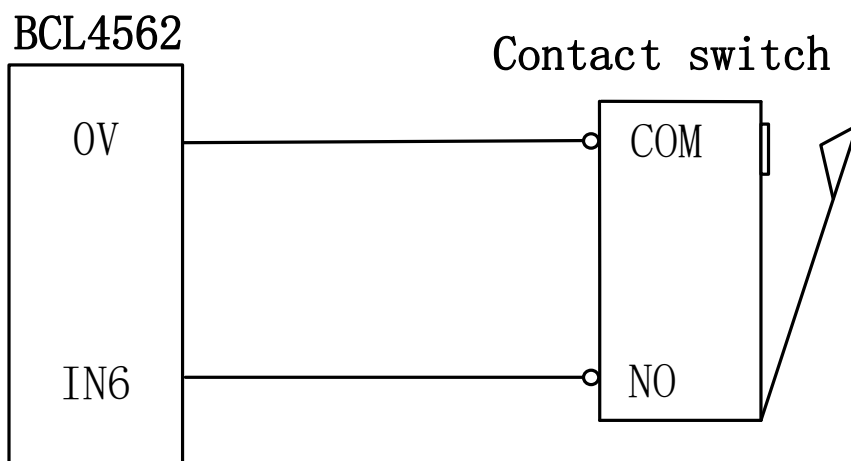


### 2.1.5 General input port

There are 6 inputs from IN1~IN6. You can assign the 6 inputs as customized button or alarm in config tool.

See details in chapter 4 configuration tool.

The typical wiring diagram of contact switch as shown below.



### 2.1.6 General output port

There are 8 relay outputs from OUT1~OUT8, the first 4 output ports are only NO contacts, the last 4 can switch to NO and NC contact. You can assign the 8 relay outputs controlling laser, cutting gas etc.

The load capability of the relay outputs in BCL4562: The maximum load current is 1.5A, not allowed to carry 220V directly. It can directly control 24V load. If you need to carry high power load, please connect external relay/ contactor.

See details in chapter 4 configuration tool.



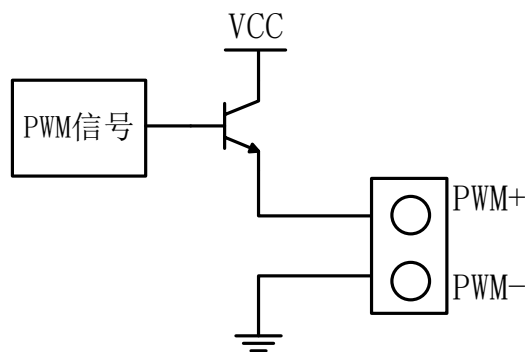
### 2.1.7 Analog output

There are two 0~10V analog relay outputs in BCL4562. You can set DA1 and DA2 for controlling laser peak power and proportional valve in config tool.

|                       |         |
|-----------------------|---------|
| Output range          | 0V~+10V |
| Maximum load          | 50mA    |
| Maximum bipolar error | +/-20mV |
| Resolution            | 2.7mV   |
| Conversion speed      | 400us   |

### 2.1.8 PWM output

There is 1 PWM output in BCL4562 IO terminal board to control average laser power. 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:



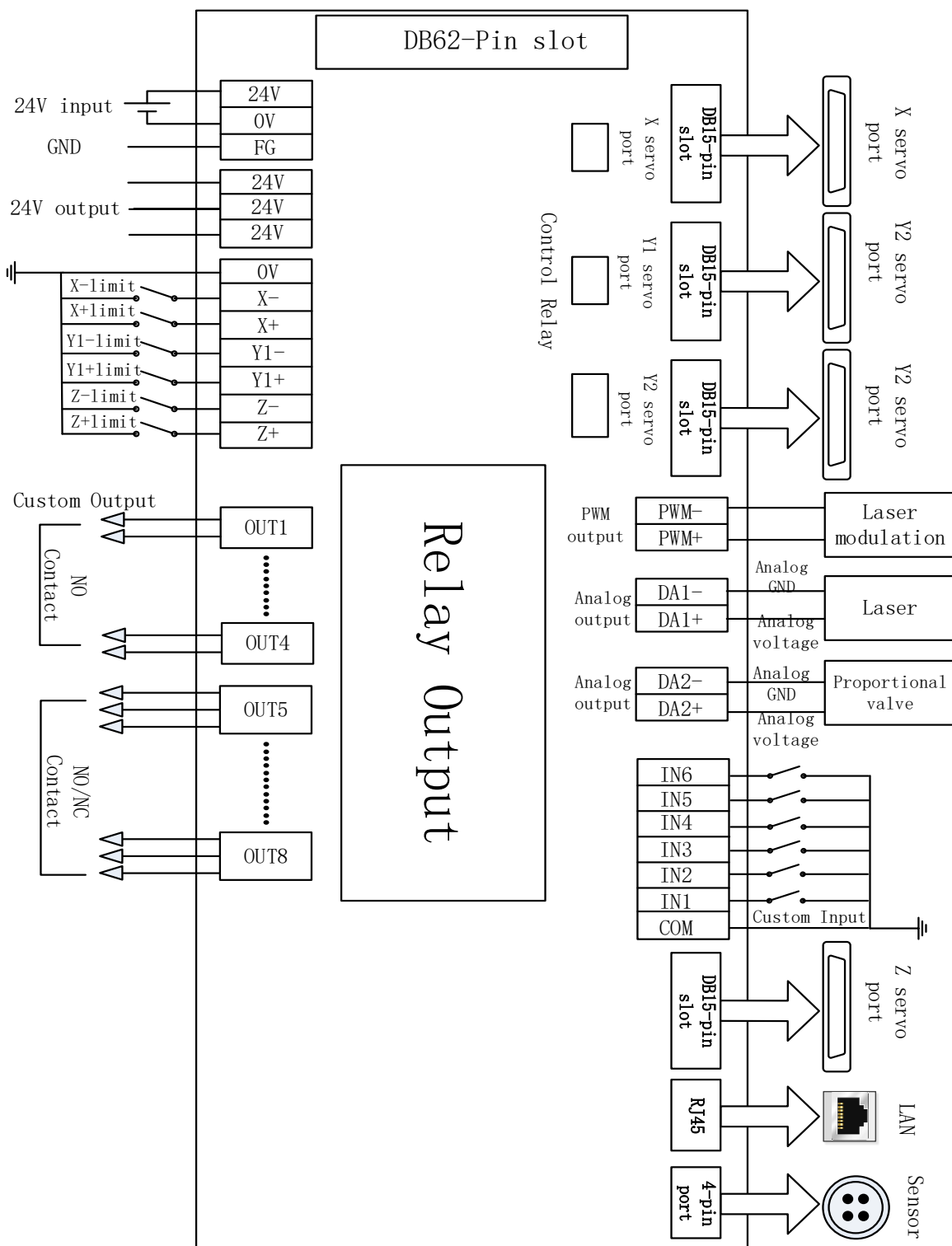
There is a DIP switch at the lower left of PWM port to switch 5V and 24V voltage:

Switch P1 and P2 to set PWM voltage

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



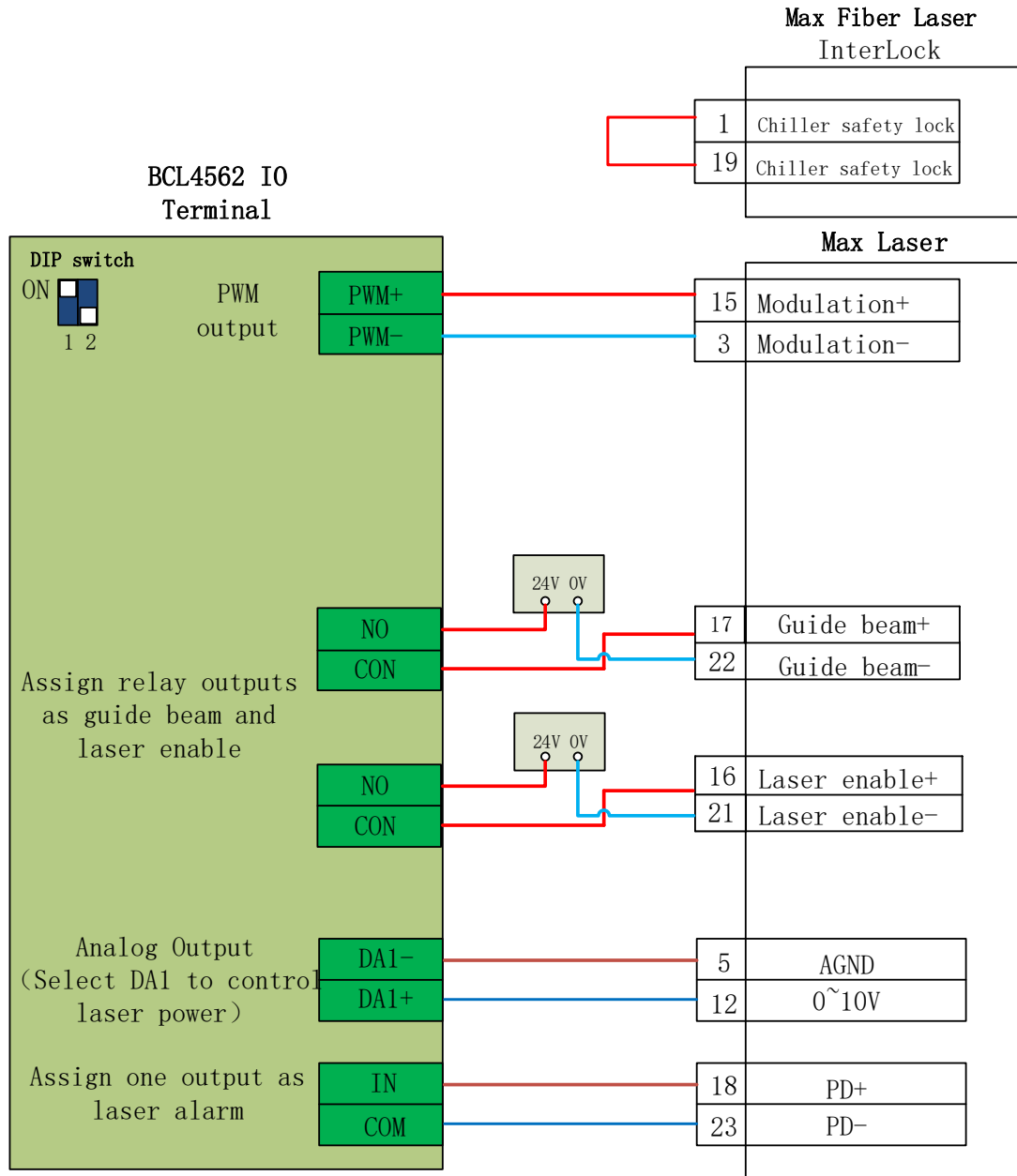
## 2.2 Wiring diagram





## 2.3 Laser wiring diagram

### 2.3.1 Max Laser Wiring Diagram



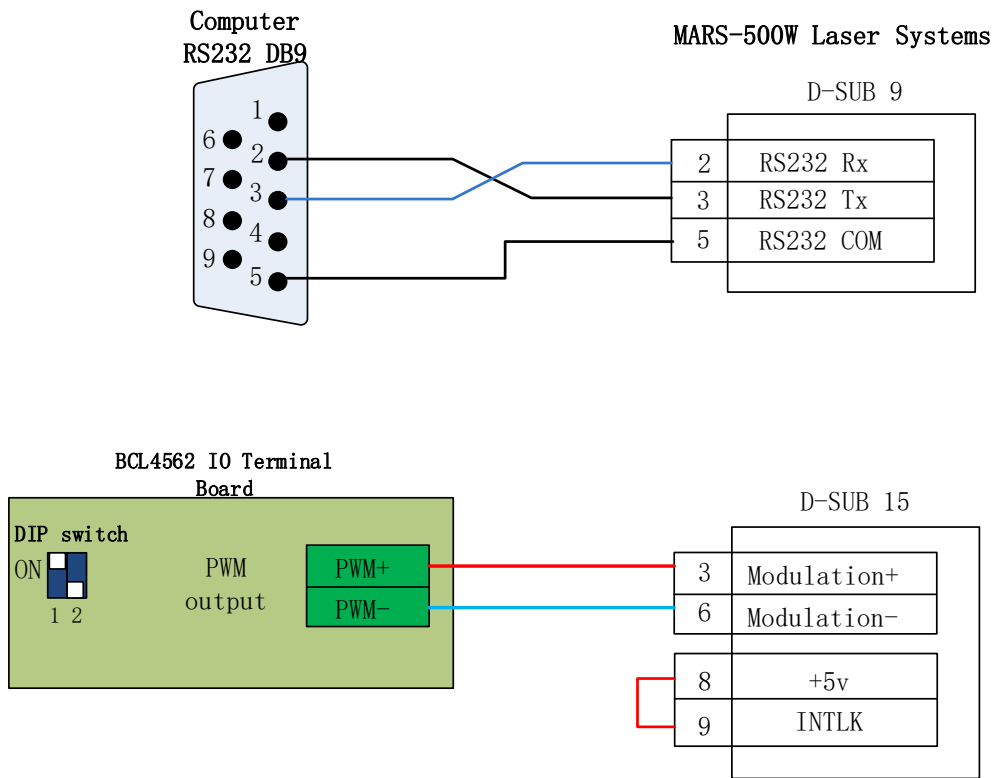
#### Notice:

1. PD+, PD- is laser alarm output, connect to any input port in BCL4562 and set a customized laser alarm in "Config tool-- alarm--customized alarm";
2. PWM select 24V control (DIP switch: P1 ON, P2 OFF)





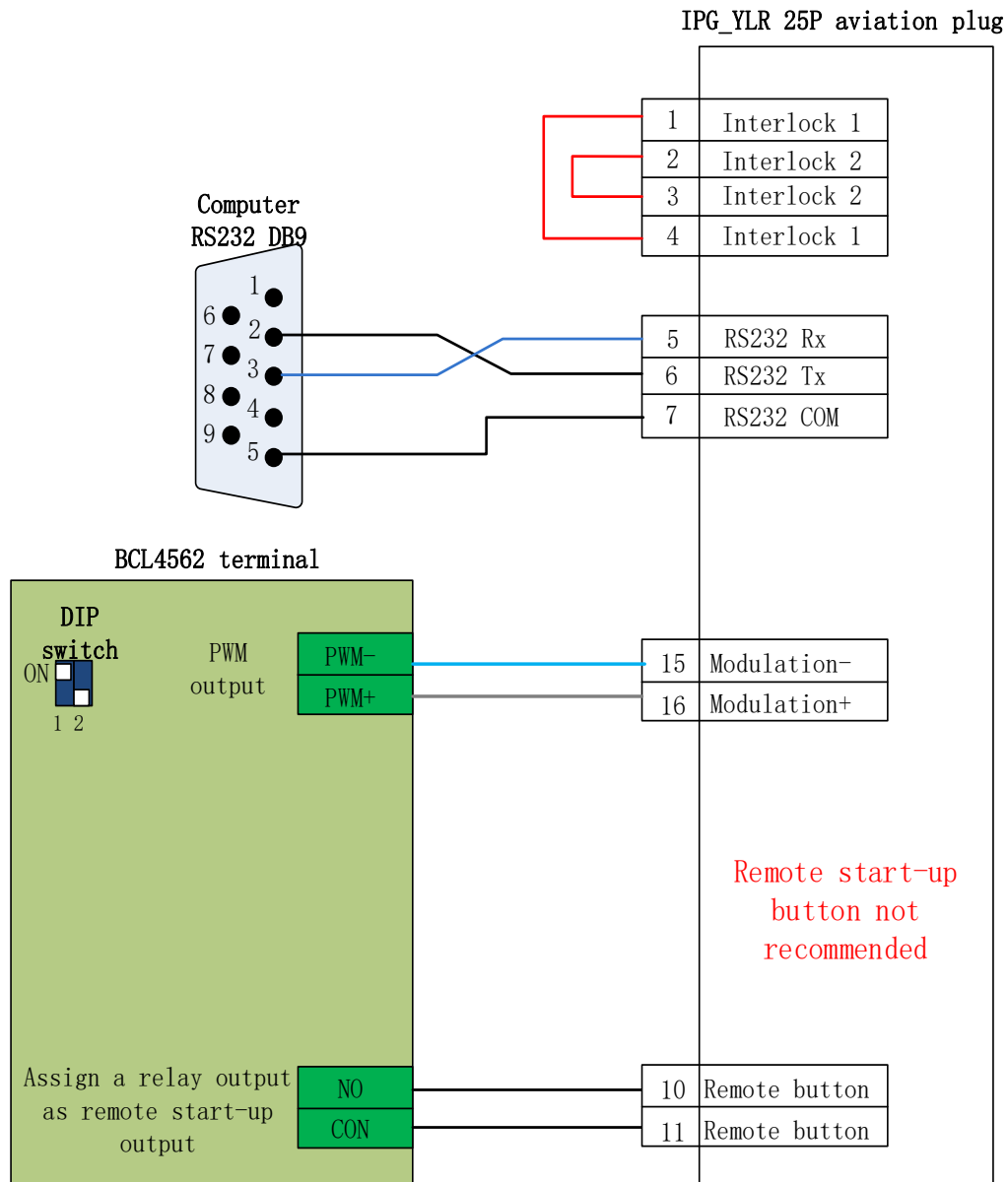
### 2.3.2 Maxs Series Wiring Diagram



**Note:**  
PWM select 24V control (P1ON, P2 OFF)



### 2.3.3 IPG-YLR series wiring diagram



We recommend you choose RS232 or network control if laser supports this communication mode, which can control laser realize the function including laser emission, turn on/off guide beam, set peak power, etc., and no need to control peak power by analog DA port.

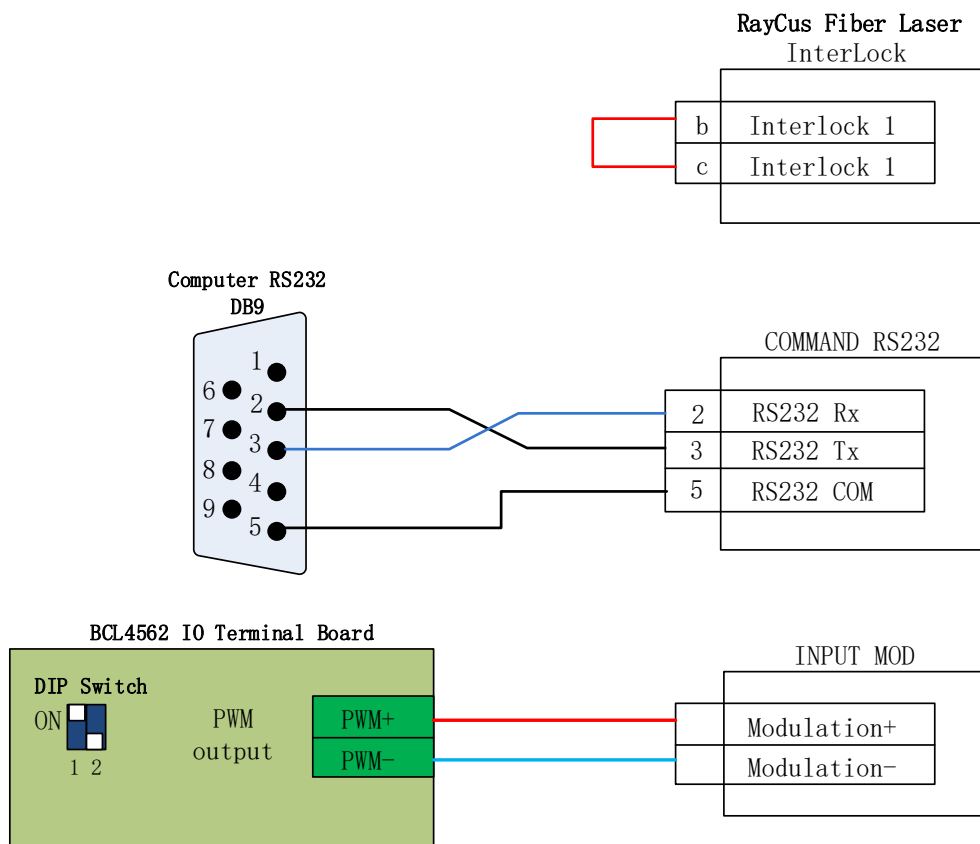
Recommend to use network communication for IPG-YLR series.

**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).



### 2.3.4 Raycus Fiber Laser wiring diagram



#### Note:

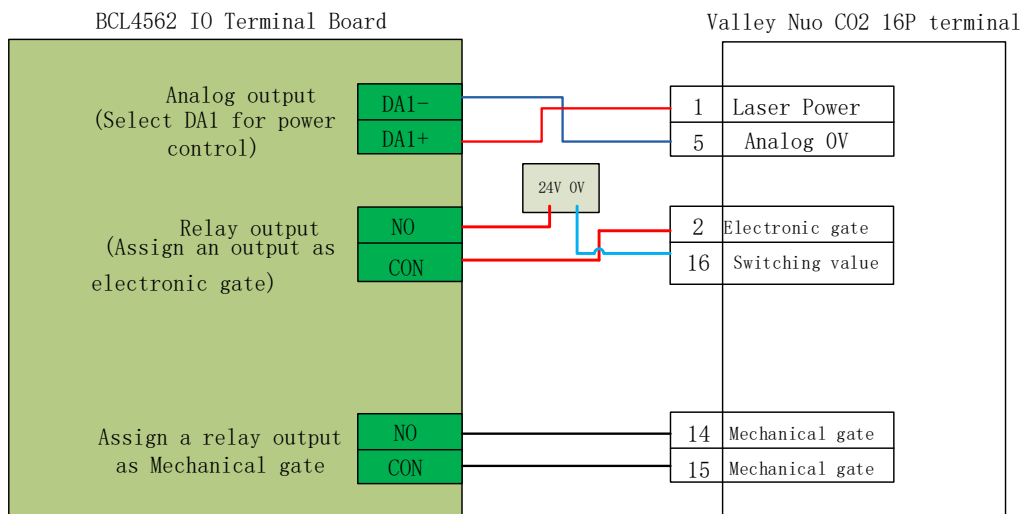
1. Raycus's latest products use 24V PWM, the old version use 5V PWM. And the key switch to REM then RS232 is available, while the old version switch to ON. Laser PWM port will indicate 24V or 5V control; No sign indicates voltage means using 5V.

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

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

### 2.3.5 Valley Nuo Laser Wiring Diagram

Here take the example of NT-3200SM model.



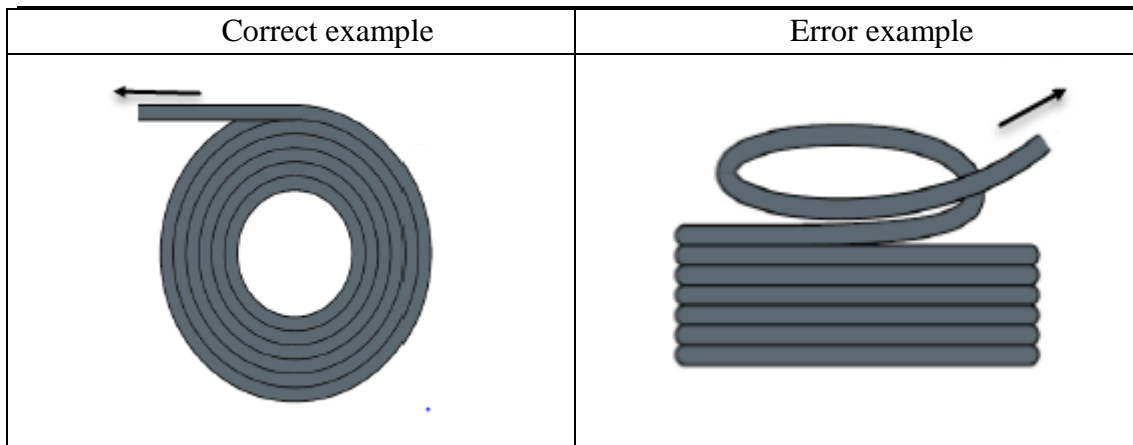
**Note:**

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

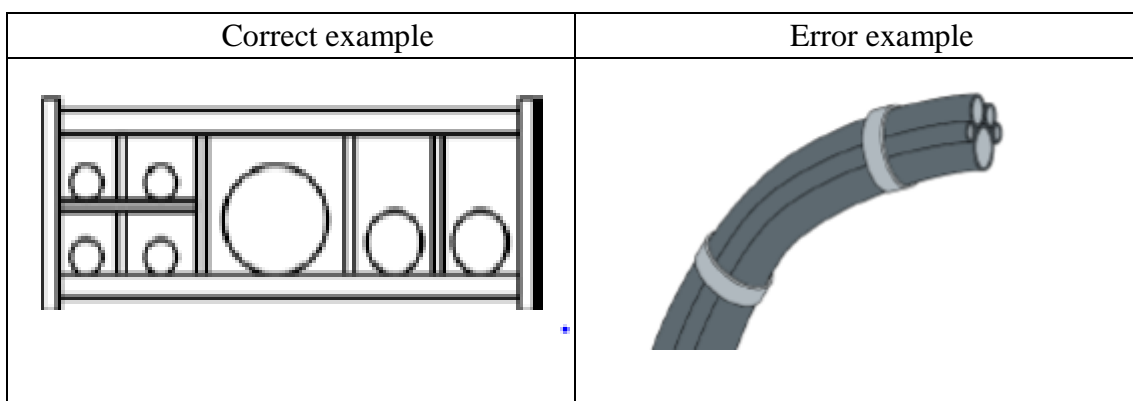
## 2.4 Wiring precautions

### 2.4.1 Specification for cable layout

1. When releasing the cable from the coil, it is necessary to prevent the cable from twisting (it needs to be laid along the tangent direction) and to straighten the cable. This work should be carried out before laying the cable, providing a period of stress release for the cable. Because the manufacturing process cannot fully guarantee that the cable is straight and without any distortion, the printed markings on the cable surface rotate along a tiny spiral.



2. The cable is not allowed to twist when it is installed in enclosed space. The twist during installation may lead to premature damage of the core strand. This effect is gradually strengthened in the operation of the cable, resulting in the phenomenon of back-twisting, which eventually leads to core breakage and failure.
3. Cables must be laid side by side in the towing brackets. Isolating pieces should be used to separate cables as far as possible. The gap between cable and isolator, separator or its adjacent cables should be at least 10% in diameter.



4. The cables should be installed symmetrically according to the weight and size of the cables. The larger diameter cables should be placed outside. Smaller and lighter cables should be placed inside. Cables can also be placed from inside to outside in order of decreasing size. One cable should be laid on the other cable without the use of isolation panels.
5. For vertical suspension tow chains, more free space must be left in the vertical bracket because the cable will be lengthened during operation. After a short period of operation, it is necessary to check whether the cables are running along the central area and adjust them if necessary.
6. For self-supported drag chain structure, cables are fastened to moving points and



fixed points. It is necessary to use the appropriate cable support provided by the towing chain supplier. When operating at high acceleration, the applicability of cable strapping is very limited. It should be prevented to tie multiple cables together. Cables should not be fixed or tied to the movable parts of the tow chain in any way. The gap between fixed point and bending motion should be wide enough.

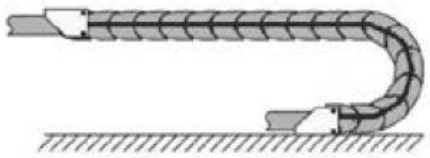
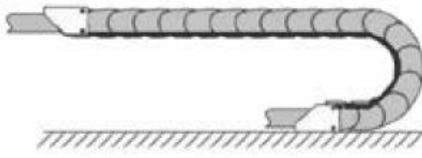


自承式



滑动式

7. For sliding towing chains, we suggest that cables should only be fixed on moving points. Setting a small cable protection area at a fixed point (refer to the assembly instructions of the tow chain supplier).
8. Make sure that the cable moves along the center area under the required bending radius. Do not apply tension to the cable (do not pull too tight), otherwise the friction inside the tow chain will lead to cable sheath wear. Do not let the cable loose too much in the tow chain, otherwise it will easily lead to wear and tear between the cable and the inner wall of the tow chain, or entanglement with other cables.

| Correct example   | Error example  |
|---|--|
|  <p style="text-align: center;">正确</p> |  <p style="text-align: center;">错误</p> |

9. If the cable is not running smoothly, you can check whether there is any distortion along the longitudinal axis during operation. The cable should rotate slowly at a



fixed point until it runs smoothly.

10. In view of the absolute size of cables and towing chains, their length variation characteristics are quite different. In the first few hours of operation, the cable stretched naturally. For towing chains, it takes many hours to run this phenomenon. Such a big difference can be solved by regularly checking the installation location of cables. We recommend regular inspections, once every three months in the first year of operation, and then at each maintenance time. The contents include checking whether the cable is completely free to move within its proper bending radius and adjusting it if necessary.

#### 2.4.2 Specification for machine tool wiring

##### 1. Wiring specification for power supply

###### (1) Strong electricity

- a) Strong and weak electricity is strictly separated.
- b) The power line is selected according to the size of the power line diameter. The attached is the cable diameter and power comparison table.

| Wire and cable specifications (mm <sup>2</sup> ) | Cable cross section (mm <sup>2</sup> ) | 25°C copper current carrying capacity (A) | Single phase 220V load power (W) | Three phase 380V load power (W) |
|--|--|---|----------------------------------|---------------------------------|
| 1.5  | 1.38                                   | 15  | 3300                             | 9476.8                          |
| 2.5  | 1.78                                   | 25  | 5500                             | 13163.2                         |
| 4  | 2.25                                   | 32  | 7040                             | 16848.8                         |
| 6  | 2.85                                   | 45  | 9900                             | 23693.6                         |
| 10   | 7*1.35                                 | 60  | 13200                            | 31591.2                         |
| 16   | 7*1.7                                  | 80  | 17600                            | 42121.6                         |
| 25   | 7*2.14                                 | 110                                       | 24200                            | 57917.6                         |

- c) Strong current plus short-circuit protector, filter and other auxiliary devices.

###### (2) Weak current (take DC24V as an example)

- a) The power positive and negative pole wiring colors are distinguished, for example: The red line is connected to the positive pole, and the blue line is connected to the negative pole.
- b) Larger interference loads, such as servo and solenoid valves, are supplied separately from the controller.

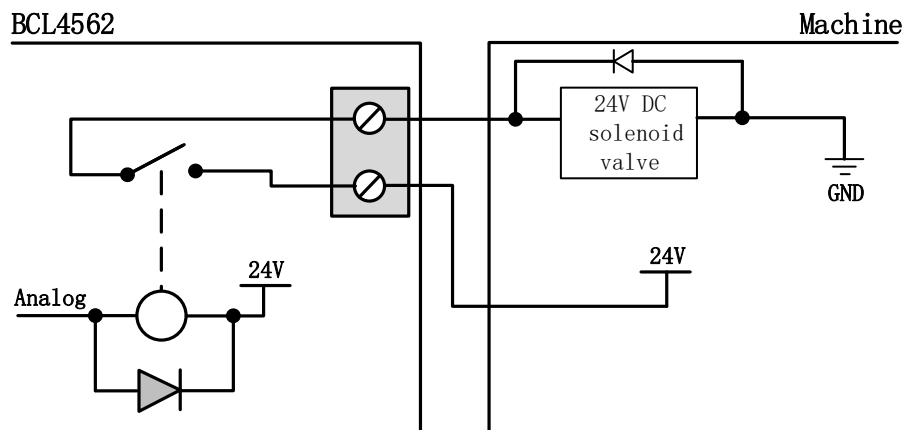
##### 2. Specification for earth wire connection



- (1) The ground wire adopts standard yellow green double color line.
- (2) There are some high frequency signals (PWM, pulse, encoder, capacitance signal, etc.) in the laser cutting machine tool. It is suggested to use multi-point grounding.
- (3) Galvanized earthing screws for machine tools and earthing with special earthing wires. The resistance between the grounded metal main body and the main grounding point should not exceed 0.1 ohms.

### 3. Specification for signal (control) wiring

- (1) Signal line color: Such as black.
- (2) The signal line is selected according to the power size.
- (3) DC 24V solenoid valve is recommended. Absorption circuit is added at both ends of solenoid valve, that is, a continuous current diode (attention direction, current resistance value, voltage resistance value) is connected in parallel at both ends of solenoid valve, as shown in the following figure:



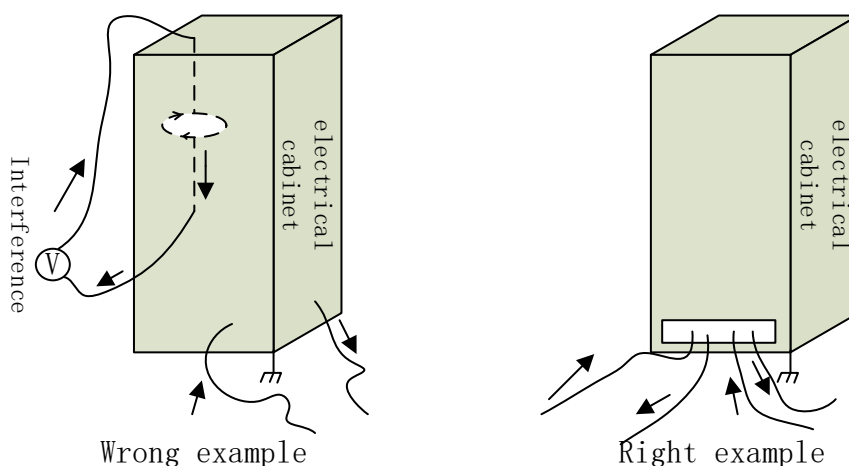
- (4) It is recommended that the digital signal (PWM) shield layer be grounded at two ends and the analog signal (DA) shield layer be grounded at one end. Single ended grounding can avoid low frequency current noise on shielding layer. Double-terminal grounding can effectively eliminate high-frequency interference. If the transmission cable is long, multi-point grounding is recommended to ensure that the shielding layer is equipotential.
- (5) The resistance of the cutting head connected by the amplifier to the shell of the machine tool is not more than 1, and the resistance of the grounding point to the electric cabinet is not more than 6.

### 4. Other specifications

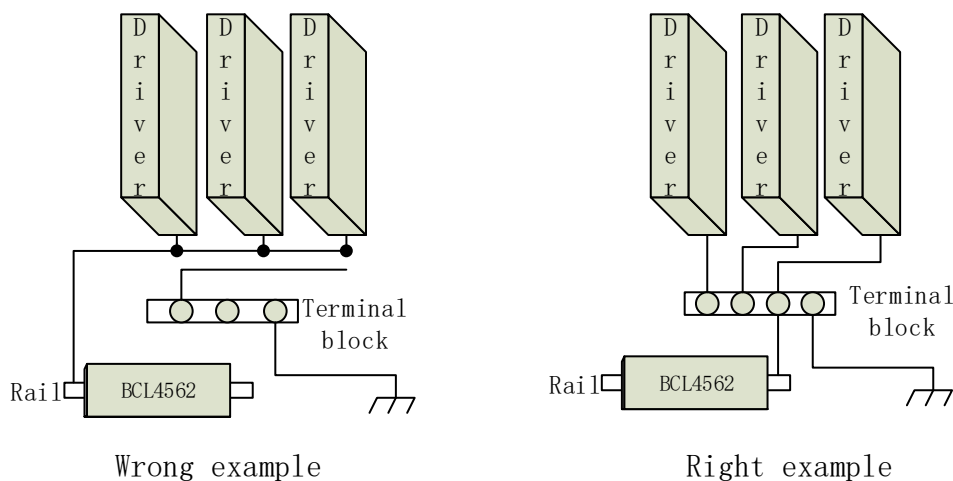
- (1) Each wire is marked and marked clearly and accurately.
- (2) Line and line are arranged in parallel. No crossover is allowed. The arrangement of wiring harness and line pipe should be straight.



- (3) When choosing Friendless wires, choose the appropriate type of wire according to the layout space, do not accumulate hovering.
- (4) All wiring must be reliable and not loose to prevent ignition.
- (5) Wiring avoids formation of loops and prevents antenna effects. A current loop consisting of a signal source, a transmission line, a load is equivalent to a magnetic field antenna. As shown in the figure below, the wrong way is on the left side and the right connection is on the right.



- (6) The recommended connection is star connected, and serial connections are not recommended.



### 2.4.3 Product assembly requirements



**Please take care of it. Before contacting the circuit of the control card or inserting/unplugging the control card, wear anti-static gloves or contact with effectively grounded metal objects to discharge the human body, so as to prevent possible electrostatic damage to the motion control card.**



**Except the USB interface, the other interfaces are not allowed to plug, and the plug may cause the internal components to burn down.**




**Please take it carefully, forbid external pressure to press the card. Pressing the card may cause bending of the card, resulting in damage to the function of the card.**



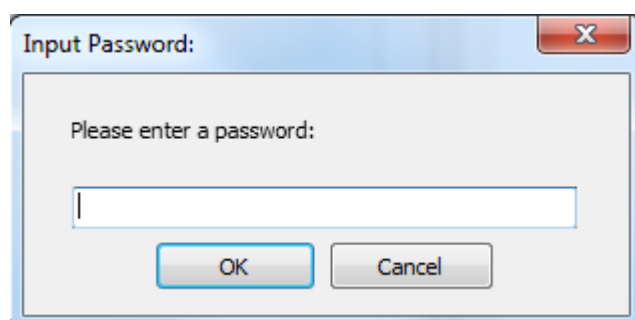
### 3.1 Installation

Configuration tool will be installed automatically in CypOne software installation.

Click "start" menu- "All programs"- "CypOne laser cutting system"- "Config tool" to startup config tool . "CypOne laser cutting system" is software name, which differs from different OEM software version.

### 3.2 Password

You have to input password to start config tool.

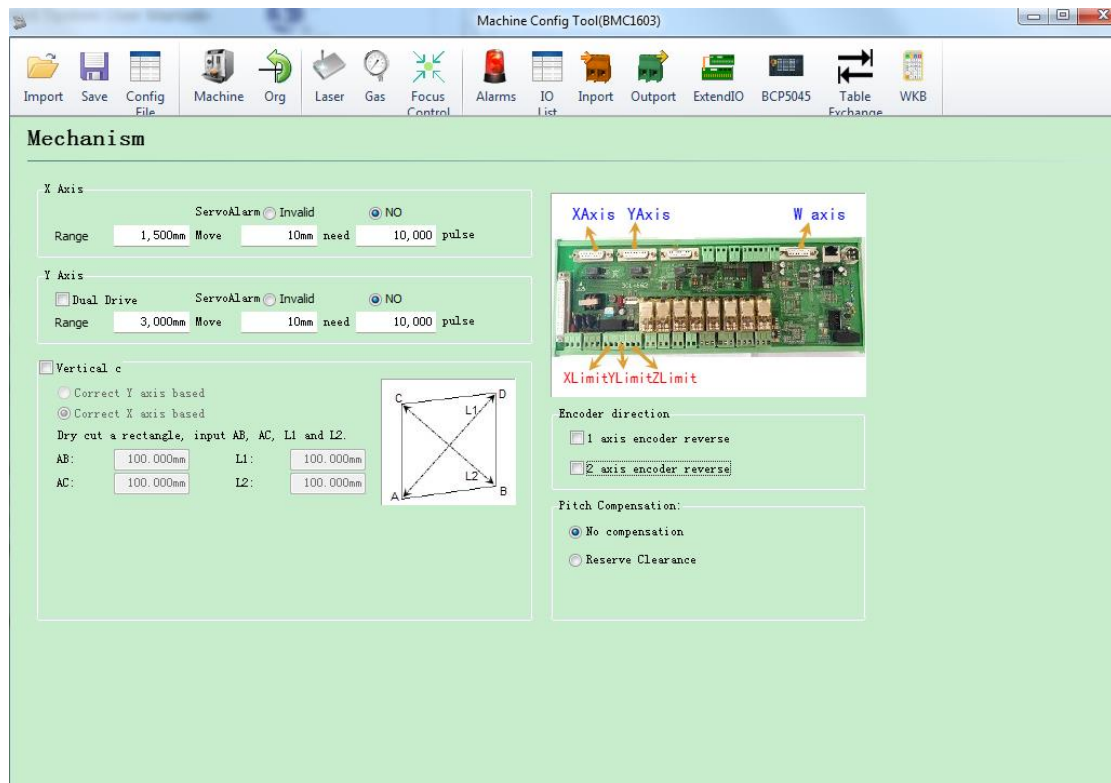


Initial password 61259023.

**Notice:** Parameter setup must accord with the actual mechanism structure, wrong setting will cause unknown serious consequences!



### 3.3 User interface

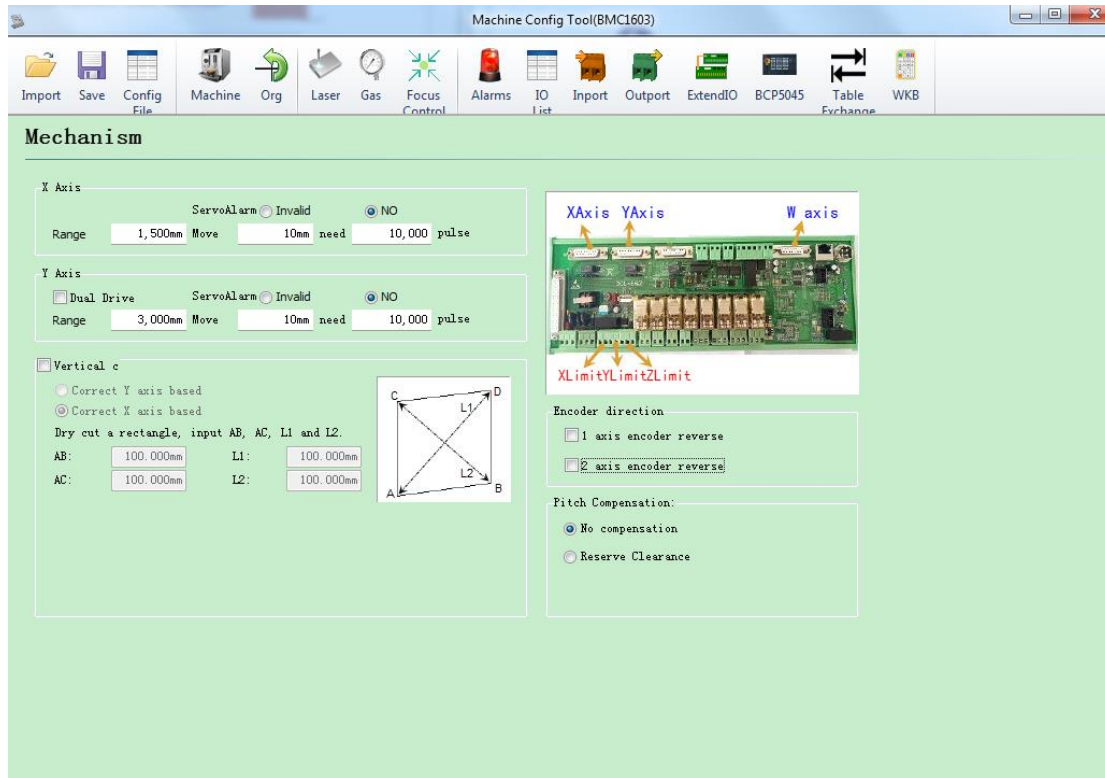


The main page of config tool is machine structure. Click the icon at top bar to enter different parameter model. You can config signal assignment of limit switch, laser, gas etc. You can click "config file" locate to Data file folder.

Users can click "Import" to load the config file. "Save" button is used to save the settings.

**Note:** Data folder contains all configuration information of CypOne.

### 3.4 Machine mechanism config



Select single drive or dual by the actual X/Y axis structure.

**The travel range of X axis:** The maximum travel range of X axis when use software limit function, and define the width of the white square in CypOne main page.

**The travel range of Y axis:** The maximum travel range of Y axis when use software limit function, and define the length of the white square in CypOne main page.

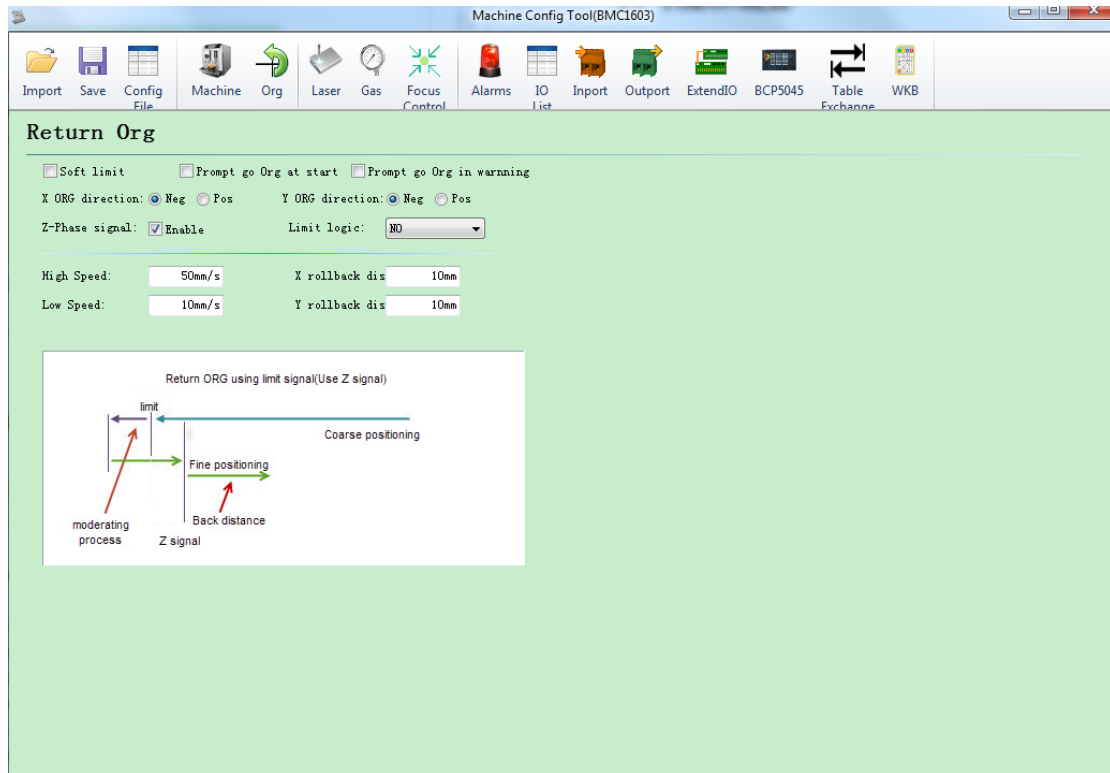
**Pulse equivalent:** Command pulses controller send to servo every 1mm linear distance on machine bed. The linear distance can set to 5 decimal places, pulse equivalent= pulses/linear distance.

**Servo alarm:** Select servo alarm signal logic.

**Verticality correction:** When X/Y axis not mounted perpendicular in 90 °, you can set this parameter to correct the deviation.



### 3.5 Return origin configuration



**Soft Limit:** Enable this function will force open the soft limit function, users can't turn off on CypOne software.

**Prompt go origin at start:** Display go origin message in main page to remind user.

**Return origin direction:** You can set different return origin direction according the axis structure. Return origin direction decides the quadrant of the machine coordinates. For example, return origin direction of both X and Y is negative direction, then machine coordinate is in the first quadrant.

**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.

**High speed:** Coarse positioning section shown as blue color recommended speed 50mm/s.

**Low speed:** Fine positioning section shown as green color, find origin signal in slow speed, recommended 10mm/s.

**Roll-back distance:** The distance can keep machine origin not too close to origin switch.

**Limit logic:** Set limit signal logic of X/Y axis.



## 3.6 Laser configuration

CypOne provides configuration parameter for Max laser, Mars, IPG, Raycus, Valley Nuo and other type, each laser type has corresponding configuration parameter.

### 3.6.1 Max Laser Configuration

**Laser**

Laser type:  
 Max  Mars  IPG  Raycus  Valley Nuo  Other

Laser Power: 1000W

Aiming: 0 Laser On En. 1

DA Select: No Use

DA Range:  0~5V  0~10V

**Guide beam output:** Set output to control guide beam.

**Laser enable:** Set output to control laser emission.

**DA port:** There are 2 analog DA ports on BCL4562 terminal board, choose either of them to control laser power

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

### 3.6.2 Mars Laser Configuration

**Laser**

Laser type:  
 Max  Mars  IPG  Raycus  Valley Nuo  Other

Laser Power: 1000W

Aiming: 0

DA Select: No Use

DA Range:  0~5V  0~10V

Use Comm COM1  Debug

**Guide beam output:** Set output to control guide beam.

**DA port:** There are 2 analog DA ports on BCL4562 terminal board, choose either of them to control laser power

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

Mars Laser supports serial communication.



### 3.6.3 IPG Laser configuration

**Guide beam output:** Set output to control guide beam.

**DA port selection:** There are 2 analog DA ports on BCL4562 terminal board, choose either of them to control laser peak power. When use RS232 or network control doesn't require DA port.

**IPG 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 the output port for remote control button.(It is not recommended to use this function, which might cause laser error)

**IPG remote control:**

After enable remote control function, CypOne can send command to laser by network or RS232 communication to 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.

### 3.6.4 Raycus Laser configuration

**Guide beam output:** Set output to control guide beam.

**DA port:** There are 2 analog DA ports on BCL4562 terminal board, choose





either of them to control laser power.

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

RayCus laser supports serial communication.

### 3.6.5 Valley Nuo Laser Configuration

**Laser**

Laser type:  
 Max  Mars  IPG  Raycus  Valley Nuo  Other

Laser Power: 1000W

---

Aiming: 0 Mechanical S 1  
DA Select: No Use Electronic Sh 0  
DA Range:  0~5V  0~10V

**Mechanical emission gate:** Output port to control mechanical emission gate.

**Electronic gate:** Output port to control electronic emission gate

**Guide beam output:** Set output to control guide beam.

**DA port:** There are 2 analog DA ports on BCL4562 terminal board, choose either of them to control laser power

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

### 3.6.6 Other laser configuration

**Laser**

Laser type:  
 Max  Mars  IPG  Raycus  Valley Nuo  Other

Laser Power: 1000W

---

Aiming: 0 Laser On En: 1  
DA Select: No Use Laser On Re: 0  
DA Range:  0~5V  0~10V Delay: 0ms

Reserved configuration, not support serial and network communication. It must use DA to control peak power.



### 3.7 Gas configuration

#### Gas

Gas Control

|               |   |  |        |  |            |   |
|---------------|---|--|--------|--|------------|---|
| Air (L):      | 0 |  | DA1    |  | Valve (L): | 0 |
| Oxygen (L):   | 0 |  | No Use |  |            |   |
| Nitrogen (L): | 0 |  | No Use |  |            |   |
|               |   |  |        |  |            |   |
| Air (H):      | 0 |  |        |  | Valve (H): | 0 |
| Oxygen (H):   | 0 |  |        |  |            |   |
| Nitrogen (H): | 0 |  |        |  |            |   |

The default set of those ports above is 0, indicates that valve is not in use.  
Different gas can share one proportional valve by setting the same DA port.

Max valve pressure: 10 bar

Set DA to 0 when Gas Off

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

**Air:** Output to turn on/off air

**Oxygen:** Output to turn on/off oxygen

**Nitrogen:** Output to turn on/off nitrogen

**DA Gas Control:** An output port to control proportional valve



### 3.8 Focus control

**Focus Control**

Enable

BCL4516E [No Connection]

Focus Range: From  to

Focus position at org:

Pulse Rate: Move  need  pulse

High Speed:  Org Dir  Pos  Neg

Low Speed:  ORG signal:

Rollback distance:

Jog speed:

Locate Speed:

acceleration:

Servo Alarm Logic:

Negative Limit Logic:

Positive Limit Logic:

Focus control function must be realized by BCL4516E terminal board. Connect in the BCL4516E in config tool-extend IO.

**Focus range:** Set software limit and travel range.

**Focus position at org position:** The focus scale at origin position

**Pulse rate:** Command pulses send to servo correspond with focus moving distance.

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

Origin signal: Sampling signal can comes from limit or origin switch as your selection.

High speed: The speed to find origin switch.

Low speed: The speed to relocate the origin switch after first receive the switch signal.

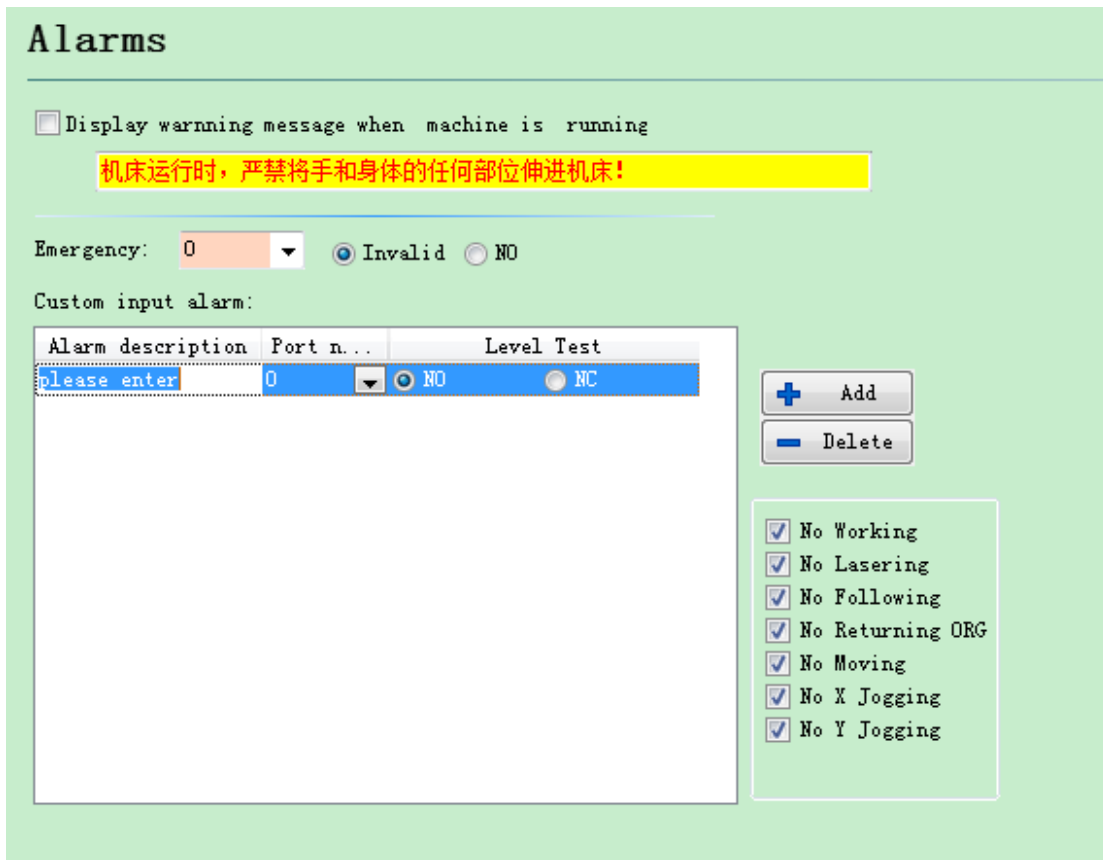
**Rollback distance:** Reverse direction motion distance after complete fine location.

**Jog speed:** Jog speed of focus

**Locate speed:** Focus switching speed.



## 3.9 Alarm setting



### 3.9.1 Warning

Display the warning message of yellow color when machine is running. You can edit the warning message.

### 3.9.2 Emergency stop button:

Assign the input port and signal logic of emergency button. Controller will send emergency stop alarm once the input signal is valid.

### 3.9.3 Custom alarm:

Users can add customized alarm and edit alarm name, assign signal pin and select signal logic. The commonly used alarms are low-pressure, water temperature over-high, and laser head collision.

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



### 3.10 General input port

#### Digit Inports

Inport function list:

| Function | Input | Level Test |
|----------|-------|------------|
|----------|-------|------------|

Functions ▼

Delete

Click function button you can select port number and set signal logic. The signal port can't be reapplied.



## 3.11 General output port

### Digit Output

**General Output**

Lasering: 0  Alarm Light 0

Working: 0  Alarm Tone: 0

- Alarm Lights Flashing
- Processing Lights Flashing
- Laser Lights Flashing
- Alarm Bell Intermit

**Auto Lubricate**

Lube Control Port: 0

Interval:

Duration:

**Custom output configuration**

| Name | Output | Lock |
|------|--------|------|
|      |        |      |

**Regional output**

Area output: 3  Row 2  Col  Display edit box

Close delay:   Output only when cutting

Note: You must reset regional output after modifying the limit range or origin direction!

|   |     |      |
|---|-----|------|
| 0 | 750 | 1500 |
|   |     | 3000 |
|   |     | 2000 |
|   |     | 1000 |
| 0 | 0   | 0    |

Enable Subregional First Enable Subregional First

### 3.11.1 Output port:

**Lasering:** If this port configured, the indicator will light when laser is firing.

**Working:** If this port configured, the indicator will light when machine in cutting process.

**Alarm light:** If this port configured, the indicator will light when there is alarm detected.

**Alarm bell:** If this port configured, the indication bell will ring when corresponding alarm triggered.

**Lights flashing/ bell intermit:** Enable this function you can customize the interval time of output open and close to realize the effect of indicator flash.

### 3.11.2 Auto lubricate

After this port assigned, program starts time count and activate related output and maintain a setup time then close.

### 3.11.3 Custom output

Setup a customized output it will displayed as a button in CypOne main page-CNC module. The output signal can select lock or contact control.





### 3.11.4 Regional output

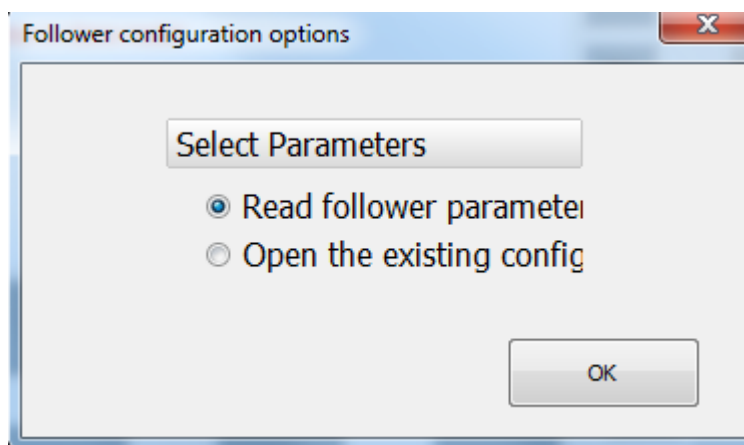
Regional output is used for dust collection. When laser is firing, the output in the region where laser head is in will open. If laser head move from region 1 to region 3, then output in region 1 close and output in region 3 open.

Close delay: The output will close in a delay time when laser head switch to another region.

### 3.12 BCS100 height controller

Height control unit of FSCUT1000 system is integrated in BCL4562 IO terminal board communicate by Ethernet network.

BCL4562 is directly connected to computer box. Parameter setup of BCS100 in CypOne-CNC- module. Click parameter config .



**Read follower parameter:** Read in the parameter of current connected height control unit.

**Open the existing config:** Open Ifg file (BCS100 parameter backup file). Select "read follower parameter", click "Ok" will prompt the parameter page:



**Follower Parameters Configuration**

**Follower Parameters**  
Click on the parameter as the default parameters  
 Speed, reset, machinery and alarm parameters configuration.

| Speed Parameters       | Alarm Parameters         |
|------------------------|--------------------------|
| Move Speed: 200 mm/s   | Max Follow Devia: 4.0 mm |
| Move Acc: 0.20 G       | Max Follow Delay: 100 ms |
| Jog Speed low: 10 mm/s | Hit Board Delay: 200 ms  |
| Jog Speed Hig: 50 mm/s |                          |

| Technological parameter | Mechanical Parameters         |
|-------------------------|-------------------------------|
| Dock Position: 0.00 mm  | Lead Screw Pitch: 5.00 mm     |
| Z Range: 999.00 mm      | Max RPM: 4,500 r/min          |
|                         | Speed-voltage Ga: 500 r/min/v |
|                         | Pulse Per Round: 10000        |

| ORG Parameters   | Servo Type  |
|--|---|
| Org Speed: 50 mm/s   | Servo Type: [Dropdown]  |
| Org when power: <input type="radio"/> Yes <input checked="" type="radio"/> No  | Servo Dir: <input checked="" type="radio"/> Pos <input type="radio"/> Neg         |
| Return dock pos: <input checked="" type="radio"/> Yes <input type="radio"/> No | Encode Dir: <input checked="" type="radio"/> Pos <input type="radio"/> Neg        |
|  | Software Limit: <input checked="" type="radio"/> Open <input type="radio"/> Close |
|  | Limit Logic: <input checked="" type="radio"/> NO <input type="radio"/> NC         |

Export Params      Write      Cancel

### 3.12.1 Velocity parameter

The parameter description shown in below list:

| Parameter name      | Description   |
|---------------------|---|
| Moving speed        | The follower move down and lift up speed. Recommended to setup a value when motor maintain a rated rotating speed to guarantee the efficiency and stable operation. |
| Moving acceleration | Follower follow down and lift up acceleration.  |
| Jog low speed       | Setup Jog low speed   |
| Jog high speed      | Setup Jog high speed  |

### 3.12.2 Cutting technique

The parameter description shown in below list:

| Parameter name | Description |
|----------------|-------------|
|----------------|-------------|





|               |  |
|---------------|--|
| Dock position | When finish cutting, laser head will lift up and park at this position.  |
| Z range       | The travel range of the Z axis. If soft limit enabled, once Z axis exceed this range will stop immediately and send alarm "exceed Z range" |

### 3.12.3 Reset Parameter

The parameter description shown in below list:

| Parameter name       | Description   |
|----------------------|---|
| Org speed            | Speed of Z axis return to origin  |
| Org when power on    | If return org when power on. Set "Yes" after finish machine tuning and debug. |
| Return dock position | If Z axis park in dock position after return origin                           |

### 3.12.4 Alarm setting

The parameter description shown in below list:

| Parameter name         | Description   |
|------------------------|---|
| Follow deviation       | The maximum following tolerance allowable in BCS100. When laser head follows to target position, meanwhile plate vibration or other vibration caused deviation will generate the alarm.   |
| Follow deviation delay | The filter time of deviation alarm. Larger value allows longer duration of deviation and stronger ability of filtering the disturbance.   |
| Hit board delay        | When system stops, the laser head will lift up automatically and output alarm signal if duration of touching the panel reached the critical value. Set the value as 0, the Tip Touch alarm will not be triggered when system stops. |

### 3.12.5 Mechanic Parameter

The parameter description shown in below list:

| Parameter name     | Description  |
|--------------------|--|
| Lead screw         | The screw lead per revolution. Theoretically the larger lead is the faster speed Z axis can reach. Recommend to use 5~10mm screw ball lead |
| Max RMP            | The maximum speed of motor. Generally no more than 4500 rpm.   |
| Speed-voltage gain | The motor revolutions per voltage. This parameter must be same with the value in servo, recommended 500rpm/V.                              |



|                       |   |
|-----------------------|---|
| Pulses per revolution | Pulses feedback every revolution. This parameter must be same with the value in servo.  |
| Servo type            | Support Panasonic/Mitsubishi, Yaskawa/Delta, Teco JSDEP these three types servo. The zero-clamp signal logic, input and output logic as well as related parameters in controller are different with different types of servo. |
| Servo direction       | The motor rotate direction.   |
| Encoder direction     | Direction of feedback pulses.   |
| Soft limit            | When soft limit protection enabled, Z axis cannot Jog under negative coordinates or following height to prevent collision. Soft limit protection only works in the BCS100 main page.  |
| Limit logic           | Limit input port (Z+, Z-) logic, default normally open.   |

**Export parameter:** Backup and export the parameter setup data, user can restore the parameter setup by "open the existing config" option.

**Write in:** Write in current parameter to BCS100.

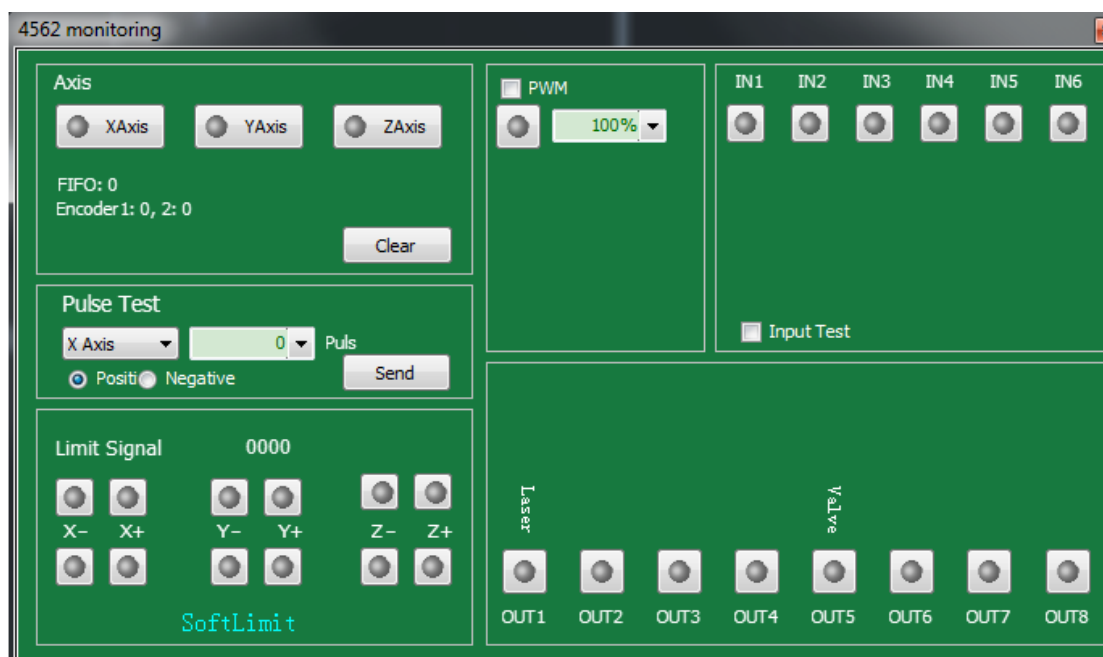


## 4.1 Input and output signal test

After finish the wiring of electric circuit, you can start machine debug and tuning:

(1) Connect terminal board and control card with C62-2 cable, and supply 24V power to terminal board. Check LED indicator of input port on IO terminal board: If limit switch is normally close, then X-/Y- LED is light. Manually trigger limit switch, if LED lights off, it means wiring is correct. If limit switch is normally open, the LED should be in off state. Manually trigger the limit switch if lights on, it means wiring is correct. Check the other input port in the same way to make sure all the wiring are correct and save time for machine debug.

(2) Start-up computer and CypOne software, enter in "BCL4562 monitor" page:



You can check all input and output status, manually change the output status. Light in grey means signal port is inactive, when signal active the light will turn green. When limit signal active the light will turn red.

When X, Y or Z axis servo enabled, the signal port turns in green, and turns blue means controller sending pulses to the servo. Press X, Y and Z button to manual enable or disable the servo. You can send command pulses in positive or negative direction to the servo and test if pulses equivalent setting right.

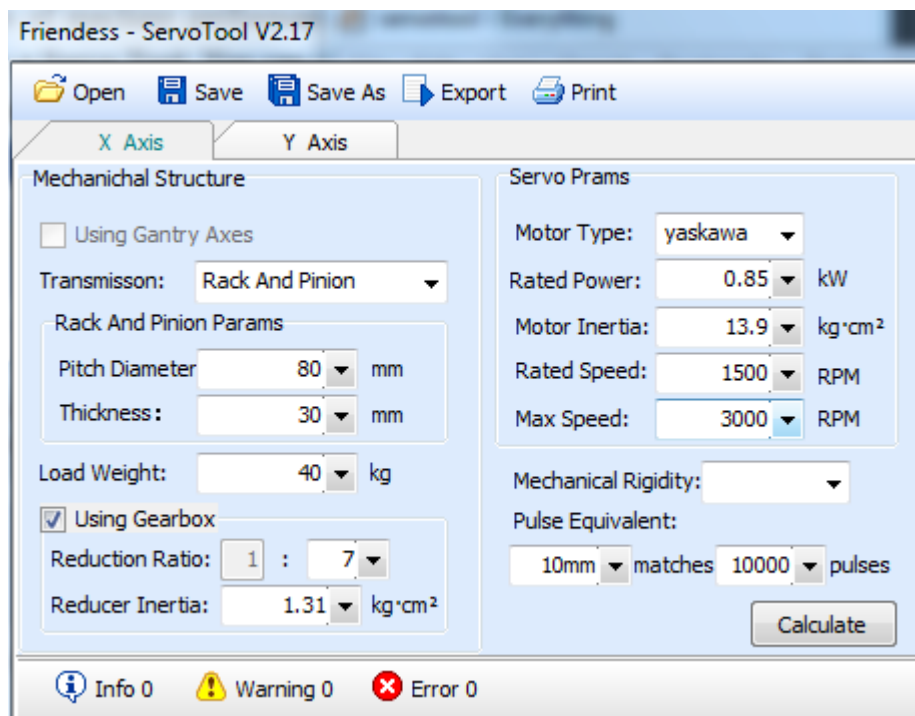
You can also check all the custom input and output name set in config tool.



(3) Close monitor page enter in CypOne main interface. At the right side in control panel manual jog Z axis up and down, press gas, laser and aiming beam, set laser power to text the machine function.

## 4.2 Calculate inertia ratio and machine performance features

The inertia ratio is a key indicators of machine performance features. You can calculate the inertia ratio of each axis by a Servo Tool. You can download Servo Tool on <http://downloads.fscut.com/>.As shown below:



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

The Inertia ratio is in 200% to 300% 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 ratio of Inertia is in 300% to 500% machine in heavy load cannot reach high speed cutting.

Inertia ratio is more than 500%. There are serious design defects. Servo tuning is hard to complete in a short time.

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



**Note:** Servo parameters calculated by servo only can be used in FSCUT4000.

## 4.3 Servo gain adjustment

### 4.3.1 Basic Requirements

This required 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.

### 4.3.2 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 as a conservative value. For example, start from level 13. Then Jog the axis in high speed by CypOne software. Watch if there are abnormal noise or vibration. Then slowly rise the rigidity level. When axis stated to have noise and vibration lower the rigidity 1~2 level to ensure axis motion stability. The final rigidity recommended within 10~20. For synchronous axis you need to change the parameters of both axis then test the motion function.

Step 3: when you finish measure the servo rigidity of X/Y axis, recommend set the same rigidity to both X/Y axis to make sure XY axis response speed is uniform. The final rigidity should be in accordance with the smaller level. For example, X axis servo rigidity is level 19, Y axis 16, final level should be 16.

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

### 4.3.3 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 roughly calculate the inertia ratio by Servo Tool download in our web [www.fscut.com](http://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.

| 刚性 | Pr1.00           | Pr1.01           | Pr1.02               | Pr1.04*2          |
|----|------------------|------------------|----------------------|-------------------|
|    | 位置环增益<br>[0.1/s] | 速度环增益<br>[0.1Hz] | 速度环积分时间常数<br>[0.1ms] | 转矩滤波器<br>[0.01ms] |
| 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                |

#### 4.3.4 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.

## 4.4 Motion control parameter adjustment

### 4.4.1 Motion Control Parameter

In FSCUT 1000S system you can set limit to speed, acceleration and low pass filter to control motion performance, and program will optimize the other motion related parameters automatically. The three parameter described as below:

| Item              | Description  |
|-------------------|--|
| Move speed        | Maximum running speed, recommended 60m/min for FSCUT1000 system.     |
| Move acceleration | Maximum running acceleration, recommended 0.5G for FSCUT1000 system. |
| Cut               | Maximum cutting acceleration directly determines the time of         |



|                         |  |
|-------------------------|--|
| <b>acceleration</b>     | ACC/DEC in corner motion, which adjusted by torque curve in servo tool.  |
| <b>Work frequency</b>   | Smaller value will improve the vibration suppression but extend the ACC/DEC time.  |
| <b>Curve precision</b>  | Larger value will smooth the curve and improve the speed but also reduce the precision. It does not represent actual accuracy. |
| <b>Corner precision</b> | Larger value will smooth the path and improve the speed but also reduce the precision. It does not represent actual accuracy.  |

#### 4.4.2 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.

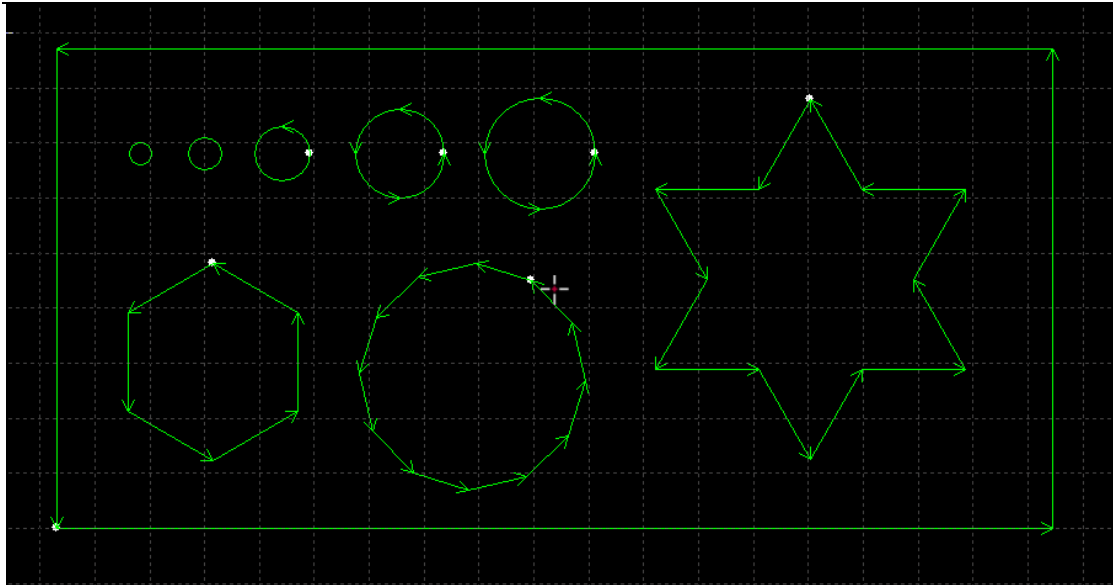
Monitor the torque curve in servo tool when jog the axis, increase the work acceleration if peak torque under 80% or reduce work acceleration if peak torque larger than 80%.

#### 4.4.3 Adjust running acceleration

You can set this value according the result calculated by the ServoTool. Or 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.

#### 4.4.4 Adjust work frequency

Adjust low-pass filter by cutting a sample. Set a small laser power marking on plate and observe the cutting path. The sample graphic could be small circle in different sizes, hexagon, dodecagon, star shape and rectangle. As shown in the following figure:



Increase the low pass filter as much as possible without affecting the cutting precision. The reference standard of test cutting is no waves around the corner in rectangular, star type cutting. You can setup as the experiential value in below table. Or you can setup the cutting acceleration then adjust the low pass filter frequency up and down within 2 levels. The cut acceleration and low pass filter frequency must match, does not setup a large value and the other too small.

#### 4.4.5 Curve precision and corner precision

Only under special circumstances to adjust the parameters in a small extent around the default value, otherwise not recommend to modify these two parameters.

If curve precision parameter set too large and cutting precision is not good, you can lower the curve precision which will limit the cutting speed at curves. If sharp corner precision is not good, lower the corner precision will limit the cutting speed at sharp corner. The value set too large the sharp corner will turns to a round corner.





## 5.1 System alarm and analysis

### 5.1.1 Z axis limit enabled

Limit sensor being triggered will send this alarm. Under this case check the items below:

- Check the wiring.
- Check if the "Limit logic" correctly set as "normally open" or "normally closed".
- Check if the limit sensor actually detected the object and sent valid level signal.
- Check if the sensor damaged or polluted by dust or oil.

### 5.1.2 Out of Z range

When Z axis oversteps the Z axis travel range will trigger this alarm. If it's false alarm, check if execute Z axis goes origin and built correct coordinates, if travel range parameter set correctly and encoder response proper.

### 5.1.3 Z- limit signal is valid

When controller executes Z go origin, axis trigger the sensor and not reverse back from sensing zone of limit switch, this alarm will be produced.

### 5.1.4 Z+ limit signal is valid

When controller executes Z go origin, axis trigger the sensor then roll back and exceed the limit+ range, this alarm will be produced. When this alarm turns out, check the "return distance" and "dock position" in BCS100 if set too large.

### 5.1.5 Servo alarm

Servo alarm is generated in software when alarm signal pin 14 detected active. The high/low level logic of alarm is unlike with different servo, "servo type" must be set correctly in BCS100. Below circumstances may cause "servo alarm" in BCS100:

- "Servo type" parameter in BCS100 not setting right.
- Wiring not right.
- Servo itself goes alarm.
- Interference (low probability for BCS100 has input filter).

### 5.1.6 Encoder abnormally moving

When BCS100 in static condition but detected encoder feedback different, this alarm will be produced. Possible reasons include:



- Axis shaking caused by external force.
- Signal pin terminal not fixed and zero speed clamp signal is invalid.
- Servo rigidity is too weak.
- There is interference to the encoder cable. Check if the cable well ground and add ceramic ring.

### 5.1.7 Encoder has no response

When controller sent analog signal to servo but no response returned from encoder, this alarm turns out. Possible reasons include:

- Signal wiring not right, analog signal not sent into the servo, or zero speed clamp signal keeps activating, or encoder feedback not returns to BCS height controller.
- Wrong servo type setting. Servo should have velocity control mode.
- Servo setting not switch to velocity mode.

### 5.1.8 Position deviation is too large

When target position is different with feedback position controller will generate this alarm. This alarm indicates that servo cannot follow up the controller's instruction of position loop. Possible reasons include:

- Encoder direction reverse. Controller not receive feedback from position loop, you need to modify related parameters.
- Wiring error and interference disturb the encoder feedback.
- Z axis is stuck or locked that increases torque instantly but not located in target position.

### 5.1.9 Capacitance is 0

Possible reasons include:

- Laser head touches the plate.
- Water cause short circuit in laser head.
- Local capacitance of laser head too large and exceed the sensing range.
- Amplifier damaged.
- Poor connection of amplifier/laser head.
- Short circuit between nozzle (positive) and laser head shell (negative).

### 5.1.10 Local capacitance decrease

Local capacitance decrease value exceed threshold will generate the alarm.

Possible reasons include:

- Laser parts connection changed or replaced, or material properties change will cause this alarm. Calibrate the capacitance will solve the problem.
- Scattered laser raise the nozzle temperature and cause temperature drift.
- Gassing pressure changes the gap between nozzle (positive) and laser shell (negative).
- Bad contact in nozzle and amplifier cable.
- Calibration range set too small in BCS100 (3D smaller than 10mm, 2D



smaller than 15mm), might cause the alarm.

- Bad contact in nozzle and amplifier cable.
- The plasma cloud impact. Plasma cloud often formed in cutting stainless steel especially with film. For stainless steel with film, it should defilm then cut, do not cut with film. Make sure the machine is well grounded. Following height shouldn't be smaller than 0.5mm, increase the following height could improve the issue; properly increase the gassing pressure.

#### 5.1.11 Capacitance abnormally became larger

When current capacitance is larger than the initial calibration value or setup threshold will generate the alarm. The possible reasons include:

- Laser head touches the plate.
- Water enters in laser head.
- Scattered laser raise the nozzle temperature and cause temperature drift.
- Gassing pressure changes the gap between nozzle (positive) and laser shell (negative).

#### 5.1.12 Following deviation is too large

When the controller is in following mode, if there is instant distance deviation detected will generate the alarm. Possible reasons include:

- Laser head moving out of the plate.
- Sharpe shaking of plate.

#### 5.1.13 Use period has expired

Registered available time of system has expired.

#### 5.1.14 Move close to board

When laser head is too close to the plate system will send this alarm to prevent the collision.

#### 5.1.15 Network Alarm

| Alarm                             | Description   |
|-----------------------------------|---|
| Data frame length error           | Data frame length error in network transmission                 |
| Data frame direction error        | Data frame direction error                                      |
| Single instruction length error   | Single instruction length error                                 |
| Single instruction category error | Instructions not in the system instruction category.            |
| Data buffer full                  | Instructions sent too frequently, buffer filled.                |
| Parameter read/write error        | CypOne read and write parameter error in network communication. |



|                   |    |                                   |
|-------------------|----|-----------------------------------|
| Instruction error | ID | CypOne send wrong instruction ID. |
|-------------------|----|-----------------------------------|

## 5.2 Analysis of common problems

### 5.2.1 There is obvious shaking and mechanical impact when Z axis in following movement.

- Bad contact between amplifier shell/controller FG pin with machine frame.  
Machine frame is the negative pole of capacitance, the impedance is very strong when amplifier shell is in bad contact with machine frame. This will cause measurement error. You can add copper wire between amplifier shell with machine shell to reduce the impedance. Specific indicators to achieve DC impedance less than 10 ohms.
- Servo rigidity level set too large  
Servo rigid level set too large will cause axis shaking and mechanical shock. Panasonic MINAS A5 series servo, for example, it is recommended that rigid settings should not exceed level 19.
- Follow speed level set too large  
If follow speed level set too large will cause axis shaking in motion, recommended level is from 3~7.
- Capacitance calibration not good  
When BCL4562 collected capacitance-position curve not smooth, vibration comes in following movement. Re-calibrate the capacitance until the sampling result turns in excellent or good level.
- You can lower the "follow gain level" when there is strong interference.

### 5.2.2 Collision in following mode

- Calibration range setting is too small or Z axis speed too large.  
If calibration range set too small and Z axis speed too large, slowing down distance is too short for Z axis to stop after follow to target position. Z axis speed larger than 100mm/s, calibration range should within 15mm. Z axis speed larger than 250mm/s, calibration range should within 20~25mm.
- Servo rigid level too small  
Servo rigidity level set too small will cause servo response speed lag than controller command cause collision. If Panasonic MINAS A5 series servo,
- Capacitance calibration problem  
When capacitance record in BCL4562 is significantly different with the current capacitance might cause laser head collision with plate in following movement. This happens when nozzle temperature rise or loosen contact. Under this scenario locate and solve the problem sources then re-calibrate the capacitance.



- No preheating  
Please preheat 2-5 minutes and wait for the sampling capacitance stable before further operations.
- Ceramic nut not tightened  
Ceramic nut not tightened may lead to unstable capacitance.

### 5.2.3 Following distance different with the actual setting

- No preheating  
Preheat the amplifier for 2~5 minutes before operate BCL4562 controller. The capacitance will change by the temperature, you need to preheat the amplifier for 2~5 minutes till the capacitance becomes stable.
- Calibration problem  
Above errors occur usually when you change the nozzle and not doing capacitance calibration.
- Laser scattering on nozzle or gassing not working right will lead to abnormal temperature rise(above 100°C) and affect the capacitance.
- The nozzle does not touch the plate in calibrating, following distance is larger than actual setting.

### 5.2.4 Lifting height not right

The lifting height is lowering in cutting process. Check if there is machinery slippery or improper mechanical connection.

### 5.2.5 Upgrade prompt "Check error, ARM upgrade failed"

Upgrade file might be damaged or infected by virus.



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