

User Manual

PLC of CNC Milling System

V3.0

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-Catalogue-

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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

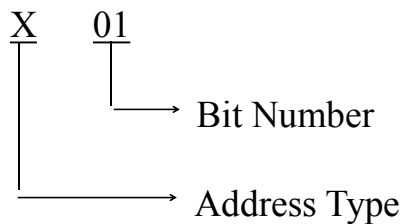
After finished well & restore into system, we could observe if the diagnostic state of every signal is consistent with the function requirement when executing CNC. Check the ladder by checking condition of each I/Os in Diagnosis interface.

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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| X00 T01 | X01 T02 | X02 T03 | X03 T04 | X04 T05 | X05 T06 | X06 T07 | X07 T08 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| X08 M34/A0 | X09 -L | X10 +L | X11 M36/Y0 | X12 X0 | X13 Z0 | X14 KRUN | X15 KHALT |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| X16 X20 | X17 Z20 | X18 KLEFT | X19 KRIGHT | X20 STOP | X21 TOK | X22 ALM | X23 ALM1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| X24 ALM2 | X25 M28 | X26 M24 | X27 M22 | X28 M18 | X29 M12 | X30 M14 | X31 M16 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| X32 HX/DS8 | X33 HY/DS4 | X34 HZ/DS2 | X35 HA/DS0 | X36 HX1/K8 | X37 HX10/K | X38 HX100/ | X39 HOFF/K |
| Output Point | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Y00 M61 | Y01 M63 | Y02 M65 | Y03 M67 | Y04 M69 | Y05 M71 | Y06 M73 | Y07 M59 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Y08 M32 | Y09 M79 | Y10 M10 | Y11 M08 | Y12 M05 | Y13 M04 | Y14 M03 | Y15 M75 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Y16 LRUN | Y17 INTH | Y18 +T | Y19 -T | Y20 S04 | Y21 S03 | Y22 S02 | Y23 S01 |

2.3.2 CNC1000 Series (total 56x32 I/Os)

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

| Output Point | | | | | | | |
|--------------|------|-----|-----|-----|-----|-----|-----|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Y00 | 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 |

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 1 st spindle (M03: turn on M53 ; M05: turn off M53) | Output |
| M54 | Spindle-CCW | M54 is valid that activate CCW rotation of 1 st 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 3 rd gear | Input |
| M113 | Detect of 4 th 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 | 2 nd -SP-CW | Valid that activate 2 nd spindle rotate with CW direction (code: M203: ON ; M205: OFF) | Output |
| M232 | 2 nd -SP-CCW | Valid that activate 2 nd 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 switch Auxiliary 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.

2.4.1 Auxiliary 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



Clear SP-JOG CW rotation



Clear SP-JOG CCW rotation

Lubricate JOG function realization

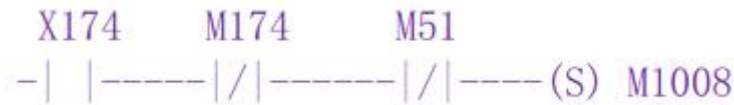


Turn on lubricate

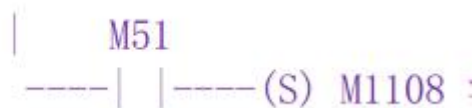


Turn off lubricate

Lubrication reciprocating key function realization



Turn on lubricate



Turn off lubricate

Remote run function realization



Remote stop function realization



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: 0~21,474,836,47.

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 is 0---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 $A \geq$ 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 $A \geq$ 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 $R103 = 0000000000000001$.

Control condition set 48,

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

When parameter $A \geq$ 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 60, 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;

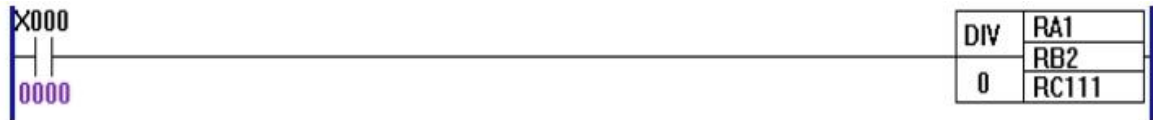
4 table 8-bit data, parameter A is constant and parameter B is address;

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 use the same marker; no jumping END1 and END2; no jumping out of subroutine; it could jump forward and backward.



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:

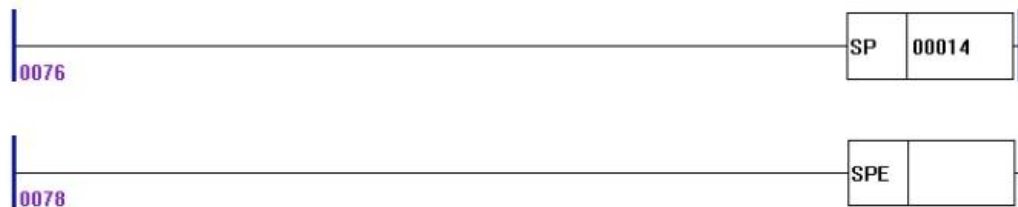
When X72 is effective, execute the subroutine which calling appoint subroutine number(eg. CALL 16) .

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.

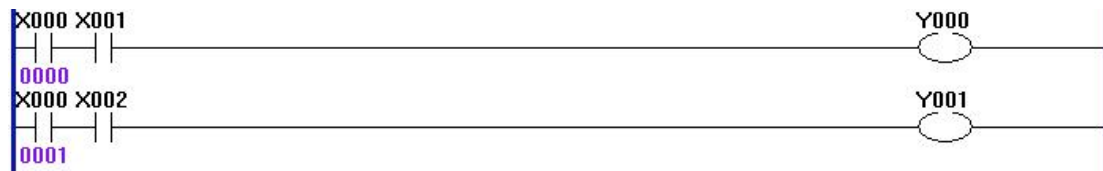
2.7.1 EXECUTING SEQUENTIAL PROGRAM

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

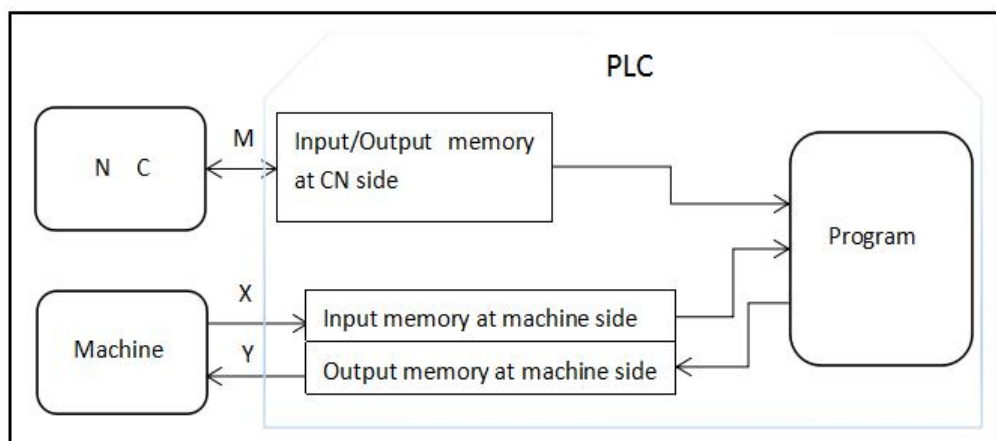
Cycle execution of sequential program is defined that PLC executes ladder from its home to end, and again from its home to end after the run is completed.

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.



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

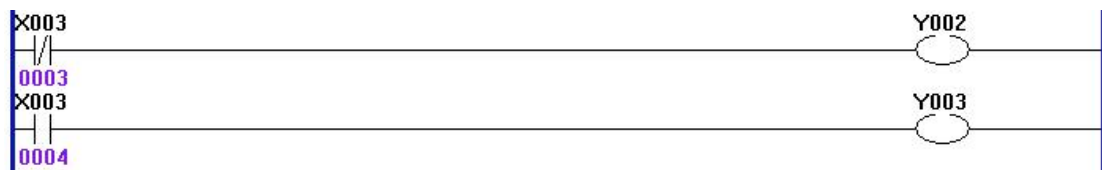
directly outputs to NC

(2)Signal to machine

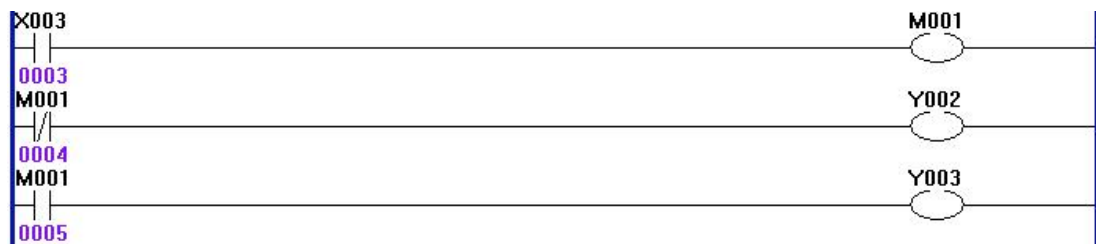
PLC transmits output signal to the output memory at machine side, and then directly outputs to memory every 2ms.

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.

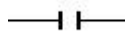
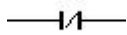
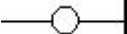
Chapter 3 PLC BASIC INSTRUCTIONS

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 |  |

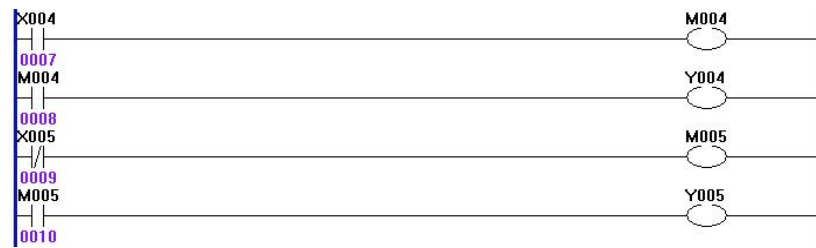
◆ Instruction explanation

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

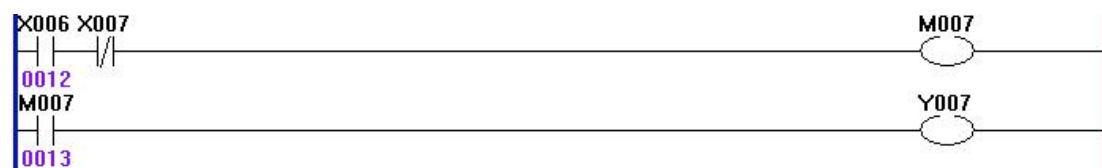
◆ Mnemonic code and function

| Mnemonic 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=1 and X007 is 0, M007 is 1, the system output Y007.

3.3 OR,ORI INSTRUCTION

◆ Mnemonic code and function

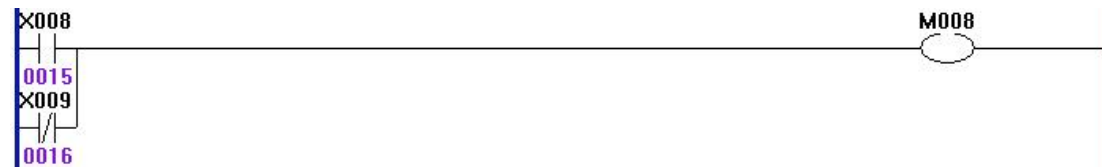
| Mnemonic code | Function | Ladder Symbol |
|---------------|----------------------------------|------------------|
| OR | Parallel normally-open contact | — — — — |
| ORI | Parallel normally-closed contact | — — — / — |

◆ 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



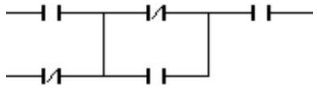
Program explanation:

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

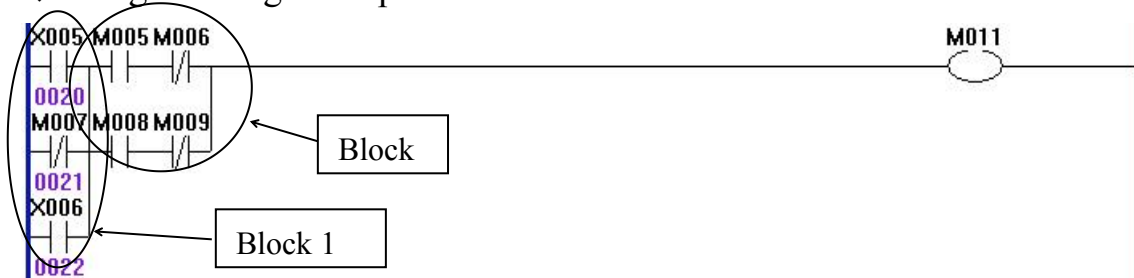
| Mnemonic code | Function | Ladder Symbol |
|---------------|----------------------------------|---|
| ANB | Parallel circuit block in series |  |

◆ 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:

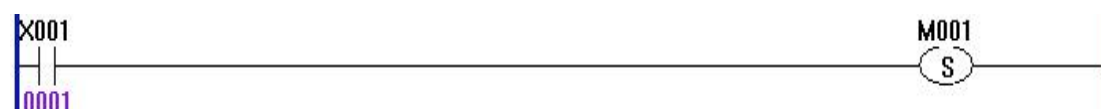
As above ladder, ORB represents the parallel serial circuit block in block 2 and ANB represents block 1 and 2 in series.

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

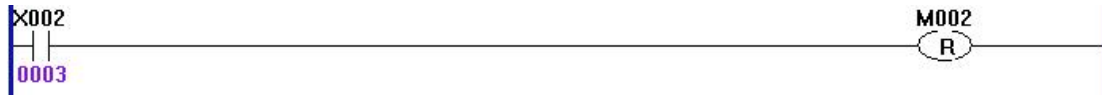
M001: set address bit, which can be a contact or output coil, and add is M, Y, T or C.

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

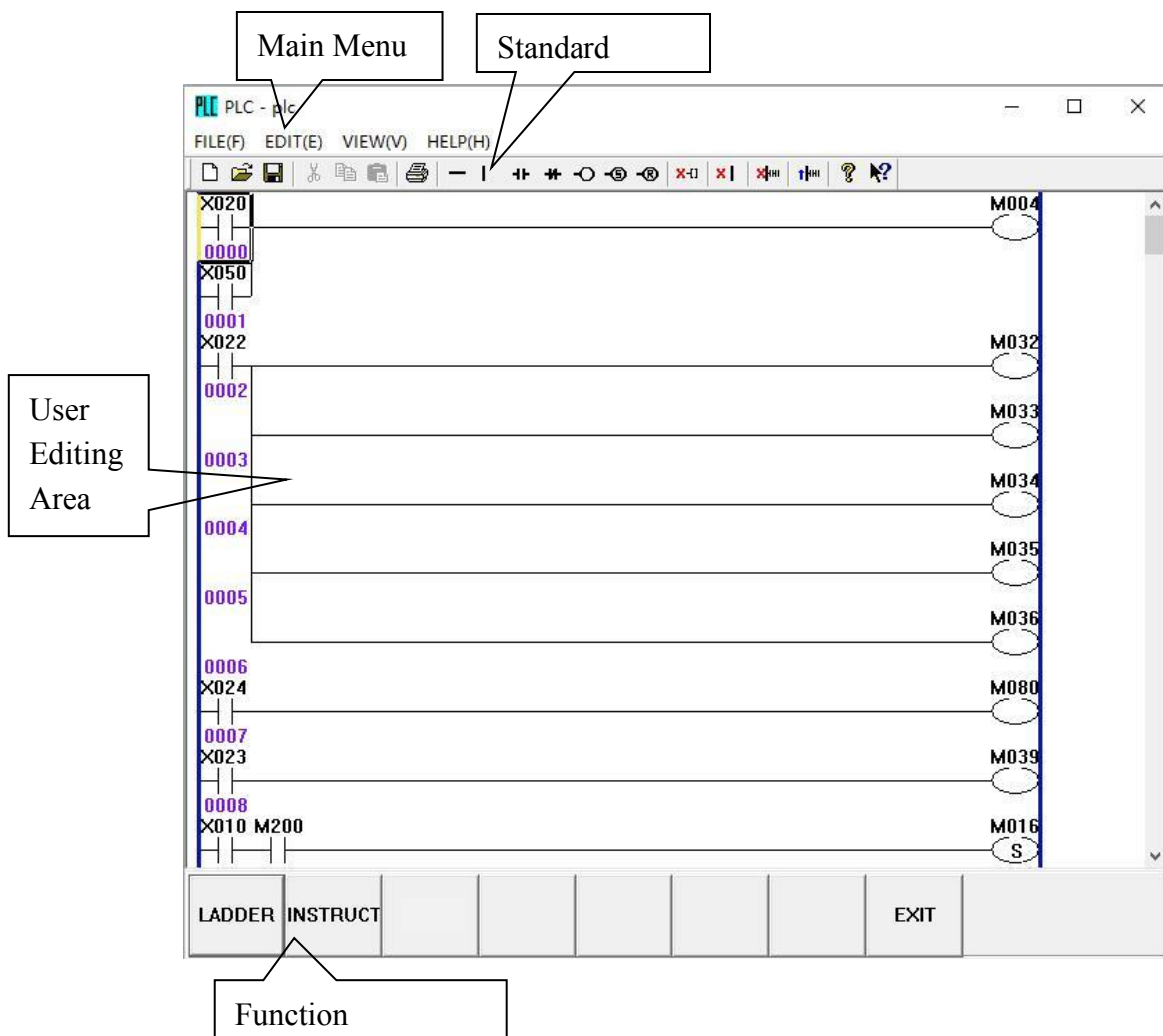


Input point X40 control M80, and then cnc system will hint No.0 alarm. And also we could edit the alarm signal according to detailed condition.

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



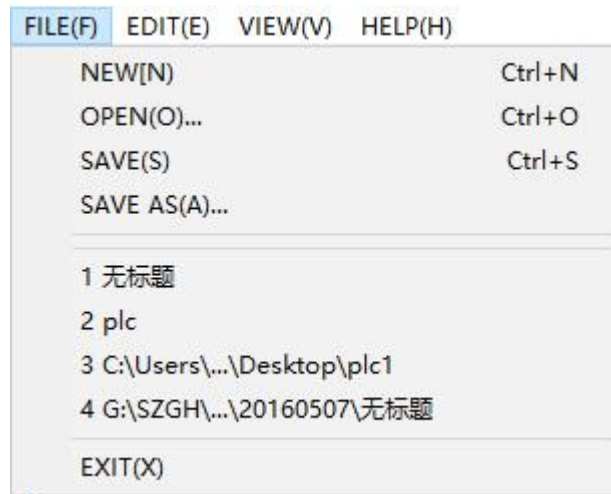
Main Menu All the operational commands

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”.

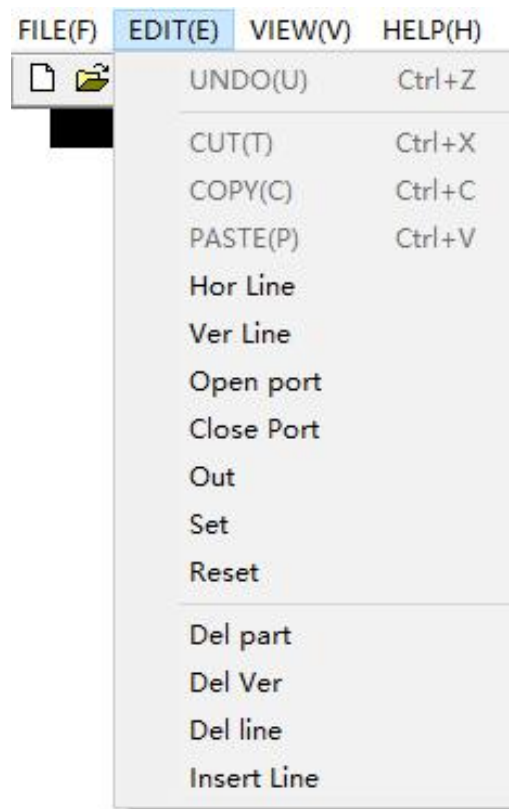
[Recent Open File List]

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.

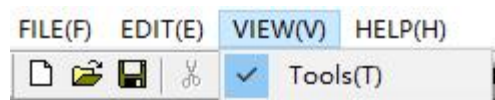
[COPY]

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
-  Delete elements of total line
-  Add null line above

| | |
|---|-------------------------|
| <div style="border: 1px solid black; padding: 5px;"> <div style="background-color: #007bff; color: white; padding: 2px 5px; margin-bottom: 5px;">-[CMP]-</div> <div style="margin-bottom: 5px;">-[MOV]-</div> <div style="margin-bottom: 5px;">-[BIT]-</div> <div style="margin-bottom: 5px;">-[ADD]-</div> <div style="margin-bottom: 5px;">-[SUB]-</div> <div style="margin-bottom: 5px;">-[MUL]-</div> <div style="margin-bottom: 5px;">-[DIV]-</div> </div> | CMP: Data compare |
| | MOV: Data Move |
| | BIT: Data Bit operation |
| | ADD: Data Add |
| | SUB: Data Subtract |
| | MUL: Data Multiple |
| | DIV: Data Division |

| | |
|------------|------------------------------------|
| -[END1]- | END1: End of 1 st grade |
| -[END2]- | END2: End of 2 nd grade |
| -[LABL]- | LABL: position label |
| -[JUMP]- | JUMP: jump with condition or not |
| -[SP]- | SP: Start of subprogram |
| -[SPE]- | SPE: End of subprogram |
| -[RETN]- | RETN: Return of subprogram |
| -[CALL]- | 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¶meters backup to U-disk.
- ⑥ Press “SYSTM” to exit to cnc system and then extract U-disk.
- ⑦ Backup PLC files is done well.

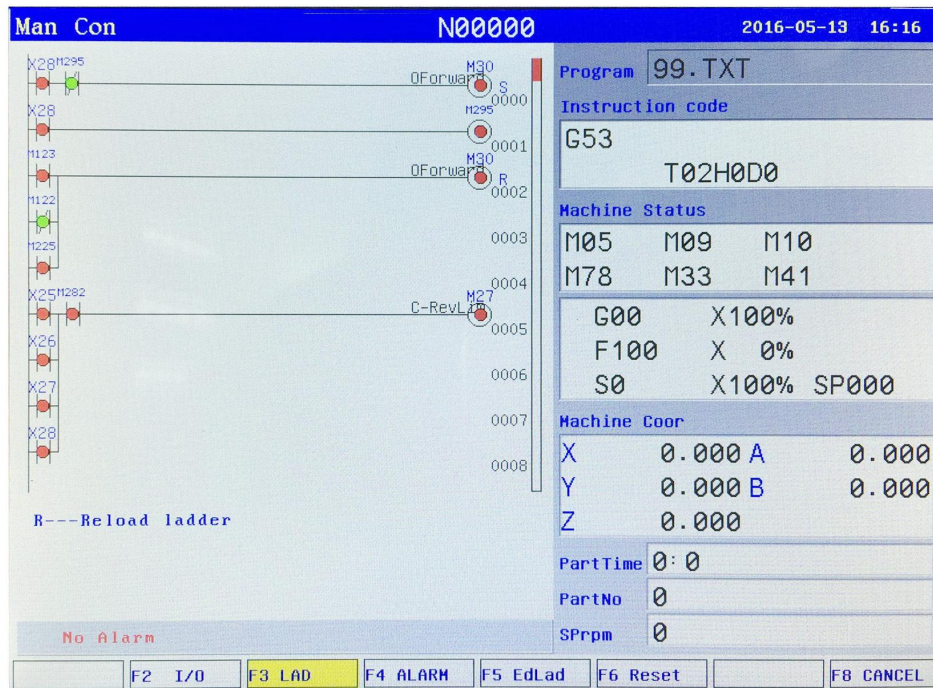
Note2: plc1.lad & plc1.plc is the copy of plc.lad & plc.plc.and it doesn't work in cnc system. Only plc.lad&plc.plc can work in cnc system, which can restore into system and cannot be backup from cnc system.

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.

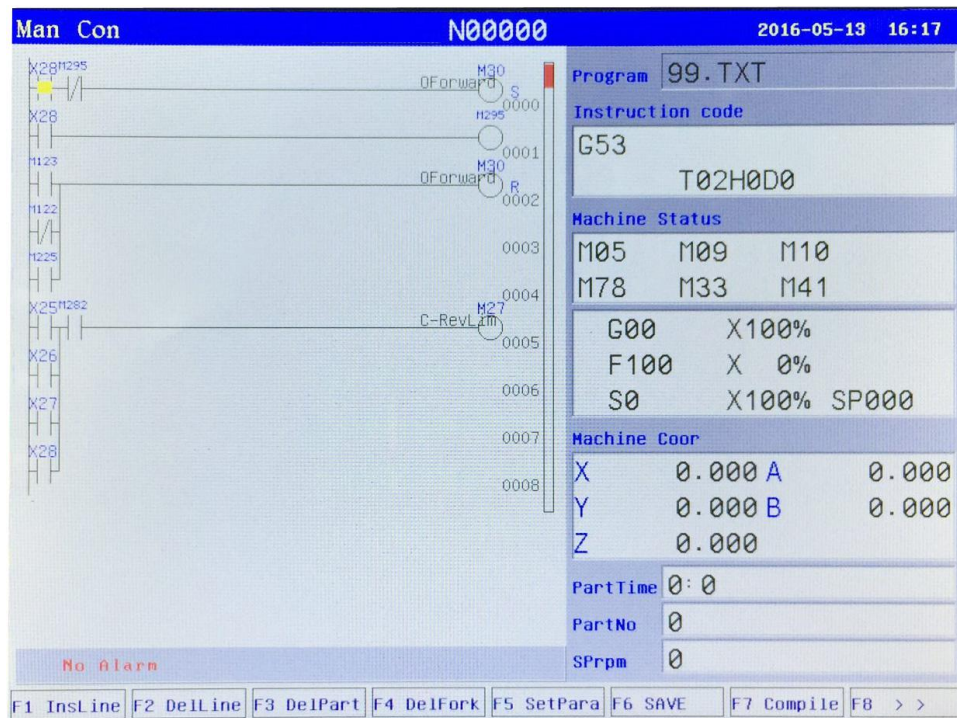
Note4:The name of all files cannot exist blank,otherwise system cannot read.

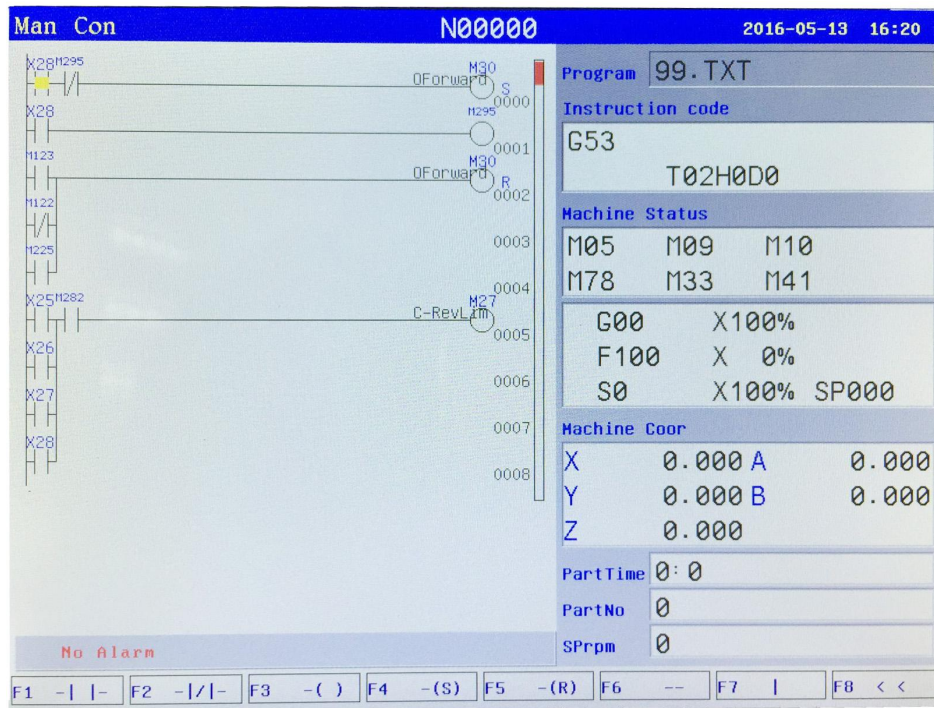
4.4 Screen Display on SZGH CNC System





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





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

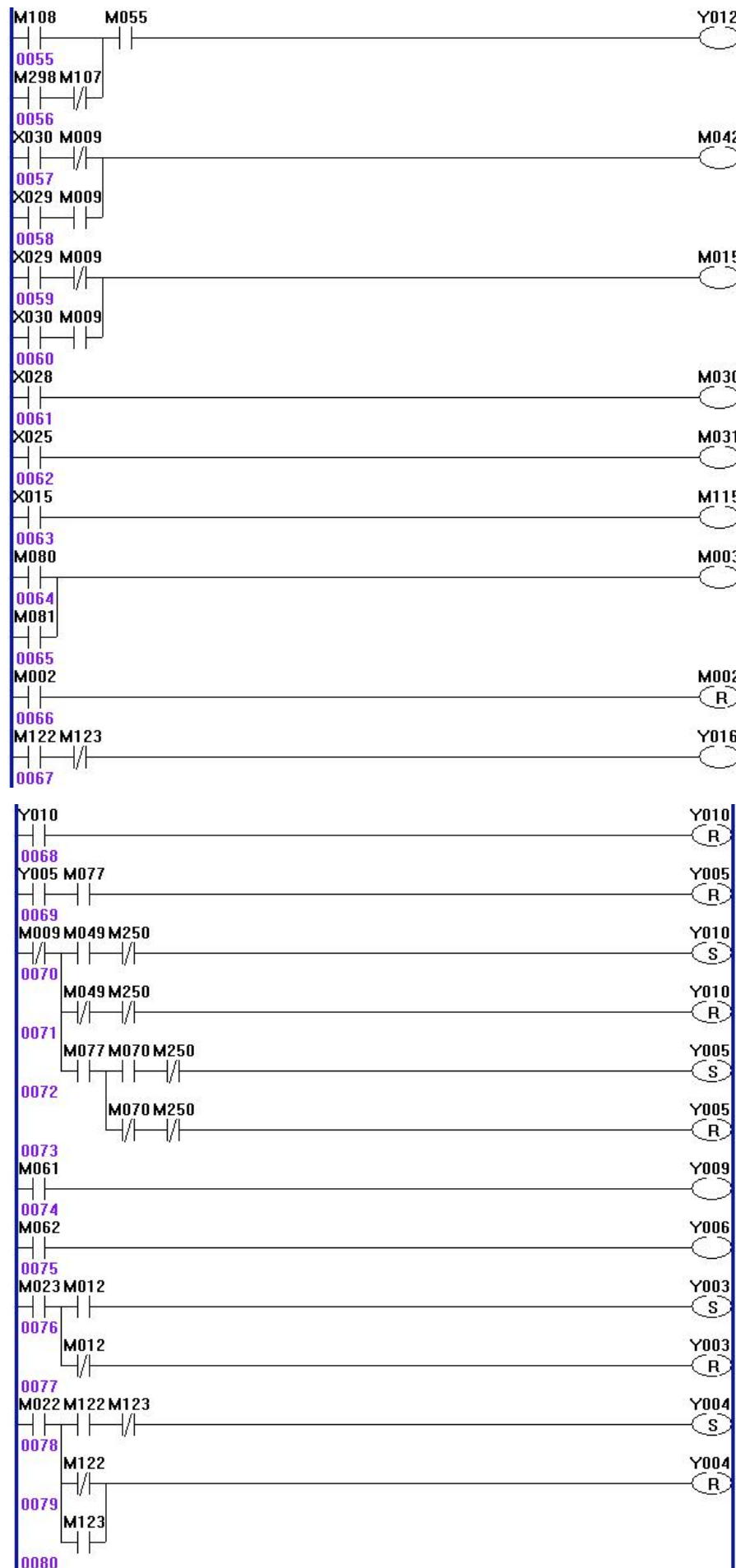
-(S) : Add set output coil

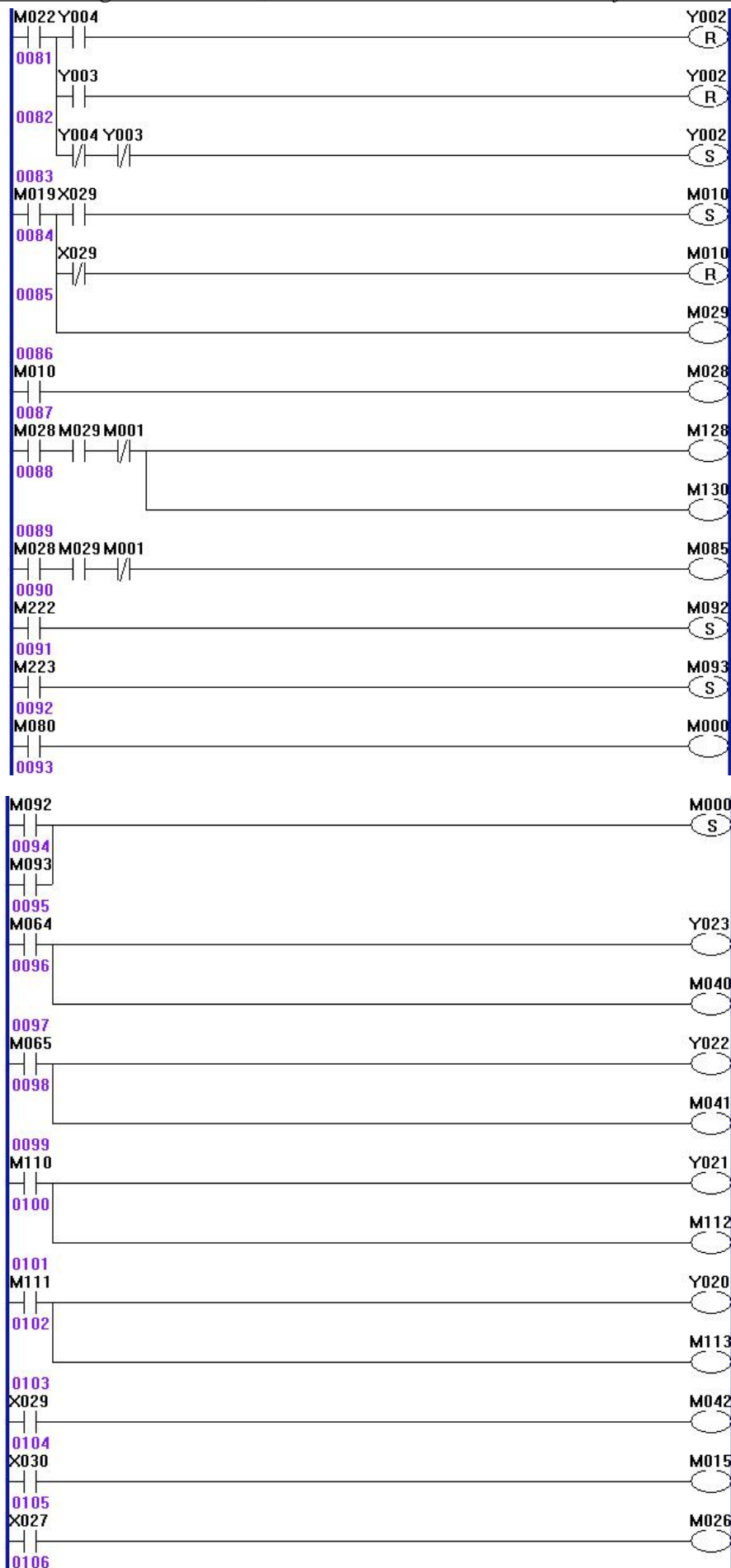
-(R) : Add reset output coil

-- : Add horizontal line at the cursor position

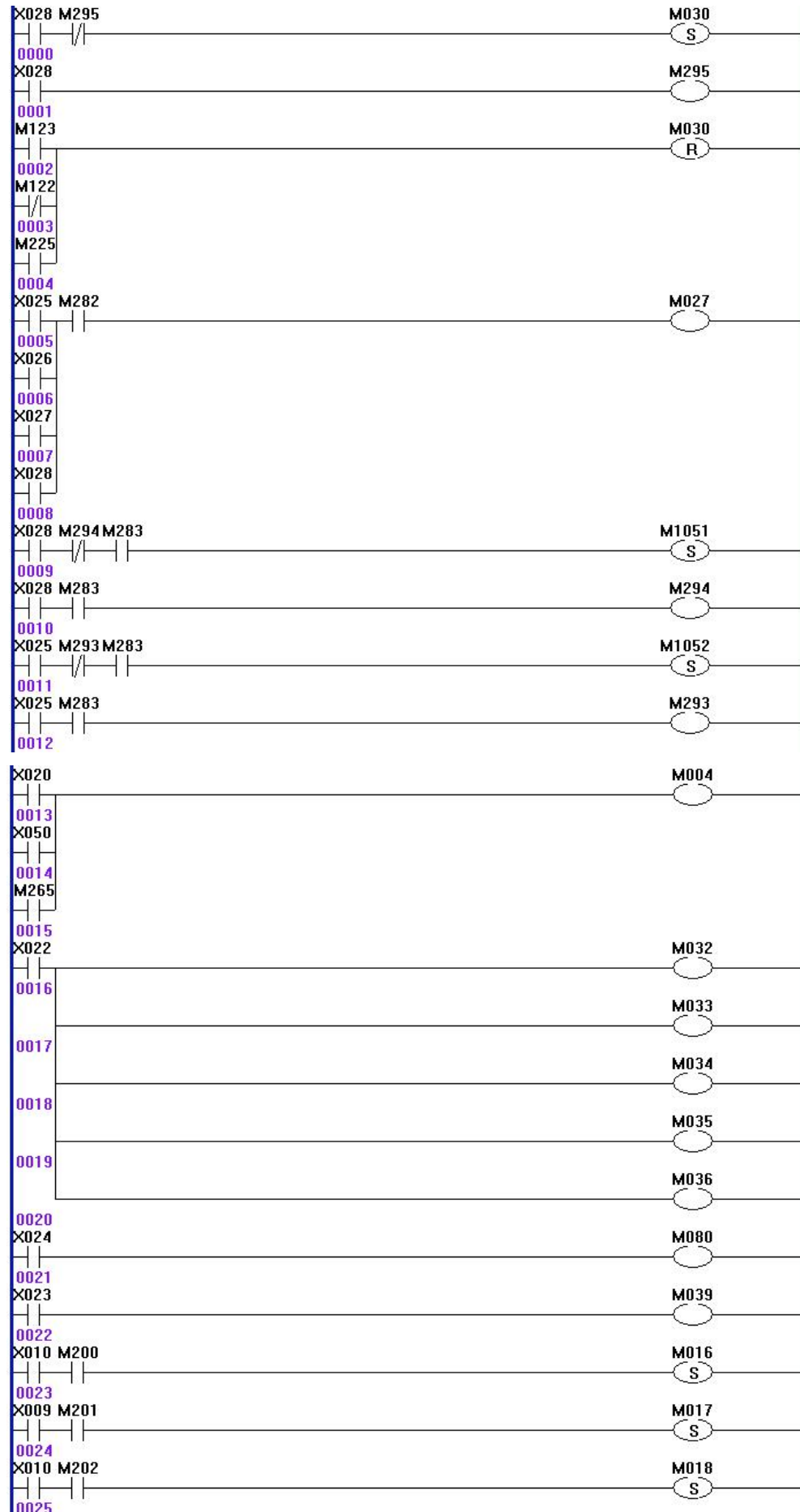
| : Add vertical line at left side of cursor position

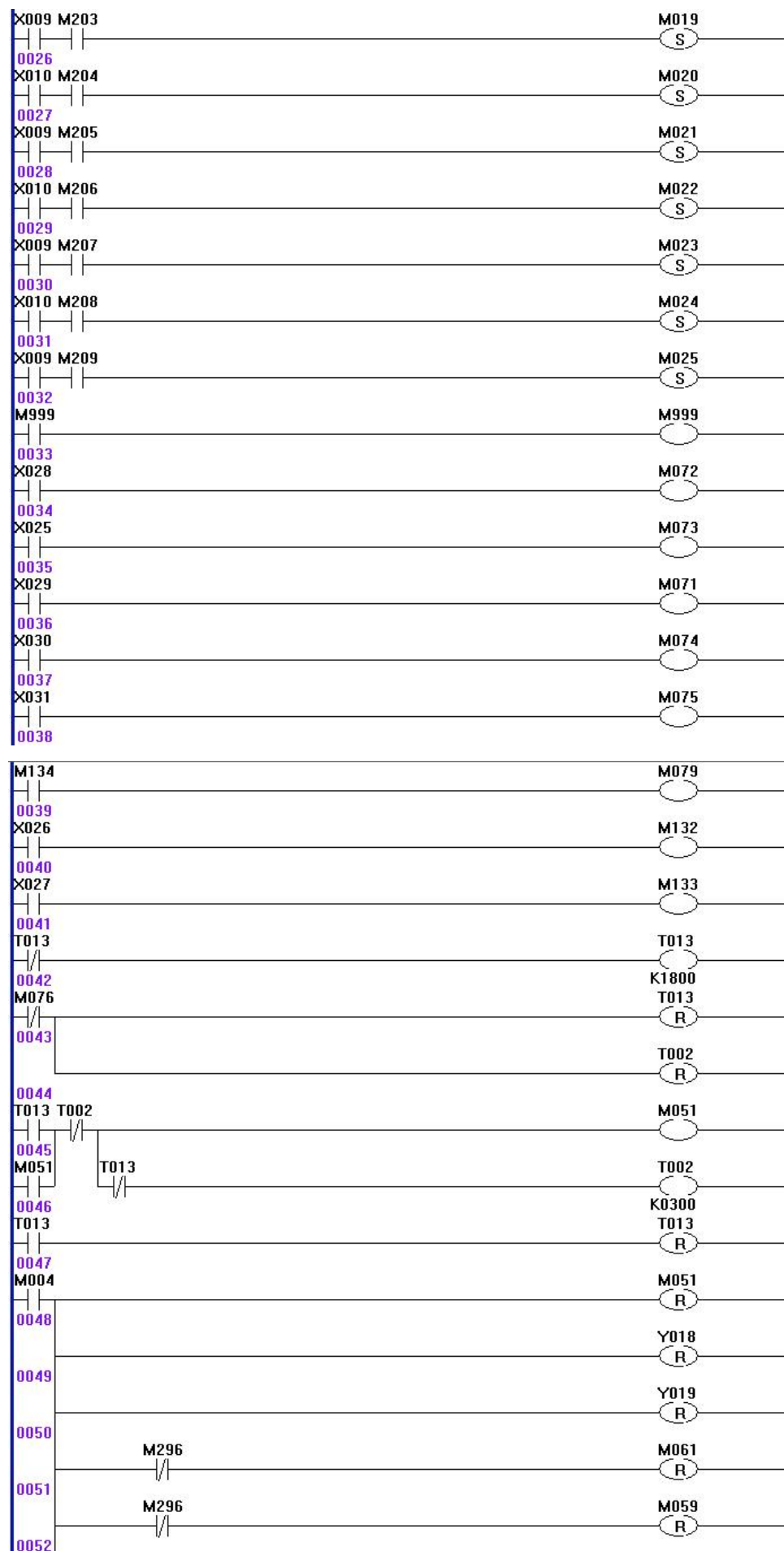
Note: Software version of cnc system is up to V6.52,which can display and edit ladder on cnc system.



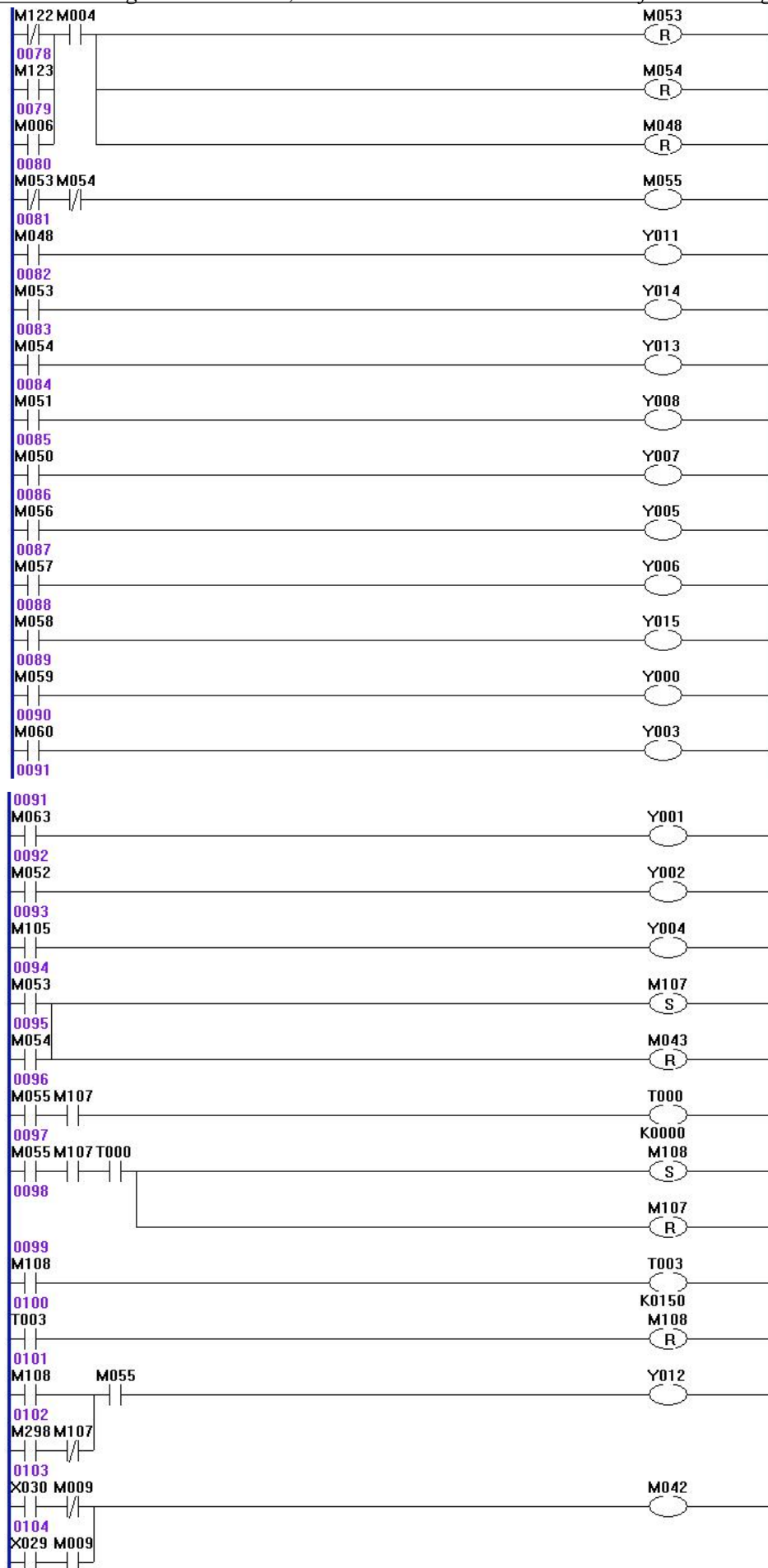


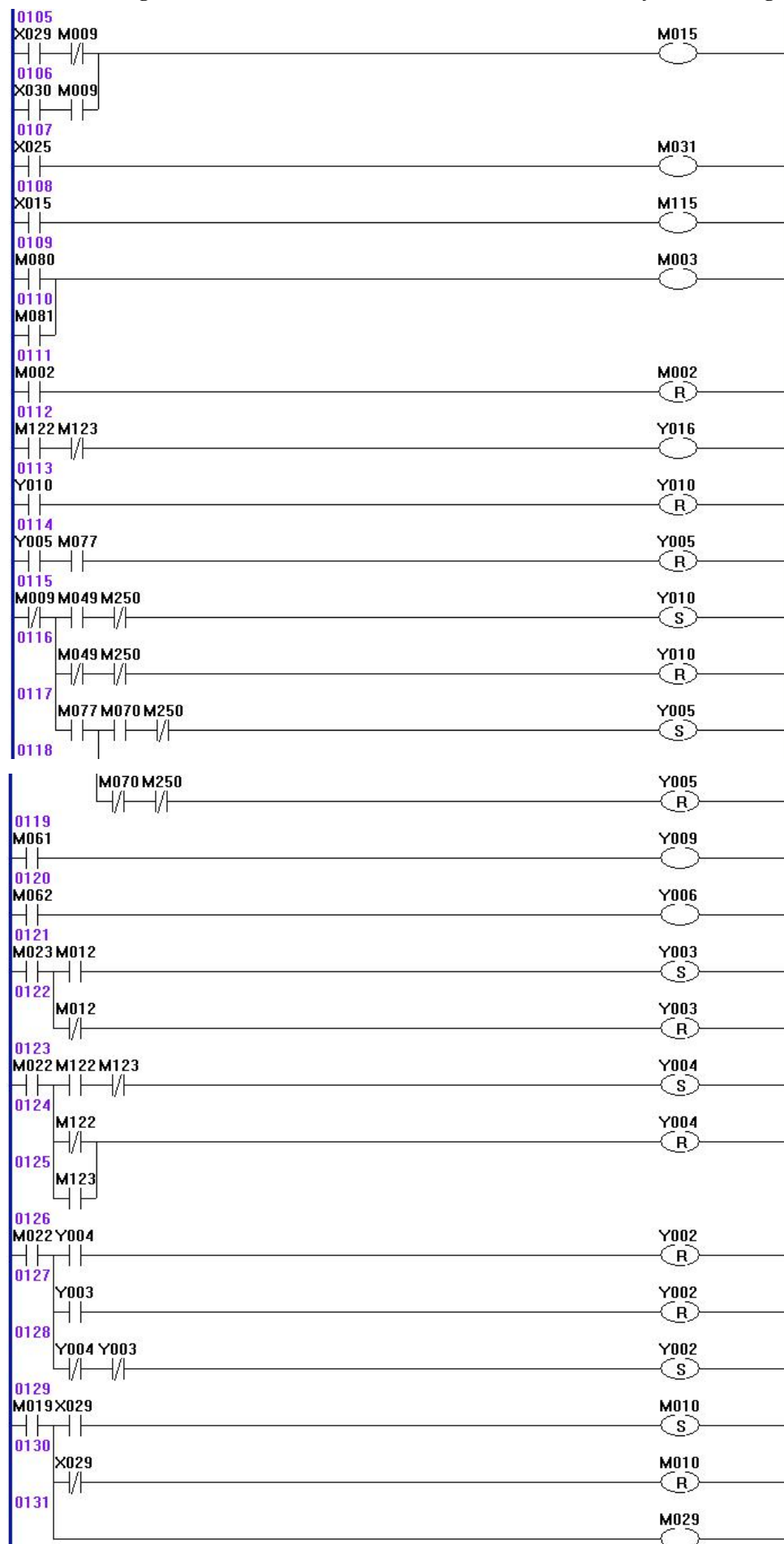
Appendix2: Ladder of SZGH-CNC1000MDb(c)(V6.51)

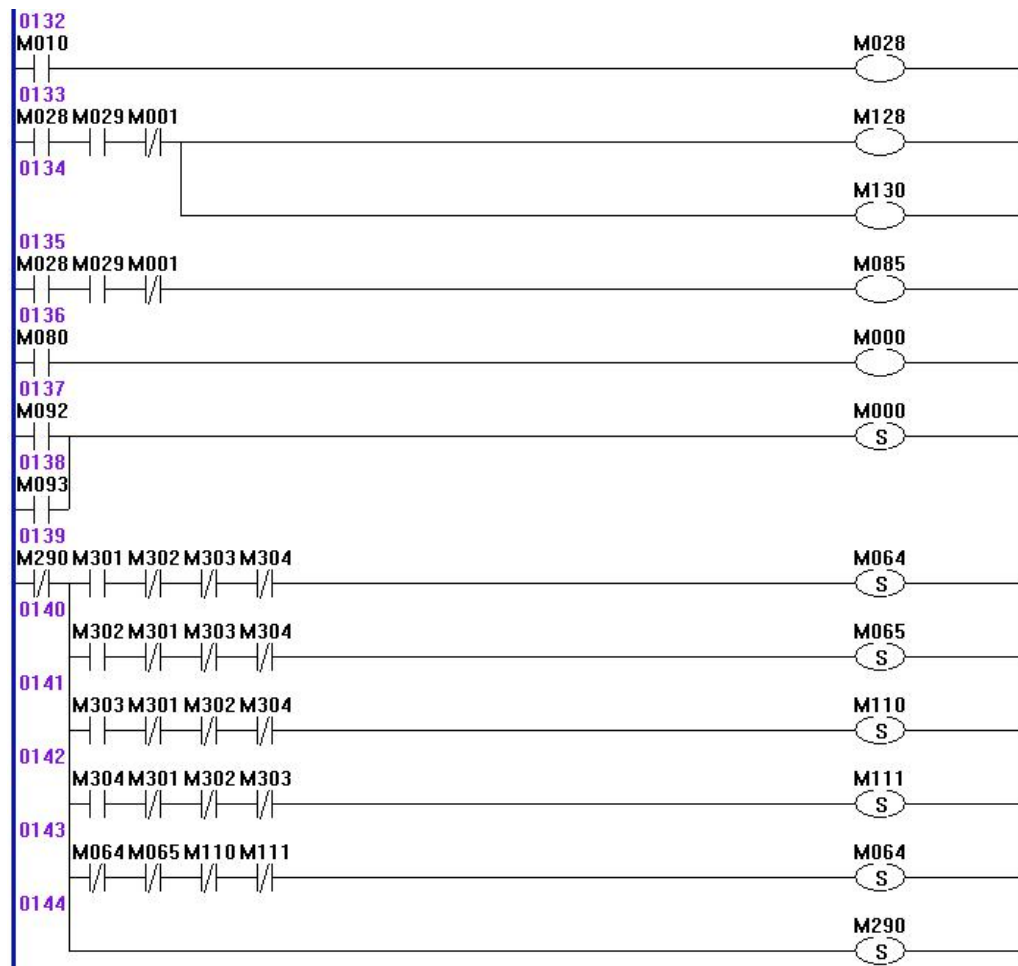


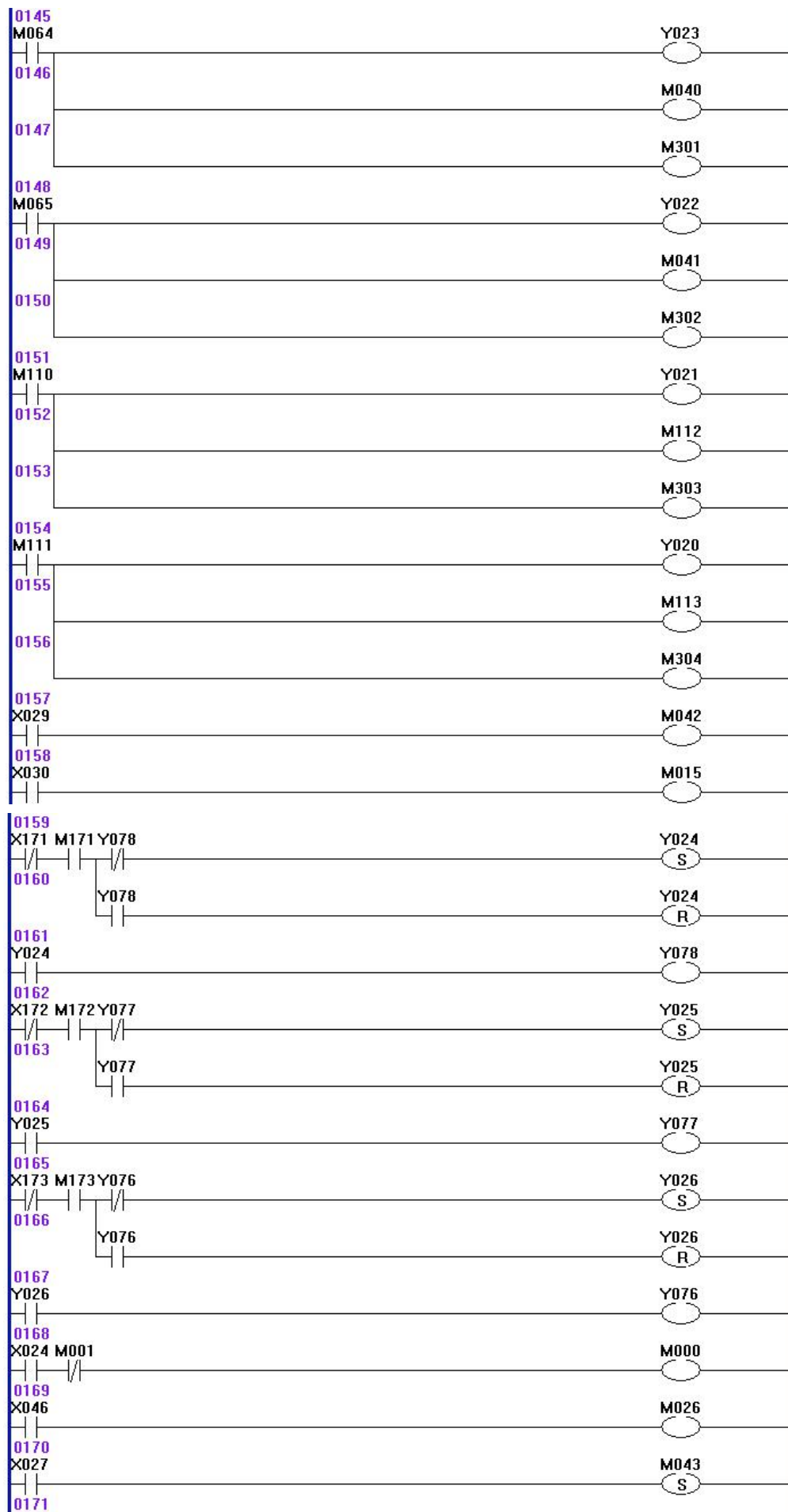


| | | |
|------|------|-----------|
| 0053 | M296 | M063 R |
| 0054 | M296 | M052 R |
| 0055 | M296 | M060 R |
| 0056 | M296 | M105 R |
| 0057 | M296 | M056 R |
| 0058 | M296 | M057 R |
| 0059 | M296 | M050 R |
| 0060 | | M048 R |
| 0061 | | M055 R |
| 0062 | | M054 R |
| 0063 | | M053 R |
| 0064 | M296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









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

