PCIMC-53B/53C

Manufacturers' Manual

Weihong Electronic Technology Co., Ltd.

Preface

Thank you for your purchase of PCIMC-53B/53C motion control cards, which are of reliable stability.

PCIMC-53B/53C motion control cards are developed independently by Weihong Electronic Technology Co., Ltd. Mating with Ncstudio motion control software, they are applied to motion control of series of routers, engraving and milling machines, drilling machines and cutting machines, available of comprehensive functions and easy to use.

Please carefully read the Introduction after purchase, which will be beneficial in using.

Contents

1 PCIMC-53B\53C Control System and Its Components

1) One motion control card of PCIMC-53B\53C

2) One CD of Ncstudio motion control software (not needed if the factory has already customized)

3) One 6B-EX1D7 extended board

4) One DB37M/F cable (1.5m or 3m)

5) One FC16-DB15F cable (with rail block) for Manual Pulse Generator (MPG)

6) NK-MPG-05 Manual Pulse Generator (Optional, 53B is with MPG function, while 53C is without)
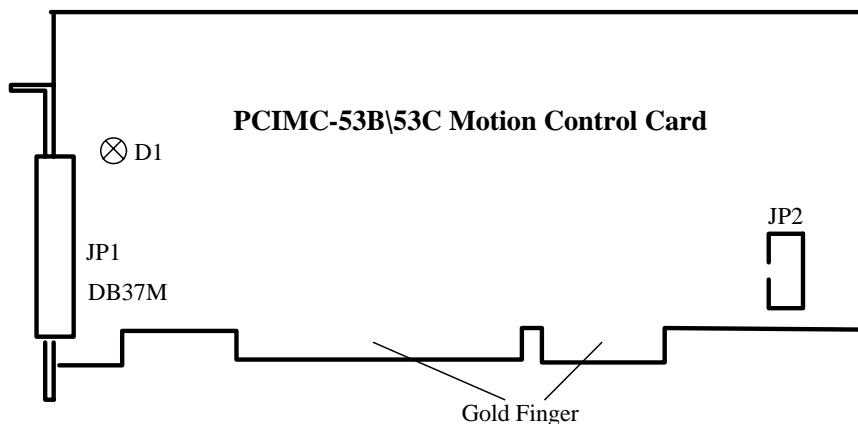
Fig. 1-1 PCIMC-53B\53C Motion Control Card

Shown in Fig. 1-1, PCIMC-53B \ 53C Motion Control Card uses PCI interface.

The size of 53B control card is 173.7mm* 121.1mm. The Control Card has 2 sockets: JP1 is the DB37M socket for the connection of control signals, and can be connected to the 6B-EX1D terminal board with the cable DB37M/F. JP2 is the socket for supporting Manual Pulse Generator (MPG) and can be connected to the back of host computer with the extended wire FC16-DB15F (with rail block).

The size of 53C control card is 140mm* 95.9mm, with only one socket: JP1, which is the DB37M socket for the connection of control signals, and can be connected to the 6B-EX1D terminal board with the cable DB37M/F.

Note:

There is a red LED D1 on these two motion cards, which indicates the work status of control cards:

when Ncstudio control system runs normally, D1 turns off; or it glows.

2 Installation Steps

1) Insert the software Ncstudio CD to the CD driver of computer, and then double click the icon

for installation of the software;

2) Power off the computer, then open the chassis of host computer, then insert the control card to a PCI slot and then fasten the rail block screw (if there is the extended flat cable, its rail block should also be fixed), and then well cover the host computer chassis;

3) Power on the computer. The computer will find the new hardware-device and install its driver automatically;

4) Double click the shortcut icon of Ncstudio on the desktop; if it runs normally, installation is over. (if the control system runs abnormally, please check whether the control card is well inserted and whether the gold finger is clean);

3   Port Instruction

The standard configuration of PCIMC-53B\53C is 6B-EX1D terminal board, which is joined to port JP1 on the back of the control card by a DB37M/F cable.

JP2 socket of PCIMC-53B is used for supporting MPG. Educe port JP2 out with the extended wire FC16-DB15F, and then join this wire to DB15 on the handwheel. Handwheel (MPG) is an optional device. You can purchase from Weihong Technology CO., Ltd., or from other company.

Pins definition of DB15F plug of the handwheel is shown as below.

Table 1 Definition of Handwheel Interface

Pins No.	Function	Description
1	+5V	Supply power to MPG encoder
2	HA	Negative terminal of phase A signal of encoder
3	HB	Negative terminal of phase B signal of encoder
4		Not connected
5		Not connected
6	X1	Select X1 ratio mode(0.001)
7	X10	Select X10 ratio mode(0.01)
8	X100	Select X100 ratio mode(0.1)
9		Not connected
10		Not connected
11	GND	Grounded (digital)
12		Not connected
13	Z	Select Z-axis
14	Y	Select Y-axis
15	X	Select X-axis

4   Wiring Connections

Guide rail installation is adopted for terminal board, and the size of 6B-EX1D7 is 154mm*72mm, shown as below.
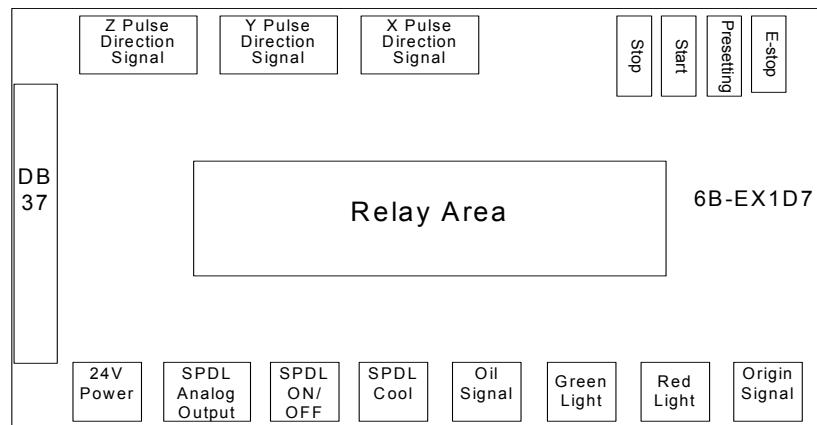
Fig. 4-1 Terminal Board 6B-EX1D7

The connection between PCIMC-53B \ 53C Motion Control Card and stepping motor driver is shown as below in Fig. 4-2:
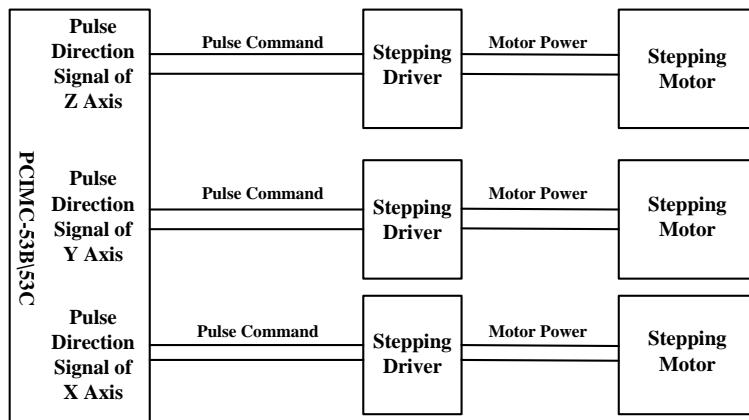
Fig. 4-2 The Whole Frame of Connection between PCIMC-53B\53C and Stepping Driver

4.1 Signal Types

4.1.1 Binary Input Signal

Binary input signal is active low; it supports NO (Normally Open) and NC (Normally Closed) input signals (by modifying the polarity of input ports in the software). When using NO switch, the signal is available as connecting with COM; when using NC switch, the signal is available as disconnecting with COM.

When the mechanical switch connects with binary input signal, one end of the mechanical switch connects to the binary input port and the other end to GND, shown in Fig. 4-3:
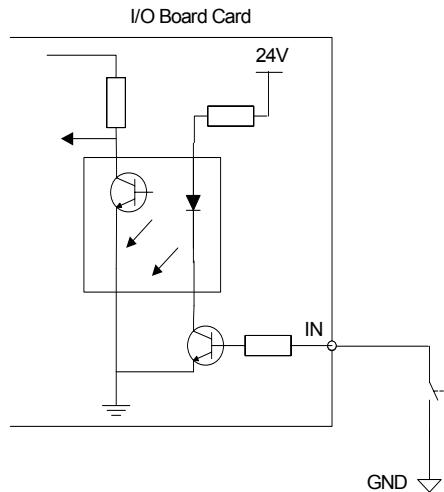
Fig. 4-3 Connection between Mechanical Switch and Binary Input Signal

The binary input signal can also be connected with a photoelectric switch or proximity switch of NPN (NO) or NPN (NC) type. The connection diagram is shown below in Fig. 4-4:
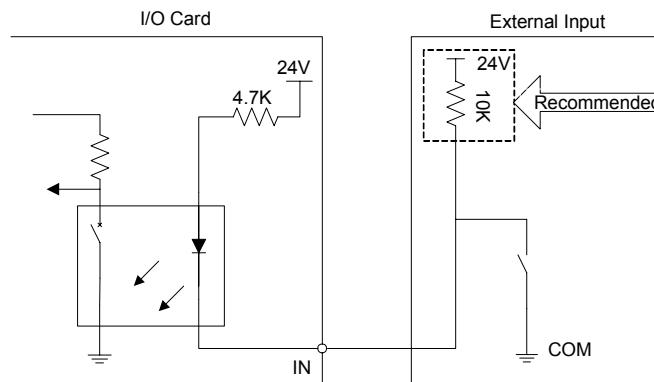
Fig. 4-4 Connection between Binary Input Signal and Photoelectric Switch (or Proximity Switch)

4.1.2 Signal Output of Relay

Contact output of relay on the terminal board bears load capacity of 10A/250V AC or 10A/30V DC. It can control low-power load of 220V alternating current. To support high-power load, it can be connected to a contactor. Demonstration in details is shown below in Fig. 4-5:
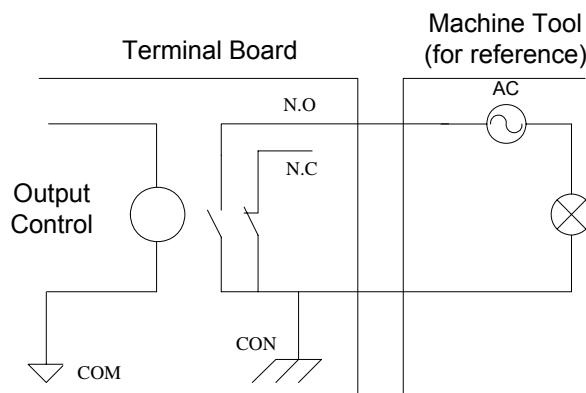
Fig. 4-5 Connection between Contactor and Output of Relay

4.1.3 Differential Output Signal

Pulse command form: pulse plus direction, negative logic. The maximum pulse frequency: 160KHZ. The sketch map of pulse mode is shown below in Fig. 4-6:
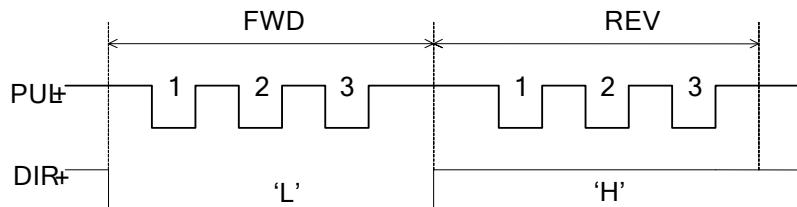
Fig. 4-6 Type of Pulse Command Output

Output mode of differential signal is shown as below in Fig. 4-7:
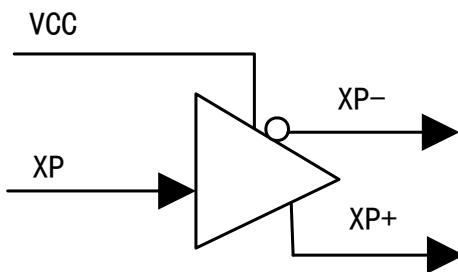

Fig. 4-7 Output Circuit of Pulse Command

4.2 Terminal Description

4.2.1 External Power Supply

Terminal board is powered by an external DC 24V power source.

+24V, COM: Connected to the corresponding end of power switch on the machine tool.

4.2.2 Stepping Driver Interface

➢ XD+ / XD-: direction signal of X-axis

➢ XP+ / XP-: pulse signal of X-axis

➢ YD+ / YD-: direction signal of Y-axis

➢ YP+ / YP-: pulse signal of Y-axis

➢ ZD+ / ZD-: direction signal of Z-axis

➢ ZP+ / ZP-: pulse signal of Z-axis

➢ +5V: +5V power source supplied by the computer or PC. This port is connected if the control signal of stepping driver is common 5V (normally marked as "+COM" or "OPTO").

4.2.3 Operation Interface

➢ ESTOP:Emergency stop, binary input signal, usually connected with NC switch, and system E-stop will occur when it is disconnected with COM;

➢ CUT: Tool calibration, binary input signal;

➢ START: To start the Motion Control System, for connecting with external operating button. The signal is available when it connects with COM;

➢ STOP: To stop the Motion Control System, for connecting with external operating button. The signal is available when it connects with COM;

➢ COM: Ground, the common port of digital signal.

4.2.4 Origin Signal

➢ X0: X axis origin, binary input, and low level effective.

➢ Y0: Y axis origin, binary input, and low level effective.

➢ Z0: Z axis origin, binary input, and low level effective.

➢ COM: Ground, the common port of the above digital signals.

4.2.5 Spindle Control

➢ SVC: Analog voltage signal output (0-10V), to control the rotary speed of the spindle motor; it connects with the input port of analog voltage frequency of transducer (normally known as AVI / VI). It changes the frequency of transducer by altering the voltage, which results in the change of the main spindle speed.

➢ GND: Analog voltage ground; it connects with analog ground of transducer (usually known as ACM).

➢ SPIN: To start/stop the main spindle; output by relay; generally it has two terminals, one connects with the digital ground (usually known as DCM) of transducer and the other with forward-rotation input port of transducer (usually known as FOR).

➢ SPCOOL: spindle cooling, which is started with the opening of spindle.

4.2.6 Signal Lights

➢ RED: red alarm lamp; when system stops emergently, the red lamp will light up. It can also be used as the information function of accomplishment of machining.

➢ GREEN: green working lamp; when machine tool runs normally, the lamp will light up.

4.2.7 Other Signals

➢ OIL: lubrication on, to control lubrication supply automatically, relay output, the LED becomes light when lubrication goes on and becomes out when lubrication stops.

4.3 Wiring Diagram

Wiring diagram of 6B-EX1D7 terminal board (its dimension: 160mm length, 85mm width, 55mm height) is shown below in Fig. 4-8. Many auxiliary functions of terminal board are optional.
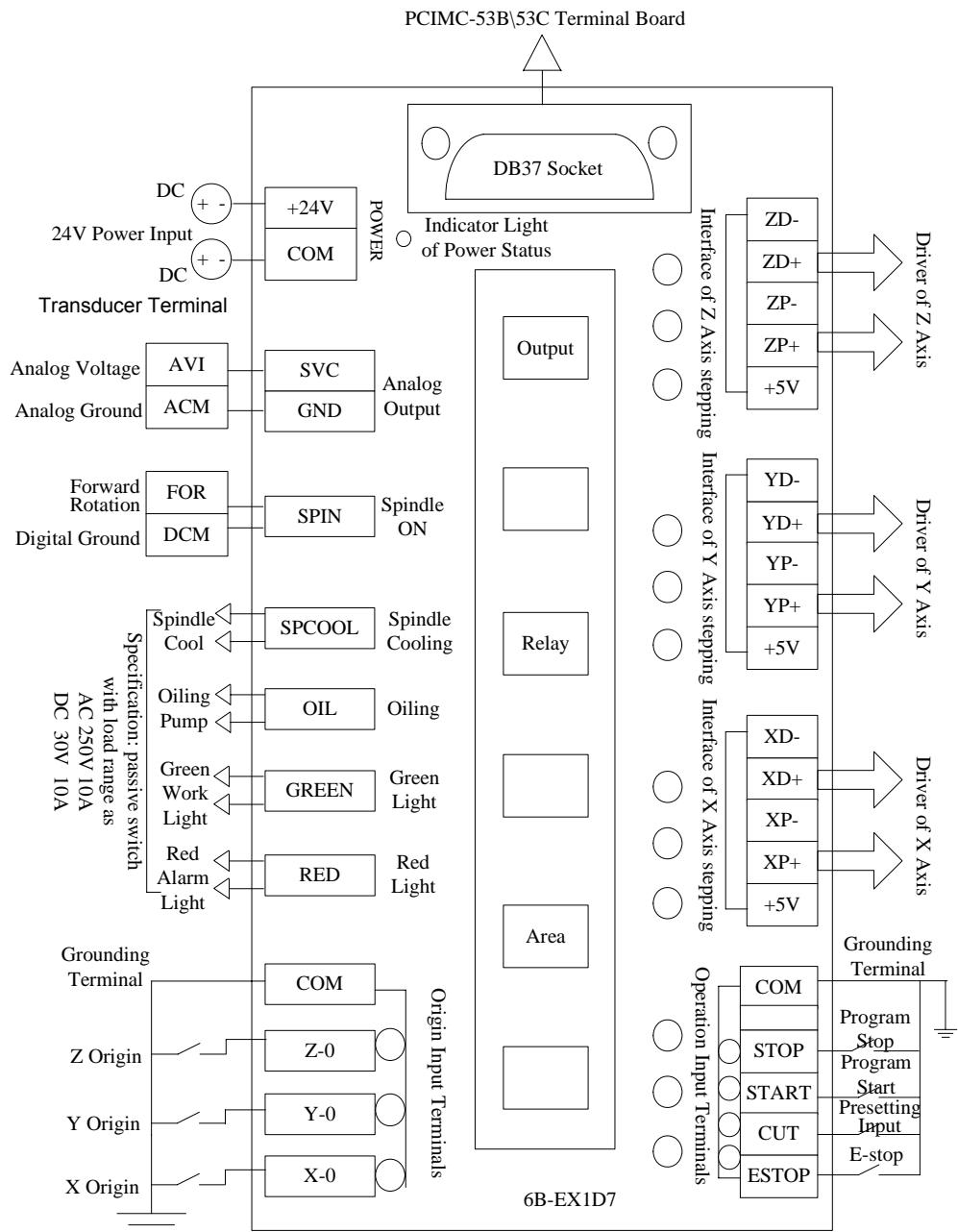
Fig. 4-8 Wiring Diagram of Terminal Board 6B-EX1D7

4.4 Wiring Diagram of Terminal Board 6B-EX1D7 & Stepping Driver

4.4.1 Common Port Connection of Terminal Board 6B-EX1D7 & Stepping Driver

Please see diagram Fig. 4-9.
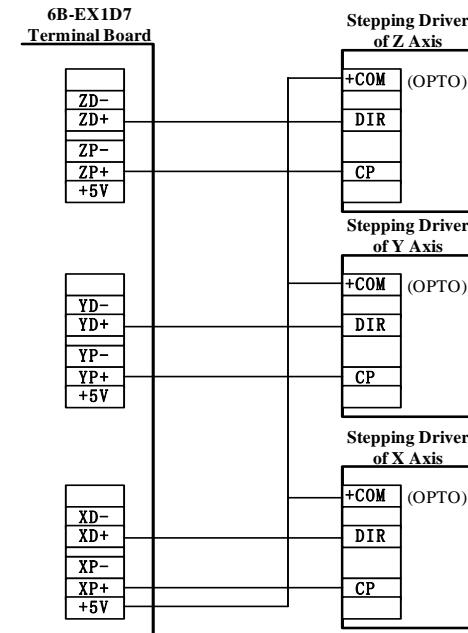
Fig. 4-9 Connection between Terminal Board 6B-EX1D7 and Stepping Motor Driver with Common Port of Pulse Signal

4.4.2 Differential Input Connection of Terminal Board 6B-EX1D7 & Stepping Driver

Please see Fig. 4-10 (differential input connection type is strongly recommended).
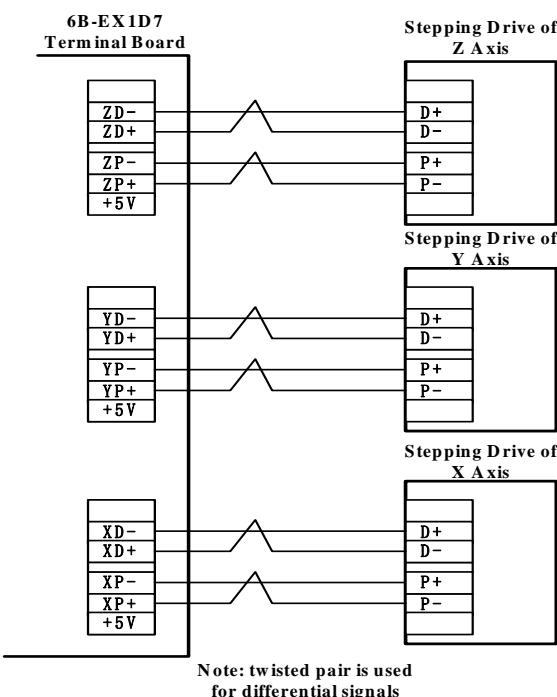
Fig. 4-10 Connection between Terminal Board 6B-EX1D7 and Stepping Driver of Differential Signal

4.5 Wiring Diagram of Terminal Board 6B-EX1D7 & Servo Driver

4.5.1 Wiring Diagram of Terminal Board 6B-EX1D7 & YASKAWA Σ-Ⅱ Servo Driver

Fig. 4-11 Connection between Terminal Board EX1D7 and YASKAWA Σ-Ⅱ Servo Driver

Note: Wiring of X, Y, and Z axis is the same. Only Z axis has two brake signal lines which can be connected to relay to control the brake.

4.5.2 Wiring Diagram of Terminal Board 6B-EX1D7 & DELTA ASDA_ A \ AB Servo Driver
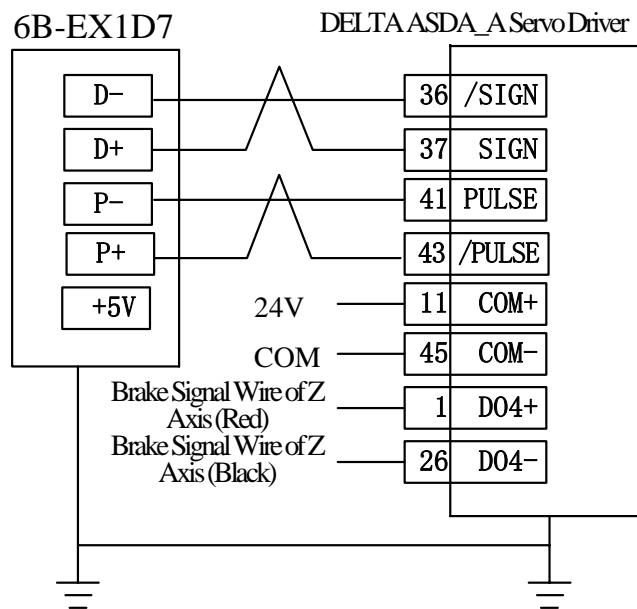
Fig. 4-12 Connection between Terminal Board EX1D7 and DELTA ASDA_A Servo Driver

Note: Wiring of X, Y, Z axis is the same. Only Z axis has two brake signal lines which can be connected to relay to control the brake.
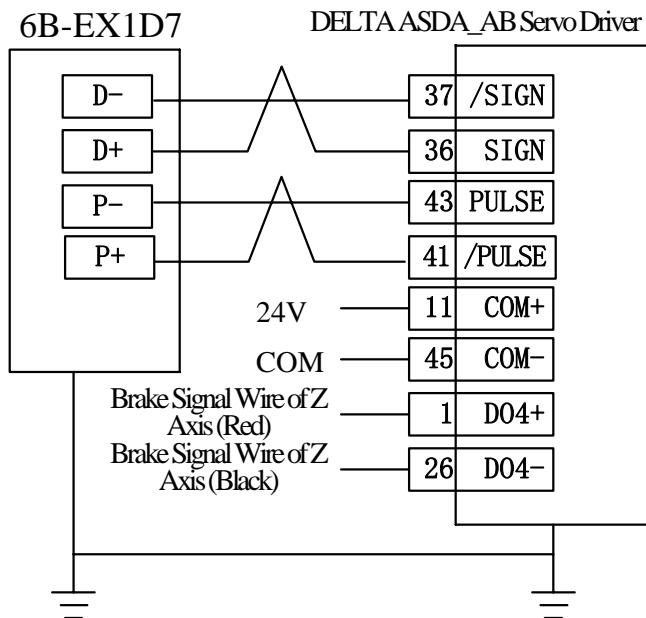
Fig. 4-13 Connection between Terminal Board EX1D7 and DELTA ASDA_AB Servo Driver

4.5.3 Wiring Diagram of Terminal Board 6B-EX1D7 & PANASONIC MINAS_A4 Servo Driver
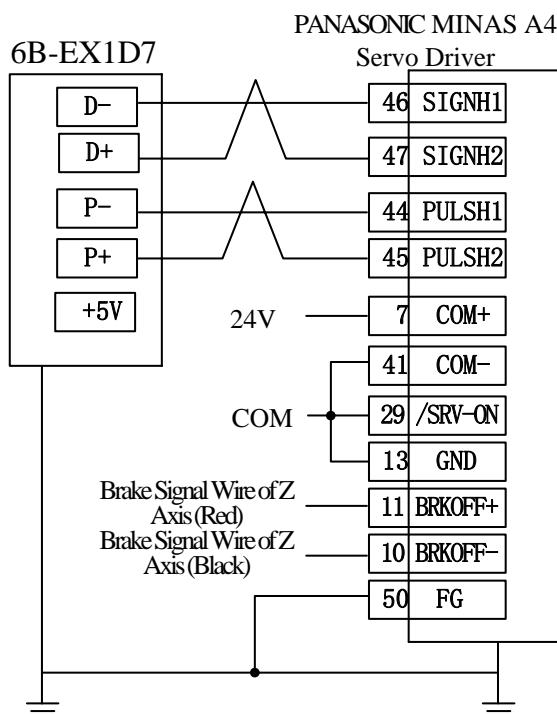
Fig. 4-14 Connection between Terminal Board EX1D7 and PANASONIC MINAS_A4 Servo Driver

Note: Wiring of X, Y, Z axis is the same. Only Z axis has two brake signal lines which can be connected to relay to control the brake.

### 4.5.4 Wiring Diagram of Terminal Board 6B-EX1D7 & MITSUBISHI MR-E Servo Driver
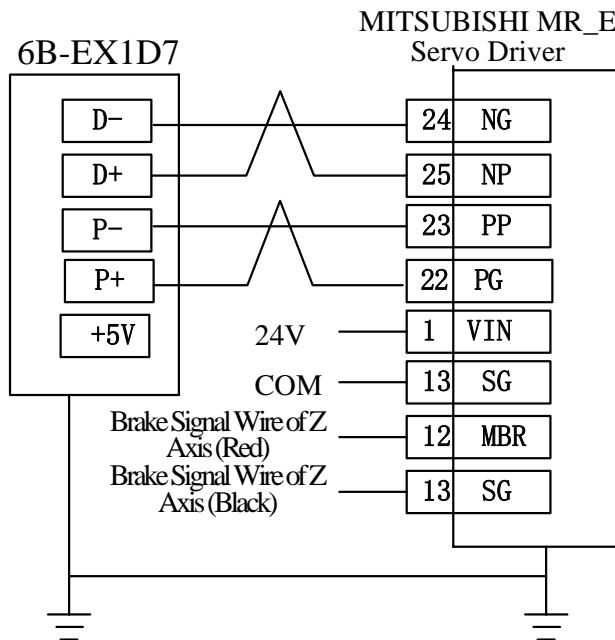
Fig. 4-15 Connection between Terminal Board EX1D7 and Mitsubishi MR-E Servo Driver

Note: Wiring of X, Y, Z axis is the same. Only Z axis has two brake signal lines which can be connected to relay to control the brake.

### 4.5.5 Wiring Diagram of Terminal Board 6B-EX1D7 & FUJI FALDIC-β Servo Driver
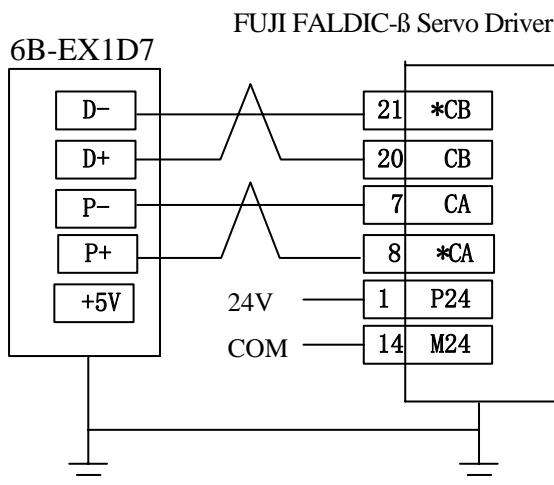
Fig. 4-16 Connection between Terminal Board EX1D7 and FUJI FALDIC-β Servo Driver

Note: Wiring of X, Y, Z axis is the same, and the brake of Z axis is internally controlled.

4.5.6   Wiring Diagram of Terminal Board 6B-EX1D7 & STONE GS Servo Driver
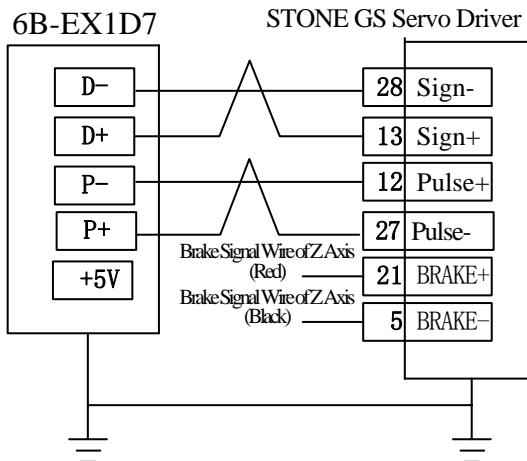
Fig. 4-17 Connection between Terminal Board 6B-EX1D7 and Stone GS Servo Driver

Note: Wiring of X, Y, Z axis is the same, and the brake of Z axis is internally controlled.

4.6 Parameters Setting of Servo Drivers

4.6.1 Parameters Setting of YASKAWA Σ-II Servo Driver

| Para. No.	Function	Setting Value	Description
UN00C	Monitor mode	LXXXX (Hexadecimal system)	Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference.
Pn000	Direction selection Control method selection	0010	Bit 0: Set 0, "CCW" is forward rotation (viewed from the load end of screw ball); Set 1, the rotation direction of the motor is reversed. Bit 1: Set 1, position control mode (calculate pulse instruction all the time).
Pn001	Selection servo off or alarm stop mode	XXX0	Bit 0: Set "0", stopping the motor by applying dynamic brake(DB) which will be maintained after stop; Set "1", stopping the motor by applying dynamic brake(DB) and then the motor can rotate freely after stop.
Pn200	Selection pulse mode	0005	Bit 0: Set "5", select instruction mode as "pulse + direction", negative logic. Bit3: Set "0", input differential signal into filter.
Pn201	Encoder cycle-divide ratio (Pulse output No. per motor cycle by encoder after cycle-divided)	Right-side	Gain encoder / Model / No. of pulse per revolution(P/R): A — 13bit 2048 B — 16bit 16384 C — 17bit 32768
Pn202	Electronic gear ratio (Numerator)	Need Calculation	Pn202 = pulse number of each encoder circle × 4 × mechanical deceleration ratio Pn203 = (lead screw pitch / pulse equivalent) Both numerator and denominator of the electronic gear ratio can be reduced. The values of Pn202 and Pn203 are the integer within the range 1~65536. Typical value:
Pn203	Electronic gear ratio (Denominator)	Need Calculation	

Para. No.	Function	Setting Value	Description
			pitch 5mm, encoder 17-bit, coaxial connection between motor and screw, pulse equivalent 0.001mm, Pn202＝16384; Pn203＝625. pitch 5mm, encoder 17-bit, coaxial connection between motor and screw, pulse equivalent 0.0005mm, Pn202＝8192; Pn203＝625

4.6.2 Parameters Setting of DELTA ASDA_ A Servo Driver

Para. No.	Function	Format & Range	Value	Description
P0-02	Driver Status display		02	Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection to determine if there is electrical interference.
P1-00	External pulse input type	ZYX	102	X=2: pulse + direction; Z=1: negative logic
P1-01	Set control mode	ZYX1X0	0000	Z=0: when switching control mode, DIO is maintaining the set value. Since switching control mode is not used, Z=0 Y=0: forward rotation (anticlockwise) (from the point of load); Y=1: the rotation direction is reversed. X1X0=00: position control mode
P1-44	Electronic Gear Ratio (Numerator) (N1)	1~32767	Need calculation	N1 / M= encoder pulses× 4× pulse equivalent× mechanical deceleration ratio / pitch. Representative value: encoder pulses 2500, pulse equivalent 0.001, pitch 5mm, mechanical deceleration ratio 1, calculation as below: N1 / M= 2500×4×0.001/5 = 2 / 1, N1=2, M=1; When the multi-electronic gear ratio is not used, P2-60~ P2-62 are not required.
P1-45	Electronic Gear Ratio (Denominator) (M)	1~32767	Need calculation	
P2-51	Servo ON setting		0	0: Servo ON must be triggered by numerical input signal. 1: when servo powered, if there is no alarm signal, servo will be automatically on. Set 1 when there is no SON signal wire.

4.6.3 Parameters Setting of DELTA ASDA_B Servo Driver

Para. No.	Function	Format & Range	Value	Description
P0-02	Driver Status display		02	Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference.
P1-00	External pulse input type	ZYX	102	X=2: pulse + direction; Z=1: negative logic
P1-01	Set control mode	YX1X0	000	Y=0: forward rotation (anticlockwise) (from the view of load); Y=1: the rotation direction is reversed. X1X0=00: position control mode
P1-32	Motor stop mode	YX	00	Y=0: when there is no servo enabled, motor dynamic brake occurs; Y=1: motor is free. X=0: motor stops instantly, X=1: motor stops with deceleration.
P1-44	Electronic Gear Ratio (Numerator) (N1)	1~32767	Need calculation	N1 / M= encoder pulses× 4× pulse equivalent× mechanical deceleration ratio / pitch. Representative value: encoder pulses 2500, pulse equivalent 0.001 mm/p, pitch 5mm, mechanical deceleration ratio 1, calculation as below: N1 / M = 2500×4×0.001/5 = 2/1, N1=2, M=1;
P1-45	Electronic Gear Ratio (Denominator) (M)	1~32767	Need calculation	When the multi-electronic gear ratio is not used, P2-60 ~P2-62 are not required.
P2-30	Servo ON SON setup		0	0: Servo ON must be triggered by signal of digital input; 1: when servo is powered on, if there is no alarming, servo will be auto ON. When there is no SON signal wire, set the value as 1.

4.6.4 Parameters Setting of PANASONIC MINAS_A4 Servo Driver

Para. No.	Function	Value	Description
01	LED initial status	12	Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference.
02	Select control mode	0	0: position mode 1: velocity mode 2: torque mode
40	Selection of command pulse input	1	1: input through exclusive difference circuit
42	Select command pulse input mode	3	Set command pulse input mode: pulse + direction, negative logic
48	Numerator of the first pulse command frequency multiplication	Need calculation Range: 1~10000	Typical values: pitch 5 mm, encoder resolution 10000, shaft coupling direct drag, pulse equivalent 0.001 mm: Pr48＝10000
4B	Denominator of the command pulse frequency multiplication	Need calculation Range: 1~10000	Pr4B＝pitch 5mm / pulse equivalent 0.001mm＝5000 Pr48 / Pr4B=10000 / 5000=2/1

## 4.6.5 Parameters Setting of MITSUBISHI MR-E Servo Driver

Para. No.	Code	Function	Value	Description
0	*STY	Control mode selection and regenerative fittings	X0X0	Bit 0: set 0: select position control mode. Bit 1, select motor series: 0: HC-KFE; 1:HC-SFE. Bit 3, select regenerative apparatus, set 0: not use. Bit 4, select motor power.
3	CMX	Electronic gear numerator	Need calculation	CMX / CDV= command unit × servo motor resolution × mechanical deceleration ratio / pitch of lead screw
4	CDV	Electronic gear denominator	Need calculation	E.G., pitch 5 mm, encoder resolution 10000, shaft coupling direct drag, pulse equivalent 0.001 mm, CMX/CDV=10000×0.001/5 = 2/1; When pulse unit = 0.0005mm, CMX / CDV = 1/1. Electronic gear ratio range: 1/50 ~ 500
18	*DMD	Status display selection	00XX	3: cumulative command pulses E: load inertia When the parameter is set [3], monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection to determine if there is electrical interference.
21	*OP3	Function selection 3 (command pulse format selection)	0001	Set pulse command input form: pulse train + sign, negative logic
41	*DIA	Signal input SON-ON, LSP-ON and LSN-ON automatically selection	0110	Bit 0: Servo-ON selection. [0]: servo on by external input; [1]: servo on all the time inside. Bit 1: last signal of positive rotation range (LSP): [1]: auto servo on inside and no need of external wiring. Bit 3: last signal of negative rotation range (LSN) : [1]: auto servo on inside and no need of external wiring.

4.6.6 Parameters Setting of FUJI FALDIC-β Servo Driver

Para. No.	Name	Value	Description
01	Command pulse numerator α	Need calculation 1～32767	Command pulse numerator and denominator are also those of the electronic gear ratio. α / β=encoder resolution× pulse equivalent× mechanical deceleration ratio / screw pitch.
02	Command pulse denominator β	Need calculation 1～32767	Typical value: encoder resolution 65536, pulse equivalent 0.001, pitch 5mm, mechanical deceleration ratio 1, α / β=65536×0.001 / 5=8192 / 625, So α=8192, β=625.
03	Pulse string input form	0	Set the input mode of pulse string as: instruction + symbol, that is 'pulse + direction'.
04	Direction of rotation switch	0 or 1	Set 0: Positive direction: Forward rotation (CCW); Set 1: Positive direction: Reverse rotation (CW).
10	CONT1 signal distribution	1	CONT1 is distributed as RUN (that is SON); if not distributed, CONT1 will be auto ON if there is no alarming when powered.
11	CONT2 signal distribution	2	CONT2 is distributed as RST (that is servo alarming clearance CLR). When parameters 12, 13 and 14 are 0, that is CONT3, CONT4 and CONT5 can't be distributed as OT over-travel or EMG (exterior emergency stop).
15	OUT1 signal distribution	1	Set 1, OUT1 is distributed as a-contact point of alarming output; Set 2, OUT1 is distributed as b-contact point of alarming detection.
27	Parameter write-protection	0 or 1	Set 0, write-enable. Set 1, write-protected.

4.6.7 Parameters Setting of STONE GS Servo Driver

Para. No.	Parameter Name	Value	Description
F0f	Electronic gear ratio numerator	2	Electronic gear ratio of position mode: 4 × pulse frequency fed back by servo encoder = command pulse frequency × F0f / F10; Value of F0f / F10 must be within 1/100~100. (calculation with pitch 10mm)
F10	Electronic gear ratio denominator	1	
F00	Control mode selection	2	0: External speed running mode; setting the value and direction of motor velocity according to the external analog －10V～+10V signal of CN2-16, 17; 1: Internal speed running mode; setting the value and direction of motor velocity according to the setting of parameter F33, F35, F37, F39 and the port status of CN2-9, CN2-25; 2: Position pulse running mode; accepting the input of external position pulse and direction level signal; 3: Jog mode; make sure the motor speed in terms of parameter setting of F3b, and control the rotation direction by the direction keystroke ▼ and ▲; 4: Torque mode; setting the value and direction of motor torque according to the external analog － 10V ～ +10V signal of CN2-43, 1; 5 ~ 10: Mixed mode; selecting mode according to the port input status of CN2-24:

F00 Value	CN2-24 Interface Status	
	OFF (Mode One)	ON (Mode Two)
5	Position Pulse Mode	External Speed Running Mode
6	Position Pulse Mode	Internal Speed Running Mode
7	Position Pulse Mode	Torque Mode
8	Internal Speed Running Mode	External Speed Running Mode
9	Internal Speed Running Mode	Torque Mode
10	External Speed Running Mode	Torque Mode

Para. No.	Parameter Name	Value	Description
F2e	Pulse input mode selection	2	Command pulse string mode selection of position mode: 1- single pulse string positive logic 2 – single pulse string negative logic 3 - double pulse strings positive logic 4 - double pulse strings negative logic 5 - quadrature pulse positive logic 6 - quadrature pulse negative logic
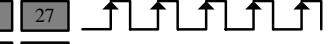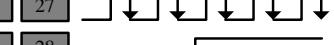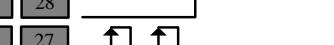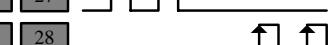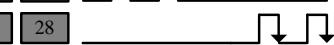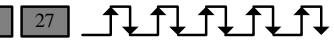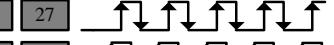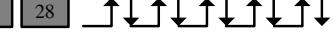
4.7 EX4A Terminal Board

Compared with 6B-EX1D7 terminal board, EX4A terminal board (Dimension: 285mm length, 85mm width, 55mm height) strengthens port output function, extending the former single X axis to 4 X axes, former single Y axis to double Y axes, and former single Z axis to 4 Z axes; functions of other ports remain the same. The wiring diagram of EX4A terminal board is as following:
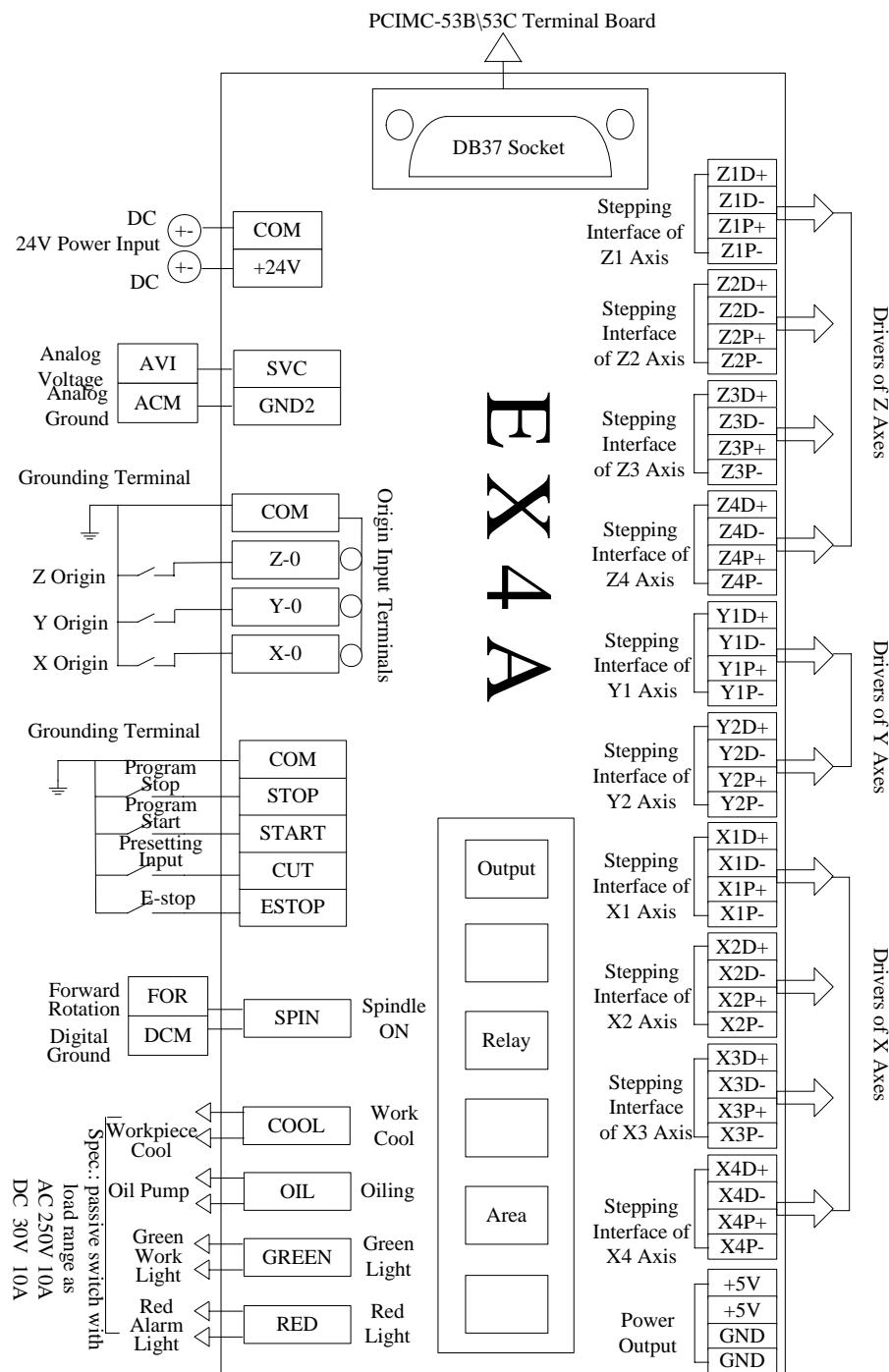

Fig. 4-18 Wiring Diagram of EX4A Terminal Board

5 Whole Machine Debugging

After finishing the wiring in accordance with the instruction above, start to debug the whole machine tool following the below steps:

1) Join the terminal board to port JP1 on the control card with DB37M/F cable, provide 24V power supply for the terminal board, and power on the machine signal system (proximity switch, etc). Examine the input signal LEDs of the terminal board: for example, if the origin switch connected is normally closed, at this time, three LEDs of X0, Y0 and Z0 are on, trigger the origin switch through artificially imitation. (For travel switch, artificial press can be used to observe whether the signals can be received. For photoelectrical switch, artificially obstruct the light to see if the signals can be gotten. For metal proximity switch, artificially approach it with a metal block to see if the signals can be gotten.) If the corresponding LED is out, it indicates the origin signals have been sent to the terminal board. If the origin switch connected is normally open, LEDs should be usually out, and by artificially touching the switch, LEDs should become light, which shows the origin signals have been sent to the terminal board. The same method can be taken to test other ports to ensure the correctness of the wiring between the terminal board and the machine tool, greatly shortening the debugging time.

2) Power on the computer, run Ncstudio software, and then switch to "I/O Ports" window, displaying many input and output signals. Solid dots represent input signals, while hollow dots represent output signals; dots in red indicate the signals are invalid at the time (with no input or output), while dots in green indicate the signals are valid at the time. The "I/O Ports" window is as shown in Fig. 5-1. (They are for reference only. Ports displayed in "I/O Ports" window will vary with the different software versions and hardware board card types. The actual situation is in line with shipment).

Fig. 5-1 "I/O Status Window" of Ncstudio Software

3) Alter the input port polarity of the software in terms of such buttons selected as origin switch and E-STOP button: the polarity of NO input ports is N; the polarity of NC input ports is P. The way to alter the polarity is as follows:

In V8 version: press Ctrl, Alt and Shift simultaneously, right click the signal to be modified its polarity, then a menu will pop up, choose "toggle polarity". After all the polarity modification has been finished, shut down Ncstudio, and then restart it, the polarity modification will become valid instantly.

In V9 version: directly click the manipulation button [ConvtPol], or press its shortcut key F5 under [IO Ports] screen of [Diagnosis] function section. After all the polarity modification has been finished, shut down Ncstudio, and then restart it, the polarity modification will be valid instantly.

4) Electrify the electrical box. Then the dots in front of such input signals as origin signals of the three axes, E-STOP signal, program start/stop signals and tool presetting signal should be in red, indicating all these signals are invalid. Otherwise, it is necessary to check the correctness of electrical circuitry and signals polarity. If electrical circuitry is correct, alter the corresponding signal polarity to ensure the dots in front of the above-mentioned signals show in red.

5) Press the [Program Start] button, and observe whether the dot color of the signal changes. When the button is being pressed, the dot color should show in green, and in red after released. If there is no change to the dot color, please turn to step 1 above to check whether the LED on the terminal board works normally when being pressed. If the terminal board works normally, it indicates that the software has not collected the signals from the terminal board. Examine the connection of cable DB37M/F and DB50M/F with the control card and the terminal board. Similar method can be taken to examine program stop signal and emergency stop signal.

In accordance with step 5, open I/O window and simulate to trigger the origin signals according to step 1, observing whether the dots in front of the origin signals turn into green when the origin button is being triggered. Be sure that all the origin signals of X, Y and Z axes can be gotten.

Tool presetting signal has been changed into pulse signal inside the system. Therefore, when the presetting signal is received in debugging, the dot color in front of tool presetting signal will turn into green instantaneously and then restore to red.

6) Set transducer parameters, make it work under 0~10V analog voltage control mode. Start / stop controlling adopts positive rotation terminal control mode. Press down the [Spindle Start] button in the software, observe in I/O window whether the color of signal dot in front of "Spindle" turns green, on the terminal board whether the green output indicator LED beside the corresponding relay becomes brightening, and whether the spindle starts to rotate. If the spindle does not rotate, please examine the connection of transducer. Adjust the spindle speed in the software and the rotation speed of spindle should be correspondingly changed; otherwise, examine the connection and the parameters setting of transducer. If the spindle rotates in a wrong direction, please transform the connection between spindle and transducer: usually, there are three wires connected with spindle. Exchanging any two of them will alter the spindle rotation direction.

7) Move the machine tool manually to make sure the correctness of the moving direction of each

axis. Notice Ncstudio adopts "right hand" coordinates system. For X-axis, right movement is the positive direction; for Z-axis, upward movement is the positive direction; while the positive direction of Y-axis is to move away from the operator (if movement of Y-axis is the movement of worktable, its positive position is the worktable moving towards the operator). If this direction is not correct, you can alter the moving direction by exchanging the two wires of a winding in the stepping motor.

8) After confirming the moving direction of each axis, set the worktable stroke in the manufacturer parameters according to the actual size of machine tool to make software limit available. The password of manufacturer parameter is "ncstudio".

9) Set subdivision value of stepping motor driver; generally, the larger the subdivision value is, the higher the resolution will be. But if the subdivision value is too large, it will affect the maximum feed speed. Generally speaking, regarding the pulse equivalent of die machines, 0.001mm/P (the maximum feedrate is 9600mm/min at this time) or 0.0005mm/P (the maximum feedrate is 4800mm/min) can be taken into consideration; for those who are not very critical about the accuracy, the pulse equivalent can be set a litter larger, such as 0.002mm/P (the maximum feedrate is 19200mm/min) or 0.005mm/P (the maximum feedrate is 48000mm/min). For two-phase stepping motor, the computational method of pulse equivalent is shown as below: pulse equivalent =pitch of lead screw / subdivision value / 200.

10) Taking-off speed: it means the maximum start-up speed of stepping motor direct from "0" without acceleration. Reasonable parameter setting will greatly improve the machining efficiency and can avoid low-speed stage of poor motion feature of the stepping motor. But if the parameter is set too large, the machine tool may be stagnated. Therefore, the parameter setting should be feasible. Usually, taking-off frequency parameter is included in ex-factory parameters of motor, but this value may be changed after the installation of machine tool; normally it will decrease especially when the machine tool runs with load. All in all, you'd better refer to the default motor parameters and your actual measurement before setting this parameter.

11) Acceleration of single axis: it describes the single axis ability to accelerate / decelerate, with unit mm/s^2. The value is determined by the physical characteristic of machine tool, such as quality of movement part, torque, resistance, and cutting load of feed-motor, and so on. The larger the value is, the less time spent in the process of acceleration / deceleration will be, and the higher the efficiency will be. Usually, for stepping motor, the value is between 100 and 500; for servo motor system, the value is between 400 and 1200. Please set the value smaller at the beginning; make the machine tool carry out several typical movements repeatedly in a period of operation, and carefully observe it. When there is no abnormality, increase the value gradually; otherwise, decrease the value and reserve 50% ~ 100% insurance allowance.

12) Turning acceleration: it is used to describe the acceleration / deceleration ability of multiple feed-axes in synchronized motion, with unit mm/s^2. The value limits the maximum speed of machine tool along circular movement. The larger this value is, the higher the maximum allowable speed of machine tool in circular movement. Usually, for stepping motor system, the value is between 400 and 1000; for servo motor system, the value is between 1000 and 5000; for heavy machine tool, the value should be smaller. Please set the value smaller at the

beginning; make the machine tool repeat various typical movements of synchronized motion in a period of operation, and carefully observe it. When there is no abnormality, increase the value gradually; otherwise, decrease the value and reserve 50% ~ 100% insurance allowance.

Usually, given the drive ability of stepping motor, frication of machine assembly, and endurance capacity of mechanical components, modification to the maximum speed of each axis in manufacturer parameters can be used to limit the speed in actual process.

13) Set "Back to Machine Origin" parameter in manufacturer parameters according to the installation position of zero sensors of three axes. After the correct setting, perform the "Move to Machine Origin" under "Operate" menu. At the beginning, only a single axis will be returned. The other two axes will be returned in turn on condition that the moving direction of the first axis is correct; otherwise, returning will stop. Please reset direction of backing to the reference point parameters in manufacturer parameters until all axes are returned to the Machine Origin.

14) Set the parameter of auto lubrication (set a smaller value, e.g. once every 5 seconds). Observe if the auto lubrication is right, if right, set this parameter based on actual need.

15) Examine whether electronic gears match with pulse equivalent. Make a mark on any axis of the machine tool and set this marked point as the workpiece origin of the workpiece coordinates. Drive this marked axis to move a fixed distance by direct command input, jog or handwheel, and so on. Measure the actual moving distance with a vernier caliper and check whether it is equal to the distance shown in the software.

16) Examine if any pulse is lost. Direct method: mark a little dot on the surface of a workpiece blank with a dagger, then set this point as the workpiece origin of workpiece coordinates; lift up Z-axis, set the coordinate of Z-axis as 0; repeatedly move the machine tool, for example, dry run a typical procedure (including three axes synchronization is much better), pause or termination during processing is permitted, then back to the workpiece origin, descend Z-axis slowly, observe whether the knifepoint matches with the marked dot. If deviation exists, please check the type of pulse signal received by stepping motor driver and the connection between extended board and driver. If the stagnation or step missing still exists, please turn to step 10, 11, and 12 to adjust some parameters, such as acceleration.

If there is any problem in the running of the machine tool, please check every part carefully according to the steps above of the whole machine debugging.

6 Customized Setup Installation Package

A tool, named NcHelper.exe, is under installation directory, which enables customized setup installation package possible. Such as, when you are in the process of using Ncstudio, values of some parameters need alternation, and to enable the best performance of machine tool, these changed values are desired to be set as the default values by making an installation package; then the best performance of machine tool can be realized just by double-clicking NcHelper.exe tool and selecting default configuration.