HNC-8 System Commissioning Manual (Milling System)

V2.4 Series

Introduction

The manual may help you to quickly get familiar with the HNC-8 system, providing detailed information about commissioning, programming or application methods. Any updates or modification of the manual is not allowed without the written permission of Wuhan Huazhong Numerical Control Co., LTD (hereafter referred to as "HCNC"). Without HCNC's authorization or written permission, any units or individuals are not allowed to modify or correct the manual. HCNC will not be responsible for any losses thus incurred to customers.

In this manual we have tried as much as possible to describe all the various matters concerning of the system. However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities. Therefore, matters which are not especially described as possible in this manual should be regarded as “impossible” or “not allowed”.

Please favor me your instruction for shortages and inadequacies of the manual.

Note

- As to notes such as "Limitations" and "Usable functions", the specification provided by the machine tool manufacturer is superior to the manual. Please conduct dryrun before actual machining and confirm machining program, tool compensation volume and workpiece offset, and so on.
- Please explain matters which are not described in the manual as "Infeasible".
- The manual is prepared on the condition that all functions are configured. Please make a confirmation according to the specification provided by the machine tool manufacturer in use.
- For relevant instructions for machine tools, please refer to the specification provided by the machine tool manufacturer.
- Usable screens and functions differ with different NC systems (or versions). Please be sure to confirm specifications before use.

Contents

1. Introduction

1.1 808DM Series CNC System

1.1.1 Product Overview

808DM series CNC milling system is a bus CNC device based on mature HNC-8 CNC system platform and a medium and high-end product of HNC-8 series CNC devices with high stability and reliability;
The product adopts aluminum alloy frame and has simple and elegant appearance. The hardware platform is upgraded and overall hardware performance improves by 50%. The product adopts new platform software which make it easier to develop customizable software;
MCP panel split structure, modular design, and customizable; 10.4 in. HBLCD;
Support two types of bus: NCUC and EtherCAT.

1.1.2 Product Features

Quick programmed path display function
Support rapid preview of graphics track while loading program, configure color of tool, display by different views, display self-adaptive optimal proportion of view, and realize local zoom for user-friendliness.
Workpiece position measurement function
Support workpiece position measurement. After measuring coordinate points in the workpiece measurement screen, the values automatically calculated according to measured coordinates will be set in the selected coordinate system for user's preparation.
Tool automatic measurement function
Measurement specific to different application scenarios: Three tool setting modes are optional in the drop-down box: "Single tool for single workpiece", "Single tool for multiple workpiece" and "Multiple tools for multiple workpiece".
Comprehensive tool life management
Make statistics of tool life through management of cutting energy consumption and cutting distance. Various life management modes can take effect simultaneously. Comprehensive statistics on tool life greatly improves the accuracy of tool life management
Automatic pitch error import function
Directly import thread pitch error report text (.REN) generated by Renishaw laser interferometer or original data of thread pitch error point (.rtl) to automatically generate pitch compensation. Support incremental compensation for the compensated axis when the .rtl file is imported again without the need to manually fill in the pitch compensation parameters, reducing the workload of factory check and realizing efficient and accurate pitch error compensation.
Configurable parameter classification function
Multi-custom classification and grouping according to parameter function: System parameters are divided into several categories according to function, namely "Submenu", which is divided into groups according to subfunction. Name available for customized classification and grouping can be prefixed with fast index keyword to facilitate commissioning personnel to search. Classification parameter can be displayed and modified according to permission. Axis parameter can be displayed by axis name in different columns to facilitate to modify and contrastively view different axes.

Alarm help function

In "Alarm message" and "Alarm history" interfaces of the system, select corresponding alarm number and press "HELP" key (shortcut key if there is no HELP key) on the NC panel to call corresponding alarm help information. "Alarm cause" of corresponding alarm, "Response" when the system gives an alarm, "Solution" after an alarm is given and corresponding "Reference" can be displayed, and can connect to Could in the later period. The solution cases uploaded by customer service personnel also can enrich the help content.

Multibus control technology

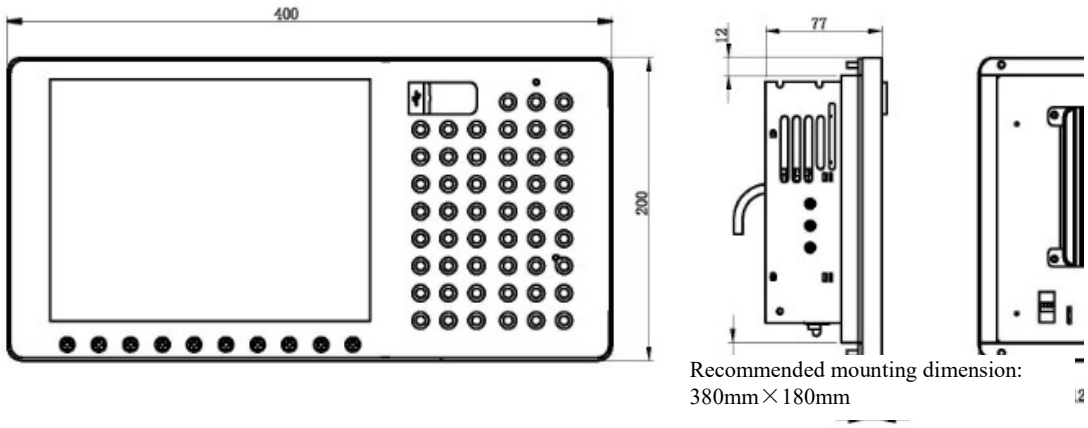
Furnished with different HPC, HNC-8 system can support single or mixed connection of servo drive and I/O of three types of real-time field bus NCUC, EtherCAT and MIII. Slave stations between different buses can realize microsecond clock synchronization, which can meet the requirements for high speed and high accuracy of the CNC system.

1.1.3 Product Parameters

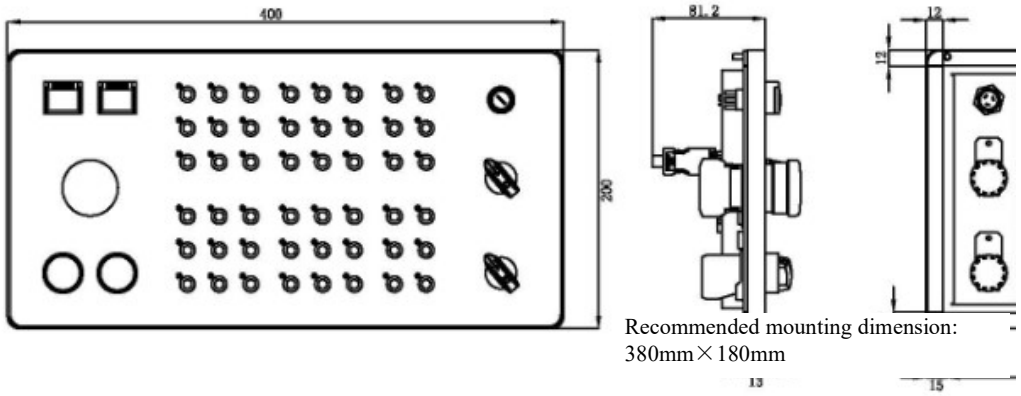
CNC function	Maximum number of channels is 1, 4 feed axes and 1 spindle are supported at most	
	Minimum resolution: 1um	Maximum movement speed: 24m/min
	Automatic acceleration/deceleration control (straight line/S curve) reference point return	
	Coordinate system setting	Machining graphic simulation and real-time tracking
	MDI function	M, S, T function
	Machining graphic static simulation and real-time tracking	Internal secondary electronic gear
	Drilling cycle	Milling cycle (optional)
CNC programming	Minimum programming unit: 0.001mm, degree	Maximum size: 99999.999
	Maximum program lines: 2 billion lines	Programming in metric/inch
	Absolute/incremental programming	Macro programming
	Subprogram call	Workpiece coordinate system setting
	Diameter/radius programming	Automatic control of chamfer (fillet angle, right angle)
	Constant linear speed cutting function	
Interpolation function	Linear interpolation, no more than 3 axes	
	Circular interpolation, thread cutting, pitch error compensation	
Tool compensation function	Tool length compensation	Tool nose radius compensation
Operation function	8.4//TFT color LCD	Antistatic film programming panel and operation panel of machine tool
	PC standard keyboard interface	Handheld unit (optional)

	Graphic display function and dynamic real-time simulation	Network communication function (optional)
Feed axis function	Infinite rotary axis function	Maximum setting speed 16000mm/min
	Feed rate override 0%-150%	Rapid traverse override 0%-100%
	Various reference point functions: unidirectional and bidirectional	
Spindle function	Spindle speed: Controllable through PLC programming (maximum 32000rpm)	
	Spindle override: 0%-150%	Spindle speed and override display
	Gear ratio and number of gear ratio stages can be controlled through PLC programming, thread function	
Auxiliary function	CW and CCW rotation of spindle Automatic tool changing Cooling ON/OFF	
PLC function	Built-in PLC, offer standard PLC routine, PLC online/offline programming and debugging function	

1.1.4 Product Size



Recommended mounting dimension:
380mm×180mm



Recommended mounting dimension:
380mm×180mm

1.2 818DM Series CNC System

1.2.1 Product Overview

HNC-818DM CNC milling system is a bus CNC device based on mature HNC-8 CNC system platform and a medium and high-end product of HNC-8 series CNC devices with high stability and reliability;
The product adopts aluminum alloy frame and pendant installation and has simple and elegant appearance;
The hardware platform is upgraded and furnished with 8G SSD, with overall hardware performance improved by 50%;
The product adopts an MCP panel split structure, modular design and combined crystal keys and is customizable. The screen display has two specifications 12.1" and 17" and can be furnished with touch screen;
Support USB, Ethernet and other program expansion and data exchange functions;
Support two bus protocols NCUC and EtherCAT. Support various installations and more compatible with appearance of machine tool. The newly designed IPC unit is thinner and smaller and is the best choice of medium and high-end machine tools due to lower power consumption and higher operating rate.

1.2.2 Product Features

Smart surface machining technology (iSurfine)
Smart surface machining technology (iSurfine)-High-speed high-precision primary algorithms
Program read-ahead 2000 blocks
Sine and cosine flexible acceleration and deceleration control
High-speed nano interpolation
High-order fitting of small line block track
Speed smoothing
Sine and cosine flexible acceleration and deceleration control
High-speed nano interpolation
Low-order spline fitting High-order spline fitting
Speed smoothing
Smart surface machining technology (iSurfine)-High-speed high-precision speed planning
Plan the optimal speed in real time according to tool path, reduce speed fluctuation during high-speed machining to ensure consistency of adjacent tool path and speed.
Original G code program of new hardware remains unchanged, CUP performance increases by 38% and surface quality and machining efficiency improve
Smart surface machining technology (iSurfine)-G code tool path optimization
Through the G code command quality analysis and G code tool path optimization, the smoothness and continuity of the G code path are improved, and the surface quality of the processed parts is improved.
Before code optimization: Obvious vertical grains of side wall and obvious touch feeling.
Before code optimization: Smooth lines of side wall and no touch feeling.
Smart surface machining technology (iSurfine)-High-performance global surface optimization
High-performance machining global speed planning, speed shaping for variable speed intervals. Reduce speed fluctuations during high-speed machining, ensure the consistency of adjacent toolpath speeds, improve machining quality, and improve machining efficiency. Provide high-precision molds, auto parts, and 3C product optimization solutions.
Sensor-based temperature compensation function

Temperature sensor is connected externally via HIO module to monitor temperature variation of temperature sensitive points of machine tool. Moreover, with the temperature rising curve and dropping curve of the machine tool temperature sensitive points, the compensation result of the machine tool thermal deformation is formed, and the thermal stability of the machine tool accuracy is improved.

Triathlon health security

Carry out self-check of machine tool to obtain the ECG, inspect change of health indexes of machine tool, and evaluate health condition of machine tool. Timely maintain machine tool according to evaluation result to ensure healthy operation. Meanwhile, carry out horizontal comparison of health condition of similar machine tools to ensure consistency of assembling and commissioning.

Feed axis load diagram

Make statistics of electric control big data of CNC system produced in the full life circle of guide screw, analyze distribution of full-travel load of guide screw, evaluate state of guide screw according to visualized statistical data, make effective and reasonable use of healthy area of guide screw, improve the operation accuracy, and extend the service life of guide screw.

Intelligent management of tool life

Various tool life management improves rationality and accuracy of intelligent management of tool life and effectively extends tool life.

Fault data recorder

The CNC system can store key data within 10s before fault occurs and replay 10s key fault data to effectively help engineers identify fault cause and improve fault maintenance efficiency.

QR code diagnosis

Main information supported by the CNC system is outputted in the form of QR code. Scan QR code by mobile phone to acquire state information of the CNC system and transmit the fault information to iNC-Cloud, and query fault diagnosis case library and historical record of machine tool to analyze fault cause more accurately.

1.2.3 Product Parameters

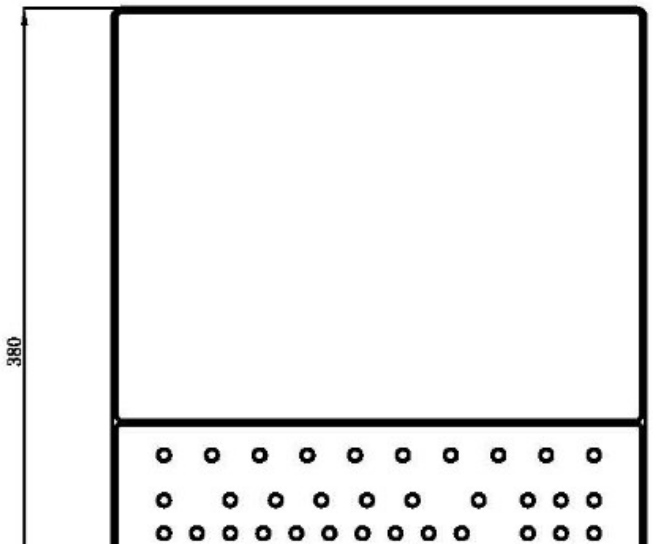
Control channels	2 channels
Controlled axes	Maximum number of control axes: 5 feed axes and 4 servo spindles Maximum number of simultaneously-controlled axes: 3 axes (linear interpolation), 2 axes (circular interpolation) Number of PLC control axes: 3 axes (support servo tool post)
Matching servo drive	Traverse axis: Low-voltage servo drive HSV-160U-020/030/050/075
	Spindle: HSV-180US-035/050/075/100
Feed axis is switched to spindle	Feed axis is switched to spindle: 4 feed axes are switched to spindles
Coordinate value (system) and size	G52 local coordinate system, G53 machine coordinate system, 6 workpiece coordinate systems (G54-G59), 60 extended coordinate systems (G54.1-G54.60)

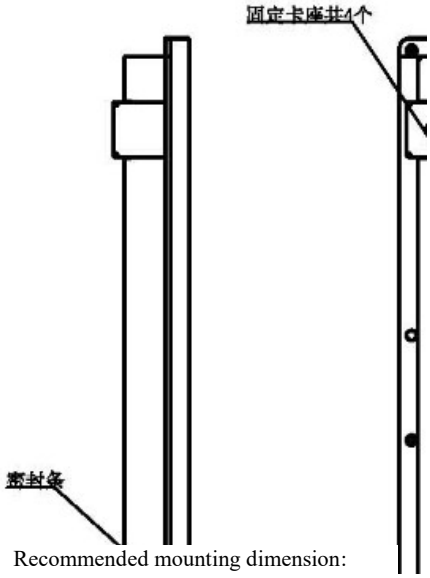
	Coordinate plane selection (G17/G18/G19)
	Position command range: μ level (IS-B) 214748.364 to +214748.364, 0.1μ level (IS-C) 21474.8364 to +21474.8364
	Absolute/incremental programming, inch/metric, linear axis/swing axis/rotary axis
G code function	71 G commands, including rapid traverse positioning, linear interpolation, circular interpolation, cylindrical interpolation, cylindrical spiral interpolation, polar coordinate interpolation, imaginary axis specifying and sine interpolation, rigid tapping, mirroring function, scaling function, rotation transformation function, drilling cycle, boring cycle, tapping cycle, small line segment high-speed high-precision machining function, program dwell, tool compensation, macroprogram call, skip, cycle, etc.
Feed function	Rapid traverse speed: μ level (IS-B) 0mm/min-60000mm/min, 0.1μ level (IS-C) 0mm/min-24000mm/min
	Rapid traverse override: Real-time override, a total of four levels: F0, 25%, 50% and 100%
	Cutting feedrate: μ level (IS-B) 0mm/min-30000mm/min, 0.1μ level (IS-C) 0mm/min-24000mm/min
	Feed rate: 0~150% real-time adjustment, a total of 12 levels
	Rapid traverse/cutting feed acceleration/deceleration: S curve acceleration/deceleration and jerk control are set by parameters
Spindle function	Spindle speed: Given by S code or PLC signal, speed range is set by parameters
	Spindle override: 50%-120% real-time override, in total of 8 levels
	Constant linear speed control of spindle
	C/S axis control
	Analog voltage input/output: 4-way analog voltage input/output
	Feedback of spindle encoder: Feedback of 2-way spindle encoder, feedback of spindle encoder can be set
Tool function	Magazine: up to 2 magazines are supported
	Tool length/radius compensation: 500 at most

Auxiliary function	Tool wear compensation: Support no more than 500
	Tool radius compensation: C type tool compensation
	Internal M command of system: (cannot be redefined) program stop M00; optional stop M01; program end M02, M30; subprogram call M98; subprogram end M99; magazine call M06; manual intervention M92, M93; other M commands are defined by PLC
PLC function	PLC command: Built-in PLC, ladder diagram programming, 21 types of basic commands, 57 types of function commands
	PLC classification: Two levels of PLC programs, the refresh cycle of the first level of programs is 1ms
	Maximum program lines: 8000 lines
	PLC program: Online dynamic display, monitor, edit; support PLC warning and PLC alarm, upload and download
	8-bit intermediate register (R): 2048 bytes (R0-R2047)
	16-bit intermediate register (W): 512 bytes (W0-W255)
	32-bit intermediate register (D): 1024 bytes (D0-D255)
	Timer (T): 512
	Counter (C): 512
	32-digit data relay (B): 6888 bytes (B0-B1721)
	User-defined parameters (P): 200 (P0-P199)
Storage and edit function of program	Program format: Program format ISO command standard, program name O+7 digits or letters; block number N+7 digits; G+3 digits; coordinate value IP± 6 digits before the decimal point and 4 digits after the decimal point; S+5 digits; T+3-digit tool number; M+3 digits; F+6 digits before the decimal point and 2 digits after the decimal point
	Program capacity: 8G
	Edit function: Program, program block, find, modify, delete, copy and past
	MDI function: Multiple lines of program blocks are allowed in MDI
	Macroprogram/subprogram call: Macro programming, 8 levels of subprogram nesting are allowed
	Reference point return: G28 reference point return
	Block skip function: G31 block skip function is used for measurement of tool and workpiece
	Programmable control function: Programmable data input (G10); tool offset, parameter and G54 can be modified

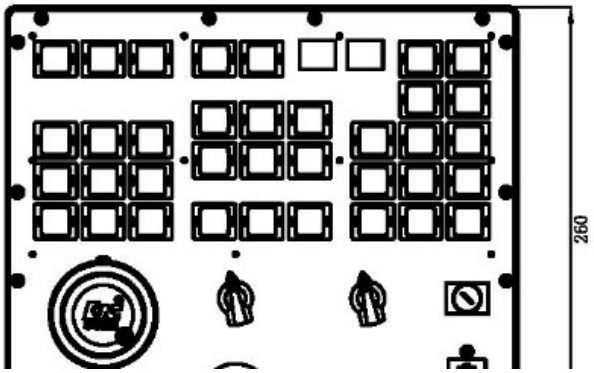
Program check function	Path preview, dryrun, machine tool lock, single block running, vertical/horizontal lathe graphic simulation
Programming simplifying	Canned cycle, rigid tapping, direct input of drawing size, automatic chamfering, macro programming
Compensation function	Backlash compensation: 0mm-10mm, backlash compensation includes machining and rapid traverse, and compensation frequency can be set by parameters
	Memory pitch error compensation: Each axis supports 2000 compensation points, compensation points of each axis can be set by parameters, and pitch error compensation table can be imported
Operation function and display	808DM uses 10.4 in. true color LED
	Machining path display
	Program, setup, entry, tool compensation, diagnosis, position
	Operating mode selection: Auto, single block, jog, incremental, MPG, reference point return
	ON/OFF operation: Dryrun, block skip, optional stop, MST lock, machine tool lock, jog tool change, chuck clamping/release, tailstock loosening/tightening, rapid traverse override, spindle override, MPG override, spindle rotation CW, spindle stop, spindle rotation CCW, spindle jog, hydraulic ON, cooling, lubrication, machine tool lighting, cyclic start, feed hold, second feed hold, over travel release, power on, power off
	Setup operation: Tool offset, tool compensation input; parameter setting of axis and servo
	4-level operation permission management
Communication function	Data interface: Ethernet and USB interfaces, realizing data transmission and network function through interface
	Data input/output: Program, system parameter, compensation value, and PLC program are inputted/outputted through data interface
	Network function: Ethernet communication, remote monitoring, remote diagnosis, remote maintenance
	Expansible bus I/O unit: HIO-1011N/P 16-point input; HIO-1021N/P 16-point output; HIO-1073 4-way A/D input and 4-way D/A output; HIO-1041 2-way D/A output and 2-way second encoder feedback
	Servo drive interface: NCUC bus interface, EtherCat bus interface (Yaskawa M3 bus interface is optional)
Safety function	Emergency stop, hardware limit, first software travel check, second software travel check, multilevel permission data protection, spindle safety speed, feed safety speed, NC alarm, PLC alarm, axis/servo alarm, tracking error monitoring, data backup and recovery
Maintenance function	Fault log, machining log, file log, operation log, machining information, batch debugging, parameter and PLC data backup, servo setup and servo load state monitoring, rigid tapping oscilloscope
Intelligent function	Thermal error compensation with temperature sensor, machining parameter optimization, intelligent high-speed high-precision optimization, full life cycle screw load statistical chart, intelligent tool life management, health security function, cloud CNC

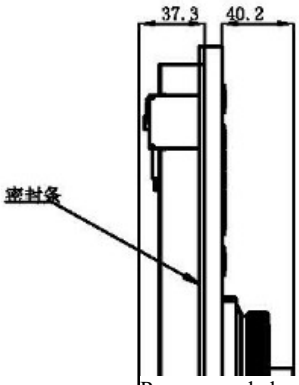
1.2.4 Product Size





Recommended mounting dimension:
272mm×362mm





Recommended mounting dimension:
272mm×242mm

2. Common Hardware Configuration List

1) 808D controller+160U traverse axis servo +180U spindle servo +HIO-1200 series I/O unit

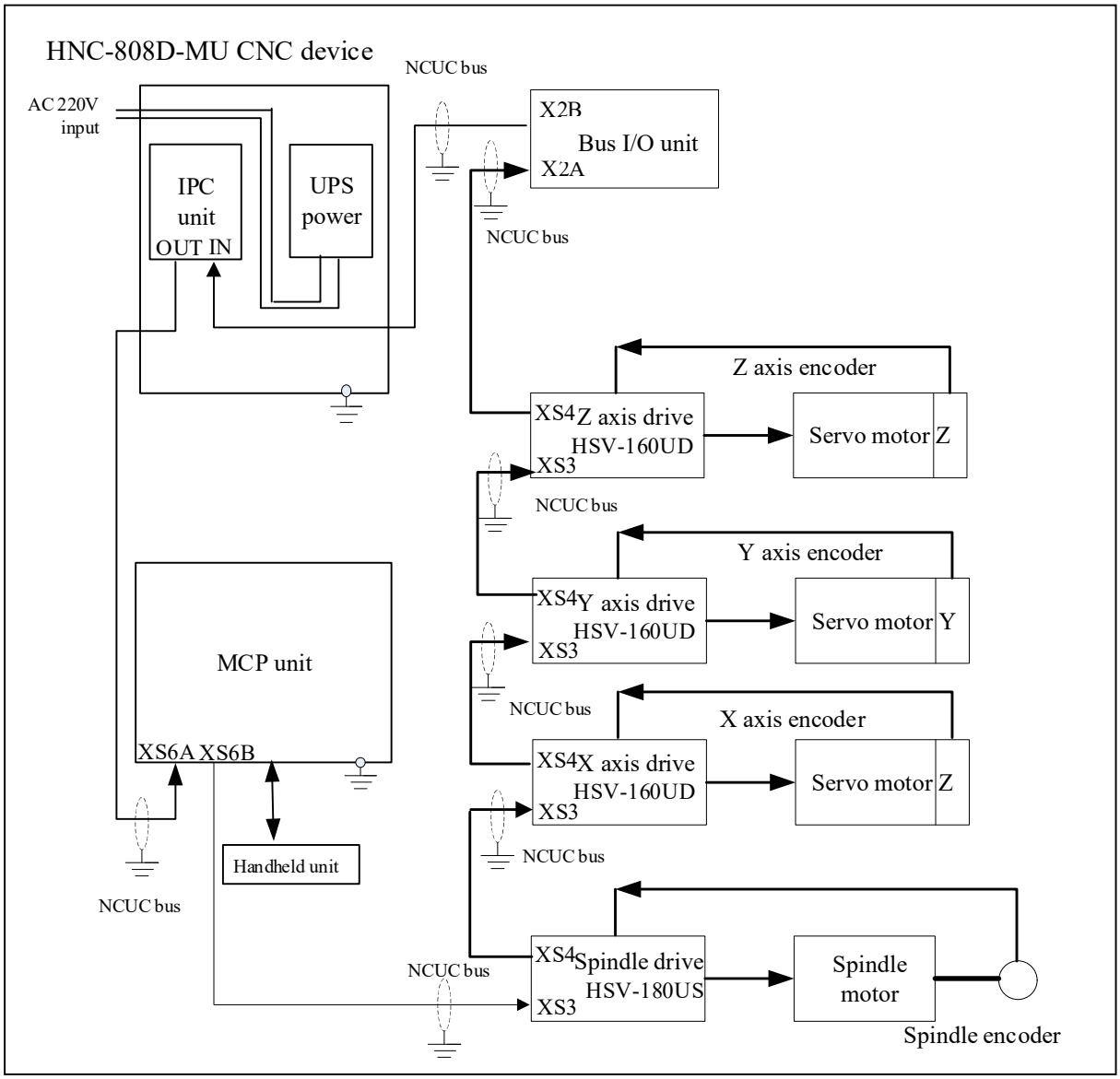
SN	Function	Quantity
1	Milling CNC controller /HNC-808D/horizontal type/NC unit	1
2	Milling CNC controller /HNC-808D/MCP unit/without MPG	1
3	PLC unit/HIO-1200-M1/detached IO unit baseplate +terminal board_V1.1	1
4	Bus cable/HCB-0000-2102-005/5m	2
5	Bus cable/HCB-0000-2102-001/1m	3
6	Bus cable /HCB-0000-2102-002/2m	1
7	Servo drive/HSV-160U-030/hardware current loop	2
8	Servo drive/HSV-160U-050 (Infineon PIM)	1
9	130ST-M10015LMB	2
10	130ST-M15015LMBZ	1
11	Power line /HCB-9160-1111-005-CG/5m/ detachable	2
12	Encoder cable/HCB-9160-0122-005-DB/5m	2
13	Power line/HCB-9160-1112-005-CH/5m	1
14	Brake line/HCB-9016-4100-005-CD/purple/5m	1
15	Encoder cable/HCB-9160-0122-005-DB/5m	1
16	Spindle drive/HSV-180US-050(Infineon PIM)	1
17	Spindle motor/CTB-45P5ZGB15-60H5GP	1
18	Electric reactor/ACL-5.5KW/ 5.5KW/15A/three-phase input/screw	1
19	Braking resistor/51Ω/1100W/RXLG/Bengbu Vanke/plug-in	1
20	Power line/HCB-9018-3000-005-CH/5m/detachable	1
21	Encoder cable/HCB-9180-2201-005-DB/5m	1
22	MPG/HWL-1013-3/3 axes	1

2) 818D system +180U traverse axis servo drive +180U spindle servo+HIO-1000 series IO unit

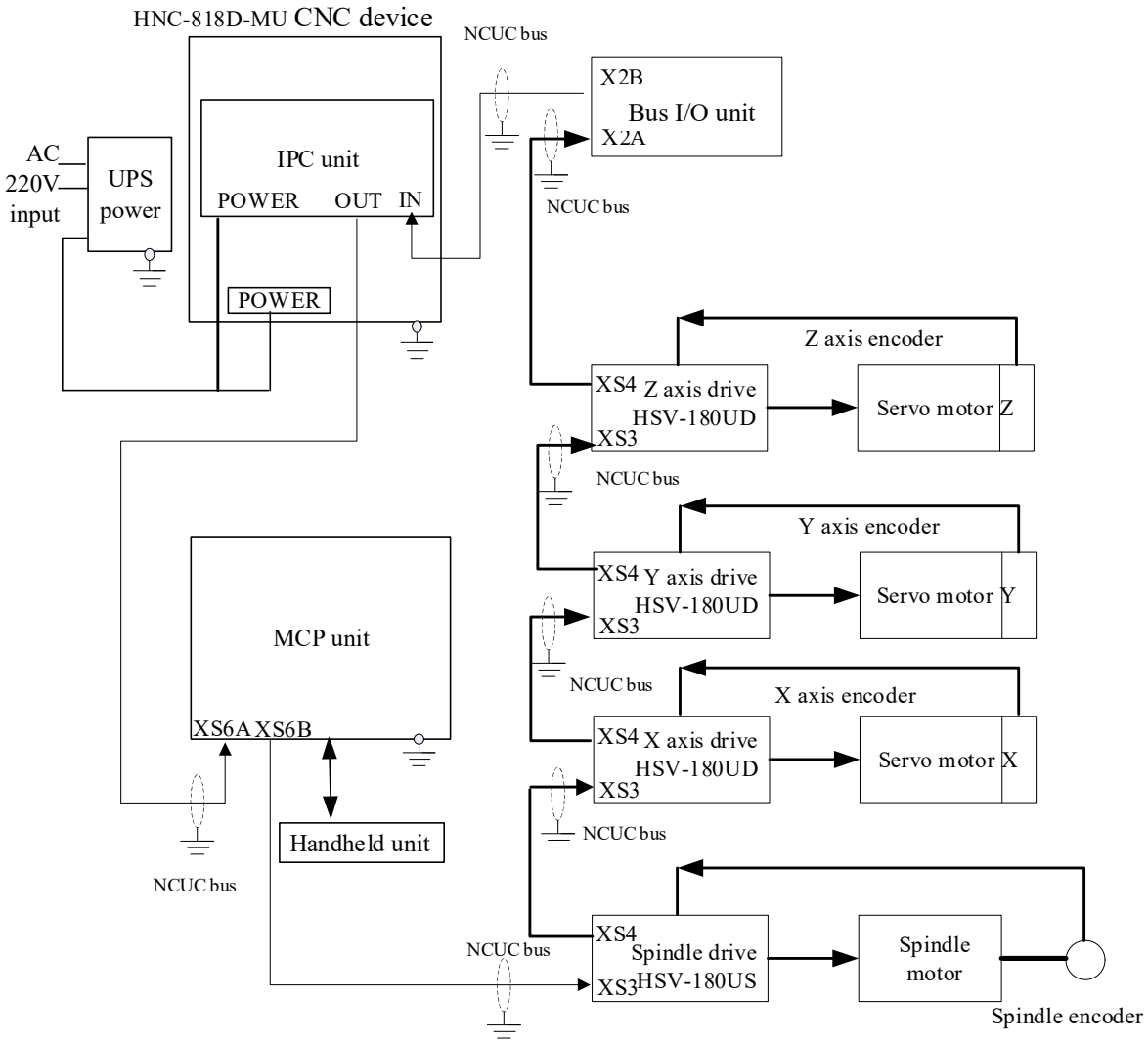
SN	Function	Quantity
1	Milling CNC controller/HNC-818D/NC unit	1
2	Milling CNC controller/HNC-818D/MCP unit/ without MPG	1
3	PLC unit /HIO-1009/9-slot baseplate	1
4	PLC unit /HIO-1061/NCUC live wire port communication board	1
5	PLC unit /HIO-1011P/PNP type input board	2
6	PLC unit /HIO-1011N/NPN type input board	1
7	PLC unit /HIO-1021P/PNP type output board	2
8	PLC unit /HIO-1021N/NPN type output board	1
9	Bus cable /HCB-0000-2102-007/7m	2
10	Bus cable /HCB-0000-2102-002/2m	1
11	Bus cable/HCB-0000-2102-0D5/0.5m	5
12	MPG/HWL-1013-3/3 axes	1
13	Switching power supply/HPW-145U/145W/24V output/V1.7	1
14	Power supply line/HCB-0008-1010-007-CD/7m	1
15	Spindle drive/HSV-180US-075(Infineon PIM)	1
16	Spindle motor/CTB-47P5ZGB15-60H5GP	1
17	Braking resistor/20Ω/2000W/RXLG /screw	1
18	Electric reactor/ACL-7.5KW /7.5KW/20A/three-phase input/screw	1
19	Power line/HCB-9018-3000-005-CH/5m/detachable	1
20	Encoder cable/HCB-9180-2201-005-DB/5m	1
21	Servo drive/HSV-180UD-075(Infineon PIM)	3
22	Braking resistor/20Ω/1200W/RXLG/screw	3
23	Electric reactor/ACL-22KW /22KW/60A/three-phase AC/screw	1
24	180ST-M23020HMBB/spigot 114.3	2
25	180ST-M27020HMBBZ/DC24V/spigot 114.3	1
26	Power line /HCB-9180-1114-007-CH/orange/7m	1
27	Encoder cable/HCB-9160-0122-007-DB/7m	1
28	Power line/HCB-9180-1114-005-CH/orange/5m	1
29	Encoder cable/HCB-9160-0122-005-DB/5m	1
30	Power line/HCB-9180-1114-005-CH/orange/5m	1
31	Brake line/HCB-9016-4100-005-CD/purple/5m	1
32	Encoder cable/HCB-9160-0122-005-DB/5m	1

3. Connection Diagram

3.1 Connection Diagram of 808D System Hardware

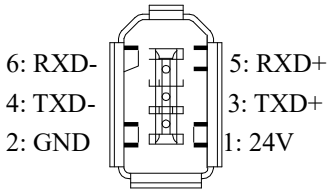


3.2 Connection Diagram Of 818D System Hardware



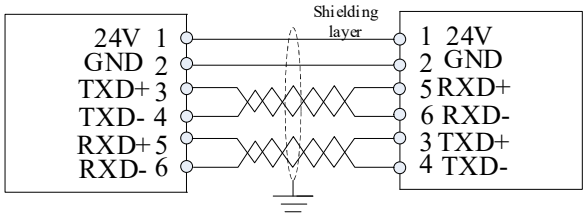
4. Interface Definition

4.1 Definition of NCUC Bus Interface

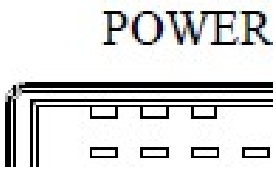


Signal	Description
24V	DC 24V voltage
GND	
TXD+	Data transmission
TXD-	
RXD+	Data receiving
RXD-	

Connection diagram of NCUC bus cable



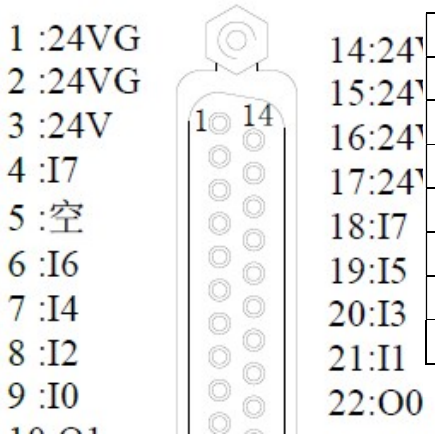
4.2 Definition of IPC24V Power Supply Interface (POWER)



1:24V UPS 2: GND 3: SGND 4: ACFail 5:PE

Signal	Description
24V UPS	DC 24V with UPS function
GND	Power ground
SGND	Signal ground
ACFail	Power failure detection signal
PE	Protective earth

4.3 Definition of Handheld Unit Interface



Signal	Description
24V, 24VG	DC24V power output
I7	Handheld unit emergency stop button
I0 to I6	Handheld unit input switch value
O0 to O3	Handheld unit output switch value
HA	Handwheel A phase
HB	Handwheel B phase
+5V, 5VG	Handwheel DC5V power output

4.4 Definition of Traverse Axis Servo Drive Encoder Interface

160U and 180U encoder interfaces correspond to XS1 and XS5 respectively and are defined consistently.

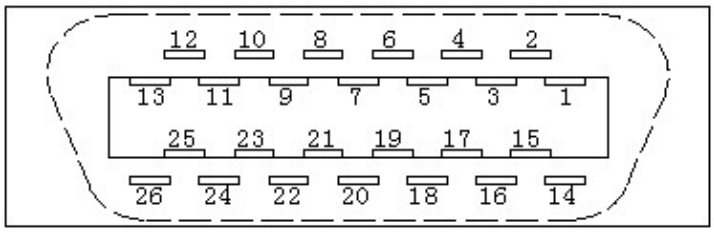
HSV-160U (basic function type) includes HSV-160UP (full-function type) and HSV-160UD series, which support different encoder protocols.

HSV-160U series can be used with composite incremental encoders and Tamagawa and Nikon absolute encoders.

HSV-160UP series can be used with composite incremental encoders and Tamagawa, Nikon, ENDAT2.1, HiperFACE and BISS absolute encoders, support dual encoder interfaces, and can be connected to grating ruler and other position feedback devices to realize full-closed loop control.

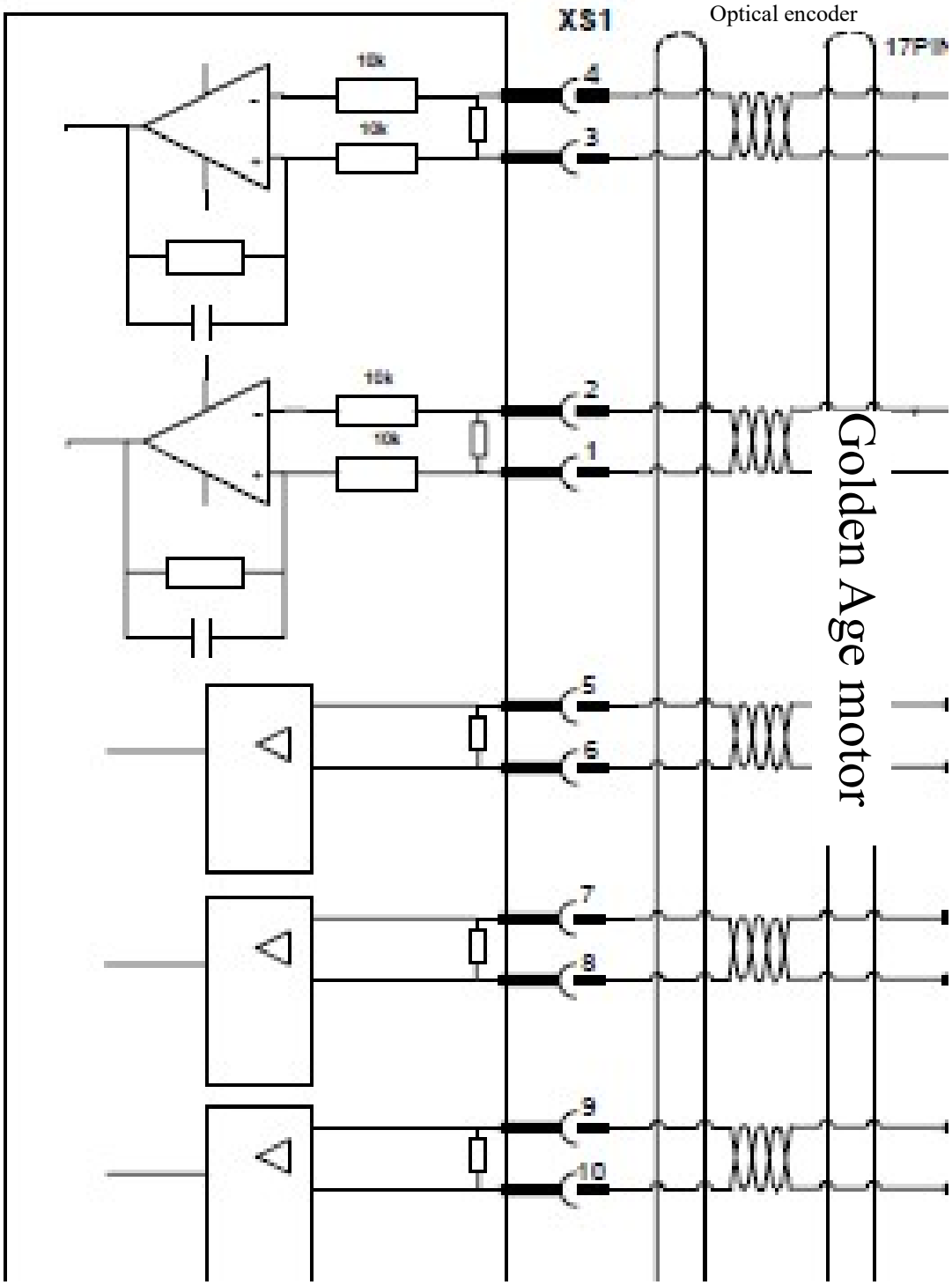
HSV-180UD-035, 050, 075, 090, 100 and 150 AC servo drive unit have uniform servo motor encoder interface and can be used with composite incremental encoders and Tamagawa and Nikon absolute encoders.

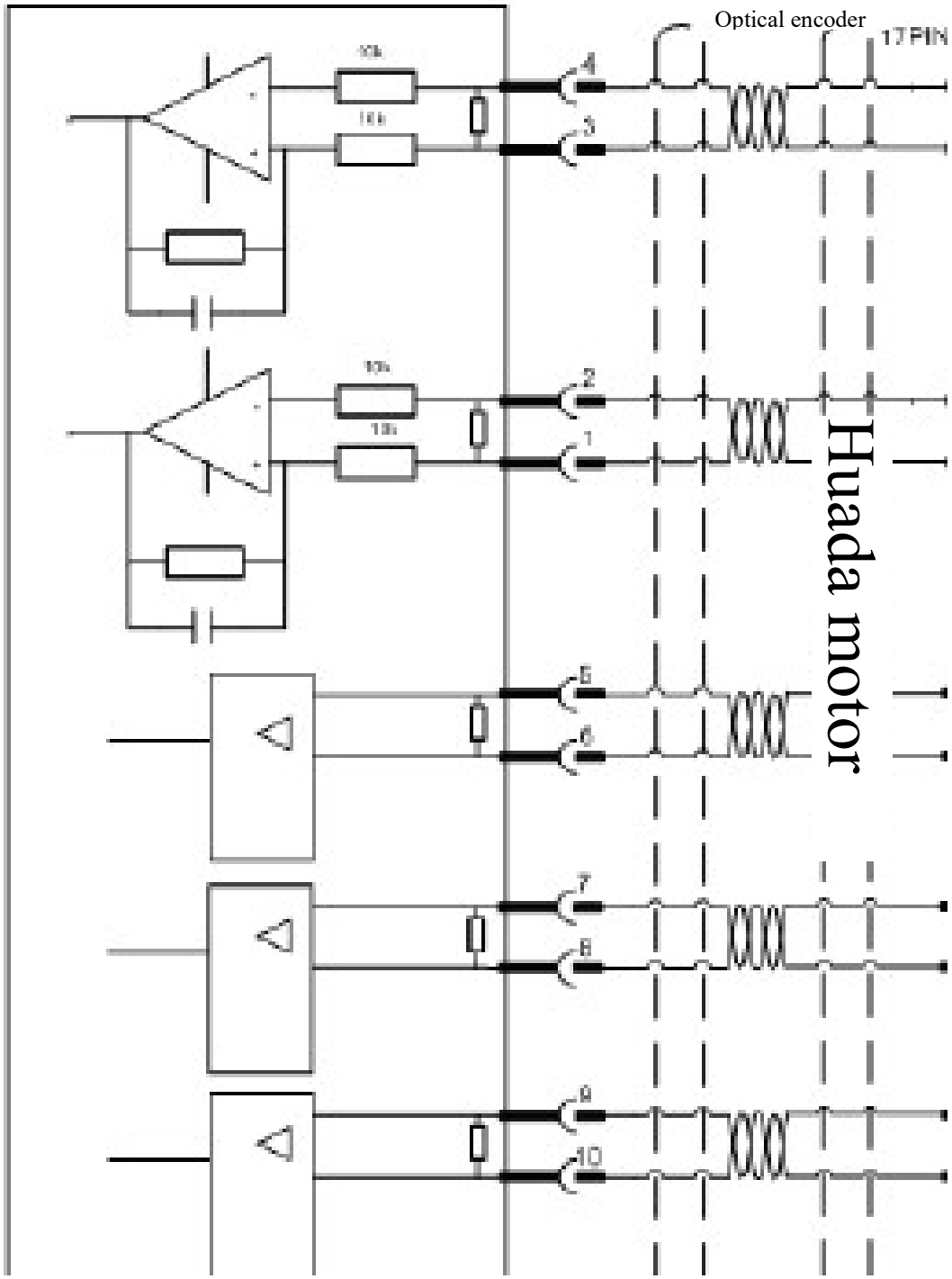
HSV-180UD-035C, 050C, 075C, 090C, 100C, 150C, 200, 300 and 450 as well as HSV-180U1D-100, 150, 200 and 300 AC servo drive units have uniform servo motor encoder interface and can be used with composite incremental encoders and Tamagawa, Nikon, Heidenhain, SICK, HiperFACE and BISS C absolute encoders, support dual encoder interfaces, and can be connected to grating ruler and other position feedback devices to realize full-closed loop control.



Input interface plug pin of servomotor encoder
(facing the plug pin)

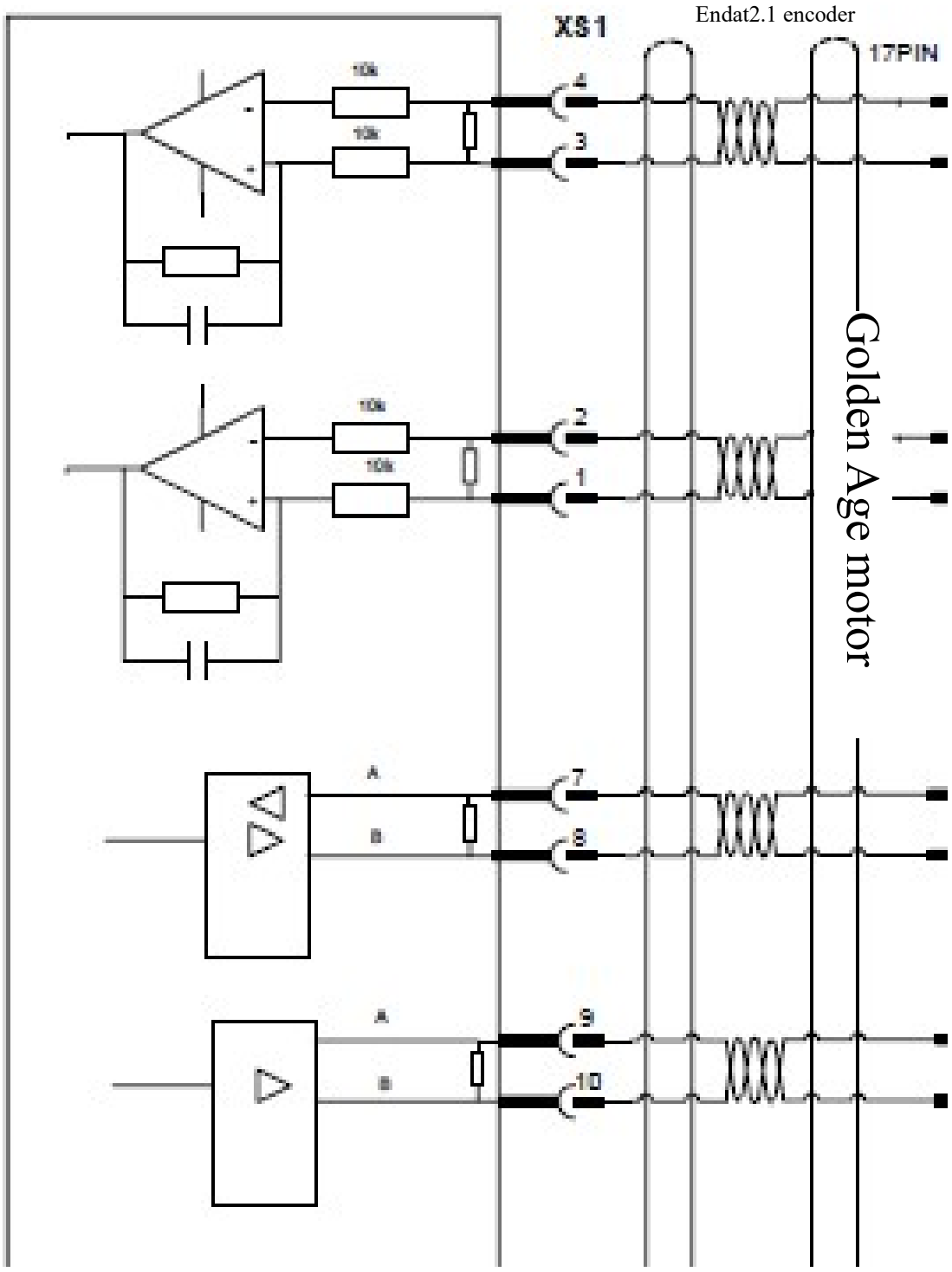
4.4.1 Servo Drive Connects to Composite Optical Encoder




Optical encoder
17PIN
Huada motor

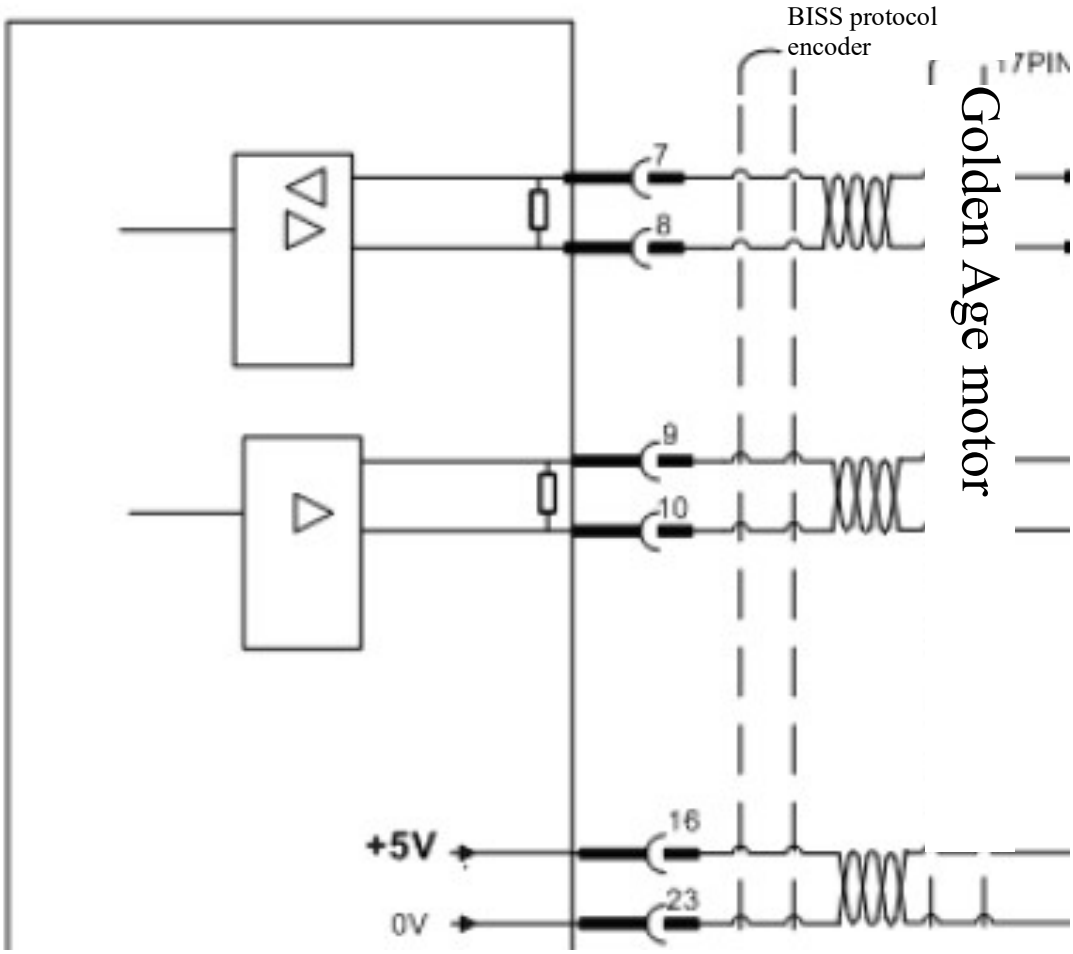
Terminal number	Terminal symbol	I/O	Signal	Function
1	A+/SINA+	I	Encoder A+ input	Connect to servomotor optical encoder A+
2	A-/SINA-	I	Encoder A- input	Connect to servomotor optical encoder A-
3	B+/COSB+	I	Encoder B+ input	Connect to servomotor optical encoder B+
4	B-/COSB-	I	Encoder B- input	Connect to servomotor optical encoder B-
5	Z+	I	Encoder Z+ input	Connect to servomotor optical encoder Z+
6	Z-	I	Encoder Z- input	Connect to servomotor optical encoder Z-
7	U+/DATA+	I	Encoder U+ input	Connect to servomotor optical encoder U+
8	U-/DATA-	I	Encoder U- input	Connect to servomotor optical encoder U-
9	V+/CLOCK+	I	Encoder V+ input	Connect to servomotor optical encoder V+
10	V-/CLOCK-	I	Encoder V- input	Connect to servomotor optical encoder V-
11	W+	I	Encoder W+ input	Connect to servomotor optical encoder W+
12	W-	I	Encoder W- input	Connect to servomotor optical encoder W-
13,26	Reserved			
16,17, 18,19	+5V	O	Output +5V	1. Supply +5V power to the connected optical encoder. 2. When cable is long, multiple core wires should be connected in parallel.
23,24,25	GNDD	O	Signal ground	1. Connect to 0V signal of servomotor optical encoder. 2. When cable is long, multiple core wires should be connected in parallel.
20,22	Reserved			
21	Reserved			
14,15	PE	O	Shielded signal	Connect to PE signal of servomotor optical encoder.

4.4.2 Servo Drive Connects to Absolute Encoder of ENDAT2.1 Protocol



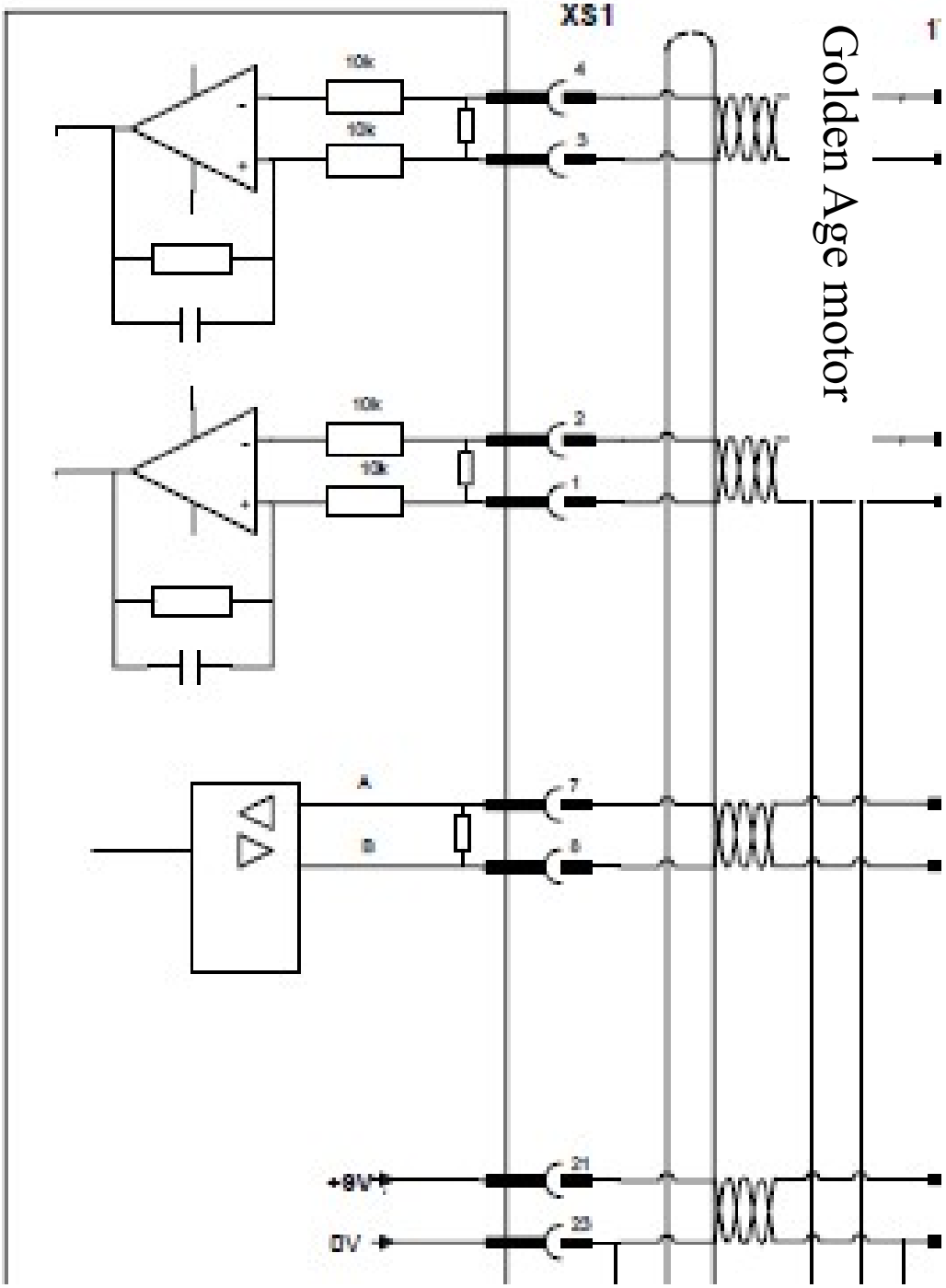
Terminal number	Terminal symbol	I/O	Signal	Function
1	A+/SINA+	I	Encoder A+ input	Connect to SINA+ of servomotor ENDAT2.1 protocol encoder
2	A-/SINA-	I	Encoder A- input	Connect to SINA- of servomotor ENDAT2.1 protocol encoder
3	B+/COSB+	I	Encoder B+ input	Connected to COSB+ of servomotor ENDAT2.1 protocol encoder
4	B-/COSB-	I	Encoder B- input	Connected to COSB- of servomotor ENDAT2.1protocol encoder
5,6	Reserved			
7	U+/DATA+	I/O	Encoder DATA+	Connect to DATA+ signal of servomotor ENDAT2.1 protocol encoder
8	U-/DATA-	I/O	Encoder DATA-	Connect to DATA- signal of servomotor ENDAT2.1 protocol encoder
9	V+/CLOCK+	O	Encoder CLOCK+	Connect to CLOCK+ signal of servomotor ENDAT2.1 protocol encoder
10	V-/CLOCK-	O	Encoder CLOCK-	Connect to CLOCK- signal of servomotor ENDAT2.1 protocol encoder
11,12	Reserved			
13,26	Reserved			
16,17, 18,19	+5V	O	Output +5V	1. Supply +5V power to the connected ENDAT2.1 protocol encoder. 2. When cable is long, multiple core wires should be connected in parallel.
23,24,25	GNDD	O	Signal ground	1. Connect to 0V signal of servomotor ENDAT2.1 protocol encoder. 2. When cable is long, multiple core wires should be connected in parallel.
20,22	Reserved			
21	Reserved			
14,15	PE	O	Shielding layer	Connect to PE signal of servomotor ENDAT2.1 protocol encoder.

4.4.3 Servo Drive Connects to Absolute Encoder of BISS Protocol



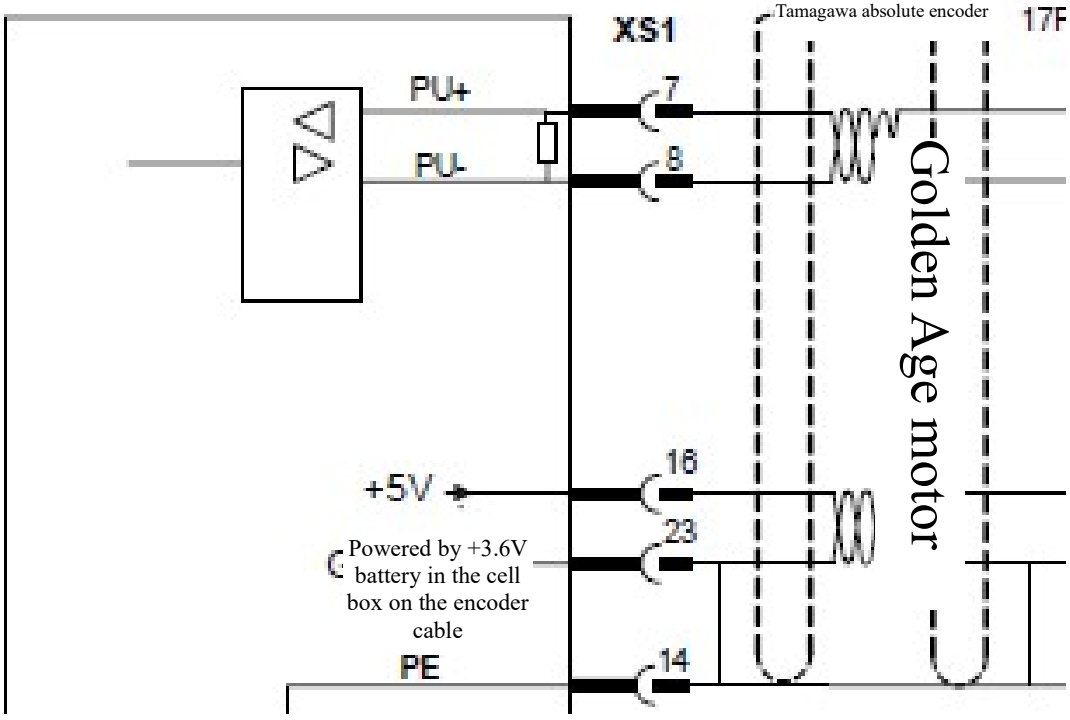
Terminal number	Terminal symbol	I/O	Signal	Function
1,2	Reserved	I		
3,4	Reserved	I		
5,6	Reserved			
7	U+/DATA+	I	Encoder DATA+	Connect to DATA+ signal of servomotor BISS protocol encoder
8	U-/DATA-	I	Encoder DATA-	Connect to DATA- signal of servomotor BISS protocol encoder
9	V+/CLOCK+	O	Encoder CLOCK+	Connect to CLOCK+ signal of servomotor BISS protocol encoder
10	V-/CLOCK-	O	Encoder CLOCK-	Connect to CLOCK- signal of servomotor BISS protocol encoder
11,12	Reserved			
13,26	Reserved			
16,17, 18,19	+5V	O	Output +5V	1. Supply + 5V power to the connected BISS protocol encoder. 2. When cable is long, multiple core wires are connected in parallel.
23,24,25	GNDD	O	Signal ground	1. Connect to 0V signal of servomotor BISS protocol encoder. 2. When cable is long, multiple core wires should be connected in parallel.
20,22	Reserved			
21	Reserved			
14,15	PE	O	Shielding layer	Connect to PE signal of servomotor BISS protocol encoder.

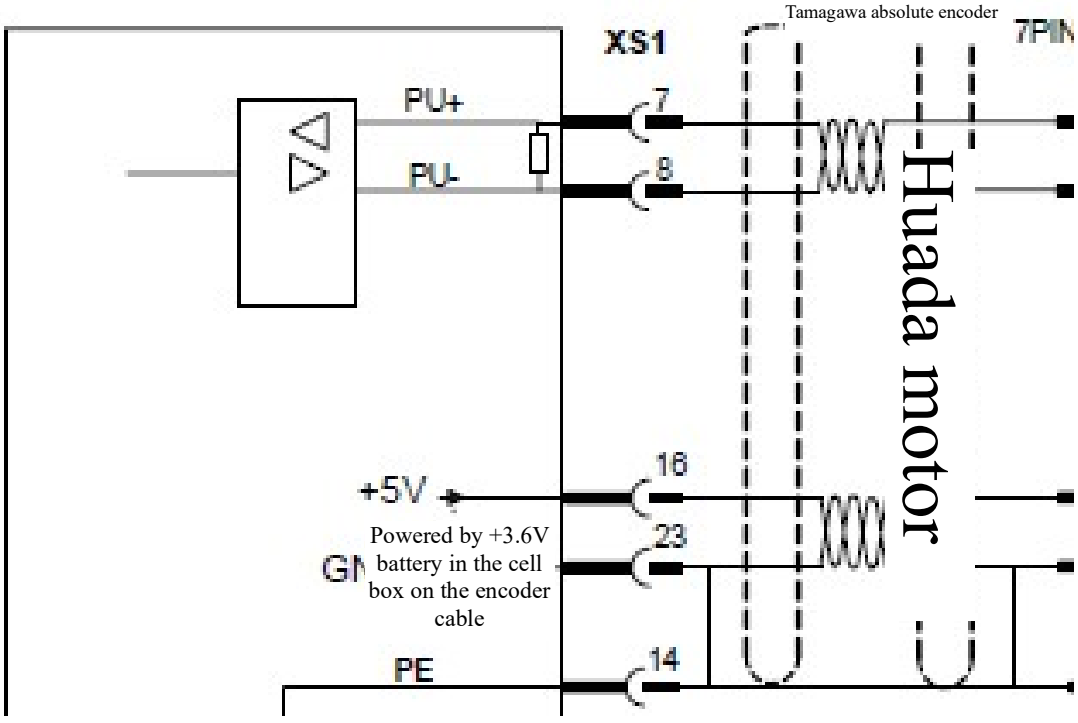
4.4.4 Servo Drive Connects to Absolute Encoder of HiperFACE Protocol



Terminal number	Terminal symbol	I/O	Signal	Function
1	A+/SINA+	I	Encoder A+ input	Connect to COS+ of servomotor HiperFACE protocol encoder
2	A-/SINA-	I	Encoder A- input	Connect to REFCOS of servomotor HiperFACE protocol encoder
3	B+/COSB+	I	Encoder B+ input	Connect to SIN+ of servomotor HiperFACE protocol encoder
4	B-/COSB-	I	Encoder B- input	Connect to REFSIN of servomotor HiperFACE protocol encoder
5,6	Reserved			
7	U+/DATA+	I/O	Encoder DATA+	Connect to DATA+ signal of servomotor HiperFACE protocol encoder
8	U-/DATA-	I/O	Encoder DATA-	Connect to DATA- signal of servomotor HiperFACE protocol encoder
9,10	Reserved			
11,12	Reserved			
13,26,	Reserved			
16,17,18,19	Reserved			
21	+9V	O	Output +9V	1. Supply +9V power to the connected HiperFACE protocol encoder. 2. When cable is long, multiple core wires are connected in parallel.
23,24,25	GNDD	O	Signal ground	1. Connect to 0V signal of servomotor HiperFACE protocol encoder. 2. When cable is long, multiple core wires are connected in parallel.
20,22	Reserved			
14,15	PE	O	Shielding layer	Connect to PE signal of servomotor HiperFACE protocol encoder.

4.4.5 Servo Drive Connect to Absolute Encoder Of TAMAGAWA Protocol





Note: 1. When **TAMAGAWA** absolute encoder is connected, encoder cable with cell box is recommended.

2. When TAMAGAWA absolute encoder is used, users are suggested to buy encoder cable with cell box produced by HCNC company. After the drive is powered off, the encoder is powered by the cell box.

Terminal number	Terminal symbol	I/O	Signal	Function
1,2	Reserved	I		
3,4	Reserved	I		
5,6	Reserved	I		
7	U+/DATA+	I	Encoder DATA+	Connect to DATA+ signal of servomotor TAMAGAWA encoder
8	U-/DATA-	I	Encoder DATA-	Connect to DATA- signal of servomotor TAMAGAWA encoder
9,10	Reserved	O		
11,12	Reserved			
13,26	Reserved			
16,17, 18,19	+5V	O	Output +5V	1. Supply + 5V power to the connect TAMAGAWA encoder. 2. When cable is long, multiple core wires are connected in parallel.
23,24,25	GNDD	O	Signal ground	1. Connect to 0V signal of servomotor TAMAGAWA encoder servomotor optical encoder. 2. When cable is long, multiple core wires should be connected in parallel.
20	Reserved	O		
22	Reserved	O		
21	Reserved	O		
14,15	PE	O	Shielding layer	Connect to PE signal of servomotor TAMAGAWA protocol encoder.

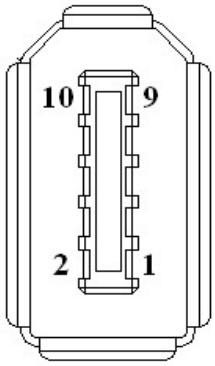
Note: When **TAMAGAWA** absolute encoder is connected, encoder cable with cell box is recommended.

Note:

1. Pins of the same name have been short circuited on the internal circuit board.
2. Diameter of encoder cable: Shielded cable (stranded shielded cable) whose sectional cross area is ≥0.12mm^2 (AWG24-26) should be adopted and the shielding layer must be connected to the metal shell of connection plug.
3. Length of encoder cable: Cable should be as short as possible and its shielding layer should be connected to GNDD signal of encoder power supply (to avoid intervention of encoder feedback signal).
4. Wiring: Keep away from power line to prevent intervention. Please install surge absorption elements for inductive elements (coil) in relevant circuits: DC coil is connected in parallel reversely
Freewheel diode and AC coil are connected to RC absorption circuit in parallel.
5. When the drive unit is connected to different encoders, the matching encoder cables are different. Please connect them upon confirmation; otherwise, burnout of encoder may occur.

4.5 Definition of Second Encoder Interface of Traverse Axis Servo Drive

160UP series, HSV-180UD-035C, 050C, 075C, 090C, 100C, 150C, 200, 300 and 450 as well as HSV-180U1D-100, 150, 200 and 300 drives support full-closed loop second encoder function and correspond to interfaces XS5 and XS6.



The second position feedback signal input interface socket (facing socket)

4.5.1 Connect Incremental Encoder

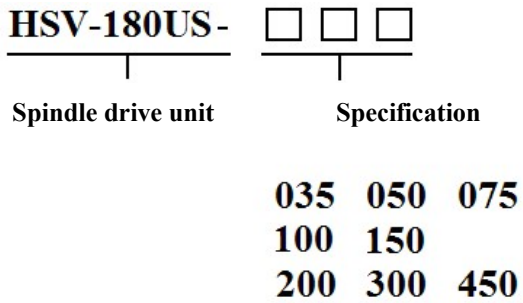
Terminal number	Terminal symbol	Signal	Function
1	+5V	Output +5V	1. Provide +5V power supply to the encoder connected to XS6. 2. Connected to power supply pin of the encoder. 3. When cable is long, multipole core wires should be connected in parallel.
2	GNDD	Signal earth	1. Connect to 0V pin of the encoder. 2. When cable is long, multiple core wires should be connected in parallel.
3	A+/SINA+	Encoder A+ input	Connect to A+ (or SINA+) of worktable position encoder
4	A-/SINA-	Encoder A- input	Connect to A- (or SINA-) of worktable position encoder
5	B+/COSB+	Encoder B+ input	Connect to B+ (or COSB+) of worktable position encoder
6	B-/COSB-	Encoder B- input	Connected to B- (or COSB-) of worktable position encoder
7	DATA+	Encoder DATA+	Connect to Z+ (or R+) of worktable position encoder
8	DATA-	Encoder DATA-	Connect to Z- (or R-) of worktable position encoder
9	Reserved		
10	Reserved		

4.5.2 Connect Endat2.1/2.2 Protocol Absolute Encoder

Terminal number	Terminal symbol	Signal	Function
1	+5V	Power supply output +	1. Supply +5V power to Endat2.1/2.2 protocol encoder connected to XS5. 2. Connect to power supply pin of the encoder. 3. When cable is long, multiple core wires should be connected in parallel.
2	GNDD	Power supply output -	1. Connect to 0V pin of the encoder. 2. When cable is long, multiple core wires should be connected in parallel.
3	A+/SINA+	Encoder A+ input	Connect to SINA+ of worktable position ENDAT2.1 protocol encoder
4	A-/SINA-	Encoder A- input	Connect to SINA- of worktable position ENDAT2.1 protocol encoder
5	B+/COSB+	Encoder B+ input	Connect to COSB+ of worktable position ENDAT2.1 protocol encoder
6	B-/COSB-	Encoder B- input	Connect to COSB- of worktable position ENDAT2.1 protocol encoder
7	DATA+	Encoder DATA+	Connect to DATA+ of worktable position ENDAT2.1 protocol encoder
8	DATA-	Encoder DATA-	Connect to DATA- of worktable position ENDAT2.1 protocol encoder
9	CLOCK+	Encoder CLOCK+	Connect to CLOCK+ of worktable position ENDAT2.1 protocol encoder
10	CLOCK-	Encoder CLOCK-	Connect to CLOCK- of worktable position ENDAT2.1 protocol encoder

4.6 Definition of Spindle Servo Drive Encoder Interface

Specification and model of spindle drive unit:



HSV-180US-035～450 spindle drive units (compatible with incremental optical encoder and incremental sin-cos encoder)

HSV-180US- □□□**R**

Spindle drive unit **Specification**

035 050 075
100 150

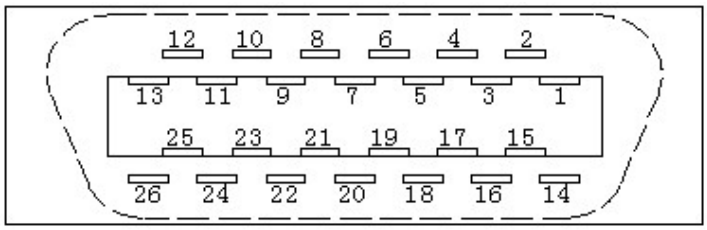
HSV-180US-035R～150R spindle drive units (compatible with incremental optical encoder, incremental sin-cos encoder and rotary transformer encoder)

HSV-180U1S- □□□

Spindle drive unit **Specification**

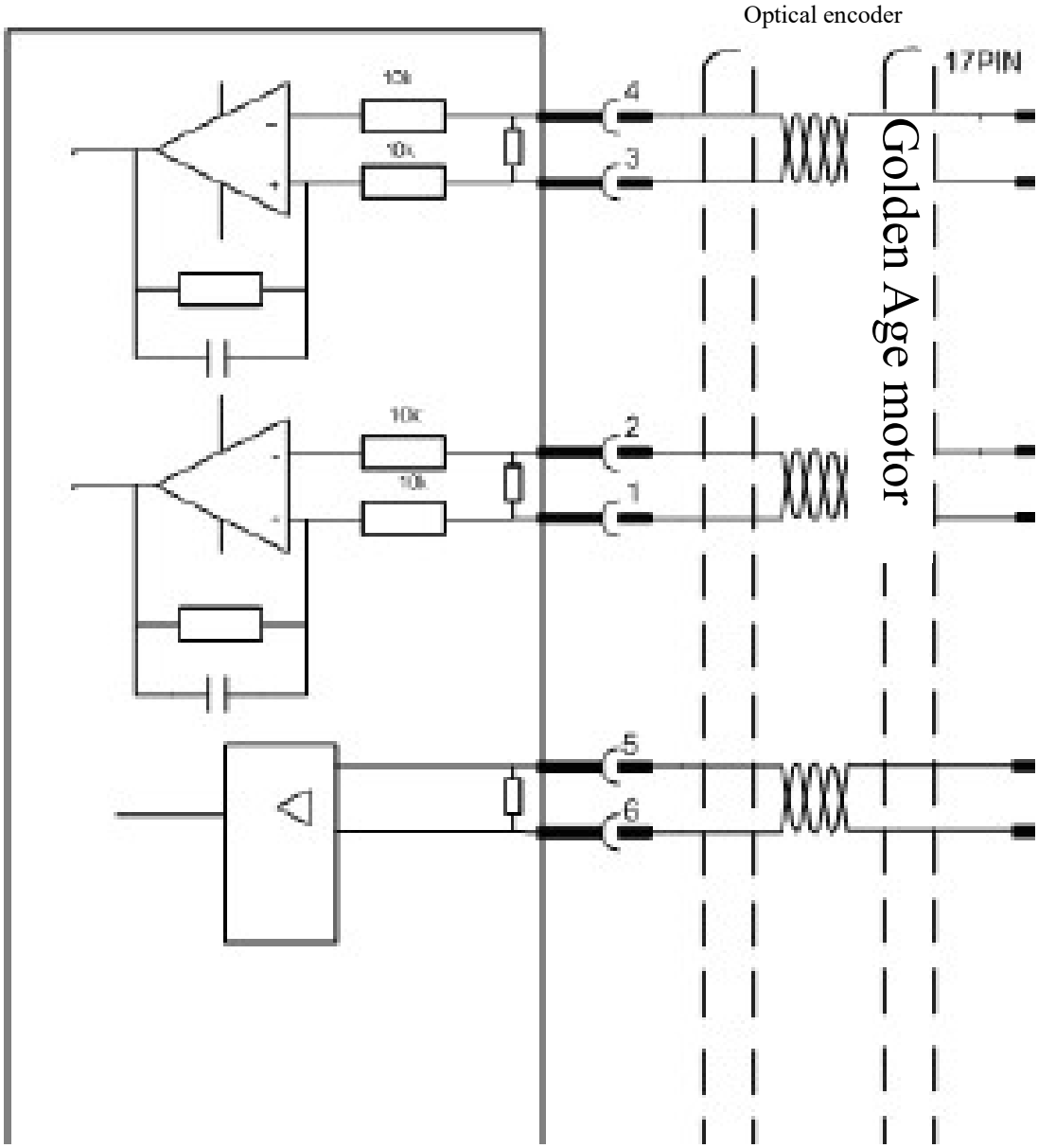
100 150
200 300

HSV-180U1S-100～300 spindle drive units (compatible with incremental optical encoder and incremental sin-cos encoder)



Input interface plug pin of XS5 spindle motor encoder
(facing the plug pin)

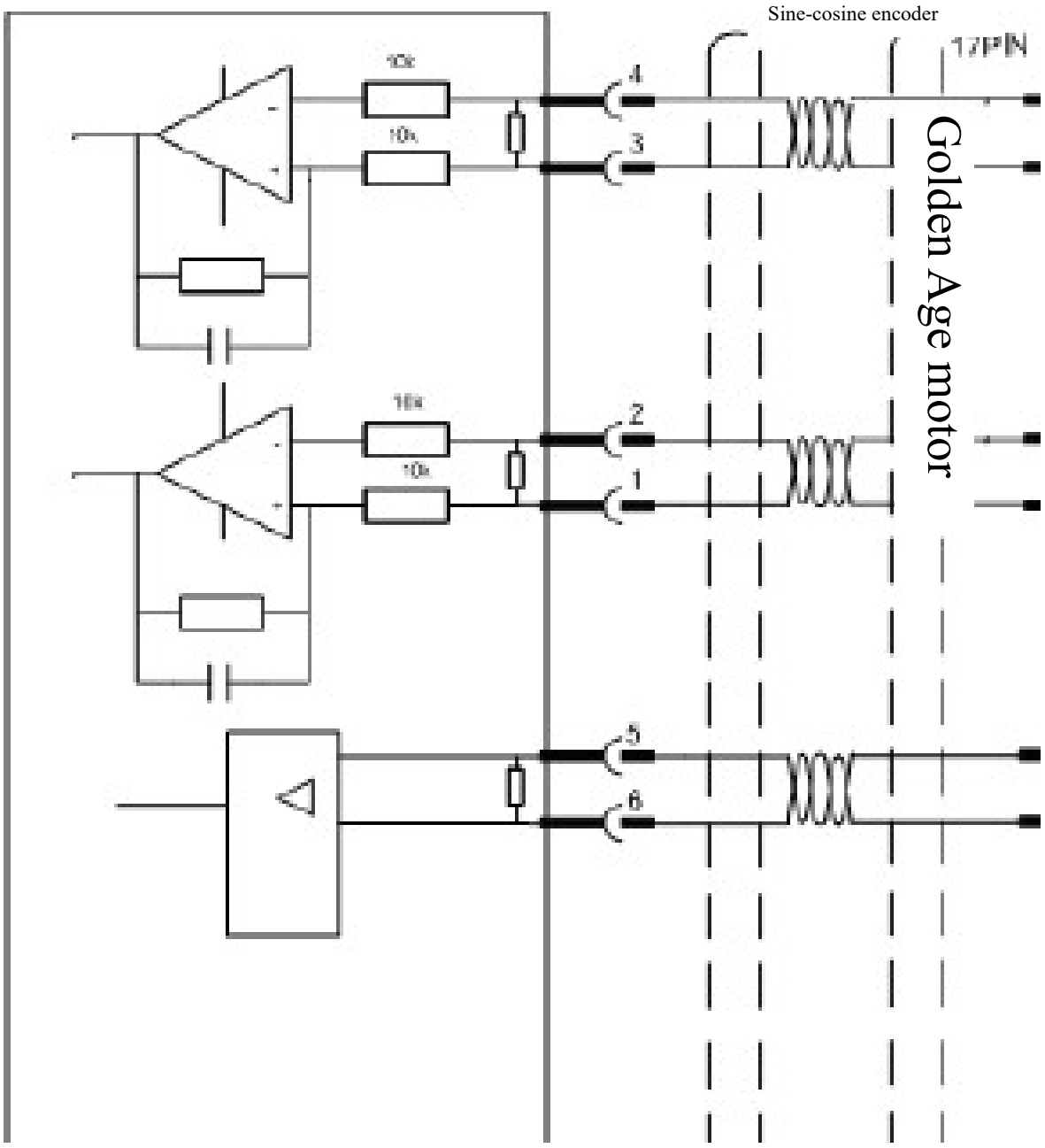
4.6.1 XS5 ENCODER1 Interface Connects to Incremental Optical Encoder



Pin	Name	Function	Signal standard
1	A+/SINA+	Motor encoder A+ phase pulse input	Wire driver and receiver RS422 standard
2	A-/SINA-	Motor encoder A- phase pulse input	
3	B+/COSB+	Motor encoder B+ phase pulse input	
4	B-/COSB-	Motor encoder B- phase pulse input	
5	Z+	Motor encoder Z+ phase pulse input	
6	Z-	Motor encoder Z- phase pulse input	
7,8	Reserved		
9,10	Reserved		
11,12	Reserved		
13	Reserved		
26	Reserved		
16,17 18,19	+5V	Power supply of motor encoder DC +5V 1. Supply +5V power to the motor encoder connected to XS5. 2. Connect to the power pin of the motor encoder. 3. When cable is too long, multiple core wires should be connected in parallel.	DC +5V/150mA
23,24,25	GNDD	Power ground of motor encoder 0V	
20	KT+	Signal input of motor temperature sensor	
22	KT_		
21	Reserved		
14,15	PE	Shielding signal Connect to PE signal of motor encoder	

Note: 1. Pins of the same name have been connected on the internal circuit board.

4.6.2 XS5 ENCODER1 Interface Connects to Incremental Sin-cos Encoder



Pin	Name	Function	Signal standard
1	A+/SINA+	Motor encoder SINA+ phase pulse input	Analog input voltage: 1Vp-p
2	A-/SINA-	Motor encoder SINA- phase pulse input	
3	B+/COSB+	Motor encoder COSB+ phase pulse input	
4	B-/COSB-	Motor encoder COSB- phase pulse input	
5	Z+/R+	Motor encoder Z+ (or R+) phase pulse input	
6	Z-/R-	Motor encoder Z- (or R-) phase pulse input	
7,8	Reserved		
9,10	Reserved		
11,12	Reserved		
13	Reserved		
26	Reserved		
16,17 18,19	+5V	Power supply of motor encoder DC +5V 1. Supply +5V power to the motor encoder connected to XS5. 2. Connect to the power supply pin of the motor encoder. 3. When cable is too long, multiple core wires should be connected in parallel.	DC +5V/150mA
23,24,25	GNDD	Power ground of motor encoder 0V	
20	KT+	Signal input of motor temperature sensor	
22	KT_		
21	Reserved		
14,15	PE	Shielding signal is connected to PE signal of motor encoder	

Note: 1. Pins of the same name have been connected on the internal circuit board.

4.6.3 XS5 ENCODER1 Interface Connects to Rotary Encoder

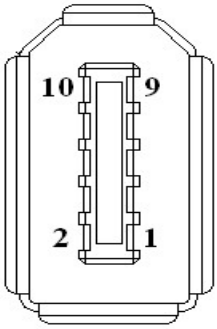
Pin	Name	Function	Signal standard
1,2	Reserved		
3,4	Reserved		
5,6	Reserved		
7	SIN+	Motor encoder SIN+ phase input	Analog input voltage: 2.4V- 3.0Vp-p@10kHz
8	SIN-	Motor encoder SIN- phase input	
9	COS +	Motor encoder COS+ phase input	
10	COS-	Motor encoder COS- phase input	
11	EXC1	Motor encoder EXC1 phase output	Analog output voltage: 4.8V- 6.0Vp-p@10kHz
12	/EXC1	Motor encoder /EXC1 phase output	
13	Reserved		
26	Reserved		
16,17 18,19	Reserved		
23,24,25	GNDD	SX5 ENCODER1 interface Internal power ground 0V	
20	KT+	Signal input of motor temperature sensor	
22	KT-		
21	Reserved		
14,15	PE	Shielding signal Connect to PE signal of motor encoder	

Note: 1. Only SV-180US-035R～150R spindle drive unit can match this type of encoder.

2. Pins of the same name have been short-circuited on the internal circuit board.

3. Resolution of rotary transformer is 14bit, namely 16384 ppr.

4.7 Definition of Second Encoder Interface of Spindle Servo Drive



XS6 ENCODER2 spindle encoder input interface diagram

4.7.1 XS6 ENCODER2 Interface Connects to Incremental Optical Encoder

Pin	Name	Function	Signal standard
1	+5V	Spindle encoder power supply DC +5V 1. Supply +5V power to the spindle encoder connected to XS6. 2. Connect to the power supply pin of the spindle encoder. 3. When cable is long, multiple core wires should be connected in parallel.	DC +5V/150mA
2	GNDD	1. Connect to 0V pin of the spindle encoder. 2. When cable is long, multiple core wires should be connected in parallel.	
3	A+/SINA+	Connect to A+ phase of the spindle encoder	Wire driver and receiver RS422 standard
4	A-/SINA-	Connect to A- phase of the spindle encoder	
5	B+/COSB+	Connect to B+ phase of the spindle encoder	
6	B-/COSB-	Connect to B- phase of the spindle encoder	
7	DATA+	Connect to Z+ phase of the spindle encoder	
8	DATA-	Connect to Z- phase of the spindle encoder	
9	Reserved		
10	Reserved		

4.7.2 XS6 ENCODER2 Interface Connects to Incremental Sin-cos Encoder

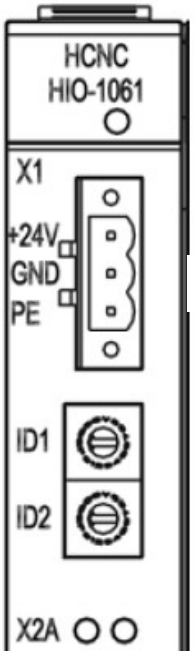
Pin	Name	Function	Signal standard
1	+5V	Power supply of motor encoder DC +5V 1. Supply +5V power to the motor encoder connected to XS5. 2. Connect to the power supply pin of the motor encoder. 3. When cable is too long, multiple core wires should be connected in parallel.	DC +5V/150mA
2	GNDD	1. Connect to 0V pin of spindle encoder. 2. When cable is long, multiple core wires should be connected in parallel.	
3	A+/SINA+	Connect to spindle encoder SINA+	Analog input voltage: 1Vp-p
4	A-/SINA-	Connect to spindle encoder SINA-	
5	B+/COSB+	Connect to spindle encoder COSB+	
6	B-/COSB-	Connect to spindle encoder COSB-	
7	DATA+	Connect to spindle encoder Z+ (or R+)	Analog input voltage: 0.5Vp-p
8	DATA-	Connect to spindle encoder Z- (or R-)	
9	Reserved		
10	Reserved		

4.8 Bus I/O Unit

4.8.1 HIO-1000 Series

Installation diagram of HIO-1000B bus I/O unit

1） Definition of industrial Ethernet communication module (HIO-1061)

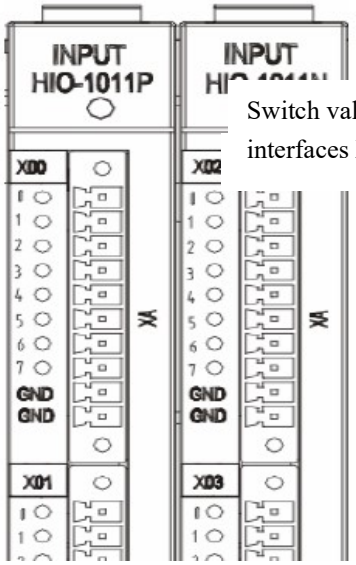


1:24V
2:24VG
NCUC bus interface

Signal	Description
24V	DC 24V power supply
24VG	DC 24V power ground
PE	Connect to ground

Signal	Description
NC	The first pin and the second pin of X2A and X2B are interconnected and they have no electric definition.
NC	
TXD+	Data transmission
TXD-	
RXD+	Data receiving
RXD-	

2） Definition of switch value input/output module interface

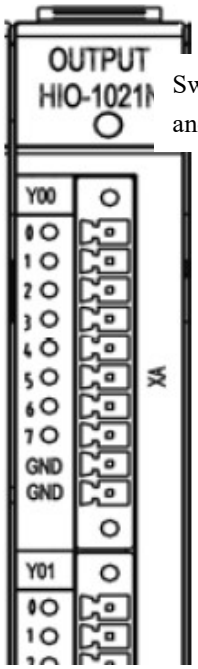


Switch value input interfaces XA and XB

Signal	Description	
	HIO-1011N XA, XB	HIO-1011P XA, XB
0-7	NPN input N0-N7 Low level is valid	N/A
0-7	N/A	NPN input N0-N7 High level is valid
GND	DC24V ground	

1 : 0
2 : 1
3 : 2
4 : 3
5 : 4
6 : 5
7 : 6

Definition of input module (HIO-1011N, HIO-1011P) interface



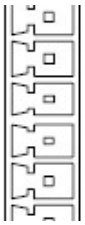
Switch value input interfaces XA and XB

出接口

XA、XB

1 : 0
2 : 1
3 : 2
4 : 3
5 : 4
6 : 5
7 : 6
8 : 7
9 :GND

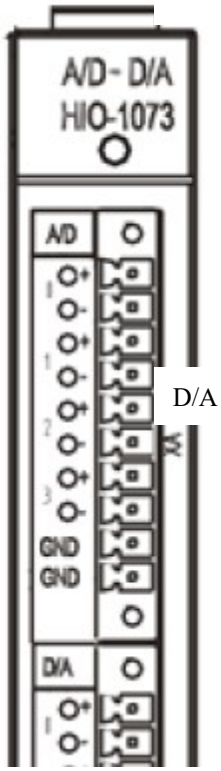
Signal	Description
0-7	NPN input O0-O7 Low level is valid
GND	DC24V ground



0～7	
GND	

Definition of output module (HIO-1021N) interface

3） Definition of analog input/output module interface



A/D input interface XA

1: 0+
2: 0-
3: 1+
4: 1-
5: 2+
6: 2-
7: 3+

No.	Signal	Description
1-2	0+, 0-	4 channels A/D input AD0-AD3 (Input range: -10V- + 10V)
3-4	1+, 1-	
5-6	2+, 2-	
7-8	3+, 3-	
9-10	GND	Ground

7~8	3+、3-
9~10	GND

D/A output interface XB

9: GND
10:GND

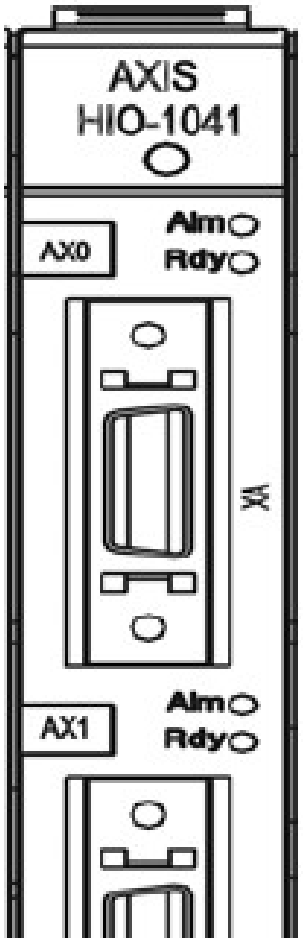
No.	Signal	Description
1-2	0+, 0-	4 channels D/A input AD0-AD3 (Input range: -10V- + 10V)
3-4	1+, 1-	
5-6	2+, 2-	
7-8	3+, 3-	
9-10	GND	Ground

D/A

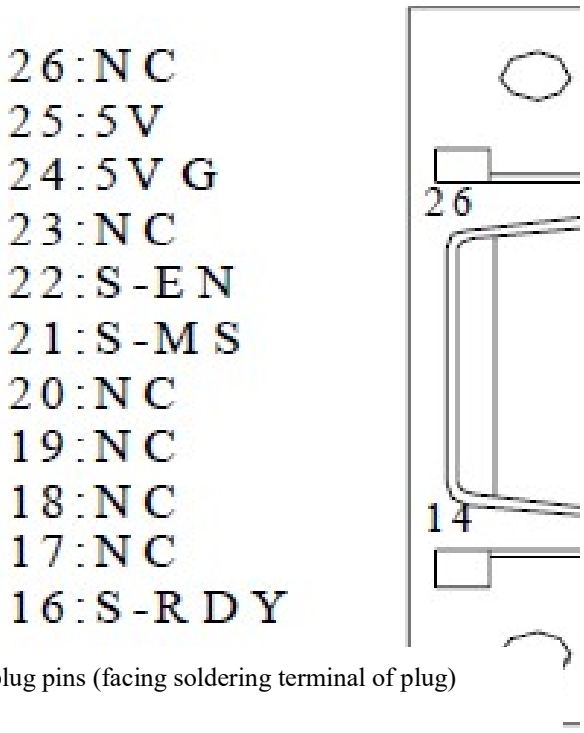
1: 0+

1~2	0+、0-

4） Definition of axis control module interface



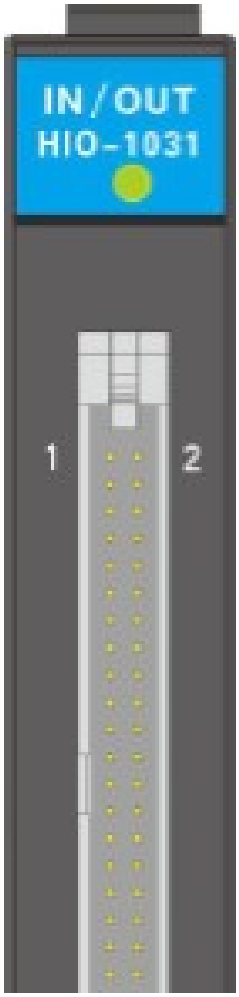
Axis control interfaces XA, XB



Sequence of plug pins (facing soldering terminal of plug)

Signal	Description
Vcmd1+ Vcmd1-	Analog output (-10V to +10V)
PA+, PA-	Encoder A phase feedback signal
PB+, PB-	Encoder B phase feedback signal
PZ+, PZ-	Encoder Z phase feedback signal
24V, 24VG	DC24V power supply
CP+, CP-	Command pulse output (A phase)
DIR+, DIR-	Command direction output (B phase)
24VB	DC24V
S-RDY	Ready
S-MS	Mode switching
S-EN	Enable
5V, 5VG	DC5V power supply
NC	Empty

5） Definition of HIO-1031 module interface

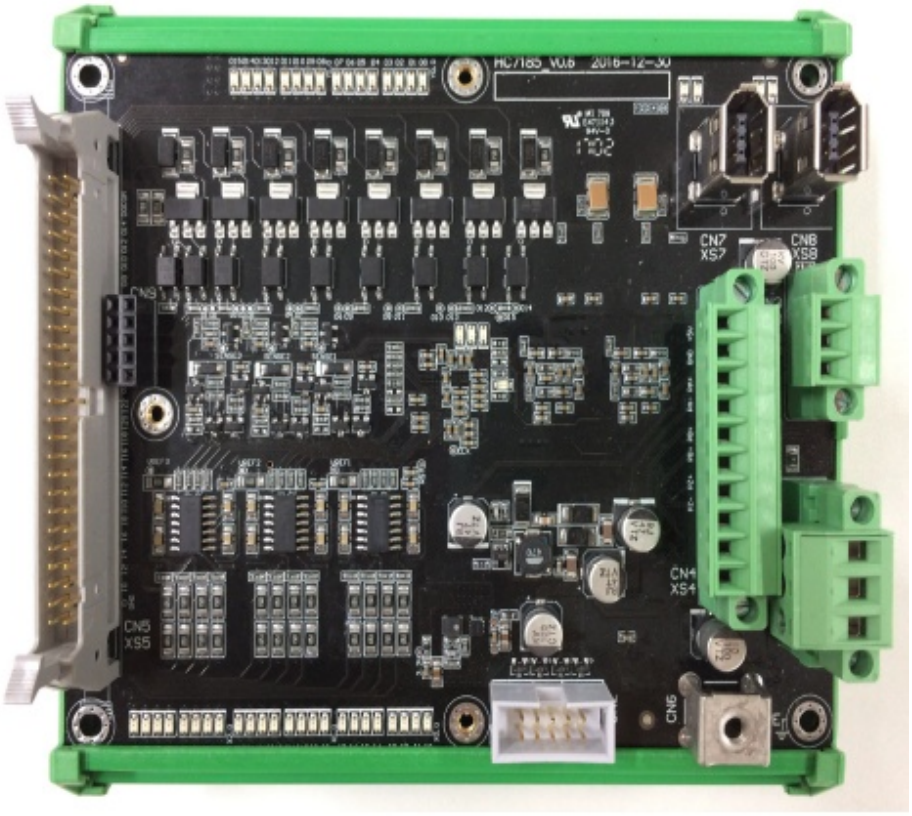


HIO-1031 port	Port function	HIO-1031 port	Port function
端口			+24V output
1	GND		
3	Xm+0.0		
5	Xm+0.2		
7	Xm+0.4		
9	Xm+0.6		
11	Xm+1.0		
13	Xm+1.2		
15	Xm+1.4		
17	Empty		
19	Xm+2.0		
21	Xm+2.2		
23	Xm+2.4		
25	Xm+2.6		
27	COM0		
29	COM2		
31	Yn+0.0		

Note:

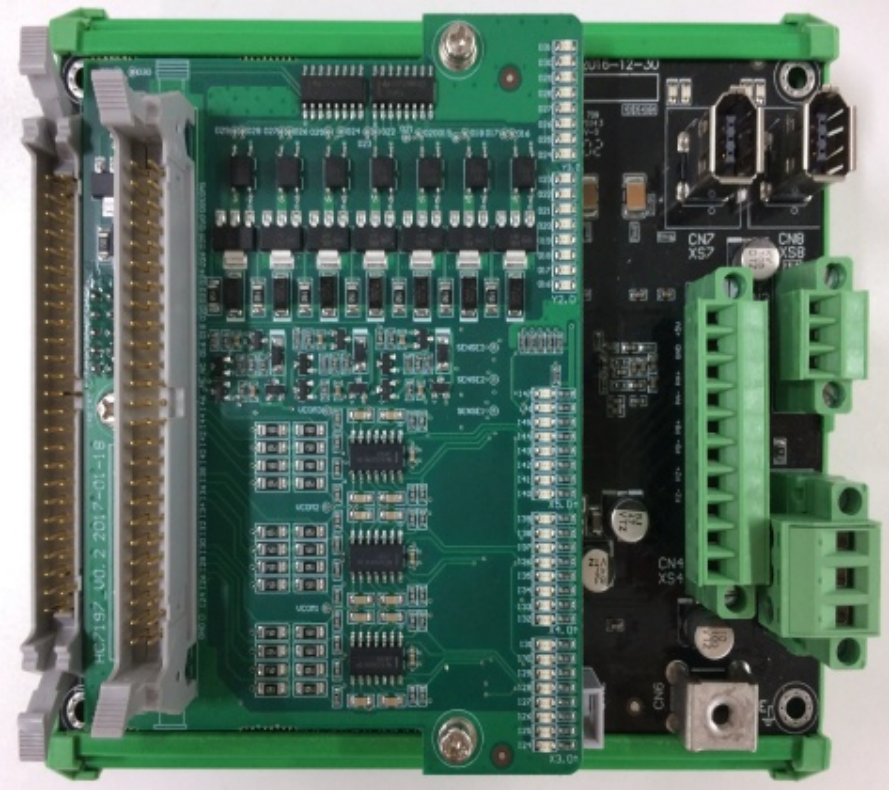
1. Three groups of input of this module occupy four groups of input points of the system, 8 bytes for each group, and the last group is reserved by default. Two groups of output occupy two groups of output points.
2. If the input configuration ports COM0 to COM2 are empty, PNP type is defaulted.
3. If COM0 port is connected to GND, Xm+0.0 ~ Xm+0.7 can be configured as PNP type input. If COM0 port is connected to 24V, Xm+0.0 ~ Xm+0.7 can be configured as NPN type input. Likewise, Xm+1.0 ~ Xm+1.7 and Xm+2.0 ~ Xm+2.7 corresponding to COM1 and COM2 can be configured as PNP type input or NPN type input. Please configure COMx port under power off and restart to validate it.
4. It is valid when the current flowing through the input port is greater than 6mA.

4.8.2 HIO-1200 Series



HIO-1200 picture

HIO-1200-M1 picture



HIO-1200-M2 picture

1) Power supply interface XS1

XS1: Power supply interface, pin is defined as below:

Pin	Signal	Port function
1	+24V1	DC24V power supply input
2	GND	GND
3	PE	PE

2) Bus interfaces XS7 and XS8

XS7-XS8, NCUC bus interface is defined as below:

Pin	Signal	Port function
1	24V	DC24V power transmission
2	GND	
3	TXD+	Data transmission
4	TXD-	
5	RXD+	Data receiving
6	RXD-	

3) Analog spindle interface XS3

Pin	Signal	Port function
1	DA+	Analog output +
2	DA-	Analog output -
3	AG1	Analog PE

4) Encoder input interface XS4

Pin	Signal	Port function
1	+5V	5V output
2	GND	GND
3	PA1+	PA1+
4	PA1-	PA1-
5	PB1+	PB1+
6	PB1-	PB1-
7	PZ1+	PZ1+
8	PZ1-	PZ1-
9	NC	Null
10	NC	Null

5) Digital input/output interface XS5

Pin	Symbol	Port function	Pin	Symbol	Port function
1	GND	GND	2	+24V	24V output
3	I0	X0.0	4	I1	X0.1
5	I2	X0.2	6	I3	X0.3
7	I4	X0.4	8	I5	X0.5
9	I6	X0.6	10	I7	X0.7
11	I8	X1.0	12	I9	X1.1
13	I10	X1.2	14	I11	X1.3
15	I12	X1.4	16	I13	X1.5
17	I14	X1.6	18	I15	X1.7
19	I16	X2.0	20	I17	X2.1
21	I18	X2.2	22	I19	X2.3
23	I20	X2.4	24	I21	X2.5
25	I22	X2.6	26	I23	X2.7
27	COM0	COM port of X0	28	COM1	COM port of X1
29	COM2	COM port of X2	30	NC	Null
31	O0	Y0.0	32	O1	Y0.1
33	O2	Y0.2	34	O3	Y0.3
35	O4	Y0.4	36	O5	Y0.5
37	O6	Y0.6	38	O7	Y0.7
39	O8	Y1.0	40	O9	Y1.1
41	O10	Y1.2	42	O11	Y1.3
43	O12	Y1.4	44	O13	Y1.5
45	O14	Y1.6	46	O15	Y1.7
47	DOCOM	24V input	48	DOCOM	24V input
49	DOCOM	24V input	50	DOCOM	24V input

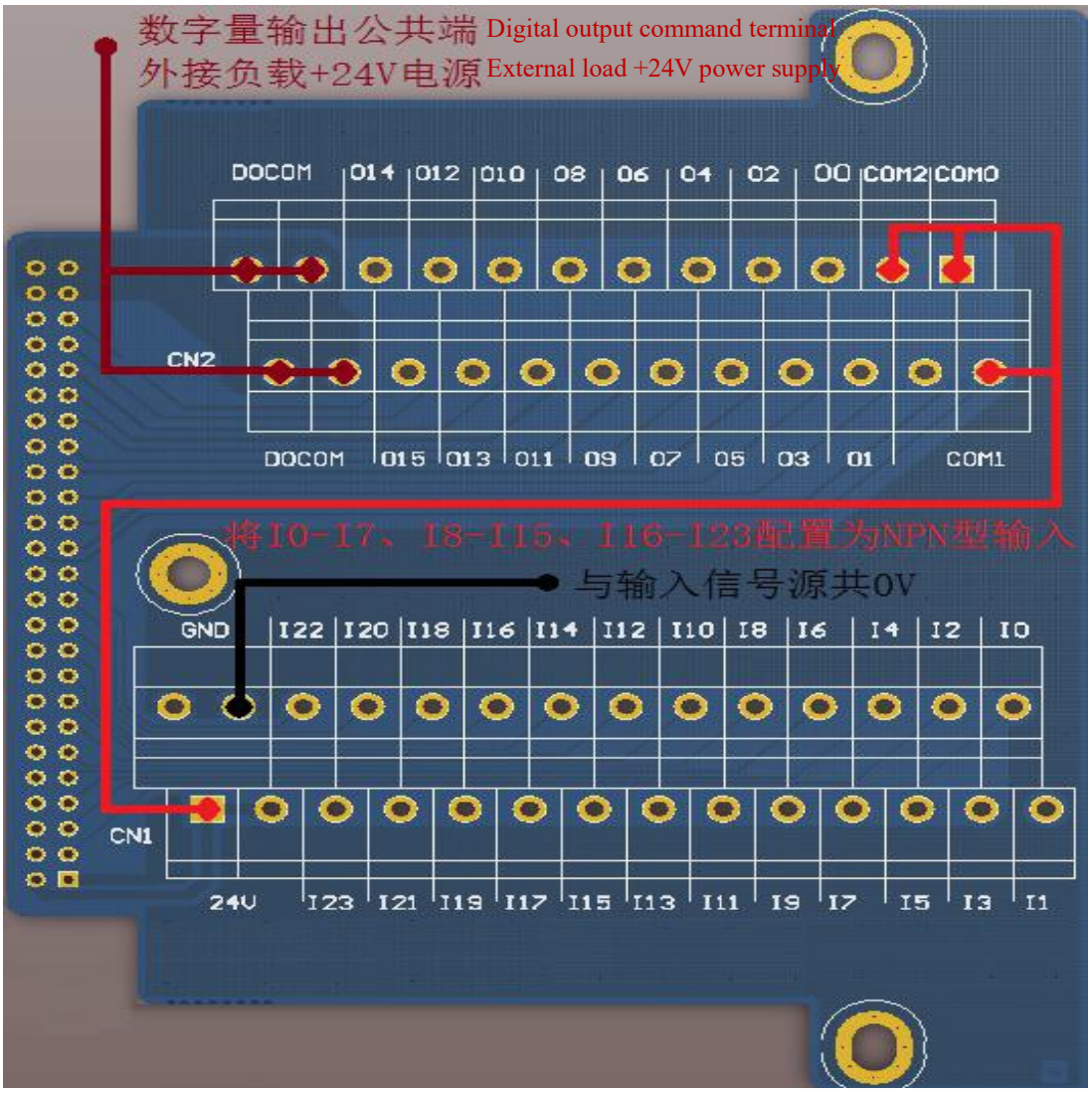
1. Please share 0V with pin 1 (GND) of I/O interface CN5 and input signal source. Pin 2 (+24V) of CN5 is 24V output inside the board and is used for input type configuration only. If pin 27 (COM0) of CN5 is empty or grounded, pins I0-I7 can be configured as PNP type input. If COM0 is connected to 24V, pins 10-17 can be

configured as NPN type input. Likewise, COM1 can be configured for I8-I15 pin input types and COM2 can be configured for I16-I23 pin input types. Please configure COMx port under power-off state and restart to validate it. Pins I0-I7 correspond to X0, pins I8-I15 correspond to X1 and pins I16-I23 correspond to X2. Definition and usage of I/O extension board interface is similar to baseboard. The PNP type input is valid when greater than 19V and NPN type input is valid when less than 4V.

2. Pins 47-50 (DOCOM) of I/O interfaces are digital output common ports and are connected to load +24V power supply externally. The rated current of PNP digital output is 100mA. If it is ≧140mA, output port will undergo overcurrent protection. Restart to recover it after fault removal. Capacity of load +24V power supply is determined according to total quantity of I/O and load power and must not be connected to the one-way load greater than 120mA for a long time to avoid irreversible damage.

Additional Description:

Picture of HIO-1200-K terminal board where I0-I7, I8-I15 and I16-I23 are set as NPN type input:



5. Preparation for Commissioning

5.1 Verification and Record

Please check whether objects are consistent with purchase order and packing list. If not, please contact HCNC company immediately.

5.2 View System Information

Steps for viewing HNC-8 software version information: Press "Maintain" on the MDI panel→F8 "System information". The system information page displays system information, system software information, servo software information and user version information.

5.3 Software Upgrade and Parameters, PLC Backup/Loading

HNC-8 software upgrade includes application program upgrade, parameter upgrade, PLC upgrade and BTF full-package upgrade.

For parameter, PLC or BTF full-package upgrade, users need to back up PLC and parameters first. Otherwise, PLC and parameters in the original system will be covered by standard parameters and PLC after upgrade is completed.

5.3.1 Parameters and PLC Backup

Operating steps:

1) Press "Maintain" on the MDI panel→ press F9 "Permission management"→ press F4 "Logout"→select user level (the backup is allowed only for workshop manager or above) → press F2 “Login”→Enter the password→ press "Enter" on the MDI panel to confirm (if the permission password is correct, parameter of this level can be modified; otherwise, the system will give a prompt message "Incorrect password".) ;

Default permission password:

Operator: Need not to enter a password

Workshop manager: GOD

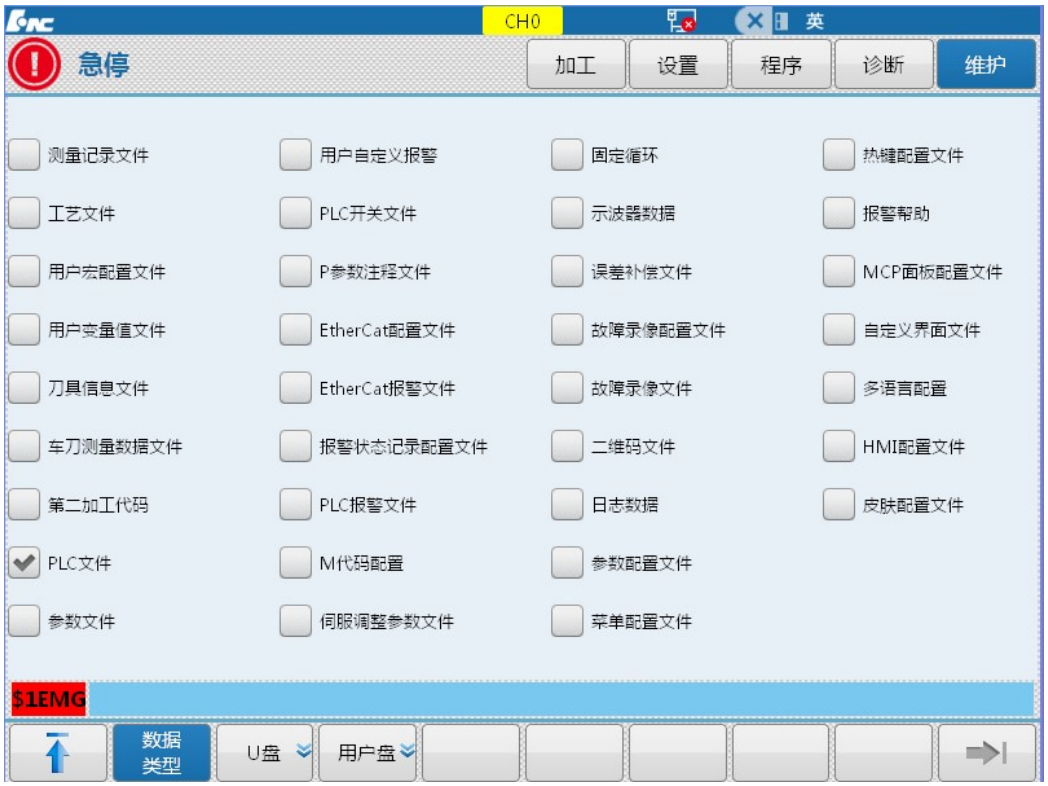
Machine tool manufacturer: HOG

CNC manufacturer: HIG

System administrator: HNC8

2) Press F1 "↑" to return-Press F7 "Data management";

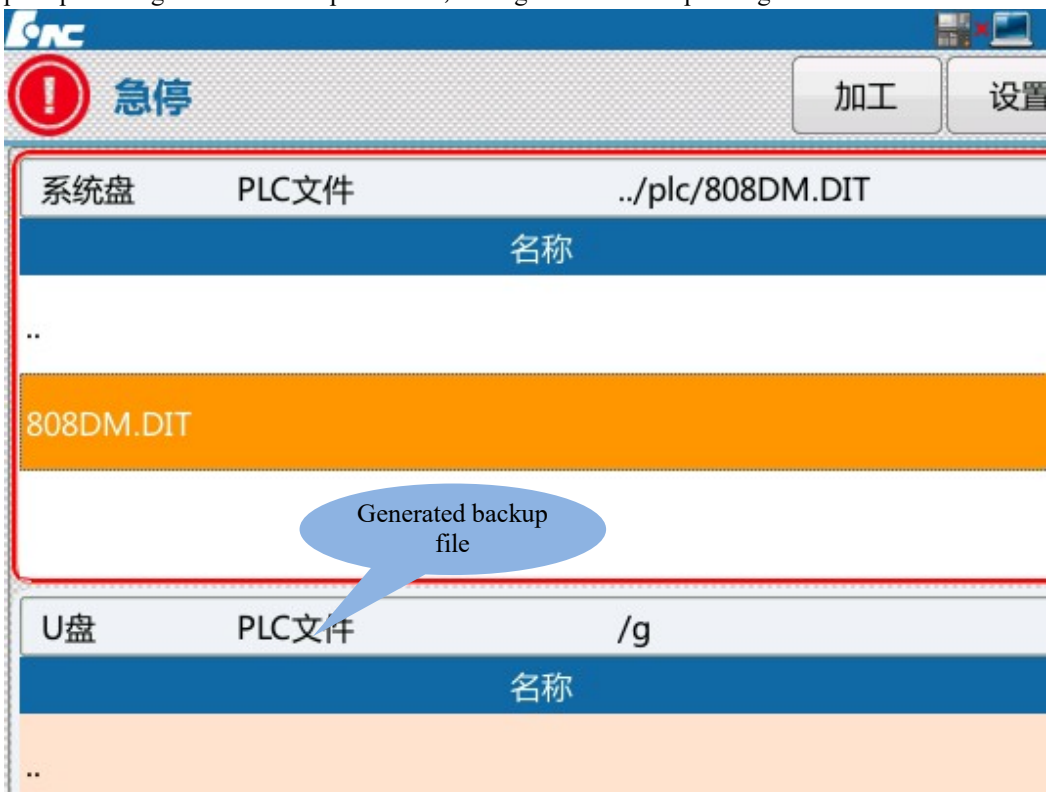
3) Select type of data to be backed up by “↑”, “↓”, “←” and “→” in the MDI panel. e.g.: To back up parameter file, select "Parameter file". To back up PLC file, select "PLC file". Then, press "Enter" on the MDI panel to confirm and “√” is displayed in front of corresponding item;



4) Select the backup path by "USB flash disk" and "User disk". For backup in USB flash disk, insert USB flash disk into USB interface of the system. When  in the upper part of the screen turns to  , it means that USB flash disk has been loaded;

5) Press F9 "Window switch" and the window returns to "System disk";

6) Press F3 "Backup" and the system will give a prompt message "Whether to back up the selected file? (Y/N)", "Y": Yes, "N": No, which correspond to "Y" and "N" on the MDI panel. Select Y and the system will give a prompt message that the backup succeeds, and generates corresponding file name suffixed with date and time.

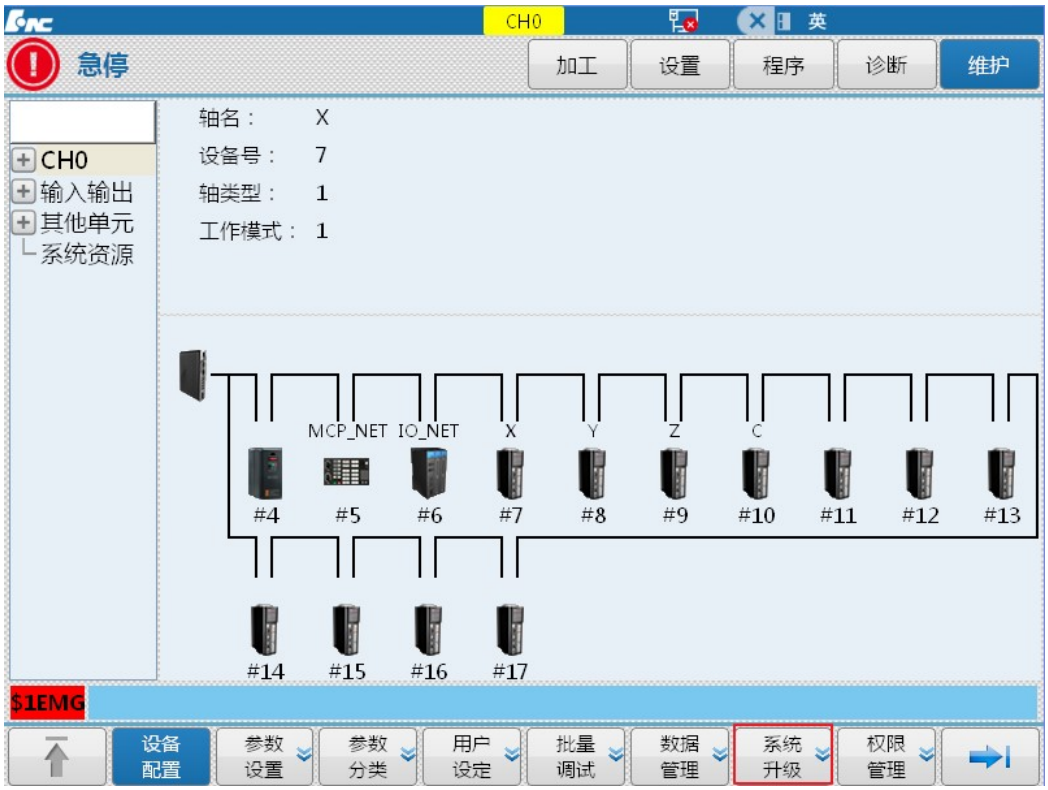


5.3.2 Software Upgrade

Note: For the sake of safety, it is better to disconnect the bus at the rear of the system after PLC or parameter upgrade; otherwise, standard PLC or parameter may differ from current machine tool and consequently the machine tool works abnormally

1） Enter permission as per operating step 1) in 4.3.1;

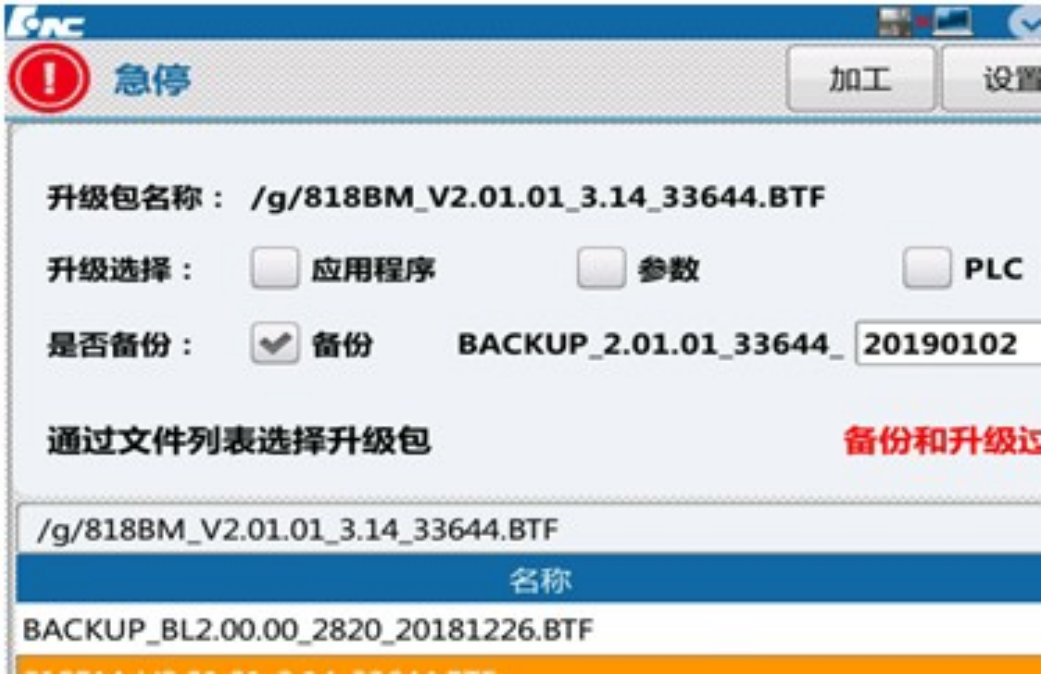
2） Press "Maintain" on the MDI panel→ press F7 "System upgrade";



3） Press "Window switch" to switch to the upgrade option and select "Type of upgrade option" and "Backup or not" by “↑”, “↓”, “←” and “→” on the MDI panel: Application program, parameter, PLC and BTF. Generally, select BTF upgrade and then press "Enter" on the MDI panel to confirm. Backup or not: Select whether backup is needed according to actual situation. After selection, “√” is displayed in front of corresponding option.

4） Select USB flash disk, switch to USB flash disk directory by "Window switch" and select corresponding upgrade patch by “↑” and “↓” on the MDI panel. After selection, press "Enter" on the MDI panel to confirm. If the backup is selected, the system will start the backup automatically and corresponding file to be backed up will be saved in the path of CF card. After the backup is completed, the system will start the automatic verification of upgrade patch after passing the verification. After upgrade is completed, the system will give a prompt message "Upgrade succeeds, please power off and restart". After the system is powered off and restarted, the loaded file is validated.

Select corresponding upgrade package file in the USB flash disk



Upgrade completed

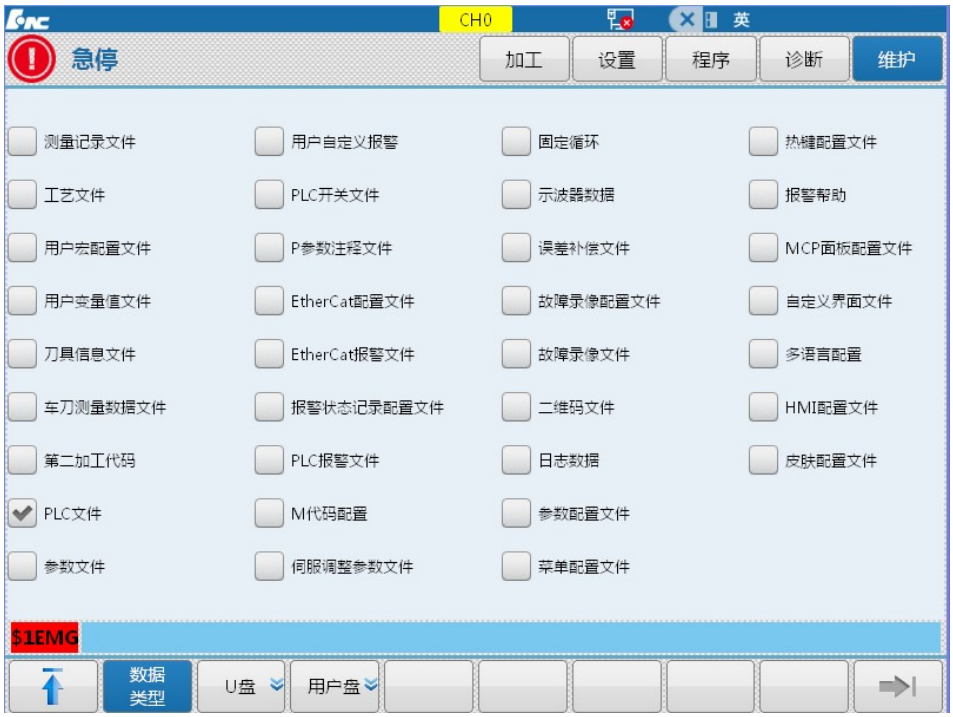
5.3.3 Parameters and PLC Loading

Operating steps:

1） Enter permission as per operating step 1) in 4.3.1;

2） Press F1 "↑" to return→Press F7 "Data management";

3） Select type of data to be loaded by “↑”, “↓”, “←” and “→” on the MDI panel. e.g.: To load parameter file, select "Parameter file". To load PLC file, select "PLC file". Then, press "Enter" on the MDI panel and "√" is displayed in front of corresponding option;



4） Select the loading path by "USB flash disk" and "User disk". For loading from USB flash disk, insert USB flash disk into USB interface of the system. When  in the upper part of the screen turns to  , it means that USB flash disk has been loaded;

5） Select the file to be loaded by “↑” and “↓” on the MDI panel, press "Load" and the system will give a prompt message "Whether to load the selected file? (Y/N)", "Y": Yes, "N": No, which correspond to "Y" and "N" on the MDI panel. Select Y and if there is a file of the same name in the system, the system will give a prompt message "Whether to cover the file? (Y/N)", select Y and the system will start to load the file. After the file is loaded, the system will give a prompt message "Loading succeeds and the system has been restarted!". After the system is powered off and restarted, the loaded file is validated.

A prompt whether to load the selected file will be given

A prompt whether to cover the original file will be given

A prompt loading succeeds and restart the system will be given

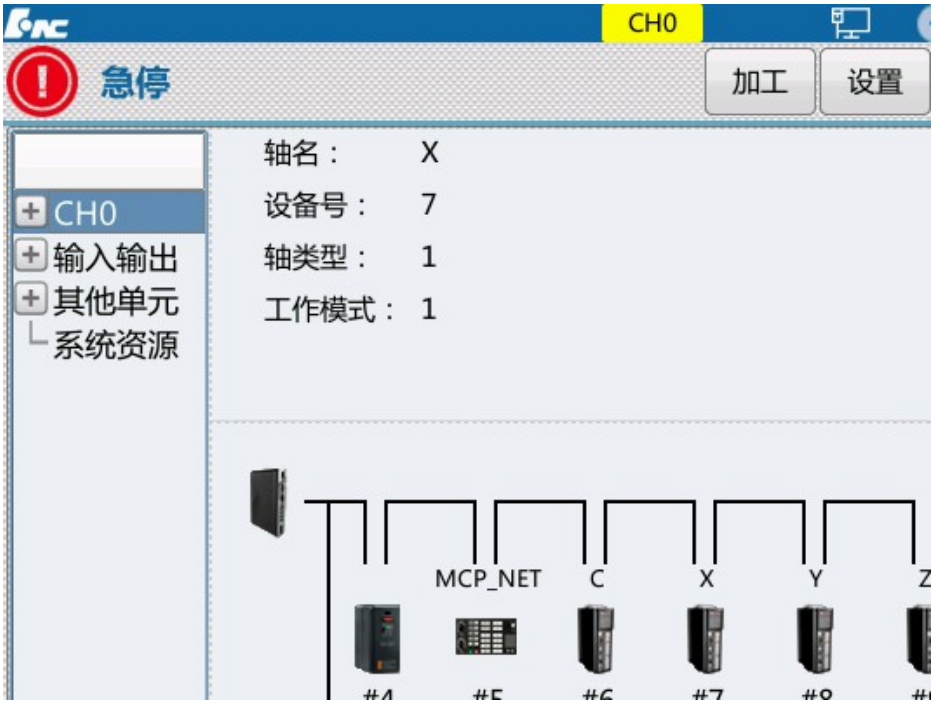
5.3.4 Batch Commissioning

Batch commissioning procedures for HNC-8 series of standard configurations will be described in this chapter.

Operating steps:

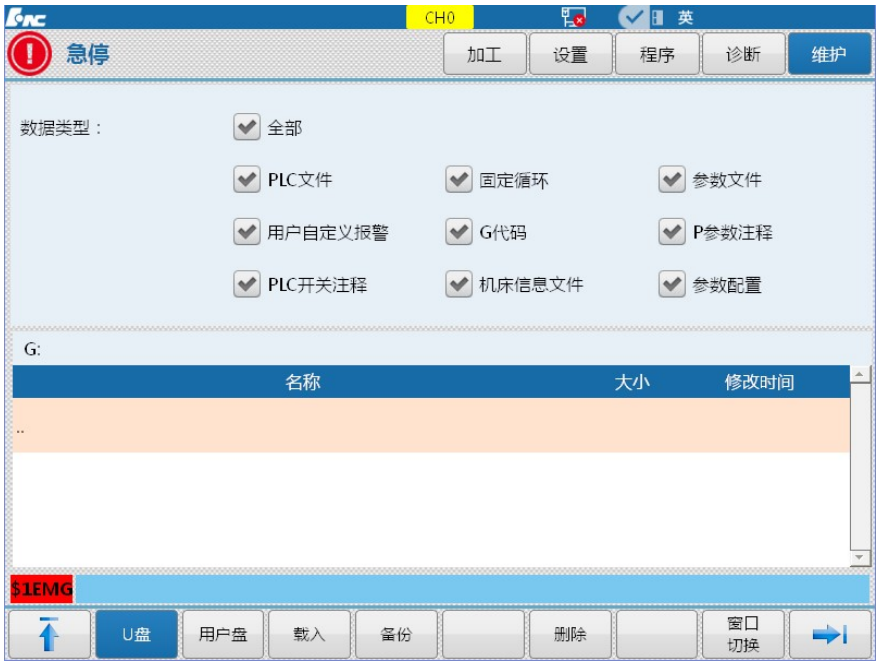
1) Enter permission as per operating step 1) in 4.3.1;

2) Press F1 “↑” to return→ press F6 “Batch commissioning”;



3) Select a single parameter type or multiple parameter types by "Enter" on the MDI panel;

Select path of load and backup by F2 “USB flash disk” and F3 “User disk”;
Select corresponding operation by F4 "Load" and F5 "Backup".



4) This function is mainly used for commissioning of several machine tools. When a machine tool reaches the correct condition, back up all parameters in a USB flask disk according to the above steps. Then, insert the USB flask disk into a machine tool system to be commissioned and load parameters in the USB flask disk in the system according to the above steps. Optimization and commissioning of the machine tool have been completed. The machine tool manufacturer can start inspection.

Note:

1. For this function, the CNC controller type, drive and motor types, electric points, and machine tool type must be consistent.
2. This function must ensure consistency of system version number.

5.4 Offline Commissioning

In order to prevent an accident, drive and motor should undergo offline commissioning before connected to actuator.

This step is extremely important while commissioning large machine tools.

Specific steps:

1) Place drive and motor in a flat and safe position (such as ground);

2) Connect drive and motor only, set the drive as the internal enable (for details, refer to *User Manual of HSV-180UD AC Servo Drive Unit*) and test operating condition;

Note: If an absolute motor rotates automatically after powered on, it means that zero setup is needed. (For specific steps of zero setup, please refer to *User Manual of HSV-180UD AC Servo Drive Unit*)

3) Connect the system to drive and drive to motor (for details, please refer to *Hardware Connection Specification*), as shown in Fig. 1.3. Recover drive parameters to the external enable and determine whether communication is normal through observing drive light or viewing device interface, (to view device interface parameters, refer to 3.1). If parameters of some devices cannot be displayed, connect them and eliminate faults one by one.

Fig. 1.3 Offline commissioning

Other key points of commissioning:

- Check whether phase sequences U, V and W of power line are correct. For Golden Age absolute motor, phase sequence should be U, W and V. For Huada absolute motor, phase sequence needs not to be exchanged.
- Check whether the CNC controller can control action of drive and motor correctly and whether drive and motor are stable and reach designed power;

4) Commission PLC and check emergency stop points;

5.5 Step-by-step Power-on Principle

In order to ensure safety of commissioning personnel and intactness of machine tool and for ease of fault diagnosis, comply with "step-by-step power-on" principle in the earlier commissioning period:

1) Power on the CNC controller and power off other parts. Check parameters and PLC and ensure correctness of power-on parts of PLC, especially when the gravity axis brakes.

2) Power on the feed axis and check whether device cables are connected correctly and whether the drive and the system are connected normally;

3) Power on the power device (motor) and check whether the motor is controlled normally, whether the machine tool works normally and whether all limits are valid;

4) Power on the spindle module and check whether the spindle speed is normal;

5) Power on the magazine module and check correctness of tool change;

5.6 HNC-8 System Boot Failure and Cause

Fault and cause that the system returns to Linux backstage after startup

1. Return to the backstage and there is printed information: Step 1/11: KernelInitErr
   Cause: System kernel failed to apply for memory.
   Solution: System memory failure.
2. Return to the backstage and there is printed information: Step 2/11: ReadCfgErr

Cause: Error occurs while reading system configuration file LNC32.CFG file.
Solution: Load normal LNC32.CFG file.

3. Return to the backstage and there is printed information: Step 3/11: NcguiErr
   Cause: System memory is insufficient and interface startup fails
   Solution: System memory failure.
4. Return to the backstage and there is printed information: Step 3/11: BmpLoadErr
   Cause: System memory is insufficient and BMP picture module initialization is abnormal
   Solution: System memory failure.
5. Return to the backstage and there is printed information: Step 3/11: FontErr
   Cause: Loading word stock fails and word stock file may be missing or damaged
   Solution: Load a correct word stock file
6. Return to the backstage and there is printed information: Step 4/11: ParmXmlLoadErr
   Cause: Loading parameter configuration file PARM-CN.XML fails
   Solution: Re-copy a normal PARM-CN.XML file to the system

Note: After returning to Linux backstage, characters still can be entered by keyboard normally. Due to Bug of Linux system, characters printed after returning to Linux system for the first time are invisible. When power is not off, start software of the CNC system manually, the system will return to Linux backstage again and users can see the printed incorrect characters.

How to start the software of the CNC system:

Enter "cd /h/lnc8" in the # interface and press the return key.

Enter "./n" in the # interface and press the return key.

If the start interface is normal, red color on the interface displays the abnormal start

1. Red color displays: 3---Interface initialization fails [2]
   Cause: There is damaged file or missing file in BMP files
   Solution: Replace BMP files again.
2. Red color displays: 4---Parameter initialization fails [-2]
   Cause: Parameter "Original file and backup file are damaged (file verification fails) or "Two files have inconsistent data".
   Solution: Alarm is eliminated after system restart. If the alarm is still not eliminated after system restart, enter "Data management" menu, delete backup file and restart the system. If the alarm still cannot be eliminated, re-import a normal parameter file to the system.
3. Red color displays: 5---Program manager initialization fails [-1]
   Cause: System memory is insufficient
   Solution: System memory failure.
4. Red color displays: 6---PLC initialization fails [-1]
   Cause: Loading DIT ladder diagram to the system fails
   Solution: Ladder diagram file is damaged
5. Red color displays: 7---Alarm module initialization fails [-2]
   Cause: Opening grammatical alarm text SYTAX.ERR fails
   Solution: The system imports a normal SYTAX.ERR file
6. Red color displays: 7---Alarm module initialization fails [-3]
   Cause: Opening system alarm text SYS.ERR fails
   Solution: The system imports a normal SYS.ERR file
7. Red color displays: 8---Saving previous power-off data fails, please check UPS power [0x0010]
   Cause: Data is not stored normally after system power-off

Solution: UPS is not fully charged or UPS is abnormal

8. Red color displays: 8---Data file import module initialization fails [0x0001]
   Cause: Workpiece coordinate system CRD.DAT file of the system, "Original file and backup file are damaged (file verification fails)" or "Two files have inconsistent data".
   Solution: Alarm is eliminated after system restart. If alarm is still not eliminated after system restart, reset the workpiece coordinate system and restart the system.
9. Red color displays: 8---Data file import module initialization fails [0x0002]
   Cause: Loading system tool file TDATA.DAT file fails
   Solution: Alarm is eliminated after system restart. If alarm is still not eliminated after system restart, reset tool data and restart the system.
10. Red color displays: 8---Data file import module initialization fails [0x0004]
    Cause: Loading system B register file REG.DAT fails
    Solution: Alarm is eliminated after system restart.
    Note 1: Different values in the brackets after 7, 8, 9 and 10 have different meanings and can be combined.
    Note 2: Machining of 3 types of files in 8, 9 and 10 is the same as machining of parameter files. For specific methods, refer to parameter machining methods in 2.
11. Red color displays: 9---"Gear ratio" and "Encoder offset" are not set [0X0003]
    Cause: Gear ratio" and "Encoder offset" of key axis parameters are not set and values in the square brackets represent the mask of the faulted axis number
    Solution: Set parameters such as "Gear ratio" and "Encoder offset" of the alarm axis
12. Red color displays: 10---Loss of motor position [0X0003]
    Cause: Motor position recorded during previous power-off exceeds the error compared with that during startup and values in the square brackets represent the mask of the faulted axis number
    Solution: Enter "Help" menu under "Diagnosis" for solution.
13. Red color displays: 11---GUI module initialization fails [3]
    Cause: System memory is insufficient and initialization of GUI related modules fails
    Solution: System memory failure.

6. Parameter Debugging

6.1 Parameter List

6.1.1 Distribution of Parameter Number

Parameter number (ID) of HNC-8 CNC system is distributed as shown below:

Parameter type	ID distribution	Description
NC parameter	000000-009999	Occupy 10000 ID numbers
Machine user parameters	010000-019999	Occupy 10000 ID numbers
Channel parameter	040000-049999	Every channel occupies 1000 ID numbers
Coordinate axis parameter	100000-199999	Every axis occupies 1000 ID numbers
Error compensation parameter	300000-399999	Every axis occupies 1000 ID numbers
Device interface parameter	500000-599999	Every device occupies 1000 ID numbers
Data table parameters	700000-799999	Occupy 100000 ID numbers

- NC parameters are basic parameters of the CNC system used to set interpolation period, operational

resolution and other parameters.

- Machine user parameters are used to set machine tool structure, number of channels and other parameters, such as lathe or milling machine and used channels, etc.
- Path of interpolation motion in channel. Different channels can execute different interpolation motions and they do not affect each other. Dual channel refers to that two types of interpolation motions can be executed simultaneously. Channel parameters are used to set relevant parameters in different channels.
- Coordinate axis parameters are used to set relevant parameters of logical axes used in the channels.
- Error compensation parameters are used to set backlash, pitch error and other error compensation parameters.
- Device interface parameters are used to set relevant parameters of axis, I/O and other physical devices.
- Data table parameters are used to set error compensation, temperature and other data tables.

6.1.2 Data Type of Parameter

Data type of HNC-8 CNC system parameters includes:

- INT4: Parameter value can only be an integer.
- BOOL: Parameter value can only be 0 or 1.
- REAL: Parameter value can be an integer or a decimal.
- STRING: Parameter value is a string containing 1-7 characters.
- HEX4: Parameters are inputted and displayed in hexadecimal.
- ARRAY: Parameters are inputted and displayed in the form of array, data is separated by "," or "." and the value range of array element is 0-127.

6.1.3 Parameter Access Level and Modification Permission

- Parameters of different levels must be modified and saved after corresponding password is entered for login.
- Low-level parameters can be modified after login of higher-level parameters.
- Curing parameters (access level 5) cannot be modified manually and are configured by the CNC system automatically (cured at the factory).
- Parameter access level is shown below:

Parameter access level	Object-oriented	English sign
1	Normal user	ACCESS_USER
2	Machine tool manufacturer	ACCESS_MAC
3	CNC manufacturer	ACCESS_NC
4	Administrator	ACCESS_RD
5	Curing	ACCESS_VENDER

6.1.4 Parameter Validation

Validation mode of parameters of HNC-8 CNC system includes:

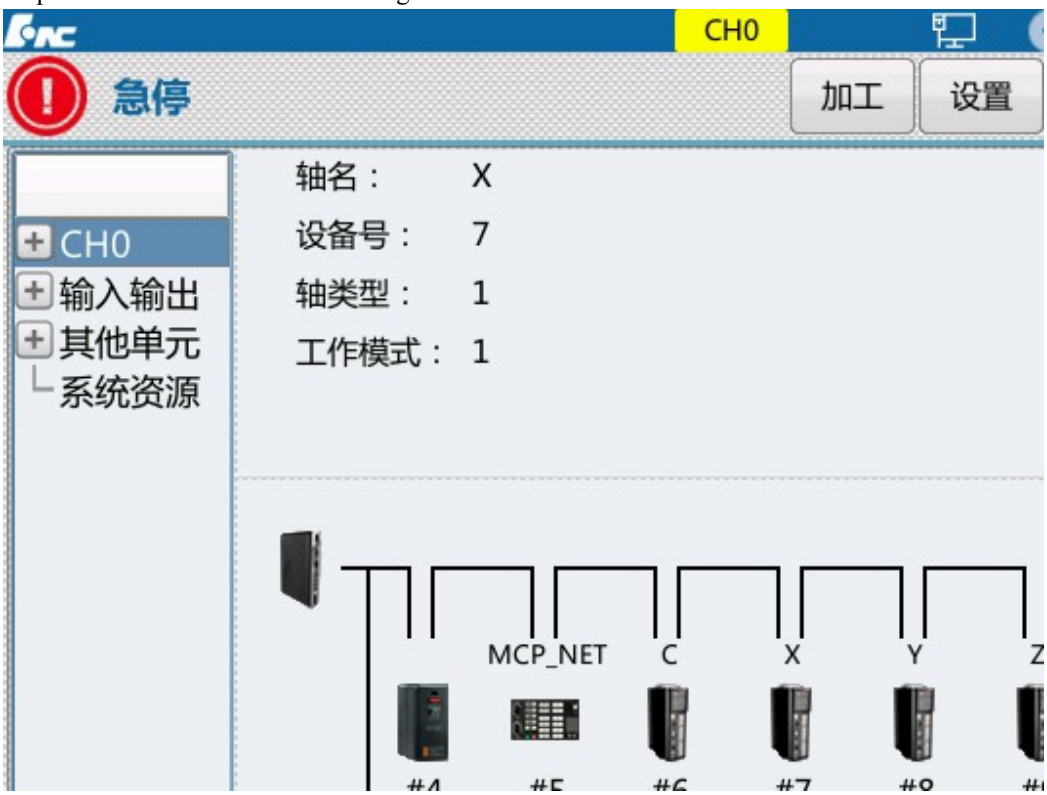
- Save: Press Save to validate the modified parameters
- Immediate: The parameters take effect immediately after modification (mainly used for adjustment of servo parameters)
- Reset: Press Reset to validate the modified parameters
- Restart: Restart the CNC system to validate the modified and saved parameters

6.2 Verification of Device Parameters

6.2.1 Device Parameters

When the system is powered on for the first time after hardware connection, verify parameters first. If corresponding devices of displayed parameters are not identified, re-check the hardware connection.

Steps: Maintain=>F2 device configuration



6.2.2 Axis number and Device Number

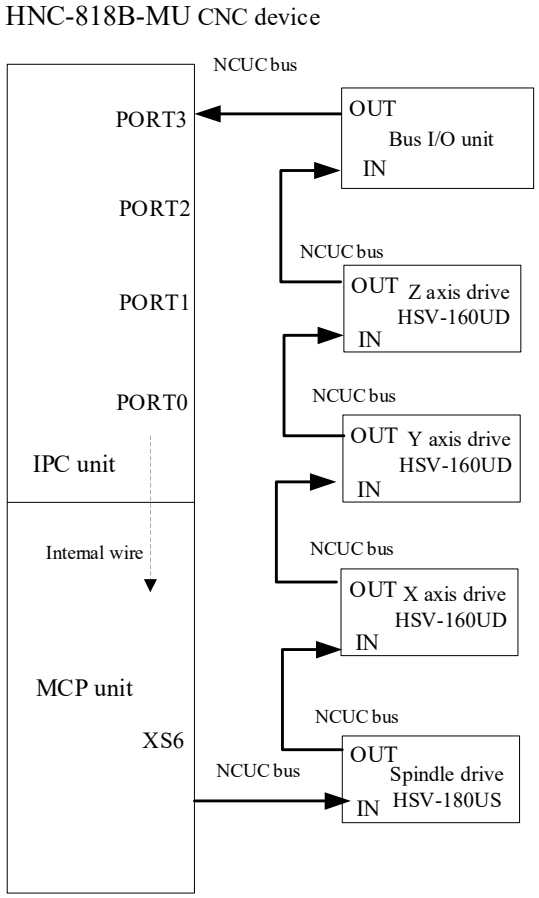
The axis number refers to the logical axis number in system and the device number refers to the number of physical devices on the bus. Different connection of the bus corresponds to different device sequences.

Device types supported by HNC-8 CNC system are shown below

Device type	Device name	Device type	Connection mode	Graphic sign
Reserved	RESERVED	1000	----	
Analog spindle	SP	1001	Local	
Local IO module	IO_LOC	1007	Local	

Local control panel	**MCP_LOC**	**1008**	**Local**	
MPG	**MPG**	**1009**	**Local**	
CNC keyboard	**NCKB**	**1010**	**Local**	
Servo axis	**AX**	**2002**	**Bus network**	
Bus IO module	**IO_NET**	**2007**	**Bus network**	
Bus control panel	**MCP_NET**	**2008**	**Bus network**	
Position control panel	**PIDC**	**2012**	**Bus network**	
Encoder interface board	**ENC**	**2013**	**Bus network**	

As shown in bus connection diagram of 818B milling system, MCP keyboard unit corresponds to device number 5, spindle corresponds to device number 6, X axis corresponds to device number 7, Z axis corresponds to device number 8, and I/O unit corresponds to device number 9.



With standard milling machine as an example, the relationship between axis number and device number is shown in Fig. 3.2.2.

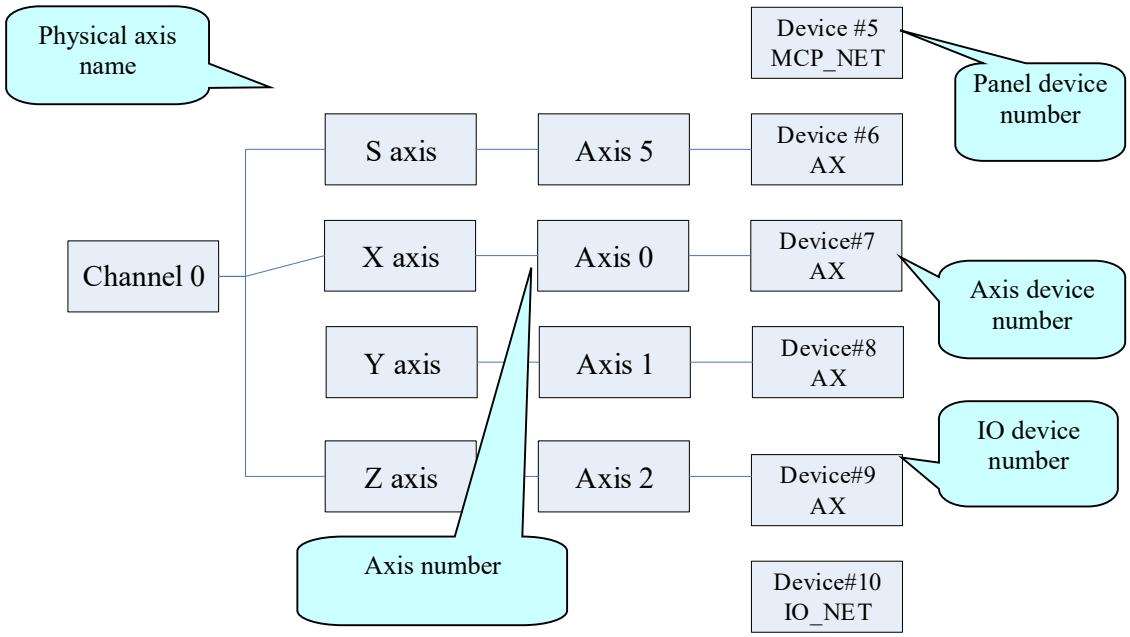


Fig. 3.2.2 Relationship between axis number and device number

6.3 Parameter Setting

1) Press "Maintain" on the MDI panel→ press F9 "Permission management"→ press F4 "Logout"→select user level (the backup is allowed only for workshop manager or above) → press F2 “Login”→Enter the password→ press "Enter" on the MDI panel to confirm (if a correct password is entered, the parameter of the permission level or the password can be modified; otherwise, the system will give a prompt message "Incorrect password".) ;

Default permission password:
Operator: Password is not needed
Workshop manager: GOD
Machine tool manufacturer: HOG
CNC manufacturer: HIG
System administrator: HNC8

2) Press F1 “↑” to return→ press F2 "Parameter setting";
3) Select the parameter type by “↑” and “↓” on the MDI panel and press "Enter" on the MDI panel to enter the suboption;
4) Press → to switch to parameter option window and modify parameter value;

6.4 Parameter Setting of HNC-8 Milling System

6.4.1 NC Parameter Setup

1) PARM000012, "tool axis selection mode", the parameter is used to determine the axis for G43/G44 tool length compensation.

- 0: Tool length should be compensated on Z axis.
- 1: Tool length compensation axis is switched through selecting modal G command (G17/G18/G19) according to coordinate plane and corresponds to Z/Y/X axis respectively.

2) PARM000013, "G00 interpolation enable", the parameter is used to determine whether to enable G00 interpolation motion like G01 interpolation motion.

- 0: G00 does not execute interpolation motion.
- 1: G00 executes interpolation motion

3) PARM000014, "Whether to restore tool length compensation automatically after G53/G28 command is executed", the parameter is used to set whether to automatically restore tool length compensation function after G53/G28 command is executed.

- 0: Tool length compensation function cannot be restored automatically after G53/G28 command is executed. (Recommended)
- 1: Tool length compensation function is restored automatically after G53/G28 command is executed.

4) PARM000018, "System time display enable", the parameter is used to set whether the HMI of the CNC system displays current system time.

- 0: System time is not displayed
- 1: System time is displayed

5) PARM000020, "Automatic display enable of alarm window", the parameter is used to set whether the CNC system displays the alarm message window automatically.

- 0: Alarm message window is not displayed automatically.
- 1: If the system gives a new alarm message, the alarm message window will be displayed automatically.

6) PARM000024, "G code line number display mode", the parameter is used to set the display mode of G code line number in the HMI of the CNC system.

- 0: G code line number is not displayed
- 1: G code line number is displayed only in the editing interface
- 2: G code line number is displayed only in the program operation interface
- 3: G code line number is displayed in the editing interface and the program operation interface

7) PARM000025, "Display in metric/inch".

- 0: Display in inch, the HMI of the CNC system displays in inch.
- 1: Display in metric, the HMI of the CNC system displays in metric.

8) PARM000026, "Decimal places of positional value", the parameter is used to set the decimal places of positional value in the HMI of the CNC system, including machine tool coordinates, workpiece coordinates and remaining feed, etc.

9) PARM000027, "Decimal places of speed value", the parameter is used to set the decimal places displayed of speed value in the HMI of the CNC system, including F feedrate, etc.

10) PARM000028, "Decimal places of rotation speed", the parameter is used to set the decimal places displayed of rotation speed in the HMI of the CNC system, including spindle speed S, etc.

11) PARM000030, "Screen protection waiting time (min)", the parameter is to set how long the system enters screen protection state while NC panel is not being operated. When it is set as 0, screen protection function is not used.

12) PARM000034, "Operation prompt enable". Use binary to indicate whether there is a confirmation prompt for the corresponding operation.

- Bit 0: Rerun.

- Bit 1: 【Tool compensation】->【Relative actual】
- Bit 2: 【Tool compensation】->【Current position】.

When the value of each bit is 0, it means there is no confirmation prompt, and when it is 1, it means there is a confirmation prompt.

Example:

When bit 0 is set as 0, press system function key [Rerun] and the interface will directly refresh the cursor to the position of program header;

When bit 0 is set as 1, press system function key [Rerun] and the interface will give a prompt message whether to execute rerun.

13) PARM000064, "Tool wear accumulation enable", it is to set whether the tool wear value is the input value or the input value plus original value

- 0: Input value
- 1: Input value plus original value

14) PARM000072, "Whether machining time display is closed", the parameter is used to close machining time display function.

- 0: Machining time is displayed
- 1: Machining time is not displayed

15) PARM000102, "Selection of coordinates displayed", the parameter is used to set type of coordinates displayed in the machining interface.

- 0: Machine actual
- 1: Machine command
- 2: Workpiece actual
- 3: Workpiece command
- 4: Remaining feed
- 5: Relative actual

16) PARM000349, "Selection of trigonometric function, 0: radian; 1: angle".

- 0: Trigonometric function is calculated by radian
- 1: Trigonometric function is calculated by angle

17) PARM000356, "Milling machine function type".

- 0: Drilling-tapping function without breakpoint function
- 1: Milling function

18) PARM000358, "Clear MDI program while exiting MDI".

- 0: MDI program is not cleared while exiting MDI
- 1: MDI program is cleared while exiting MDI

19) PARM000359, "Default permission".

- 0: The default permission after power on is the workshop manager permission
- 1: The default permission after power on is the operator permission

20）PARM000370, "Intelligent function switch".

Set by bit: 0: OFF, 1: ON.

- Bit 0: Triathlon health security function
- Bit 1: Single sensor thermal error compensation function
- Bit 2: Fault data recorder function
- Bit 3: None
- Bit 4: Feed axis load diagram function
- Bit 5: Process parameter evaluation function
- Bit 6: Broken tool detection function

- Bit 7: One-key restore function
- Bit 8: Power-on consistency detection function
- Bit 9: Enable servo self-diagnosis function
- Bit 15: Current/power switching function

6.4.2 Machine User Parameter Setting

1) PARM010000, "Maximum number of channels", the parameter is used to set allowable maximum number of channels. It is set as 1 by default and 2 when there are two channels.

2) PARM010001, "Cutting type of channel 0", the parameter is used to specify the type of the station.

- 0: Milling machine
- 1: Lathe system
- 2: Turn-mill combination system

3) PARM010009, "Channel 0 selection sign".

Many spindles and drive feed axes can work on a workpiece clamping position, that is, a workpiece corresponds to more than one channels.

This set of parameters are effective after reset. Bits 0-7 represent selection signs of channels 0-7 respectively. While configuring a channel for a station, the designated position of channel selection sign of the station should be set as 1 for this station.

4) PARM010017, "Channel 0 display axis sign [1]"

The HMI of the CNC system can display axes in every station selectively based on actual need.

This set of parameters are effective after reset. Bits 0-31 of "Station display axis sign【1】" represent selections signs of axes 0-31 respectively. When the system supports no more than 64 axes, bits 0-31 of the extension parameter "Station display axis sign【2】" represent selections signs of axes 32-63 respectively. While configuring the display axis for a station, the specified bit of display axis sign of the station should be set as 1 for this station.

Note

This set of parameters should be inputted in hexadecimal.

Example

If station 0 includes two channels, there are 10 axes including coordinate axes 0, 2, 4, 5, 6, 7, 8, 10, 13 and 17, but the HMI of the CNC system just needs to display the first 5 axes and Parm010017 "Station 0 axis display sign 【1】" should be set as 0x75 (hexadecimal input, bits 0, 2, 4, 5 and 6 should be set as 1).

5) PARM010033, "Customization of load current display axis in channel 0".

The HMI of the CNC system can determine which axis load current is displayed in each station based on actual needs.

This set of parameters is array type parameters used to set axis number of load current display axes in the station and the inputted axis number is separated by "." or ",".

Note

Array parameters support to 8 data to be input simultaneously and the value ranges from 0 to 127.

Example

Station 1 includes 5 axes including coordinate axes 0, 1, 2, 8 and 9. Axes 0, 1 and 2 are feed axes and axes 8 and 9 are spindles.

If the HMI of the CNC system needs to display load current of feed axes in station 1, Parm010033 "Customization of load current display axis in station 1" should be set as "0, 1, 2".

If the HMI of the CNC system needs to display load current of spindles in station 1, Parm010033 "Customization of load current display axis in station 1" should be set as "8, 9".

If the HMI of the CNC system needs to display load current of all axes in station 1, Parm010033 "Customization of load current display axis in station 1" should be set as "0, 1, 2, 8, 9".

6) PARM010041, "Whether coordinate axis is displayed dynamically"

The parameter is used to set that the spindle coordinates are not displayed in speed mode and displayed in position mode.

- 0: This axis is displayed regardless of whether the spindle is in position mode or speed mode;
- 1: The spindle coordinates are not displayed in speed mode and displayed in position mode.

Note

The parameter must be validated when there is logical axis number of the spindle in PARM010017/010018 "Station display axis sign".

7) PARM010046, "Radius compensation intervention control"

When radius compensation is intervened, the parameter enables to give an alarm, stop operation, or correct intervention path automatically. The parameter can avoid intervention and prevent overcut.

- 0: Intervention alarm.
- 1: Automatic correction of intervention.

8) PARM010049, "Maximum allowable number of axes of machine tool"

The parameter is used to set maximum allowable number of logical axes for machine tool. If the parameter is set as 10, the machine tool is allowed to use axes 0-9, 10 logical axes in total. If other logical axes (logical axes whose axis number is greater than 9) are configured in the channels, these axes will have no control command output.

9) PARM010083, "Drilling canned cycle type"

This parameter is to set which system of drilling and tapping canned cycle commands are compatible.

- 0: HNC8 ssytem
- 1: SYNTEC
- 2. MITSUBISHI system
- 3. FANUC system

10) PARM010084, "Peck tapping/deep hole tapping", (specific to canned cycle of other systems than HCNC system)

The parameter is used to set tapping mode.

- 0: Peck tapping, the retract amount is set according to G74/G84 feed amount
- 1: Deep hole tapping. In this mode, the tool retracts to R reference level each time

The value is effective only when there is and feed amount Q in G74/G84 command.

11) PARM010085, "G73 retract amount", (specific to canned cycle of other systems than HCNC system)

The parameter is used to set retract amount of G73 high-speed deep hole drilling cycle.

12) PARM010086, "G83 retract amount", (specific to canned cycle of other systems than HCNC system)

The parameter is used to set retract amount of G83 high-speed deep hole drilling cycle.

13) PARM010087, "G74/G84 retract amount", (specific to canned cycle of other systems than HCNC system)

The parameter is used to set retract amount of G74/G84 tapping cycle and the value is effective only in peck tapping mode.

14) PARM010088, "tool offset direction after boring spindle orientation stops"

The parameter is used to set offset direction of tool after spindle orientation is completed. (Fine boring cycle is valid)

- 0: X+
- 1: X-
- 2: Y+
- 3: Y-
- 4: Z+
- 5: Z-

15) PARM010089, "T command control mode"

Set T command tool change mode and tool machining mode in binary.

- Bit 0: If it is 0, T command only has the tool selection function and is used for magazine with tool preselection function, such as manipulator magazine, etc.

  If it is 1, T command has tool selection and tool change functions, such as magazine of drilling-tapping center.
- Bit 1: If it is 0, the tool machining mode is disabled; if it is 1, the tool machining mode is enabled.

16) PARM010091, "#500-#999 user macro-variable Enable"

The parameter is used to set whether #500 to #999 macro-variables are used as user-defined macro-variables.

- 0: #500-#999 are not used as user macro-variables.
- 1: #500-#999 are used as user macro-variables and consistent with Mitsubishi and FANUC.

17) PARM010098, " Whether G02/G03 converts to G01 when lack of parameters"

The parameter is used to set the processing mode when center or radius is not specified during G02/G03 programming.

- 0: Alarm prompt
- 1: Convert to G01

18) PARM010099, "Whether to open magazine management interface for large and small tools"

- 0: Not open magazine management interface for large and small tools.
- 1: Open magazine management interface for large and small tools.

19) PARM010104, "New function debugging parameters"

- 0X1: Enable G68 space rotation function.
- 0X2: When program is executed automatically, press one-click subprogram call on the MCP panel

and call corresponding subprogram after the breakpoint is saved automatically, such as "One-click tool lifting"

- 0X4: Enable program operation debugging, run the line in blue to the canned cycle, run the canned cycle in single block
- 0X8: Superpose workpiece zero in G91G52
- 0X0010: Enable multiaxis M instruction: Spindle 0 (M3/4/5) spindle 1 (M13/14/15) Spindle 1 (M23/23/25) spindle 3 (M33/34/35)
- 0X0020: Output the interpolation file under Win simulated version
- 0X0040: Stop interpolation when an interpolation point is produced under Win simulated version until data is taken away.
- 0X0080: M99 does not produce the dwell block
- 0X0100: Synchronization of user-defined variable type
- 0X0200: Continuously waiting for a response when there is no response of M code synchronization
- 0X0400: When it is set as 1, return to G00 speed for execution in any line mode; otherwise return to G01+040030 speed for execution
- 0X0800: Set the default modal of the first group of G codes (set OX0800 initial modal as G00 and OX00×× initial modal as G01)

20) PARM010110, "Internal inhibition mask of machine tool protection area"

See special function application description.

21) PARM010111, "External inhibition mask of machine tool protection area"

See special function application description.

22) PARM010165, "Delay time of reference point return (ms)"

The parameter is used to set lag time from finding the Z pulse to the completion of reference point return in the process of machine tool feed axis returning to the reference point.

23) PARM010166, "Maximum time of exact stop check (ms)"

The parameter is used to set maximum time of detecting positional tolerance of coordinate axis after rapid traverse positioning (G00). The parameter is validated only when coordinate axis parameter PARM10X060 "Positional tolerance" is not 0.

24) PARM010169, "Enable G64 exact stop check at corner"

The parameter is used to set whether to stop at the corner for the exact stop check in G64. When the parameter is set as 1, the CNC system will enable the exact stop check function under G64 mode.

Note:

Under G64 modal, if feed length of two straight lines is ≤5mm and vector angle is ≤36° , the CNC system will adopt arc transition automatically and will not be controlled by the parameter.

25) PRAM010170, "M code corresponding to G1007"

The parameter is used to set corresponding M code, through which user-defined macro program is called.

6.4.3 Channel Parameter Setting

1) RARM040000, "Channel name"

The parameter is used to set channel name. E.g.: Set name of channel 0 as CH0 and name of channel 1 as CH1. The status bar of the HMI of the CNC system can display name of current channel. The channel name displayed in the status bar is changed as the channel is switched.

2) PARM040001, "Coordinate axis number of X axis"

The parameter is used to configure X axis number in current channel, realizing mapping between feed axis and logical axis of channel.

0-127: Specify the feed axis number in current channel.

-1: If the feed axis in current channel is not mapped to logical axis, it is an invalid axis.

-2: The feed axis in current channel is reserved for C/S axis switching, and after switching the axis type is the rotary axis in position mode.

-3: Feed axis in current channel is reserved for C/S axis switching, and after switching the axis type is the linear axis in position mode.

3) PARM040010, "Axis number of spindle 0"

The parameter is used to set the axis number of spindle 0 in current channel, realizing mapping between spindle and logical axis in channel.

0-127: Specify spindle number in current channel.

-1: If the spindle in current channel is not mapped to logical axis, it is an invalid axis.

4) RARM040014, "Programming name of X axis"

If CNC is configured with multiple channels, in order to distinguish from axes in each channel during programming, the system supports the user-defined programming name of coordinate axis. This group of parameters is used to set programming name of X axis in current channel. The default value is the nine coordinate axis names based on Cartesian coordinate system in each channel (X/Y/Z/A/B/C/U/V/W).

5) PARM040023, "Programming name of spindle 0"

Each channel of HNC-8 CNC system supports no more than 4 spindles. In order to distinguish from spindles during programming, the system allows user-defined spindle names in different channels.

6) PARM040027, "Spindle speed display mode"

The parameter takes effect after reset, which is used to set the spindle speed display mode in channels. Bits 0-3 correspond to speed display mode of spindles 0-3. When it is 1, the command speed is displayed. When it is 0, the actual speed is displayed.

7) PARM040028, "Display number of spindle"

The parameter is used to set logical axis number of spindle in current channel. Set as many logical axis numbers of spindle as there are spindles in the current channel. If this parameter is not set, the spindle speed cannot be displayed.

Note

Whereas there is no "，" on the system panel, logical axis number of spindle is differentiated by ".".

8) PARM040029, "Maximum deceleration time of emergency stop (ms)"

The parameter is used to handle the time that the command speed of coordinate axes reduces to zero when the system is in emergency stop.

9) PARM040030, "Default feedrate of channel (mm/min)"

When the program in current channel is not specified with the feedrate, CNC will execute the program using the specified default feedrate.

10) PARM040031, "Feedrate of dryrun (mm/min)"

When CNC switches to dryrun mode, the machine tool will execute the program using this set feedrate .

11) PARM040037, "Acceleration/deceleration time coefficient in hand wheel"

The parameter is used to set the movement acceleration by the handwheel. Taking the corresponding axis parameter "Rapid traverse acceleration and deceleration time constant" as the reference, the acceleration and deceleration time in handwheel is converted by the "acceleration and deceleration time constant coefficient in handwheel", and then the handwheel acceleration is changed. The conversion formula is as follows:

Converted value of acceleration and deceleration time in handwheel = acceleration and deceleration time constant in rapid traverse * acceleration and deceleration time constant coefficient in handwheel

12) PARM040038, "Acceleration/deceleration jerk time coefficient in handwheel"

The parameter is used to set the jerk of handwheel. Taking the corresponding axis parameter "Acceleration and deceleration time constant in rapid traverse" as the reference, the acceleration and deceleration jerk time in handwheel is converted by the "acceleration and deceleration jerk time constant coefficient in handwheel", and then the handwheel jerk is changed. The conversion formula is as follows:

Converted value of acceleration and deceleration jerk time in handwheel = Acceleration and deceleration jerk time constant in rapid traverse * Acceleration and deceleration jerk time constant coefficient in handwheel

13) PARM040050, "Maximum magnification for feedrate override"

The parameter is used to limit the maximum magnification of feedrate override.

E.g.

When the feedrate override button of the panel is set to the maximum 200%, the parameter needs to be set as 2.

14) PARM040113, "Any line mode selection"

The parameter is used to select the execution mode of any line command.

- 0: Non-scanning mode: commands before the target line will not produce a modal effect.
- 1: Scanning, return without Z axis: commands before the target line will produce a modal effect, but Z axis motion command modal is not inherited.
- 2: Scanning, return with Z axis;

Note

When the target line which executes any line command is the circular interpolation commands, the system will report circular interpolation parameter error, unless current coordinates coincide with the starting point of circular interpolation.

15) PARM040114, "Axis in position sequence in any line"

The parameter is used to set sequence of axis motion. Parameter is of numeric type and values are XYZABCUVW from low to high. 0 means no axis configuration.

E.g.

For milling system, 040114=211 means X/Y axis moves to the right position and then Z axis starts to move.

16）PARM040130, "Tool life management mode"

The parameter is used to set tool life management mode.

- 0: Disable tool life function.
- 1: Enable tool life function, and grouping is not supported.
- 2: Enable tool life function, grouping is supported, T command specifies tool group number.
- 3: Enable tool life function, grouping is supported, T command specifies tool number. (Just for milling machine)

6.4.4 Coordinate Axis Parameter Setting

1) PARM100000, "Display axis name"

The parameter is used to set the displayed name of specified axis on the interface.

For multichannel CNC, in order to distinguish from address words in the program of different channels, and the name consists of a letter and a digit; otherwise, axis name will be displayed incorrectly. Axis name is often defined such as X0 and X1.

If Parm100000 is set as X0, it will be displayed on the interface as follows.

Figure

Note

The parameter is different from the channel parameters Parm040015-040023 "Programming name of coordinate axis". The former is used for the display on the interface only and the latter is used for programming. Both may be different, but they' are recommended to be consistent.

The following characters cannot be used to set axis name: D, F, H, M, EQ, LT, GT, GE, LE and PI.

2) PARM100001, "Axis type"

All physical axes of machine tool are useful and this parameter is used to configure the axis type.

- 0: Not configured, default value.
- 1: Linear axis.
- 2: Swing axis, the coordinate value of displayed angle is not limited.
- 3: Rotary axis, the coordinate value of displayed angle must be within the specified range and the it will be displayed modulo when the actual coordinates exceed the value.
- 9: When the traverse axis is used as a spindle, the drive is the feed axis drive.
- 10: Spindle.

3) PARM100004, "Numerator of electronic gear ratio [displacement] (um)"

For linear axis, this parameter is used to set the movement distance of machine tool per revolution of motor.

For rotary axis, this parameter is used to set the movement angle of machine tool per revolution of motor.

4) PARM100005, "Denominator of electronic gear ratio [pulse]"

The parameter is used to set the number of pulse commands per revolution of motor.

Example

For servomotor of 131072 ppr encoder, lead of guide screw is 6mm and electronic gear ratio is 2/3.

The machine tool moves 6mm* 2/3 = 4mm, namely 4000um, per revolution of motor, then:

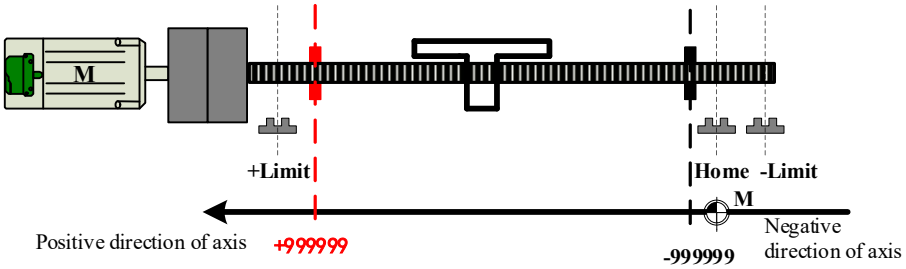
4000/131072

Parm100004 "Numerator of electronic gear ratio" is set as 4000 and Parm100005 "Denominator of electronic gear ratio" is set as 131072.

5) PARM100006, "Positive software limit coordinate (mm)"

Limit software protection position in the positive direction stipulated by CNC software. The moving range of traverse axis or rotary axis cannot exceed the limit.

Figure



Note

The parameter is valid only after the machine tool returns to the reference point.

Set an appropriate parameter value according to the mechanical travel of machine tool and the size of workpiece. If the setting is too small, the software limit alarm may be issued repeatedly during machining.

When the third bit of G((80*logical axis number)+1) is 1, the positive software limit coordinate is invalid and the second positive software limit coordinate is valid.

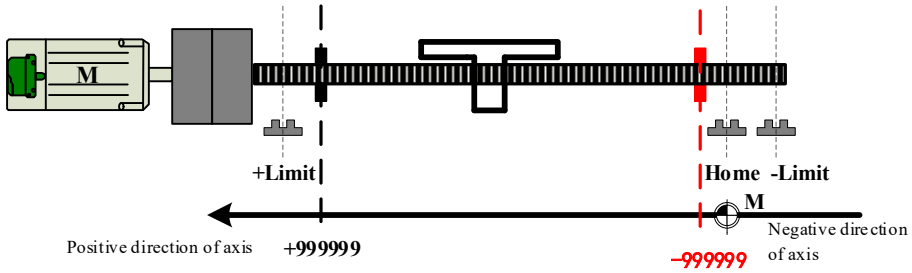
Example

The first software limit of logical axis 0 is valid and the second positive software limit coordinates of logical axes 1 and 2 are valid. G1.2 is set as 0 and G81.2 and G161.2 are set as 1 in the ladder diagram.

6) PARM100007, "Negative software limit coordinate (mm)"

Limit software protection position in the negative direction stipulated by CNC software. The moving range of traverse axis or rotary axis cannot exceed the limit.

Figure



Note

The parameter is valid only after the machine tool returns to the reference point.

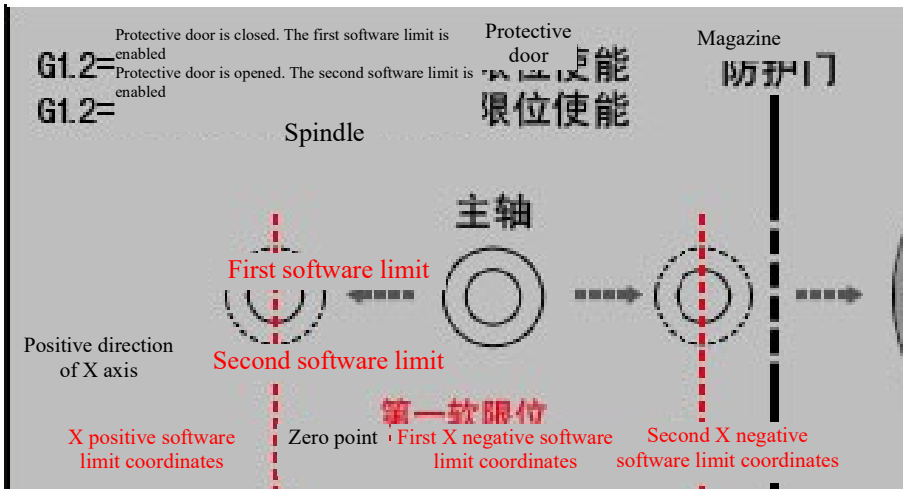
Set an appropriate parameter value according to the mechanical travel of machine tool and the size of workpiece. If it is too small, the software limit alarm may be issued repeatedly during machining.

When the third bit of G((80*logical axis number)+1) is 1, the positive software limit coordinate is invalid and the second positive software limit coordinate is valid.

7) PARM100008, "The second positive software limit coordinate (mm)"

Limit software protection position in the positive direction stipulated by CNC software. It takes effect when the second software limit is enabled. The moving range of traverse axis or rotary axis cannot exceed the limit.

Figure



Note

The parameter is valid only after the machine tool returns to the reference point.

Set an appropriate parameter value according to the mechanical travel of machine tool and the size of workpiece. If the setting is too small, the software limit alarm may be given repeatedly during machining.

The first software limit is invalid after the second software limit is enabled. It is determined by G register.

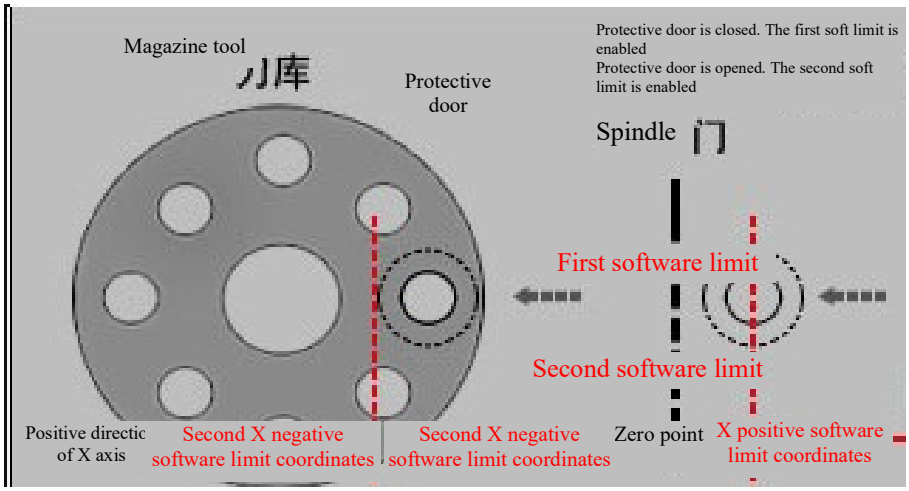
Example

Enable the first positive software limit during normal machining and set G1.2 as 0. For tool change, set G1.2 as 1 in the ladder diagram, and the first positive software limit is disabled and the second positive software limit is enabled. After the tool change is completed, set G1.2 as 0 in the ladder diagram and enable the first software limit.

8) PARM100009, "The second negative software limit coordinate (mm)"

Limit software protection position in the negative direction stipulated by CNC software. The moving range of traverse axis or rotary axis cannot exceed the limit.

Figure



Note

The parameter is valid only after the machine tool returns to the reference point.

Set an appropriate parameter value according to the mechanical travel of machine tool and the size of workpiece. If it is too small, the software limit alarm may be issued repeatedly during machining.

The first software limit is invalid after the second software limit is enabled. It is determined by G register.

Example

Enable the first negative software limit during normal machining and set G1.2 as 0. For tool change, set G1.2 as 1 in the ladder diagram, and the first negative software limit is disabled and the second negative software limit is enabled. After tool change is completed, set G1.2 as 0 in the ladder diagram to enable the first software limit.

9) PARM100010, "Reference point return mode"

HNC-8 CNC system has the following reference point return modes:

➢ 0: Absolute coding

When the encoder is powered on, the position value can be obtained immediately and offered to the CNC system. When the CNC system is powered off, the current position of machine tool is not lost, so the system need not move axes of the machine tool to locate the reference point and the machine tool can run immediately.

➢ 2: + -

Move to the reference point switch from the current position at high speed of reference point return in the direction of reference point return. Press the reference point switch and move in the opposite direction at low speed of reference point return until the system detects the first Z pulse position. Continue moving a certain distance based on the set value of Parm100013“Offset after reference point return” to complete the reference point return.

➢ 3: + - +

Move to the reference point switch from the current position at high speed of reference point return in the direction of reference point return. Press the reference point switch and move in the opposite direction to leave the reference point switch. Search Z pulse in the opposite direction at low speed of reference point return until the system detects the first Z pulse position. Continue moving a certain distance based on the set value of Parm100013“Offset after reference point return” to complete the reference point return.

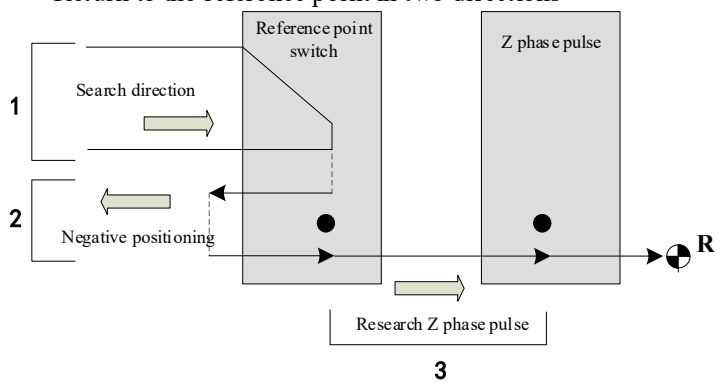
➢ 4: Distance-coded reference point return 1

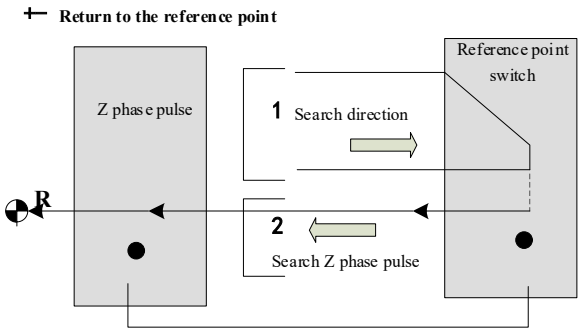
When CNC is equipped with distance-coded grating ruler, the machine tool just needs to move a short distance to locate the reference point and build a coordinate system. It is set to 4 when the grating ruler feedback and the reference point return direction are the same.

➢ 5: Distance-coded reference point return 2

When CNC is equipped with distance-coded grating ruler, the machine tool just needs to move a short distance to locate the reference point and build a coordinate system. It is set to 5 when grating ruler feedback and reference point direction are opposite.

Return to the reference point in two directions





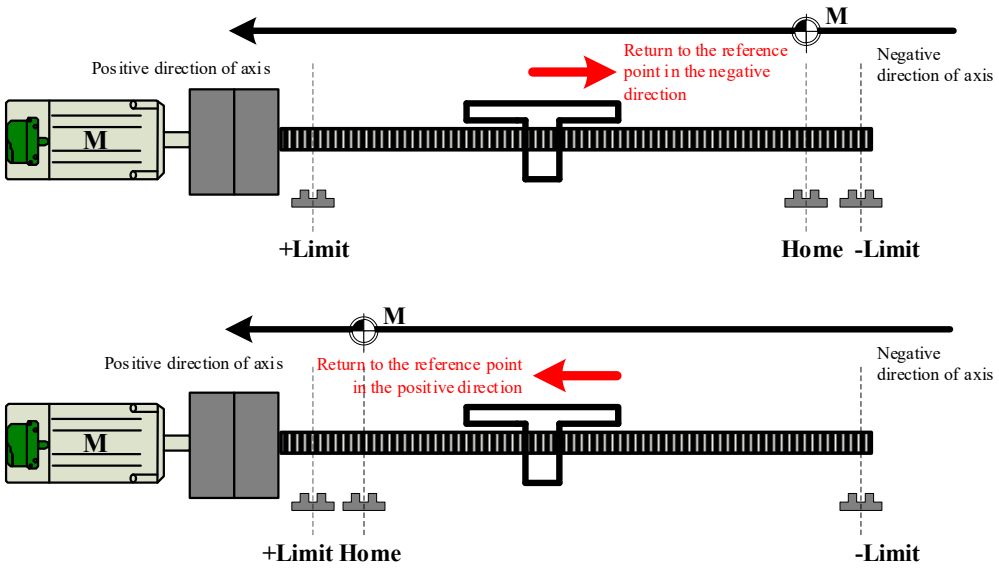
Note

The reference point return mode is determined by type of feedback component adopted by axes of machine tools. After machine tool is started, build a coordinate system and the program can run automatically. If an axis uses incremental displacement measurement feedback system, the axis must return to the reference point first.

10) PARM100011, "reference point return direction"

The parameter is used to set the initial moving direction of coordinate axis at the time of reference point return.

- 1: Positive direction
- -1: Negative direction
- 0: Reference point direction is not specified (for distance-coded reference point return)



Note

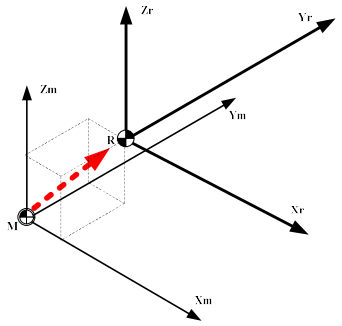
The parameter setting is related to the position the machine reference point switch is installed. If an incorrect reference point direction is set, the reference point return failure will occur.

While using this reference point return mode, the "working mode" of axis in device parameters must be set as 1 (incremental encoder type).

Whereas the distance-coded reference point return direction is controlled by PLC, this parameter must be set as 0 when the distance-coded reference point return is adopted.

11) PARM100012, "Encoder feedback offset (mm)"

The parameter is mainly for absolute encoder motor. Whereas the absolute encoder will feed back a random position value when it is used for the first time, users can fill the value in the parameter and the current position is the origin of the machine coordinate system.



Note

If coordinates of machine tool are not cleared after current coordinate position is filled out, after gear ratio of axis is set, press Alt+left/right key in the program interface to adjust the top right corner of the interface to "Motor position" and record motor position of each axis,

Encoder feedback offset= motor position/pulse count per axis revolution * lead of guide screw (mm).

Example

e.g.: Motor position is 266700000, pulse count is 131072 per axis revolution and lead of guide screw is 4mm. Set the position as the zero point of X axis of current machine tool, then the encoder feedback offset =266700000/131072*4=8139.0381.

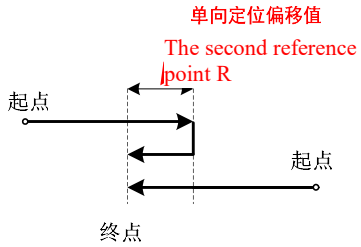
Note

The system can calculate the offset value automatically. Press "Auto offset" to set zero point of all axes.

12) PARM100021, "Coordinate value of the second reference point (mm)"

The system can specify no more than 5 reference points under the machine coordinate system. The parameter is used to set the coordinate value of the second reference point.

This reference point can be returned with the command G30 P2.



Note

When the actual position of machine tool is at the coordinates of the second reference point, F (logical axis number * 80).8 is 1. During tool change, this register can be used to determine whether the axis is at the tool change point.

Example

Axes 0, 1 and 2 move to the second reference point respectively. Determine whether F0.8, F80.8 and F160.8 are 1 in the ladder diagram. If they are 1, it means that the machine tool is at the second reference point.

13) PARM100025, "Deviation of reference point range (mm)"

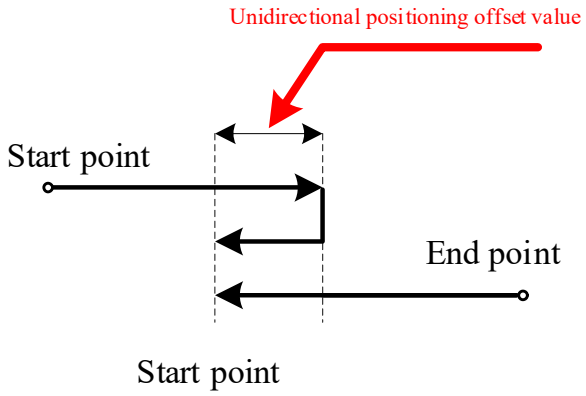
The parameter is used to determine the error range that whether the axis is at the reference point.

When positional deviation between actual position of machine tool and reference position is less than the parameter, it can be determined that the axis is at the reference point and reference point position mark in state sign field of axis is set to 1.

14) PARM100030, "Unidirectional positional (G60) offset value (mm)"

In order to eliminate the effect of the screw nut pair backlash during positioning, the coordinate axis can be specified to be positioned from a fixed direction to the target position. That is, whether the final position is in the positive direction or the negative direction of the initial position, the direction of approaching the final position is fixed. When the parameter is positive, it means that G60 is positive positioning. When it is negative, it means that G60 is negative positioning. When G60 positioning direction is opposite to the moving direction of command, the axis will continue moving a certain distance after reaching the destination and then move oppositely to the destination in the G60 positioning direction. The parameter is used to designate the moving distance and G60 positioning direction.

Figure



Note

It should be noted that the set value of the parameter should be greater than backlash of corresponding axis.

15) PARM100031, "Converted radius of rotary axis (mm)"

The parameter is used to set radius of current rotary axis and it is set to convert angular speed of rotary axis into linear speed.

Maximum speed of rotary axis (mm/min)=Maximum rotation speed of axis*2*PI*Converted radius of rotary axis.

Note

Whereas the rotary axis rotates for 360° in a revolution, linear speed is 360mm/min if the rotary axis rotates for a revolution within a minute.

360=2∏R

R=360/2 /∏=57.3

Thus, converted radius of rotary axis should be 57.3.

Example

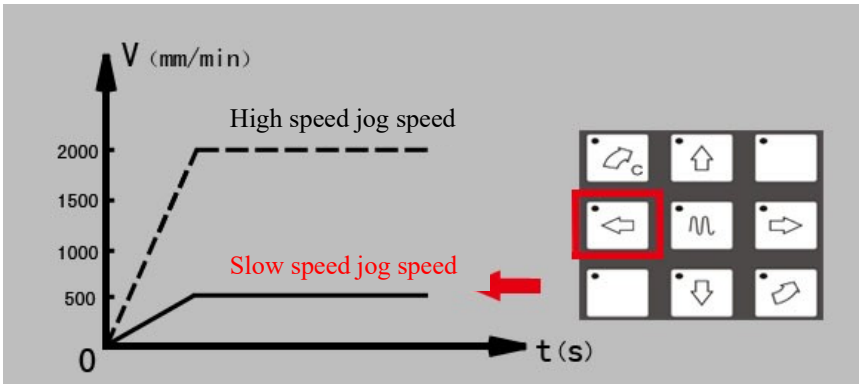
If maximum speed of rotary axis is 3000r/min, converted radius of rotary axis is 57.3mm.

Maximum speed of current axis=3000*2*3.1415*57.3=1079532mm/min.

16) PARM100032, "Slow speed jog speed (mm/min)"

The parameter is used to set slow speed jog speed of axis in jog mode (JOG).

Figure



Note

While jogging axis under jog mode (JOG), movement speed of axis is affected by feed rate override.

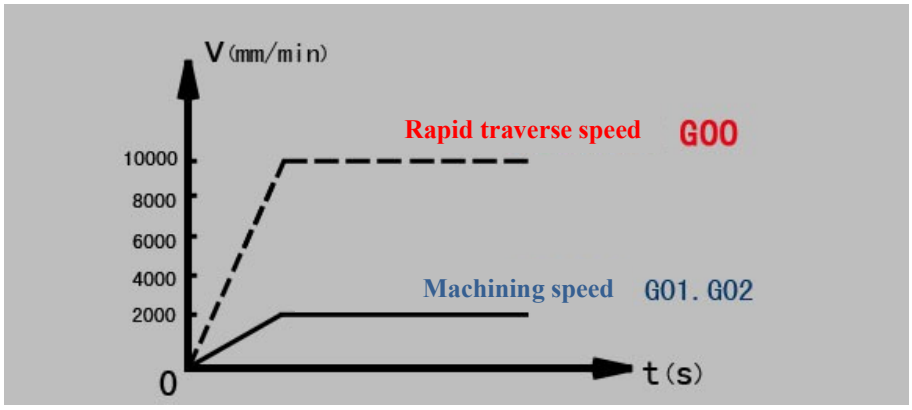
Rotary axis is affected by its converted radius.

17) PARM100034, "Maximum rapid traverse speed (mm/min)"

The parameter is used to set maximum speed of rapid traverse positioning (G00) of axis.

Maximum speed of rotary axis = Maximum speed of axis *2*PI* Converted radius of rotary axis.

Figure



Note

Maximum rapid traverse speed must be the maximum value of all speed parameters of an axis. Maximum rapid travese speed is closely related to the ratio between numerator and denominator of external pulse equivalent. This parameter must be set reasonably in order to avoid exceeding the motor speed range. e.g.: If rated speed of motor is 2000rev/min, and the motor is connected to the ball screw whose screw lead is 6mm through a pair of synchronous toothed belts whose transmission ratio is 1:1.5, then:

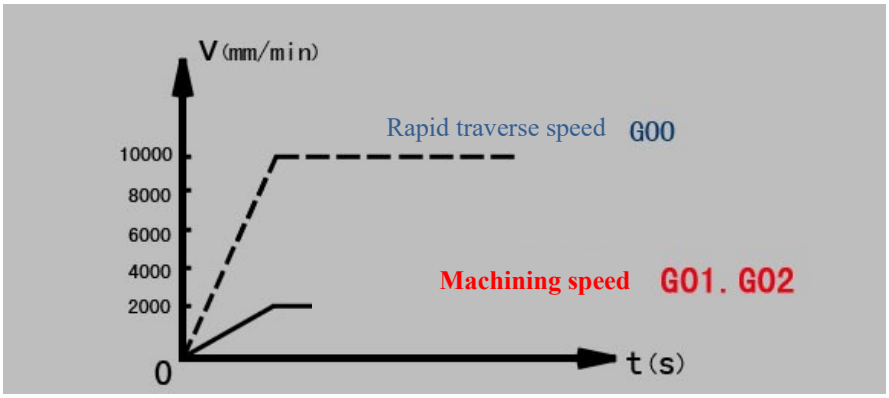
Maximum rapid traverse speed ≤2000× (1/1.5) ×6=8000mm/min.

Rotary axis is affected by its converted radius.

18) PARM100035, "Maximum machining speed (mm/min)"

The parameter is used to set maximum machining speed (G01, G02…) of axis.

Figure



Note

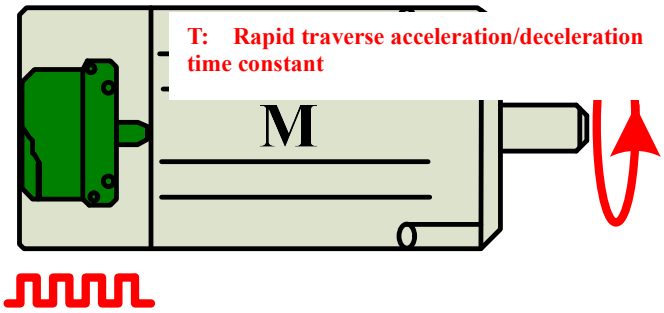
The parameter is related to machining requirements, mechanical transmission and load. Maximum machining speed must be less than maximum movement speed.

Rotary axis is affected by its converted radius.

19) PARM100036, "Rapid traverse acceleration and deceleration time constant (ms)"

It refers to the time that linear axis speeds up from 0 to 1000mm/min or slows down from 1000mm/min to 0 during rapid traverse (G00). The parameter determines acceleration of axis. The larger this parameter the smaller acceleration and deceleration.

Figure



Note

The parameter is determined by motor rotational inertia, load rotational inertia and drive acceleration capacity.

Comparison between common rapid traverse acceleration/deceleration time constant and acceleration:

Acceleration/deceleration Time constant	2ms	8 ms	16 ms	32 ms	64 ms
Acceleration	1g	0.2g	0.1g	0.05g	0.02g

Example

Rapid traverse acceleration/deceleration time constant is set as 4ms, rapid traverse acceleration is figured out as shown below:

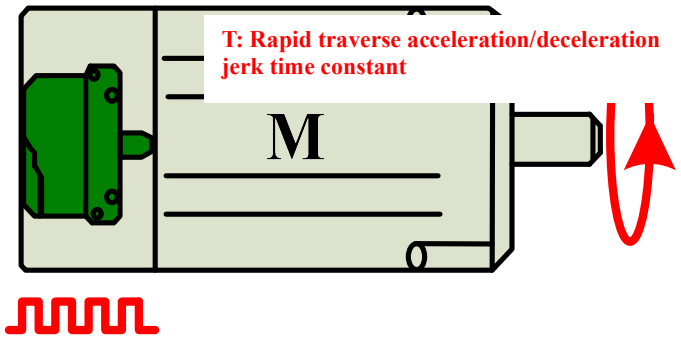
1000mm/60s≈16.667mm/s

16.667/0.004≈4167mm/s^2 ≈0.425g (1g=9.8m/s^2)

20) PARM100037, "Rapid traverse acceleration/deceleration jerk time constant (ms)"

This parameter refers to the time that an axis speeds up from 0 to 1m/s^2 or slows down from 1m/s^2 to 0 during rapid traverse (G00). The parameter determines rapid traverse jerk of axis. The larger the time constant, the more gently the acceleration changes.

Figure



Note

The parameter is determined by motor size, drive performance and load size and it is often limited to 8-150.

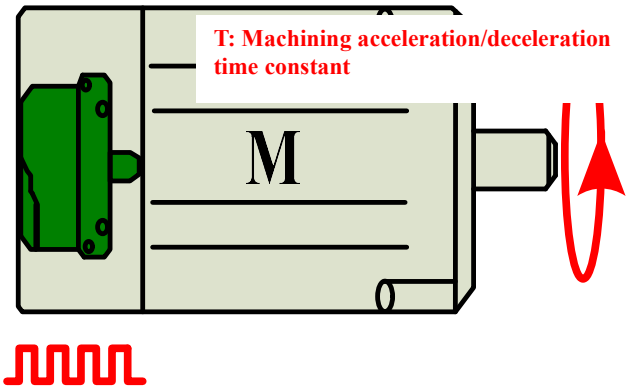
Example

Suppose rapid traverse acceleration is 0.2g (namely 1.96m/s^2) and rapid traverse acceleration/deceleration jerk time constant is set as 8ms, then the jerkis 1.96/0.008=245m/s^3.

21) PARM100038, "Machining acceleration/deceleration time constant (ms)"

This parameter refers to the time that the linear axis speeds up from 0 to 1000mm/min or slows down from 1000mm/min to 0 during machining (G01 and G02, etc.). The parameter determines machining speed of axis. The larger machining acceleration and deceleration time constant is the smaller acceleration and deceleration is.

Figure



Note

The parameter is determined by motor rotational inertia, load rotational inertia and drive acceleration capacity.

Comparison between common machining acceleration/deceleration time constant and acceleration:

Machining acceleration and deceleration time constant	2ms	8 ms	16 ms	32 ms	64 ms
Acceleration	1g	0.2g	0.1g	0.05g	0.02g

Example

Machining acceleration/deceleration time constant is set as 6ms, machining acceleration is figured out as shown below:

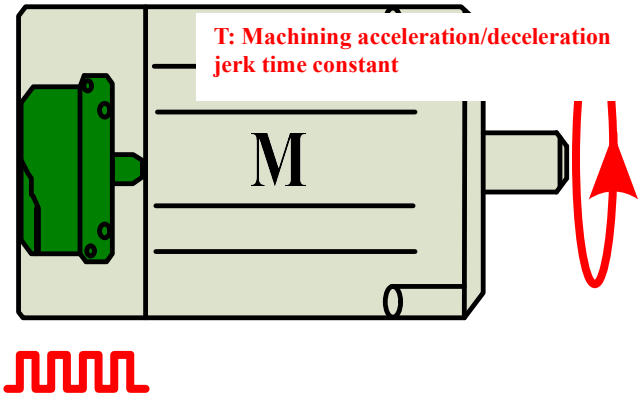
1000mm/60s≈16.667mm/s

16.667/0.006≈2778mm/s^2≈0.283g (1g=9.8m/s^2)

22) PARM100039, "Machining acceleration and deceleration jerk time constant (ms)"

"Machining acceleration and deceleration jerk time constant refers to the time that an axis speeds up from 0 to 1m/s^2 or slows down from 1m/s^2 to 0 during machining (G01 and G02, etc.). This parameter determines machining jerk of axis. The larger the time constant is the more gently the acceleration changes.

Figure



Note

The parameter is determined by motor size, drive performance and load size and it is often limited to 8-150.

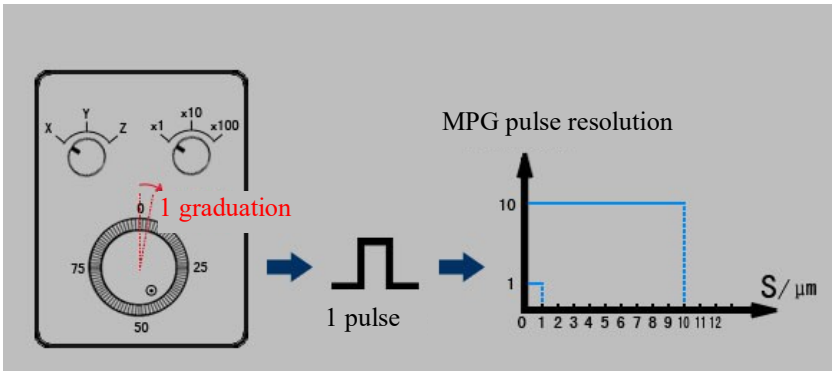
Example

Suppose machining acceleration is 0.05g (namely 0.49m/s^2) and machining acceleration/deceleration time constant is set as 128ms, then the jerk is 0.49/0.128≈3.8m/s^3.

23) PARM100043, "Pulse resolution of MPG (um)"

The parameter is used to set the distance of a pulse axis as the MPG rotates a graduation when the MPG override is ×1.

Figure



Note

When Parm010001“Station machine type” is set 1 (lathe) and Parm040032 "Diameter/Radius programming” is set as 1, the MPG pulse resolution corresponding to X axis should be set as 0.5.

Example

e.g.: When in the MPG mode the lathe X axis needs to move 0.0001mm as the MPG rotates one graduation, this parameter should be set as 0.05. While the lathe Z axis needs to move 0.0001mm as the MPG rotates one graduation, the parameter should be set as 0.1.

24) PARM100045, MPG Buffer Periods

Within the number of MPG buffer periods, the machine tool moves at low speed. When beyond the number

of MPG buffer periods, the machine speeds up.

25) PARM100047, MPG Maximum Speed

The parameter is used for the situation that uneven speed of MPG occurs during th.

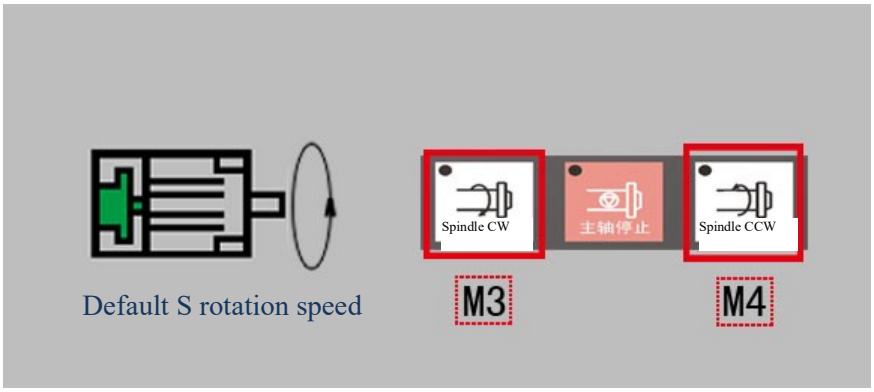
26) PARM100048, Overspeed Alarm Coefficient"

The parameter is used to set the coefficient value when the system gives an alarm against overspeed of axis, namely when actual speed of axis exceeds the product of command speed of system and axis, the system will give an alarm against overspeed of axis.

27) PARM100050, Default S Rotation Speed (r/min)"

When the spindle rotation M03 or M04 is specified, if the rotation speed S is not specified, the default rotation speed S set by this parameter is adopted.

Figure



Note

If M3 command is followed by the spindle speed and the new M3 is not followed by the spindle speed, the default rotation speed S is valid only when spindle speed is not specified.

Example

When 1000 is set, and M3 or rotating spindle CW is executed after power-on, the spindle speed is 1000r/min.

28) PARM100052, Allowable Fluctuation Ratio of Spindle Speed

According to machine tool conditions, the parameter is used to detect whether the spindle speed fluctuates normally within a certain range.

Fluctuation range of actual spindle speed= ± current command spindle speed * allowable fluctuation ratio of spindle speed.

29) PARM10006, "Positioning tolerance"

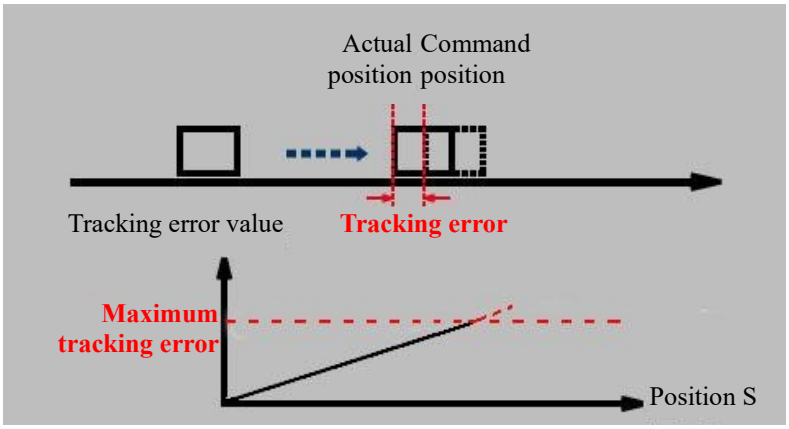
The parameter is used to set allowable exact stop error of rapid traverse positioning (G00) of coordinate axis.

- 0: There is no positioning tolerance limit for the current axis
- >0: If machine coordinates of current axis still exceed the set value of positioning tolerance after reaching Parm 010166 "Maximum time for exact stop check", the system will give an alarm.

30) PARM100061, "Maximum tracking error (mm)"

Allowable maximum error when the coordinate axis moves. When Parm100090 "Encoder working mode" is set as 0, the tracking error is calculated by servo drive and the CNC system acquires tracking error directly from the servo drive. When it is set as 1, the tracking error is calculated by the system.

Figure



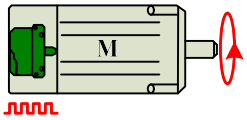
Note

When the coordinate axis moves, CNC will monitor whether tracking error of axis is within the parameter setup range in real time. Tracking error is often limited to 0.1-1. If the parameter is too small, the system may easily shut down due to large positioning error. If the parameter is too large, machining accuracy will be affected. Generally, the larger machine tool is the larger the value is; the worse mechanical drive and accuracy of machine tool is the larger the value is; the larger the movement speed of machine tool is the larger the value is.

31) PARM100067, "Pulse count per revolution of axis (pulse)"

The parameter refers to pulse count received by CNC device when the current axis rotates one revolution, namely, the number of pulses fed back to CNC device when the servo drive or the servomotor controls the axis to rotate one revolution. Generally, it is the actual pulse count of position encoder of servomotor. If there is reduction ratio, it is the product of pulse count of motor per revolution and reduction ratio.

Figure



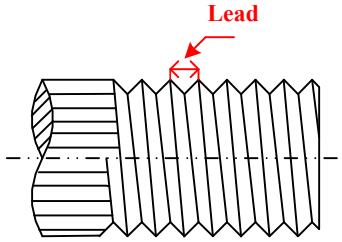
Example

If pulse count of motor per revolution is 131072 and reduction ratio is 40:1, the parameter is 131072*40, namely 5242880.

32) PARM100068, "Guide screw lead"

The axial distance between corresponding points of two adjacent teeth on the same helical line.

Figure



33) PARM100073, "Speed display coefficient of rotary axis"

When the parameter is set as 1.0, speed display unit of rotary axis is "°/min".

For rotary axis requiring high rotation speed, speed F displayed in "°/min" is often very large. In this case, speed display of rotary axis can be adjusted through this parameter setting. If the parameter is set as 0.0028, speed F display unit of rotary axis will be converted into "rev/min".

34) PARM100082, "Short path mode of rotary axis"

- 0: Common mode, CW rotation when the command coordinate value is greater than current position and CCW rotation when it is smaller than current position.
- 1: Short path rotation mode.
- 2: Unidirectional rotation CW mode.
- 3: Unidirectional rotation CCW mode.

To use this function, PARM100001 "Axis type" must be set as 3, namely the rotary axis type, and "Feedback position cycle enable" in device parameters must be set as 1. While specifying rotary axis in incremental mode correspondingly, the moving direction of rotary axis is the symbol of increment and the movement amount is the command value.

35) PARM100090, "Encoder working mode"

The parameter is used to set usage mode of specified axis motor encoder by bit.

Bit 8: Tracking error monitoring of feed axis

- 0: Tracking error is calculated by the servo drive and the CNC system acquires tracking error directly from the servo drive.
- 1: Tracking error is calculated by the CNC system based on the encoder feedback.

If the servo drive does not upload tracking error and the parameter is set as 0, the CNC system will not display or the monitor tracking error of feed axis.

Bit 12: Whether to enable counter rollover of absolute encoder

- 0: When it is disabled, pulse count of absolute encoder is valid only within a single count range.
- 1: When it is enabled, effectively increase count range of encoder through recording rollover times of absolute encoder.

For linear axis of extra-long travel or linear axis/rotary axis with large reduction ratio, if absolute encoder is used, the rollover count function of absolute encoder must be enabled in order to avoid loss of machine tool coordinates arising from power-off after the axis runs long in the same direction.

Note

The parameter is inputted and displayed in hexadecimal.

Example

Existing rotary axis A (logical axis 3, device 10) adopts single-turn 17-digit and multi-turn 12-digit absolute encoder and has reduction ratio of 180:1. In order to avoid loss of machine tool coordinates arising from power-off after the axis runs long in the same direction, parameter setting is shown below:

Coordinate axis parameter PARM103090 “Encoder working mode” is set as 0x1100;

Coordinate axis parameter PARM103094 "Encoder counting digits" is set as 29;

Coordinate axis parameter PARM103067 "Pulse count per revolution of axis (pulse)" is set as 23592960 (131078*180);

Device interface parameter PARM510014 “Feedback position cycle mode" is set as 1;

Device interface parameter PARM510015 ““Feedback position cycle pulse count" is set as 23592960;

36) PARM100094, "Encoder counting digits"

The parameter is set according to the number of counting digits (single-turn + multi-turn digits) of absolute rotary pulse encoder and it can be set as 0 for incremental rotary pulse encoder and linear grating ruler and other types of encoders.

Suppose number of digits of absolute rotary pulse encoder is N, the counting range of encoder is 0 to 2^N-1.

Note

If the counting range of absolute encoder is less than the travel of feed axis, the counter rollover exists when the axis runs long in the same direction. In this case, the bit 12 of coordinate axis parameter PARM103090 "Encoder working mode" should be set as 1.

Example

A linear feed axis is furnished with absolute rotary pulse encoder and the number of single-cycle digits is 17 (namely pulse count per revolution of encoder is 2^{17}=131072) and number of multi-turn digits is 12, the parameter should be set as 17+12=29.

37) PARM100130, "Maximum error compensation rate (mm or degree)"

Comprehensive compensation value of current axis can be smoothened via this parameter setting in order to prevent impact on machine tool arising from abrupt change of compensation value. If the variation of comprehensive error compensation value of two adjacent interpolation periods is greater than the set value of the parameter, the system will give a prompt message "error compensation rate reaches the upper limit", the program will continue running and the variation of comprehensive error compensation value will be restricted to this maximum value.

38) PARM100131, "Maximum error compensation value (mm or degree)"

The allowable maximum displacement error of axis can be set by the parameter. If the comprehensive error compensation value outputted to current axis is greater than the set value of the parameter, the system will give a prompt message "error compensation value reaches the upper limit", the program will continue running and the comprehensive error compensation value will be restricted to this maximum value.

39) PARM100132, "Feed axis feedback deviation (mm)"

To solve sudden jump of absolute motor, set "Feed axis feedback deviation" in coordinate axis parameters. When this parameter value is 0, the sudden jump of motor position is not monitored after power on. When position deviation of axis exceeds this deviation value, F[logical axis number *80+68] is set as 1. Users can decide whether alarm issuing or emergency stop is used according to state of this register point.

40) PARM100196, "Power-off feedback pulse position tolerance (pulse)"

41) PARM100197, "Power-off position tolerance (pulse)"

If the parameter is 0, this function is disabled by default. It is valid when any number greater than 0 is set and the unit is pulse.

The parameter is used when multi-turn position of absolute encoder is memorized by battery power (such as Tamagawa absolute encoder) and the system gives an alarm when batteries are exhausted and multi-turn position is lost. The value is related to encoder resolution. If 131072 pulses are fed back when the absolute encoder rotates one revolution, the parameter value should be 131072.

6.4.5 Error Compensation Parameter Setting

HNC-8 CNC system has over-quadrant sudden jump compensation function, pitch error compensation function, backlash compensation function, perpendicularity compensation function and thermal error compensation function with/without temperature sensor. For details, refer to "HNC-8 User Manual Milling System".

6.4.6 Device Interface Parameters

1) Device 0-Device 4

Definition of device 0-device 4 is determined by the value of G2963 in PLC initialization (INIT) module.

Register G2963 (decimal)	Drive description	Note
0	Devices 0-3 are devices reserved by the system	Default configuration
1	Devices 0-4 are imaginary axes and can be allocated to	Configurable

	system axis.	
2	Imaginary axis and imaginary MCP panel are mixed. Devices 0-3 are imaginary axes that can be allocated to system axis and are used during simulation running. Device 4 is an imaginary MCP and after it is enabled the keyboard can be used as MCP. This function can be used when there is no MCP panel.	Configurable
4	Driven by imaginary pulse axis. Devices 0-3 are imaginary axes and this function is used when pulse axis card is used.	Configurable

2) Bus control panel

a. MCP type

The parameter is used to specify type of bus control panel.

- 0: Invalid
- 1: HNC-8A type control panel
- 2: HNC-8B type control panel
- 3: HNC-8C type control panel
- 7: User-defined control panel

b. Initial number of input point group

The parameter is used to set the position of input signal of bus control panel in X register.

c. Number of input point groups

The parameter is used to identify number of input signal groups of bus control panel.

d. Initial number of output point group

The parameter is used to set the position of output signal of bus control panel in Y register.

e. Number of output point groups

The parameter is used to identify number of output signal groups of bus control panel.

f. Inverse MPG direction mark

When the MPG direction of the bus control panel is opposite to the feed direction of axis, the MPG feed direction can be changed through this parameter setting. The meaning of the parameter values is as follows,

- 0: Manual pulse is directly inputted into the CNC system.
- 1: Inverse manual pulse is inputted into the CNC system.

g. Band switch code type

- 0: Band switch adopts 8421 code
- 1: Band switch adopts Grey code

h. Number of Additional analog spindles

The system is configured with only a group of analog spindles by default. More analog spindles can be configured by this parameter.

Note

After analog spindles are added, power off and restart to display the added spindle analog devices. The corresponding number of spindle analog devices under the last device previously identified are added in the corresponding position.

3) Bus IO module

a. Initial group number of input point

The parameter is used to set the position of input signal of bus IO module in X register.

b. Number of input point groups

The parameter is used to identify number of input signal groups of bus IO module.

c. Initial number of output point group

The parameter is used to set the position of output signal of bus IO module in Y register.

d. Number of output point groups

The parameter is used to identify group number of output signal of bus IO module.

e. Encoder A type

The axis interface board device in the bus IO module includes two encoder feedback interfaces (interface A and interface B). This parameter is used to specify the type of the encoder connected to interface A.

- 0 or 1: Incremental encoder
- 3: Absolute encoder

Note

The parameter is valid only for axis interface board device in the bus IO module and invalid for input/output board devices and AD/DA interface board devices.

f. Pulse count per revolution of encoder A

When the encoder connected to interface A is an incremental encoder, the parameter should be set as pulse count per revolution of encoder.

g. Type of encoder B

The axis interface board device in the bus IO module includes two encoder feedback interfaces (interface A and interface B). The parameter is used to specify type of the encoder connected to interface B.

- 0 or 1: Incremental encoder
- 3: Absolute encoder

Note

The parameter is valid only for axis interface board device in the bus IO module and invalid for input/output board devices and AD/DA interface board devices.

h. Pulse count per revolution of encoder B

When the encoder connected to interface B is an incremental encoder, the parameter should be set as pulse count per revolution of encoder.

4) Servo axis

a. Working mode

The parameter is used to set default working mode of servo axis in the bus network.

- 0: No position command output
- 1: Position incremental mode
- 2: Position absolute mode
- 3: Speed mode
- 4: Current mode (torque mode)

Working mode of feed axis is often set as 1 and that of spindle is often set as 3.

Note

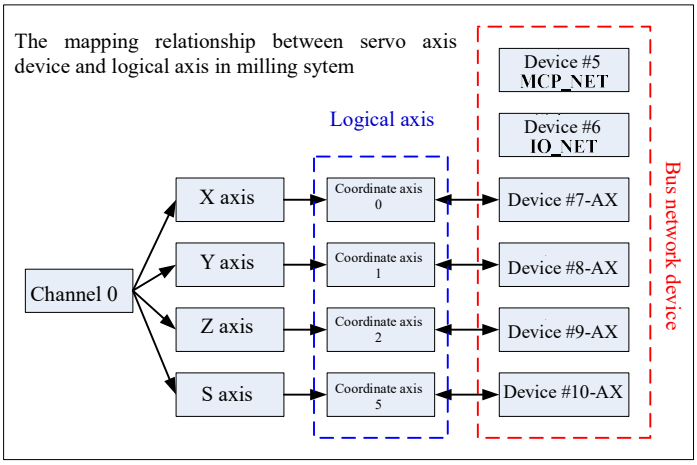
The parameter is used to set default working mode of servo axis only. In practical application, working mode of servo axis can be switched according to control command of CNC system (such as C/S switch function).

b. Logical axis number

The parameter is used to build the mapping relation between servo axis device and logical axis.

- -1: There is no mapping between device and logical axis
- 0-127: Mapping logical axis number

Figure



c. Inverse encoder feedback mark

- 0: Encoder feedback is directly inputted into the CNC system
- 1: Inverse encoder feedback is inputted into the CNC system

When spindle feedback rotation speed is displayed oppositely to the actual rotation direction, the parameter can be set as 1.

d. Feedback position cycle mode

- 0: Feedback position does not adopt cycle count mode
- 1: Feedback position adopts cycle count mode
- 2: This mode is adopted when feed axis servo is switched to spindle

For linear feed axis or swing axis, this parameter should be set as 0. For rotary axis or spindle, this parameter should be set as 1.

e. Feedback position cycle pulse count

When feedback position cycle is enabled, this parameter is used to set number of cycle pulses. Generally, pulse count per revolution of axis should be filled out.

f. Encoder type

The parameter is used to specify type of servo axis encoder and feedback mode of Z pulse signal.

- 0 or 1: Incremental encoder with Z pulse signal feedback
- 2: Incremental linear grating ruler with distance-coded Z pulse signal feedback
- 3: Absolute encoder without Z pulse signal feedback
- 4: Reserved

5) Analog spindle

a. Working mode

The parameter is used to set working mode of analog spindle.

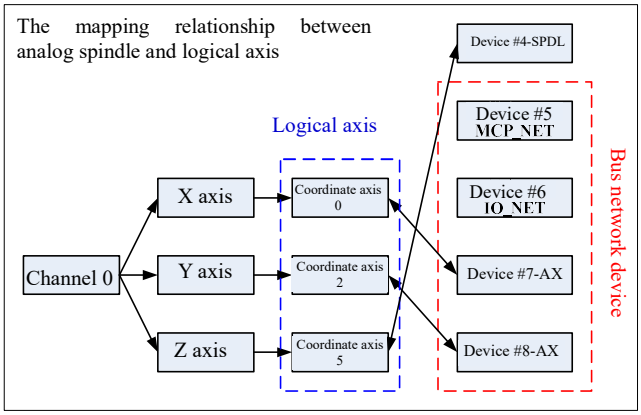
- 0: There is no control command output
- 3: Speed mode

b. Logical axis number

The parameter is used to build the mapping relation between analog spindle device and logical axis.

- -1: There is no mapping between device and logical axis
- 0-127: Mapping logical axis number

Figure



c. Inverse encoder feedback mark

- 0: Encoder feedback is directly inputted into the CNC system
- 1: Inverse encoder feedback is inputted into the CNC system

When spindle feedback rotation speed is displayed oppositely to the actual rotation direction, the parameter can be set as 1.

d. Spindle DA output type

- 0: Not distinguish from spindle CW and CCW rotation, output voltage value of 0-10V
- 1: Distinguish from CW and CCW rotation of spindle, output voltage value of -10- 10V

e. Zero drift adjustment of spindle DA output (mv)

When spindle DA output voltage has zero drift, output voltage can be calibrated through setting this parameter and actual output voltage of port will substract the set value of the parameter.

Example

When the spindle rotation speed is not output, the voltage value of corresponding DA output port measured by multimeter is 0.2V (it should be around 0V normally). At this time, to calibrate the output voltage, the parameter should be set as 200.

f. Feedback position cycle pulse count

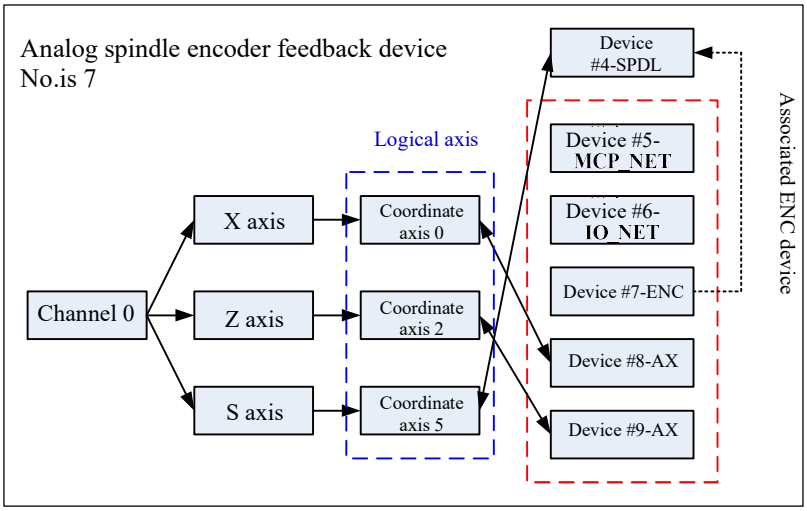
The parameter is used to set number of spindle encoder feedback cycle pulses. Generally, pulse count per revolution of spindle should be filled out.

g. Spindle encoder feedback device number

When the analog spindle gives feedback of encoder pulse count through axis interface board device of bus IO module, the parameter is used to correlate analog spindle and encoder feedback device. Generally, the parameter should be set as axis interface board device number in bus IO module.

If the spindle has no encoder feedback, the parameter can be set as -1.

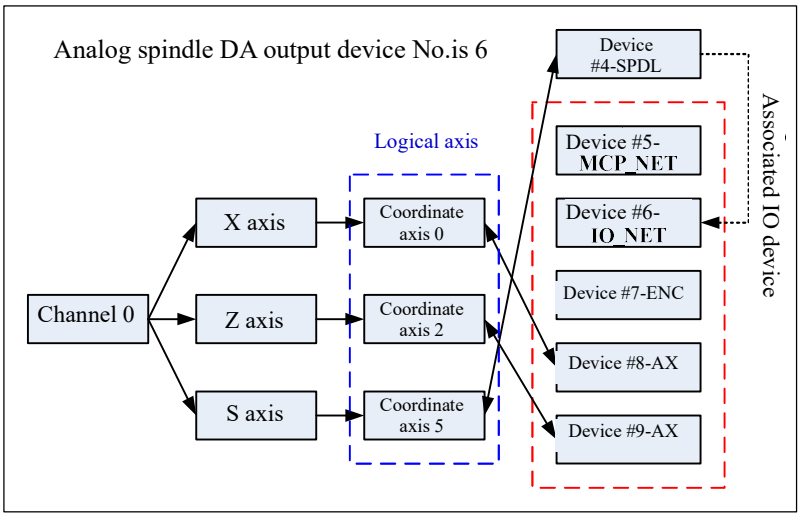
Figure



h. Spindle DA output device number

The parameter is used to correlate analog spindle and DA output device. Generally, the parameter should be set as IO device number with AD/DA function.

Figure



i. Spindle encoder feedback interface number

An axis interface board device includes two encoder feedback interfaces. The parameter is used to specify the serial number of interfaces used by current analog spindle.

- 0: Use encoder feedback interface A
- 1: Use encoder feedback interface B

j. Spindle DA output port number

A DA output port occupies 2 groups of Y registers (16-bit output). After IO device number corresponding to spindle DA output, the parameter is used to locate DA output Y registers, namely offset relative to initial group number of IO device output point.

Note

Before the parameter is configured, users must fully understand connection of bus IO module and confirm the position (group number) of spindle DA output Y registers in order to avoid mutual intervention between DA output and IO output arising from parameter setting error.

Example

Suppose DA output device is the bus IO module IO_NET (device #6), initial group number of output point of this device is 10. Where, Y10-Y13 are used for IO output and Y14-Y19 are used for DA output. Thus, analog spindle DA output can be configured as follows:

Parm500017 “Spindle DA output device number” is set as 6.

When the specified spindle DA output port number is 2, the position of DA output Y register is Y14-Y15;

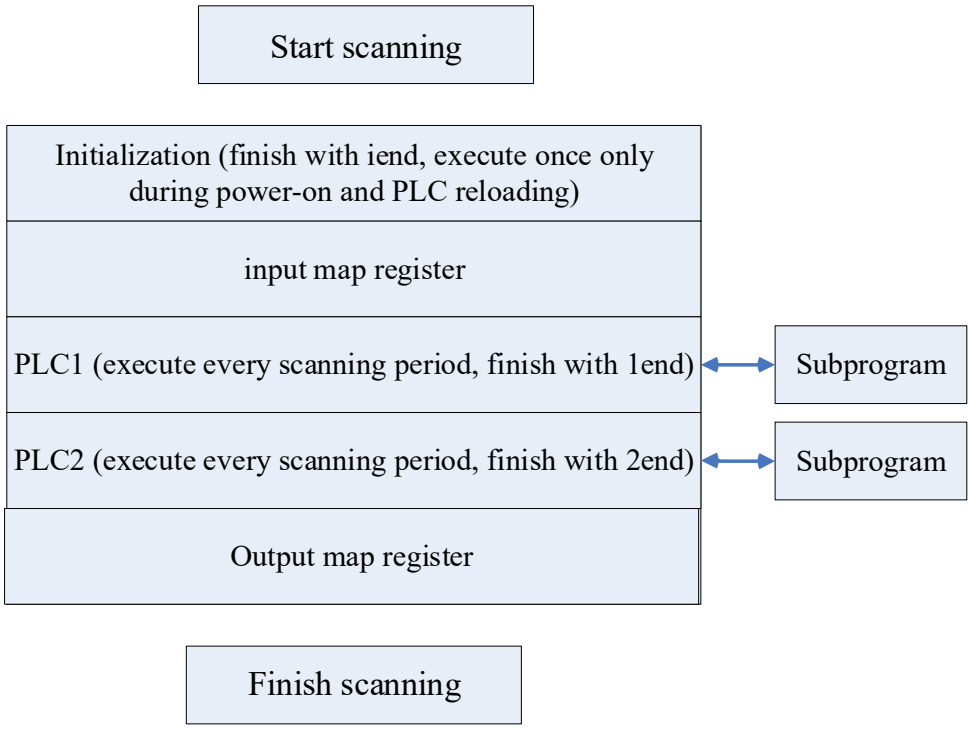
When the specified spindle DA output port number is 3, the position of DA output Y register is Y16-Y17;

When the specified spindle DA output port number is 4, the position of DA output Y register is Y18-Y19.

7. PLC Commissioning

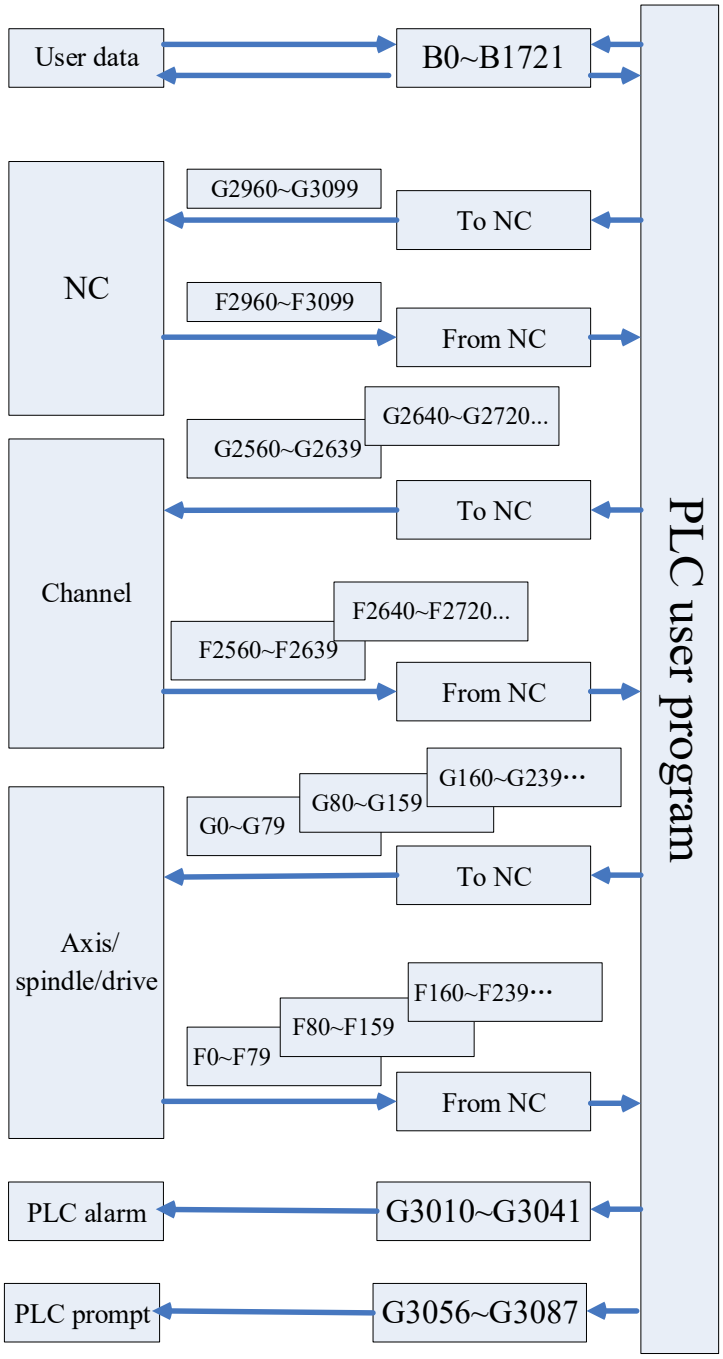
7.1 HNC-8 PLC Structure

HNC-8 ladder diagram PLC adopts cyclic scanning mode. In the beginning of program execution, PLC will be initialized once when it is powered on or reloaded. Then, all inputted states is sent to the input map register and user programs PLC1 and PLC2 are called in sequence. When a scanning cycle is completed, all results will be transmitted to the output map register to control actual output of PLC, and so on.



7.2 Working Principle of PLC Interface Signal

PLC interface signal is responsible for information exchange between PLC and NC.



- F register is a status flag register used to input CNC input signal to PLC control module from CNC.
- G register is a control flag register used to output CNC output signal to CNC from PLC control module and signals processed by CNC.
- B register is a data register (its value can remain at the state before power-off). The data register can also be used as PLC parameter and users can define usage of every parameter.

7.3 PLC Specification

Specification	HNC8
Programming language	Ladder，STL
The first-level program execution cycle	1ms
Program capacity Ladder diagram Statement list Symbol name	 5000 lines 10000 lines 1000 Pcs.
Command Basic command, function command	
Single-byte internal relay (R) Double-byte internal register (W) Four-byte internal relay (D) Timer (T) Counter (C) Subprogram (S) Mark number （L） User-defined parameter (P) Single-byte internal register (I) Single-byte internal register (Q) Hold storage area Four-byte register (B) Hold relay (K)	2048 bytes (R0-R2047) 512 bytes (W0-W255) 1024 bytes (D0-D255) 512（T0--T511） 512 (C0--C511） 253（S0-S252） 10000（L0-L9999） 700 （P0-P699） 128 bytes (I0-I127) 128 bytes (Q0-Q127) 6888 bytes (B0-B1721) 128 bytes (K0-K15)
I/O module (X) （Y）	X0--X511 Y0--Y511

7.4 Ladder Diagram Operation on CNC Controller

To realize functions of ladder diagram on the CNC system end, permission of machine tool manufacturer or above should be inputted.

Press "Ladder " in the diagnosis operation interface to enter the ladder diagram operation interface.

7.4.1 Ladder Diagram Monitoring

Select function key "Ladder Monitor" to enter the ladder diagram monitoring interface. The ladder diagram monitoring interface includes 7 function keys: program list, find, disable, allow, restore, lock list and cross reference.

1） Program list

Function: Display PLC program block.

2） Find

Search according to type:

1. Address: Search according to address
2. Command: Search according to function instruction
3. Output: Search according to output result
4. Line number: Search according to line number of PLC

Continue searching:

1. Find next: Continue searching downwards
2. Find previous: Continue searching upwards

Search range:

1、 Search mode: Fuzzy search mode, accurate search mode

2、 Search range: Local search, global search

3） Disable

Function key "Disable". Move the cursor to an element and press this key to shield the element. As shown below, move the cursor to an element, press this key and the element turns red. It means that the element is shielded and cannot be outputted.

Note: The inhibited conditions here are valid for current line only. As shown above, after R2.0 normally-closed is disabled, it is turned off for this line only.

4） Allow

Function key "Allow". Move the cursor to an element and press Allow to activate the element. As shown below, move the cursor to an element, press Allow and the element turns green. It means that the element is activated. As shown in the figure, X3.0 is the normally open. Move the cursor to X3.0, press "Allow", the element turns green.

Note: The inhibited conditions here are valid for current line only. As shown above, after X3.0 normally open is allowed, it is turned on for this line only.

5） Restore

Function key "Restore". Move the cursor to an element, press Restore to cancel operation of the aforesaid shielded or activated element. Press Restore after the Disable and red color of the element disappears. It means that functions of the element are restored, as shown below.

6） Lock list

Lock list (register lock list) is mainly used to write specified data of register and lock register value. Presently, only write, lock and unlock of X/Y register are supported.

索引	寄存器	格式	设定值	当前值
1	X0	0	11111111B	1111111
2	X1	1	255D	255D
3	X2	2	FFH	FFH
4	Y0.0	0	1	1

1. Add: Add index
2. Delete: Delete index (current index item is at unlock state)
3. Write: It is used for a write of register (bit). If other logics in PLC also modify the current register (bit) where data is written, the written value may be eliminated by other bits.
4. Lock: Assign the set value to register forcibly. While adding register (bit) in the lock list interface, the system sets mutual exclusion rules for registers. That is, only register value or register bit can be inputted when index number of registers of the same type is the same. e.g.: After X0 is inputted, subsequent data including the register bit information such as X0.0 and X0.7 cannot be inputted, because they are exclusive of the previously inputted X0. Likewise, after Y0.0 register bit is inputted, the newly added data must be register bit data between Y0.1 and Y0.7 and Y0 register value cannot be inputted.
5. Unlock: Release lock state.
6. Format:

   Format value range:

   0: Binary

   1: Decimal

2: Hexadecimal

e.g.:

Initial state of system input and output:

X	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0

Y	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0

Lock and assign X0, X1 and X2 groups and Y0.0:

索引	寄存器	格式	设定值	当前
1	X0	0	11111111B	111111
2	X1	1	255D	255
3	X2	2	FFH	FFH
4	Y0.0	0	1	1

The locked input and output state is shown below:

X	7	6	5	4	3	2	1	0
0	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0

Y	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	1
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0

7） Cross reference

Similar to finding register, the cross reference is mainly used to search reference relationship of register (bit) information in a global range. How to use: Move the cursor to the register to be searched, press this key and the block diagram of cross reference will pop up automatically.

7.4.2 Ladder Editing

Select "Ladder edit" to enter the ladder diagram edit interface. The ladder diagram edit interface includes 16 function keys, including program list, straight line, normally open, normally closed, logical output, inverse output, vertical line, delete vertical line, find, delete element, function module, edit network, list edit, double

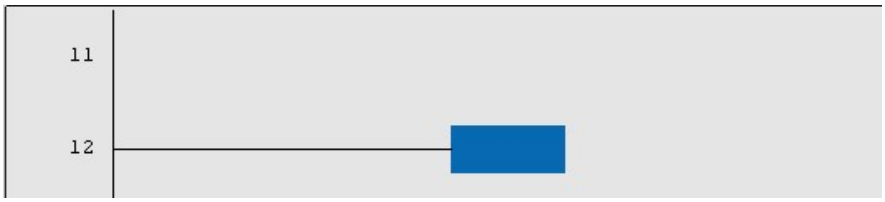
coil, update modification and abandon modification.

1） Program list

Function: Display PLC program block. Consistent with program list function in ladder diagram monitoring.

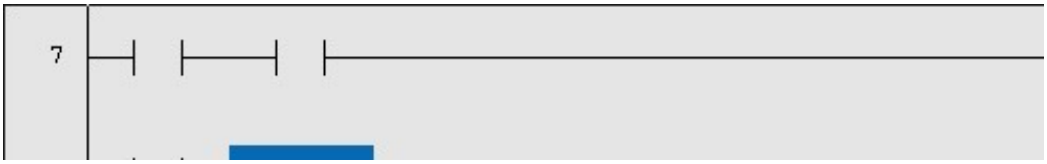
2） Straight line

Press this key to insert a straight line in the ladder diagram.



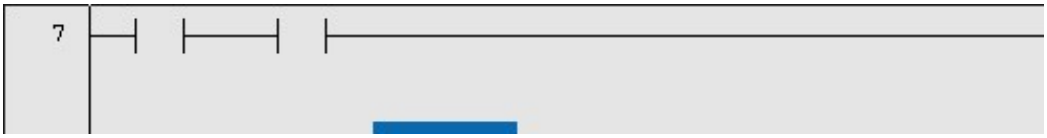
3） Normally open

Move the cursor to the position where normally open needs to be inserted and press this key to insert normally open in the specified position in the ladder diagram.



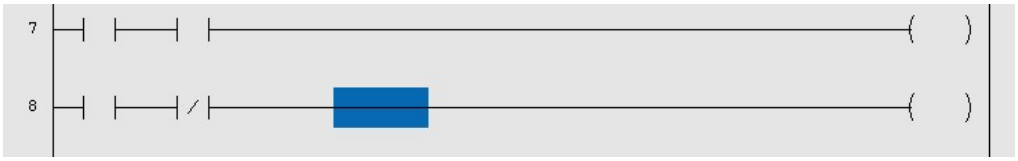
4） Normally closed

Move the cursor to the position where normally closed needs to be inserted and press this key to insert normally closed in the specified position in the ladder diagram.

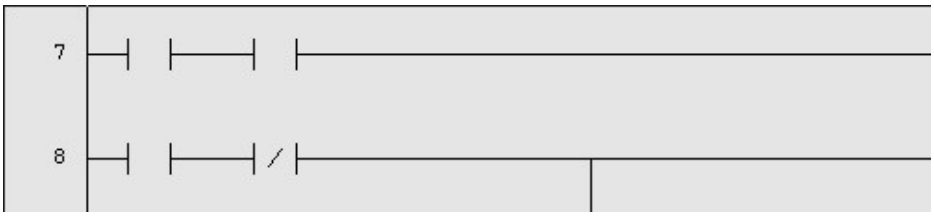


5） Logical output

Move the cursor to the position where logical output needs to be inserted and press this key to insert logical output in the specified position of the ladder diagram.

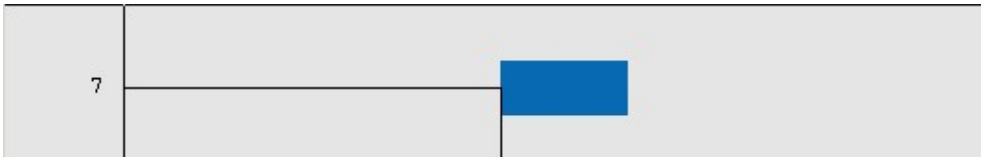


6） Inverse output



Move the cursor to the position where inverse output needs to be inserted and press this key to insert the inverse output in the specified position in the ladder diagram.

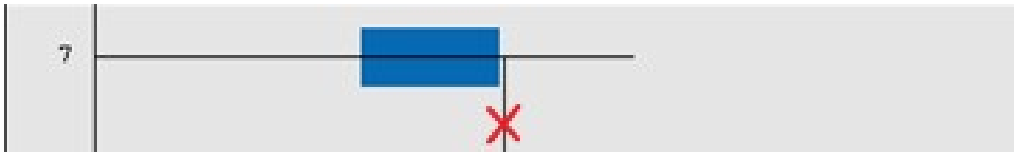
7） Vertical line



Press this key to insert a vertical line after the cursor.

8） Delete vertical line

Press this key to delete the vertical line after the cursor.



9） Find

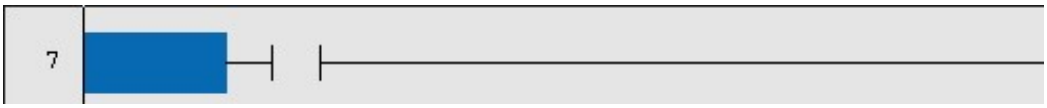
Consistent with the find function in ladder diagram monitoring.

10） Delete element

Move the cursor to the element to be deleted and press this key to delete the element in the ladder diagram.

Before deletion:

After deletion:



11） Function module

Function module includes all function ommand lists and corresponding help files of the CNC system.

e.g.:

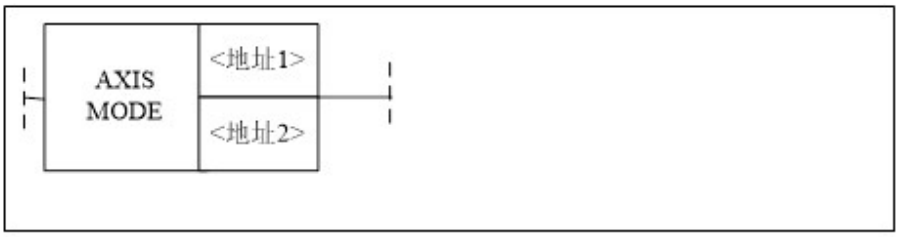
When the cursor moves to the position of axis working mode, press Help and the system will display the help instructions of corresponding function module.

LDC	LDNC	SET	RST
TMRB	STMR	CTR	CTRC
1END	2END	JMP	LBL
SPE	RETN	LOOP	NEXT
ADD	ALARM	ALT	ASSEM
AXISHOM2	AXISLMF2	AXISLOCK	AXISMODE
AXISNLMT	AXISRDY	AXISPLMT	BMOV
COD	COIN	CYCL	CYCLED
DESYN	DISAS	DIV	DRYRUN
EVENT	FEEDOVRD	FILT	FMOV
HOLDLED	HOMELED	HOMERUN	HOMERUN1
JOGSW	JOGVEL	LT	MACK

LadCellHelp.html

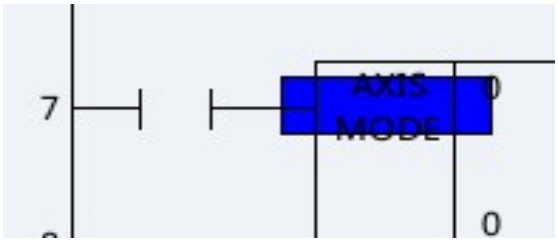
AXISMODE

格式



参数	参数格式	数据类型	存储区域	说明	属性
<地址1>	□□□□	INT	常数		前置○

If it is unnecessary to view help file, Press Enter on the function module of corresponding cursor in the function instruction list and the system will insert the function module into current PLC.



12） Edit network

Edit network includes insert line, delete line, insert column, select network, copy network, cut network, paste network and delete network.

a. Insert line

Move the cursor to the next line of the line to be inserted and press this key to insert a line, as shown below. It should be noted that the inserted line is often above the line where the cursor is inserted.

Before inserting line:

After inserting line:

b. Delete line

Move the cursor to the position where the line to be deleted and press this key to delete this line of PLC ladder diagram.

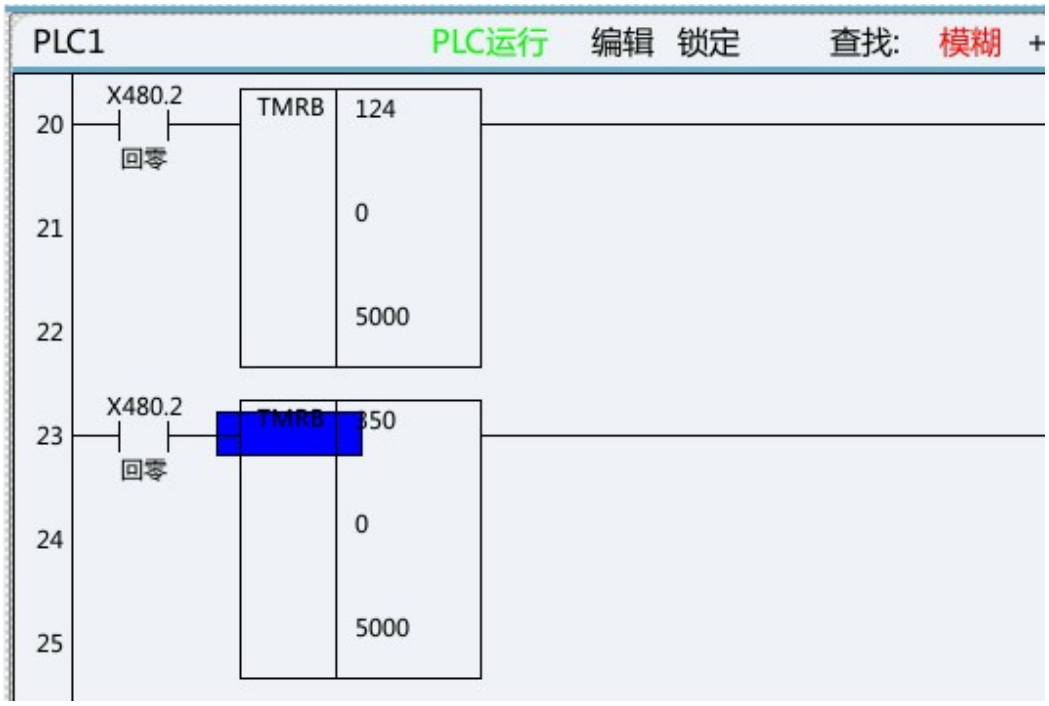
Before deletion:

After deletion:

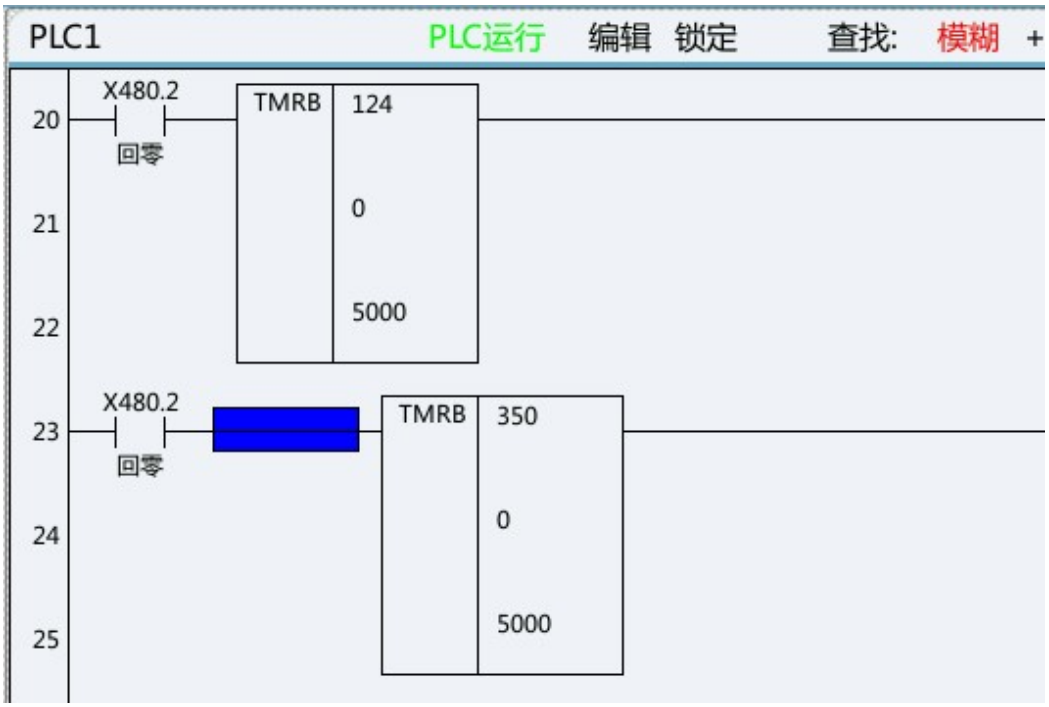
c. Insert column

Move the cursor to the next position of the column to be inserted and press this key to insert a column.

Before inserting column:

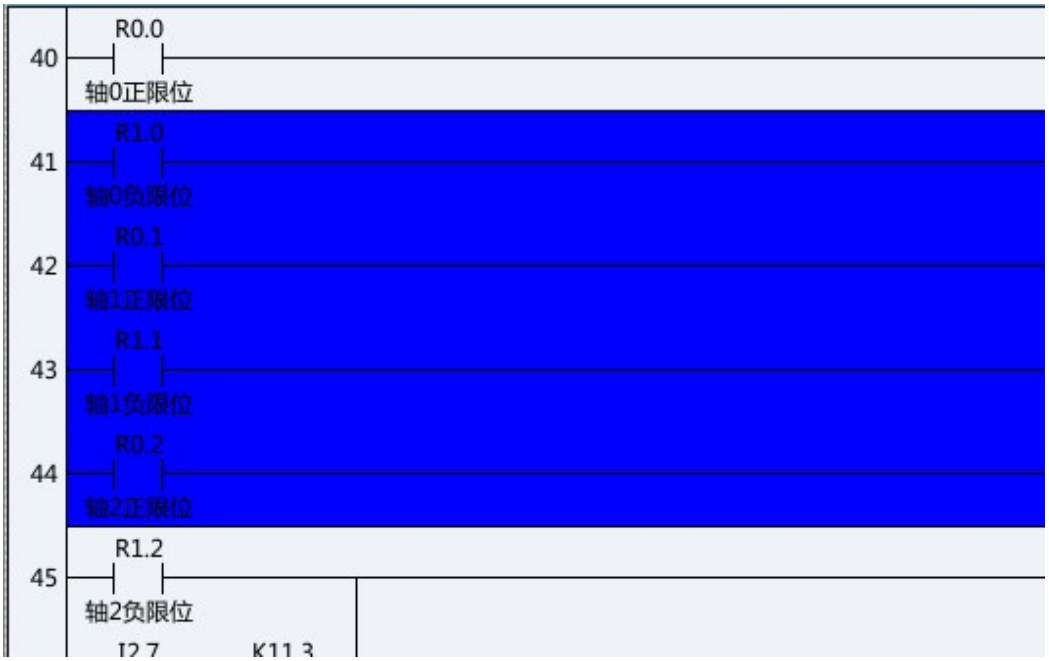


After inserting column:



d. Select network

Move the cursor to the line to be selected, press this key, and the selected line turns blue. Press this key again to select the next line of current line. Select the selected network for subsequent operations such as copy network, cut network and delete network.



e. Copy network

After a network is selected, press this key to copy the network.

f. Cut network

After a network is selected, press this key to realize movement of network.

g. Paste network

After a network is copied or cut, move to the target position and press this key to paste the network.

h. Delete network

After a network is selected, press this key to delete the network.

13） List editing

List edit includes modify list, modify notes, add module, delete module, update modification and abandon modification.

a. Modify list

This function can realize modification of program name.

b. Modify annotation

This function can realize detailed comments of current subprogram.

索引	子程序名	编译者	版本	标号	行数
6	报警输出		0000	S2	69
7	报警清除		0000	S3	74
8	刀盘正反转		0000	S4	21
9	斗笠式刀库		0000	S5	159
10	圆盘刀库ATC		0000	S6	173
11	圆盘刀库选刀		0000	S7	158
12	MCP面板		0000	S8	91
13	I/O报警		0000	S9	60

程序注释(I/O报警):

c. Add module

This function can add subprogram to current PLC.

索引	子程序名	编译者	版本	标号	行数
8	刀盘正反转		0000	S4	21
9	斗笠式刀库		0000	S5	159
10	圆盘刀库ATC		0000	S6	173
11	圆盘刀库选刀		0000	S7	158
12	MCP面板		0000	S8	91
13	I/O报警		0000	S9	60
14	S15		0000	S15	3
15	外部I/O		0000	S10	97

程序注释(S15):

d. Delete module

This function can delete current subprogram.

索引	子程序名	编译者	版本	标号	行数
8	刀盘正反转		0000	S4	21
9	斗笠式刀库		0000	S5	159
10	圆盘刀库ATC		0000	S6	173
11	圆盘刀库选刀		0000	S7	158
12	MCP面板		0000	S8	91
13	I/O报警		0000	S9	60
14	S15		0000	S15	3
15	外部I/O		0000	S10	97

程序注释(S15):

e. Update modification

This function can update and save the modified PLC file.

f. Abandon modification

This function can abandon saving the current modified file.

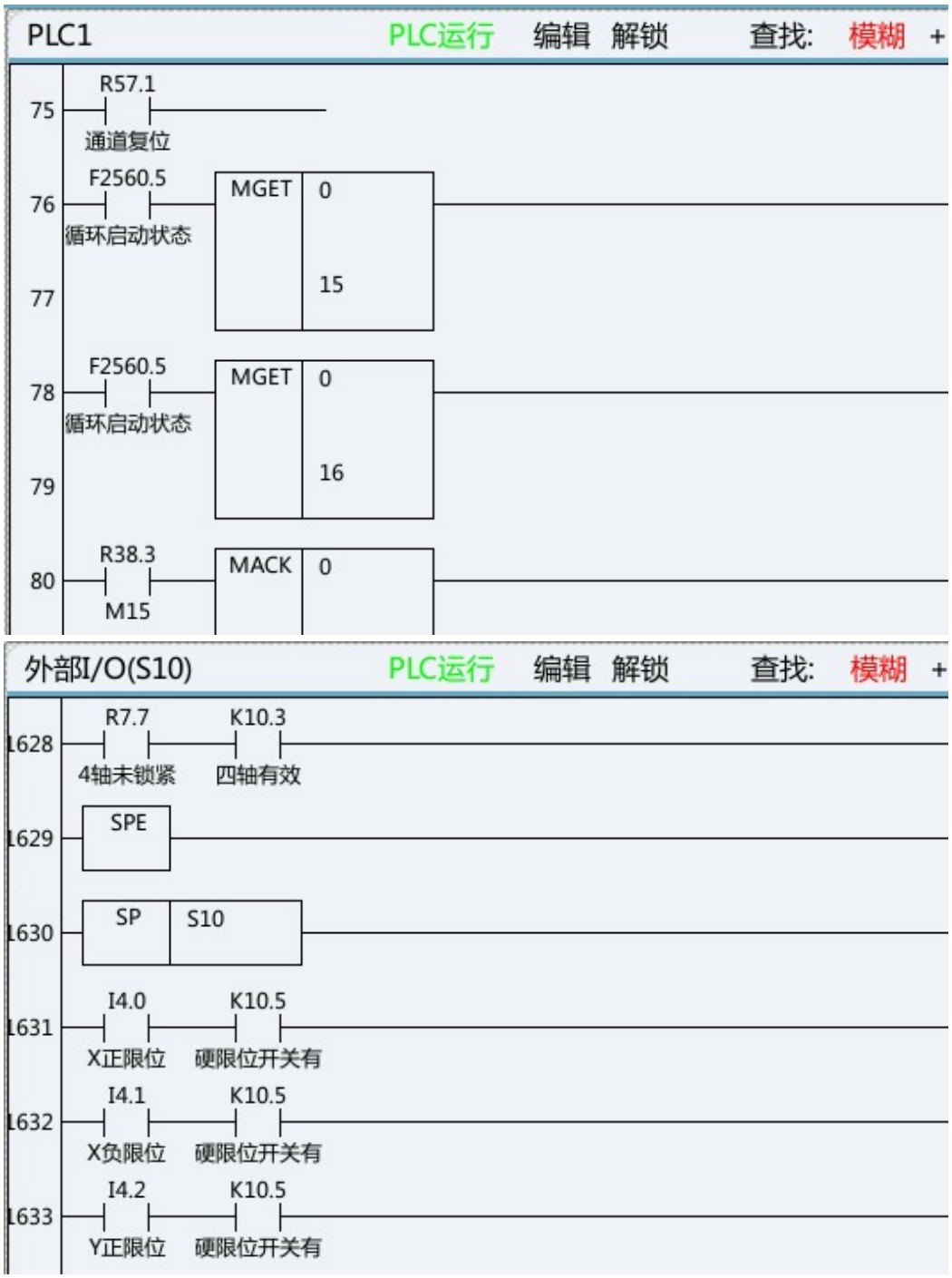
14） Double coil

Double coil function is used to check problems of double coil output in PLC.

Note: The parameter is used to inspect all coils or coils of current line according to double coil inspection mode in ladder diagram option function. While inspecting coils of current line, the cursor should move to the line where it is necessary to inspect whether there is double coil output. While inspecting all coils, the cursor can be in any position.

e.g.:

Line 76 and line 1631 in the original PLC output R0.0 simultaneously.



Move the cursor to line 76 or line 1631, press Double Coil, then the system will display R0.0 register as double coil output automatically.

15） Update modification

This function can update and save the modified PLC file.

16） Abandon modification

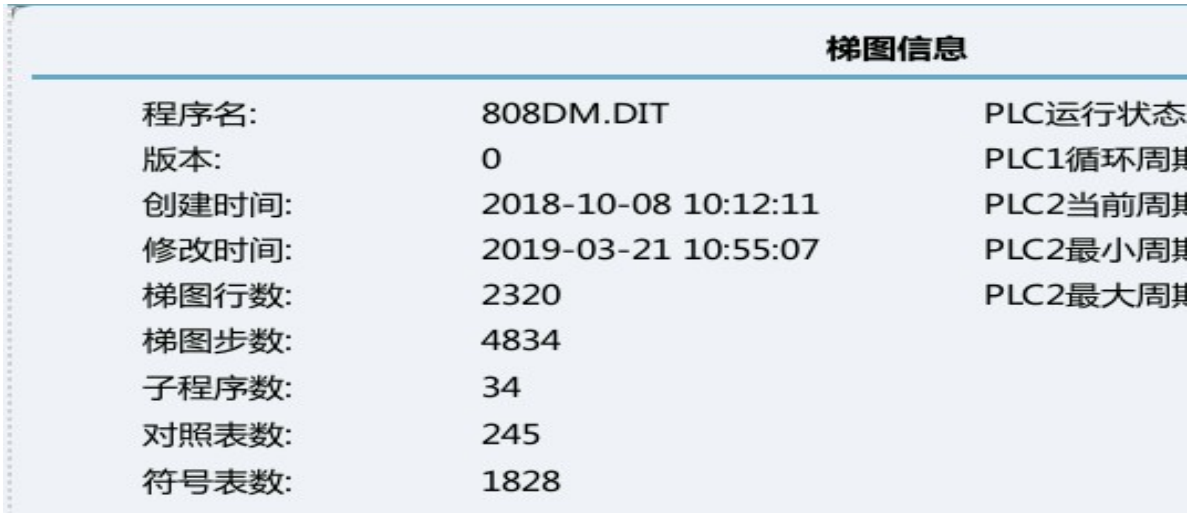
This function can abandon saving the currently modified file.

7.4.3 Ladder Diagram Information

This function includes ladder diagram title, symbol table, IO comparison table, K parameter, timer, counter, alarm setting, run stop and online commissioning.

1） Ladder diagram title

Ladder diagram title stores some descriptive information of current PLC file, including project version, project name, writer, comments, machine tool manufacturer information, manufacturer information and PLC running status, etc.



2） Symbol table

Symbol table is mainly used to store symbol names and comments of register (bit) information.

3） IO comparison table

IO comparison table is a new function of HNC-8 new version of ladder diagram which is mainly used to standardize ladder diagram PLC writing. That is, in the standard ladder diagram, input and output of standard functions that offered to users are replaced by I and Q, in which I is mapped to X and Q is mapped to Y. Users can correspond X and Y points to I and Q according to the electrical schematic diagram of machine tool. In this case, it is unnecessary to modify element parameters of ladder diagram PLC but to update data of corresponding IO comparison table in order to ensure normal operation of PLC. As a result, developer and commissioning personnel's work is greatly simplified and work efficiency improves.

The ladder diagram software specifies the range of IQ registers according to usage scenario. The number of IQ comparison tables (users) is 80 and the range is indexes 0-79. The number of IQ comparison tables (system panels) is 48 and the range is indexes 80-127.

In the ladder diagram software interface, IQ register is edited in 2 interfaces (user IO comparison table and panel IO comparison table). The index values of IQ registers which can be edited in different interfaces are different.

索引	寄存器(I/Q)	IO点(X/Y)	电平	周期	符号
1	I0.0	X2.1	0	1	紧刀
2	I0.1	X2.0	0	1	松刀
3	I0.2	X3.5	0	1	扣
4	I0.3		0	1	刀臂
5	I0.4	X2.2	0	1	刀臂
6	I0.5		0	0	
7	I0.6	X0.5	0	0	刀库
8	I0.7	X0.4	0	1	刀库
9	I1.0	X2.6	0	0	前进
10	I1.1	X2.5	0	0	后退
11	I1.2		0	0	

索引	寄存器(I/Q)	IO点(X/Y)	电平	周期	符号
1	I80.0	X481.0	0	1	自
2	I80.1	X481.1	0	1	单
3	I100.2	X480.0	0	1	手
4	I100.3	X480.1	0	1	手
5	I100.4	X480.2	0	1	回参
6	I100.5	X483.4	0	1	刀具
7	I100.6		0	1	
8	I100.7	X480.6	0	1	空运
9	I101.0	X480.7	0	1	程序
10	I101.1	X481.6	0	1	选择
11	I101.2		0	1	

4） K parameter

Used to set K parameter value.

地址	注释	7	6	5	4
K0	面板类型	0	0	0	0
K1	刀库类型	0	0	0	0
K2	刀库调试1	0	0	0	0
K3	刀库调试2	0	0	0	0
K4	主轴功能	0	0	0	0
K5	回零方式	0	0	0	0
K6	进给轴	0	0	0	0
K7	排屑吹气	0	0	0	0
K8	润滑功能	0	0	0	0
圆盘刀库类型(K1.0)					
00000001:圆盘刀库;00000010:斗笠式刀库					

5） Timer

Used to view state of timer used in the system.

6） Counter

Used to view state of counter used in the system.

7） Alarm setup

Used to view and set alarm and prompt messages of system PLC.

8） Stop operation

Run stop function is used to stop running of current PLC.

Note: After running is stopped, press Run stop again to rerun PLC.

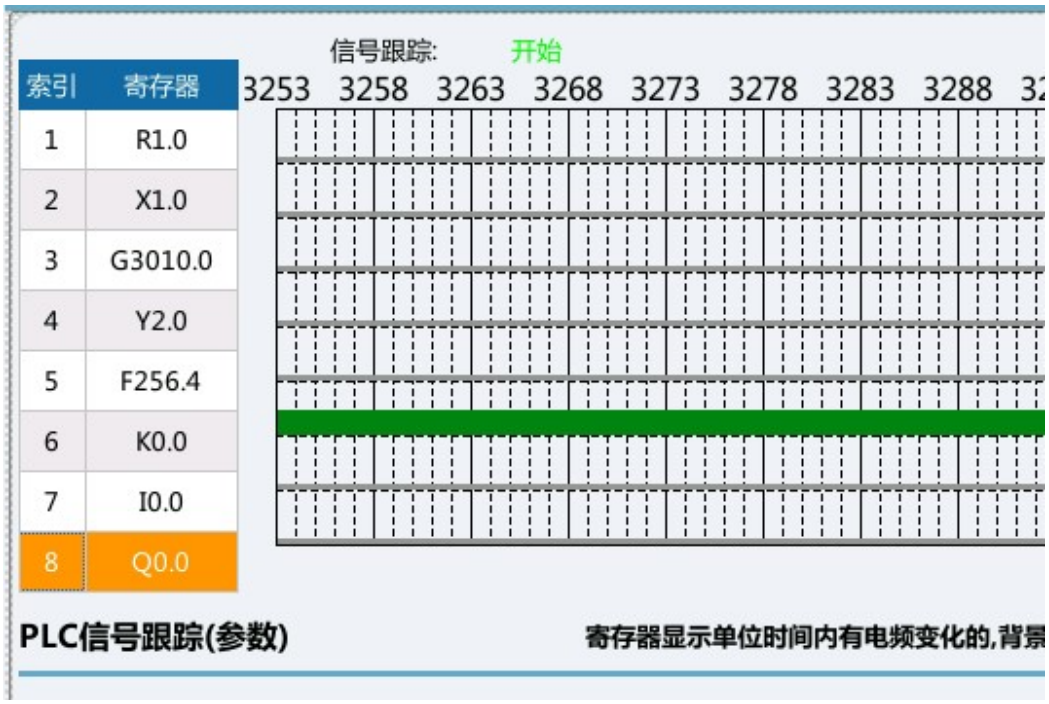
9） Online commissioning

Online commissioning function enables the user to monitor running status of NC remotely and commission specific points and program state. The communication with HNCLadder software can be realized.

6.4.4 Signal Tracking

Signal tracking is mainly used to display data of real-time sequence chart of register points X, Y, F, G, R, I, Q and K.

8 groups of data can be acquired simultaneously. If the default sampling period is 1ms, the maximum sampling time is 60s.



7.4.5 Ladder Diagram Option

1) Double coil inspection

- Not ticked: Inspect all
- Ticked: Inspect current line of coils

Note: This function should be used cooperatively with double coil function in ladder diagram edit.

2） Ladder diagram monitoring register value

- Not ticked: Latched value
- Ticked: Current value

This function is mainly used to eliminate conflicts incurred during inspection of values in PLC assignment statement. This function is mainly used to check the investigation work when the assignment conflicts in the plc assignment statement

Current value is ticked by default and values of registers displayed in the ladder diagram monitoring screen are

consistent.

When latched value is displayed, values of registers displayed in the ladder diagram monitoring screen are displayed independently for each module.

8. Design Example of CNC Milling System

With the section 1.1 as an example, corresponding bus should be connected as per section 2.1.

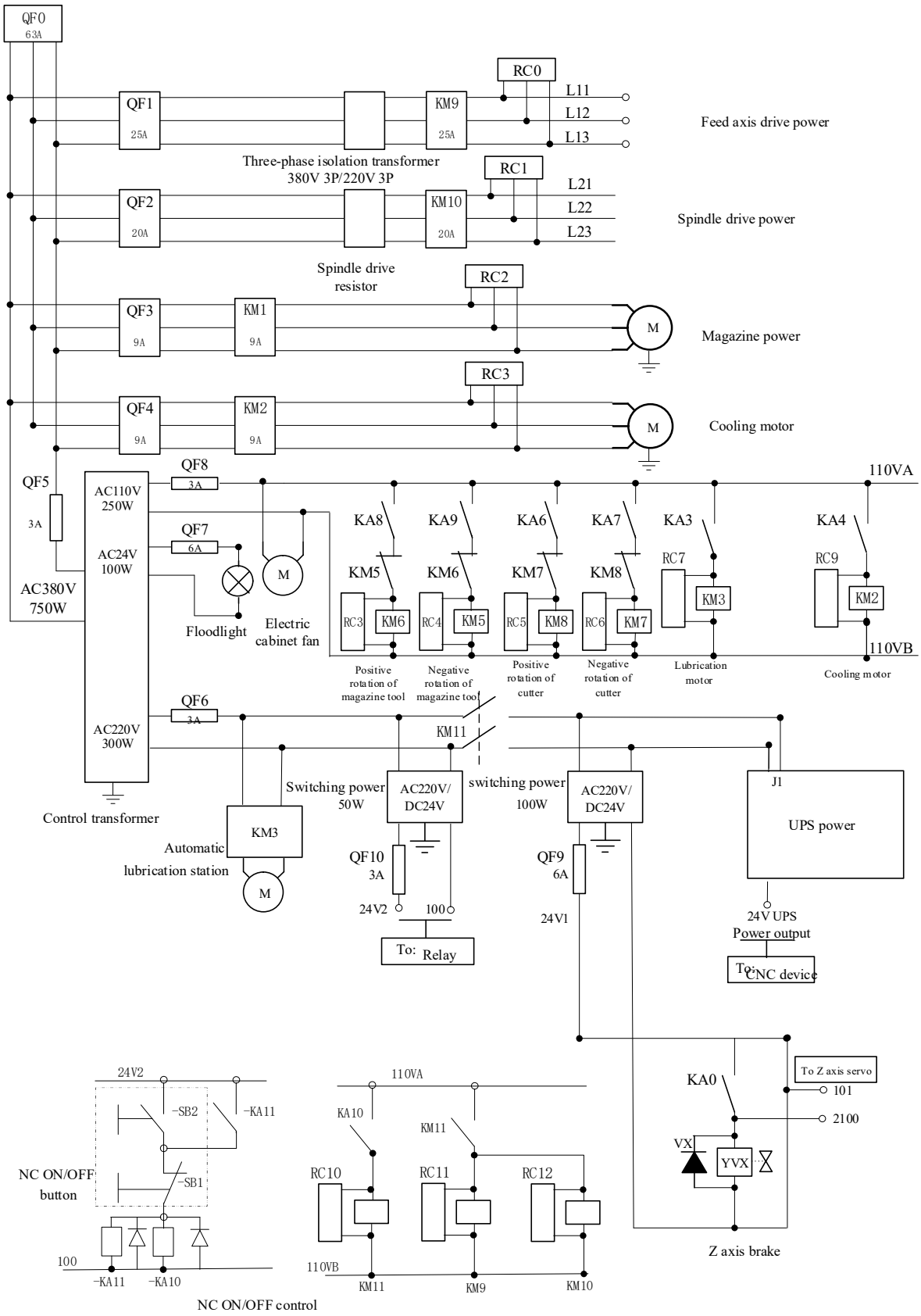
8.1 Electrical Schematic Diagram

In the design, AC24V power supply of floodlight, DC24V power supply used by magnetic valve of large operating current and DC24V power supply used by output switch value (such as relay and servo control signal, etc.) are independent and separated by a low pass filter.

Anti-interference magnet ring and high-voltage ceramic capacitor at the main power supply inlet and

transformer input end are not indicated in the figure. As shown below.

In the figure below, QF0-QF4 are three-phase air switches; QF5-QF11 are single-phase air switches; KM1-KM4 are three-phase AC contactors; RC0-RC3 are three-phase RC absorbers (arc extinguishers); RC4-RC12 are single-phase RC absorbers (arc extinguishers); KA0-KA11 are DC 24V relays; VX is freewheel diode; YVZ is magnetic valve and Z axis motor brake.



Electrical schematic diagram of typical CNC system-power supply diagram

8.2 Commissioning Procedure

8.2.1 First Power-on and Commissioning Procedure of Machine Tool

Note: Do not turn on the emergency stop button of the system. If conditions permit, it's best not to connect the power line of traverse axis servo motor and power line of spindle servo motor.

Parameters to be set or checked when the machine tool is powered on for the first time:

Machine user parameters:

Parm010000, maximum number of channels: 1
Parm010001, cutting type of channel 0: 0 (milling system)
Parm010009, selection mark of channel 0: 1
Parm010017, display axis mark [1] of channel 0: 0x27
Parm010033, load current display axis customization of channel 0: 0,1,2,5

Channel parameters (channel 0):

Parm040001, X coordinate axis number: 0
Parm040002, Y coordinate axis number: 1
Parm040003, Z coordinate axis number: 2
Parm040010, axis number of spindle 0: 5
Parm040028, display axis number of spindle: 5

Coordinate axis parameters:

Logical axis 0:
Parm100000, display axis name: X
Parm100001, axis type: 1 (linear axis)
Logical axis 1:
Parm101000, display axis name: Y
Parm101001, axis type: 1 (linear axis)
Logical axis 2:
Parm102000, display axis name: Z
Parm102001, axis type: 1 (linear axis)
Logical axis 5:
Parm105000, display axis name: C
Parm105001, axis type: 10 (spindle)

Device interface parameters:

Device 4:
Parm504000, device name: SP
Parm504011, logical axis number: -1
Device 5:
Parm505000, device name: MCP_NET

Parm505010, MCP type: 7
Parm505012, initial group number of input point: 480
Parm505013, number of input point groups: 10
Parm505014, initial group number of output point: 480
Parm505015, number of output point groups: 10
Device 6:
Parm506000, device name: MCP_NET
Parm506010, MCP type: 7
Parm506012, initial group number of input point: 490
Parm506013, number of input point groups:10
Parm506014, initial group number of output point: 490
Parm506015, number of output point groups: 10
Device 7:
Parm507000, device name: AX
Parm507010, working mode: 3 (speed mode)
Parm507011, logical axis number: 5
Parm507014, feedback position cycle mode: 1
Parm507015, feedback position cycle pulse count: 4096 (spindle encoder is of 1024 PPR and quadruple frequency)
Parm507016, encoder type: 1 (incremental encoder with Z pulse signal feedback)
Device 8:
Parm508000, device name: AX
Parm508010, working mode: 1 (position increment mode)
Parm508011, logical axis number: 0
Parm508014, feedback position cycle mode: 0
Parm508015, feedback position cycle pulse count: 131072 (absolute encoder single-turn 131072 PPR)
Parm508016, encoder type: 3 (absolute encoder without Z pulse signal feedback)
Device 9:
Parm509000, device name: AX
Parm509010, working mode: 1 (position increment mode)
Parm509011, logical axis number: 1
Parm509014, feedback position cycle mode: 0
Parm509015, feedback position cycle pulse count: 131072 (absolute encoder single-turn 131072 PPR)
Parm509016, encoder type: 3 (absolute encoder without Z pulse signal feedback)
Device 10:
Parm510000, device name: AX
Parm510010, working mode: 1 (position increment mode)
Parm510011, logical axis number: 2
Parm510014, feedback position cycle mode: 0
Parm510015, feedback position cycle pulse count: 131072 (absolute encoder single-turn 131072 PPR)
Parm510016, encoder type: 3 (absolute encoder without Z pulse signal feedback)
Device 11:
Parm511000, device name: IO_NET
Parm511012, initial group number of input point: 0
Parm511013, number of input point groups: 10
Parm511014, initial group number of output point: 0

Parm511015, number of output point groups: 10
Device 12:
Parm512000, device name: IO_NET
Parm512012, initial group number of input point: 10
Parm512013, number of input point groups: 10
Parm512014, initial group number of output point: 10
Parm512015, number of output point groups: 10

Save modifications, power off and restart the machine tool.

8.2.2 Second Power-on and Commissioning Procedure

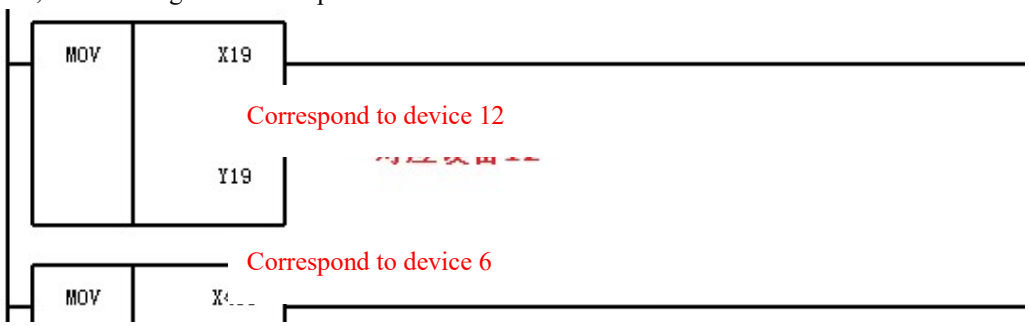
Note: Do not turn on the emergency stop button of the system. If conditions permit, it's best not to connect the power line of traverse axis servo motor and power line of spindle servo motor.

1） Set PLC softdog

The system stipulates that the last group of input and output corresponding to the last group of IO_NET identified by each IO box is the plc softdog.

Setup rules of softdog of MCP_NET are consistent with IO_NET. Input and output can be communicated normally only when softdog is set correctly.

Thus, PLC softdog in this example is set as follows:



2） Set K parameter and fill out user IO comparison table

地址	注释	7	6	5	4
K0	面板类型	0	0	0	0
K1	刀库类型	0	0	0	0
K2	刀库调试1	0	0	0	0
K3	刀库调试2	0	0	0	0
K4	主轴功能	0	0	0	0
K5	回零方式	0	0	0	0
K6	进给轴	0	0	0	0
K7	排屑吹气	0	0	0	0
K8	润滑功能	0	0	0	0
圆盘刀库类型(K1.0)					
00000001:圆盘刀库;00000010:斗笠式刀库					

The system offers IQ comparison table and users can connect external input and output points according to practical situation. During commissioning, fill external input and output switch value pointss in corresponding IQ comparison table.

索引	寄存器(I/Q)	IO点(X/Y)	电平	周期	符号
1	I0.0	X2.1	0	1	紧刀
2	I0.1	X2.0	0	1	松刀
3	I0.2	X3.5	0	1	扣
4	I0.3		0	1	刀臂
5	I0.4	X2.2	0	1	刀臂
6	I0.5		0	0	
7	I0.6	X0.5	0	0	刀库
8	I0.7	X0.4	0	1	刀库
9	I1.0	X2.6	0	0	前进
10	I1.1	X2.5	0	0	后退
11	I1.2		0	0	

3） Set coordinate axis parameters

Set parameters of logical axes 0, 1, 2 and 5.

Parm10X004, numerator of electronic gear ratio (displacement) (um)

Parm10X005, denominator of electronic gear ratio [pulse]

Parm10X010, reference point return mode

Parm10X032, low speed jog speed (mm/min)

Parm10X033, high speed jog speed (mm/min)

Parm10X034, maximum rapid traverse speed (mm/min)

Parm10X035, maximum machining speed (mm/min)
Parm10X067, pulse count per revolution of axis (pulse)
Parm10X068, lead of guide screw (mm)
Parm10X090, encoder working mode
Parm10X094, encoder counting digits
Parm10X543, drive specification/motor type code
Note: If driver parameters cannot be read in coordinate axis parameters, please inspect STA-0 of corresponding drive: Whether instruction interface option is 1 (NCUC bus).

Save modifications, power off and restart the machine tool.

8.2.3 Third Power-on and Commissioning Procedure

Note: Before power-on, connect the power line of traverse axis servo motor and power line of spindle servo motor. Emergency stop is not enabled.
1） Check coordinate axis parameters
Check parameters of logical axes 0, 1, 2 and 5 on drive.
Logical axis 0, logical axis 1 and logical axis 2:
Parm10X517, maximum speed limit (1rad/min)
Parm10X522, pulse command input mode
Parm10X523, control mode selection
Parm10X524, number of servomotor pole pairs
Parm10X525, encoder type selection
Parm10X526. encoder zero offset
Parm10X586, motor rated current (0.01A)
Parm10X587, motor rated speed (1rad/min)
Logical axis 5:
Parm105517, maximum speed limit (1rad/min)
Parm105522, pulse command input mode
Parm105523, control mode selection
Parm105524, number of spindle motor pole pairs
Parm105525, resolution of spindle motor encoder
Parm105535, IM spindle motor rated speed (1rad/min)
Parm105553, IM motor rated current (0.1A)
After the above parameters have been checked, turn on the emergency stop button. After turning on the emergency stop button, checj whether drive enable is normal and whether the brake of gravity axis is turned on.
2） Move the axis, set zero point, positive and negative limits
a. Move the axis at low speed and check whether the moving direction is correct. If the moving direction is opposite, change the numerator of electronic gear ratio in logical axis parameters into a negative value. If it is a negative value, change it into a positive value. Power off and restart to validate the modification.
b. Move the traverse axis to the position where zero point is set and set zero points of traverse axes through automatic offset function. After setup, press and turn on the emergency stop button and observe whether actual coordinates of the machine tool are cleared.
c. Set positive and negative soft limits of logical axes 0, 1 and 2, corresponding parameters are as follows:
parm10X006, positive software limit coordinate (mm)
parm10X007, negative software limit coordinate (mm)

3） Spindle, set and test whether the spindle is started and stopped normally, whether the orientation is normal and whether speed loop of spindle can be switched to position loop normally.

a. Start/stop of spindle

The servo spindle corresponds to the module of control spindle speed:

Corresponding machine user parameters:

Parm010359, maximum spindle speed

Parm010351, minimum spindle speed at gear 1

Parm010352, maximum spindle speed at gear 1

Parm010353, numerator of gear ratio at spindle gear 1

Parm010354, denominator of gear ratio at spindle gear 1

After setup, test whether the spindle is started and stopped correctly.

b. Test whether the spindle orientation is normal, and set the orientation position while commissioning magazine.

c. Test whether speed loop of spindle can be switched to position loop normally.

This function requires to set spindle drive STA-8 (whether mode switch function is allowed) parameter as 1 (allowed). Power off and restart to validated the setting.

Generally MDI test is performed:

%1111

G109

M03 S500

G04 X2

M05

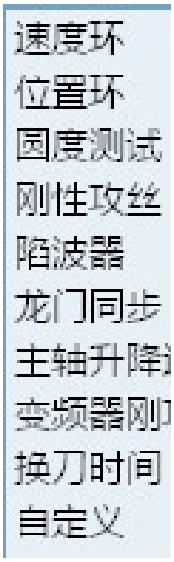
G108

G91G01C360F10000

G109

Run this program to check whether speed loop of the spindle can be switched to position loop normally.

8.2.4 Servo Adjustment



Servo adjustment includes test feed axis characteristic adjustment, roundness compatibility adjustment, rigid tapping synchronization adjustment, notch filter setup and spindle speed adjustment.

8.2.5 Three-axis Burn-in

Check whether the machine tool is lubricated normally. Start the burn-in of the machine tool when lubrication works normally.

8.2.6 Pitch Error Compensation

Pitch error compensation increases or decreases pulses of command value through parameters of the CNC system to improve positional accuracy of machine tool.

8.2.7 Joint Debugging of Complete Machine

Complete functional debugging of magazine and other elements, system parameter setup optimization, precutting, debugging report and final software backup.

8.2.8 Burn-in Test Of Complete Machine

Write burn-in test procedure and run the burn-in test program. After the burn-in is completed, complete the commissioning of complete machine.

Annexed Table A Technical Specifications of HSV-160U Series Servo Drive Unit and Motor Code

Technical specification of HSV-160U series AC servo drive unit

Model	Continuous current (A/30 min) (Effective value)	Short-time maximum current (A/1 min) (Effective value)	Maximum matching motor power (KW)
HSV-160U-005	1.5	4.5	0.20
HSV-160U-007	2	6	0.40
HSV-160U-009	3	7.2	0.75
HSV-160U-010	4.8	7.2	0.75
HSV-160U-020	6.9	10.4	1.5
HSV-160U-030	9.6	14.4	2.3
HSV-160U-050	16.8	25.2	3.8
HSV-160U-075	24.8	37.3	5.5
HSV-160U-100	30.0	45.0	6.5

Huada motor **LMBB** parameter comparison table

Servomotor model	Rated torque (Nm)	Rated speed (rpm)	Rated phase current (A)	Rated power （KW）	Drive unit	Motor Code
80ST-M01330LMBB	1.3	3000	2.8	0.40	HSV-160U-010	1000
110ST-M02420LMBB	2.4	2000	2.9	0.50	HSV-160U-010	1001
110ST-M02515LMBB	2.5	1500	3.5	0.40	HSV-160U-010	1002
					HSV-160U-020	1102
80ST-M02430LMBB	2.4	3000	4.8	0.75	HSV-160U-020	1103
					HSV-160U-030	1203
80ST-M03330LMBB	3.3	3000	6.2	1.0	HSV-160U-030	1204
110ST-M03215LMBB	3.2	1500	4.5	0.5	HSV-160U-020	1105
110ST-M05415LMBB	5.4	1500	6.5	0.85	HSV-160U-030	1206
110ST-M04820LMBB	4.8	2000	6.0	1.0	HSV-160U-030	1207
130ST-M03215LMBB	3.2	1500	4.5	0.5	HSV-160U-020	1208
130ST-M04820LMBB	4.8	2000	6.2	1.4	HSV-160U-030	1209
110ST-M06415LMBB	6.4	1500	8.0	1.0	HSV-160U-030	1210
130ST-M05415LMBB	5.4	1500	7.0	0.85	HSV-160U-030	1211
130ST-M06415LMBB	6.4	1500	8.0	1.0	HSV-160U-030	1212
130ST-M09615LMBB	9.6	1500	11.5	1.5	HSV-160U-050	1313
130ST-M07220LMBB	7.2	2000	9.5	1.5	HSV-160U-050	1314
130ST-M09620LMBB	9.6	2000	13.5	2.0	HSV-160U-075	1416
130ST-M14615LMBB	14.6	1500	16.5	2.3	HSV-160U-075	1415
					HSV-160U-100	1515
130ST-M14320LMBB	14.3	2000	17.0	3.0	HSV-160U-075	1417
					HSV-160U-100	1515
150ST-M14615LMBB	14.6	1500	20.0	2.3	HSV-160U-075	1418
					HSV-160U-100	1518
150ST-M19115LMBB	19.1	1500	21.0	3.0	HSV-160U-075	1419
					HSV-160U-100	1519
150ST-M14320LMBB	14.3	2000	20.0	3.0	HSV-160U-075	1420
					HSV-160U-100	1520

Annexed Table B Technical Specifications of HSV-180U Series Servo Drive Unit and Motor Code

Technical specification of HSV-180U series AC servo drive unit:

Drive unit model		HSV-180UD-035	HSV-180UD-050	HSV-180UD-075
Motor power (KW)		3.7KW	5.5KW	7.5KW
Rated output current (A)		12.5	16	23.5
Short-time maximum current (A)		22	28	42
Breaker (A)		25	32	40
Contactor (A)		18	25	32
Input AC electric reactor	Current (A)	10	15	20
	Inductance (mH)	1.4	0.93	0.7
Input filter (A)		10	15	20
Maximum brake current (A)		25	25	40
Braking resistor recommended	Resistance (Ω)	51Ω	51Ω	20Ω
	Power (W)	800W	800W	1200W
	Quantity	1	1	1
Recommended value of main circuit cable (mm^2)		4	4	4

Drive unit model		HSV-180UD-090	HSV-180UD-100	HSV-180UD-150
Motor power (KW)		9KW	11KW	15KW
Rated output current (A)		30	32	47
Short-time maximum current (A)		52	56	84
Breaker (A)		63	63	100
Contactor (A)		40	40	63
Input AC electric reactor	Current (A)	30	30	50
	Inductance (mH)	0.47	0.47	0.28
Input filter (A)		30	30	50
Maximum braking current (A)		50	50	75
Recommended braking resistor	Resistance (Ω)	20Ω	33Ω	33Ω
	Power (W)	2000W	1500W	1500W
	Quantity	1	2	2
Recommended value of main circuit cable (mm^2)		6	10	16

Drive unit model		HSV-180UD-035C	HSV-180UD-050C	HSV-180UD-075C
Motor power (KW)		3.7KW	5.5KW	7.5KW
Rated output current (A)		12.5	16	23.5
Short-time maximum current (A)		22	28	42
Breaker (A)		25	32	40
Contactor (A)		18	25	32
Input AC electric reactor	Current (A)	10	15	20
	Inductance (mH)	1.4	0.93	0.7
Input filter (A)		10	15	20
Maximum braking current (A)		25	25	40
Recommended braking resistor	Resistance value (Ω)	51Ω	51Ω	20Ω
	Power (W)	800W	800W	1200W
	Quantity	1	1	1
Recommended value of main circuit cable (mm^2)		4	4	4

Drive unit model		HSV-180UD-090C	HSV-180UD-100C	HSV-180UD-150C
Motor power (KW)		9KW	11KW	15KW
Rated output current (A)		30	32	47
Short-time maximum current (A)		52	56	84
Breaker (A)		63	63	100
Contactor (A)		40	40	63
Input AC electric reactor	Current (A)	30	30	50
	Inductance (mH)	0.47	0.47	0.28
Input filter (A)		30	30	50
Maximum braking current (A)		50	50	75
Recommended braking resistor	Resistance (Ω)	20Ω	33Ω	33Ω
	Power (W)	2000W	1500W	1500W
	Quantity	1	2	2
Recommended value of main circuit cable (mm^2)		6	10	16

Drive unit model		HSV-180UD-200	HSV-180UD-300	HSV-180UD-450
Motor power (KW)		30KW	37KW	51KW
Rated output current (A)		64.3	94	128
Short-time maximum current (A)		110	168	224
Breaker (A)		125	200	300
Contactor (A)		95	150	250
Input AC power Electric reactor	Current (A)	80	150	250
	Inductance (mH)	0.17	0.095	0.056
Input filter (A)		80	150	250
Maximum braking current (A)		100	100	150
Recommended braking resistor	Resistance (Ω)	30Ω	30Ω	30Ω
	Power (W)	2500W	2500W	2500W
	Quantity	3	4	6
Recommended value of main circuit cable (mm^2)		35	70	95

Drive unit model		HSV-180U1D-100	HSV-180U1D-150
Motor power (KW)		11KW	15KW
Rated output current (A)		32	47
Short-time maximum current (A)		56	84
Breaker (A)		63	100
Contactor (A)		40	63
Input AC electric reactor	Current (A)	30	50
	Inductance (mH)	0.47	0.28
Input filter (A)		30	50
Maximum braking current (A)		50	75
Recommended braking resistance	Resistance (Ω)	33Ω	33Ω
	Power (W)	1500W	1500W
	Quantity	2	2
Recommended value of main circuit cable (mm^2)		10	16

Drive unit model		HSV-180U1D-200	HSV-180U1D-300
Motor power (KW)		30KW	37KW
Rated output current (A)		64.3	94
Short-time maximum current (A)		110	168
Breaker (A)		125	200
Contactor (A)		95	150
Input AC electric reactor	Current (A)	80	150
	Inductance (mH)	0.17	0.095
Input filter (A)		80	150
Maximum braking current (A)		100	100
Recommended braking resistor	Resistance (Ω)	30Ω	30Ω
	Power (W)	2500W	2500W
	Quantity	3	4
Recommended value of main circuit cable (mm2)		35	70

Specification and adaptability of Golden Age motor:

Servomotor model	Rated Speed (rpm)	Static torque （Nm）	Phase current (A)	Motor Type code	PA-43 parameter value	Matching drive unit
GK6073-6AC61	2000	11	5.6	00	0	HSV-180UD-035 HSV-180UD-035C
GK6080-6AC61	2000	16	6.8	01	1	
GK6081-6AC61	2000	21	10	02	102	HSV-180UD-050 HSV-180UD-050C
GK6083-6AC61	2000	27	13.3	03	103	
GK6085-6AC61	2000	33	16.5	04	204	HSV-180UD-075 HSV-180UD-075C
GK6087-6AC61	2000	37	18.5	05	205	
GK6089-6AC61	2000	42	21	06	306	HSV-180UD-090 HSV-180UD-090C
GK6105-8AC61	2000	45	19.5	07	307	HSV-180UD-090 HSV-180UD-090C
GK6107-8AB61	1500	55	17.9	08	308	HSV-180UD-090 HSV-180UD-090C
GK6109-8AB61	1500	70	23.1	09	309	HSV-180UD-100 HSV-180UD-100C HSV-180U1D-100

Specification and adaptability of Huada motor:

Servomotor type	Rated speed (rpm)	Rated torque （Nm）	Rated current (A)	Motor type code	PA-43 parameter value	Drive unit/ Overload multiple
110ST-M02515HMBB	1500	2.5	2.5	20	20	HSV-180UD-035/8.8 HSV-180UD-035C/8.8
110ST-M03215HMBB	1500	3.2	2.5	21	21	HSV-180UD-035/8.8 HSV-180UD-035C/8.8
110ST-M05415HMBB	1500	5.4	3.5	22	22	HSV-180UD-035/6.3 HSV-180UD-035C/6.3
110ST-M06415HMBB	1500	6.4	4.0	23	23	HSV-180UD-035/5.5 HSV-180UD-035C/5.5
110ST-M02420HMBB	2000	2.4	2.5	24	24	HSV-180UD-035/8.8 HSV-180UD-035C/8.8
110ST-M04820HMBB	2000	4.8	3.5	25	25	HSV-180UD-035/6.3 HSV-180UD-035C/6.3
130ST-M03215HMBB	1500	3.2	2.5	26	26	HSV-180UD-035/8.8 HSV-180UD-035C/8.8
130ST-M05415HMBB	1500	5.4	3.8	27	27	HSV-180UD-035/5.8 HSV-180UD-035C/5.8
130ST-M06415HMBB	1500	6.4	4.0	28	28	HSV-180UD-035/5.5 HSV-180UD-035C/5.5
130ST-M09615HMBB	1500	9.6	6.0	29	29	HSV-180UD-035/3.7 HSV-180UD-035C/3.7
130ST-M14615HMBB	1500	14.3	9.5	33	33	HSV-180UD-035/2.3 HSV-180UD-035C/2.3
130ST-M04820HMBB	2000	4.8	3.5	30	30	HSV-180UD-035/6.3 HSV-180UD-035C/6.3
130ST-M07220HMBB	2000	7.2	5.0	31	31	HSV-180UD-035/4.4 HSV-180UD-035C/4.4
130ST-M09620HMBB	2000	9.6	7.5	32	32	HSV-180UD-035/2.9 HSV-180UD-035C/2.9
130ST-M14320HMBB	2000	14.3	9.5	34	34	HSV-180UD-035/2.3 HSV-180UD-035C/2.3
150ST-M14615HMBB	1500	14.6	9.0	35	35	HSV-180UD-035/2.5 HSV-180UD-035C/2.5
150ST-M19115HMBB	1500	19.1	12.0	37	137	HSV-180UD-050/2.4 HSV-180UD-050C/2.4
150ST-M22315HMBB	1500	22.3	13.0	38	238	HSV-180UD-075/3.2 HSV-180UD-075C/3.2
150ST-M28715HMBB	1500	28.7	17.0	39	239	HSV-180UD-075/2.5 HSV-180UD-075C/2.5
150ST-M14320HMBB	2000	14.3	9.0	36	36	HSV-180UD-035/2.5 HSV-180UD-035C/2.5

150ST-M23920HMBB	2000	23.9	14.5	40	240	HSV-180UD-075/2.9 HSV-180UD-075C/2.9
150ST-M26320HMBB	2000	26.3	15.5	41	241	HSV-180UD-075/2.7 HSV-180UD-075C/2.7
180ST-M18020HMBB	2000	18.0	12.5	42	142	HSV-180UD-050/2.4 HSV-180UD-050C/2.4
180ST-M23020HMBB	2000	23.0	15.0	43	243	HSV-180UD-075/2.8 HSV-180UD-075C/2.8
180ST-M27020HMBB	2000	27.0	18.0	44	244	HSV-180UD-075/2.4 HSV-180UD-075C/2.4
180ST-M36015HMBB	1500	36.0	22.5	45	345	HSV-180UD-090/2.4 HSV-180UD-090C/2.4 HSV-180U1D-090/2.4
180ST-M45015HMBB	1500	45.0	30.0	46	446	HSV-180UD-150/2.8 HSV-180UD-150C/2.8 HSV-180U1D-150/2.8
180ST-M55015HMBB	1500	55.0	35.0	47	447	HSV-180UD-150/2.5 HSV-180UD-150C/2.5 HSV-180UID-150/2.5

Annexed Table C Technical Specifications of HSV-180US Series Spindle Drive Unit and Motor Code

Specifications and model of spindle drive unit

Drive unit model		HSV-180US-035		HSV-180US-050		HSV-180US-075	
Motor power (KW)		3.7KW	5.5KW	5.5KW	7.5KW	7.5KW	11KW
Rated output current (A)		16.8		21.9		31.4	
Short-time maximum current (A)		22		28		42	
Breaker (A)		25	32	32	40	40	63
Contactor (A)		18	25	25	32	32	40
Input AC Electric reactor	Current (A)	10	15	15	20	20	30
	Inductance (mH)	1.4	0.93	0.93	0.7	0.7	0.47
Input filter (A)		10	15	15	20	20	30
Maximum braking current (A)		25		25		40	
Recommended braking resistor	Resistance (Ω)	51Ω		51Ω		20Ω	
	Power (W)	1100W		1100W		2000W	
	Quantity	1		1		1	
Recommended value of main circuit cable (mm^2)		4	4	4	4	4	10

Drive unit model		HSV-180US-100		HSV-180US-150	
Motor power (KW)		11KW	15KW	18.5KW	22KW
Rated output current (A)		43.8		62.8	
Short-time maximum current (A)		56		84	
Breaker (A)		63	63	100	100
Contactor (A)		40	50	63	80
Input AC electric reactor	Current (A)	30	40	50	60
	Inductance (mH)	0.47	0.35	0.28	0.24
Input filter (A)		30	40	50	65
Maximum braking current (A)		50		75	
Recommended braking resistor	Resistance (Ω)	33Ω		20Ω	
	Power (W)	1500W		2000W	
	Quantity	2		2	
Recommended value of main circuit cable (mm^2)		10	16	16	25

Drive unit model		HSV-180US-200		HSV-180US-300	HSV-180US-450
Motor power (KW)		30KW	37KW	51KW	75KW
Rated output current (A)		85.7		125	170
Short-time maximum current (A)		110		168	224
Breaker (A)		125	160	200	400
Contactor (A)		95	115	150	250
Input AC electric reactor	Current (A)	80	90	150	250
	Inductance (mH)	0.17	0.16	0.095	0.056
Input filter (A)		80	100	150	250
Maximum brake current (A)		100		100	150
Recommended braking resistor	Resistance (Ω)	30Ω		30Ω	30Ω
	Power (W)	2500W		2500W	2500W
	Quantity	3		4	6
Recommended value of main circuit cable (mm^2)		35		70	95

Drive unit model		HSV-180US-035R		HSV-180US-050R		HSV-180US-075R	
Motor power (KW)		3.7KW	5.5KW	5.5KW	7.5KW	7.5KW	11KW
Rated output current (A)		16.8		21.9		31.4	
Short-time maximum current (A)		22		28		42	
Breaker (A)		25	32	32	40	40	63
Contactor (A)		18	25	25	32	32	40
Input AC electric reactor	Current (A)	10	15	15	20	20	30
	Inductance (mH)	1.4	0.93	0.93	0.7	0.7	0.47
Input filter (A)		10	15	15	20	20	30
Maximum braking current (A)		25		25		40	
Recommended braking resistor	Resistance (Ω)	51Ω		51Ω		20Ω	
	Power (W)	1100W		1100W		2000W	
	Quantity	1		1		1	
Recommended value of main circuit cable (mm^2)		4	4	4	4	4	10

Drive unit model		HSV-180US-100R		HSV-180US-150R	
Motor power (KW)		11KW	15KW	18.5KW	22KW
Rated output current (A)		43.8		62.8	
Short-time maximum current (A)		56		84	
Breaker (A)		63	63	100	100
Contactor (A)		40	50	63	80
Input AC Electric reactor	Current (A)	30	40	50	60
	Inductance (mH)	0.47	0.35	0.28	0.24
Input filter (A)		30	40	50	65
Maximum braking current (A)		50		75	
Recommended braking resistor	Resistance (Ω)	33Ω		20Ω	
	Power (W)	1500W		2000W	
	Quantity	2		2	
Recommended value of main circuit cable (mm^2)		10	16	16	25

Drive unit model		HSV-180U1S-100		HSV-180U1S-150	
Motor power (KW)		11KW	15KW	18.5KW	22KW
Rated output current (A)		43.8		62.8	
Short-time maximum current (A)		56		84	
Breaker (A)		63	63	100	100
Contactor (A)		40	50	63	80
Input AC electric reactor	Current (A)	30	40	50	60
	Inductance (mH)	0.47	0.35	0.28	0.24
Input filter (A)		30	40	50	65
Maximum braking current (A)		50		75	
Recommended braking resistance	Resistance (Ω)	33Ω		20Ω	
	Power (W)	1500W		2000W	
	Quantity	2		2	
Recommended value of main circuit cable (mm^2)		10	16	16	25

Drive unit model		HSV-180U1S-200		HSV-180U1S-300
Motor power (KW)		30KW	37KW	51KW
Rated output current (A)		85.7		125
Short-time maximum current (A)		110		168
Breaker (A)		125	160	200
Contactor (A)		95	115	150
Input AC power Electric reactor	Current (A)	80	90	150
	Inductance (mH)	0.17	0.16	0.095
Input filter (A)		80	100	150
Maximum brake current (A)		100		100
Recommended braking resistance	Resistance (Ω)	30Ω		30Ω
	Power (W)	2500W		2500W
	Quantity	3		4
Recommended value of main circuit cable （mm2）		35		70

Code of common Golden Age asynchronous spindle motor

Motor type code	Motor model	Rated power (KW)	Rated torque (Nm)	Rated current (A)	Drive unit	PA-59 Parameter value
00	GM7101-4SB61	3.7	23.6	10	HSV-180US-035 HSV-180US-035R	0
01	GM7103-4SB61	5.5	35	13	HSV-180US-035 HSV-180US-035R	1
					HSV-180US-050 HSV-180US-050R	101
02	GM7105-4SB61	7.5	47.8	18.8	HSV-180US-050 HSV-180US-050R	102
					HSV-180US-075 HSV-180US-075R	202
03	GM7109-4SB61	11	70	25	HSV-180US-075 HSV-180US-075R	203
					HSV-180US-100 HSV-180US-100R HSV-180U1S-100	303
04	GM7133-4SB61	15	95.5	34	HSV-180US-100 HSV-180US-100R HSV-180U1S-100	304
					HSV-180US-150 HSV-180US-150R HSV-180U1S-150	404
05	GM7135-4SB61	18.5	117.8	42	HSV-180US-150 HSV-180US-150R HSV-180U1S-150	405
06	GM7137-4SB61	22	140.1	57		406

Annexed Table D HNC-8 System MCP Panel Input/Output

- 808D panel of milling system

	0	1	2	3	4	5	6	7
X480	Jog	MPG	Reference point return	Rapid traverse override -10%	Rapid traverse override 100%	Rapid traverse override +10%	Dryrun	Block skip
X481	Auto	Single block	MDI	Spindle Orientation	Spindle Jog	3-axis home	Optional stop	Machine lock
X482	Cooling auto	Cooling manual	Air blow	Spindle CW	Spindle Stop	Spindle CCW	Protective door	MPG precut
X483	+4TH	+Z	-Y	Next tool	Tool Clamping/release	Tool change	Chip removal CW	Chip removal CCW
X484	+X	Rapid traverse	-X	F1	Magazine debug	Tool arm CW	Back flush	Machine light
X485	+Y	-Z	-4TH	F2	Magazine CW	Magazine CCW	Overtravel Release	Lubrication
X486	Cycle Start	Feed Hold	Program lock		Feedrate override			
X487	Feedrate override							
X488	Spindle system							
X496	Incremental pulses per cycle of handwheel							
X497	Emergency stop, MPG axis selection and MPG override							

- 818D panel of milling system with MPG

	0	1	2	3	4	5	6	7
X480	Jog	Handwheel	Reference point return	Auto	MDI	Magazine CW	Magazine CCW	Magazine debugging
X481	Magazine home	+4TH	+Z	-Y	Single block	Dryrun	Block skip	X1
X482	X10	X100	+X	Fast forward	-X	Optional stop	MPG precut	Machine lock
X483	Lubricatio n	Protective door	3-axis home	+Y	-Z	-4TH	Spindle CW	Spindle stop
X484	Spindle orientatio n	Cooling	Machine light	Tool return/ install	Cycle start	Feed hold	Program lock	
X486	Feedrate override							
X487	Spindle system							
X494	Incremental pulses per cycle of handwheel							
Y486 Y487	Magazine tool number is displayed by Nixie tube							
Y488 Y489	Spindle tool number is displayed by Nixie tube							

- 818D panel of milling system without handwheel

	0	1	2	3	4	5	6	7
X480	Jog	Handwheel	Reference point return	Auto	MDI	Magazine CW	Magazine CCW	Magazine debugging
X481	Magazine home	+4TH	+Z	-Y	Single block	Dryrun	Program Skip	Shortcut
X482	F1	F2	+X	Rapid traverse	-X	Optional stop	MPG precut	Machine lock
X483	Lubricati on	Protective door	3-axis home	+Y	-Z	-4TH	Spindle CW	Spindle stop
X484	Spindle orientatio n	Cooling	Machine light	Tool return/inst all	Cycle start	Feed hold	Program lock	
X486	Rapid traverse override							
X487	Spindle system							
X488	Feedrate override							
X496	Incremental pulses per cycle of handwheel							
X497	Emergency stop, MPGaxis selection and MPG override							
Y486 Y487	Magazine tool number is displayed by Nixie tube							
Y488 Y489	Spindle tool number is displayed by Nixie tube							

Annexed Table E Detailed List of HNC-8 F-G Registers

Axis status word:

Each axis is configured with 80 status words. Each word has 16 bytes, the first line represents 0-7 bits and the second line represents 8-15 bits. When axis status word is used, logical number offset of axis should be added.

【F0.0】Axis is moving: It is 1 when axes are moving and 0 when axes do not move.

【F0.1】First step of reference point return: It is 1 when an axis returns to the reference point and does not touch the block; otherwise, it is 0.

【F0.2】Second step of reference point return: It is 1 while looking for Z pulse; otherwise, it is 0.

【F0.3】Reference point return fails: It is 1 when reference point return of axis fails; otherwise, it is 0.

【F0.4】Reference point return succeeds: It is 1 when reference point return of axis succeeds; otherwise, it is 0.

【F0.5】Salve axis is homing.

【F0.6】check of slave axis zero is completed.

【F0.7】Following state of slave axis has been relieved.

【F0.8】 Confirmation of the first reference point: It is 1 when the axis is at the first reference point; otherwise, it is 0.

【F0.9】Confirmation of the second reference point: It is 1 when the axis is at the second reference point; otherwise, it is 0.

【F0.10】 Confirmation of the third reference point: It is 1 when the axis is at the third reference point; otherwise, it is 0.

【F0.11】Confirmation of the fourth reference point: It is 1 when the axis is at the fourth reference point; otherwise, it is 0.

【F0.12】Axis overload mark: It is 1 when the axis is overloaded; otherwise, it is 0.

【F0.13】Axis parameters are validated.

【F0.14】Axis is locked.

【F0.15】Axis has been relocated.

【F1.0】PMC control enable. It is 1 when PMC control is enabled; otherwise, it is 0.

【F1.1】Feed spindle mode. It is 1 under position mode and 0 under speed mode.

【F1.5】Feed spindle has been oriented.

【F1.6】Zero speed of feed spindle.

【F1.7】Arrival of feed spindle speed.

【F2.0】 It is 1 when reference point return Z pulse signal is captured; otherwise, it is 0.

【F2.3】The second encoder Z pulse is captured. It is mainly used for reference point return of distance-coded grating ruler.

【F2.6】Zero position is captured. It is mainly used for spindle. It is set as 1 when the Z pulse is touched during spindle rotation. It should be 1 during CS switching.

【F2.8】It is 1 when bus servo is prepared; otherwise, it is 0.

【F2.9】It is 1 when the servo is under position control mode; otherwise, it is 0.

【F2.10】 It is 1 when the servo is under speed control mode; otherwise, it is 0.

【F2.11】 It is 1 when the servo is under torque control mode; otherwise, it is 0.

【F2.14】It is 1 for the spindle speed arrival; otherwise, it is 0.

【F2.15】Zero speed of spindle: It is 1 when the spindle stops; otherwise, it is 0.

【F3.0】It is 1 when the servo is normal.

【F3.1】It is 1 when the servo gives an alarm.

【F3.2】It is 1 when the servo gives a prompt message.

【F3.8】Orientation of spindle is completed: It is 1 after orientation of spindle is set, the spindle starts orientation and the servo gives feedback of spindle orientation signal; otherwise, it is 0.

【F4】Channel number of axis.

【F5】Number of slave axes

【F[6/7]】Command increment outputted in real time, coordinates of motor.

【F[8/9]】Command position outputted in real time, coordinates of motor.

【F[12/13]】Output command pulse position, unit: pulse.

【F[16/17]】Output command pulse increment, unit: pulse.

【F[18/19]】Output command torque.

【F[20/21]】Actual position of encoder 1.

【F[24/25]】Actual position of encoder 2.

【F[28/29]】Machine command position.

【F[32/33]】Machine command position.

【F[36/37]】Axis alarm.

【F36.2】Press positive limit block.

【F36.3】Press negative limit block.

【F36.4】Actual speed is overspeed.

【F36.6】Overspeed.

【F36.7】Super acceleration.

【F36.8】Z pulse cannot be found.

【F36.9】Disconnected.

【F36.10】Not return to the reference point.

【F36.11】Synchronous position out-of-tolerance.

【F36.12】Slave axis zero check failed.

【F36.13】Synchronous speed out-of-tolerance.

【F37.0】Exceed positive limit of travel.

【F37.2】Exceed negative limit of travel.

【F37.2】Acceleration mismatches maximum speed.

【F[38/39]】Axis prompt.

【F38.0】Exceed maximum compensation rate.

【F38.1】Exceed maximum compensation value.

【F38.2】Zero offset parameter is too small.

【F38.4】Software limit value is too large.

【F38.5】The second software limit value is too large.

【F38.6】Absolute encoder cycle digits are illegal

【F38.7】Position overflow.

【F38.8】The target point is beyond the positive limit.

【F38.9】The target point is beyond the negative limit.

【F38.10】Z pulse mask angle needs to be adjusted.

【F38.11】Reference position needs to be adjusted.

【F38.12】Tracking error is too large.

【F[70]】Current mode of axis. When the axis mode status is 102, handwheel interrupt mode is valid. When the axis mode status is 103, PMC axis mode is valid.

【F[474]】Target gear stage of spindle. BIT0-BIT3 represent gear 1-4 respectively.

Axis control word

【G0.0】Positive limit switch of axis.
【G0.1】Negative limit switch of axis.
【G0.2】Positive movement of axis is disabled.
【G0.3】Negative movement of axis is disabled.
【G0.4】Start to set reference point return.
【G0.5】Set reference point return start.
【G0.6】Set axis lock.
【G0.7】Set axis enable.
【G0.11】Set to release following function of slave axis.
【G0.15】Reset of single axis.
【G1.0】Absolute movement enable of PMC axis.
【G1.1】Relative movement enable of PMC axis.
【G1.2】The second software limit enable.
【G1.3】Extended software limit enable.
【G1.5】Feed spindle orientation.
【G1.6】Feed spindle clockwise rotation.
【G1.7】Feed spindle counter clockwise rotation.
【G1.12】Response mark of PLC to spindle C/S switching.
【G2.0】Capture zero pulse.
【G2.1】Wait for zero pulse.
【G2.2】Disable zero pulse search function.
【G2.3】Capture zero pulse of the second encoder.
【G2.8】Servo parameter switching 0: Default parameter 1: Switch to the second set of parameters
【G2.9】Switch to position control mode
【G2.10】Switch to speed control mode.
【G2.11】Switch to torque control mode.
【G2.12】Start spindle orientation.
【G2.14】Select an orientation point for spindle orientation: 0 refers to the first orientation point and 1 refers to the second orientation point.
【G2.15】Enable current-limiting function of servo axis.
【G3.0】Servo enable switch.
【G3.1】Reset servo, clear servo alarm.
【G4】Jog mark of axis. The mark is valid when the axis in Jog, reference point return, and rotation.
【G5】Increment mark of axis. The mark is valid during incremental movement of axis.
【G[6/7]】Jog speed, 0, stop; 1, jog speed in parameters; 2, rapid traverse seed; >2, user-defined speed.
【G8】Incremental magnification.
【G9】Handwheel magnification.
【G[10/11]】Pulse count of handwheel.
【G[12/13]】Axis feedback position, unit: pulse.
【G[16/17]】Axis feedback position 2, unit: pulse.
【G[20/21]】Axis feedback increment, unit: pulse.
【G[22/23]】Axis feedback increment 2, unit: pulse.
【G[24/25]】Axis feedback torque current.

【G[26/27]】Axis feedback tracking error, unit: pulse.

【G[28/29]】Counter value of encoder 1.

【G[32/33]】Counter value of encoder 2.

【G[36/37]】Real-time compensation value.

【G[38/39]】Sampling time stamp.

【G[48/49]】Absolute movement position of PMC axis.

【G[52/53]】Incremental movement amount of PMC axis.

【G[56/57]】Servo alarm number.

【G[58/59]】Servo prompt number.

【G60】Switching of axis control mode.

When the axis control mode is set to 102, request the axis control mode to switch to the handwheel interrupt mode. When set to 0, exit the handwheel interrupt mode. When the axis control mode is set to 103, the axis control mode is requested to switch to the PMC axis mode. When set to 0, exit PMC axis mode.

【G61】PMC axis override value.

【G62.0】PMC axis stop.

【G62.1】Clear handwheel interrupt amount.

【G462.9】Enable spindle gear change speed.

When this signal is valid, the motor runs a the speed set by "Motor speed during spindle gear change".

【G464】Current gear stage of spindle. BIT0-BIT3 represent gear 1-4 respectively.

Channel status word

【F2560.0 -F2560.3】

0: Reset mode 1: Auto mode 2: Jog mode

3: Incremental mode 4: MPG mode 5: Reference point return mode

6: PMC mode 7: Single block mode 8: MDI mode

【F2560.4】Feed hold: The channel is at feed hold state.

【F2560.5】Cycle start: The channel is at cycle start state.

【F2560.7】Under user motion intervention.

【F2560.9】Thread cutting: The channel is at thread cutting state and feed hold is not allowed.

【F2560.12】Channel reset: When channel is reset or reset key on the panel is pressed, channel reset is valid until channel reset response is set.

【F2560.13】Channel is being reset.

【F2560.14】Z pulse search of reference point return is in progress, mode switching is not allowed.

【F2561.0】Program selected, set by interpreter.

【F2561.1】Program start, set by channel control.

【F2561.2】Program completed, set by channel control.

【F2561.3】G28/G31 and other interrupt commands are completed.

【F2561.4】Interrupt command is skipped.

【F2561.5】Wait command is completed.

【F2561.6】Program rerun reset.

【F2561.7】Any line request mark.

【F2561.8】Channel loading breakpoint.

【F2562.8】Tool selection mark.

【F2562.9】Tool offset mark [T includes tool offset number].

【F2562.10】PLC indexing command mark.

【F2562.11】Spindle constant linear speed.

【F2562.12】 Spindle 0 of channel 0 has S command.
【F2569】Tool offset number.
【F[2570/2571】The first S command, unit: 0.001r/min.
【F[2572/2573】The second S command, unit: 0.001r/min.
【F[2574/2575】The third S command, unit: 0.001r/min.
【F[2576/2577】The fourth S command, unit: 0.001r/min.
【F2578】G31 number of current wait signal.
【F[2581/2589]】Numbers of 9 axes in channel.
【F[2590/2593]】Number of 4 spindles in channel.
【F[2594/2595]】Syntax error alarm number.
【F[2596/2599]】Channel alarm number.
【F[2600/2603]】Channel prompt number.
【F[2604/2607]】User output.
【F[2608/2615]】M codes running in the channel, no more than 8 codes.
【F2616】T codes running in the channel.
【F2617】B codes running in the channel.
【F2637.1】Manually subprogram-calling mark: 1: Subprogram is being called manually; otherwise, it is 0.

Channel control word

【G2560.3】 Single block mode: When MDI key is on the MCP panel, set single block mode of channel and hold state.
【G2560.4】Feed hold: Set feed hold of channel.
【G2560.5】Cycle start: Set cycle start of channel.
【G2560.6】Dryrun: Set dryrun state of channel.
【G2560.9】Reset response: Set reset response after channel is reset.
【G2560.11】Emergency stop: Set emergency stop of channel.
【G2560.12】Clear buffer of channel.
【G2560.13】Reset: Set reset of channel.
【G2560.14】Recover data of channel.
【G2560.15】Save data of channel.
【G2561.0】Start interpreter.
【G2561.1】The program reruns the second step.
【G2561.2】Block skip: Set block-skip state of channel.
【G2561.3】Optional stop: Set optional stop state of channel.
【G2561.4】Reset interpreter.
【G2561.5】The program reruns.
【G2561.6】Any line of program runs.
【G2561.7】Recover data of interpreter.
【G2561.8】Save data of interpreter.
【G2561.10】User motion control.
【G2561.11】External interrupt.
【G2561.12】Enable handwheel interrupt function.
【G2561.14】Program modification mark.
【G2562.0】Gear change completion response.
【G2562.10】Spindle speed check.
【G2562.11】Channel MST lock.

【G2562.12】There is no spindle in channel, rotation speed arrival needs not to be checked.

【G2562.13】Spindle speed arrival of channel.

【G2620.0】Auto: Set channel to auto mode.

【G2620.1】Single block/MDI: When MDI key is on the NC panel, set single block mode of channel. When MDI key is on the MCP panel, set MDI mode of channel.

【G2620.2】Jog: Set channel jog mode.

【G2620.3】Increment: Set channel to incremental mode.

【G2620.4】Reference point return: Set channel to reference point return mode.

【G2620.5】MPG: Set channel to handwheel mode of channel.

【G2620.6】PMC: Set channel to PMC mode.

【G2620.7】Panel enable: To use registers with ◆, panel enable must be set as 1.

【G2620.8-G2620.9】Increment magnification: Increment magnification occupies 2 bits. 00 represents x1, 01 represents x10; 10 represents x100; 11 represents x1000.

【G2620.10】Rapid traverse: Set movement mode of all axes in channel 0 as rapid traverse mode.

【G2621.0-2621.7】Handwheel axis option: Each axis of handwheel occupies 4 bits and a 4-bit figure represents current axis option. e.g.: If 4 bits of axis option is 0000, it represents X axis; 0001 represents Y axis; 0010 represents Z axis.

【G2621.8-G2621.11】Handwheel magnification: Every magnification of handwheel occupies 2 bits and a 2-bit figure represents current magnification. 00 represents x1; 01 represents x10; 10 represents x10; 11 represents x1000.

【G2621.12】 Handwheel 1 enable: Handwheel 1 can be used only after handwheel 1 enable is set.

【G2622】-【G2623】When the axis requires jog, incremental, reference point return movement or spindle CW/CCW rotation, only the axis motion control register needs to be set. If positive/negative movement mark of axis is set at the same time, the axis will not move. Under jog mode, if positive/negative movement mark of axis is set, the axis will move in positive/negative direction manually. Under incremental mode, if an effective period of positive/negative movement mark of axis (rising edge) is set, the axis will move a certain distance. Under reference point return mode, if positive/negative movement sign of axis is set, the axis will start the reference point return (under distance-coded reference point return mode, positive/negative movement mark of axis represents reference point return direction of feed axis). Under speed control mode, if positive/negative movement sign of axis is set, the axis will rotate in positive/negative direction.

【G2626.0】Channel alarm bit, the channel gives an alarm when it is set as 1.

【G2626.1】Channel prompt bit, the channel gives a prompt message when it is set as 1.

【G2562.10】Spindle fluctuation detection, spindle fluctuation starts to be checked when it is set as 1.

【G2563】Tool number displayed in the channel.

【G2564】Feed override in the channel.

【G2565】Rapid traverse override in the channel.

【G[2566/2569】 4 spindle override in the channel.

【G[2570/2571]】Spindle 1 output command, override and gear ratio have been calculated. Analog spindle represents the outputted DA value.

【G[2572/2573]】Spindle 2 output command.

【G[2574/2575]】Spindle 3 output command.

【G[2576/2577]】Spindle 4 output command.

【G2578.0】Control of workpiece coordinate system.

【G2578.1】Control of imaginary axis coordinate system.

【G2578.8】Initialization of tool coordinate system control.

【G2578.9】Running of tool coordinate system control.

【G2578.0】Control of workpiece coordinate system.

【G2579】Count of workpiece.

【G2580】Internal inhibition mask.

【G2581】External inhibition mask.

【G2582】G31 number when measurement is interrupted.

【G[2608/2615]】Response of 8 M codes in the channel.

【G2616】Response of T codes in the channel.

【G[2628/2629]】Output command speed of spindle 1. Spindle fluctuation is detected according to deviation between the actual speed and it.

【G[2630/2631]】Output command speed of spindle 2.

【G[2632/2633]】Output command speed of spindle 3.

【G[2634/2635]】Output command speed of spindle 4.

【F2961】Channel shield status word.

【G2637】Manual call of subprogram.

【F2978】Active channel number of system.

【G2961】Channel shield request word.

【G2978】Active channel request of system.

【G2960.0】The first emergency release mark. It is set as 1 after emergency stop is released for the first time.

【G2960.6】Program lock. Program can be edited only when it is set as 1.

【G2963】 Device 0-device 4 in device interface parameters.

0: Devices 0-3 are devices reserved by the system;

1: Devices 0-4 are imaginary axes which can be allocated to system axis;

2: Mix imaginary axis and virtual MCP panel. Devices 0-3 are imaginary axes which can be allocated to system axes and used during simulation running. Device 4 is the imaginary MCP, when it is enabled the keyboard can be used as MCP function. This function can be used if there is no MCP panel;

4: Imaginary pulse axis drive. Devices 0-3 are imaginary axes and this function is used when pulse axis interface is used.

Annexed Table F Detailed List of HNC-8 User PLC Events

User PLC event number	Usage
102	After hardware reset is completed, software processes some initialization contents. e.g.: Load the previously loaded program, etc.
103	PLC notifies HMI, PLC modifies B register, HMI saves B register during power failure
104	Channel switching request when there are multiple channels
105	Channel switching shielding when there are multiple channels
106	Dedicated for DMTG
107	Dedicated for DMTG
108	Dedicated for DMTG
109	Dedicated for DMTG
110	One-click offset event. Modify coordinate system, tool offset and other data during feed hold. After one-click offset, the system executes rerun operation automatically so that the modified data is validated immediately. (For special use)
115	Reset function triggered by PLC, which equals to pressing Reset key
116	Automatically load digital program name designated by channel variable 1131
117	Dedicated for glass machine
118	Dedicated for glass machine
119	Notify HMI that MCP key is pressed for timing of "Screen protection" function
120	When multiple channels are reset, PLC has selected set channel number events
121	PLC gives a message of permission switching
122	RFID reads data of electronic label to CNC
123	RFID writes CNC data to electronic label
124	Channel 0 changes tool in tool life management
125	Channel 1 changes in during tool life management
126	Channel 2 changes tool in tool life management
127	Channel 3 changes tool during tool life management