



## SG2 PLR USER Manual



**SG2 Relé Logico Programable**

# Table of Contents

<b>Chapter 1: Getting Started</b>	<b>4</b>
Examination Before Installation	5
Environmental Precautions	5
SG2 Model Identification	5
<b>Quick Start Setup</b>	<b>6</b>
<b>Chapter 2: Installation</b>	<b>12</b>
General Specifications	12
Product Specifications	13
Mounting	14
Wiring	16
<b>Chapter 3: Program Tools</b>	<b>19</b>
PC Programming Software “SG2 Client”	19
Memory Cartridge	27
LCD Display and Keypad	28
<b>Chapter 4: Relay Ladder Logic Programming</b>	<b>29</b>
Specialty Memory Types	31
Output Instructions	32
Counter Instructions	34
High Speed Counters (DC Version PLRs Only)	40
Timer Instructions	42
Real Time Clock (RTC) Instructions	49
Comparator Instructions	51
HMI Display Instructions	53
PWM Output Instruction (DC Transistor Output Models Only)	54
Data Link/Remote I/O Instruction (SG2-20Vxx Models Only)	55

<b>Chapter 5: Function Block Diagram Programming</b> .....	<b>57</b>
Coil Block Instruction .....	57
Logic Block Instructions .....	57
PWM Function Block .....	58
SHIFT Function Block .....	58
AND Logic Block .....	59
AND (Edge) Logic Block .....	59
NAND Logic Block .....	59
NAND (Edge) Logic Block .....	59
OR Logic .....	60
NOR Logic .....	60
XOR Logic .....	60
SR Logic Block .....	60
NOT Logic Block .....	61
Pulse Logic Block .....	61
Counter Function Block .....	61
Counter Mode 5 .....	62
Counter Mode 6 .....	62
High Speed Counter Function Block .....	63
Timer Function Block .....	63
RTC Function Block .....	65
Analog comparator Function Block .....	66

# Chapter 1: Getting Started

The SG2 PLR 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 PLR 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 PLR is open and exposed. For the open-board models, all electrical components are exposed. For this reason, it is recommended the SG2 PLR 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 PLR should only be installed and wired by properly experienced and certified personnel.*

**!** *Make sure the wiring of the SG2 PLR 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 PLR, 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 PLR operation must be shut down immediately.*

## Examination Before Installation

Every SG2 PLR has been fully tested and examined before shipment. Please carry out the following examination procedures after unpacking your SG2 Programmable Logic 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 PLR to the power supply if there is any sign of damage.

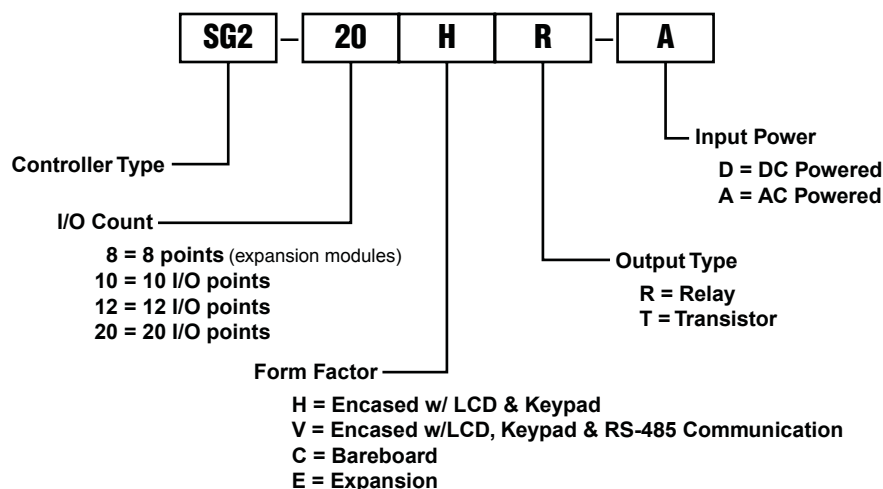
Contact FactoryMation if you find any abnormal conditions as mentioned above.

## Environmental Precautions

The installation site of the SG2 PLR 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: 32°F - 131°F (0°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 PLR
- 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.

## SG2 Model Identification



# Quick Start Setup

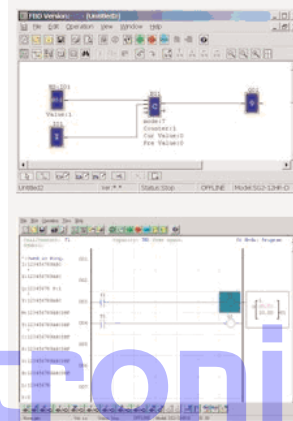
This section is a simple 6-step guide to connecting, programming and operating your new SG2 Programmable Logic Relay. This is not intended to be the complete instructions for programming and installation of your system. Many steps refer to other sections in the manual for more detailed information.

## 1. Install SG2 Client Software

Install the SG2 Client Software from CD or from the free internet download.



SG2-SW



### TECO Genie II Programming Software

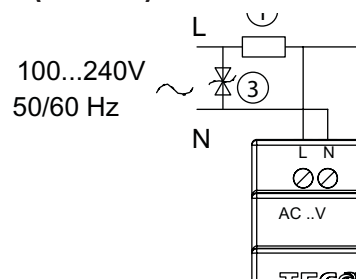
The SG2 Client PC Software provides two edit modes, LADDER and FBD. The software includes the following features:

1. Easy and convenient program creation and editing.
2. Programs can be saved on a computer and accessed at any time. Programs can also be upload from the controller and then edited.
3. Enables users to print programs for reference and review.
4. The Simulation Mode allows users to virtually run and test the program before it is loaded to the controller.
5. Real-time communication allows the user to monitor the SG2 PLR operation during RUN mode.

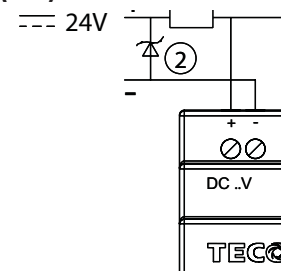
## 2. Connect Power to SG2 PLR

Connect power to the PLR using the below wiring diagrams for AC or DC supply for the applicable models. See "Chapter 2: Installation" for complete wiring and installation instructions

### AC (100-240V)



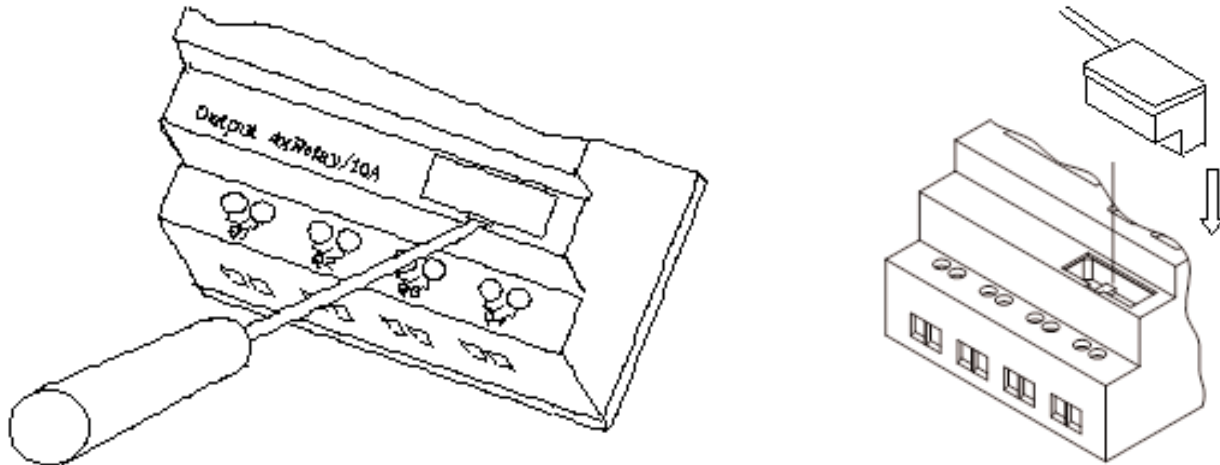
### DC (24V)



- ① Fuse (2A)
- ② Surge absorber (36V DC)
- ③ Surge absorber (400V AC)

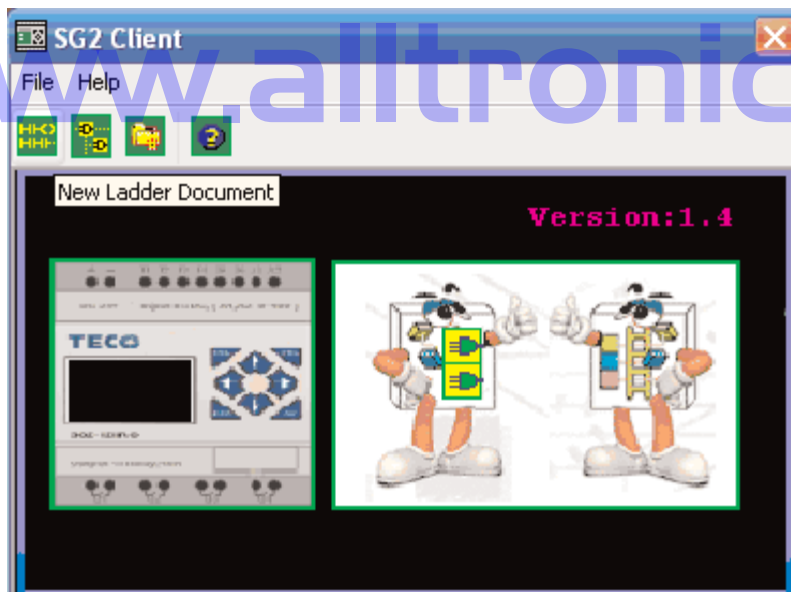
### 3. Connect Programming Cable

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 PLR as shown in the figure below. Connect the opposite end of the cable to an RS232C serial port on the computer.

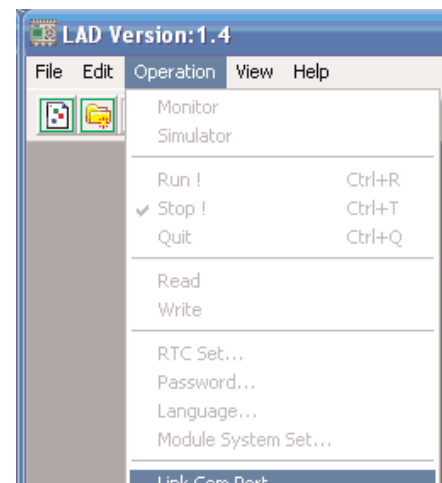


### 4. Establish Communication

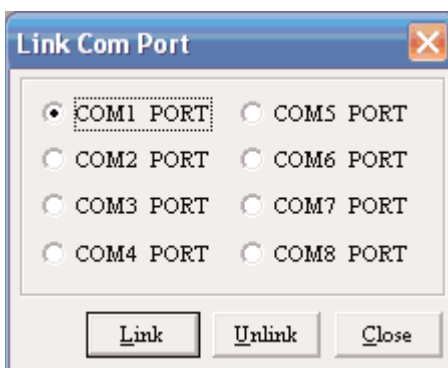
- a. Open the SG2 Client software and select “New Ladder Document” as shown below.



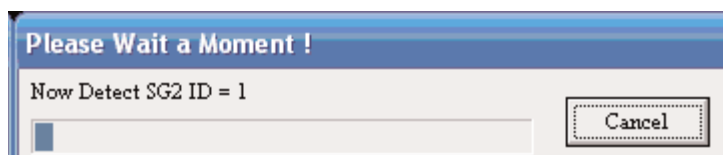
- b. Select “Operation/Link Com Port...” as shown



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

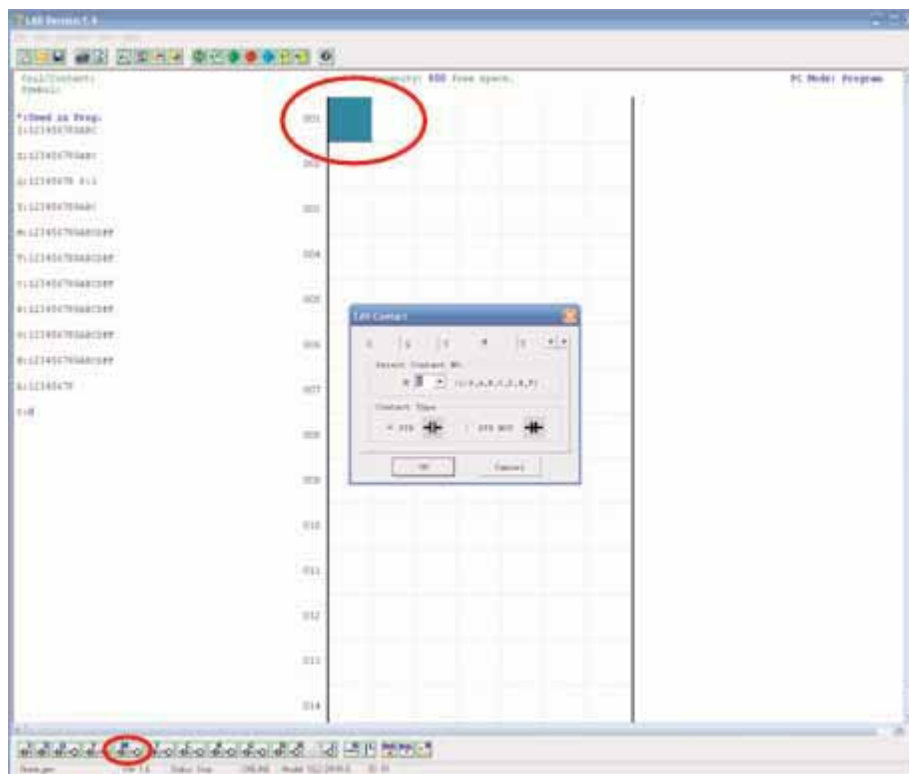


- d. The SG2 Client will then begin to detect the connected PLR to complete it's connection as shown below.



## 5. Write simple program

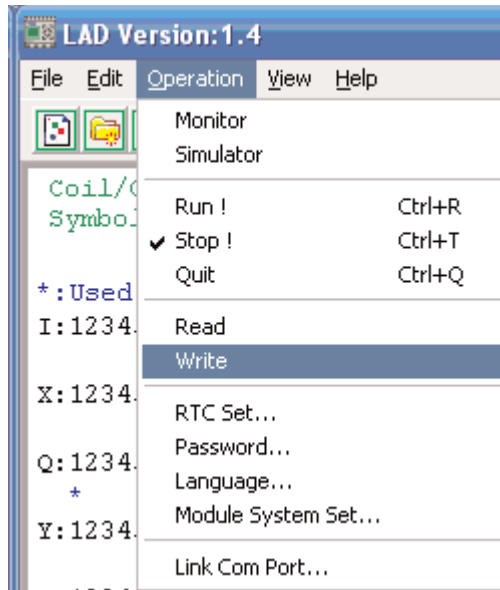
- a. Write a simple one rung program by clicking on the leftmost cell at line 001 of the programming grid, then click on the “M” contact icon on the ladder toolbar, as shown below. Select M1 and press the OK button. See Chapter 4: Ladder Programming instructions for complete instruction set definitions.



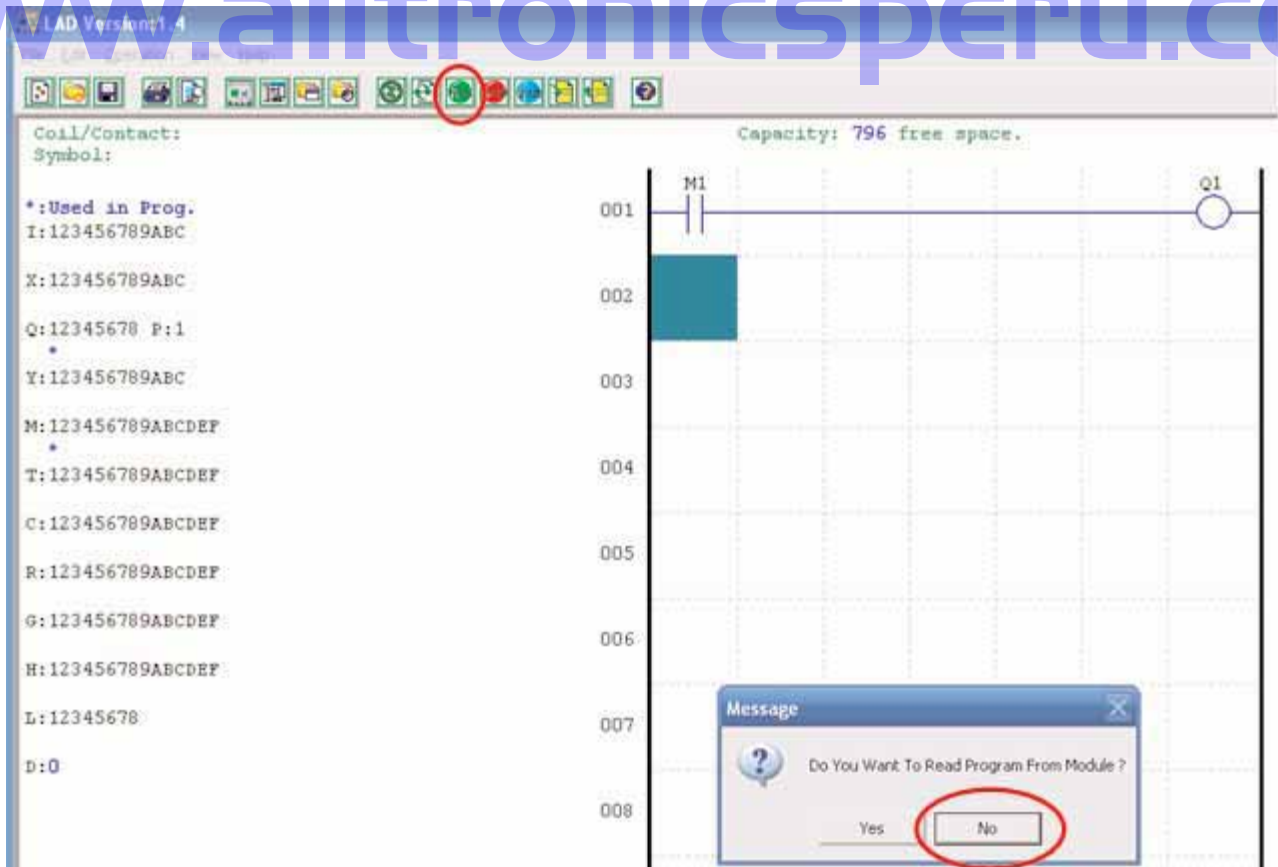
Note: If the ladder toolbar is not visible at the bottom of the screen, select View>Ladder Toolbar from the menu to enable.



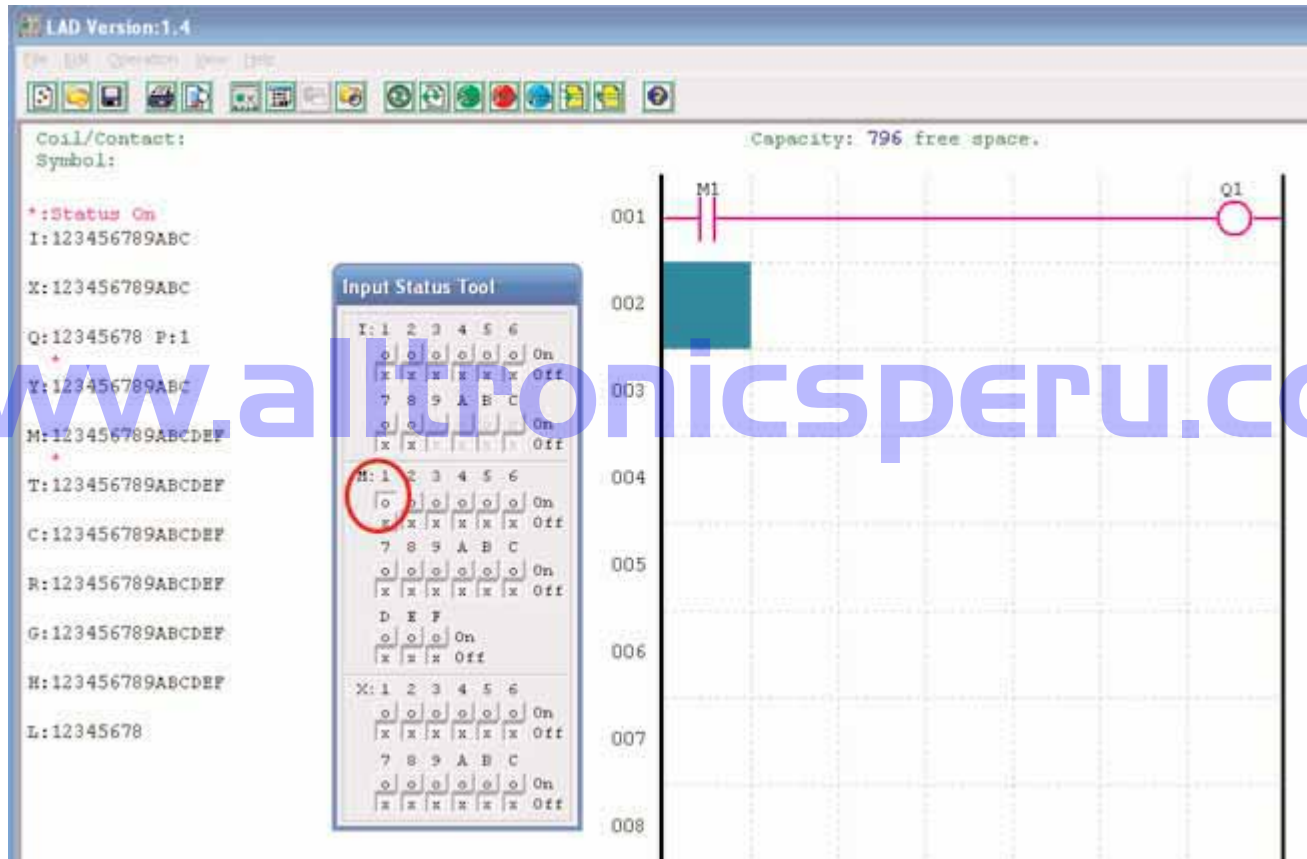
- d. Test the simple program. From the Operation menu, select the Write function and write the program to the connected PLR as shown below.



- 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. From the Input Status dialog, click on M1 to activate the contact M1 which will turn ON the Output Q1, as shown below. The highlighted circuit will show active and the first Output (Q1) on the connected PLR will be ON. See Chapter 3: Programming Tools for more detailed software information.



# Chapter 2: Installation

## General Specifications

SG2 is a miniature smart PLR (Programmable Logic 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 X 4-output modules.

Power Supply	
Input Power Voltage Range	DC Models: 20.4-28.8V AC Models: 85-265V
Power Consumption	24VDC: 10-point, 90mA 20-point: 150mA 100-240VAC: 90mA
Wire Size (all terminals)	26 to 14 AWG
Programming	
Programming languages	Ladder/Function Block
Program Memory	200 Lines or 99 Function Blocks
Programming storage media	Flash
Execution Speed	10ms/cycle
LCD Display	4 lines x 12 characters
Timers	
Maximum Number	15
Timing ranges	0.01s-9999min
Counters	
Maximum Number	15
Highest count	999999
Resolution	1
RTC (Real Time Clock)	
Number available	15
Resolution	1min
Time span available	week, year, month, day, hour, min
Compare Instructions (Analog, Timer, or Counter Values)	
Number available	15
Compare versus other inputs	Timer, Counter, or Numeric values
Environmental	
Enclosure Type	IP20
Maximum Vibration	1G according to IEC60068-2-6
Operating Temperature Range	32° to 131°F (0° 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	10-point: 230g 8-point: 190g 20-point: 345g
Agency Approvals	cUL , CE, UL

Discrete Inputs	
Current consumption	4mA @12VDC 3.2mA @24VDC 1.3mA @100-240VAC
Input Signal "OFF" Threshold	< 5VDC; < 40VAC
Input Signal "ON" Threshold	> 15VDC; > 79VAC
Input On delay	DC: 5ms 240VAC: 50ms 120VAC: 90ms
Input Off Delay	DC: 3ms 240VAC: 50ms 120VAC: 90ms
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	10 bit
Voltage Range acceptable	Analog input: 0-10VDC, 24VDC when used as discrete input
Input Signal "OFF" Threshold	< 5VDC (as 24VDC discreet input)
Input Signal "ON" Threshold	> 9.8VDC (as 24VDC discreet input)
Isolation	None
Short circuit protection	Yes
Total number available	A1-A8
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	0.5kHz (1ms on, 1ms 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

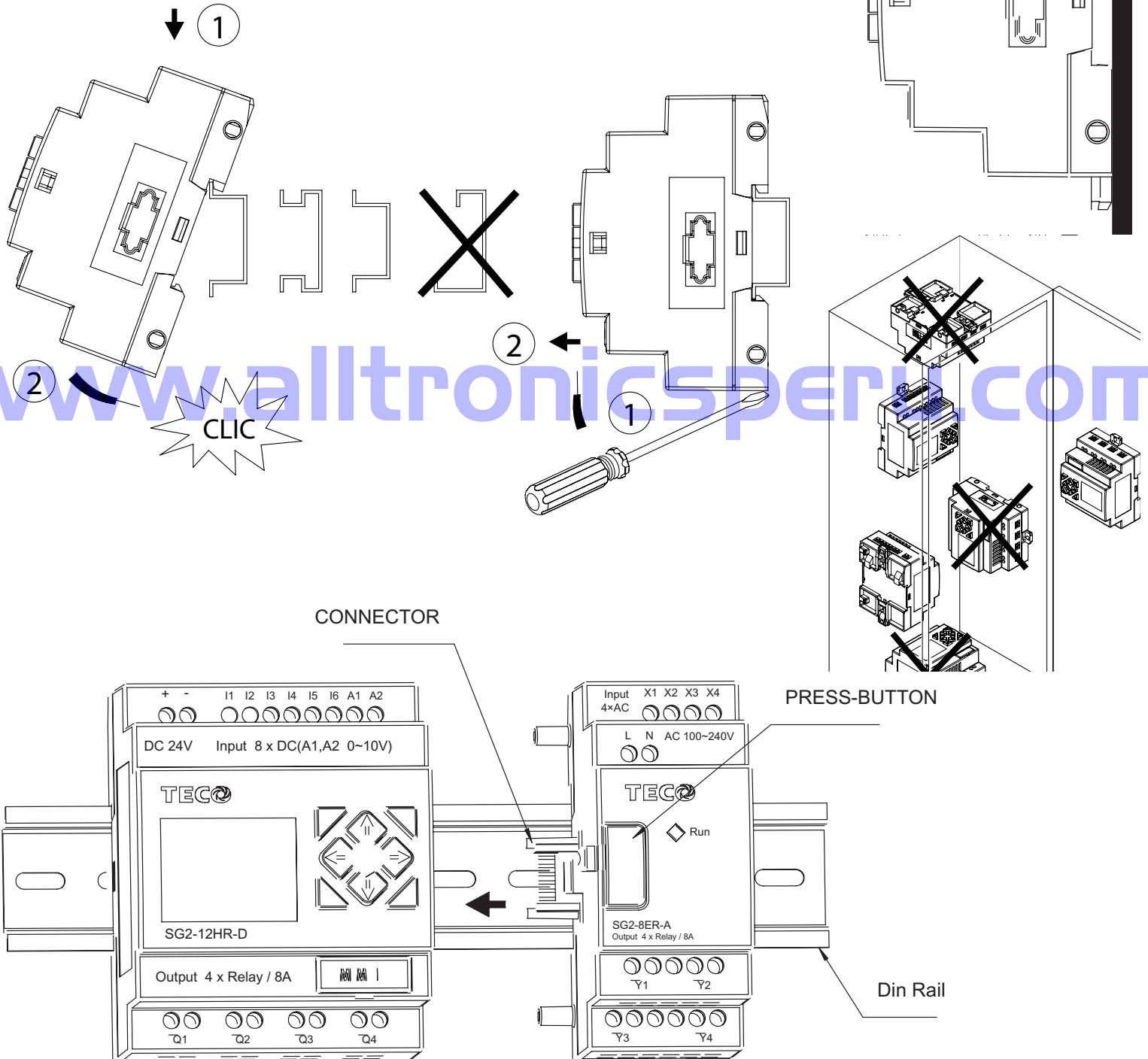
# Product Specifications

Part #	Input Power	Inputs	Outputs	Display	RS-485 Communications	Max I/O*
SG2-12HR-D	24 VDC	6 DC, 2 Analog	4 Relay	✓	N/A	36
SG2-12HT-D		6 DC, 2 Analog	4 Trans.	✓	N/A	36
SG2-20HR-D		8 DC, 4 Analog	8 Relay	✓	N/A	44
SG2-20HT-D		8 DC, 4 Analog	8 Trans.	✓	N/A	44
SG2-20VR-D		8 DC, 4 Analog	8 Relay	✓	Built-in MODBUS	44
SG2-20VT-D		8 DC, 4 Analog	8 Trans.	✓	Built-in MODBUS	44
SG2-10HR-A	85-240 VAC	6 AC	4 Relay	✓	N/A	34
SG2-20HR-A		12 AC	8 Relay	✓	N/A	44
Expansion Modules						
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	85-240VAC	4 AC	4 Relay	N/A	N/A	N/A
SG2-4AI	12-24 VDC	4 Analog	N/A	N/A	N/A	N/A
SG2-MODBUS	24 VDC	Communications Module, RS-485 MODBUS-RTU				
OEM “Blind” Models, No Keypad, No Display						
SG2-12KR-D	24VDC	6 DC, 2 Analog	4 Relay	X	N/A	12
SG2-20KR-D		8 DC, 4 Analog	8 Relay	X	N/A	20
SG2-10KR-A	85-240VAC	6 AC	4 Relay	X	N/A	10
SG2-20KR-A		12 AC	8 Relay	X	N/A	20
OEM “Bareboard” Models, No Keypad, No Display, No Expansion						
SG2-12CR-D	24VDC	6 DC, 2 Analog	4 Relay	X	N/A	12
SG2-20CR-D		8 DC, 4 Analog	8 Relay	X	N/A	20
SG2-10CR-A	85-240VAC	6 AC	4 Relay	X	N/A	10
SG2-20CR-A		12 AC	8 Relay	X	N/A	20
Accessories						
SG2-PL01	SG2 Programming Cable					
SG2-PM05	SG2 Memory cartridge					
SG2-SW	SG2 Programming software. Available on CD or FREE via download from Web					

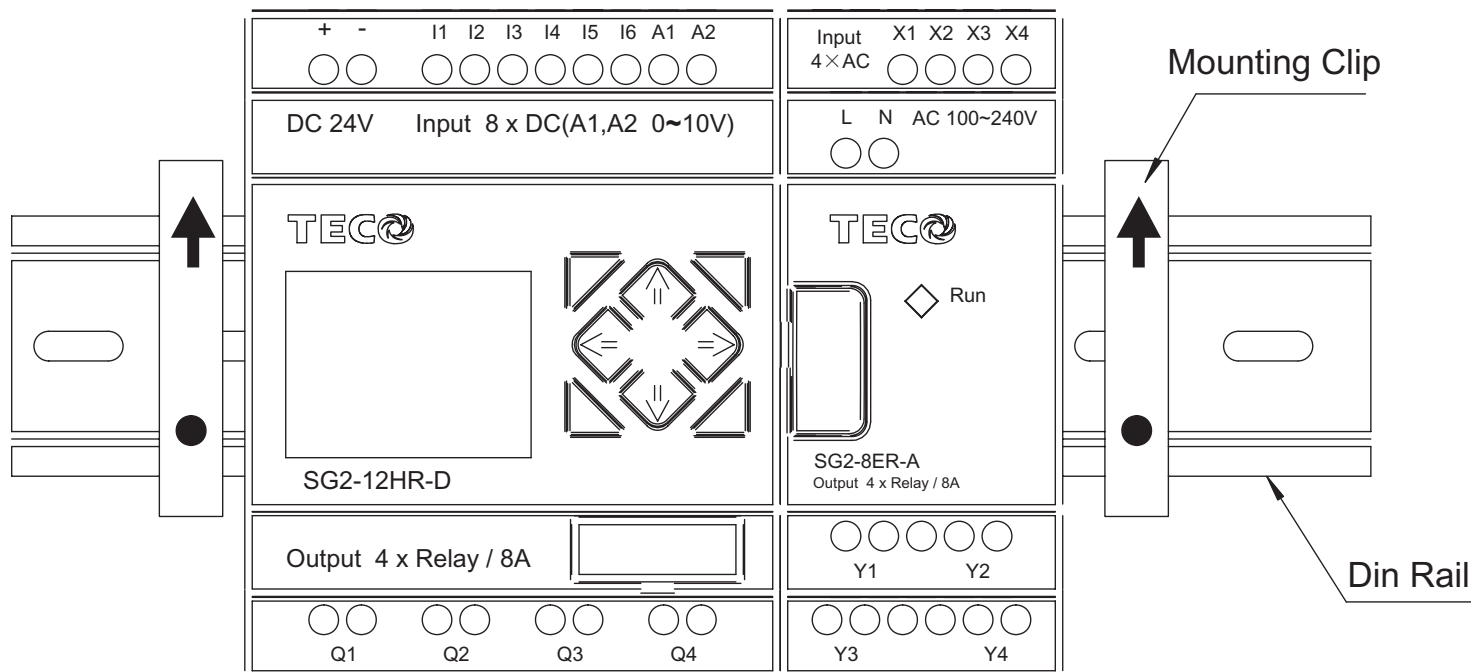
# Mounting

## DIN-rail Mounting

The SG2 PLR 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)



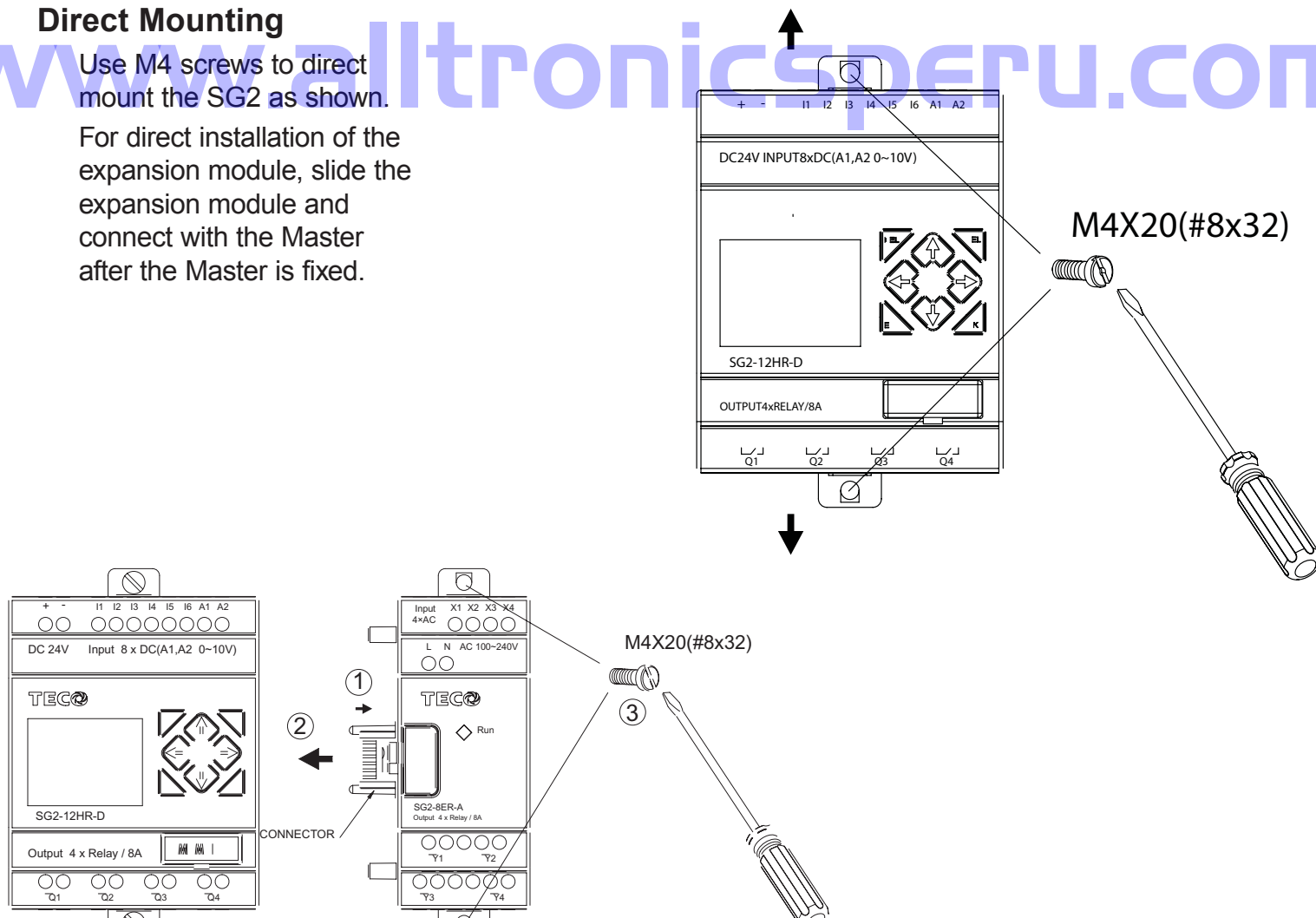
It is recommended to apply a DIN-rail end clamp to hold the SG2 in place.



### 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.**

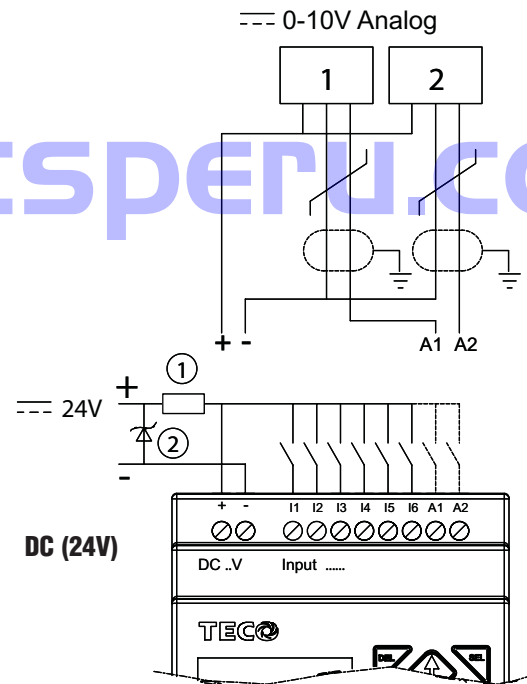
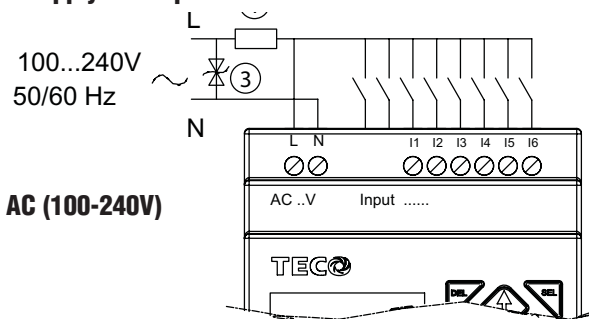
### Wire size and Terminal Torque

mm <sup>2</sup>	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
 Ø3.5 (0.14in)					
C		 Nm		0.6	
		lb-in		5.4	

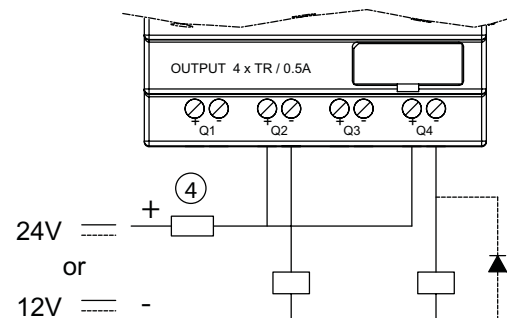
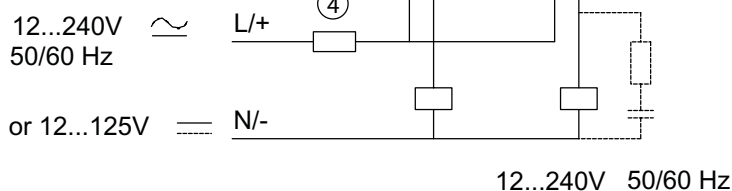
### 10/12-point Versions

- ① Fuse (2A)
- ② Surge absorber (36V DC)
- ③ Surge absorber (400V AC)
- ④ Fuse or short circuit Protective Device

#### Power Supply and Input Terminals



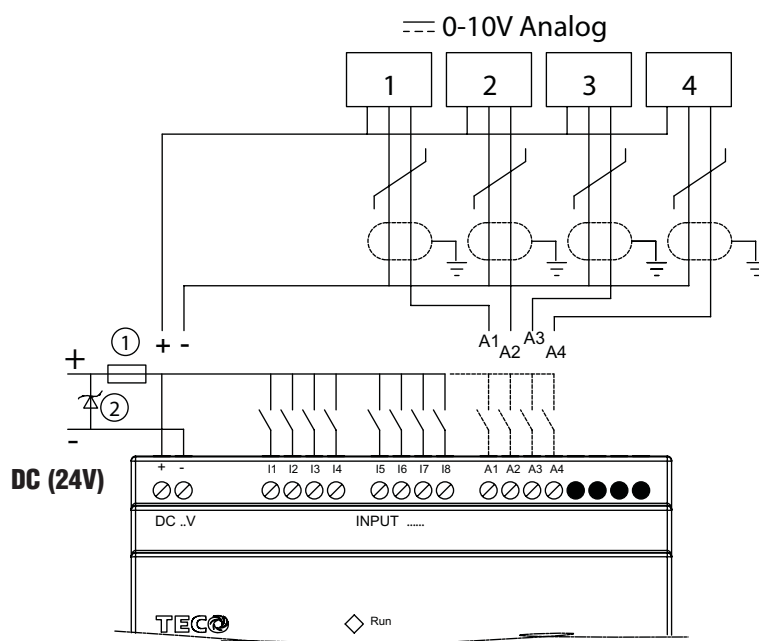
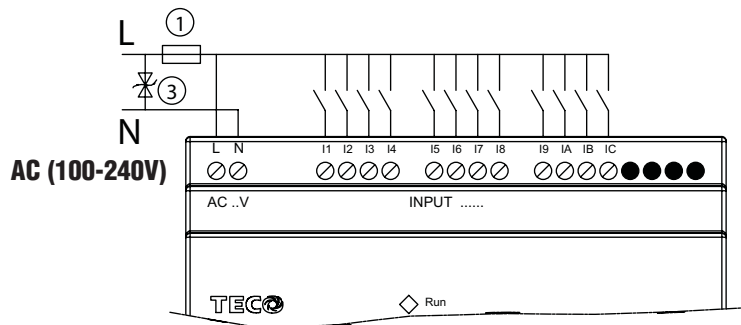
#### Output Terminals



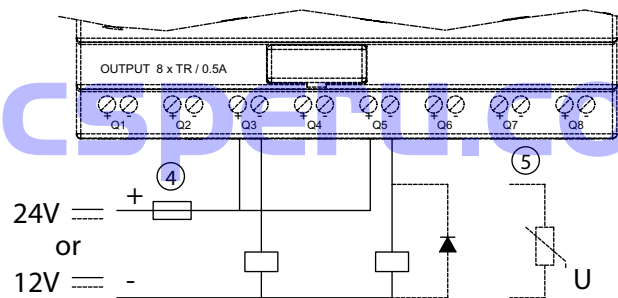
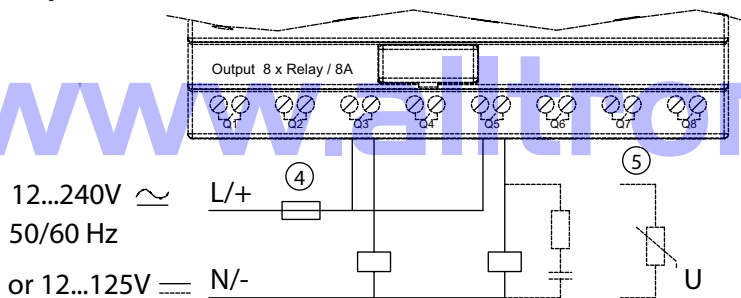
## 20-point Versions

- ① Fuse (2A)
- ② Surge absorber (36V DC)
- ③ Surge absorber (400V AC)
- ④ Fuse or short circuit Protective Device

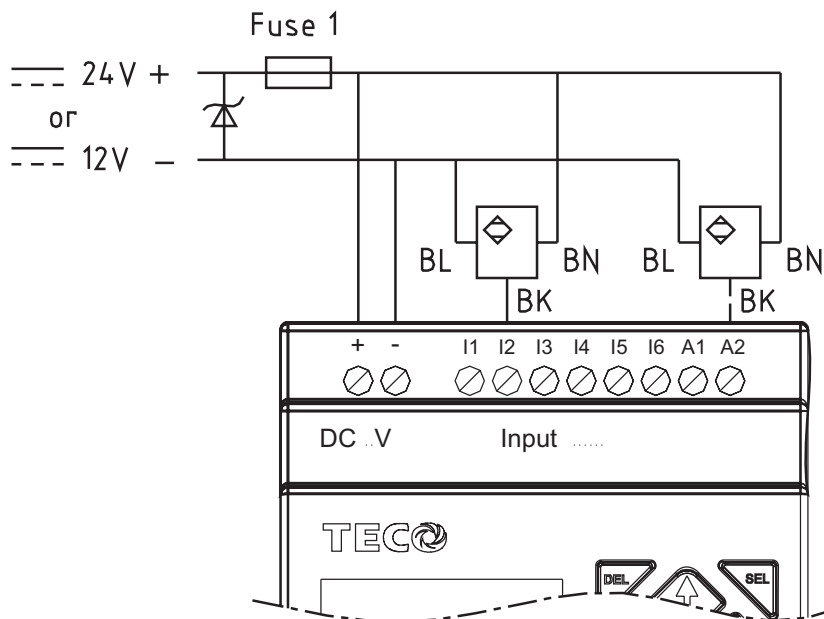
### Power Supply and Input Terminals



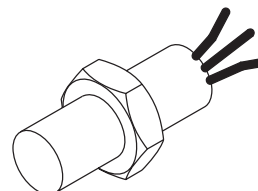
### Output Terminals



## Sensor Connection

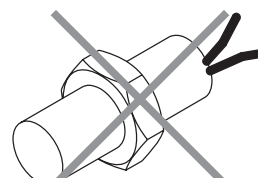


3-wire, PNP only



**YES**

2-wire

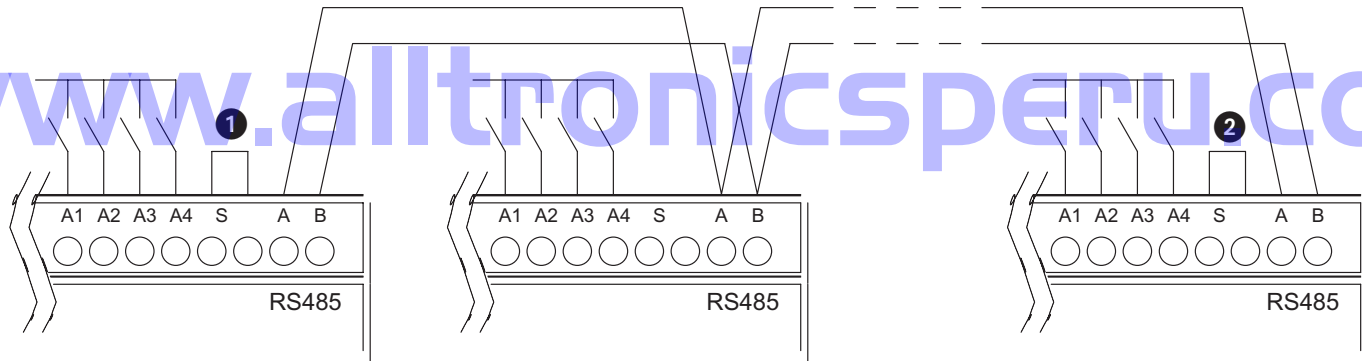


**NO**

## DATA LINK OR REMOTE I/O LINK

- ① The power supply and the I/O supply should share the same power source.
- ② Only short circuit the first and the last module.

In accordance to EIA RS-485 standard, DATA LINK can connect Max.8 Modules (ID:1-8). REMOTE I/O can only connect 2 modules (MASTER & SLAVE).



# Chapter 3: Program Tools

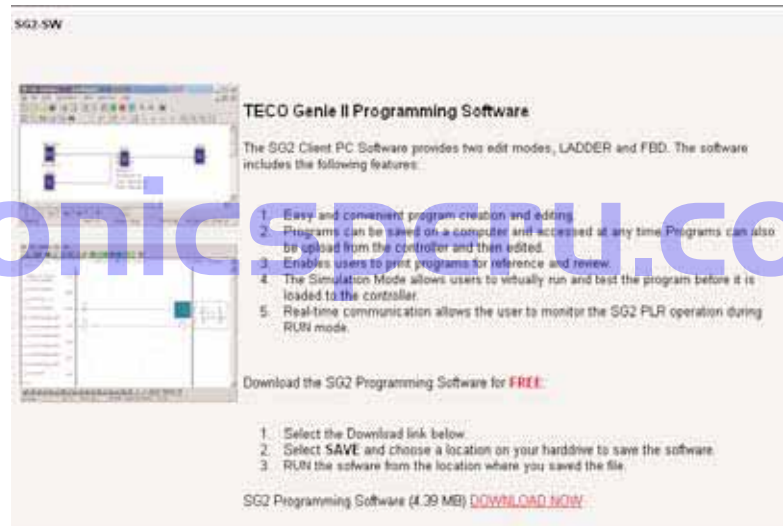
## PC Programming Software “SG2 Client”

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 an 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 PLR operation during RUN mode.

### Installing the Software

Install the SG2 Client Software from CD or from the free internet download at [www.factorymation.com](http://www.factorymation.com)

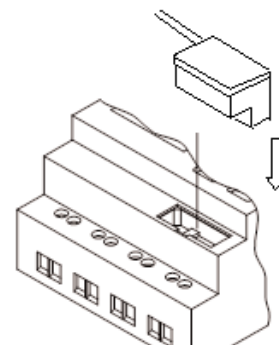
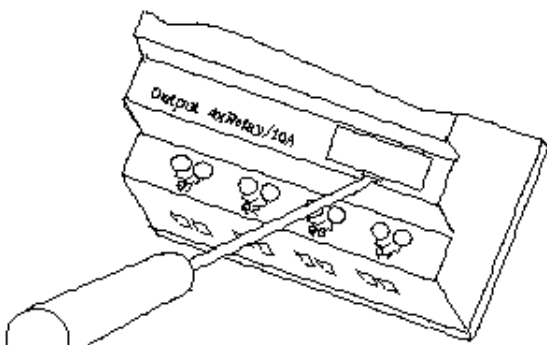


### Connecting the Software

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 PLR 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 following 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

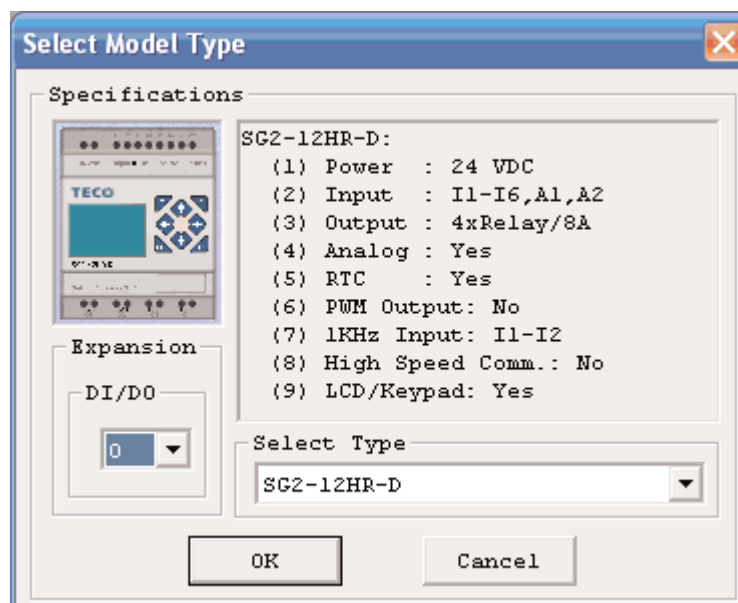
Select File-->New-->New FBD to enter the development environment for a new FBD (Function Block Diagram) program.

## 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

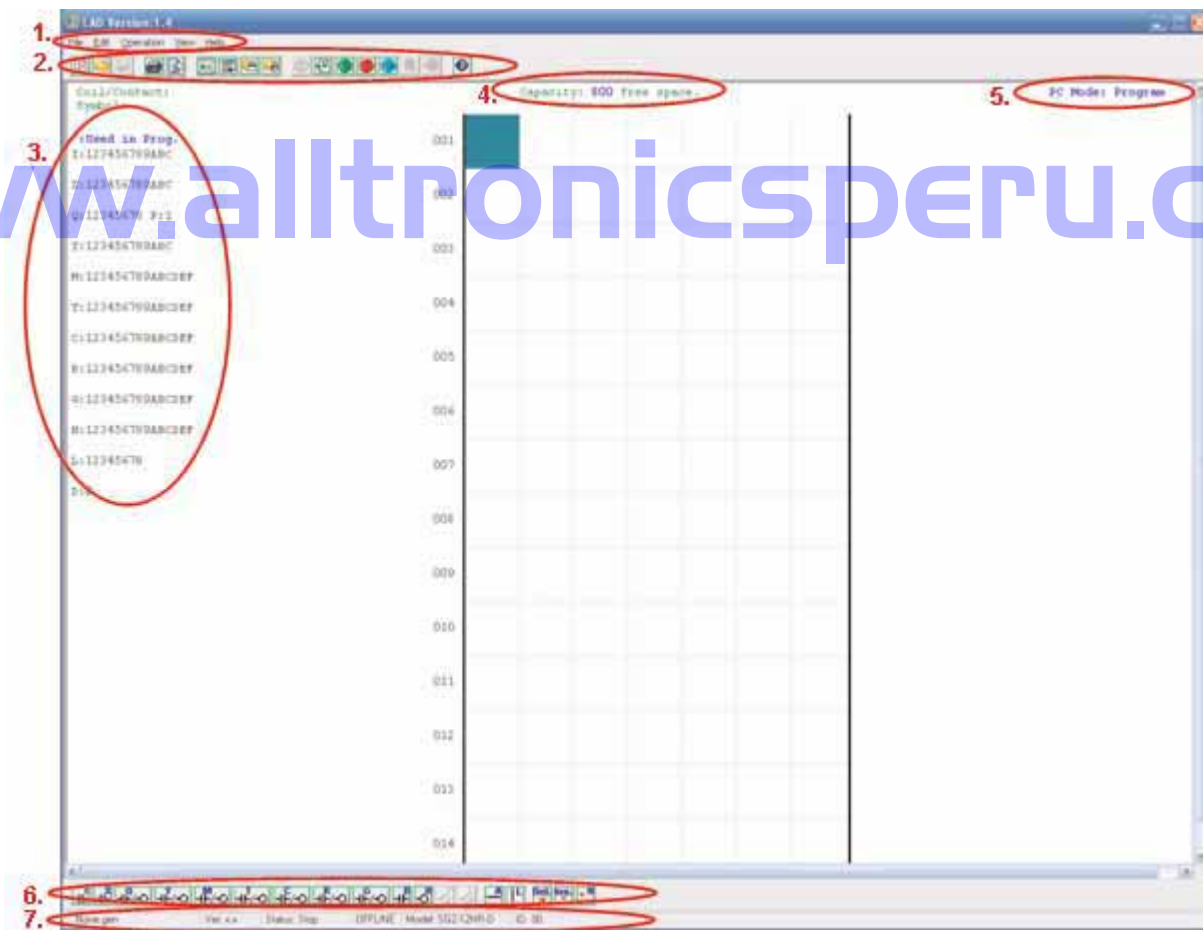
The Ladder Logic Programming Environment includes all the functions for programming and testing the SG2 PLR using the Ladder Logic programming language. To begin a new program select File-->New--> and select the desired model of SG2, and the number of connected expansion units if applicable, as shown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



## Menus, Icons and Status Displays

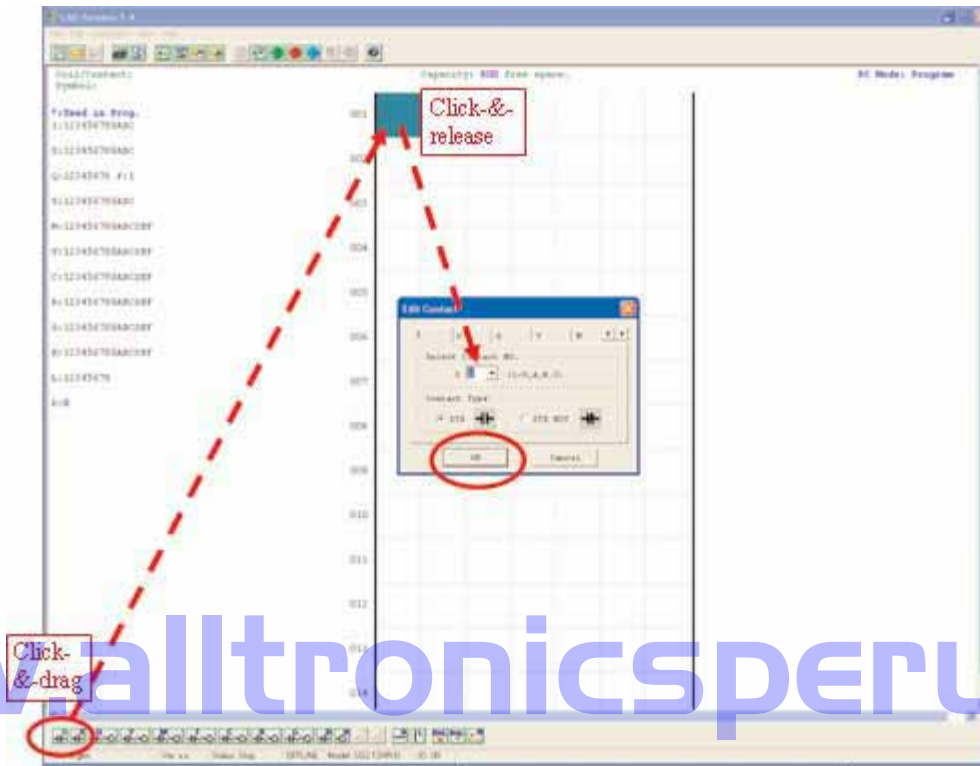
The Ladder programming environment includes the following Menus, Icons and Status Displays

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 a New program, opening a program, and printing  
Icons for Keypad, Ladder view, HMI/Text editing and Symbol (comments) editing.  
Icons for Monitor, Simulator, Controller Mode changes (Run, Stop, and Quit), and Read/Write programs to/from the PLR.
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 – operation mode of the controller, or simulator, from the connected PC.
6. Ladder Toolbar – Icons for selecting and entering all available Ladder Logic instructions.
7. Status Bar – Status of current open project and connected PLR.

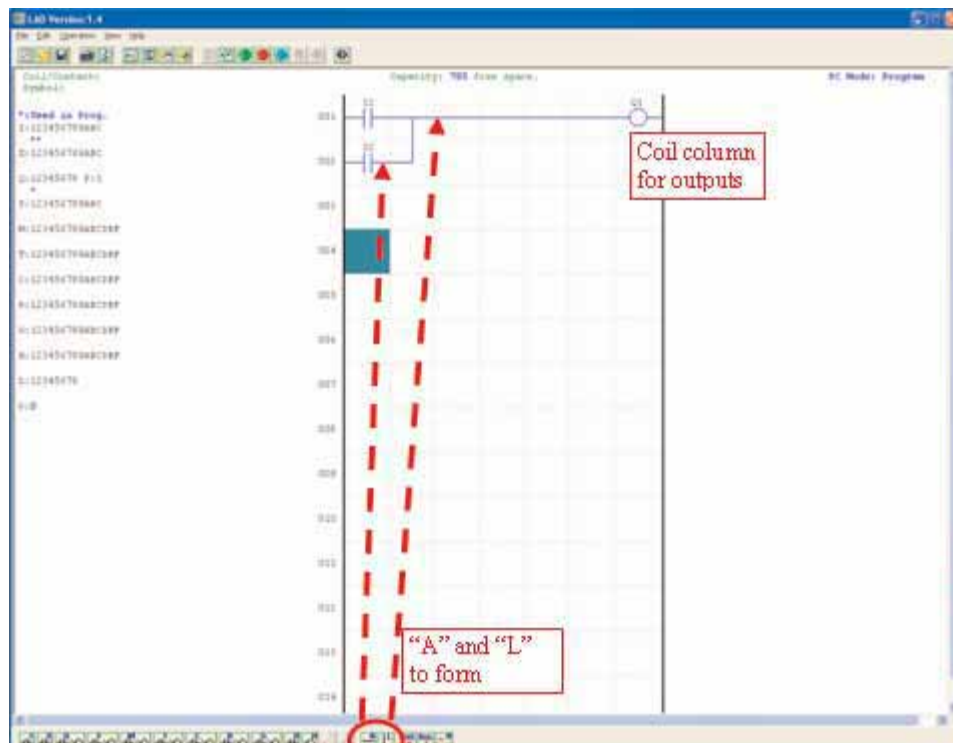


## Programming

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.

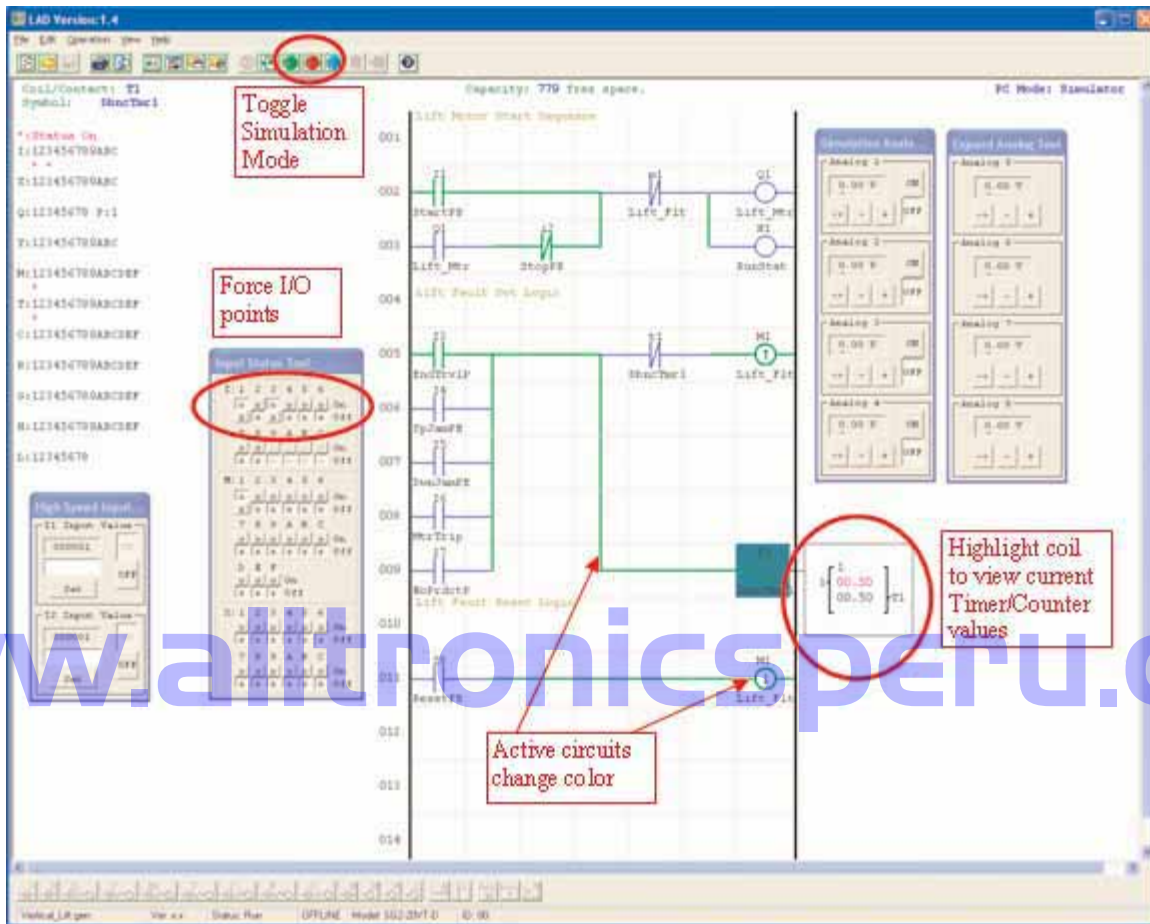


The “A” and “L” keys or icons are used to complete parallel and serial circuits. The rightmost column is for output coils.



## Simulation Mode

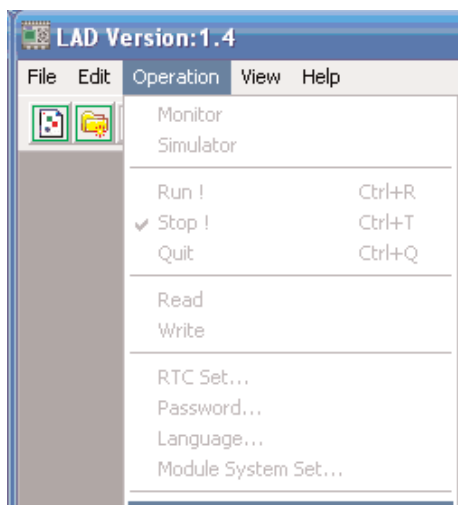
The SG2 Client software includes a built-in simulator to test and debug programs easily without the need for downloading to a controller. To activate simulation mode, simply press the red RUN icon. The program below is shown in simulation mode, identifying the significant available features.



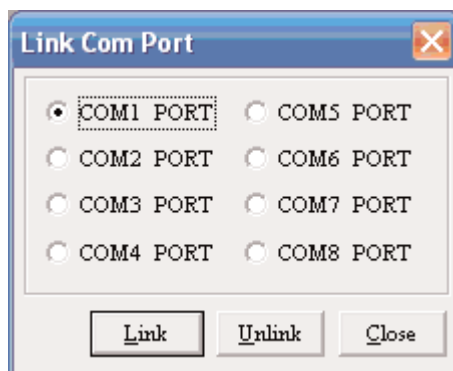
## Establish Communication

The following is the simple procedure for establishing communication between the connected PC and the SG2 PLR.

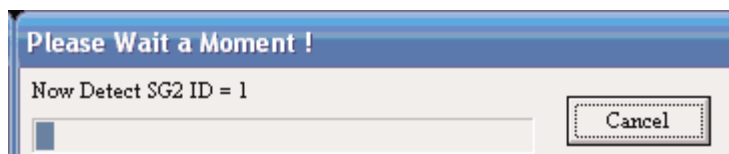
- Select "Operation/Link Com Port..." as shown below.



- b. Select the correct Com Port number where the programming cable is connected to the computer then press the “Link” button.

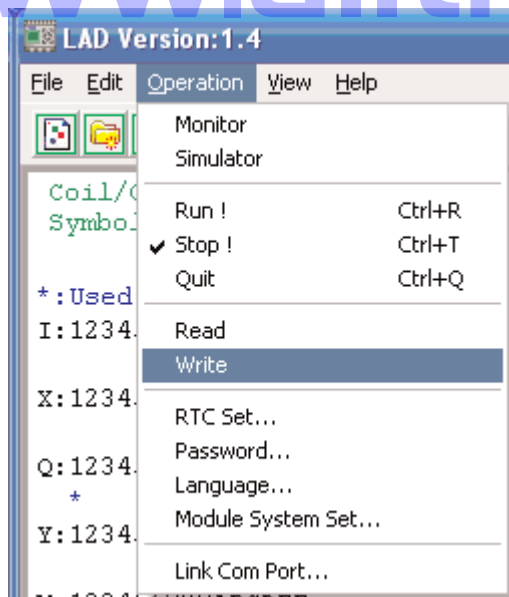


- c. The SG2 Client software will then begin to detect the connected PLR to complete it's connection as shown below.



## Writing Program to PLR

From the Operation menu, select the Write function and write the program to the connected PLR as shown below.



## Operation menu

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

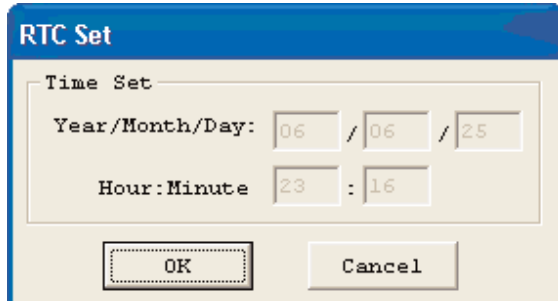
**Monitor** – Online function for runtime monitor and editing when connected to a controller

**Simulator** – Offline function for testing and debugging a program.

**Run-Stop-Quit** – Mode change selections for both runtime editing and simulation mode.

**Read-Write** – Reading and writing programs to and from a connected PLR.

**RTC Set** – Online function for setup of the Real-time clock/calendar (see dialog below)



**Password** – Set a password for accessing the current program after upload to the PLR

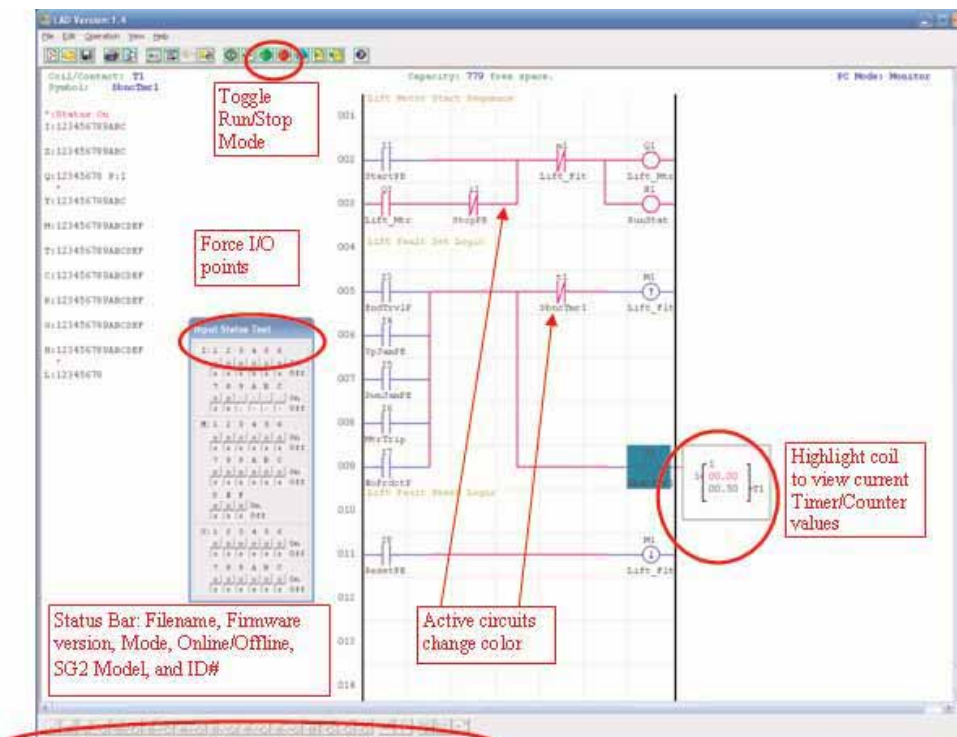
**Language** – Change software language

**Module System Set** – Dialog for changing important system setup functions including Module ID, Remote I/O preferences, Expansion I/O settings, and Retentive memory preferences (Keeping) for (C ) Counters, (M) Auxiliary Coils, and the LCD Backlight.

## 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).

**Note:** 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 PLR while in Stop mode.



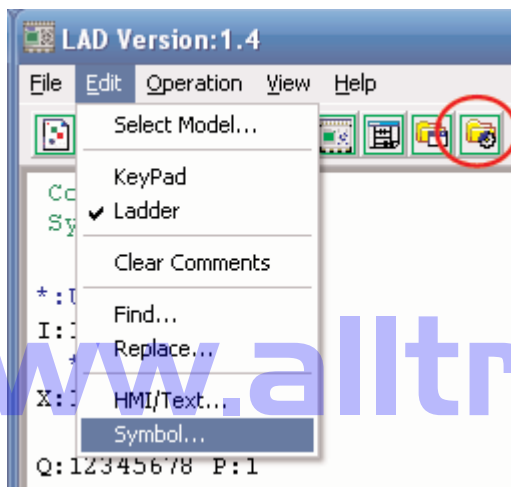
## Program Documentation

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.

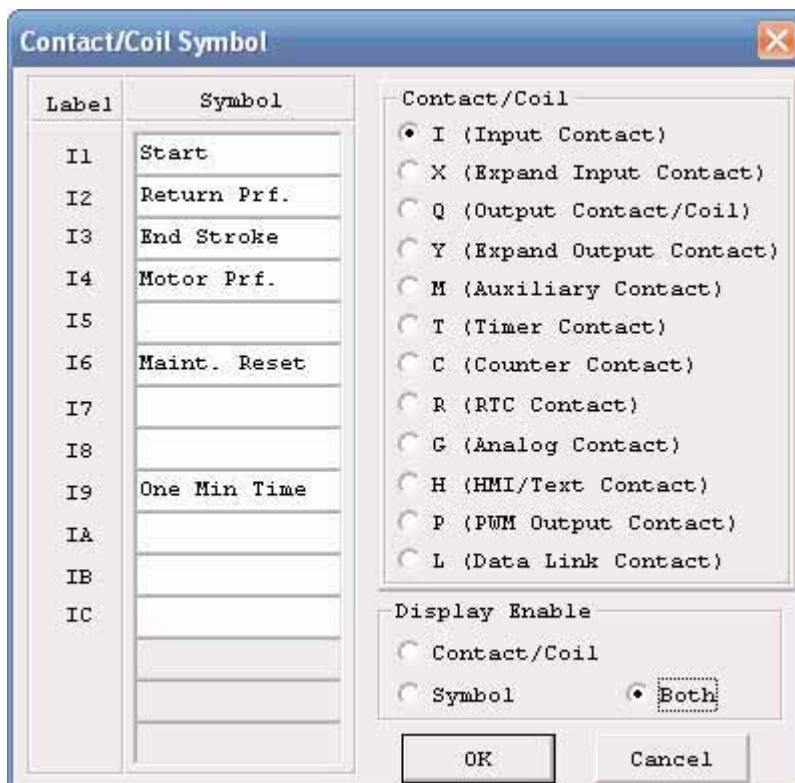
### Symbol

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.

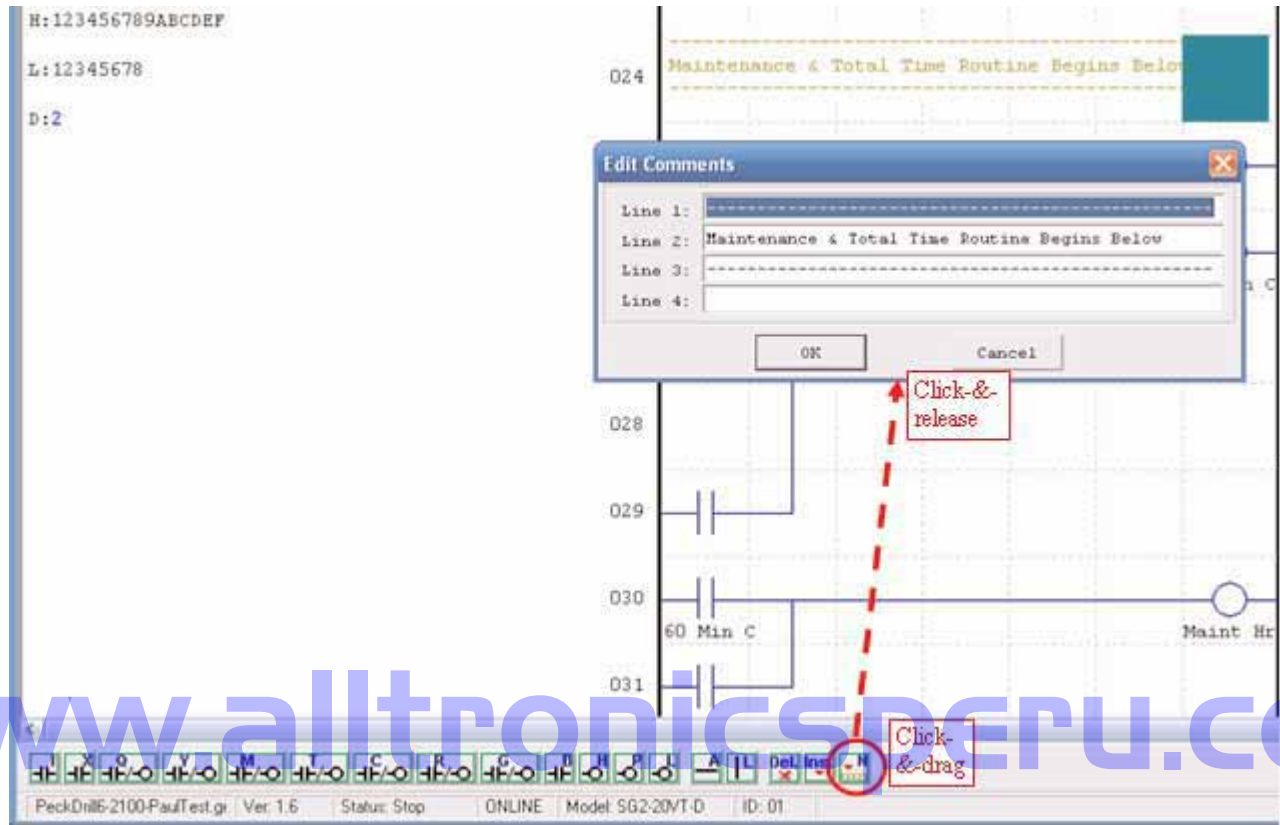
The Symbol editing environment allows for documenting all the contact and coil memory types, and selecting display modes as shown below.



### Line Comments



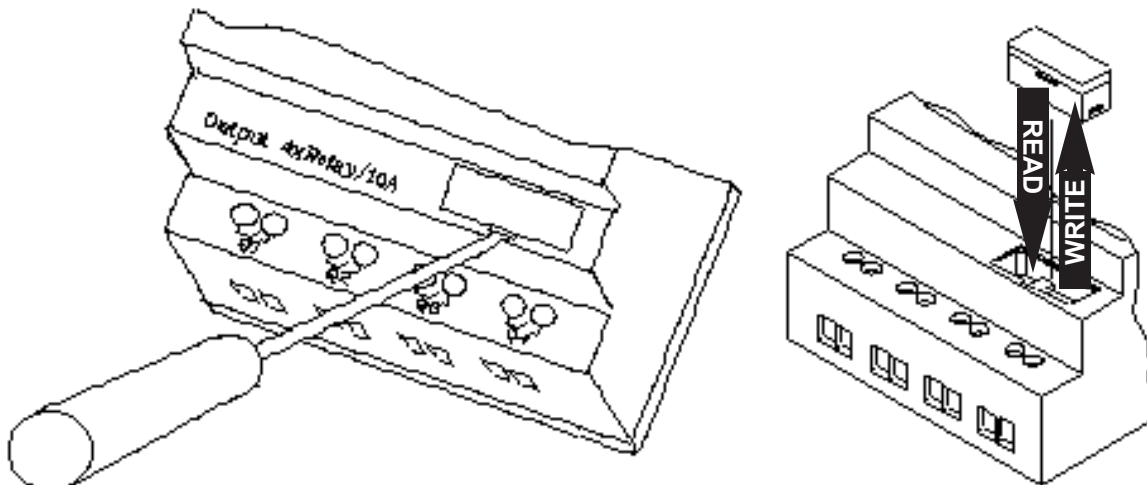
The Line Comment editor is accessed by clicking the “N” icon on the Ladder Toolbar. After clicking on the “N” icon, to drag the line number you want to comment and release, then type the desired comments and press OK.



### Memory Cartridge (sold separately)

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

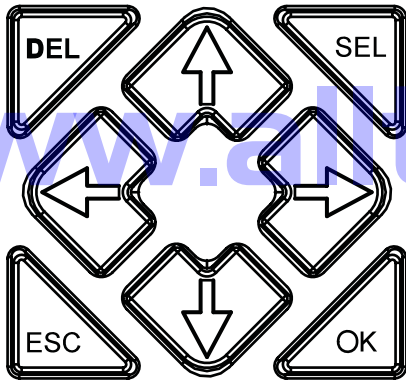
1. Remove the plastic connector cover from SG2 using a flathead screwdriver as shown in the figure above.
2. Insert the PM05 memory cartridge onto the connector as shown above.



3. From the display keypad on the face of the SG2 PLR, select either WRITE (to PM05) or READ (from PM05) to transfer the program to or from the PLR to the PM05 memory cartridge.

## LCD Display and 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 setpoints, 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** – Used to select the available memory and instruction types for editing. Holding the Select button for 3 seconds (and releasing) 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.

# Chapter 4: Relay Ladder Logic Programming

## Common Memory Types

### Inputs (I Memory Type)

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

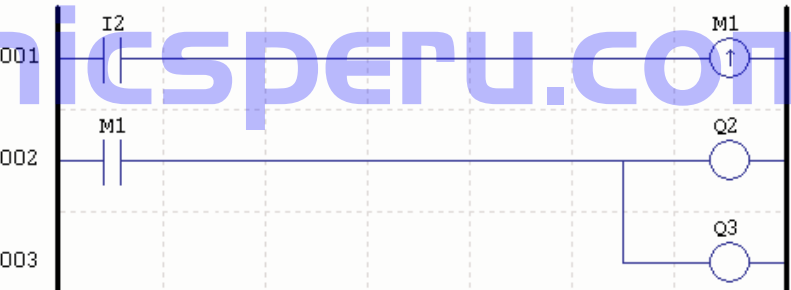
### Outputs (Q Memory Type)

The SG2 digital output points are designated Q memory types. The number of digital Q output points are 4 or 8 depending on each SG2 model. In this example, output point Q1 will be turned on when input I1 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. 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 M1 is being used as an output coil and will energize when input I2 turns on. In the second rung auxiliary relay M1 is being used as an input and when energized, will turn on outputs Q2 and Q3.



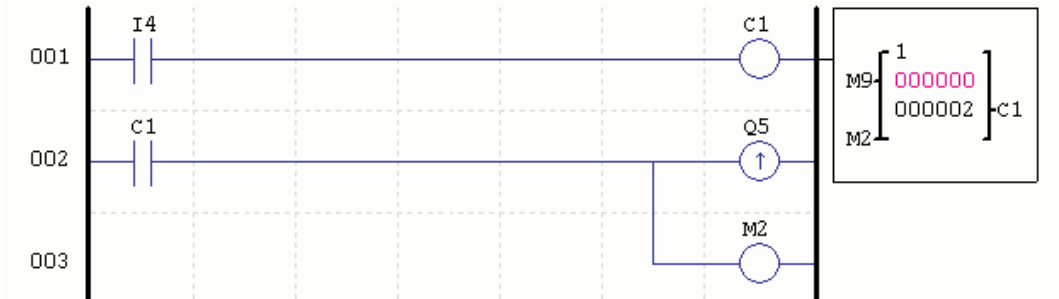
### Timers and Timer Status Bits (T Memory Type)

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 I3 turns on, timer T1 will start. When the timer reaches the preset of 5 seconds timer status contact T1 turns on. When T1 turns on, output Q4 turns on. Turning off I3 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 to or greater than the preset value of a selected counter. In this example, each time the input contact I4 transitions from off to on, the counter (C1) increments by one. When the counter reaches the preset of 2 counts, the counter status contact C1 turns on. When C1 turns on, output Q5 turns on. When M2 turns on counter C1 will reset. If M9 is turned on, the counter will change from a count-up counter to a count-down counter.



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 (I1-IC / i1-iC)
Output coil	Q	Q	Q	Q	Q	q	8 (Q1-Q8 / q1-q8)
Auxiliary contact	M	M	M	M	M	m	15 (M1-MF / m1-mF)
Counter	C				C	c	15 (C1-CF / c1-cF)
Timer	T			T	T	t	15 (T1-TF / t1-tF)

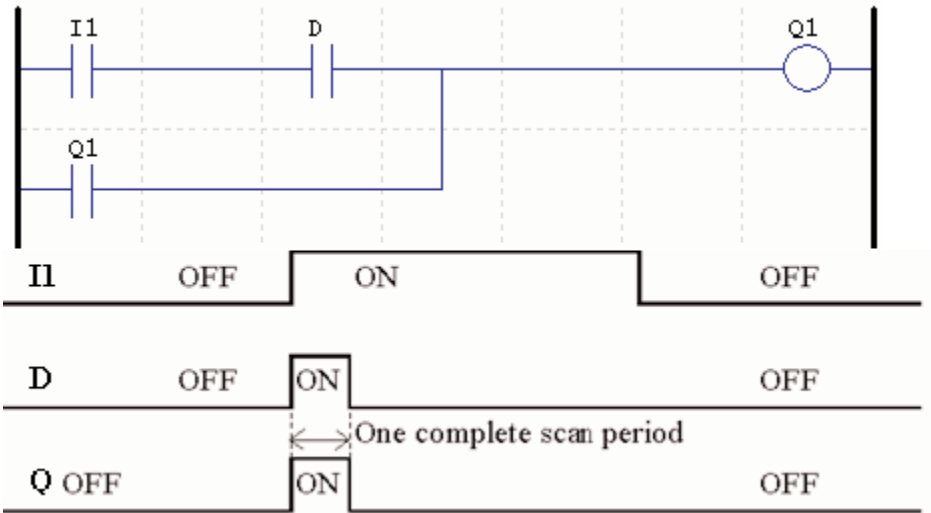
Specialty Memory Types

	General output	SET output	RESET output	PULSE output	N.O. Contact	N.C. Contact	Number
Symbol	( )	(↑)	(↓)	(P)			(N.O. / N.C.)
Expansion input coil					X	x	12 (X1-XC / x1-xC)
Expansion output coil	Y	Y	Y	Y	Y	y	12 (Y1-YC / y1-yC)
Differential (one shot)					D (Positive)	d (Negative)	
RTC	R				R	r	15 (R1-RF / r1-rF)
Analog comparator	G				G	g	15 (G1-GF / g1-gF)
HMI	H						15 (H1-HF)
PWM	P						1 (P1)
DATA LINK	L						8 (L1-L8)

# Specialty Memory Types

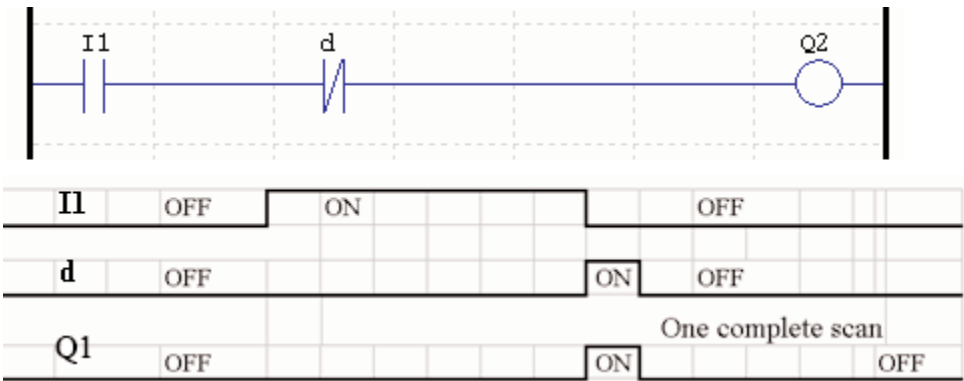
## Positive Input Differential Instruction (One-Shot)

An 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)

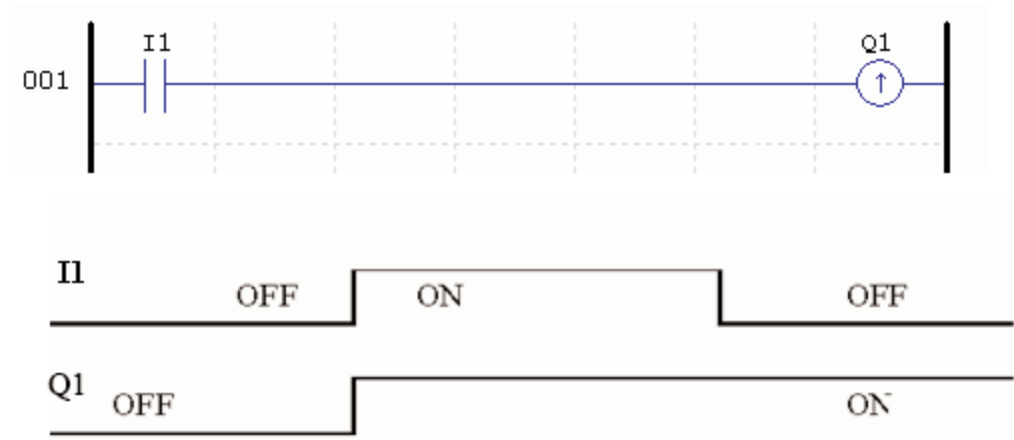
A negative input differential instruction, or One-Shot, holds its status ON for one CPU scan when the preceding series contact transitions from ON to OFF. This transition from ON to OFF is called a Negative Input Differential.



## Output Instructions

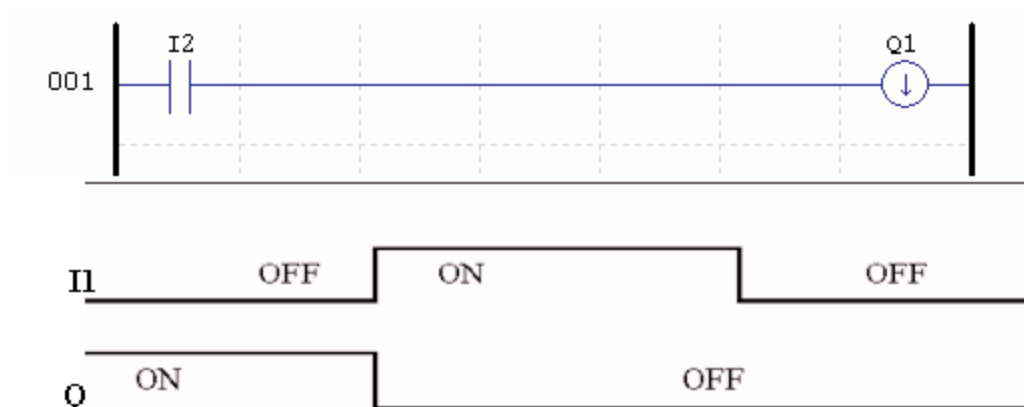
### Set Output Instruction (Latch) ( $\uparrow$ )

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.



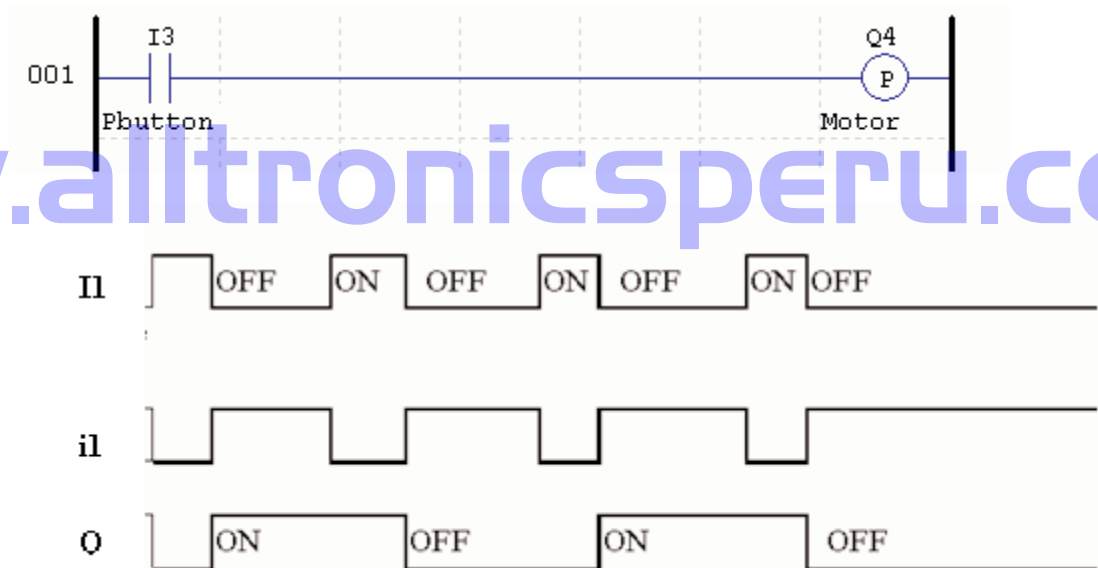
### Reset Output Instruction (Unlatch) ( $\downarrow$ )

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.



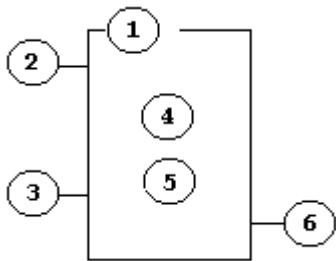
## Pulse Output Instruction (Flip-Flop) (P)

A pulse output instruction, or Flip-Flop, turns ON a coil (Q) or an auxiliary contact (M) when the preceding input contact transitions 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 I3 is pressed and released Motor Q4 will turn ON and remain on. When Pushbutton I3 is pressed again, Motor Q4 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 I3.



# Counter Instructions

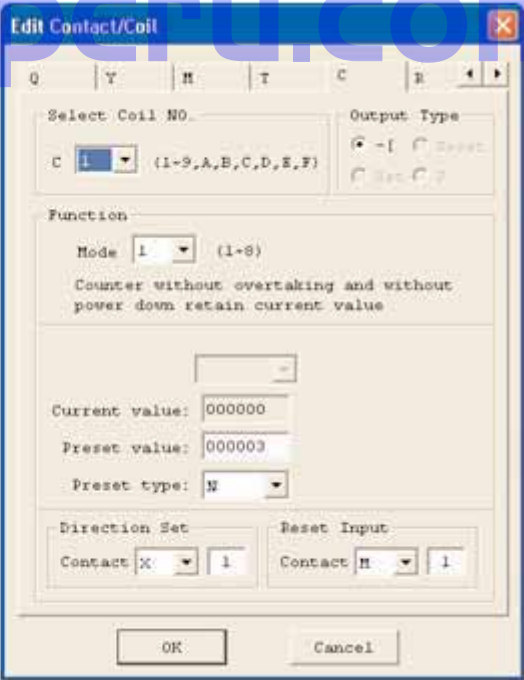
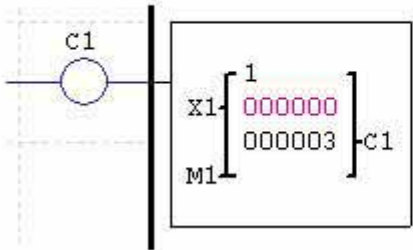
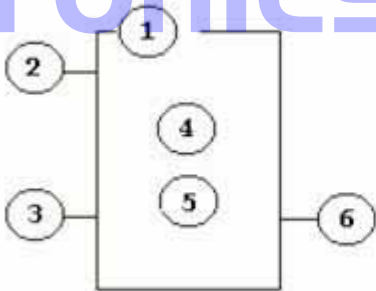
The SG2 PLR includes a total 15 separate counters that can be used throughout a program. Each counter has a choice of 8 operation modes, 6 for general purpose counting and 2 for high speed counting. Additionally, each counter has 6 parameters for proper configuration. The tables below describes each configuration parameter and lists each compatible memory type for configuring counters.



Symbol	Description
①	Counting Mode (1-6)
②	Use (I1 ~ gF) to set counting up or counting down
③	OFF: counting up (0, 1, 2, 3, 4....)
	ON: counting down ( ....3, 2, 1, 0)
	Use (I1 ~ gF) to RESET the counting value
④	ON: the counter resets to zero and OFF
⑤	OFF: the counter continues to count
	Present Counting Value, range:0~999999
	Target (Setting) Value, range:0~999999
⑥	Code of the counter (C1 ~ CF total: 15 counters)

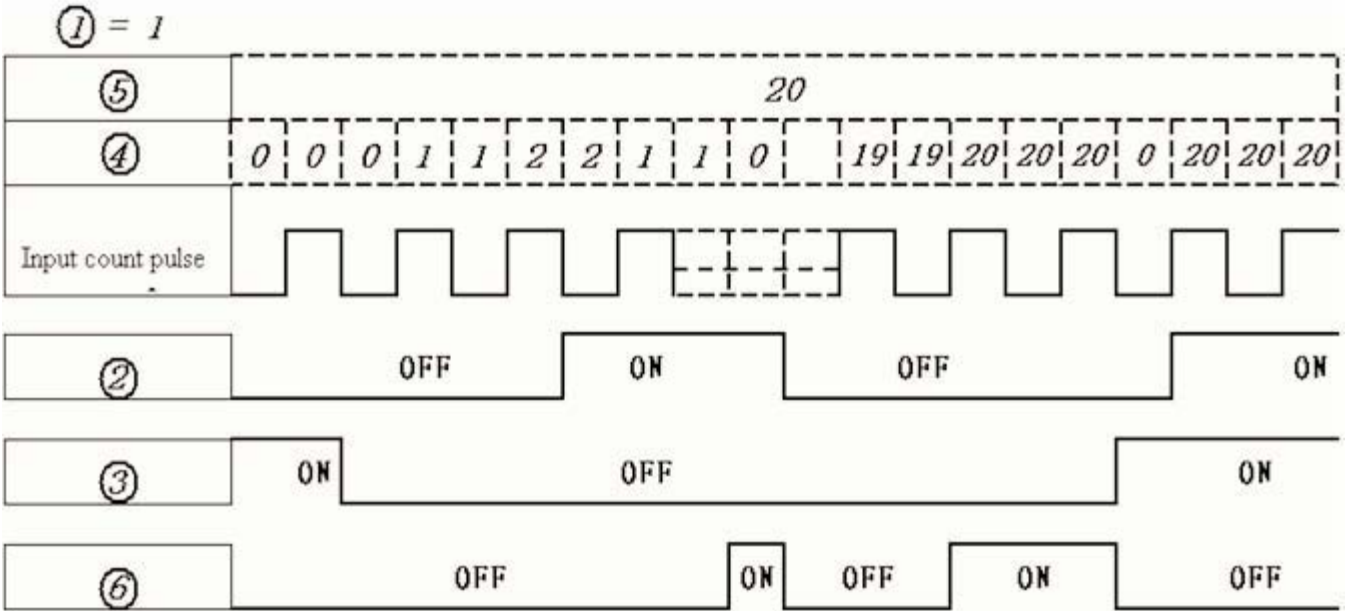
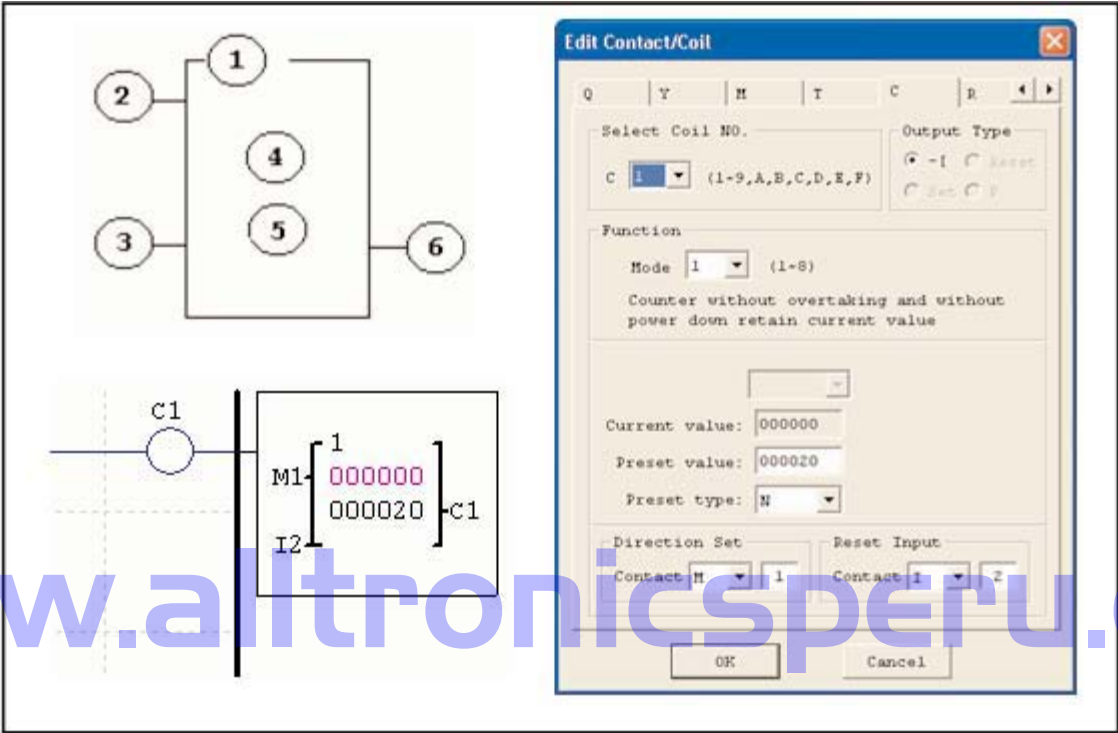
Compatible Instructions	Range
Inputs	I1-IC / i1-iC
Outputs	Q1-Q8 / q1-q8
Auxiliary coil	M1-MF / m1-mF
Expansion inputs	X1-XC / x1-xC
Expansion outputs	Y1-YC / y1-yC
RTC	R1-RF / r1-rF
Counter	C1-CF / c1-cF
Timer	T1-TF / t1-tF
Analog comparator	G1-GF / g1-gF

The figure to the right shows the relationship between the numbered block diagram for a Counter, the ladder diagram view, and the software Edit Contact/Coil dialog box.



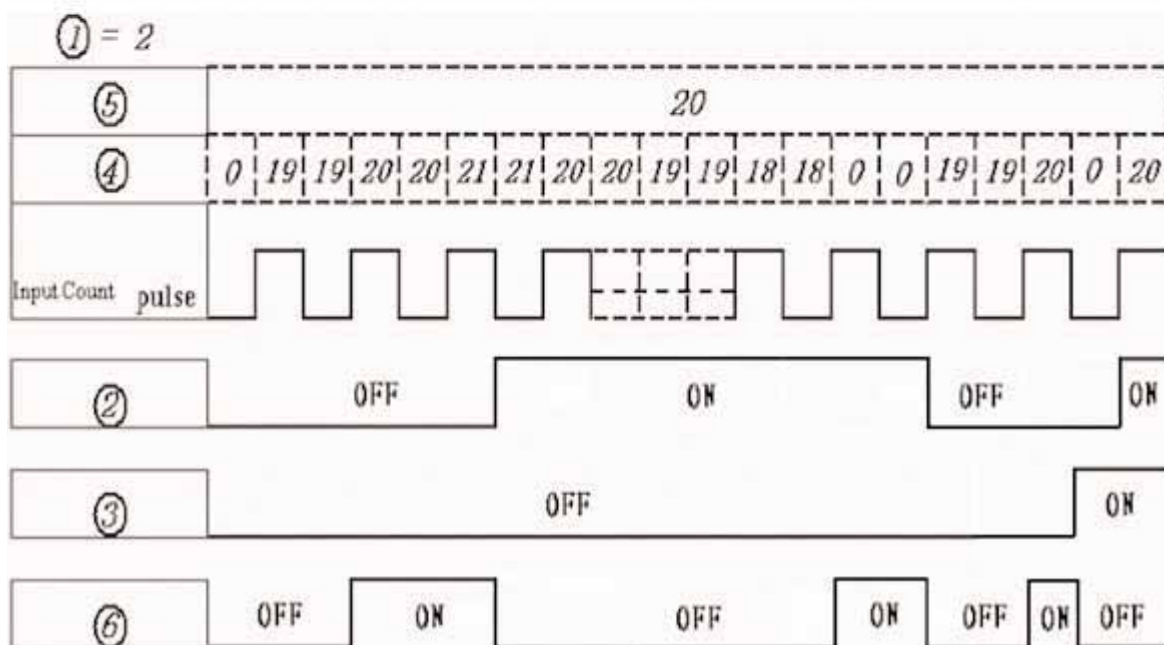
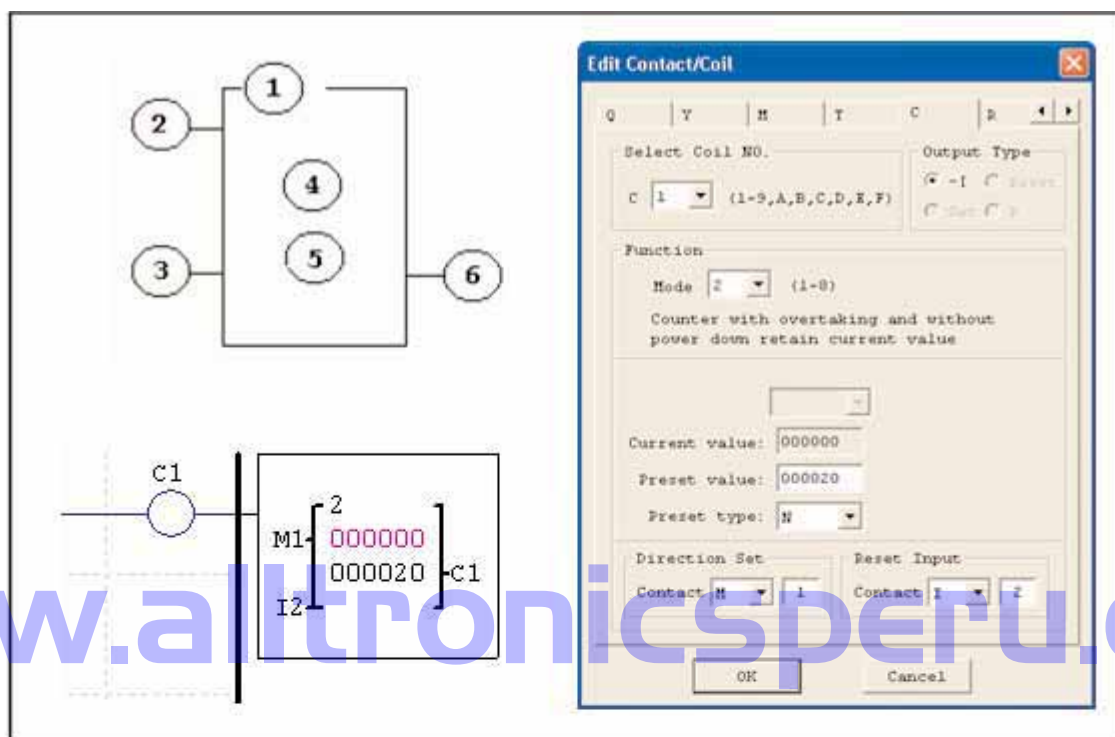
Counter Mode 1 (Fixed Count, Non-Retentive)

Mode 1 Counter will count up to a fixed preset value and stop counting when the current count is equal to the preset value. Additionally, the current count value is non-retentive and will reset to zero on a loss of power to the PLR. In the example below, the counter will stop counting when it reaches the preset value of 20. Counter status bit C1 will be ON when the current value is 20.



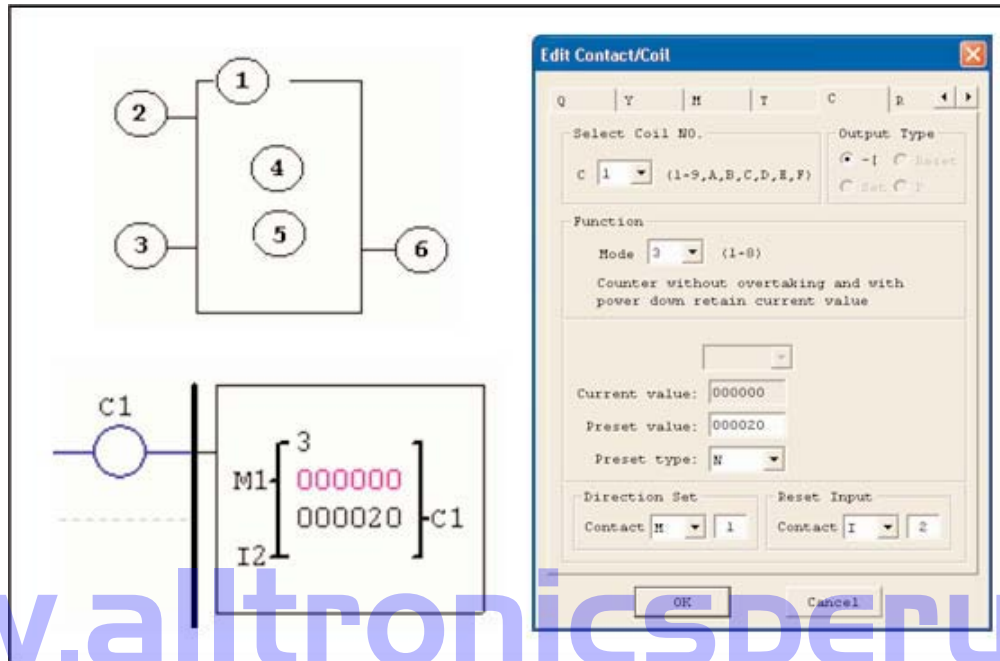
## Counter Mode 2 (Continuous Count, Non-Retentive)

Mode 2 Counter will count up to a fixed preset value and continue counting after the preset value. Additionally, the current count value is non-retentive and will reset to zero on a loss of power to the PLR. In the example below, the counter will continue counting after its preset value of 20. Counter status bit C1 will be ON when the current value is 20.



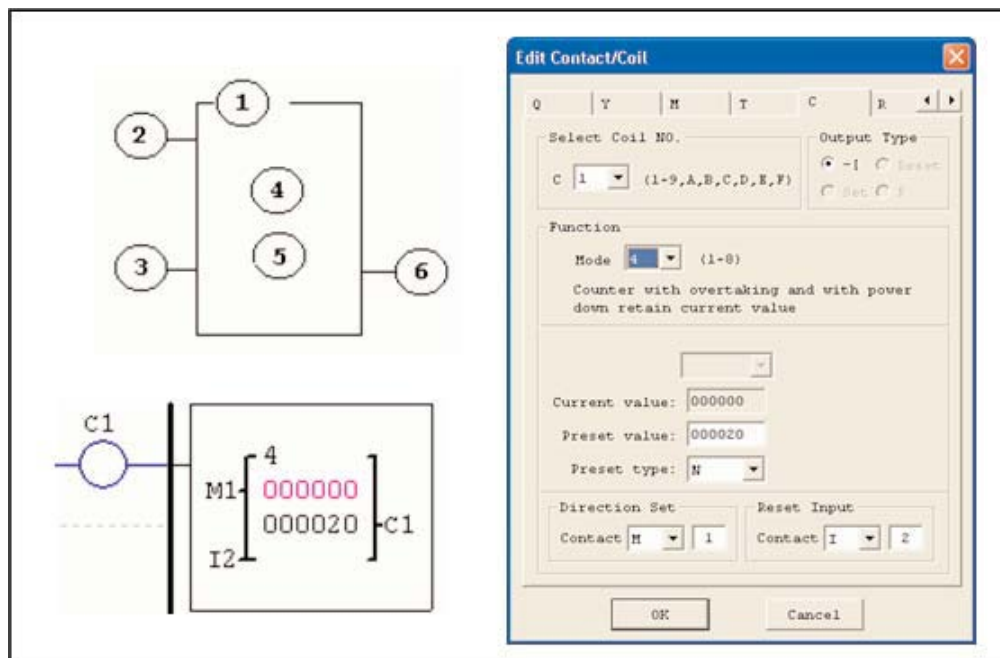
### Counter Mode 3 (Fixed Count, Retentive)

Mode 3 Counter operation is similar to Mode 1 except its current count value is retentive. Mode 3 Counter will count up to a fixed preset value and stop counting at that value. Additionally, the current count value is retentive and will keep its current count after a loss of power to the PLR. In the example below, the counter will stop counting when it reaches the preset value of 20. Counter status bit C1 will be ON when the current value is 20.



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

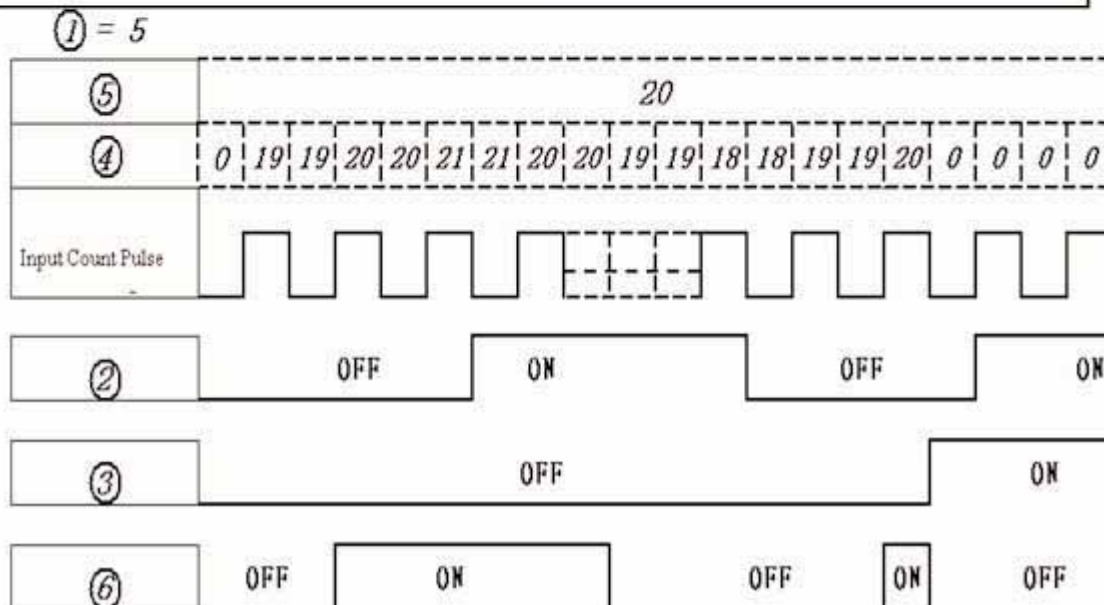
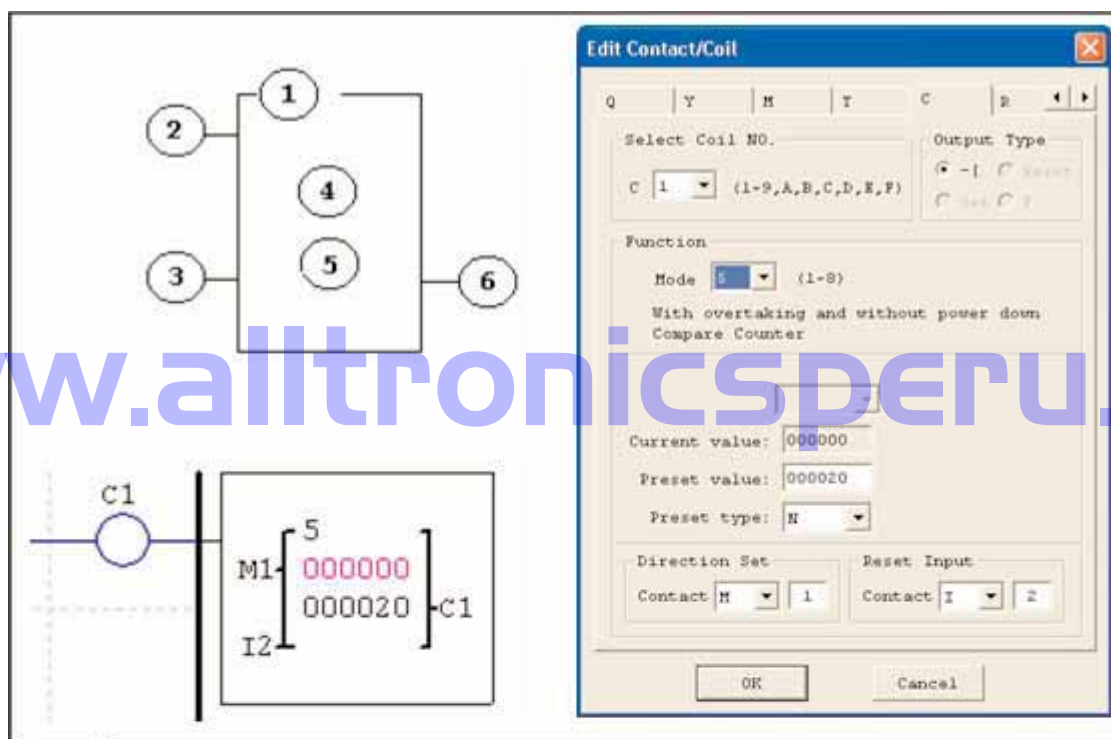
Mode 4 Counter operation is similar to Mode 2 except its current count value is retentive. Mode 4 Counter will count up to a fixed preset value and continue counting after the preset value. Additionally, the current count value is retentive and will keep its current count after a loss of power to the PLR. In the example below, the counter will continue counting after its preset value of 20. Counter status bit C1 will be ON when the current value is 20.



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

Mode 5 Counter operation is similar to Mode 2 where its current count value is continuous and non-retentive, except its C1 status bit will only be ON when the counter counts up to its preset, or down to its preset from a count higher than its preset. Even with its direction bit set to ON, it will not turn on its C1 status bit when it counts down to zero. The C1 status bit is fixed to the non-zero preset value regardless of the state of the direction bit. Additionally, the Mode 5 counter is always reset to zero, unrelated to the state of its direction bit.

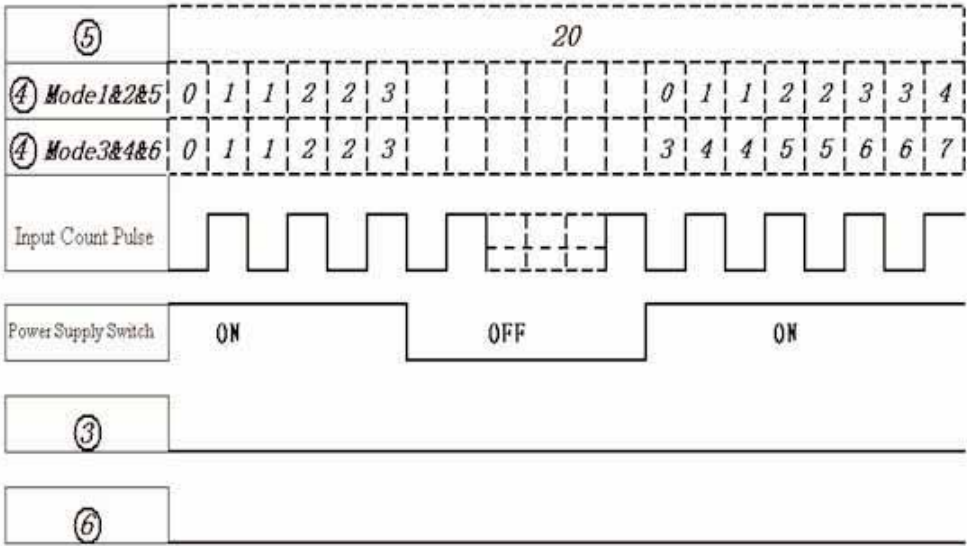
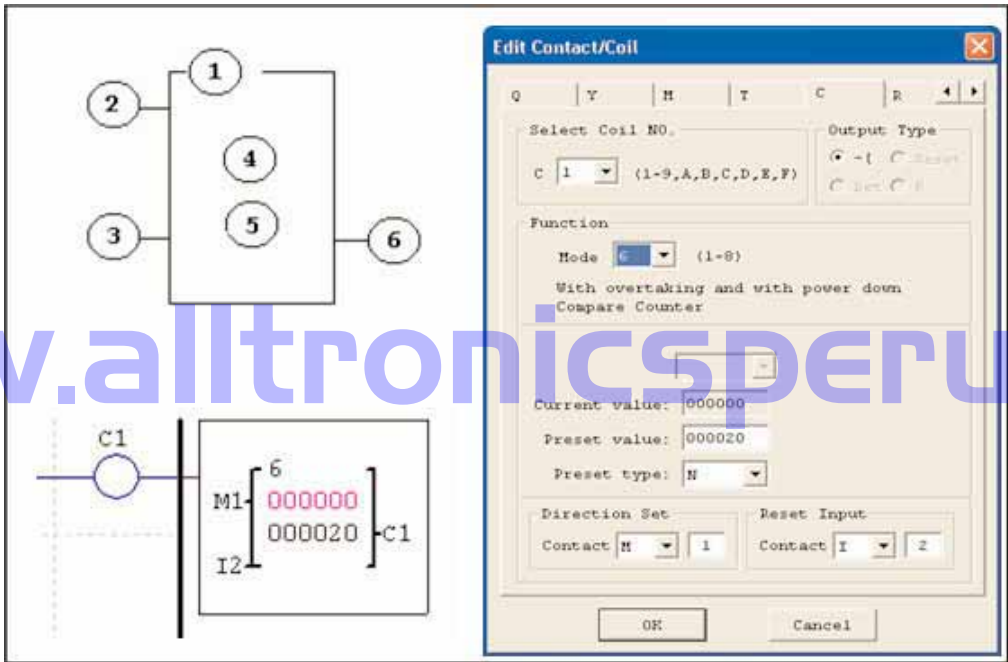
The Mode 5 Counter will count up to a fixed preset value and continue counting after the preset value. Additionally, the current count value is non-retentive and will reset to zero on a loss of power to the PLR. In the example below, the counter will continue counting after its preset value of 20. Counter status bit C1 will be ON when the current value is 20.



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

Mode 6 Counter operation is similar to Mode 4 where its current count value is continuous and retentive, except its C1 status bit will only be ON when the counter counts up to its preset or down to its preset from a count higher than its preset. Even with its direction bit set to ON, it will not turn on its C1 status bit when it counts down to zero. The C1 status bit is fixed to the non-zero preset value regardless of the state of the direction bit. Additionally, the Mode 5 counter is always reset to zero, unrelated to the state of its direction bit.

The Mode 6 Counter will count up to a fixed preset value and continue counting after the preset value. Additionally, the current count value is retentive and will keep its current count after a loss of power to the PLR. . In the example below, the counter will continue counting after its preset value of 20. Counter status bit C1 will be ON when the current value is 20.

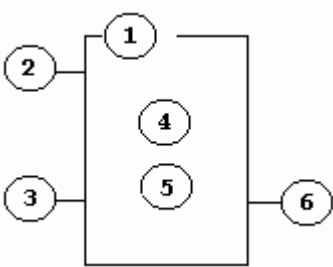


# High Speed Counters (DC Version PLRs Only)

The DC powered version PLRs include two 1Khz high speed inputs on terminal I1 and I2. 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. These are often used for counting something moving very fast (>40hz) or used as a speed reference on a machine. The high speed counters are configured using the same software Edit Contact/Coil dialog box, except selecting Counter Mode 7 or Mode 8.

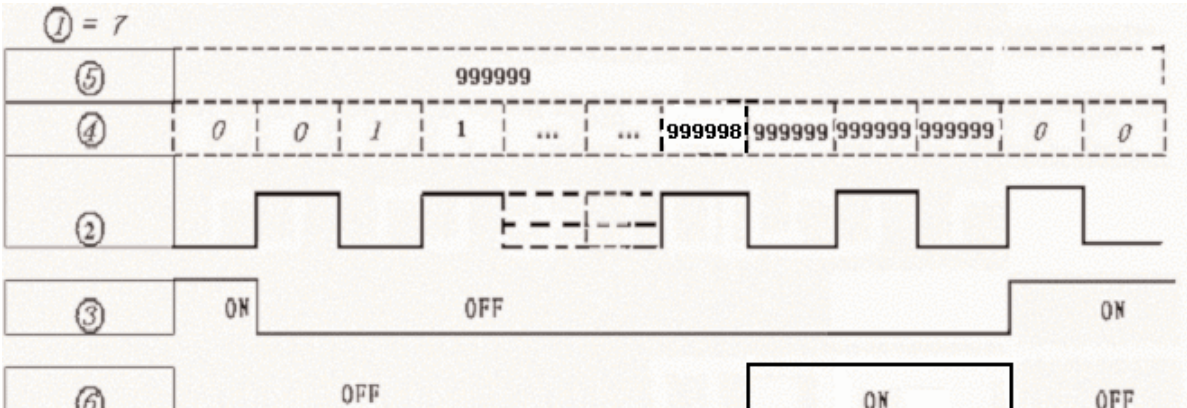
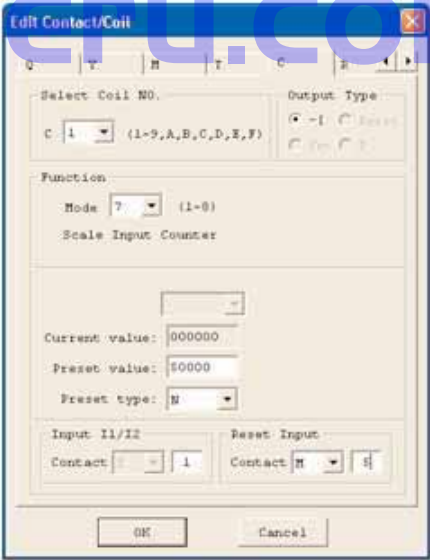
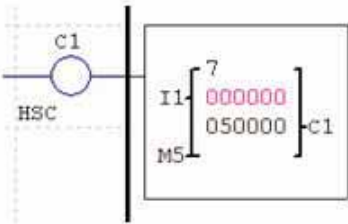
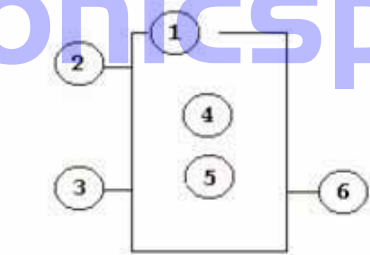
## High Speed Counter Mode 7 (DC powered versions only)

The Mode 7 High Speed Counter can use either input terminals I1 or I2 for forward up-counting to 1Khz maximum at 24VDC high speed input signal. The selected Counter Coil (C1-CF) will turn ON when the pulse count reaches the target setpoint and remain ON. The counter will reset when the preceding rung is inactive or the Reset Input is active.



Symbol	Description
①	Counting Mode (7) high speed counting
②	High speed counting input terminal: I1 or I2 only
③	Use (I1 ~ gF) to RESET the counting value ON: the counter reset to zero OFF: the counter continues to count
④	Current Count Value, range:0~999999
⑤	Preset Value, range:0~999999
⑥	Counter Coil Number (C1 ~ CF total: 15 counters)

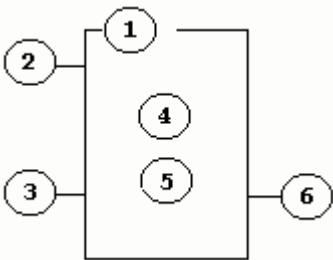
The figure to the right shows the relationship between the numbered block diagram for a Mode 7 Counter, the ladder diagram view, and the software Edit Contact/Coil dialog box.



High Speed Counter Mode 8 (DC powered versions only)

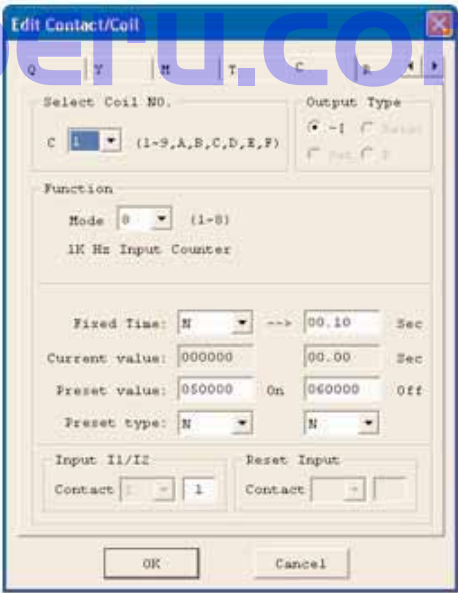
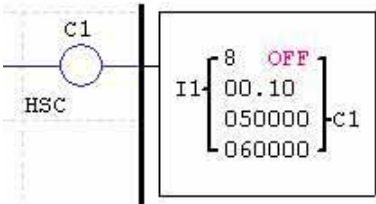
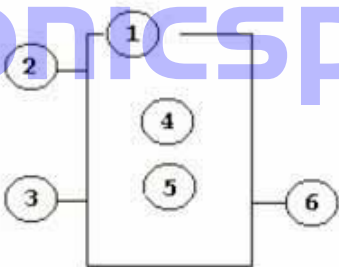
The Mode 8 High Speed Counter can use either input terminals I1 or I2 for forward up-counting to 1Khz maximum at 24VDC high speed input signal. The selected Counter Coil (C1-CF) will turn ON when the pulse count reaches the target “Preset ON” value and remain ON until the pulse count reaches the target “Preset OFF” value. The Fixed Time xxxx. The counter will reset when the preceding rung is inactive.

The table below describes each configuration parameter for High Speed Counter Mode 8



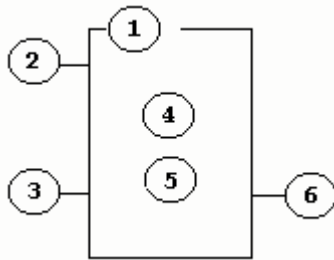
Symbol	Description
①	Counting Mode (8) frequency comparison
②	High speed counting input terminal: I1 or I2 only
③	Use (I1 ~ gF) to RESET the counting value ON: the counter reset to zero OFF: the counter continues to count
④	Current Count Value, range:0~999999
⑤	Preset Value, range:0~999999
⑥	Counter Coil Number (C1 ~ CF total: 15 counters)

The figure to the right shows the relationship between the numbered block diagram for a Mode 8 Counter, the ladder diagram view, and the software Edit Contact/Coil dialog box.



## Timer Instructions

The SG2 PLR includes a total of 15 separate timers that can be used throughout a program. Each timer has a choice of 7 operation modes, 6 for general purpose timing and 1 (mode 7) for a pulse 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 counters.

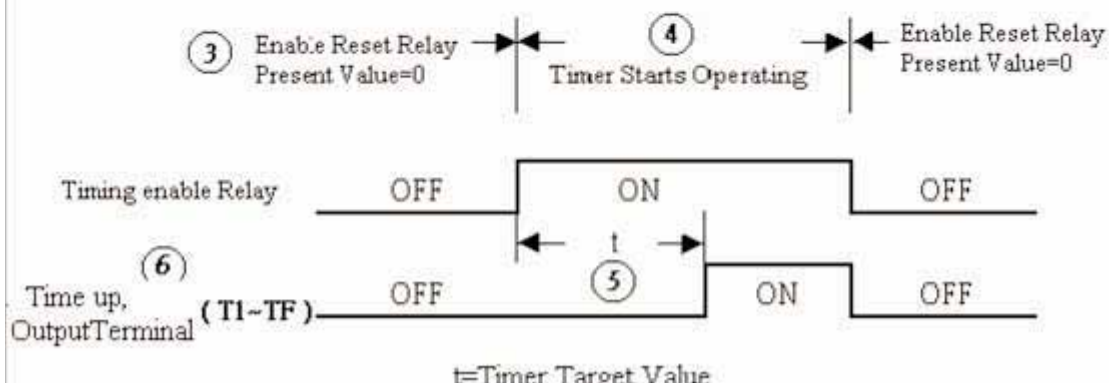
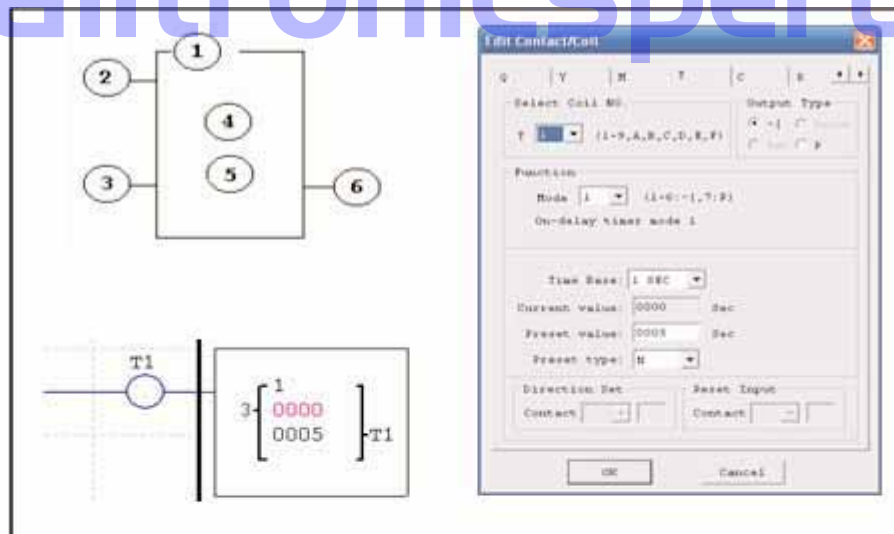


Symbol	Description
①	Timer Mode (1-7)
②	Timer Unit: 0.00 - 99.99 sec 0.0 - 999.9 sec 0 - 9999 sec 0 - 9999 min
③	ON: the timer reset to zero OFF: the timer continues to time
④	Current timer value
⑤	Timer preset value
⑥	Timer Coil Number (C1 ~ CF total: 15 timers)

Compatible Instructions	Range
<b>Inputs</b>	I1-IC / i1-iC
<b>Outputs</b>	Q1-Q8 / q1-q8
<b>Auxiliary coil</b>	M1-MF / m1-mF
<b>Expansion inputs</b>	X1-XC / x1-xC
<b>Expansion outputs</b>	Y1-YC / y1-yC
<b>RTC</b>	R1-RF / r1-rF
<b>Counter</b>	C1-CF / c1-cF
<b>Timer</b>	T1-TF / t1-tF
<b>Analog comparator</b>	G1-GF / g1-gF

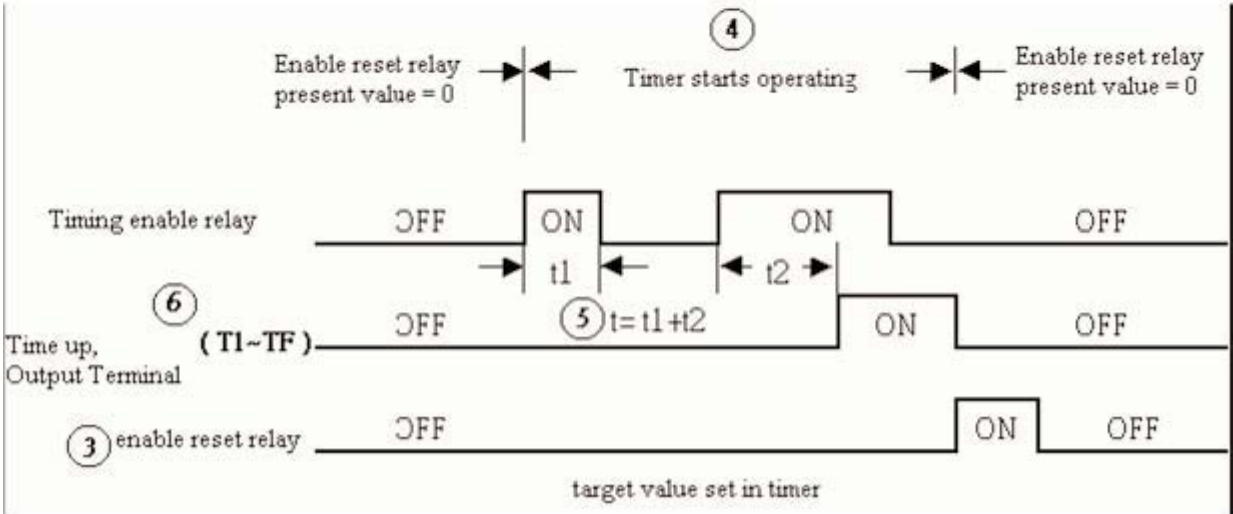
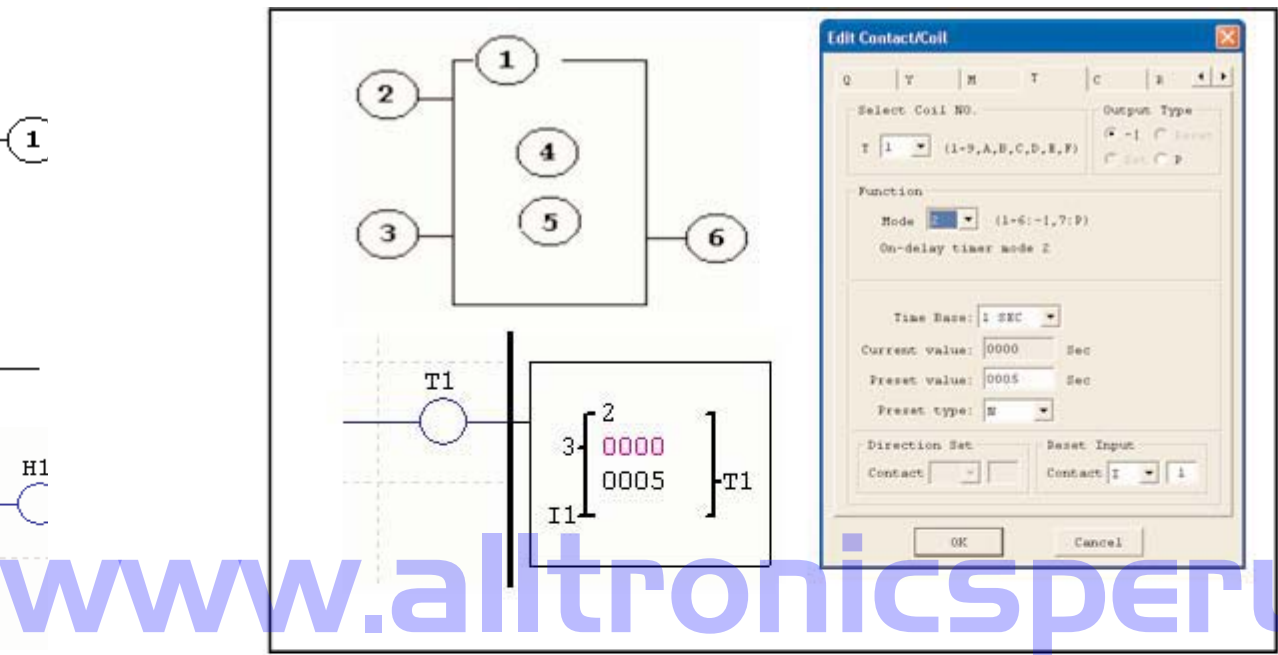
### Timer Mode 1 (ON-Delay)

Mode 1 Timer (ON-Delay) will time up to a fixed preset value and stop timing when the current time is equal to the preset value. Additionally, the current time value is non-retentive and will reset to zero on a loss of power to the PLR. In the example below, the timer will stop timing when it reaches the preset value of 5 seconds. Timer status bit T1 will be ON when the current value is 5.



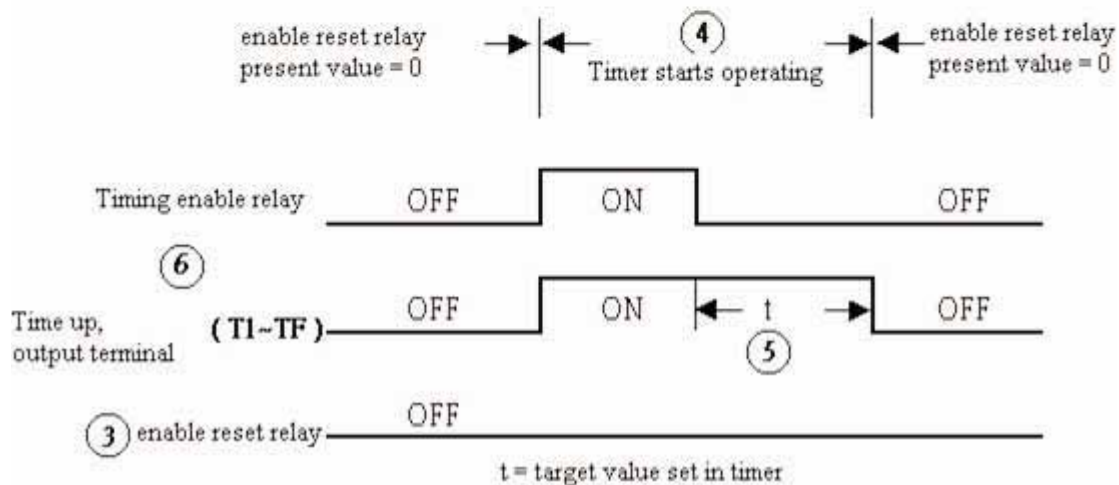
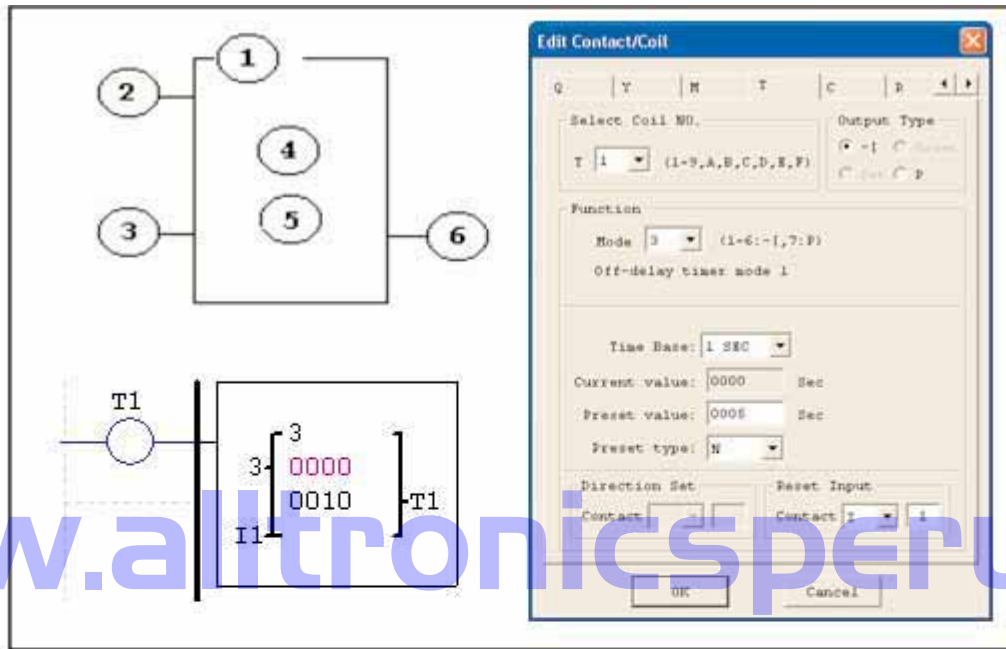
Timer Mode 2 (ON-Delay with Reset)

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 current time value is non-retentive and will reset to zero on a loss of power to the PLR. The timer reset input is Input I 1. In the example below, the timer will stop timing when it reaches the preset value of 5 seconds. Timer status bit T1 will be ON when the current value is 5.



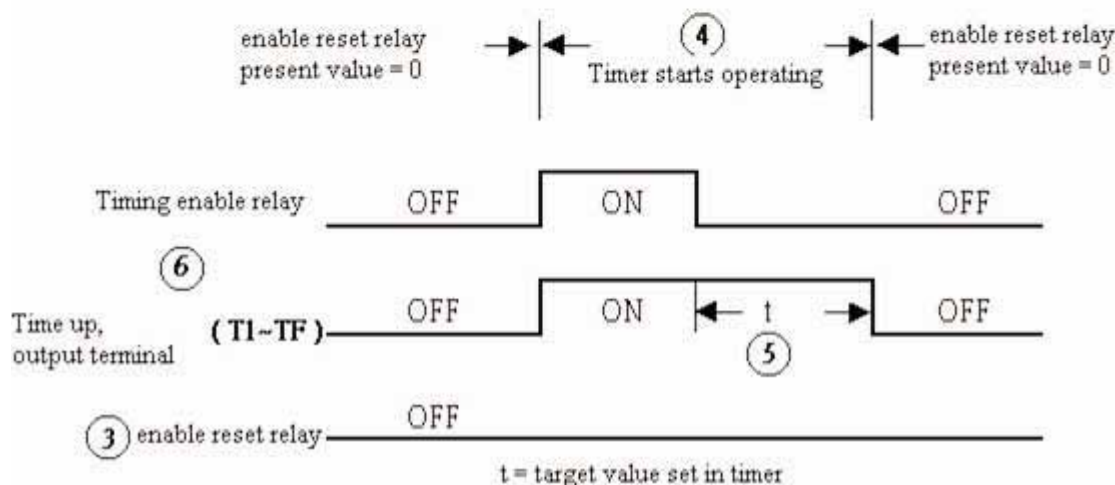
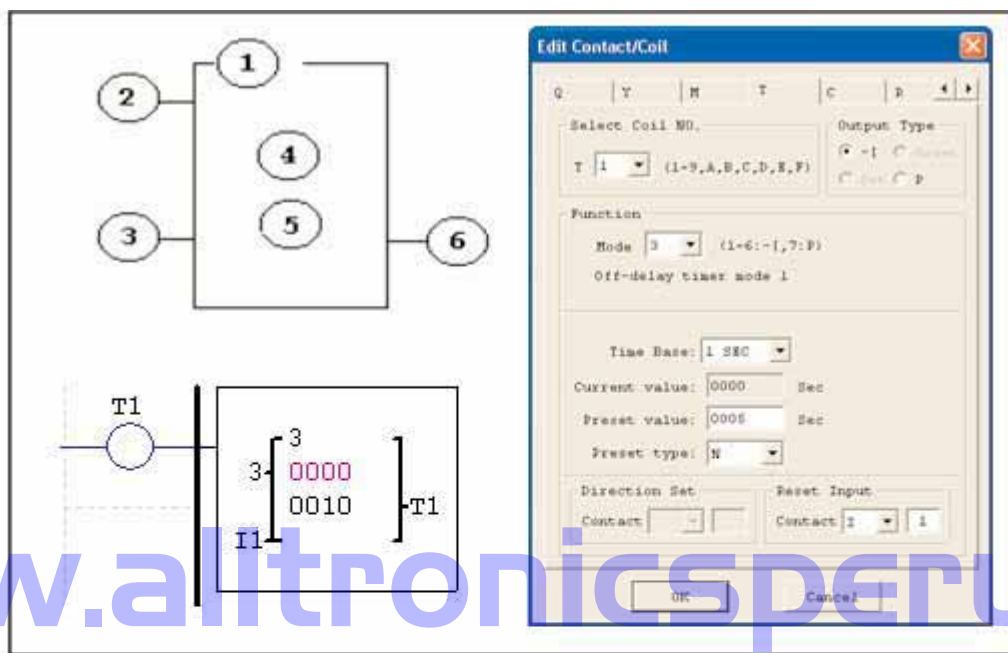
### Timer Mode 3 (OFF-Delay)

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 current time value is non-retentive and will reset to zero on a loss of power to the PLR. In the example below, the timer reset input is Input I1. Also in the example below, timer status bit T1 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 T1 will turn OFF when the current time value reaches 10 seconds.



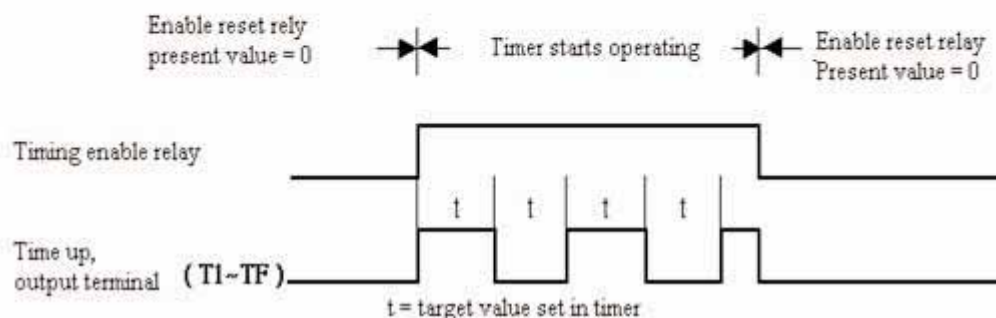
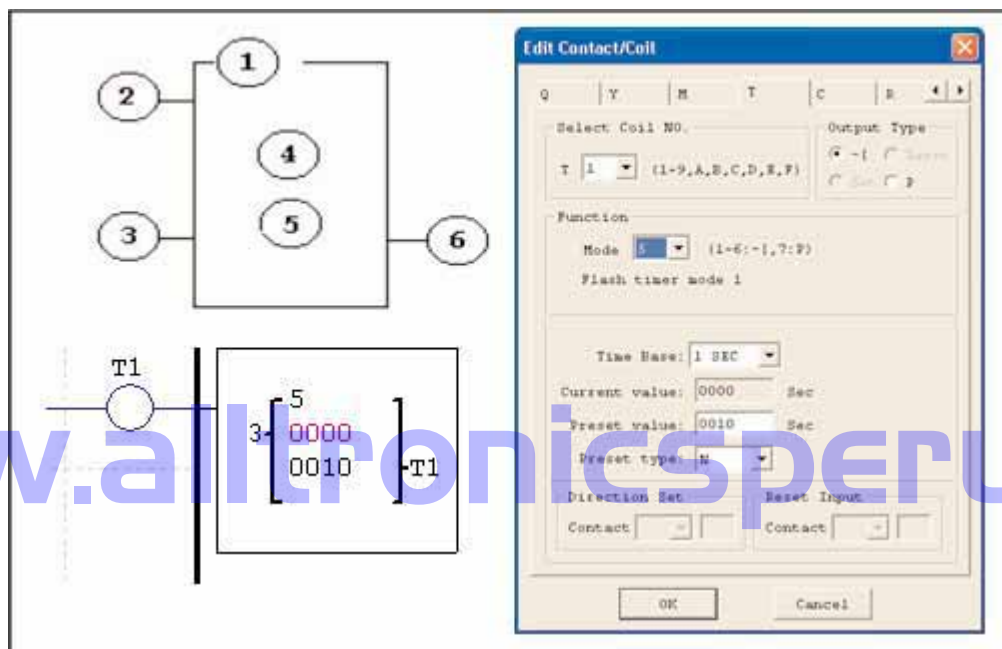
## Timer Mode 4 (OFF-Delay)

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 current time value is non-retentive and will reset to zero on a loss of power to the PLR. In the example below, the timer reset input is Input I 1. Also in the example below, the timer status bit T1 will turn ON only after its rung transitions from true to false. Timer status bit T1 will turn OFF when the current time value reaches 10 seconds.



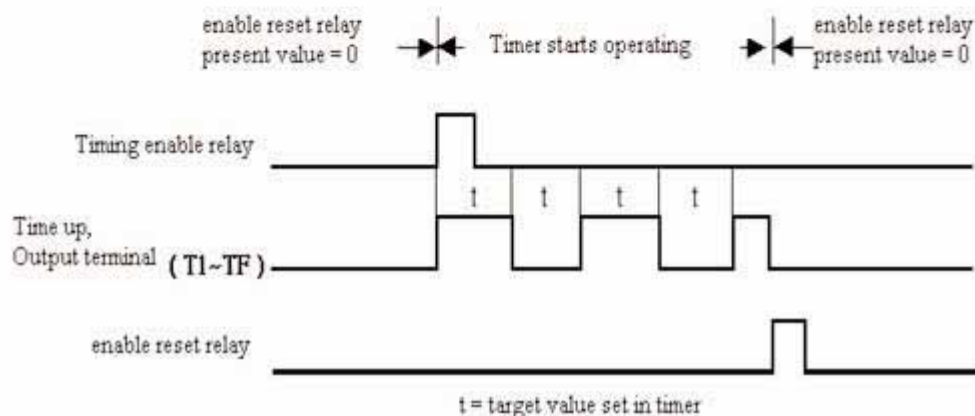
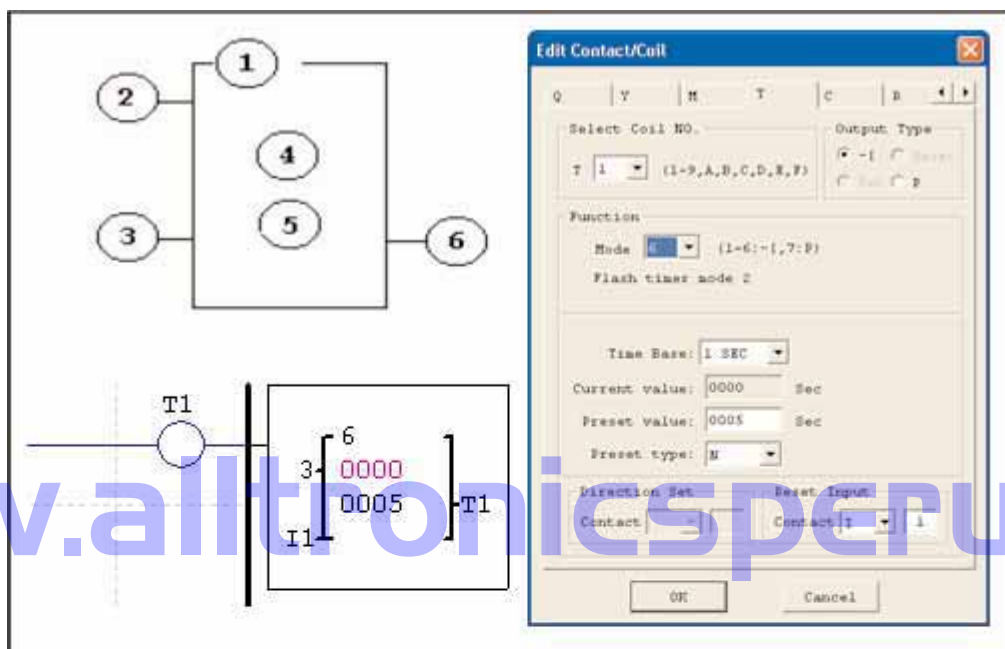
## Timer Mode 5 (FLASH without Reset)

Mode 5 Timer is a Flash timer without reset that will time up to a fixed preset value then change the state of its status bit when the current time is equal to the preset value. Additionally, the current time value is non-retentive and will reset to zero on a loss of power to the PLR. In the example below, timer status bit T1 will be ON immediately when its rung is true and begin its timing sequence. Timer status bit T1 will turn OFF when the current time value reaches its preset of 10 seconds. This Flash sequence of the timer status bit T1 will continue as long as its rung remains true.



## Timer Mode 6 (FLASH with Reset)

Mode 6 Timer is a Flash timer without reset that will time up to a fixed preset value then change the state of its status bit when the current time is equal to the preset value. Additionally, the current time value is non-retentive and will reset to zero on a loss of power to the PLR. In the example below, the timer reset input is Input I 1. Also in the example below, timer status bit T1 will be ON immediately when its rung is true and begin its timing sequence. Timer status bit T1 will turn OFF when the current time value reaches its preset of 5 seconds. This Flash sequence of the timer status bit T1 will continue as long as its rung remains true.

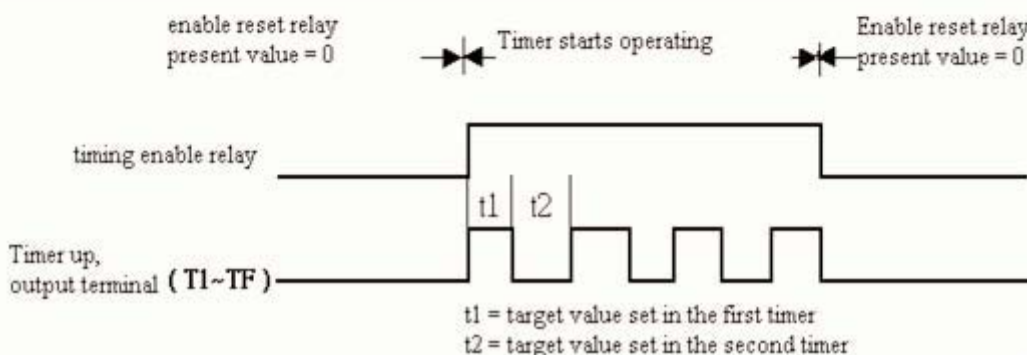
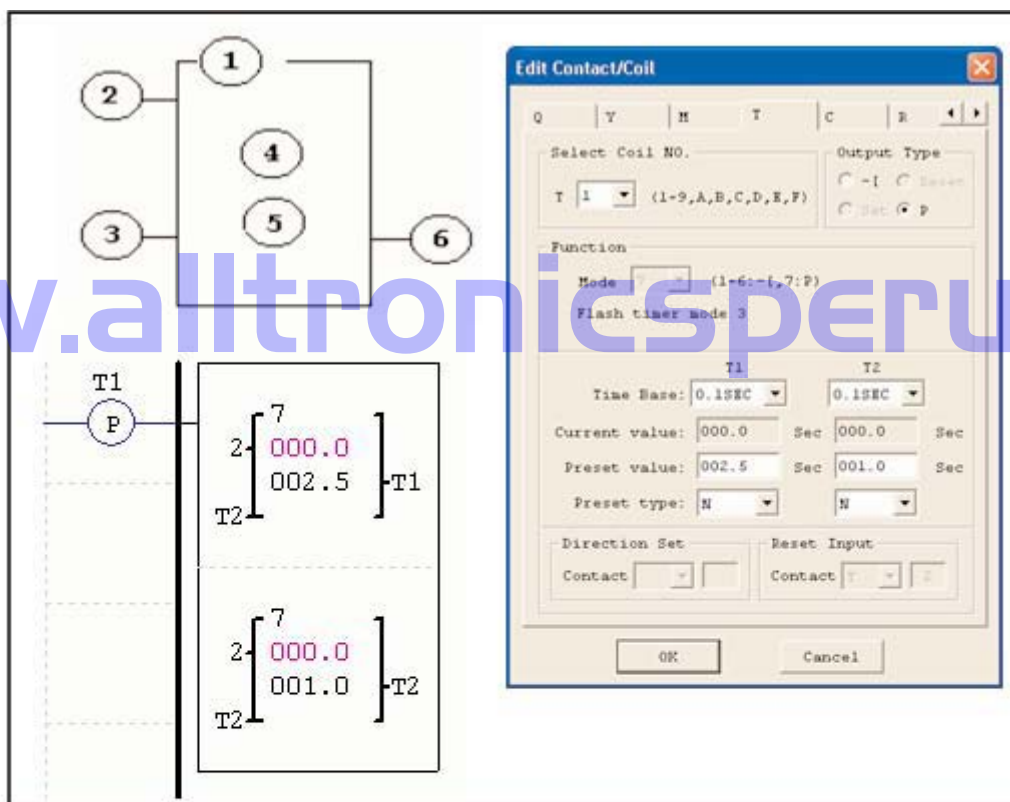


## Timer Mode 7 (FLASH Cascade without Reset)

Mode 7 Timer is a Flash timer without reset that uses two timers in a cascade configuration. 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 current time value is non-retentive and will reset to zero on a loss of power to the PLR. In the example below, timer status bit T1 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 T2 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.

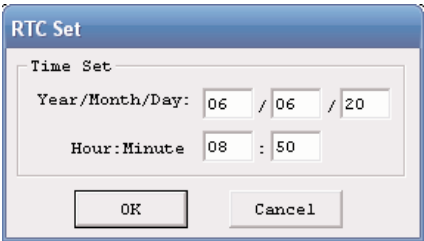


**Note:** Timer Mode 7 uses two timers. These timers cannot be reused as timers for other modes in other areas of the program.



# Real Time Clock (RTC) Instructions

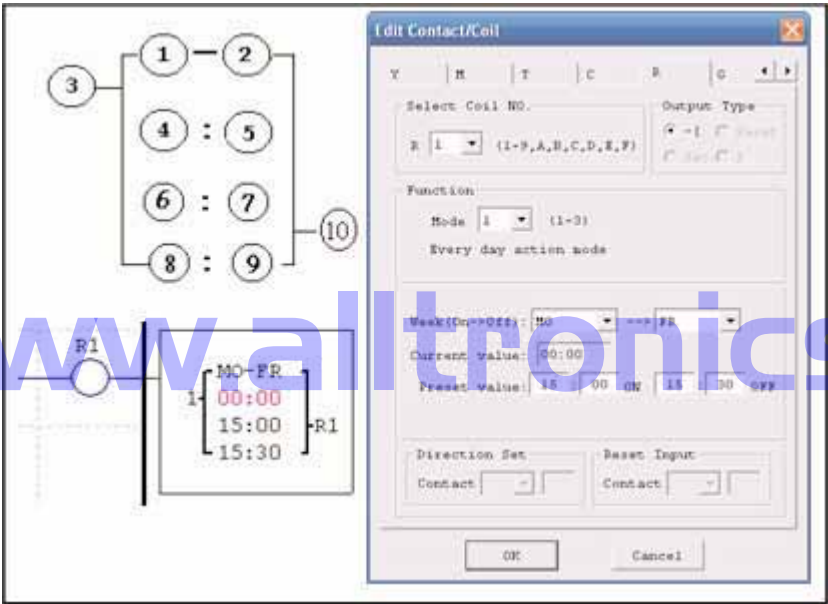
The SG2 PLR includes a total of 15 separate RTC instructions that can be used throughout a program. Each RTC instruction has a choice of 3 operation modes, and has 10 parameters for proper configuration. The initial clock/calendar setting for each connected SG2 is set using the **Operation»RTC Set** menu selection from the SG2 Client software.



## Daily Mode 1

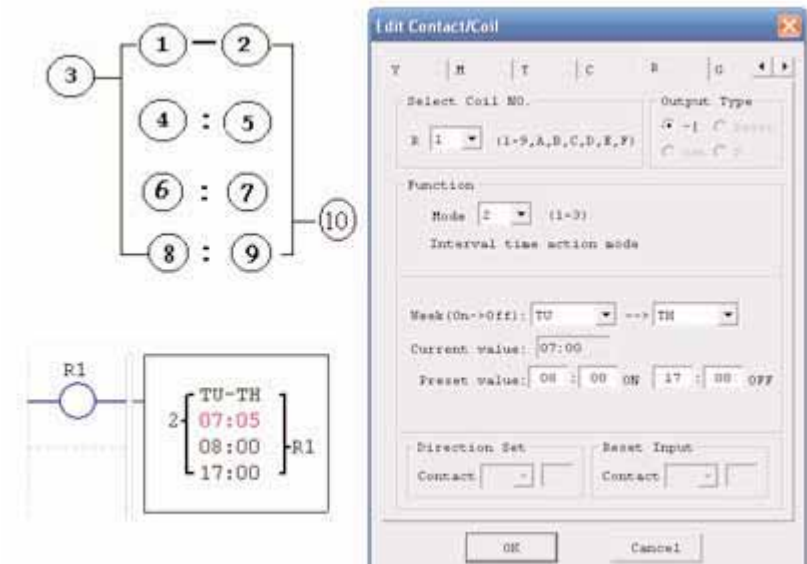
The Daily Mode 1 allows the Rx coil to activate based on a fixed time across a defined set of days per week. The configuration dialog below allows for selection of the number of days per week (i.e. Mon-Fri) and the Day and Time for the Rx coil to activate ON, and Day and Time for the Rx coil to deactivate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

## Interval Time Mode 2 (weekly)



Symbol	Description
①	Input the first day to RTC
②	Input the second day to RTC
③	RTC mode 1
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 (R1~RF Total: 15 RTCs)

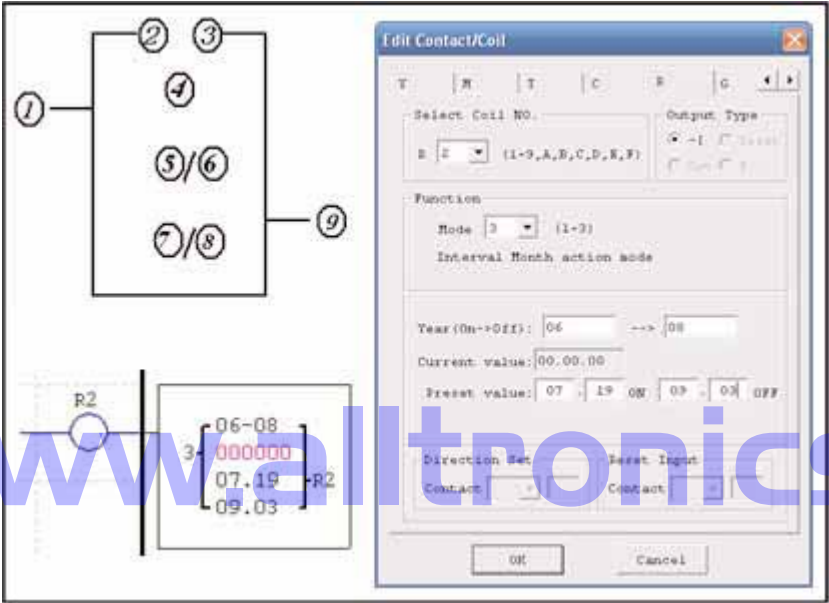
The Interval Time Mode 2 allows the Rx coil to activate based on time and day per week. The configuration dialog below allows for selection of Day and Time for the Rx coil to activate ON, and Day and Time for the Rx coil to deactivate OFF.



Symbol	Description
①	Input the first day to RTC
②	Input the second day to RTC
③	RTC mode 2
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 (R1~RF Total: 15 RTCs)

### Year-Month-Day Mode 3

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

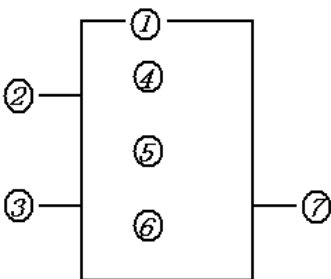


Symbol	Description
①	RTC mode 3. Year-Month-Day
②	Set RTC Year ON
③	Set RTC Year OFF
④	Displays RTC current time: Year-Month-Day
⑤	Set RTC Month ON
⑥	Set RTC Day ON
⑦	Set RTC Month OFF
⑧	Set RTC Day OFF
⑨	RTC coil number (R1-RF Total: 15 RTCs)

Symbol	Description
①	RTC mode 3, Year-Month-Day
②	Setting RTC Year ON
③	Setting RTC Year OFF
④	Display RTC Present time: Year-Month-Day
⑤	Setting RTC month ON
⑥	Setting RTC Day ON
⑦	Setting RTC month OFF
⑧	Setting RTC Day OFF
⑨	RTC Code (R1~RF, total 15 group)

# Comparator Instructions

The SG2 PLR includes a total of 15 separate comparator instructions that can be used throughout a program. Each comparator has a choice of 5 operation modes. Additionally, each comparator has 7 parameters for proper configuration. The table below describes each configuration parameter, and lists each compatible memory type for configuring counters.



Symbol	Description
①	Comparison Mode(1~5)
②	A <sub>X</sub> analog input (A1~A8), the present value of the timer, counter, or a constant value.
③	A <sub>Y</sub> analog input (A1~A8), the present value of the timer, counter, or a constant value.
④	A <sub>X</sub> analog input value(0.00~9.99)
⑤	A <sub>Y</sub> analog input value (0.00~9.99)
⑥	Set reference comparative value: could be constant, or the present value of the timer, counter and analog input.
⑦	Output terminal(G1~GF)

Comparison Mode 1 ( $A_Y - ⑥ \leq A_X \leq A_Y + ⑥$ , ⑦ ON)

Comparison Mode 2 ( $A_X \leq A_Y$ , ⑦ ON)

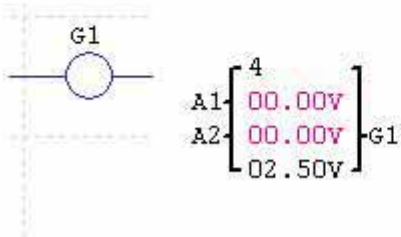
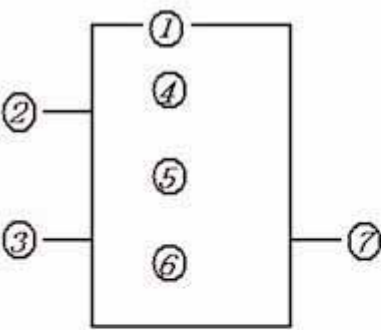
Comparison Mode 3 ( $A_X \geq A_Y$ , ⑦ ON)

Comparison Mode 4 ( $A_X \leq ⑥$ , ⑦ ON)

Comparison Mode 5 ( $A_X \geq ⑥$ , ⑦ ON)

## Example 1: Analog Signal Compare

In the example below, Mode 4 is the selected function that compares the value of analog input A1 to a constant value (N) of 2.50. Status coil G1 turns ON is A1 is <= to 2.50.



Edit Contact/Coil

M | T | C | P | G | H

Select Coil NO.  
G 1 (1-9,A,B,C,D,E,F)

Output Type  
☒ -I ☐ Sset ☐ Set ☐ R

Function  
Mode 4 (1-5)  
A<sub>X</sub> <= Reference value

A<sub>X</sub> A<sub>Y</sub>  
A1 A2

Current value: 00.00 A1 00.00 A2

Preset value: 02.50 Ref

Preset type: N

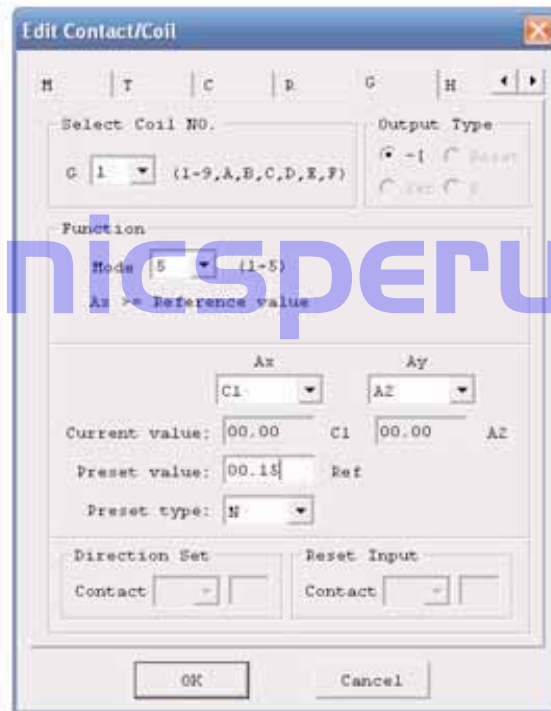
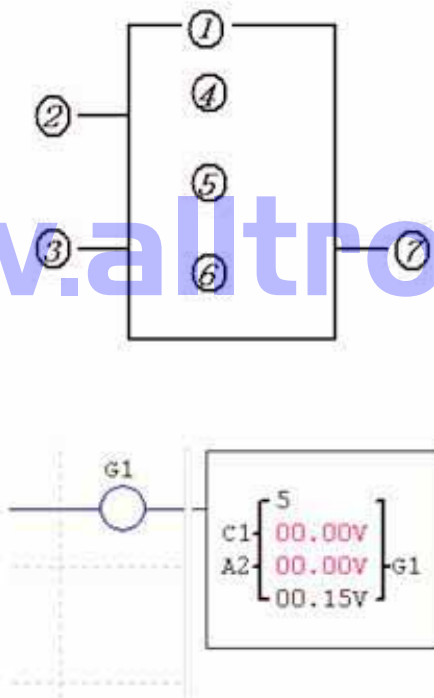
Direction Set  
Contact ☐

Reset Input  
Contact ☐

OK Cancel

## Example 2: Timer/Counter Preset Value Compare

The Comparator instruction can be used to compare Timer, Counter, and RTC values to a constant value or to each other. In this example below, Mode 5 is the selected function that compares the value of Counter (C1) to a constant value (N) of 15 counts (the decimal point is ignored). Status coil G1 turns ON if  $C1 \geq 15$  counts.



# HMI Display Instructions

The SG2 PLR includes a total of 15 HMI instructions that can be used throughout a program. Each HMI instruction can be configured to display information on the SG2 12×4 character LCD in text, numeric, or bit format for items such as current value and target value for timers/counters, Input/Output bit status, RTC (real time clock) and Analog comparator. Each HMI instruction is configured separately using the **Edit»HMI/Text** menu selection from the SG2 Client software.

In the adjacent example, HMI instruction H1 is configured to display the value of I1 and T1, and some descriptive text. Numeric display data selections are Timer, Counter, RTC, and Analog. Bit display data selections for “ON” and “OFF” messages are “I” inputs, “M” internal relays, and “X” expansion inputs.

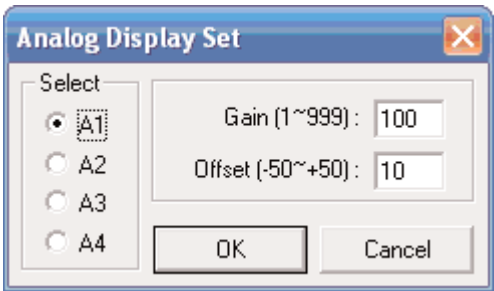


Allows the SEL button on the SG2 keypad to activate the selected message onto the LCD even when Hx coil is inactive.

☒ Unit Allows the HMI message to include coil number and selected value (i.e. T1=003 Sec).

Analog Display Set ...

Provides access to the Analog Display Set dialog for scaling and offset parameters shown below.



The Analog Display Set dialog allows the user to specify a scaling factor (Gain) and an offset for each analog input value.

Phone Number  
18009720436

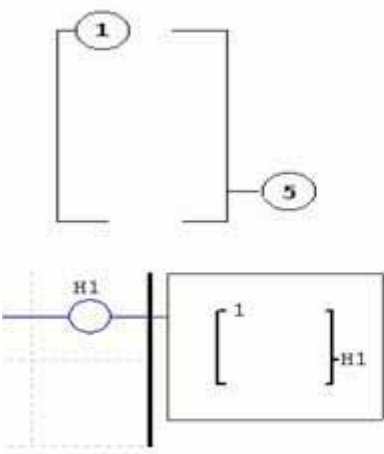
Add

A phone number can be displayed on the screen to alert an operator to call for help.



*Note: The Phone Number field does not dial a modem or allow for a modem connection.*

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

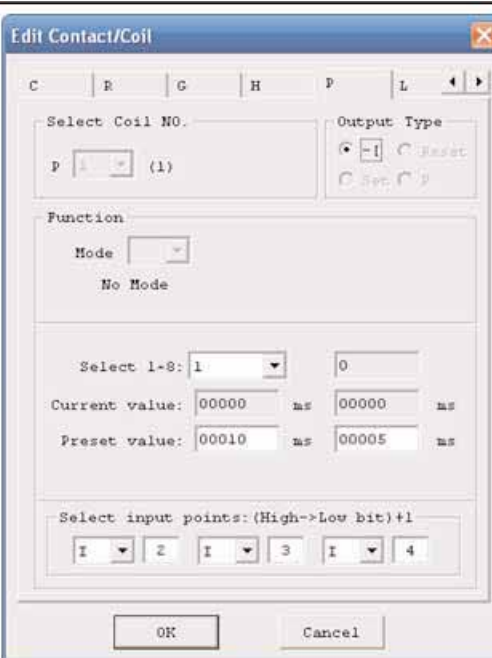
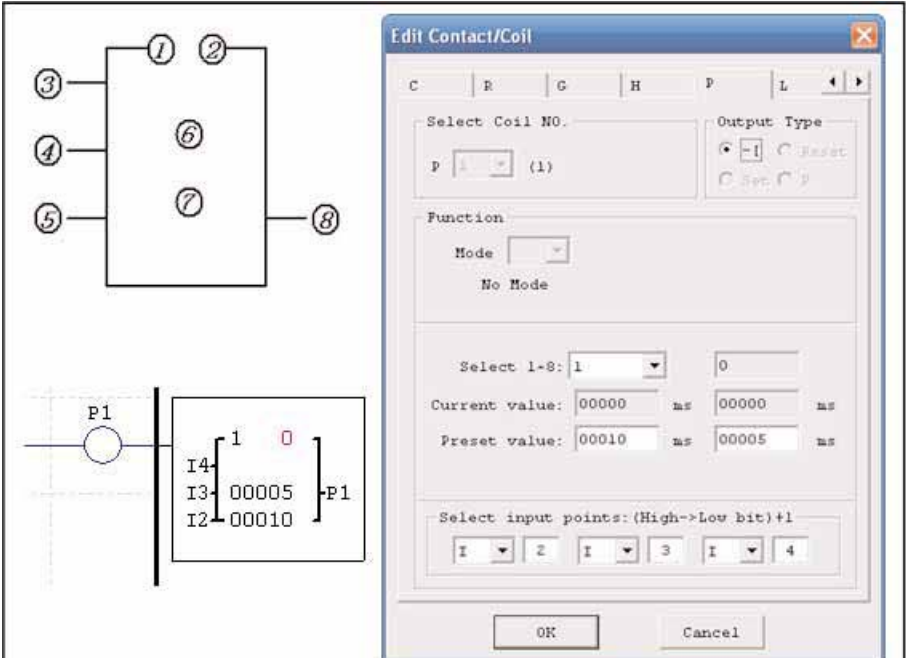


Symbol	Description
①	Display Mode (1-2)
⑤	HMI character output terminal (H1-H8)

## PWM Output Instruction (DC Transistor Output Models Only)

The transistor output model SG2 PLRs include the capability to provide a PWM (Pulse Width Modulation) output on terminal Q1. The PWM instruction is able to output up to an 8-stage PWM waveform.

Symbol	Description	Enable	⑤	④	③	②	⑧ Output PWM
①	Set display stages (1~8)	OFF	X	X	X	0	OFF
②	Display the present stage as operation(0~8)	ON	OFF	OFF	OFF	1	Set stage 1
③	Input Selected Stage 1(I1~gF)	ON	OFF	OFF	ON	2	Set stage 2
④	Input Selected Stage 2(I1~gF)	ON	OFF	ON	OFF	3	Set stage 3
⑤	Input Selected Stage 3(I1~gF)	ON	OFF	ON	ON	4	Set stage 4
⑥	Set PWM pulse width (0~32768ms)	ON	ON	OFF	OFF	5	Set stage 5
⑦	Set PWM Period(1~32768ms)	ON	ON	OFF	ON	6	Set stage 6
⑧	PWM output terminal P1	ON	ON	ON	OFF	7	Set stage 7
		ON	ON	ON	ON	8	Set stage 8




# Data Link/Remote I/O Instruction (SG2-20Vxx Models Only)

The SG2-20Vxxx transistor output models include the capability to link additional SG2-20Vxx units via the RS-485 connection terminals. 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 PLR. Up to 2 additional SG2 units can be configured as Remote I/O nodes, and linked to one Master PLR.

Symbol	Description
①	Mode setting (1, 2) 1:sending 2:receiving
②	Set the send/receive points(1-8)
③	Set the send/receive points
④	Send/receive memory list location
⑤	I/O link output terminal (L1-L8)

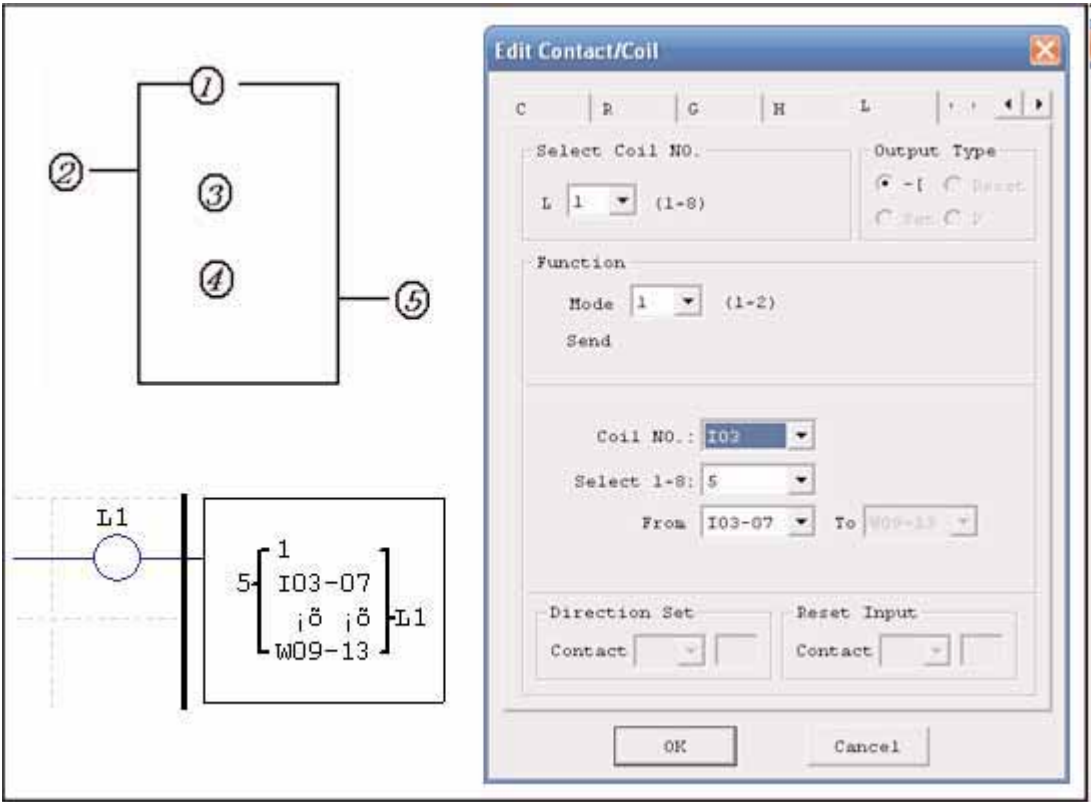
Selectable Points	Range
Inputs	I1-IC / i1-iC
Outputs	Q1-Q8 / q1-q8
Auxiliary coil	M1-MF / m1-mF
Expansion inputs	X1-XC / x1-xC
Expansion outputs	Y1-YC / y1-yC

 **Note:** Only one “Mode 1 Send” Data Link instruction (L1-L8) is allowed per Master PLR. All other Data Link instructions must be “Mode 2 Receive” instructions.

The Mode 2 Receive memory range is determined by the Controller ID. Each controller ID is allocated a range of 8 I/O points (Wx-Wx) that can be read into the Master PLR using a DataLink instruction. The adjacent table show the memory range of Wx locations associated with each controller ID.

ID	Memory List Location
0	W1~W8
1	W9~W16
2	W17~W24
3	W25~W32
4	W33~W40
5	W41~W48
6	W49~W56
7	W57~W64

The Data Link instruction below is setup for Mode 1 Send where the Master PLR is sending 5 I/O points of Inputs to each connected Slave PLR. The starting Input is I03 with the resulting range of 5 sending inputs equal to I3 – I7.



### Example 1: Data Link Mode 1

Set ① = 1, ② = 5, set ③ as the initiate of I3, the state of actual sending terminal I3~I7 is sent to memory list; the controller ID = 3, the state of corresponding memory list position W17~W24- ④ and relationship of sending terminal is as below:

① = 1    ② = 5    ③ : I3 ~ I7    ID = 3 (④ : W17 ~ W24)

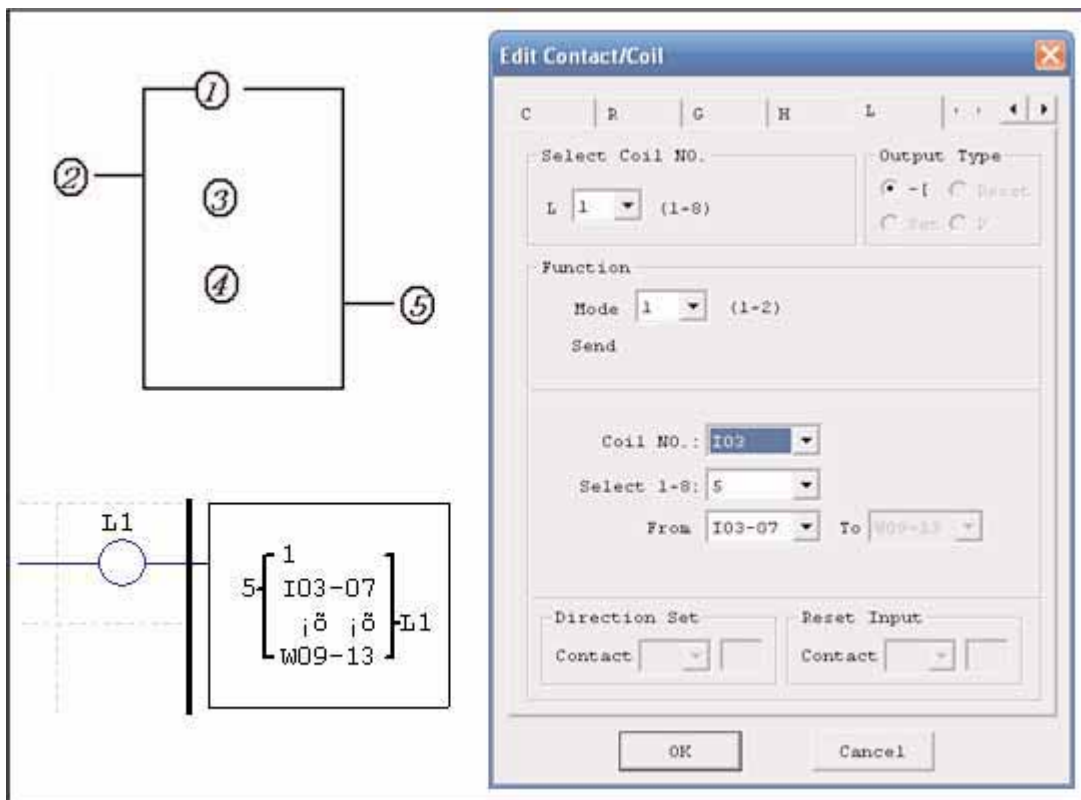
Memory List Position	W17	W18	W19	W20	W21	W22	W23	W24
	↑	↑	↑	↑	↑	↑	↑	↑
Corresponding receiving and sending terminal	I3	I4	I5	I6	I7	0	0	0

### Example 2: DataLink Receive mode 2

Set ① = 1, ② = 5, set ③ as start from I3, set ④ as start from W17, when enabling the Data Link, the state 'ON/OFF' of I3~I7 is controlled by the state of memory list position W17~W21-④, which is irrelative to the actual state of input terminal.

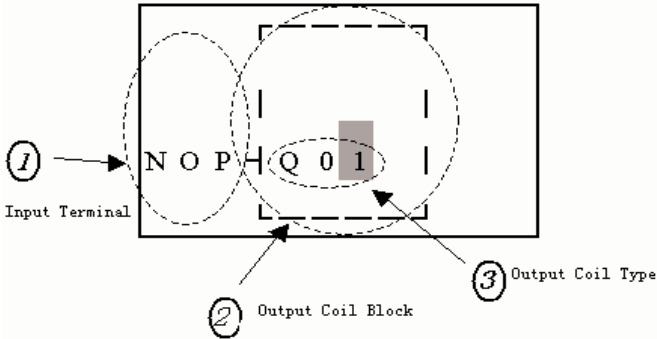
① = 1    ② = 5    ③ : I3 ~ I7    ④ : W17 ~ W21

Memory List Position:	W17	W18	W19	W20	W21
	↓	↓	↓	↓	↓
Corresponding Receiving and Sending Terminal:	I3	I4	I5	I6	I7



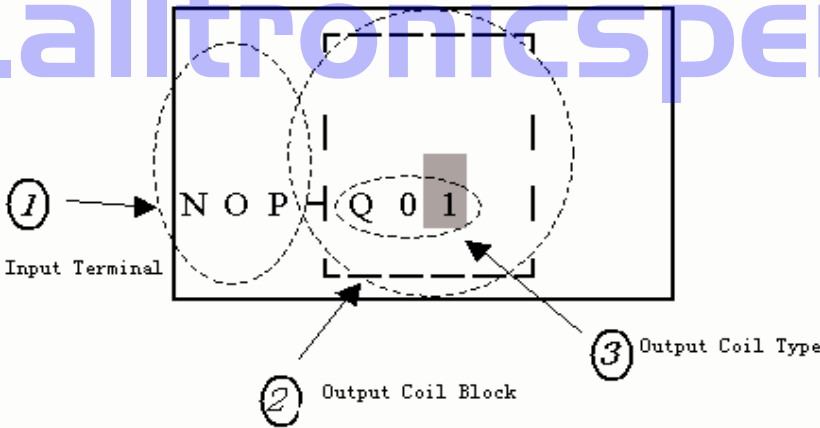
# Chapter 5: Function Block Diagram Programming

## FBD Instructions

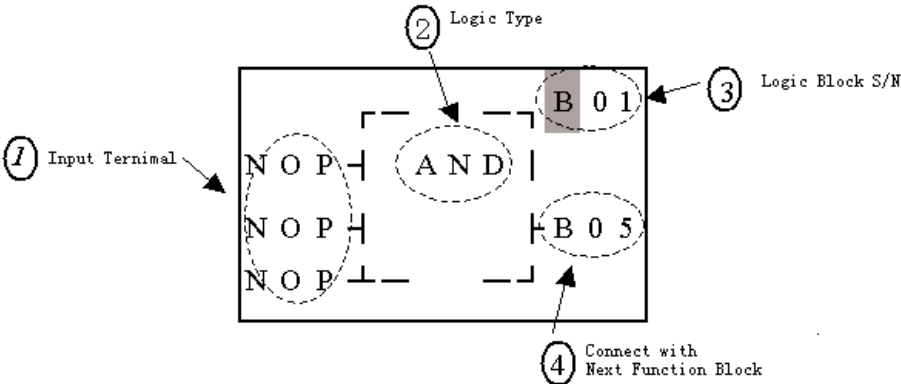
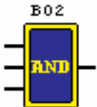


Function Block	① Input Terminal	② Output Coil	Range
Input	I		I01~I0C(12)
Expansion Input	X		X01~X0C(12)
Output	Q	Q	Q01~Q08(8)
Expansion Output	Y	Y	Y01~Y0C(12)
Auxiliary	M	M	M01~M0F(15)
Knob	N	N	N01~N0F(15)
HMI		H	H01~H0F(15)
PWM		P	P01(1)
SHIFT		S	S01(1)
I/O LINK		L	L01~L08(8)
Logic /Function Block	B		B01~B99(99)
Normal ON	Hi		
Normal OFF	Lo		
No Connection	Nop		

### Coil Block Instruction

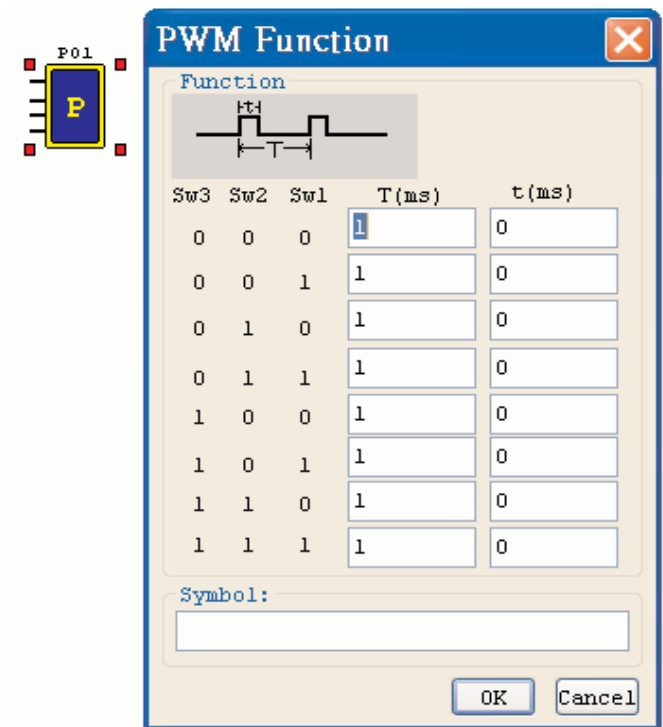
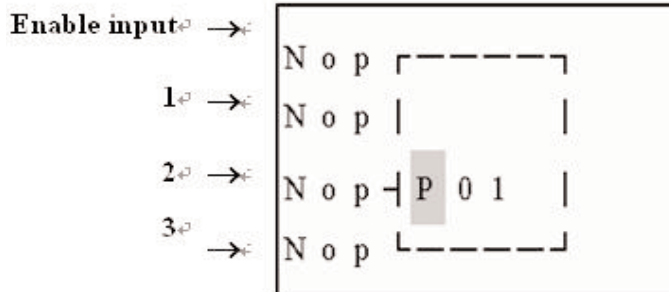


### Logic Block Instructions



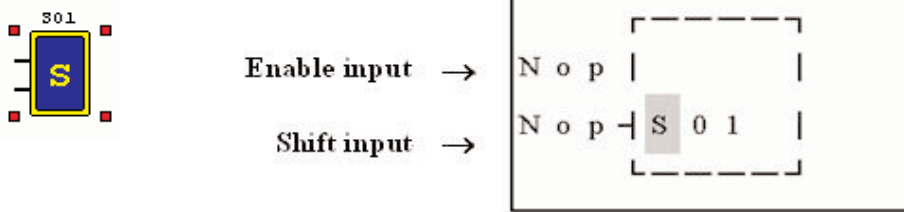
## PWM Function Block

The PWM output terminal 'Q1' can output 8 PWM waveforms. (only provided for transistor output version)

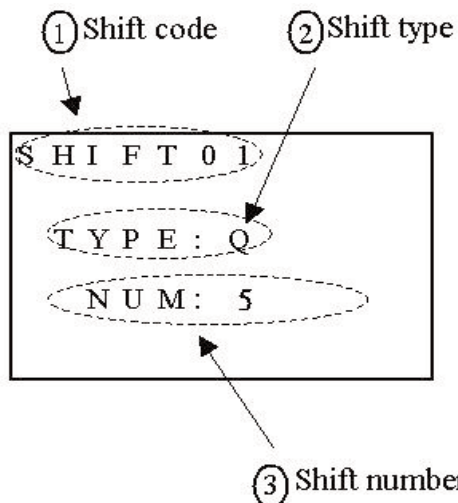


## SHIFT Function Block

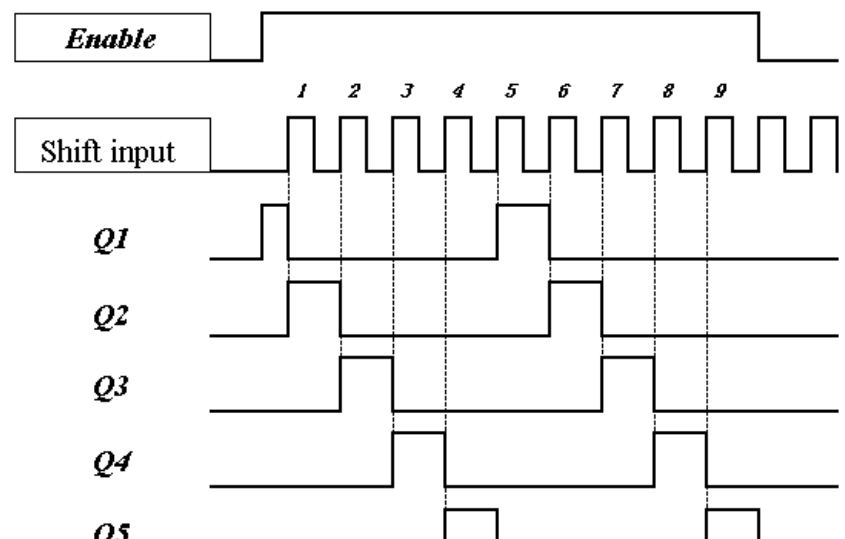
Input terminal description



Symbol	Description
①	SHIFT code (Total 1 group)
②	Set output type (Q, Y)
③	Set output shift number (1-8)

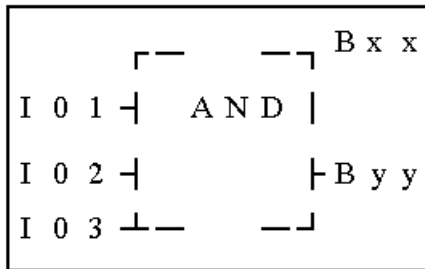


② = Q , ③ = 5 Shift output range: Q1~Q5

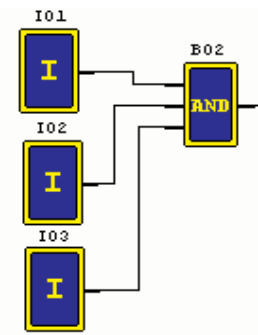
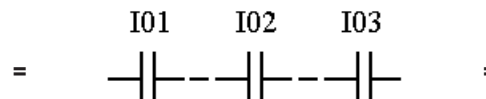


## AND Logic Block

FBD

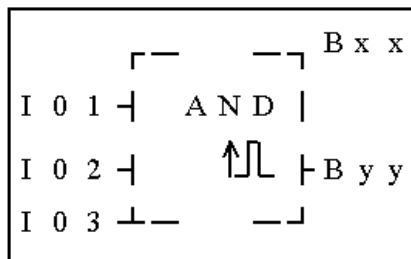


Ladder

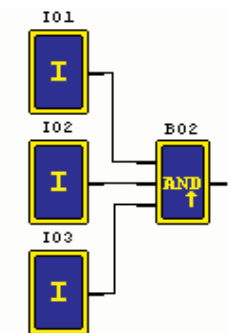
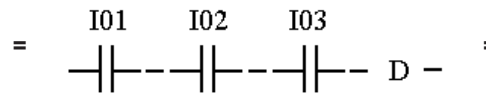


## AND (Edge) Logic Block

FBD



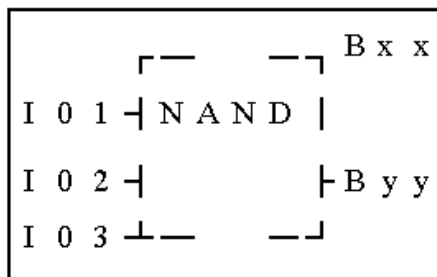
Ladder



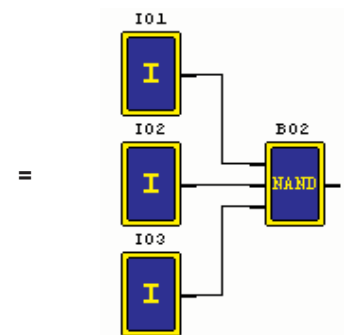
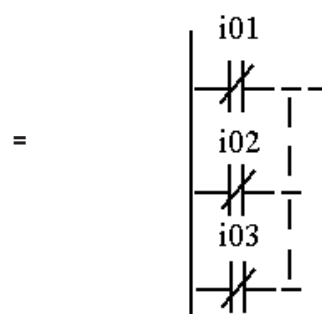
Note: The input terminal is NOP which is equivalent to 'Hi'

## NAND Logic Block

FBD

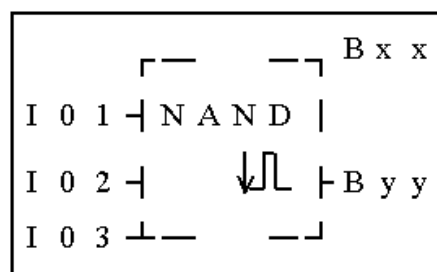


Ladder

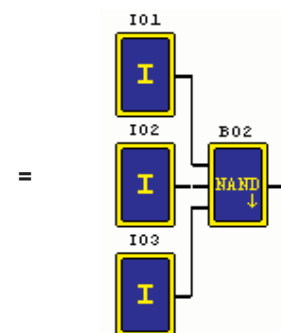
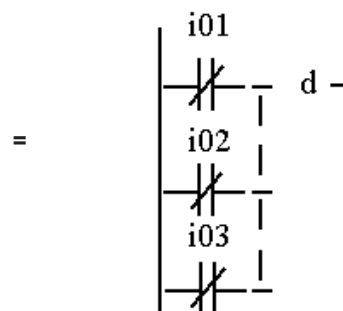


## NAND (Edge) Logic Block

FBD

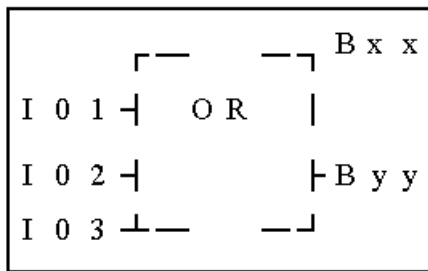


Ladder

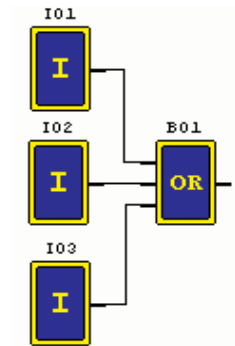
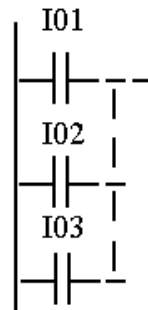


## OR Logic

FBD

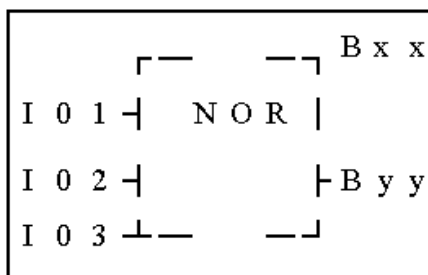


Ladder

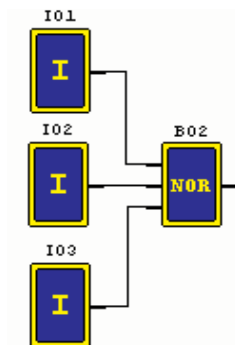
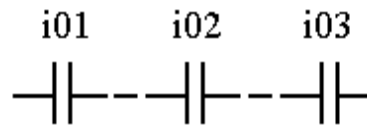


## NOR Logic

FBD



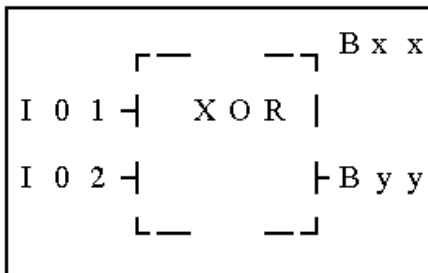
Ladder



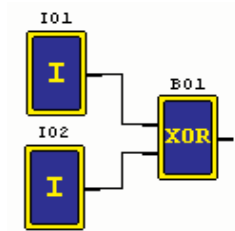
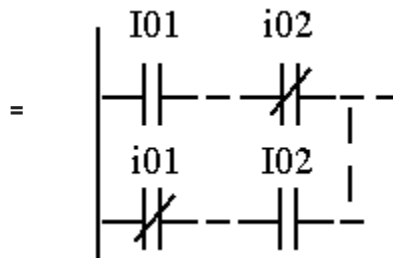
Note: The input terminal is NOP which is equivalent to 'Lo'

## XOR Logic

FBD

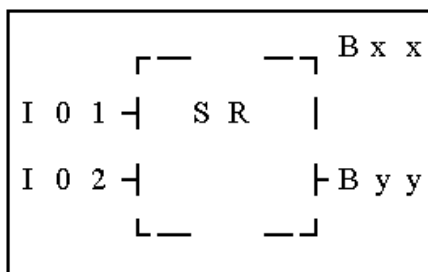


Ladder

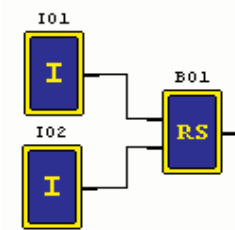
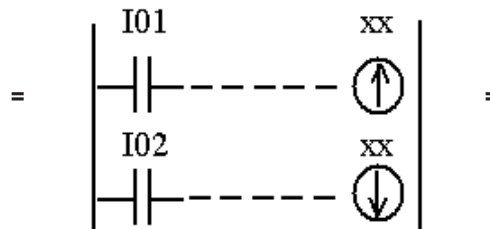


## SR Logic Block

FBD

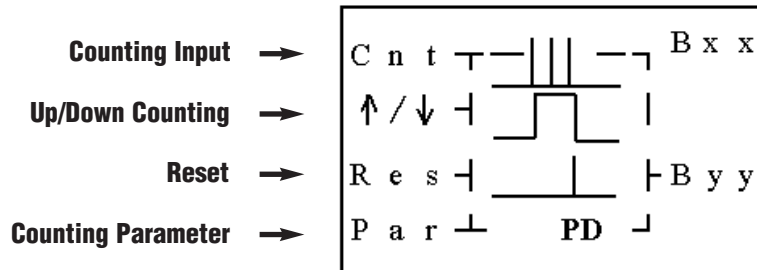


Ladder

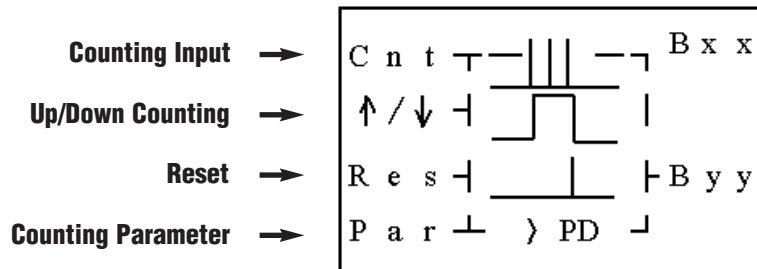




### Counter Mode 3

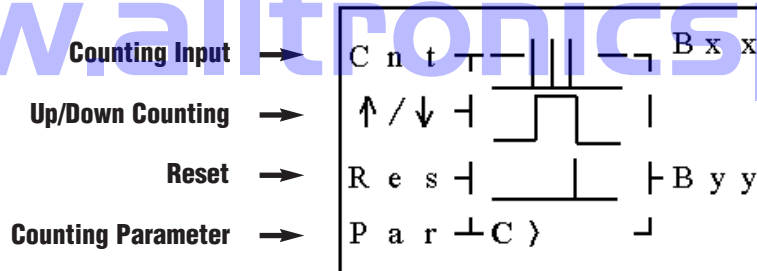


### Counter Mode 4

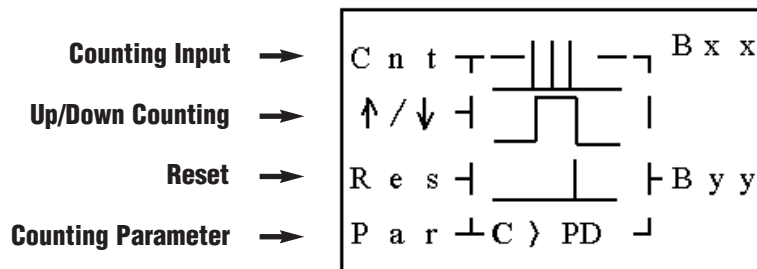


Note: The "PD" means the current value will be retain until the power recover.

### Counter Mode 5



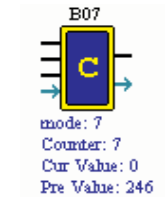
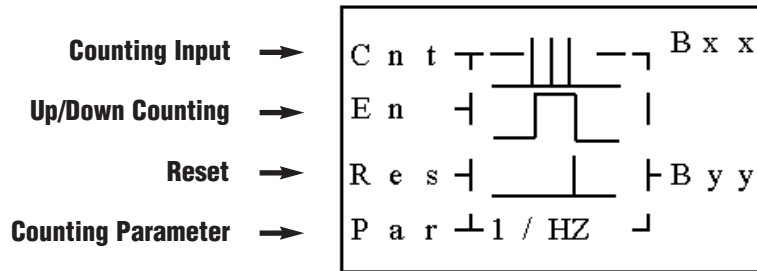
### Counter Mode 6



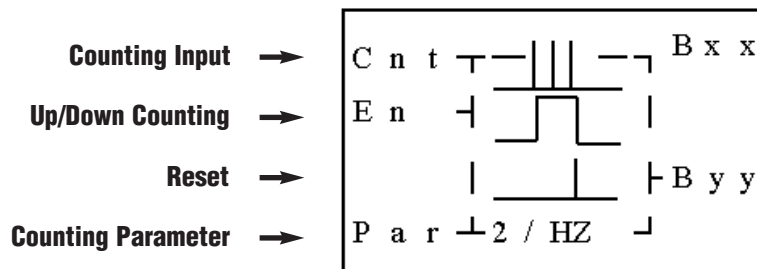
Note: The "C" means that will keep the current value in 0 during the Reset pin be enable.

## High Speed Counter Function Block

### Counter Mode 7



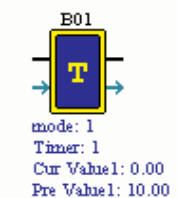
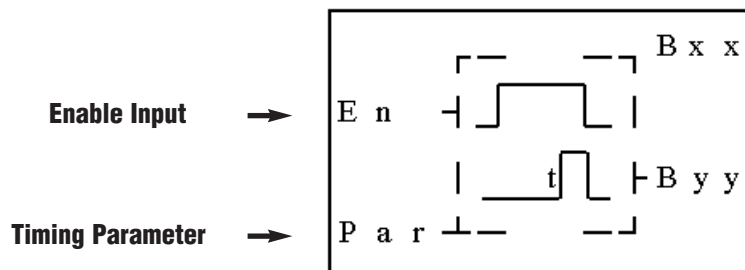
### Counter Mode 8



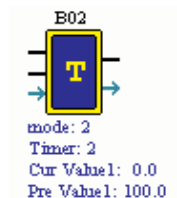
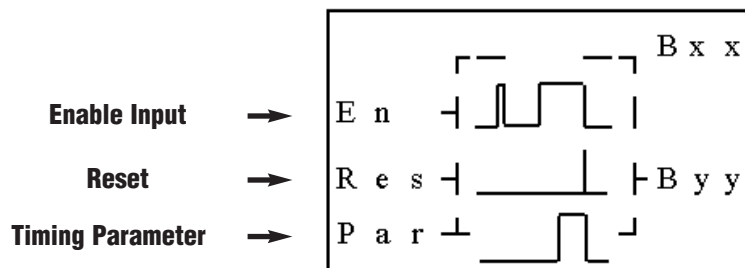
Note: High speed input terminal I1, I2

## Timer Function Block

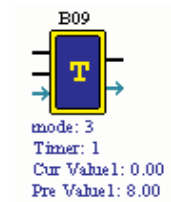
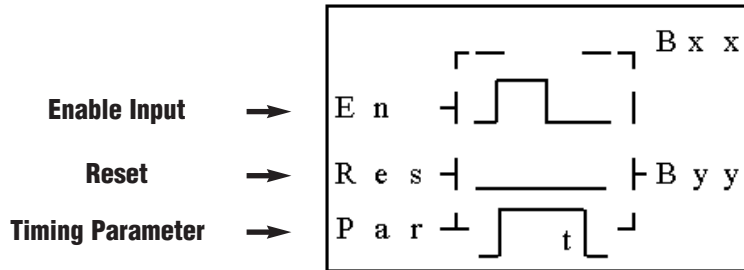
### Timer Mode 1 (ON-Delay A Mode)



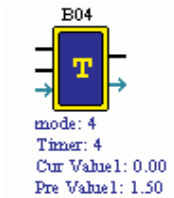
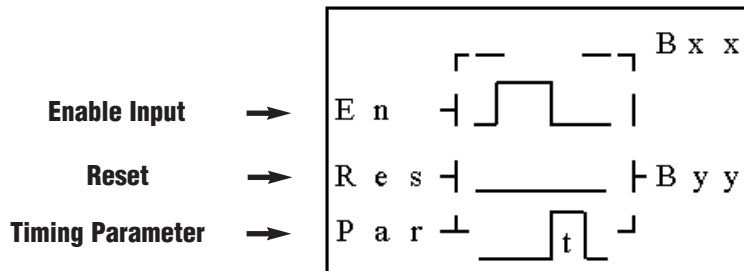
### Timer Mode 2 (ON-Delay B Mode)



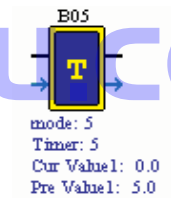
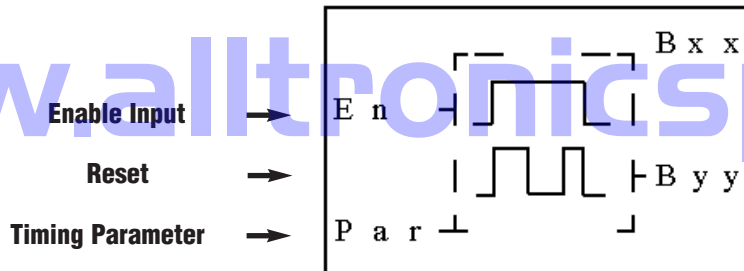
### Timer mode 3 (OFF-Delay A Mode)



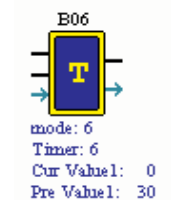
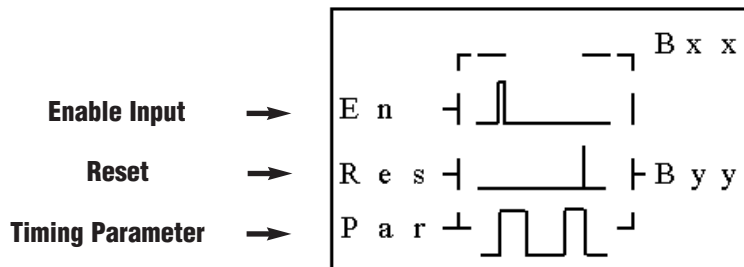
### Timer mode 4 (OFF-Delay B Mode)



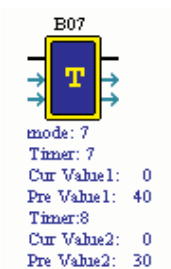
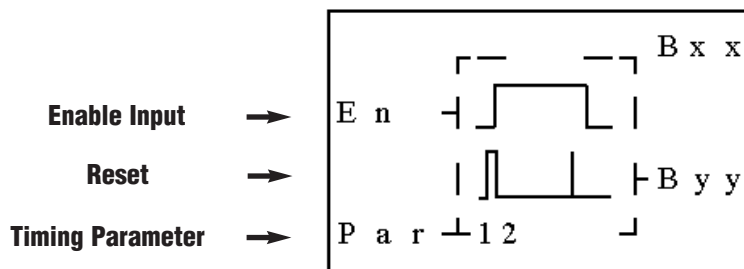
### Timer mode 5 (FLASH A Mode)



### Timer mode 6 (FLASH B Mode)

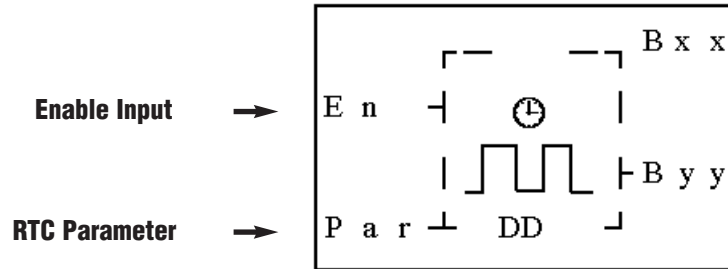


### Timer mode 7 (FLASH C Mode)

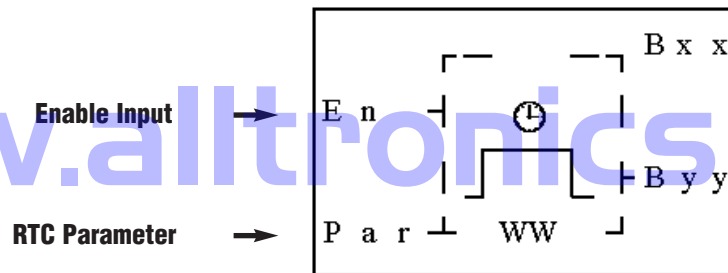


## RTC Function Block

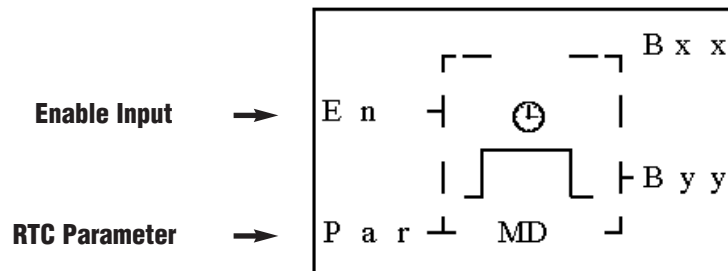
### RTC Mode 1 (Daily)



### RTC Mode 2 (Weekly)



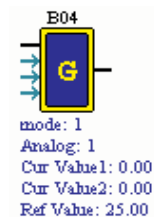
### RTC Mode 3 (Year Month Day)



## Analog comparator Function Block

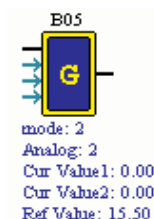
### Analog Comparison Mode 1

Enable Input	→	$E_n \quad \overline{\quad} \quad \quad \quad \overline{\quad} \quad B_{xx}$
Analog Input	→	$A_x \quad \overline{\quad} A_y - R \quad  $
Analog Input	→	$A_y \quad \overline{\quad} \leq A_x \leq \quad   B_{yy}$
Reference	→	$R_{ef} \quad \overline{\quad} A_y + R \quad \overline{\quad}$



### Analog Comparison Mode 2

Enable Input	→	$E_n \quad \overline{\quad} \quad \quad \quad \overline{\quad} B_{xx}$
Analog Input	→	$A_x \quad \overline{\quad} A_x \quad  $
Analog Input	→	$A_y \quad \overline{\quad} \leq A_y \quad   B_{yy}$
Reference	→	$R_{ef} \quad \overline{\quad} \quad \quad \quad \overline{\quad}$



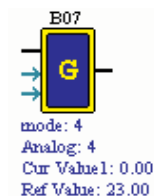
### Analog Comparison Mode 3

Enable Input	→	$E_n \quad \overline{\quad} \quad \quad \quad \overline{\quad} B_{xx}$
Analog Input	→	$A_x \quad \overline{\quad} A_x \quad  $
Analog Input	→	$A_y \quad \overline{\quad} \geq A_y \quad   B_{yy}$
Reference	→	$R_{ef} \quad \overline{\quad} \quad \quad \quad \overline{\quad}$



### Analog Comparison Mode 4

Enable Input	→	$E_n \quad \overline{\quad} \quad \quad \quad \overline{\quad} B_{xx}$
Analog Input	→	$A_x \quad \overline{\quad} R_{ef} \quad  $
Analog Input	→	$\quad \quad \quad \geq A_x \quad   B_{yy}$
Reference	→	$R_{ef} \quad \overline{\quad} \quad \quad \quad \overline{\quad}$



### Analog Comparison Mode 5

Enable Input	→	$E_n \quad \overline{\quad} \quad \quad \quad \overline{\quad} B_{xx}$
Analog Input	→	$A_x \quad \overline{\quad} R_{ef} \quad  $
Analog Input	→	$\quad \quad \quad \leq A_x \quad   B_{yy}$
Reference	→	$R_{ef} \quad \overline{\quad} \quad \quad \quad \overline{\quad}$

