

User Manual

PLC of CNC Milling System

V1.2

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Chapter 1 PROGRAMMING

1.1 PLC Specification

Specification	Milling System
Programming Language	Ladder
Programming Software	SZGHPLCSc.exe & SZGHPLCe.exe
Programming Grade	1
Exectutive Cycle of Program	8ms
Max Step of Program	1000 steps
Programming Instruction	Basic Instruction + Function Instruction
Internal Assistant Relay(M)	256
Timer(T)	80
CUNTER(C)	16
Input(X)	40(CNC990MD) / 56(CNC1000MD)
Output(Y)	24(CNC990MD) / 32(CNC1000MD)

1.2 Sequential program

The sequential program is defined to logically control refer to the machine and relative devices. After converting the program into a certain format, CPU can be decoded and arithmetic processing, and stored in RAM. And CPU read the codes in high speed and executed by the arithmetic operation.

Sequential program is compiled in the beginning of ladder.

1.2.1 Distribution of I/Os (step1)

The interface can be distributed after control target is defined and the corresponding input/output signal points are counted. Refer to input/output interface signal list.

1.2.2 Edit of Ladder (step2)

Ladder cannot be edited online,only edited by SZGHPLCS.exe on computer.After finished well,it needs to debug.

1.2.3 Debug of Ladder (step3)

After finished, the ladder is debugged as follows:

A: Emulator

Use one emulator (TEST in PLC software) instead of machine to debug it. Machine signal state is represented with switch ON/OFF,and output signal state is done with indicator ON/OFF. Observe if ever indicator on the emulator is correct when test on software.

B: Diagnosis of CNC

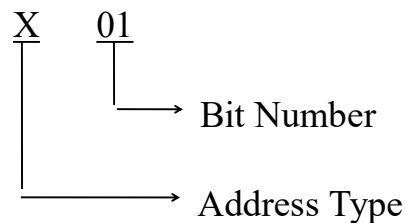
After finished well & restore into system, we could observe if the diagnostic state of every signal is consistent with the function requiriment when executing CNC. Check the ladder by checking condition of each I/Os in Diagnosis interface.

C: Actual Run

There may be unexpected result in the actual debugging machine and so we need to do preventive measures before debugging.

Chapter 2 ADDRESS

Addresses are used for distinguishing signals. Different addresses separately correspond to input/output signal at machine side and CNC side, internal relay, counter, timer, holding relay and data list. An address number is consisted of address type, address number and bit number as follows:



Address type: X , Y , M , T , C

Bit Number: 0 ~ 999

Address	Explanation	Range
X	Machine → PLC	X00 - X67
Y	PLC → Machine	Y00 - Y31
M	Internal Auxiliary Relay	M00 - M313
C	Counter	C00 - C15
T	Timer	T00 - T79

2.1 Inputs (X)

Input address(X) are divided into two types,the first one is X00 ~ X67 which are distributed to CNC I/Os interfaces,includ fixed addresses & definable addresses. The second one is distributed to input keys on

operational panel, which are fixed addresses. The other addresses are reserved. The value range is 0 or 1.

(1) Fixed address: these inputs are fixed well by system, which don't need to be altered.

(2) Address range: X00~X47&X60~X67 are separately distributed by I/O interface of CNC system.

(3) Definable address: their functions can be defined by user according to requirement and used for connecting with external electric circuit and ladder.

2.2 Outputs (Y)

Output address (Y) are distributed to I/O interfaces, including fixed address and definable address. Other addresses are reserved. Their values are 0 or 1.

2.3 I/O interface

2.3.1 CNC990 Series (total 40x24 I/Os)

Input point							
0	0	0	0	0	0	0	0
X00	X01	X02	X03	X04	X05	X06	X07
T01	T02	T03	T04	T05	T06	T07	T08
0	0	0	0	0	0	0	0
X08	X09	X10	X11	X12	X13	X14	X15
M34/A0	-L	+L	M36/Y0	X0	Z0	KRUN	KHALT
0	1	1	0	0	0	0	0
X16	X17	X18	X19	X20	X21	X22	X23
Z20	Z20	KLEFT	KRIGHT	STOP	TOK	ALM	ALM1
0	0	0	0	0	0	0	0
X24	X25	X26	X27	X28	X29	X30	X31
ALM2	M28	M24	M22	M18	M12	M14	M16
1	1	1	1	1	1	1	1
X32	X33	X34	X35	X36	X37	X38	X39
HX/DS8	HY/DS4	HZ/DS2	HA/DS0	HX1/K8	HX10/K	HX100/	HOFF/K

Output Point							
0	0	0	0	0	0	0	0
Y00 M61	Y01 M63	Y02 M65	Y03 M67	Y04 M69	Y05 M71	Y06 M73	Y07 M59
0	0	0	0	0	0	0	0
Y08 M32	Y09 M79	Y10 M10	Y11 M08	Y12 M05	Y13 M04	Y14 M03	Y15 M75
0	0	0	0	0	0	0	0
Y16 LRUN	Y17 INTH	Y18 +T	Y19 -T	Y20 S04	Y21 S03	Y22 S02	Y23 S01

2.3.2 CNC1000 Sereis (total 56x32 I/Os)

Input point							
0	0	0	0	0	0	0	0
X00 T01	X01 T02	X02 T03	X03 T04	X04 T05	X05 T06	X06 T07	X07 T08
0	0	0	0	0	0	0	0
X08 M34/A0	X09 -L	X10 +L	X11 M36/Y0	X12 X0	X13 Z0	X14 KRUN	X15 KHALT
0	0	1	0	0	0	0	0
X16 X20	X17 Z20	X18 KLEFT	X19 KRIGHT	X20 STOP	X21 T0K	X22 ALM	X23 ALM1
0	0	0	0	0	0	0	0
X24 ALM2	X25 M28	X26 M24	X27 M22	X28 M18	X29 M12	X30 M14	X31 M16
1	1	1	1	1	1	1	1
X32 HX	X33 HY	X34 HZ	X35 HA	X36 HX1	X37 HX10	X38 HX100	X39 H0FF
0	0	0	0	0	0	0	0
X40	X41	X42	X43	X44	X45	X46	X47
1	1	1	1	0	1	1	0
X60 DS3	X61 DS2	X62 DS1	X63 DS0	X64 DK3	X65 DK2	X66 DK1	X67 DK0

Output Point							
0	0	0	0	0	0	0	0
Y00 M61	Y01 M63	Y02 M65	Y03 M67	Y04 M69	Y05 M71	Y06 M73	Y07 M59
0	0	0	0	0	0	0	0
Y08 M32	Y09 M79	Y10 M10	Y11 M08	Y12 M05	Y13 M04	Y14 M03	Y15 M75
0	0	0	0	0	0	0	0
Y16 LRUN	Y17 INTH	Y18 +T	Y19 -T	Y20 S04	Y21 S03	Y22 S02	Y23 S01
0	0	0	0	0	0	0	0
Y24	Y25	Y26	Y27	Y28	Y29	Y30	Y31

Note: 1) X32-X39 , X60-X67 as normal close,also internalis +5V power, pls do not connect more than +5V voltage; others is as normal open;All of input output 0 V is available

2) Pay more attention the function can not same as previous PLC and controller to reusage

2.4 PLC internal assistant relay

Definition of milling and machine centers internal auxiliary relays

Seq.	No	Name (Function)	Description
1	M00	Feed ban	Each axis feed ban when the relay valid
2	M01	Manual states	State relay, when the system is in manual mode this relay is valid, on the contrary is void when this relay system will be in automatic mode
3	M02	Just started	State relay, when the system has just started and remain valid for this relay.
4	M03	Prohibit procedures	When the effective prohibition of the relay run automatically
5	M04	Emergency stop	When the system is in the emergency stop relay valid state.
6	M05	tool in selecting	State relay, when the system is selected cutter (cutter rotation) state of this relay is valid.
7	M06	tool in changing	State relay, when the system is a tool change (tool change) the status of this relay is valid.
8	M07	Magazine back to zero	When the relay system to perform effectively magazine zeroing
9	M08	Feeding running	State relay, when the system axis feed this relay is valid.
10	M09	Pocket Lift	When the relay system to perform effectively lift function pocket.
11	M10	Protective door open	When the relay system is an effective protective door open
12	M11	Main grasping the tool	State relay, when the control system is mechanical manual magazine gripper (robot is buckle knife and tool change position) state of this relay is valid.
13	M12	Machine abnormal	State relays, emergency stop or drive when the system alarm or custom alarm relays or hard limit this effect.
14	M13	There tool detection	Said pocket has a tool change position (for Armless library) when the relay is valid. (Input)
15	M14	Spindle orientation	When the relay system to perform spindle orientation function effectively. (Output

16	M15	Broach detection	Said cutter knife in a tight state when the relay is valid. (Input)
17	M16	X+ limit	Said X-axis in the positive hardware limit state when the relay is valid. (Input)
18	M17	X- limit	Said X-axis in the negative hardware limit state when the relay is valid. (Input)
19	M18	Y+ limit	Said Y-axis in the positive hardware limit state when the relay is valid. (Input)
20	M19	Y- limit	Said Y-axis in the negative hardware limit state when the relay is valid. (Input)
21	M20	Z+ limit	Said Z-axis in the positive hardware limit state when the relay is valid. (Input)
22	M21	Z- limit	Said Z-axis in the negative hardware limit state when the relay is valid. (Input)
23	M22	A+ limit	A shaft is in said forward hard limit state when the relay is valid. (Input)
24	M23	A- limit	A shaft is negative indicates a hard limit state when the relay is valid. (Input)
25	M24	B+ limit	A shaft is negative indicates a hard limit state when the relay is valid. (Input), said B-axis in the positive hardware limit state when the relay is valid. (Input)
26	M25	B- limit	Said B-axis in the negative hardware limit state when the relay is valid. (Input)
27	M26	M01	M01 This signal is active when the command pause (input)
28	M27	C- limit	Said C-axis in the negative hardware limit state when the relay is valid. (Input)
29	M28	Turret forward / pocket down	When the relay system to perform effectively turret forward (Armless library) / pocket down (rotary magazine) function. (Output)
30	M29	Turret Back / pocket lift	When the system is running turret retreat (Armless library) when the relay valid / pocket Lift (rotary magazine) function. (Output)
31	M30	Forward positioning / fall into place	Said knife forward in place (Armless library) / pocket down (rotary magazine) in place of the relay when the state effectively. (Input)
32	M31	Back Positioning /	Said knife back into place (Armless library) / pocket Lift (rotary magazine) in

		lifted into place	place of the relay when the state effectively. (Input)
33	M32	X driver alarm	X-axis indicates the drive is in an alarm state when the relay is valid. (Input)
34	M33	Y driver alarm	Y-axis indicates the drive is in an alarm state when the relay is valid. (Input)
35	M34	Z driver alarm	Said Z-axis drive is in an alarm state when the relay is valid. (Input)
36	M35	A driver alarm	A drive shaft, said in an alarm state when the relay is valid. (Input)
37	M36	B driver alarm	B-axis indicates the drive is in an alarm state when the relay is valid. (Input)
38	M37	C driver alarm	C-axis indicates the drive is in an alarm state when the relay is valid. (Input)
39	M38	After running ()	During automatic operation, when the relay effective program block "()" will be performed within the otherwise contrary. (Input)
40	M39	Spindle alarm	Said spindle drive in an alarm state when the relay is valid. (Input)
41	M40	Detection of high-grade spindle	Expressed in high-grade spindle when the relay state is valid. (Input)
42	M41	Spindle low detection	Said spindle is low state when the relay is valid. (Input)
43	M42	Loose knife detection	Said cutter knife in loose state when the relay is valid. (Input)
44	M43	Spindle back to zero	Said spindle is executed back to zero when the action is completed state relay valid. (Input)
45	M44	Cooling overload	Said machine tool cooling motor is overload alarm status when the relay is valid. (Input)
46	M45	Lack of liquid cooling	Means that when the relay is the lack of an effective tool coolant fluid (liquid enough) alarm status. (Input)
47	M46	Lubrication overload	Said machine lubricated motor is overload alarm status when the relay is valid. (Input)
48	M47	Lubrication starvation alarm	Said machine is short of oil lubricants (oil level is not enough) alarm status when the relay is valid. (Input)

49	M48	Cooling	When the relay efficient cooling system to perform open action. (Output, which can be controlled with a command M08/M09 valid / invalid)
50	M49	Elastic knife	When the relay system to perform effective tool loose action. (Output, which can be controlled with a command M10/M11 valid / invalid)
51	M50	Blowing	When the relay when the system is running effectively blowing action. (Output, which can be controlled with a command M24/M25 valid / invalid)
52	M51	Lubricating	When the relay is active lubrication system to perform the action. (Output, which can be controlled with a command M32/M33 valid / invalid)
53	M52	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M57 / M58 can control the valid / invalid)
54	M53	Spindle Forward	When the relay is active spindle rotation system to perform the action. (Output, with instructions M03/M04, M05 can control the valid / invalid)
55	M54	Spindle reverse	When the relay system to perform effectively reversing the spindle movement. (Output, with instructions M04/M03, M05 can control the valid / invalid)
56	M55	Spindle stop	When the relay system to perform effectively reversing the spindle movement. (Output, with instructions M05/M03, M04 can control the valid / invalid)
57	M56	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M41 / M42 can control the active / inactive, when the magazine PLC control system defaults to the knife forward (Armless library) / pocket down (rotary magazine) Control)
58	M57	User-defined	When the relay is active the system

			performs the appropriate action by the PLC. (Output, with instruction M43 / M44 can control the active / inactive, when the magazine PLC control system defaults to the knife back (Armless library) / pocket Lift (rotary magazine) Control)
59	M58	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M45 / M46 can control the valid / invalid)
60	M59	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M47 / M48 can control the valid / invalid)
61	M60	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M49 / M50 can control the valid / invalid)
62	M61	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M51 / M52 can control the valid / invalid)
63	M62	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M53 / M54 can control the valid / invalid)
64	M63	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M55 / M56 can control the valid / invalid)
65	M64	Spindle high gear	When the relay when the system performs efficiently spindle upshift action. (Output)
66	M65	Spindle low gear	When the relay when the system performs efficiently spindle downshift action. (Output)
67	M66	Spindle servo	When the relay switch in place an effective system to perform the spindle servo (position control) system mode. (Output)
68	M67	Spindle lock	When the relay is active spindle drive control system allows the spindle motor in the power-lock status. (Output)
69	M68	Spindle back	When the relay is active spindle system

		to zero	performs the action back to zero. (Output)
70	M69	Speed in place	This effectively means that when the relay command rpm spindle speed reaches the actual speed. (Input)
71	M70-M79	backup	When the relay is active the system performs the appropriate action by the PLC. (Input / output)
72	M80-M95	No 0-15user-defin e alarm	When the relay PLC prompted by an effective system corresponding alarm message, if you want to restrict certain actions need to edit the PLC program to achieve. (Input)
73	M105	backup	When the relay is active the system performs the appropriate action by the PLC. (Input / output)
74	M107-M109		
75	M110	Third gear output	When the relay system to perform effectively the third spindle gear change action. (Output)
76	M111	Four gear output	When the relay system to perform effectively spindle fourth gear change action. (Output)
77	M112	Third gear test	Said third gear shaft in the state when the relay is valid. (Input)
78	M113	Four gear test	Said spindle is the fourth tranche of the state when the relay is valid. (Input)
79	M114	Remote operation	When the relay to run the program effectively. (Input) with an external Run button.
80	M115	Remote stop	When the relay effectively stop the program. (Input) with an external stop button.
81	M120	Forward magazine	When the relay system to perform effectively magazine forward movement. (Output)
82	M121	Magazine reversal	When the relay system to perform effectively magazine reversal action. (Output)
83	M122	The program runs	State relay, then this means that the system is effective relay automatically running.
84	M123	The program pause	State relay, the relay was effectively suspended state indicates that the system is in Program.

85	M124	Spindle speed gear 0	Spindle gear 4 compiled binary code output value, the corresponding command S0-S15.
86	M125	Spindle speed gear 1	
87	M126	Spindle speed gear 2	
88	M127	Spindle speed gear 3	
89	M128	Prohibit X axis	X-axis movement is prohibited when the relay is valid. (Input)
90	M129	Prohibit Y axis	Y-axis movement is prohibited when the relay is valid. (Input)
91	M130	Prohibit Z axis	Z-axis movement is prohibited when the relay is valid. (Input)
92	M131	Prohibit A axis	A-axis movement is prohibited when the relay is valid. (Input)
93	M132	Prohibit B axis	B-axis movement is prohibited when the relay is valid. (Input)
94	M133	Prohibit C axis	C-axis movement is prohibited when the relay is valid. (Input)
95	M134	Backup	When the relay is active the system performs the appropriate action by the PLC. (Input / output)
96	M135	Backup	
97	M151-M198	Backup	X151-X198 relay relay last saved state.
98	M200	Running state	X axis forward run
99	M201	Running state	X axis negative Run
100	M202	Running state	Y axis forward run
101	M203	Running state	Y axis negative Run
102	M204	Running state	Z axis forward run
103	M205	Running state	Z axis negative Run
104	M206	Running state	A axis forward run
105	M207	Running state	A axis negative Run
106	M208	Running state	B axis forward run
107	M209	Running state	B axis negative Run
108	M210	Running state	C axis forward run
109	M211	Running state	C axis negative Run
110	M212	Back to the zero state	X-axis has returned zero state

111	M213	Back to the zero state	Y-axis has returned zero state
112	M214	Back to the zero state	Z-axis has returned zero state
113	M215	Back to the zero state	A-axis has returned zero state
114	M266	Equivalent X182	Milling-X key
115	M267	Equivalent X180	Milling +X key
116	M268	Equivalent X179	Milling -Y key
117	M269	Equivalent X178	Milling +Z key
118	M270	Equivalent X177	Milling +4 key
119	M271	Equivalent X183	Milling +Y key
120	M272	Equivalent X184	Milling -Z key
121	M273	Equivalent X185	Milling -4 key
122	M274	Equivalent X181	milling fast overlay key
123	M250--M265	Internal system backup	M265 valid table just press the reset button, passed by the NC layer to the PLC layer needs to be reset by the PLC itself the auxiliary relay.
124	M266--M281	Internal system backup	
125	M250	System takes	Chuck M10M11 short signal timing used.
126	M251	System takes	Top M51M53 short signal timing used
127	M266--M274	System takes	Manual input for external signal.
128	M275	System takes	Resolving power wire spindle rigidity ratio of two to one problem.
129	M276	System takes	Follow signs currently in tapping state.
130	M277	System takes	When it is valid to implementation of a user-defined control program
131	M278:	System takes	When it is valid to implementation of Z axis gap setting function

132	M218--M23 3	Internal system backup	
133	M234--M24 9	Internal system backup	
134	M218	System takes	Use with M219.
135	M219	System takes	Tight knife instruction execution M10 becomes active, the instruction execution loose knife M11 becomes invalid.
136	M220	System takes	Running open
137	M221	System takes	Accessibility MST locked
138	M222	System takes	System +5 V power supply is low.
139	M223	System takes	+24 V power supply system is low.
140	M282--M29 7	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Input / output)
141	M298--M31 3	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Input / Output))
142	M171/X172	K1	K1 last state
143	M172/X172	K2	K2 last state
144	M173/X173	K3	K3 last state
145	Y78	K1 light	
146	Y77	K2 light	
147	Y76	K3 light	
	M265		Reset Relay
Seq.	Mark No.	Name (Function)	Description
1	M00	Feed ban	Each axis feed ban when the relay valid
2	M01	Manual states	State relay, when the system is in manual mode this relay is valid, on the contrary is void when this relay system will be in automatic mode
3	M02	Just started	State relay, when the system has just started and remain valid for this relay.
4	M03	Prohibit procedures	When the effective prohibition of the relay run automatically
5	M04	Emergency stop	When the system is in the emergency stop relay valid state.
6	M05	tool in selecting	State relay, when the system is selected cutter (cutter rotation) state of this relay is

			valid.
7	M06	tool in changing	State relay, when the system is a tool change (tool change) the status of this relay is valid.
8	M07	Magazine back to zero	When the relay system to perform effectively magazine zeroing
9	M08	Feeding running	State relay, when the system axis feed this relay is valid.
10	M09	Backup	
11	M10	Protective door open	When the relay system is an effective protective door open
12	M11	Backup	
13	M12	Machine abnormal	State relays, emergency stop or drive when the system alarm or custom alarm relays or hard limit this effect.
14	M13	backup	Clamp test
15	M14	Spindle orientation	When the relay system to perform spindle orientation function effectively. (Output
16	M15	Clamp detection	When the relay is valid , it means chuck is in clamp situation
17	M16	X+ limit	It means X-axis in the positive limit state when the relay is valid. (Input)
18	M17	X- limit	It means X-axis in the negative limit state when the relay is valid. (Input)
19	M18	Y+ limit	It means Y-axis in the positive hardware limit state when the relay is valid. (Input)
20	M19	Y- limit	It means Y-axis in the negative limit state when the relay is valid. (Input)
21	M20	Z+ limit	It means Z-axis in the positive limit state when the relay is valid. (Input)
22	M21	Z- limit	It means Z-axis in the negative limit state when the relay is valid. (Input)
23	M22	A+ limit	A shaft is in said forward limit state when the relay is valid. (Input)
24	M23	A- limit	A shaft is negative indicates limit state when the relay is valid. (Input)
25	M24	B+ limit	A shaft is negative indicates a hard limit state when the relay is valid. (Input), said B-axis in the positive limit state when the relay is valid. (Input)
26	M25	B- limit	It means B-axis in the negative limit state when the relay is valid. (Input)

27	M26	C+ limit	It means C-axis in the positive limit state when the relay is valid. (Input)
28	M27	C- limit	It means C-axis in the negative limit state when the relay is valid. (Input)
29	M28	Backup	
30	M29	Backup	
31	M30	Forward positioning	When the relay is valid , it means final forward is in position
32	M31	Back Positioning	When the relay is valid , it means final back is in position
33	M32	X driver alarm	X-axis indicates the drive is in an alarm state when the relay is valid. (Input)
34	M33	Y driver alarm	Y-axis indicates the drive is in an alarm state when the relay is valid. (Input)
35	M34	Z driver alarm	Said Z-axis drive is in an alarm state when the relay is valid. (Input)
36	M35	A driver alarm	A drive shaft, said in an alarm state when the relay is valid. (Input)
37	M36	B driver alarm	B-axis indicates the drive is in an alarm state when the relay is valid. (Input)
38	M37	C driver alarm	C-axis indicates the drive is in an alarm state when the relay is valid. (Input)
39	M38	After running ()	During automatic operation, when the relay effective program block "()" will be performed within the otherwise contrary. (Input)
40	M39	Spindle alarm	Said spindle drive in an alarm state when the relay is valid. (Input)
41	M40	Detection of high-grade spindle	Expressed in high-grade spindle when the relay state is valid. (Input)
42	M41	Spindle low detection	Said spindle is low state when the relay is valid. (Input)
43	M42	Loose knife detection	Said cutter knife in loose state when the relay is valid. (Input)
44	M43	Spindle back to zero	Said spindle is executed back to zero when the action is completed state relay valid. (Input)
45	M44	Cooling overload	Said machine tool cooling motor is overload alarm status when the relay is valid. (Input)
46	M45	Lack of liquid	Means that when the relay is the lack of an

		cooling	effective tool coolant fluid (liquid enough) alarm status. (Input)
47	M46	Lubrication overload	Said machine lubricated motor is overload alarm status when the relay is valid. (Input)
48	M47	Lubrication starvation alarm	Said machine is short of oil lubricants (oil level is not enough) alarm status when the relay is valid. (Input)
49	M48	Cooling	When the relay efficient cooling system to perform open action. (Output, which can be controlled with a command M08/M09 valid / invalid)
50	M49	Chuck elastic	When the relay system to perform effective tool loose action. (Output, which can be controlled valid / invalid by a command M10/M11)
51	M50	Blowing	When the relay when the system is running effectively blowing action. (Output, which can be controlled with a command M24/M25 valid / invalid)
52	M51	Lubricating	When the relay is active lubrication system to perform the action. (Output, which can be controlled with a command M32/M33 valid / invalid)
53	M52	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M57 / M58 can control the valid / invalid)
54	M53	Spindle Forward	When the relay is active spindle rotation system to perform the action. (Output, with instructions M03/M04, M05 can control the valid / invalid)
55	M54	Spindle reverse	When the relay system to perform effectively reversing the spindle movement. (Output, with instructions M04/M03, M05 can control the valid / invalid)
56	M55	Spindle stop	When the relay system to perform effectively reversing the spindle movement. (Output, with instructions M05/M03, M04 can control the valid / invalid)
57	M56	User-defined	When the relay is active the system

			performs the appropriate action by the PLC. (Output, with instruction M41 / M42 can control the active / inactive, when the magazine PLC control system defaults to the knife forward (Armless library) / pocket down (rotary magazine) Control)
58	M57	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M43 / M44 can control the active / inactive, when the magazine PLC control system defaults to the knife back (Armless library) / pocket Lift (rotary magazine) Control)
59	M58	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M45 / M46 can control the valid / invalid)
60	M59	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M47 / M48 can control the valid / invalid)
61	M60	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M49 / M50 can control the valid / invalid)
62	M61	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M51 / M52 can control the valid / invalid)
63	M62	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M53 / M54 can control the valid / invalid)
64	M63	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Output, with instruction M55 / M56 can control the valid / invalid)
65	M64	Spindle high gear	When the relay when the system performs efficiently spindle upshift action. (Output)
66	M65	Spindle low gear	When the relay when the system performs efficiently spindle downshift action. (Output)

67	M66	Spindle servo	When the relay switch in place an effective system to perform the spindle servo (position control) system mode. (Output)
68	M67	Spindle lock	When the relay is active spindle drive control system allows the spindle motor in the power-lock status. (Output)
69	M68	Spindle back to zero	When the relay is active spindle system performs the action back to zero. (Output)
70	M69	Speed in place	This effectively means that when the relay command rpm spindle speed reaches the actual speed. (Input)
71	M70-M79	backup	When the relay is active the system performs the appropriate action by the PLC. (Input / output)
72	M80	Tool Motor over load alarm	When the relay is in valid , it means motor with tool is in over load alarm sate
73	M81	hydraulic motor over load alarm	When the relay is valid , indicate hydraulic motor is in over load alarm sate (input)
74	M82	hydraulic pressured alarm	When the relay is valid , indicate hydraulic pressured is not enough alarm sate (input)
75	M83	hydraulic block alarm	When the relay is valid , indicate hydraulic oil passage is in block alarm sate (input)
76	M84	Motor over load alarm	When the relay is valid , indicate motor is in over load alarm sate (input)
77	M85-M95	No 5-15 user-defined alarm	When the relay is in valid, Press PLC on system prompt relative alarm message, if limit some move, it need edit PLC program to achieve (input)
78	M100	Tool no 0	Tool no (5-digit binary value code , 0-63)
79	M101	Tool no 1	
80	M102	Tool no 2	
81	M103	Tool no 3	
82	M104	Tool no 4	
83	M105	backup	When the relay is active the system performs the appropriate action by the PLC. (Input / output)
84	M107-M109		
85	M110	Third gear output	When the relay system to perform effectively the third spindle gear change action. (Output)

86	M111	Four gear output	When the relay system to perform effectively spindle fourth gear change action. (Output)
87	M112	Third gear test	Said third gear shaft in the state when the relay is valid. (Input)
88	M113	Four gear test	Said spindle is the fourth tranche of the state when the relay is valid. (Input)
89	M114	Remote operation	When the relay to run the program effectively. (Input) with an external Run button.
90	M115	Remote stop	When the relay effectively stop the program. (Input) with an external stop button.
91	M120	Forward magazine	When the relay system to perform effectively magazine forward movement. (Output)
92	M121	Magazine reversal	When the relay system to perform effectively magazine reversal action. (Output)
93	M122	The program runs	State relay, then this means that the system is effective relay automatically running.
94	M123	The program pause	State relay, the relay was effectively suspended state indicates that the system is in Program.
95	M124	Spindle speed gear 0	Spindle gear 4 compiled binary code output value, the corresponding command S0-S15.
96	M125	Spindle speed gear 1	
97	M126	Spindle speed gear 2	
98	M127	Spindle speed gear 3	
99	M128	Prohibit X axis	X-axis movement is prohibited when the relay is valid. (Input)
100	M129	Prohibit Y axis	Y-axis movement is prohibited when the relay is valid. (Input)
101	M130	Prohibit Z axis	Z-axis movement is prohibited when the relay is valid. (Input)
102	M131	Prohibit A axis	A-axis movement is prohibited when the relay is valid. (Input)
103	M132	Prohibit B axis	B-axis movement is prohibited when the relay is valid. (Input)

104	M133	Prohibit C axis	C-axis movement is prohibited when the relay is valid. (Input)
105	M134	Backup	When the relay is active the system performs the appropriate action by the PLC. (Input / output)
106	M135	Backup	
107	M151-M198	Backup	X151-X198 relay relay last saved state.
108	M200	Running state	X axis forward run
109	M201	Running state	X axis negative Run
110	M202	Running state	Y axis forward run
111	M203	Running state	Y axis negative Run
112	M204	Running state	Z axis forward run
113	M205	Running state	Z axis negative Run
114	M206	Running state	A axis forward run
115	M207	Running state	A axis negative Run
116	M208	Running state	B axis forward run
117	M209	Running state	B axis negative Run
118	M210	Running state	C axis forward run
119	M211	Running state	C axis negative Run
120	M212	Back to the zero state	X-axis has returned zero state
121	M213	Back to the zero state	Y-axis has returned zero state
122	M214	Back to the zero state	Z-axis has returned zero state
123	M215	Back to the zero state	A-axis has returned zero state
124	M266	Equivalent X182	Lathe-X key
125	M267	Equivalent X180	Lathe +X key
126	M268	Equivalent X179	Lathe -Y key
127	M269	Equivalent X178	Lathe +Z key
128	M270	Equivalent X177	Lathe +4 key
129	M271	Equivalent X183	Lathe +Y key

130	M272	Equivalent X184	Lathe -Z key
131	M273	Equivalent X185	Lathe -4 key
132	M274	Equivalent X181	Lathe fast overlay key
133	M250--M26 5	Internal system backup	M265 valid table just press the reset button, passed by the NC layer to the PLC layer needs to be reset by the PLC itself the auxiliary relay.
134	M266--M28 1	Internal system backup	
135	M250	System takes	Chuck M10M11 short signal timing used.
136	M251	System takes	Top M51M53 short signal timing used
137	M266--M27 4	System takes	Manual input for external signal.
138	M275:	System takes	Resolving power wire spindle rigidity ratio of two to one problem.
139	M276	System takes	Follow signs currently in tapping state.
140	M277	System takes	When it is valid to implementation of a user-defined control program
141	M278:	System takes	When it is valid to implementation of Z axis gap setting function
142	M218--M23 3	Internal system backup	
143	M234--M24 9	Internal system backup	
144	M218	System takes	Use with M219.
145	M219	System takes	Tight knife instruction execution M10 becomes active, the instruction execution loose knife M11 becomes invalid.
146	M220	System takes	Running open
147	M221	System takes	Accessibility MST locked
148	M222	System takes	System +5 V power supply is low.
149	M223	System takes	+24 V power supply system is low.
150	M282--M29 7	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Input / output)
151	M298--M31 3	User-defined	When the relay is active the system performs the appropriate action by the PLC. (Input / Output))

152	M171/X172	K1	K1 last state
153	M172/X172	K2	K2 last state
154	M173/X173	K3	K3 last state
155	Y78	K1 light	
156	Y77	K2 light	
157	Y76	K3 light	
	M265		Reset Relay

2.5 COUNTER ADDRESS (C)

The address area is used for storing current counting value of counter and data are saved after the system is switched off. Address range: C00 ~ C15, value range: 0~65536.

2.6 TIMER ADDRESS (T)

The address area is used for storing current value of timer and T0000 ~ T0079 are zero after the system is switched on. T0080 ~ T0099 are saved after it is switched off. Value range: 0~21,4748,3647.

Unit is 10ms : General type: T0-T3&T16-T31;

Accumulated type: T4~T7&T32-T47

Unit is 1s : General type: T8-T11&T48-T63;

Accumulated type: T12~T15&T64-T79

2.7 STRUCTURE of SEQUENTIAL PROGRAM

Sequential program is defined to logically control the machine and relative devices according to sequence of ladder.

There is the copy of edited sequential program(ladder program) that can be backup from CNC system. They are PLC1.LAD & PLC1.PLC which don't work in CNC system, only for spare. PLC.LAD & PLC.PLC can work in CNC system.

2.7.1 EXECUTING SEQUENTIAL PROGRAM

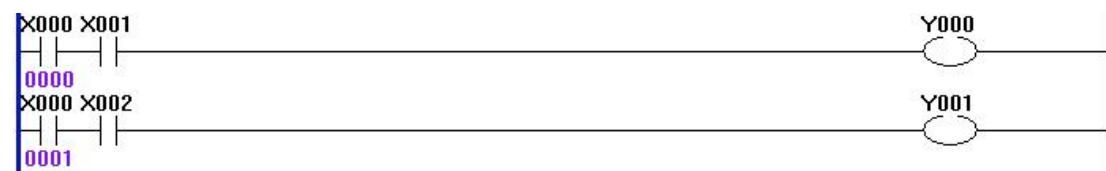
The edited sequential programs(ladder program) are downloaded to 990MD/1000MD series by USB-disk, CNC reads the ladder and converts into some format identified by it after it is switched on again, and then CPU decodes and

operation processes them to store into RAM, and last reads every instruction in memory to execute it by arithmetical operation.

2.7.2 Execution Process of Sequential Program

PLC sequence control is executed by software and there is different from general relay circuit, and so its method is understandingly considered in editing PLC sequential programs.

Every relay can output simultaneously for general relay control circuit as the following figure. Y000 and Y001 output simultaneously when contactor X000, X001 and X002 are closed; in PLC sequence control, every relay outputs in order. For example, Y000 outputs and then Y001 does when X000,X001 and X002 are closed, namely, outputs are executed in order as ladder.



2.7.3 Cycle Execution of Sequential Program

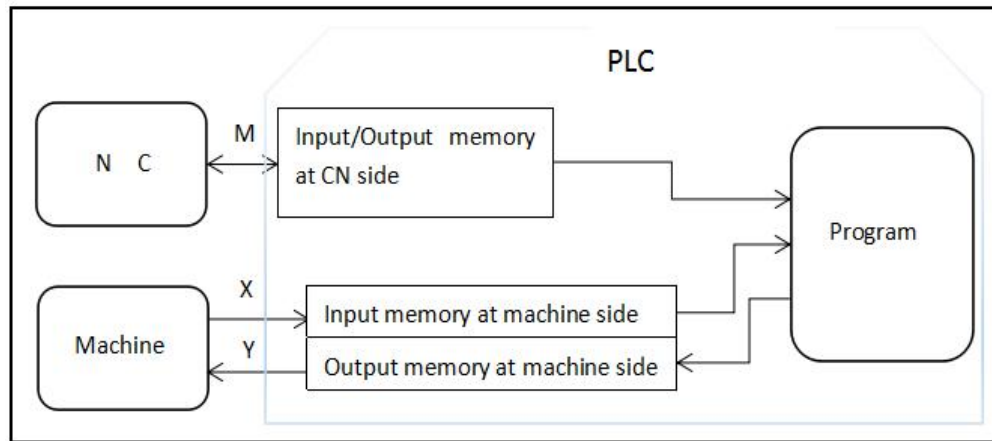
Cycle execution of sequential program is defined that PLC executes ladder from its home to end, and again from its home to end after the run is completed.

Processing cycle is defined to runtime of ladder from home to end. The shorter the processing cycle is, the stronger the response of signal is.

2.7.4 Processing Input/Output Signal

Processing of input/output signal is as the following figure. X signal of machine I/O interface and M signal of NC are separately input to input memories at machine side and NC side, and directly used by program; they separately input to synchronous input memories are used by the program. Output signals of the program are separately output to output memories at NC side and machine side, and then separately output to NC and I/O interface of machine.

Signal states of the above-mentioned memories are displayed by diagnostic interface, and the diagnostic number corresponds to address number of program.



2.7.4.1 Processing Input Signal

(1) Signal to NC

Input memory at NC side is scanned every 8ms and stores M signal from NC, and the system directly use its state when the first is executed.

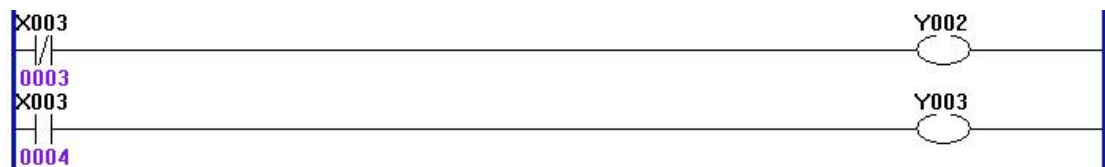
PLC transmits output signal to the output memory at NC side every 8ms, and then directly outputs to NC

(2) Signal to machine

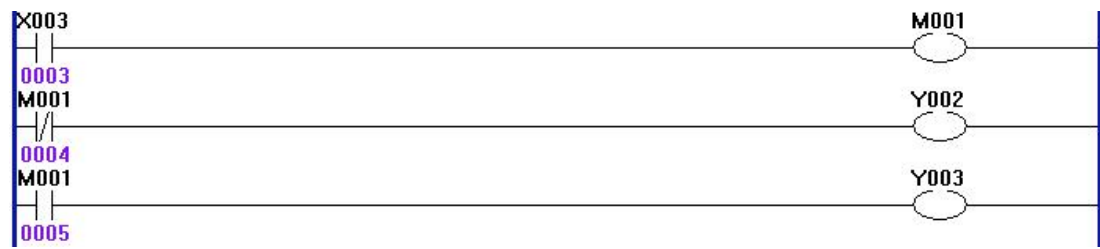
PLC transmits output signal to the output memory at machine side, and then directly outputs to memory every 2ms.

2.7.4.2 Synchronous Procession of Short Pulse Signal

The program is used for processing the short pulse signal. When it is less than 8ms, namely when the system executes the first, the input signal state may be changed, which may execute programs by mistake.



As above, X003=0 is changed to X003=1 after Y002=1 is executed, and if the system executes the next line of ladder and Y003=1, at the moment Y002=1 and Y003=1. To avoid the above, process synchronously the short pulse signal as follows:



After the program is executed synchronously and when X003=1,Y003=1,Y002=0;
when X003=0, Y002=1, and Y003=0, but Y0003.3=1 or Y0002.3=1.

2.7.4.3 Interlock Signal

For safety, the signals must be employed with soft interlock in sequence control, and with hard interlock to relay control circuit of power electric box at machine side at the same time. Because the hardware is failure, the interlock is invalid in executing sequential program even if it is employed logically with soft interlock, which can ensure the operator is not injured and the machine is prevented from damage.

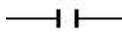
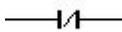
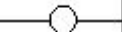
Chapter 3 PLC BASIC INSTRUCTIONS

Basic instructions are used for editing sequential programs and executing 1-bit operation. There are basic instructions for SZGH-CNC990TD & SZGH-CNC1000TD series PLC as follows:

Instruction Name	Function	Component
LD	Read normally-open contact	X,Y,M
LDI	Read normally-closed contact	X,Y,M
OUT	Output coil	X,Y,M
AND	Normally-open contact in series	X,Y,M
ANI	Normally-closed contact in series	X,Y,M
OR	Parallel normally-open contact	X,Y,M
ORI	Parallel normally-closed contact	X,Y,M
ORB	Parallel series circuit block	
ANB	Parallel circuit block in series	
SET	Set	
RST	Reset	

3.1 LD, LDI, OUT INSTRUCTION

◆ Mnemonic code and function

Mnemonic code	Function	Ladder Symbol
LD	Read normally-open contact	
LDI	Read normally-closed contact	
OUT	Output coil	

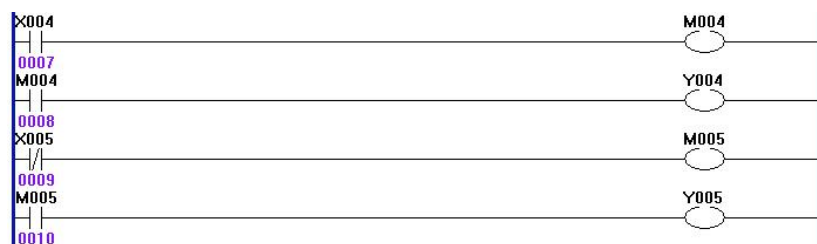
◆ Instruction explanation

A: LD, LDI are used for connecting contact to bus bar. Each one can combine with instruction ANB and can be used at starting point of branch.

B: OUT is used for driving output relay, internal relay coil instead of input relay.

C: Parallel instruction OUT can be continuously used.

◆ Programming Example



Program Explantion:

When X004 is 1, M004 is 1, the system output Y004

When X005 is 0, M005 is 1, the system output Y005

3.2 AND,ANI INSTRUCTION

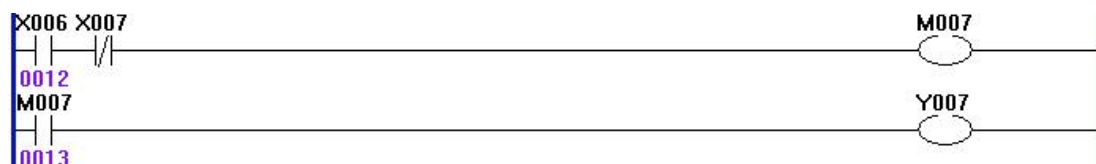
◆ Mnemonic code and function

Memonic code	Function	Ladder Symbol
AND	Normally-open contact in series	
ANI	Normally-closed contact in series	

◆ Instruction explanation

AND, ANI can connect one contact in serial. There can be many contacts in serial and the instructions can be used many times.

◆ Programming Example



Program Explantion:

If X006=1and X007 is 0, M007 is 1, the system output Y007.

3.3 OR,ORI INSTRUCTION

◆ Mnemonic code and function

Memonic code	Function	Ladder Symbol
OR	Parallel normally-open contact	
ORI	Parallel normally-closed contact	

◆ Instruction explanation

A: OR, ORI can be connected to one contact in parallel. When more than two contacts are connected in series and the serial loop is connected with other loop in parallel, the system should use ORB.

B: The system executes OR, ORI from its current step with LD, LDI in parallel.

◆ Programming Example



Program Explanation: If X08 is 1 or X09 is 0, the system outputs M008.

3.4 ORB INSTRUCTION

◆ Mnemonic code and function

Mnemonic code	Function	Ladder Symbol
ORB	Parallel series circuit block	

◆ Instruction explanation

A: Serial loop block is defined to its loop combined by more than contacts in series. When the serial loop is connected in parallel, starting point of branch uses LD and its end point uses ORB.

B: ORB is sole instruction without address.

◆ Programming Example



Program explanation:

As above figure, there are three branches(0017,0018,0019) from left bus line to node, and 0017 and 0018 are serial circuit blocks. There is parallel serial circuit block between bus line and node or among nodes, the following ending of branch use ORB except for the first one. Use OR instruction if the branch 0019 is not serial circuit block.

ORB and ANB are instructions without operation function, representing or, and relationship among circuit blocks.

3.5 ANB INSTRUCTION

◆ Mnemonic code and function

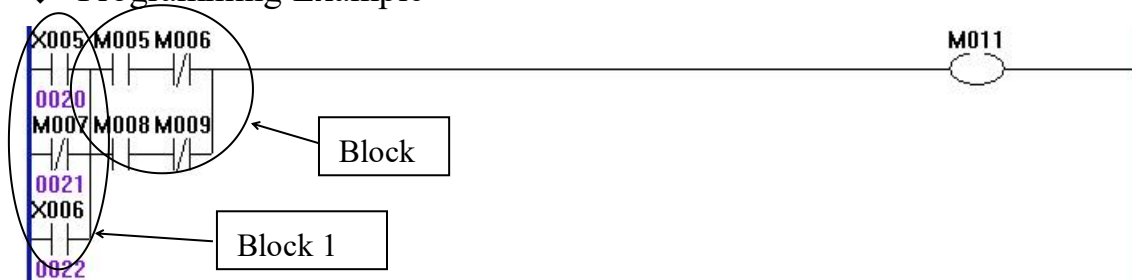
Memonic code	Function	Ladder Symbol
ANB	Parallel circuit block in series	

◆ Instruction explanation

A: Use ANB when the branch loop is serially connected with the previous loop. Use LD, LDI at the starting point of branch, and use ANB to serially connect with the previous loop.

B: ANB is sole instruction without address.

◆ Programming Example



Program explanation:

As above ladder, ORB represents the parallel serial circuit block in block 2 and ANB represents block 1 and 2 in series.

3.6 SET

● Instruction function

Specified address is set to 1.

● Program example



Explanation: When X001 = 0: M001 is reserved; when X001 = 1: M001 is set to 1.

● Relative parameter

M001: set address bit, which can be a contact or output coil, and add is M, Y, T or C.

3.7 RST(RESET)

● Instruction function

Specified address is set to 0.

● Program example



Explanation: When X002 = 0: M001 is reserved; when X002=1: M001 is set to 0.

● Relative parameter

M002: reset address bit, which can be a contact or output coil, and add is M, Y, T or C.

3.8 Alarm

The alarm signal can be defined by user. They controller by related M codes. We edit alarm signal in both IO & IO1 files, which could be backup from cnc system, and then restore into cnc system.

Signal	Related M code	Explanation
0 号报警	M80	No.0 Alarm, controlled by M80
1 号报警	M81	No.1 Alarm, controlled by M81
2 号报警	M82	No.2 Alarm, controlled by M82
3 号报警	M83	No.3 Alarm, controlled by M83
4 号报警	M84	No.4 Alarm, controlled by M84
门开关	M85	Alarm of Door switch, controlled by M85
6 号报警	M86	No.6 Alarm, controlled by M86
7 号报警	M87	No.7 Alarm, controlled by M87
无润滑油	M88	Alarm of non lubricant, controlled by M88
9 号报警	M89	No.9 Alarm, controlled by M89
主轴没有卡紧	M90	Chuck no clamping, controlled by M90
11 号报警	M91	No.11 Alarm, controlled by M91
+5V 欠压	M92	+5V undervoltage, controlled by M92
+24V 欠压	M93	+24V undervoltage, controlled by M93
14 号报警	M94	No.14 Alarm, controlled by M94
15 号报警	M95	No.15 Alarm, controlled by M95

Take No.0 alarm(M80) as Example

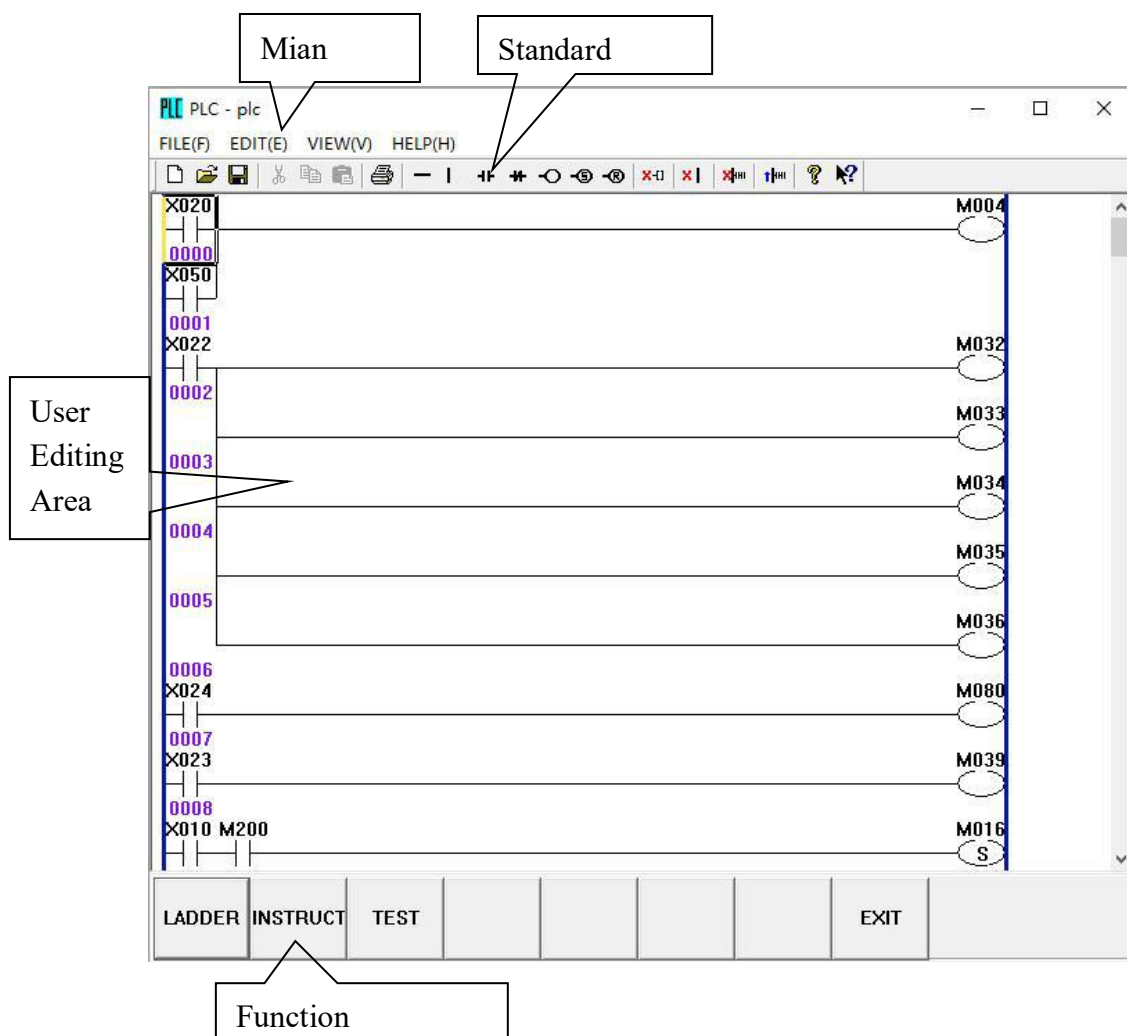


Input point X40 control M80, and then cnc system will hint No.0 alarm. And also we could edit the alarm signal according to detailed condition.

CHAPTER4 INSTRUCTION OF LADDER

There are two solutions for editing PLC ladder. The first solution is that edit ladder by our special software(SZGHPLCS) ; The second solution is that edit ladder in our CNC system.

4.1 Screen Display of SZGHPLCS software



Main Menu

All the operation commands

Standard Toolbar

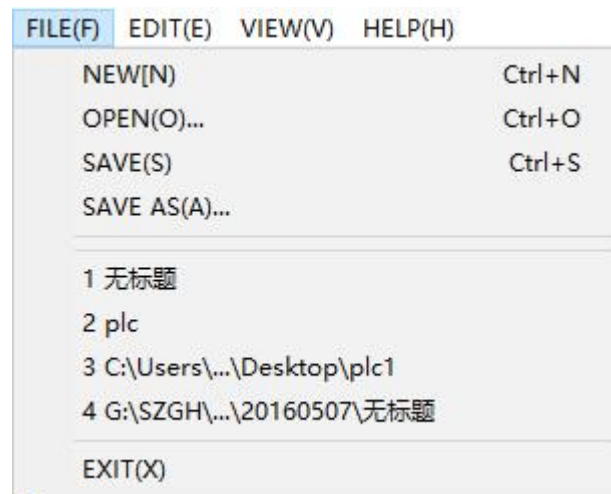
Daily-used commands

User Editing Area

Different views can be displayed, exchanged in the function exchanging, and the operation such as ladder, instruction table & test can be executed.

4.2 Main Menu Commands

4.2.1 File Menu



[NEW]

You can create a new project by using the keystroke of Ctrl+N, or clicking  on the standard toolbar.

The newly created project will be named “PLC” . The project should be stored in disk by clicking “Save”, then a “Save as” dialogue box will pop up. Enter a proper name and savepath, and then click “OK” to save.

[OPEN]

You can open an existing project by using keystroke of [Ctrl+O] or clicking  on the standard toolbar, then, a dialogue box will pop up. Select the desired project, then, click [Open] to open the project.

[SAVE]

You can save the current open project by using keystroke of [Ctrl+S] or clicking  on the standard toolbar.

[SAVE AS]

The current project can be backed up and saved as another file. When this command is executed, the following dialogue box will pop up. Fill in a proper name and save path, and then click “Save”.

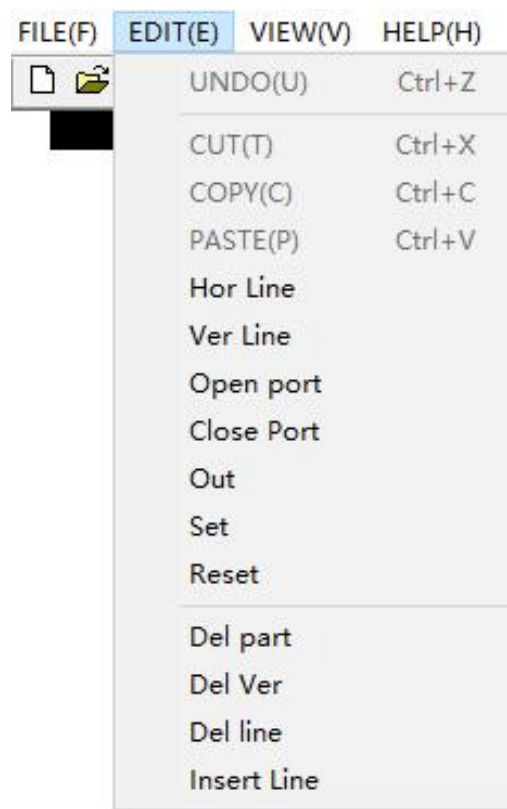
[Recent Open File List]

The list is the file names displayed below [SAVE AS]. Four recent open projects can be listed and opened directly by clicking.

[EXIT]

It is used to quit from the current project. If the project is not saved, a hint will pop up to confirm whether to save the current project.

4.2.2 Edit Menu



Note: From Hor Line to Insert Line, we will make introduction in the Chapter 4.3.2 Ladder Edit Toolbar. The functions of UNDO , CUT , COPY , PASTE are ungrading in the SZGHPLCSe software.

[UNDO]

You can undo the recent modified contents (up to 20 times) by using keystroke of [Ctrl+Z] on the standard toolbar.

[CUT]

You can cut the selected contents and copy it to the clipboard by using keystroke of [Ctrl+X] or clicking on the standard toolbar.

[COPY]

You can copy the selected contents in the clipboard by using keystroke of [Ctrl+C] or clicking on the standard toolbar.

[PASTE]

You can paste the contents in the clipboard to the selected position by using keystroke of [Ctrl+V] or on the standard toolbar.

4.2.3 View Menu



[Tools]

Display/Do not display Ladder View toolbar.

4.2.4 Main Menu Commands



-  Create a new project
-  Open an existing project
-  Save the current project
-  Select All
-  Cut the selected area
-  Copy the selected area
-  Paste in the selected area
-  Find
-  Print the ladder diagram
-  Display program information & version number

4.2.5 Ladder Edit Toolbar



-  Add horizontal line at the cursor position
-  Add vertical line at left side of cursor position
-  Add NO contact at the cursor position
-  Add NC contact at the cursor position
-  Add output coil
-  Add set output coil
-  Add reset output coil
-  Delete element
-  Delete vertical line
-  Delete elements of total line
-  Add null line above

4.3 Using Steps of SZGHPLCS software

Step1: Turn on SZGHPLCS software on PC.

Step2: Open ladder of PLC (plc.lad)

Step3: Edit ladder

Step4: After edit,press SAVE in LADDER screen & in INSTRUCT screen

Step5: Restore plc.lad & plc.plc into cnc system

Note1: plc.lad can be backup from cnc system, the steps as following:

- ① Prepare U-disk that special for cnc system,and insert cnc system;
- ② Press “Program” and “USBdisk” to enter U-disk;
- ③ Press “Backup” and Input password;
- ④ Press “Enter” to confirm backup PLC & parameters from cnc system;
- ⑤ CNC system hint successfully,PLC files¶meters backup to U-disk.
- ⑥ Press “SYSTEM” to exit to cnc system and then extract U-disk.
- ⑦ Backup PLC files is done well.

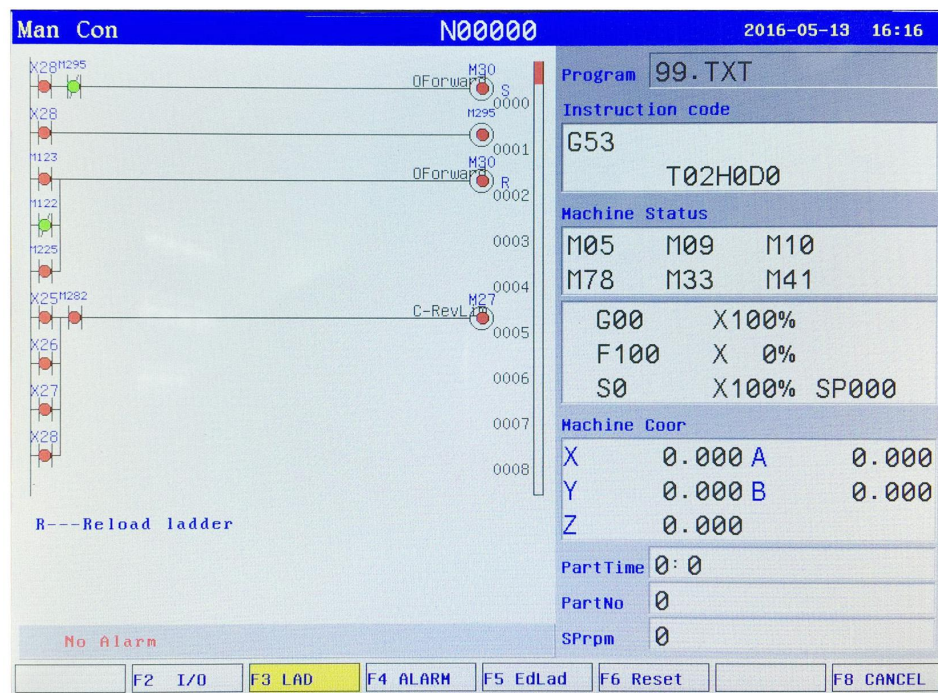
Note2: plc1.lad & plc1.plc is the copy of plc.lad & plc.plc.and it doesn't work in cnc system. Only plc.lad&plc.plc can work in cnc system, which can restore into system and cannot be backup from cnc system.

Note3: After edit well,we need to restore into cnc system ,the steps are as following:

- ① Alter the name of plc1.lad&plc1.plc to plc.lad & plc.plc;
- ② Copy plc.lad&plc.plc to U-disk;
- ③ Insert U-disk to CNC system;
- ④ Press “Program” & “USBdisk” to enter U-disk;
- ⑤ Select the folder of plc.lad & plc.plc
- ⑥ Press “Restore” & “Enter”
- ⑦ Input password to restore plc.lad & plc.plc into system
- ⑧ It will hints restore successfully,reboot it.
- ⑨ Reboot CNC system, new PLC files will work.

Note4:The name of all files cannot exist blank,otherwise system cannot read.

4.4 Screen Display on SZGH CNC System

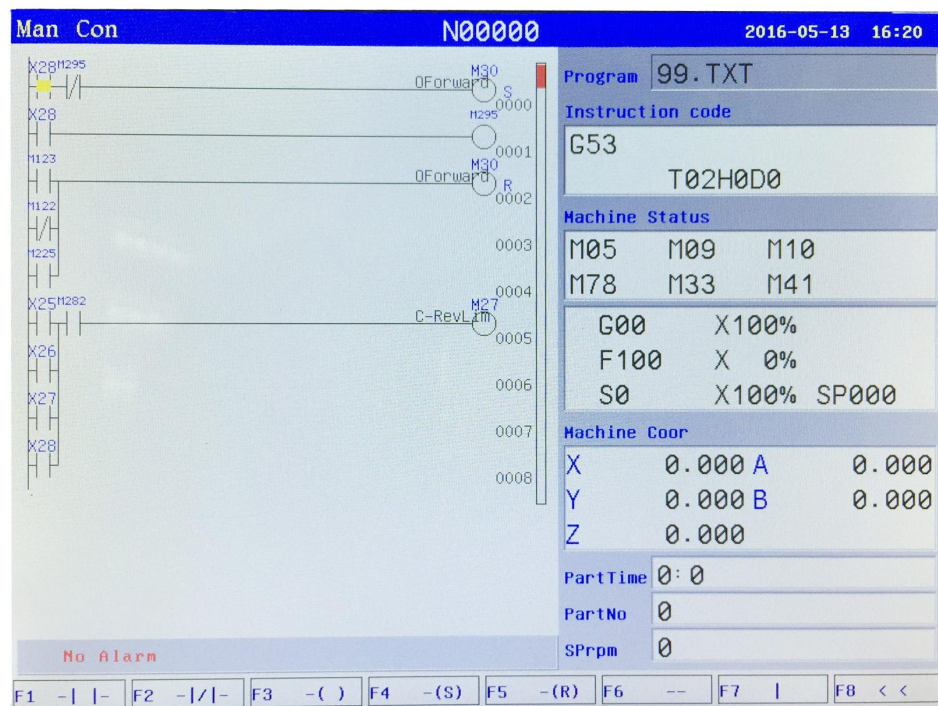
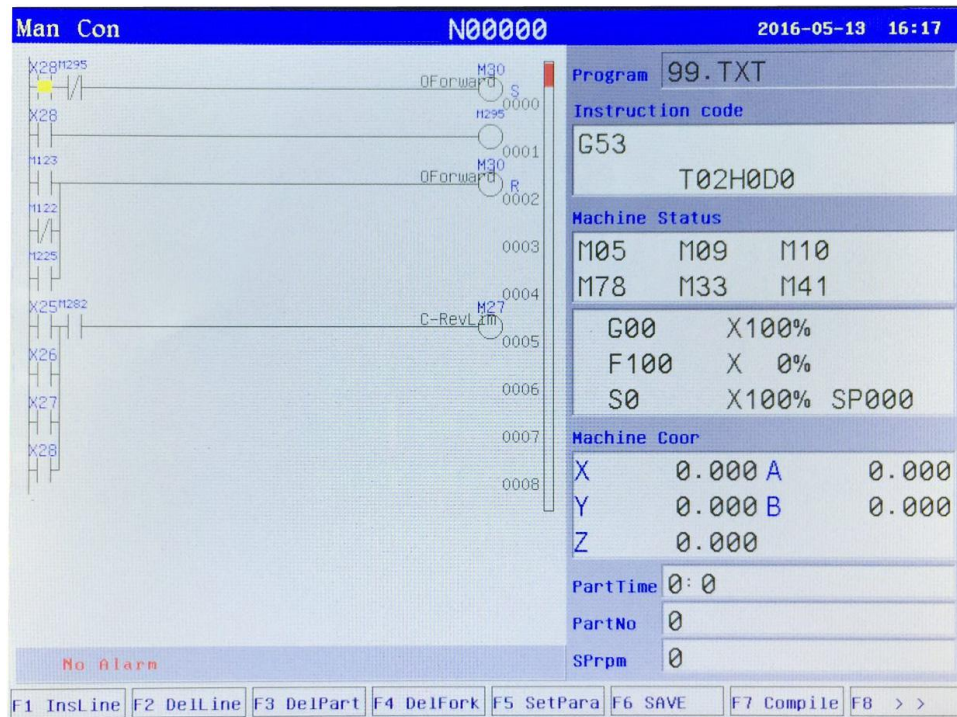


4.4.1 Steps of enter screen of PLC

- ① Alter No.1 parameter to disable in Password;
- ② Press “Diagonous” or Press “Parameter” twice to enter diagonous screen;

- ③ Press “F3”button to enter and check ladder of PLC;
- ④ Press “F5”button to edit ladder of PLC.

a.Press F8 to exchange the functions



InsLine: Insert null Line above, same as  of PLC software

DelLine: Delete line, same as  of PLC software

Del Part: Delete element, same as  of PLC software

DelFork: Delete verticl line,same as  of PLC software

SetPara: Set parameter

SAVE: Save current ladder,

Compile: Compile current ladder

-[]- : Add NO contact at the cursor position

-[/]- : Add NC contact at the cursor position

-() : Add output coil

-(S) : Add set output coil

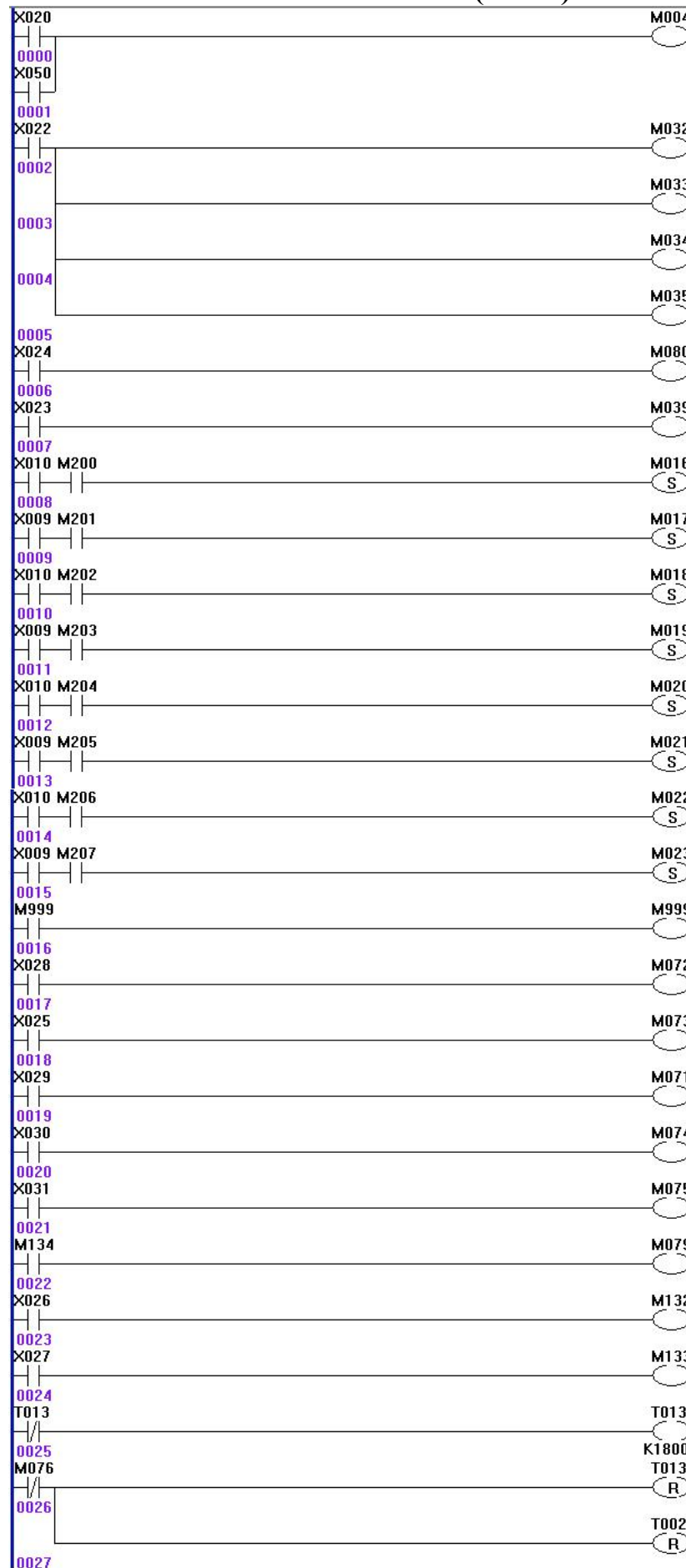
-(R) : Add reset output coil

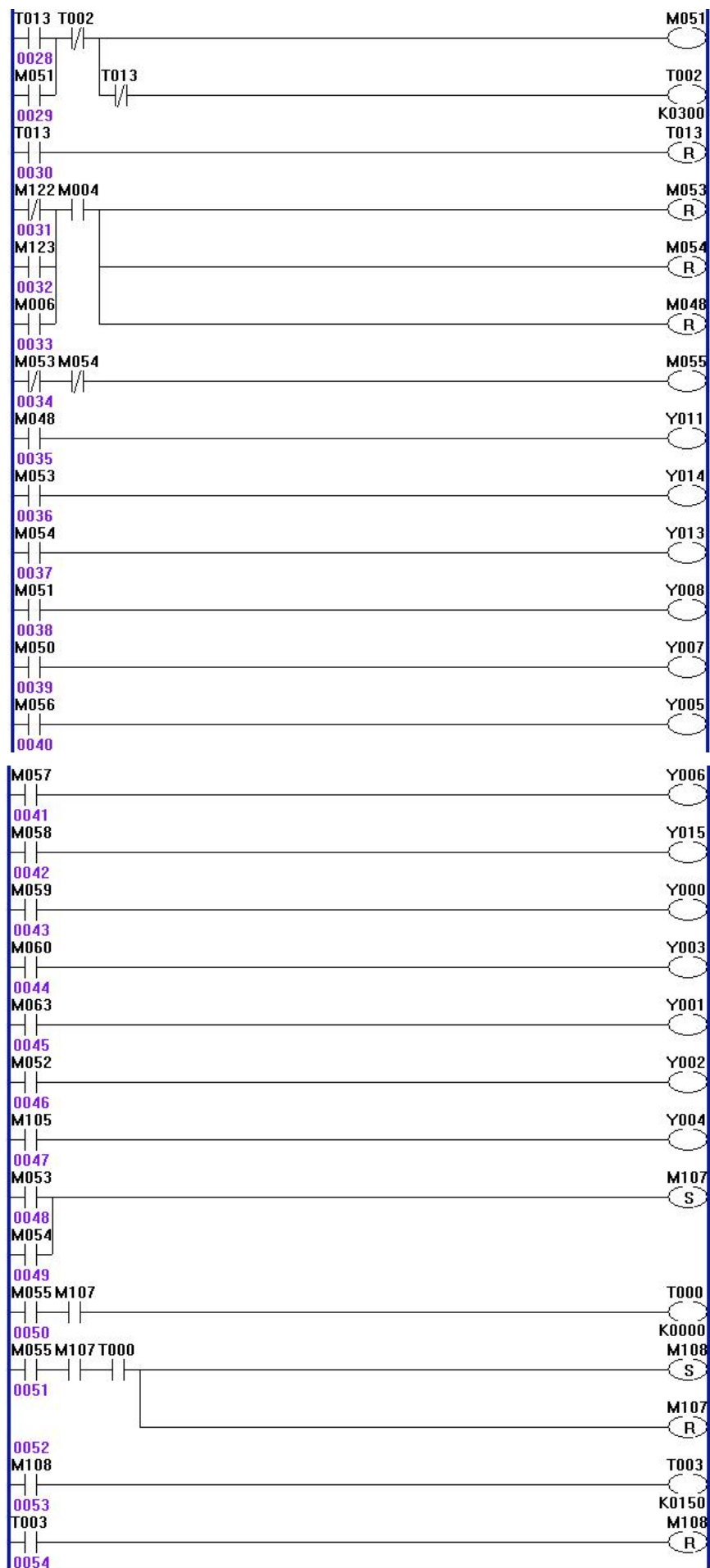
-- : Add horizontal line at the cursor position

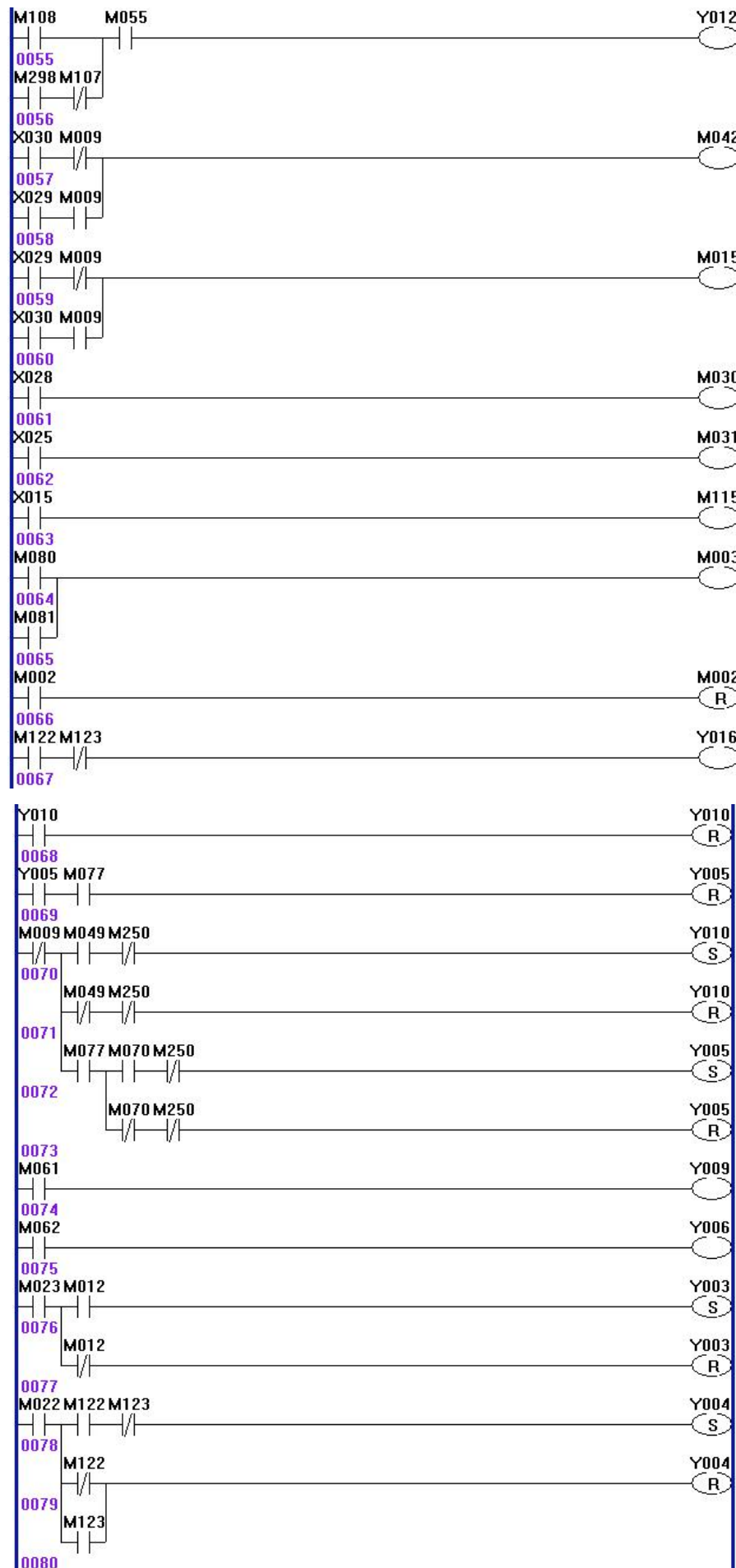
| : Add vertical line at left side of cursor position

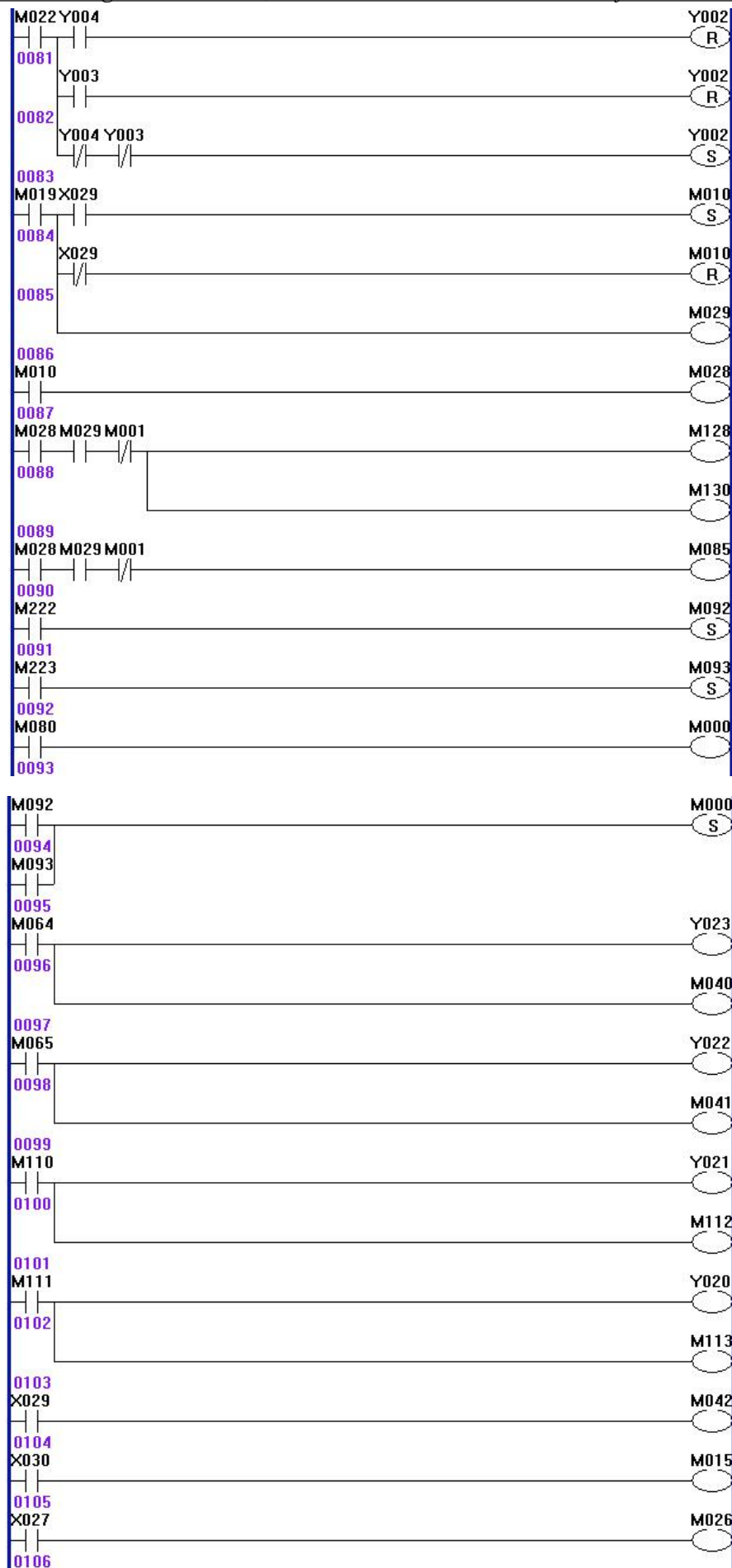
Note: Software version of cnc system is up to V6.52,which can display and edit ladder on cnc system.

Appendix1: Ladder of SZGH-CNC990MDb(V5.12)

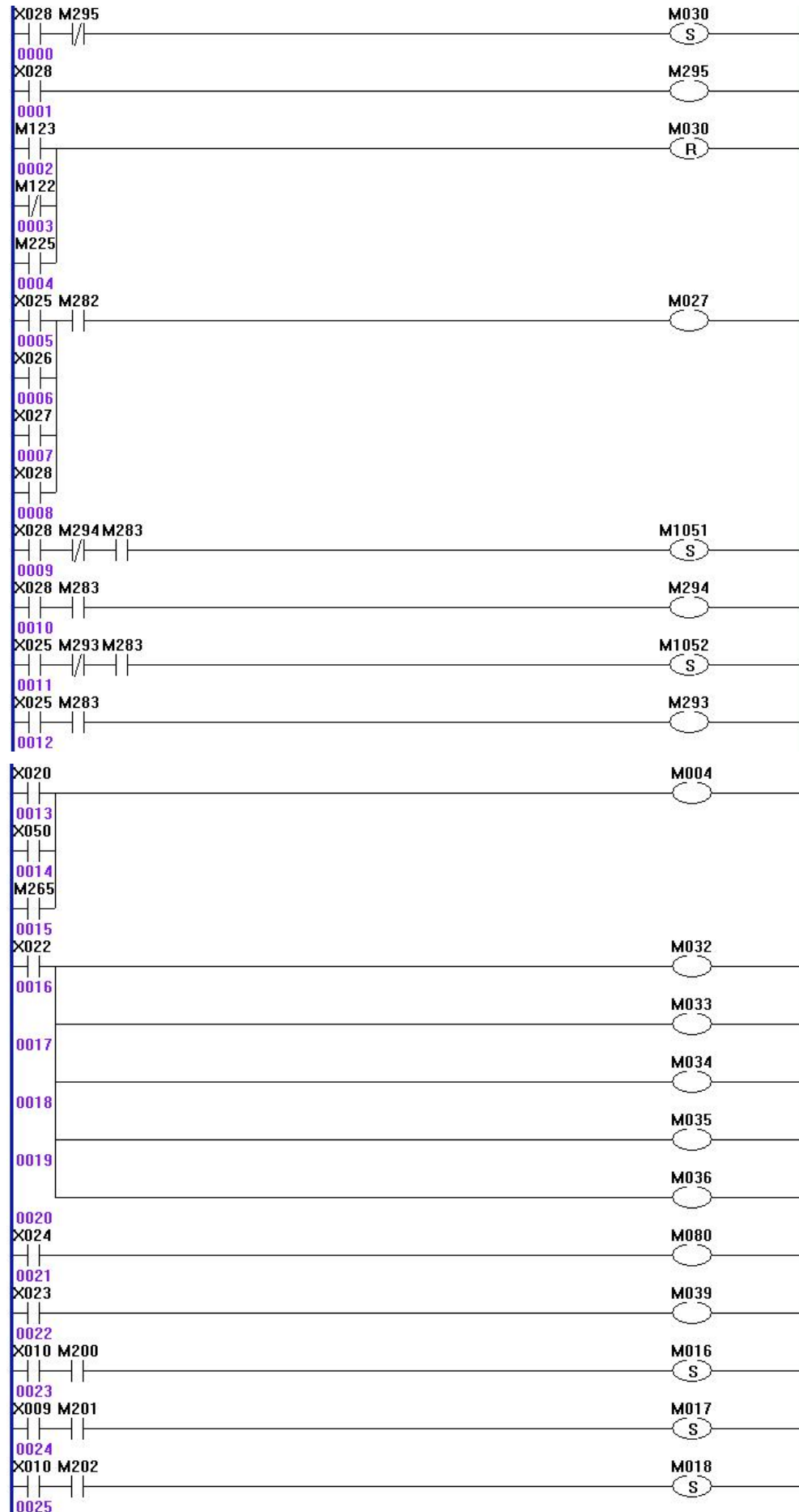


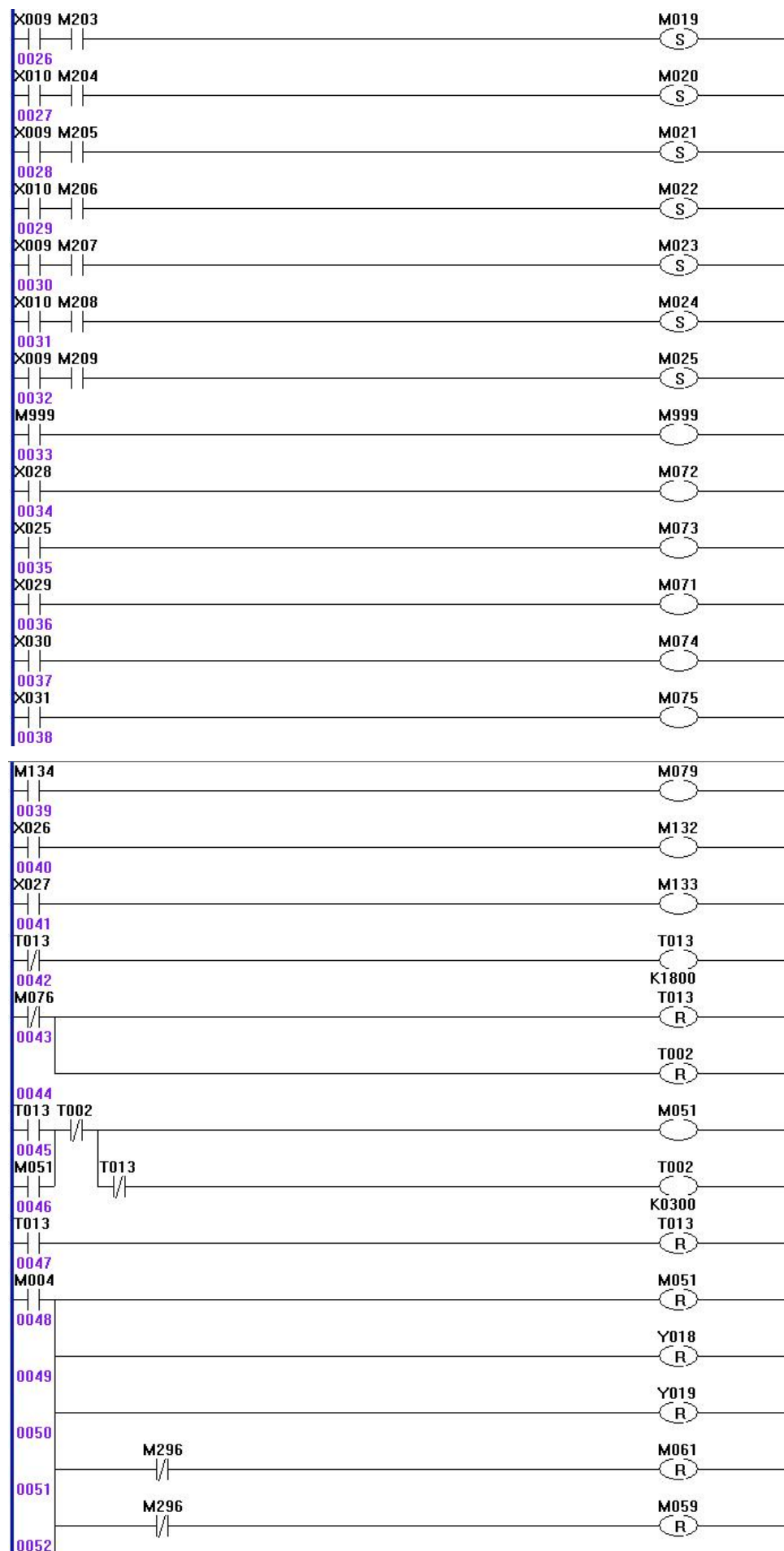




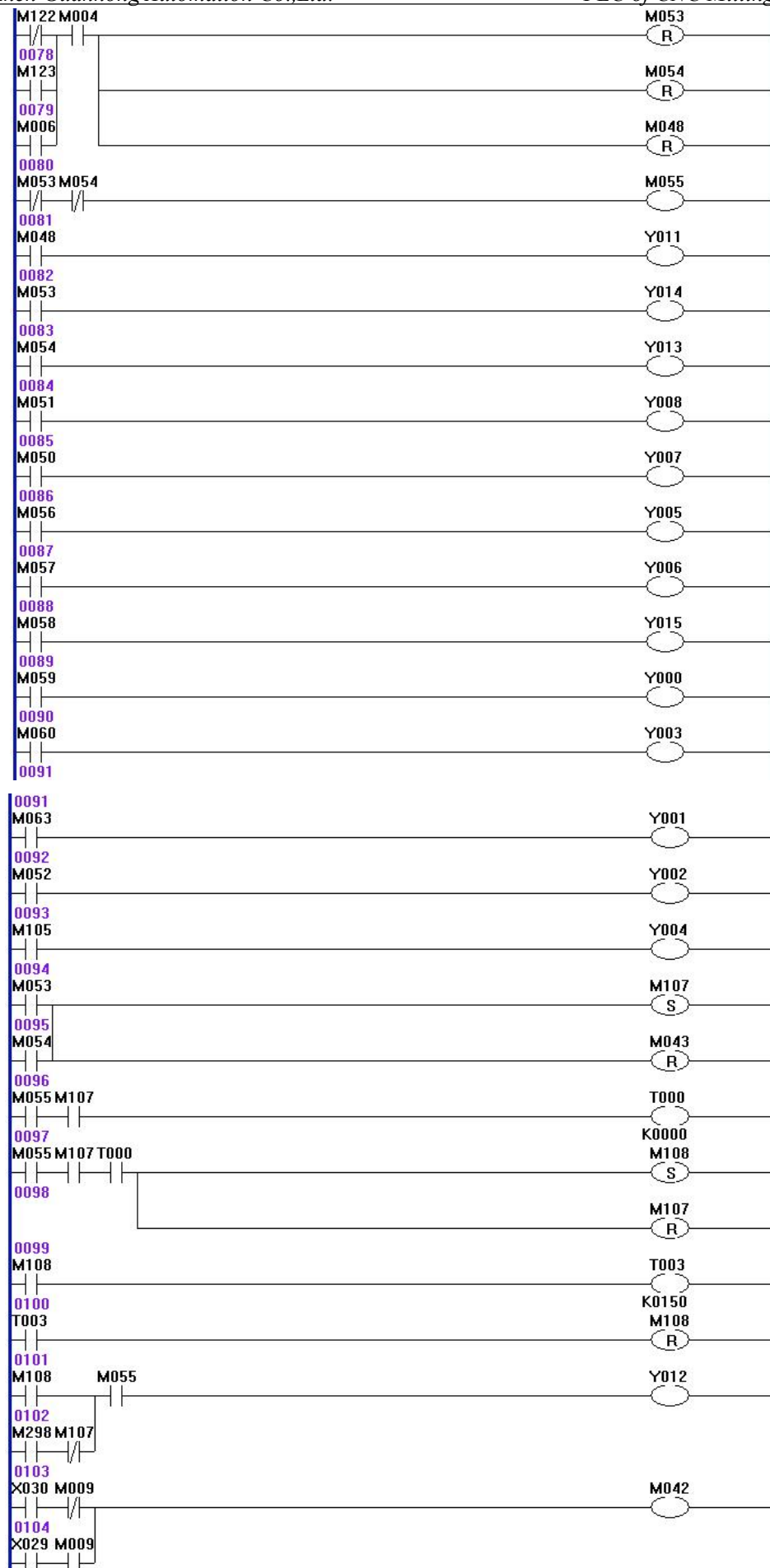


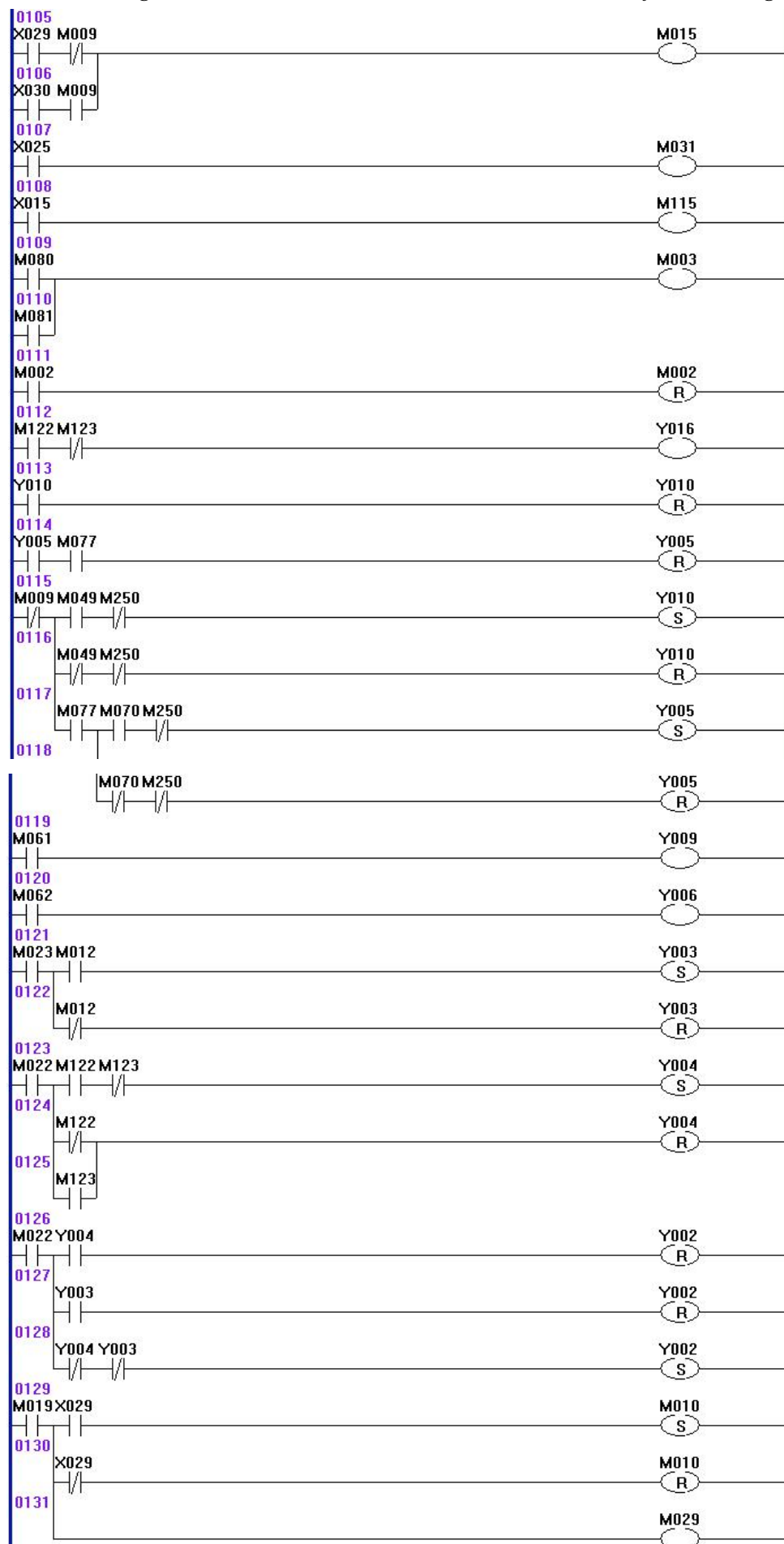
Appendix2: Ladder of SZGH-CNC1000MDb(c)(V6.51)

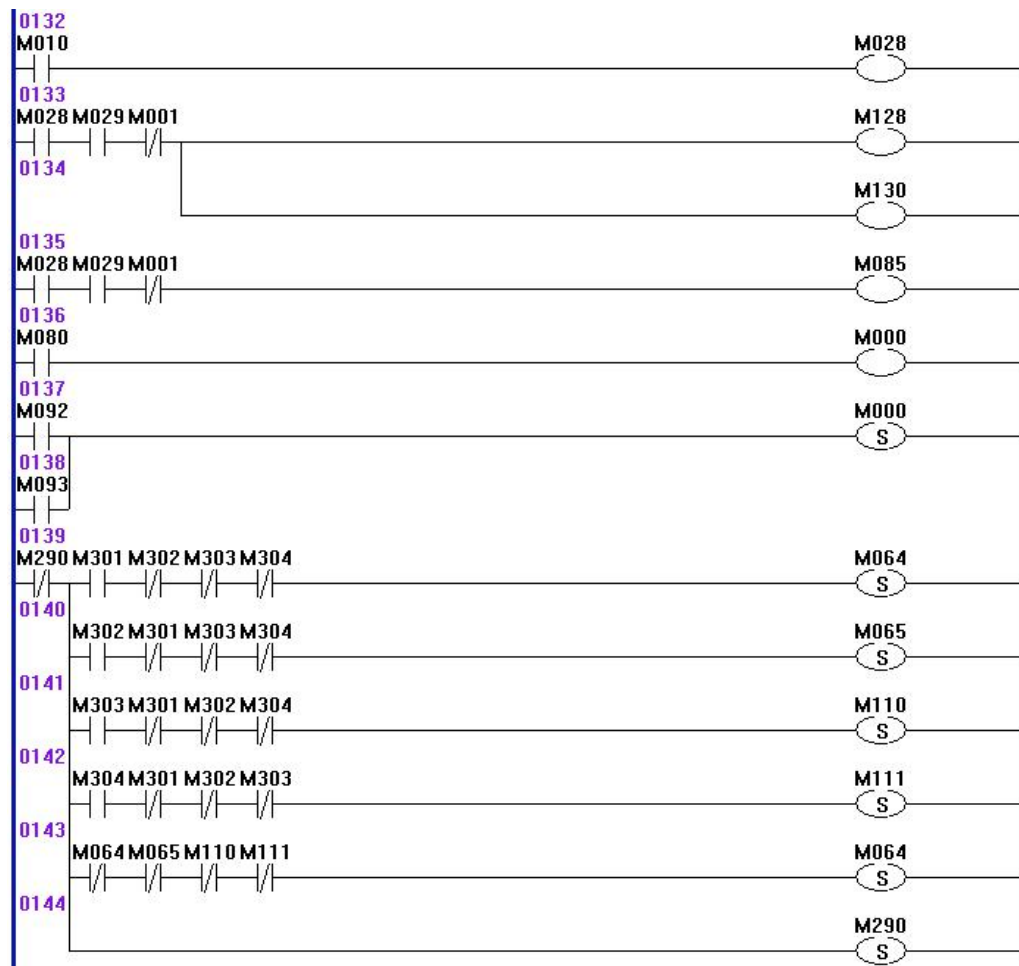


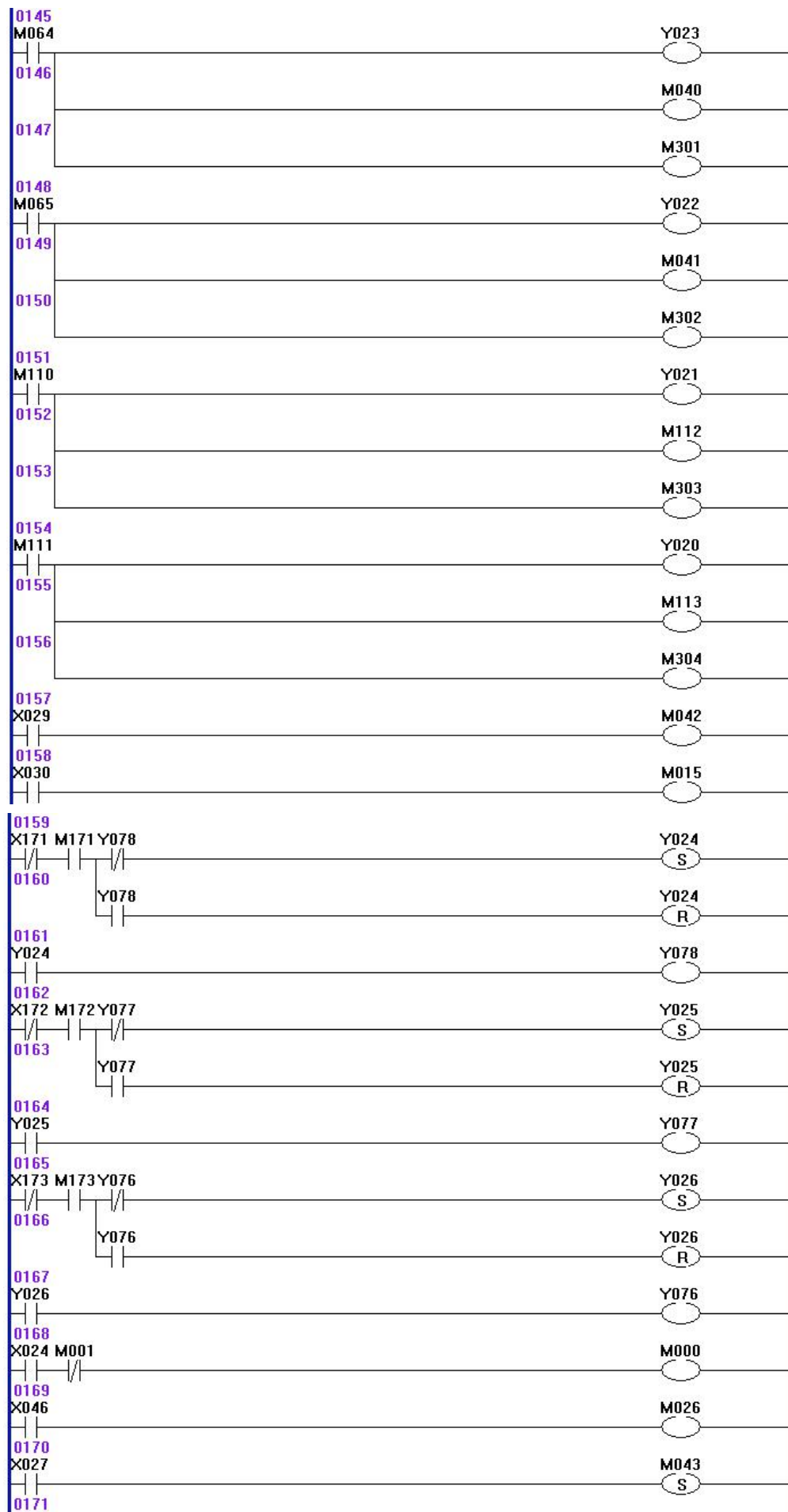


0053	M296	M063 R
0054	M296	M052 R
0055	M296	M060 R
0056	M296	M105 R
0057	M296	M056 R
0058	M296	M057 R
0059	M296	M050 R
0060		M048 R
0061		M055 R
0062		M054 R
0063		M053 R
0064	M296	M058 R
0065		M122 R
	M296	M070 R
0066	M296	M070 R
0067	M296	M009 R
0068	M296	Y024 R
0069	M296	Y025 R
0070	M296	Y026 R
0071	M296	Y027 R
0072	M296	Y028 R
0073	M296	Y029 R
0074	M296	Y030 R
0075	M296	Y031 R
0076		M265 R
		M043 R









Appendix3: Ladder of SZGH-CNC1000MDcb(V6.52)

