
Instruction Manual

IMO iSmart v4 Series

Programmable Relay



Content

| | |
|---|----|
| Content..... | 1 |
| Chapter 1 Summary | 5 |
| Precautions for installation..... | 6 |
| Environmental requirements | 8 |
| SMT model explanation..... | 9 |
| Quick use instructions | 10 |
| Install SMT Client Software..... | 10 |
| Connect the power | 10 |
| Connect programming cable | 11 |
| Configure the gateway | 11 |
| Establish communication | 13 |
| Write simple program..... | 14 |
| Chapter 2 Installation | 18 |
| Type selection form..... | 22 |
| Installation and fixing | 23 |
| Wiring..... | 25 |
| 24V DC input wiring..... | 25 |
| 100~240V input wiring | 26 |
| 12/24V input wiring | 26 |
| Relay output wiring..... | 26 |
| Transistor output wiring | 26 |
| IO Link or remote IO Link (for RS485 type only) | 27 |
| Indicator | 27 |
| Chapter 3 Programming Tool..... | 28 |
| PC programming software SMT Client..... | 29 |
| Install the software | 29 |
| Start screen..... | 29 |
| Ladder programming environment..... | 30 |
| FBD programming environment | 51 |
| LCD display and keys..... | 57 |
| Keys | 57 |
| Initial screen..... | 59 |
| Main menu screen..... | 63 |
| RTC summer-time/winter time setting | 68 |
| System error display and action | 73 |
| Chapter 4 Parameter Transfer..... | 74 |
| Internal data type of SMT | 75 |
| Transfer of parameters out of range | 77 |
| Chapter 5 Ladder Programming Instructions | 79 |
| Basic Elements..... | 80 |
| Special Functional Instructions | 85 |
| Output Instructions..... | 87 |
| Analog Instructions | 89 |
| Timer Instructions | 90 |
| Counter Instructions | 99 |

| | |
|---|-----|
| Real-time clock (RTC) Instructions | 111 |
| Analog Comparator Instructions | 122 |
| Filter Instructions | 124 |
| HMI Instructions | 128 |
| PWM Instructions (for DC power and transistor output type only) | 131 |
| IO Link/Remote IO Instructions (for RS485 type only) | 139 |
| MU (Modbus) Instructions (for RS485 type only) | 143 |
| SHIFT Instructions | 152 |
| AQ Analog Output Instructions | 153 |
| AS (Addition and Subtraction) Instructions | 156 |
| MD (Multiplication and Division) Instructions | 157 |
| PID Instructions | 158 |
| MX (Multiplex Controller) Instructions | 162 |
| AR (Ramp Function Generator) Instructions | 163 |
| DR (Data Register) Instructions | 167 |
| Chapter 6 FBD Programming Instructions | 170 |
| FBD Coil | 171 |
| FBD Program Storage Space | 172 |
| Analog Coil | 176 |
| Analog input | 176 |
| Analog output | 178 |
| Coil Blocks | 180 |
| HMI graph block | 181 |
| PWM graph block (for transistor type only) | 183 |
| IO Link graph block (for RS485 type only) | 190 |
| SHIFT graph block | 193 |
| Logic Block Diagrams | 194 |
| AND logic block diagram | 194 |
| AND (EDGE) logic block diagram | 195 |
| NAND logic block diagram | 196 |
| NAND (EDGE) logic block diagram | 196 |
| OR logic block diagram | 197 |
| NOR logic block diagram | 198 |
| XOR logic block diagram | 198 |
| RS logic block diagram | 198 |
| NOT logic block diagram | 199 |
| Pulse logic block diagram | 199 |
| BOOLEAN logic block diagram | 199 |
| Functional Block Diagrams | 201 |
| Timer functional block diagram | 203 |
| General counter functional block diagram | 213 |
| High-speed counter functional block diagram (for DC type only) | 222 |
| RTC functional block diagram | 226 |
| Analog comparator functional block diagram | 236 |
| Filter functional block diagram | 240 |
| Addition and subtraction functional block diagram | 243 |
| Multiplication and division functional block diagram | 244 |

| | |
|--|-----|
| PID functional block diagram | 245 |
| Multiplex controller (MX) functional block diagram..... | 247 |
| Ramp function generator (AR) functional block diagram | 249 |
| Data register (DR) functional block diagram | 254 |
| Modbus functional block diagram..... | 255 |
| Chapter 7 Hardware Specifications | 266 |
| General Specifications..... | 267 |
| Type Selection Form | 268 |
| Input Power Specifications (current consumption to be tested) | 269 |
| General type specifications..... | 269 |
| Schematic diagram of incoming power line: | 270 |
| Input Specifications..... | 271 |
| 100~240V AC type..... | 271 |
| 12/24V DC type 12 I/O | 272 |
| 12/24V DC type 20 I/O | 273 |
| Output Specifications | 274 |
| Precautions for Output Terminal Connection | 275 |
| Relay life | 275 |
| Outline Drawing (unit: mm)..... | 276 |
| Chapter 8 Function Specification of 20-point RS485 High-Performance Type | 277 |
| Communication Specifications..... | 278 |
| Function Description | 280 |
| MU instructions (Modbus communication master function)..... | 284 |
| Modbus communication slave function..... | 286 |
| Modbus communication protocol..... | 286 |
| Chapter 9 Extended Module Instructions | 288 |
| Overview..... | 289 |
| Module Power..... | 291 |
| Module Dimensions | 291 |
| Extended Digital IO Modules | 294 |
| Extended Analog Modules | 299 |
| Analog input module 4AI..... | 299 |
| Temperature input module 4PT | 300 |
| Analog output module 2AO | 301 |
| Chapter 10 External Memory..... | 312 |
| User program reading and writing with SD card..... | 313 |
| Data logging and output (LOG function)..... | 315 |
| Card formatting | 317 |
| Configuration file reading | 318 |
| Chapter 11 Ethernet Communication Function | 320 |
| Overview..... | 321 |
| Device connection..... | 321 |
| PC Client programming software connection..... | 323 |
| Extended device connection and network block configuration | 324 |
| Network server..... | 327 |
| Network communication between two SMT devices | 329 |
| Modbus TCP function/Modbus RTU over TCP function | 332 |

| | |
|--------------------------------|-----|
| E-mail transfer function | 336 |
|--------------------------------|-----|

Chapter 1 Summary

| | |
|------------------------------------|----|
| Chapter 1 Summary | 5 |
| Precautions for installation | 6 |
| Environmental requirements | 8 |
| SMT model explanation | 9 |
| Quick use instructions | 10 |
| Install SMT Client Software..... | 10 |
| Connect the power | 10 |
| Connect programming cable | 11 |
| Configure the gateway | 11 |
| Establish communication | 13 |
| Write simple program..... | 14 |

Precautions for installation

This product is used in industrial premises, and indoor use.

For your safety, this manual for SMT small logic controller provides [Danger], [Caution] and other symbols. Please pay attention to the safety precautions during handling, installation, running and inspection, and try to make it safer during SMT running.



[WARNING]: Personal injury or death may be caused by misuse.



[CAUTION]: Personal injury or mechanical system damage may be caused by misuse.

Precautions during installation:



Do not use in an environment not allowed in the catalog and manual, as electric shock, fire, malfunction and other adverse circumstances may occur in an environment exposed to high temperature, moisture, dust, corrosive gas, vibration and impact.



Please install SMT according to the installation precautions herein to avoid falling, fault or malfunction of the programmable controller.



Please turn off the power before wiring, connection, installation (Battery extended modules) or movement, must be not operate with power.



The wiring method of external connection of terminal block is used for output end of SMT relay, where the connection is not covered and all externally-connected electronic parts are exposed; therefore, it is suggested that SMT and external parts be installed in a covered space or the dedicated distribution cabinet to avoid accidental contact.

Precautions during wiring:



Be sure to make the third grounding according to electrotechnical regulations. No grounding or wrong grounding will lead to electric shock, malfunction, and other faults.

Please follow the rated power specification for wiring. Inconsistent power specification will cause fire.



Wiring operation should be performed by the qualified electrician according to electrotechnical regulations.

Wrong wiring will lead to fire, electric shock, fault and other adverse situations.

Precautions during use:



Please use SMT according to the instruction manual and perform safety confirmation of operation and wiring prior to running. Any mis operation may cause machine damage or personal injury.



Do not contact breakpoint or exposed parts after power-on, so as to avoid machine damage or personal injury.



Please install an emergency stop circuit, external interlock circuit and other wires for protection of the safety system to prevent machine damage caused by SMT fault.

Precautions before installation

Each SMT has passed test and inspection before delivery. Please verify as instructed below after opening the package.

- Check the model/ specification of SMT is consistent with the order.
- Check whether SMT is damaged during transportation. Do not power on SMT in case of any damage.

Précautions d'installation

Pour votre sécurité, ce manuel fournit des symboles tels que [danger], [attention] pour les petits contrôleurs logiques SMT. Lors de la manutention, de l'installation, de l'exploitation et de l'inspection, veuillez prêter attention aux précautions de sécurité et essayer de rendre le SMT aussi sûr que possible.



[avertissement]: un mauvais usage peut causer des blessures corporelles ou la mort.



[Note]: un mauvais usage peut causer des blessures corporelles ou des dommages mécaniques au système.

Précautions d'installation:



Ne pas utiliser dans des environnements qui ne sont pas autorisés dans les catalogues et les manuels, car des chocs électriques, des incendies, des défaillances et d'autres conditions défavorables peuvent survenir dans des environnements exposés à des températures élevées, à l'humidité, à la poussière, aux gaz corrosifs, aux vibrations et aux chocs.



Suivez les précautions d'installation ici pour installer SMT afin d'éviter les chutes, les défaillances ou les défaillances du PLC.



Éteignez l'alimentation avant de câbler, de connecter, d'installer ou de déplacer.



L'extrémité de sortie du relais SMT adopte le mode de câblage externe du terminal, le câblage n'est pas couvert et toutes les parties électroniques externes sont exposées; Par conséquent, il est recommandé que le SMT et les composants externes soient installés dans un espace couvert ou dans une armoire de distribution spéciale afin d'éviter tout contact accidentel.

Précautions de câblage:



La troisième mise à la terre doit toujours être effectuée conformément aux procédures électriques.. Le défaut de mise à la terre ou une erreur de mise à la terre peut entraîner un choc électrique, une défaillance, etc.



Le câblage doit être conforme aux spécifications de puissance nominale. Des spécifications d'alimentation incohérentes peuvent causer un incendie. Le câblage doit être effectué par un électricien qualifié conformément aux procédures électriques. Une erreur de câblage peut causer un incendie, un choc électrique, une défaillance, etc.

Précautions d'emploi:



Veuillez utiliser SMT conformément aux instructions et confirmer le fonctionnement et le câblage en toute sécurité avant le fonctionnement. Tout mauvais fonctionnement peut causer des dommages à la machine ou des blessures corporelles..



Ne touchez pas aux points de rupture ou aux parties exposées après l'alimentation électrique afin d'éviter des dommages à la machine ou des blessures corporelles..



Installer un circuit d'arrêt d'urgence, un circuit d'enclenchement externe et d'autres fils pour protéger le système de sécurité contre les dommages causés à la machine par une défaillance du SMT.

Précautions avant installation

Chaque SMT a été testé et inspecté avant de quitter l'usine. Après ouverture de l'emballage, vérifier comme suit.

- Vérifier que le modèle / spécification du SMT est conforme à la commande.
- Inspecter le SMT pour déceler tout dommage pendant le transport. Ne pas alimenter le SMT en cas de dommages.

Environmental requirements

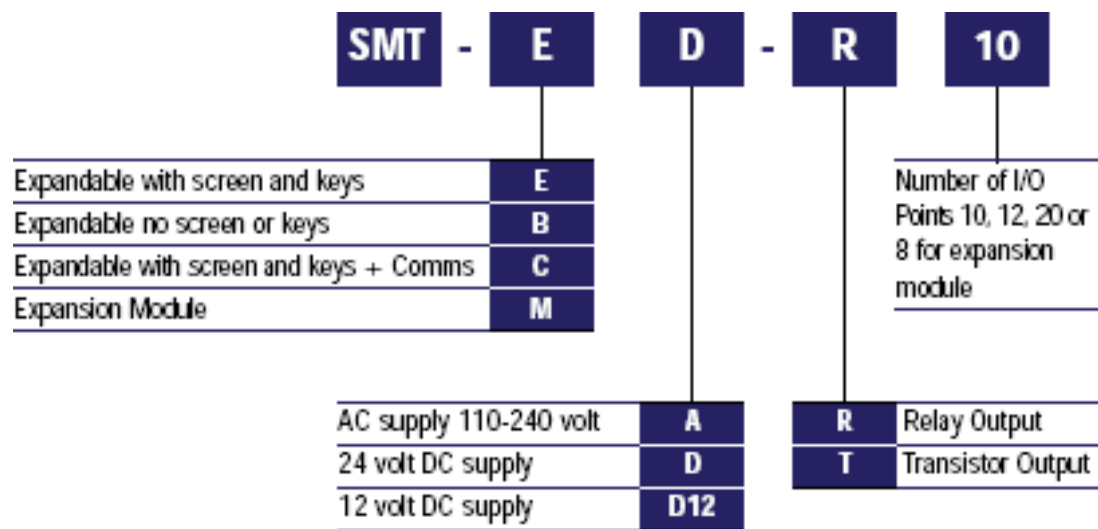
The installation environment of SMT is vital, which may affect its function and service life. Please select the place of installation as required below:

- Vertical placement.
- Please use it in dry environment
- Ambient temperature: -4°F - 122°F (-20°C - 50°C)
- Keep SMT away from heating equipment
- Avoid any place exposed to volatile oil gas, organic solvent, ammonia gas, electrolyte and other harmful gases
- Avoid direct sunlight
- Avoid corrosive and combustible gases
- Avoid entry of dust, particles or metal filing
- Avoid electromagnetic induction and interference
- SMT must be installed in the control cabinet and avoid vibration; please mount a damping device for SMT if vibration is inevitable.

Disclaimer

We have checked content of the manual to ensure consistency with SMT hardware and software. As it is impossible to completely rule out some varying factors, we do not guarantee full consistency between the manual and hardware and software. However, we have strictly checked the manual, including necessary content of subsequent upgrade version. We assume no liability for any losses caused by operation in violation of this manual.

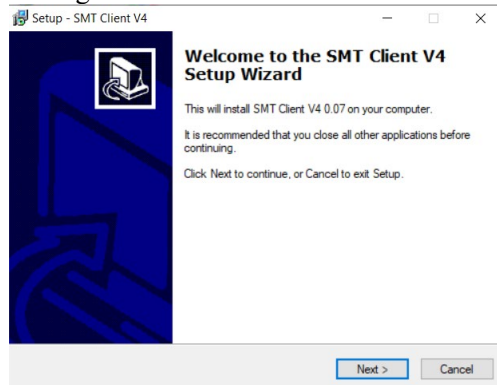
SMT model explanation



Quick use instructions

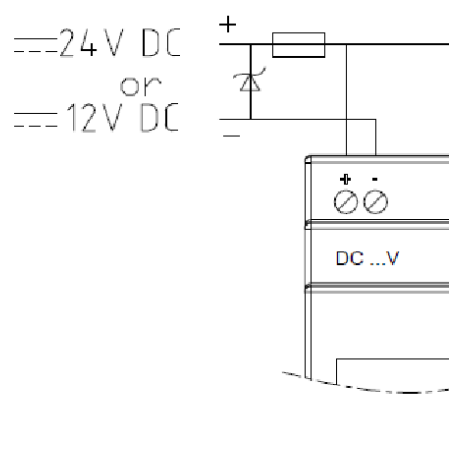
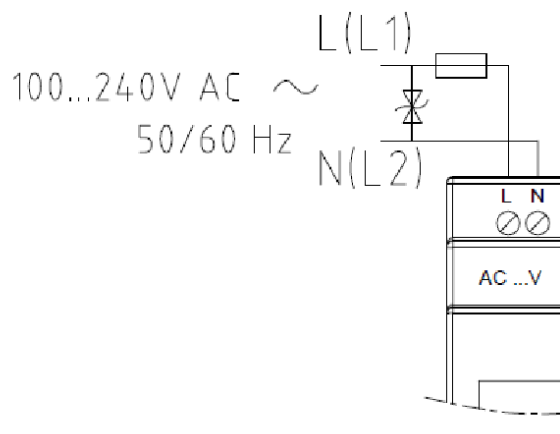
This section provides instructions on how to connect, program and operate the new SMT. This is not a complete programming instruction or an installation operation. Refer to other sections for other detailed procedures. **Install SMT Client Software**

Download SMT programming software SMT Client from CD or network; <http://www.imopc.com>



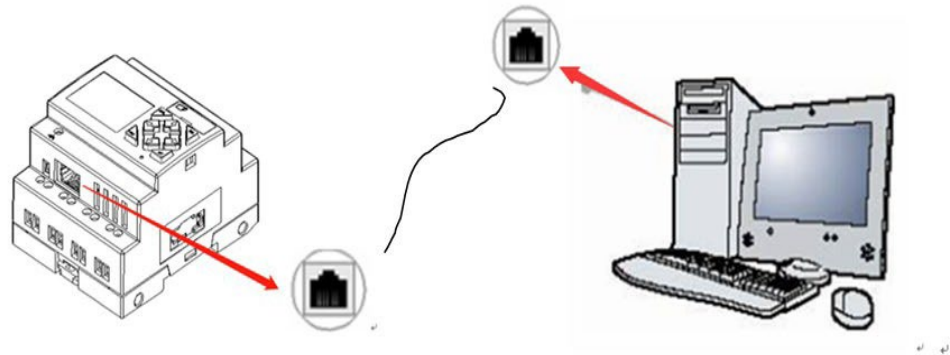
Connect the power

Select a proper power supply for the module and connect SMT to the power source, as shown below; refer to “[Chapter II: Installation](#)” for the detailed installation and wiring methods.



Connect programming cable

Insert the SMT programming cable into the communication port of SMT equipment and connect the other cable end to network port of PC, as shown below.



Configure the gateway

1. Configure SMT IP address

```
OUTPUT RECORD
FORMAT Card
>NETCONFIG
NET IO SET
```

```
> IP ADDRESS
SUBNET MASK
GETEWAY
MASTER IP
```

Move the cursor, choose “Network setting” and press “OK” for network configuration of SMT; set IP address, subnet mask and gateway address, move the cursor and press “OK” for network configuration of SMT.

Take IP address editing as an example: press “OK” to enter the editing interface, move the cursor to the last data bit, and press “SEL” to enter the editing mode.

```
IP ADDRESS
255.255.255.255 █
```

```
IP ADDRESS
255.255.255.255_
```

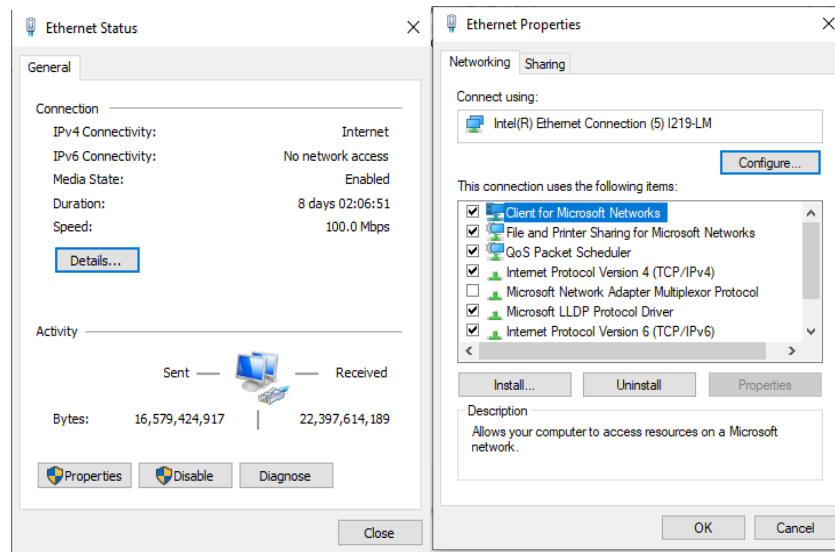
At this time, the cursor turns to “_” state; press Up/Down key for data editing, after completion of editing, press "ESC" to return to “NETCONFIG” menu.

After set all items, press ‘ESC’ return to main menu and save all settings, SMT will power off and restart automatically.

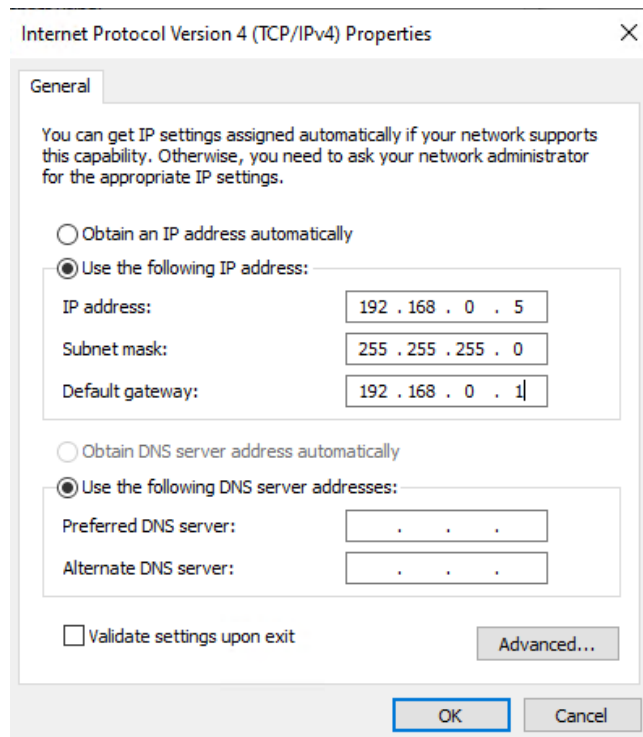
#The default maximum value of each field is 255, which is applied when the set value is greater than 255.

2. Configure IP address of PC side

Select “Attribute” option of local area connection and choose Internet protocol version 4.



Configure IP address, Subnet mask and the default Gateway.



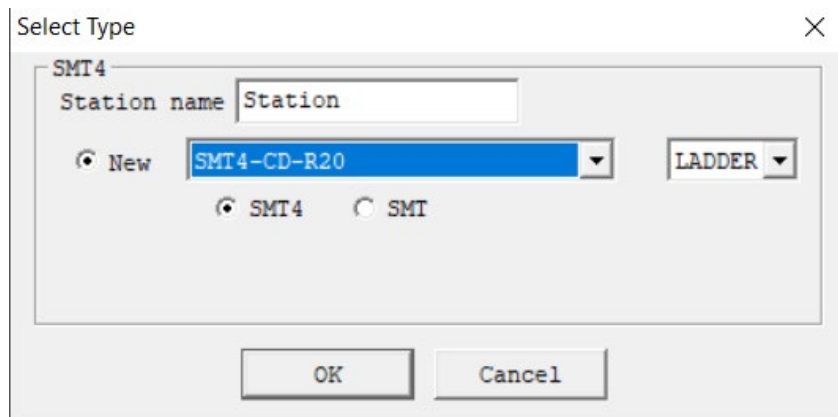
Example:

PC configurations:

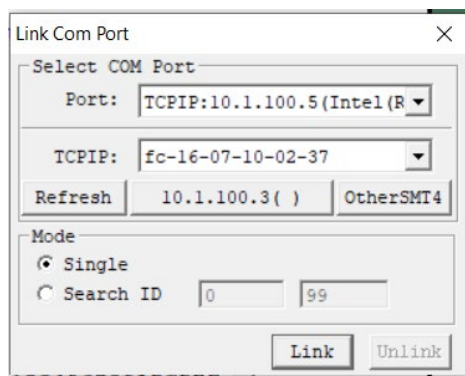
IP address: 192.168.0.5
 Subnet mask: 255.255.255.0
 Default gateway: 192.168.0.1

Establish communication

- a. Open the SMT programming software, and select “New”, as shown in the left below.
- b. Click menu operation “Operation —>Link”, as shown in the right below.



- c. Select TCP/IP of programming cable connection, and click “Link”

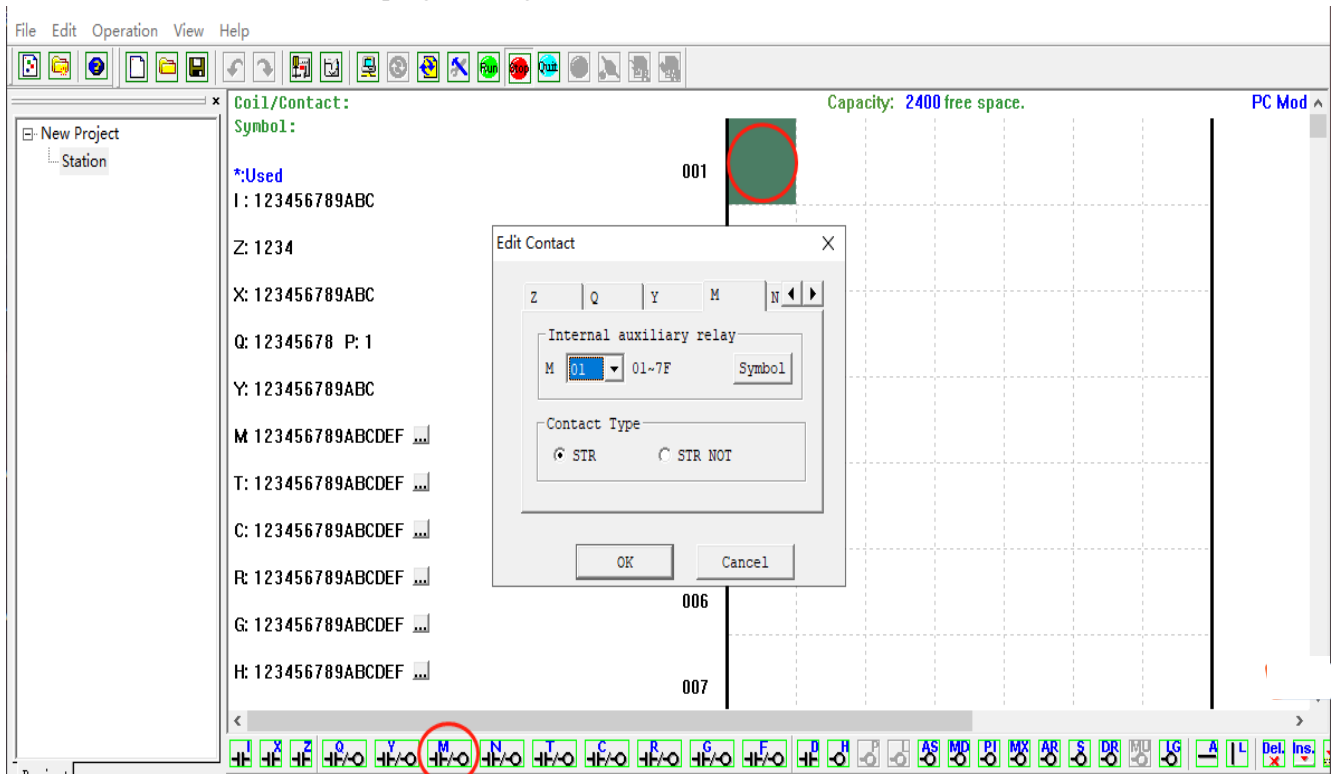


- d. SMT programming software is successfully connected with SMT.



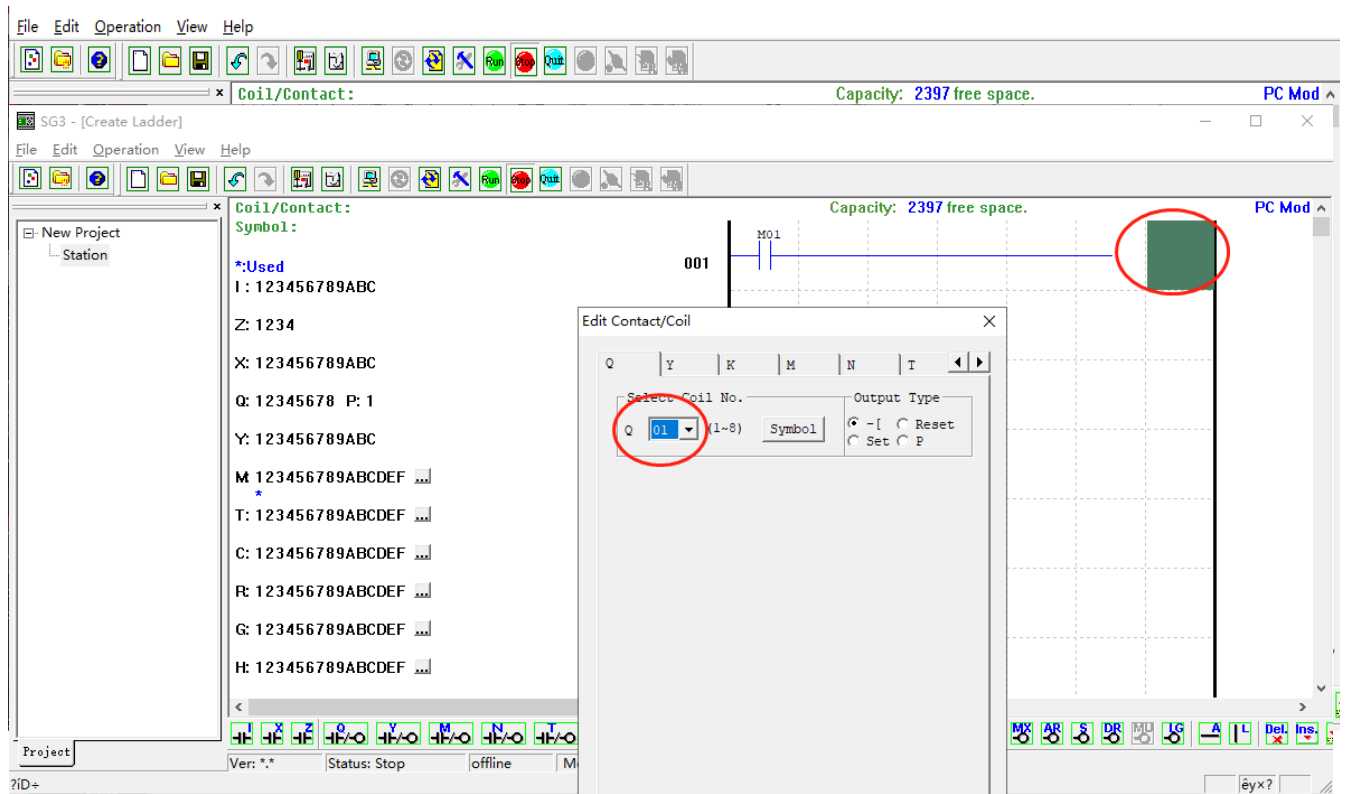
Write simple program

- a. Write a simple program: Click on the far left of line 001 in the programming area, and then click the icon “M” in the Ladder toolbar, as shown below; select M01 and press OK. Refer to “[Chapter IV: Ladder Programming Instructions](#)” for the detailed programming method.



※ Click “View/Ladder toolbar” on the menu if the Ladder toolbar is not displayed on the screen.

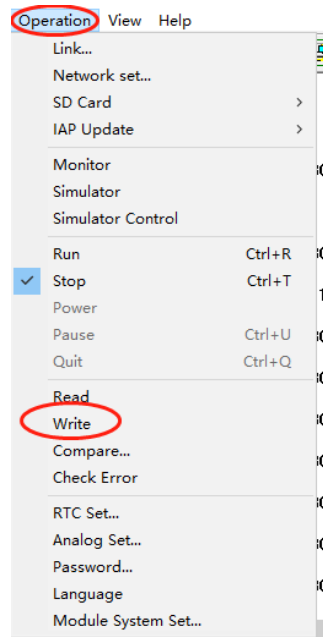
b. Use the key “A” on the keyboard (or icon “A” in the Ladder toolbar) to draw a line from coil M to the rightmost unit of the programming area, as shown below.



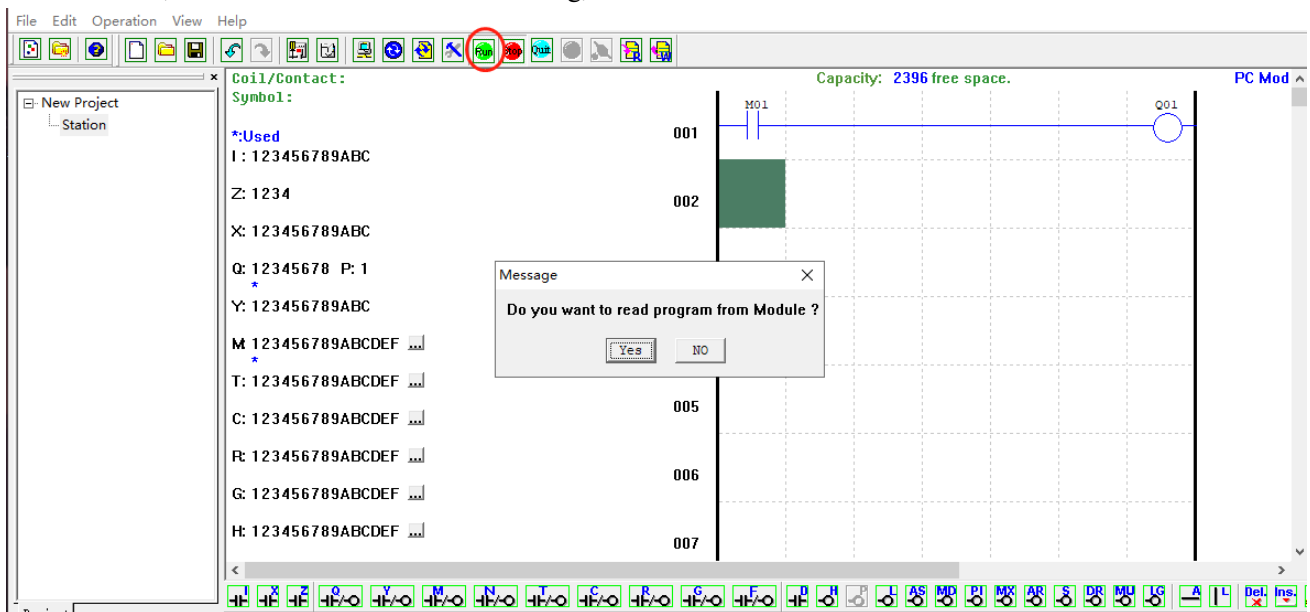
dialog box and press OK, as shown below.

✘ Refer to “[Chapter IV: Ladder Programming Instructions](#)” for the detailed setting.

d. Test the program: Select the menu operation “Operation—> Write”, as shown below, to write the sample program into SMT controller.

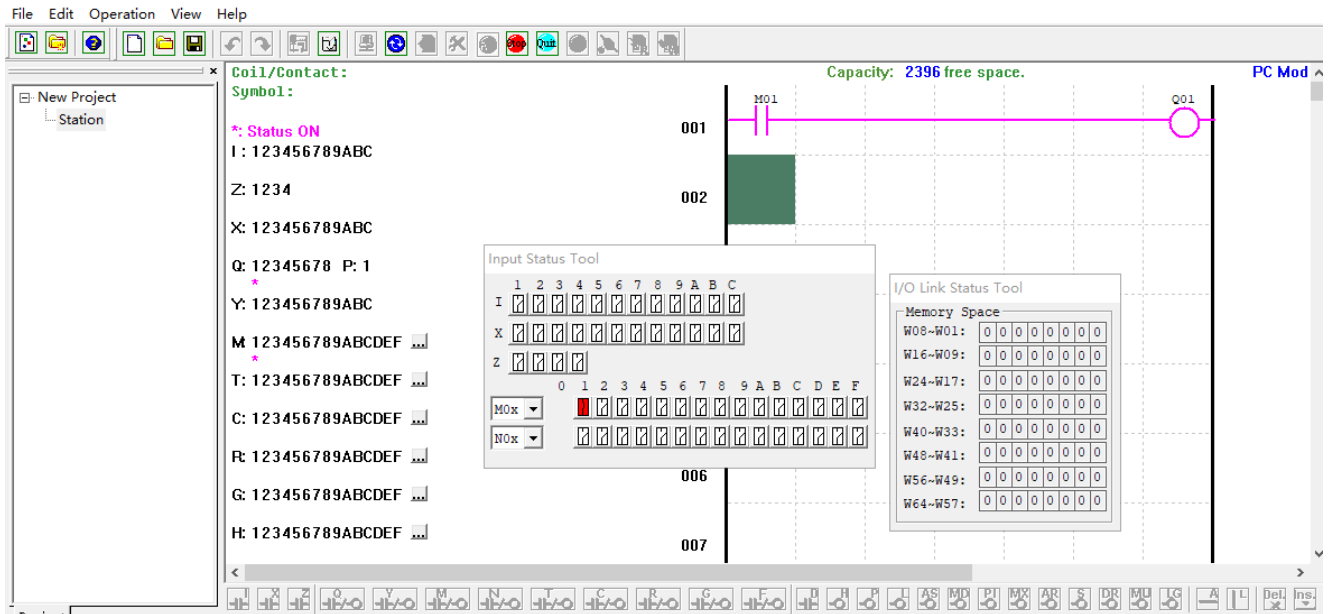


d. Click the button “RUN” on the toolbar, when the system pops up the dialog box “Read program from the module?”; select “No” to control SMT running, as shown below.



f. Select the input status tool dialog, click coil M01 to make it ON, when output Q01 is enabled as ON, as shown below; the highlighted part is enabled, and output Q01 is ON.

Refer to “[Chapter III: Programming Tool](#)” for more information about the programming software.



Chapter 2 Installation

| | |
|---|----|
| Chapter 2 Installation | 18 |
| Type selection form..... | 22 |
| Installation and fixing | 23 |
| Wiring | 25 |
| Wire size and locking torque..... | |
| 12/24V DC input wiring..... | 25 |
| 100~240V input wiring | 26 |
| Sensor input wiring | 26 |
| Relay output wiring..... | 26 |
| Transistor output wiring | 26 |
| IO Link or remote IO Link (for RS485 type only) | 27 |
| Indicator | 27 |

General specification

iSmart is a miniature smart Relay with a maximum of 44 I/O points and can be programmed in Relay Ladder Logic or FBD (Function Block Diagram) program. The iSmart can expand to its maximum I/O count by adding 3 groups of 4-input and 4-output modules.

| Power supply | |
|----------------------|--|
| Supply voltage range | DC type: 12/24VDC AC type: 100-240VAC |
| Average current | DC: 12 points: 300mA; 20 points: 400mA 100-240VAC: 90mA; |
| Wire specification | 14AWG /0.8NM |

| Programming | |
|--------------------------|--|
| Programming language | Ladder diagram (Ladder) /functional block diagram (FBD) |
| Programming space | 600 lines under Ladder, 500 functional blocks under FBD |
| Program storage medium | Flash |
| Execution speed | 5 msec/cycle |
| LCD display | 4 lines x 16 characters |
| Timer | |
| Maximum number | Ladder: 31; FBD: 500 |
| Timing range | 0.01 s–9999 min |
| Counter | |
| Maximum number | Ladder: 31; FBD: 500 |
| Maximum counting range | 999999 |
| Accuracy | 1 |
| RTC | |
| Maximum number | Ladder: 31; FBD: 500 |
| Accuracy | 1min |
| Effective time parameter | Week, year, month, day, hour, minute |
| Comparator | |
| Maximum number | Ladder: 31; FBD: 500 |
| Comparator input | Current value of analog input, timer, counter, temperature input, analog output, analog input parameter, addition and subtraction, multiplication, and division, PID control, multiplexing, ramp function generator, data register and other functional blocks |

| Operating environment | |
|------------------------------|---|
| Protection grade | IP20 |
| Vibration resistance | IEC60068-2-6 0.075mm amplitude/1.0g acceleration |
| Operating temperature | -4° to 122°F (-20° to 50°C) |
| Storage temperature | -40° to 158°F (-40° to 70°C) |
| Operating humidity | 90% RH, no condensation |
| Weight | 8-point module 190g 10-point /12-point module 230g (type C 160g) 20-point module 345g (type C 250g) |
| Safety certification | CUL, CE, UL |
| OVC | OVC II |
| pollution degree | PD2 |
| altitude | less than 2000m |

| Digital input | |
|----------------------------|---|
| Input current | 3.2mA @12/24VDC 1.3mA@100-240VAC |
| Input OFF voltage | 24VDC: < 5VDC 100-240VAC: < 40VAC |
| Input ON voltage | 24VDC: > 15VDC 100-240VAC: > 79VAC |
| Input ON delay | 24VDC: 5ms 240VAC: 25ms 120VAC: 50ms |
| Input OFF delay | 24DC: 3ms 240VAC: 90/85ms 50/60Hz; 120VAC: 50/45ms 50/60Hz |
| Input characteristics | PNP, 3-wire |
| High-speed input frequency | 10kHz |
| General input frequency | < 40 Hz |
| Protection | Reverse voltage protection required |
| Wire specification | 14AWG/0.8NM |
| RS485 Wire specification | 14AWG/0.8NM |

| Analog input | |
|--------------------------|--|
| Specification | DC host module: 12bits Extended analog input module: 12bits |
| Analog input range | DC host module: 0~10V DC voltage input Extended module: 0~10V voltage input or 0~20mA current input |
| Input signal OFF voltage | < 5VDC (same with 24VDC type digital input) |
| Input signal ON voltage | > 9.8VDC (same with 24VDC type digital input) |
| Isolation | None |
| Short-circuit protection | Provided |
| Analog input quantity | Host module: A1~A4 |

| | |
|--------------------|------------------------|
| | Extended module: A5~A8 |
| Wire specification | 14AWG/0.8NM |

| Relay output | |
|-----------------------|---------------------------|
| Contact medium | Ag Alloy |
| Current level | 8A |
| Maximum load | Resistive load: 8A /point |
| Maximum response time | 15ms (general condition) |
| Life | 100k times of operation |
| Minimum load | 16.7mA |
| Wire specification | 14AWG /0.8NM |
| Power specification | 0-240VAC |

| Transistor output | |
|-------------------------------------|-----------------------------|
| Maximum frequency of PWM output | 1.0kHz (0.5ms on,0.5ms off) |
| Maximum frequency of general output | 100Hz |
| Power specification | 30VDC |
| Current capacity | 0.5A |
| Maximum load | Resistive load: 0.5A/point; |
| Minimum load | 0.2mA |
| Wire specification | 14AWG /0.8NM |

Type selection form

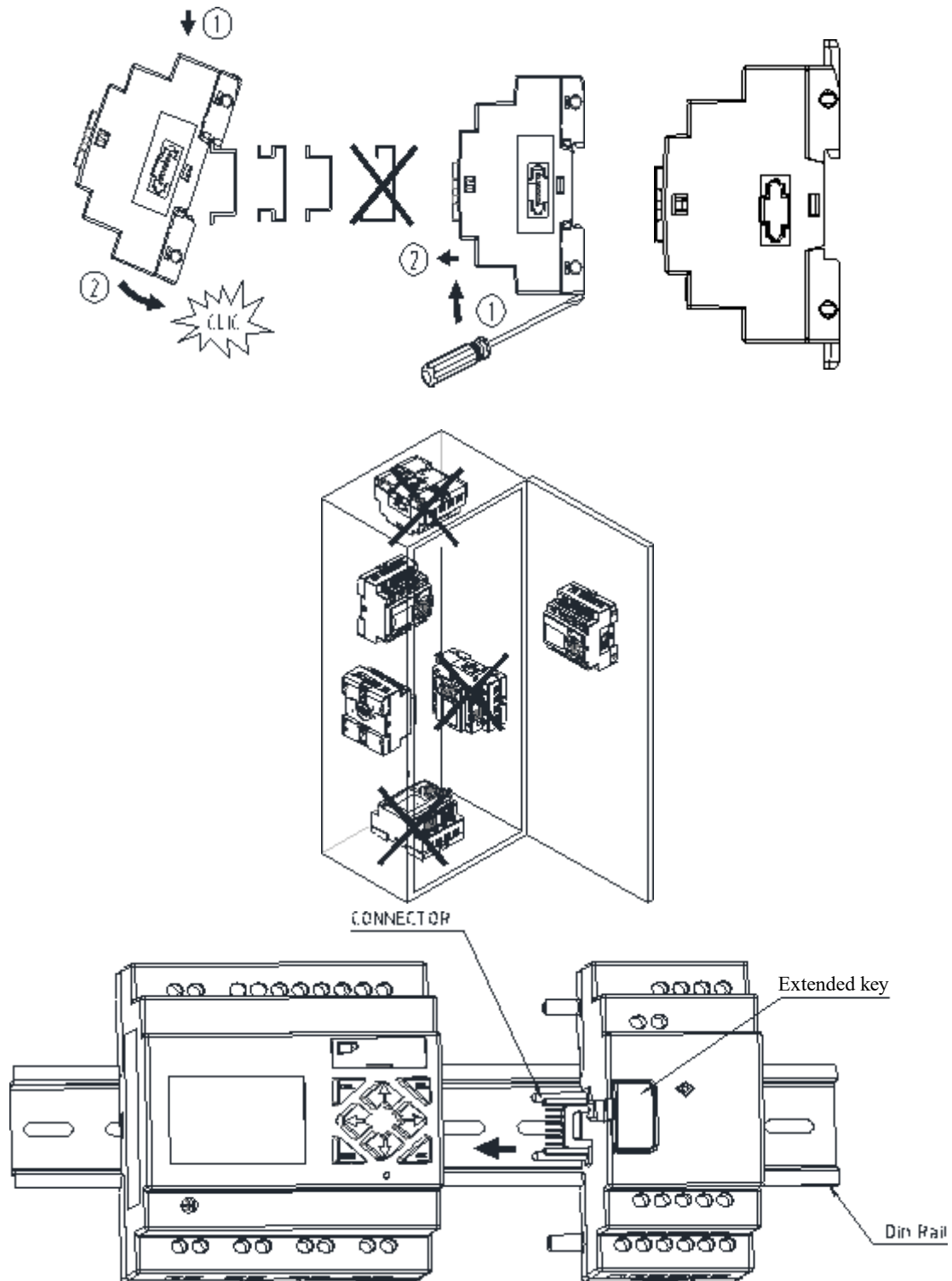
| | Part Number | Power | Digital In | Digital Out | Analogue In | Analogue Out | HMI | Comments |
|---------------------|-------------|------------|------------|--------------|-------------|--------------|-----|----------------------------------|
| BASE MODELS | SMT4-EA-R10 | 100-240VAC | 6 AC | 4 (8A Rly) | - | - | Yes | |
| | SMT4-EA-R20 | 100-240VAC | 12 AC | 8 (8A Rly) | - | - | Yes | |
| | SMT4-ED-R12 | 12-24VDC | 8 DC*1 | 4 (8A Rly) | 2 (0-10V) | - | Yes | 2 High Speed Inputs (up to 1kHz) |
| | SMT4-ED-R20 | 12-24VDC | 12 DC*1 | 8 (8A Rly) | 4 (0-10V) | - | Yes | 2 High Speed Inputs (up to 1kHz) |
| | SMT4-BD-R12 | 12-24VDC | 8 DC*1 | 4 (8A Rly) | 2 (0-10V) | - | No | 2 High Speed Inputs (up to 1kHz) |
| | SMT4-BD-R20 | 12-24VDC | 12 DC*1 | 8 (8A Rly) | 4 (0-10V) | - | No | 2 High Speed Inputs (up to 1kHz) |
| | SMT4-CD-R20 | 12-24VDC | 12 DC*1 | 8 (8A Rly) | 4 (0-10V) | - | Yes | 2 HSI (1kHz), RS485 Modbus, Link |
| EXPANSIONS / EXTRAS | SMT-MA-R8 | 100-240VAC | 4 AC | 4 (8A Rly) | - | - | - | Maximum 3 per Base Unit |
| | SMT-MD-R8 | 24VDC | 4 DC | 4 (8A Rly) | - | - | - | Maximum 3 per Base Unit |
| | SMT-MD-T8 | 24VDC | 4 DC | 4 (0.5A Trn) | - | - | - | Maximum 3 per Base Unit |
| | SMT-MD-4AI | 24VDC | - | - | 4 (V, mA) | - | - | Maximum 1 per Base Unit |
| | SMT-4PT | 24VDC | - | - | 4 (PT100) | - | - | Maximum 1 per Base Unit |
| | SMT-2AO | 24VDC | - | - | - | 2 (V, mA) | - | Maximum 2 per Base Unit |
| MADE TO ORDER | SMT4-BD-T12 | 24VDC | 8 DC*1 | 4 (0.5A Trn) | 2 (0-10V) | - | No | 2 PWM (0.5kHz) |
| | SMT4-BD-T20 | 24VDC | 12 DC*1 | 8 (0.5A Trn) | 4 (0-10V) | - | No | 2 PWM (0.5kHz) |
| | SMT4-BA-R10 | 100-240VAC | 6 AC | 4 (8A Rly) | - | - | No | |
| | SMT4-BA-R20 | 100-240VAC | 12 AC | 8 (8A Rly) | - | - | No | |
| | SMT4-ED-T12 | 24VDC | 8 DC*1 | 4 (0.5A Trn) | 2 (0-10V) | - | Yes | 2 PWM (0.5kHz) |
| | SMT4-ED-T20 | 24VDC | 12 DC*1 | 8 (0.5A Trn) | 4 (0-10V) | - | Yes | 2 PWM (0.5kHz) |
| | SMT4-CD-T20 | 24VDC | 12 DC*1 | 8 (0.5A Trn) | 4 (0-10V) | - | Yes | 2 PWM (0.5kHz), RS485 Modbus |

- ✘ In case of standard module, there will be Keypad and LCD display, and the maximum I/O points may be increased by 4 points of Keypad input Z01~Z04.
- ✘ Refer to [Chapter VI: Hardware Specification](#) for details on the models.
- ✘ SMT is compatible with SMT module.

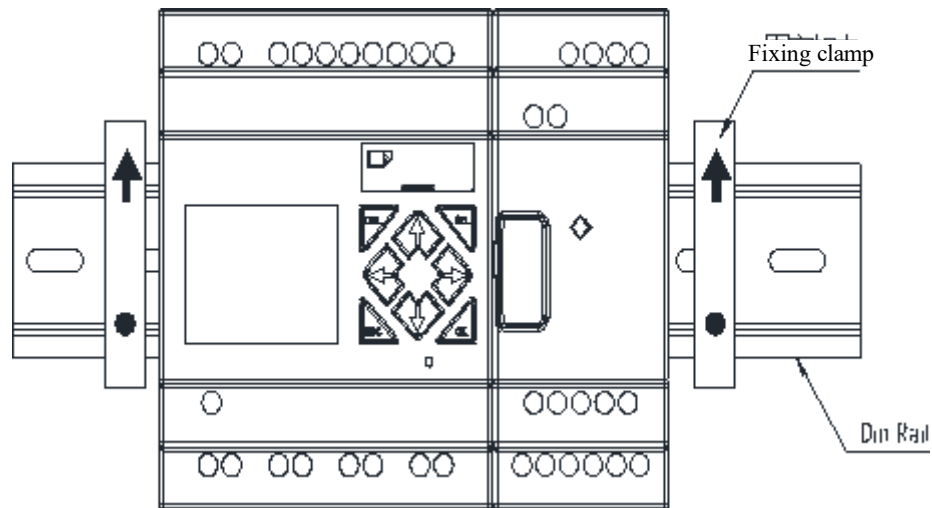
Installation and fixing

DIN-rail fixing

SMT controller may be fixed directly with DIN-rail. After the mounting support in the back of SMT host or extended module is pulled out, the module can be fixed on the rail, and the extended module be connected to the host with expansion connector (press the button as shown below). SMT can be used alone or with a module.

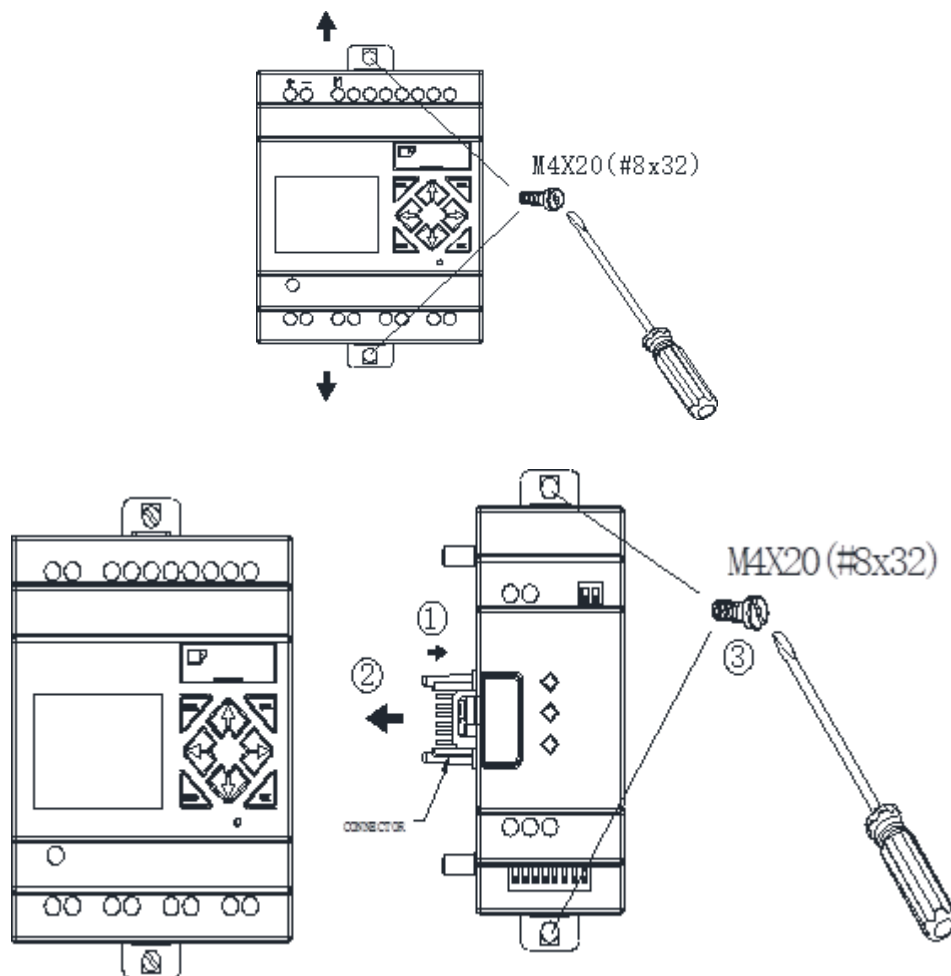


It is suggested that a clamp be mounted at the rail end to fix SMT on the rail (as shown below).



Direct fixing

Pull out the mounting support in the back of module and use M4 screws for fixing SMT directly (as shown below). For installation of extended module, the module should be moved, connected with the host and fixed with screws after the host is properly fixed.



Wiring

⚠ Output/input signal wire should not be parallel to high-voltage power line or placed in the same duct with such line.

⚠ It is suggested that fast acting fuse or circuit protector be connected in each output section to avoid short circuit.

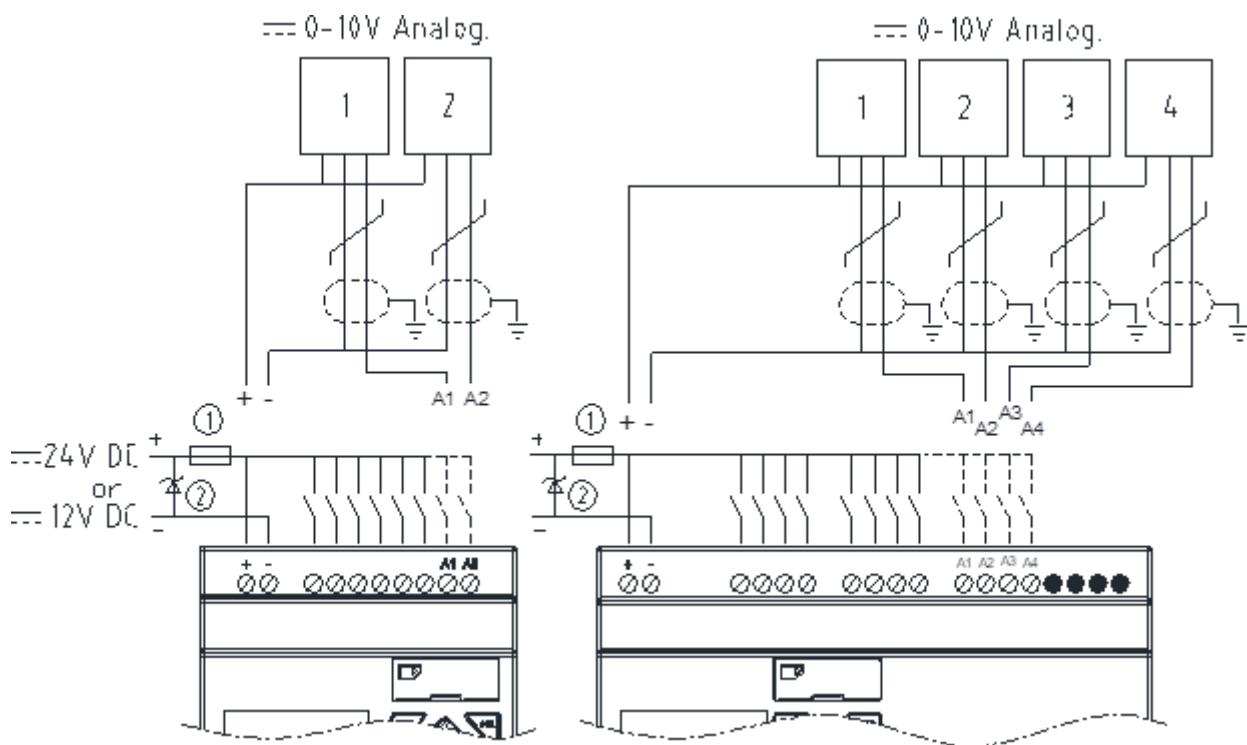
⚠ Power and Signal cables should be selected by the following conditions:

Use Copper Conductors Only, and minimum temperature rating of the cable to be connected to the field wiring terminals, 105°C.

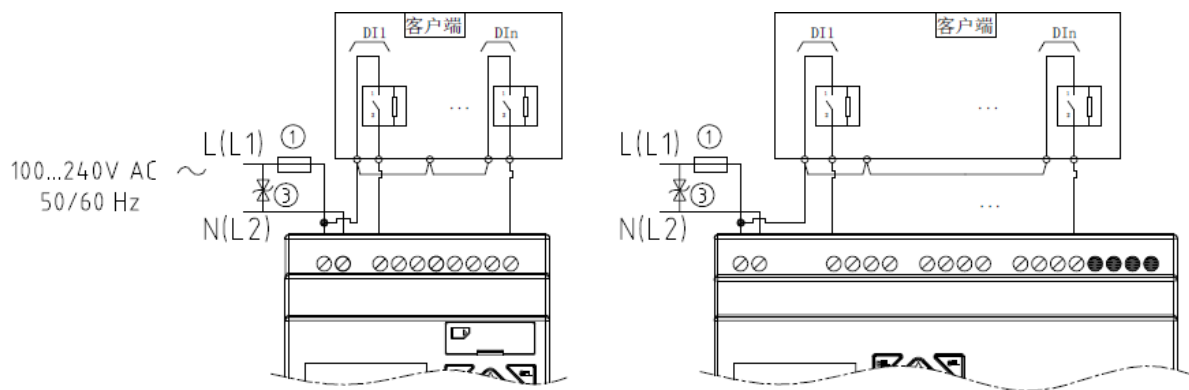
⚠ Les câbles d'alimentation et de signal doivent être sélectionnés selon les conditions suivantes :

Utilisez uniquement des conducteurs en cuivre et une température minimale du câble à connecter aux bornes de câblage sur le terrain, 105 ° C.

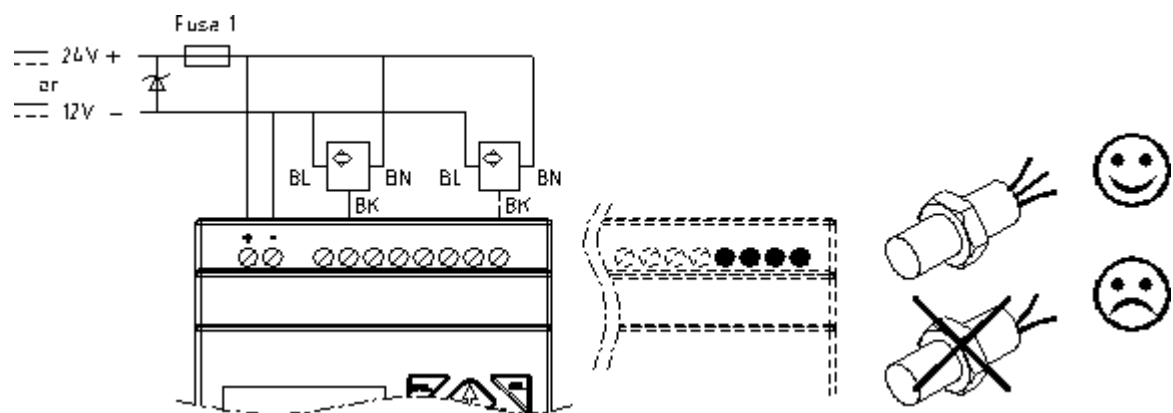
24V DC input wiring



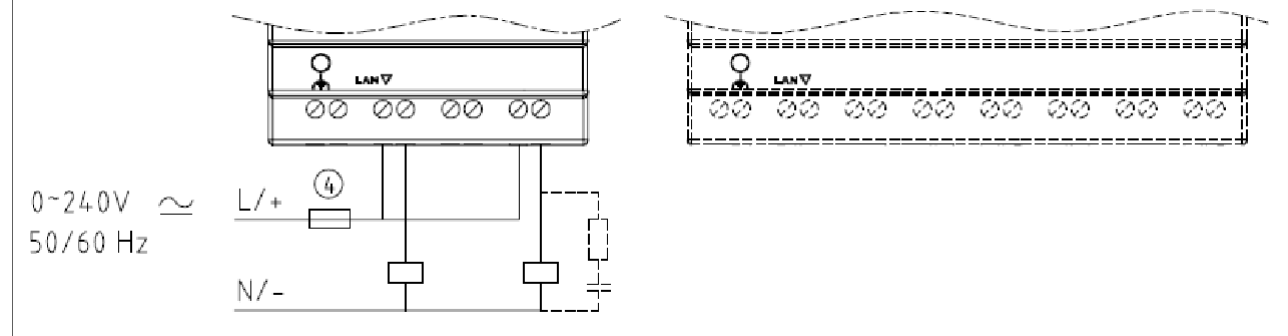
100~240V input wiring



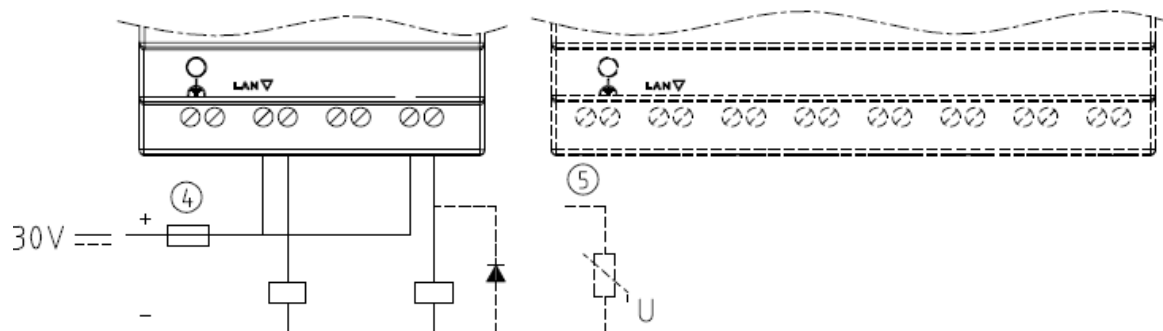
12/24V input wiring

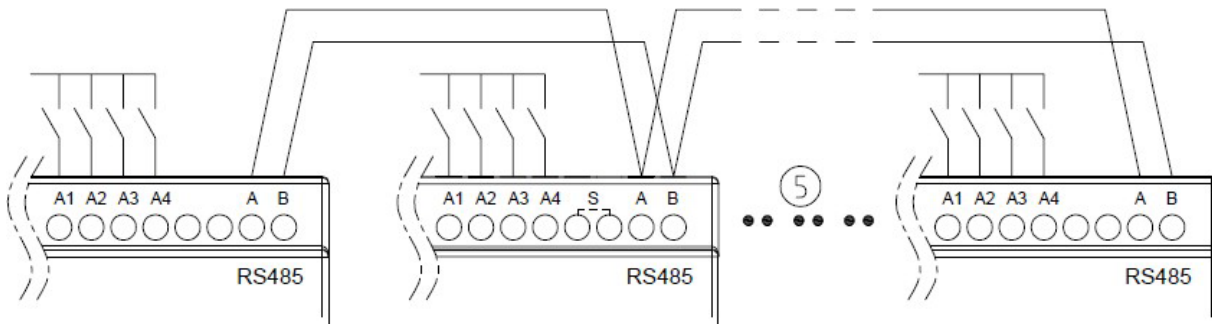


Relay output wiring



Transistor output wiring



IO Link or remote IO Link (for RS485 type only)

Common ground is provided for SMT power supply and I/O port inside.

When used as IO Link, it can be connected to 8 machines (ID: 0~7) at most.

When used as Remote I/O, it can be connected to 2 machines (host & slave) at most.

※ Refer to [Chapter VIII: Functional Specification of RS485 high-performance Type](#) for details of RS485 type.

- ① - 1A fast acting fuse
- ② - Surge absorber (43V DC)
- ③ - Surge absorber (input 100~240VAC; 430V AC)
- ④ - Fuse
- ⑤ - Applicable standard: EIA RS-485.

Fuse description

When using SMT machine, fuse must be prepared by customer.

Fuse category is JDDZ,1A.CLASS CC.

Battery installation instructions

SMT machine has battery installation slot on the back, the factory machine does not install batteries, customers need to install according to the need.

The battery model is CR1220.



To avoid explosion or fire, install the correct type of battery.

La machine SMT a un emplacement d'installation de batterie à l'arrière, la machine d'usine n'installe pas de batteries, les clients doivent installer en fonction des besoins.

Le modèle de batterie est CR1220.



Pour éviter une explosion ou un incendie, installez le bon type de batterie.

Indicator

There is an indicator light to indicate the status of iSmart (B type) smart, and the below table shows the relationship between the light and the iSmart status

| Status | Description |
|-------------------|---|
| Green normally on | SMT is in standby state after power-on |
| Green blinking | SMT is in running state |
| Red blinking | RTC error |
| Red normally on | System program error Brown-out circuit error User program not available Logic error of FBD program Extended I/O error |

Chapter 3 Programming Tool

| | |
|--|----|
| Chapter 3 Programming Tool..... | 28 |
| PC programming software SMT Client..... | 29 |
| Install the software | 29 |
| Start screen..... | 29 |
| Ladder programming environment..... | 30 |
| Menu, icon and status display | 31 |
| Programming..... | 32 |
| Simulation mode | 33 |
| Establish the connection..... | 34 |
| Write program | 35 |
| Online monitoring | 36 |
| Run menu..... | 37 |
| HMI/TEXT..... | 39 |
| Program comment | 43 |
| AQ analog output setting..... | 45 |
| 3-column input/5-column input..... | 46 |
| DR data register setting | 47 |
| View menu | 50 |
| FBD programming environment | 51 |
| Menu, icon and status bar..... | 52 |
| Programming..... | 53 |
| Simulation mode | 54 |
| Online monitoring | 55 |
| Program comment and parameter list..... | 56 |
| LCD display and keys..... | 57 |
| Keys | 57 |
| Initial screen..... | 59 |
| Main menu screen..... | 63 |
| RTC summer time/winter time setting..... | 68 |
| System error display and action | 73 |

PC programming software SMT Client

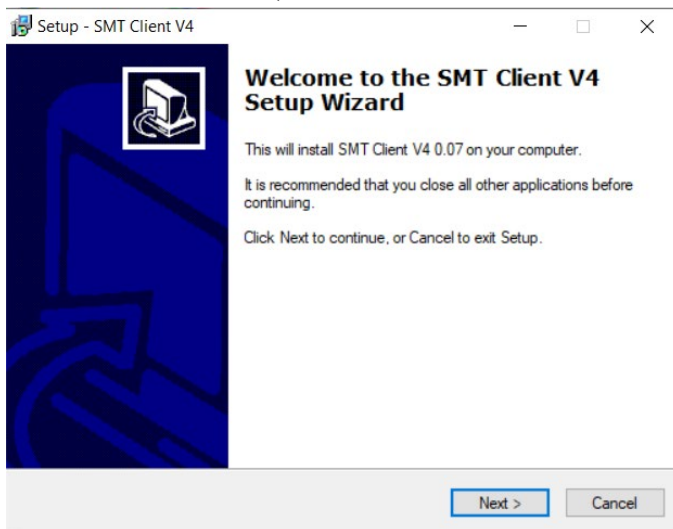
The programming software SMT Client has two editing modes: Ladder diagram (Ladder) and functional block diagram (FBD).

SMT Client is characterized as below:

1. Program can be established and edited simply and easily.
2. Program can be saved in PC and reused, or directly uploaded from SMT for saving or editing
3. Program can be printed for reference.
4. SMT program can be tested in the simulation mode while it is not downloaded.
5. IO state can be monitored on a real-time basis or changed forcibly while SMT is in the running mode.

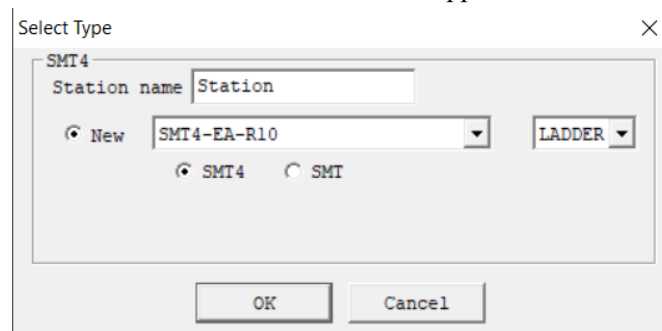
Install the software

Install the SMT Client (free download from the IMO website):



Start screen

Start the software SMT Client when the start screen below appears to enable the following operations:



Create ladder diagram

Select the menu “File (F) → New (N) → ladder” and enter a new ladder diagram (Ladder) program editing environment.

Create FBD

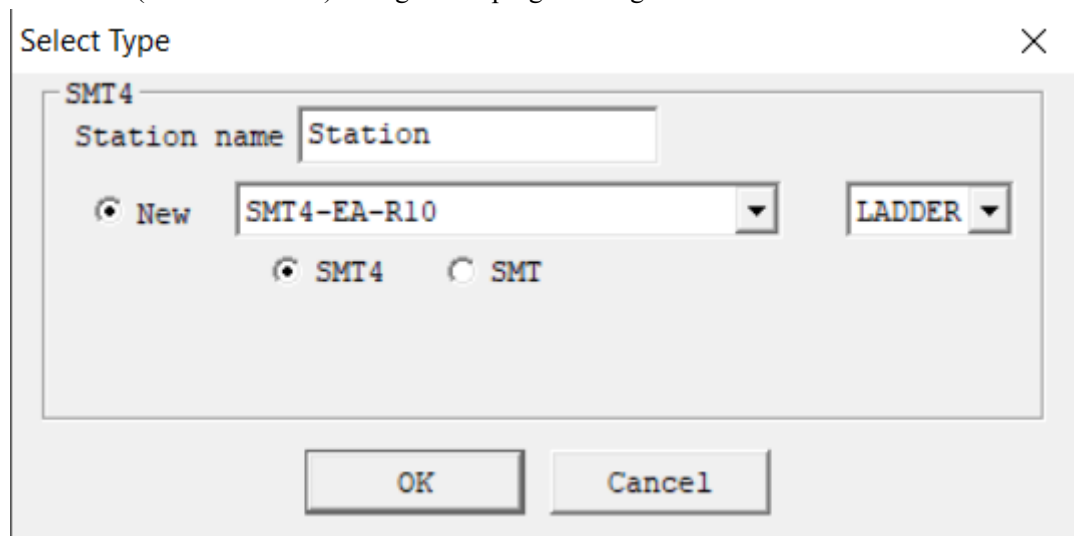
Select the menu “File (F) → New (N) → FBD” and enter a new functional block diagram (FBD) program editing environment.

Open an existing file

Select the menu “File (F) → Open (O)”, choose a file (FBD or Ladder type) to be opened, select the file name and click to open it.

Ladder programming environment

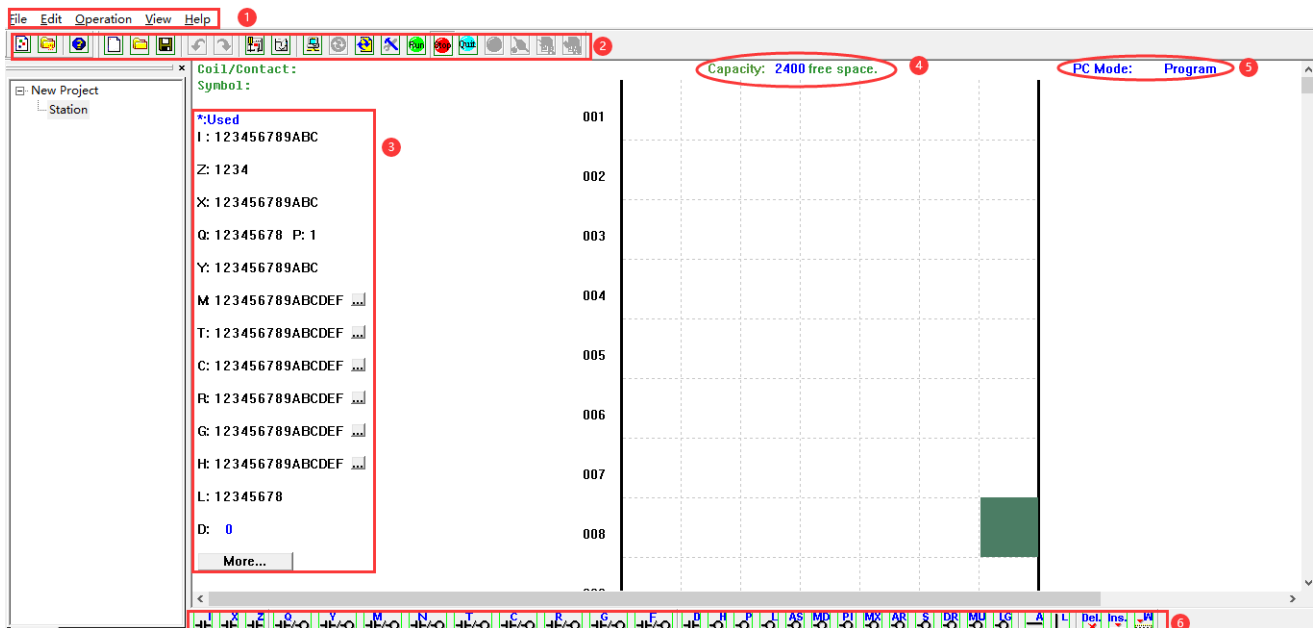
The Ladder programming environment includes all programming and simulation functions. Select the menu “File (F) —> New (N)”, choose the Ladder mode and SMT type, set the number of extended connections, and select the corresponding SMT version (as shown below) to begin new programming.



Menu, icon and status display

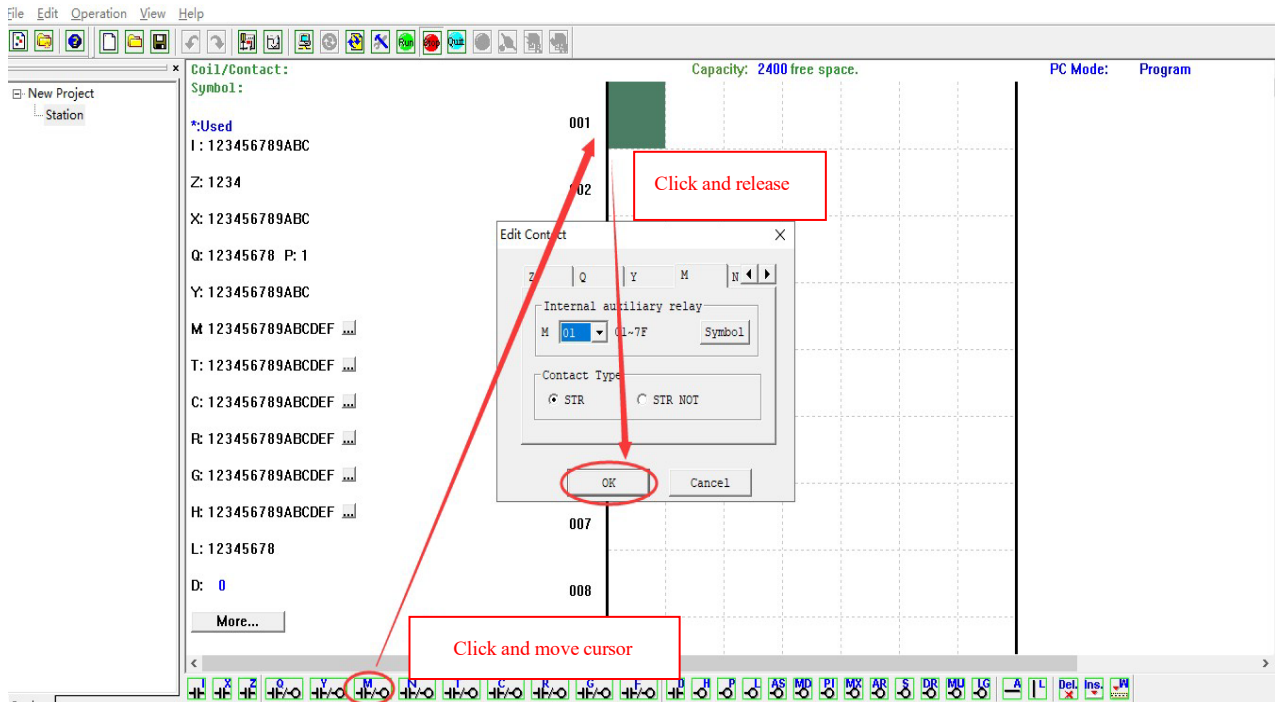
Ladder programming environment includes the following menu, icon and status display.

1. Menu bar: 5 menu options, including File, Edit, Operation, View and Help; for SMT communication setting, special functions, display setting, help information and other functions are configured.
2. Tool bar: The icons from left to right are:
Creating a new project, opening an existing project, saving the project and printing the project;
Keypad, LADDER programming interface, HMI/Text editing, symbol (comment) editing
Monitoring, simulation, simulation control, change of control mode (run, stop, quit), reading program from SMT, writing program to SMT.
3. List of used resources: The resources used by the current program are listed and marked with “*” below each used coil or functional block.
4. Free space available for the program.
5. Current mode display: Programming mode, simulation mode and monitoring mode
6. Ladder tool bar: Coil and functional block instructions can be selected for editing.

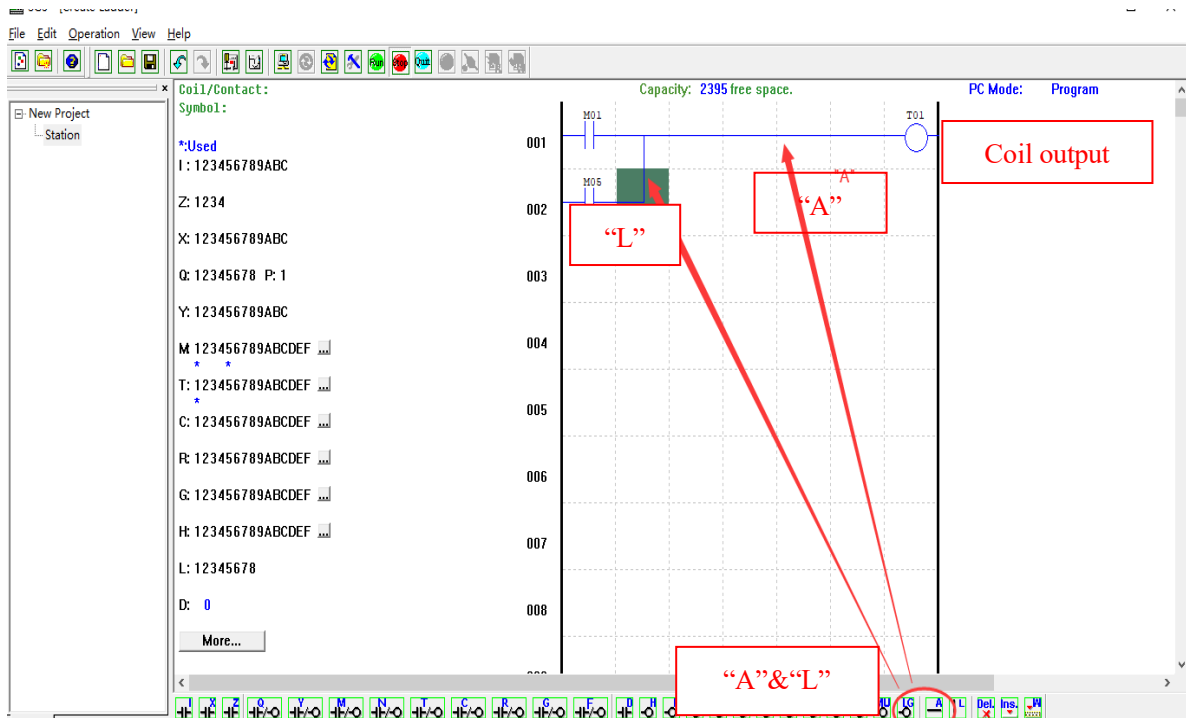


Programming

The icon can be clicked or keys on the keyboard be used for programming with SMT Client. The program instructions are illustrated below.

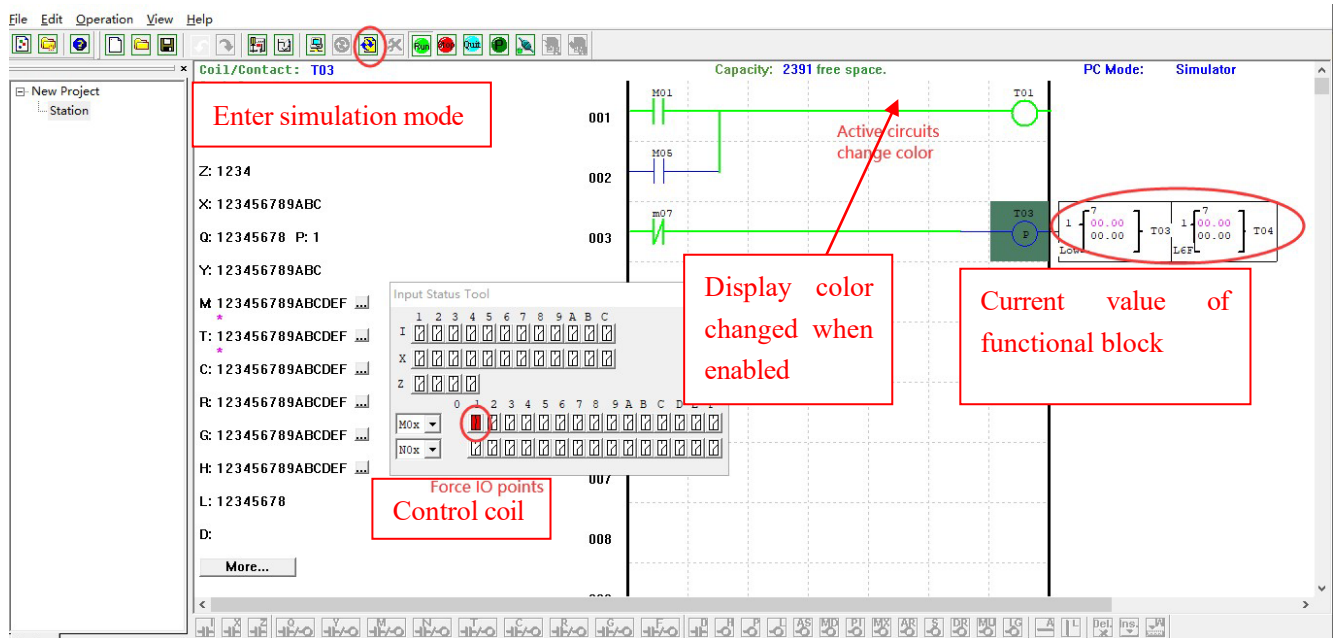


Use the key or symbol “A” and “L” and connect various coils; the rightmost is the programming column of output coil.



Simulation mode

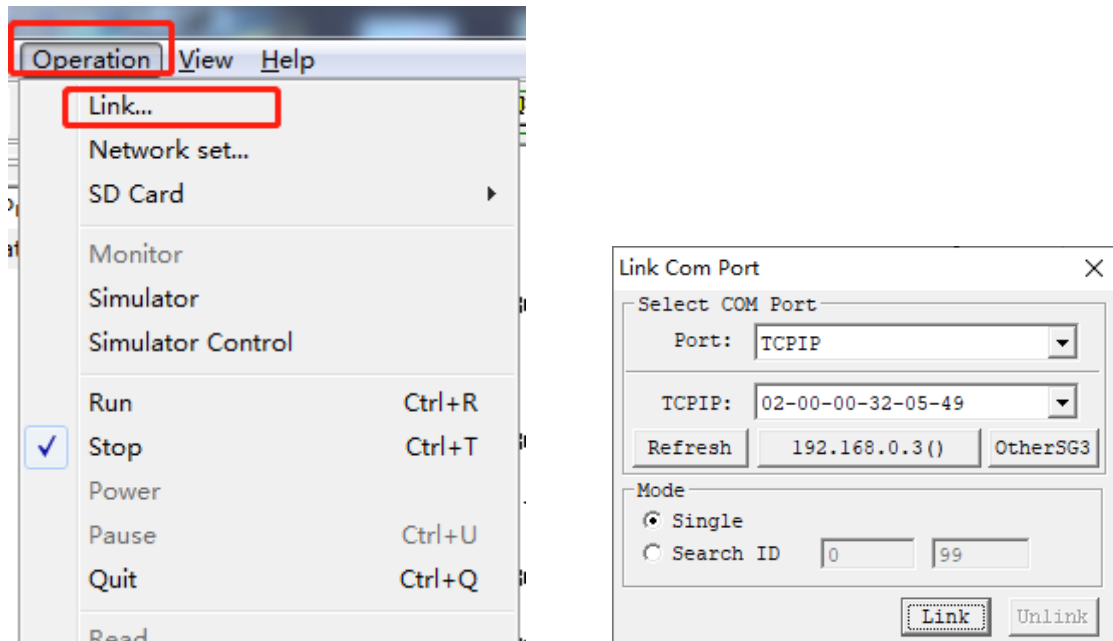
SMT Client has built-in simulation test function to enable simulation test and debugging of program while it is not downloaded to SMT controller. While SMT Client is not connected to the controller, click the icon RUN to enter the simulation mode, as shown below. Some display characteristics in the simulation mode are also shown below.



Establish the connection

The procedures for establishing the connection between PC programming software and SMT controller are described below:

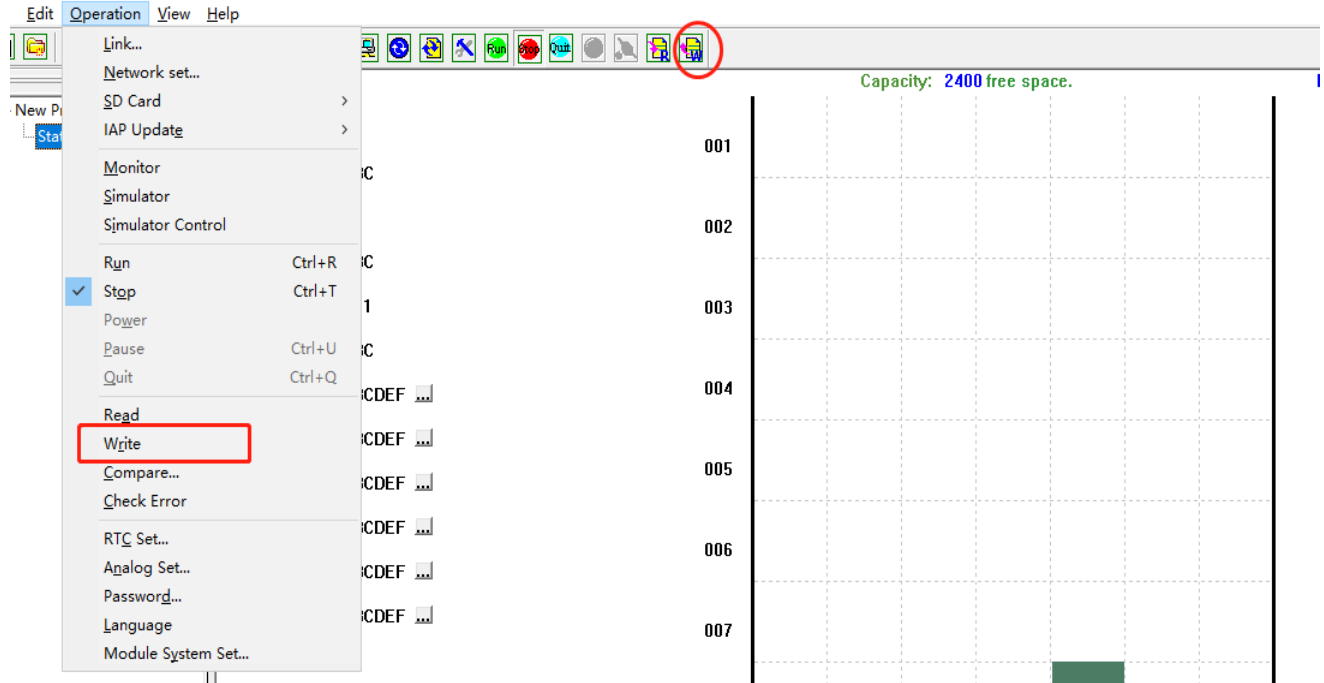
- a. Select “Operation—> Link...” in the menu, when the serial port selection window pops up, as shown below.



- b. Configure the correct IP address of PC and SMT device, select the correct TCPIP of the connection between SMT controller and PC, and click “Connect”.
- c. The PC Client programming software is automatically connected with SMT controller.

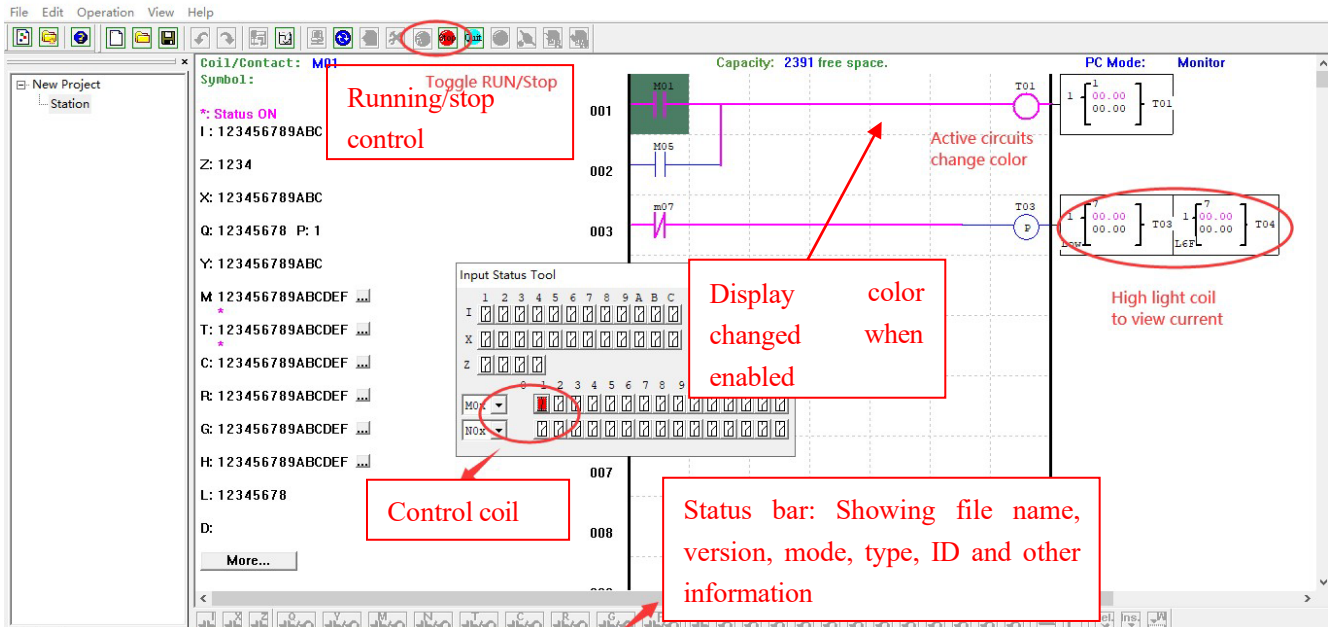
Write program

As shown below, click the menu “Operation—> Write” to write the edited program into the connected SMT controller; or click the icon WRITE in the programming tool bar to write the program.



Online monitoring

SMT programming software allows online monitoring of the running program state, forced control of IO state and change of mode (Run, Stop or Exit).



- ※ SMT does not support online change of program control logic in the running mode. All logic editing (including coil, timer, counter and functional connection) must be written while SMT is in the stop mode.

Run menu

The Run menu includes some system setting functions to enable function setting while SMT is connected or not connected. The detailed reference is listed below:

| Run menu | Function description |
|-----------------------|---|
| Link | Select the communication port of PC software and controller; |
| Network set | Set network communication related parameters, and network input/output map; |
| SD Card | Set storage card operation; |
| Monitor | Run online monitoring function and change coil state when SMT is connected; |
| Simulator | Test and debug program while SMT is not connected; |
| Simulator Control | Set user-defined control of simulation; |
| Run | Change to the running state and enter the monitoring mode while SMT is connected, or enter the simulation mode while it is not connected; |
| Stop | Change to the stop state while SMT is connected, or exit the simulation mode while SMT is not connected, |
| Power | Simulate the power down state in the simulation mode; |
| Pause | Suspend in the simulation mode; |
| Quit | Exit the monitoring/simulation mode; |
| Read | Read program from SMT controller; |
| Write | Write program into SMT controller; |
| Compare | Read program from SMT controller, and compare with the current PC program; |
| Check Error | Check errors in user program; |
| RTC Set | Set real-time clock and summer-time/winter time while SMT is connected; |
| Analog set | Set the gain and offset of analog input A01~A08; |
| Password | Set password to control access to the current program written into SMT; |
| Language | Set the menu display language of SMT controller; |
| Module system setting | Important setting function of SMT system, including module ID, function setting of RS485 type and extended settings; |

As shown in the figure below Compare, RTC Set, Analog Set, Module System Set

Compare

| Index | Line | Differenc Type |
|-------|------|----------------|
| 001 | 001 | Parameter |
| 002 | 003 | Parameter |
| 003 | 301 | Coil |
| 004 | 301 | Coil |
| 005 | 301 | Coil |
| 006 | 301 | Function block |
| 007 | 302 | Coil |
| 008 | 302 | Coil |
| 009 | 302 | Coil |

OK

RTC Set

Time Set

Week: FR PC Clock

Hour:Minute: 17

Year.Month.Day: 21 . 1 . 1

Daylight saving

Mode: NO

Summer

M: 1 D: 0 H: 1

Winter

M: 1 D: 0

Time Zone

☒ Enable UTC: 0

OK Cancel

Analog Set

| Index | Gain(1-999) | Offset(-50~+50) |
|-------|-------------|-----------------|
| A1 | 10 | +0 |
| A2 | 10 | +0 |
| A3 | 10 | +0 |
| A4 | 10 | +0 |
| A5 | 10 | +0 |
| A6 | 10 | +0 |
| A7 | 10 | +0 |
| A8 | 10 | +0 |

OK Cancel

Module System Set

Set ID

Current ID: 1

New ID(00-99): 1

Remote I/O

☒ NO

☐ Master

☐ Slave

Set Expand I/O

I/O Num: 0

☐ I/O Alarm

Others

☒ M Keep

☐ C Keep

☐ Back Light

☐ Z Set

RS485 Set

Comm. Mode: 8/N/2

Baud Rate: 38400

Coil Record

☒ None ☐ M ☐ N

Range: 01-10 SUM=0

DR Format Set

☒ Unsigned

☐ Signed

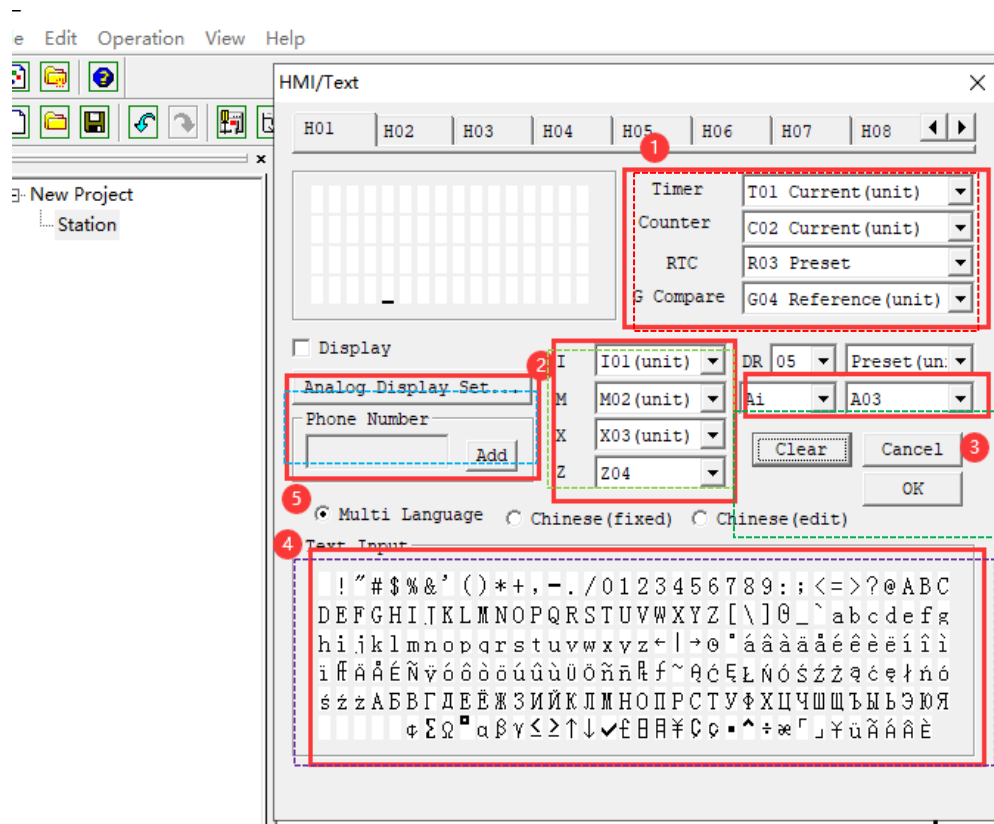
Cancel Set

HMI/TEXT

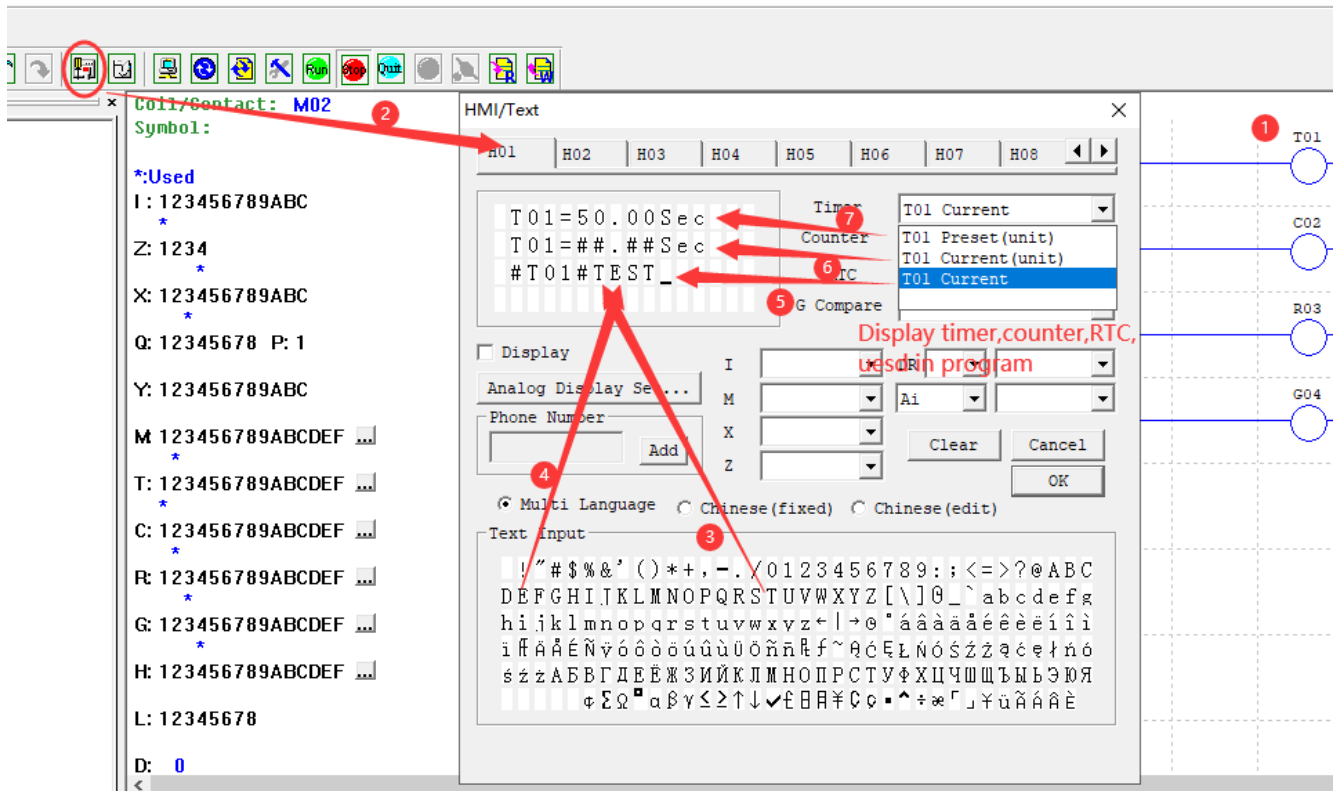
HMI functional blocks: Status information displayed on 16*4 LCD of SMT includes:

1. Current and preset values of functional blocks, including timer, counter, RTC, comparator and DR register; the preset values of these functional blocks can be modified by the displayed HMI in the running mode.
2. Coil status, including input I, key input Z, extended input Z and auxiliary coil M; status of M may be modified by the displayed HMI in the running mode.
3. Analog input and output values, including analog input A, temperature input AT and analog output AQ.
4. Built-in ASCII characters and characters of other languages; 85 built-in Chinese characters; 60 user-defined Chinese characters.
5. Phone number for SMS warning.

Enter HMI/Text editing and parameter setting interface, as shown below:

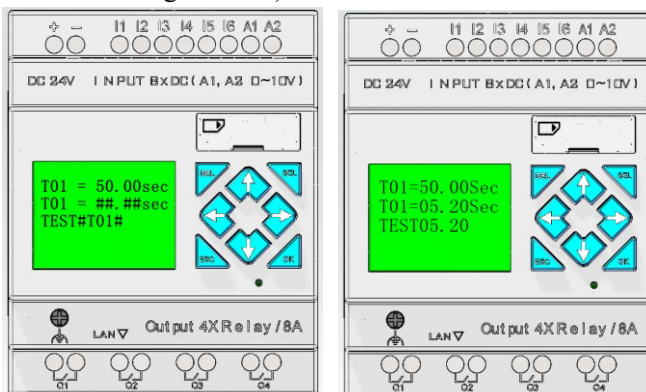


HMI/TEXT editing steps: The steps ①~⑦ are shown and described below:



- ① Enter coil H01.
- ② Enter the HMI/TEXT editing interface.
- ③ Select letter “T”
- ④ Select letter “E”
- ⑤ Select the current value of timer T01
- ⑥ Select the current value of timer T01 (with unit)
- ⑦ Select the preset value of timer T01 (with unit), which can be modified when H01 is displayed on LCD;

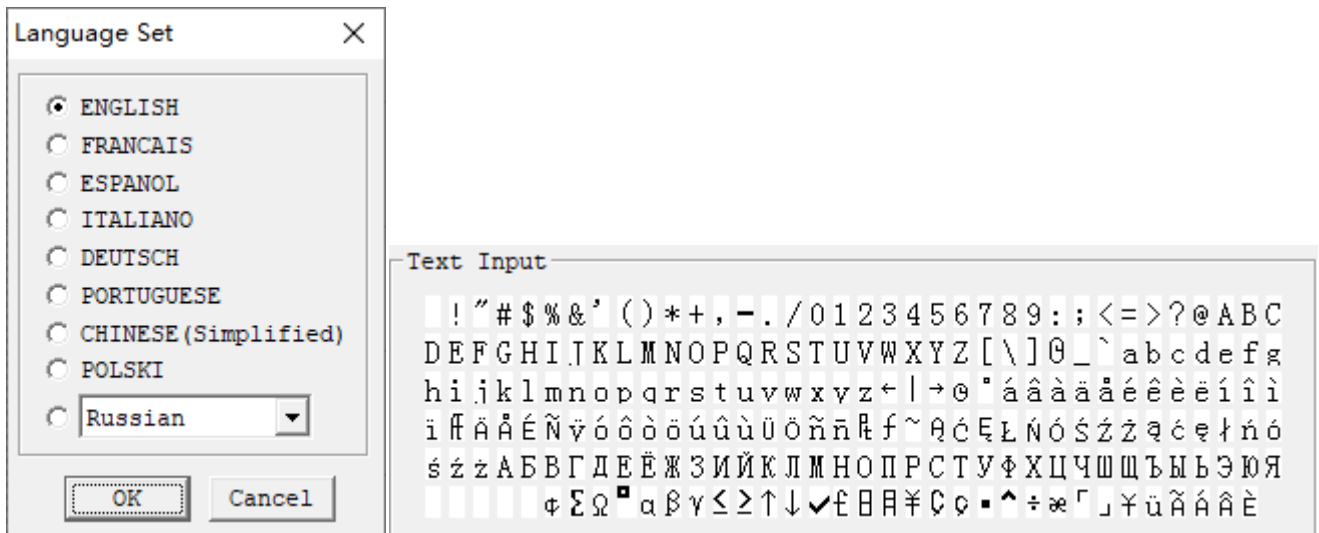
H01 setting mode 1: download program into SMT controller; press the key SEL to display H01 content on LCD when stopped (as shown in the left below); put I01 to ON to enable H01 and display H01 content on LCD during running (as shown in the right below).



- I. Press “↑” or “↓” to select other H coil;
- II. Press “SEL” and then press “↑” or “↓” to change the preset value of T01, and then press “OK” for confirmation (in this example, T01=50.00sec may be modified, and the present value of T01 is edited and displayed on HMI).

Built-in ASCII characters and other languages:

There are various built-in languages, including English, French, Spanish, Italian, German, Portuguese and Polish; In addition, it can be set to display in Russian or Turkish characters.

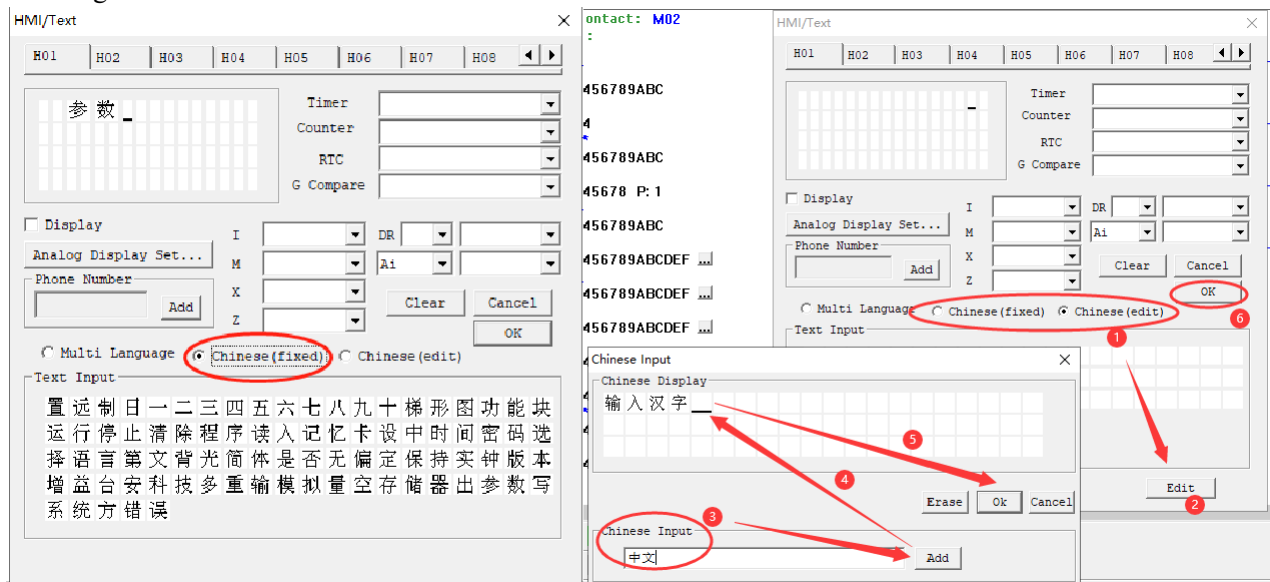


85 built-in Chinese characters: The content is shown in the HMI/TEXT editing window in the left below

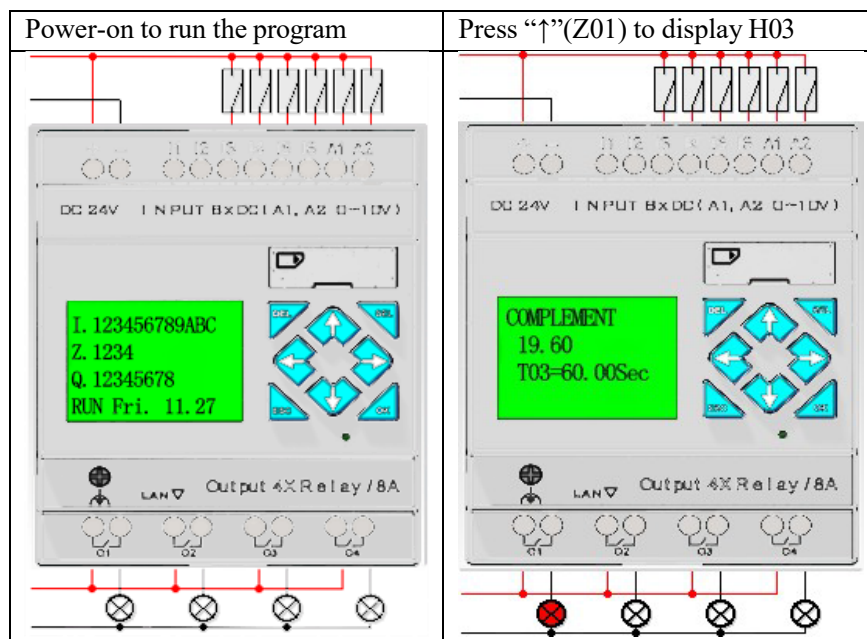
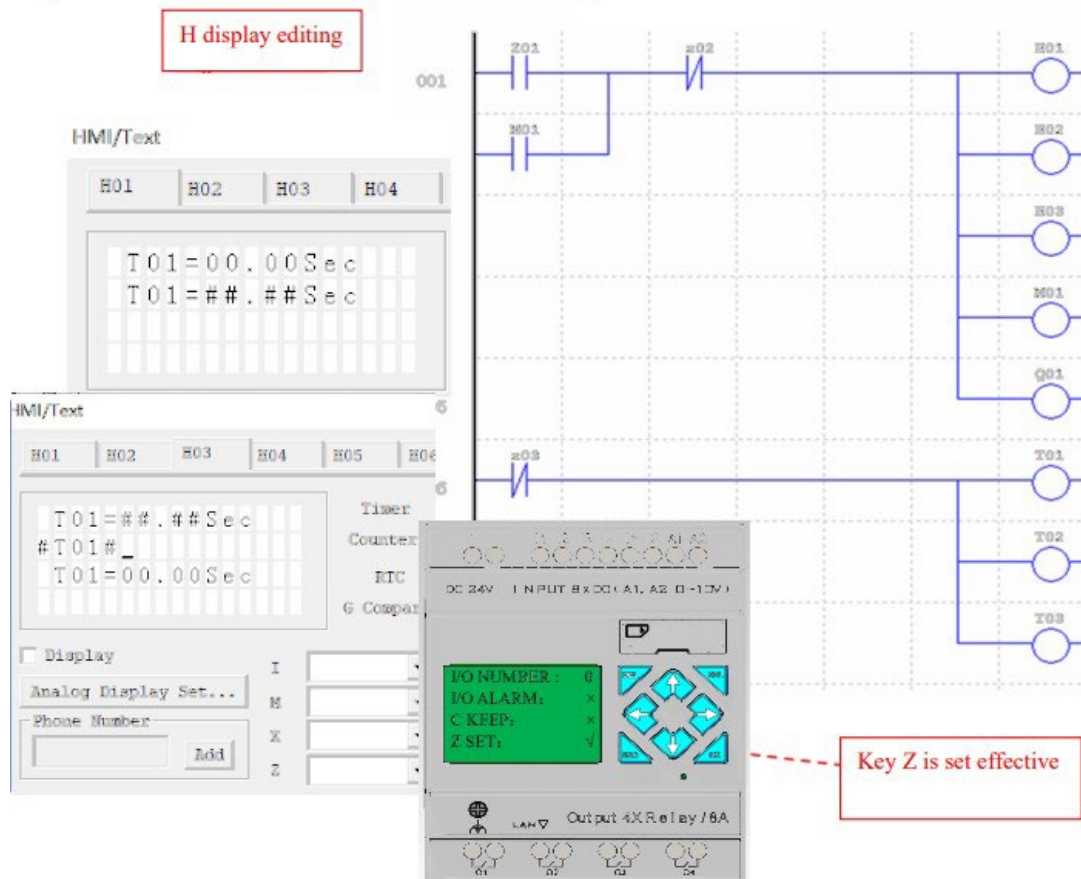
60 user-defined characters: The editing method is shown in the HMI/TEXT editing window in the right below;

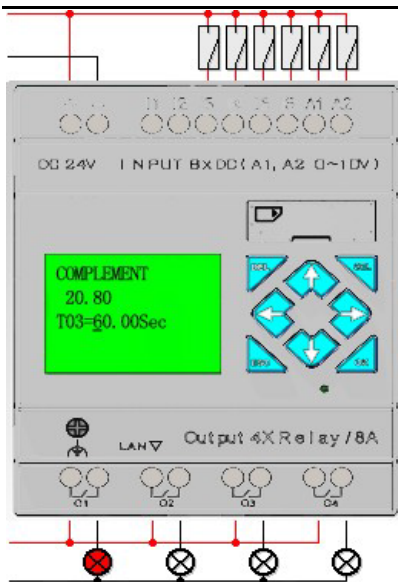
User-defined Chinese input method is described below:

1. Select “Chinese (Edit)”, when a blank or edited “Text input” box appears.
2. Click “Edit”, when the “Chinese input” dialog box appears.
3. Move cursor to “Enter Chinese”, enter user-defined characters, and click “Add”.
4. The user-defined characters are displayed in the “Chinese display” frame.
5. Click “OK” in the Chinese input dialog box, and user-defined Chinese characters are displayed in the HMI edited “Text input” box.
6. Click “OK” in the HMI/TEXT editing interface, and user-defined characters are saved in the user program for calling.

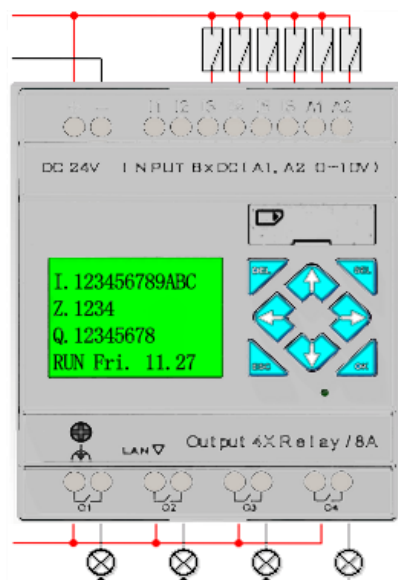


Example: HMI/TEXT function and input function of the key Z





- ① Press “SEL” when the cursor blinks.
- ② Press “↑”, “↓”, “←” or “→” to move the cursor.
- ③ Then press “SEL”, the blinking cursor changes to underline in the editable position.
- ④ Press “↑” or “↓” to change digital value, and press “←” or “→” to confirm the input and move the underline.
- ⑤ Press “OK” to complete editing.



Press “←” (Z02) to disable H03, when the initial screen is displayed on LCD, as shown to the left.

Press “↓”(Z03) to disable timer T01, T02 and T03.

Program comment

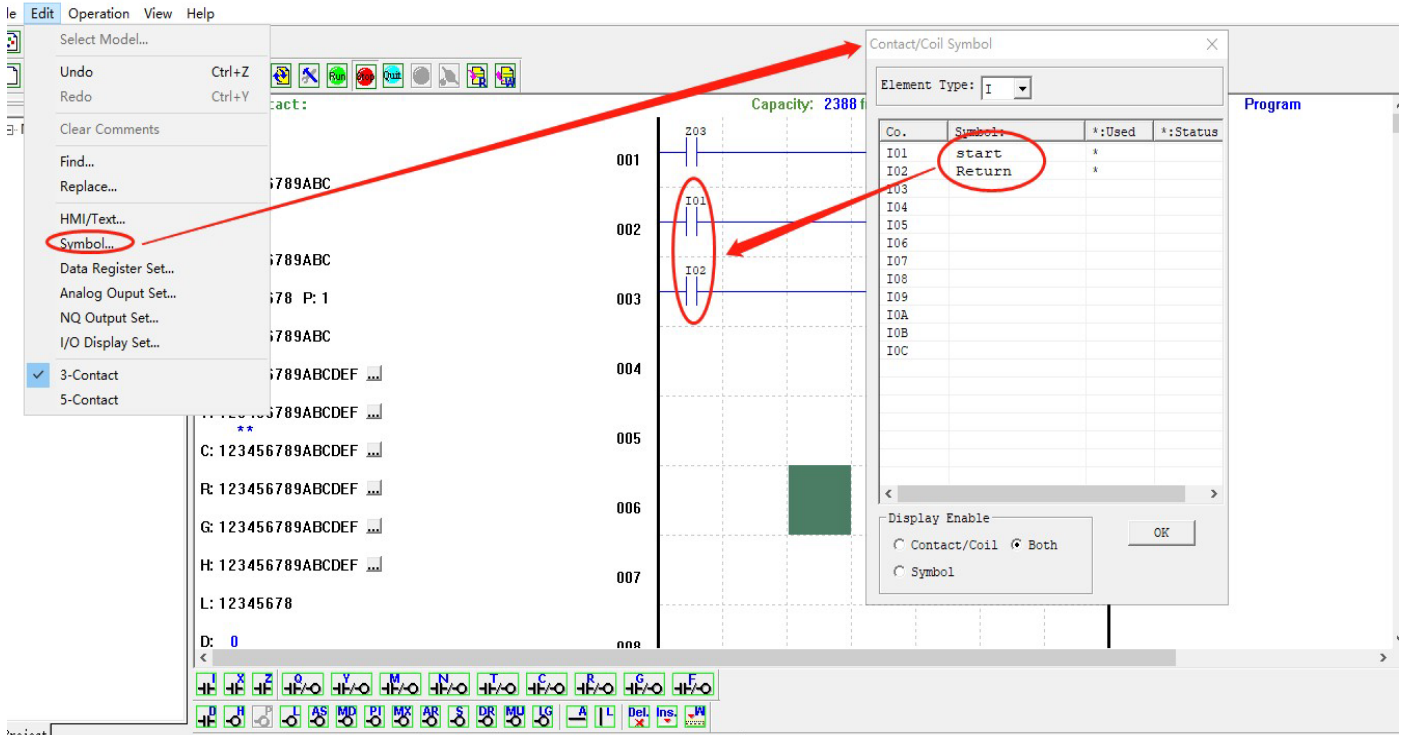
SMT programming software allows editing of comment, including contact coil symbol and full line of comment.

Contact coil symbol uses a form, and each contact coil address allows input of 12 characters (corresponding to 6 Chinese characters) to the maximum.

A line of comment may be used for description of a program function, and each line comment allows input by four lines, with the maximum length of 50 characters in each line. Example of contact coil symbol and line comment is provided below.

Contact/coil symbol

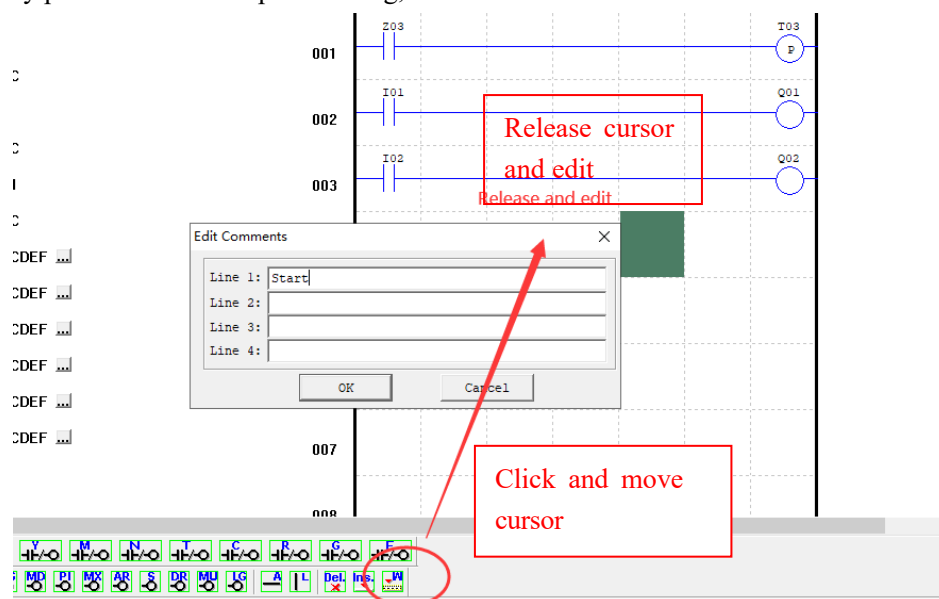
Select the menu “Edit (E) —> Symbol” or click the symbol “...” or “More...” in the resource list for editing of contact/coil symbol; enter symbol in the corresponding number after the coil is selected; the contact/coil symbol editing function enables editing of all coil types and setting of display in the program editing area, as shown below.



Line comment

Click the icon “W” in the Ladder tool bar to enter line comment editing.

After click of “W”, move cursor to the line to be commented, and then click cursor to release it and edit the comment content, and finally press “OK” to complete editing, as shown below.



AQ analog output setting

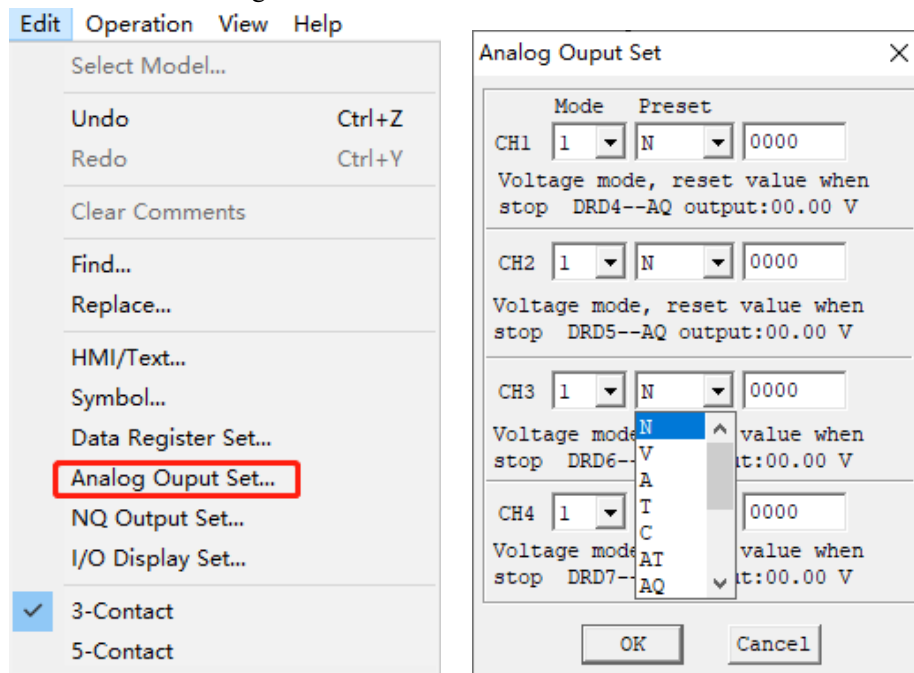
Select the menu “Edit (E)—>Analog Output set” for editing of analog output, as shown in the left below. After the setting dialog box pops up, use channel 1~channel 4 for setting output AQ01~AQ04.

When AQ0x is in the voltage output mode, the preset value range is 0~4095;

When AQ0x is in the current output mode, the preset value range is 0~2047.

The preset value may be a constant or the current value of other data types. See the following diagram for setting of output mode and preset value, and refer to [Chapter IV: Ladder Programming Instructions—AQ analog output instruction](#) for more information about display of output mode and other modes.

The preset value of AQ output mode is stored in the current value of register DRD0~DRD3, and preset value of AQ output in the current value of register DRD4~DRD7.



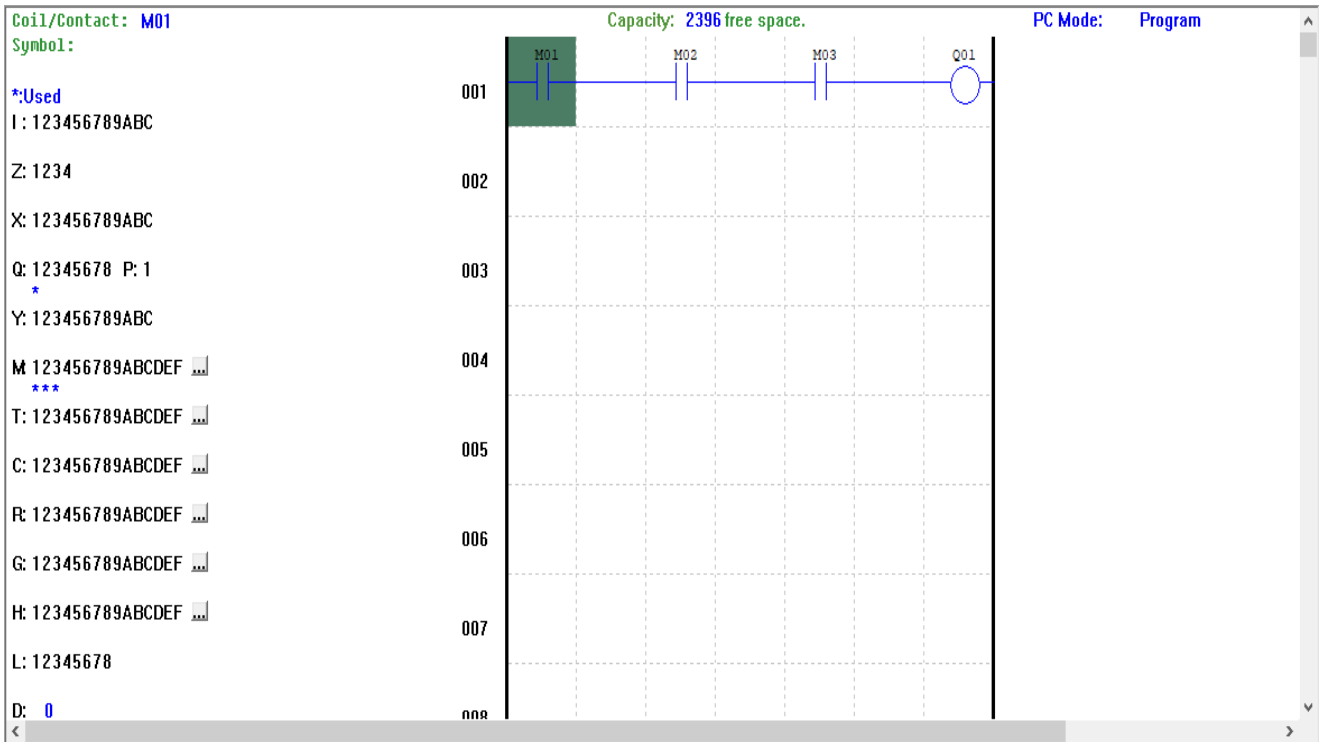
The above register and output are explained below:

| | Mode register | Output register | AQ output |
|-----------|---|---|---|
| Channel 1 | DRD0=0 AQ output mode 1: voltage mode, reset to 0 when stopped. | DRD4=3000 | AQ01=732 (DRD4/4.095) AQ output 7.32V; |
| Channel 2 | DRD1=1 AQ output mode 2: current mode, reset to 0 when stopped. | DRD5=A01*4.095 Current mode 0~2047 | AQ02=A01 Current mode 0~500; |
| Channel 3 | DRD2=2 AQ output mode 3: voltage mode, output maintained when stopped. | DRD6=V01*4.095 Voltage mode 0~4095; | AQ03=V01 Voltage mode 0~1000; |
| Channel 4 | DRD3=3 AQ output mode 4: current mode, output maintained when stopped. | DRD7=2047 | AQ04=500 (DRD7/4.095) AQ output 20.00mA. |

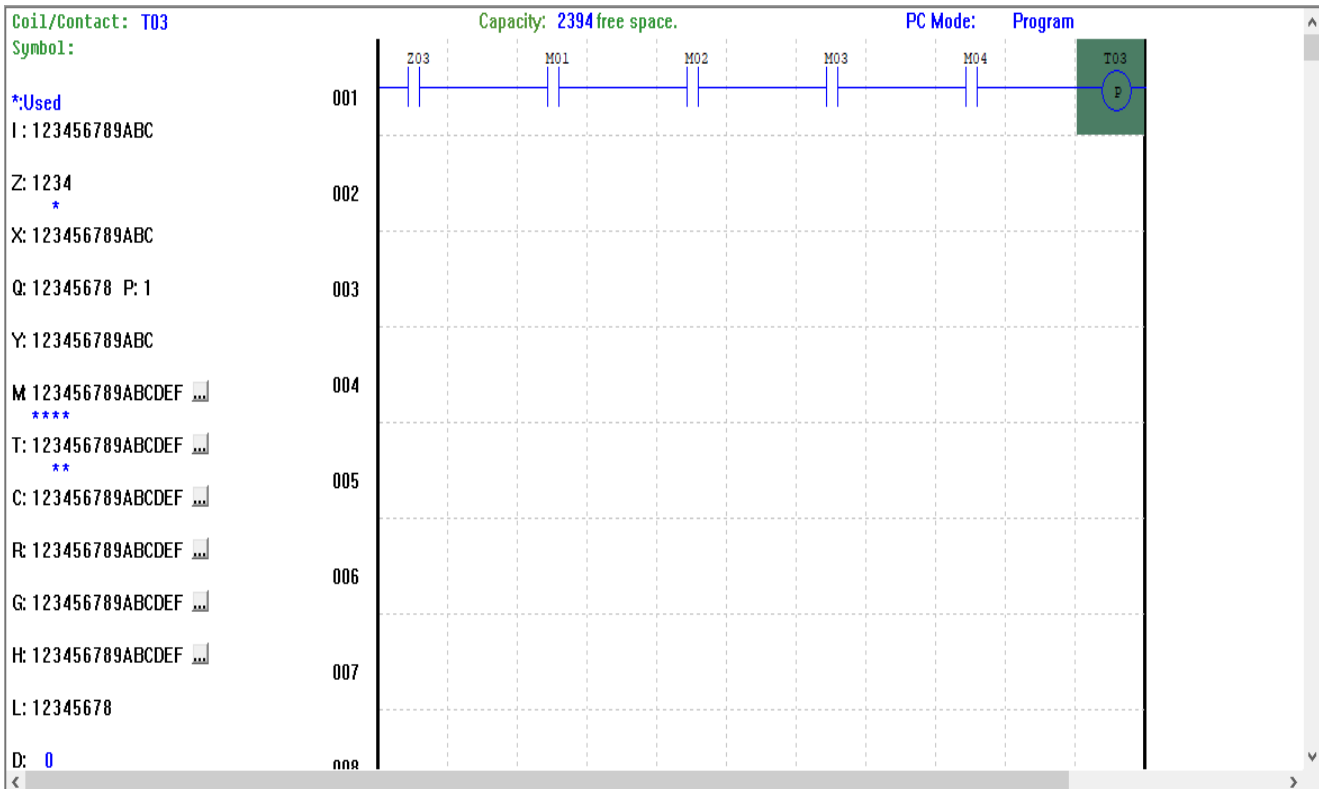
- ※ When the type of preset value of AQ is a constant, value of the corresponding DR register changes, and AQ output value is modified accordingly ($AQx=DRx/4.095$).
- ※ When the type of preset value of AQ is other parameter variable, value of DR register varies with AQ ($DRx=AQx*4.095$).

3-column input/5-column input

The editing mode of 3-column input or 5-column input may be selected in the SMT LADDER programming mode. In the 3-column mode, three input coils and one output coil or functional block may be used in a line of Ladder instruction. The maximum number of lines of program is 500.



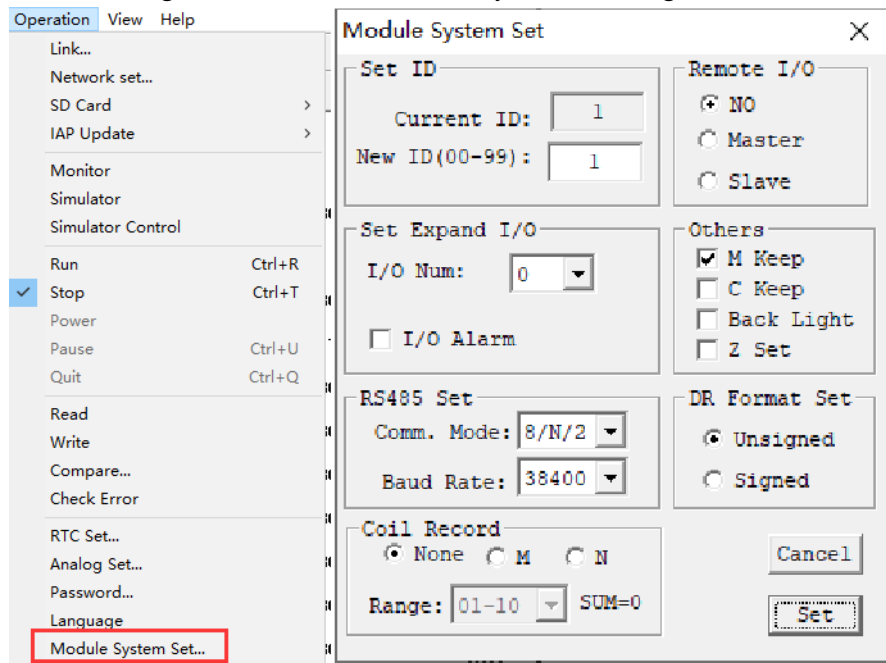
In the 5-column mode, five input coils and one output coil or functional block may be used in a line of Ladder instruction. The maximum number of lines is 300.



In the 3-line mode, it is impossible to change to the 5-line mode when the number of lines edited exceeds 200. In the 5-line mode, it is impossible to change to the 3-line mode when the number of inputs in a line exceeds 3.

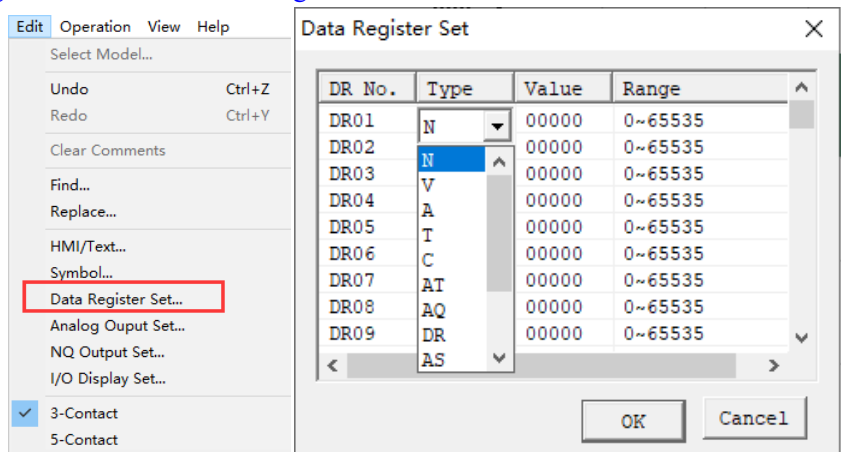
DR data register setting

Data type of DR may be the type with symbol or without symbol, which may be set as shown below.
 For data without symbol, DR range is 0~65535; for data with symbol, DR range is -32768~32767.

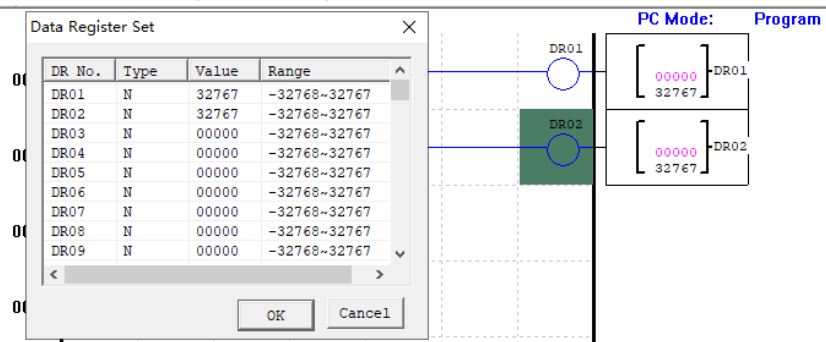


After the above operation, select the menu “Edit (E)—Data Register Set” to enter the setting dialog, as shown below; the preset value of DR may be a constant or the current value of another functional block.

DR should be used according to DR instruction, and some DR has special function definition; refer to [Chapter IV: Ladder Programming Instructions—DR data register instruction](#) for more information.



When DR is data with symbol, “DR data register setting” is shown as below:



Description of special DR function

The current value of DR65~DRF0 may be kept in case of power failure.

When DR is used as a special register, the enabling coil is not to be set. For enabling coil setting of special register under the enabled state ON, the current value of DR register will be covered by the preset value of the register. Therefore, it should be checked whether the current value of DR register is the value required by user when DR special register is used as a general data register in the program.

Specifically, DRD0~DRE3 are special registers for parameter setting. Its function of current value output is described below:

| No. | Function description | |
|------------------|---|--|
| DRD0 | AQ01 mode | 0, voltage mode, output 0 when stopped; 1, current mode, output 0 when stopped. 2, voltage mode, original value kept when stopped. 3, current mode, original value kept when stopped; |
| DRD1 | AQ02 mode | |
| DRD2 | AQ03 mode | |
| DRD3 | AQ04 mode | |
| DRD4 | AQ01 output value 0~4095 | Analog output setting; |
| DRD5 | AQ02 output value 0~4095 | |
| DRD6 | AQ03 output value 0~4095 | |
| DRD7 | AQ04 output value 0~4095 | |
| DRD8 | I/O interface hiding | Refer to “ Chapter III: LCD Display and Keys> initial screen ” for details. |
| DRE1~DRE3 | Standby registers for parameter setting | |

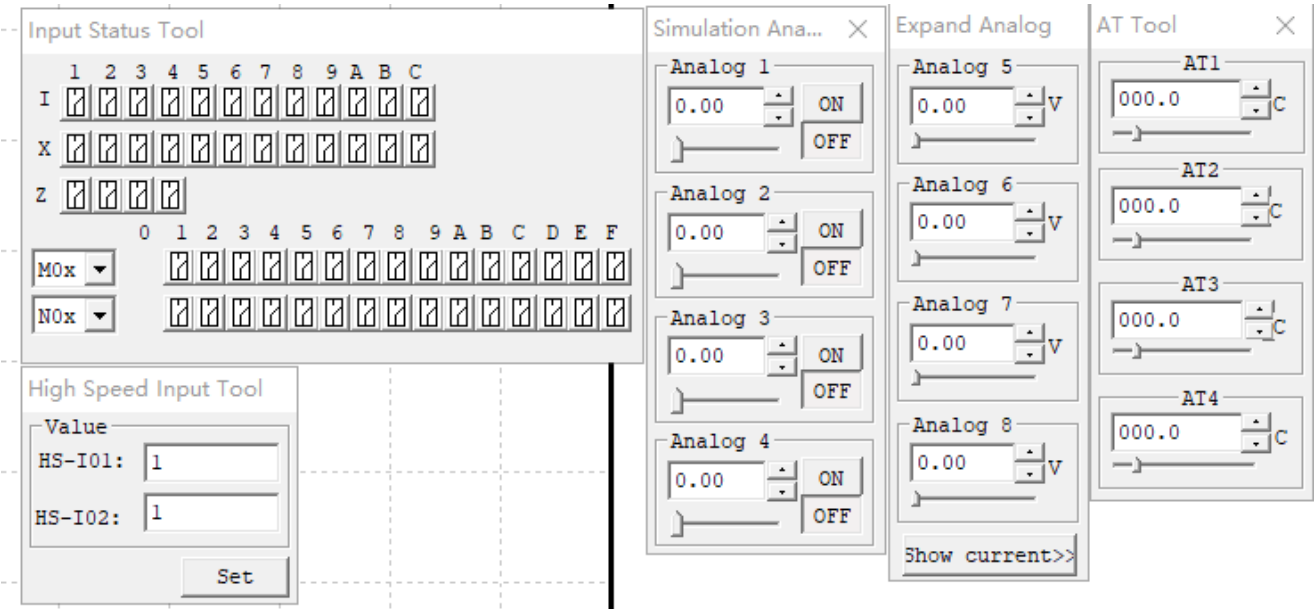
DRC9~DRCF and DRD9~DRF0 are special status registers, the current value output function of which is described below:

| No. | Function description | |
|-----------|--|--|
| DRC9 | PLSY instruction for output of current value of pulse number | |
| DRCA | AT01 current Fahrenheit degree | Used as general DR register when there is no AT01~AT04 (4PT not connected) |
| DRCB | AT02 current Fahrenheit degree | |
| DRCC | AT03 current Fahrenheit degree | |
| DRCD | AT04 current Fahrenheit degree | |
| DRCE~DRCF | Sunrise/sunset time of RTC functional block | |
| DRD9~DRDF | Save current value of RTC | Year, month, day, week, hour, minute, second |
| DRE0 | Finally enabled M/N number | M/N range is selected as status memory in the system setting, and the most recently enabled M/M number is recorded in DRE0 during program running. |
| DRE1~DRE3 | Standby special status register | |
| DRE4 | A05 current value 0~2000 | Used as general DR register when there is no AT05~AT08 (4AI not connected) |
| DRE5 | A06 current value 0~2000 | |
| DRE6 | A07 current value 0~2000 | |
| DRE7 | A08 current value 0~2000 | |
| DRE8 | A01 current value 0~4095; | Used as general DR register when there is no A01 and A02 (AC type); |
| DRE9 | A02 current value 0~4095 | |
| DREA | A03 current value 0~4095 | Used as general DR register when there is no A03 and A04 (AC type or 12-point DC); |
| DREB | A04 current value 0~4095 | |
| DREC | A05 current value 0~4095 | Used as general DR register when there is no A05~A08 (4AI not connected); |
| DRED | A06 current value 0~4095 | |
| DREE | A07 current value 0~4095 | |
| DREF | A08 current value 0~4095 | |
| DRF0 | Standby special status register | |

View menu

The view menu includes some functions of display setting on PC Link software interface, as detailed below:

| View menu | View function description |
|--------------------------|---|
| I/O | Display of the list of resources used; |
| Function | Display of functional block parameter; |
| Capacity | Display of free space of program; |
| Input Status Tool... | Monitoring and simulation of status of coils I, X, Z, M and N; |
| I/O Link Status Tool... | Monitoring and simulation of internal W status of IO Link (for RS485 only); |
| Analog tool... | Monitoring and simulation of master analog input A01~A04 (for DC only); |
| Extended Analog tool... | Monitoring and simulation of extended analog input A05~A08; |
| High-Speed input Tool... | Simulation of the function of high-speed input I01 and I02 (for DC only); |
| AT Tool... | Monitoring and simulation of extended temperature input AT01~AT04; |
| Ladder Toolbar | Display of Ladder tool bar; |

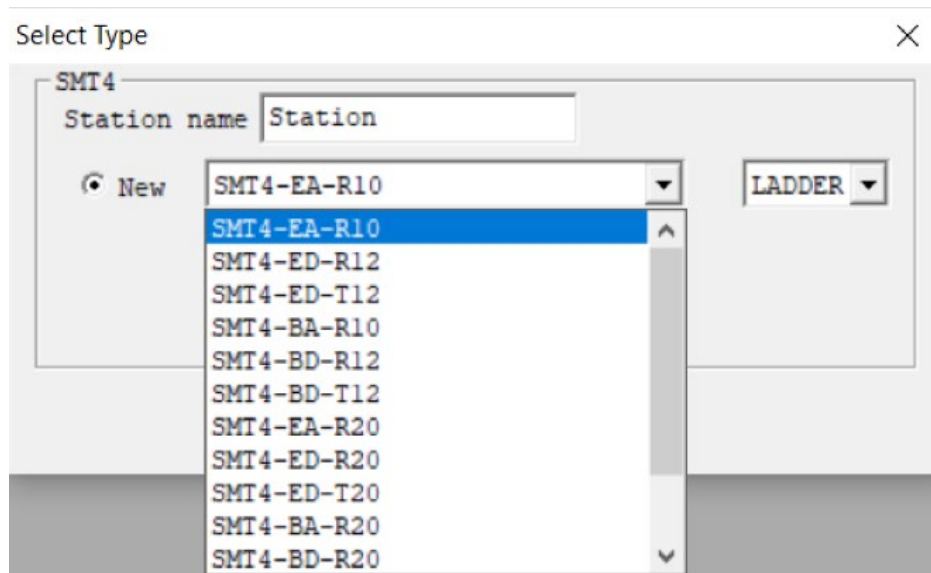


- Analog input A01~A04 corresponds to input I09~I0C;
When analog input is up to 9.98v, the corresponding coil status is put ON; when it is down to 5.00v, the coil is put OFF;
- Extended analog input A05~A08: Input range is 0~9.99v; specifically, 0~5.00v corresponds to 0~20.00mA current mode display;
- Extended temperature input AT01~AT04: Input range is -100.0~600.0°C;
- High-speed input tool for simulating high-speed input of DC type;

FBD programming environment

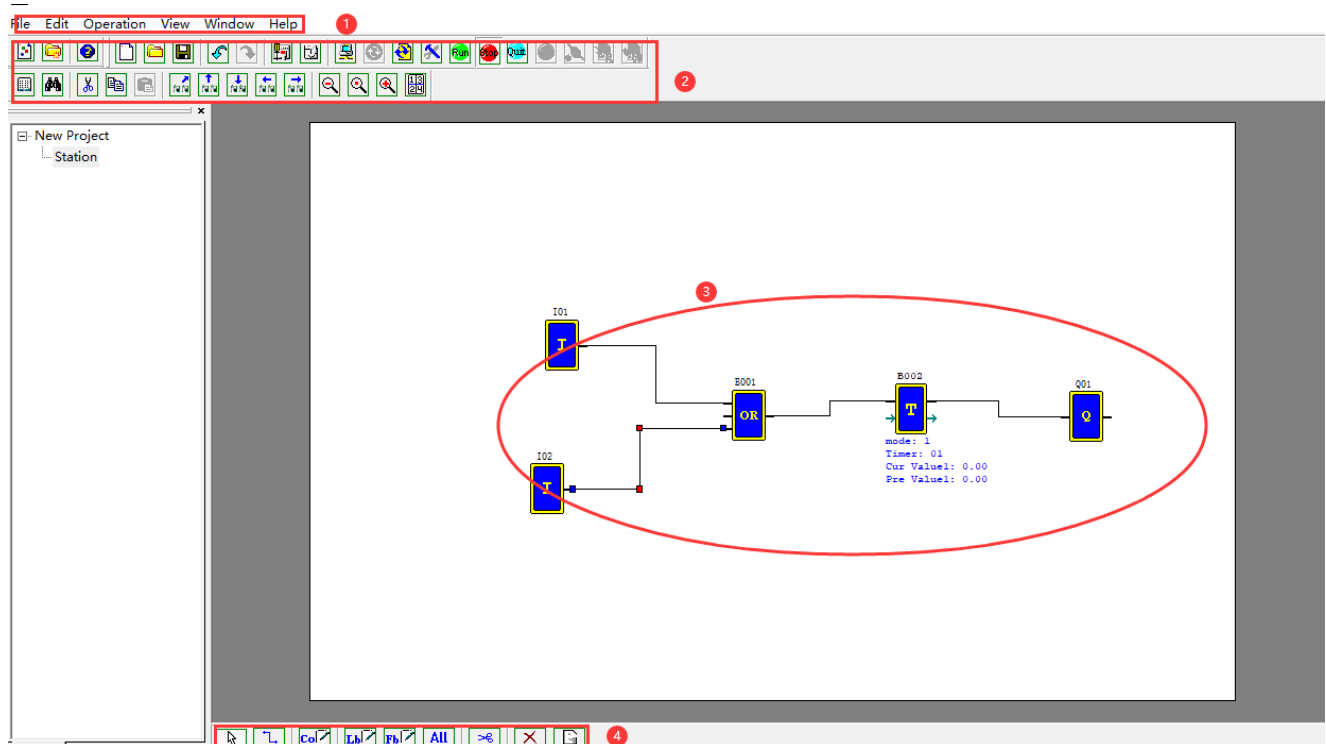
The functional block diagram (FBD) programming environment includes all programming and simulation functions; select the menu “File (F) → New (N)” and choose the type SMT (as shown below) to begin new programming.

The programming operations under FBD are similar to Ladder, as described below.



Menu, icon and status bar

FBD programming includes the following menu, icon and status bar.

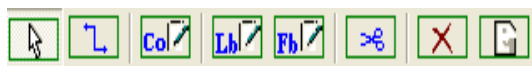


1. Menu: 6 menu options, including file operation, editing, SMT communication setting, special functions, display setting and help information.

2. Tool bar: The icons in the first row are (from left to right): New, Open, Save program icon; Monitor, Simulation, Control mode change (RUN, STOP and QUIT), Read program from SMT and Write program into SMT; the icons in the second row are (from left to right): Key panel display, FBD display, HMI/TEXT editing, comment symbol editing and parameter list etc.

3. Programming area: Move the coil and logic function block to be programmed into the editing area and use line connection.

4. FBD tool bar: Select coil and functional block instruction for editing;



The icons (from left to right) represent: general selection, wiring, coil, logic function block (LFB), special function block, scissors

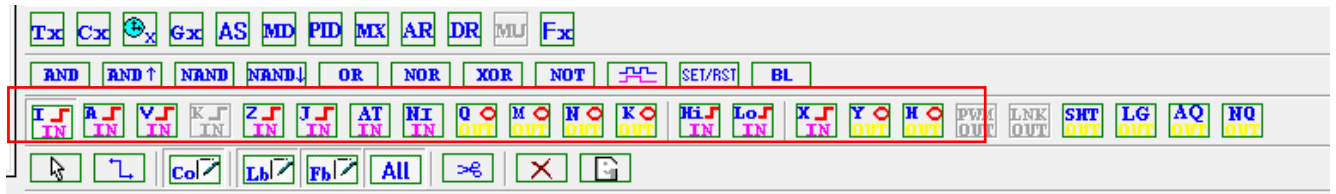
operation, deletion and comment tool.

5. Status bar: It represents the current program, the connected SMT status and other information.

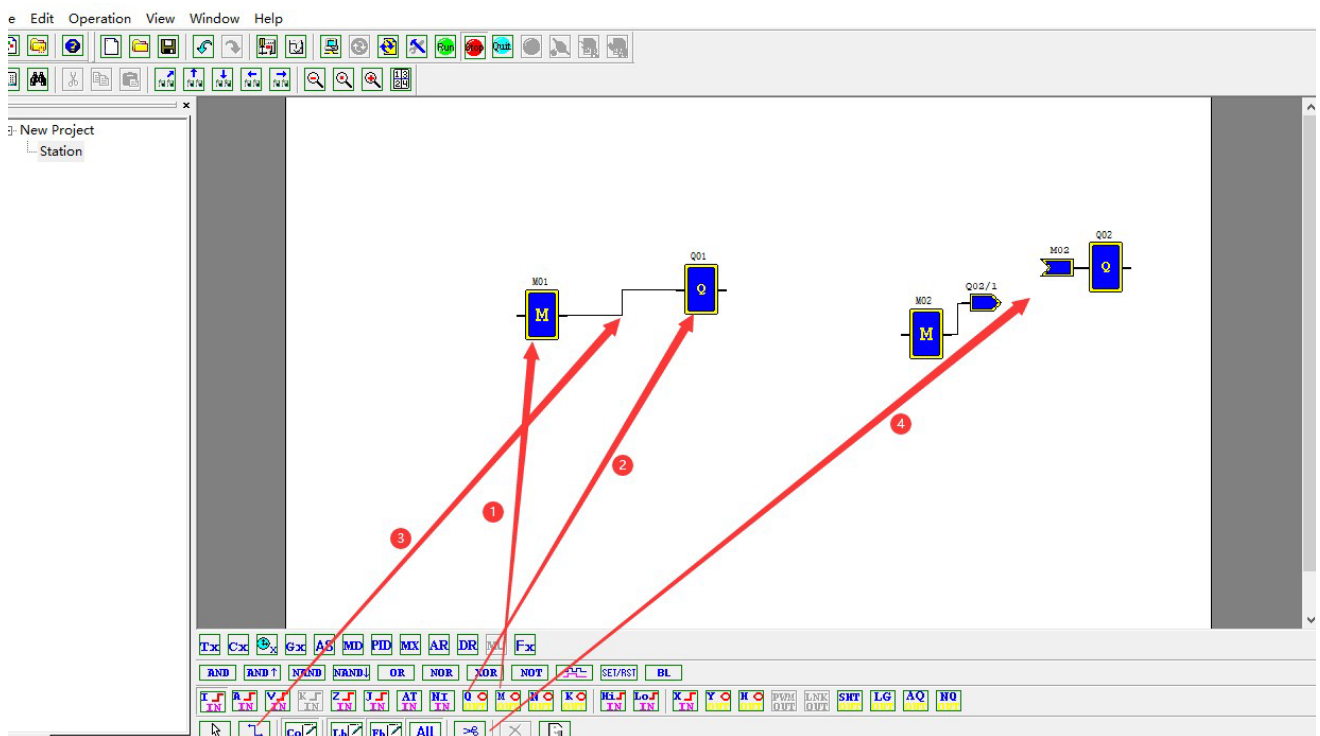
Programming

SMT Client allows programming with mouse. The programming instructions are illustrated below.

Right click to pop up the left screen below, select **Coil (C)**, or click FBD tool bar below the editing window (as shown in the right below), when all available coil icons appear in FBD tool bar.

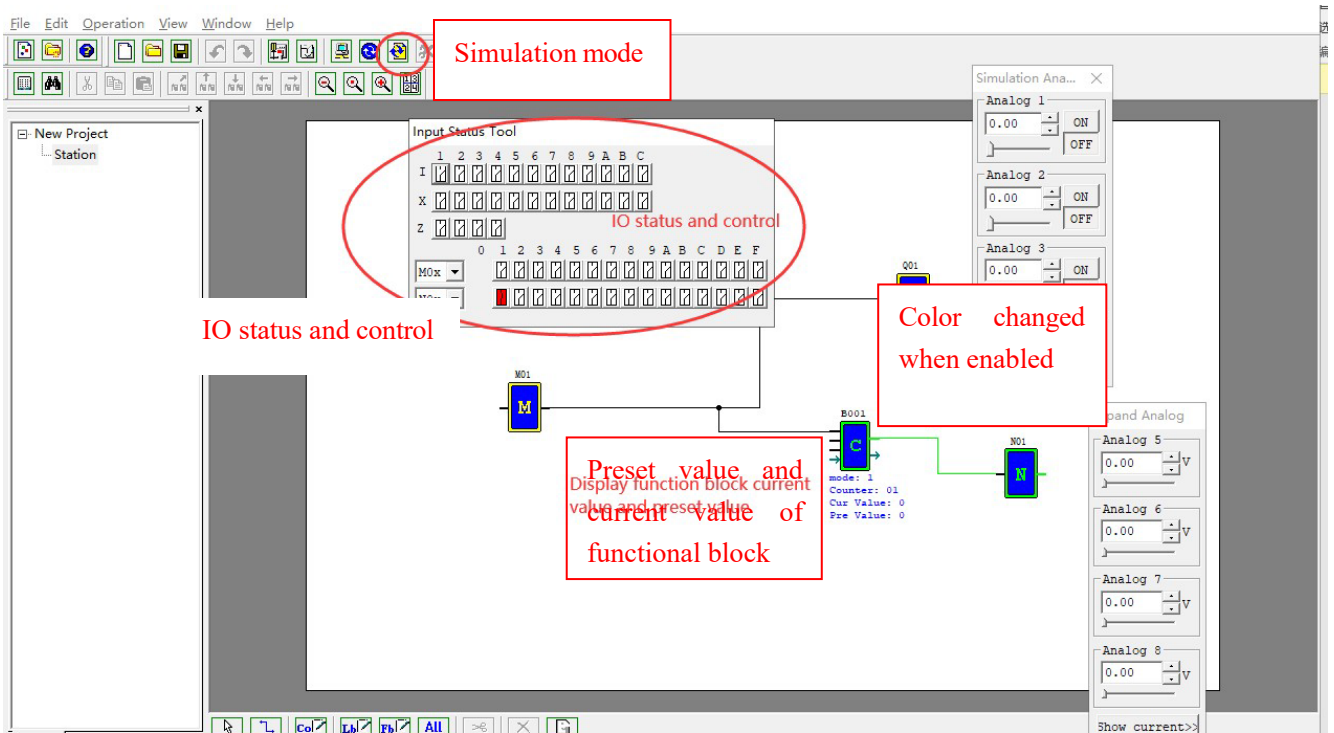


Select the symbols “M” and “Q”, move icon to the editing area, and draw lines to connect the two coils, as shown in the left below (operation 1~3); if the lines are crossed, use the “Scissors” function for separate display of the lines, as shown in the right below (operation 4).




Simulation mode

SMT Client has built-in simulation test function; the method for entering the simulation mode under FBD is consistent with Ladder. Some display features in the simulation mode are shown below.



Online monitoring

File Edit Operation View Window Help



Control mode (RUN, STOP and QUIT)

New Project Station

Input Status Tool

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | | | | | | | | | | | | |
| X | | | | | | | | | | | | |
| Z | | | | | | | | | | | | |

IO status and control

0 1 2 3 4 5 6 7 8 9 A B C D E F

M0x

M0x

Color changed when enabled

Active circuits change color

Q01

Q

Color changed when enabled

Active circuits change color

Preset value and current value of functional block

B001

C

mode: 1

Counter: 01

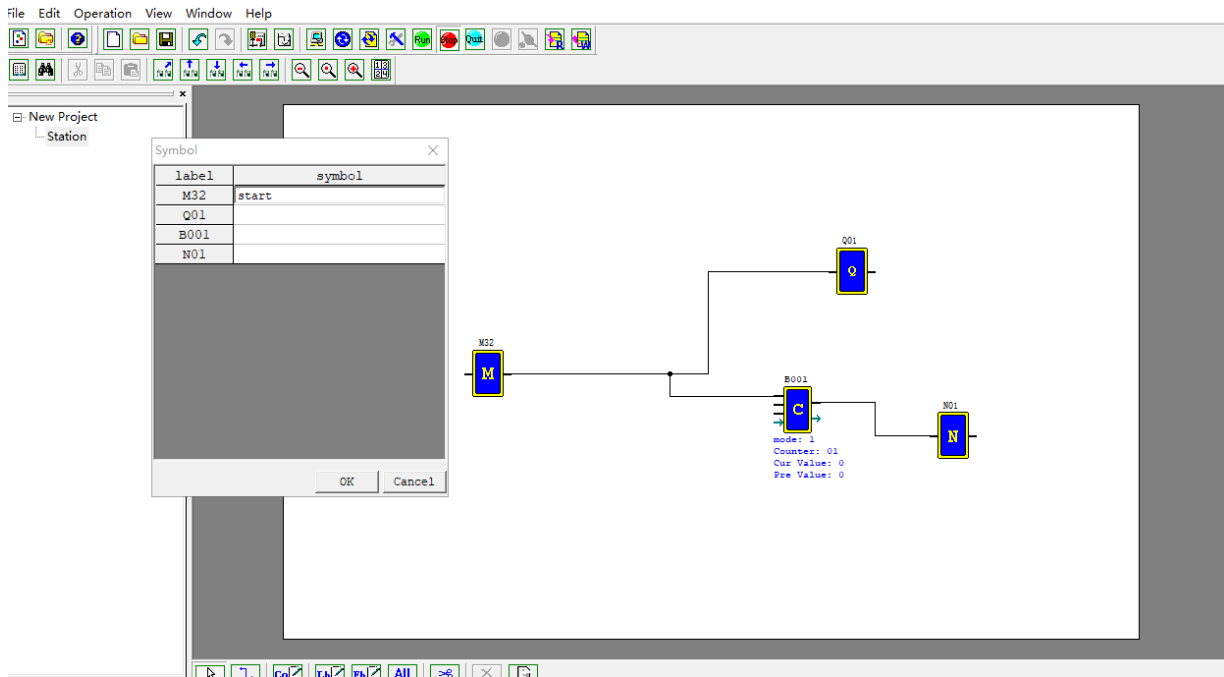
N01

N

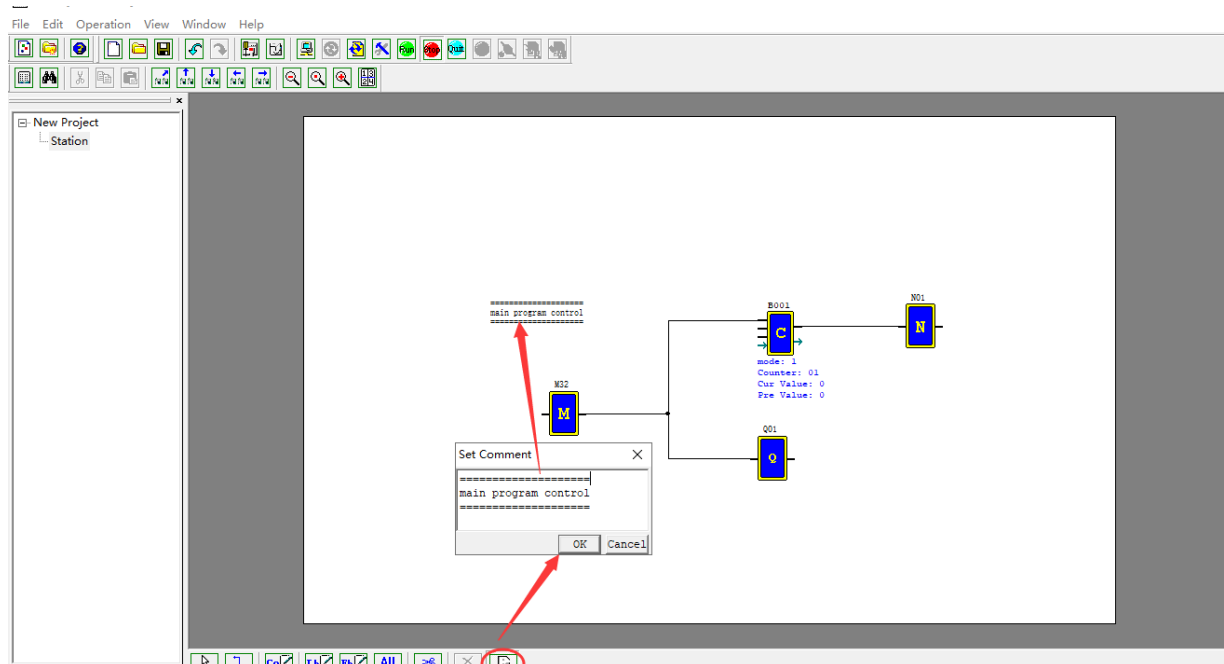
Col Ln Fb All

Program comment and parameter list

Under FBD, comment is effective for the used coils and functional blocks only, and displayed in the program.

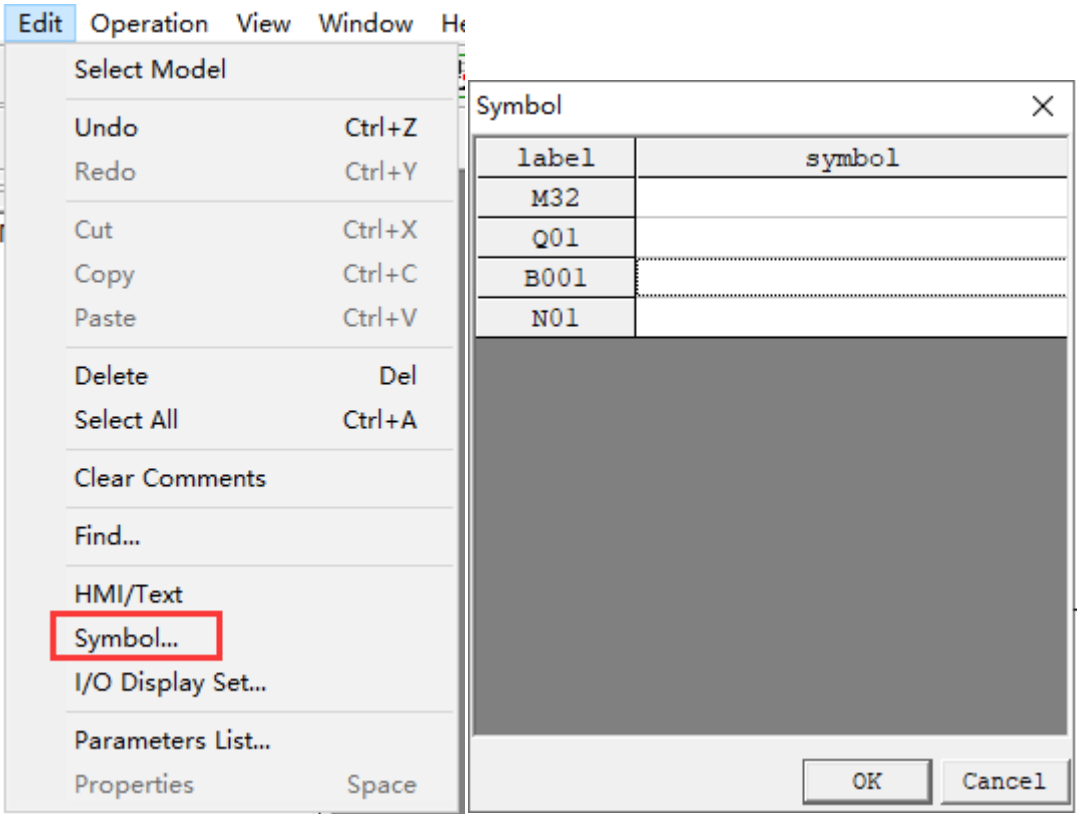


Comment is function description of the whole program. As shown below, click “Comment” in FBD tool bar to pop up the comment setting dialog box, and click “OK” after completion of editing, when comment is displayed on the programming interface and may be moved by cursor.



Parameter list:

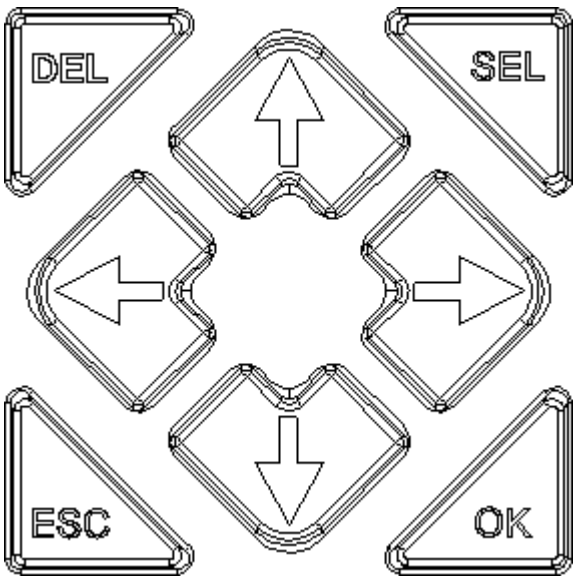
Under FBD, all used coils and functional blocks are provided in the parameter list, which includes function and mark of coils, and set value and mark of functional blocks, as shown below.



LCD display and keys

Keys

The standard type of SMT includes Keypad and LCD display functions, which may be used for change of functional block setting, control of Run/Stop mode, user program reading and writing, real-time clock setting, as well as logic program editing in Ladder programming environment.



Definition of keys:

SEL — Editing and selection key: It is used to select coil function and editing instruction during program editing; the key “SEL” can be pressed on the initialization interface to display content of functional block H in the editing mode 1.

OK — Confirmation key: It is used for confirmation during instruction or functional block editing, or selection of display function on the menu interface.

※ During Ladder programming, “SEL+OK” can be pressed to insert a line under the current cursor.

ESC — Cancellation key: It is used to return from the current display to the previous display interface, cancel the current editing or switch between the initial interface and menu interface. After modification of parameter, the key ESC can be pressed to save data.

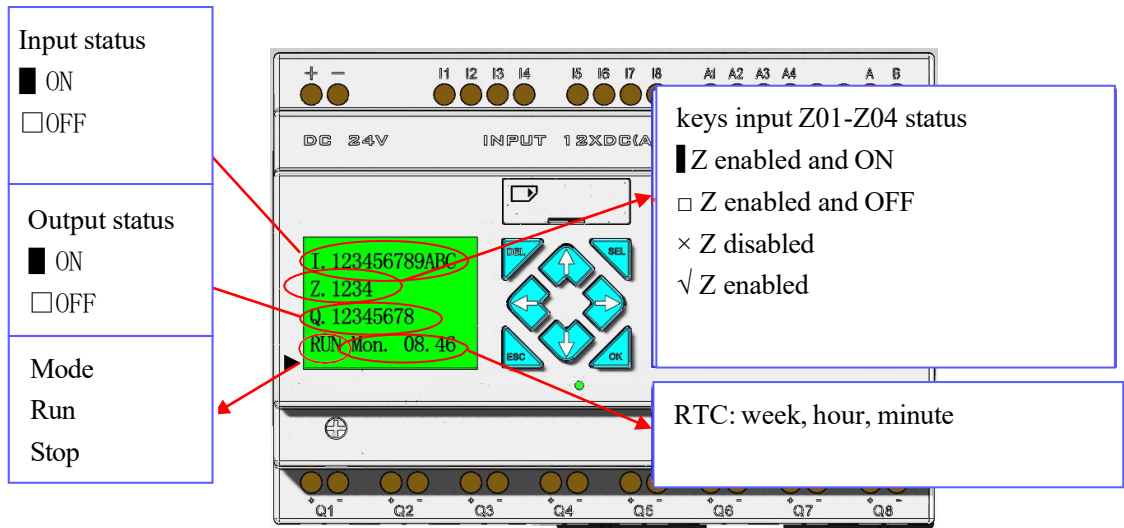
DEL — Deletion key: It is used to delete instruction during Ladder programming.

Four direction keys (↑←↓→): They are used to move the cursor during SMT program display and editing. The four direction keys can also be used for input, which correspond to the input coils Z01~Z04 respectively (‘↑’= Z01, ‘←’=Z02, ‘↓’=Z03, ‘→’=Z04).

Initial screen

LCD displays 4 lines of status information.

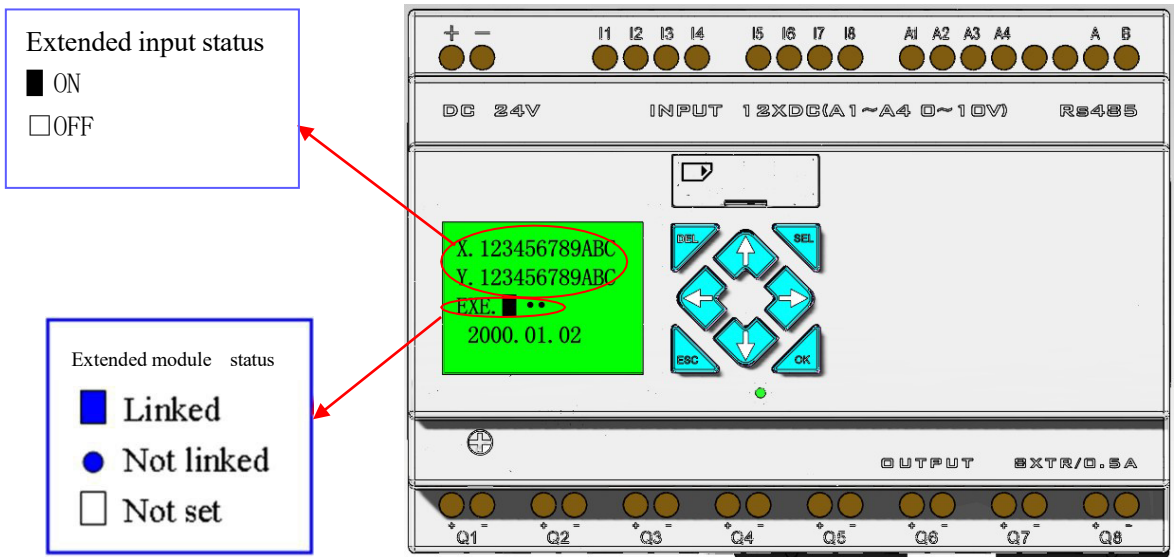
☉ Power-on initial screen



At this time, the following keys can be used.

| | |
|-----------------|---|
| ESC | Return to main menu |
| SEL+↑↓ or ↑↓ | When the current value of DRD8 is 0 in the Ladder editing mode, the keys can be pressed to display status of other relay coils (I/Z/Q ⇔ X/Y ⇔ M ⇔ N ⇔ T ⇔ C ⇔ R ⇔ G ⇔ A ⇔ AT ⇔ AQ) When the current value of DRD8 is 0 in the FBD editing mode, the keys can be pressed to display status of other relay coils (I/Z/Q ⇔ X/Y ⇔ M ⇔ N ⇔ A ⇔ AT ⇔ AQ) |
| SEL+←→ or ←→ | Voltage/current display mode when A05~A08 is displayed; Fahrenheit/Celsius display mode when AT01~AT04 is displayed; |
| SEL | Functional block H with the minimum coded value in the display mode 1 |
| SEL+OK | Enter RTC setting menu |

☉ Extended status display interface



※ Refer to the main menu “System setting” for extended module setting.

⊙ Other status display

Status of coils M, N, T, C, R, G: (T, C, R and G are effective in the Ladder mode only)

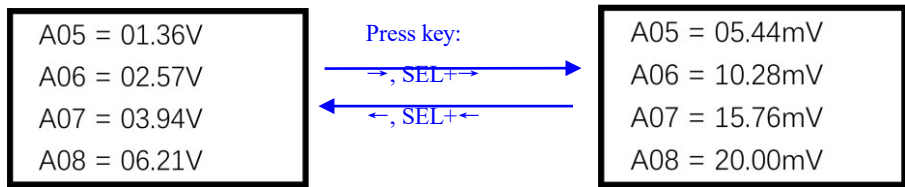
Coil M2x~3x,
Being M, N,
T, C, R or G

M2.0123456789
2.ABCDEF
3.0123456789
3.ABCDEF

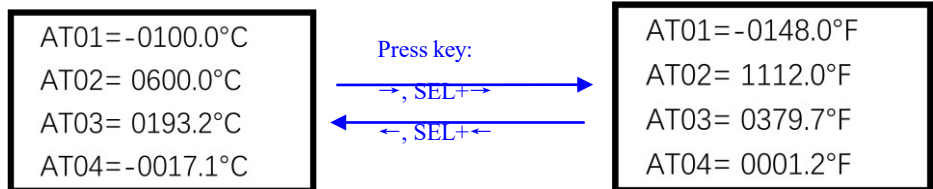
Analog input A01~A04: 0~9.99V

A01=01.00V
A02=02.00V
A03=01.30V
A04=07.04V

Extended analog input A05~A08: 0~9.99V or 0~20.00mA

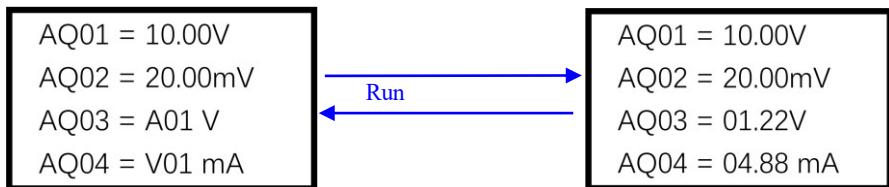


Extended analog temperature input AT01~AT04: -100.0°C~600.0°C or -148.0°F~1112.0°F



Extended analog output AQ01~AQ04: 0~10.00V or 0~20.00mA

※ Voltage mode and current mode are set during programming, as described in [Chapter IV: Ladder Programming Instructions—AQ analog output instruction.](#)



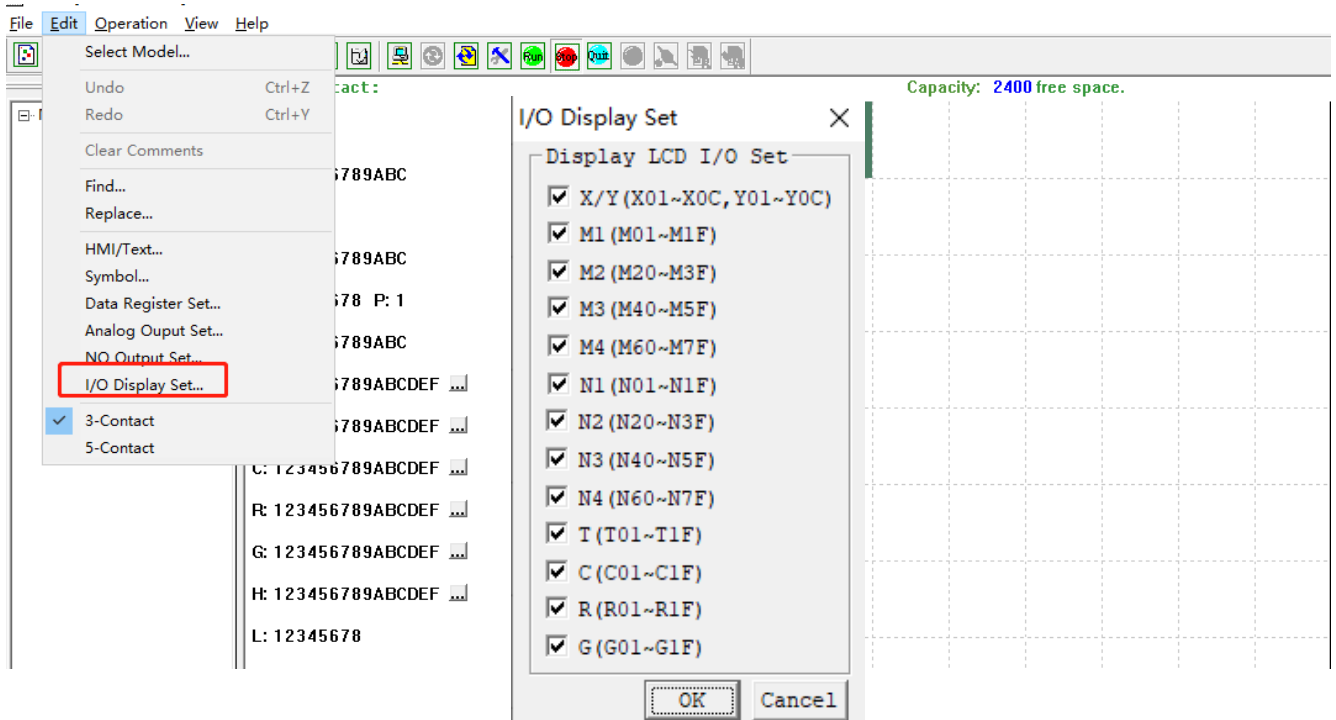
© I/O interface hiding: (to be tested)

The initial interface includes 14 I/O display interfaces in total. Each of the lower 14 bits of the current value of DRD8 corresponds to one I/O interface. When one of the bits is 1, the corresponding I/O interface is hidden (it is impossible to switch to this I/O interface by the keys SEL+ \uparrow \downarrow or \uparrow \downarrow). The correspondence between the current value of DRD8 and I/O interface display is listed below:

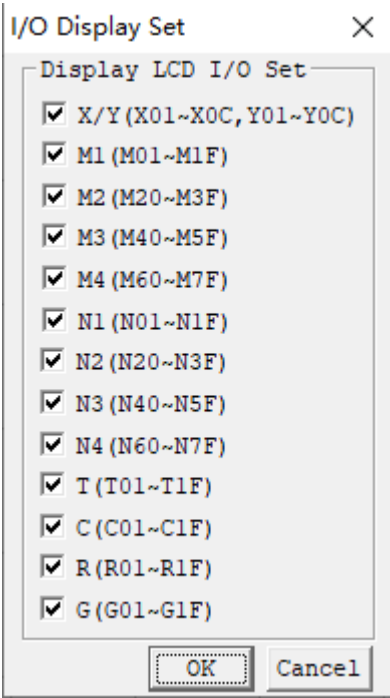
| No. | Display content of IO interface | | Current value of DRD8 |
|-----|---------------------------------|---------------------------|---|
| 0 | I/Z/Q | I01~I0C, Z01~Z04, Q01~Q08 | Bit0: * displayed constantly and can not be hidden |
| 1 | X/Y | X01~X0C, Y01~Y0C | Bit1: displayed when =0; not displayed when =1 |
| 2 | M1 | M01~M1F | Bit2: displayed when =0; not displayed when =1 |
| 3 | M2 | M20~M3F | Bit3: displayed when =0; not displayed when =1 |
| 4 | M3 | M40~M5F | Bit4: displayed when =0; not displayed when =1 |
| 5 | M4 | M60~M7F | Bit5: displayed when =0; not displayed when =1 |
| 6 | N1 | N01~N1F | Bit6: displayed when =0; not displayed when =1 |
| 7 | N2 | N20~N3F | Bit7: displayed when =0; not displayed when =1 |
| 8 | N3 | N40~N5F | Bit8: displayed when =0; not displayed when =1 |
| 9 | N4 | N60~N7F | Bit9: displayed when =0; not displayed when =1 |
| 10 | T | T01~T1F | Bit10: displayed when =0; not displayed when =1 |
| 11 | C | C01~C1F | Bit11: displayed when =0; not displayed when =1 |
| 12 | R | R01~R1F | Bit12: displayed when =0; not displayed when =1 |
| 13 | G | G01~G1F | Bit13: displayed when =0; not displayed when =1 |

Example of interface hiding function: For I/O interface hiding, the Ladder/FBD program can be run directly to control the current value of DRD8, or PC-LINK be used directly to set the current value of DRD8. The procedure is described below:

1. Open “Edit>I/O display set...”:



2. Set “I/O display setting” as shown below: (the checked I/O interface will be displayed)



3. Finally, use communication cable to connect PC and SMT, and download program into SMT.

After download, I/O interface “M01~M1F, M40~M5F, N01~N1F, N20~N3F, T01~T1F” will be hidden:

| | |
|-----------------|---|
| SEL+↑↓ or ↑↓ | In Ladder mode, the current value of DRD8 is 1750, and relay coils are displayed as below (I/Z/Q ⇔ M⇔ N ⇔ T⇔ C ⇔ R ⇔ G ⇔ A1⇔A5⇔AT⇔AQ) ⇔ initial screen |
|-----------------|---|

※ In FBD mode, the same method can be used to hide I/O interface.

Main menu screen

(1) Main menu screen when SMT is stopped

On SMT initial interface, press “ESC” to enter Ladder main menu or FBD main menu:

| LADDER | FBD | Menu | Description |
|----------------|----------------|---------------|--|
| FUN.BLOCK | PARAMETER | > LADDER | Ladder edit |
| PARAMETER | RUN | FUN.BLOCK | Ladder function block (timer/counter/RTC ...) edit |
| RUN | DATA REGISTER | FBD | FBD display |
| DATA REGISTER | CLEAR PROG.RAM | PARAMETER | FBD block or LADDER function block parameter display |
| CLEAR PROG.RAM | PLC->CARD | RUN | RUN or STOP |
| PLC->CARD | CARD-> PLC | DATA REGISTER | DR display |
| CARD-> PLC | SET | CLEAR PROG. | Clear the user program and the password |
| SET | RTC SET | PLC->CARD | Save user program to SD card |
| RTC SET | ANALOG SET | CARD-> PLC | Read user Program from SD card |
| ANALOG SET | PASSWORD | SET | System setting |
| PASSWORD | LANGUAGE | RTC SET | RTC setting |
| LANGUAGE | INITIAL | ANALOG SET | Analog setting |
| INITIAL | OUTPUT RECORD | PASSWORD | Password setting |
| OUTPUT RECORD | NET IO STATUS | LANGUAGE | Select the language |
| FORMAT Card | | INITIAL | initially set Edit method |
| NETCONFIG | | OUTPUT RECORD | output Save r files to the card |
| NET IO SET | | FORMAT Card | Format SD card |
| | | NETCONFIG | Setting IP address, gateway and IAP upgrade |
| | | NET IO SET | I/O setting of network communication |
| | | NET IO STATUS | I/O status of network communication |

(2) Main menu display of SMT running screen

| LADDER | LADDER | > | LADDER | FBD |
|---------------|---------------|---|---------------|--|
| FUN.BLOCK | PARAMETER | | FUN.BLOCK | |
| PARAMETER | RUN | | PARAMETER | FBD block or LADDER function block parameter display |
| RUN | DATA REGISTER | | STOP | RUN or STOP |
| DATA REGISTER | PLC->CARD | | DATA REGISTER | DR display |
| PLC->CARD | RTC SET | | WRITE | Save user program to card |
| RTC SET | PASSWORD | | RTC SET | RTC setting |
| PASSWORD | LANGUAGE | | PASSWORD | Password setting |
| LANGUAGE | OUTPUT RECORD | | LANGUAGE | Select the language |
| OUTPUT RECORD | NET IO STATUS | | OUTPUT RECORD | output Save r files to the card |
| NET IO STATUS | | | NET IO STATUS | Monitor J K NAI NAQ |

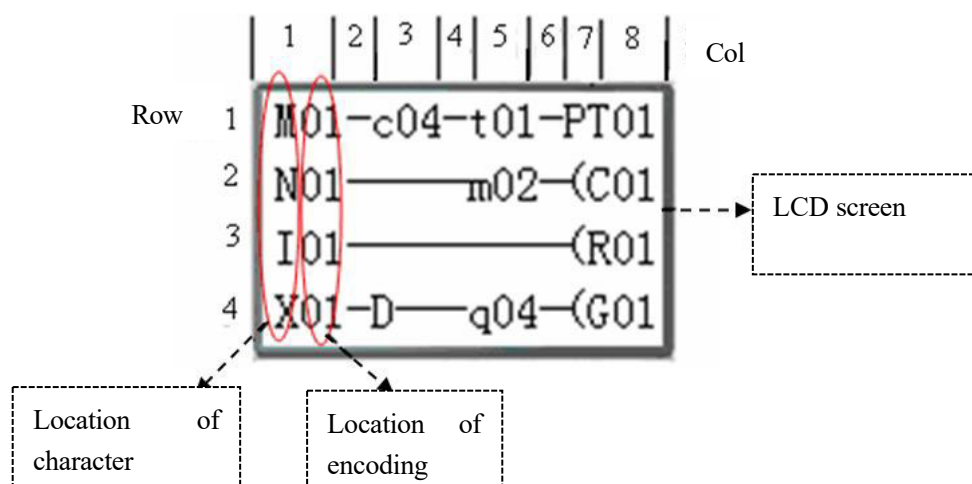
At this time, the following keys can be used.

| | |
|-----|---|
| ↑↓ | Move cursor and select main menu function |
| OK | Enter the selected main menu function |
| ESC | Return to initial screen |

✘ It is possible for program modification, editing, clearing and reading only when SMT is stopped.

✘ When user program is modified, SMT will automatically back up program in internal FLASH.

◎ Ladder diagram



At this time, the following keys can be used.

| Key | Function description |
|-----------|---|
| SEL | 1. Ixx ⇒ ixx ⇒ — ⇒ space ⇒ Ixx (Used for digit or character in columns 1, 3 and 5 only) 2. Qxx ⇒ space ⇒ Qxx (Used for digit or character in column 8 only) 3. $\begin{array}{c} \text{T} \\ \text{I} \end{array} \Rightarrow \text{Space} \Rightarrow \begin{array}{c} \text{T} \\ \text{I} \end{array}$ (Used for columns 2, 4 and 6, except the first row) |
| SEL+↑/↓ | 1. I ⇔ X ⇔ Z ⇔ Q ⇔ Y ⇔ M ⇔ N ⇔ J ⇔ K ⇔ D ⇔ T ⇔ C ⇔ R ⇔ G ⇔ F ⇔ I (when cursor is in columns 1, 3 and 5) 2. Q ⇔ Y ⇔ M ⇔ N ⇔ T ⇔ C ⇔ R ⇔ G ⇔ H ⇔ L ⇔ P ⇔ S ⇔ F ⇔ AS ⇔ MD ⇔ PI ⇔ MX ⇔ AR ⇔ DR ⇔ MU ⇔ Q (when cursor is in column 8) 3. (⇔ ^ ⇔ v ⇔ P ⇔ ((when cursor is in column 7 and coil in column 8 is Q, Y, M or N) 4. (⇔ P ⇔ ((when cursor is in column 7 and coil in row 8 is T) |
| SEL + ←/→ | Confirm the input data and move the cursor |
| ↑↓←→ | Move the cursor |
| DEL | Clear an instruction component |
| ESC | 1. Cancel the instruction component or action being edited 2. Return to main menu when program is browsed (save data modified or edited) |
| OK | 1. Enter data, save automatically, and move cursor to the next input program 2. Press the key in column 8 to automatically enter functional block for setting of parameters (such as T/C...) |
| SEL+DEL | Delete a line of instruction |
| SEL+ESC | Display number of lines and status of SMT (RUN/STOP) |
| SEL+↑/↓ | 4 lines of program skipped after each press, namely page turning |
| SEL+OK | Inset a blank line above the current cursor |

Refer to [Annex A: Keypad programming in Ladder mode](#) for more instructions on key programming.

In FBD mode, the used Block parameters are displayed in proper order.

◎ Run or Stop

| (1) RUN Mode | | (2) STOP Mode | |
|--------------|--|---------------|--|
| Run | | Stop | |
| Yes | | Yes | |
| >No | | >No | |

| | |
|-----|--|
| ↑ ↓ | Move the cursor |
| OK | Return to main menu after execution of instruction |
| ESC | Return to main menu |

◎ DR register

The preset value of DR is displayed in the stop mode, and the current value of DR displayed during running.

| | | |
|--------------|------------|--------------|
| DR01 = 00000 | SEL+↓ → | DR05 = 00000 |
| DR02 = 00000 | | DR06 = 00000 |
| DR03 = 00000 | | DR07 = 00000 |
| DR04 = 00000 | | DR08 = 00000 |

| | |
|----------|---|
| ↑ ↓ ← → | Move the cursor |
| OK | Confirm the operation |
| SEL | Enter editing mode (for modification of DR display number or preset value) |
| SEL+SEL | Edit the preset value of DR and modify value type |
| SEL+ ↑ ↓ | 1. Change the current display number of DR (first row) 2. Modify the preset value of DR |
| ESC | 1. Cancel the current editing 2. Return to main menu when DR is browsed (save the edited data) |
| SEL+↑/ ↓ | 4 lines of program skipped after each press (page turning) |

◎ Other menu items

- (1) Clear program (clear RAM and password)
- (2) PLC->SD card: Write program in SMT into SD card
- (3) SD card ->PLC: Read program stored in SD card into

SMT The following keys can be used for items (1)~ (3):

| | |
|-----|---------------------|
| ↑ ↓ | Move the cursor |
| OK | Execute instruction |
| ESC | Return to main menu |

(4) System setting

| | content | default | | |
|------------|------------|---------|---|---|
| ID SET | ID SET | 01 | → | ID setting (00~99) |
| REMOTE I/O | REMOTE I/O | N | → | Remote I/O Mode (N: none M: Master S: Slave) |
| BACK LIGHT | BACK LIGHT | × | → | Back light mode (√: always light ×: light for 10s after pressed.) |
| M KEEP | M KEEP | √ | → | M: non-Volatile (√: Volatile ×: non-Volatile) |
| I/O NUMBER | I/O NUMBER | 0 | → | Setting expansion I/O module number (0~3) |
| I/O ALARM | I/O ALARM | √ | → | Siren setting when is not available to Expansion I/O Points (√:Yes ×:No) |
| C KEEP | C KEEP | × | → | in stop/run switching, Counter Present Value Keeping (√:Yes ×:No) |
| Z SET | Z SET | × | → | Enable or disable keypad input Z01-Z04 (√:enable ×:disable) |
| RS485 SET | RS485 SET | 03 | → | Setting the form and baud rate of RS-485 |
| DATA REG. | DATA REG. | U | → | Setting the Data Register type (U: 16bit-unsigned S: 16bit-sign) |
| MEMORY SET | | | | |
| M/S SET | | | | |

※ When M holding function is set, status of coil M and current value of timers TOE and TOF are held in case of power failure.

At this time, the following keys can be used:

| | |
|-----------|---|
| ↑ ↓ ← → | Move the cursor |
| SEL | Begin setting |
| SEL+← /→ | Move the cursor for ID setting or RS485 communication setting |
| SEL+ ↑ /↓ | 1. ID setting= 00~99; I/O module = 0~3 2. Remote I/O = N↔M↔S↔N 3. Backlight, C holding, Z setting = ×↔√ 4. M holding, I/O warning = √↔× 5. RS485 communication setting = (0~3) (0~5) 6. DR setting = U↔S |
| OK | Editing confirmation |
| ESC | 1. Cancel the current setting 2. Return to main menu (save the edited data) |

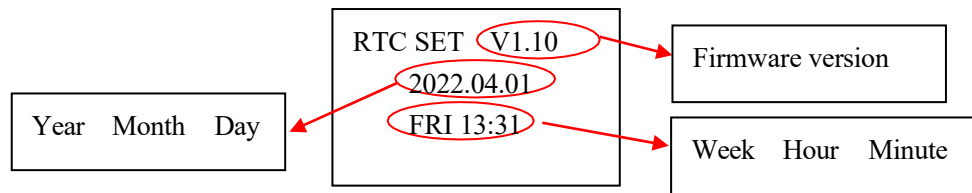
※ When IO LINK is used, ID setting range is 0~7 and must be continuous, where ID=0 is taken as master and ID=1~7 as slave by default.

※ When remote I/O is used, the master mode must be set as M (master) and slave mode as S (slave). Master remote I/O setting is as follows:

| | Master | | Slave |
|---------------|---------|---|---------|
| Remote input | X01~X0C | ← | I01~I0C |
| Remote output | Y01~Y08 | → | Q01~Q08 |

※ Refer to [Chapter VII: Function Specification of 20-point RS485 high-performance Type](#) for detailed instructions on use of remote I/O and I/O link functions.

(5) Clock setting (RTC)



At this time, the following keys can be used:

| | |
|----------|--|
| ↑↓ | Clock setting, switching of winter/summertime setting menu |
| SEL | Begin parameter setting |
| SEL+ ←/→ | Move cursor to the set item |
| SEL+ ↑/↓ | 1. Year=00~99, month=01~12, day=01~31 2. Hour = 00~23, minute = 00~59 |
| OK | Confirm the setting |
| ESC | 1. Cancel the setting 2. Return to main menu |

✗ Week is computed automatically based on the set year, month and day.

✗ RTC accuracy:

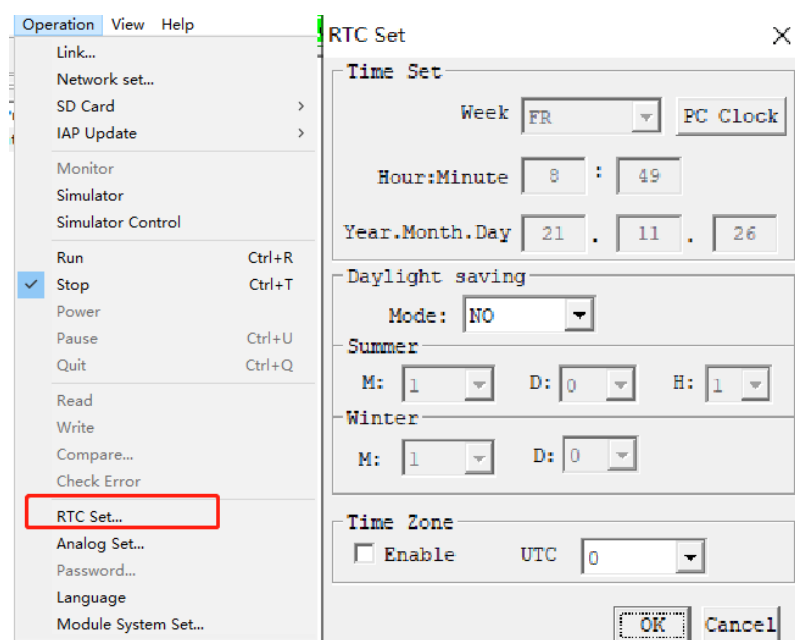
| Temperature | Error |
|-------------------------|------------|
| Normal temperature+25°C | ±3 sec/day |
| -20°C/+50°C | ±6 sec/day |

RTC summer time/winter time setting

SMT has built in European standard and USA standard summer time/winter time, and a group of summer time/winter time available for setting.

Summer time/winter time setting can be completed by PC software SMT Client or Keypad, as shown below.

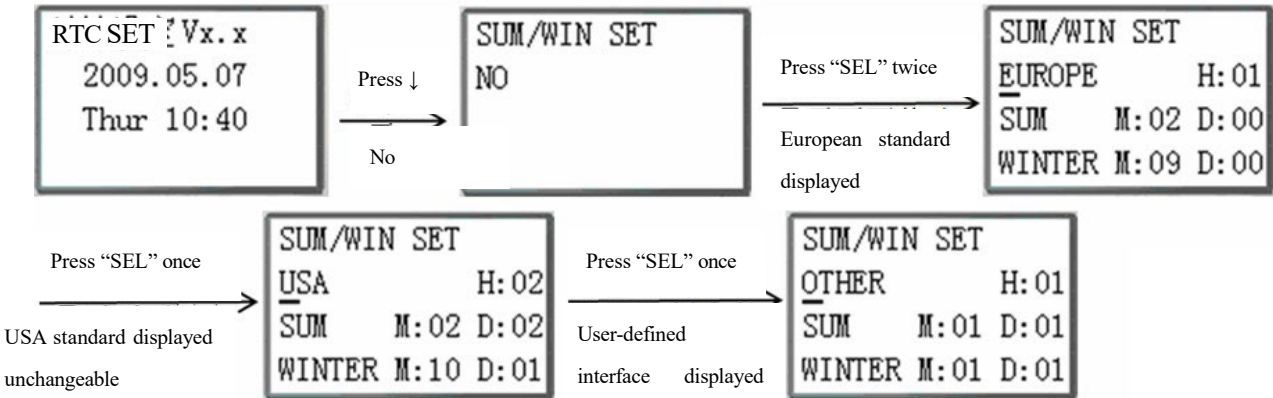
1) SMT Client



Rules of summer time/winter time setting:

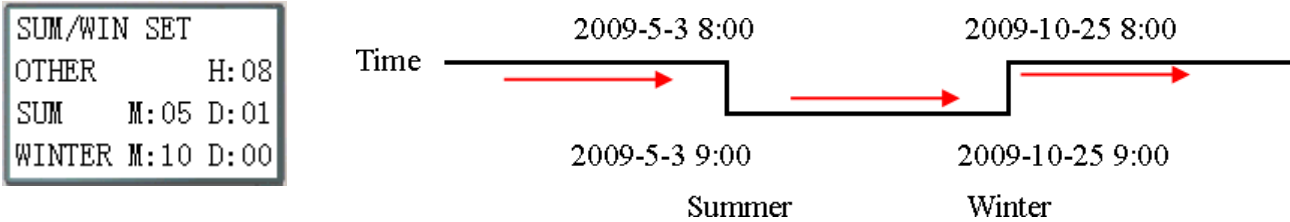
- ① Month (M) range is 1~12;
- ② Week (D) range is 0~5, which means. 0~5th Sunday of the current month; No. 0 Sunday means the final Sunday in the current month;
- ③ Hour (H) range is 1~22; hour parameter of summer time and winter time is the same.

2) Keypad



Press “→” to move cursor to the set position, press “↑” or “↓” to change the set value, and Press OK to finish the setting.

Example: 2009, SUM M: 05 D: 01 → 2009-5-3; M: 10 D: 00 → 2009-10-25.



(6) Analog setting

| | | | |
|-----------------|----------------------|---|--------------------------------------|
| | A 1: Gain: 010 | ➔ | Gain (0~999), default value is 10 |
| A01 = Gain: 010 | Offset: +00 | ➔ | Offset (-50~+50), default value is 0 |
| Offset: +00 | A 2: Gain: 010 | | |
| A02 = Gain: 010 | Offset: +00 | | |
| Offset: +00 | A3~A8...Gain+ offset | | |

Press the following keys at this time:

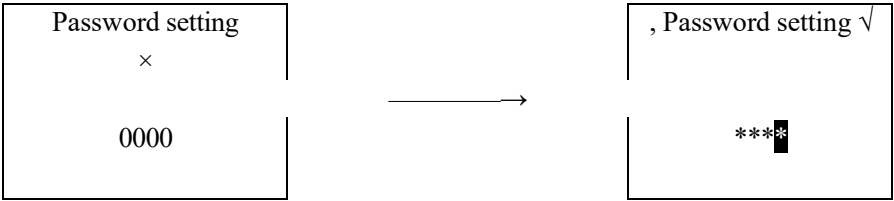
| | |
|----------|--|
| ↑↓ | 1. Move the cursor upward and downward 2. Switch the setting interface: A01/A02→ A03/A04→ A50/A06 → A07/A08 |
| SEL | Begin setting |
| SEL+ ← → | Move the cursor |
| SEL+ ↑↓ | 1. Gain=000~999 2. Offset=-50~+50 |
| OK | Confirm the setting |
| ESC | 1. Cancel the current editing 2. Return to main menu (save the edited data) |

※ $V01 = A01 * A01_gain + A01_offset$

.....

$V08 = A08 * A08_gain + A08_offset$

(7) Password setting



Press the following keys at this time:

| | |
|---------|---|
| SEL | 1. Begin password input 2. When password is ON, 0000 is not displayed, but **** is displayed |
| SEL+← → | Move the cursor |
| SEL+↑ ↓ | Password input 0~F |
| OK | Saved input data not being 0000 or FFFF, PASSWORD ON |
| ESC | 1. Cancel “SEL” input data 2. Return to main menu |

※ Level A password: Password range 0001~9FFF.

Level B password: Password range A000~FFFE.

Password function is cleared when the set password is 0000 or FFFF.

When H coil (HMI) is enabled, passwords of levels A and B have the same access permission; when no H coil is enabled, passwords of level A and B have different access permissions. Function description of level A/B password:

| | No H coil ON | | H coil ON | |
|--------------------------|------------------|------------------|------------------|------------------|
| Main menu | Level A password | Level B password | Level A password | Level B password |
| Ladder diagram | √ | √ | √ | √ |
| Functional block | √ | √ | √ | √ |
| FBD | √ | √ | √ | √ |
| Parameter | | √ | √ | √ |
| Run/Stop | | √ | √ | √ |
| DR register | | √ | √ | √ |
| Clear program | √ | √ | √ | √ |
| Write in memory card | √ | √ | √ | √ |
| Read from memory card | √ | √ | √ | √ |
| System setting | | √ | √ | √ |
| Clock setting | | ※ | ※ | ※ |
| Analog setting | | √ | √ | √ |
| Select language | | √ | √ | √ |
| Program language setting | √ | √ | √ | √ |

√: Password protection

※ Press SEL+OK to enter the clock setting menu

(8) Select language

ENGLISH
FRANÇAIS
ESPAÑOL
ITALIANO

DEUTSCH
PORTUGUES
>简体中文 ✓
POLSKI

ТУССКИЙ *
TÜRKÇE

| | |
|---|--------------------|
| ➔ | English |
| ➔ | French |
| ➔ | Spanish |
| ➔ | Italian |
| | |
| ➔ | German |
| ➔ | Portuguese |
| ➔ | Simplified Chinese |
| ➔ | Polish |
| | |
| ➔ | Russian |
| ➔ | Turkish |

Press the following keys at this time:

| | |
|-----|---------------------|
| ↑↓ | Move the cursor |
| OK | Select language |
| ESC | Return to main menu |

- ※ A language followed by “✓” is the current language selected;
- ※ A language followed by “*” represents HMI language list selection, which may only be Russian or Turkish;
- ※ Press ↑ or ↓ to move the cursor and press OK to select the language; in case of Russian or Turkish, HMI language list selection should be modified accordingly; HMI language list is not modified when it is changed to other language;

(9) Program language selection

INITIAL

>LADDER ✓
FBD

Press the following keys at this time:

| | |
|-----|---------------------|
| ↑↓ | Move the cursor |
| OK | Select mode |
| ESC | Return to main menu |



The previously stored user program will be lost when Ladder or FBD editing mode is changed!

System error display and action

Important system modules are monitored by SMT during power-on and running. In case of abnormality, the corresponding error code is displayed on SMT LCD immediately, and the machine is stopped, or warning signal is given based on severity of abnormality. The meanings of error codes and the corresponding actions are provided below:

| Error code | Meaning | Corresponding action | Fault cause and solutions |
|-------------|---|----------------------|--|
| ROM ERROR | System program error | SMT stopped | Contact the supplier. |
| Vpd ERROR | Power-off circuit error | SMT stopped | Low voltage; load the correct voltage; |
| PROG ERROR | User program unavailable | SMT stopped | Download the user program again |
| LOGIC ERROR | Logic error of FBD program | SMT stopped | Logic error of user program; modify the user program. |
| EXT.ERROR | Extended I/O error (“I/O” warning function may be disabled in “System setting”) | SMT stopped | The extended module setting is inconsistent with actual number of links. check system setting. |
| COMM ERROR | 485 communication error of type RS485 machine | Warning only | Communication error of type V machine; check communication protocol. |
| RTC ERROR | RTC error | Warning only | Can be used continuously; contact the supplier for elimination of error. |

Chapter 4 Parameter Transfer

| | |
|---|----|
| Chapter 4 Parameter Transfer..... | 74 |
| Internal data type of SMT | 75 |
| Transfer of parameters out of range | 77 |

In SMT, almost all functional blocks use the current value of other blocks as the preset value. This process is called parameter transfer. The rules and precautions of parameter transfer are introduced in this chapter.

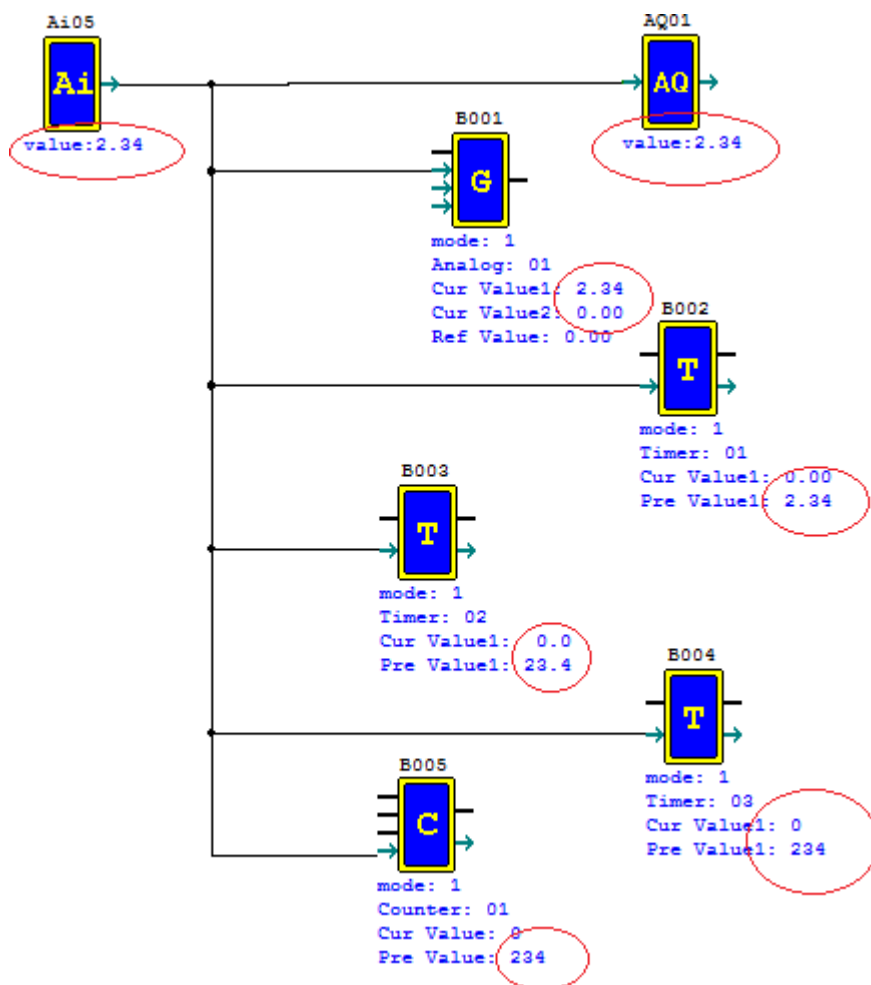
Internal data type of SMT

All data in SMT exists in the integer form. Take the displayed parameter “A01 = 9.99V” for example: “9.99” is stored in SMT in the integer type “999”, and the decimal point is only displayed according to physical meaning of data when it is required. Similarly, AT01=56.7°C is stored as 567 in SMT in the integer type; AQ01=3.37V is stored as 337 in SMT in the integer type. When AT01 and AQ01 are transferred as parameter to another functional block as the preset value, only the integers “567” and “337” are transferred essentially. After being transferred as preset value of other functional block, these integers will be automatically added with decimal point based on physical meaning of the block.

Example 1:

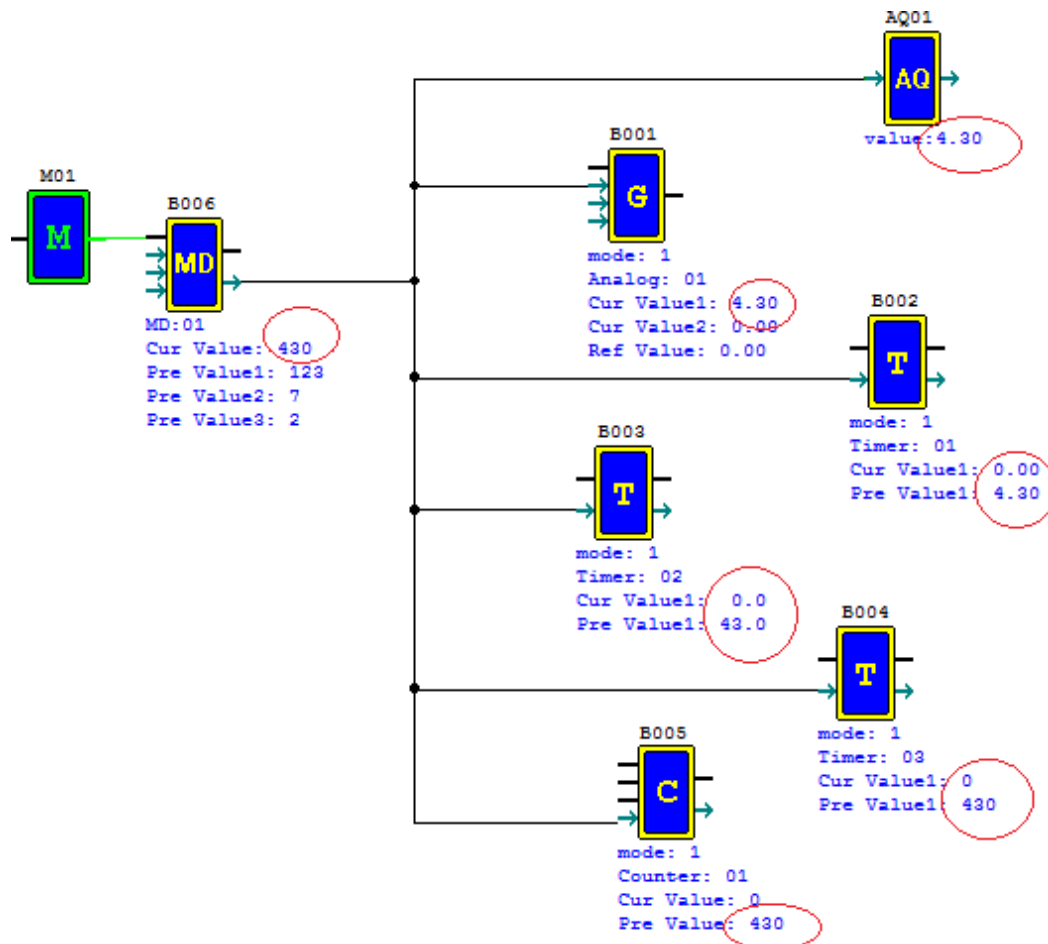
Current value of A05 is transferred to another functional block as the preset value:

A05=2.34V is transferred to another functional block as the present value, which is automatically displayed as 2.34V when transferred to AQ01 and B001(G01), as 2.34s when transferred to B002 (T01 time base 0.01s), as 23.4s when transferred to B003 (T02 time base 0.1s), and as 234s when transferred to B004 (T01 time base 1s) and B005 (C01).



Example 2: Current value of MD is transferred to another functional block as the preset value.

It is simulated that B006(MD01) = 430 and 430 is transferred as preset value to other functional blocks, where AQ01 is automatically 4.30v, B001(G01) is 4.30, B002 (T01 timing setting 0.01s) is 4.30s, B003 (T02 timing setting 0.1s) is 43.0s, B004 (T03 timing setting 1s) is 430s and B005(C01) is 430.



Transfer of parameters out of range

Assuming the current value of MD (range -32768~32767) is transferred to T (range 0~9999) as the preset value. Obviously, the current value of MD may be higher than the upper limit of preset value of T or lower than the lower limit of the preset value. Under this condition, SMT will take the upper or lower limit applying the preset value of T as T preset value. This method is used in SMT under other similar conditions.

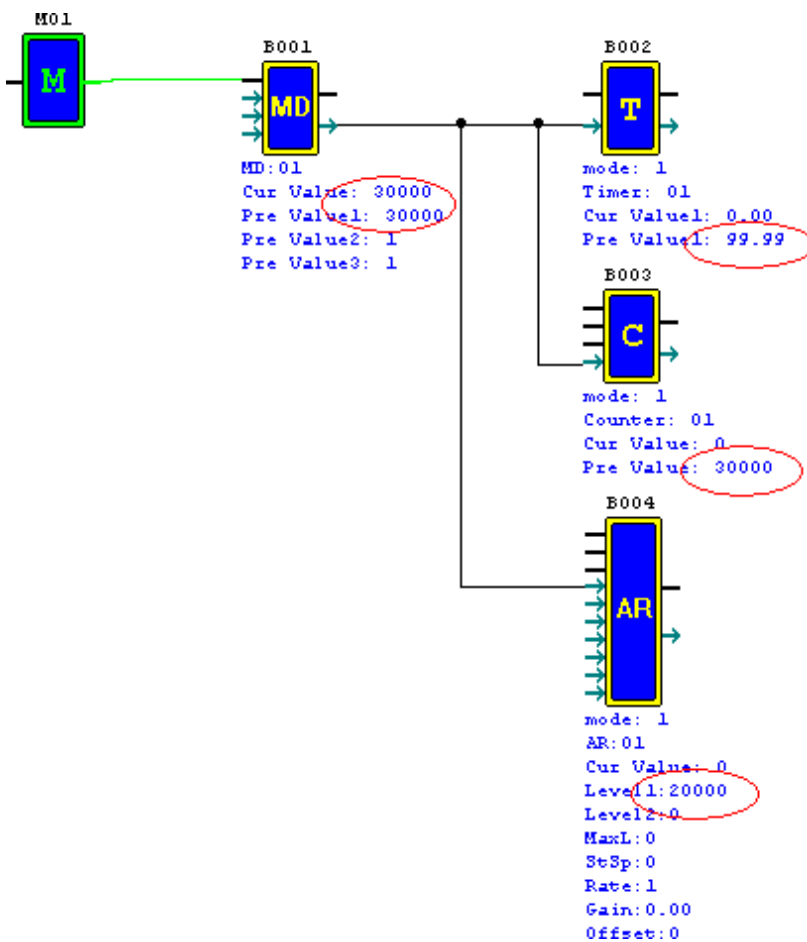
Example 3:

B006(MD01)=30000 is transferred to other functional blocks as the preset value.

When transferred to B002 (T01 time base 0.01s) as the preset value, it is automatically 99.99 as 30000 is higher than the upper limit 9999 of the preset value of T01.

When transferred to B003 (C01) as the preset value, it is automatically 30000 as 30000 is within the range of C01;

When transferred to B004 (AR01) as the preset value, it is automatically 20000 as 30000 is higher than the upper limit 20000 of AR01.

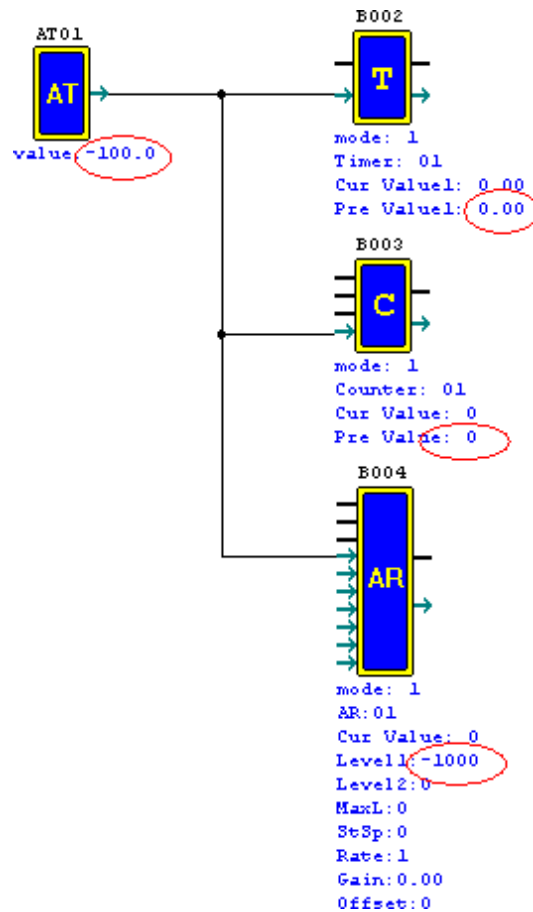


Example 2:

Given AT01=-100.0°C, and internal value -1000 of AT01 is transferred to other functional blocks as the preset value. When transferred to B002 (T01 time base 0.01s) as the preset value, it is automatically 00.00 as -1000 is lower than the lower limit 0 of T01.

When transferred to B003 (C01) as the preset value, C01 preset value is automatically 0 as -1000 is lower than the lower limit of C01.

When transferred to B004 (AR01), AR01 preset value is automatically -1000 as -1000 does not exceed the lower limit -10000 of AR01.



Chapter 5 Ladder Programming Instructions

| | |
|---|-----|
| Basic Elements | 80 |
| Special Functional Instructions | 85 |
| Output Instructions | 87 |
| Analog Instructions | 89 |
| Timer Instructions | 90 |
| Counter Instructions | 99 |
| Real-time clock (RTC) Instructions | 111 |
| Analog Comparator Instructions | 122 |
| Filter Instructions | 124 |
| HMI Instructions | 128 |
| PWM Instructions (for DC power and transistor output type only) | 131 |
| IO Link/Remote IO Instructions (for RS485 type only) | 139 |
| MU (Modbus) Instructions (for RS485 type only) | 143 |
| SHIFT Instructions | 152 |
| AQ Analog Output Instructions | 153 |
| AS (Addition and Subtraction) Instructions | 156 |
| MD (Multiplication and Division) Instructions | 157 |
| PID Instructions | 158 |
| MX (Multiplex Controller) Instructions | 162 |
| AR (Ramp Function Generator) Instructions | 163 |
| DR (Data Register) Instructions | 167 |

Basic Elements

| | General output | Set output | Reset output | Pulse output | Normally open (NO) contact | Normally closed (NC) contact | Quantity and number |
|----------------|----------------|------------|--------------|--------------|----------------------------|------------------------------|----------------------|
| Symbol | [| ▲ | ▼ | P | ┆┆ | ┆/┆ | (N.O./N.C.) |
| Digital Input | | | | | I | i | 12(I01-I0C/i01-i0C) |
| Keypad Input | | | | | Z | z | 4(Z01-Z04/z01-z04) |
| Digital Output | Q | Q | Q | Q | Q | q | 8(Q01-Q08/q01-q08) |
| Auxiliary Coil | M | M | M | M | M | m | 127(M01-M7F/m01-m7F) |
| Auxiliary Coil | N | N | N | N | N | n | 127(N01-N7F/n01-n7F) |
| Counter | C | | | | C | c | 31(C01-C1F/c01-c1F) |
| Timer | T | | | T | T | t | 31(T01-T1F/t01-t1F) |
| Network Input | | | | | J | j | 63(J01-J3F/j01-j3F) |
| Network Output | K | K | K | K | K | k | 63(K01-K3F/k01-k3F) |

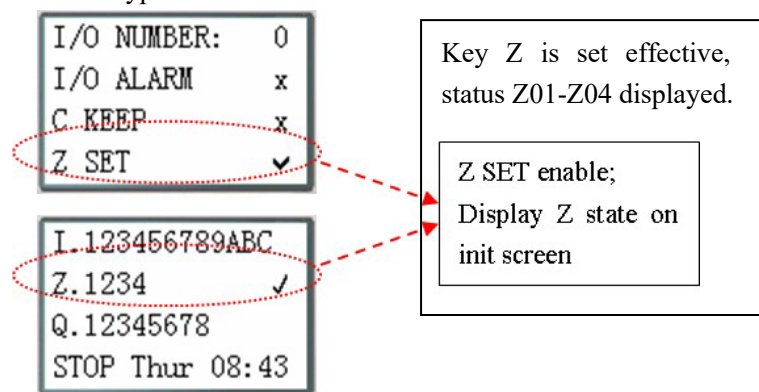
Digital input I

Based on point of different machine types, SMT digital input I is 6, 8 or 12 points.

✘ The latter 4 inputs I09~I0C of 12-point input type are analog input, which correspond to A01~A04.

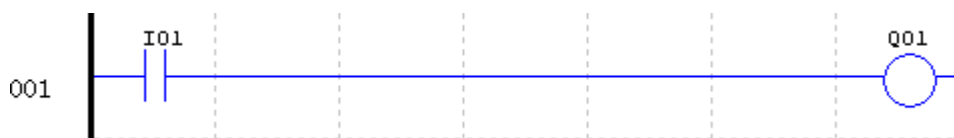
Key input Z

The iSmart keypad input points are designated as Z contacts. The number of keypad input points is 4 which only exist on SMT CD type model and ED type model.



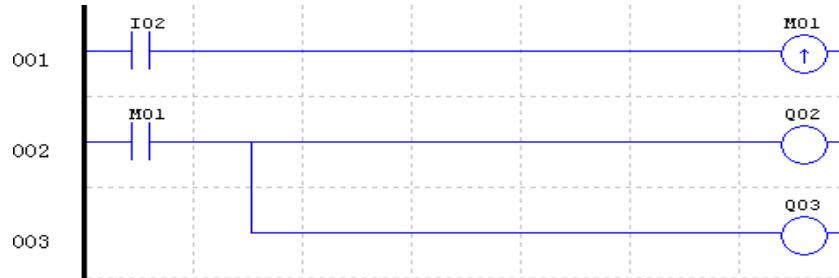
Digital output Q

Based on point of different machine types, SMT digital output Q is 4 or 8. In the following example, Q01 output is ON when I01 is ON. The digital output Q is for on-off control of Q01~Q08.

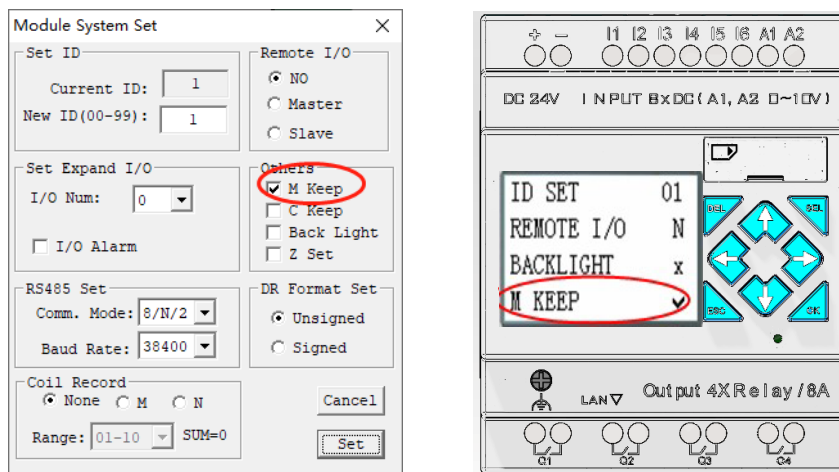


Auxiliary contact M

As internal digital coil, the auxiliary coil M is not physical input/output coil, thus it is not controlled by peripheral equipment (such as switch, sensor and relay), and can be used for control of logic program. Its number of points is 127. Program can be used as digital input (contact) or digital output (contact). In the following example, in the first line, M01 is output coil and set ON when I02 is enabled ON; in the second line, M01 is input coil, and output coils Q02 and Q03 are set ON when M01 is ON.



✘ In case of power failure of SMT, status of coil “M01~M7F” is kept if “M Keep” is effective. “M Keep” can be set by the following two means.



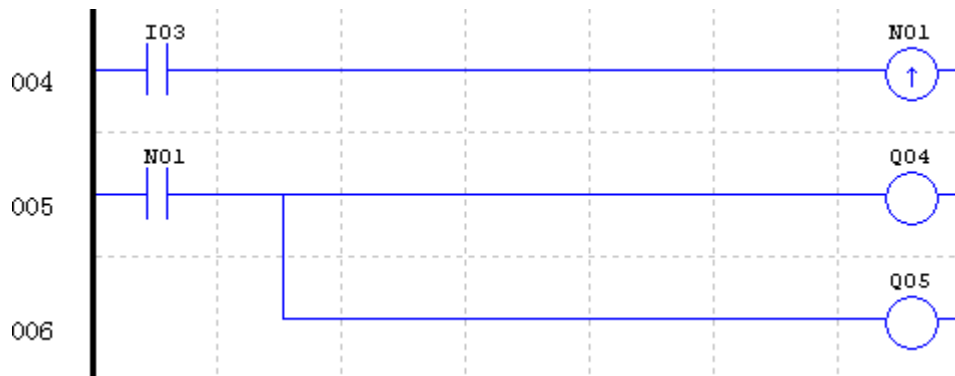
Auxiliary contacts M31~M3F as special auxiliary contact

| No. | Meaning | |
|-----|-------------------------|---|
| M31 | User program start icon | User program outputs ON in the first scanning cycle and is reset after the first program execution cycle, M31 is used as general coil in subsequent cycles. |
| M32 | 1second blinking output | 0.5s ON, 0.5s OFF |
| M33 | Summer/Winter output | Output ON when summer-time switching, and output OFF when winter -Time switching; M33 can be used as general coil. |
| M34 | AT01 flag | Output ON in case of error in channel I of extended temperature module 4PT |
| M35 | AT02 flag | Output ON in case of error in channel II of extended temperature module 4PT |
| M36 | AT03 flag | Output ON in case of error in channel III of extended temperature module 4PT |

| | | |
|-----|---|---|
| M37 | AT04 flag | Output ON in case of error in channel IV of extended temperature module 4PT |
| M38 | RS485 receiving icon | Output ON when RS485 receives data |
| M39 | Network communication port receiving icon | Output ON when network communication port receives data |
| M3A | Counter direction flag | Counter mode9 “high speed input counter” Counter direction |
| M3B | Reserved | |
| M3C | SMTP sending email | SMT sends an E-mail each time when it is in the rising edge of M3C point |
| M3D | Receiving completed | Used for MODBUS instruction (MU instruction) |
| M3E | Error indication | |
| M3F | Timeout judgment | |

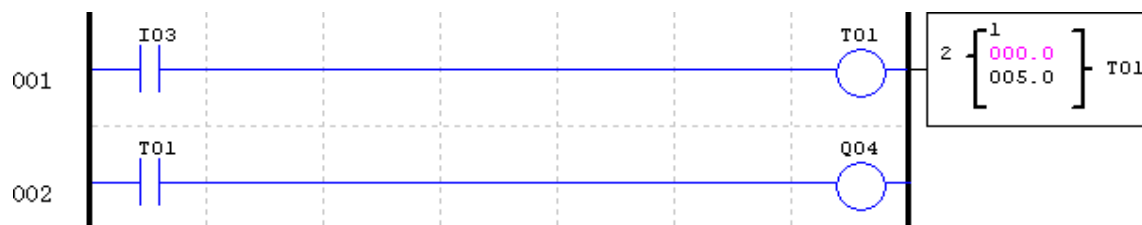
Auxiliary contact N

Auxiliary contact N is the same as the auxiliary contact M, but status of coil N is not kept in case of power failure, and there is no special auxiliary contact. The effect is the same if M is changed to N in the above example.



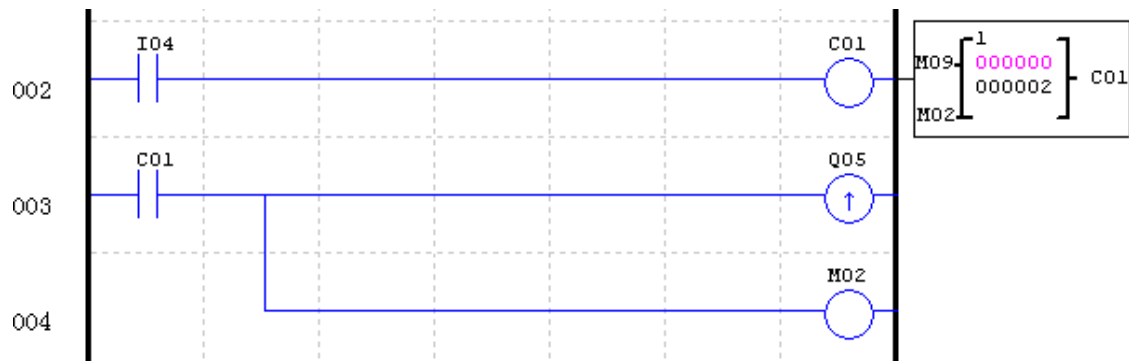
Timer status coil T

Status of coil T depends on the relation between current value and preset value of timer. Coil T is set ON when the current value of timer is higher than or equal to the pre-set value. In the following example, I03 is set ON to enable timer T01, and when the current value of timer is greater than or equal to 5s (preset value), coil T01 is set ON to enable digital output Q01.



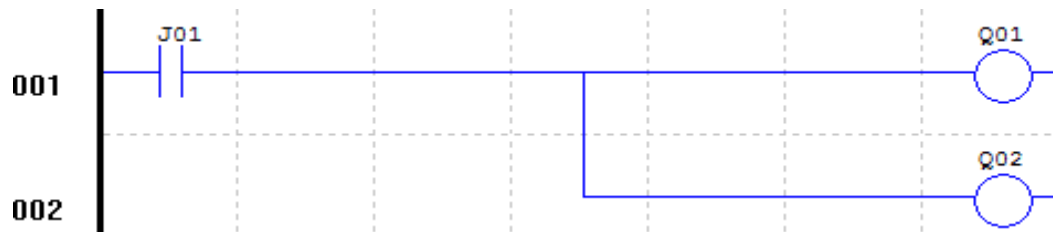
Counter status coil C

Status of coil C depends on the relation between current value and preset value of counter. Coil C is set ON when the counter is set to count up and its current value is greater than or equal to the preset-value, or set OFF when the counter is set to count down and its current value is 0. In the following example, the counter direction is decided by coil M09 (refer to Counter Instruction) and coil M02 is reset. Assuming the counter is set to count up, when the count of I04 rising edge recorded by C01 reaches the preset value 2, coil C01 is set ON to make Q05 output ON and enable M02. After M02 is set ON and counter C01 is reset, both the current value and coil status are reset to 0.



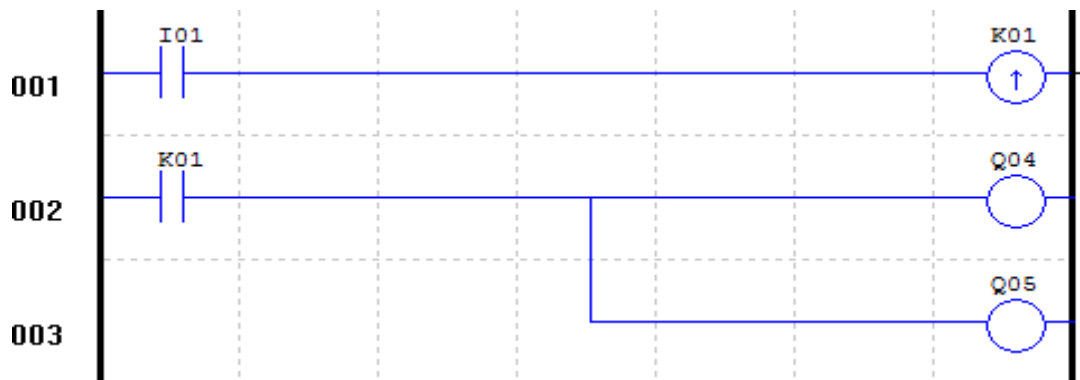
Network input J

J is a remote I/O configured through network, as described in chapter 11. Network input J can only be used as input coil, the status of which is decided by status of remote I/O. As shown below, Q1 and Q2 are set ON after J01 is enabled.







Network output K

K is a remote I/O configured through network, as described in chapter 11. Network output K can only be used as output coil, the status of which is transferred through network to remote I/O.

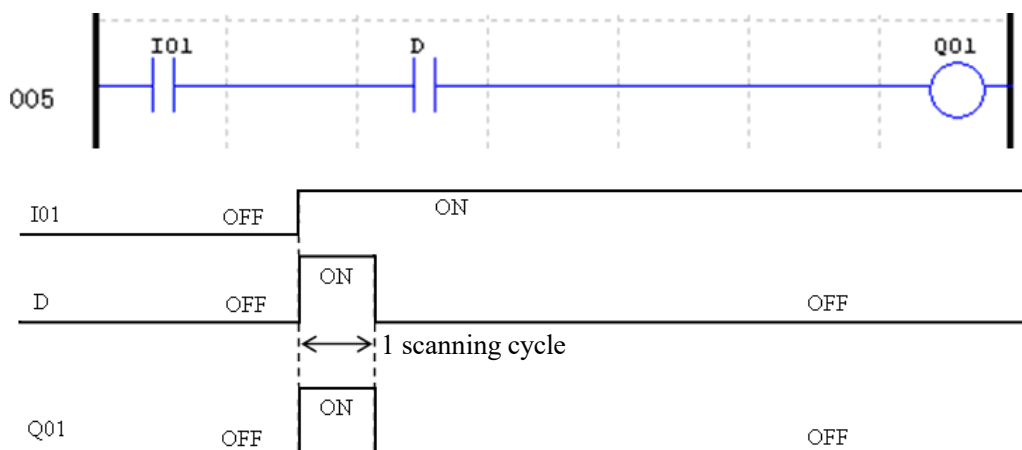


Special Functional Instructions

| | Basic output | Set output | Reset output | Pulse output | NO contact | NC contact | Quantity and number |
|-----------------------|--------------|---|---|--------------|--|---|--------------------------|
| Symbol | [|  |  | P |  |  | (N.O./N.C.) |
| | | | | | Lo | Hi | For functional block use |
| Extended input coil | | | | | X | x | 12(X01-X0C/x01-x0C) |
| Extended output coil | Y | Y | Y | Y | Y | y | 12(Y01-Y0C/y01-y0C) |
| Differential | | | | | D | d | |
| Real-time clock (RTC) | R | | | | R | r | 31(R01-R1F/r01-r1F) |
| Analog comparator | G | | | | G | g | 31(G01-G1F/g01-g1F) |
| HMI | H | | | | | | 31(H01-H1F) |
| PWM | P | | | | | | 2(P01-P02) |
| IO LINK | L | | | | | | 8(L01-L08) |
| SHIFT | S | | | | | | 1(S01) |
| F | F | | | | | | 31(F01-F1f) |

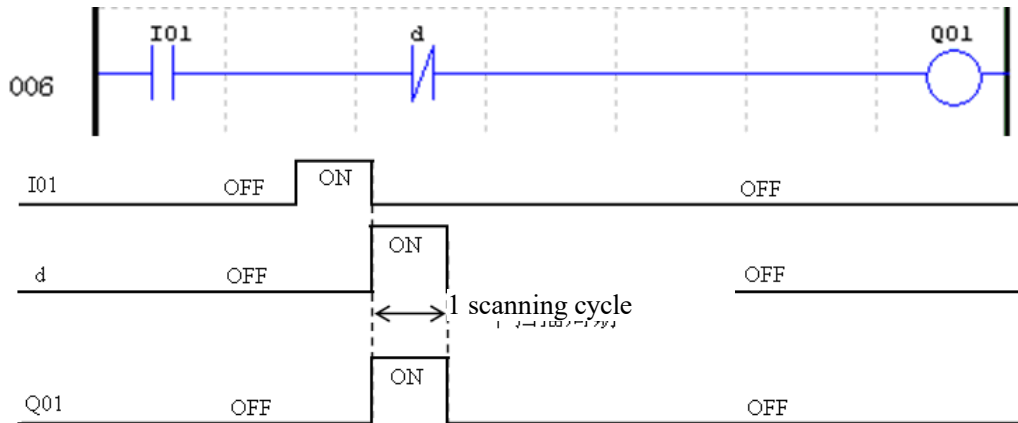
Positive Edge Trigger - Pulse Output (D)

A positive edge trigger (D) holds its status ON for one CPU scan time when the preceding series contact changes its state from OFF to ON. The transition from OFF to ON is called the “Positive Edge Trigger”.



Negative Edge Trigger - Pulse Output (d)

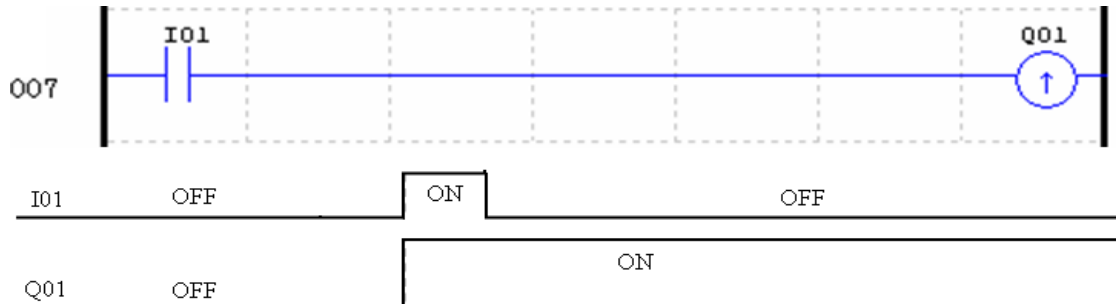
When the contact of subdifferential instruction changes from ON to OFF, subdifferential instruction will output ON and maintain a scanning cycle. As shown below, when I01 changes from ON to OFF, d outputs ON and maintains a scanning cycle, and Q01 outputs ON in a scanning cycle.



Output Instructions

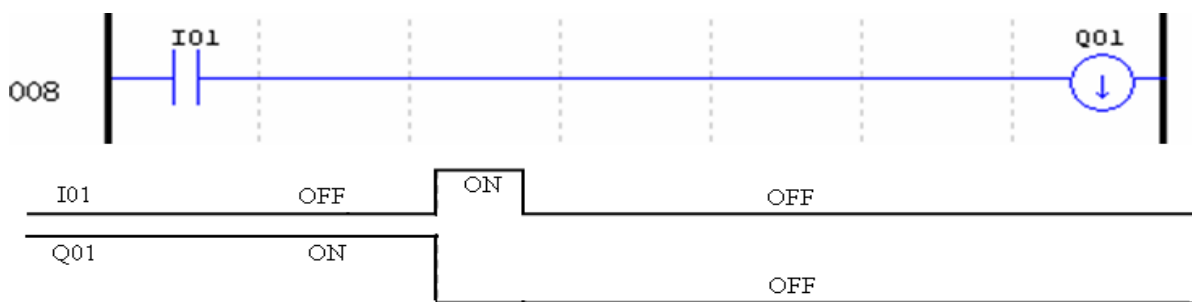
Set output instruction (A)

A set output instruction, or Latch, turns ON an output coil (Q) or an auxiliary contact (M) when the preceding input contact turns from OFF to ON. Once the output is ON or set, it will remain ON until it is reset using the “Reset output” instruction. It is not necessary to retain the input contact at ON state once the output is at ON state.



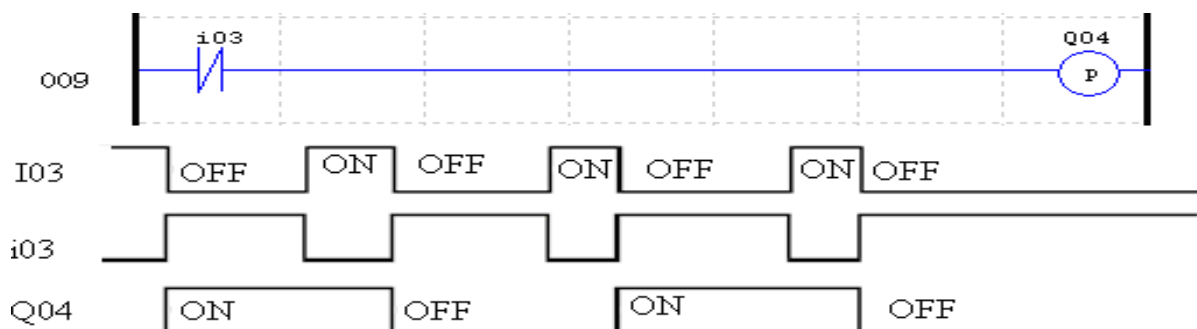
Reset output instruction (V)

A reset output instruction, or unlatch, turns OFF a previous set output coil (Q) or an auxiliary contact (M) when the preceding input contact transitions from OFF to ON. Once the output is OFF or reset, it will remain OFF until it be “Set” again.



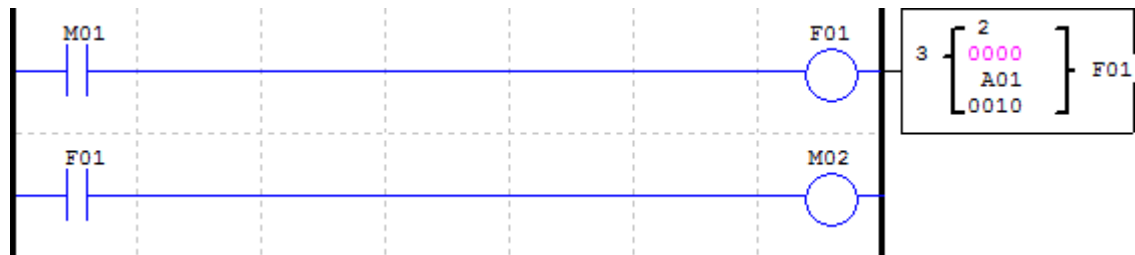
Pulse Output Instruction (Flip-Flop) (P)

Flip-Flop changes the ON/OFF state of the coil (Q) or an auxiliary contact (M) when the preceding input contact turns from OFF to ON. Once the output is ON, it will remain ON until the next time the preceding input contact turns from OFF to ON. In the example below, when Pushbutton I03 is pressed and released coil, Q04, it will turn on and remain on. When Pushbutton I03 is pressed again, coil Q04 will turn off and remain off.



Filter status coil (F)

Status of filter status coil F depends on filtering condition. When filter meets the filtering condition, the current value of the functional block is updated, the current value of filter is the filtering result, and the filter coil is set ON. As shown below, after coil M01 is enabled, coil F01 outputs and the current value is updated every 10s.



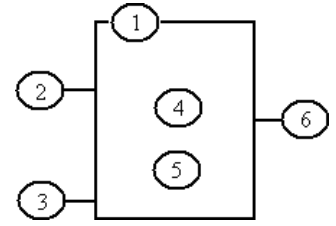
Analog Instructions

| | Analog input | Analog output | Quantity and number |
|--------------------------|--------------|---------------|---------------------|
| Analog input | A | | 8 (A01~A08) |
| Analog input parameter | V | | 8 (V01~V08) |
| Temperature input | AT | | 4 (AT01~AT04) |
| Analog output | | AQ | 4 (AQ01~AQ04) |
| Add-Subtract control | AS | AS | 31 (AS01~AS1F) |
| Multiply-Divide control | MD | MD | 31 (MD01~MD1F) |
| PID control | PID | PID | 15 (PI01~PI0F) |
| Data Multiplexer control | MX | MX | 15 (MX01~MX0F) |
| Analog Ramp control | AR | AR | 15 (AR01~AR0F) |
| Data Register | DR | DR | 240 (DR01~DRF0) |
| MODBUS | | | 15 (MU01~MU0F) |
| Network analog input | NI | | 31 (NI01~NI1F) |
| Network analog output | | NQ | 15 (NQ01~NQ0F) |

The current value of analog quantity (A01~A08, V01~V08, AT01~AT04, AQ01~AQ04) and functional blocks (T01~T1F, C01~C1F, AS01~AS1F, MD01~MD1F, PI01~PI0F, MX01~MX0F, AR01~AR0F, DR01~DRF0, NI01~NI1F, NQ01~NQ0F) may be used as preset value of functional block parameter; when the current value exceeds the parameter range, the limit value is taken as the preset value of the corresponding parameter.

Timer Instructions

SMT includes 31 independent timers. If “M KEEP” is set effective, the current values of T0E and T0F are kept in case of power failure. The timers have 8 working modes, and each timer has 6 configuration parameters to realize the 9 modes of timer (mode 0~ mode 8). The definitions of 6 timer parameters and available coil types are listed below.



| Symbol | Function | |
|--------|--|----------------|
| ① | Timer mode (0-8) | |
| ② | Timing unit | Timing range |
| | 1: 0.01s | 0.00 - 99.99 s |
| | 2: 0.1s | 0.0 - 999.9s |
| | 3: 1s | 0 - 9999s |
| ③ | ON: Timer reset as 0 | |
| | OFF: Timer running continuously | |
| ④ | Current value of timer | |
| ⑤ | Preset value of timer | |
| ⑥ | Timer code (T01~T1F: 31 timers in total) | |

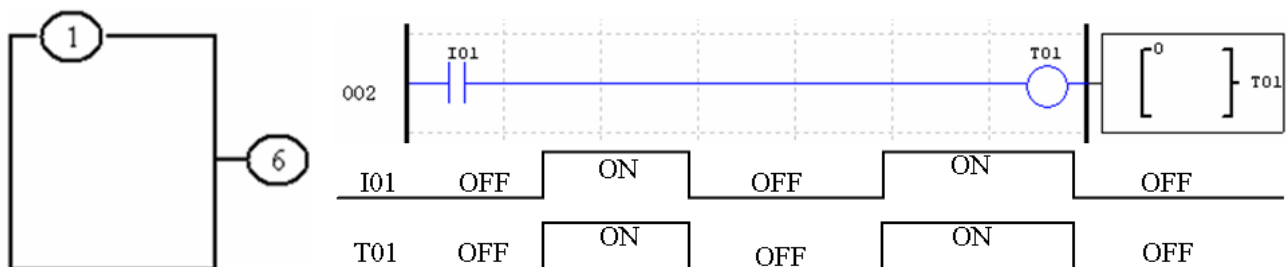
| Available coil type | Range |
|------------------------|-----------------|
| Digital input | I01-I0C/i01-i0C |
| Key input | Z01-Z04/z01-z04 |
| Digital output | Q01-Q08/q01-q08 |
| Auxiliary contact | M01-M7F/m01-m7F |
| Auxiliary contact | N01-N7F/n01-n7F |
| Extended input | X01-X0C/x01-x0C |
| Extended output | Y01-Y0C/y01-y0C |
| RTC | R01-R1F/r01-r1F |
| Counter coil | C01-C1F/c01-c1F |
| Timer coil | T01-T1F/t01-t1F |
| Analog comparator coil | G01-G1F/g01-g1F |
| NO contact | Lo |
| Filter coil | F01-F1F/f01-f1F |
| Network input coil | J01-J3F/j01-j3F |
| Network output coil | K01-K3F/k01-k3F |

✘ The preset value of timer may be a constant or code of other data type.

✘ When M-KEEP is effective, the current values of T0E and T0F are kept in case of power failure.

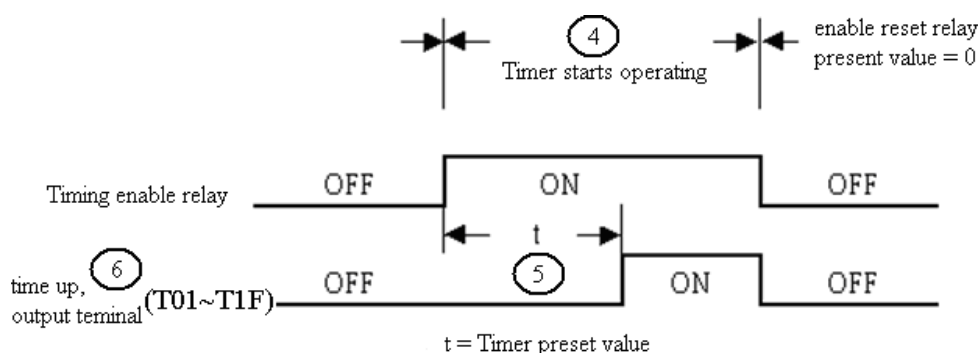
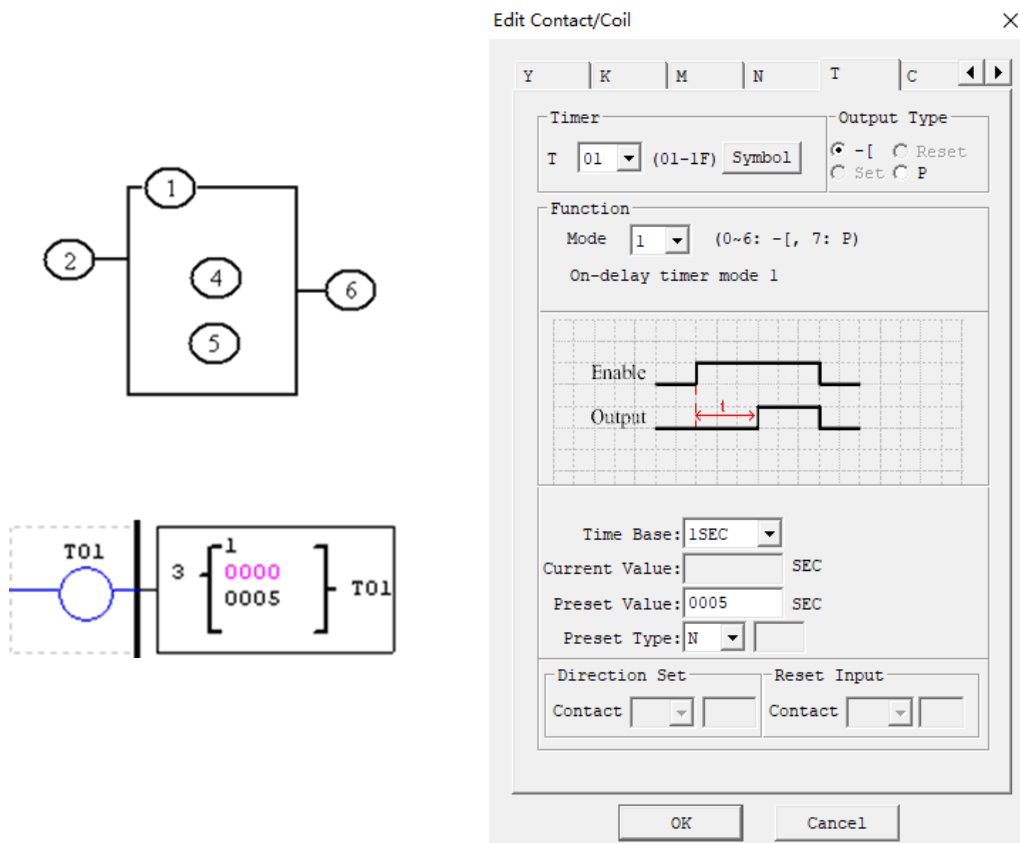
Timer mode 0 (internal coil)

The timer of mode 0 is used as internal auxiliary coil similar to M/N coil, which does not have a preset value. As shown below, timer T01 is in mode 0. Output status of timer 1 varies with status of I01.



Timer mode 1 (ON Delay A)

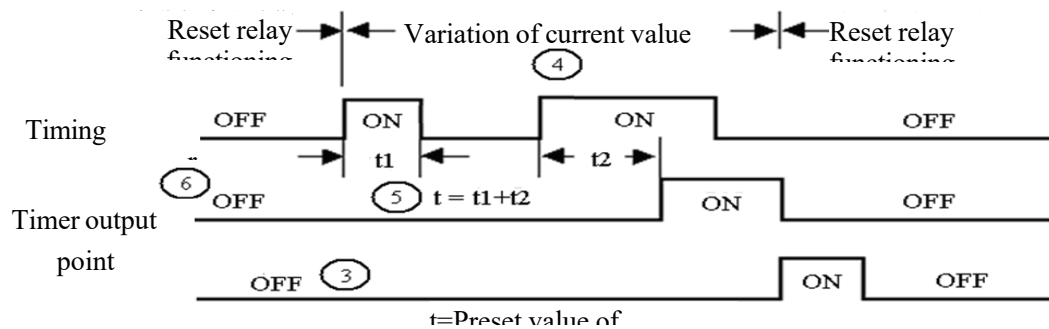
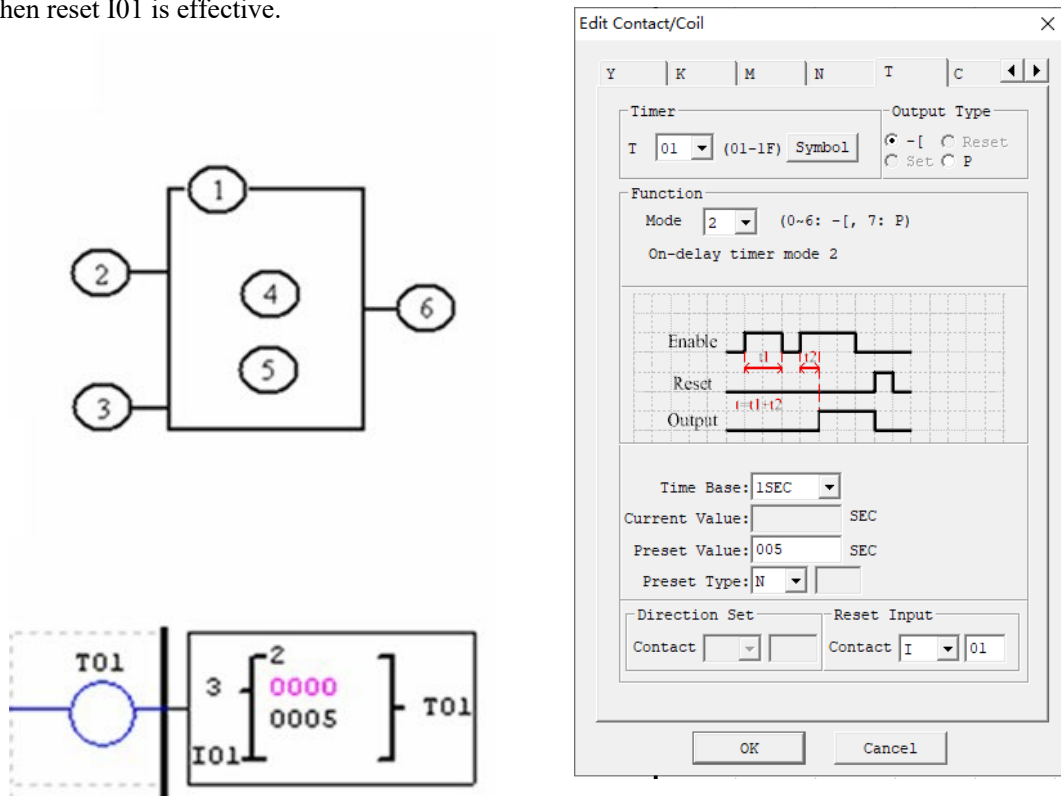
Timer begins timing when the control condition of timer mode 1 (ON Delay A) changes from OFF to ON, and it stops timing, and the timer coil output is ON when the current value of timing reaches the preset value. The current value of timer and coil status are reset to 0 when the control condition of timer is OFF.



※ When “M Keep” is effective, the current values of T0E and T0F are kept in case of power failure.

Timer Mode 2 (ON-Delay with Reset)

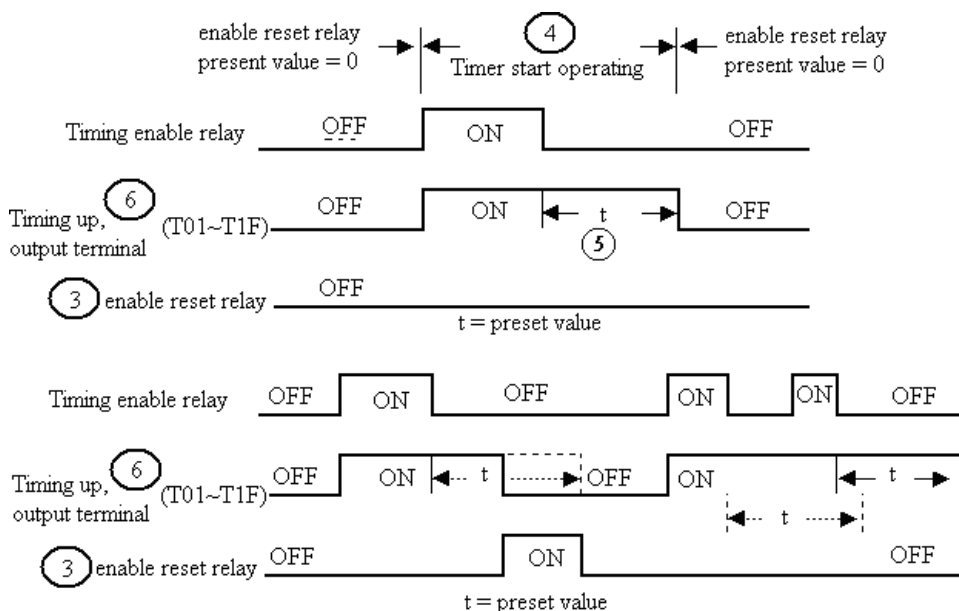
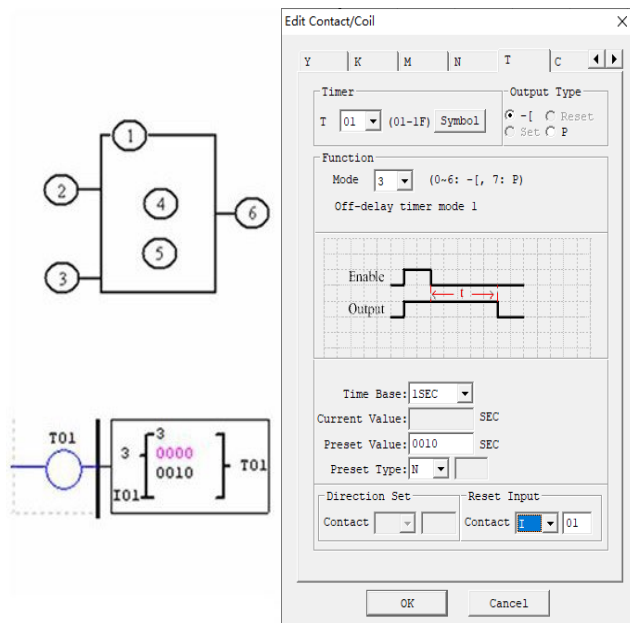
Timer mode 2 (ON Delay B) is designed with reset control. The timer begins timing when the control condition turns from OFF to ON, the current value of timer is kept when the control condition is OFF, and output coil is ON and timing is stopped when the current value of timer reaches the preset value. The current value of timer and coil status are reset to 0 when reset control is effective. In the following example, timing is stopped, output coil T01 is set ON and the current value is kept at 5 when the current value of timer T01 reaches the preset value 5. The current value and coil are reset to 0 when reset I01 is effective.



※ When “M Keep” is effective, the current values of T0E and T0F are kept in case of power failure.

Timer mode 3 (OFF Delay A)

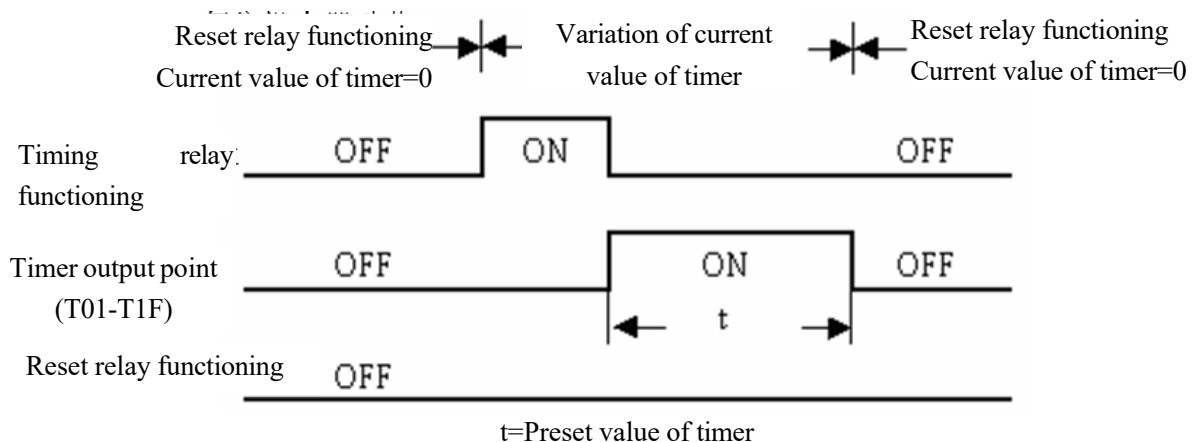
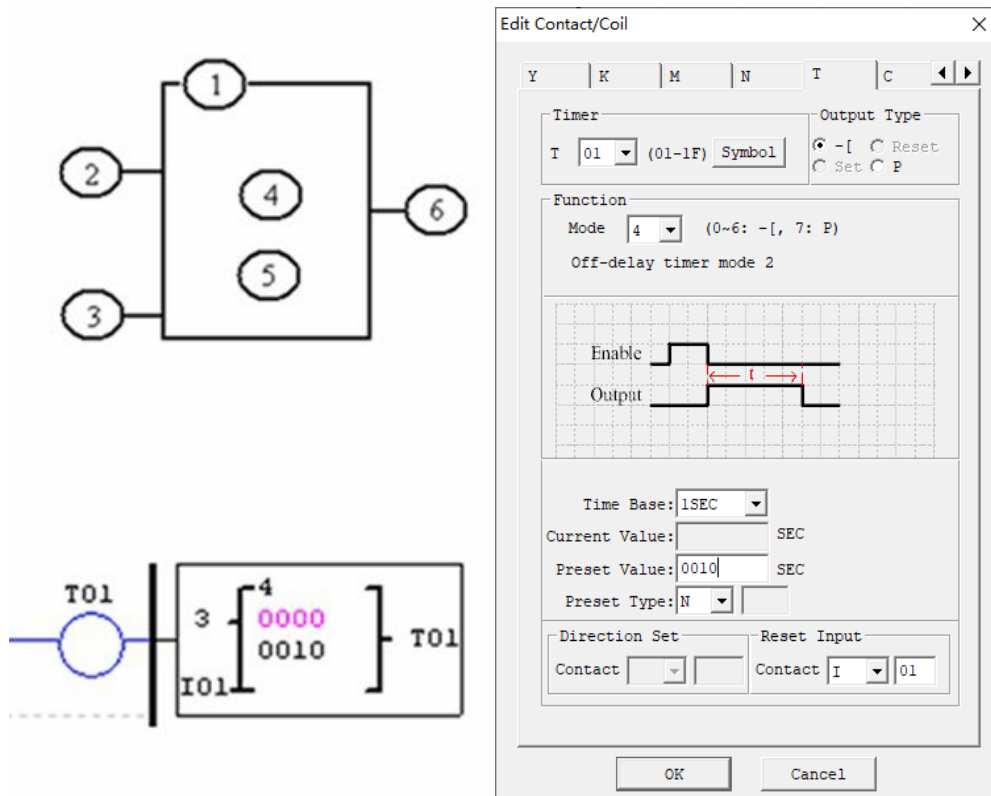
Timer mode 3 (OFF Delay A) is designed with reset control. T output is ON but the timer does not work when the control condition turns from OFF to ON; timer is started up for timing when the control condition turns from ON to OFF; timing is stopped, the current value is reset as 0 and T output is OFF when the current value of timer reaches the preset value; the current value and coil status are reset to 0 when reset control is effective. As shown below, T01 is set ON but the timer does not work when the control condition turns from OFF to ON; the timer begins timing and T01 output keeps ON when the control condition turns from ON to OFF; timing is stopped and T01 output is OFF when the current value of timer reaches 10; the current value of T01 and coil status are reset to 0 when reset input I01 is effective.



✖ When “M Keep” is effective, the current values of T0E and T0F are kept in case of power failure.

Timer Mode 4 (OFF-Delay)

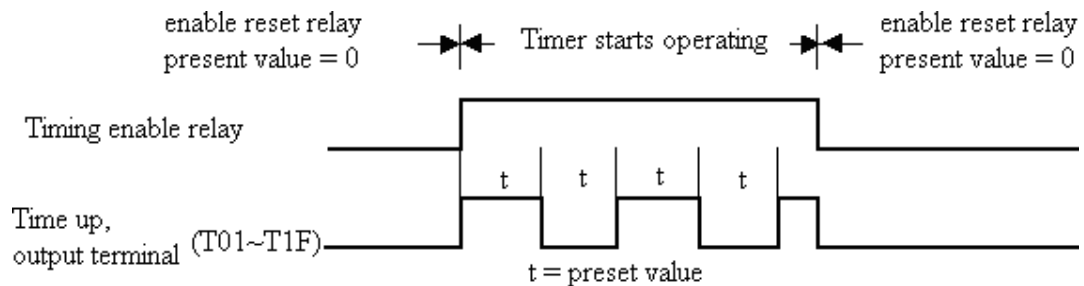
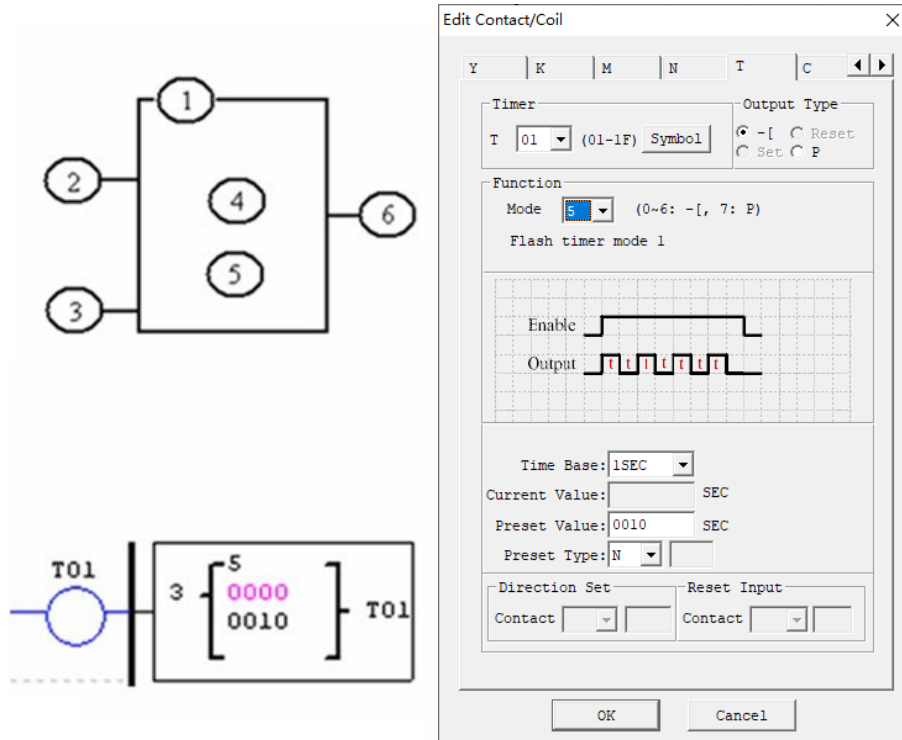
Timer mode 4 (OFF Delay B) is designed with reset control. Timing is started and T output is ON when the control condition turns from ON to OFF; timing is stopped, the current value is reset and T output is OFF when the current value of timer reaches the preset value; the current value of timer and coil status are reset to 0 when reset control is effective. As shown below, the timer T01 begins timing and T01 output is ON when the control condition turns from ON to OFF; timing is stopped and T01 output is OFF when the current value of T01 reaches 10; the current value of T01 is 0 and T01 output is OFF when reset control I01 is ON.



※ When “M Keep” is effective, the current values of T0E and T0F are kept in case of power failure.

Timer Mode 5 (FLASH without reset)

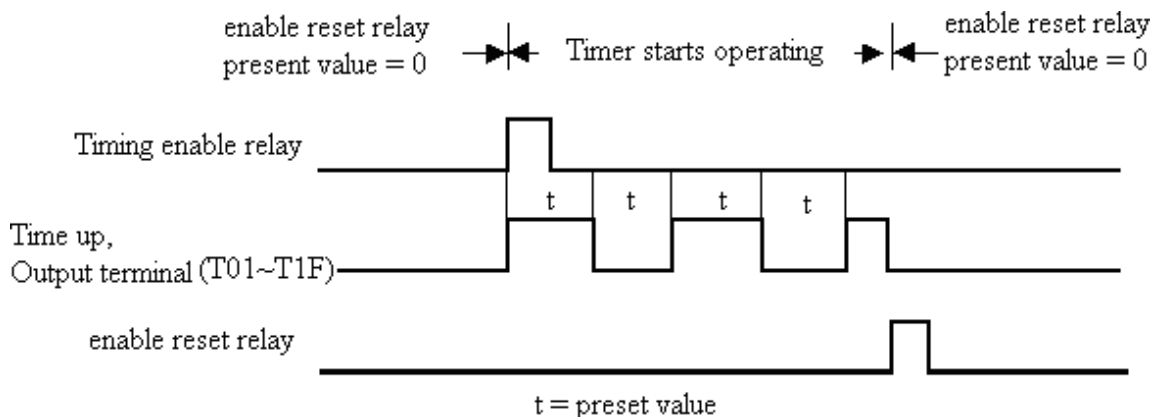
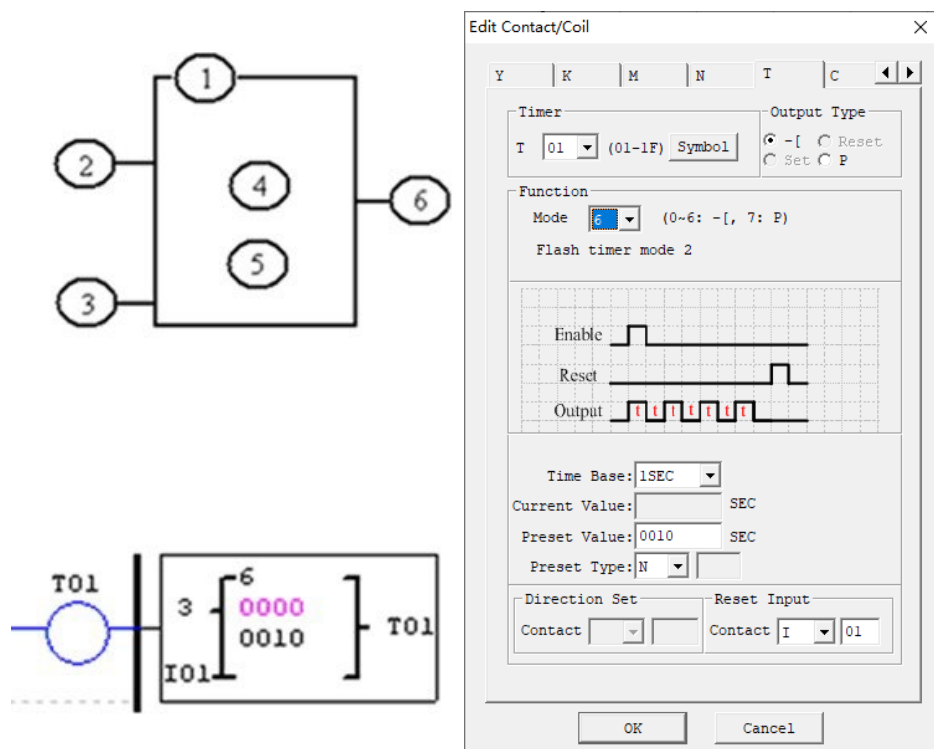
Timer mode 5 is a flash output mode without reset control. The timer begins timing when the control condition is effective; status of output coil T is shifted when the current value of timer reaches the preset value; timing is continued when the current value is reset to 0. As shown below, output status of T01 is shifted when the control condition is ON, and the current value of timer reaches the preset value 10; timing is restored when the current value of T01 is reset to 0.



※ The current value of Timer cannot be kept on a loss of power to SMT.

Timer mode 6 (FLASH with Reset)

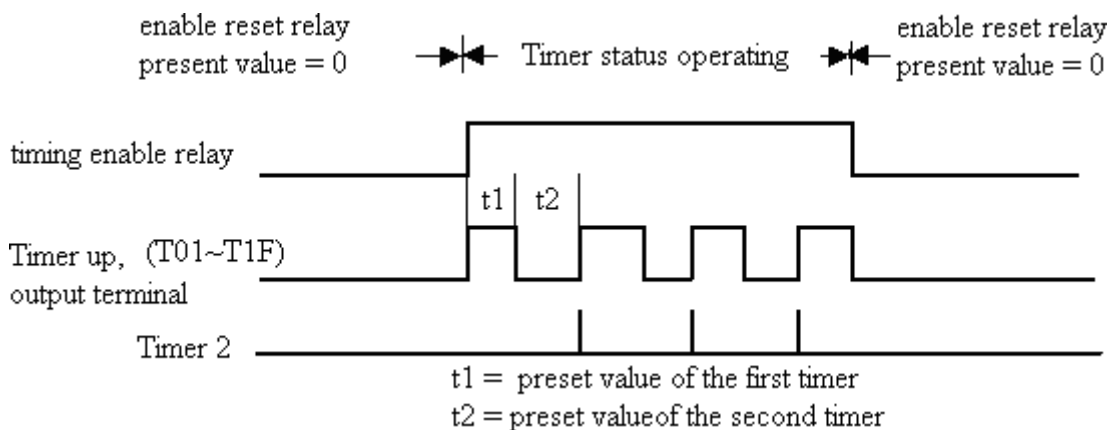
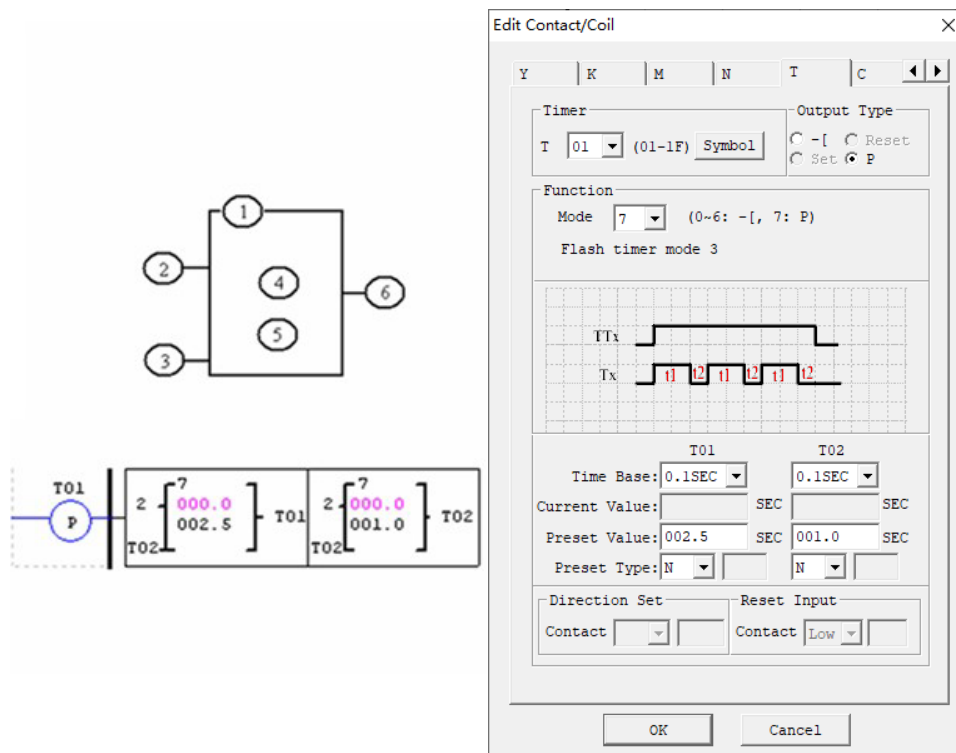
Timer mode 6 is a flash output mode with reset control. The timer begins timing when the control condition turns from OFF to ON, status of output coil is shifted when the preset value is reached, and timing is continued when the current value of timer is reset to 0. In mode 6, the control condition is not required to be kept ON, and the current value of timer and output coil are reset to 0 when reset control is effective. As shown below, the timer is started up when the control condition turns from OFF to ON, output status of T01 is shifted when the current value of timer reaches the preset value 10, timing is restored when the current value is reset to 0, and the current value of T01 and coil status are reset to 0 when reset control is effective.



✘ The current value of Timer cannot be kept on a loss of power to SMT.

Timer mode 7(FLASH Cascade without Reset)

Timer mode 7 is a pulse output timer without reset control, which uses two timers T1 and T2. T1 begins timing and T1 output is ON when the control condition turns from OFF to ON; timing is stopped, the current value of T1 is kept, T1 output is OFF and T2 is started up when the current value of T1 reaches the preset value; timing is stopped and T2 output is ON when the current value of T2 reaches its preset value; T1 is restarted when the rising edge of T2 resets T1 and T2, namely the current value of T1 is reset as 0 and the current value of T2 and T2 coil are reset as 0. As shown below, T01 begins timing and T01 output is ON when the control condition turns from OFF to ON; T01 stops timing, the current value of T01 is kept, T01 output is OFF and T02 is started up by the falling edge of T01 but T02 output is OFF when the current value of T01 reaches the preset value 2.5s; timing is stopped and T02 output is ON when the current value of T02 reaches the preset value 1.0s; T01 is restarted when the two timers are reset by the rising edge of T02, and so forth.

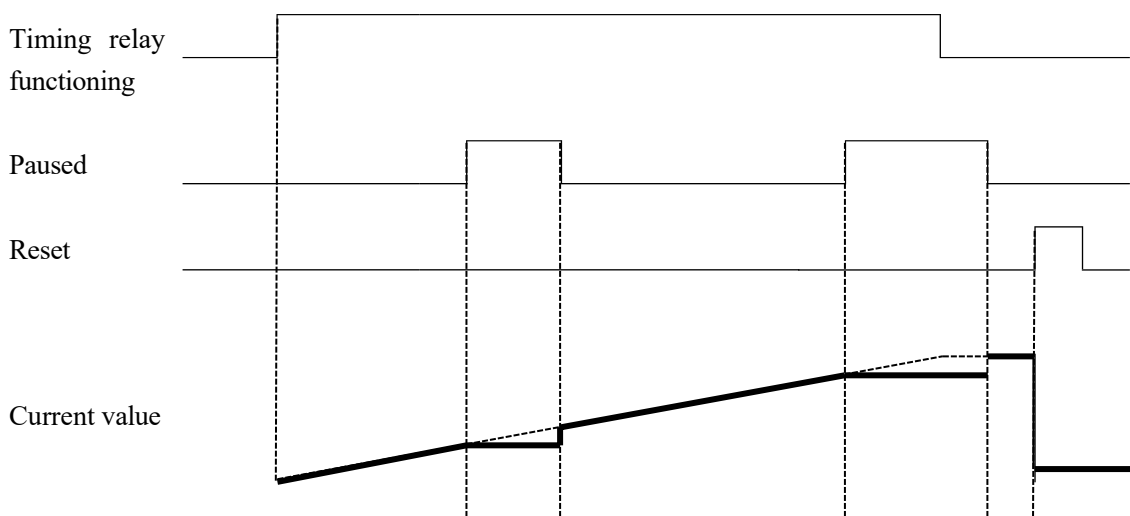
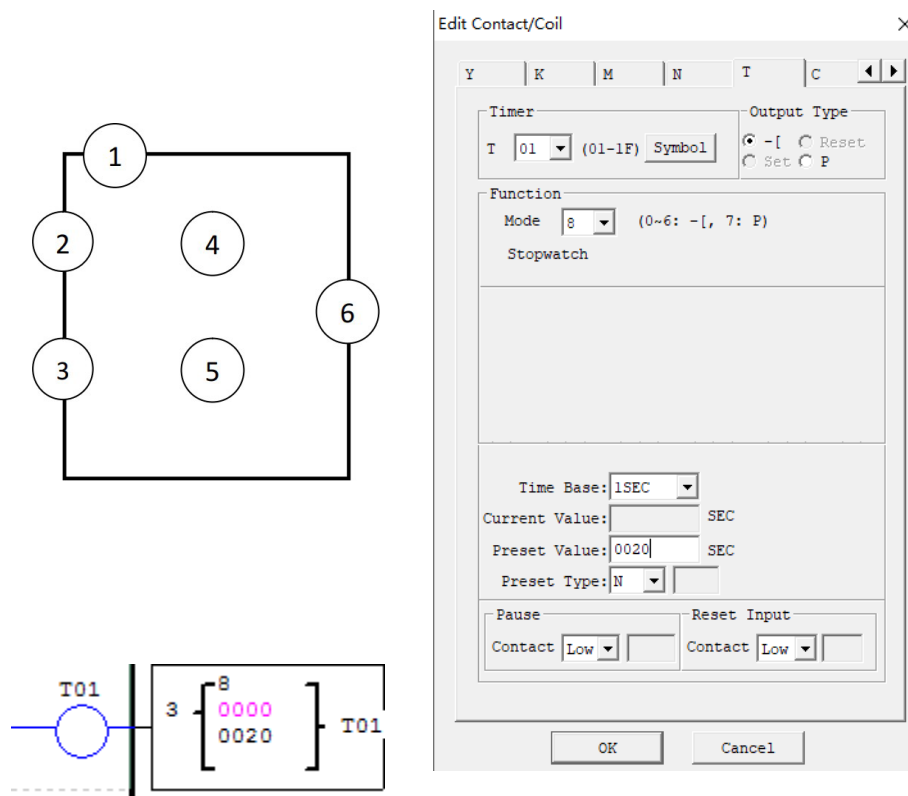


※ The two timers of mode 7 cannot be used in another place of the same user project

Timer mode 8

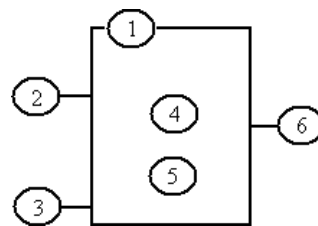
Timer mode 8 is a stopwatch mode with reset control and pause control. The timer begins timing when the control condition turns from OFF to ON; status of output coil is shifted, the current value of timer is displayed as the **preset value and timing is discontinued** when the preset value is reached; the current value of timer and output coil are reset to 0 when reset control is effective.

The current value is not updated (timing continued) when Pause input is set ON; the current value is updated (to current actual value) when Pause input is OFF; the current value is displayed as **9999 and timing is discontinued** when Pause input is ON and actual value reaches the preset value.



Counter Instructions

SMT has 31 independent counters. Each counter has 6 parameters and 10 working modes, 1 of which is used as internal coil, 6 as general counter and 2 as high-speed counter. The 6 parameters and available coils are listed below.



General counter

| Symbol | Description |
|--------|---|
| ① | Counter mode (0~9) |
| ② | Counting direction coil OFF: Count up (from 0 or current value to preset value) ON: Count down (from preset value or current value to 0) |
| ③ | Reset coil ON: Current value of counter is reset to 0, and output coil is OFF; OFF: Counter continues counting, and output coil is ON after completion of counting; |
| ④ | Current counting value of counter, range: 0~999999 |
| ⑤ | Preset value of counter, range: 0~999999 |
| ⑥ | Counter code (C01~C1F, 31 counters in total) |

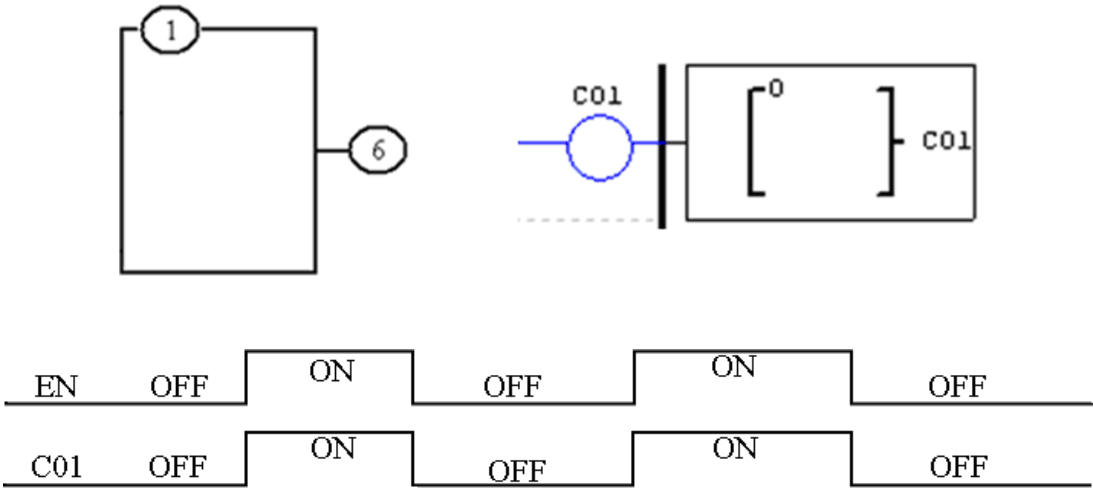
| Available coil | Number |
|-------------------------------|-----------------|
| Input coil | I01-I0C/i01-i0C |
| Key input | Z01-Z04/z01-z04 |
| Output coil | Q01-Q08/q01-q08 |
| Auxiliary coil | M01-M7F/m01-m7F |
| Auxiliary coil | N01-N7F/n01-n7F |
| Extended input | X01-X0C/x01-x0C |
| Extended output | Y01-Y0C/y01-y0C |
| RTC output coil | R01-R1F/r01-r1F |
| Counter output coil | C01-C1F/c01-c1F |
| Timer output coil | T01-T1F/t01-t1F |
| Analog comparator output coil | G01-F1F/g01-g1F |
| NO contact | Lo |
| Filter coil | F01-F1F/f01-f1F |
| Network input coil | J01-J3F/j01-j3F |
| Network output coil | K01-K3F/k01-k3F |

※ The preset value of counter may be a constant or code of other data type.

※ The following modes are described based on counting up. Counting down is from the current value to the preset value (not kept) or counting of input rising edge from the current value (kept); the current value is decreased by 1, and counting is stopped when the current value is 0; when it is reset, the current value is equal to the preset value.

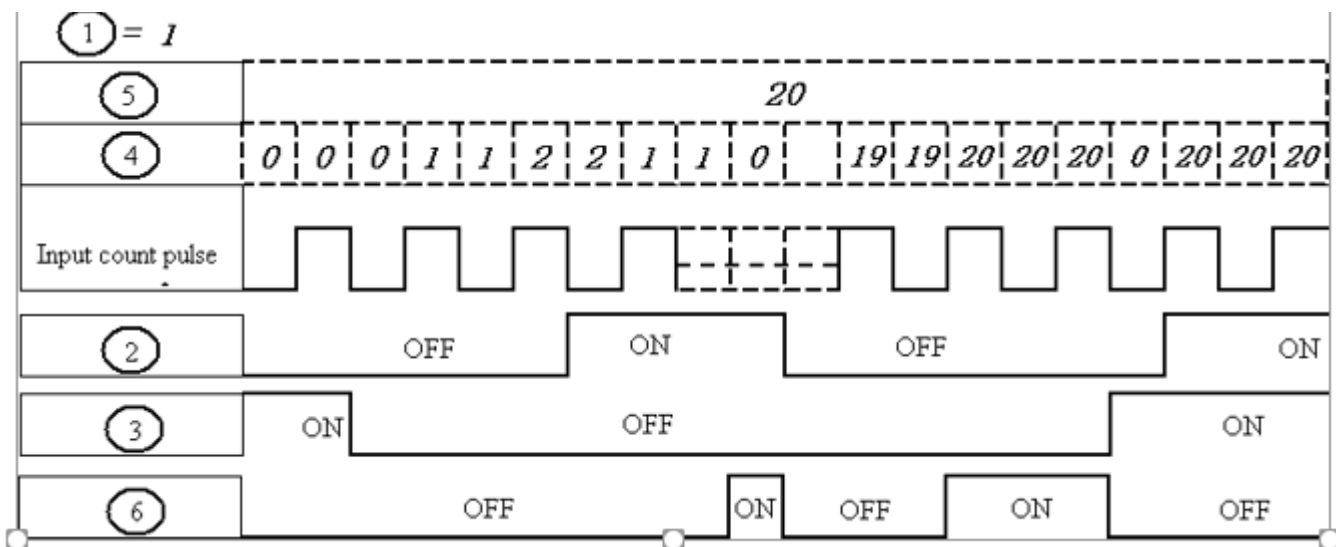
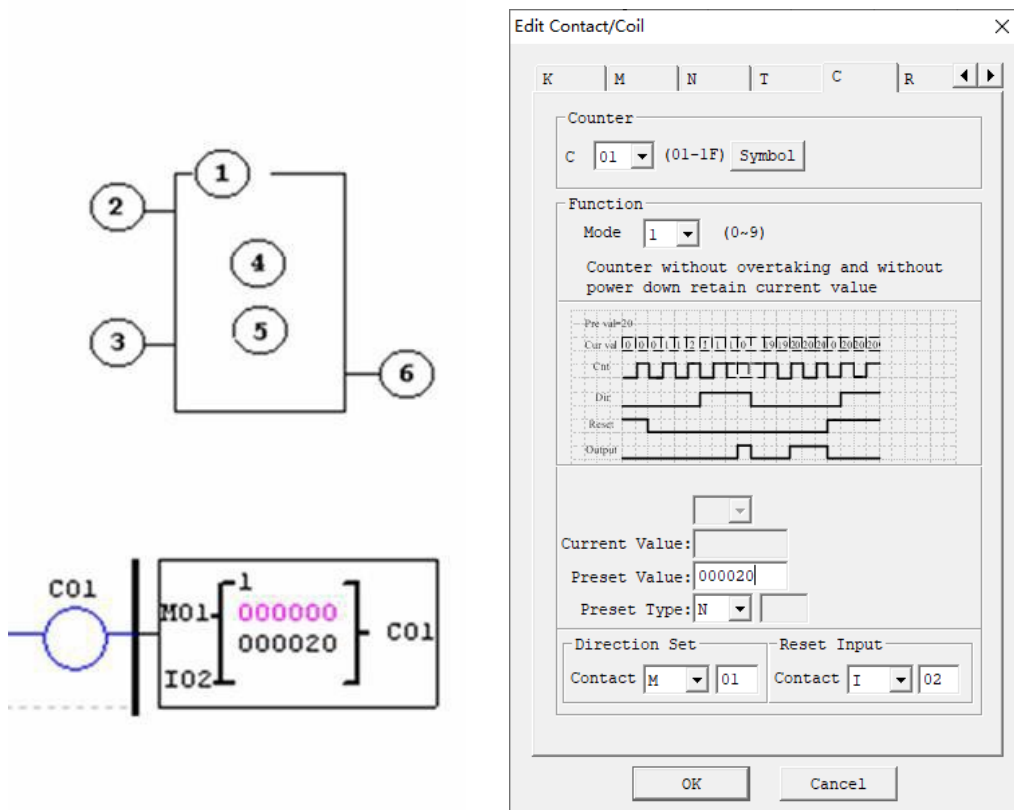
Counter mode 0 (internal coil)

As the internal coil, counter mode 0 does not have a reset value, and status of counter coil varies with status of input coil, as shown below.



Counter mode 1 (Non-Overtake, Non-Retentive)

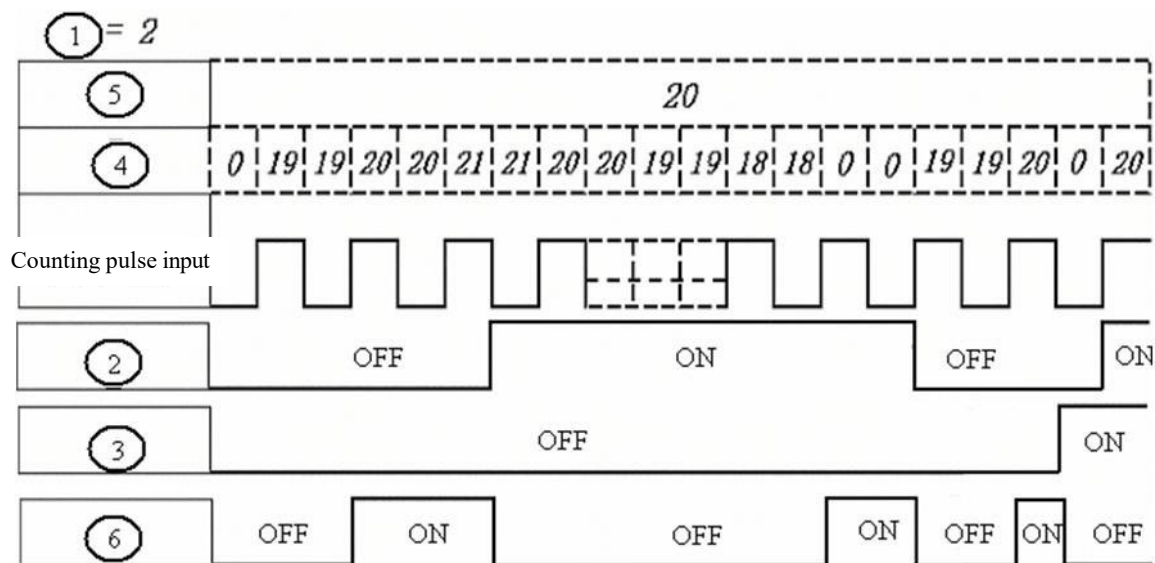
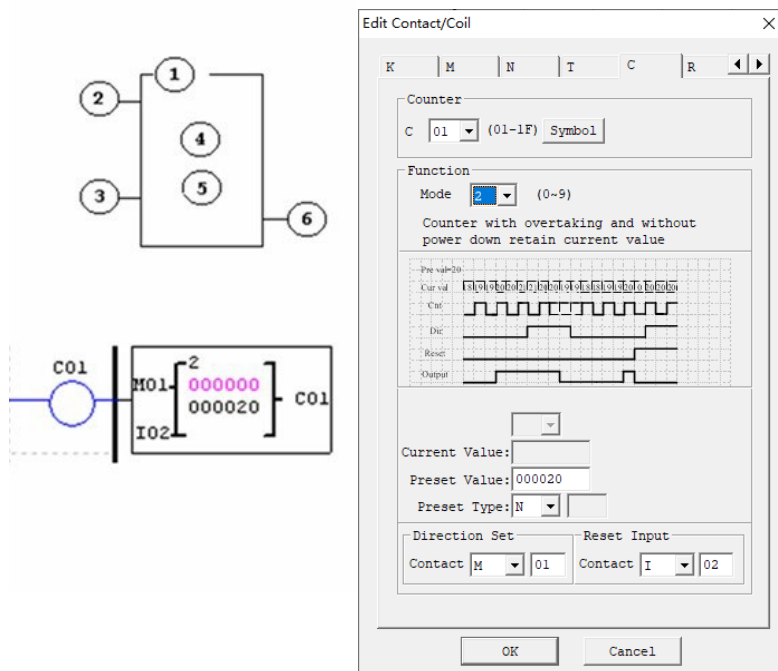
The current value of counter is counted up from 0, counting is stopped, and output coil is ON when the preset value is reached. In case of power failure, the current value is not kept and changes to 0 after power-on again or RUN/STOP switching. As shown below, I02 is the reset coil and M01 the counting direction coil; the counter C01 counts the input rising edge, counting is stopped and C01 output is ON after the preset value 20 is reached (if the direction coil M01 is enabled, the counter counts down from 20 after resetting, till the current value is 0; in case of power failure in this process, the current value is not kept, and counting is re-started from 20).



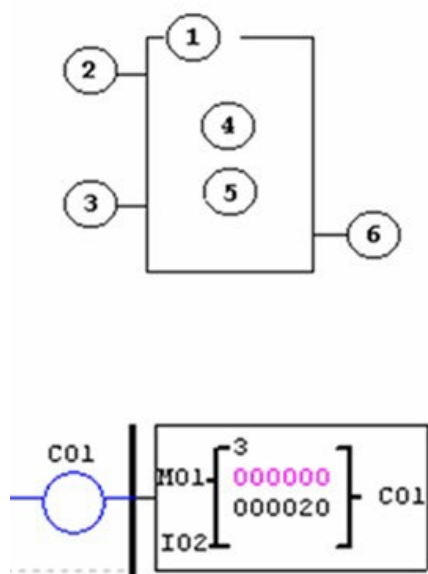
✖ In this mode, the current value of counter is initialized to 0 (counting up) or the preset value (counting down) after power-on or RUN/STOP switching; the current value is 0(counting up) or the preset value (counting down) after resetting.

Counter mode 2 (overflow allowed, not kept)

The current value of counter is counted up from 0; after the preset value is reached, output coil is ON, but counting of input rising edge is continued till the current value is 65535. After power-on or RUN/STOP switching, the current value of counter is not kept but reset to 0. In the following example, I02 is the reset coil and M01 the counting direction coil; the counter C01 counts the input rising edge, and C01 output is ON and C01 current value increases continuously after the preset value 20 is reached.



✘ In this mode, the current value of counter increases continuously after the preset value is reached and initialized to 0 (counting up) or the preset value (counting down) after power-on or RUN/STOP switching. After resetting, the current value is 0 (counting up) or the preset value (counting down).



Edit Contact/Coil

K | M | N | T | **C** | R

Counter
 C 01 (01-1F) Symbol

Function
 Mode 3 (0-9)
 Counter without overtaking and with power down retain current value

Timing Diagram:
 Pre val: 20
 Cur val: 0 0 0 0 1 1 1 2 1 1 0 1 0
 Cnt: [Pulse train]
 Dir: [High for 10 pulses, then low]
 Reset: [High for 10 pulses, then low]
 Output: [Pulse train]

Current Value:
 Preset Value: 000020
 Preset Type: N

Direction Set
 Contact M 01

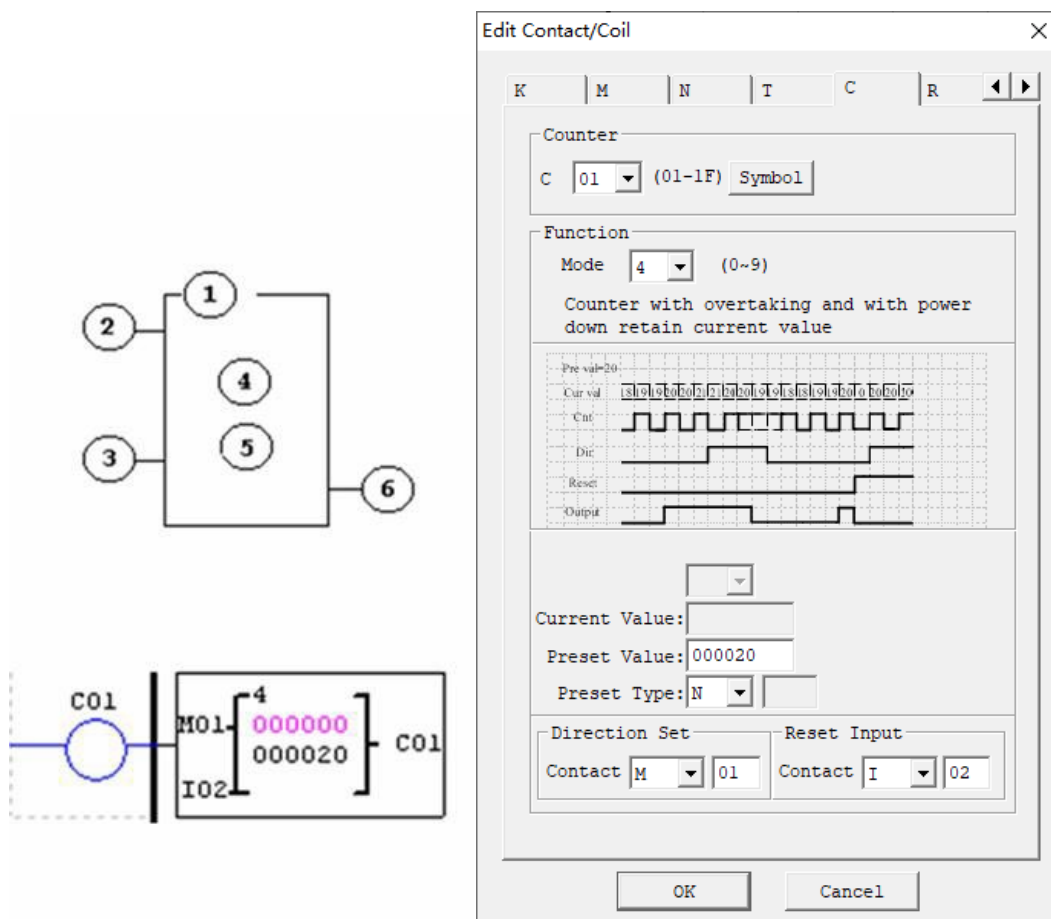
Reset Input
 Contact I 02

OK Cancel

- ✖ Mode 3 is similar to mode 1, but the current value is kept in case of power failure.
- ✖ If C KEEP is set, the current value is kept after RUN/STOP switching.
- ✖ The current value is 0 (counting up) or the preset value (counting down) when resetting.

Counter mode 4 (overflow allowed, kept)

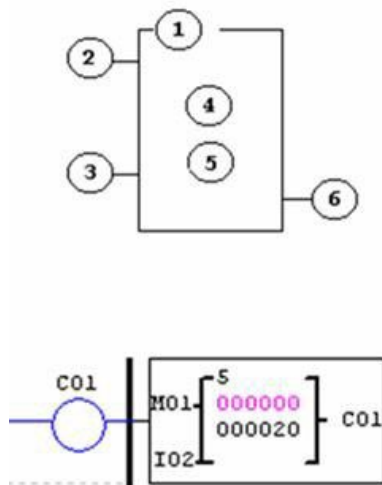
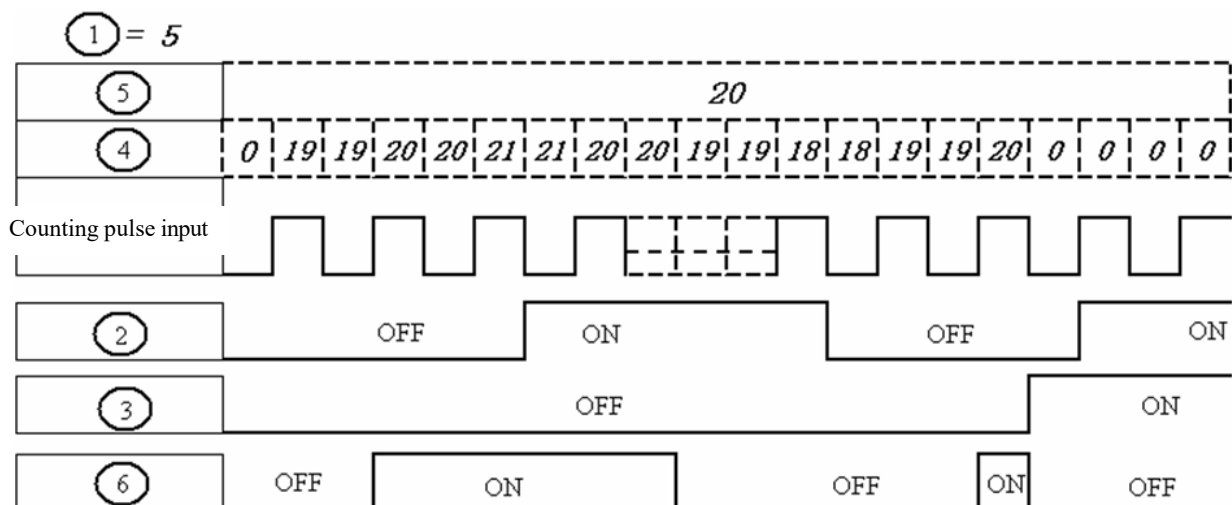
The counter mode 4 is similar to mode 2, namely counting is continued after the current value reaches the preset value, but the current value is kept after power failure. If C KEEP is set, the current value is kept after RUN/STOP switching. In the following example, I02 is the reset coil and M01 the counting direction coil; counter C01 counts the input rising edge, and counting is continued and C01 output is ON after the preset value 20 is reached.



- ✘ Mode 4 is similar to mode 2, namely counting continues after the current value reaches the preset value, but the current value is kept after power failure.
- ✘ If C KEEP is set, the current value is kept after RUN/STOP switching.
- ✘ The current value is 0 (counting up) or the preset value (counting down) when resetting.

Counter mode 5 (Overtaking, Up-Down Count, Non-Retentive)

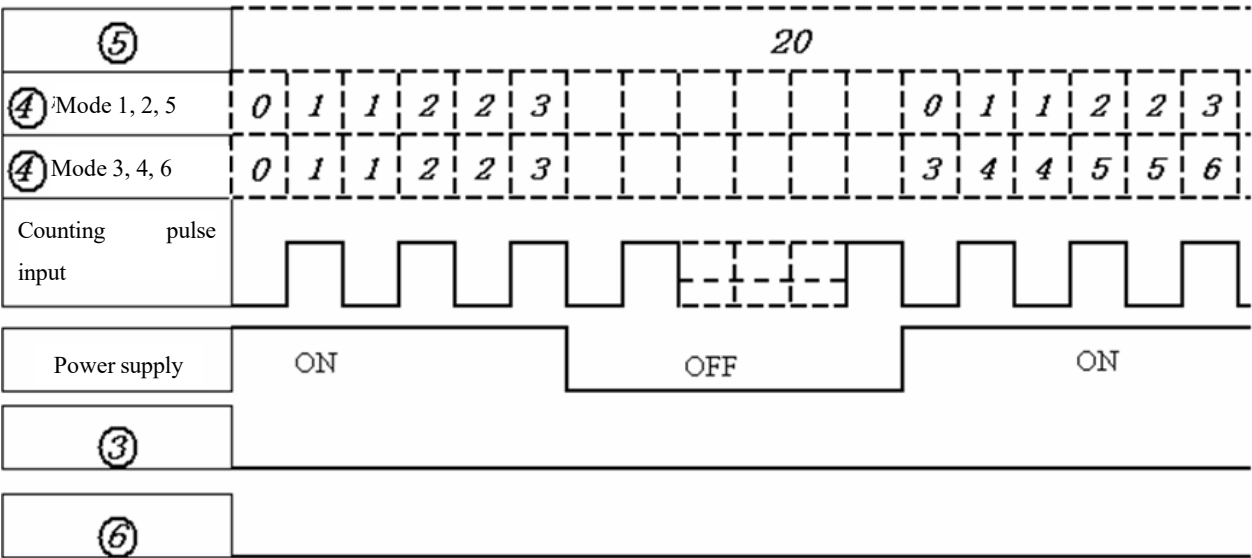
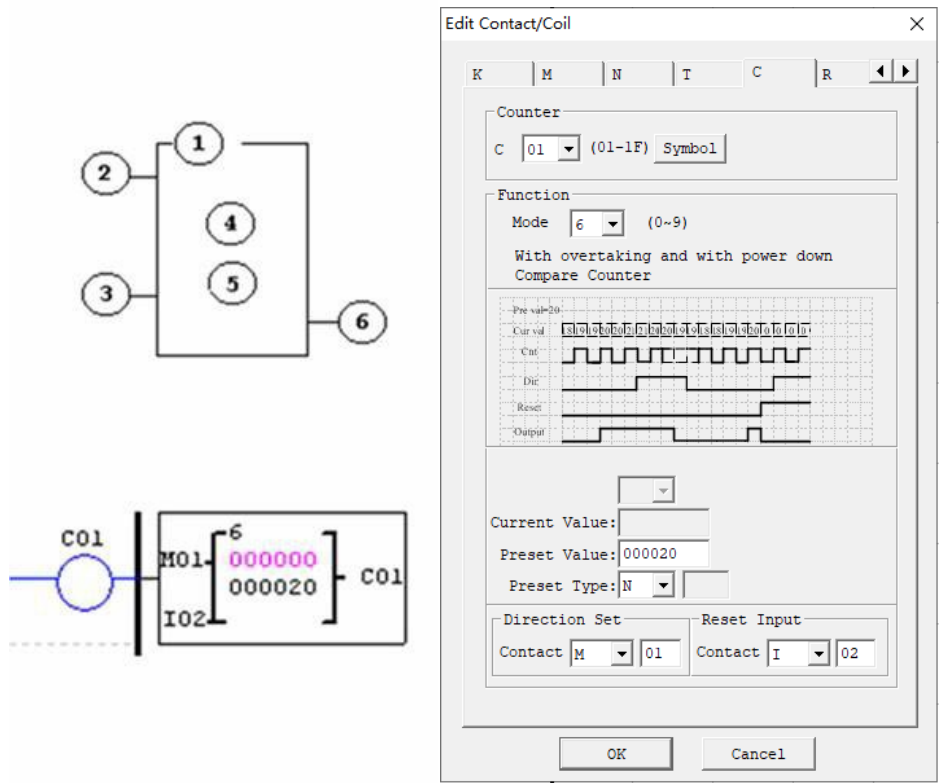
The counter mode 5 is similar to mode 2, namely counting overflow is allowed, but the current value is not kept after power-on again or RUN/STOP switching. Regardless of counting direction in mode 5, output is ON only when the current value is higher than or equal to the pre-set value, and the current value is 0 after resetting, power failure or RUN/STOP switching. In the following example, I02 is the reset coil and M01 the counting direction coil; the counter C01 counts the input rising edge, and C01 output is ON and counting continues after the preset value 20 is reached.

※ In this mode, counting continues after the current value of counter reaches the preset value; regardless of counting direction, the current value is 0 after resetting, and not kept after power-on again or RUN/STOP switching.

Counter mode 6 (overflow allowed, kept, comparison counter)

The counter mode 6 is similar to mode 5, but the current value is kept in case of power failure; if C KEEP is set, the current value is kept after RUN/STOP switching. In the following example, I02 is the reset coil and M01 the counting direction coil; the counter C01 counts the input rising edge, and C01 output is ON and counting continues after the preset value 20 is reached.



- ✖ In mode 6, the current value is kept in case of power failure.
- ✖ If C KEEP is effective, the current value is kept after RUN/STOP switching.

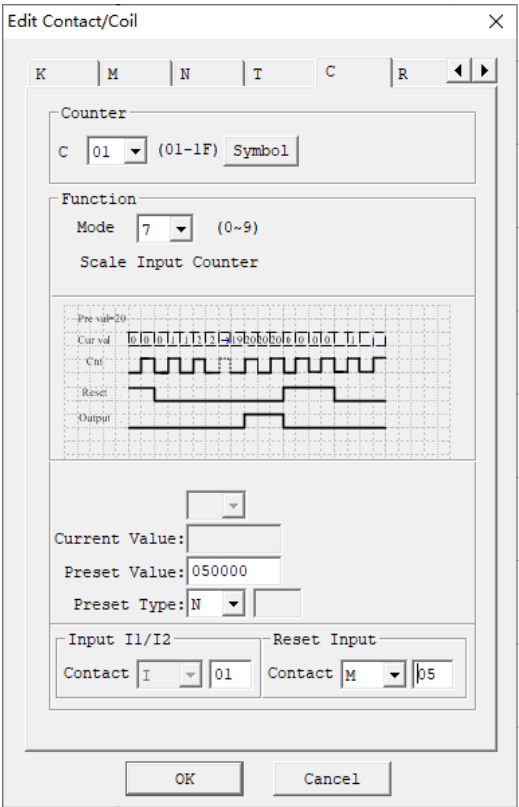
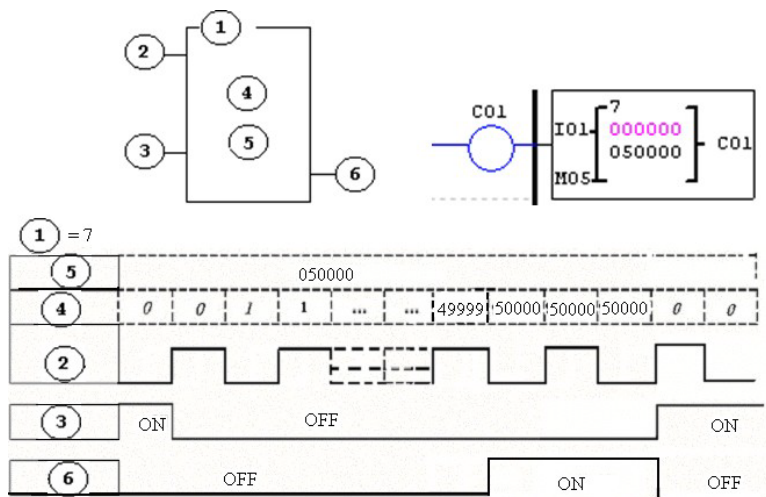
High-speed counter (for DC type)

The type of DC power supply provides two 1KHz high-speed inputs I01 and I02, and uses two counters to realize two groups of high-speed counting. Counter modes 7 and 8 are high-speed counting that uses the same editing method with general counter but has different parameters.

High-speed counter mode 7 (proportional input counter)

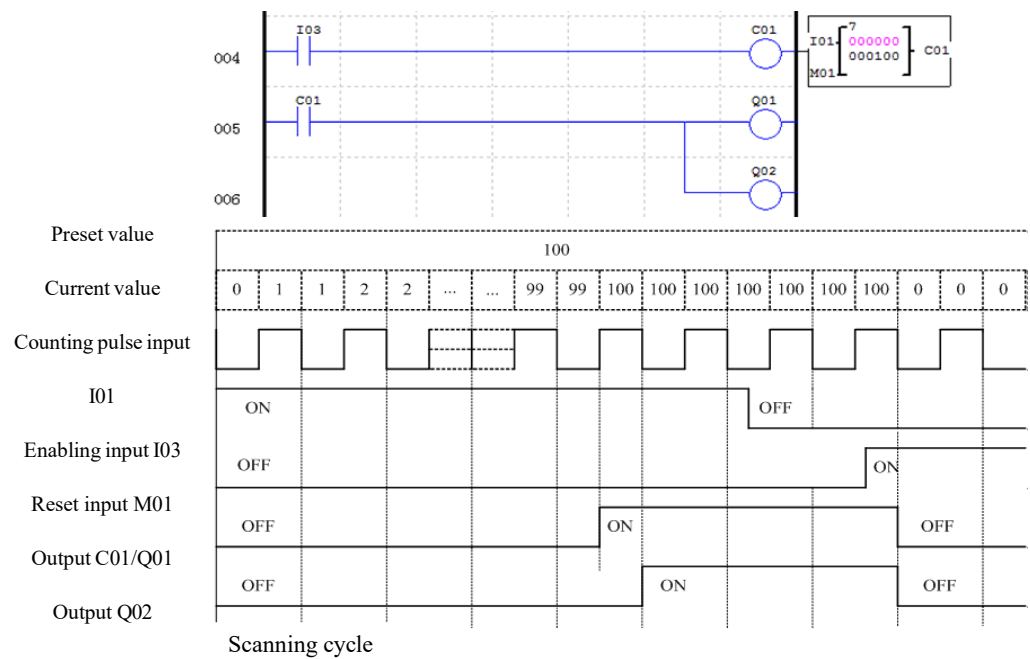
In DC machine, high-speed counter mode 7 uses I01 or I02 as the maximum 1KHz high-speed input, and counting is stopped and output coil is ON after the counting value reaches the preset value. After resetting, the current value of counter is reset to 0 and output coil is OFF. In the following example, the rising edge of high-speed input I01 is counted after C01 is enabled; counting is stopped and C01 output is ON after the counting value reaches the preset value 50000; the counter C01 is reset when M05 is ON.

| Symbol | Description |
|--------|---|
| ① | High-speed counter mode7 |
| ② | High-speed counter input, I01, I02 |
| ③ | Reset coil ON: Current value of counter is reset to 0 OFF: Counter continues counting |
| ④ | Current value of counter: 0~999999 |
| ⑤ | Preset value of counter 0~999999 |
| ⑥ | Counter code (C01~C1F, 31 counters in total) |



Output example:

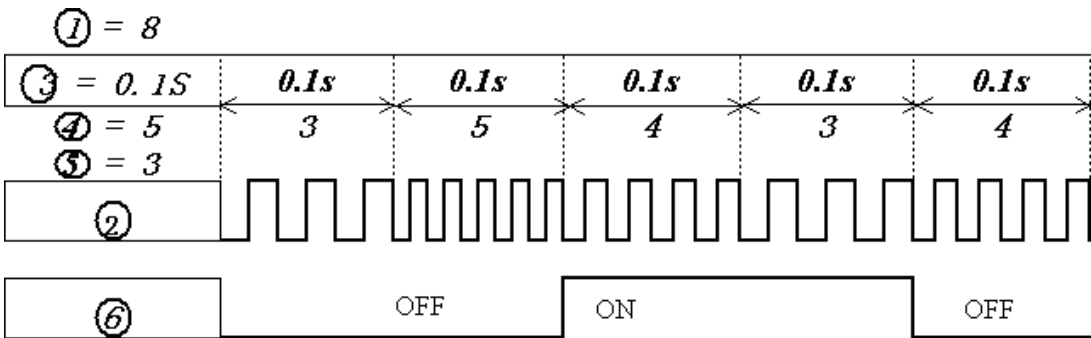
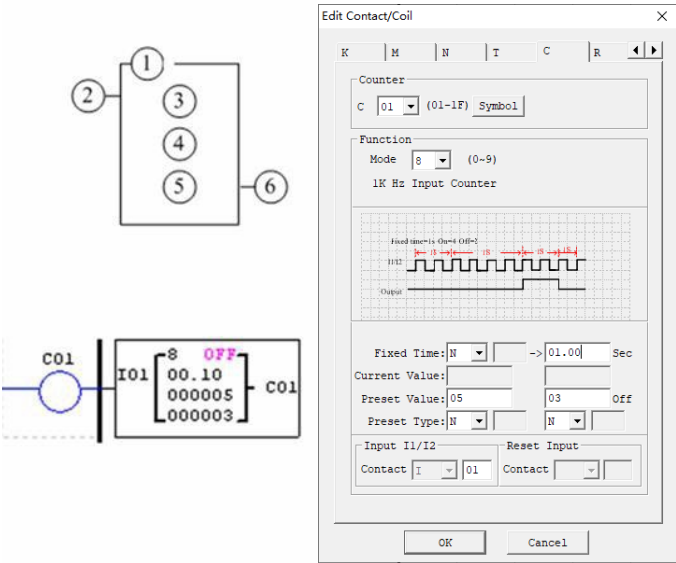
In the following example, Q01 outputs ON immediately when C01 counting value reaches the preset value, and Q02 outputs ON only when output is executed in the scanning cycle.



High-speed counter mode 8 (1KHZ input counter) (DC powered versions only)

The Mode 8 High Speed Counter can use either input terminals I01 or I02 for forward up-counting to 1 KHz maximum at 24VDC high speed input signal. It will reflash its counted value in each “fixed time”. When the counted value reaches or exceeds the “Preset ON”, then the selected counter coil turns ON at the next cycle. If the counted value change to a value less than “Preset ON” but still large than “Preset OFF”, it still retains ON state. The counter coil does not turn OFF at next cycle until the counted value less than “Preset OFF”. The counter will reset when the preceding rung is inactive. The table below describes each configuration parameter for High-Speed Counter Mode 8.

| Symbol | Description |
|--------|--|
| ① | High-speed counter mode 8 |
| ② | High-speed counter input: I01 or I02 |
| ③ | Timing interval: 0~99.99 s |
| ④ | Preset value of Preset ON, range: 0~999999 |
| ⑤ | Preset value of Preset OFF, range: 0~999999 |
| ⑥ | Counter code (C01~C1F, 31 counters in total) |

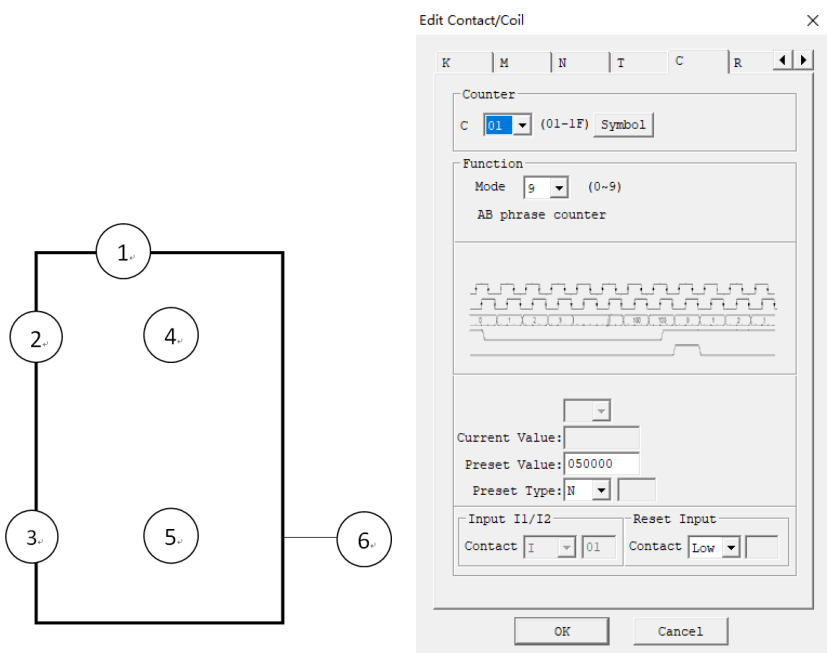


High-speed counter mode 9 (1KHZ input AB-phase counter)

Mode 9 is AB-phase high-speed counting function for counting of two lines of pulse with consistent periodic pulse width and phase difference of 90°, which uses the same editing method with general high-speed counting function but has different parameters.

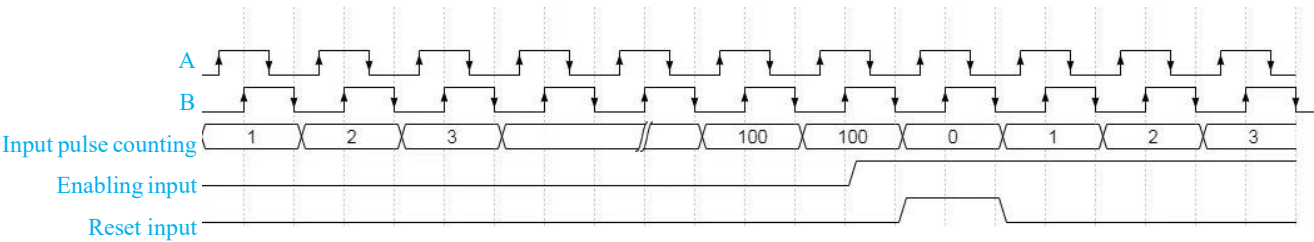
In DC machine, high-speed counter mode 9 enables high-speed input counting of the maximum 1KHz AB phases of I01 (A) ahead of I02 (B); the current value of counter is (0~999999), counting is stopped, and output coil is ON when the counting value reaches the preset value; the current value of counter is reset to 0 and output coil is OFF after resetting.

| Symbol | Description |
|--------|---|
| ① | High-speed counter mode 9 |
| ② | High-speed counter input, I01, I02 |
| ③ | Reset coil ON: Current value of counter is reset to 0 OFF: Counter continues counting |
| ④ | Current value of counter: 0~999999 |
| ⑤ | Preset value of counter 0~999999 |
| ⑥ | Counter code (C01~C1F, 31 counters in total) |



Coil M3A is the special coil, A/B is the counting direction flag. When Phase A leads phase B, M3A coil will be OFF, when phase B leads phase A, M3A will be ON.

When the current value overflows (The current value is greater than 999999);And next Phase A leads phase B, The current value will be 0; When the current value overflows(The current value is less than 0);And next Phase B leads phase A, current value will be 999999;



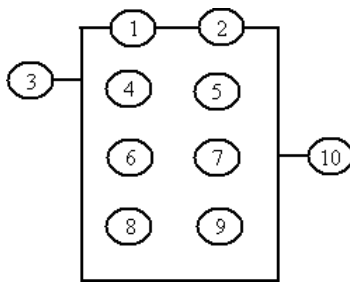
Real-time clock (RTC) Instructions

SMT includes 31 independent RTC functional blocks, and each block has 6 operating modes (mode 0~mode 5) and 6 parameters. Display of functional blocks and meaning of each parameter under Ladder are provided below.

Clock setting V3.0

2009.04.30

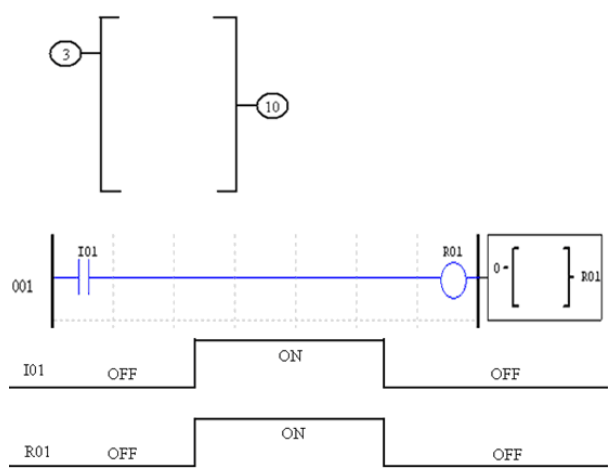
Thur 13:30



| Symbol | Description |
|--------|--|
| ① | RTC input in the first week |
| ② | RTC input in the second week |
| ③ | RTC mode 0~2: 0, internal coil mode; 1. day mode; 2. week mode |
| ④ | Current hour shown by RTC |
| ⑤ | Current minute shown by RTC |
| ⑥ | Set hour of RTC ON |
| ⑦ | Set minute of RTC ON |
| ⑧ | Set hour of RTC OFF |
| ⑨ | Set minute of RTC OFF |
| ⑩ | RTC code (R01~R1F, 31 RTCs in total) |

RTC mode 0 (internal coil)

In RTC mode 0, coil R is used as internal coil and preset value is not required. In the following example, R01 is mode 0 and its status varies with the control condition I01.



Edit Contact/Coil

M | N | T | C | R | G

Real time clock

R 01 (01-1F) Symbol

Function

Mode 0 (0-5)

Internal Coil

| MO | TU | WE | TH | FR | SA | SU |
|----|----|----|----|----|----|----|
| 1 | 0 | 0 | 0 | 0 | 0 | 0 |

Enable

Rx

Week(On->Off): SU --> SU

Current Value: 10:07

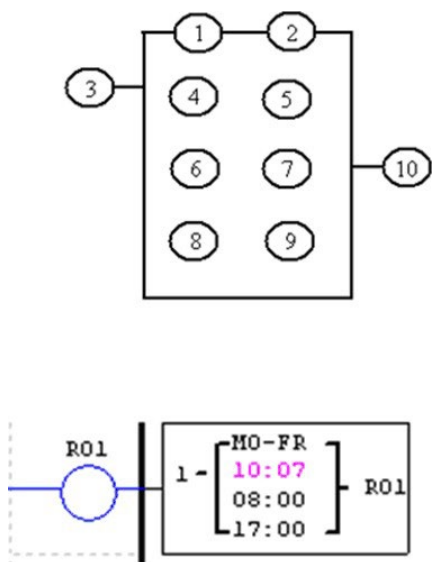
Preset Value: 00 : 00 Sec 00 : 00 Sec (hour:minute)

OK Cancel

RTC mode 1 (day mode)

RTC mode 1 is for setting the daily ON/OFF time of each week.

In the following example (1), effective time of each week is set as MO (Monday) 8:00 to FR (Friday) 17:00, namely coil R01 outputs ON from 8:00 to 17:00 in Monday to Friday, and outputs OFF at other times.



Edit Contact/Coil

M N T C R G

Real time clock

R 01 (01-1F) Symbol

Function

Mode 1 (0-5)

Every day action mode

| | | | | | | |
|------|------|------|------|------|------|------|
| MO | TU | WE | TH | FR | SA | SU |
| 8:00 | 7:00 | 8:00 | 7:00 | 8:00 | 7:00 | 8:00 |

Enable

Rx

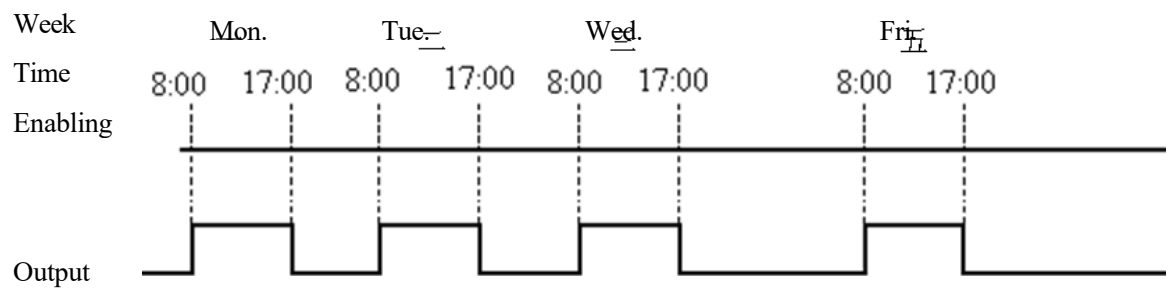
Week (On->Off): MO --> FR

Current Value: 10:11

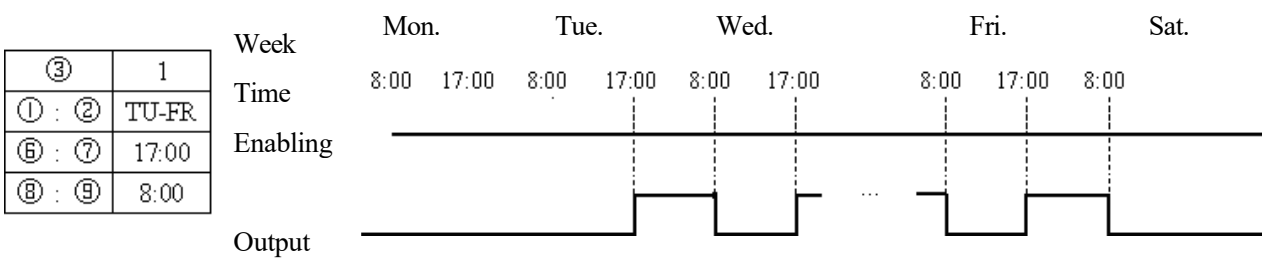
Preset Value: 08 : 00 Sec 17 : 00 Sec (hour:minute)

OK Cancel

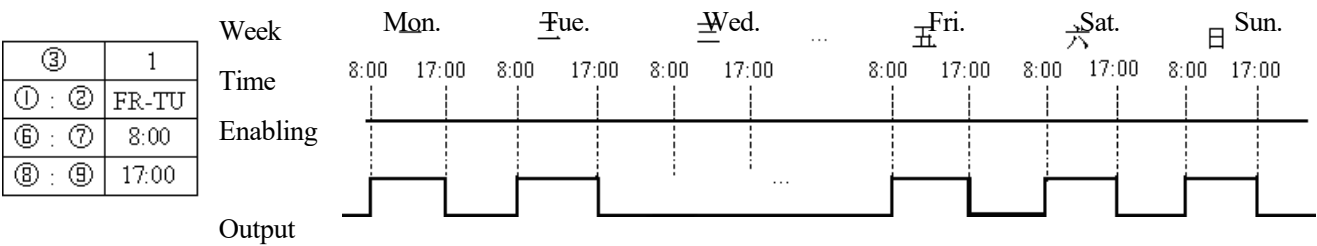
Example 1:



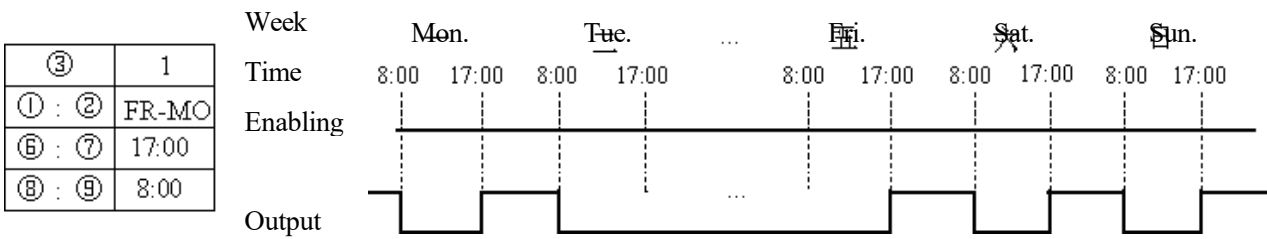
Example 2:



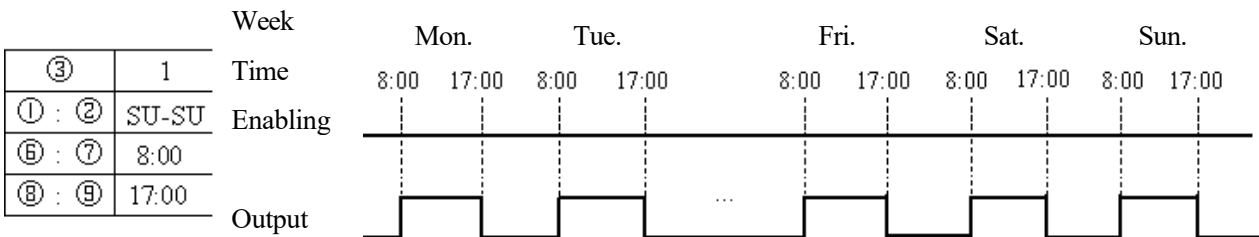
Example 3:



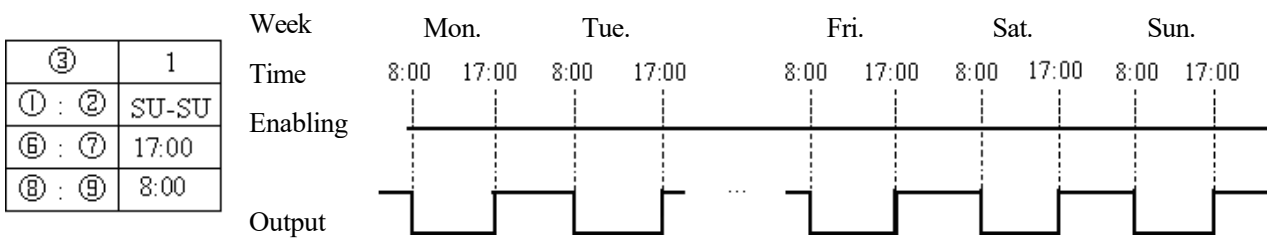
Example 4:



Example 5:

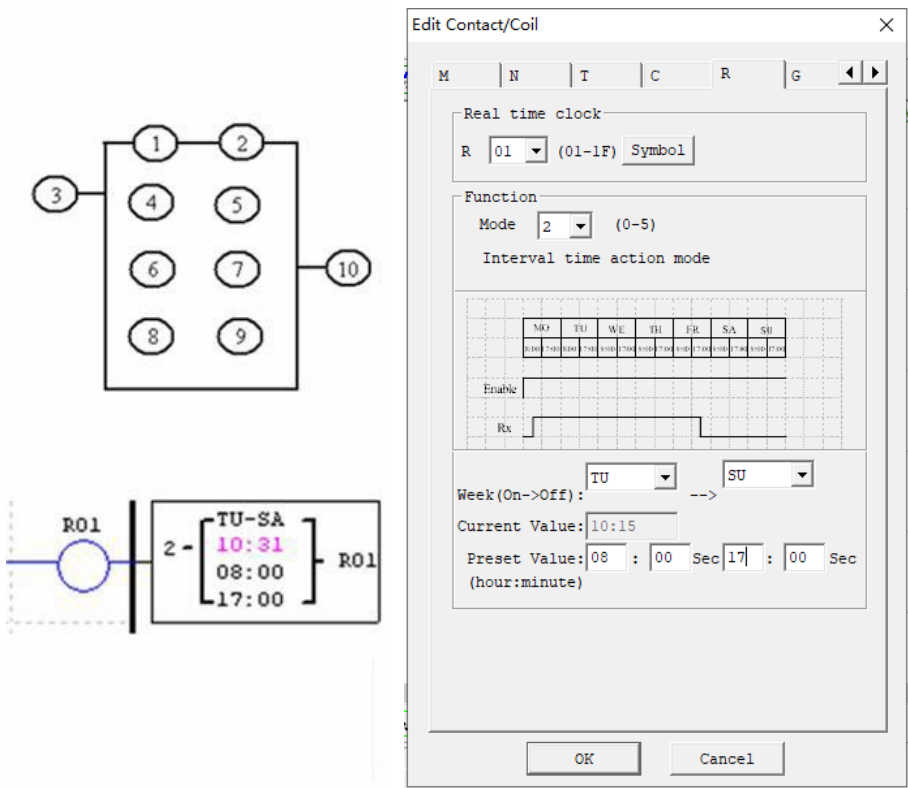


Example 6:

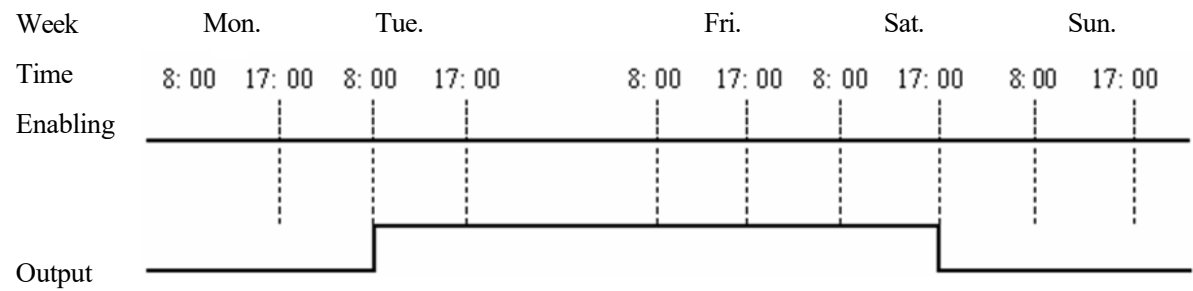


RTC mode 2 (week mode)

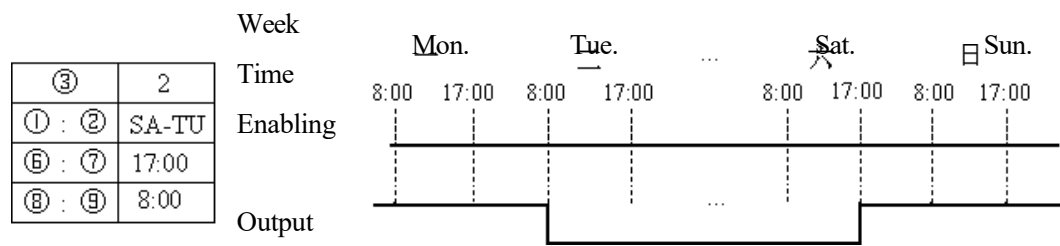
RTC mode 2 is for setting ON/OFF time of coil R in a week. In the following example (1), coil R01 outputs ON from TU (Tuesday) 8:00 to SA (Saturday) 17:00, and outputs OFF at other times.



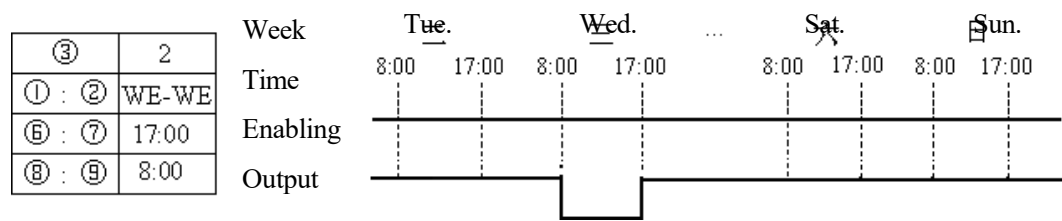
Example 1:



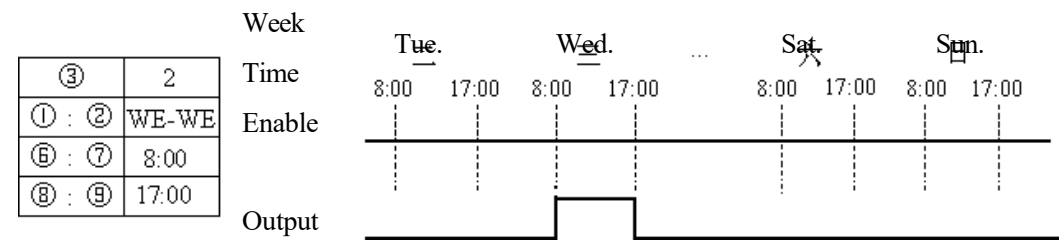
Example 2:



Example 3:



Example 4:

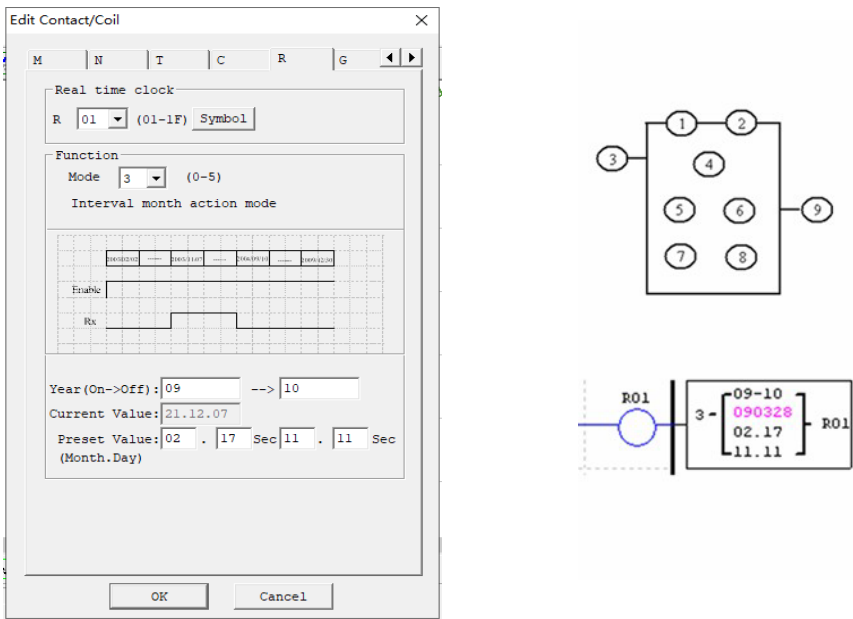


RTC mode 3 (year-month-day mode)

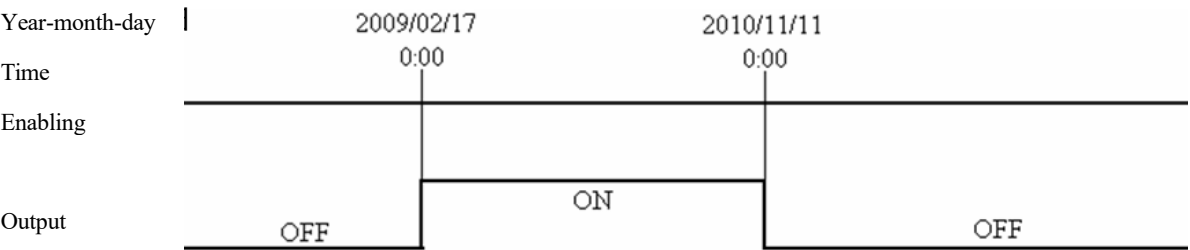
RTC mode 3 uses the set year-month-day to control status of coil R. The parameters of this mode and meanings of the parameters are provided below. In example 1, coil outputs ON from February 17, 2009 to November 11, 2010.

When the year setting is 00-00 in RTC mode3, a special mode is used to enable RTC from the beginning month and day to the end month and day of each year, as shown in example 4.

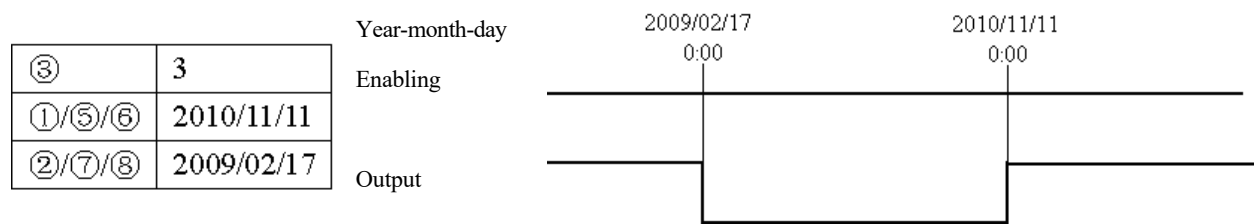
| Symbol | Description |
|--------|--------------------------------------|
| ① | Set year of RTC ON |
| ② | Set year of RTC OFF |
| ③ | RTC mode 3, year-month-day |
| ④ | RTC current time: year-month-day |
| ⑤ | Set month of RTC ON |
| ⑥ | Set day of RTC ON |
| ⑦ | Set month of RTC OFF |
| ⑧ | Set day of RTC OFF |
| ⑨ | RTC code (R01~R1F, 31 RTCs in total) |



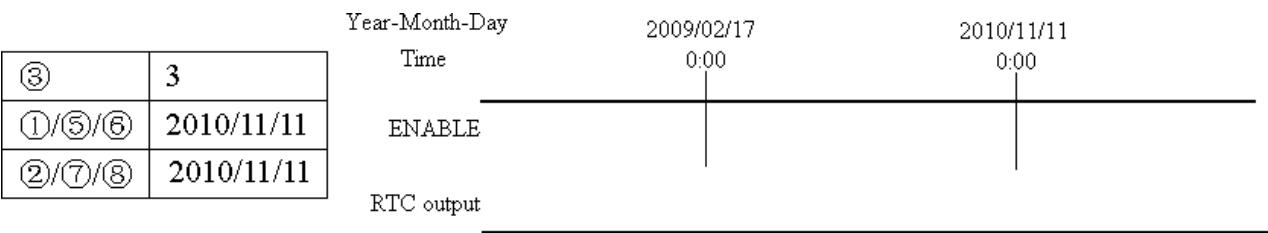
Example 1:



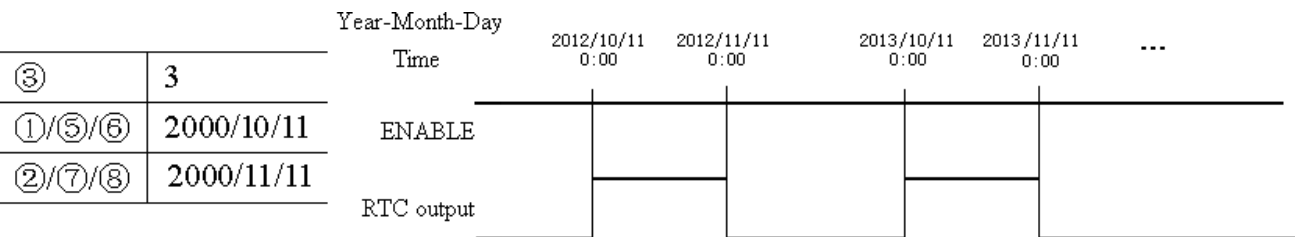
Example 2:



Example 3:

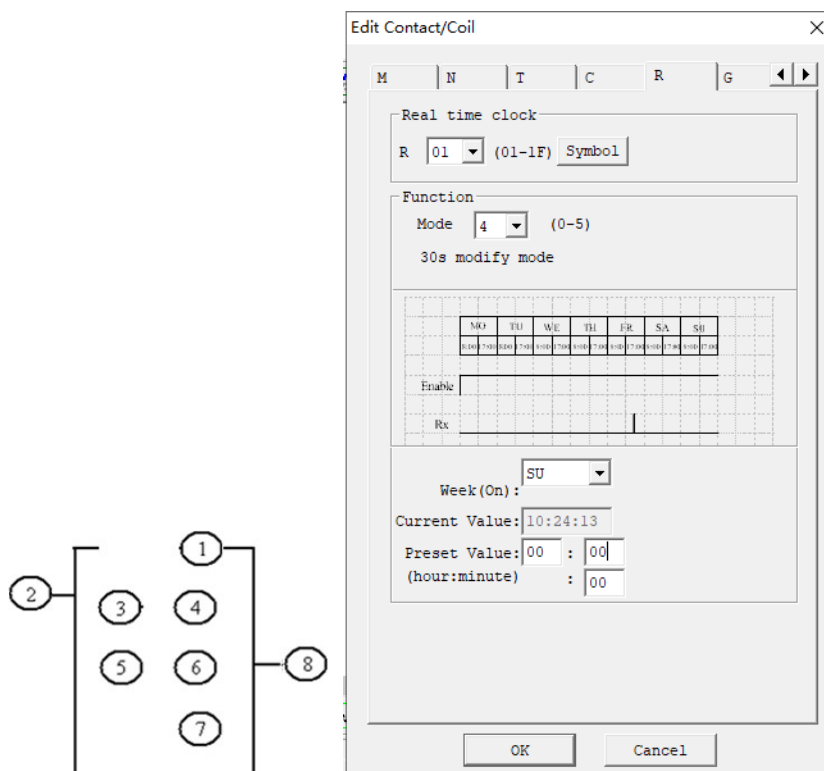


Example 4:



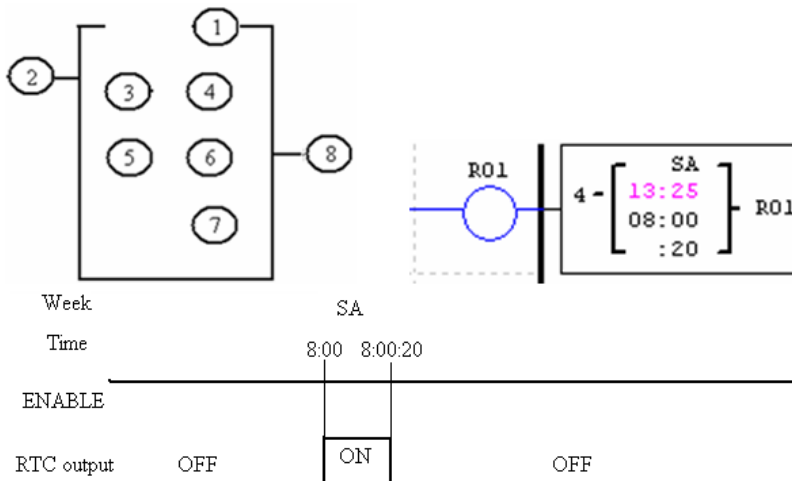
RTC mode 4 (30s compensation)

RTC mode 4 is a 30s compensation mode, which uses the set week, hour, minute and second for operation of the current value of RTC and correction of RTC error. The display form and parameter meaning of RTC mode 4 and programming interface under Ladder are provided below.

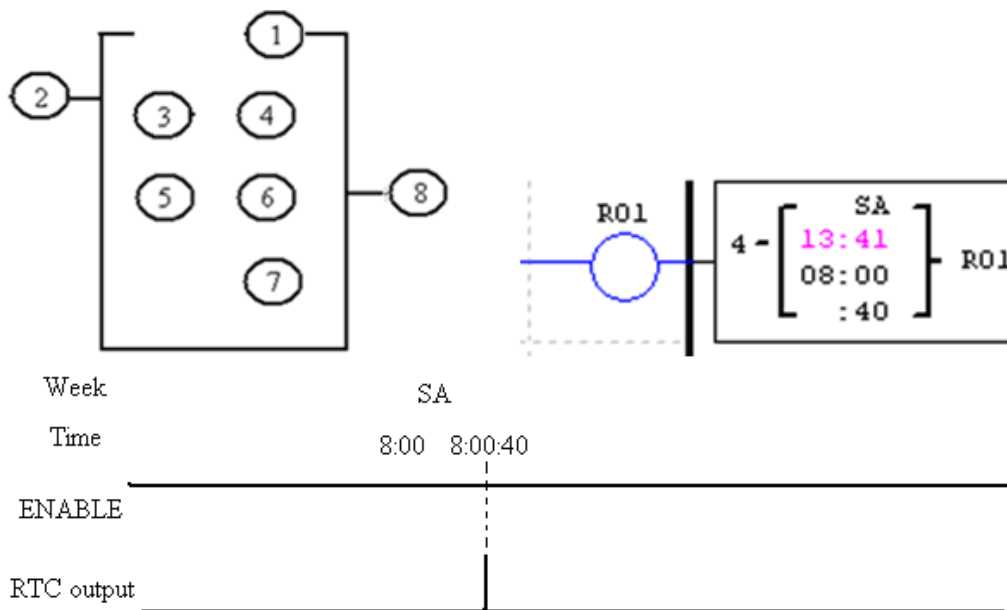


| Symbol | Description |
|--------|--------------------------------------|
| ① | Corrected week of RTC |
| ② | RTC mode 4 |
| ③ | Current hour of RTC |
| ④ | Current minute of RTC |
| ⑤ | Corrected hour of RTC |
| ⑥ | Corrected minute of RTC |
| ⑦ | Corrected second of RTC |
| ⑧ | RTC code (R01~R1F, 31 RTCs in total) |

Example 1: Corrected second < 30s



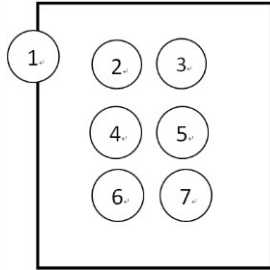
✘ When RTC time is 8:00:20, the current time returns to 8:00:00 for continuous timing, and coil outputs ON. When RTC time reaches 8:00:20 again, coil outputs OFF and RTC continues timing. So, the duration when coil outputs ON is 21s.

Example 2: Corrected second \geq 30s

✘ R01 outputs ON when the current value of RTC is 8:00:40, and outputs OFF when RTC time changes to 8:01:00. The duration when output is ON is a scanning cycle only.

RTC mode 5 (astronomical clock)

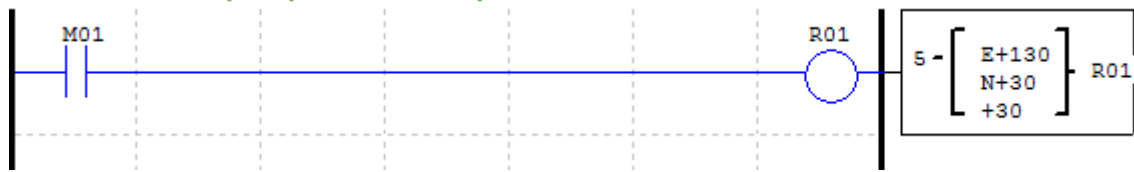
RTC mode 5 is the astronomical clock mode that uses the set longitude and latitude and offset time to control output of RTC coil. The display form and parameter meaning of RTC mode 5 and programming interface under Ladder are provided in the following diagram and table.



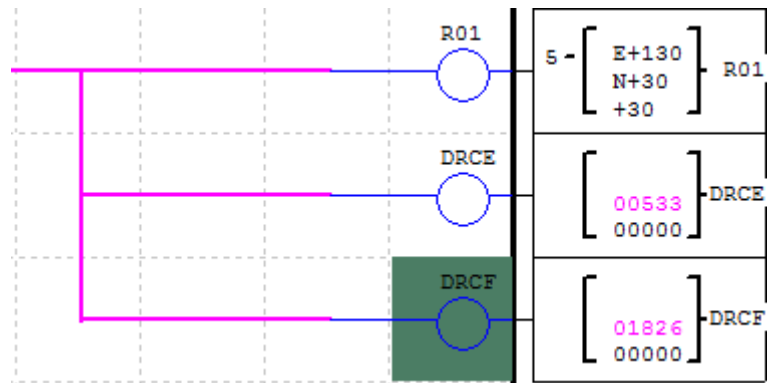
| Symbol | Description |
|--------|-----------------------------|
| ① | RTC mode 5 |
| ② | RTC set longitude W/E |
| ③ | RTC set E/W longitude value |
| ④ | RTC set latitude S/N |
| ⑤ | RTC set S/N latitude value |
| ⑥ | RTC set offset +, - |
| ⑦ | RTC set offset value |

After the corresponding parameter, E/W (east/west longitude) and longitude value, S/N (south/north latitude) and latitude value are set as shown in the table above, the functional block R will work out the sunrise time and sunset time in the set place in the current season and enable the setting of forward (-) or backward (+) offset time (0~59min) of sunrise/sunset time by setting the offset direction, and coil R will output ON from sunrise to sunset and output OFF at other times.

Example 1: Set east longitude 130°, north latitude 30° and offset value +30min



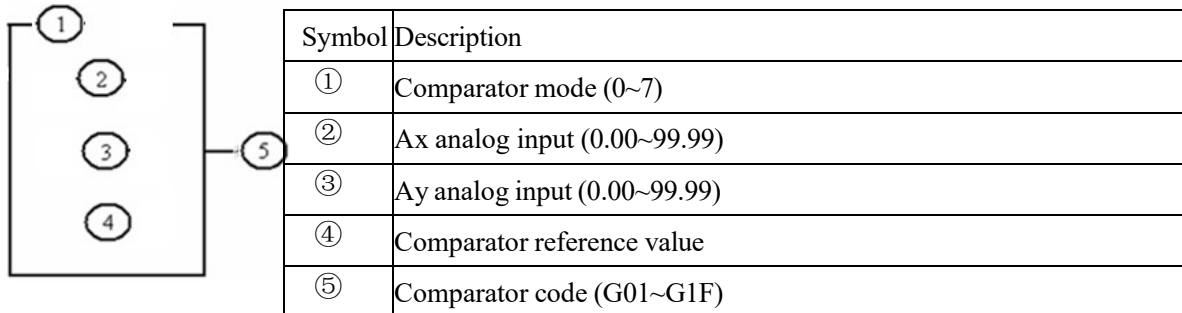
※ Sunrise/sunset time is computed based on the current value of RTC, and R01 is set ON from sunrise to sunset.



※ DRCE and DRCF are special registers where longitude and latitude-based sunrise, sunset and time (excluding offset) are stored.

Analog Comparator Instructions

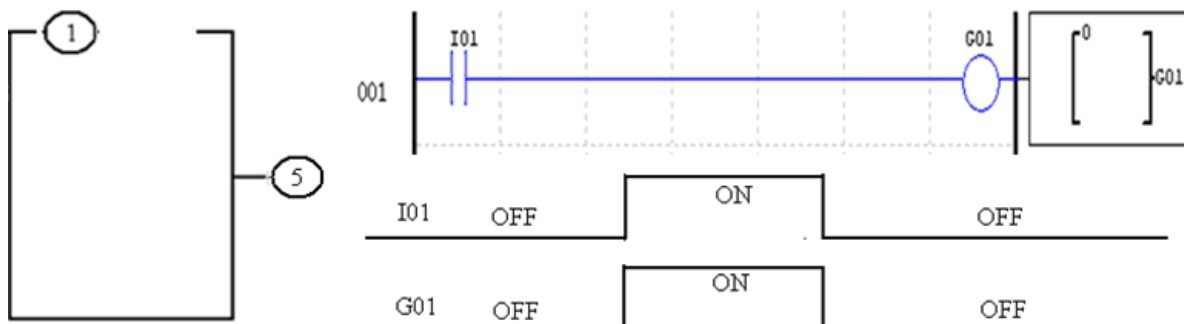
SMT includes 31 independent comparator instructions, and each comparator has 8 working modes and 5 functional parameters. The display diagram and parameters of the comparator are provided below.



※ The preset value of analog inputs Ax and Ay and comparator reference value may be a constant or code of other data type.

Comparator mode 0 (internal coil)

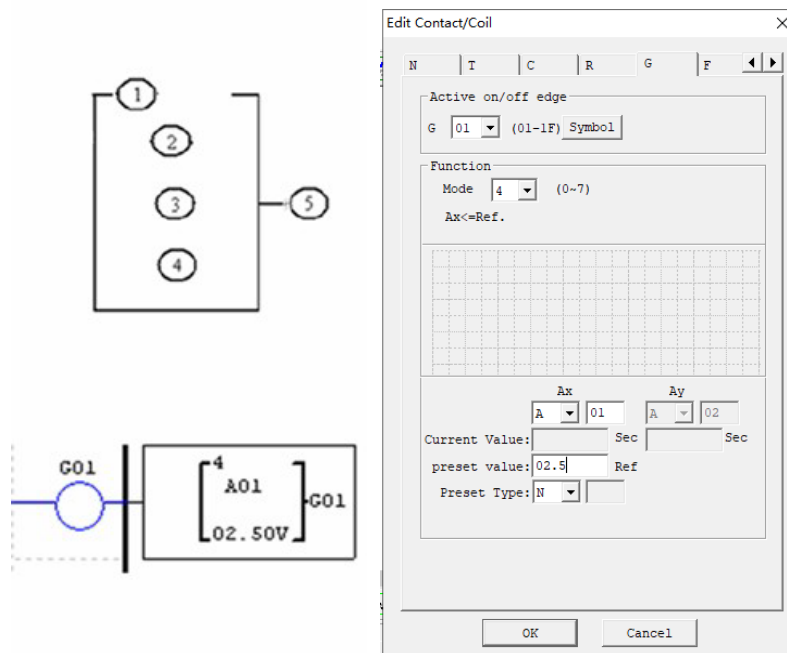
Mode 0 Comparator (Internal Coil) used as internal auxiliary coils. No preset value. In the example below shows the relationship among the numbered block diagram for a Mode 0 Comparator, the ladder diagram view, and the software Edit Contact/Coil dialog box.



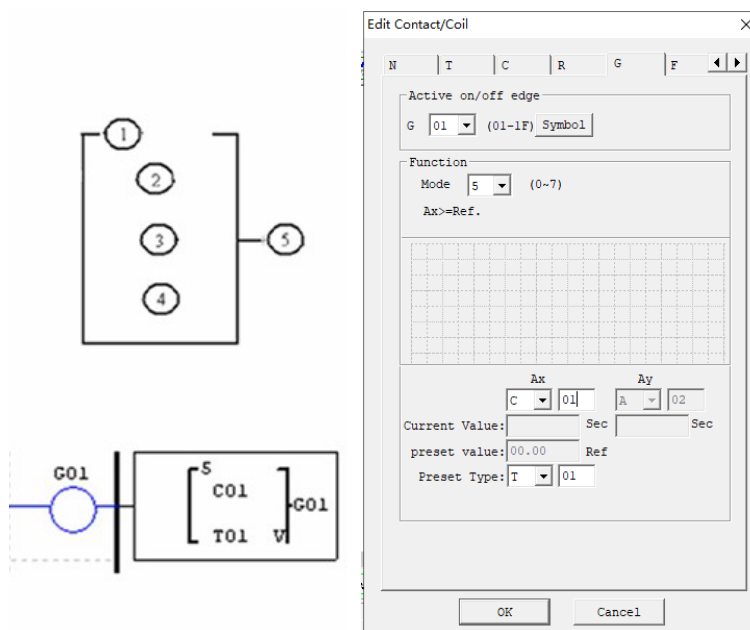
Comparator mode 1~7

- (1) Comparator mode 1: $Ay - ④ \leq Ax \leq Ay + ④$, ⑤ ON ;
- (2) Comparator mode 2: $Ax \leq Ay$, ⑤ ON ;
- (3) Comparator mode 3: $Ax \geq Ay$, ⑤ ON ;
- (4) Comparator mode 4: $④ \geq Ax$, ⑤ ON ;
- (5) Comparator mode 5: $④ \leq Ax$, ⑤ ON ;
- (6) Comparator mode 6: $④ = Ax$, ⑤ ON ;
- (7) Comparator mode 7: $④ \neq Ax$, ⑤ ON ;

Example 1: The comparator works in mode 4, and G01 outputs ON when comparator reference value 2.50V is higher than or equal to Ax analog input A01, or outputs OFF otherwise.



Example 2: The comparator works in mode 5, and G01 outputs ON when comparator reference value T01 is lower than or equal to Ax analog input C01, or outputs OFF otherwise.

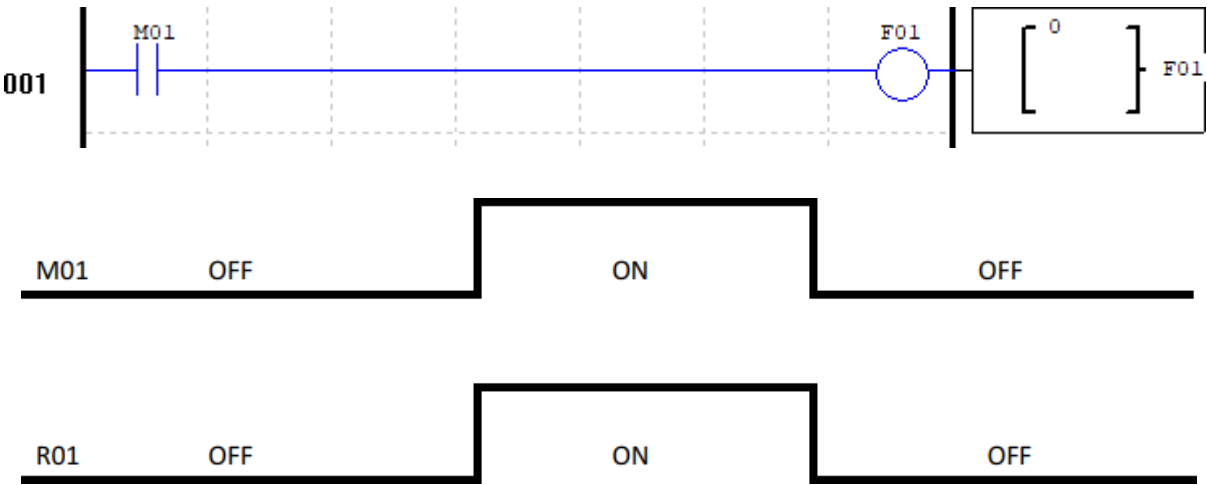


Filter Instructions

SMT includes 31 independent Filter instructions, and each filter has 5 working modes. The display diagram and parameters of filter are provided below.

Filter Mode 0 (internal coil)

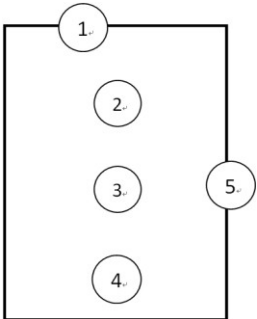
Mode 0 Filter (Internal Coil) used as internal auxiliary coils. No preset value. In the example below shows the relationship among the numbered block diagram for a Mode 0 Filter, the ladder diagram view, and the software Edit Contact/Coil dialog box.



Filter mode 1: analog filter

Function description: Analog filter function is started after parameters are configured and status of the enabled coil turns from 0 to 1. This function enables filtering of Ax analog value based on the selected sampling mode, and the filtered value is the current value of coil F.

Output: The analog value of input Ax is calculated based on the current number of samples Sn.



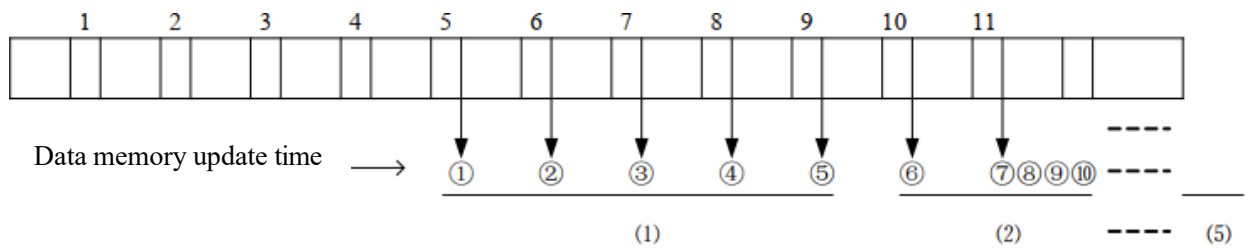
| Symbol | Description |
|--------|-----------------------|
| ① | F mode selection |
| ② | Ax analog input |
| ③ | Current value |
| ④ | Sampling mode |
| ⑤ | Filter code (F01~F1F) |

Software filter mode:

(Mode 1): Data is updated in each scanning cycle, and the recent 5 AD values (maximum and minimum values removed) is averaged.

(Mode 2): Data is updated every 5 scanning cycles. The average values of mode 1 are further averaged after statistics for 5 times.

(Mode 3): Data is updated every 25 scanning cycles. The maximum and minimum averages of the values obtained in mode 2 are used after statistics for 5 times.



Example: Data 1=161, data 2=120, data 3=154, data 4=160, data 5=190, data 6=169, data 7=110, data 8=121, data 9=150, data 10=198, data 11=199.

Mode 1:

① Updated data = $(161 + 154 + 160) / 3 = 158$ - filter (1, 2, 3, 4, 5)

Maximum value 190 and minimum value 120 will be deleted.

② Updated data = $(154 + 160 + 169) / 3 = 161$ - filter (2, 3, 4, 5, 6)

Maximum value 190 and minimum value 120 will be deleted.

③ Updated data = $(154 + 160 + 169) / 3 = 161$ - filter (3, 4, 5, 6, 7)

Maximum value 190 and minimum value 110 will be deleted.

::

⑦ Updated data = $(121 + 150 + 198) / 3 = 156$ - filter (7, 8, 9, 10, 11)

Maximum value 199 and minimum value 110 will be deleted.

Mode 2:

The 5 data values of mode 1 are averaged.

$(① + ② + ③ + ④ + ⑤) / 5$

Mode 3:

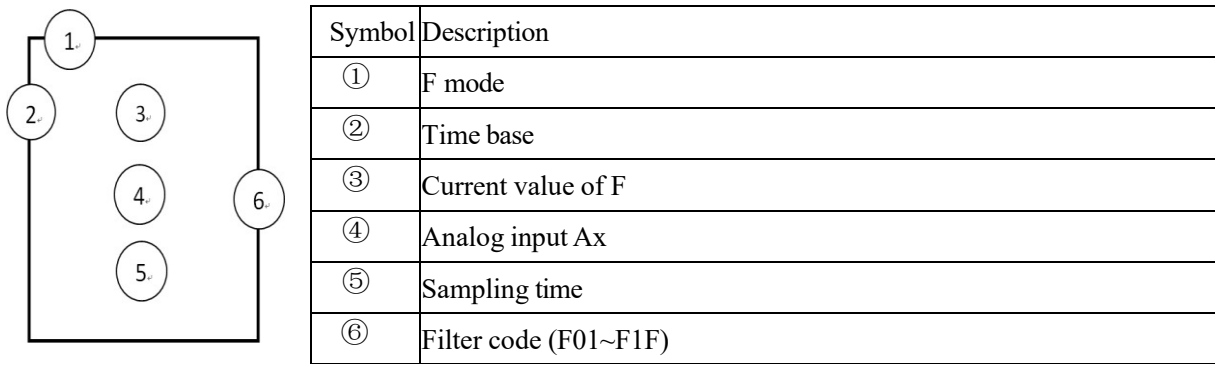
Among the 5 data values obtained after 5 operations of mode 2, the maximum value and minimum value are taken, and then the two values are averaged.

This mode is effective in filtering ripple or ripple noise.

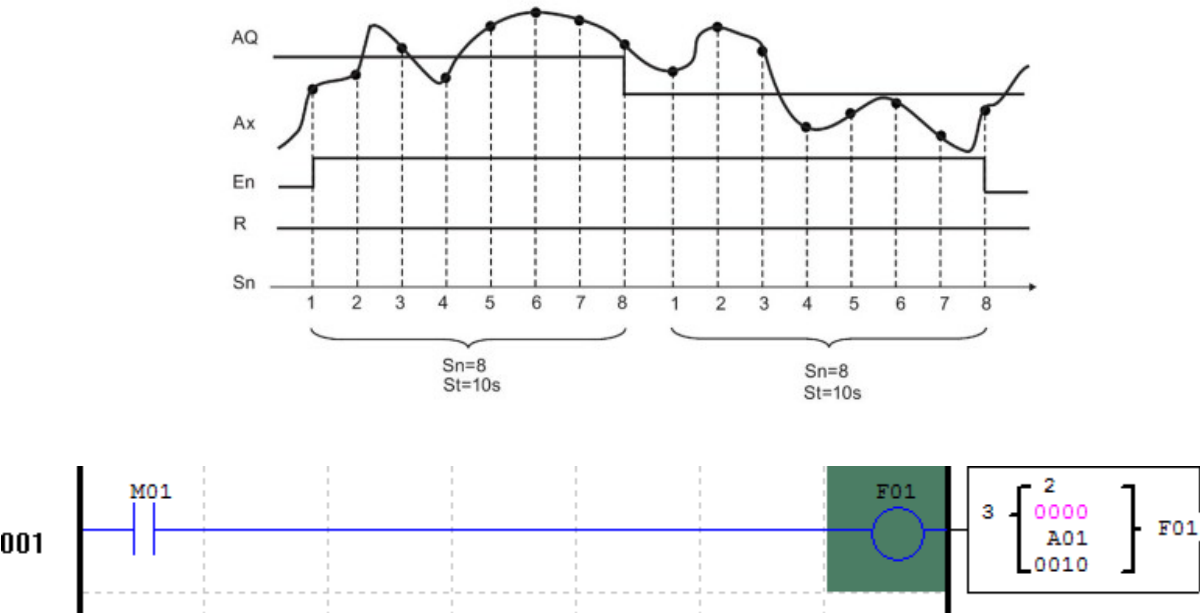
$(\text{Maximum value} + \text{minimum value}) / 2$ (wherein, the maximum and minimum value range is ((1)(2)(3)(4)(5)).

Filter mode 2: average value

Function description: The enabling coil is set ON to enable the average function, which is used to calculate the average value of analog inputs in the set time period.



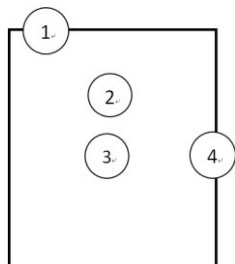
Timing Diagram (for example)



Example: As shown above, the current value of F is updated every 10s, and coil F01 is set ON each time when the current value is updated.

Filter mode 3: maximum value

The maximum value function is enabled and status of output coil and enabling coil is consistent after the enabling coil is set ON, and the function is disabled and status of output coil and enabling coil is consistent after the enabling coil is set OFF. While the enabling coil is ON, the current value of block F is recorded as the maximum value of analog input Ax.

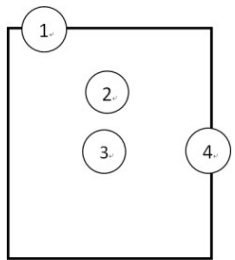


| Symbol | Description |
|--------|---------------------------|
| ① | Comparator mode |
| ② | Current value |
| ③ | Ax analog input |
| ④ | Comparator code (G01~G1F) |

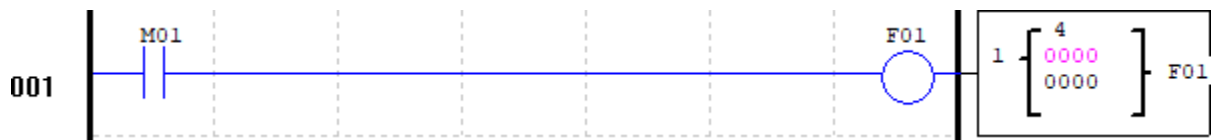


Filter mode 4: minimum value

The minimum value function is enabled and status of output coil and enabling coil is consistent after the enabling coil is set ON, and the function is disabled and status of output coil and enabling coil is consistent after the enabling coil is set OFF. While the enabling coil is ON, the current value of block F is recorded as the minimum value of analog input Ax.

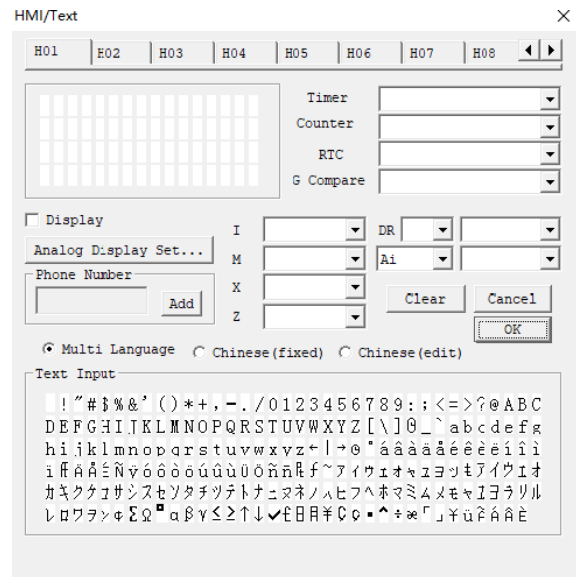


| Symbol | Description |
|--------|---------------------------|
| ① | Comparator mode |
| ② | Current value |
| ③ | Ax analog input |
| ④ | Comparator code (G01~G1F) |



HMI Instructions

SMT includes 31 independent HMI instructions, and each HMI instruction enables display of content in 16×4 characters on LCD in the form of text, figure, coil status, preset value and current value of functional block. Text displayed by HMI has three types: multi-language (as shown to the right), built-in Chinese and user-defined Chinese. Each HMI instruction must be edited by SMT software. Select the menu “Edit -> HMI/TEXT”, and the HMI editing interface as shown to the right will pop up.



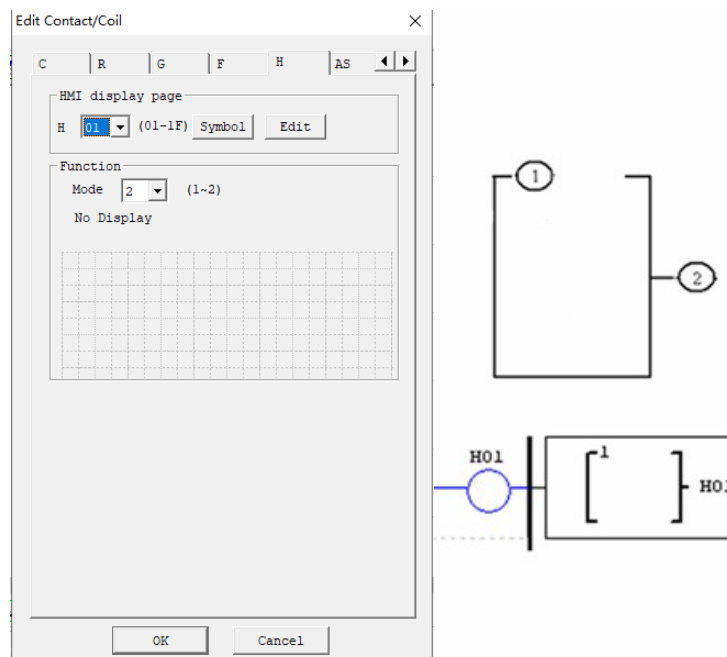
While HMI instructions are not enabled, press SEL on I/O interface, when HMI of the lowest coded value will appear on LCD.

Allows the SEL button on the SMT keypad to activate the selected message onto the LCD even the Hxx is inactive.

※ Refer to [Chapter III: Programming Tool-Ladder Programming Environment-HMI/TEXT](#) for editing and use methods of HMI function.

Each HMI has 2 working modes and 2 parameters. The meaning and display form of the parameters are provided below.

| Symbol | Description |
|--------|--------------------|
| ① | HMI mode (1~2) |
| ② | HMI code (H01~H1F) |



HMI display description

1. HMI enables display of characters, built-in Chinese characters, user-defined Chinese characters and phone number which cannot be modified by keypad.
2. HMI enables display of the preset value and current value of functional blocks (T, C, R, G, DR) and analog input and output (A, AT, AQ), among which, preset value can be modified by keypad.
3. HMI enables display of status of coils (I, X, Z, M and N), which may be modified by keypad.
4. When display is enabled by multiple HMIs, keypad can be used to for scrolling display of any enabled HMI.
5. When a new HMI is enabled, it will be displayed if the current HMI number displayed is lower than the new HMI number; otherwise, the original display is kept.

Key description

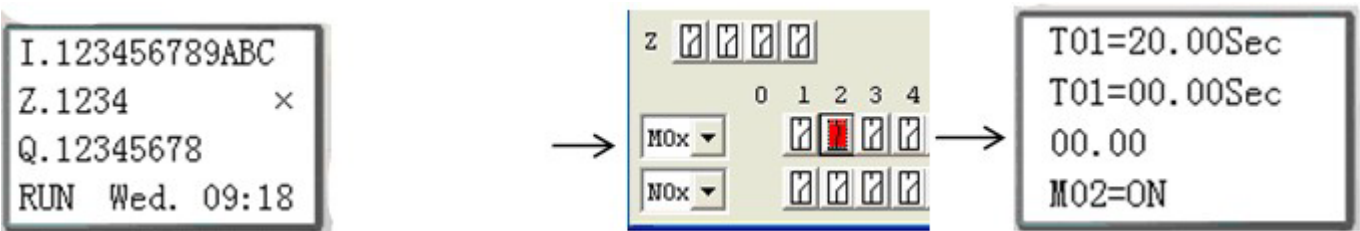
| | |
|--------------|--|
| SEL | Enter status 3 from status 1 or 2 Enter status 4 from status 3 Change the type of preset value of functional block under status 4 |
| ↑ or ↓ | Find the close HMI of mode 1 under status 1 Find the close HMI enabled under status 2 Move the cursor upward or downward under status 3 Change data or coil status under status 4 |
| (SEL+↑ or ↓) | Find the close HMI of mode 1 under status 1 Find the close HMI enabled under status 2 Move the cursor upward or downward under status 3 |
| ← or → | Move the cursor to the left or right under status 3 or 4 |
| OK | Confirm and save the editing |
| ESC | Exit |

Description of HMI status 1~4

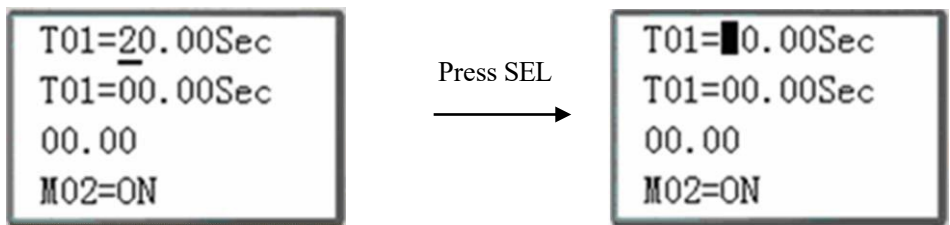
1. HMI scanning status: Press SEL on the I/O interface.



2. HMI running status: Enable HMI on the I/O interface.



3. HMI editing ready status: Press SEL under scanning or running status of HMI; if the current HMI displayed has editable content, the cursor will blink on the content.



4. HMI editing status: Press SEL under the editing ready status, and blinking cursor will change to underline.



PWM Instructions (for DC power and transistor output type only)

SMT of transistor type includes 5 PWM instructions. The PWM instructions have 5 working modes, PWM mode and PLSY mode. PWM mode enables output of 8 groups of PWM waveform of different duty cycles, and PLSY mode enables output of pulses of varying frequency and configurable number. Meanwhile, two configurable lines of pulse of the same duty cycle can be output in mode PWM.

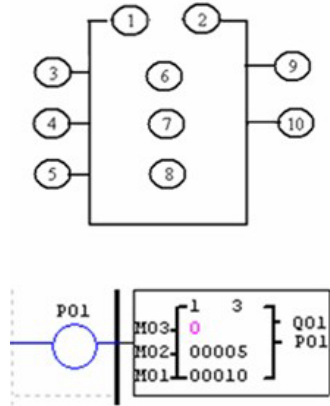
| | Mode | Output port |
|-----|-----------|-------------|
| P01 | PWM, PLSY | Q01 |
| P02 | PWM PLSY | Q02 |

PWM mode

Both P01 and P02 can work in PWM mode with 8 groups of preset value of pulse width and period. During PWM running, status of the selected coil is changed, and waveform of duty cycle variation is output. The PWM mode has 10 parameters as listed below:

| Symbol | Description | Enabling | S3 | St2 | S1 | Class range | Output |
|--------|---|----------|-----|-----|-----|-------------|---------------|
| ① | PWM mode (1) | OFF | X | X | X | 0 | OFF |
| ② | Display of current output class range (1~8) | ON | OFF | OFF | OFF | 1 | Class range 1 |
| ③ | Input selection S1 (I01~g1F) | ON | OFF | OFF | ON | 2 | Class range 2 |
| ④ | Input selection S2 (I01~g1F) | ON | OFF | ON | OFF | 3 | Class range 3 |
| ⑤ | Input selection S3 (I01~g1F) | ON | OFF | ON | ON | 4 | Class range 4 |
| ⑥ | Display of current output class range (1~8) | ON | ON | OFF | OFF | 5 | Class range 5 |
| ⑦ | Pulse width (0~32767 ms) | ON | ON | OFF | ON | 6 | Class range 6 |
| ⑧ | Period (1~32767 ms) | ON | ON | ON | OFF | 7 | Class range 7 |
| ⑨ | Output port (Q01~Q02) | ON | ON | ON | ON | 8 | Class range 8 |
| ⑩ | PWM code (P01~P02) | | | | | | |

Example:



The diagram shows a PLC module with 10 pins. Pins 1 and 2 are at the top, 3-5 on the left, 6-8 in the middle, and 9 and 10 on the right. Below the module, a ladder logic diagram shows a coil labeled P01 connected to a coil labeled Q01. The coil Q01 has a value of 00010.

Edit Contact/Coil

Function: Mode 1 (1~5) PWM

PWM Parameters:

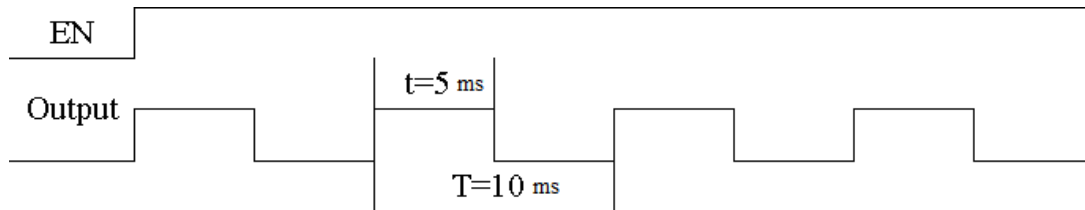
| Parameter | Value | Unit |
|---------------|-------|------|
| Current Value | 00000 | ms |
| Preset Value | 00010 | ms |
| Preset Type | N | |

Select input points: (high->low bit)+1

M 01 M 02 M 03

OK Cancel

As status of coils M01, M02 and M03 is 010, PWM outputs the preset value of group 3 duty cycle.



✘ Which group of pulse wide and period is output by PWM depends on status of coils M01, M02 and M03.

PLSY mode

The output port of PLSY function is Q01 or Q02. The PLSY mode has 6 parameters as listed below.

| Symbol | Description |
|--------|--|
| ① | PLSY mode (2) |
| ② | PLSY output cumulative pulse number (stored in DRC9) |
| ③ | PF: PLSY output frequency (1~1000Hz) |
| ④ | PN: PLSY output set pulse number (0~32767) |
| ⑤ | Output port (Q01) |
| ⑥ | PWM code (P01) |

Example:

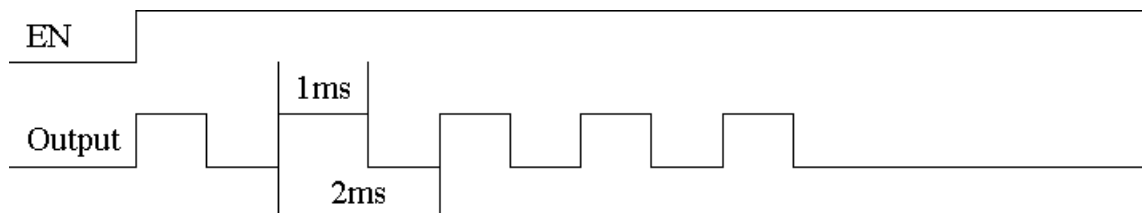
The preset value of PLSY output frequency and output number of pulses may be a constant or code of other

data type and decoding follows the rules of parameter limits. When the output number of pulses reaches the preset value, PLSY stops output. After PLSY is enabled again, it outputs the pulses of set number, and the cumulative number of pulses increases continuously on the basis of original number.

- ※ In the above example, pulse frequency is the current value of C01, namely pulse frequency changes during PLSY running, and the preset value of output pulse number is 100.
- ※ If the current value of output frequency C01 is higher than 1000 during PLSY running, 1000 is taken as the set value of output pulse frequency.
- ※ Output stops when PLSY output pulse number reaches the preset value 100.
- ※ If the set pulse number is 0, PLSY will output pulse continuously till PLSY is disabled.

Example:

Parameter setting: ③ = 500Hz, ④ = 5, output waveform as follows:

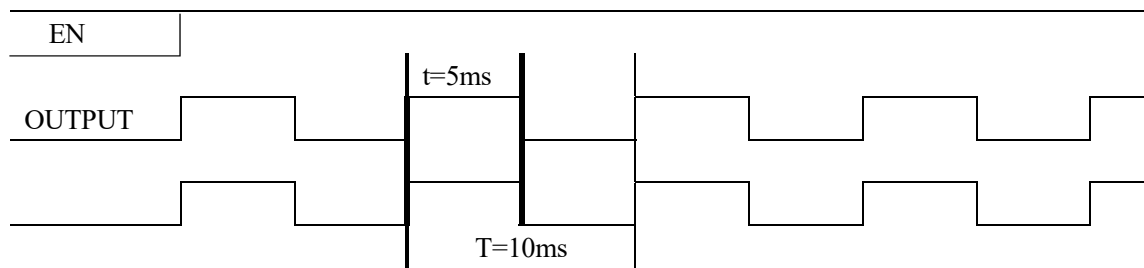
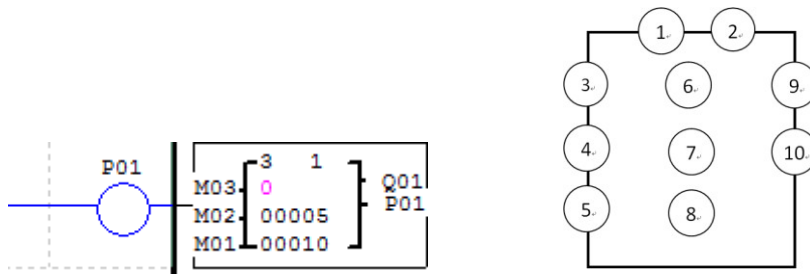


PLSY stops output when the output pulse number reaches the preset value 5.

Mode 3: PWM mode of joint output

This mode is the same with general PWM mode, but output is Q1 and Q2 and P01 and P02 send the configured pulse at the same time. PWM mode 3 has 8 groups of preset value of pulse width and period. During running in this mode, status of the selected coil is changed, and waveform of varying duty cycle is output. This mode has 10 parameters as listed below:

| Symbol | Description | Enabling | S3 | St2 | S1 | Class range | Output |
|--------|---|----------|-----|-----|-----|-------------|---------------|
| ① | PWM mode (3) | OFF | X | X | X | 0 | OFF |
| ② | Display of the current output class range (1~8) | ON | OFF | OFF | OFF | 1 | Class range 1 |
| ③ | Input selection S1 (I01~g1F) | ON | OFF | OFF | ON | 2 | Class range 2 |
| ④ | Input selection S2 (I01~g1F) | ON | OFF | ON | OFF | 3 | Class range 3 |
| ⑤ | Input selection S3 (I01~g1F) | ON | OFF | ON | ON | 4 | Class range 4 |
| ⑥ | Display of the current output class range (1~8) | ON | ON | OFF | OFF | 5 | Class range 5 |
| ⑦ | Pulse width (0~32767 ms) | ON | ON | OFF | ON | 6 | Class range 6 |
| ⑧ | Period (1~32767 ms) | ON | ON | ON | OFF | 7 | Class range 7 |
| ⑨ | Output port (Q01Q02) | ON | ON | ON | ON | 8 | Class range 8 |
| ⑩ | PWM code (P01) | | | | | | |

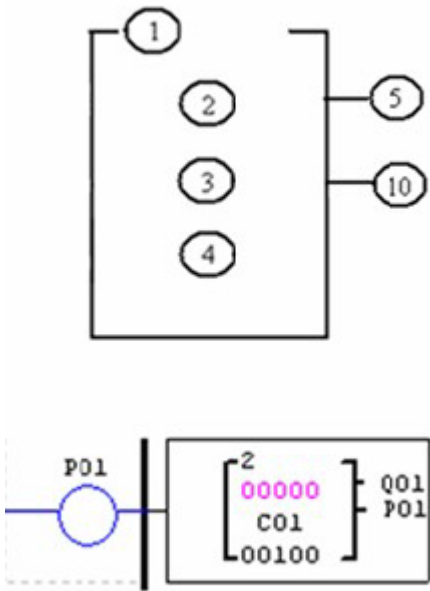


Mode 4: PLSY mode of simultaneous output

The output ports of PLSY function are Q01 and Q02. The PLSY mode has 6 parameters as listed below.

| Symbol | Description |
|--------|--|
| ① | PLSY mode 4 |
| ② | PLSY output cumulative pulse number (stored in DRC9) |
| ③ | PF: PLSY output frequency (1~1000Hz) |
| ④ | PN: PLSY output set pulse number (0~32767) |
| ⑤ | Output port (Q01) |
| ⑥ | PWM code (P01) |

Example:



Edit Contact/Coil

R | G | F | H | P | L

PWM

P 01 (01~02) Symbol

Output Q 01

Function

Mode 4 (1~5)

PLSY

PF PN

Select 1~8: 1

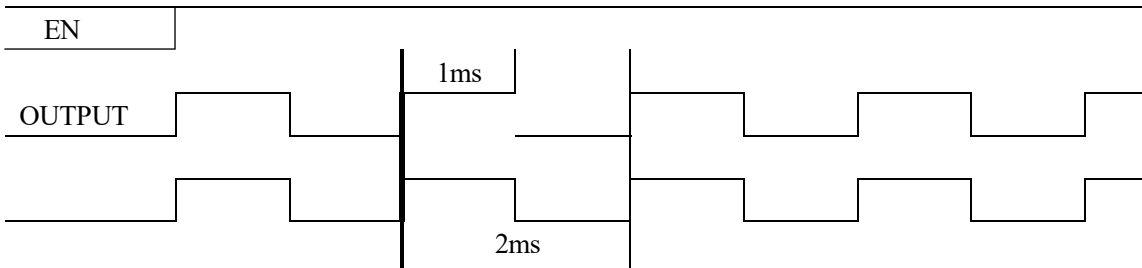
Current Value: 00000 00000

Preset Value: 00000 Hz 00100

Preset Type: C 01 N

OK Cancel

Parameter setting: ③ = 500Hz, ④ = 5, output waveform as follows:



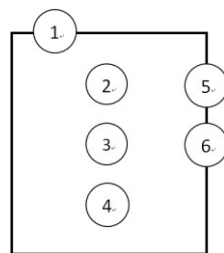
The preset value of PLSY output frequency and output number of pulses may be a constant or code of other data type and decoding follows the rule of parameter limits. When the output number of pulses reaches the preset value, PLSY stops output. After PLSY is enabled again, it outputs the pulses of set number, and the cumulative number of pulses increases continuously on the basis of original number.

※ If the set pulse number is 0, PLSY will output pulse continuously till PLSY is disabled.

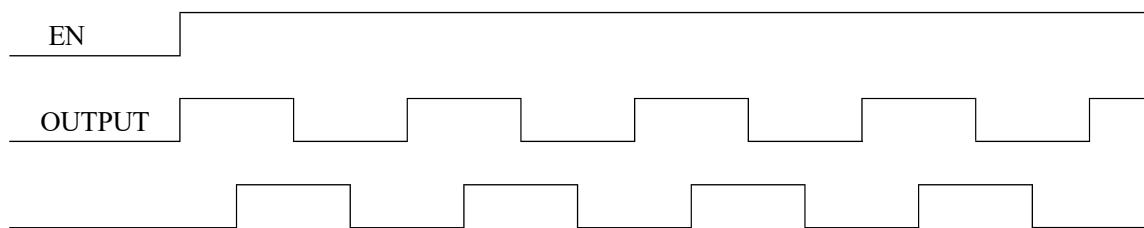
PWM mode 5: AB phase PLSY mode

AB phase PLSY function is similar to general PLSY function, but it uses the ports Q1 and Q2 at the same time and sends Q1 (phase A) pulse ahead of Q2 (phase B). This PWM mode 5 has 6 parameters as listed below.

| Symbol | Description |
|--------|--|
| ① | PLSY mode (5) |
| ② | PLSY output cumulative pulse number |
| ③ | PF: PLSY output frequency (1~1000Hz) |
| ④ | PN: PLSY output set pulse number (0~32767) |
| ⑤ | Output port (Q01Q02) |
| ⑥ | PWM code (P01P02) |



Parameter setting: ③ = 500Hz, ④ = 5, output waveform as follows:

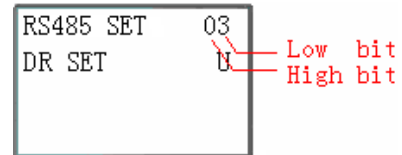


The preset value of AB phase PLSY output frequency and output number of pulses may be a constant or code of other data type, and decoding follows the rule of parameter limits. When the output number of pulses reaches the preset value, PLSY stops output. After PLSY is enabled again, it outputs the the pulses of set number, and the cumulative number of pulses increases continuously on the basis of original number.

- ✘ Pulse frequency changes during PLSY running, and the preset value of output pulse number is 100.
- ✘ If the value of output frequency is higher than 1000 during running in mode 5, 1000 is taken as the set value of output pulse frequency.
- ✘ Output stops when output pulse number in mode 5 reaches the preset value.
- ✘ If the set pulse number is 0, PWM mode 5 keeps pulse output till PLSY is disabled.

IO Link/Remote IO Instructions (for RS485 type only)

SMT4-CD/ED has built in RS-485 communication port. It can be used as master/slave station of Modbus RTU or connected with other SMT-20Vxx to form IO Link or remote IO. The communication mode and baud rate can be set through **Operation(Q)»Module**



system setting(Y) of SMT programming software or **keypad**. The keypad setting is shown to the right, and meaning of the two bits in **RS485 setting** is explained in the following table.

| | Code | Meaning |
|-----------|------|---|
| Upper bit | 0 | 8/N/2: 8 data bits without check, 2 stop bits |
| | 1 | 8/E/1: 8 data bits with even parity check, 1 stop bit |
| | 2 | 8/O/1: 8 data bits with odd parity check, 1 stop bit |
| | 3 | 8/N/1: 8 data bits without check, 1 stop bit |
| Lower bit | 0 | 4800bps |
| | 1 | 9600bps |
| | 2 | 19200bps |
| | 3 | 38400bps |
| | 4 | 57600bps |
| | 5 | 115200bps |

Module System Set

Set ID
Current ID: 1
New ID(00-99): 1

Set Expand I/O
I/O Num: 0
☐ I/O Alarm

Remote I/O
☒ NO
☐ Master
☐ Slave

Others
☒ M Keep
☐ C Keep
☐ Back Light
☐ Z Set

RS485 Set
Comm. Mode: 8/N/2
Baud Rate: 38400

DR Format Set
☒ Unsigned
☐ Signed

Coil Record
☒ None ☐ M ☐ N
Range: 01-10 SUM=0

Cancel Set

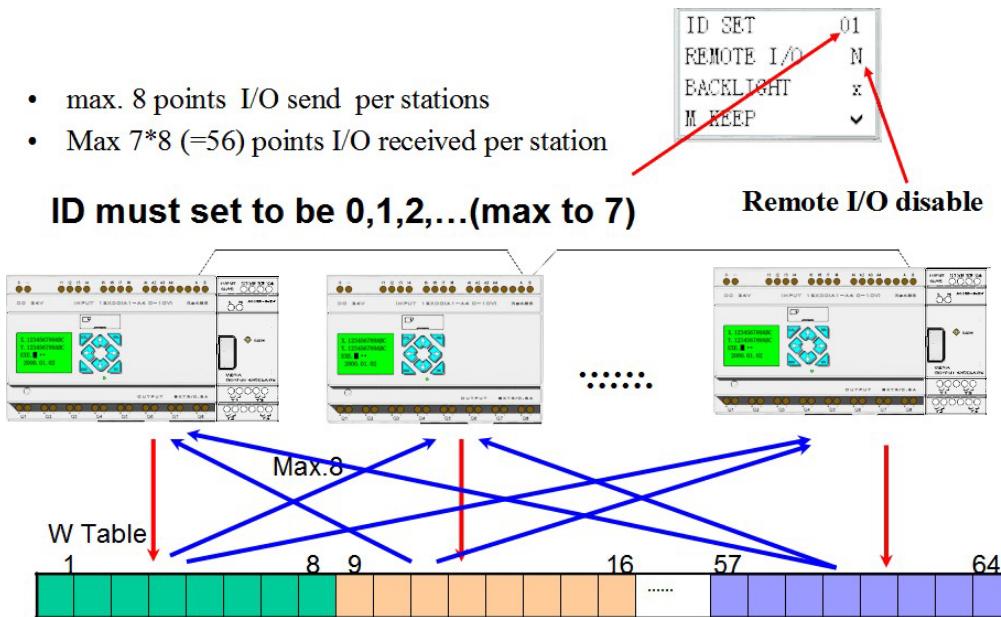
IO LINK

An IO Link is composed of 8 SMT of RS485 type at most, where each slave contact is used as an independent station for running of its logic program and all slave contacts are connected to the same master station. IO Link ID must be continuous and be 0~7; master station ID is 0, and slave station ID begins from 1 to 7; if slave station ID is not continuous, such as 1, 2, 4, 5, the master station will take it as there are only two slave stations 1 and 2 and communicate with slave stations 1 and 2 only.

- max. 8 points I/O send per stations
- Max 7*8 (=56) points I/O received per station

ID must set to be 0,1,2,...(max to 7)

Remote I/O disable



| ID | W table comparison |
|----|--------------------|
| 0 | W01~W08 |
| 1 | W09~W16 |
| 2 | W17~W24 |
| 3 | W25~W32 |
| 4 | W33~W40 |
| 5 | W41~W48 |
| 6 | W49~W56 |
| 7 | W57~W64 |

✖ When each station uses L01~L08, only one can be set as mode 1: sending mode, and the other L can only be set as mode 2: receiving mode.

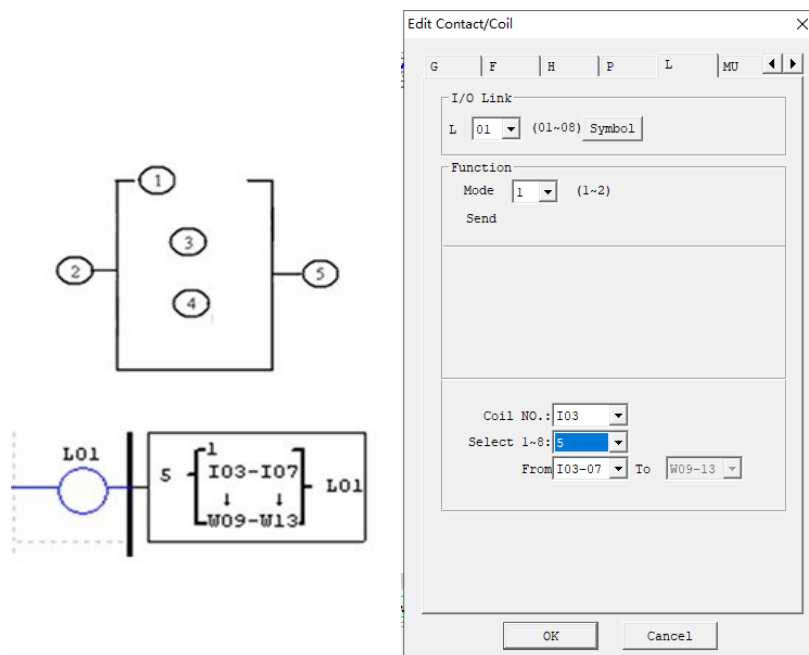
Sending mode: Address in W table is controlled by ID of SMT itself and cannot be changed, and status of the selected coil is put in the corresponding W table. The correspondence of ID and W table is shown in the above table.

Receiving mode: content of the selected W table is transferred to the selected coil; if input coil I or X is selected, content of W table will not change status of coils I and X.

| Symbol | Description |
|--------|---|
| ① | IO Link mode, 1: sending, 2: receiving |
| ② | Sending/receiving points (1~8) |
| ③ | Sending/receiving coil type |
| ④ | Position of sent/received data in W table |
| ⑤ | I/O Link code (L01~L08) |

| Coil type | Number |
|-----------------|-----------------|
| Input coil | I01~I0C/i01~i0C |
| Output coil | Q01~Q08/q01~q08 |
| Auxiliary coil | M01~M3F/m01~m3F |
| Auxiliary coil | N01~N3F/n01~n3F |
| Extended input | X01~X0C/x01~x0C |
| Extended output | Y01~Y0C/y01~y0C |

In the following example, L01 works in mode 1; it can be concluded from position of W table that the machine ID is 1 and it is a slave station.



Example 1: Sending mode

The set mode is 1, coil number is 5, starting coil is I03 and SMT ID is 1, status of coil I03~I07 will be sent to W09~W13, as shown below.

| ① =1, ② = 5, ③ = I03~I07, ID=1 (④:W09~W13) | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|-----|
| W table position | W09 | W10 | W11 | W12 | W13 | W14 | W15 | W16 |
| Receiving or sending coil | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ |
| | I03 | I04 | I05 | I06 | I07 | 0 | 0 | 0 |

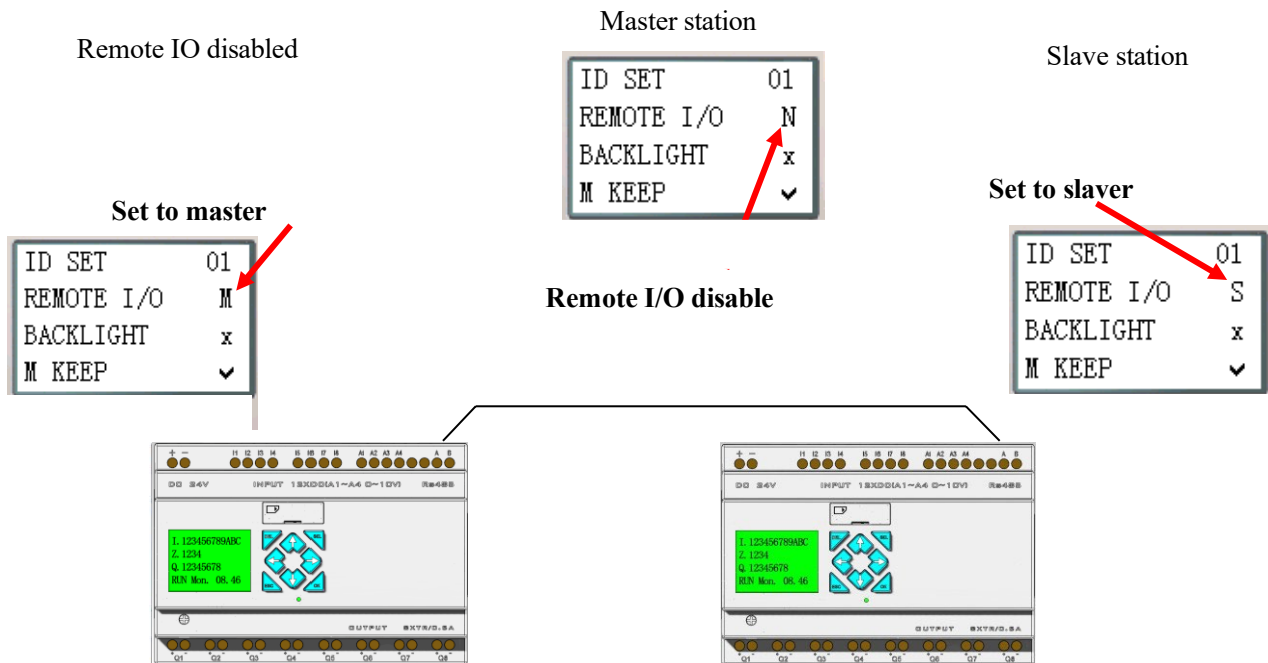
Example 2: Receiving mode

The set ① = 2 mode is 2, coil number is 5, starting coil is M03, W table position is W17 and not controlled by ID, content of W17~W21 will be sent to coil M03~M07.

| ① =1, ② = 5, ③ = M03~M07, ④:W17~W21 | | | | | |
|-------------------------------------|-----|-----|-----|-----|-----|
| W table position | W17 | W18 | W19 | W20 | W21 |
| Receiving or sending coil | ↓ | ↓ | ↓ | ↓ | ↓ |
| | M03 | M04 | M05 | M06 | M07 |

Remote IO

A remote IO network is composed of two SMT at most, where one is the master station and the other is the slave station. The setting method and IO correspondence are as follows.



Master station

Valid user program

Extended input X = slave station input I

Extended output Y = slave station

Valid user program

X = slave station input

Y = slave station output

Slave station

Invalid user program

Input I = master station extended input X

Output Q = master station extended output

Invalid user program

X = master station extended input

Y = master station extended output

Logic program runs in the master station, but not in slave station. The master station writes extended output Y to slave station Q, and slave station writes input I to master station extended input X.

※ **Extended IO module should not be used when the remote IO function is used.**

MU (Modbus) Instructions (for RS485 type only)

The Modbus block of RS485 type realizes Modbus RTU master communication at RS485 interface. SMT type CD includes 15 Modbus blocks, MU01~MU0F. RS485 type communication gives priority to Remote IO and IO Link, namely the functional block is not executed by Remote IO master and slave and IO Link master, and Modbus instruction is executed only when it is set as N (remote IO) and ID is not 0.

| | |
|------------|----|
| ID SET | 01 |
| REMOTE I/O | N |
| BACKLIGHT | x |
| M KEEP | ✓ |

Multiple communication instructions may be used in a program, but only one instruction can be driven at the same time. For example, when multiple Modbus instructions are used and enabled, only one instruction utilizes serial port for execution of its function, while the other Modbus instructions keep the enabled state but do not execute function, namely the other instructions enter the execution waiting state. When the Modbus instruction utilizing serial port is disabled and releases the serial port after the end of an instruction cycle, the other enabled Modbus instructions begin to preempt the serial port.

Comparison table of Modbus mode and communication function code:

| Mode | Function code |
|------|------------------------------|
| 1 | 03 (read register) |
| 2 | 06 (write a single register) |
| 3 | 10 (write various registers) |
| 4 | 01 (read coils) |
| 5 | 05 (write a single coil) |

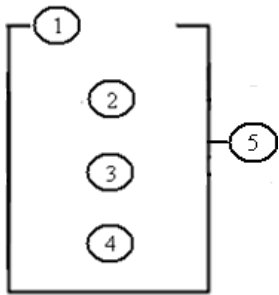
Auxiliary contacts used during execution of Modbus instructions:

| | |
|-------------------------|---|
| Receiving completed M3D | After completion of receiving, M3D is set for error checking, and the received data is sent to the designated register if no error is found; |
| Error indication M3E | Communication error indication |
| Timeout judgment M3F | Enter the receiving waiting state after completion of sending; when timeout is determined as no data is received within the specified time period, the timeout output flag M3F is ON, receiving is ended and M3D outputs ON; M3F is automatically reset at the time of M3D resetting. |

Timeout judgment and time-out period are determined by baud rate.

| Baud rate (bps) | Timeout (ms) |
|--------------------------|--------------|
| 4800, 9600, 19200, 38400 | 125 |
| 57600 | 100 |
| 115200 | 80 |

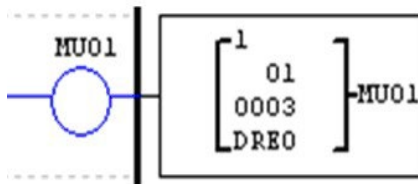
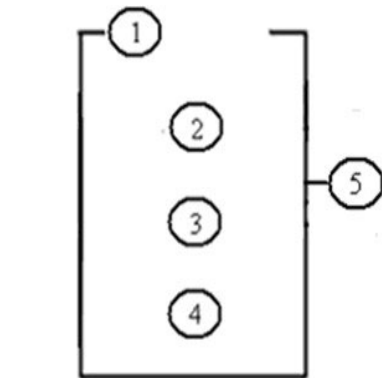
Modbus block has 5 parameters, the display and meaning of which are listed below.



| Symbol | Description |
|--------|--|
| ① | MU block mode 1~5 |
| ② | Communication address: Slave station ID, range 0~7f |
| ③ | Communication command address and communication data length: 1) Constant, range 0000~ffff; Data length of modes 1 and 3 is 1 word; Data length of mode 4 is 16 bits; 2) DR number, command address and length being stored from the DR |
| ④ | DR number, data sent/received being stored from the DR |
| ⑤ | MU code (MU01~MU0F) |

※ The maximum communication data length of modes 1 and 3 is 25 words, and that of mode 4 is 400 bits.

MU display and editing interface are shown below:



Given command address constant 0003 and data length 1 word,

The sending command is:
01 03 00 03 00 01 CRC16.

Receiving response data of slave station 1:

01 03 02 data1 data2 CRC16.

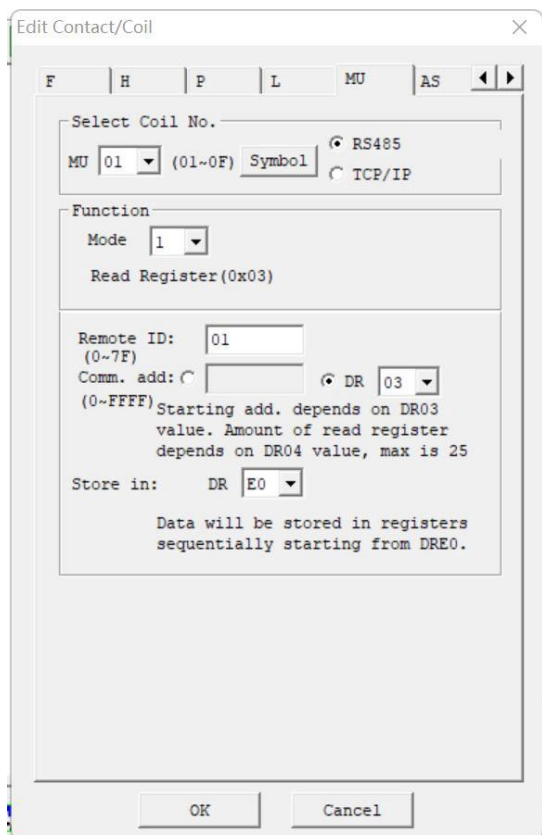
Data stored in DRE0:

DRE0 = data1~2

MU mode 1: Read register

Set communication address of parameter ③ as a constant: As shown above, communication data length is 1.

Set communication address of parameter ③ as register DR:



Functional block parameters are displayed as below:



Set command address DR03=0001,

Set data length DR04=0002,

The sending command is:

01 03 00 01 00 02 CRC16.

Receiving response data of slave station 1:

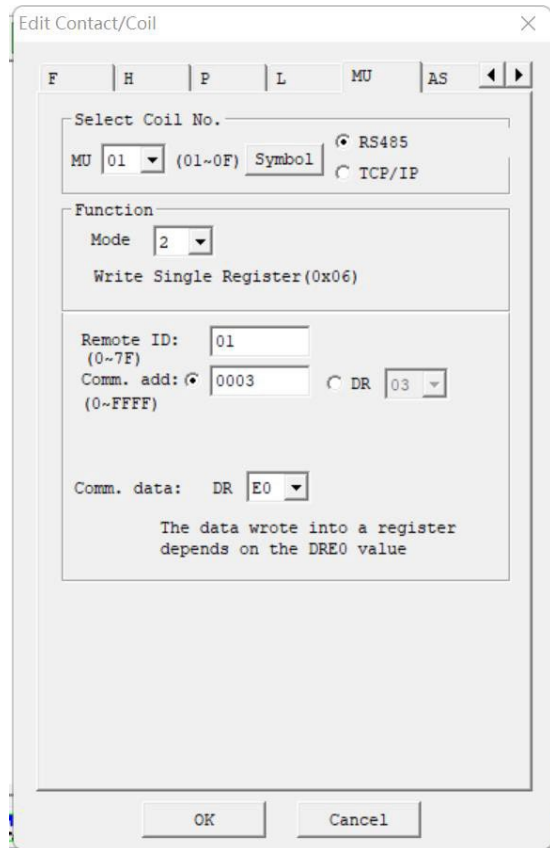
01 03 04 data1 data2 data3 data4 CRC16;

Data stored in DRE0~DRE1:

DRE0 = data1~2

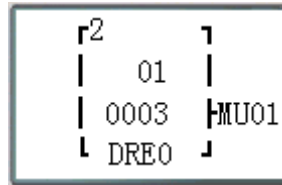
DRE1 = data3~4

※ The maximum value of data length register is 25.

MU mode 2: Write a single register

Set communication address of parameter ③ as a constant:

Functional block parameters are displayed as below:



Command address constant 0003,

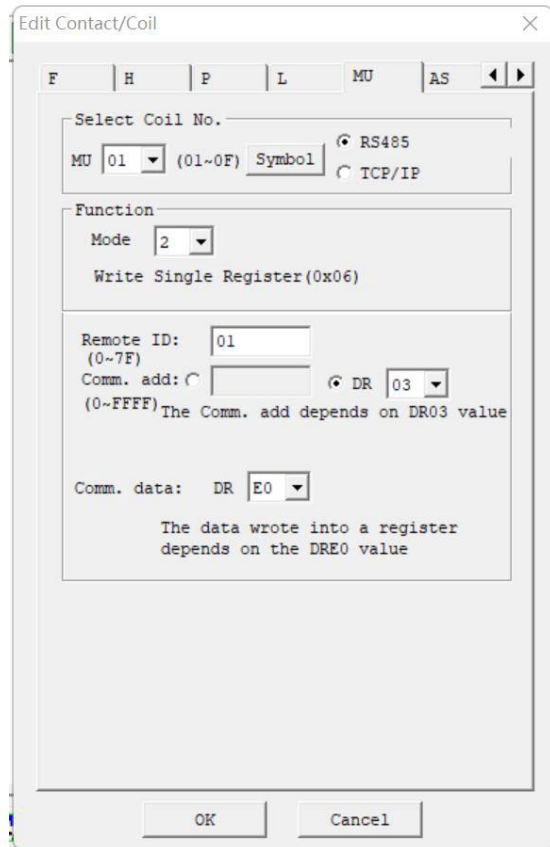
Set numerical data DRE0=1234 (hex: 04D2),

The sending command is:

01 06 00 03 04 D2 CRC16.

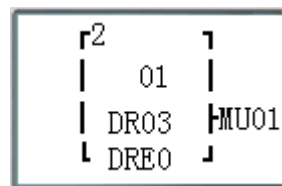
Receiving response data of slave station 1:

01 06 00 03 04 D2 CRC16.



Set communication address of parameter ③ as register DR:

Functional block parameters are displayed as below:



Set command address DR03=0001,

Set data DRE0=1234 (hex: 04D2),

The sending command is:

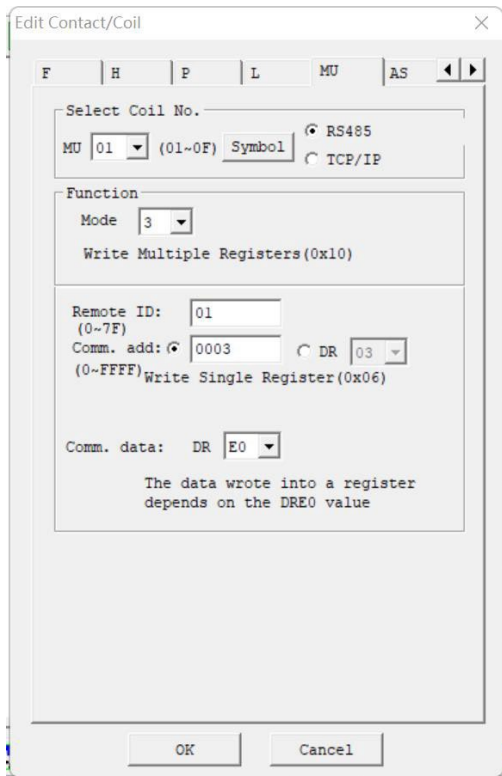
01 06 00 01 04 D2 CRC16.

Receiving response data of slave station 1:

01 06 00 01 04 D2 CRC16.

MU mode 3: Write various registers

Set communication address of parameter ③ as a constant:



Functional block parameters are displayed as below:



Command address constant 0003,

Data length is 1 word,

Set data DRE0=1234 (hex: 04D2),

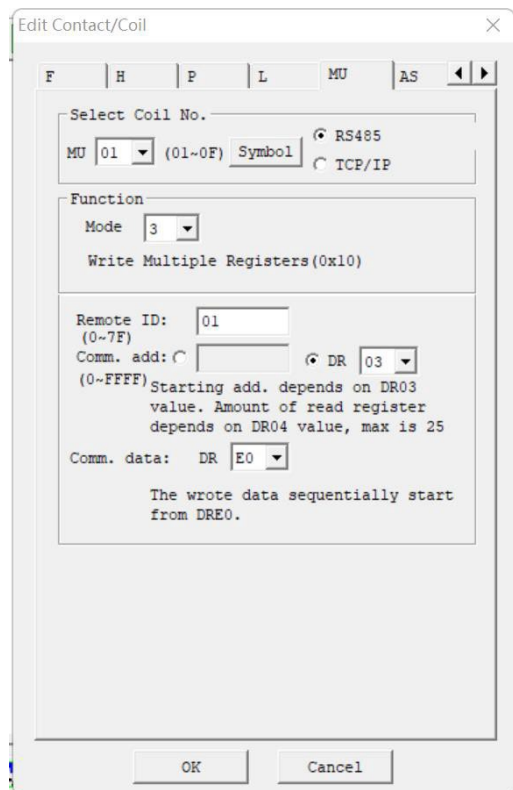
The sending command is:

01 10 00 03 00 01 02 04 D2 CRC16;

Receiving response data of slave station 1:

01 10 00 03 00 01 CRC16;

Set communication address of parameter ③ as register DR:



Functional block parameters are displayed as below:



Set command address DR03=0001,

Set data length DR04=0002,

Set data DRE0=1234 (hex: 04D2),

Set data DRE1=5678 (hex: 162E),

The sending command is:

01 10 00 01 00 02 04 04 D2 16 2E CRC16;

Receiving response data of slave station 1:

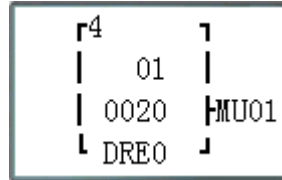
01 10 00 01 00 02 CRC16;

✖ The maximum value of data length register is 25.

MU mode 4: Read coil

Set communication address of parameter ③ as a constant:

Functional block parameters are displayed as below:



Command address constant 32 (hex: 0020),

Data length is 16 (hex: 10H, 1word),

The sending command is:

01 01 00 20 00 10 CRC16.

Receiving response data of slave station 1:

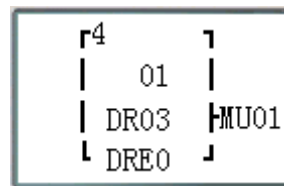
01 01 02 data1 data2 CRC16.

Data stored in DRE0:

DRE0 = data1~2

Set communication address of parameter ③ as register DR:

Functional block parameters are displayed as below:



Set command address DR03=0001,

Set data length DR04=0015 (hex: 000F);

The sending command is:

01 01 00 01 00 0F CRC16.

Receiving response data of slave station 1:

01 01 02 data1 data2 CRC16.

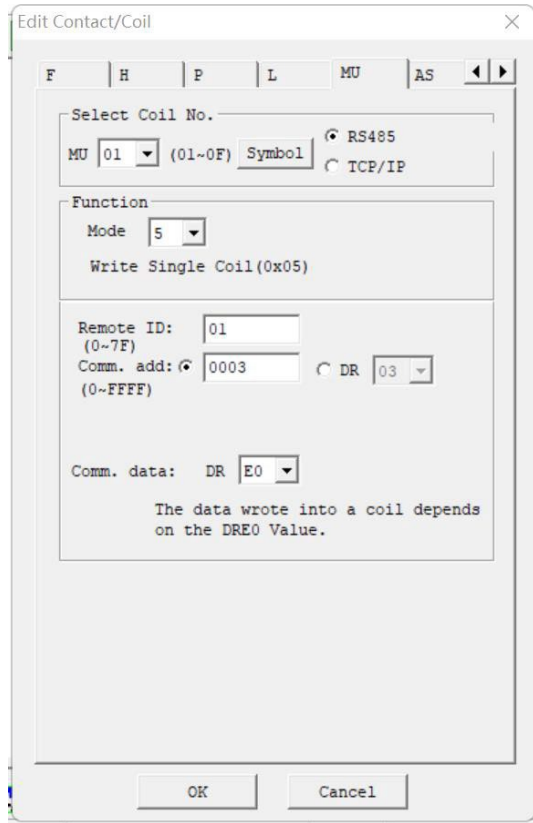
Data stored in DRE0:

DRE0 = data1~2

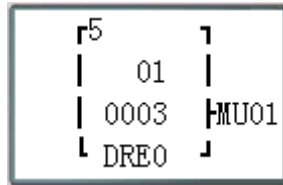
✖ The maximum value of data length register is 400.

MU mode 5: Write a single coil

Set communication address of parameter ③ as a constant:



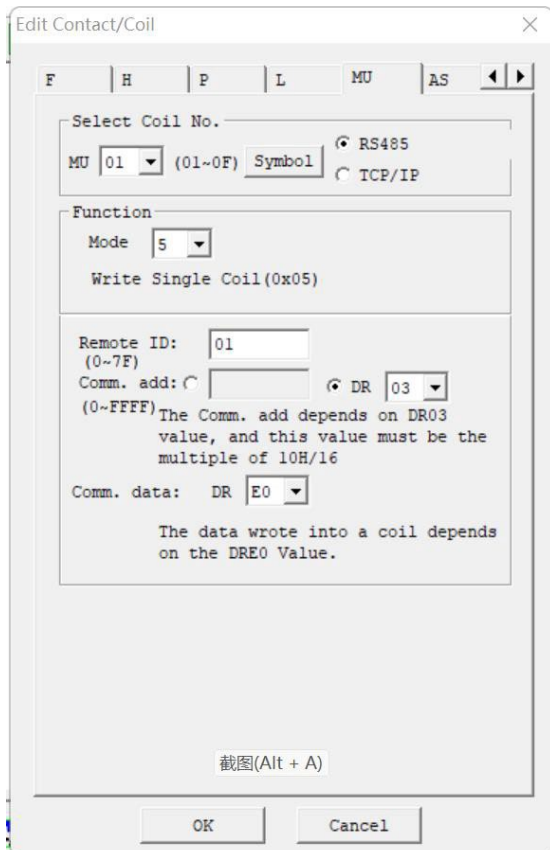
Functional block parameters are displayed as below:



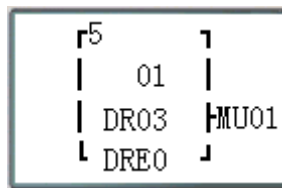
Command address constant 0003,
Set data DRE0=65280 (hex: FF00),
The sending command is:
01 05 00 03 FF 00 CRC16.

Receiving response data of slave station 1:
01 05 00 03 FF 00 CRC16.

Set communication address of parameter ③ as register DR:



Functional block parameters are displayed as below:

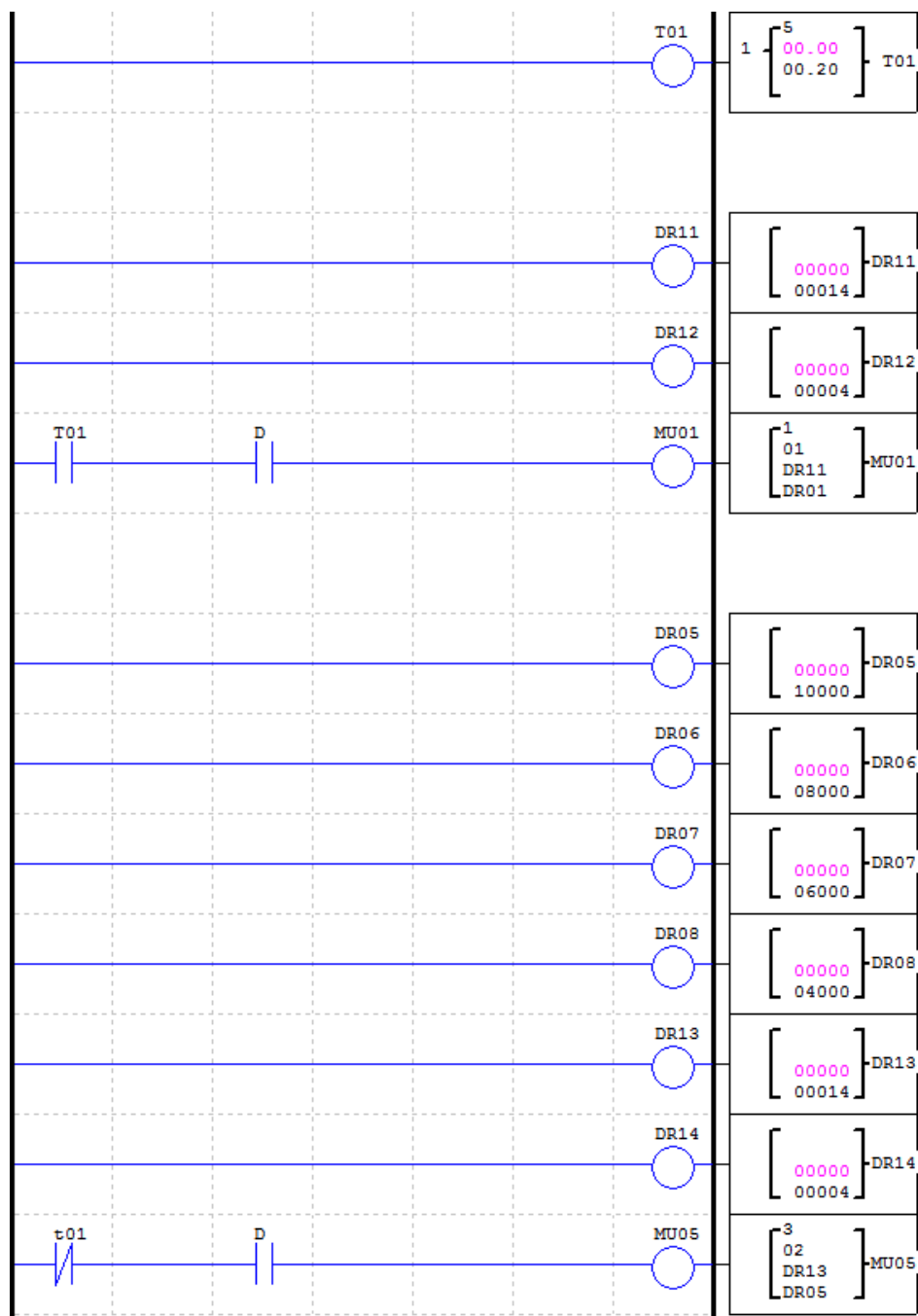


Set command address DR03=0001,
Set data DRE0=65280 (hex: FF00),
The sending command is:
01 05 00 01 FF 00 CRC16.

Receiving response data of slave station 1:
01 05 00 01 FF 00 CRC16.

Example:

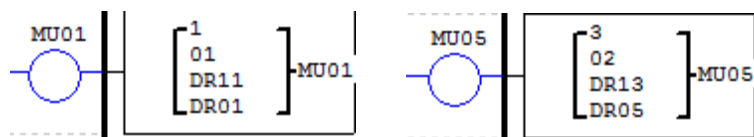
Data is sent and received through RS485 port after MU is enabled. It is suggested to use communication of D trigger control MU instruction.



T01 controls MU01 and MU05;

Set MU01 mode 1, read register, address is DR11=14 (0x0E), length is DR12=4, save to register DR01~DR04;

Set MU05 mode 3, write register, address is DR13=14 (0x0E), length is DR14=4, data is fetched from register DR05~DR08 (DR05=10000=0x2710, DR06=8000=0x1F40, DR07=6000=0x1770, DR08=4000=0x0FA0);



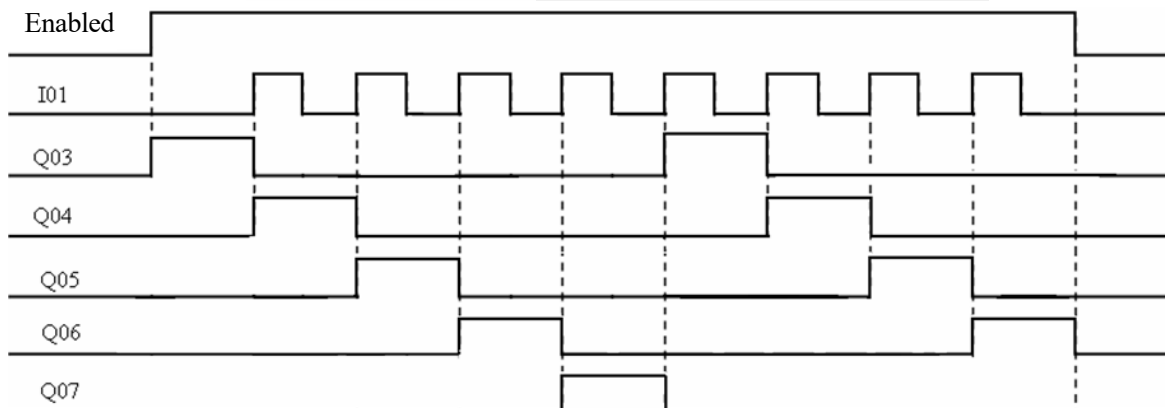
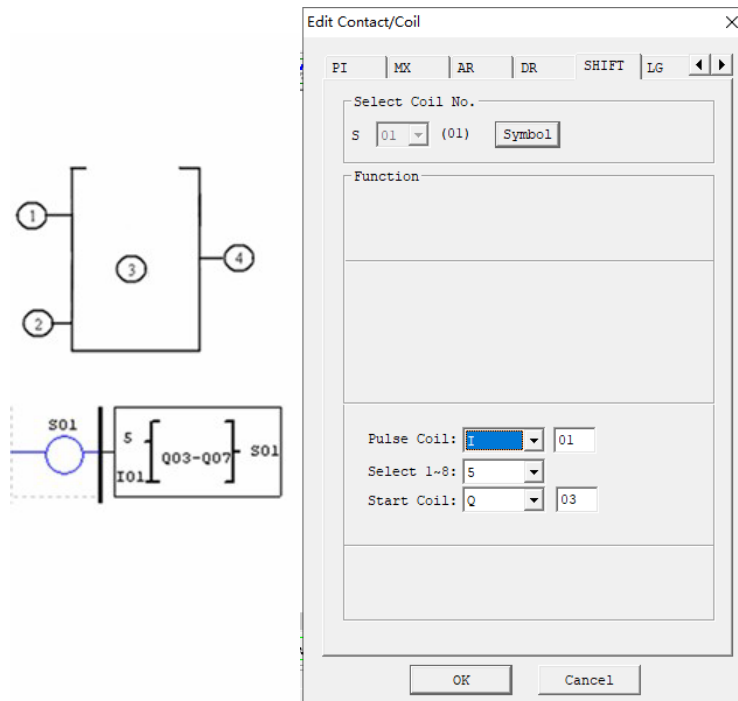
During running, T01 is ON, a MU01 communication is triggered, command 01 03 00 0E 00 04 CRC16 is sent, data is stored in DR01~DR04 after response is received from slave station 1; 0.2s later, T01 is OFF, MU05 communication is triggered, command 01 10 00 0E 00 04 08 27 10 1F 40 17 70 0F A0 CRC16 is sent; 0.2s later, T01 ON triggers MU01, and 0.2s later, T01 OFF triggers MU05.....cycling in order.

SHIFT Instructions

SMT includes 1 SHIFT instruction, which is for cycling and alternating output of effective status at the specified contacts. SHIFT instruction has 4 parameters, the display and meaning of which are listed below.

| Symbol | Description |
|--------|-----------------------------------|
| ① | Number of output contacts (1~8) |
| ② | SHIFT input contact (I01~g1F) |
| ③ | SHIFT output contact (Q, Y, M, N) |
| ④ | SHIFT code (S01) |

In the following example, the number of output contacts is 5, input contact is I01, output contact is Q03~Q07, and output timing is shown below.



※ After SHIFT is enabled, the first contact Q03 outputs ON, and the rising edge of I01 resets the previous contact and effects the next contact, and so forth, till SHIFT is disabled and all contacts are reset.

AQ Analog Output Instructions

AQ analog output instructions are used with the extended analog output module 2AO.

The default output mode of AQ is voltage mode 0~10V, where 12bits value is 0~4095 and the corresponding AQ value is 0~1000.

When the output mode is set as current mode 0~20 mA, 12bits value is 0~2047 and the corresponding AQ value is 0~500.

12bits value of AQ is stored in register DRD4~DRD7, and output mode is based on the current value of register DRD0~DRD3, as listed below.

| | Output register | Mode register | Mode | DRD0~DRD3 data definition |
|-----------------|-----------------|---------------|------|--|
| Channel 1: AQ01 | DRD4 | DRD0 | 1 | 0: voltage mode, AQ output value 0 in STOP mode |
| Channel 2: AQ02 | DRD5 | DRD1 | 2 | 1: current mode, AQ output value 0 in STOP mode |
| Channel 3: AQ03 | DRD6 | DRD2 | 3 | 2: voltage mode, AQ output value kept in STOP mode |
| Channel 4: AQ04 | DRD7 | DRD3 | 4 | 3: current mode, AQ output value kept in STOP mode |

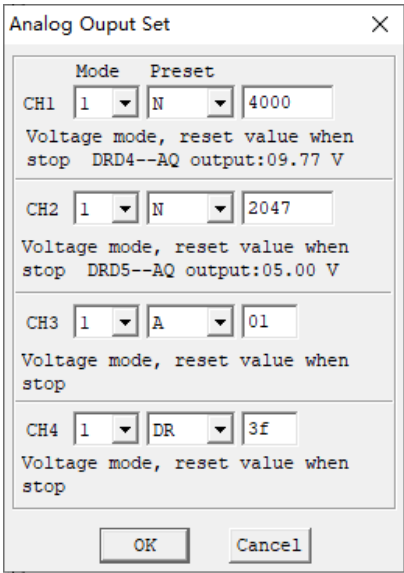
※ DRD0~DRD3 value is taken as 0 when it is not 0~3, namely AQ output mode is mode 1.

※ 2AO connected to the near-end of master corresponds to output AQ01 and AQ02, and that to the far-end corresponds to output AQ03 and AQ04.

※ Refer to [Chapter VIII: Extended Module Instructions-Extended Analog Modules](#) for use of analog output modules.

AQ display

※AQ displays the preset value (constant or code of other data type) in STOP mode, or the current value in RUN mode.



Display in STOP mode

AQ01=09.77V
AQ02=20.00mA
AQ03= A01 V
AQ04=DR3F mA

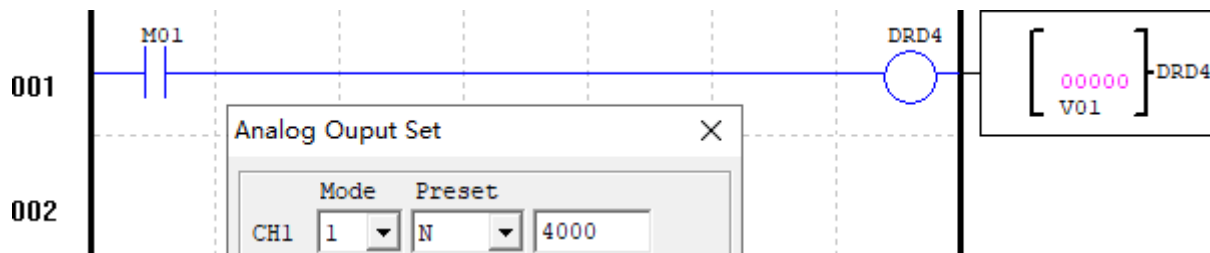
Display in RUN mode

AQ01=09.77V
AQ02=20.00mA
AQ03=02.10V
AQ04=00.00mA

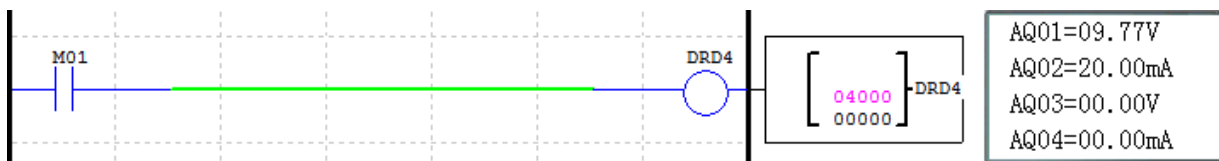
When AQ output mode is the current mode, the correspondence between DR value, AQ current value and the displayed value is as follows:
DRD5 current value=2047, corresponding AQ02=500, displayed value: 20.00mA

- ※ When the preset value type of AQ is set as constant, value of the corresponding DR register is changed and AQ output value is modified accordingly ($AQx=DRx/4.095$);
- ※ When the preset value type of AQ is set as other parameter variable, value of DR register varies with AQ ($DRx=AQx*4.095$);

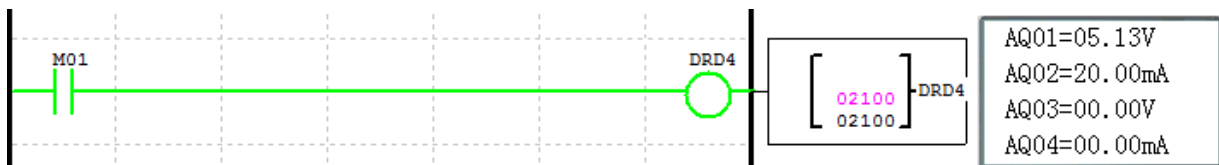
Example 1: AQ01 preset value as a constant;



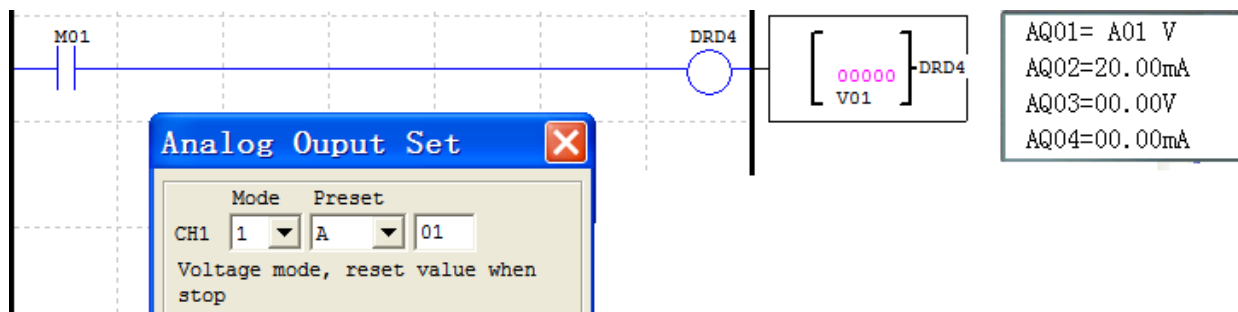
During running, M01 is not enabled, DRD4 current value is AQ01 set value 4000, and AQ01 outputs 9.77V;



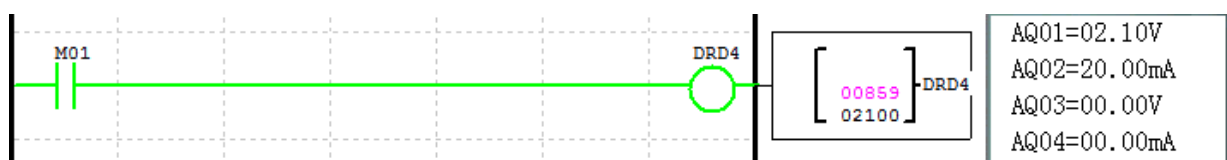
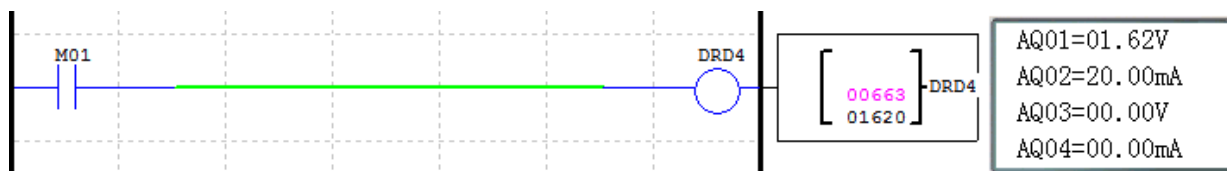
When M01 is enabled, DRD4 output is V01 value, and AQ01 output varies while V01 value is regulated;



Example 2: AQ01 preset value as other parameter;

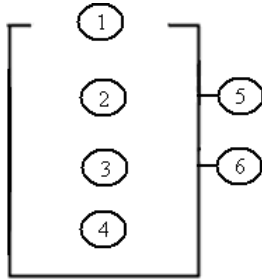


During running, DRD4 block output is not controlled by enabling, and AQ01 output value and DRD4 change while A01 is regulated.



AS (Addition and Subtraction) Instructions

SMT includes 31 independent AS instructions for data addition and subtraction. AS instruction has 6 parameters, the display and meaning of which are provided below.

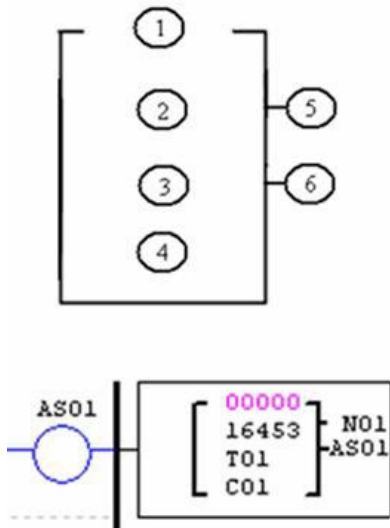


| Symbol | Description |
|--------|--------------------------------|
| ① | AS current value: -32768~32767 |
| ② | V1: operand 1: -32768~32767 |
| ③ | V2: operand 2: -32768~32767 |
| ④ | V3: operand 3: -32768~32767 |
| ⑤ | Error output coil (M, N, NOP) |
| ⑥ | AS code (AS01~AS1F) |

Computing formula: $AS = V1 + V2 - V3$

Operand V1~V3 may be a constant or code of current value of another functional block. Error coil is set ON in case of AS result overflow, or there will be no response if error coil is NOP.

Display and editing interface of AS instructions are shown below:



Edit Contact/Coil

H P L MU AS MD

Select Coil No. AS 01 (01~1F) Symbol Error Coil N 01

Function

Current value:

AS=V1+V2-V3

V1 + V2 - V3

Preset: 16453 00000 00000

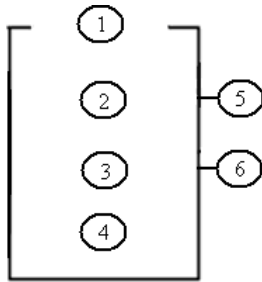
Pre Type: N T C

OK Cancel

※ Coil N01 is set ON when the computed result exceeds the range of current value.

MD (Multiplication and Division) Instructions

SMT includes 31 independent MD instructions for data multiplication and division. MD instruction has 6 parameters, the display and meaning of which are provided below.



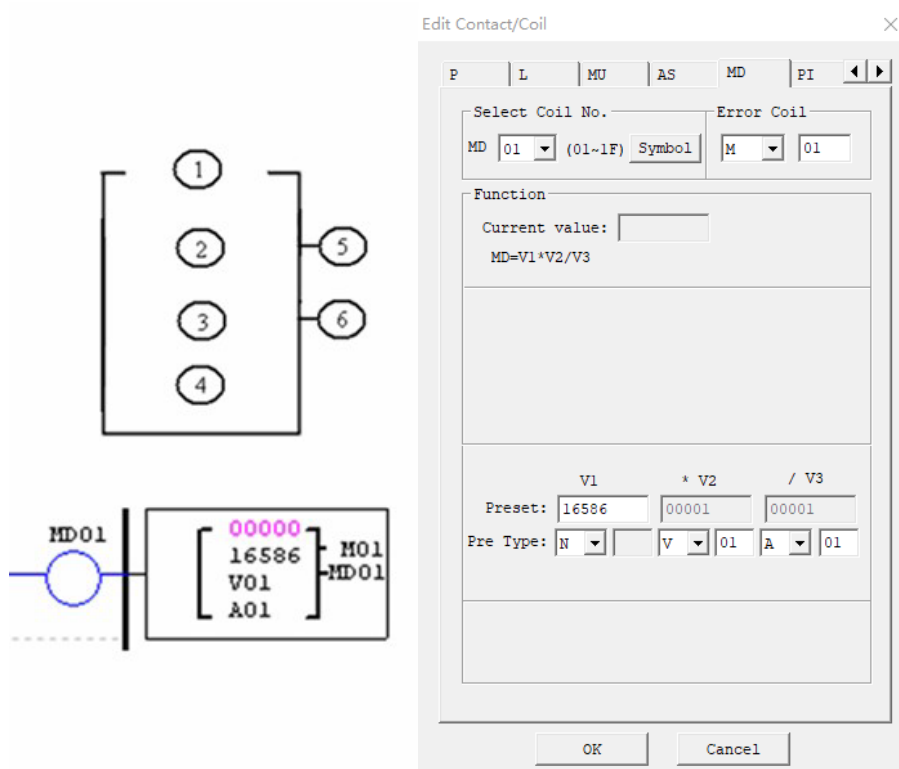
| Symbol I | Description |
|----------|--------------------------------|
| ① | MD current value: -32768~32767 |
| ② | V1: operand 1: -32768~32767 |
| ③ | V2: operand 2: -32768~32767 |
| ④ | V3: operand 3: -32768~32767 |
| ⑤ | Error output coil (M, N, NOP) |
| ⑥ | MD code (MD01~MD1F) |

Computing formula: $MD = V1 * V2 / V3$

Operand V1~V3 may be a constant or code of current value of another functional block. Error coil is set ON in case of MD result overflow or V3=0, or there will be no response if error coil is NOP.

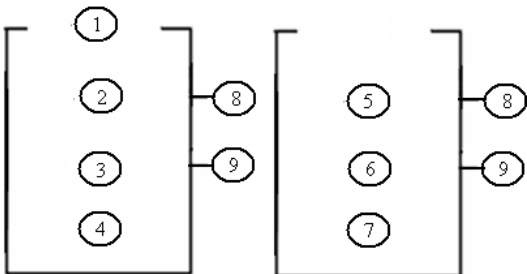
- ✘ Error events:
1. Operand V3 is 0, in which case multiplication and division will not be executed.
 2. Overflow of computed result.

Display and editing interface of MD instructions are shown below:



PID Instructions

SMT includes 15 independent PID instructions for PID operation of integer data. PID instruction has 9 parameters, the display and meaning of which are provided below.



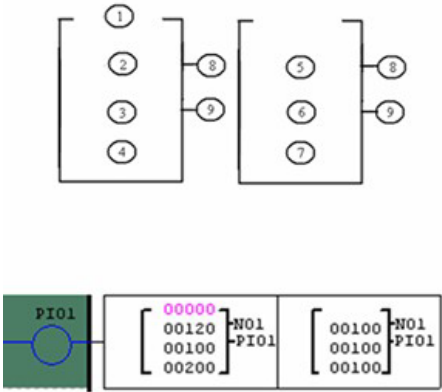
| Symbol | Description |
|--------|--|
| ① | PI: PID current value (-32768~32767) |
| ② | SV: target value (-32768~32767) |
| ③ | PV: measured value (-32768~32767) |
| ④ | T _S : sampling time (1~32767 * 0.01s) |
| ⑤ | K _P : proportional gain (1~32767%) |
| ⑥ | T _I : integral time (1~32767 * 0.1s) |
| ⑦ | T _D : differential time (1~32767 * 0.01s) |
| ⑧ | Error output coil (M, N, NOP) |
| ⑨ | PID code (PI01~PI0F) |

Parameter ①~⑦ may be a constant or code of current value of another functional block. Error coil is set as 1 and PID function is not executed when T_S or K_P is 0.

PID computing formula:

$$EV_n = SV - PV_n$$
$$\Delta PI = K_P \left\{ (EV_n - EV_{n-1}) + \frac{T_I}{T_S} EV_n + D_n \right\}$$
$$D_n = \frac{T_D}{T_S} (2PV_{n-1} - PV_n - PV_{n-2})$$
$$PI = \sum \Delta PI$$

Display and editing interface of PID are shown below:



Edit Contact/Coil

L | MU | AS | MD | PI | MX

Select Coil No. PID03 (01~0F) Symbol Error Coil N 01

Function

Current value: PID(-32768~32767)

SV: N 00120 (-32768~32767)

EV: N 00100 (-32768~32767)

Ts: N 00200 (1~32767)

Kp: N 00100 (1~32767)

Ti: N 00100 (1~32767)

Td: N 00100 (1~32767)

OK Cancel

There are three basic types of controls.

Proportional control (P).

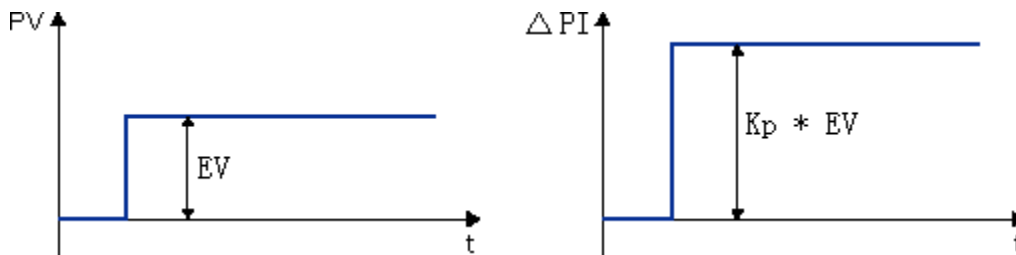
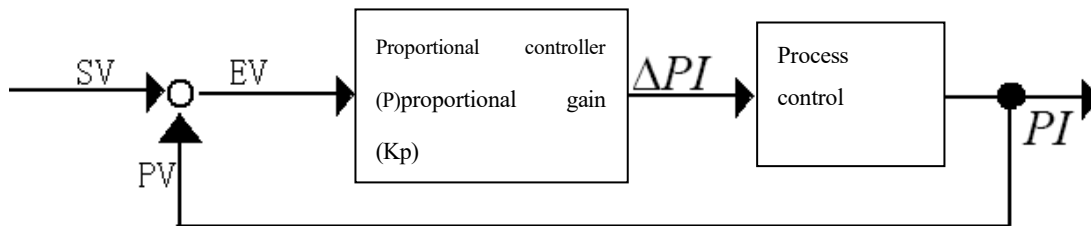
Integral control (I).

Differential control (D).

The controllers form the proportion integration differentiation controller (PID controller).

Functions of the basic controllers are explained below.

Proportional controller



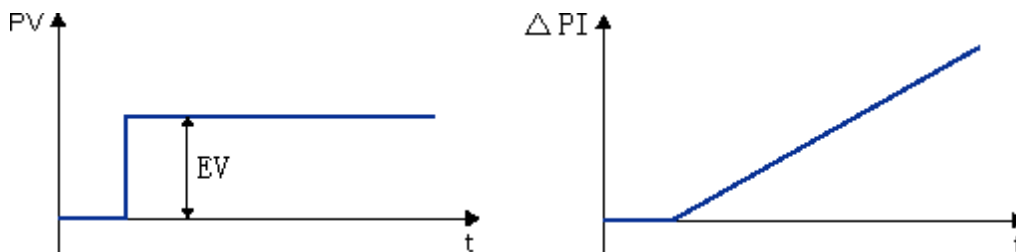
Based on the error EV between the target value SV and measured value PV, the regulated variable ΔPI is changed proportionally (K_p) to change the output result PI of process control.

Proportional controller can work immediately, but it cannot make error 0.

Proportional controller characteristics: Respond to variation of process value immediately.

Integral controller

Integral controller changes the regulated variable ΔPI in proportion to loop error EV and time t, works based on the delayed operation, and can completely eliminate loop error.



Integral controller characteristics: Eliminating error, delayed in operation and unstable.

Differential controller

Differential controller changes the regulated variable ΔPI in proportion to variation of the measured value PV to control the output result PI . In response to variation of the measured value PV , it changes the regulated variable to quickly complete the transition process.

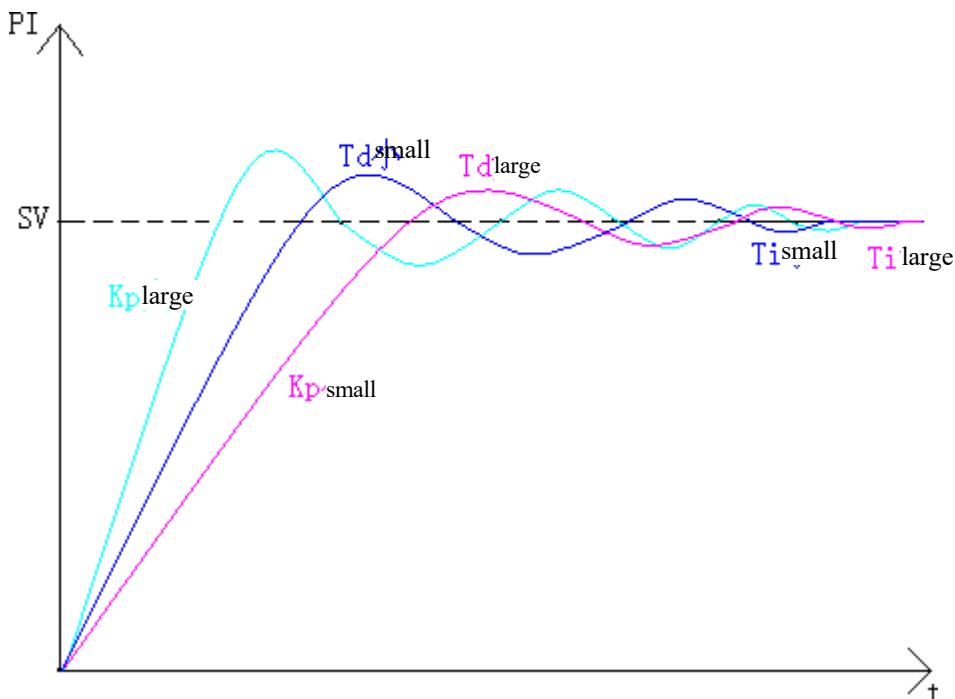
Differential controller characteristics: overcoming oscillation, improving stability and speeding up the transition process.,

PID controller characteristics: Fast, stable and accurate.

The three parameters K_P , T_I and T_D of PID control are described below:

A large K_P may speed up regulation and reduce error, but excessive K_P will impair system stability and even lead to system instability; integral regulation continues till there is no error, and low T_I results in strong integral action and vice versa; differential control has early control action to eliminate error before it is generated; therefore, differential control can improve dynamic performance of system; in addition, a large T_D can speed up system response, reduce overshoot and improve stability, but it may impair system resistance to disturbance and result in sensitive response to disturbance; however, we actually expect system not to be extremely sensitive to disturbance; therefore, T_D should not be too large.

Effects of K_P , T_I and T_D on output curve are shown below.



Small T_s will increase controller load, and minor deviation variation between two samplings will lead to insignificant variation of controller output value; large T_s may improve system stability, but result in poor control quality.

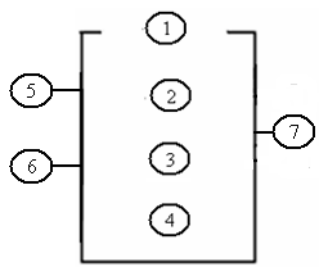
Parameter setting reference:

| Control quantity | Application scenario | K _P (%) | T _I (*0.1s) | T _D (*0.01s) | T _S (*0.01s) |
|-------------------|-------------------------|--------------------|------------------------|-------------------------|-------------------------|
| Rapid temperature | Small space or capacity | 625 | 30 | 100 | 50 |
| Slow temperature | Large space or capacity | 1250 | 120 | 800 | 100 |
| Slow pressure | Slow pressure change | 1500 | 5 | 400 | 100 |
| Rapid pressure | Rapid pressure change | 3750 | 2 | 1000 | 100 |

K_P, T_I and T_D may be adjusted as per the curve chart in specific scenarios.

MX (Multiplex Controller) Instructions

SMT includes 15 independent MX (multiplex controller) instructions, and each MX instruction has 7 parameters as listed below. When MX is disabled, MX current value is 0; when MX is enabled, MX current value is one of the parameters ①~④ based on status of ⑤ and ⑥, namely parameter is output.



| Symbol | Description |
|--------|-----------------------------|
| ① | Operand V0: -32768 ~32767 |
| ② | Operand V1: -32768 ~32767 |
| ③ | Operand V2: -32768 ~32767 |
| ④ | Operand V3: -32768 ~32767 |
| ⑤ | Control selection bit 1: S1 |
| ⑥ | Control selection bit 2: S2 |
| ⑦ | MX code (MX01~MX0F) |

Operand V1~V4 may be a constant or code of other data type. The relation between control selection bit and MX current value is shown in the following table.

| | |
|-------------|--|
| MX disabled | MX = 0 |
| MX enabled | S1=0, S2=0; MX = V0. S1=0, S2=1; MX = V1. S1=1, S2=0; MX = V2. S1=1, S2=1; MX = V3. |

Display and editing interface of MX are shown below:

Edit Contact/Coil

MUASMDPI**MX**AR

Select Coil No.
MX 01 (01~0F) Symbol

Function
Current value:
Data multiplexer(Output value selected by S1 and S2)

Preset Value0: N 16513
Preset Value1: AT 01
Preset Value2: AQ 01
Preset Value3: DR 01

S1Contact Low
S2Contact X 01

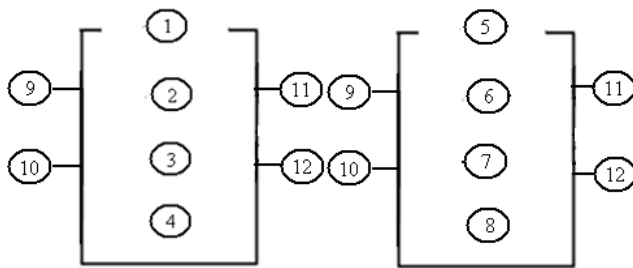
OKCancel

AR (Ramp Function Generator) Instructions

SMT includes 15 independent AR (ramp function generator) instructions which are used to make the current level of AR change to the set level gradually at the set rate by operation of integer data. Each AR instruction has 2 modes.

AR mode 1

In mode 1, AR current value changes from the starting level to the target level at stepping rate. The following 12 parameters should be set for AR mode 1 setting.



| Symbol | Description |
|--------|------------------------------------|
| ① | AR current value (AR: 0~32767) |
| ② | Level 1 (Levl1: -10000~20000) |
| ③ | Level 2 (Levl2: -10000~20000) |
| ④ | Maximum level (MaxL: -10000~20000) |
| ⑤ | Start/Stop offset (StSp: 0~20000) |
| ⑥ | Stepping rate (Rate: 1~10000/s) |
| ⑦ | Gain (A: 0~10.00) |
| ⑧ | Offset (B: -10000~10000) |
| ⑨ | Level selection (Sel) |
| ⑩ | Stop coil (St) |
| (11) | Error output coil (M, N, NOP) |
| (12) | AR code (AR01~AR0F) |

$$AR \text{ current value} = (AR \text{ current level} - \text{offset } B) / \text{gain } A$$

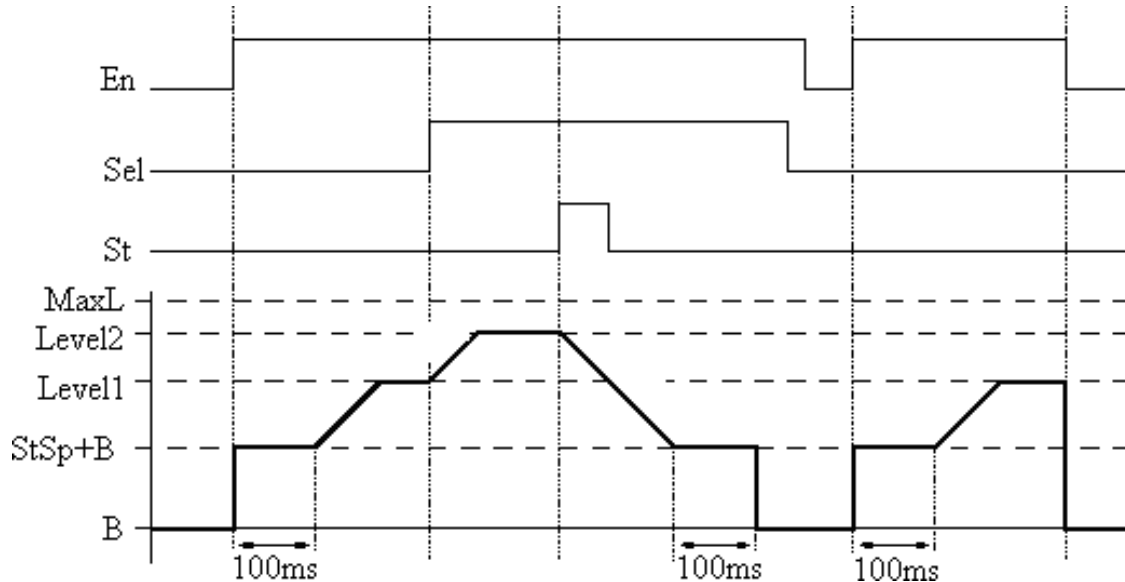
Parameter ②~⑧ may be a constant or code of other data type; error coil is set ON and AR instruction is not executed when gain A is 0.

| | |
|--------------------------|--|
| Level selection coil Sel | Level selection rule Sel = 0: Lev11 as the target level Sel = 1: Lev12 as the target level ※MaxL is taken as the preset value of target level if the target level is higher than the maximum level. |
| Stop coil St | When the stop coil is set ON (not kept), AR is stopped, decreased gradually from the current level to “Start/Stop offset+ offset” and kept at the level for 100ms, then the current level is offset B, leading to the current value 0, when AR instruction is ended. |

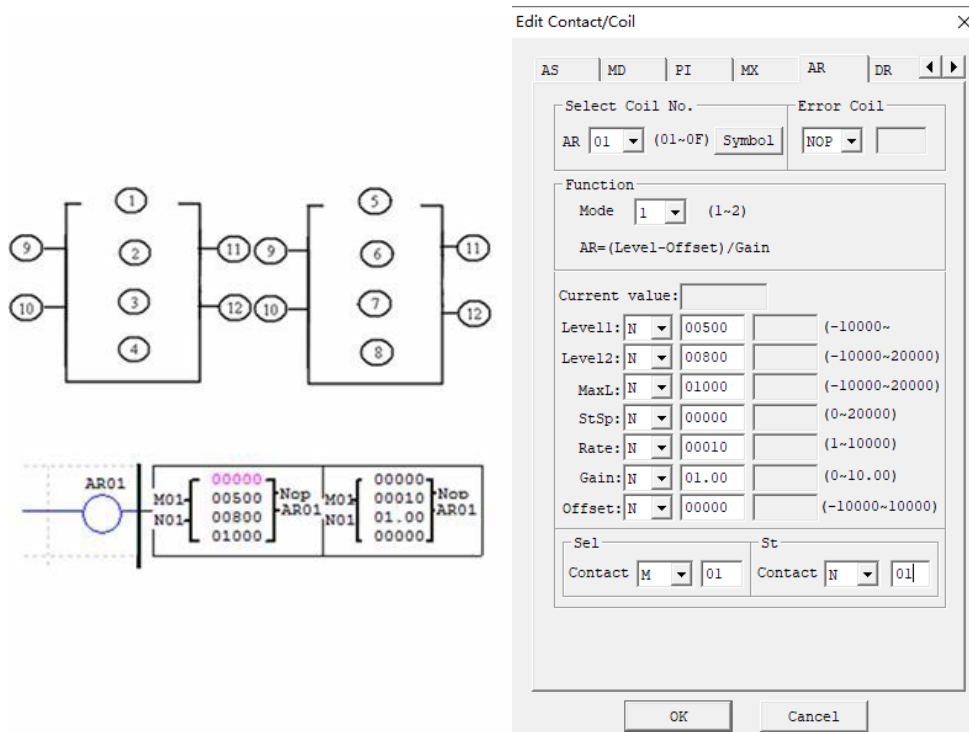
After AR is enabled, the current level is kept at “Start/Stop offset+ offset” for 100ms, and then changed to the set level at the set stepping rate. If the stop coil is enabled, AR level is gradually decreased from the current

level to “Start/Stop offset+ offset” at the set stepping rate and kept at this level for 100ms, then the current level is offset B, making AR current value 0, when AR instruction ends.

Timing diagram of AR current level:

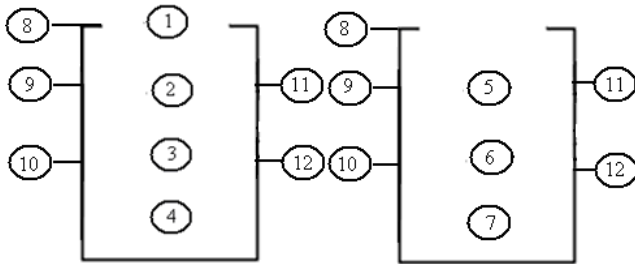


Display and editing interface of AR are shown below.



AR mode2

In mode 2, the four output levels L0~L3 can be set, and at the same time, one of the levels can be output as the target level as per the level selection ports Sel1 and Sel2. AR mode 2 has 12 parameters for setting.



| Symbol | Description |
|--------|-----------------------------------|
| ① | AR current value (AR:0~32767) |
| ② | Level 0 (Level0:0~32767) |
| ③ | Level 1 (Level1:0~32767) |
| ④ | Level 2 (Level2:0~32767) |
| ⑤ | Level 3 (Level3:0~32767) |
| ⑥ | Level upper limit (MaxL: 0~32767) |
| ⑦ | Acceleration time (Ta:0.1~3276.7) |
| ⑧ | Mode |
| ⑨ | Level selection 1(Sel1) |
| ⑩ | Level selection 2(Sel2) |
| (11) | Error output coil (M, N, NOP) |
| (12) | AR code (AR01~AR0F) |

Parameter ② ~ ⑦ may be a constant or current value of another functional block. AR output variation rate:

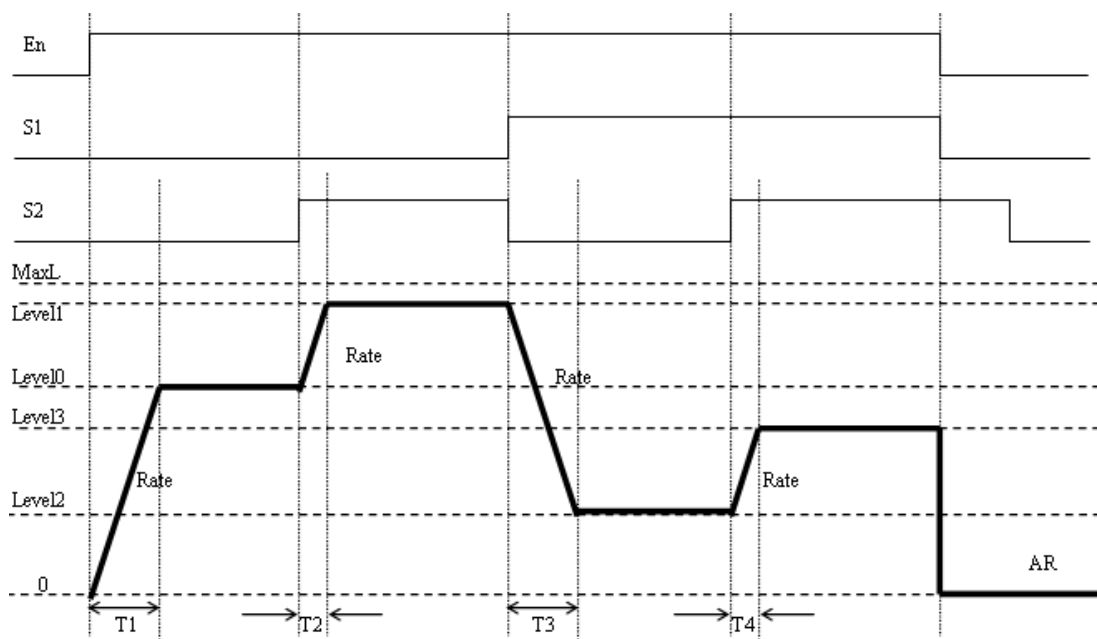
$Rate = \frac{MaxL}{Ta}$. Refer to the following table for description of parameters:

| | |
|--------------|--|
| Sel1 Sel2 | S1=0, S2=0: target level = Level 0; S1=0, S2=1: target level = Level 1; S1=1, S2=0: target level = Level 2; S1=1, S2=1: target level = Level 3; |
| MaxL | MaxL is taken as the target level if the target level is higher than the maximum level. |
| Ta | Quotient of MaxL/Ta rate as AR output variation rate |

$$Rate = \frac{MaxL}{Ta}$$

After AR is enabled, AR output will change from 0 to the target level at $Rate = \frac{MaxL}{Ta}$. In response to variation of Sel1 and Sel2, AR output will subsequently change from the current level to the target level at the Rate. After AR is disabled, AR output will turn to 0 immediately. Refer to the timing diagram in the next page.

Timing diagram of AR mode 2

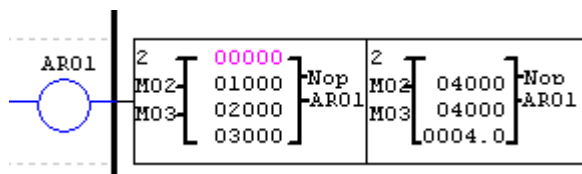
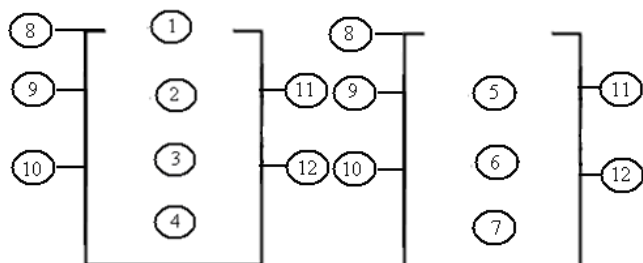


$$\text{Rate} = \text{MaxL}/T_a; \quad T1 = \text{Level0} * T_a / \text{MaxL};$$

$$T2 = (\text{Level1} - \text{Level0}) * T_a / \text{MaxL};$$

$$T3 = (\text{Level1} - \text{Level2}) * T_a / \text{MaxL}; \quad T4 = (\text{Level3} - \text{Level2}) * T_a / \text{MaxL};$$

Example:



Edit Contact/Coil

AS MD PI MX AR DR

Select Coil No. AR 01 (01~0F) Symbol NOP

Error Coil NOP

Function Mode 2 (1~2) Multi-speed Output

Current value:

Level0: N 01000 (0~32767)

Level1: N 02000 (0~32767)

Level2: N 03000 (0~32767)

Level3: N 04000 (0~32767)

MaxL: N 04000 (0~32767)

Ta: N 0010.0 (0.1~)

Sel1 Contact M 02 Sel2 Contact N 03

OK Cancel

DR (Data Register) Instructions

SMT includes 240 independent DR (data register) instructions, and each DR instruction has 3 parameters. When DR is enabled, the preset value is transferred to DR current value register. Data in DR may be the type with symbol or the type without symbol, and the control bit can be set by SMT user programming software menu **Operation (Q)>>Module system setting(Y)...**or keypad. Display and data type setting are provided below.

| Symbol | Description |
|--------|---------------------|
| ① | DR current value |
| ② | DR preset value |
| ② | DR code (DR01~DRF0) |

RS485 SET 03

DR S ET U

U: data without symbol
S: data with symbol

Module System Set

Set ID
Current ID: 1
New ID(00-99): 1

Set Expand I/O
I/O Num: 0
☐ I/O Alarm

RS485 Set
Comm. Mode: 8/N/2
Baud Rate: 38400
Coil Record
☒ None ☐ M ☐ N
Range: 01-10 SUM=0

Remote I/O
☒ NO
☐ Master
☐ Slave

Others
☒ M Keep
☐ C Keep
☐ Back Light
☐ Z Set

DR Format Set
☒ Unsigned
☐ Signed

Cancel Set

DR preset value may be a constant or code of current value of another functional block. Display and editing interface of DR are shown below.

Edit Contact/Coil

MD PI MX AR DR SHIFT

Select Coil No.
DR 01 (01-F0) Symbol

Function
Mode

Preset Value: DEC 00000 HEX 0000
Preset Type: C 01

OK Cancel

Menu interface DR register: DR preset value is displayed in STOP mode, and DR current value is displayed in RUN mode.

| STOP | RUN (DR01 = C01 current value) |
|---|---|
| <div>DR01= C01</div> <div>DR02= 00000</div> <div>DR03= 00000</div> <div>DR04= 00000</div> | <div>DR01= 00009</div> <div>DR02= 00000</div> <div>DR03= 00000</div> <div>DR04= 00000</div> |

- ※ Current value of DR65~DRF0 is kept in case of power failure or in the STOP mode.
 - ※ The final 40 DRs are special data registers, as listed below.
- DRD0~DRE3 are special registers for parameter setting the current value output function of which is described below.

DRC9~DRCF and DRD9~DRF0 are special status registers, the current value output function of which is described below:

| No. | Function description | |
|-----------|--|--|
| DRC9 | PLSY instruction for output of current value of pulse number | |
| DRCA | AT01 current Fahrenheit | Used as general DR register when there is no AT01~AT04 (4PT not connected); |
| DRCB | AT02 current Fahrenheit | |
| DRCC | AT03 current Fahrenheit | |
| DRCD | AT04 current Fahrenheit | |
| DRCE | RTC mode5 sunrise time | |
| DRCF | RTC mode5 sunset time | |
| DRD9~DRDF | Saving RTC current value | Year month day week hour minute second |
| DRE0 | Finally enabled M/N number | M/N range selected for status memory in system setting, and the finally enabled M/N number recorded in DRE0 during program running |
| DRE1~DRE3 | Standby special status registers | |
| DRE4 | A05 input current 0~2000 | Used as general DR register when there is no A05~A08 (4AI not connected); |
| DRE5 | A06 input current 0~2000 | |
| DRE6 | A07 input current 0~2000 | |
| DRE7 | A08 input current 0~2000 | |
| DRE8 | A01 current value 0~4095 | Used as general DR register when there is no A01~A02 (For AC type); |
| DRE9 | A02 current value 0~4095 | |
| DREA | A03 current value 0~4095 | Used as general DR register when there is no A03~A04 (For AC type for 12 points DC); |
| DREB | A04 current value 0~4095 | |
| DREC | A05 current value 0~4095 | Used as general DR register when there is no A05~A08 (4AI not connected); |
| DRED | A06 current value 0~4095 | |
| DREE | A07 current value 0~4095 | |
| DREF | A08 current value 0~4095 | |
| DRF0 | Standby special status registers | |

Chapter 6 FBD Programming Instructions

| | |
|--|-----|
| FBD Coil..... | 171 |
| FBD Program Storage Space..... | 172 |
| Analog Coil..... | 176 |
| Analog input..... | 176 |
| Analog output..... | 178 |
| Coil Blocks..... | 180 |
| HMI graph block..... | 181 |
| PWM graph block (for transistor type only)..... | 183 |
| IO Link graph block (for RS485 type only) | 190 |
| SHIFT graph block..... | 193 |
| Logic Block Diagrams | 194 |
| AND logic block diagram | 194 |
| AND (EDGE) logic block diagram | 195 |
| NAND logic block diagram | 196 |
| NAND (EDGE) logic block diagram | 196 |
| OR logic block diagram | 197 |
| NOR logic block diagram | 198 |
| XOR logic block diagram | 198 |
| RS logic block diagram..... | 198 |
| NOT logic block diagram..... | 199 |
| Pulse logic block diagram | 199 |
| BOOLEAN logic block diagram..... | 199 |
| Functional Block Diagrams..... | 201 |
| Timer functional block diagram | 203 |
| General counter functional block diagram | 213 |
| High-speed counter functional block diagram (for DC type only) | 222 |
| RTC functional block diagram | 226 |
| Analog comparator functional block diagram | 236 |
| Filter functional block diagram | 240 |
| Addition and subtraction functional block diagram | 243 |
| Multiplication and division functional block diagram..... | 244 |
| PID functional block diagram | 245 |
| Multiplex controller (MX) functional block diagram..... | 247 |
| Ramp function generator (AR) functional block diagram | 249 |
| Data register (DR) functional block diagram | 254 |
| Modbus functional block diagram..... | 255 |

FBD Coil

| | Input | Output | Range |
|-------------------------------|-------|--------|-----------------|
| Input coil | I | | 12 (I01~I0C) |
| Key input | Z | | 4 (Z01~Z04) |
| Extended input | X | | 12 (X01~X0C) |
| Output coil | Q | Q | 8 (Q01~Q08) |
| Extended output | Y | Y | 12 (Y01~Y0C) |
| Auxiliary contact | M | M | 127(M01~M7F) |
| Auxiliary contact | N | N | 127(N01~N7F) |
| HMI | | H | 31 (H01~H1F) |
| PWM | | P | 2 (P01~P02) |
| SHIFT | | S | 1 (S01) |
| I/O LINK | | L | 8 (L01~L08) |
| Logic block/ functional block | B | B | 260 (B001~B260) |
| NC contact | Hi | | |
| NO contact | Lo | | |
| Not connected | Nop | | |
| Analog input | A | | 8 (A01~A08) |
| Analog input parameter | V | | 8 (V01~V08) |
| Analog output | | AQ | 4 (AQ01~AQ04) |
| Analog temperature input | AT | | 4 (AT01~AT04) |
| Network input | J | | 63 (J01~J3F) |
| Network output | | K | 63 (K01~K3F) |
| Network analog input | NI | | 31 (NI01~NI1F) |
| Network analog output | | NQ | 15 (NQ01~NQ0F) |

User can only edit and modify FBD program in SMT user programming software, write in SMT lower computer by programming communication cable, and check parameters of the used functional block in FBD program or the modified program. The preset value of block may be a constant or code of another block current value. Block parameter limit is taken as the preset value in case of decoded data overflow.

FBD Program Storage Space

SMT provides limited resource for FBD program:

| Number of graph block B | System memory (byte) |
|----------------------------|----------------------|
| 500 | 10000 |

✘ The size of each block diagram B varies with its function.

✘ Functional block diagrams include special functional block diagram, regulating functional block diagram and serial port communication functional block diagram. Specific functions and quantitative limits are listed below.

| | Functional block diagram | Quantity |
|-------------------------------------|-------------------------------------|----------|
| Special functional block diagram | Timer (T) | 250 |
| | Counter (C) | 250 |
| | RTC (R) | 250 |
| | Analog comparator (G) | 250 |
| | Filter (F) | 250 |
| Adjust-controlling function | Addition and subtraction (AS) | 250 |
| | Multiplication and division (MD) | 250 |
| | PID control (PI) | 30 |
| | Multiplex controller (MX) | 250 |
| | Ramp function generator (AR) | 30 |
| | Data register (DR) | 240 |
| | Network analog input (NAI) | 250 |
| | Network analog output (NAQ) | 250 |
| Communication function | Modbus instruction (MU) | 250 |

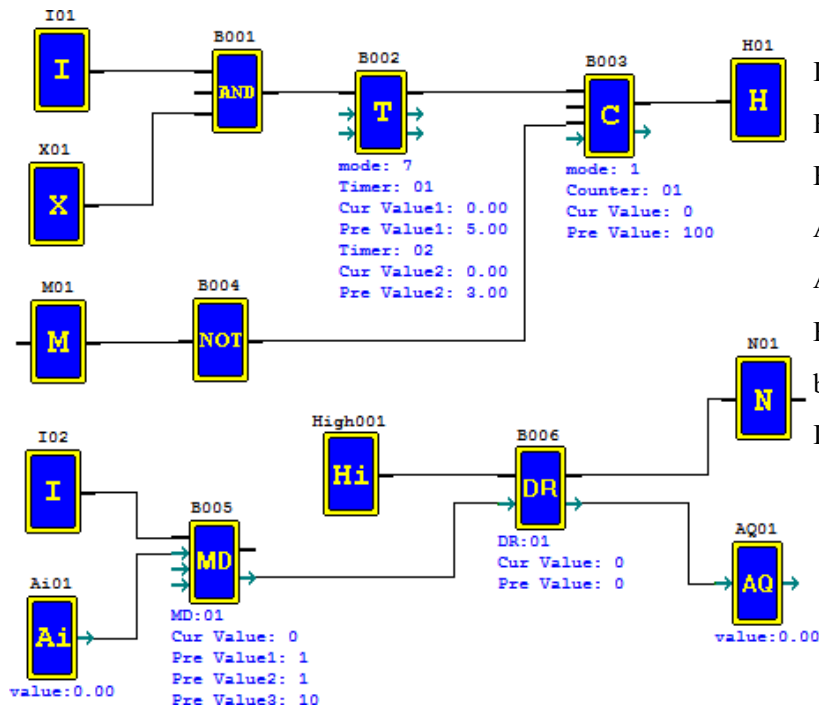
※Each functional block uses 1 B. The available quantity depends on number of B, system memory space and number of functional blocks.

[illegible]

※ Logic block diagrams include AND, AND EDGE, NAND, NAND EDGE, OR, NOR, XOR, NOT, RS, PULSE and BOOLEAN functions; each logic block uses 1 B, and the available quantity is limited by number of B and system memory space.

| Logic function block | Number of graph blocks B | System memory (byte) |
|----------------------|--------------------------|----------------------|
| AND | 1 | 8 |
| AND(EDGE) | 1 | 8 |
| NAND | 1 | 8 |
| NAND(EDGE) | 1 | 8 |
| OR | 1 | 8 |
| NOR | 1 | 8 |
| XOR | 1 | 6 |
| RS | 1 | 6 |
| NOT | 1 | 4 |
| PULSE | 1 | 4 |
| BOOLEAN | 1 | 12 |

Example and resource computing



| No. | Function | Memory byte | Function number |
|------|--------------------------------|-------------|-----------------|
| B001 | AND (and) | 8 | |
| B002 | Timer T mode 7 | 12 | T01, T02 |
| B003 | Counter C mode 1 | 14 | C01 |
| B004 | NOT (not) | 4 | |
| B005 | Multiplication and division MD | 11 | MD01 |
| B006 | Data register DR | 6 | DR01 |

| | B number | Memory byte | |
|--------------------|----------|-------------|--|
| Available resource | 500 | 10000 | |
| Occupied resource | 6 | 55 | |
| Free resource | 494 | 9945 | |

Analog Coil

Analog coil includes analog input A01~A04, extended analog input A05~A08, analog offset gain V01~V08, extended analog temperature input AT01~AT04 and extended analog output AQ01~AQ04. Analog value may be used as preset value of other functional blocks.

| | |
|-----------------------------|-----------|
| Analog input | A01~A04 |
| Expansion analog input | A05~A08 |
| Analog input count value | V01~V08 |
| Expansion temperature input | AT01~AT04 |
| Expansion analog output | AQ01~AQ04 |

Analog input

DC type body: Analog input A01~A04, value 0~999, corresponding to 0~9.99V;

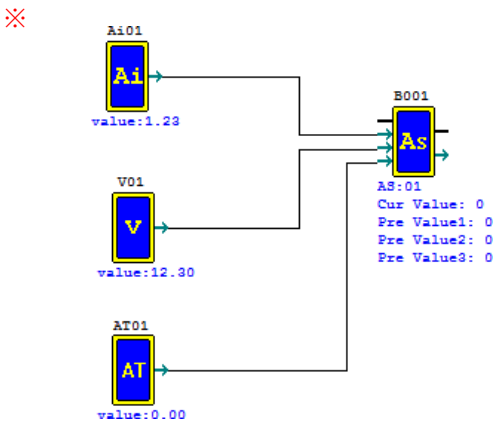
Extended module 4AI: Analog input A05~A08, value 0~999, corresponding to 0~9.99V.

Extended module 4PT: Analog temperature input AT01~AT04, value -1000~6000, corresponding to -100.0~600.0°C;

Analog offset gain V01~V08, value range 0~999999, calculating relation: $V0x = A0x * \text{gain} + \text{offset}$.

| | Number | Range | Meaning |
|-----------------------------------|-----------|------------|----------------|
| Analog input value | A01~A04 | 0~999 | 0~9.99V |
| Expansion analog input value | A05~A08 | 0~999 | 0~9.99V |
| Analog input count value | V01~V08 | 0~999999 | |
| Expansion temperature input value | AT01~AT04 | -1000~6000 | -100.0~600.0°C |

Example: $A01=1.23$, $V01=A01*10-0=12.30$;
 $B001 (AS01)=A01+V01-AT01$;



Ainput

Parameters

Input Number: Ai01

Value: 1.23 v

All the 12-bit value is kept in DRES

Symbol:

OK Cancel

Vinput

Parameter

V01 value: 0.00 v

Ai01 value: 1.23 v

Gain: 10 Offset: -0

Symbol:

OK Cancel

AT

Parameters

AT number: AT01 C

F in DRCA~DRCD

Symbol:

OK Cancel

Refer to [Chapter VIII: Extended Module Instructions-Analog Extended Modules](#) for use of extended analog input module.

Analog output

AQ analog output instructions are used with extended analog output module 2AO.

Default output mode of AQ is voltage mode 0~10V, where 12bits value is 0~4095, and the corresponding AQ value is 0~1000.

When the output mode is set as current mode 0~20 mA, 12bits value is 0~2047, and the corresponding AQ value is 0~500.

The 12bits value of AQ is stored in register DRD4~DRD7. Output mode depends on the current value of DRD0~DRD3, as listed below.

| | Output register | Mode register | Mode | DRD0~DRD3 data definition |
|--------------------|-----------------|---------------|------|--|
| Channel 1: AQ01 | DRD4 | DRD0 | 1 | 0: voltage mode, AQ output value is 0 in STOP mode |
| Channel 2: AQ02 | DRD5 | DRD1 | 2 | 1: current mode, AQ output value 0 in STOP mode |
| Channel 3: AQ03 | DRD6 | DRD2 | 3 | 2: voltage mode, AQ output value kept in STOP mode |
| Channel 4: AQ04 | DRD7 | DRD3 | 4 | 3: current mode, AQ output value kept in STOP mode |

※ DRD0~DRD3 value is taken as 0 when it is not 0~3, namely AQ output mode is mode 1.

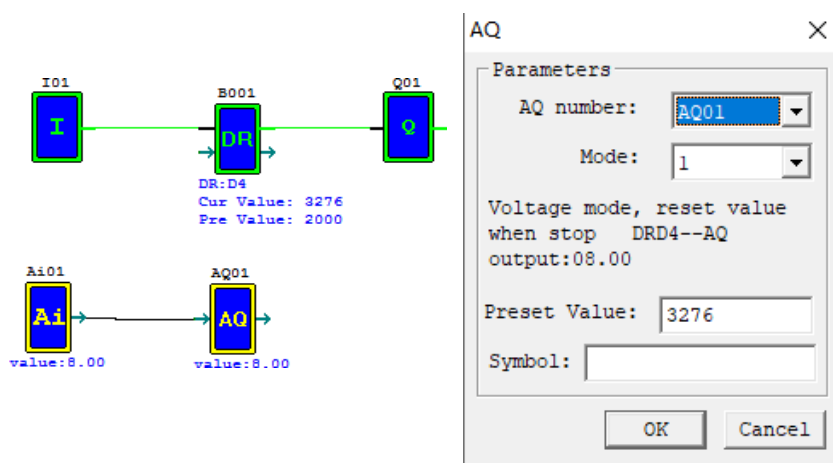
※ 2AO connected to the near-end of master corresponds to output AQ01 and AQ02, and that to the far-end corresponds to output AQ03 and AQ04.

※ Refer to [Chapter VIII: Extended Module Instructions-Analog Extended Modules](#) for use of analog output module.

※ When the preset value type of AQ is set as constant, value of the corresponding DR register is changed and AQ output value is modified accordingly ($AQ_x = DR_x / 4.095$).

※ When the preset value type of AQ is set as other parameter variable, value of DR register varies with AQ ($DR_x = AQ_x * 4.095$);

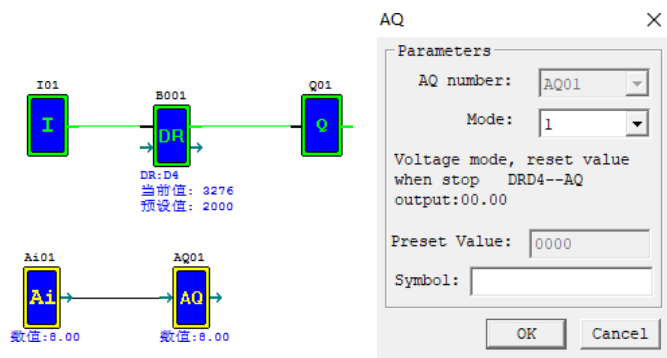
Example 1: AQ01 preset value as a constant.



During running, I01 is not enabled, DRD4 current value is AQ01 set value 4000, and AQ01 outputs 9.77V;

When I01 is enabled, AQ01 output varies while DRD4 value is regulated.

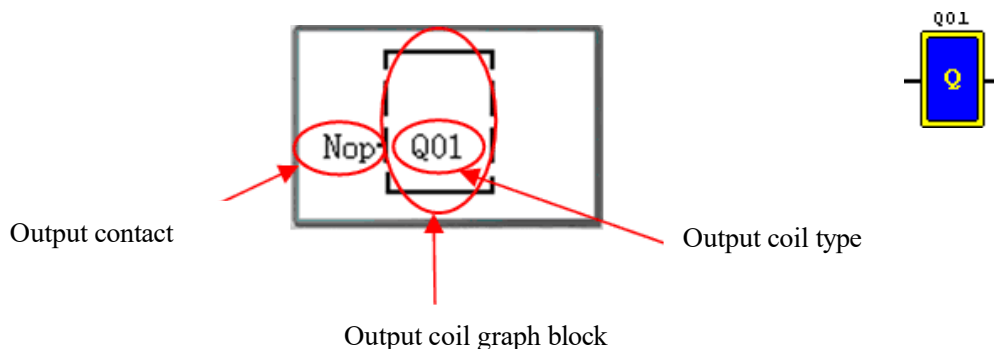
Example 2: AQ01 preset value as other parameter.



AQ01 output value and DRD4 vary with A01, while DRD4 output is not controlled by enabling.

Coil Blocks

Output coils include Q, Y, M, N, H, L, P and S; FBD menu display is shown below:



H, L, P and S special functional output coils; press “OK” to enter the functional display interface.

Press the following keys at this time:

| | |
|----|---|
| OK | Enter the functional display interface when cursor is in the coil position and coil type is H, L, P or S. |
| → | Move the cursor, input contact→ output coil→ output coil number |
| ← | Move the cursor, output coil number→ output coil→ input contact→ logic/functional display (when input contact is B) |
| ↑↓ | Change coil type Q ⇔ Y ⇔ M ⇔ N ⇔ H ⇔ L ⇔ P ⇔ S ⇔ Q... when cursor is in the coil position. Change coil number when cursor is in the position of coil number. |

HMI graph block

SMT includes 31 independent HMI instructions, and each HMI enables display of content in 16×4 characters on LCD in the form of text, figure, coil status, preset value and current value of functional block, and current value of analog. Text displayed by HMI has three types: multi-language, built-in Chinese and user-defined Chinese.

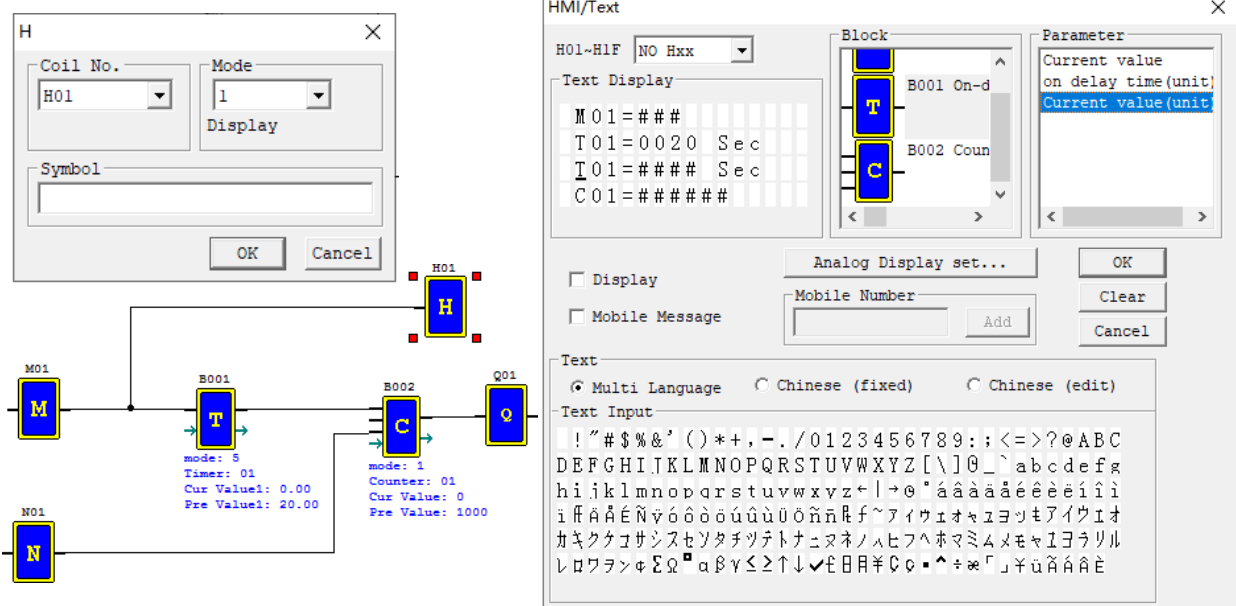
✗ Only the coil, functional block and analog quantity used in program are available for setting of display status, preset value and current value in HMI.

Each HMI has 2 working modes:

Model, display mode when pressing key “SEL” can display HMI preset.

Mode2, no display mode when pressing key “SEL” cannot display HMI preset. Displays preset only be enabled.

Example: M01 controls H01; set to display status of coil M01, preset value and current value of functional block B001 (timer T01) and current value of block B002 (counter C01) in H01 mode 1.



| Coil output display under FBD | Press “OK” to enter functional display | Press “SEL” to modify the mode |
|-------------------------------|--|--------------------------------|
| | | |

HMI display and key editing method are consistent with that under Ladder.

| Press “SEL” for display when stopped | Enable HMI display during running | Press “SEL” to modify the preset value of functional block |
|--|--|---|
| <div>M01=### T01=20.00Sec T01=##.##Sec C01=#####</div> | <div>M01=ON T01=20.00Sec T01=10.00Sec C01=000001</div> | <div>M01=ON T01=<u>3</u>0.00Sec T01=03.60Sec C01=000002</div> |

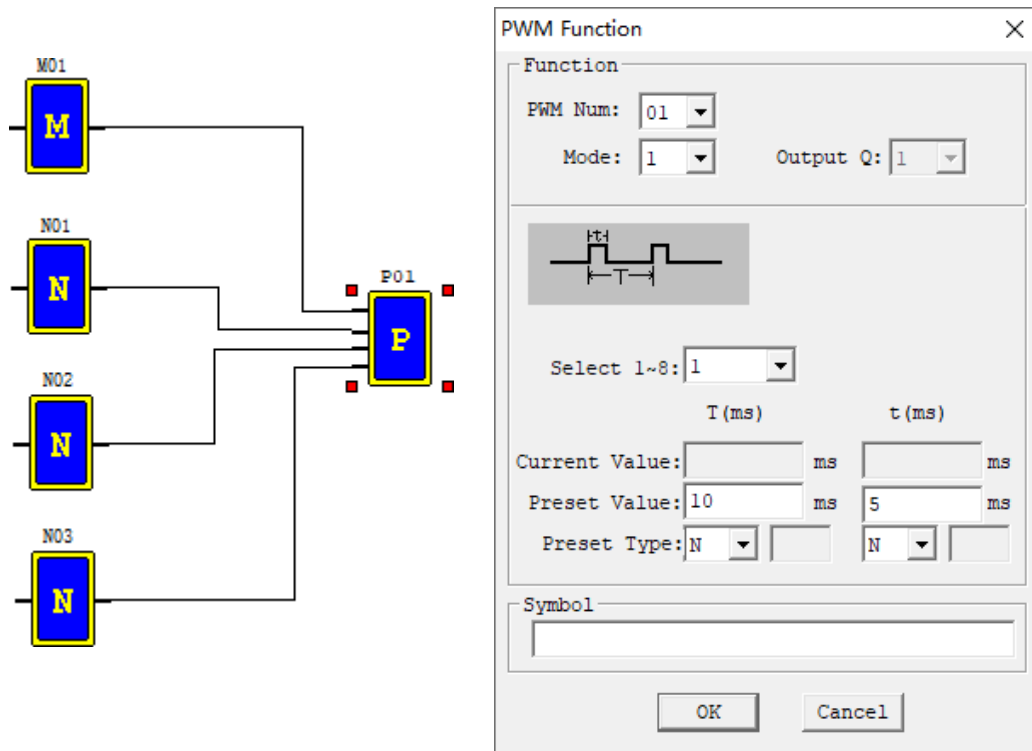
※ Refer to [Chapter III: Programming Tool-Ladder Programming Environment-HMI/TEXT](#) for details on editing and use of HMI function.

PWM graph block (for transistor type only)

SMT of transistor type includes 5 PWM instructions. The PWM instructions have 5 working modes. PWM mode enables output of 8 groups of PWM waveform of different duty cycles, and PLSY mode enables output of pulses of varying frequency and configurable number.

Model PWM

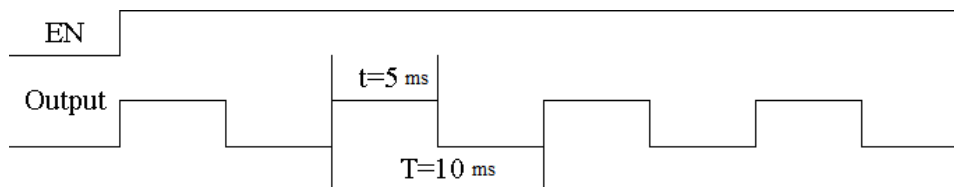
Both P01 and P02 can work in PWM mode with 8 groups of preset value of pulse width and period. During PWM running, status of the selected coil is changed, and waveform of duty cycle variation is output.



| Coil output display under FBD | Press OK to enter functional display | Press “SEL” to select class range and modify the preset value |
|-------------------------------|---|---|
| | <pre>PWM01 Mode:1 SET 1 Out:Q01 TP1=00005 TT1=00010</pre> | <pre>PWM01 Mode:1 SET 2 Out:Q01 TP2=00002 TT2=00011</pre> |

| Display description | Enabling | S3 | St2 | S1 | Class range | Output |
|--|----------|-----|-----|-----|-------------|---------------|
| P01: code (PWM01~PWM02) | OFF | X | X | X | 0 | OFF |
| M01: enabling input (I01~B260) | ON | OFF | OFF | OFF | 1 | Class range 1 |
| N01: input selection S1 (I01~ B260) | ON | OFF | OFF | ON | 2 | Class range 2 |
| N02: input selection S2 (I01~ B260) | ON | OFF | ON | OFF | 3 | Class range 3 |
| N03: input selection S3 (I01~ B260) | ON | OFF | ON | ON | 4 | Class range 4 |
| Mode: PWM mode (1) | ON | ON | OFF | OFF | 5 | Class range 5 |
| SET x: display of the current output range (1~8) | ON | ON | OFF | ON | 6 | Class range 6 |
| Out: output port (Q01~Q02) | ON | ON | ON | OFF | 7 | Class range 7 |
| TPx: pulse width (0~32767 ms) | ON | ON | ON | ON | 8 | Class range 8 |
| TTx: period (1~32767 ms) | | | | | | |

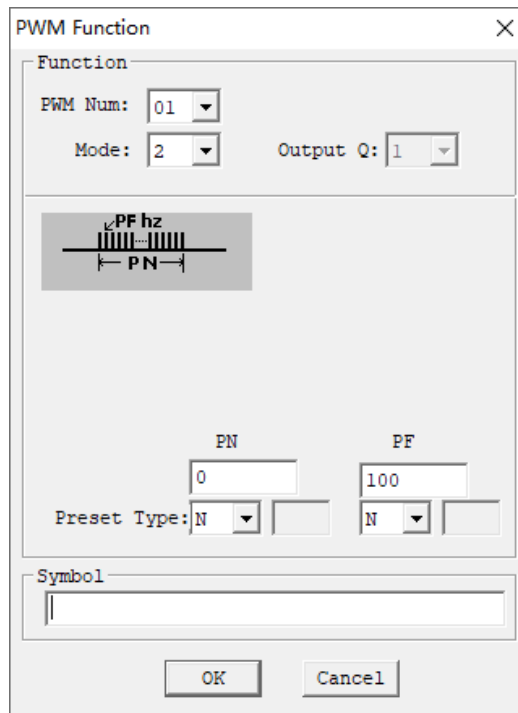
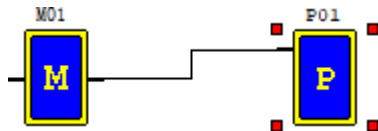
Example: Status of coils N01, N02 and N03 is 000, so PWM outputs the preset value of group 1 duty cycle.



※ Which group of pulse wide and period is output by PWM depends on status of coils N01, N02 and N03.

Mode2 PLSY

Output ports Q01 and Q02



| Coil output display under FBD | Press OK to enter functional display | Press "SEL" to modify the preset value |
|-------------------------------|--------------------------------------|--|
| | | |

※ PF: PLSY output frequency (1~1000Hz); PN: PLSY output set pulse number (0~32767).

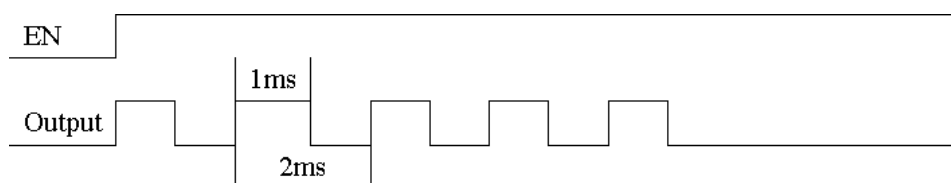
※ Cumulative output pulse number is stored in DRC9.

※ Output stops when PLSY output pulse number reaches the preset value.

※ If the set pulse number is 0, PLSY will output pulse continuously till PLSY is disabled.

Example:

Parameter setting: PF= 500Hz, PN = 5, output waveform as follows:

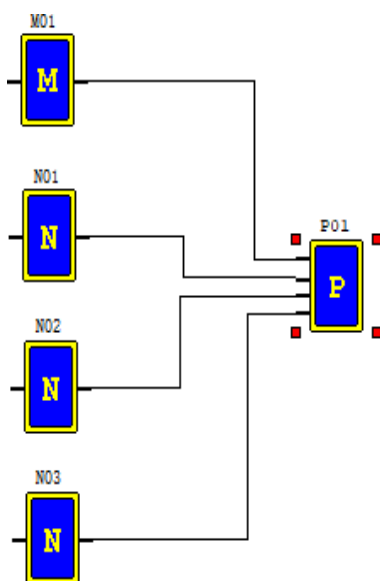


PLSY stops output when the output pulse number reaches the preset value 5.

Mode 3 PWM Output Simultaneously Mode

This mode is the same with general PWM mode, P01 and P02 send the configured pulse at the same time. PWM mode 3 has 8 groups of preset value of pulse width and period. During running in this mode, status of the selected coil is changed, and waveform of varying duty cycle is output. This mode has 10 parameters as listed below:

| Symbol | Description | Enabling | S3 | St2 | S1 | Class range | Output |
|--------|---|----------|-----|-----|-----|-------------|---------------|
| ① | PWM mode (3) | OFF | X | X | X | 0 | OFF |
| ② | Display of the current output class range (1~8) | ON | OFF | OFF | OFF | 1 | Class range 1 |
| ③ | Input selection S1 (I01~g1F) | ON | OFF | OFF | ON | 2 | Class range 2 |
| ④ | Input selection S2 (I01~g1F) | ON | OFF | ON | OFF | 3 | Class range 3 |
| ⑤ | Input selection S3 (I01~g1F) | ON | OFF | ON | ON | 4 | Class range 4 |
| ⑥ | Display of the current output class range (1~8) | ON | ON | OFF | OFF | 5 | Class range 5 |
| ⑦ | Pulse width (0~32767 ms) | ON | ON | OFF | ON | 6 | Class range 6 |
| ⑧ | Period (1~32767 ms) | ON | ON | ON | OFF | 7 | Class range 7 |
| ⑨ | Output port (Q01Q02) | ON | ON | ON | ON | 8 | Class range 8 |
| ⑩ | PWM code (P01) | | | | | | |



PWM Function

Function

PWM Num: 01

Mode: 3

Output Q: 1

Select 1~8: 1

T(ms)

t(ms)

Current Value:

ms

ms

Preset Value: 10

ms

5

ms

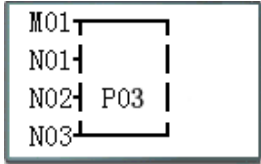
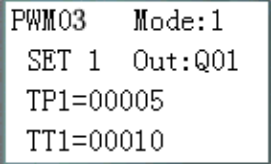
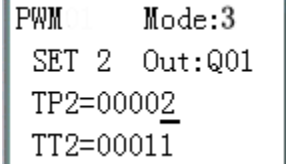
Preset Type: N

N

Symbol

OK

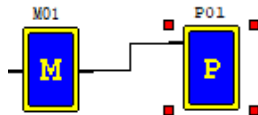
Cancel

| | | |
|---|---|--|
| Coil output display under FBD | Press OK to enter functional display | Press “SEL” to select class range and modify the preset value |
|  |  |  |

Mode 4 PLSY mode of simultaneous output

The output ports of PLSY function are Q01 and Q02. The PLSY mode has 6 parameters as listed below.

Example:



The screenshot shows the 'PWM Function' dialog box. The 'Function' section has 'PWM Num' set to 01, 'Mode' set to 4, and 'Output Q' set to 1. Below this is a waveform diagram showing a pulse train with frequency 'PF hz' and period 'PN'. The 'Preset Type' is set to 'N'. The 'PN' value is 0 and the 'PF' value is 100. The 'Symbol' field is empty. The 'OK' and 'Cancel' buttons are at the bottom.

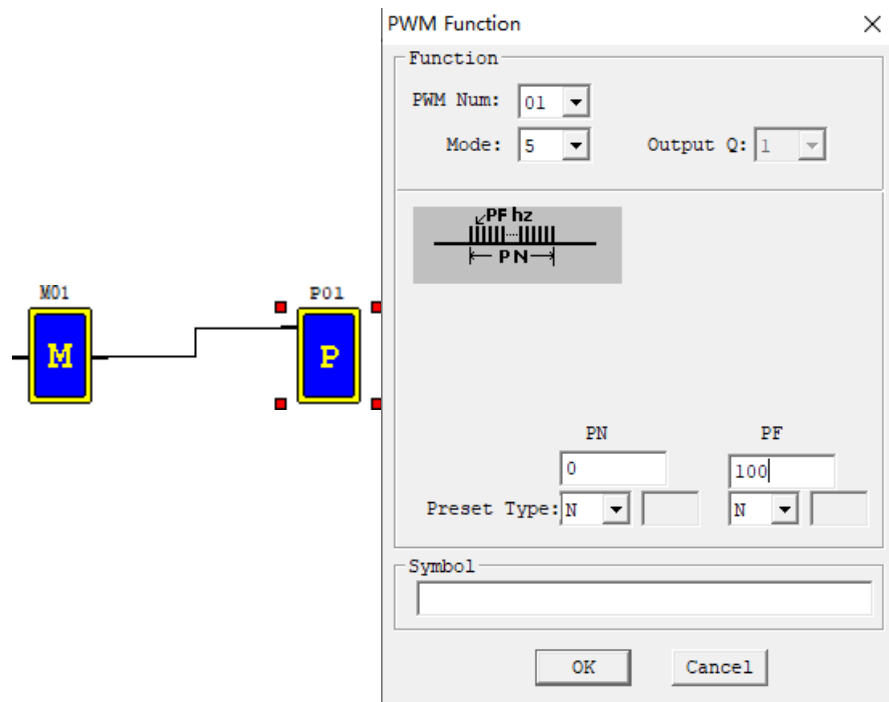
| Coil output display under FBD | Press OK to enter functional display | Press “SEL” to modify the preset value |
|-------------------------------|--------------------------------------|--|
| | | |

The preset value of PLSY output frequency and output number of pulses may be a constant or code of other data type, and decoding follows the rule of parameter limits. When the output number of pulses reaches the preset value, PLSY stops output. After PLSY is enabled again, it outputs the set number of pulses, and the cumulative number of pulses increases continuously based on the original number.

※ If the set pulse number is 0, PLSY will output pulse continuously till PLSY is disabled.

PWM mode 5: AB phase PLSY mode

AB phase PLSY function is similar to general PLSY function, but it uses the ports Q1 and Q2 at the same time and sends Q1 (phase A) pulse ahead of Q2 (phase B). This PWM mode has 6 parameters as listed below.



| Coil output display under FBD | Press OK to enter functional display | Press “SEL” to modify the preset value |
|-------------------------------|--------------------------------------|--|
| | | |

The preset value of AB phase PLSY output frequency and output number of pulses may be a constant or code of other data type, and decoding follows the rule of parameter limits. When the output number of pulses reaches the preset value, PLSY stops output. After PLSY is enabled again, it outputs the set number of pulses, and the cumulative number of pulses increases continuously on the basis of original number.

- ※ Pulse frequency changes during PLSY running, and the preset value of output pulse number is 100.
- ※ If the value of output frequency is higher than 1000 during running in mode 5, 1000 is taken as the set value of output pulse frequency.
- ※ Output stops when output pulse number in mode 5 reaches the preset value.
- ※ If the set pulse number is 0, PWM mode 5 keeps pulse output till PLSY is disabled.

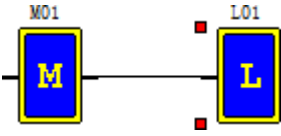
IO Link graph block (for RS485 type only)

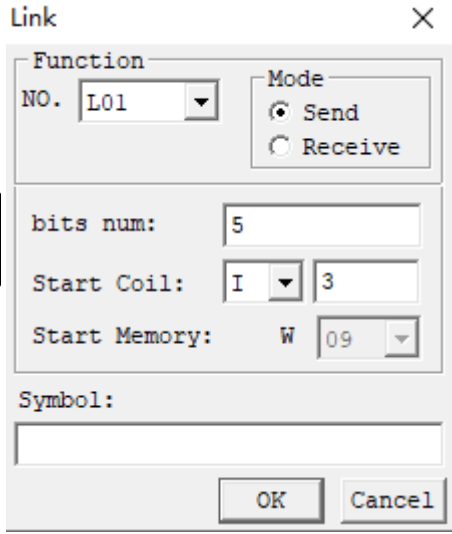
An IO Link is composed of 8 SMT of RS485 type at most, where each contact is used as an independent station for running of its logic program and all slave contacts are connected to the same master station. IO Link ID must be continuous and be 0~7; master station ID is 0, and slave station ID begins from 1 to 7; if slave station ID is not continuous, such as 1, 2, 4, 5, the master station will take it as there are only two slave stations 1 and 2 and communicate with slave stations 1 and 2 only.

When each station uses L01~L08, only one can be set as mode 1: sending mode, and the other L can only be set as mode 2: receiving mode.

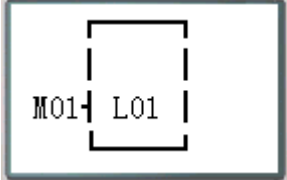
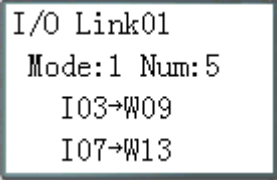
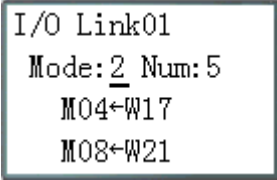
Sending mode: Address in W table is controlled by ID of SMT itself and cannot be changed, and status of the selected coil is put in the corresponding W table. The correspondence of ID and W table is shown in the following table.

Receiving mode: content of the selected W table is transferred to the selected coil; if input coil I or X is selected, content of W table will not change status of coils I and X.





| ID | W table comparison |
|----|--------------------|
| 0 | W01~W08 |
| 1 | W09~W16 |
| 2 | W17~W24 |
| 3 | W25~W32 |
| 4 | W33~W40 |
| 5 | W41~W48 |
| 6 | W49~W56 |
| 7 | W57~W64 |

| Coil output display under FBD | Press OK to enter functional display | Press “SEL” to modify mode, coil number and type and W position |
|---|---|---|
|  |  |  |

| Display description |
|--|
| L01: I/O Link code (L01~L08) |
| M01: enabling input (I01~B260) |
| Mode: IO Link mode, 1: sending ;2: receiving |
| Num x: sending/receiving points (1~8) |
| I03...I07: sending/receiving coil type |
| W09...W13: Position of sent/received data in W table |

| Coil type | Number |
|-----------------|-----------------|
| Input coil | I01~I0C/i01~i0C |
| Output coil | Q01~Q08/q01~q08 |
| Auxiliary coil | M01~M3F/m01~m3F |
| Auxiliary coil | N01~N3F/n01~n3F |
| Extended input | X01~X0C/x01~x0C |
| Extended output | Y01~Y0C/y01~y0C |

Example 1: Sending mode

The set mode is 1, coil number is 5, starting coil is I03 and SMT ID is 1, status of coil I03~I07 will be sent to W09~W13, as shown below.

| Mode=1, Num= 5, coil= I03~I07, ID=1 (W09~W13) | | | | | | | | | |
|---|----------|----------|----------|----------|----------|--------|--------|--------|--|
| W table position | W09 | W10 | W11 | W12 | W13 | W14 | W15 | W16 | |
| Receiving or sending coil | ↑ I03 | ↑ I04 | ↑ I05 | ↑ I06 | ↑ I07 | ↑ 0 | ↑ 0 | ↑ 0 | |

Example 2: Receiving mode

The set mode is 2, coil number is 5, starting coil is M03, W table position is W17 and not controlled by ID, content of W17~W21 will be sent to coil M03~M07.

| Mode=1, Num = 5, coil = M03~M07, W table W17~W21 | | | | | |
|--|----------|----------|----------|----------|----------|
| W table position | W17 | W18 | W19 | W20 | W21 |
| Receiving or sending coil | ↓ M03 | ↓ M04 | ↓ M05 | ↓ M06 | ↓ M07 |

I/O Link02
Mode:2 Num:5
M03+W17
M07+W21

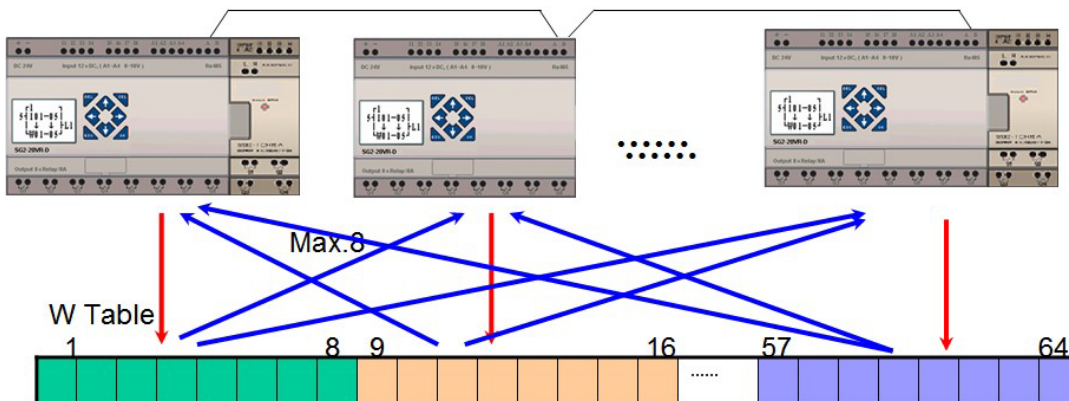
IO Link diagram:

- max. 8 points I/O send per stations
- Max 7*8 (=56) points I/O received per station

ID SET 01
REMOTE I/O N
BACKLIGHT x
M KEEP ✓

ID must set to be 0,1,2,...(max to 7)

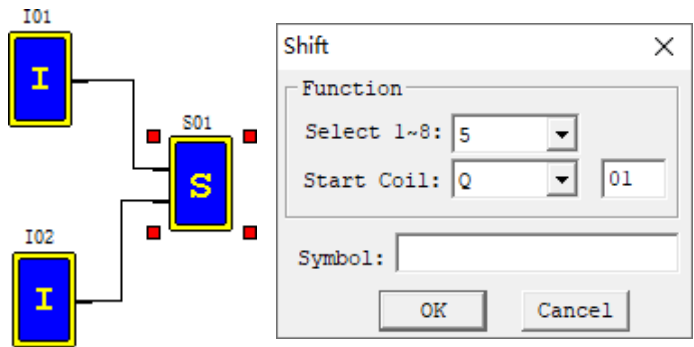
Remote I/O disable



✳Refer to [Chapter VII: Function Specification of 20-point RS485 High-performance Type](#) for use of IO Link function.

SHIFT graph block

SMT includes 1 SHIFT instruction, which is for cycling and alternating output of effective status at the specified contacts.

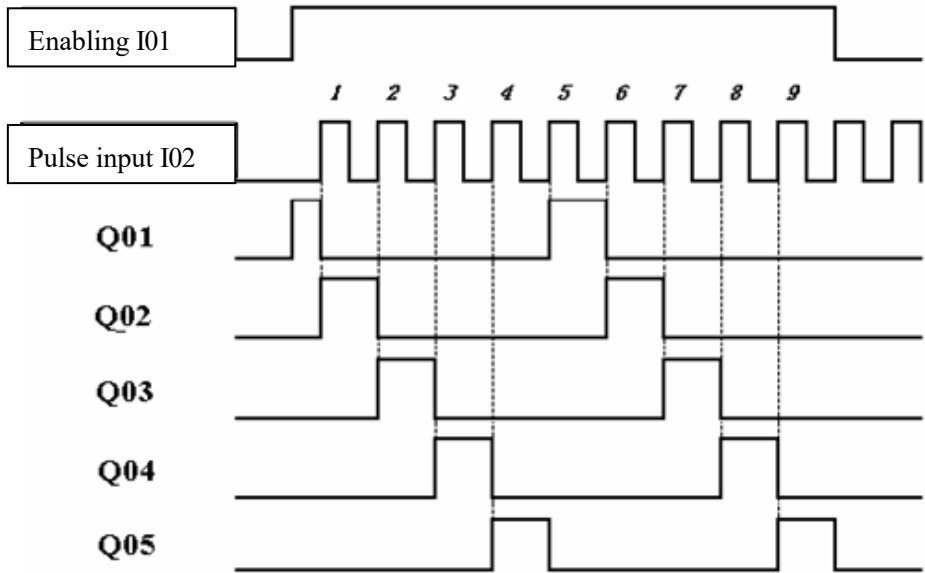


| Coil output display under FBD | Press OK to enter functional display | Press “SEL” to modify coil number and type |
|-------------------------------|--------------------------------------|--|
| | | |

| Display description |
|--------------------------------------|
| S01: SHIFT code (S01) |
| I01: enabling input (I01~B260) |
| I02: pulse input contact (I01~ B260) |
| Type: output contact |
| Num: number of output contacts (1~8) |

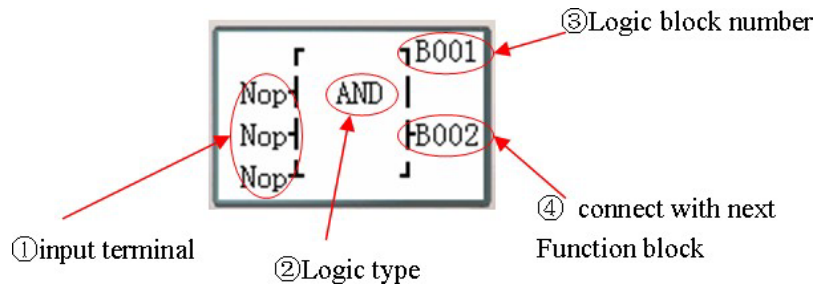
| Output contact | Number |
|-----------------|---------|
| Output coil | Q01~Q08 |
| Extended output | Y01~Y0C |
| Auxiliary coil | M01~M3F |
| Auxiliary coil | N01~N3F |

Timing diagram



Logic Block Diagrams

Logic block display under FBD:

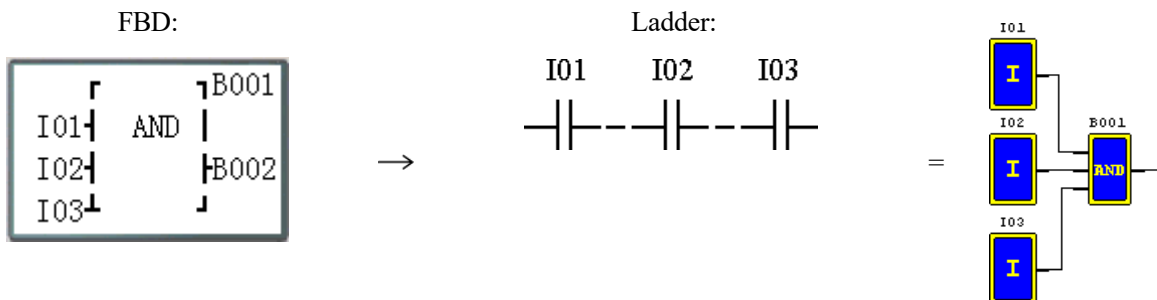


Press the following keys:

| | |
|----|--|
| → | Move the cursor, input contact→ graph block code→ next connected graph block/coil display |
| ← | Move the cursor, graph block code→ input contact→ logic/functional display (When input contact is B) |
| ↑↓ | Move the cursor upward or downward (multiple input contacts) |

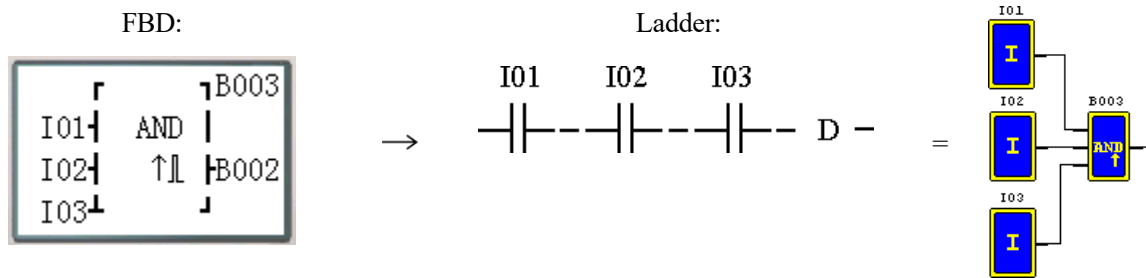
※ Logic block diagrams include AND, AND EDGE, NAND, NAND EDGE, OR, NOR, XOR, NOT, RS, PULSE and BOOLEAN functions;

AND logic block diagram



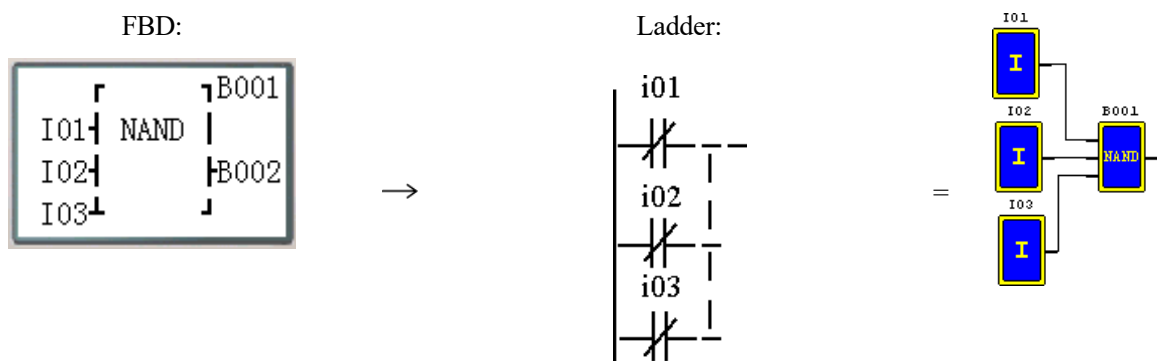
I01 And I02 And I03

- ※ Input contact NOP is equivalent to Hi;
- ※ B outputs ON when all input contacts are ON;

AND (EDGE) logic block diagram

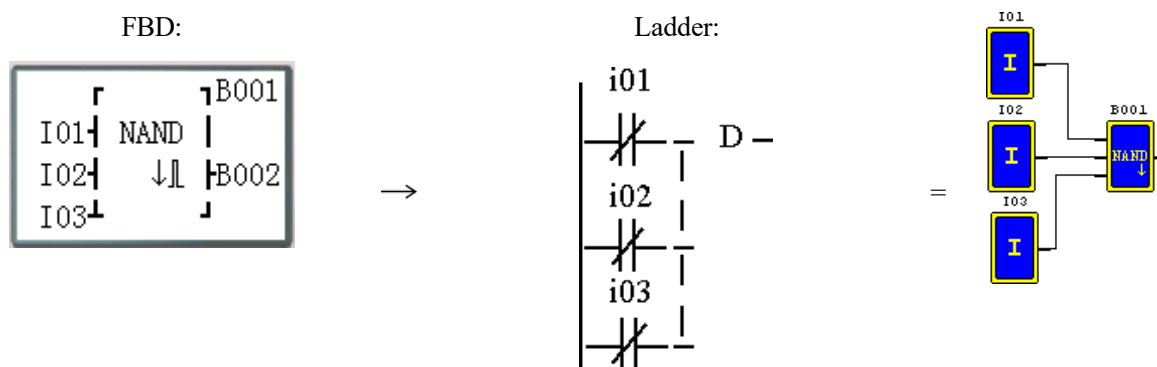
I01 And I02 And I03 And D

- ✘ Input contact NOP is equivalent to Hi;
- ✘ B outputs ON in a scanning cycle when all input contacts are ON;

NAND logic block diagram

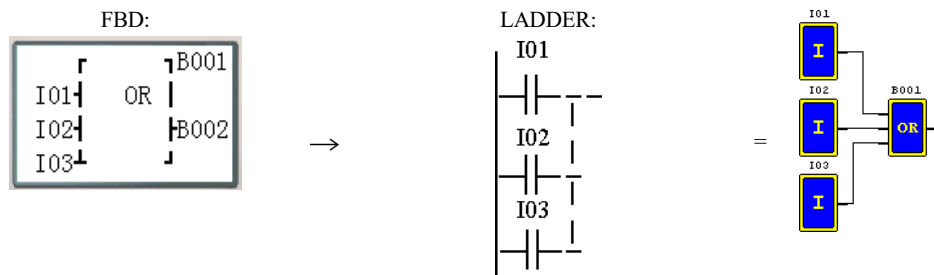
Not (I01 And I02 And I03)

- ※ Input contact NOP is equivalent to Hi;
- ※ B outputs ON when any input contact is OFF;

NAND (EDGE) logic block diagram

Not (I01 And I02 And I03) And D

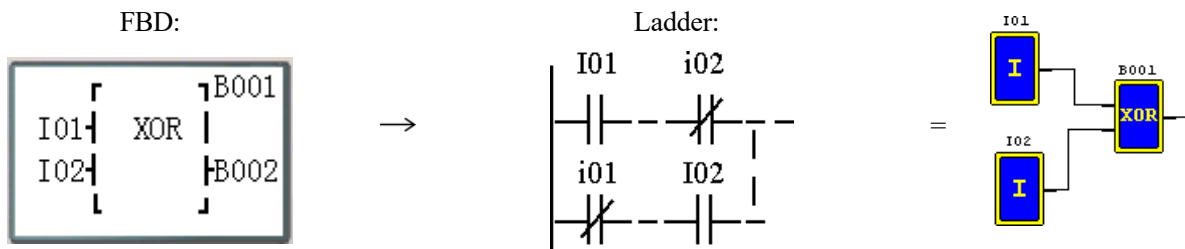
- ※ Input contact NOP is equivalent to Hi;
- ※ B outputs ON in a scanning cycle when all input contacts are ON, and any input is OFF.

OR logic block diagram

I01 or I02 or I03

Note: The input terminal is NOP which is equivalent to “Lo”;

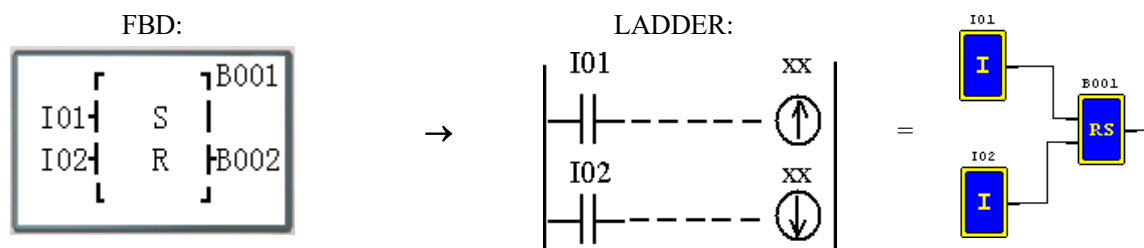
The B output ON when one of the input terminals status is ON;

XOR logic block diagram

I01 XOR I02

※ Input contact NOP is equivalent to Lo;

※ B outputs ON when status of input contact is different;

RS logic block diagram

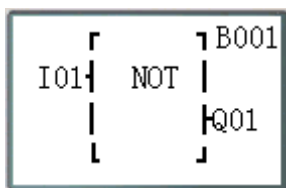
Logic Table

| I01 | I02 | B001 |
|-----|-----|---------|
| 0 | 0 | holding |
| 0 | 1 | 0 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

Note: The input terminal is NOP which is equivalent to “Lo”.

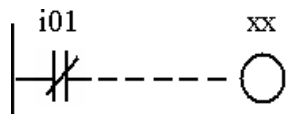
NOT logic block diagram

FBD:

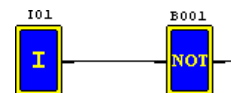


→

Ladder:



=

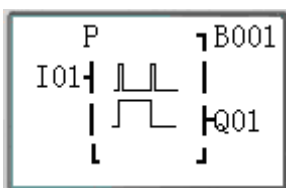


Not I01

※ Input contact NOP is equivalent to Hi;

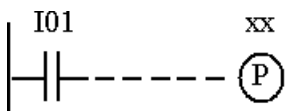
Pulse logic block diagram

FBD:

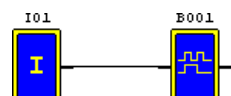


→

Ladder:



=

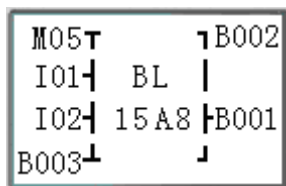


※ Input contact NOP is equivalent to Lo;

※ B output status changes when input contact status changes from OFF to ON;

BOOLEAN logic block diagram

FBD:

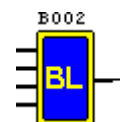


→

Ladder:

None

=



※ Input contact NOP is equivalent to Lo;

Example of BOOLEAN function:

| | | | | |
|--------|---------|---|---------|-----------|
| Input1 | M 0 5 | ┐ | | ┐ B x x x |
| Input2 | I 0 1 | ┐ | B L | |
| Input3 | I 0 2 | ┐ | 1 5 A 8 | ┐ B y y y |
| Input4 | B 0 0 3 | └ | | └ |

Functional block code

Truth table display; connection output

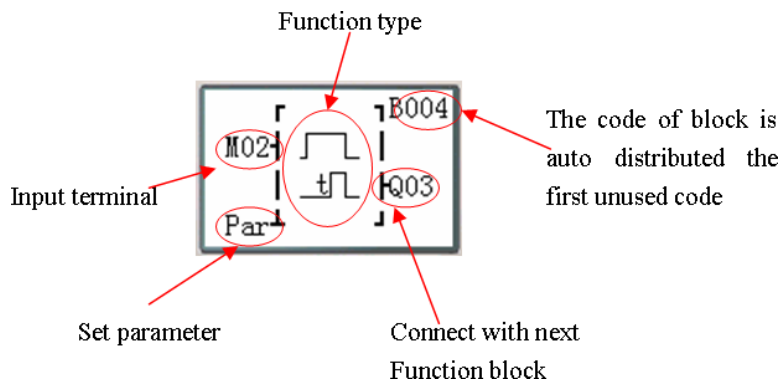
BOOLEAN truth table comparison is as follows:

| Input1 | Input2 | Input3 | Input4 | Output (edit) | Example | Truth table display |
|--------|--------|--------|--------|---------------|---------|---------------------|
| 0 | 0 | 0 | 0 | 0/1 | 0 | 8 |
| 1 | 0 | 0 | 0 | 0/1 | 0 | |
| 0 | 1 | 0 | 0 | 0/1 | 0 | |
| 1 | 1 | 0 | 0 | 0/1 | 1 | |
| 0 | 0 | 1 | 0 | 0/1 | 0 | A |
| 1 | 0 | 1 | 0 | 0/1 | 1 | |
| 0 | 1 | 1 | 0 | 0/1 | 0 | |
| 1 | 1 | 1 | 0 | 0/1 | 1 | |
| 0 | 0 | 0 | 1 | 0/1 | 1 | 5 |
| 1 | 0 | 0 | 1 | 0/1 | 0 | |
| 0 | 1 | 0 | 1 | 0/1 | 1 | |
| 1 | 1 | 0 | 1 | 0/1 | 0 | |
| 0 | 0 | 1 | 1 | 0/1 | 1 | 1 |
| 1 | 0 | 1 | 1 | 0/1 | 0 | |
| 0 | 1 | 1 | 1 | 0/1 | 0 | |
| 1 | 1 | 1 | 1 | 0/1 | 0 | |

Functional Block Diagrams

※ Operation rule of all functional blocks in FBD mode is basically the same with that in Ladder mode.

Functional block display under FBD:

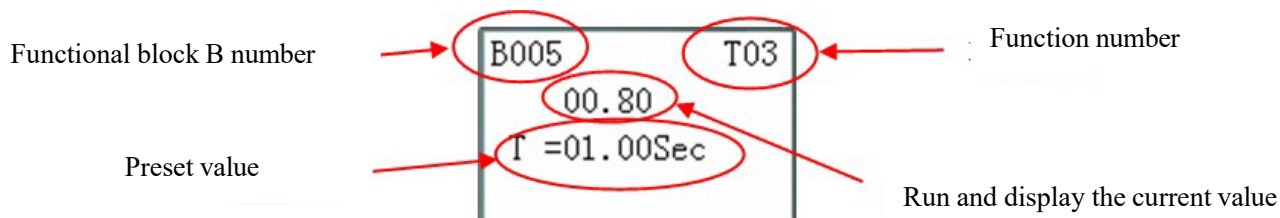


※ When the cursor is in parameter setting “Par”, press “OK” to enter the parameter display setting interface for editing and modifying the preset value of functional blocks.

Press the following keys :

| | |
|----|--|
| → | Move the cursor, input contact or parameter setting→ graph block code → next connected graph block /coil display |
| ← | Move the cursor, graph block code→ input contact or parameter setting → logic/functional display (when input contact is B) |
| ↑↓ | Move the cursor upward or downward (input contact, parameter setting) |
| OK | Enter the functional block parameter display interface when cursor is in parameter setting |

Display of functional block parameters:



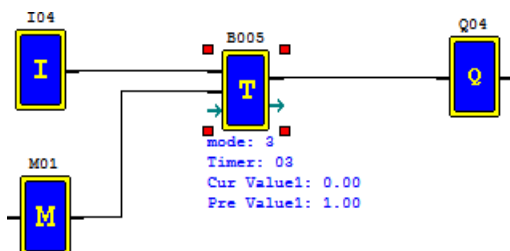
Press the following keys:

| | |
|------------|--|
| ← or → | Find the close functional block when cursor is in the position of B; Move the cursor to the left or right when it is in the position of preset value; |
| SEL+↑ or ↓ | Find the close functional block when cursor is in the position of B; |
| SEL+← or → | Parameter display menu 1~2 switching when B is function PI, MX or AR; |
| ↑ ↓ | Move the cursor upward or downward (B ↔ preset value); Modify value or number when status is edited; |
| SEL | Enter the editing mode when cursor is in the position of preset value Modify parameter type of preset value in the editing mode; |
| ESC | Cancel the current editing Exit the parameter display interface; |
| OK | Confirm the current editing and save; |

Timer functional block diagram

Under FBD, 250 timers may be used at the maximum in mode 0~8 where the function is the same with that under Ladder.

- ✘ In timer mode 7 under FBD, a functional block B uses two timers T.
- ✘ When M KEEP is effective, the current values of timers T0E and T0F are kept in case of power failure.



Timer editing and display:

Timer Function Block

Function

Mode: 3 Timer number: 03

Off-delay timer mode 1

Time Base: 0.01Sec

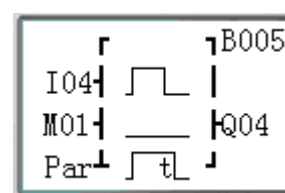
Current Value: 0 Sec

Preset Value: 01.00 Sec

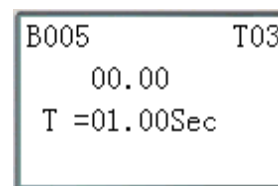
Symbol

OK Cancel

FBD display:



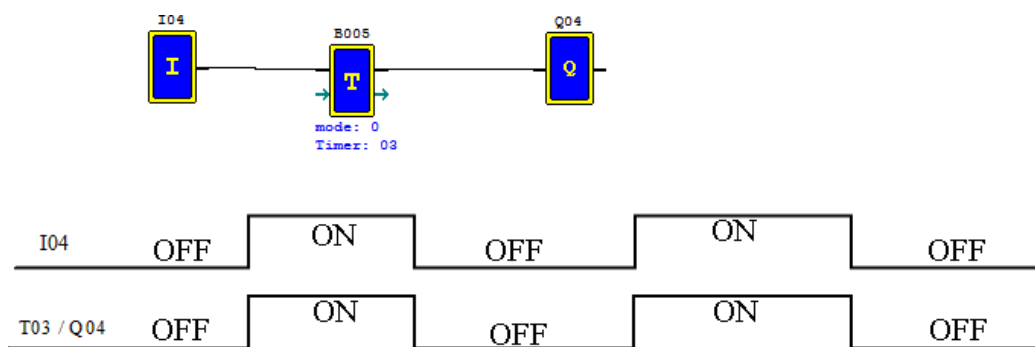
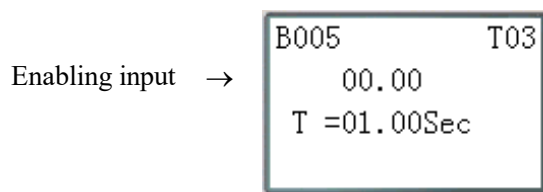
Parameter display:



Timer mode 0 (internal coil)

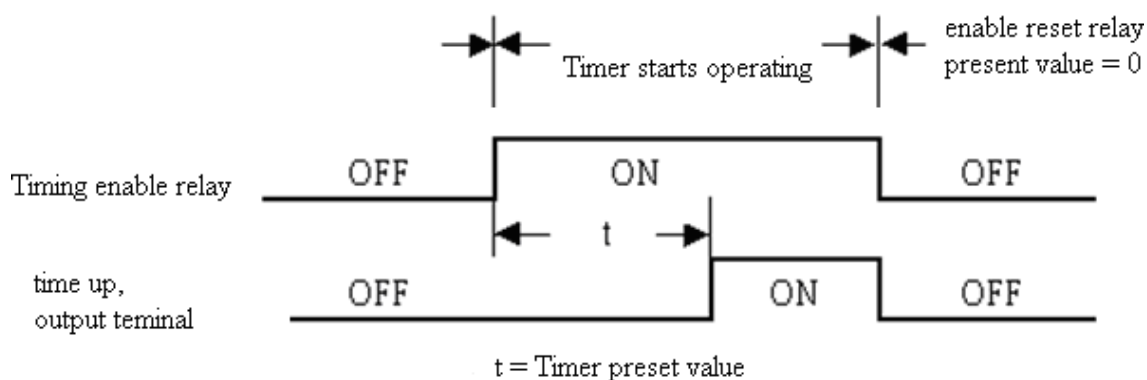
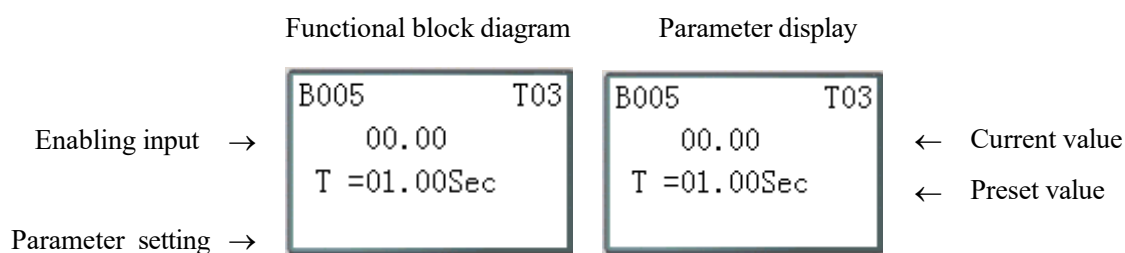
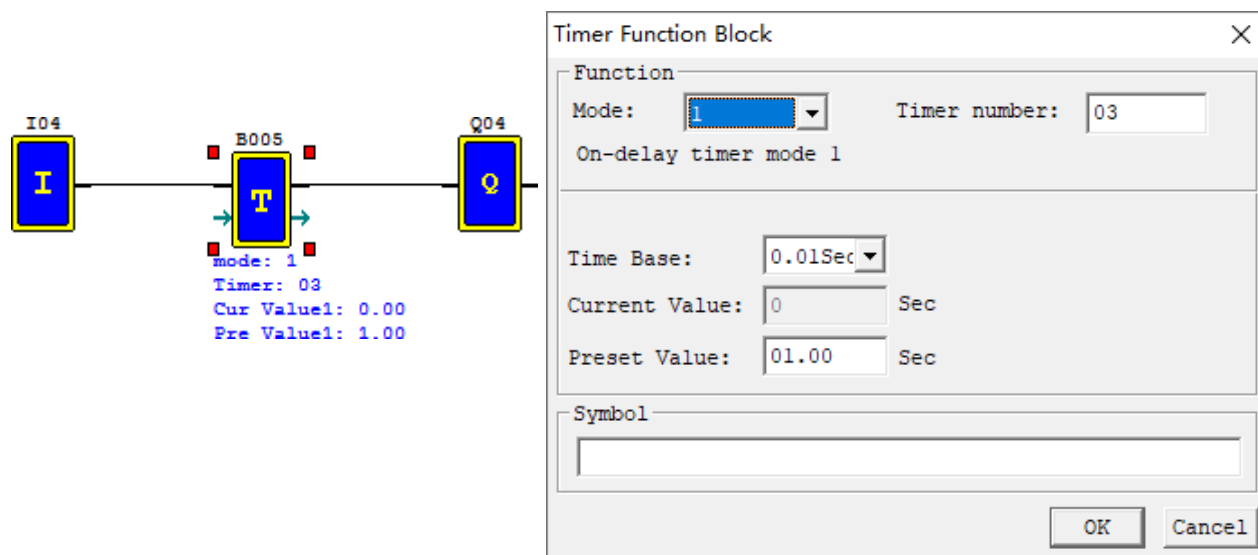
In mode 0, timer is used as internal auxiliary coil, there is no preset value and parameter display.

Functional block diagram



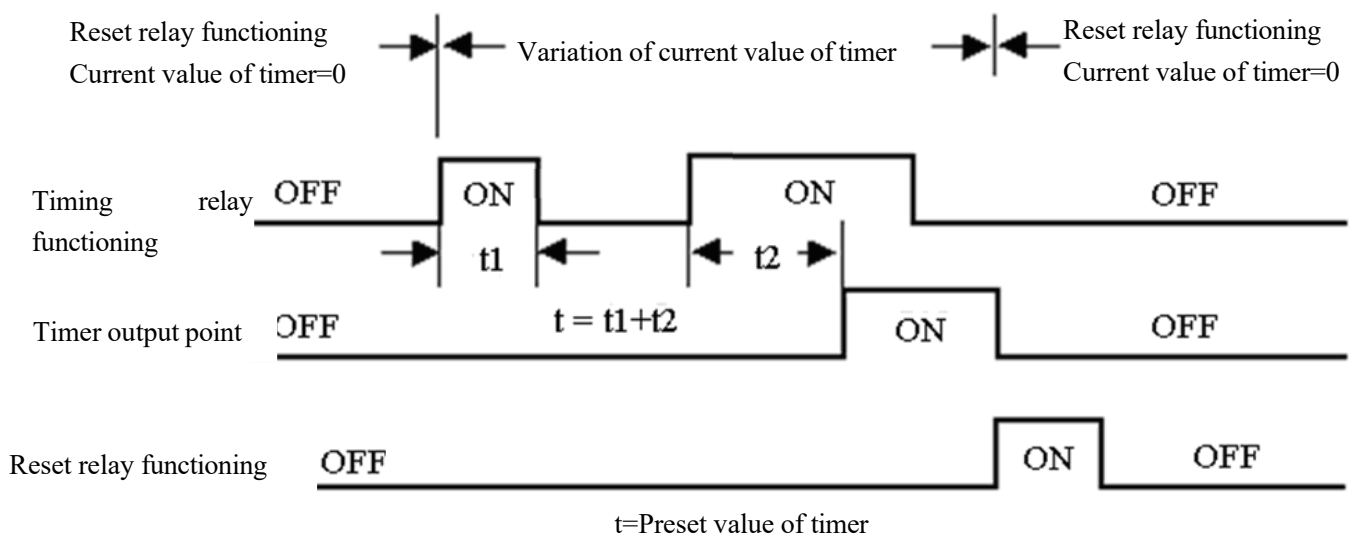
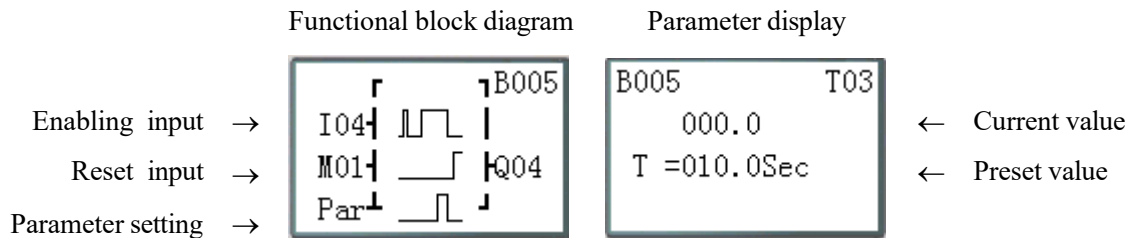
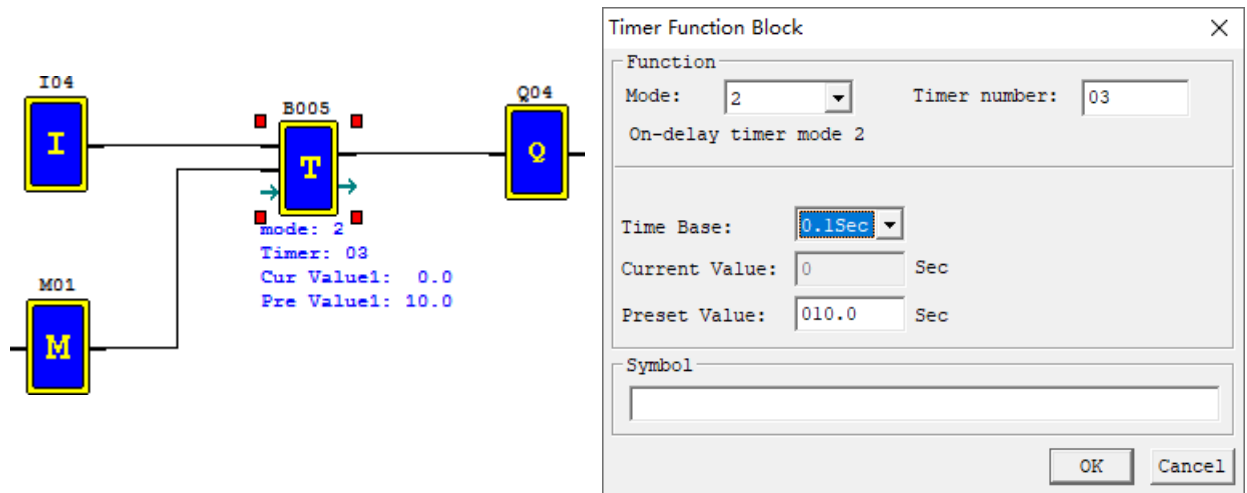
Timer mode 1 (ON-Delay A mode)

Timer begins timing when the control condition of timer mode 1 changes from OFF to ON, and it stops timing and the timer coil outputs ON when the current value of timing reaches the preset value. The current value of timer and coil status are reset to 0 when the timer control condition is OFF.



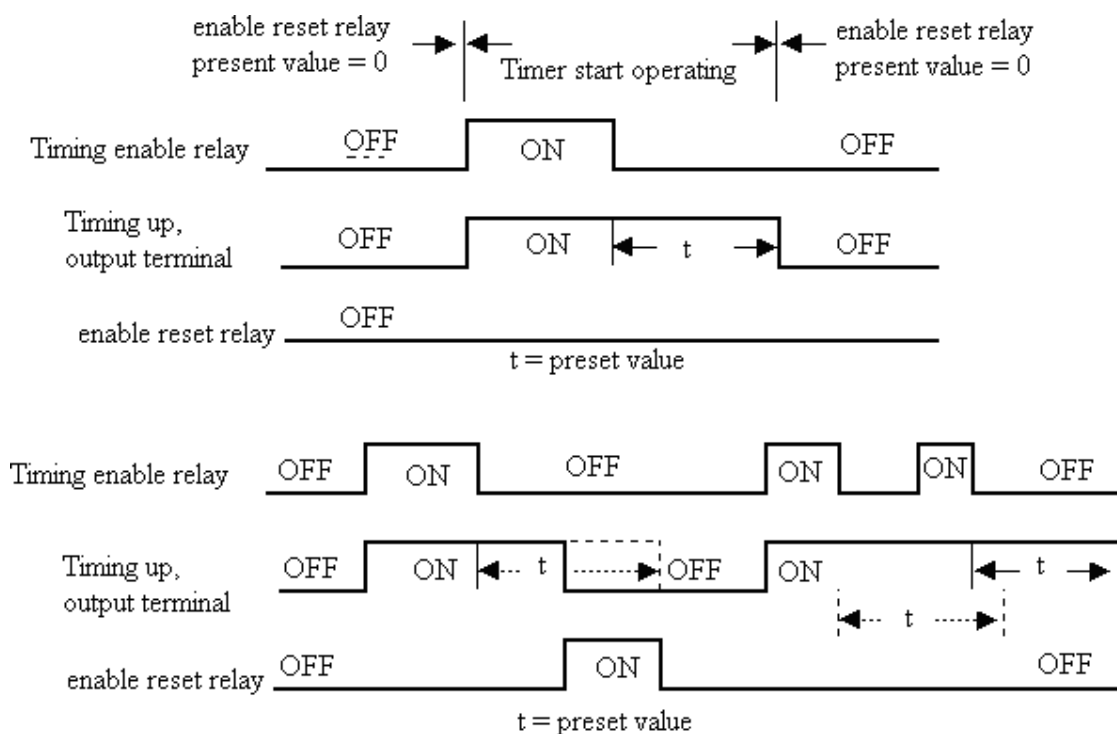
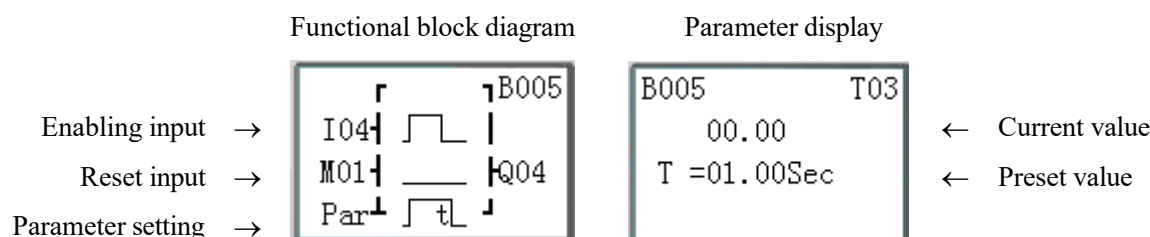
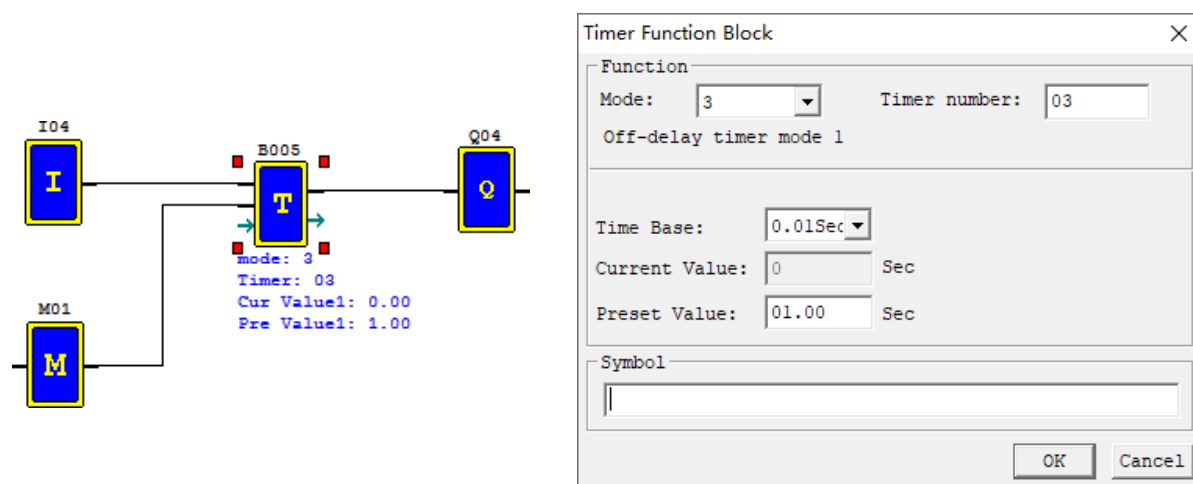
Timer mode 2 (ON-Delay B mode)

Timer mode 2 is designed with reset control. The timer begins timing when the control condition turns from OFF to ON, the current value of timer is kept when the control condition is OFF, and output coil is ON and timing is stopped when the current value of timer reaches the preset value. The current value of timer and coil status are reset to 0 when reset control is effective.



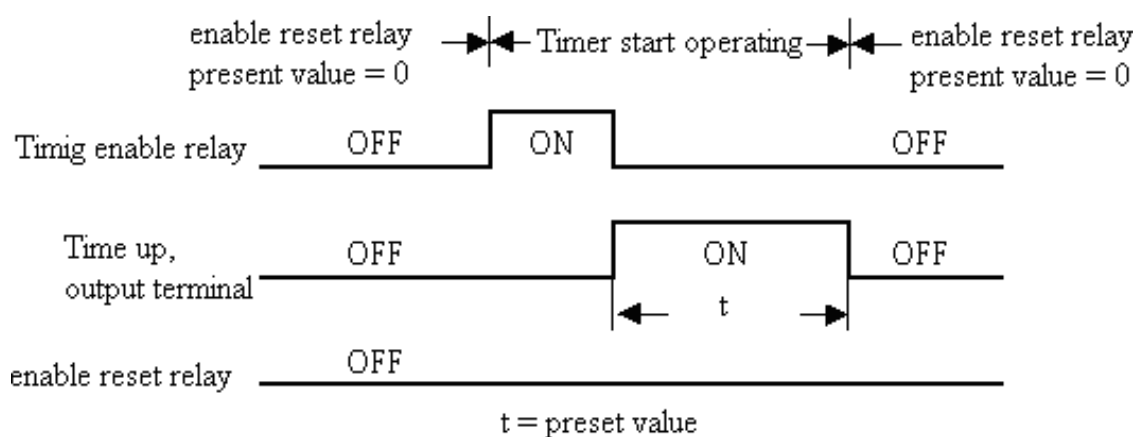
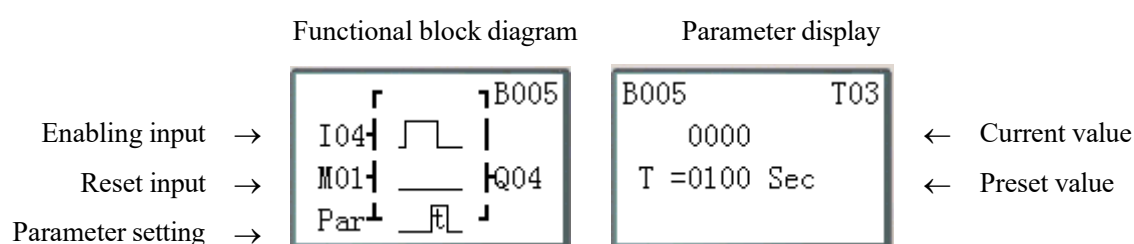
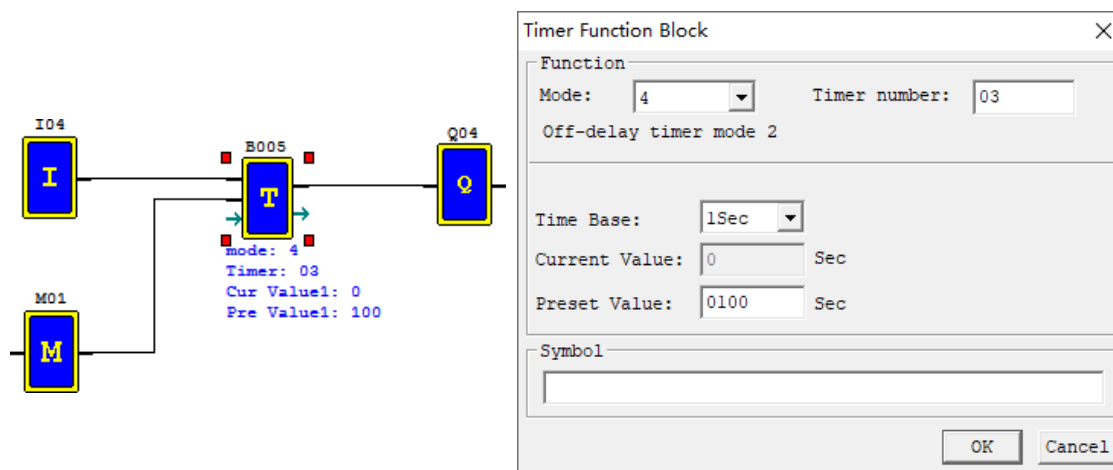
Timer mode 3 (OFF-Delay A mode)

Timer mode 3 is designed with reset control. T output is ON but the timer does not work when the control condition turns from OFF to ON; timer is started up for timing when the control condition turns from ON to OFF; timing is stopped, the current value is reset as 0 and T output is OFF when the current value of timer reaches the preset value; the current value and coil status are reset to 0 when reset control is effective.



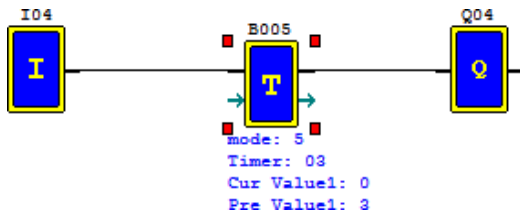
Timer mode 4(OFF-Delay B mode)

Timer mode 4 is designed with reset control. Timing is started and T output is ON when the control condition turns from ON to OFF; timing is stopped, the current value is reset, and T output is OFF when the current value of timer reaches the preset value; the current value of timer and coil status are reset to 0 when reset control is effective.



Timer mode 5(FLASH A mode)

Timer mode 5 is a flash output mode without reset control. The timer begins timing when the control condition is effective; status of output coil T is shifted when the current value of timer reaches the preset value; timing is continued when the current value is reset to 0.



Timer Function Block

Function

Mode: 5 Timer number: 03

Flash timer mode 1

Time Base: 1Sec

Current Value: 0 Sec

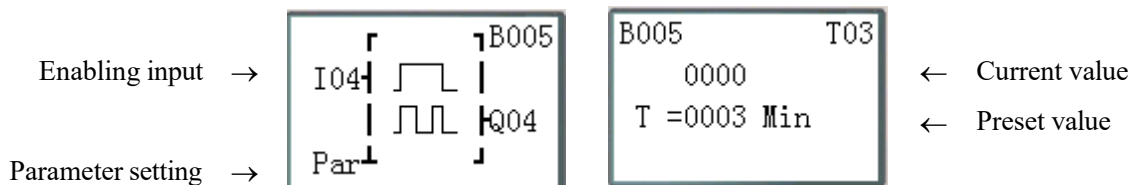
Preset Value: 0100 Sec

Symbol

OK Cancel

Functional block diagram

Parameter display



Reset relay functioning

Current value of timer=0

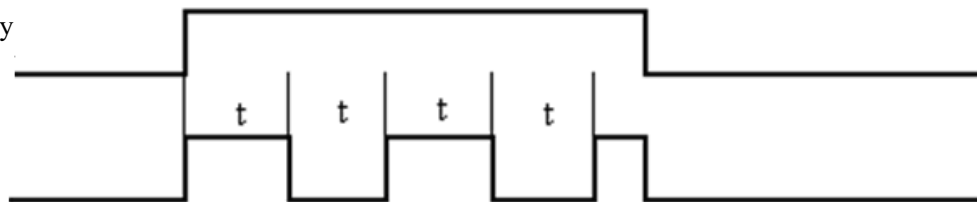
Variation of current value
of timer

Reset relay functioning

Current value of timer=0

Timing
relay
functioning

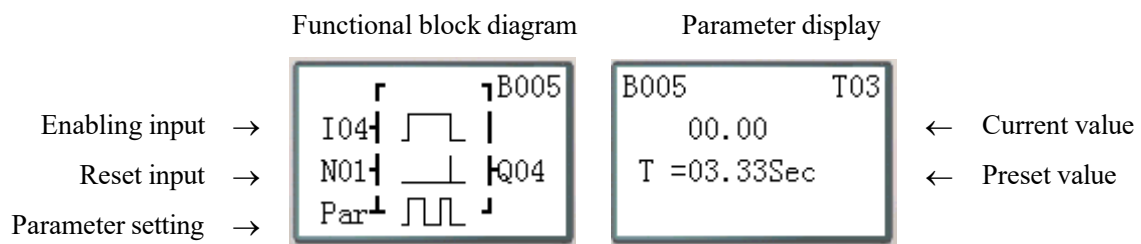
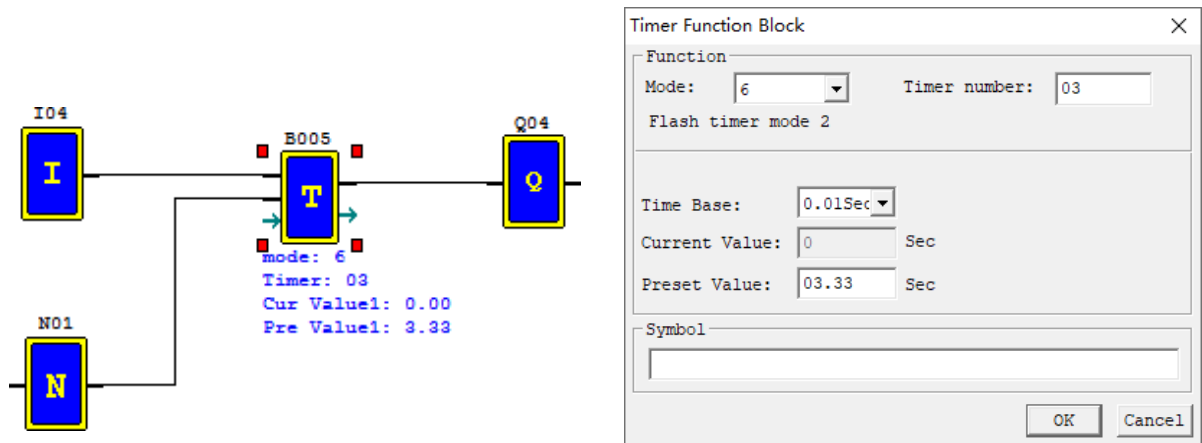
Timer output point



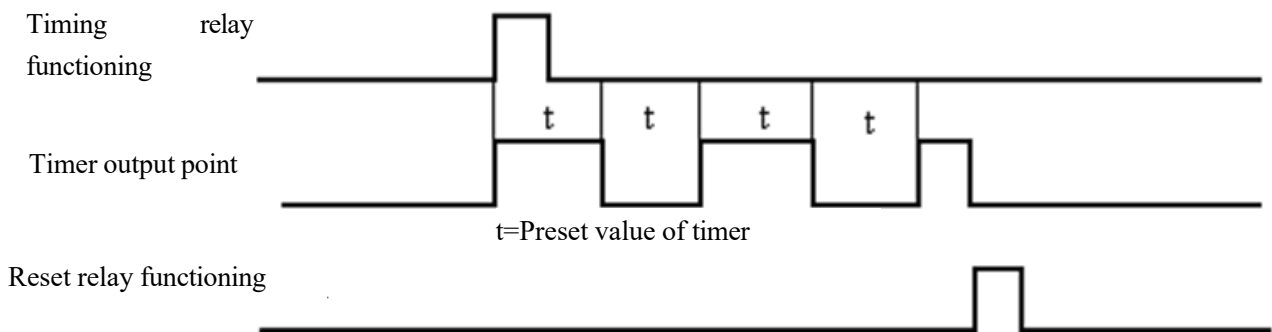
t=Preset value of timer

Timer mode 6 (FLASH B mode)

Timer mode 6 is a flash output mode with reset control. The timer begins timing when the control condition turns from OFF to ON, status of output coil is shifted when the preset value is reached, and timing is continued when the current value of timer is reset to 0. In mode 6, the control condition is not required to be kept ON, and the current value of timer and output coil are reset to 0 when reset control is effective.

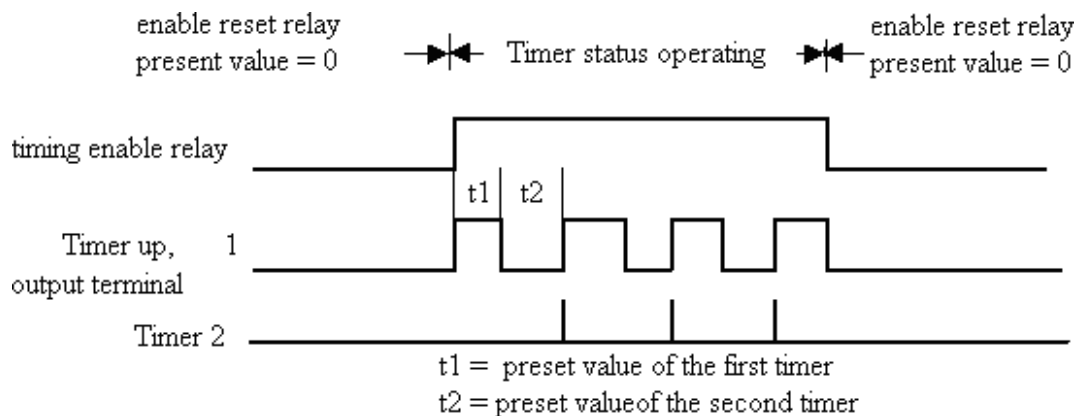
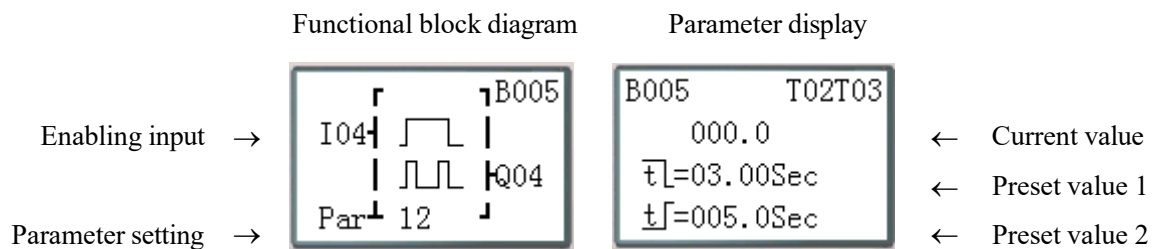
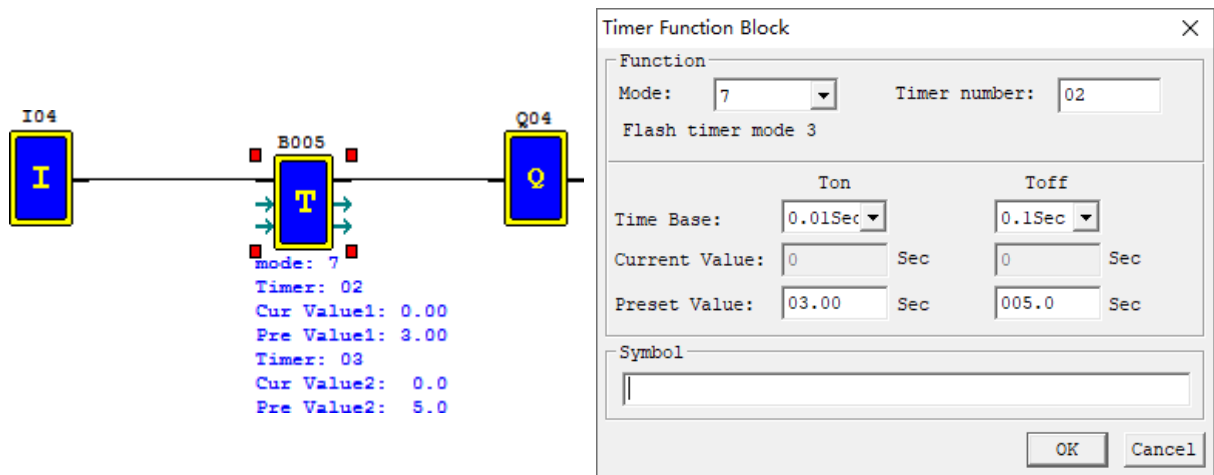


Reset relay functioning
Current value of timer=0 → Variation of current value of timer → Reset relay functioning
Current value of timer=0



Timer mode 7 (FLASH C mode)

Timer mode 7 is a pulse output timer without reset control, which uses two timers T1 and T2. T1 begins timing and T1 outputs ON when the control condition turns from OFF to ON; timing is stopped, the current value of T1 is kept, T1 outputs OFF and T2 is started up when the current value of T1 reaches the preset value; timing is stopped and T2 outputs ON when the current value of T2 reaches its preset value; T1 is restarted when the rising edge of T2 resets T1 and T2, namely the current value of T1 is reset as 0 and the current value of T2 and T2 coil are reset as 0.



Timer mode 8

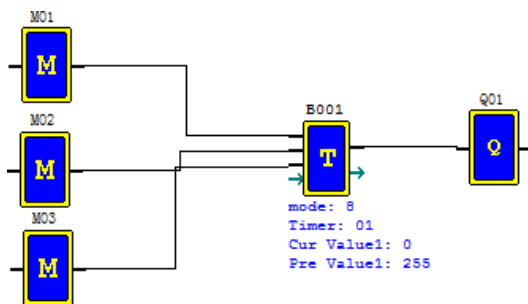
Timer mode 8 is a stopwatch mode with reset control and pause control. The timer begins timing when the control condition turns from OFF to ON; status of output coil is shifted, the current value of timer is displayed as the **preset value and timing is discontinued** when the preset value is reached; the current value of timer and output coil are reset to 0 when reset control is effective.

The current value is not updated (timing continued) when Pause input is set ON; the current value is updated (to current actual value) when Pause input is OFF; the current value is displayed as **9999 and timing is discontinued** when Pause input is ON and actual value is the preset value.

| | Functional block diagram | | Parameter display | | |
|-------------------|--------------------------|-----|-------------------|------------|-----|
| Pause input | → | M03 | B001 | B001 | T01 |
| Enabling input | → | M01 | | | |
| Reset input | → | M02 | Q01 | T = 255sec | |
| Parameter setting | | Par | | | |

← Current value

← Preset value



Timer Function Block

Function
Mode: 8 Timer number: 01

Stopwatch

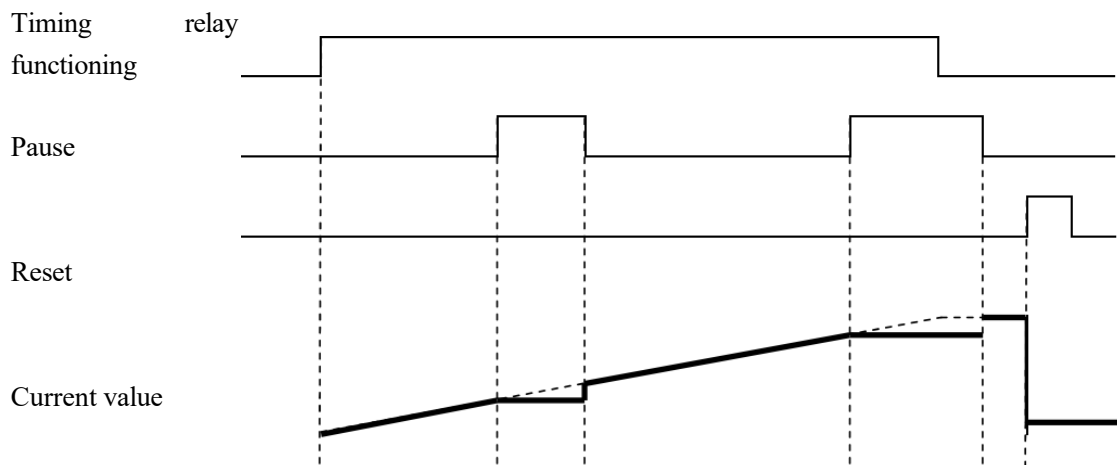
Time Base: 1Sec

Current Value: 0 Sec

Preset Value: 0020 Sec

Symbol

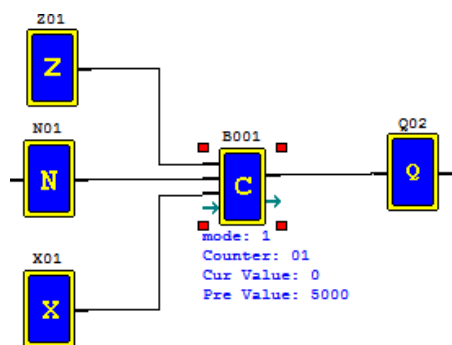
OK Cancel



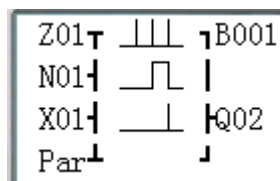
General counter functional block diagram

The maximum number of counters used under FBD is 250. Modes 0~6 is general counter, and modes 7~9 are high-speed counter: the counter function is the same with that under Ladder.

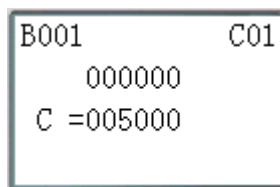
Counter editing and display:



FBD display:



Parameter display:



Counter Function Block

Function

Mode: 1

Counter number: 01

Counter without overtaking and without power down retain current value

Current Value: 0

Preset Value: 005000

Fixed Time (Sec):

Upper:

Lower:

Symbol

OK

Cancel

※ The following modes are described based on counting up. Counting down is counting of input rising edge from the preset value (not kept) or the current value (kept); the current value is decreased by 1, and counting is stopped when the current value is 0; when it is reset, the current value is equal to the preset value.

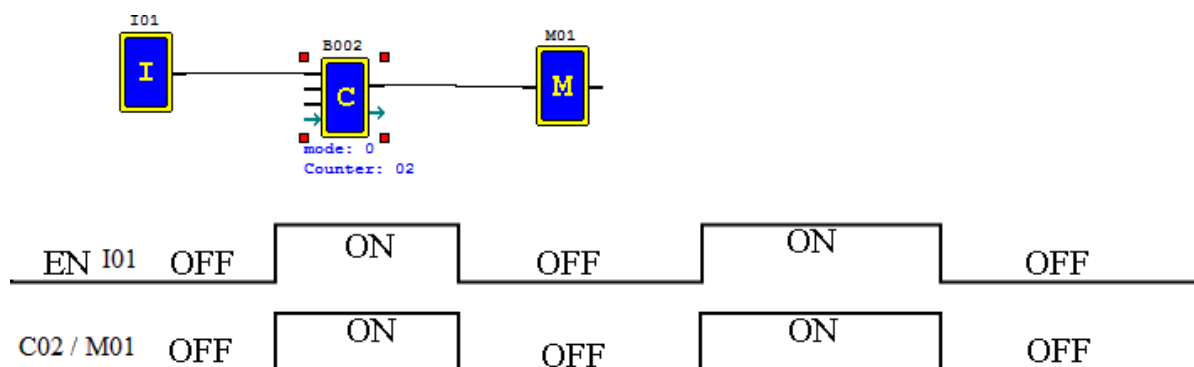
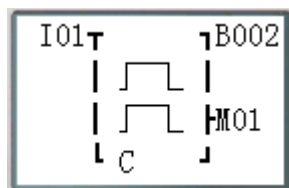
(1) Counter mode 0 (internal coil)

Used as internal auxiliary coil, counter of mode 0 does not have a reset value and parameter display.

Functional block diagram

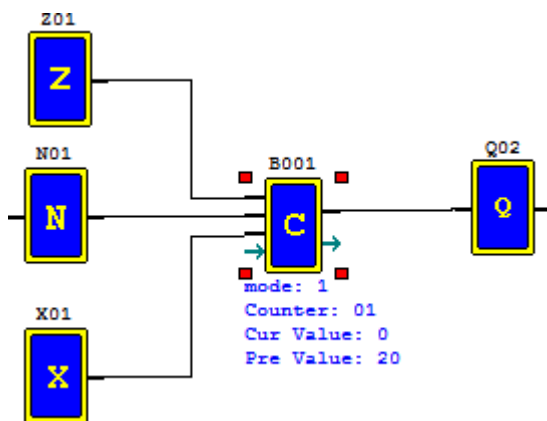
Counter enabling

input →



Counter mode 1 (overflow not allowed, not kept)

The current value of counter is counted up from 0, counting is stopped and output coil is ON when the preset value is reached. In case of power failure, the current value is not kept after power-on again or RUN/STOP switching.



Counter Function Block

Function

Mode: 1 Counter number: 01

Counter without overtaking and without power down retain current value

Current Value: 0

Preset Value: 005000

Fixed Time(Sec):

Upper:

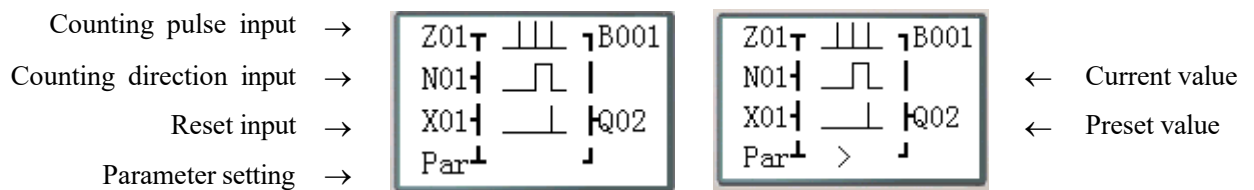
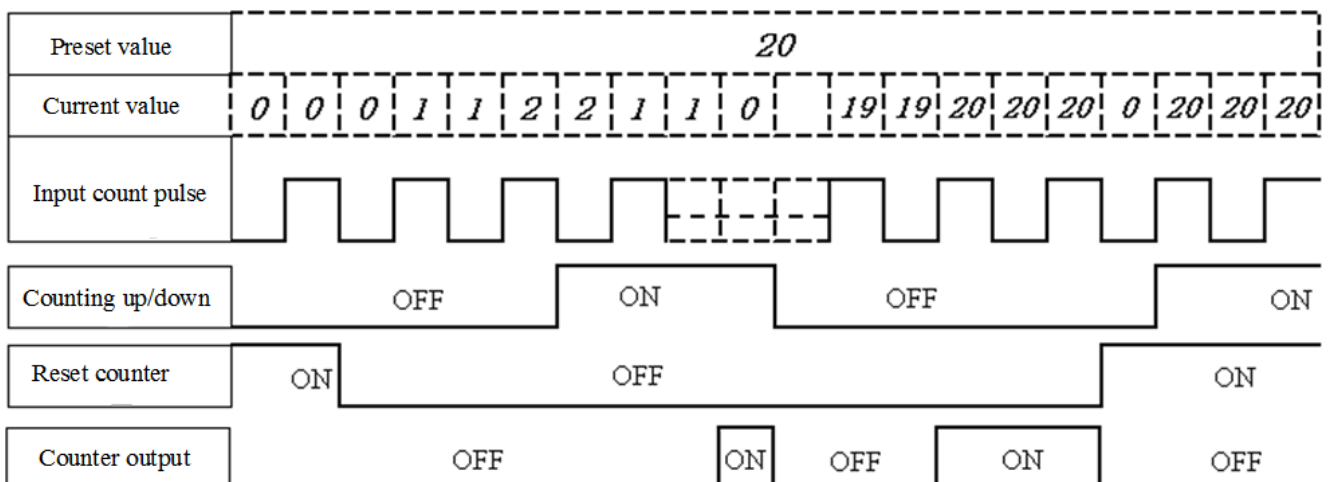
Lower:

Symbol

OK Cancel

Functional block diagram

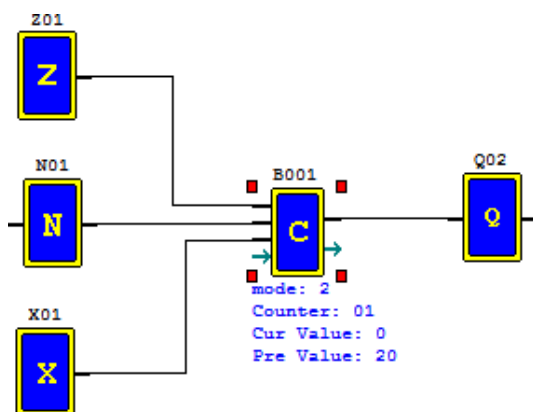
Parameter display

**Mode=1**

※ In this mode, the current value of counter is initialized to 0 (counting up) or the preset value (counting down) after power-on or RUN/STOP switching; the current value is 0 (counting up) or the preset value (counting down) after resetting.

Counter mode 2 (overflow allowed, not kept)

The current value of counter is counted up from 0; after the preset value is reached, output coil is ON, but counting of input rising edge is continued till the current value is 65535. After power-on or RUN/STOP switching, the current value of counter is not kept.



Counter Function Block

Function

Mode: 2 Counter number: 01

Counter with overtaking and without power down retain current value

Current Value: 0

Preset Value: 000020

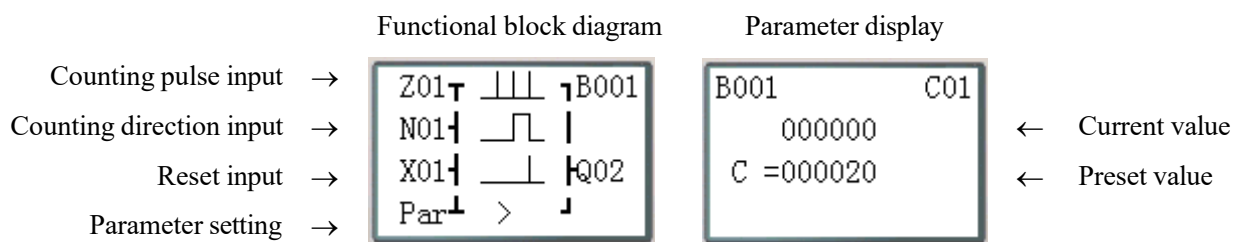
Fixed Time(Sec):

Upper:

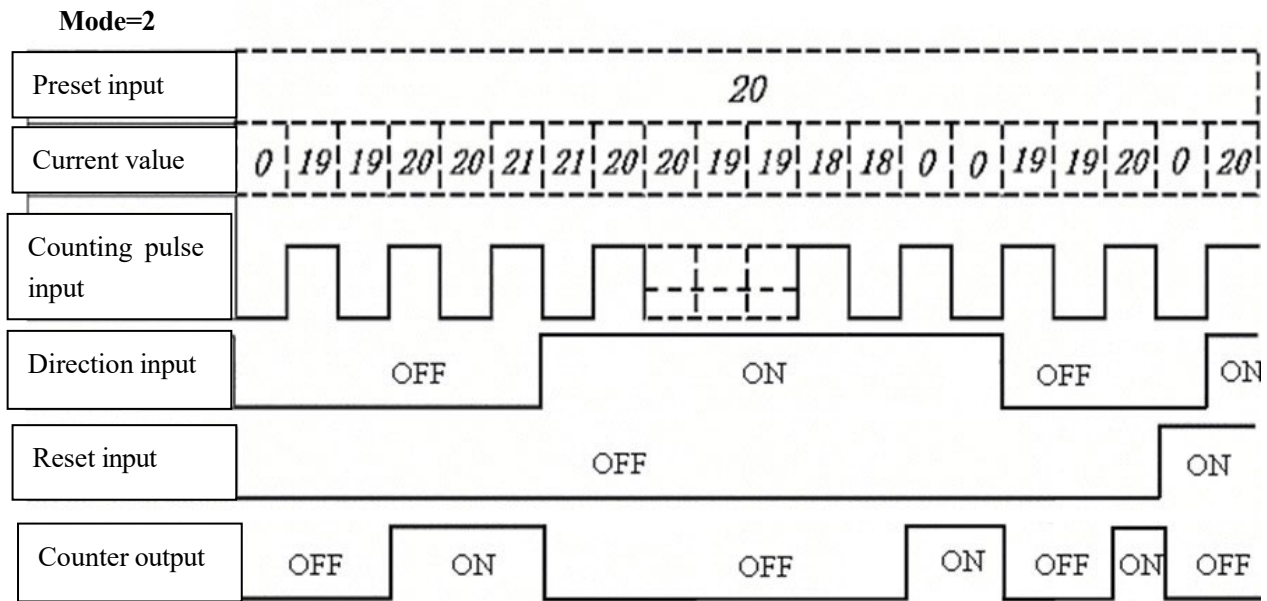
Lower:

Symbol

OK Cancel



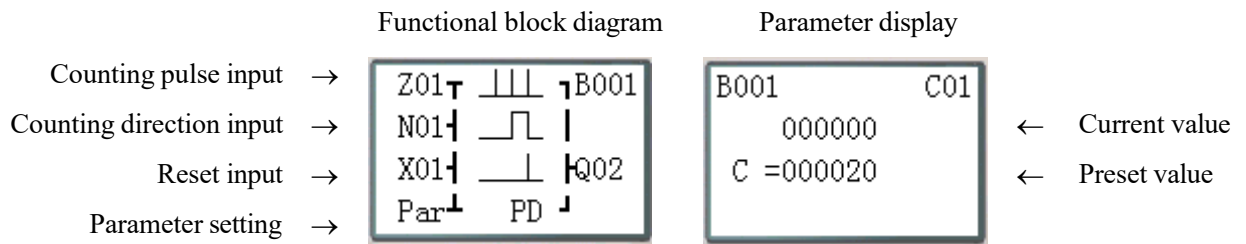
※ “>”: Counter allowing overflow



✘ In this mode, the current value of counter increases continuously after the preset value is reached, and initialized to 0 (counting up) or the preset value (counting down) after power-on or RUN/STOP switching. After resetting, the current value is 0 (counting up) or the preset value (counting down).

Counter mode 3 (overflow not allowed, kept)

The counter mode 3 is similar to mode 1, namely counting is stopped and output coil is ON when the current value reaches the preset value, but the current value is kept after power-on again. If “C KEEP” is effective, the current value is kept after RUN/STOP switching.

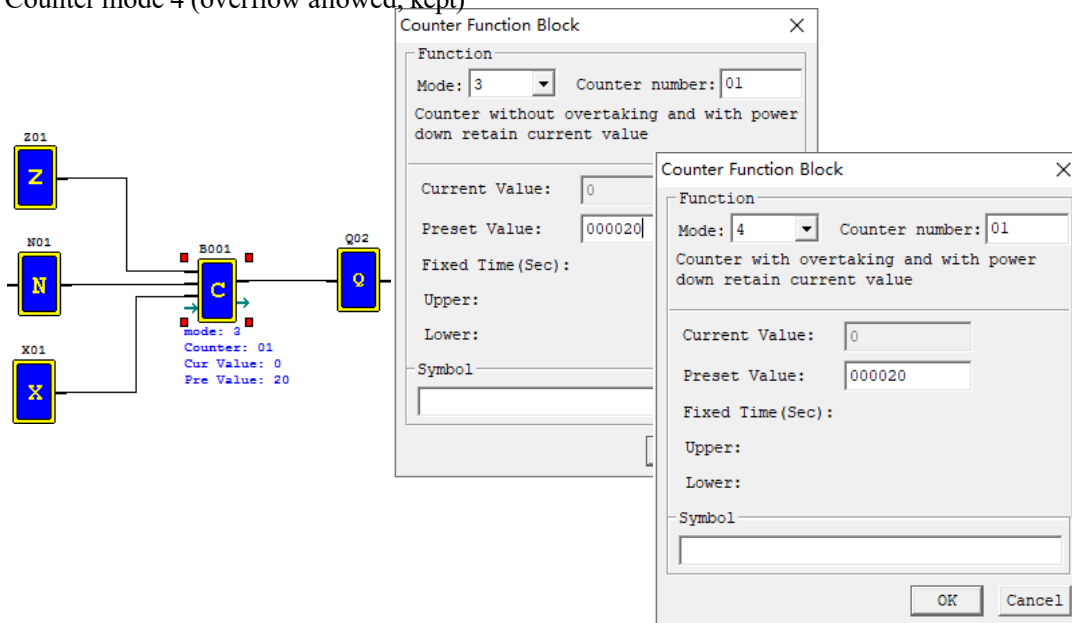


※“PD”: The current value is kept in case of power failure;

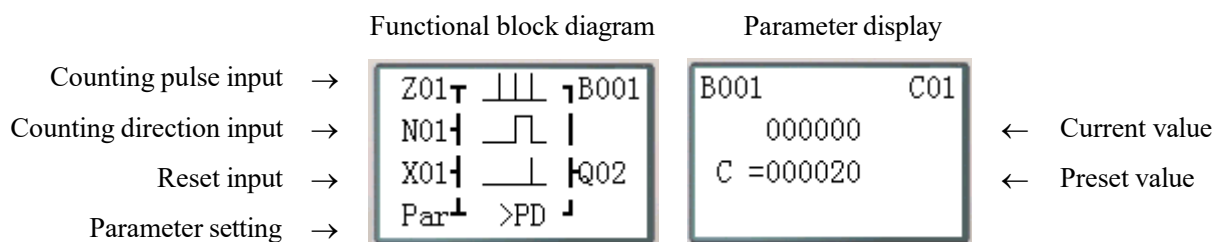
※Mode 3 is similar to mode 1, but the current value of the first 31 counters (C01~C1F) is kept in case of power failure.

※If C KEEP is set, the current value is kept after RUN/STOP switching.

※The current value is 0 (counting up) or the preset value (counting down) when resetting.

(5) Counter mode 4 (overflow allowed, kept)

The counter mode 4 is similar to mode 2, namely counting is continued after the current value reaches the preset value, but the current value is kept after power failure. If C KEEP is set, the current value is kept after RUN/STOP switching.



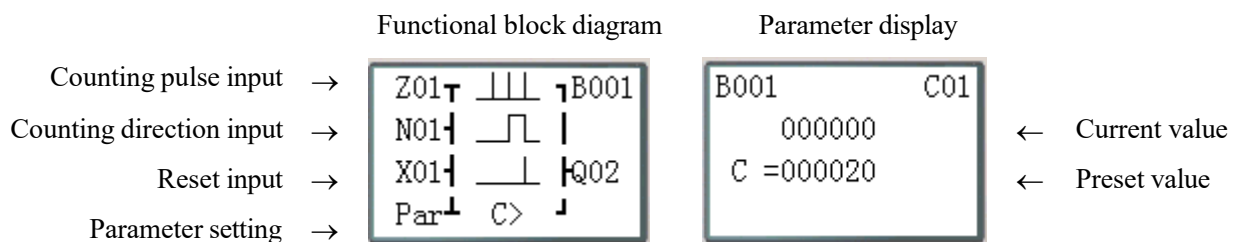
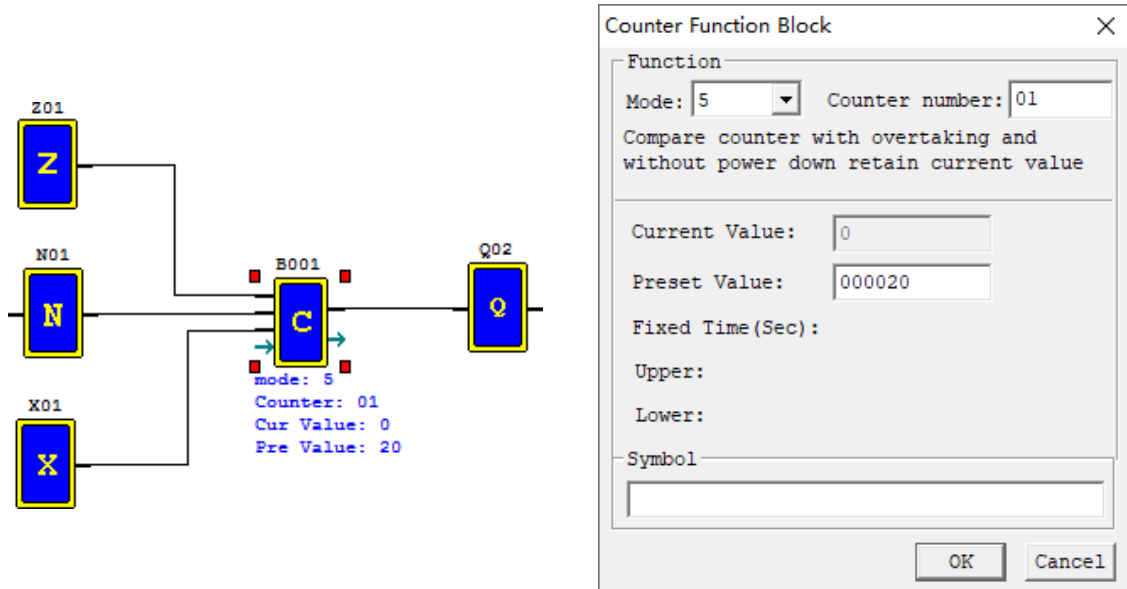
※ “>”: Counter allowing overflow;

“PD”: The current value is kept in case of power failure;

- ※ Mode 4 is similar to mode 2, namely counting continues after the current value reaches the preset value, but the current value of the first 31 counters (C01~C1F) is kept after power failure.
- ※ If C KEEP is set, the current value is kept after RUN/STOP switching.
- ※ The current value is 0 (counting up) or the preset value (counting down) when resetting.

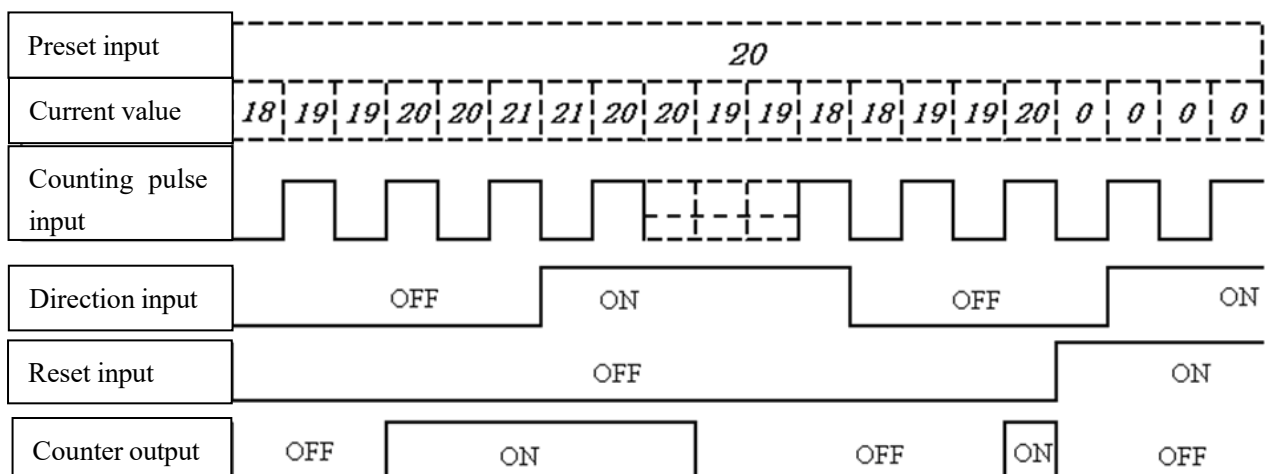
Counter mode 5 (overflow allowed, not kept, comparison counter)

The counter mode 5 is similar to mode 2, namely counting overflow is allowed, but the current value is not kept after power-on again or RUN/STOP switching. Regardless of counting direction in mode 5, output is ON only when the current value is higher than or equal to the preset value, and the current value is 0 after resetting, power failure or RUN/STOP switching.



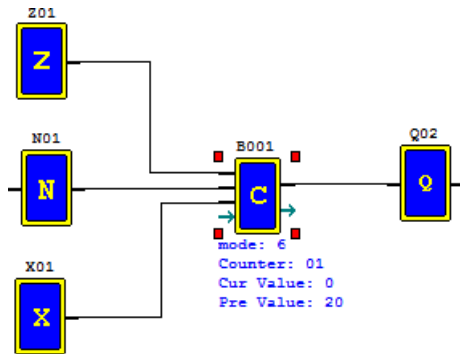
※ “C”: Comparison counter

“>”: Counter allowing overflow;

Mode=5

Counter mode 6 (overflow allowed, kept, comparison counter)

The counter mode 6 is similar to mode 5, but the current value is kept in case of power failure; if C KEEP is set, the current value is kept after RUN/STOP switching.



Counter Function Block

Function

Mode: 6 Counter number: 01

Compare counter with overtaking and with power down retain current value

Current Value: 0

Preset Value: 000020

Fixed Time(Sec):

Upper:

Lower:

Symbol

OK Cancel

Functional block diagram

Parameter display



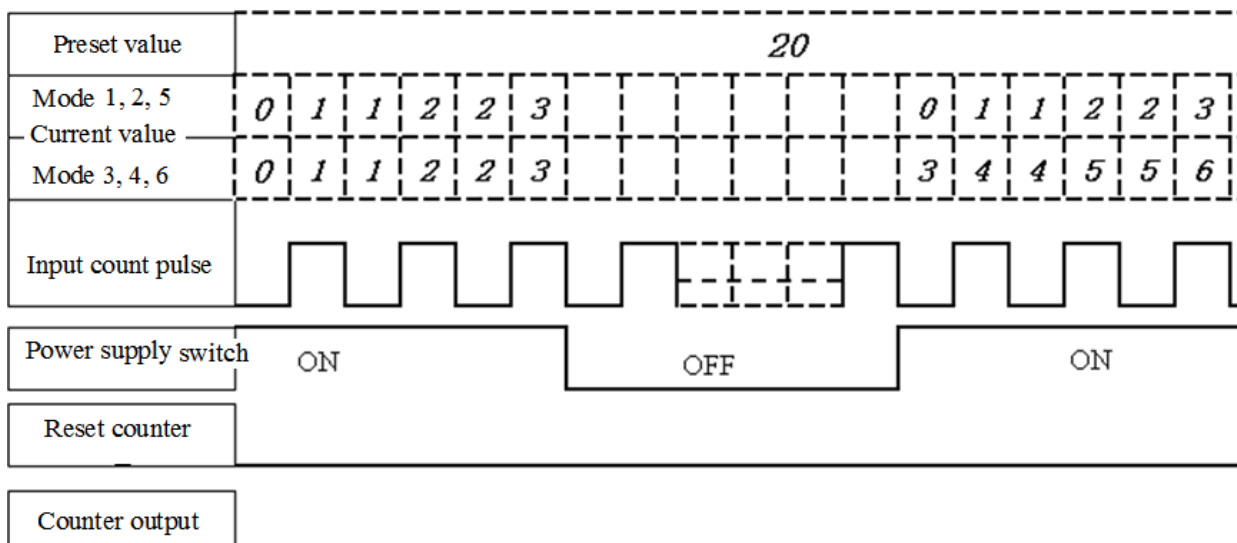
※“C”: Comparison counter;

“>”: Counter allowing overflow.

“PD”: The current value is kept in case of power failure;

※The current value of the first 31 counters (C01~C1F) is kept after power failure.

※If C KEEP is effective, the current value is kept after RUN/STOP switching.

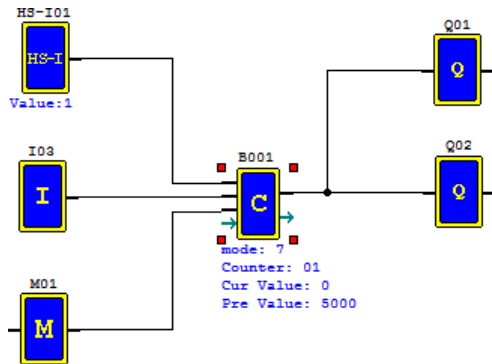


High-speed counter functional block diagram (for DC type only)

The type of DC power supply provides two 1KHz high-speed inputs I01 and I02 and uses two counters to realize two groups of high-speed counting. Counter modes 7~9 are high-speed counting function.

(1) High-speed counter mode 7 (proportional input counter)

In DC machine, high-speed counter mode 7 uses I01 or I02 as the maximum 1KHz high-speed input, and counting is stopped and output coil is ON after the counting value reaches the preset value. After resetting, the current value of counter is reset to 0 and output coil is OFF.



Counter Function Block

Function

Mode: 7 Counter number: 01

1KHz input counter

Current Value: 0

Preset Value: 005000

Fixed Time(Sec):

Upper:

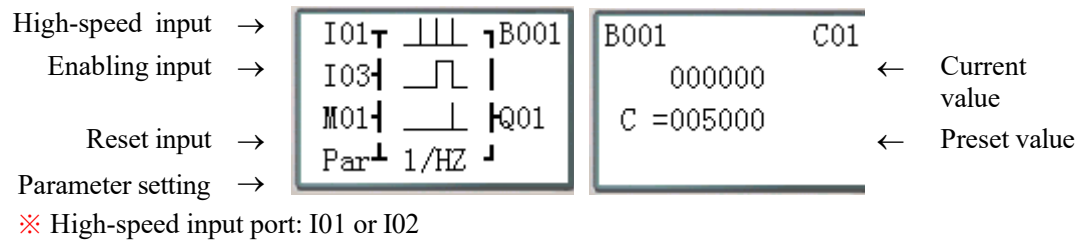
Lower:

Symbol:

OK Cancel

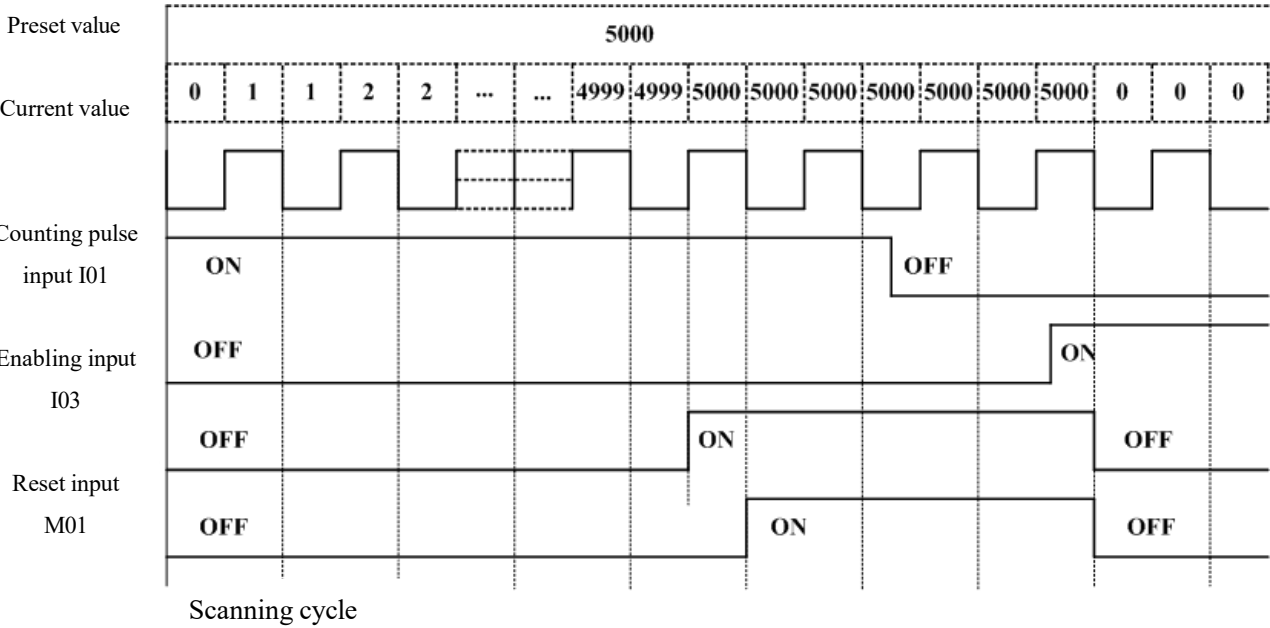
Functional block diagram

Parameter display



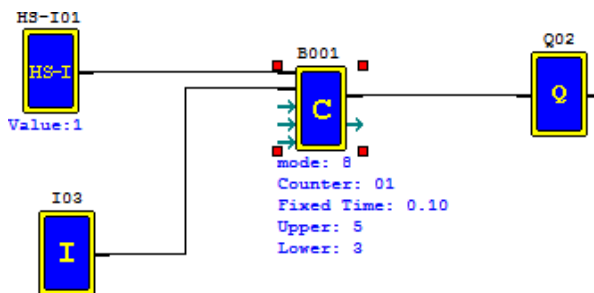
Output example:

In the above example, Q01 outputs ON immediately when C01(B001) counting value reaches the preset value, and Q02 outputs ON only when output is executed in the scanning cycle.



High-speed counter mode 8 (1KHZ input counter)

In high-speed counter mode 8, I01 or I02 is used as the maximum 1KHz high-speed input port. Output coil is ON if the number of rising edges counted in the set time interval is more than or equal to the ON preset value; on the contrary, output coil is OFF if the counted number of rising edges is less than the OFF preset value; the output status is kept under other conditions.



Counter Function Block

Function
 Mode: 8 Counter number: 01
 1KHz input compare counter

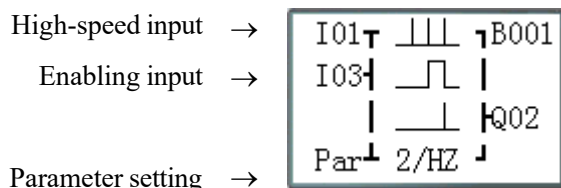
Current Value: 0
 Preset Value: 005000
 Fixed Time(Sec): 00.10
 Upper: 5
 Lower: 3

Symbol

OK Cancel

Functional block diagram

Parameter display

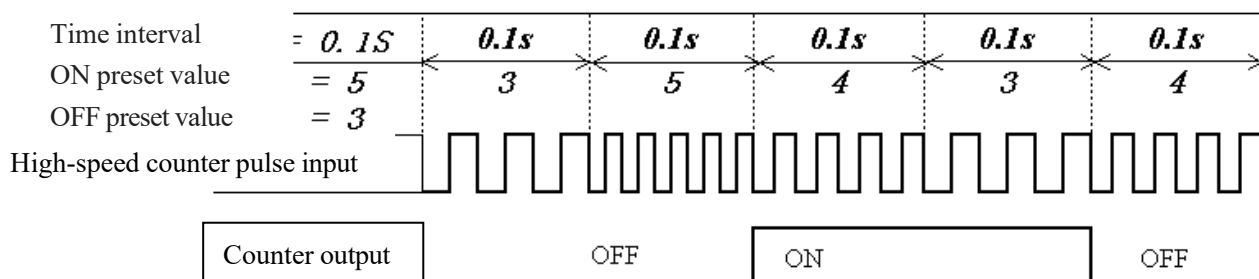


B001 C01
 T = 00.10Sec
 C↑ = 000005
 C↓ = 000003

← Time preset value
 ← ON preset value
 ← OFF preset value

※ High-speed input port: I01 or I02

Mode=8

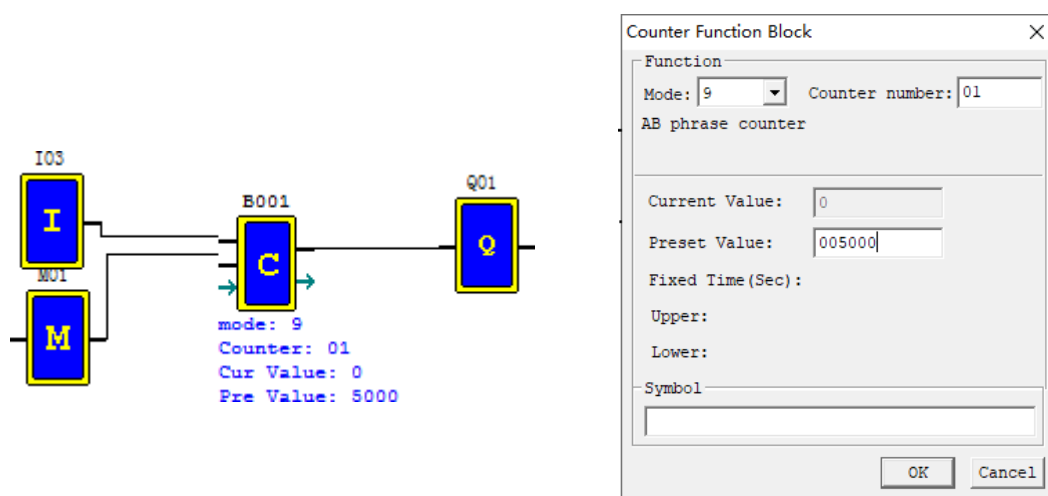


High-speed counter mode 9 (1KHZ input AB phase counter)

Mode 9 is AB-phase high-speed counting function for counting of two lines of pulse with consistent periodic pulse width and phase difference of 90°, which uses the same editing method with general high-speed counting but has different parameters.

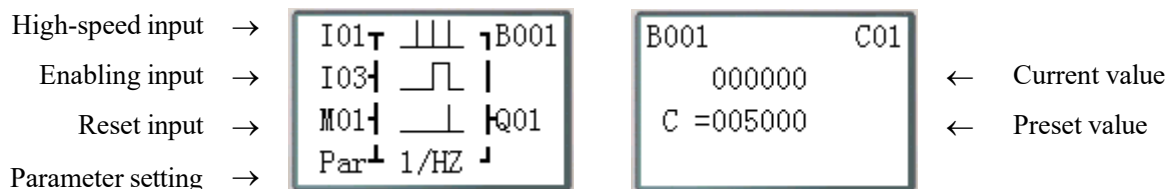
In DC machine, high-speed counter mode 9 enables high-speed input counting of the maximum 1KHz AB phases of I01 (A) ahead of I02 (B); the current value of counter is (0~999999), output coil is ON when the counting value reaches the preset value; the current value of counter is reset to 0 and output coil is OFF after resetting.

As a special coil, the coil **M3A** indicates the counting direction of AB phase counter; M3A is set OFF when phase A is ahead of phase B, or set ON when phase A is behind phase B.



Functional block diagram

Parameter display



※ High-speed input port: I01 (A) and I02 (B)

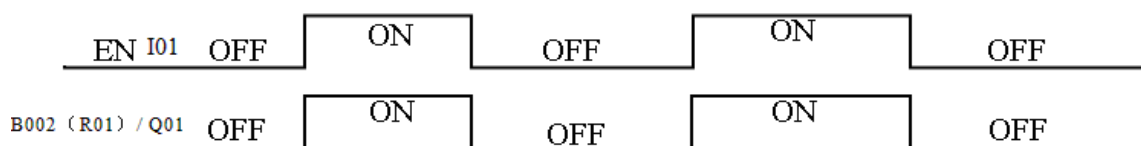
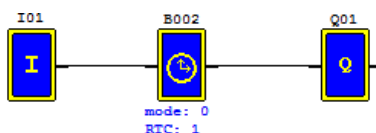
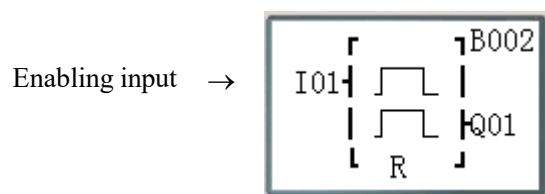
RTC functional block diagram

The maximum number of RTC functional blocks used under FBD is 250. RTC works in modes 0~5, and its function is the same with that under Ladder.

RTC mode 0 (internal coil)

RTC of mode 0 is used as internal coil, which does not have preset value and parameter display.

Functional block diagram

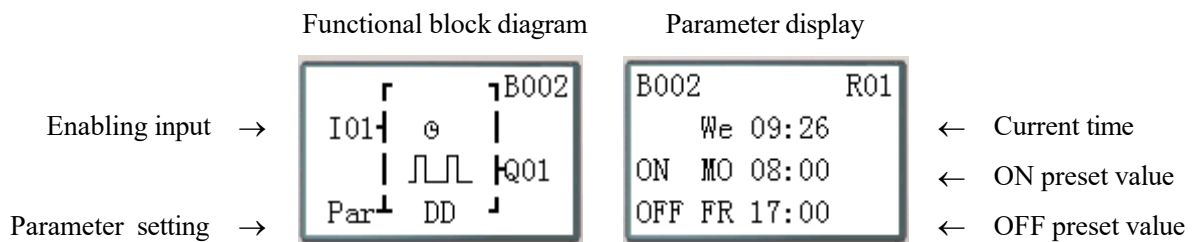
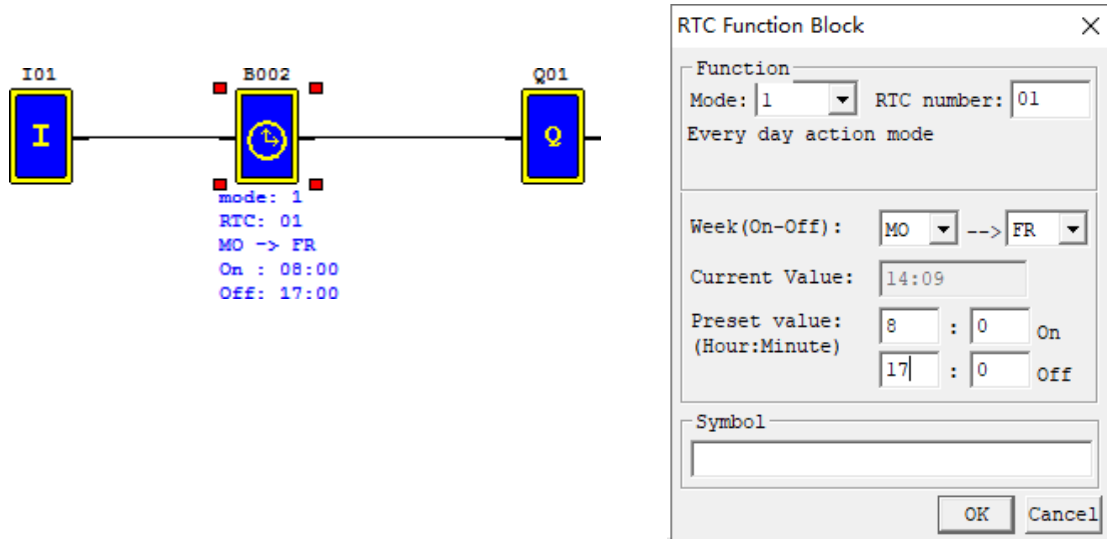


RTC mode 1 (day mode)

RTC mode 1 is for setting the daily ON/OFF time of each week.

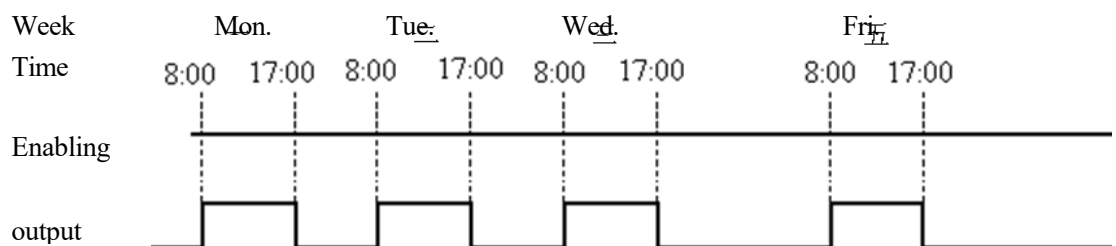
In the following example (1), effective time of each week is set as MO (Monday) 8:00 to FR (Friday) 17:00, namely coil B002 (R01) outputs ON from 8:00 to 17:00 on Monday to Friday, and outputs OFF at other times.

Example 1:

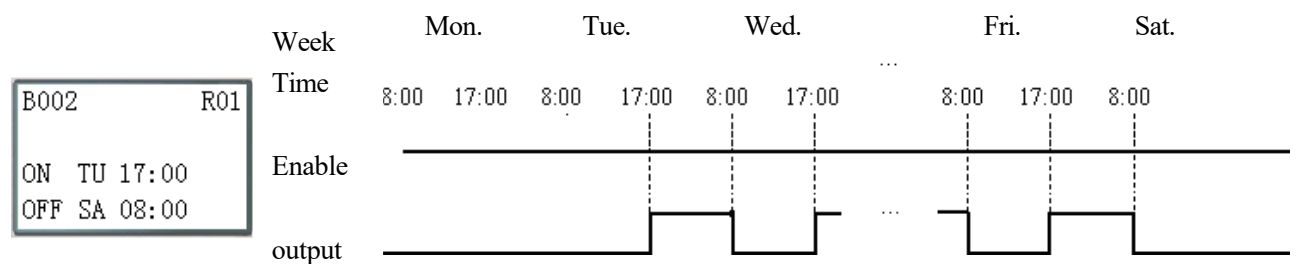


✖ The displayed current time is week- hour- minute.

✖ The displayed ON/OFF preset value is week- hour- minute.



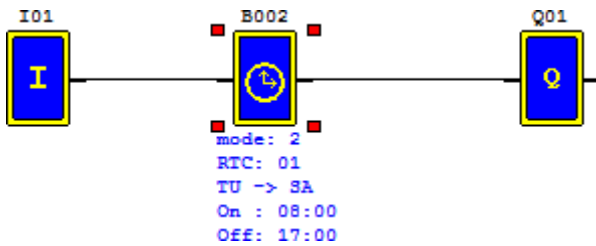
Example 2:



RTC mode 2 (week mode)

RTC mode 2 is for setting ON/OFF time of coil R in a week. In the following example (1), coil B002 (R01) outputs ON from TU (Tuesday) 8:00 to SA (Saturday) 17:00, and outputs OFF at other times.

Example 1:



RTC Function Block

Function
Mode: 2 RTC number: 01
Interval week action mode

Week(On-Off): TU --> SA

Current Value: 10:22

Preset value: 8 : 0 On
(Hour:Minute) 17 : 0 Off

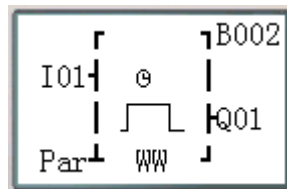
Symbol

OK Cancel

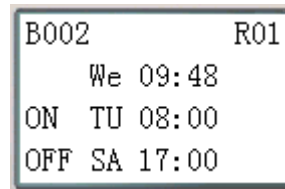
Functional block diagram

Parameter display

Enabling input →



Parameter setting →



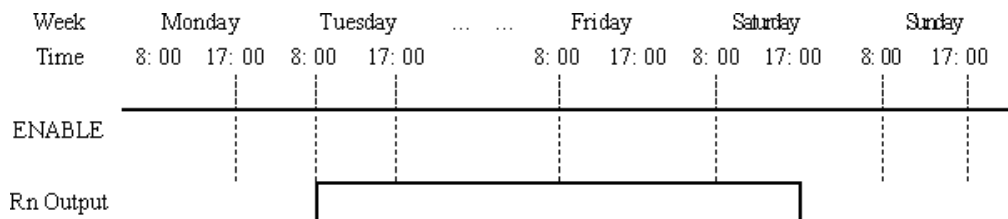
← Current time

← ON preset value

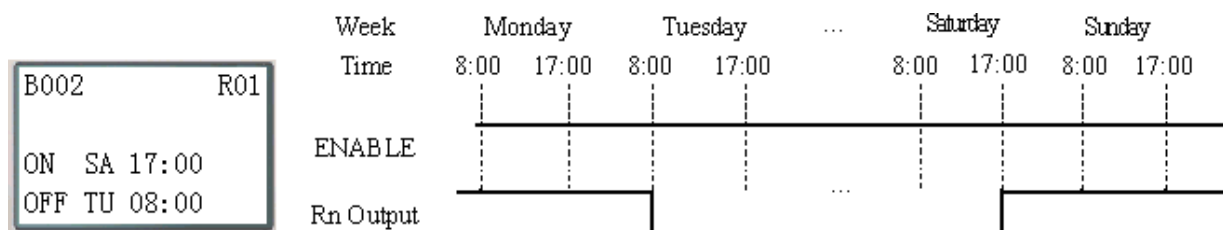
← OFF preset value

✗ The displayed current time is week- hour- minute.

✗ The displayed ON/OFF preset value is week- hour- minute.



Example 2:

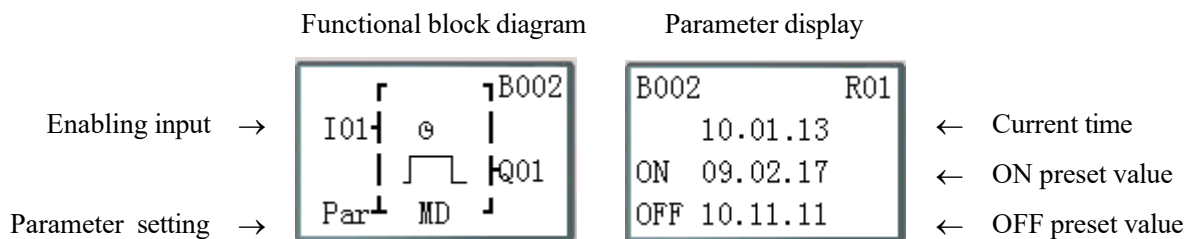
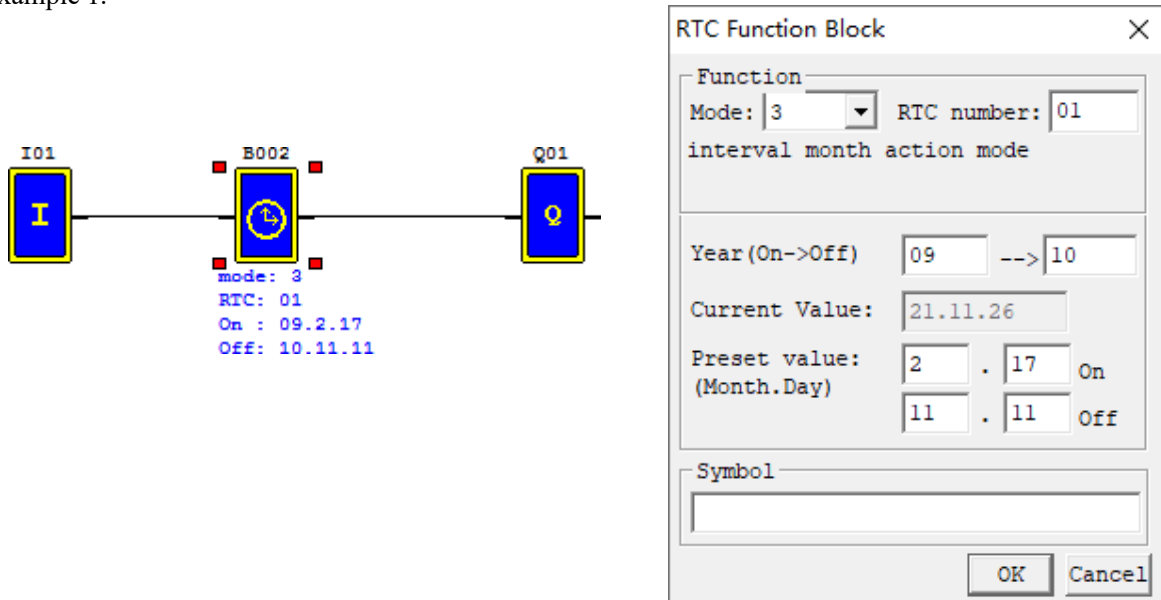


RTC mode 3 (year-month-day mode)

RTC mode 3 uses the set year-month-day to control status of coil R. In example 1, coil outputs ON from February 17, 2009 to November 11, 2010.

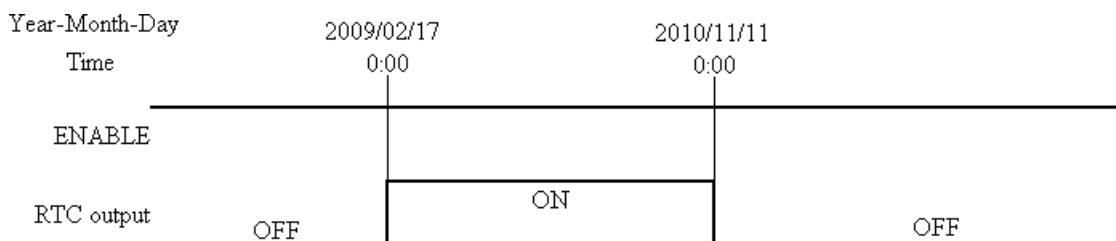
When the year setting is 00-00 in RTC mode3, a special mode is used to enable RTC from the beginning month and day to the end month and day of each year, as shown in example 3.

Example 1:

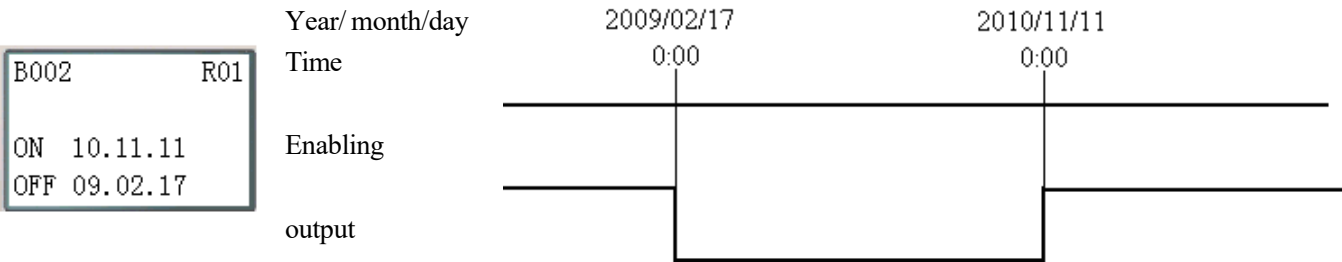


※ The displayed current time is year- month-day.

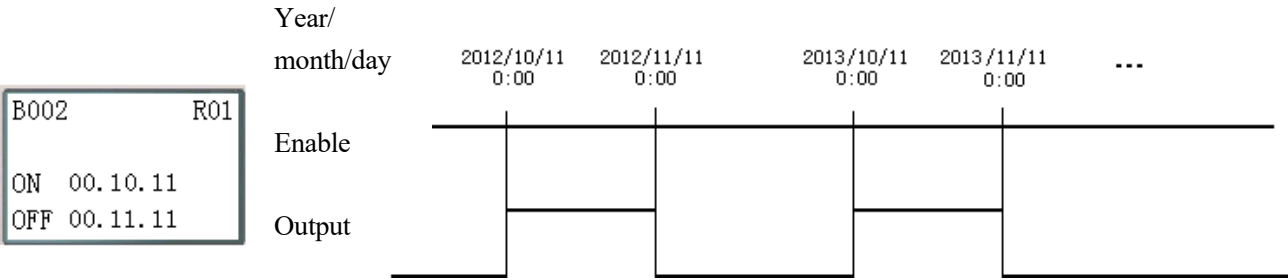
※ The displayed ON/OFF preset value is year- month-day.



Example 2:



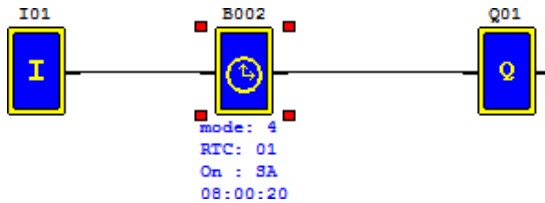
Example 3:



RTC mode 4 (30s compensation)

RTC mode 4 is a 30s compensation mode, which uses the set week, hour, minute and second for operation of the current value of RTC and correction of RTC error.

Example 1: Corrected second < 30s



RTC Function Block

Function
Mode: 4 RTC number: 01
30s modify mode

Week(On): SA

Current Value: 15:50:51

Preset Value: (Hour:Min:Sec)
8 : 0 : 20

Symbol

OK Cancel

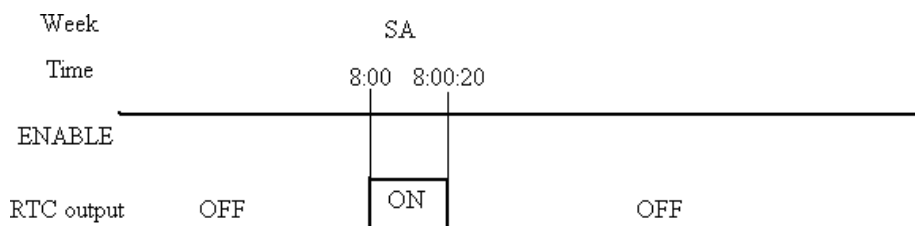
Functional block diagram

Parameter display



※ The displayed current time is week-hour-minute-second.

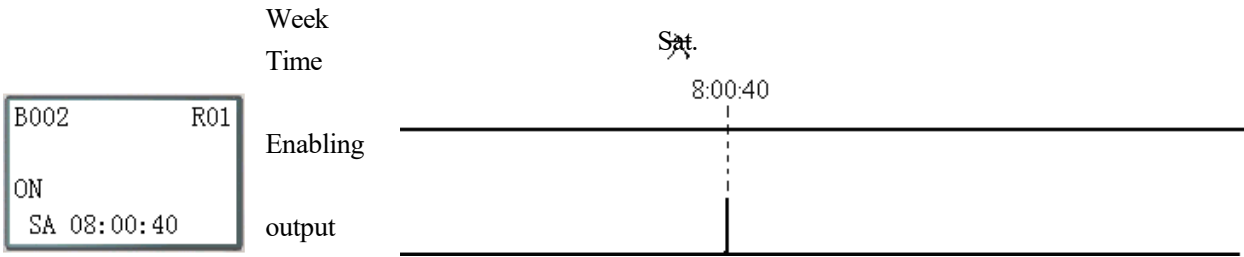
※ The displayed compensation preset value is week-hour-minute-second.



※ When RTC time is 8:00:20, the current time returns to 8:00:00 for continuous timing, and coil outputs ON.

When RTC time reaches 8:00:20 again, coil outputs OFF and RTC continues timing. So, the duration when coil outputs ON is 21s.

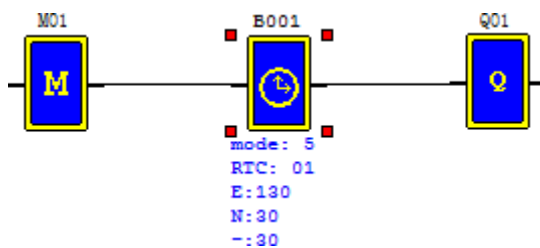
Example 2: Corrected second >= 30s



※ R01 outputs ON when the current value of RTC is 8:00:40, and outputs OFF when RTC time changes to 8:01:00. The duration when outputs ON is a scanning cycle only.

RTC mode 5 (astronomical clock)

RTC mode 5 is the astronomical clock mode that uses the set longitude and latitude and offset time to control output of RTC coil. The display form and parameter meaning of RTC mode 5 and programming interface under Ladder are provided in the following diagram and table.



RTC Function Block

Function

Mode: 5 RTC number: 01

Sunset mode

E/W: ☒ E ☐ W

longitude: 130 (0~180)

S/N: ☐ S ☒ N

latitude: 30 (0~90)

☒ ?a ☐ +

Offset time (min): 30 (0~59)

Symbol

OK Cancel

After the corresponding parameter, E/W (east/west longitude) and longitude value, S/N (south/north latitude) and latitude value are set, the functional block R will work out the sunrise time and sunset time in the set place in the current season and enable the setting of forward (-) or backward (+) offset time (0~59min) of sunrise/sunset time by setting the offset direction, and coil R will output ON from sunrise to sunset and output OFF at other times.

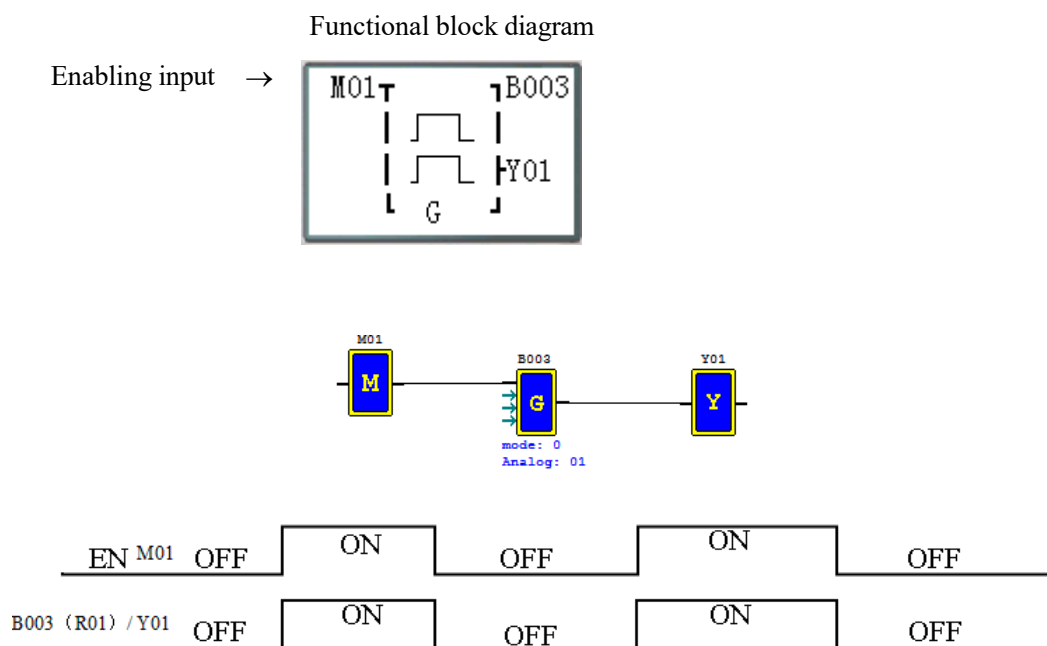
- ※ Sunrise/sunset time is computed based on the current value of RTC, and R01 is set ON from sunrise to sunset.
- ※ DRCE and DRCF are special registers where longitude and latitude-based sunrise, sunset and time are stored.

Analog comparator functional block diagram

The maximum number of analog comparator functional blocks used under FBD is 250. Analog comparator works in modes 0~7, and its function is the same with that under Ladder.

Analog comparator mode 0 (internal coil)

Analog comparator of mode 0 is used as internal auxiliary coil, which does not have preset value and parameter display.



Analog comparator mode 1~7

The set parameters of analog comparator include analog input Ax, analog input Ay and comparison reference value.

The relations are as follows:

Comparator mode 1: $(Ay - \text{comparison reference value}) \leq Ax \leq (Ay + \text{comparison reference value})$, output ON;

Comparator mode 2: $Ax \leq Ay$, output ON;

Comparator mode 3: $Ax \geq Ay$, output ON;

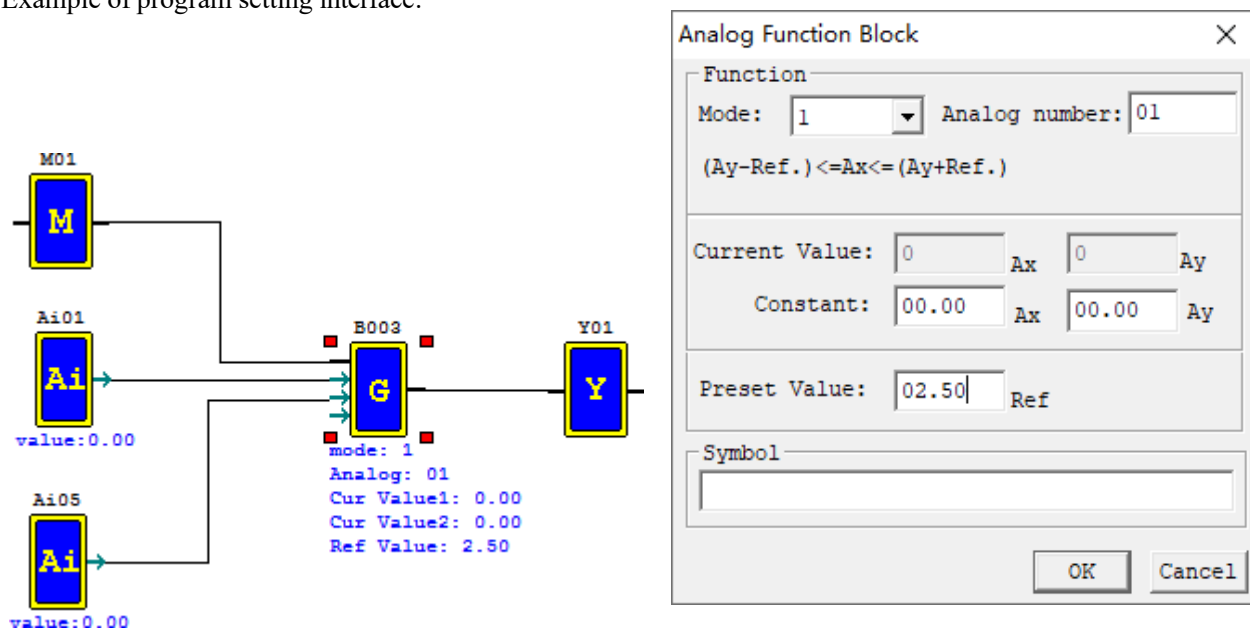
Comparator mode 4: comparison reference value $\geq Ax$, output ON;

Comparator mode 5: comparison reference value $\leq Ax$, output ON;

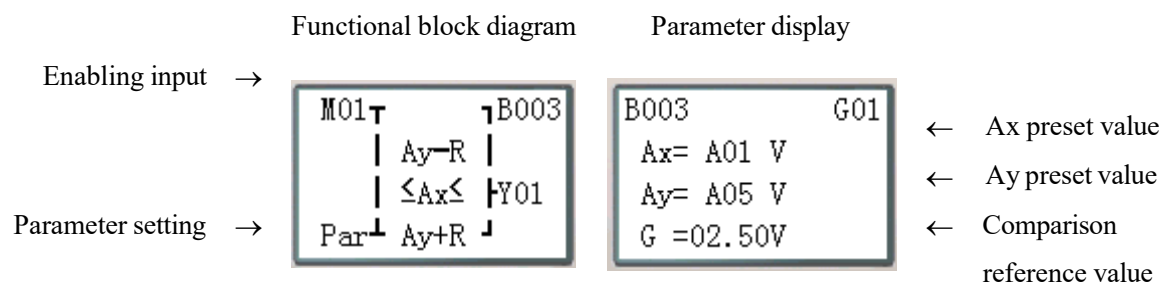
Comparator mode 6: comparison reference value $= Ax$, output ON;

Comparator mode 7: comparison reference value $\neq Ax$, output ON;

Example of program setting interface:



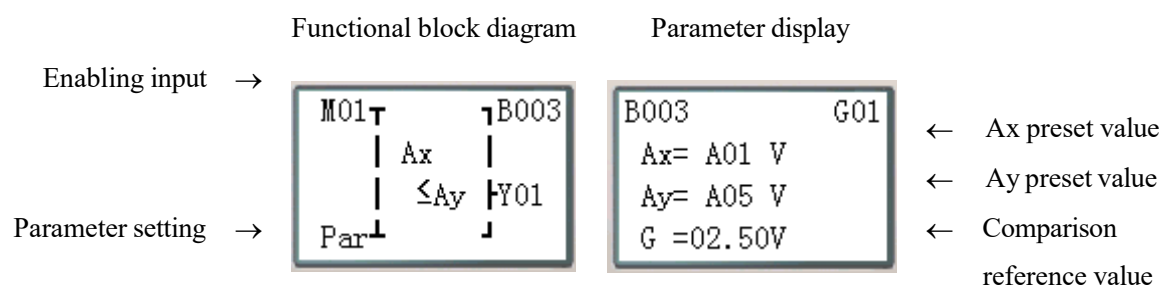
Comparator mode 1



B003 (G01) outputs ON when A01 value is in the range $(A05-2.50) \sim (A05+2.50)$;

The current values of Ax and Ay are displayed in the RUN mode.

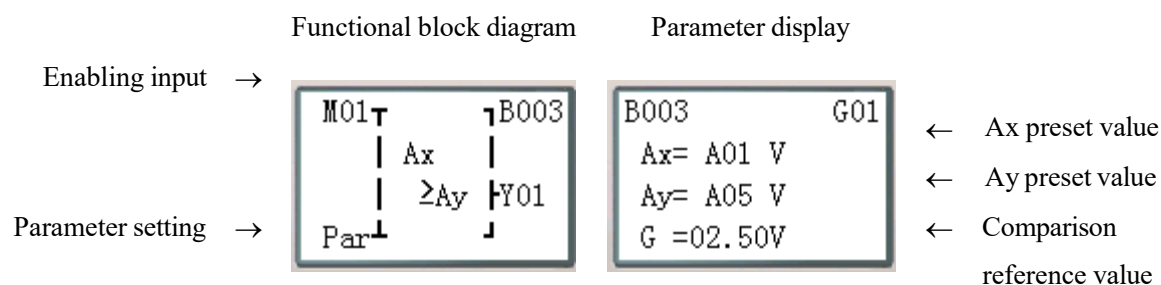
Comparator mode 2



B003 (G01) outputs ON when A01 value is not more than A05 value;

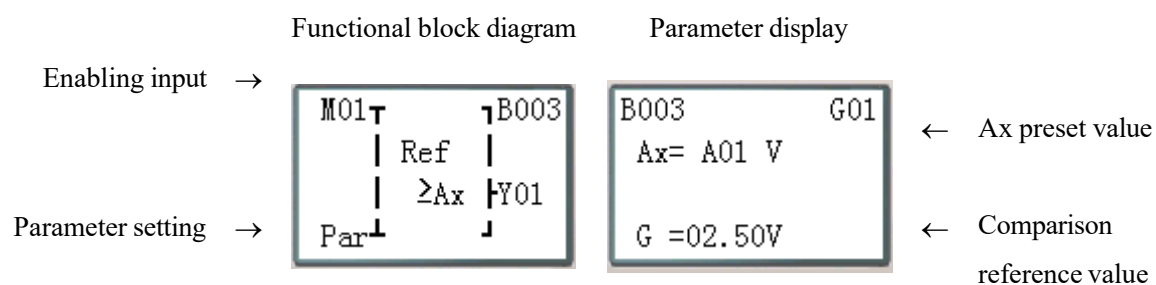
The current values of Ax and Ay are displayed in the RUN mode.

Comparator mode 3



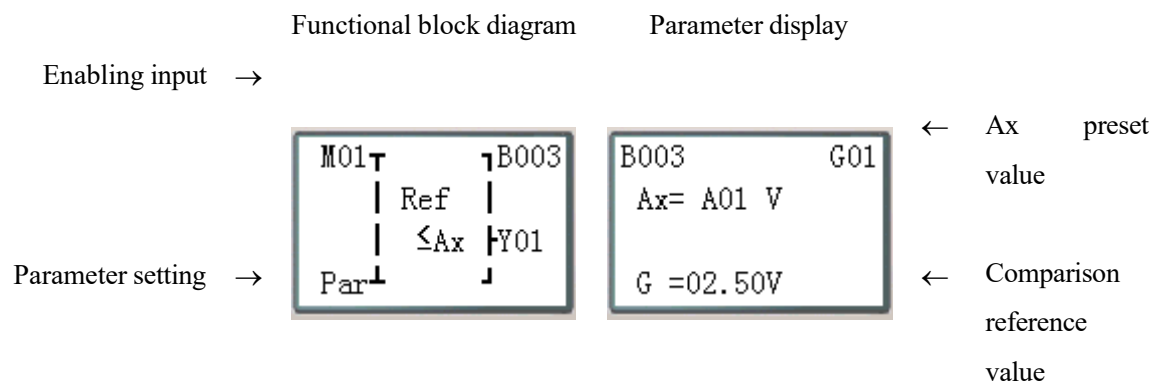
B003 (G01) outputs ON when A01 value is not less than A05 value; the current values of Ax and Ay are displayed in the RUN mode.

Comparator mode 4



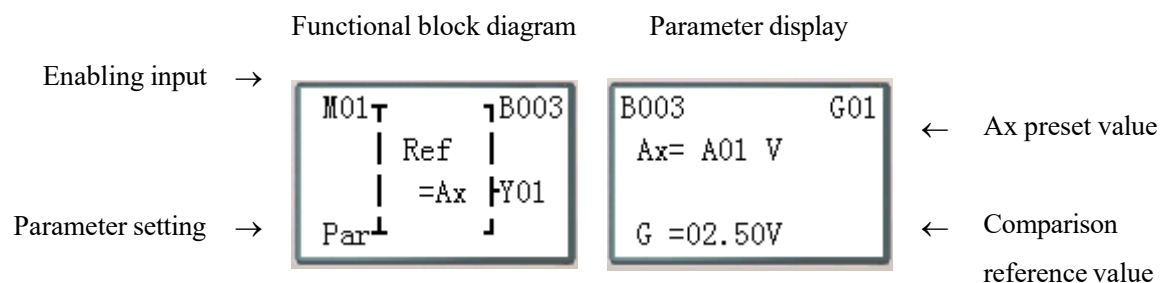
B003 (G01) outputs ON when A01 value is not more than 2.50; the current value of Ax is displayed in the RUN mode.

Comparator mode 5



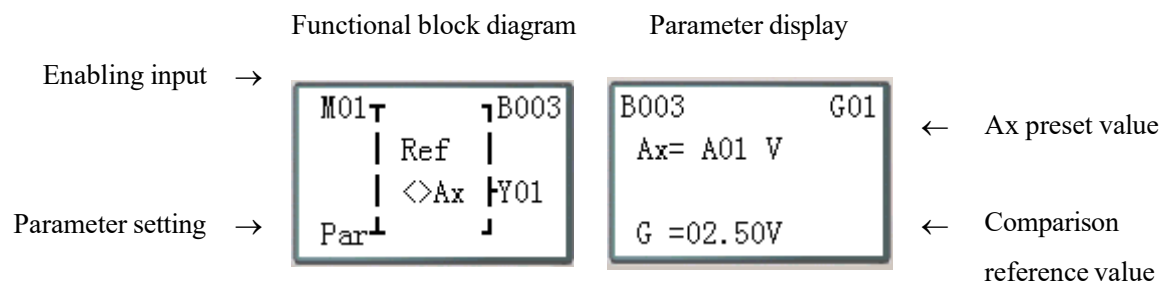
B003 (G01) outputs ON when A01 value is not less than 2.50; the current value of Ax is displayed in the RUN mode.

Comparator mode 6



B003 (G01) outputs ON when A01 value is equal to 2.50; the current value of Ax is displayed in the RUN mode.

Comparator mode 7



B003 (G01) outputs ON when A01 value is not 2.50; the current value of Ax is displayed in the RUN mode.

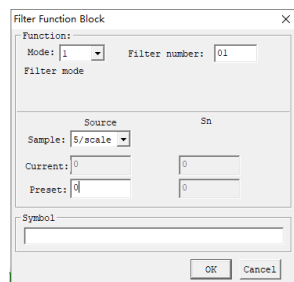
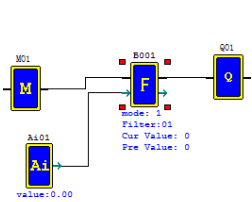
Filter functional block diagram

The maximum number of filter functional blocks used under FBD is 250. Filter works in mode 0~4 and its function is the same as under Ladder.

Filter mode 1: analog filter

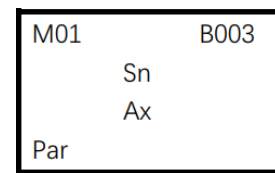
Function description: Analog filter function is started after parameters are configured and status of the enabled coil turns from 0 to 1. This function enables filtering of Ax analog value based on the selected sampling mode, and the filtered value is the current value of coil F.

Output: The analog value of input Ax is calculated based on the current number of samples Sn.



Functional block diagram

Enabling input →



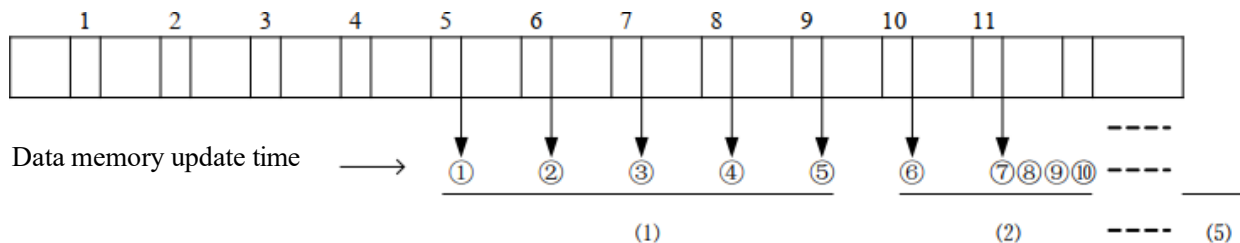
Parameter setting →

Software filter mode:

(Mode 1): Data is updated in each scanning cycle, and the recent 5 AD values (maximum and minimum values removed) is averaged.

(Mode 2): Data is updated every 5 scanning cycles. The average values of mode 1 are further averaged after statistics for 5 times.

(Mode 3): Data is updated every 25 scanning cycles. The maximum and minimum averages of the values obtained in mode 2 are used after statistics for 5 times.



Example: Data 1=161, data 2=120, data 3=154, data 4=160, data 5=190, data 6=169, data 7=110, data 8=121, data 9=150, data 10=198, data 11=199.

Mode 1:

① Updated data = $(161 + 154 + 160) / 3 = 158$ - filter (1, 2, 3, 4, 5)

Maximum value 190 and minimum value 120 will be deleted.

② Updated data = $(154 + 160 + 169) / 3 = 161$ - filter (2, 3, 4, 5, 6)

Maximum value 190 and minimum value 120 will be deleted.

③ Updated data = $(154 + 160 + 169) / 3 = 161$ - filter (3, 4, 5, 6, 7)

Maximum value 190 and minimum value 110 will be deleted.

∴

⑦ Updated data = $(121 + 150 + 198) / 3 = 156$ - filter (7, 8, 9, 10, 11)

Maximum value 199 and minimum value 110 will be deleted.

Mode 2:

The 5 data values of mode 1 are averaged. $(① + ② + ③ + ④ +$

⑤) / 5

Mode 3:

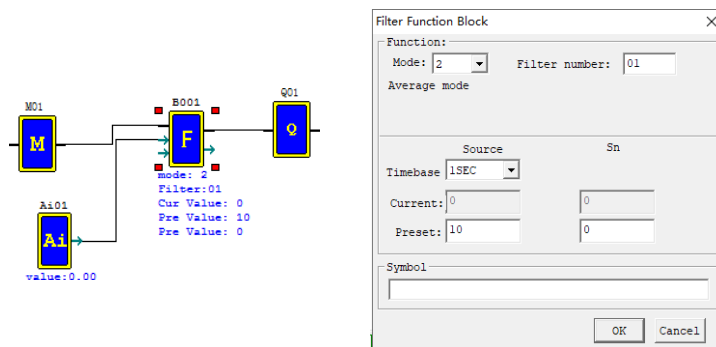
Among the 5 data values obtained after 5 operations of mode 2, the maximum value and minimum value are taken, and then the two values are averaged.

This mode is effective in filtering ripple or ripple noise.

$(\text{Maximum value} + \text{minimum value}) / 2$ (wherein, the maximum and minimum value range is (1)(2)(3)(4)(5)).

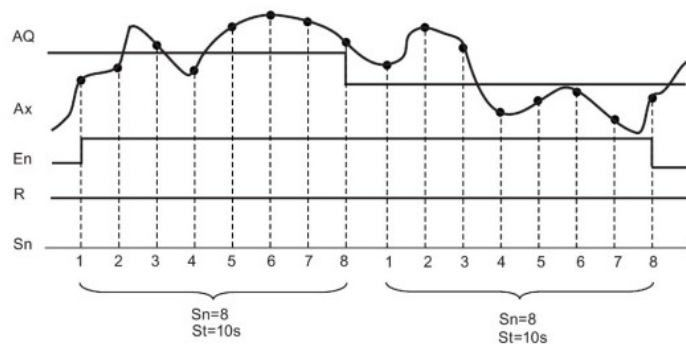
Filter mode 2: Average value

The enabling coil is set ON to enable the average function, which is used to calculate the average value of analog inputs in the set time period.



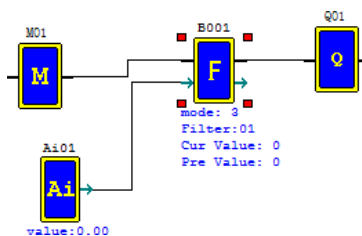
After the enabling coil is set ON, the average value of analog inputs in the set time period is calculated based on the configured parameters and updated to the current value of functional block, and meanwhile, output coil is set ON.

Timing diagram (for example)

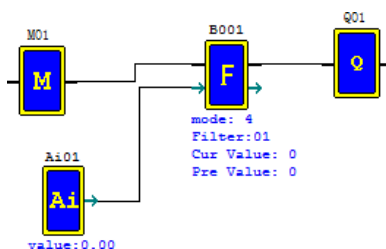


Filter mode 3: maximum value

The maximum value function is enabled and status of output coil and enabling coil is consistent after the enabling coil is set ON, and the function is disabled and status of output coil and enabling coil is consistent after the enabling coil is set OFF. While the enabling coil is ON, the current value of block F is recorded as the maximum value of analog input Ax.

**Filter mode 4: minimum value**

The minimum value function is enabled and status of output coil and enabling coil is consistent after the enabling coil is set ON, and the function is disabled and status of output coil and enabling coil is consistent after the enabling coil is set OFF. While the enabling coil is ON, the current value of block F is recorded as the minimum value of analog input Ax.



Addition and subtraction functional block diagram

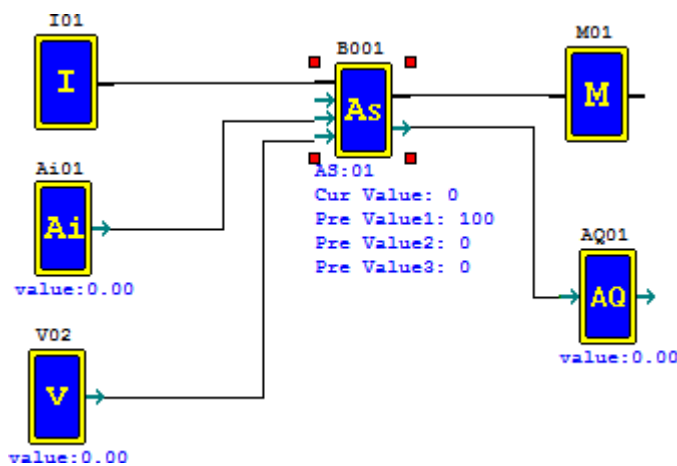
The maximum number of addition and subtraction functional blocks used under FBD is 250. The function is the same as under Ladder.

$$\text{Computing formula: } AS = V1 + V2 - V3$$

Operand V1~V3 may be a constant or code of current value of another functional block. Output coil is set ON in case of AS result overflow.

Example:

$$AQ01 = AS01 = 100 + A01 - V02$$



AS Function Block

Function: AS=V1+V2-V3

AS number: 01

Current Value: 0

Preset V1: 100

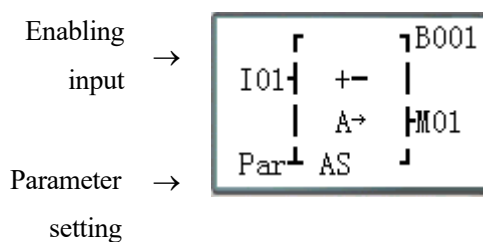
Preset V2: 0

Preset V3: 0

SYMBOL

OK Cancel

Functional block diagram



Parameter display

| | STOP | RUN | |
|-------------------|------------------------|------------------------------|--------------------|
| Preset value V1 → | B001 AS01 V1= 00100 | B001 00404 AS01 V1= 00100 | ← AS output value |
| Preset value V2 → | V2= A01 | V2= 00424 | ← V1 current value |
| Preset value V3 → | V3= V02 | V3= 00120 | ← V2 current value |
| | | | ← V3 current value |

The range of AS output value and V1~V3 current value is -32768~32767.

Multiplication and division functional block diagram

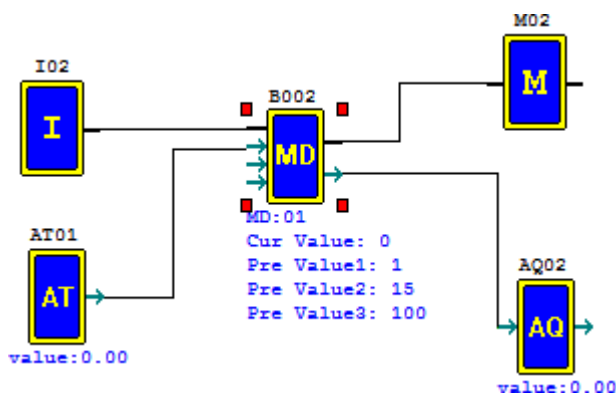
The maximum number of multiplication and division functional blocks used under FBD is 250. The function is the same as under Ladder.

$$\text{Computing formula: } MD = V1 * V2 / V3$$

Operand V1~V3 may be a constant or code of current value of another functional block. Output coil is set ON in case of MD result overflow or V3=0.

Example:

$$AQ02 = MD01 = AT01 * 15 / 100$$



MD Function Block

Function: MD=V1*V2/V3

MD number: 01

Current Value: 0

Preset V1: 1

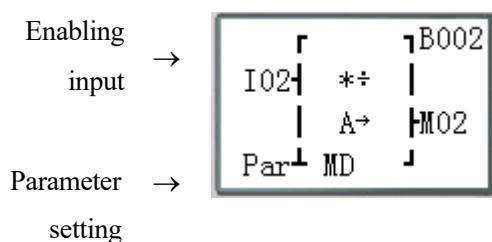
Preset V2: 15

Preset V3: 100

SYMBOL

OK Cancel

Functional block diagram



Parameter display

| | STOP | RUN | |
|-------------------|-----------------------|------------------------------|--------------------|
| Preset value V1 → | B002 MD01 V1= AT01 | B002 00184 MD01 V1= 01227 | ← MD output value |
| Preset value V2 → | V2= 00015 | V2= 00015 | ← V1 current value |
| Preset value V3 → | V3= 00100 | V3= 00100 | ← V2 current value |
| | | | ← V3 current value |

The range of MD output value and V1~V3 current value is -32768~32767.

PID functional block diagram

The maximum number of analog comparator functional blocks used under FBD is 30. The function is the same as under Ladder.

PID computing formula:

$$EV_n = SV - PV_n$$

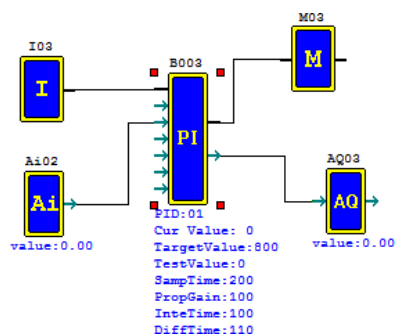
$$\Delta PI = K_p \left\{ (EV_n - EV_{n-1}) + \frac{T_s}{T_I} EV_n + D_n \right\}$$

$$D_n = \frac{T_D}{T_s} (2PV_{n-1} - PV_n - PV_{n-2})$$

$$PI = \sum \Delta PI$$

PID parameters may be a constant or code of current value of another functional block. Error coil is set as 1 and PID function is not executed when T_s or K_p is 0.

Example:



PID Function Block X

Function:

PID number: 01

Current Value: 0

SV: 800

PV: 0

Ts: 200

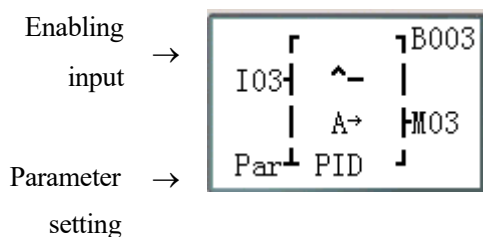
Kp: 100

Ti: 100

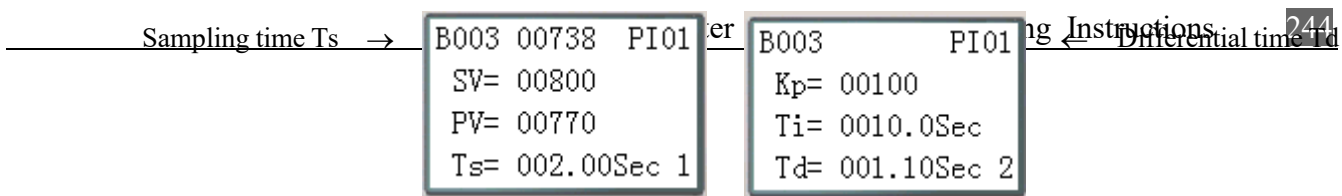
Td: 100

Symbol

OK Cancel

Functional block diagram**Parameter display****Parameter display 1****Parameter display 2**

- PI output value →
- Target value SV →
- Measured value PV →
- ← Proportional gain Kp
- ← Integral time Ti



- ※ PI output value is displayed only during running;
- ※ The code A02 is displayed when stopped and the current value of A02 is displayed during running; the measured value PV is preset, such as PV=00770;
- ※ Press “SEL+←→”, to switch parameter display 1 and 2;
- ※ Refer to [Chapter IV: Ladder Programming Instructions-PID Functional Block Instructions](#) for details on PID.

Multiplex controller (MX) functional block diagram

The maximum number of multiplex controller functional blocks used under FBD is 30. The function is the same as under Ladder.

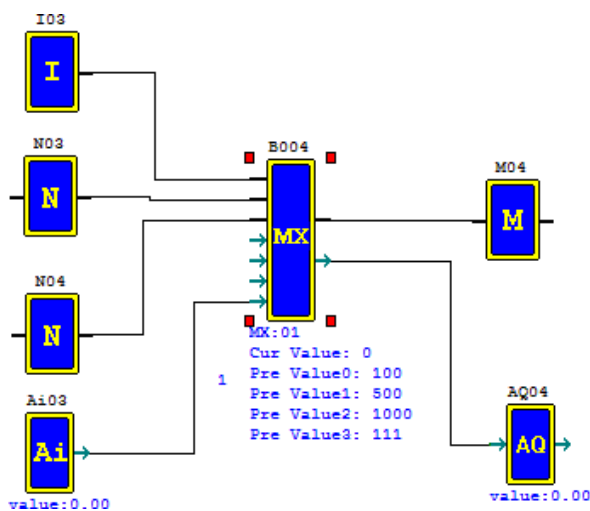
When MX is enabled, status of S1 and S2 is input as per setting, output value of MX is one of the preset parameters V0~V3, and coil outputs ON; when MX is disabled, MX output is 0 and coil outputs OFF.

Operand V1~V3 may be a constant or code of other data type.

The relation between selection control bit and MX current value is shown in the following table.

| Control condition | | MX output coil | MX output value |
|-------------------|------------|----------------|-----------------|
| MX disabled | | 0 | MX = 0 |
| MX enabled | S1=0, S2=0 | 1 | MX = V0 |
| | S1=0, S2=1 | 1 | MX = V1 |
| | S1=1, S2=0 | 1 | MX = V2 |
| | S1=1, S2=1 | 1 | MX = V3 |

Example:



MX Function Block

Function:

MX number: 01

Current Value: 0

Preset V0: 100

Preset V1: 500

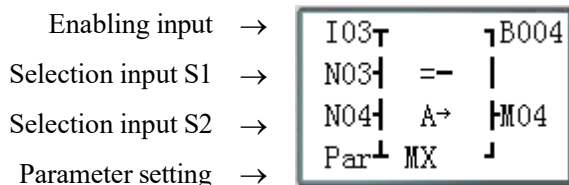
Preset V2: 1000

Preset V3: 0

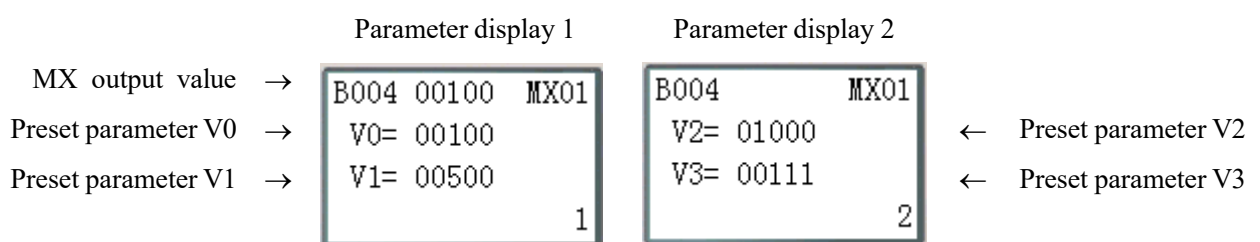
Symbol

OK Cancel

Functional block diagram



Parameter display



- ※ MX output value is displayed only during running.
- ※ The code A03 is displayed when stopped and the current value of A03 is displayed during running; the parameter V3 is preset, such as V3=00111
- ※ Press “SEL+←→” to switch parameter display 1 and 2.
- ※ The range of MX output value and current value of preset parameters V0~V3 is -32768~32767.

Ramp function generator (AR) functional block diagram

The maximum number of AR functional blocks used under FBD is 30. The function of AR mode 1 and mode 2 is the same as under Ladder.

AR mode 1

Function description:

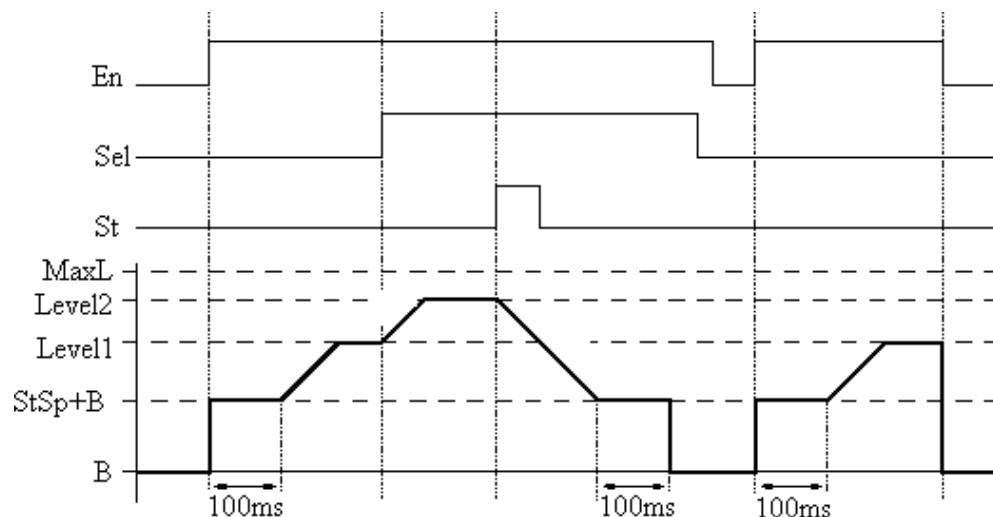
After AR is enabled, the current level is kept at “Start/Stop offset+ offset” for 100ms, and then changed to the set level at the set stepping rate. If the stop coil is enabled, AR level is gradually decreased from the current level to “Start/Stop offset+ offset” at the set stepping rate and kept at this level for 100ms, then the current level is offset B, making AR current value 0, when AR instruction ends.

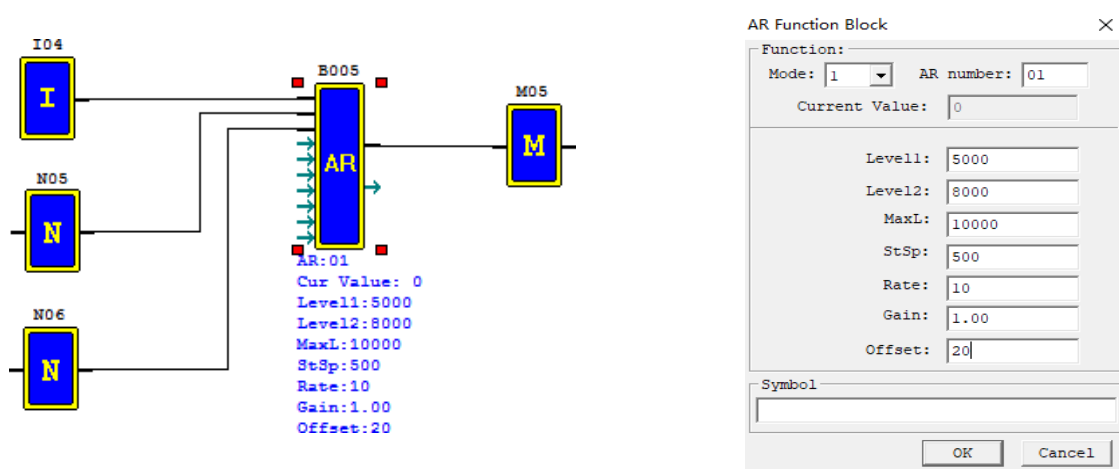
| |
|-----------------------------------|
| AR current value (AR: 0~32767) |
| Level 1 (Levl1: -10000~20000) |
| Level 2 (Levl2: -10000~20000) |
| Maximum level (MaxL:-10000~20000) |
| Start/Stop offset (StSp: 0~20000) |
| Stepping rate (Rate: 1~10000/s) |
| Gain (A: 0~10.00) |
| Offset (B: -10000~10000) |

$$AR \text{ current value} = (AR \text{ current level} - \text{offset } B) / \text{gain } A$$

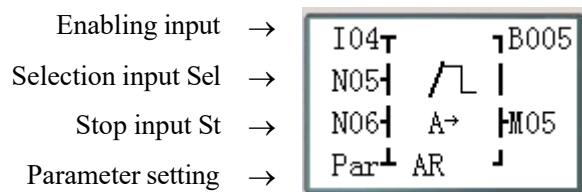
The preset parameters may be a constant or code of other data type; output coil is set ON when gain A is 0.

| | |
|--------------------------|---|
| Level selection coil Sel | <p>Level selection rule Sel = 0: Lev11 as the target level</p> <p> Sel = 1: Lev12 as the target level</p> <p>※MaxL is taken as the preset value of target level if the target level is higher than the maximum level.</p> |
| Stop coil St | <p>When the stop coil is set ON (not kept), AR is stopped, decreased gradually from the current level to “Start/Stop offset+ offset” and kept at the level for 100ms, then the current level is offset B, leading to the current value 0, when AR instruction is ended.</p> |

AR mode 1 timing diagram



Functional block diagram



Parameter display

| | Parameter display 1 | Parameter display 2 | |
|------------------------|---------------------|---------------------|-----------------|
| AR output value → | B005 00528 AR01 | S = 00500 AR01 | ← Preset StSp |
| Preset level L1 → | L1= 05000 | R = 00010 | ← Preset rate |
| Preset level L2 → | L2= 08000 | A = 01.00 | ← Preset gain |
| Preset maximum value → | ML= 10000 1 | B = 00020 2 | ← Preset offset |

✗ AR output value is displayed only during running;

✗ Press “SEL+←→” for switching of parameter display 1 and 2.

AR mode 2**Function description:**

In AR02, the current output level is decided by level selection ports Sel1 and Sel2, and the fixed variation Rate by parameters MaxL and Ta. After AR is enabled, AR output will change from 0 to the current output level at the Rate. Afterwards, AR output will change to the target level at the fixed rate as per variation of selection ports Sel1 and Sel2. After AR is OFF, AR output will turn from the current level to 0 immediately.

AR current value (AR:0~32767)

Level 0 (Levl0:0~32767)

Level 1 (Levl0:0~32767)

Level 2 (Levl0:0~32767)

Level 3 (Levl0:0~32767)

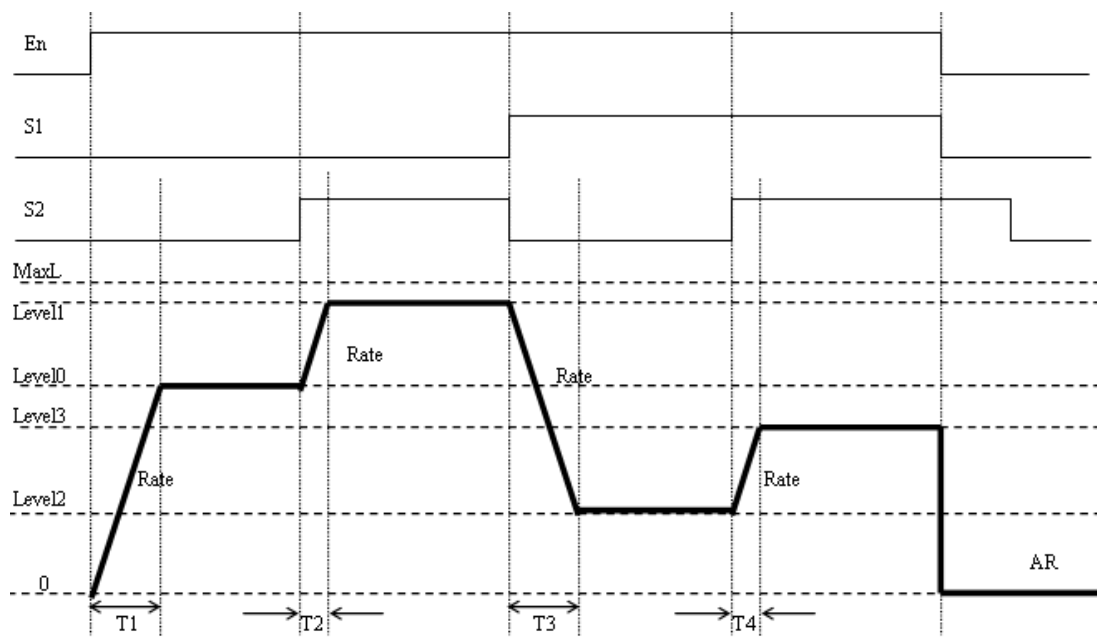
Level upper limit (MaxL:0~32767)

Acceleration time Ta: 0~3276.7

User-defined rate: $Rate = \frac{MaxL}{Ta}$. AR mode 2 is detailed below:

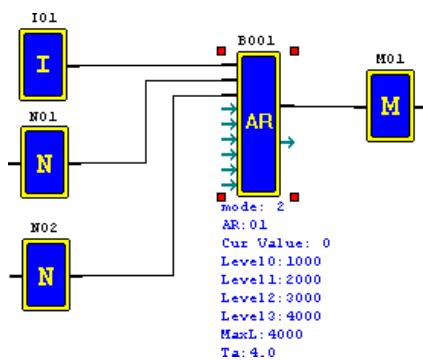
| | |
|--------------|--|
| Sel1 Sel2 | S1=0,S2=0: target level = Level 0; S1=0,S2=1: target level = Level 1; S1=1,S2=0: target level = Level 2; S1=1,S2=1: target level = Level 3; |
| MaxL | MaxL is taken as the target level if the selected level is higher than the maximum level. |
| Ta | Quotient of MaxL/Ta rate as the rate of variation to target level |

AR mode2 timing diagram



$$\text{Rate} = \text{MaxL}/\text{Ta}; \quad \text{T1} = \text{Level0} * \text{Ta} / \text{MaxL}; \quad \text{T2} = (\text{Level1} - \text{Level0}) * \text{Ta} / \text{MaxL};$$

$$\text{T3} = (\text{Level1} - \text{Level2}) * \text{Ta} / \text{MaxL}; \quad \text{T4} = (\text{Level3} - \text{Level2}) * \text{Ta} / \text{MaxL};$$



AR Function Block

Function:

Mode: AR number:

Current Value:

Level0:

Level1:

Level2:

Level3:

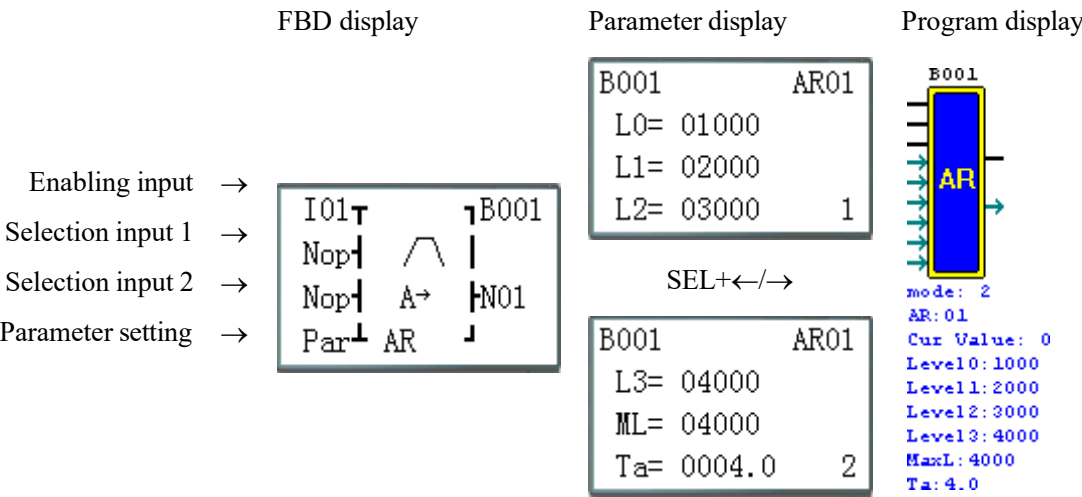
MaxL:

Ta:

Symbol

OK Cancel

Example:



※AR output value is only displayed during running.

Data register (DR) functional block diagram

The maximum number of DR functional blocks used under FBD is 240. The function is the same as under Ladder.

When DR is enabled, the preset value is transferred to DR current value register, and coil B outputs ON; when DR is disabled, the current value is kept and coil B outputs OFF.

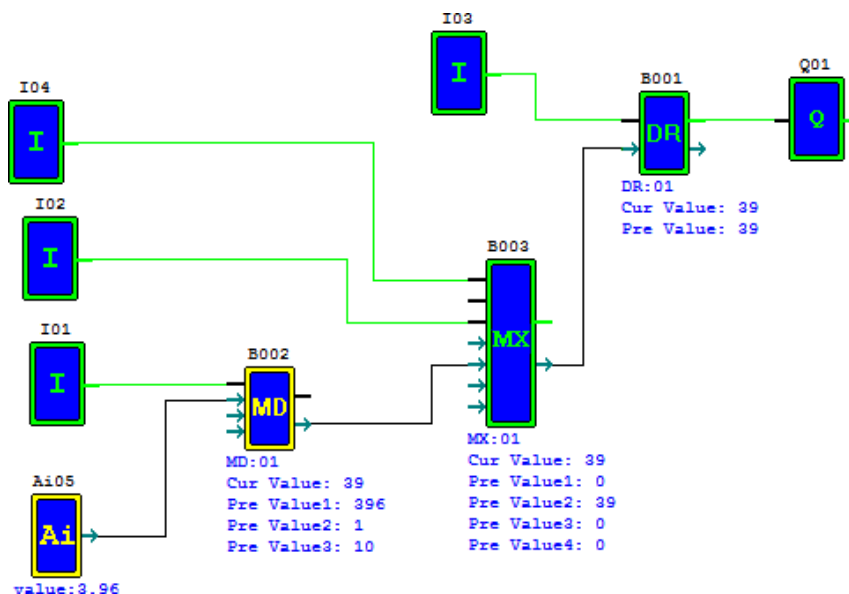
Data in DR may be the type with symbol or the type without symbol, and the control bit can be set by SMT user programming software menu **Operation (Q)>>Module system setting(D)...or keypad**.

- ※ The current value of DR65~DRF0 is kept when stopped and in case of power failure;
- ※ The final 40 DRs are special data registers, as defined in [Chapter III: Programming Tool- DR Setting](#).

Example:

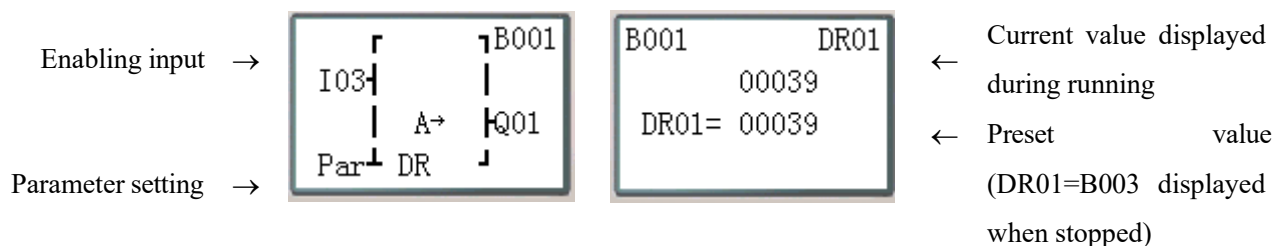
When I01 is set ON, A05 is transferred to B003 as the preset value V2 after B002 computation;

When I02 is set ON, B003 outputs to block B001 the preset value V2, namely the computed value of analog input A05; when I02 is set OFF, B003 outputs 0 to B001.



Functional block
diagram

Parameter display



Modbus functional block diagram

The maximum number of Modbus functional blocks used under FBD is 250. Modbus works in mode 1~5, and its function is the same as under Ladder.

RS485 communication gives priority to Remote IO and IO Link, namely the functional block is not executed by Remote IO master and slave and IO Link master, and Modbus instruction is executed only when it is set as N (remote IO) and ID is not 0.

Comparison table of Modbus mode and communication function code:

| Mode | Function code |
|------|------------------------------|
| 1 | 03 (read register) |
| 2 | 06 (write a single register) |
| 3 | 10 (write various registers) |
| 4 | 01 (read coil) |
| 5 | 05 (write a single coil) |

✖ The maximum communication data length is 25 words in mode 1 and 3, and 400 bits in mode 4.

Auxiliary contacts used during execution of Modbus instructions:

| | |
|-------------------------|---|
| Receiving completed M3D | After completion of receiving, M3D is set for error checking, and the received data is sent to the designated register if no error is found; |
| Error indication M3E | Communication error indication |
| Timeout judgment M3F | Enter the receiving waiting state after completion of sending; when timeout is determined as no data is received within the specified time period, the timeout output flag M3F is ON, receiving is ended and M3D outputs ON; M3F is automatically reset at the time of M3D resetting. |

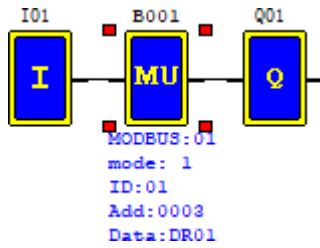
Timeout judgment and time-out period are determined by baud rate.

| Baud rate (bps) | Timeout (ms) |
|-----------------------------|--------------|
| 4800, 9600, 19200, 38400 | 125 |
| 57600 | 100 |
| 115200 | 80 |

✖ Refer to [Chapter VII: Function Specification of 20-point RS485 High-performance Type](#) for use of communication.

MU mode 1: read register

Set communication address as a constant:



Set command address constant 0003,

Set data length as 1 word,

The sending command is:

01 03 00 03 00 01 CRC16;

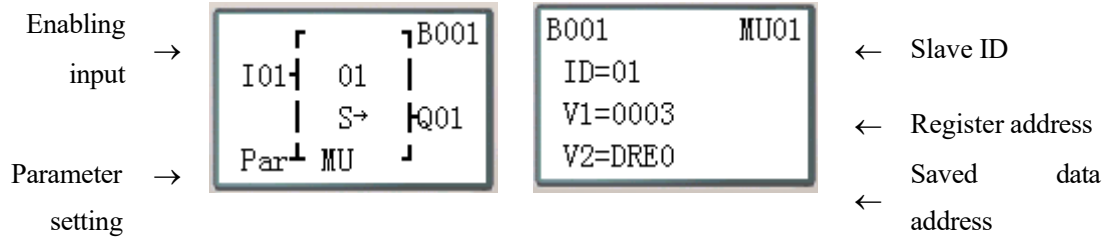
Receiving response data of slave station 1:

01 03 02 data1 data2 CRC16;

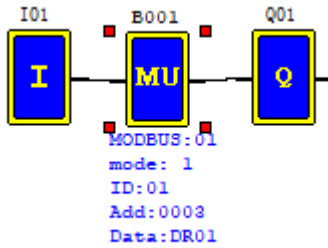
Mode 1

Functional block diagram

Parameter display



Set communication address as register DR:



Set command address DR03=0001,

Set data length DR04=0002,

The sending command is:

01 03 00 01 00 02 CRC16;

Receiving response data of slave station 1:

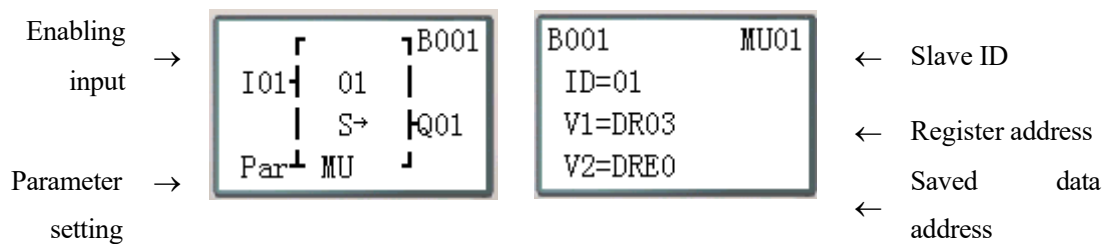
01 03 04 data1 data2 data3 data4 CRC16;

Data saved in DRE0~DRE1:

DRE0 = data1~2, DRE1 = data3~4

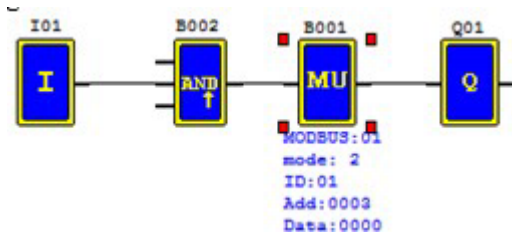
✗ The maximum value of data length register is 25.

Parameter display



MU mode 2: Write a single register

Set communication address as a constant:



Command address constant 0003,
Set value data DRE0=1234 (hex: 04D2),
The sending command is:
01 06 00 03 04 D2 CRC16;

Receiving response data of slave station 1:
01 06 00 03 04 D2 CRC16;

MU Function

Function
Mode MU Number:
Write Single Register(0x06)
☒ 485 ☐ TCP/IP

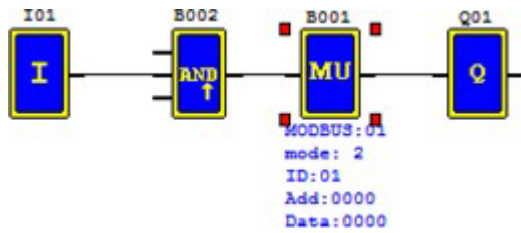
Remote ID:
(0~7F)
Comm. add: ☒
(0~FFFF) ☐ DR
Comm. data: DR
The data wrote into a register depends on the DR01 value

Symbol

OK Cancel

| Mode 2 | Functional block diagram | Parameter display | |
|-------------------|--------------------------|-------------------|------------------------|
| Enabling input | → | | ← Slave ID |
| Parameter setting | → | | ← Register address |
| | | | ← Fetched data address |

Set communication address as register DR:



Set command address DR03=0001,
Set data DRE0=1234 (hex: 04D2),
The sending command is:
01 06 00 01 04 D2 CRC16

Receiving response data of slave station 1:
01 06 00 01 04 D2 CRC16

MU Function

Function
Mode MU Number:
Write Single Register(0x06)
☒ 485 ☐ TCP/IP

Remote ID: (0~7F) The Comm. add depends on DR03 value
Comm. add: ☐ (0~FFFF)
☒ DR
Comm. data: DR

The data wrote into a register depends on the DR01 value

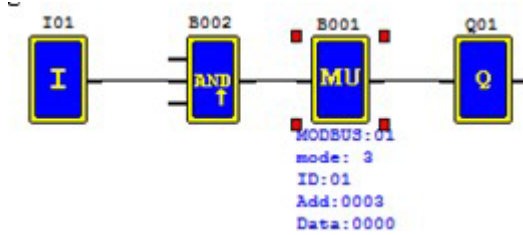
Symbol

OK Cancel

| Mode 2 | Functional block diagram | Parameter display |
|---------------------|--------------------------|--|
| Enabling input → | | |
| Parameter setting → | | ← Slave ID ← Register address ← Fetched data address |

MU mode 3: Write various registers

Set communication address as a constant:



Command addresses constant 0003,

Set data length as 1 word,

Set data DRE0=1234 (hex: 04D2),

The sending command is:

01 10 00 03 00 01 02 04 D2 CRC16

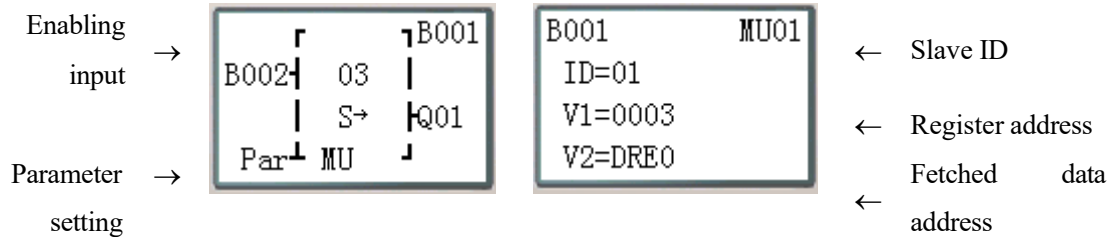
Receiving response data of slave station 1:

01 10 00 03 00 01 CRC16

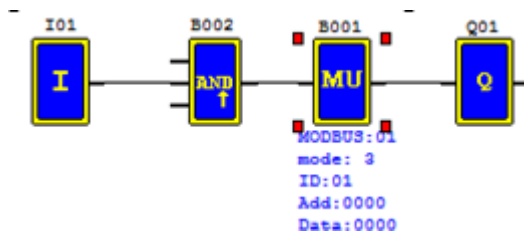
Mode 3

Functional block diagram

Parameter display

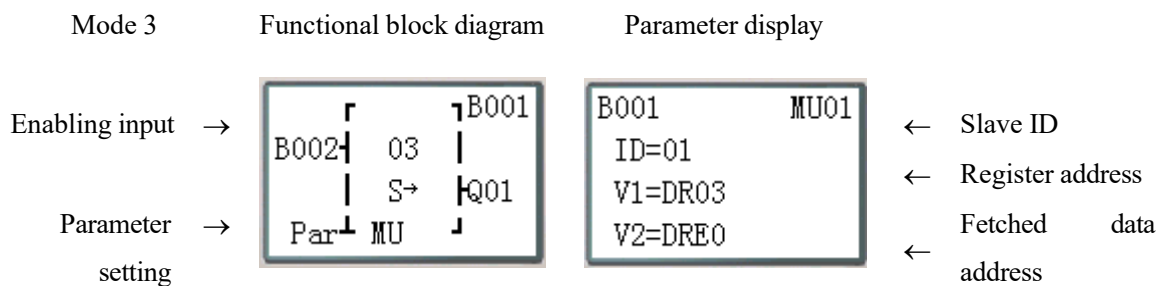


Set communication address as register DR:



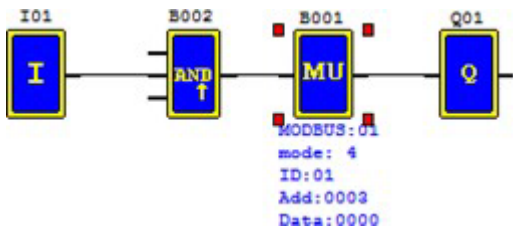
Set command address DR03=0001,
 Set data length DR04=0002,
 Set data DRE0=1234 (hex:04D2),
 Set data DRE1=5678 (hex:162E),
 The sending command is:
 01 10 00 01 00 02 04 04 D2 16 2E CRC16

Receiving response data of slave station 1:
 01 10 00 01 00 02 CRC16.



MU mode 4: Read coil

Set communication address as a constant:



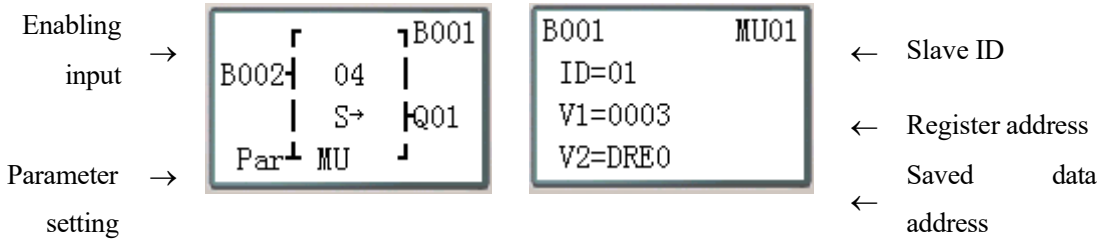
Command address constant 32 (hex: 0020),
Set data length as 16 (hex: 10H, 1word),
The sending command is:
01 01 00 20 00 10 CRC16

Receiving response data of slave station 1:
01 01 02 data1 data2 CRC16
Data saved in DRE0:

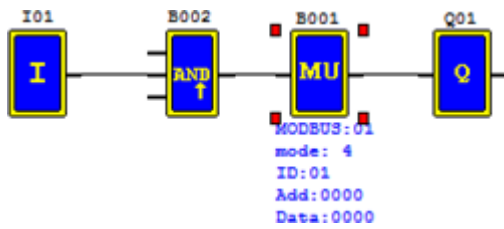
Mode 4

Functional block diagram

Parameter display



Set communication address as register DR:



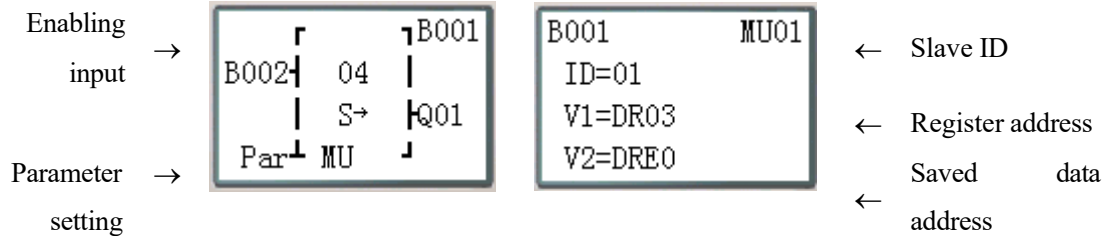
Set command address DR03=0001,
Set data length DR04=0015 (hex: 000F);
The sending command is:
01 01 00 01 00 0F CRC16

Receiving response data of slave station 1:
01 01 02 data1 data2 CRC16
Data saved in DRE0:
DRE0 = data1~2

Mode 4

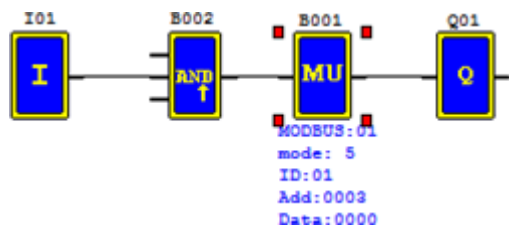
Functional block diagram

Parameter display



MU mode 5: Write a single coil

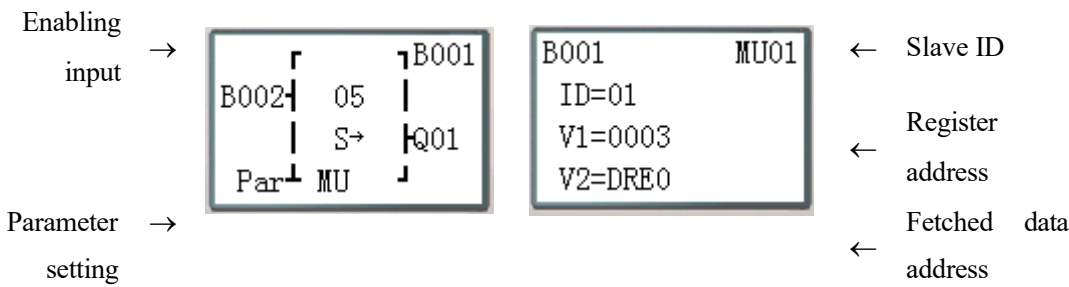
Set communication address as a constant:



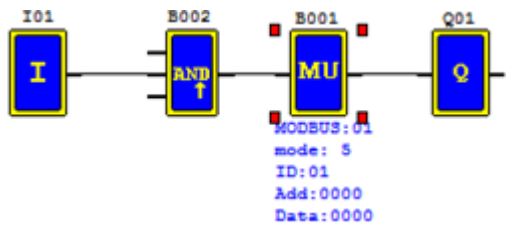
Command addresses constant 0003,
Set data DRE0=65280 (hex: FF00),
The sending command is:
01 05 00 03 FF 00 CRC16

Receiving response data of slave station 1:
01 05 00 03 FF 00 CRC16

Mode 5 Functional block diagram Parameter display



Set communication address as register DR:



Set command address DR03=0001,
Set data DRE0=65280 (hex: FF00),
The sending command is:
01 05 00 01 FF 00 CRC16

Receiving response data of slave station 1:
01 05 00 01 FF 00 CRC16

MU Function

Function
Mode MU Number:
Write Single Coil(0x05)
☒ 485 ☐ TCP/IP

Remote ID: (0~7F)
Comm. add: ☐ (0~FFFF)
☒ DR
Comm. data: DR

The Comm. add depends on DR03 value, and this value must be the multiple of 10H/16
The data wrote into a coil depends on the DR01 Value.

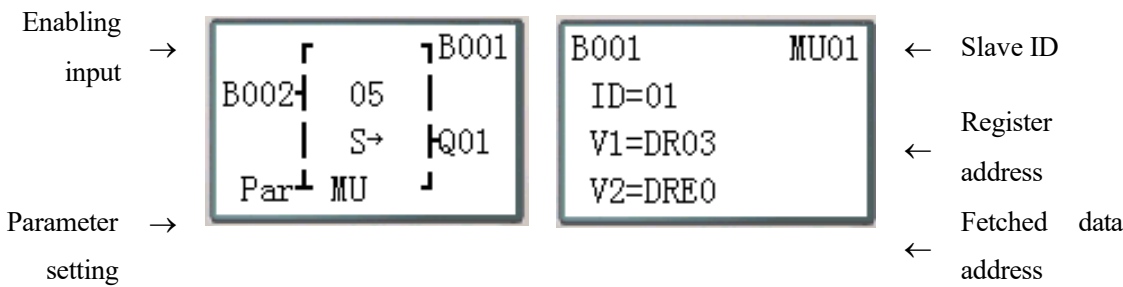
Symbol

OK Cancel

Mode 5

Functional block diagram

Parameter display



Chapter 7 Hardware Specifications

| | |
|---|-----|
| Chapter 7 Hardware Specifications | 266 |
| General Specifications..... | 267 |
| Type Selection Form | 268 |
| Input Power Specifications (current consumption to be tested) | 269 |
| General type specifications..... | 269 |
| Schematic diagram of incoming power line: | 270 |
| Input Specifications..... | 271 |
| 100~240V AC type..... | 271 |
| 12/24V DC type 12 I/O | 272 |
| 12/24V DC type 20 I/O | 273 |
| Output Specifications | 274 |
| Precautions for Output Terminal Connection | 275 |
| Relay life..... | 275 |
| Outline Drawing (unit: mm)..... | 276 |

General Specifications

| Item | | Specification |
|-----------------------|-----------------------|---|
| Program input method | | Ladder and FBD |
| Operating environment | Operating temperature | -20~50°C |
| | Storage temperature | -40~70°C |
| | Operating humidity | 90% RH, no condensation |
| | Operating gas | Non-corrosive gas |
| Body structure | Vibration resistance | IEC60068-2-6 Amplitude 0.075mm /acceleration 1.0G |
| | Impact resistance | IEC60068-2-27 Peak 15G peak, duration 11ms |
| Noise resistance | ESD | Contact ±4KV, air discharge ±8KV |
| | EFT | Power supply AC: ±2KV DC: ±1KV |
| | CS | 0.15~80MHz 10V/m |
| | RS | 80~1000MHz 10V/m |
| | EMI | EN55011 B level |
| Installation | Protection grade | IP20 |
| | Fixing method | Direct mounting or rail (35mm) mounting |
| | Direction | Refer to Chapter II: Installation and Fixing |
| Assembly wire | | AWG 14/ψ2.6mm ² |
| Dimensions | | For:10/12P 72X90X59.6mm (W x H x D) Din rail 72X106X59.6mm (W x H x D) direct mounting For:20P 126X90X59.6mm (W x H x D) Din rail 126X106X59.6mm (W x H x D) direct mounting |

Product Specifications

| | Part Number | Power | Digital In | Digital Out | Analogue In | Analogue Out | HMI | Comments |
|---------------------|-------------|------------|------------|--------------|-------------|--------------|-----|----------------------------------|
| BASE MODELS | SMT4-EA-R10 | 100-240VAC | 6 AC | 4 (8A Rly) | - | - | Yes | |
| | SMT4-EA-R20 | 100-240VAC | 12 AC | 8 (8A Rly) | - | - | Yes | |
| | SMT4-ED-R12 | 12-24VDC | 8 DC*1 | 4 (8A Rly) | 2 (0-10V) | - | Yes | 2 High Speed Inputs (up to 1kHz) |
| | SMT4-ED-R20 | 12-24VDC | 12 DC*1 | 8 (8A Rly) | 4 (0-10V) | - | Yes | 2 High Speed Inputs (up to 1kHz) |
| | SMT4-BD-R12 | 12-24VDC | 8 DC*1 | 4 (8A Rly) | 2 (0-10V) | - | No | 2 High Speed Inputs (up to 1kHz) |
| | SMT4-BD-R20 | 12-24VDC | 12 DC*1 | 8 (8A Rly) | 4 (0-10V) | - | No | 2 High Speed Inputs (up to 1kHz) |
| | SMT4-CD-R20 | 12-24VDC | 12 DC*1 | 8 (8A Rly) | 4 (0-10V) | - | Yes | 2 HSI (1kHz), RS485 Modbus, Link |
| EXPANSIONS / EXTRAS | SMT-MA-R8 | 100-240VAC | 4 AC | 4 (8A Rly) | - | - | - | Maximum 3 per Base Unit |
| | SMT-MD-R8 | 24VDC | 4 DC | 4 (8A Rly) | - | - | - | Maximum 3 per Base Unit |
| | SMT-MD-T8 | 24VDC | 4 DC | 4 (0.5A Trn) | - | - | - | Maximum 3 per Base Unit |
| | SMT-MD-4AI | 24VDC | - | - | 4 (V, mA) | - | - | Maximum 1 per Base Unit |
| | SMT-4PT | 24VDC | - | - | 4 (PT100) | - | - | Maximum 1 per Base Unit |
| | SMT-2AO | 24VDC | - | - | - | 2 (V, mA) | - | Maximum 2 per Base Unit |
| MADE TO ORDER | SMT4-BD-T12 | 24VDC | 8 DC*1 | 4 (0.5A Trn) | 2 (0-10V) | - | No | 2 PWM (0.5kHz) |
| | SMT4-BD-T20 | 24VDC | 12 DC*1 | 8 (0.5A Trn) | 4 (0-10V) | - | No | 2 PWM (0.5kHz) |
| | SMT4-BA-R10 | 100-240VAC | 6 AC | 4 (8A Rly) | - | - | No | |
| | SMT4-BA-R20 | 100-240VAC | 12 AC | 8 (8A Rly) | - | - | No | |
| | SMT4-ED-T12 | 24VDC | 8 DC*1 | 4 (0.5A Trn) | 2 (0-10V) | - | Yes | 2 PWM (0.5kHz) |
| | SMT4-ED-T20 | 24VDC | 12 DC*1 | 8 (0.5A Trn) | 4 (0-10V) | - | Yes | 2 PWM (0.5kHz) |
| | SMT4-CD-T20 | 24VDC | 12 DC*1 | 8 (0.5A Trn) | 4 (0-10V) | - | Yes | 2 PWM (0.5kHz), RS485 Modbus |

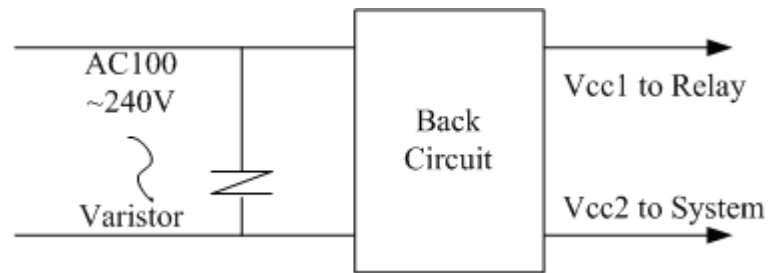
Power Specifications

General type specifications

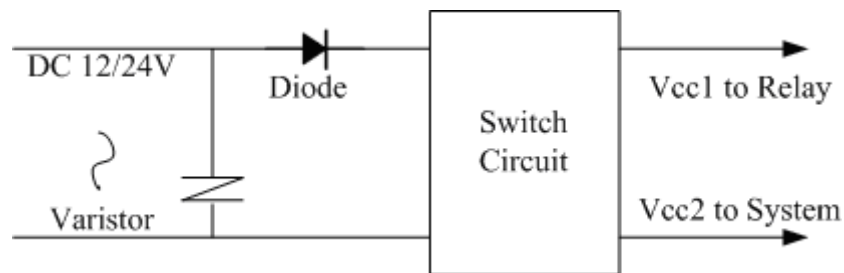
| | AC Models | | DC Models | | Expansion Units |
|-----------------------------|---|---------------|--|---------------|------------------------------|
| | 10 I/O | 20 I/O | 12 I/O | 20 I/O | |
| Operating Temperature | -20 to +55°C | | | | |
| Storage Temperature | -40 to +70°C | | | | |
| Humidity | 5 - 90% RH no frost | | | | |
| Vibration | IEC60068-2-6 (0.075mm Amplitude / 1G Acceleration) | | | | |
| Impact Resistance | IEC60068-2-28 (15g peak, 1ms duration) | | | | |
| Installation | IP20, Direct or DIN Rail Mount (TS35 - 35mm) | | | | |
| Noise Resistance | ESD: ±4kV, Air Discharge: ±8kV, EFT: Power AC: ±2kV, AC: ±1kV, CS: 0.15-80mHz 10V/m, RS: 80-1000mHz 10V/m, EMI: EN55011 Class B | | | | |
| Approvals | CE, UL, cUL | | | | |
| Dimensions | 72x90x59.6mm | 126x90x59.6mm | 72x90x59.6mm | 126x90x59.6mm | 38x90x59.6mm |
| Weight | 230g | 345g | 220g | 345g | 190g |
| Clock Accuracy | 2s per day at 0-55°C / 5s per day over 55°C | | | | |
| Power Supply | 85-260VAC, 19.6-28.8VAC (24V) | | 19.6-28.8VDC (24V, 10.2-13.8VDC (12V) | | Same as equivalent Base Unit |
| Power Consumption | 2.4W | 2.4W | 3W | 4.4W | 1W |
| Input Threshold | ON: >79VAC, OFF: <40VAC | | ON: >9.5VDC, OFF: <5VDC | | Same as equivalent Base Unit |
| Input Current | 1.3mA | | 3.2mA | | Same as equivalent Base Unit |
| Input Impedance | 200kΩ | | 8kΩ | | Same as equivalent Base Unit |
| Input Response Time | 50-90ms (240-120VAC) | | 3.5ms | | Same as equivalent Base Unit |
| Input Max. Voltage | 260VAC | | 30VDC | | Same as equivalent Base Unit |
| High Speed Input (Hz) | - | | 1000 (I1), 500/500 (I1/I2) | | - |
| Standard Input (Hz) | - | | <40 | | <40 |
| Max. Digital Output Current | Relay: 8A (Resistive), 2A (Inductive) | | Relay: 8A(R), 2A(I), Trans: 0.5A(R), 0.2A(I) | | Same as equivalent DC model |
| Min. Digital Output Current | 16.7mA | | 0.2mA | | Same as equivalent Base Unit |
| PWM Transistor O/P (Hz) | - | | 500 (1ms ON, 1ms OFF) | | - |
| Relay Life (No Load) | 10 million operations | | | | |
| Analogue Input Range | - | | 0.00 to 9.99V | | 0.00 to 9.99V |
| Analogue Input Resolution | - | | 12 bit nominal (0.01V) | | 12 bit nominal (0.01V) |
| Analogue Input Impedance | - | | 45kΩ | | 22.5kΩ |
| RTD Input Range | - | | - | | -100 to +600°C |
| RTD Input Resolution | - | | - | | 0.1°C |
| RTD Excitation Current | - | | - | | 0.33mA |
| Analogue Output Range | - | | - | | 0-10V, 4-20mA |
| Analogue Output Resolution | - | | - | | 0.01V, 0.01mA |
| Output External Power | Less than AC 265, DC30V (Relay) | | | | 23.9-24.1V (Transistor) |
| Program Size | 1200 Steps (600 Lines of Ladder), 500 Function Blocks | | | | - |
| Program Backup | Battery Backed Up (Lifetime: 5 years) | | | | |

Schematic diagram of incoming power line:

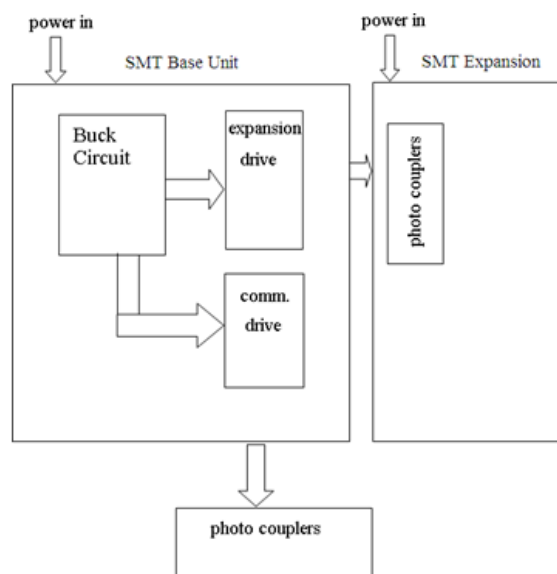
- 1) AC 10/20 points



- 2) DC 24V (power supply 12/24)

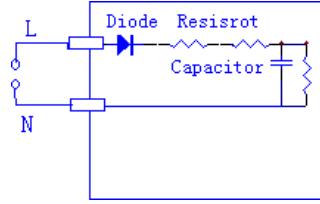


- 3) Master, extension, and communication

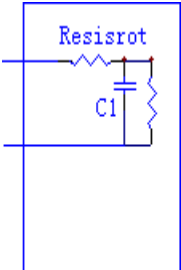
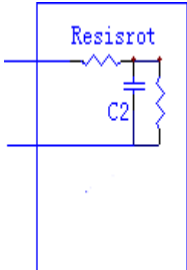
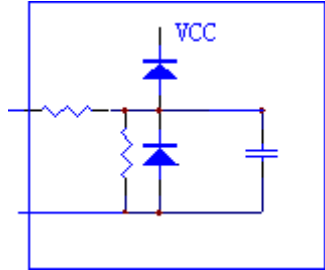


Input Specifications

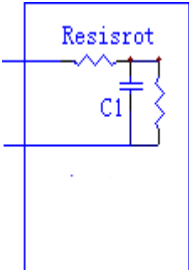
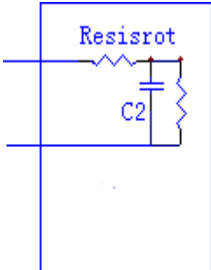
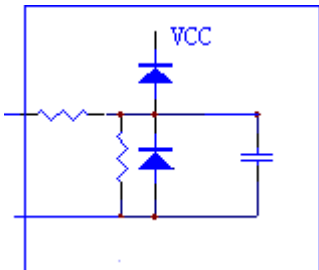
100~240V AC type

| Item | SMT4-EA-R10 | SMT4-EA-R20 |
|--------------------------|--|-------------------------------------|
| Input circuit components | I1~I6 | I1~I9,IA,IB,IC |
| |  | |
| Quantity | 6 (digital input) | 12 (digital input) |
| Input signal current | AC 240V 1.3mA | AC 240V 1.3mA |
| Input ON current | > AC 79 V / 0.41mA | > AC 79 V / 0.4mA |
| Input OFF current | < AC 40 V / 0.28mA | < AC 40 V / 0.15mA |
| Wire length | < / = 100 m | < / = 100 m |
| Input response time | On=>Off | On=>Off |
| | Typical 50/60 Hz 50/45 ms(AC 110 V) | Typical 50/60 Hz 50/45 ms(AC 110 V) |
| | Typical 50/60 Hz 90/85 ms(AC 220 V) | Typical 50/60 Hz 90/85 ms(AC 220 V) |
| | Off=>On | Off=>On |
| | Typical 50/60 Hz 50/45 ms(AC 110 V) | Typical 50/60 Hz 50/45 ms(AC 110 V) |
| | Typical 50/60 Hz 22/18 ms(AC 220 V) | Typical 50/60 Hz 22/18 ms(AC 220 V) |

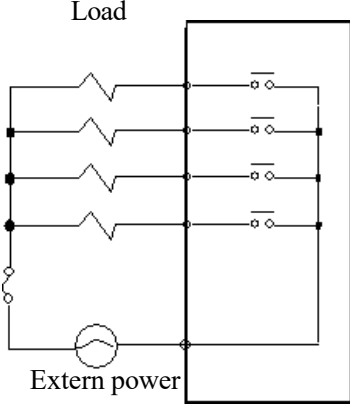
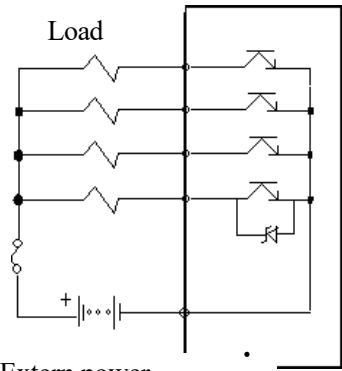
12/24V DC type 12 I/O

| Item | SMT4-ED-R12 & SMT4-ED-T12 | | | |
|--------------------------|--|---|---|-------------------------------|
| | General digital input | High speed input | Analog input | |
| Input circuit components | I3~I6  | I1, I2  | A1, A2  | |
| Quantity | 4 | 2 | 2 | |
| Input signal current | 3.2mA:12/24VDC | 3.2mA:12/24V DC | <0.17 mA/0~10V | |
| Input current ON | >1.52mA/10V | >1.52mA/10V | >0.161mA/9.8V | |
| Input current OFF | < 1.136mA/7.5V | < 1.136mA/7.5V | < 0.085mA/5V | |
| Wire length | < / = 100 m | < / = 100 m | < / = 100 m | < / = 30 m (shielded wire) |
| Input response time | On=>Off | On=>Off | On=>Off | |
| | 0.3ms | 0.03ms | Typical: 5ms | |
| | Off=>On | Off=>On | Off=>On | |
| | 0.6ms | 0.4ms | Typical: 3ms | |
| Input voltage | | | | 0~10 V DC |
| Display class | | | | 0.01V DC |
| Conversion bits | | | | 12 |
| Error with actual value | | | | ±2%±0.12 V |
| Conversion time | | | | 1 CPU scanning cycle |
| Sensor resistance | | | | <1K ohm |

12/24V DC type 20 I/O

| Item | SMT4-ED-R20 & SMT4-CD-R20 & SMT4-CD-T20 | | | |
|-------------------------|--|---|--|-------------------------------|
| | General digital input | High speed input | Analog input | |
| Input circuitry | I3~I8  | I1, I2  | A1、A2、A3、A4  | |
| Quantity | 6 | 2 | 4 | |
| Input signal current | 3.2mA:12/24V DC | 3.2mA:12/24V DC | <0.17 mA/0~10V | |
| Input ON current | >1.52mA/10V | >1.52mA/10V | >0.163mA/9.8V | |
| Input OFF current | < 0.625mA/7.5V | < 0.625mA/7.5V | < 0.083mA/5V | |
| Wire length | < / = 100 m | < / = 100 m | < / = 100 m | < / = 30 m (Shielded wire) |
| Input response time | On=>Off | On=>Off | On=>Off | |
| | 0.3ms | 0.03ms | Typical: 5ms | |
| | Off=>On | Off=>On | Off=>On | |
| | 2ms | 0.4ms | Typical: 3ms | |
| Input voltage | | | | 0~10 V DC |
| Display class | | | | 0.01V DC |
| Conversion bits | | | | 12 |
| Error with actual value | | | | ±2%±0.12V |
| Conversion time | | | | 1 CPU scanning cycle |
| Sensor resistance | | | | <1K ohm |

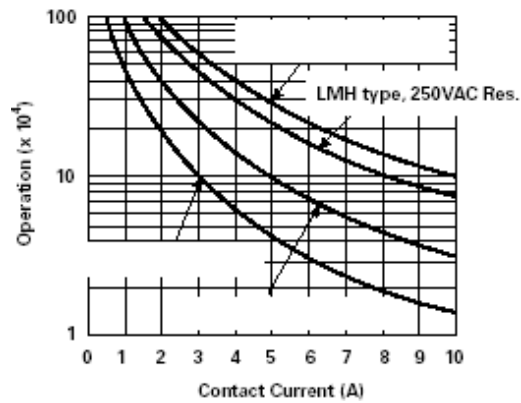
Output Specifications

| content | | relay | transistor |
|---------------------|-----------|---|--|
| output circuitry | |  |  |
| Extern power | | Less than AC265, DC30V | 23.9~24.1V |
| circuitry isolation | | mechanism isolation | Photo couplers isolation |
| Maximal Load | Resistive | 8A/point | 0.3A/point |
| | Inductive | — | — |
| | light | 200W | 10W/DC 24V |
| Open drain current | | — | <10uA |
| Minimum Load | | — | — |
| Response time | OFF ON | 15 ms | 25 us |
| | ON OFF | 15 ms | Less than 0.6 ms |

Precautions for Output Terminal Connection

Relay life

Life Expectancy



Note 1: The above shown is standard value, but relay life may be affected by temperature of the operating environment.

Note 2: Relay life is generally over 100 thousand times when current is below 2A.

Power module

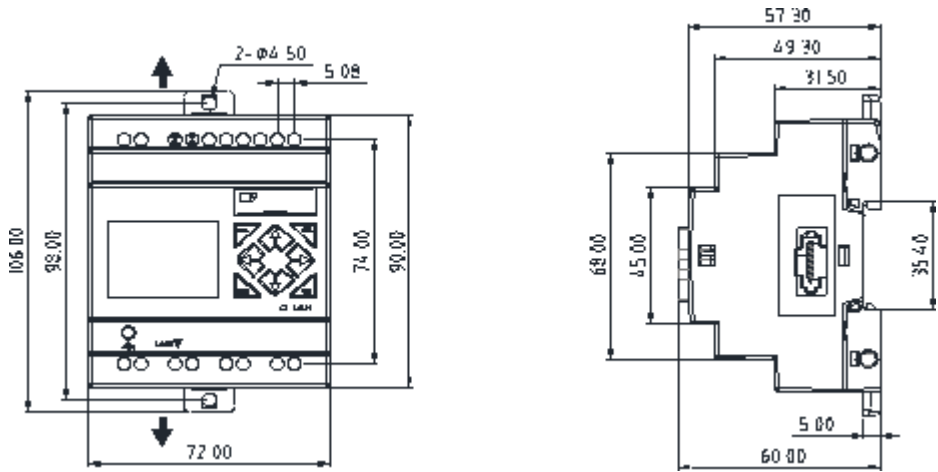
| | |
|---------|-----------------------|
| Module | Input/output |
| DC +24V | AC 100~240V / DC +24V |

Optional accessories

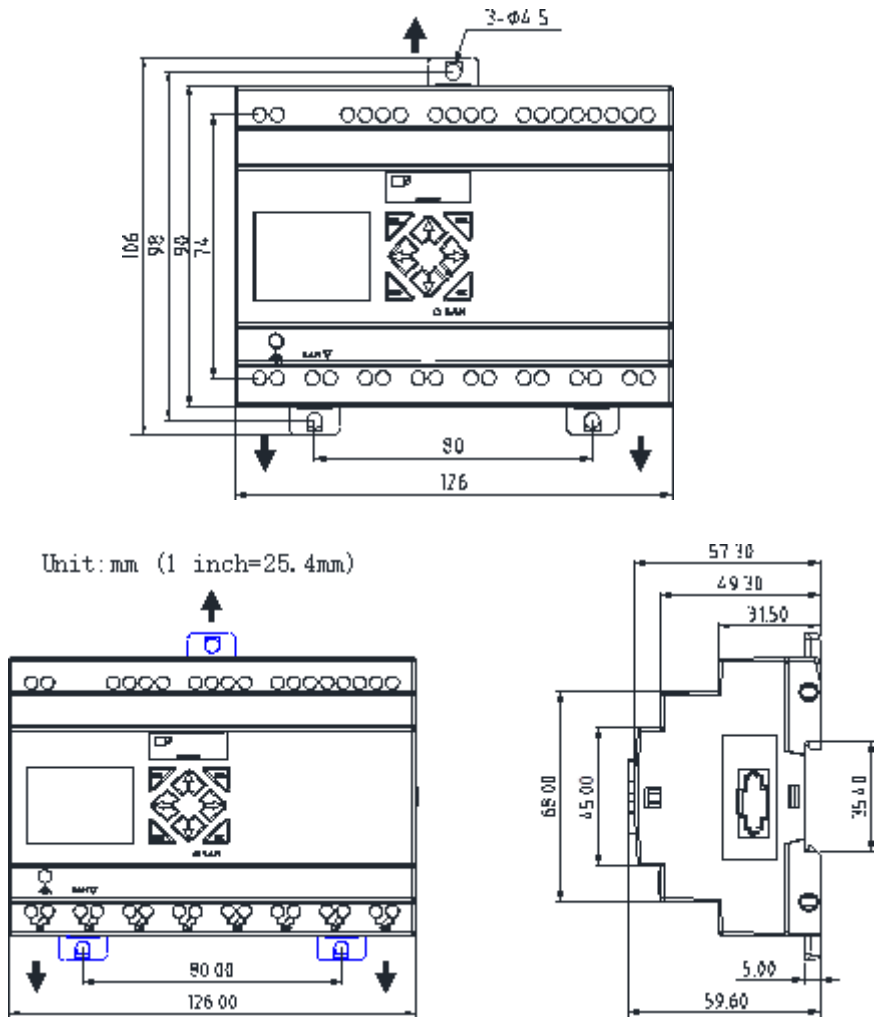
| MODE | Description |
|------------|----------------------|
| SMT Client | Programming Software |

Outline Drawing (unit: mm)

© 10/12 points



© 20 points



Chapter 8 Function Specification of CD/ED RS485 High-Performance Type

| | |
|---|-----|
| Chapter 8 Function Specification of CD/ED RS485 High-Performance Type | 277 |
| Communication Specifications | 278 |
| Function Description | 280 |
| MU instructions (Modbus communication master function) | 284 |
| Modbus communication slave function | 286 |
| Modbus communication protocol | 286 |

RS485 function is specific to SMT4-CD-R20 and SMT4-TD-R20 types. The RS485 interface of SMT4-CD-R20 and SMT4-TD-R20 can be connected to industrial equipment with RS485 communication function and itself. Take two SMT with RS485 function communicating through RS485 interface as an example (one host and one slave). The master and slave positions have the following requirements:

- a. If the slave is placed on the left or right of the host, it shall be at least 10mm away from the host
- b. If the host is connected to the module, the slave should be placed behind the module, at least 10mm away from the module
- c. The slave can only be placed on the left or right sides of the host.

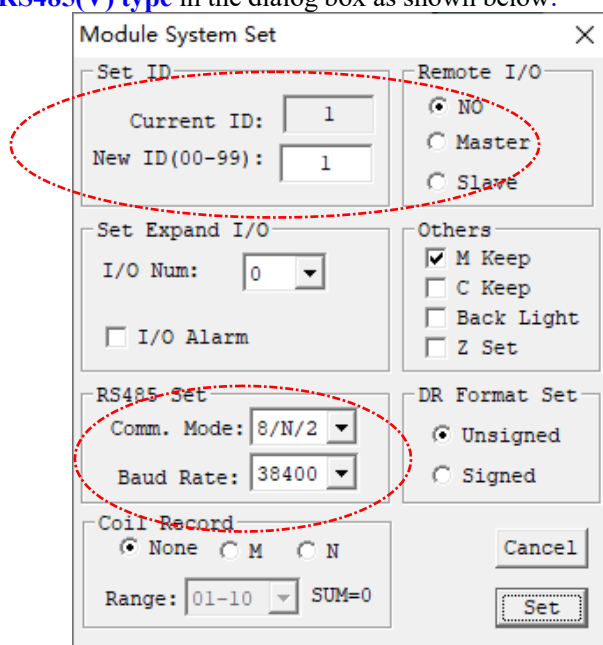
Communication Specifications

Note: Any function using RS485 communication port requires for setting the matching functional and communication parameters to ensure normal use.

The functional and communication parameters of SMT RS485 port are optional and can be set according to the following 2 methods:

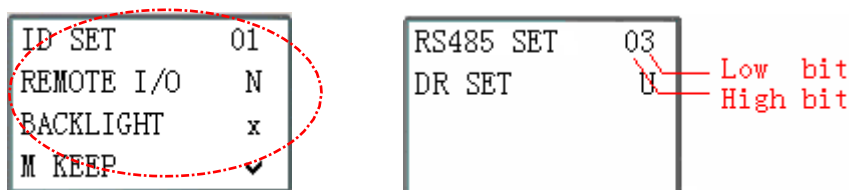
● PC-connected software setting

- (1) Open the dialog box “**Module System Set**” in the “**Operation**” menu of PC-connected software.
- (2) Set **ID**, **Remote I/O** and **RS485(V) type** in the dialog box as shown below:



● SMT keypad setting:

- (1) Press to enter the main menu.
- (2) Move the cursor to the system setting menu and press OK
- (3) Press ↓ to enter the setting menu for setting of **ID**, **Remote I/O** and **RS485**, as shown below.



- (4) In **RS485 setting**, the upper bit is communication mode and lower bit is baud rate
- (5) Select the required setting and press OK to save it.

Functional parameters:

| | | | |
|------------|----|---|---|
| ID setting | 01 | ➔ | ID setting (00~99) |
| Remote I/O | N | ➔ | Remote IO mode (N: none M: master S: slave) |

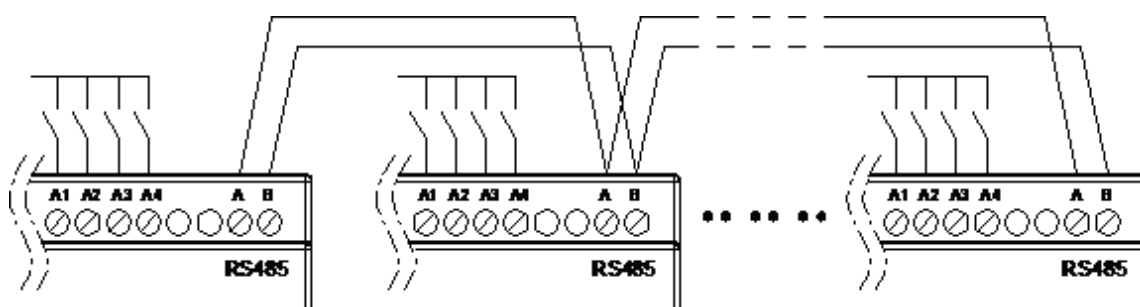
Function description:

| Function | ID setting | Remote I/O setting | Description |
|----------------------------|------------|--------------------|---|
| Remote IO function | 00~99 | M & S | Two sets (master, slave) connected; |
| IO Link function | 0~7 | N | 8 sets connected at most; ID setting being continuous 0~7; |
| MU instructions | 1~99 | N | MU may be enabled when there is no remote I/O and I/O Link function; |
| Modbus communication slave | 1~99 | N | Slave function may be enabled when there is no remote I/O function, I/O Link function and MU instruction. |

Communication format parameters:

| RS485 setting | Data | Meaning |
|--------------------|------|--|
| Communication mode | 0 | 8/N/2: 8 data bits without check, 2 stop bits; |
| | 1 | 8/E/1: 8 data bits with even parity check, 1 stop bit; |
| | 2 | 8/O/1: 8 data bits with odd parity check, 1 stop bit; |
| | 3 | 8/N/1: 8 data bits without check, 1 stop bit. |
| Baud rate | 0 | 4800 bps |
| | 1 | 9600 bps |
| | 2 | 19200 bps |
| | 3 | 38400 bps |
| | 4 | 57600 bps |
| | 5 | 115200 bps |

- ✘ SMT ID is 1 and remote I/O function is none (N) by default.
- ✘ SMT communication parameter setting is 8/N/2 (8 data bits without check, 2 stop bits) and baud rate is 38400 bps by default.
- ✘ The parameters become effective after power-on again.



Function Description

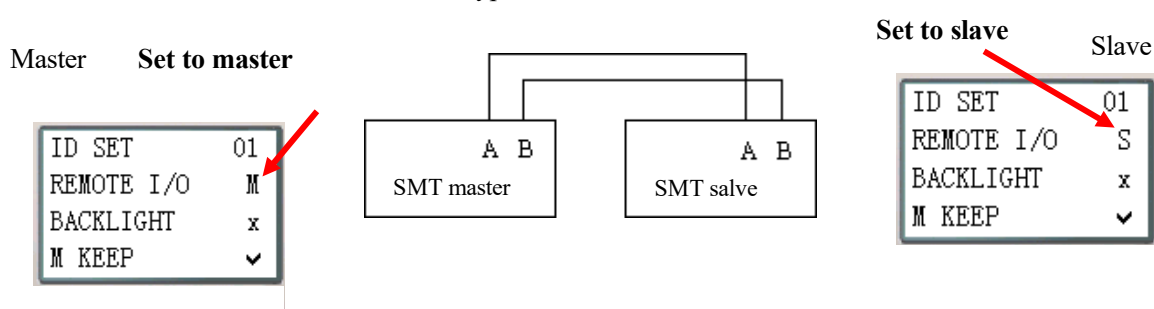
Function description:

SMT slave input (I)/output (Q) is used as extended input (X)/output (Y) of SMT master.

| I/O address | Master (M) | Slave (S) |
|----------------------|------------|-----------|
| Input coil | I01~I0C | |
| Output coil | Q01~Q08 | |
| Extended input coil | X01~X0C | I01~I0C |
| Extended output coil | Y01~Y08 | Q01~Q08 |

Hardware setting:

1. Connect A and B lines of two SMT of RS485 type, as shown below



2. Set the REMOTE I/O option under SET menu of one SMT as M (master)
3. Set the REMOTE I/O option under SET menu of another SMT as S (slave)

Logic program runs in the master, but not in the slave.

The master writes extended output Y to slave Q, and the slave writes input I to extended input X of the master.

※Extended I/O module should not be used when remote I/O function is used.

Example:

Write program in SMT master, and run the program to observe status of coils X and Y

X02—————Y01
X03—————Y02

Connect input coils I02~I03 in SMT slave and check status of the coils is consistent with coils X02~X03 in SMT master. SMT slave outputs Q01 when IO2 is connected, and outputs Q02 when I03 is connected

I/O status of slave during running

```

I. 1 2 3 4 5 6 7 8 9 0 A B C
Z. 1 2 3 4
Q. 1 2 3 4 5 6 7 8 9 0 A B C
MO 14 : 42

```

Extended I/O status of master during running

```

X. 1 2 3 4 5 6 7 8 9 0 A B C
Y. 1 2 3 4 5 6 7 8 9 0 A B C
EXE
2010.05.09

```

Function description:

An IO Link is composed of 8 SMT of RS485 type at most, where each contact is used as an independent station for running of its logic program and all slave contacts are connected to the same master station. IO Link ID must be continuous and be 0~7; master station ID is 0, and slave station ID begins from 1 to 7; if slave station ID is not continuous, such as 1, 2, 4, 5, the master station will take it as there are only two slave stations 1 and 2 and communicate with slave stations 1 and 2 only

When each station uses L01~L08, only one can be set as mode 1: sending mode, and the other L can only be set as mode 2: receiving mode.

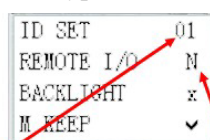
Sending mode: Address in W table is controlled by ID of SMT itself and cannot be changed, and status of the selected coil is put in the corresponding W table. The correspondence of ID and W table is shown in the following table.

Receiving mode: content of the selected W table is transferred to the selected coil; if input coil I or X is selected, content of W table will not change status of coils I and X.

Hardware setting:

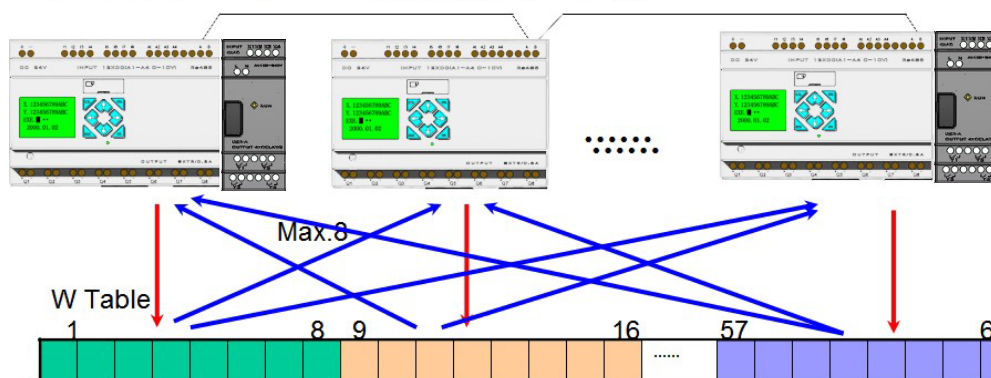
1. Connect A and B lines of multiple (1~8 sets) SMT of RS485 type, as shown below.

- max. 8 points I/O send per stations
- Max 7*8 (=56) points I/O received per station



ID must set to be 0,1,2,...(max to 7)

Remote I/O disable

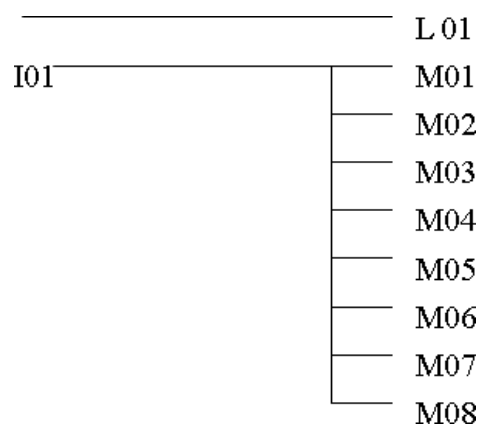


| ID | W table comparison |
|----|--------------------|
| 0 | W01~W08 |
| 1 | W09~W16 |
| 2 | W17~W24 |
| 3 | W25~W32 |
| 4 | W33~W40 |
| 5 | W41~W48 |
| 6 | W49~W56 |
| 7 | W57~W64 |

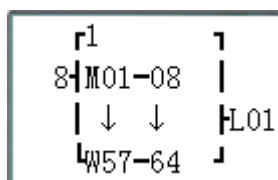
2. Set the Remote I/O option under SMT SET menu as N (no remote IO) ;
3. Set the ID SET option under SMT SET menu as 00, 01, 02, ...(maximum ID SET is 07) ;

Example:

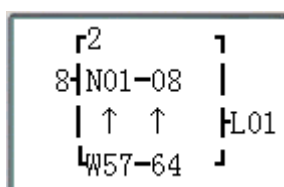
1. Connect points A and B of 8 SMT of 20-point RS485 type, as shown above
2. Set its ID as 00~07, and edit the program under Ladder as below



3. Select SMT program with ID=7 and set L01 as below:



4. Set L01 of the other 7 programs as below



5. Power on and run the program, and control the SMT of ID=7; M01~M08 output ON when I01 is ON
6. Observe the other 7 SMT, and check output status of N01~N08 is consistent with status of M01~M0 with ID-7.

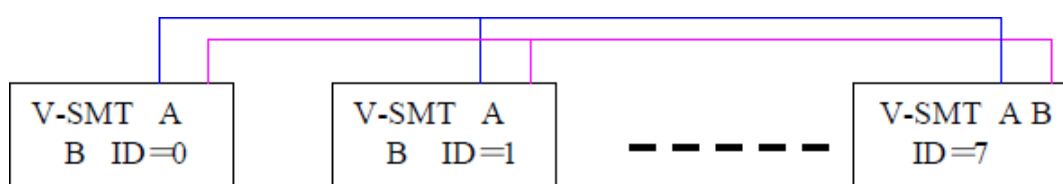
MU instructions (Modbus communication master function)

Modbus block of RS485 type realizes Modbus RTU master communication through RS485 interface. In Ladder programming mode, there are 15 Modbus blocks (MU01~MU0F); in FBD programming mode, 250 Modbus blocks can be used at most.

Multiple communication instructions may be used in a program, but only one instruction can be driven at the same time. For example, when multiple Modbus instructions are used and enabled, only one instruction utilizes serial port for execution of its function (coil B outputs ON in FBD mode), while the other Modbus instructions keep the enabled state but do not execute function, namely the other instructions enter the execution waiting state (coil B outputs OFF in FBD mode). When the Modbus instruction utilizing serial port is disabled and releases the serial port after the end of an instruction cycle, the other enabled Modbus instructions begin to preempt the serial port.

Hardware setting:

1. Connect A and B lines of RS485 type SMT with another Modbus slave, as shown below:



2. Set the Remote I/O option under SMT SET menu as N (No remote I/O);
3. Set the ID SET option under SMT SET menu as 01~99 (not 00);

Comparison table of Modbus mode and communication function code:

| Mode | Function code |
|------|------------------------------|
| 1 | 03 (read register) |
| 2 | 06 (write a single register) |
| 3 | 10 (write various registers) |
| 4 | 01 (read coil) |
| 5 | 05 (write a single coil) |

| | |
|------------|----|
| ID SET | 01 |
| REMOTE I/O | N |
| BACKLIGHT | x |
| M KEEP | ✓ |

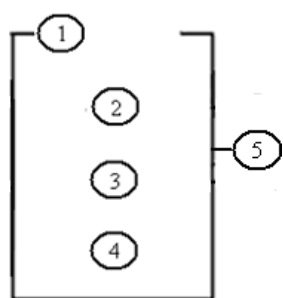
Contacts used during execution of Modbus instructions:

| | |
|-------------------------|---|
| Receiving completed M3D | After completion of receiving, M3D is set for error checking, and the received data is sent to the designated register if no error is found; |
| Error indication M3E | Communication error indication |
| Timeout judgment M3F | Enter the receiving waiting state after completion of sending; when timeout is determined as no data is received within the specified time period, the timeout output flag M3F is ON, receiving is ended and M3D outputs ON; M3F is automatically reset at the time of M3D resetting. |

Timeout judgment and time-out period are determined by baud rate.

| Baud rate (bps) | Timeout (ms) |
|--------------------------|--------------|
| 4800, 9600, 19200, 38400 | 125 |
| 57600 | 100 |
| 115200 | 80 |

In Ladder mode, Modbus block has 5 parameters, the display and meaning of which are listed below.

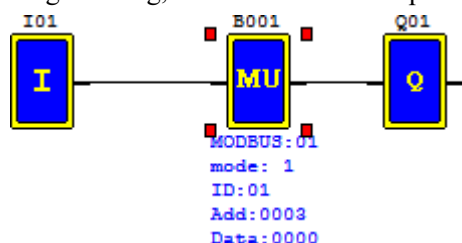
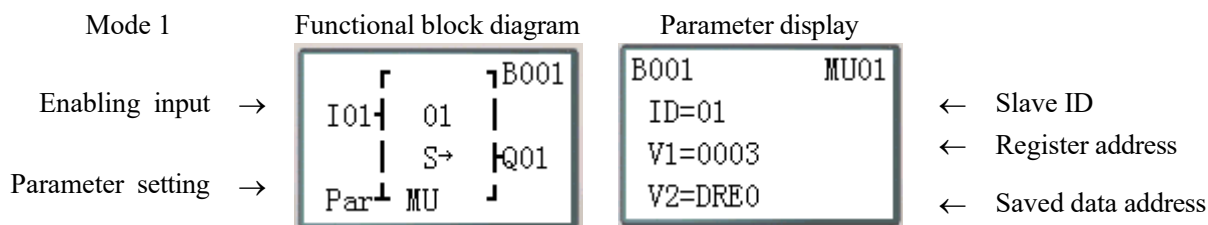


| Symbol | Description |
|--------|--|
| ① | MU block mode 1~5 |
| ② | Communication address: Slave ID, range 0~7f |
| ③ | Communication command address and communication data length: 1) Constant, range 0000~ffff; Data length of modes 1 and 3 is 1 word; Data length of mode 4 is 16 bits; 2) DR number, command address and length being stored from the DR |
| ④ | DR number, data sent/received being stored from the DR |
| ⑤ | MU code (MU01~MU0F) |

Refer to [Chapter IV: Ladder Programming Instructions-MU \(Modbus\) Instructions \(for RS485 type only\)](#) for examples of the function.

✖ The maximum communication data length of modes 1 and 3 is 25 words, and that of mode 4 is 400 bits.

Programming, functional block and parameter display in FBD mode

Refer to [Chapter V: FBD Programming Instructions- Modbus block Diagram](#) for examples of the function.

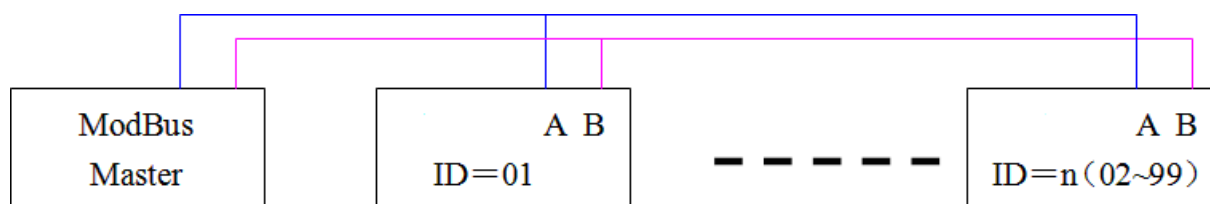
✖ The maximum communication data length of modes 1 and 3 is 25 words, and that of mode 4 is 400 bits.

Modbus communication slave function**Function description:**

According to Modbus communication protocol, SMT, as Modbus communication slave, supports reading and writing coil status, reading the current value of functional blocks, writing, and reading the preset value of blocks, and control of running and stop status of SMT. The maximum transmission capacity is 128 bytes.

Hardware setting:

1. Connect A and B lines of multiple SMT of RS485 type, and connect to Modbus communication master, as shown below



2. Set the Remote I/O option under SMT SET menu as N (No remote I/O)
3. Set the ID SET option under SMT Set menu as 01~99 (not 00)

| | |
|------------|----|
| ID SET | 01 |
| REMOTE I/O | N |
| BACKLIGHT | x |
| M KEEP | ✓ |

Modbus communication protocol

When SMT receives the correct command format from upper computer or computer, SMT will execute the command. After processing, SMT will send the correct format back to the upper computer or computer. In case of abnormal content or unallowable command, SMT will send a response format to the upper computer or computer.

- Command format and response format:

| CRC check range | | | |
|-----------------|---------------|------|--------|
| Slave address | Function code | Data | CRC-16 |

- Exception response format:

| CRC check range | | | |
|-----------------|---------------|----------------|--------|
| Slave address | Function code | Exception code | CRC-16 |

Description:

| Slave address | Function code | | Data | CRC-16 | Exception code |
|-----------------------------------|---------------|--------------------------|--|--|---|
| 00H: broadcast to all the drivers | 01H | Read coils | For detail please refer register address | CRC verifying range contain Slave Address Function Code Exception Code | For detail, please refer Exception Code Instruction |
| 01H: to the No.01 driver | 05H | Write single coil | | | |
| 0FH: to the No.15 driver | 03H | Read registers | | | |
| 10H: to the No.16 driver | 06H | Write single register | | | |
| | 10H | Write multiple registers | | | |
| 63H: to the No.99 driver | 08H | diagnostic | | | |

Note: The receiving response time on the master computer side (timeout) should be the time of communication command of the maximum 128 bytes (based on baud rate) plus the waiting time of PLC scanning cycle.

Exception code

In case of exception during online communication, the upper computer will send the function code followed by 80H (final bit set as 1) to the master system together with exception code.

| Exception code | Description |
|----------------|--|
| 51H | Communication command error (function code error, invalid data address, parity error etc.) |
| 52H | Communication command error in the Run mode |
| 53H | Communication command error in the Password mode |
| 54H | Invalid data |
| 55H | Reserved |
| 56H | Reserved |
| 57H | SMT other errors |
| 58H | SMT editing mode (Ladder/FBD) error |
| 59H | Reserved |

Register address

| Register address | Function | Available function code | |
|--------------------|---------------------------|-------------------------|-----------------------------|
| 0000H~0016H | Coil (word) status | 03H, 06H, 10H | |
| 0100H~012FH | Control command | 03H, 06H, 10H | |
| 0200H~0237H, 0260H | Current value of register | 03H | |
| 0300H~033BH | User-defined character | 03H, 10H | |
| 0400H~043EH | Preset value of register | 03H, 10H | |
| 0500H~05FFH | Coil (bit) status | 01H, 05H | |
| 0600H~0630H | Coil (word) status | 03H, 06H, 10H | SMT New register address |
| 0700H~072FH | Control command | 03H, 06H, 10H | |
| 0800H~11EFH | Current value of register | 03H | |
| 1200H~2703H | Preset value of register | 03H, 06H, 10H | |
| 2B00H~2E0FH | Coil (bit) status | 01H, 05H | |

Chapter 9 Extended Module Instructions

| | |
|--------------------------------------|-----|
| Overview | 289 |
| Module Power | 291 |
| Module Dimensions..... | 291 |
| Extended Digital IO Modules..... | 294 |
| Extended Analog Modules | 299 |
| Analog input module 4AI..... | 299 |
| Temperature input module 4PT | 300 |
| Analog output module 2AO..... | 301 |
| Extended Communication Modules | 303 |
| Extended MBUS module..... | 303 |
| Extended DNET module | 306 |
| Extended PBUS module..... | 309 |

Overview

Digital Input/Output module: SMT-MA-R8 , SMT-MD-8 ,SMT-MD -T8

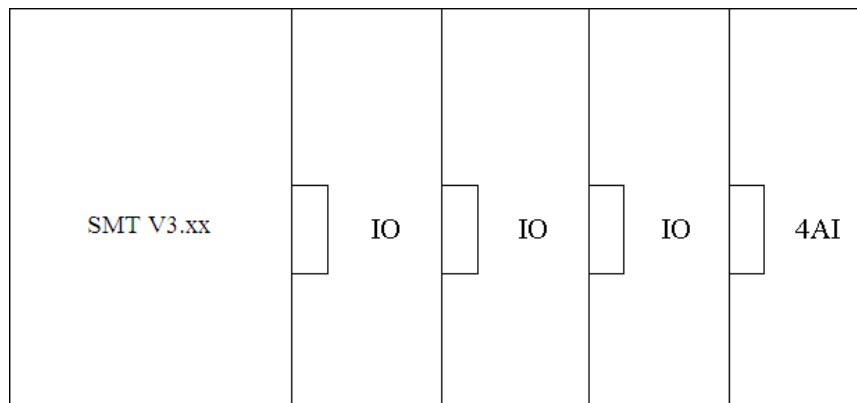
Analog Input module: SMT-4PT, SMT-4AI

Analog Output module: SMT-2AO

iSmart can connect with expansion module. The maximal connectible number to the expansion module is: 3 Digital IO modes, 2 Analog Output modes, 2 Analog Input modules (one 4PT and one 4AI). If the iSmart system is combined with digital IO, analog IO and communication module, it must follow the standard arrangement, “SMT + digital IO module + analog IO module”, otherwise it cannot work correctly.

SMT-4AI must be the last one of analog module.

Mainframe + digital IO * 3 + 4AI*1

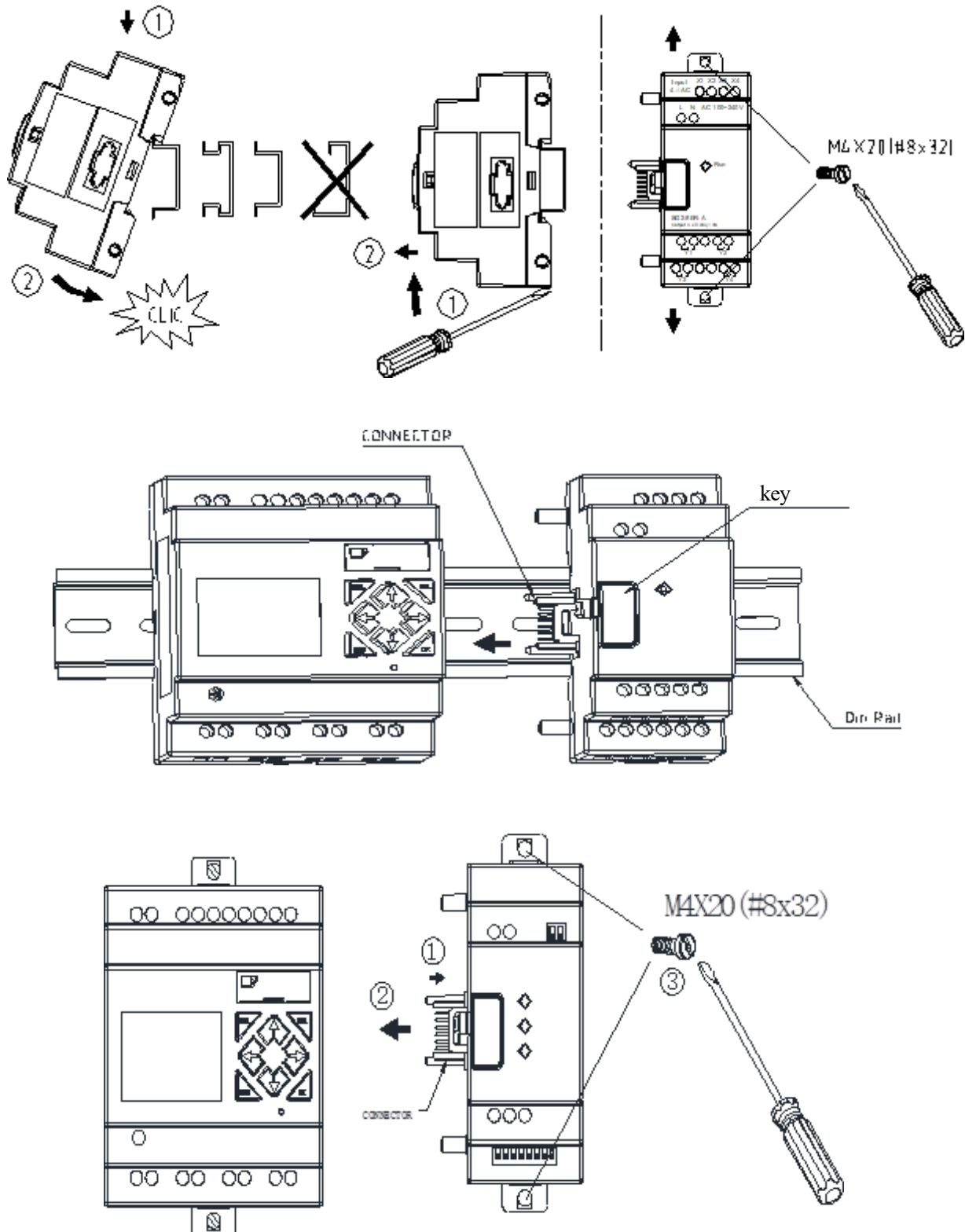


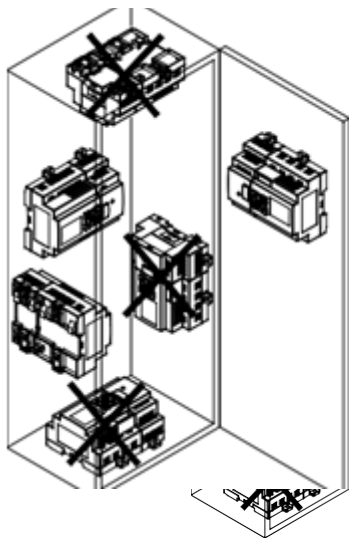
| Expansion module | Add single module Influence | Max connecting num | Max influence to scanning cycle |
|----------------------|-----------------------------|--------------------|---------------------------------|
| Digital I/O module | scanning cycle +1ms | 3 | +1 ms*3=3ms |
| 4PT module | scanning cycle +7ms | 1 | +7 ms*1=7ms |
| 2AO module | scanning cycle +8ms | 2 | +8 ms*2=16ms |
| 4AI module | scanning cycle +13ms | 1 | +13ms*1=13ms |
| Communication module | scanning cycle +4~16ms | 3 | +4~16ms*3=12~48ms |

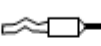
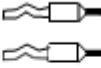



1. The scanning cycle of SMT is **2~20ms**, which will be extended if extended modules are connected; specifically, the cycle will be extended by **1ms** per digital I/O, by **7ms** per 4PT module, by **8ms** per 2AO module, by **13ms** per 4AI module and by 4~16ms per communication module. In addition, the scanning cycle will be extended by about 100ms when the preset value of SMT functional block is modified by communication module.
2. 4PT data of one channel is updated in each host scanning cycle, and data of 4 channels is updated after 4 host scanning cycles.





Installation

The installation method of all SMT expansion modules is the same, Modules are connected to each other via connectors as shown below:





| | | | | | |
|-----------------|---|---|---|---|---|
| |  |  |  |  |  |
| mm ² | 0.14...1.5 | 0.14...0.75 | 0.14...2.5 | 0.14...2.5 | 0.14...1.5 |
| AWG | 26...16 | 26...18 | 26...14 | 26...14 | 26...16 |

| | | | |
|--|--|---|---|
|  ø 3.5 (0.14in) |  C |  C |  |
| | C | Nm | 0.6 |
| | | lb-in | 5.4 |

DANGER:
HAZARDOUS VOLTAGE
Cut off all power before maintenance
Electric shock will result in death or serious injury.

Extended Digital IO Modules

The number of extended digital IO modules connected should be set in the system. In case of setting error, the extended digital IO modules cannot be used normally, and use of the connected analog modules and communication modules will be affected.

Setting method of extended IO:

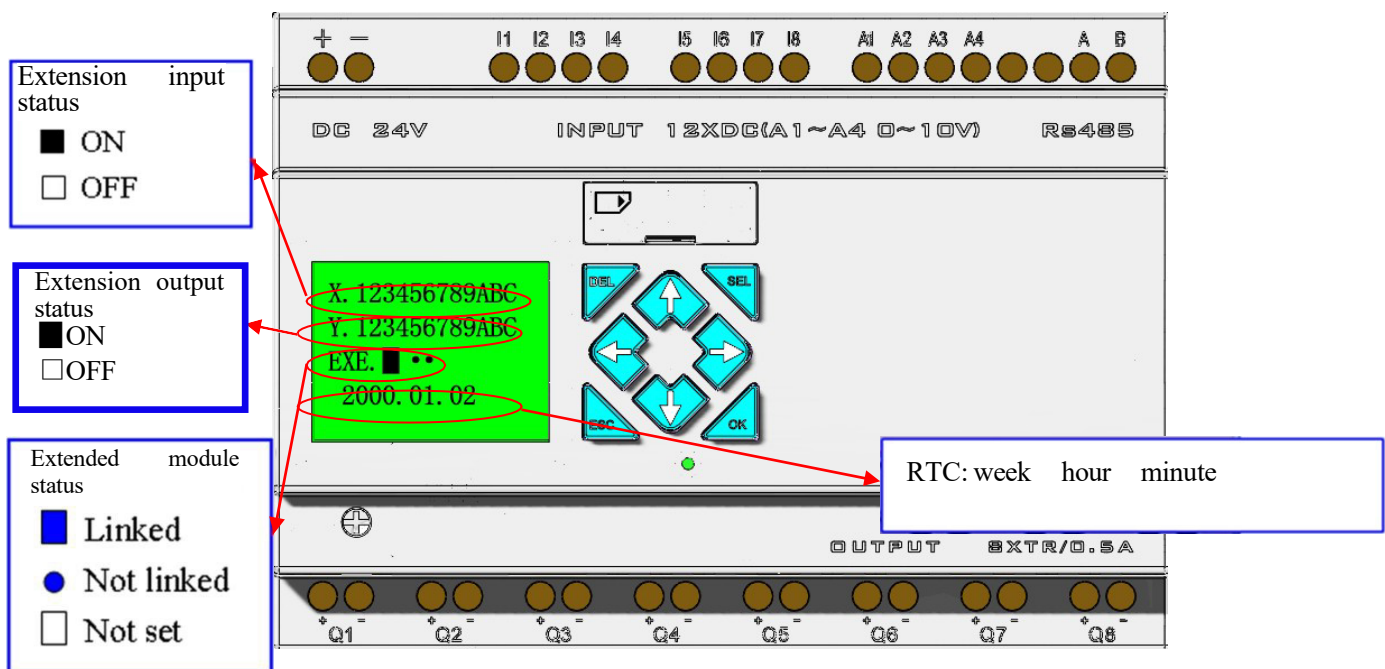
1. Key setting menu:



2. SMT Client setting menu:

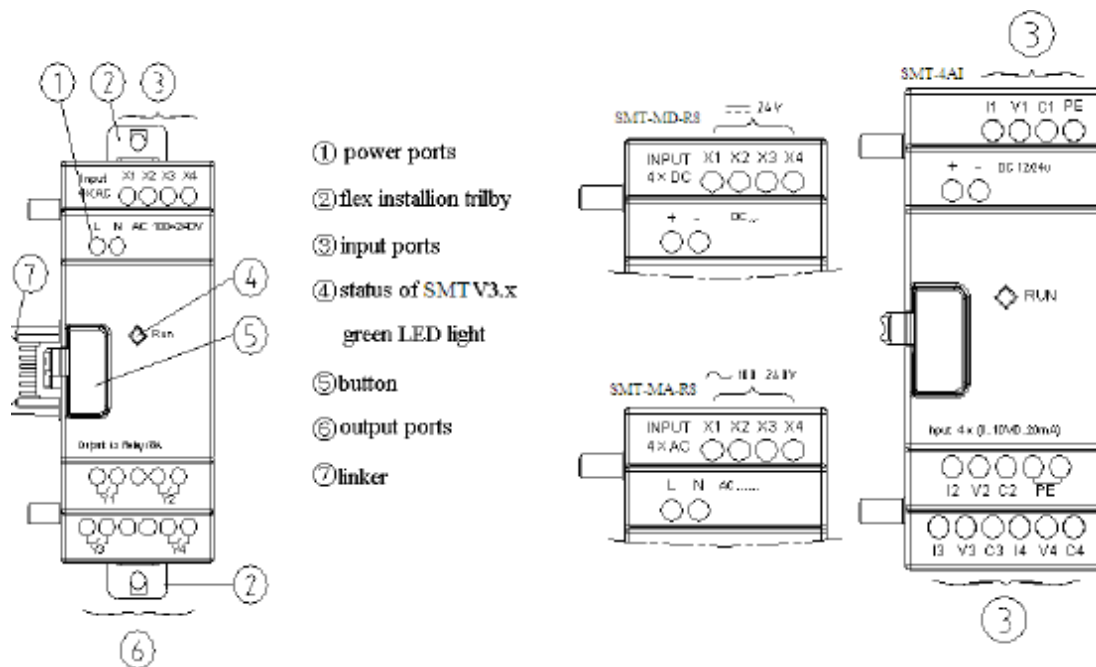
| Module System Set | |
|--|---|
| Set ID Current ID: <input type="text" value="1"/> New ID(00-99): <input type="text" value="1"/> | Remote I/O <input checked="" type="radio"/> NO <input type="radio"/> Master <input type="radio"/> Slave |
| Set Expand I/O I/O Num: <input type="text" value="0"/> <input type="checkbox"/> I/O Alarm | Others <input checked="" type="checkbox"/> M Keep <input type="checkbox"/> C Keep <input type="checkbox"/> Back Light <input type="checkbox"/> Z Set |
| RS485 Set Comm. Mode: <input type="text" value="8/N/2"/> Baud Rate: <input type="text" value="38400"/> | DR Format Set <input checked="" type="radio"/> Unsigned <input type="radio"/> Signed |
| Coil Record <input checked="" type="radio"/> None <input type="radio"/> M <input type="radio"/> N Range: <input type="text" value="01-10"/> SUM=0 | <div>Cancel</div> <div>Set</div> |

Display status of digital IO extension



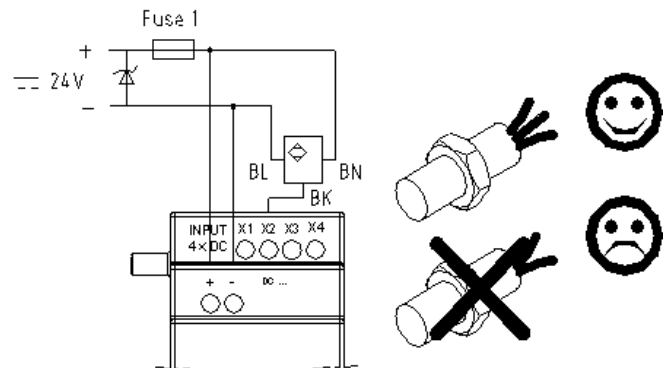
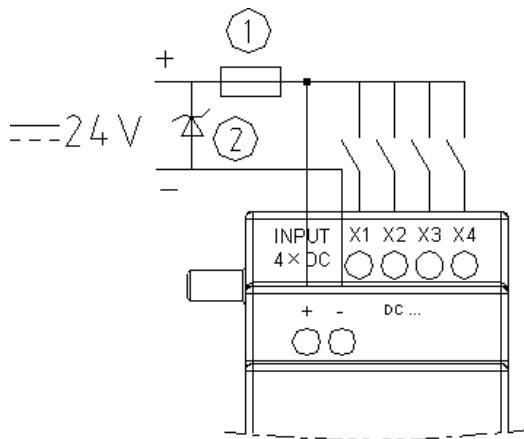
Installation and wiring

SMT-MD-R8/T8, SMT-MA-R8/MA24-R8

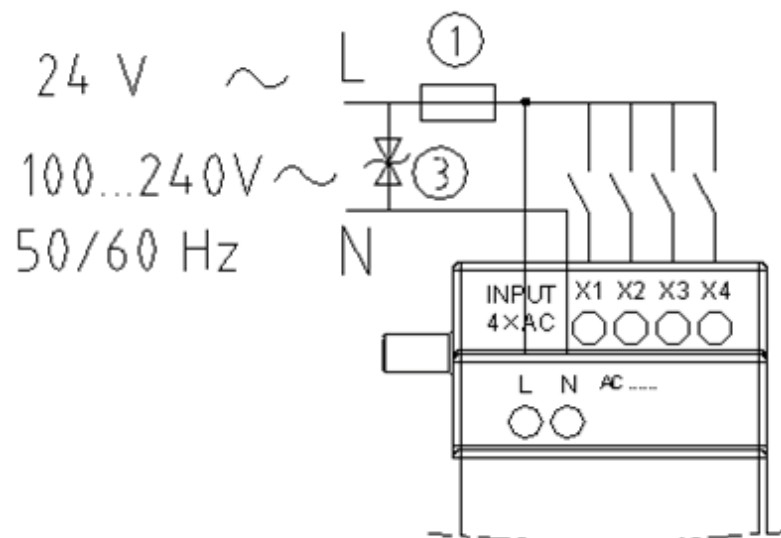


Wiring

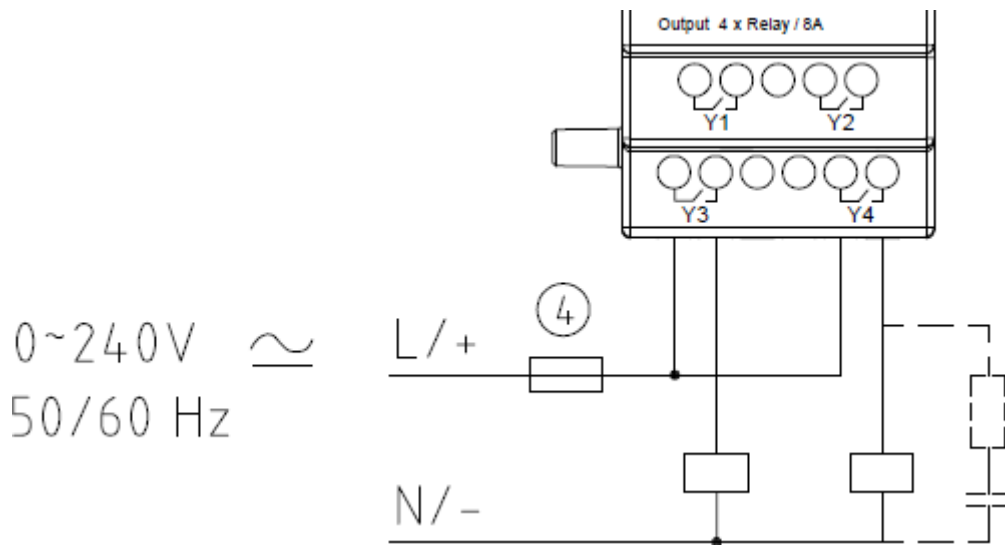
1) Input 24V DC



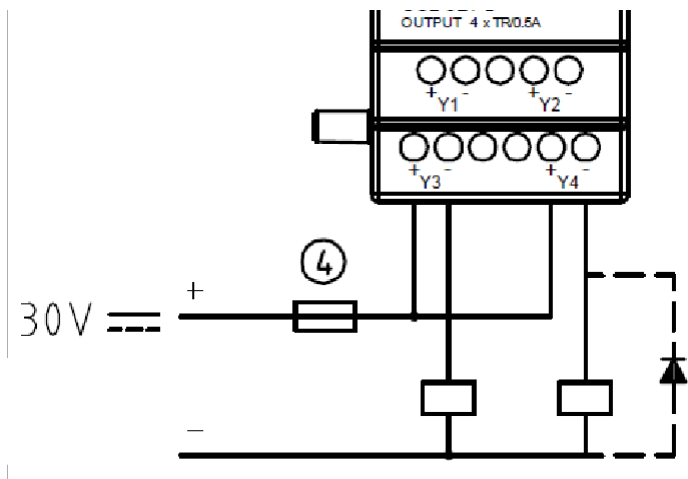
2) Input 24V/100~240V AC:



Output relay (Relay):

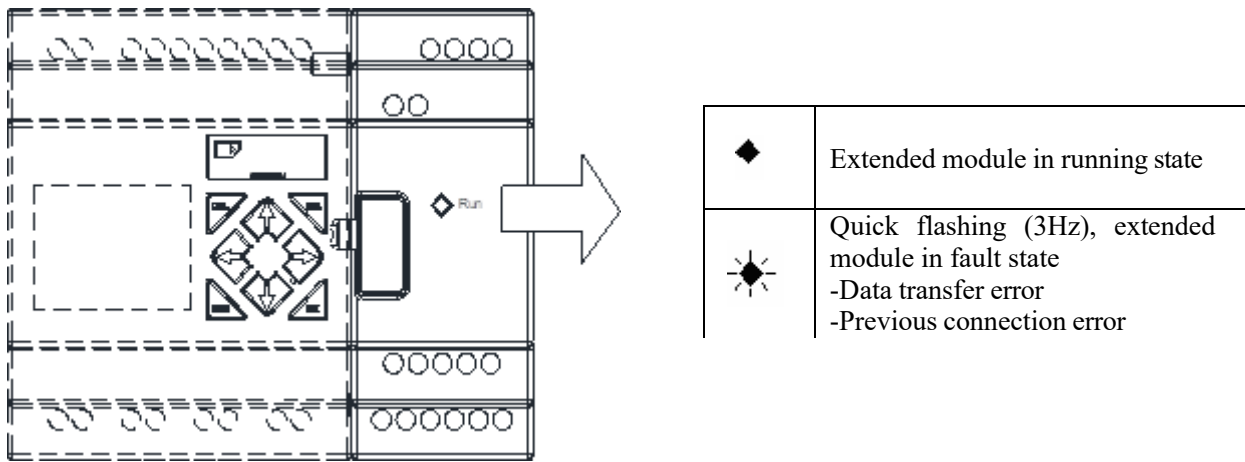


3) Output transistor (Transistor):



- ① -1A fast acting fuse
- ② -Surge absorber (43V DC)
- ③ - Surge absorber (input 100~240VAC: 430V AC)
- ④ -Fuse

Both extended digital module and extended analog module are designed with orange status LED, the display status of which is the same in different operating modes, as shown below:



Extended Analog Modules

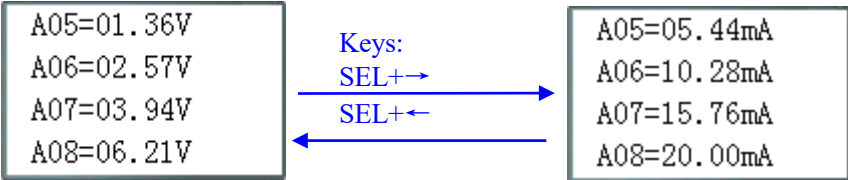
SMT can be simultaneously connected to two 2AO, one 4PT and one 4AI at most.

Analog input module 4AI

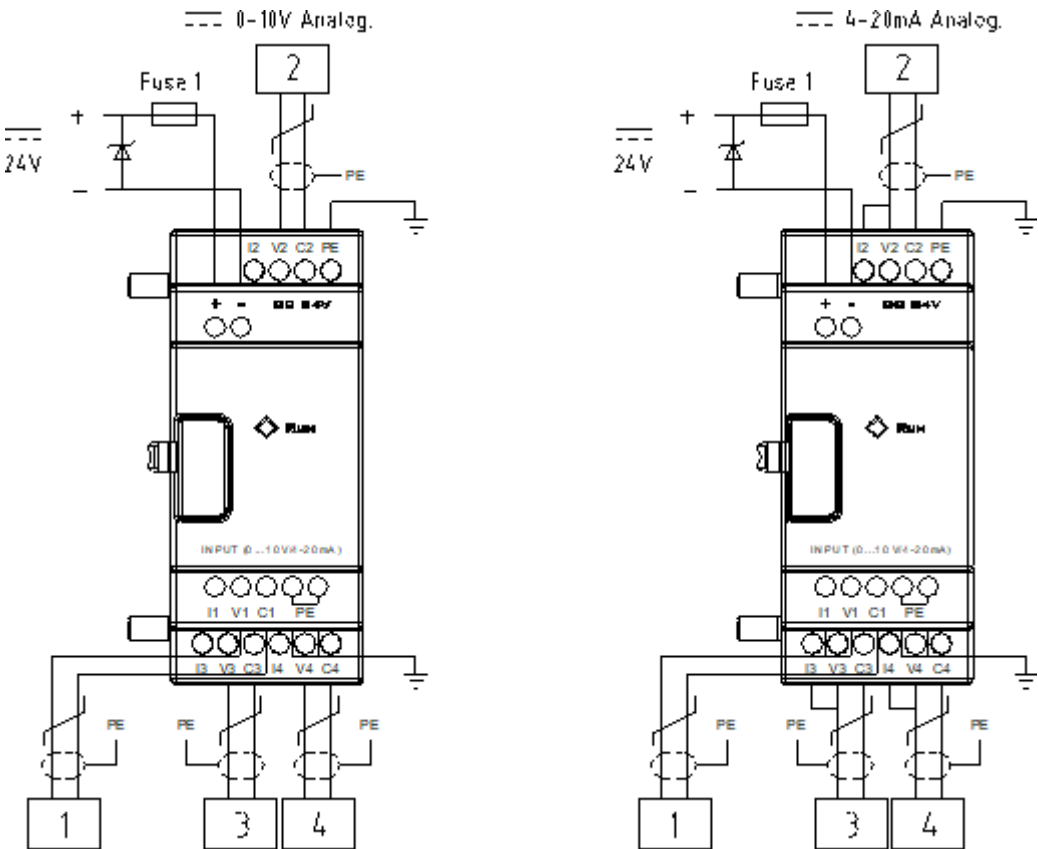
This is 4-channel 12bits analog input module with input corresponding to A05~A08, which is available for input of 0~10V voltage signal or 0~20mA current signal. The 12bit value 0~4095 is stored in register DREC~DREF. When 0~20mA current is input into A05~A08, the corresponding value (0~2000) is stored in DRE4~DRE7.

| Item | | Specification | |
|------------------------------|-----------|---------------|----------------|
| Mode | | Voltage | Current |
| Analog input range | | 0V~10V | 0mA~20mA |
| Resolution | | 10mV | 40μA |
| Digital display | | 0.00V~9.99V | 0.00mA~20.00mA |
| Corresponding register value | A05~A08 | 0~999 | 0~500 |
| | DREC~DREF | 0~4095 | 0~2047 |
| | DRE4~DRE7 | | 0~2000 |
| Accuracy | | ±2.5% | ±2.5% |

Current value display of 4AI input:



Wiring



Temperature input module 4PT

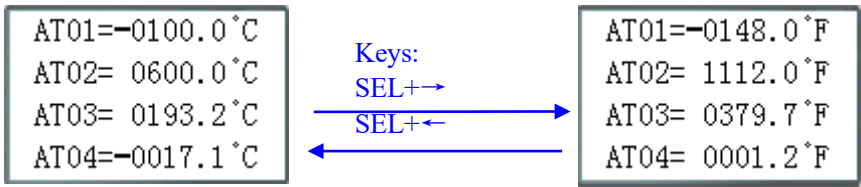
This is 4-channel 12bits temperature (PT100) analog input module with input corresponding to AT01 ~ AT04, which is available for input of -100°C~600°C signal.

| Item | Specification |
|-------------------------|------------------|
| Temperature input range | -100°C~600°C |
| Digital display | -100.0°C~600.0°C |
| Resolution | 0.1°C |
| Accuracy | ±1 % |

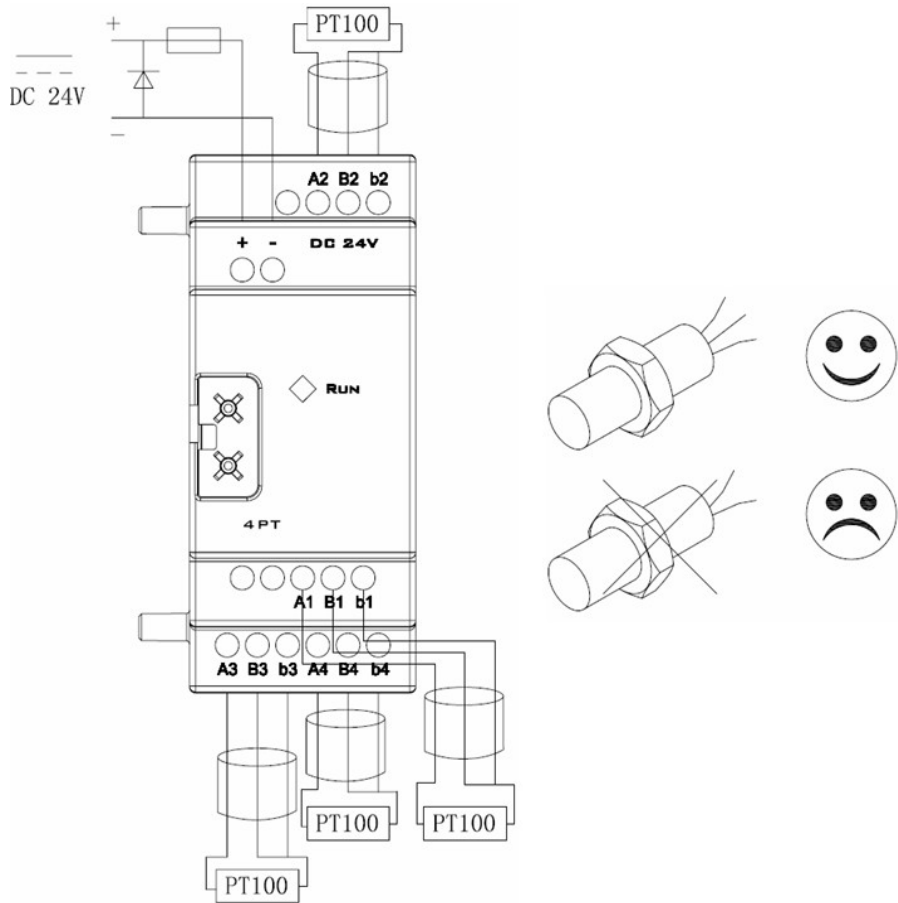
4PT wiring error or lack of connection will lead to input out of range. In this case, SMT does not receive the AT channel corresponding to the temperature, and coil M of the corresponding channel is set ON.

| M coil | AT No. | |
|--------|--------|----------------------------|
| M34 | AT01 | 4PT channel I error flag |
| M35 | AT02 | 4PT channel II error flag |
| M36 | AT03 | 4PT channel III error flag |
| M37 | AT04 | 4PT channel IV error flag |

Current value display of 4PT input:



Wiring



Analog output module 2AO

This is 2-channel 12bits analog output module. Two of the modules can be connected at the same time. Output of the 2AO close to SMT corresponds to AQ01~AQ02, and output of the second 2AO corresponds to AQ03~AQ04. The module enables output of 0~10V voltage signal or 0~20mA current signal. The 12bit value 0~4095 is stored in register DRD4~DRD7.

| Item | | Specification | |
|------------------------------|-----------|------------------------------|-------------------------------|
| Mode | | Voltage | Current |
| Analog output range | | 0V~10V | 0mA~20mA |
| | | External impedance over 500Ω | External impedance below 500Ω |
| Resolution | | 10mV | 40μA |
| Digital output | | 0.00V~10.00V | 0.00mA~20.00mA |
| Corresponding register value | AQ01~AQ04 | 0~1000 | 0~500 |
| | DRD4~DRD7 | 0~4095 | 0~2047 |
| Accuracy | | ±2.5% | ±2.5% |

Output mode depends on the current value of register DRD0~DRD3, as listed below.

| | Output register | Mode register | Mode | DRD0~DRD3 data definition |
|-----------------|-----------------|---------------|------|--|
| Channel 1: AQ01 | DRD4 | DRD0 | 1 | 0: voltage mode, AQ output value 0 in STOP mode |
| Channel 2: AQ02 | DRD5 | DRD1 | 2 | 1: current mode, AQ output value 0 in STOP mode |
| Channel 3: AQ03 | DRD6 | DRD2 | 3 | 2: voltage mode, AQ output value kept in STOP mode |
| Channel 4: AQ04 | DRD7 | DRD3 | 4 | 3: current mode, AQ output value kept in STOP mode |

※ DRD0~DRD3 value is taken as 0 when it is not 0~3, namely AQ output mode is mode 1.

AQ display

The preset value (constant or code of other data type) is displayed by AQ in STOP mode, and current value displayed in RUN mode.

Display in STOP mode

```
AQ01=09.77V
AQ02=20.00mA
AQ03= A01 V
AQ04=DR3F mA
```

Display in RUN mode

```
ID SET      01
REMOTE I/O  S
BACKLIGHT   x
M KEEP      ✓
SG2-20VT-D
```

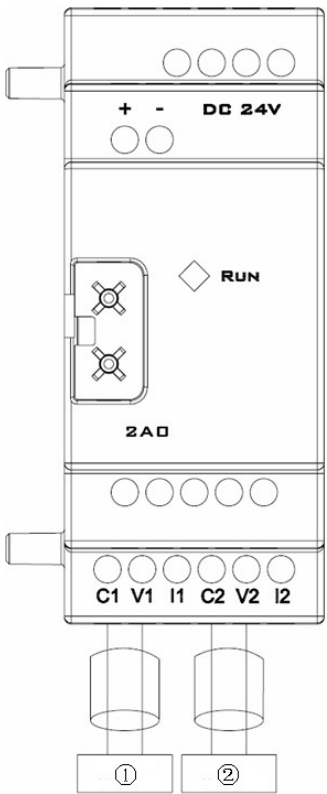
When AQ output mode is the current mode, the correspondence of DR value, AQ current value and displayed value is as follows:

DRD5 current value=2047, corresponding AQ02=500, displayed value: 20.00mA

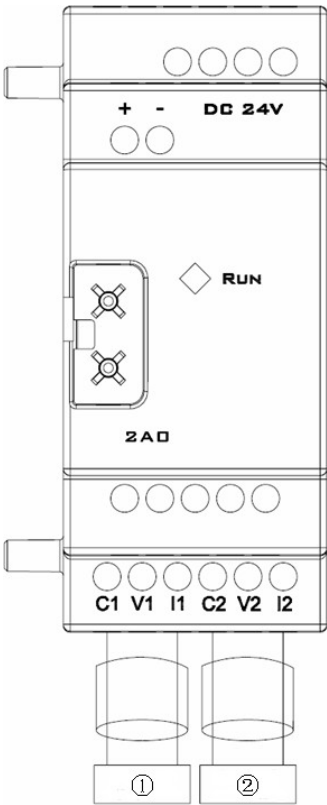
- ※ When the preset value type of AQ is constant, the corresponding DR value changes, and AQ output value is modified accordingly ($AQx = DRx / 4.095$);
- ※ When the preset value type of AQ is set as other parameter variable, DR value varies with AQ ($DRx = AQx * 4.095$);
- ※ Refer to [Chapter IV: Ladder Programming Instructions-AQ Analog Output Instructions](#) for the correspondence of AQ and DR.

Wiring

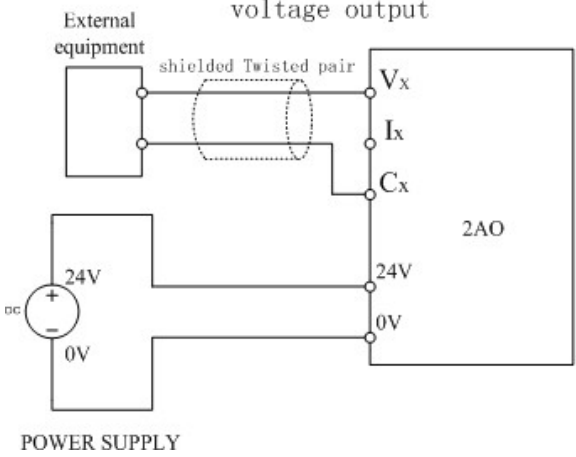
Voltage output



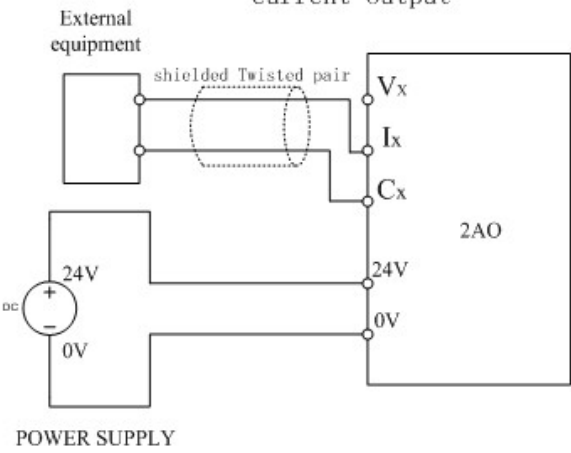
Current output



voltage output



current output



Chapter 10 External Memory

| | |
|---|-----|
| Chapter 10 External Memory | 312 |
| User program reading and writing with SD card | 313 |
| Data logging and output (LOG function)..... | 315 |
| Card formatting | 317 |
| Configuration file reading | 318 |

iSmart Storage Card Instruction

SMT uses SD card as external memory for data logging and transfer:

1. User programming reading and writing: Read and write SD card to duplicate user program by three means (screen key, upper PC operation and SMT power-on automatic operation).
2. Data logging and output: SMT enables to write user program for data logging and storage in SD card as required.
3. Card formatting: SMT only supports microSD card of FAT32 file system format for storage of program; memory card of other format should be formatted as FAT32 before operation.
4. Configuration file reading and writing: PC client is used for reading configuration files in SD card and reconfiguration of SMT (IP address and gateway etc.).

SMT only supports SD card of standard capacity and standard SDHC card of high capacity. The maximum card capacity is 32GB.

User program reading and writing with SD card

1. User program writing from SD card into SMT by key operation

For the types with LCD display and key function (types H and V), push-button menu can be used directly for SD card operation. Select “CARD-> SMT” in the main men to enter secondary menu where status of the current SD card is displayed. When there is SD card, press “OK” to transfer user program in memory card into SMT.

The status of memory card is displayed in the corresponding submenu:

- a. Whether card is detected in the slot
- b. Current remaining capacity of card

```
CLEAR PROGRAM
SMT->CARD
>CARD->
SMT SET
```

```
CARD -> SMT
DISK: 29714MB
>Yes
No
```

Notes:

It is allowed to use card to write user program in SMT only when SMT is stopped.

#In case of power failure during user program duplication in SMT, please repeat the process after power recovery.

2. User program writing from SMT into SD card by key operation

Use the type with LCD display and key function, select “SMT->SD card” in the main menu to enter secondary menu where status of the current SD card is displayed; when there is SD card, press “OK” to transfer user program in SMT into memory card.

```
CLEAR PROGRAM
>SMT->CARD
CARD->
SMT SET
```

```
SMT->CARD
DISK: 29714MB
>Yes
No
```

Notes:

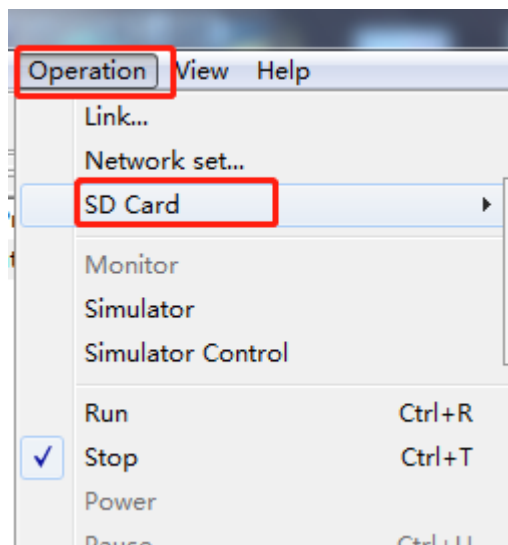
#In case of power failure during user program duplication in SMT, please repeat the process after power recovery.

#The protected password in SMT is similarly valid for program in the card.

SMT allows storage of one user program in the memory only. To modify circuit program or create the second program while the first one is not deleted, please save the program in other memory in advance.

3. SD card operation with upper PC

For the iSmart which have no on-screen buttons, you can use SMT Client for SD card operation card.



While the upper computer is connected, select “SD” under the “Connection” option in Ladder or FBD mode for operation of memory card.

Notes:

- It is allowed to use card to write user program in SMT only when SMT is stopped.

-In case of power failure during user program duplication in SMT, please repeat the process after power recovery.

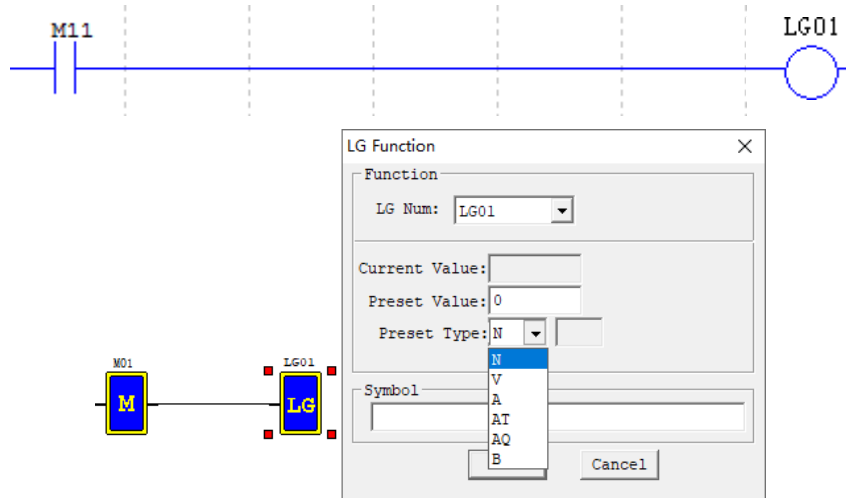
4. Auto program reading

When SD card is correctly inserted, SMT is powered on again and in the STOP state, SMT will automatically read user program stored in SD card as well as parameter configuration file.

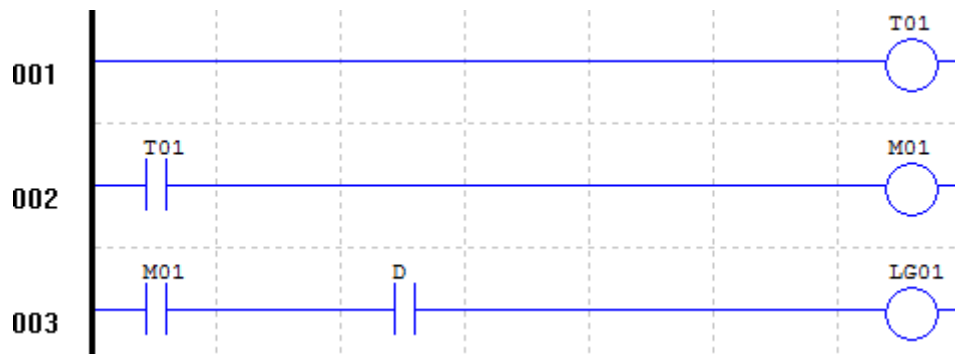
Data logging and output (LOG function)

1. Data logging

As shown below, the data logging function is configured.



LOG can be used for recording of the selected parameters. In the above program, value of the set target register T1 is stored in SMT or micro-SD card after coil M11 is enabled; SMT will record the set parameters in each scanning cycle after M11 is enabled. As high rate may lead to data loss, the combined use of timer (T) function and LOG function is recommended.



SMT provides buffer memory space of 1k bytes for data logging, namely SMT is capable of storage of 50 entries of data record. When the number of stored data entries is up to 50, the original cached data will be covered by new data from the first entry after coil is enabled continuously.

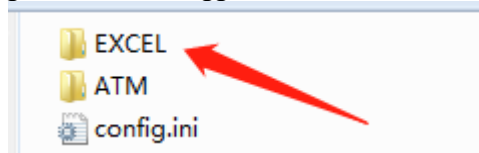
Note:

Please apply enabling signal to the data logging block in a time interval no less than 500 ms to avoid data loss. Excessive writing frequency will lead to loss of data.

2. Data storage location and format

If you insert the same card into a SMT host module, new data will be stored following the file saved in the current day, but the maximum line number of a file to be saved is limited by the memory size. Micro SD card allows storage of data log file of 20,000 lines to the maximum.

1. When the LOG function is used for the first time, SMT will create a folder named EXCEL under the root directory of memory card, which is used for storage of data files logged.



2. Data log file in SMT is named based on the current date (year-month-day). New data entries logged in a same day will be stored in the same file following the previous ones, but will not cover the previous data. The size of data to be stored is limited by free space of memory card.



3. After the data log form is created, select “Output parameter -> Card function” in the main menu to write the cached data log into memory card.

File is stored in .xls format by default. You can open the file in PC. Each line in the EXCEL file includes a time point, functional block number and actual value recorded.

```
>OUTPUT RECORD
  FORMAT Card
  NETCONFIG
  NET IO SET
```

```
OUTPUT    RECORD
DISK: 29714MB
>YES
NO
```

| A | B | C | D |
|----------------|------------------|---------------|---------------|
| FUN_Number:144 | Current_Value:35 | Coil_Name:M11 | Time0/0 0:0:0 |
| FUN_Number:147 | Current_Value:35 | Coil_Name:M14 | Time0/0 0:0:0 |
| FUN_Number:149 | Current_Value:35 | Coil_Name:M16 | Time0/0 0:0:0 |
| FUN_Number:151 | Current_Value:35 | Coil_Name:M18 | Time0/0 0:0:0 |

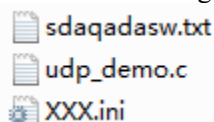
Card formatting

- 1) SMT only supports microSD card of FAT32 format for storage of program. A memory card of any other format should be formatted to FAT32 format in advance.
- 2) The “Format card” option under the main menu enables formatting of SD card. Please back up data in the card before formatting, as all data stored in the card will be cleared after formatting.

| |
|---------------|
| OUTPUT RECORD |
| > FORMAT Card |
| NETCONFIG |
| NET IO SET |

Configuration file reading

For the types without LCD, parameter can be setting by reading the configuration file XXX.ini:



Located under the root directory of SD card, XXX.ini file can be written in the set parameter of SMT (removing the file from the root directory or rewriting the file name will lead to file reading error).

When powered on and put under the STOP state, SMT (B type) will read content in the configuration file, and modify the target register as per data in the file.

Use of configuration file

Set IP address

For SMT types without screen, IP address can be configured by diary file writing and then reading by SD card;

```
#-----
#SET IP ADDR
#-----
IP_ADDR0 = 010;
IP_ADDR1 = 128;
IP_ADDR2 = 019;
IP_ADDR3 = 246;
```

Open the “XXX.ini” file under root directory of SD card to modify the file content and complete SMT parameter setting. The following rules should be followed for file modification:

1. The set value should be between the punctuation marks "=" and ";".
2. The content behind the symbol "/" is annotation not to be read by SMT.
3. Set “10,128,19,246” as the IP address; divide “10.128.19.246” into four fields, “010”, “128”, “019” and “246”; then fill the four fields into the corresponding location as shown above.
4. If a field greater than 255 is filled, 255 will be read by SMT by default.
5. Put SD card in SMT, power on again and put it under the STOP state, when SMT will automatically read and configure IP address.

Set subnet mask address

For SMT types without screen, subnet mask address can be configured by diary file writing and then reading by SD card

```
IP_ADDR2 = 019;
IP_ADDR3 = 246;
#-----
#SET SUBNET MASK
#-----
SUB_ADDR0 = 255;
SUB_ADDR1 = 255;
SUB_ADDR2 = 255;
SUB_ADDR3 = 000;
#-----
#SET GATEWAY
```

Open the “XXX.ini” file under root directory of SD card to modify the file content and complete SMT parameter setting. The following rules should be followed for file modification:

1. The set value should be between the punctuation marks "=" and ";".
2. The content behind the symbol "/" is annotation not to be read by SMT.
3. Set “255.255.255.0” as the IP address; divide “255.255.255.0” into four fields, “255”, “255”, “255” and “000”; then fill the four fields into the corresponding location as shown above.
4. If a field greater than 255 is filled, 255 will be read by SMT by default;
5. Put SD card in SMT, power on again and put it under the STOP state, when SMT will automatically read and configure subnet mask address.

Set gateway address

Follow the same method of IP address and subnet mask setting for setting gateway address.

```
SUB_ADDR0 = 255;  
SUB_ADDR1 = 255;  
SUB_ADDR2 = 255;  
SUB_ADDR3 = 000;
```

```
#-----  
#SET GATEWAY  
#-----
```

```
GATE_ADDR0 = 192;  
GATE_ADDR1 = 168;  
GATE_ADDR2 = 000;  
GATE_ADDR3 = 002;
```

```
#-----  
#SET MASTER IP ADDR  
#-----
```

```
IP_ADDR0 = 010;  
IP_ADDR1 = 128;  
IP_ADDR2 = 019;  
IP_ADDR3 = 245;
```


Chapter 11 Ethernet Communication Function

| | |
|---|-----|
| Chapter 11 Ethernet Communication Function..... | 320 |
| Overview | 321 |
| Device connection | 321 |
| PC Client programming software connection..... | 323 |
| Extended device connection and network block configuration..... | 324 |
| Network server | 327 |
| Network communication between two SMT devices | 329 |
| Modbus TCP function/Modbus RTU over TCP function..... | 332 |
| E-mail transfer function..... | 336 |

Overview

SMT series products support the Ethernet communication function. User can realize the following functions through Ethernet communication:

- User program reading, writing and monitoring
- Extended device connection and network functional block configuration
- Network server
- Device program upgrade

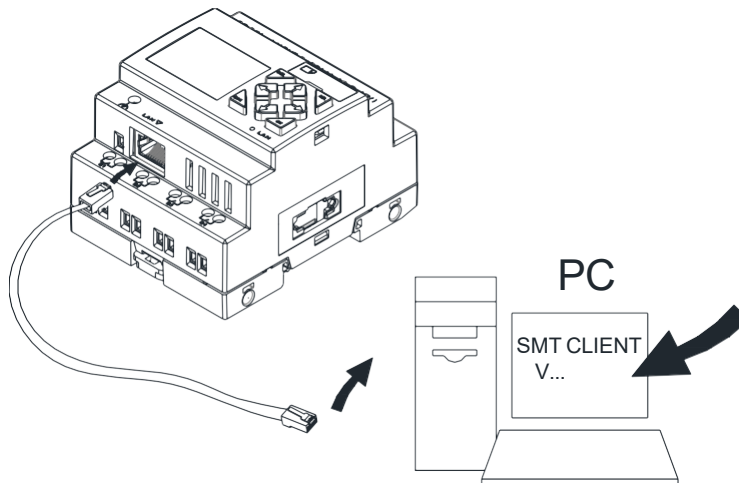
Device connection

The module is designed with an Ethernet RJ45 interface and a network status LED.

The shielded twisted-pair Ethernet cable can be used to connect device with PC, router, switch or other extended devices with RJ45 network interface

Network status LED indicates whether network communication of device is normal, which is off when network is disconnected, and the green LED is lit during normal network connection; the LED flashing frequency is an indicator of network communication status.

Device connection:



Network information setting

The LCD interface of SMT shows the device IP address, Subnet mask, Gateway address, master/slave working mode, as well as remote master IP address, IAP upgrade flag and other functions in the slave mode. The selected information can be modified by keypad.

Press the direction key to page up/down, Select “NETCONFIG” under the main menu.

```

OUTPUT RECORD
Format card
>NETCONFIG
Net IO SET
  
```

Press OK to enter “NETCONFIG”

```

>IP ADDRESS
SUBNET MASK
GATEWAY
MASTER IP
  
```

```

>GATEWAY
MASTER IP
IAP SET
NET SET

```

Select the corresponding option under “Network setting”, and press “OK”.

Set IP address: Press “SEL” to enter the editing mode, and press “↑” “↓” for digit selection.

-> IP ADDRESS ->

```

IP ADDRESS
192.168.000.003

```

Set subnet mask:

->SUBNET MASK ->

```

SUBNET MASK
255.255.255.000

```

Set gateway address:

->GATEWAY->

```

GATEWAY
192.168.000.001

```

Set master IP:

->MASTER IP->

```

MASTER IP
192.169.000.005

```

IAP upgrade setting:

```

IAP SET

Yes
No

```

Network communication Master/slave station setting:

->M/S SET->

```

M/S SET      M

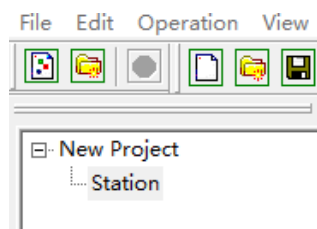
```

After setting all ,press “ESC” to return to the NETCONFIG menu(this time will not save your settings to flash) , press “ESC” to return to the main menu when SMT automatically save the network settings

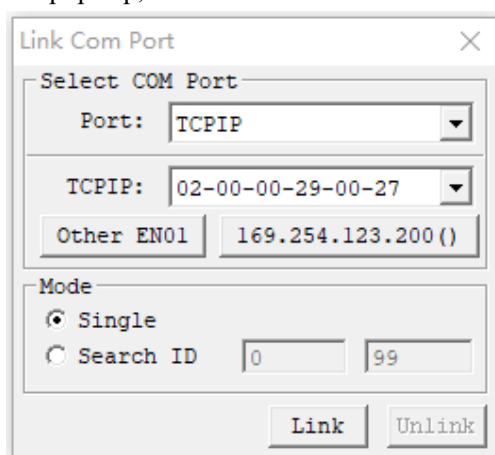
PC Client programming software connection

After communication network connection of device and PC, open SMT Client, and enter Ladder or FBD program editing environment.

Right click “Station” under the project and select the “Link” item popped up.



The “Select communication port” window pops up, as shown below:



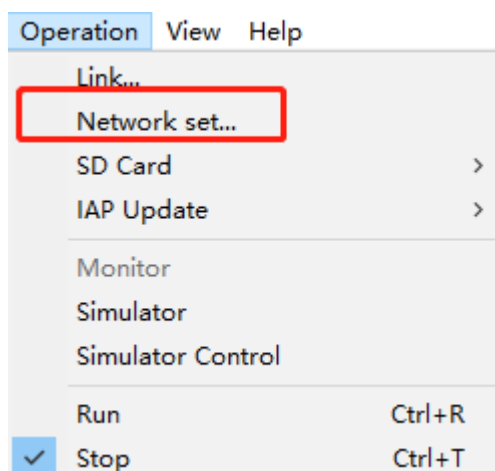
Note: Modify IP address of PC and SMT device in the same network segment.

Select MAC address of the SMT to be linked, and click “Link”, when PC Client will be automatically connected with SMT controller.

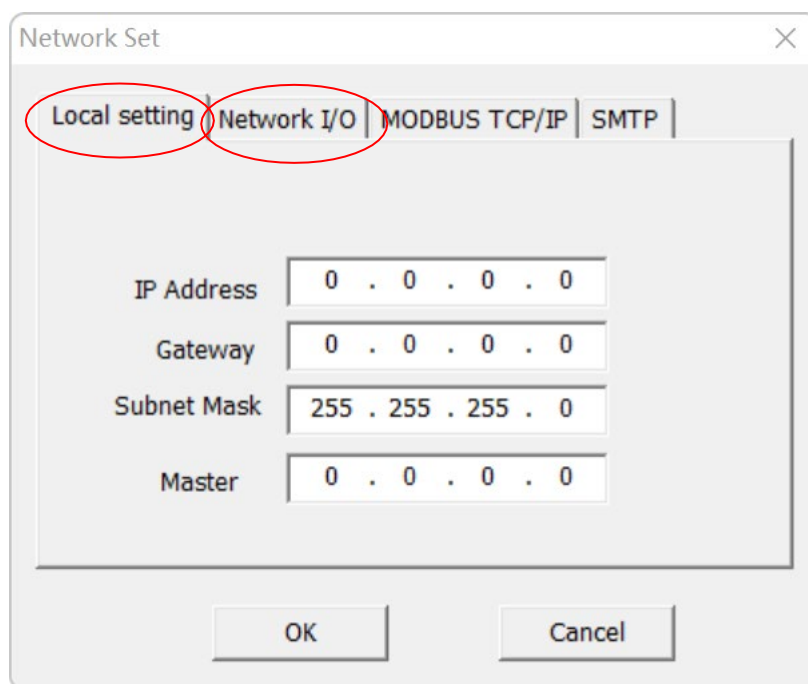
Extended device connection and network block configuration

Complete network information setting of device and communication configuration of network input and output ports after the upper computer is linked.

Upper computer menu bar: " Operation "→" Network Set "; enter the Network Set window.



“Local setting” Set the device IP address, subnet mask, gateway address, remote master IP address and Master address in the device setting bar. When SMT is in STOP mode.



Inputs and Outputs function:

SMT provides network digital inputs/outputs and network analog inputs/outputs.

The master SMT can communicate with the slave SMT using the network inputs and outputs.

| Blocks | Function | Number |
|-------------|-------------------------|--------|
| J01 ~ J3F | Network digital inputs | 63 |
| K01 ~ K3F | Network digital outputs | 63 |
| NI01 ~ NI1F | Network analog inputs | 31 |
| NQ01 ~ NQ0F | Network analog outputs | 15 |

Complete network configuration of network input and output ports of the master device in the Network I/O bar.

Network Set

Local setting | Network I/O | MODBUS TCP/IP | SMTP

J-NI

| Coil | IP | Type | Num |
|------|---------------------|------|-----|
| J01 | 192 . 168 . 0 . 102 | N | 01 |
| J02 | 0.0.0.0 | M | 02 |
| J03 | 0.0.0.0 | M | 03 |
| J04 | 0.0.0.0 | M | 04 |
| J05 | 0.0.0.0 | M | 05 |
| J06 | 0.0.0.0 | M | 06 |

OK Cancel

As shown above, network digital input port J01 reads status of point N01 of slave device 192.168.0.102.

Network Set

Local setting | Network I/O | MODBUS TCP/IP | SMTP

K-NQ

| Coil | IP | Type | Num |
|------|---------------------|------|-----|
| K01 | 192 . 168 . 0 . 102 | M | 02 |
| K02 | 0.0.0.0 | M | 41 |
| K03 | 0.0.0.0 | M | 42 |
| K04 | 0.0.0.0 | M | 43 |
| K05 | 0.0.0.0 | M | 44 |
| K06 | 0.0.0.0 | M | 45 |

OK Cancel

As shown above, status of network digital output port K01 is output to point M02 of slave device 192.168.0.102.

Network Set

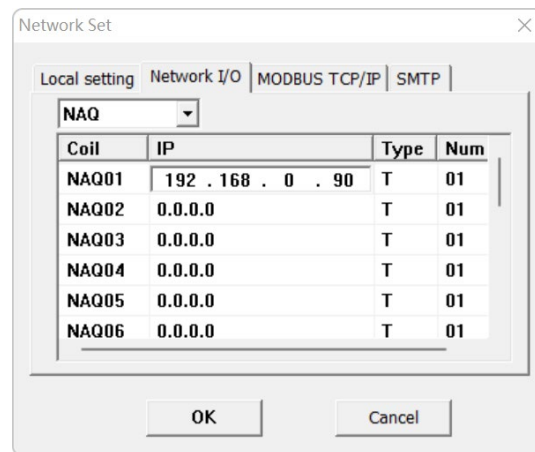
Local setting | Network I/O | MODBUS TCP/IP | SMTP

NAI

| Coil | IP | Type | Num |
|-------|--------------------|------|-----|
| NAI01 | 192 . 162 . 0 . 88 | C | 01 |
| NAI02 | 0.0.0.0 | T | 01 |
| NAI03 | 0.0.0.0 | T | 01 |
| NAI04 | 0.0.0.0 | T | 01 |
| NAI05 | 0.0.0.0 | T | 01 |
| NAI06 | 0.0.0.0 | T | 01 |

OK Cancel

As shown above, network analog input port NAI01 reads the value of C01 of slave device 192.168.0.88

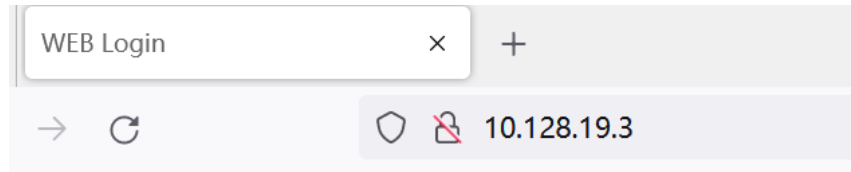


As shown above, the value of network digital output port NAQ01 is output to T01 of slave device 192.168.0.90

Network server

SMT series are designed with the network server function to enable view of SMT device information and working state through PC or mobile device in the network. At present, display of device status in English character and digit is supported, but display in Chinese and other special characters is not supported.

Open the browser, enter IP address of SMT device, and select the SMT network server page.



A user authorized by password login (Username: IMO, Password: SMT4) can check device information and working state.

| LOGIN | SYSTEM | STATUS | IP ADDRESS |
|--|--------|--------|------------|
| Please enter the password | | | |
| <div> <div>User</div> <input type="text"/> </div> <div> <div>Password</div> <input type="password"/> </div> <div> <input type="button" value="Login"/> <input type="button" value="Reset"/> </div> | | | |

It is required to re-enter the correct information in case of user name or password error.

| LOGIN | SYSTEM | STATUS | IP ADDRESS |
|--|--------|--------|------------|
| User name or password error! | | | |
| <div> <div>User</div> <input type="text"/> </div> <div> <div>Password</div> <input type="password"/> </div> <div> <input type="button" value="Login"/> <input type="button" value="Reset"/> </div> | | | |

Not secure | 192.168.1.10/IP_address.html

| logout | Device model | Running status | IP address |
|---------------------------------------|-----------------|----------------|------------|
| Device network connection information | | | |
| IP address | 192.168.001.010 | | |
| Subnet mask | 255.255.255.000 | | |
| Gateway address | 192.168.001.254 | | |
| Remote IP | 010.001.100.010 | | |
| Master-slave mode | SERVER | | |

View device working state information:

Press “Previous” or “Next” on the I/O display interface to switch the displayed page. The setting interface does not allow page switching and supports display in digit and English characters only.

View device IP address, subnet mask, gateway, remote master IP and master/slave mode:

| LOGOUT | SYSTEM | STATUS | IP ADDRESS |
|---------------------------------------|-----------------|--------|------------|
| Device network connection information | | | |
| Device IP | 010.128.019.003 | | |
| Sub Mask | 255.255.252.000 | | |
| Gateway | 010.128.016.254 | | |
| Remote IP | 192.168.000.005 | | |
| Server/Client | SERVER | | |

Log out:

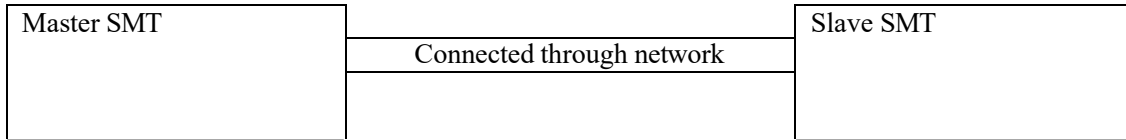
LOGOUT

Network communication between two SMT devices

Multiple SMT can be used for monitoring of input and output points through network and for remote control of the input and output points.

Network input and output: Network digital input and output J (01~3F), K (01~3F); network analog input and output NAI(01~1F), NAQ(01~0F); SMT may use network input and output as coil or parameter.

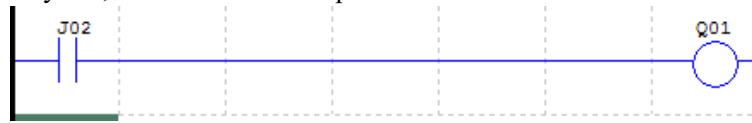
Example:



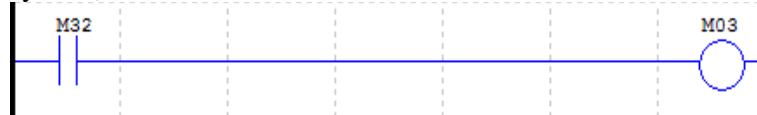
Master J01~J3F can be configured according to status of the corresponding slave point.

Master and slave setting in the case master J02 reads status of slave coil M03:

Master: Q01 is controlled by J02, and status of J02 depends on status of slave M03



Slave: M03 is controlled by M32, and set ON or OFF within 0.5s.



Phenomenon: Status of master Q1 and J01 and slave M03 is consistent.

Master

1: Configure master IP

Enter the main menu, select “Network configuration”, and press “OK” for network configuration.

Configure IP address, gateway address and subnet mask based on link status.

```

IP ADDRESS
SUBNET MASK
GATEWAY
MASTER IP
  
```

Select “IP ADDRESS”, and press “OK” to ensure the IP address setting menu.

Press “SEL” to enter the editing mode, set master address as 10.128.19.247, and press “OK” to save the IP address setting.

```

IP ADDRESS
010.128.019.247
  
```

Select “SUBNET MASK”, and press “OK” to enter the subnet mask setting menu.

Press “SEL” to enter the editing mode, set subnet mask as 255.255.255.0, and press “OK” to save the subnet mask setting.

```

SUBNET MASK
255.255.255.000
  
```

Select “GATEWAY”, and press “OK” to enter the gateway address setting menu.

Press “SEL” to enter the editing mode, set master address as 192.168.000.001, and press “OK” to save the gateway address setting.

```

GATEWAY
192.168.000.001
  
```

2. Set master

Select “NETCONFIG” under the main menu, and press “OK”.

```

OUTPUT RECORD
FORMAT Card
>NETCONFIG
NET IO SET

```

Select “NET SET” under the “NETCONFIG” menu, and press “OK”.

```

GATEWAY
MASTER IP
IAP SET
>NET SET

```

Select master.

```

M/S SET          M

```

3: Configure network I/O address mapping

Select “NET IO SET” under the main menu, press OK key then move cursor to “JNI01”; press “SEL” to enter the editing mode, select “JNI02” and press “OK” for configuration of coil J02.

```

Set:      J02
Set:      K01
Set:      NAI01
Set:      NAQ01

```

Press “SEL” to enter the editing mode:

Enter the correct IP address (slave IP address, 10.128.19.245 in this example)

Enter the correct slave coil

```

SET:      J01
SLAVE IP
010.128.019.245
SET:      M03

```

4: Edit program under main menu

J02-----Q01

Press “ESC” to exit the program editing interface.

Caution: Please complete step 3 before turning to step 4.

Slave:

1: Configure slave IP

Configure IP address, gateway address, subnet mask and master IP according to link status.

```

IP ADDRESS
SUBNET MASK
GATEWAY
MASTER IP

```

Set IP address, gateway address and subnet mask as per instructions for master setting.

Set IP address as: 10.128.19.245

Set subnet mask as: 255.255.255.000

Set gateway address as: 192.168.000.001

Select “Set master IP”, and press “OK” to enter the master IP setting menu.

Press “SEL” to enter the editing mode, set master address as 10.128.19.246, and press “OK”, when the device will restart automatically and save the gateway address setting.

```

Set master IP
010.128.019.246

```

2: Set slave

Select “NETCONFIG” under the main menu, and press “OK”.

| |
|--|
| OUTPUT RECORD FORMAT Card >NETCONFIG NET IO SET |
|--|

Select “NET SET” under the “NETCONFIG” menu, and press “OK”.

| |
|---|
| GATEWAY MASTER IP IAP SET >NET SET |
|---|

Select slave.

| | |
|---------|---|
| M/S SET | S |
|---------|---|

Run the program after correct configuration and connection; ETHNET LED should be flashing in case of successful communication.

Modbus TCP function/Modbus RTU over TCP function

MODBUS function block of SMT device enables Modbus TCP and Modbus RTU over TCP communication functions through Ethernet interface

Device ID setting:

Open PC Client software, and click Module System Set window under the operation menu:

Module System Set

Set ID

Current ID: 1

New ID (00-99): 1

Remote I/O

☒ NO

☐ Master

☐ Slave

Set Expand I/O

I/O Num: 0

☐ I/O Alarm

Others

☒ M Keep

☐ C Keep

☒ Back Light

☐ Z Set

RS485 Set

Comm. Mode: 8/N/2

Baud Rate: 38400

DR Format Set

☒ Unsigned

☐ Signed

Coil Record

☒ None ☐ M ☐ N

Range: 01-10 SUM=0

Cancel Set

Enable SMT device of the master station mode and set ID as 0; enable SMT device of the slave station mode and set ID as 0~99 (except 0); slave station device ID is unrepeatable.

Master station device setting:

Enter LCD interface of SMT device (-> Network setting->Network communication->),and set the device in the master station mode.

Open PC Client software, and click Network Set window under the operation menu:

Network Set

Local setting | Network I/O | MODBUS TCP/IP | SMTP

| Index | ID | IP |
|-------|----|----------------|
| 1 | 1 | 169.254.200.33 |
| 2 | 2 | 169.254.200.53 |
| 3 | 3 | 169.254.200.44 |
| 4 | 0 | 0.0.0.0 |
| 5 | 0 | 0.0.0.0 |
| 6 | 0 | 0.0.0.0 |

☒ MODBUS TCP/IP ☐ MODBUS Via TCPIP

OK Cancel

Set ID and IP address of the slave station to be connected (**Note: It should be consistent with that of slave station device**) in the MODBUS TCP/IP column. The options in the red frame at the bottom are for selection of Modbus TCP or Modbus RTU over TCP when the communication mode is set.

Download to SMT device after setting. **The setting becomes effective only after the device is powered-on again.**

The above setting can be modified by KEYPAD in the LCD interface:

-> MODBUS SET->

| | |
|------------|-----|
| MODBUS_TCP | |
| RTU/TCP | TCP |
| CHANNEL | 01 |

| | |
|------------|-----|
| MODBUS TCP | |
| RTU/TCP | RTU |
| CHANNEL | 01 |

Select Modbus TCP or Modbus RTU over TCP for communication mode setting.

Change CHANNEL (01~08), and press OK to enter the channel setting:

| | |
|-----------|-----------------|
| CHANNEL | 01 |
| SERVER_IP | 192.168.000.006 |
| ID: | 01 |

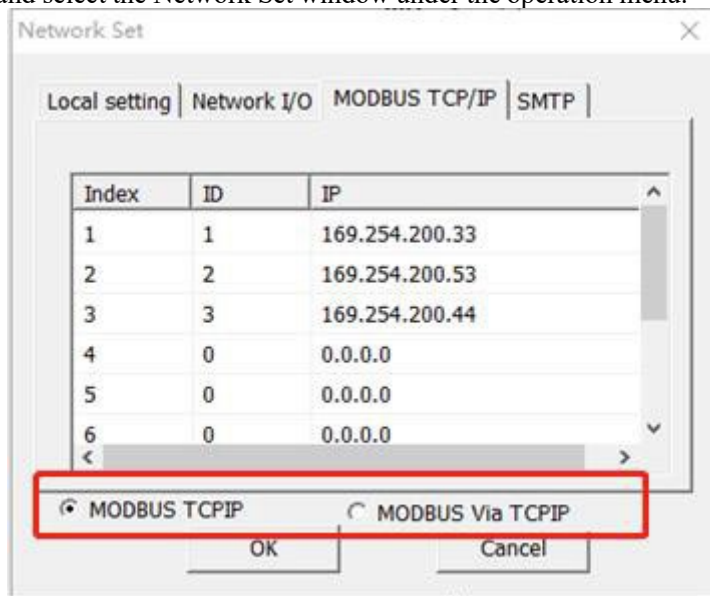
IP address of the corresponding slave station and device ID can be modified in this interface.

The device is to be powered-on again after modification of setting. Otherwise, the setting will not become effective.

Slave station device setting:

Enter LCD interface of SMT device (-> Network setting->Network communication->)and set the device in the slave station mode.

Open PC Client software, and select the Network Set window under the operation menu:



In the MODBUS TCP/IP column, the options in the red frame are for selection of Modbus TCP or Modbus RTU over TCP for communication mode setting (to be consistent with the master station setting). Download to SMT device after setting. **The device is to be powered-on again; otherwise, the setting will not become effective.**

The above setting can be modified by KEYPAD in the LCD interface:

-> MODBUS SET->

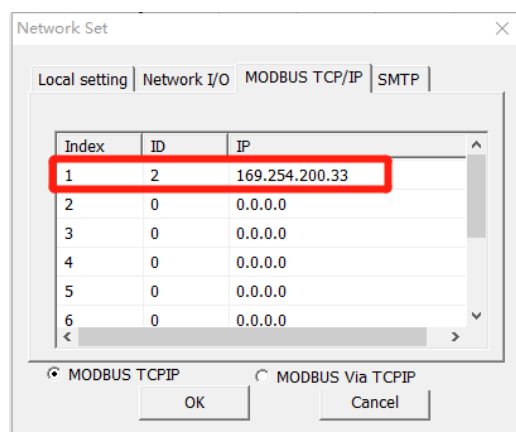
| | | |
|------------|-----|--|
| MODBUS_TCP | | |
| RTU/TCP | TCP | |
| CHANNEL | 01 | |

| | | |
|------------|-----|--|
| MODBUS_TCP | | |
| RTU/TCP | RTU | |
| CHANNEL | 01 | |

Select Modbus TCP or Modbus RTU over TCP for communication mode setting.

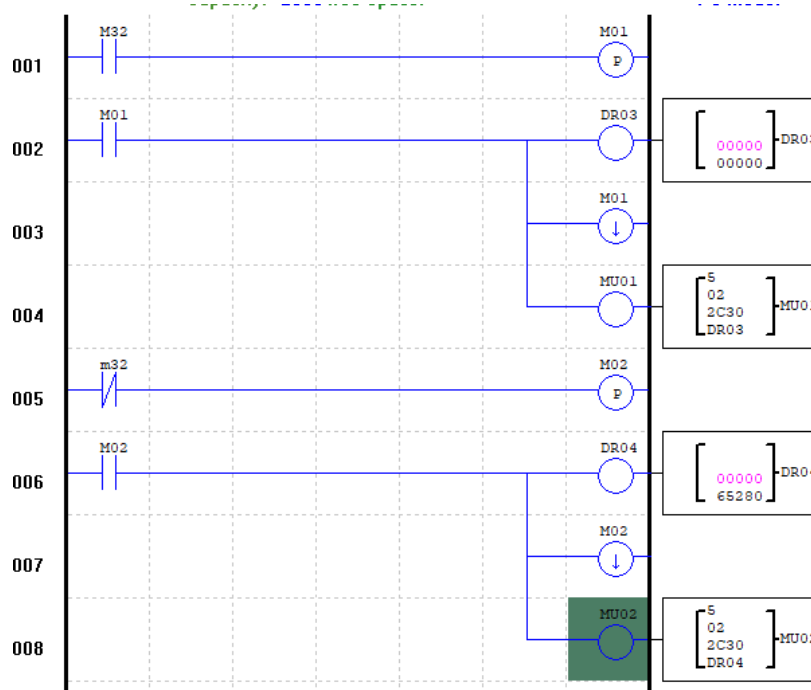
The setting becomes effective only after the device is powered-on again upon modification.

Example:



Set ID of the slave station device corresponding to channel 1 as 2 and IP address as 169.254.200.33.

User code:



MU module setting:

Edit Contact/Coil

F H P L MU AS

Select Coil No.

MU 01 (01~0F) Symbol

☐ RS485
☒ TCP/IP

Function

Mode S

Write Single Coil(0x05)

Remote ID: 02 (0~7F)

Comm. add: 2C30 (0~FFFF) ☐ DR

Comm. data: DR 03

The data wrote into a coil depends on the DR03 Value.

OK Cancel

As shown above, TCP/IP is to be selected when Modbus TCP or Modbus RTU over TCP communication is used for the MU module.

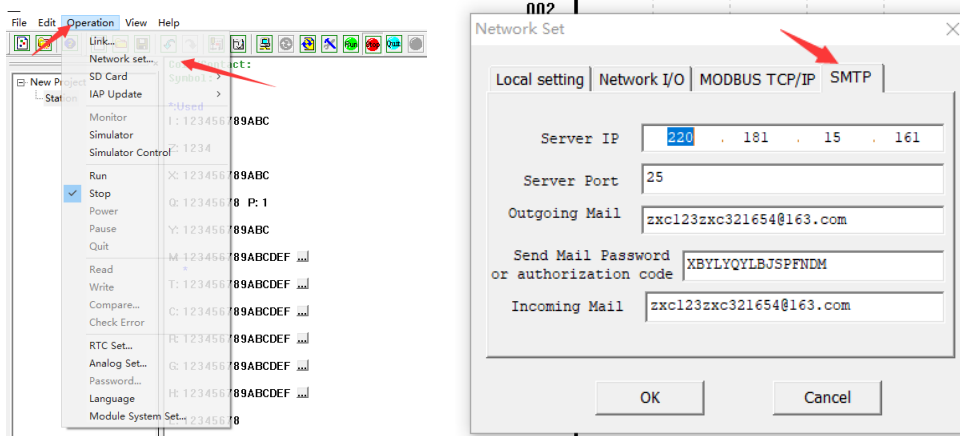
E-mail transfer function

After SMT device is connected to Ethernet, E-mail can be sent to the E-mail box designated by user through SMTP E-mail transfer protocol. The mail content includes the current status of device input and output points. The corresponding fault code will be sent if the device fails.

E-mail transfer function setting:

Open PC Client software, and check the software version number is above 0.10, as shown in the top left corner of the interface:

Open Network Set window under the operation menu, and then set relevant information in the SMTP column:



Notes: Server IP is IP address of SMTP server for the sending mailbox;
 Server Port is the port of SMTP server for the sending mailbox;
 The sending mailbox should have SMTP service enabled and authorization code recorded. The code is the password for third-party client to log in the sending mailbox;
 The receiving mailbox should support SMTP mail receiving to avoid SMTP mail from being treated as junk mail.

Example of sending mailbox setting:

User needs to enter two E-mail boxes, namely the sending mailbox and receiving mailbox, for using the SMTP E-mail transfer function. Third-party client login authorization should be enabled for the sending mailbox, so as to allow SMT login for mail sending.

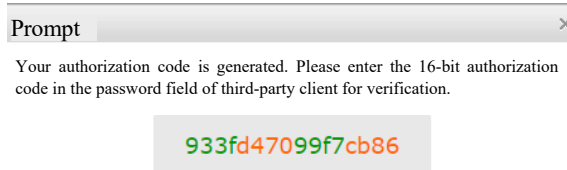
Client authorization code

Authorization status: ON OFF (POP/IMAP/SMTP to be disabled simultaneously)

Administration: [Reset authorization code](#)

There may be risk of password disclosure when third-party client is used to log-in the mailbox. Authorization code is the special password used for logging in third-party mail client, which is applicable to: POP3/IMAP/SMTP.
[What's authorization code? How to use?](#)

The authorization code (not the password created during mailbox registration) is obtained when authorization is enabled.



Note: After being obtained, the authorization code is to be used to re-login the client already logged in.

☒ Enable POP/SMTP

☒ Enable IMAP/SMTP

SMTP server of Sina mailbox is shown below:

Client setting: POP3 server: pop.sina.com

SMTP server: smtp.sina.com

SMTP server of Netease mailbox is as follows:

Server address: POP3 server: pop.163.com

SMTP server: smtp.163.com

IMAP server: imap.163.com

As SMTP server address varies with mailbox, user needs to check before using it for acquiring the IP address of SMTP, as instructed below:

Press win+R key on the PC, and enter ping (the above-checked SMTP address) in the pop-up window (as shown below) to obtain IP address of SMTP server:

```
Ping 32-byte data of smtp.163.com [220.181.15.161]
Response from 220.181.15.161: bytes=32 Time=52ms TTL=53
Response from 220.181.15.161: bytes=32 Time=50ms TTL=53
Response from 220.181.15.161: bytes=32 Time=49ms TTL=53
Response from 220.181.15.161: bytes=32 Time=48ms TTL=53

Ping statistical information of 220.181.15.161
  Data packages: sent=4, received=4, lost=0 (0% lost)
Estimated time of round trip (in ms):
Shortest=48ms, longest=52ms, average=49ms
```

The above selected is the IP address, which is to be entered in server IP.

SMTP server port number may be 25, 587. Port number of the sending mailbox server used is to be confirmed.

SMTP related information can be checked in the LCD interface:

-> SMTP DATA->

```
NETCONFIG
NET TO SET
MODBUS SET
>SMTP DATA
```

Enter SMTP DATA, and press Up/Down to view SMTP related information.

```
SMTP_SERVER_IP
049.007.036.022
```

```
PORT
00025
```

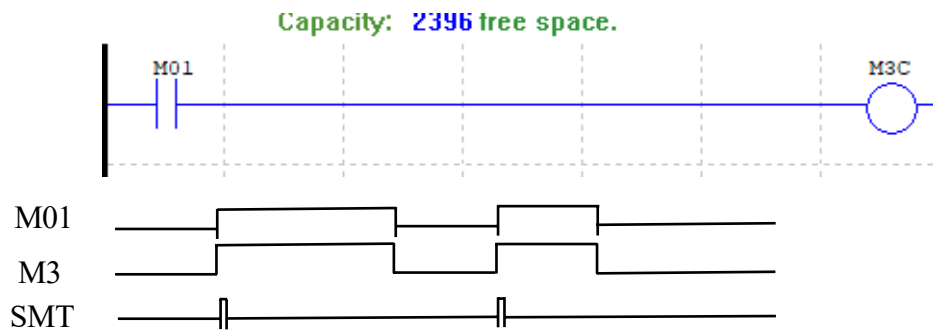
```
SEND_MAIL
abcdef123456@sina
.com
```

PASSWORD
4d792abd454dddd8

RECEIVE_MAIL
xyz456789@163.co
m

User may check the above-listed information in the LCD interface but cannot change the same by KEPAD.

User code example of E-mail transfer function:



SMT sends an E-mail each time when it is in the rising edge of M3C point.

IMO Worldwide Offices

IMO Precision Controls Limited

The Interchange
Frobisher Way
Hatfield, Herts AL10 9TG
United Kingdom

Tel: 01707 414 444

Email: imo@imopc.com
Web: www.imopc.com

IMO Jeambrun Automation SAS

Parc de la Broye
14 rue du Chauffour
59710 ENNEVELIN
France

Tel: 0800 912 712 (n° gratuit)

Email: imo-fr@imopc.com
Web: www.imojeambrun.fr

IMO Automazione

Via Belfiore 10,
50144 Firenze (FI)
Italia

Tel: 800 930 872 (toll free)

Email: imo-it@imopc.com
Web: www.imopc.it

IMO Canada

1B-701 Rossland Road East
Suite #608
Whitby, Ontario L1N 9K3
Canada

Tel: 416 639 0709

Email: sales-ca@imopc.com
Web: www.imopc.com

IMO Automation LLC

Steeplechase Industrial Park
Suite E, 5845 Steeplechase Blvd
Cumming, GA 30040
USA

Tel: 404 476 8810

Email: sales-na@imopc.com
Web: www.imoautomation.com

IMO South Africa (Pty) Ltd

Unit 2, Trio Park
Prime Park, Printers Way
Cape Town 7441
South Africa

Tel: 021 551 1787

Email: info@imopc.co.za
Web: www.imopc.co.za

IMO Pacific Pty Ltd

Unit 9, Dillington Pass
Landsdale
Perth WA 6065
Australia

Tel: 1300 34 21 31

Email: sales@imopacific.com.au
Web: www.imopacific.com.au



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