Manufacturer's Manual of Ncstudio V15 Laser Cutting (LS1500, LS3000, LS8000M) Control System

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Contents

1 Quick Start

1.1 Overview

This section introduces the hardware and software of the **NcStudio V15 laser cutting control system**.

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    - Non-bus control systems: Lambda 5E controller
    - Bus control systems: Lambda NE controller
  - EX33A extension terminal board (for follow control)
  - EX31A extension terminal board (for extension of terminal board ports)
  - SE001 follow-up amplifier
  - DB9M/F communication cables * 2
  - RF cable * 1
  - M16 three-core aviation plug towline cable * 1
  - WHB05L wireless handwheel / WHB05N wireless handwheel

  For hardware connection diagram, see Hardware Connection Diagram.
- Software

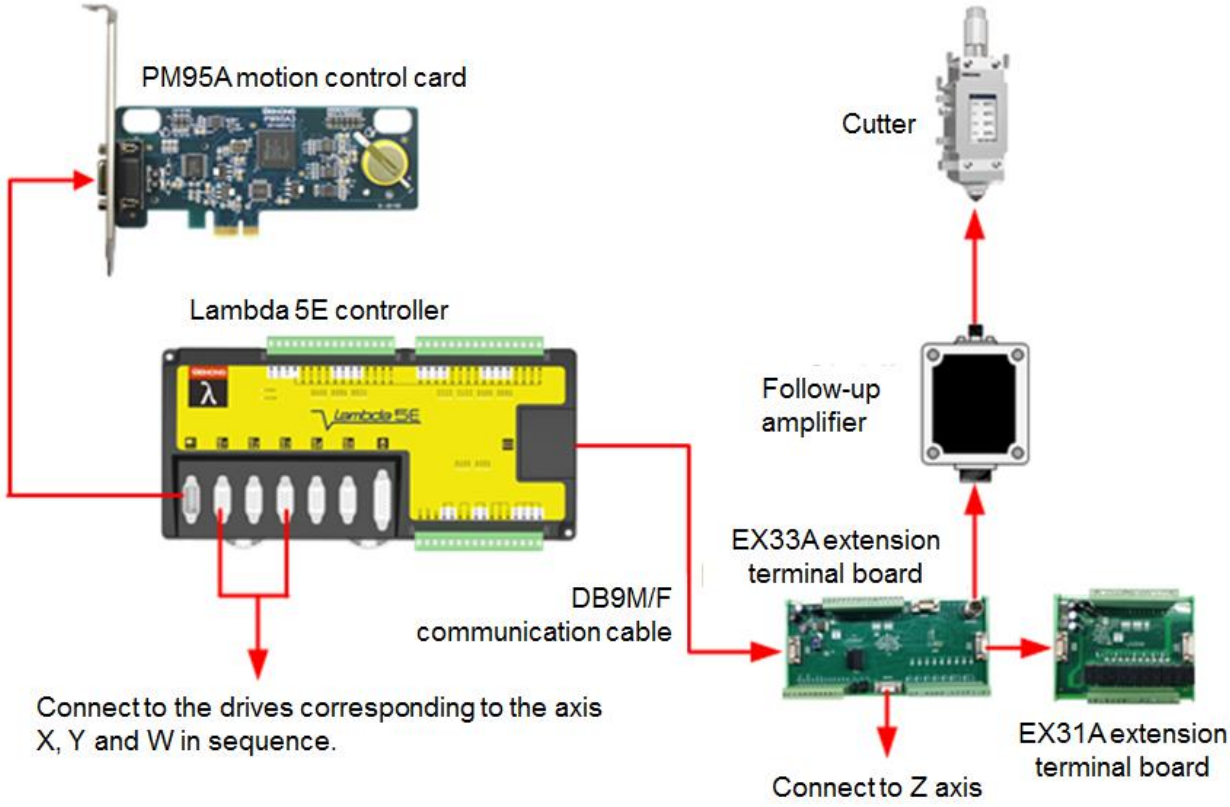
  For introduction of the software interface of the **NcStudio V15 laser cutting control system**, see introduction of the software interface.

1.2 Hardware Connection Diagram

The connection method varies based on the control system type.

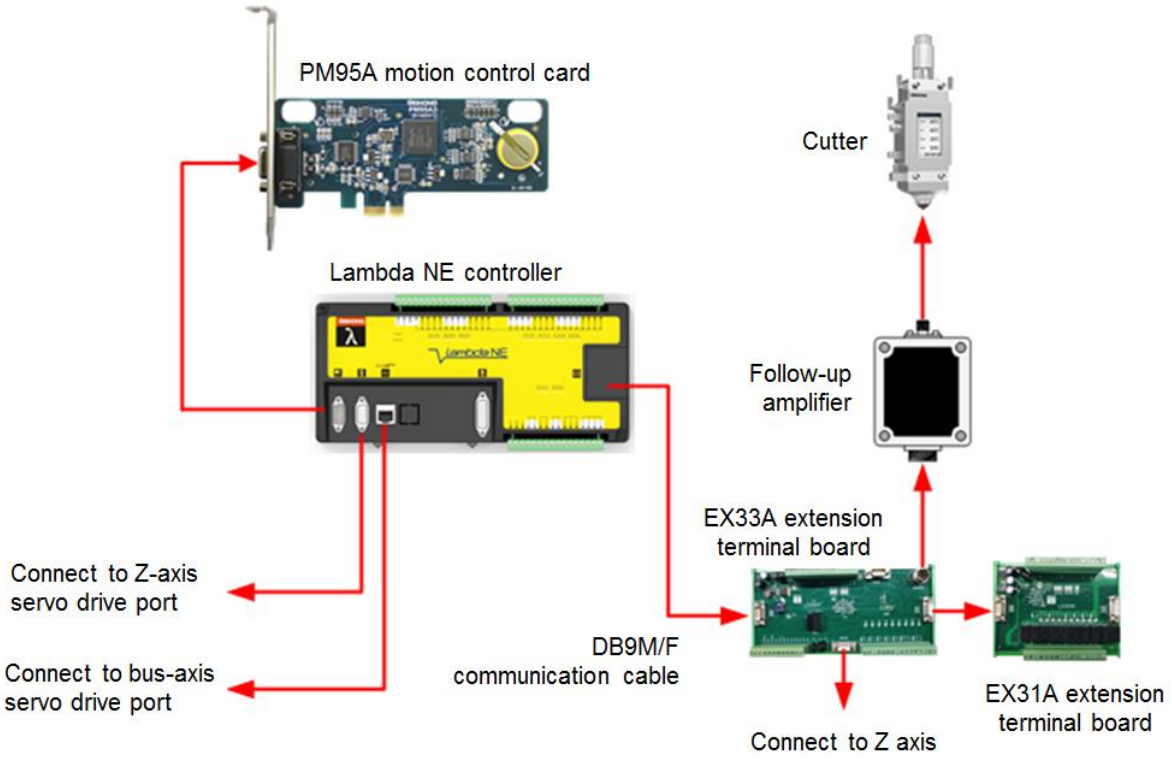
Non-bus control systems

The connection diagram is shown below:



Bus control systems

The connection diagram is shown below:



1.3 Shortcut Keys

The shortcut keys are as follows:

Shortcut Key	Function	Shortcut Key	Function
F1	Show shortcut keys	Ctrl + C	Copy
F2	E-stop	Ctrl+ V	Paste
F5	Set workpiece origin	Delete	Delete
F8	Simulate	Ctrl + Z	Undo
F12	Clear track	Ctrl + Y	Redo
Alt + 0	Ports setting	Ctrl + G	Gallery
Num+	Zoom in	Ctrl + T	Shape check
Num-	Zoom out	Ctrl + 1	Instant setting
Num*	Fit to window	Ctrl + 2	Layer setting
Ctrl + N	New	Ctrl + J	Combine
Ctrl + O	Open	Ctrl + W	Set lead-in/out line
Ctrl + S	Save	Ctrl + Q	Start cut point
Ctrl + I	Import	Ctrl + P	System parameters
Ctrl + A	Select all	Ctrl + D	Set machining direction
Ctrl + Shift + A	Select invert	Ctrl + E	Auto set machining order
Shift + A	Clear selected	Ctrl + R	Set kerf compensation
Ctrl + X	Cut	End	Middle current point

2 Install the System

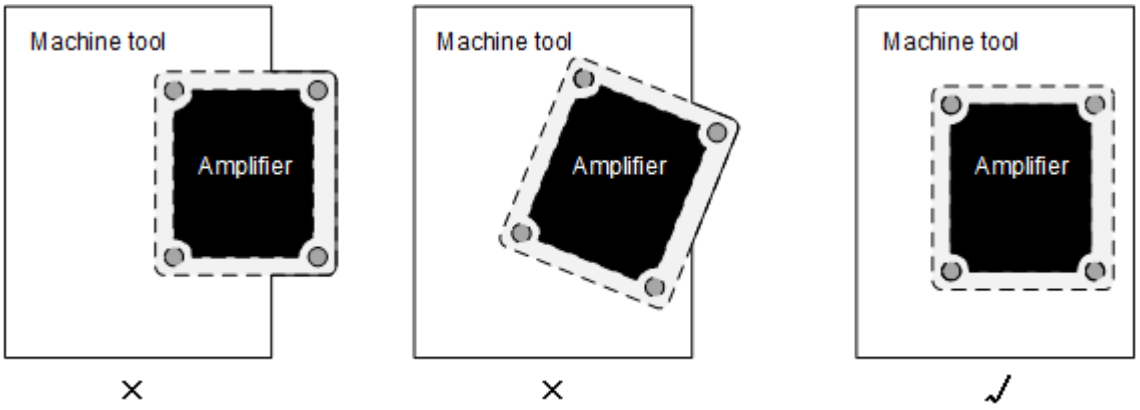
2.1 Overview

This section gives an overview of system installation.

2.2 Install Follow-up Amplifier

During installation of the follow-up amplifier, the external metal part of the amplifier contact side needs to be installed correctly on the machine to shield signal interference effectively.

Install the follow-up amplifier as shown below:



2.3 Install Motion Control Card

PM95A motion control card is used together with the **NcStudio** motion control software for a fast and accurate control of laser cutting movement.

Before installing the motion control card, ensure that:

- CPU: ＞ 1G
- RAM: ＞ 1G
- Hard drive: ＞ 20G
- Video card
- Display: ≥ 14VGA
- Motherboard extension slot: PCI-E slot ≥ 1

The PM95A motion control card needs to be installed on the computer.

Follow the steps below to install the PM95A control card:

1. Turn off the computer power supply and open the mainframe cover.
2. Gently press the two sides of the control card to secure it in the PCI-E slot.
3. Fix the control card screws and close the mainframe cover.
4. Restart the computer.

If the control card is installed, and Install the Drive is successful, but the **NcStudio** software cannot run normally, turn off the computer and check to see if the gold fingers are clean:

- Yes: Clean them with an eraser.
- No: Replace the control card.

2.4 Install the Software

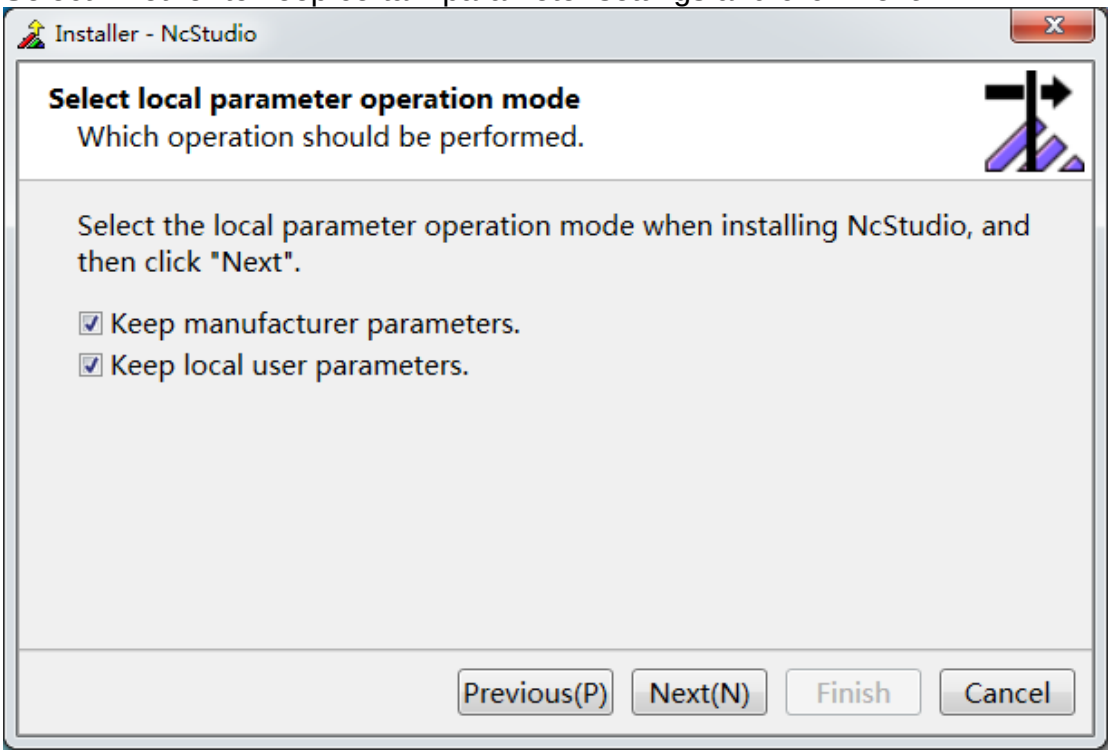
This section introduces how to install the software of the **NcStudio V15 laser cutting control system**.

Before installing the software, ensure that:

- The computer has a disk D.
- If it is the first time that you install the software on the computer, ensure that the basic environment package **PhoenixEnvironmentsBeta1.msi** is already installed.

Copy the software installation package to the computer and follow the steps below to install the software:

1. Decompress the installation package and double-click . An installation wizard window will be displayed.
2. Select the installation language and click **OK** > **Next**.
3. Select the target configuration: bus or non-bus configuration. Click **Next**.
4. Select whether to keep certain parameter settings and click **Next**.



5. Finish the installation.

The installation program will prompt you to Install the Drive.

To uninstall the software, follow the steps below:

1. Delete the **NcStudio** folder under **C:\Program Files\Weihong**.
2. Delete the **NcStudio** shortcut on the desktop.

2.5 Install the Drive

The corresponding drive matching the software and hardware needs to be installed to install the **NcStudio V15 laser cutting control system**.

The system will perform Automatic Installation during software installation process. If the automation fails, you need to Manual Installation.

2.5.1 Automatic Installation

Taking a Win7 system as an example, after the software is installed, the system will display a Windows security dialog box, asking whether you would like to install the device software. Continue installation.

After the drive is installed, the system will prompt you for a restart, which means the drive has been installed successfully.

2.5.2 Manual Installation

After installation of the motion control card and software, if the software cannot open, the automatic installation of the drive may have failed. After ruling out the possibilities such as poor contact of the control card, install the drive manually.

Taking a Win7 system as an example, follow the steps below to manually install the drive:

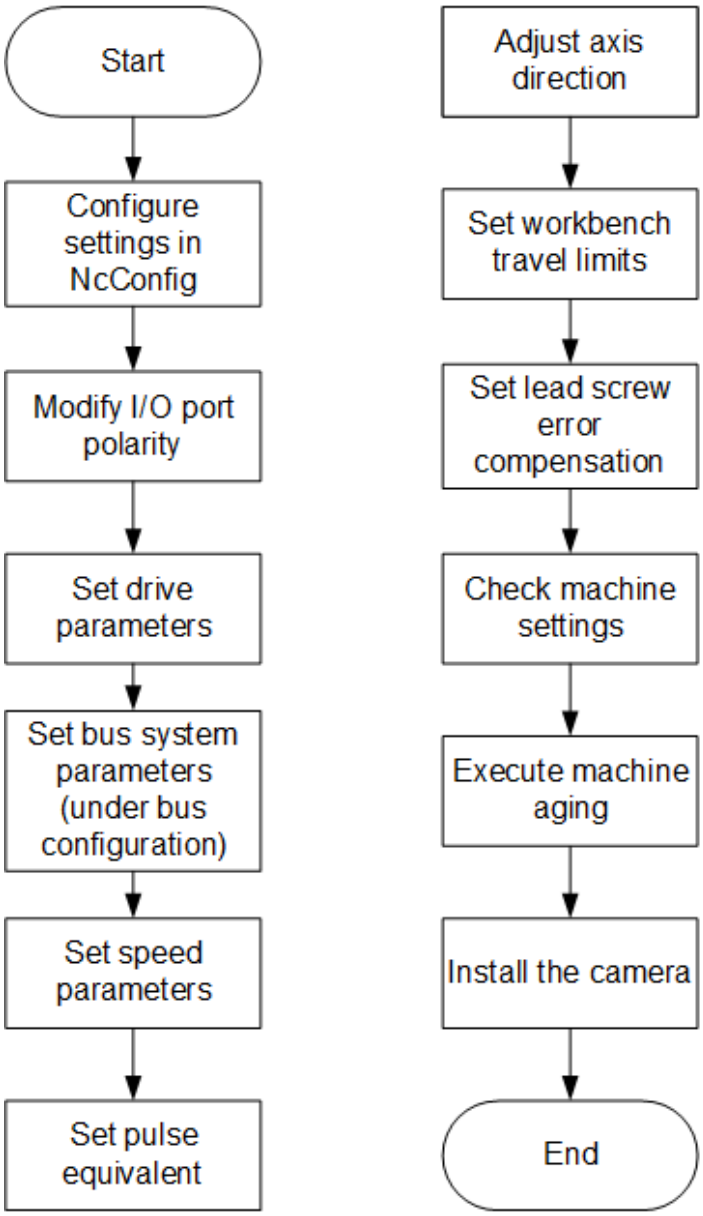
1. Right-click on **Computer**, click **Manage**:
    - First-time manual drive update: In the left list, click **Device Manager**. Go to **Action** > **Scan for hardware changes** in the menu bar or click the **Scan for hardware changes** icon under the menu bar. In the right list under **Other devices**, click the network and computer encryption and decryption controller option.
    - Non-first manual drive update: In the left list, click **Device Manager**. In the right list under motion controller, click the WEIHONG motion controller (PM series) option.
2. Follow the steps below to find the INF configuration file:
    a. In the displayed dialog box, browse the computer to find the drive program.
    b. Click the option of selecting from the computer device program list.
    c. Click **Install From Disk**. The **Install From Disk** dialog box is displayed.
    d. Click **Browse**.
    e. In the file searching dialog box, find the file and click **Open**.
    The file storage path is **C:\Program Files\Weihong\NcStudio\Bin\DriverCH365**.
3. In the displayed Windows security dialog box, click **Install**.

After installing the drive manually, restart the system as prompted.

3 System Debugging

3.1 Overview

This section gives an overview of the debugging process for the **NcStudio V15 laser cutting control system**:



3.2 Configure Settings in NcConfig

The offline configuration tool NcConfig can be used to backup/restore data, configure devices, and map/protect the ports to improve project development efficiency.

Follow the steps below the configure settings in NcConfig:

1. Open the Ncstudio installation path **C:\Program Files\Weihong\NcStudio\NcConfig\Bin**. Find and double-click **NcConfig.exe**.
2. Use the following functions based on your needs:
   - Data Backup
   - Data Restoration
   - Device and Port Mapping Configuration

- Port Protection

3.2.1 Data Backup

Follow the steps below to use NcConfig to back data:

1. In the menu bar, go to **Systems** > **Backup and Restore**.
2. In the **Backup and Restore Data** window, select **Backup Data**. Click **Next**.
3. Edit the backup file name and storage path as needed.
4. Click **Finish**.

3.2.2 Data Restoration

If data is lost due to incorrect operation, you can use NcConfig to restore data. If system environment data is lost due to system damage, you can use the installation package and the data restoration function to recover the system.

Before restoring the data, ensure that the data was backed up as described in Data Backup.

Follow the steps below to restore data in **NcConfig**:

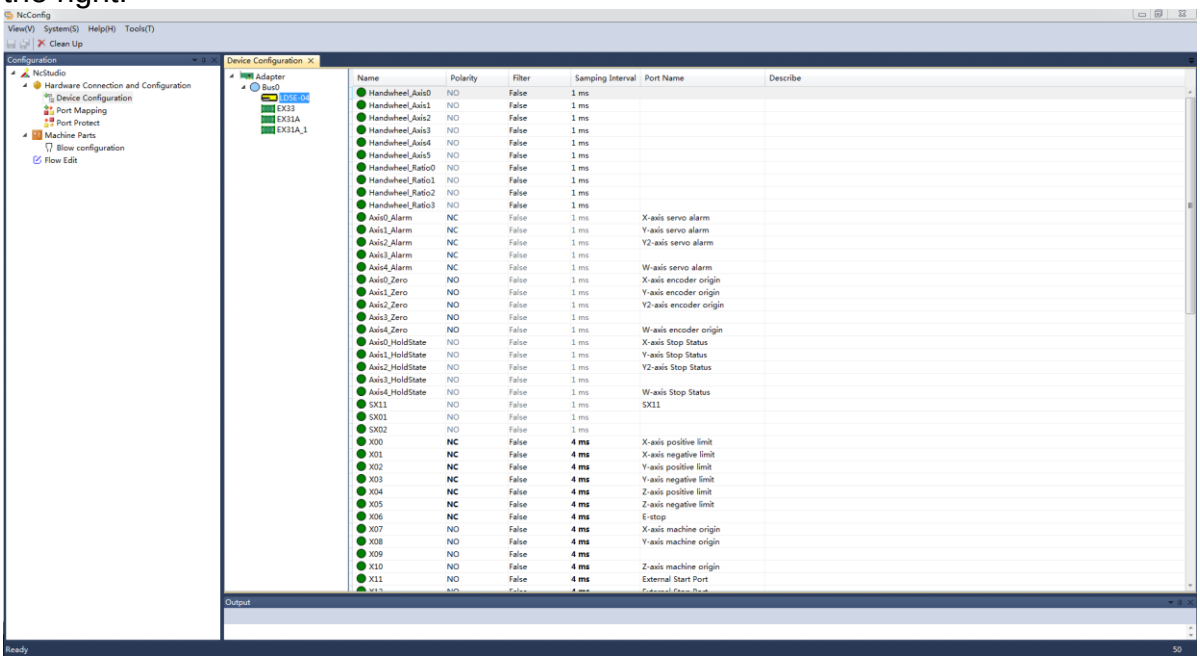
1. In the menu bar, go to **Systems** > **Backup and Restore**.
2. In the **Backup and Restore Data** window, select **Data Restore**. Click **Next**.
3. Click **Browse** to select the backup file and the target data collection you want to import.
4. Click **Finish**.

3.2.3 Device and Port Mapping Configuration

You can configure devices and modify port physical addresses to match their logical addresses.

Follow the steps below to configure devices:

1. In the left **Configuration** column, go to **NcStudio** > **Hardware Connection and Configuration** > **Device Configuration**.
2. Double-click **Device Configuration** to open the **Device Configuration** window to the right:



3. Configure the devices based on your demands:

- To add a controller/terminal board, right-click on **Bus0** and select **Add controller** and select the target controller/terminal board.
- To replace a controller/terminal board, right-click on the controller/terminal board to be replaced and click **Replace**. Select the target controller/terminal board in the displayed list.
- To delete a controller/terminal board, right-click on the controller/terminal board to be deleted and click **Delete**.
- To move a controller/terminal board, click the controller/terminal board to be moved and click **Up/Down**.

4. Save the change by clicking  or  .

Follow the steps below to configure port mapping:

1. In the left column, click the **Configuration** tab. Go to **NcStudio** > **Hardware Connection and Configuration** > **Port Mapping**.
2. Double-click **Port Mapping** to open the **Port Mapping** window to the right.
3. In the port list:
   - To show only a certain type of ports, click the category on the left, such as **Lubricate**.
   - To modify the physical address of a logical address, double-click the corresponding physical address box and select the target controller and port.
   - To show/hide the logical addresses, right-click on the **Enter**/**Output** list and select **Display logical address/Hide logical address**.
   - To delete a port mapping, right-click on the **Enter**/**Output** list and select **Delete port mapping**.
   - To delete invalid port mapping, right-click on the **Enter**/**Output** list and select **Delete invalid port mapping**.

3.2.4 Port Protection

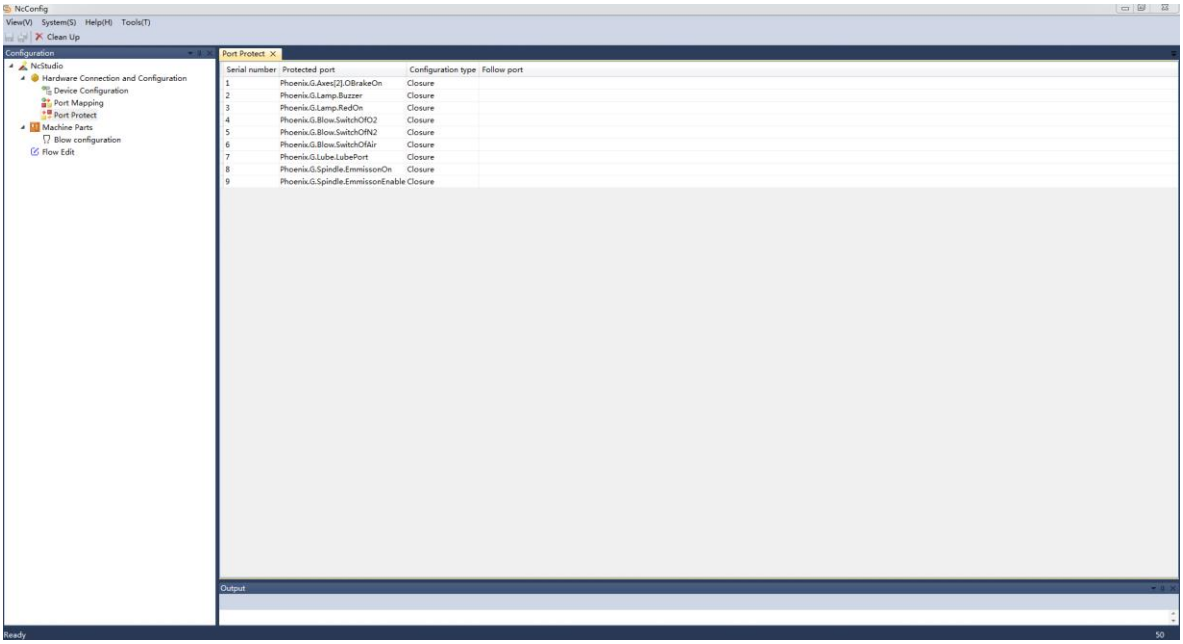
When the software is closed, the protected ports will be automatically closed, opened, following the status of the specified port, or reversed based on their port protection type.

There are several types of port protection:

- **Open**: The port will be automatically opened when the software is closed.
- **Closure**: The port will be automatically closed when the software is closed.
- **Follow**: The protected port status will be turned the same with that of the port specified in the **Follow port** column.
- **Reverse**: The protected port status will be turned the opposite to that of the port specified in the **Follow port** column.

Follow the steps below to set port protection:

1. In the left **Configuration** list, double-click **Port Protect** to open the **Port Protect** window to the right:



2. Select and click the **Configuration type** field of the target port and select a protection type in the pull-down menu.
3. Select one from the following methods to save the changes:
    - To save changes on the current page, click  under the menu bar.
    - To save changes on all open pages, click  under the menu bar.

The * symbol on an open window tab indicates that the changes on the page have not been saved. The * symbol disappears after changes on the page are saved.

3.3 Modify I/O Port Polarity

During debugging, you can modify the I/O port polarity based on your needs or to check to see if the port input and output are normal.

Set the polarity of normally closed switches to **NC**. Set the polarity of normally open switches to **NO**.

Follow the steps below to modify the I/O port polarity:

1. In the menu bar, click **System** > **Port Setting**.
2. In the **Port Setting** window, click the target port and click **Convert** to reverse its current polarity.  indicates no signal while  indicates signals are detected.
3. The following functions are also supported:
    - To test port signal output: Click **Test On/Test Off**. When the port symbol becomes  or  , the port is under test.
    - To cancel testing of the selected port: Click **Cancel Test**.
    - To cancel testing of all ports: Click **Cancel All**.
    - To set sampling interval, click **Filter** and drag the **Interval** slider. The system will rule out signals whose duration is smaller than the interval.

3.4 Set Drive Parameters

Basic drive parameters need to be set before the drive can start driving machining movement.

Different control systems require different settings.

- Set Drive Parameters in Non-bus Control Systems

- Set Drive Parameters in Bus Control Systems

3.4.1 Set Drive Parameters in Non-bus Control Systems

Different servo drive parameters need to be set in different follow control modes:

- Set Drive Parameters in Position Loop Control Mode
- Set Drive Parameters in Velocity Loop Control Mode

If you are using a non-WEIHONG drive (WISE):

- Ensure that the servo drive SON signal is active low (ON when connected to GND of a 24V power supply).
- If the servo drive is active low when it works normally, set the polarity of the drive alarm input port to **NC**. If the servo drive is active low when it reports an alarm, set the polarity of the drive alarm input port to **NO**.
- Set the drive **pulse signal type** parameter to **pulse + direction**.
- Ensure that the servo drive does not have an external emergency stop signal input port. If it does, check the signal logic.
  Ensure that the terminal board is connected to a 24V power supply before drive trial run.

3.4.1.1 Set Drive Parameters in Position Loop Control Mode

Test parameter settings in position loop control mode as shown below:

- WISE
- Yaskawa Σ-Ⅱ
- Yaskawa Σ-Ⅱ Σ-Ⅴ / Σ-7
- Panasonic MINAS A4
- Panasonic MINAS A5
- Fuji FALDIC-β
- Fuji ALPHA 5
- Delta ASDA-A
- Delta ASDA-A2
- Delta ASDA-B
- Delta ASDA-B2

3.4.1.1.1 WISE

The parameters and descriptions are shown below:

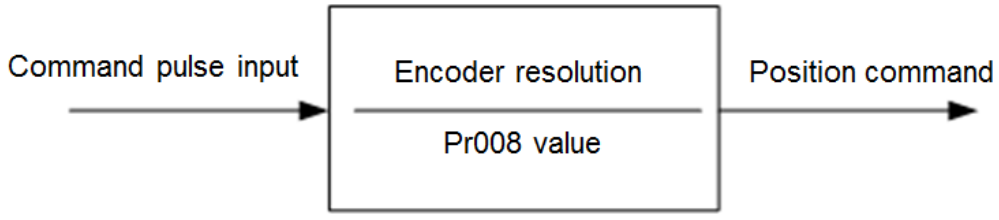
- **Pr001 Control mode selection**
  - Description: Control mode setting
  - Unit: -
  - Range
    - 1: Position control mode
    - 2: Velocity control mode
  - Value: 1
- **Pr528 LED initial state**
  - Description: Pulse detection is used in WEIHONG control systems to check to see if correct pulses are sent and determine if there is electric interference.
  - Unit: -
  - Range: -
  - Value: 6 Command pulse sum
- **Pr008 Number of command pulses per motor turn**
  - Description: The number of command pulses for the motor to rotate by one turn

- Unit: -
- Range
  - 0: **Pr009** and **Pr010** are effective
  - Not 0: **Pr008 = Screw pitch/(pulse equivalent * mechanical reduction ratio)**
- Value: 0

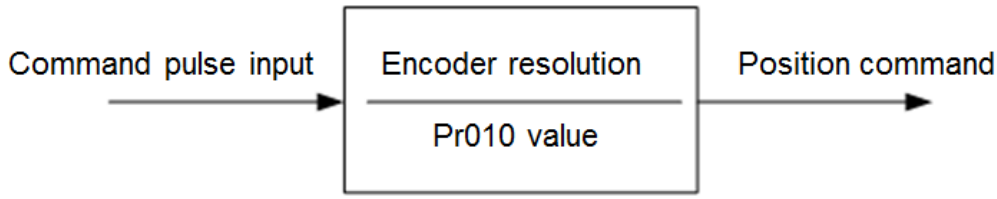
- **Pr009 1st command division and multiplication (numerator), Pr010 Command division and multiplication (denominator)**
  - Description: Pay attention to the ratio between Pr009 and Pr010.
  - Unit: -
  - Range: $0–2^{30}$
  - Value: If screw pitch = 5 mm, encoder resolution = 10000, directly connected to the coupler, pulse equivalent = 0.001 mm: Pr009 = 10000, Pr010＝screw pitch / pulse equivalent＝5000, which means Pr009/Pr010 = 10000/5000=2/1.
- **Pr011 Number of pulses output by one motor turn**
  - Description: Number of pulses output by one motor turn
  - Unit: -
  - Range: -
  - value: If pulse equivalent = 0.001, there is no speed reducer, screw pitch = 10 mm: Pr011=2500; if screw pitch = 5 mm: Pr011 = 1250
- **Pr100 1st position loop gain**
  - Description: 1st position loop gain
  - Unit: 0.1/s
  - Range: -
  - Value: 480 (default) or subject to actual situation.
- **Pr101 1st velocity loop gain**
  - Description: 1st velocity loop gain
  - Unit: 0.1 Hz
  - Range: -
  - Value: 270 (default) or subject to actual situation.
- **Pr102 1st velocity loop integral time constant**
  - Description:1st velocity loop integral time constant
  - Unit: 0.1 ms
  - Range: -
  - Value: 210 (default) or subject to actual situation.

Relationship between Pr008, Pr009, and Pr010

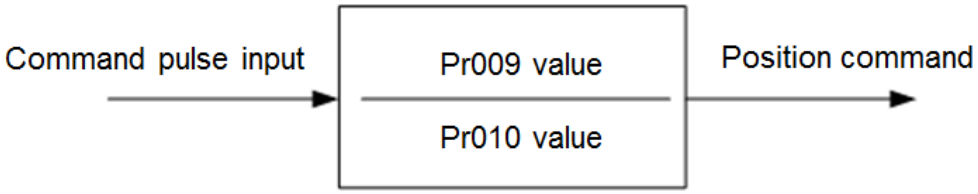
- Pr009 and Pr010 values are not valid. System processing is based on the Pr008 value.



- If Pr008 and Pr009 are 0, system processing is based on the Pr010 value.



- If Pr008 is 0, and Pr009 and Pr010 values are not valid:



3.4.1.1.2 Yaskawa Σ-Ⅱ

The parameters and descriptions are shown below:

- **Fn010 Password setting (preventing random parameter modification)**
  - Description: Password setting (preventing random parameter modification)
  - Unit: -
  - Range
    - If Fn010 is set to 0000, modification of user parameters (PnXXX) and some auxiliary function parameters (FnXXX) is allowed.
    - If Fn010 is set to 0001, modification of user parameters (PnXXX) and some auxiliary function parameters (FnXXX) is not allowed.
  - Value: 0000
- **Un00C Input command pulse counter**
  - Description: Pulse detection is used in WEIHONG control systems to check to see if correct pulses are sent and determine if there is electric interference.
  - Unit: -
  - Range: -
  - Value: In hexadecimal, low-order (L) 4 digits
- **Pn000 Rotation direction and control mode selection**
  - Direction: Rotation direction and control mode selection
  - Unit: -
  - Range
    - 0: The motor rotates CW (anti-clockwise when observing from the load/lead screw side).
    - 1: The motor rotates CCW. The control mode is position control. Always calculates pulse commands.
  - Value: 0010
- **Pn200 Pulse command format selection**
  - Description: Pulse command format selection
  - Unit: -
  - Range
    - Digit 0: If digit 0 is set to 5, the command is pulse + direction, negative logic.
    - Digit 3: If digit 3 is set to 0, the differential signal goes into the filter.
  - Value: 0005

- **Pn50A Function selection**
  - Description: Function selection
  - Unit: -
  - Range
    - Digit 1: If digit 1 is set to 0, the /S-ON signal is enabled and its input pin is No.40. If digit 1 is set to 7, the /S-ON signal is always ON.
    - Digit 3: If digit 3 is set to 8, the CW input inhibition signal P-OT will not be used.
  - Value: 8100
- **Pn50B Function selection**
  - Description: Function selection
  - Unit: -
  - Range: Digit 0: If digit 0 is set to 8, the CCW input inhibition signal N-OT will not be used.
  - Value: 6548
- **Pn50F Function selection**
  - Description: Applicable when the servo motor has a brake.
  - Unit: -
  - Range: Digit 2: If digit 2 is set to 3, CN1-29 and 30 output brake interlocking signal/BK to control the 24V relay for brake.
  - Value: 0300
- **Pn50E Function selection**
  - Description: Applicable when the servo motor has a brake.
  - Unit: -
  - Range: None of the four digits can be set to 3 in case that CN1-29 and CN1-30 are used for other functions, causing braking failure.
  - Value: 0211
- **Pn506 Brake delay when servo motor is off**
  - Description: Applicable when the servo motor has a brake.
  - Unit: 10 ms
  - Range: -
  - Value: Subject to actual situation.
- **Pn202 Electronic gear ratio numerator, Pn203 Electronic gear ratio denominator**
  - Description: Relation between Pn202 and Pn203
  - Unit: 10 ms
  - Equation:
    - **Pn202 = Pulse number per encoder turn × 4 × Mechanical deceleration rate**
    - **Pn203 = Screw pitch/ Pulse equivalent**
  - Range: -
  - Value
    - When screw pitch = 5 mm, the encoder is 17 digits, axis coupling joint is used, pulse equivalent = 0.001 mm: Pn202＝16384 and Pn203＝625
    - When screw pitch = 5 mm, the encoder is 17 digits, axis coupling joint is used, pulse equivalent = 0.0005 mm: Pn202＝8192 and Pn203＝625

3.4.1.1.3 Yaskawa Σ-Ⅴ/Σ-7

The parameters and descriptions are shown below:

- **Fn010 Parameter input inhibition setting**
  - Description: Parameter input inhibition setting
  - Unit: -
  - Range
    - If Fn010 is set to 0000, modification of user parameters (PnXXX) and some auxiliary function parameters (FnXXX) is allowed.
    - If Fn010 is set to 0001, modification of user parameters (PnXXX) and some auxiliary function parameters (FnXXX) is not allowed.
  - Value: 0000
- **Pn000 Function selection basic switch 0**
  - Description: Function selection basic switch 0
  - Unit: -
  - Range
    - Digit 0: If digit 0 is set to 0, the motor rotates CW after receiving CW commands.
    - Digit 1: If digit 1 is set to 1, the control mode is position control (pulse sequence commands).
  - Value: 0010
- **Pn200 Position control command format selection switch**
  - Description: Position control command format selection switch
  - Unit: -
  - Range: If digit 0 is set to 5, the command format is pulse + direction, negative logic.
  - Value: 0005
- **Pn50A Input signal selection 1**
  - Description: Input signal selection 1
  - Unit: -
  - Range
    - Digit 1: If digit 1 is set to 0, /S-ON signal is enabled and its input pin is No.40. If digit 1 is set to 7, the servo drive is always ON.
    - Digit 3: If digit 3 is set to 8, the CW input inhibition signal P-OT will not be used.
  - Value: 8100
- **Pn50B Input signal selection 2**
  - Description: Input signal selection 2
  - Unit: -
  - Range: If digit 0 is set to 8, the CCW input inhibition signal N-OT will not be used.
  - Value: 6548
- **Pn50F Output signal selection 2**
  - Description: Applicable when the servo motor has a brake.
  - Unit: -
  - Range: If digit 2 is set to 3, CN1-29 and 30 output brake interlocking signal/BK to control the 24V relay for brake.
  - Value: 0300
- **Pn50E Output signal selection 1**
  - Description: Applicable when the servo motor has a brake.

- Unit: -
- Range: None of the four digits can be set to 3 in case that CN1-29 and CN1-30 are used for other functions, causing braking failure.
- Value: 0211

- **Pn506 Brake command: Servo OFF delay**
  - Description: Applicable when the servo motor has a brake.
  - Unit: ms
  - Range: -
  - Value: Subject to actual situation.
- **Pn20E Electronic gear ratio numerator, Pn210 Electronic gear ratio denominator**
  - Description: Relation between Pn20E and Pn210
  - Unit: -
  - Equation: **Pn20E/Pn210 = (Encoder resolution × pulse equivalent × mechanical reduction ratio)/screw pitch**
  - Range: -
  - Value: Manual calculation
- **Pn212 Encoder allocated pulse number**
  - Description: Encoder allocated pulse number
  - Unit: -
  - Range:2^4–2^{30}
  - Value: When pulse equivalent = 0.001, there is no reducer, and screw pitch = 10 mm, Pn212 = 2500; when screw pitch = 5 mm, Pn212 = 1250

3.4.1.1.4 Panasonic MINAS A4

The parameters and descriptions are shown below:

- **Pr01 LED initial state**
  - Description: Pulse detection is used in WEIHONG control systems to check to see if correct pulses are sent and determine if there is electric interference.
  - Unit: -
  - Range: -
  - Value: 15
- **Pr02 Control mode selection**
  - Description: Control mode selection
  - Unit: -
  - Range
    - 0: Position control
    - 1: Velocity control
    - 2: Torque control
  - Value: 0
- **Pr40 Command pulse input selection**
  - Description: Command pulse input selection
  - Unit: -
  - Range: 1: input via dedicated differential circuit.
  - Value: 1
- **Pr42 Command pulse input format selection**
  - Description: Command pulse input format selection
  - Unit: -
  - Range: 3: The command pulse input format is pulse + direction, negative logic

- Value: 3

- **Pr44 Feedback pulse division and multiplication numerator**
  - Description: Feedback pulse division and multiplication numerator
  - Unit: -
  - Range: 1–32767
  - Typical value: When pulse equivalent = 0.001, there is no reducer, and screw pitch = 10 mm, Pr44 = 2500; when screw pitch = 5 mm, Pr44 = 1250
- **Pr48 Command pulse division and multiplication 1st numerator, Pr4B Command pulse division and multiplication denominator**
  - Description: Relation between Pr48 and Pr4B
  - Unit: -
  - Range: 1–10000
  - Value: When screw pitch = 5 mm, the encoder resolution is 10000, axis coupling joint is used, and pulse equivalent = 0.001 mm: Pr48= 10000, Pr4B ＝ screw pitch/pulse equivalent = 5/0.001=5000. Pr48/Pr4B=10000/5000=2/1.

3.4.1.1.5 Panasonic MINAS A5

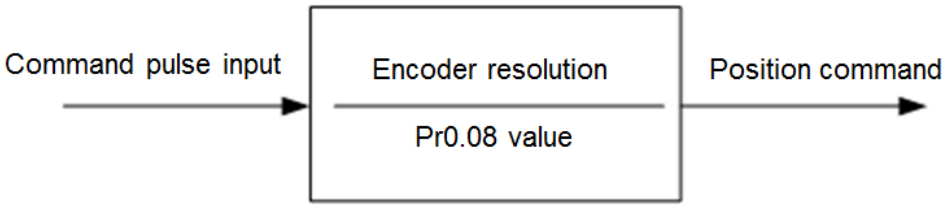
The parameters and descriptions are shown below:

- **Pr5.28 LED initial state**
  - Description: Pulse detection is used in WEIHONG control systems to check to see if correct pulses are sent and determine if there is electric interference.
  - Unit: -
  - Range: -
  - Value: 6
- **Pr0.01 Control mode setting**
  - Description: Control mode setting
  - Unit: -
  - Range
    - 0: Position control.
    - 1: Velocity control.
    - 2: Torque control.
  - Value: 0
- **Pr0.05 Command pulse input selection**
  - Description: Command pulse input selection
  - Unit: -
  - Range
    - 0: Opto-electronic coupler input (PULS1, PULS2, SIGN1, SIGN2)
    - 1: Dedicated line drive input (PULSH1, PULSH2, SIGNH1, SIGNH2)
  - Value: 1 (in common cases)
- **Pr0.07 Command pulse input format selection**
  - Description: Command pulse input format selection
  - Unit: -
  - Range: 3: the command pulse input format is pulse + direction, negative logic
  - Value: 3
- **Pr0.08 Number of command pulses per turn**
  - Description: Number of command pulses per turn
  - Unit: -
  - Range
    - If Pr0.08 is set to 0, Pr0.09 and Pr0.10 are valid.

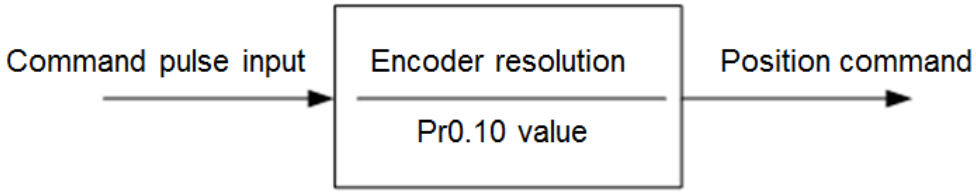
        - If Pr0.08 is not 0, **Pr0.08 = screw pitch/(pulse equivalent × mechanical reduction ratio)**
    - Value: 0
- **Pr0.09 1st command division and multiplication numerator, Pr0.10 Command pulse division and multiplication denominator**
    - Description: Relation between Pr0.09 and Pr0.10
    - Unit: -
    - Range: 0–2^{30}
    - Value: When screw pitch = 5 mm, the encoder resolution is 10000, axis coupling joint is used, and pulse equivalent = 0.001 mm: Pr0.09＝10000 and Pr0.10＝screw pitch/pulse equivalent=5/0.001＝5000. Pr0.09/Pr0.10=10000/5000=2/1.
- **Pr0.11 Number of pulse output by one motor turn**
    - Description: Number of pulse output by one motor turn
    - Unit: -
    - Range: 1–262144
    - Value: When pulse equivalent = 0.001, there is no reducer, and screw pitch = 10 mm, Pr0.11 = 2500; when screw pitch = 5 mm, Pr0.11 = 1250

Relation between Pr0.08, Pr0.09, and Pr0.10 values

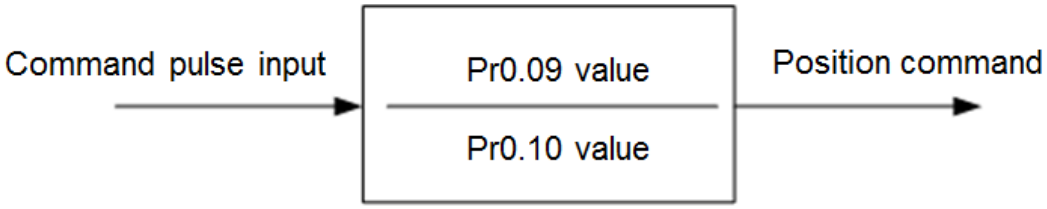
- Pr0.09 and Pr0.10 values are not valid. System processing is based on the Pr0.08 value.



- If Pr0.08 and Pr0.09 are 0, system processing is based on the Pr0.10 value.



- If Pr0.08 is 0 but Pr0.09 is not 0, system processing is based on the Pr0.09 and Pr0.10 values.



3.4.1.1.6 Fuji FALDIC-β

The parameters and descriptions are shown below:

- **Command pulse numerator α, 02 Command pulse denominator β**
  - Description: Stand for electronic gear ratio numerator and denominator.
  - Unit: -
  - Range: 1–32767
  - Equation: **α/β = (encoder resolution × pulse equivalent × mechanical reduction ratio)/screw pitch**
  - Value: When encoder resolution = 65536, pulse equivalent = 0.001, screw pitch = 5 mm, and mechanical reduction ratio = 1: α/β=65536×0.001/5=8192/625, which means α=8192 and β=625.
- **Pulse train input format**
  - Description: Pulse train input format
  - Unit: -
  - Range: 0: The pulse train input format is pulse + direction (symbol), negative logic
  - Value: 0
- **Rotation direction**
  - Description: Rotation direction
  - Unit: -
  - Range
    - 0: Rotates CW (anti-clockwise when observing from the load side)
    - 1: Rotates CCW (clockwise when observing from the load side)
  - Value: 0 or 1
- **CONT1 signal distribution**
  - Description: CONT1 signal distribution
  - Unit: -
  - Range: 1: CONT1 is distributed to RUN (SON). If CONT1 is not distributed, it becomes ON if there is no alarm after power-on.
  - Value: 1
- **CONT2 signal distribution**
  - Description: CONT2 signal distribution
  - Unit: -
  - Range: 2: CONT2 is distributed to RST (CLR: servo alarm clearing). Parameter 12, 13, and 14 are 0, which means that CONT3, CONT4, and CONT5 cannot be distributed to OT (overtravel) or EMG (external emergency stop).
  - Value: 2
- **OUT1 signal distribution**
  - Description: OUT1 signal distribution
  - Unit: -
  - Range
    - 1: OUT1 is distributed to alarm output contact a, which is normally open.
    - 2: OUT1 is distributed to alarm output contact b, which is normally closed.
  - Value: 1
- **Parameter modification inhibition**
  - Description: Parameter modification inhibition

- Unit: -
- Range
  - 0: Drive parameter values can be modified.
  - 1: Drive parameter values cannot be modified.
- Value: 0 or 1

- **CONT 1 constant validity 1**
  - Description: CONT 1 constant validity 1
  - Unit: -
  - Range: 1: valid upon servo motor start (RUN).
  - Value: 1

3.4.1.1.7 Fuji ALPHA 5

The parameters and descriptions are shown below:

- **PA1_01 Control mode selection**
  - Description: PA1_01 control mode selection
  - Unit: -
  - Range
    - 0: Position control.
    - 1: Velocity control.
  - Value: 0
- **PA1_06 Electronic gear ratio numerator 0, PA1_07 Electronic gear ratio denominator**
  - Description: Relation between PA1_06 and PA1_07
  - Unit: -
  - Range: 1–32767
  - Equation: **PA1_06/PA1_07 =(Encoder resolution × pulse equivalent × mechanical reduction ratio)/screw pitch**
  - Value: When encoder resolution = 65536, pulse equivalent = 0.001, screw pitch = 5 mm, and mechanical reduction ratio = 1: PA1_06/PA1_07 =65536×0.001/5=8192/625. Therefore, PA1_06 = 8192 and PA1_07 = 625.
- **PA1_03 Command pulse format**
  - Description: PA1_03 command pulse format
  - Unit: -
  - Range: 0: The pulse train input format is pulse + direction (symbol), negative logic.
  - Value: 0
- **PA1_04 Rotation direction**
  - Description: Rotation direction
  - Unit: -
  - Range
    - 0: Rotates CW (anti-clockwise when observing from the load side)
    - 1: Rotates CCW (clockwise when observing from the load side)
  - Value: 0 or 1
- **PA3_01 CONT1 signal distribution**
  - Description:CONT1 signal distribution
  - Unit: -
  - Range: 1: CONT1 is distributed to RUN (SON). If CONT1 is not distributed, it becomes ON if there is no alarm after power-on.
  - Value: 1
- **PA3_02 CONT2 signal distribution**

  - Description: CONT2 signal distribution
  - Unit: -
  - Range 2: CONT2 is distributed to RST (CLR: servo alarm clearing). Parameter 12, 13, and 14 are 0, which means that CONT3, CONT4, and CONT5 cannot be distributed to OT (overtravel) or EMG (external emergency stop).
  - Value: 2
- **PA3_51 OUT1 signal distribution**
  - Description: OUT1 signal distribution
  - Unit: -
  - Range
    - 16: OUT1 is distributed to alarm output contact a, which is normally open.
    - 76: OUT1 is distributed to alarm output contact b, which is normally closed.
  - Value: 16
- **PA3_26 CONT 1 constant validity 1**
  - Description: CONT 1 constant validity 1
  - Unit: -
  - Range: 1: valid upon servo motor start (RUN).
  - Value: 0–77
- **PA1_08 Number of pulse output by one motor turn**
  - Description: Number of pulse output by one motor turn
  - Unit: -
  - Range: 16–214
  - Typical value: When pulse equivalent = 0.001, there is no reducer, and screw pitch = 10 mm, PA1_08 = 2500; when screw pitch = 5 mm, PA1_08 = 1250

3.4.1.1.8 Delta ASDA-A

The parameters and descriptions are shown below:

- **P0-02 Drive status display**
  - Description: Pulse detection is used in WEIHONG control systems to check to see if correct pulses are sent and determine if there is electric interference.
  - Unit: -
  - Format: -
  - Range: -
  - Value: 02
- **P1-00 External pulse input format**
  - Description: External pulse input format
  - Unit: -
  - Format: ZYX
    - X=2: The external pulse input format is pulse + direction, negative logic
    - Z=1: negative logic
  - Range: -
  - Value: 102
- **P1-01 Control mode setting**
  - Description: Control mode setting
  - Unit: -

- Format: ZYX1X0
  - Z=0: DIO value does not change when the control mode is switched. Control mode was not switched; therefore, Z=0.
  - Y=0: Rotates CW (anti-clockwise when observing from the load side). Y=1: Rotates CCW.
  - X1X0=00: The control mode is position control.
- Range: -
- Value: 0000

- **P1-32 Motor stopping mode**
  - Description: Motor stopping mode
  - Unit: -
  - Format: YX
    - Y=0: When the servo motor is disabled, dynamic braking is used. Y=1: When the servo motor is disabled, the motor moves freely.
    - X=0: The motor is stopped instantly. X=1: The motor decelerates before stops completely.
  - Range: -
  - Value: 00
- **P1-44 Electronic gear ratio numerator N1, P1-45 Electronic gear ratio denominator M**
  - Description: Relation between P1-44 and P1-45.
  - Unit: -
  - Format: -
  - Range: 1–32767
  - Equation: **N1/M =(Encoder pulse number × 4 × pulse equivalent × mechanical reduction ratio)/screw pitch.**
  - Value: When the encoder pulse number = 2500, pulse equivalent = 0.001, screw pitch = 5 mm, and mechanical reduction ratio = 1, N1/M=2500×4×0.001/5=2/1. Therefore, N1=2 and M=1.
- **P2-10 Digital input pin DI1 function setting**
  - Description: Digital input pin DI1 function setting
  - Unit: -
  - Format: X2X1X0
    - X1X0=01: Set digital input DI1 to SON, matching pin No.9 of CN1.
    - X2=1: Set input DI1 to the normally open contact a.
  - Range: -
  - Value: 101
- **P2-15 Digital input pin DI6 function setting and P2-16 Digital input pin DI7 function setting**
  - Description: DI6 are DI7 are NC position limit signal input by default. The drive cannot work before the CN1 pin No.32 and pin No.31 are connected.
  - Unit: -
  - Format: P2-15=P2-16=X2X1X0
    - X2=1: Set DI6 and DI7 input to the NO contact a.
    - X1X0=00: Drive position limit input was not used.
  - Range: -
  - Value: P2-15=P2-16=100
- **P2-17 Digital input pin DI8 function setting**
  - Description: Digital input pin DI8 function setting
  - Unit: -

- Format: X2X1X0. X2X1X0=100: External EMG (emergency stop input) was not used.
- Range: -
- Value: 100

- **P2-21 Digital output pin DO4 function setting**
  - Description: DO4 pins are pin No.1 and No.26, which are used for Z-axis clamping position braking signals.
  - Unit: -
  - Format: X2X1X0
    - X2=1: Set DO4 output to the NO contact a. X2=1: Set DO4 output to the NC contact b.
    - X1X0=08: Set pin No.1 and No.26 to BK+ and BK- respectively.
  - Range: -
  - Value: 108
- **P2-22 Digital output pin DO5 function setting**
  - Description: DO5 pins are pin No.28 and No.27, which are used for servo alarm signals.
  - Unit: -
  - Format: X2X1X0
    - X2=0: Set DO5 output to the NC contact b.
    - X1X0=07: Set pin No.28 and No.27 to ALRM+ and ALRM- respectively.
  - Range: -
  - Value: 007
- **P2-51 Servo enablement SON setting**
  - Description: Servo enablement SON setting
  - Unit: -
  - Format: -
  - Range
    - 0: Servo motor enablement must be triggered by digital signals.
    - 1: Servo motor is automatically enabled after powered on if there is no alarm.
  - Value: 0 (1 when SON signal cables are unavailable)

3.4.1.1.9 Delta ASDA-A2

The parameters and descriptions are shown below:

- **P0-02 Drive status display**
  - Description: Pulse detection is used in WEIHONG control systems to check to see if correct pulses are sent and determine if there is electric interference.
  - Unit: -
  - Format: -
  - Range: -
  - Value: 02
- **P1-00 External pulse input format**
  - Description: External pulse input format
  - Unit: -
  - Format: ZYX
    - X=2: The external pulse input format is pulse + direction, negative logic
    - Z=1: negative logic

- Range: -
- Value: 102

- **P1-01 Control mode setting**
  - Description: Control mode setting
  - Unit: -
  - Format: ZYX1X0
    - Z=0: DIO value does not change when the control mode is switched. Control mode was not switched; therefore, Z=0.
    - Y=0: Rotates CW (anti-clockwise when observing from the load side). Y=1: Rotates CCW.
    - X1X0= 00: The control mode is position control.
  - Range: -
  - Value: 0000
- **P1-44 Electronic gear ratio numerator N1 and P1-45 Electronic gear ratio denominator M**
  - Description: Relation between P1-44 and P1-45
  - Unit: -
  - Format: -
  - Range: 1–32767
  - Equation: **P1-44/P1-45 = (Encoder resolution × pulse equivalent × mechanical reduction ratio)/screw pitch.**
  - Value: When the encoder pulse number = 2500, pulse equivalent = 0.001, screw pitch = 5 mm, and mechanical reduction ratio = 1, N1/M=2500×4×0.001/5=2/1. Therefore, N1=2 and M=1.
- **P1-46 Detector pulse output number setting**
  - Description: Setting of the revolving single-direction pulse number.
  - Unit: -
  - Format: -
  - Range: 20–320000
  - Value: When pulse equivalent = 0.001, there is no reducer, and screw pitch = 10 mm, P1-46 = 10000; when screw pitch = 5 mm, P1-46 = 5000
- **P2-10 Digital input pin DI1 function setting**
  - Description: Setting of the revolving single-direction pulse number.
  - Unit: -
  - Format: X2X1X0
    - X1X0=01: Set digital input DI1 to SON, matching pin No.9 of CN1.
    - X2=1: Set input DI1 to the normally open contact a.
  - Range: -
  - Value: 101
- **P2-15 Digital input pin DI6 function setting**
  - Description: DI6 are DI7 are NC position limit signal input by default. The drive cannot work before the CN1 pin No.32 and pin No.31 are connected.
  - Unit: -
  - Format: X2X1X0
    - X2=1: Set DI6 and DI7 input to the NO contact a.
    - X1X0=00: Drive position limit input was not used.
  - Range: -
  - Value: 100
- **P2-16 Digital input pin DI7 function setting**
  - Description: Digital input pin DI7 function setting

- Unit: -
- Format: X2X1X0
- Range: -
- Value: 100

- **P2-17 Digital input pin DI8 function setting**
  - Description: Digital input pin DI8 function setting
  - Unit: -
  - Format: X2X1X0. X2X1X0=100: External EMG (emergency stop input) was not used.
  - Range: -
  - Value: 100
- **P2-21 Digital output pin DO4 function setting**
  - Description: DO4 pins are pin No.1 and No.26, which are used for Z-axis clamping position braking signals.
  - Unit: -
  - Format: X2X1X0
    - X2=1: Set DO4 output to the NO contact a. X2=1: Set DO4 output to the NC contact b.
    - X1X0=08: Set pin No.1 and No.26 to BK+ and BK- respectively.
  - Range: -
  - Value: 108
- **P2-22 Digital output pin DO5 function setting**
  - Description: DO5 pins are pin No.28 and No.27, which are used for servo alarm signals.
  - Unit: -
  - Format: X2X1X0
    - X2=0: Set DO5 output to the NC contact b.
    - X1X0=07: Set pin No.28 and No.27 to ALRM+ and ALRM- respectively.
  - Range: -
  - Value: 007

3.4.1.1.10 Delta ASDA-B

The parameters and descriptions are shown below:

- **P0-02 Drive status display**
  - Description: Pulse detection is used in WEIHONG control systems to check to see if correct pulses are sent and determine if there is electric interference.
  - Unit: -
  - Format: -
  - Range: -
  - Value: 02
- **P1-00 External pulse train input format**
  - Description: Setting of external pulse train input format
  - Unit: -
  - Format: ZYX
    - X=2: The external pulse input format is pulse + direction, negative logic
    - Z=1: negative logic1
  - Range: -
  - Value: 102

- **P1-01 Control mode setting**
  - Description: Control mode setting
  - Unit: -
  - Format: YX1X0
    - Y=0: Rotates CW (anti-clockwise when observing from the load side). Y=1: Rotates CCW.
    - X1X0=00: The control mode is position control.
  - Range: -
  - Value: 000
- **P1-32 Motor stopping mode**
  - Description: Motor stopping mode
  - Unit: -
  - Format: YX
    - Y=0: When the servo motor is disabled, dynamic braking is used. Y=1: When the servo motor is disabled, the motor moves freely.
    - X=0: The motor is stopped instantly. X=1: The motor decelerates before stops completely.
  - Range: -
  - Value: 00
- **P1-44 Electronic gear ratio numerator N1 and P1-45 Electronic gear ratio denominator M**
  - Description: Relation between P1-44 and P1-45
  - Unit: -
  - Format: -
  - Range: 1–32767
  - Equation: **P1-44/P1-45 = (Encoder resolution × pulse equivalent × mechanical reduction ratio)/screw pitch**.
  - Value: When the encoder pulse number = 2500, pulse equivalent = 0.001, screw pitch = 5 mm, and mechanical reduction ratio = 1, N1/M=2500×4×0.001/5=2/1. Therefore, N1=2 and M=1.
- **P2-10 Digital input pin DI1 function setting**
  - Description: Digital input pin DI1 function setting
  - Unit: -
  - Format: X2X1X0
    - X1X0=01: Set digital input DI1 to SON, matching pin No.17 of CN1.
    - X2=1: Set input DI1 to the normally open contact a.
  - Range: -
  - Value: 101
- **P2-15 Digital input pin DI6 function setting**
  - Description: DI6 is NC position limit signal input by default. The drive cannot work before the CN1 pin No.32 and pin No.31 are connected.
  - Unit: -
  - Format: X2X1X0
    - X2=1: Set input DI6 to the normally open contact a.
    - X1X0=00: Drive position limit input was not used.
  - Range: -
  - Value: 100
- **P2-18 Digital output pin DO1 function setting**
  - Description: DO1 pin is pin No.16, which is used for Z-axis clamping position braking signals.

- Unit: -
- Format: X2X1X0
  - X2=1: Set DO1 output to the NO contact a. X2=0: Set DO4 output to the NC contact b.
  - X1X0=08: Set pin No.16 to BK+.
- Range: -
- Value: 108

- **P2-20 Digital output pin DO3 function setting**
  - Description: DO3 pin is pin No.1, which is used for servo alarm signals.
  - Unit: -
  - Format: 2X1X0
    - X2=0: Set DO3 output to the NC contact b.
    - X1X0=07: Set pin No.1 to ALRM+.
  - Range: -
  - Value: 007

3.4.1.1.11 Delta ASDA-B2

The parameters and descriptions are shown below:

- **P0-02 Drive status display**
  - Description: Pulse detection is used in WEIHONG control systems to check to see if correct pulses are sent and determine if there is electric interference.
  - Unit: -
  - Format: -
  - Range: -
  - Value: 02
- **P1-00 External pulse train input format**
  - Description: Setting of external pulse train input format
  - Unit: -
  - Format: ZYX
    - X=2: The external pulse input format is pulse + direction, negative logic
    - Z=1: negative logic
  - Range: -
  - Value: 102
- **P1-01 Control mode setting**
  - Description: Control mode setting
  - Unit: -
  - Format: ZYX1X0
    - Z=0: DIO value does not change when the control mode is switched. Control mode was not switched; therefore, Z=0.
    - Y=0: Rotates CW (anti-clockwise when observing from the load side). Y=1: Rotates CCW.
    - X1X0=00: The control mode is position control.
  - Range: -
  - Value: 0000
- **P1-44 Electronic gear ratio numerator N1 and P1-45 Electronic gear ratio denominator M**
  - Description: Relation between P1-44 and P1-45
  - Unit: -
  - Format: ZYX1X0

        - Z=0: DIO value does not change when the control mode is switched. Control mode was not switched; therefore, Z=0.
        - Y=0: Rotates CW (anti-clockwise when observing from the load side). Y=1: Rotates CCW.
        - X1X0=00: The control mode is position control.
    - Range: 1–32767
    - Equation: **P1-44/P1-45 = (Encoder resolution × pulse equivalent × mechanical reduction ratio)/screw pitch**.
    - Value: When the encoder pulse number = 2500, pulse equivalent = 0.001, screw pitch = 5 mm, and mechanical reduction ratio = 1, N1/M=2500×4×0.001/5=2/1. Therefore, N1=2 and M=1.
- **P1-46 Detector pulse output number setting**
    - Description: Setting of the revolving single-direction pulse number.
    - Unit: -
    - Format: -
    - Range: 20–40000
    - Value: When pulse equivalent = 0.001, there is no reducer, and screw pitch = 10 mm, P1-46 = 10000; when screw pitch = 5 mm, P1-46 = 5000
- **P2-10 Digital input pin DI1 function setting**
    - Description: Digital input pin DI1 function setting
    - Unit: -
    - Format: X2X1X0
        - X1X0=01: Set digital input DI1 to SON, matching pin No.9 of CN1.
        - X2=1: Set input DI1 to the normally open contact a.
    - Range: -
    - Value: 101
- **P2-15 Digital input pin DI6 function setting**
    - Description: DI6 are DI7 are NC position limit signal input by default. The drive cannot work before the CN1 pin No.32 and pin No.31 are connected.
    - Unit: -
    - Format: X2X1X0
        - X2=0: Set DI6 and DI7 input to the NC contact b.
        - X1X0=00: Drive position limit input was not used.
    - Range: -
    - Value: 000
- **P2-16 Digital input pin DI7 function setting**
    - Description: Digital input pin DI7 function setting
    - Unit: -
    - Format: X2X1X0
    - Range: -
    - Value: 000
- **P2-17 Digital input pin DI8 function setting**
    - Description: Digital input pin DI8 function setting
    - Unit: -
    - Format: X2X1X0. When X2X1X0=000: External EMG (emergency stop input) was not used.
    - Range: -
    - Value: 000
- **P2-18 Digital output pin DO1 function setting**

    - Description: DO1 pins are pin No.6 and No.7, which are used for Z-axis clamping position braking signals.
    - Unit: -
    - Format: X2X1X0
        - X2=1: Set DO1 output to the NO contact a. X2=1: Set DO4 output to the NC contact b.
        - X1X0=08: Set pin No.6 and No.7 to BK- and BK+ respectively.
    - Range: -
    - Value: 108
- **P2-22 Digital output pin DO5 function setting**
    - Description: DO5 pins are pin No.28 and No.27, which are used for servo alarm signals.
    - Unit: -
    - Format: X2X1X0
        - X2=0: Set DO5 output to the NC contact b.
        - X1X0=07: Set pin No.28 and No.27 to ALRM+ and ALRM- respectively.
    - Range: -
    - Value: 007

3.4.1.2 Set Drive Parameters in Velocity Loop Control Mode

Test parameter settings in velocity loop control mode as shown below:

- WISE
- Yaskawa Σ- 7
- Panasonic MINAS A5
- Fuji ALPHA 5

To make the motor output rated rotational speed under 10V voltage in velocity loop control mode, parameters need to be set differently from that [in position loop control mode](../topic_ls6000/set_driver_para_en.md#set-drive-parameters-in-position-loop-control-mode), as shown below (taking a screw pitch of 10 mm as an example):

Parameter	WISE	Yaskawa Σ- 7	Panasonic MINAS A5	Fuji ALPHA 5
Control mode selection	Pr001=2	Pn000=0	Pr0.01=1	PA1_01=1
Command pulse number	Pr011=2500	Pn212=2500	Pr011=2500	PA1_08=250
Motor rotational speed under 10V	Pr302=300	Pn300=1000	Pr3.02=300	PA3-31=10

The parameter **Motor rotational speed under 10V** is available only in velocity loop control mode.

3.4.2 Set Drive Parameters in Bus Control Systems

Parameter setting methods vary based on the servo drive brand. This section mainly introduces how to set basic parameters and station addresses of WISE drive and Yaskawa ∑5 / ∑7 drives.

1. [Set Common Drive Parameters](../topic_ls6000/set_driver_para_en.md#set-common-drive-parameters)

2. [Set Station Address](../topic_ls6000/set_driver_para_en.md#set-station-address)

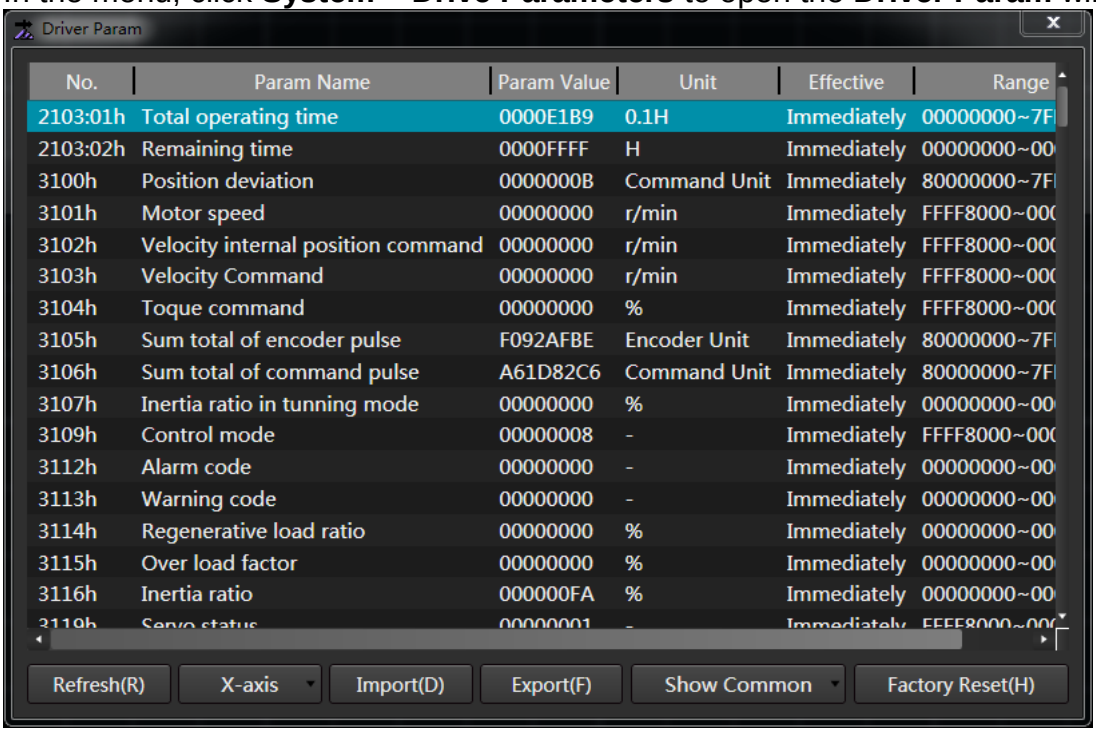
3.4.2.1 Set Common Drive Parameters

Two methods are available for you to set the drive parameters:

- Drive front panel. For details, see the drive user manual.
- **NcStudio** software.

Follow the steps below to set drive parameters in **NcStudio**:

1. In the menu, click **System** > **Drive Parameters** to open the **Driver Param** window:



2. Click **Refresh** to update the drive parameters.
3. Double-click the target parameter to set it.

Basic parameters that need setting in **NcStudio** are shown below. Refer to the user manual of the drive brand to set other parameters.

Yaskawa drives:

- Pn00B function selection basic switch B: 0000 (three-phase)/0100 (single-phase)
- Pn50A input signal selection 1: 8881
- Pn50B input signal selection 2: 8888
- Pn50E output signal selection 1: 0000
- Pn50F output signal selection 2: 0100
- Pn510 output signal selection 3: 0000
- Pn514 output signal selection 4: 0000

WISE drives: Pr001 Control mode setting: 1 (position control)

3.4.2.2 Set Station Address

By setting the station address, information can be transferred between the software, Lambda controller, and drive.

Station address of each axis drive is unique and has to be consistent with the value of the corresponding station address parameter in NcStudio for V15. If its station address parameter is set to **0**, the communication function is disabled.

3.4.2.2.1 Set Station Address for Yaskawa Drives

Set the station addresses for Yaskawa drives by using two types of switches on the drive:

- Flip switches: Four small switches numbered 1–4 for setting of ON/OFF.
- Rotation switch: Rotate the switch to select from 0–9.

Follow the steps below to set station addresses for Yaskawa drives:

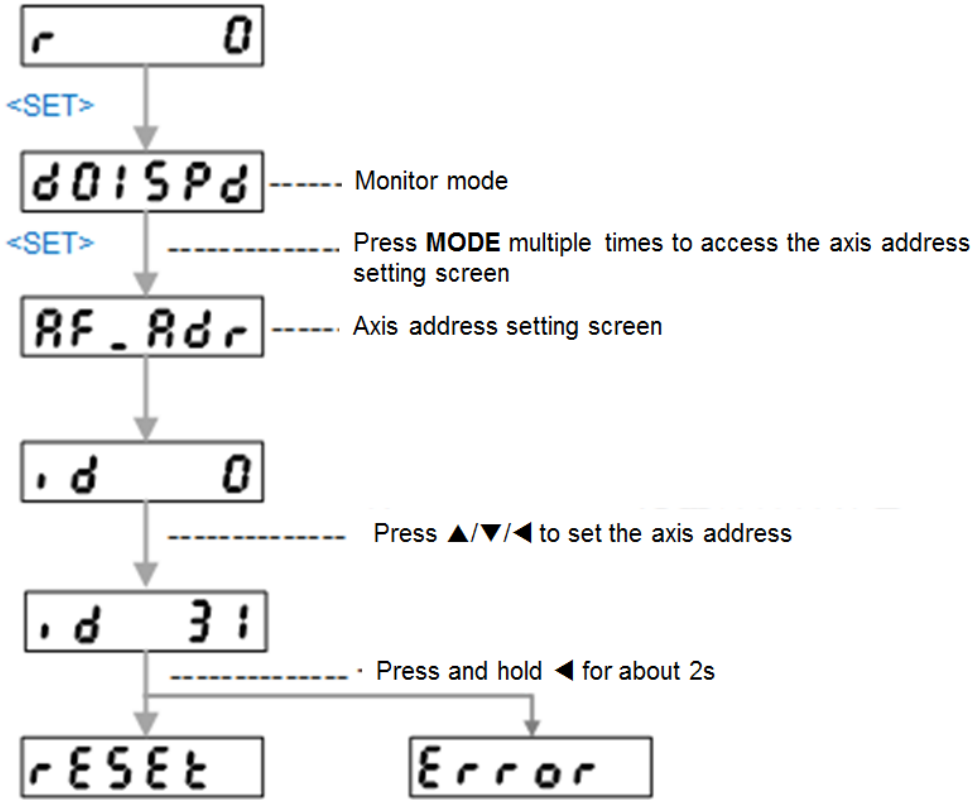
1. Set flip switch 1–4 to ON, ON, OF, and OFF respectively to enable bus functions.
2. Rotate the rotation switch to select a number as the station address.
   Note: Select station addresses for the axes in sequence (for example, 1 for X axis, 2 for Y axis, and 3 for Z axis, etc.).
3. Open **NcStudio**. Set the axis station address parameters to the values set by the drive rotation switch.

3.4.2.2.2 Set Station Address for WISE Drives

Set the station addresses for WISE drives by using the drive front panel.

Follow the steps below to set station addresses for WISE drives:

1. Set Pr001 **Control mode setting** to **1**.
2. Set the station addresses:



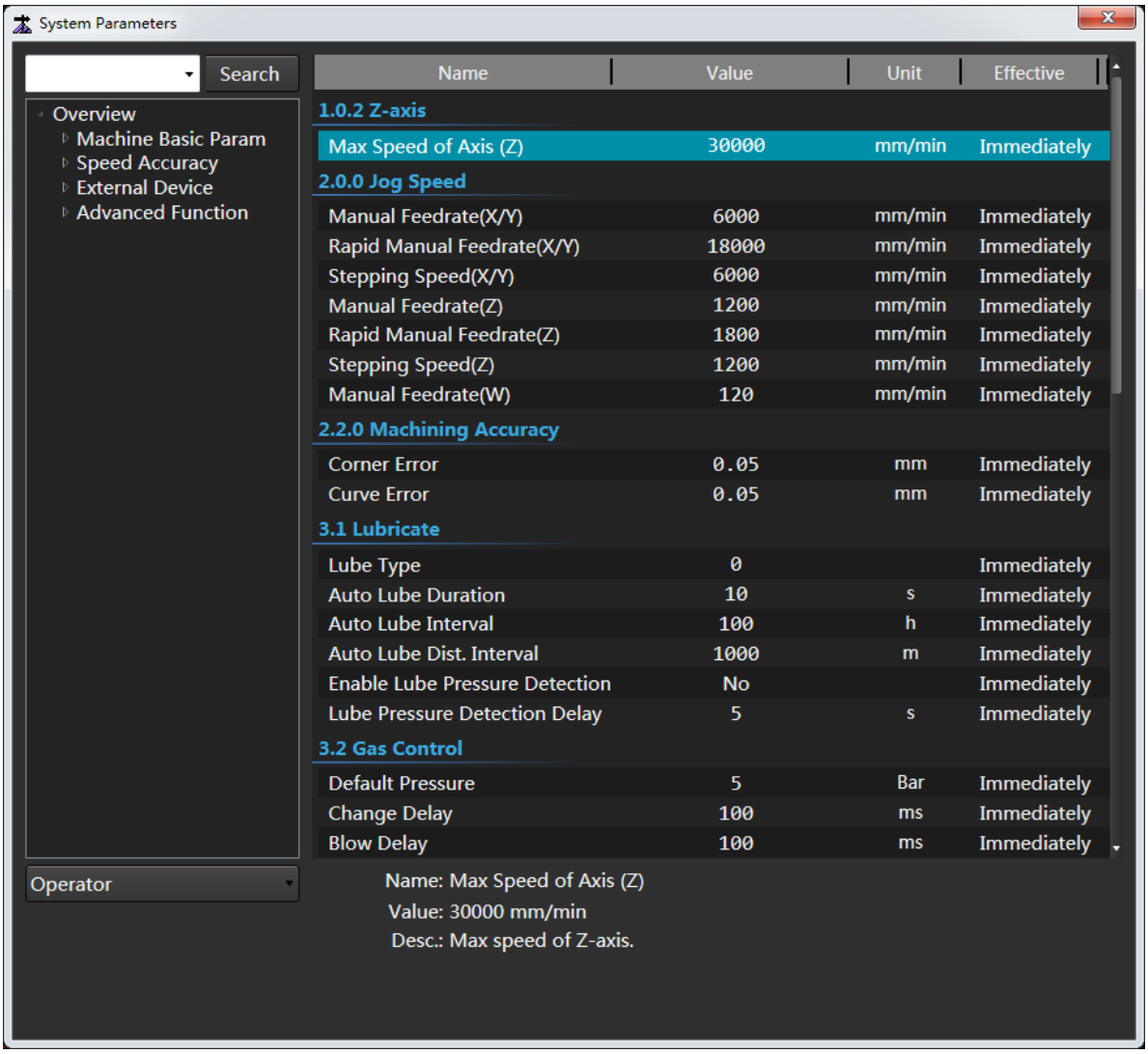
   - If **reset** is displayed, the station address is set successfully.
     Power off and restart the drive to make the setting take effect.
   - If **Error** is displayed, the station address setting has failed. Restart the drive and try again.
3. Open **NcStudio**. Set the axis station address parameters to the values set by the drive front panel.

3.5 Set Bus System Parameters

If you are using a bus system, set the bus system parameters.

Follow the steps below to set the bus system parameters:

1. In the menu bar, click **System** > **System Parameters** to open the **System Parameters** window:



2. Click the pull-down menu in the lower-left corner and select **Manufacturer**.
3. Double-click and set the following parameters:
   - **Drive station address (X/Y1/Y2)**: The values need to be the same as those set by the drive rotation switch. 0 is ineffective.
   - **Encoder Digits (X/Y1/Y2)**: The digit number of the servo motor encoder.
   - **Numerator of Electronic Gear Ratio**: Set it to the numerator of the axis electronic gear ratio.
   - **Denominator of Electronic Gear Ratio**: Set it to the denominator of the axis electronic gear ratio.
   - **Axis direction**
   - **Encoder direction**

3.6 Set Speed Parameters

You can set basic speed parameters to adjust machining speeds.

Follow the steps below to set speed parameters:

1. In the menu bar, click **System** > **System Parameters**.
2. In the **System Parameters** window, click **Speed Accuracy** category in the left list to adjust corresponding parameters on the right.

3.7 Set Pulse Equivalent

During debugging, you need to adjust the pulse equivalent and electronic gear ratio before starting to control the machine movement.

Use one of the following methods to set pulse equivalent:

- In the menu bar, click **System** > **System Parameters** to set **Pulse Equivalent** for each axis.
- In the menu bar, click **System** > **Drive Parameters** to set the electronic gear ratio numerator and denominator parameters.
  For details, see the user manual of the drive brand.

Calculation methods are shown below.

Equation

The equation varies based on the type of motor axis.

- Linear axis
  - Stepping motor:
    Pulse equivalent = screw pitch / (360/stepping angle × subdivision × mechanical reduction ratio)
  - Servo motor:
    Electronic gear ratio = (encoder resolution × pulse equivalent) / screw pitch × mechanical reduction ratio
- Rotary axis
  - Stepping motor:
    Pulse equivalent = 360 / (360/stepping angle × subdivision × mechanical reduction ratio)
  - Servo motor:
    Electronic gear ratio = (encoder resolution × pulse equivalent) / 360 × mechanical reduction ratio

Parameter definition

The parameter definitions vary based on the control system type.

Parameters in bus systems

- **Lead screw pitch**: Pitch is the distance from the crest of one thread to the next, or the distance travelled by the lead screw rotating by one turn.
- **Encoder type**: Set it to the type of the axis motor encoder.
  - 0: incremental encoder
  - 1: absolute encoder
- **Encoder digits**: Set it to the digit number of the axis motor encoder.
- **Electronic gear ratio**: Determines how much the servo drive enlarges or shrinks the pulse frequency received. Set it to the drive electronic gear ratio. The default value is 1:1.
- **Mechanical reduction ratio**: Equals speed reducer deceleration input/speed reducer rotational speed output, slave gear number/master gear number, or motor axis rotation speed/lead screw rotation speed.

- **Encoder resolution**: The number of pulses required to make the servo motor axis rotate by one turn.

Parameters in non-bus systems

- **Pulse equivalent**
  - The straight distance travelled by the lead screw or the angle turned by the rotary axis when the system sends one pulse. It is the smallest distance control unit. The smaller it is, the higher the machining accuracy and workpiece surface quality. The bigger it is, the faster the machine maximum feed rate.
  - Calculate the pulse equivalent based on the drive electronic gear ratio and set **Pulse Equivalent**.
- **Electronic gear ratio**
  - Determines how much the servo drive enlarges or shrinks the pulse frequency received. The servo drive enlarges the received pulse frequency if it is larger than 1 and shrinks the received pulse frequency if it is less than 1.
  - Calculate the electronic gear ratio based on the pulse equivalent value.

3.8 Check Axis Direction

Determine the axis directions with the **right hand rule** and set the axis direction parameters.

Taking the X axis as an example, follow the steps below to check the X axis direction:

1. Determine the X-axis positive direction based on the right hand rule.
2. In the software, click the **X+/X-** button in the machine control area to control the X axis to travel a certain distance.
3. Check to see if the axis movement direction is consistent with that determined by the right hand rule.
   - Yes: The axis direction setting is correct.
   - No: In the menu bar, click **System** > **System Parameters**. Set **Axis Direction(X)** to the opposite of its current value.

3.9 Set Workbench Travel Limits

After checking the axis movement direction and setting the mechanical origin, you need to set the axis travel limits based on the machine size to achieve soft limit functions.

Follow the steps below to set the workbench travel limits:

1. In the menu bar, click **System** > **System Parameters**.
2. Set the axis **Enable Soft Limit Protection** to **Yes**.
3. Set the axis **Upper Limit of Soft Limit** and **Lower Limit of Soft Limit** based on actual situation.

3.10 Set the Screw Error Compensation

It is used to compensate the screw error and improve the machining precision when errors exist in the machine tool and the desired precision cannot be reached.

Before using screw error compensation, click **System** > **System Parameters** in the menu bar. Select **Machine Basic Param** > **Error Compensation** in the left list, set **Lead Screw Compensation Mode** to a non-0 value:

- 0: no compensation
- 1: backlash compensation
- 2: backlash and unidirectional compensation: Operation methods are the same as those for bidirectional compensation.

- 3: bidirectional compensation

3.10.1 Set the Backlash Compensation

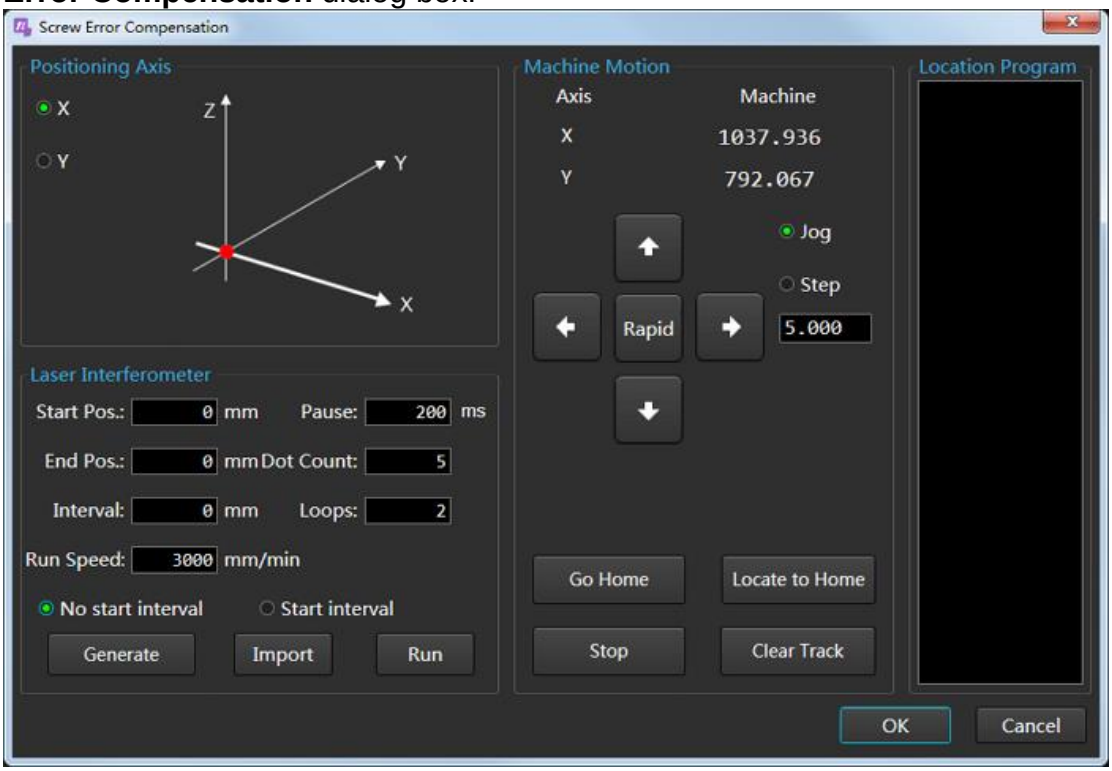
In the menu bar, click **System** > **System Parameters**. Select **Machine Basic Param** > **Error Compensation** in the left list and set the following parameters:

- **Backlash(X)**
- **Backlash(Y)**
- **Backlash(W)**

3.10.2 Set the Bidirectional Compensation

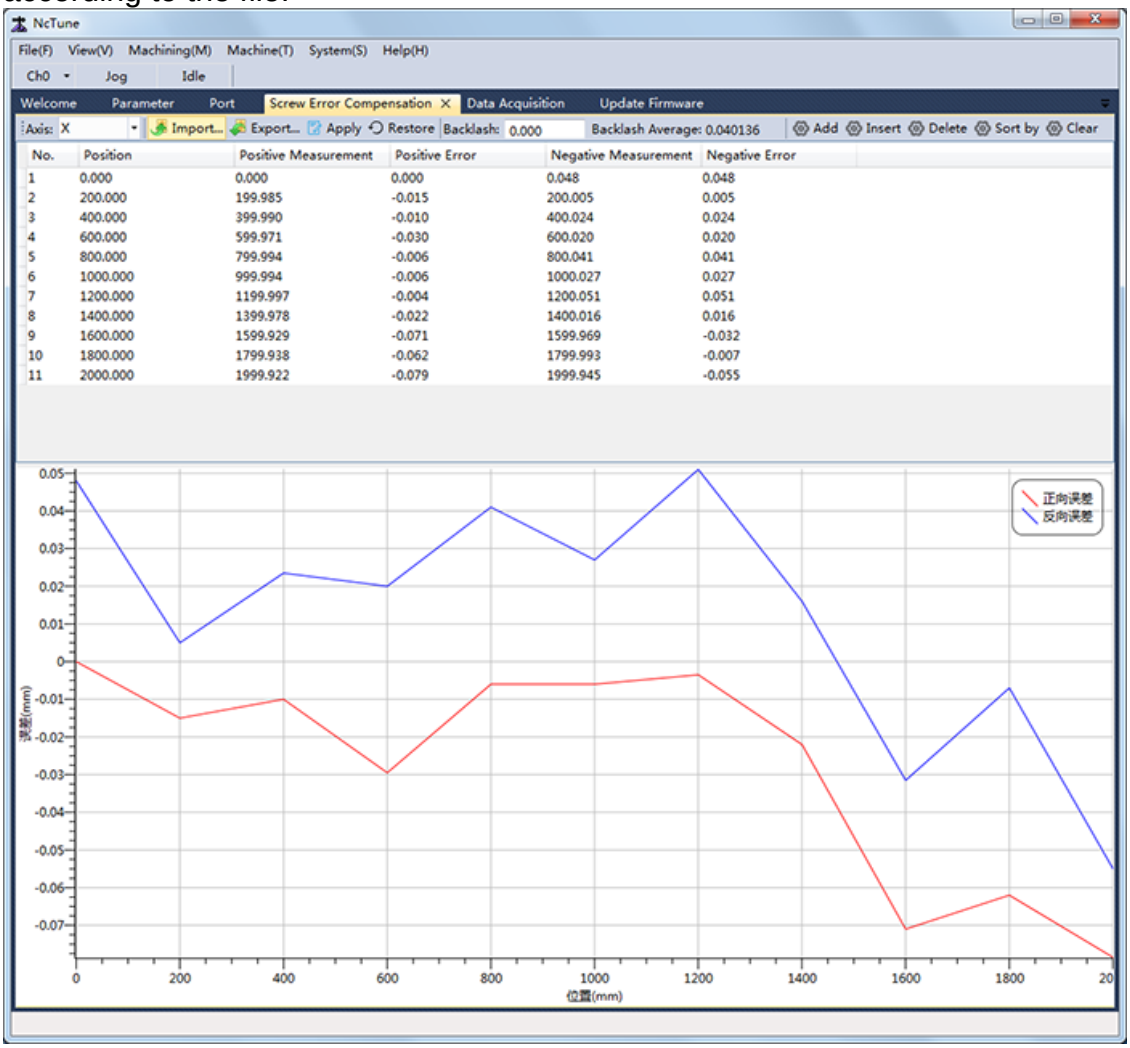
To set the bidirectional compensation, do the following:

1. In the menu bar, click **System** > **Screw Error Compensation** to open the **Screw Error Compensation** dialog box:



2. **Optional:** If X axis and Y axis have not returned to the machine origin, in **Home Behavior** area, click **X Home** and **Y Home**.
3. Get the actual measurement data of the machine tool:
   a. In the **Positioning Axis** area, select a positioning axis.
   b. In the **Laser Interferometer** area, set related parameters, and click **Generate**. The results automatically show in **Location Program** area.
   c. Click **Run**. The machine tool moves according to the generated positioning program and the system records position data at the measuring points.
   d. Save the data as a RTL or LIN compensation file in the laser interferometer.
4. Close the software, and double-click **NcTune.exe** in the installation directory **C:\Program Files\Weihong\NcStudio\Bin**.
5. **Optional**: In the menu bar, go to 帮助 > 语言 to switch the software language to English.
6. To enter **Screw Error Compensation** page, select **Screw Error** in the **Welcome** interface.

7. To import a compensation file, click **Import**. **NcTune** generates the error curve according to the file:



   Red curve: positive error; blue curve: negative error.
8. Click **Apply**. The system automatically saves the compensation data to the corresponding configuration file.

Restart **NcStudio** to make the setting effective.

During machining, the system automatically compensates the screw error according to the compensation data.

3.11 Check Machine Settings

After debugging is complete, you need to check to see if the machine parameters are set properly:

- Pulse Equivalent and Electronic Gear Ratio
- Pulse
- Laser Technic Settings

3.11.1 Pulse Equivalent and Electronic Gear Ratio

Check to see if the electronic gear ratio and pulse equivalent are matched.

Follow the steps below to check the electronic gear ratio and pulse equivalent:

1. Mark a point on any axis and set it as the workpiece origin.

2. Control the axis to move by a certain distance.
3. Use a vernier calliper to measure if the axis actual movement distance is consistent with that indicated by the coordinate system. If not, repeat step 1 and 2.

3.11.2 Pulse

You can check to see if any pulses are lost with the following methods:

- Observation: simple
- Servo Drive: accurate

3.11.2.1 Observation

Follow the steps below:

1. Laser-drill a point on the material surface and set the point as the workpiece origin.
2. Control the machine to execute dry run several times and make the axes go to the workpiece origin. Laser-drill on the material surface again.
3. Check to see if the second point entirely overlaps the first point. If not, check to see if mechanical gap is too large and if pulses are lost:
   If mechanical gap is too large:
   - Calibrate motor and driving gear meshing again.
   - Adjust the **Backlash** parameters.

   If pulses are lost: Reduce electric interference to the machine.

3.11.2.2 Servo Drive

Follow the steps below:

1. Set the drive monitor mode to **Input pulse count method** (e.g in yaskawa drives, set **UN00C**)
2. Select the lowest 4 characters of the displayed value (hexadecimal). Select the workpiece origin and record the pulse count.
3. Control the machine to execute dry run several times and make the axes go to the workpiece origin.
4. Check the current pulse count:
   - Yaskawa drives: Check to see if the difference between the pulse count and the feedback output pulse count is larger than 4 (the quadruple frequency sent by the drive).
     If the difference is larger than 4, check the drive pulse signal type and set the drive pulse reception type the same as the type of pulses sent.
   - Other drive brands: Check to see if the second pulse count is consistent with the first pulse count.
     If not, check the drive pulse signal type and set the drive pulse reception type the same as the type of pulses sent.

3.11.3 Laser Technic Settings

Follow the steps below to check laser technic settings:

1. Check to see if the laser, blow, follow, and burst control ports can control the correct functions.
   If not, set the control ports again.
2. Check to see if the voltage changes of the laser power control port **AVC** are consistent with the laser power changes.
   If not, check the wiring between the **AVC** port and the laser.
3. Check to see if the laser technic parameters in the layer are properly set based on the material type and thickness.
   If not, set the parameters again.

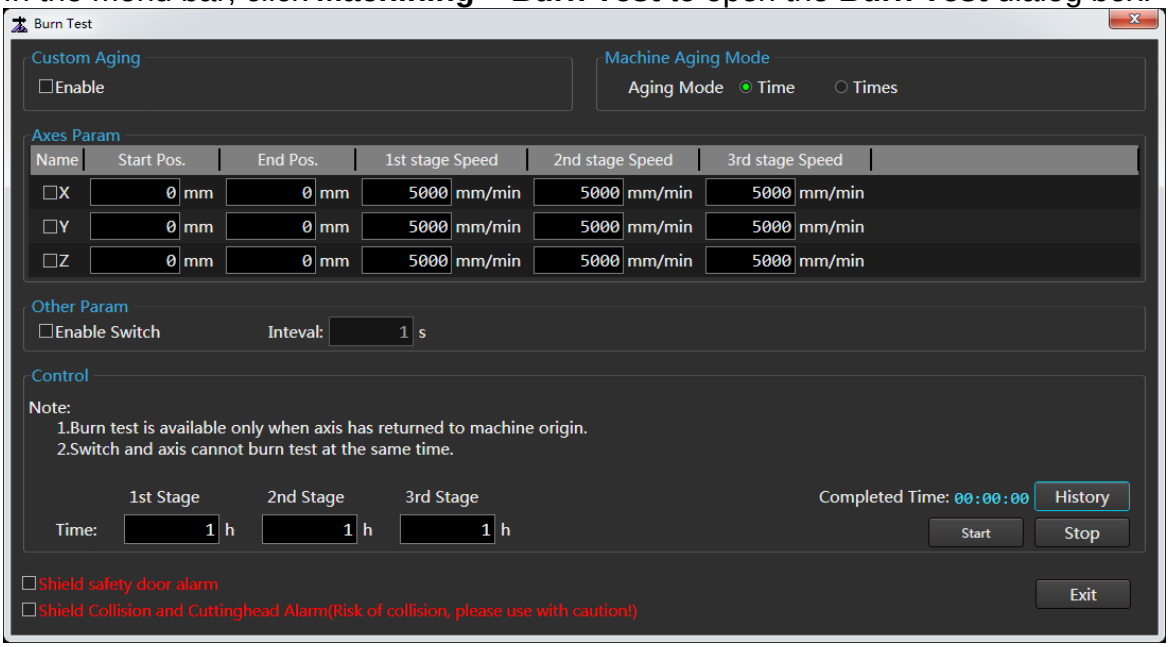
3.12 Do a Burn Test

At the first commissioning for the machine tool, a burn test is required to make sure the motion stability of each axis.

Before doing a burn test, make sure all axes are at the machine origin.

To do a burn test, do the following:

1. In the menu bar, click **Machining** > **Burn Test** to open the **Burn Test** dialog box:



2. Select the target axis, and set the start position, end position and speed at 1st, 2nd and 3rd stage for the burn test.
3. **Optional:** Check **Enable Switch** and set **Interval** in **Other Param** area.
4. In the **Control** area, set **Time** in 1st, 2nd and 3rd stage for the burn test.
5. **Optional:** To check the history records of burn tests, click **History**.
6. **Optional:** Check **Shield Collision and Cuttinghead Alarms(Risk of collision, please use with caution!)**.
   Warning: Risk of collision. Please use it with caution!
7. Click **Start**. The system starts to do a burn test.

During a burn test, to stop it, click **Stop**.

3.13 Install and Use the Camera

When installing the **NcStudio V15 laser cutting control system**, you can select whether to enable the camera functions for machining monitor and control.

Currently, only Hikvision and Dahua Technology cameras are supported.

Follow the steps below to install and use a camera:

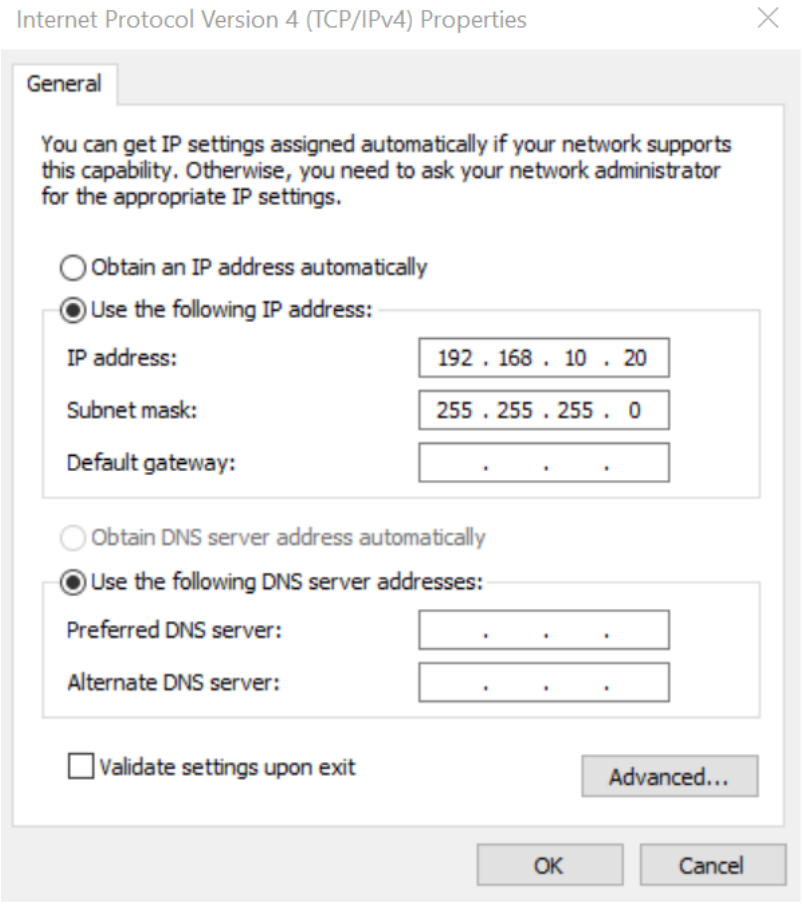
1. Connect the camera to the computer.
   At most two cameras can be connected at the same time.
2. Acquire the camera IP address, port, subnet mask, and default gateway:
   - Hikvision: Use the **SADPTool.exe** software.
   - Dahua Technology: Check the camera manufacturer's manual.
3. Modify the computer or camera IP address as shown below:
   - Modify the computer IP address

- Modify the camera IP address

3.13.1 Modify the Computer IP Address

Follow the steps below to change the computer IP address:

1. Taking Ethernet 3 as an example, follow the steps below to set the computer IP address based on the acquired camera information to make the computer and camera connected:
   a. Go to **Control Panel** > **Network and Internet** > **Network and Sharing Center** > **Ethernet 3**.
   b. Go to **Properties** > **Internet Protocol Version 4 (TCP/IPv4)** > **OK**.
   c. Select **Use the following IP address** and enter an IP address that is in the same network segment with the camera IP address. Click **OK**.



   The IP address first three sections, subnet mask, and default gateway need to be the same as those for the camera. The last section of the IP address needs to be different from that of the camera IP address.
2. In the **NcStudio** menu bar, click **System** > **System Parameters**. In the **External Device** > **3.0 Monitoring** category, set **Enable Camera** to **Yes**.
3. In the camera monitor area, click **login** in the right-click menu:
4. Select the camera type, camera IP address, port number, username, and password.

After logging in, the camera image will be displayed in the camera monitoring area. Double-click in the camera monitor area to switch between different numbers of cameras.

If the camera is replaced in the future, click **Logout** in the right-click menu in the camera monitor area and repeat the previous steps to log in again.

3.13.2 Modify the Camera IP Address

Taking **Dahua** cameras as an example, follow the steps below to change the camera IP address (those for **Hikvision** cameras are the same):

1. Open the browser and enter the camera IP address. The camera login screen will be displayed.
2. Contact the camera manufacturer to acquire the initial password and log in:
   Note: You need to change the password after initial login.
3. Follow the steps below to open the **TCP/IP** dialog box:
   a. Click the **Settings** tab.
   b. In the left list, click **Network Setting** > **TCP/IP**.
   c. The IP address first three sections, subnet mask, and default gateway need to be the same as those for the computer. The last section of the IP address needs to be different from that of the computer IP address.
4. Click **Connect** and check **TCP port**.
5. In the **NcStudio** menu bar, click **System** > **System Parameters**. In the **External Device** > **3.0 Monitoring** category, set **Enable Camera** to **Yes**.
6. In the camera monitor area, click **login** in the right-click menu. Enter information in the blank fields.
7. Select the camera type, camera IP address, port number, username, and password.

After logging in, the camera image will be displayed in the camera monitoring area. Double-click in the camera monitor area to switch between different numbers of cameras.

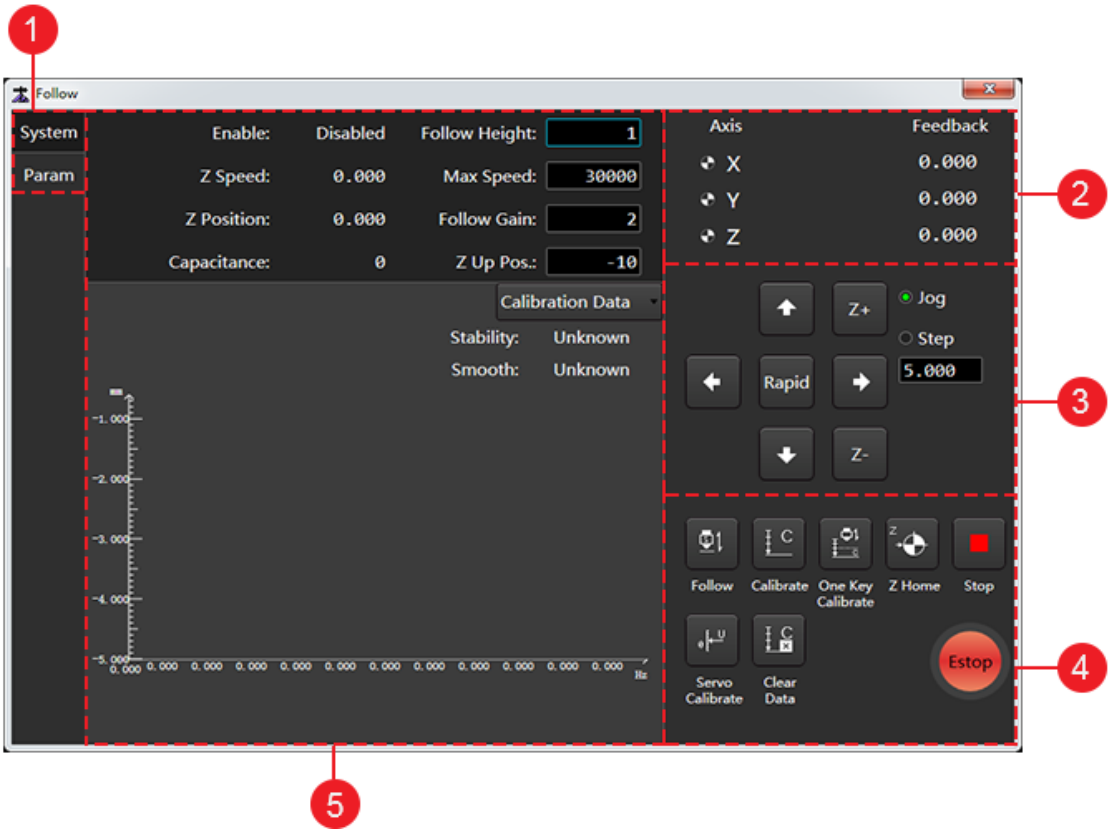
If the camera is replaced in the future, click **Logout** in the right-click menu in the camera monitor area and repeat the previous steps to log in again.

4 Follow Debugging

4.1 Overview

This function is used to control the Z axis up and down movement via matching between the capacitance and distance so as to keep a fixed distance between the cutter and material.

You can click  in the software machine control area to enable following; or: in the menu bar, click **Advanced** → **Follow Control** to open the **Follow** window:



1. Tab Area
2. Coordinate Area
3. Manual Control Area
4. Follow Control Buttons
5. Follow Control Area/Follow Parameter Setting Area

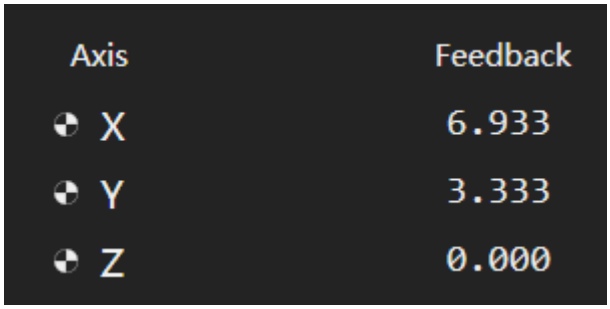
4.1.1 Tab Area

Includes:

- **System** tab: Access the follow control area.
- **Param** tab: Access the follow parameter setting area.

4.1.2 Coordinate Area

This area shows the axis mechanical coordinates and workpiece coordinates.



4.1.3 Manual Control Area

This area is for you to manually control the axis movement.

In this area:

- Axis direction buttons: Click the axis direction buttons to control the target axis to move in the target direction.
- Rapid mode: Select **Jog** and highlight the **Rapid** button in the middle to enter **Rapid** mode.
  In **Jog/Rapid** mode, press and hold an axis direction button to make the axis move at a relatively slow/rapid speed in the target direction. Release the axis direction button to stop axis movement. To make multiple axes move or stop moving at the same time, press and hold/release the corresponding axis direction buttons at the same time.
- Step mode: Select **Step**. Click an axis direction button once and the target axis moves by the set step and then stops.

4.1.4 Follow Control Buttons

This area allows for operations related to the follow functions.

-  **Follow**: If this button is highlighted, the system automatically execute following if there is calibration data. Deselect the button to stop following and make the Z axis go to the **Z Up Pos.** position.
- 

Z Home: Makes the Z axis go to the mechanical origin. Deselect the button to stop this process.

After the Z axis has gone to the mechanical origin, the symbol will be displayed before Z axis in the coordinate area.

-  **Stop**: Makes the system stop current movement and enter idle state. You can click this button to interrupt system tasks normally during follow control.
-  **Servo Calibrate**: Only available in velocity loop control mode. If it is highlighted, the system automatically executes compensation and clears servo zero drift.
- 

Estop: Executes system emergency stop.
-  **Calibrate**: Highlight the button to calibrate the cutter. Deselect the button to stop automatic calibration.
-  **One Key Calibrate**: Makes the system execute one-key cutter calibration.

4.1.5 Follow Control Area/Follow Parameter Setting Area

Includes

- Main Parameter Area
- Data Chart Area

4.1.5.1 Main Parameter Area

Click the **System** tab to access this area. The following parameters are displayed:

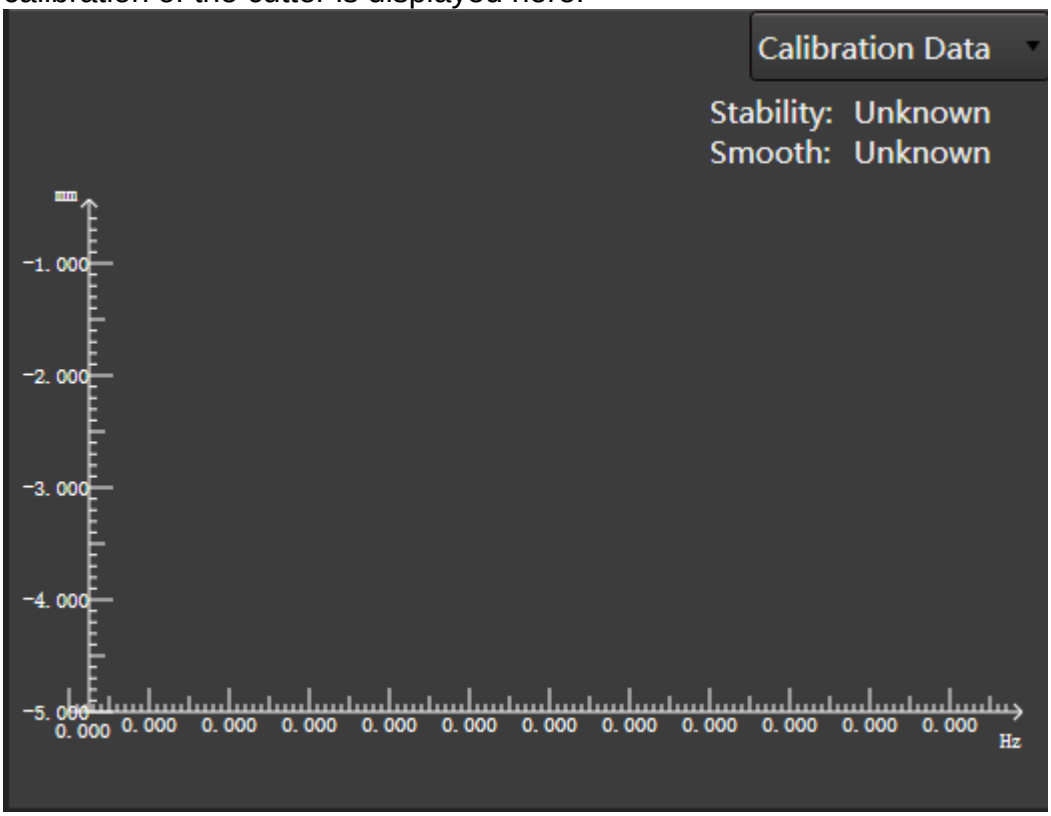
- Real-time monitor parameters (cannot be modified on this page):
  - **Enable**: After the  **Follow** button is highlighted, the status of this parameter will become **Enabled**.
  - **Z Speed**: Shows the current Z-axis movement speed.
  - **Z Position**: Shows the current Z-axis mechanical coordinates.
  - **Capacitance**: Shows the current capacitance value. The closer the cutter from the material, the smaller it is. When the cutter touches the material (metal), it becomes 0.
- Some of the common follow parameters (can be modified on this page):
  - **Follow Height**: The height of the cutter during following.
  - **Max Speed**: The cutter maximum speed during following.
  - **Follow Gain**: Controls the follow sensitivity.
  - **Z Up Pos.**: Specifies the coordinate you want the Z axis to be after it goes to the mechanical origin and the following or machining is stopped.

  To modify the parameters, click the parameter current value and enter the new value. For details about follow parameters, see Follow Parameter.

4.1.5.2 Data Chart Area

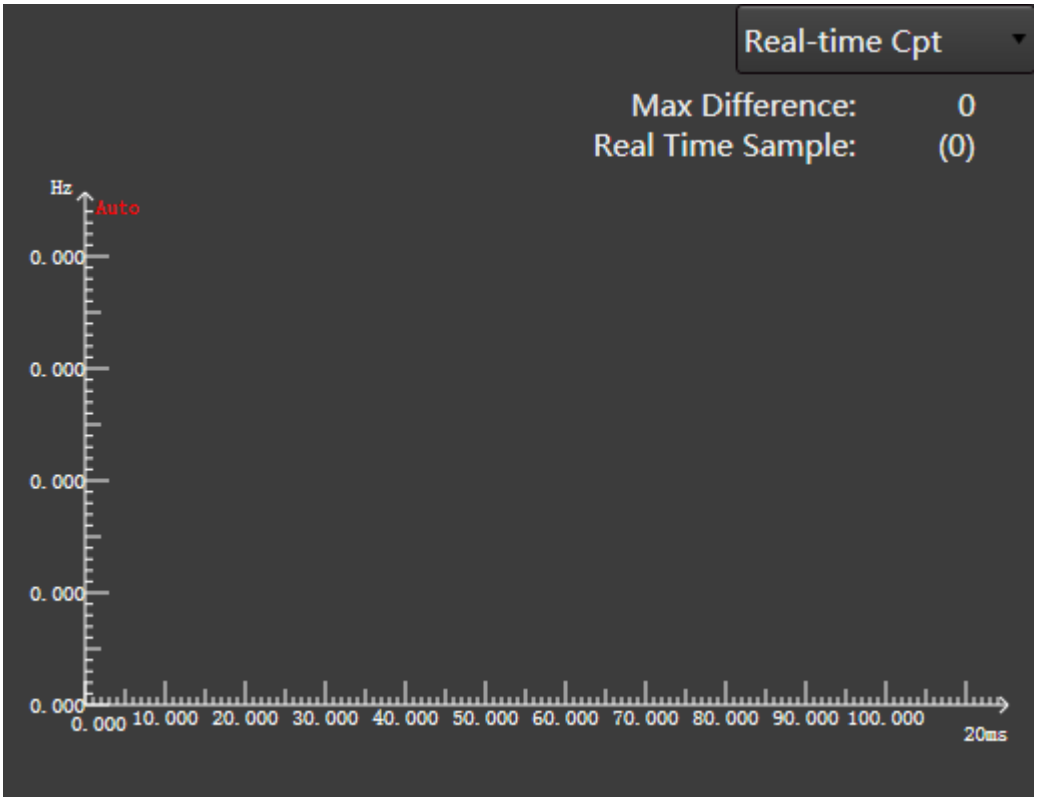
Click the **System** tab to access this area. Click the pull-down menu in the chart upper right corner to switch between the following charts:

- **Calibration Data**
  Mapping between the cutter/material capacitance and position during auto-calibration of the cutter is displayed here.



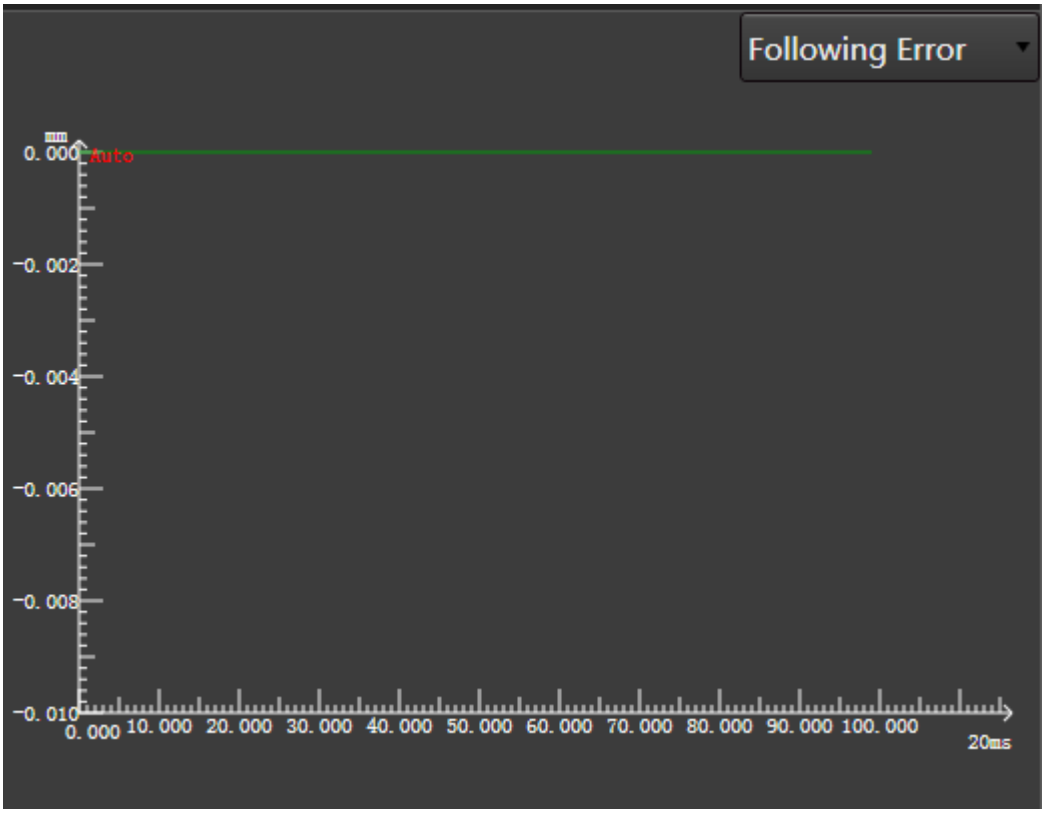
  X axis: capacitance; Y axis: distance between the cutter and material

- **Real-time Cpt**
  Real-time capacitance changes during a period of time are displayed here.



X axis: time; Y axis: capacitance.
Keep the cutter and material stable. Check the **Max Difference** value in the chart upper right corner. The larger the value, the larger the interference and the more unstable the capacitance measurement. The ideal value is no larger than 30.

- **Following Error**
  Difference between the actual follow height and the parameter **Follow Height** value is displayed here, dynamically reflecting the following accuracy.



To pause the wave movement, double-click any point on the chart. The Auto icon beside the Y axis top side becomes Auto!!.

4.1.5.3 Follow Parameter Setting Area

On the **Follow** window, click the **Param** tab to access this area. It displays all parameters related to the follow function. For details, see Follow Parameter.

The parameters are divided into **Operator** parameters and **Manufacturer** parameters based on the user identity and permission. **Operator** parameters are displayed by default.

Select one from the following methods to modify a parameter value:

- Double-click the target parameter row.
- Press the ↑ and ↓ keys to select the target parameter row and press **Enter**.

To view or modify **Manufacturer** parameters, check **Manufacturer** in the area bottom and enter the password.

4.2 Operations

Before starting to debug:

1. Prepare
2. Measure the Capacitance

Follow the steps below to debug:

1. Execute Servo Calibration
2. Execute Calibration

After performing the steps above, perform Check the Follow Function.

4.2.1 Prepare

Follow the steps below:

1. Ensure that the hardware is installed properly.

2. Ensure that Set Drive Parameters and Follow Parameter are set properly.
3. In **Step** mode, make the Z axis move in the positive or negative direction. Check to see if the Z-axis coordinates change by the step.
   Ensure that the coordinate changes by the step in the correct direction. If not, repeat step 1 and 2.
4. Ensure that the software reports no alarm and there is a valid reading of the **Capacitance** parameter (**Set** > **Follow** > **System**).
5. Ensure that the Z axis direction is correct. For details, see Check Axis Direction.
6. Ensure that the related software system parameters are set correctly to ensure correct motion control and coordinate display, and that the Z axis can go to the mechanical origin properly.

4.2.2 Measure the Capacitance

Check the capacitive sensor status when the cutter is stationary and moving.

Follow the steps below to check the capacitance:

1. Make the cutter nozzle touch the material and ensure that the current capacitance is 0.
2. Set the follow parameter **Z Up Pos.**.
3. Make the cutter move to a position more than 30 mm from the material surface and keep it stable. Ensure that the capacitance is such situation is stable.
   If the capacitance is not stable, there is serious electric interference. Refer to Serious Electric Interference for troubleshooting.

4.2.3 Execute Servo Calibration

This step aims to solve the problem of zero drift of the servo motor brought by velocity loop control.

Follow the steps below to execute servo calibration:

1. In the manual control area, click the axis direction buttons to move the cutter to the middle of the travel path to prevent it from moving outside the travel range.
2. Click 

Servo Calibrate, the system generates the **Servo Compensation Parameter** value.
   The cutter moves back and forth within a small range for compensation.

4.2.4 Execute Calibration

This step aims to collect capacitance data and map capacitance values to heights.

Before executing automatic calibration, ensure that:

- The follow parameter **Nonmetal Calibration** is set based on the material type.
- The current measured capacitance is 0.

Follow the steps below to execute automatic calibration:

1. Move the cutter to about 5 mm from the material surface. Keep the material stable.
2. Click 

Calibrate. The system starts calibration, which takes about 20s.

3. **Optional:** To execute automatic calibration, click  **One Key Calibrate**.

Note: One-key calibration requires manual calibration being executed first.

During automatic calibration:

1. The cutter slows lowers and touches the material board.
2. After it touches the material, it moves up by 5 mm.
3. It slowly lowers again to touch the material.
4. After it touches the material, it slowly moves up by the set calibration distance. The system generates the calibration curve based on the data.

After calibration is complete, the system provides a rating of the stability and smooth of the generated calibration curve:

- **Stability**: Indicates the difference between the data collected during lowering by 5 mm and up by 5 mm. The larger the difference, the poorer the stability.
  If the stability rating is poor, there might have been a large vibration or strong external interference. Another time of calibration is required.
- **Smooth**: Indicates the curve smooth.
  If the smooth rating is poor, the curve is not smooth or there are burrs. Another time of calibration is required.

Note: During calibration, you can click the Estop button as needed to prevent the cutter from continuing lowering when there is capacitance exception and causing machine damage.

4.2.5 Check the Follow Function

After calibration is complete, follow the steps below to check the follow function:

1. Ensure that the cutter does not jitter and follows from the correct distance.
   After starting following, you can move a screwdriver or small piece of iron sheet under the cutter back and forth and see if the cutter moves accordingly and if the cutter jitters.
   If it jitters, you can choose to lower the positioning gain and increase in-position tolerance.
2. In the menu bar, click **System** > **System Parameters**. Set **Detect Out-margin** to **Yes**.
   This function aims to improve machining safety.
3. Prepare a machining program and run it without opening the laser. Check to see if the cutter jitters during following.
   If it jitters, you can choose to lower the positioning gain and increase in-position tolerance.

4.3 Follow Parameter

The follow parameters (**Set** > **Follow** > **Param**) are divided into the following categories:

- System Setting
- Follow Setting
- Follow-up
- Calibrate Setting
- Speed Setting
- Real-time State Check
- Manual Speed

4.3.1 System Setting

Includes the following parameters:

- **Axis Direction(Z)**
  - Description: Specifies the direction for Z-axis mechanical coordinate increments. Modify the parameter value if you find out during manual operation that the axis movement direction is opposite to that determined by the **right hand rule**.
  - Range
    - 1: positive direction.
    - -1: negative direction.
  - Value: 1
- **Pulse Equivalent**
  - Description: The distance or angle change for each control pulse.
  - Range: 0.000001mm/p–999mm/p
  - Value: 0.001mm/p
- **Upper Limit of Soft Limit**
  - Description: Indicates the upper threshold of the soft limits.
  - Range: -1000 mm–99999 mm
  - Value: 0
- **Lower Limit of Soft Limit**
  - Description: Indicates the lower threshold of the soft limits.
  - Range: -99999 mm–0 mm
  - Value: -1000
- **Screw Pitch**
  - Description: Indicates the Z-axis screw pitch.
  - Range: 0 mm–360 mm
  - Value: 10
- **Coarse Positioning Direction**
  - Description: The axis movement direction during coarse positioning phase of going to the mechanical origin.
  - Range
    - 1: positive.
    - -1: negative.
  - Value: 1
- **Coarse Positioning Speed**
  - Description: The axis feed rate during coarse positioning phase of going to the mechanical origin.
  - Range: 0.1mm/min–10000mm/min
  - Value: 1800
- **Retract Distance**
  - Description: The axis additional moving distance after coarse positioning phase. A positive value means inward movement and a negative value means outward movement. 0 means no movement.
  - Range: -100mm–1000mm
  - Value: 2

4.3.2 Follow Setting

Includes the following parameters:

- **Follow Height**

  - Description: Indicates the distance between the cutter and material plate during follow control.
  - Range: 0 mm–30 mm
  - Value: 1
- **Z UP Pos.**
  - Description: Indicates the mechanical coordinate you want the Z axis to stop at after the Z axis go to the mechanical origin and the follow/machining is complete.
  - Range: -100 mm–100 mm
  - Value: -10
- **Safe Lift Height**
  - Description: Indicates the safe lift height of the Z axis when it is not at the mechanical origin.
  - Range: 0 mm–100 mm
  - Value: 40
- **Follow Max.H.**
  - Description: Indicates the maximum direct follow height.
  - Range: 0.01 mm–16 mm
  - Value: 5

4.3.3 Follow-up

Includes the following parameters:

- **Positioning Gain**
  - Description: Used to control the sensitivity of positioning movement during follow
  - Range: 1–20
  - Value: 8
- **Follow-up Gain**
  - Description: Used to control the follow sensitivity.
  - Range: 1–5
  - Value: 1
- **Follow-up feed forward**
  - Description: During a certain range, the larger this value, the quicker the response. If this value is too larger, jitters will be created during follow.
  - Range: 0–100
  - Value: 50
- **INposition Tolerance**
  - Description: When the system detects that the current height = **follow height ± in position tolerance**, the system thinks that the cutter has moved to the follow position.
  - Range: 0 mm–655 mm
  - Value: 0.3
- **Vibration Suppression Level**
  - Description: The larger this value, the stronger the suppression of the material vibration during machining and the lower the follow sensitivity.
  - Range: 0–5
  - Value: 1
- **Servo Compensation Parameter**
  - Description: Available in velocity control mode. The value is generated after servo drive calibration.

  - Range: -255–255
  - Value: 0
- **Part Touching Delay (Positioning)**
  - Description: Indicates the part touching delay during positioning.
  - Range: 0 ms–20000 ms
  - Value: 300
- **Part Touching Delay (Follow-up)**
  - Description: Indicates the part touching delay during following.
  - Range: 0 ms–20000 ms
  - Value: 500
- **Part Touching Delay (Punch)**
  - Description: Indicates the part touching delay during piercing.
  - Range: 0 ms–20000 ms
  - Value: 600
- **Enable Anti-collision**
  - Description: After this parameter is enabled, if the system detects during dry running that the cutter may have a collision, the cutter will be lifted automatically.
  - Range
    - Yes: enable
    - No: disable
  - Value: Yes
- **Speed Gain**
  - Description: Available in velocity control mode. Its value equals to the motor rated power divided by 10V. It matches the motor velocity speed command input gain.
  - Range: 10–2000
  - Value: 300
- **Cutting Head Alarm Tolerance**
  - Description: Indicates the capacitance change threshold that triggers the cutter exception alarm.
  - Range: 100 Hz–100000 Hz
  - Value: 500
- **Cutting Head Alarm Additional Tolerance**
  - Description: The capacitance change threshold that triggers the cutter exception alarm will equal **Cutting Head Alarm Tolerance** plus **Cutting Head Alarm Additional Tolerance** if **Capacitor Compensation** is enabled.
  - Range: 100 Hz–100000 Hz
  - Value: 1500
- **Capacitor Compensation**
  - Description: Indicates whether to enable capacitance compensation.
  - Range
    - Yes: Enable
    - No: Disable
  - Value: No

4.3.4 Calibrate Setting

Includes the following parameters:

- **Nonmetal Calibration**
  - Description: Specifies the type of material to be calibrated.

  - Range
    - Yes: Non-metal materials, such as wood or glass.
    - No: Metal materials.
  - Value: No
- **Touch Part Capacitance**
  - Description: Capacitance expressed in frequency unit when touching the plates
  - Range: 0-10,000,000 Hz
  - Value: 0
- **Calibration Length**
  - Description: During calibration, capacitance data within this length will be recorded. This parameter can be lowered if the Z-axis travel range is short.
  - Range: 5 mm–50 mm
  - Value: 18
- **Touch part speed**
  - Description: The speed of the part touching movement during calibration.
  - Range: 0 mm/min–10000000 mm/min
  - Value: 80
- **Calibrating Speed**
  - Description: Indicates the calibration speed.
  - Range: 0 mm/min–10000000 mm/min
  - Value: 80
- **Capacitance fluctuation detection**
  - Description: Calibration will be stopped if the capacitance fluctuation every 1 mm is less than this value.
  - Range: -
  - Value: 30

4.3.5 Speed Setting

Includes the following parameters:

- **G00 Speed(Z)**
  - Description: The Z axis upward and downward dry movement speed. If this value is large, the **Calibration Length** needs to be increased to allow enough distance for axis deceleration to avoid collision with the material.
  - Range: 0–axis maximum speed
  - Value: 15000
- **Follow Acceleration**
  - Description: The acceleration during following.
  - Range: 1000 mm/s^2–50000 mm/s^2
  - Value: 12000
- **Max Speed of Axis(Z)**
  - Description: The following speed and G00 speed cannot be larger than this value.
  - Range: 1mm/min–100000mm/min
  - Value: 30000
- **Max Motor Speed of Axis(Z)**
  - Description: Indicates the maximum speed of the Z-axis motor.
  - Range: 1000 r/min–20000 r/min
  - Value: 6000

4.3.6 Real-time State Check

Includes the following parameters:

- **Detect Out-margin**
  - Description: Indicates whether to enable out-of-edge detection during following. Axis movement will be stopped if the system detects that it has exceeded the edge.
  - Range
    - Yes: Enable
    - No: Disable
  - Value: Enable
- **Empty Leapfrog Detection Tolerance**
  - Description: The tolerance of empty leapfrog detection.
  - Range: 0 mm–225 mm
  - Value: 3

4.3.7 Manual Speed

Includes the following parameters:

- **Manual Acceleration(Z)**
  - Description: The Z-axis acceleration in manual mode.
  - Range: 0 mm/s^2–100000 mm/s^2
  - Value: 5000
- **Rapid Manual Feedrate(Z)**
  - Description: The Z-axis speed in rapid manual mode.
  - Range: 1200 mm/min–30000 mm/min
  - Value: 1800
- **Manual Feedrate(Z)**
  - Description: The default Z-axis speed in manual mode.
  - Range: 0.1 mm/min–1800 mm/min
  - Value: 1200

4.4 Common Problems

This section introduces troubleshooting methods for the following common problems:

- Serious Electric Interference
- Capacitance is Not Zero when Touching the Material
- Cutter Continues Lowering After Touching the Material During Calibration
- Actual Follow Height Differs from Setting
- Cutter Stops Working Frequently when Capacitance Feedback and Calibration Results are Normal
- Cutter Has Severe Jitters When Cutting Thin Plates and Causing Workpiece Outline Deformation
- System Reports Follow Error when Moving Z axis or Enable Follow
- Encoder Direction or Axis Direction Error
- Follow In-position Waiting Timeout
- Large Follow Error Alarm
- System Reports Material Collision Alarm when Follow is Enabled in Idle Status or During Machining
- System Reports Material Collision Alarm when the System Has No Movement
- Follow Overshoot

4.4.1 Serious Electric Interference

Reason

- The position of the servo drive creates some interference.
- The shielding layer has been damaged or entangled on the external iron frame.
- There is no conductivity between the No.4 pin of the M16 three-core aviation plug towline cable and the amplifier.
- There is gap between the follow-up amplifier and the machine.
- The RF cable is damaged.
- The machine is poorly grounded.

Solution

- Ensure that the servo drive, Lambda 5E controller, and EX33A extension terminal board are grounded properly.
  If there is poor contact, construct paling again.
- Ensure that the cable shielding layer is intact.
  If not, replace the shielding layer.
- Ensure conductivity between the No.4 pin of the M16 three-core aviation plug towline cable and the amplifier.
  If not, replace the cable.
- Ensure that the follow-up amplifier is entirely in close contact with the machine.
  If not, before installing the amplifier, use a piece of abrasive paper to remove the oxidized layer from the contact surface.
- Use a multimeter to check the RF cable.
  If the RF cable is not working, replace it.
- Ensure that the machine is grounded properly.

4.4.2 Capacitance is Not Zero when Touching the Material

Reason

- There is no conductivity or the conductivity is poor between the material and machine.
- The material has insulative objects such as rusts or paint in the calibration area.

Solution

Follow the steps below to help troubleshoot:

1. In **Step** mode, slowly lower the cutter to make it touch the material and check the capacitance again.
2. Set **Touch Part Capacitance** to a value larger than the capacitance currently displayed.

4.4.3 Cutter Continues Lowering After Touching the Material During Calibration

Reason

After the cutter nozzle touches the material, the system receives no signal from the follow-up amplifier that indicates zero capacitance.

Solution

See Capacitance is Not Zero when Touching the Material.

4.4.4 Actual Follow Height Differs from Setting

Reason

Calibration is not executed after replacing the ceramic ring or nozzle, or the ceramic ring/nozzle is not installed properly, causing large capacitance changes during blowing and certain deviation of the capacitance curve.

Solution

Follow the steps below to help troubleshoot:

1. Ensure that the ceramic ring and nozzle are installed properly.
2. Ensure that the capacitance fluctuation during blowing is within the set compensation range.
3. Execute Execute Calibration again.

4.4.5 Cutter Stops Working Frequently when Capacitance Feedback and Calibration Results are Normal

Reason

The external force by the air flowing through the cutter may have caused poor contact between the ceramic ring internal contact point and the cutter signal port, triggering a touch-material-plate alarm, which makes the cutter stops working when the nozzle is actually not touching the material plate.

Solution

Use a qualified ceramic ring.

4.4.6 Cutter Has Severe Jitters When Cutting Thin Plates and Causing Workpiece Outline Deformation

Reason

When cutting thin plates, the plates may have obvious vibration due to the cutting pressure.

Solution

Lower **Positioning Gain**, increase **INposition Tolerance**, or increase **Vibration Suppression Level** properly to suppress vibration.

4.4.7 System Reports Follow Error when Moving Z axis or Enable Follow

Reason

- Occurrence of both reversed Z-axis motor direction and **zero drift** caused by external interference.
- Occurrence of **zero drift** alone.
  A simple method for determining whether there is **zero drift**:
  a. Power on the servo drive.
  b. Open the software to enable the servo drive. Check the drive display panel. If the values displayed on the panel are having big fluctuations, there is heavy external electric interference.
  c. Check the axis coupler where the Z-axis motor and lead screw is connected to see if it is having small rotations.

Solution

Execute Execute Calibration again.

4.4.8 Encoder Direction or Axis Direction Error

Reason

Encoder direction or axis direction parameters are not set correctly.

Solution

Follow the steps below to help troubleshoot:

- Modify the encoder direction parameter and see if the alarm disappears.
  If not, undo the encoder direction modification and modify the axis rotation direction.

- If both the axis direction and encoder direction are incorrect, reverse both the encoder direction and axis rotation values.

4.4.9 Follow In-position Waiting Timeout

Reason

- The value of **INposition Tolerance** is too small.
- Calibration data error.
- Influence of external slag discharge during machining.
- Follow overshooting.

Solution

Follow the steps below to help troubleshoot:

- Check the **INposition Tolerance** value.
  The recommended value is 0.1.
- Execute Execute Calibration again.
- Adjust the cutting technic settings.
- Check the follow parameters and drive parameter settings.
  Ensure that they are set correctly.

4.4.10 Large Follow Error Alarm

Reason

Within a certain period of time, the follow error is larger than the out-of-edge tolerance setting.

Solution

Follow the steps below to help troubleshoot:

- If this alarm was reported when the material surface is quite flat, it may have been caused by follow overshooting. In this case, check the servo drive gain value.
  If the value is too small, increase it as needed.
- If this alarm was reported during cutter lifting, the follow gain value may have been too small.

4.4.11 System Reports Material Collision Alarm when Follow is Enabled in Idle Status or During Machining

Reason

The current capacitance is equal to or smaller than the **Touch Part Capacitance** value.

Solution

Follow the steps below to help troubleshoot:

1. Set **Touch Part Capacitance** to a proper value.
   It is recommended that you use the default value (0).
2. If the alarm is reported when enabling the follow function:
   a. Ensure that **Pulse Equivalent**, **Feedback Pulse Count**, **Speed Gain** are set correctly.
   b. Ensure that the drive gain parameter is set correctly.
3. If the alarm is reported during machining:
   a. Ensure that there is no exception under manual following.
   b. Ensure that the capacitance change during blowing is less than 50.
4. If the alarm is still reported, increase the servo drive gain as needed.

4.4.12 System Reports Material Collision Alarm when the System Has No Movement

Reason

The current capacitance is equal to or smaller than the **Touch Part Capacitance** value.

Solution

Follow the steps below to help troubleshoot:

1. Ensure that the machine and material colliding capacitance are correct.
   If not, replace the machine and material colliding capacitors.
   The normal machine capacitance for SE001 later than V1.4 is about 650,000 while that for SE001 earlier than V1.4 is about 1.3 million.
2. Use a multimeter to measure the conductivity of the copper core between the cutter nozzle and sensor.
   If the conductivity is zero, the cutter is damaged.
3. Use a multimeter to measure the conductivity of the copper core between the cutter nozzle and RF cable.
   If the conductivity is zero, the RF cable is damaged.
4. Check to see if the resistance between the No.1 and No.2 ports of SE001 is 4.8 KΩ–5.3 KΩ (tolerance≤5%) and if the resistance between the No.2 and No.4 ports is 0 Ω–1 Ω.
   If not, SE001 is damaged. Replace it.
5. Measure the conductivity of the corresponding pins of the M16 three-core aviation cable.
   If the conductivity is zero, replace the cable.
6. If the alarm is still reported, replace the EX33A extension terminal board.

4.4.13 Follow Overshoot

Reason

The speed of servo drive response is slower than the command speed.

Solution

Follow the steps below to help troubleshoot:

1. Ensure that **Pulse Equivalent**, **Speed Gain**, **Pulse Counter Per Turn** are set correctly.
2. Increase the servo drive gain.
3. Ensure matching between the Z axis maximum speed and dry run speed. The Z axis dry run speed can be lowered by certain amount if needed.

5 Wiring

5.1 Controller and Terminal Board

This section introduces the port definitions of the Lambda controllers and extension terminal board.

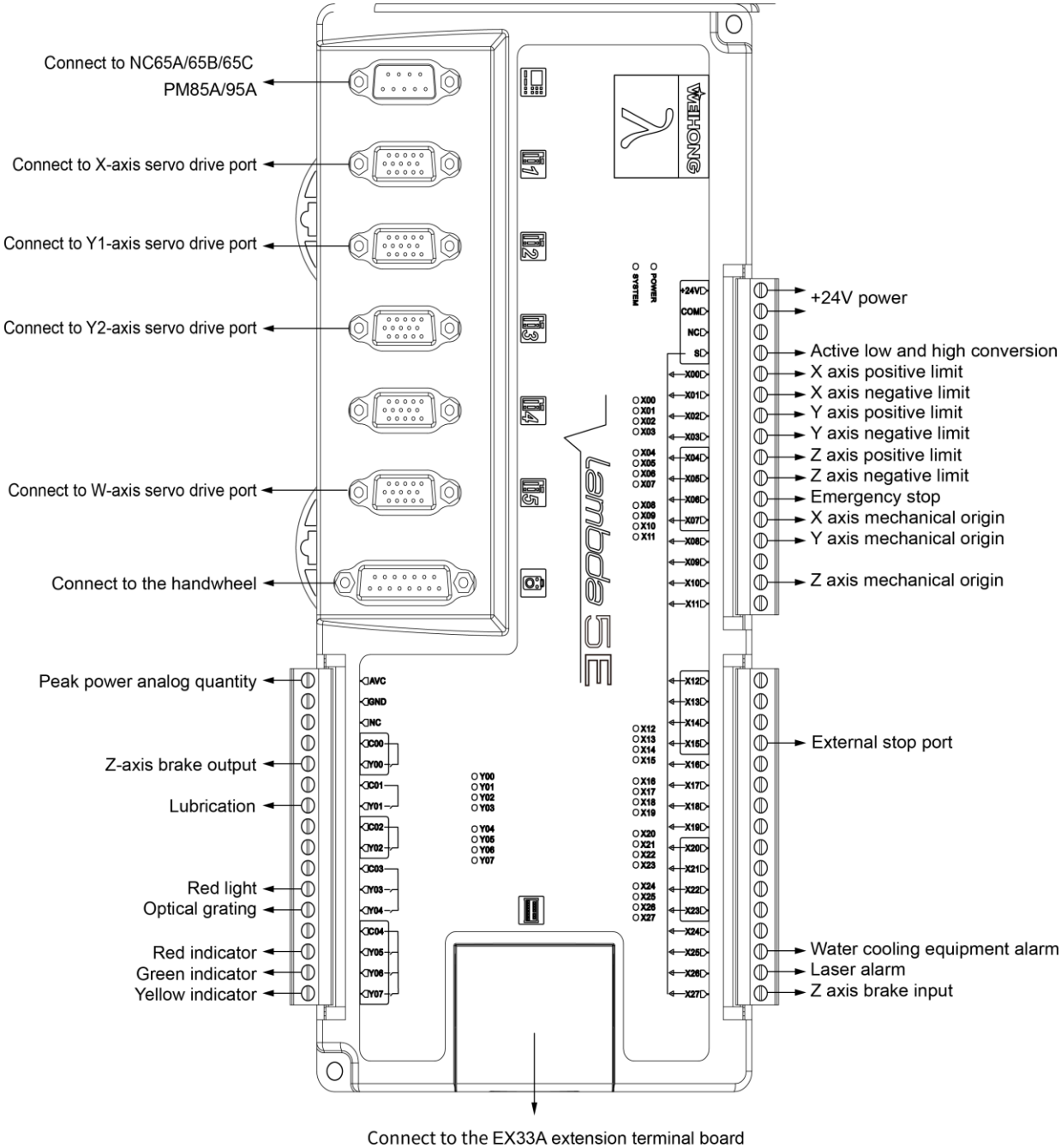
5.1.1 Lambda Controller

Different Lambda controllers need to be used based on the system type:

- Non-bus systems: Lambda 5E
- Bus systems: Lambda NE

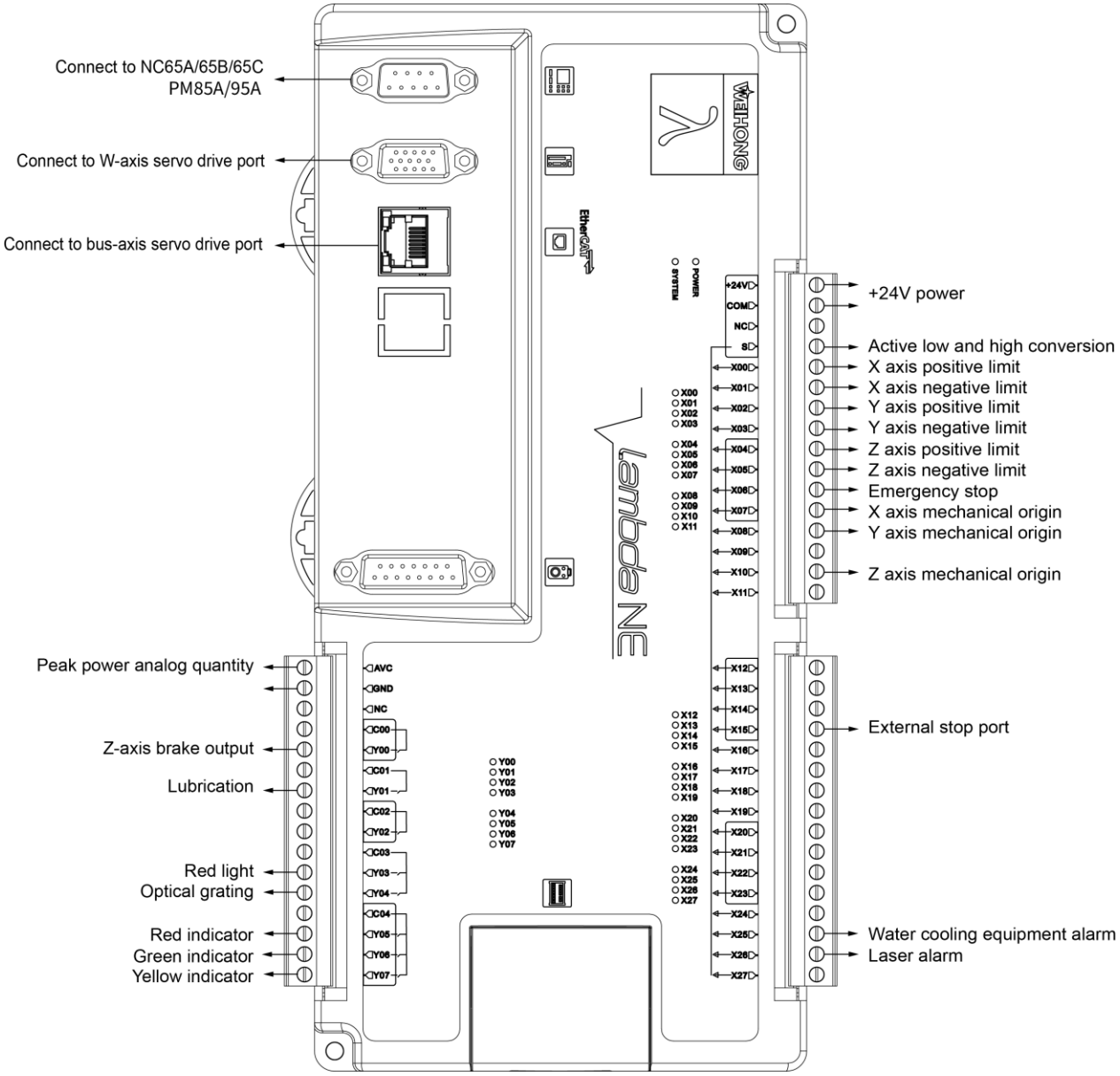
Lambda 5E

The port definitions are shown below:



Lambda NE

The port definitions are shown below:

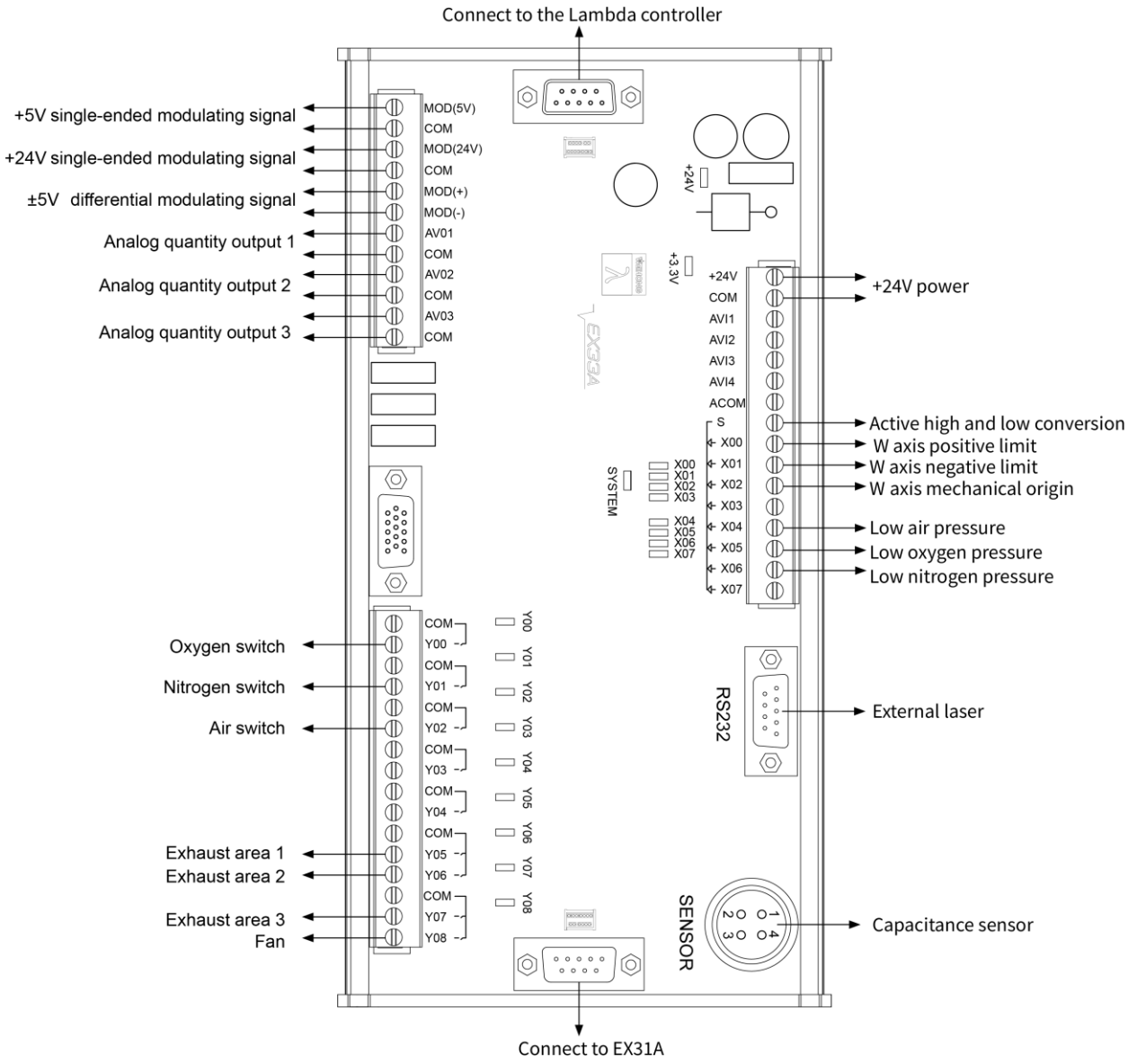


5.1.2 Extension Terminal Board

The port definitions of EX33A and EX31A extension terminal boards are the same in bus or non-bus control systems.

EX33A extension terminal board

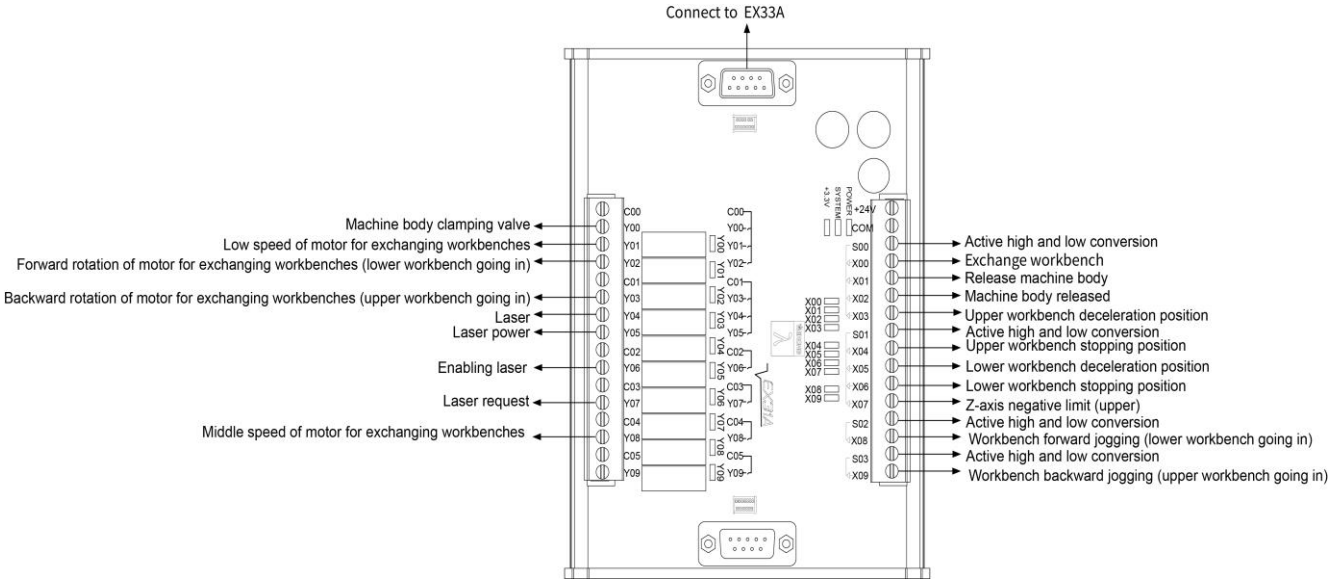
The port definitions are shown below:



- Output working voltage: 24V.
- Port **COM**: 0V output.
- Rated current: 200 mA.
- Darlington transistor.

EX31A extension terminal board

The port definitions are shown below:



5.2 Laser

This section introduces wiring methods for different brands of lasers.

Before connecting the laser, do the following preparation:

- Connect to applicable pulse modulation signals based on the laser.
  The pulse modulation signals provided by the **NcStudio V15 laser cutting control system** and the corresponding EX33A ports are shown below:
  - +24V single-ended signal: MOD(24V) & COM
  - +5V single-ended signal: MOD(5V) & COM
  - ±5V differential signal: MOD(+) & MOD(-)
- If the laser supports RS232 communication, you can use a DB9 cable to connect the laser RS232 port to the EX33A RS232 to achieve communication between the laser and the software.
  RS232 is a serial communication standard developed by the U.S. Electronic Industry Association along with Bell System, and modem and computer manufacturers.
  It is applicable to communication with a data transmission rate of 0 b/s–20000 b/s. Commonly used for communication within 20m.

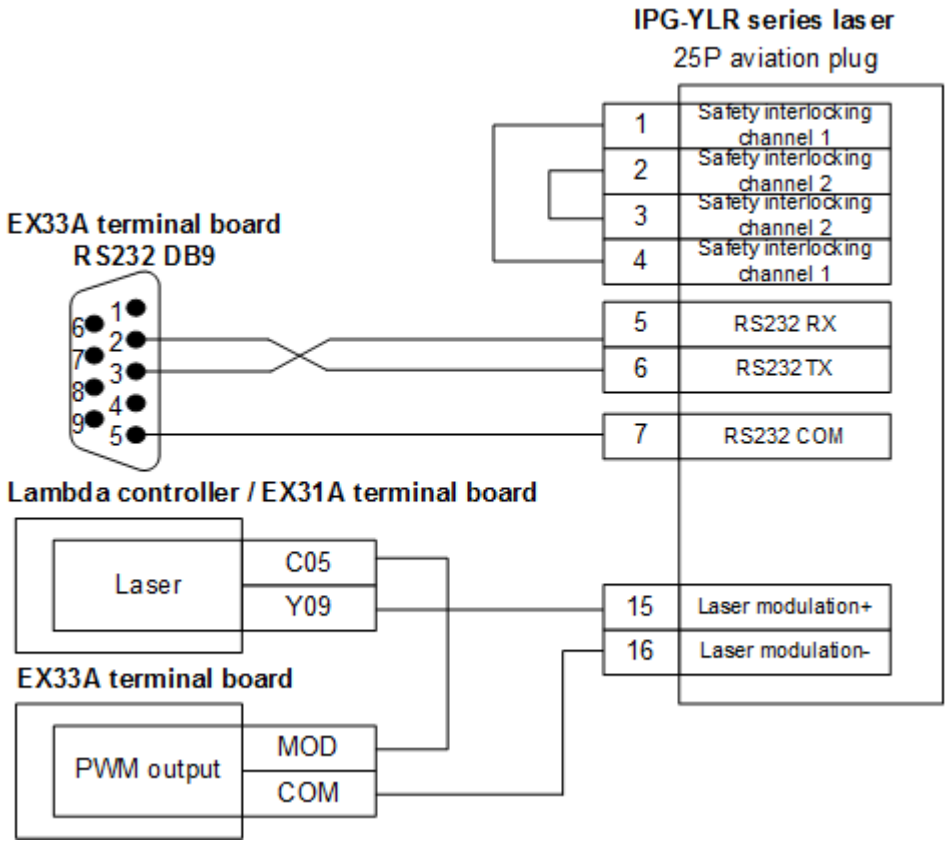
The wiring diagrams for the following lasers are provided below for your reference:

- IPG-YLR series laser
- Feibo MARS-500W laser
- Raycus optical fiber laser
- JK / GSI-500W-FL laser
- MAX optical fiber laser
- SPI-500W-R4 laser
- HFB 1000-1500W laser
- GW SMATLas 3S laser

Note: All MOD pins of EX33A extension terminal boards shown in the following diagrams are MOD(24V).

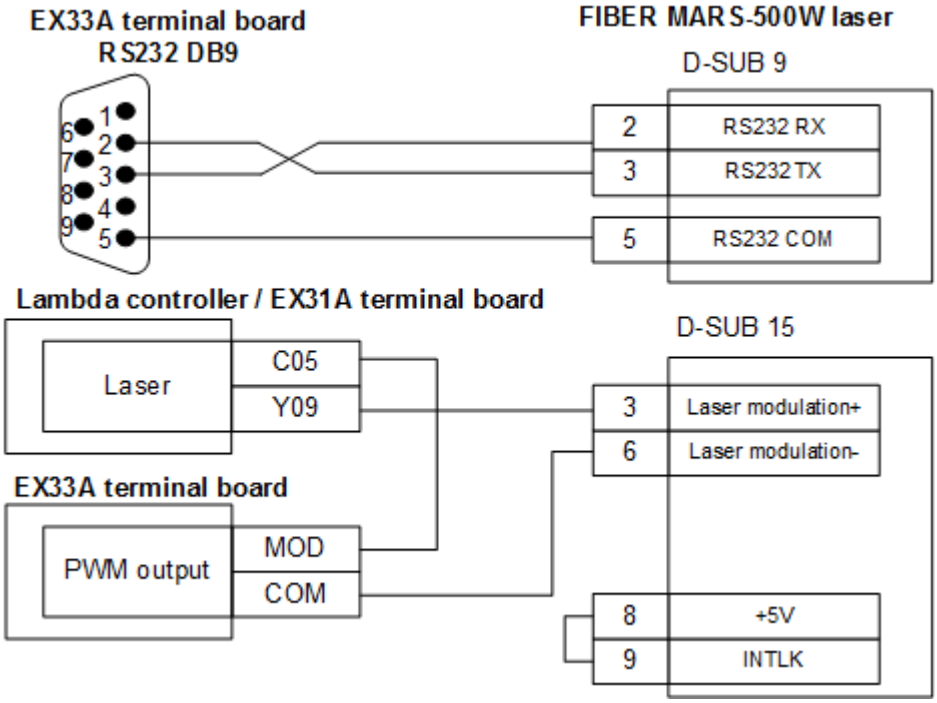
5.2.1 IPG-YLR Series Laser

The wiring diagram is shown below:



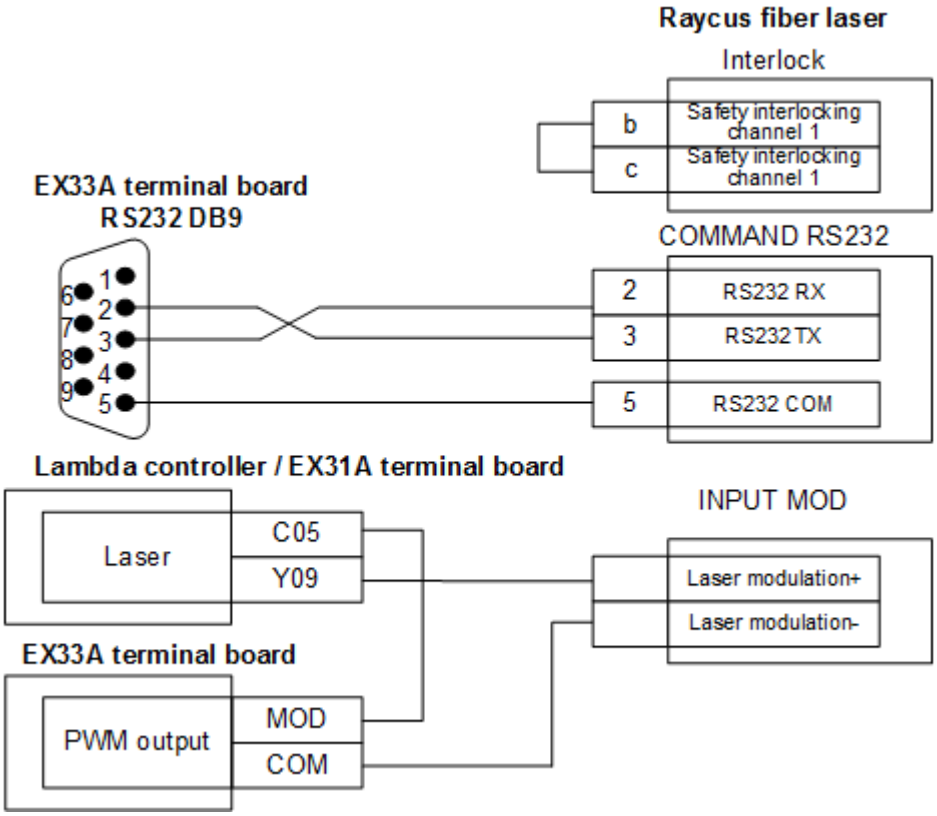
5.2.2 Feibo MARS-500W Laser

The wiring diagram is shown below:



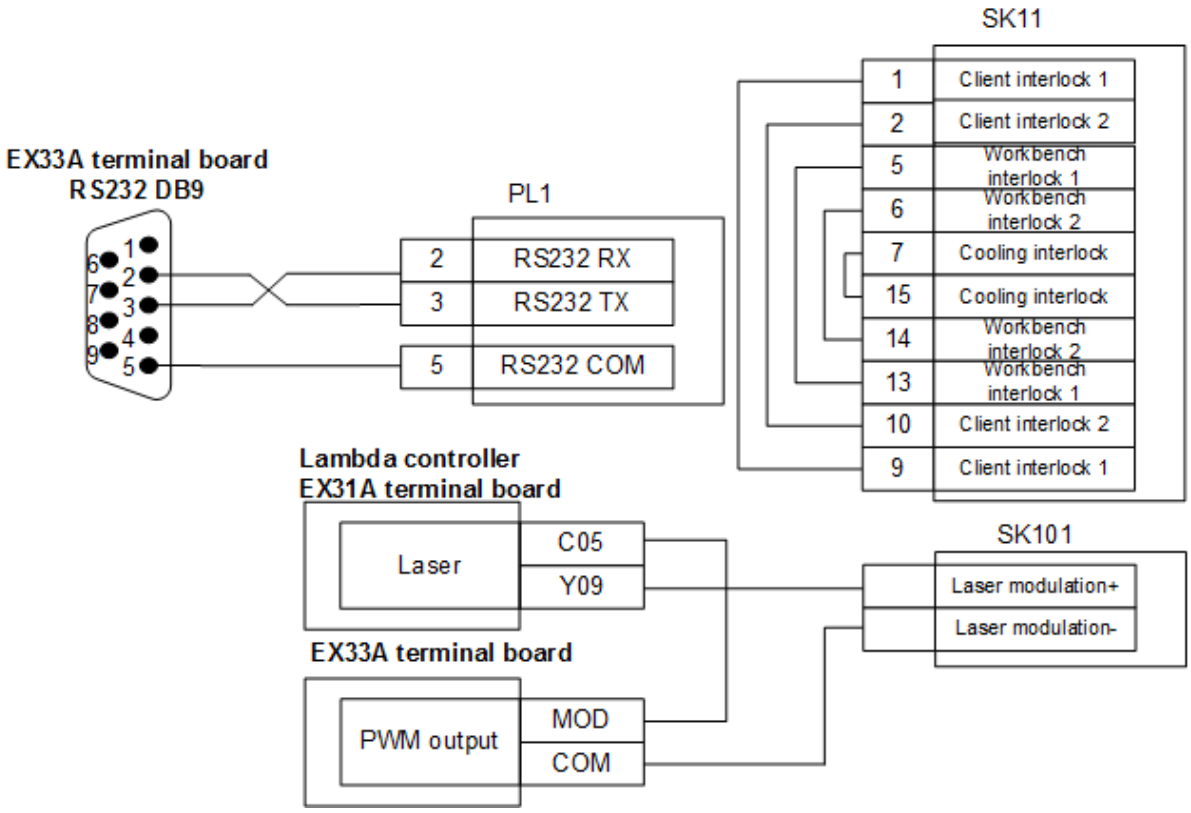
5.2.3 Raycus Fiber Laser

The wiring diagram is shown below:



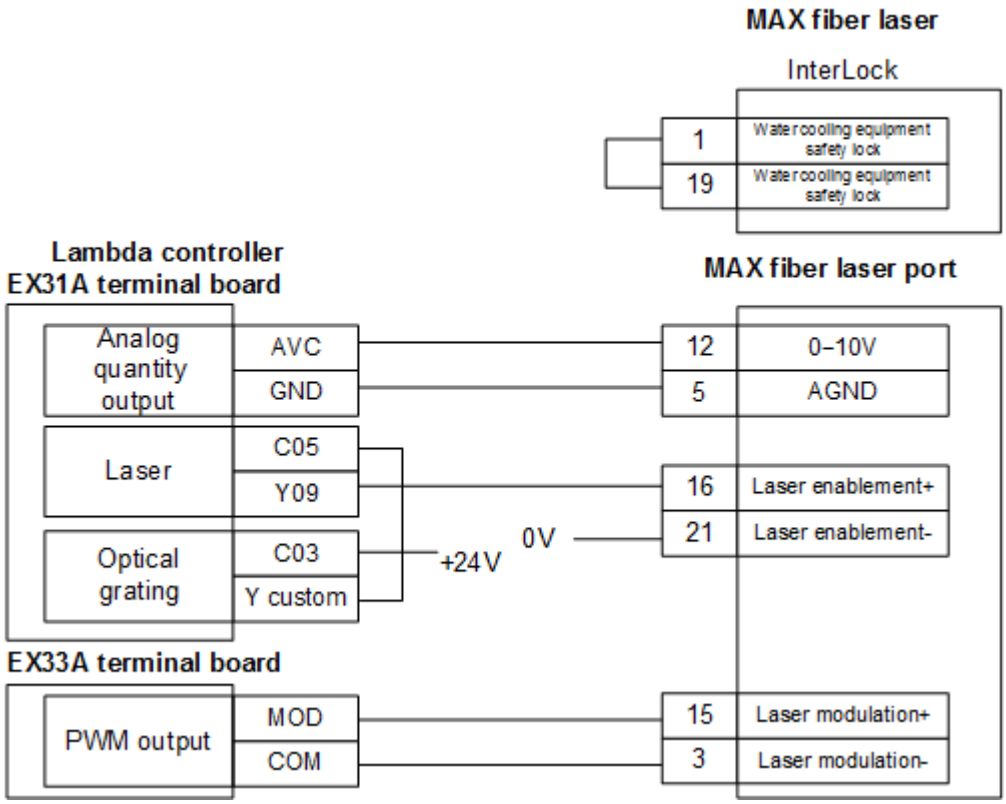
5.2.4 JK / GSI-500W-FL Laser

The wiring diagram is shown below:



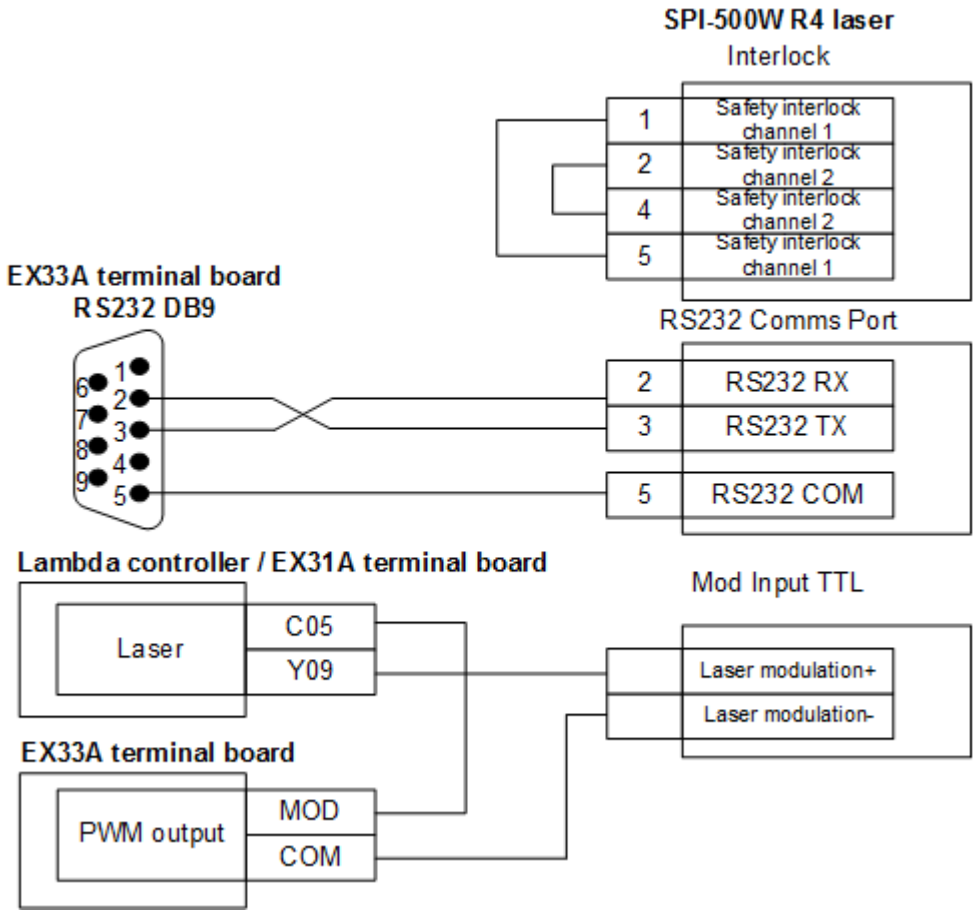
5.2.5 MAX Fiber Laser

The wiring diagram is shown below:



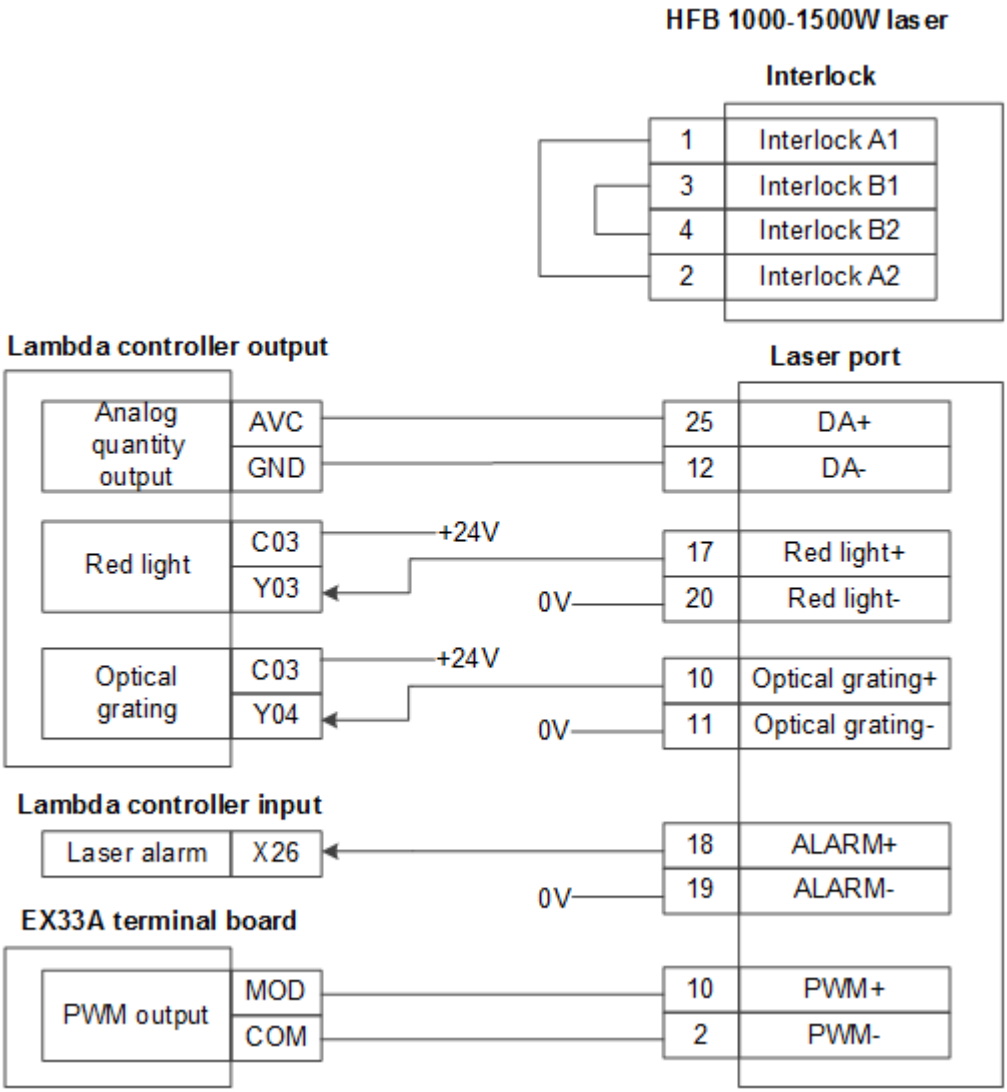
5.2.6 SPI-500W-R4 Laser

The wiring diagram is shown below:



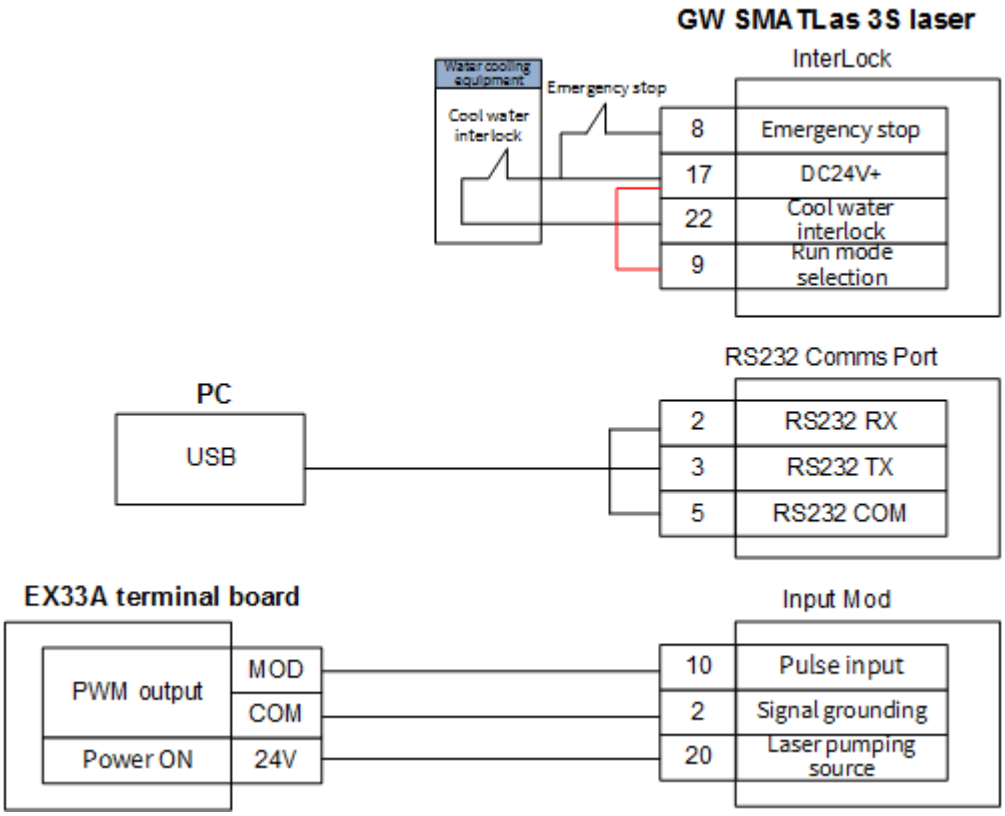
5.2.7 HFB 1000-1500W Laser

The wiring diagram is shown below:



5.2.8 GW SMATLas 3S Laser

The wiring diagram is shown below:



5.3 Wiring Diagram of the Drive

This section introduces how to connect WEIHONG DB15 drive port to different brands of servo motors.

Drive wiring methods may vary based on the control mode. Check the drive port definition before referring to the following wiring diagrams:

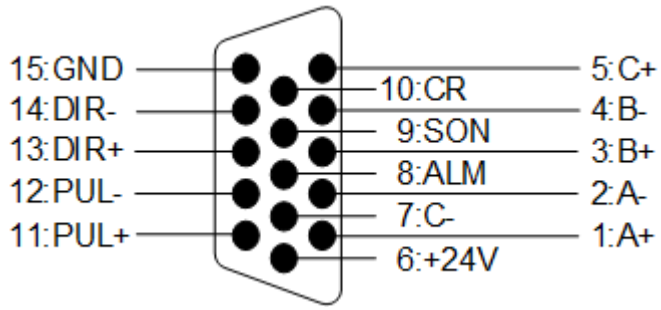
- Wiring Diagram of the Drive (in Position Control Mode)
- Wiring Diagram of the Drive (in Velocity Control Mode) (Exclusive for laser cutting industry)

5.3.1 Drive Port Definition

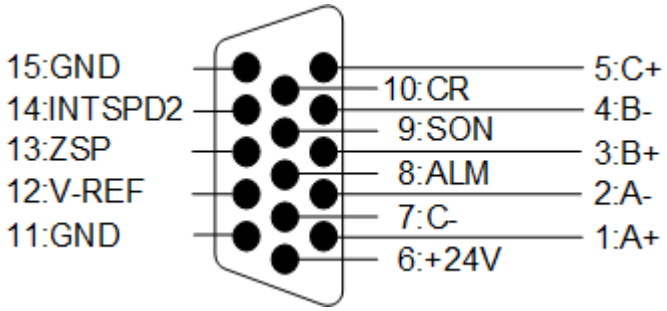
The WEIHONG servo drive plug has three-row DB15 holes.

The definitions are shown as follows:

- Position control mode



- Velocity control mode



Descriptions of the holes and signals are as follows:

Signal	Definition	Input/Output	Remark
A+, A-	Feedback signal of encoder phase A	Input Differential signal transmission mode	It is used to receive the differential output of encoder phase A signal from drive frequency divider (equal to RS422).
B+, B-	Feedback signal of encoder phase B	Input Differential signal transmission mode	It is used to receive the differential output of encoder phase B signal from drive frequency divider (equal to RS422).
C+, C-	Feedback signal of encoder phase C	Input Differential signal transmission mode	It is used to receive the differential output of encoder phase C signal from drive frequency divider (equal to RS422).
ALM	Drive alarm signal	Input	When the drive detects failure, this output (transistor) switch will be closed or disconnected.
SON	Servo ON signal	Output	It is used to turn on (power on) and turn off (power off) servo motor. When it is connected to COM, dynamic brake will be released and the drive is allowed to work (servo enabled).
CLR	Drive alarm clear signal	Output	It is used to remove alarms/warnings.
PUL+, PUL-	Pulse output	Output Differential signal transmission mode	-
DIR+, DIR-	Direction output	Output	-

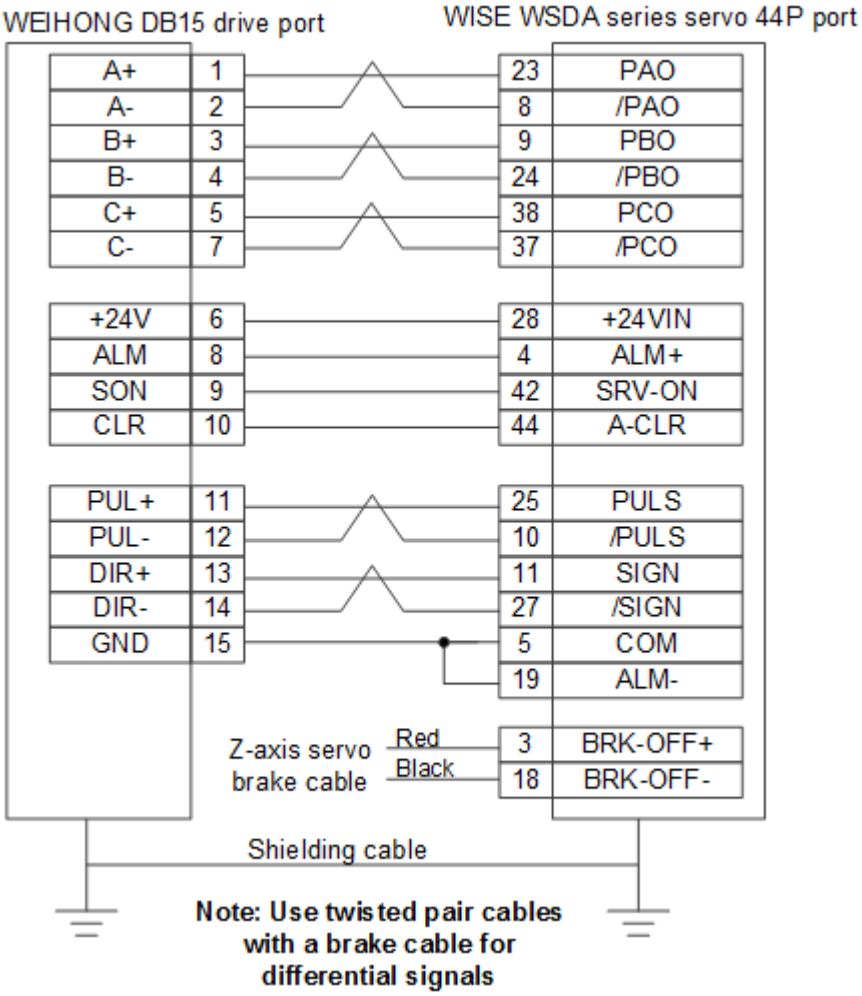
Signal	Definition	Input/Output	Remark
		Differential signal transmission mode	
INTSPD2	Internal command speed option 2	Output	-
ZSP	Speed zero clamp detection signal	Output	In speed zero clamp detection status, the output transistor is turned on.
V-REF	Analog speed command	Output	-
+24V, GND	DC 24V power	Output	It is connected to drive.

5.3.2 Wiring Diagram of the Drive (in Position Control Mode)

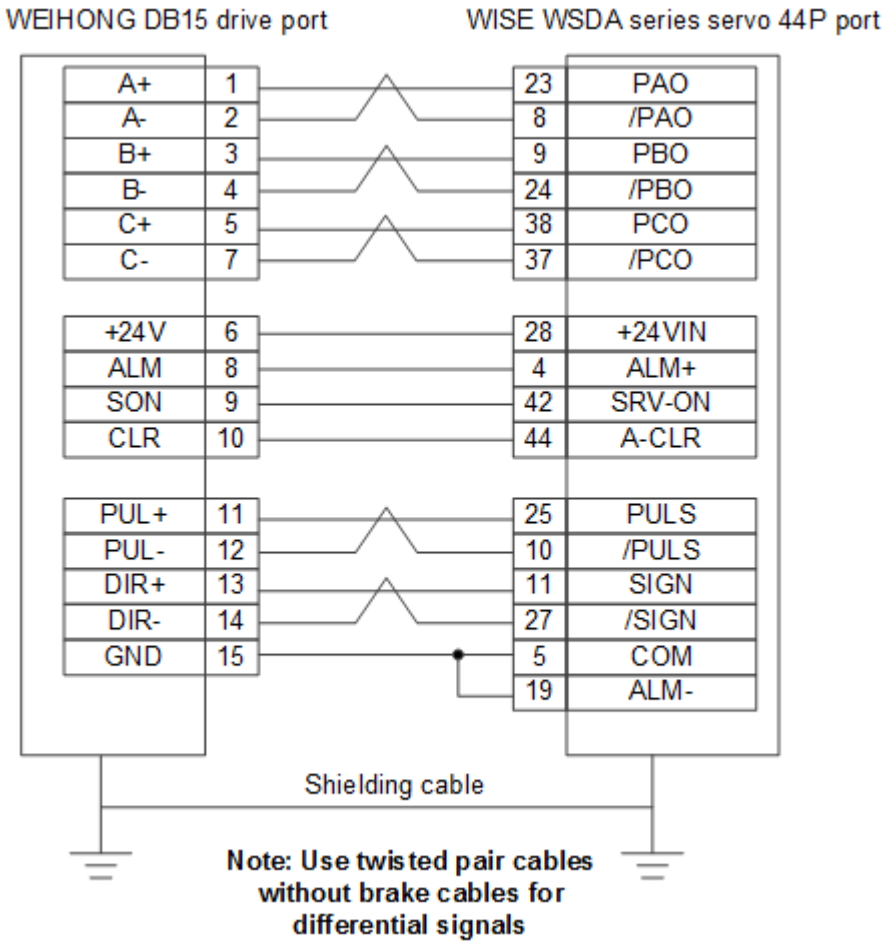
5.3.2.1 Wiring Diagram of WISE Servo Drive

The wiring diagram is as follows:

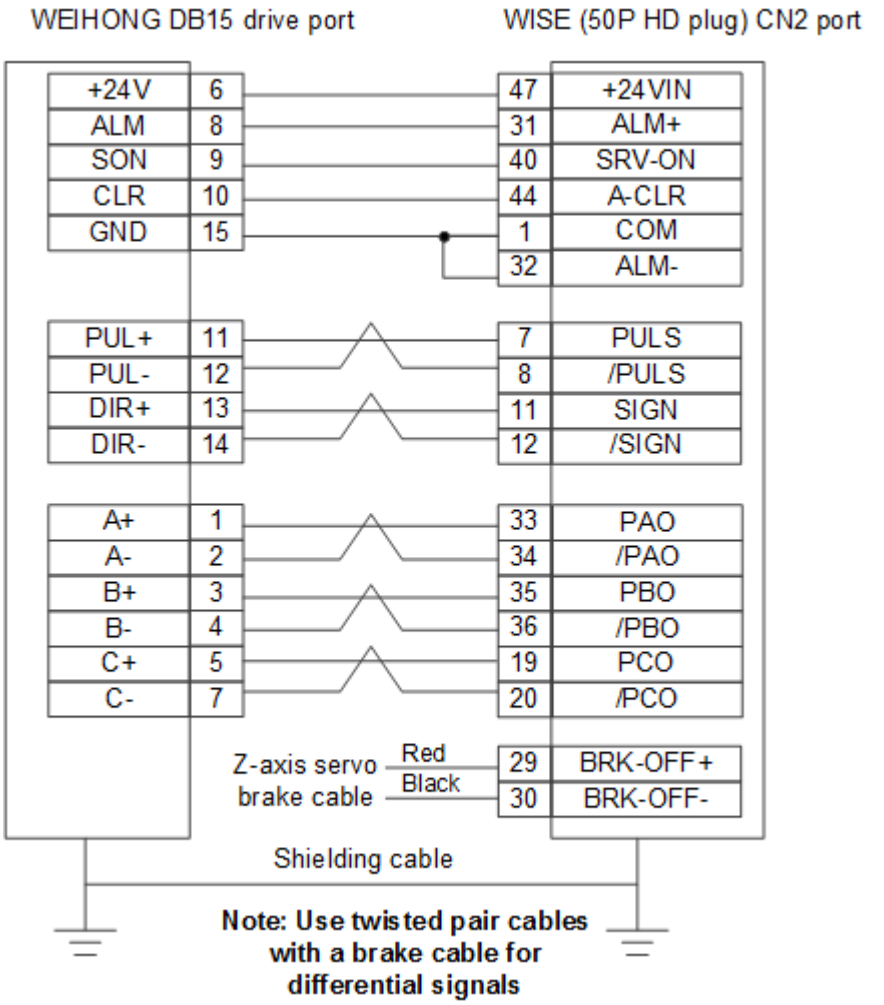
- With brake lines (44P interface)



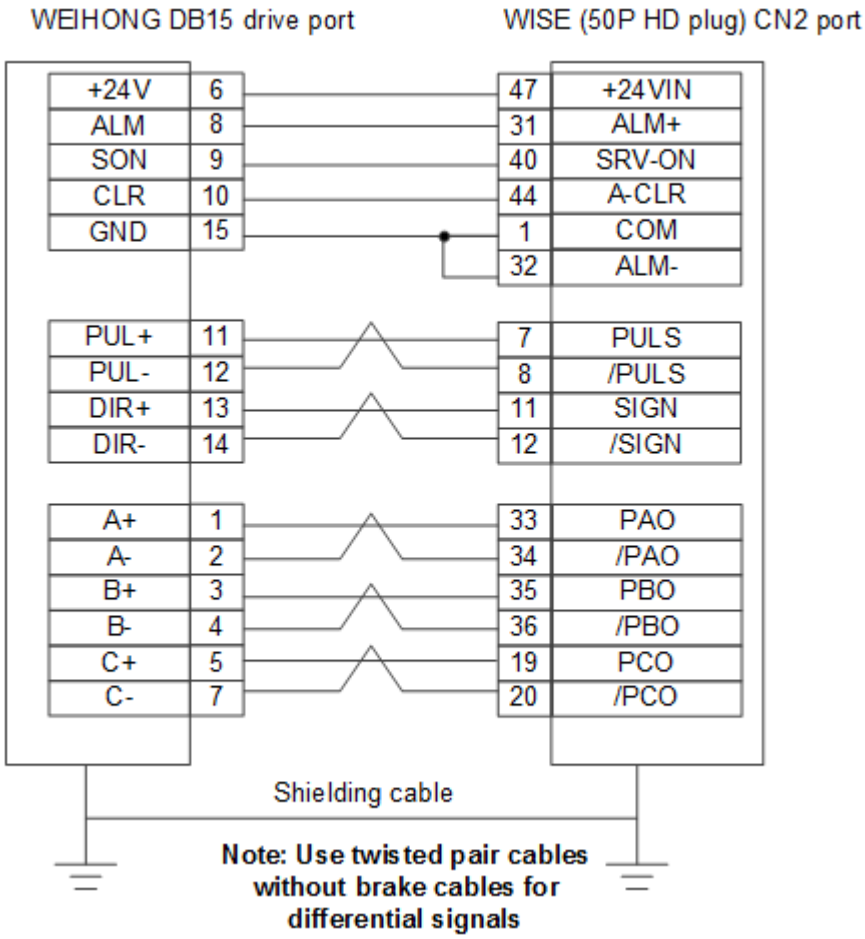
- Without brake lines (44P interface)



- With brake lines (50P HD plug)



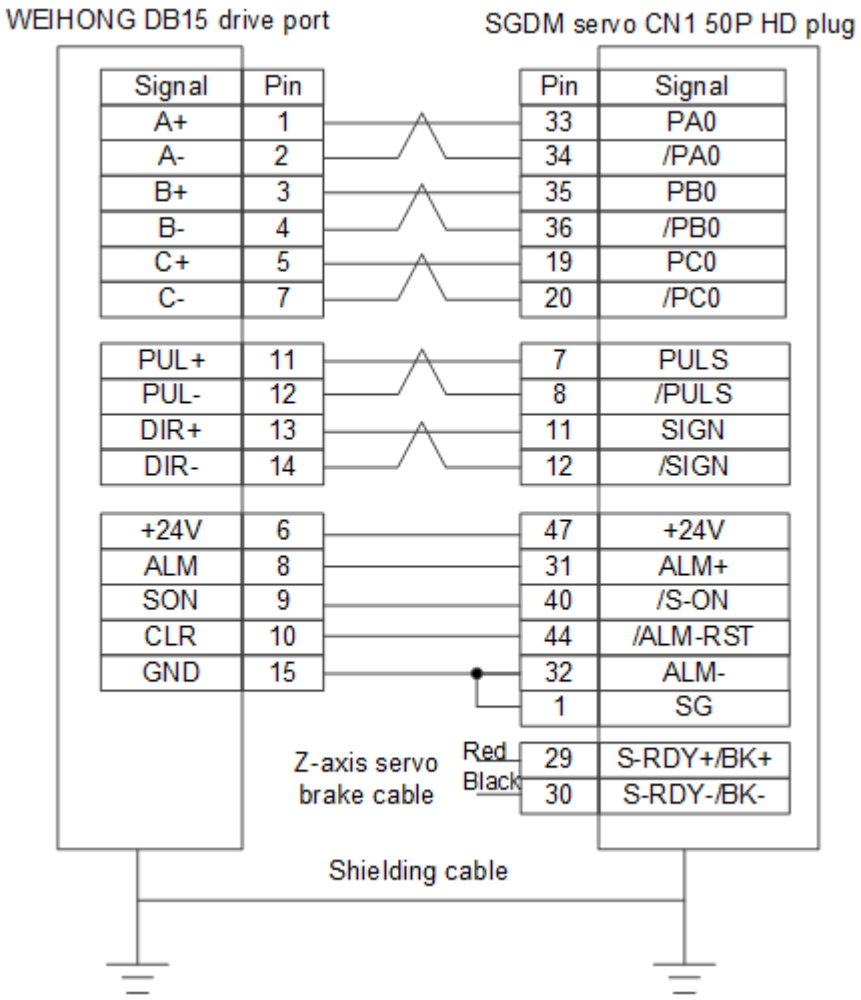
- Without brake lines (50P HD plug)



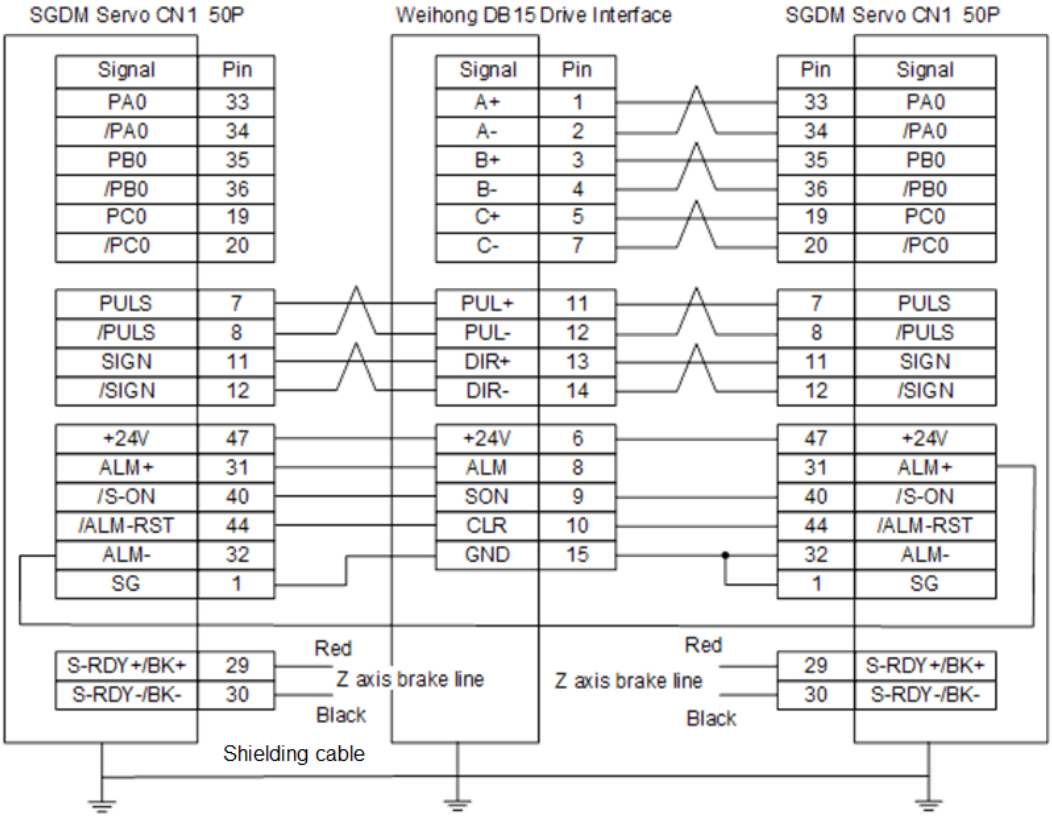
5.3.2.2 Wiring Diagram of YASKAWA Σ-Ⅱ/Σ-Ⅴ/Σ-7 Servo Drive

The wiring diagram is as follows:

- Common:


WEIHONG DB15 drive port
SGDM servo CN1 50P HD plug
Signal
Pin
Pin
Signal
A+ 1 33 PA0
A- 2 34 /PA0
B+ 3 35 PB0
B- 4 36 /PB0
C+ 5 19 PC0
C- 7 20 /PC0
PUL+ 11 7 PULS
PUL- 12 8 /PULS
DIR+ 13 11 SIGN
DIR- 14 12 /SIGN
+24V 6 47 +24V
ALM 8 31 ALM+
SON 9 40 /S-ON
CLR 10 44 /ALM-RST
GND 15 32 ALM-
1 SG
Z-axis servo brake cable
Red
Black
29 S-RDY+/BK+
30 S-RDY-/BK-
Shielding cable

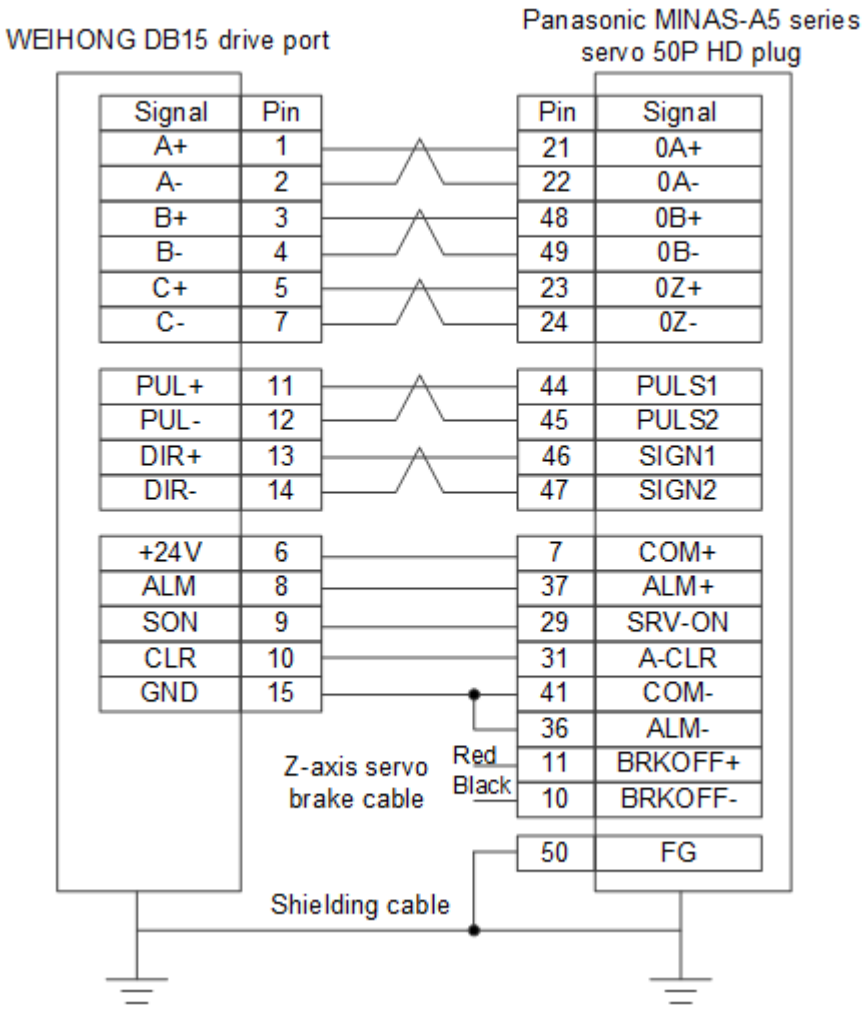
- One-to-two:



5.3.2.3 Wiring Diagram of Panasonic Servo Drive

Wiring diagram is as follows:

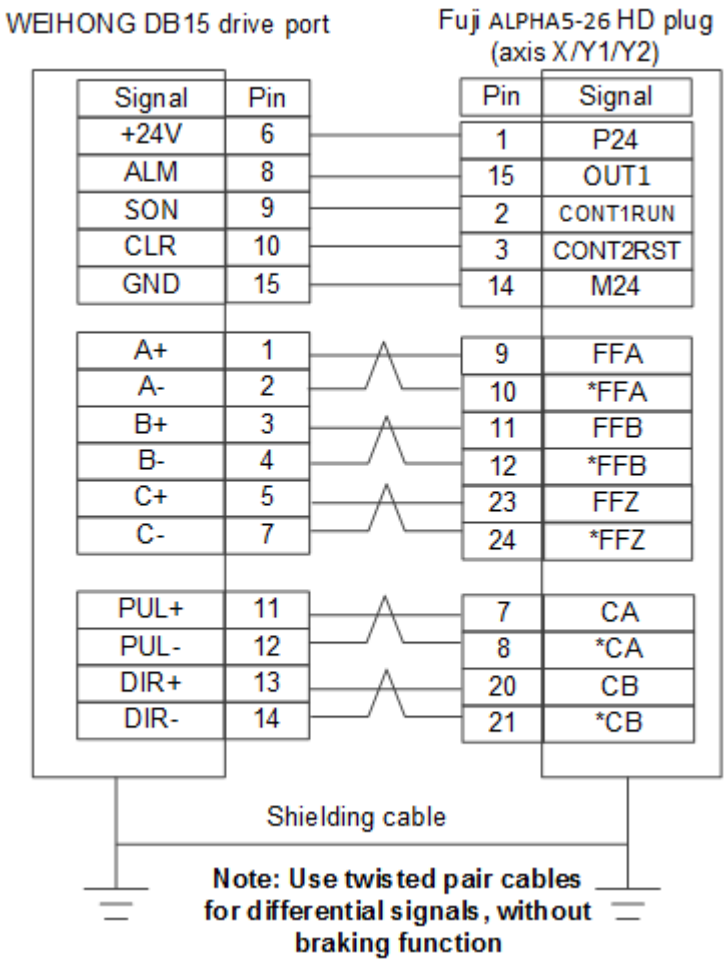
- Common:



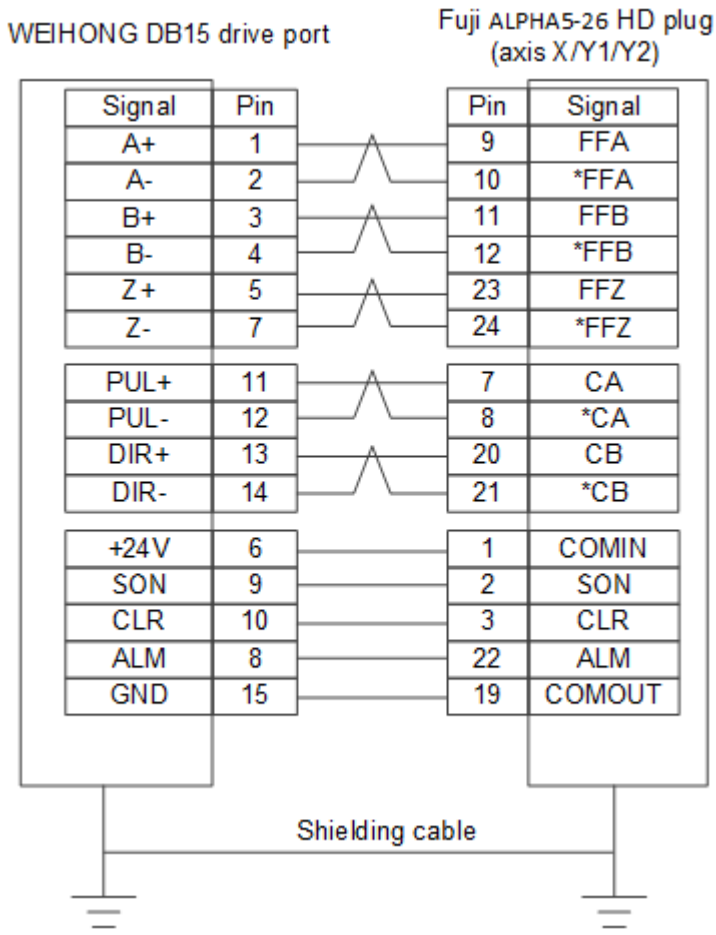
5.3.2.4 Wiring Diagram of Fuji Servo Drive

Wiring diagram is as follows:

- Common:



- Fuji alpha5 plus (axis X/Y1/Y2)

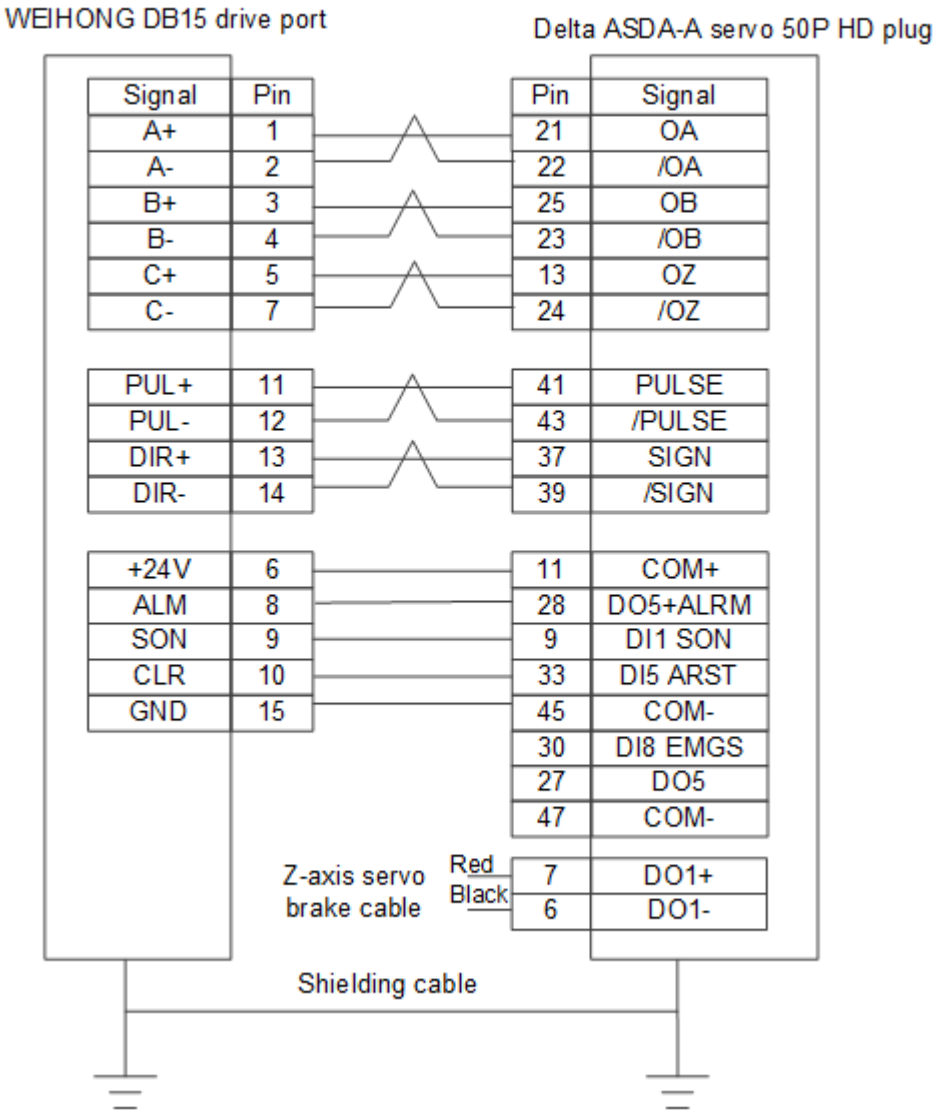


5.3.2.5 Wiring Diagram of Delta Servo Drive

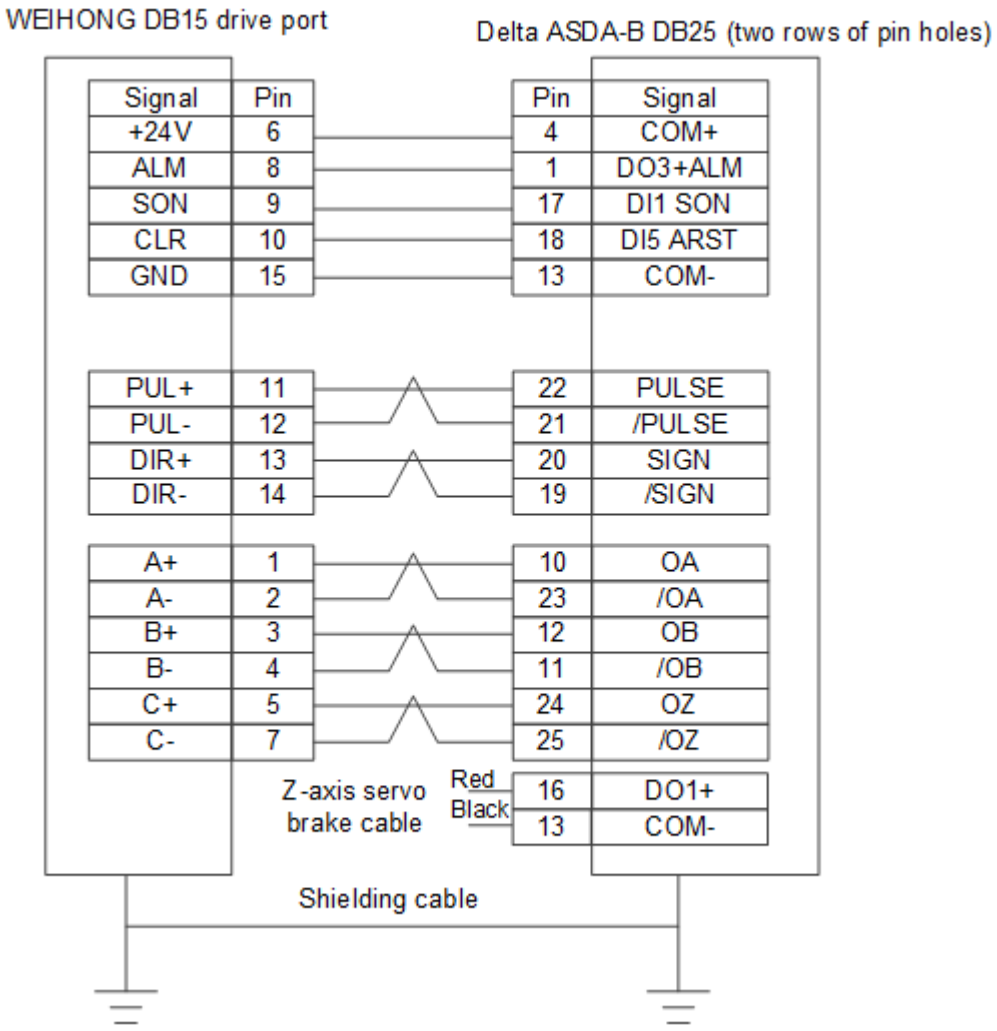
Delta ASDA-A, ASDA-B, ASDA-B (one-to-two), and ASDA-B2 servo drives use the same type of cables.

Wiring diagrams are as follows:

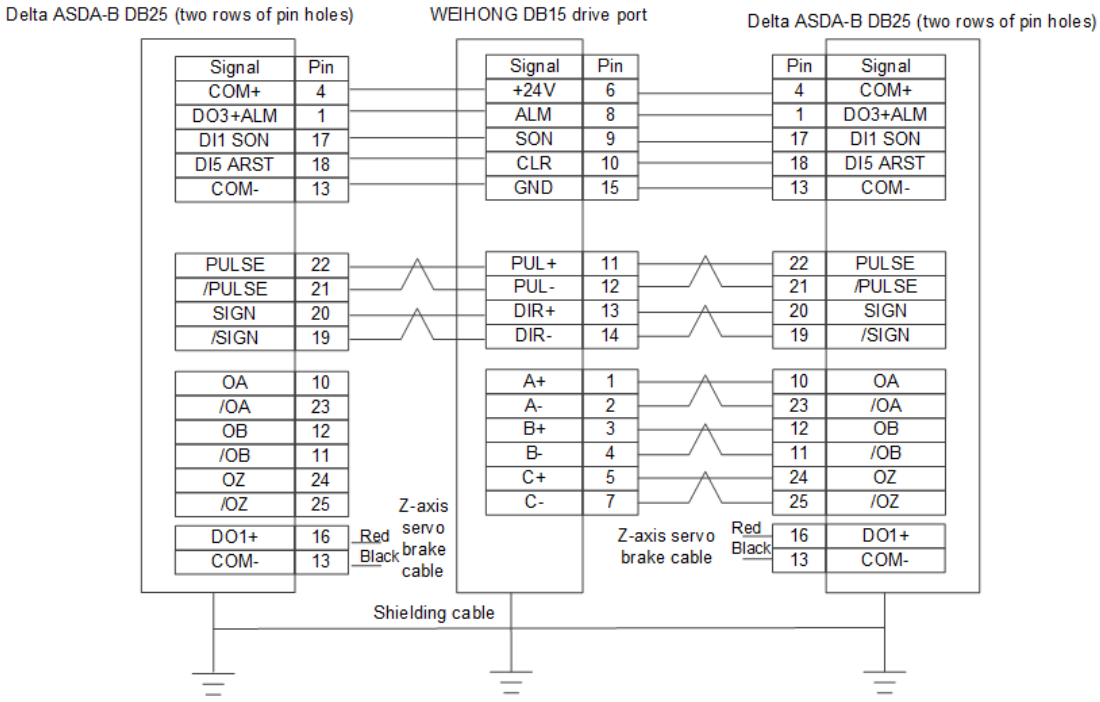
- Delta ASDA-A


WEIHONG DB15 drive port
Delta ASDA-A servo 50P HD plug
Signal
Pin
Pin
Signal
A+ 1 21 OA
A- 2 22 /OA
B+ 3 25 OB
B- 4 23 /OB
C+ 5 13 OZ
C- 7 24 /OZ
PUL+ 11 41 PULSE
PUL- 12 43 /PULSE
DIR+ 13 37 SIGN
DIR- 14 39 /SIGN
+24V 6 11 COM+
ALM 8 28 DO5+ALRM
SON 9 9 DI1 SON
CLR 10 33 DI5 ARST
GND 15 45 COM-
30 DI8 EMGS
27 DO5
47 COM-
Z-axis servo brake cable
Red
Black
7 DO1+
6 DO1-
Shielding cable

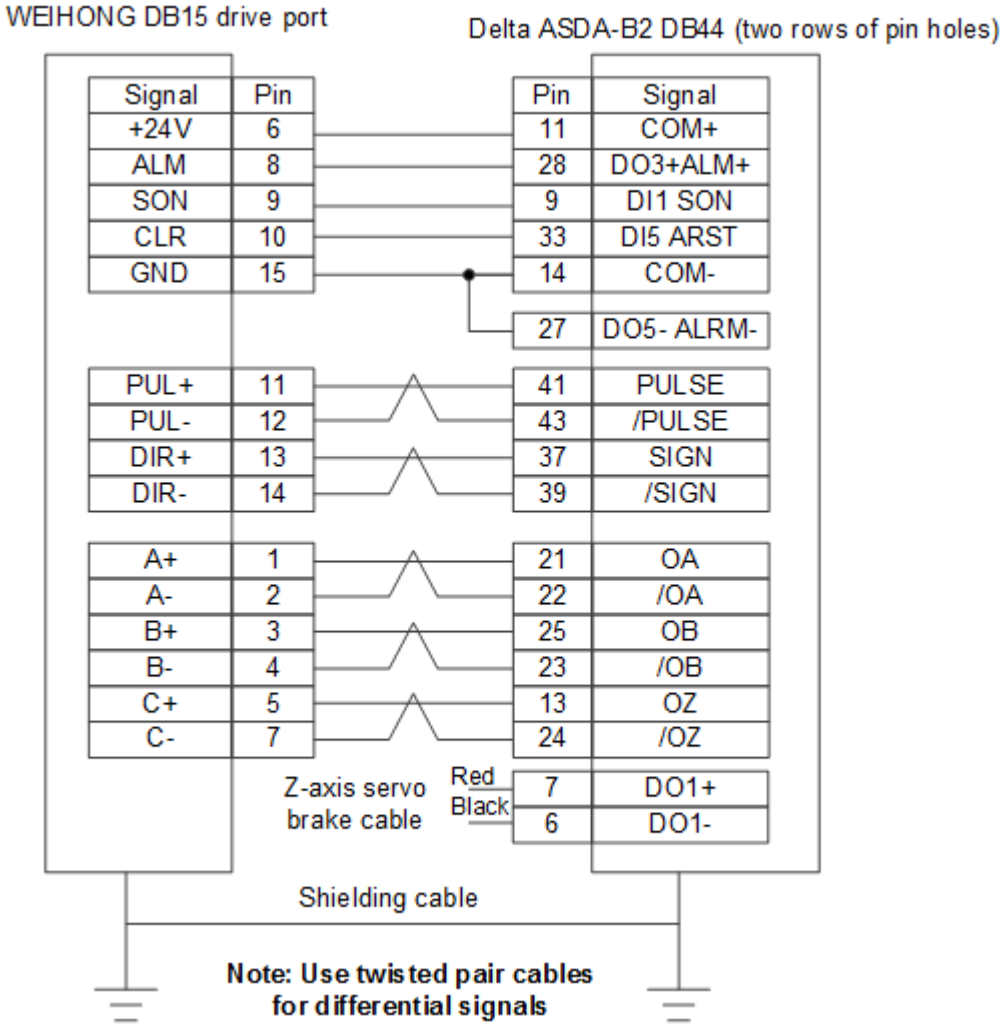
- Delta ASDA-B



- Delta ASDA-B (one-to-two)



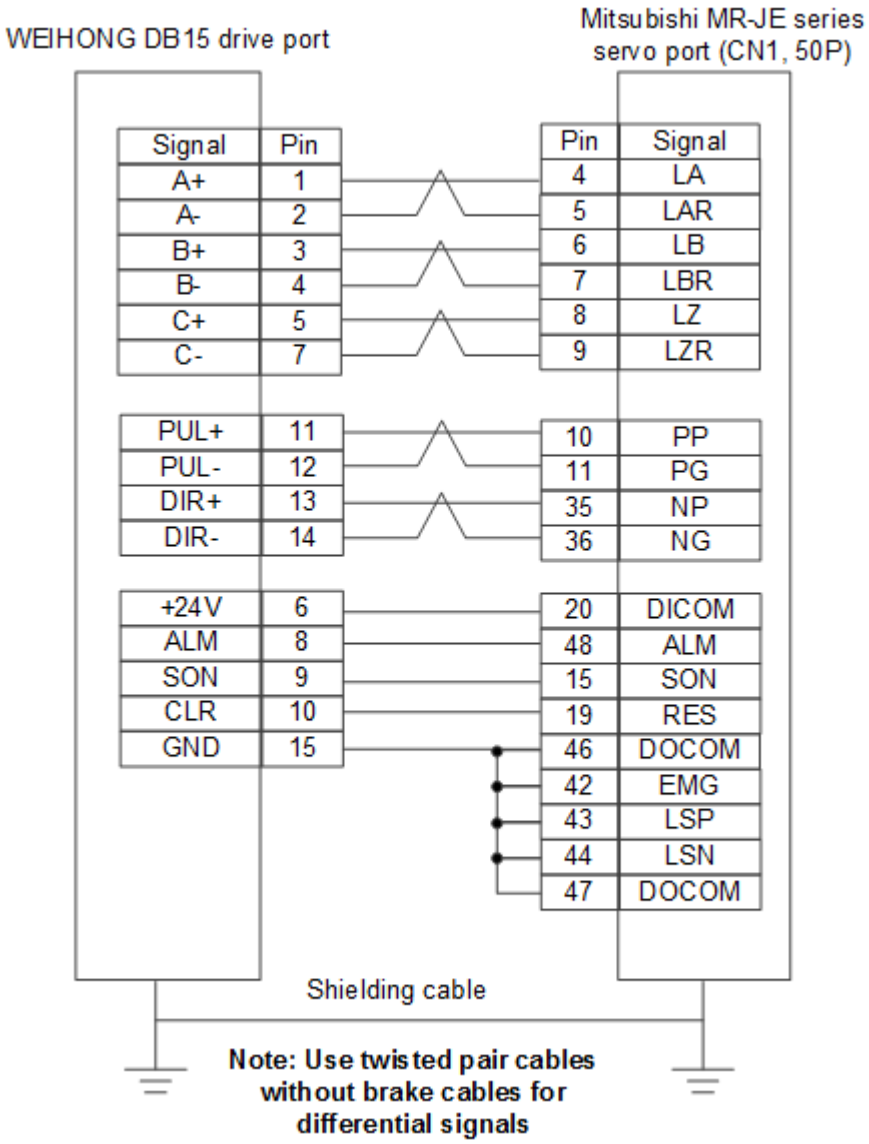
- Delta ASDA-B2



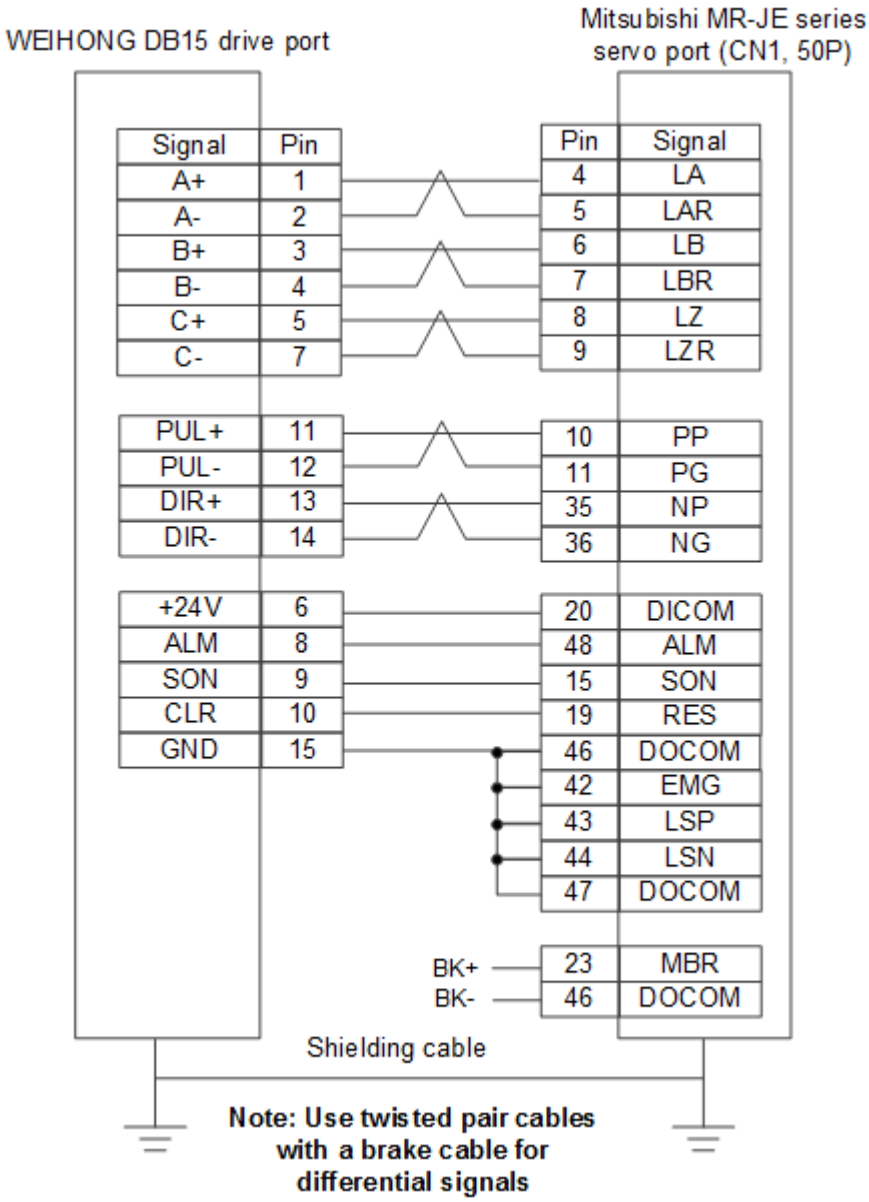
5.3.2.6 Wiring Diagram of Mitsubishi Servo Drive

Wiring diagrams are as follows:

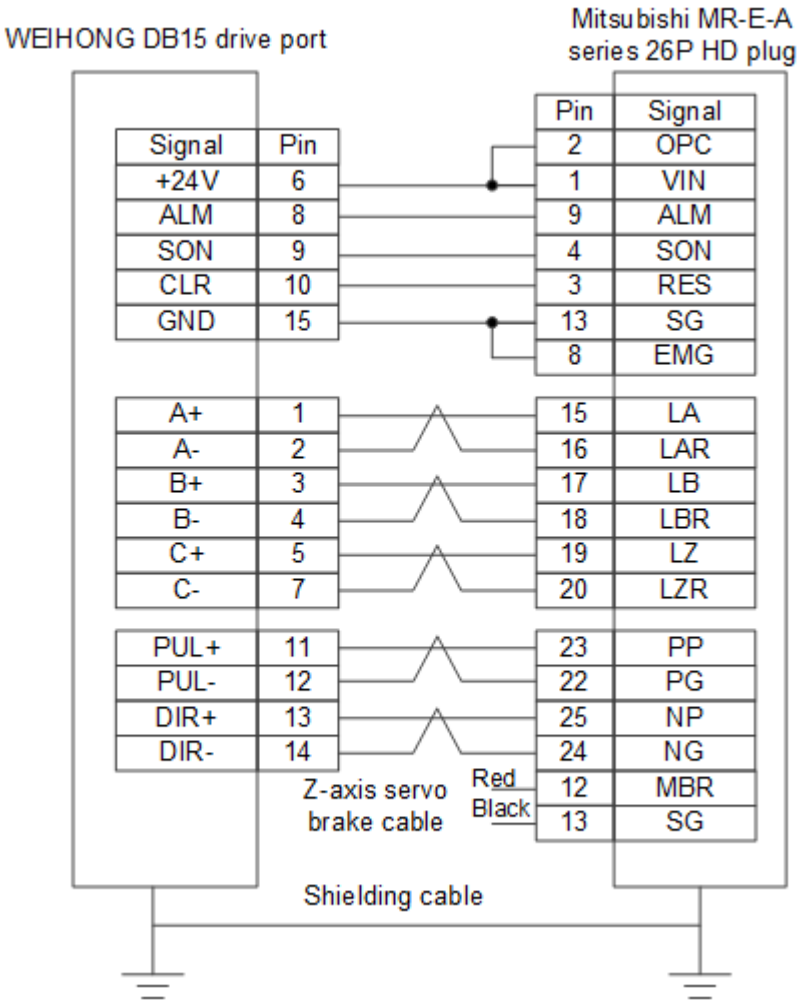
- MR-JE (without brake cable)



- MR-JE (with brake cable)

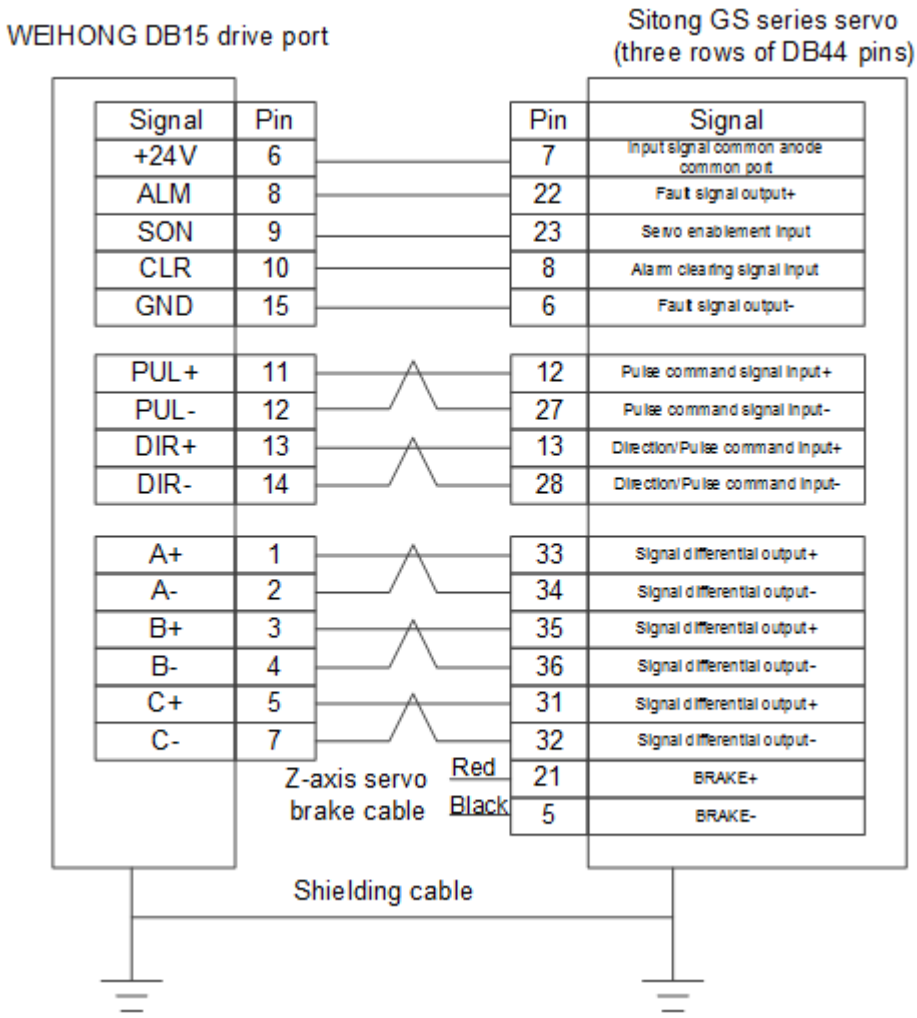

WEIHONG DB15 drive port
Mitsubishi MR-JE series servo port (CN1, 50P)
Signal
Pin
A+ 1
A- 2
B+ 3
B- 4
C+ 5
C- 7
PUL+ 11
PUL- 12
DIR+ 13
DIR- 14
+24V 6
ALM 8
SON 9
CLR 10
GND 15
Pin
Signal
4 LA
5 LAR
6 LB
7 LBR
8 LZ
9 LZR
10 PP
11 PG
35 NP
36 NG
20 DICOM
48 ALM
15 SON
19 RES
46 DOCOM
42 EMG
43 LSP
44 LSN
47 DOCOM
BK+ 23 MBR
BK- 46 DOCOM
Shielding cable
Note: Use twisted pair cables with a brake cable for differential signals

- MR-E



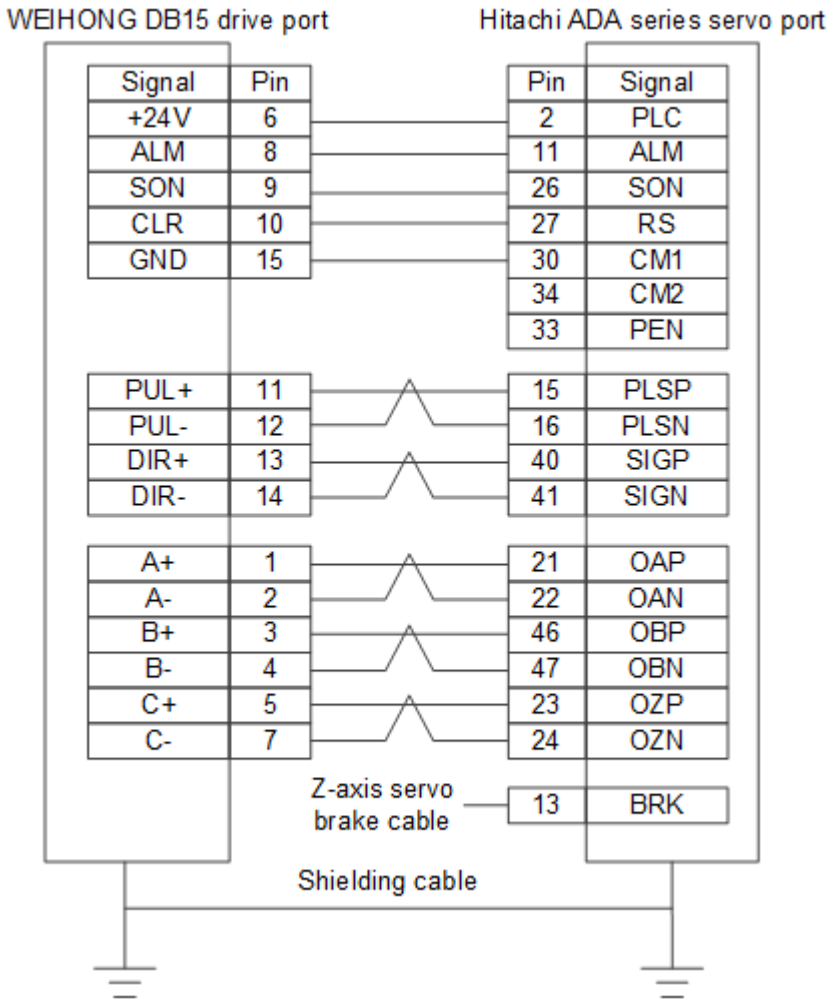
5.3.2.7 Wiring Diagram of Sitong Servo Drive

The wiring diagram is as follows:



5.3.2.8 Wiring Diagram of Hitachi Servo Drive

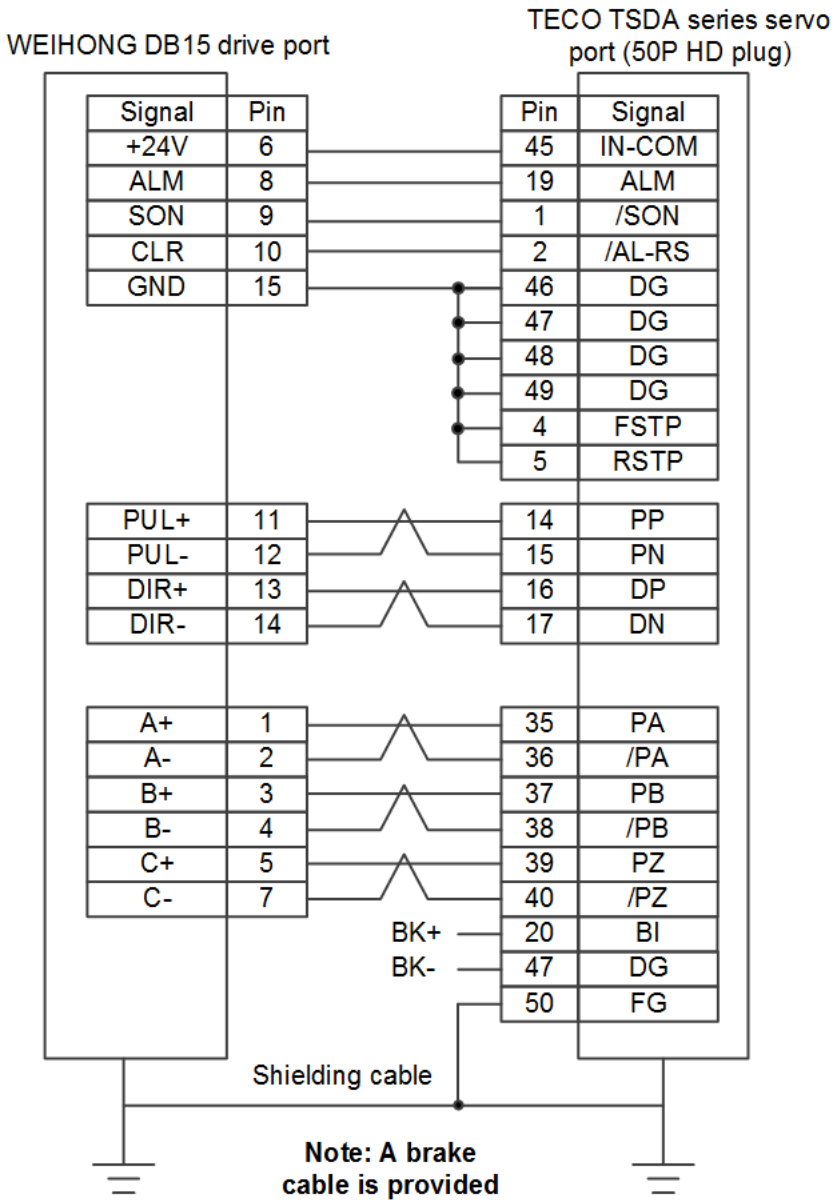
The wiring diagram is as follows:



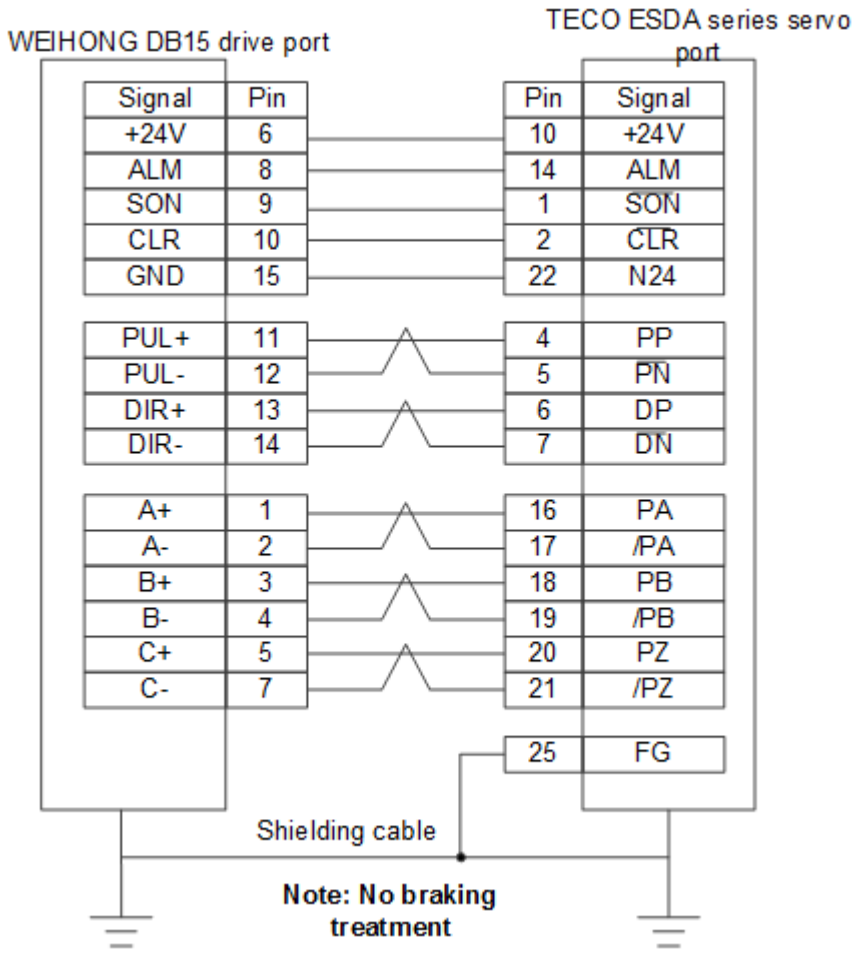
5.3.2.9 Wiring Diagram of Teco Servo Drive

Wiring diagrams are as follows:

- TSDA


WEIHONG DB15 drive port
TECO TSDA series servo port (50P HD plug)
Signal
Pin
+24V
6
ALM
8
SON
9
CLR
10
GND
15
PUL+
11
PUL-
12
DIR+
13
DIR-
14
A+
1
A-
2
B+
3
B-
4
C+
5
C-
7
Pin
Signal
45
IN-COM
19
ALM
1
/SON
2
/AL-RS
46
DG
47
DG
48
DG
49
DG
4
FSTP
5
RSTP
14
PP
15
PN
16
DP
17
DN
35
PA
36
/PA
37
PB
38
/PB
39
PZ
40
/PZ
BK+
20
BI
BK-
47
DG
50
FG
Shielding cable
Note: A brake cable is provided

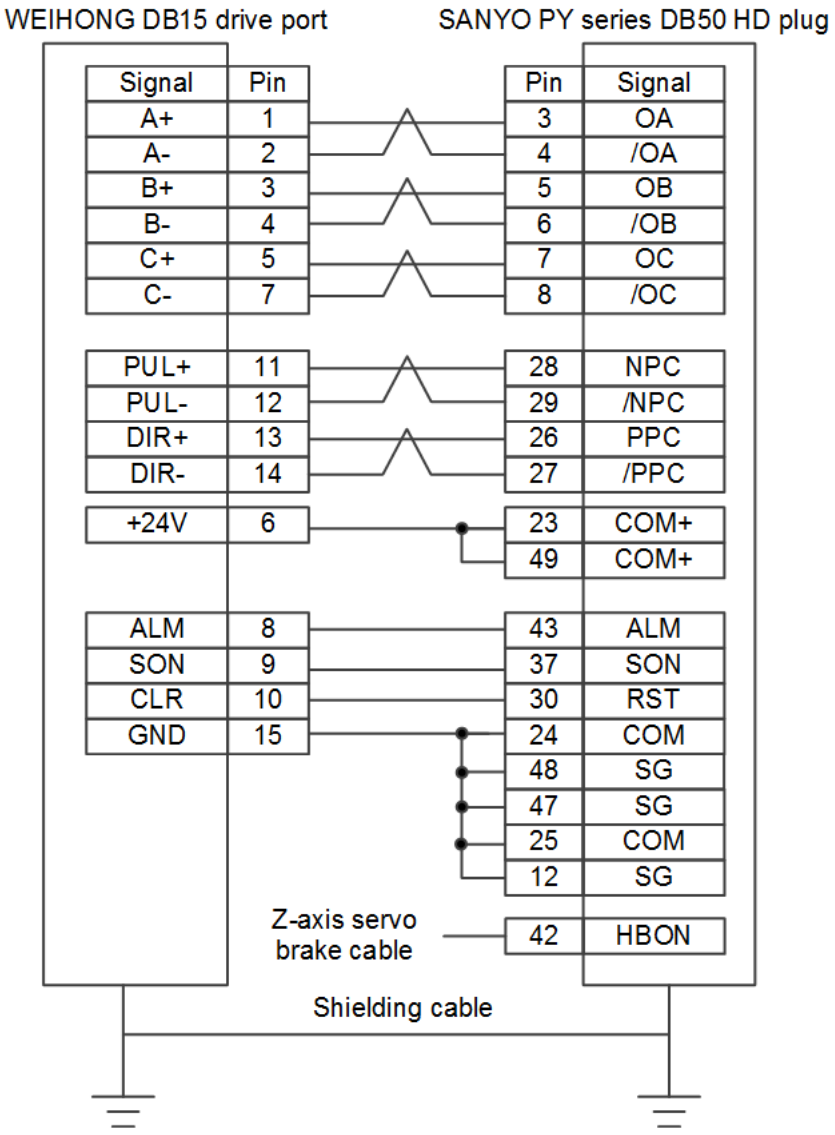
- ESDA



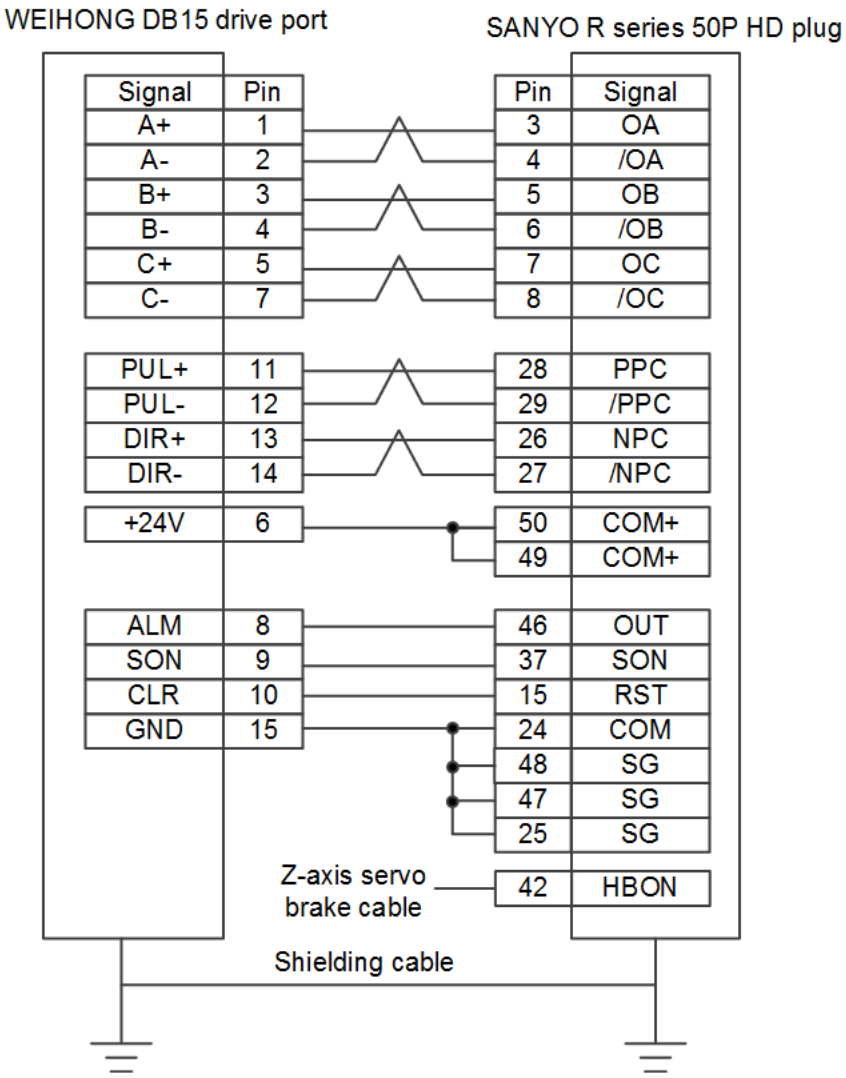
5.3.2.10 Wiring Diagram of Sanyo Servo Drive

Wiring diagrams are as follows:

- PY series

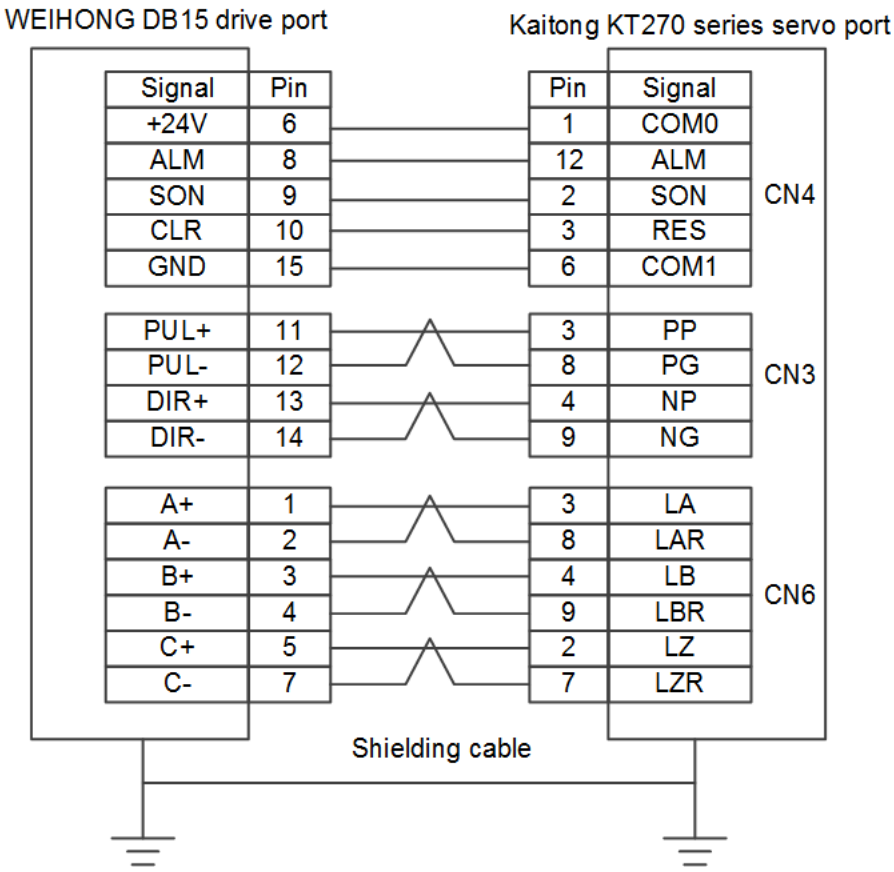

WEIHONG DB15 drive port
SANYO PY series DB50 HD plug
Signal
Pin
A+ 1
A- 2
B+ 3
B- 4
C+ 5
C- 7
PUL+ 11
PUL- 12
DIR+ 13
DIR- 14
+24V 6
ALM 8
SON 9
CLR 10
GND 15
Pin
Signal
3 OA
4 /OA
5 OB
6 /OB
7 OC
8 /OC
28 NPC
29 /NPC
26 PPC
27 /PPC
23 COM+
49 COM+
43 ALM
37 SON
30 RST
24 COM
48 SG
47 SG
25 COM
12 SG
Z-axis servo brake cable
42 HBON
Shielding cable

- R series



5.3.2.11 Wiring Diagram of Kaitong KT270 Series Servo Drive

The wiring diagram is as follows:

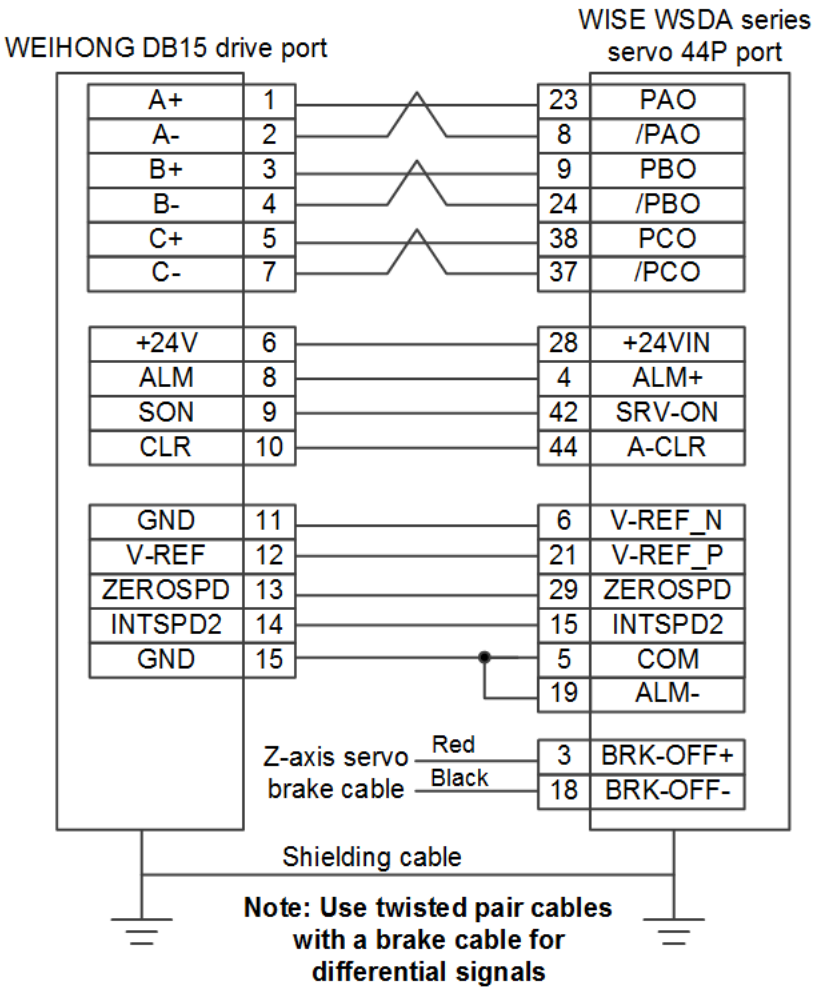


5.3.3 Wiring Diagram of the Drive (in Velocity Control Mode)

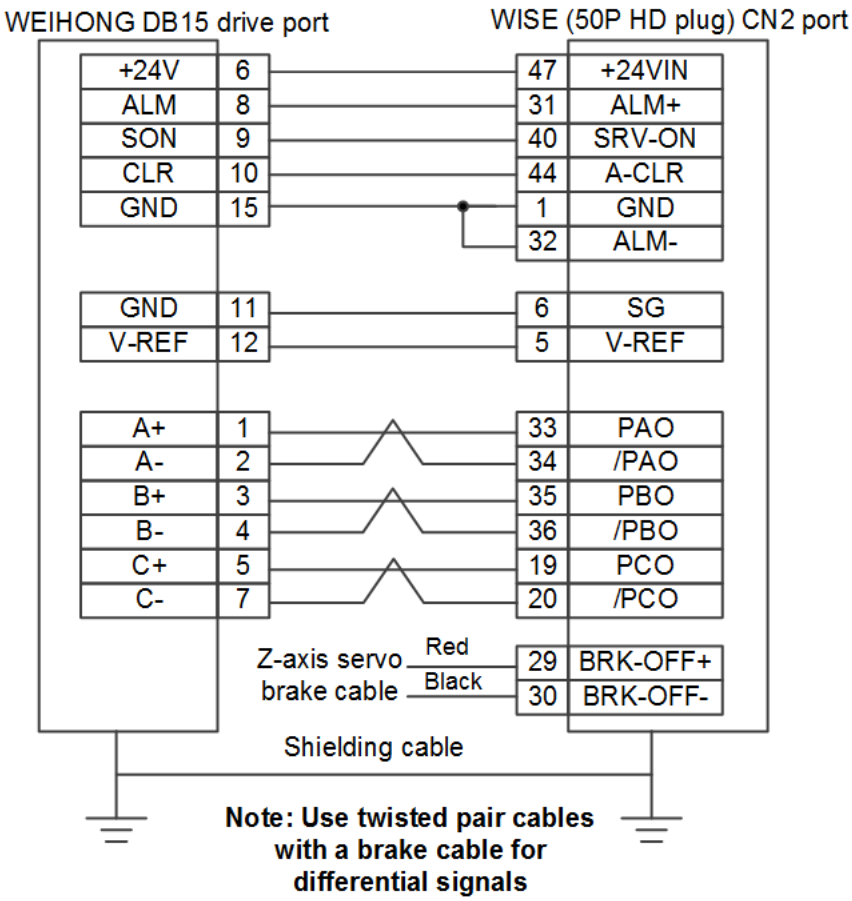
5.3.3.1 Wiring Diagram of WISE Servo Drive

Wiring diagrams are as follows:

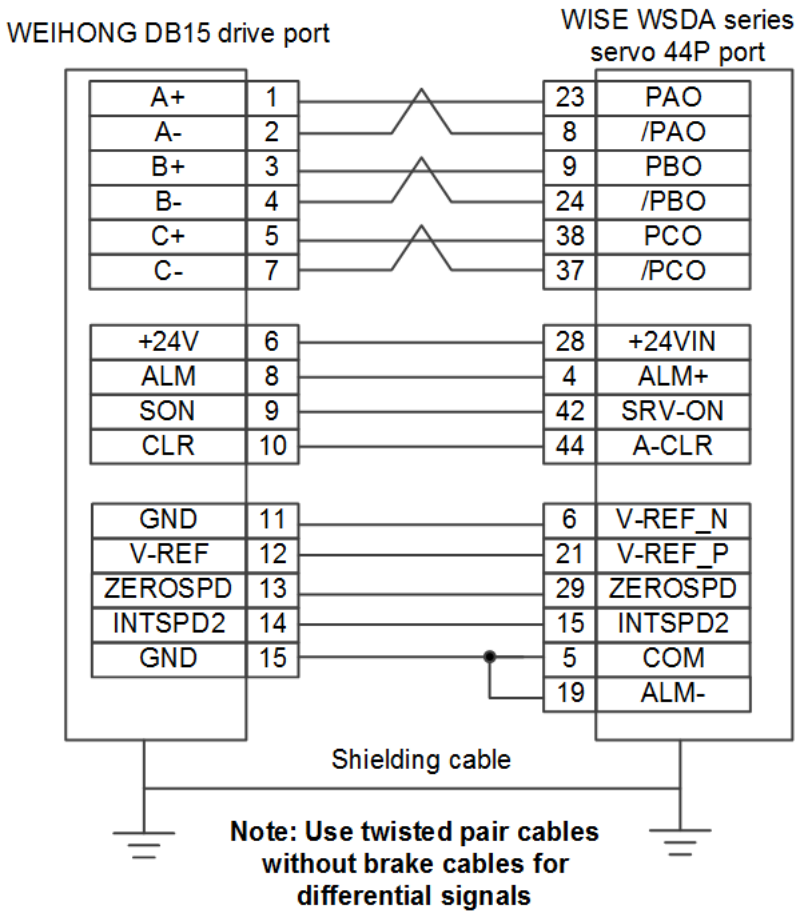
- With brake lines (44P interface)



- With brake lines (50P HD plug)

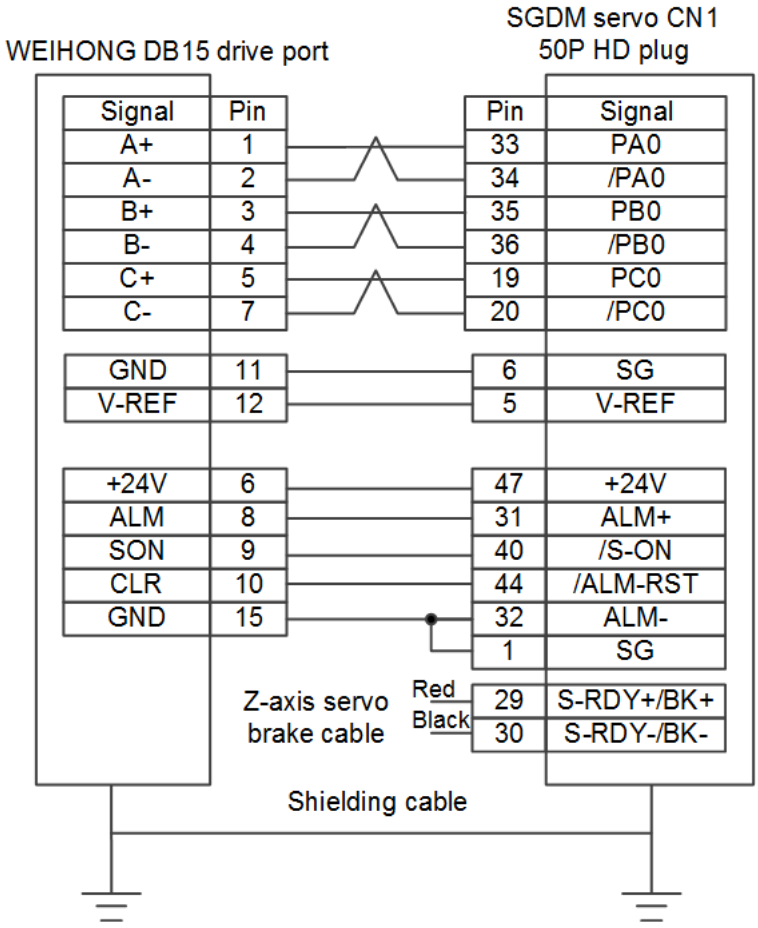


- Without brake lines (44P interface)



5.3.3.2 Wiring Diagram of YASKAWA Σ-5/Σ-7 Servo Drive

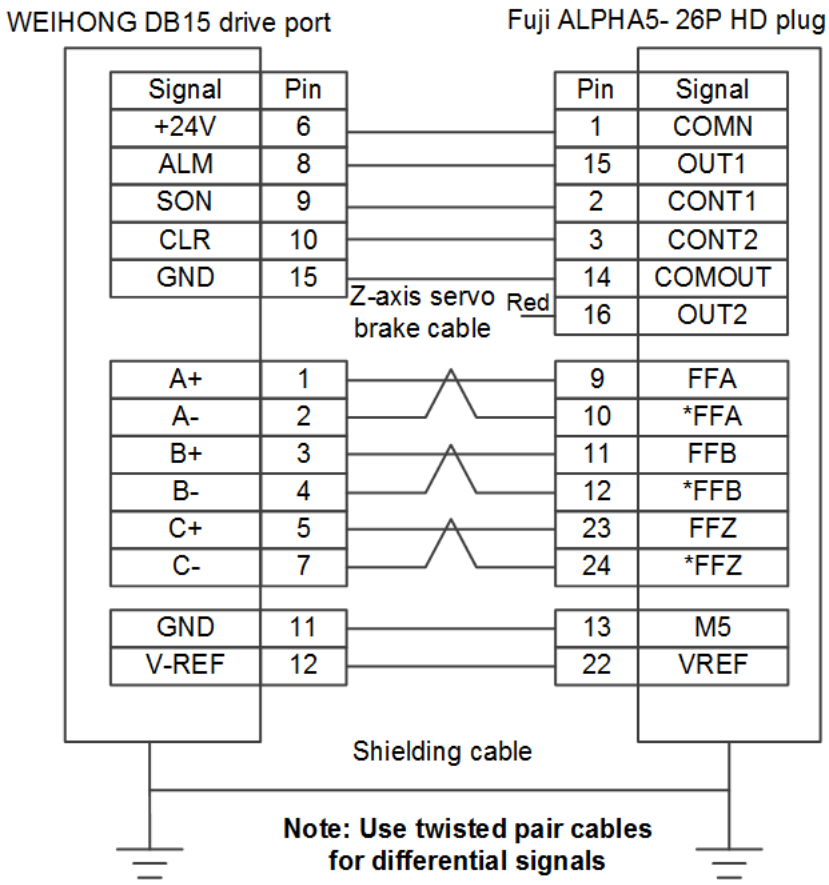
The wiring diagram is as follows:



5.3.3.3 Wiring Diagram of Fuji Servo Drive

Wiring diagrams are as follows:

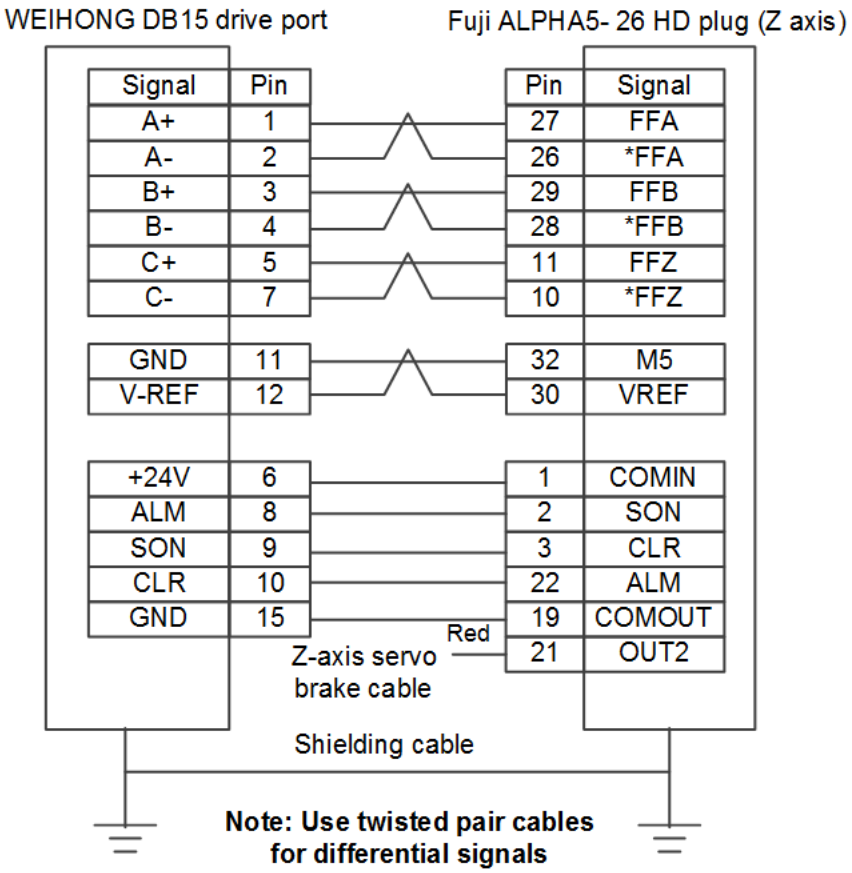
- Common:



Parameter description:

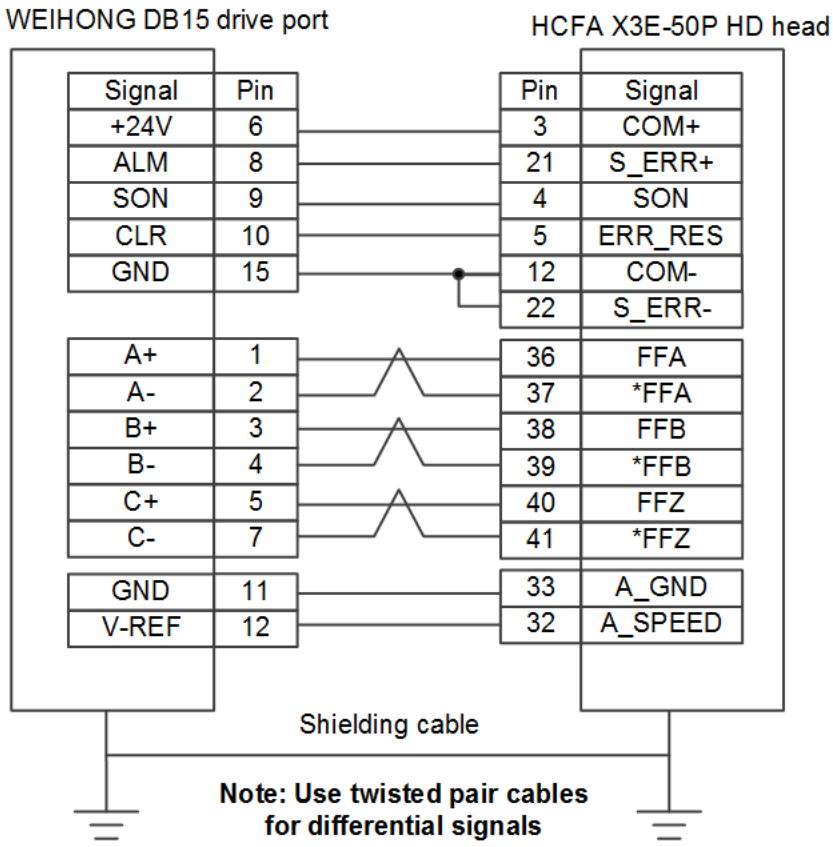
- PA1-01
  - Name: Control mode selection
  - Value: 1
  - Description: Velocity control
- PA1-08
  - Name: Number of pulse output per turn
  - Value: 2500
  - Description: Set it to 2500 if the pulse equivalent is 0.001, screw pitch is 10 mm, and there is no speed reducer. Set it to 1250 if the screw pitch is 5 mm.
- PA3-31
  - Name: Speed command graduation
  - Value: 10
  - Description: Rated rotational speed for 10V
- PA3-01
  - Name: CONT1 signal distribution
  - Value: 1
  - Description: Servo ON
- PA3-26
  - Name: CONT constant validity 1
  - Value: 2
  - Description: CW rotation command

- Fuji alpha5 plus (Z axis):



5.3.3.4 Wiring Diagram of HCFA Servo Drive

Wiring diagram is as follows:



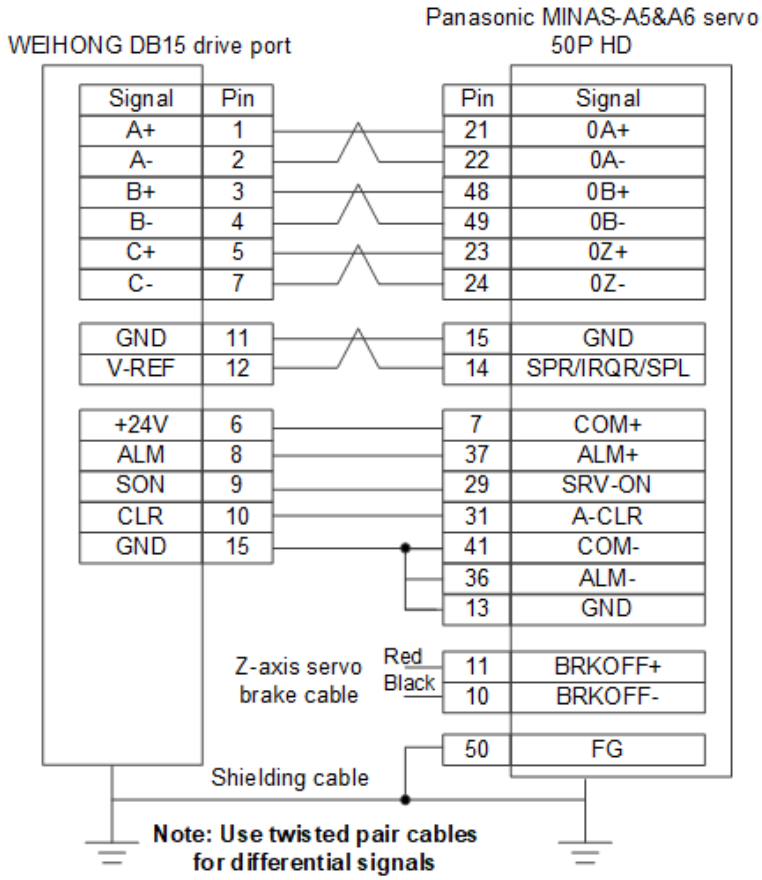
Parameter description:

- P00.01
  - Name: Control mode selection
  - Value: 1
  - Description: Velocity control
- P00.02
  - Name: Automatic adjustment
  - Value: 1
  - Description: If it is set to 0, real-time auto-adjustment is disabled. If it is set to 1, standard auto-adjustment is enabled without gain switching. Set it to 1 and let the system run for a period of time. If the Z axis has no overshoot or abnormal sounds, it is recommended to set this parameter to 10.
- P00.03
  - Name: Rigidity level
  - Value: 19 (recommended value)
  - Range: 0–31
- P00.14
  - Name: Number of pulse output per turn
  - Value: 2500
  - Description: Set it to 2500 if the pulse equivalent is 0.001, screw pitch is 10 mm, and there is no speed reducer. Set it to 1250 if the screw pitch is 5 mm.
- P03.00
  - Name: Speed command source
  - Value: 1
  - Description: SPR (default: AI1)

- P05.00
  - Name: AI1 minimum input
  - Value: -10
  - Range: -10.00V–10.00V
- P05.01
  - Name: Rotational speed matching AI1 minimum input
  - Value: -100
  - Description: 100% speed matches the system maximum rotational speed.
- P05.02
  - Name: AI1 maximum input
  - Value: 10
  - Range: -10.00V–10.00V
- P05.03
  - Name: Rotational speed matching AI1 maximum input
  - Value: 100
  - Description: 100% speed matches the system maximum rotational speed.
- P05.04
  - Name: AI1 zero micro-adjustment
  - Unit: 1 mv
  - Range: -500–500
- P05.14
  - Name: AI setting 100% rotational speed
  - Value: 3000
  - Range: 0 rpm–9000 rpm
- P04.01
  - Name: DI1 port function selection
  - Value: 1
  - Description: Servo enablement
- P04.11
  - Name: DI1 port logic selection
  - Value: 0
  - Description: If it is set to 0, active low. If it is set to 1, active high.
- P04.02
  - Name: DI2 port function selection
  - Value: 2
  - Description: Alarm reset signal
- P04.12
  - Name: DI2 port logic selection
  - Value: 0
  - Description: If it is set to 0, active low. If it is set to 1, active high.
- P04.28
  - Name: D08 port function selection
  - Value: 2
  - Description: Fault output
- P04.38
  - Name: D08 port logic selection
  - Value: 1
  - Range: If it is set to 0, the contact point is NO. If it is set to 1, the contact point is NC.

5.3.3.5 Wiring Diagram of Panasonic Servo Drive

Wiring diagram is as follows:

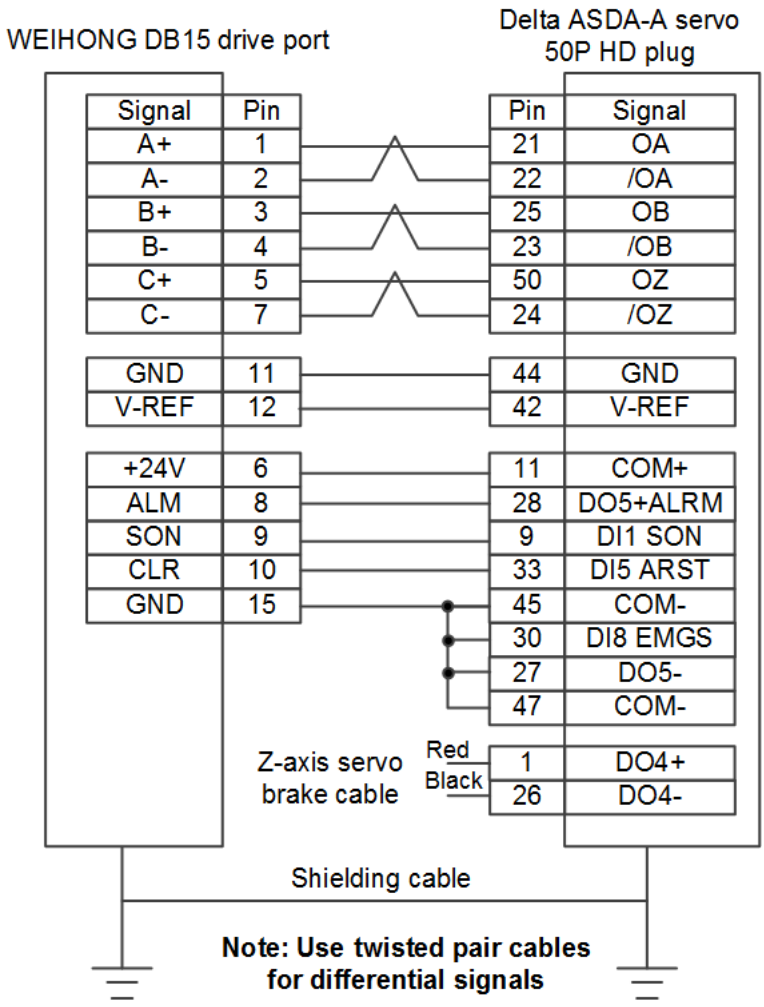


5.3.3.6 Wiring Diagram of Delta Servo Drive

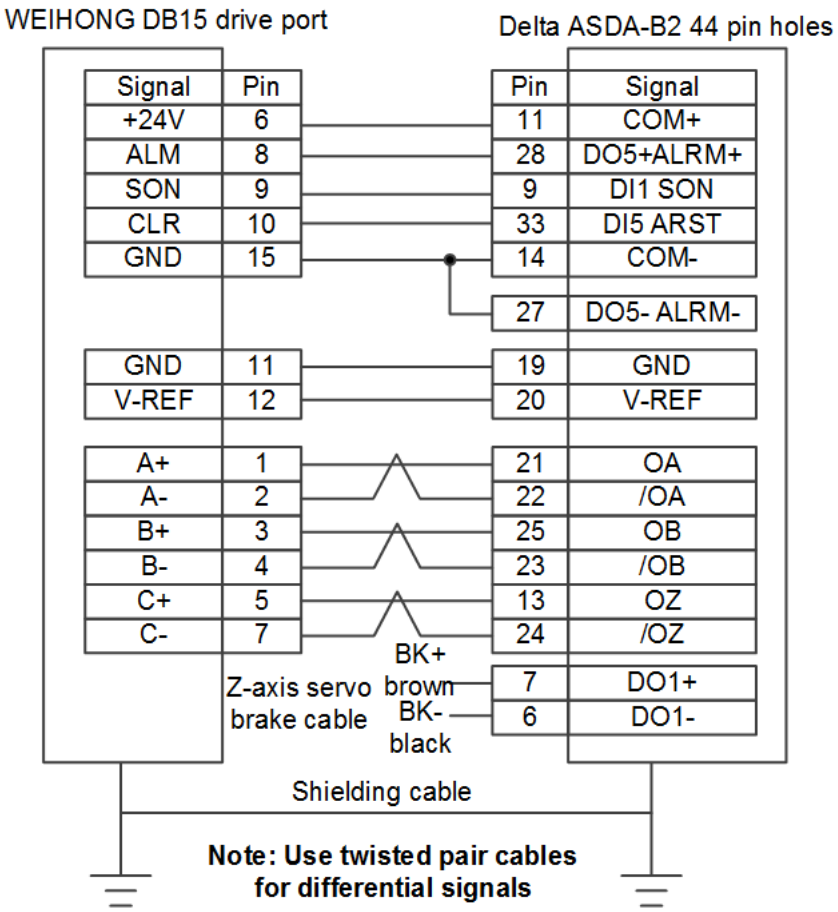
Delta ASDA-A and ASDA-B2 servo drives use the same type of cables.

Wiring diagrams are as follows:

- Delta ASDA-A



- Delta ASDA-B2



Parameter description:

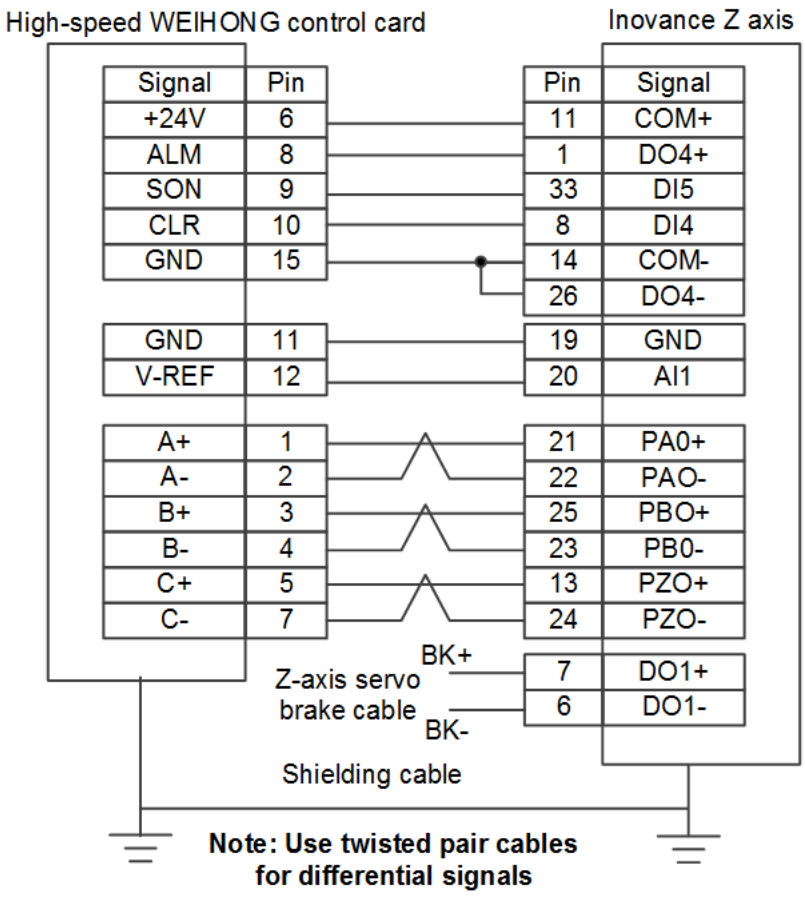
- P0-00:
  - Name: Drive status display
  - Range: -
  - Value: 2
  - Description: Set this parameter to monitor the number of pulses sent and received and see if there is electric interference.
- P1-00:
  - Name: External pulse input format setting
  - Range: ZYX
  - Value: 102
  - Description: X=2: Set the format of external pulse input to pulse + direction; Z=1: negative logic.
- P1_01
  - Name: Control mode setting
  - Range: ZYX1X0
  - Value: 2
  - Description
    - Z=0: When switching the control mode, DIO value does not change.
    - Y=0: Rotation direction is anti-clockwise CW when observing from the load side. If it is set to 1, rotation direction is clockwise CCW when observing from the load side.
    - X1X0=02: The control mode is velocity control.
- P1_44

  - Name: Electronic gear ratio numerator N1
  - Range: 1–32767
  - Value: -
  - Description: N1/M = Encoder pulse number * 4 * pulse equivalent * mechanical reduction ratio/screw pitch. Typical value: If the encoder pulse number = 4000, pulse equivalent = 0.001, screw pitch = 5mm, and mechanical reduction ratio = 1: N1/M = 4000 * 4 * 0.001/5=32/1. Set N1 to 32 and M to 1. Because multi-segment electronic gear ratio is not used, there is no need to set P2_60–P2_62.
- P1_45
  - Name: electronic gear ratio denominator M
  - Range: 1–32767
  - Value: -
  - Description: N1/M = Encoder pulse number * 4 * pulse equivalent * mechanical reduction ratio/screw pitch. Typical value: If the encoder pulse number = 4000, pulse equivalent = 0.001, screw pitch = 5 mm, and mechanical reduction ratio = 1: N1/M=4000 * 4 * 0.001/5=32/1. Set N1 to 32 and M to 1. Because multi-segment electronic gear ratio is not used, there is no need to set P2_60–P2_62.
- P1_46
  - Name: Detector output pulse number setting
  - Range: 20–40000
  - Value: -
  - Description: If the pulse equivalent = 0.001, there is no speed reducer, and screw pitch = 10 mm, set it to 10000. If the screw pitch = 5 mm, set it to 5000.
- P1_40
  - Name: Simulation speed command maximum revolving speed
  - Range: 0–10000
  - Value: -
  - Description
    - In velocity control mode, it indicates the revolving speed when the simulation speed command input reaches the maximum voltage (10V). If it is set to 3000, the velocity control command is 3000 r/min when the external voltage input is 10V and 1500 r/min when the external voltage input is 5V. Velocity control command = input voltage * P1_40 value/10.
    - In position or torque control mode, it indicates the revolving speed when the simulation speed limit input reaches the maximum voltage (10V). Speed limit command = input voltage * P1_40 value/10. It is mapped to the follow parameter **Speed Gain** in the software. If P1_40 is set to 3000, the corresponding **Speed Gain** is 300.
- P2_10
  - Name: Digital input pin DI1 function setting
  - Range: X2X1X0
  - Value: 101
  - Description: X1X0=01: Set DI1 to SON, mapping CN1 pin No.9. X2=1: Set DI1 to NO contact a.
- P2_15
  - Name: Digital input pin DI6 function setting
  - Range: X2X1X0

    - Value: 0
    - Description: DI6 are DI7 NC position limit signal input by default. The drive does not work if not connected to CN1 pin No.32 and No.31.
        - X2=0: Set DI6 and DI7 to the NC contact b.
        - X1X0=00: Do not use the drive position limit input.
- P2_16
    - Name: Digital input pin DI7 function setting
    - Range: X2X1X0
    - Value: 0
    - Description: DI6 are DI7 NC position limit signal input by default. The drive does not work if not connected to CN1 pin No.32 and No.31.
        - X2=0: Set DI6 and DI7 to the NC contact b.
        - X1X0=00: Do not use the drive position limit input.
- P2_17
    - Name: Digital input pin DI8 function setting
    - Range: X2X1X0
    - Value: 0
    - Description: Do not use external emergency stop input.
- P2_18
    - Name: Digital input pin D01 function setting
    - Range: X2X1X0
    - Value: 108
    - Description: D01 matches pin No.6 and No.7. It is used as the Z-axis clamping position braking signal.
        - X2=1: Set D01 output to the NO contact a. X2=0: Set D01 output to the NC contact b.
        - X1X0=08: Set pin No.6 and No.7 to BK- and BK+ respectively.
- P2_22
    - Name: Digital input pin D05 function setting
    - Range: X2X1X0
    - Value: 7
    - Description: D05 matches pin No.28 and No.27. It is used as the servo alarm signal.
        - X2=0: Set D05 output to the NC contact b.
        - X1X0=07: Set pin No.28 and No.27 to ALRM+ and ALRM- respectively.

5.3.3.7 Wiring Diagram of Inovance Servo Drive

The wiring diagram is as follows:



Parameter description:

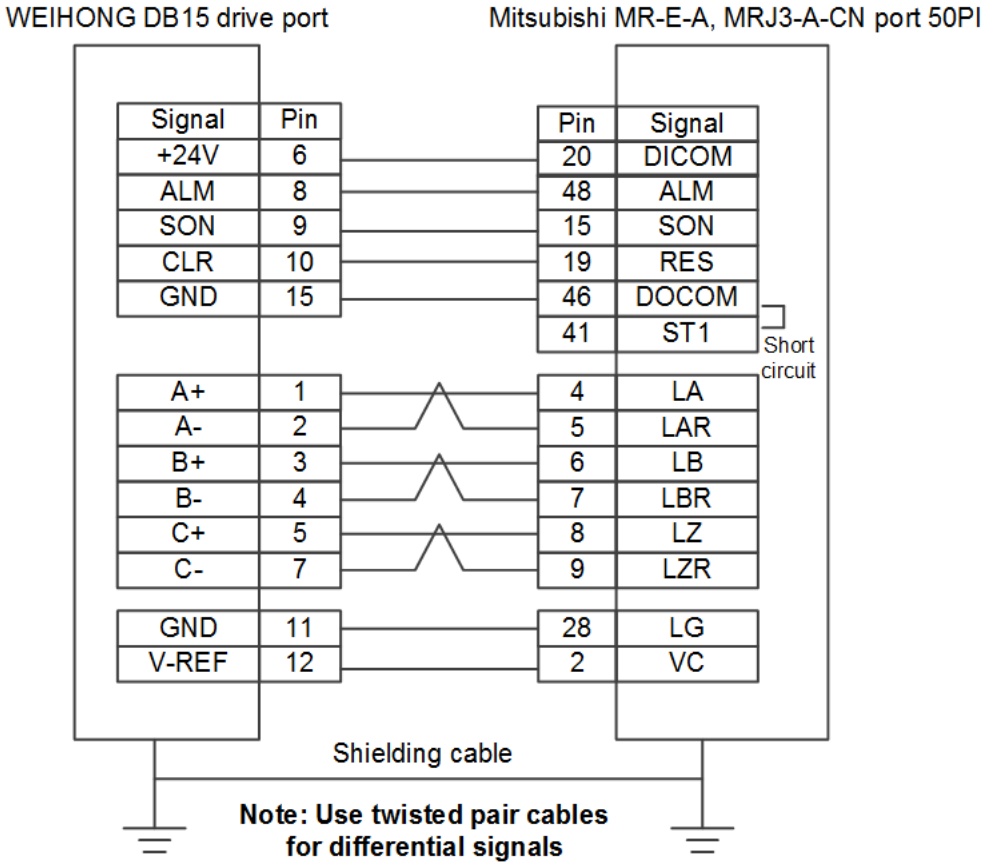
- H0200
  - Name: Control mode
  - Value: 0
- H0203
  - Name: Output pulse phase
  - Value: 1
- H0206
  - Name: Fault stop and zero-speed stop
  - Value: 0
- H0401
  - Name: Brake
  - Value: 9
- H0407
  - Name: Effective output of active high
  - Value: 1
- H0600
  - Name: ALI
  - Value: 1
- H0815
  - Name: Inertia ratio
  - Value: Around 2.5
- H0900
  - Name: Rigidity mode

- Value: 1

- H0901
  - Name: Rigidity level
  - Value: 18
- H0502
  - Name: Pulse number per turn
  - Value: 10000

5.3.3.8 Wiring Diagram of Mitsubishi Servo Drive

The wiring diagram is as follows:



6 Wireless Handwheel

WHB05 Series Wireless CNC Handwheel is a series of wireless handwheels that can make the machine tools do specified actions through WEIHONG CNC control system. The wireless CNC handwheel is independently designed by WEIHONG Company (short for Weihong Electronic Technology Co., Ltd.) with copyright and manufactured by a third-party supplier, Chengdu Xinhongchang Technology Co., Ltd.

Among them, the following are applicable to WEIHONG **NcStudio V15 laser cutting control system**:

- WHB05L(V4): Applicable to integrated plate and tube cutting systems.
- WHB05L(V5): Applicable to integrated plate and tube cutting systems.
- WHB05N(V1): Applicable to professional tube cutting systems.

The WHB05 series wireless handwheels consist of two parts:

- Handheld operational panel (transmitter)
- USB receiver

The handwheel have a control area of 40 meters (in open spaces) to facilitate machining control and improve operation efficiency.

6.1 WHB05L(V4)

WHB05L(V4) is an upgrade of WHB05S, in which buttons for control of axis W (rotary axis) going zero and other functions are added.

Its structure is shown below:

The button definitions are shown below:

6.2 WHB05L(V5)

WHB05L(V5) is an upgrade of WHB05L(V4), which replaces the button text with images to demonstrate the functions more vividly.

The WHB05L(V5) rotary axis is axis B.

Its structure is shown below:

The button definitions are shown below:

Machining control buttons


Start


Resume


Stop

Emergency stop

Axis direction buttons


Y-axis positive movement


X-axis positive movement


Y-axis negative movement


X-axis negative movement

Z-axis positive movement

B axis CW

Z-axis negative movement

B axis CCW

Function buttons


Follow


Blow


Burst


Optical grating


Laser ON upon inching


Red light

Make axis Z go origin


Make all axes go origin


Backward


Forward


Rapid


Step


Set as workpiece origin


Go to workpiece origin


Cut frame


Dry run

Custom sub-program R1

Custom sub-program R2

Combination

Calibration

Go mark point

Simulation

Set mark point

Leveling and centering

Make axis B go origin

Edge finding

Break point positioning

Custom sub-program AuxR1

Custom sub-program AuxR2

or

X-axis high-speed movement

or

Y-axis high-speed movement

or

Z-axis high-speed movement

or

B-axis high-speed movement

6.3 WHB05N(V1)

WHB05N(V1) is a dedicated handwheel for Phoenix tube cutting systems.

The WHB05N(V1) rotary axis is axis B.

Its structure is shown below:

The button definitions are shown below:

Machining control buttons

 Start

 Resume

 Stop

 Emergency stop

Axis direction buttons

 Y-axis positive movement

 X-axis positive movement

 Y-axis negative movement

 X-axis negative movement

 Z-axis positive movement

 B axis CW

 Z-axis negative movement

 B axis CCW

Function buttons

 Follow

 Blow

 Burst

 Optical grating

 Red light

 Make axis Z go to origin

 Clamp rear chuck

 Clamp front chuck

 Backward

 Forward

 Rapid

 Step

 Set as workpiece origin

 Go to workpiece origin

 Leveling and centering

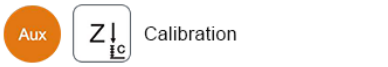
 Tube edging

 Dry run

 Custom sub-program R1

 Custom sub-program R2

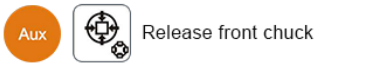
Combination

 Calibration

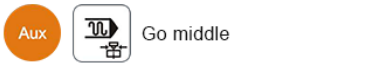
 Go mark point

 Release rear chuck

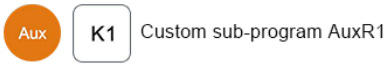
 Set mark point

 Release front chuck

 Make all axes go to origin

 Go middle

 Break point positioning

 Custom sub-program AuxR1

 Custom sub-program AuxR2

 or

 X-axis high-speed movement

 or

 Y-axis high-speed movement

 or

 Z-axis high-speed movement

6.4 Specifications

Electric parameters

- Working voltage & current (handheld device): 3V / 6 mA (two AA batteries)
- Low voltage alarm (handheld device): < 2.2V
- Transmitting power (handheld device): 14 dB
- Receiver sensitivity: -90 dB
- Wireless communication frequency: 433 MHz band
- Delay: 32 ms

Other parameters

- Lifespan of keys: 400–500 thousand times
- Wireless communication distance: 40m in open spaces
- Working temperature: -25°–70°
- Anti-collision height: 1.5m
- Receiver port: USB 2.0, with 1.5m USB dual-layer shield cable
- USB communication distance: ≤5m

6.5 Precautions

Pay attention to the following:

- Ensure that the wireless handwheel is connected properly before opening the software.
- Each handheld device has its matching USB receiver. Avoid mix use.
- If the yellow indicator on the handwheel is on, the battery is about to run out. Use new batteries in time.
- Do not install the receiver inside cabinets to avoid affecting signal reception.

6.6 FAQs

If the following situations occur:

- After pressing a handwheel button, the machine gives responses after a period of delay.
- After pressing a handwheel button, the machine has no response.
- After pressing a handwheel button, it automatically pops back.

Check the working environment as follows:

Case one: The wireless handwheel is placed inside an indoor metal cabinet. No USB extension cable is used. Communication distance is smaller than or equal to 2m.

- **Cause:** The metal cabinet blocks transmission of wireless signal and causes unstable communication.
- **Solution:** Place the handwheel outside any metal cabinet, and use it in a barrier-free environment.

Case two: The wireless handwheel is placed indoor and not inside any metal cabinet. A USB extension cable of 2–3m long is used. Communication distance is 10m.

- **Cause:** Use of extension cable can cause unstable communication. If the interference is severe, it can cause exceptional USB communication and response delay.
- **Solution**: Do not use extension cable.

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