

Debugging of GH-1000MC

V1.5

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-Catalog-

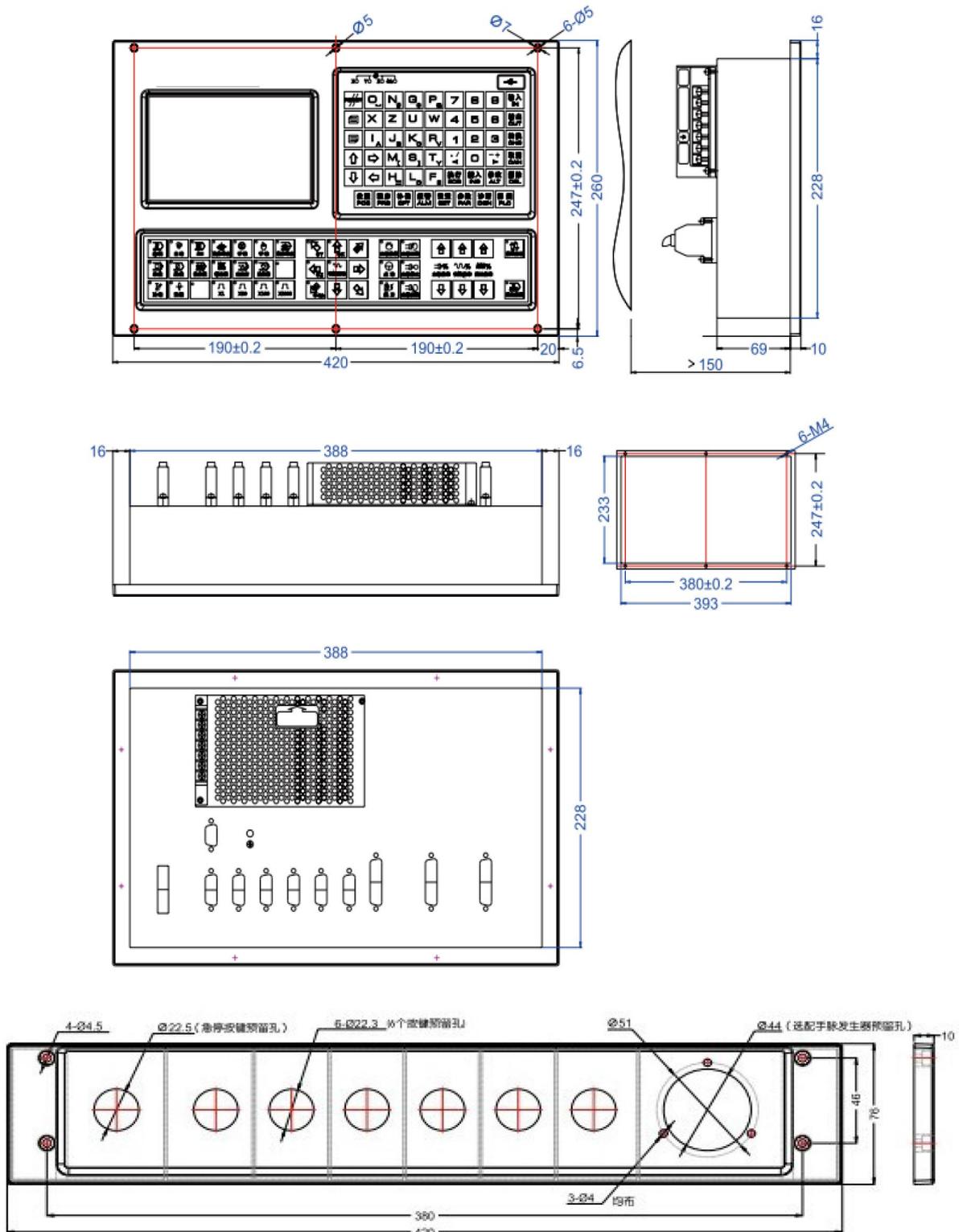
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CHAPTER 1 Brief Introduction of Product

1.1 GH-1000MC installation size



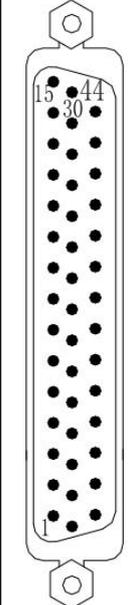
1.2 Power supply of system



1. Input :L,N(AC):Take the AC220V from the isolation transformer.
 2. Output :+V :+24V -V:0V ;
 3. The +24V,0V of system I/O interface has the common attribute with the +24V, 0V switch source.When we wiring the line ,+24V,0V can be brought out directly in the switching power supply.
- Note : This source box can be used only for giving power to the system.

CHAPTER 2 Definition & Connection of Plugs

2.1 CN61 input signal_GH-1000MC



PIN	Add.	Explain
21~24	0V	0V_Power supply
18~20	NULL	Suspended
25~28	+24V	+24V_Power supply
1	X0.0	Signal of guard gate detection/Air blower Control Input
2	X0.1	External connection interrupt input
3	X0.2	Input for Manual Clamp/Loose Tool
4	X0.3	Home switch input of X-axis
5	X0.4	Jump signal of G31/Tool Probe Input
6	X0.5	Signal of urgent stop (NC input)
7	X0.6	Signal of lubricating detection input
8	X0.7	Signal of pressure detection input
9	X1.0	Position Signal of Spindle Loose Tool
10	X1.1	Position Signal of Spindle Tighten Tool
11	X1.2	Home switch input of tool magazine
12	X1.3	Home switch input of Z-axis
13	X1.4	Signal of external cycle start (NO input)
14	X1.5	Signal of Automatic shift 1 stop /Clamp Position of worktable
15	X1.6	Signal of Automatic shift 2 stop/Unclamp position of worktable
16	X1.7	Over-travel input of Tool Probe
29	X2.0	Position Signal of Magazine Forward/downward tool holder
30	X2.1	Position Signal of Magazine Backward/Upward tool holder
31	X2.2	Signal of Magazine counter tools
32	X2.3	Home switch input of Y-axis
33	X2.4	Home switch input of A-axis
34	X2.5	Home switch input of 5th-axis/Braking Signal for ATC Arm
35	X2.6	Tool detection switch signal/Position of ATC arm grasp
36	X2.7	Spindle tool detection switch signal/Zero point of ATC arm
37	X3.0	X-Limit Input//M82/M83 K0 detection//External SP-Rate A
38	X3.1	Y-Limit Input//M82/M83 K2 detection//External SP-Rate F
39	X3.2	Z-Limit Input//M82/M83 K2 detection//External SP-Rate B
40	X3.3	A-Limit Input//M82/M83 K3 detection//External SP-Rate E
41	X3.4	External Feed Rate A//M82/M83 K4 detection signal
42	X3.5	External Feed Rate F//M85/M83 K5 detection signal
43	X3.6	External Feed Rate B//M82/M83 K6 detection signal
44	X3.7	External Feed Rate E///M82/M83 K7 detection signal

CN61
(DB44
Male
plug)

Note 1 : Some input interface can definite many functions ,and show it in table with “/”.

Note2 : Input signal break over with +24V, the input is effectively . If not,the input is ineffectively .

Note3 : +24V,COM end and the same name terminal which is in the supporting power box(GH-1000MC) are effectively .

Note4: M82K_ means waiting X to input the signal (X is normally open contact); M83K_ means waiting X to input the signal (X1.0 is normally close contact)

2.2 CN62 output signal_GH-1000MC

PIN	Add.	Explain
17~19 26~28	0V	0V_Power supply
20~25	+24V	+24V_Power supply
1	Y0.0	Cooling output (M8/M9)
2	Y0.1	Lubrication output(M32/M33)
3	Y0.2	Loosen/clamp tool (M16/M17)
4	Y0.3	CW Rotation of Spindle axis(M3forward)
5	Y0.4	CCW rotation of Spindle axis(M4 reversal)
6	Y0.5	Principal axis stops (M5)
7	Y0.6	Air Blower (M07/M9)
8	Y0.7	Principal axis braking/M89 I0 output
9	Y1.0	Principal axis mechanical gear 1
10	Y1.1	Principal axis mechanical gear 2
11	Y1.2	Principal axis mechanical gear 3
12	Y1.3	Principal axis mechanical gear 4
13	Y1.4	K1 Air Blower for Tool Probe (M70/M71)
14	Y1.5	K2 User-defined output (M72/M73)
15	Y1.6	K4 Clamp worktable output(M10)
16	Y1.7	K4 Unclamp worktable output (M11)
29	Y2.0	Protective door output (M34/M35)
30	Y2.1	Brake Output/M89 I6 output
31	Y2.2	Yellow Indicator Output
32	Y2.3	Green Indicator Output
33	Y2.4	Red Indicator Output
34	Y2.5	Stop of 2 nd Spindle axis M65
35	Y2.6	CCW Rotation of 2 nd Spindle M63
36	Y2.7	CW Rotation of 2 nd Spindle M64
37	Y3.0	K3 User-defined output (M74/M75)
38	Y3.1	Tool Magazine CW
39	Y3.2	Tool Magazine CCW
40	Y3.3	Tool Magazine forward/Downward Tool holder
41	Y3.4	Tool Magazine Backward/Upward Tool holder
42	Y3.5	Backward Indicator Output/ATC Arm
43	Y3.6	Chip Remove Output M36/M37
44	Y3.7	Working indicator Output M38/M39

CN61
(DB44 Female
Plug)

Note 1 : Some output interface can definite many function ,and show it in table with “//”.

Note2: When the output function is effectively ,the inside of output signal breakover with 0V .When the output function is ineffectively ,the output signal high-impedance cuts-off.

Note3: +24V,COM end and the same name terminal which is in the supporting power box(GH-1000MC) are effectively .

2.3 Function and Connection of IOs

NOTE! The functions & defines of I/Os on GH-1000MC CNC milling system function and are defined by PLC ladder program . When GH-1000MC is applied to machine tool, functions & defines of I/O is decided by manufacturer, please refer to the details of manual from machine tool factory .

The functions & descriptions of the I/O in this chapter is about the standard PLC ladder program of GH-1000MC.Please note it without special explanation.

2.3.1 Pause/Cycle start/Emergency-stop

Correlation signal

SP: Signal of external connection pause.When it cuts off with +24V,the pause is effective .

ESP: Urgent stop signal . When it cuts off with +24V,there is a alarm of urgent stop .

ST: External connection cycle start signal . When it join with +24V, the start is effective.

Signal Diagnosis

SP	ESP	ST
X0.1	X0.5	X1.4
Pin02_CN61	Pin06_CN61	Pin13_CN61

Control parameters

Bit parameters

B021.0==0 Start/Run Signal (0:valid, 1:Invalid)

B021.1==0 Pause Signal (0: Valid, 1:Invalid)

B021.2==0 Emergency Stop signal (0:Valid, 1:Invalid)

B021	****	****	****	****	****	BIT2	BIT1	BIT0
------	------	------	------	------	------	------	------	------

BIT0: External connection cycle start (0: Valid 1: Invalid).

BIT1: External connection pause(0: Valid , 1:Invalid)

BIT2: External Emergency stop (0: Valid , 1:Invalid)

PLC parameters

K20.0==0 Type of Cycle Start Button (0: NO , 1:NC)

K20.1==1 Type of Pause button (0:NO, 1:NC)

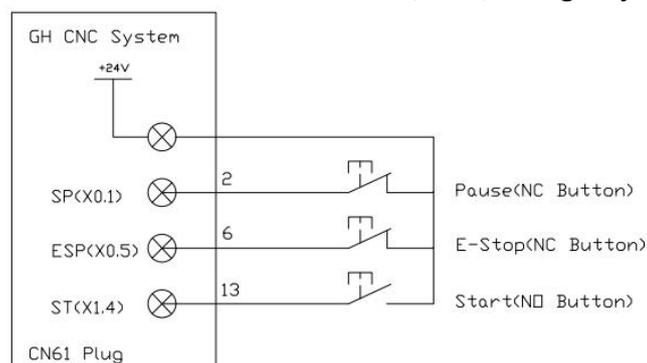
K020	****	****	****	****	****	****	BIT1	BIT0
------	------	------	------	------	------	------	------	------

BIT0: Type of Cycle Start Button (0: NO , 1:NC)

BIT1: Type of Pause button (0:NO, 1:NC)

External connection for Pause/Start-E-Stop

The link drawing of External connection's for Pause,Start,Emergency-Stop :



2.3.2 Limit Setting with Switch/Software

Correlation signal

LMIX:X axis travel limit detection input

LMIY:Y axis travel limit detection input

LMIZ:Z axis travel limit detection input

LMI4:4th axis travel limit detection input

LMI5:5th axis travel limit detection input

Signal Diagnosis

Signal	LMIX	LMIY	LMIZ	LMI4	LMI5
Address	X3.0	X3.1	X3.2	X3.3	X3.4
pin	P37_CN61	P38_CN61	P39_CN61	P42_CN61	P43_CN61

Note:Limit inputs and External Rate signal can not be used at the same time .

Control parameters

PLC parameters

K10.5==1 Cancel over-travel alarm signal(0: Invalid, 1:Valid)

K10.6==1 Type of limit switch of each axis (0:NO, 1:NC)

K10.7==1 Limitation for All Axes (0: Invalid, 1:Valid)

K24.0==0 X-axis over-travel (0:valid , 1:invalid)

K24.1==0 Y-axis over-travel (0:valid , 1:invalid)

K24.2==0 Z-axis over-travel (0:valid , 1:invalid)

K24.3==1 4th-axis over-travel (0:valid , 1:invalid)

K24.4==1 5th-axis over-travel (0:valid , 1:invalid)

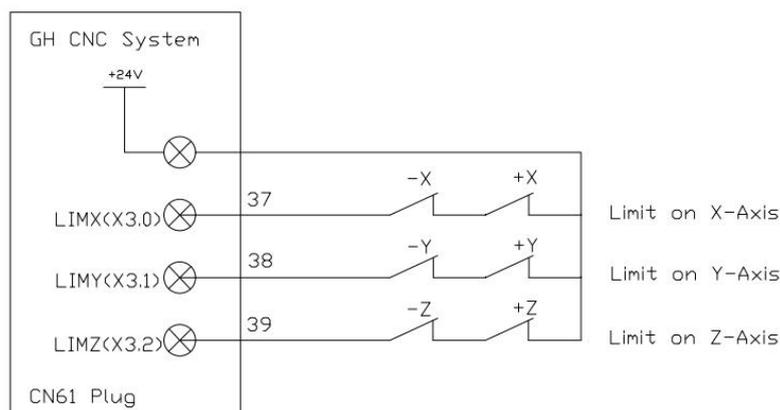
K010	BIT7	BIT6	BIT5	****	****	****	****	****
------	------	------	------	------	------	------	------	------

BIT5: Cancel over-travel alarm signal(0: Invalid, 1:Valid)

BIT6: Type of limit switch of each axis (0:NO, 1:NC)

BIT7: Limitation for All Axes (0: Invalid, 1:Valid)

External connections for limit switches



Setting steps of software limit

1. Set the Bit parameters P022.1 to one (It is effective before it comes back to zero)
2. Input the maximum(minimum)travel lathe coordinate of X axis's positive(negative) direction into the data parameters P010 and the data parameters P011.
3. Input the maximum(minimum)travel lathe coordinate of Y axis's positive(negative) direction into the data parameters P012 and the data parameters P013.
4. Input the maximum(minimum)travel lathe coordinate of Z axis's positive(negative) direction

into the data parameters P014 and the data parameters P015.

Bit parameters

- 022.1==1 Soft limit is effective before returning to mechanical zero point.
- 022.2==1 Send the over travel instructions, and there is an alarm when it is over travel .
- 022.3==0 Soft limit of returning to zero is effective.
- 051.0==1 Check the route before moving .
- 051.2==1 The alarm of quickly moving soft limit is accurate .

0	2	2	****	****	****	****	MASF	BFA	LZR	OUT2
---	---	---	------	------	------	------	------	-----	-----	------

- LZR=0: Soft limit is ineffective before returning to mechanical zero point.
- =1: Soft limit is effective before returning to mechanical zero point.
- BFA=0: Send the over travel instructions, and there is an alarm when it is before travel .
- =1: Send the over travel instructions, and there is an alarm when it is over travel .
- MASF=0: Soft limit of returning to zero is effective
- =1: Soft limit of returning to zero is ineffective

0	5	1	****	****	****	****	****	KYSD	****	SCBM
---	---	---	------	------	------	------	------	------	------	------

- SCBM=0: Do not check the route before moving
- =1: Check the route before moving
- KSYD =0: The alarm of quickly moving soft limit is lagging
- =1: The alarm of quickly moving soft limit is accurately

Data parameters

0	1	0	Max Travel on the negative direction of X axis (Default:-9999.0000)
0	1	1	Max Travel on the forward direction of X axis (Default:9999.0000)
0	1	2	Max Travel on the negative direction of Y axis (Default:-9999.0000)
0	1	3	Max Travel on the forward direction of Y axis (Default:9999.0000)
0	1	4	Max Travel on the negative direction of Z axis (Default:-9999.0000)
0	1	5	Max Travel on the forward direction of Z axis (Default:9999.0000)
0	1	6	Max Travel on the negative direction of 4 axis (Default:-9999.0000)
0	1	7	Max Travel on the forward direction of 4 axis (Default:9999.0000)
0	1	8	Max Travel on the negative direction of 5 axis (Default:-9999.0000)
0	1	9	Max Travel on the forward direction of 5 axis (Default:9999.0000)

2.3.3 Home/Machine Zero

DECX:Deceleration signal of X axis

DECY:Deceleration signal of Y axis

DECZ:Deceleration signal of Z axis

DEC4:Deceleration signal of 4 axis

DEC5:Deceleration signal of 5 axis

Diagnosis of signals

Signal	DXCX	DXCY	DXCZ	DXC4	DXC5
Address	X0.3	X2.3	X1.3	X2.4	X3.6
Pin	Pin4_CN61	Pin32_CN61	Pin12_CN61	Pin33_CN61	Pin43_CN61

Note: K20.7=1; home of 5th axis is effective.

Control parameters

Bit parameters

006.0==1 Input it before selecting block of returning to zero mode

006.3==1 There is a one turn signal in the way back to zero

012.0==1 After connect to the electricity,and before the lathe back to zero ,move it quickly with hand and it is effective

026.0==1 Choose the direction of returning to zero on the(X)axis as the negative direction of returning to zero

026.1==1 Choose the direction of returning to zero on the(Y)axis as the negative direction of returning to zero

026.2==1 Choose the direction of returning to zero on the(Z)axis as the negative direction of returning to zero

026.3==1 Choose the direction of returning to zero on the(4)axis as the negative direction of returning to zero

026.4==1 Choose the direction of returning to zero on the(5)axis as the negative direction of returning to zero

0	0	6	****	****	****	****	ZPLS	****	****	ZMOD
---	---	---	------	------	------	------	------	------	------	------

ZMOD=0 : Input it after choose block mode of returning to zero

=1: Input it before choose block mode of returning to zero

ZPLS=0: There is a one turn signal in the way back to zero

=1: There is a one turn signal and there is no way back to zero

0	1	2	****	****	****	****	****	****	****	ISOT
---	---	---	------	------	------	------	------	------	------	------

ISOT=0: After connect to the electricity,and before the lathe back to zero ,move it quickly with hand and it is ineffective

=1: After connect to the electricity,and before the lathe back to zero ,move it quickly with hand and it is effective

0	2	6	****	****	****	****	****	MZRZ	MZRY	MZRZ
---	---	---	------	------	------	------	------	------	------	------

MZRZ=0: Choose the direction of returning to zero on the(X)axis as the positive direction of returning to zero

- =1: Choose the direction of returning to zero on the(X)axis as the negative direction of returning to zero
- MZRY=0: Choose the direction of returning to zero on the(Y)axis as the positive direction of returning to zero
- =1: Choose the direction of returning to zero on the(Y)axis as the negative direction of returning to zero
- MZRZ=0: Choose the direction of returning to zero on the(Z)axis as the positive direction of returning to zero
- =1: Choose the direction of returning to zero on the(Z)axis as the negative direction of returning to zero
- MZR4=0: Choose the direction of returning to zero on the(4)axis as the positive direction of returning to zero
- =1: Choose the direction of returning to zero on the(4)axis as the negative direction of returning to zero
- MZR5=0: Choose the direction of returning to zero on the(5)axis as the positive direction of returning to zero
- =1: Choose the direction of returning to zero on the(5)axis as the negative direction of returning to zero

PLC parameters

- K22.4==0 The X axis deceleration signal switch is selected as the normally closed contact
- K22.5==0 The Y axis deceleration signal switch is selected as the normally closed contact
- K22.6==0 The Z axis deceleration signal switch is selected as the normally closed contact
- K22.7==0 The 4 axis deceleration signal switch is selected as the normally closed contact
- K22.3==0 The 5 axis deceleration signal switch is selected as the normally closed contact
- K20.7==1 The signal of 5 axis return to zero is effective

K	2	2	DEC4	DECZ	DECY	DECX	DEC5	****	****	****
---	---	---	------	------	------	------	------	------	------	------

- DECX=0: The X axis deceleration signal switch is selected as the normally closed contact
- =1: The X axis deceleration signal switch is selected as the normally opened contact
- DECY=0: The Y axis deceleration signal switch is selected as the normally closed contact
- =1: The Y axis deceleration signal switch is selected as the normally opened contact
- DECZ=0: The Z axis deceleration signal switch is selected as the normally closed contact
- =1: The Z axis deceleration signal switch is selected as the normally opened contact
- DEC4=0: The 4 axis deceleration signal switch is selected as the normally closed contact
- =1: The 4 axis deceleration signal switch is selected as the normally opened contact
- DEC5=0: The 5 axis deceleration signal switch is selected as the normally closed contact
- =1: The 5 axis deceleration signal switch is selected as the normally opened contact

K	2	0	TFRX	****	****	****	****	****	****	****
---	---	---	------	------	------	------	------	------	------	------

- TFRX=0: Tool management system forward signal is effective
- =1: The signal of 5 axis return to zero deceleration is effective

Data parameters

0	8	0
---	---	---

Low speed of the Omani-axial back to the mechanical zero (default value:40)

0 7 0

High speed of the X axis back to the mechanical zero (default value:4000)

0 7 1

High speed of the Y axis back to the mechanical zero (default value:4000)

0 7 2

High speed of the Z axis back to the mechanical zero (default value:4000)

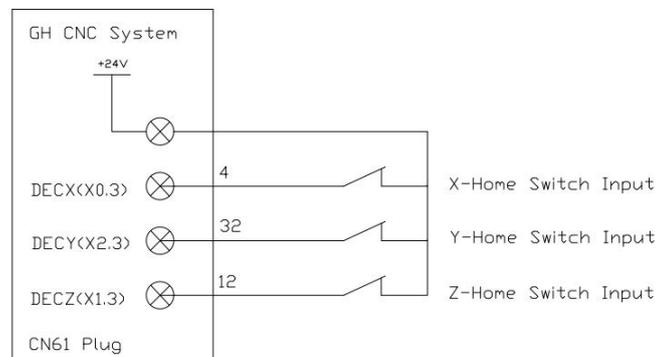
0 7 3

High speed of the 4 axis back to the mechanical zero (default value:4000)

0 7 4

High speed of the 5 axis back to the mechanical zero (default value:4000)

Drawing of lathe external links



2.3.4 Spindle Chuck control

Related signal (Definition of standard PLC program)

X0.2: Input for Control Spindle Chuck

X1.0 :The signal of principal axis tools be loosened in place.

X1.1: The signal of principal axis tools be clamped in place.

Y0.2: Tools loose and clamp .

Address	X0.2	X1.0	X1.1	Y0.2
Pin	Pin03_CN61	Pin09_CN61	Pin10_CN61	Pin3_CN62
Note	(NO button)	(NO sensor)	(NO sensor)	M16/M17

Diagnostic signal

Control parameters

PLC parameters

K14.7==1 Using the tool loose clamp device

K14.0==0 Spindle of tools loose signal is effective when it connects with +24V

K14.1==0 Spindle of tools clamp signal is effective when it connects with +24V

K14.5==0 Interlock between SP-Chuck and SP-Rotation(0:Yes,1:No)

K14.6==0 Checking the tools clamp signal / Loose and in position signal

K13.7==0 Type of External button input (X0.2)for chuck(0:Pulse, 1: Mode)

K13.6==0 Chuck key in the panel (0:Valid 1:Invalid)

K31.0==0 Detect position of chuck clamp/unclamp even if without tool(0:Yes, 1:No)

K	1	4
---	---	---

TCUS	TAML	****	****	****	****	TCLS	TOPN
------	------	------	------	------	------	------	------

TOPN=0 :Spindle tools loose signal is effective when it connects with +24V
 =1 :Spindle tools loose signal is effective when it disconnects with +24V
 TCLS =0 : Spindle tools loose signal is effective when it connects with +24V
 =1 :Spindle tools loose signal is effective when it disconnects with +24V
 TAML=0 : Checking the tools clamp signal / Loose and in position signal
 =1 : Do not check the tools clamp signal / Loose and in position signal
 TCUS =0 : Using the tool loose clamp device
 =1 : Do not use the tool loose clamp device

2.3.5 Cooling pump control

Connected instructions signal (The definition of standard PLC program)

Types of signal	Sign	Interface	Address	Functional description
Output signs	M08	Pin1_CN62	Y0.0	Cooling output
Instructions form	M08			Coolant on
	M09			Coolant close

PLC Parameter

K10.1=0 Reset output of Cooling/SP/Lubrication/Blower when press Reset (0:Yes,1:No)

Functional description (The definition of standard PLC program)

CNC power on and M09 is effective,the output M08 is ineffective . Implement M08 and the output of it is effective,the cooling pump open. Implement M09 and cancel the output of M08 ,turn off cooling pump .

2.3.6 Lubrication control

Connected interface signal (The definition of standard PLC program)

Types of signal	Signs	Signal interface	Address	Functional description
Output signs	M32	Pin02_CN62	Y0.1	Lubrication output
Instructions form	M32			Lubrication open
	M33			Lubrication close

Control parameters

PLC parameters

K10.1=0 When end of Program,reset output of Spindle/Lubrication/Cooling.

K16.2=1 Output lubricate After booting with Auto-lubricate

K010	BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
------	------	------	------	------	------	------	------	------

T	1	3
---	---	---

Automatic lubrication output time(0~65535ms)(It has the same function of the data parameter 112)

T	5	3
---	---	---

Automatic lubrication interval time (0~65535) unit:48ms.

2.5.7 Tricolor lamp

Connected signal (The definition of standard PLC program)

CLPY : The yellow lamp of tricolor lamp

CLPG: The green lamp of tricolor lamp

CLPR: The red lamp of tricolor lamp

Signal diagnosis

Signal	CLPY	CLPG	CLPR
Address of diagnosis	Y2.1	Y2.2	Y2.3
Interface pin	CN62.31	CN62.32	CN62.33
Note	Normal state	Running state	Alarming state

2.5.8 User-Defined Inputs

Connected signal (The definition of standard PLC program)

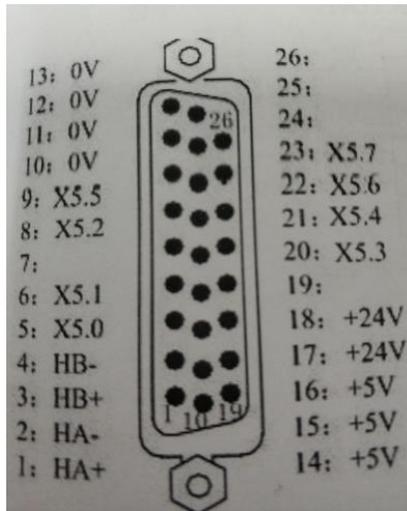
Type	Code	Interface	Add.	Function of signal	Note
Waiting for Input signals	M82K0	CN61.37	X3.0	Waiting for Input +24V to X3.0	Wait Level of X3.0 Signal
	M83K0			Waiting for Disconnect +24V to X3.0	
	M82K1	CN61.38	X3.1	Waiting for Input +24V to X3.1	Wait Level of X3.1 Signal
	M83K1			Waiting for Disconnect +24V to X3.1	
	M82K2	CN61.39	X3.2	Waiting for Input +24V to X3.2	Wait Level of X3.2 Signal
	M83K2			Waiting for Disconnect +24V to X3.2	
	M82K3	CN61.40	X3.3	Waiting for Input +24V to X3.3	Wait Level of X3.3 Signal
	M83K3			Waiting for Disconnect +24V to X3.3	
	M82K4	CN61.41	X3.4	Waiting for Input +24V to X3.4	Wait Level of X3.4 Signal
	M83K4			Waiting for Disconnect +24V to X3.4	
	M82K5	CN61.42	X3.5	Waiting for Input +24V to X3.5	Wait Level of X3.5 Signal
	M83K5			Waiting for Disconnect +24V to X3.5	
	M82K6	CN61.43	X3.6	Waiting for Input +24V to X3.6	Wait Level of X3.6 Signal
	M83K6			Waiting for Disconnect +24V to X3.6	
M82K7	CN61.44	X3.7	Waiting for Input +24V to X3.7	Wait Level of X3.7 Signal	
M83K7			Waiting for Disconnect +24V to X3.7		

Note 1 :When the input signal is custom input,the definition the default interface is ineffective .

Note 2 :M82/M83 K_ Waiting to complete the input of the signal to complete the code operation.

2.6 Handwheel connection setting instructions

Definition of handwheel interface



CN31 Handwheel interface
(DB26 Male Connector)

Signal	Instruction
HA+,HA-	The signal of handwheel A phase
HB+,HB -	The signal of handwheel B phase
X5.0	X handwheel shaft selection
X5.1	Y handwheel shaft selection
X5.2	Z handwheel shaft selection
X5.3	4 handwheel shaft selection
X5.4	5 handwheel shaft selection
X5.5	Increment ×1
X5.6	Increment ×10
X5.7	Increment ×100
+24V	DC power supply
VCC,GND	

Note 1: Handwheel shaft selection/Increment is effective with connection of +24V

Control parameters

Bit parameters

- 013.0 ==1 Coordinate increases when the handwheel is clockwise
- 013.7 ==1 Finish fully rotating displacement of handwheel
- 013.6 ==1 Hand wheel trial cut function is effective.

0	1	3	HPF	RHPG	****	****	****	****	****	HNGD
---	---	---	-----	------	------	------	------	------	------	------

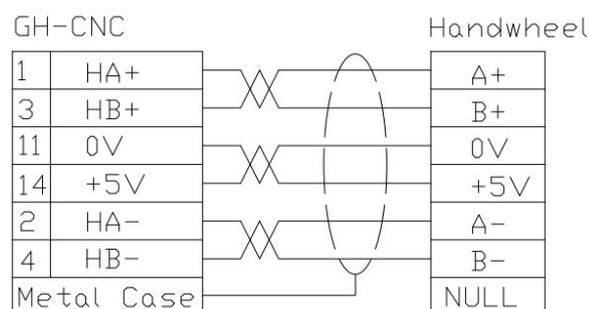
- HNGD =0: The coordinate increases when the handwheel is clockwise
- =1: The coordinate increases when the handwheel is anti-clockwise
- RHPG =0: Hand wheel trial cut function is ineffective.
- =1: Hand wheel trial cut function is effective.
- HPF =0: Not Must Finish fully rotating displacement of handwheel
- =1 : Must Finish fully rotating displacement of handwheel

Data parameters

1	0	2	Maximum speed of handwheel without complete operation (Default :2000)
---	---	---	---

1	0	3	Acceleration Constant of handwheel without complete operation (Default :50)
---	---	---	---

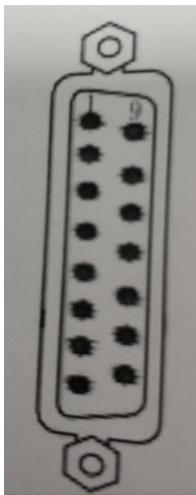
Signal connections for Handwheel



CN31 Plug

2.7 Spindle encoder connection

2.7.1 Definition of encoder interface

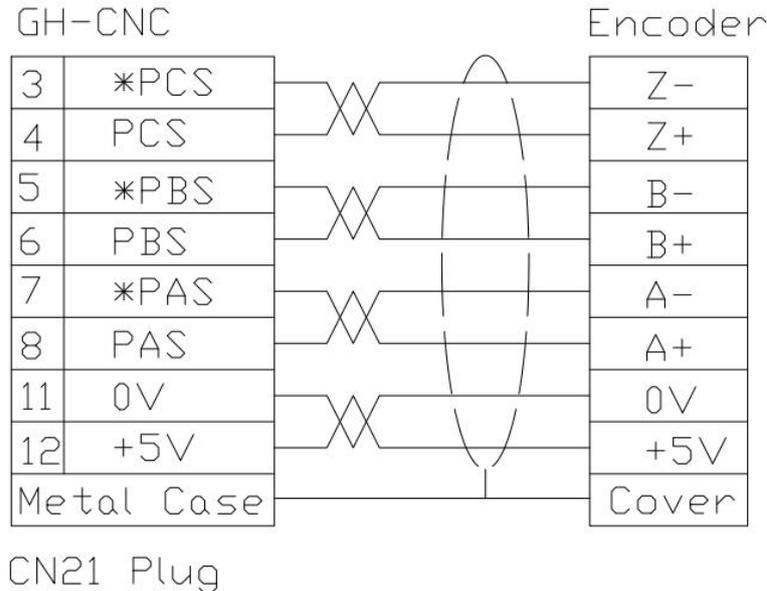


CN21 Interface of encoder
(DB15 Male Plug)

Pin	Name	Instruction
1,11,14,15	GND	Spindle 0V
2	Retain	Retain
3	#PCS	Negative pulse of C phase
4	PCS	Forward pulse of C phase
5	#PBS	Negative pulse of B phase
6	PBS	Forward pulse of B phase
7	#PAS	Negative pulse of A phase
8	PAS	Forward pulse of A phase
9	Retain	Retain
12	TH5IO5V	5V
13	TH5IO5V	5V

2.7.2 Encoder connection

The connection of GH-1000M/1000MC/3000M-V to the principal axis is as the following drawing and use twisted pair to connect them. (For example, the encoder of SZGHTECH)



Control parameter

Data parameters

2	2	0
---	---	---

The ratio of the encoder and the principal axis gear: Number of gear teeth in principal axis end (default value: 1)

2	2	3
---	---	---

The ratio of the encoder and the principal axis gear: Number of gear teeth in encoder end (default value: 1)

2.8 Spindle Axis

2.8.1 Interface definition of Spindle Axis(CN15)

Pin	Address	Definition
3,16	0V	Supply power :0V
17	+24V	Supply power :+24V
1	CP5+	spindles pulse positive signal
2	DIR5+	Spindles positive signal
4	ALM5	spindles pulse driving alarm
5	X4.0	Detecting Position Mode of SP
6	X4.1	spindles speed reach
7	RDY5	spindles ready signal
8	X4.2	spindles positioning in place signal
9	GND	0V end of supply power
10	PC5	spindles zero point signal
11	+24V	+24V end of supply power
12	GND	Analog voltage 0V end of spindles
13	SVC-OUT1	Analog output voltage 1 of spindles
14	CP5 -	Spindles pulse negative signal
15	DIRD -	spindles negative signal
19	EN5	Enable signal
20	Y4.0	Output for SP-Position Mode (tapping)
21	Y4.1	Pulse spindle enable
22	Y4.2	Directional output of spindle
23	Y4.3	Retain
24	SVC-OUT2	Analog output voltage 2 of spindle
25	GND	Analog voltage 0V end of spindle

Note1 :X4.0~X4.2 are effective when it is connected to +24V,

Note2 : X4.3, alarm signal, is effective when it is connected to 0V.

Note3:when Y4.0~Y4.3 are effective, which are connected to 0V,also output 0V.

2.8.2 Spindle control

Correlation signal (The definition of standard PLC program)

Symbol	Pin	Signal	Address	Signal function
nALM_M	Pin04_CN15	Input	X4.3	Input the abnormal alarm of spindle
M03	Pin04_CN62	Output	Y0.3	spindle anti-clockwise rotation (Positive rotation)
M04	Pin05_CN62		Y0.4	spindle clockwise rotation (Reversal rotation)
M05	Pin06_CN62		Y0.5	Spindle stop
SPZD	Pin08_CN62		Y0.7	Spindle brake
GND	Pin12_CN15			Analog voltage 0V end of spindle
SVC_OUT	Pin13_CN15			Analog output voltage end of spindle

Control parameter

Bit parameters

001.4 = 0 Analog voltage control of spindle speed

009.7 = 1 High level alarm of input signal for abnormal detection of spindle (disconnect with 0V)

0	0	1	****	****	****	SPTY	****	****	****	****
---	---	---	------	------	------	------	------	------	------	------

SPTY = 0: Analog voltage control of spindle speed

=1: Spindle shaft speed and switching value 999 control

0	0	9	SALM	****	****	****	****	****	****	****
---	---	---	------	------	------	------	------	------	------	------

SALM=0: High level alarm of input signal for abnormal detection of spindle (connect with 0V)

=1 :High level alarm of input signal for abnormal detection of spindle (disconnect with 0V)

Data parameters

2	0	0	Max speed of spindle (Default value:6000)
---	---	---	---

2	0	1	Line number of spindle encoder(Default value:1024)
---	---	---	--

2	0	6	Offset compensation value of analog voltage output of spindle (Default value:0)
---	---	---	---

2	0	8	Rotation speed of the spindle jog(Default value:50)
---	---	---	---

2	0	9	Max speed of spindle during tapping cycle (Default value:2000)
---	---	---	--

2	1	0	Max speed of first gear(M41) for spindle (Default value:6000)
---	---	---	---

PLC parameter

T	1	0	Spindle input brake relay time (Default value:0)
---	---	---	--

T	1	1	Spindle input brake time (Default value:50)
---	---	---	---

T	1	2	Spindle jog time (Default value:3000)
---	---	---	---------------------------------------

2.8.3 Switching control Speed of Spindle Axis

Related signal (Definition of standard PLC program)

S01~S04 : Spindle speed switching control signal , definition of standard PLC program
S01~S04 signal interface is a multiplexing interface .S01~S04 use the same interface with M41~M44 .

Control logic (Definition of standard PLC program)

When CNC is powered on, the output of S1~S4 is ineffective . Execute any code of S01,S02,S03,S04. The output of “S” signal is effective and retaining and the other “S” signal

output are canceled . Execute the code S00 ,cancel S1~S4 output and there is only one output is effective among the S1~S4.

Signal diagnosis

Signal	S1	S2	S3	S4
Diagnosis	Y1.0	Y1.1	Y1.2	Y1.3
Interface pin	CN62.09	CN62.10	CN62.11	CN62.12

Control parameter

Bit parameter

0	0	1	****	****	****	SPTY	****	****	****	****	****
---	---	---	------	------	------	------	------	------	------	------	------

001.4 =1 Spindle speed switching control

SPTY =0: Spindle analog voltage control

=1: Spindle speed switching control

2.8.4 Spindle automatic gear Shift control

Related signal (definition of standard PLC program)

M41~M44 : Signal of spindle automatic transmission,when choose the spindle speed switching control analog control (0~10V analog voltage output),it supports 4 automatic transmission of the principal axis control .

M41I,M42I: The signal of no.1 or 2 spindle automatic transmission in position. And it supports 2 gear shift in position detection function.

Signal diagnosis

Signal	M41I	M42I	M41	M42	M43	M44
Address	X1.5	X1.6	Y1.0	Y1.1	Y1.2	Y1.3
Pin	CN61.14	CN61.15	CN62.09	CN62.10	CN62.11	CN62.12

Control parameter

Bit parameter

001.4 =0 spindle analog voltage control

0	0	1	****	****	****	SPTY	****	****	****	****	****
---	---	---	------	------	------	------	------	------	------	------	------

Note: When using auto gear shift,it must be set to 0.

SPTY =0 : Spindle analog voltage control

=1 : Spindle speed switching control

PLC parameter

K15.0==1 Spindle automatic transmission function is effective .

K15.1==1 Spindle automatic transmission to 1,2. Check the signal M41I,M42I of transmission in position.

K15.2==0 Transmission in position signal M41I,M42I connect with +24V is effective.

K15.3==1 Power loss memory of spindle

K	1	5	****	****	****	****	SHT	AGIM	AGIN	AGER	****
---	---	---	------	------	------	------	-----	------	------	------	------

AGER =0 : Spindle automatic transmission function is ineffective .

=1 :Spindle automatic transmission function is effective .

AGIN=0:Spindle automatic transmission to 1,2. Do not check to the in position signals of M41I,M42I

=1 : Spindle automatic transmission to 1,2. Check to the in position signals of

M41I,M42I

SHT=0: Power loss do not have memory of spindle .

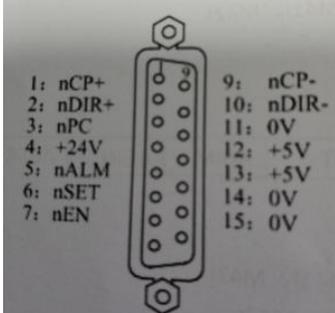
=1:Power loss memory of spindle

Data parameter

2	1	0	Highest speed of spindle no.1 gear (M41)(default value:6000)
2	1	1	Highest speed of spindle no.2 gear (M42)(default value:6000)
2	1	2	Highest speed of spindle no.3 gear (M43)(default value:6000)
2	1	3	Highest speed of spindle no.4 gear (M44)(default value:6000)

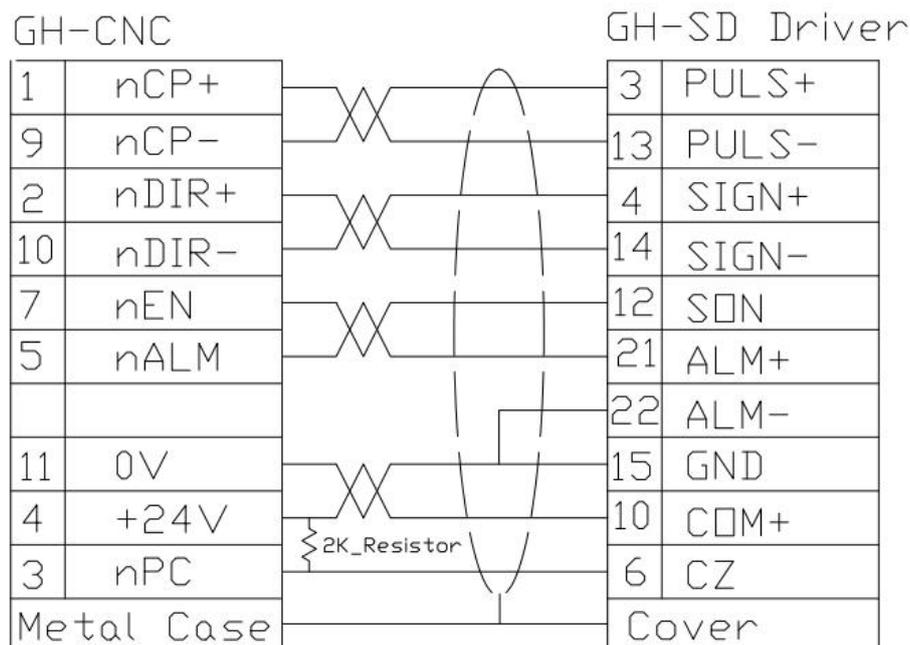
2.9 Connection of Driver Units

2.9.1 Pin definition of Feeding Axes Driver

	Signal	Instruction
1: nCP+	nCP+,cCP-	Instruction pulse signal
2: nDIR+	nDIR+,nDIR-	Instruction direction signal
3: nPC	nPC	Zero point signal
4: +24V	nALM	Driver alarm signal
5: nALM	nEN	Axis enable signal
6: nSET	nSET	Pulse prohibition signal
7: nEN		
9: nCP-		
10: nDIR-		
11: 0V		
12: +5V		
13: +5V		
14: 0V		
15: 0V		

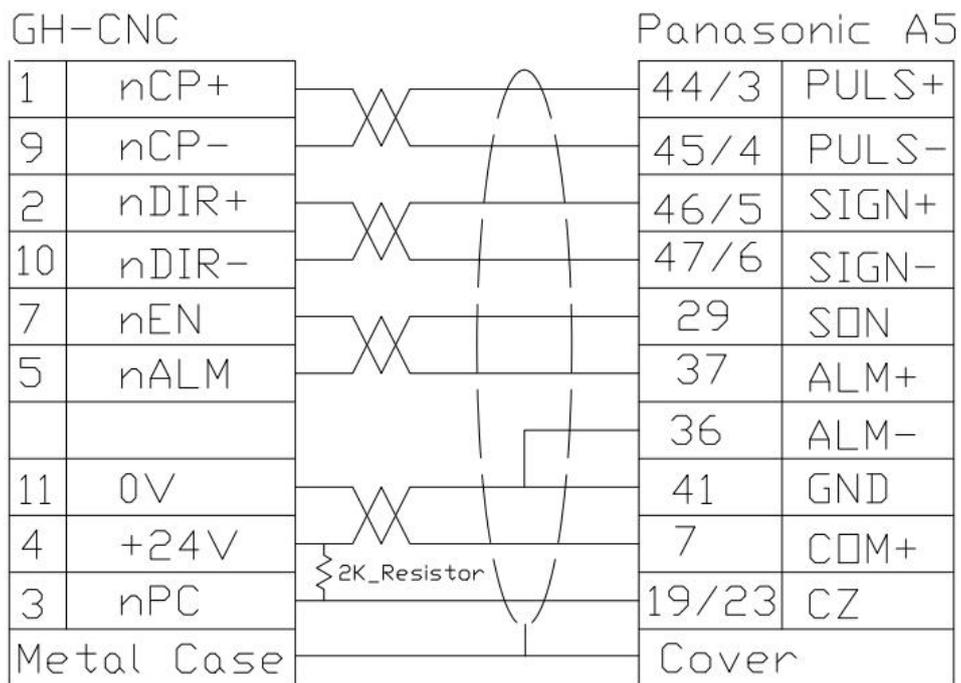
Note: Interface of CN11,CN12,CN13,CN14 plug are DB15 female connector.

2.9.2 Wiring Diagram of GH-CNC and GH-SD series Driver



Note: Please add one pcs of 2K Ohms/0.5W Resistor between +24V & nPC

2.9.3 Wiring Diagram of GH-CNC and Panasonic A5 Driver



Driver Parameter

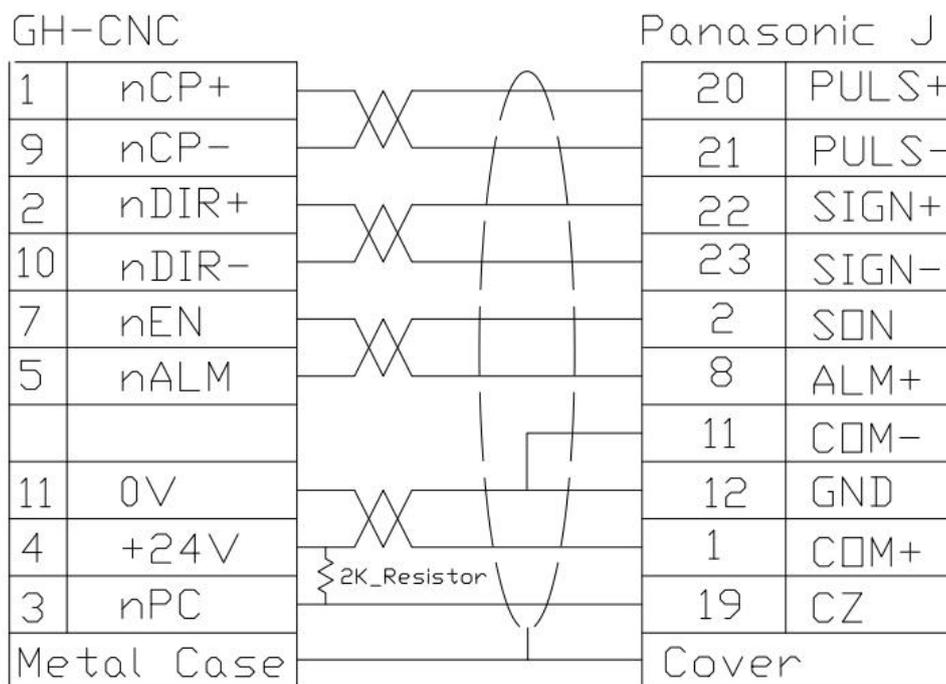
Pr0.01 Control mode setting (0:position mode)

Pr0.05 Input of interface pulse chooses 0--1,
if there is high speed such like 44/45 and 46/47 ,choose line driver for inputting .If
there is low speed such like 3/4 and 5/6,choose optocoupler for inputting .

Pr0.06 Interface pulse rotation direction setting

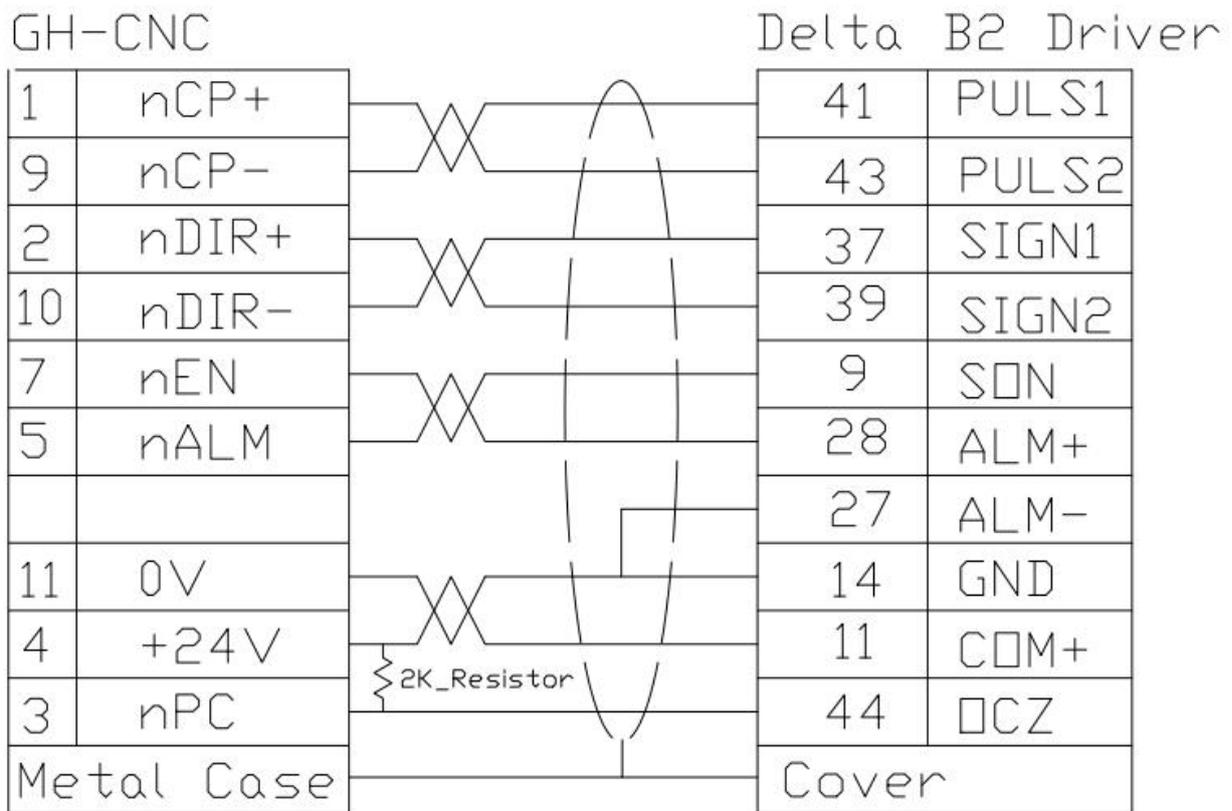
Pr0.07 Interface pulse input mode setting 0--3,0:Pulse +Direction;

2.9.4 Wiring Diagram of GH-CNC and Panasonic J Series Driver

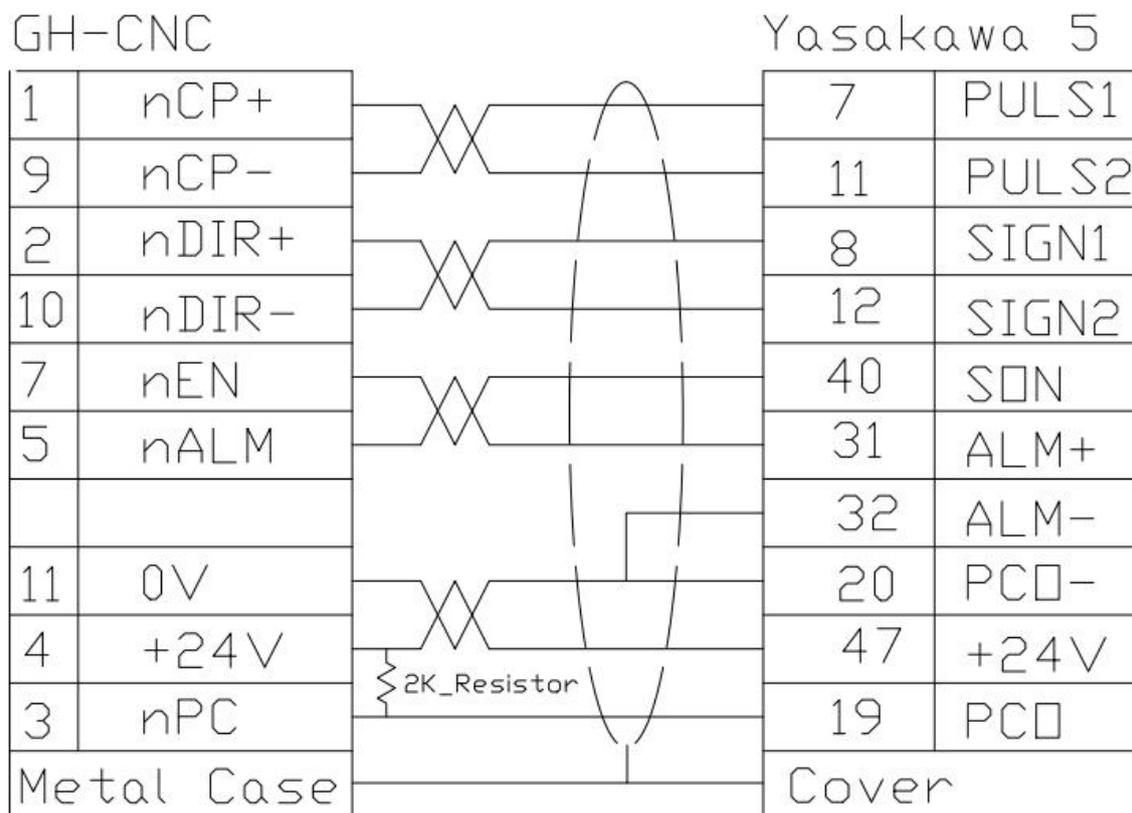


Note: Please add one pcs of 2K Ohms/0.5W Resistor between 24V & nPC

2.9.5 Wiring Diagram of GH-CNC and Delta B2 Series Driver



2.9.6 Wiring Diagram of GH-CNC and Yasakawa 5 Series Driver



Note: Please add one pcs of 2K Ohms/0.5W Resistor between 24V & nPC

Chapter III Description of Parameter

3.1 All parameter table--Machine

Number	Meaning of parameter
0010	Ingnore Alarm of E-Stop(0:NO 1:YES)
0020	Ingnore Alarm of Spindle Driver(0:NO 1:YES)
0021	Alarm Level of X-axis Driver(0:High 1:Low)
0022	Alarm Level of Z-axis Driver(0:High 1:Low)
0023	Alarm Level of Y-axis Driver(0:High 1:Low)
0024	Alarm Level of 4th-axis Driver(0:High 1:Low)
0040	over-travel of each axis hard limit(0:ineffective 1:effective)
0050	Soft limit function before returning to zero(0:ineffective 1:effective)
0060	Alarm of run G28 when no homing(0:NO 1:YES)
0070	External Switch for Cycle-Run(0:YES 1:NO)
0071	External Switch for Pause(0:YES 1:NO)
0072	Type of External Run Switch(0:NO 1:NC)
0073	Type of External F-Halt Switch(0:NO 1:NC)
0080	Protective door function(0:NO 1:YES)
0081	Type of Protective-door signal(0:NO 1:NC)
0082	Close Spindle when door is open(0:YES 1:NO)
0090	Lubricate when booting(0:NO 1:YES)
0091	Lubrication start time(0:No Limit)
0092	Automatic lubrication interval
0093	Type of Lubricate Alarm(0:NO 1:NC)
0094	Lubricating Detecting Time(ms)
0095	The underpressure warning signal +24V(0: on 1: off)
0096	Pressure Detection Time(ms)
0100	G54 function with one key(0:invalid 1:valid)
0110	Function of Tool Probe/Setter instrument (0:effective 1:invalid)
0111	Button for set tool automatically (0:invalid 1:effective)
0112	Type of over-travel on Tool setter (0:NC 1:NO)
0113	Type of input for G31 skip signal(0:NC 1:NO)
0130	Enable each shaft through G39 signal (0: no 1: yes)
0131	Emergency stop(0:yes 1:no)close X axis enable
0132	Emergency stop(0:yes 1:no)close Y axis enable
0133	Emergency stop(0:yes 1:no)close Z axis enable
0134	Emergency stop(0:yes 1:no)close A axis enable
0135	Emergency stop(0:yes 1:no)close B axis enable
0220	Allow Edit of Program O8000~O8999(0:YES 1:NO)
0221	Allow Edit of Program O9000~O9999(0:YES 1:NO)

3.2 All parameter table---Speed

Number	Meaning of parameter
0310	Cutting feed speed when switching on power
0311	Cutting feed speed (0:read 1:given internally)
0312	A given rate of cutting into the interior
0315	The maximum cut speed is independent(0:no 1:yes)
0320	The maximum control speed in the prereading mode(all)
0321	The minimum control speed in the prereading mode(all)
0322	Fast position and non-prereading maximum control speed(all)
0323	Fast position and non-prereading minimum control speed(all)
0330	Each shaft's fast operating multiplier Fo speed(all)
0350	Each axis manual (JOG) continuous feeding speed
0351	JOG running acceleration and deceleration (0:linear 1:ladder)
0352	Acceleration Time Constant at Staged JOG Mode
0360	X_Manual Rapid Feed Speed
0361	Y_Manual Rapid Feed Speed
0362	Z_Manual Rapid Feed Speed
0363	4TH_Manual Rapid Feed Speed
0364	5TH_Manual Rapid Feed Speed
0410	X_G00 Speed
0411	Y_G00 Speed
0412	Z_G00 Speed
0413	4TH_G00 Speed
0414	5TH_G00 Speed
0420	Fast running mode (0: forward 1: backward)
0421	Acceleration and deceleration before fast operation(0:linear 1:S)
0422	Fast X axis forward acceleration and deceleration s-type time constant
0423	Fast Y axis forward acceleration and deceleration s-type time constant
0424	Fast Z axis forward acceleration and deceleration s-type time constant
0425	Fast 4th axis forward acceleration and deceleration s-type time constant
0426	Fast 5th axis forward acceleration and deceleration s-type time constant
0430	Select processing method (0: non-prereading 1: prereading)
0431	Accelerate of Pre-Read Front Linear(mm/s/s)
0432	Pre-read mode, S time constant before cutting feed
0433	Pre-read mode, linear time constant after cutting feed
0434	Pre-read mode, exponential time constant after cutting feed
0435	Pre-read mode, exponential minimum speed (FL)
0440	X.feedrate max. ctrl speed
0441	Y.feedrate max. ctrl speed
0442	Z.feedrate max. ctrl speed
0443	4 TH .feedrate max. ctrl speed
0444	5 TH .feedrate max. ctrl speed
0450	X_High speed return mechanical zero
0451	Y_High speed return mechanical zero

0452	Z_High speed return mechanical zero
0453	4TH_High speed return mechanical zero
0454	4TH_High speed return mechanical zero
0455	ALL_Low speed return mechanical zero
0470	NULL
0480	NULL

3.3 All parameter table---Spindle

Number	Meaning of parameter
0510	Alarm Type of SP-driver(0:NO,1:NC)
0511	Spindle control type,0:Analog,1:I/O control)
0515	System startup (0: yes 1: no) set spindle speed
0516	The system is powered up to set the spindle speed value
0520	Spindle speed simulates the compensation value of output offset voltage
0530	Upper limit spindle speed
0531	To max. spindle speed of gear stage 1
0532	To max. spindle speed of gear stage 2
0533	To max. spindle speed of gear stage 3
0535	Constant surface speed control (G96) when the spindle minimum speed
0560	Spindle encode lines
0561	Number of teeth of spindle side gear (1st gear)
0562	Position encoder side gear number (1st gear)
0563	Number of teeth of spindle side gear (2nd gear)
0564	Position encoder side gear number (2nd gear)
0565	Number of teeth of spindle side gear (3rd gear)
0566	Position encoder side gear number (3rd gear)
0570	Spindle brake output time
0571	Spindle delay output braking
0580	Spindle inching timing
0581	Spindle orientate F or motor F when gear shift
0600	0/1:Spindle auto gear function valid/invalid
0601	Shift in position signal (0: no check 1: check)
0602	Shift in position signal is valid with +24V(0: on 1: off)
0603	Timing when the spindle is switched off
0604	The delay of the end of the spindle's new gear output in place
0605	V.spindle of gear shifting point output(mV)
0607	Spindle automatic shift (0: no output 1: output) forward signal
0608	Delay disconnect output after spindle shift (0: invalid 1: valid)
0609	1/0:Spindle gear yes/no power-off memory
0650	Multi Spindle Control Func.(0:NO 1:YES)
0652	Multispindle function (0: invalid 1: valid) analog quantity
0660	2nd Spindle voltage output is 10V, the highest speed
0675	Is the 4th axis set as the pulse spindle (0: no 1: yes)
0676	Is the 5th axis set as the pulse spindle (0: no 1: yes)
0678	Select (0: 1: 2) spindle,4th axis is simulated spindle

0679	Select (0: 1: 2) spindle,5th axis is simulated spindle
0680	SP multiplication coefficient(CMR)
0681	SP frequency division coefficient(CMD)
0682	SP-Index multiplication coefficient(CMR)
0683	SP-Index frequency division coefficient(CMD)
0690	Pulse SP-CW Output Delay(ms)(=300)
0691	Pulse SP-CCW Output Delay(ms)(=300)
0692	Pulse SP-Stop Delay(Y4.1)(ms)(=1000)
0710	NULL
0730	NULL
0750	NULL
0760	NULL

3.4 All parameter table ——Axis

Number	Meaning of parameter
0810	The number of CNC control axes
0811	Program name of no.4 axis(3:A,4:B,5:C)
0812	Program name of no.5 axis(3:A,4:B,5:C)
0830	Alarm Type of SP-driver(0:NO,1:NC)
0831	Alarm Type of X-driver(0:NO,1:NC)
0832	Alarm Type of Y-driver(0:NO,1:NC)
0833	Alarm Type of Z-driver(0:NO,1:NC)
0834	Alarm Type of 4th-driver(0:NO,1:NC)
0860	X multiplication coefficient (CMR)
0861	X command frequency division coefficient (CMD)
0862	Y multiplication coefficient (CMR)
0863	Y command frequency division coefficient (CMD)
0864	Z multiplication coefficient (CMR)
0865	Z command frequency division coefficient (CMD)
0866	4TH multiplication coefficient (CMR)
0867	4TH command frequency division coefficient (CMD)
0868	5TH multiplication coefficient (CMR)
0869	5TH command frequency division coefficient (CMD)
0880	(0:No reverse direction 1:Reverse direction) of X axis moving coordinate
0881	(0:No reverse direction 1:Reverse direction) of Y axis moving coordinate
0882	(0:No reverse direction 1:Reverse direction) of Z axis moving coordinate
0883	(0:No reverse direction 1:Reverse direction) of 4 th axis moving coordinate
0884	(0:No reverse direction 1:Reverse direction) of 5 th axis moving coordinate
0890	The reverse clearance compensation of the X-axis
0891	The reverse clearance compensation of the Y-axis
0892	The reverse clearance compensation of the Z-axis
0893	The reverse clearance compensation of the 4TH-axis
0894	The reverse clearance compensation of the 4TH-axis
0920	X-axis(0:negative 1:positive)moves,signal is high
0921	Y-axis(0:negative 1:positive)moves,signal is high

0922	Z-axis(0:negative 1:positive)moves,signal is high
0923	4TH-axis(0:negative 1:positive)moves,signal is high
0924	5TH-axis(0:negative 1:positive)moves,signal is high
0925	Handwheel(0:inverse 1:clockwise) coordinates increase
0930	DIR.of X-Manual Feed Key(0:Reverse 1:Normal)
0931	DIR.of Y-Manual Feed Key(0:Reverse 1:Normal)
0932	DIR.of Z-Manual Feed Key(0:Reverse 1:Normal)
0933	DIR.of 4th-Manual Feed Key(0:Reverse 1:Normal)
0934	DIR.of 5th-Manual Feed Key(0:Reverse 1:Normal)
1110	Setting X axis as(0:straight axis,1:rotary axis)
1111	Setting Y axis as(0:straight axis,1:rotary axis)
1112	Setting Z axis as(0:straight axis,1:rotary axis)
1113	Setting 4 th axis as(0:straight axis,1:rotary axis)
1114	Setting 5 th axis as(0:straight axis,1:rotary axis)
1150	4th is rotation axis,absolute loop(0:invalid 1:valid)
1151	4th is rotation axis,(0:in symbolic direction 1:nearby)
1152	4th is rotation axis,Relative loop(0:invalid 1:valid)
1160	5th is rotation axis,absolute loop(0:invalid 1:valid)
1161	5th is rotation axis,(0:in symbolic direction 1:nearby)
1162	5th is rotation axis,Relative loop(0:invalid 1:valid)
1210	Pulse mode selection (0:pulse+direction 1:orthogonal pulse)
1230	NULL
1240	NULL

3.5 All parameter table --Limit

Number	Meaning of parameter
1310	Over-travel of each axis (0:invalid 1:invalid)
1320	The over-travel signal alarm +24V(0:on 1:off)valid
1330	Over-range cancellation signal of each axis(0:invalid 1:effective)
1340	Homing point as Soft-Limit point(0:NO 1:YES)
1341	Software-limit when homing(0:YES 1:NO)
1342	Alarm if overtravel during home?(0:front,1:behind)
1343	Extra Value of Soft-Limit when Homing
1350	X max stroke positive direction(first stroke limit)
1351	X max stroke negative direction(first stroke limit)
1352	Y max stroke positive direction(first stroke limit)
1353	Y max stroke negative direction(first stroke limit)
1354	Z max stroke positive direction(first stroke limit)
1355	Z max stroke negative direction(first stroke limit)
1356	4TH max stroke positive direction(first stroke limit)
1357	4TH max stroke negative direction(first stroke limit)
1358	5TH max stroke positive direction(first stroke limit)
1359	5TH max stroke negative direction(first stroke limit)
1360	X-axis hard limit superrange(0:effective 1:invalid)
1361	Y-axis hard limit superrange(0:effective 1:invalid)

1362	Z-axis hard limit superrange(0:effective 1:invalid)
1363	4TH-axis hard limit superrange(0:effective 1:invalid)
1364	5TH-axis hard limit superrange(0:effective 1:invalid)
1370	NULL
1380	NULL

3.6 All parameter Table -- Homing

Number	Meaning of parameter
1410	Homing Mode(0:Behind,1:Front)
1411	Detecting Z signal when Homing(0:No,1:YES)
1420	Manual clearance of mechanical coordinates (0: no 1: yes)
1430	X_Homing Direction(0:positive,1:negative)
1431	Y_Homing Direction(0:positive,1:negative)
1432	Z_Homing Direction(0:positive,1:negative)
1433	4TH_Homing Direction(0:positive,1:negative)
1434	5TH_Homing Direction(0:positive,1:negative)
1450	X_High speed return mechanical zero
1451	Y_High speed return mechanical zero
1452	Z_High speed return mechanical zero
1453	4TH_High speed return mechanical zero
1454	5TH_High speed return mechanical zero
1455	Return the mechanical zero low speed(all axes)
1460	1/0:X axis deceleration high/low level valid
1461	1/0:Y axis deceleration high/low level valid
1462	1/0:Z axis deceleration high/low level valid
1463	1/0:4TH axis deceleration high/low level valid
1464	1/0:5TH axis deceleration high/low level valid
1470	The X-axis grid offset or reference point offset
1471	The Y-axis grid offset or reference point offset
1472	The Z-axis grid offset or reference point offset
1473	The 4TH-axis grid offset or reference point offset
1474	The 5TH-axis grid offset or reference point offset

3.7 All parameter Table -- ABS

Number	Meaning of parameter
1510	Control Mode for Driver(0:Pulse 1:Modbus)
1520	Machine zero(0:not memory,1:memory)
1530	Allow Error between Link Coord. & Motor Coord.
1540	Communication channel baud rate(DNC)
1550	Absoute Servo_X-Axis(0:YES,1:NO)
1551	Absoute Servo_Y-Axis(0:YES,1:NO)
1552	Absoute Servo_Z-Axis(0:YES,1:NO)
1553	Absoute Servo_4th-Axis(0:YES,1:NO)
1554	Absoute Servo_5th-Axis(0:YES,1:NO)
1560	Readout X_ABS.Coord.(0:Normal 1:Reverse)

1561	Readout Y_ABS.Coor.(0:Normal 1:Reverse)
1562	Readout Z_ABS.Coor.(0:Normal 1:Reverse)
1563	Readout 4th_ABS.Coor.(0:Normal 1:Reverse)
1564	Readout 5th_ABS.Coor.(0:Normal 1:Reverse)
1580	X multiplication coefficient (CMR)
1581	X command frequency division coefficient(CMD)
1582	Y multiplication coefficient (CMR)
1583	Y command frequency division coefficient(CMD)
1584	Z multiplication coefficient (CMR)
1585	Z command frequency division coefficient(CMD)
1586	4TH multiplication coefficient (CMR)
1587	4TH command frequency division coefficient(CMD)
1588	5TH multiplication coefficient (CMR)
1589	5TH command frequency division coefficient(CMD)

3.8 All parameter Table -- Tool(Chuck)

Number	Meaning of parameter
1800	1/0:YES/NO use tool clamp or release
1801	Type of External Chuck Control Signal(0:Point 1:Modal)
1803	Tool loose clip and spindle (0: interlock 1: non-interlock)
1810	1/0:Detect/Not Position of Chuck Tighten/Loose
1811	1/0:Spindle release low/high level valid
1812	1/0:Spindle clamp low/high level valid
1813	Spindle tool release finished
1814	Delay of SP Tighten Tool Finish
1815	Delay of SP Loose Tool Detect
1816	Spindle tool clamp detection time-delay
1820	Spindle zero speed output range(r/min)
1830	No tool after clamping(0:yes 1:no)can detect clamping signal

3.9 All parameter table -- T-Library (Tool Magazine)

Number	Meaning of parameter
1840	Spindle current tool number
1841	Total Tool Number
1850	(0: forbidden 1: allowed) knife library use
1851	Use of knife store (0: other knife store 1: row knife)
1860	Z of the fst ref pnt in machine crd system(Max)
1861	Z of the sec ref pnt in machine crd system(Min)
1862	Z is the third reference point in the coordinate system
1870	Knife store (0: no 1: yes) enters debugging mode
1871	Disc type knife arm (0: no 1: yes) enters debug mode
1872	(0: no 1: yes) shield soft limit in the tool change
1873	Spindle current tool number is 0(0: is 1: no) warning
1880	1/0:MAG. exist reference return switch yes/no
1881	1/0:MAG.reference return switch low/high level valid

1882	1/0:MAG.counter switch low/high level valid
1883	1/0:MAG.move forward switch low/high level valid
1884	1/0:MAG.move backward switch low/high level valid
1885	1/0:MAG.move forward in-position after
1886	Back tool store/back position tool(0:No disconnect 1:disconnect)
1887	The brake signal of disc type knife store is valid with +24V(0:on 1:off)
1888	The hook signal of disc type knife store is valid with +24V(0:on 1:off)
1889	The origin signal of the disc-type knife store is valid with +24V(0:on 1:off)
1890	1/0:Spindle tool detection YES/NO valid
1891	1/0:Spindle tool detection switch low/high level valid
1892	1/0:Current cutterhead tool detection YES/NO valid
1893	1/0:Current cutterhead detection switch
1910	Manual forward button delay in knife store
1911	Manual button reversal delay in knife store
1912	The delay detection of knife store is stopped
1913	Delay detection of counter in knife store
1914	Time delay detection of feed/cut in knife store
1915	Delay detection of return/return knives in the knife store
1916	Feed/pour finish delay in knife store
1917	Complete the delay of returning/returning knives
1918	Delay detection of counting switch in knife library
1919	Time delay detection of tool store back to zero in place signal
1920	Rotary delay detection of knife store
1921	Delay detection of knife store counter in place
1922	Delay detection of mechanical arm bucking knife in place
1923	Delay detection of mechanical arm pull-down and rise to position
1924	The delay detection of the robot arm returning to the origin
1925	Total time of arm output
1926	Delay the knife disc in place
1930	Minimum rotation interval is allowed in the tower knife store
1931	Maximum rotation interval is allowed in the tower knife store
1932	Minimum value of forbidden rotation interval of spindle in tower knife store
1933	Maximum value of forbidden rotation interval of spindle in tower knife store
1934	Minimum value of tool change interval in tower tool store
1935	Maximum value of tool change interval in tower tool store
1936	Speed limit of slow speed interval of z-axis tool change(0:invalid 1:effective)
1937	The speed F in the slow interval of z-axis tool change
1938	Minimum of slow speed interval for z-axis tool change
1939	Maximum of slow speed interval for z-axis tool change
1940	Speed limit of slow speed interval of x-axis tool change(0:invalid 1:effective)
1941	The speed F in the slow interval of x-axis tool change
1942	Minimum of slow speed interval for x-axis tool change
1943	Maximum of slow speed interval for x-axis tool change
1944	Speed limit of slow speed interval of y-axis tool change(0:invalid 1:effective)

1945	The speed F in the slow interval of y-axis tool change
1946	Minimum of slow speed interval for y-axis tool change
1947	Maximum of slow speed interval for y-axis tool change

3.10 All parameter Table --Tap/Orientation

Number	Meaning of parameter
2110	Spindle when tapping (0: follow 1: servo)
2111	F setting of rigid tapping pitch (0: no 1: yes)
2112	Does tapping become a high speed deep hole tapping cycle (0: no 1: yes)
2120	Maximum spindle speed during tapping cycle
2121	Rigid tapping select axis 4 (0: no 1: yes)
2130	Tapping spindle instruction multiplication coefficient(CMR)
2131	Tapping spindle instruction frequency division coefficient(CMD)(250)
2132	Tapping spindle instruction multiplication coefficient(CMR)(2)
2133	Tapping spindle instruction frequency division coefficient(CMD)(2)
2134	Tapping spindle instruction multiplication coefficient(CMR)(3)
2135	Tapping spindle instruction frequency division coefficient(CMD)(3)
2140	Position mode complete signal +24V(0:disconnect 1:on) valid
2141	M29 Delay complete ms
2142	M28 Delay complete ms
2143	M28 Switching speed mode delay detection
2144	M29 Delay detection in switching position mode
2300	Spindle positioning complete +24V(0:disconnect 1:on)valid
2310	Spindle orientation in place to complete the delay(ms)
2311	Delay detection of spindle directional arrival signal
2312	Spindle orientation in place to detect delay
2400	NULL
2410	NULL

3.11 All parameter Table --Process

Number	Meaning of parameter
6100	Read file format type (0:currency 1:carving)
6110	Set rigid tapping pitch F(0:no 1:yes)
6130	Setting the G76,G87 tool retract direction (0:positive 1:negative)
6140	Setting the G76,G87 tool retract axis(0:X, 1:Y)
6150	Alarm without cut amount in G73/G83(0:NO 1:YES)
6160	Retract amount of high speed deep hole recycle G73
6170	Left blank of fixed recycle G83
6210	Open corner speed optimization function(0:NO 1:YES)
6220	The highest speed limit of circular arc programming(0:ineffective 1:effective)
6230	Max Speed of Arc Programming Speed(Default:5000)
6240	The speed of deceleration radius 1 of arc(Default: 2000)
6250	The speed of deceleration radius 2 of arc(Default:2500)
6260	The speed of deceleration radius 3 of arc (Default: 3000)
6270	Deceleration radius 1 of arc(shortest) (Default:5)

6280	Deceleration radius 2 of arc(Default:8)
6290	Deceleration radius 3 of arc(longest)(Default:10)
6300	Setting of tools radius compensation value (0: radius 1:diameter)
6310	(0:not 1:yes)do interference check for radius compensation
6320	High speed machining (0:not turn on 1:turn on)
6330	Prospective processing of high speed(0:not turn on 1:turn on)
6340	Corner speed of high speed machining
6350	Acceleration of high speed machining
6360	High speed machining efficiency level
6370	The number of high speed machining priority

3.12 All parameter Table --User

Number	Meaning of parameter
7110	Number of pieces finish machining
7111	Required process total workpieces
7120	1/0:Alarm/Not Hint when finished all pieces
7130	Execute M99 machining number (0: no 1: yes) plus 1
7140	Reset the total processing amount (0: non-clear 1: clear)
7210	Single piece cutting time automatically reset(0:no 1:yes)
7220	Spindle lubrication and cooling output when reset(0:closed 1:keep)
7230	Lubricant opening time(=0:No_Limit)
7231	Auto lubricant interval time(S)
7240	M30 Cursor (0:not return 1:return) back to the beginning
7241	M02 Cursor (0:not return 1:return) back to the beginning
7242	Press reset back to the beginning of the program(0:edit 1:other)
7250	Press edit (0: no 1: yes) to the program interface
7251	Alarm (0: no 1: yes) cut to the alarm interface
7260	MDI press reset(0:no 1:yes)to delete the program
7261	MDI run program(0:no 1:yes)to delete the program
7262	Program state interface execution, start behavior(0:first 1:cursor)
7270	Program editing (0: no 1: yes) supports block deletion
7280	Whether to insert sequence number automatically (0: no 1: yes)
7290	Position & process monitor display (0:relative 1:remaining)
7300	Display of boot position page (0: program monitor 1: integration)
7310	#100~#199,after reset (0: not empty 1: empty)
7320	#1~#50,after reset (0: not empty 1: empty)
7330	Program Settings switch on when starting (0: yes 1: no)

3.13 Parameters and calculation of Electric gear ratio

Data parameters

0	0	0	X axis pulse output multiplier system(molecule)(default value:10)
0	0	5	X axis pulse output spit frequency(denominator)(default value:10)
0	0	1	Y axis pulse output multiplier system(molecule)(default value:10)

0	0	6	Y axis pulse output spit frequency(denominator)(default value:10)
0	0	2	Z axis pulse output multiplier system(molecule)(default value:10)
0	0	7	Z axis pulse output spit frequency(denominator)(default value:10)
0	0	3	4th axis pulse output multiplier system(molecule)(default value:10)
0	0	8	4th axis pulse output spit frequency(denominator)(default value:10)
0	0	4	5th axis pulse output multiplier system(molecule)(default value:10)
0	0	9	5th axis pulse output spit frequency(denominator)(default value:10)

Calculation of gear ratio of direct connecting screw for 2500 wire speed motor :

$$\frac{\text{Molecule}}{\text{Denominator}} = \frac{10}{\text{Lead screw pitch}}$$

Gear ratio calculation of 2500 line speed motor connecting screw with reduction ratio :

$$\frac{\text{Molecular}}{\text{Denominator}} = \frac{10}{\text{Lead screw pitch}} \times \frac{Z_M}{Z_D}$$

Gear ratio calculation for 2500 line speed motor for rotary (index) shaft:

$$\frac{\text{Molecule}}{\text{Denominator}} = \frac{1}{36} \times \frac{Z_M}{Z_D}$$

Note : *ZM : Number of teeth of the screw end gear.*

ZD: Number of teeth of the motor end gear

Chapter IV Debugging For Other Function

4.1 Orientation / Rigid tapping

Diagnostic signal (Standard PLC program definition)

Signal	Orientation End	C-Axis Ready	Orientation output	Position Shift output
Address	X4.2	X4.0	Y4.2	Y4.0
Pin	Pin08_CN15	Pin05_CN15	Pin22_CN15	Pin20_CN15

Control parameters

All Parameter list-- Orientation/Tapping

Number	Parameter meaning	Value
3010	Spindle (0:following 1: servo) during tapping	1
3020	Rigid tapping selects the 4th axis(0:no 1:yes)	0
3030	Rigid tapping pitch F setting(0:no 1:yes)	1
3040	Upper limit speed of the spindle during tapping cycle	2000
3050	Tapping spindle command multiplication coefficient(molecular)(Spindle motor line speed setting value)	2500
3053	Tapping spindle command division factor (denominator) (first gear)	250
3060	Linear acceleration time constant of the main shaft and the tapping shaft (first gear)	200
3063	Linear acceleration time constant of the spindle and the tapping axis when retracting (first gear)	200
3070	Minimum pause time at the bottom of the hole	10
3071	Maximum pause time at the bottom of the hole	9999
3080	Magnification value when rigid tapping retracts	1
3084	Retraction amount or void amount during deep hole tapping cycle	0
3100	Cs axis (orientation) function (0: invalid 1: valid)	1
3120	Spindle mode switch +24V (0: connect 1: disconnect) is valid	0
3130	Spindle positioning completion detection and +24V (0: disconnect 1: connect) are valid	1
3140	After the spindle positioning is completed (0: no output is disconnected 1: output is disconnected)	0

Note:3020 rigid tapping selects the fourth axis (0:not 1:yes) 0:5th axis tapping 1:4th axis tapping

3020	Rigid tapping selects the fourth axis(0:not 1:yes)	0
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Note :3050 tapping spindle command multiplication factor (molecular) (spindle motor line speed setting value) is set according to motor encoder line number

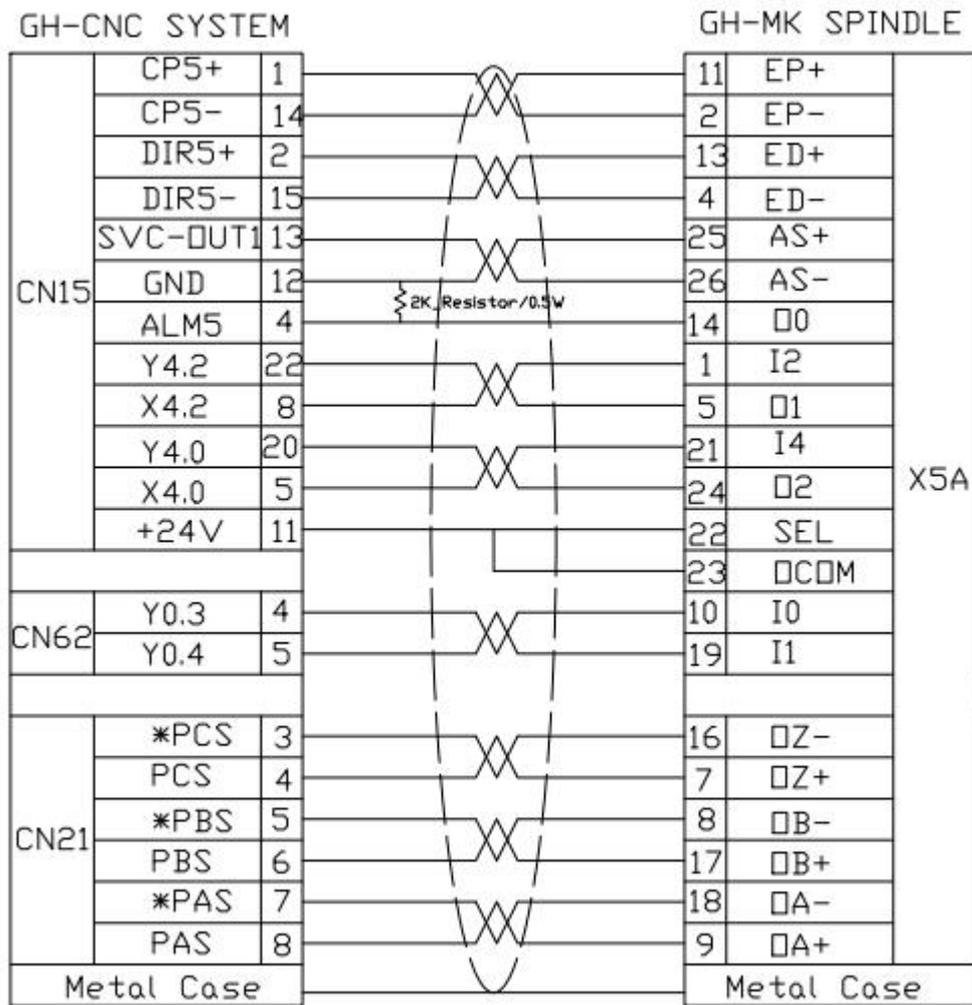
3050	Tapping spindle command multiplication factor (molecular) (spindle motor line speed setting value)	2500
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Note:3120,3130 depending on the actual wiring definition settings

3120	Type of Spindle mode switch (0:NO 1:NC)	0
3130	Spindle mode switch +24V (0: connect 1: disconnect) is valid Spindle positioning completion detection and +24V (0: disconnect 1:	1

	connect) are valid
--	--------------------

4.2 Connection between GH-1000MC & MK Series Spindle System



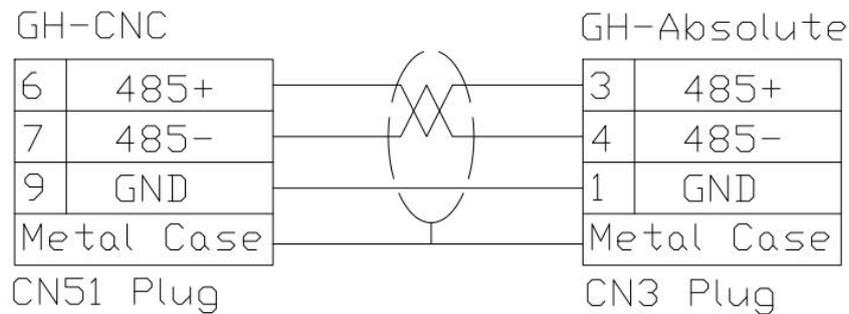
System Parameter Setting

Parameter list —— Spindle parameters

Number	Parameter meaning	Value
0660	Spindle speed(0:Analog voltage control 1:Switching control)	0
0669	Spindle upper limit speed	6000
0670	Corresponding to the maximum speed of the main shaft of the gear 1	6000
0680	Number of lines of spindle encoder	1024
0690	The maximum setting value corresponding to the inverter	65535
0710	Spindle speed analog output bias voltage compensation value	0.00
0900	Whether to set the fifth axis as the analog spindle(0:not 1:yes)	1
0901	Whether to set the fifth axis as the analog spindle(0:not 1:yes)	0
0916	Spindle pulse multiplication factor	1
0917	Spindle pulse division factor	6
0918	Pulse spindle coordinate degree multiplication factor	36
0919	Pulse spindle coordinate degree division factor	1

0930	Pulse spindle forward rotation output delay time(ms)(Effective, set 300)	300
0931	Pulse spindle reverse rotation output delay time(ms)(Effective, set 300)	300
0932	Pulse spindle turn off Y4.1 delay time(ms)(Effective time set 300)	1000

4.3 Debugging with GH Absolute Servo Drive



Wiring Diagram of communication connection

Debugging step:

1. Check the connection of the communication cable.

2. Drive and motor adjustment:(Generally set up, no need to set again;when the alarm 42/43/44 rings,needs to set again)

Steps of zeroing motor

(1) Modify the driver parameter PA-0 to 620,PA-1 to (Motor signal corresponding to the motor code)return to Wr (which seems like ur) press [Enter] for 3 seconds ,it is completed when the “finish”appears.Restart the driver and check if PA-67 is similar with motor rated current multiplied by 10 .

(2) Modify drive parameters PA-0 to 620 ,PA-4 to 4,PA-53 to 0001 ,return to CO—mode,press [Enter] untilA.2000 appears;Return to modify PA-0 to 510.

3. Adjust drivers’ parameters

Steps of adjusting drive parameters:

(1)Eliminate drive alarm:If the drive appears alarm 42,needs to modify PA-0 to 620,modify PA-1 (to the motor code),return to WR mode and press [Enter] for 3 seconds until the “finish” appears,power outage takes effect ;When “Error”appears (failed or input wrong password)

If drive alarm 40 after power on ,modify PA-99 to 1

If drive alarm 44 ,modify PA-0 to 620; Modify PA-4 to 4;Modify PA-53 to 0001,back to co--mode,and press [Enter] until A.2000 appears ;And return to PA-0 ,modify it to 510 .

(2)Setting drive parameters :Setting the motor code ,modify PA-0 to 620,modify PA-1 to(Corresponding motor code). Modify PA-0==510, modify PA-80A to (?)(X axis -1,Y axis-2,Z axis-3, 4th axis -4,5th axis-5)

(PA81==2,PA82==0,PA84==0 Driver defaults do not need to be changed)

(3)Drive parameter saving:Return to EE—mode ,press [Enter] into EE-SET mode ,press [Enter] until“finish”appears,it means complete.

4. System parameter modification

Parameters list——Absolute parameter

Number	Parameter meaning	Value
1500	Drive communication method(0:Pulse 1:Total wire)	1
1510	System coordinate and motor coordinate alarm difference of Link mode	0.10
1520	Communication channel baud rate (transfer file)	19200
1540	Mechanical zero(0:Not remembering)	1

1550	X axis (0:is 1:not absolute value switch)	0
1551	Y axis (0:is 1:not absolute value switch)	0
1552	Z axis (0:is 1:not absolute value switch)	0
1553	4 th axis (0:is 1:not absolute value switch)	0
1554	5 th axis (0:is 1:not absolute value switch)	0
1580	X-axis read absolute coordinate (0: no reverse 1: Reverse)	0
1581	Y-axis read absolute coordinate (0: no reverse 1: Reverse)	0
1582	Z-axis read absolute coordinate (0: no reverse 1: Reverse)	0
1583	A-axis read absolute coordinate (0: no reverse 1: Reverse)	0
1584	B-axis read absolute coordinate (0: no reverse 1: Reverse)	0
1600	Servo X-axis command multiplication factor(CMR)	1
1601	Servo Y-axis command multiplication factor(CMR)	1
1602	Servo Z-axis command multiplication factor(CMR)	1
1603	Servo 4 th axis command multiplication factor(CMR)	1
1604	Servo 5 th axis command multiplication factor(CMR)	1
1605	Servo X-axis command division factor (CMD)	1
1606	Servo Y-axis command division factor(CMD)	1
1607	Servo Z-axis command division factor(CMD)	1
1608	Servo 4 th -axis command division factor(CMD)	1
1609	Servo 5 th -axis command division factor(CMD)	1

Parameters list ——Limit/Home parameter

Number	Parameter meaning	Value
1200	manually clear machine coordinates(0:ineffective 1:effective)	1

5. Electronic electric gear ratio setting (Absolute gear ratio in system settings)

Parameters list —feed axis parameters

Number	Meaning of parameters	Value
1060	X-axis command multiplication factor (molecular)	10
1061	X-axis command division factor (denominator)	10
1062	Y-axis command multiplication factor (molecular)	10
1063	Y-axis command division factor (denominator)	10
1064	Z-axis command multiplication factor (molecular)	10
1065	Z-axis command division factor (denominator)	10
1066	4 th -axis command multiplication factor (molecular)	10
1067	4 th -axis command division factor (denominator)	10
1068	5 th -axis command multiplication factor (molecular)	10
1069	5 th -axis command division factor (denominator)	10

Absolute gear ratio algorithm :

The number of pulses emitted by the encoder $(10000) \div (L \times 1000)$; L is the screw pitch;

Multiply the reduction ratio when there is a reduction ratio.

Note:GH-1000C absolute value drive has pulse conversion function inside. Calculate the electronic gear ratio only needs to calculate by 10,000 pulses .

6. Clear the zero point of machine

Press continuously the button [Position] ,until the [Current position (integrated coordinates)] shows on the system screen upper left corner .Press the [Lathe zero point] button and press the buttons [X/Y/Z] of system panel,after the X,Y,Z of machine coordinate flashing ,

press the button [Cancel],clear the lathe coordinate

7. Trial run each axis

Move each axis manually or by handwheel, shut down lathe and restart

Observe is there a alarm (The axis drive coordinates are inconsistent with the system coordinates. Press the reset button to correct the communication error.)

If there is no alarm , that means it is normal :

If there is a prompt message : Communication error alarm. Check if the communication line is normal . Bit parameter of system parameters 174.0=1, data parameters of communication method total wire : P164==0.1 , P44==19200,if there is setting correctly ; Drive parameters PA-80 , whether the setting corresponding axis is correct or not .

If there is a prompt message : The axis drive coordinates are inconsistent with the system coordinates. Press the reset button and renew the alarm . Now position (comprehensive coordinate) record (machine coordinate) coordinate value of each axis, press [Reset] to update the coordinates, and observe whether the coordinate value of each axis of the current position (combined coordinate) (machine coordinate) changes more than 0.1.

If there are individual axes whose coordinate changes exceed 0.1, the system parameters can be modified. :

Parameters list —Absolute parameter.

Number	Meaning of parameters	Value
1580	Read X axis absolute coordinate (0:not negate 1:negate)	0
1581	Read Y axis absolute coordinate (0:not negate 1:negate)	0
1582	Read Z axis absolute coordinate (0:not negate 1:negate)	0
1583	Read 4 th axis absolute coordinate (0:not negate 1:negate)	0
1584	Read 5 th axis absolute coordinate (0:not negate 1:negate)	0

Modify the data parameter PA-15;Change the 0 into 1,change the 1 into 0.Power off and restart ,press [Reset] update coordinates . And move each axis manually or by handwheel, shut down lathe and restart,if there is no alarm , that means it is normal.If there is a alarm ,check that whether the electronic gear ratio setting is normal or not .

Note :After the adjustment is normal, you need to change the direction of the axis movement to change the system status parameter 008.

After the setting is normal,reset the lathe zero ,set the machine tool soft limit:

8. Soft limit setting

Parameter list —Limit/Homing parameter

Number	Meaning of parameters	Value
1210	Soft limit function before zero return (0:ineffective 1:effective)	1
1211	Lathe zero mode (0:check 1:not check)soft limit alarm	0
1212	Send the exceed speed instruction ,alarm (0:in 5MM 1:after0 .5MM)	1
1213	Fast moving software limit alarm (0:lag 1:correct)	1
1220	X-axis soft limit negative maximum stroke setting	-9999
1221	X-axis software limit positive maximum stroke setting	9999
1222	Y-axis soft limit negative maximum stroke setting	-9999
1223	Y-axis software limit positive maximum stroke setting	9999
1224	Z-axis soft limit negative maximum stroke setting	-9999
1225	Z-axis software limit positive maximum stroke setting	9999
1226	4 th -axis soft limit negative maximum stroke setting	-9999

1227	4 th -axis software limit positive maximum stroke setting	9999
1228	5 th -axis soft limit negative maximum stroke setting	-9999
1229	5 th -axis software limit positive maximum stroke setting	9999

Chapter V Debug with Umbrella tool magazine

5.1 Tool magazine debugging precautions

- (1) During the tool change process, make sure that each action is completed before proceeding to the next action.
- (2) The tool magazine positioning sensor is not confirmed before it can be fed.
- (3) The spindle tool number does not correspond to the tool holder number.
- (4) The spindle of the machine tool has not returned to the tool change point and cannot be fed.
- (5) The spindle cannot be changed before the spindle positioning is completed.
- (6) The knife sleeve cannot rotate without the position where the knife sleeve rotates.
- (7) The tool change is not completed, and the spindle head cannot be moved before the knife sleeve is returned to the home position.
- (8) When the motor voltage is too high, the overload protection relay should trip first to avoid the motor burning.
- (9) Please perform the tool change manually, to check the forward movement of the knife sleeve, back, the spindle grasping knife and so on, and then start the CNC automatic sequence program control.
- (10) During the debugging process, you only need to modify the input and output signals X, Y in the ladder program to complete the debugging requirements. In case of uncertainty, do not modify others to avoid accidents.

5.2 Input/output signal of Umbrella type tool magazine

5.2.1 Input signal (CN61 plug,DB44/Female)

Pin	Add.	Instruction	Note
3	X0.2	Manual clamp/loose tools	Use NO type input
9	X1.0	Spindle tool loose in place signal	Use NO type input
10	X1.1	Spindle tool clamp in place signal	Use NO type input
11	X1.2	Zero point of Magazine	K30.2: input type selection
29	X2.0	Position of Forward Magazine	K30.3: input type selection
30	X2.1	Tool magazine back in place signal	K30.4: input type selection
31	X2.2	Tool magazine count in place signal	K30.5: input type selection
35	X2.6	Exist Tool on current tool holder	K32.3: input type selection
36	X2.7	Exist Tool on Spindle Chuck	K32.1: input type selection

5.2.2 Input/Output signal (CN15 plug,DB25/Male)

Pin	Add.	Definition	Note
8	X4.2	Orientation end	K21.1:input type selection
22	Y4.2	Spindle Orientation output	M19/M18

5.2.3 Output signal (CN62 plug,DB44/Mmale)

Pin	Add.	Definition	Instruction	Note
3	Y0.2	TCLA	Tools release	M16/M17
38	Y3.1	TCCY	Tool magazine forward	M21/M22
39	Y3.2	TCWY	Tool magazine reverse	M21/M22
40	Y3.3	TFRY	Tool magazine move forward	M21
41	Y3.4	TBAY	Tool magazine backward	M24
42	Y3.5	TBAL	Output for backward indicator	

Note: M21/M22/M24 cannot be used alone.

5.3 Parameters for Umbrella type tool magazine

Parameters list—Tools parameters

Para.	Number	Meaning of parameters
NUM	P052	1st reference point value of Z-axis (default:0)
NUM	P057	2nd reference point value of Z-axis (Position for put/take tool)
NUM	P062	3rd reference point value of Z-axis (Safe Position for up spindle)
Note: default value of 1 st reference point is set to 0, 2 nd reference point is for put tool back to magazine & take tool from magazine,3rd reference point is up position for spindle chuck,so that magazine can be rotated after chuck is loose.(all are machine coordinate value).		
PLC	K014.6	(0:Check 1:Not check)tool clamping/releasing in-position signal
PLC	K014.0	Spindle losing signal is effective(0:connect 1:disconnect)with +24V
PLC	K014.1	Spindle clamping signal is effective(0:connect 1:disconnect)with +24V
PLC	K021.1	Spindle Orientation signal is effective(0:connect 1:disconnect)with +24V
PLC	K030.1	Tool magazine (0: no 1: yes) with zero return switch
PLC	K030.2	Magazine zero return switch is effective with +24V(0:disconnect 1:connect)
PLC	K030.3	Type of switch/sensor for detect position of magazine forward (0:NO,1:NC)
PLC	K030.4	Type of sensor for detect position of magazine backward (0:NO,1:NC)
PLC	K030.5	Tpe of counting tools switch/sensor (0:NO,1:NC)
PLC	K030.7	Magazine enter debug mode (0:No, 1:Yes)
PLC	K031.0	It can detecting position signal of clamp even if without tool(0:Yes 1:No)
Note: this parameter is used for that sensor can not detect signal after spindle is clamped without tool, if with this spindle&sensor, set to 1.		
PLC	K031.2	Reset output after position of tool magazine forward (0:No, 1:Yes)
PLC	K031.3	Reset output after position of tool magazine backward(0:No, 1:Yes)
PLC	K032.0	Detection that exist tool in spindle(0:No, 1:Yes)
It is used for that if there is switch on spindle for checking tool or not, normally machine tool hasn't this switch, set to 0.		
PLC	K032.1	Type of detection switch for check tool in spindle(0:NO, 1:NC)
PLC	K032.2	Detection that exist tool in current tool holder on magazine(0:No, 1:Yes)
It is used for that if there is switch for detecting current tool holder is with tool or not, normally machine tool hasn't this switch, set to 0.		
PLC	K32.3	Type of switch for detecting current tool holder in position(0:NO, 1:NC)
PLC	K032.4	Prohibit software-limit during exchanging tool(0:No,1:Yes)
<i>Set to 0 on umbrella tool magazine.</i>		

PLC	K032.5	Alarm when current tool number in spindle is 0 (0:Yes, 1:No)
<i>This parameter is just for hint that don't put tool into spindle chuck when current tool number in spindle is 0.</i>		
PLC	T007	Delay time after spindle unclamp tool done (default: T007=30 unit: ms)
PLC	T008	Delay time after spindle clamp tool done (default: T008=30 unit: ms)
PLC	T009	Delay time for detect position of spindle unclamp tool(T009=5000 unit: ms)
PLC	T020	Delay time for detect position of spindle clamp tool(T020=5000 unit: ms)
PLC	T004	Delay time after output orientation (default: T004=30 unit: ms)
PLC	T018	Delay time before detecting orientation end (default: T018=2000 unit:ms)
PLC	T023	Time of finishing detection of orientation end (default: T023=10000 unit: ms)
PLC	T100	Delay time of output CW_Magazine on manual (default: T100=0 unit:ms)
PLC	T101	Delay time of output CCW_Magazine on manual (default: T101=0 unit:ms)
PLC	T102	Delay time before detecting magazine stop. (default: T102=0 unit:ms)
PLC	T103	Time of detecting counting tool sensor (default: T103=0 unit:ms)
PLC	T104	Delay of detection of downward tool holder (default: T104=5000 unit:ms)
PLC	T105	Delay of detection of upward tool holder (Default: T105=5000 unit:ms)
PLC	T106	Delay after downward tool holder (default: T106=50 unit:ms)
PLC	T107	Delay after detection of upward tool holder (default: T107=50 unit:ms)
PLC	T108	Delay time before detecting counting tool sensor (default: T108=0 unit:ms)
PLC	T109	Delay time before detecting magazine home sensor (default: T109=0 unit:ms)
PLC	T110	Delay time of magazine rotation (default: T110=3000 unit: ms)
PLC	T111	Delay time before detecting position of counting sensor (default: T111=2000 unit:ms)
PLC	T116	Delay time for positioning of counting sensor (default: T116=60 unit:ms)
PLC	C100	Total tools on magazine (C100= must be total tool number on magazine)
PLC	D100	Total tools on magazine (D100= C100, don't need set)
PLC	D101	Command Tool number (input by command,cannot be altered)
PLC	D102	Front one tool number of command tool number (cannot be altered)
PLC	D103	Counting position of magazine plate (cannot be altered)
PLC	D104	Exchange tool number when manual change tool (cannot be altered)
PLC	D105	Current tool number in spindle (can be altered if wrong)
PLC	D120	Address of magazine return tool back/search tool (cannot be altered)
PLC	D121	Result of magazine return tool back/search tool (cannot be altered)
PLC	D124	Range of search tool (D123=D100+1,figure out auto, cannot be altered))
PLC	D126	Range of spindle zero speed output (D126=30 , unit: rpm)
PLC	D000	Tool number on No.0 tool pot of magazine (D000=100)
PLC	D001	Tool number on No.1 tool pot of magazine (D001=1)
PLC	D002	Tool number on No.2 tool pot of magazine (D002=2)
PLC	D003	Tool number on No.3 tool pot of magazine (D003=3)
...	...	
PLC	D097	Tool number on No.97 tool pot of magazine (D097=97)
PLC	D098	Tool number on No.98 tool pot of magazine (D098=98)
PLC	D099	Tool number on No.99 tool pot of magazine (D099=99)

Note: C100,D100 must be less than 100,max tools are 99 pcs. E.g.: when C100=16, D000-D016 are valid,

when C100=24, D000-D024 are valid.

5.4 M commands & Parameter

5.4.1 M commands table

M16	Spindle chuck Loose Tool
M17	Spindle chuck Clamp Tool
M18	Spindle orientation cancel
M19	Spindle orientation
M21	Magazine Forward
M22	Magazine search tool
M24	Magazine Backward
M50	Starting change tool
M51	End of change tool

5.4.2 Parameter set For Umbrella Tool Magazine

1. There are functions that loose/clamp tool on spindle chuck, which can select that with sensor/switch for detecting position of loose/clamp tool.
 2. Spindle can be selected with orientation function or not, if without orientation function, delete M19/M18 on O9101 macro program.
 3. Total tools on magazine must be less 100pcs
 4. Magazine can be rotated with CW & CCW direction
 5. There are counting switch/sensor, switches/sensors for detecting position of forward/backward on tool magazine
 6. User can select home switch or not on tool magazine.
- If tool magazine is without home switch, all of detection switches on magazine are NO type, set K030.1=0 , K030.3=0 , K030.4=0 , K030.5=0 .

5.5 Control conditions of Umbrella Tool Magazine

5.5.1 Process of Auto Tool Change

- (1) Execute exchange tool code: M06 T##; judge if exchange tool, machine lock, M.S.T lock, tool number in spindle is same to T##, CNC machine doesn't exchange tool;
- (2) In Start of change tool, spindle, coolant,model status are canceled;
- (3) Start auto tool change, judge if conditions for exchange tool are fitted, otherwise alarm. Conditions: right T## code, Z-axis homing successfully,tool is clamped;
- (4) Judge if skip parts of return tool back to magazine if current tool number in spindle is 0, or switch/sensor detecting that there isn't tool on spindle.
- (5) If not skip, magazine search for tool holder ,which is for put tool in spindle, after okay,move to point of put tool,forward tool magazine,unclamp tool & move up Z-axis to 3rd reference point, for return tool back to magazine;
- (6) Magazine rotate & search for T## tool,& confirm counting sensor is valid;if T0,don't search tool on magazine,just skip this parts;
- (7) Spindle down to clamp tool after magazine is at position of forward;
- (8) Magazine backward after spindle clamp tool;
- (9) End of change tool.

5.5.2 Conditions of Manual Control Tool Magazine

There are special Tool control pages for controlling tool magazine manually on PLC screen,after select F5 enter [Tool Ctrl] page,press F5 again to enter menu of [Tool Ctrl] page.

Functions of F keys are corresponding as following:

[ToolsZero]: Tool Magazine go home

[Forward]: Magazine rotate with forward direction

[Reverse]: Magazine rotate with reverse direction

[AheadOver]: Magazine go forward to put tool back (umbrella tool magazine) or down tool holder pot for exchange tool (arm tool magazine).

[BackTurn]: Magazine go backward to exit tool(umbrella tool magazine) or up tool holder pot back to magazine(arm tool magazine)

[Arm Ctrl]: Rotate arm for grasp tool/ exchange /back arm to home(arm tool magazine)

[Refer 2]: Z-axis moves to No.2 reference point

[Refer3]: Z-axis moves to No.3 reference point

User can control actions of tool magazine manually,for checking if every steps of change tool is right or not.

Conditions:

1) User control rotation of magazine/forward or backward magazine manually must at Manual/MPG status, do homing of magazine must at Machine Zero/Homing status.

2) Conditions of user can control rotation of magazine: CNC system is standby, Manual/MPG status, Z-axis is at 3rd reference point or magazine is at backward position.

3) Conditions of magazine go home: there is homing switch on magazine, CNC system is standby, Machine zero status, magazine is at backward position.

4) Conditions of forward magazine: CNC system is standby, on Manual/MPG status, tool number in spindle & current tool holder number are same,Z-axis is at 2nd reference point, counting sensor is ON, spindle orientation end.

5) Conditions of backward magazine; CNC system is standby, on Manual/MPG status, spindle clamp tool in position.

Precautions:

1. Confirm Emergency stop button is working.

2. Ensure wiring diagram for tool magazine is right.

3. There are nothing during movement of magazine.

5.5.3 Debug of Umbrella Tool Magazine

<1> Function of tool change is valid

A. PLC ladder of ladder01.grp is for hat tool magazine, and set P304 on NUMPAR to 1.

B. PLC parameter: K1.0=1 ; K1.1=0 ; K1.3=0

<2> Check direction of rotating magazine manually

A. Set K30.7=1,open debug function of ATC, cancel control condition of magazine.

B. Press **[Forward]** key on Manual/MPG status,for checking tool number is increasing, Press **[Reverse]**key on Manual/MPG status, for checking tool number is decreasing, if opposite,which will affect tool counting wrong,and exchange tool failure.We can change output wires or phases of magazine motor to solve it.

<3> Check Forward/Backward Magazine manually

A.Set K30.7=1, open debug function of ATC, cancel control conditions of magazine.

B.Z-axis goes to home,and ensure magazine cannot hit to spindle.

C.Press **[AheadOver]** key on Manual/MPG status, Magazine go forward to put tool back (on right side); Press **[BackTurn]** key on Manual/MPG status, Magazine go backward to exit tool(on left side). If directions are opposite, exchange electric valves/air pipe.

<4> Homing Operation of Umbrella tool magazine

a. when there is homing switch on hat tool magazine, set K30.1=1 , K30.7=1 , open debug function of tool magazine, cancel limitations of manual control tool magazine.

1) Press **[BackTurn]** key on Manual/MPG status ,let magazine back to left side

2) Shift to Machine Zero status, press **[ToolsZero]** key,magazine is homing,and cnc hints warning of magazine is do homing.(A20.5);

3) After magazine homing is done, cancel A20.5 alarm,and hints A15.3, magazine's home set successfully, press **[RESET]** key to cancel alarm, homing of magazine is finished,and current tool number on spindle turns to 1.

4) If magazine doesn't detect homing switch signals within 5 minutes, system will alarm A15.2, magazine homing detection failure.

b. when there isn't homing switch on hat tool magazine, set K30.1=0.

1) In Manual/MPG status, press **[Forward]** or **[Reverse]** key to rotate plate of tool magazine to No.1 tool pot;

2) Holding on **[Machine Zero]** key with 7 seconds, system will hint A15.3 alarm, magazine's home set successfully,press **[RESET]** key to cancel alarm, homing of magazine is finished.

Note: After homing of tool magazine, tool pot & tool on spindle both are 1.

<4> Set of Spindle Orientation Position & Z-axis Coordinate value

a. Degree of spindle orientation(please check manual for spindle servo driver)

Example: take SZGH-MK series spindle servo system:

1. CNC system enter to level2 operation authority, open debug function of ATC (K30.7=1), CNC system hints A20.4 alarm, function of debug of ATC is open, magazine can be operated without limiting conditions;

2. On Machine Zero status,let Z-axis go home, after Z-axis homing done, if Z-axis height is not right for exchange tool, move Z-axis up on Manual/MPG,avoid magazine hits spindle devices.

3. Prepare one tool handle, remove pull stud,

4. Shift to Manual/MPG status, press **[AheadOver]** key,let magazine go forward to right side for put/take tool tool,

5. Put this tool handle without pull stud into tool holder,adjust position well;

6. Shift to MPG status, which can move up/down of Z-axis(operate carefully!!!); adjust position of spindle chuck,which can let spindle chuck fit to tool holder;

7. Press Down key on spindle servo driver(it display run) to H display,H means absolute position of one rev of spindle, set H value to P54_12 on spindle servo driver,

8. Move up Z-axis, let spindle chuck move away from tool handle, &take out tool.

b. Set of Z-axis coordinate points for exchange tool:

1. After spindle orientation position set done, on Manual/MPG status, move Z-axis up to safe position, press **[Orientation]** key, spindle do orientation, and then press **[T.Change]** key to loose tool on spindle chuck, put tool with pull stud into magazine,and adjust position well(currently magazine still is at right side for put/take tool) .

2. Shift to MPG status on CNC, move Z-axis to safe position after loose tool,(it must be higher than height of pull stud),record current Z-axis machine coordinate value,and input to 3rd reference point(P062 on NUMPAR/Safe Position for up spindle),which must be set well & right,otherwise it will damage mechanical parts on tool magazine (Ensure spindle is at range of allow magazine rotation);normally Z0 point is higher than height of pull stud, so we can set same values for 1st reference point & 3rd reference point.

3. After step2 okay,ensure spindle chuck is on loose status,and spindle orientation end, move down Z-axis to position of put/take tool with handwheel,(ensure spindle chuck is loosen), record current Z-axis machine coordinate value, and input to 2nd reference point (P057 on NUNPAR/Position for put/take tool), .

4. Press [**T.Change**] key to clamp tool,confirm tool is clamp well, and press [**BackTurn**] key to return magazine back to left side.

5. After okay, turn off function of debug of ATC,set K30.7 to 0.

Note: it must confirm 2nd & 3rd reference points are set right.

5.6 Debug of Macro Program

Open the tool macro program O09101, add a tool number at the beginning of the program, automatically run the program in single segment, observe the tool change process in the tool change process, the tool magazine advances and retreats, the loose tool clamp knife is correct; Confirm the automatic tool change After the action is correct, delete the tool number at the beginning of the O9101 program.

```
O9101;
T1;//Added when debugging single-stage operation, delete after debugging;
G65H81P50Q#1003R1;//G54.3 interface tool is equal to spindle tool not performing tool
change
G69G50G15G80G40;
M50;//Automatic tool change starts
G65H81P20Q#1000R1;//G54.0 Spindle without tools
M19G00G91G49G30Z0;//Z axis go under spindle orientation.(Quickly reach the second
reference point)
M21;//Tools forward .
N20M16;// Tools loose tool
M19G91G49Z28Z0;//Z axis go up (Quickly reach the first reference point)
G65H81P30Q#1002R1;//G54.2 interface tool is zero
M22;//Tool magazine rotation
G91G30G49Z0;//Z axis go under (Quickly reach the second reference point)
N30M17; Spindle tools hold
M24;//Tool magazine back
M18;//Cancel the spindle orientation
M51;//Automatic tool change end
N50 M99;
%
```

Debugging completed, delete tool number with a beginning of 09101. Under the MDI mode. Run the tool change command M6 T; Observe whether the automatic tool change action is normal. After confirming that it is normal, close it and modify the macro parameters.

Complete tool change macro program

```
O9101:
G65H81P50Q#1003R1;//G54.3 The interface tool is equal to the spindle tool and does not
perform the tool change .
G69G50G15G80G40;
M50;// Automatic tool change starts
G65H81P20Q#1000R1;//G54.0 spindle without a tool
```

```

M19G00G91G49G30Z0;//Z axis go under spindle orientation (Quickly reach the second
reference point)
M21;//Tool magazine move forward
N20M16;//tools loosing .
M19G91G49G29Z0;Z axis goes up (Quickly reach first reference point)
G65H81P30Q#1002R1;//G54.2 interface tool is zero
M22;//Tool magazine rotation
G91G30G49Z0;//Z axis go down (Quickly reach the second reference point)
N30M17;//Spindle hold tool
M24;//Tool magazine retreating
M18;//Cancel spindle orientation
M51;//Automatic tool change end
N50 M99;
%
```

5.7 Scrambled tool processing

After the tool change process is correct, confirm that the current tool number of the spindle matches the tool magazine cutter number. If they are consistent, the debugging is completed. If they are inconsistent, the tool magazine must be adjusted to correspond to the spindle tool number:

Adjustment steps

- (1)The tool magazine has a zero switch installed. You only need to press the [tool magazine zero return key] in the mechanical zero return mode.
- (2)When the tool magazine does not replace the zero switch, turn the tool magazine to the position of the No. 1 tool, and press and hold the [Machine zero button] for 10 seconds until the system alarms to indicate that the magazine zero setting is valid. Press [Reset] to clear. Alarm prompt .

5.8 Solution for solve alarm of Tool magazine

(1) Alarm information:A002.1 Low pressure alarm (Input signal is X0.7)

Cause of error :1.Air pressure valve is not open, pressure is not enough

2.There is a problem with the effective level setting of the pressure detection signal.

Solution: 1.Open the air valve

2.Increase pressure

3.Set the parameters correctly according to the high and low levels of the pressure detection signal

The following parameters can be modified

Parameter list - machine tool

0110	Pressure detection time(ms)
0111	Pressure alarm signal (0:disconnect 1:connect)with +24V

(2)Alarm information:A010.4 Spindle tool clamping detection abnormal

Cause of error :When the tool clamping action is executed(Y0.2=0), the magazine clamp detection switch (X1.1) is not closed within the time set by T020.

Solution: 1.Check if the spindle loose clamp device has a loose/clip detection switch. If the test switch is not installed, it can be shielded and detected.

2.If there is a loose/clip detection switch, check if the detection switch is normal.

3.If there is a loose/clip detection switch,(1)Every time the tool change is started, the alarm is needed,the detection and clamping time needs to be modified. (2)After the change is completed, the detection switch X1.1 has been sensed, but after the detection of the clamping time, the alarm is also issued, and the detection switch must be modified.

The following parameters can be modified:

Parameter list -Tools

1820	(0:check 1:do not check)tool loose/clip in-position signal	0
1830	Spindle clamping signal is valid (0:connect 1:disconnect)with +24V	1
1843	Spindle tool clamping detection delay	8000

(1) Alarm information:A010.5 spindle tool release detection abnormal

Cause of error :When the tool release action is executed (Y0.2=1), the tool magazine clamp detection switch (X1.0) is not closed within the time set by T009.

Solution:1.Check whether the spindle loose clamp device has a loose/clip tool detection switch , if it is not equipped with a detection switch, it can be shielded and detected.

2.If there is a loose/clip tool detection switch, check if the detection switch is normal.

3.If there is a loose/clip detection switch,(1) an alarm will appear each time the tool change starts, then the detection release time will be modified.

(2)After the tool is released, the detection switch X1.0 has sensed, but after the detection release time, the alarm is also issued, and the detection switch is modified to be high and low.

The following parameters can be modified:

Parameter list -Tools

1820	(0:check 1:do not check)tool loose/clip in-position signal	0
1831	Spindle loosening signal is valid (0:connect 1:disconnect)with +24V	1
1842	Spindle tool loosening detection delay	8000

(2) Alarm information:A010.7 The spindle loose/clip knife is abnormally detected.

Cause of error : The spindle tool is neither in the released position nor in the clamped position

K014.0(1/0 spindle loosening signal of low level / high level is effective)and K014.1(1/0 spindle loosening signal of low level / high level is effective),the setting is incorrect

Solution: 1 Check whether the spindle loose clamp device has a loose/clip tool detection switch , if it is not equipped with a detection switch, it can be shielded and detected.

2 Check if the detection switches X1.0 and X1.1 are normal.

3 If the switch is normal, K014.0 and K014.1 are correctly set according to the effective output levels of the two signals.

The following parameters can be modified

Parameter list -Tools

1820	(0:check 1:do not check)tool loose/clip in-position signal	0
1831	Spindle clipping signal is valid (0:connect 1:disconnect)with +24V	1
1842	Spindle tool losing detection delay	1

(5)Alarm information: A012.2 The tool magazine stops abnormally and reconfirms the tool number.

Cause of error :During the execution of the Txx command and the magazine is spinning, an alarm has occurred or the reset button has been pressed, which will cause this alarm to occur.

Solution:1 If there is a zero return switch, the tool magazine can be re-executed.

2 If there is no magazine for the zero return switch, you need to change K30.6 to 1, press the reset button to cancel K30.6 and change back to 0; then press the tool magazine to solve the problem.

(6)Alarm information:A012.5 Spindle orientation timing detection is abnormal

Cause of error :1. X4.2 signal is abnormal
2. X4.2 signal input high and low settings are incorrect .

Solution:1. Check if the X4.2 signal is normal.
2. According to the effective output level of X4.2, correctly set the parameter K021.1

The following parameters can be modified :

Parameter list - Orientation/tapping

3130	Detection of Spindle Orientation End with +24V (0: disconnect 1: connect) are valid	1
3140	(0:Do not disconnect output 1:disconnect output)after spindle orientation end	0

(7) Alarm information:A013.1 Spindle positioning in position detection abnormal

Cause of error : When the tool change macro program is executed to M19, the system does not detect the orientation to the incomplete signal within the set time of T023 and generates an alarm (X4.2 directed in-position signal).

Solution:1 . Check if there is any orientation to complete the feedback signal, and if the orientation is complete, the feedback signal is connected to the internal 24V of the system.

2. After the orientation is completed, the feedback signal is connected, and the system does not detect the completion signal, indicating that the relay terminal of the servo driver is not working. Please modify the servo driver parameters.

(8)Alarm information:A013.3 The magazine is not rotatable at the origin position

Cause of error :When the Z axis is not at the first reference point, press the [tool magazine forward key] or [tool magazine reverse key] to issue an alarm in the manual mode; No alarm will occur in the tool magazine

debugging state K30.7=1.

Solution:1.Perform machine zero return, so that the system remembers the machine zero position. The Z axis zero position is the Z-axis first meal opening position, then manually rotate the tool magazine.

2.When the machine has returned to zero, the G91 G28 Z0 can be run in the MDI program state, so that the Z axis returns to the first reference point.

(9)Alarm information:A013.6 Spindle tool cannot be changed at release state

Cause of error :When the spindle tool is released in the state of Y0.2=1, an alarm is issued when the tool change macro program is executed to the M50 automatic tool change.

Solution:Manually press [Change Tool Key] to turn off Y0.2 output, and then change the tool again.

(10)Alarm information: A013.7 The tool magazine is not in the retracting position and cannot be changed.

Cause of error :The system does not detect the tool retracting in-position signal when executing the tool change macro program execution to the M50 automatic tool change.

Solution:1.Check if the tool magazine is in the backward position. If the backward position signal is sensed and there is signal input X2.1, it is treated by [2]. If the backward position signal is sensed but no signal input X2.1, use [1]] Method processing.

[1] Check if the tool magazine retreats in place signal X2.1 is damaged, replace the sensor

[2] Check if the magazine is back to the bit signal level setting error, reset the level

The following parameters can be modified :

Parameter list - tools

1962	Tool magazine vertical/reverse in-position signal is effective when (0:disconnect 1:connect)with +24V	1
------	---	---

(11) Alarm information: A014.5 The tool magazine origin position is lost and needs to be returned to zero.

Cause of error : The tool magazine with the tool magazine zero return switch, press [Reset] or emergency stop or alarm during the zero return process, the tool magazine stops rotating, and the tool magazine does not return to the tool magazine origin position and does not sense the tool magazine zero return in place signal X2.5. An alarm is issued.

Solution: 1.Check if the tool magazine has a zero return switch. If there is no zero return switch, set the parameter to no zero return switch. Press the reset button to cancel the alarm.
2.If there is a tool return switch, check whether the zero

return level signal level setting is correct; you can eliminate the alarm by performing a tool magazine zero return.

The following parameters can be modified:

Parameter list - tools

1960	The tool magazine(0:has not 1:has) a zero return switch	0
1961	Tool magazine return to zero switch is effective when (0:connect 1:disconnect)with +24V	1

(12)Alarm information:A015.0 The tool magazine is abnormal and needs to be re-zeroed.

Cause of error :1. When the magazine rotation is stopped, the magazine counter input X2.2 is not sensed after the T102 setting time.

2.After the T103 setting time in the tool change tool selection, the tool magazine counter signal input has not been sensed.

Solution: 1.Check if the position of the magazine counter is correct (can be sensed after the tool change is stopped). If the position is wrong, adjust the counter position; if the position is correct and the counter has a sensing signal input, modify the counter input level; if the position is correct but the counter is not induction signal input, need to replace the tool magazine counter

2.If the counter setting is correct and the counter sensing is not damaged, only the position of the tool magazine rotation stop is wrong. Processing method 1: There is a zero return switch tool magazine that can directly return the tool magazine to zero, and the library can be returned to zero. 2: Tool magazine When there is no return switch, it is processed according to the chaotic tools processing method of the tool magazine without zero return switch.

The following parameters can be modified:

Parameter list - tools

1964	Tool magazine counting switch is effective when (0:connect 1:disconnect)with +24V	0
------	---	---

(13)Alarm information:A015.1 Tool magazine feed detection abnormal

Cause of error : 1.The tool magazine advance signal is sent. After the set time of T104, the tool magazine advancement in-position signal X2.0 is not detected, and an alarm is issued.

Solution: 1.Check if the X2.0 signal is normal. If the sensor is damaged, it needs to be replaced. If the signal input is normal, an alarm is still issued. 1. The position of the sensor is not correct. After the magazine is advanced, there is still no induction. The position of the sensor needs to be adjusted. 2. The tool magazine advances and senses the switch, and there is X2.0 signal input, there is still an alarm, need to modify the X2.0 input level selection

2. The tool magazine generates an alarm as soon as a forward

signal is issued, it is because the tool magazine advances the position detection time setting too short, and it is necessary to reset the tool magazine forward position detection time.

The following parameters can be modified:

Parameter list - tools

1963	Tool magazine horizontal /advancement in-position signal is effective when(0:disconnect 1:connect)with +24V	1
2011	Tool magazine feed/vertical delay detection	5000

(14) Alarm information:A015.2 Tool magazine retraction detection abnormal

Cause of error :The tool magazine back signal is sent. After the set time of T105, the tool magazine does not detect the backward position signal X2.1, and an alarm is issued.

Solution:①Check if the X2.1 signal is normal. If it is damaged, please replace the sensor. If the signal input is normal, there is still an alarm. 1. The position of the sensor is not correct. The magazine is retracted but not sensed. You need to adjust the position of the sensor. 2. The tool magazine has already detected the switch and has X2.1 signal input, but there is still an alarm. It is necessary to modify the X2.1 input level selection.

②When the tool magazine generates a back signal and generates an alarm, it is because the tool magazine back position detection time setting is too short, and the tool magazine is reset to the position detection time.

The following parameters can be modified

Parameter list - tools

1962	Tool magazine vertical/reverse in-position signal is effective when (0:disconnect 1:connect)with +24V	1
2012	Tool magazine retraction/horizontal delay detection	5000

(15) Alarm information:A015.3 Tool magazine zero position setting is successful

Cause of error :1.After manually resetting the tool magazine or the tool magazine to return to zero, the alarm will indicate that the tool magazine origin has been reset.

Solution: 1. Press the [Reset] and clear the alarm .

(16) Alarm information:A015.4 The tool change stops abnormally to ensure that the tool magazine is normal.

Cause of error :When the system is powered on, if the tool magazine is not in the back position, or the back-in position sensor switch is damaged or the back-in position signal input level is set incorrectly, an alarm will be issued.

Solution:1.When the alarm occurs when the power is turned on, it is detected whether the tool magazine is in the position of the rear position. If the tool magazine

is not in the backward position, adjust the position of the tool magazine or adjust the position of the backward position sensor.

- ① Check the sensor for damage and replace the sensor if it is damaged.
 - ② Modify the X2.1 input level if there is an inductive signal input
2. An alarm occurs during the tool change and press the[reset] button to cancel the alarm. If there is chaos tools, according to the chaos tools.

The following parameters can be modified

Parameter list - tools

1962	Tool magazine vertical/reverse in-position signal is effective when (0:disconnect 1:connect) with +24V	1
------	--	---

(17) Alarm information:A015.5 No command tool number or command tool number repeat in the tool table

- Cause of error :
- 1.The tool has run a tool change command that is greater than the total number of tool positions set in the system (for example, the total number of tool positions set in the system is 8, the program has M6 T9 edited, and when it runs to this segment, it will alarm)
 - 2.The parameters D001 to D024 in the PLC parameters are not set.

- Solution:
- 1. Pay attention to the total number of cutters set when programming, and cannot exceed the set value.
 - 2.Correctly set parameters D001 to D024 (correctly set to D001~D024 respectively set to 1~24)

(18) Alarm information: A015.6 The tool magazine cannot be fed in the tool change position.

- Cause of error :
- 1.The tool magazine advancement is not in place, the Z axis returns to the first reference point is not completed, the tool change program runs to the M22 tool magazine rotation to issue an alarm.
 - 2.The tool magazine is not in position, the Z axis returns to the second reference point and is not completed. The tool change program runs to the M21 tool magazine and sends an alarm.
 - 3.When the spindle is not at the first or second reference point, pressing [Vault Forward] in manual mode will give an alarm.

Solution: 1.Z axis back to machine zero

- 2.If an alarm occurs during the tool change, the G04 X1 pause time can be added in front of the M21.
- 3.If the current tool number of the spindle is 0, the current tool pocket of the cutter head is inconsistent with the command tool number. When the Z axis rises to the first reference point, the M22 tool magazine rotation alarm is run, and a pause G04 X1 can be added in front of the M22.
- 4.When manually controlling the magazine forward, the Z axis should be in the first or second reference point.

Program modification such as: M19G00G91G49G30Z0;//Z axis go down spindle orientation (fast arrival to second reference point)

G04 X1;// Input pause
M21;//Tool magazine forward
N20M16;//Tool loosening
M19G91G49G28Z0;// Z axis go up (Quickly reach the first reference point)
G65H81P30Q#1002R1;//G54.2 The command tool is 0
G04 X1;// Input pause
M22;//Tool magazine rotation

(19) Alarm information:A015.7 The spindle is missing position and the magazine cannot be fed

Cause of error :When the tool advance signal is sent, the system does not detect the spindle orientation completion signal.

Solution:1.If the spindle has no orientation function, modify the input signal X4.2 input level and delete the M19 in the tool change macro program O9101.

2.If the tool changer requires the spindle orientation function, and the spindle has the orientation function, but the alarm is also given after the orientation is completed, it is detected whether the input signal X4.2 input is correct (the system only detects +24V connection and disconnection), but not normal. Check if the input power is +24V: check the input signal level setting normally.

The following parameters can be modified

Parameter list -Orientation/tapping

3100	Cs axis (orientation) function(0:Ineffective 1:effective)	1
3130	Spindle positioning completed detection is effective when (0;disconnect 1:connect) with +24V	1
3140	(0:Connect output 1:disconnect output)after the spindle positioning is completed	0

(20)Alarm information: A016.0 Tool release Bit tool magazine cannot retract

Cause of error :The system does not detect the tool clamping signal when the magazine is retracted

Solution:1.If the tool loose/clip detection switch is not installed on the machine, the tool loose/clip in position detection function is turned off.

2.If the tool loose/clip detection switch is installed on the machine,Check if the sensor switch is damaged. If it is damaged, replace the sensor switch. If the sensor switch is normal, check if the switch is installed correctly. Check the sensor switch input signal X1.0, X1.1 if the level setting is entered.

The following parameters can be modified

Parameter list -Tools

1820	(0:Check 1:Do not check)Tool clamping/releasing in-position signal	0
1830	Spindle clamping signal is effective when (0:connect 1:disconnect)with +24V	1
1831	Spindle releasing signal is effective when (0:connect 1:disconnect)with +24V	1
1840	Spindle tool release completion delay	0
1841	Spindle tool clamp completion delay	0

1842	Spindle tool release detection delay	8000
1843	Spindle tool clamp detection delay	8000

(21) Alarm information:A016.1 The spindle has a tool that cannot be fed

Cause of error :1.In the mechanical zero return mode, the Z axis returns to the first reference point. When the [tool magazine advance button] is pressed, the system detects that the spindle has an alarm.

Solution:1.When the current spindle tool number is 0, the alarm does not generate

2.Press [Reset] to cancel the alarm

(22)Alarm information:A016.2 The spindle and the current tool number of the magazine are different and cannot be fed.

Cause of error :1.In the mechanical zero return mode, the Z axis returns to the second reference point. When the [tool magazine advance key] is pressed, the system detects that the current tool number of the spindle does not match the cutter tool number and generates an alarm.

Solution:1. Press [Reset] to clear the alarm.

(23)Alarm information:A016.7 Please carefully operate the tool adjustment mode

Cause of error :1. Started the tool magazine debugging function K30.7=1

Solution: 1. Press [Reset] to clear the alarm.

(24) Alarm information: A017.3 T code knife number is abnormal and cannot be changed

Cause of error :1. The command tool number exceeds the total number of tool positions in the magazine.

Solution:1.Press [Reset] to clear the alarm

2. Check the total number of tool positions in the magazine setting is right or not.

Check if the D1~D24 setting is 1~24.

(25) Alarm information:A017.5 Not at the origin position, can not retract the tool.

Cause of error :1.In the mechanical zero return mode, when the Z axis is not at the first and the second reference point, press the [tool magazine back button] to generate an alarm.

Solution:Press the [Reset] to clear the alarm .

(26) Alarm information:A018.3 Tool magazine forward and backward detection abnormal

Cause of error :At the same time, the tool forward/reverse position signal is detected, and the tool loose/clip check is valid, K14.6=0. An alarm is generated.

Solution:1.Check the sensor for damage and replace if damaged

2.If the sensor is not damaged, check the tool magazine forward in-position signal X2.0 and retreat in-position signal X2.1 input level setting.

The following parameters can be modified

Parameter list -Tools

1820	(0:Check 1:Do not check)Tool clamping/releasing in-position signal	0
1962	Tool vertical/reverse in-position signal is effective when (0:disconnect	1

	1:connect)with +24V	
1963	Tool level/forward in-position signal is effective when (0:disconnect 1:connect)with +24V	1

(27)Alarm information:A018.6 The Z axis does not return to the mechanical zero point and the tool cannot be changed.

Cause of error :Perform automatic tool change without the machine returning to zero

Solution:Execute the machine to zero

(28)Alarm information:A018.7 The magazine rotates abnormally and is forced to stop rotating

Cause of error :1. In the process of rotary tool selection/finding in the tool magazine, the alarm is generated when the tool bank counter X2.2 signal has not changed by the time set by T103 or T108.

2. The tool magazine machine is stuck

3. T103/T108/T109 ,time setting is too small.

Solution:1.Observe the tool magazine. After the rotation signal Y3.1/Y3.2 is sent, the tool magazine rotates. If the tool magazine does not rotate, check whether the tool magazine is stuck,the tool magazine circuit is normal.

2.If the tool magazine is mechanical, the circuit is normal, check if the tool magazine counter is normal, if it is damaged, replace it.

3.When the counter is normal, check if the time setting of T103/T108/T109 is too small.

The following parameters can be modified

Parameter list -Tools

2010	Tool magazine rotation delay detection(T103)	2000
2015	Tool magazine count switch delay detection(T108)	3000
2016	Delay detection in the rotation Bit of the magazine(T109)	5000

(29)Alarm information:A019.0 Spindle tool number of detection is abnormal

Cause of error :1.When the automatic tool change is executed, the current tool number of the spindle is 0, the spindle tool detection switch is turned on K32.0=1, and the alarm is issued when X2.6 and X2.7 are simultaneously sensing.

Solution:1.If the spindle is not required to have a tool detection, the tool detection function of the spindle can be turned off.

2.If the spindle is required to have a tool detection, check if the sensor switch is damaged. When the sensor is normal, modify the X2.7 input level K32.1, (normally open sensor of X2.6, X2.7)

The following parameters can be modified

Parameter list -Tools

1980	Detection of tools of spindle	0
1981	Spindle tool detection switch is effective when (0:connect 1:disconnect)with +24V	1

(30) Alarm information: A019.1 The current tool magazine and the cutter head have a tool that cannot move forward.

Cause of error :1.When performing automatic tool change, the tool magazine has a tool detection switch to open K32.1 and the X2.6 cutter head has a tool detection and an alarm is issued.

Solution:1.If the tool detection in the tool magazine and the cutter head is not needed, the tool detection function in the magazine and the cutter head can be closed .

2.If the tool detection in the tool magazine and the cutter head is needed, check if the sensor switch is damaged. When the sensor is normal, modify the X2.2 input level K32.3, (X2.6, X2.7 are normally open sensor)

The following parameters can be modified

Parameter list -Tools

1982	Tool detection for the current tool magazine and the cutter head(0:ineffective 1:effective)	0
1983	Current tool magazine detection switch is effective when (0:connect 1:disconnect)with +24V.	1

(31)Alarm information:A019.2 The cutter head is not in place and the magazine cannot go forward.

Cause of error :1.The cutter counter is not detected when the magazine is going forward. An alarm is issued.

Solution:1.Check if the magazine counter switch is damaged. If it is damaged, it needs to be replaced.

2.Check counter input level setting K30.5

The following parameters can be modified

Parameter list -Tools

1964	Tool magazine counter is effective when (0:connect 1:disconnect)with +24V	0
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Chapter VI Debugging of Arm Tool Magazine

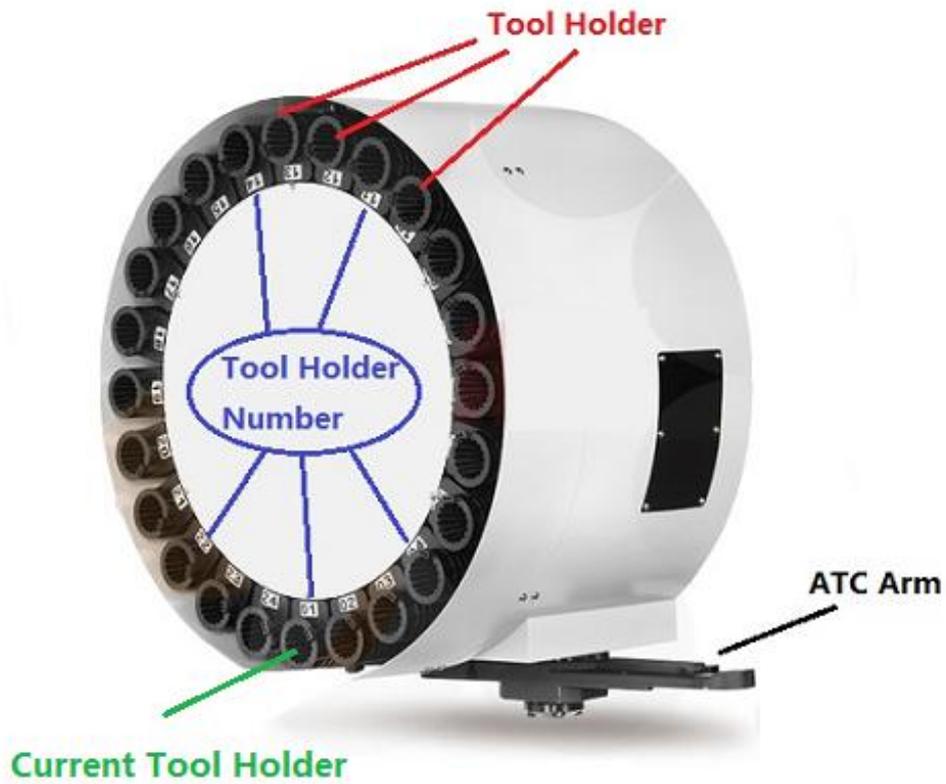


Figure 6-1 Picture of Circle-plate Arm Tool Magazine

6.1 Tool magazine debugging precautions

1 Tool magazine debugging matters needing attention

1) During the tool change process, the completion of the first action must be confirmed before the next action can be performed.

2) The tool cannot be reversed until the magazine positioning sensor is confirmed.

3) During the process of reversing the tools and without confirming the completion of the boring, the magazine motor cannot be started and the cutter head is rotated.

4) Do not change the tool until the reverse tool is confirmed.

5) The spindle of the machine does not return to the tool change point, and the tool cannot be changed.

6) The tool cannot be changed before the spindle positioning is completed.

7) If the tool change is not completed and the arm is not returned to the origin location, spindle head can not be moved

8) When the voltage of the motor is too high, the overload protection relay should trip first to avoid the motor burning.

9) Please perform the tool change manually, to check the tool sleeve reverse tool, the tool change mechanical transfer tool, the spindle grasping tool and so on.

After make sure there is no error , start the CNC automatic sequence program control.

10) During the debugging process, the debugging requirements can be completed by simply modifying the input and output signals X and Y in the ladder program. In the case, do not modify the other to avoid accidents if you not 100% sure .

6.2 Input/output signal of Umbrella type tool magazine

6.2.1 Input signal (CN61 plug,DB44/Female)

Pin	Add.	Instruction	Note
3	X0.2	Manual clamp/loose tools	Use NO type input
9	X1.0	Spindle tool loose in place signal	Use NO type input
10	X1.1	Spindle tool clamp in place signal	Use NO type input
11	X1.2	Zero point of Magazine	K30.2: input type selection
29	X2.0	Position of Downward tool pot	K30.3: input type selection
30	X2.1	Position of Upward tool pot	K30.4: input type selection
31	X2.2	Tool magazine count in place signal	K30.5: input type selection
34	X2.5	Brake signal for Arm grasp	K31.5: input type selection
35	X2.6	Signal for Arm grasp tool	K31.6: input type selection
36	X2.7	Home of Arm grasp	K31.7: input type selection

6.2.2 Input signal (CN15 plug,DB25/Male)

Pin	Add.	Definition	Note
8	X4.2	Orientation end	K21.1:input type selection
22	Y4.2	Spindle Orientation output	M19/M18

6.2.3 Output signal (CN62 plug,DB44/Male)

Pin	Add.	Definition	Instruction	Note
3	Y0.2	TCLA	Tools release/tighten	M16/M17
38	Y3.1	TCCY	Tool magazine forward	M22
39	Y3.2	TCWY	Tool magazine reverse	M22
40	Y3.3	TFRY	Downward Tool Pot	M21
41	Y3.4	TBAY	Upward Tool Pot	M24
42	Y3.5	TBAL	Output for arm grasp	M23/M25/M26

Note: M21/M22/M23/M24/M25/M26 cannot be used alone.

6.3 Parameters for Arm type tool magazine

Parameters list—Tools parameters

Para.	Number	Meaning of parameters
NUM	P052	1st reference point value of Z-axis (default:0)
NUM	P057	2nd reference point value of Z-axis (Position for put/take tool)
NUM	P062	3rd reference point value of Z-axis (Safe Position for up spindle)
Note: default value of 1 st reference point is set to 0, 2 nd reference point is for put tool back to magazine & take tool from magazine,3rd reference point is up position for spindle chuck,so that magazine can be rotated after chuck is loose.(all are machine coordinate value).		
PLC	K001.0	Activate function of Tool change(0:No, 1:Yes)
PLC	K001.1	Type of Tool Magazine (0: Other, 1:Linear)
PLC	K001.3	Use tool magazine after activate function of tool change(0:Yes, 1:No)
PLC	K014.6	Detect position of clamp/unclamp tool (0:Yes, 1:No)
PLC	K014.0	Spindle unclamping signal is effective(0:connect 1:disconnect)with +24V
PLC	K014.1	Spindle clamping signal is effective(0:connect 1:disconnect)with +24V
PLC	K021.1	Type of orientation end signal (0:NO, 1:NC)
PLC	K030.1	Homing Switch of magazine(0:No, 1:Yes)
PLC	K030.2	Type of homing switch on magazine (0:NO, 1:NC)
PLC	K030.3	Type of Position signal of downward tool pot(0:NO, 1:NC)
PLC	K030.4	Type of Position signal of upward tool pot(0:NO, 1:NC)
PLC	K030.5	Type of counting switch on magazine (0: NO, 1:NC)
PLC	K030.6	Arm/Hat tool magazine enter debug mode (0:No, 1:Yes)
Note: 1.When set K30.6 to 1,actions of arm grasp doesn't be limited, take carefully!		
PLC	K030.7	Magazine enter debug mode (0:No, 1:Yes)
Note: this parameter is used for that sensor can not detect signal after spindle is clamped without tool, if with this spindle&sensor, set to 1.		
PLC	K031.2	Reset output after position of tool pot downward (0:No, 1:Yes)
PLC	K031.3	Reset output after position of tool pot upward(0:No, 1:Yes)
PLC	K031.5	Type of Brake signal for arm grasp(0:NO, 1:NC)
PLC	K031.6	Type of sensor for arm grasp tool(0:NO, 1:NC)
PLC	K031.7	Type of sensor for detect arm back home(0:NO, 1:NC)
PLC	K032.4	Prohibit software-limit during exchanging tool(0:No,1:Yes)
<i>Set to 0 on arm tool magazine.</i>		
PLC	K032.5	Alarm when current tool number in spindle is 0 (0:Yes, 1:No)
<i>This parameter is just for hint that don't put tool into spindle chuck when current tool number in spindle is 0.</i>		
PLC	T007	Delay time after spindle unclamp tool done (default: T007=30 unit: ms)

PLC	T008	Delay time after spindle clamp tool done (default: T008=30 unit: ms)
PLC	T009	Delay time for detect position of spindle unclamp tool(T009=5000 unit: ms)
PLC	T020	Delay time for detect position of spindle clamp tool(T020=5000 unit: ms)
PLC	T004	Delay time after output orientation (default: T004=30 unit: ms)
PLC	T018	Delay time before detecting orientation end (default: T018=2000 unit:ms)
PLC	T023	Time of finishing detection of orientation end (default: T023=10000 unit: ms)
PLC	T100	Delay time of output CW_Magazine on manual (default: T100=0 unit:ms)
PLC	T101	Delay time of output CCW_Magazine on manual (default: T101=0 unit:ms)
PLC	T102	Delay time before detecting magazine stop. (default: T102=0 unit:ms)
PLC	T103	Time of detecting counting tool sensor (default: T103=0 unit:ms)
PLC	T104	Delay of detection of downward tool holder (default: T104=5000 unit:ms)
PLC	T105	Delay of detection of upward tool holder (Default: T105=5000 unit:ms)
PLC	T106	Delay after downward tool holder (default: T106=50 unit:ms)
PLC	T107	Delay after detection of upward tool holder (default: T107=50 unit:ms)
PLC	T108	Delay time before detecting counting tool sensor (default: T108=0 unit:ms)
PLC	T109	Delay time before detecting magazine home sensor (default: T109=0 unit:ms)
PLC	T110	Delay time of magazine rotation (default: T110=3000 unit: ms)
PLC	T111	Delay time before detecting position of counting sensor (default: T111=2000 unit:ms)
PLC	T112	Delay time of detection for arm grasp tool (default: T112=3000 unit:ms)
PLC	T113	Delay time of detection for arm exchange tool (default: T113=3000 unit:ms)
PLC	T114	Delay time of detection for arm back home (default: T114=3000 unit:ms)
PLC	T115	Delay time of detection for output arm grasp (default: T115=3000 unit:ms)
PLC	T116	Delay time for positioning of counting sensor (default: T116=60 unit:ms)
PLC	C100	Total tools on magazine (C100= must be total tool number on magazine)
PLC	D100	Total tools on magazine (D100= C100, don't need set)
PLC	D101	Command Tool number (input by command,cannot be altered)
PLC	D102	Front one tool number of command tool number (cannot be altered)
PLC	D103	Counting position of magazine plate (cannot be altered)
PLC	D104	Exchange tool number when manual change tool (cannot be altered)
PLC	D105	Current tool number in spindle (can be altered if wrong)
PLC	D120	Address of magazine return tool back/search tool (cannot be altered)
PLC	D121	Result of magazine return tool back/search tool (cannot be altered)
PLC	D124	Range of search tool (D123=D100+1,figure out auto, cannot be altered))
PLC	D126	Range of spindle zero speed output (D126=30 , unit: rpm)
PLC	D000	Tool number on No.0 tool pot of magazine (D000=100)
PLC	D001	Tool number on No.1 tool pot of magazine (D001=1)
PLC	D002	Tool number on No.2 tool pot of magazine (D002=2)
PLC	D003	Tool number on No.3 tool pot of magazine (D003=3)
...	...	
PLC	D097	Tool number on No.97 tool pot of magazine (D097=97)
PLC	D098	Tool number on No.98 tool pot of magazine (D098=98)
PLC	D099	Tool number on No.99 tool pot of magazine (D099=99)

Note: C100,D100 must be less than 100,max tools are 99 pcs. E.g.: when C100=16, D000-D016 are valid, when C100=24, D000-D024 are valid.

6.4 M commands & Parameter

6.4.1 M commands table

M16	Spindle chuck Loose Tool
M17	Spindle chuck Clamp Tool
M18	Spindle orientation cancel
M19	Spindle orientation
M21	Downward tool holder
M22	Magazine search tool
M23	ATC Arm grasp tool
M24	Upward tool holder
M25	ATC Arm exchange tool
M26	ATC Arm back home
M50	Starting change tool
M51	End of change tool

6.4.2 Parameter set For Arm Tool Magazine

1. There are functions that loose/clamp tool on spindle chuck, which can select that with sensor/switch for detecting position of loose/clamp tool.

2. Spindle can be selected with orientation function or not, if without orientation function, delete M19/M18 on O9101 macro program.

3. Total tools on magazine must be less 100pcs

4. Magazine can be rotated with CW & CCW direction

5. There are counting switch/sensor, switches/sensors for detecting position of downward/upward tool holder

6. User can select home switch or not on tool magazine.

If tool magazine is without home switch, all of detection switches on magazine are NO type, set K030.1=0 , K030.3=0 , K030.4=0 , K030.5=0 .

6.5 Control conditions of Arm Tool Magazine

6.5.1 Process of Auto Tool Change

(1) Execute exchange tool code: M06 T##; judge if exchange tool, machine lock, M.S.T lock, tool number in spindle is same to T##, CNC machine doesn't exchange tool;

(2) In Start of change tool, spindle, coolant,model status are canceled;

(3) Start auto tool change, judge if conditions for exchange tool are fitted, otherwise alarm. Conditions: right T## code, Z-axis homing successfully,tool is clamped;

(4) Spindle orientation is done , Z-axis goes to 2nd reference point.

(5) Magazine rotate & search for T## tool,& confirm counting sensor is valid;if T0,don't search tool on magazine,just skip this parts;

(6) Magazine downward tool on magazine, after done, ATC arm do 1st step to grasp tool on Spindle chuck & tool holder of magazine;

(7) After grasp tool,spindle chuck loose tool,after confirm position of unclamp tool, ATC arm do 2nd step to exchange tool(down-rotate 180degrees to exchange tool-up);

(8) Spindle chuck clamp tool, after confirm position of spindle clamp tool, ATC arm back home ;

(9) After confirm position of ATC arm back home, upward tool holder back to tool magazine,

(10) After position of tool holder back to tool magazine, End of change tool.

6.5.2 Conditions of Manual Control Tool Magazine

There are special Tool control pages for controlling tool magazine manually on PLC screen,after select F5 enter [Tool Ctrl] page,press F5 again to enter menu of [Tool Ctrl] page. Functions of F keys are corresponding as following:

[ToolsZero]: Tool Magazine go home

[Forward]: Magazine rotate with forward direction

[Reverse]: Magazine rotate with reverse direction

[AheadOver]: Magazine go forward to put tool back (umbrella tool magazine) or down tool holder pot for exchange tool (arm tool magazine).

[BackTurn]: Magazine go backward to exit tool(umbrella tool magazine) or up tool holder pot upward back to magazine(arm tool magazine)

[Arm Ctrl]: Rotate arm for grasp tool/ exchange /back arm to home(arm tool magazine)

[Refer 2]: Z-axis moves to No.2 reference point

[Refer3]: Z-axis moves to No.3 reference point

User can control actions of tool magazine manually,for checking if every steps of change tool is right or not.

Conditions:

1) User control rotation of magazine,Downward/Upward Tool holder on magazine, ATC arm grasp manually must at Manual/MPG status, do homing of magazine must at Machine Zero/Homing status.

2) Conditions of user can control rotation of magazine: CNC system is standby, Manual/MPG status, Tool holder on magazine is at upward position.

3) Conditions of magazine go home: there is homing switch on magazine, CNC system is standby, Machine zero status, Tool holder on magazine is at upward position.

4) Conditions of downward tool holder on magazine: CNC system is standby, on Manual/MPG status, tool holder is at position of counting sensor & ATC arm is at home position.

5) Conditions of upward tool holder on magazine; CNC system is standby, on Manual/MPG status, ATC arm is at home position.

6) Conditions of control ATC arm: Set K30.6=1, open debug function of ATC arm,run without conditions; set K30.7=1,debug of tool magazine is turned on, position of tool holder downward, spindle do orientation end,Z-axis is at 2nd reference point

Precautions:

1. Confirm Emergency stop button is working.

2. Ensure wiring diagram for tool magazine is right.

3. There are nothing during movement of magazine.

4. Don't do next step until above step is done well

6.5.3 Debug of Arm Tool Magazine

<1> Function of tool change is valid

A. PLC ladder of ladder02.grp is for arm type tool magazine, and set P304 on NUMPAR to 2. It needs to reboot CNC after these set.

B. PLC parameter: K1.0=1 ; K1.1=0 ; K1.3=0

<2> Check direction of rotating magazine manually

A. Set K30.7=1, open debug function of ATC, cancel control condition of magazine.

B. Press [**BackTurn**] key to let tool holder upward to magazine, also in horizontal position, Press [**Forward**] key on Manual/MPG status, for checking tool number is increasing, Press [**Reverse**] key on Manual/MPG status, for checking tool number is decreasing, if opposite, which will affect tool counting wrong, and exchange tool failure. We can change output wires or phases of magazine motor to solve it.

Note: It must ensure tool holder pot is upward position, also at horizontal position, otherwise it will damage magazine.

<3> Check Downward/Upward Magazine manually

A. Set K30.7=1, open debug function of ATC, cancel control conditions of magazine.

B. Ensure ATC arm is at home position

C. Press [**AheadOver**] key on Manual/MPG status, downward tool holder on Magazine (on vertical line); Press [**BackTurn**] key on Manual/MPG status, upward tool holder to Magazine (on horizontal line). If directions are opposite, exchange electric valves/air pipe.

<4> Homing Operation of Umbrella tool magazine

a. when there is homing switch on hat tool magazine, set K30.1=1 , K30.7=1 , open debug function of tool magazine, cancel limitations of manual control tool magazine.

1) Press [**BackTurn**] key on Manual/MPG status ,upward tool holder back to magazine;

2) Shift to Machine Zero status, press [**ToolsZero**] key, magazine is homing, and cnc hints warning of magazine is do homing.(A20.5);

3) After magazine homing is done, cancel A20.5 alarm, and hints A15.3, magazine's home set successfully, press [**RESET**] key to cancel alarm, homing of magazine is finished, and current tool number on spindle turns to 0.

4) If magazine doesn't detect homing switch signals within 5 minutes, system will alarm A15.2, magazine homing detection failure.

b. when there isn't homing switch on hat tool magazine, set K30.1=0.

1) In Manual/MPG status, press [**Forward**] or [**Reverse**] key to rotate plate of tool magazine to No.1 tool holder pot;

2) Holding on [**Machine Zero**] key with 7 seconds, system will hint A15.3 alarm, magazine's home set successfully, press [**RESET**] key to cancel alarm, homing of magazine is finished.

Note: After homing of tool magazine, table of tool holder number will refresh & please renew confirm tools on tool holder, if wrong tools, which will affect tool hits.

<5> Debug for ATC arm control

A. System shift to Machine Zero status, let Z-axis go home (ensure home of Z-axis is at upper position of ATC arm, avoid hit spindle)

B. System shift to Manual/MPG status, press [**AheadOver**] key to let tool holder upward to magazine, also in horizontal line.

C. Open debug function of ATC arm control by set K30.6=1, cancel all conditions of ATC arm control.

D. Press [**Arm Ctrl**] key one time on Manual/MPG status, ATC arm do 1st step to grasp tool; press [Arm Ctrl] key again, ATC arm do 2nd step to exchange tools (down-rotate 180 degrees to exchange tool-up); press [Arm Ctrl] key 3rd time, ATC do 3rd step, back to home. If press [Arm Ctrl] key, which will do above 3 steps repeatably. Check if each step is correct, if not, please check wiring connections, sensors and parameters set for type of sensors.

<6> Set of Spindle Orientation Position & Z-axis Coordinate value

a. Degree of spindle orientation(please check manual for spindle servo driver)

Example: take SZGH-MK series spindle servo system:

1. CNC system enter to level2 operation authority, open debug function of ATC Arm (K30.6=1), CNC system hints A20.4 alarm, function of debug of ATC arm is open, ATC arm can be operated without limiting conditions;

2. On Machine Zero status, let Z-axis go home, after Z-axis homing done, if Z-axis height is in the upper position of ATC arm, avoid ATC arm hits spindle devices;

3. Prepare one tool handle, remove pull stud,

4. Shift to Manual/MPG status, press [**Arm Ctrl**] key, let ATC arm do 1st step, go forward to grasp tool;

5. Put this tool handle without pull stud into ATC arm, adjust position well;

6. Shift to MPG status, which can move up/down of Z-axis(operate carefully!!!); adjust position of spindle chuck, & rotate spindle chuck over one resolutions, which can let spindle chuck fit to keyway of tool holder;

7. Press Down key on spindle servo driver(it display run) to H display, H means absolute position of one rev of spindle, set H value to P54_12 on spindle servo driver;

8. Move up Z-axis, let spindle chuck move away from tool handle, & take out tool holder from ATC arm;

9. Press [**Arm Ctrl**] key twice to back ATC arm to home.

b. Set of Z-axis coordinate points for exchange tool:

1. After spindle orientation position set done, on Manual/MPG status, move Z-axis up to safe position, ensure ATC arm is at home position, press [**Orientation**] key, spindle do orientation, and then press [**T.Change**] key to loose tool on spindle chuck, press [Arm Ctrl] key & let ATC arm do 1st step to grasp tool, then put tool with pull stud into ATC arm, and adjust position well (currently ATC arm still is at position of grasp tool) .

2. Shift to MPG status on CNC, move Z-axis to tool change position after loose tool, record current Z-axis machine coordinate value, where spindle can clamp/loosen tool.

3. Ensure spindle chuck loose tool, move Z-axis to safe position , disassemble tool holder in the ATC arm, and press [Arm Ctrl] key to back ATC arm to home;

4. Write record Z-axis machine coordinate value to 2nd reference point of Z-axis(P057 _Num Parameter)

5. After okay, turn off function of debug of ATC arm, set K30.6 to 0.

Note: We must confirm 2nd reference points are set right, otherwise it will damage machine .

<7> **Debug All steps for exchange tool with ATC arm**

A. Open debug function of Tool magazine, K30.7=1; & turn off debug function of ATC arm, K30.6=0, Action of ATC arm are limited with conditions;

B. System shift to Manual/MPG status, press [**Refer 2**] key, let Z-axis moves to No.2 reference point

C. System shift to Manual/MPG status, press [Orientation] key to let spindle orientation

D. Press [AheadOver] key to downward tool holder in vertical line;

E. Press [Arm Ctrl] key to let ATC arm do 1st step to grasp tool

F. Press [T.Change] key to let spindle chuck loose tool;

G. Press [Arm Ctrl] key to let ATC arm do 2nd step for exchange tool

H. Press [T.Change] key to let spindle chuck clamp tool & position;

I. Press [Arm Ctrl] key to let ATC arm do 3rd step for back home;

J. Press [BackTurn] key to let Tool holder back to magazine in horizontal line;

K. Finish all steps of manual exchange tool;

L. If all steps are correctly, turn off debug function of Tool Magazine(K30.7=0);

Conditions of ATC arm do 1st & 3rd steps: Spindle orientation; Z-axis is at 2nd reference point, Tool holder downward in vertical line, Spindle chuck clamp tool;

Conditions of ATC arm do 2nd step: Spindle orientation; Z-axis is at 2nd reference point, Tool holder downward in vertical line, Spindle chuck loose tool;

6.6 Debug of Macro Program

Open the tool macro program O09102 on edit status, add a tool number at the beginning of the program, automatically run the program in single segment, observe the tool change process in the tool change process, the tool magazine advances and retreats, the loose tool clamp knife is correct; Confirm the automatic tool change After the action is correct, delete the tool number at the beginning of the O9101 program.

We need to set B029.5 to 0 for alter macro program for exchange tool, O9102, after revised okay, set B029.5 back to 1, avoid wrong revises of O9102 macro program. Macro program after revised should be as following:

```
O9102;
T1;//Added when debugging single-stage operation, delete after debugging;
G65H81P50Q#1003R1;//G54.3 interface tool is equal to spindle tool not performing tool
change
G69G50G15G80G40;
M05; //turn off rotation of spindle
M09; // turn off coolant
M50;//Automatic tool change starts
M19G00G91G49G30Z0;//Z axis go down & spindle orientation.(Quickly reach the second
reference point)
M22; //Tool magazine rotation & select tool
M21;//Tool holder on magazine downward in vertical line
M23;//ATC Arm do 1st step to grasp tool
M16;// spindle loose tool
M25;//ATC arm do 2nd step to exchange tool(down-rotate 180°-Up)
M17;// Spindle clamp tool
M26;// ATC arm do 3rd step & back to home;
M24;//Tool holder upward to tool magazine in horizontal line
M18;//Cancel the spindle orientation
N50M51;//Automatic tool change end
M99;
%
```

Debugging completed well, delete T1 with a beginning of 09102. Under the MDI mode. Run the tool change command M6 T_; Observe whether the automatic tool change action is normal. After confirming that it is normal, close it and modify the macro parameters.

Complete tool change macro program

```
O9102;
G65H81P50Q#1003R1;//G54.3 interface tool is equal to spindle tool not performing tool
change
G69G50G15G80G40;
```

```

M05; //turn off rotation of spindle
M09; // turn off coolant
M50;//Automatic tool change starts
M19G00G91G49G30Z0;//Z axis go down & spindle orientation.(Quickly reach the second
reference point)
M22; //Tool magazine rotation & select tool
M21;//Tool holder on magazine downward in vertical line
M23;//ATC Arm do 1st step to grasp tool
M16;// spindle loose tool
M25;//ATC arm do 2nd step to exchange tool(down-rotate 180°-Up)
M17;// Spindle clamp tool
M26;// ATC arm do 3rd step & back to home;
M24;//Tool holder upward to tool magazine in horizontal line
M18;//Cancel the spindle orientation
N50M51;//Automatic tool change end
M99;
%
Format of Exchange tool code: (1) M06 T###
(2) T###;
G54 G90; processing program
G1 X100 Y100;
...
M06;
(1) & (2) are same function for exchange tool, (2) can choose tool in tool magazine firstly;and
then exchange tool
Note: Wrong format of Program:
    T1;
    T2;
    M06;

```

6.7 Scrambled tool processing

After the tool change process is correct, confirm that the current tool number of the spindle matches the tool magazine cutter number. If they are consistent, the debugging is completed. If they are inconsistent, the tool magazine must be adjusted to correspond to the spindle tool number:

Adjustment steps

- (1)The tool magazine has a zero switch installed. You only need to press the [tool magazine zero return key] in the mechanical zero return mode.
- (2)When the tool magazine does not replace the zero switch, turn the tool magazine to the position of the No. 1 tool, and press and hold the [Machine zero button] for 10 seconds until the system alarms to indicate that the magazine zero setting is valid. Press [Reset] to clear. Alarm prompt .

Chapter VII Debugging of Hat Tool Magazine

7.1 Debugging Attention Points of Hat Tool magazine

- 1) During the tool change process, the completion of the first action must be confirmed before the next action can be performed.
- 2) Z-axis cannot down when positioning sensor of tool magazine is not confirmed.
- 3) The spindle of the machine does not return to the tool change point, and the tool magazine cannot be changed.
- 4) The tool cannot be changed before the spindle orientation is completed.
- 5) If spindle chuck doesn't down & clamp tool, spindle head can not be rotated
- 6) When the voltage of the motor is too high, the overload protection relay should trip first to avoid the motor burning.
- 7) Please perform the tool change manually, to check the tool sleeve reverse tool, the tool change mechanical transfer tool, the spindle grasping tool and so on.
After make sure there is no error , start the CNC automatic sequence program control.
- 8) During the debugging process, the debugging requirements can be completed by simply modifying the input and output signals X and Y in the ladder program. In the case, do not modify the other to avoid accidents if you not 100% sure .

7.2 Input/Output signals of Hat Tool magazine

Pin	Add.	Instruction	Note
CN61.11	X1.2	Home Input of Tool Magazine	K30.2: controlling voltage
CN61.31	X2.2	Counting Tool Sensor Input	K30.5: controlling voltage
CN15.08	X4.2	Spindle Orientation End	K21.1: controlling voltage
CN62.38	Y3.1	CW Rotation of Tool Magazine	M22
CN62.39	Y3.2	CCW Rotation of Tool Magazine	M22
CN15.22	Y4.2	Spindle Orientation Output	M19/M18

Note: M22 cannot be used alone.

7.3 Parameter List of Hat Tool magazine

Type	Para.	Explanation
NUM	P052	Z-axis coordinate of 1 st reference point on MCS(default: 0)
NUM	P057	Z-axis coordinate of 2 nd reference point on MCS
NUM	P062	Z-axis coordinate of 3 rd reference point on MCS
NUM	P226	Min Z-axis coordinate that allow magazine rotate(F23.4)
NUM	P227	Max Z-axis coordinate that allow magazine rotate
NUM	P228	Min Z-axis coordinate that rotate magazine with low speed(F23.5)
NUM	P229	Max Z-axis coordinate that rotate magazine with low speed
BIT	B23.5	Limit speed that Z-axis go through range of unclamp/clamp tool(0:No; 1:Yes)
NUM	P216	Limiting low speed (default:1000)

Note: If we need to move hat tool magazine with low speed through low speed area,open limit speed function by set B23.5=1, speed is set by P216 on NUMPAR,which limit speed of CNC move through low speed area with G0/G53/G28/G30,when its speed is greater than P216, move with P216. If magazine doesn't need limit speed,set B23.5 to 0.

NUM	P236	Min Z-axis coordinate that forbid spindle move up(F23.6)
NUM	P237	Max Z-axis coordinate that forbid spindle move up (default:9999)
NUM	P238	Min Z-axis coordinate that magazine change tool(F23.7)
NUM	P239	Max Z-axis coordinate that magazine change tool (default: 9999)
<p>Note: 1. Spindle can move up to area of P236~P237 after orientation 2. Activate spindle orientation manual/mpg mode is invalid after enter area of change tool 3. Activate orientation when move magazine to change tool area on Manual/MPG status.(K32.7=1) 4. Other commands move magazine to area of tool change except M6,CNC will alarm A16.4.</p>		
PLC	K001.0	Activate function of Tool change(0:No, 1:Yes)
PLC	K001.1	Type of Tool Magazine (0: Other, 1:Linear)
PLC	K001.3	Use tool magazine after activate function of tool change(0:Yes, 1:No)
PLC	K014.6	Detect position of clamp/unclamp tool (0:Yes, 1:No)
PLC	K021.1	Type of orientation end signal (0:NO, 1:NC)
PLC	K030.1	Homing Switch of magazine(0:No, 1:Yes)
PLC	K030.2	Type of homing switch on magazine (0:NO, 1:NC)
PLC	K030.5	Type of counting switch on magazine (0: NO, 1:NC)
PLC	K030.6	Arm/Hat tool magazine enter debug mode (0:No, 1:Yes)
<p>Note: 1. When set K30.6 to 1, movement of Z-axis doesn't be limited, take carefully! 2. When turn off software limit by set K32.4=1 during tool change& open debug function by set K30.7=1, software limit doesn't work.</p>		
PLC	K030.7	Magazine enter debug mode (0:No, 1:Yes)
PLC	K032.4	Turn off software limit during changing tool (0:No, 1:Yes)
<p>Note: Don't need to set these two parameters on Hat tool magazine, set to 0.</p>		
PLC	K032.5	Alarm when current tool number on spindle is 0 (0:Yes, 1:No)
<p>Note: this parameter is just for hint that don't put tool back to spindle chuck when current tool number is 0.</p>		
PLC	K032.7	Output orientation auto when Z-axis enter tool change area(0:No, 1:Yes)
<p>Note: When K32.7=1.Z-axis move to tool change area on manual/mpg,output orientation automatically.</p>		
PLC	T004	Delay time after output orientation (default: T004=30 unit: ms)
PLC	T018	Delay time before detecting orientation end (default: T018=2000 unit:ms)
PLC	T023	Time of finishing detection of orientation end (default: T023=10000 unit: ms)
PLC	T100	Delay time of output CW_Magazine on manual (default: T100=0 unit:ms)
PLC	T101	Delay time of output CCW_Magazine on manual (default: T101=0 unit:ms)
PLC	T102	Delay time before detecting magazine stop. (default: T102=0 unit:ms)
PLC	T103	Time of detecting counting tool sensor (default: T103=0 unit:ms)
PLC	T108	Delay time before detecting counting tool sensor (default: T108=0 unit:ms)
PLC	T109	Delay time before detecting magazine home sensor (default: T109=0 unit:ms)
PLC	T110	Delay time of magazine rotation (default: T110=3000 unit: ms)
PLC	T111	Delay time before detecting position of counting sensor (default: T111=2000 unit:ms)
PLC	T116	Delay time for positioning of counting sensor (default: T116=60 unit:ms)
PLC	C100	Total tools on magazine (C100= must be total tool number on magazine)
PLC	D100	Total tools on magazine (D100= C100, don't need set)
PLC	D101	Command Tool number (input by command,cannot be altered)
PLC	D102	Front one tool number of command tool number (cannot be altered)
PLC	D103	Counting position of magazine plate (cannot be altered)

PLC	D104	Exchange tool number when manual change tool (cannot be altered)
PLC	D105	Current tool number in spindle (can be altered if wrong)
PLC	D120	Address of magazine return tool back/search tool (cannot be altered)
PLC	D121	Result of magazine return tool back/search tool (cannot be altered)
PLC	D124	Range of search tool (D123=D100+1,figure out auto, cannot be altered))
PLC	D126	Range of spindle zero speed output (D126=30 , unit: rpm)
PLC	D000	Tool number on No.0 tool pot of magazine (D000=100)
PLC	D001	Tool number on No.1 tool pot of magazine (D001=1)
PLC	D002	Tool number on No.2 tool pot of magazine (D002=2)
PLC	D003	Tool number on No.3 tool pot of magazine (D003=3)
...	...	
PLC	D097	Tool number on No.97 tool pot of magazine (D097=97)
PLC	D098	Tool number on No.98 tool pot of magazine (D098=98)
PLC	D099	Tool number on No.99 tool pot of magazine (D099=99)

Note: C100,D100 must be less than 100,max tools are 99 pcs. E.g.: when C100=16, D000-D016 are valid, when C100=24, D000-D024 are valid.

7.3 M commands & Parameter

7.3.1 M commands table

M18	Spindle orientation cancel
M19	Spindle orientation
M22	Magazine search tool
M50	Starting change tool
M51	End of change tool

7.3.2 Parameter set For Hat Tool Magazine

1.Spindle can be selected with orientation function or not, if without orientation function, delete M19/M18 on O9103 macro program.

2.Total tools on magazine must be less 100pcs

3. Magazine can be rotated with CW & CCW direction

4. There is counting switch/sensor on tool magazine

5. User can select home switch or not on tool magazine.

If tool magazine is without home switch, all of detection switches on magazine are NO type, set K030.1=0 , K030.5=0 .

7.4 Control conditions of Hat Tool Magazine

7.4.1 Process of Auto Tool Change

(1) Execute exchange tool code: M06 T##; judge if exchange tool, machine lock, M.S.T lock, tool number in spindle is same to T##, CNC machine doesn't exchange tool;

(2) In Start of change tool, spindle, coolant,model status are canceled;

(3) Start auto tool change, judge if conditions for exchange tool are fitted, otherwise alarm.

Conditions: right T## code, Z-axis homing successfully,tool is clamped;

(4) Spindle move to point of change tool,unclamp tool & return tool back to magazine;

(5) Magazine rotate & search for T## tool,& confirm counting sensor is valid;

(6) Spindle down to clamp tool;

(7) End of change tool.

7.4.2 Manual Change Tool

There are special Tool control pages for controlling tool magazine manually on PLC screen, after select F5 enter [Tool Ctrl] page, press F5 again to enter menu of [Tool Ctrl] page. Functions of F keys are corresponding as following:

[ToolsZero]: Tool Magazine go home

[Forward]: Magazine rotate with forward direction

[Reverse]: Magazine rotate with reverse direction

[AheadOver]: Magazine go forward to put tool back (umbrella tool magazine) or down tool holder pot for exchange tool (arm tool magazine).

[BackTurn]: Magazine go backward to exit tool(umbrella tool magazine) or up tool holder pot back to magazine(arm tool magazine)

[Arm Ctrl]: Rotate arm for grasp tool/ exchange /back arm to home(arm tool magazine)

[Refer 2]: Z-axis moves to No.2 reference point

[Refer3]: Z-axis moves to No.3 reference point

User can control actions of tool magazine manually, for checking if every steps of change tool is right or not.

Conditions:

1) User control rotation of magazine manually must at Manual/MPG status, do homing of magazine must at Machine Zero/Homing status.

2) Conditions of user can control rotation of magazine: CNC system is standby, Manual/MPG status, Z-axis is at range that allow rotating magazine.

3) Conditions of magazine go home: there is homing switch on magazine, CNC system is standby, Machine zero status, Z-axis is at range that allow rotating magazine.

Precautions:

1. *Confirm Emergency stop button is working.*

2. *Ensure wiring diagram for tool magazine is right.*

3. *There are nothing during movement of magazine.*

7.4.3 Debug of Hat Tool Magazine

<1> Function of tool change is valid

A. PLC ladder of ladder03.grp is for hat tool magazine, and set P304 on NUMPAR to 3.

B. PLC parameter: K1.0=1 ; K1.1=0 ; K1.3=0

<2> Check direction of rotating magazine manually

A. Set K30.7=1, open debug function of ATC, cancel control condition of magazine.

B. Set K30.6=1, open debug function of HAT magazine, condition of Z-axis movement are be canceled, operate carefully & avoid broken of magazine.

C. Z-axis go home , after done of home, do orientation of spindle, after orientation end of spindle, use MPG to move Z-axis, record max & min machine coordinate value of Z-axis, also range that forbid rotation of spindle.

Note: Z-axis home be at down place of magazine.

D. Record max & min machine coordinate value of Z-axis that for range of allow rotating magazine. & record one point during this range of allow rotating magazine at same time, and set to P62 on NUMPAR, also No.3 reference point of Z-axis.

E. Record point of finish tool change, and set to P57 on NUMPAR, also No.2 reference point of Z-axis, which can be same to machine zero point of Z-axis.

F. When change tool , and user need Z-axis move with low speed through range of clamp/unclamp tool, which needs to set max & min value of range of low speed, and also open

limit speed function that Z-axis go through range of unclamp/clamp tool(B23.5) and Limiting low speed (default:1000) low speed(P216 on NUMPAR). If user need spindle do orientation automatically when Z-axis move to range of change tool on Manual/MPG status,which needs to set max & min values for range of change tool,and open function of spindle do orientation auto, also K32.7=1, After Z-axis enter this range of change tool,cnc system will output spindle orientation automatically.Min value of range for change tool should less over 10mm than min value of range for forbid spindle,which is for remain buffer space(during spindle do orientation, Z-axis still move up,so avoid spindle orientation is not end and enter spindle forbid range,which affect alarm of CNC).

G. After Z-axis move to range of magazine allow rotation, on Manual/MPG mode, press **[Forward]** key,magazine should rotate with direction that increase tool number; press **[Reverse]** key, magazine should rotate with direction that decrease tool number. Otherwise,it will affect wrong tool exchange, we can change output wires or phases of magazine motor to solve it.

H.After set ranges & tool points coordinate value,we should set K30.6 to 0,which open limit conditions for Z-axis at different ranges.

<3> Homing Operation of Hat tool magazine

a. when there is homing switch on hat tool magazine, set K30.1=1 , K30.7=1 , open debug function of tool magazine, cancel limitations of manual control tool magazine.

1) Move Z-axis to range that allow tool magazine do rotating;

2) Shift to Machine Zero status, press **[ToolsZero]** key,magazine is homing,and cnc hints warning of magazine is do homing.(A20.5);

3) After magazine homing is done, cancel A20.5 alarm,and hints A15.3, magazine's home set successfully, press **[RESET]** key to cancel alarm, homing of magazine is finished,and current tool number on spindle turns to 1.

4) If magazine doesn't detect homing switch signals within 5 minutes, system will alarm A15.2, magazine homing detection failure.

b. when there isn't homing switch on hat tool magazine, set K30.1=0.

1) In Manual/MPG status, press **[Forward]** or **[Reverse]** key to rotate plate of tool magazine to No.1 tool pot;

2) Holding on **[Machine Zero]** key with 7 seconds, system will hint A15.3 alarm, magazine's home set successfully,press **[RESET]** key to cancel alarm, homing of magazine is finished.

Note: After homing of tool magazine, tool pot & tool on spindle both are 1.

<4> Set of Z-axis Coordinate value

a. Set of Z-axis coordinate point for exchange tool (UP):

Record Z-axis machine coordinate value,and input to P062 on NUMPAR,which must be set well & right,otherwise it will damage mechanical parts on tool magazine (Ensure spindle is at range of allow magazine rotation);

b. Set of Z-axis coordinate point of exchange tool (DOWN):

Use handwheel to move down Z-axis, and ensure tool is clamped on spindle chuck, record Z-axis machine coordinate value,and input to P057 on NUMPAR (which can be same to machine zero point of Z-axis)

c. Set max & min value for range of spindle forbid rotation/ magazine allow rotation at same time; at range of spindle forbid rotation, spindle cannot rotation, tool magazine only can rotate at range of magazine allow rotation.

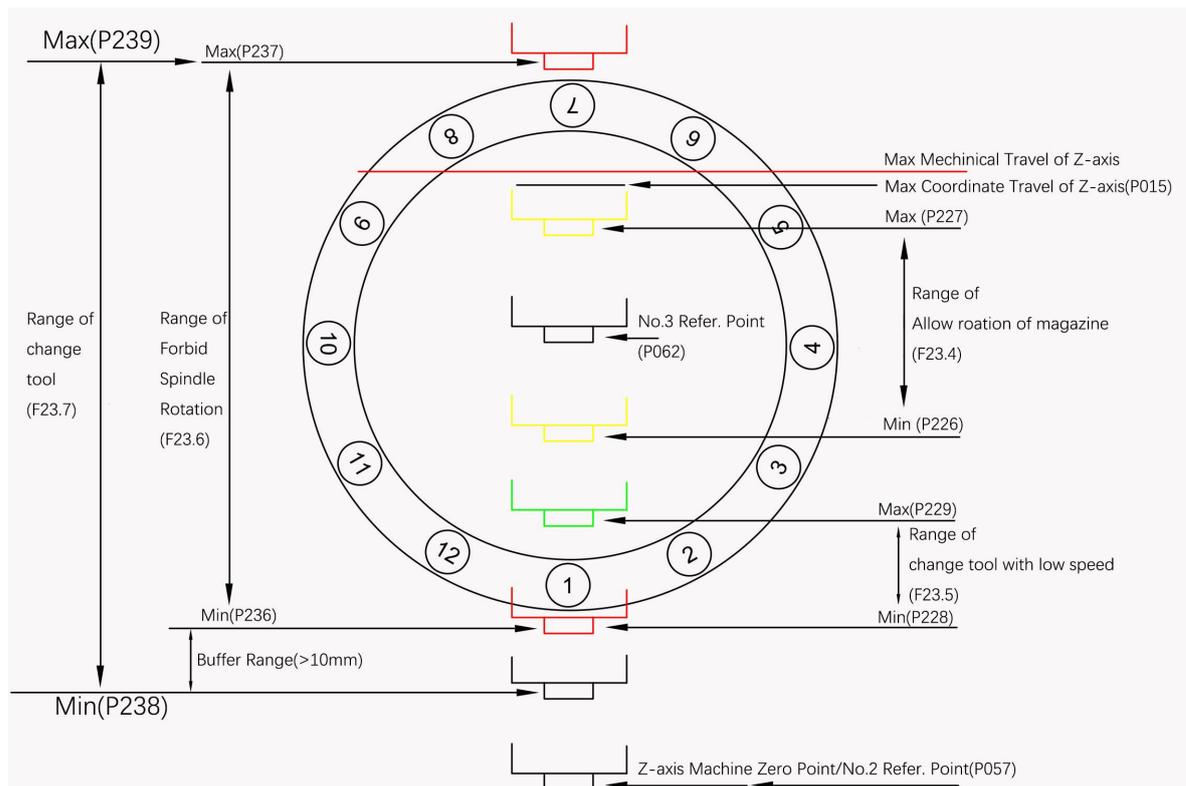


Fig7.2 Coordinate of Exchange Tool

<5> After operations of above two steps, we can call tool change program, O9103, write T## code in the start of macro program, and then shift to Auto/ Single block mode, check if steps of exchange tool is right or not. (In order to alter O9103 program, user needs to set P029.5=0 on BITPAR, after debugging done, set P029.5=1 back on BITPAR, which avoid wrong revise).

Program of O9103 after altered:

```

T##; (add it when user check program on Auto/Single Mode, after done, delete it)
G65H81P50Q#1003R1; //G54.3=1, T code is same to tool number in spindle, don't exchange tool.
G65H81P50Q#1002R1; //G54.2, T code is 0.
G69G50G15G80G40;
M05; // turn off spindle
M09; // turn off coolant
M50; //Starting of ATC.
G65H81P20Q#1000R1; //G54.0=1 tool number on spindle is 0.
M19G91G49G30Z0; // Spindle do orientation & Z-axis move to No.2 reference point.
G91G49G30Z0P3; //Z-axis move to No.3 reference point.
M22; // Rotation of tool magazine
G91G49G30Z0; // Z-axis move down to No.2 reference point.
M18; // cancel spindle orientation.
N50M51; //End of ATC
M99;
%
```

<6> After execute <5> step successfully, delete T## in the front of O9103, on Auto/ MDI mode, run ATC code : T## M6 or M6 T## ;

Warning: When spindle tool number is 0, there must be without tool in spindle, otherwise during ATC, it will be failure & cause broken of tool magazine.

7.5 Process of Special conditions

Right processing ways when CNC happens E-stop, Reset, Alarm during ATC:

1) During change tool automatically, search tool on magazine is finished, but spindle doesn't down & clamp tool, & CNC occurs Emergency stop, Reset, alarm or power off, if user needs to continue using CNC machine, which needs to down Z-axis on manual/MPG mode (at this time, tool number already refresh to T code number), cnc can be used normally.

2) During change tool automatically, Z-axis move up to tool change point & unclamp tool, but plate of magazine doesn't rotate, & CNC occurs Emergency stop, Reset, alarm or power off, if user needs to continue using CNC machine, which needs to down Z-axis on manual/MPG mode & clamp tool (at this time, tool number doesn't change to T code number), cnc can be used normally.

3) During change tool automatically, Z-axis move up to tool change point & unclamp tool, plate of magazine rotate but search tool on magazine is not finished, & CNC occurs Emergency stop, Reset, alarm or power off, also current tool number is different to real tool number on magazine, CNC will hint A015.0 (Counting of tool magazine error, magazine needs do homing again) or A015.4 (Tool change failure & stop, ensure magazine normal) alarm, if user needs to continue using CNC machine, which needs to reset tool number on magazine (magazine goes home, after home done, tool number on magazine & on spindle, both should be 1) and then down Z-axis on manual/MPG mode & clamp tool, cnc can be used normally.

7.6 Explanation of Hat Tool magazine Program

```
O9103;//name of program
G65H81P50Q#1003R1; //G54.3=1, T code is same to tool number in spindle, don't exchange tool.
G65H81P50Q#1002R1; //G54.2, T code is 0, jump to N50, end of ATC.
G69G50G15G80G40; // cancel model status
M05; // turn off spindle
M09; // turn off coolant
M50; //Starting of ATC.
G65H81P20Q#1000R1; //G54.0=1 tool number on spindle is 0.
M19G91G49G30Z0; // Spindle do orientation & Z-axis move to No.2 reference point.
G91G49G30Z0P3; //Z-axis move to No.3 reference point.
M22; // Rotation of tool magazine
G91G49G30Z0; // Z-axis move down to No.2 reference point.
M18; // cancel spindle orientation.
N50M51; //End of ATC
M99;
%
```

Appendix I Alarm/Warn

A001.5 Cannot Start Program When debug Magazine(K30.7:OFF)

Reason: CNC are using debug function of ATC,start run program & alarm;

Solution: Press [Reset] key to cancel alarm, check if tool magazine are normally, if normal, turn off debug function of ATC,also set K30.7=0; if abnormal, after troubleshoot,and then turn off debug function of ATC.

A001.6 External Cycle-Start Too Long(NO)(K20.0)

Reason: Time of external Cycle-Start key are ON is over 4 seconds

Solution: check if use NO type button for external cycle start(X1.4),K20.0=0, or cycle-start button is broken.

A001.7 External Pause Too Long(NC)(K20.1)

Reason: Time of external pause key are ON(off of 24V) is over 4 seconds

Solution: check if use NC type button for external Pause(X0.1),K20.1=1, or pause button is broken.

A002.0 Protective door no close Not permit auto run

Reason: on Auto, protective door is not closed, run program.

Solution: Press Reset key to clear alarm,if protective door is closed,please check if door sensor is broken, or K14.3 is set right or not.

A002.1 Give an alarm to the tool over the stroke

Reason:After over travel of probe/tool setter is ON,also X1.7 is ON(K24.6=0,NC type), and Z-axis still move to negative direction;

Solution:Press Reset key to clear alarm,and then move Z-axis to positive direction, or set K24.6=1 if without probe.

A002.2 All Pieces is Finished!

Reason: Processing Pieces is reached to N361 on Numpara, and K16.3=1,CNC hints alarm when pieces is finished with value of N361.

Solution: Press [Reset] key to clear alarm.

A002.3 Spindle rotation,can't loosen tool

Reason:Loose tool during spindle is rotating

Solution: Press [Reset] key to clear alarm

A002.4 Spindle rotation,clamping in-position invalid alarm

Reason:Clamp tool in position is invalid during spindle is rotating;

Solution: Press[Reset] key to clear alarm,and check if chuck & sensor are okay.

A002.5 Clamping in-position invalid,can't start spindle

Reason: Start spindle when sensor for detect clamp tool in position is invalid;

Solution: Press [Reset]key to clear alarm,ensure clamp tool in position,then start spindle.

A002.6 Spindle tool release,can't start spindle

Reason: Start spindle when spindle chuck is in status of unclamp

Solution:Press [Reset]key to clear alarm,start spindle when clamp tool.

A004.1 Current isn't spindle analog voltage control

Reason: use switch to control spindle,open jog function of spindle;

Solution:Press [Reset]key to clear alarm,Cannot use jog function of spindle when spindle is controlled by switch signals.

A004.2 M03,M04 appoint code error

Reason: Start 2nd spindle with opposite direction directly without stop

Solution:Press [Reset]key to clear alarm,it only can start spindle with opposite direction when 2nd spindle is stop,also only M5 firstly,then shift M3/M4

A004.3 M63,M64 Code specification error

Reason: Start spindle with opposite direction directly without stop

Solution:Press [Reset]key to clear alarm,it only can start spindle with opposite direction when spindle is stop,also only M65 firstly,then shift M63/M64

A004.4 Spindle gear shift time is too long

Reason:CNC activate function of gear shift,execute M41~M44 code, don't finish gear shift within the time of T045

Solution: Press [Reset]key to clear alarm,Check if gear shift is done & sensor/switch for detect gear shift in position is right.

A008.0 Change spindle speed position mode abnormal

Reason: After run M29 code,CNC didn't finish this code within T024 time;

Solution: Press [Reset]key to clear alarm,check if T024/T025 are set right(T025<T024), Set of signal for Position mode shift done is right(K21.0)

A008.1 Change position speed mode abnormal

Reason: After run M28 code,CNC didn't finish this code within T028 time;

Solution: Press [Reset]key to clear alarm,check if T027/T028 are set right(T027<T028).

A008.2 Low pressure alarm,K20.2

Reason: CNC detect air pressure is low with time of T02;

Solution: Check if air pressure is normal, detection device for air pressure is normal, type of detecting signal(K20.2) is set right, after air pressure is normal,Press [Reset]key to clear alarm.

A010.1 Spindle rotation tool can't loosen

Reason:CNC stop spindle, but spindle is not reach at zero speed, Speed>D126,CNC alarm when loose tool;

Solution:Press [Reset]key to clear alarm,check value of D0126(default D126=20); or delay some time after spindle stop,and then loose tool.

A010.4 Spindle tool clamp detection abnormal

Reason: After clamp tool, within T020,CNC doesn't detect position signal of clamp tool;

Solution: Press [Reset]key to clear alarm,check if T020 is set right;check switch is okay

A010.5 Spindle tool loosen detection abnormal

Reason:After unclamp tool, within T09, CNC doesn't detect position signal of unclamp;

Solution:Press [Reset]key to clear alarm,check if T020 is set right;check switch is okay

A010.7 Spindle release/clamp detection abnormal

Reason:CNC detect position of clamp&unclamp tool both

Solution: Press [Reset]key to clear alarm,check if position of switches are right

A011.0 Indexing table lock release is not in place

Reason: Output for indexing table unlock/lock, CNC doesn't detect signal within T43/T44

Solution:Press [Reset]key to clear alarm, check if switch/sensor is okay.

A011.1 Indexing table lock release detection abnormal

Reason:CNC detect indexing table locking&unlocking position signal both at same time

Solution: Press [Reset]key to clear alarm,check if related switch/sensor is okay.

A011.2 Indexing table is not released can not move the fourth axis

Reason: On Auto index table,K1.7=1,CNC move 4th axis when CNC didn't detect position signal of unlock index table;

Solution: Press [Reset]key to clear alarm,move 4th axis under unlock index table.

A011.3 Indexing table is not released can not move the XYZ axis

Reason:On Auto index table, K1.7=1,K1.4=0,CNC move XYZ axis when system doesn't detect indexing table is unlock status;

Solution:Press [Reset]key to clear alarm,move XYZ axis when index table is unlocking, or set K1.4 to 1.

A012.5 Spindle directional sequence detection abnormal

Reason:There is signal input to orientation end,but alarm of orientation

Solution: Press [Reset]key to clear alarm,reset type of orientation end signal(K21.1)

A012.6 Spindle positioning cannot be performed with spindle tool release

Reason: Spindle run orientation when spindle unlock tool

Solution:Press [Reset]key to clear alarm,CNC cannot orientation when unlock tool

A012.7 The knife store is not at the origin

Reason:Umbrella tool magazine: Tool magazine isn't at backward position, do orientation

Arm tool magazine: ATC arm isn't at origin point, spindle do orientation

Hat tool magazine:Z-axis is at range of change tool, spindle do orientation

Solution:Press [Reset]key to clear alarm, do orientation when magazine back to origin.

A013.0 Command tool number T is 0

Reason: Hat tool magazine: run T0 code

Solution: Press [Reset] key to clear alarm, don't run T0 code on hat tool magazine.

A013.1 Spindle detection abnormal in-position

Reason: CNC do orientation after T023&T018, doesn't detect orientation end signal

Solution: Press [Reset] key to clear alarm, check type of orientation end signal (X4.2/K21.1), wiring connections is right; T023&T018 are set correctly.

A013.2 The spindle tool number is inconsistent with the tool library

Reason: open ATC function, tool in spindle is different to tool pot number, user control Forward of magazine on Manual/MPG status

Solution: Press [Reset] key to clear alarm, condition of forward magazine is tool in spindle is same to current tool pot number, so rotate tool magazine manually to correct tool pot.

A013.3 The z-axis is not at the 2/3 reference point

Reason: Reason: open ATC function, Z-axis isn't at 2nd/3rd reference point, user control Forward of magazine on Manual/MPG status

Solution: Press [Reset] key to clear alarm, condition of forward magazine is Z-axis is at 2nd or 3rd reference point, so we can run G91G30Z0 in MDI, return to 2nd reference point

A013.4 The knife store is not in the back position

Reason: Tool magazine isn't at backward or Z-axis isn't at 3rd reference point (Umbrella)

Tool pot isn't at horizontal level, magazine cannot rotate (Arm)

Z-axis isn't in the range of allow rotate, magazine can't rotate (Hat/Turret)

Solution: Press [Reset] key to clear alarm.

A013.5 You cannot manually control the knife store in manual/handwheel mode

Reason: open ATC function, manual control tool magazine isn't in MPG/Manual status

Solution: Press [Reset] key to clear alarm, ensure manual tool control in MPG/manual.

A013.6 The knife store is not returnable at the origin

Reason: Tool magazine isn't at backward position, let tool magazine go home (Umbrella)

Tool pot isn't at horizontal level, let tool magazine go home (Arm)

Z-axis isn't in the range of allow rotate, let tool magazine go home (Hat/Turret)

Solution: before let tool magazine go home, ensure tool magazine is at right position

A013.7 Change the knife first execute T instruction knife number

Reason: open ATC function, before run M6, not specify T code

Solution: Press [Reset] key to clear alarm, run T code before M06

A014.0 The Z axis does not return to mechanical zero

Reason: open ATC function, change tool when Z-axis doesn't go home

Solution: Press [Reset] key to clear alarm, Z-axis go home before change tool

A014.1 The cutter plate is not in the counting position

Reason: Tool plate isn't in the position of counting signal is on, cannot forward (Umbrella)

Tool plate isn't in the position of counting signal is on, cannot downward (Arm)

Tool plate isn't in the position of counting signal is on, Z-axis can't move

Solution: Press [Reset] key to clear alarm, manual rotate tool plate and ensure tool plate is in the point of counting sensor is on.

A014.2 The knife store is not at the origin

Reason: magazine isn't in the backward, alarm when turn on spindle (umbrella)

ATC arm isn't in the original point, alarm when turn on spindle (arm)

Z-axis is at range of change tool, alarm when turn on spindle (hat/turret)

Solution: Press [Reset] key to clear alarm, let magazine go to right position manually

A014.3 Spindle tool release

Reason: After open ATC function, do ATC when tool is release

Solution: Press [Reset] key to clear alarm, do ATC after tool is tighten

A014.4 There is a knife in the current blade number

Reason: After open ATC function, there is tool in current tool pot/plate, alarm when tool magazine forward

Solution: Press [Reset] key to clear alarm, let tool magazine go home, or reset tool number in spindle (D105)

A014.5 At present, both the cutter number and the spindle have knives

Reason: After open ATC function, there are tools in current tool pot & spindle chuck, alarm when forward tool magazine

Solution: Press [Reset] key to clear alarm, take off tool in spindle

A014.6 Current spindle tool number is zero, spindle has a knife

Reason: After open ATC function, there is tool in spindle when current tool number in spindle is 0

Solution: Press [Reset] key to clear alarm, take off tool in spindle

A014.7 Spindle has a knife, Z axis is not installed in the position of the knife

Reason: After open ATC function, CNC detect that there is tool in spindle, and Z-axis isn't at 2nd reference point, alarm when forward tool magazine

Solution: Press [Reset] key to clear alarm, move Z-axis to 2nd reference point.

A015.0 Abnormal detection of counting signal of knife number in knife store

Reason: After open ATC function & rotating tool magazine & stop, CNC doesn't detect counting signal (X2.2) within T102 (T102=2000 default)

Solution: Press [Reset] key to clear alarm,

A015.1 Knife store origin lost

Reason: After open ATC function, there is home switch for tool magazine, when tool counting number is 1, CNC didn't detect home switch signal, or there is home switch signal, but current tool pot number is not 1

Solution:Press [Reset]key to clear alarm,tool magazine do homing again.

A015.2 Abnormal detection of knife store back to zero

Reason:After open ATC function,alarm when tool magazine doesn't finish home after do home for tool magazine within 5 minutes.

Solution:Press [Reset]key to clear alarm,tool magazine do homing again.

A015.3 MAG.zero point position setting valid

Reason:After open ATC function,home of tool magazine is done successfully,or holding press [Machine Zero] key with 7 seconds without home switch,cnc hints alarm

Solution:Press [Reset]key to clear alarm,tool counting is renew done.

A015.4 Ensure MAG.normal,change tool emergency stop

Reason:After open ATC function,CNC occurs E-Stop/Reset/Alarm during change tool

Solution:Press [Reset]key to clear alarm,check if tool magazine is normal

A015.5 No inst tool number or repeat in tool list

Reason:After open ATC function,T code is over max tool, or there are same number in D0-D99

Solution:Press [Reset]key to clear alarm,use right T code, or alter current tool number D105 when return tool back to magazine; check Data-sheet of D00-D99 is right.

A015.6 tool store in the forward state,loosen the Z axis can not move

Reason:After open ATC function,Tool magazine is in the status of forward, spindle doesn't loose tool, move Z-axis

Solution:Press [Reset]key to clear alarm,Spindle chuck must loose tool ,then we can move Z-axis when tool magazine is in the forward position

A015.7 The spindle axis of is not positioned,cannot move forward

Reason:After open ATC function,orientation function of spindle is open,but magazine forward when spindle doesn't orientation (Umbrella type)

After open ATC function,orientation function of spindle is open,but Z-axis move to range of change tool when spindle doesn't orientation (Hat/Turret type)

Solution:Press [Reset]key to clear alarm,after spindle orientation end,then magazine do forward, if without orientation function, set K21.1 to 1.

A016.0 knife storehouse forward/back in place abnormal detection

Reason:After open ATC function,CNC doesn't detect position signals of forward/down too pot when magazine forward(umbrella type)/down tool pot(arm type) after the time of T104

Solution:Press [Reset]key to clear alarm,check if T104 is set right(T104=3000), check if tool magazine is normal, we control magazine forward/down tool pot manually

A016.1 back knife/back knife in position to detect abnormalities

Reason:After open ATC function,CNC doesn't detect position signals of backward/up tool pot when magazine backward(umbrella type)/up tool pot(arm type) after the time of T105

Solution:Press [Reset]key to clear alarm,check if T105 is set right(T105=3000), check if

tool magazine is normal, we control magazine backward/up tool pot manually

A016.2 knife storehouse forward and backward/backhoe knife detection abnormal

Reason:After open ATC function,CNC detect signals of magazine forward/down tool pot and magazine backward/up tool pot both at same time

Solution:Press [Reset]key to clear alarm,check position of sensors/switches for forward/backward, down/up tool pot, check type set of these sensors/switches(K30.3/K30.4)

A016.3 tool arm not clamped can not return to the origin

Reason:Return arm back to original point when spindle chuck don't clamp tool well yet

Solution:Press [Reset]key to clear alarm,It only can return arm back to original point after spindle chuck tighten tool well.

A016.4 spindle tool not clamping tool store can not be backward

Reason:After open ATC function,magazine backward when spindle don't clamp tool well

Solution:Press [Reset]key to clear alarm,It only can let tool magazine backward when spindle chuck tighten tool well.

A016.5 The rotation of knife store is forced to stop due to abnormal rotation

Reason:After open ATC function,CNC doesn't detect change of counting sensor signal after rotating tool magazine with time of T110,T111,T103

Solution:Press [Reset]key to clear alarm,check if magazine was rotating,if rotating, check T110,T111,T103 & counting sensor signal (T110=5000;T111=3000;T103=3000); if without rotating, check circuit for rotate tool magazine

A016.6 knife store is not at the origin. It cannot be started

Reason:Start program when magazine isn't at backward position(Umbrella)

Start program when ATC arm isn't at original position (Arm)

Start program when Z-axis is at range of tool change(Hat/Turret)

Solution:Press [Reset]key to clear alarm,move magazine backward manually

A016.7 is not in the mechanical return to zero mode,can not return to zero

Reason:After open ATC function,magazine is with home switch,but do home of magazine when CNC isn't at status of Machine Zero .

Solution:Press [Reset]key to clear alarm,magazine do home in machine zero status.

A017.0 knife store is not at the origin, the Z axis is not movable

Reason:Umbrella tool magazine isn't at backward,move Z-axis

ATC Arm isn't at original position, move Z-axis

Solution:Press [Reset]key to clear alarm,move magazine backward manually.

A017.1 ATC arm is not at the origin, the knife store can not reverse/return

Reason:ATC arm isnot original point,magazine plate down/up tool holder

Solution:Press [Reset]key to clear alarm,move ATC arm back to original point manually.

A017.2 knife rack is not in place, the knife arm cannot move

Reason:ATC arm action when tool holder isn't downward
Solution:Press [Reset]key to clear alarm,downward tool holder manually.

A017.3 The main axis of is not positioned, the knife arm cannot move

Reason:ATC arm action when spindle didn't finish orientation

Solution:Press [Reset]key to clear alarm,after spindle orientation,do action of ATC arm.

A017.4 The Z axis is not at the second reference point.

Reason:ATC arm action when Z-axis isn't at 2nd reference point

Solution:Press [Reset]key to clear alarm,Z-axis must be at 2nd reference point,then do ATC action.

A017.5 tool not clamped, knife arm not buckle knife or back to the origin

Reason:ATC arm grasp tool when spindle doesn't tighten tool

Solution:Press [Reset]key to clear alarm,only when spindle tighten tool,and then ATC arm grasp tool.

A017.6 if the cutter is not released, the arm cannot be pulled down

Reason:ATC down/exchange tool when spindle doesn't loose tool

Solution:Press [Reset]key to clear alarm,only when spindle loose tool,and then ATC arm down & exchange tool.

A017.7 The operating time of knife arm is too long

Reason:Rotating time of ATC arm is over time of T115

Solution:Press [Reset]key to clear alarm,check if T115 is set correctly,check braking signal of ATC arm is valid or not.

A018.0 knife arm buckle knife is not in place

Reason:ATC arm do grasp tool,after T112, CNC didn't detect position signal of grasp tool;

Solution:Press [Reset]key to clear alarm,check if T112 is set correctly, check if position signal of grasp tool is valid or not.

A018.1 The downward rotation of knife arm is not in place

Reason:ATC arm down/exchange tool,after T113, CNC didn't detect position signal of grasp tool;

Solution:Press [Reset]key to clear alarm,check if T113 is set correctly, check if position signal of grasp tool is valid or not.

A018.2 knife arm does not return to the origin

Reason:ATC arm back to origin point, after T114,CNC didn't detect position of origin.

Solution:Press [Reset]key to clear alarm,check if T114 is set correctly, check if position signal of original point is valid.

A018.3 knife arm is in abnormal operation

Reason:ATC arm do actions, CNC hints reset/Alarm/E-stop

Solution:Press [Reset]key to clear alarm.

A020.0 protective door has been opened warning

Reason:Open function of protective door,CNC doesn't detect position signal of protective door is closed.

Solution:Press [Reset]key to clear alarm after close protective door,CNC cannot start when CNC hints this warn

A020.1 Warning of insufficient lubricating oil , test delay T03

Reason:CNC detect lubricate oil isn't enough,after T03, CNC hints this warn

Solution:Add lubricate oil,press [Reset]key to clear alarm,check if type of sensor for lubricate oil is right(K16.2)

A020.2 low pressure warning

Reason:CNC detect pressure is low,after T02, CNC hints this warn;

Solution:Check if unit for import air is normal,after air pressure is enough,cancel warn; check if type set of sensor/switch for low air pressure sis right(K20.2)

A020.3 spindle tool number is zero warning

Reason:Current tool in spindle is 0 without in the processing of changing tool;

Solution:Check if there is tool in spindle,disassemble tool and do exchange tool again, or revise current tool number in spindle by D105.

A020.4 The debugging function of knife library turns on the warning

Reason:Open debug function of tool magazine,also K30.7=1,CNC hints warn;

Solution:Ensure tool magazine is normal, turn off debug function(K30.7=0).CNC cannot start program when CNC hints this warn.

A020.5 knife store back to zero warning

Reason:CNC hints warn when tool magazine is doing home

Solution:After tool magazine homing done, cancel warn; CNC cannot start program when CNC hints this warn.

A020.6 knife store is no longer in retreat position warning

Reason:Umbrella tool magazine isn't at backward without in process of ATC.

Arm arm isn't original point without in the process of ATC

Z-axis is at range of tool change without in the process of ATC

Solution:After let magazine backward, cancel this warn;CNC cannot start program when CNC hints this warn.