

# 3 Basic Program Instructions

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In this chapter, we tell the basic instructions and their functions.

3-1 . Basic Instructions List

3-2 . [LD], [LDI], [OUT]

3-3 . [AND], [ANI]

3-4 . [OR], [ORI]

3-5 . [LDP], [LDF], [ANDP], [ANDF], [ORP], [ORF]

3-6 . [LDD], [LDDI]

3-7 . [ORB]

3-8 . [ANB]

3-9 . [MCS], [MCR]

3-10 . [ALT]

3-11 . [PLS], [PLF]

3-12 . [SET], [RST]

3-13 . [OUT], [RST] (Aim at counter device)

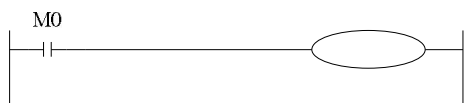




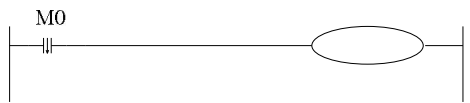




3-14 . [NOP], [END]



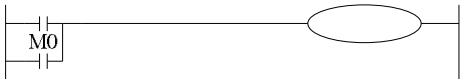
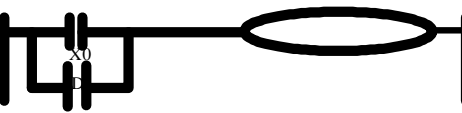
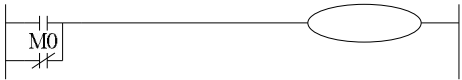


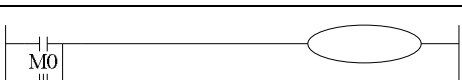
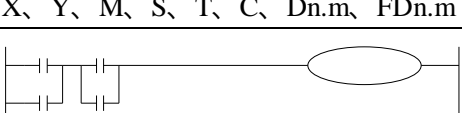
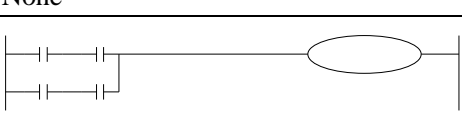
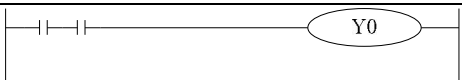
3-15 . [GROUP], [GROUPE]


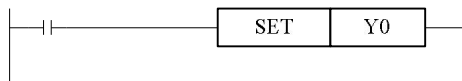
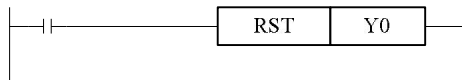
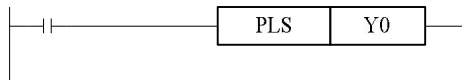
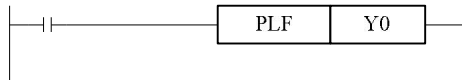
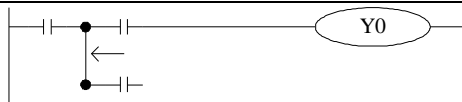
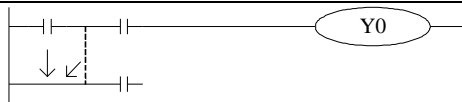
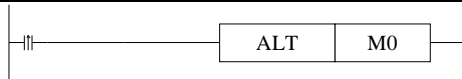
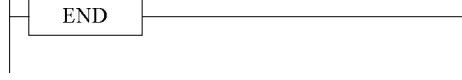


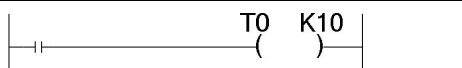
3-16 . Items to be attended when programming

### 3-1 . Basic Instructions List

All XC1, XC2, XC3, XC5, XCM series support the below instructions:



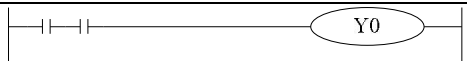
Mnemonic	Function	Format and Device	Chapter
LD (LoaD)	Initial logical operation contact type NO (normally open)	 X, Y, M, S, T, C, Dn.m, FDn.m	3-2
LDD (LoaD Directly)	Read the status from the contact directly	 X	3-6
LDI (LoaD Inverse)	Initial logical operation contact type NC (normally closed)	 X, Y, M, S, T, C, Dn.m, FDn.m	3-2
LDDI	Read the normally closed contact directly	 X	3-6
LDP (LoaD Pulse)	Initial logical operation-Rising edge pulse	 X, Y, M, S, T, C, Dn.m, FDn.m	3-5
LDF (LoaD Falling Pulse)	Initial logical operation-Falling /trailing edge pulse	 X, Y, M, S, T, C, Dn.m, FDn.m	3-5
AND (AND)	Serial connection of NO (normally open) contacts	 X, Y, M, S, T, C, Dn.m, FDn.m	3-3
ANDD	Read the status from the contact directly	 X	3-6
ANI (AND Inverse)	Serial connection of NC (normally closed) contacts	 X, Y, M, S, T, C, Dn.m, FDn.m	3-3
ANDDI	Read the normally closed contact directly	 X	3-6

ANDP (AND Pulse)	Serial connection of rising edge pulse	 <p>X, Y, M, S, T, C, Dn.m, FDn.m</p>	3-5
ANDF (AND Falling pulse)	Serial connection of falling/trailing edge pulse	 <p>X, Y, M, S, T, C, Dn.m, FDn.m</p>	3-5
OR (OR)	Parallel connection of NO (normally open) contacts	 <p>X, Y, M, S, T, C, Dn.m, FDn.m</p>	3-4
ORD	Read the status from the contact directly	 <p>X</p>	3-6
ORI (OR Inverse)	Parallel connection of NC (normally closed) contacts	 <p>X, Y, M, S, T, C, Dn.m, FDn.m</p>	3-4
ORDI	Read the normally closed contact directly	 <p>X</p>	3-6
ORP (OR Pulse)	Parallel connection of rising edge pulse	 <p>X, Y, M, S, T, C, Dn.m, FDn.m</p>	3-5
ORF (OR Falling pulse)	Parallel connection of falling/trailing edge pulse	 <p>X, Y, M, S, T, C, Dn.m, FDn.m</p>	3-5
ANB (ANd Block)	Serial connection of multiply parallel circuits	 <p>None</p>	3-8
ORB (OR Block)	Parallel connection of multiply parallel circuits	 <p>None</p>	3-7
OUT (OUT)	Final logic operation type coil drive	 <p>Y, M, S, T, C, Dn.m</p>	3-2

OUTD	Output to the contact directly	 Y	3-6
SET (SET)	Set a bit device permanently ON	 Y、M、S、T、C、Dn.m	3-12
RST (ReSeT)	Reset a bit device permanently OFF	 Y、M、S、T、C、Dn.m	3-12
PLS (PuLSe)	Rising edge pulse	 X、Y、M、S、T、C、Dn.m	3-11
PLF (PuLse Falling)	Falling/trailing edge pulse	 X、Y、M、S、T、C、Dn.m	3-11
MCS (New bus line start)	Connect the public serial contacts	 None	3-9
MCR (Bus line return)	Clear the public serial contacts	 None	3-9
ALT (Alternate state)	The status of the assigned device is inverted on every operation of the instruction	 X、Y、M、S、T、C、Dn.m	3-10
END (END)	Force the current program scan to end	 None	3-14
GROUP	Group	 None	3-15
GROUPE	Group End	 None	3-15
TMR	Time		2-7

### 3-2 . [LD] , [LDI] , [OUT]

#### Mnemonic and Function

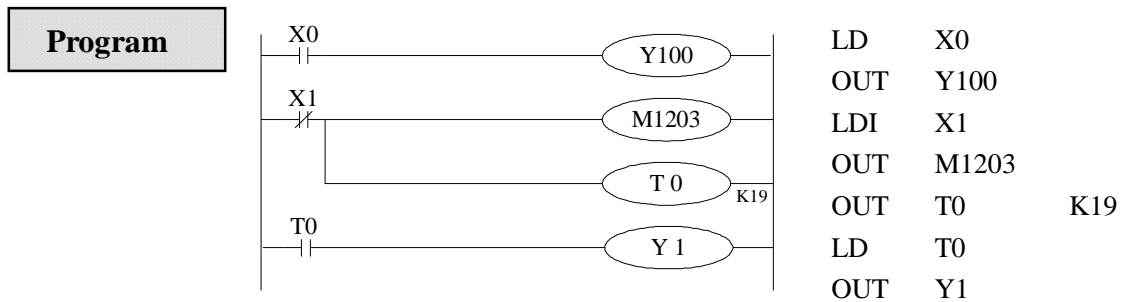
Mnemonic	Function	Format and Operands
LD (Load)	Initial logic operation contact type NO (Normally Open)	 Operands: X、 Y、 M、 S、 T、 C、 Dn.m、 FDn.m
LDI (Load Inverse)	Initial logic operation contact type NC (Normally Closed)	 Devices :X、 Y、 M、 S、 T、 C、 Dn.m、 FDn.m
OUT (OUT)	Final logic operation type drive coil	 Operands: X、 Y、 M、 S、 T、 C、 Dn.m

#### Statement

- | Connect the LD and LDI instructions directly to the left bus bar. Or use them to define a new block of program when using ANB instruction.
- | OUT instruction is the coil drive instruction for the output relays、 auxiliary relays、 status、 timers、 counters. But this instruction can't be used for the input relays
- | Can not sequentially use parallel OUT command for many times.
- | For the timer's time coil or counter's count coil, after using OUT instruction, set constant K is necessary.
- | For the constant K's setting range、 actual timer constant、 program's step relative to OUT instruction (include the setting value), See table below:



Timer, Counter	Setting Range of constant K	The actual setting value
1ms Timer	1 ~ 32,767	0.001 ~ 32.767 sec
10ms Timer		0.01 ~ 327.67 sec
100ms Timer		0.1 ~ 3276.7 sec
16 bits counter	1 ~ 32,767	Same as the left

32 bits counter	1 ~ 2,147,483,647	Same as the left
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### 3-3 . [AND] , [ANI]

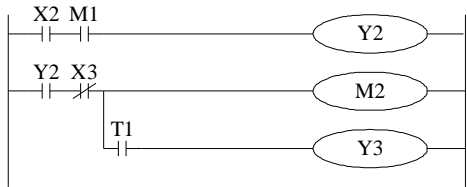
#### Mnemonic and Function

Mnemonic	Function	Format and Operands
AND (AND)	Serial connection of NO (Normally Open) contacts	 Operands: X, Y, M, S, T, C, Dn.m, FDn.m
ANI (AND Inverse)	Serial connection of NC (Normally Closed) contacts	 Operands: X, Y, M, S, T, C, Dn.m, FDn.m

#### Statements

- l Use the AND and the ANI instruction for serial connection of contacts. As many contacts as required can be connected in series. They can be used for many times.
- l The output processing to a coil, through writing the initial OUT instruction is called a “follow-on” output (For an example see the program below: OUT M2 and OUT Y003). Follow-on outputs are permitted repeatedly as long as the output order is correct. There’s no limit for the serial connected contacts’ Nr. and follow-on outputs’ number.

Program




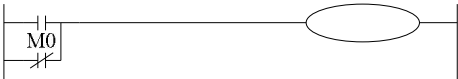
```

LD    X2
AND   M1
OUT   Y2
LD    Y2
ANI   X3
OUT   M2
AND   T1
OUT   Y3

```

3-4 . [OR] , [ORI]

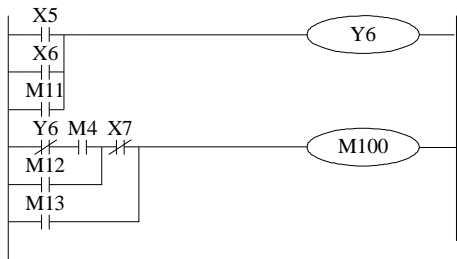
Mnemonic and Function

Mnemonic	Function	Format and Operands
OR (OR)	Parallel connection of NO (Normally Open) contacts	 <p>Operands: X、Y、M、S、T、C、Dn.m、FDn.m</p>
ORI (OR Inverse)	Parallel connection of NC (Normally Closed) contacts	 <p>Operands: X、Y、M、S、T、C、Dn.m、FDn.m</p>

Statements

- Use the OR and ORI instructions for parallel connection of contacts. To connect a block that contains more than one contact connected in series to another circuit block in parallel, use an ORB instruction, which will be described later;
- OR and ORI start from the instruction’s step, parallel connect with the LD and LDI instruction’s step said before. There is no limit for the parallel connect times.

Program



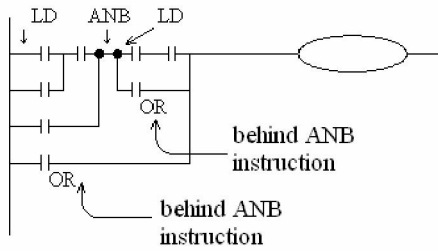
```

LD    X5
OR    X6
OR    M11
OUT   Y6
LDI   Y6
AND   M4
OR    M12
ANI   X7
OR    M13
OUT   M100

```









## Relationship with ANB



The parallel connection with OR, ORI instructions should connect with LD, LDI instructions in principle. But behind the ANB instruction, it's still ok to add a LD or LDI instruction.

## 3-5 . [LDP] , [LDF] , [ANDP] , [ANDF] , [ORP] , [ORF]

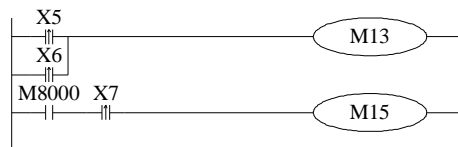
### Mnemonic and Function

Mnemonic	Function	Format and Operands
LDP (LoaD Pulse)	Initial logical operation-Rising edge pulse	 <p>Operands: X, Y, M, S, T, C, Dn.m, FDn.m</p>
LDF (LoaD Falling pulse)	Initial logical operation Falling/trailing edge pulse	 <p>Operands: X, Y, M, S, T, C, Dn.m, FDn.m</p>
ANDP (AND Pulse)	Serial connection of Rising edge pulse	 <p>Operands: X, Y, M, S, T, C, Dn.m, FDn.m</p>
ANDF (AND Falling pulse)	Serial connection of Falling/trailing edge pulse	 <p>Operands: X, Y, M, S, T, C, Dn.m, FDn.m</p>
ORP (OR Pulse)	Parallel connection of Rising edge pulse	 <p>Operands: X, Y, M, S, T, C, Dn.m, FDn.m</p>
ORF (OR Falling pulse)	Parallel connection of Falling/trailing edge pulse	 <p>Operands: X, Y, M, S, T, C, Dn.m, FDn.m</p>

## Statements

- | LDP, ANDP, ORP are active for one program scan after the associated devices switch from OFF to ON.
- | LDF, ANDF, ORF are active for one program scan after the associated devices switch from ON to OFF.

## Program





```

LDP   X5
ORP   X6
OUT   M13
LD     M8000
ANDP  X7
OUT   M15
  
```

## 3-6 . [LDD] , [LDDI] , [ANDD] , [ANDDI] , [ORD] , [ORDI] , [OUTD]

## Mnemonic and Function

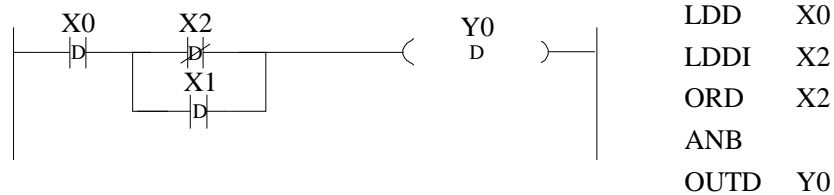
Mnemonic	Function	Format and Operands
LDD	Read the status from the contact directly	 Devices: X
LDDI	Read the normally closed contact directly	 Devices: X
ANDD	Read the status from the contact directly	 Devices: X
ANDDI	Read the normally closed contact directly	 Devices: X
ORD	Read the status from the contact directly	 Devices: X

		Devices: X
ORDI	Read the normally closed contact directly	 Devices: X
OUTD	Output to the contact directly	 Devices: Y

### Statements


- The function of LDD, ANDD, ORD instructions are similar with LD, AND, OR; LDDI, ANDDI, ORDI instructions are similar with LDI, ANDI, ORI; but if the operand is X, the LDD, ANDD, ORD commands read the signal from the terminals directly, this is the only difference.
- OUTD and OUT are output instructions. But if use OUTD, output immediately if the condition comes true, needn't wait the next scan cycle.

### Program



### 3-7 . [ORB]

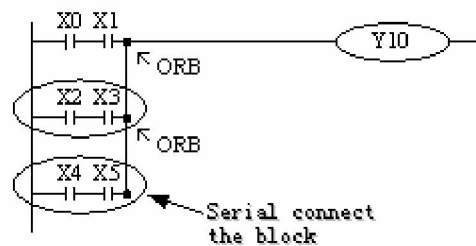
### Mnemonic and Function

Mnemonic	Function	Format and Devices
ORB (OR Block)	Parallel connection of multiply parallel circuits	 Devices: none

## Statements

- | The serial connection with two or more contacts is called "serial block". If parallel connect the serial block, use LD, LDI at the branch start place, use ORB at the stop place;
- | As the ANB instruction , an ORB instruction is an independent instruction and is not associated with any device number.
- | There are no limitations to the number of parallel circuits when using an ORB instruction in the sequential processing configuration.

## Program




Recommended good  
programming method :

```
LD    X0
AND   X1
LD    X2
AND   X3
ORB
LD    X4
AND   X5
ORB
```

Non-preferred batch  
programming  
method :

```
LD    X0
AND   X1
LD    X2
AND   X3
LD    X4
AND   X5
ORB
ORB
```

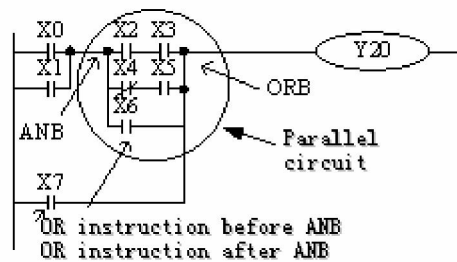
## Mnemonic and Function

Mnemonic	Function	Format and Devices
ANB (And Block)	Serial connection of multiply parallel circuits	 Devices: none

## Statements

- To declare the starting point of the circuit block, use a LD or LDI instruction. After completing the parallel circuit block, connect it to the preceding block in series using the ANB instruction.
- It is possible to use as many ANB instructions as necessary to connect a number of parallel circuit blocks to the preceding block in series.

## Program





```

LD      X0
OR      X1
LD      X2      ┌── Start of a branch
AND     X3      │
LDI     X4      └──
AND     X5
ORB      ┌── End of a parallel circuit block
OR       X6  └──
ANB
OR      X7      ─── Serial connect with the preceding circuit
OUT     Y20

```

### 3-9 . [MCS] , [MCR]

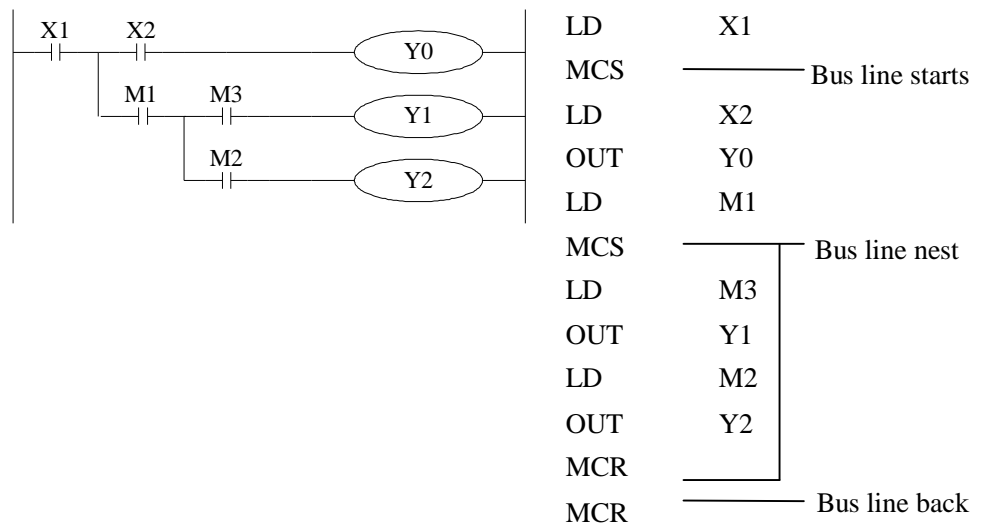
#### Mnemonic and Function

Mnemonic	Function	Format and Devices
MCS (Master control)	Denotes the start of a master control block	 Devices : None
MCR (Master control Reset)	Denotes the end of a master control block	 Devices : None

#### Statements


- | After the execution of an MCS instruction, the bus line( LD, LDI )shifts to a point after the MCS instruction. An MCR instruction returns this to the original bus line.
- | MCS、 MCR instructions should use in pair.
- | The bus line could be used nesting. Between the matched MCS、 MCR instructions use matched MCS、 MCR instructions. The nest level increase with the using of MCS instruction. The max nest level is 10. When executing MCR instruction, go back to the upper bus line.
- | When use flow program, bus line management could only be used in the same flow. When end some flow, it must go back to the main bus line.

#### Program



### 3-10 . [ALT]

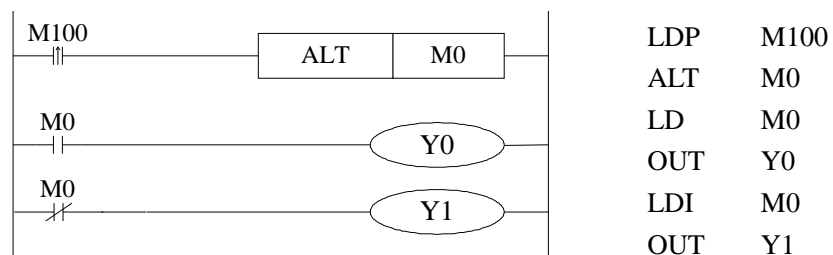
#### Mnemonic and Function

Mnemonic	Function	Format and Devices
ALT (Alternate status)	The status of the assigned devices inverted on every operation of the instruction	 Devices : Y, M, S, T, C, Dn.m

#### Statements

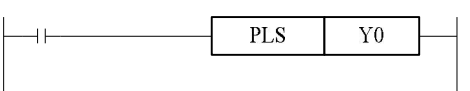
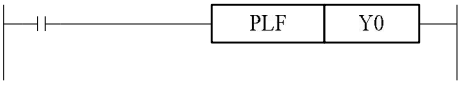
The status of the destination device is alternated on every operation of the ALT instruction.

#### Program



### 3-11 . [PLS] , [PLF]

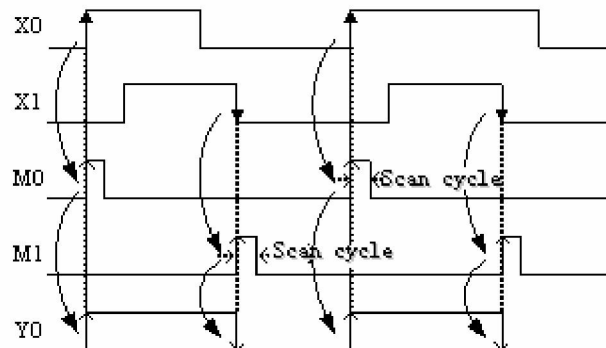
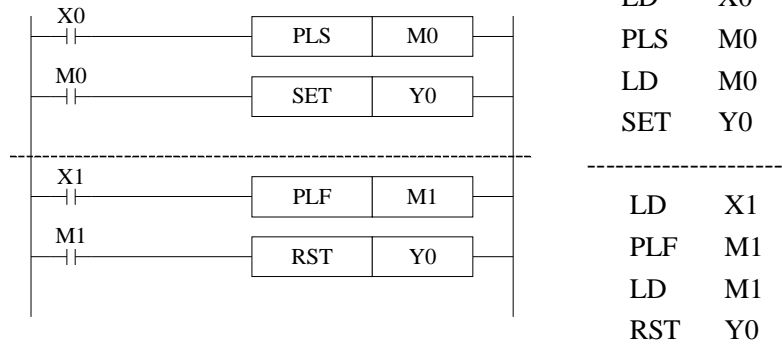
#### Mnemonic and Function

Mnemonic	Function	Format and Devices
PLS (Pulse)	Rising edge pulse	 Devices : Y, M, S, T, C, Dn.m
PLF (Pulse Falling)	Falling/trailing edge pulse	 Devices : Y, M, S, T, C, Dn.m

### Statements


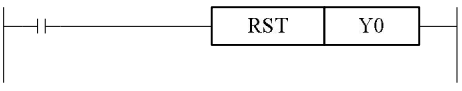
- When a PLS instruction is executed, object devices Y and M operate for one operation cycle after the drive input signal has turned ON.
- When a PLF instruction is executed, object devices Y and M operate for one operation cycle after the drive input signal has turned OFF.

### Program



## 3-12 . [SET] , [RST]

### Mnemonic and Function

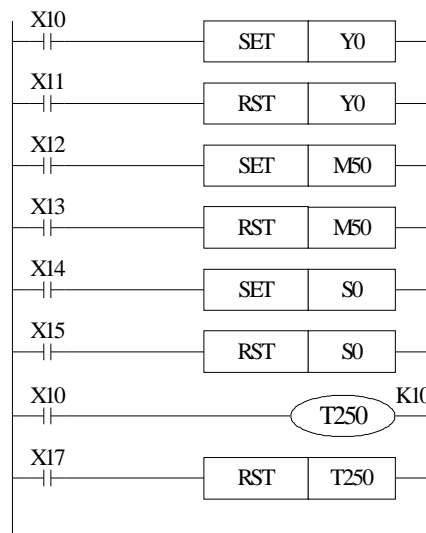
Mnemonic	Function	Format and Devices
SET ( Set )	Set a bit device permanently ON	 Devices : Y、M、S、T、C、Dn.m
RST(Reset)	Reset a bit device permanently OFF	 Devices : Y、M、S、T、C、Dn.m



## Statements

- | Turning ON X010 causes Y000 to turn ON. Y000 remains ON even after X010 turns OFF. Turning ON X011 causes Y000 to turn OFF. Y000 remains OFF even after X011 turns OFF. It's the same with M、 S.
- | SET and RST instructions can be used for the same device as many times as necessary. However, the last instruction activated determines the current status.
- | Besides, it's also possible to use RST instruction to reset the current contents of timer, counter and contacts.
- | When use SET, RST commands, avoid to use the same ID with OUT command;

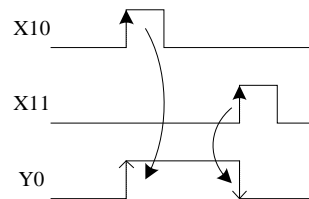
## Program



```


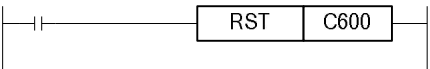
LD    X10
SET   Y0
LD    X11
RST   Y0
LD    X12
SET   M50
LD    X13
RST   M50
LD    X14
SET   S0
LD    X15
RST   S0
LD    X10
OUT   T250    K10
LD    X17
RST   T250

```

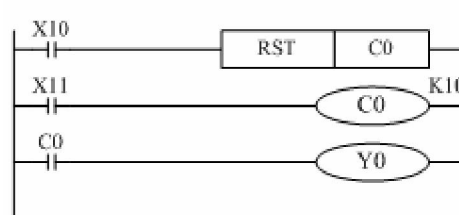


### 3-13 . 【OUT】 , 【RST】 for the counters

#### Mnemonic and Function

Mnemonic	Function	Format and Devices
OUT	Final logic operation type coil drive	 Device : K、 D
RST	Reset a bit device permanently OFF	 Device : C

#### Programming of interior counter

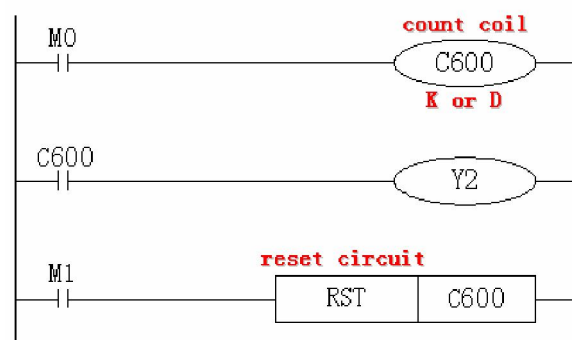


Counter used for power cut retentive. Even when power is cut, hold the current value and output contact's action status and reset status.

C0 carries on increase count for the OFF ON of X011. When reach the set value K10, output contact C0 activates. Afterwards, even X011 turns from OFF to ON, counter's current value will not change, output contact keep on activating.

To clear this, let X010 be the activate status and reset the output contact. It's necessary to assign constant K or indirect data register's ID behind OUT instruction.

#### Programming of high speed

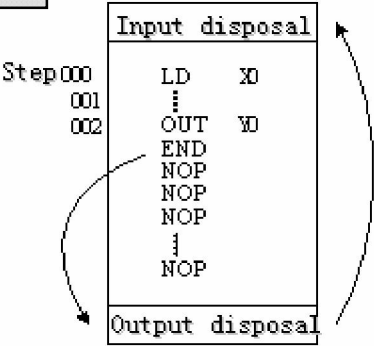


- | In the preceding example, when M0 is ON, carry on positive count with OFF ON of X0.
- | Counter's current value increase, when reach the set value (K or D), the output contact is reset.
- | When M1 is ON, counter's C600 output contact is reset, counter's current value turns to be 0.

Mnemonic and Function

Mnemonic	Function	Format and Devices : None
END (END)	Force the current program scan to end	<div><div>END</div><div>Devices: None</div></div>

Statements



PLC repeatedly carry on input disposal, program executing and output disposal. If write END instruction at the end of the program, then the instructions behind END instruction won't be executed. If there's no END instruction in the program, the PLC executes the end step and then repeat executing the program from step 0.

When debug, insert END in each program segment to check out each program's action.

Then, after confirm the correction of preceding block's action, delete END instruction.

Besides, the first execution of RUN begins with END instruction.

When executing END instruction, refresh monitor timer. (Check if scan cycle is a long timer.)

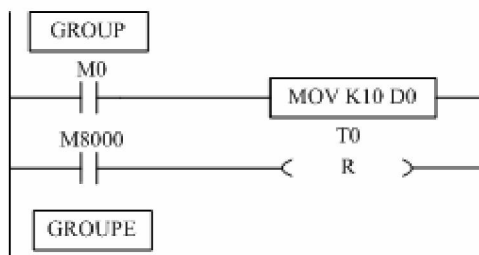
### 3-15 . [GROUP] , [GROUPE]

#### Mnemonic and Function

Mnemonic	Function	Format and Device
GROUP	GROUP	<div>GROUP</div> <div>Devices: None</div>
GROUPE	GROUP END	<div>GROUPE</div> <div>Devices: None</div>

#### Statements

- | GROUP and GROUPE should used in pairs.
- | GROUP and GROUPE don't have practical meaning, they are used to optimize the program structure. So, add or delete these instructions doesn't effect the program's running;
- | The using method of GROUP and GROUPE is similar with flow instructions; enter GROUP instruction at the beginning of group part; enter GROUPE instruction at the end of group part.



Generally, GROUP and GROUPE instruction can be programmed according to the group's function. Meantime, the programmed instructions can be FOLDED or UNFOLDED. To a redundant project, these two instructions are quite useful.

### 1、 Contacts' structure and step number

Even in the sequential control circuit with the same action, it's also available to simple the program and save program's steps according to the contacts' structure. General program principle is :a )write the circuit with many serial contacts on the top ; b ) write the circuit with many parallel contacts in the left.

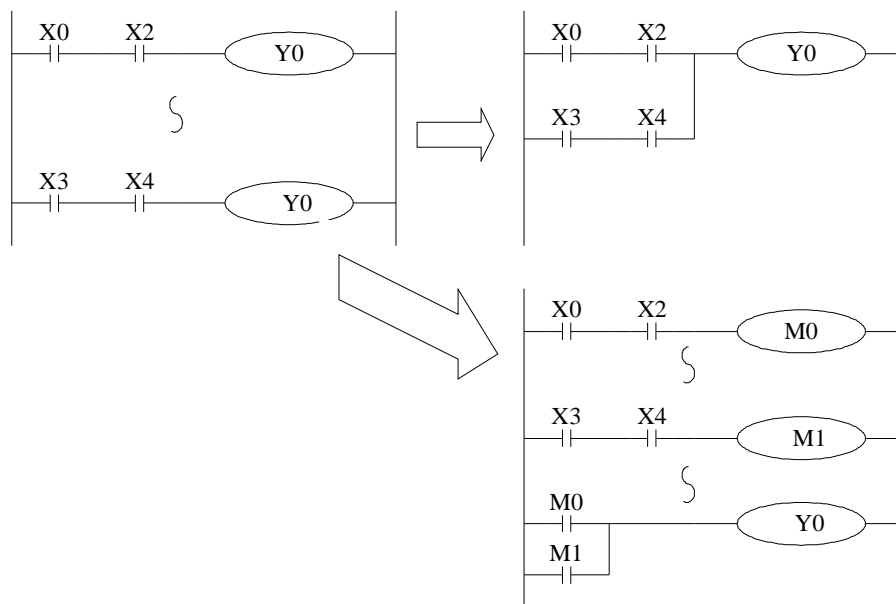
### 2、 Program's executing sequence

Handle the sequential control program by 【From top to bottom】 and 【From left to right】

Sequential control instructions also encode following this flow.

### 3、 Dual output dual coil's activation and the solution

- | If carry on coil's dual output (dual coil) in the sequential control program, then the backward action is prior.
- | Dual output (dual coil) doesn't go against the input rule at the program side. But as the preceding action is very complicate, please modify the program as in the following example.



There are other methods. E.g. jump instructions or step ladder. However, when use step ladder, if the main program's output coil is programmed, then the disposal method is the same with dual coil, please note this.