



SG2 Smart PLC USER Manual



SG2 Programmable Logic Smart Relay

4KA72X023 Version: 04 2010.11.24

0086-0510-8522-7555

Apply to: SG2 firmware version 3.3,

www.taian-technology.com

PC client program software version 3.3

Content

Content.....	I
Summary of changes.....	IV
Chapter 1: Getting Started.....	1
Examination before Installation	3
Environmental Precautions	3
SG2 Model Identification.....	3
Quick Start Setup	4
Install SG2 Client Software	4
Connect Power to SG2 smart relay	4
Connect Programming Cable	5
Establish Communication	5
Write simple program.....	6
Chapter 2: Installation.....	10
General Specifications	11
Product Specifications.....	14
Mounting.....	15
Wiring	17
K type Indicator Light.....	19
Chapter 3: Program Tools	20
PC Programming Software “SG2 Client”	21
Installing the Software	21
Connecting the Software	21
Start Screen	21
Ladder Logic Programming Environment	22
Menus, Icons and Status Bar	23
Programming.....	24
Simulation Mode.....	25
Establish Communication	25
Writing Program to smart relay	26
Online Monitoring/Editing.....	27
Operation menu	28
HMI/TEXT.....	29
Program Documentation	33
Analog Output Set.....	35
Data Register Set.....	36
View menu	38
FBD Programming Environment	39
Menu, Icons and Status Bar.....	39
Programming.....	40
Simulation Mode.....	41
Online Monitoring/Editing.....	41
Symbol and Parameters list.....	42
Memory Cartridge (sold separately)	44

LCD Display and Keypad	45
Keypad	45
Original Screen	46
LCD Display Main Menu.....	49
RTC Daylight saving setting	54
SG2 system error.....	58
Chapter 4: Parameter passing.....	59
SG2 inner data type.....	60
Passing parameter out of range	61
Chapter 5: Relay Ladder Logic Programming.....	64
Common Memory Types.....	65
Specialty Memory Types.....	68
Output Instructions.....	69
Analog memory type.....	70
Timer Instruction.....	71
Counter Instructions.....	78
Real Time Clock (RTC) Instructions.....	89
Comparator Instructions.....	97
HMI Display Instructions.....	99
PWM Output Instruction (DC Transistor Output Models Only).....	102
IO Link/Remote I/O Instruction (SG2-20Vxxx model only).....	105
MU (Modbus) (SG2-20Vxxx model only)	108
SHIFT (shift output).....	115
AQ (Analog Output)	116
AS (Add-Subtract)	118
MD (MUL-DIV)	119
PID (Proportion- Integral- Differential).....	120
MX (Multiplexer).....	123
AR (Analog-Ramp).....	124
DR (Data register).....	128
Chapter 6: Function Block Diagram Programming	130
FBD system memory space.....	132
Analog.....	134
Analog Input	134
Analog Output.....	135
Coil Block Instruction.....	136
HMI.....	137
PWM function block (only transistor output version).....	138
IO Link function block.....	140
SHIFT function block	142
Logic Block Instructions.....	143
AND Logic Diagram.....	143
AND (EDGE) Logic Diagram	143
NAND Logic Diagram.....	144
NAND (EDGE) Logic Diagram.....	144
OR Logic Diagram.....	144
NOR Logic Diagram.....	145
XOR Logic Diagram.....	145

SR Logic Diagram	145
NOT Logic Diagram	145
Pulse Logic Diagram.....	146
BOOLEAN Logic Diagram	146
Function Block.....	147
Timer Function Block	148
Common Counter function block.....	156
High Speed Counter Function Block (DC Version Only)	162
RTC Comparator Function Block	164
Analog Comparator Function Block	169
AS (ADD-SUB) function block.....	172
MD (MUL-DIV) function block	173
PID (Proportion- Integral- Differential) function block.....	174
MX (Multiplexer) function block.....	175
AR (Analog-Ramp) function block.....	176
Example:	179
DR (Data-Register) function block	180
MU (Modbus) function block	181
Chapter 7: Hardware Specification	187
Normal Specification	188
Product Specifications.....	189
Power Specifications.....	190
Normal model machine Specifications	190
12V DC model Specifications.....	191
24V AC model Specifications.....	191
Power circuitry diagram.....	192
Input Specifications.....	193
100~240V AC model	193
24V AC model	193
24V DC, 12 I/O model	194
24V DC, 20 I/O model	195
12V DC, 12 I/O model	196
12V DC, 20 I/O model	197
Output Specifications	198
Output Port wiring notice.....	198
Light Load.....	198
Inductance Load.....	199
Life of relay.....	199
Size diagram of SG2	200
Chapter 8: 20 Points RS485 type Models Instruction	201
Communication function.....	202
Detail instruction.....	204
Remote IO function.....	204
IO Link Function.....	205
MU instruction (Modbus RTU master)	207
Modbus RTU slave function	209
SG2 Modbus protocol	209

Chapter 9: Expansion Module.....	211
Summarize	212
Digital IO Module.....	216
Analog Module	220
Analog Input Module 4AI.....	220
Temperature Input Module 4PT	221
Analog Output Module 2AO.....	222
Communication Module	224
MBUS Module.....	224
DNET Module.....	227
PBUS Module	230
EN01 (TCP/IP) Module	233
GSM Module.....	239
Appendix: Keypad Programming	243
Appendix A: Keypad programming in Ladder mode.....	243
Appendix B: Keypad programming in Ladder FUNCTION BLOCK	247

Summary of changes

This user manual is modified by firmware V3.x and SG2 Client programming software V3.x. SG2 V3.x adds some new functions with firmware version V3.x to strong SG2 function. The upgrade content is shown as the 2 tables below simply. More information about idiographic function to see function instruction.

Edit and Display

	SG2 V3.x	SG2 V2.x
Ladder	300 lines	200 lines
FBD	260blocks	99blocks
LCD	4 lines * 16 characters	4 lines * 12 characters

Contact and function block

	input	output	SG2 V3.0	SG2 V2.x
Auxiliary relay M	M	M	63(M01~M3F)	15(M1~MF)
Auxiliary relay N	N	N	63(N01~N3F)	Ladder: NO FBD: 15(N1~NF)
temperature input	AT		4(AT01~AT04)	NO
analog output		AQ	4(AQ01~AQ04)	NO
PWM		P	2(P01~P02, P01 adds PLSY mode)	1(P1: PWM)
HMI			31(H01~H1F)	15(H1~HF)
Timer	T	T	Ladder: 31(T01~T1F) FBD: 250(T01~TFA)	15(T1~TF)
Counter	C	C	Ladder: 31(C01~C1F) FBD: 250(C01~CFA)	15(C1~CF)
RTC	R	R	Ladder: 31(R01~R1F) FBD: 250(R01~RFA)	15(R1~RF)
Analog Comparator	G	G	Ladder: 31(G01~G1F) FBD: 250(G01~GFA)	15(G1~GF)
AS(Add-Sub)	NO	NO	Ladder: 31(AS01~AS1F) FBD: 250(AS01~ASFA)	NO
MD(Mul-Div)			Ladder: 31(MD01~MD1F) FBD: 250(MD01~MDFA)	NO
PID			Ladder: 15(PI01~PI0F) FBD: 30(PI01~PI1E)	NO
MX(Multiplexer)			Ladder: 15(MX01~MX0F) FBD: 250(MX01~MXFA)	NO
AR(Analog Ramp)			Ladder: 15(AR01~AR0F) FBD: 30(AR01~AR1E)	NO
DR(Data Register)			240(DR01~DRF0)	NO
MU(MODBUS)			Ladder: 15(MU01~MU0F) FBD: 250(MU01~MUFA)	NO
Block	B	B	Logic function: BOOLEAN	NO
			260(B001~B260)The capability of each block is alterable, and the total capability of block is 6000bytes	99(B01~B99)The capability of each block is fixed
PM05(3rd)			PM05(3rd) can be used with all version of SG2	PM05 can not be used with SG2 V3.x

Chapter 1: Getting Started

Examination before Installation.....	3
Environmental Precautions	3
SG2 Model Identification	3
Quick Start Setup.....	4
Install SG2 Client Software	4
Connect Power to SG2 smart relay	4
Connect Programming Cable.....	5
Establish Communication	5
Write simple program	6

The SG2 tiny smart Relay is an electronic device. For safety reasons, please carefully read and follow the paragraphs with "WARNING" or "CAUTION" symbols. They are important safety precautions to be aware of while transporting, installing, operating, or examining the SG2 Controller.



WARNING: Personal injury may result from improper operation.



CAUTION: The SG2 smart relay may be damaged by improper operation.

Precaution for Installation



Compliance with the installation instructions and the user manual is absolutely necessary. Failure to comply could lead to improper operation, equipment damage or in extreme cases even death, serious bodily injury or considerable damage to property.



When installing the open-board models, insure that no wiring or foreign materials can fall into the exposed circuits and components. Damage to equipment, fire, or considerable damage to property could result.



Always switch off power before you wire, connect, install, or remove any module.



The wiring for the SG2 smart relay is open and exposed. For the open-board models, all electrical components are exposed. For this reason, it is recommended the SG2 smart relay be installed in an enclosure or cabinet to prevent accidental contact or exposure to the electrical circuits and components.



Never install the product in an environment beyond the limits specified in this user manual such as high temperature, humidity, dust, corrosive gas, vibration, etc.

Precaution for Wiring



Improper wiring and installation could lead to death, serious bodily injury or considerable damage to property.



The SG2 smart relay should only be installed and wired by properly experienced and certified personnel.



Make sure the wiring of the SG2 smart relay meets all applicable regulations and codes including local and national standards and codes.



Be sure to properly size cables for the required current rating.



Always separate AC wiring, DC wiring with high-frequency switching cycles, and low-voltage signal wiring.

Precaution for Operation



To insure safety with the application of the SG2 smart relay, complete functional and safety testing must be conducted. Only run the SG2 after all testing and confirming safe and proper operation is complete. Any potential faults in the application should be included in the testing. Failure to do so could lead to improper operation, equipment damage or in extreme cases even Death, serious bodily injury or considerable damage to property.



When the power is on, never contact the terminals, exposed conductors or electrical components. Failure to comply could lead to improper operation, equipment damage or in extreme cases even death, serious bodily injury or considerable damage to property.



It is strongly recommended to add safety protection such as an emergency stop and external interlock circuit in case the SG2 smart relay operation must be shut down immediately.

Examination before Installation

Every SG2 smart relay has been fully tested and examined before shipment. Please carry out the following examination procedures after unpacking your SG2 smart relay.

- Check to see if the model number of the SG2 matches the model number that you ordered.
- Check to see whether any damage occurred to the SG2 during shipment. Do not connect the SG2 smart relay to the power supply if there is any sign of damage.

Contact  if you find any abnormal conditions as mentioned above.

Environmental Precautions

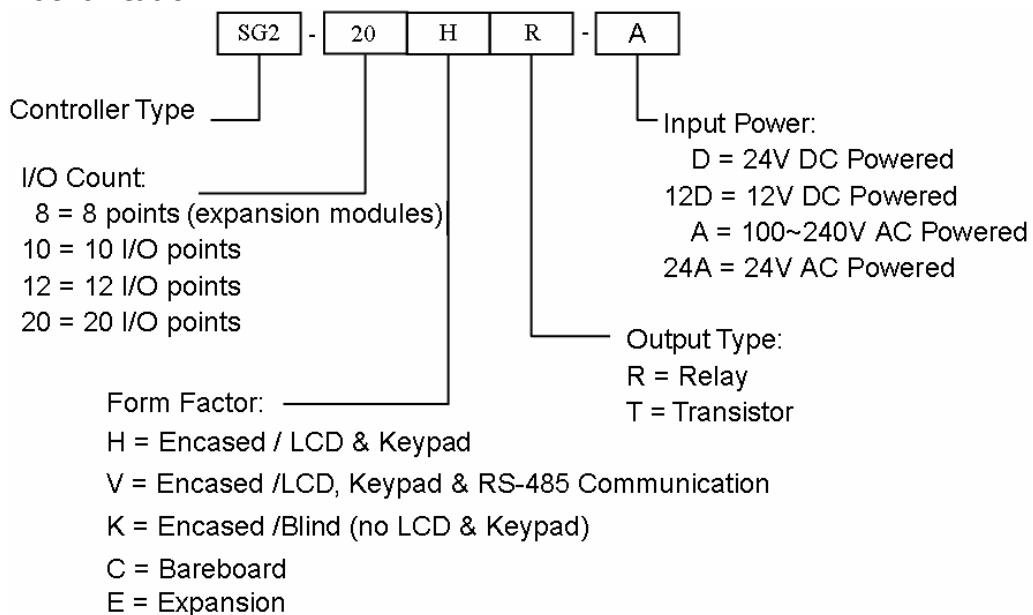
The installation site of the SG2 smart relay is very important. It relates directly to the functionality and the life span of your SG2. Please carefully choose an installation site that meets the following requirements:

- Mount the unit vertically
- Environment temperature: -4°F - 131°F (-20°C - 55°C)
- Avoid placing SG2 close to any heating equipment
- Avoid dripping water, condensation, or humid environment
- Avoid direct sunlight
- Avoid oil, grease, and gas
- Avoid contact with corrosive gases and liquids
- Prevent foreign dust, flecks, or metal scraps from contacting the SG2 smart relay
- Avoid electric-magnetic interference (soldering or power machinery)
- Avoid excessive vibration; if vibration cannot be avoided, an anti-rattle mounting device should be installed to reduce vibration.

Disclaim of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

SG2 Model Identification

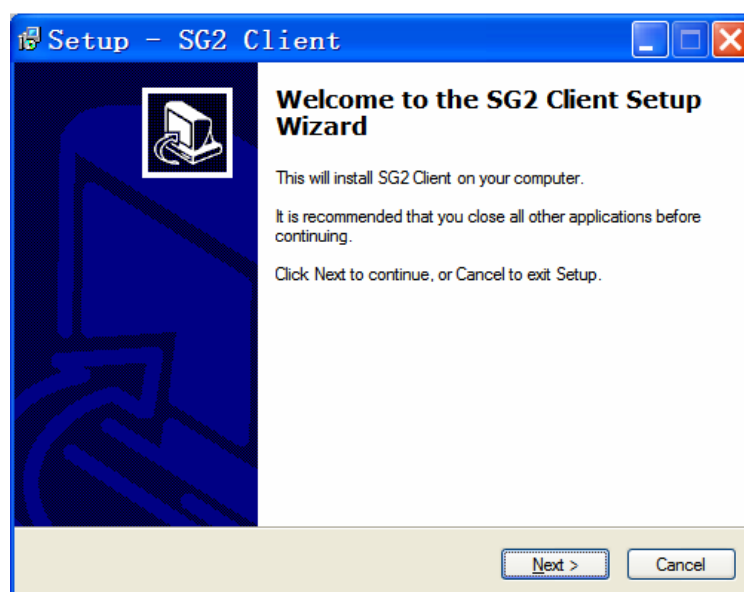


Quick Start Setup

This section is a simple 5-steps guide to connecting, programming and operating your new SG2 smart relay. This is not intended to be the complete instructions for programming and installation of your system. Many steps refer to other sections in the manual for more detailed information.

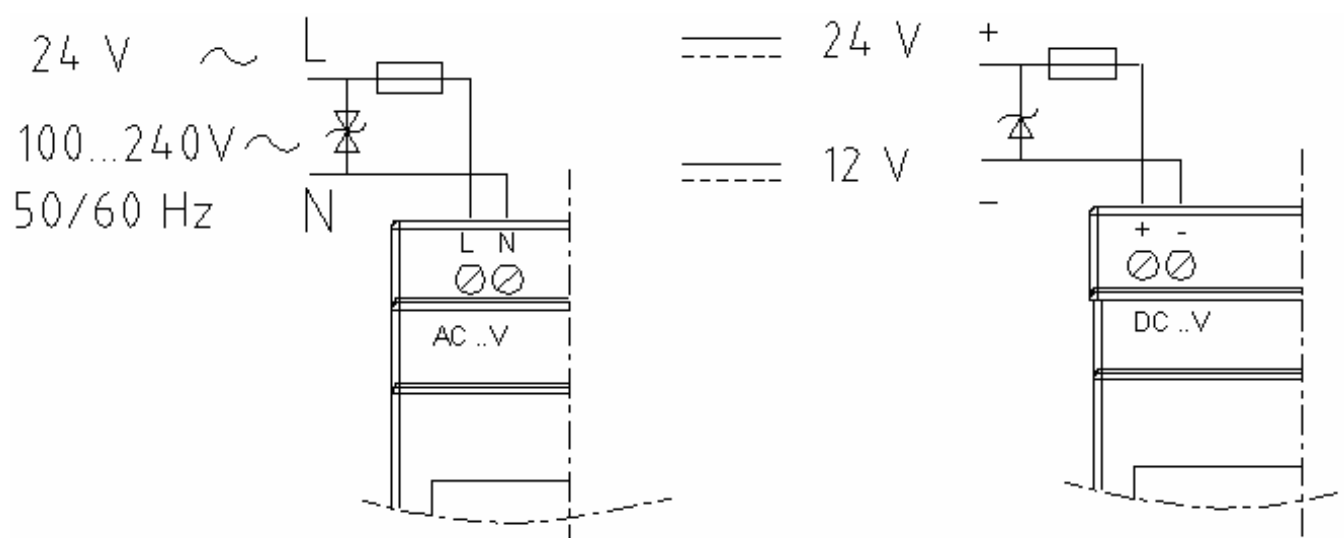
Install SG2 Client Software

Install the SG2 Client Software from CD or from the free internet download at www.taian-technology.com



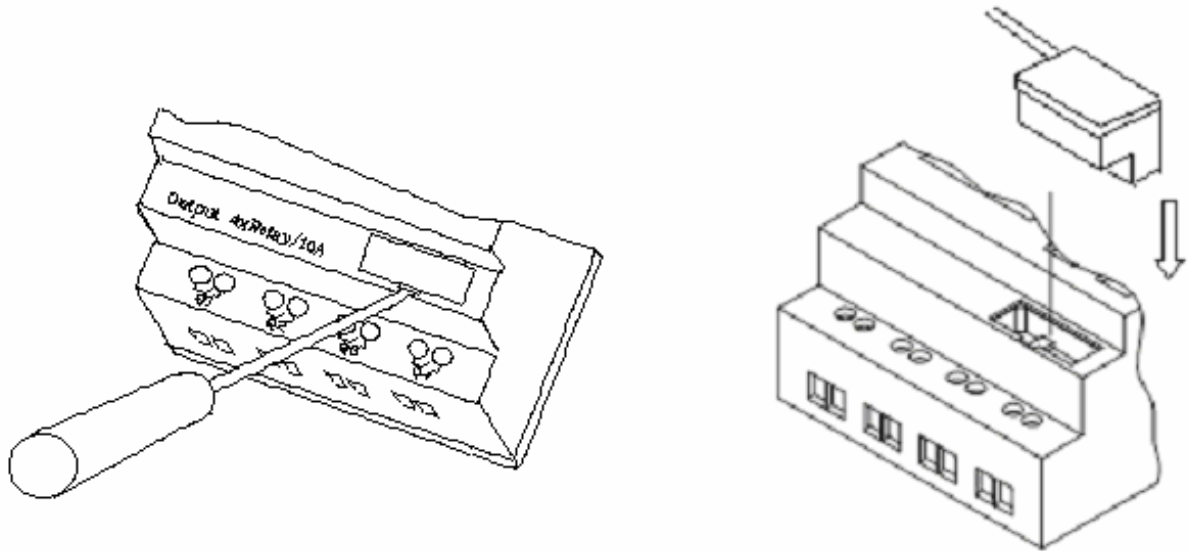
Connect Power to SG2 smart relay

Connect power to the Smart Relay using the below wiring diagrams for AC or DC supply for the applicable modules. See “Chapter 2: Installation” for complete wiring and installation instructions.



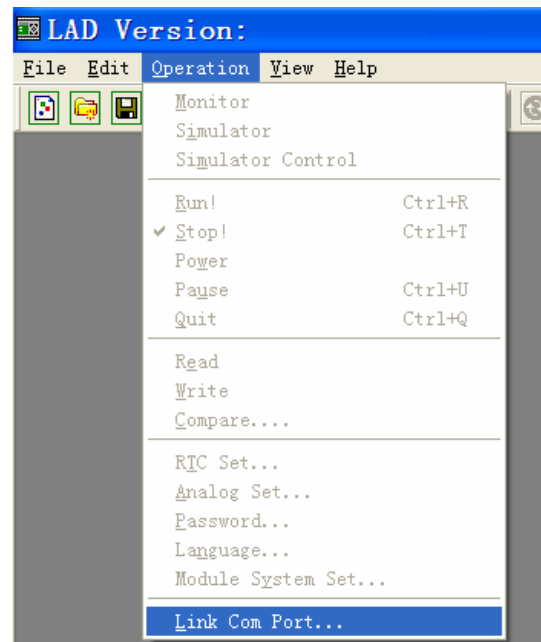
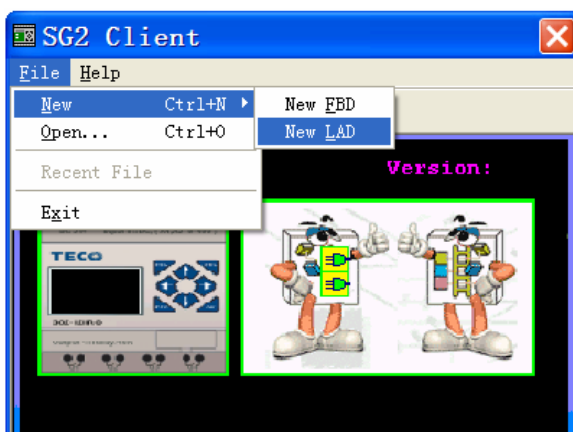
Connect Programming Cable

Remove the plastic connector cover from the SG2 using a flathead screwdriver as shown in the figure below. Insert the plastic connector end of the programming cable into the SG2 smart relay as shown in the figure below. Connect the opposite end of the cable to an RS232 serial port on the computer.

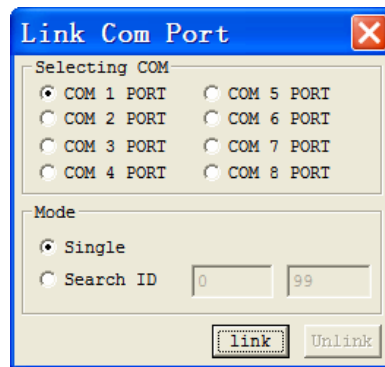


Establish Communication

- Open the SG2 Client software and select “New LAD” as shown below left.
- Select “Operation/Link Com Port...” as shown below right.



c. Select the correct Com Port number where the programming cable is connected to the computer then press the “link” button.

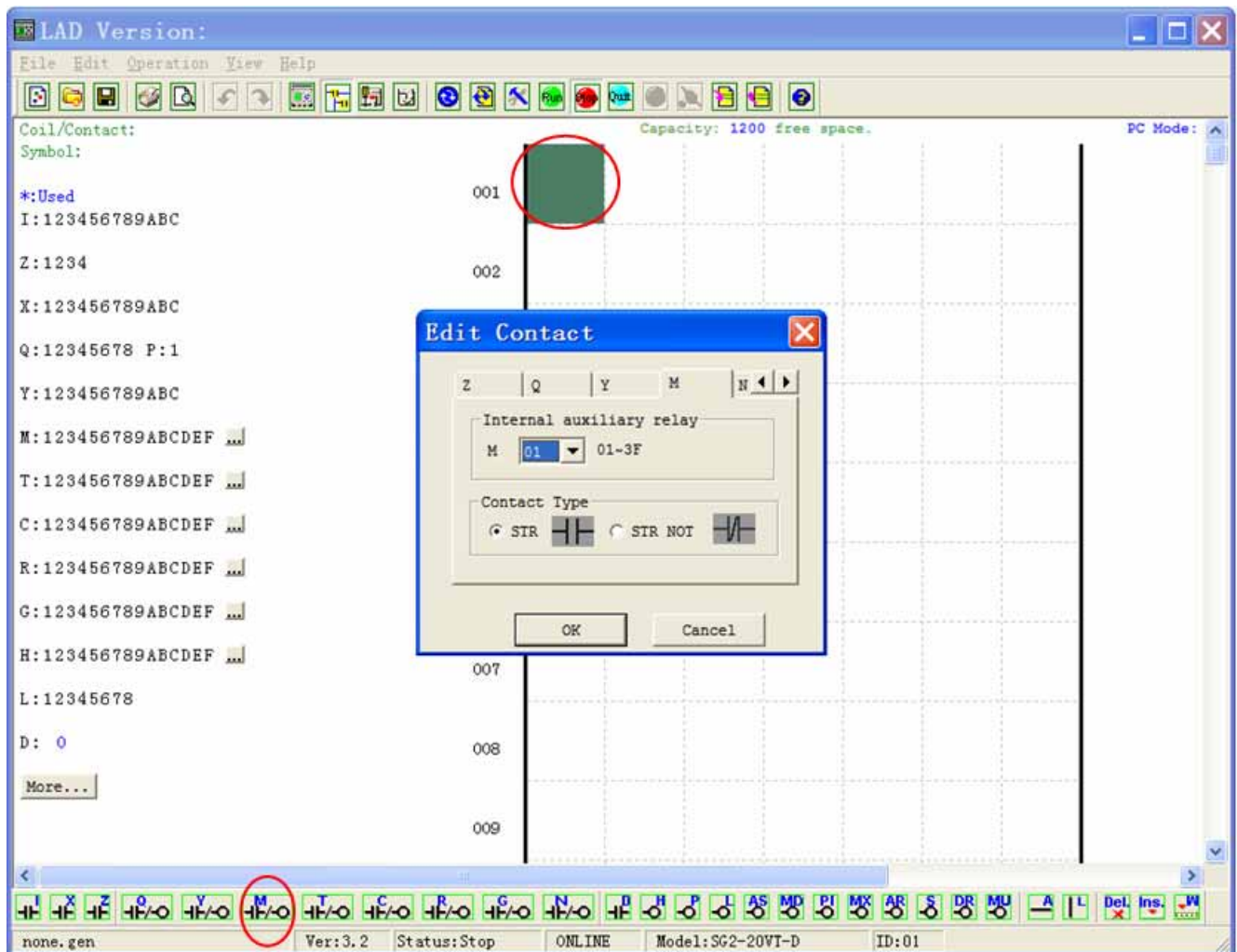


d. The SG2 Client will then begin to detect the connected smart relay to complete its connection.

Write simple program

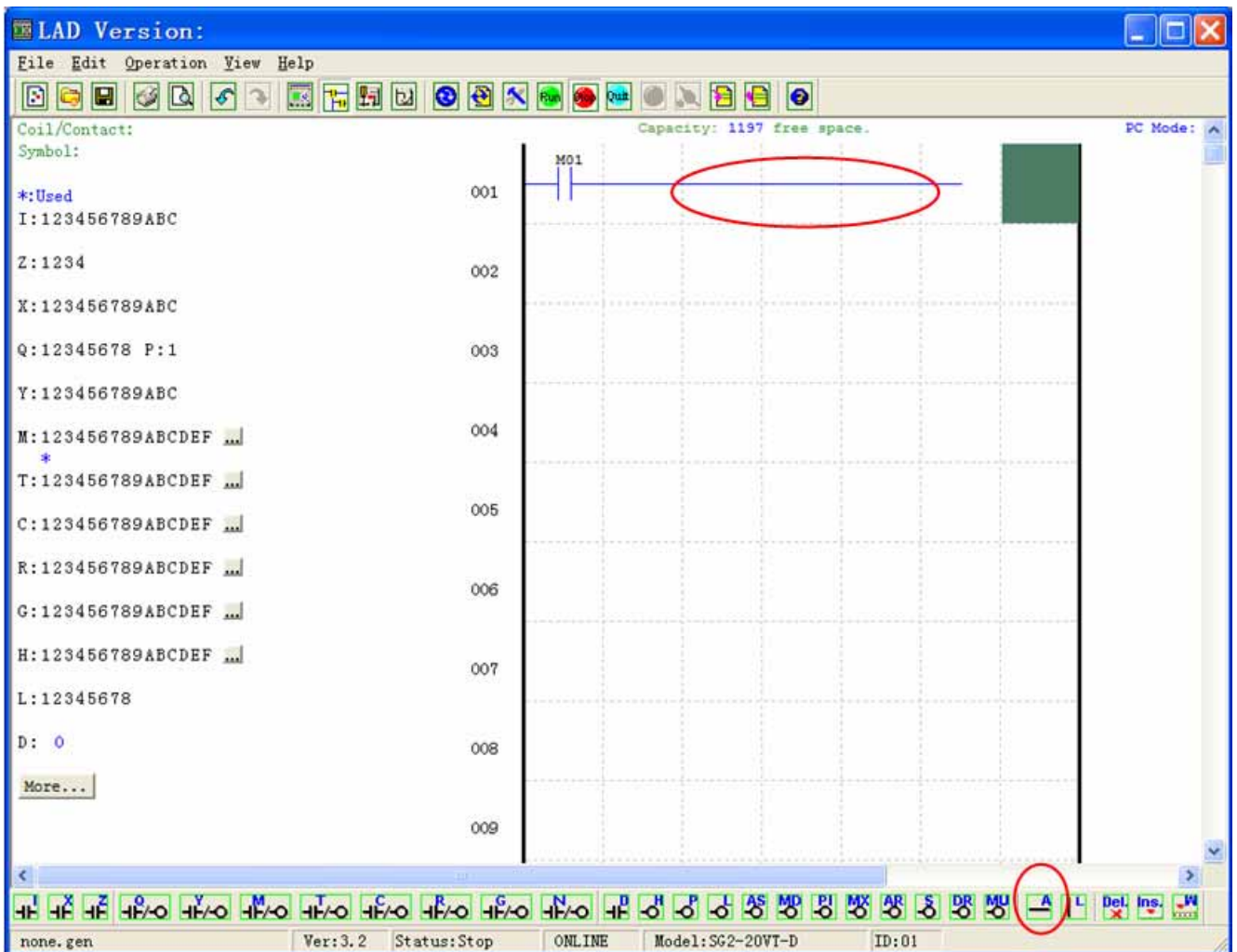
a. Write a simple one rung program by clicking on the leftmost cell at line 001 of the programming grid, then click on the “M” contact icon on the ladder toolbar, as shown below. Select M01 and press the OK button.

See “[Chapter 5: Ladder Programming instructions](#)” for complete instruction set definitions.

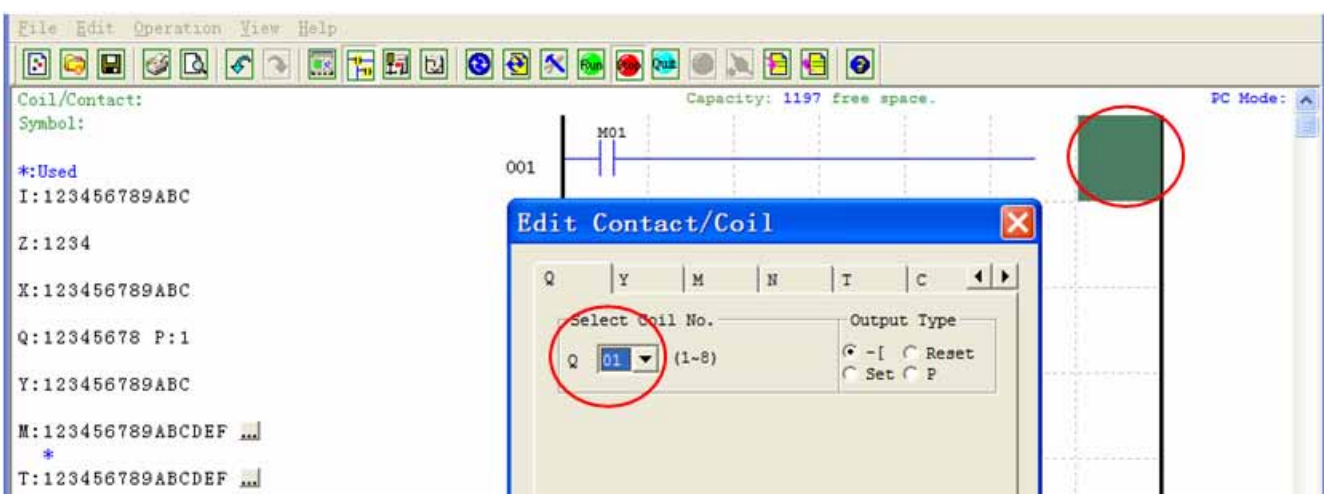


Note: If the ladder toolbar is not visible at the bottom of the screen, select **View/Ladder Toolbar** from the menu to enable.

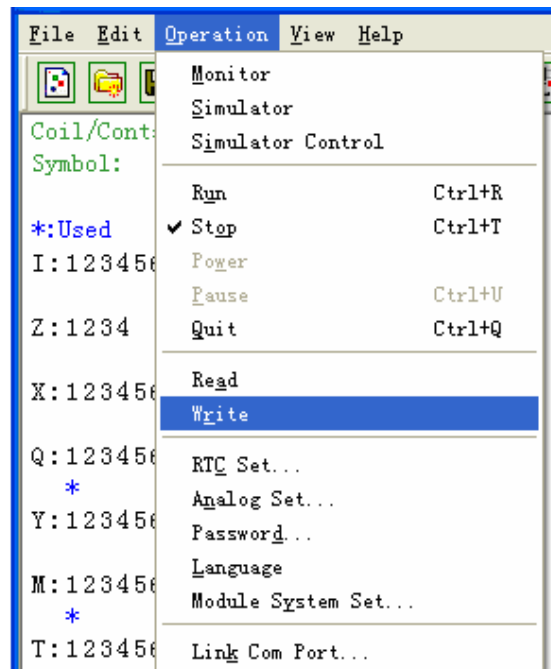
b. Use the “A” key on your keyboard (or the “A” icon on the ladder toolbar) to draw the horizontal circuit line from the M contact to the right most cell, as shown below.



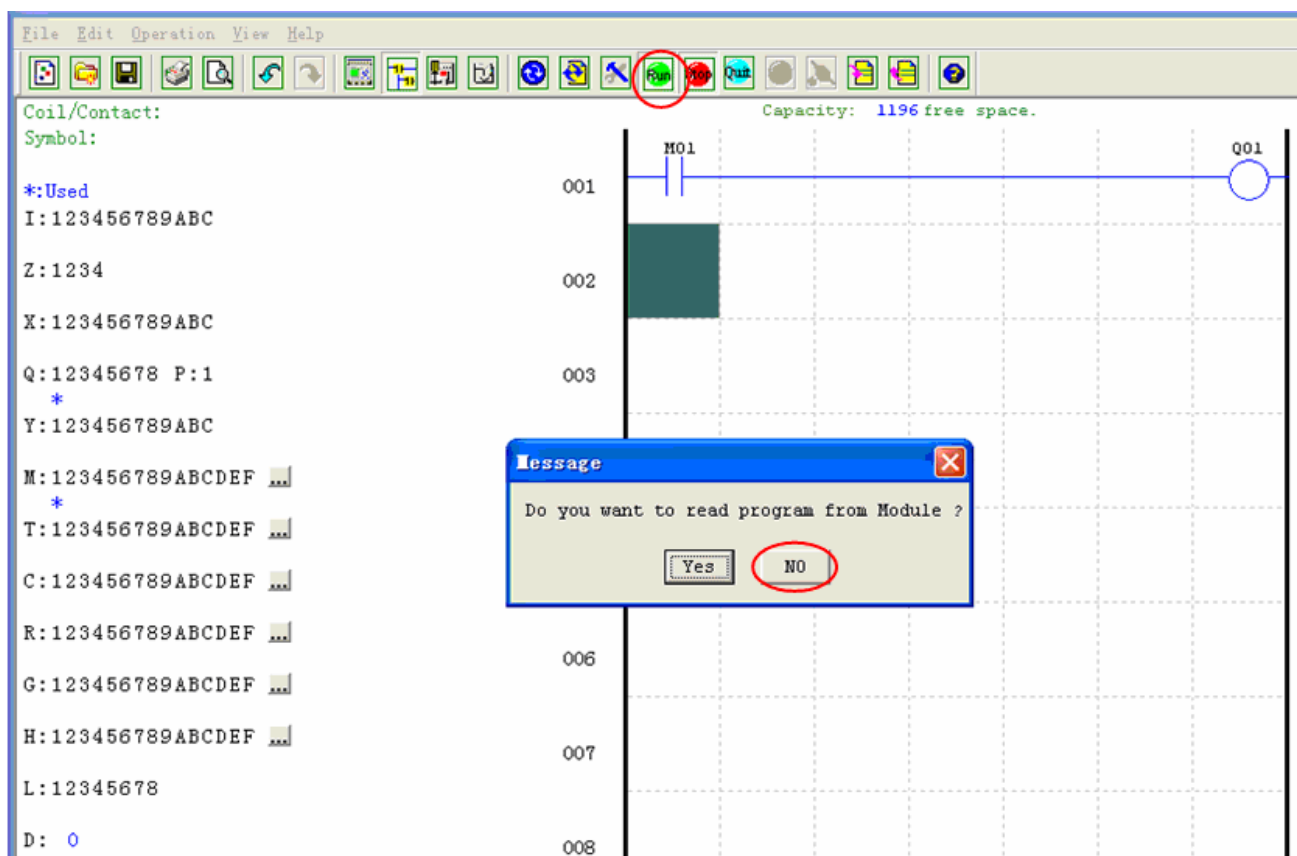
c. Select the “Q” coil icon from the ladder toolbar and drop it on the right most cells. Select Q01 from the dialog and press OK as shown below. See “[Chapter 5: Ladder Programming instructions](#)” for complete instruction set definitions.



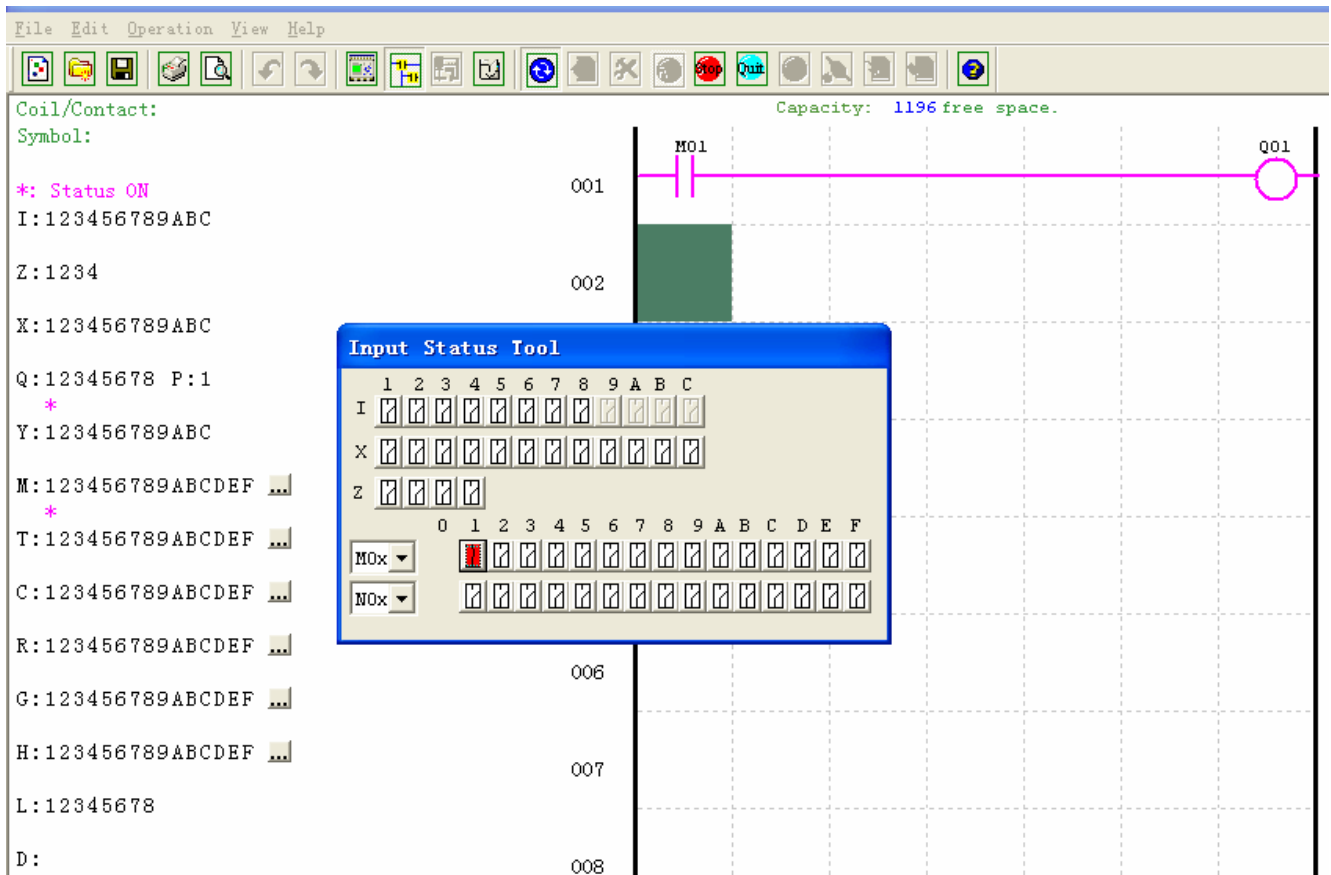
d. Test the simple program. From the Operation menu, select the Write function and write the program to the connected smart relay as shown below.



e. Select the RUN icon from the toolbar, and select “No” when the pop-up message asks “Do you want to read program from module?”, as shown below.



f. On the Input Status dialog, click on M01 to activate the contact M01 which will turn ON the Output Q01 as shown below. The highlighted circuit will show active and the first Output (Q01) on the connected smart relay will be ON. See “[Chapter 3: Programming Tools](#)” for more detailed software information.



Chapter 2: Installation

General Specifications	11
Product Specifications.....	14
Mounting.....	15
Wiring	17
K type Indicator Light.....	19

General Specifications

SG2 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 SG2 can expand to its maximum I/O count by adding 3 groups of 4-input and 4-output modules.

Power Supply	
Input Power Voltage Range	24V DC Models: 20.4-28.8V 12V DC Models: 10.4~14.4V AC Models: 85-265V 24V AC Models: 20.4-28.8V
Power Consumption	24VDC: 12-point :125mA 20-point: 185mA 12VDC: 12-point: 195mA 20-point: 265mA 100-240VAC: 100mA 24VAC: 290mA
Wire Size (all terminals)	26 to 14 AWG

Programming	
Programming languages	Ladder/Function Block Diagram
Program Memory	300 Lines or 260 Function Blocks
Programming storage media	Flash
Execution Speed	10ms/cycle
LCD Display	4 lines x 16 characters
Timers	
Maximum Number	Ladder: 31; FBD: 250
Timing ranges	0.01s–9999min
Counters	
Maximum Number	Ladder: 31; FBD: 250
Highest count	999999
Resolution	1
RTC (Real Time Clock)	
Maximum Number	Ladder: 31; FBD: 250
Resolution	1min
Time span available	week, year, month, day, hour, min
Analog compare	
Maximum Number	Ladder: 31; FBD: 250
Compare versus other inputs	Numeric values or function block current value, such as Analog input(A), Timer, Counter, Temperature Input (AT), Analog Output (AQ), Analog*gain + Offset, AS, MD, PI, MX, AR , DR ...

Environmental	
Enclosure Type	IP20
Maximum Vibration	1G according to IEC60068-2-6
Operating Temperature Range	-4° to 131°F (-20° to 55°C)
Storage Temperature Range	-40° to 158°F (-40° to 70°C)
Maximum Humidity	90% (Relative, non-condensing)
Vibration	0.075mm amplitude, 1.0g acceleration
Weight	8-point: 190g 10,12-point: 230g (C type: 160g) 20-point: 345g (C type: 250g)
Agency Approvals	CUL, CE, UL

Discrete Inputs	
Current consumption	3.2mA @24VDC; 4mA @12VDC 1.3mA @100-240VAC 3.3mA @24VAC
Input Signal "OFF" Threshold	24VDC: < 5VDC; 12VDC: < 2.5VDC 100-240VAC : < 40VAC 24VAC: <6VAC
Input Signal "ON" Threshold	24VDC: > 15VDC 12VDC: > 7.5VDC 100-240VAC : > 79VAC 24VAC: >14VAC
Input On delay	24, 12VDC: 5ms 240VAC: 25ms 120VAC: 50ms 24VAC: 5ms
Input Off Delay	24, 12VDC: 3ms 240VAC: 90/85ms 50/60Hz 120VAC: 50/45ms 50/60Hz 24VAC: 3ms
Transistor device compatibility	PNP, 3-wire device only
High Speed Input frequency	1kHz
Standard Input frequency	< 40 Hz
Required protection	Inverse voltage protection required

Analog Inputs	
Resolution	Basic unit: 12 bit Expansion unit: 12bit
Voltage Range acceptable	Basic unit: Analog input: 0-10VDC voltage, 24VDC when used as discrete input; Expansion unit: Analog input: 0-10VDC voltage or 0-20mA current
Input Signal "OFF" Threshold	< 5VDC (as 24VDC discrete input)
Input Signal "ON" Threshold	> 9.8VDC (as 24VDC discrete input)
Isolation	None
Short circuit protection	Yes
Total number available	Basic unit: A01-A04 Expansion unit: A05-A08

Relay Outputs	
Contact material	Ag Alloy
Current rating	8A
HP rating	1/3HP@120V 1/2HP@250V
Maximum Load	Resistive: 8A /point Inductive: 4A /point
Maximum operating time	15ms (normal condition)
Life expectancy (rated load)	100k operations
Minimum load	16.7mA

Transistor Outputs	
PWM max. output frequency	1.0kHz (0.5ms on,0.5ms off)
Standard max. output frequency	100Hz
Voltage specification	10-28.8VDC
Current capacity	1A
Maximum Load	Resistive: 0.5A/point Inductive: 0.3A/point
Minimum Load	0.2mA

Product Specifications

Part #	Input Power	Inputs	Outputs	Display & Keypad	RS-485 Communications	Max I/O
SG2-12HR-D	24 VDC	6 DC, 2 Analog	4 Relay	√, Z01-Z04	N/A	36 + 4 *1
SG2-12HT-D		6 DC, 2 Analog	4 Trans.	√, Z01-Z04	N/A	36 + 4 *1
SG2-20HR-D		8 DC, 4 Analog	8 Relay	√, Z01-Z04	N/A	44 + 4 *1
SG2-20HT-D		8 DC, 4 Analog	8 Trans.	√, Z01-Z04	N/A	44 + 4 *1
SG2-20VR-D		8 DC, 4 Analog	8 Relay	√, Z01-Z04	Built-in MODBUS	44 + 4 *1
SG2-20VT-D		8 DC, 4 Analog	8 Trans.	√, Z01-Z04	Built-in MODBUS	44 + 4 *1
SG2-12HR-12D	12 VDC	6 DC, 2 Analog	4 Relay	√, Z01-Z04	N/A	36 + 4 *1
SG2-20HR-12D		8 DC, 4 Analog	8 Relay	√, Z01-Z04	N/A	44 + 4 *1
SG2-20VR-12D		8 DC, 4 Analog	8 Relay	√, Z01-Z04	Built-in MODBUS	44 + 4 *1
SG2-10HR-A	100-240 VAC	6 AC	4 Relay	√, Z01-Z04	N/A	34 + 4 *1
SG2-20HR-A		12 AC	8 Relay	√, Z01-Z04	N/A	44 + 4 *1
SG2-12HR-24A	24VDC	8 AC	4 Relay	√, Z01-Z04	N/A	36 + 4 *1
SG2-20HR-24A		12 AC	8 Relay	√, Z01-Z04	N/A	44 + 4 *1
Expansion Modules and Accessories						
SG2-8ER-D	24VDC	4 DC	4 Relay	N/A	N/A	N/A
SG2-8ET-D		4 DC	4 Trans.	N/A	N/A	N/A
SG2-8ER-A	100-240VAC	4 AC	4 Relay	N/A	N/A	N/A
SG2-8ER-24A	24VAC	4 AC	4 Relay	N/A	N/A	N/A
SG2-4AI	24 VDC	4 Analog	N/A	N/A	N/A	N/A
SG2-4PT		4 Analog	N/A	N/A	N/A	N/A
SG2-2AO		N/A	2 Analog	N/A	N/A	N/A
SG2-MBUS		Communications Module, RS-485 ModBus RTU slaver				
SG2-DNET		Communications Module, DeviceNet Group2 slaver				
SG2-PBUS		Communications Module, Profibus-DP slaver				
EN01		Communications Module, TCP/IP				
GSM		Communications Module, EGSM 900MHz, DCS1800MHz				
SG2-PL01	SG2 Programming Cable, SG2 Programming software					
SG2-PM05(3rd)	SG2 Memory cartridge					
OEM “Blind” Models, No Keypad, No Display						
SG2-12KR-D	24VDC	6 DC, 2 Analog	4 Relay	X	N/A	36
SG2-12KT-D		6 DC, 2 Analog	4 Trans.	X	N/A	36
SG2-20KR-D		8 DC, 4 Analog	8 Relay	X	N/A	44
SG2-20KT-D		8 DC, 4 Analog	8 Trans.	X	N/A	44
SG2-12KR-12D	12VDC	6 DC, 2 Analog	4 Relay	X	N/A	36
SG2-10KR-A	100-240VAC	6 AC	4 Relay	X	N/A	34
SG2-20KR-A		12 AC	8 Relay	X	N/A	44
OEM “Baseboard” Models, No Keypad, No Display, No Expansion						
SG2-12CR-D	24VDC	6 DC, 2 Analog	4 Relay	X	N/A	12
SG2-12CT-D		6 DC, 2 Analog	4 Trans.	X	N/A	12
SG2-20CR-D		8 DC, 4 Analog	8 Relay	X	N/A	20
SG2-20CT-D		8 DC, 4 Analog	8 Trans.	X	N/A	20
SG2-10CR-A	100-240VAC	6 AC	4 Relay	X	N/A	10
SG2-20CR-A		12 AC	8 Relay	X	N/A	20

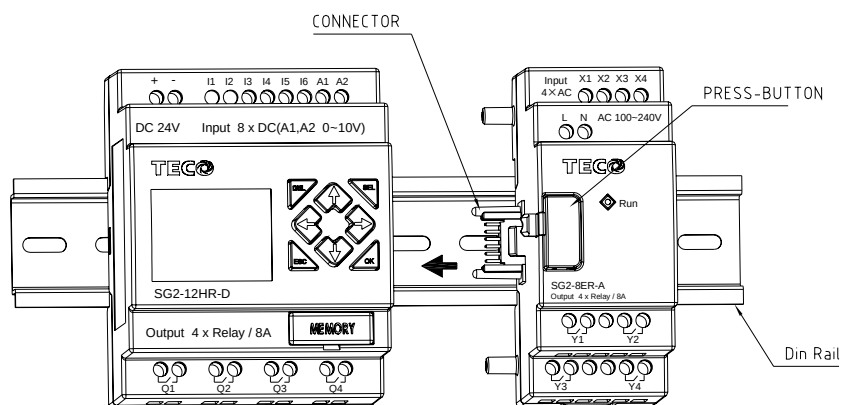
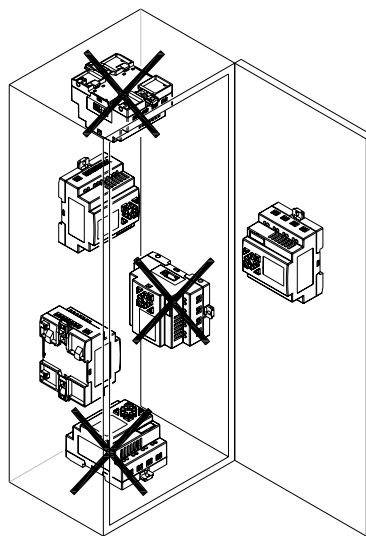
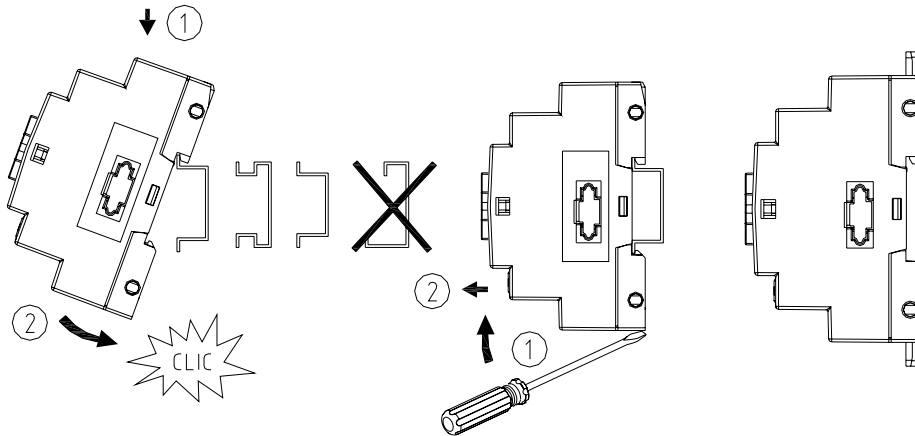
✘ If module with keypad and display, Max IO can be added keypad input Z01-Z04.

✘ More information about Product Specifications to see “[chapter 7: Hardware Specification](#)”.

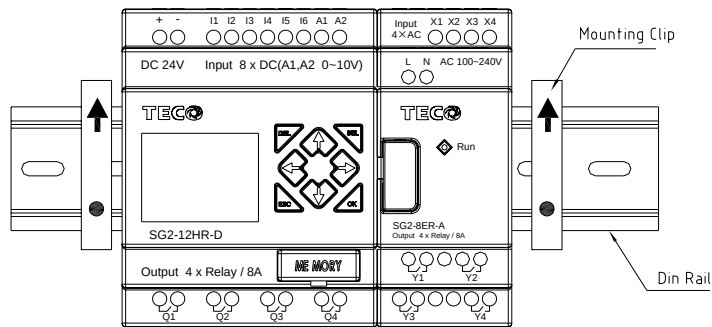
Mounting

DIN-rail Mounting

The SG2 smart relay should always be mounted vertically. Press the slots on the back of the SG2 and expansion module plug CONNECTOR onto the rail until the plastic clamps hold the rails in place. Then connect the expansion module and CONNECTOR with the Master (press the PRESS-BUTTON simultaneously)

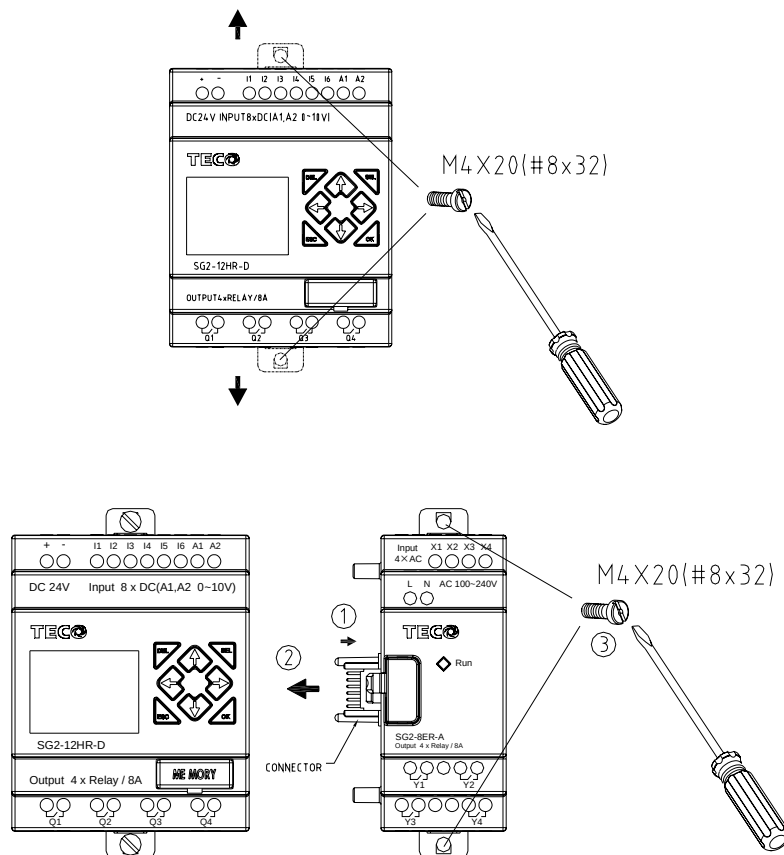


It is recommended to apply a DIN-rail end clamp to hold the SG2 in place.



Direct Mounting

Use M4 screws to direct mount the SG2 as shown. For direct installation of the expansion module, slide the expansion module and connect with the Master after the Master is fixed.



Wiring

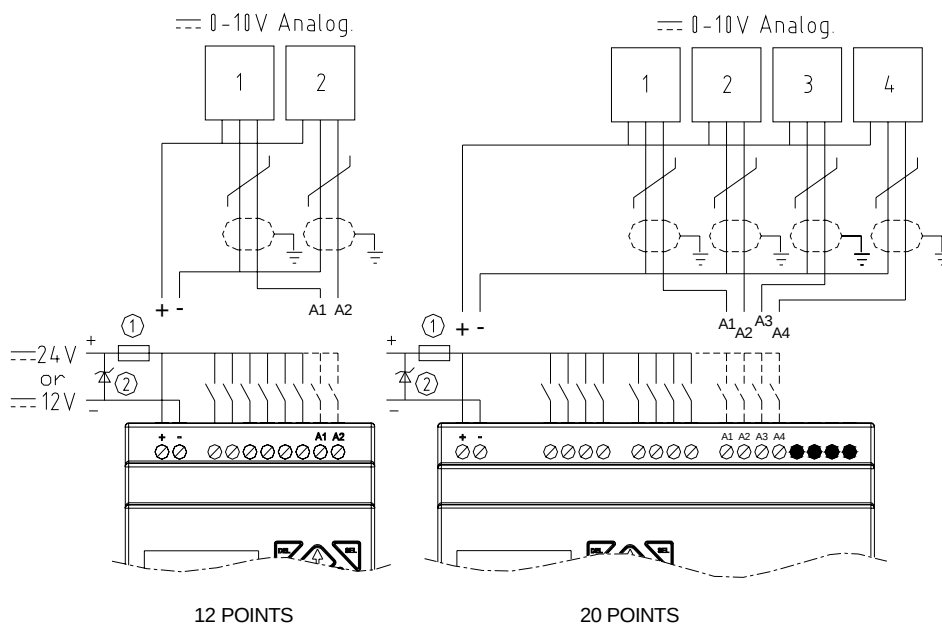
! **WARNING:** The I/O signal cables should not be routed parallel to the power cable, or in the same cable trays to avoid the signal interference.

! To avoid a short circuit on the load side, it is recommended to connect a fuse between each output terminals and loads.

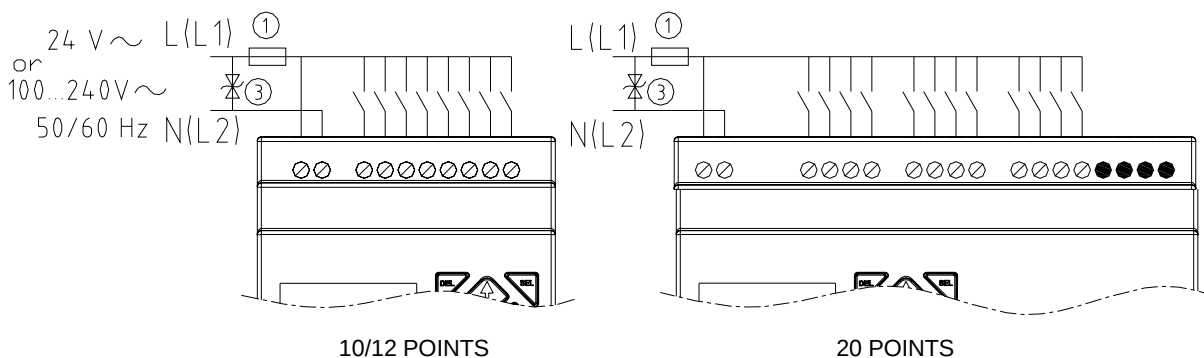
Wire size and Terminal Torque

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
$\varnothing 3.5$ (0.14in)					
C		Nm		0.6	
		lb-in		5.4	

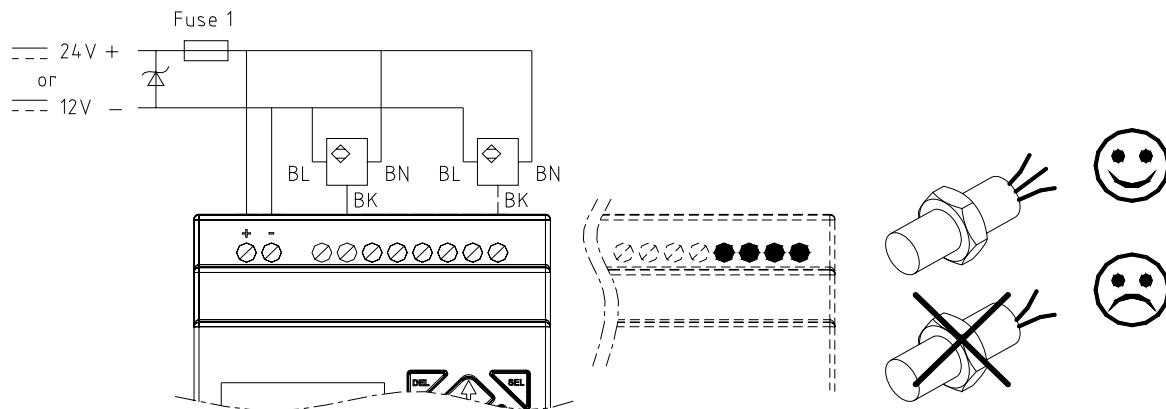
Input 12/24V DC



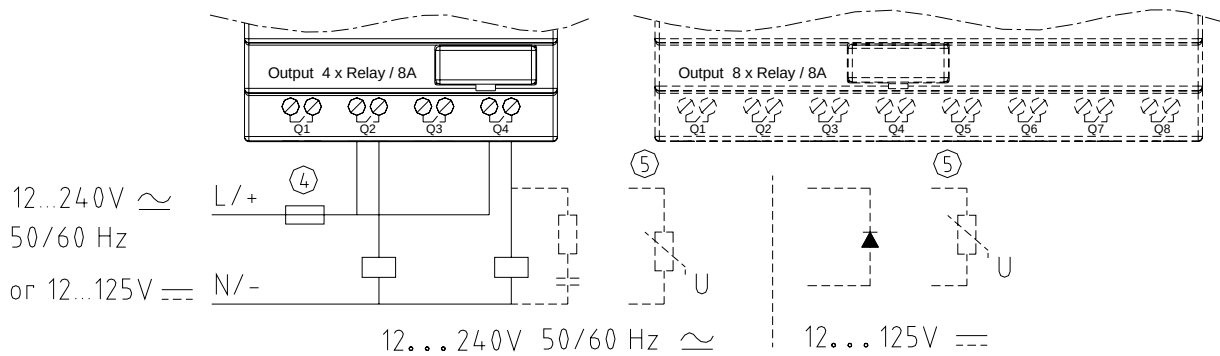
Input 100~240V /24V AC



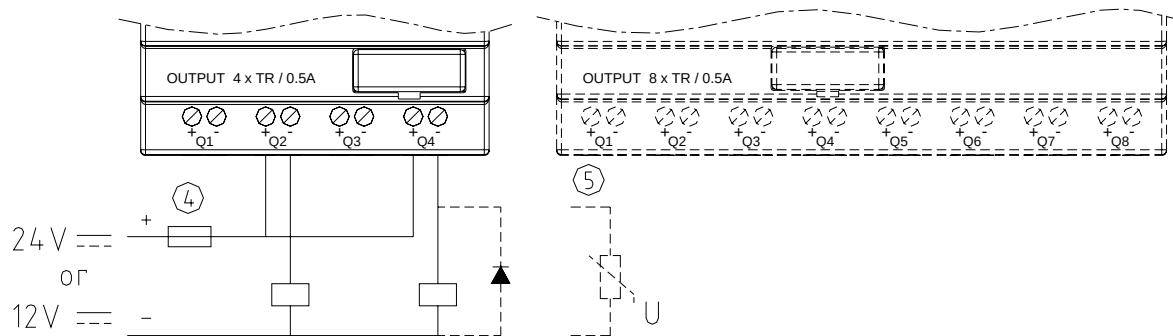
Sensor Connection



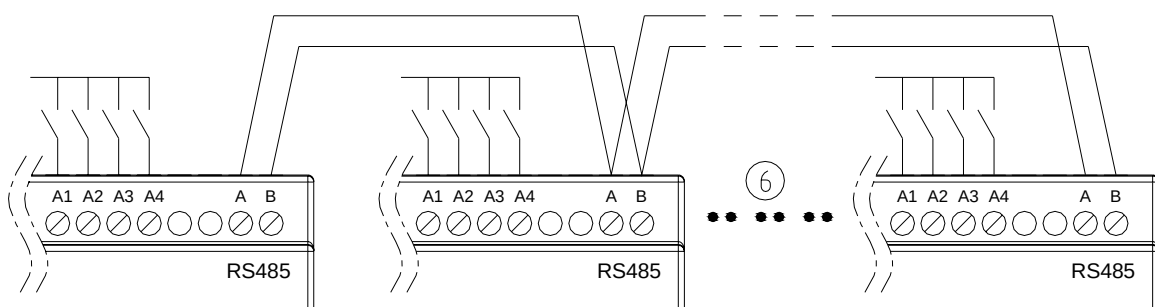
Output (Relay)



Output (Transistor)



IO Link OR Remote I/O Link



The power supply and the I/O supply should share the same power source. Only short circuit the first and the last module.

When I/O link, the net can connect 8 products in max. (ID: 0-7).

When Remote I/O is available, it only can connect 2 products max (Master & Slave).

※ More information about RS485 Model communication to see “[Chapter 8 20 Points RS485 type Models Instruction](#)”.

- ①-1A quick-blowing fuse, circuit-breaker or circuit protector
- ②-Surge absorber (43V DC)
- ③-Surge absorber (Input 24VAC:43V; Input 100~240VAC:430V AC)
- ④-Fuse, circuit-breaker or circuit protector
- ⑤-Inductive load
- ⑥-Comply with standard: EIA RS-485.

K type Indicator Light

There is an indicator light to indicate the status of SG2 (K type) smart, and the below table shows the relationship between the light and the SG2 status.

State of light	Description
	Power up, SG2 is stopping
	Flicker slow(1Hz), SG2 is running
	Flicker quick(5Hz), SG2 is under failure status
	—Flash error
	—Illogicality in user program
	—Expansion model error
	—RTC error

Chapter 3: Program Tools

PC Programming Software “SG2 Client”	21
Installing the Software	21
Connecting the Software	21
Start Screen	22
Ladder Logic Programming Environment	22
Menus, Icons and Status Bar	23
Programming	24
Simulation Mode	25
Establish Communication	25
Writing Program to smart relay	26
Online Monitoring/Editing	27
Operation menu	28
HMI/TEXT	29
Program Documentation	33
Analog Output Set	35
Data Register Set	36
View menu	38
FBD Programming Environment	39
Menu, Icons and Status Bar	39
Programming	40
Simulation Mode	41
Online Monitoring/Editing	41
Symbol and Parameters list	42
Memory Cartridge (sold separately)	44
LCD Display and Keypad	45
Keypad	45
Original Screen	46
LCD Display Main Menu	49
RTC Daylight saving setting	54
SG2 system error	58

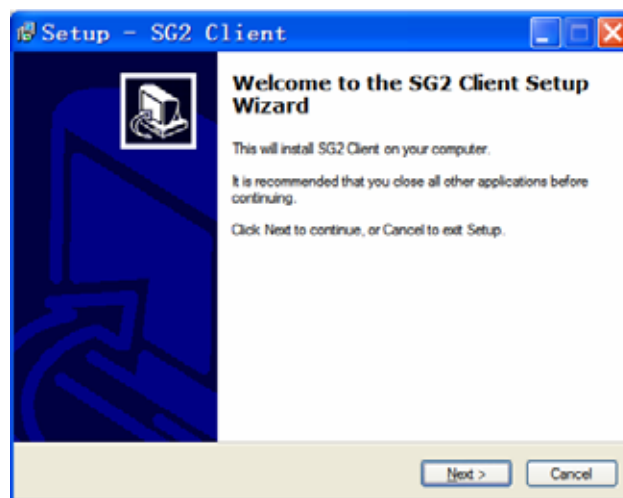
PC Programming Software “SG2 Client”

The SG2 Client programming software provides two edit modes, Ladder Logic and Function Block Diagram (FBD). The SG2 Client software includes the following features:

1. Easy and convenient program creation and editing.
2. Programs can be saved on a computer for archiving and reuse. Programs can also be uploaded directly from a SG2 and saved or edited.
3. Enables users to print programs for reference and review.
4. The Simulation Mode allows users to run and test their program before it is loaded to the controller.
5. Real-time communication allows the user to monitor and force I/O on the SG2 smart relay operation during RUN mode.

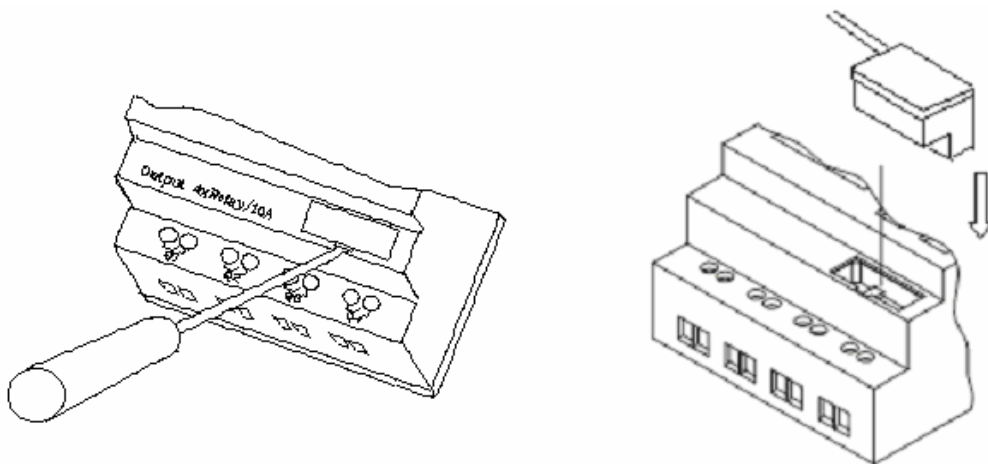
Installing the Software

Install the SG2 Client Software from CD or from the free internet download at www.taian-technology.com.



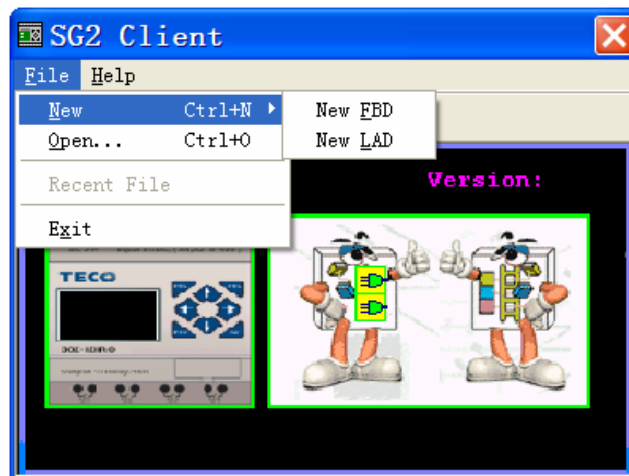
Connecting the Software

Remove the plastic connector cover from SG2 using a flathead screwdriver as shown in the figure below. Insert the plastic connector end of the programming cable into the SG2 smart relay as shown in the figure below. Connect the opposite end of the cable to an RS232C serial port on the computer.



Start Screen

Run the SG2 Client software and the below Start screen will be displayed. From this screen, you can perform the following functions



New Ladder Program

Select **File** --> **New** --> **New LAD** to enter the development environment for a new Ladder program.

New FBD Program

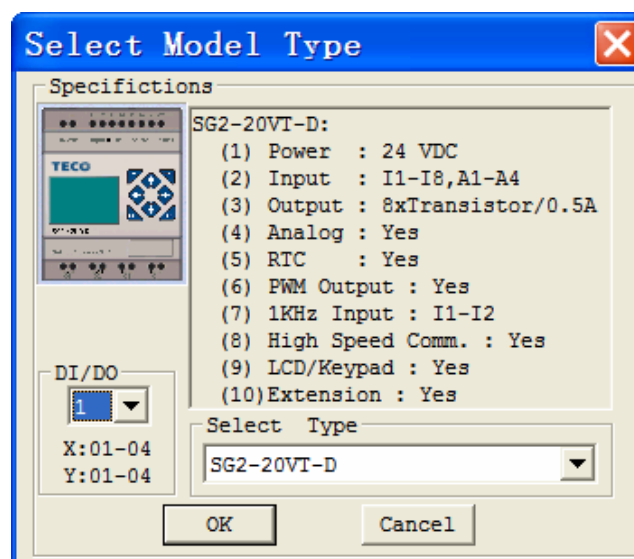
Select **File** --> **New** --> **New FBD** to enter the development environment for a new FBD (Function Block Diagram) program.

Open Existing File

Select **File** --> **Open** to choose the type of file to open (Ladder or FBD), and choose the desired program file, and then click Open.

Ladder Logic Programming Environment

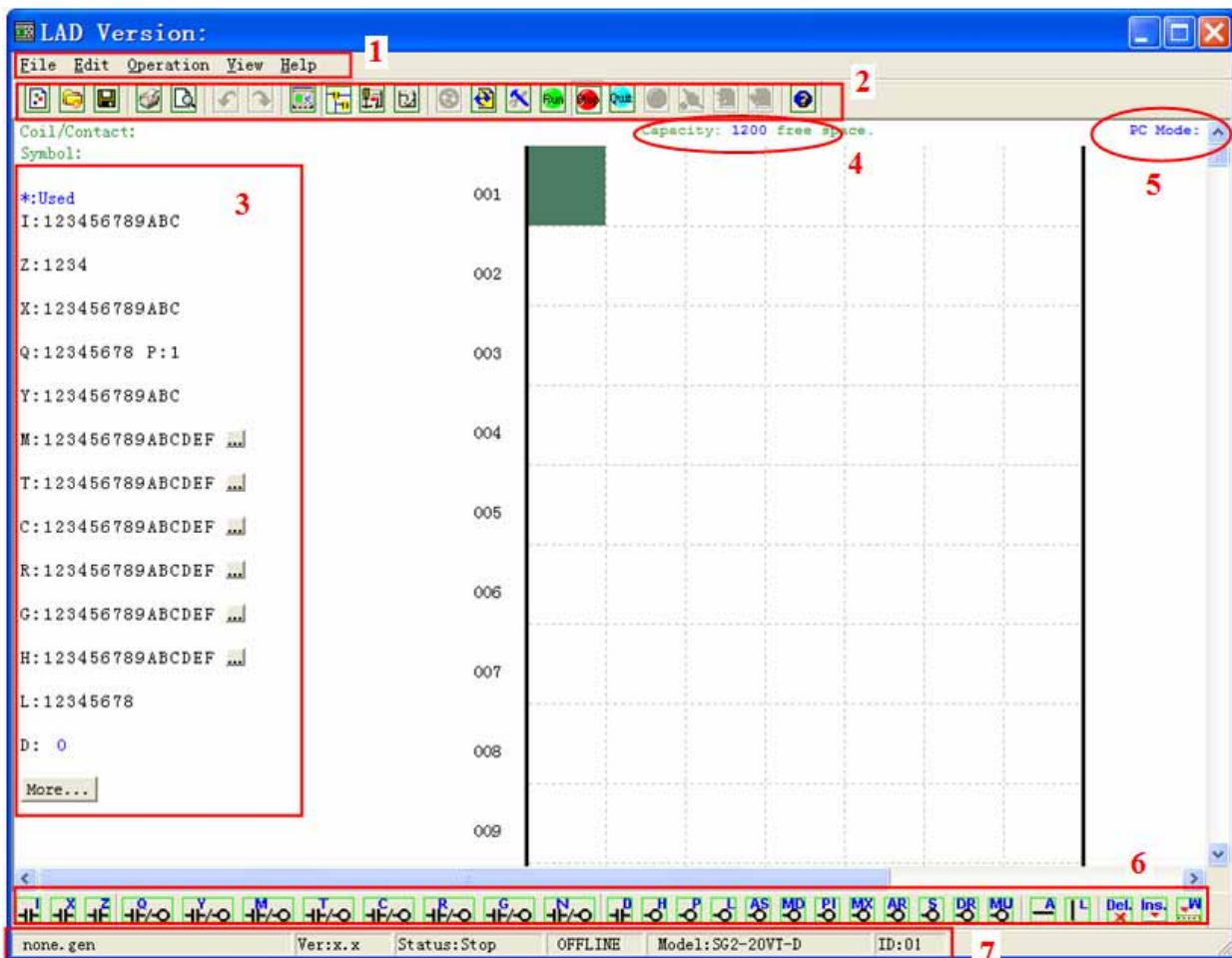
The Ladder Logic Programming Environment includes all the functions for programming and testing the SG2 using the Ladder Logic programming language. To begin a new program select **File**-->**New**, and select the desired model of SG2, and the number of connected expansion units if applicable, as shown below.



Menus, Icons and Status Bar

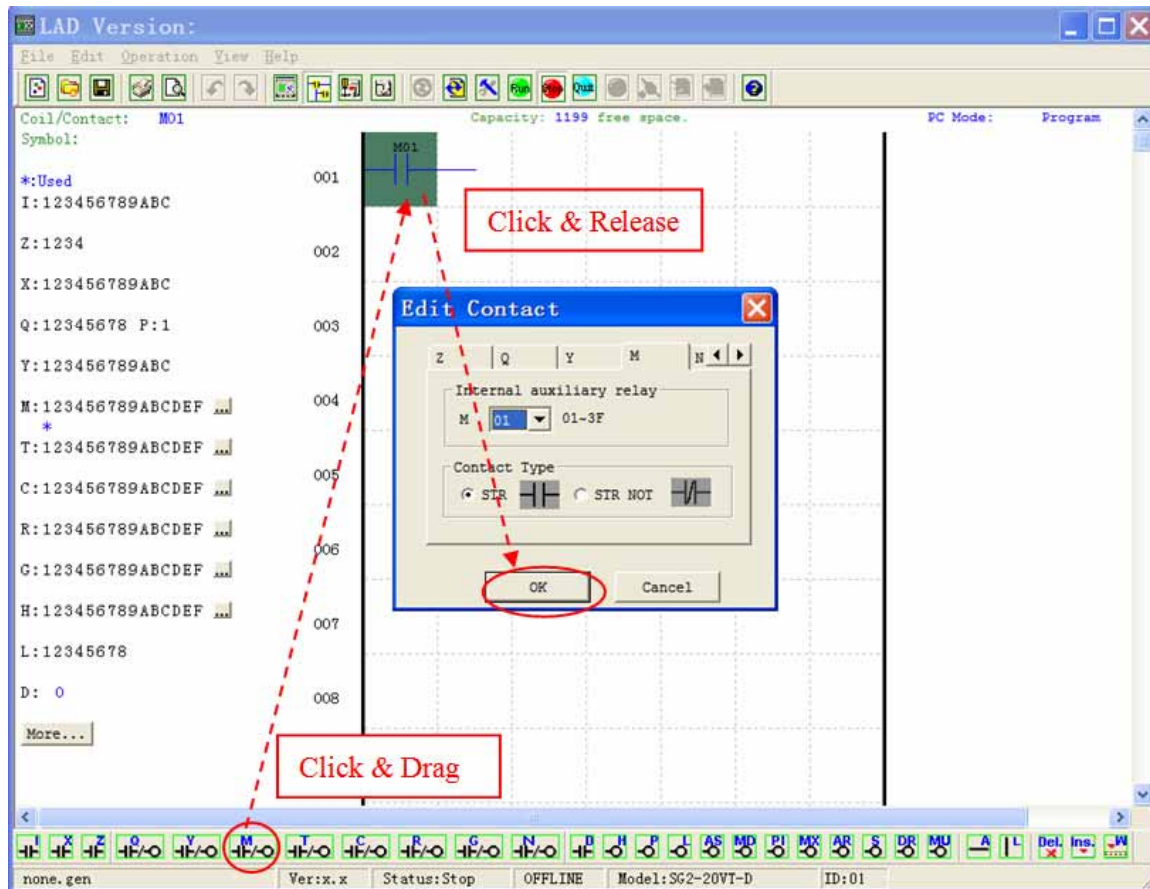
The Ladder programming environment includes the following Menus, Icons and Status Displays

1. Menu bar – Five menu selections for program development and retrieval, editing, communication to connected controllers, configuration of special functions and viewing preference selections.
2. Main Toolbar – (From Left to Right)
Icons for create a new program, open a program, save a program and print a program.
Icons for Keypad, Ladder view, HMI/Text edit and Symbol (comments) edit.
Icons for Monitor, Simulator, Simulator Controller, Controller Mode changes (Run, Stop, and Quit), and Read/Write programs from/to the SG2 smart relay.
3. Usage List – List for all memory types and addresses used with the current open program. Used addresses are designated by a “*” symbol below each address.
4. Amount of free programming memory available.
5. Current Mode – Program mode, Simulator mode, Monitor mode.
6. Ladder Toolbar – Icons for selecting and entering all available Ladder Logic instructions.
7. Status Bar – Status of current open project and connect SG2 smart relay.

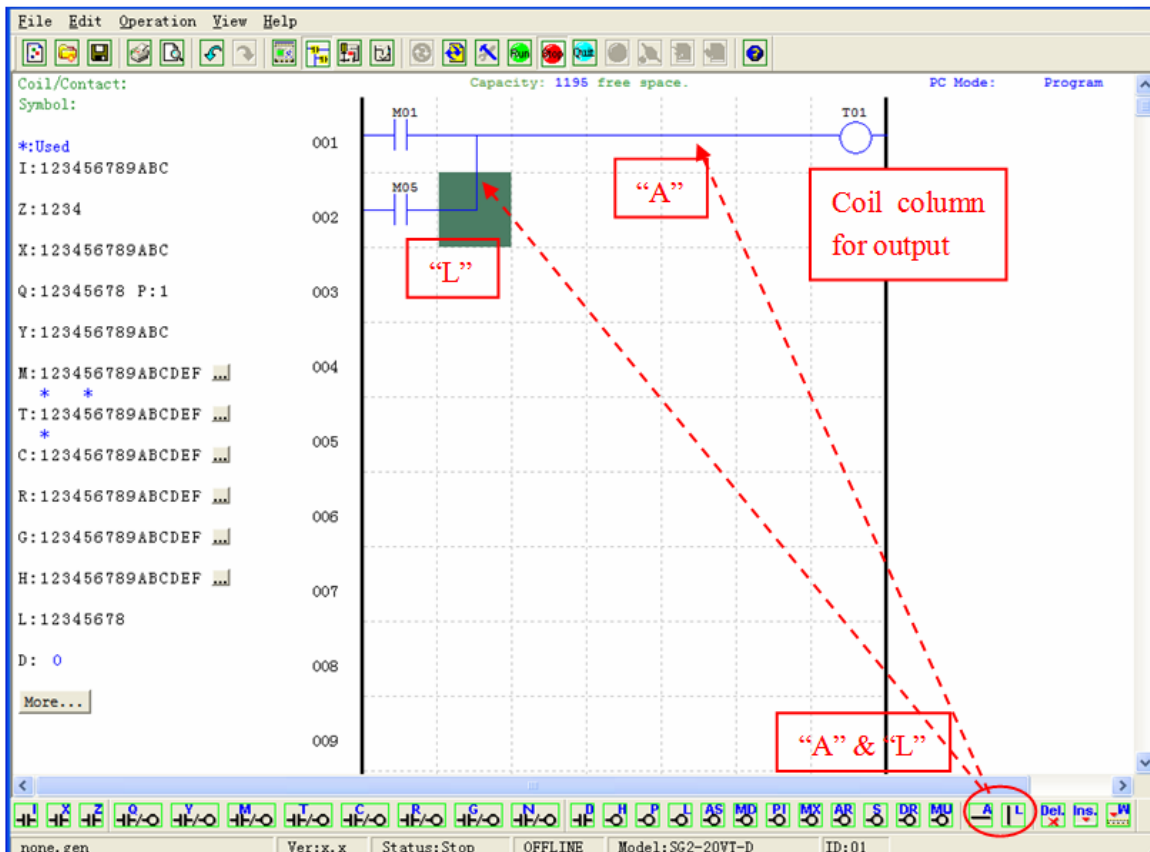


Programming

The SG2 Client software can be programmed by either drag-and-drop of instructions or by using keyboard entry commands. Below is an example of some common methods of entering programming instructions.

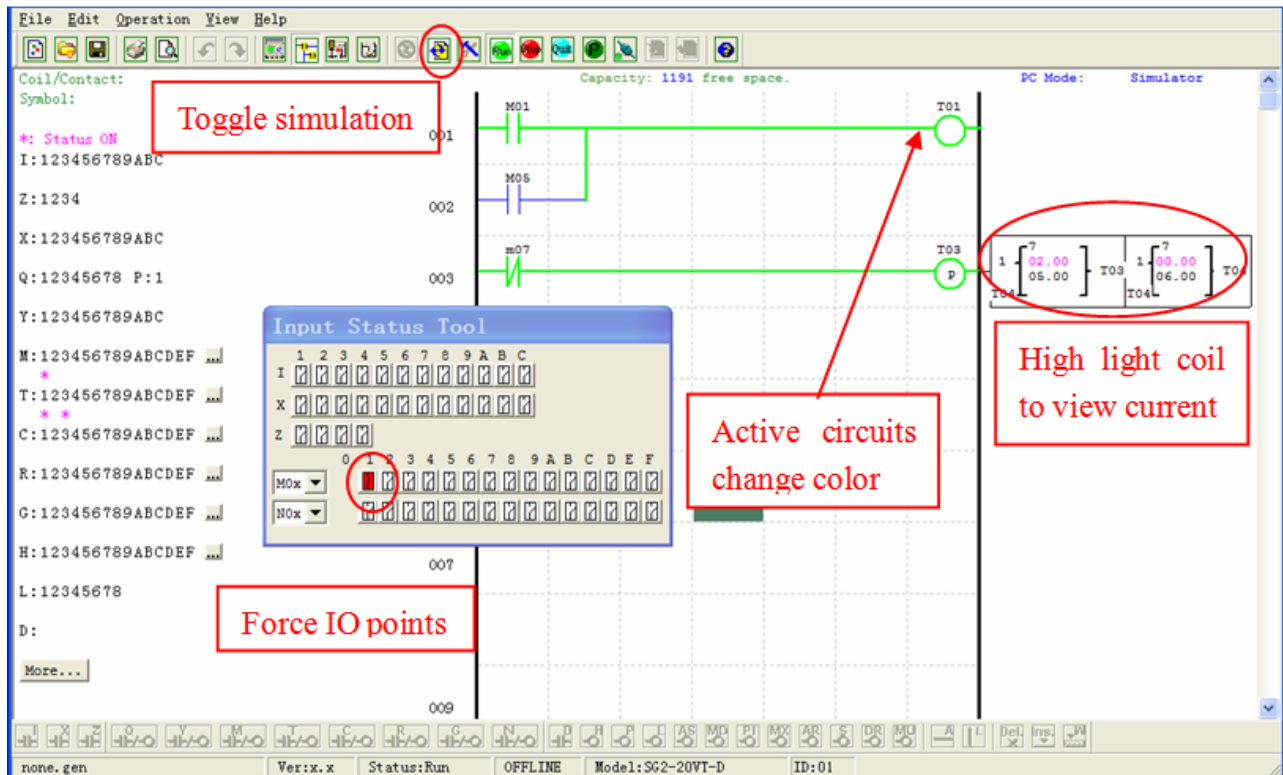


The “A” and “L” keys or icons are used to complete parallel and serial circuits. The right column is for output coils.



Simulation Mode

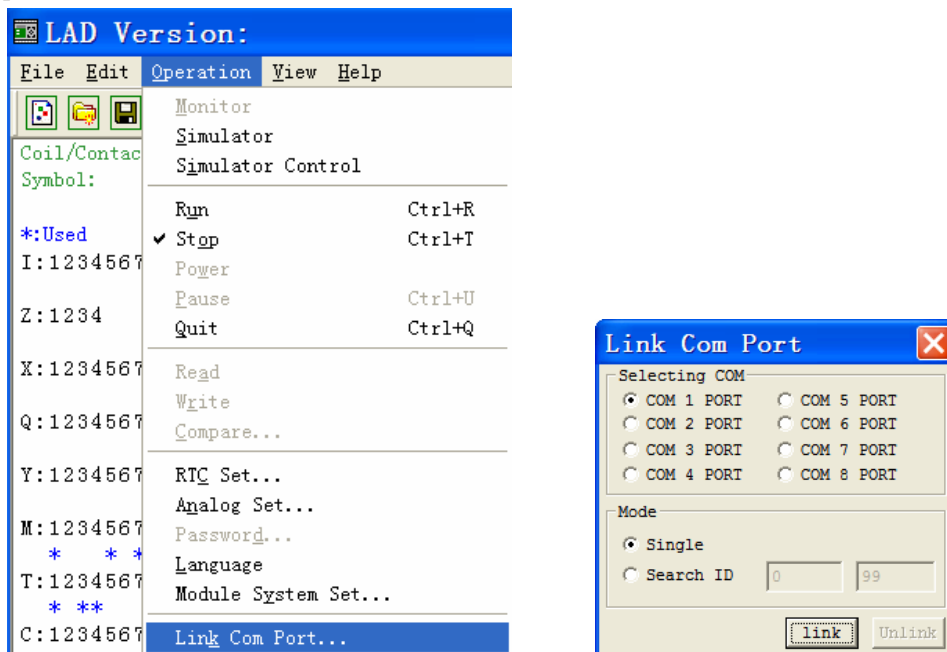
The SG2 Client software includes a built-in simulator to test and debug programs easily without the need for downloading to a controller. To activate simulation mode, simply press the RUN icon. The program below is shown in simulation mode, identifying the significant available features.



Establish Communication

The following is the simple procedure for establishing communication between PC and the SG2 smart relay.

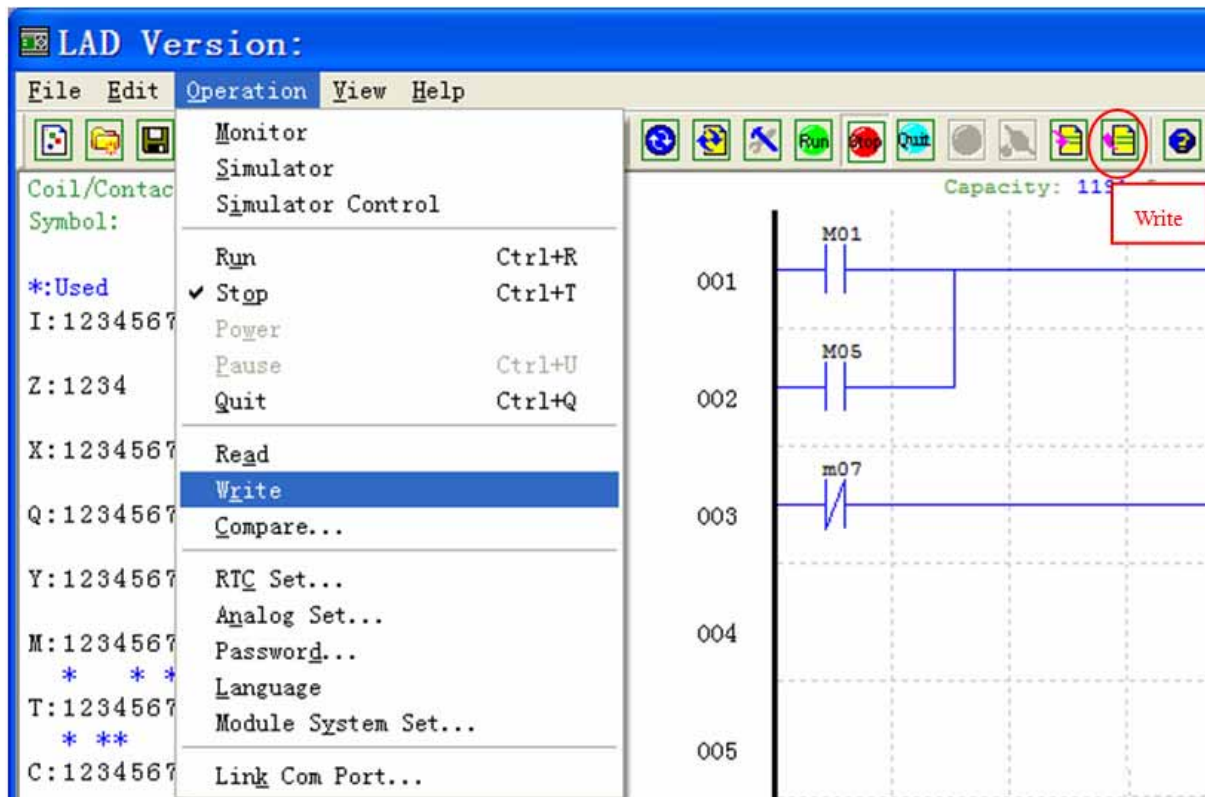
- Select “Operation/Link Com Port...” as shown below.



- Select the correct Com Port number where the programming cable is connected to the computer then press the “link” button.
- The SG2 Client software will then begin to detect the connected smart relay to complete its connection.

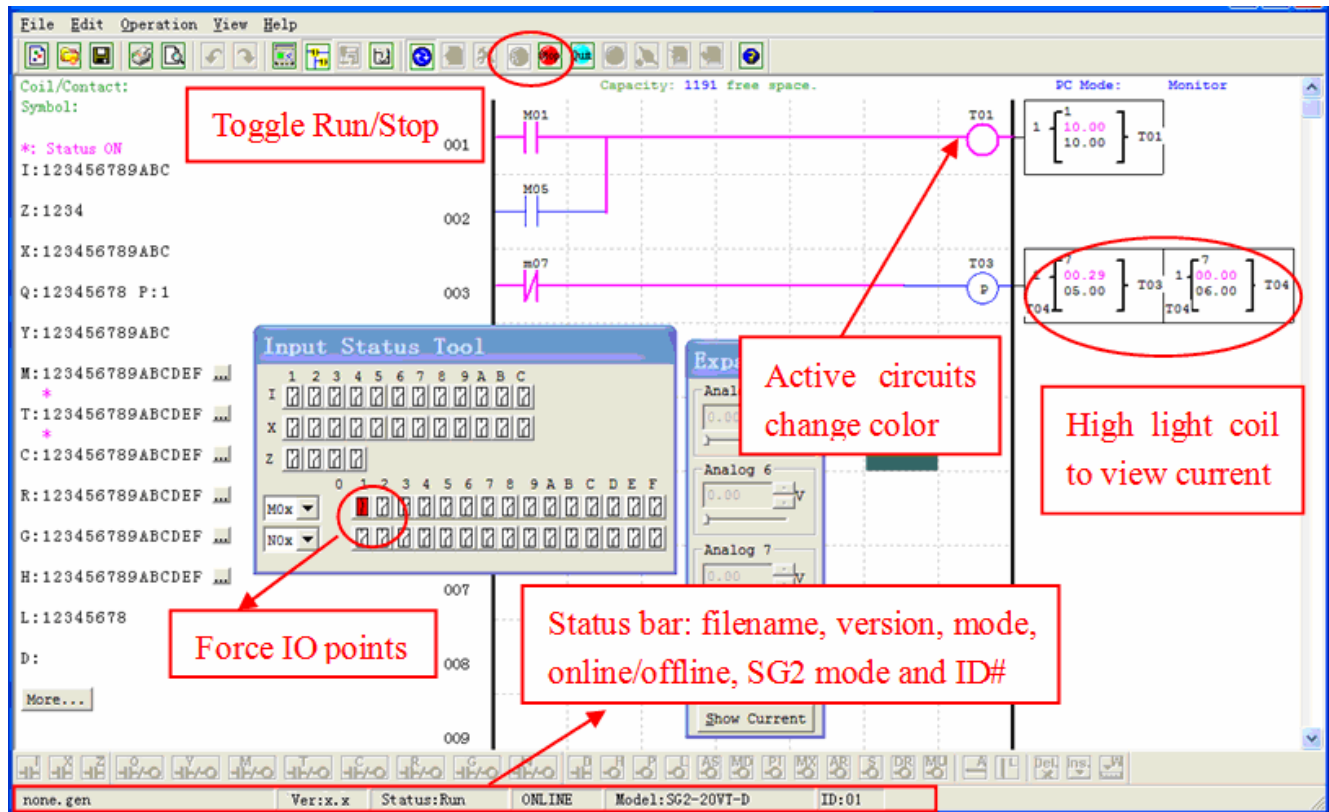
Writing Program to smart relay

From the Operation menu, select the Write function and write the program to the connected smart relay as shown below, or press Write button to write program to connected smart relay as shown below.



Online Monitoring/Editing

The SG2 Client software allows for online monitoring of the currently running program during runtime. Additional online functions include, I/O forcing, and Mode changes (Run/Stop/Quit).

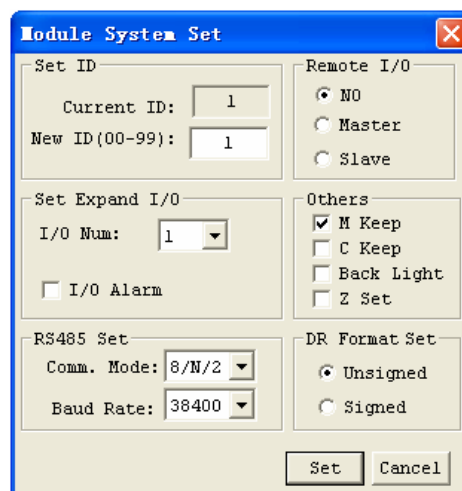
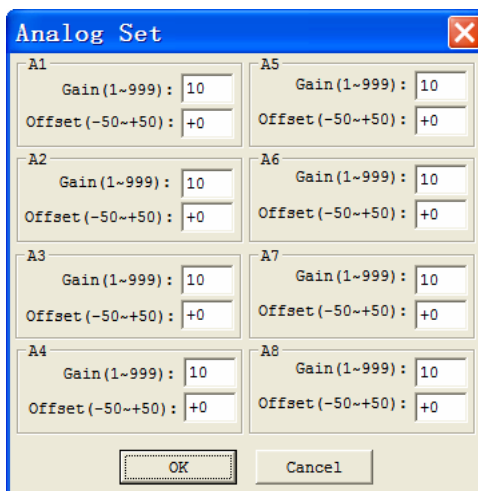
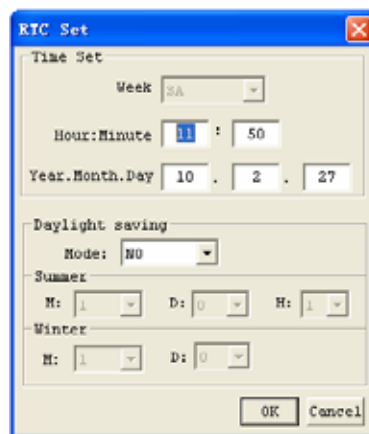
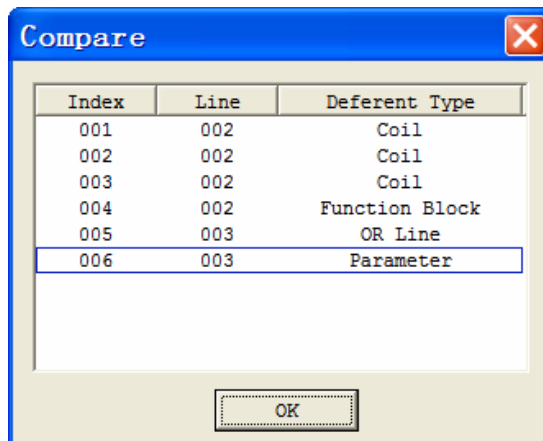


✘ The SG2 Client software does not support runtime logic editing changes. All logic edits to contacts, coils, Timers/Counters, and circuit connecting lines must be written to the connected smart relay while in Stop mode.

Operation menu

The Operation menu, includes several system configuration functions for both online and offline setup. The following explains the details of each function.

Operation View Help	Functional Description
<u>M</u> onitor	Online function for runtime monitor when connected to a smart relay
<u>S</u> imulator	Offline function for testing and debugging a program
<u>S</u> imulator <u>C</u> ontrol	Self-motion simulator control
<u>R</u> un	Control running or simulator if not connect a smart relay
✓ <u>S</u> top	Stop running or stop simulator
<u>P</u> ower	Simulator control power down
<u>P</u> ause	Pause simulator
<u>Q</u> uit	Quit monitor or simulator mode
<u>R</u> ead	Read program form smart relay
<u>W</u> rite	Write program to smart relay
<u>C</u> ompare...	Read program form smart relay and compare difference with PC program
<u>R</u> TC Set...	Online function for setup of the Real-time clock/calendar
<u>A</u> nalog Set...	Setup analog input A01-A08 gain and offset
<u>P</u> assword...	Set a password for accessing the current program after upload to the smart relay
<u>L</u> anguage	Change SG2 smart relay menu language
<u>M</u> odule System Set...	Dialog for changing important system setup functions including Module ID...
<u>L</u> ink <u>C</u> om Port...	Select the port communication with smart relay

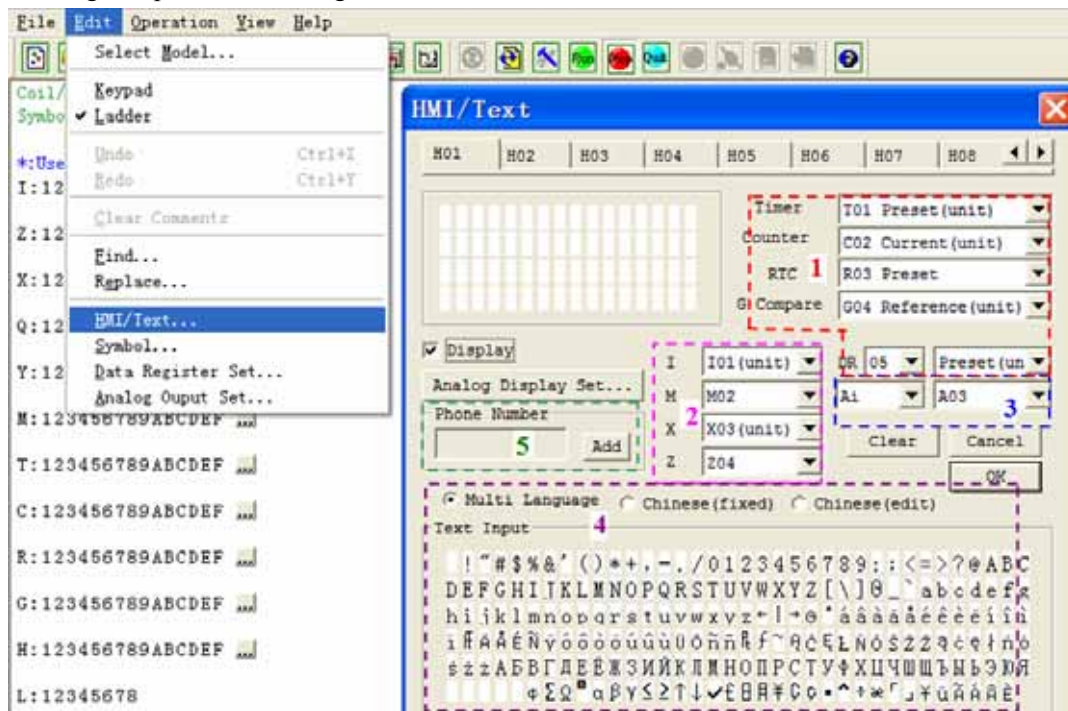


HMI/TEXT

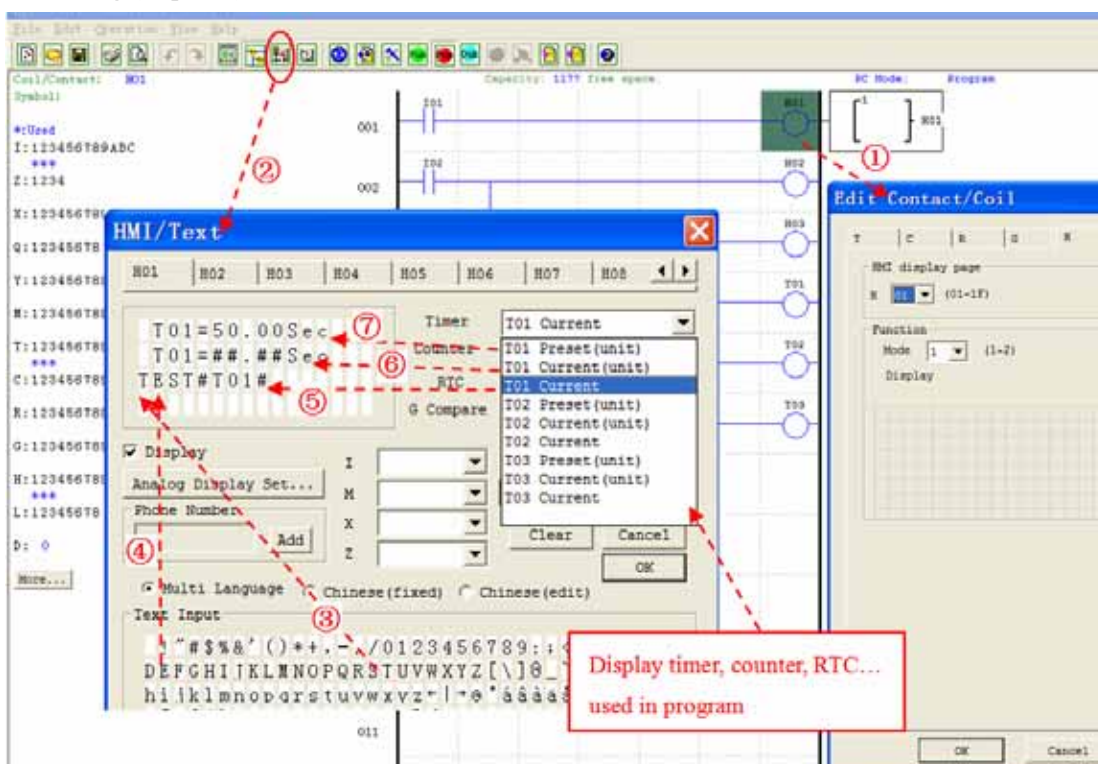
This function block can display information on 16×4 LCD screen:

- 1, Preset value or current value of function blocks, such as Counter, Timer, RTC, Analog comparator and DR register etc. Under running mode, to modify the preset value via HMI is available.
- 2, Coils status, such as input coils I, Z, X and auxiliary coils M. Under running mode, to modify the M status via HMI is available.
- 3, Analog input value (A, AT) and analog output value (AQ);
- 4, Build-in ASCII code and multi-language characters; Build-in Chinese characters; User-defined Chinese characters;
- 5, Telephone number used by GSM module (SMS Alarm function).

HMI/TEXT editing and parameter setting interface, as shown below.



HMI/TEXT setting (step 1~7):



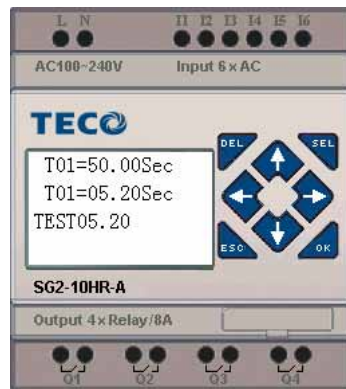
- ① Enter H01 coil
- ② Into HMI/TEXT edit frame
- ③ Choice the “T”
- ④ Choice the “E”
- ⑤ Choice T01 current
- ⑥ Choice T01 current (unit)
- ⑦ Choice T01 present (unit), user can modify T01 preset value when H coil enable and display on LCD.

Download to SG2, and I01 turn ON, or press “SEL” if the H coils is set to mode 1, then the SG2 LCD will display the first H text as shown below.

Stop display



Run display

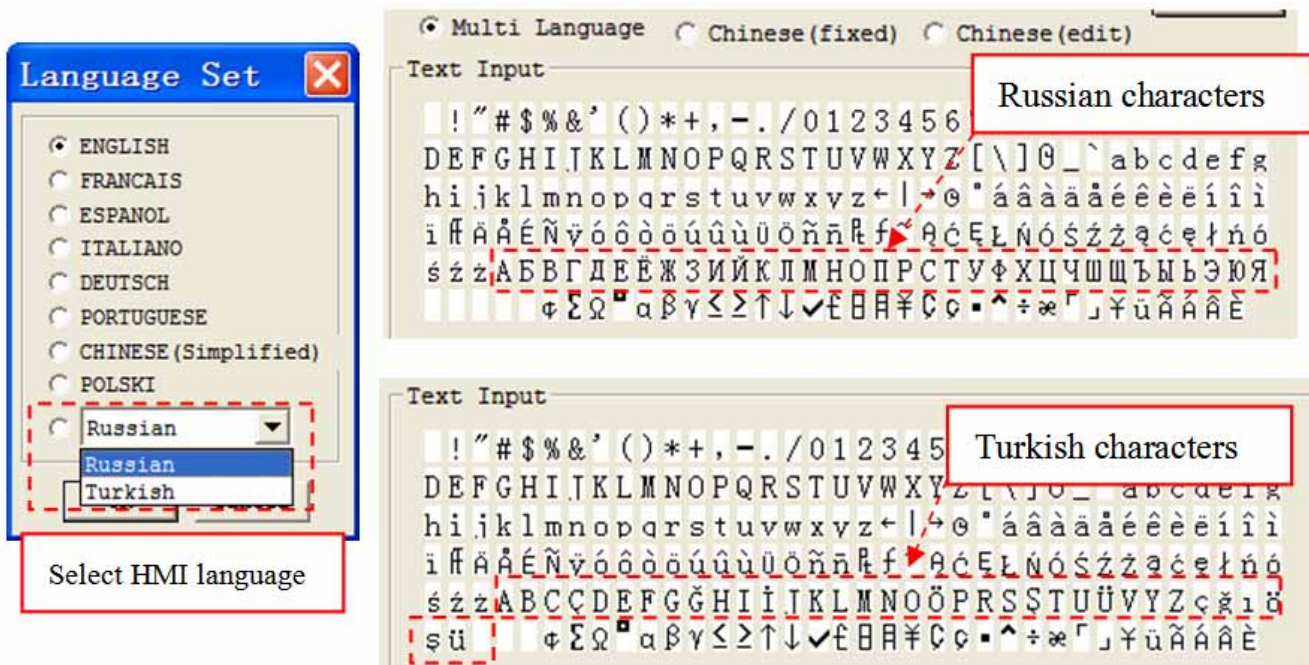


I, Press “↑” or “↓” to choice the nearest H coil

II, Press “SEL”+“↑” or “↓” and “OK” update T01 preset value (In this example, 050.0 can update, T01 preset value depends on HMI/TEXT edit frame setting.)

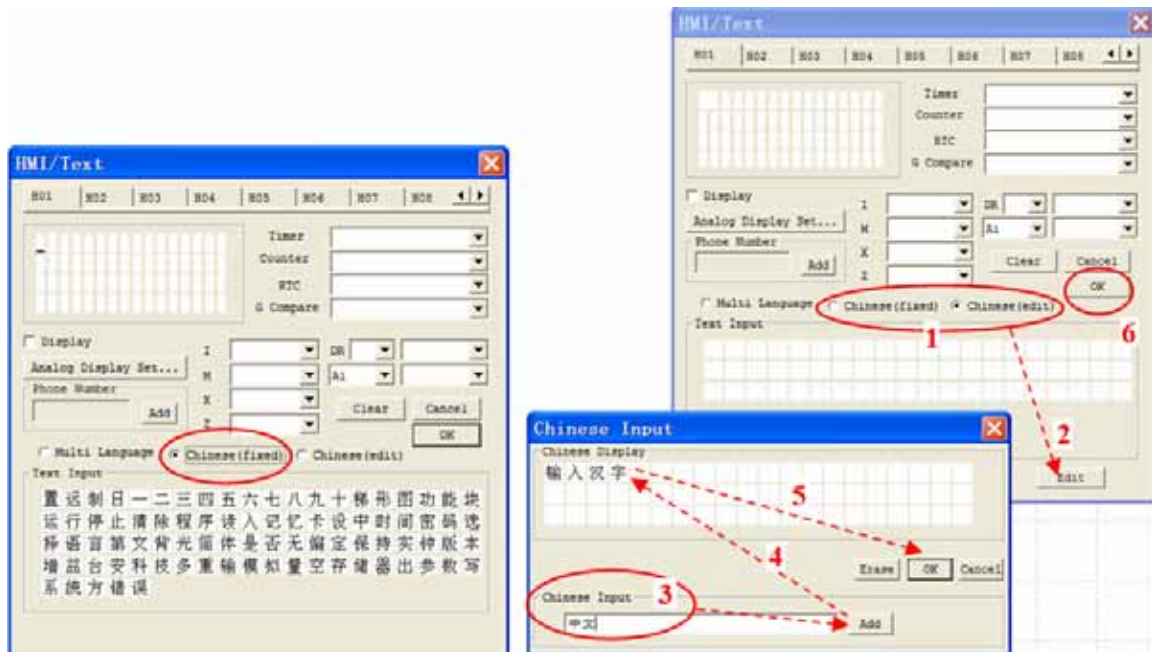
Build-in ASCII code and multi-language characters:

Multi-language characters including English, French, Spanish, Italian, German, Portuguese, Polish; Also, according to the different settings, you can display Russian or Turkish characters.



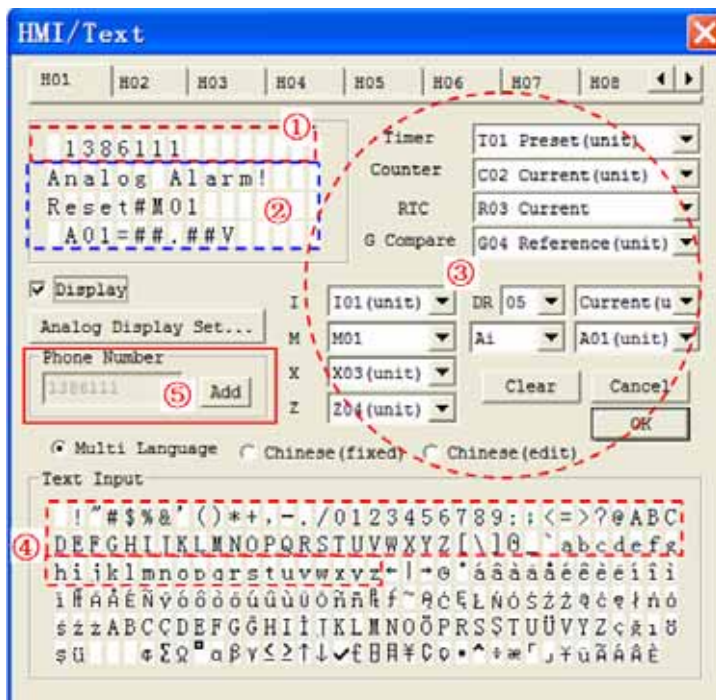
85 Built-in Chinese characters, which read as following left of the HMI/TEXT editor window;

60 characters which user define, edit step 1~6 as follows right of the HMI/TEXT editor window.



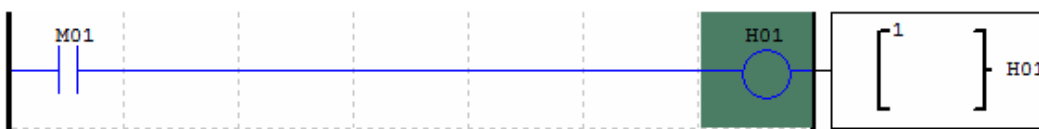
Setting telephone number (GSM module SMS function) :

Build-in 20 HMI (H01~H14) can be set telephone number for SMS alarm. When HMI which set telephone is enabled, SG2 save text information. Extension GSM module send this HMI text to telephone after reading this HMI text.



Line1 set telephone number (shown as ①). Only set by dialog ⑤ and max 15 number characters.

Line2~line4 set text information (show as ②), include preset value and current value of function block, coil status (shown as ③) and ASCII characters (shown as ④).



Stop display

```
1386111
Analog Alarm!
Reset#M01
A01=##.##V
```

Run display

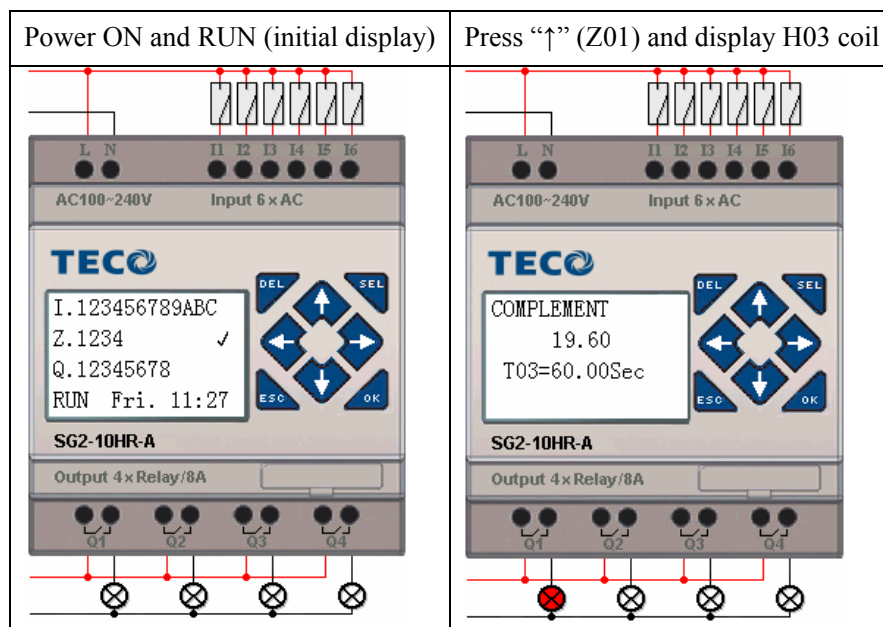
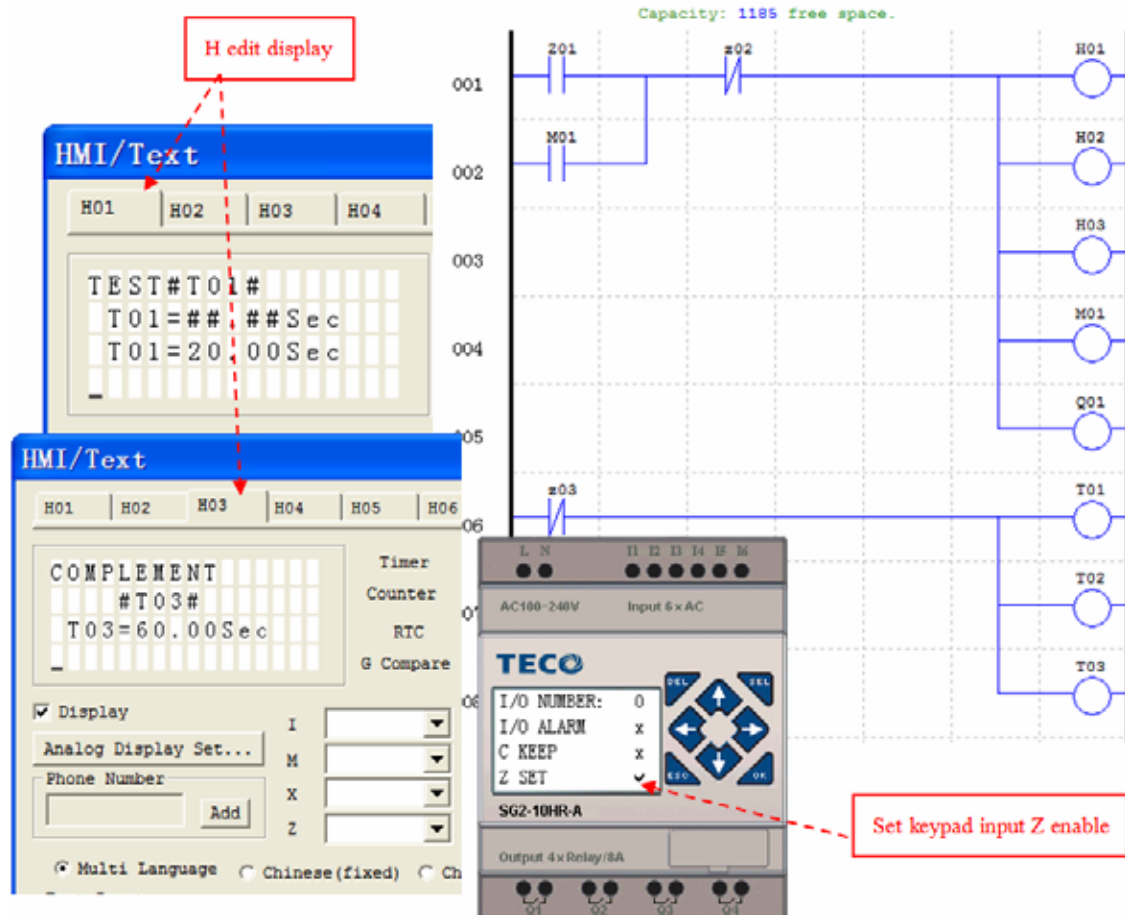
```
PHONE
Analog Alarm!
Reset OFF
A01=09.00V
```

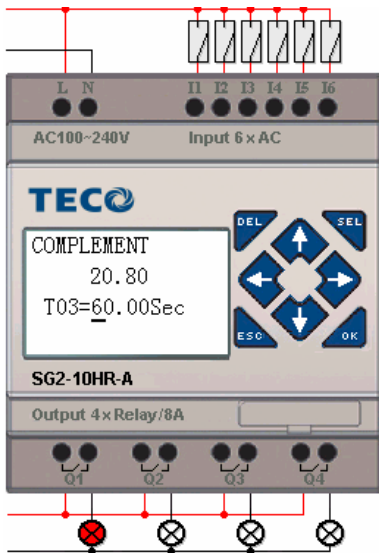
Example:

1, SG2 saved H01 display information (M01 status and A01 value) when M01 is enabled rising edge.

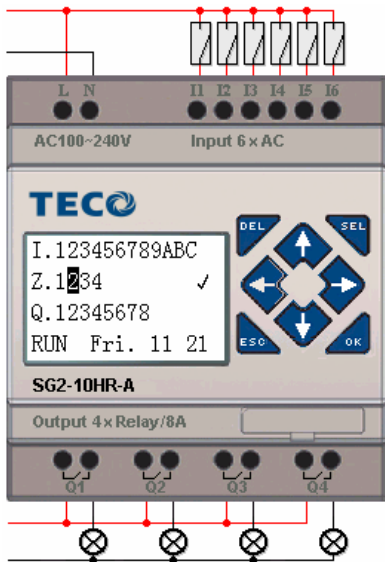
2, Extension GSM module send SMS to telephone (H01 line1 number) after reading message (H01 line2~line4 text information).

Example: HMI/TEXT and Z keypad input function





- ① Press “SEL” to display cursor
- ② Press “↑”, “↓”, “←”, “→” to move cursor
- ③ Press “SEL” again to choice modified position
- ④ Press “↑”, “↓” to change number and press “←”, “→” to move cursor
- ⑤ Press “OK” to make sure the modify value



Press “←” (Z02) to disable H03 coil, and the LCD display changes to initial frame.

Press “↓”(Z03) to reset Timer (T01、 T02、 T03) as program designed.

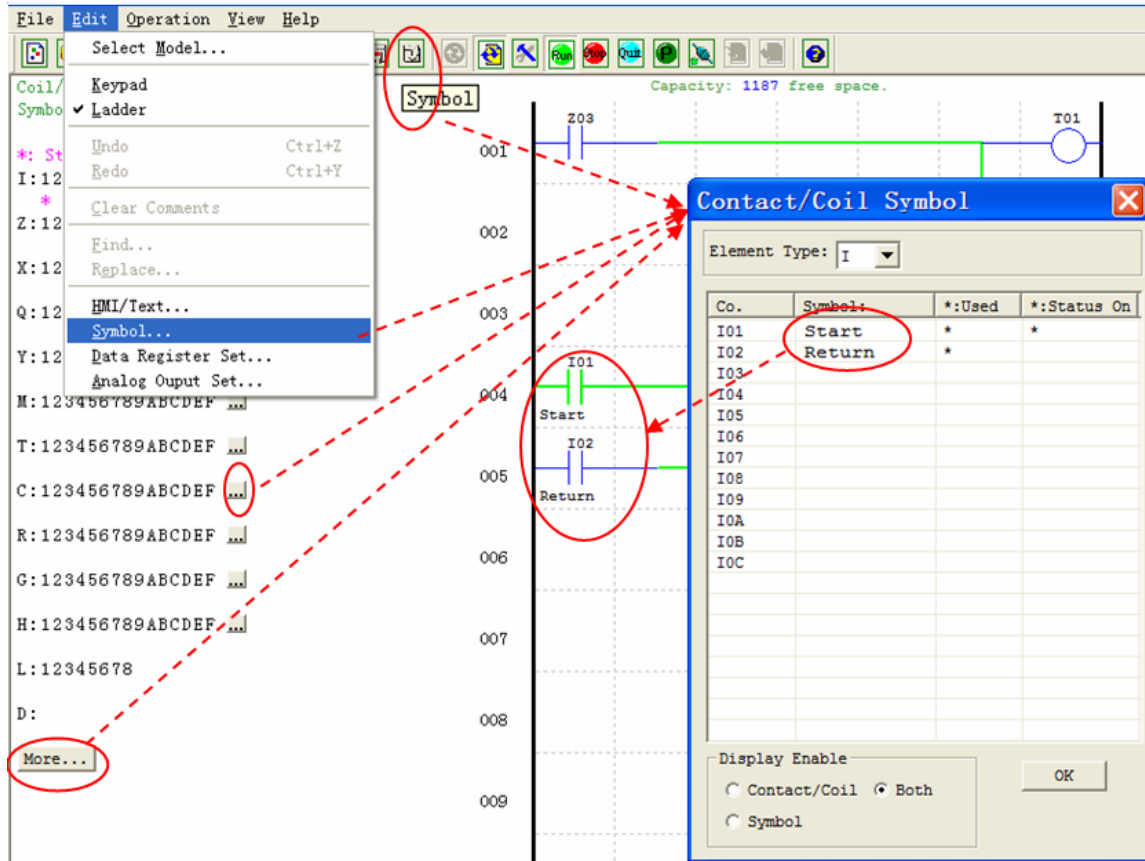
Program Documentation

The SG2 Client software includes the ability to document a program using Symbols and Line Comments. Symbols are used to label each I/O address up to a length of 12 characters. Line Comments are used to document sections of a program. Each Line Comment can have up to 4 lines with each line containing up to 50 characters in length. Below are examples of entering Symbols and Line Comments.

Symbol...

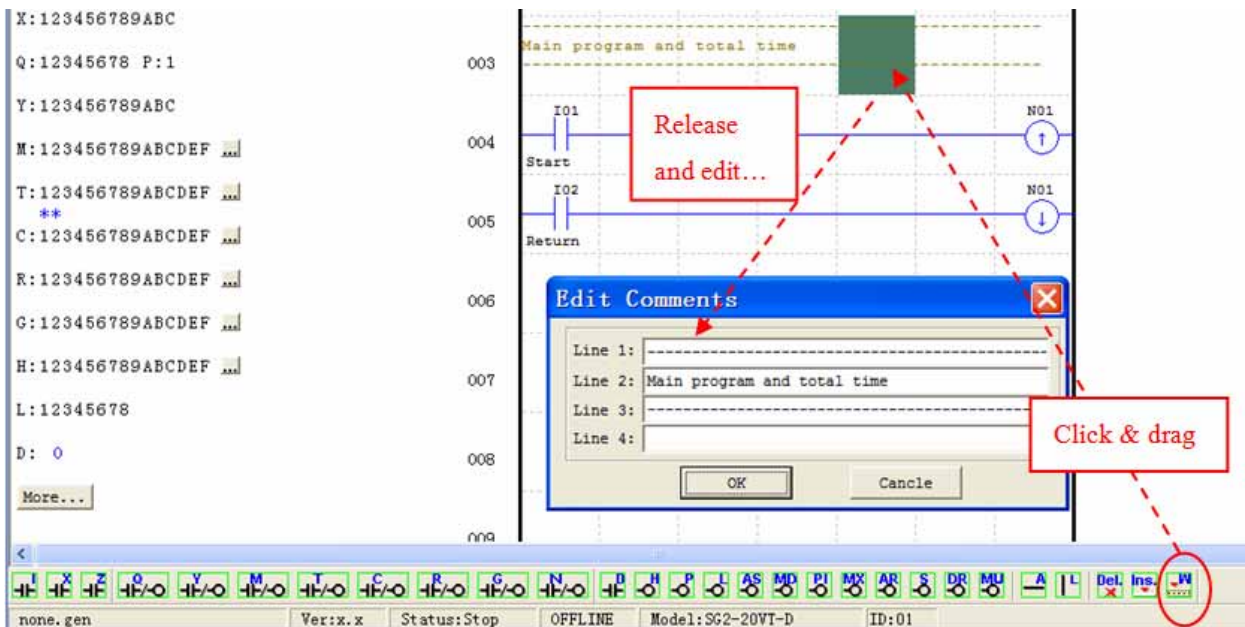
The Symbol editing environment can be accessed through the menu using the **Edit>>Symbol...** selection or using the symbol icon on the main toolbar shown below.

The Symbol editing environment allows for documenting all the contact and coil memory types, and selecting display modes as shown below.



Line Comments

The Line Comment editor is accessed by clicking the “W” icon on the Ladder Toolbar. After clicking on the “W” icon, to drag the line number you want to comment and release, and then type the desired comments and press OK.



Analog Output Set...

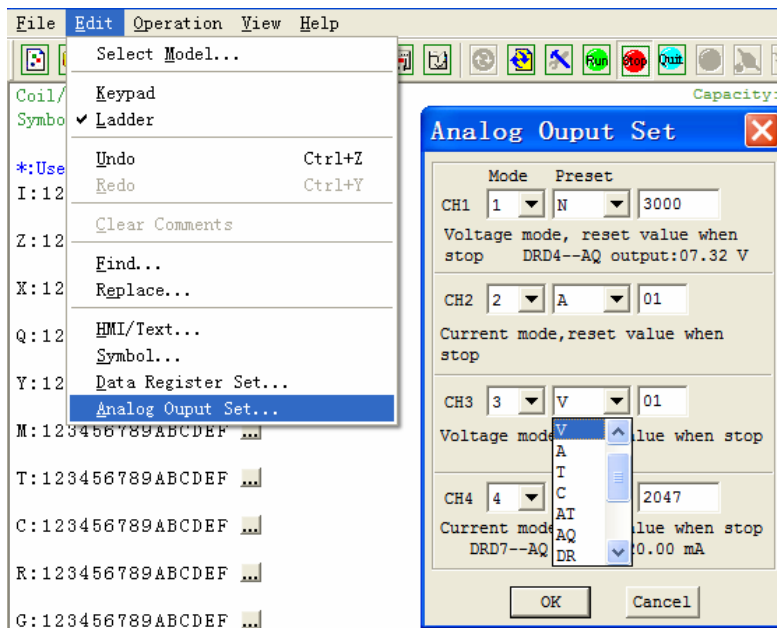
The AQ editing environment can be access through the menu using the **Edit>> Analog Output Set...** selection shown below. CH1~CH4 correspond to analog output AQ01~AQ04.

The range is 0~4095 if the output mode is voltage mode.

The range is 0~2047 if the output mode is current mode.

The preset value of AQ can be set as either a constant or a code of other data. The output mode of AQ and preset value are set as below. More information about output mode and displaying to see: [Chapter 5: Relay Ladder Logic Programming-AQ \(Analog Output\)](#).

Output mode setting value of AQ saved in the registers of DRD0~DRD3 (current value); the preset value saved in the registers DRD4~DRD7 (current value).



The figure shows an example register and output:

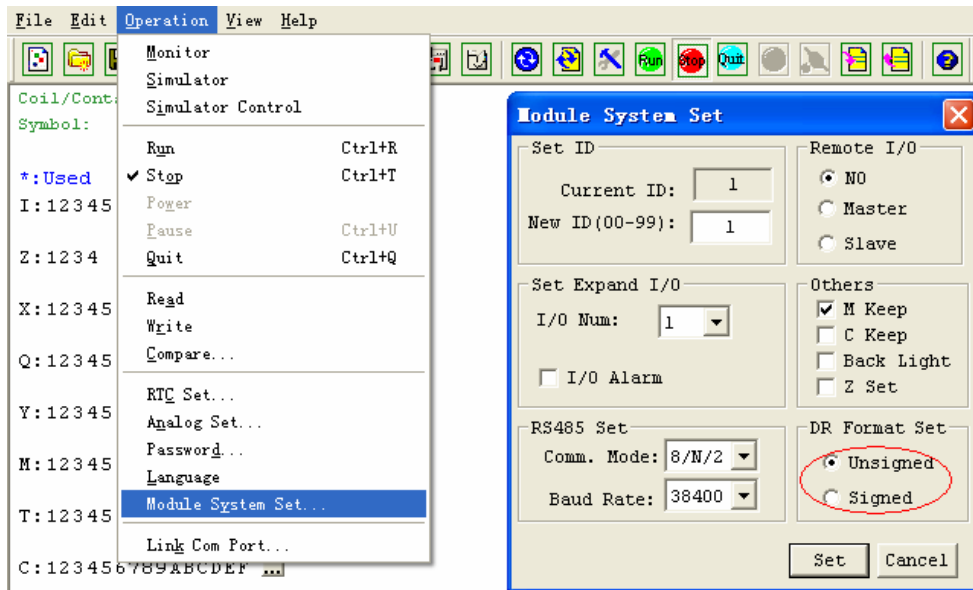
	Mode Register	Output Value Register	AQ output value
Channel1	DRD0=0 AQ output mode 1: voltage mode and reset value when stop;	DRD4=3000	AQ01=732 (DRD4/4.095) AQ output 7.32V
Channel2	DRD1=1 AQ output mode 2: Current mode and reset value when stop;	DRD5=A01*4.095 Current mode 0~2047	AQ02=A01 Current mode 0~500
Channel3	DRD2=2 AQ output mode 3: voltage mode and keep value when stop;	DRD6= V01*4.095 Voltage mode 0~4095	AQ03=V01 Voltage mode 0~1000
Channel4	DRD3=3 AQ output mode 4: Current mode and keep value when stop;	DRD7=2047	AQ04=500 (DRD7/4.095) AQ output 20.00mA

- ✘ When output value type of AQ is set to constant, AQ output value changed by DR value ($AQ_x = DR_x / 4.095$);
- ✘ When output value type of AQ is set to other parameters variables, DR value changed by AQ output value ($DR_x = AQ_x * 4.095$).

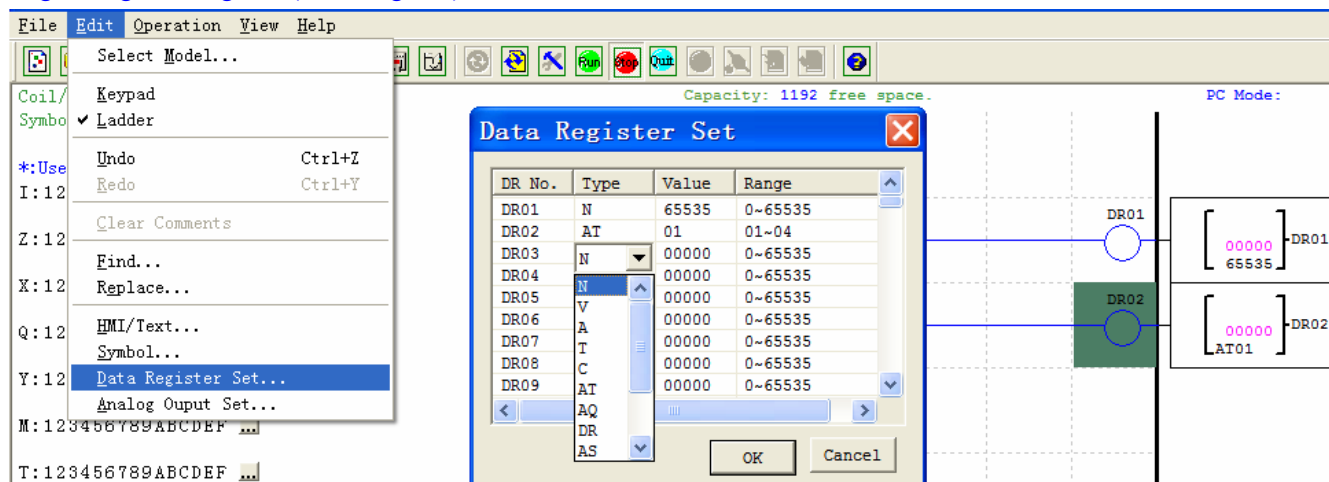
Data Register Set...

The content of Data Register is either unsigned or signed, it can be set as shown below.

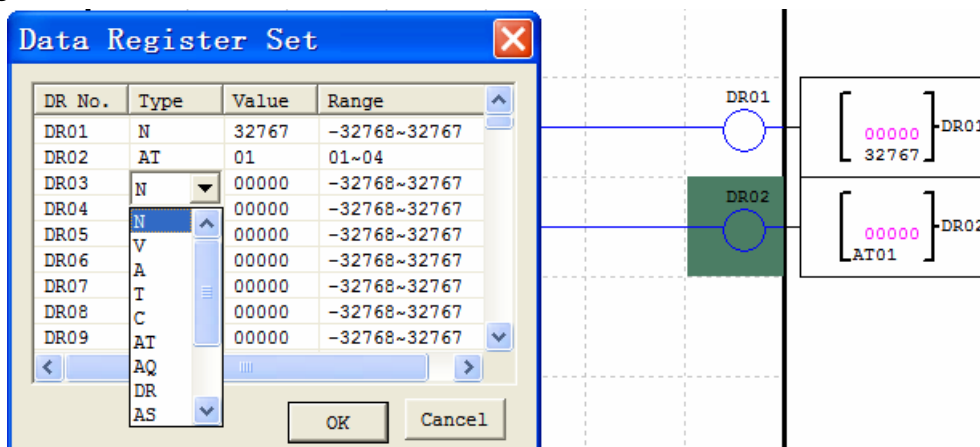
Selecting Unsigned, the range of DR is 0~65535; and selecting Signed, the range of DR is -32768~32767.



After the operating above, the Data Register editing environment can be access through the menu using the **Edit>> Data Register Set...** selection shown below. The preset value of DR can be set as either a constant or a code of other data type. Data register must used with DR instruction, more information about DR to see: [Chapter 5: Relay Ladder Logic Programming-DR \(Data Register\)](#).



DR is set as signed shown below.



Special DR Register Function

The current value of DR65~DRF0 holding when stop or power down.

DRD0 ~ DRE3 as special registers used to set parameters, the output value function is as follows:

No.	Function description	
DRD0	AQ01 output mode	0, voltage mode and reset value when stop; 1, current mode and reset value when stop; 2, voltage mode and keep value when stop; 3, current mode and keep value when stop;
DRD1	AQ02 output mode	
DRD2	AQ03 output mode	
DRD3	AQ04 output mode	
DRD4	AQ01 output value	Analog output value 0~4095;
DRD5	AQ02 output value	
DRD6	AQ03 output value	
DRD7	AQ04 output value	
DRD8	I/O interface hidden	Refer to “ Chapter3:LCD Display and Keypad > Original screen ”
DRD9~DRE3	Reserved;	

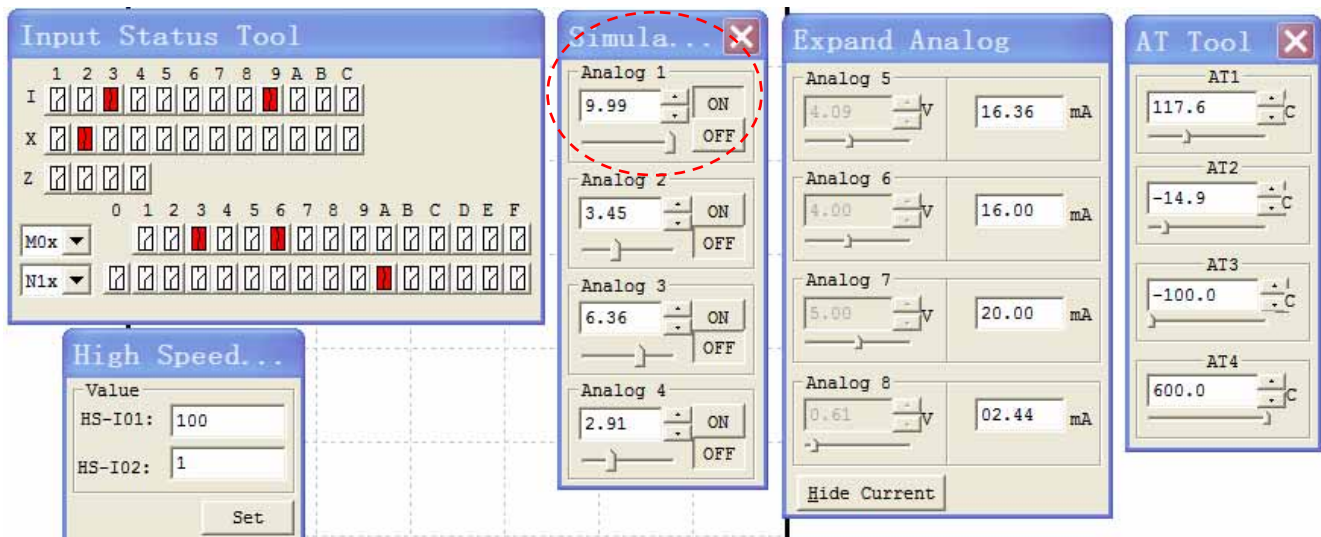
DRC9~DRCF and DRE4~DRF0 as special registers used to store status, the output current value function is as follows:

No.	Function description	
DRC9	Output pulse number of instruction PLSY	
DRCA	AT01 current degree Fahrenheit	Used as normal registers when no AT01~AT04 input, such as don't connected with extension module 4PT;
DRCB	AT02 current degree Fahrenheit	
DRCC	AT03 current degree Fahrenheit	
DRCD	AT04 current degree Fahrenheit	
DRCE	Reserved	
DRCF	Reserved	
DRE4	A05 input electric current 0~2000	Used as normal registers when no A05~A08 analog input, such as don't connected with extension module 4AI;
DRE5	A06 input electric current 0~2000	
DRE6	A07 input electric current 0~2000	
DRE7	A08 input electric current 0~2000	
DRE8	A01 current value 0~4095	Used as normal registers when no A01 and A02 analog input, such as AC type;
DRE9	A02 current value 0~4095	
DREA	A03 current value 0~4095	Used as normal registers when no A03 and A04 analog input, such as AC type or 12points DC type;
DREB	A04 current value 0~4095	
DREC	A05 current value 0~4095	Used as normal registers when no A05~A08 analog input, such as don't connected with extension module 4AI.
DRED	A06 current value 0~4095	
DREE	A07 current value 0~4095	
DREF	A08 current value 0~4095	
DRF0	Reserved	

View menu

The view menu includes software display option selection. The following explains the details of each function.

View	Functional Description
✓ I/Q	Display usage list
✓ Function	Display function block and parameter
✓ Capacity	Display capacity left space
✓ Input Status Tool	Monitoring or Simulation coil status (I, X, Z, M, N)
Data Link Status Tool...	Simulation IO Link W status(only RS485 type)
✓ Simulation Analog Tool...	Monitoring or Simulation analog input A01~A04(only DC type)
✓ Expand Analog Tool...	Monitoring or Simulation expand analog input A05~A08
✓ High Speed Input Tool...	Simulation high speed input(only DC type)
✓ AT Tool...	Monitoring or Simulation expand temperature input AT01~AT04
✓ Ladder Toolbar	Display Ladder Toolbar

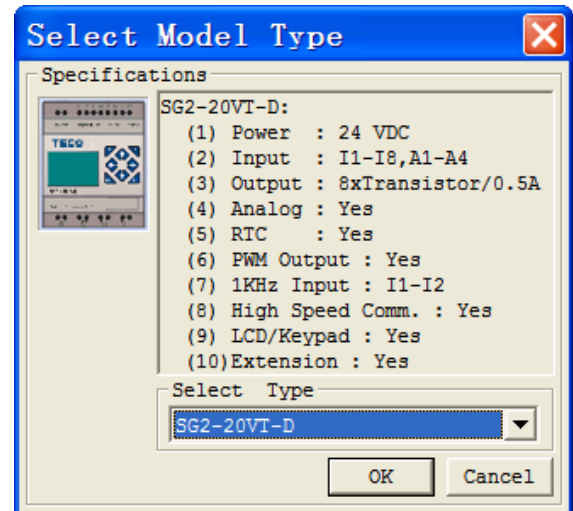


- Analog input A01~A04, correspond to coil input I09~I0C;
When analog input increased to 9.98v, the coil input set ON;
When analog input reduced to 5.00v, the coil input set OFF;
- Expand analog input A05~A08, the input data value 0~9.99v, and current display mode 0~20.00mA;
- Expand temperature input AT01~AT04, the input data value -100.0~600.0°C;
- High speed input tools, used for simulation high speed input I01&I02.

FBD Programming Environment

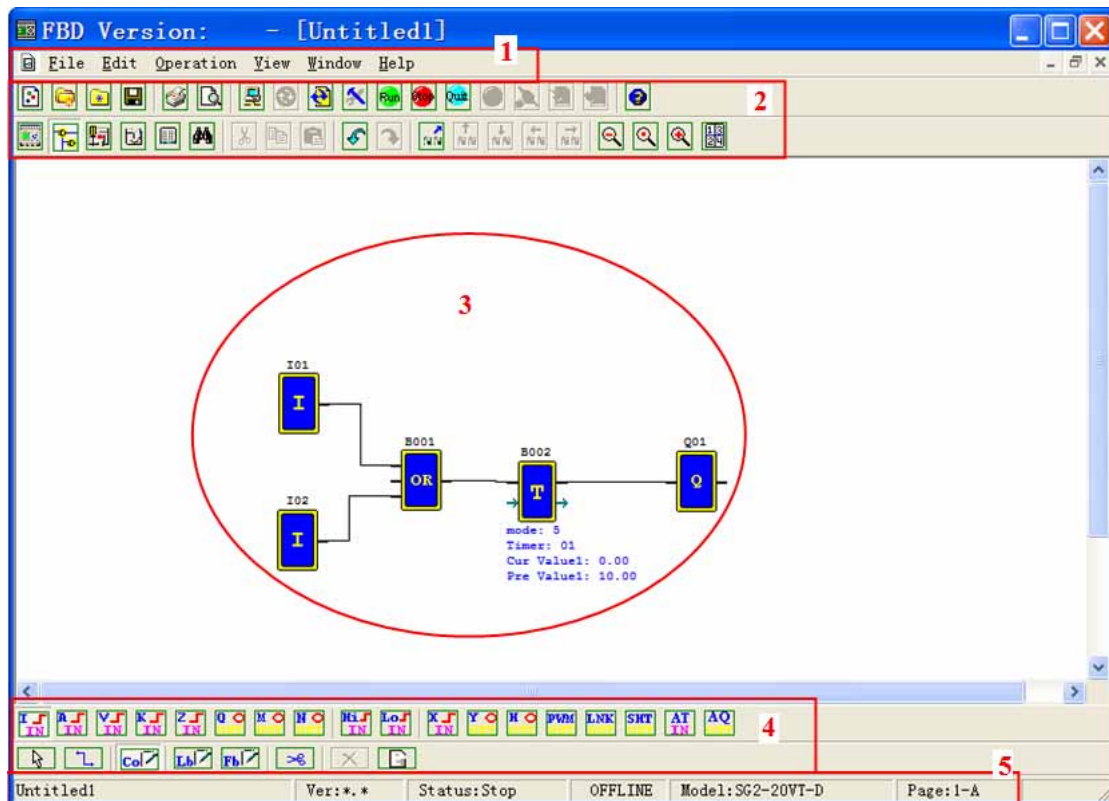
The FBD Programming Environment includes all the functions for programming and testing the SG2 using the FBD programming language. To begin a new program select **File-->New**, and select the desired model of SG2, as shown right.

FBD programming operation is same as Ladder.

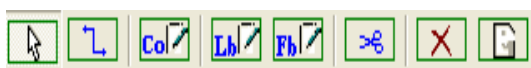


Menu, Icons and Status Bar

FBD environment include menu, icon and status bar refer to below figure.



- 1, Menu: 6 menu options, including file operations, editing, and SG2 communications settings, configure the special features, display settings, help information and other functions;
- 2, Tools bar: The first line of icons from left to right in turn is expressed as: new, open, save program icons, monitoring, simulation, control mode change (RUN, STOP, QUIT), read program from SG2, write program to SG2; The second line of icons from left to right in turn is expressed as: button panel displays, FBD display, HMI / TEXT editor, comments Symbol Editor icon, the parameter list, etc.;
- 3, Programming Area: Coils and logic function blocks will need programming into the editing area, and use the connection to connect;
- 4, FBD tools bar: Can choose to edit the coil and function block instructions;



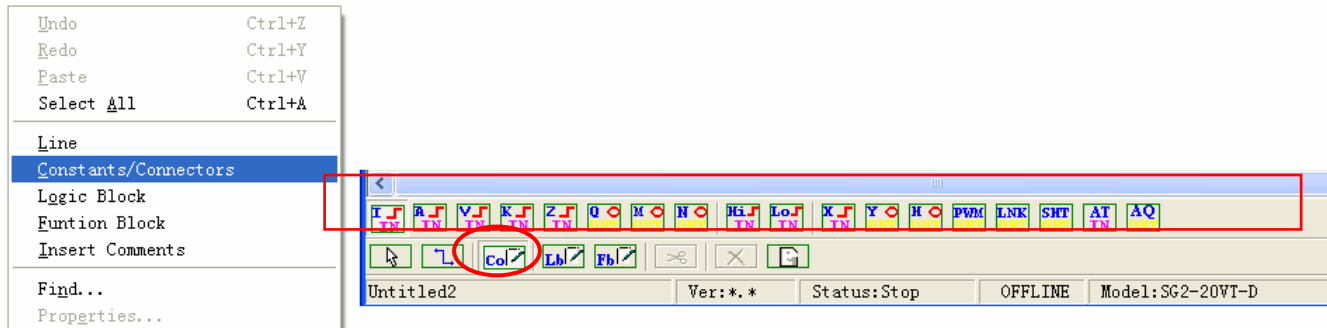
From left to right for normal selection operation, connection, coil, logic function blocks, special function blocks, scissors operation, deletion, and annotation tools.

- 5, Status bar: Indicated that the current program and the connection status and other information SG2;

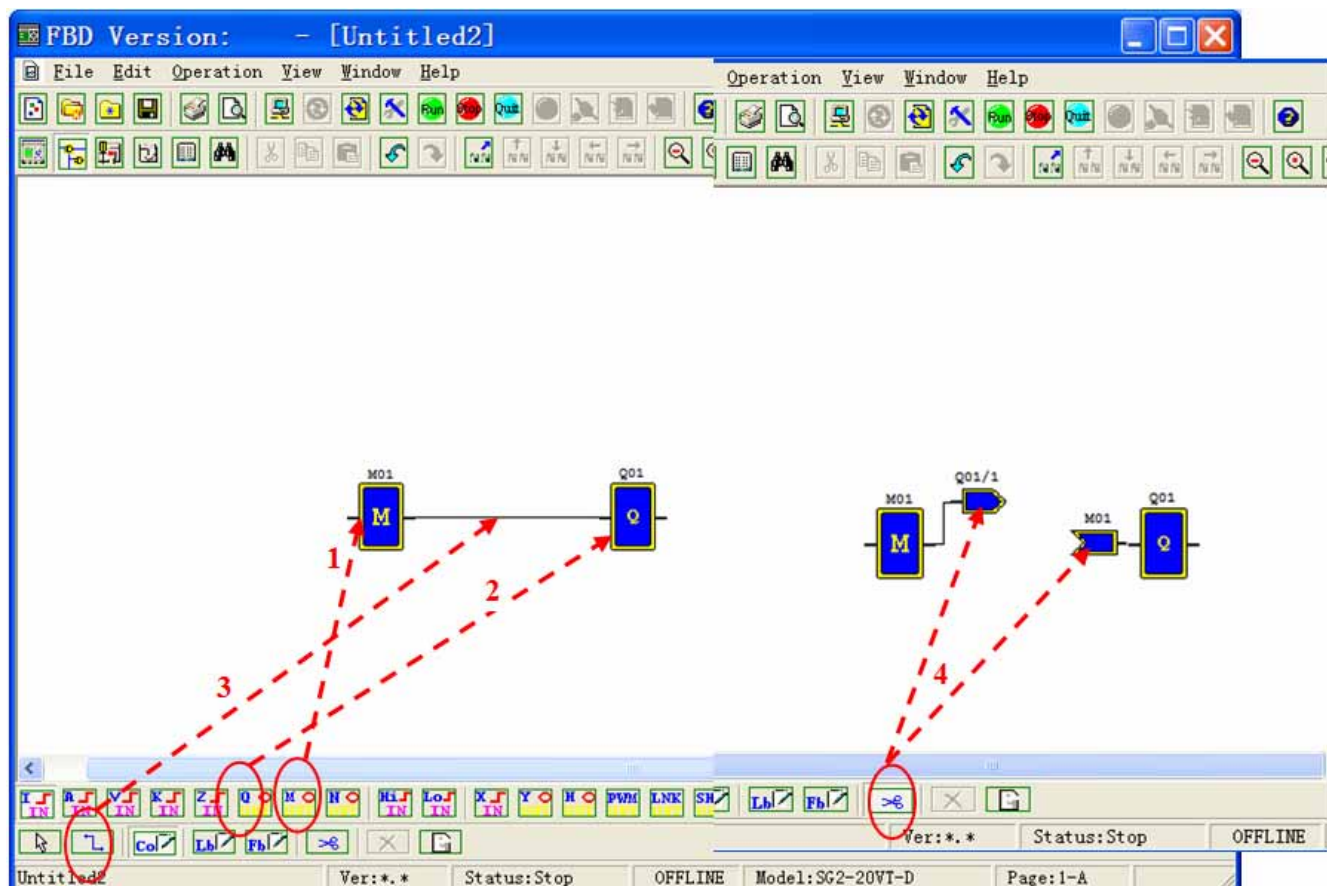
Programming

SG2 Client Programming software can be programmed using the mouse, the following examples of program instructions.

Click the right mouse button appears below the left screen and select **Constants/Connectors**, or simply click on the FBD the toolbar (see below right), there will be all available coils icon above the toolbar.

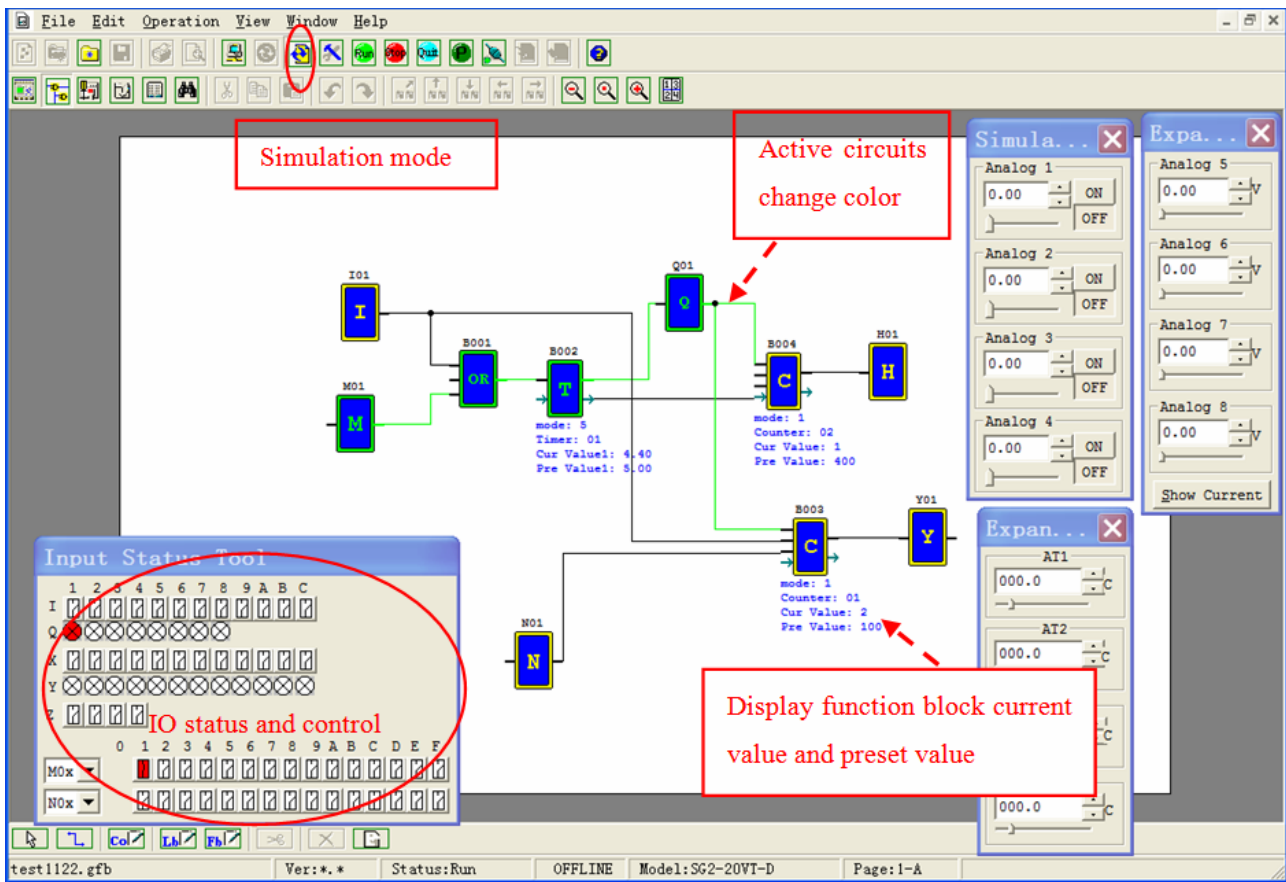


Were selected symbol "M" and the "Q", the icon will be put to the editor area, and used to connect the two coils connected as the left part of (Operation 1~3); if multiple cross-connections, they can use "scissors" functional separation of the connection shown in the following figure the right part (operation 4);

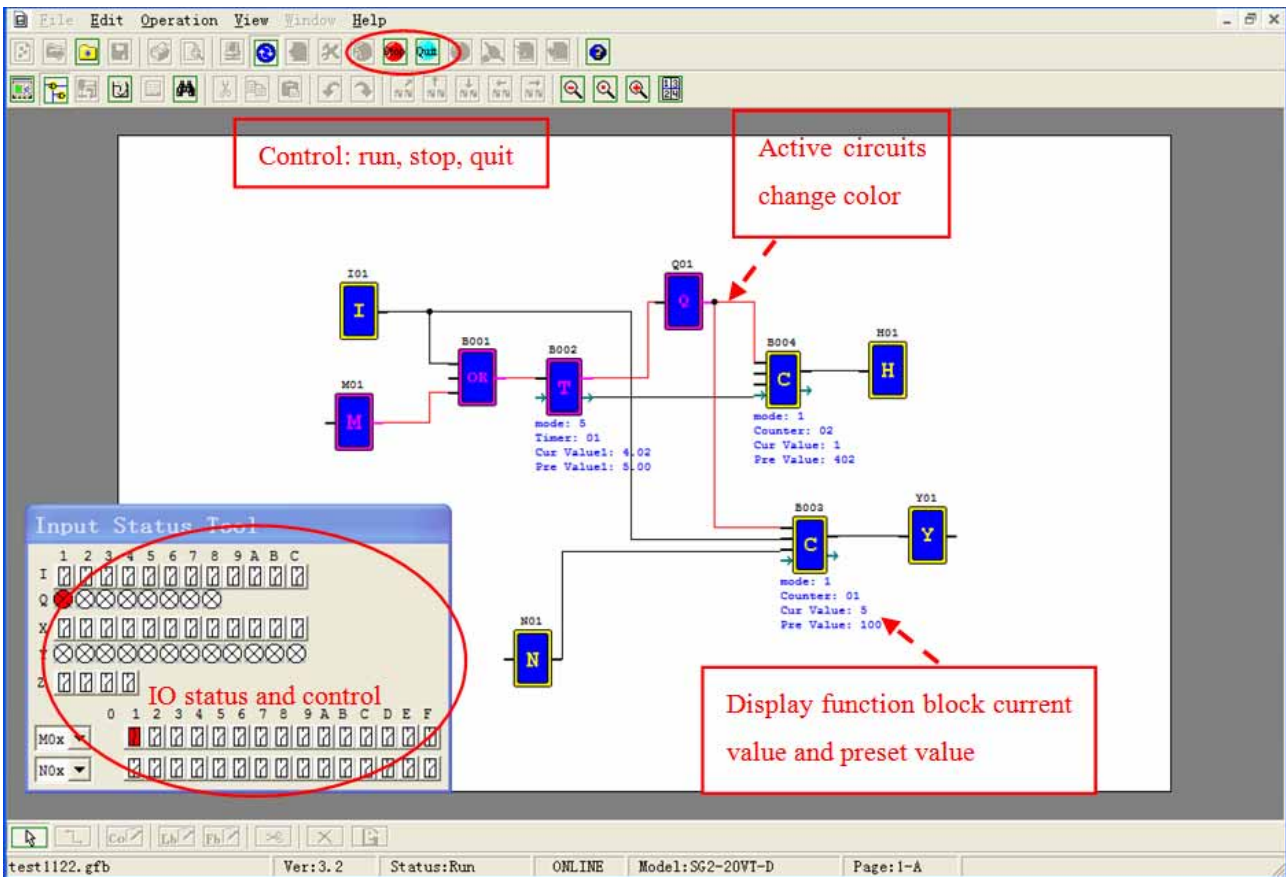


Simulation Mode

SG2 Client build-in simulation test function, the following diagram shows the display characteristics in simulation mode.

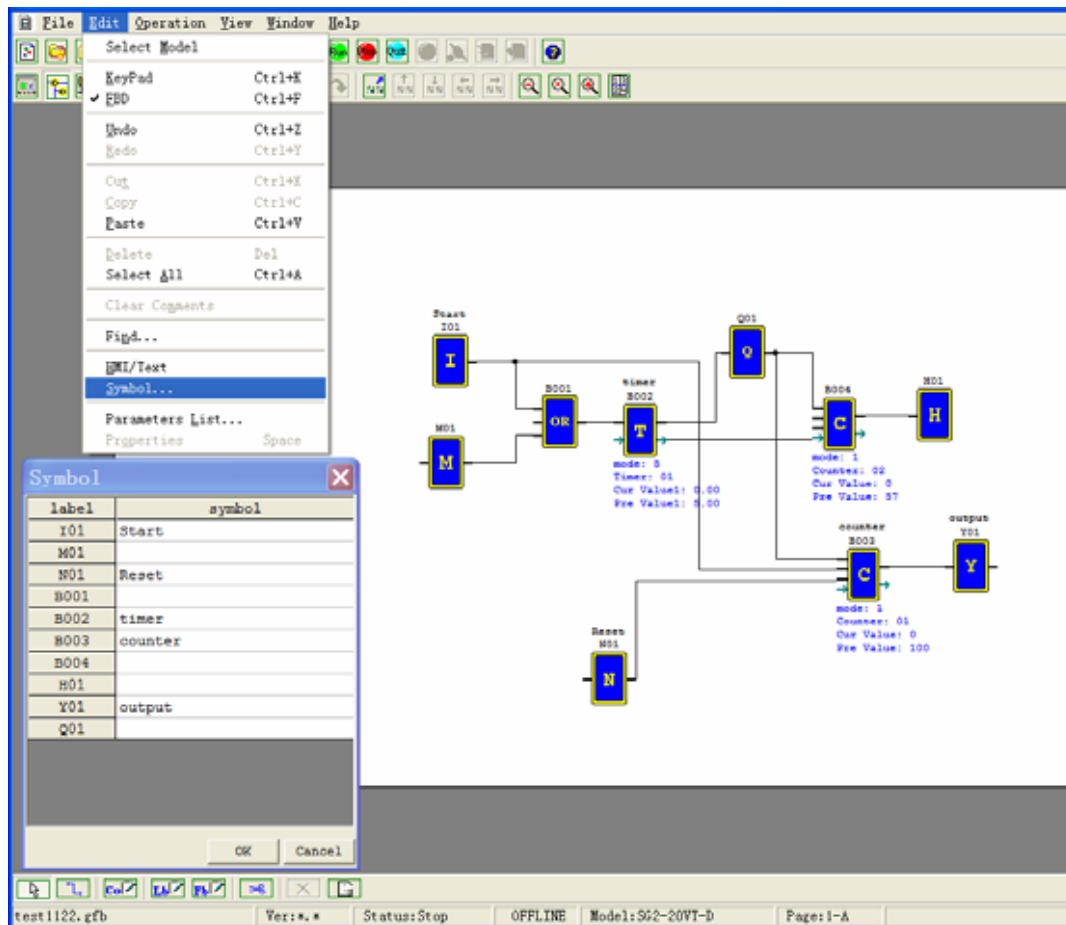


Online Monitoring/Editing

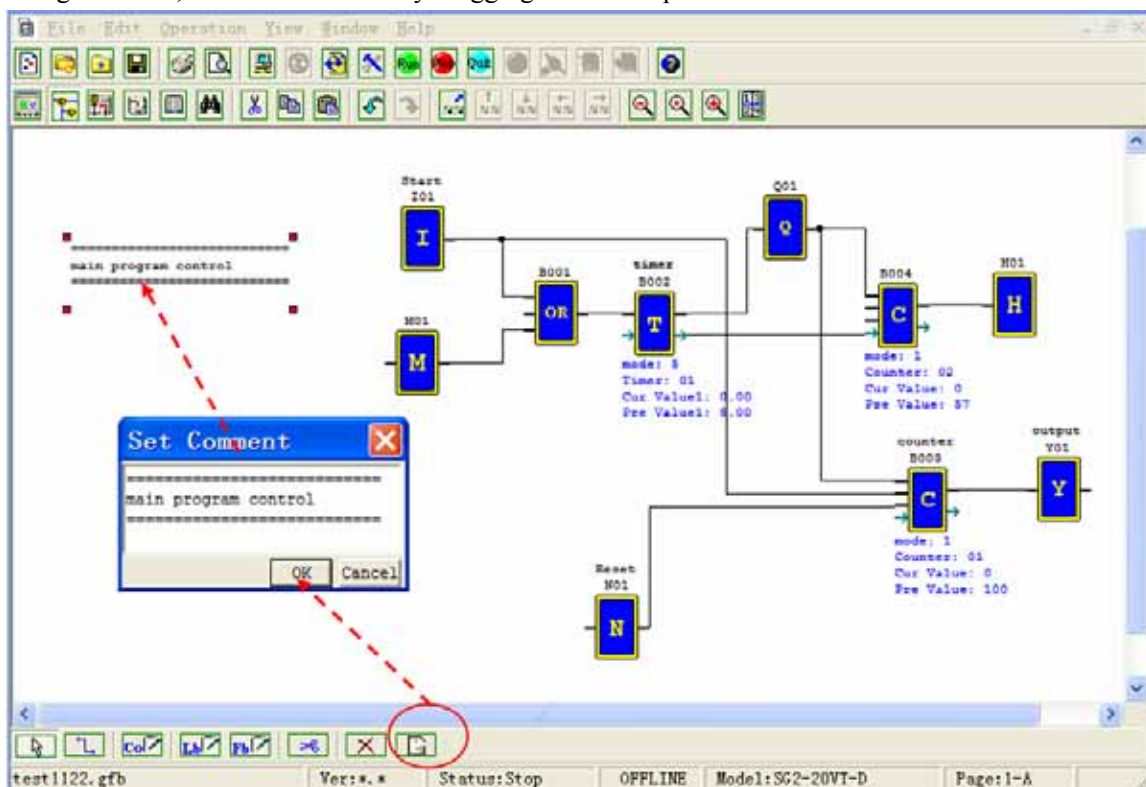


Symbol and Parameters list

FBD list symbols for coils and function blocks which only been used in program, and will comment tags appear in the program;

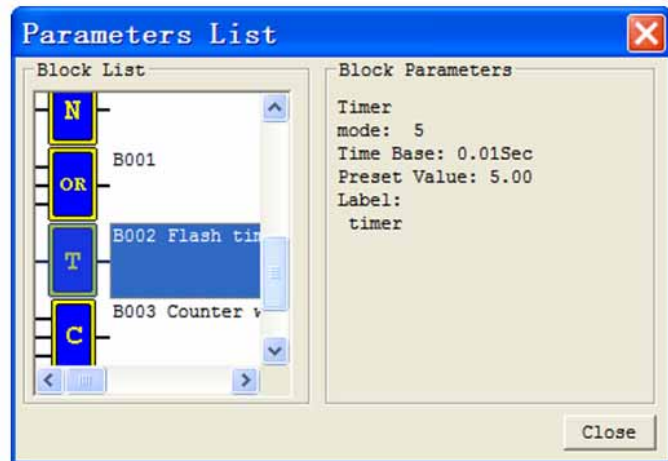
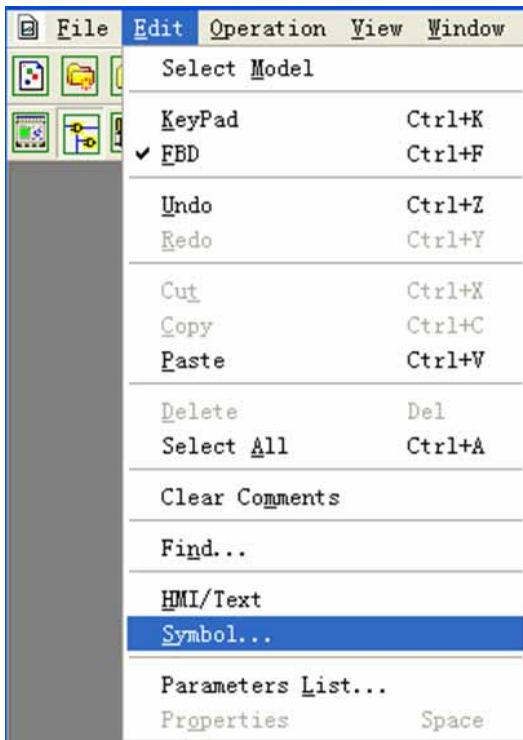


Symbol also can describe the function of main program. The following diagram operation, click the toolbar "Comments", Comments configuration dialog box appears, edit and click "OK", notes will be displayed in the programming interface, and can be moved by dragging the mouse position.



Parameters List:

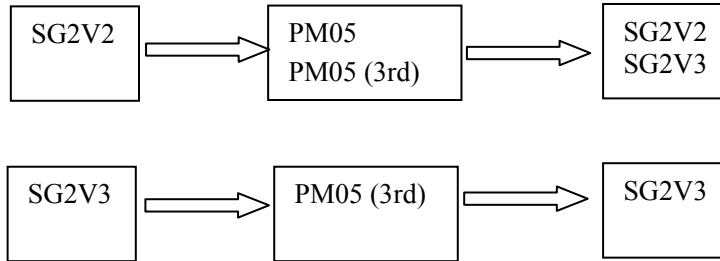
Parameters list display coils and functional blocks which used in program and explain coil functions and tags, function block settings and markings and other information, as shown below.



Memory Cartridge (sold separately)

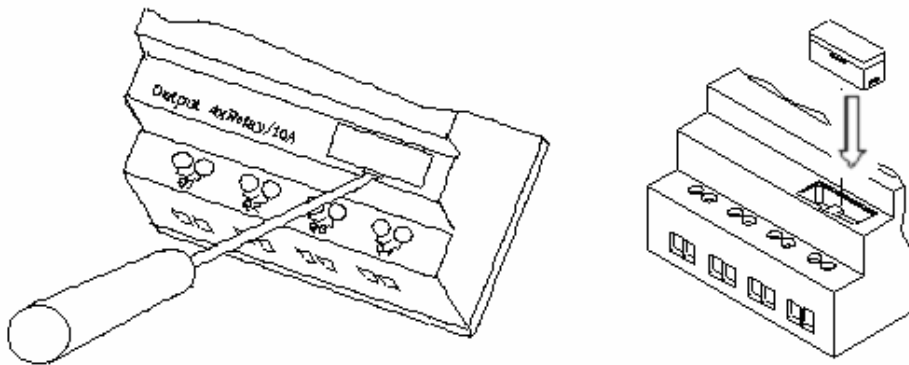
PM05 (3rd) is a special kind of PM05, it can be used in all version of SG2. There is an icon  on SG2 V3 smart and side of PM05 (3rd).

About to use PM05 and PM05 (3rd) with SG2V2/3, see next figure:



The optional PM05 (3rd) memory cartridge is used to easily transfer programs from one smart relay to another. The PM05 (3rd) memory cartridge plugs into the same connector as the programming cable (see procedure below).

1. Remove the plastic connector cover from SG2 using a flathead screwdriver as shown in the figure below.
2. Insert the PM05 (3rd) memory cartridge onto the connector as shown below.



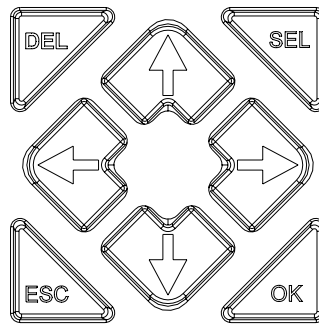
3. From the display keypad on the face of the SG2 smart relay, select either **WRITE** or **READ** to transfer the program to PM05 (3rd) or from the PM05 (3rd) memory cartridge to the smart relay.
4. K type and C type, electrify the product, the program in PM05 (3rd) will automatically download and executed.
5. Program in different types are not compatible, here are the regulations:

- A-1: 10/12 point type program ---- available in 20 point type
- A-2: 20 point type program ---- unavailable in 10/12 point type
- B-1: AC type program ---- available in DC type
- B-2: DC type program ---- unavailable in AC type
- C-1: Relay type program ---- available in Transistor type
- C-2: Transistor type program ---- unavailable in Relay type
- D-1: Not-RS485 type Model program ---- available RS485 type Model
- D-2: RS485 Model type program ---- unavailable Not-RS485 type Model
- E-1: SG2V2 program ---- available SG2V3 type
- E-2: SG2V3 program ---- unavailable SG2V2 type

LCD Display and Keypad

Keypad

Most SG2 CPU units include the built-in LCD Display and Keypad. The keypad and display are most often used for changing timer/counter set points, controller mode changes (Run/Stop), uploading/downloading to the PM05 memory cartridge, and updating the RTC (Real Time Clock/Calendar). Although, logic programming can be performed from the keypad and display, it is highly recommended to only perform logic changes using the SG2 Client software. Below is an overview of the basic keypad and display functions.



Select (SEL) – Used to select the available memory and instruction types for editing. Holding the Select button will display all “H” HMI/Text messages on the LCD.

OK – Used to accept the selection displayed of an instruction or function. It is also used to select any of the Main Menu options on the LCD.

Note: Press the “SEL” and “OK” simultaneously to insert a rung above the current active cursor position.

Escape – Used to exit a selected display screen and go to the previous screen. When in a ladder display screen, press the ESC to display the main menu.

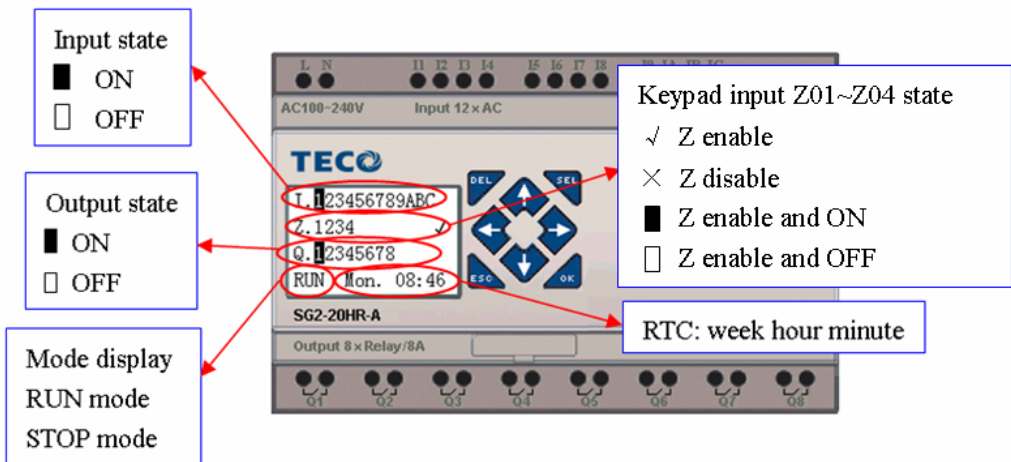
Delete – Used to delete an instruction or rung from the ladder program.

The 4 navigation buttons (↑←↓→) are used to move the cursor throughout the functions of the SG2 display or active program. The 4 buttons also can be set programmable input coils Z01-Z04 (‘↑’= Z01, ‘←’=Z02, ‘↓’=Z03, ‘→’=Z04);

Original Screen

LCD displays 4-line state

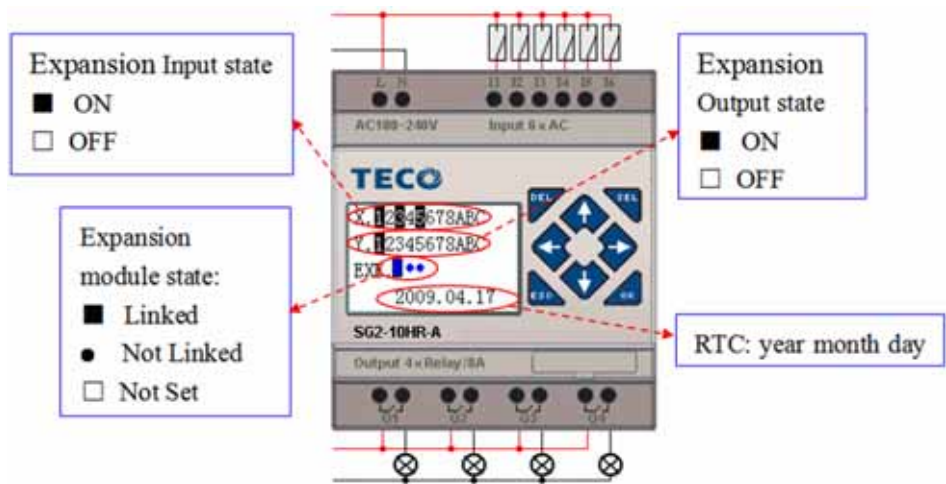
⊙ Original screen as power on



Press the button:

ESC	Enter Main Menu screen
SEL+↑↓ Or ↑↓	Under LADDER Mode, DRD8 current value=0, display the state of relays (I/Z/Q ⇔ X/Y ⇔ M ⇔ N ⇔ T ⇔ C ⇔ R ⇔ G ⇔ A ⇔ AT ⇔ AQ) ⇔ Original Screen Under FBD Mode, DRD8 current value=0, display the state of relays (I/Z/Q ⇔ X/Y ⇔ M ⇔ N ⇔ A ⇔ AT ⇔ AQ) ⇔ Original Screen
SEL+←→ Or ←→	When display A05~A08 value, change voltage or current mode When display AT01~AT04 value, change Celsius display or Fahrenheit display
SEL	H Function will be displayed whose mode is 1 as the button is pressed.
SEL+OK	Enter RTC setting screen

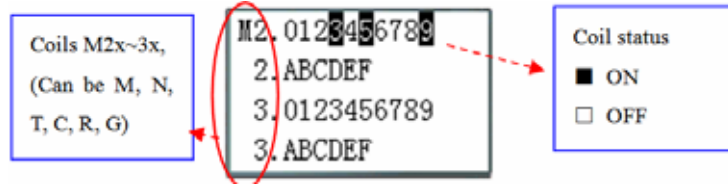
⊙ Expansion display State



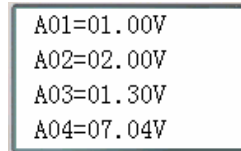
※ Expansion module setting: refer to [Main Menu "SET"](#)

◎ Other Display State

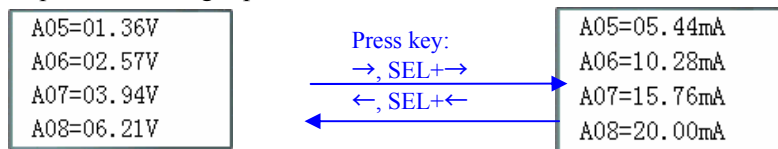
Coils M、N、T、C、R、G status: (T/C/R/G display only Ladder mode)



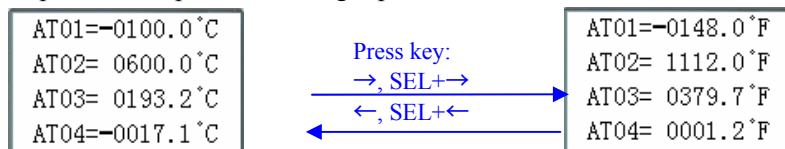
Analog input A01~A04: 0~9.99V



Expansion Analog input A05~A08: 0~9.99V or 0~20.00mA

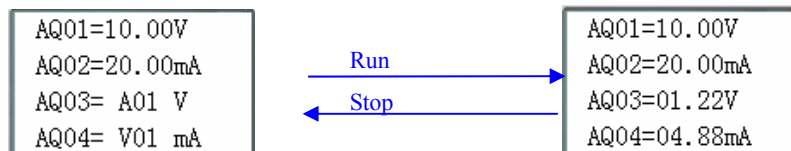


Expansion temperature analog input AT01~AT04: -100.0~600.0 Cent degree or -148.0~1112.0 Fahrenheit degree



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

※ Setting voltage mode or current mode, more information to see: [Chapter 5: Relay Ladder Logic Programming-AQ\(Analog Output\)](#).



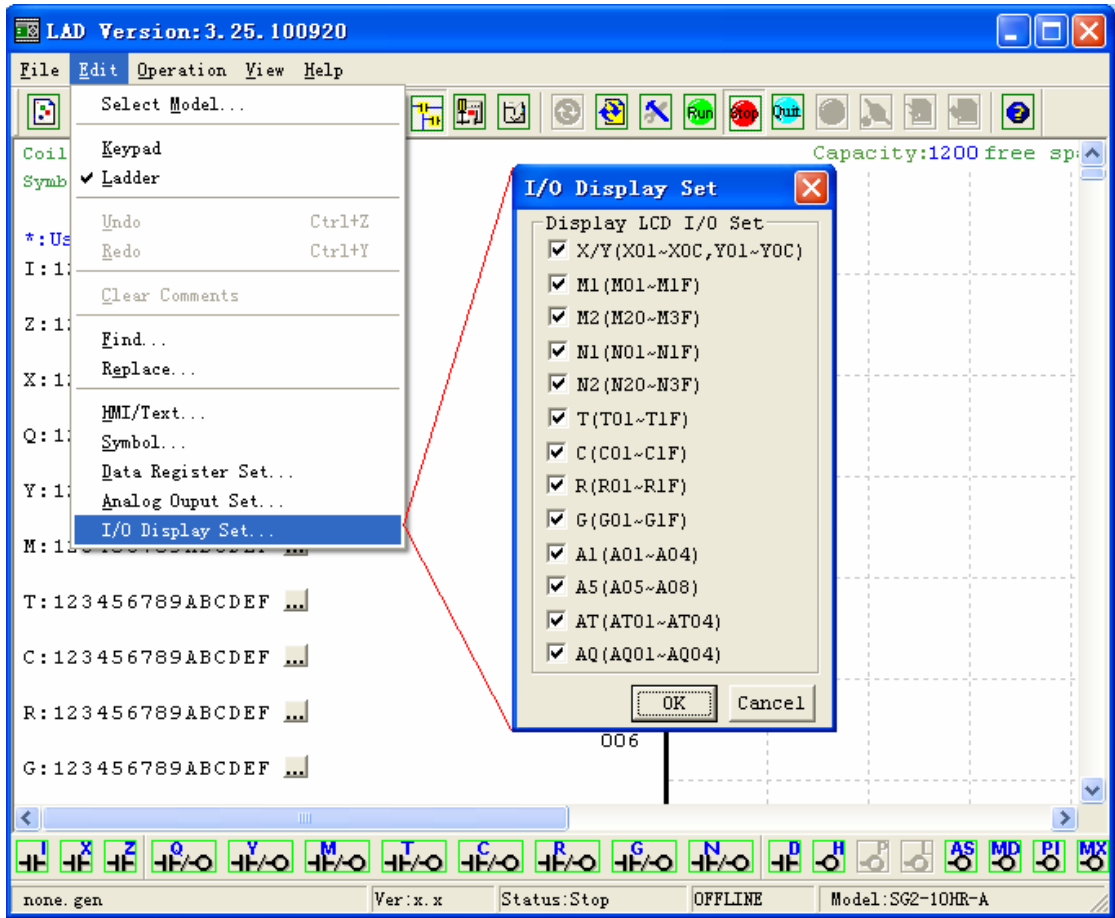
◎ Hidden I/O interface function:

There are 14 I/O interfaces. Each bit of DRD8 current value's low 14bits corresponding one I/O interface. When one bit equal 1, the corresponding I/O interface is hide(mean you can't display the I/O interface by pressing SEL+↑↓ or ↑↓). The table below show the congruent relationship between DRD8 current value and I/O interface:

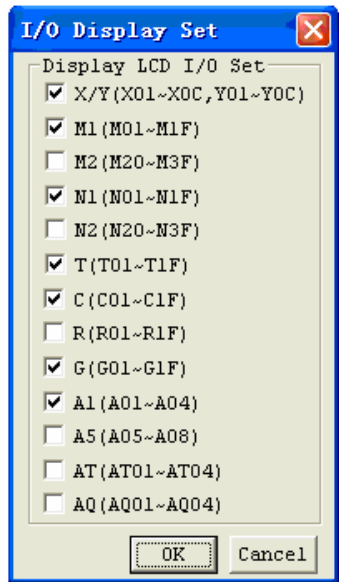
Num	I/O interface		DRD8 current value
0	I/Z/Q:	I01~I0C,Z01~Z04,Q01~Q08	Bit0:* =0 Display; =1 Display
1	X/Y	X01~X0C,Y01~Y0C	Bit1:=0 Display; =1 Not displayed
2	M1	M01~M1F	Bit2:=0 Display; =1 Not displayed
3	M2	M20~M3F	Bit3:=0 Display; =1 Not displayed
4	N1	N01~N1F	Bit4:=0 Display; =1 Not displayed
5	N2	N20~N3F	Bit5:=0 Display; =1 Not displayed
6	T	T01~T1F	Bit6:=0 Display; =1 Not displayed
7	C	C01~C1F	Bit7:=0 Display; =1 Not displayed
8	R	R01~R1F	Bit8:=0 Display; =1 Not displayed
9	G	G01~G1F	Bit9:=0 Display; =1 Not displayed
10	A1	A01~A04	Bit10:=0 Display; =1 Not displayed
11	A5	A05~A08	Bit11:=0 Display; =1 Not displayed
12	AT	AT01~AT04	Bit12:=0 Display; =1 Not displayed
13	AQ	AQ01~AQ04	Bit13:=0 Display; =1 Not displayed

e.g. In order to hidden some I/O interfaces. You can setting DRD8 current value through running a Ladder/FBD program, you also can setting it by PC-LINK as shown below:

1. Open “Edit>I/O Display Set...”:



2. Setting “I/O Display Set” as the picture shown below, and click OK :



3. Down load the program.

This time I/O interface “M20~M3F, N20~N3F, R01~R1F, A05~A08, AT01~AT04, AQ01~AQ04” are hide:

SEL+↑↓	Under LADDER Mode,DRD8 current value=1750, display the state of relays (I/Z/Q ⇔
Or ↑↓	X/Y ⇔ M 1⇔ N2 ⇔ T ⇔ C ⇔ G ⇔ A1) ⇔ Original Screen

※ I/O interface can be hide in the same way in FBD.

LCD Display Main Menu

(1) The Main Menu as SG2 under 'STOP' Mode.

Into ladder main function to press ESC after power on when the user program is ladder type or empty program.

Into FBD main function to press ESC after power on when the user program is FBD type or empty program.

>LADDER FUN.BLOCK PARAMETER RUN	>FBD PARAMETER RUN DATA REGISTER
DATA REGISTER CLEAR PROG. WRITE >READ	CLEAR PROG. WRITE READ >SET
SET RTC SET ANALOG SET >PASSWORD	RTC SET ANALOG SET PASSWORD >LANGUAGE
ANALOG SET PASSWORD LANGUAGE >INITIAL	ANALOG SET PASSWORD LANGUAGE >INITIAL

Menu	Description
> LADDER	Ladder edit
FUN.BLOCK	Ladder function block (timer/counter/RTC ...) edit
FBD	FBD display
PARAMETER	FBD block or LADDER function block parameter display
RUN	RUN or STOP
DATA REGISTER	DR display
CLEAR PROG.	Clear the user program and the password
WRITE	Save user program to PM05 (3rd)
READ	Read user Program from PM05
SET	System setting
RTC SET	RTC setting
ANALOG SET	Analog setting
PASSWORD	Password setting
LANGUAGE	Select the language
INITIAL	initially set Edit method

(2) The Main Menu as SG2 under 'RUN' Mode.

>LADDER FUN.BLOCK PARAMETER STOP	>FBD PARAMETER STOP DATA REGISTER
DATA REGISTER WRITE RTC SET >PASSWORD	WRITE RTC SET PASSWORD >LANGUAGE
WRITE RTC SET PASSWORD >LANGUAGE	

>	LADDER	FBD
	FUN.BLOCK	
	PARAMETER	
	STOP	
	DATA REGISTER	
	WRITE	
	RTC SET	
	PASSWORD	
	LANGUAGE	

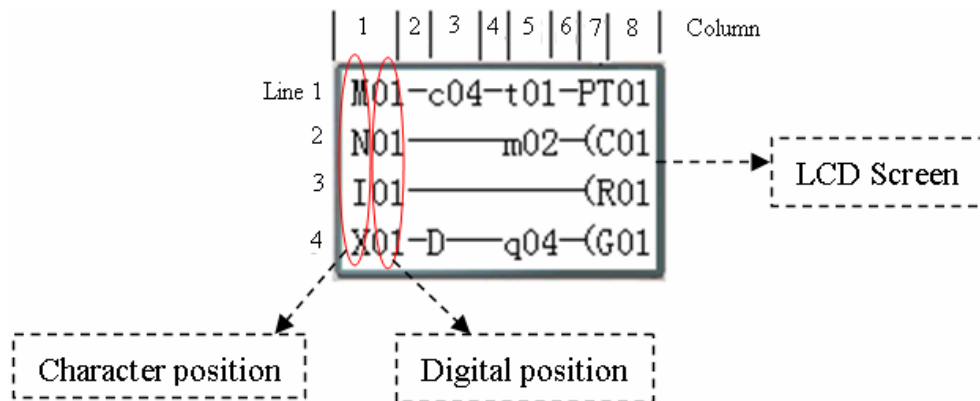
Press the Button

↑ ↓	Move the Cursor to select Main Menu
OK	Confirm the selected Function
ESC	Skip to Initial Screen

※SG2 can be modified, edited, cleared and read user program only when it is under STOP Mode.

※As the program is modified, SG2 will automatically backup it to FLASH.

◎ Main Menu LADDER



Press the Button

Button	Description
SEL	1. Ixx ⇒ ixx ⇒ — ⇒ space ⇒ Ixx (only for digital and character position of 1, 3, 5 column) 2. Qxx ⇒ space ⇒ Qxx (only for digital and character position of 8 column) 3. $\begin{matrix} \text{T} \\ \perp \end{matrix} \Rightarrow \text{Space} \Rightarrow \begin{matrix} \text{T} \\ \perp \end{matrix}$ (all available but the 2,4,6 column of the first line)
SEL, then ↑/↓	1. I ⇔ X ⇔ Z ⇔ Q ⇔ Y ⇔ M ⇔ N ⇔ D ⇔ T ⇔ C ⇔ R ⇔ G ⇔ I (the cursor located at 1, 3, 5 column) 2. Q ⇔ Y ⇔ M ⇔ N ⇔ T ⇔ C ⇔ R ⇔ G ⇔ H ⇔ L ⇔ P ⇔ S ⇔ AS ⇔ MD ⇔ PI ⇔ MX ⇔ AR ⇔ DR ⇔ MU ⇔ Q (When the cursor located at 8 column) 3. (⇔ ^ ⇔ v ⇔ P ⇔ ((When the cursor located at 7 column, and the 8 column is set as Q, Y, M, N) 4. (⇔ P ⇔ ((When the cursor located at 7 column, and the 8 column is set as T)
SEL, then ←/→	Confirm the input data and move the cursor.
↑ ↓ ← →	Move the cursor.
DEL	Delete an instruction.
ESC	1. Cancel the Instruction or action under Edition. 2. Back to Main Menu after query the program (save program to flash).
OK	1. Confirm the data and automatically save, the cursor moves to next input position. 2. When the cursor is on Column 8, Press the button to automatically enter the function blocks and set the parameters (such as T/C...).
SEL+DEL	Delete a Line of Instruction.
SEL+ESC	Display the number of the Lines and operation state of SG2 (RUN/STOP).
SEL+↑/↓	Skip up/ down every 4-line program.
SEL+OK	Insert a space line

Operation Sample: more detailed to see [Appendix A: Keypad programming in Ladder mode](#).

◎ FUNCTION BLOCK program input

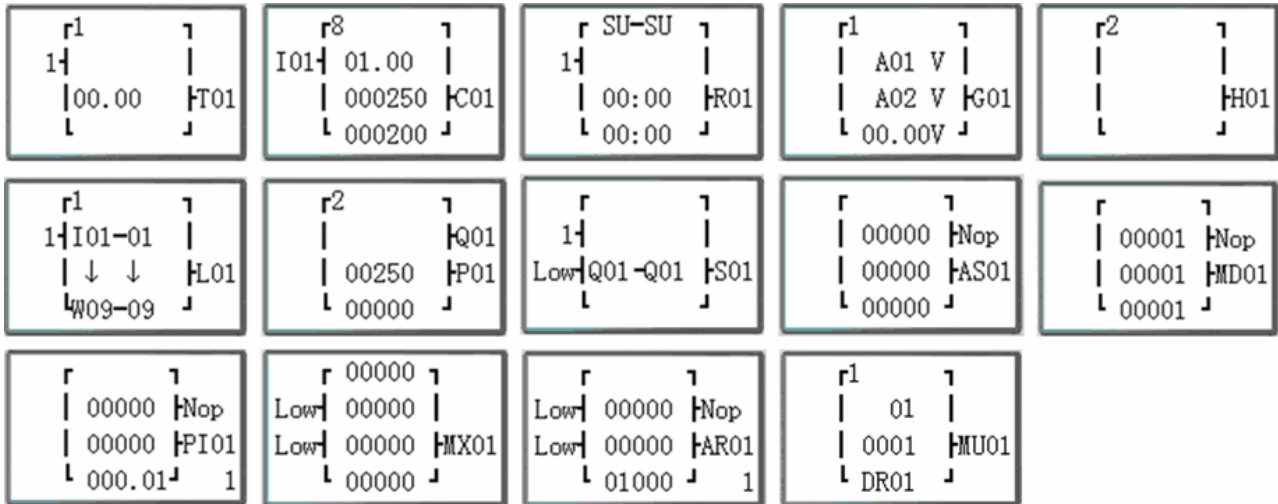
After into FUNCTION BLOCK, cursor flicker on “T”, press “SEL” key, cursor will into edit mode.

This time if press “SEL” key continuously. Ladder function block display in sequence:

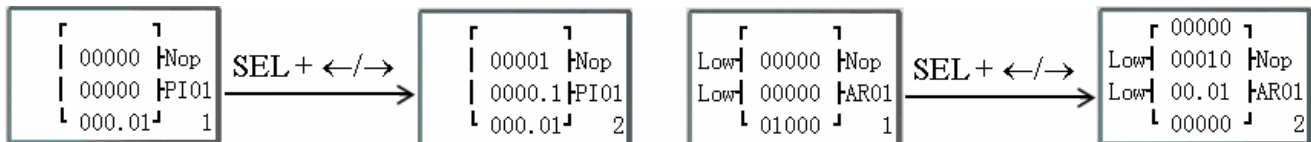
T→C→R→G→H→L→P→S→AS→MD→PI→MX→AR→MU→T...

This time if cursor flicker on “T”, press “↑/↓”. Ladder function block display in sequence:

T↔C↔R↔G↔H↔L↔P↔S↔AS↔MD↔PI↔MX↔AR↔MU↔T...



Function PI and AR, more key display:



Operation Sample: more detailed to see [Appendix B: Keypad programming in Ladder FUNCTION BLOCK](#).

◎ PARAMETER

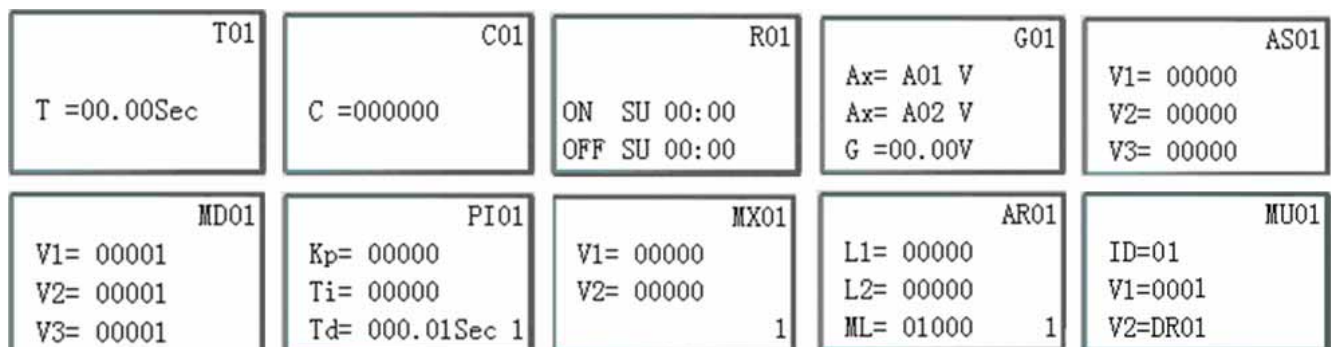
Under Ladder mode into PARAMETER, press “SEL” key, cursor will into edit mode.

This time if press “SEL” key continuously. Function blocks display in sequence:

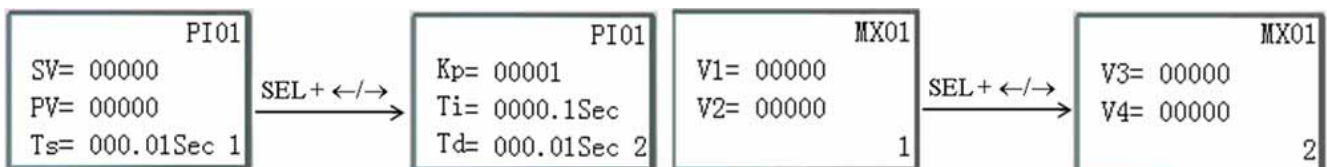
T→C→R→G→AS→MD→PI→MX→AR→MU→T...

This time if cursor flicker on “T”, press “↑/↓”. Function blocks display in sequence:

T↔C↔R↔G↔AS↔MD↔PI↔MX↔AR↔MU↔T...

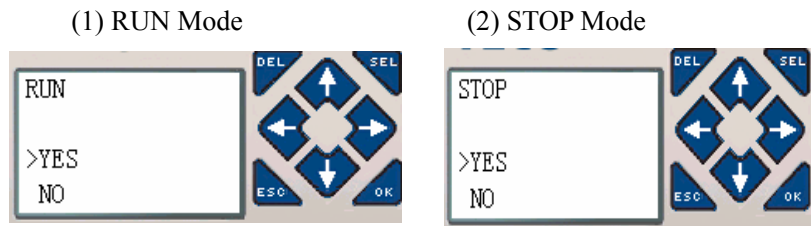


Function PI and AR, more key display:



Under FBD mode, Press “SEL” key, Block which used in program displays in sequence.

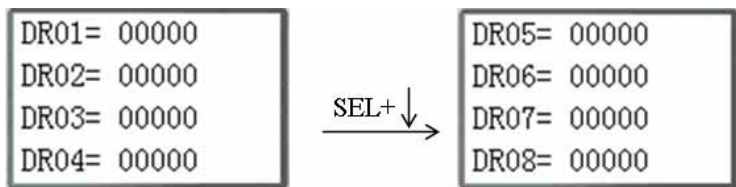
◎ RUN or STOP



↑ ↓	Move the cursor
OK	Execute the instruction, then back to main menu
ESC	Back to main menu

◎ DATA REGISTER

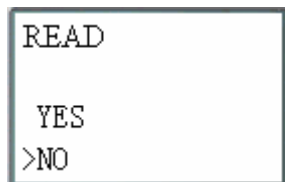
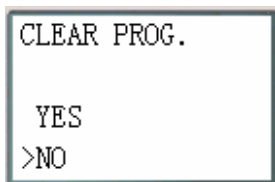
Displaying preset value when the smart is STOP status and displaying current value when the smart is RUN status.



↑ ↓ ← →	Move the cursor
OK	Ensure the edit
SEL	Enter edit (edit DR display number or DR preset value)
'SEL' then 'SEL'	Edit DR preset value type
'SEL' then '↑ ↓'	1. Edit DR display number (only first line) 2. Edit DR preset value
ESC	1. Cancel edit. 2. Back to main menu (save DR preset data)
SEL+↑/ ↓	Tip-up/down page

◎ Other Menu Items

- (1) CLEAR PROGRAM (Clear RAM, Program in flash and Password at the same time)
- (2) WRITE: save the program (RAM) to PM05 (3rd) program spare cartridge
- (3) READ: read the program from the PM05 or PM05 (3rd) program spare cartridge to SG2 (RAM)



(1) ~ (3) Now Press:

↑ ↓	Move the cursor
OK	Execute the instruction
ESC	Back to main menu

(4) SET (system setting)

		content	default		
ID SET	01	ID SET	01	→	ID setting (00~99)
REMOTE I/O	N	REMOTE I/O	N	→	Remote I/O Mode (N: none M: Master S: Slave)
BACKLIGHT	x	BACK LIGHT	x	→	Back light mode (√: always light x: light for 10s after pressed.)
M KEEP	✓	M KEEP	√	→	M: non-Volatile (√:Volatile x: Non- Volatile)
I/O NUMBER:	0	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 x:No)
C KEEP	x	C KEEP	x	→	in stop/run switching, Counter Present Value Keeping (√:Yes x:No)
Z SET	x	Z SET	x	→	Enable or disable keypad input Z01-Z04 (√:enable x:disable)
RS485 SET	03	RS485 SET	03	→	Setting the form and baud rate of RS-485
DATA REG.	U	DATA REG.	U	→	Setting the Data Register type (U: 16bit-unsigned S: 16bit-sign)

※ M KEEP function is available for keeping M status and current value of T0E/T0F when power is re-supplied after loss.

Now Press:

↑ ↓ ← →	Move the cursor
SEL	Begin to edit.
'SEL' then '←/→'	Move the cursor for 'ID SET' item and 'RS485 SET' item
'SEL' then '↑/↓'	1. ID SET = 00~99 ; I/O NUMBER = 0~3 2. REMOTE I/O = N↔M↔S↔N 3. BACK LIGHT ; C KEEP ; Z SET = x↔√ 4. M KEEP; I/O ALARM = √↔x 5. RS485 SET = (0~3)(0~5) 6. DATA REG. = U↔S
OK	Confirm the Edition Data
ESC	1. Cancel the setting when pressed 'SEL' 2. Back to Main Menu(save edit data)

※ When IO LINK is selected, ID setting range is 0~7, which should be continuous.

ID=0 default as Master, ID=1~7 default as Slave.

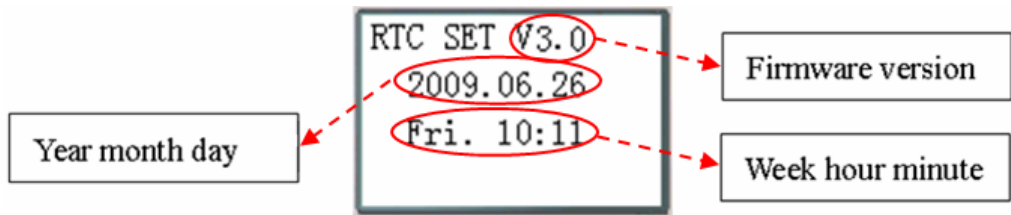
※ When REMOTE I/O is selected, the distribution of the remote I/O is as follows:

	Master		Slave
Remote Input	X01~X0C	←	I01~I0C
Remote Output	Y01~Y08	→	Q01~Q08

※ The high bit of RS485 SET detects the form of RS-485, and the low bit detects the baud rate of RS-485.

More detailed to see [chapter 8: 20 Points RS485 type Models Instruction](#).

(5) RTC SET



Now Press

↑↓	Enter RTC setting or Daylight saving setting
SEL	Begin to input parameters
'SEL' then '←/→'	Move the Cursor
'SEL' then '↑/↓'	1. year=00~99, month=01~12, day=01~31 2. hour = 00~23 , minute = 00~59
'SEL' then 'SEL'	Daylight saving setting: NO – EUROPE – USA – OTHER – NO ...
OK	Save the Input Data
ESC	1. Cancel the Input Data when press 'SEL'. 2. Back to Main Menu.

※ According to set the date automatically calculate weeks

※ RTC precision:

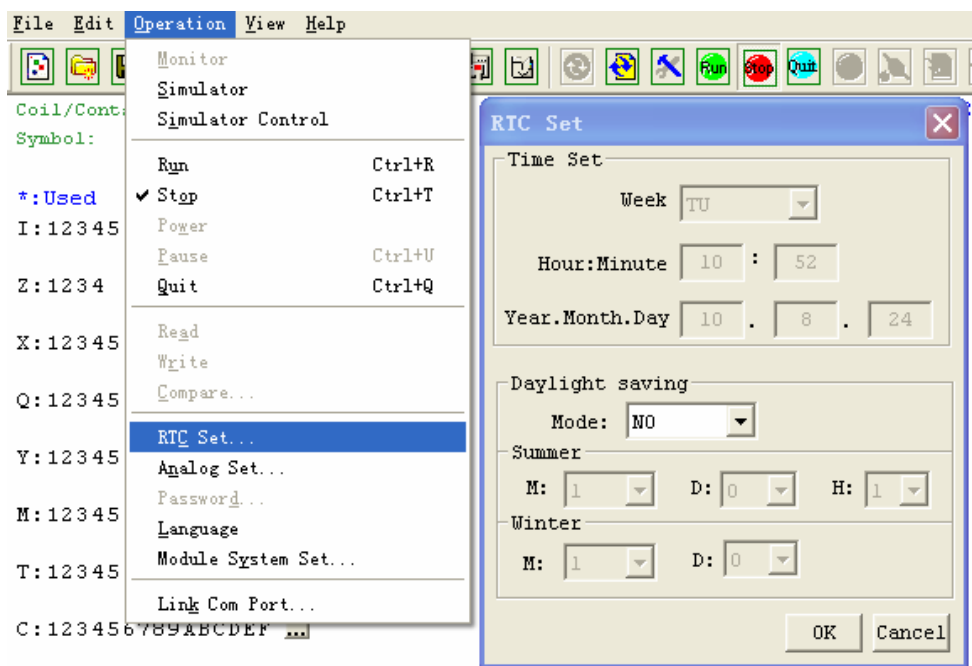
Temperature	Error
+25°C	± 3s/day
-20°C/+50°C	± 6s/day

RTC Daylight saving setting

There are 2 fixed Daylight saving options, EUROPE and USA, 1 editable Daylight saving option in SG2.

Daylight saving options can be set through the two methods as shown below.

1) PC Client

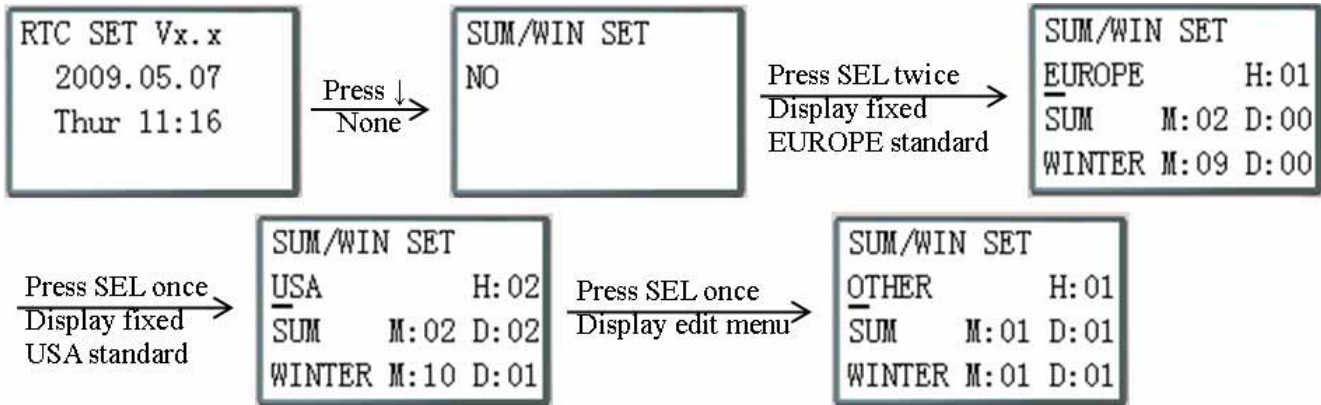


Edit rule: ①M: Month range 1~12;

②D: Week range 0~5, means the 0 to 5th Sunday of the setting month and 0 said the last Sunday of the setting month;

③H: Hour range 1~22; summer hour and winter hour are the same.

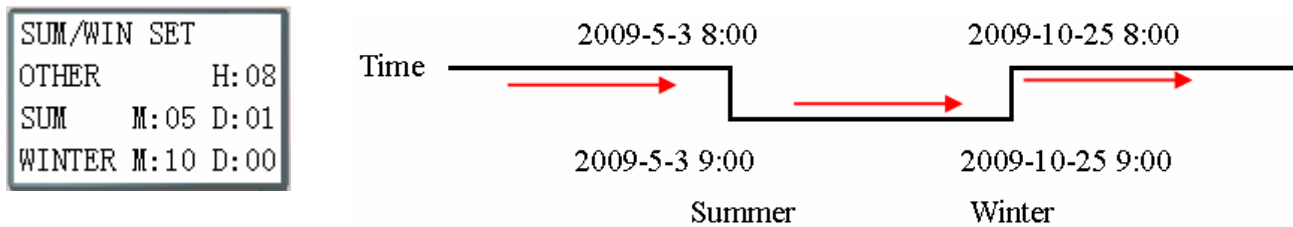
2) Keypad



Then pressing “→” selects edit location, pressing “↑”, “↓” edit content.

Example:

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



(6) ANALOG SET

A01=GAIN :010	A 1=GAIN : 010	→ GAIN (0~999), default 10
OFFSET:+00	OFFSET : +00	→ OFFSET (-50~+50), default 0
A02=GAIN :010	A 2=GAIN : 010	
OFFSET:+00	OFFSET : +00	
	A3~A8...Gain + Offset	

Now Press

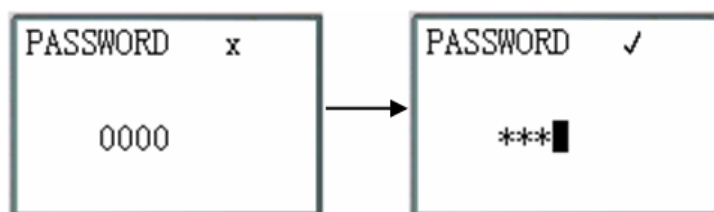
↑ ↓	1. Move downward the Cursor 2. Switch the setting screen from A01/A02→ A03/A04→ A50/A06 → A07/A08
SEL	Begin to input parameters
‘SEL’ then ‘←/→’	Move the Cursor
‘SEL’ then ‘↑/↓’	1. GAIN =000~999 2. OFFSET=-50~+50
OK	Save the Input Data
ESC	1. Cancel the Input Data when press ‘SEL’. 2. Back to Main Menu (save edit data).

※ $V01 = A01 * A01_GAIN + A01_OFFSET$

.....

$V08 = A08 * A08_GAIN + A08_OFFSET$

(7) PASSWORD (setting password)



Now Press

SEL	1. Begin to input numeral 2. When the password is ON, it will not display 0000, but ****.
'SEL' then '←/→'	Move the cursor
'SEL' then '↑/↓'	Data changed 0~F
OK	Save the input data, not 0000 or FFFF, as the PASSWORD is ON.
ESC	1. Cancel the Input Data when press 'SEL'. 2. Back to Main Menu.

※ A Class: Password number is set to 0001~9FFF.

B Class: Password number is set to A000~FFFE.

Password number = 0000 or FFFF is disabled Password function, Default setting: 0000.

If there are H coils(HMI coils) enable, A/B Class password have same access right; If there are no H coils enable, A/B password have different access right. A/B Class password Description:

	No H coil ON		H coil ON	
Menu	A Class	B Class	A Class	B Class
LADDER	√	√	√	
FUN.BLOCK	√	√	√	
FBD	√	√	√	
PARAMETER		√	√	
RUN/STOP		√	√	
DATA REGISTER		√	√	
CLEAR PROG.	√	√	√	
WRITE	√	√	√	
READ	√	√	√	
SET		√	√	
RTC SET				
ANALOG SET		√	√	
LANGUAGE		√	√	
INITIAL	√	√	√	

√: cannot accessed under password protecting

(8) LANGUAGE (Selection menu language)

ENGLISH	→	English
FRANÇAIS	→	French
ESPAÑOL	→	Spanish
ITALIANO	→	Italian
DEUTSCH	→	German
PORTUGUES	→	Portuguese
> 简体中文 ✓	→	Simplified Chinese
POLSKI	→	Polish
TYCCKWĀ *	→	Russian
TÜRKÇE	→	Turkish

Now Press

↑↓	Vertically move the Cursor
OK	Select the language the cursor located
ESC	Back to Main Menu

- ※ Language display “✓” means current selection for menu language;
- ※ Language display “*” means current selection for HMI multi-language characters, only Russian or Turkish;
- ※ Press key “↑” or “↓” to move cursor and press OK key to select language, if select Russian or Turkish, HMI multi-language characters also changed; if select other language, HMI multi-language characters don’t changed.

(9) INITIAL (select Ladder Logic and Function Block Diagram (FBD))

INITIAL
> LADDER ✓
FBD

Now Press:

↑↓	Vertically move the Cursor
OK	Select the mode the cursor located
ESC	Back to Main Menu



The origin program will be cleared as the change of edition method.

SG2 system error

After power on, SG2 keep detecting the running state. Once system error occurred, the error code will display on LCD. At the same time, SG2 will stop or just give error-warning base on the error type. Error types are show in the table below:

Error code	Explain	Error action
ROM ERROR	System ROM/Flash memory check error	STOP SG2
Vpd ERROR	Power down circuits check error	STOP SG2
PROG ERROR	Ladder / FBD code invalid in EEPROM.	STOP SG2
LOGIC ERROR	FBD code logic check error	STOP SG2
EXT. ERROR	Expansion I/O error (When disable I/O alarm in “SET” of the main function, The alarm cannot appear.)	STOP SG2
COMM ERROR	RS485 type communication error	Warning only
RTC ERROR	RTC check or work error	Warning only
EMPTY PACK	Memory pack is empty, when reading from the memory pack.	Warning only
MEM.ERROR	Memory packs check error, when writing to the memory pack.	Warning only

Chapter 4: Parameter passing

SG2 inner data type.....	60
Passing parameter out of range	62

In SG2, almost all the function block can use other function block's current value as its preset value. This process we called data transmission. This chapter will describe some regulation about data transmission.

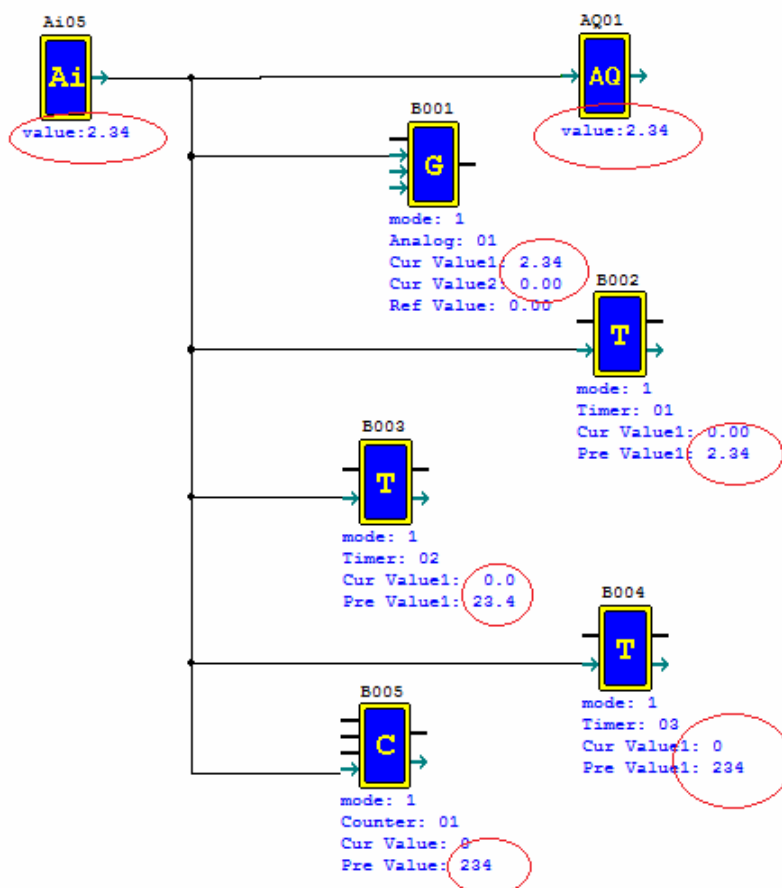
SG2 inner data type

All the data stored in SG2 inner system are integer. Even through some parameter likes "A01 = 9.99V" display in LED, in fact "9.99" stored in SG2 inner system is "999". Only in display stage, the decimal point of "9.99" added according to its physical significance. **When analog variable and other function block current value passed to other function block or analog output as preset value, essentially just integers passed. When need to display those passed integer preset value in LED, decimal point will be added according to physical significance.**

Example1:

A05 current value passing to other function block as preset value:

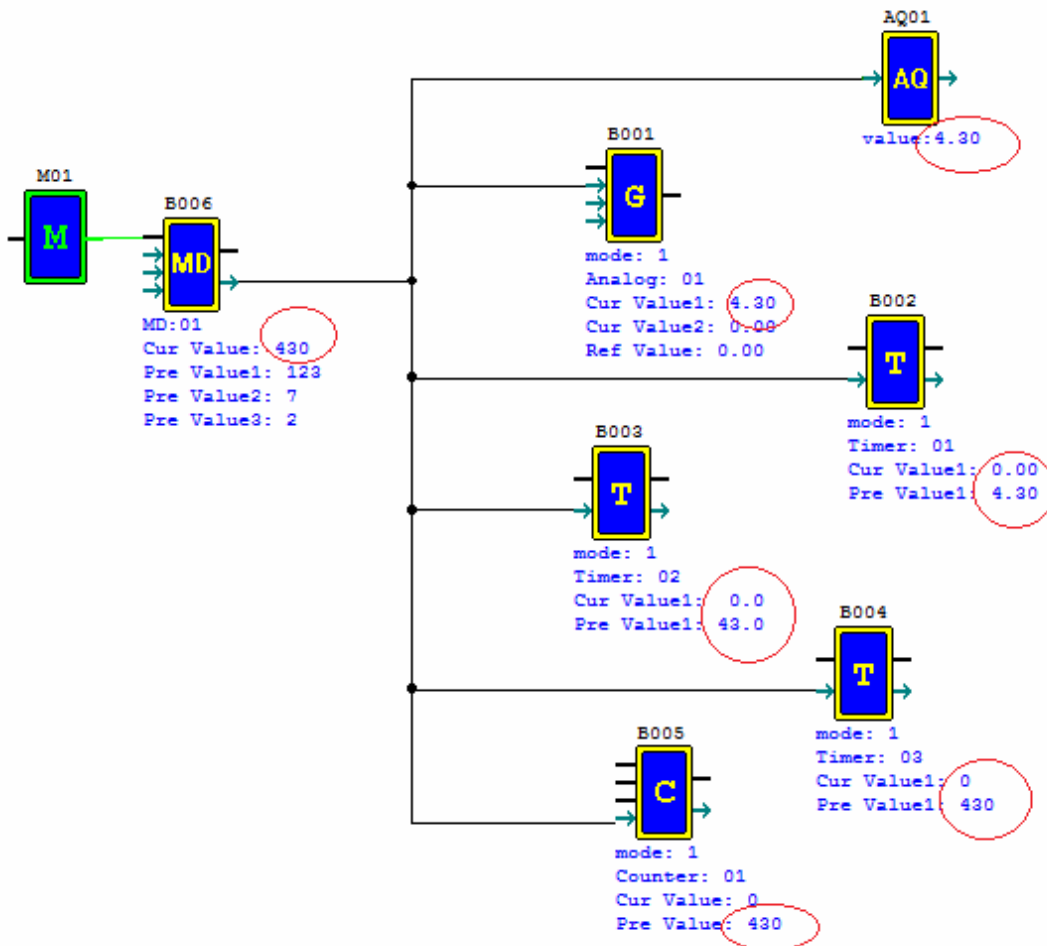
When A05=2.34V, A05's inner value 234 is passed to other function block as preset value. Passing to AQ01 automatically as 2.34V, Passing to B001 (G01) automatically as 2.34V, Passing to B002(T01 time base is 0.01s) automatically as 2.34s, Passing to B003(T02 time base is 0.1s) automatically as 23.4s, Passing to B004(T03 time base is 1s) automatically as 234s, Passing to B005(C01) automatically as 234:



Example2:

MD01 current value passing to other function block as preset value:

When B006(MD01)=430, MD01's inner value 430 is passed to other function block as preset value. Passing to AQ01 automatically as 4.30V, Passing to B001(G01) automatically as 4.30, Passing to B002(T01 time base is 0.01s) automatically as 4.30s, Passing to B003(T02 time base is 0.1s) automatically as 43.0s, Passing to B004(T03 time base is 1s) automatically as 430s, Passing to B005(C01) automatically as 430:



Passing parameter out of range

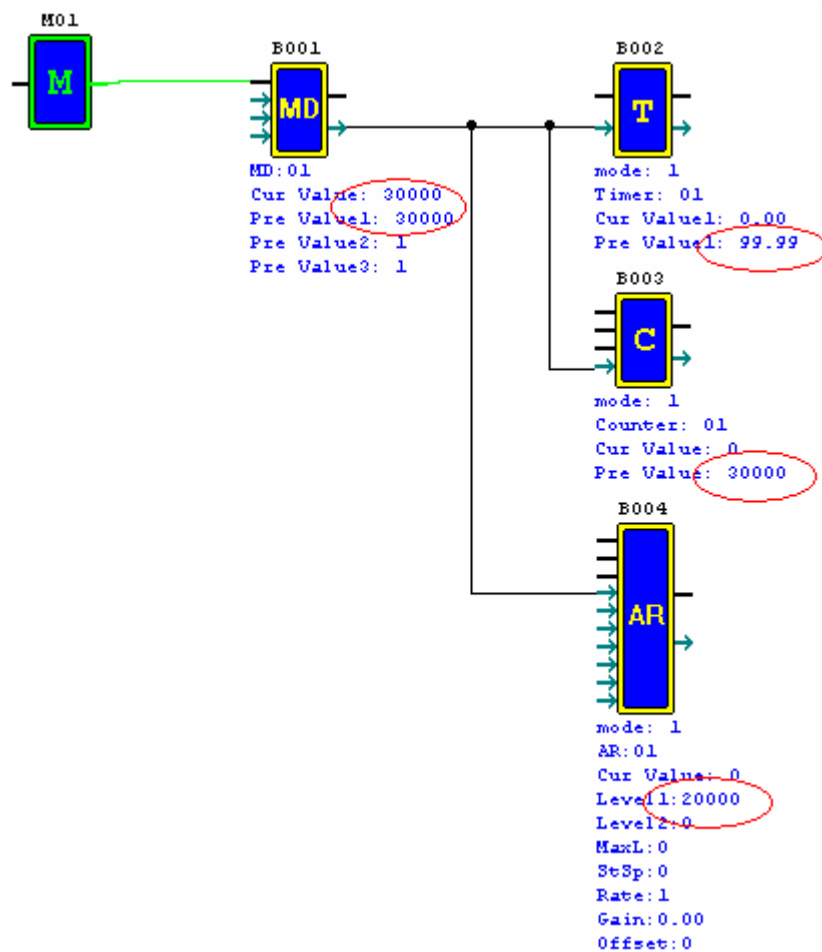
MD current value data range is -32768~32767, T preset value data range is 0~9999. If MD current value is passed to T as preset value, obviously sometimes MD current may greater T preset value upper limit, or less than T preset value down limit. This moment SG2 will use upper limit or down limit value as its preset value. Similar situation of passing parameter, SG2 will use the same processing method.

Example1:

When B006(MD01)=30000, MD01's value 30000 is passed to other function block as preset value. Passing to B002(T01 time base is 0.01s) as preset value. 30000 is greater than upper limit of T01 9999, so automatically as 99.99;

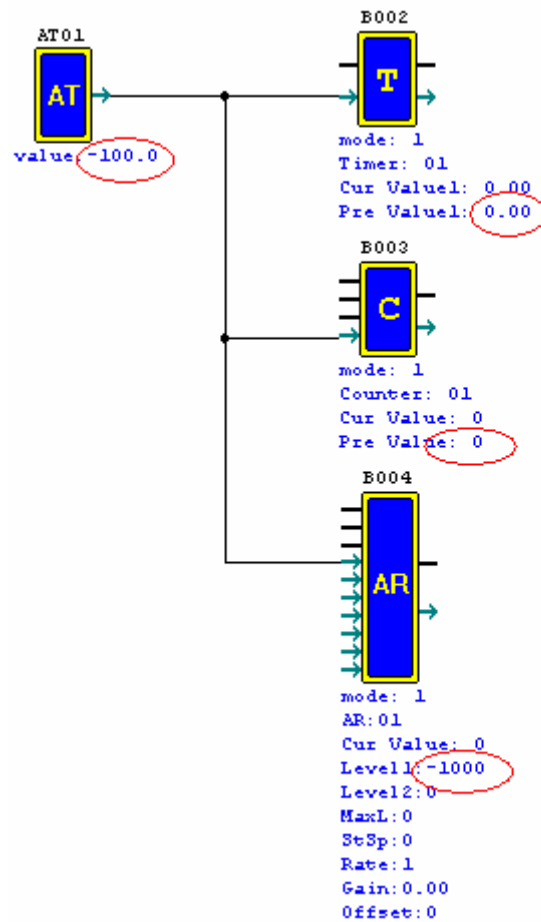
Passing to B003(C01) as preset value. The number 30000 is not out of data range of C01, so C01 preset value automatically as 30000;

Passing to B004(AR01) as preset value. The number 30000 is greater than upper limit of AR01 20000, so automatically as 20000;



Example2:

When AT01=-100.0, AT01's inner value -1000 is passed to other function block as preset value. Passing to B002(T01 time base is 0.01s) as preset value. -1000 is less than lower limit of T01 0, so automatically as 00.00;
 Passing to B003(C01) as preset value. -1000 is less than lower limit of C01, so C01 preset value automatically as 0;
 Passing to B004(AR01) as preset value. -1000 is not out of data range of AR01 -10000, so automatically as -1000;



Chapter 5: Relay Ladder Logic Programming

Common Memory Types.....	65
Specialty Memory Types.....	68
Output Instructions.....	69
Analog memory type.....	70
Timer Instruction.....	71
Counter Instructions.....	79
Real Time Clock (RTC) Instructions	89
Comparator Instructions.....	97
HMI Display Instructions.....	99
PWM Output Instruction (DC Transistor Output Models Only).....	102
IO Link/Remote I/O Instruction (SG2-20Vxxx model only).....	105
MU (Modbus) (SG2-20Vxxx model only)	108
SHIFT (shift output).....	115
AQ (Analog Output)	116
AS (Add-Subtract)	118
MD (MUL-DIV)	119
PID (Proportion- Integral- Differential).....	120
MX (Multiplexer).....	123
AR (Analog-Ramp).....	124
DR (Data register).....	128

Common Memory Types

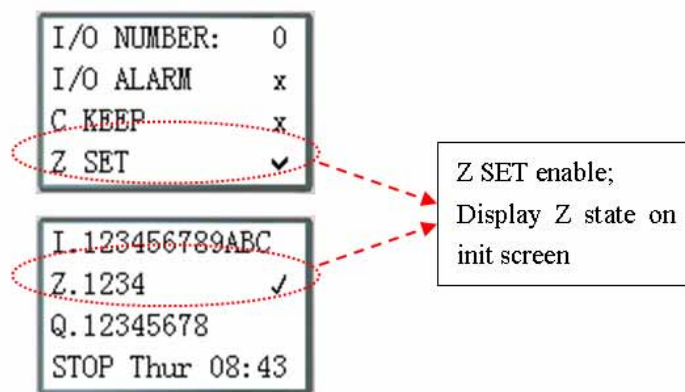
	General output	SET output	RESET output	PULSE output	N.O. contact	N.C. contact	Number
Symbol	[	▲	▼	P	⏏	⏏	(N.O./N.C.)
Input contact					I	i	12(I01-I0C/i01-i0C)
Keypad input					Z	z	4(Z01-Z04/z01-z04)
Output coil	Q	Q	Q	Q	Q	q	8(Q01-Q08/q01-q08)
Auxiliary relay	M	M	M	M	M	m	63(M01-M3F/m01-m3F)
Auxiliary relay	N	N	N	N	N	n	63 (N01-N3F/n01-n3F)
Counter	C				C	c	31(C01-C1F/c01-c1F)
Timer	T			T	T	t	31(T01-T1F/t01-t1F)

Inputs (I memory Type)

The SG2 digital input points are designated I memory types. The number of digital I input points is 6, 8 or 12 depending on each SG2 model.

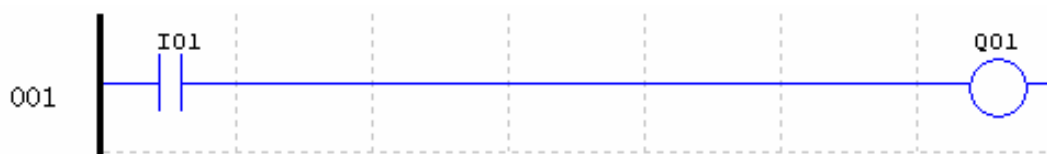
Keypad inputs (Z Memory type)

The SG2 keypad input points are designated Z memory types. The number of digital Z input points is 4 depending on SG2 H type model and RS485 type model.



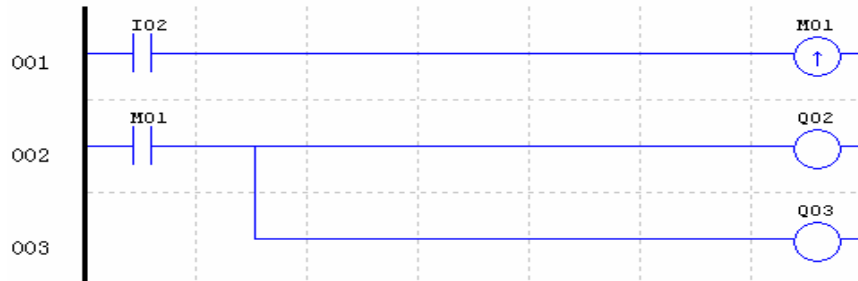
Outputs (Q Memory Type)

The SG2 digital output points are designated Q memory types. The number of digital Q output points is 4 or 8 depending on each SG2 model. In this example, output point Q01 will be turned on when input point I01 is activated.

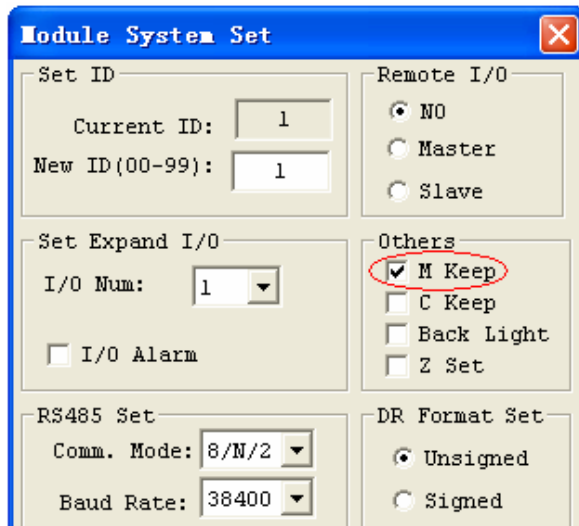


Auxiliary Relays (M memory type)

Auxiliary relays are digital internal memory bits used to control a ladder logic program. The auxiliary relays are not physical inputs or outputs that can be wired to any external device, switches, sensors, relays, lamps, etc. The number of Auxiliary Relays M is 63. Since auxiliary relays are internal bits within the CPU, they can be programmed as digital inputs (contacts) or digital outputs (coils). In the first rung of this example, auxiliary relay M01 is being used as an output coil and will energize when input I02 turns on. In the second rung auxiliary relay M01 is being used as an input and when energized, will turn on outputs Q02 and Q03.



※ The state of auxiliary relays “M01~M3F” will be kept when the smart powers down if “M Keep” is active. “M Keep” can be set by the two ways below.



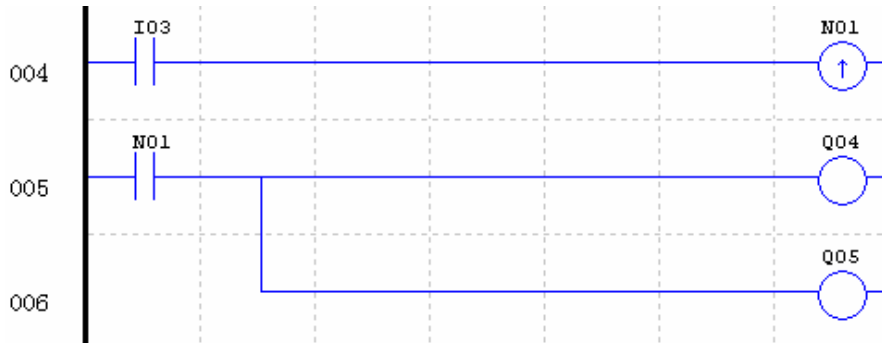
Special Auxiliary Relays: M31~M3F

Code	Signification	Description
M31	User program upstart flag	Outputting ON during the first scanning period; and used as normal auxiliary relay at other scan period.
M32	1second blinking output	0.5s ON, 0.5s OFF
M33	Summer/Winter output	Summer time turn ON, winter time turn OFF, used as normal auxiliary relay.
M34	AT01 flag	Output ON when the first channel of SG2-4PT is error
M35	AT02 flag	Output ON when the second channel of SG2-4PT is error
M36	AT03 flag	Output ON when the third channel of SG2-4PT is error
M37	AT04 flag	Output ON when the fourth channel of SG2-4PT is error
M38~M3C	Reserved	
M3D	Received flag	MODBUS function using (MU instruction)
M3E	Error flag	
M3F	Time out flag	

Auxiliary Relays (N memory type)

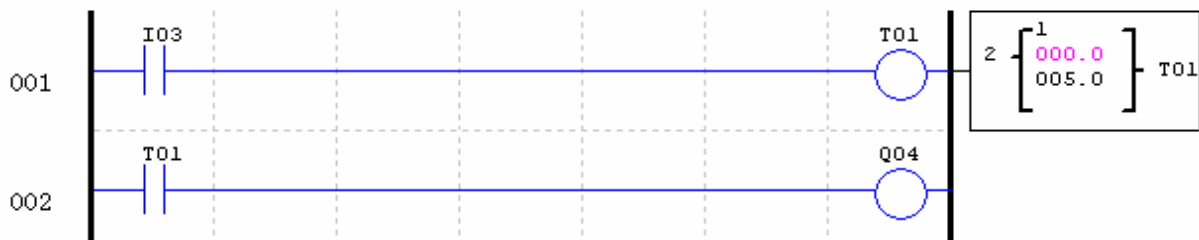
Auxiliary relays N is the same to auxiliary relays M, but it can't be kept when the smart powers down.

In the first rung of this example, auxiliary relay N01 is being used as an output coil and will energize when input I03 turns on. In the second rung auxiliary relay N01 is being used as an input and when energized, will turn on outputs Q04 and Q05.



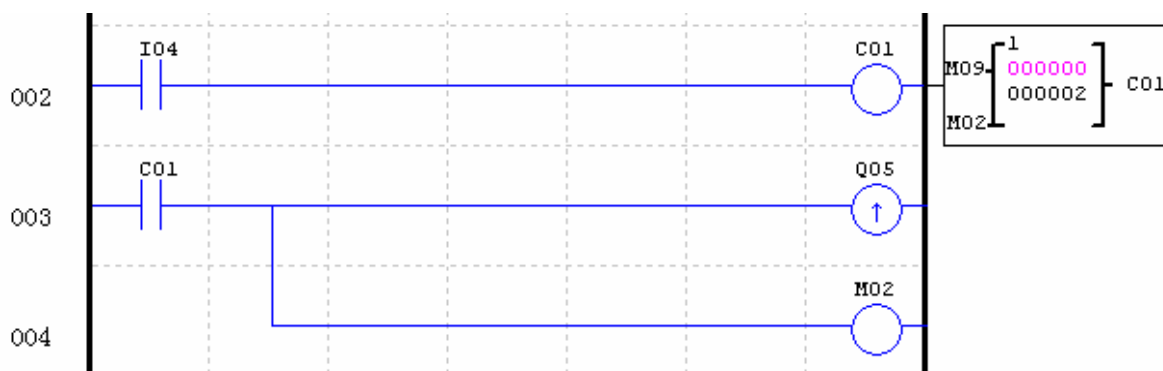
Timers and Timer Status Bits (T Memory Type)

Timer status bits provide the relationship between the current value and the preset value of a selected timer. The timer status bit will be on when the current value is equal or greater than the preset value of a selected timer. In this example, when input I03 turns on, timer T01 will start. When the timer reaches the preset of 5 seconds timer status contact T01 turns on. When T01 turns on, output Q04 will turn on. Turning off I03 will reset the Timer.



Counters and Counter Status Bits (C Memory Type)

Counter status bits provide the relationship between the current value and the preset value of a selected counter. The counter status bit will be on when the current value is equal or greater than the preset value of a selected counter. In this example, each time the input contact I04 transitions from off to on, the counter (C01) increments by one. When the counter reaches the preset of 2 counts, the counter status contact C01 turns on. When C01 turns on, output Q05 will turn on. When M02 turns on counter C01 will reset. If M09 is turned on, the counter will change from a count-up to a count-down counter.

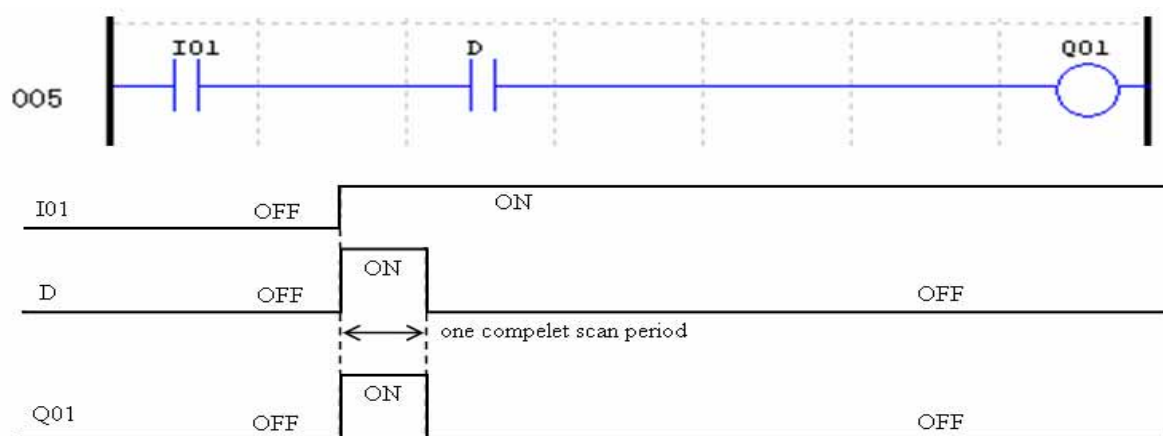


Specialty Memory Types

	General output	SET output	RESET output	PULSE output	N.O. contact	N.C. contact	Number
Symbol	[	▲	▼	P	⏏	⏏	(N.O./N.C.)
					Lo	Hi	Used in function block
Expansion input coil					X	x	12(X01-X0C/x01-x0C)
Expansion output coil	Y	Y	Y	Y	Y	y	12(Y01-Y0C/y01-y0C)
Differential (one shot)					D	d	
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)
DATA LINK	L						8(L01-L08)
SHIFT	S						1(S01)

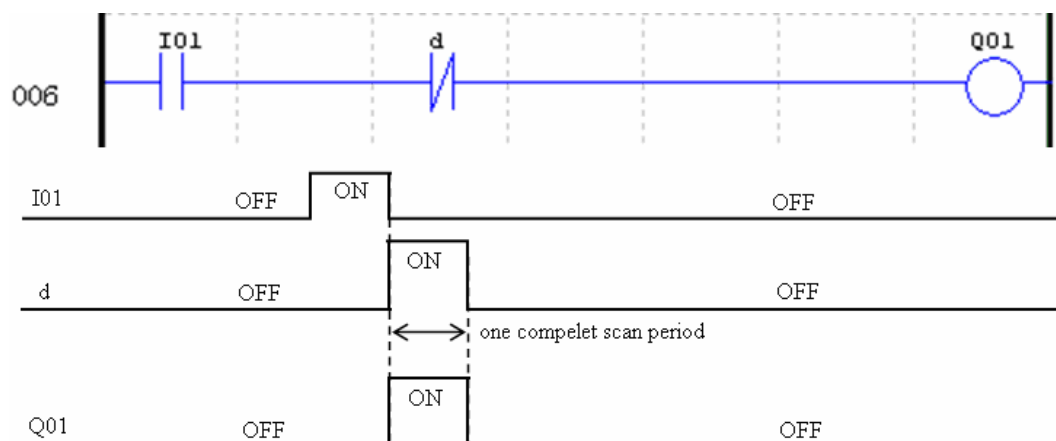
Positive input Differential Instruction (One-Shot)

A positive input differential instruction, or One-Shot, holds its status ON for one CPU scan when the preceding series contact transitions from OFF to ON. This transition from OFF to ON is called a Positive Input Differential.



Negative Input Differential Instruction (One-Shot)

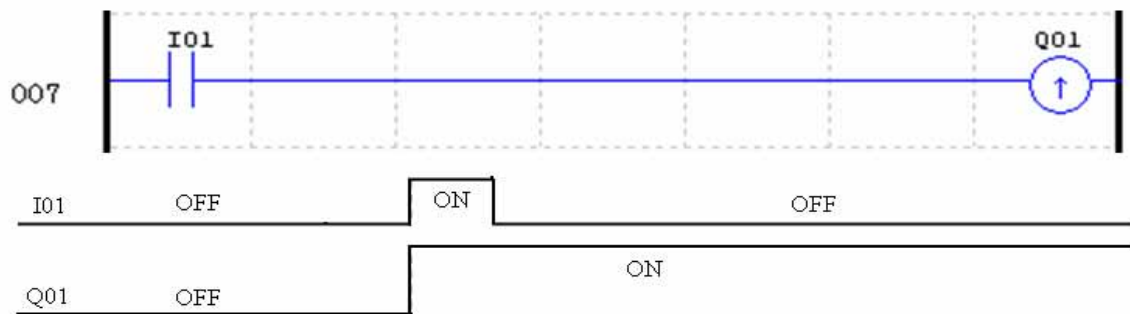
A negative input differential instruction, or One-Shot, holds its status ON for one CPU scan when the preceding series contact transitions from ON to OFF. This transition from ON to OFF is called a Negative Input Differential.



Output Instructions

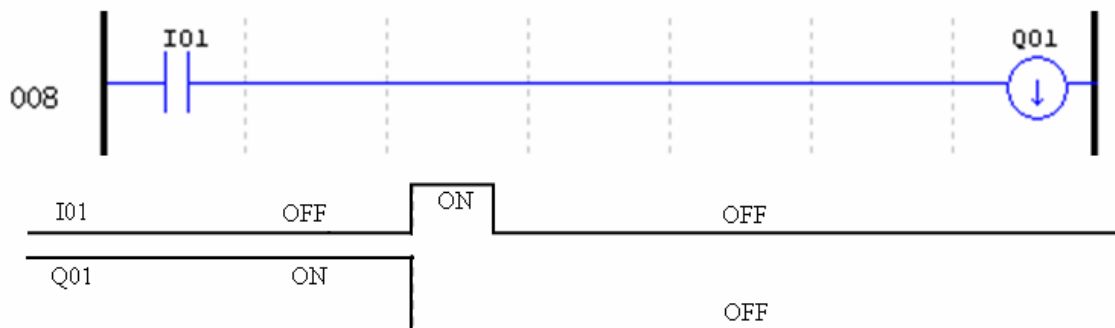
Set Output Instruction (Latch) (▲)

A set output instruction, or Latch, turns ON an output coil (Q) or an auxiliary contact (M) when the preceding input contact transitions 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 for the preceding input contact controlling the Set output instruction to remain ON.



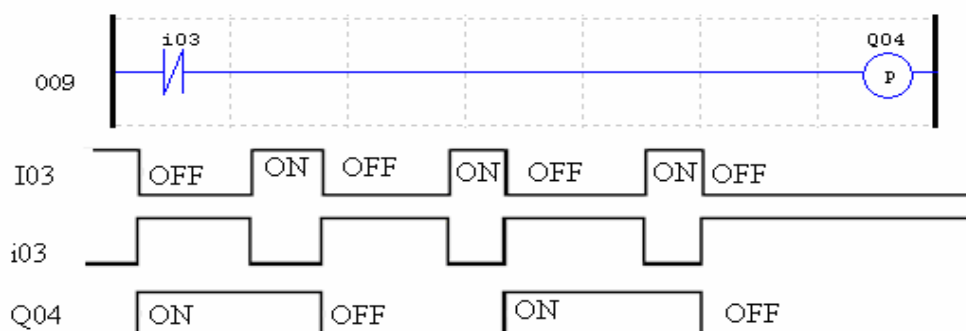
Reset Output Instruction (Unlatch) (▼)

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 is reset using another output instruction. It is not necessary for the preceding input contact controlling the Reset output instruction to remain ON.



Pulse Output Instruction (Flip-Flop) (P)

A pulse output instruction, or Flip-Flop, turns ON a coil (Q) or an auxiliary contact (M) when the preceding input contact transition from OFF to ON. Once the output is ON, it will remain ON until the preceding input contact transitions from OFF to ON a second time. In the example below, when Pushbutton I03 is pressed and released Motor Q04 will turn on and remain on. When Pushbutton I03 is pressed again, Motor Q04 will turn off and remain off. The pulse output instruction (P) will “flip-flop” its state from ON to OFF at each press of Pushbutton I03.



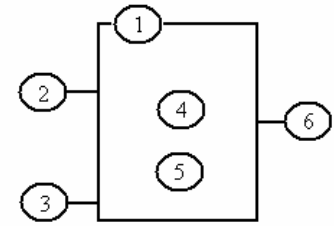
Analog memory type

	Analog input	Analog output	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)

Analog value (A01~A08, V01~V08, AT01~AT04, AQ01~AQ04) and current value of functions (T01~T1F, C01~C1F, AS01~AS1F, MD01~MD1F, PI01~PI0F, MX01~MX0F, AR01~AR0F, and DR01~DRF0) can be used as other function's preset value. And the parameter preset value is its limit value when the current value of those functions is bigger or less than parameter's limit value.

Timer Instruction

The SG2 includes a total of 31 separate Timers that can be used throughout a program. T0E and T0F keep their current value after a loss of power to the smart relay if “M Keep” is active, but the other Timers’ current value is non-retentive. Each Timer has a choice of 8 operation modes, 1 for a pulse Timer and 7 for general purpose Timer. Additionally, each Timer has 6 parameters for proper configuration. The table below describes each configuration parameter and lists each compatible memory type for configuring Timers.



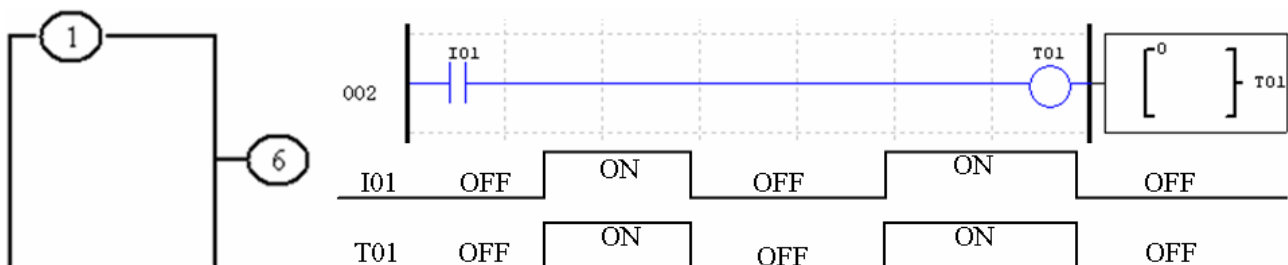
Symbol	Description
①	Timer Mode (0-7)
②	Timer Unit 1: 0.01s, range: 0.00 - 99.99 sec 2: 0.1s, range: 0.0 - 999.9 sec 3: 1s, range: 0 - 9999 sec 4: 1min, range: 0 - 9999 min
③	ON: the Timer reset to 0 OFF: the Timer continues timing
④	Timer current value
⑤	Timer preset value
⑥	Timer code(T01~T1F total: 31 Timers)

Compatible Instructions	Range
Input	I01-I0C/i01-i0C
Keypad input	Z01-Z04/z01-z04
Output	Q01-Q08/q01-q08
Auxiliary coil	M01-M3F/m01-m3F
Auxiliary coil	N01-N3F/n01-n3F
Expansion input	X01-X0C/x01-x0C
Expansion output	Y01-Y0C/y01-y0C
RTC	R01-R1F/r01-r1F
Counter	C01-C1F/c01-c1F
Timer	T01-T1F/t01-t1F
Analog comparator	G01-G1F/g01-g1F
Normal open contact	Lo

- ✘ The preset value of Timer could be a constant or other function current value.
- ✘ The current value of T0E and T0F will be kept when SG2 on a loss of power if the “M-Keep” is active.

Timer Mode 0 (Internal Coil)

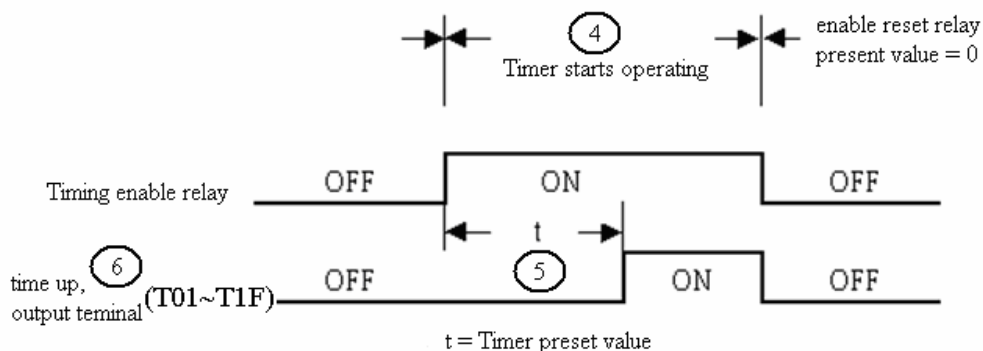
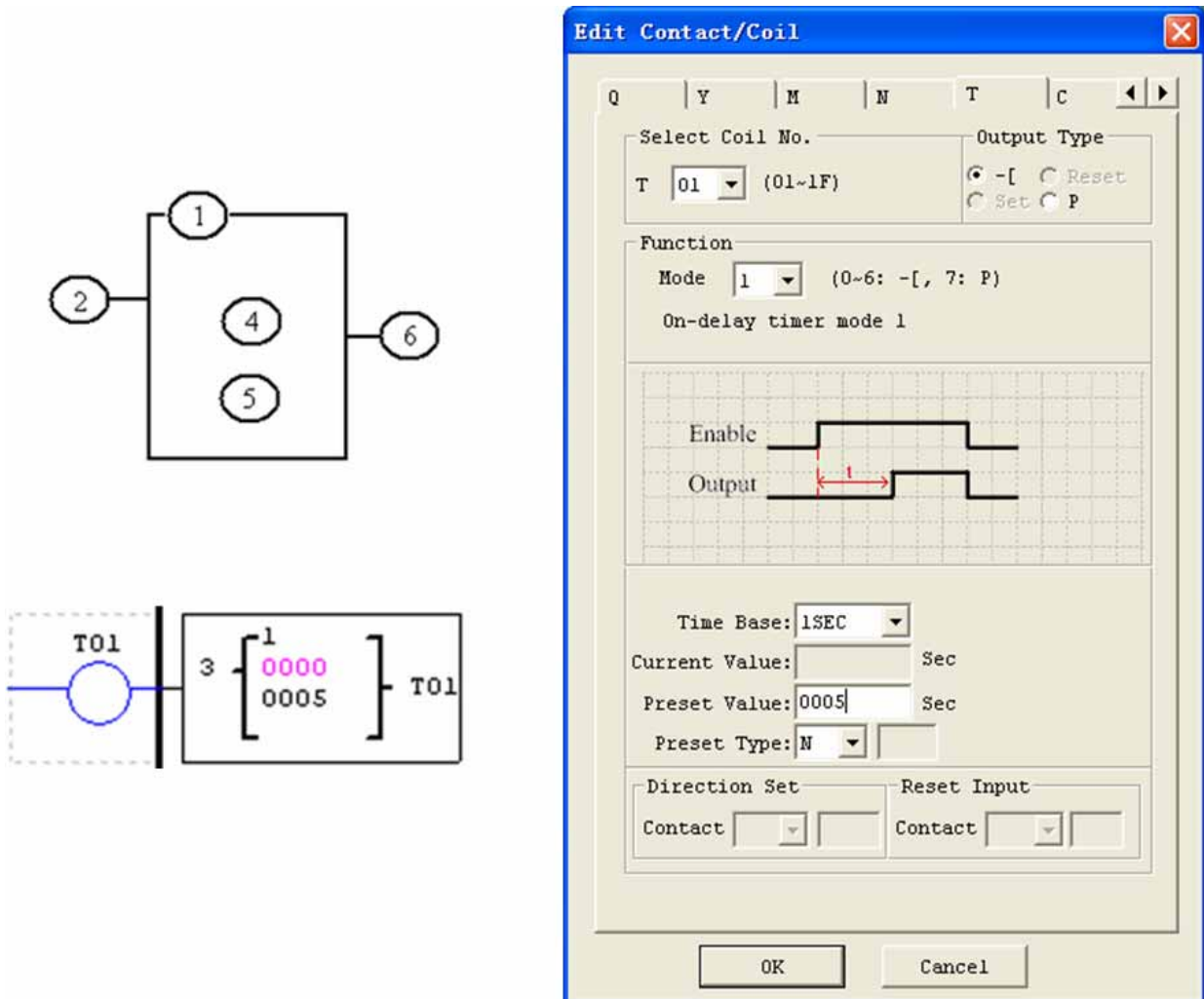
Mode 0 Timer (Internal Coil) used as internal auxiliary coils. No timer preset value. The status of T coil becomes with enable coil as shown below.



- ✘ I01 is enable coil.

Timer Mode 1 (ON-Delay)

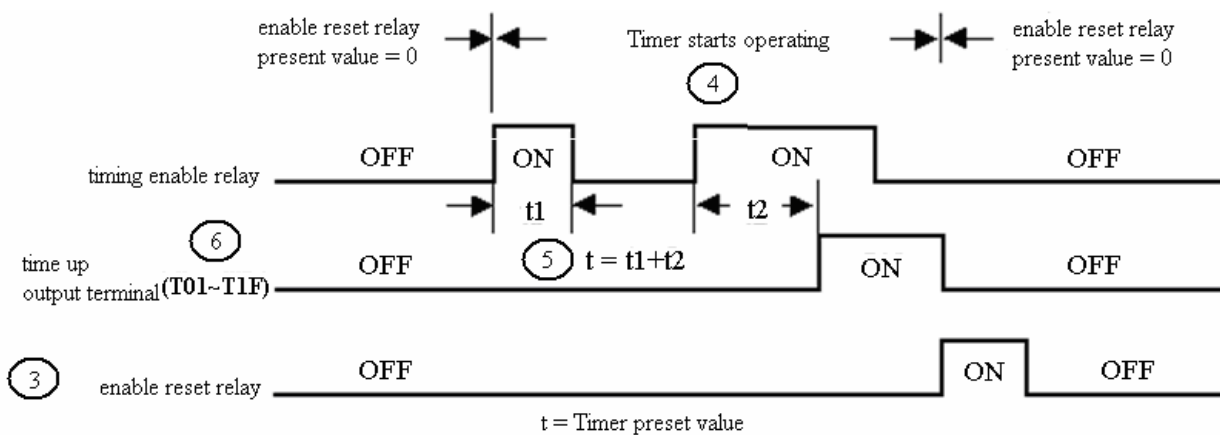
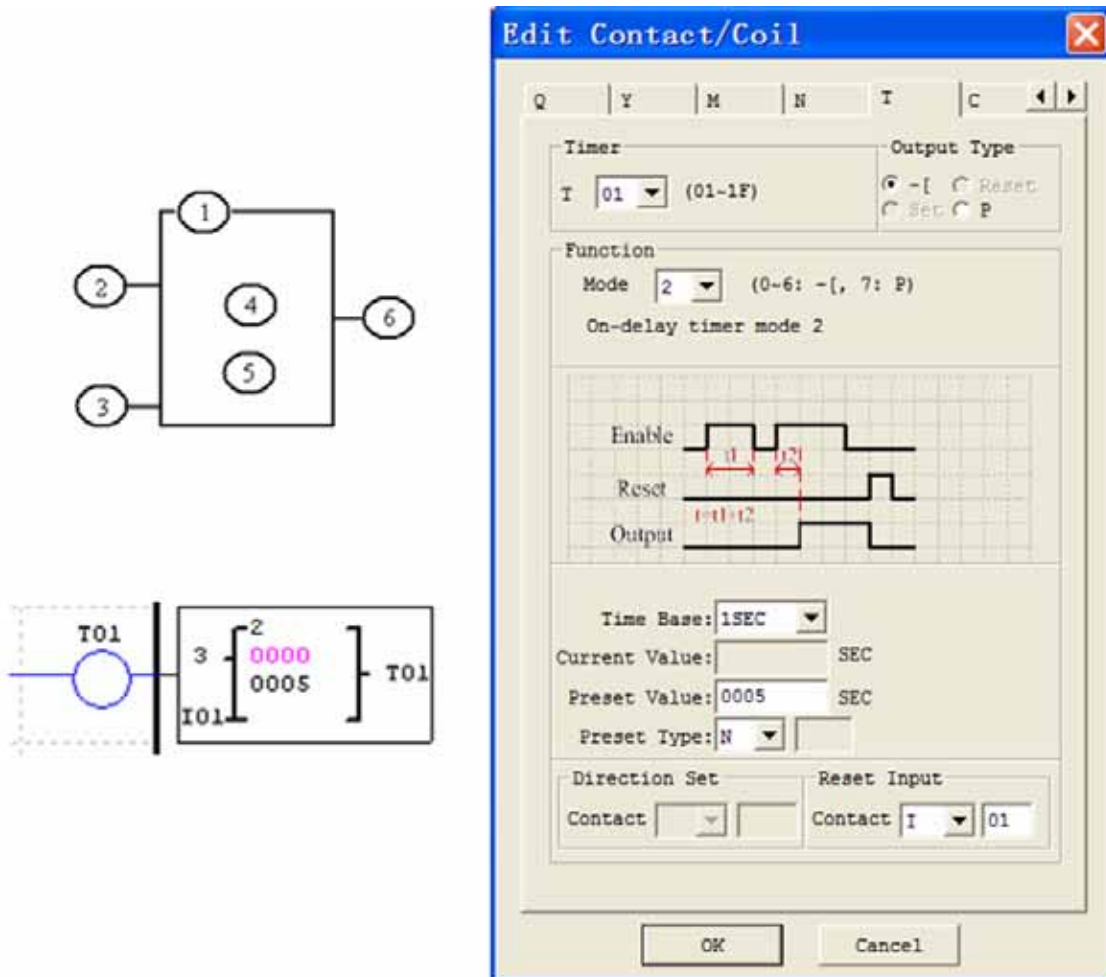
Mode 1 Timer (ON-Delay) will time up to a fixed value and stop timing when the current time is equal to the preset value. Additionally, the Timer current value will reset to zero when Timer is disabled. In the example below, the timer will stop timing when it reaches the preset value of 5 seconds. Timer status bit T01 will be ON when the current value is 5.



※ T0E and T0F keep their current value after a loss of power to the smart relay if “M Keep” is active, but the others’ reset to 0.

Timer Mode 2 (ON-Delay with Reset)

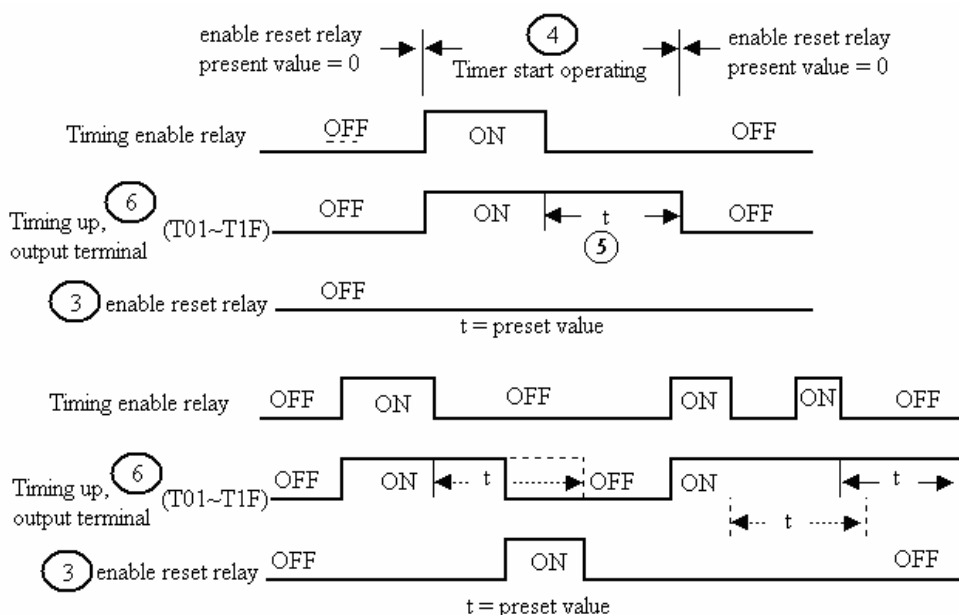
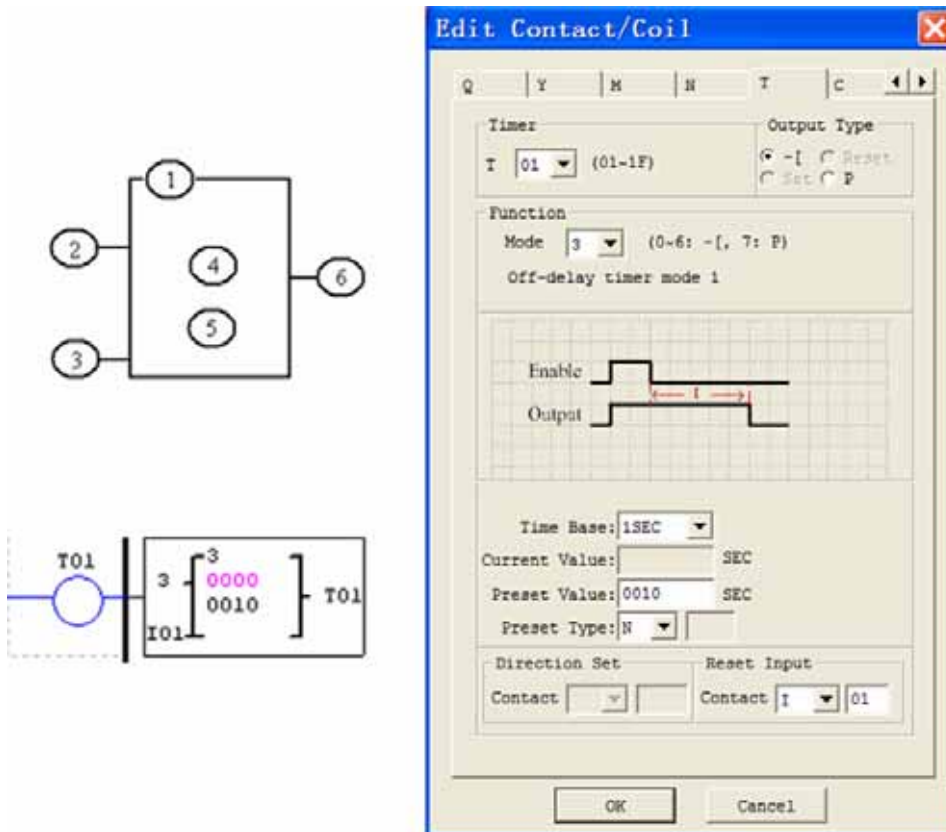
Mode 2 Timer is an ON-Delay with reset that will time up to a fixed preset value and stop timing when the current time is equal to the preset value. Additionally, the Timer current value will be kept when Timer is disabled. In the example below, the Timer will stop timing when it reaches its preset value of 5 seconds. Timer status bit T01 will be ON when the current value is 5. The timer reset input is input I01. The timer current value will reset to 0, and Timer status bit T01 will turn off when I01 is ON.



※ T0E and T0F keep their current value after a loss of power to the smart relay if “M Keep” is active, but the others’ reset to 0.

Timer Mode 3 (OFF-Delay)

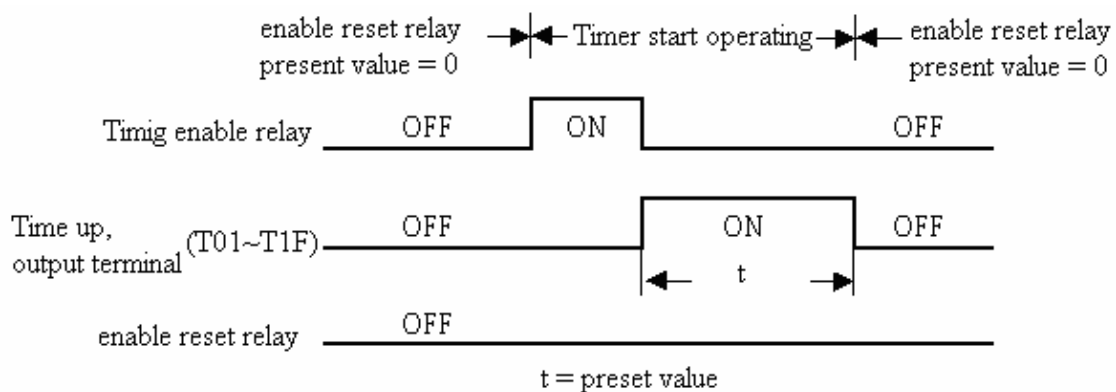
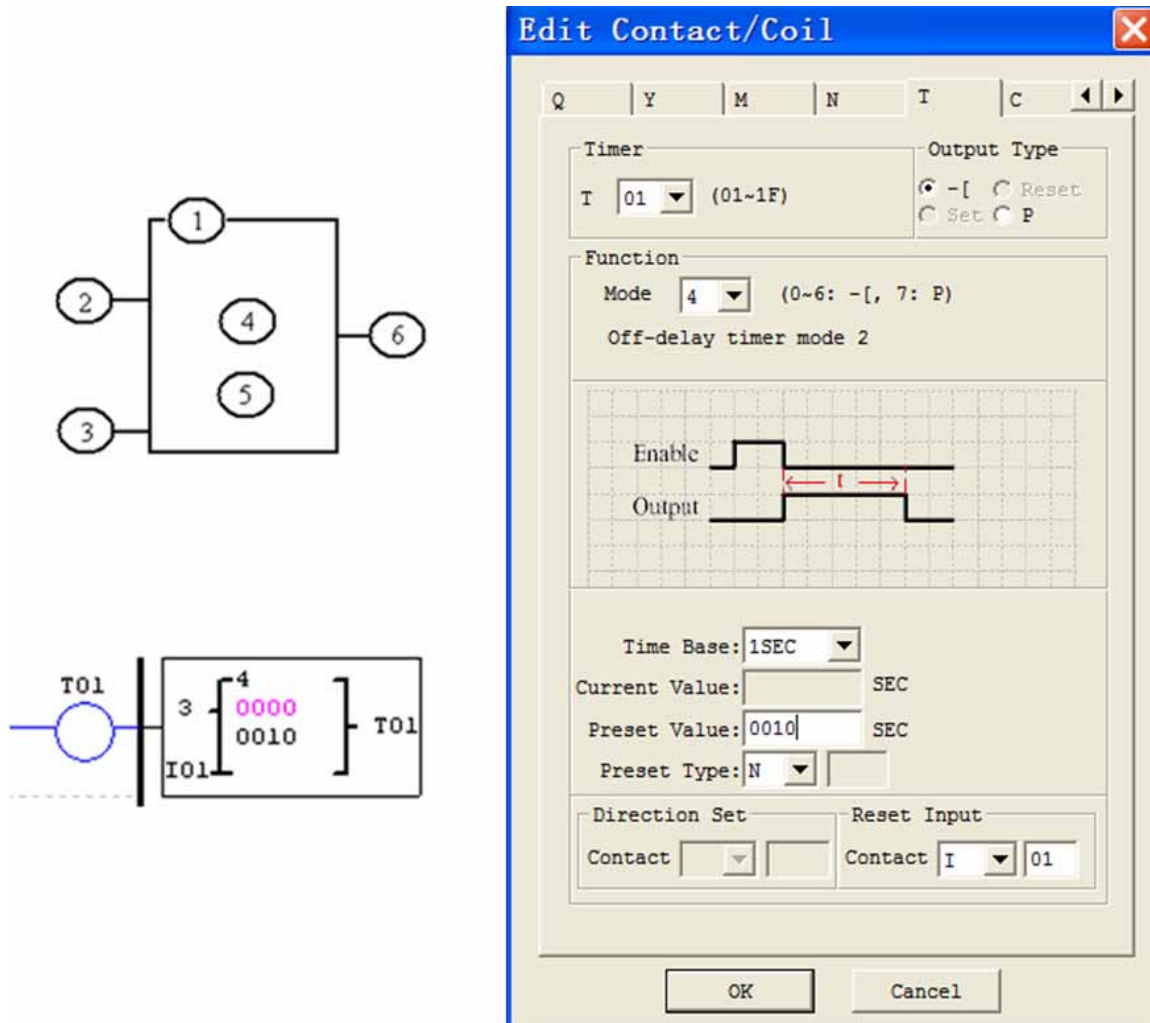
Mode 3 Timer is an OFF-Delay with reset that will time up to a fixed preset value and stop timing when the current time is equal to the preset value. Additionally, the Timer current value will reset to zero when Timer is disabled. In the example below, the timer reset input is Input I01. Timer status bit T01 will be ON immediately when its rung is true. The timer will only begin timing up when its rung changes to false. Timer status bit T01 will turn OFF when the current time value reaches its preset value of 10 seconds.



※ T0E and T0F keep their current value after a loss of power to the smart relay if “M Keep” is active, but the others’ reset to 0.

Timer Mode 4 (OFF-Delay)

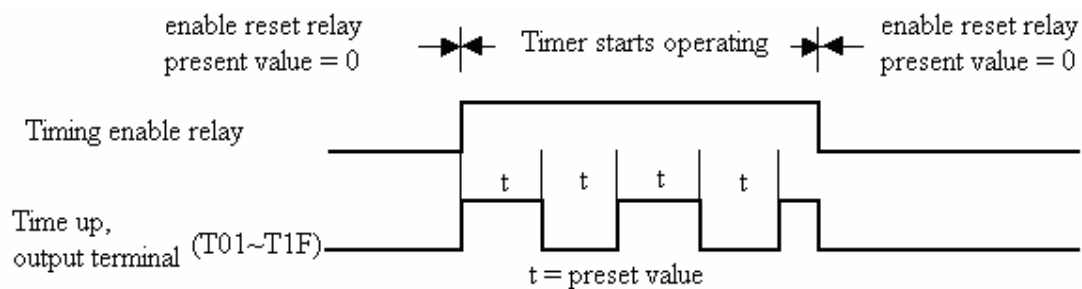
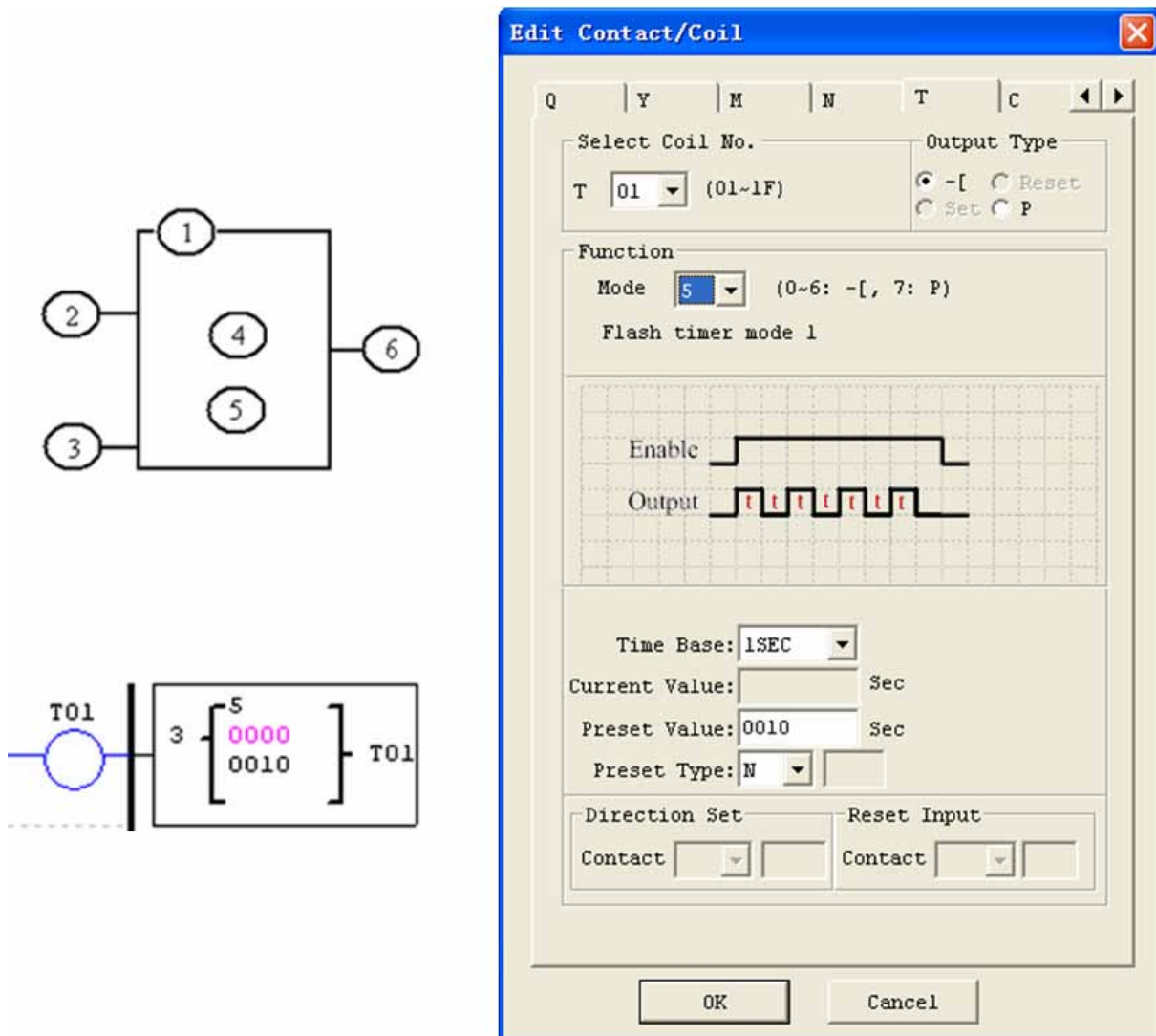
Mode 4 Timer is an OFF-Delay with reset that will time up to a fixed preset value and stop timing when the current time is equal to the preset value. Additionally, the Timer current value will reset to zero when Timer is disabled. In the example below, the timer reset input is Input I01. The timer status bit T01 will turn ON only after its rung transitions from true to false. Timer status bit T01 will turn OFF when the current time value reaches its preset value of 10 seconds.



※ T0E and T0F keep their current value after a loss of power to the smart relay if “M Keep” is active, but the others’ reset to 0.

Timer Mode 5 (FLASH without reset)

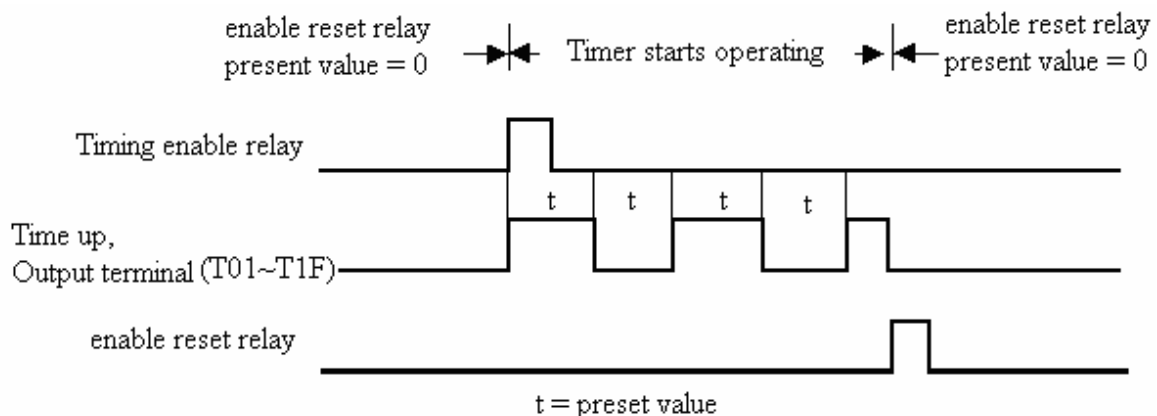
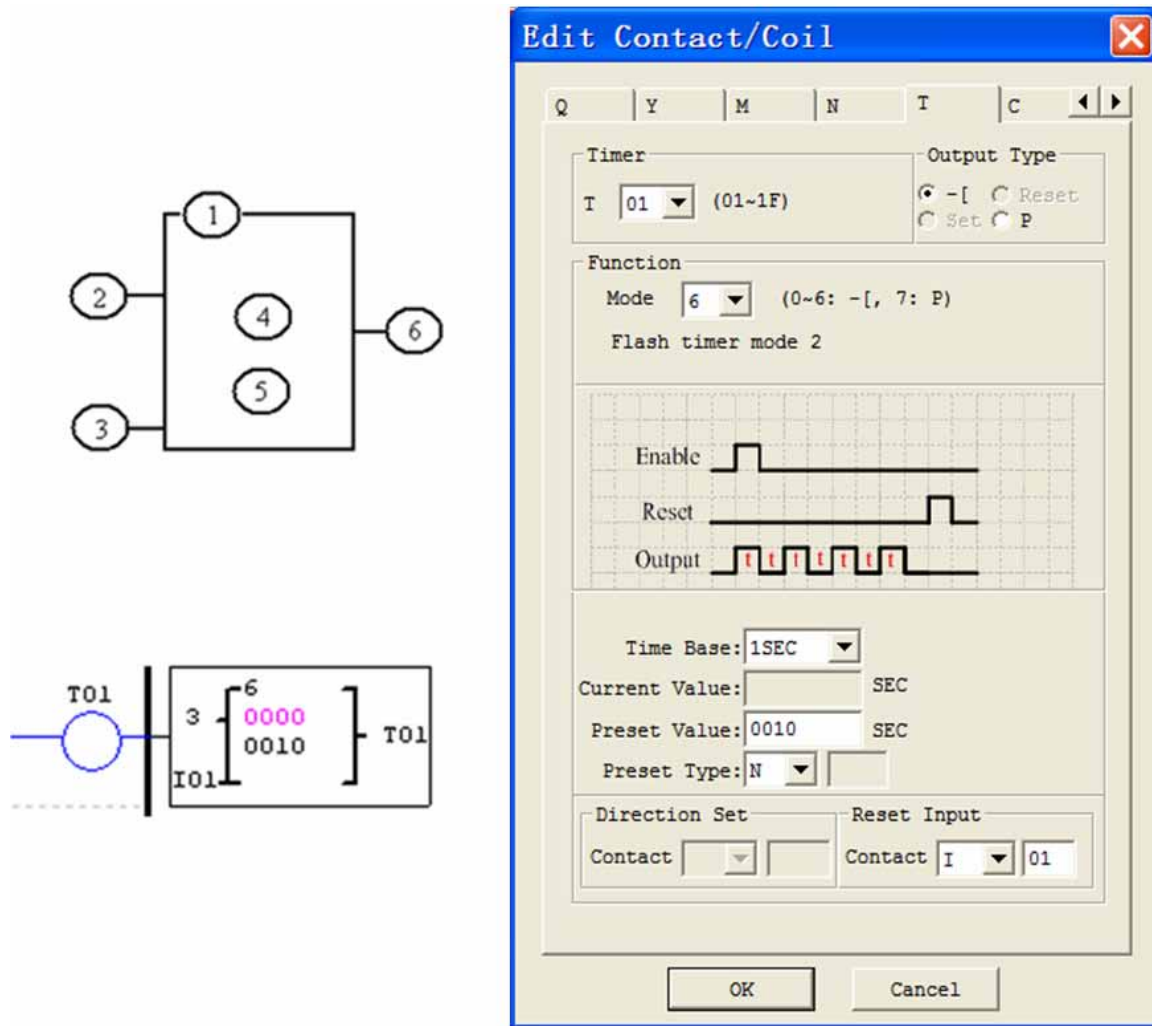
Mode 5 Timer is a Flash timer without reset that will time up to a fixed preset value and then change the state of its status bit. Additionally, the Timer current value will reset to zero when Timer is disabled. In the example below, timer status bit T01 will be ON immediately when its rung is true and begin its timing sequence. Timer status bit T01 will turn OFF when the current time value reaches its preset of 10 seconds. This Flash sequence of the Timer status bit T01 will continue as long as its rung remains true.



※ The current value of Timer can not be kept on a loss of power to smart.

Timer Mode 6 (FLASH with Reset)

Mode 6 Timer is a Flash timer with reset that will time up to a fixed preset value and then change the state of its status bit. Additionally, the Timer current value will reset to zero when Timer is disabled. In the example below, the timer reset input is Input I01. Timer status bit T01 will be ON immediately when its rung is true and begin its timing sequence. Timer status bit T01 will turn OFF when the current time value reaches its preset of 10 seconds. This Flash sequence of the timer status bit T01 will continue as long as its rung remains true.

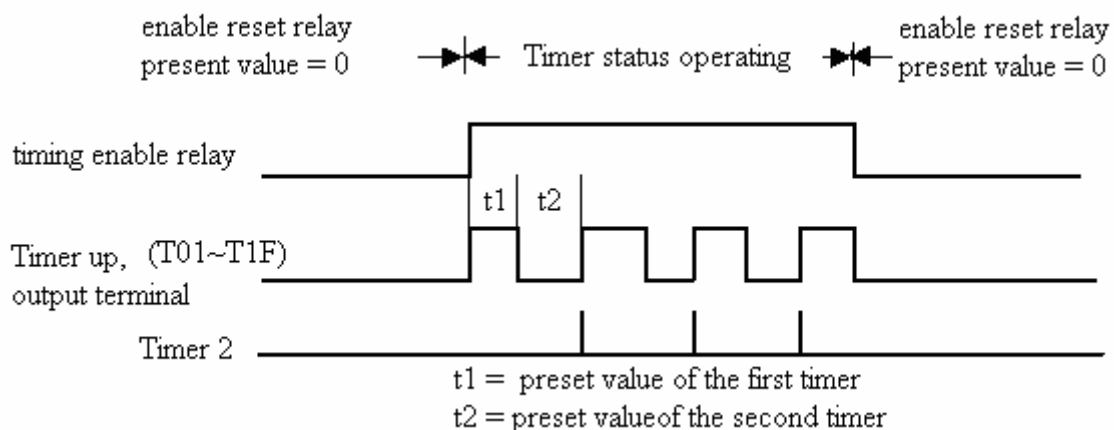
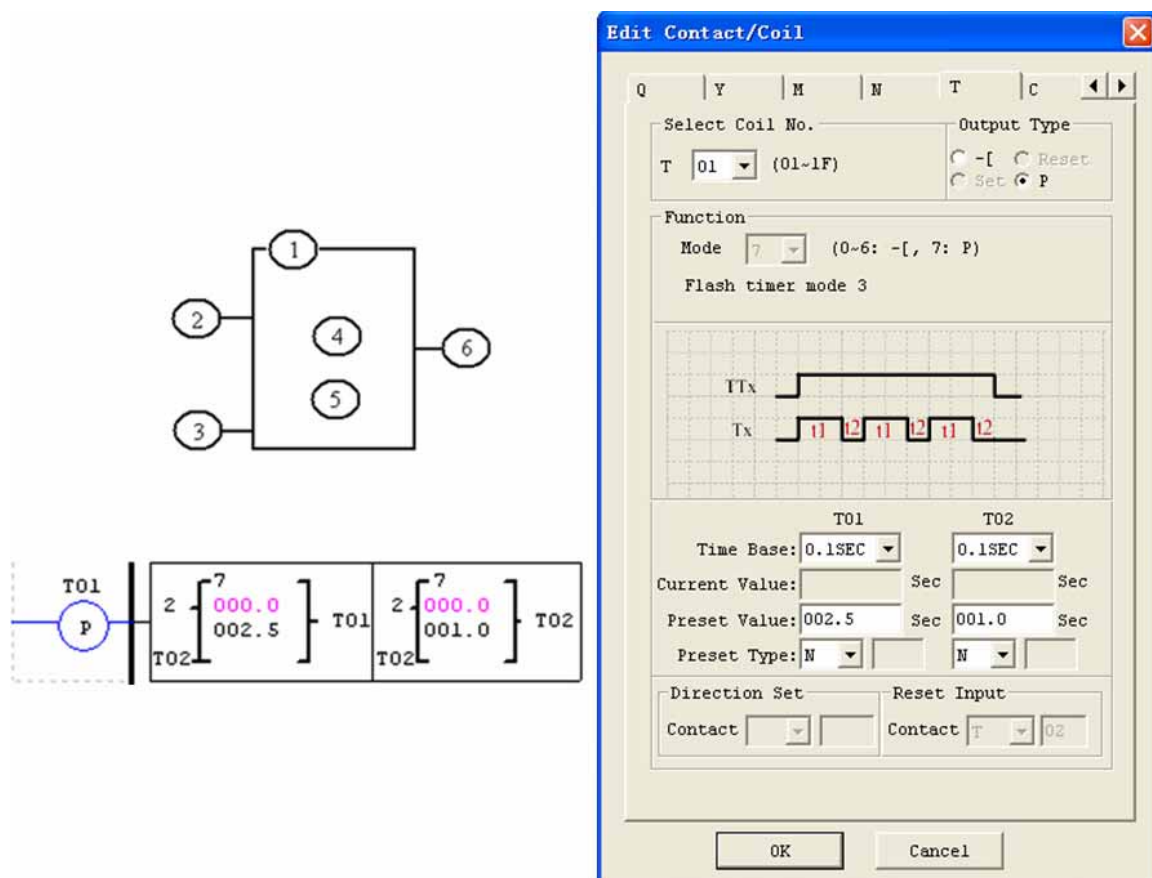


※ The current value of Timer can not be kept on a loss of power to smart.

Timer Mode 7 (FLASH Cascade without Reset)

Mode 7 Timer is a Flash Timer which using two Timers in a cascade configuration without reset. The second Timer number follows the first Timer. The cascade configuration connects the timer status bit of first timer to enable the second timer. The second timer will time up to its preset value then flash and its timer status bit will enable the first timer. Additionally, the Timer current value will reset to zero when Timer is disabled. In the example below, timer status T01 will be ON after it completes its timing sequence of 2.5 seconds. Timer 2 will then begin its timing sequence of 1 second. When the current time value of Timer 2 reaches its preset of 1 second, its status bit T02 will flash and Timer 1 will begin timing again. This type of cascade timer is often used in combination with a counter in applications where it is necessary to count the number of time cycles completed.

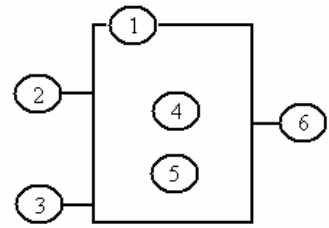
✖ Those two timers of Timer Mode 7 that cannot be double used as Timers for other modes in the same program.



✖ The current value of Timer can not be kept on a loss of power to smart.

Counter Instructions

The SG2 includes a total 31 separate counters that can be used throughout a program. Each counter has a choice of 9 operation modes, 1 for pulse counter, 6 for general purpose counting and 2 for high speed counting. Additionally, each counter has 6 parameters for proper configuration. The tables below describe each configuration parameter and lists each compatible memory type for configuring counters.



Common Counter

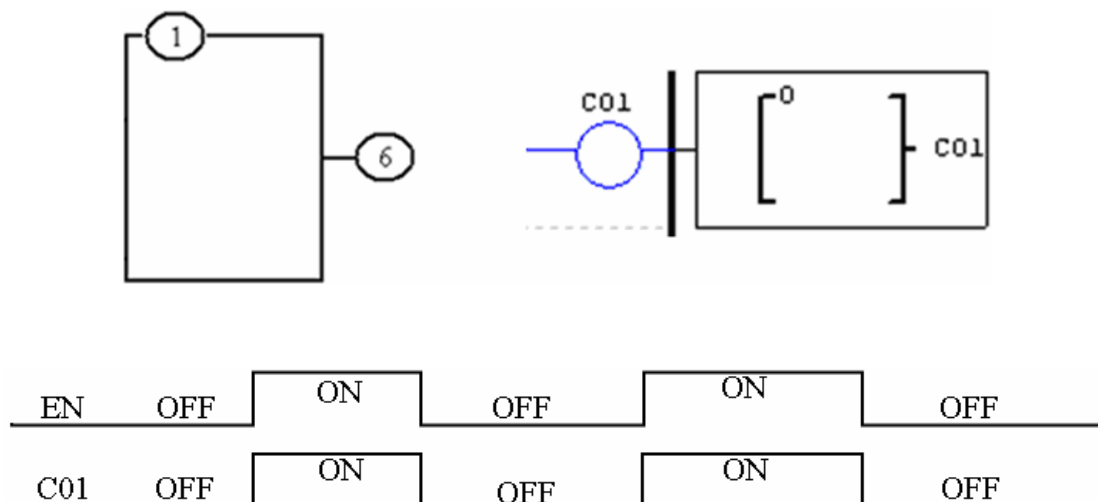
Symbol	description
①	Counting Mode (0-6)
②	Use (I01~g1F) to set counting up or down OFF: counting up (0, 1, 2, 3.....) ON: counting down (.....3, 2, 1, 0)
③	Use (I01~g1F) to reset the counting value ON: the counter value reset to 0 OFF: the counter continues to count
④	Counter current Value, range: 0~999999
⑤	Counter preset Value, range: 0~999999
⑥	Counter Code (C01~C1F total: 31 Counters)

Compatible Instructions	Range
Input	I01-I0C/i01-i0C
Keypad input	Z01-Z04/z01-z04
Output	Q01-Q08/q01-q08
Auxiliary coil	M01-M3F/m01-m3F
Auxiliary coil	N01-N3F/n01-n3F
Expansion input	X01-X0C/x01-x0C
Expansion output	Y01-Y0C/y01-y0C
RTC	R01-R1F/r01-r1F
Counter	C01-C1F/c01-c1F
Timer	T01-T1F/t01-t1F
Analog comparator	G01-F1F/g01-g1F
Normal open contact	Lo

※ The preset value of Counter could be a constant or other function current value.

Counter Mode 0 (Internal coil)

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



Counter Mode 1 (Fixed Count, Non-Retentive)

Mode 1 Counter will count up to a fixed preset value and stop counting when the current count is equal to the preset value, or count down to 0 and stop counting when the current count is equal to 0. Additionally, the current count value is non-retentive and will reset to init value on a powering up to the smart relay. In the example below, the counter will stop counting when it reaches the preset value of 20. Counter status bit C01 will be ON when the current value is 20.

The diagram illustrates the configuration and operation of Counter Mode 1. On the left, a ladder logic diagram shows a counter coil (C01) connected to a reset coil (R01) and a set coil (S01). The counter is configured to count up to a preset value of 20. The timing diagram shows the counter's behavior over time. The counter value starts at 0 and increases to 20. The counter status bit C01 is ON when the counter value is 20. The timing diagram also shows the input count pulse and the output status of the counter (C01, R01, S01).

Edit Contact/Coil

Y M N T C R

Counter
C 01 (01~1F)

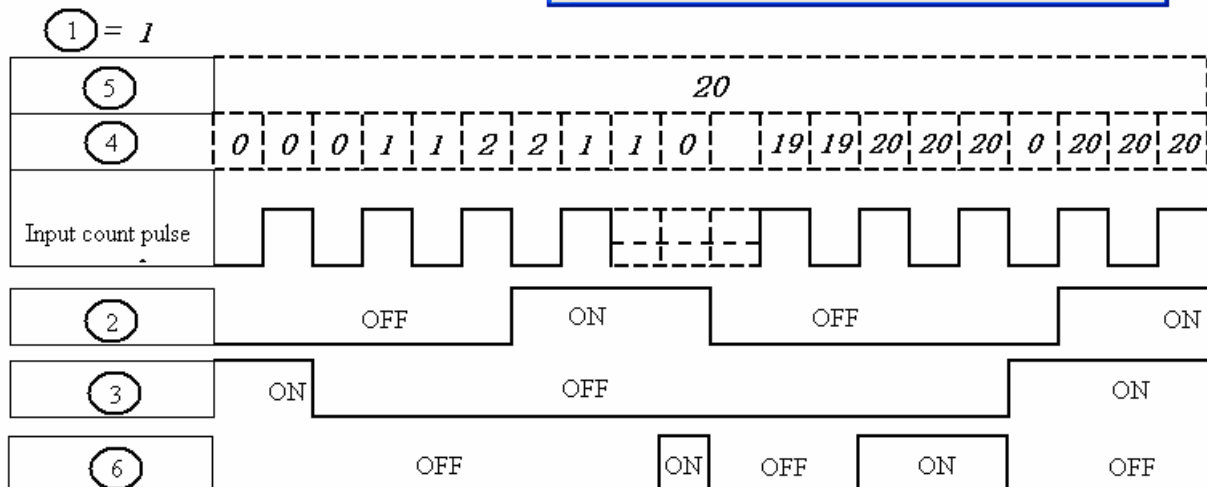
Function
Mode 0 (0~8)
Counter without overtaking and without power down retain current value

Pre val=20
Cur val 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

Current Value: 000000
Preset Value: 000020
Preset Type: N

Direction Set
Contact M 01
Reset Input
Contact I 02

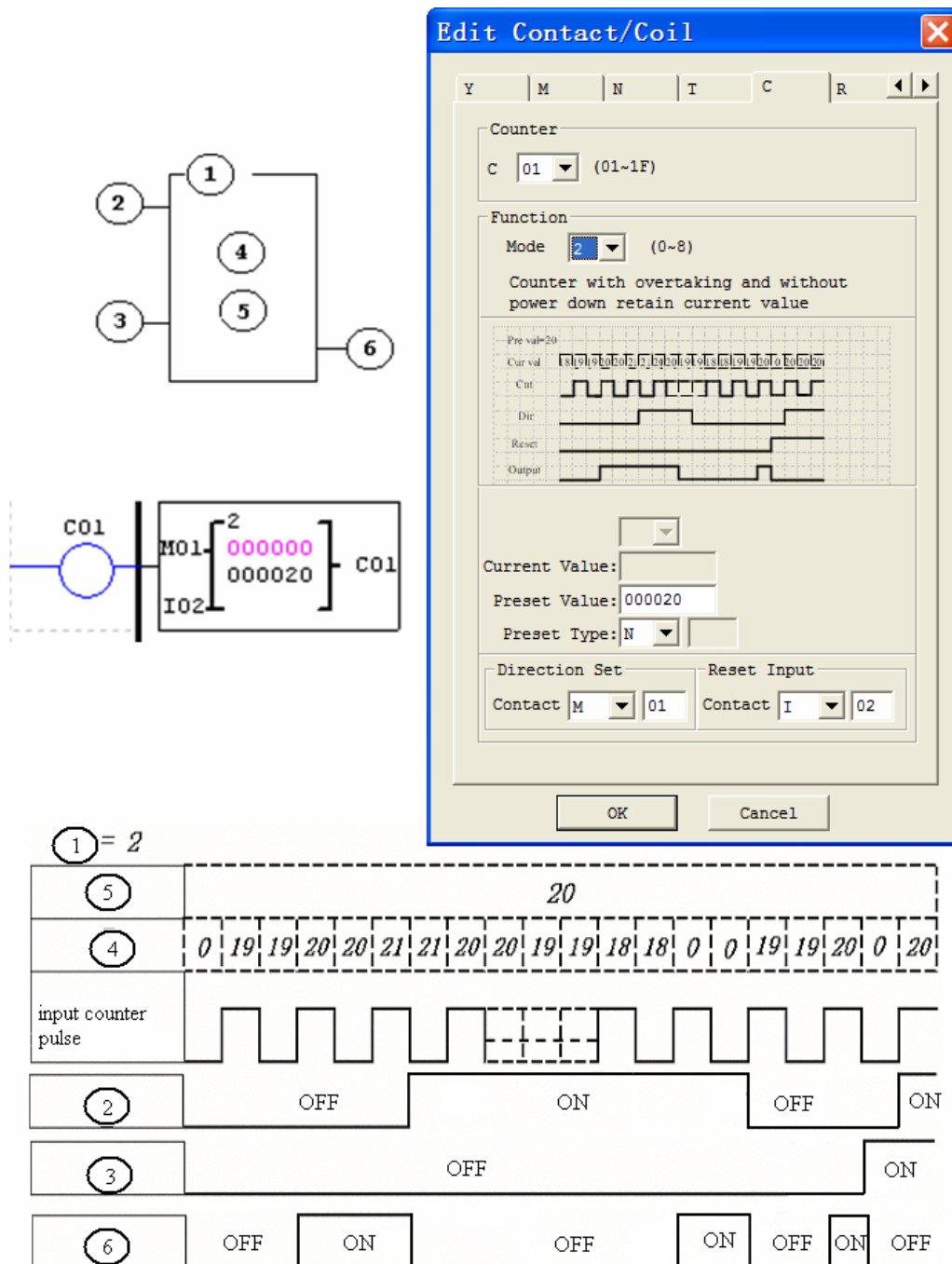
OK Cancel



※ Under this mode, the counter current value will be init value when the smart is power up or switching between RUN and STOP. The init value is 0 if the counter configured as counting up, else, it is preset value.

Counter Mode 2 (Continuous Count, Non-Retentive)

Mode 2 Counter will count up to a fixed preset value and continue counting after the preset value, but it won't count when the current value equals 0 if it's configured as down Counter. Additionally, the current count value is non-retentive and will reset to init value on a powering up to the smart relay or switching between RUN and STOP. In the example below, the counter will continue counting after its preset value of 20. Counter status bit C01 will be ON when the current value is 20.

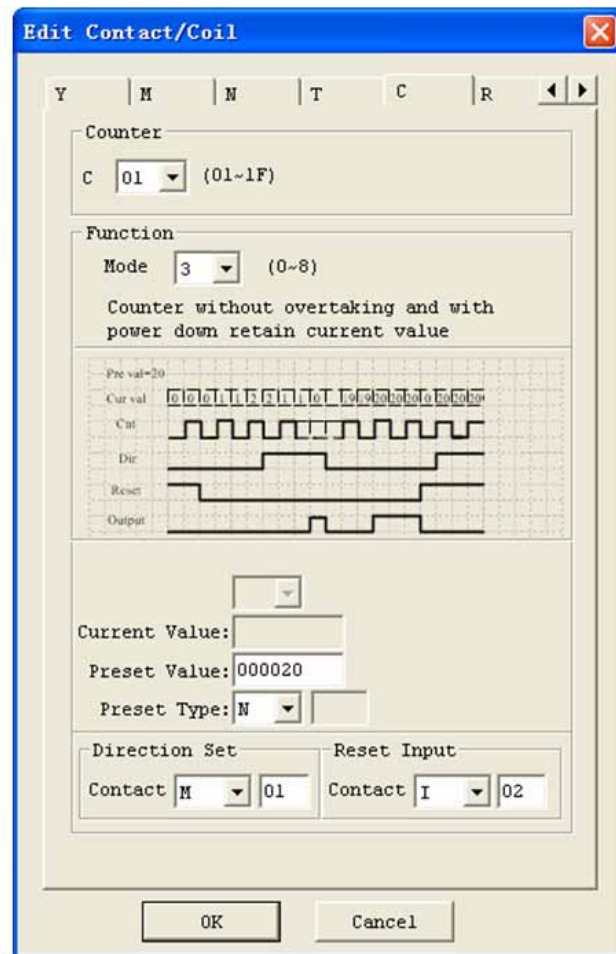
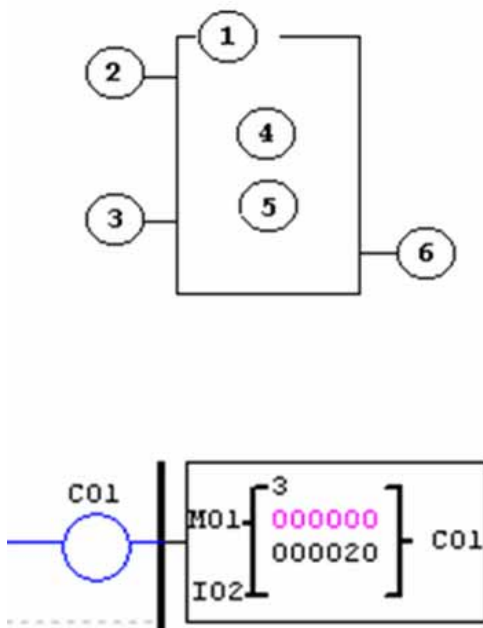


✘ Under this mode, Counter will continue counting after reaching preset value if it's configured as counter up. But it stops counting when its current value is 0 if it's configured as counter down.

✘ The counter current value will be init value when the smart's status switches between RUN and STOP or the smart is power up. If the counter configured as counting up, the init value is 0, else, it is preset value.

Counter Mode 3 (Fixed Count, Retentive)

Mode 3 Counter operation is similar to Mode 1 except its current count value is retentive when Counter powers down. So, the current value won't be init value when Counter powers up, but be the value when it powering down. Mode 3 Counter will count up to a fixed preset value and stop counting at that value, or stop counting when its current value is 0 if it's configured as down counter. Additionally, the current count value is retentive when the smart switches between RUN and STOP if "C Keep" is active. In the example below, the counter will stop counting when it reaches the preset value of 20. Counter status bit C01 will be ON when the current value is 20.

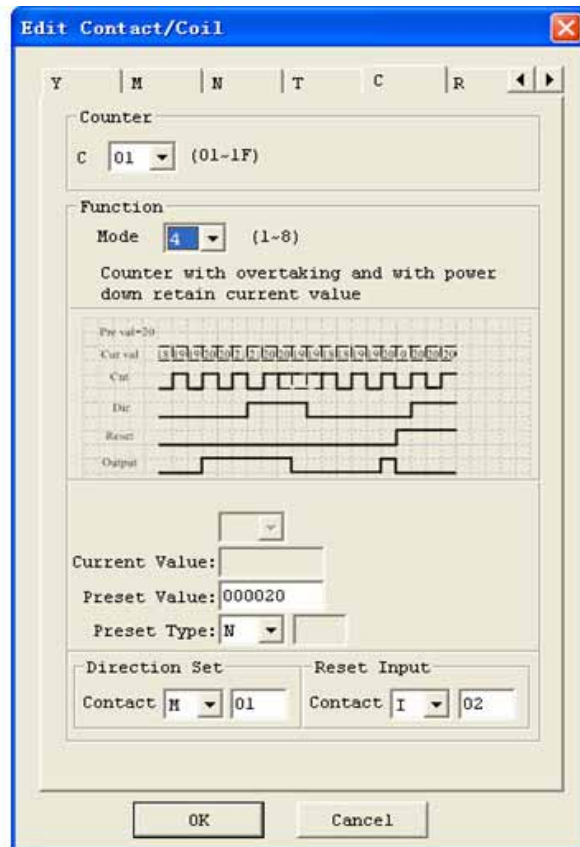
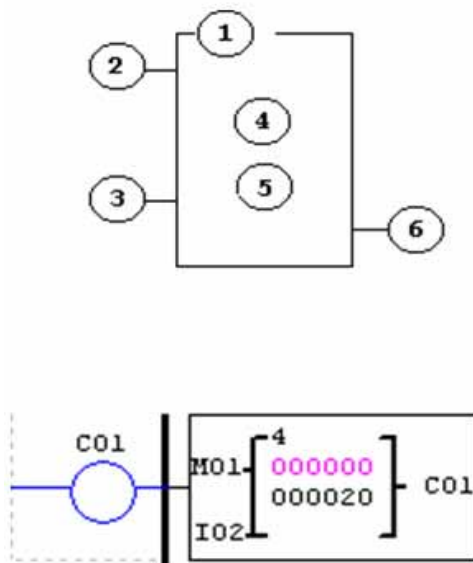


This mode is similar to mode 1, but:

- ✘ The current counter value will keep on a loss of power when the smart status is RUN;
- ✘ The current counter value will keep when the smart switches between RUN and STOP if C-keep is active.

Counter Mode 4 (Continuous Count, Retentive)

Mode 4 Counter operation is similar to Mode 2 except its current count value is retentive. The current count value is retentive and will keep its current count after a loss of power to the smart relay. Mode 4 Counter will count up to a fixed preset value and then continue counting after the preset value, but it won't count when the current value equals 0 if it's configured as down Counter. Additionally, the current count value is retentive when the smart switches between RUN and STOP if "C Keep" is active. In the example below, the counter will continue counting after its preset value of 20. Counter status bit C01 will be ON when the current value isn't less than 20.



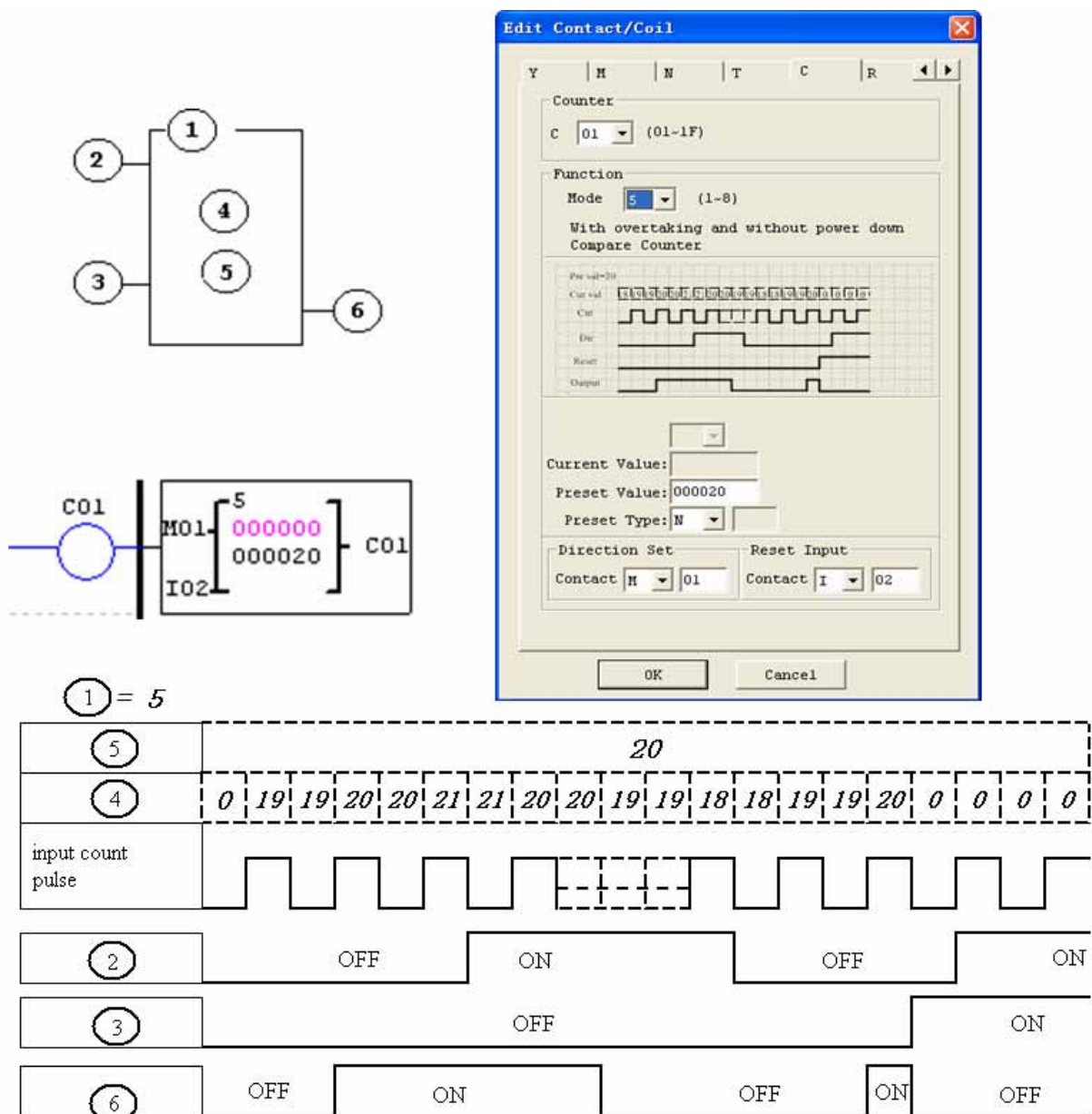
This mode is similar to mode 2, but:

- ✘ The current counter value will be kept on a loss of power when the smart status is RUN;
- ✘ The current counter value will be kept when the smart switches between RUN and STOP if "C-keep" is active.

Counter Mode 5 (Continuous Count, Up-Down Count, Non-Retentive)

Mode 5 Counter's operation is similar to Mode 2 except its current count value is continuous and non-retentive. The status bit is fixed to the non-zero preset value regardless of the state of the direction bit. Its status bit will be ON when the counter current value isn't less than its preset value, and will be OFF when the current value is less than its preset value.

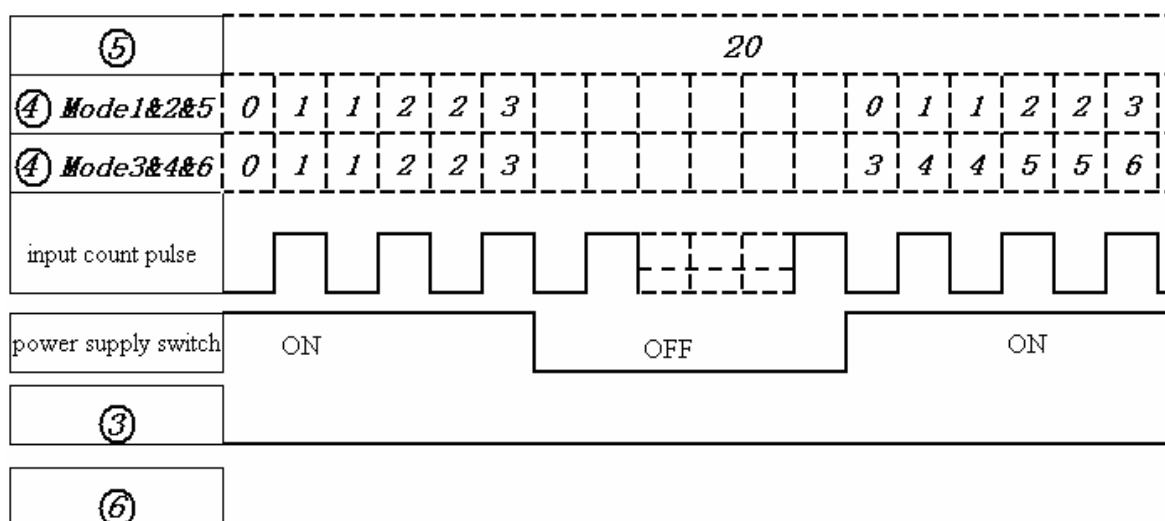
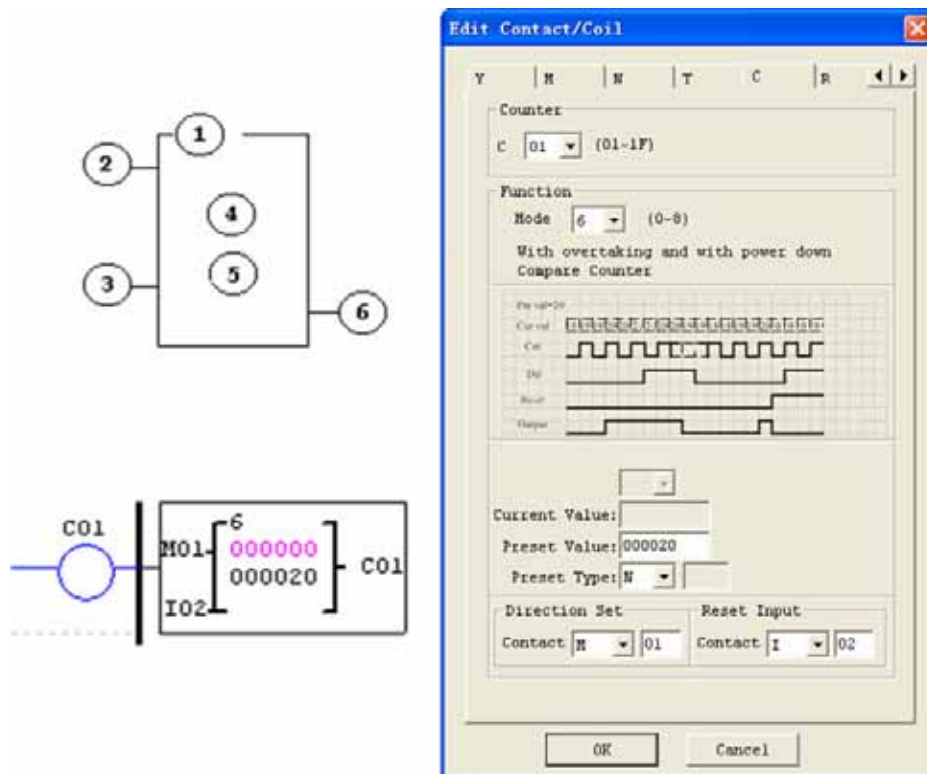
The Mode 5 Counter will count up to a fixed preset value and continue counting after the preset value. Additionally, the current count value is non-retentive and will reset to 0 on a loss of power to the smart relay. Additionally, the Mode 5 counter is always reset to zero, and the current value also is always 0 when the smart switches between RUN and STOP unrelated to the state of its direction bit. In the example below, the counter will continue counting after its preset value of 20. Counter status bit C01 will be ON when the current value is 20.



- ✖ Under this mode, the count will continuous after reaching its preset value;
- ✖ The current value is always 0 regardless of the state of its direction bit when the reset is availability;
- ✖ The current value is always 0 regardless of the state of its direction bit when the smart switches between RUN and STOP.

Counter Mode 6 (Continuous Count, Up-Down Count, Retentive)

Mode 6 Counter's operation is similar to Mode 4 except its current count value is continuous and retentive. The status bit is fixed to the non-zero preset value regardless of the state of the direction bit. Its status bit will be ON when the counter current value isn't less than its preset value, and will be OFF when the current value is less than its preset value. Additionally, the Mode 6 counter is always reset to zero, unrelated to the state of its direction bit. The current count value is retentive and will keep its current count after a loss of power to the smart relay. And Counter will keep current value if "C Keep" is active. In the example below, the counter will continue counting after its preset value of 20. Counter status bit C01 will be ON when the current value isn't less than 20.



This mode is similar to mode 5, but:

- ✖ The current value is kept on a loss of power down to the smart when it status is RUN;
- ✖ The current value is kept when the smart switches between RUN and STOP if "C Keep" is active.

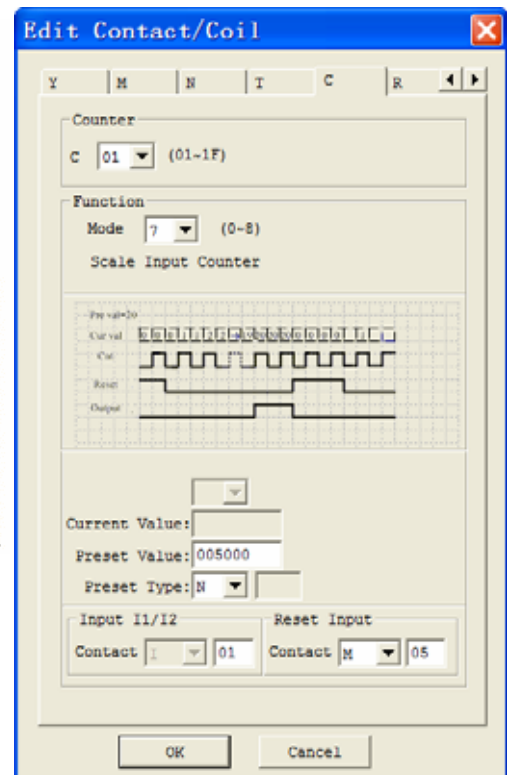
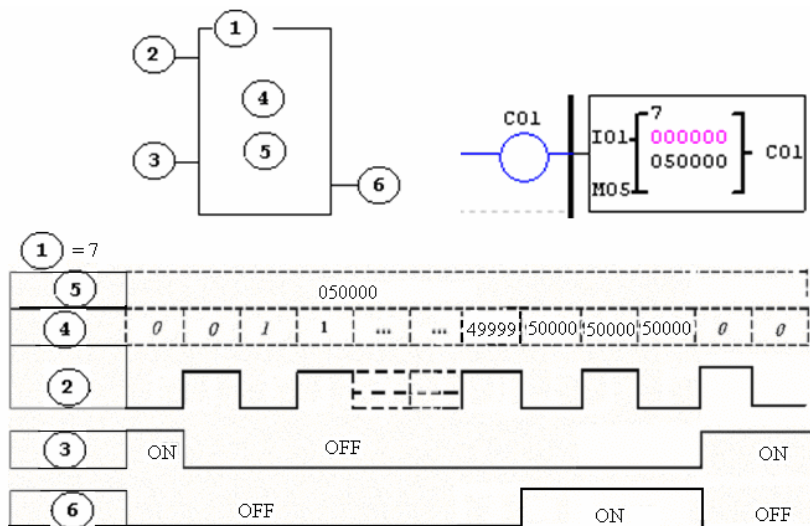
High Speed Counters (DC Version Only)

The DC powered version smart relays include two 1 KHz high speed inputs on terminal I01 and I02. These can be used as general purpose DC inputs or can be wired to a high speed input device (encoder, etc.) when configured for high speed counting.

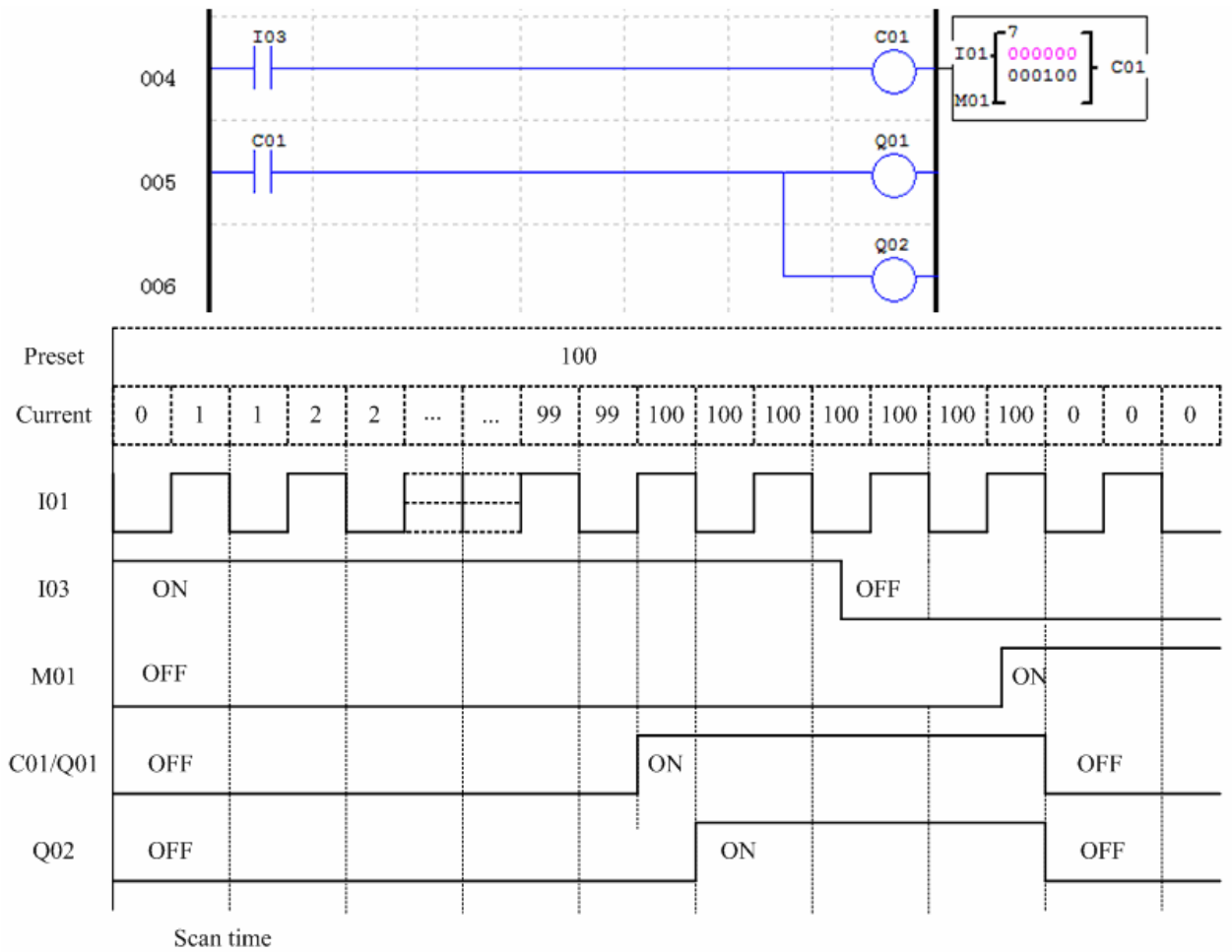
High Speed Counter Mode 7 (DC powered versions only)

The Mode 7 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. The selected Counter Coil (C01-C1F) will turn ON when the pulse count reaches preset value and remain ON. The counter will reset when the Reset Input is active. In the example below shows the relationship among the numbered block diagram for a Mode 7 Counter, the ladder diagram view, and the software Edit Contact/Coil dialog box.

Symbol	Description
①	Counting Mode (7) high speed counting
②	High speed counting input terminal: I01 or I02 only
③	Use (I01~g1F) to Reset the counting value ON: the counter reset to 0 OFF: the counter continues to count
④	Current Count Value, range: 0~999999
⑤	Preset Value, range: 0~999999
⑥	Counter Coil Number (C01~C1F total: 31 counters)



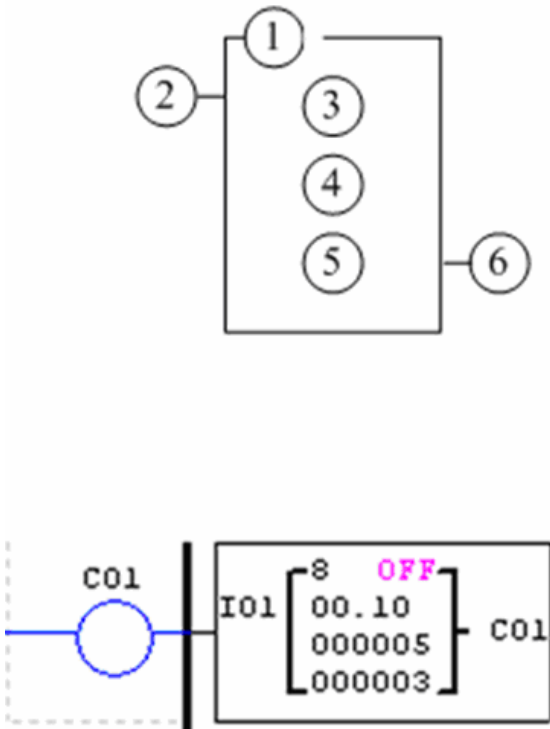
Example : Q01 output ON with C01, and Q02 output ON with scan time.



High Speed Counter Mode 8 (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. The selected Counter Coil (C01-C1F) will turn ON when the pulse count reaches the target “Preset ON” value and remain ON until the pulse count reaches the target “Preset OFF” value. 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	Counting Mode (8) high speed counting
②	High speed counting input terminal: I01 or I02 only
③	Counting interval time: 0~99.99 sec
④	Counter ‘on’ preset Value, range: 0~999999
⑤	Counter ‘off’ preset Value, range: 0~999999
⑥	Counter Coil Number (C01~C1F total: 31 counters)



Edit Contact/Coil

Y M N T C R

Counter
C 01 (01~1F)

Function
Mode 8 (0~8)
1K Hz Input Counter

Fixed time=1s On=4 Off=2

Fixed Time: N -> 01.00 Sec

Current Value:

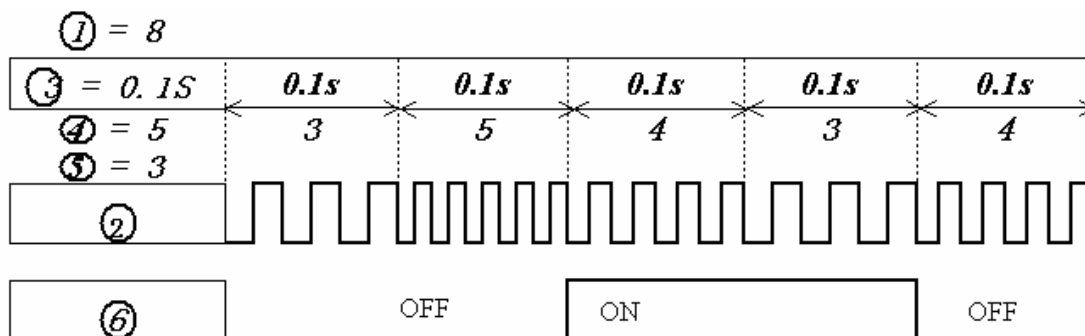
Preset Value: 000005 000003 Off

Preset Type: N N

Input I1/I2 Contact I 01

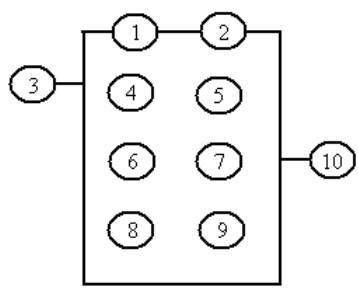
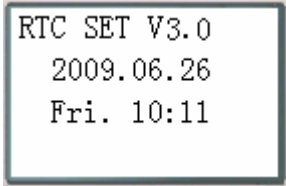
Reset Input Contact

OK Cancel



Real Time Clock (RTC) Instructions

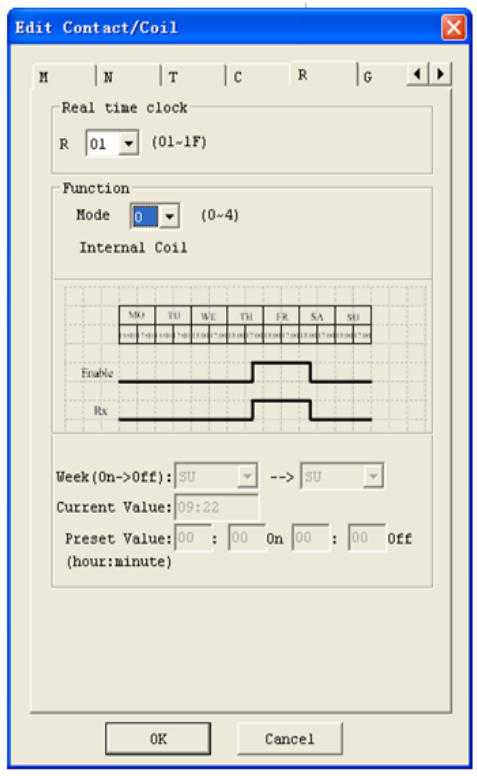
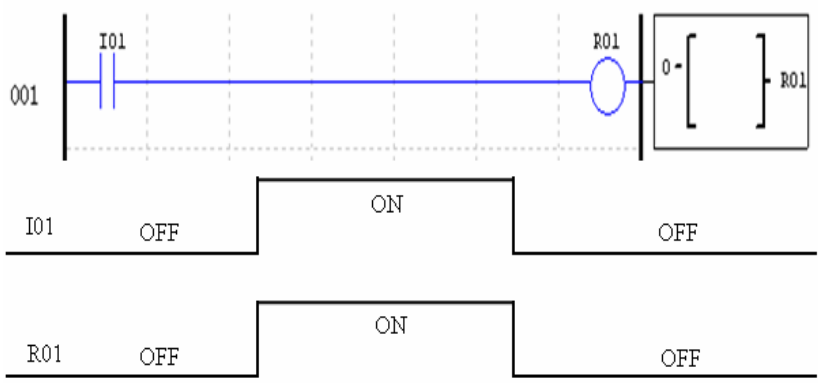
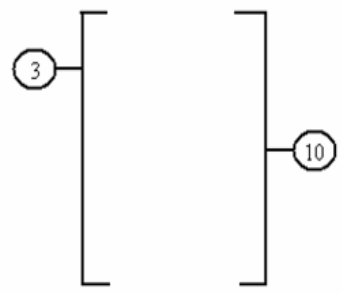
The SG2 smart relay includes a total of 31 separate RTC instructions that can be used throughout a program. Each RTC instruction has a choice of 5 operation modes, and has 10 parameters for proper configuration. The initial clock/calendar setting for each connected SG2 is set using the **Operation»RTC Set** menu selection from the SG2 Client software.



Symbol	Description
①	Input the first week to RTC
②	Input the second week to RTC
③	RTC mode 0~2, 0: internal coil 1:daily, 2:consecutive days
④	RTC displays the hour of present time.
⑤	RTC displays the minute of present time
⑥	Set RTC hour ON
⑦	Set RTC Minute ON
⑧	Set RTC Hour OFF
⑨	Set RTC Minute OFF
⑩	RTC Coil Number (R01~R1F Total: 31 RTC)

RTC Mode 0 (Internal Coil)

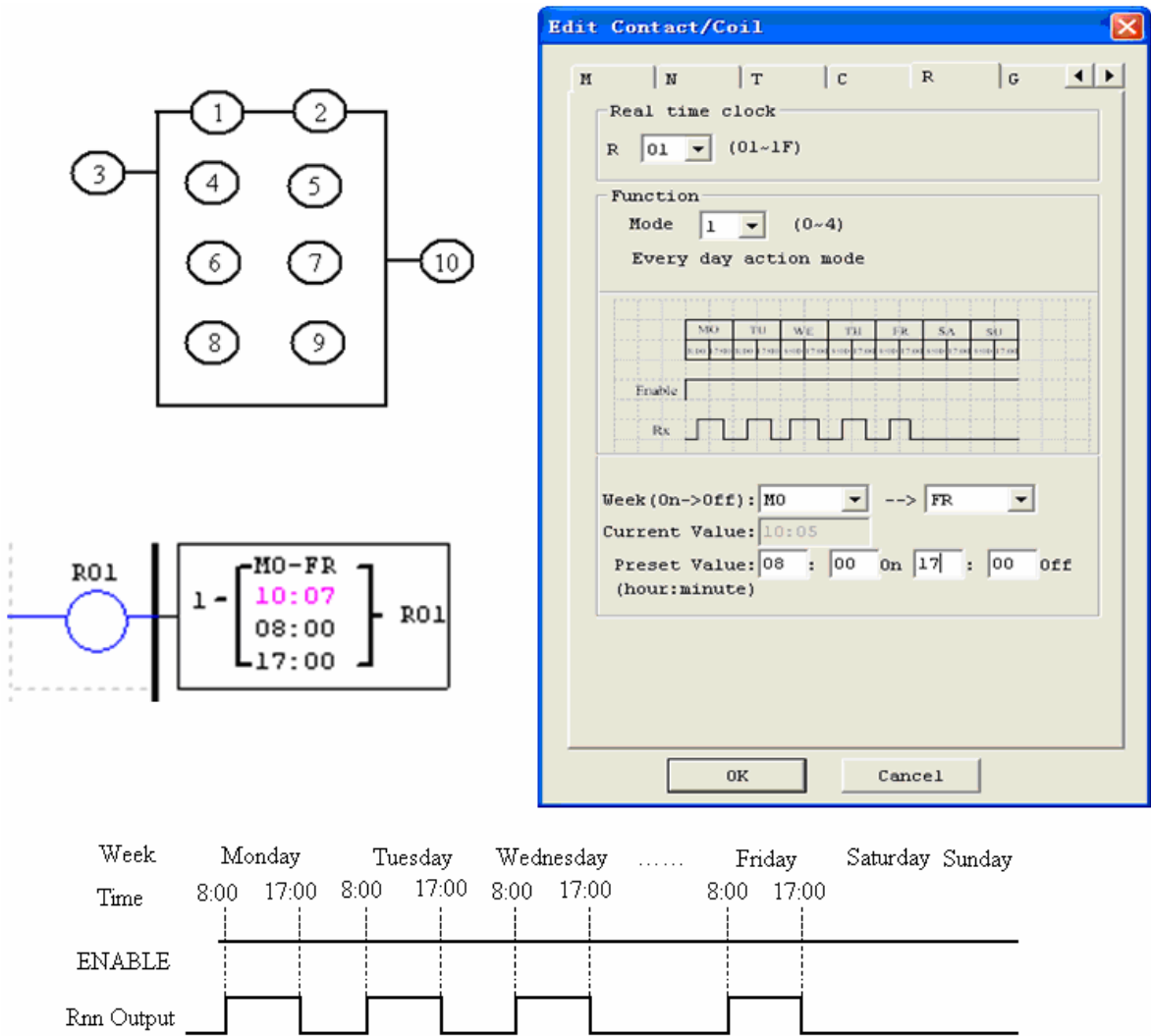
Mode 0 RTC (Internal Coil) used as internal auxiliary coils. No preset value. In the example below shows the relationship among the numbered block diagram for a Mode 0 RTC, the ladder diagram view, and the software Edit Contact/Coil dialog box.



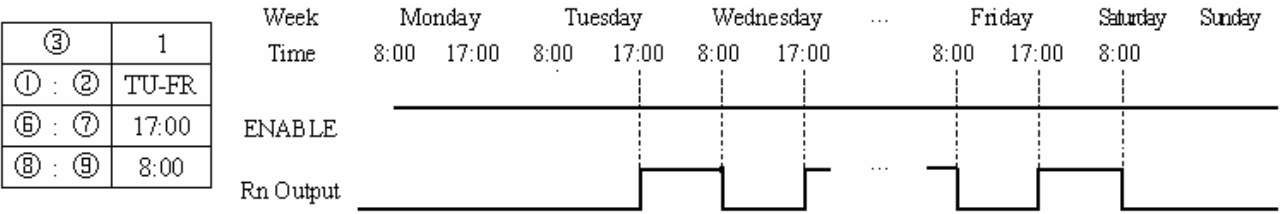
RTC Mode 1 (Daily)

The Daily Mode 1 allows the Rxx coil to active based on a fixed time across a defined set of days per week. The configuration dialog below (example 1) allows for selection of the number of days per week (i.e. Mon-Fri) and the Day and Time for the Rxx coil to activate ON, and the Day and Time for the Rxx coil to deactivate OFF.

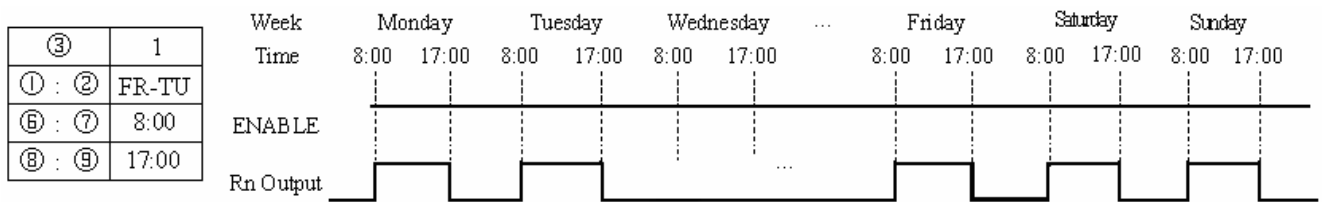
Example 1:



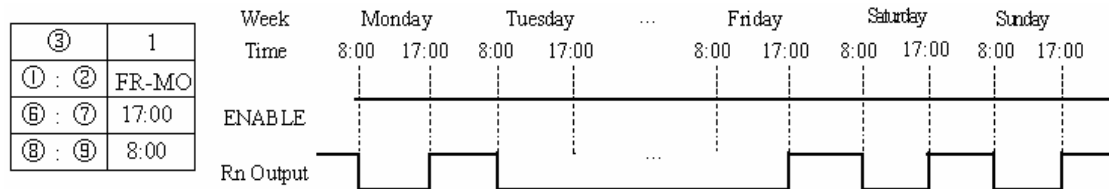
Example 2:



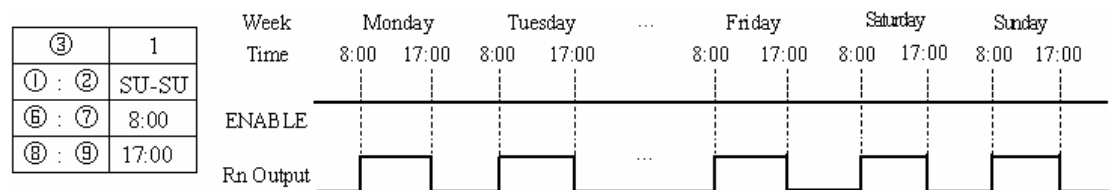
Example 3:



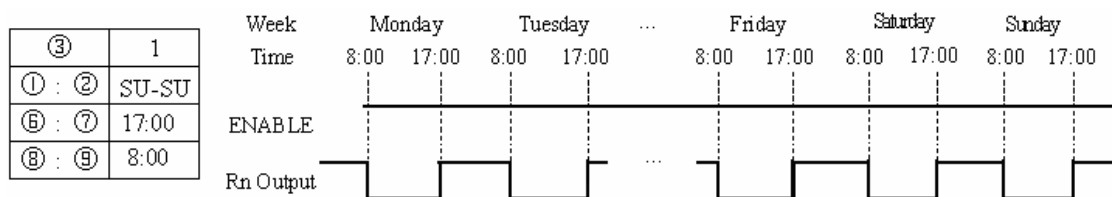
Example 4:



Example 5:



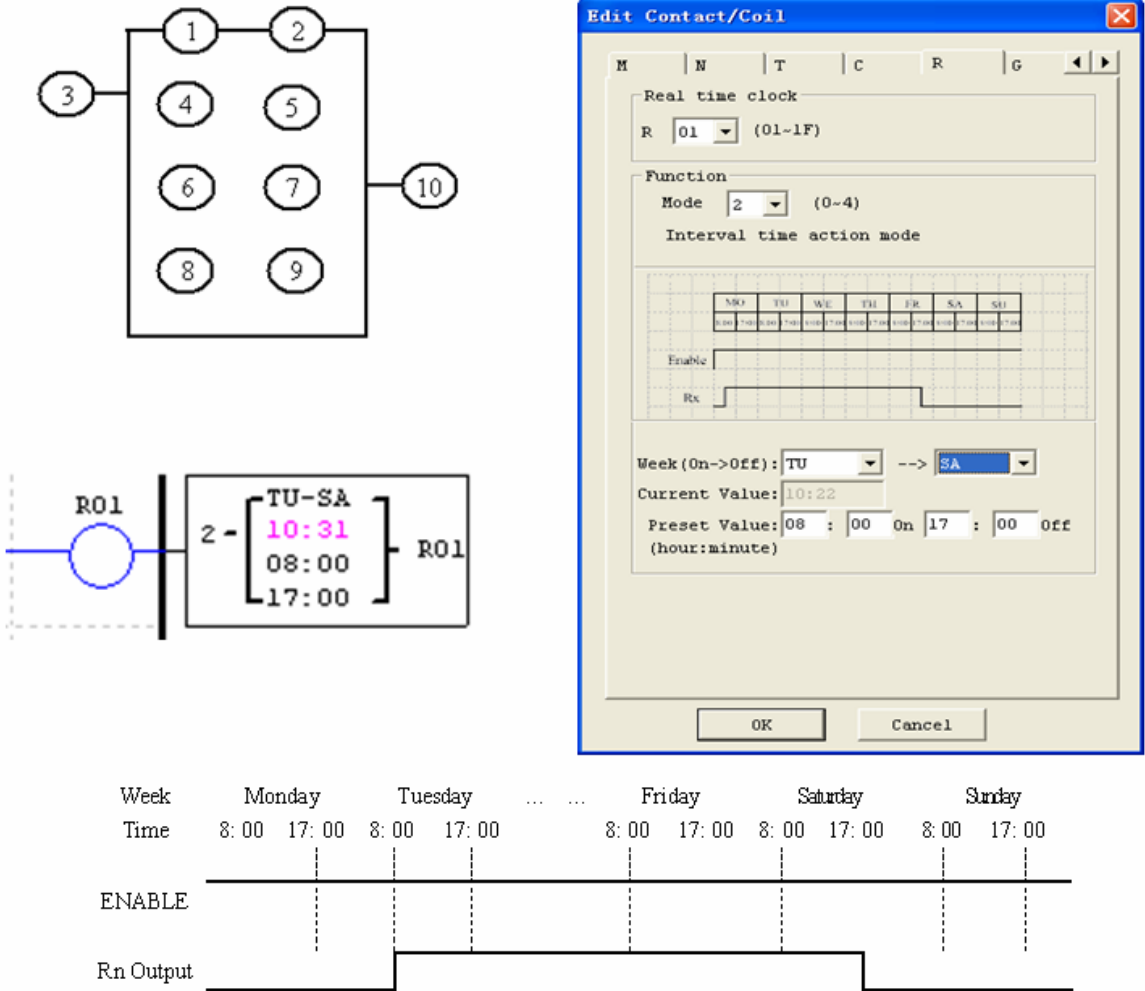
Example 6:



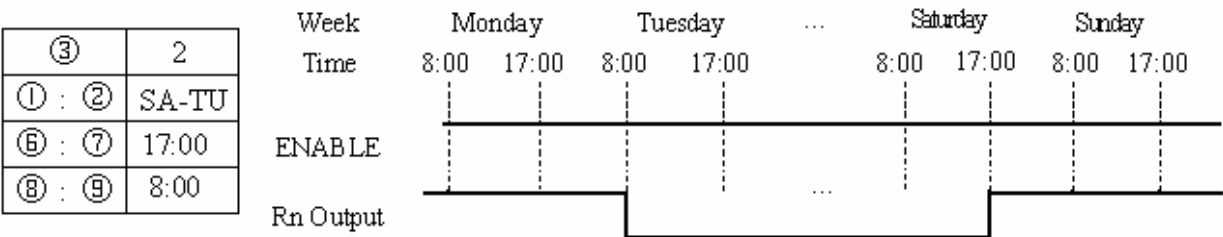
RTC Mode 2 (Interval weekly)

The Interval Time Mode 2 allows the Rxx coil to activate based on time and day per week. The configuration dialog below (example 1) allows for selection of Day and Time for the Rxx coil to activate ON, and Day and Time for the Rxx coil to deactivate OFF.

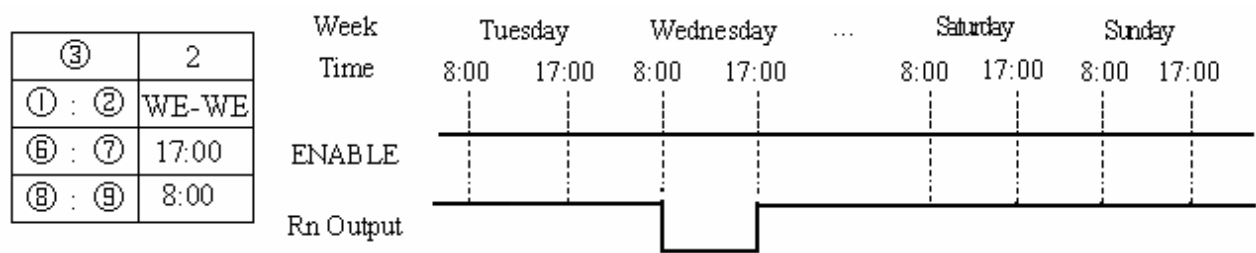
Example 1:



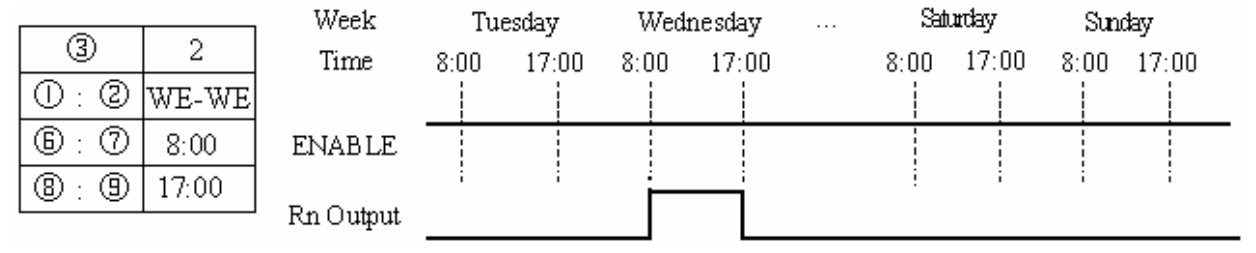
Example 2:



Example 3:

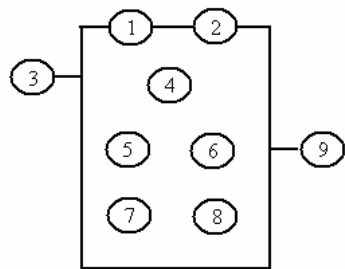


Example 4:



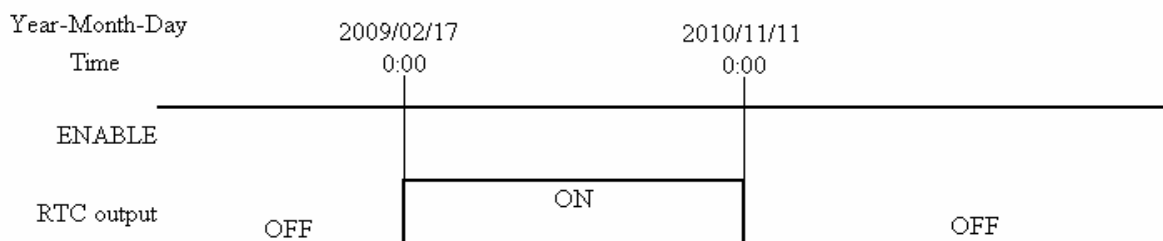
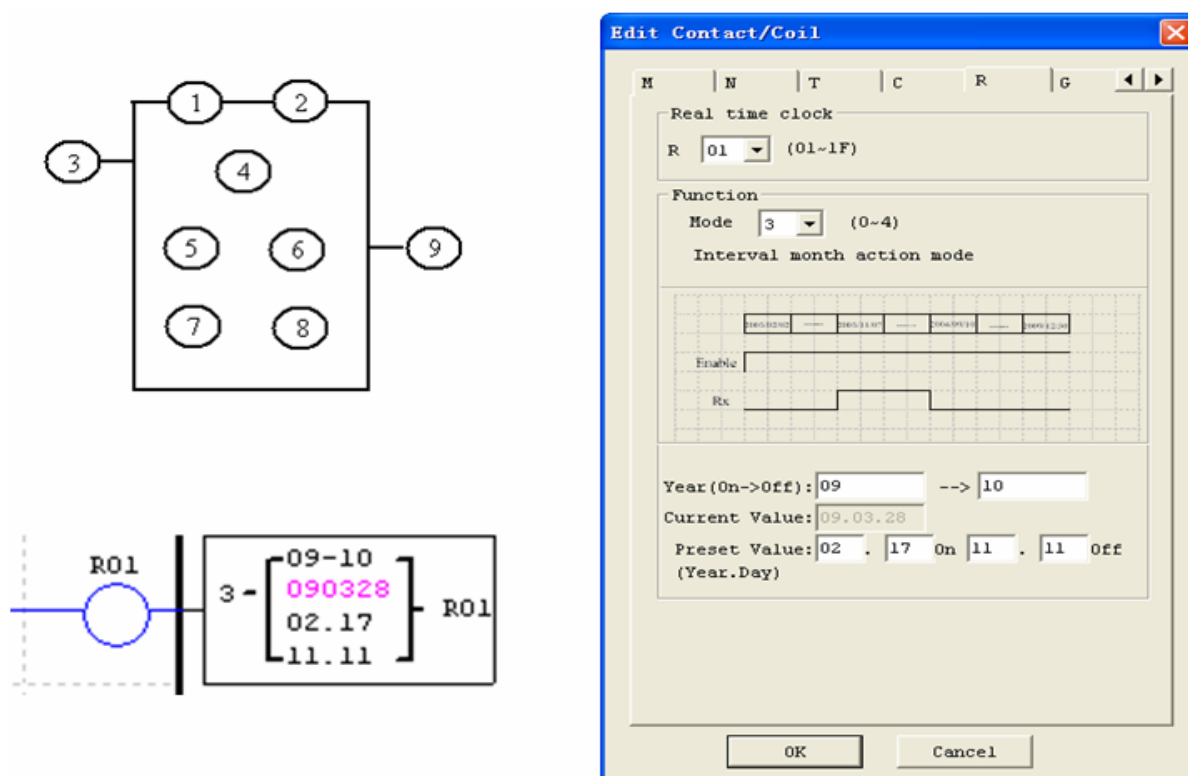
RTC Mode 3 (Year-Month-Day)

The Year-Month-Day Mode 3 allows the Rxx coil to activate based on Year, Month, and Date. The configuration dialog below (example 1) allows for selection of Year and Date for the Rxx coil to activate ON, and Year and Date for the Rxx coil to deactivate OFF.

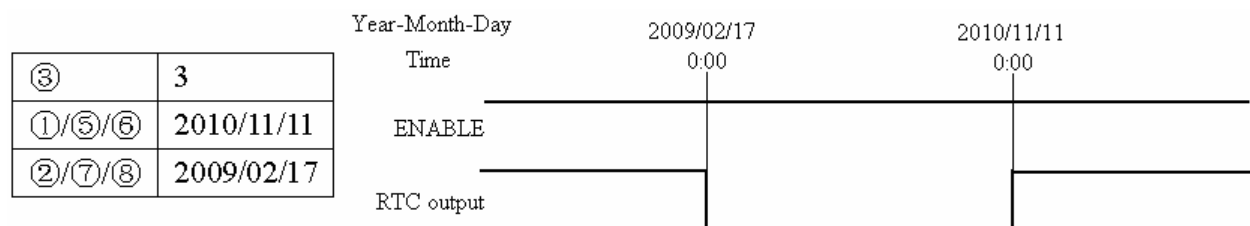


Symbol	Description
①	RTC Year ON
②	RTC Year OFF
③	RTC Mode 3, Year-Month-Day
④	Display RTC present time, Year-Month-Day
⑤	RTC month ON
⑥	RTC day ON
⑦	RTC month OFF
⑧	RTC day OFF
⑨	RTC code (R01~R1F, total 31 group)

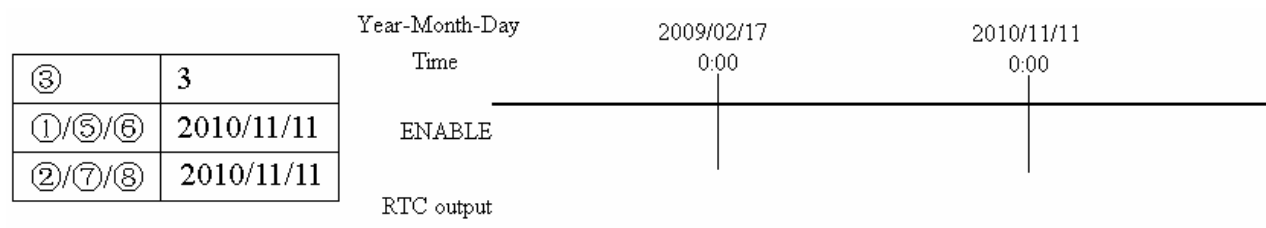
Example 1:



Example 2:

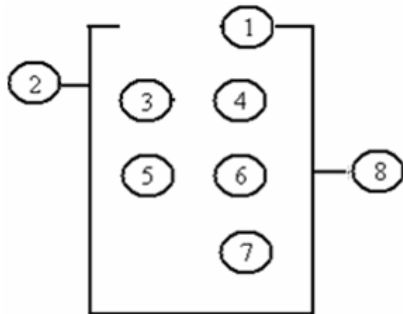


Example 3:



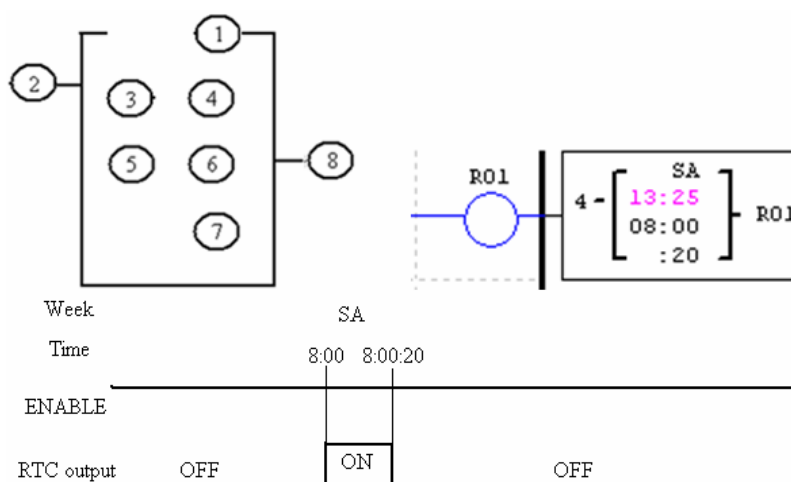
RTC Mode 4 (30-second adjustment)

The 30-second adjustment Mode 4 allows the Rxx coil to activate based on week, hour, minute and second. The configuration dialog below shows for selection of week, hour, minute and second for the Rxx coil to activate ON, and 30-second adjustment then Rxx OFF.



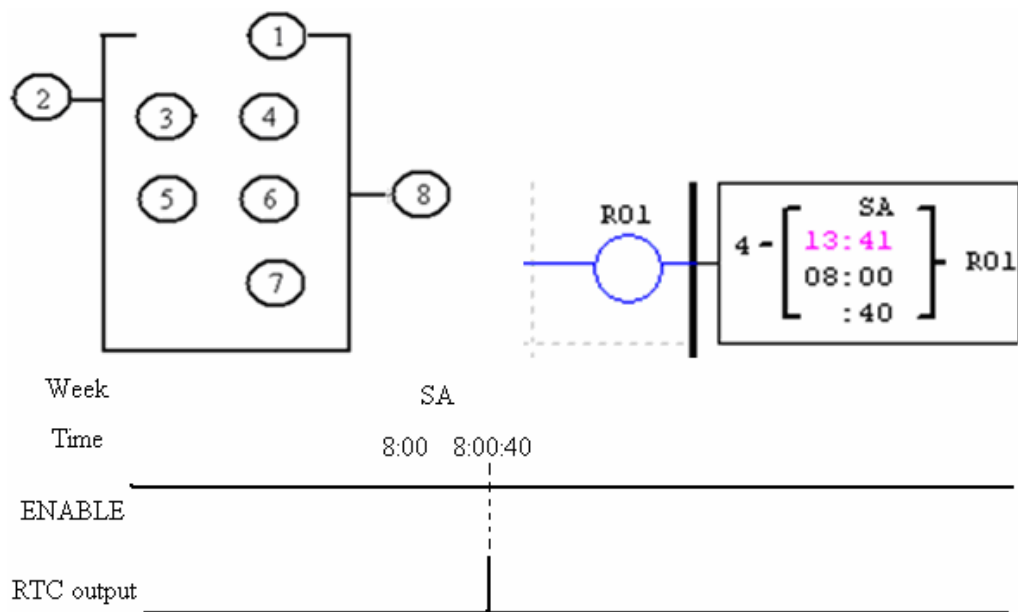
Symbol	Description
①	RTC adjustment week
②	RTC mode 4
③	RTC present hour
④	RTC present minute
⑤	RTC adjustment hour
⑥	RTC adjustment minute
⑦	RTC adjustment second
⑧	RTC code (R01~R1F, total 31 group)

Example 1: preset second < 30s



※ The present time will be 8:00:00 when it achieves 8:00:20 at first time, and RTC status bit R01 will be ON. RTC status bit R01 will be OFF when the present time achieves 8:00:20 at second time. Then time continuous going. So, this means that RTC status bit is ON for 21 seconds.

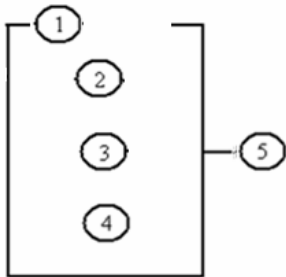
Example 2: preset second $\geq$ 30s



✖ The present time will change to be 8:01:00 when it achieves 8:00:40, and RTC status bit R01 turns ON. Then time is gonging on and R01 turns OFF. This means that the RTC status bit will be ON for one pulse.

Comparator Instructions

The SG2 smart relay includes a total of 31 separate comparator instructions that can be used throughout a program. Each comparator has a choice of 8 operation modes. Additionally, each comparator has 5 parameters for proper configuration. The table below describes each configuration parameter, and lists each compatible memory type for configuring Comparators.

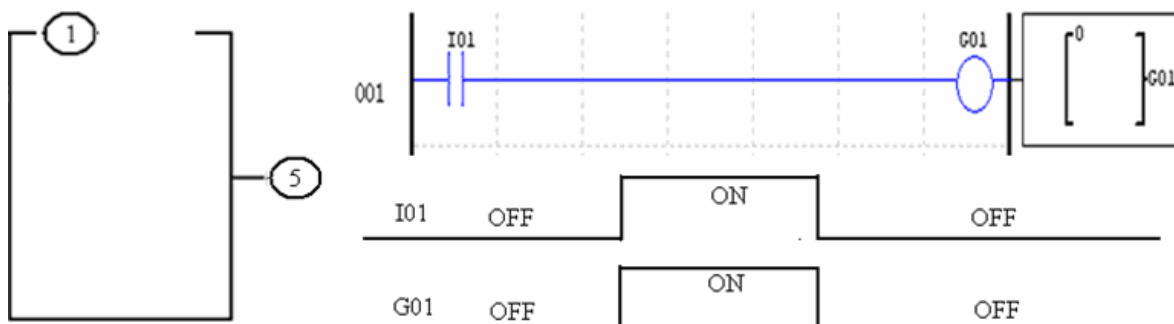


Symbol	Description
①	Comparison Mode (0~7)
②	Ax analog input value (0.00~99.99)
③	Ay analog input value (0.00~99.99)
④	Reference comparative value, could be constant, or other data code
⑤	Output terminal (G01~G1F)

※ The preset value ②, ③ and ④ can be a constant or other function current value.

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.

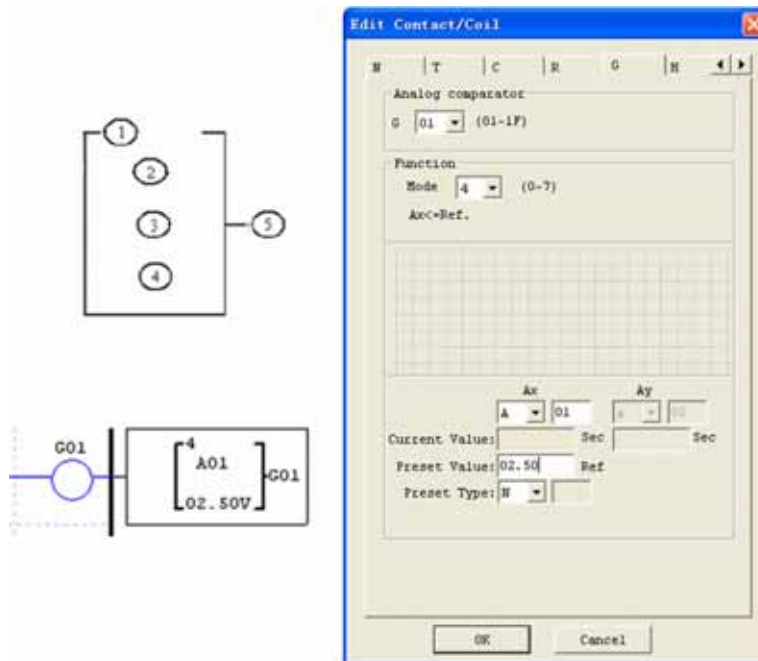


Analog comparator Mode 1~7

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

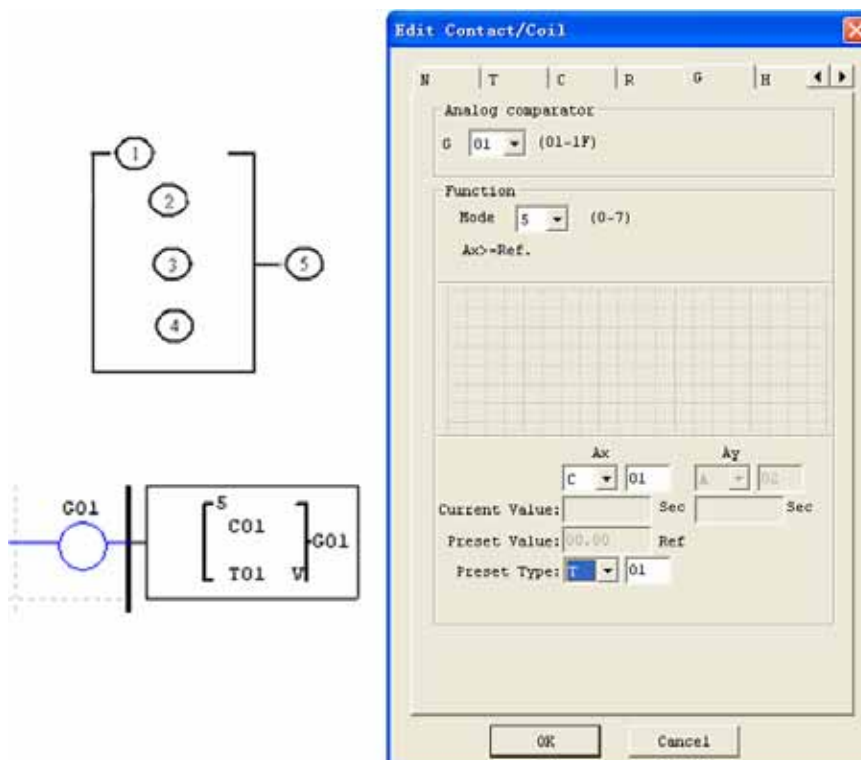
Example 1: Analog Signal Compare

In the example below, Mode 4 is the selected function that compares the value of analog input A01 to a constant value (N) of 2.50. Status coil G01 turns ON when A01 is not less than constant 2.50.



Example 2: Timer/Counter present value Compare

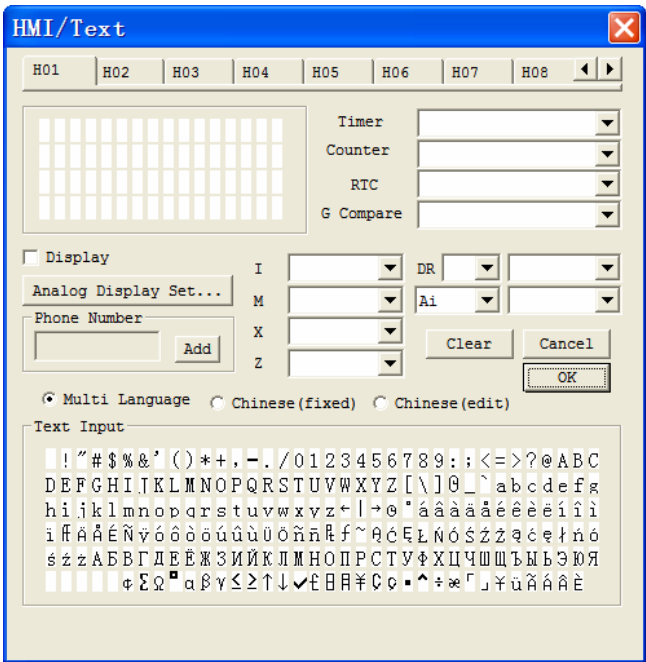
The Comparator instruction can be used to compare Timer, Counter, or other function values to a constant value or each other. In this example below, Mode 5 is the selected function that compares the value of Counter (C01) with the value of Timer (T01). Status coil G01 turns ON if present value of C01 isn't less than present value of T01.



HMI Display Instructions

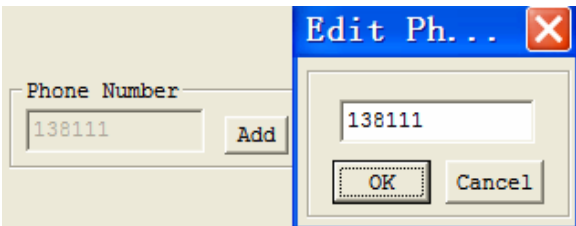
The SG2 smart relay includes a total of 31 HMI instructions that can be used throughout a program. Each HMI instruction can be configured to display information on the SG2 16×4 character LCD in text, numeric, or bit format for items such as current value and preset value for functions, Input/Output bit status, and text. There are three kinds of text in HMI. They are Multi Language, Chinese (fixed) and Chinese (edit), Multi Language is shown in the adjacent example. Each HMI instruction can be configured separately using the **Edit>>HMI/Text** menu selection from the SG2 Client software.

Allows the SEL button on the SG2 keypad to activate the selected message onto the LCD even the Hxx is inactive.



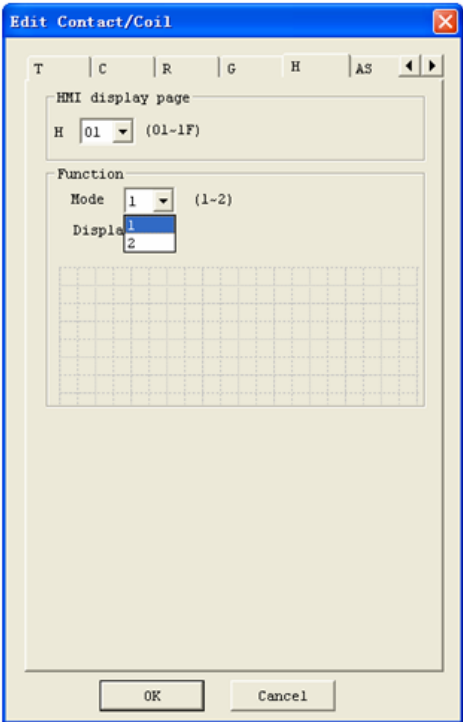
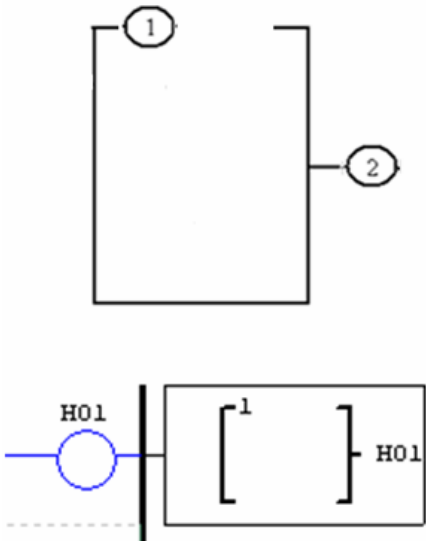
✖ More information about HMI/TEXT to see:
[Chapter 3: Program Tools—Ladder Logic Programming Environment —HMI/TEXT.](#)

H01~H14 can display the setting telephone number and send alarm message to the setting number by GSM module.



Each HMI instruction has a choice of 2 operation modes. The table below describes each configuration parameter.

Symbol	Description
①	Display mode (1-2)
②	HMI character output terminal (H01~H1F)



HMI function instruction

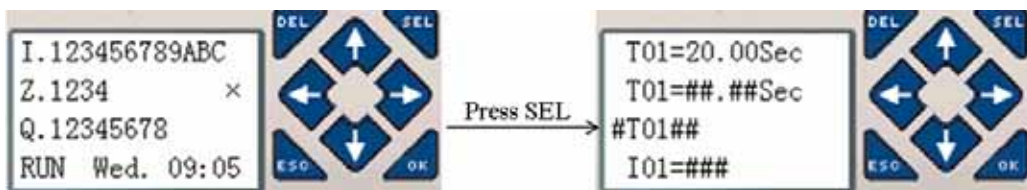
1. HMI can display character, built-in Chinese, user-defined Chinese and GSM telephone number. This information can not be edited through keypad.
2. HMI can display function current value (T, C, R, G and DR), analog input/output value (A, AT, AQ). This information can not be edited through keypad.
3. HMI can display preset value of function (T, C, R, G and DR). This information can be edited through keypad.
4. HMI display state of coil (I, X, Z, M and N), state of M and N can be edited through keypad.
5. Multiple HMI enabled at the same time, by pressing a button next page shows an arbitrary enabled HMI.
6. The new HMI is enabled to determine number greater than the currently displayed HMI numbers showed a new HMI, or keep the original display.

Keypad instruction

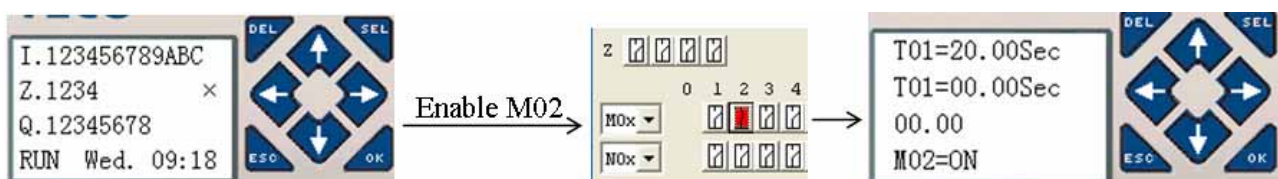
SEL	Under status 1 or 2, go into status 3. Under status 3, go into status 4. Under status 4, change function preset type.
↑ or ↓	Under status 1, find the nearest HMI whose mode is 1. Under status 2, find the nearest enabled HMI. Under status 3, move cursor up or down. Under status 4, change data and number, function preset data; change coil state
(SEL+↑ or ↓)	Under status 1, find the nearest HMI whose mode is 1. Under status 2, find the nearest enabled HMI. Under status 3, move cursor up or down.
← or →	Under status 3 or 4, move cursor left or right.
OK	Validate editing and store automatic.
ESC	Abrogate operation.

HMI status 1~4:

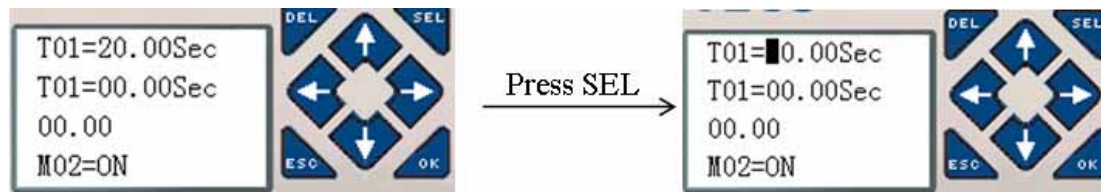
1. HMI scanning state, press SEL into HIM at IO interface



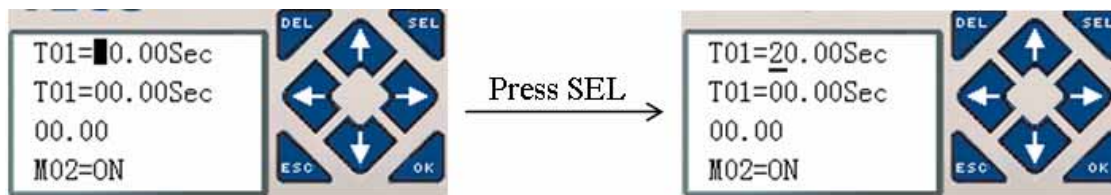
2. HMI running state, HMI is enabled at IO interface



3. HMI edit preparing state, press SEL when HMI is scanning or running state, flicker cursor will show if there is edited content.



4. HMI editing state, press SEL again under status 3.



PWM Output Instruction (DC Transistor Output Models Only)

The transistor output model smart relay includes the capability to provide a PWM (Pulse Width Modulation) output on terminal Q01 and Q02. The PWM instruction is able to output up to an 8-stage PWM waveform. It also provides a PLSY (Pulse output) output on terminal Q01, whose pulse number and frequency can be changed. The table below describes number and mode of PWM.

	Mode	Output
P01	PWM, PLSY	Q01
P02	PWM	Q02

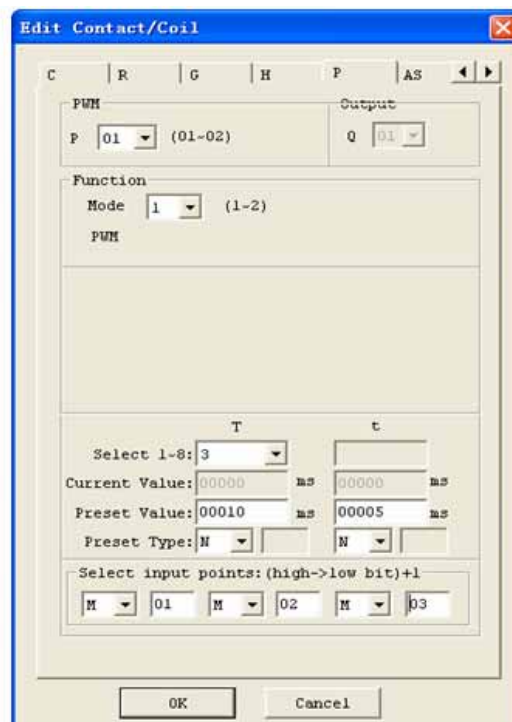
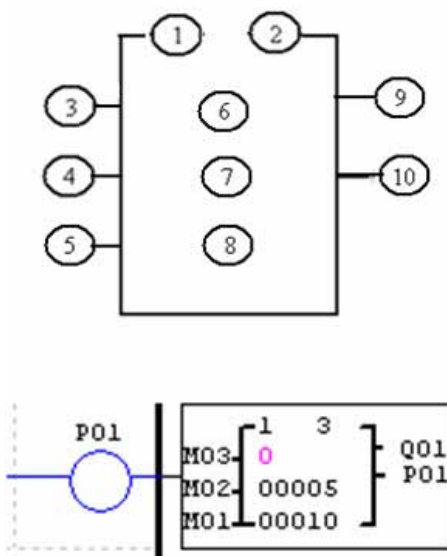
PWM mode

P01 and P02 both can work under this mode. Each PWM has 8 group preset stages which contents Width and Period. The 8 group preset values can be constant or other function current value. Each PWM has 10 parameters for proper configuration. The table below describes each configuration parameter, and lists each compatible memory type for configuring PWM.

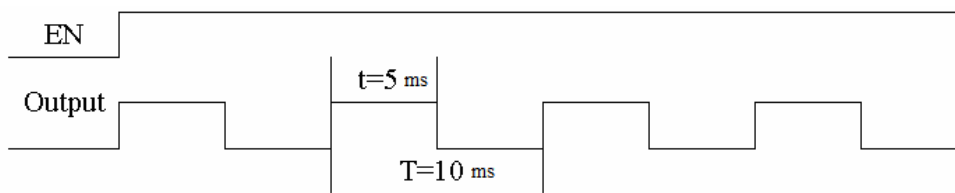
Symbol	Description
①	PWM mode (1)
②	present stages as operating (1~8)
③	Select1 (I01~g1F)
④	Select2 (I01~g1F)
⑤	Select3 (I01~g1F)
⑥	present stages as operating (1~8)
⑦	Width of preset stage ② (0~32767 ms)
⑧	Period of preset stage ② (1~32767 ms)
⑨	Output port (Q01~Q02)
⑩	PWM code (P01~P02)

Enable	Select3	Select2	Select1	stage	PWM Output
OFF	X	X	X	0	OFF
ON	OFF	OFF	OFF	1	Preset stage 1
ON	OFF	OFF	ON	2	Preset stage 2
ON	OFF	ON	OFF	3	Preset stage 3
ON	OFF	ON	ON	4	Preset stage 4
ON	ON	OFF	OFF	5	Preset stage 5
ON	ON	OFF	ON	6	Preset stage 6
ON	ON	ON	OFF	7	Preset stage 7
ON	ON	ON	ON	8	Preset stage 8

Example:



The state of M01, M02 and M03 are 010, so PWM output pulse is stage1 like this as setting above:



The state of M01, M02 and M03 decide PWM output. PWM stages can be changed by the status of M01, M02 and M03 when P01 is running. ⑥ displays the number of pulse when P01 is running, but ⑥ equals 0 when P01 is disabled.

PLSY mode

Only P01 can work under this mode, and the output is Q01. PLSY has 6 parameters for proper configuration. The table below describes the information of PLSY parameters.

Symbol	Description
①	PLSY mode (2)
②	Total number of pulse (storing in DRC9)
③	Preset frequency of PLSY (1~1000Hz)
④	Preset pulse number of PLSY(0~32767)
⑤	Output port (Q01)
⑥	PWM code (P01)

Example:

The example shows a relay ladder logic network and a screenshot of the 'Edit Contact/Coil' dialog box for the PLSY function.

Relay Ladder Logic Network:

- Network 1: A normally open contact labeled ① is connected to a coil labeled ⑤.
- Network 2: A normally open contact labeled ② is connected to a coil labeled ⑩.
- Network 3: A normally open contact labeled ③ is connected to a coil labeled ④.
- Network 4: A normally open contact labeled ④ is connected to a coil labeled ⑥.

Software Interface (Edit Contact/Coil):

- Function:** PLSY
- Mode:** 2 (1-2)
- Output:** Q 01
- Current Value:** 00000
- Preset Value:** 00000 Hz
- Preset Type:** C 01
- Select 1-8:** 2
- Output Port:** Q01
- Frequency:** 00100

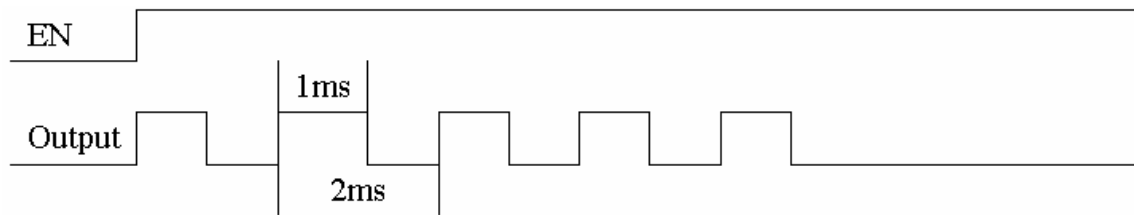
The preset frequency and pulse number could be constant or other function current value. They are variable if the preset are other data code. The PLSY will stop output if it has outputted the number of ④ pulse. PLSY will

run again if it is enabled for a second time.

- ✘ In the example above, the frequency is other data code (C01). So the wave's frequency will change following the current value of C01.
- ✘ In the example above, frequency is 1000 if the current value of C01 is bigger than 1000.
- ✘ PLSY stops outputting pulse after it has output 100 pulses.
- ✘ PLSY will be going on as long as it's enabled if ④ is 0.

Example:

Parameter setting: ③ = 500Hz, ④ = 5, output as shown below:

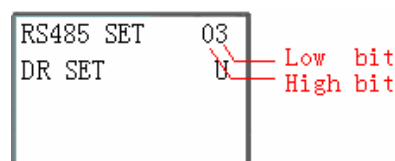


PLSY stops outputting when the number of output pulse is completed.

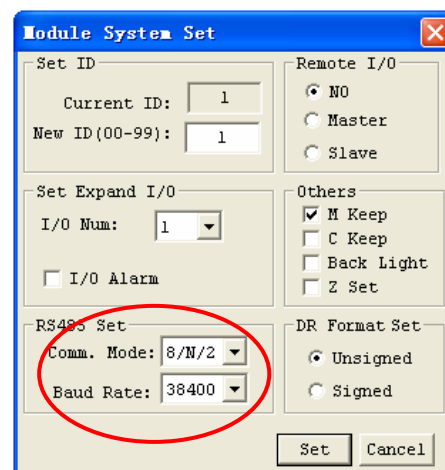
IO Link/Remote I/O Instruction (SG2-20Vxxx model only)

The SG2-20Vxxx models include the capability to link additional SG2-20Vxx units via the RS-485 connection terminals. The baud rate and communication format both can be set using the **Operation»Module System Set...** menu selection from the SG2 Client software. They also can be set through keypad like adjacent picture.

The two bits of keypad how to decide the communication format and baud rate like describing below.



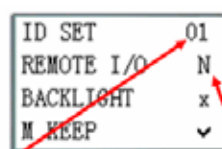
	Data	Meaning
High bit	0	8/N/2 Data 8bit, No Parity, 2 Stop bit.
	1	8/E/1 Data 8bit, Even Parity, 1 Stop bit.
	2	8/O/1 Data 8bit, Odd Parity, 1 Stop bit.
	3	8/N/1 Data 8bit, No Parity, 1 Stop bit.
Low bit	0	4800bps
	1	9600bps
	2	19200bps
	3	38400bps
	4	57600bps
	5	115200bps



IO Link

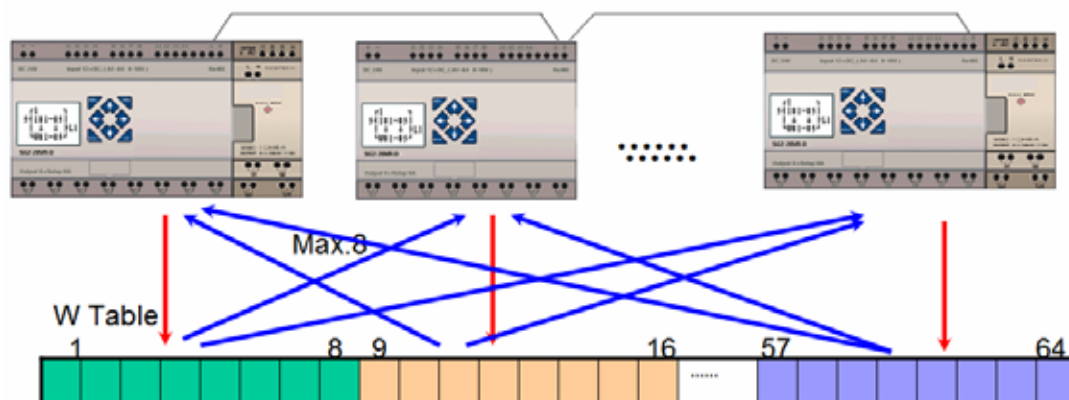
Up to 8 additional SG2 units can be configured as independent Slave nodes, each running their own logic program and their I/O linked to one Master smart relay. The Master smart relay's ID must be 00, and Slave nodes' ID should start with 01 and be continuous. If nodes' ID isn't continuous, the Master won't communication with those nodes which are behind the first broken. For example, the nodes' ID is 01, 02, 04 and 05. The Master thinks there are only two Slave nodes whose ID is 01 and 02, and communication with them.

- 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



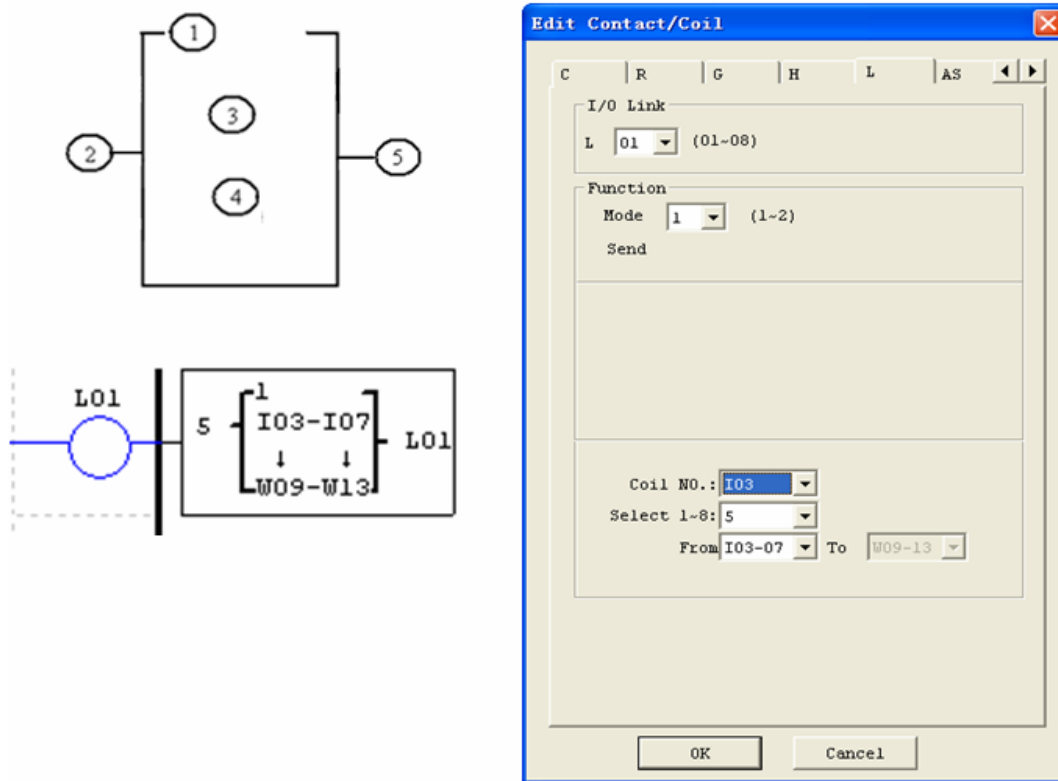
ID	Memory list location
0	W01~W08
1	W09~W16
2	W17~W24
3	W25~W32
4	W33~W40
5	W41~W48
6	W49~W56
7	W57~W64

※ One controller can use 8 IO Link (L01~L08). Only one IO Link instruction can work at Mode 1(send mode), and the other IO Link instructions must be Mode 2 (receive mode).

The Mode 1: Send memory range is determined by the Controller ID. The adjacent table show the memory range of Wxx locations associated with each controller ID.

The Mode 2: read the selected Wxx status and write to the selected coil. If the select coil type is input coil I or X, coil status can't be changed by Wxx status.

Symbol	Description	Type of points	Range
①	Setting mode(1,2) 1:sending 2:receiving	Inputs	I01~I0C/i01~i0C
②	Number of send/receive points (1~8)	Outputs	Q01~Q08/q01~q08
③	Type of send/receive points	Auxiliary coil	M01~M3F/m01~m3F
④	Send/Receive W Table list location	Auxiliary coil	N01~N3F/n01~n3F
⑤	I/O link output terminal (L01~L08)	Expansion inputs	X01~X0C/x01~x0C
		Expansion outputs	Y01~Y0C/y01~y0C



Example 1: IO Link Mode 1

Set ① = 1, ② = 5, set ③ as the initiate of I03, the state of actual sending terminal I03~I07 is sent to memory list; the controller ID = 1, the state of corresponding memory list position W09~W13, and relationship of sending terminal is as below:

①=1, ② = 5, ③ = I03~I07, ID=1 (④:W09~W13)								
Memory List Position	W09	W10	W11	W12	W13	W14	W15	W16
Corresponding receiving	↑	↑	↑	↑	↑	↑	↑	↑
Or sending terminal	I03	I04	I05	I06	I07	0	0	0

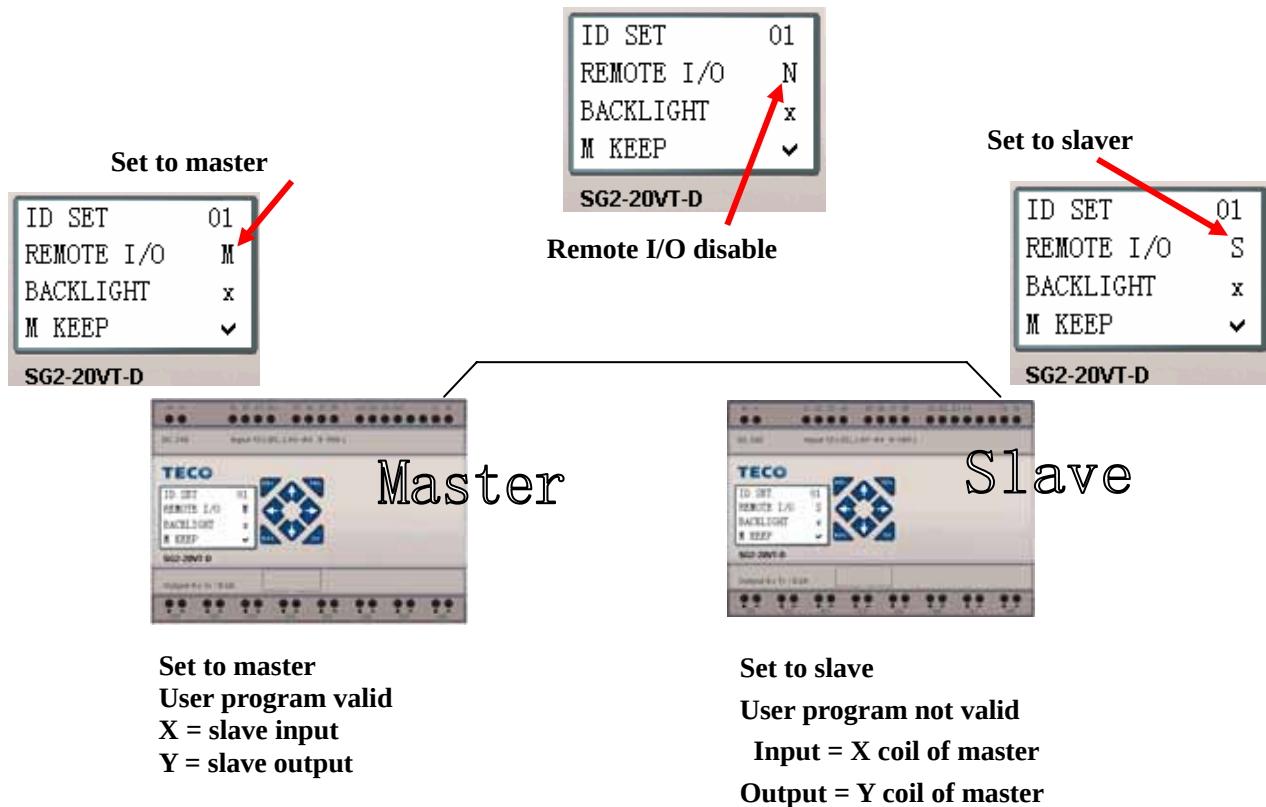
Example 2: IO Link Mode 2

Set ① = 2, ② = 5, set ③ as start from M03, set ④ as from W17, when enabling the IO Link, the state “ ON/OFF ” of M03~M07 is controlled by the state of memory list position W17~W21.

	①=1, ② = 5, ③ = M03~M07, ④:W17~W21				
Memory List Position	W17	W18	W19	W20	W21
Corresponding receiving	▼	▼	▼	▼	▼
Or sending terminal	M03	M04	M05	M06	M07

Remote I/O

Up to 2 additional SG2 units can be configured as Remote I/O nodes, and linked to one master smart relay.



Don't use expansion DI/DO modules, when remote I/O function is enabled.

MU (Modbus) (SG2-20Vxxx model only)

MU function carries out Modbus RTU master communication at RS485 port. There are 15 MU functions: MU01~MU0F.

Remote IO and IO Link are precedence than MU. MU is executed when the system setting is N (No Remote IO) and ID isn't 0.

MU comes into possession of communication port, release the port when disable and one MU period is completed. There can be a number of communication orders in one program, but only one order can come into possession of communication port at the same time. And the others keep their enable state for executing function.

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

Function mode corresponding communication function code:

mode	Communication function code
1	03 (read registers)
2	06 (write single register)
3	10 (write multiple registers)
4	01 (read coils)
5	05 (write single coil)

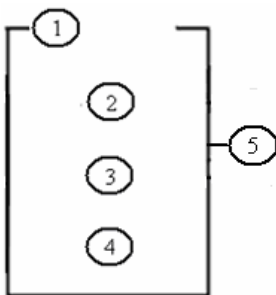
The coil used in MU function:

M3D: Received	M3D is set to ON after received, then check-up for error. Transferring data to target address if there is no error.
M3E: Error flag	communication error flag
M3F: Time out flag	M3F is set to 1 when the time from after sending to start receiving is longer than setting, and M3D also be set to 1. M3F is automatically reset if M3D reset.

The time out time is depending communication baud rate as shown in the table below:

Baud rate (bps)	Time out (ms)
4800、9600、19200、38400	125
57600	100
115200	80

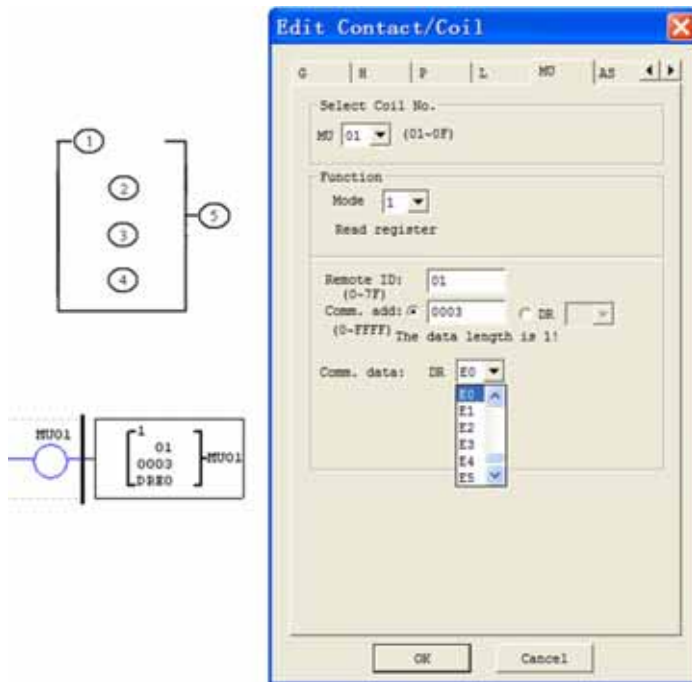
There are 5 parameters in MU function as shown below.



symbol	Description
①	MU mode (1~5)
②	Communication address: slave ID, range: 0~127
③	Communication content: address and data length: 1) address is constant, range: 0000~ffff; if mode 1 or 3, data length is fixed at 1 word; if mode 4, data length is fixed at 16 bits; 2) DR code, get address and length from this DR and the next
④	DR code, store sending/receiving data from this DR
⑤	MU code (MU01~MU0F)

※ The max data length for Mode 1 and 3 is 25words. The max data length for Mode 4 is 400bits.

The example below shows how to configure DR function.



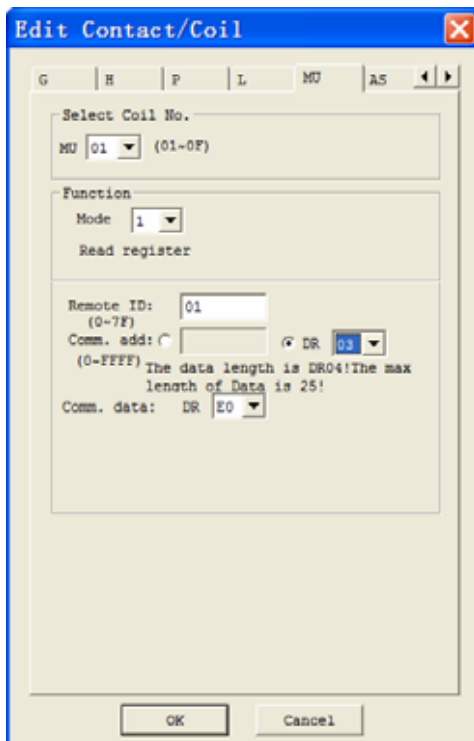
Address is constant 0003,
Data length is fixed at 1word,
Send data:
01 03 00 03 00 01 CRC16;

Received response form slave1:
01 03 02 data1 data2 CRC16;
Saving date to DRE0:
DRE0 = data1~2

MU mode1: Read Registers

Setting parameter③ communication address is constant: as show the previous figure, the data length is fixed at 1.

Setting parameter③ communication address is data register DR:



Function parameter display:



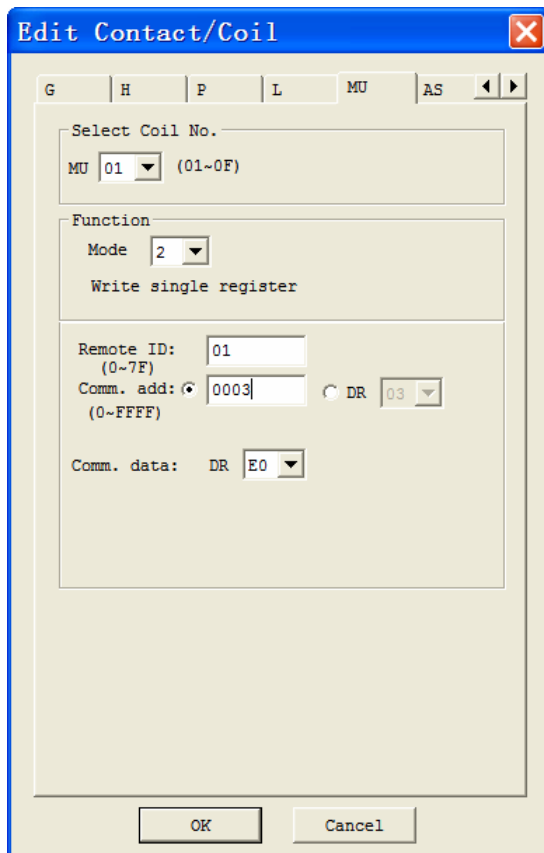
Setting address DR03=0001,
Setting data length DR04=0002,
Send data:
01 03 00 01 00 02 CRC16;

Received response from slave1:
01 03 04 data1 data2 data3 data4 CRC16;
Saving data to DRE0~DRE1:
DRE0 = data1~2
DRE1 = data3~4

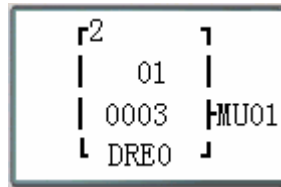
※ the max length of data is 25.

MU mode2: Write single register

Setting parameter③ communication address is constant:



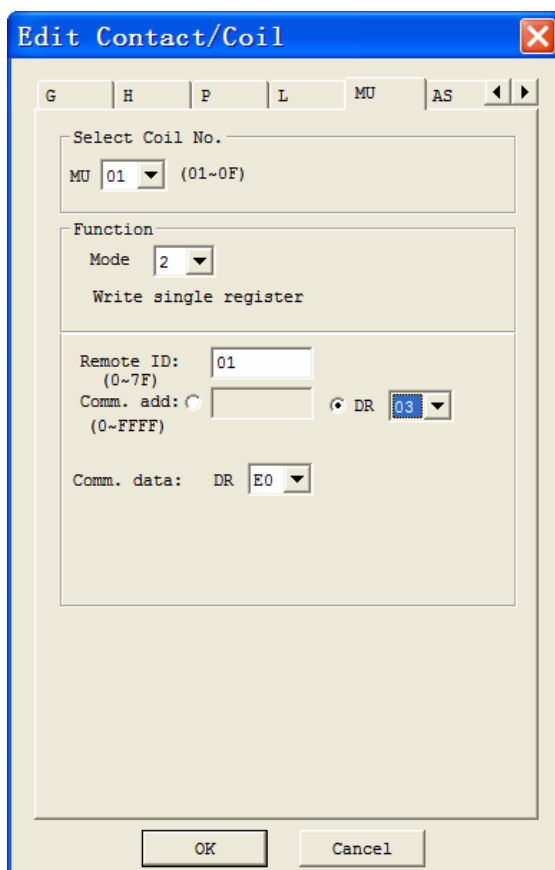
Function parameter display:



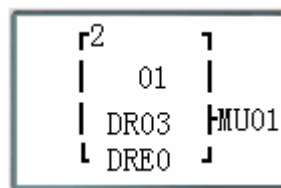
Address is constant 0003,
Setting data DRE0=1234 (hex: 04D2),
Send data:
01 06 00 03 04 D2 CRC16;

Received response from slave1:
01 06 00 03 04 D2 CRC16 ;

Setting parameter③ communication address is data register DR:



Function parameter display:

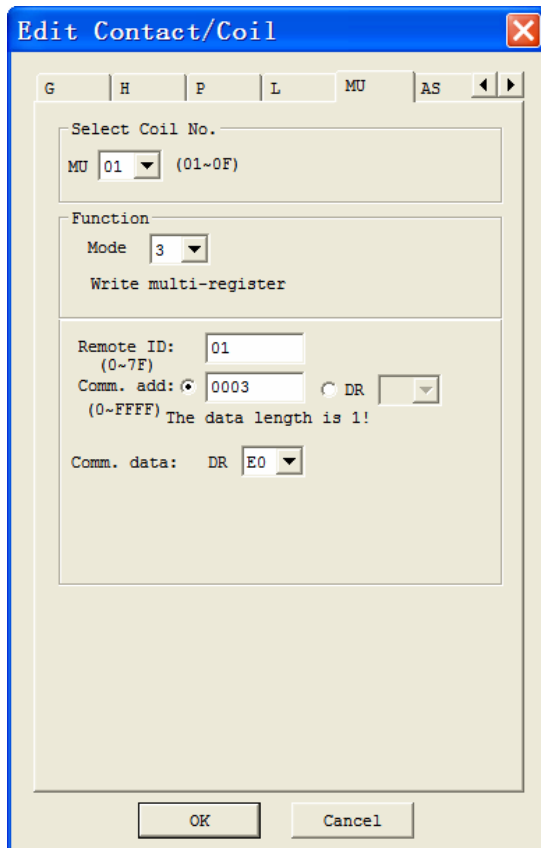


Setting address DR03=0001,
Setting data DRE0=1234 (hex: 04D2),
Send data:
01 06 00 01 04 D2 CRC16;

Received response from slave1:
01 06 00 01 04 D2 CRC16;

MU mode3: Write Multiple Registers

Setting parameter③ communication address is constant:



Function parameter display:



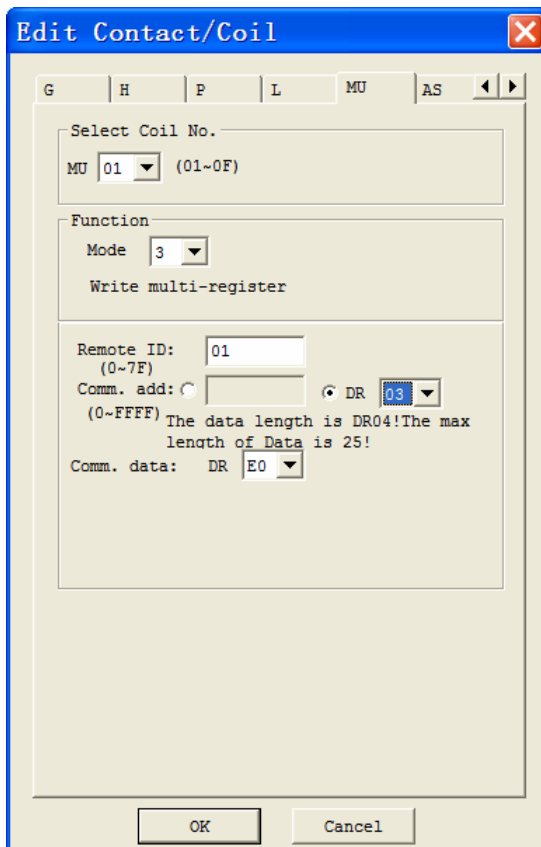
Address is constant 0003,
Data length is fixed at 1 word,
Setting data DRE0=1234 (hex: 04D2),
Send data:

01 10 00 03 00 01 02 04 D2 CRC16;

Received response from slave1:

01 10 00 03 00 01 CRC16;

Setting parameter③ communication address is data register DR:



Function parameter display:



Setting address DR03=0001,
Setting data length DR04=0002,
Setting data DRE0=1234 (hex: 04D2),
Setting data DRE1=5678 (hex: 162E),
Send data:

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

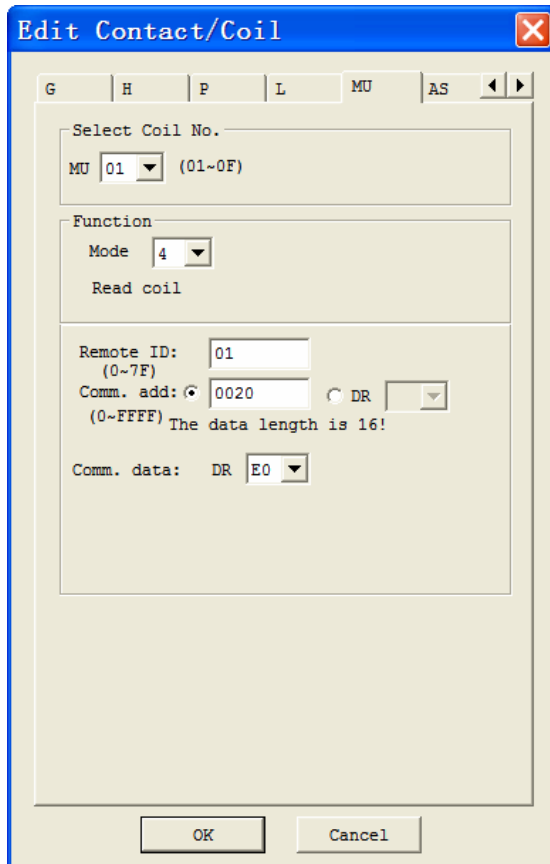
Received response from slave1:

01 10 00 01 00 02 CRC16;

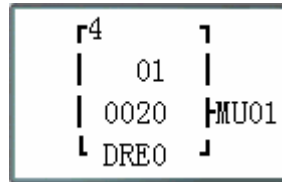
※ the max length of data is 25.

MU mode4: Read Coils

Setting parameter③ communication address is constant:



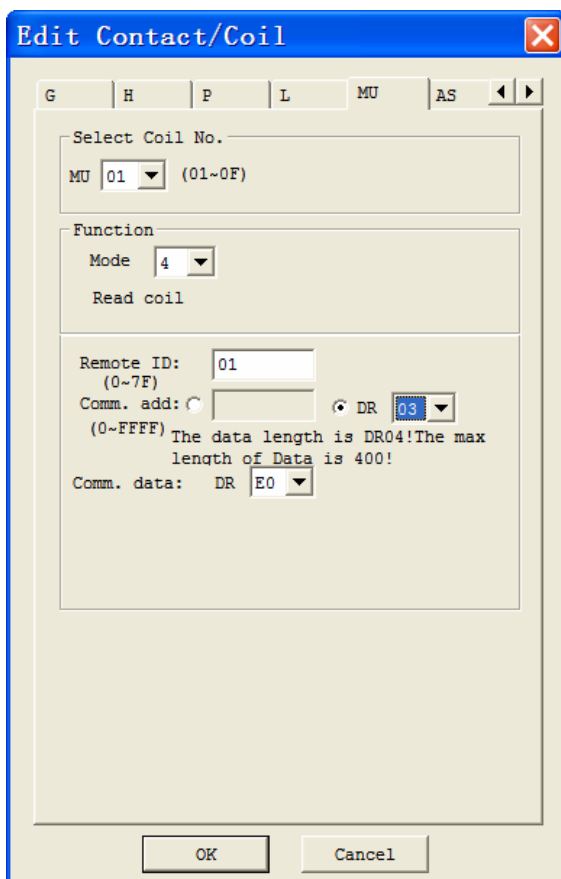
Function parameter display:



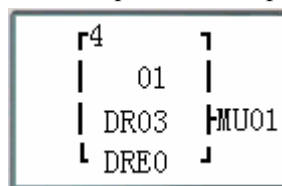
Address is constant 32 (hex: 0020),
Data length is fixed at 16 (hex: 10H, 1word),
Send data:
01 01 00 20 00 10 CRC16;

Received response from slave1:
01 01 02 data1 data2 CRC16;
Saving data to DRE0:
DRE0 = data1~2

Setting parameter③ communication address is data register DR:



Function parameter display:



Setting address DR03=0001,
Setting data length R04=0015 (hex: 000F);
Send data:
01 01 00 01 00 0F CRC16;

Received response from slave1:
01 01 02 data1 data2 CRC16;
Saving data to DRE0:
DRE0 = data1~2

※ the max length of data is 400.

MU mode5: Write single coil

Setting parameter③ communication address is constant:

Function parameter display:

```

  5  1
  |  01  |
  | 0003  | MU01
  | DRE0  |

```

Address is constant 0003,
Setting data DRE0=65280 (hex: FF00),
Send data:

01 05 00 03 FF 00 CRC16;

Received response from slave1:

01 05 00 03 FF 00 CRC16;

Setting parameter③ communication address is data register DR:

Function parameter display:

```

  5  1
  |  01  |
  | DR03  | MU01
  | DRE0  |

```

Setting address DR03=0001,
Setting data DRE0=65280 (hex: FF00),
Send data:

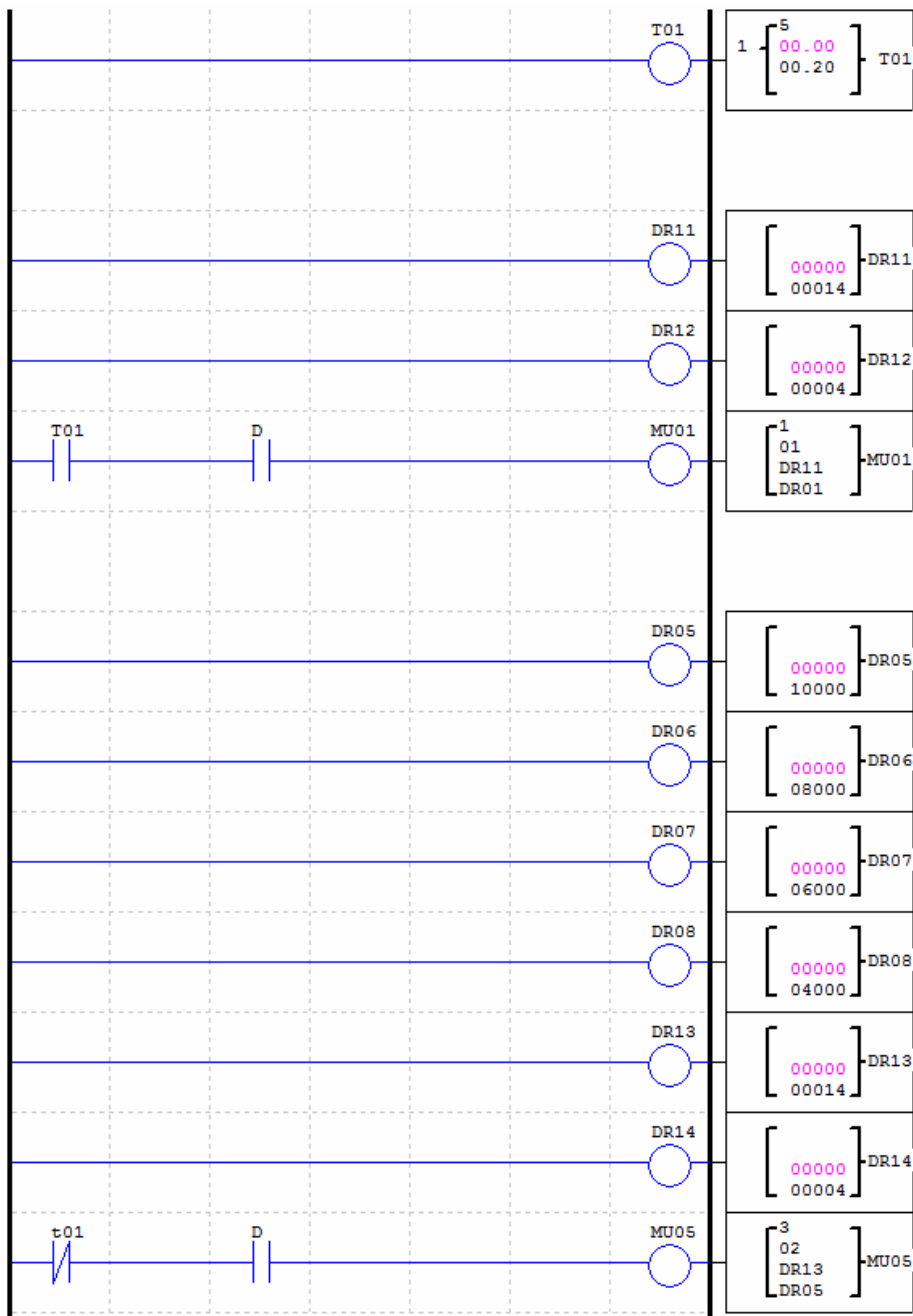
01 05 00 01 FF 00 CRC16;

Received response from slave1:

01 05 00 01 FF 00 CRC16;

Example :

MU sending and receiving data via RS485 port when it's enabled. It is recommended that you use D-trigger to control MU.

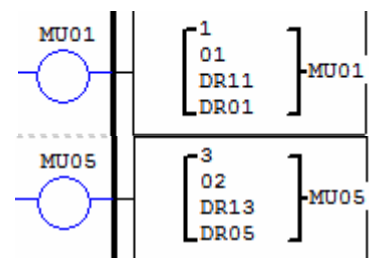


MU01 and MU05 controlled by T01;

Setting MU01 mode1, read registers, address DR11=14=0x0E, data length DR12=4, and saving data to registers DR01~DR04;

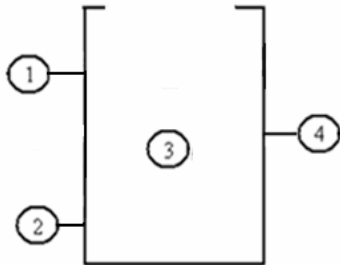
Setting MU05 mode3, write multiple registers, address DR13=14=0x0E, data length DR14=4, and getting data from register DR05~DR08 (DR05=10000=0x2710, DR06=8000=0x1F40, DR07=6000=0x1770, DR08=4000=0x0FA0);

T01 ON when running, then trigger MU01 sending command 01 03 00 0E 00 04 CRC16, and saving data to DR01~DR04 after receiving response. After 0.2s T01 OFF, then trigger MU05 sending command 01 10 00 0E 00 04 08 27 10 1F 40 17 70 0F A0 CRC16. After 0.2s T01 ON then trigger MU01, After 0.2s T01 OFF then trigger MU05.....



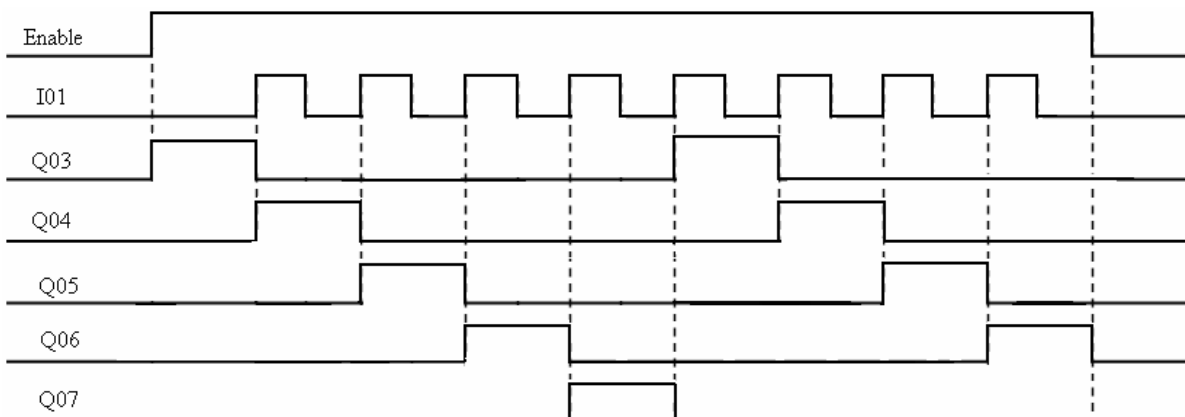
SHIFT (shift output)

The SG2 smart relay includes only one SHIFT instruction that can be used throughout a program. This function outputs a serial of pulse on selection points depending on SHIFT input pulse. It has 4 parameters for proper configuration. The table below describes each configuration parameter, and lists each compatible memory type for configuring SHIFT.



Symbol	Description
①	Preset number of output pulse (1~8)
②	SHIFT input coil (I01~g1F)
③	SHIFT output coils (Q, Y, M, N)
④	SHIFT code (S01)

In the example below, ① = 5, ② = I01, ③: Q03~Q07.



※ Q03 is ON, and from Q04 TO Q07 are OFF when ENABLE is active. Q04 turns ON when I01's rising edge coming on, and others points turn OFF. The next coil turns ON at each rising edge of SHIFT input, and others turn OFF.

AQ (Analog Output)

AQ instructions need to use with extension analog out module 2AO.

The default output of AQ is 0~10V voltage, the 12bits data is 0~4095 and the corresponding value of AQ is 0~1000. It also can be set as 0~20mA current output, the 12bits data is 0~2047 and the corresponding value of AQ is 0~500. The 12bits data saved in DRD4~DRD4. The output mode of AQ is set by the current value of DRD0~DRD3

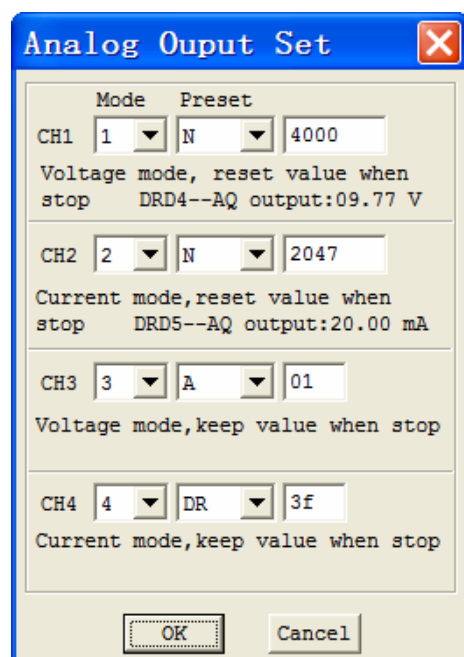
	Output register	Mode register
Channel 1: AQ01	DRD4	DRD0
Channel 2: AQ02	DRD5	DRD1
Channel 3: AQ03	DRD6	DRD2
Channel 4: AQ04	DRD7	DRD3

Mode	DRD0~DRD3 data definition
1	0: voltage mode and reset value when stop;
2	1: Current mode and reset value when stop;
3	2: voltage mode and keep value when stop;
4	3: Current mode and keep value when stop;

※ It will be thought as 0 if the value of DR isn't in the range of 0~3. That means the output mode of AQ is mode 1.

AQ display

AQ displays the preset value under STOP mode, and displays the current value under RUN mode.



STOP display

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

RUN display

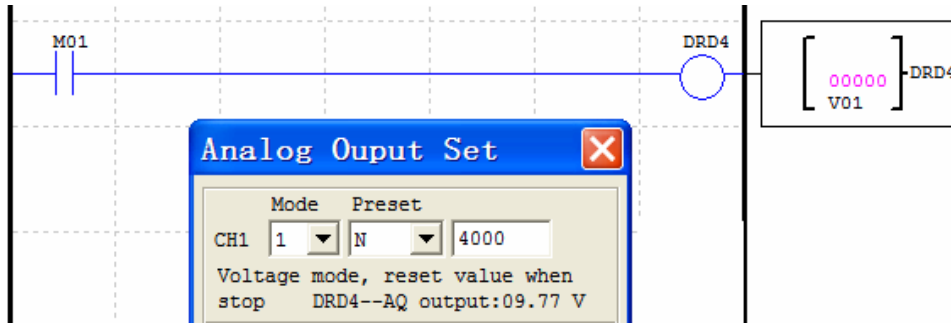
```
AQ01=09.77V
AQ02=20.00mA
AQ03=02.10V
AQ04=00.00mA
```

When AQ mode is current output, the DR value conversion AQ output value and display value show as below:

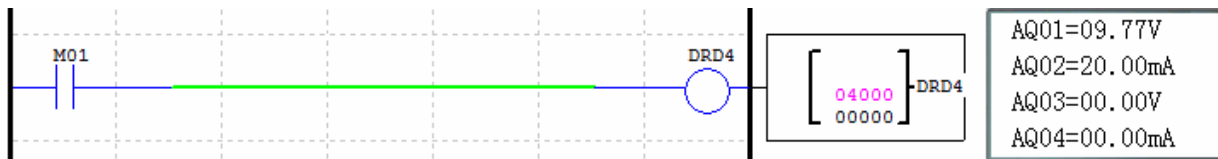
DRD5=2047, conversion AQ02=500, display: 20.00mA

- ※ When output value type of AQ is set to constant, AQ output value changed by DR value ($AQx = DRx / 4.095$);
- ※ When output value type of AQ is set to other parameters variables, DR value changed by AQ output value ($DRx = AQx * 4.095$).
- ※ More information about expansion analog input to see: [Chapter 9 Expansion Module-Analog Module](#).

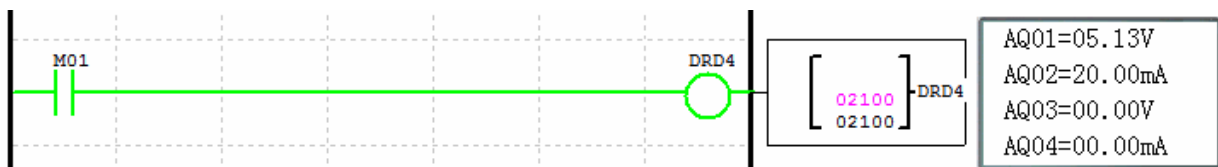
Example 1: AQ01 preset value is constant;



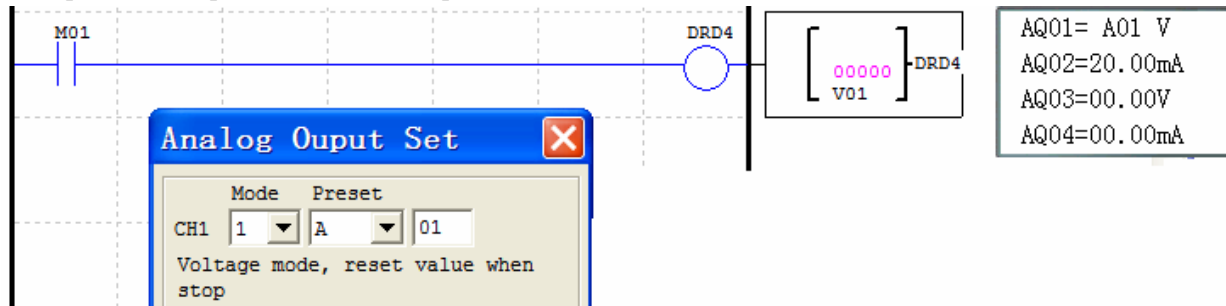
When running and disable M01, DRD4 output value is AQ01 setting value 4000, and AQ01 output 9.77V;



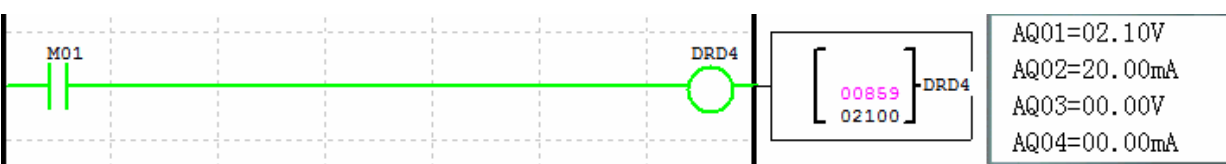
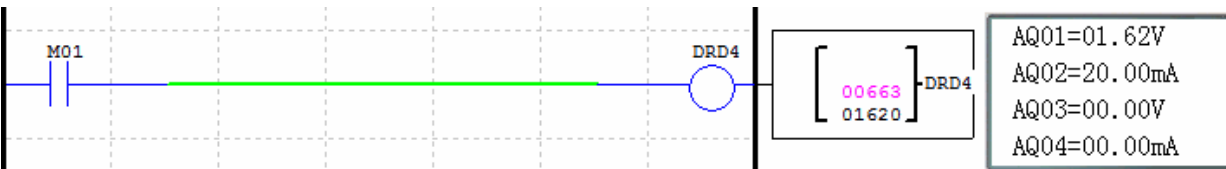
When running and enable M01, DRD4 output value is V01, adjust the value of V01, AQ01 output value changed with V01;



Example 2: AQ01 preset value is other parameters;

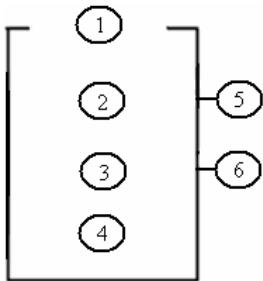


When running, DRD4 output value is out control of M01 and V01. AQ01 output value is A01, adjust the value of A01, DRD4 output value changed with A01;



AS (Add-Subtract)

The SG2 smart relay includes a total of 31AS instructions that can be used throughout a program. The ADD-SUB Addition and/or Subtraction function enables simple operations to be carried out on integers. There are 6 parameters for proper configuration. The table below describes each configuration parameter, and lists each compatible memory type for configuring AS.

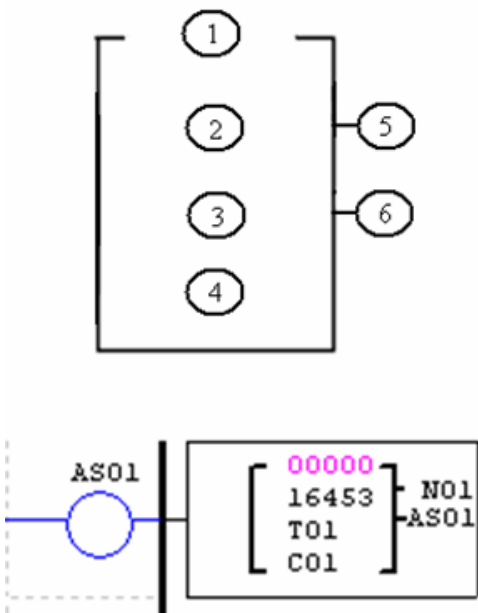


Symbol	Description
①	AS current value (-32768~32767)
②	V1 parameter (-32768~32767)
③	V2 parameter (-32768~32767)
④	V3 parameter (-32768~32767)
⑤	Error output coil (M, N, NOP)
⑥	AS code (AS01~AS1F)

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

AS current value is the result of compute. Parameters V1, V2, and V3 can be a constant or other function current value. The output coil will be set to 1 when the result is overflow. And the current value is no meaning at this time. But it will do nothing if the output coil is NOP. The output coil will turns OFF when the result is right or the function is disabled.

The example below shows how to configure AS function.



Edit Contact/Coil

C

R

G

H

AS

MD

Select Coil No.

AS

01

(01~1F)

Error Coil

N

01

Function

Current value:

AS=V1+V2-V3

V1

+ V2

- V3

Preset:

16453

00000

00000

Pre Type:

N

T

01

C

01

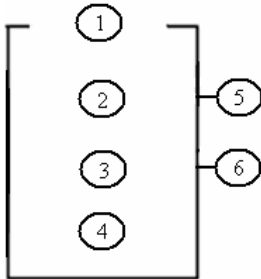
OK

Cancel

✘ Error output coil N01 will turn ON when the compute result is overflow.

MD (MUL-DIV)

The SG2 smart relay includes a total of 31MD instructions that can be used throughout a program. The MUL-DIV Multiplication and Division function enables simple operations to be carried out on integers. There are 6 parameters for proper configuration. The table below describes each configuration parameter, and lists each compatible memory type for configuring MD.

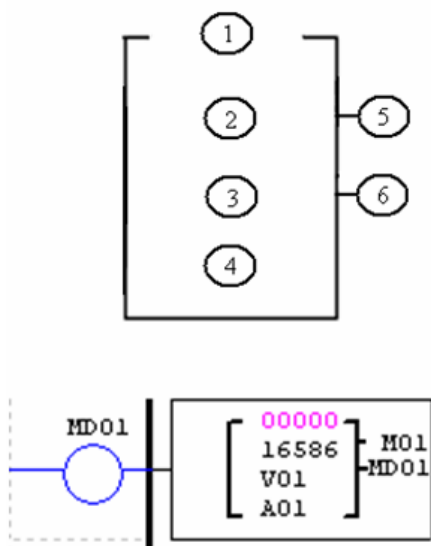


Symbol	Description
①	MD current value (-32768~32767)
②	V1 parameter (-32768~32767)
③	V2 parameter (-32768~32767)
④	V3 parameter (-32768~32767)
⑤	Error output coil (M, N, NOP)
⑥	MD code (MD01~MD1F)

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

MD current value is the result of compute. Parameters V1, V2, and V3 can be a constant or other function current value. The output coil will be set to 1 when the result is overflow or parameter V3 is zero. And the current value is no meaning at this time. But it will do nothing if the output coil is NOP. The output coil will turns OFF when the result is right or the function is disabled.

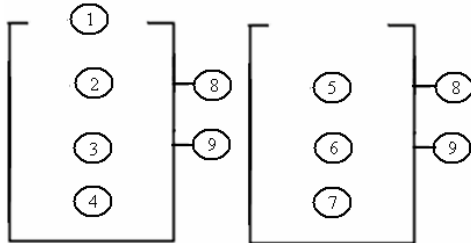
The example below shows how to configure MD function.



※ Error output coil M01 will turn ON when the compute result is overflow.

PID (Proportion- Integral- Differential)

The SG2 smart relay includes a total of 15 PID instructions that can be used throughout a program. The PID function enables simple operations to be carried out on integers. There are 9 parameters for proper configuration. The table below describes each configuration parameter, and lists each compatible memory type for configuring PID.



Symbol	Description
①	PI: PID current value (-32768~32767)
②	SV: Destination value (-32768~32767)
③	PV: Test value (-32768~32767)
④	T _S : Sampling time (1~32767 * 0.01s)
⑤	K _P : Proportional gain (1~32767 %)
⑥	T _I : Integration 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)

The parameters from ① to ⑦ can be constant or other function current value. The error coil will turn ON when either T_S or K_P is 0. But it will do nothing if the output coil is NOP. The output coil will turn OFF when the result is right or the function is disabled.

PID computes formula:

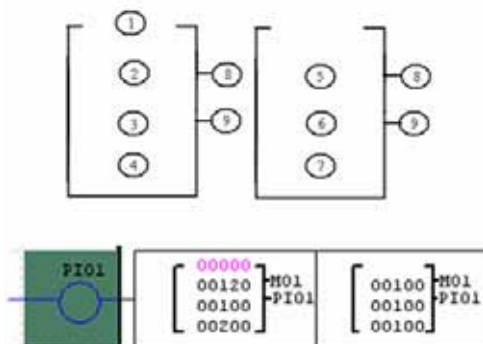
$$EV_n = SV - PV_n$$

$$\Delta PI = K_p \left\{ (EV_n - EV_{n-1}) + \frac{T_s}{T_i} EV_n + D_n \right\}$$

$$D_n = \frac{T_D}{T_s} (2PV_{n-1} - PV_n - PV_{n-2})$$

$$PI = \sum \Delta PI$$

The example below shows how to configure PID function.



The screenshot shows the 'Edit Contact/Coil' dialog box for the PID function. The 'Select Coil No.' is set to 'PID 01' (01-0F). The 'Error Coil' is set to 'NOP'. The 'Function' is set to 'PID (-32768~32767)'. The 'Current value' is set to '00120'. The 'SV' (Setpoint) is set to '00120' (-32768~32767). The 'PV' (Process Value) is set to '00100' (-32768~32767). The 'Ts' (Sampling time) is set to '00200' (1~32767). The 'Kp' (Proportional gain) is set to '00100' (1~32767). The 'Ti' (Integration time) is set to '00100' (1~32767). The 'Td' (Differential time) is set to '00100' (1~32767). The 'OK' and 'Cancel' buttons are at the bottom.

Three types of PID controller:

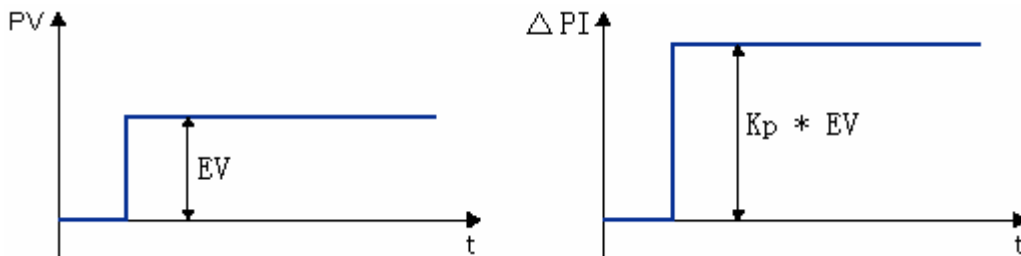
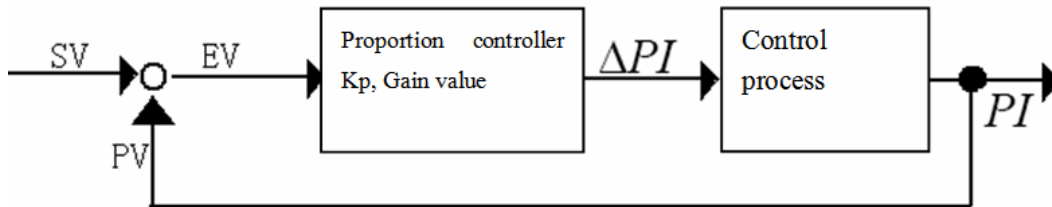
Proportional loop (P);

Integral loop (I);

Differential loop (D);

(PID controller diagram)

Proportional controller

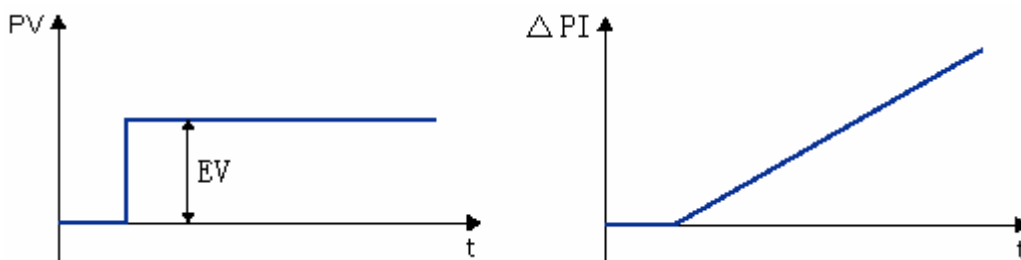


According to the difference (or error) EV between the target value and measuring value, this alters the adjustable value (or variables) ΔPI proportionally, then change the output (result) PI of the program control. Proportion controller can work promptly, but it can't make the difference to 0. The feature of the proportion controller: Correspond to the change (or variation) of the process value instantly.

Integral controller

For smooth and stabilize the system once the EV value and is change drastically, integral control can delay the react of the system and shrink control loop variation.

EV and time automatically adjust variable ΔPI .



Integral controller characteristic: reduce variation, delay reaction time.

Differential controller

System react is depends by PV value then convert to variable ΔPI and control the output result.

ΔPI will change depend on the value of PV. Process time is reduced via differential controller.

Differential control characteristic: reduce vibration, increase stability accelerate process time.

The features of PID control: fast, stable and accurate

Description of K_p , T_I , T_D as show next page:

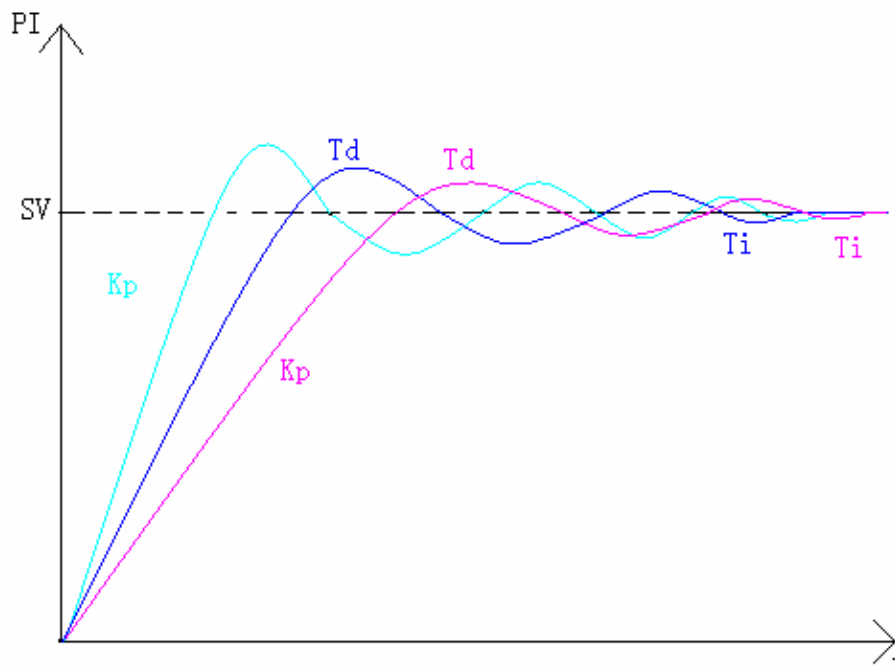
The PID function control variable K_p , T_i and T_d :

Increase K_p value to has a fast response time and reduce deviation quickly and the large K_p value will eventually affect the stability of the system or even unstable.

Once the variation is occurred and integral loop start to process, a small T_i setting value has a greater integral result and vice versa.

Differential control has a fast react feature, greater differential time T_d setting is able to increase the system response, and minimal the variation but the large differential time settings will un-stabilize the system easily. Although the large T_d setting value could reduce response time, user should setting differential time T_d value properly to prevent a system become a ultra sensitive controller.

Illustrate diagram for K_p , T_i , T_d variable setting value to SV



1, T_d and T_i setting value is large. K_p setting value is small.

2, T_d and T_i setting value is small.

3, K_p setting value is large.

A micro sampling time T_s setting, will consume lots of resource of controller and variation value won't have sufficient change, A huge sampling time T_s setting, expect stable system and a slow response.

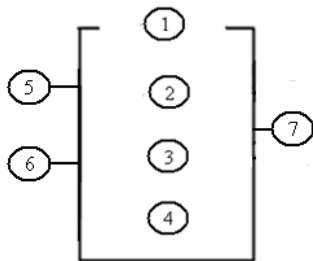
Variable reference chart:

Control type	Application field	K_p (%)	T_i (*0.1s)	T_d (*0.01s)	T_s (*0.01s)
Fast temperature variation	Small space and capacity	625	30	100	50
Slow Temperature variation	Large space and capacity	1250	120	800	100
Slow Pressure	Slow pressure variation	1500	5	400	100
Fast Pressure	Fast pressure variation	3750	2	1000	100

K_p , T_i , T_d is adjustable after observe the application field.

MX (Multiplexer)

The SG2 smart relay includes a total of 15 MX instructions that can be used throughout a program. This special function transmits 0 or one of 4 preset values to MX current value memory. The MX function enables simple operations to be carried out on integers. There are 7 parameters for proper configuration. The table below describes each configuration parameter, and lists each compatible memory type for configuring MX.

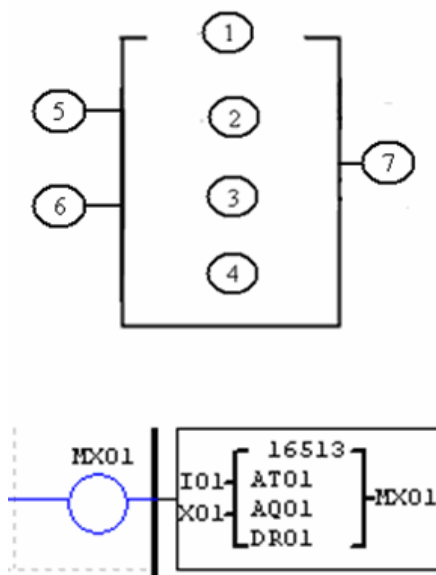


symbol	description
①	V0 parameter (-32768~32767)
②	V1 parameter (-32768~32767)
③	V2 parameter (-32768~32767)
④	V3 parameter (-32768~32767)
⑤	Selection bit 1: S1
⑥	Selection bit 2: S2
⑦	MX code (MX01~MX0F)

The parameters from ① to ④ can be constant or other function current value. The table below describes the relationship between parameter and MX current value.

disable	MX = 0;
enable	S1=0,S2=0: MX = V0; S1=0,S2=1: MX = V1; S1=1,S2=0: MX = V2; S1=1,S2=1: MX = V3;

The example below shows how to configure MX function.

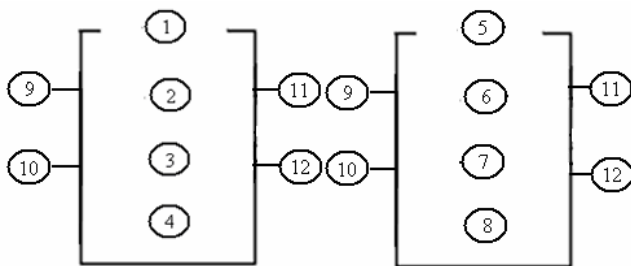


AR (Analog-Ramp)

The SG2 smart relay includes a total of 15 AR instructions that can be used throughout a program. Each AR instruction has 2 modes.

AR mode 1

In mode1, AR function enables simple operations to be carried out on integers. Analog Ramp instruction allows AR current level to be changed by step from starting level to target level at a specified rate. There are 12 parameters for proper configuration. The table below describes each configuration parameter, and lists each compatible memory type for configuring AR.



symbol	Description
①	AR current value: 0~32767
②	Level1:-10000~20000
③	Level2:-10000~20000
④	MaxL (max level):-10000~20000
⑤	Start/Stop level (StSp): 0~20000
⑥	stepping rate (rate): 1~10000
⑦	Proportion (A): 0~10.00
⑧	Excursion (B): -10000~10000
⑨	Level selection coil (Sel)
⑩	Stop selection coil (St)
(11)	Error output coil (M, N, NOP)
(12)	AR code (AR01~AR0F)

$$AR_current_value = (AR_current_level - B) / A$$

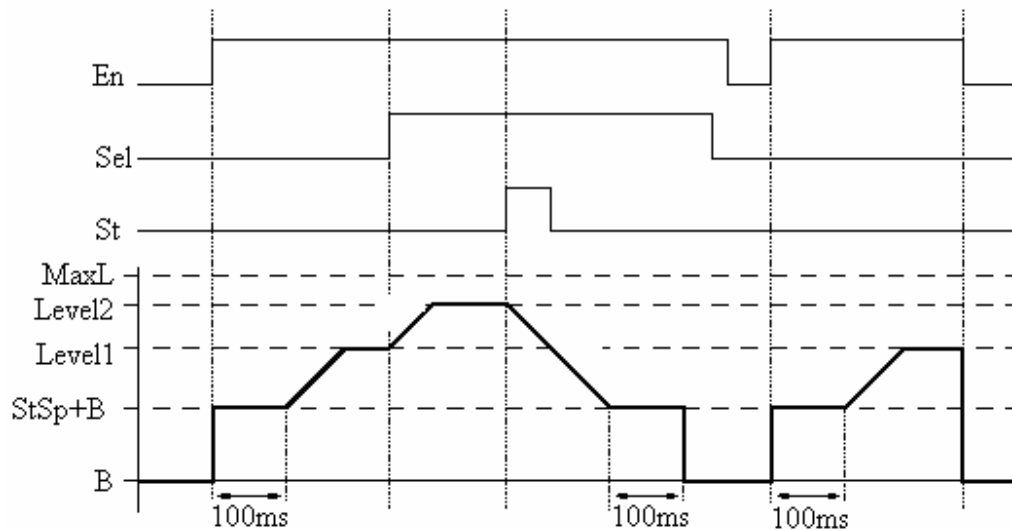
The parameters from ② to ⑧ can be constant or other function current value. The table below describes detail information of each parameter of AR.

Sel	Selection level Sel = 0: target level = Level1 Sel = 1: target level = Level2 ✘ MaxL is used as target level if the selected level is bigger than MaxL.
St	Selection stop coil. The St's state becomes from 0 to 1 will startup the current level decrease to start/stop level (StSp + excursion "B"), and then keep this level for 100ms. Then AR current level is set to B which will make AR current value equals 0.
Output coil	The output coil turns ON when A is 0.

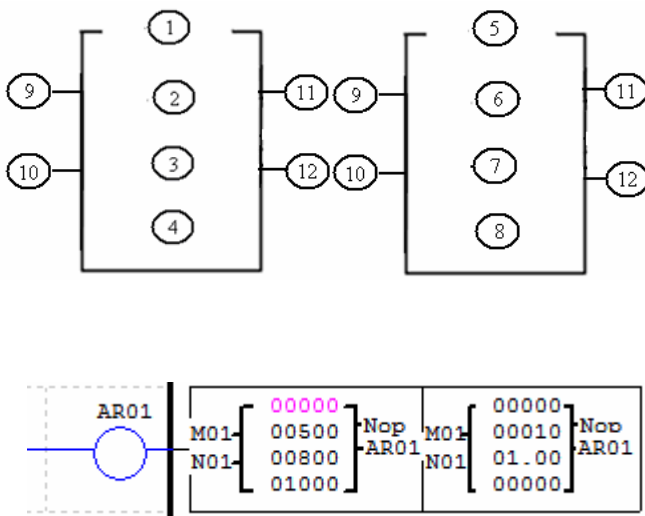
✘ The output coil can be M, N or NOP. The output coil is set when the wrong thing happens, but it will do nothing if the output coil is NOP. And the current value is no meaning at this time.

AR will keep the current level at "StSp + Offset "B"" for 100ms when it's enabled. Then the current level runs from StSp + Offset "B" to target level at enactment Rate. If St is set, the current level decreases from current level to level StSp + B at enactment Rate. Then AR holds the level StSp + Offset "B" for 100ms. After 100ms, AR current level is set to offset "B", which makes AR current value equals 0.

Timing diagram for AR



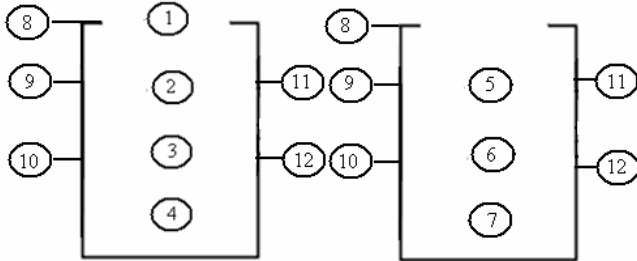
The example below shows how to configure AR function.



The screenshot shows the 'Edit Contact/Coil' dialog box for the AR function. The 'AR' tab is selected. The 'Select Coil No.' is set to AR01 (01~0F). The 'Error Coil' is set to NOP. The 'Function' section shows the current value and the formula $AR = (Level - Offset) / Gain$. The 'Level1' is set to 00500, 'Level2' to 00800, 'MaxL' to 01000, 'StSp' to 00000, 'Rate' to 00010, 'Gain' to 01.00, and 'Offset' to 00000. The 'Sel' section shows 'Contact' set to M and '01'. The 'St' section shows 'Contact' set to N and '01'. The 'OK' and 'Cancel' buttons are at the bottom.

AR mode2

In mode 2, four output levels can be preset, and at one time only one of this 4 preset levels can be target level. The current level will switch to target level at a designed rate by user. There are 12 parameters for proper configuration. The table below describes each configuration parameter, and lists each compatible memory type for configuring AR mode2.



symbol	Description
①	AR current value:0~32767
②	Level0:0~32767
③	Level1:0~32767
④	Level2:0~32767
⑤	Level3:0~32767
⑥	MaxL(max level): 0~32767
⑦	Ta(acceleration time):0.1~3276.7
⑧	AR mode
⑨	Level selection coil(Sel1)
⑩	Level selection coil(Sel2)
(11)	Error output coil(M,N,NOP)
(12)	AR code(AR01~AR0F)

The parameters from ② to ⑦ can be constant or other function current value. The rate designed by user:

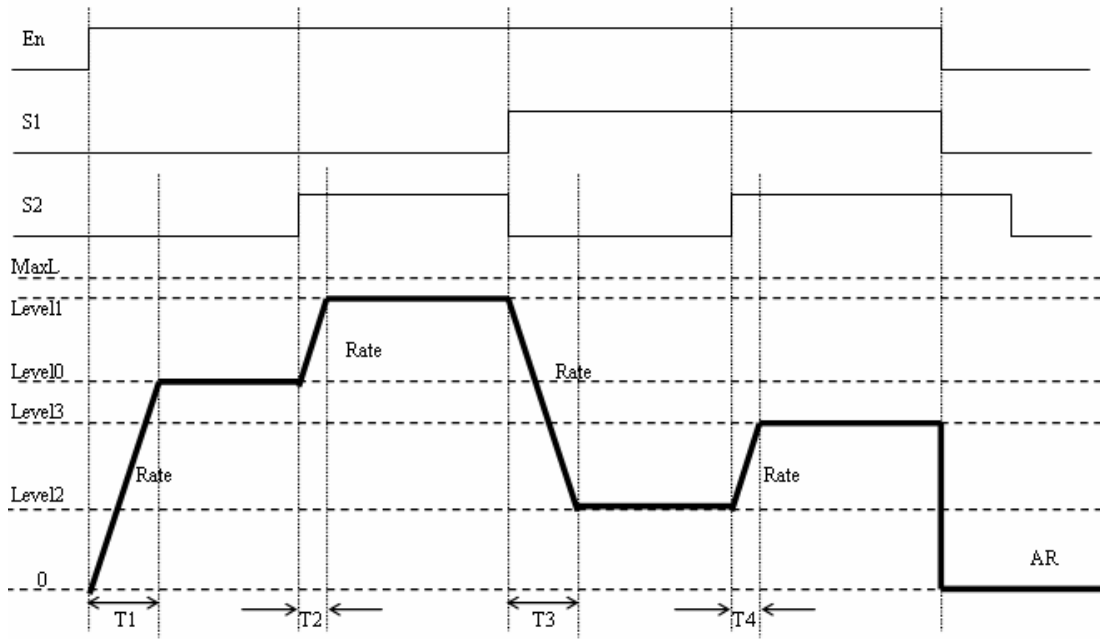
$Rate = \frac{MaxL}{Ta}$. The table below describes detail information of each parameter of AR mode2.

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 used as target level if the selected level is bigger then MaxL.
Ta	The result of MaxL divided by Ta is the change rate from current level to target level.
Output coil	The output coil turns ON when A is 0.

✖ The output coil can be M,N or NOP. The output coil is set when the wrong thing happens, but it will do nothing if the output coil is NOP. And the current value is no meaning at this time.

AR will vary from 0 to current level at a designed rate when it's enabled. Then the current level will change to different level base on Sel1 and Sel2. When AR is disabled, current outputs vary to 0 immediately. For detail, you can see the "Timing diagram" show next page.

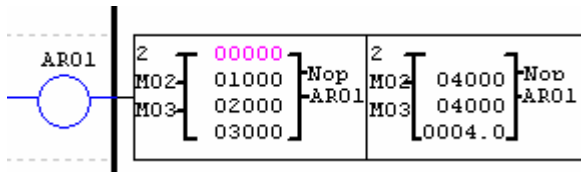
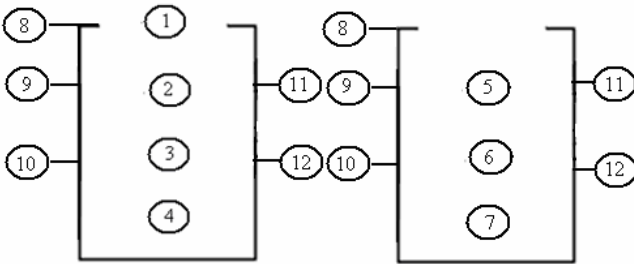
Timing diagram for AR



$$\text{Rate} = \text{MaxL}/\text{Ta}; \quad T1 = \text{Level0} * \text{Ta}/\text{MaxL}; \quad T2 = (\text{Level1} - \text{Level0}) * \text{Ta}/\text{MaxL};$$

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

The example below shows how to configure AR function.



Edit Contact/Coil

AS MD PI MX AR DR

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

Function Mode 2 (1~2)

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)

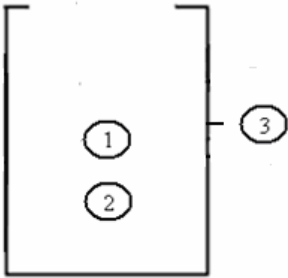
Ta: N 0004.0 (0.1~3276.7)

Sel1 Contact M 02 Sel2 Contact M 03

OK Cancel

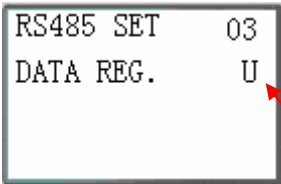
DR (Data register)

The SG2 smart relay includes a total of 240 DR instructions that can be used throughout a program. The DR function is transferring data. DR is a temp register. DR sends data from prevention registers to current register when it's enabled. The data can be signed or unsigned by **Operation>>module system set...** menu selection from the SG2 Client software **or keypad set**. There are 3 parameters for proper configuration. The table below describes each configuration parameter, and lists each compatible memory type for configuring DR.

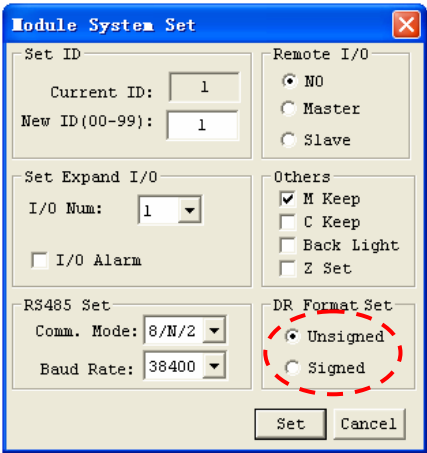


symbol	Description	
①	Current value	Unsigned: 0~65535
②	Preset value	Signed: -32768~32767
③	DR code (DR01~DRF0)	

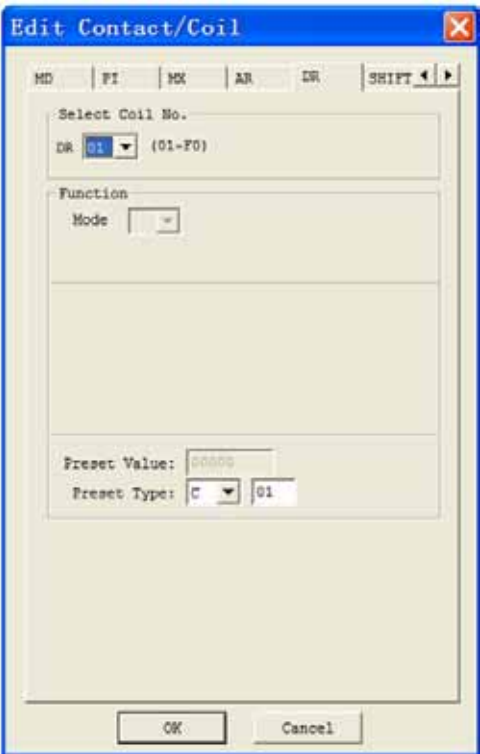
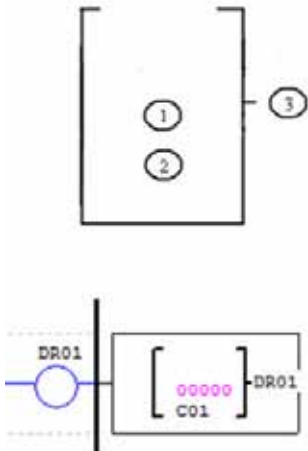
The parameter ① can be a constant or other function current value.



U: unsigned data
S: signed data



The example below shows how to configure DR function.



DATA REGISTER menu display DR preset value in stop mode and display DR current value in run mode.

STOP	RUN (DR01 = C01 current value)
DR01= C01 DR02= 00000 DR03= 00000 DR04= 00000	DR01= 00009 DR02= 00000 DR03= 00000 DR04= 00000

The data registers from DR65 to DRF0 will be kept when the smart stop or powers down.

The last 40 DR that from DRC9 to DRF0 are special data register as shown below.

DRD0 ~ DRE3 as special registers used to set parameters, the output value function is as follows:

No.	Function description	
DRD0	AQ01 output mode	0, voltage mode and reset value when stop; 1, current mode and reset value when stop; 2, voltage mode and keep value when stop; 3, current mode and keep value when stop;
DRD1	AQ02 output mode	
DRD2	AQ03 output mode	
DRD3	AQ04 output mode	
DRD4	AQ01 output value	Analog output value 0~4095;
DRD5	AQ02 output value	
DRD6	AQ03 output value	
DRD7	AQ04 output value	
DRD8	I/O interface hidden	Refer to “ Chapter3:LCD Display and Keypad > Original screen ”
DRD9~DRE3	Reserved;	

DRC9~DRCF and DRE4~DRF0 as special registers used to store status, the output current value function is as follows:

No.	Function description	
DRC9	Output pulse number of instruction PLSY	
DRCA	AT01 current degree Fahrenheit	Used as normal registers when no AT01~AT04 input, such as don't connected with extension module 4PT;
DRCB	AT02 current degree Fahrenheit	
DRCC	AT03 current degree Fahrenheit	
DRCD	AT04 current degree Fahrenheit	
DRCE	Reserved	
DRCF	Reserved	
DRE4	A05 input electric current 0~2000	Used as normal registers when no A05~A08 analog input, such as don't connected with extension module 4AI;
DRE5	A06 input electric current 0~2000	
DRE6	A07 input electric current 0~2000	
DRE7	A08 input electric current 0~2000	
DRE8	A01 current value 0~4095	Used as normal registers when no A01 and A02 analog input, such as AC type;
DRE9	A02 current value 0~4095	
DREA	A03 current value 0~4095	Used as normal registers when no A03 and A04 analog input, such as AC type or 12points DC type;
DREB	A04 current value 0~4095	
DREC	A05 current value 0~4095	Used as normal registers when no A05~A08 analog input, such as don't connected with extension module 4AI.
DRED	A06 current value 0~4095	
DREE	A07 current value 0~4095	
DREF	A08 current value 0~4095	
DRF0	Reserved	

Chapter 6: Function Block Diagram Programming

FBD system memory space.....	132
Analog.....	134
Analog Input	134
Analog Output.....	135
Coil Block Instruction.....	136
HMI.....	137
PWM function block (only transistor output version).....	138
IO Link function block.....	140
SHIFT function block	142
Logic Block Instructions.....	143
AND Logic Diagram.....	143
AND (EDGE) Logic Diagram	143
NAND Logic Diagram.....	144
NAND (EDGE) Logic Diagram.....	144
OR Logic Diagram.....	144
NOR Logic Diagram.....	145
XOR Logic Diagram.....	145
SR Logic Diagram	145
NOT Logic Diagram	145
Pulse Logic Diagram.....	146
BOOLEAN Logic Diagram	146
Function Block.....	147
Timer Function Block	148
Common Counter function block.....	156
High Speed Counter Function Block (DC Version Only)	162
RTC Comparator Function Block	164
Analog Comparator Function Block	169
AS (ADD-SUB) function block	172
MD (MUL-DIV) function block	173
PID (Proportion- Integral- Differential) function block.....	174
MX (Multiplexer) function block.....	175
AR (Analog-Ramp) function block.....	176
Example:	179
DR (Data-Register) function block	180
MU (Modbus) function block	181

FBD Instructions

	Input	Output coil	Range
Input	I		12 (I01~I0C)
Keypad input	Z		4 (Z01~Z04)
Expansion input	X		12 (X01~X0C)
Output	Q	Q	8 (Q01~Q08)
Expansion output	Y	Y	12 (Y01~Y0C)
Auxiliary coil	M	M	63(M01~M3F)
Auxiliary coil	N	N	63(N01~N3F)
HMI		H	31 (H01~H1F)
PWM		P	2 (P01~P02)
SHIFT		S	1 (S01)
I/O LINK		L	8 (L01~L08)
Logic/Function Block	B	B	260 (B001~B260)
Normal ON	Hi		
Normal OFF	Lo		
No connection	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)

FBD program can only be edited and modified in the SG2 Client software and write to SG2 controlled equipments via communication cable. Via controlled equipment, FBD program is available for querying or the parameter of the function block of the program for modifying. The preset value of Block could be a constant or other block code. That means the preset value of this block is other block's current value.

The size of a FBD program in SG2 is limited by the memory space (memory used by the blocks).
Resources available in SG2:

Block number	System memory (byte)
260	6000

※ Function Block includes three kinds of function: special function, adjust-controlling function and communication function. Function type and number are shown in the table below.

	Function type	Number
special function	Timer (T)	250
	Counter (C)	250
	RTC (R)	250
	Analog Comparator (G)	250
adjust-controlling function	Addition and Subtraction (AS)	250
	Multiplication and Division (MD)	250
	PID control (PI)	30
	Multiplexer (MX)	250
	Analog Ramp control (AR)	30
	data register (DR)	240
communication function	Modbus instruction (MU)	250

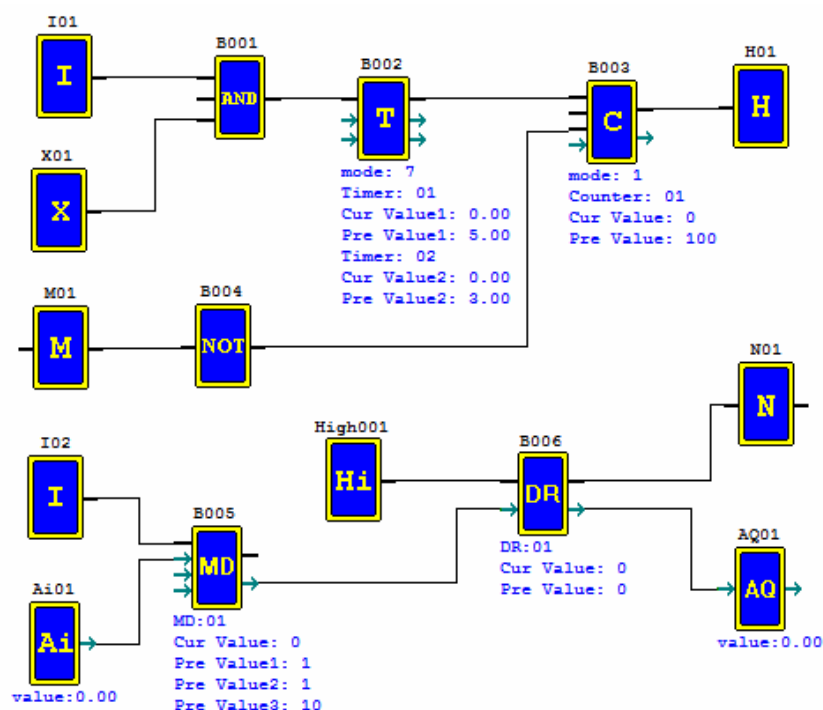
- ✖ Each function block occupied a BLOCK; the available number is limited by the number of B, system memory space and function block number.

[illegible]

※ Logic Block include: AND, AND EDGE, NAND, NAND EDGE, OR, NOR, XOR, NOT, RS, PULSE, BOOLEAN. Each logic block occupied a BLOCK; the available number is limited by the number of B and system memory space. Logic function blocks source show as blow table:

Logic	Block number	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: calculating resources



Number	Function / Logic	Memory bytes	Function number
B001	AND	8	
B002	Timer mode 7	12	T01, T02
B003	Counter mode 1	14	C01
B004	NOT	4	
B005	MD	11	MD01
B006	DR register	6	DR01

	B number	Memory bytes	
Memory space limits in SG2	260	2600	
Resource used by program	6	55	
Still available in SG2	254	2545	

Analog

Analog include:

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

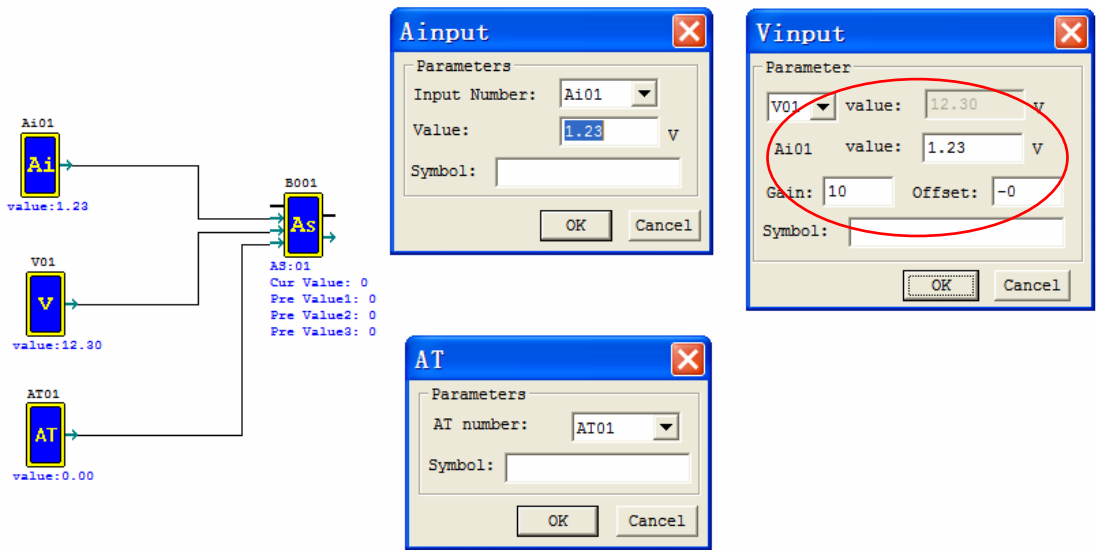
Analog input and output value can be used as preset value of other function blocks.

Analog Input

	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

$$V0x = A0x * Gain + OffSet$$

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



More information about expansion analog input to see: [Chapter 9 Expansion Module-Analog Module](#).

Analog Output

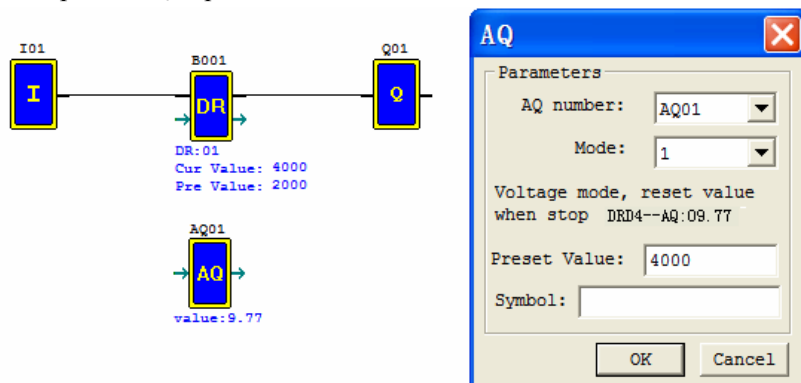
AQ instructions need to use with extension analog out module 2AO.

The default output of AQ is 0~10V voltage, the 12bits data is 0~4095 and the corresponding value of AQ is 0~1000. It also can be set as 0~20mA current output, the 12bits data is 0~2047 and the corresponding value of AQ is 0~500. The 12bits data saved in DRD4~DRD4. The output mode of AQ is set by the current value of DRD0~DRD3.

	Output register	Mode register	Mode	DRD0~DRD3 data definition
Channel 1: AQ01	DRD4	DRD0	1	0: voltage mode and reset value when stop;
Channel 2: AQ02	DRD5	DRD1	2	1: Current mode and reset value when stop;
Channel 3: AQ03	DRD6	DRD2	3	2: voltage mode and keep value when stop;
Channel 4: AQ04	DRD7	DRD3	4	3: Current mode and keep value when stop;

- ✘ It will be thought as 0 if the value of DR isn't in the range of 0~3. That means the output mode of AQ is mode 1.
- ✘ When output value type of AQ is set to constant, AQ output value changed by DR value ($AQx = DRx / 4.095$);
- ✘ When output value type of AQ is set to other parameters variables, DR value changed by AQ output value ($DRx = AQx * 4.095$).
- ✘ More information about expansion analog input to see: [Chapter 8 Expansion Module-Analog Module](#).

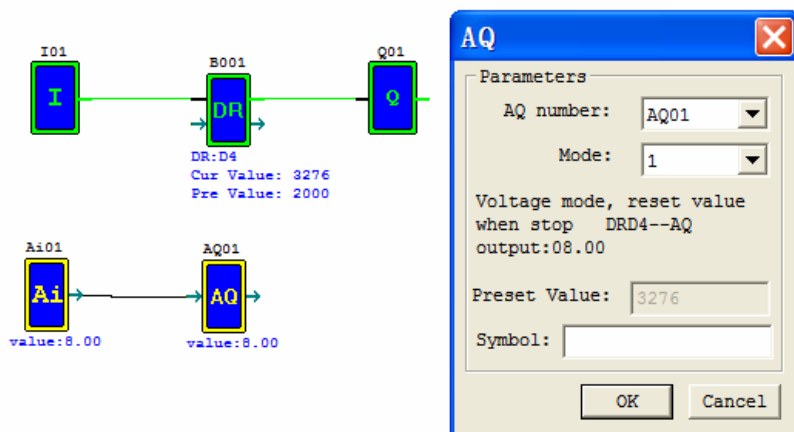
Example 1: AQ01 preset value is constant;



When running and disable M01, DRD4 output value is AQ01 setting value 4000, and AQ01 output 9.77V;

When running and enable M01, adjust the value of DRD4, AQ01 output value changed with DRD4;

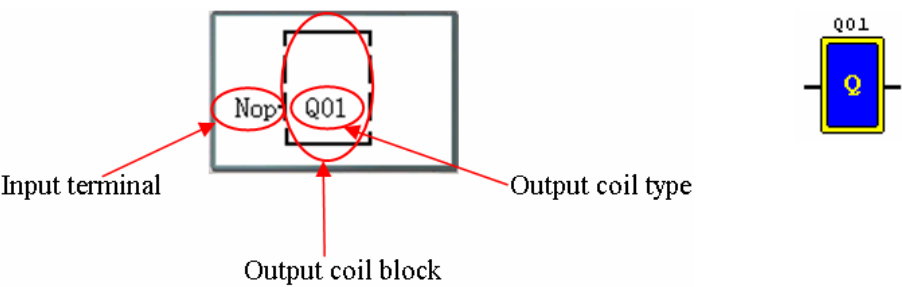
Example 2: AQ01 preset value is other parameters;



When running, DRD4 output value is out control of I01. AQ01 output value is A01, adjust the value of A01, DRD4 output value changed with A01;

Coil Block Instruction

Output coils including Q, Y, M, N, H, L, P, S.
FBD menu display:



H, L, P, S is special function coil, and press “OK” button into function display.

Press the button:

OK	Into function display when cursor address is output coil and coil type is H, L, P, S.
→	Move cursor: input terminal → output coil type → output coil number
←	Move cursor: output coil number → output coil → input terminal → Logic/Function display (input terminal is block)
↑ ↓	Change output coil type when cursor address is output coil: Q ⇔ Y ⇔ M ⇔ N ⇔ H ⇔ L ⇔ P ⇔ S ⇔ Q...; Change output coil number when cursor address is output coil number;

HMI

The SG2 smart relay includes a total of 31 HMI instructions that can be used throughout a program. Each HMI instruction can be configured to display information on the SG2 16×4 character LCD in text, numeric, or bit format for items such as current value and preset value for functions, Input/Output bit status, and text. There are three kinds of text in HMI. They are Multi Language, Chinese (fixed) and Chinese (edit).

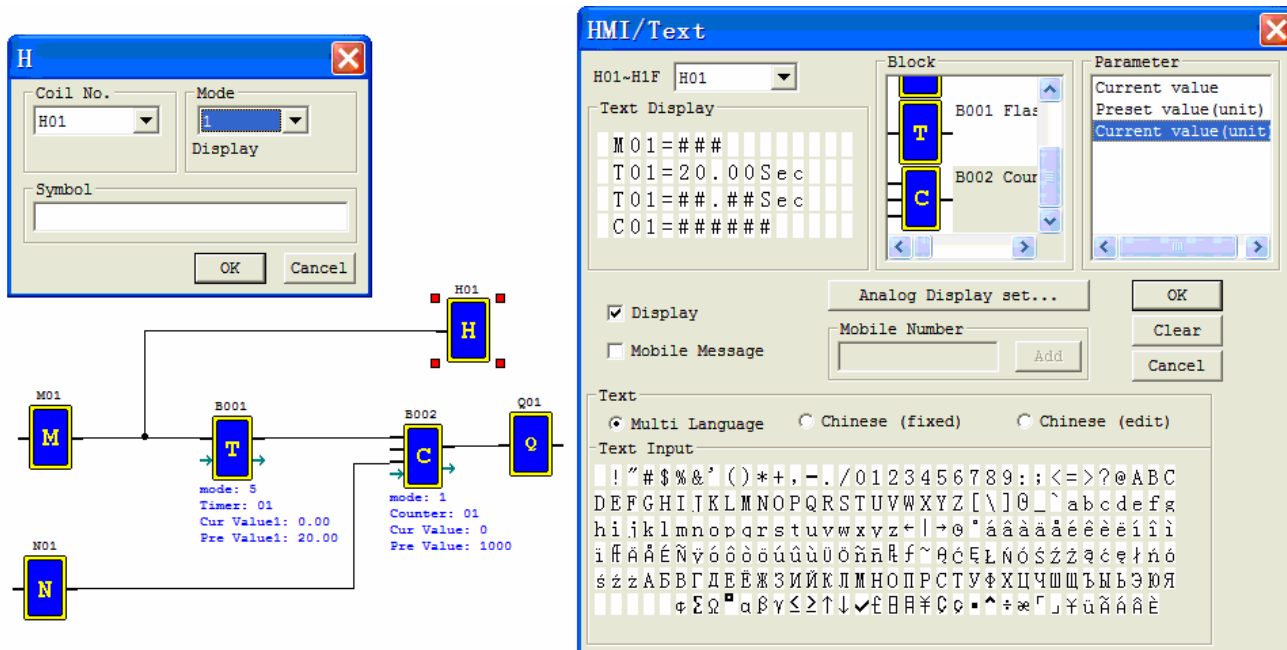
✘ Only the coils, function blocks and analog value which used in the program can be set in HMI to display status, preset value and current value.

Each HMI instruction has a choice of 2 operation modes.

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

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

Example: H01 controlled by M01, and setting H01 model, display M01 status, preset value and current value for block B001 (Timer T01), current value for block B002 (Counter C01).



FBD output coil display M01: enable input coil	Press “OK” button into function display	Press “SEL”, “↑↓” and “OK” to edit HMI mode

HMI display and keypad function, same as ladder mode HMI function.

Press “SEL” button when stopping	Enabled display when running	Press “SEL”, “↑↓” and “OK” to edit preset value, coil status

✘ More information about HMI/TEXT to see:

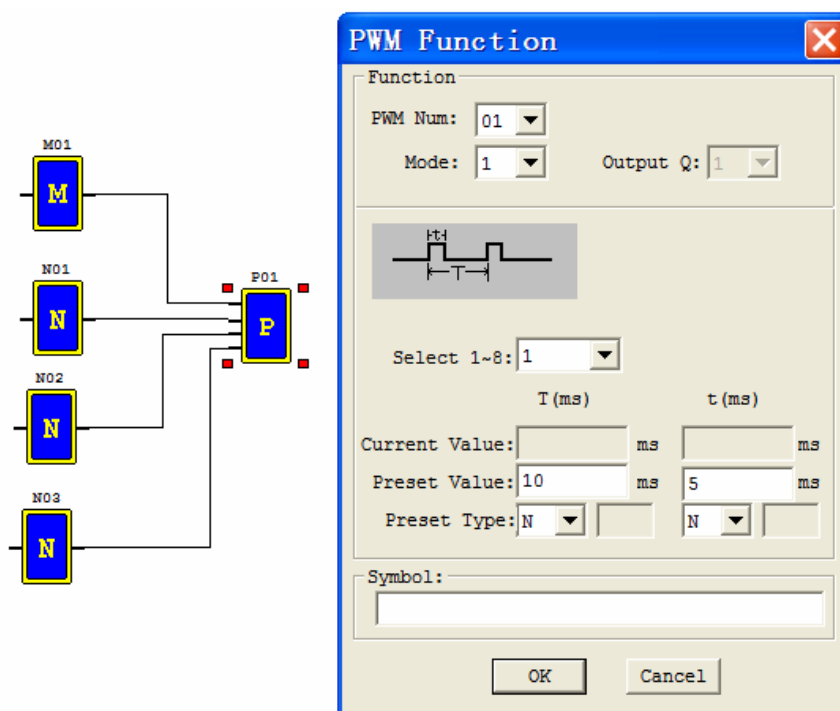
[Chapter 3: Program Tools—Ladder Logic Programming Environment —HMI/TEXT.](#)

PWM function block (only transistor output version)

The transistor output model smart relay includes the capability to provide a PWM (Pulse Width Modulation) output on terminal Q01 and Q02. The PWM instruction is able to output up to an 8-stage PWM waveform. It also provides a PLSY (Pulse output) output on terminal Q01, whose pulse number and frequency can be changed. The table below describes number and mode of PWM.

PWM mode

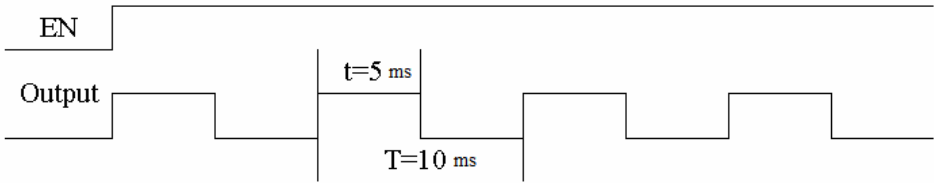
The PWM output terminal Q01 or Q02 can output 8 PWM waveforms. Each PWM has 8 group preset stages which contents Width and Period. The 8 group preset values can be constant or other function current value.



FBD output coil display	Press "OK" button into function display	Press "SEL", "↑↓" and "OK" to select stage and edit preset value
M01 N01 N02 N03 P01	PWM01 Mode:1 SET 1 Out:Q01 TP1=00005 TT1=00010	PWM01 Mode:1 SET 2 Out:Q01 TP2=00002 TT2=00011

Display Description	Enable	Select3	Select2	Select1	stage	PWM Output
P01: PWM code (PWM01~PWM02)	OFF	X	X	X	0	OFF
M01: Enable Input (I01~ B260)	ON	OFF	OFF	OFF	1	Preset stage 1
N01: Select1 (I01~ B260)	ON	OFF	OFF	ON	2	Preset stage 2
N02: Select2 (I01~ B260)	ON	OFF	ON	OFF	3	Preset stage 3
N03: Select3 (I01~ B260)	ON	OFF	ON	ON	4	Preset stage 4
Mode: PWM mode (1)	ON	ON	OFF	OFF	5	Preset stage 5
SET x: present stages as operating (1~8)	ON	ON	OFF	ON	6	Preset stage 6
Out: Output port (Q01~Q02)	ON	ON	ON	OFF	7	Preset stage 7
TPx: Width of preset stage (0~32767 ms)	ON	ON	ON	ON	8	Preset stage 8
TTx: Period of preset stage (1~32767 ms)						

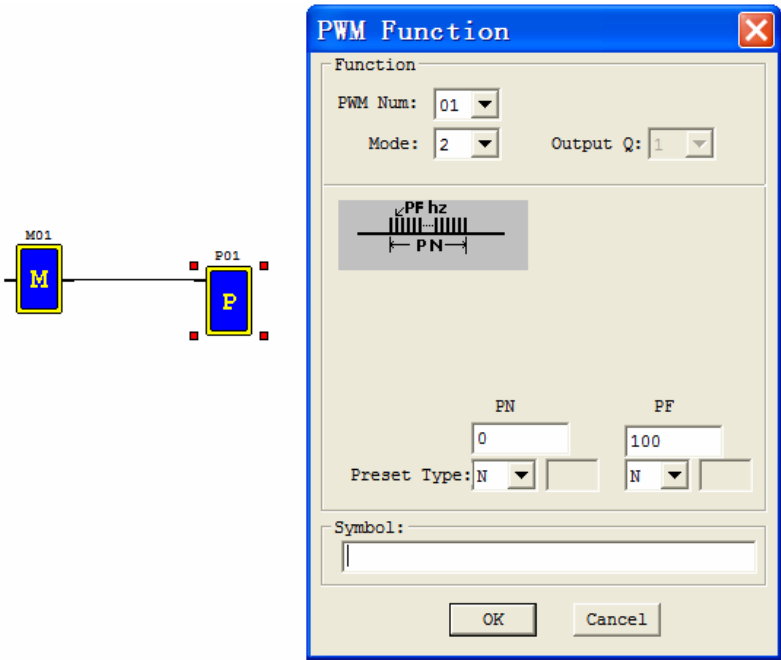
Example:
The state of N01, N02 and N03 are 000, so PWM output pulse is stage1 like this as setting above:



The state of N01, N02 and N03 decide PWM output. PWM stages can be changed by the status of N01, N02 and N03 when P01 is running.

PLSY mode

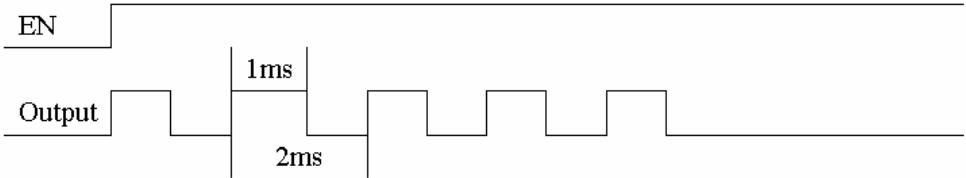
The PLSY output terminal Q01 can output preset number of pulse whose frequency is variable from 1 to 1000 Hz.



FBD output coil display M01: enable input coil	Press “OK” button into function display	Press “SEL” , “↑ ↓” and “OK” to edit preset value

- ※ PF: Preset frequency of PLSY (1~1000Hz); PN: Preset pulse number of PLSY (0~32767);
- ※ Total number of pulse storing in DRC9;
- ※ PLSY stops outputting pulse after it has output PN pulses.
- ※ PLSY will be going on as long as it’s enabled if PN is 0.

Example:
Parameter setting: PF= 500Hz, PN = 5, output as shown below:



PLSY stops outputting when the number of output pulse is completed.

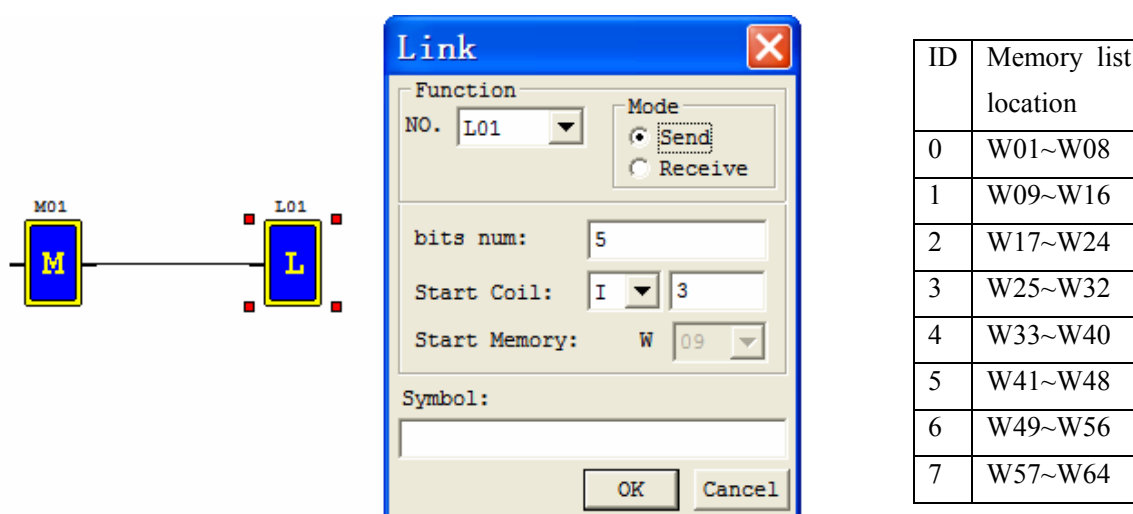
IO Link function block

Up to 8 additional SG2 units can be configured as independent Slave nodes, each running their own logic program and their I/O linked to one Master smart relay. The Master smart relay's ID must be 00, and Slave nodes' ID should start with 01 and be continuous. If nodes' ID isn't continuous, the Master won't communication with those nodes which are behind the first broken. For example, the nodes' ID is 01, 02, 04 and 05. The Master thinks there are only two Slave nodes whose ID is 01 and 02, and communication with them.

Each controller can use 8 IO Link (L01~L08). Only one IO Link instruction can work at Mode 1(send mode), and the other IO Link instructions must be Mode 2 (receive mode).

The Mode 1: Send memory range is determined by the Controller ID. The adjacent table show the memory range of Wxx locations associated with each controller ID.

The Mode 2: read the selected Wxx status and write to the selected coil. If the select coil type is input coil I or X, coil status can't be changed by Wxx status.



FBD output coil display M01: enable input coil	Press "OK" button into function display	Press "SEL" , "↑↓" and "OK" to modify mode, coil number, coil type and W address

Display Description
L01: I/O link output terminal (L01~L08)
M01: Enable Input (I01~ B260)
Mode: Setting mode(1,2) 1:sending; 2:receiving
Num: Number of send/receive points (1~8)
I03...I07: Type of send/receive points
W09...W13: Send/Receive W Table list location

Type of points	Range
Inputs	I01~I0C/i01~i0C
Outputs	Q01~Q08/q01~q08
Auxiliary coil	M01~M3F/m01~m3F
Auxiliary coil	N01~N3F/n01~n3F
Expansion inputs	X01~X0C/x01~x0C
Expansion outputs	Y01~Y0C/y01~y0C

Example 1: IO Link Mode 1

Set mode=1, num=5, set type of points as I03, the state of actual sending terminal I03~I07 is sent to memory list; the controller ID=1, the state of corresponding memory list position W09~W13, and relationship of sending terminal is as below:

mode=1, num=5, type=I03~I07, ID=1 (W09~W13)								
Memory List Position	W09	W10	W11	W12	W13	W14	W15	W16
Corresponding receiving	↑	↑	↑	↑	↑	↑	↑	↑
Or sending terminal	I03	I04	I05	I06	I07	0	0	0

Example 2: IO Link Mode 2

Set mode=2, num=5, set type of points as start from M03, set W table as from W17, when enabling the IO Link, the state “ON/OFF” of M03~M07 is controlled by the state of memory list position W17~W21.

mode=1, num=5, type=M03~M07, W=W17~W21					
Memory List Position	W17	W18	W19	W20	W21
Corresponding receiving	↓	↓	↓	↓	↓
Or sending terminal	M03	M04	M05	M06	M07

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

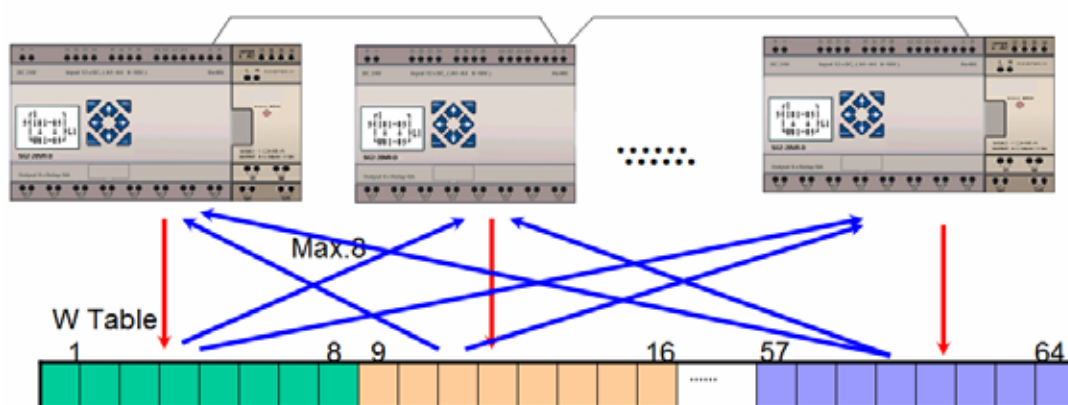
IO Link diagram as blow:

- 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)

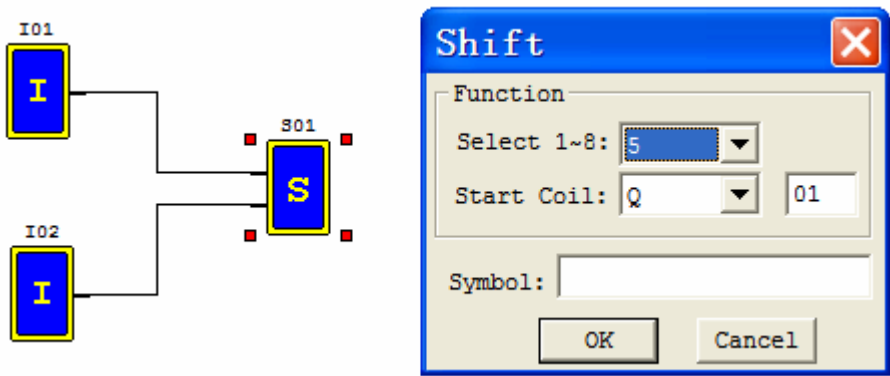
Remote I/O disable



※ More information about IO Link to see “[Chapter 8 20 Points RS485 type Models Instruction](#)”.

SHIFT function block

The SG2 smart relay includes only one SHIFT instruction that can be used throughout a program. This function output a serial of pulse on selection points depending on SHIFT input pulse.

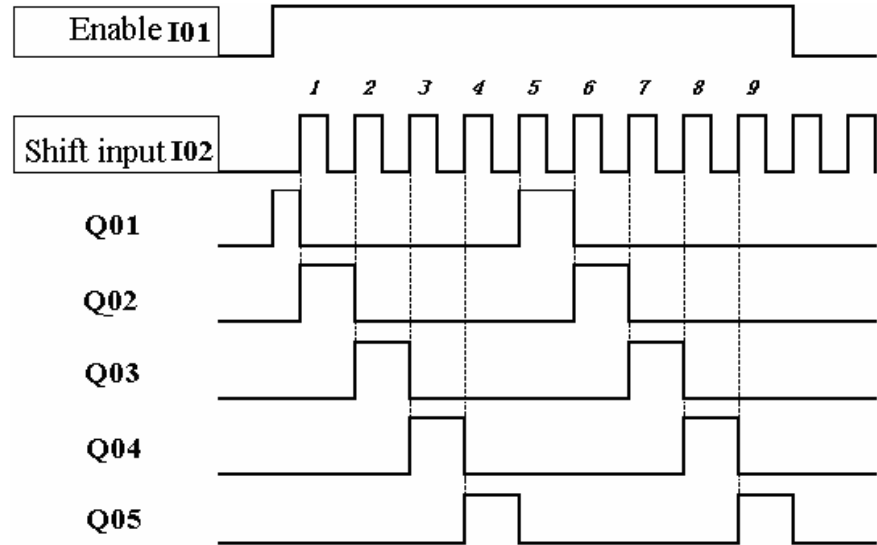


FBD output coil display I01: enable input coil	Press “OK” button into function display	Press “SEL” , “↑↓” and “OK” to modify coil number and coil type

Display Description
S01: Shift code (S01)
I01: Enable Input (I01~ B260)
I02: Shift input (I01~ B260)
Type: Shift output coils
Num: Preset number of output pulse (1~8)

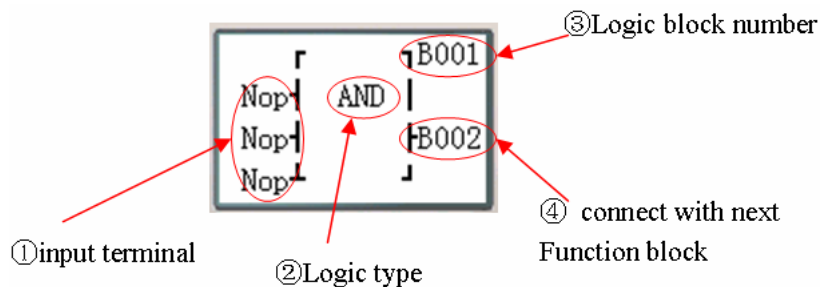
Shift output coils	Range
Outputs	Q01~Q08
Expansion outputs	Y01~Y0C
Auxiliary coil	M01~M3F
Auxiliary coil	N01~N3F

Timing diagram



Logic Block Instructions

Logic blocks display in FBD:

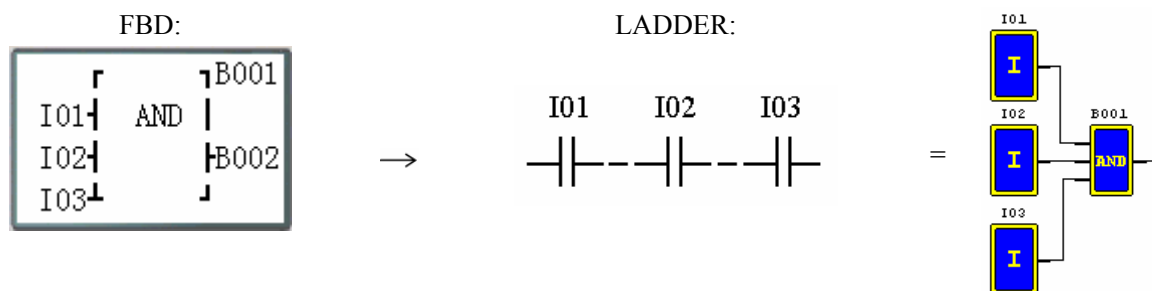


Press the button:

→	Move cursor: input terminals ① → Logic block number ③ → display next connected block or coil
←	Move cursor: Logic block number ③ → input terminals ① → Logic/Function display (input terminal is block)
↑ ↓	Move cursor up or down (when multiple input terminals)

※ Logic Block include: AND, AND EDGE, NAND, NAND EDGE, OR, NOR, XOR, NOT, RS, PULSE, BOOLEAN.

AND Logic Diagram

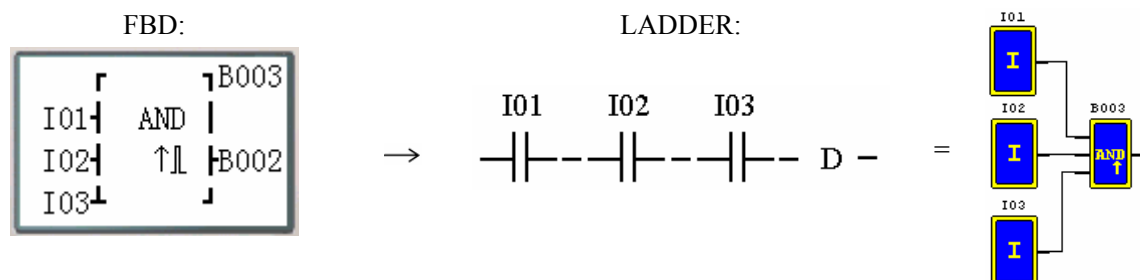


I01 And I02 And I03

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

The B output ON when all input terminals status are ON;

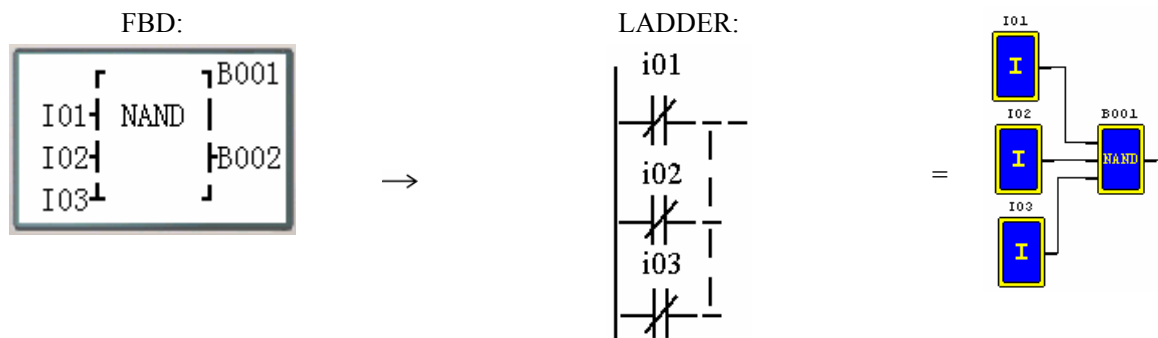
AND (EDGE) Logic Diagram



I01 And I02 And I03 And D

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

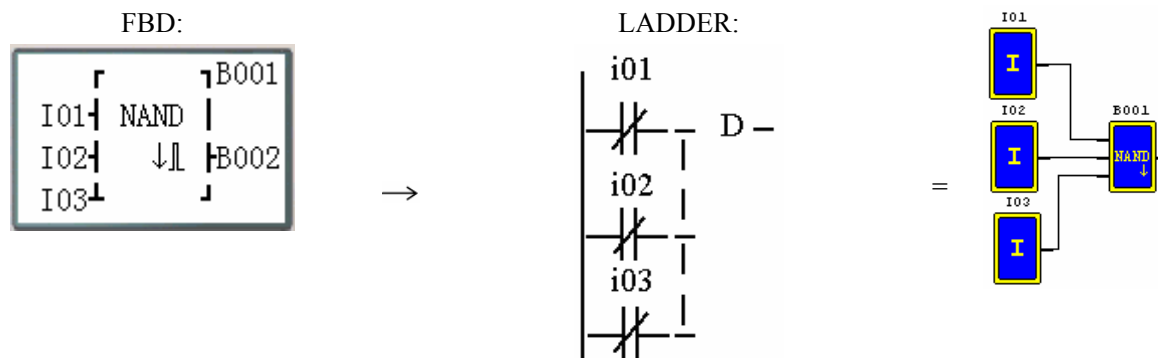
The B output ON a scan cycle time when all input terminals status are ON;

NAND Logic Diagram

Not(I01 And I02 And I03)

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

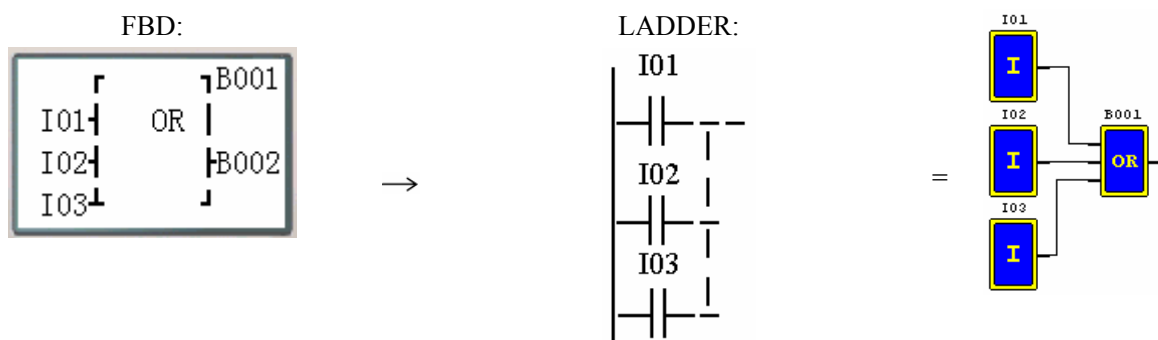
The B output ON when one of the input terminals status is OFF;

NAND (EDGE) Logic Diagram

Not(I01 And I02 And I03) And D

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

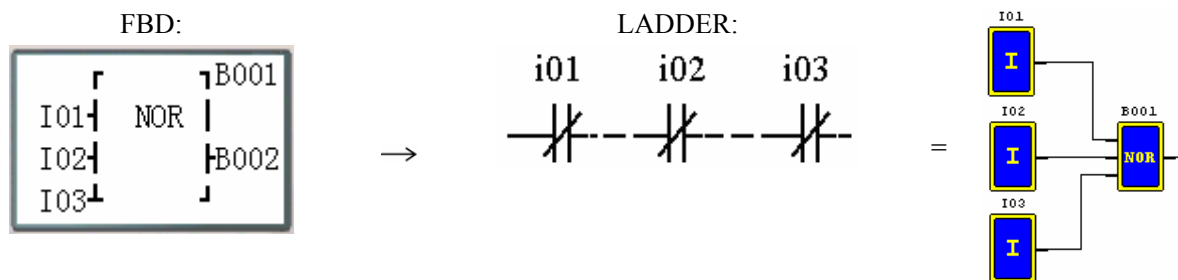
If change one input terminal to OFF when all input terminals are ON, the B output ON a scan cycle time;

OR Logic Diagram

I01 or I02 or I03

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

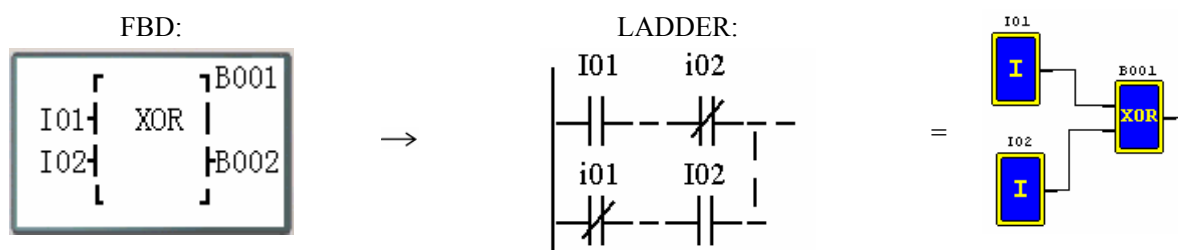
The B output ON when one of the input terminals status is ON;

NOR Logic Diagram

Not (I01 or I02 or I03)

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

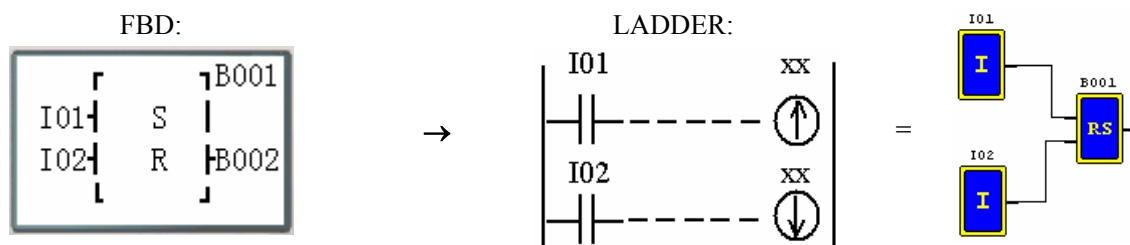
The B output ON when all input terminals status are OFF;

XOR Logic Diagram

I01 XOR I02

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

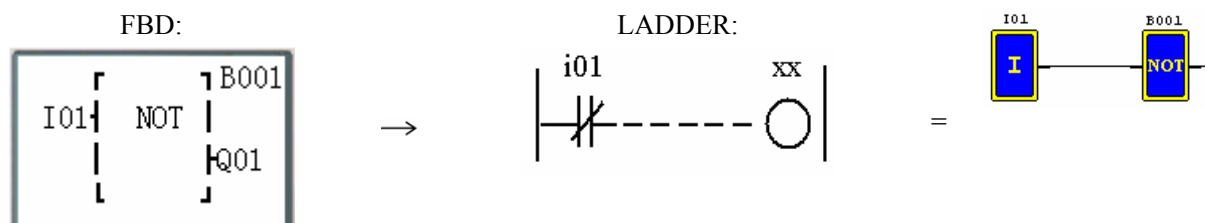
The B output ON when the input terminals status are different;

SR Logic Diagram

Logic Table

I01	I02	B001
0	0	holding
0	1	0
1	0	1
1	1	0

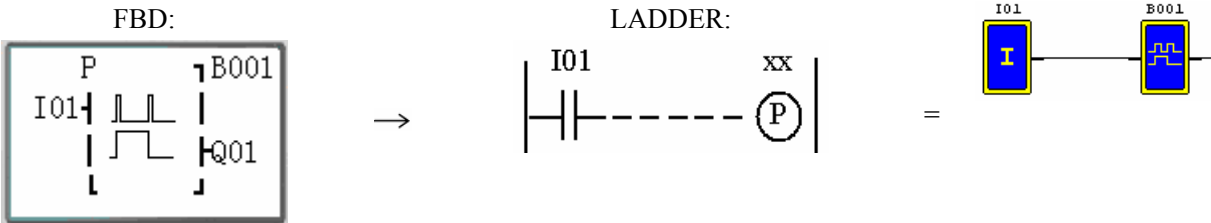
Note: The input terminal is NOP which is equivalent to “Lo”;

NOT Logic Diagram

Not I01

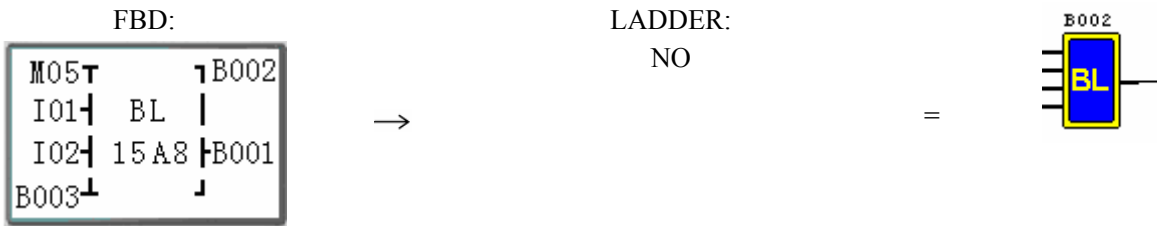
Note: The input terminal is NOP which is equivalent to “Hi”;

Pulse Logic Diagram



Note: The input terminal is NOP which is equivalent to “Lo”;
The B output change status when input terminal OFF→ON;

BOOLEAN Logic Diagram



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

Description:

Input1	M 0 5 T	1 B x x x	block code
Input2	I 0 1 1	B L	
Input3	I 0 2 1	1 5 A 8	1 B y y y real table; output
Input4	B 0 0 3 1		

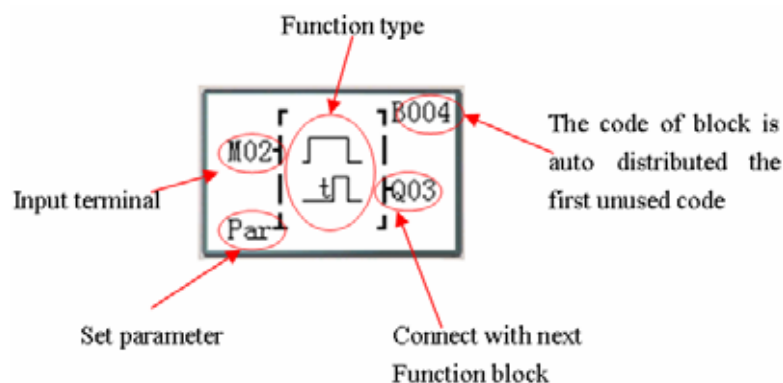
The relationship between input and real table is shown below.

Input1	Input2	Input3	Input4	Output (edit)	Example	Real table
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	

Function Block

Operation rules of FBD function blocks is basically same as ladder mode.

Function blocks display in FBD:

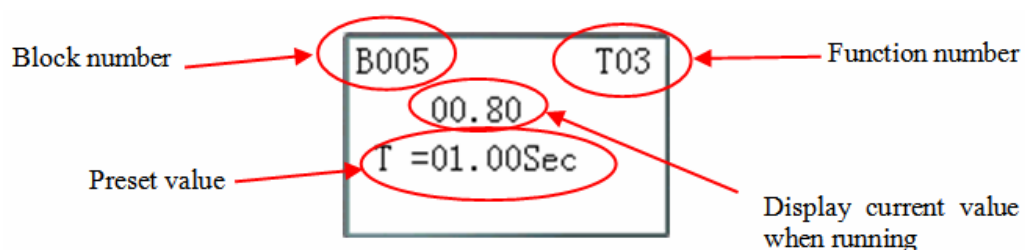


If cursor address is “Par”, user can press “OK” button into parameter display and edit preset value.

Press the button:

→	Move cursor: input terminals or Parameter → Function block number → display next connected block or coil
←	Move cursor: Logic block number → input terminals or parameter → Logic/Function display (input terminal is block)
↑↓	Move cursor up or down (input terminals ⇔ set parameter)
OK	Enter parameter display when cursor address is Set parameter

Parameter display:



Press the button:

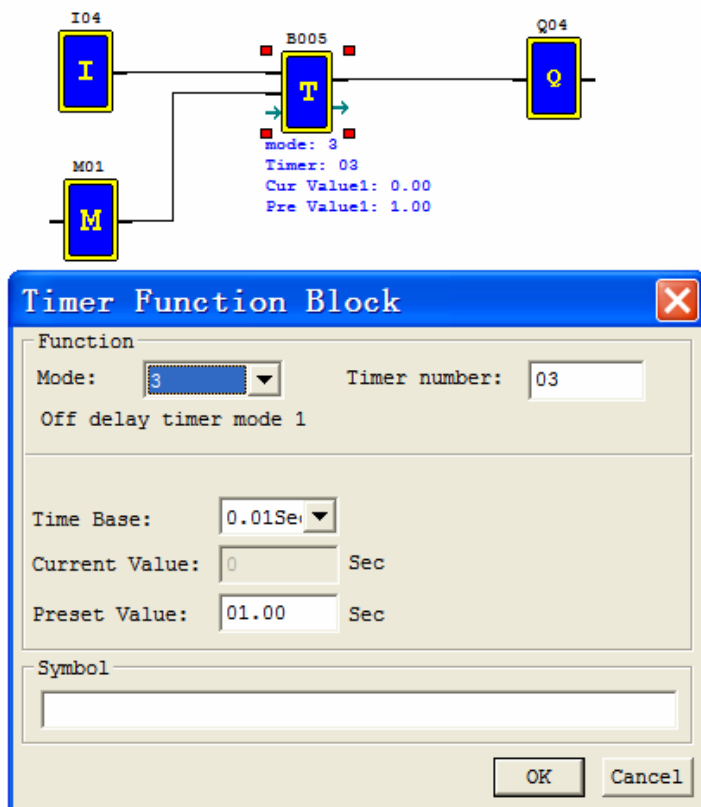
← →	Find and display previous or next function block when cursor address is Block number; Move cursor left or right when cursor address is Preset value;
SEL+↑↓	Find and display previous or next function block when cursor address is Block number;
SEL+← →	Display parameter1 or parameter2 when B function is PI, MX or AR;
↑↓	Move cursor up or down (Block number ⇔ Preset value); Modify data or number when in edit mode;
SEL	Enter edit mode when cursor address is Preset value; Modify preset value type when in edit mode;
ESC	Cancel the current edit; Quite parameter display;
OK	Save the current edit;

Timer Function Block

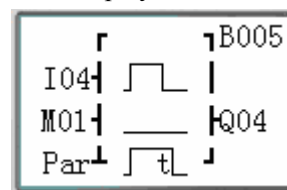
There is a maximum of 250 timers function blocks under FBD mode, can be set mode 0~7 and the function is same as Ladder mode.

- ※ Timer Mode7 occupied one blocks and two timers.
- ※ T0E and T0F keep their current value after a loss of power to the smart relay if “M Keep” is active.

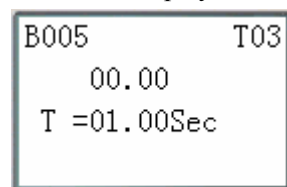
Timer edit and display:



FBD display:

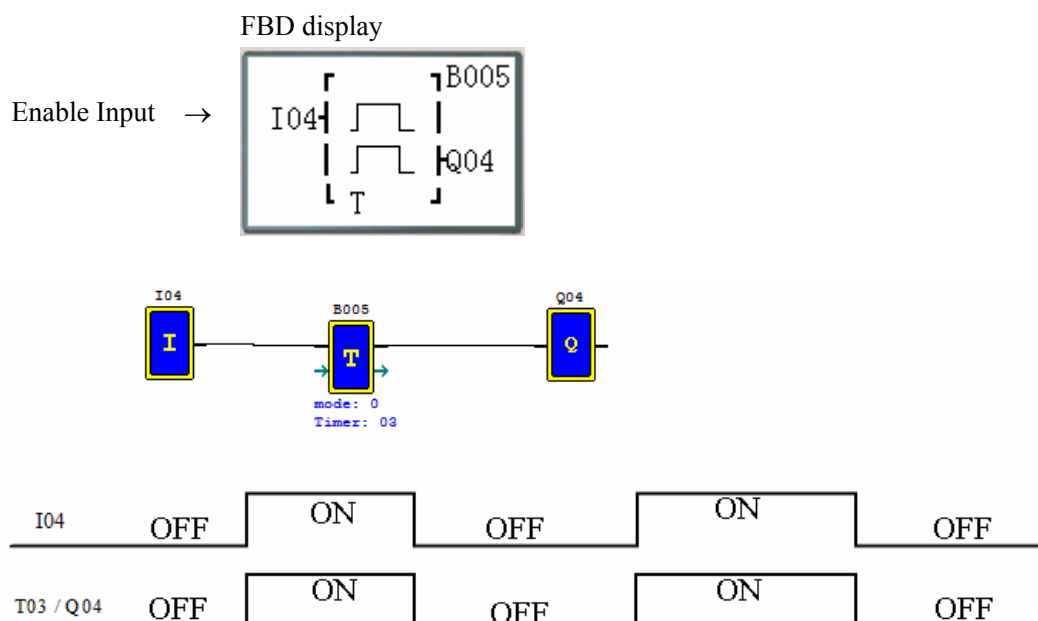


Parameter display:



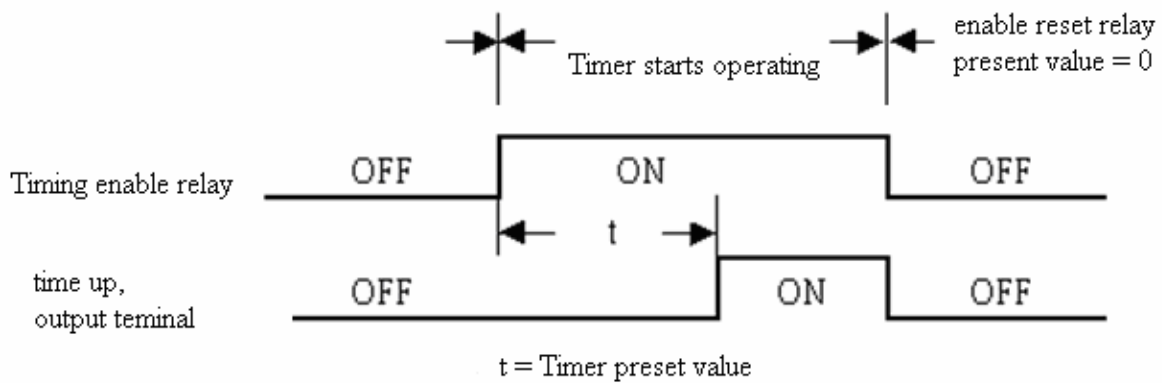
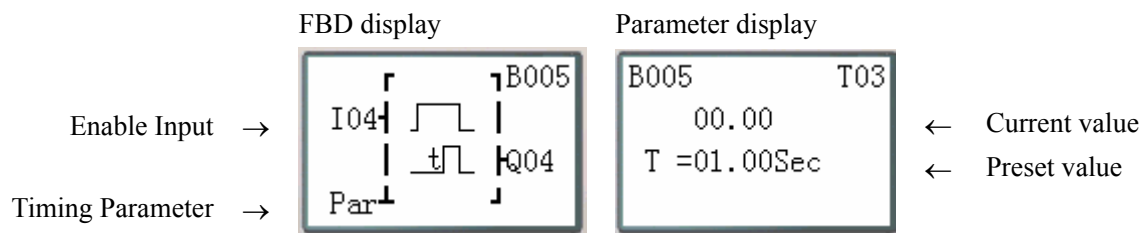
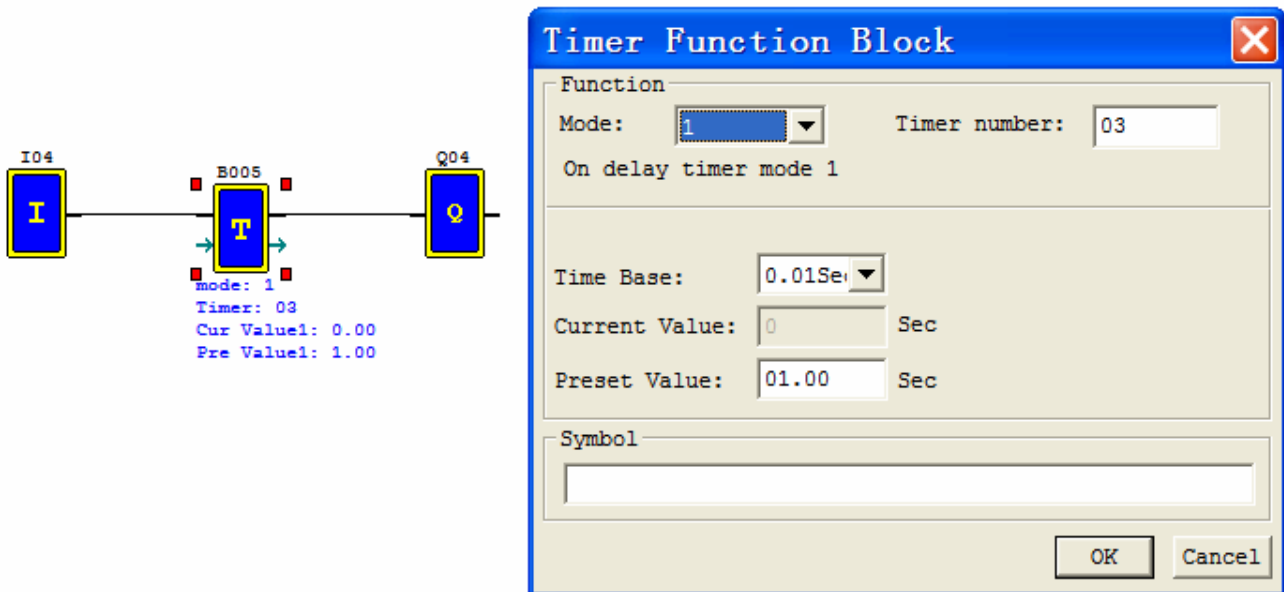
(1) Timer mode 0 (Internal coil Mode)

Mode 0 Timer (Internal Coil) used as internal auxiliary coils. No timer preset value and no parameter display.



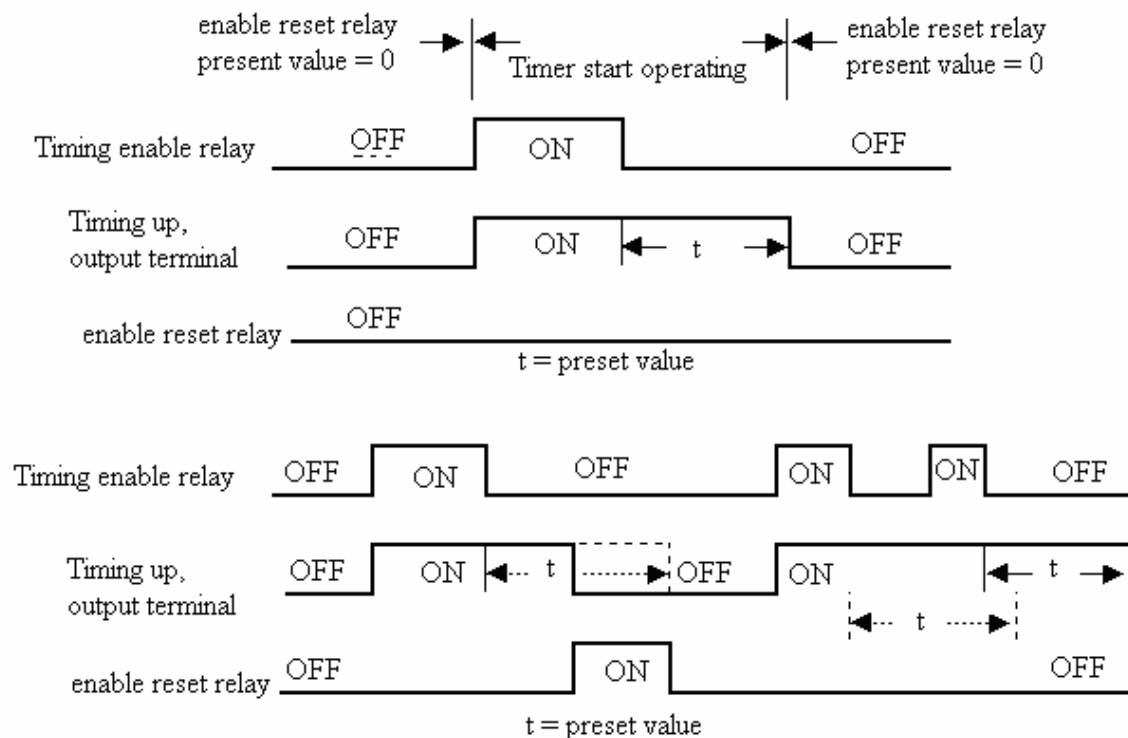
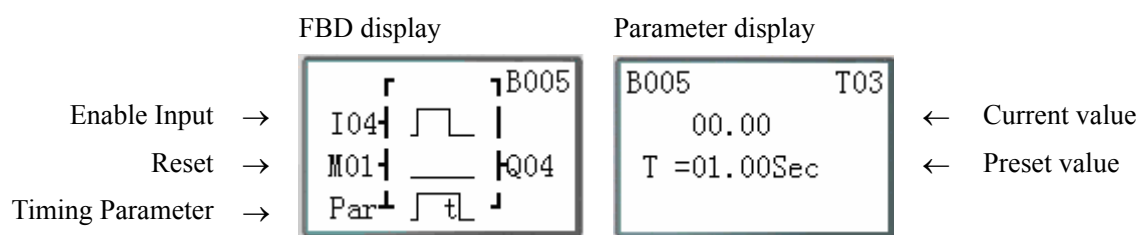
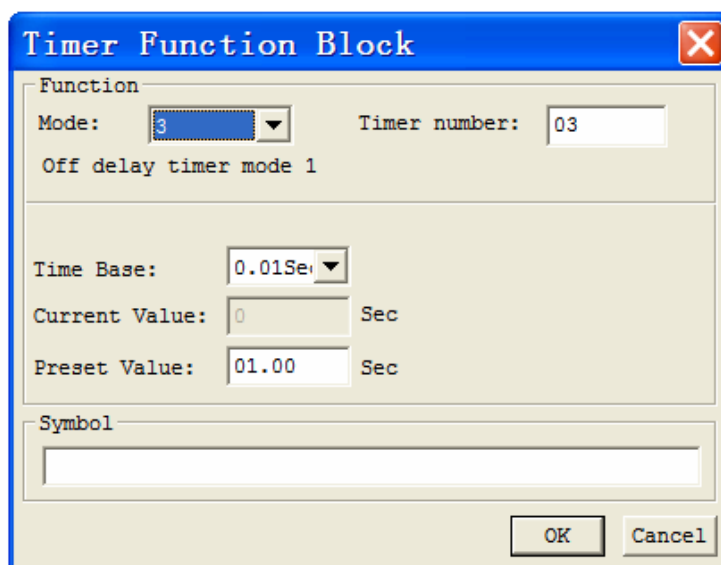
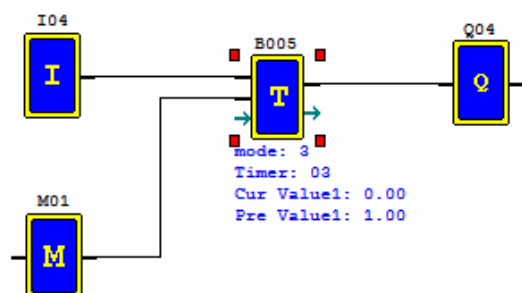
(2) Timer mode 1 (ON-Delay A Mode)

Mode 1 Timer will time up to a fixed value and stop timing when the current time is equal to the preset value. Additionally, the Timer current value will reset to zero when Timer is disabled.



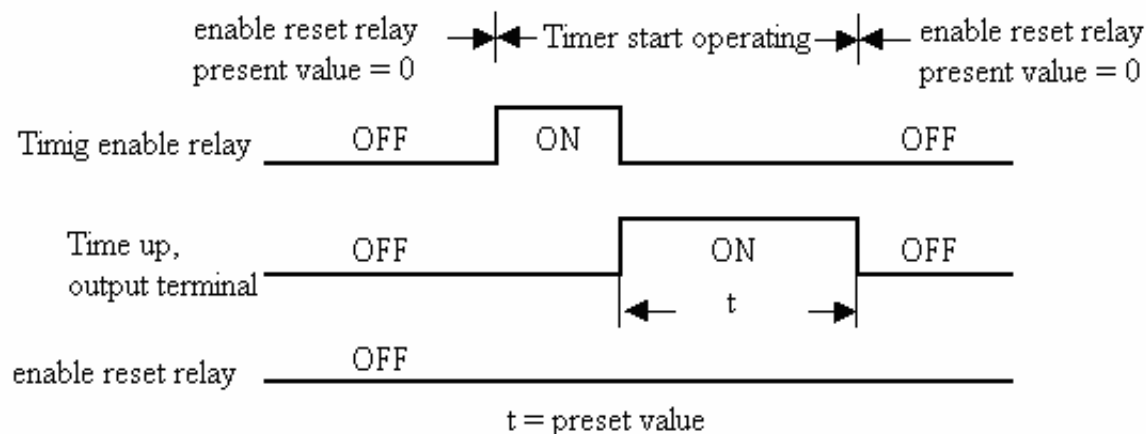
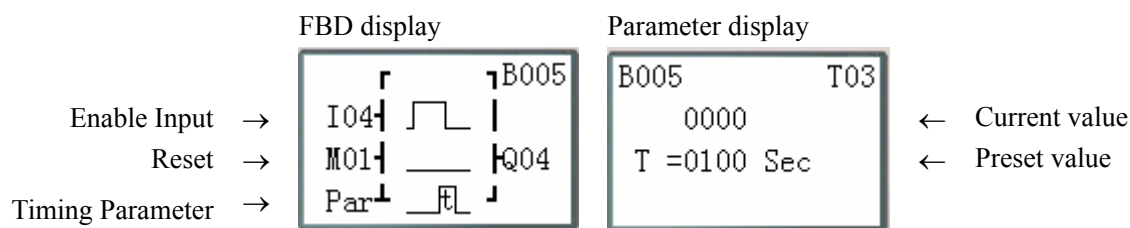
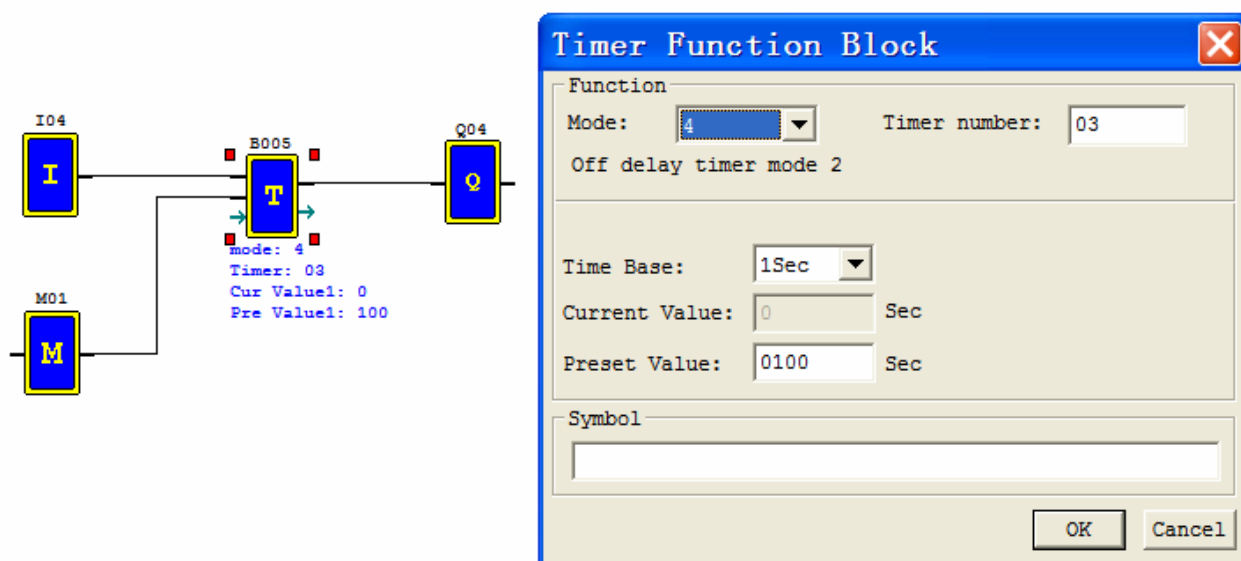
(4) Timer mode 3 (OFF-Delay A Mode)

Mode 3 Timer is an OFF-Delay with reset that will time up to a fixed preset value and stop timing when the current time is equal to the preset value. Additionally, the Timer current value will reset to zero when Timer is disabled.



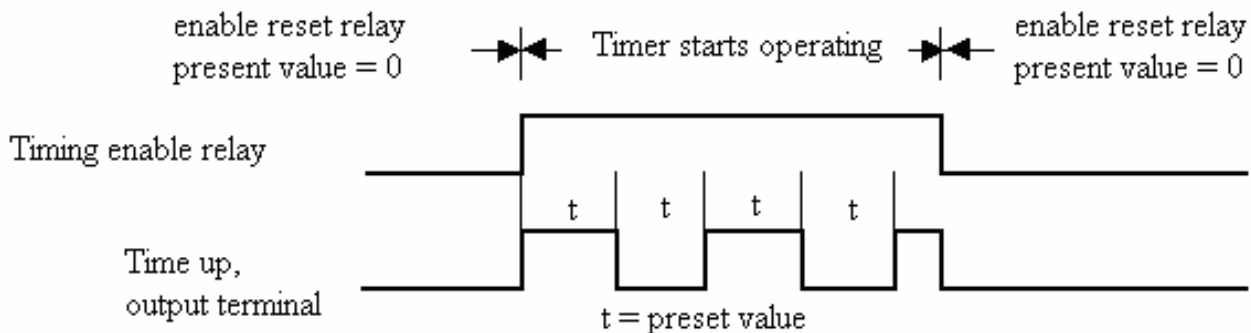
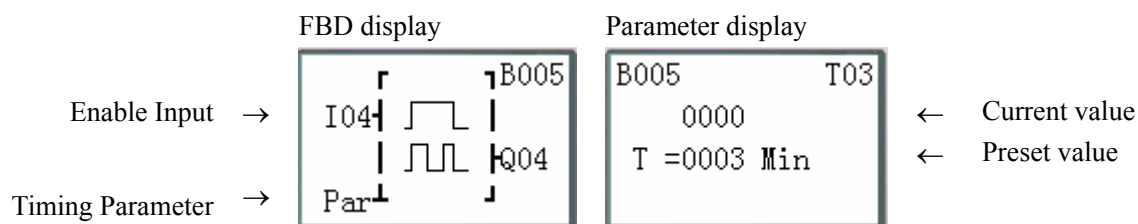
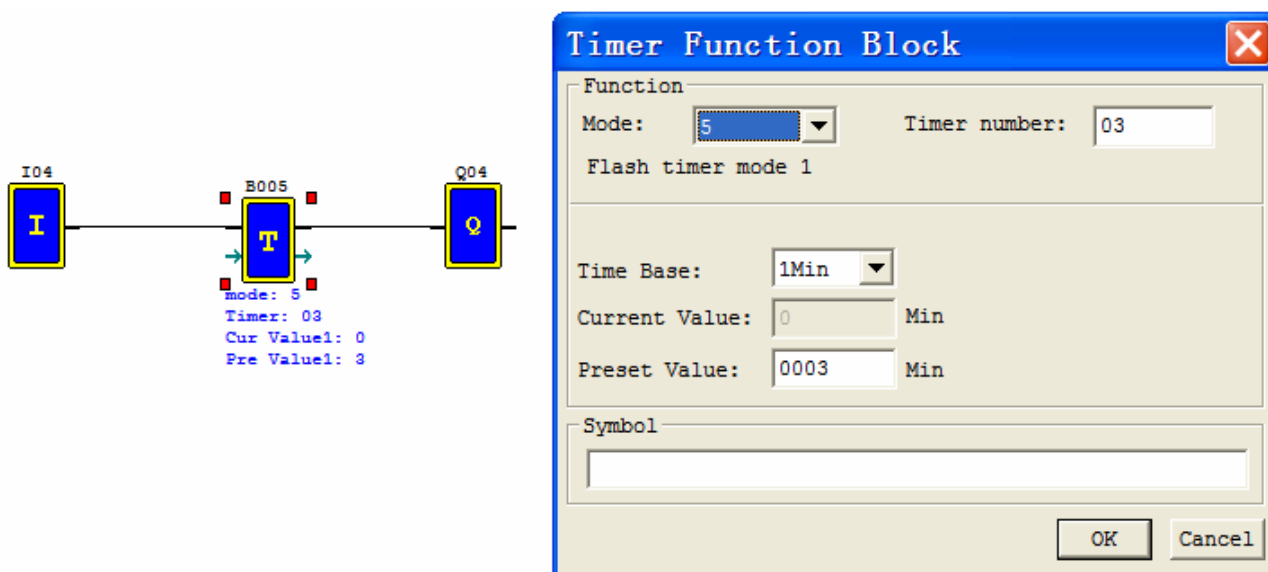
(5) Timer mode 4(OFF-Delay B Mode)

Mode 4 Timer is an OFF-Delay with reset that will time up to a fixed preset value and stop timing when the current time is equal to the preset value. Additionally, the Timer current value will reset to zero when Timer is disabled.



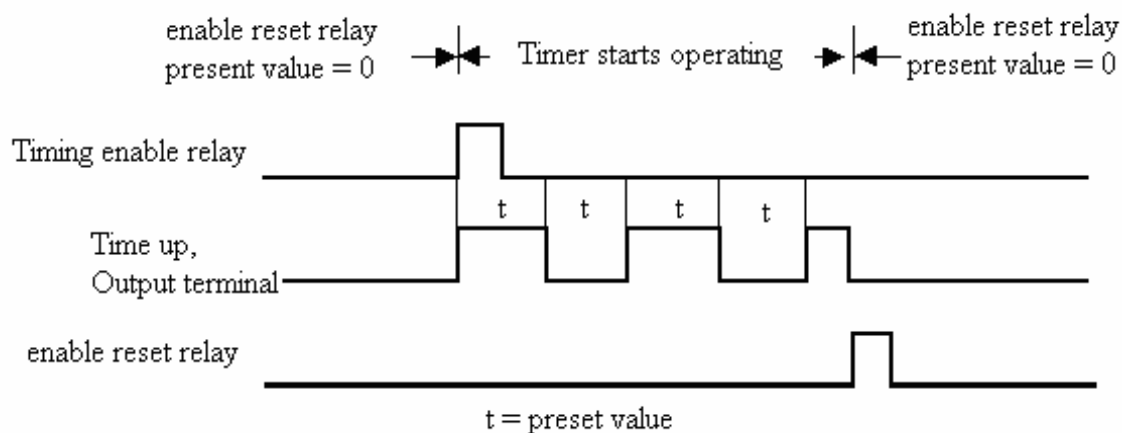
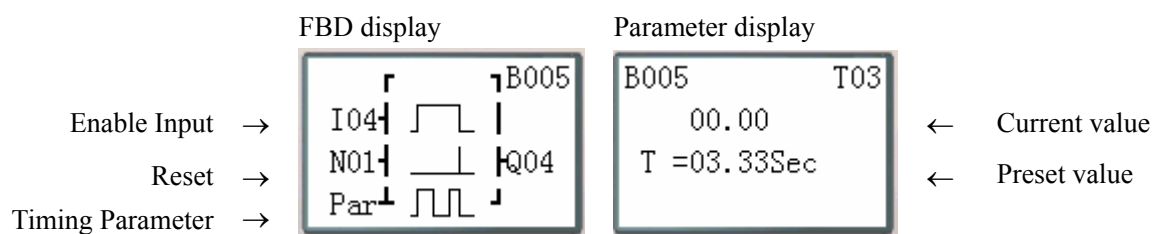
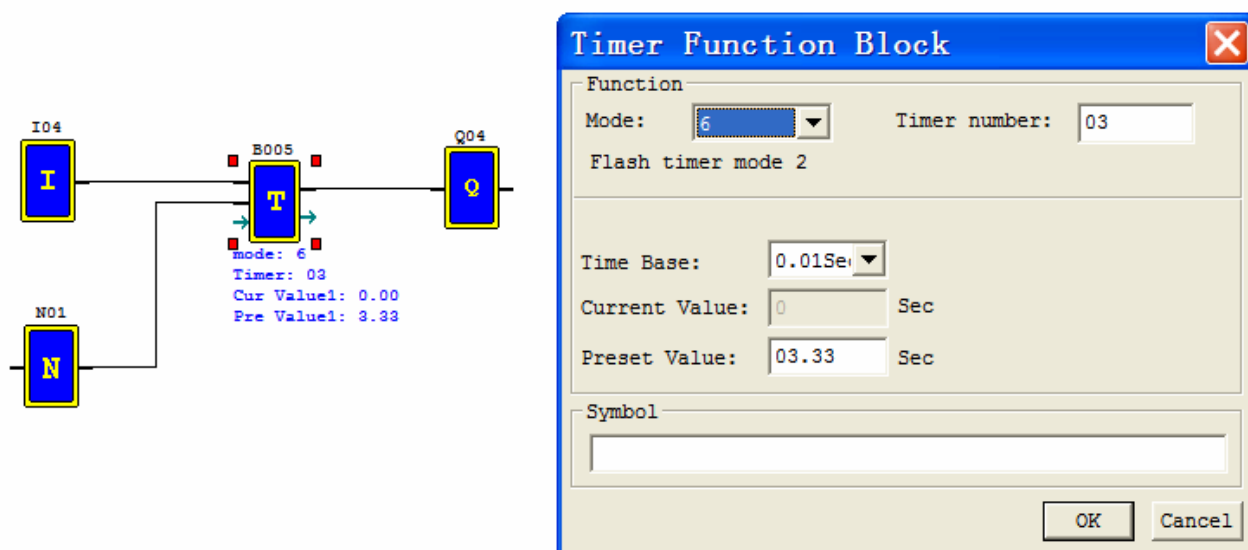
(6) Timer mode 5(FLASH A Mode)

Mode 5 Timer is a Flash timer without reset that will time up to a fixed preset value and then change the state of its status bit. Additionally, the Timer current value will reset to zero when Timer is disabled.



(7) Timer mode 6(FLASH B Mode)

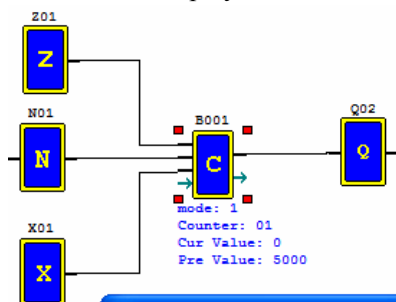
Mode 6 Timer is a Flash timer with reset that will time up to a fixed preset value and then change the state of its status bit. Additionally, the Timer current value will reset to zero when Timer is disabled.



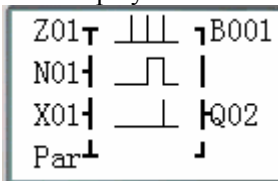
Common Counter function block

There is a maximum of 250 counter function blocks under FBD mode, can be set mode 0~6 as common counter and mode 7~8 as high-speed counter, and the function is same as Ladder mode.

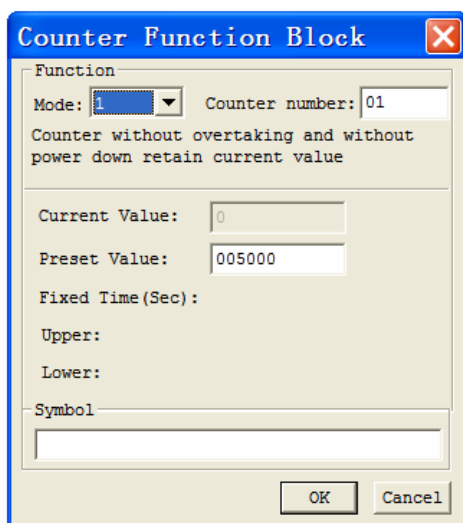
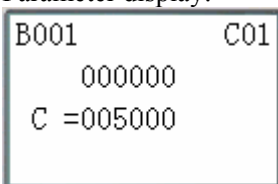
Counter edit and display:



FBD display:

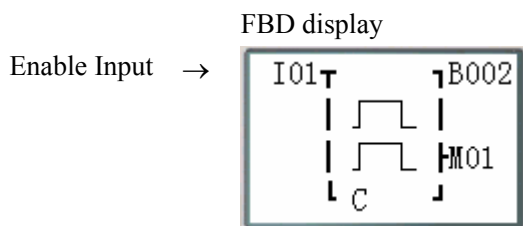


Parameter display:

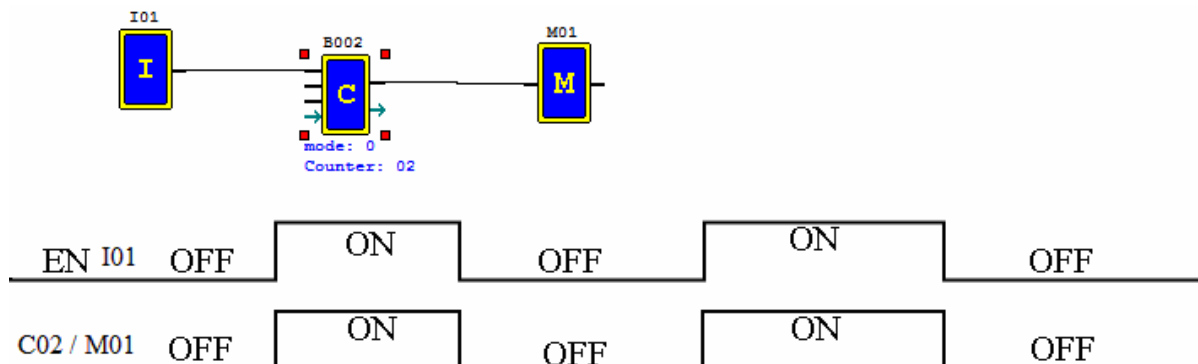
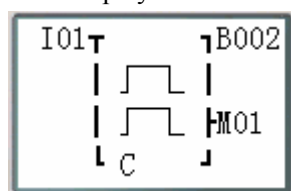


(1) Counter Mode 0 (internal coil)

Mode 0 counter (Internal Coil) used as internal auxiliary coils. No timer preset value and no parameter display.

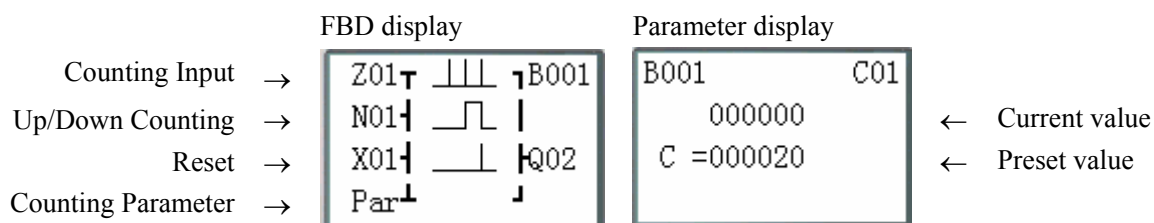
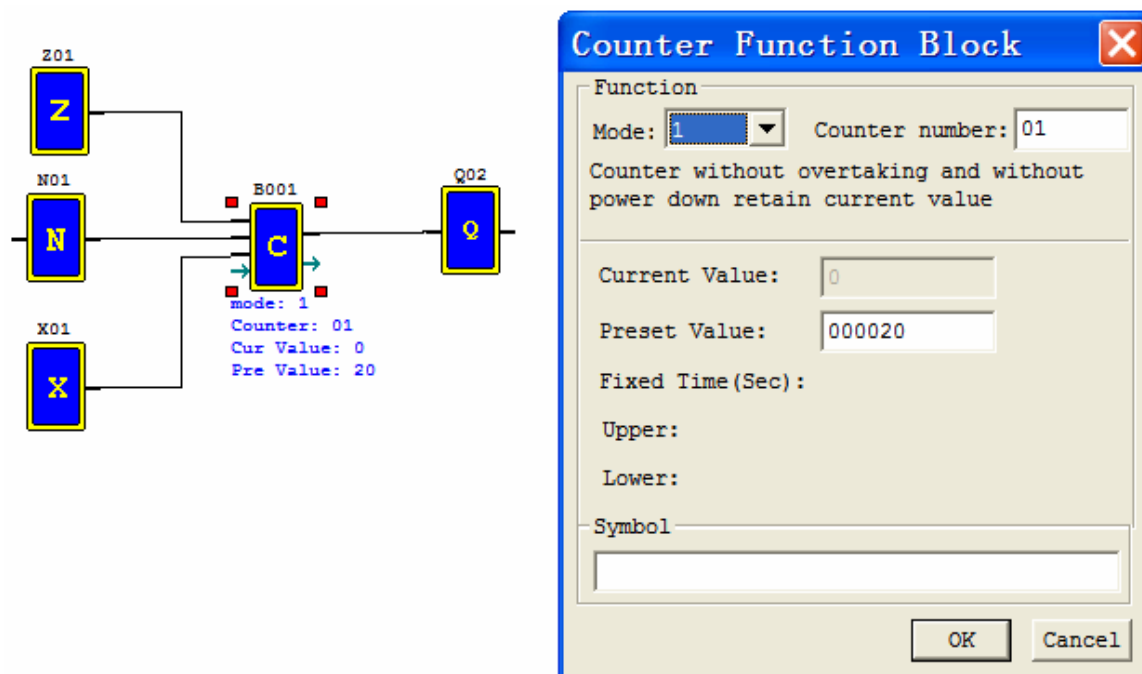


FBD display

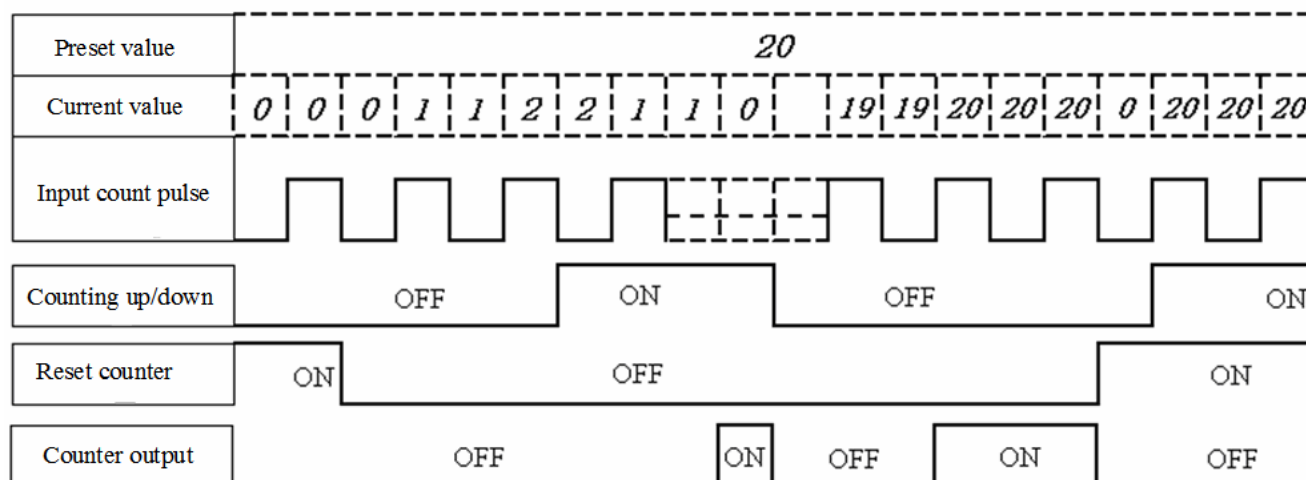


(2) Counter Mode 1 (Fixed Count, Non-Retentive)

Mode 1 Counter will count up to a fixed preset value and stop counting when the current count is equal to the preset value, or count down to 0 and stop counting when the current count is equal to 0. Additionally, the current count value is non-retentive and will reset to init value on a powering up to the smart relay.



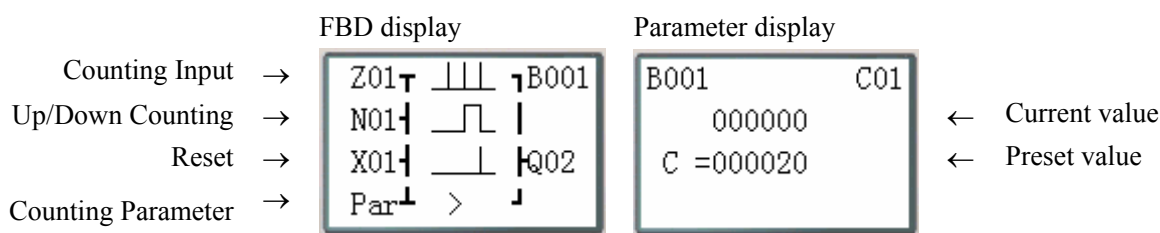
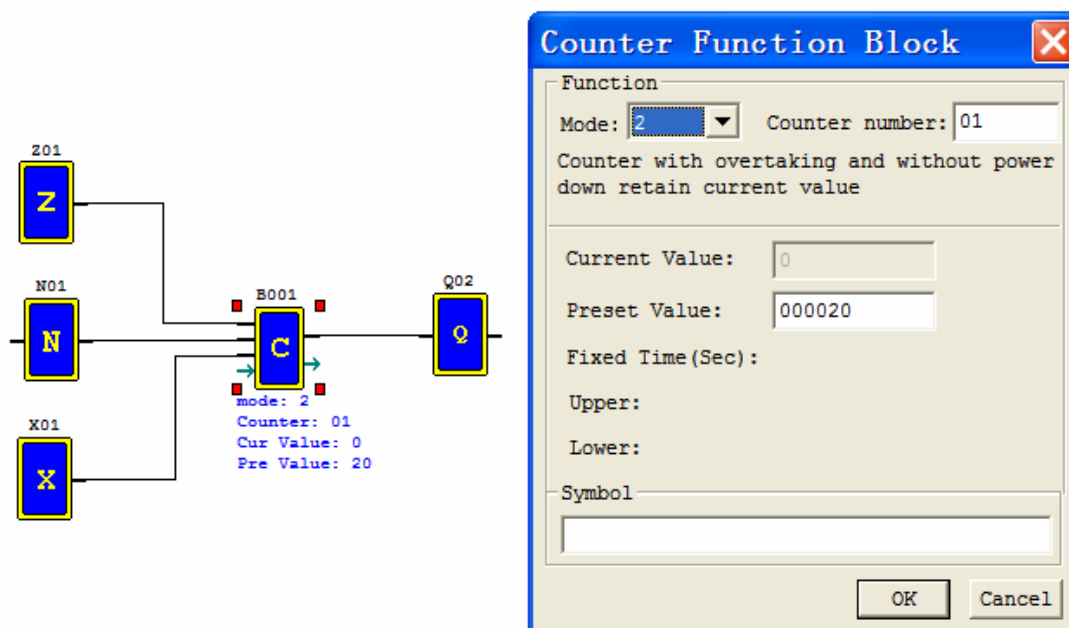
Mode=1



※ Under this mode, the counter current value will be init value when the smart is power up or switching between RUN and STOP. The init value is 0 if the counter configured as counting up, else, it is preset value.

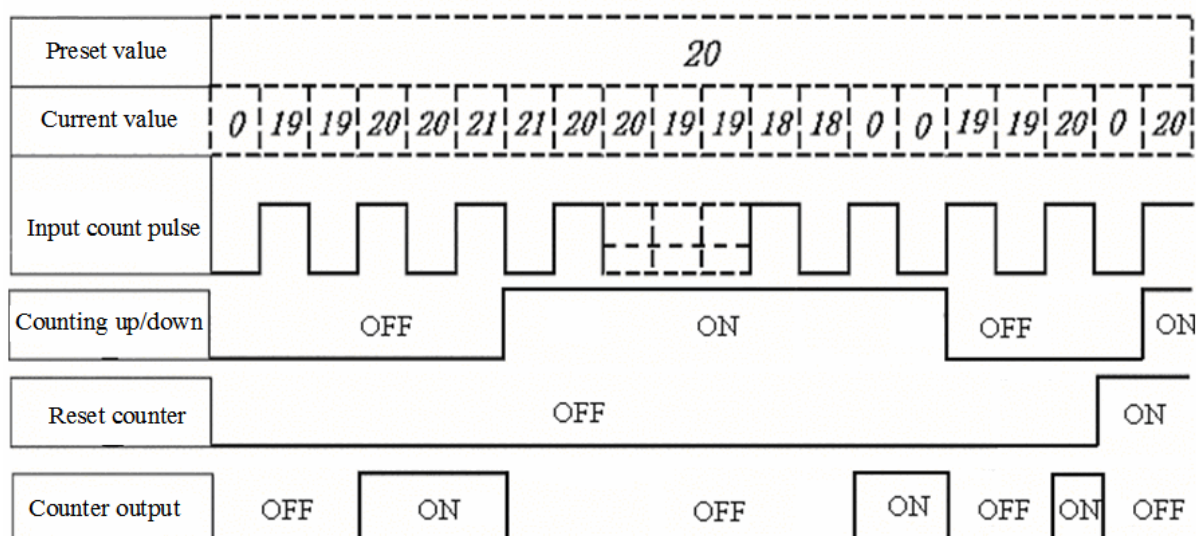
(3) Counter Mode 2 (Continuous Count, Non-Retentive)

Mode 2 Counter will count up to a fixed preset value and continue counting after the preset value, but it won't count when the current value equals 0 if it's configured as down Counter. Additionally, the current count value is non-retentive and will reset to init value on a powering up to the smart relay or switching between RUN and STOP.



Note: The ">" means the current value appeared will be greater than present value.

Mode=2

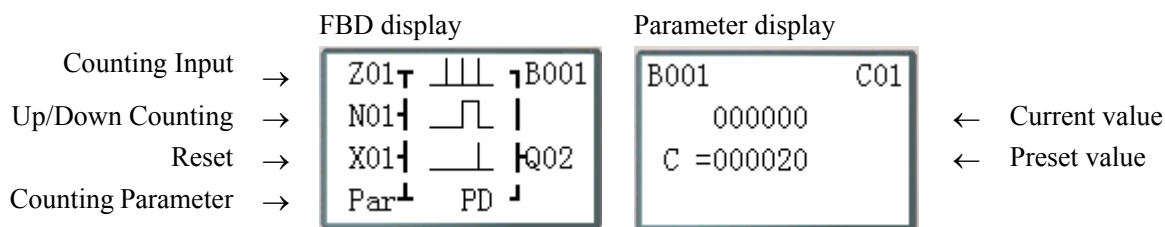


✘ Under this mode, Counter will continue counting after reaching preset value if it's configured as counter up. But it stops counting when its current value is 0 if it's configured as counter down.

✘ The counter current value will be init value when the smart's status switches between RUN and STOP or the smart is power up. If the counter configured as counting up, the init value is 0, else, it is preset value.

(4) Counter Mode 3(Fixed Count, Retentive)

Mode 3 Counter operation is similar to Mode 1 except its current count value is retentive when Counter powers down. So, the current value won't be init value when Counter powers up, but be the value when it powering down. Mode 3 Counter will count up to a fixed preset value and stop counting at that value, or stop counting when its current value is 0 if it's configured as down counter.



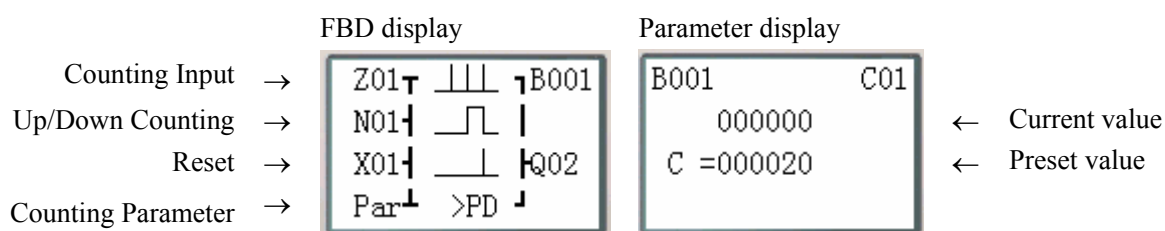
Note: The “PD” means the current value will be retain until the power recover ;

This mode is similar to mode 1, but:

- ✘ First 31 Counter functions (C01~C1F) can keep their current value after a loss of power to the smart relay.
- ✘ The current counter value will keep when the smart switches between RUN and STOP if C-keep is active.

(5) Counter Mode 4(Continuous Count, Retentive)

Mode 4 Counter operation is similar to Mode 2 except its current count value is retentive. The current count value is retentive and will keep its current count after a loss of power to the smart relay. Mode 4 Counter will count up to a fixed preset value and then continue counting after the preset value, but it won't count when the current value equals 0 if it's configured as down Counter.

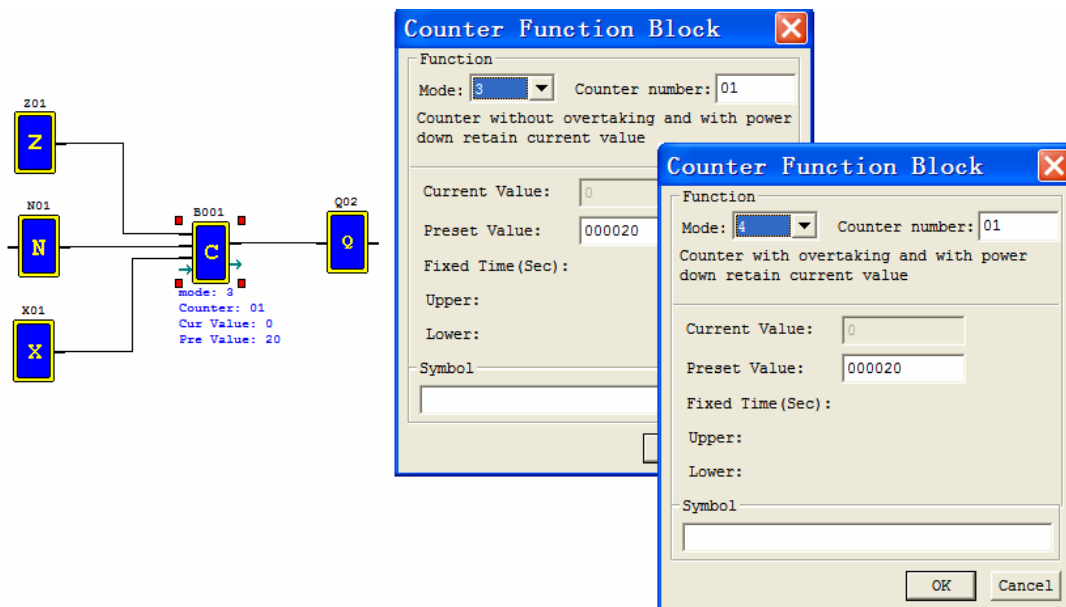


Note: The “>” means the current value appeared will be greater than present value;

The “PD” means the current value will be retain until the power recover ;

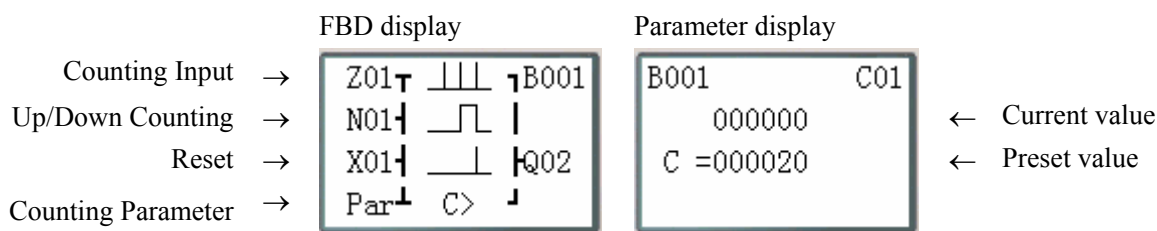
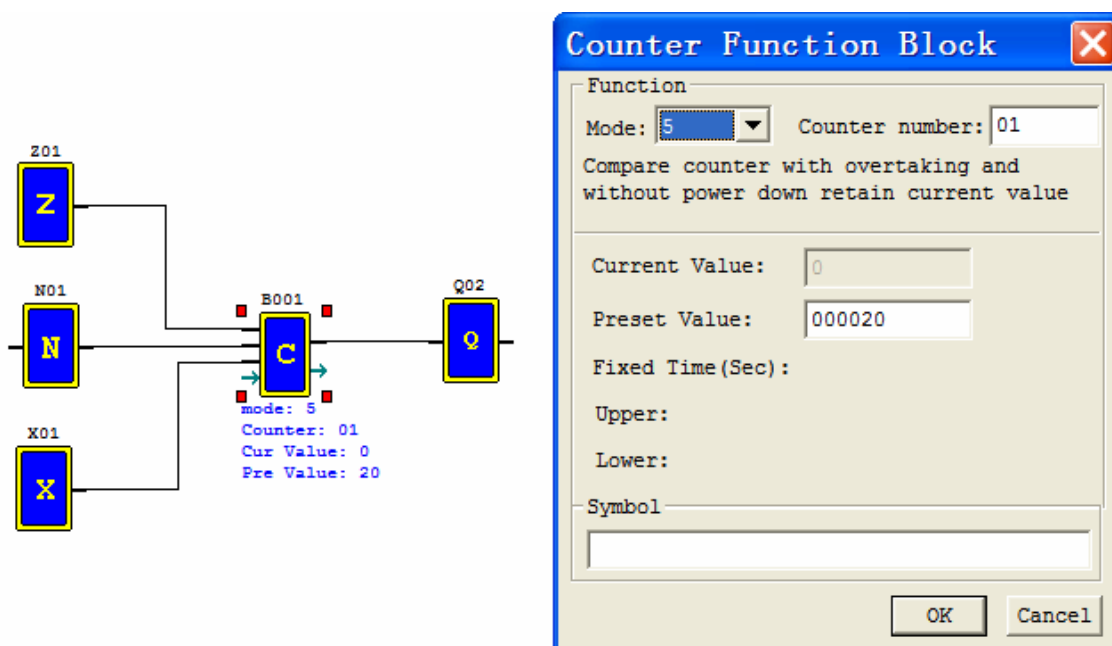
This mode is similar to mode 2, but:

- ✘ First 31 Counter functions (C01~C1F) can keep their current value after a loss of power to the smart relay.
- ✘ The current counter value will be kept when the smart switches between RUN and STOP if “C-keep” is active.



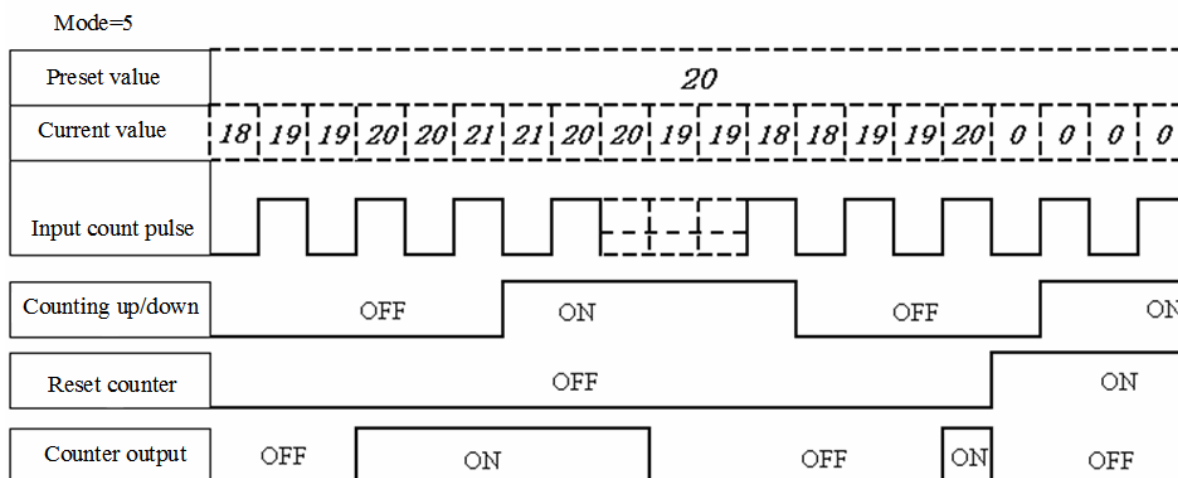
(6) Counter Mode 5 (Continuous Count, Up-Down Count, Non-Retentive)

Mode 5 Counter's operation is similar to Mode 2 except its current count value is continuous and non-retentive. The status bit is fixed to the non-zero preset value regardless of the state of the direction bit. Its status bit will be ON when the counter current value isn't less than its preset value, and will be OFF when the current value is less than its preset value.



Note: The "C" means compare count;

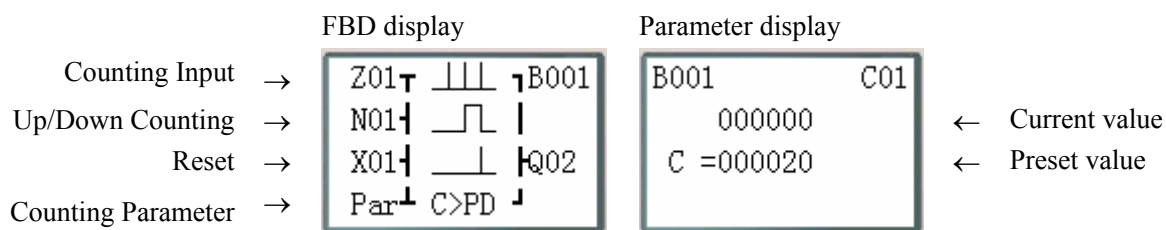
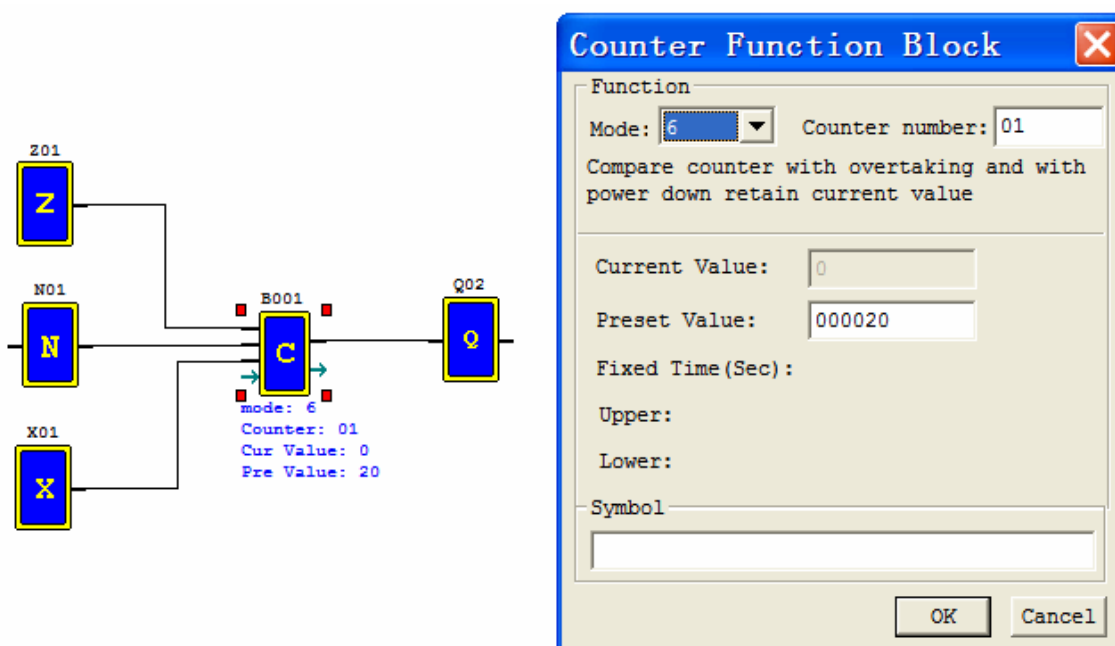
The ">" means the current value appeared will be greater than present value.



- ✖ Under this mode, the count will continuous after reaching its preset value;
- ✖ The current value is always 0 regardless of the state of its direction bit when the reset is availability;
- ✖ The current value is always 0 regardless of the state of its direction bit when the smart switches between RUN and STOP.

(6) Counter Mode 6(Continuous Count, Up-Down Count, Retentive)

Mode 6 Counter's operation is similar to Mode 5 except its current count value is continuous and retentive.

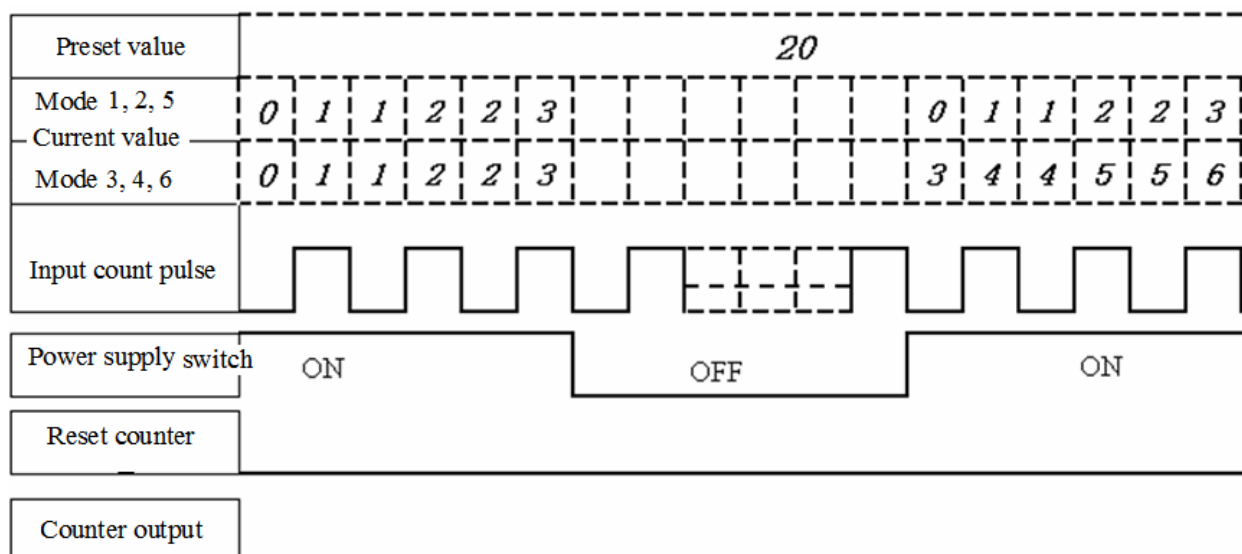


Note: The "C" means compare count;

The ">" means the current value appeared will be greater than present value;

The "PD" means the current value will be retain until the power recover ;

- ※ First 31 Counter functions (C01~C1F) can keep their current value after a loss of power to the smart relay.
- ※ The current counter value will be kept when the smart switches between RUN and STOP if "C-keep" is active.

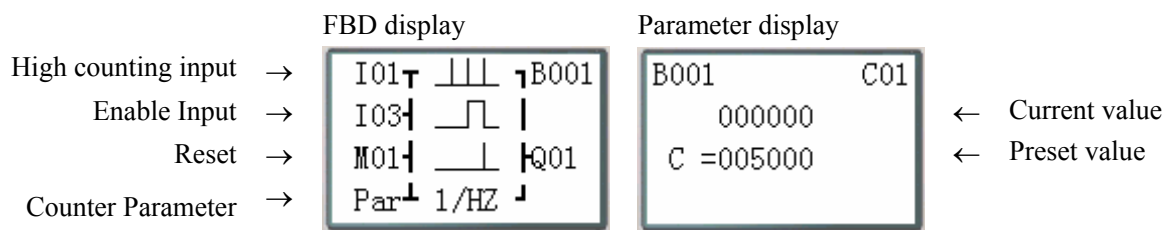
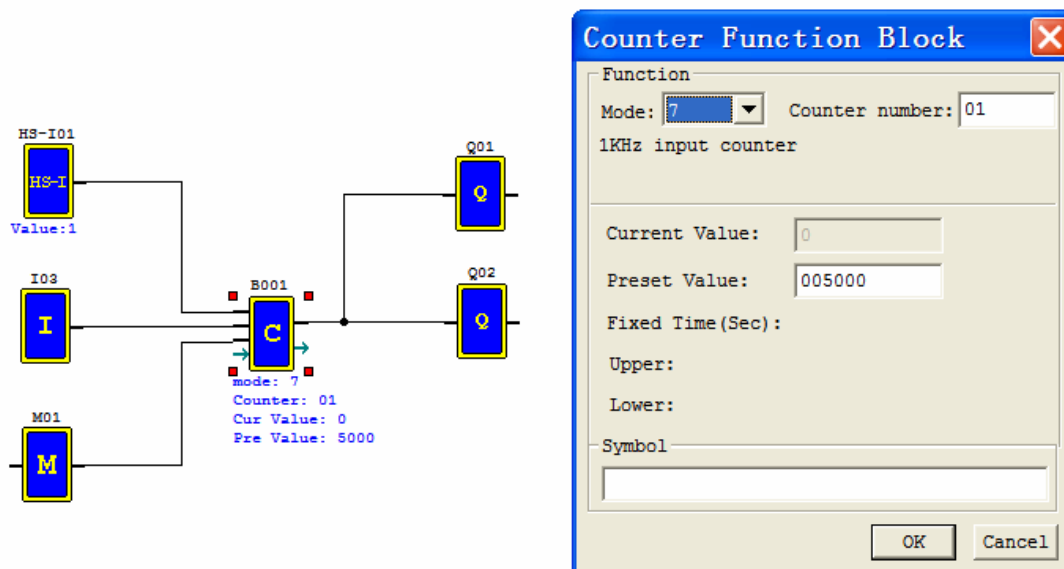


High Speed Counter Function Block (DC Version Only)

The DC powered version smart relays include two 1 KHz high speed inputs on terminal I01 and I02. These can be used as general purpose DC inputs or can be wired to a high speed input device (encoder, etc.) when configured for high speed counting.

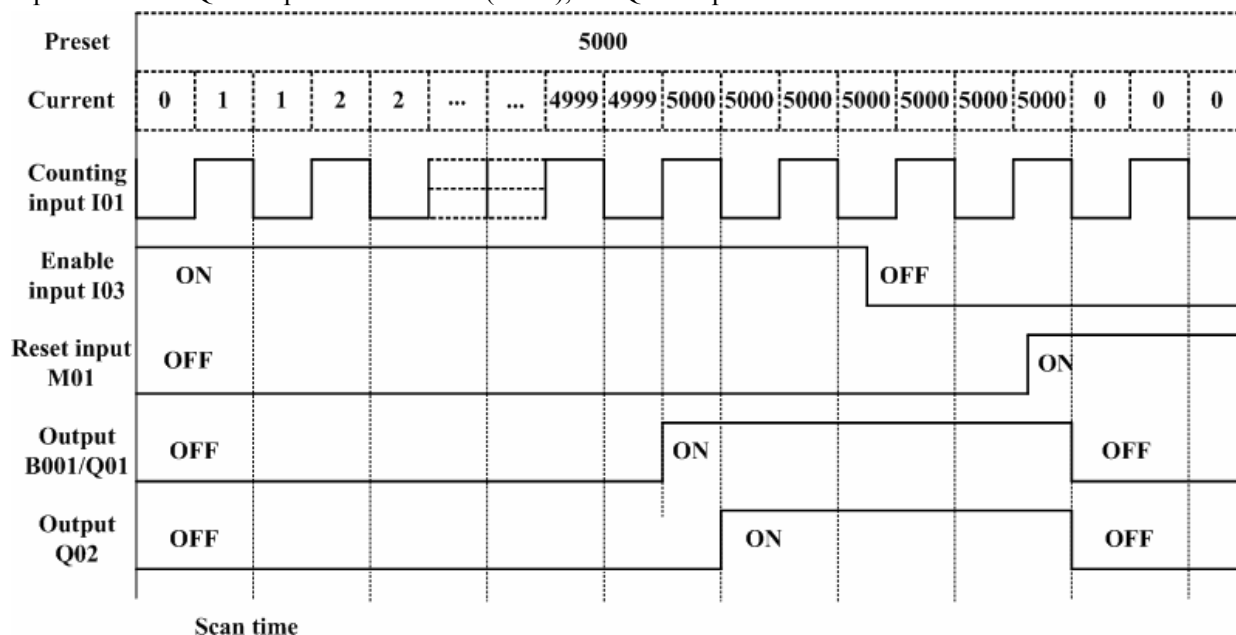
(1) Counter Mode 7 (DC powered versions only)

The Mode 7 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. The selected Counter Coil (B) will turn ON when the pulse count reaches preset value and remain ON. The counter will reset when the Reset Input is active.



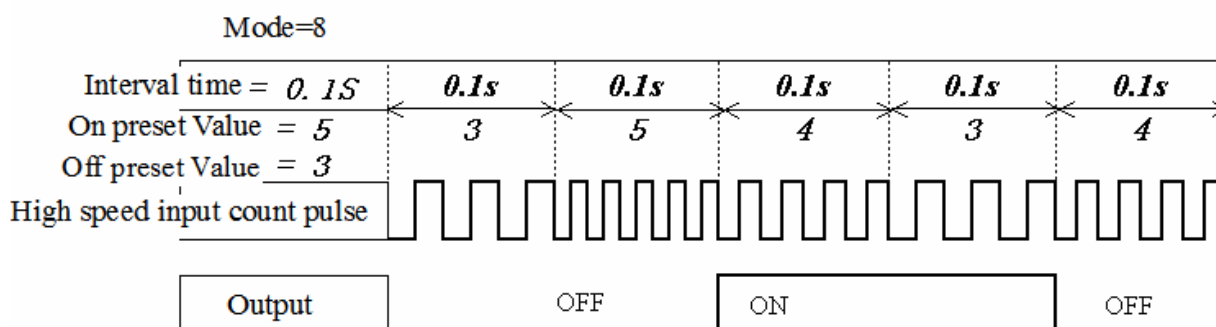
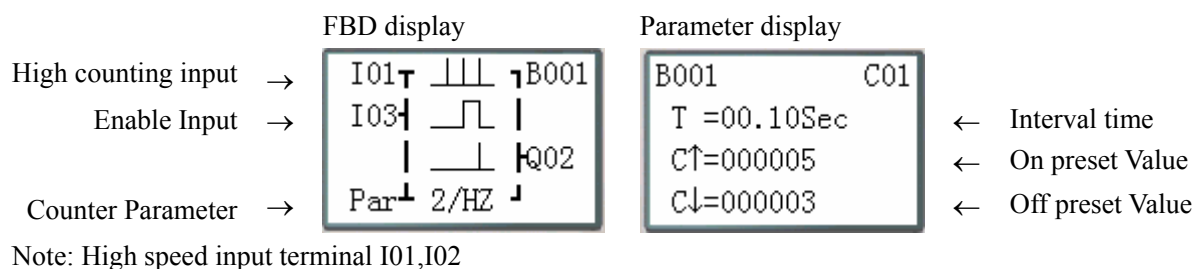
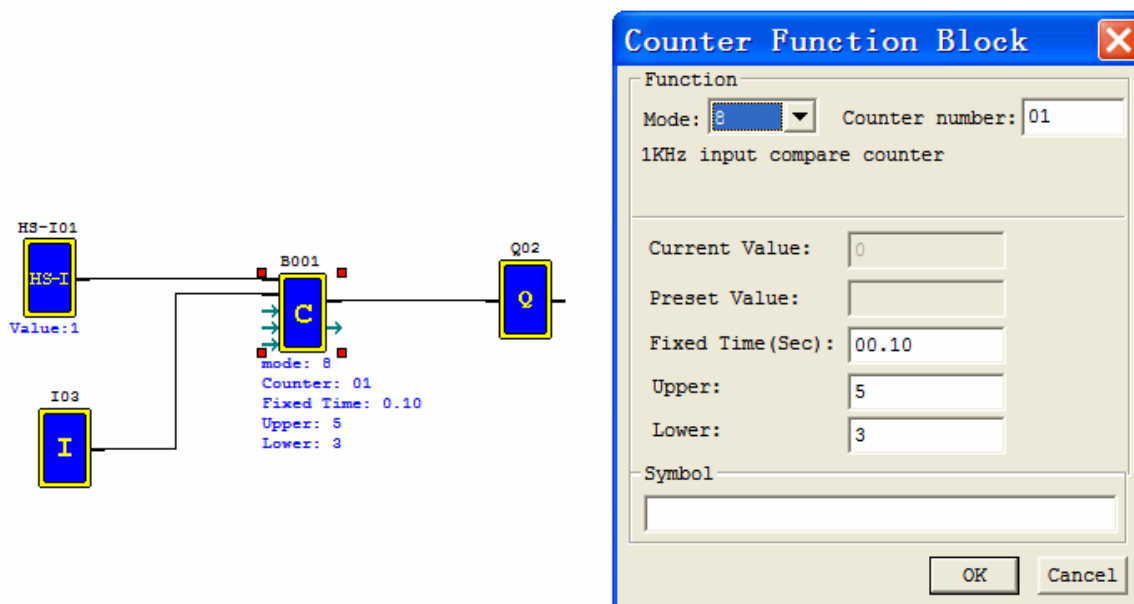
Note: High speed input terminal I01, I02

Example as shown: Q01 output ON with C01 (B001), but Q01 output with scan time.



(2) Counter Mode 8 (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. The selected Counter Coil (C01-C1F) will turn ON when the pulse count reaches the target “Preset ON” value and remain ON until the pulse count reaches the target “Preset OFF” value. The counter will reset when the preceding rung is inactive.

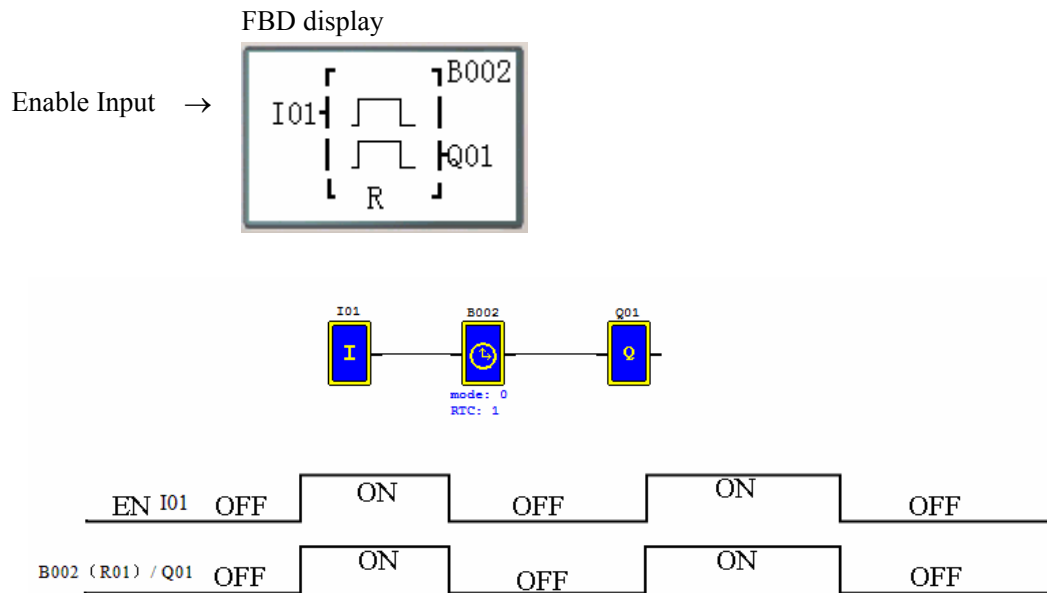


RTC Comparator Function Block

There is a maximum of 250 RTC function blocks under FBD mode, can be set mode 0~4 and the function is same as Ladder mode.

(1) RTC Mode 0(Internal Coil)

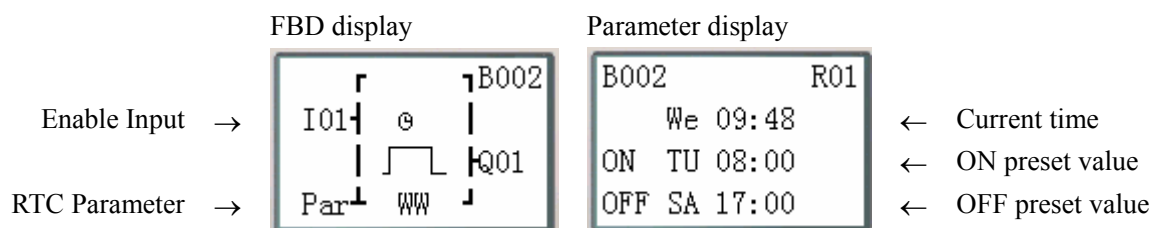
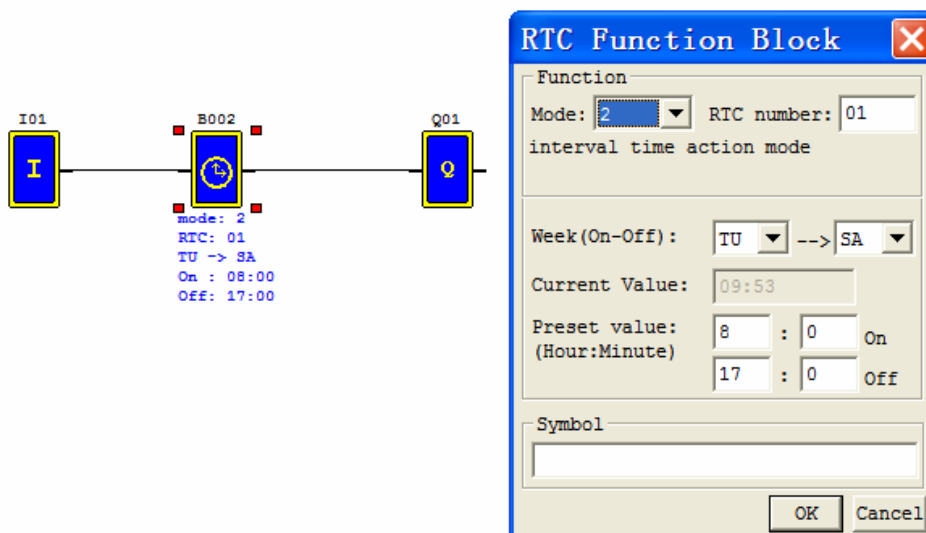
Mode 0 RTC (Internal Coil) used as internal auxiliary coils. No timer preset value and no parameter display.



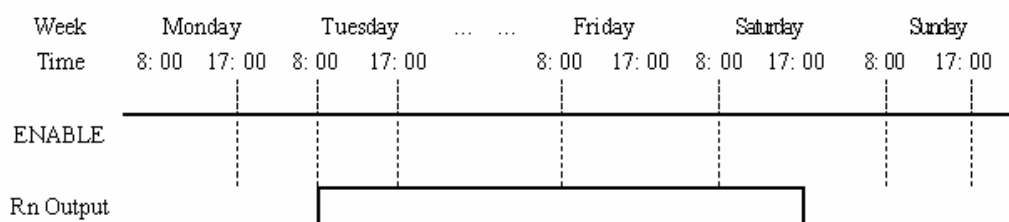
(3) RTC Mode 2 (Continuous)

The Interval Time Mode 2 allows the Bxxx (Rxx) coil to activate based on time and day per week. The below example1 allows for selection of Day and Time for the B002 (R01) coil to activate ON, and Day and Time for the B002 (R01) coil to deactivate OFF.

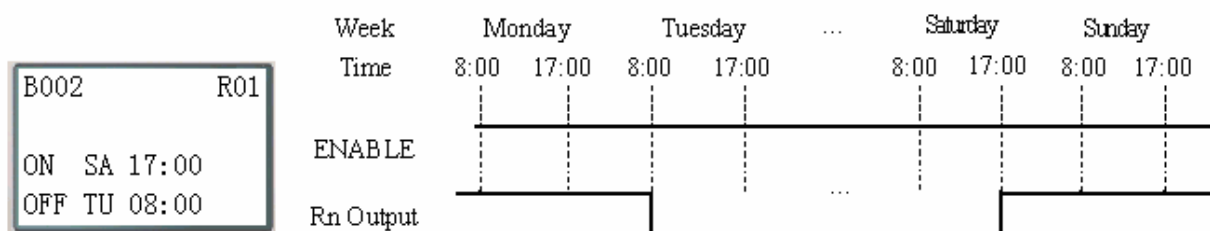
Example 1:



Note: Parameter display current time: week, hour and minute;
Parameter display ON/OFF preset value: week, hour and minute.



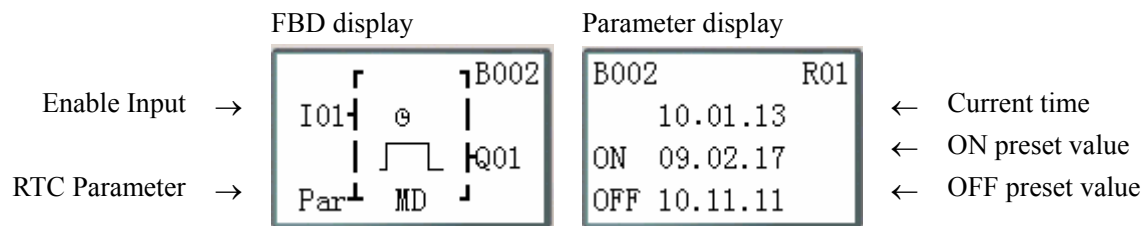
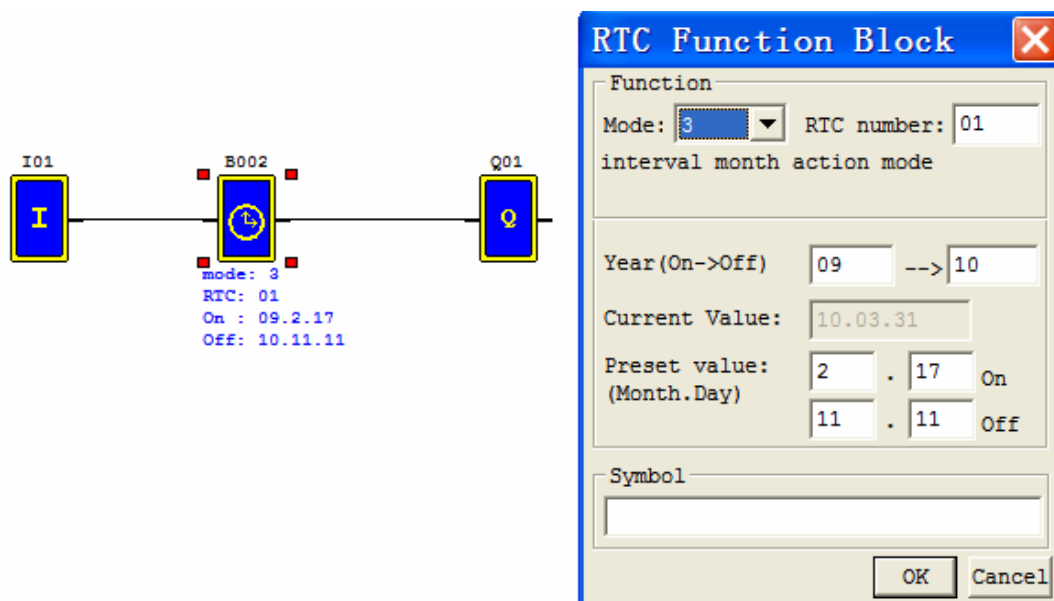
Example 2:



(4) RTC Mode 3 (Year Month Day)

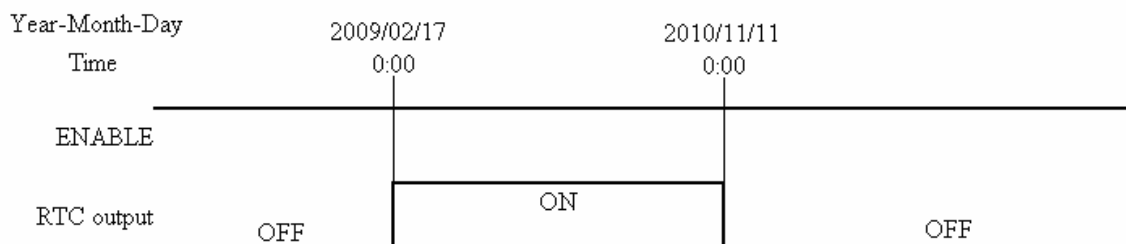
The Year-Month-Day Mode 3 allows the Bxxx (Rxx) coil to activate based on Year, Month, and Date. The below example1 allows for selection of Year and Date for the B002 (R01) coil to activate ON, and Year and Date for the B002 (R01) coil to deactivate OFF.

Example 1:

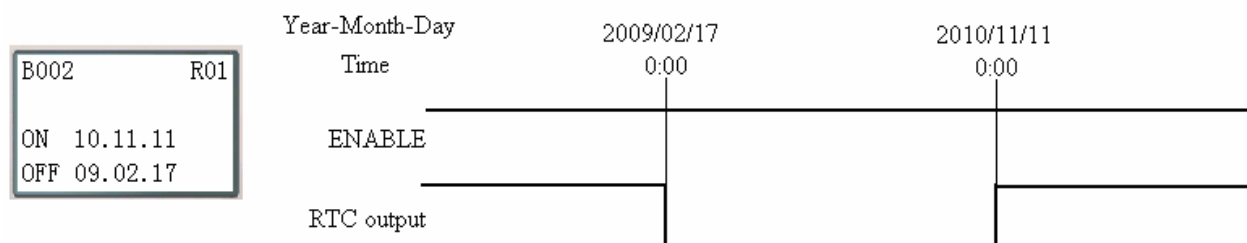


Note: Parameter display current time: year, month and day;

Parameter display ON/OFF preset value: year, month and day.



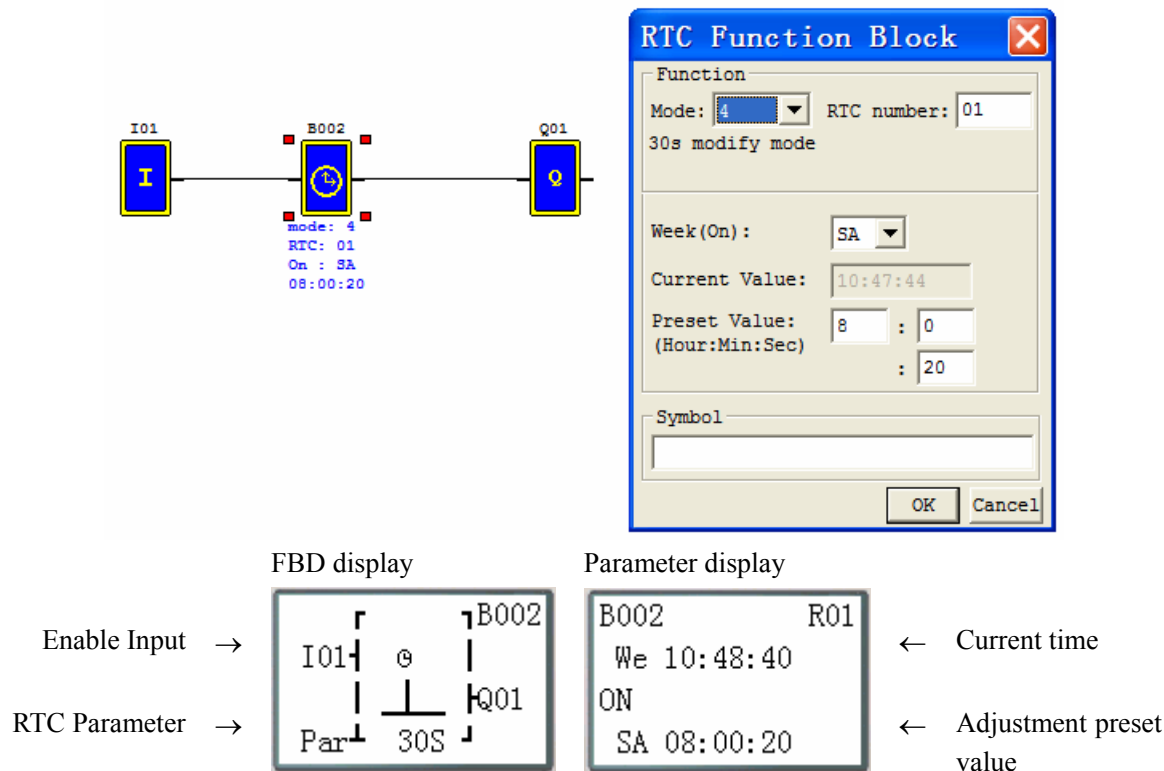
Example 2:



(5) RTC Mode 4(30-second adjustment)

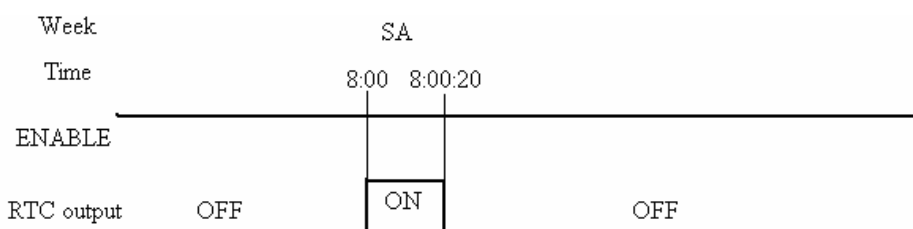
The 30-second adjustment Mode 4 allows the Bxxx (Rxx) coil to activate based on week, hour, minute and second. The below examples show for selection of week, hour, minute and second for the B002 (R01) coil to activate ON, and 30-second adjustment then B002 (R01) OFF.

Example 1: adjustment preset second < 30s



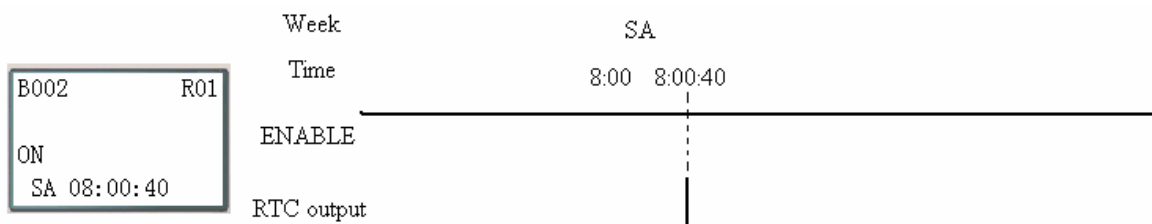
Note: Parameter display current time: week, hour, minute and second;

Parameter display adjustment preset value: week, hour, minute and second.



✱ The present time will be 8:00:00 when it achieves 8:00:20 at first time, and RTC status bit B002 (R01) will be ON. RTC status bit B002 (R01) will be OFF when the present time achieves 8:00:20 at second time. Then time continuous going. So, this means that RTC status bit is ON for 21 seconds.

Example 2: adjustment preset second $\geq$ 30s



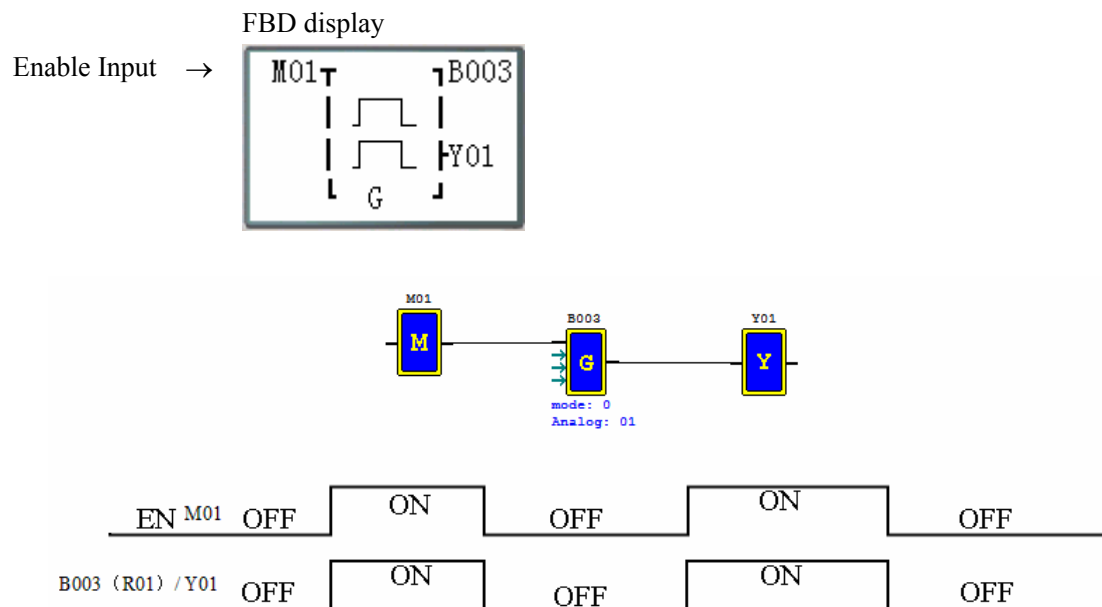
✱ The present time will change to be 8:01:00 when it achieves 8:00:40, and RTC status bit B002 (R01) turns ON. Then time is gonging on and B002 (R01) turns OFF. This means that the RTC status bit will be ON for one pulse.

Analog Comparator Function Block

There is a maximum of 250 analog comparator function blocks under FBD mode, can be set mode 0~7 and the function is same as Ladder mode.

(1) Analog Comparison Mode 0 (Internal coil)

Mode 0 analog comparator (Internal Coil) used as internal auxiliary coils. No timer preset value and no parameter display.



(2) Analog Comparison Mode 1~7

Analog comparator mode 1~7, setting three parameters, analog input Ax, analog input Ay and reference value G.

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

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

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

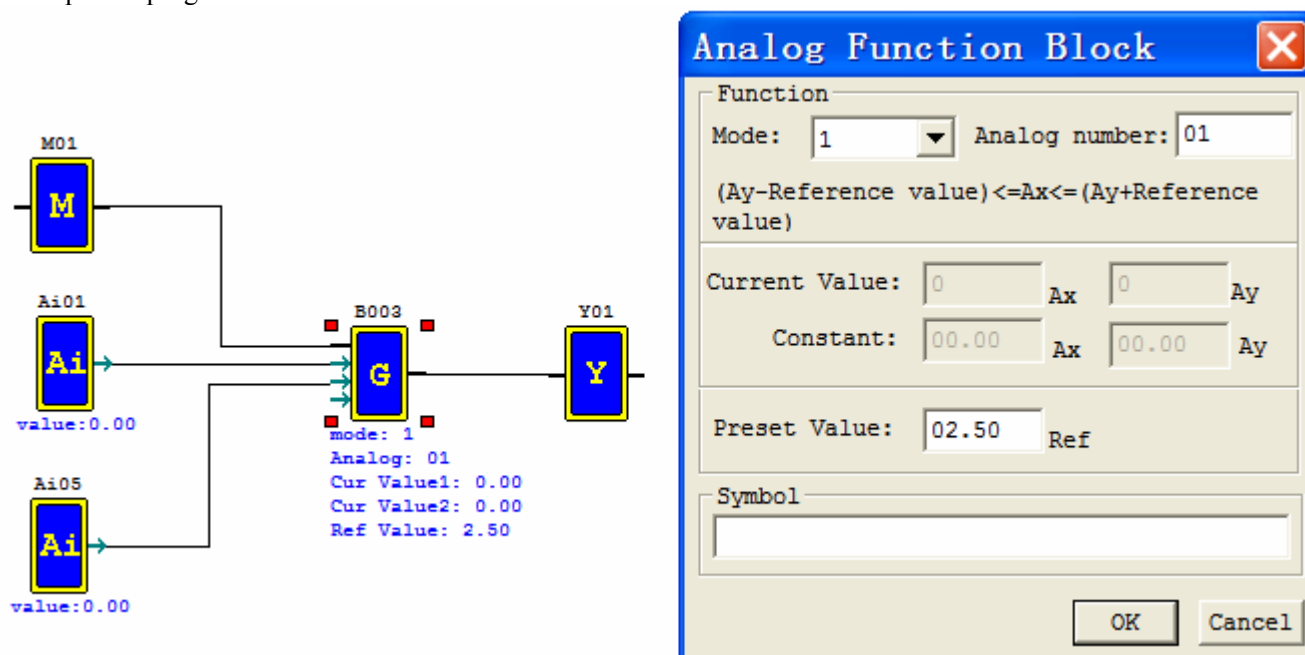
Analog Comparator mode 4: reference value $G \geq Ax$, output ON;

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

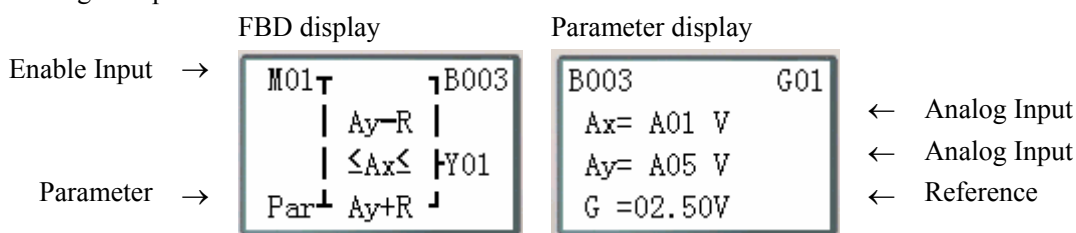
Analog Comparator mode 6: reference value $G = Ax$, output ON;

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

Example for program and edit:



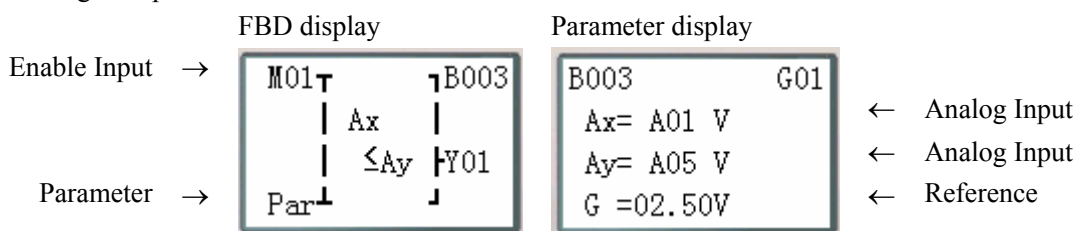
Analog Comparison Mode 1



B003 (G01) output ON when the value of A01 in between $(A05-2.50) \sim (A05+2.50)$;

Parameter display current value of Ax and Ay when running mode;

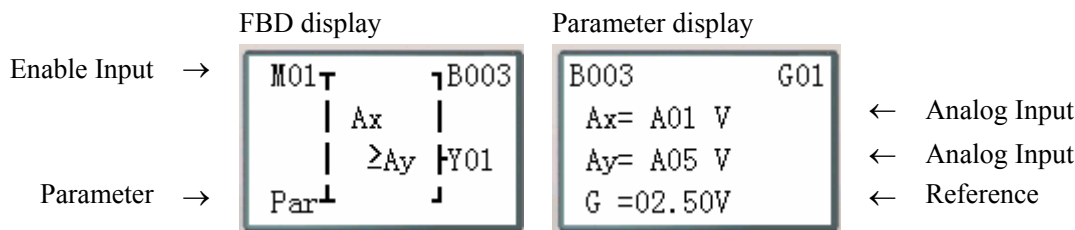
Analog Comparison Mode 2



B003 (G01) output ON when the value of A01 is not greater than the value of A05;

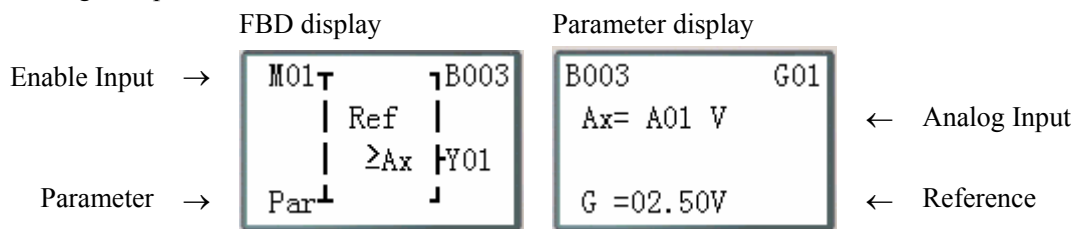
Parameter display current value of Ax and Ay when running mode;

Analog Comparison Mode 3



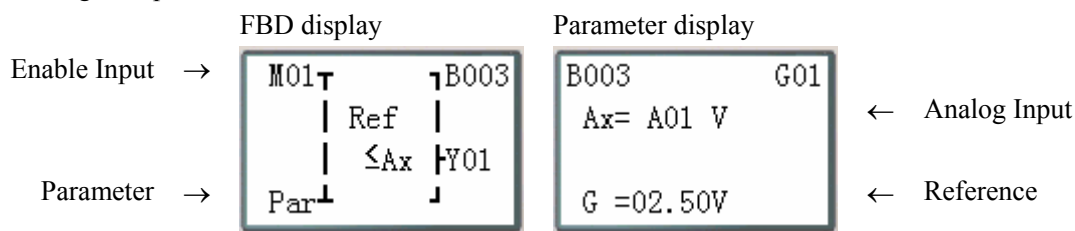
B003 (G01) output ON when the value of A01 is not lower than the value of A05;
 Parameter display current value of Ax and Ay when running mode;

Analog Comparison Mode 4



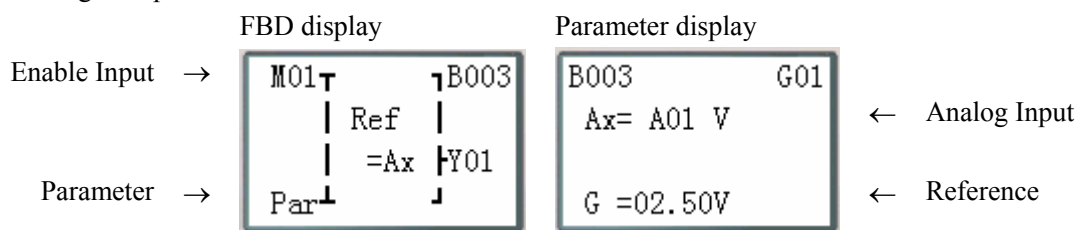
B003 (G01) output ON when the value of A01 is not greater than 2.50;
 Parameter display current value of Ax when running mode;

Analog Comparison Mode 5



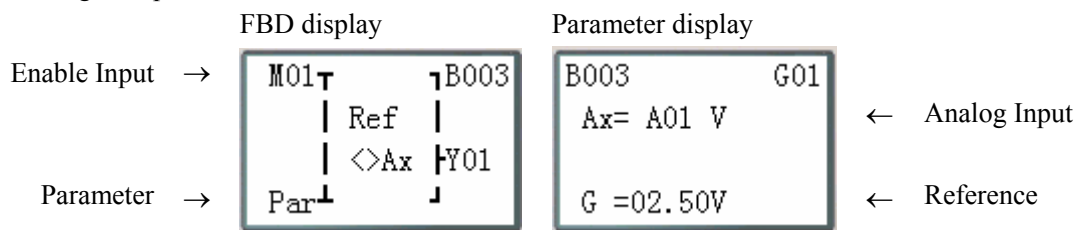
B003 (G01) output ON when the value of A01 is not low than 2.50;
 Parameter display current value of Ax when running mode;

Analog Comparison Mode 6



B003 (G01) output ON when the value of A01 is equal to 2.50;
 Parameter display current value of Ax when running mode;

Analog Comparison Mode 7



B003 (G01) output ON when the value of A01 is not equal to 2.50;
 Parameter display current value of Ax when running mode;

AS (ADD-SUB) function block

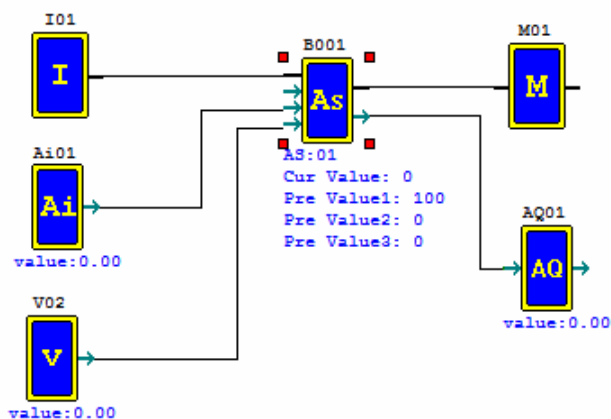
There is a maximum of 250 AS (Addition and Subtraction) function blocks under FBD mode, and the function is same as Ladder mode.

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

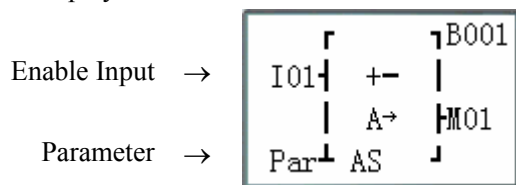
Parameters V1, V2, and V3 can be a constant or other function current value. The output coil will be set to 1 when the result is overflow.

Example:

$$AQ01 = AS01 = 100 + A01 - V02$$



FBD display:



Parameter display:

	Stopping	Running	
Preset V1 →	B001 AS01	B001 00404 AS01	← AS output value
Preset V2 →	V1= 00100	V1= 00100	← Current value V1
Preset V3 →	V2= A01	V2= 00424	← Current value V2
	V3= V02	V3= 00120	← Current value V3

AS and V1~V3, values range from -32768~32767

MD (MUL-DIV) function block

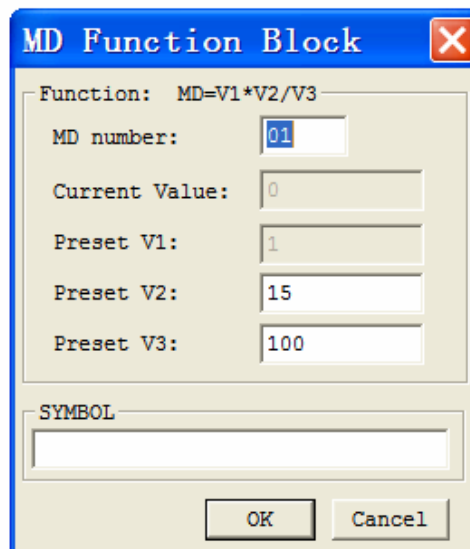
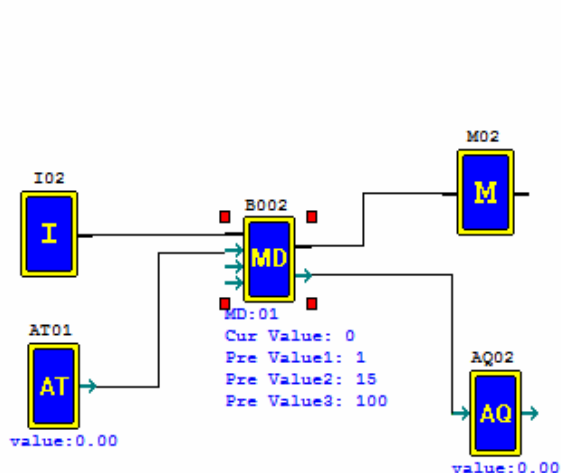
There is a maximum of 250 MD (Multiplication and Division) function blocks under FBD mode, and the function is same as Ladder mode.

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

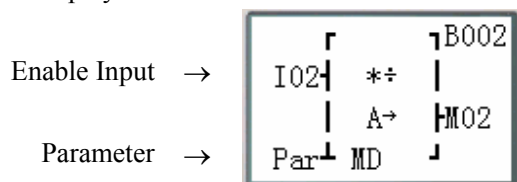
Parameters V1, V2, and V3 can be a constant or other function current value. The output coil will be set to 1 when the result is overflow or parameter V3 is zero.

Example:

AQ02 = MD01 = AT01*15/100



FBD display:



Parameter display:

	Stopping	Running	
Preset V1 →	B002 MD01 V1= AT01	B002 00184 MD01 V1= 01227	← MD output value
Preset V2 →	V2= 00015	V2= 00015	← Current value V1
Preset V3 →	V3= 00100	V3= 00100	← Current value V2
			← Current value V3

MD and V1~V3, values range from -32768~32767

PID (Proportion- Integral- Differential) function block

There is a maximum of 30 PI (PID) function blocks under FBD mode, and the function is same as Ladder mode.

PID computes formula:

$$EV_n = SV - PV_n$$

$$\Delta PI = K_P \left\{ (EV_n - EV_{n-1}) + \frac{T_s}{T_I} EV_n + D_n \right\}$$

$$D_n = \frac{T_D}{T_s} (2PV_{n-1} - PV_n - PV_{n-2})$$

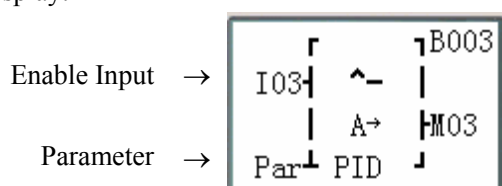
$$PI = \sum \Delta PI$$

Parameters can be constant or other function current value. The output coil will turn ON when either T_s or K_P is 0.

Example:

PI: PID current value (-32768~32767)
SV: Destination value (-32768~32767)
PV: Test value (-32768~32767)
T_s : Sampling time (1~32767 * 0.01s)
K_P : Proportional gain (1~32767 %)
T_I : Integration time (1~32767 * 0.1s)
T_D : Differential time (1~32767 * 0.01s)

FBD display:



Parameter display:

	Parameter display 1	Parameter display 2	
PID current value	B003 00738 PI01	B003 PI01	
Destination value	SV= 00800	Kp= 00100	← Proportional gain
Test value	PV= 00770	Ti= 0010.0Sec	← Integration time
Sampling time	Ts= 002.00Sec 1	Td= 001.10Sec 2	← Differential time

- ※ Display PID current value when running mode;
- ※ Test value (PV) display code A02 when stopping mode, and display current value (as example PV= 00770) when running mode.
- ※ Press “SEL+←→” button can convert between display1 and display2.
- ※ More information about PID function to see [Chapter 5: Relay Ladder Logic Programming—PID](#).

MX (Multiplexer) function block

There is a maximum of 250 MX (Multiplexer) function blocks under FBD mode, and the function is same as Ladder mode.

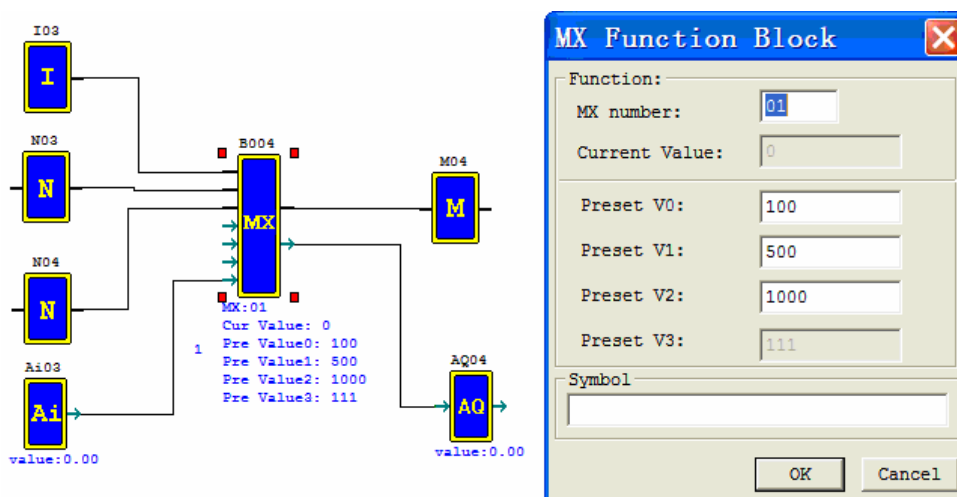
This special function transmits 0 or one of 4 preset values to MX current value memory by selection control coils S1 and S2. The MX function enables simple operations to be carried out on integers.

The preset value V1~V4 can be constant or other function current value.

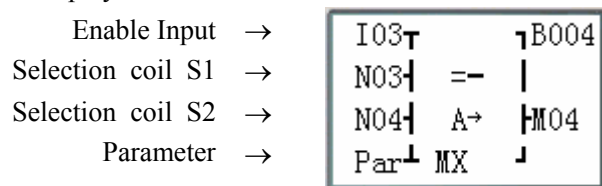
The table below describes the relationship between parameter and MX current value.

Control status		MX output coil	MX output value
MX disable		0	MX = 0
MX enable	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

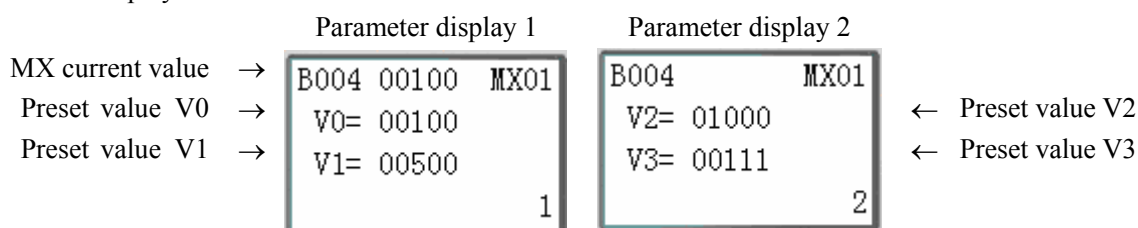
Example:



FBD display:



Parameter display:



- ※ Display MX current value when running mode;
- ※ Preset Value V3, display code A03 when stopping mode and display current value (as example V3=00111) when running mode;
- ※ Press “SEL+←→” button can convert between display1 and display2.
- ※ MX and V0~V3, values range from -32768~32767

AR (Analog-Ramp) function block

There is a maximum of 30 AR (analog ramp control) function blocks under FBD mode, and the function is same as Ladder mode.

(1)AR model

Function description:

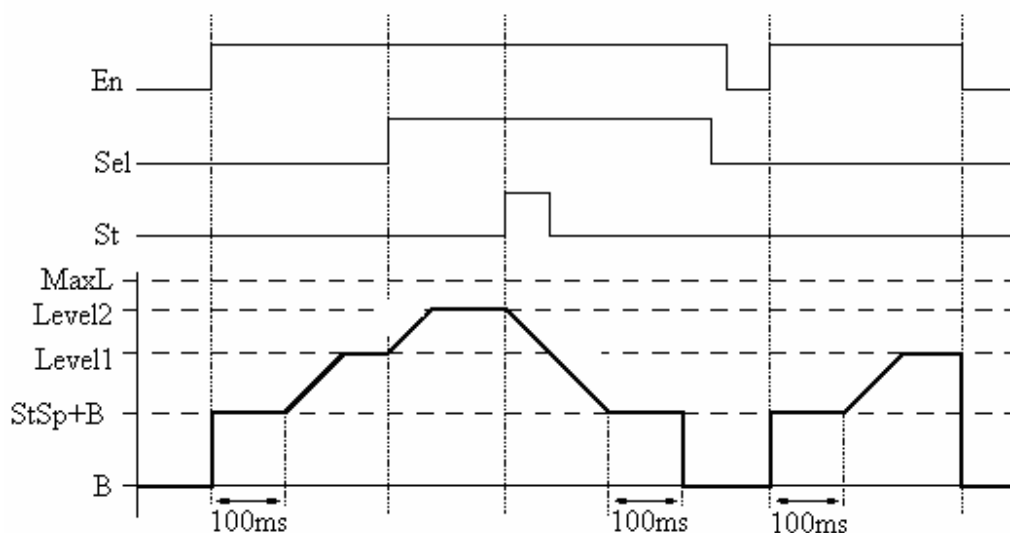
AR will keep the current level at “StSp + Offset “B”” for 100ms when it’s enabled. Then the current level runs from StSp + Offset “B” to target level at enactment Rate. If St is set, the current level decreases from current level to level StSp + B at enactment Rate. Then AR holds the level StSp + Offset “B” for 100ms. After 100ms, AR current level is set to offset “B”, which makes AR current value equals 0.

AR current value: 0~32767
Level1:-10000~20000
Level2:-10000~20000
MaxL (max level):-10000~20000
Start/Stop level (StSp): 0~20000
stepping rate (rate): 1~10000
Proportion (A): 0~10.00
Excursion (B): -10000~10000

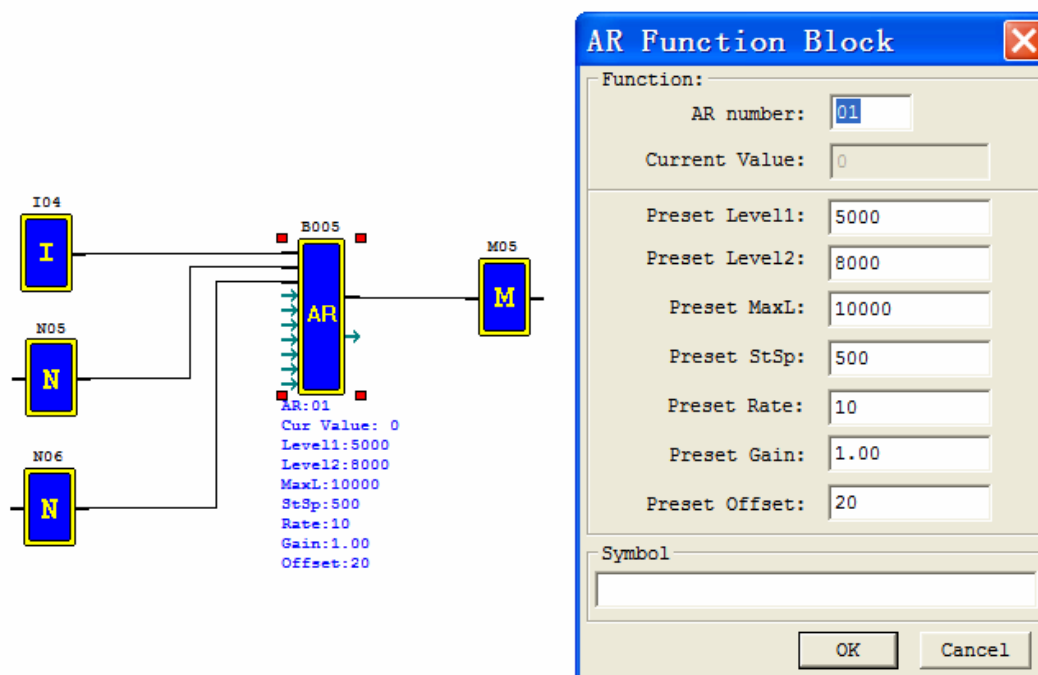
$$AR_current_value = (AR_current_level - B) / A$$

The parameters can be constant or other function current value.

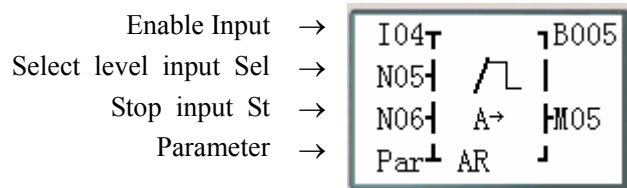
Sel	Selection level Sel = 0: target level = Level1 Sel = 1: target level = Level2 ✖ MaxL is used as target level if the selected level is bigger than MaxL.
St	Selection stop coil. The St’s state becomes from 0 to 1 will startup the current level decrease to start/stop level (StSp + excursion “B”), and then keep this level for 100ms. Then AR current level is set to B which will make AR current value equals 0.
Output coil	The output coil turns ON when Proportion (A) is 0.

Timing diagram for AR

Example:



FBD display:



Parameter display:

	Parameter display 1	Parameter display 2	
AR current value	→ B005 00528 AR01	S = 00500 AR01	← Start/Stop level
Preset level1	→ L1= 05000	R = 00010	← Stepping rate
Preset level2	→ L2= 08000	A = 01.00	← Proportion value
Max level	→ ML= 10000 1	B = 00020 2	← Excursion value

※ Display AR current value when running mode;

※ Press “SEL+←→” button can convert between display1 and display2.

(2)AR mode2

Function description:

AR will vary from 0 to current level at a preset rate when it's enabled. Based on the state of Sel1 and Sel2, current level will change to other preset level at the preset rate. When AR is disabled, current output varies to 0 immediately.

AR current value: 0~32767

Level0:0~32767

Level1:0~32767

Level2:0~32767

Level3:0~32767

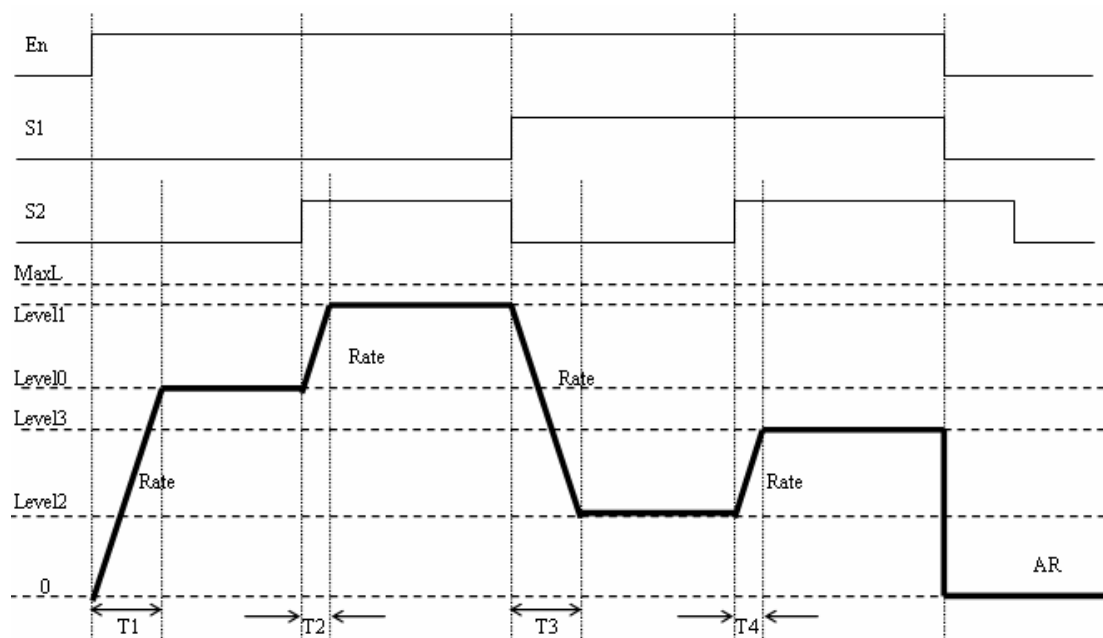
MaxL:0~32767

Ta: 0~3276.7

The rate designed by user: $Rate = \frac{MaxL}{Ta}$. The table below describes detail information of each parameter:

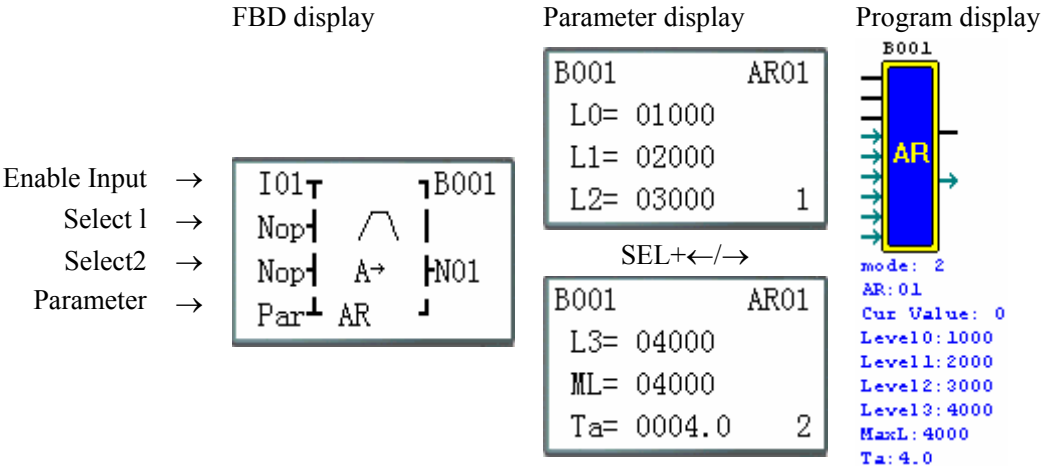
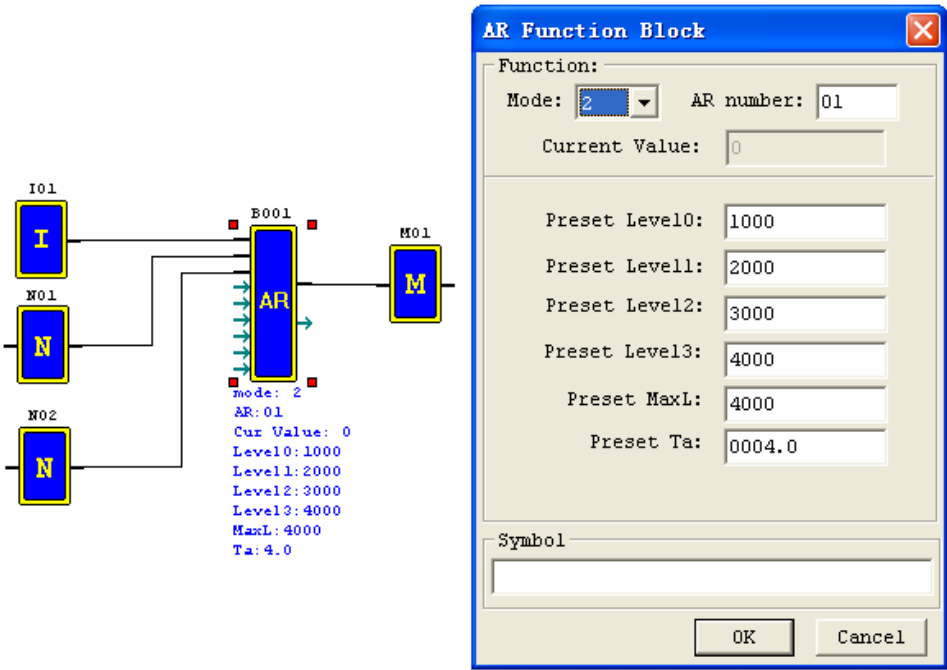
Sel1 Sel2	S1=0,S2=0: target level = Level 0; S1=0,S2=1: target level = Level 1; S1=1,S2=0: target level = Level 2; S1=1,S2=1: target level = Level 3;
MaxL	MaxL is used as target level if the selected level is bigger than MaxL.
Ta	The result of MaxL divided by Ta is the change rate from current level to target level.
Output coil	The output coil turns ON when A is 0.

Timing diagram for AR



$$Rate = MaxL / Ta; \quad T1 = Level0 * Ta / MaxL; \quad T2 = (Level1 - Level0) * Ta / MaxL; \\ T3 = (Level1 - Level2) * Ta / MaxL; \quad T4 = (Level3 - Level2) * Ta / MaxL;$$

Example:



※ Display AR current value when running mode;

DR (Data-Register) function block

There is a maximum of 240 DR (data register) function blocks under FBD mode, and the function is same as Ladder mode.

The DR function is transferring data. DR sends data from prevention registers to current register and output coil Bxxx ON when it's enabled. DR holding the out value and output coil Bxxx OFF when it's disabled.

The data can be signed or unsigned by **Operation>>module system set...** menu selection from the SG2 Client software or keypad set.

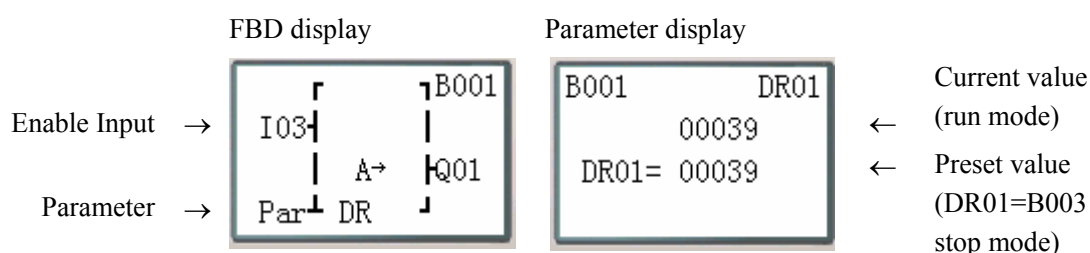
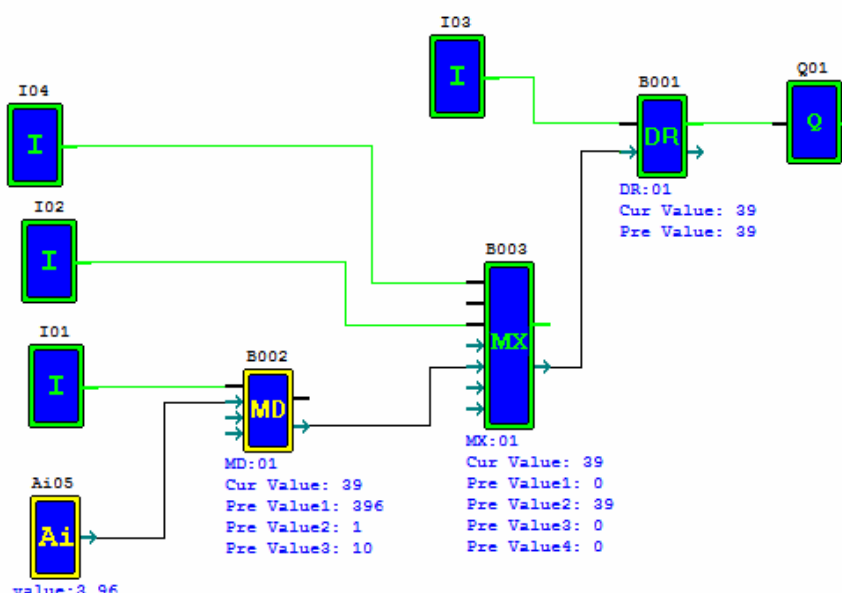
The data registers from DR65 to DRF0 will be kept when the smart stop or powers down.

The last 40 DR that from DRC9 to DRF0 are special data register, more information to see [Chapter 3 Program Tools—Data Register Set](#).

Example:

Setting I02 ON, B001 (DR01) output (A05*1/10) count value;

Setting I02 OFF, B001 (DR01) output 0;



MU (Modbus) function block

There is a maximum of 250 MU (Modbus) function blocks under FBD mode, can be set mode 1~5 and the function is same as Ladder mode.

Remote IO and IO Link are precedence than MU. MU is executed when the system setting is N (No Remote IO) and ID isn't 0.

Function mode corresponding communication function code:

mode	Communication function code
1	03 (read registers)
2	06 (write single register)
3	10 (write multiple registers)
4	01 (read coils)
5	05 (write single coil)

※ The max data length for Mode 1 and 3 is 25words. The max data length for Mode 4 is 400bits.

The coil used in MU function:

M3D: Received	M3D is set to ON after received, then check-up for error. Transferring data to target address if there is no error.
M3E: Error flag	communication error flag
M3F: Time out flag	M3F is set to 1 when the time from after sending to start receiving is longer than setting, and M3D also be set to 1. M3F is automatically reset if M3D reset.

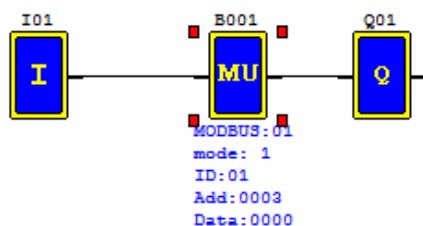
The time out time is depending communication baud rate as shown in the table below:

Baud rate (bps)	Time out (ms)
4800、9600、19200、38400	125
57600	100
115200	80

※ More information about communication to see: [Chapter 8 20 Points RS485 type Models Instruction](#).

MU mode1: Read Registers

Setting communication address is constant:



Address is constant 0003,

Data length is fixed at 1 word,

Send data:

01 03 00 03 00 01 CRC16;

Received response from slave1:

01 03 02 data1 data2 CRC16;

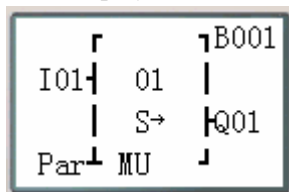
Saving data to DRE0: DRE0 = data1~2

Model

FBD display

Parameter display

Enable Input →

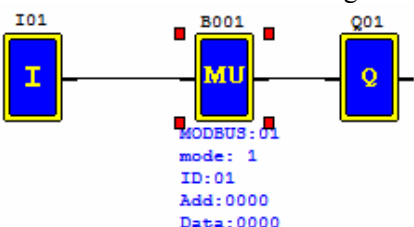


← Slaver ID

← Register address

← Saving data address

Setting communication address is data register DR:



Setting address DR03=0001,

Setting data length DR04=0002,

Send data:

01 03 00 01 00 02 CRC16;

Received response from slave1:

01 03 04 data1 data2 data3 data4 CRC16;

Saving data to DRE0~DRE1:

DRE0 = data1~2, DRE1 = data3~4

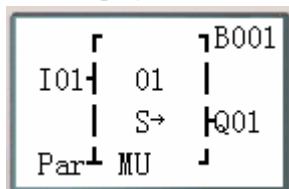
※ the max length of data is 25.

Model

FBD display

Parameter display

Enable Input →



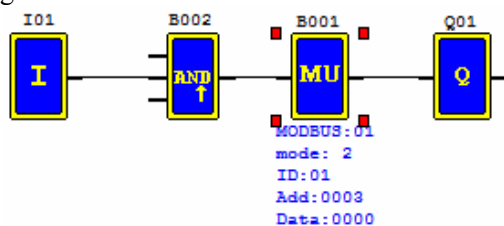
← Slaver ID

← Register address

← Saving data address

MU mode2: Write single register

Setting communication address is constant:



Address is constant 0003,

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

Send data:

01 06 00 03 04 D2 CRC16;

Received response from slave1:

01 06 00 03 04 D2 CRC16 ;

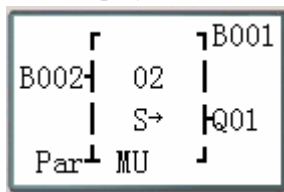
Mode2

FBD display

Parameter display

Enable Input →

Parameter →

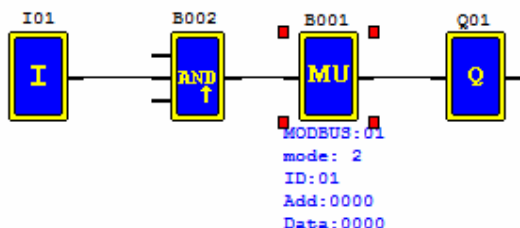


← Slaver ID

← Register address

← Source data address

Setting communication address is data register DR:



Setting address DR03=0001,

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

Send data:

01 06 00 01 04 D2 CRC16;

Received response from slave1:

01 06 00 01 04 D2 CRC16;

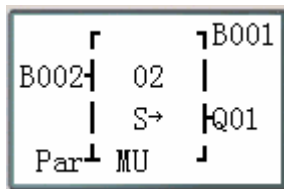
Mode2

FBD display

Parameter display

Enable Input →

Parameter →



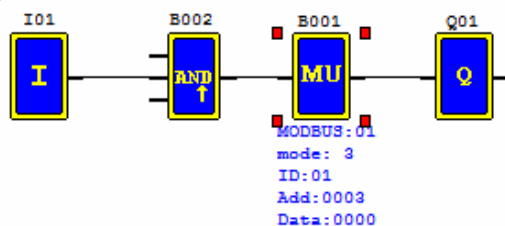
← Slaver ID

← Register address

← Source data address

MU mode3: Write Multiple Registers

Setting communication address is constant:



Address is constant 0003,
Data length is fixed at 1 word,
Setting data DRE0=1234 (hex: 04D2),
Send data:
01 10 00 03 00 01 02 04 D2 CRC16;

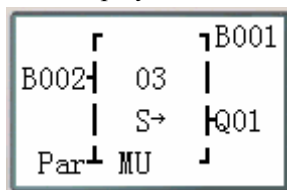
Received response from slave1:
01 10 00 03 00 01 CRC16;

Mode3

FBD display

Enable Input →

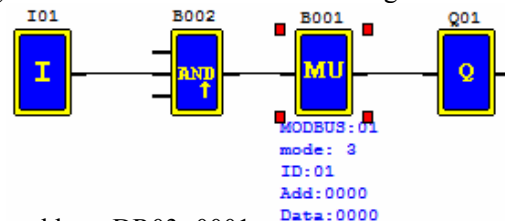
Parameter →



Parameter display

← Slaver ID
← Register address
← Source data address

Setting communication address is data register DR:



Setting address DR03=0001,
Setting data length DR04=0002,
Setting data DRE0=1234 (hex: 04D2),
Setting data DRE1=5678 (hex: 162E),
Send data:
01 10 00 01 00 02 04 04 D2 16 2E CRC16;

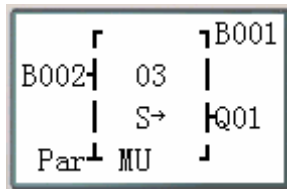
Received response from slave1:
01 10 00 01 00 02 CRC16;
✗ the max length of data is 25.

Mode3

FBD display

Enable Input →

Parameter →

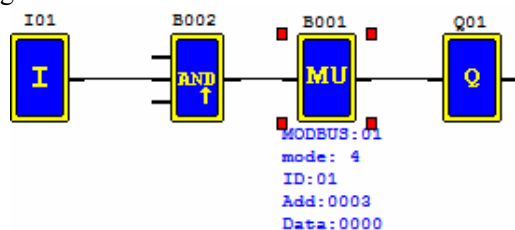


Parameter display

← Slaver ID
← Register address
← Source data address

MU mode4: Read Coils

Setting communication address is constant:



Address is constant 32 (hex: 0020),
Data length is fixed at 16 (hex: 10H, 1word),
Send data:
01 01 00 20 00 10 CRC16;

Received response from slave1:
01 01 02 data1 data2 CRC16;
Saving data to DRE0: DRE0 = data1~2

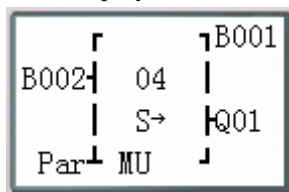
Mode4

FBD display

Parameter display

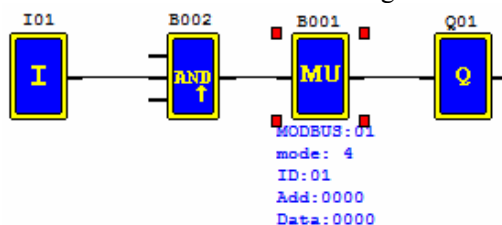
Enable Input →

Parameter →



← Slaver ID
← Register address
← Saving data address

Setting communication address is data register DR:



Setting address DR03=0001,
Setting data length R04=0015 (hex: 000F);
Send data:
01 01 00 01 00 0F CRC16;

Received response from slave1:
01 01 02 data1 data2 CRC16;
Saving data to DRE0: DRE0 = data1~2
※ the max length of data is 400.

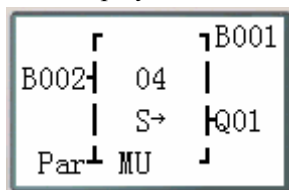
Mode4

FBD display

Parameter display

Enable Input →

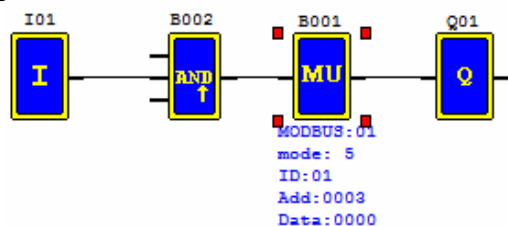
Parameter →



← Slaver ID
← Register address
← Saving data address

MU mode5: Write single coil

Setting communication address is constant:



Address is constant 0003,

Setting data DRE0=65280 (hex: FF00),

Send data:

01 05 00 03 FF 00 CRC16;

Received response from slave1:

01 05 00 03 FF 00 CRC16;

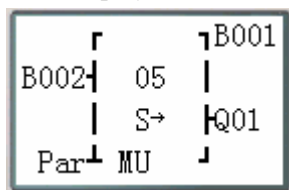
Mode5

FBD display

Parameter display

Enable Input →

Parameter →

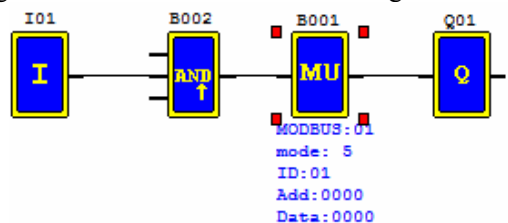


← Slaver ID

← Register address

← Source data address

Setting communication address is data register DR:



Setting address DR03=0001,

Setting data DRE0=65280 (hex: FF00),

Send data:

01 05 00 01 FF 00 CRC16;

Received response from slave1:

01 05 00 01 FF 00 CRC16;

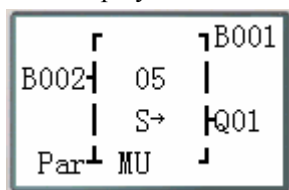
Mode5

FBD display

Parameter display

Enable Input →

Parameter →



← Slaver ID

← Register address

← Source data address

Chapter 7: Hardware Specification

Normal Specification	188
Product Specifications.....	189
Power Specifications.....	190
Normal model machine Specifications	190
12V DC model Specifications.....	191
24V AC model Specifications.....	191
Power circuitry diagram.....	192
Input Specifications.....	193
100~240V AC model	193
24V AC model	193
24V DC, 12 I/O model.....	194
24V DC, 20 I/O model.....	195
12V DC, 12 I/O model.....	196
12V DC, 20 I/O model.....	197
Output Specifications.....	198
Output Port wiring notice.....	198
Light Load.....	198
Inductance Load.....	199
Life of relay.....	199
Size diagram of SG2	200

Normal Specification

Content		Specification
Mode of user program		Ladder & FBD
Environmental	Operation temperature	-4° to 131°F (-20° to 55°C)
	Storage temperature	-40° to 158°F (-40° to 70°C)
	Maximum Humidity	90% (Relative, non-condensing)
	Operation Gas	No corrosive gases
Main machine	Maximum Vibration	0.075mm amplitude, 1.0g acceleration according to IEC60068-2-6
	Maximum Concussion	peak value 15g, 11ms according to IEC60068-2-27
Maximum Noise	ESD	Contact ±4KV, air discharge ±8KV
	EFT	Power AC: ±2KV DC: ±1KV
	CS	0.15~80MHz 10V/m
	RS	80~1000MHz 10V/m
	EMI	EN55011 class B
installation	Enclosure Type	IP20
	Mounting mode	Direct Mounting or DIN-rail (35mm) Mounting
	Direction	According to chapter 2: Installing
Wiring		AWG 14/ψ2.6mm ²
size		2×90×59.6 mm(W×L×H) Din rail 72×126×59.6 mm(W×L×H) Direct

Product Specifications

	MODE	Input Power				Input point	Output point	Analog input	RTC	LCD keypad	expansion	1KHz High speed input	PWM	I/O LINK	
		AC 100~240V	AC 24V	DC 24V	DC 12V										
10 / 12 points	Expansion models														
	10HR-A	⊙				6	4	relay		⊙	⊙	⊙			
	12HR-D			⊙		8*	4	relay	2	⊙	⊙	⊙	⊙		
	12HT-D			⊙		8*	4	transistor	2	⊙	⊙	⊙	⊙	⊙	
	12HR-12D				⊙	8*	4	relay	2	⊙	⊙	⊙	⊙		
	12HR-24A		⊙			8	4	relay		⊙	⊙	⊙			
	OEM “Blind” Models, No Keypad, No Display														
	10KR-A	⊙				6	4	relay		⊙		⊙			
	12KR-D			⊙		8*	4	relay	2	⊙		⊙	⊙		
	12KT-D			⊙		8*	4	transistor	2	⊙		⊙	⊙	⊙	
	12KR-12D				⊙	8*	4	relay	2	⊙		⊙	⊙		
	12KR-24A		⊙			8	4	relay		⊙		⊙			
	OEM “Baseboard” Models, No Keypad, No Display, No Expansion														
	10CR-A	⊙				6	4	relay		⊙					
	12CR-D			⊙		8*	4	relay	2	⊙			⊙		
	12CT-D			⊙		8*	4	transistor	2	⊙			⊙	⊙	
	12CR-12D				⊙	8*	4	relay	2	⊙			⊙		
20 points	Expansion models														
	20HR-A	⊙				12	8	relay		⊙	⊙	⊙			
	20HR-D			⊙		12*	8	relay	4	⊙	⊙	⊙	⊙		
	20HT-D			⊙		12*	8	transistor	4	⊙	⊙	⊙	⊙	⊙	
	20HR-12D				⊙	12*	8	relay	4	⊙	⊙	⊙	⊙		
	20HR-24A		⊙			12	8	relay		⊙	⊙	⊙			
	OEM “Blind” Models, No Keypad, No Display														
	20KR-A	⊙				12	8	relay		⊙		⊙			
	20KR-D			⊙		12*	8	relay	4	⊙		⊙	⊙		
	20KT-D			⊙		12*	8	transistor	4	⊙		⊙	⊙	⊙	
	20KR-12D				⊙	12*	8	relay	4	⊙		⊙	⊙		
	20KR-24A		⊙			12	8	relay		⊙		⊙			
	OEM “Baseboard” Models, No Keypad, No Display, No Expansion														
	20CR-A	⊙				12	8	relay		⊙					
	20CR-D			⊙		12*	8	relay	4	⊙			⊙		
	20CT-D			⊙		12*	8	transistor	4	⊙			⊙	⊙	
	20CR-12D				⊙	12*	8	relay	4	⊙			⊙		
	RS485 communication models														
	20VR-D			⊙		12*	8	relay	4	⊙	⊙	⊙	⊙		⊙
	20VT-D			⊙		12*	8	transistor	4	⊙	⊙	⊙	⊙	⊙	⊙
	20VR-12D				⊙	12*	8	relay	4	⊙	⊙	⊙	⊙		⊙
	8ER-A	⊙				4	4	relay							
	8ER-D			⊙		4	4	relay							
	8ET-D			⊙		4	4	transistor							
	8ER-24A		⊙			4	4	relay							
	4AI			⊙		4*			4						
	4PT			⊙		4*			4						
	2AO			⊙			2	analog							

⊙: exist * : There are analog input points in.

Power Specifications

Normal model machine Specifications

content	SG2-10HR-A SG2-10KR-A SG2-10CR-A		SG2-20HR-A SG2-20KR-A		SG2-20HR-D SG2-20KR-D SG2-20HT-D SG2-20KT-D		SG2-12HR-D SG2-12KR-D SG2-12CR-D SG2-12HT-D SG2-12KT-D SG2-12CT-D	
operation Power range	AC 100~240V		AC 100~240V		DC 24V		DC 24V	
Voltage Rating	AC 85~265V		AC 85~265V		DC 20.4~28.8V		DC 20.4~28.8V	
Frequency Rating	50 / 60 Hz		50 / 60 Hz					
Frequency range	47~63Hz		47~63Hz					
instantaneous power down time allowable	10 ms(half cycle) / 20 times (IEC61131-2)		10 ms(half cycle) / 20 times (IEC61131-2)		1ms/10times (IEC61131-2)		10ms/10times (IEC61131-2)	
fuse	Need connect a fuse or breaker of current 1A		Need connect a fuse or breaker of current 1A		Need connect a fuse or breaker of current 1A		Need connect a fuse or breaker of current 1A	
Isolation	None		None		None		None	
Current average	AC 110V	AC 220V	AC 110V	AC 220V	DC 24V	DC 28.8V	DC 24V	DC 28.8V
	All inputs and relays are ON 90mA	All inputs and relays are ON 90mA	All inputs and relays are ON 100mA	All inputs and relays are ON 100mA	All inputs and relays are ON 145mA	All inputs and relays are ON 185mA	All inputs and relays are ON 115mA	All inputs and relays are ON 125mA
	All inputs and relays are OFF 85mA	All inputs and relays are OFF 85mA	All inputs and relays are OFF 90mA	All inputs and relays are OFF 90mA	All inputs and relays are OFF 80mA	All inputs and relays are OFF 120mA	All inputs and relays are OFF 75mA	All inputs and relays are OFF 85mA
Consume power	7.5 W		12.5 W		5 W		4.5W	

12V DC model Specifications

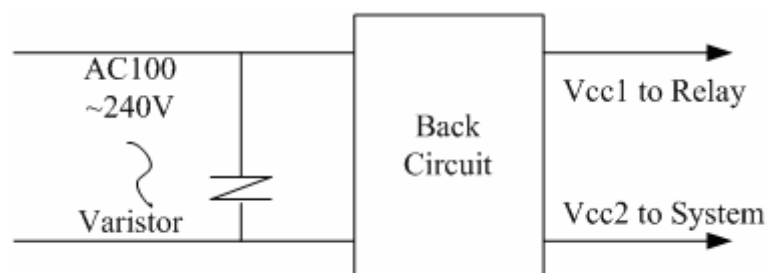
content	SG2-12HR-12D		SG2-20HR-12D	
Voltage Rating	DC 12 V		DC 12 V	
operation Power range	DC 10.4~14.4 V		DC 10.4~14.4 V	
instantaneous power down time allowable	10 ms / 10 times (IEC 61131-2)		1ms/ 10 times (IEC 61131-2)	
fuse	Need connect a fuse or breaker of Current 1A		Need connect a fuse or breaker of current 1A	
Isolation	None		None	
Current average	DC 12V	DC 14.4V	DC 12V	DC 14.4V
	All inputs and relays are ON 195mA	All inputs and relays are ON 195mA	All inputs and relays are ON 265mA	All inputs and relays are ON 265mA
	All inputs and Relays are OFF 160mA	All inputs and Relays are OFF 160mA	All inputs and Relays are OFF 200mA	All inputs and Relays are OFF 200mA
Consume power	2.5W		3.5 W	

24V AC model Specifications

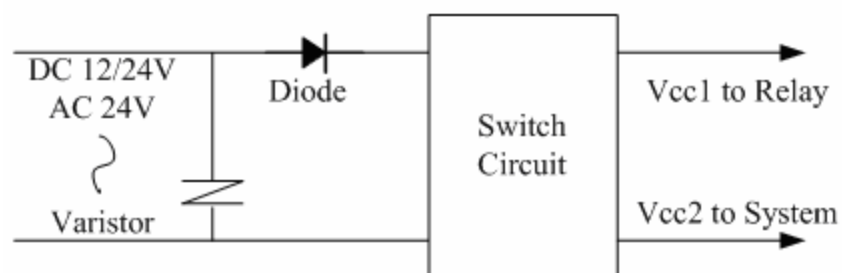
content	SG2-12HR-24A SG2-12KR-24A		SG2-20HR-24A SG2-20KR-24A	
Voltage Rating	AC 24V		AC 24V	
operation Power range	20.4~28.8V AC		20.4~28.8V AC	
instantaneous power down time allowable	10 ms(half cycle) / 20 times		10 ms(half cycle) / 20 times	
fuse	Need connect a fuse or breaker of Current 1A		Need connect a fuse or breaker of current 1A	
Isolation	None		None	
Current average	AC 24V	AC 28.8V	AC 24V	AC 28.8V
	All inputs and relays are ON 270mA	All inputs and relays are ON 250mA	All inputs and relays are ON 290mA	All inputs and relays are ON 260mA
	All inputs and Relays are OFF 160mA	All inputs and Relays are OFF 160mA	All inputs and Relays are OFF 200mA	All inputs and Relays are OFF 200mA
Consume power	6.5W		7 W	

Power circuitry diagram

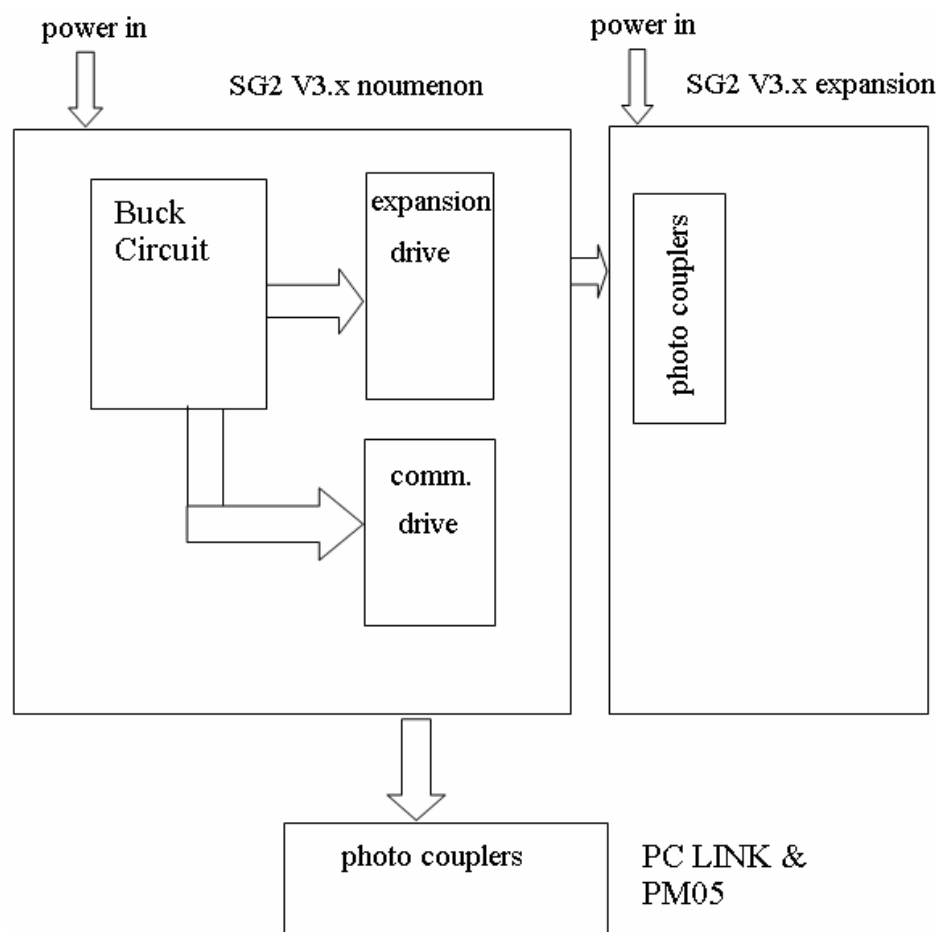
- 1) AC 10/20 points



- 2) DC 12V, DC 24V

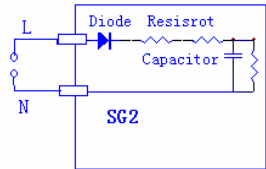


- 3) Mainframe, expansion and communication

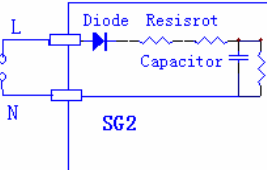


Input Specifications

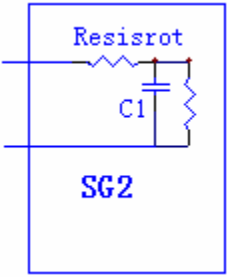
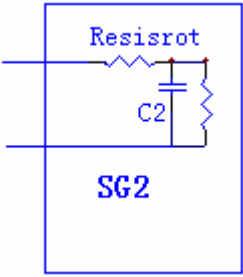
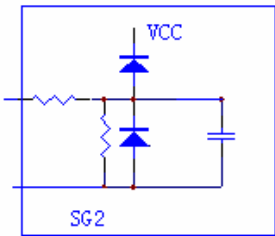
100~240V AC model

content	SG2-10HR-A SG2-10KR-A SG2-10CR-A		SG2-20HR-A & SG2-20KR-A	
Input circuitry	I01~I06		I01~I09, I0A, I0B, I0C	
				
number	6(digital input)		12(digital input)	
Signal current input	AC 110V 0.66mA	AC 220V 1.3mA	AC 110V 0.55mA	AC 220V 1.2mA
ON current input	> AC 79 V /0.41mA		> AC 79 V/ 0.4mA	
OFF current input	< AC 40 V /0.28mA		< AC 40 V / 0.15mA	
wire length	< / = 100 m		< / = 100 m	
response time of input	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)	

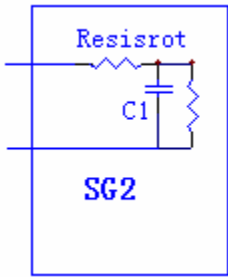
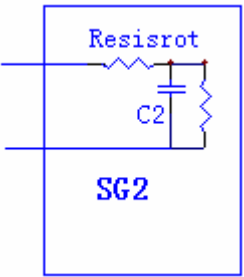
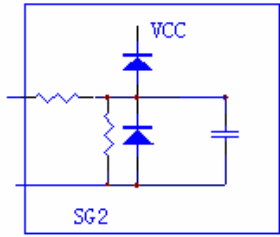
24V AC model

content	SG2-12HR-24A	SG2-20HR-24A
Input circuitry	I01~I06, I09, I0A	I01~I09, I0A, I0B, I0C
		
number	8(digital input)	12(digital input)
Signal current input	3mA	3mA
ON current input	> AC 14 V / 3mA	> AC 14 V / 3mA
OFF current input	< AC 6 V / 0.85 mA	< AC 6 V / 0.85mA
wire length	< / = 100 m	< / = 100 m
response time of input	On=>Off	On=>Off
	Typical 50/60 Hz 90/90ms	Typical 50/60 Hz 90/90ms
	Off=>On	Off=>On
	Typical 50/60 Hz 90/90ms	Typical 50/60 Hz 90/90ms

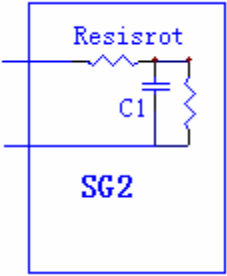
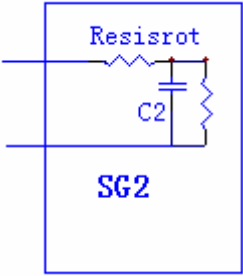
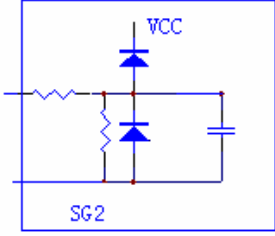
24V DC, 12 I/O model

content	SG2-12HR-D & SG2-12KR-D & SG2-12CR-D SG2-12HT-D & SG2-12KT-D & SG2-12CT-D			
	Normal digital input	High speed input	Analog input used as normal digital input	Analog input
Input circuitry	I03~I06 	I01,I02 	I09,I0A 	
number	4	2	2	2
Signal current input	3.2mA/24V DC	3.2mA/24V DC	0.63mA/24V	<0.17 mA/10V
ON current input	>1.875mA/15V	>1.875mA/15V	>0.161mA/9.8V	
OFF current input	< 0.625mA/5V	< 0.625mA/5V	< 0.085mA/5V	
wire length	< / = 100 m	< / = 100 m	< / = 100 m	< / = 30 m(shield wire)
response time of input	On=>Off	On=>Off	On=>Off	
	3ms	0.3ms	Typical: 5ms	
	Off=>On	Off=>On	Off=>On	
	5ms	0.5ms	Typical: 3ms	
Input voltage				0~10 V DC
Precision class				0.01V DC
bit of conversion				12
error				±2%±0.12V
Conversion time				1 cycle
sensor resistance				<1K ohm

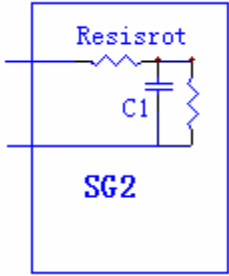
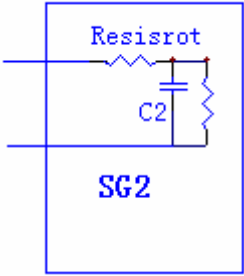
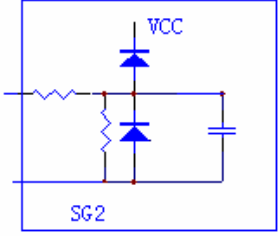
24V DC, 20 I/O model

content	SG2-20HR-D & SG2-20KR-D SG2-20HT-D & SG2-20KT-D			
	Normal digital input	High speed input	Analog input used as normal digital input	Analog input
Input circuitry	I03~I08 	I01,I02 	I09,I0A,I0B,I0C 	
number	6	2	4	4
Signal current input	3.1mA/24V DC	3.1mA/24V DC	0.63mA/24V	<0.17 mA/10V
ON current input	>1.875mA/15V	>1.875mA/15V	>0.163mA/9.8V	
OFF current input	< 0.625mA/5V	< 0.625mA/5V	< 0.083mA/5V	
wire length	< / = 100 m	< / = 100 m	< / = 100 m	< / = 30 m(shield wire)
response time of input	On=>Off	On=>Off	On=>Off	
	5ms	0.5ms	Typical: 5ms	
	Off=>On	Off=>On	Off=>On	
	3ms	0.3ms	Typical: 3ms	
Input voltage				0~10 V DC
Precision class				0.01V DC
bit of conversion				12
error				±2%±0.12V
Conversion time				1 cycle
sensor resistance				<1K ohm

12V DC, 12 I/O model

content	SG2-12HR-12D			
	Normal digital input	High speed input	Analog input used as normal digital input	Analog input
Input circuitry	I03~I06 	I01,I02 	I09,I0A 	
number	4	2	2	2
Signal current input	3.2mA/12V DC	3.2mA/12V DC	0.32mA/12V	<0.17 mA/10V
ON current input	>1.875mA/7.5V	>1.875mA/7.5V	>0.161mA/9.8V	
OFF current input	< 0.625mA/2.5V	< 0.625mA/2.5V	< 0.085mA/5V	
wire length	< / = 100 m	< / = 100 m	< / = 100 m	< / = 30 m(shield wire)
response time of input	On=>Off	On=>Off	On=>Off	
	3ms	0.3ms	Typical: 5ms	
	Off=>On	Off=>On	Off=>On	
	5ms	0.5ms	Typical: 3ms	
Input voltage				0~10 V DC
Precision class				0.01V DC
bit of conversion				12
error				±2%±0.12V
Conversion time				1 cycle
sensor resistance				<1K ohm

12V DC, 20 I/O model

content	SG2-20HR-12D			
	Normal digital input	High speed input	Analog input used as normal digital input	Analog input
Input circuitry	I03~I08 	I01,I02 	I09,I0A,I0B,I0C 	
number	6	2	4	4
Signal current input	3.2mA/12V DC	3.2mA/12V DC	0.63mA/12V	<0.17 mA/10V
ON current input	>1.875mA/7.5V	>1.875mA/7.5V	>0.163mA/9.8V	
OFF current input	< 0.625mA/2.55V	< 0.625mA/2.55V	< 0.083mA/5V	
wire length	< / = 100 m	< / = 100 m	< / = 100 m	< / = 30 m(shield wire)
response time of input	On=>Off	On=>Off	On=>Off	
	5ms	0.5ms	Typical: 5ms	
	Off=>On	Off=>On	Off=>On	
	3ms	0.3ms	Typical: 3ms	
Input voltage				0~10 V DC
Precision class				0.01V DC
bit of conversion				12
error				±2%±0.12V
Conversion time				1 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

Output Port wiring notice

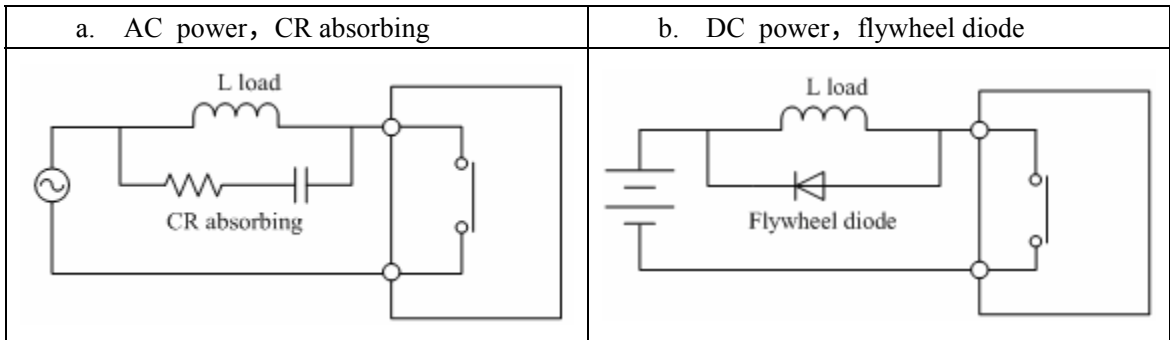
Light Load

The current value will be 10~20 times of normal value for several 10ms when filament is turning-on. A distributaries resistance or restricted current resistance is added at output port to reduce the concussion current value.

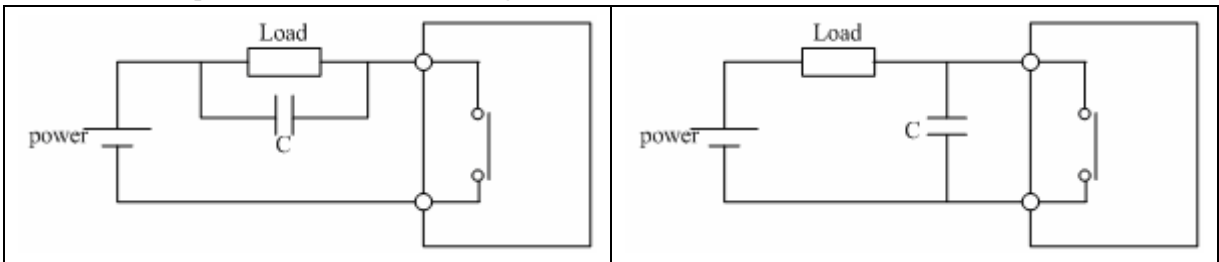
distributaries resistance There is a little current makes light shine faintness, so the value of resistance must be careful.	restricted current resistance The brightness will be described if the resistance value is too big.
--	--

Inductance Load

There will be a concussion voltage (KV) when the inductance load switches between ON and OFF, especially relay model. The methods of different power mode for absorbing the concussion voltage are shown below.

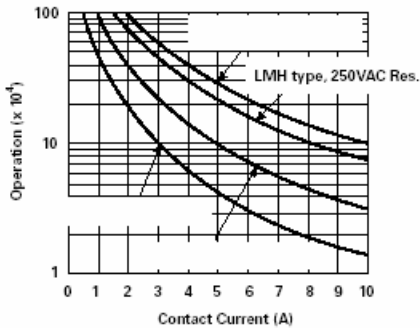


Please do can't use capacitance alone as absorbing as shown below.



Life of relay

Life Expectancy



- ✖ The data of picture above is standard, but the life of relay is influenced by the temperature of operation environmental.
- ✖ The life is more than 100K times if the current is less than 2A.

Power mode

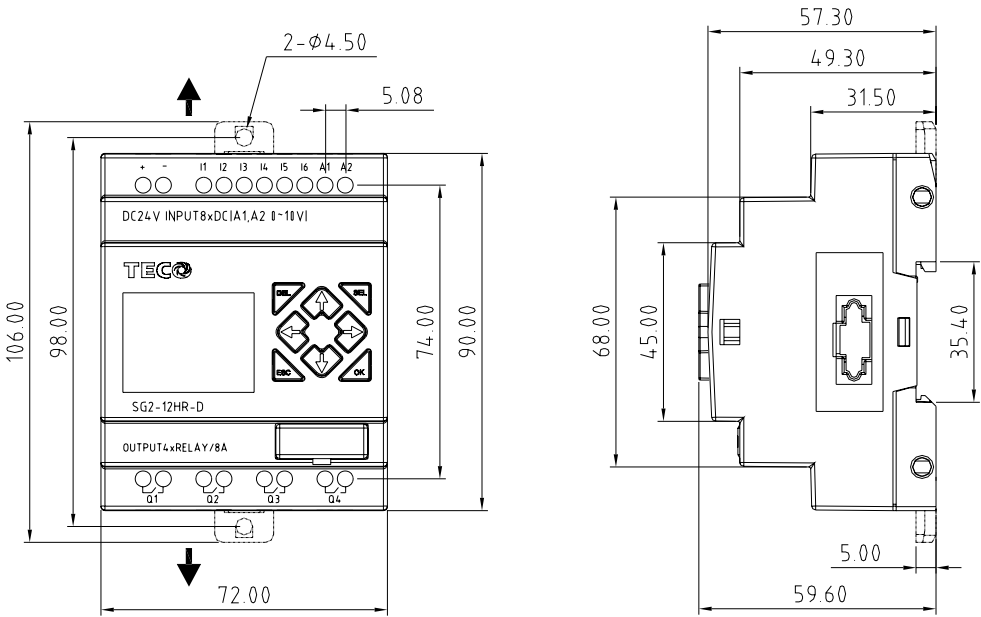
Mode	Input/Output
DC +12V	AC 100~240V / DC +12V
DC +24V	AC 100~240V / DC +24V

Accessory

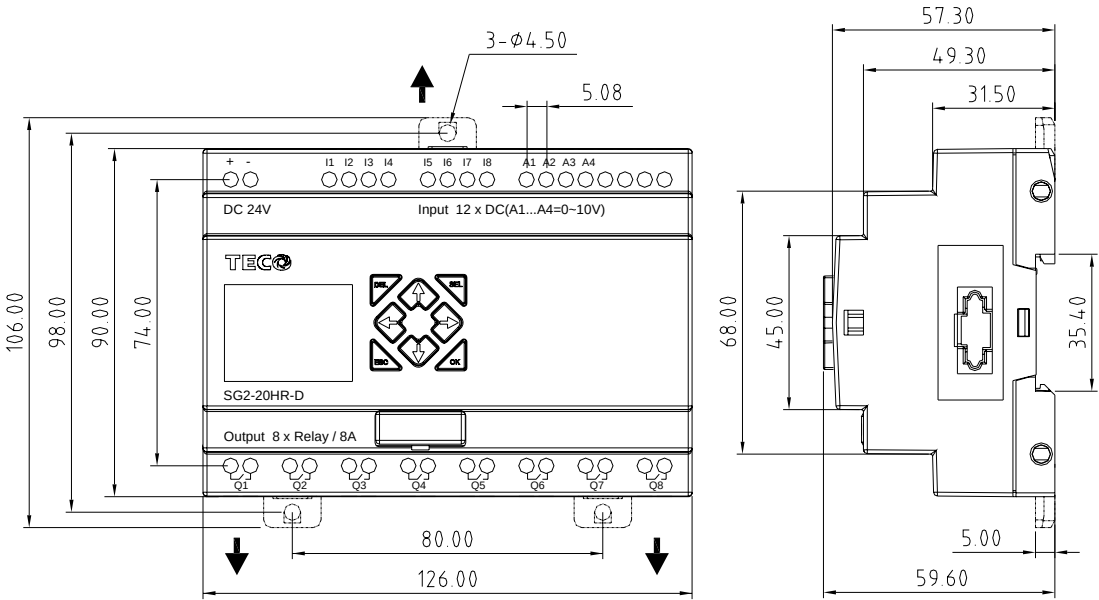
MODE	description
PM05	memory cartridge
SG2 Client	SG2 program software

Size diagram of SG2

10/12 points



20 points



Chapter 8: 20 Points RS485 type Models Instruction

Communication function.....	202
Detail instruction.....	204
Remote IO function.....	204
IO Link Function.....	205
MU instruction (Modbus RTU master).....	207
Modbus RTU slave function	209
SG2 Modbus protocol	209

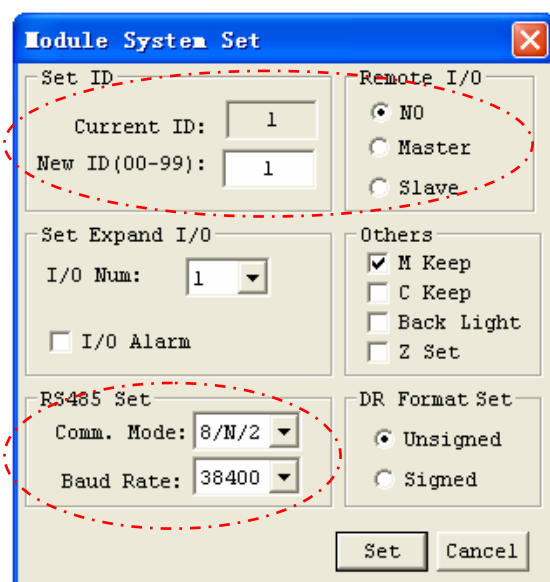
Only SG2-20VR-D, SG2-20VT-D, SG2-20VR-12D do have RS485 communication function.

Communication function

In order to suit your needs of RS 485 communication, there are many parameters needed to be set. And there are two ways to set that parameter.

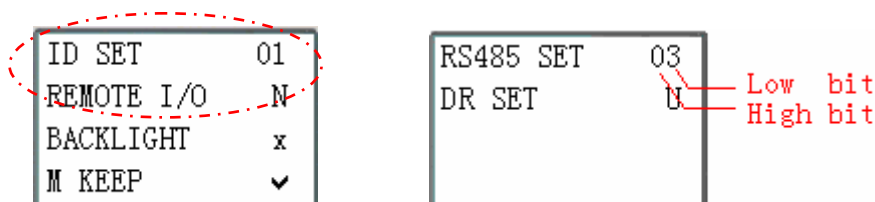
- Setting parameters via SG2 Client software:

- In SG2 Client Soft Select **Operation**>>**Module System Set**;
- Open the dialog box as show below, setting parameters **SET ID**, **Remote I/O** and **RS485 Set**.



- Setting parameters via keypad button on SG2.

- Press button to enter main menu.
- Press UP/DOWN to choose SET menu, and press OK to enter it.
- Press UP/DOWN makes the LCD to display the options as show below, setting parameters **ID SET**, **REMOTE I/O** and **RS485 SET**.



- Parameter **RS485 SET**, high bit means communication format and low bit means Baud Rate.
- Press OK button to save setting.

Function parameters:

ID SET	01	→	ID setting (00~99)
REMOTE I/O	N	→	Remote I/O Mode (N: none M: Master S: Slave)

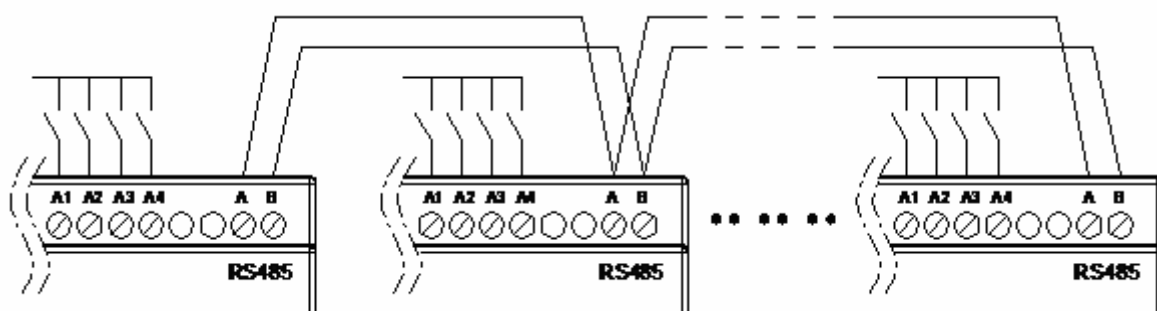
Function description:

Function	ID SET	REMOTE I/O	Description
Remote IO function	00~99	M & S	Up to 2 additional SG2 units can be configured as Remote I/O nodes (master and slave);
IO Link function	0~7	N	Up to 8 additional SG2 units can be configured as IO Link and ID must be continuous 0~7;
MU instruction	1~99	N	MU can be enabled only when no remote IO function and IO Link function;
Modbus RTU slave	1~99	N	Modbus RTU slave is effective when no remote IO function, IO Link function and MU instruction;

Communication parameters:

Content	Data	Meaning
Format	0	8/N/2 Data 8bits, No Parity, 2 Stop bits.
	1	8/E/1 Data 8bits, Even Parity, 1 Stop bit.
	2	8/O/1 Data 8bits, Odd Parity, 1 Stop bit.
	3	8/N/1 Data 8bits, No Parity, 1 Stop bit.
Baud Rate	0	4800 bps
	1	9600 bps
	2	19200 bps
	3	38400 bps
	4	57600 bps
	5	115200 bps

- ※ SG2 default ID SET=1, and REMOTE I/O=N (no remote I/O).
- ※ SG2 RS485 port default communication format is 8/N/2 (Data 8bits, No parity, 2 stop bits) and baud rate is 38400bps.
- ※ The communication parameter setting takes effect after power up again.



Detail instruction

Remote IO function

Function Description:

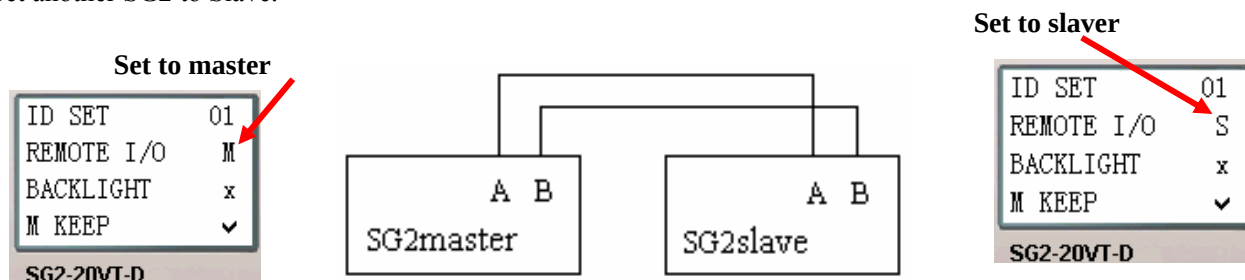
Up to 2 additional SG2 units can be configured as Remote I/O nodes, and linked to one master smart relay.

The Master can run its programming, but the Slave can't. The Master writes its state of expansion output coil Y to Slaver's output coil Q. The Slave writes its state of input coil I to Master's expansion input coil X.

I/O Address	Master	Slave
Input Coils	I01~I0C	
Output Coils	Q01~Q08	
Expansion Input Coils	X01~X0C	I01~I0C
Expansion Output Coils	Y01~Y08	Q01~Q08

Hardware Configuration:

1. Link 2 RS485 type SG2 as illustration show below.
2. Set left SG2 in the illustration to master.
3. Set another SG2 to Slave.



Master user program is valid and slave user program is not valid.

Don't use expansion DI/DO modules, when remote I/O function is enabled.

Example:

Create a Ladder program as show below in SG2 which is master.

```

X02----- Y01
X03----- Y02

```

If input coils I02 and I03 in the Slave are on. X02 and X03 in master will be on state with the influencing of I02 and I03 in the Slave. Obviously, Y01 and Y02 in the master will be the on state. Then for the influencing of Y01 and Y02 in master, Q01 and Q02 in slave will on. You can see the consequence on the IO interface show below.

I/O State on Slave Run mode

```

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

```

I/O State on Master Run mode

```

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

```

IO Link Function

Function Description:

Up to 8 additional SG2 units can be configured as independent Slave nodes, each running their own logic program and their I/O linked to one Master smart relay. The Master smart relay's ID must be 00, and Slave nodes' ID should start with 01 and be continuous. If nodes' ID isn't continuous, the Master won't communication with those nodes which are behind the first broken. For example, the nodes' ID is 01, 02, 04 and 05. The Master thinks there are only two Slave nodes whose ID is 01 and 02, and communication with them.

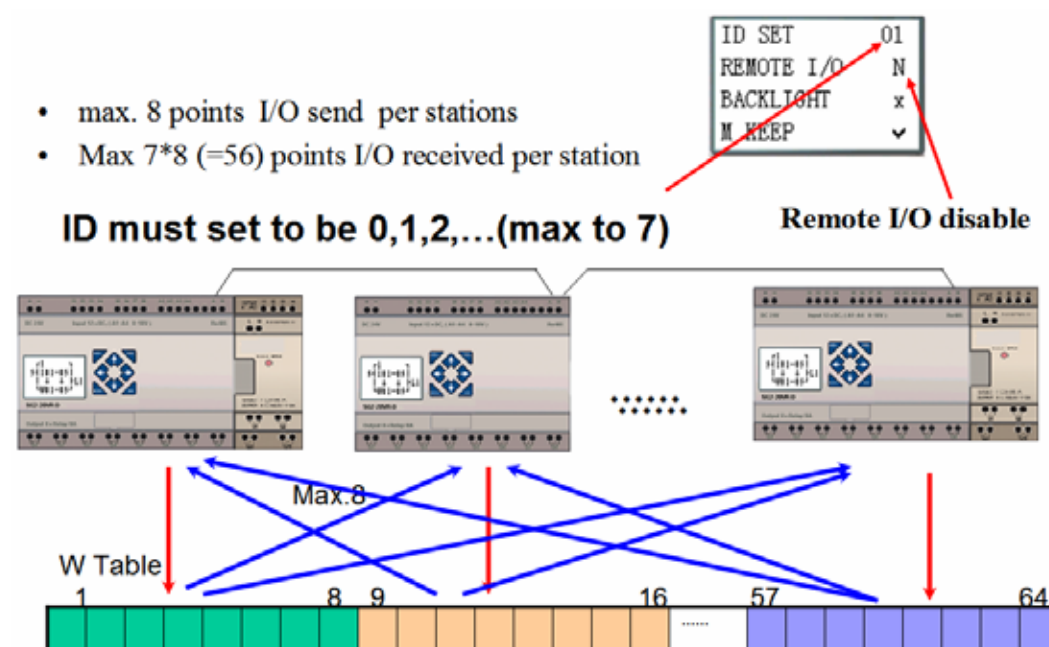
One controller can use 8 IO Link (L01~L08). Only one IO Link instruction can work at Mode 1(send mode), and the other IO Link instructions must be Mode 2 (receive mode).

The Mode 1: Send memory range is determined by the Controller ID. The adjacent table show the memory range of Wxx locations associated with each controller ID.

The Mode 2: read the selected Wxx status and write to the selected coil. If the select coil type is input coil I or X, coil status can't be changed by Wxx status.

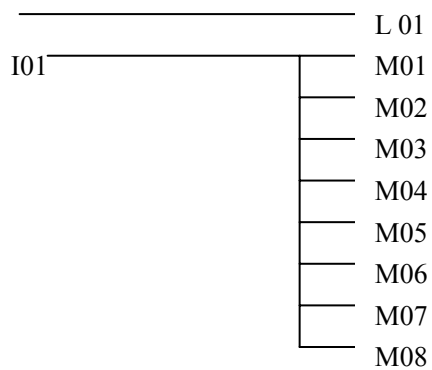
Hardware Configuration:

1. Link not more 8 RS485 type SG2 as show below.
2. Set all the SG2 in SET menu to No Remote IO.
3. Set those SG2's ID continuously 00, 01, 02... The max number of the ID is 07.

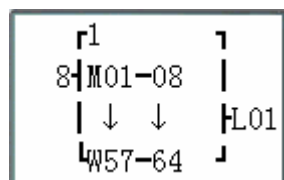


Example:

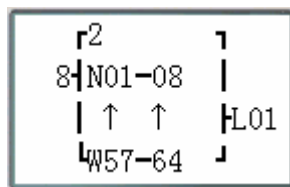
1. Link 8 20 pointes RS485 models SG2 according to the steps of the Hardware Configuration.
2. Create a ladder program as show below in those 8 SG2.



3. Set L01 of the SG2 which's ID =7 as fellow illustration.



4. L01 of other 7 SG2 set as fellow illustration.



5. Run program and let I01 of the SG2 which's ID = 7 on. And M01~M08 will be on state.
6. You will find N01~N08 of other 7 SG2 will be controlled by the M01~M08 of the SG2 which's ID=7.

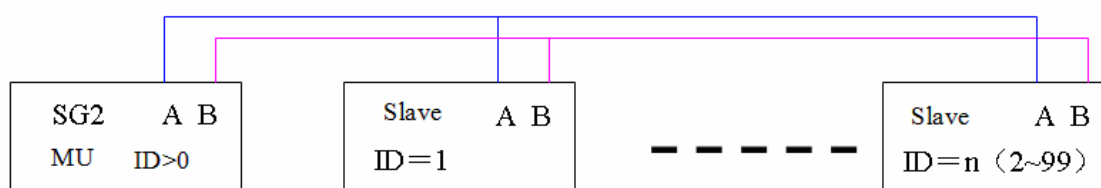
MU instruction (Modbus RTU master)

MU function carries out Modbus RTU master communication at RS485 port. There are 15 Modbus functions under ladder program mode (MU01~MU0F) and up to max 250 Modbus function blocks under FBD program mode.

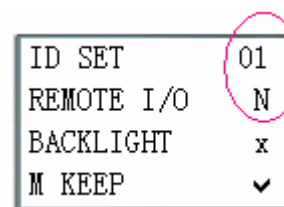
Modbus comes into possession of communication port, release the port when disable and one Modbus period is completed. There can be a number of communication orders in one program, but only one order can come into possession of communication port at the same time (FBD mode coil B output ON). And the others keep their enable state for executing function (FBD mode coil B output OFF).

Hardware Configuration:

1. Line SG2 RS485 port A, B with other Modbus Slave, as show below;



2. Set SG2 in the SET menu to No Remote IO;
3. Set SG2 ID = 01~99;



Function mode corresponding communication function code:

mode	Communication function code
1	03 (Read Registers)
2	06 (Write Single Register)
3	10 (Write Multiple Registers)
4	01 (Read Coils)
5	05 (Write Single Coil)

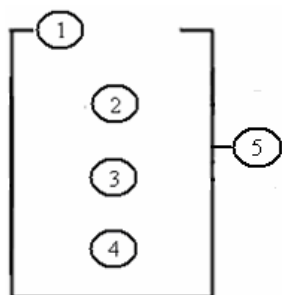
The M coil used in Modbus function:

Received (M3D)	M3D is set to ON after received, then check-up for error. Transferring data to target address if there is no error.
Error flag (M3E)	communication error flag
Time out flag (M3F)	M3F is set to 1 when the time from after sending to start receiving is longer than setting, and M3D also be set to 1. M3F is automatically reset if M3D reset.

The time out time is depending communication baud rate as shown in the table below:

Baud rate (bps)	Time (ms)
4800、9600、19200、38400	125
57600	100
115200	80

Under Ladder program mode there are 5 parameters in Modbus function as shown below.

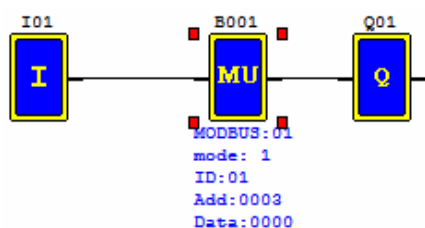


symbol	Description
①	MU mode (1~5)
②	Communication address: slave ID, range: 0~127
③	Communication content: address and data length: 1) address is constant, range: 0000~ffff; if mode 1 or 3, data length is fixed at 1 word; if mode 4, data length is fixed at 16 bits; 2) DR code, get address and length from this DR and the next
④	DR code, store sending/receiving data from this DR
⑤	MU code (MU01~MU0F)

More description and examples to see [Chapter4: Relay Ladder Logic Programming-MU \(Modbus\)](#).

※ The max data length for Mode 1 and 3 is 25words. The max data length for Mode 4 is 400bits.

Under FBD program mode, program, edit and parameter display as shown blow;

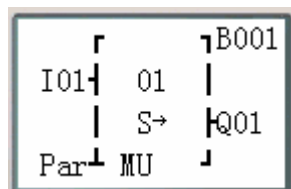


Model

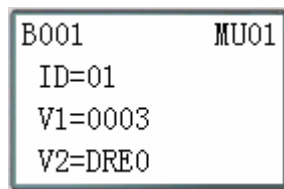
FBD display

Parameter display

Enable Input →



Parameter →



← Slaver ID

← Register address

← Saving data address

More description and examples to see [Chapter5: FBD Block Diagram Programming-MU \(Modbus\) function block](#).

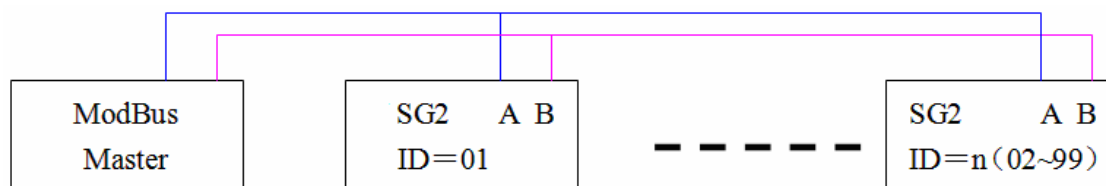
※ The max data length for Mode 1 and 3 is 25words. The max data length for Mode 4 is 400bits.

Modbus RTU slave function**Function Description:**

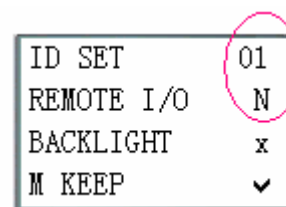
SG2 series PLC can be communication controlled by the computer or other controller with the communication. PC and other controller can read and write IO state, Function Block preset value. It also can use to read Function Block current value, control SG Run/Stop mode. Frame length maximum is 128bytes.

Hardware Configuration:

1. Line some SG2 RS485 port A, B as show below.

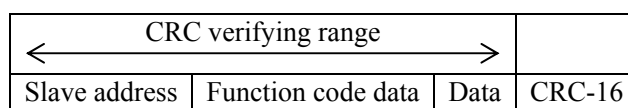


2. Set all the SG2 in the SET menu to No Remote IO.
3. Set SG2 ID = 01~99, each of those SG2's ID is different.

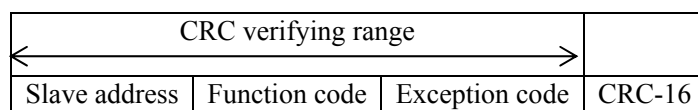
**SG2 Modbus protocol**

If SG2 receive a correct frame, it will carry out the command, it responses a correct frame to computer or other controller. If the command that SG2 received is not allowed, SG2 responses Exception code to computer or controller.

- Command format and Response format



- The Response command format, once SG2 receive an unexpected command.

**Command Format:**

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			

Exception Code

Under communication linking, the controller responses the Exception Code and send Function Code add 80H to main system if there is error happened.

Exception Code	Description
51	Frame error (Function Code error, Register Encoding error, Data Quantity Error)
52	Run mode and command disable
53	Secret mode and command disable
54	Data value over rang
55	Reserved
56	Reserved
57	SG2 the other error
58	Commands do not match SG2 edit mode
59	Reserved

Register Address

Register address	Function	Usable command	
0000H~0016H	Coil status (word) address	03H, 06H, 10H	
0100H~012FH	Control register	03H, 06H, 10H	
0200H~0237H, 0260H	Current value of register	03H	
0300H~033BH	User character address	03H, 0H	
0400H~043EH	Preset value of register	03H, 10H	
0500H~05FFH	Coil status (bit) address	01H, 05H	
0600H~0630H	Coil status (word) address	03H, 06H, 10H	New command for SG2V3
0700H~072FH	Control register	03H, 06H, 10H	
0800H~11EFH	Current value of register	03H	
1200H~2703H	Preset value of register	03H, 06H, 10H	
2B00H~2E0FH	Coil status (bit) address	01H, 05H	

Get more protocol information form '[R09-SG2-C03V04\(SG2V3 Modbus protocol \)](#)'.

Chapter 9: Expansion Module

Summarize	212
Digital IO Module	216
Analog Module	220
Analog Input Module 4AI	220
Temperature Input Module 4PT	221
Analog Output Module 2AO	222
Communication Module	224
MBUS Module	224
DNET Module	227
PBUS Module	230
EN01 (TCP/IP) Module	233
GSM Module	239

Summarize

Digital Input/Output module: SG2-8ER-A, SG2-8ER-D, SG2-8ET-D, SG2-8ER-24A

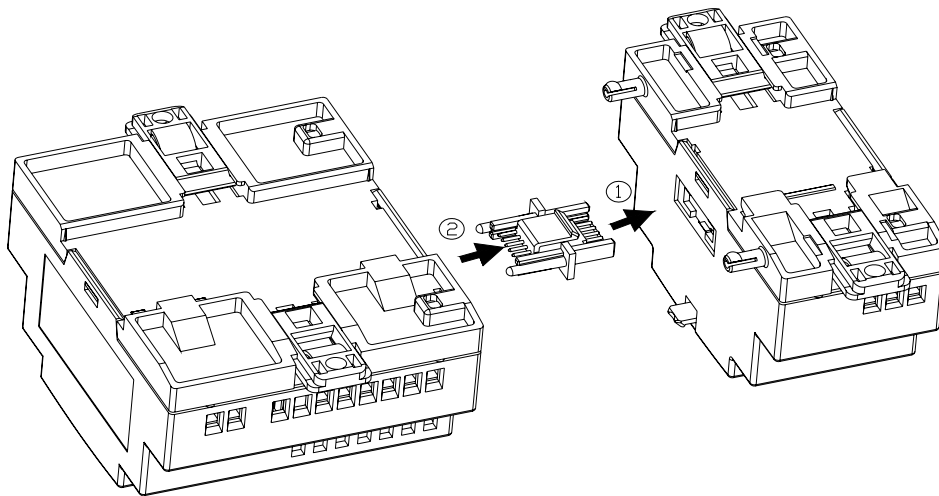
Analog Input module: SG2-4PT, SG2-4AI

Analog Output module: SG2-2AO

Communication module: MBUS, DNET, PBUS, EN01(TCP/IP), GSM

SG2 RS485 type, H type and K type all can connect expansion module. And the maximal expansion team is 3 Digital IO modes, 2 Analog Output modes, 2 Analog Input modules (one 4PT and one 4AI) and 1 Communication module. The sequence of these expansion modules connect with SG2 is digital, analog and communication.

※ SG2-4AI must be the last one of analog module.



- ※ The method of all expansion modules (except EN01 and GSM) connecting with SG2 is the same as shown above.
- ※ The method of EN01 module and GSM module connecting with SG2 is used programming cable PL01.
- ※ The number of digital module must be accord with IO number set if there are other modules after digital module. But the IO number set can be less than connecting if there is no other expansion module after digital module.
- ※ When SG2 unlink expansion module, it's scanning cycle time is about 2~20ms. Connecting with expansion module will increase SG2's scanning cycle. Connecting different expansion module has different influence to scanning cycle. For details, see the table below.

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	5	+4~16ms*5=20~80ms

* When setting function block's preset value via communication module during one scanning cycle. scanning cycle time increase about 50ms.

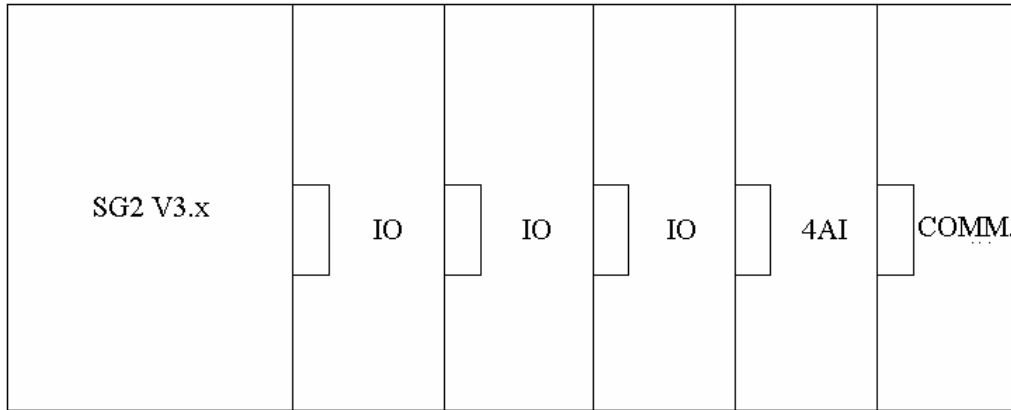
* When SG2 connecting with 4PT module, every scanning cycle transmits one channel data from 4PT to SG2. All of the four Channels will be update within four scanning cycles.

The digital models have 2 kinds: version 1.2 and version 3.0. They can connect with SG2 together.

There are 3 kinds of connecting of expansion modules as shown below.

Connecting communication modules are including MBUS, DNET and PBUS. EN01 and GSM module connected with SG2 by PL01.

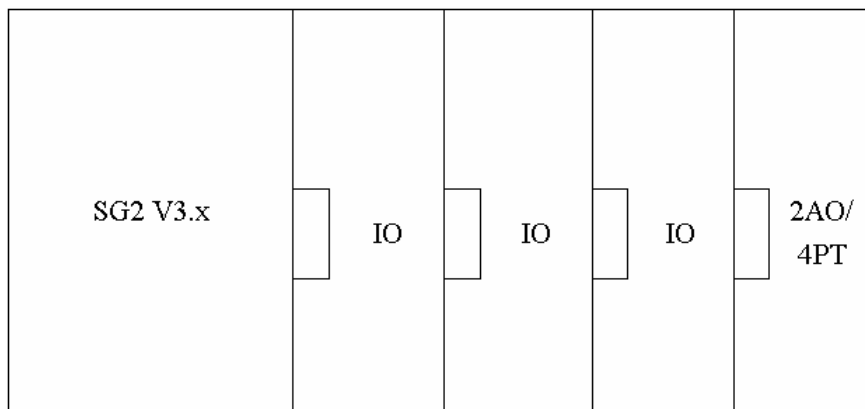
Mainframe + digital IO (V1.2/V3.0) * 3 + 4AI*1+COMM.*1



※ digital IO: SG2-8ER-A, SG2-8ER-D, SG2-8ET-D, SG2-8ER-24A

※ Digital IO version can be either 1.2 or 3.0

Mainframe + digital IO (V1.2/V3.0) * 3 + 2AO*1/4PT*1

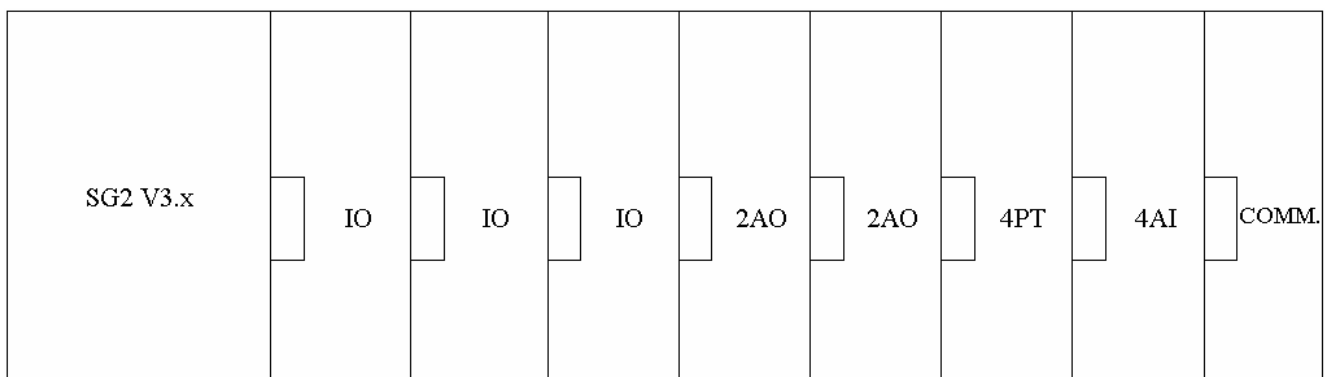


※ digital IO: SG2-8ER-A, SG2-8ER-D, SG2-8ET-D, SG2-8ER-24A

※ Digital IO version can be either 1.2 or 3.0

※ Either 2AO or 4PT.

Mainframe + digital IO (V3.0) * 3+2AO*2+4PT*1+4AI*1+ COMM.*1

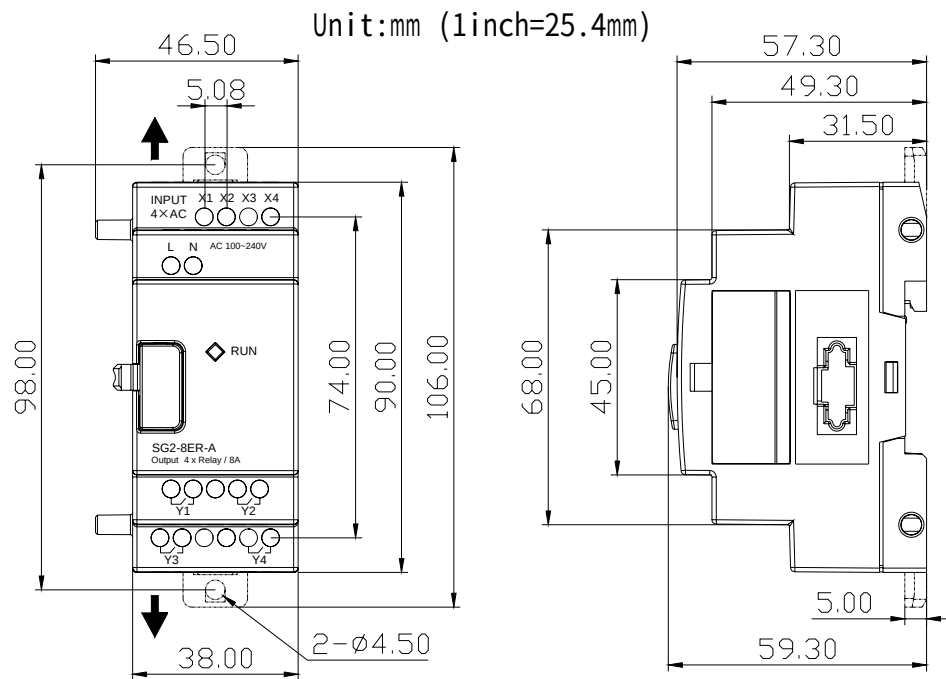


※ digital IO: SG2-8ER-A, SG2-8ER-D, SG2-8ET-D, SG2-8ER-24A

※ V3.0: Digital IO version is V3.0

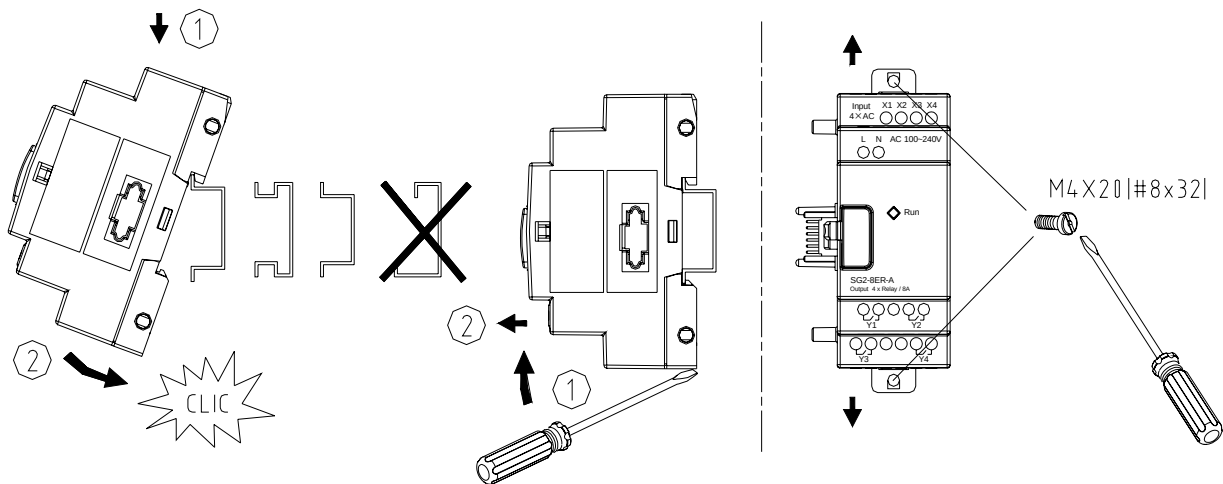
Size

※ All the expansion modules' size is the same as shown below.



Installation

※ All the expansion modules (except EN01 and GSM module) installation method is the same as shown below.



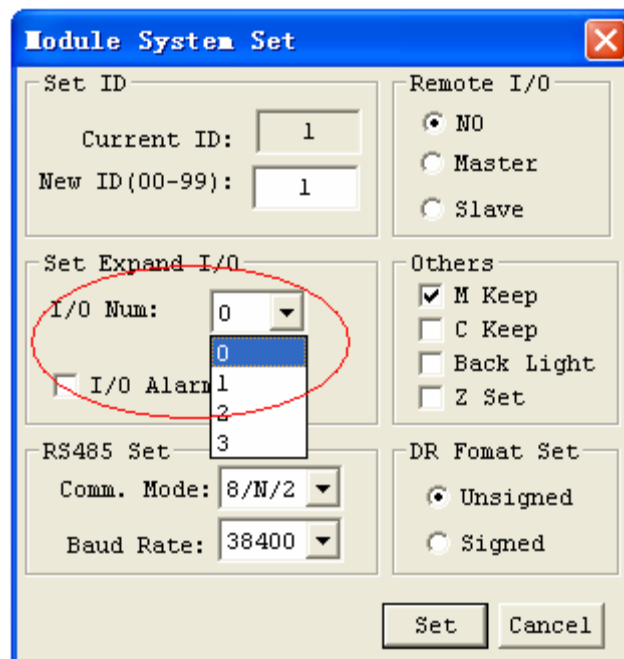
Digital IO Module

The SG2 must set the number of expansion IO when connect expansion module. The method of setting IO number is shown below.

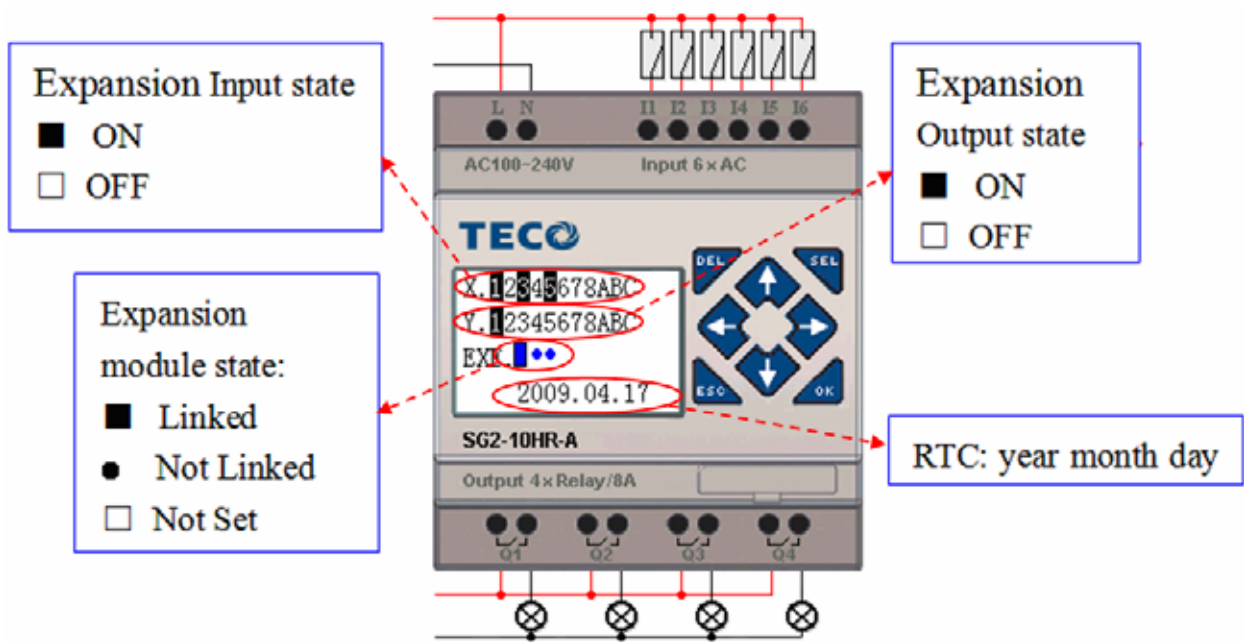
1) Keypad



2) SG2 Client software

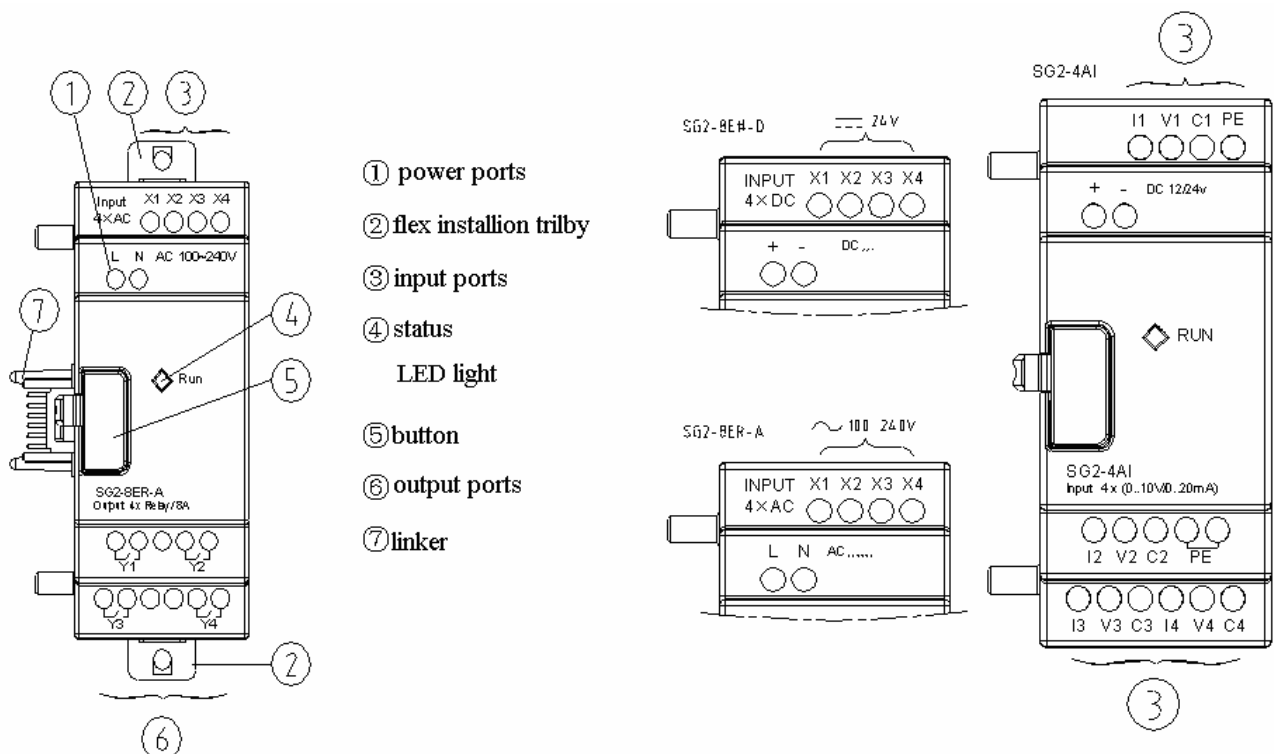


Expansion display State



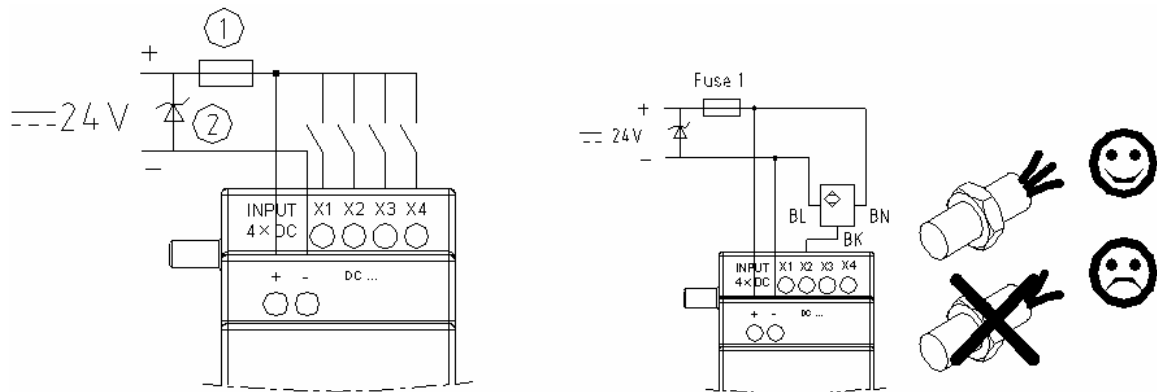
Installation and Wiring

E type of expansion module: SG2-8ER-D/8ET-D, SG2-8ER-A/8ER-24A



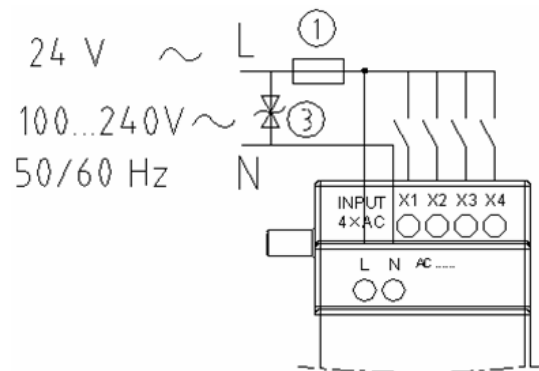
Wiring

1) 24V DC power input



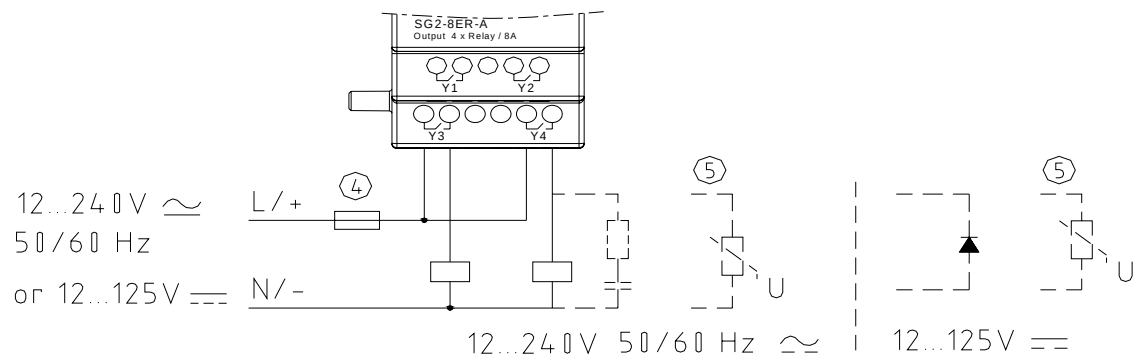
SG2-8ER-D/8ET-D

2) 24V/100~240V AC power input

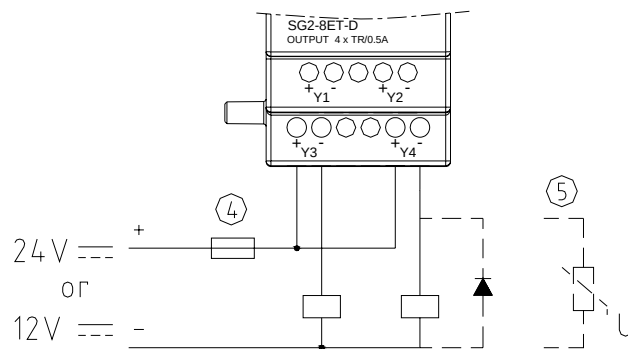


SG2-8ER-A/8ER-24A

3) Relay Output



4) Transistor output



①-1A quick-blowing fuse, circuit-breaker or circuit protector

②-Surge absorber (43V DC)

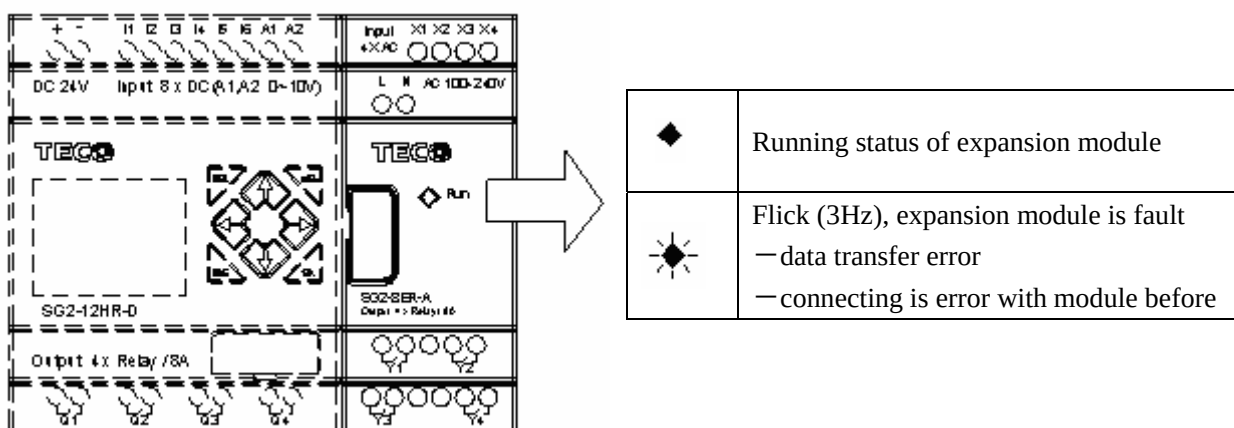
③-Surge absorber (Input 24VAC:43V; Input 100~240VAC:430V AC)

④-Fuse, circuit-breaker or circuit protector

⑤-Inductive load

※ AC inductive load needs parallel connect Surge absorber to describe noise if the SG2 output is relay. DC inductive load needs parallel connect commute diode if the SG2 output is relay. The commute diode 's inverted voltage should be more than 5~10 times of load voltage, and the positive current should be more than load current. Inductive load needs parallel connect commute diode if the SG2 output is transistor.

Digital IO module and Analog module both have orange indicator light. The state of indicator light is the same. The state of indicator light is shown below.



Analog Module

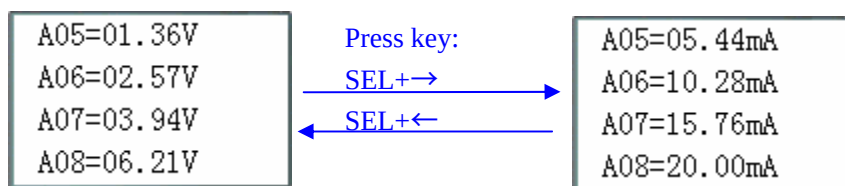
The maximal assembled of Analog expansion module to SG2 is 2*2AO, 1*4PT and 1*4AI.

Analog Input Module 4AI

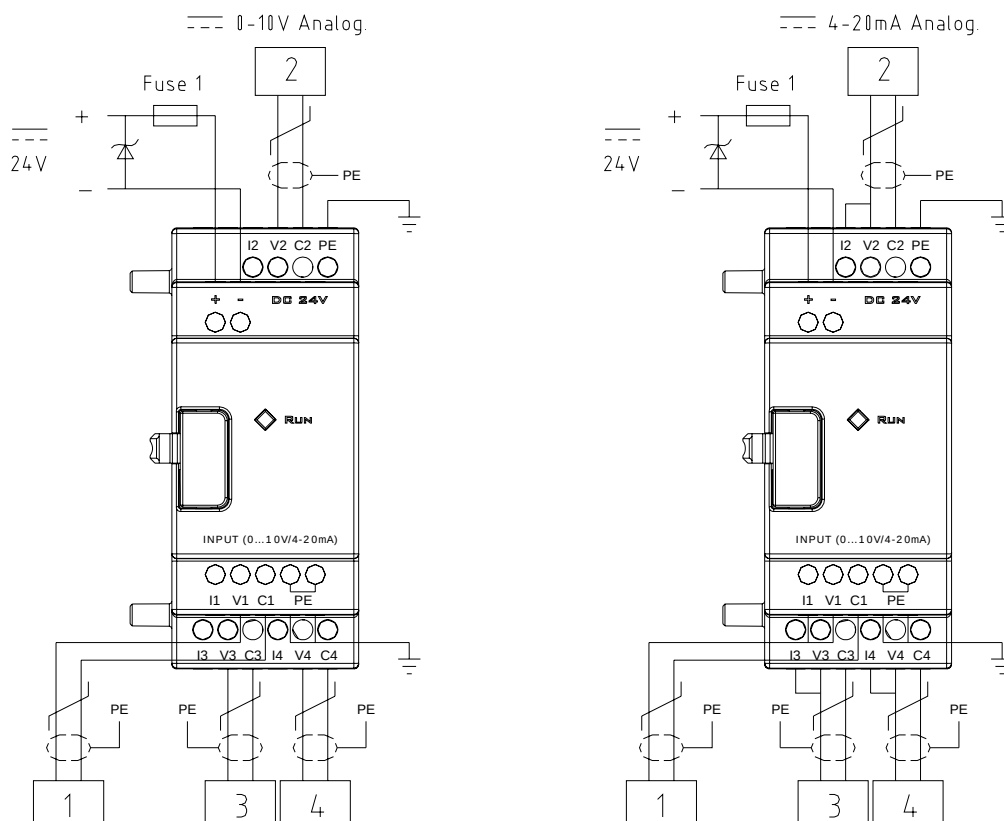
The 4 channel 12bits analog input of 4AI corresponds with A05~A08. It accepted the 0~10V voltage signal or 0~20mA current signal, and 12bits data 0~4095 stored in data register of DEEC~DREF. When input 0~20mA to Expand analog input A05~A08, corresponding value (0~2000) will be stored in DRE4~DRE7.

content		standard	
Mode		voltage	current
Analog output range		0V~10V	0mA~20mA
Differentiation		10mV	40μA
Digital output		0.00V~9.99V	0.00mA~20.00mA
Register value	A05~A08	0~999	0~500
	DREC~DREF	0~4095	0~2047
	DRE4~DRE7		0~200
Definition		±2.5%	±2.5%

The current value of 4AI input displaying as shown below:



Wiring



Temperature Input Module 4PT

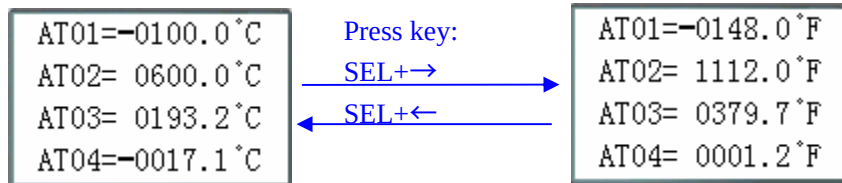
The 4 channel 12bits temperature (PT100) analog input of 4PT corresponds with AT01~AT04.

content	standard
Temperature input range	-100°C~600°C
Digital output	-100.0°C~600.0°C
Differentiation	0.1°C
Definition	±1%

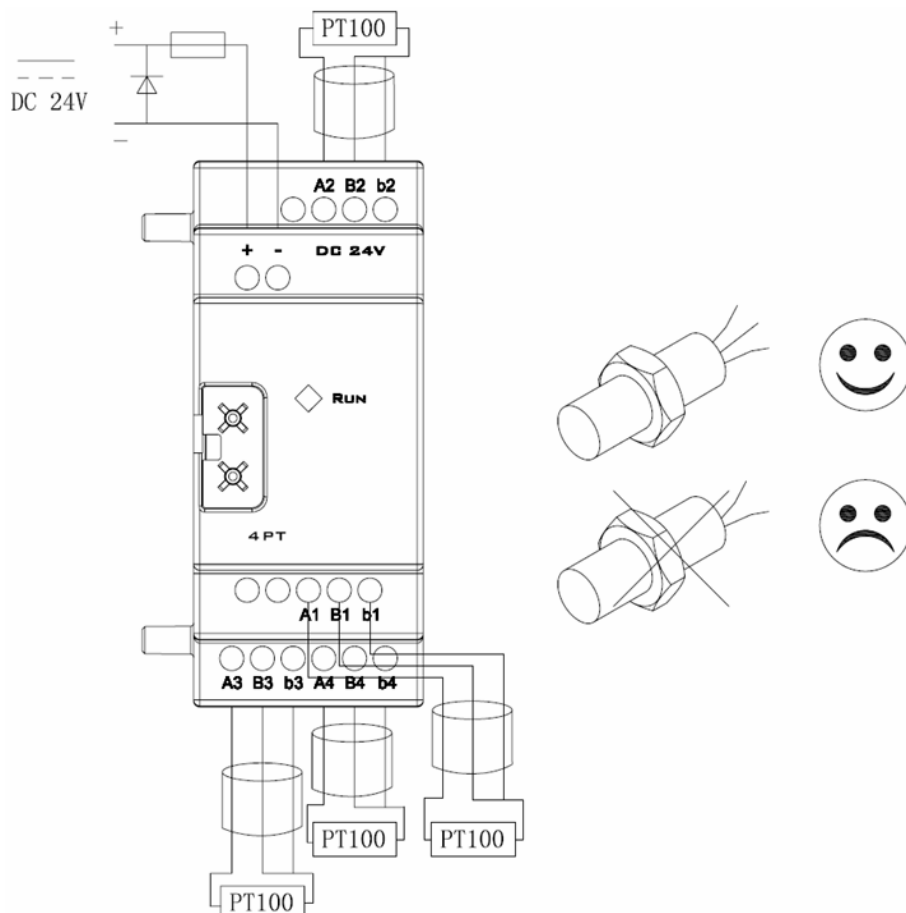
The input value of SG2-4PT is over range if wiring error or no input, SG2 will not receive and store the value of corresponding channel, and the corresponding channel's coil M turns ON.

coil	AT number	
M34	AT01	SG2-4PT channel 1 error
M35	AT02	SG2-4PT channel 2 error
M36	AT03	SG2-4PT channel 3 error
M37	AT04	SG2-4PT channel 4 error

The current value of 4PT input displaying as shown below:



Wiring



Analog Output Module 2AO

The 2 channel 12bits analog output and SG2 can connect two 2AO at the same time. The nearer 2AO to SG2 corresponds with AQ01~AQ02, and the farer 2AO to SG2 corresponds with AQ03~AQ04. It can out 0~10V voltage signal or 0~20mA current signal, and 12bits data 0~4095 stored in data register of DRD4~DRD7.

content		standard	
Mode		voltage	current
Analog output range		0V~10V	0mA~20mA
		Load impedance should be bigger than 500Ω	Load impedance should be smaller than 500Ω
Differentiation		10mV	40μA
Digital output		0.00V~10.00V	0.00mA~20.00mA
Register value	AQ01~AQ04	0~1000	0~500
	DRD4~DRD7	0~4095	0~2047
Definition		±2.5%	±2.5%

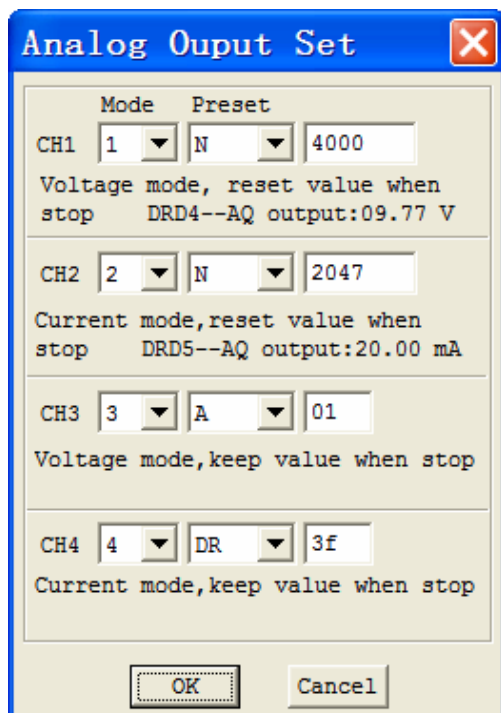
The output mode of AQ is set by the current value of DRD0~DRD3

	Output Register	Mode Register	Mode	DRD0~DRD3 data definition
Channel 1: AQ01	DRD4	DRD0	1	0: voltage mode and reset value when stop;
Channel 2: AQ02	DRD5	DRD1	2	1: Current mode and reset value when stop;
Channel 3: AQ03	DRD6	DRD2	3	2: voltage mode and keep value when stop;
Channel 4: AQ04	DRD7	DRD3	4	3: Current mode and keep value when stop;

※ It will be thought as 0 if the value of DR is not in the range of 0~3.

AQ display

AQ displays the preset value under STOP mode, and displays the current value under RUN mode.



STOP display

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

RUN display

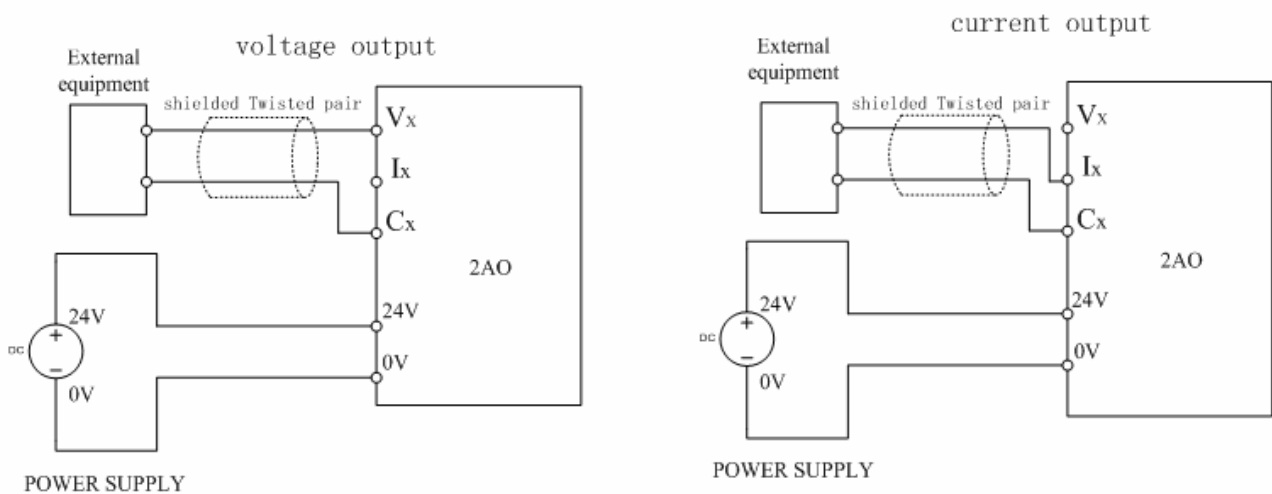
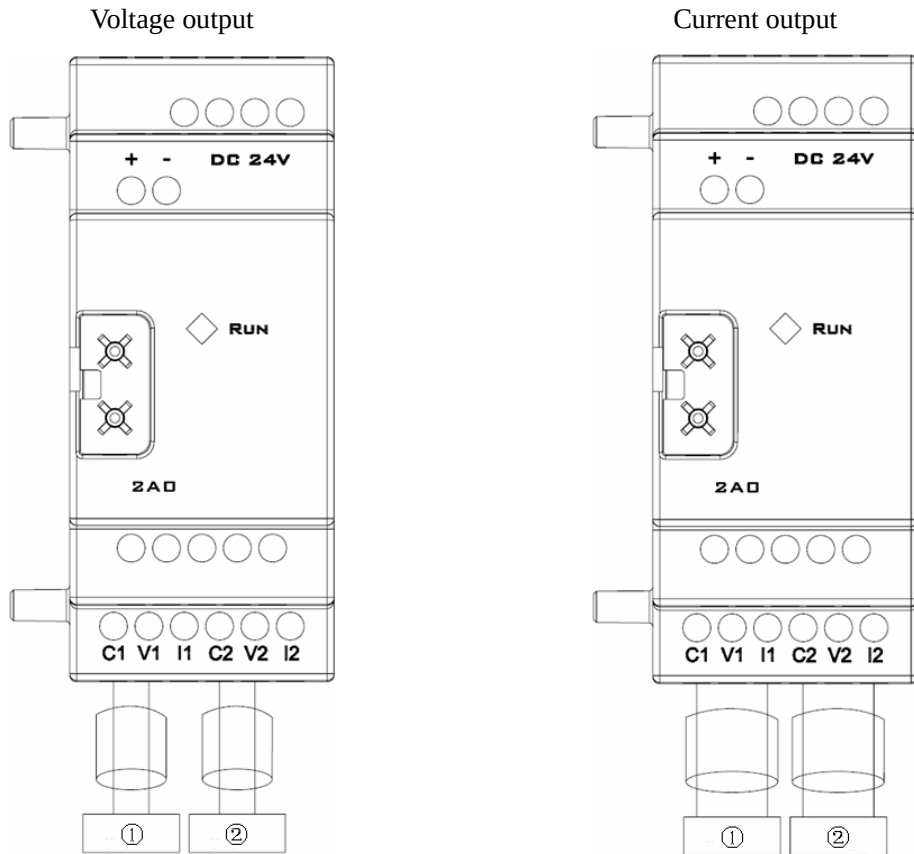
```
AQ01=09.77V
AQ02=20.00mA
AQ03=02.10V
AQ04=00.00mA
```

When AQ mode is current output, the DR value conversion AQ output value and display value show as below:

DRD5=2047, conversion AQ02=500, display: 20.00mA

- ※ When output value type of AQ is set to constant, AQ output value changed by DR value ($AQx=DRx/4.095$);
- ※ When output value type of AQ is set to other parameters variables, DR value changed by AQ output value ($DRx=AQx*4.095$).
- ※ More information about AQ correspondence with the DR to see [Chapter4: Relay Ladder Logic Programming-AQ \(Analog output\)](#).

Wiring



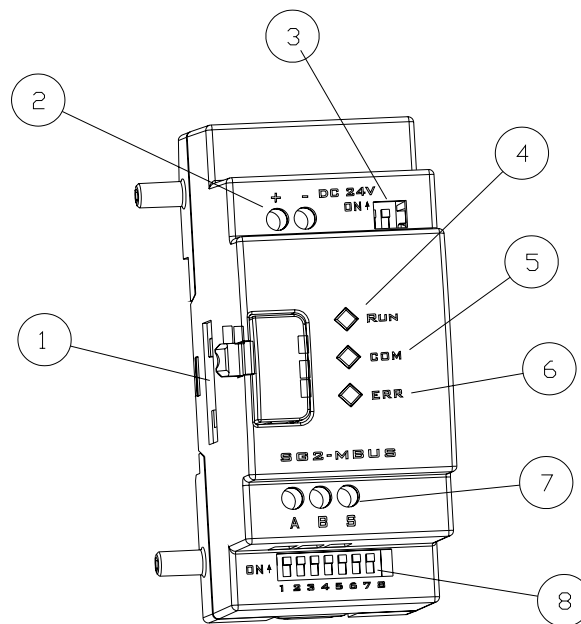
Communication Module

MBUS Module

Summarize

MBUS module makes SG2, which doesn't have communication ability, to communicate with other controller as master/slave mode. MBUS works as RTU slave node, responses RTU master node's request, but it can't communicate initiatively. MBUS makes the scan period of SG2 become longer; it is different from difference communication order. Normally, the extend time is less than 20ms, but it will be 100ms if the order is to rework the preset value of function.

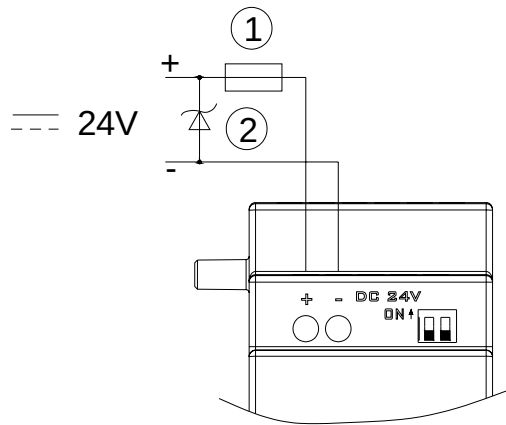
MBUS Cell Configuration



- ①: Connecting port
- ②: Power
- ③: SW2, 2-bit switch (terminal resistance selection)
- ④: RUN, running LED light
- ⑤: COMM. Communication LED light
- ⑥: Error, state LED light
- ⑦: RS 485 port
- ⑧: SW1, 8-bit switch (set format of communication)

Connect with electrical source

Input 24VDC



①-1A quick-blowing fuse, circuit-breaker or circuit protector.

②-Surge absorber.

Communication set

The MBUS communication baud rate and format can be set by 8 bits switch (DIP) SW1.

Baud rate

SW1-1~SW1-3 set communication baud rate is 4.8K, 9.6K, 19.2K, 38.4K, 57.6K as shown below.

SW1-1	SW1-2	SW1-3	SW1-6	Baud rate (Kbps)
OFF	OFF	OFF	OFF	4.8
ON	OFF	OFF	OFF	9.6
OFF	ON	OFF	OFF	19.2
ON	ON	OFF	OFF	38.4
*	*	ON	OFF	57.6
*	*	*	ON	38.4

※ * can be ON or OFF

Parity bit and stop bit

SW1-4~SW1-5, set stop bit and verifying bit

SW1-6, assembled setting

SW1-7~SW1-8, reserved

More information as shown below:

SW1-4	SW1-5	SW1-6	SW1-7	SW1-8	Stop bit, parity bit, assembled set
OFF	OFF	OFF	*	*	2 stop bits, no parity bit
OFF	ON	OFF	*	*	1 stop bit, no parity bit
ON	OFF	OFF	*	*	1 stop bit, 1 odd parity bit
ON	ON	OFF	*	*	1 stop bit, 1 even parity bit
*	*	ON	*	*	SW1-1~SW1-5 are inefficacy, communication format is default as 38.4Kbps, 2 stop bits, no parity bit

※ * can be ON or OFF

Address

The ID of MBUS module whose range is from 0H used for broadcast address to 63H must be the one of the SG2 basic unit. The ID of the master device changed if it doesn't get the ModBus order when it gets power or is running, the extended module gets the ID itself and renews it.

LED state display

Error code	State indication	Error type and reason	Manage method	remark
56H	The error LED light flick slow (2Hz)	The connection between SG2 and COMM. Mode is improper	check-up connection among SG2, IO mode and COMM. Mode	The question is connection with the mode before it if there are many expansion modes.
55H	The error LED light is ON	SG2 set error: IO number set is different from factual.	check-up SG2 set	
51H 54H	The error LED light flick slow (2Hz)	ModBus order error: data frames, function code, address of register, CRC , data unseemliness, verifying error, etc.	check-up the order and communication set according COMM. protocol	
59H	The error LED light flick quickly(5Hz)	COMM. data error: Verifying bit error, Length of data respond error, CRC error	Make sure the connection between SG2 and COMM. Mode is credible, describe environment interfere.	

※ More information to see [R06-SG2-MBUS-D01V31\(SG2-MBUS Communication User Manual\)](#).

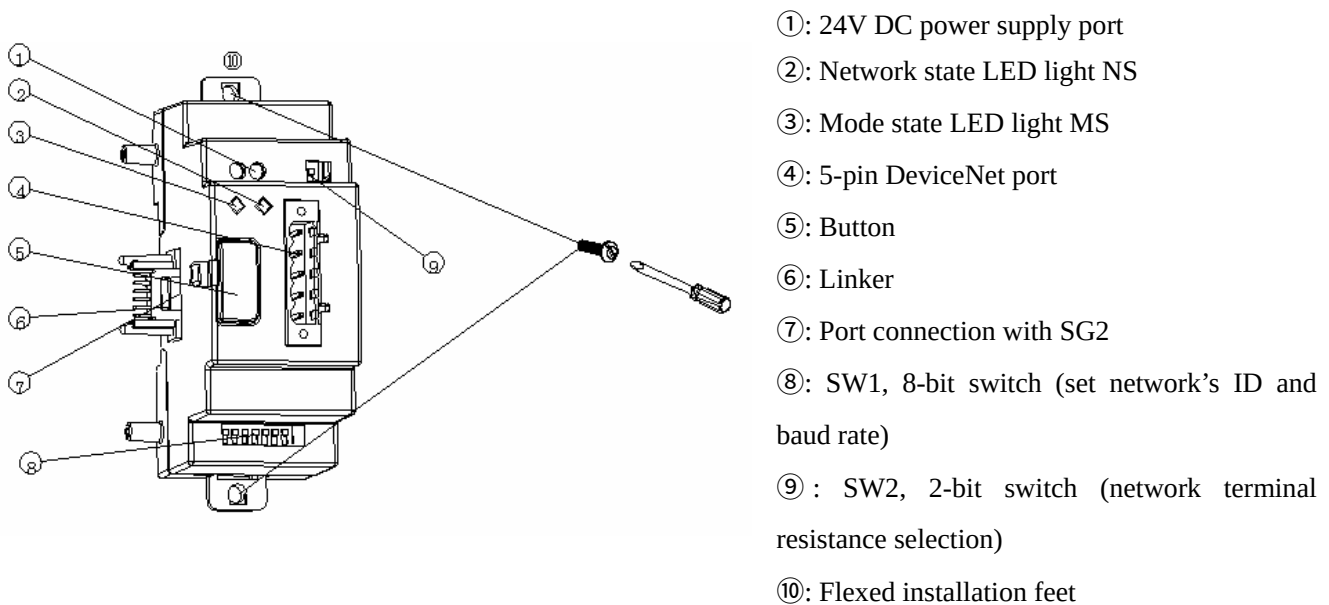
DNET Module

Summarize

DNET makes SG2, which doesn't have the ability of DeviceNet, to work in DeviceNet network. At DeviceNet side, DNET is a GROUP 2 ONLY equipment, slave equipment in this network. At PLC side, DNET communicate with SG2 through SG2 COMM. Port, it is point-to-point communication equipment.

DNET is together with SG2 as one slave equipment in DeviceNet network.

DNET Cell Configuration



DNET function description

Support predefine master slave connection

Support predefine explicit message connection

Support predefine poll IO message connection

Support explicit and IO message fragment

Support duplicate MAC Id check

UCMM incapable device

No bit-strobe IO message

No change of state and cycle IO message

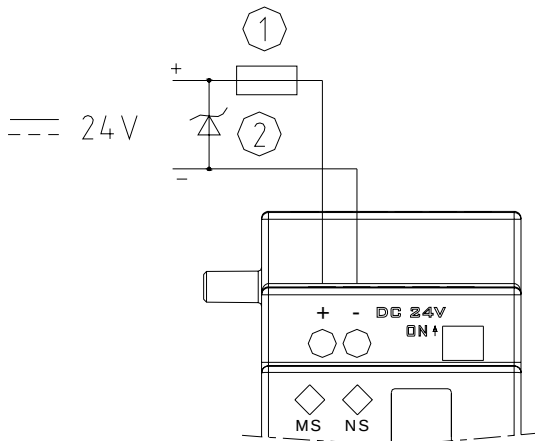
No device communication faulted message

No device heartbeat message

No device shutdown message

Connect with electrical source

Input 24VDC

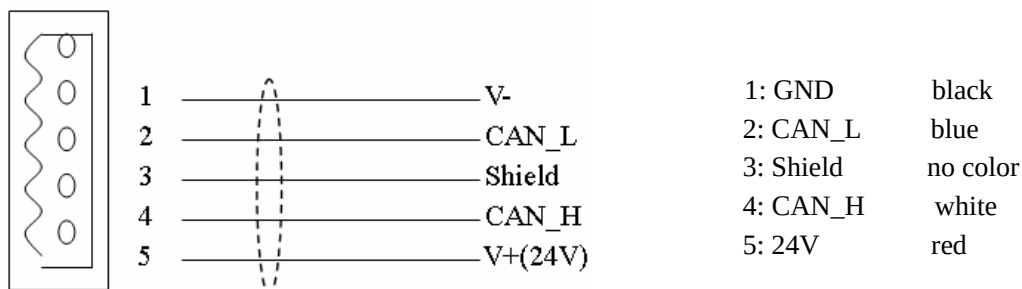


①-1A quick-blowing fuse, circuit-breaker or circuit protector.

②-Surge absorber.

Connect with DeviceNet network

Using 5-pin network tie-in connected DNET to DeviceNet bus. Please use network tie-in and cable ordained by ODVA. The style of cable decides the maximal length of cable and baud rate of communication at more degree.



Address and Baud rate set

In equipment network, each slave node needs a difference MAC ID, and the maximal number of ID is 64 (0~63). The address of node can be set by SW1-1~SW1-6 of DNET oneself mode. And the baud rate of communication can be set by SW1-7 and SW1-8, the baud rate set must be the same as equipment network.

SW1_1~SW1_6: ID in network

SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6	ID
OFF	OFF	OFF	OFF	OFF	OFF	0
ON	OFF	OFF	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	OFF	OFF	2
ON	ON	OFF	OFF	OFF	OFF	3
OFF	OFF	ON	OFF	OFF	OFF	4
----	----	----	----	----	----	----
OFF	ON	ON	ON	ON	ON	62
ON	ON	ON	ON	ON	ON	63

SW1_7~SW1_8: Baud rate

SW1-7	SW1-8	Baud Rate
OFF	OFF	125K
ON	OFF	250K
OFF	ON	500K
ON	ON	Reserved (default baud rate: 125K)

LED state display

DNET has two LED lights, watching itself and communication Bus' state.

1) mode state LED (MS)

Double color LED (green and red) indicates DNET state.

Module status LED	Explanation	Correct or prevent fault
Off	No power	Power up
Green on	Normal operation status	No
Green flash	No connected with SG2 basic unit	Connected with SG2 correctly.
Red flash	Connect with SG2 but communication error.	Set SG2 IO number correctly.
Red on	Device hardware error.	Use a new module.

2) network state LED (NS)

Double color LED (green and red) indicates equipment network bus state.

Net status LED	Explanation	Correct or prevent fault
Off	·No power. ·The device is a single node in the net.	Power up. Add other device in the net.
Green on	Normal operation mode, and connected with master.	No
Green flash	Normal operation mode, but not connected with master or had be set free	No
Red flash	IO connection time out, waiting green flash after a few seconds.	No
Red on	·Dup MAC ID check error ·Communication error and restart	Replace node address and power up again.

※ More information about protocol and EDS file to see:

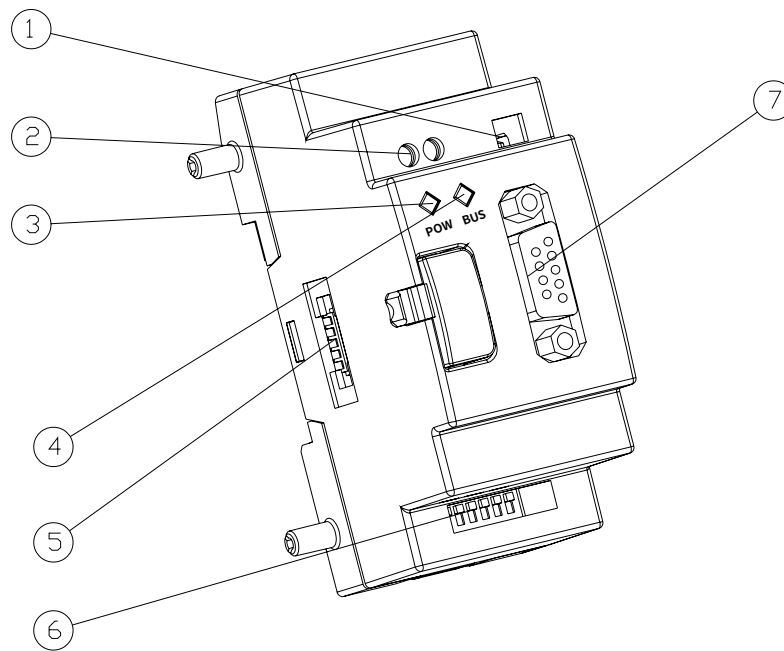
[R06-SG2-DNET-D01X30\(SG2-DNet user manual\)](#)

[R09-SG2-DNET-C02X30\(04D2000C00020300\).eds](#)

PBUS Module**Summarize**

PBUS makes SG2, which can't work in ProfiBus DP network, to work in ProfiBus DP network. At ProfiBus DP side, PBUS mode is a gateway, a slave node in network. At PLC side, PBUS communicate with SG2 through SG2 COMM. Port, it is point-to-point communication equipment.

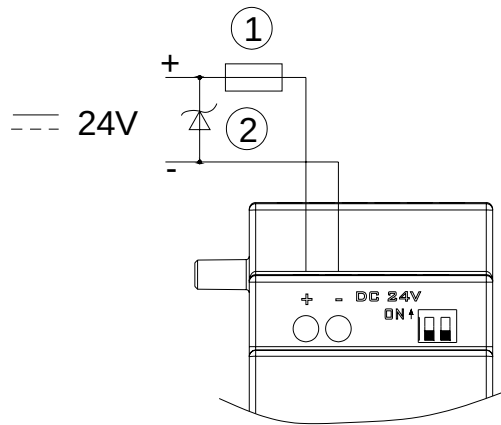
PBUS is together with SG2 as one slave equipment in ProfiBus DP network.

PBUS Cell Configuration

- ①: 2-bit switch (terminal resistance selection)
- ②: 24V DC power supply port
- ③: Power indicate light
- ④: BUS indicate light
- ⑤: Port connection with SG2
- ⑥: 8-bit switch (slave node ID set)
- ⑦: 9-hole PROFIBUS DP socket

Connect with electrical source

Input 24VDC



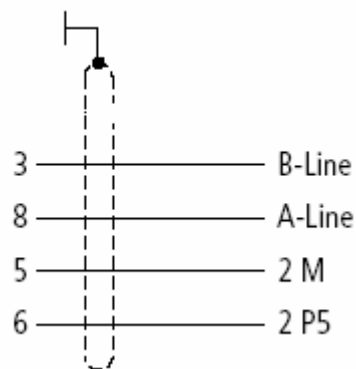
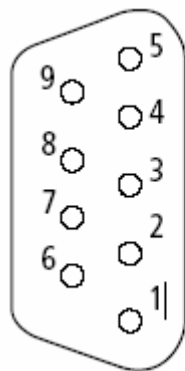
①-1A quick-blowing fuse, circuit-breaker or circuit protector.

②-Surge absorber.

Connection with Profibus Net

Using 9-hole pin to connect with PROFIBUS DP bus, please use the regulated pin and cable.

Ports assign



NO.	name	description
1	reserved	
2	reserved	
3	RxD/TxD-P (B- Line)	Send/receive data (positive)
4	reserved	
5	DGND (2M)	Digital GND
6	VP(2 P5)	+5V DC (supply bus expansion)
7	reserved	
8	RxD/TxD-N (A-Line)	Send/receive data (negative)
9	reserved	

Baud rate adapt oneself and address set

After PBUS mode powers up, it can identify the baud rate on Profibus automatically when at least one master sends right message. The baud rate range is: 9.6Kbit/s ~6Mbit/s. In equipment network, each slave node has a difference ID, and the maximal number of ID is 127 (0~126). Its ID can be set by 8-bit switch integration on itself.

SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW_7	SW_8	ID
OFF	OFF	OFF	OFF	OFF	OFF	OFF	*	0
ON	OFF	OFF	OFF	OFF	OFF	OFF	*	1
OFF	ON	OFF	OFF	OFF	OFF	OFF	*	2
ON	ON	OFF	OFF	OFF	OFF	OFF	*	3
OFF	OFF	ON	OFF	OFF	OFF	OFF	*	4
---	---	---	---	---	---	---	*	---
ON	OFF	ON	ON	ON	ON	ON	*	125
OFF	ON	ON	ON	ON	ON	ON	*	126

※ The SW_8 bit is reserved.

LED state display

PBUS module has two number of double color LED (green and red) used for fast diagnostics, to indicate the state of COMM. Bus and itself.

1) power LED

State of LED	Description
Green ON	natural
Yellow (red and green) flash (4Hz)	Hardware error
Yellow (red and green) flash (2Hz)	IO number error
Red flash (2Hz)	Connection with SG2 error
Red flash (1Hz)	Read/write order COMM. With Network bus error
OFF	Power down

2) BUS LED

State of LED	Description
Green ON	Connect with DP Net and communication right
OFF	Not connect with DP Net

※ More information about protocol and GSD file to see:

[R09-SG2-DP-C04 X 30 \(SG2-PROFIBUS-DP manual E\)](#)

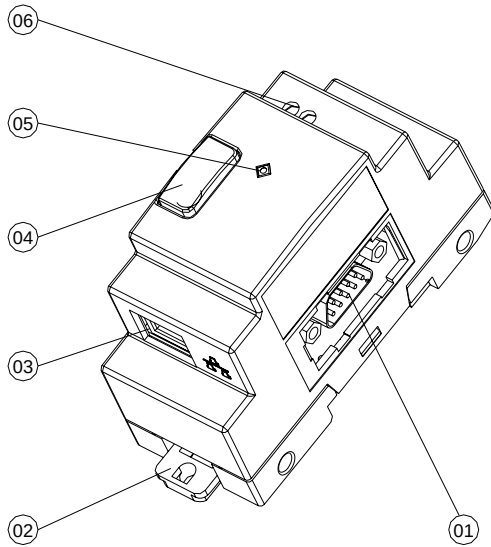
[TECO_SG2.GSD](#)

EN01 (TCP/IP) Module

Summarize

EN01 makes SG2 to work in TCP/IP network, read, write and monitor program by software PC Link.

EN01 Cell Configuration



①: 9-hole socket (PL01 connect with SG2)

②: Flexed installation feet

③: TCP/IP port

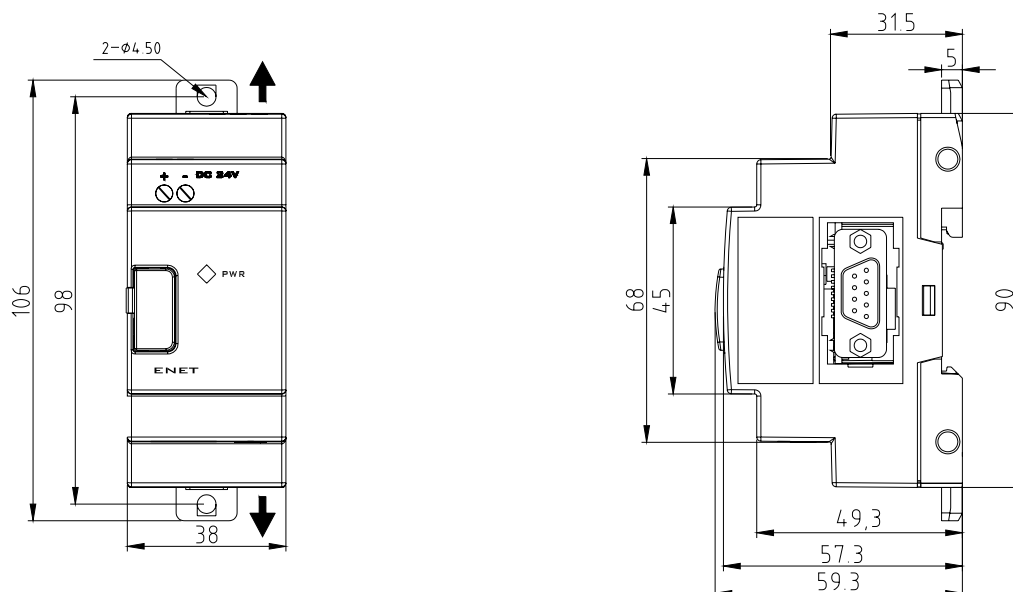
④: Button

⑤: Power indicate light (orange)

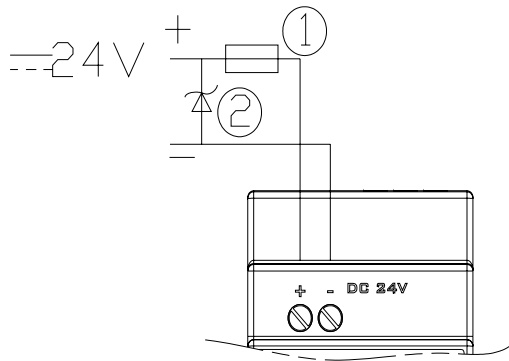
⑥: 24V DC power supply port

Dimensions

Unit: mm (1inch=25.4mm)

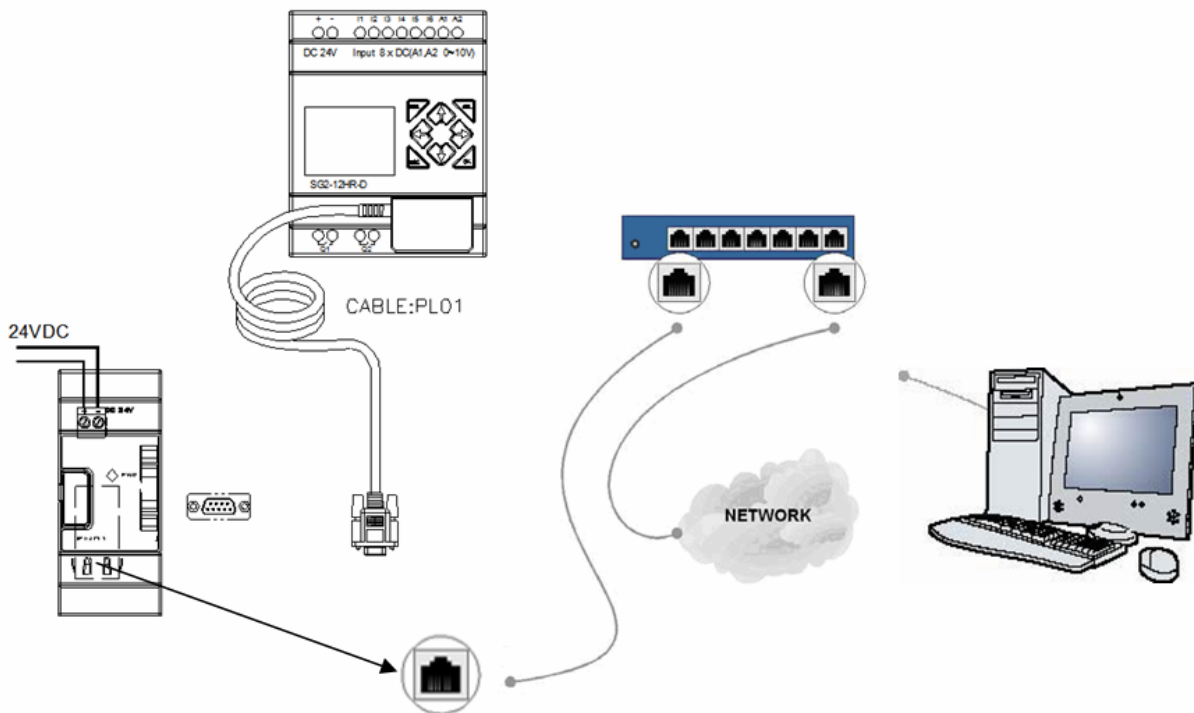


Connect with electrical source



- ①-1A quick-blowing fuse, circuit-breaker or circuit protector.
- ②-Surge absorber.

Communication (product EN01)



Verification Check: If powered up correctly, the EN01 Evaluation Board power LED indicator lights orange and remains on.

Install Device

1. Select dotnetfx.exe and Run.
2. Select XPortInstallerSetup.msi and Run.
3. Select red32bit_3.0.0.2.exe and Run.

Note: Obtain the software from supplier and after you complete the installation, please restart your Computer.

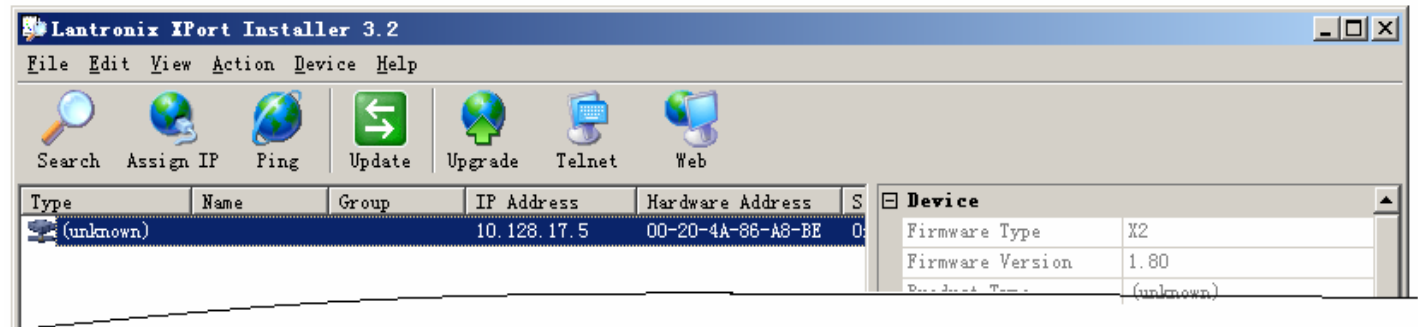
Configure

You can use Local area network or Ethernet to configure this module. In the Ethernet this module need to have the IP address that can visit. You can obtain the IP address through the Network address Translation or The manager of the Ethernet. In the Local area network, please be sure to follow the procedures given below.

1. Click **Start** in the Windows Taskbar → **Programs** → **XPortInstaller** → **XPortInstaller**.



2. Click the **Search** icon and choose it.



A. Hardware Address

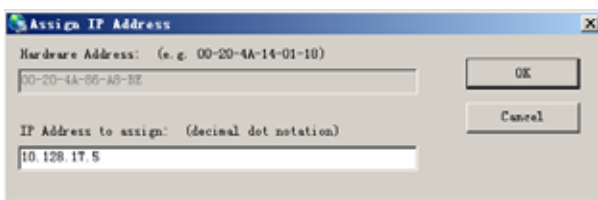
The format: 00-20-4A-XX-XX-XX, where the XXs are unique numbers assigned to the product.

B. IP Address

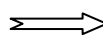
EN01 must have a unique IP address on your network. The systems administrator generally provides the IP address, subnet mask, and gateway. The IP address must be within a valid range, unique to your network, and in the same subnet as your PC. The format: 0.0.0.0 (e.g. 10.128.19.119).



3. Click the **Assign IP** icon.



Click the **Assign IP** icon



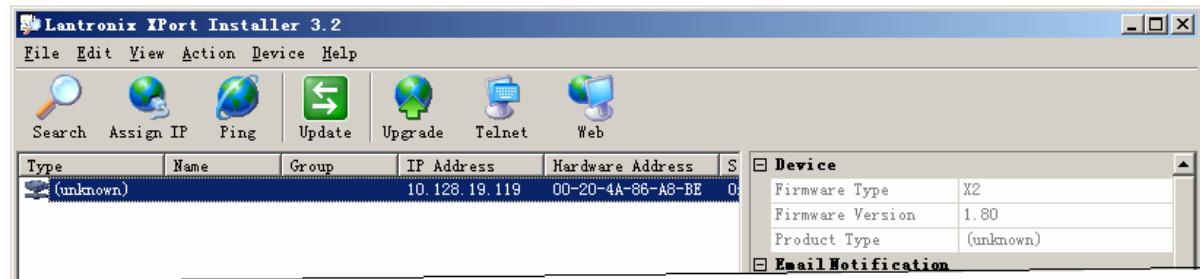
Enter the IP address Format and click **OK**

Note: Enter the IP address Format: 0.0.0.0, and click **OK**.

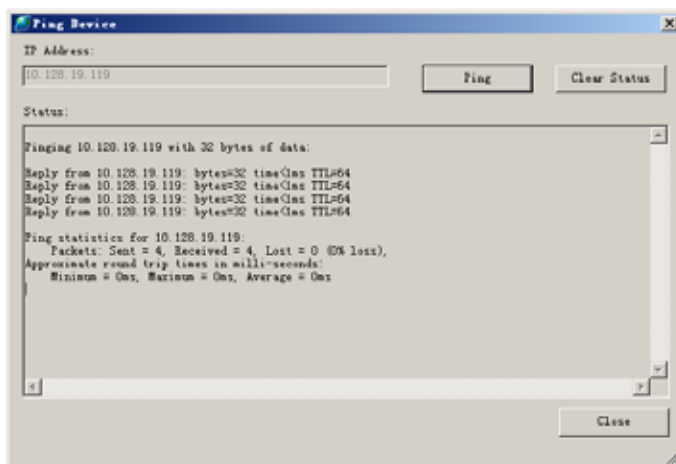
Waiting for about 10Sec and the window displays in your window, click **OK**.



4. Click the **Search** icon  and choose it.



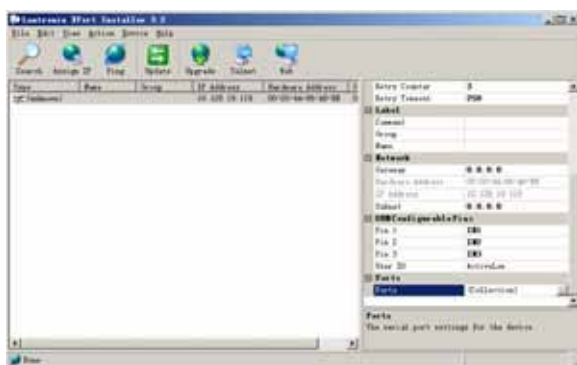
5. Click the **Ping** icon  → **Ping** button. The results display in the Status area, make sure the unit is properly attached to the network and that the IP address assigned is valid for the particular network segment you are working with. Click the **Close** button.



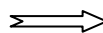
6. Click the **Ports**. Rework the **Baud Rate** member, **Data Bits** member, **Stop Bits** member. But make sure these members accord with the Main type module. Write down the **Local Port** member: **10001**. When you are finished then click **OK**. Click the **Update Settings** button to save your settings.

Note1: We recommend **Baud Rate: 19200bps**; **Data Bits: 8**; **Stop Bits: 1**; **Parity bit: no parity**.

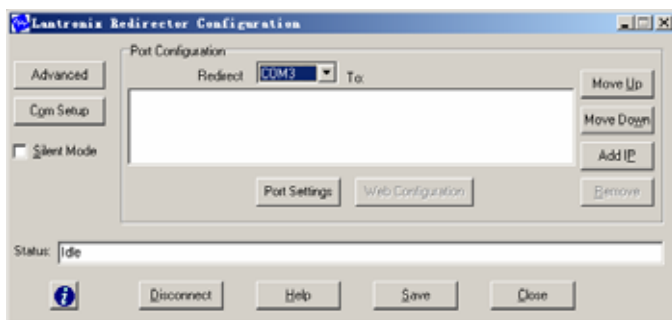
Note2: When you click the **Update Settings** button to save your settings, the “status: **online**” will turn to “status: **busy**”; Waiting for about 5 Sec. the “status: **busy**” will turn to “status: **online**”. After this you are **configuring** successful.



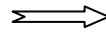
Click Ports



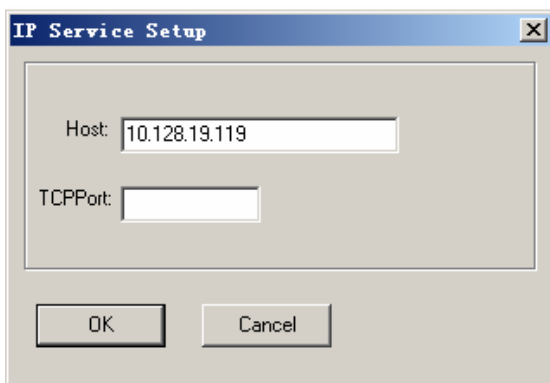
7. Click **Start** in the Windows Taskbar, → **Programs** → **Lantronix** → **Redirector** → **Configuration**. Click **Com Setup** button, A Port Setup dialog box displays; Click all the logical ports to which the PC will be redirected.



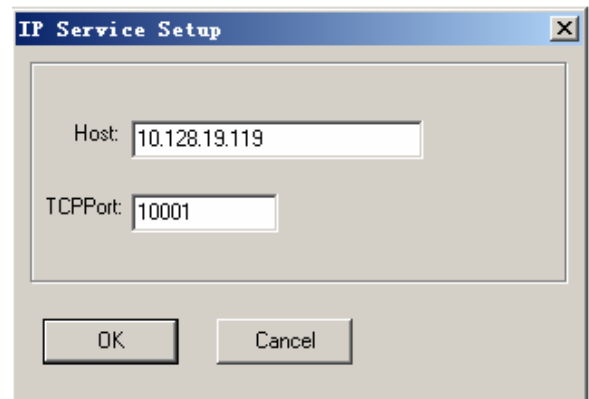
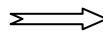
Click **Com Setup**



8. Click **Add IP** button



Enter the **hardware address**

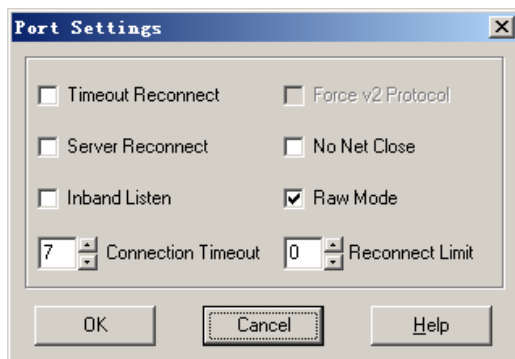


Enter the **Local Port member** and click **OK**

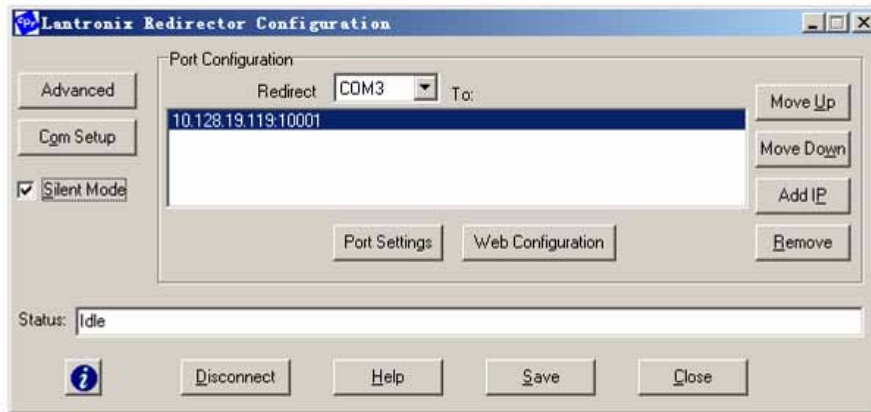
Note: The Host member is the Automation obtain IP to your unit (e.g. 10.128.19.119);

The TCP Port member is the **Local Port member: 10001**.

9. Click **Port Setting** button; Choose the **Raw Mode** option and click **OK**



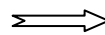
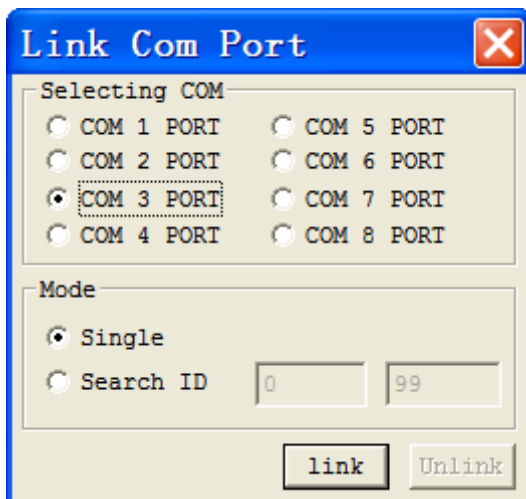
10. To hide the pop-up window, check **Silent Mode** on the Com Port Redirector Configuration window.



11. Click **Save** button and **Close** button.

Note: After completing this **Configure**, you can Link and control your product.

Choose the **Com** port and click **Link** button.

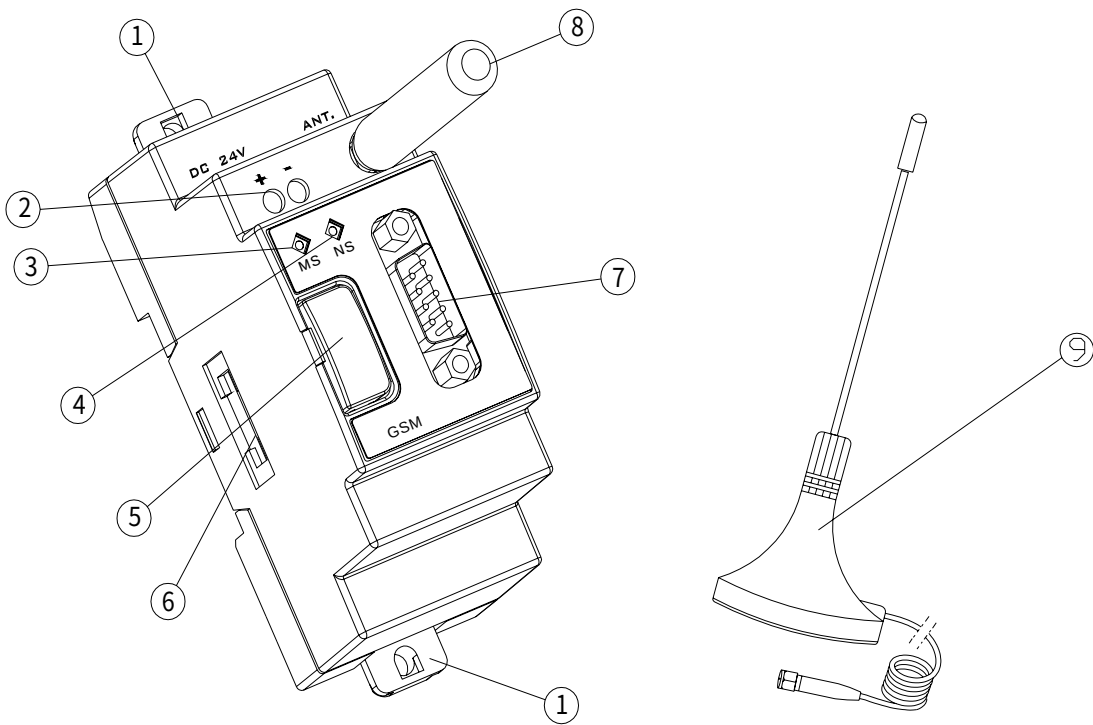


GSM Module

Summarize

With a GSM module, SG2(V3.2 and above version)/TP03 can be monitored and controlled by sending and receiving short message. Module support dual band EGSM900MHz/DCS1800MHz, those frequency channel support all the world except North America.

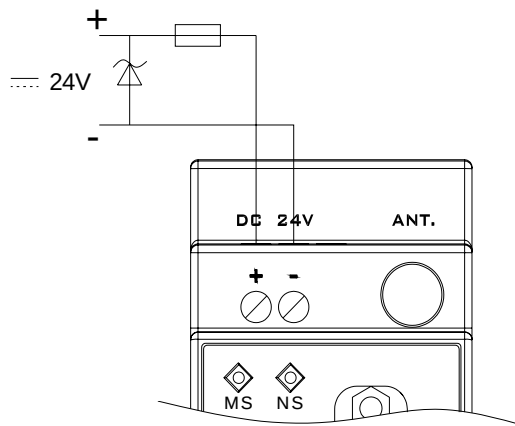
GSM Cell Configuration



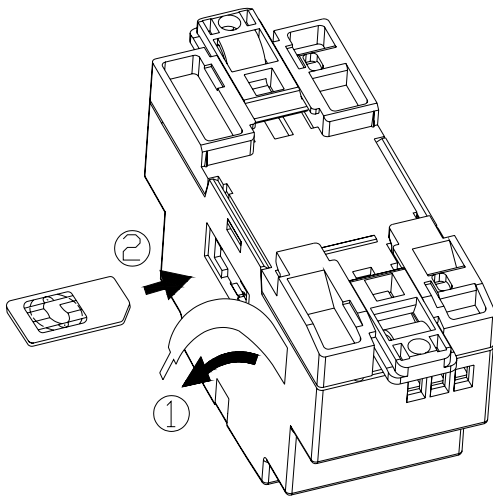
- ①: Flexed installation feet
- ②: 24V DC power supply port
- ③: Mode state LED light MS
- ④: Network state LED light NS
- ⑤: Button
- ⑥: SIM card port
- ⑦: 9-hole socket (PL01 connect with SG2)
- ⑧: Antenna (SMA port)
- ⑨: Sucked type antenna (SMA port)

Connect with electrical source

Input 24VDC



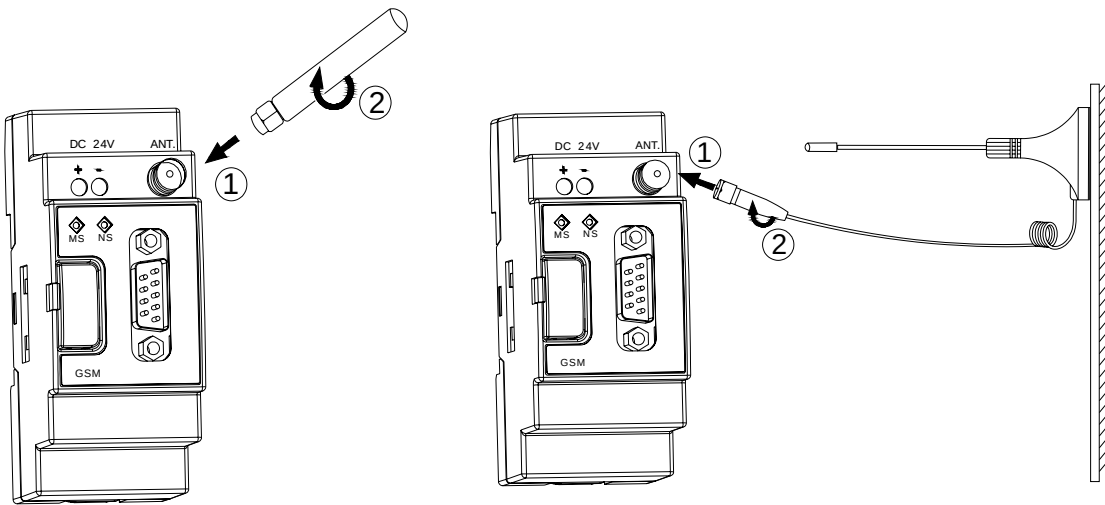
- ①-1A quick-blowing fuse, circuit-breaker or circuit protector.
- ②-Surge absorber.

Insert SIM card

- Step 1: uncover the tag paper;
- Step 2: insert SIM card, as the picture above show;
- Step 3: recover the tag paper;

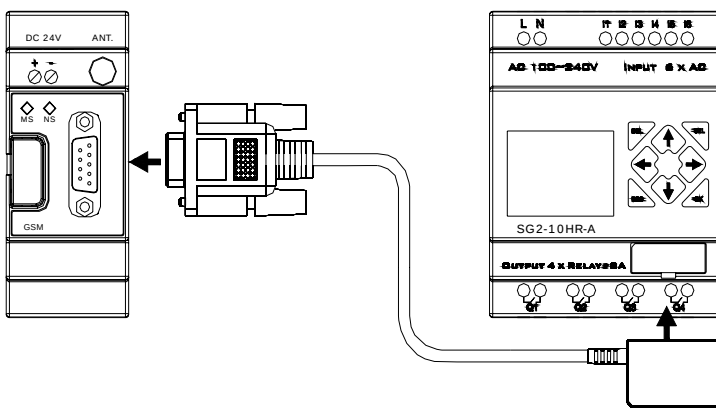
Warning :Before inserting and removing SIM card, must cut off the power of GSM module.

Installation of antenna

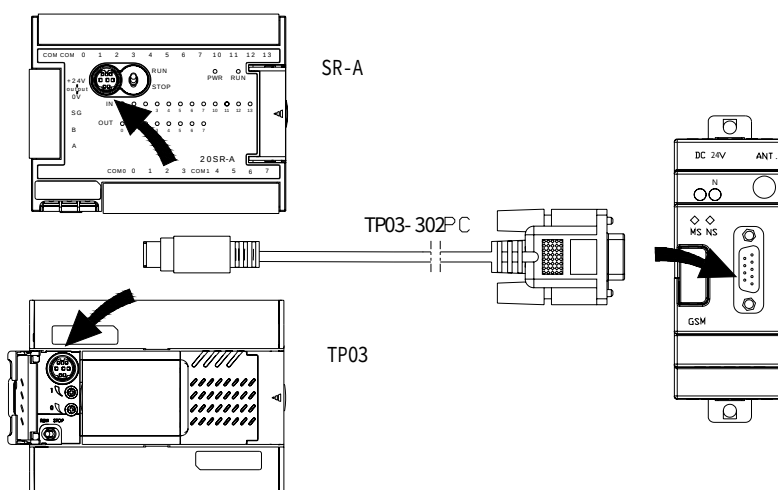


* Sucked type antenna can attracts to any metal form.

Connect to SG2 with the PL01 cable



Connect to TP03 with the TP03-302PC cable



LED state display

GSM module has two number of double color LED used for fast diagnostics, to indicate the state.

MS : Module State LED

State of LED	Description
ON when the moment power on, then OFF	Power on program initialization
ON	Link to PLC normally
Flash (2Hz)	Fail to link to PLC
Flash (1Hz)	System configuration mode
Flash (5Hz)	Hardware error
OFF	No power

NS : Net State LED

State of LED	Description
Flash (5Hz)	Search net signal (about 20s)
Flash (0.5Hz)	GSM net ready, signal weak
Flash (1Hz)	GSM net ready, signal strength
ON	Network error
OFF	No power or module error

※ More information to see “[SG2-GSM Module User Manual](#)”.

Appendix: Keypad Programming

Appendix A: Keypad programming in Ladder mode

Operation Sample:

	1	2	3	4	5	6	7	8	Column
Line 1	>	L	A	D	D	E	R		
2		F	U	N	.	B	L	O	C
3		P	A	R	A	M	E	T	E
4		R	U	N					

	1	2	3	4	5	6	7	8	Column
Line 1									
2									
3									
4									

Procedure 1 :
Press 'OK'

Enter LADDER Edition

	1	2	3	4	5	6	7	8	Column
Line 1	I	0	1						
2									
3									
4									

Procedure 2 :
Press 'SEL'

(When cursor located at character or digital, press the button to show I01)

	1	2	3	4	5	6	7	8	Column
Line 1	Q	0	1						
2									
3									
4									

Procedure 3 :
Press '↑' 3 times

(Press '↑ ↓', and the digital cursor located will change from I to G).

	1	2	3	4	5	6	7	8	Column
Line 1	q	0	1						
2									
3									
4									

Procedure 4 :
Press 'SEL'

(start /end modifying parameter)

	1	2	3	4	5	6	7	8	Column
Line 1	q	0	1						
2									
3									
4									

Procedure 5 :
Press '→' 2 times

(Press '← →', the cursor located in digital)

	1	2	3	4	5	6	7	8	Column
Line 1	q	0	4						
2									
3									
4									

Procedure 6 :
Press '↑' for 3 times

(Press '↑ ↓', the digital the cursor located will change from 1 to 4)

Procedure 7 :	1 2 3 4 5 6 7 8 Column
Press '←' 2 times	Line 1 q 0 4
(Press 'SEL' + '← →' to move the cursor to the position Required revision.	2
	3
	4

OR

Automatically Link

Procedure 7 :	1 2 3 4 5 6 7 8 Column
Press 'OK'	Line 1 q 0 4 —
(Move the cursor to character in column 3)	2
	3
	4

OR

Automatically Link

Procedure 7 :	1 2 3 4 5 6 7 8 Column
Press '→'	Line 1 q 0 4
(move the cursor to the link location in column 2)	2
	3
	4

Repeat the step1~7, and input M01, I03 Instruction to column 3, 5.

Procedure 8 :	1 2 3 4 5 6 7 8 Column
Press 'OK' in Column 5	Line 1 q 0 4 — M 0 1 — I 0 3 —
(move the cursor to the character in column 8)	2
	3
	4

Procedure 9 :	1 2 3 4 5 6 7 8 Column
Press 'SEL'	Line 1 q 0 4 — M 0 1 — I 0 3 — (Q 0 1
(when the cursor located at character and digital, press 'SEL' to show ' (Q01'	2
	3
	4

Auto Add "("

Procedure 10 :	1 2 3 4 5 6 7 8 Column
Press 'OK'	Line 1 q 0 4 — M 0 1 — I 0 3 — (Q 0 1
Save the input program data, the position of the cursor will not move.	2
	3
	4

Procedure 11 :	1 2 3 4 5 6 7 8 Column
Press '→' 3 times	Line 1 q 0 4 — M 0 1 — I 0 3 — (Q 0 1
(Move the cursor to column 1 and Line 2.)	2
	3
	4

[illegible]

Change Wire '—' to ' I '

[illegible][illegible]

Repeat the step 1~7 and key in 'r0 3', '—' at Line 2 and column 3~6.

[illegible][illegible]

Auto Add “(”

[illegible][illegible]

Procedure :	1	2	3	4	5	6	7	8	Column								
Press 'SEL+DEL' (Simultaneously)	Line 1	q	0	4	T	M	0	1	—	I	0	3	—	(	Q	0	1
	2				T	r	0	3	—	—	—	—	—	(	C	0	7
	3	C	L	E	A	R		L	n		0	0	2				
('ESC' Cancel , 'OK' Execute)	4	E	S	C		?				O	K		?				

Insert a whole line.

	1	2	3	4	5	6	7	8	column							
line 1	q	0	4	T	M	0	1	—	I	0	3	—	(	Q	0	1
2				T	r	0	3	—	—	—	—	—	(	C	0	7
3																
4																

Step:	1	2	3	4	5	6	7	8	column								
Press“SEL+OK” (at the same time)	Line 1	q	0	4	—	M	0	1	—	I	0	3	—	(	Q	0	1
	2			I	r	0	3	—	—	—	—	—	—	(	C	0	7
	3																
	4																

Turn page (move upward/ downward 4 lines program):

	1	2	3	4	5	6	7	8	column							
line 1	q	0	4	T	M	0	1	—	I	0	3	—	(	Q	0	1
2				T	r	0	3	—	—	—	—	—	(	C	0	7
3																
4																
5																

Step:		1	2	3	4	5	6	7	8	column							
Press 'SEL+↑/↓' (at the same time)	line 1	q	0	4	T	M	0	1	—	I	0	3	—	(	Q	0	1
	2				T	r	0	3	—	—	—	—	—	(	C	0	7
	3																
	4																
	5																

Appendix B: Keypad programming in Ladder FUNCTION BLOCK

	1	2	3	4	5	6	7	8	Column	
Line 1	L	A	D	D	E	R				
2	>	F	U	N	.	B	L	O	C	K
3	P	A	R	A	M	E	T	E	R	
4	R	U	N							

Present action area

The present value will appear when SG2 is under 'RUN' mode.

Procedure 1: Press 'OK'	1	2	3	4	5	6	7	8	Column
(Enter FUNCTION BLOCK edition)	Line 1	1 0 0 0 0 S e c T 0 1							

Preset action value area

	1	2	3	4	5	6	7	8	Column
If you want to edit T02 Press 'SEL+↑'(simultaneously)	Line 1		4						
	2	1							
	3		2	2	.	2	2	S e c	T 0 2
	4	N 0 1							

Step 2: modify ①present target value ②preset the action relay

Preset the target value

	1	2	3	4	5	6	7	8	Column
Procedure 2-1: Press '←' (move the cursor to the preset action area)	Line 1		1						
	2	1							
	3		0	0	.	0	0	S e c	T 0 1
	4								

	1	2	3	4	5	6	7	8	Column
Procedure 2-2: Press 'SEL' (begin input the target value)	Line 1		1						
	2	1							
	3		0	0	.	0	0	S e c	T 0 1
	4								

	1	2	3	4	5	6	7	8	Column
Procedure 2-3: Press '↑' for 3 times (Press 'SEL' and followed by '↑,↓' The digital '0' is changed to '3')	Line 1		1						
	2	1							
	3		0	0	.	0	3	S e c	T 0 1
	4								

	1	2	3	4	5	6	7	8	Column
Procedure 2-4: Press 'OK' (Save the input data)	Line 1		1						
	2	1							
	3		0	0	.	0	3	S e c	T 0 1
	4								

	1	2	3	4	5	6	7	8	Column
Procedure 2-5: Press '←'	Line 1		1						
	2	1							
	3		0	0	.	0	3	S e c	T 0 1
	4								

Repeat Step 2-2 ~ step 2-4 for 3 times, to enter the following screen:

	1	2	3	4	5	6	7	8	Column
Procedure 2-6:	Line 1		1						
	2	1							
	3		3	3	.	3	3	S e c	T 0 1
	4								

As the present value of the timer, counter, analog input (A01-A08) and analog gain value (V01-V08) is set as the preset value of them. Next to the step 2-2, to execute the following operation:

	1	2	3	4	5	6	7	8	column
Step2-3A: Press 'SEL'	line 1		1						
	2	1							
	3			V	<u>0</u>	1	S	e	c
	4							T	0

Repeat the step 2-3A, following screen will be shown in turn:

	1	2	3	4	5	6	7	8	column
Step2-3B: Press 'SEL'	line 1		1						
	2	1							
	3			A	<u>0</u>	1	S	e	c
	4							T	0

	1	2	3	4	5	6	7	8	column
Step 2-3C: press 'SEL'	line 1		1						
	2	1							
	3			T	<u>0</u>	1	S	e	c
	4							T	0

	1	2	3	4	5	6	7	8	column
Step 2-3D: Press 'SEL'	line 1		1						
	2	1							
	3			C	<u>0</u>	1	S	e	c
	4							T	0

	1	2	3	4	5	6	7	8	column
Step 2-3E: Press 'SEL'	line 1		1						
	2	1							
	3			A	T	<u>0</u>	1	S	e
	4							c	T

	1	2	3	4	5	6	7	8	column
Step 2-3F: Press 'SEL'	line 1		1						
	2	1							
	3			A	Q	<u>0</u>	1	S	e
	4							c	T

	1	2	3	4	5	6	7	8	column
Step 2-3G: Press 'SEL'	line 1		1						
	2	1							
	3			D	R	<u>0</u>	1	S	e
	4							c	T

	1	2	3	4	5	6	7	8	column
Step 2-3H: Press 'SEL'	line 1		1						
	2	1							
	3			A	S	<u>0</u>	1	S	e
	4							c	T

		1	2	3	4	5	6	7	8	Column
Procedure 2-8: Press 'SEL' (begin to edit data)	Line 1			1						
	2		<u>1</u>							
	3			3	3	.	3	3	S e c	T 0 1
	4									

		1	2	3	4	5	6	7	8	Column
Procedure 2-9: Press '↑' (Press 'SEL' + '↑/↓' to change '1' to '2')	Line 1			1						
	2		<u>2</u>							
	3			3	3	.	3	3	S e c	T 0 1
	4									

		1	2	3	4	5	6	7	8	Column
Procedure 2-10: Press 'OK' (save the input data)	Line 1			1						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4									

		1	2	3	4	5	6	7	8	Column
Procedure 2-11: Press '↑' (move the cursor to '1' position)	Line 1			1						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4									

		1	2	3	4	5	6	7	8	Column
Procedure 2-12: Press 'SEL' (begin to edit data)	Line 1			<u>1</u>						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4									

		1	2	3	4	5	6	7	8	Column
2-13: Press '↑' for 3 times (Press 'SEL' and followed by '↑↓' to change 1 to 4)	Line 1			<u>4</u>						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	L o w								

		1	2	3	4	5	6	7	8	Column
Procedure 2-14: Press 'OK' (save input data)	Line 1			4						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	L o w								

		1	2	3	4	5	6	7	8	Column
Procedure 2-15: Press '↓' for 3 times (this step leads to editing the action relay)	Line 1			4						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	L o w								

② Edit action program and preset the action relay

		1	2	3	4	5	6	7	8	Column
Procedure 2-16: Press “→” 2 times, Press ‘SEL’ (Begin to modify)	Line 1			4						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	L	o	w						

		1	2	3	4	5	6	7	8	Column
Procedure 2-16A: Press ‘SEL’ (Begin to modify)	Line 1			4						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	I	0	1						

Repeat the step 2-16A, the following screen will be shown in turn:

		1	2	3	4	5	6	7	8	Column
Procedure 2-16B: Press ‘SEL’	Line 1			4						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	i	0	1						

		1	2	3	4	5	6	7	8	Column
Procedure 2-16C: Press ‘SEL’	Line 1			4						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	L	o	w						

Next to step 2-16A, then ‘↑’, the following screen will be shown.

		1	2	3	4	5	6	7	8	Column
Procedure 2-17: Press ‘↑’ for 5 times (Press ‘SEL’ + ‘↑/↓’ to change I to M)	Line 1			4						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	M	0	1						

		1	2	3	4	5	6	7	8	Column
Procedure 2-18: Press ‘→’ 2 times (Press ‘SEL’ + ‘← →’ to move the cursor to digital location)	Line 1			4						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	M	0	1						

		1	2	3	4	5	6	7	8	Column
Procedure 2-19: Press ‘↑’ for 3 times (Press ‘SEL’ + ‘↑ ↓’ to change ‘1’ to ‘4’)	Line 1			4						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	M	0	4						

		1	2	3	4	5	6	7	8	Column
Procedure 2-20: Press 'OK' (save the input data)	Line 1			4						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	M	0	4						

		1	2	3	4	5	6	7	8	Column
Procedure 2-21: Press '↑' (Move the cursor to preset action value area to repeat the step 2-1)	Line 1			4						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	M	0	4						

		1	2	3	4	5	6	7	8	Column
Procedure 2-22: Press '↑' (Move the cursor to position '2' to repeat the 2-8)	Line 1			4						
	2		2							
	3			3	3	.	3	3	S e c	T 0 1
	4	M	0	4						

The detail operation of modify the analog comparator Ax, Ay:

		1	2	3	4	5	6	7	8	column
	Line 1			1						
	2				A	0	1	V		
	3				A	0	2	V		
	4				0	0	.	0	0	V

		1	2	3	4	5	6	7	8	column
step 2-23: Press '←', press 'SEL' (press '↑↓', Select A01-A08)	line 1			1						
	2				A	0	1	V		
	3				A	0	2	V		
	4				0	0	.	0	0	V

		1	2	3	4	5	6	7	8	column
Step 2-24: Press '←', Press 'SEL' (press 'SEL' Select A02 – T01 – C01–AT01–AQ01–DR01–AS01–MD01–PI01–MX01–AR01–00.00–V01–A01)	line 1			1						
	2				A	0	1	V		
	3				T	0	1	V		
	4				0	0	.	0	0	V

		1	2	3	4	5	6	7	8	column
Step 2-25: Press '→', press '↑' (Select T01~T1F, C01~C1F, A01~A08, V01~V08...)	line 1			1						
	2				A	0	1	V		
	3				T	0	2	V		
	4				0	0	.	0	0	V

	1	2	3	4	5	6	7	8	Column
Step 2-26: Press 'OK'									
Save the present data	line 1		1						
	2			A	0	1	V		
	3			T	0	2	V	G	0 1
	4			0	0	.	0 0 V		

Continue to input Function Block

Method1: Next Function Block

	1	2	3	4	5	6	7	8	Column
	Line 1		4						
	2	2							
	3		3	3	.	3	S e c	T	0 1
	4	M	0	4					

	1	2	3	4	5	6	7	8	Column
Press 'SEL+↑' (Simultaneously)									
	Line 1		1						
	2	1							
	3		0	0	.	0	0 S e c	T	0 2
	4								

Last Function Block

	1	2	3	4	5	6	7	8	Column
	Line 1		4						
	2	2							
	3		3	3	.	3	S e c	T	0 1
	4	M	0	4					

	1	2	3	4	5	6	7	8	Column
Press 'SEL+↓' (Simultaneously)									
	v 1		1						
	2	1							
	3		0	0	.	0	0 S e c	T	1 F
	4								

Method 2: Next Function Block

	1	2	3	4	5	6	7	8	Column
	Line 1		4						
	2	2							
	3		3	3	.	3	S e c	T	0 1
	4	M	0	4					

	1	2	3	4	5	6	7	8	Column
Press '→' 1 times									
	Line 1		4						
	2	2							
	3		3	3	.	3	S e c	T	0 1
	4	M	0	4					

	1	2	3	4	5	6	7	8	Column
Press 'SEL'	Line 1		4						
	2	2							
	3		3 3 . 3 3 S e c					T 0 1	
	4	M 0 4							

	1	2	3	4	5	6	7	8	Column
Press '↓' or '↑' 1 times	v 1		4						
	2	2							
	3		3 3 . 3 3 S e c					T 1 1	
	4	M 0 4							

	1	2	3	4	5	6	7	8	Column
Press '→' 1 times	v 1		4						
	2	2							
	3		3 3 . 3 3 S e c					T 1 1	
	4	M 0 4							

	1	2	3	4	5	6	7	8	Column
Press '↑' 4 times or Press '↓' 11 times	v 1		4						
	2	2							
	3		3 3 . 3 3 S e c					T 1 6	
	4	M 0 4							

	1	2	3	4	5	6	7	8	Column
Press 'OK'	v 1		1						
	2	2							
	3		2 0 . 2 0 S e c					T 1 6	
	4								

Clear Function Block

	1	2	3	4	5	6	7	8	Column
Press 'SEL+DEL' (Simultaneously)	Line 1		1						
	2	2							
	3	C L E A R		B L O C K !					
	4	E S C ?		O K ?					

('ESC': Cancel ;
'OK': Execute)

Back to Main Menu:

	1	2	3	4	5	6	7	8	Column
Press 'ESC'	Line 1		L A D D E R						
	2	>	F U N . B L O C K						
	3		P A R A M E T E R						
	4		R U N						

Change Function Block Category:

	1	2	3	4	5	6	7	8	Column
Line 1			4						
2		1							
3			3	3	.	3	3	S e c	<u>T</u> 0 1
4	M	0	4						

Method 1:

Move the cursor to change to T, C, R, G, H, L, P, S, AS, MD, PI, MX, AR, MU

	1	2	3	4	5	6	7	8	Column
Line 1			4						
2		1							
3			3	3	.	3	3	S e c	<u>T</u> 0 1
4	M	0	4						

	1	2	3	4	5	6	7	8	Column
Line 1			1						
2	L	o	w						
3				0	0	0	0	0	<u>C</u> 0 1
4	L	o	w						

	1	2	3	4	5	6	7	8	Column
Line 1				S	u	—	S	u	
2		1							
3				0	0	:	0	0	<u>R</u> 0 1
4				0	0	:	0	0	

	1	2	3	4	5	6	7	8	Column
Line 1			1						
2				A	0	1	V		
3				A	0	2	V		<u>G</u> 0 1
4				0	0	.	0	0	V

	1	2	3	4	5	6	7	8	Column
Line 1			1						
2									
3								<u>H</u>	0 1
4									

	1	2	3	4	5	6	7	8	Column
Line 1			1						
2		1		I	0	1	—	I	0 1
3				↓			↓		<u>L</u> 0 1
4				W	0	9	—	W	0 9

	1	2	3	4	5	6	7	8	Column
Step 7: Press 'SEL'	Line 1		1						
	2	L	o	w				Q	0 1
	3	L	o	w		0	0	0	0 0 0 0
	4	L	o	w		0	0	0	0 0 0 1
								<u>P</u>	0 1

	1	2	3	4	5	6	7	8	Column
Step 8: Press 'SEL'	Line 1		1						
	2		1						
	3	L	o	w		Q	0	1	— Q 0 1
	4								
								<u>S</u>	0 1

	1	2	3	4	5	6	7	8	Column
Step 9: Press 'SEL'	Line 1								
	2			0	0	0	0	0	
	3			0	0	0	0	0	N o p
	4			0	0	0	0	0	A <u>S</u> 0 1

	1	2	3	4	5	6	7	8	Column
Step 10: Press 'SEL'	Line 1								
	2			0	0	0	0	1	
	3			0	0	0	0	1	N o p
	4			0	0	0	0	1	M <u>D</u> 0 1

	1	2	3	4	5	6	7	8	Column
Step 11-A: Press 'SEL'	Line 1								
	2			0	0	0	0	0	
	3			0	0	0	0	0	N o p
	4			0	0	0	.	0 1	P <u>I</u> 0 1

	1	2	3	4	5	6	7	8	Column
Step 11-B: Press 'SEL + →'	Line 1								
	2			0	0	0	0	1	
	3			0	0	0	0	.	1
	4			0	0	0	.	0 1	P <u>I</u> 0 1

	1	2	3	4	5	6	7	8	Column
Step 12: Press 'SEL'	Line 1			0	0	0	0	0	
	2	L	o	w		0	0	0	0 0
	3	L	o	w		0	0	0	0 0
	4			0	0	0	0	0	M <u>X</u> 0 1

	1	2	3	4	5	6	7	8	Column
Step 13-A: Press 'SEL'	Line 1								
	2	L	o	w		0	0	0	0 0
	3	L	o	w		0	0	0	0 0
	4			0	1	0	0	0	A <u>R</u> 0 1

		1	2	3	4	5	6	7	8	Column
Step 13-B: Press 'SEL + →'	Line	1			0	0	0	0	0	
	2	L	o	w		0	0	0	1	0
	3	L	o	w		0	1	.	0	0
	4				0	0	0	0	0	

		1	2	3	4	5	6	7	8	Column
Step 14: Press 'SEL'	Line	1								
	2		1		0	1				
	3			0	0	0	1			
	4			D	R	0	1			

		1	2	3	4	5	6	7	8	Column
Step 15: Press 'OK'	Line	1								
	2		1		0	1				
	3			0	0	0	1			
	4			D	R	0	1			

Method 2:

		1	2	3	4	5	6	7	8	Column
Step 1: Press 'SEL'	Line	1								
	2		2							
	3			3	3	.	3	3	S	e
	4	M	0	4						

Press '↓'

		1	2	3	4	5	6	7	8	Column
Step 2:	Line	1								
	2	L	o	w						
	3			0	0	0	0	0	0	0
	4	L	o	w						

Press '↓'

Press '↑'

		1	2	3	4	5	6	7	8	Column
Step 3:	Line	1			S	u	—	S	u	
	2		1							
	3			0	0	:	0	0		
	4			0	0	:	0	0		

Press '↓'

Press '↑'

		1	2	3	4	5	6	7	8	Column
Step 4:	Line	1								
	2		1		A	0	1	V		
	3				A	0	2	V		
	4			0	0	.	0	0	V	

Press '↓' ↑
Press '↑'

	1	2	3	4	5	6	7	8	Column
Line 1			1						
Line 2									
Line 3									
Line 4									

Press '↓' ↑
Press '↑'

	1	2	3	4	5	6	7	8	Column
Line 1			1						
Line 2		1	I	0	1	—	I	0	1
Line 3				↓			↓		
Line 4			W	0	9	—	W	0	9

Press '↓' ↑
Press '↑'

	1	2	3	4	5	6	7	8	Column
Line 1			1						
Line 2	L	o	w						Q 0 1
Line 3	L	o	w		0	0	0	0	P 0 1
Line 4	L	o	w		0	0	0	0	1

Press '↓' ↑
Press '↑'

	1	2	3	4	5	6	7	8	Column
Line 1			1						
Line 2		1							
Line 3	L	o	w	Q	0	1	—	Q	0
Line 4									S 0 1

Press '↓' ↑
Press '↑'

	1	2	3	4	5	6	7	8	Column
Line 1									
Line 2			0	0	0	0	0		N o p
Line 3			0	0	0	0	0		A S 0 1
Line 4			0	0	0	0	0		

Press '↓' ↑
Press '↑'

	1	2	3	4	5	6	7	8	Column
Line 1									
Line 2			0	0	0	0	1		N o p
Line 3			0	0	0	0	1		M D 0 1
Line 4			0	0	0	0	1		

Press '↓' ↑ Press '↑'

	1	2	3	4	5	6	7	8	Column
Line 1									
2			0	0	0	0	0	N o p	
3			0	0	0	0	0	P <u>I</u> 0 1	
4			0	0	0	.	0	1	1

Step 11-B:
Press 'SEL + →'

	1	2	3	4	5	6	7	8	Column
Line 1									
2			0	0	0	0	1	N o p	
3			0	0	0	0	. 1	P <u>I</u> 0 1	
4			0	0	0	.	0	1	2

Press '↓' ↑ Press '↑'

	1	2	3	4	5	6	7	8	Column
Line 1			0	0	0	0	0		
2 L o w			0	0	0	0	0		
3 L o w			0	0	0	0	0	M <u>X</u> 0 1	
4			0	0	0	0	0		

Press '↓' ↑ Press '↑'

	1	2	3	4	5	6	7	8	Column
Line 1									
2 L o w			0	0	0	0	0	N o p	
3 L o w			0	0	0	0	0	A <u>R</u> 0 1	
4			0	1	0	0	0		1

Step 13-B:
Press 'SEL + →'

	1	2	3	4	5	6	7	8	Column
Line 1			0	0	0	0	0		
2 L o w			0	0	0	1	0	N o p	
3 L o w			0	1	.	0	0	A <u>R</u> 0 1	
4			0	0	0	0	0		2

Press '↓' ↑ Press '↑'

	1	2	3	4	5	6	7	8	Column
Line 1			1						
2				0	1				
3			0	0	0	1		M <u>U</u> 0 1	
4			D R	0	1				



Jump from T01 to T09

Press '↑'

Step 15: Press '→'		1	2	3	4	5	6	7	8	Column
	Line	1			4					
	2		2							
	3				3	3	.	3	3	
	4	M	0	4						

T

0

1

Step 16: Press '↑' 8 times or Press '↓' 7 times		1	2	3	4	5	6	7	8	Column
	Line	1			4					
	2		2							
	3				3	3	.	3	3	
	4	M	0	4						

T

0

9

Step 17: Press 'OK'		1	2	3	4	5	6	7	8	Column
	Line	1			4					
	2		2							
	3				3	3	.	3	3	
	4	M	0	4						

T

0

9