User Manual

PLC of CNC Milling System

V3.0

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-Catalogue-

Chapter 1 PROGRAMMING

1.1 PLC Specification

Specification	Milling System
Programming Language	Ladder
Programming Software	SZGHPLCSc.exe & SZGHPLCSe.exe
Programming Grade	1
Executive 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.And also we can edit plc ladder on diagnosis screen of CNC controller

1.2.3 Debug of Ladder (step3)

After finished, the ladder is debugged as follows:

A: Diagnosis of CNC

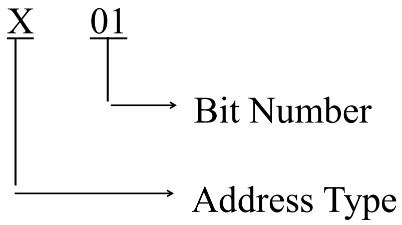
After finished well & restore into system, we could observe if the diagnostic state of every signal is consistent with the function requirement when executing CNC. Check the ladder by checking condition of each I/Os in Diagnosis interface.

B: 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,include fixed addresses & definable addresses. The second one is distributed to input keys on operational panel,which are fixed addresses.The other address are reserved. The value range is 0 or 1.

(1) Fixed address: 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.

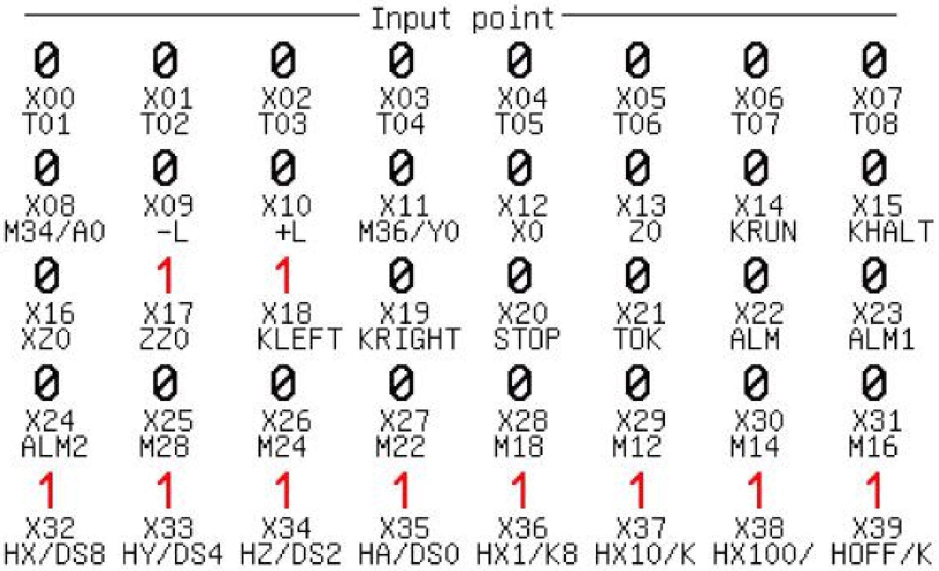
(3) Definable address: their functions can be defined by user according to requirement and used for connecting with external electric circuit and ladder.

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.

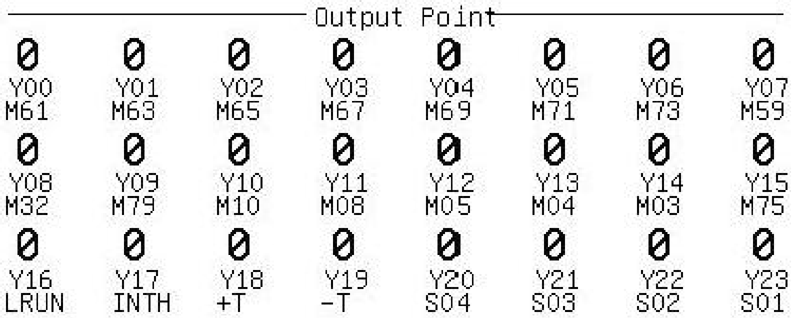
2.3 I/O interface

2.3.1 CNC990 Series (total 40x24 I/Os)



Input point

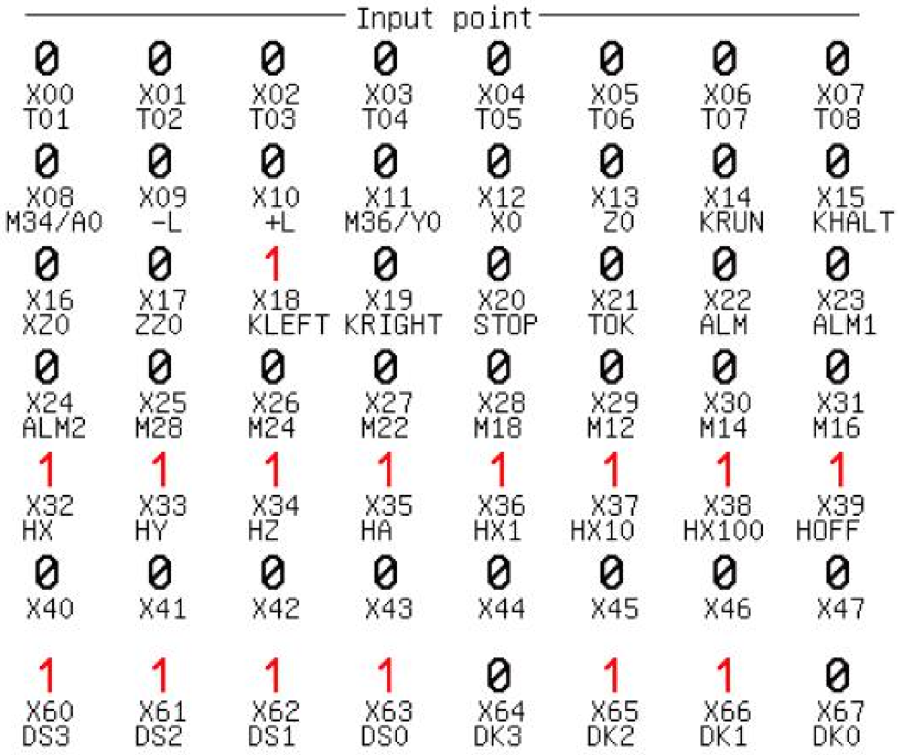
0 X00 T01	0 X01 T02	0 X02 T03	0 X03 T04	0 X04 T05	0 X05 T06	0 X06 T07	0 X07 T08
0 X08 M34/A0	0 X09 -L	0 X10 +L	0 X11 M36/Y0	0 X12 X0	0 X13 Z0	0 X14 KRUN	0 X15 KHALT
0 X16 XZ0	1 X17 ZZ0	1 X18 KLEFT	0 X19 KRIGHT	0 X20 STOP	0 X21 TOK	0 X22 ALM	0 X23 ALM1
0 X24 ALM2	0 X25 M28	0 X26 M24	0 X27 M22	0 X28 M18	0 X29 M12	0 X30 M14	0 X31 M16
1 X32 HX/DS8	1 X33 HY/DS4	1 X34 HZ/DS2	1 X35 HA/DS0	1 X36 HX1/K8	1 X37 HX10/K	1 X38 HX100/	1 X39 HOFF/K



Output Point

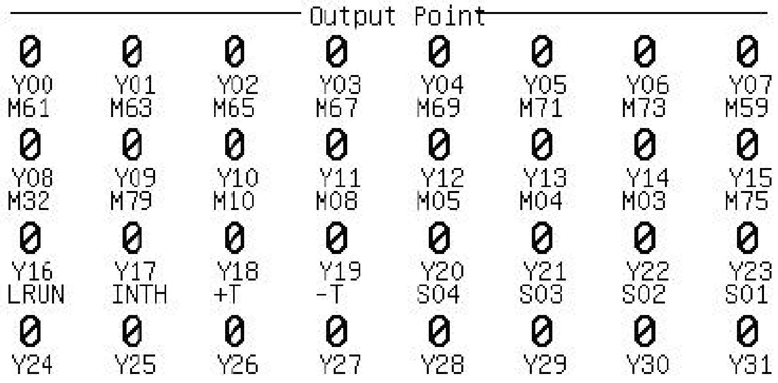
0 Y00 M61	0 Y01 M63	0 Y02 M65	0 Y03 M67	0 Y04 M69	0 Y05 M71	0 Y06 M73	0 Y07 M59
0 Y08 M32	0 Y09 M79	0 Y10 M10	0 Y11 M08	0 Y12 M05	0 Y13 M04	0 Y14 M03	0 Y15 M75
0 Y16 LRUN	0 Y17 INTH	0 Y18 +T	0 Y19 -T	0 Y20 S04	0 Y21 S03	0 Y22 S02	0 Y23 S01

2.3.2 CNC1000 Series (total 56x32 I/Os)



Input point

0 X00 T01	0 X01 T02	0 X02 T03	0 X03 T04	0 X04 T05	0 X05 T06	0 X06 T07	0 X07 T08
0 X08 M34/A0	0 X09 -L	0 X10 +L	0 X11 M36/Y0	0 X12 X0	0 X13 Z0	0 X14 KRUN	0 X15 KHALT
0 X16 XZ0	0 X17 ZZ0	1 X18 KLEFT	0 X19 KRIGHT	0 X20 STOP	0 X21 TOK	0 X22 ALM	0 X23 ALM1
0 X24 ALM2	0 X25 M28	0 X26 M24	0 X27 M22	0 X28 M18	0 X29 M12	0 X30 M14	0 X31 M16
1 X32 HX	1 X33 HY	1 X34 HZ	1 X35 HA	1 X36 HX1	1 X37 HX10	1 X38 HX100	1 X39 HOFF
0 X40	0 X41	0 X42	0 X43	0 X44	0 X45	0 X46	0 X47
1 X60 DS3	1 X61 DS2	1 X62 DS1	1 X63 DS0	0 X64 DK3	1 X65 DK2	1 X66 DK1	0 X67 DK0



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                          Output Point
  0      0      0      0      0      0      0      0
 Y00    Y01    Y02    Y03    Y04    Y05    Y06    Y07
 M61    M63    M65    M67    M69    M71    M73    M59
  0      0      0      0      0      0      0      0
 Y08    Y09    Y10    Y11    Y12    Y13    Y14    Y15
 M32    M79    M10    M08    M05    M04    M03    M75
  0      0      0      0      0      0      0      0
 Y16    Y17    Y18    Y19    Y20    Y21    Y22    Y23
 LRUN   INTH   +T     -T     S04    S03    S02    S01
  0      0      0      0      0      0      0      0
 Y24    Y25    Y26    Y27    Y28    Y29    Y30    Y31
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Note: 1) X32-X39 , X60-X67 as normal close,also internal is +5V power, please do not connect more than +5V voltage；others is as normal open;

2) All of input output 0 V is available

3) Don’t use IOs which are occupied by CNC system already.

2.4 PLC Internal Auxiliary Relay

Definition for internal auxiliary relays of SZGH milling system.

Note: These M codes are auxiliary relays on plc ladder, different to M codes on milling system.

Code	Function	Description	Type
M00	Forbid Feed	Forbid feeding when M00 is valid	Status
M01	Manual states	When the system is in manual mode M01 is valid, on the contrary M01 is invalid when system is in automatic mode	Status
M02	Just booting	M02 is valid and keep its status when system is just booting .	Status
M03	Prohibit procedures	When M03 is valid, system will prohibit running program automatically	Status
M04	Emergency stop	When M04 is valid,system is in E-stop	Status
M05	Selecting tool	M05 is valid when system is selecting tool.	Status
M06	Exchanging tool	M06 is valid when system is exchange tool.	Status
M07	Homing(Mag.)	M07 is valid when magazine is do homing.	Status
M08	Feeding	M08 is valid when axes are feeding.	Status
M09	Status of Chuck	M09 is valid when M10;invalid when M11/chuck	Status
	Home of Arm	M09 is valid during arm exchange tool, it is invalid before exchange tool(MC)	
M10	Safe door open	M10 is valid when safe door is open	Status
M11	Arm grasping tool	M11 is valid when arm is grasping tool (System is machine center for arm type tool magazine)	Status
M12	Alarm Output	M12 is valid when system is alarming, like E-stop , or driver is alarming, or hard limit .	Output
M13	Exist Tool	M13 is valid when there is tool on current tool pocket (umbrella type tool magazine)	Input

M14	Spindle orientation	When M14 is valid,system output Y00/M61 to let spindle do orientation.	Output
M15	Detection of chuck is tighten	M15 is valid when chuck tighten tool in position (M10)	Input
M16	X+ limit	M16 is valid when X-axis is in the status of positive hardware limit	Input
M17	X- limit	M17 is valid when X-axis is in the status of negative hardware limit	Input
M18	Y+ limit	M18 is valid when Y-axis is in the status of positive hardware limit	Input
M19	Y- limit	M19 is valid when Y-axis is in the status of negative hardware limit	Input
M20	Z+ limit	M20 is valid when Z-axis is in the status of positive hardware limit	Input
M21	Z- limit	M21 is valid when Z-axis is in the status of negative hardware limit	Input
M22	A+ limit	M22 is valid when A-axis is in the status of positive hardware limit	Input
M23	A- limit	M23 is valid when A-axis is in the status of negative hardware limit	Input
M24	B+ limit	M24 is valid when B-axis is in the status of positive hardware limit	Input
M25	B- limit	M25 is valid when B-axis is in the status of negative hardware limit	Input
M26	Optional stop	When M26 is valid, run optional stop(M01 code), system will pause program.	Input
M27	High-Speed input	When M27 is valid, related input points are high-speed input points in the front of M27.	Input
M28	Magazine goes forward	When M28 is valid, system will output and umbrella tool magazine goes forward	Output
	Down Pocket	When M28 is valid, system will output and arm tool magazine down tool pocket	
M29	Magazine goes backward	When M29 is valid, system will output and umbrella tool magazine goes backward	Output
	Up Pocket	When M29 is valid, system will output and arm tool magazine lift up tool pocket	
M30	Forward in position	M30 is valid ,which means that umbrella tool magazine goes forward in position	Input
	Down pocket in position	M30 is valid ,which means that arm type tool magazine down tool pocket in position	
M31	Backward in position	M31 is valid,which means that umbrella tool magazine return backward in position	Input

	Down pocket in position	M31 is valid,which means that arm tool magazine down tool pocket in position	
M32	X driver alarm	M32 is valid that means X-axis driver is alarming.	Input
M33	Y driver alarm	M33 is valid that means Y-axis driver is alarming.	Input
M34	Z driver alarm	M34 is valid that means Z-axis driver is alarming.	Input
M35	A driver alarm	M35 is valid that means A-axis driver is alarming.	Input
M36	B driver alarm	M36 is valid that means B-axis driver is alarming.	Input
M37	C driver alarm	M37 is valid that means C-axis driver is alarming.	Input
M38	Skip/Run program in ()	When M38 is valid, System will run program in “()”,otherwise skip these blocks in “()”	Input
M39	Spindle alarm	M39 is valid that means spindle is alarming	Input
M40	Detection of SP-high gear	M40 is valid that means spindle is in status of high-gear [also M41(M code) is ON]	Input
M41	Detection of SP-low gear	M41 is valid that means spindle is in the status of low-gear [also M42(M code) is ON]	Input
M42	Detection of Chuck is Loosen	M42 is valid when chuck loosen tool in position (M11)	Input
M43	Spindle home	M43 is valid that means spindle finish homing	Input
M44	Cooling overload	M44 is valid that means coolant pump is overload	Input
M45	Lack of cooling liquid	M45 is valid that means cooling liquid on machine tool is lack or liquid level is too low	Input
M46	Lubrication overload	M46 is valid that means lubricate pump is overload and alarming.	Input
M47	Lack of Lubrication oil	M47 is valid that means lubricate oil on machine tool is lack or oil level is too low	Input
M48	Coolant	M48 is valid that activate coolant function (M08:Turn on coolant/M09:Turn off coolant)	Output
M49	Chuck	M49 is valid that activate chuck loosen tool (M10: Chuck tighten tool; M11: Chuck loosen tool)	Output
M50	Huff	M50 is valid that activate huff/blower (M59: Turn on huff, M58: Turn off huff)	Output
M51	Lubricate	M51 is valid that activate lubricate (M32: turn on lubricate, M33: turn off lubricate)	Output
M52	User-defined Output	M52 is valid that activate M65 output (M65: turn on output Y02, M64: turn off output Y02)	Output
M53	Spindle-CW	M53 is valid that activate CW rotation of 1st spindle (M03: turn on M53 ; M05: turn off M53)	Output
M54	Spindle-CCW	M54 is valid that activate CCW rotation of 1st spindle (M04: turn on M54 ; M05: turn off M54)	Output
M55	Spindle-Stop	M55 is valid that activate stop of spindle, output M05/Y12.	Output

M56	User-defined Output	M56 is valid that activate M71 output (M71: turn on output Y05, M70: turn off output Y05)	Output
M57	User-defined Output	M57 is valid that activate M73 output (M73: turn on output Y06, M72: turn off output Y06)	Output
M58	User-defined Output	M58 is valid that activate M75 output (M75: turn on output Y15, M74: turn off output Y15)	Output
M59	User-defined Output	M59 is valid that activate M61 output (M61: turn on output Y00, M60: turn off output Y00)	Output
M60	User-defined Output	M60 is valid that activate M67 output (M67: turn on output Y03, M72: turn off output Y03)	Output
M61	Tailstock thimble	M61 is valid that activate M79 output (M79: turn on output Y09, M72: turn off output Y09)	Output
M62	Thimble double	M62 is valid that activate M78 output (M79: turn on output Y06, M78: turn off output Y06)	Output
M63	User-defined Output	M63 is valid that activate M63 output (M63: turn on output Y01, M72: turn off output Y01)	Output
M64	Spindle high gear	M64 is valid that activate S01 output-high-gear output(M41 code: output S01)	Output
M65	Spindle low gear	M65 is valid that activate S02 output for spindle low-gear output(M42 code: output S02)	Output
M66	Spindle servo	M66 is valid that activate Y15 output for shift to position control mode of spindle servo	Output
M67	Enable of Spindle	M67 is valid that enable of spindle	Output
M68	Homing of Spindle	M68 is valid that activate homing function of spindle axis	Output
M69	Speed of spindle is reached	M69 is valid that means speed of spindle is reached (which is set by P33 on User parameter)	Input
M70	Chuck (double)	Double outputs for chuck, M70 is valid that activate chuck loose tool	Output
M71	User-defined input	User-defined input (M12 code)	Input
M72	User-defined input	User-defined input (M18 code)	Input
M73	User-defined input	User-defined input (M28 code)	Input
M74	User-defined input	User-defined input (M14 code),high-speed punch	Input
M75	User-defined input	User-defined input (M16 code)	Input
M76	Auto Lubricate	M76 is valid that means auto lubricate is on	Status
M77	Chuck Double	M77 is valid that means double outputs for chuck	Status

M78	Tailstock Double	M78 is valid that means double output for M79	Status
M79	Occupancy	Occupied by system	-
M80	User-defined alarm	Valid that means magazine motor is overload	Input
M81	User-defined alarm	Valid that means air pressure is alarming	Input
M82	User-defined alarm	Valid that means chip-remove motor is overload	Input
M83	User-defined alarm	Valid that means SP-blower motor is overload	Input
M84	User-defined alarm	Valid that means detection signal is alarming	Input
M85	User-defined alarm	Valid that means Safe-door is open &alarm(M12)	Input
M86	User-defined alarm	Valid that means Driver is alarming(X20)/Modbus	Input
M87	User-defined alarm	Valid that means Driver is alarming(X21)/Modbus	Input
M88-M95	User-defined alarm	Valid that means related alarming is activated	Input
M96-M99 are remain			
M100-M103	Tool position coding	Valid that means tool position coding（T01-T08）	Input
M104	Remain		
M105	User-defined output	M105 is valid that activate M69 output (M69: turn on Y04 output, M68:turn off Y04 output)	Output
M106	Remain		
M107	Occupancy	Occupied by system	-
M108	Occupancy	Occupied by system	-
M109	Remain		
M110	3rd gear output	M110 is valid that activate output S03(M43 code)	Output
M111	4th gear output	M111 is valid that activate output S04(M44 code)	Output
M112	Detect of 3rd gear	M112 is valid that means spindle is on 3rd gear	Input
M113	Detect of 4th gear	M113 is valid that means spindle is on 4th gear	Input
M114	Remote Run	M114 is valid that activate running program, which is used for external run button	Input
M115	Remote Pause	M115 is valid that activate pause program, which is used for external Pause button	Input
M116-M119 are remain			

M120	Magazine Rotate CW	M120 is valid that activate magazine rotate with CW direction (Output Y01)	Output
M121	Magazine Rotate CCW	M121 is valid that activate magazine rotate with CCW direction (Output Y05)	Output
M122	Running Program	Valid that means system is auto running program	Status
M123	Pause Program	Valid that means system pause program	Status
M124	Spindle-gear 0	Spindle gear 4 compiled binary code output value, the corresponding command S0-S15.	
M125	Spindle-gear 1		
M126	Spindle-gear 2		
M127	Spindle-gear 3		
M128	Prohibit X axis	M128 is valid that prohibit movement of X-axis	Input
M129	Prohibit Y axis	M129 is valid that prohibit movement of Y-axis	Input
M130	Prohibit Z axis	M130 is valid that prohibit movement of Z-axis	Input
M131	Prohibit A axis	M131 is valid that prohibit movement of A-axis	Input
M132	Prohibit B axis	M132 is valid that prohibit movement of B-axis	Input
M133	Prohibit C axis	M133 is valid that prohibit movement of C-axis	Input
M134-M150 are occupied by CNC system			
M151-M170 are Remain			
M171	K1	Last status of K1 button (1000/1500 series)	Status
M172	K2	Last status of K2 button (1000/1500 series)	Status
M173	K3	Last status of K3 button (1000/1500 series)	Status
M174-M199 are Remain			
M200	X-Running	X axis is running with positive direction	Status
M201	X-Running	X axis is running with negative direction	Status
M202	Y-Running	Y axis is running with positive direction	Status
M203	Y-Running	Y axis is running with negative direction	Status
M204	Z-Running	Z axis is running with positive direction	Status
M205	Z-Running	Z axis is running with negative direction	Status
M206	A-Running	A axis is running with positive direction	Status
M207	A-Running	A axis is running with negative direction	Status
M208	B-Running	B axis is running with positive direction	Status
M209	B-Running	B axis is running with negative direction	Status
M210	C-Running	C axis is running with positive direction	Status
M211	C-Running	C axis is running with negative direction	Status
M212	Xs-Running	Xs axis is running with positive direction/Modbus	Status
M213	Xs-Running	Xs axis is running with negative direction/Modbus	Status
M214	Ys-Running	Ys axis is running with positive direction/Modbus	Status
M215	Ys-Running	Ys axis is running with negative direction/Modbus	Status
M212	X-Home	Valid that means X-axis finish homing	Status

M213	Y-Home	Valid that means Y-axis finish homing	Status
M214	Z-Home	Valid that means Z-axis finish homing	Status
M215	A-Home	Valid that means A-axis finish homing	Status
M800	B-Home	Valid that means B-axis finish homing	Status
M216-M219 are occupied by CNC system			
M220	Occupancy	Valid that means system is dry running/simulate	Status
M221	Occupancy	Valid that means auxiliary function/MST is locked	Status
M222	Occupancy	Valid that means +5V power of system is low	Status
M223	Occupancy	Valid that means +24V power of system is low	Status
M224-M230 are Remain			
M231	2nd-SP-CW	Valid that activate 2nd spindle rotate with CW direction (code: M203: ON ; M205: OFF)	Output
M232	2nd-SP-CCW	Valid that activate 2nd spindle rotate with CCW direction (code: M204: ON ; M205: OFF)	Output
M233-M241 are Remain			
M242	Unclamp magazine	Valid that activate unclamp output (Y25) for servo type tool magazine	Output
M243	Detect of unclamp magazine	Valid that means unclamp servo tool magazine in position (X43)	Input
M244	Remain		
M245	Wait Input	Waiting for input, alarm&reset when time is finished & input is valid	Status
M246-M249 are Remain			
M250	Occupy		
M251	Occupy		
M250-M264 are Remain			
M265	Reset	Valid that means press “Reset ” key just now	Status
M266	Equivalent X182	Milling-X key	Status
M267	Equivalent X180	Milling +X key	Status
M268	Equivalent X179	Milling -Y key	
M269	Equivalent X178	Milling +Z key	
M270	Equivalent X177	Milling +4 key	
M271	Equivalent X183	Milling +Y key	
M272	Equivalent X184	Milling -Z key	
M273	Equivalent X185	Milling -4 key	
M274	Equivalent X181	milling fast overlay key	

M279	Remain	Milling +5 key	
M280	Remain	Milling -5 key	
M281	Rigid Tapping	Valid that means system is do rigid tapping(Y29)	Status
M282-M289 are Remain			
M290	Initialize SP-Gear	Valid that means initialize spindle gear after boot	Status
M291	Occupy		
M292	Occupy		
M293	Teach-In	Valid that means external teach-in function is on	Input
M294	Record End point	Valid that means external input is valid for record end point	Input
M295	Occupy	Valid that means M18 is valid, high-speed input	Input
M296	Reset Output	Set whether press “Reset”key reset related output points,which is set by P912 on User parameter,	Status
M297	Occupy	Valid that means M14 is valid, high-speed input	Input
M298	Occupy		
M299	Record Middle point	Valid that means external input is valid for record middle point	Input
M300	Driver Alarm1	Set for type of driver alarm1(X20)/Modbus	Status
M301	S1 SP-Gear	Valid means SP-gear S1 is valid,save when power off, same to M64	Status
M302	S2 SP-Gear	Valid means SP-gear S2 is valid,save when power off, same to M65	Status
M303	S3 SP-Gear	Valid means SP-gear S3 is valid,save when power off, same to M110	Status
M304	S4 SP-Gear	Valid means SP-gear S4 is valid,save when power off, same to M111	Status
M305	Driver Alarm2	Set for type of driver alarm1(X21)/Modbus	Status
M306	K1	K1 key(1000series/simple)/Modbus	
M307	K2	K2 key(1000series/simple)/Modbus	
M308	K3	K3 key(1000series/simple)/Modbus	
M309	K1	Valid means that K1 key is pressed/Modbus	Status
M310	K2	Valid means that K2 key is pressed/Modbus	Status
M311	K3	Valid means that K3 key is pressed/Modbus	Status
M312	Occupy	Prevent constant set Y15 and reset M014	
M313	Lubricate Alarm	Set for type of lubricate alarm/NO- NC/Modbus	Status
M314	C driver alarm	Valid that means C-axis driver is alarming	Input
M315	Xs driver alarm	Valid that means Xs-axis driver is alarming.	Input

M316	Ys driver alarm	Valid that means Ys-axis driver is alarming.	Input
M317	Running Indicator	Valid that means running indicator is on	Output
M318-M329 are occupied by CNC system			
M330-M361: responding to M3330/M4330~ M3361/M4361 codes (Modbus)			Output
M824	X-Home	Valid that means X-axis finish homing (Modbus)	Status
M825	Y-Home	Valid that means Y-axis finish homing (Modbus)	Status
M826	Z-Home	Valid that means Z-axis finish homing (Modbus)	Status
M827	A-Home	Valid that means A-axis finish homing (Modbus)	Status
M828	B-Home	Valid that means B-axis finish homing (Modbus)	Status
M829	C-Home	Valid that means C-axis finish homing (Modbus)	Status
M830	Xs-Home	Valid that means Xs-axis finish homing (Modbus)	Status
M831	Ys-Home	Valid that means Ys-axis finish homing (Modbus)	Status
M999	High-Speed PLC	Running speed of plc are high-speed before M999	Status
M1014	Emergency-stop	Symbol for reset/emergency-stop/down speed	Status
M1050	Auto	Set M1069 for shift to Auto mode	Status
M1051	Teach-In	Valid that means external teach-in function is on	Input
M1052	Record End point	Valid that means external input is valid for record end point	Input
M1053	Record middle point	Valid that means external input is valid for record middle point	Input
M1069	Manual	Set M1069 for shift to manual mode	Status
M1070-M1079 are corresponding to macro program of ProgramUser0-ProgramUser9			

2.3 Special relay for robot system

2.3.1 Coordinate return to Auxiliary Relay M1056-M1060;

2.3.2 Spindle rate bond switchAuxiliary Relay M258-M259-M260-M261;

M1025:spindle rate raise;

M1023:spindle rate 100%;

M1024:spindle rate down.

2.3.3 Arcing control detection Auxiliary Relay

M71 effective arcing succeed,M71 invalid extinction voltage succeed.

Arcing detection input point:X0.Only after X0 keep a parameter setting time(this time can be modified in PLC), Auxiliary Relay M71 could have corresponding changes.

2.3.4 Arcing control Auxiliary Relay

M56 effective arcing succeed,M56 invalid extinction voltage succeed.

Reproduce the programming instructions:M71 arcing,M70 arc out.

Arcing control output point:Y16.

2.3.5 Send and return wire Auxiliary Relay

Teach send wire Auxiliary Relay:M53.

Teach return wire Auxiliary Relay:M54.

Stop send and return Auxiliary Relay:M55.

Reproduce the programming instructions:M3 send wire,M4 return wire,M5 stop.

Output point:Y14 send wire,Y13 return wire,Y12 stop.

2.3.6 Output point

Y106 define BELL buzzer, press the key once to output 0.3s high level, and the alarm will be valid for a long time; output point Y107 define ARLM alarm signal, output high level in case of alarm.

2.4.1Auxiliary Relay(32pieces): M282~M297 ; M298~M313(Spare relays)

M298~M313: system can save their status even if power off.

Power-link/EtherCAT modbus: M282~M289: connecting status of 1~8 stations , valid means connection are normal, invalid means connections are abnormal.

2.4.2 Auxiliary Relay: M314~M329; M330~M345; M346~M361; M362~M377.

M314: 6th axis driver alarm (C-axis)

M315: 7th axis driver alarm (Xs-axis)

M316: 8th axis driver alarm (Ys-axis)

M317: It is valid when CNC system is ready well

M318: Forbid movement of 6th axis

M319: Forbid movement of 7th axis

M320: Forbid movement of 8th axis

M321: Remain

M322: Hardware limit in Positive direction of 6th axis

M323: Hardware limit in Positive direction of 7th axis

M324: Hardware limit in Positive direction of 8th axis

M325: Remain, collision detection of robot

M326: Hardware limit in negative direction of 6th axis

M327: Hardware limit in negative direction of 7th axis

M328: Hardware limit in negative direction of 8th axis

M329: Remain, drag mode detection of robot

M330~M345;M346~M361;M362~M377 auxiliary relays, user-defined.

2.4.3 Status auxiliary relay for system: M800~M831

M800: Spare

M801: Doing home

M802: Single mode(on Auto:single mode, on Manual: Step/Handwheel mode)

M803: Simulate mode

M804: Manual Step/Handwheel mode 0.1

M805: Manual Step/Handwheel mode 0.01

M806: Manual Step/Handwheel mode 0.001

M807: Manual mode

M808: Handwheel mode

M809: Auto mode

M810: MDI mode

M811: Diagnosis mode

M812: Parameter mode

M813: Program mode

M814: Period of use is less than 5 days

M815: Period of use is done

M816: D0 bit for current axis on handwheel

M817: D1 bit for current axis on handwheel

M818: D2 bit for current axis on handwheel

X-axis: status of M818/M817/M816 is 0/0/1

Y-axis: status of M818/M817/M816 is 0/1/0

Z-axis: status of M818/M817/M816 is 0/1/1

A-axis: status of M818/M817/M816 is 1/0/0

B-axis: status of M818/M817/M816 is 1/0/1

C-axis: status of M818/M817/M816 is 1/1/0

Xs-axis: status of M818/M817/M816 is 1/1/1

Ys-axis: status of M818/M817/M816 is 0/0/0

M819: Executing return to zero point of program

M820: Robot system is on remote running mode

M821~M823: Remain

M824~M831: 1st~8th axis home already (status)

M200~M215: Running direction of 1st~8th axis (status)

M200: X+; M201:X-; M202:Y+; M203:Y-; M204:Z+; M205:Z-; M206:A+; M207:A-; M208: B+; M209:B-; M210:C+; M211:C-; M212:XS+; M213:XS-; M214:YS+; M215:YS-

M821: used for dual channel system, 1 means current channel display on front of CNC controller, 0 means run in the background.

2.4.4 Status Relay

M1050: Auto Mode (don’t return to main screen)

M1069: Manual Continuous Mode (don’t return to main screen)

M1080: Handwheel Mode (don’t return to main screen)

M1083: Manual Increment Mode (don’t return to main screen)

M1084: Single Mode (Valid both on Auto and on Manual)

M1085: Continuous (Valid both on Auto and on Manual)

M1029: Single/Continuous shift (Valid both on Auto and on Manual)

M1054: Optional Stop

M1055: Program Skip

M1032: Start from real block number

M1033: Start from remark block number(N)

M1034: Start from tool code block

M1035: *1 gear

M1036: *10 gear

M1037: *100 gear

M1082: G00 Rate Increase(+)

M1027: G00 Rate 100%

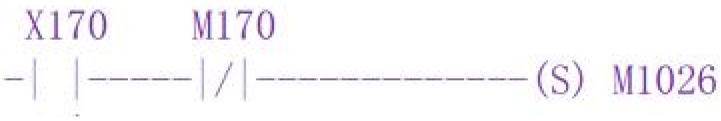
M1083: G00 Rate Decrease(-)
M1021: Feed Rate Increase(+)
M1022: Feed Rate 100%
M1020: Feed Rate Decrease(-)
M1025: SP Rate Increase (+)
M1023: SP Rate 100%
M1024: SP Rate Decrease (-)
M1026: SP Rate Decrease (-)
M1019: Current tool pot number setting on machine center
M1042: Status of power supply
M1043: Enter to MDI status
M1044: Machine Tool Lock
M1045: Auxiliary Lock
M1046: Simulate Run
M1030: SP shift to High Gear (M41)
M1038: SP shift to Low Gear (M42)
M1039: SP shift to 3rd Gear (M43)
M1040: SP shift to 4th Gear (M44)
M1003: SP Rotation CW
M1031: SP-CW-JOG Rotation
M1006: SP-Stop
M1004: SP Rotation CCW
M1041: SP-CCW-JOG Rotation
M1015: SP orientation
M1016: Feeding Axes return to tool change point
M1017: CW-Rotation of tool magazine
M1018: CCW-Rotation of tool magazine
M1126: Chuck
M1013: Home
M1009: Coolant
M1008: Turn on lubricate
M1108: Turn off lubricate
M1007: Huff
M1127: Tailstock
M1002: Clear SP-JOG rotation
M1005: Program Run
M1047: Program Pause
M1014: Reset
M1088: Exit system
M1010: Increment Shift(*1,*10,*100)(old version)
M1011: Single/Continuous Shift (only work on Auto) (old version)
M1012: Graph/Coordinate Shift
M1048: Manual/Auto Shift (don’t return to main screen)

M1049: Chuck&Tailstock both are valid [also both M1126&M1127 are valid]
M1056: Shift to UCS (Robot controller)
M1057: Shift to Tool coordinate system(Robot controller)
M1058: Shift to World coordinate system (Robot controller)
M1059: Shift to Joint coordinate system (Robot controller)
M1060: Shift current coordinate system cycle
M1061: Shift to X-axis selection (Handwheel on panel)
M1062: Shift to Y-axis selection (Handwheel on panel)
M1063: Shift to Z-axis selection (Handwheel on panel)
M1064: Shift to A-axis selection (Handwheel on panel)
M1065: Shift to B-axis selection (Handwheel on panel)
M1066: Shift to C-axis selection (Handwheel on panel)
M1067: Shift to Xs-axis selection (Handwheel on panel)
M1068: Shift to Ys-axis selection (Handwheel on panel)
M1051: Enter Teach-in mode when program edit
M1052: Record end point one time when program edit
M1053: Record middle point of arc one time when program edit
M1070-M1079: corresponding to ProgramUser0-ProgramUser9
M1081: External Axis shift(Robot controller)
M1086: Display screen shift cycle (dual cnc controller)

2.4.5 The KB code of the key is the number of the key auxiliary relay minus 1000.

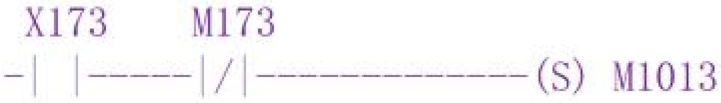
Eg:

Feed Rate Increase



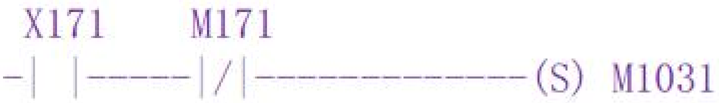
Feed Rate Increase

Home:

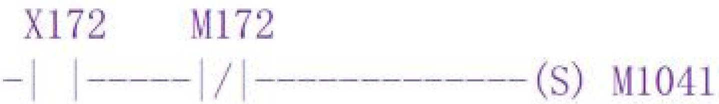


home

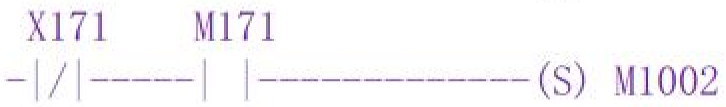
Spindle JOG function realization



SP-CW-JOG Rotation

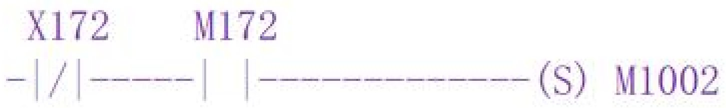


SP-CCW-JOG Rotation



```
  X171     M171
-|/|-----| |-------------(S)  M1002
```

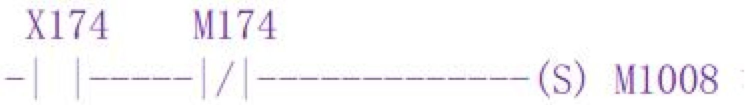
Clear SP-JOG CW rotation



```
  X172     M172
-|/|-----| |-------------(S)  M1002
```

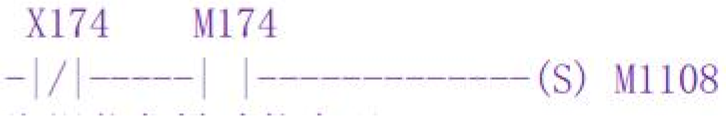
Clear SP-JOG CCW rotation

Lubricate JOG function realization



```
  X174     M174
-| |-----|/|-------------(S)  M1008
```

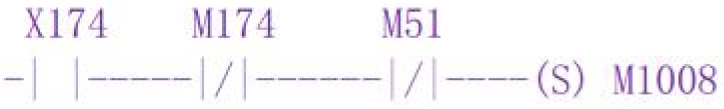
Turn on lubricate



```
  X174     M174
-|/|-----| |-------------(S)  M1108
```

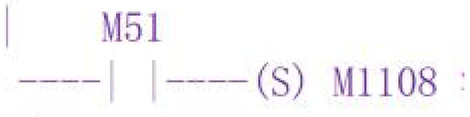
Turn off lubricate

Lubrication reciprocating key function realization



```
  X174     M174       M51
-| |-----|/|------|/|---(S)  M1008
```

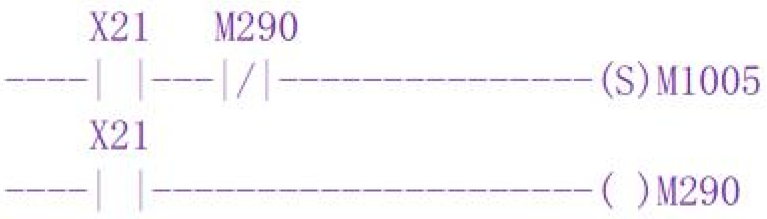
Turn on lubricate



```
|      M51
 ----| |----(S)  M1108
```

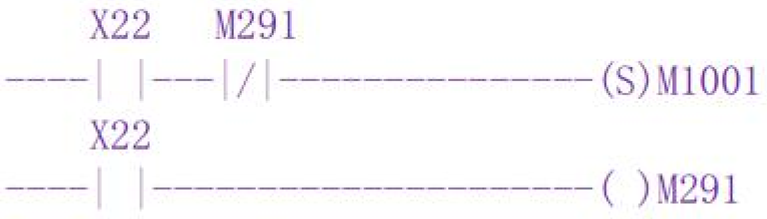
Turn off lubricate

Remote run function realization



```
      X21    M290
----| |---|/|---------------(S)M1005
      X21
----| |---------------------( )M290
```

Remote stop function realization



```
      X22    M291
----| |---|/|---------------(S)M1001
      X22
----| |---------------------( )M291
```

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;

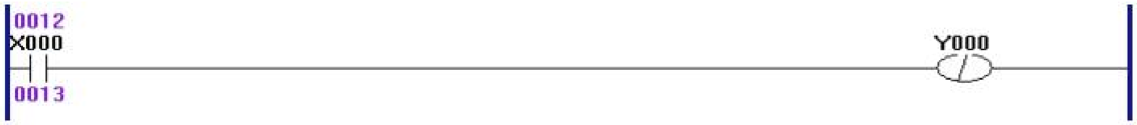
Unit is 10ms, Accumulated type: T4~T7&T32-T47

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

Unit is 1s : Accumulated type: T12~T15&T64-T79

2.6.1 Basic instruction

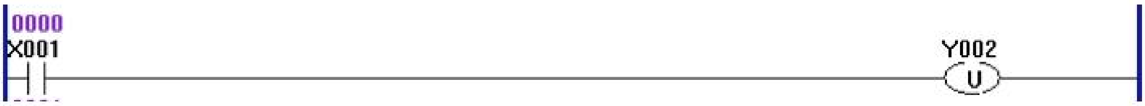
1.--[/][Basic instruction]: reverse output coil



When X00 is invalid, it is Y00 output signal.

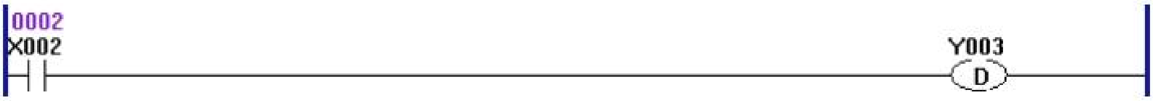
When X00 is valid, Y00 output signal is invalid.

2. --[U]:[Basic instruction]: rising edge output coil



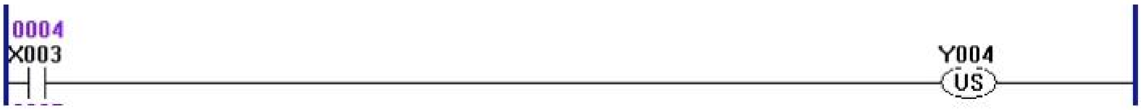
When X01 changes from invalid to effective rising edge, there will output Y02.

3. --[D]:[Basic instruction]: falling edge output coil



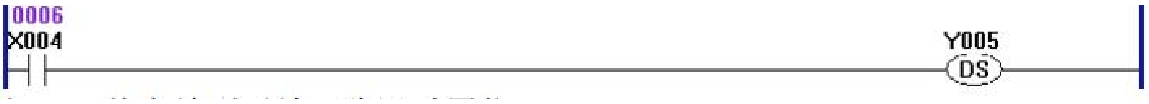
When X02 changes from invalid to effective rising edge, there will output Y03.

4. --[US]:[Basic instruction]: rising edge set coil



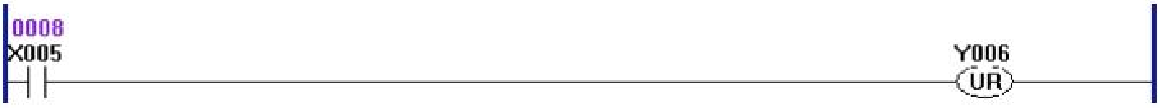
When X03 changes from invalid to effective rising edge, there will set Y04.

5. --[DS]:[Basic instruction]:falling edge set coil



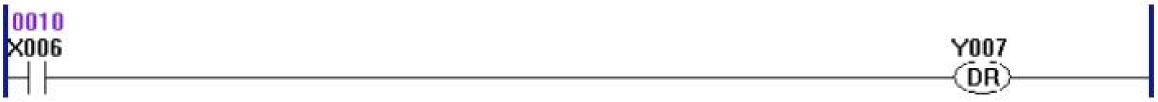
When X04 changes from invalid to effective rising edge, there will set Y05.

6. --[UR]:[Basic instruction]: rising edge reset coil



When X05 changes from invalid to effective rising edge, there will reset Y06.

7. --[DR]:[Basic instruction]: falling edge reset coil



When X06 changes from invalid to effective rising edge, there will reset Y07.

2.6.2 Logic operation function block rule definition

Particular attention: 1. Parameter C is always the address

2. The value range of the parameter is0---255.

1.CMP: Data comparison

Control condition:

0 table 8-bit data, parameter A and parameter B are addresses;

1 table 16-bit data, parameter A and parameter B are addresses;

2 table 8-bit data, parameter A is address and parameter B is constant;

3 table 16-bit data, parameter A is address and parameter B is constant;

4 table 8-bit data, parameter A is constant and parameter B is address;

5 table 16-bit data, parameter A is constant and parameter B is address;

8 table parameter A and parameter B are constants;

16 table parameter A and parameter B are macro variable code,0-99 corresponding macro variable #900-#999.

48 table parameter A and parameter B are macro variable code,0-99 corresponding macro variable #900-#999(Modbus system effective).

When parameter A>=parameter B, the parameter C corresponding M Auxiliary Relay is be set effective.

When parameter A<parameter B, the parameter C corresponding M Auxiliary Relay is be set invalid.

Operation rules:

When parameter A>parameter B ,assignment parameter C(Lower three bits) equals 1;

When parameter A=parameter B ,assignment parameter C(Lower three bits) equals 2;

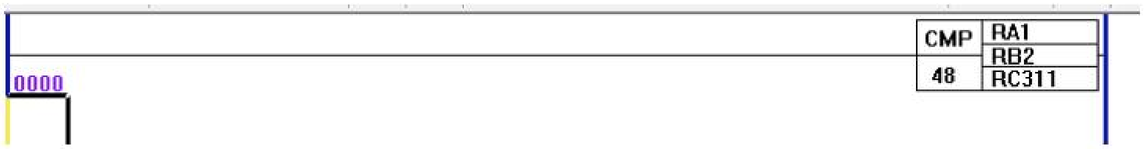
When parameter A<parameter B ,assignment parameter C(Lower three bits) equals 4;

When control condition add 32 on the basis of the original value, operation rules have changed:

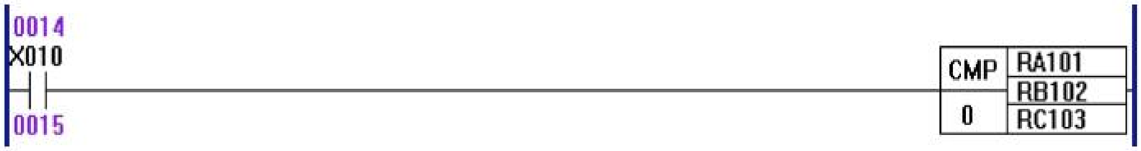
When parameter A>=parameter B, the parameter C corresponding M Auxiliary Relay is be set effective.

When parameter A<parameter B, the parameter C corresponding M Auxiliary Relay is be set invalid.

Eg1:



Eg2:



If control condition is 0,parameter A is address and parameter B is address.

When X10 is effective ,parameter A=01000101,parameter B=00010010, compare the result is A>B and assign R103, if R103 original value is 0, now after assign R103=00000001.

Eg2:

If control condition is 1,parameter A is address and parameter B is address.

When X10 is effective,parameter A=0000010110100001,parameter B=0000010110100000 , compare the result is A>B and assign R103, if R103 original value is 0, now after assign R103=000000000000001.

Control condition set 48,

Parameter A and parameter B are macro variable code,0-99 corresponding macro variable #900-#999.

When parameter A>=parameter B, the parameter C corresponding M Auxiliary Relay is be set effective.

When parameter A<parameter B, the parameter C corresponding M Auxiliary Relay is be set invalid.

Param#P294G1= 140,Auxiliary Relay M78 indicates the position of the current coordinate relative to the reference point

Param#P503G1= 141, Auxiliary Relay M77 indicates the position of the current coordinate relative to the reference point

Meaning:

1001: Compared with the first reference point of feed axis X.

1002: Compared with the second reference point of feed axis X.

1003: Compared with the third reference point of feed axis X.

1004: Compared with the fourth reference point of feed axis X.

2001: Compared with the first reference point of feed axis Y.

2002: Compared with the second reference point of feed axis Y.

2003: Compared with the third reference point of feed axis Y.

2004: Compared with the fourth reference point of feed axis Y.

3001: Compared with the first reference point of feed axis Z.

3002: Compared with the second reference point of feed axis Z.

3003: Compared with the third reference point of feed axis Z.

3004: Compared with the fourth reference point of feed axis Z.

4001: Compared with the first reference point of feed axis A.

4002: Compared with the second reference point of feed axis A.

4003: Compared with the third reference point of feed axis A.

4004: Compared with the fourth reference point of feed axis A.

5001: Compared with the first reference point of feed axis B.

5002: Compared with the second reference point of feed axis B.

5003: Compared with the third reference point of feed axis B.

5004: Compared with the fourth reference point of feed axis B.

When the current coordinate value of the machine tool is less than the set value of the reference point, the auxiliary relay M78 / M77 becomes effective, otherwise M78 / M77 invalid .When the reference value is not the above setting value, M78 / M77 is user-defined auxiliary relay.

2.MOV:Data mobility

Control condition:

0 table 8-bit data, parameter A and parameter B are addresses;

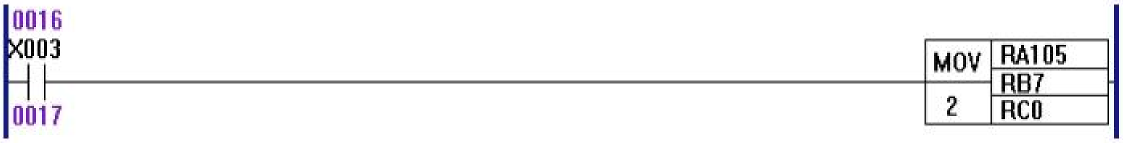
1 table 16-bit data, parameter A and parameter B are addresses;

2 table 8-bit data, parameter A is address and parameter B is constant;

3 table 16-bit data, parameter A is address and parameter B is constant;

Operation rules:

Assign parameter B to parameter A. Parameter A is always address.



Control condition is 2, parameter A is address, parameter B is constant.

When X03 is effective, parameter B=7, and 00000111, and send it to parameter A=R105, and R105=00000111.

3.BIT: Data bit operation.

Control condition: made up of double digits.

One digit on the left:

1 table logic and;

2 table logic or;

3 table logic XOR;

4 table logic non. Let A logic non direct assignment to C, and it has nothing to do with parameter B.

5 table move left.

6 table move right.

One digit on the right:

0 table 8-bit data, parameter A and parameter B are addresses;

1 table 16-bit data, parameter A and parameter B are addresses;

2 table 8-bit data, parameter A is address and parameter B is constant;

3 table 16-bit data, parameter A is address and parameter B is constant;

4 table 8-bit data, parameter A is constant and parameter B is address;

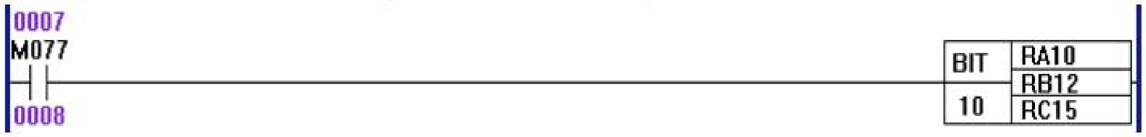
5 table 16-bit data, parameter A is constant and parameter B is address;

8 table parameter A and parameter B are constants.

Eg: Control condition equals 305 express: 16 bits data logic XOR, parameter A is constant, parameter B is address.

Operation rules:

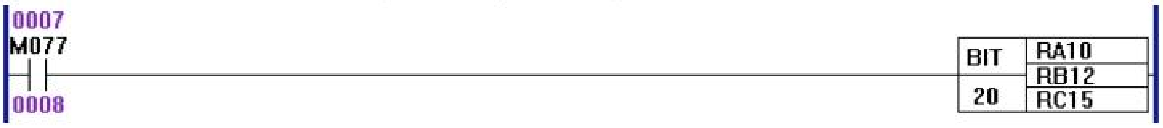
(1)logic and: parameter C = (parameter A & parameter B).



When M77 is effective, control condition is 10, express logic and, parameter A and parameter B are addresses.

When parameter A is address 10=10000111, parameter B is address 12=01100001, parameter C is address 15=00000001.

(2)logic or: parameter C = (parameter A | parameter B).

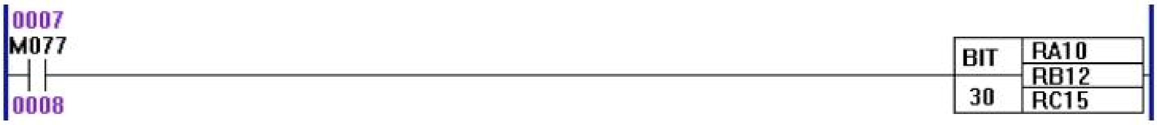


When M77 is effective, control condition is 20, express logic or, parameter A and parameter

B are addresses.

When parameter A is address 10=10000111, parameter B is address 12=01100001, parameter C is address 15=11100111.

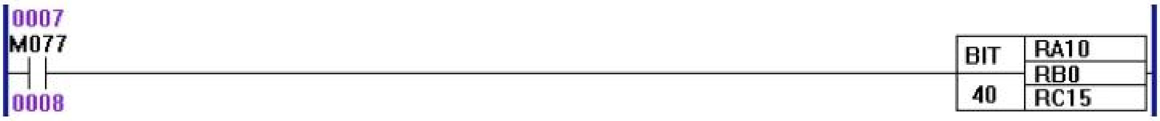
(3)logic XOR: parameter C = (parameter A ^ parameter B).



When M77 is effective, control condition is 30, express logic XOR, parameter A and parameter B are addresses.

When parameter A is address 10=10000111, parameter B is address 12=01100001, parameter C is address 15=11100110.

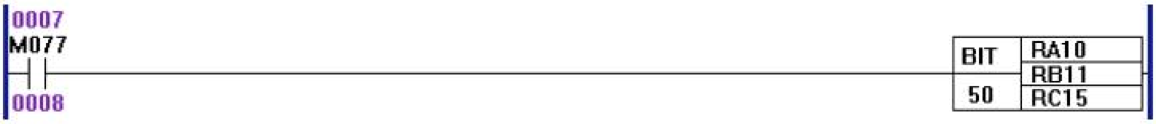
(4)logic non: parameter C = (~ parameter A).



When M77 is effective, control condition is 40, express logic non, parameter A is address.

When parameter A is address 10=10000111, parameter C is address 15=01111000.

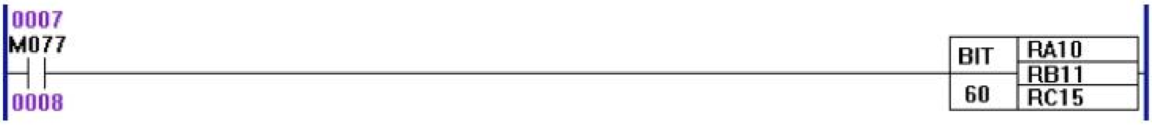
(5)Move left: parameter C = (parameter A<< parameter B).(parameter B specifies the number of bits to shift left).



When M77 is effective, control condition is 50, express logic move left, parameter A and parameter B are addresses.

When parameter A is address 10=10000111, parameter B is address 11=00000011, parameter C is address 15=00111000.

(6) Move right: parameter C = (parameter A >> parameter B).(parameter B specifies the number of bits to shift right).



When M77 is effective, control condition is 50, express logic move right, parameter A and parameter B are addresses.

When parameter A is address 10=10000111, parameter B is address 11=00000011, parameter C is address 15=000110000.

4.ADD：Data addition.

Control condition:

0 table 8-bit data, parameter A and parameter B are addresses;

1 table 16-bit data, parameter A and parameter B are addresses;

2 table 8-bit data, parameter A is address and parameter B is constant;

3 table 16-bit data, parameter A is address and parameter B is constant;

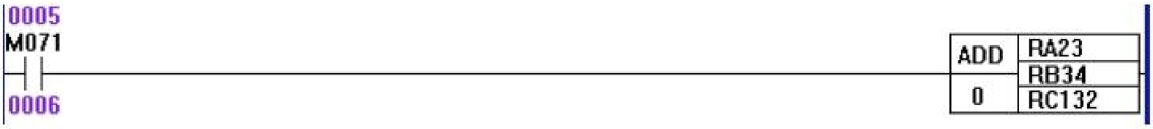
4 table 8-bit data, parameter A is constant and parameter B is address;

5 table 16-bit data, parameter A is constant and parameter B is address;

8 table parameter A and parameter B are constants.

Operation rules:

Parameter C = parameter A + parameter B.



When M71 is effective, control condition is 0, parameter A and parameter B are addresses.

When parameter A is address 23=10000111, parameter B is address 34=01100001, parameter C is address 32=11101000.

5.SUB: Data subtraction.

Control condition:

0 table 8-bit data, parameter A and parameter B are addresses;

1 table 16-bit data, parameter A and parameter B are addresses;

2 table 8-bit data, parameter A is address and parameter B is constant;

3 table 16-bit data, parameter A is address and parameter B is constant;

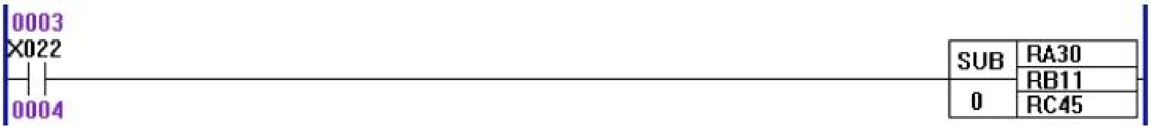
4 table 8-bit data, parameter A is constant and parameter B is address;

5 table 16-bit data, parameter A is constant and parameter B is address;

8 table parameter A and parameter B are constants.

Operation rules:

Parameter C = parameter A - parameter B.



When X22 is effective, control condition is 0, parameter A and parameter B are addresses.

When parameter A is address 23=10000111, parameter B is address 34=01100000, parameter C is address 45=01000000.

6.MUL: Data multiplication

Control condition:

0 table 8-bit data, parameter A and parameter B are addresses;

1 table 16-bit data, parameter A and parameter B are addresses;

2 table 8-bit data, parameter A is address and parameter B is constant;

3 table 16-bit data, parameter A is address and parameter B is constant;

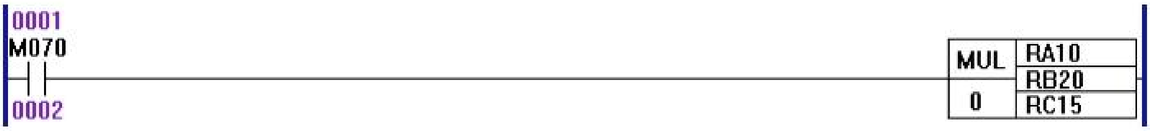
4 table 8-bit data, parameter A is constant and parameter B is address;

5 table 16-bit data, parameter A is constant and parameter B is address;

8 table parameter A and parameter B are constants.

Operation rules:

Parameter C = parameter A * parameter B.



When M70 is effective, control condition is 0, parameter A and parameter B are addresses.

When parameter A is address 10=10100111, parameter B is address 20=00000101, parameter C is address 45=01000011.

7.DIV: data division

Control condition:

0 table 8-bit data, parameter A and parameter B are addresses;

1 table 16-bit data, parameter A and parameter B are addresses;

2 table 8-bit data, parameter A is address and parameter B is constant;

3 table 16-bit data, parameter A is address and parameter B is constant;

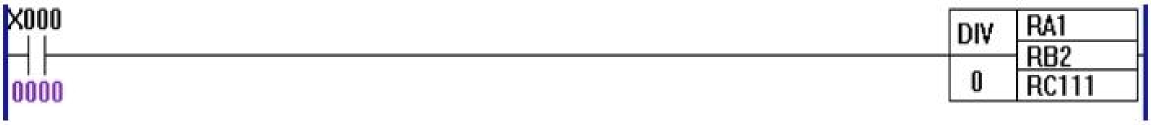
4 table 8-bit data, parameter A is constant and parameter B is address;

5 table 16-bit data, parameter A is constant and parameter B is address;

8 table parameter A and parameter B are constants.

Operation rules:

Parameter C = parameter A / parameter B.



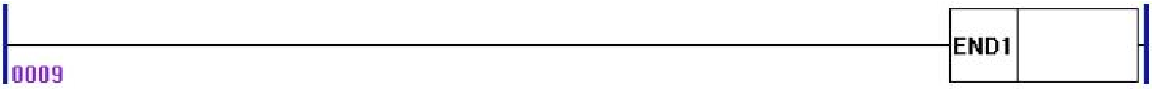
When X00 is effective, control condition is 0, parameter A and parameter B are addresses.

When parameter A is address 1=10100111, parameter B is address 2=00000101, parameter C is address 111=00100001.

2.6.3 Process control function block

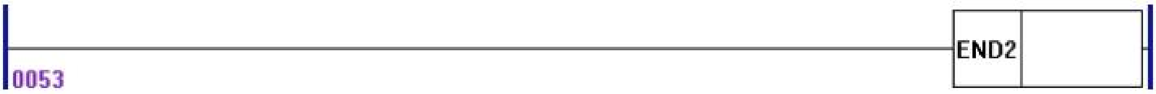
1.END1:[Process control function block]: end of first level

PLC in the front of END1 is high speed scanning, every scan cycle is 8 ms.



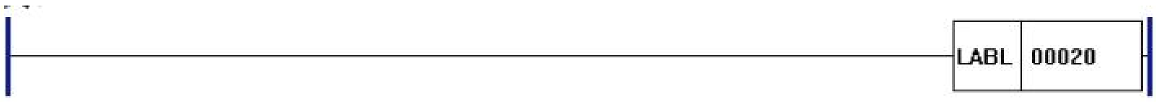
2. END2:[Process control function block]: end of second level

PLC in the front of END2 is low speed scanning, every scan cycle is 100 ms.



3.LABL: [Process control function block]: location label

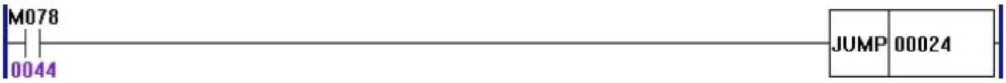
Specifying a marker in the ladder, that JMPB specify the destination of the jump and a LABL marker.



LABL marker parameter setting is 1-9999.

4.JUMP: [Process control function block]: conditional and unconditional jump.

Transfer program to the program location for label setting at once. It has the following characteristics, multiple jumps can us the same marker; no jumping END1 and END2; no jumping out of subroutine; it could jump forward and backward.

Example: 

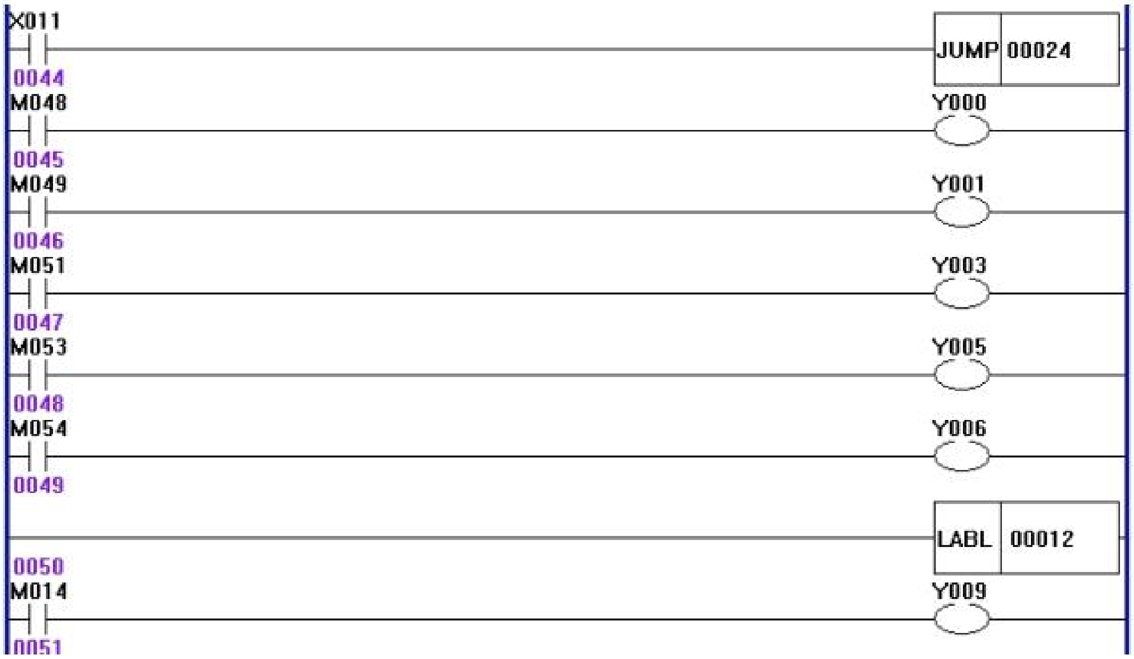
Control condition:

When M78 is invalid, no jump, and execute the next statement of the JUMP.

When M78 is effective, jump to the appoint marker and execute the next statement of the marker.

JUMP marker parameter setting is 1-9999.

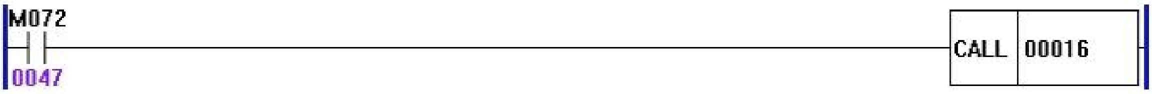
Eg2:



Explain: When X11 is effective, directly execute line 51, jump execution the line 45 to 49. When X11 is invalid, directly execute line 45.

5. CALL: [Process control function block]: conditionally and unconditionally calling subroutine.

Calling subroutine appoint program, which has the following characteristics, multiple calling instructions can call the same subroutine; call instructions can be nested; it can not call instruction at the first level of the program; the instructions must write after the END2.



Control condition:

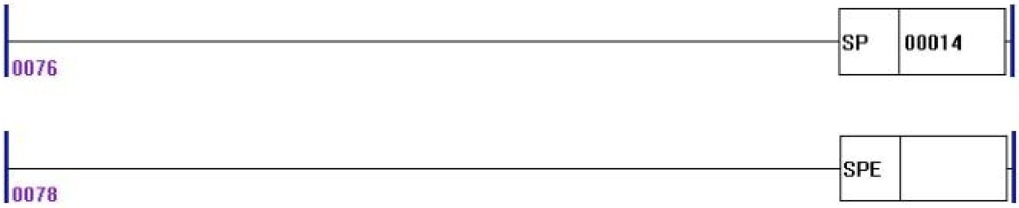
When X72 is effective, execute the subroutine which calling appoint subroutine number(eg. CALL 16) .

When X72 is invalid, execute the next statement of the CALL.

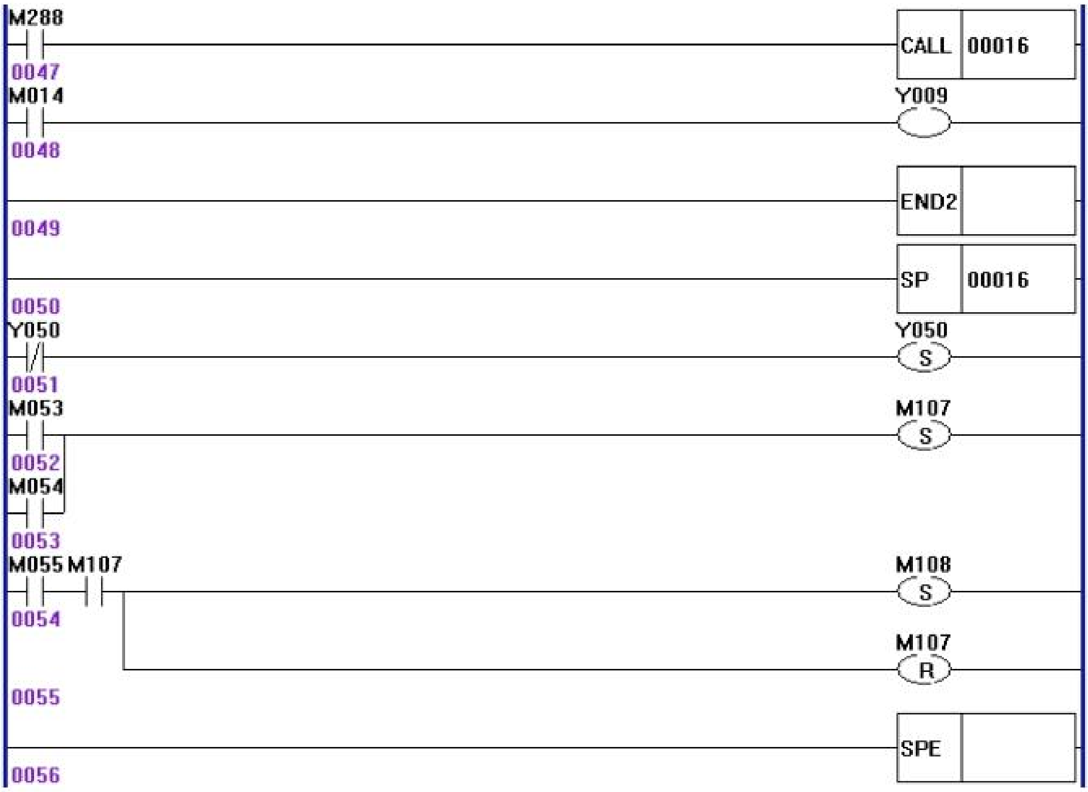
6.SP: [Process control function block]: subroutine start.

7.SPE: [Process control function block]: subroutine stop.

SP is used for generating subroutine, the subroutine number is the subroutine name, SPE is used for the marker of the subroutine stop. When order is executed, the control will return to call the subroutine in the main program, SP and SPE is used to appoint the range of the subroutine. Using subroutine must write after END2. Eg1:



Eg2: Such as the following SP16 subroutine.



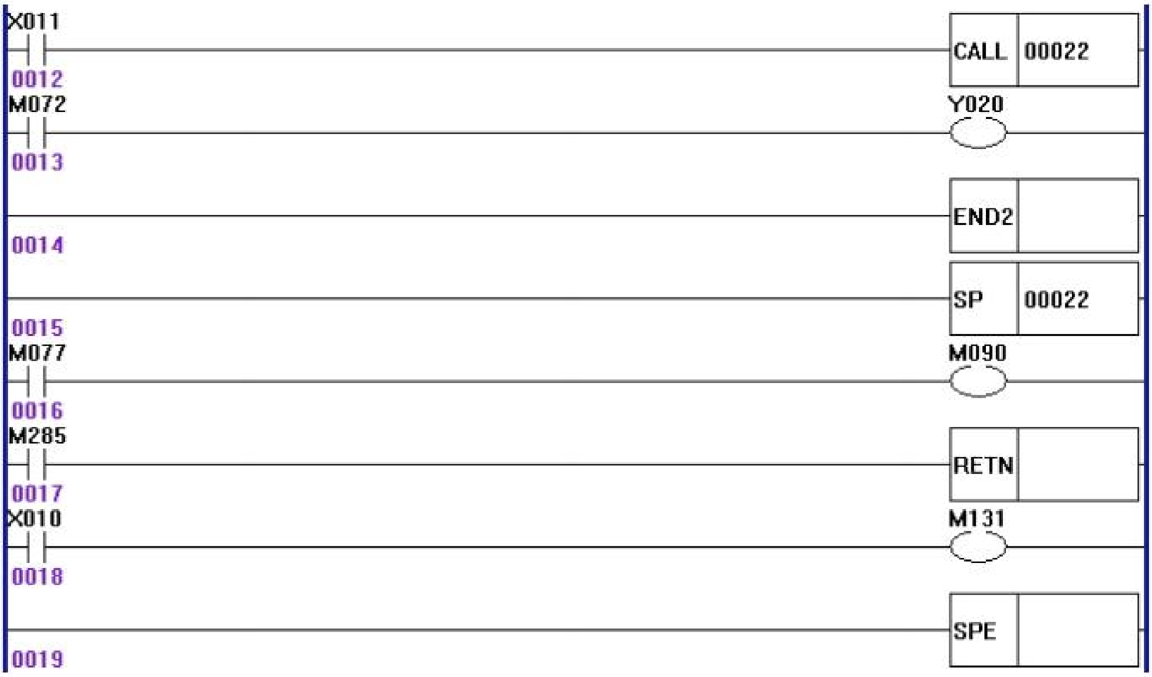
Explain: When M288 is effective, the program execute calling subroutine SP16.

When M288 is invalid, the program no execute calling subroutine SP16.

8.RETN: [Process control function block]: subroutine return.

When the condition is satisfied to execute calling subroutine and the condition is satisfied to return RETN in subroutines, that will return main program directly.

When the condition is satisfied to execute calling subroutine and the condition is not satisfied to return RETN in subroutines, that will execute calling subroutine, then return main program.



Explain: When X11 is effective, it will execute calling subroutine SP22; when M285 in the subroutine is effective and RETN is satisfied, that will return main program directly and execute line13.

When X11 is effective, it will execute calling subroutine SP22; when M285 in the subroutine is invalid and RETN is not satisfied, that will execute calling subroutine line 18 to end, then return main program.

2.6.4 parameter address

1.Input Output point parameter address definition:

parameter address definition	parameter
1	X0-X7
2	X8-X15
3	X16-X23
4	X24-X31

7	X50-X57
8	X58-X65
9	X66-X73
10	X74-X81
13	X151-X158
14	X159-X166
15	X167-X174
16	X175-X182
17	X183-X190
18	X191-X198
31	X200-X207
32	X208-X208
51	Y0-Y7
52	Y8-Y15
53	Y16-Y23
54	Y24-Y31
55	Y50-Y57
57	Y71-Y78
58	Y79-Y80

2.Auxiliary Relay parameter address definition

parameter address definition	parameter
101	M0--M7
102	M8—M15
103	M16—M23
104	M24—M31
105	M32—M39
106	M40—M47
107	M48—M55

108	M56—M63
109	M64--M71
110	M72--M79
111	M80—M87
112	M88—M95
113	M100—M107
114	M108—M115
115	M120—M127
116	M128—M135
117	M200—M207
118	M208—M215
119	M250—M257
120	M258—M265
121	M266—M273
122	M274—M281
123	M218—M225
124	M226—M233
125	M234—M241
126	M242—M249
127	M282—M289
128	M290—M297
129	M298—M305
130	M306—M313
131	M800—M807
132	M808—M815
151	Total number of tools
153	Current tool pocket number
155	Target tool pocket number

Attention:

1. For odd number addresses can use for 8 bit parameter and also use for 16 bit parameter;
2. But for even number addresses just can use for 8 bit parameter and can not use for 16 bit parameter.
3. For 16 bit odd addresses contain the parameters of the odd address and the next even address actually.
4. The maximum number of constants is 8 bit.

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.

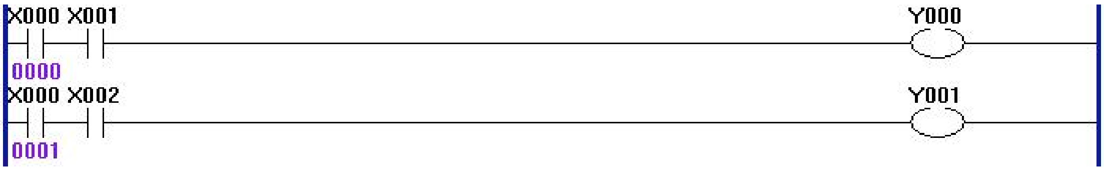
2.7.1 EXECUTING SEQUENTIAL PROGRAM

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

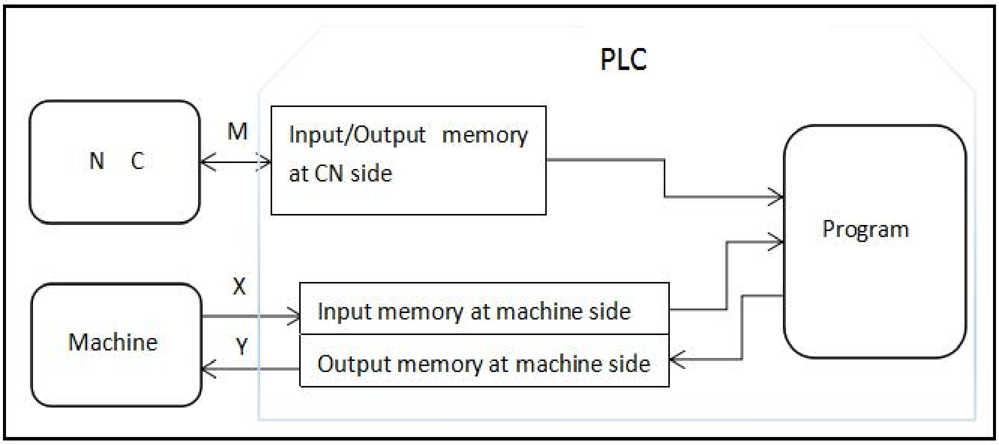
Cycle execution of sequential program is defined that PLC executes ladder from its home to end, and again from its home to end after the run is completed.

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.


PLC
N C
M
Input/Output memory at CN side
Program
Machine
X
Y
Input memory at machine side
Output memory at machine side

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.

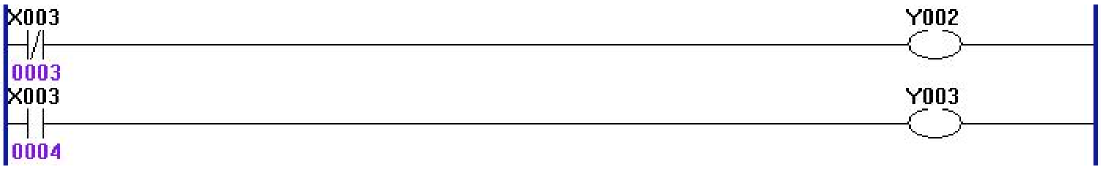
PLC transmits output signal to the output memory at NC side every 8ms,and then directly outputs to NC

(2)Signal to machine

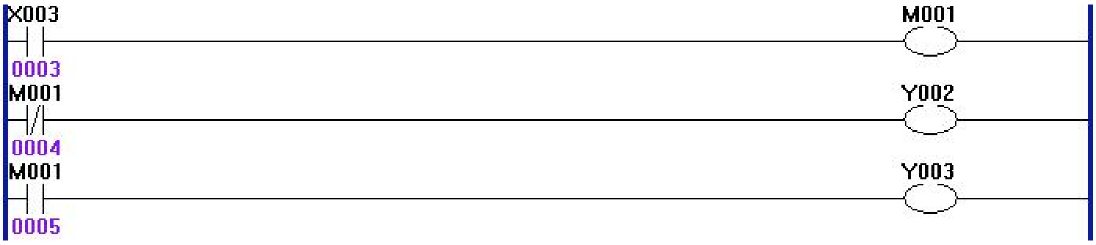
PLC transmits output signal to the output memory at machine side, and then directly outputs to memory every 2ms.

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 Y0002=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.

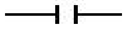
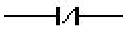
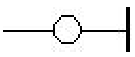
Chapter 3 PLC BASIC INSTRUCTIONS

Basic instructions are used for editing sequential programs and executing 1-bit operation. There are basic instructions for SZGH-CNC990MD & SZGH-CNC1000MD 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	

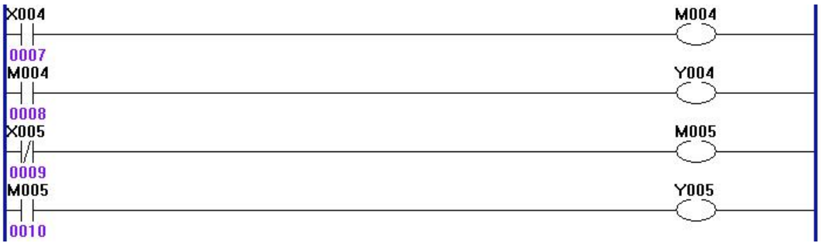
◆ Instruction explanation

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



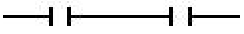
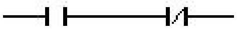
Program Explanation:

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

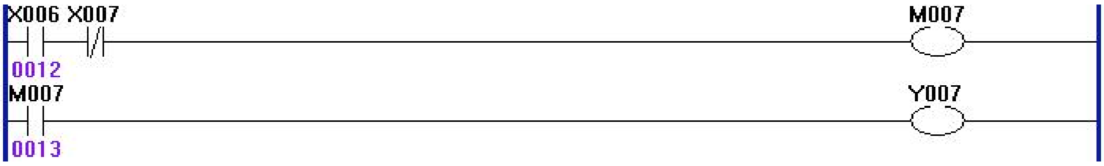
- Mnemonic code and function

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

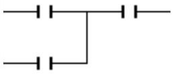
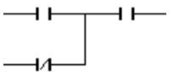


Program Explanation:

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

3.3 OR,ORI INSTRUCTION

- Mnemonic code and function

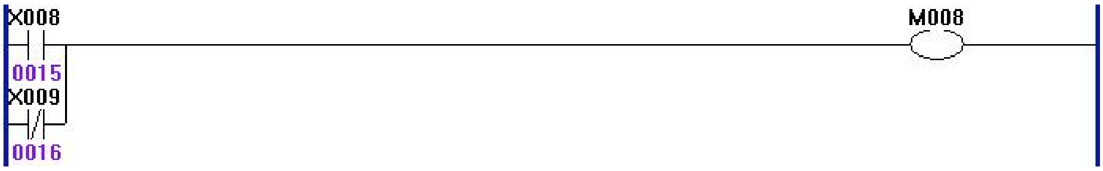
Mnemonic code	Function	Ladder Symbol
OR	Parallel normally-open contact	
ORI	Parallel normally-closed contact	

◆ 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.

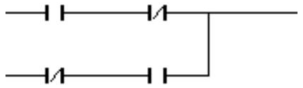
◆ Programming Example



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

3.4 ORB INSTRUCTION

◆ Mnemonic code and function

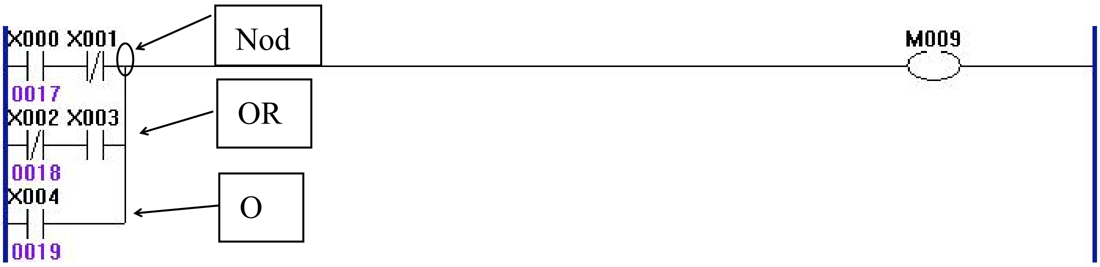
Mnemonic code	Function	Ladder Symbol
ORB	Parallel series circuit block	

◆ 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



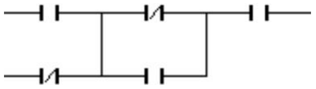
Program explanation：

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

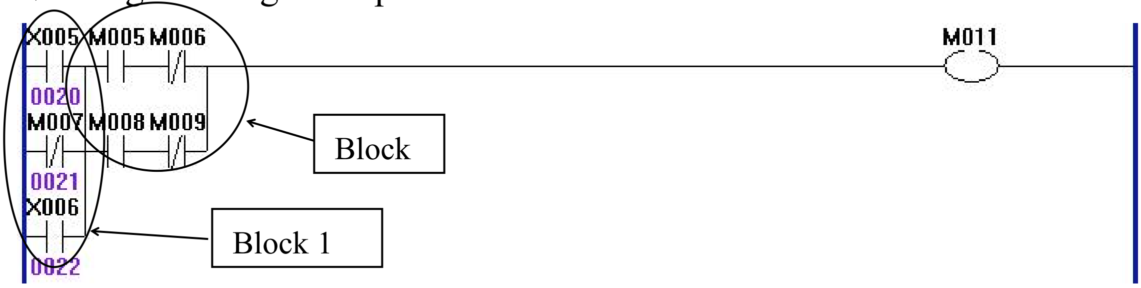
Mnemonic code	Function	Ladder Symbol
ANB	Parallel circuit block in series	

◆ 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：

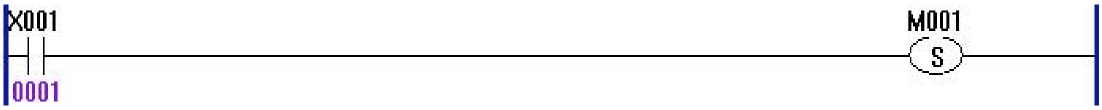
As above ladder, ORB represents the parallel serial circuit block in block 2 and ANB represents block 1 and 2 in series.

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**

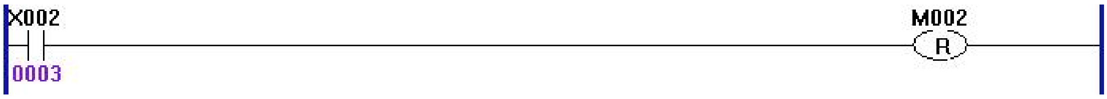
M001: set address bit,which can be a contact or output coil, and add is M,Y, T or C.

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

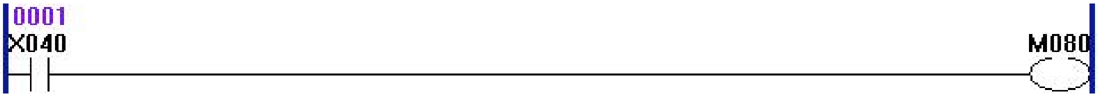
M002: reset address bit,which can be a contact or output coil, and add is M,Y, T or C.

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	M code	Explanation
No.0 Alarm	M80	No.0 Alarm,controlled by M80
No.0 Alarm	M81	No.1 Alarm,controlled by M81
No.0 Alarm	M82	No.2 Alarm,controlled by M82
No.0 Alarm	M83	No.3 Alarm,controlled by M83
No.0 Alarm	M84	No.4 Alarm,controlled by M84
Door is Open	M85	Alarm of Door switch, controlled by M85
No.6 Alarm	M86	No.6 Alarm,controlled by M86
No.7 Alarm	M87	No.7 Alarm,controlled by M87
No lubricate oil	M88	Alarm of non lubricant, controlled by M88
No.9 Alarm	M89	No.9 Alarm,controlled by M89
Chuck no tighten	M90	Chuck no clamping,controlled by M90
No.11 Alarm	M91	No.11 Alarm,controlled by M91
+5V Undervoltage	M92	+5V Undervoltage,controlled by M92
+24V Undervoltage	M93	+24V Undervoltage, controlled by M93
No.14 Alarm	M94	No.14 Alarm,controlled by M94
No.15 Alarm	M95	No.15 Alarm,controlled by M95

Take No.0 alarm(M80) as Example

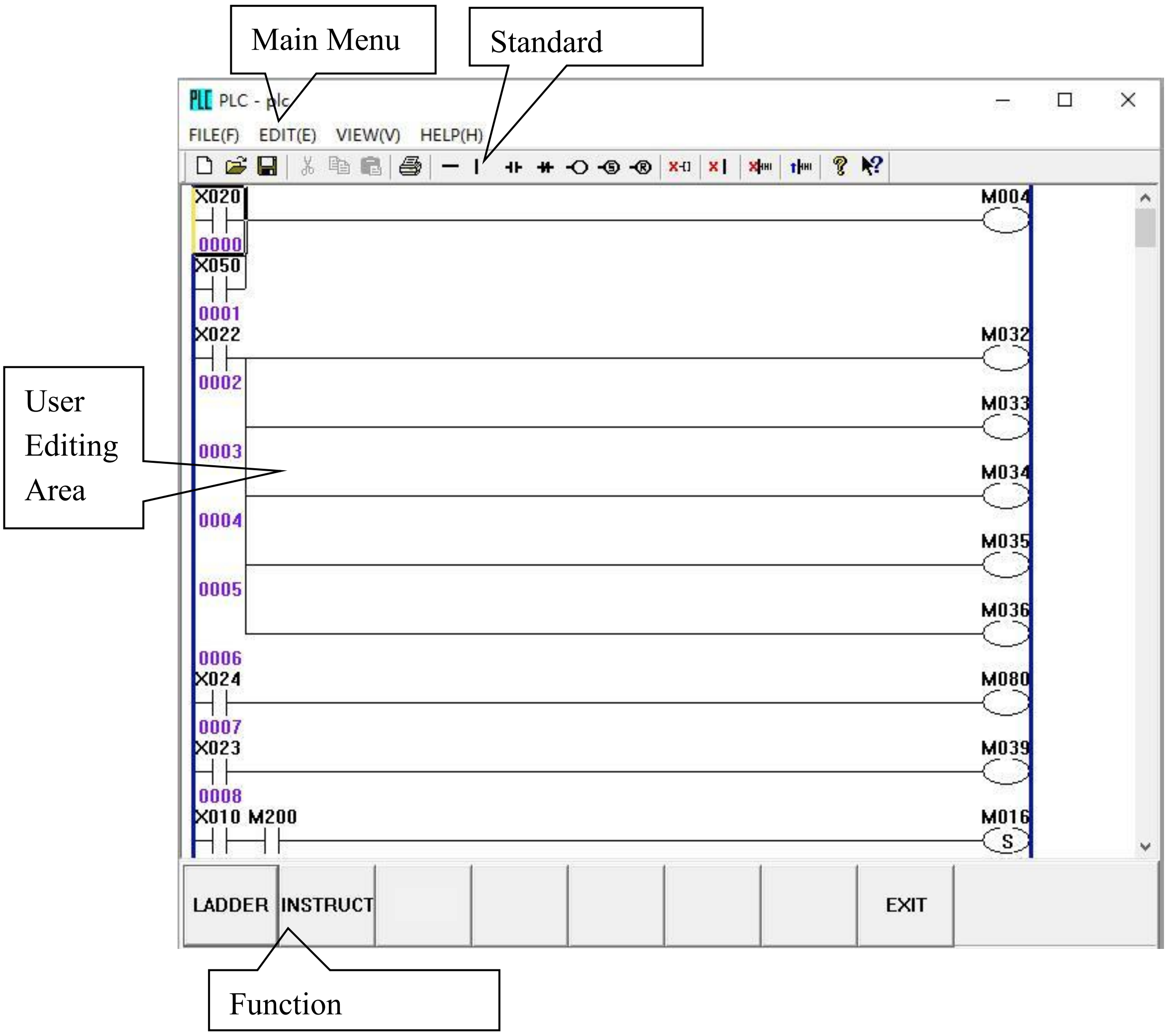


Input point X40 control M80, and then cnc system will hint No.0 alarm. And also we could edit the alarm signal according to detailed condition.

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



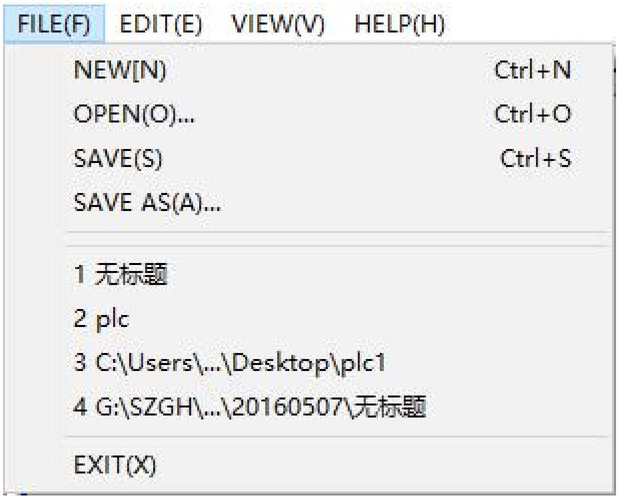
Main Menu All the operational commands

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 save-path,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”.

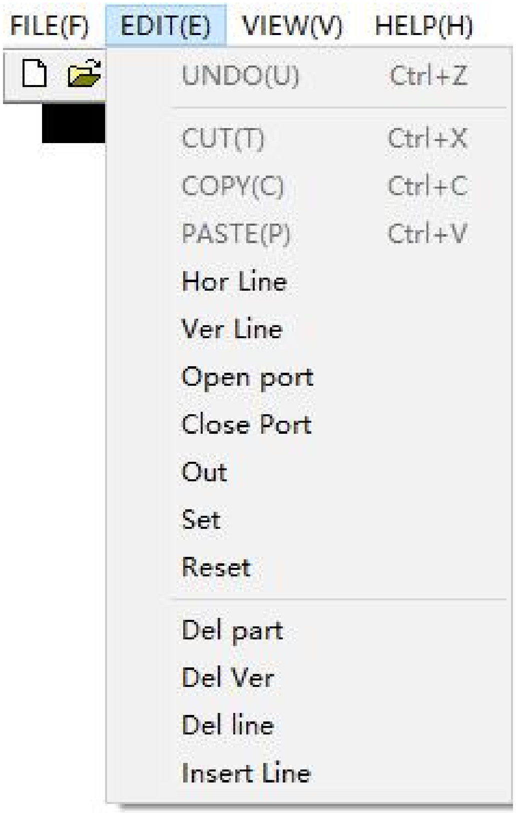
[Recent Open File List]

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 Horn 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 upgrading 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.

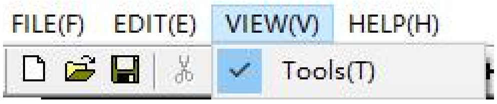
[COPY]

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.

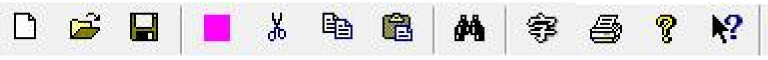
4.2.3 View Menu



[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

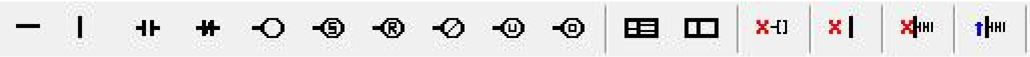
Paste in the selected area

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

-⊘ Add reverse output coil

-Ⓤ Add up edge output coil

-Ⓓ add down edge output coil

-[US] add up edge set output coil

-[DS] add down edge set output coil

-[UR] add up edge set output coil

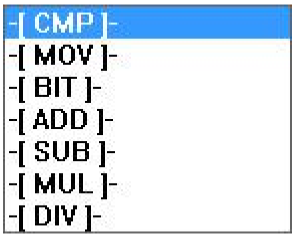
-[DR] add down edge reset output coil

×-[] Delete element

×| Delete vertical line

×|HH Delete elements of total line

↑|HH Add null line above

 -[CMP]- -[MOV]- -[BIT]- -[ADD]- -[SUB]- -[MUL]- -[DIV]-	CMP: Data compare
	MOV: Data Move
	BIT: Data Bit operation
	ADD: Data Add
	SUB: Data Subtract
	MUL: Data Multiple
	DIV: Data Division

-[END1]- -[END2]- -[LABL]- -[JUMP]- -[SP]- -[SPE]- -[RETN]- -[CALL]-	END1: End of 1st grade
	END2: End of 2nd grade
	LABL: position label
	JUMP: jump with condition or not
	SP: Start of subprogram
	SPE: End of subprogram
	RETN: Return of subprogram
	CALL: call subprogram

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 “USB-disk” 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&parameters backup to U-disk.

⑥ Press “SYSTM” 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”

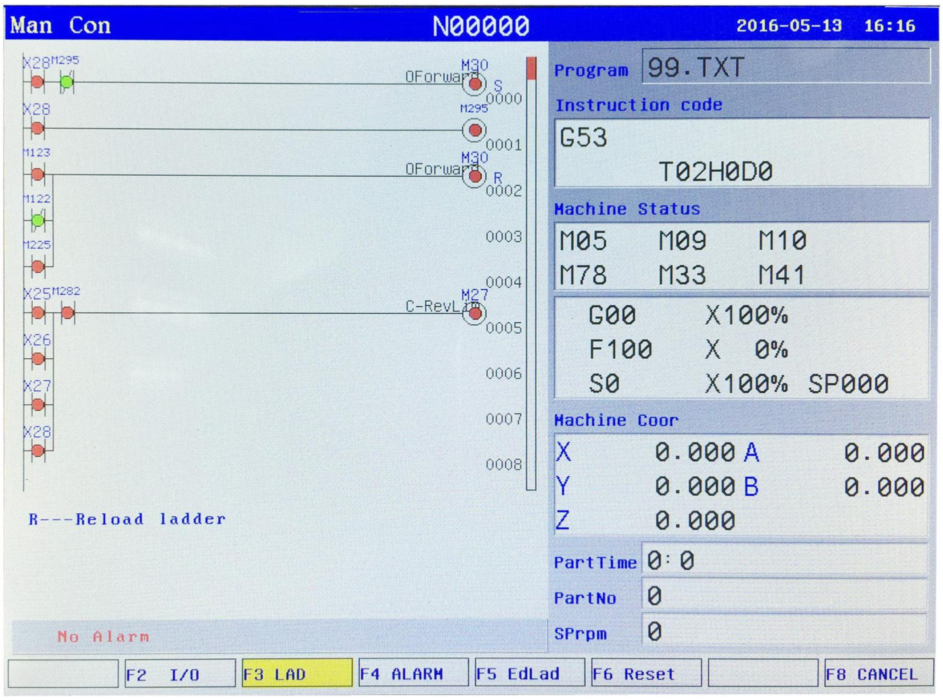
⑦ Input password to restore plc.lad & plc.plc into system

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



Program 99.TXT

Instruction code
G53
T02H0D0

Machine Status
M05 M09 M10
M78 M33 M41

G00 X100%
F100 X 0%
S0 X100% SP000

Machine Coor
X 0.000 A 0.000
Y 0.000 B 0.000
Z 0.000

PartTime 0: 0
PartNo 0
SPrpm 0

4.4.1 Steps of enter screen of PLC

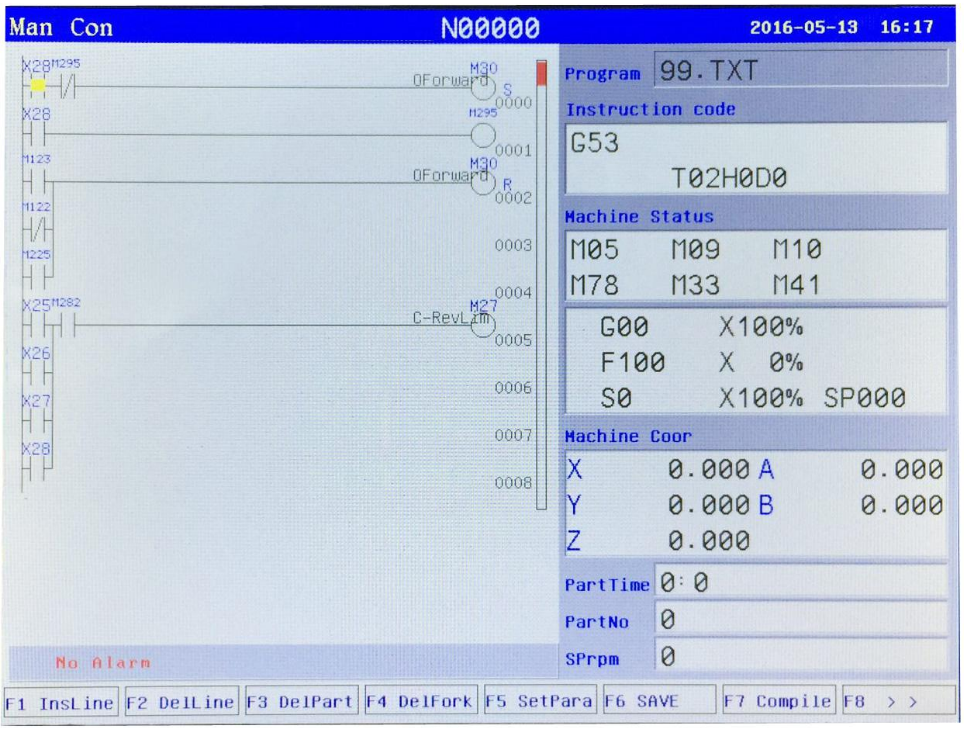
① Alter No.1 parameter to disable in Password;

② Press “Diagnosis” or Press “Parameter” twice to enter diagnosis 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



Program 99.TXT

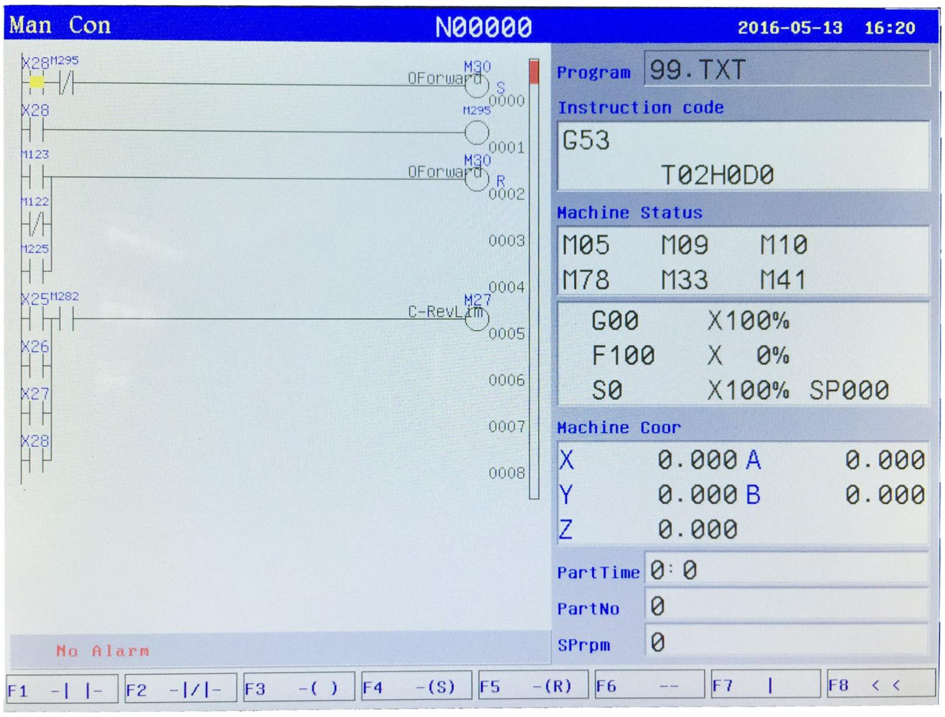
Instruction code
G53
T02H0D0

Machine Status
M05 M09 M10
M78 M33 M41

G00 X100%
F100 X 0%
S0 X100% SP000

Machine Coor
X 0.000 A 0.000
Y 0.000 B 0.000
Z 0.000

PartTime 0: 0
PartNo 0
SPrpm 0



Man Con N00000 2016-05-13 16:20

Program 99.TXT

Instruction code

G53
T02H0D0

Machine Status

M05 M09 M10
M78 M33 M41

G00 X100%
F100 X 0%
S0 X100% SP000

Machine Coor

X	0.000	A	0.000
Y	0.000	B	0.000
Z	0.000		

PartTime 0:0

PartNo 0

SPrpm 0

No Alarm

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 vertical 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

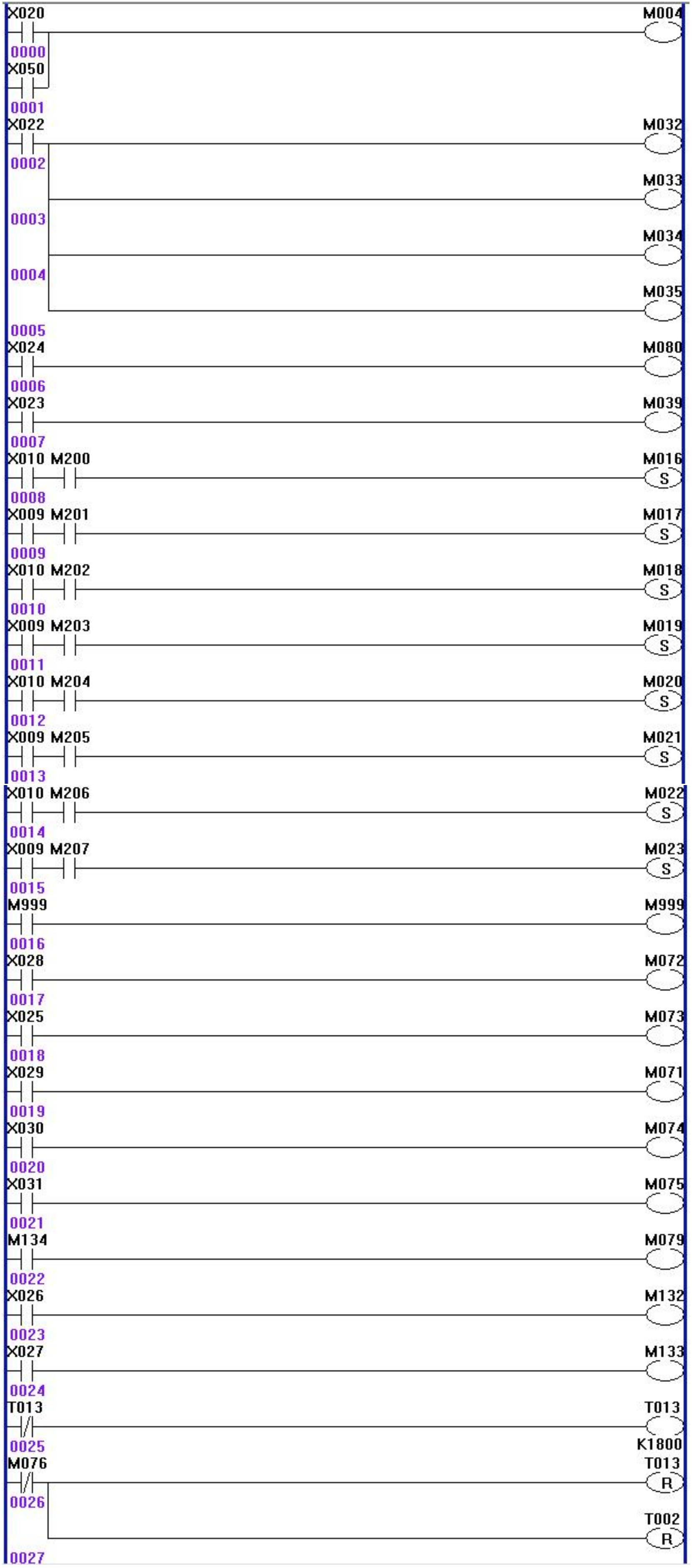
-(R) : Add reset output coil

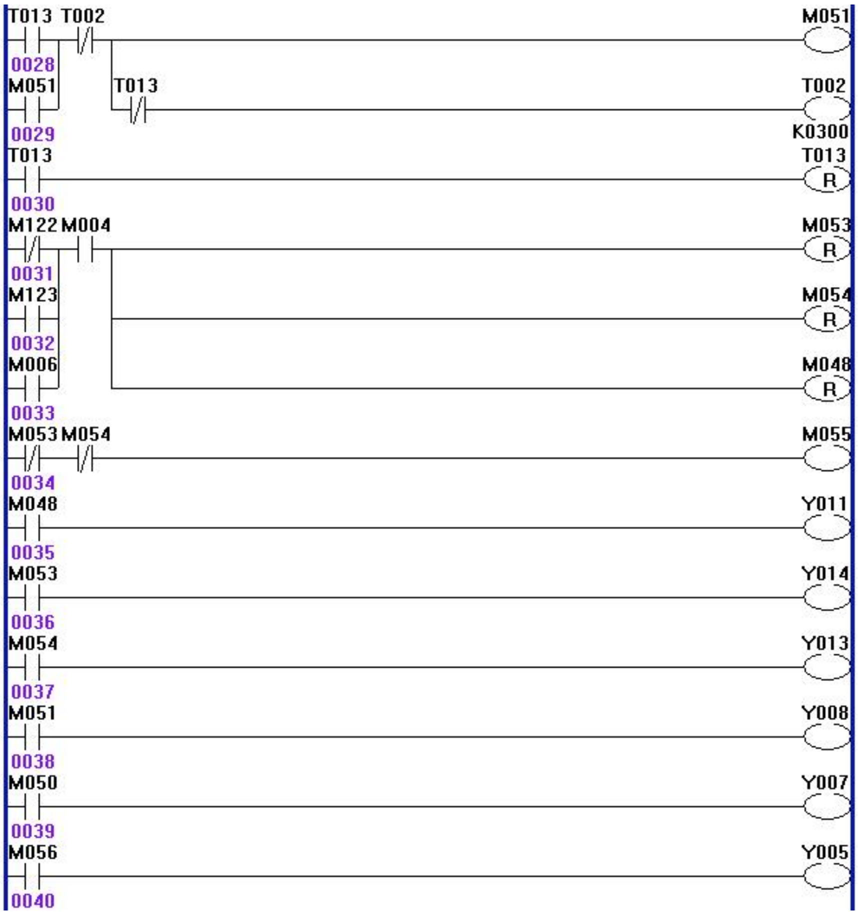
-- : Add horizontal line at the cursor position

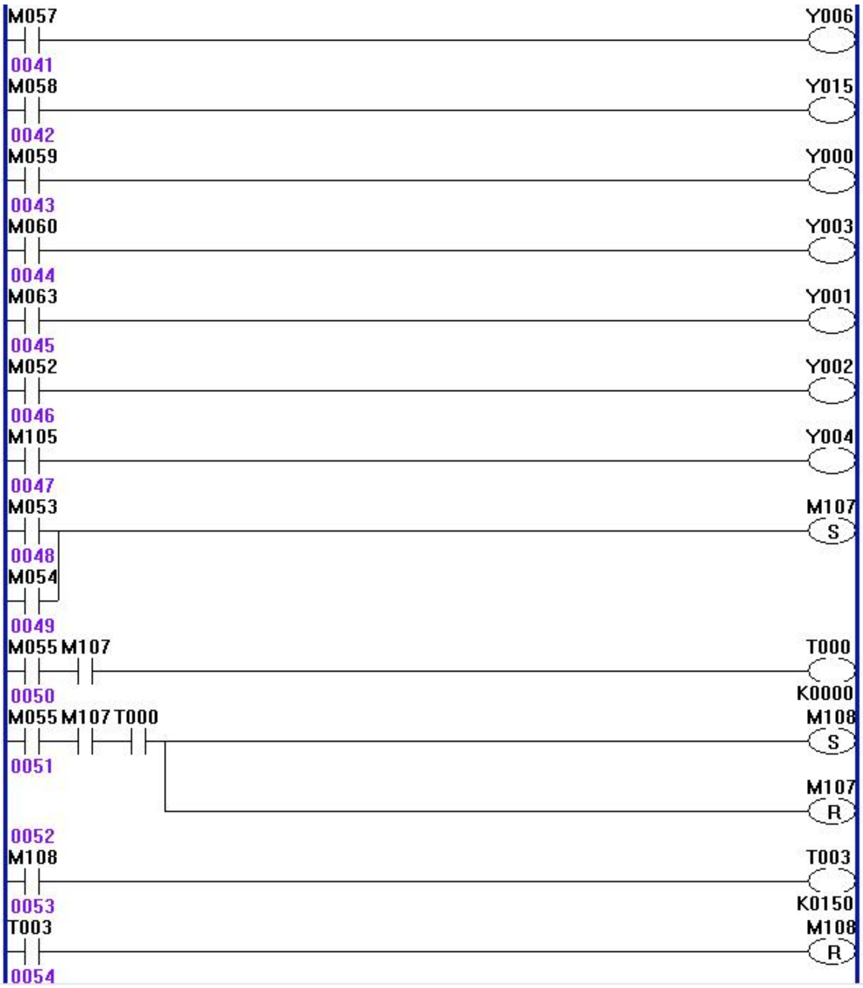
| : Add vertical line at left side of cursor position

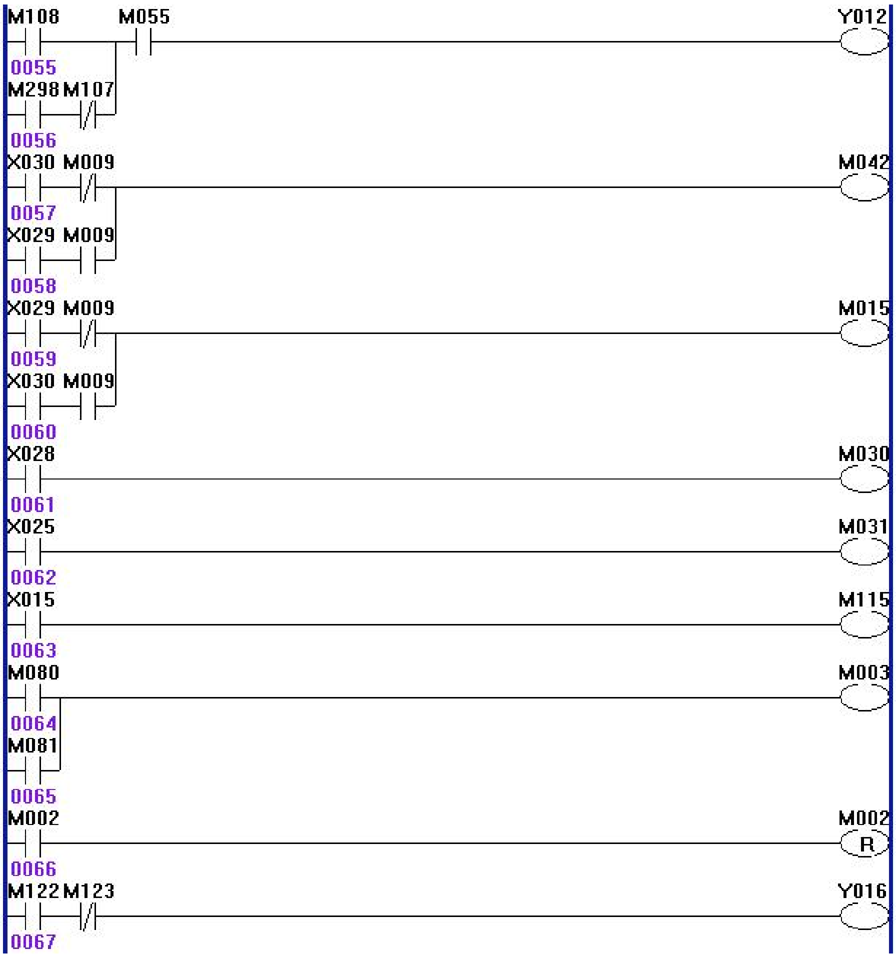
Note: Software version of cnc system is up to V6.52,which can display and edit ladder on cnc system.

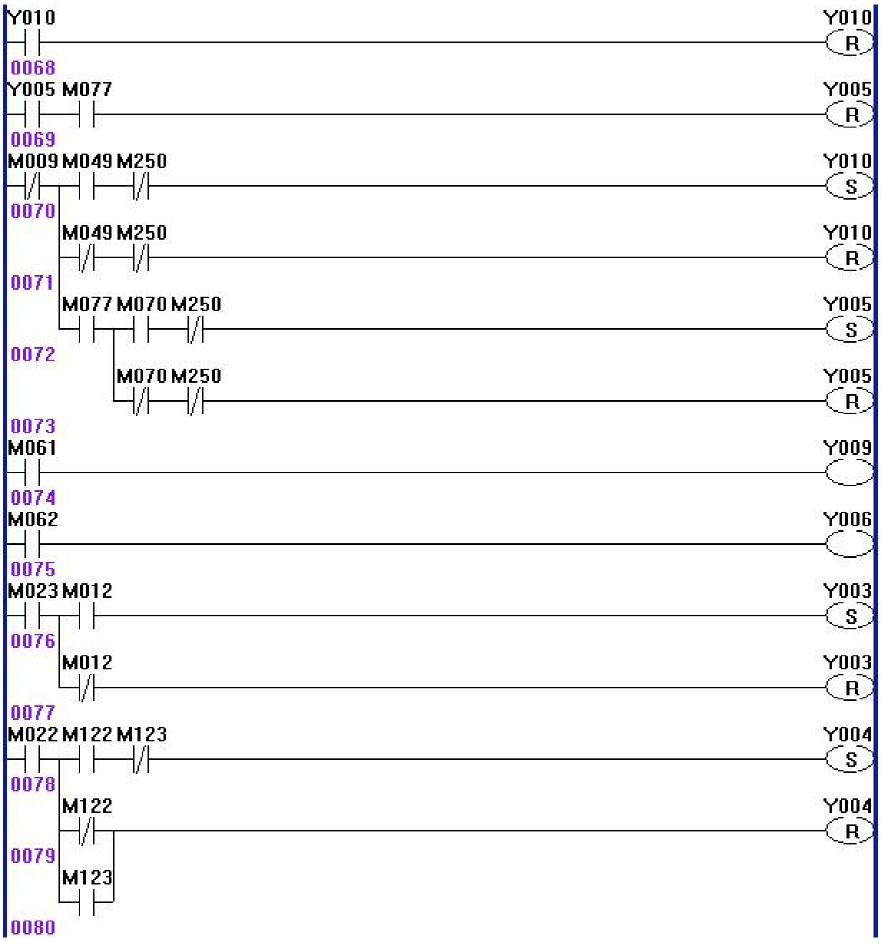
Appendix1: Ladder of SZGH-CNC990MDb(V5.12)

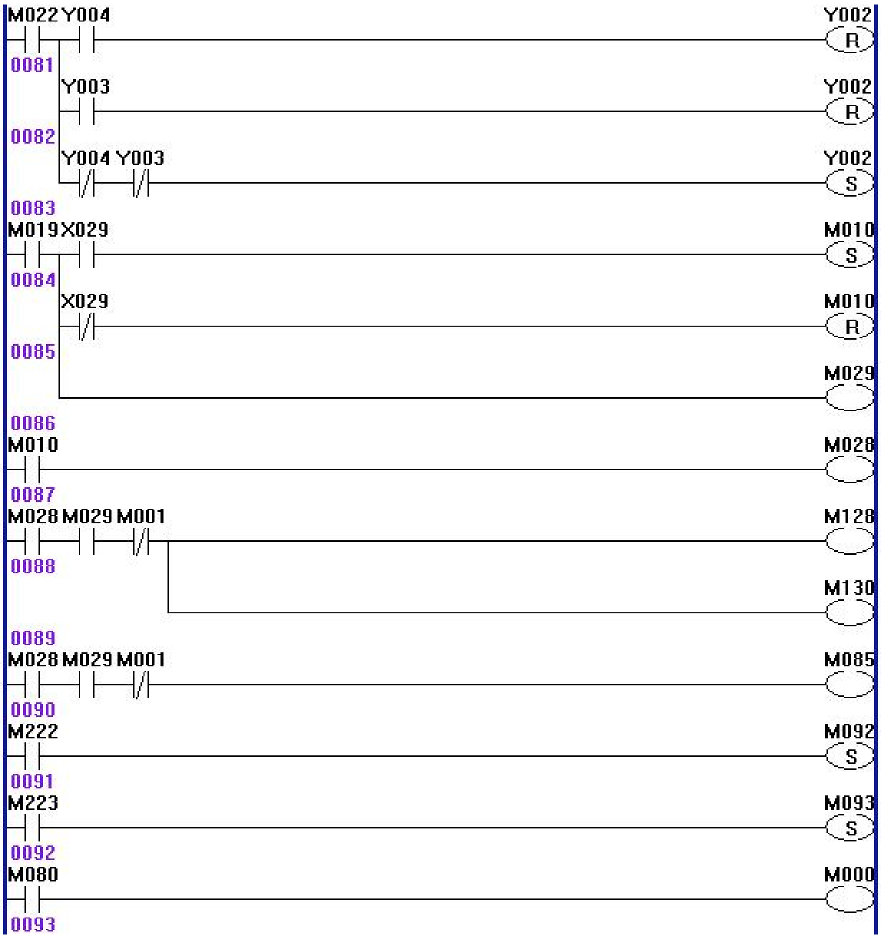


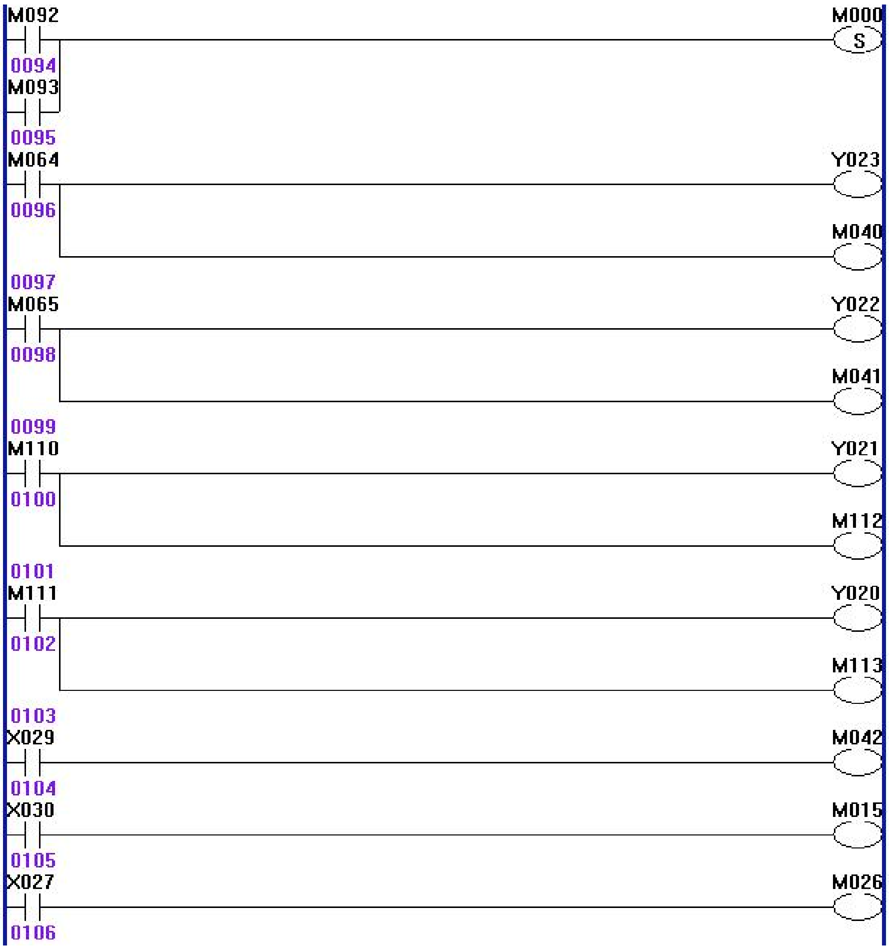

T013 T002
M051
0028
M051
T013
T002
K0300
0029
T013
T013
R
0030
M122 M004
M053
R
0031
M123
M054
R
0032
M006
M048
R
0033
M053 M054
M055
0034
M048
Y011
0035
M053
Y014
0036
M054
Y013
0037
M051
Y008
0038
M050
Y007
0039
M056
Y005
0040


M057
Y006
0041
M058
Y015
0042
M059
Y000
0043
M060
Y003
0044
M063
Y001
0045
M052
Y002
0046
M105
Y004
0047
M053
M107
S
0048
M054
0049
M055 M107
T000
K0000
0050
M055 M107 T000
M108
S
0051
M107
R
0052
M108
T003
K0150
0053
T003
M108
R
0054

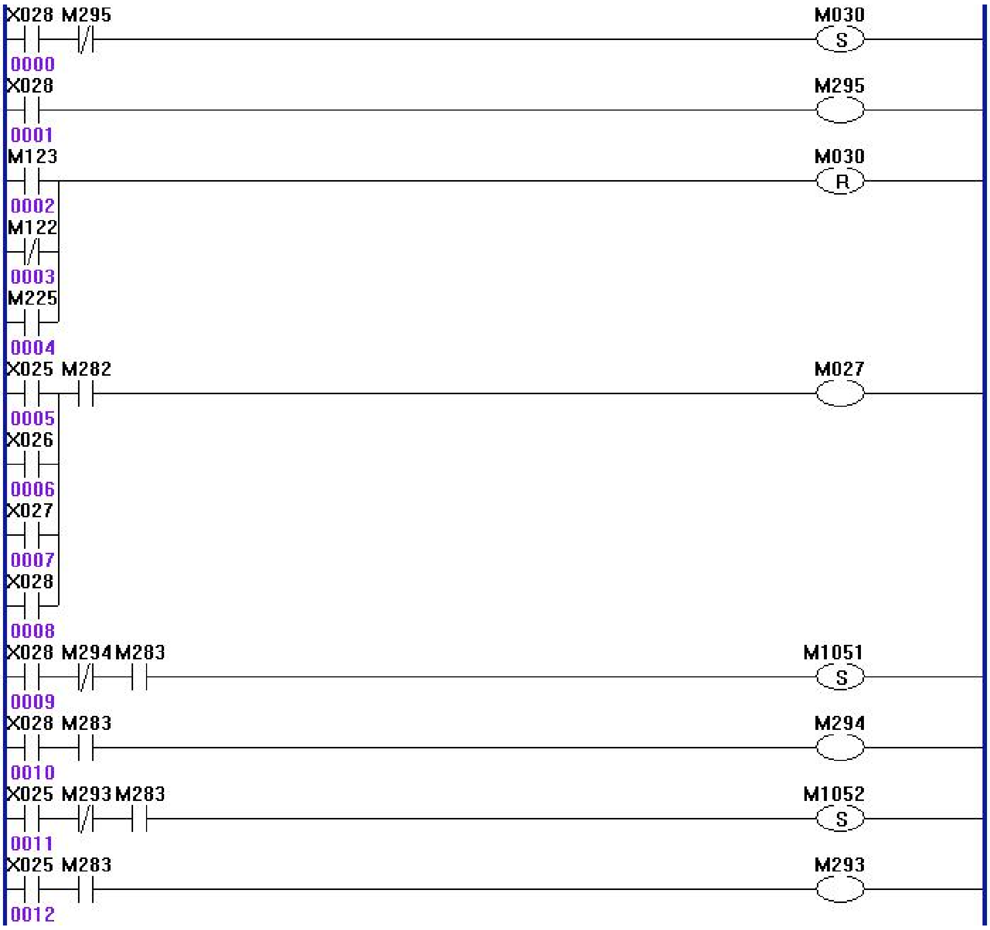

M108
M055
Y012
0055
M298
M107
0056
X030
M009
M042
0057
X029
M009
0058
X029
M009
M015
0059
X030
M009
0060
X028
M030
0061
X025
M031
0062
X015
M115
0063
M080
M003
0064
M081
0065
M002
M002
R
0066
M122
M123
Y016
0067

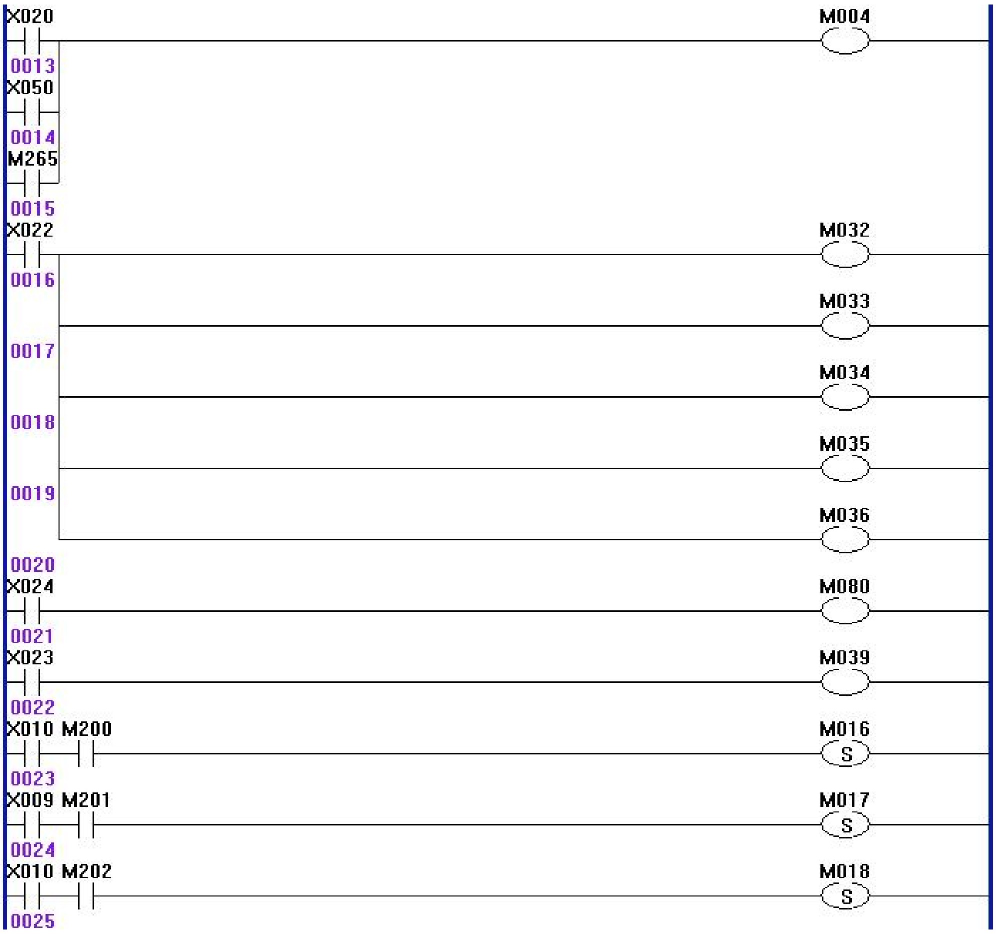

Y010
Y010
R
0068
Y005
M077
Y005
R
0069
M009
M049
M250
Y010
S
0070
M049
M250
Y010
R
0071
M077
M070
M250
Y005
S
0072
M070
M250
Y005
R
0073
M061
Y009
0074
M062
Y006
0075
M023
M012
Y003
S
0076
M012
Y003
R
0077
M022
M122
M123
Y004
S
0078
M122
Y004
R
0079
M123
0080

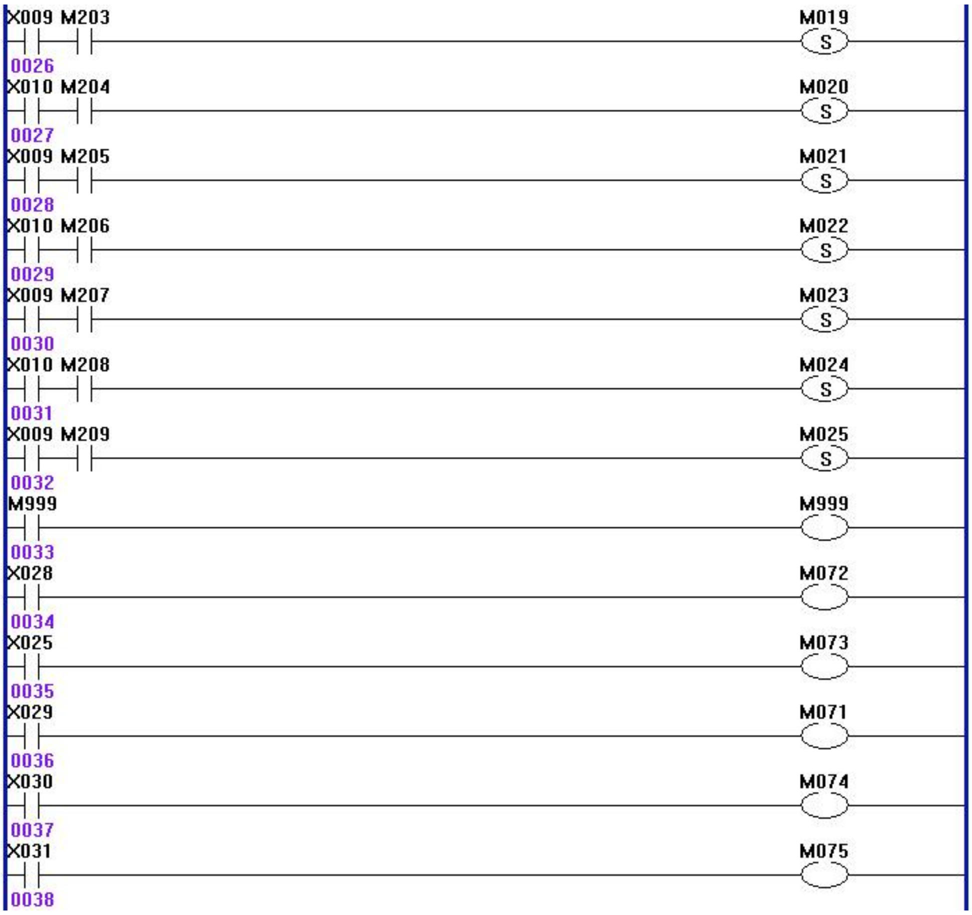

M022 Y004
Y002 R
0081
Y003
Y002 R
0082
Y004 Y003
Y002 S
0083
M019 X029
M010 S
0084
X029
M010 R
0085
M029
0086
M010
M028
0087
M028 M029 M001
M128
0088
M130
0089
M028 M029 M001
M085
0090
M222
M092 S
0091
M223
M093 S
0092
M080
M000
0093

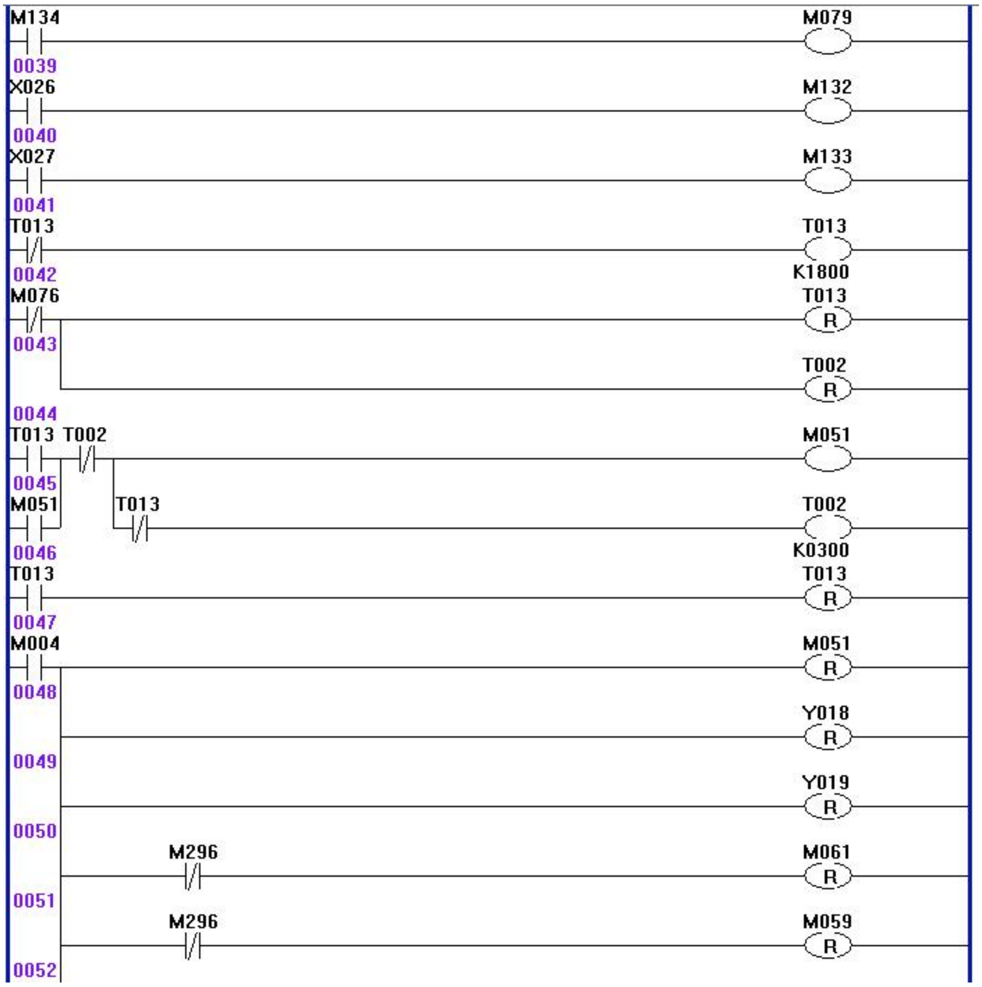

M092
M000 S
0094
M093
0095
M064
Y023
0096
M040
0097
M065
Y022
0098
M041
0099
M110
Y021
0100
M112
0101
M111
Y020
0102
M113
0103
X029
M042
0104
X030
M015
0105
X027
M026
0106

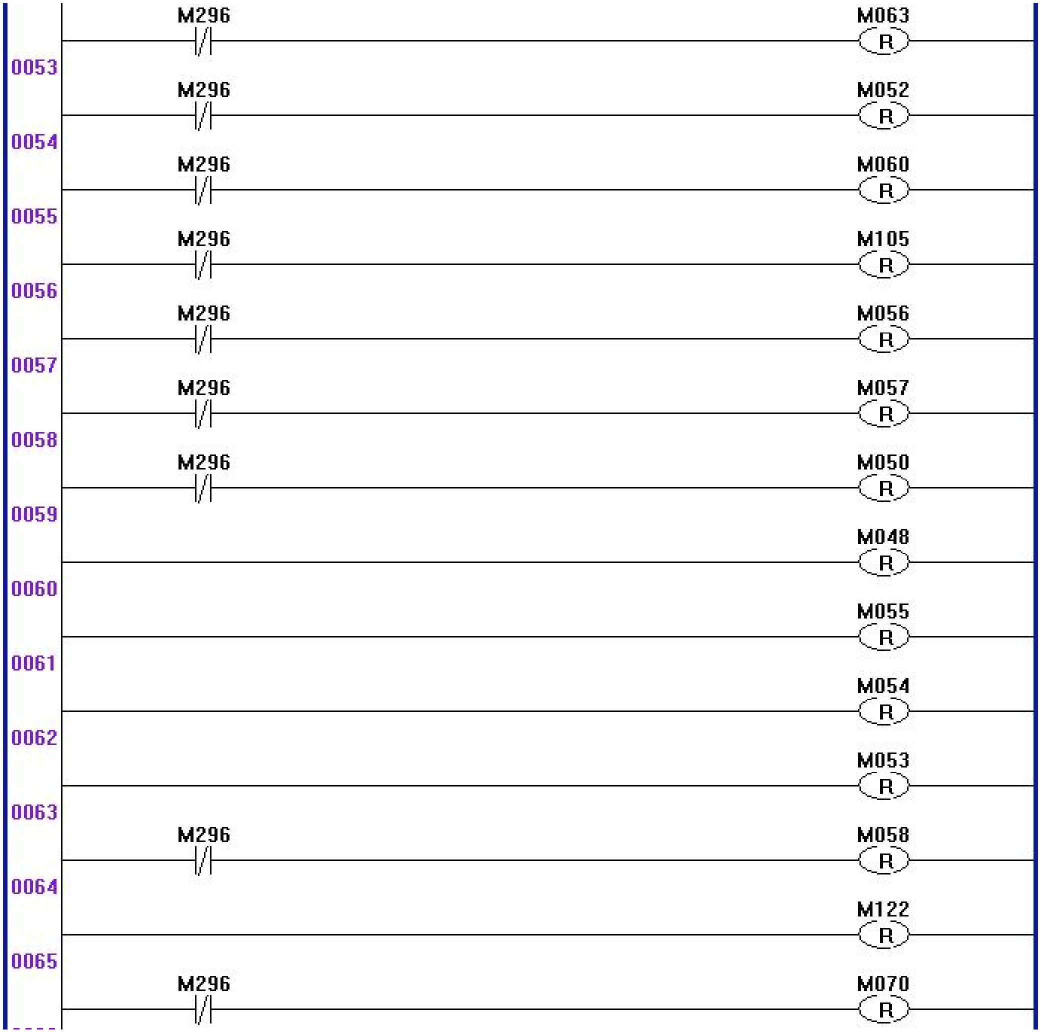
Appendix2: Ladder of SZGH-CNC1000MDb(c)(V6.51)

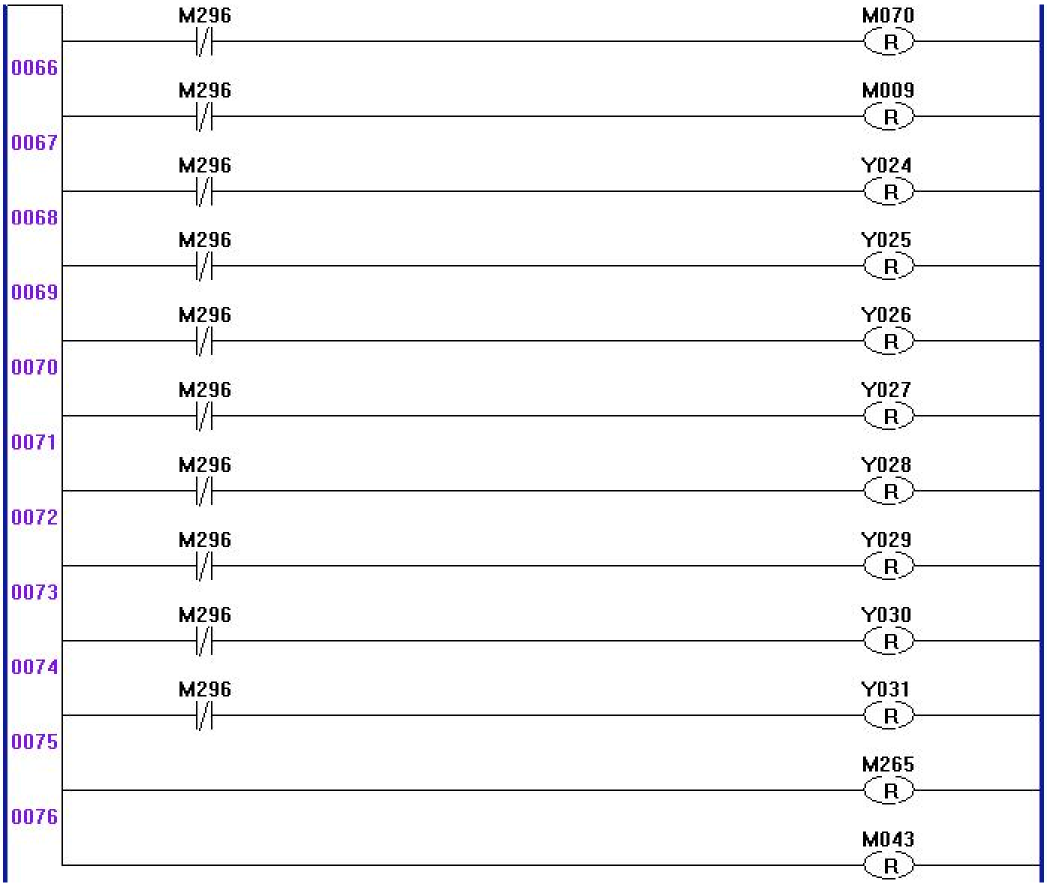


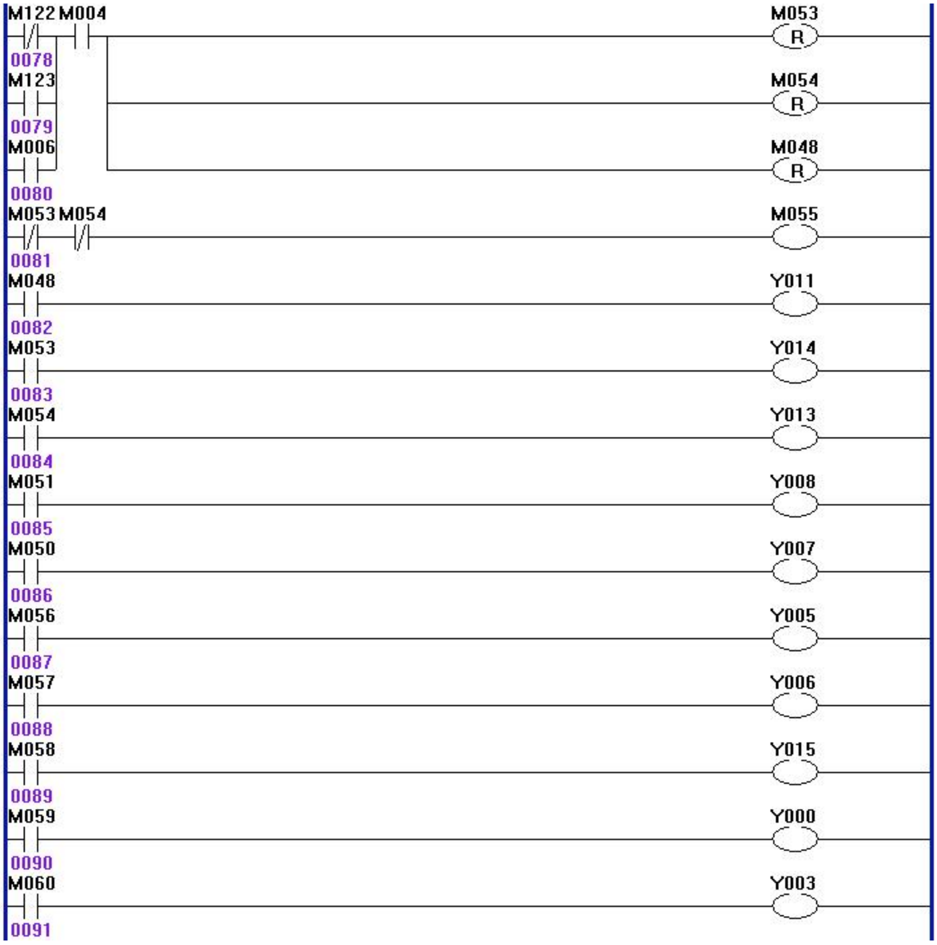


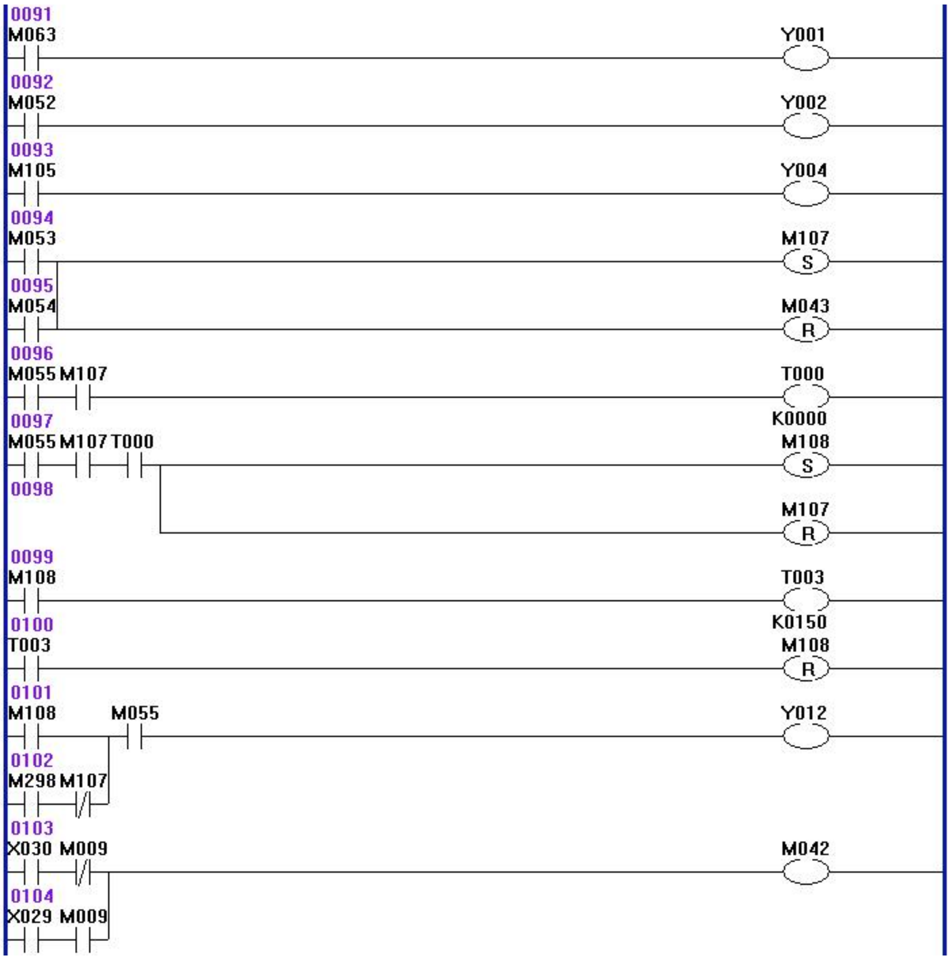

X009 M203
M019
S
0026
X010 M204
M020
S
0027
X009 M205
M021
S
0028
X010 M206
M022
S
0029
X009 M207
M023
S
0030
X010 M208
M024
S
0031
X009 M209
M025
S
0032
M999
M999
0033
X028
M072
0034
X025
M073
0035
X029
M071
0036
X030
M074
0037
X031
M075
0038

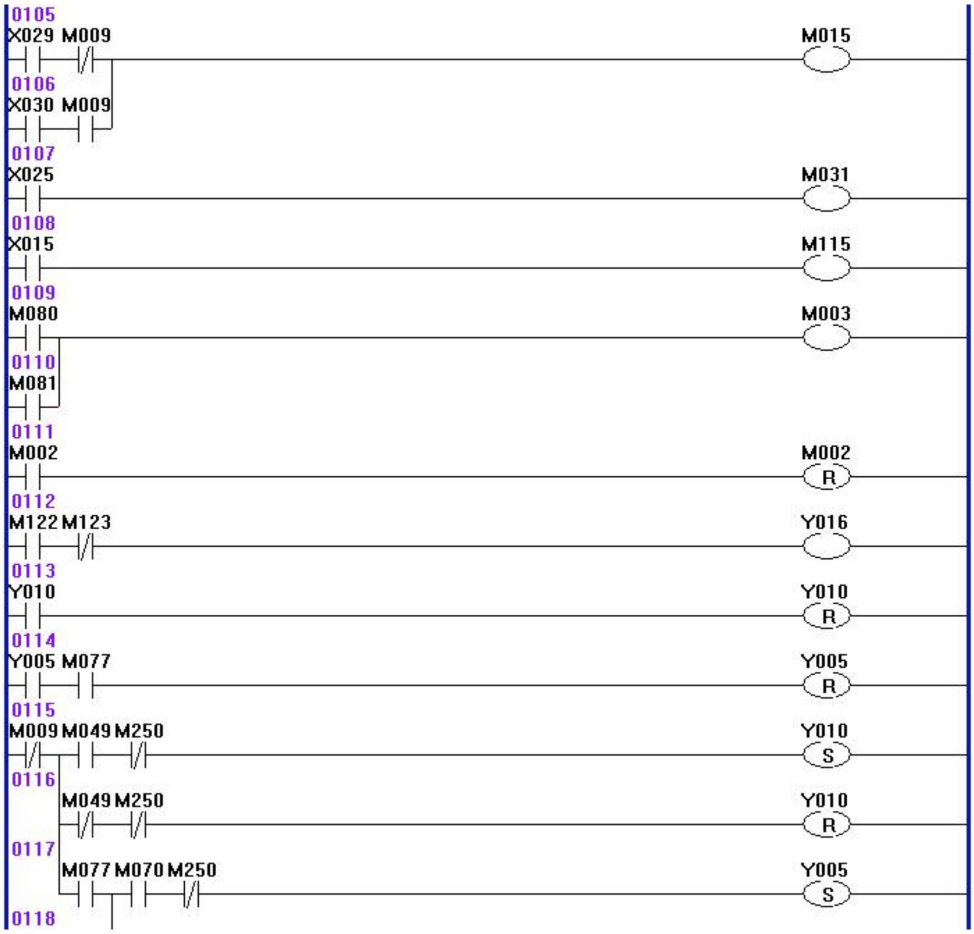

M134
M079
0039
X026
M132
0040
X027
M133
0041
T013
T013
K1800
0042
M076
T013
R
0043
T002
R
0044
T013 T002
M051
0045
M051
T013
T002
K0300
0046
T013
T013
R
0047
M004
M051
R
0048
Y018
R
0049
Y019
R
0050
M296
M061
R
0051
M296
M059
R
0052

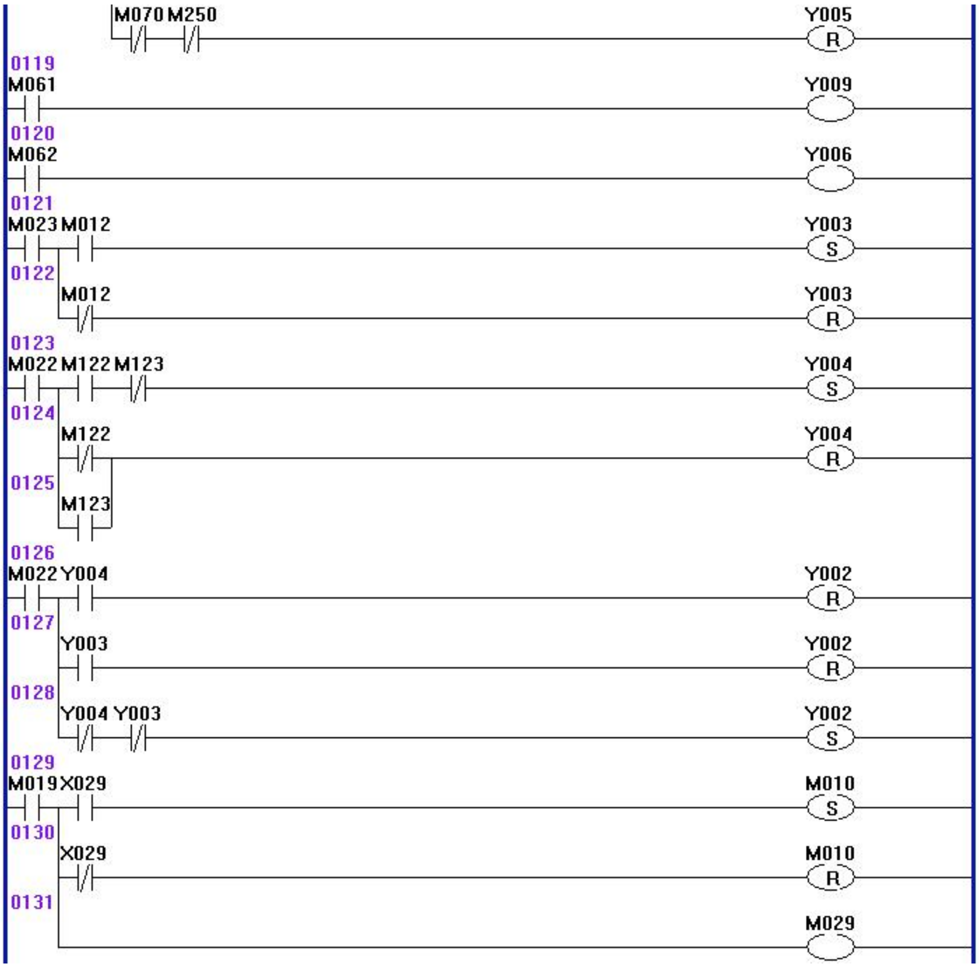

M296
M063
R
0053
M296
M052
R
0054
M296
M060
R
0055
M296
M105
R
0056
M296
M056
R
0057
M296
M057
R
0058
M296
M050
R
0059
M048
R
0060
M055
R
0061
M054
R
0062
M053
R
0063
M296
M058
R
0064
M122
R
0065
M296
M070
R

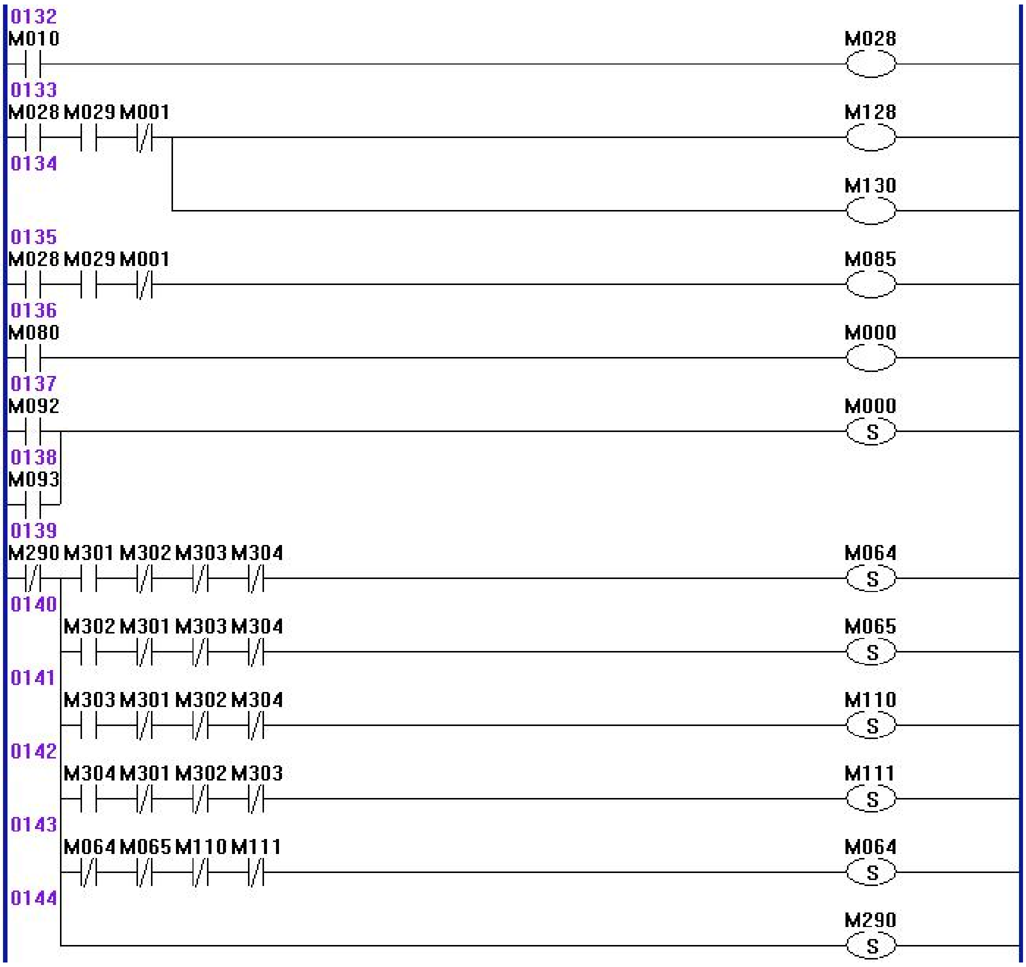

M296
M070
R
0066
M296
M009
R
0067
M296
Y024
R
0068
M296
Y025
R
0069
M296
Y026
R
0070
M296
Y027
R
0071
M296
Y028
R
0072
M296
Y029
R
0073
M296
Y030
R
0074
M296
Y031
R
0075
M265
R
0076
M043
R

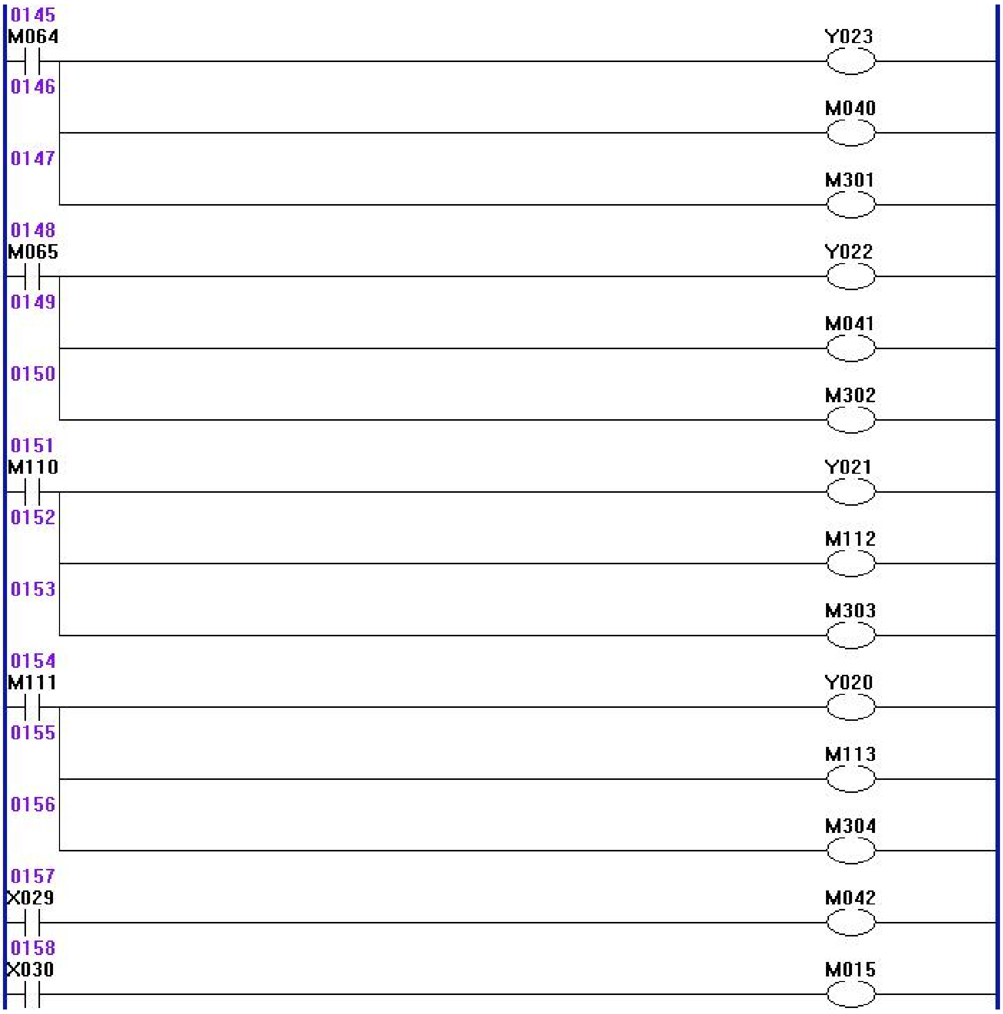

M122 M004
M053 R
0078
M123
M054 R
0079
M006
M048 R
0080
M053 M054
M055
0081
M048
Y011
0082
M053
Y014
0083
M054
Y013
0084
M051
Y008
0085
M050
Y007
0086
M056
Y005
0087
M057
Y006
0088
M058
Y015
0089
M059
Y000
0090
M060
Y003
0091

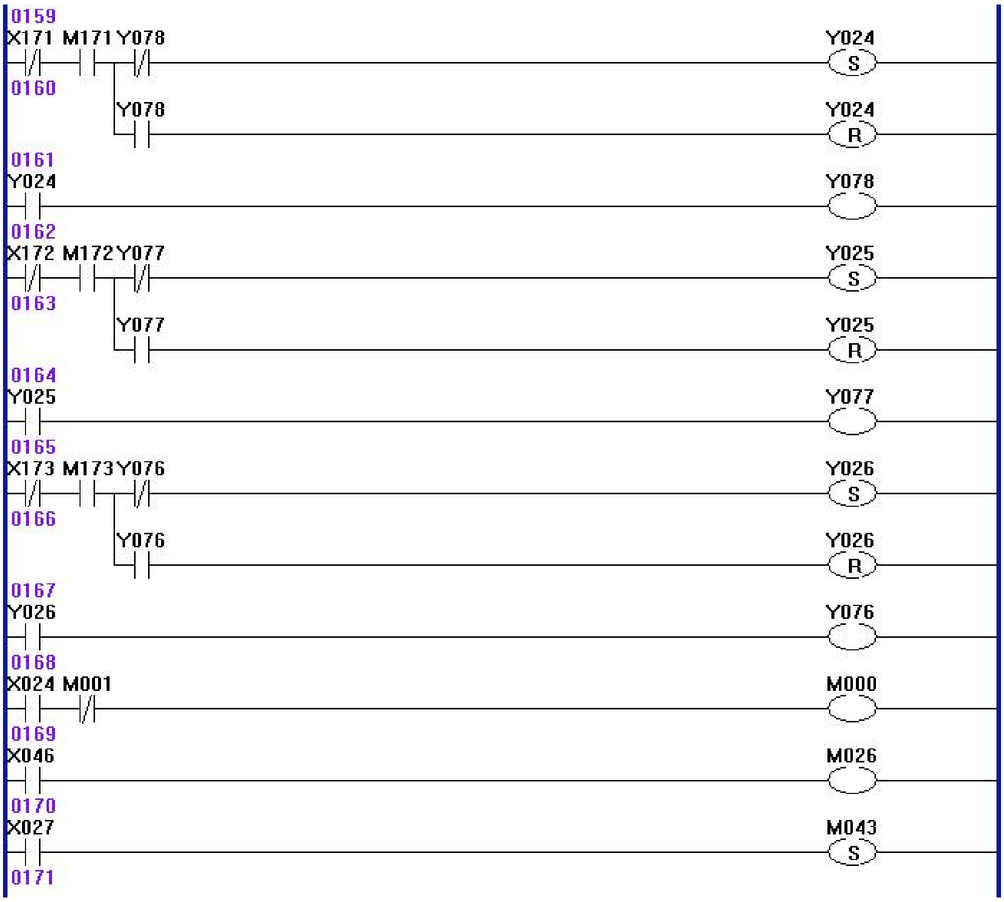

0091
M063
Y001
0092
M052
Y002
0093
M105
Y004
0094
M053
M107 S
0095
M054
M043 R
0096
M055 M107
T000
K0000
0097
M055 M107 T000
M108 S
0098
M107 R
0099
M108
T003
K0150
0100
T003
M108 R
0101
M108
M055
Y012
0102
M298 M107
0103
X030 M009
M042
0104
X029 M009


0105
X029
M009
M015
0106
X030
M009
0107
X025
M031
0108
X015
M115
0109
M080
M003
0110
M081
0111
M002
M002
R
0112
M122
M123
Y016
0113
Y010
Y010
R
0114
Y005
M077
Y005
R
0115
M009
M049
M250
Y010
S
0116
M049
M250
Y010
R
0117
M077
M070
M250
Y005
S
0118

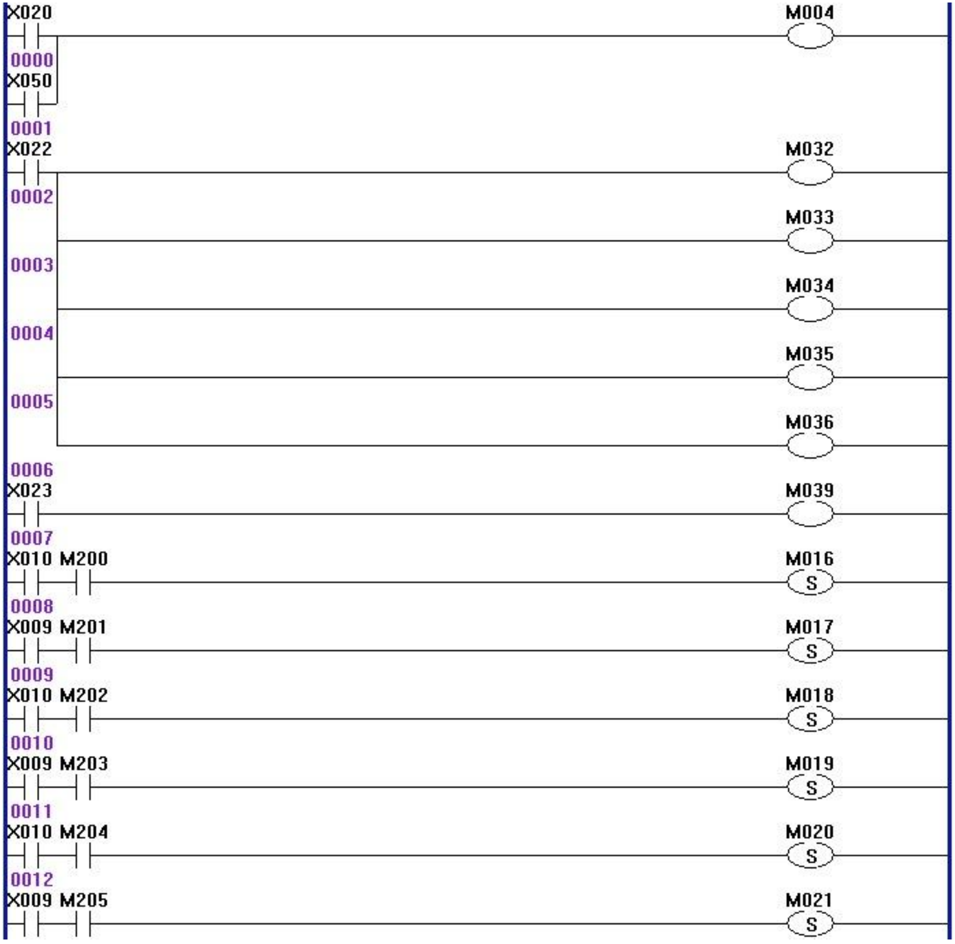

M070
M250
Y005
R
0119
M061
Y009
0120
M062
Y006
0121
M023
M012
Y003
S
0122
M012
Y003
R
0123
M022
M122
M123
Y004
S
0124
M122
Y004
R
0125
M123
0126
M022
Y004
Y002
R
0127
Y003
Y002
R
0128
Y004
Y003
Y002
S
0129
M019
X029
M010
S
0130
X029
M010
R
0131
M029

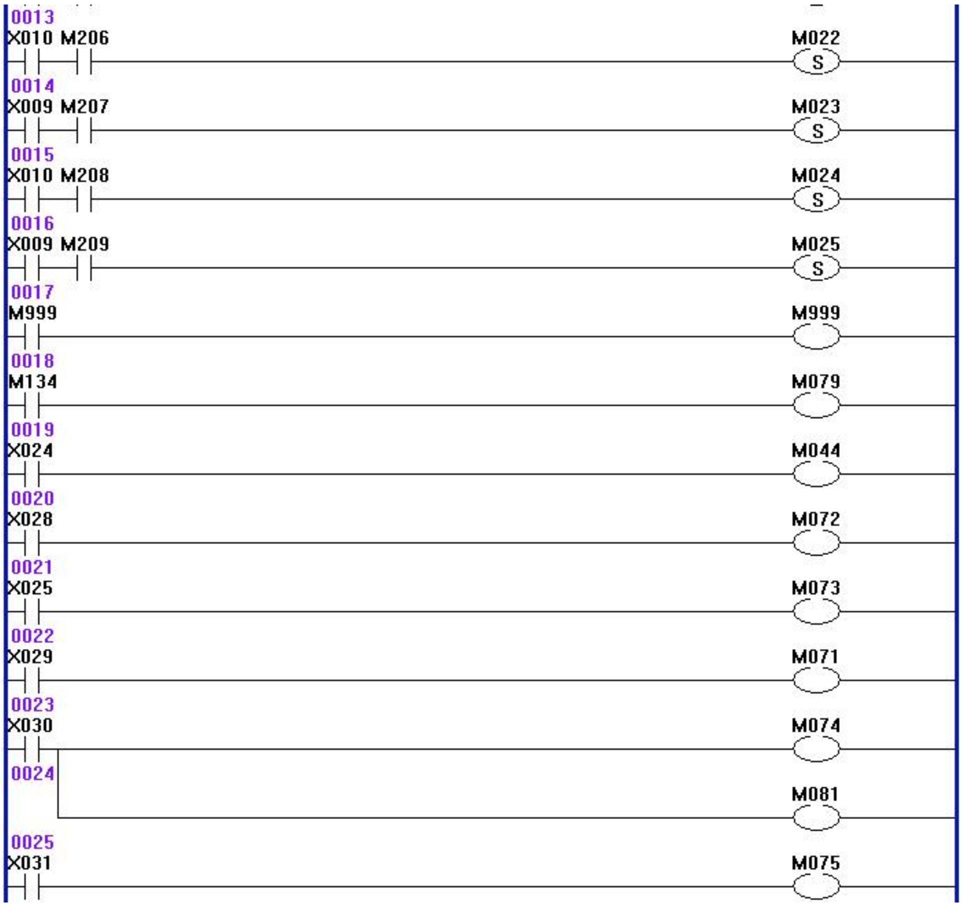

0132
M010
M028
0133
M028 M029 M001
M128
0134
M130
0135
M028 M029 M001
M085
0136
M080
M000
0137
M092
M000
S
0138
M093
0139
M290 M301 M302 M303 M304
M064
S
0140
M302 M301 M303 M304
M065
S
0141
M303 M301 M302 M304
M110
S
0142
M304 M301 M302 M303
M111
S
0143
M064 M065 M110 M111
M064
S
0144
M290
S

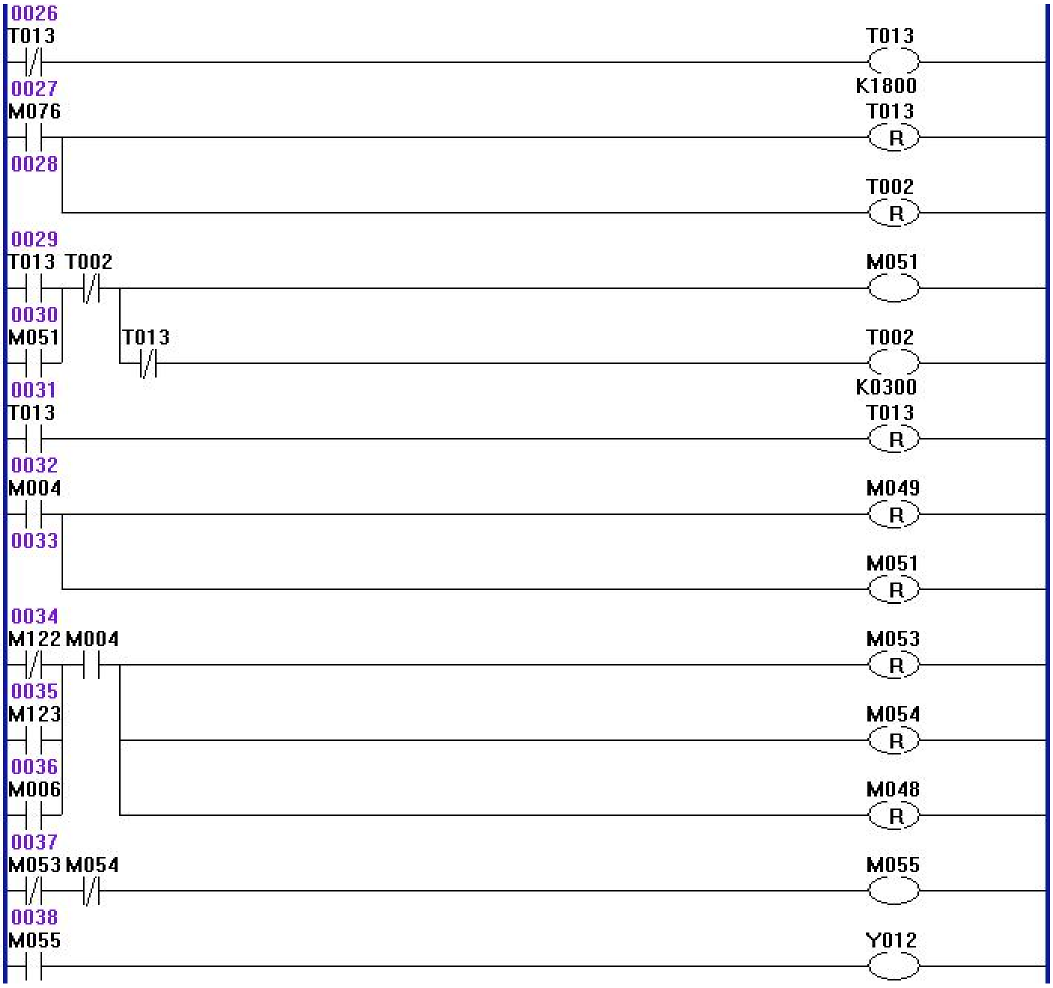

0145
M064
Y023
0146
M040
0147
M301
0148
M065
Y022
0149
M041
0150
M302
0151
M110
Y021
0152
M112
0153
M303
0154
M111
Y020
0155
M113
0156
M304
0157
X029
M042
0158
X030
M015

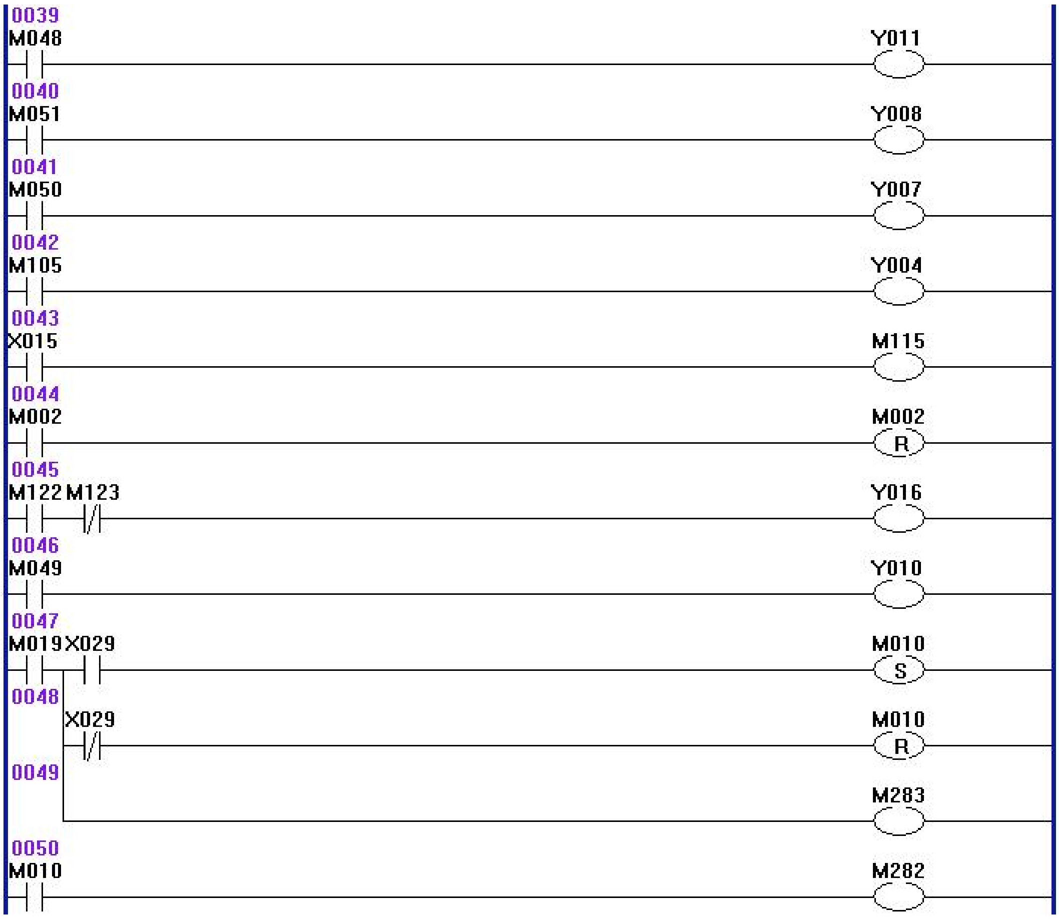

0159
X171 M171 Y078
Y024
S
0160
Y078
Y024
R
0161
Y024
Y078
0162
X172 M172 Y077
Y025
S
0163
Y077
Y025
R
0164
Y025
Y077
0165
X173 M173 Y076
Y026
S
0166
Y076
Y026
R
0167
Y026
Y076
0168
X024 M001
M000
0169
X046
M026
0170
X027
M043
S
0171

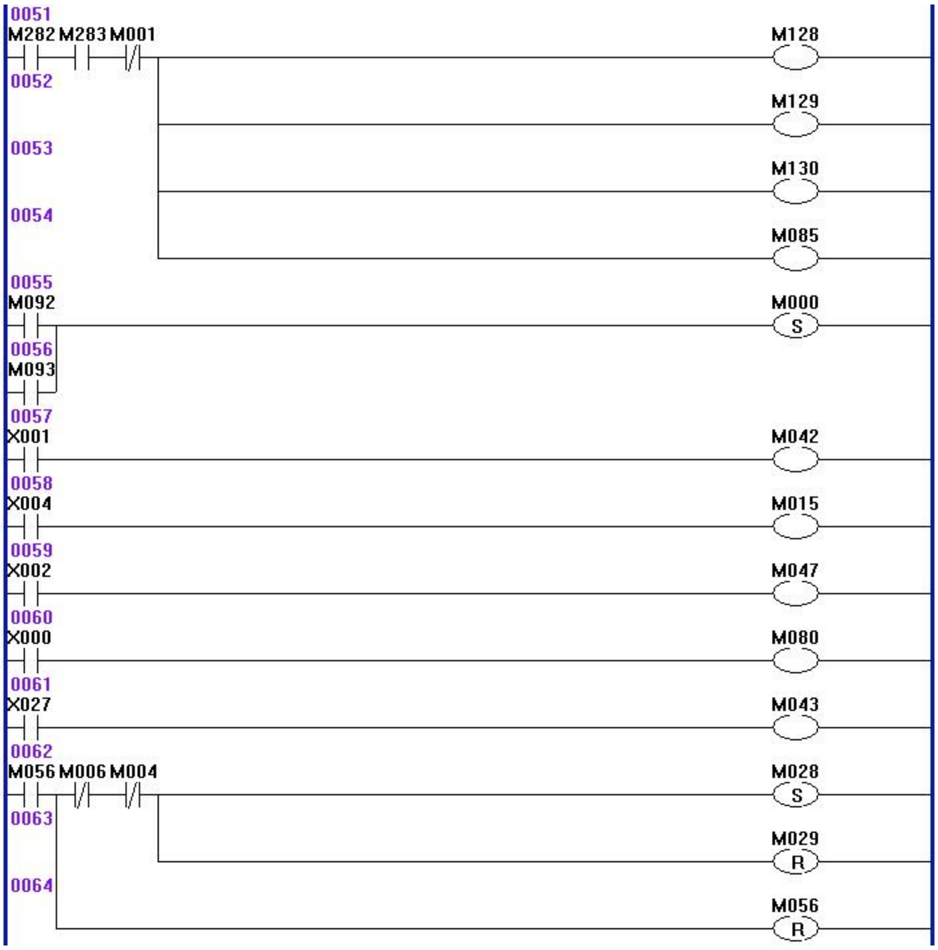
Appendix3: Ladder of SZGH-CNC1000MDcb(V6.52)

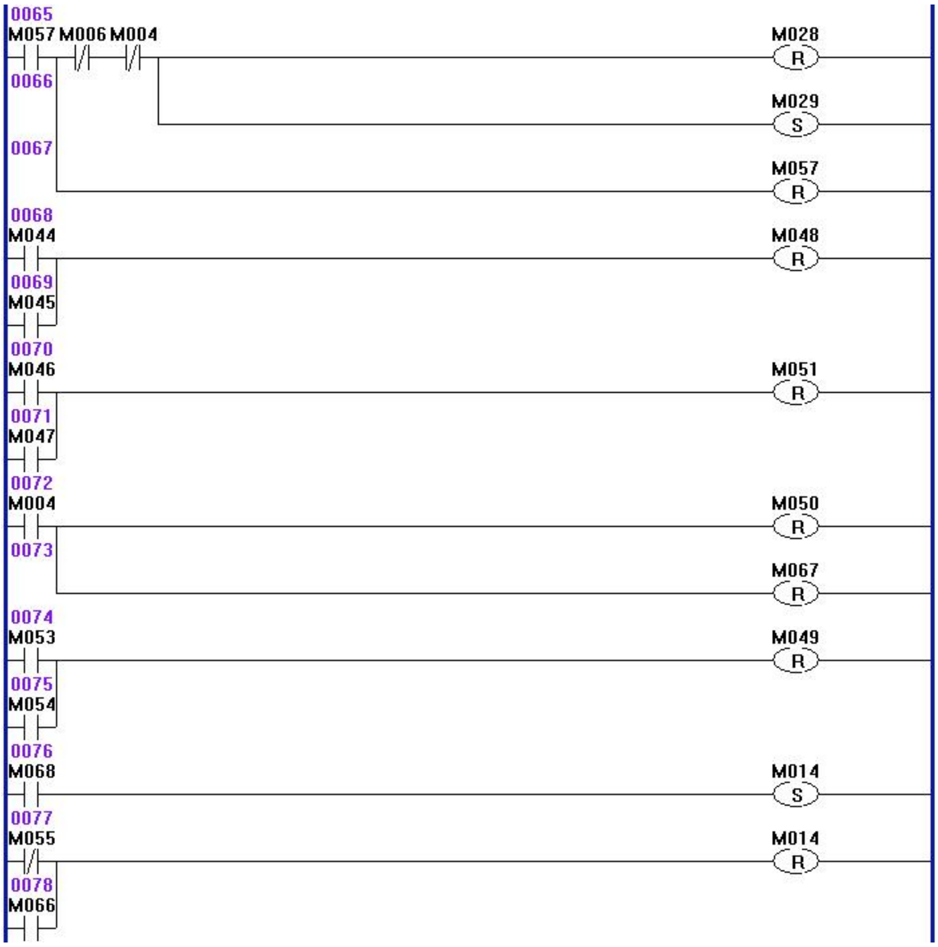


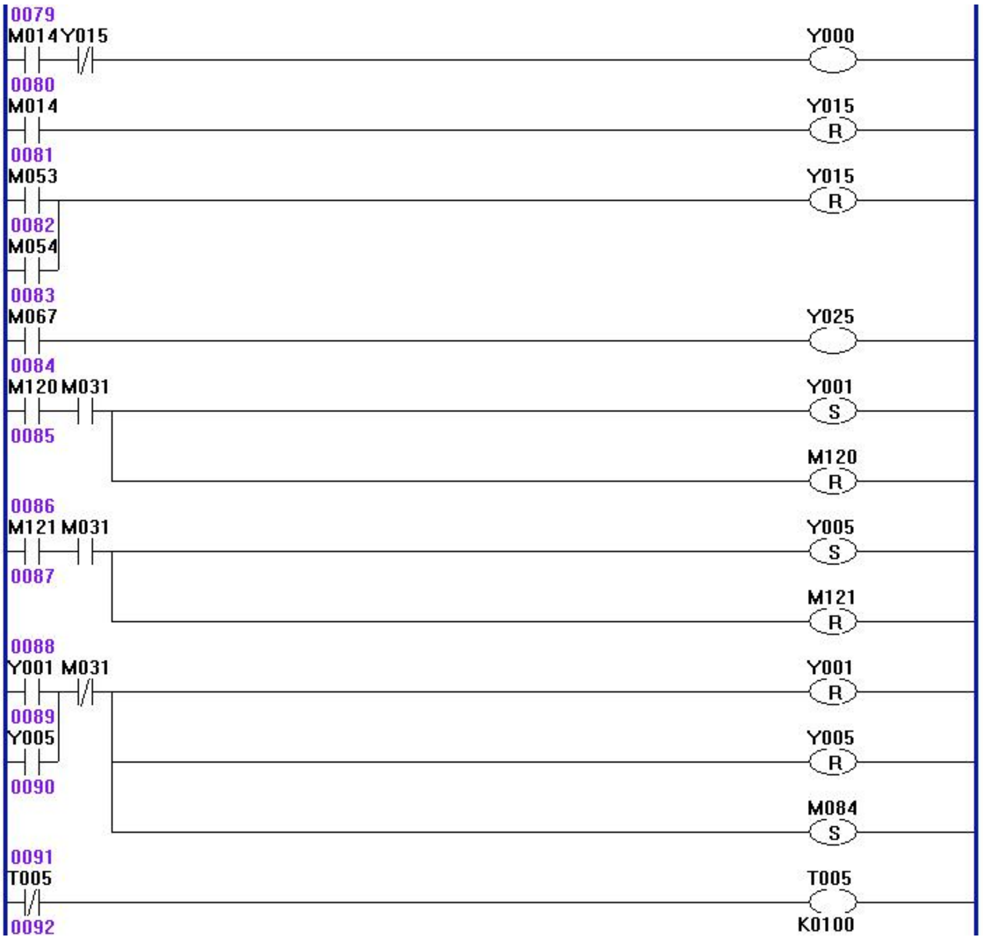


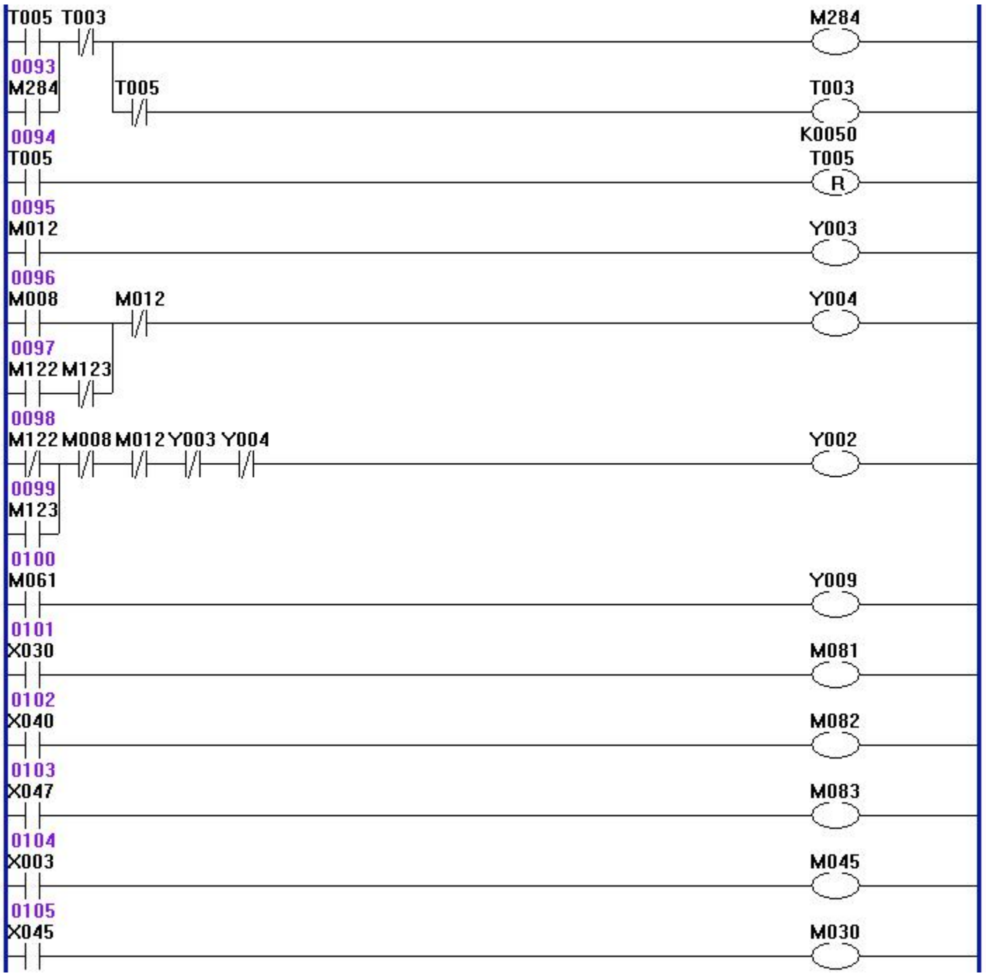

0026
T013
T013
0027
K1800
M076
T013
R
0028
T002
R
0029
T013 T002
M051
0030
M051
T013
T002
0031
K0300
T013
T013
R
0032
M004
M049
R
0033
M051
R
0034
M122 M004
M053
R
0035
M123
M054
R
0036
M006
M048
R
0037
M053 M054
M055
0038
M055
Y012

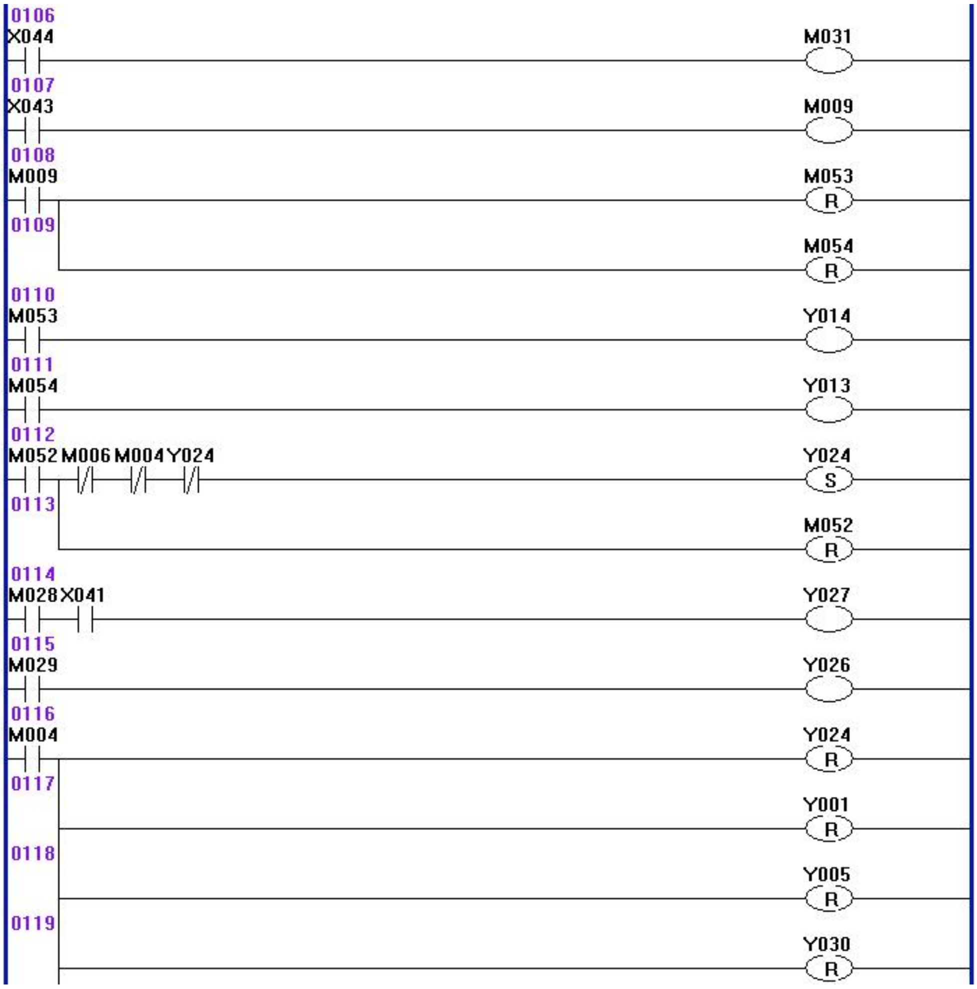

0039
M048
Y011
0040
M051
Y008
0041
M050
Y007
0042
M105
Y004
0043
X015
M115
0044
M002
M002
R
0045
M122 M123
Y016
0046
M049
Y010
0047
M019 X029
M010
S
0048
X029
M010
R
0049
M283
0050
M010
M282

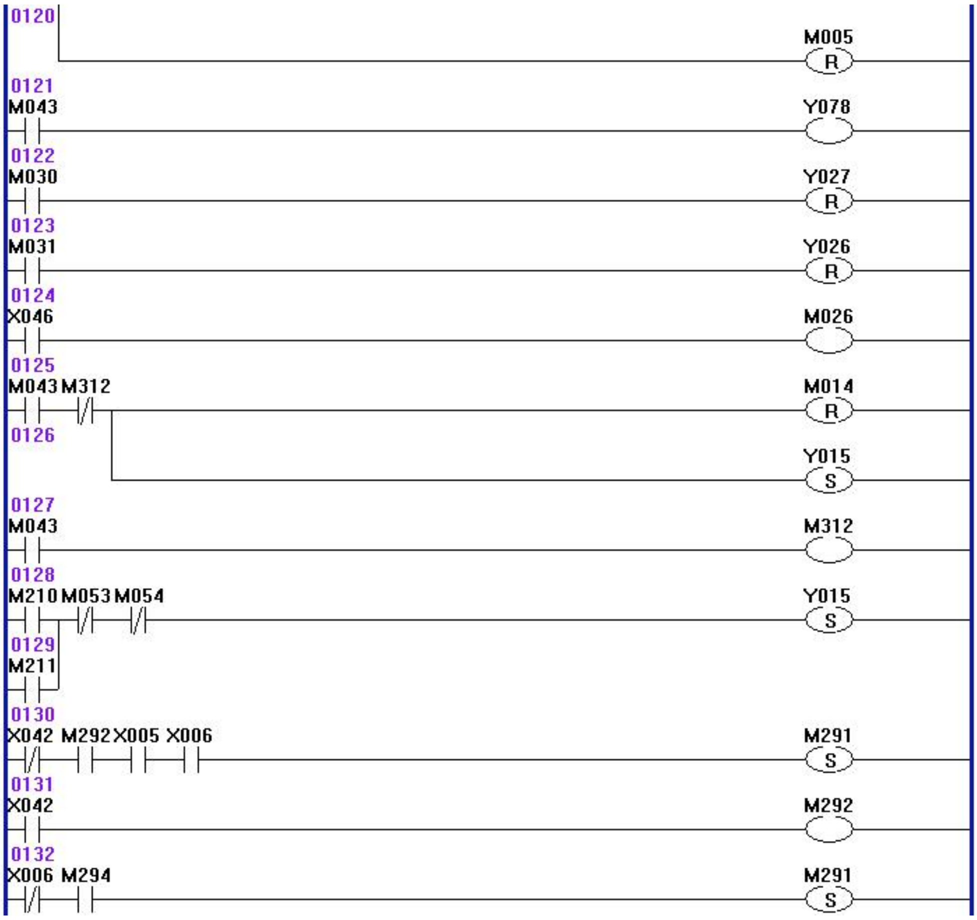

0051
M282 M283 M001
M128
0052
M129
0053
M130
0054
M085
0055
M092
M000
S
0056
M093
0057
X001
M042
0058
X004
M015
0059
X002
M047
0060
X000
M080
0061
X027
M043
0062
M056 M006 M004
M028
S
0063
M029
R
0064
M056
R

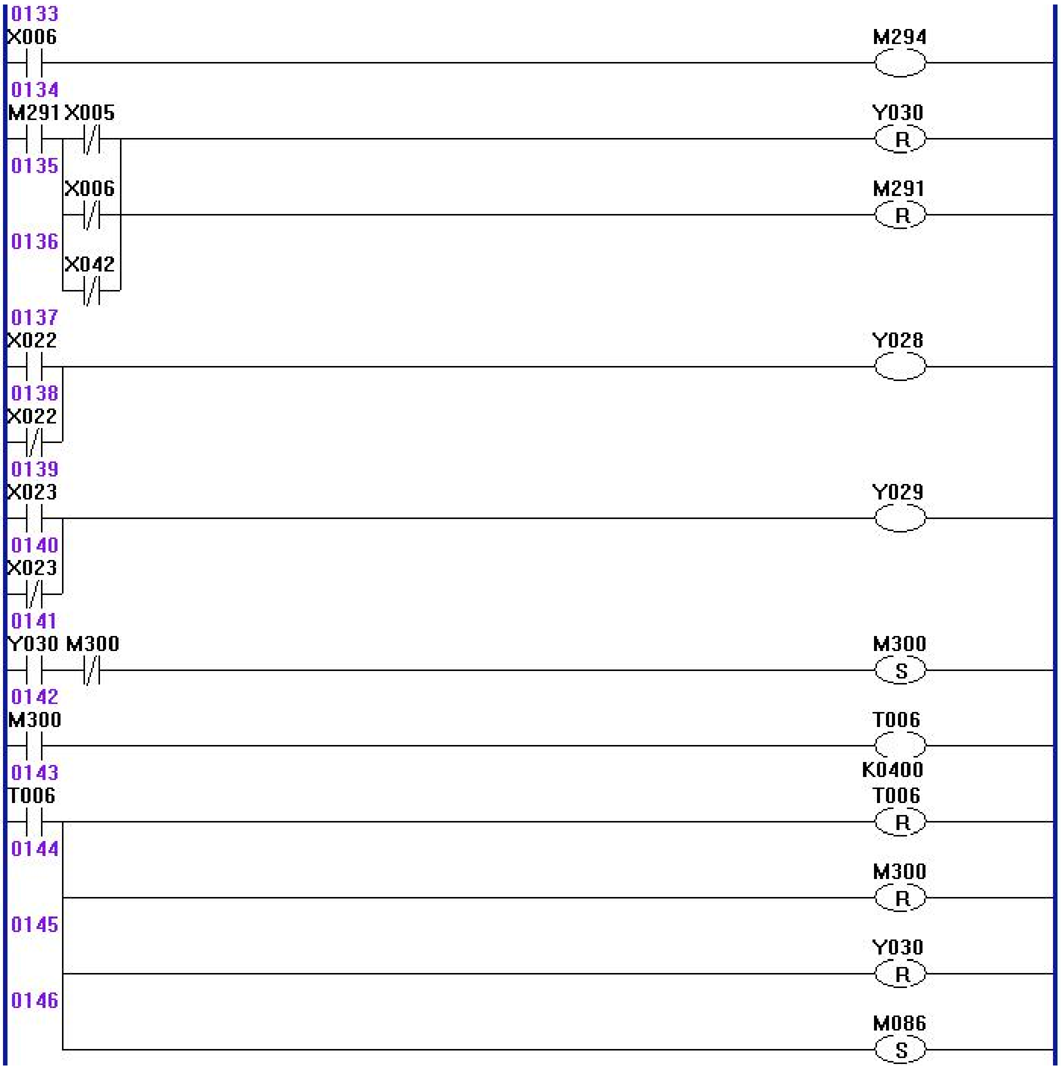

0065
M057 M006 M004
M028
R
0066
M029
S
0067
M057
R
0068
M044
M048
R
0069
M045
0070
M046
M051
R
0071
M047
0072
M004
M050
R
0073
M067
R
0074
M053
M049
R
0075
M054
0076
M068
M014
S
0077
M055
M014
R
0078
M066

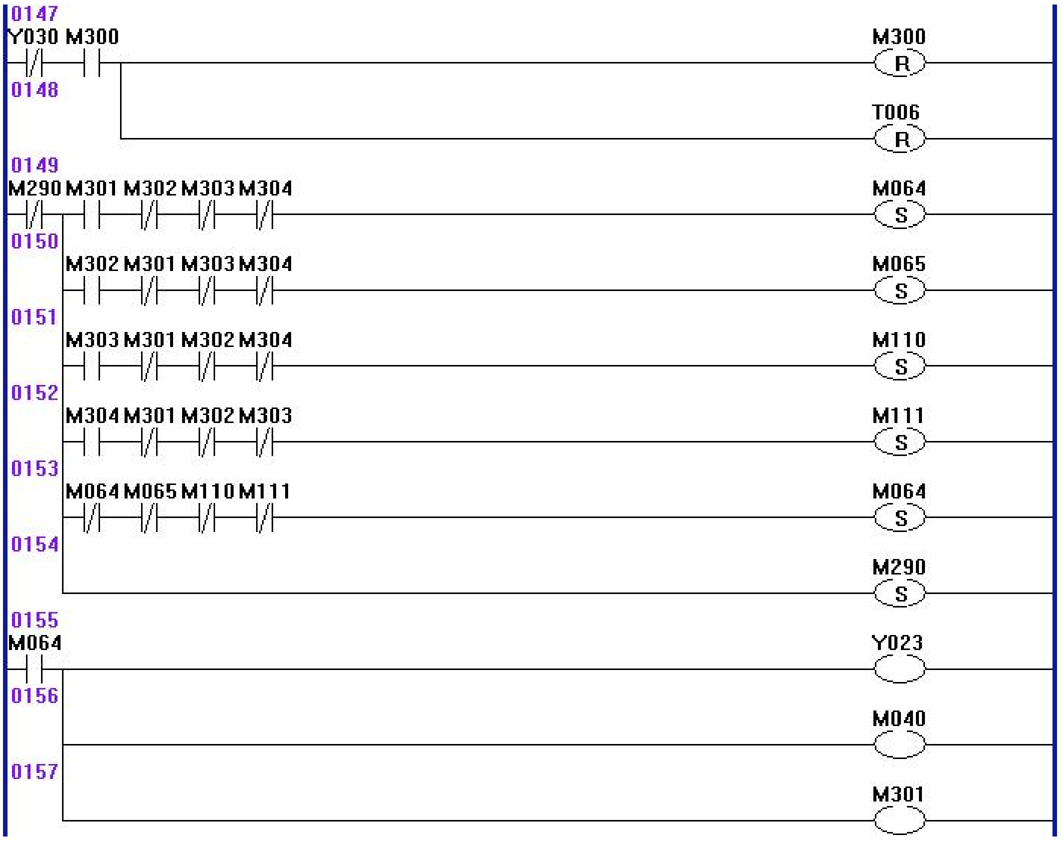

0079
M014 Y015
Y000
0080
M014
Y015
R
0081
M053
Y015
R
0082
M054
0083
M067
Y025
0084
M120 M031
Y001
S
0085
M120
R
0086
M121 M031
Y005
S
0087
M121
R
0088
Y001 M031
Y001
R
0089
Y005
Y005
R
0090
M084
S
0091
T005
T005
0092
K0100

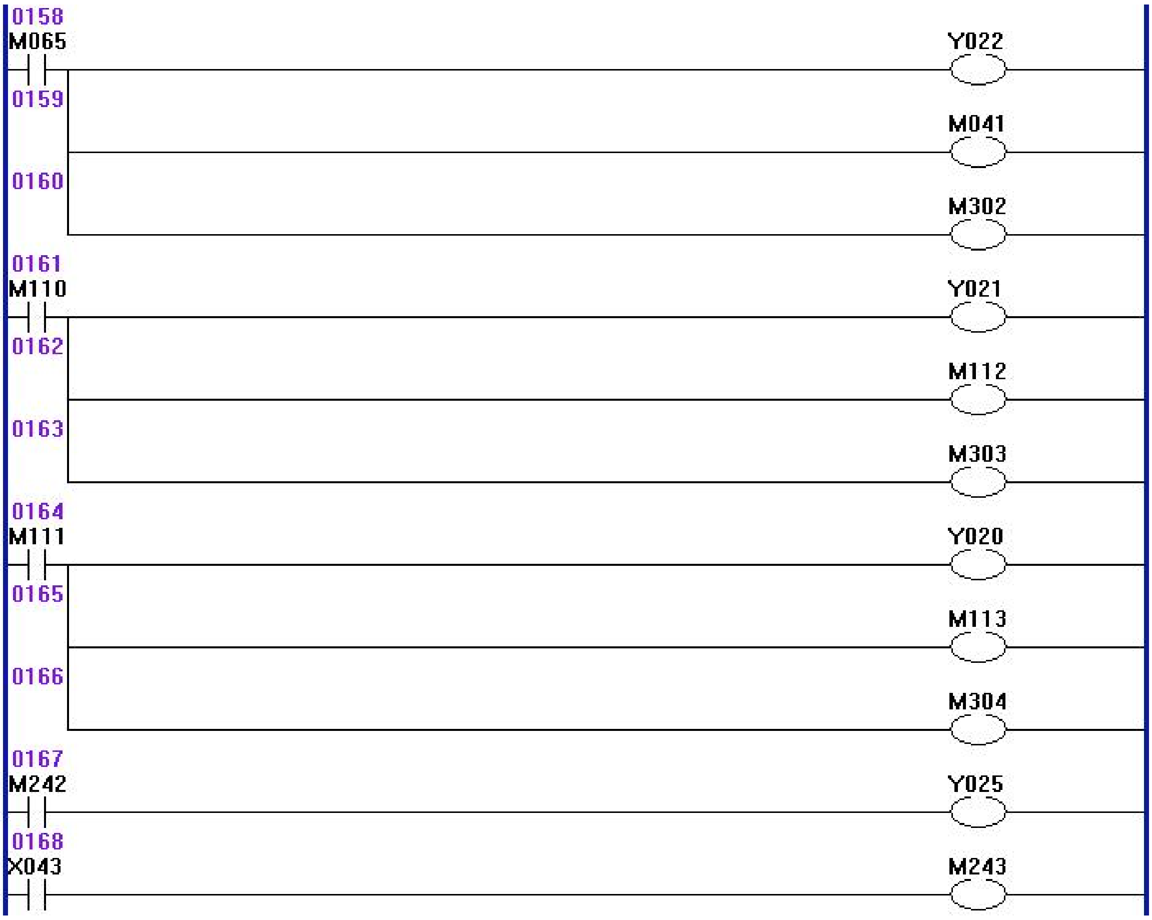

T005 T003
M284
0093
M284
T005
T003
K0050
0094
T005
T005
R
0095
M012
Y003
0096
M008
M012
Y004
0097
M122 M123
0098
M122 M008 M012 Y003 Y004
Y002
0099
M123
0100
M061
Y009
0101
X030
M081
0102
X040
M082
0103
X047
M083
0104
X003
M045
0105
X045
M030


0106
X044
M031
0107
X043
M009
0108
M009
M053
R
0109
M054
R
0110
M053
Y014
0111
M054
Y013
0112
M052 M006 M004 Y024
Y024
S
0113
M052
R
0114
M028 X041
Y027
0115
M029
Y026
0116
M004
Y024
R
0117
Y001
R
0118
Y005
R
0119
Y030
R


0120
M005
R
0121
M043
Y078
0122
M030
Y027
R
0123
M031
Y026
R
0124
X046
M026
0125
M043 M312
M014
R
0126
Y015
S
0127
M043
M312
0128
M210 M053 M054
Y015
S
0129
M211
0130
X042 M292 X005 X006
M291
S
0131
X042
M292
0132
X006 M294
M291
S


0133
X006
M294
0134
M291 X005
Y030
R
0135
X006
M291
R
0136
X042
0137
X022
Y028
0138
X022
0139
X023
Y029
0140
X023
0141
Y030 M300
M300
S
0142
M300
T006
K0400
0143
T006
T006
R
0144
M300
R
0145
Y030
R
0146
M086
S


0147
Y030 M300
M300
R
0148
T006
R
0149
M290 M301 M302 M303 M304
M064
S
0150
M302 M301 M303 M304
M065
S
0151
M303 M301 M302 M304
M110
S
0152
M304 M301 M302 M303
M111
S
0153
M064 M065 M110 M111
M064
S
0154
M290
S
0155
M064
Y023
0156
M040
0157
M301


0158
M065
Y022
0159
M041
0160
M302
0161
M110
Y021
0162
M112
0163
M303
0164
M111
Y020
0165
M113
0166
M304
0167
M242
Y025
0168
X043
M243