2 Soft Component's Function

In chapter 1, we briefly tell the program language of XC series PLC. However, the most important element to a program is the operands. These elements relate to the relays and registers inside the controller. In this chapter, we will describe the functions and using methods of these relays and registers.

2-1   Summary of the Soft Components

2-2   Structure of the Soft Components

2-3   List of the Soft Components

2-4   Input/output Relays (X   Y)

2-5   Auxiliary Relays (M)

2-6   Status Relays (S)

2-7   Timers (T)

2-8   Counters (C)

2-9   Data Registers (D)

2-10   Constant (K   H)

2-11   Pointer (P   I)

2-12   Program Principle

2-1   Summary of the Soft Components

There are many relays, timers and counters inside PLC. They all have countless NO (Normally ON) and NC (Normally Closed) contactors. Connect these contactors with the coils will make a sequential control circuit. Below, we will introduce these soft components briefly;

Input Relay (X)

l   Usage of the input relays

 The input relays are used to accept the external ON/OFF signal, we use **X** to state.

l   Address Specify Principle

 Ø   In each basic unit, specify the ID of input relay, output relay in the form of X000~X007　X010~X017…,Y000~Y007　Y010~Y017… (octal form)

 Ø   The expansion module's ID obeys the principle of channel 1 starts from X100/Y100, channel 2 starts from X200/Y200… 7 expansions can be connected in total.

l   Points to pay attention when using

 Ø   For the input relay's input filter, we use digital filter. Users can change the filter parameters via relate settings.

 Ø   We equip enough output relays inside PLC; for the output relays beyond the input/output points, use them as auxiliary relays, program as normal contactors/coils.

Output Relay   Y

l   Usage of the output relays

Output relays are the interface of drive external loads, represent with sign Y;

l   Address Assignment Principle

 Ø   In each basic unit assign the ID of output relays in the form of Y000~Y007 Y010~Y017… this octal format.

 Ø   The ID of expansion obeys the principle of: channel 1 starts from Y100, channel 2 starts from Y200… 7 expansions could be connected totally.

Auxiliary Relays   M

l   Usage of Auxiliary Relays

Auxiliary relays are equipped inside PLC, represent with the sign of M;

l   Address assignment principle

In basic units, assign the auxiliary address in the form of decimal

l   Points to note

 Ø   This type of relays are different with the input/output relays, they can't get external load, can only use in program;

 Ø   Retentive relays can keep its ON/OFF status in case of PLC power OFF;

Status Relays　S

l　Usage of status relays

　　Used as relays in Ladder, represent with "S"

l　Address assignment principle

　In basic units, assign the ID in the form of decimal

l　Points to note

　If not used as operation number, they can be used as auxiliary relays, program as normal contactors/coils. Besides, they can be used as signal alarms, for external diagnose.

Timer　T

l　Usage of the timers

Timers are used to calculate the time pulse like 1ms, 10ms, 100ms etc. when reach the set value, the output contactors acts, represent with "T"

l　Address assignment principle

In basic units, assign the timer's ID in the form of decimal. But divide ID into several parts according to the clock pulse, accumulate or not. Please refer to chapter 2-2 for details.

l　Time pulse

There are three specifications for the timer's clock pulse: 1ms　10ms　100ms. If choose 10ms timer, carry on addition operation with 10ms time pulse;

l　Accumulation/not accumulation

The times are divided into two modes: accumulation time means even the timer coil's driver is OFF, the timer will still keep the current value; while the not accumulation time means when the count value reaches the set value, the output contact acts, the count value clears to be 0;

Counter　C

According to different application and purpose, we can divide the counters to different types as below:

l　For internal count (for general using/power off retentive usage)

　　Ø　16 bits counter: for increment count, the count range is 1~32,767

　　Ø　32 bits counter: for increment count, the count range is 1~2,147,483,647

　　Ø　These counters can be used by PLC's internal signal. The response speed is one scan cycle or longer.

l　For High Speed Count (Power off retentive)

　　Ø　32 bits counter: for increment/decrement count, the count range is -2,147,483,648~ +2,147,483,647

　　(single phase increment count, single phase increment/decrement count, AB phase cont)

　　specify to special input points

Ø The high speed counter can count 80KHz frequency, it separates with the PLC's scan cycle;

Data Register   D

l Usage of Data Registers

   Data Registers are used to store data, represent with "D"

l Addressing Form

The data registers in XC series PLC are all 16 bits (the highest bit is the sign bit), combine two data registers together can operate 32 bits (the highest bit is the sign bit) data process.

l Points to note

Same with other soft components, data registers also have common usage type and power off retentive type.

FlashROM Register   FD

l Usage of FlashROM registers

   FlashROM registers are used to store data soft components, represent with "FD"

l Addressing Form

   In basic units, FlashROM registers are addressed in form of decimal;

l Points to note

   Even the battery powered off, this area can keep the data. So this area is used to store important parameters. FlashROM can write in about 1,000,000 times, and it takes time at every write. Frequently write can cause permanent damage of FD.

Constant   B   K   H

l   In every type of data in PLC, B represents Binary, K represents Decimal, H represents Hexadecimal. They are used to set timers and counters value, or operands of application instructions.
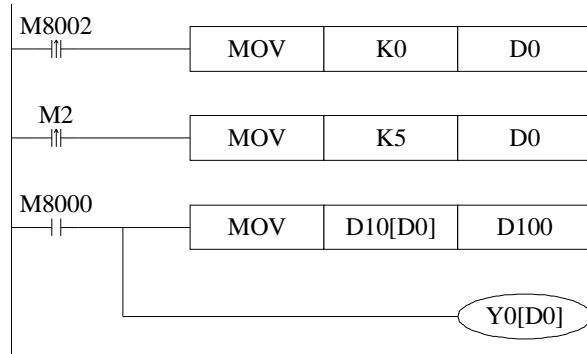
2-2   Structure of Soft Components

2-2-1   Structure of Memory

In XC series PLC, there are many registers. Besides the common data registers D, FlashROM registers, we can also make registers by combining bit soft components.

Data Register D

| For common use, 16 bits
| For common use, 32 bits (via combine two sequential 16 bits registers)
| For power off retentive usage, can modify the retentive zone
| For special usage, occupied by the system, can't be used as common instruction's parameters
| For offset usage (indirect specifies)
  Ø   Form: Dn[Dm]   Xn[Dm]   Yn[Dm]   Mn[Dm] etc.

```
M8002
 |↑|          ┌──────┬──────┬──────┐
              │ MOV  │  K0  │  D0  │
              └──────┴──────┴──────┘

 M2
 |↑|          ┌──────┬──────┬──────┐
              │ MOV  │  K5  │  D0  │
              └──────┴──────┴──────┘

M8000
 | |          ┌──────┬────────┬──────┐
      ├───────│ MOV  │ D10[D0]│ D100 │
      │       └──────┴────────┴──────┘
      │
      └────────────────────────( Y0[D0] )
```

In the above sample, if D0=0, then D100=D10, Y0 is ON.

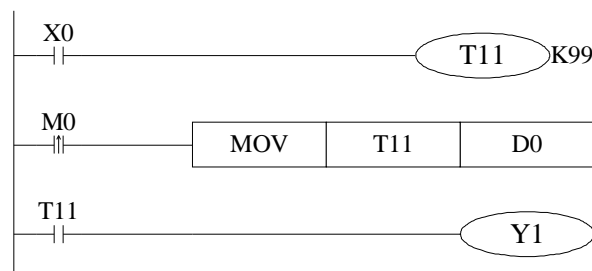　　　　If M2 turns from OFF to be ON, D0=5, then D100=D15, Y5 is ON.

　　　　Therein, D10[D0]=D[10+D0]   Y0[D0]=Y[0+D0]

  Ø   The word offset combined by bit soft components: DXn[Dm] represents DX[n+Dm]
  Ø   The soft components with offset, the offset can be represent by soft component D.

Timer T/Counter C

| For common usage, 16 bits, represent the current value of timer/counter;
| For common usage, 32 bits, (via combine two sequential 16 bits registers)
| To represent them, just use the letter+ID method, such as T10, C11.
  E.g.

```
 X0
 | |                              ( T11 )K99

 M0          ┌──────┬──────┬──────┐
 |↑|         │ MOV  │ T11  │  D0  │
             └──────┴──────┴──────┘
T11
 | |                              ( Y1 )
```

In the above example, MOV T11 D0, T11 represents word register;

　　　　LD T11, T11 represents bit register.

FlashROM Register FD

l   For power off retentive usage, 16 bits

l   For power off retentive usage, 16 bits, (via combine two sequential 16 bits registers)

l   For special usage, occupied by the system, can't be used as common instruction's parameters

Expansion's internal register ED

l   For common usage, 16 bits,

l   For common usage, 32 bits, (via combine two sequential 16 bits registers)

Bit soft components combined to be register

l   For common usage, 16 bits, (via combine two sequential 16 bits registers)

l   The soft components which can be combined to be words are: X Y M S T C

l   Format: add "D" in front of soft components, like DM10, represents a 16 bits data from M10~M25

l   Get 16 points from DXn, but not beyond the soft components range;

l   The word combined by bit soft components can't realize bit addressing;

E.g.:

M0			
	MOV	K21	DY0

M1			
	MOV	K3	D0

M8000			
	MOV	DX2[D0]	D10
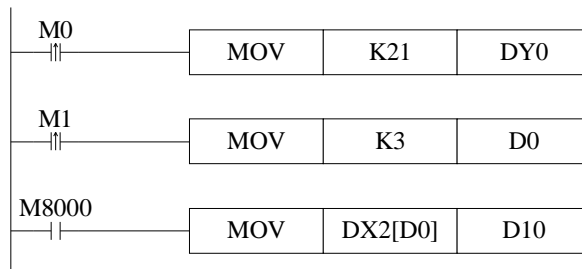
Ø   When M0 changes from OFF to be ON, the value in the word which is combined by Y0~Y17 equals 21, i.e. Y0   Y2   Y4 becomes to be ON

Ø   Before M1 activates, if D0=0, DX2[D0] represents a word combined by X2~X21

Ø   If M1 changes from OFF   ON, D0=3   then DX2[D0] represents a

2-2-2　Structure of Bit Soft Components

Bit soft components structure is simple, the common ones are X　Y　M　S　T　C, besides, a bit of a register can also represents:

Relay

| Input Relay X, octal type
| Output Relay Y, octal type
| Auxiliary Relay M　S, decimal type
| Auxiliary Relay T　C, decimal type, as the represent method is same with registers, so we need to judge if it's word register or bit register according to the register.

Register's Bit

| Composed by register's bit, support register D
| Represent method: Dn.m (0　m　15): the Nr.m bit of Dn register
| The represent method of word with offset: Dn[Dm].x
| Bit of Word can't compose to be word again;
E.g.:

```
      D0.4
      ─┤├──────────────────────(  Y0  )

  D5[D1].4
  ───┤├────────────────────────(  Y1  )
```
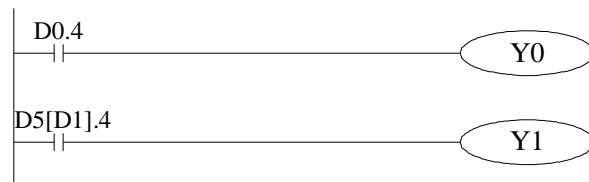
Ø　D0.4 means when the Nr.4 bit of D0 is 1, set Y0 ON .
Ø　D5[D1].4 means bit addressing with offset, if D1=5, then D5[D1] means the Nr.4 bit of D10

2-3-1   Soft Components List

XC1 Series

Mnemonic	Name	Range				points			
		10I/O	16 I/O	24 I/O	32 I/O	10 I/O	16 I/O	24 I/O	32 I/O
I/O points [1]	Input Points	X0~X4	X0~X7	X0~X13	X0~X17	5	8	12	16
	Output Points	Y0~Y4	Y0~Y7	Y0~Y13	Y0~Y17	5	8	12	16
X [2]	Internal Relay	X0~X77				64			
Y [3]	Internal Relay	Y0~Y77				64			
M	Internal Relay	M0~M199 M200~M319 [4]				320			
		For Special Usage [5]M8000~M8079				128			
		For Special Usage [5]M8120~M8139							
		For Special Usage [5]M8170~M8172							
		For Special Usage [5]M8238~M8242							
		For Special Usage [5]M8350~M8370							
S	Flow	S0~S31				32			
T	Timer	T0~T23: 100ms not accumulation				80			
		T100~T115: 100ms accumulation							
		T200~T223: 10ms not accumulation							
		T300~T307: 10ms accumulation							
		T400~T403: 1ms not accumulation							
		T500~T503: 1ms accumulation							
C	Counter	C0~C23: 16 bits forward counter				48			
		C300~C315: 32 bits forward/backward counter							
		C600~C603: single-phase HSC							
		C620~C621							
		C630~C631							
D	Data Register	D0~D99 D100~D149 [4]				150			
		For Special Usage [5]D8000~D8029				138			
		For Special Usage [5]D8060~D8079							
		For Special Usage [5]D8120~D8179							
		For Special Usage [5]D8240~D8249							
		For Special Usage [5]D8306~D8313							
		For Special Usage [5]D8460~D8469							
FD	FlashROM	FD0~FD411				412			

	Register [6]	For Special Usage [5]FD8000~FD8011	98
		For Special Usage [5]FD8202~FD8229	
		For Special Usage [5]FD8306~FD8315	
		For Special Usage [5]FD8323~FD8335	
		For Special Usage [5]FD8350~FD8384	

XC2 Series

Mnemonic	Name	Range				Points			
		14 I/O	16 I/O	24/32 I/O	48/60 I/O	14 I/O	16 I/O	24/32 I/O	48/60 I/O
I/O Points [1]	Input Points	X0~X7	X0~X7	X0~X15 X0~X21	X0~X33 X0~X43	8	8	14/18	28/36
	Output Points	Y0~Y5	Y0~Y7	Y0~Y11 Y0~Y15	Y0~Y23 Y0~Y27	6	8	10/14	20/24
X [2]	Internal Relay	X0~X1037				544			
Y [3]	Internal Relay	Y0~Y1037				544			
M	Internal Relay	M0~M2999 M3000~M7999 [4]				8000			
		For Special Usage [5]M8000~M8767				768			
S	Flow	S0~S511 S512~S1023 [4]				1024			
T	Timer	T0~T99: 100ms not accumulation				640			
		T100~T199: 100ms accumulation							
		T200~T299: 10ms not accumulation							
		T300~T399: 10ms accumulation							
		T400~T499: 1ms not accumulation							
		T500~T599: 1ms accumulation							
		T600~T639: 1ms precise time							
C	Counter	C0~C299: 16 bits forward counter				640			
		C300~C599: 32 bits forward/backward counter							
		C600~C619: single-phase HSC							
		C620~C629: double-phase HSC							
		C630~C639: AB phase HSC							
D	Data Register	D0~D999 D4000~D4999 [4]				2000			
		For Special Usage [5]D8000~D8511				612			

		For Special Usage [5]D8630~D8729	
FD	FLASH Register	FD0~FD127	128
		For Special Usage [5]FD8000~FD8383	384

XC3 Series

Mnemonic	Name	Range			Points		
		14 I/O	24/32 I/O	48/60 I/O	14 I/O	24/32 I/O	48/60 I/O
I/O Points [1]	Input Points	X0~X7	X0~X15 X0~X21	X0~X33 X0~X43	8	14/18	28/36
	Output Points	Y0~Y5	Y0~Y11 Y0~Y15	Y0~Y23 Y0~Y27	6	10/14	20/24
X [2]	Internal Relay	X0~X1037			544		
Y [3]	Internal Relay	Y0~Y1037			544		
M	Internal Relay	M0~M2999 M3000~M7999 [4]			8000		
		For Special Usage [5]M8000~M8767			768		
S	Flow	S0~S511 S512~S1023 [4]			1024		
T	TIMER	T0~T99: 100ms not accumulation			640		
		T100~T199: 100ms accumulation					
		T200~T299: 10ms not accumulation					
		T300~T399: 10ms accumulation					
		T400~T499: 1ms not accumulation					
		T500~T599: 1ms accumulation					
		T600~T639: 1ms precise time					
C	COUNTER	C0~C299: 16 bits forward counter			640		
		C300~C599: 32 bits forward/backward counter					
		C600~C619: single-phase HSC					
		C620~C629: double-phase HSC					
		C630~C639: AB phase HSC					
D	DATA REGISTER	D0~D3999 D4000~D7999 [4]			8000		
		For Special Usage [5]D8000~D9023			1024		

FD	FlashROM REGISTER [6]	FD0~FD1535		1536
		For Special Usage [5]FD8000~FD8511		512
ED [7]	EXPANSION'S INTERNAL REGISTER	ED0~ED16383		16384

XC5 Series

Mnemonic	Name	I/O RANGE		POINTS	
		24/32 I/O	48/60 I/O	24/32 I/O	48/60 I/O
I/O Points [1]	Input Points	X0~X15 X0~X21	X0~X33 X0~X43	14/18	28/36
	Output Points	Y0~Y11 Y0~Y15	Y0~Y23 Y0~Y27	10/14	20/24
X [2]	Internal Relay	X0~X1037		544	
Y [3]	Internal Relay	Y0~Y1037		544	
M	Internal Relay	M0~M3999 M4000~M7999 [4]		8000	
		For Special Usage [5]M8000~M8767		768	
S	Flow	S0~S511 S512~S1023 [4]		1024	
T	TIMER	T0~T99: 100ms not accumulation		640	
		T100~T199: 100ms accumulation			
		T200~T299: 10ms not accumulation			
		T300~T399: 10ms accumulation			
		T400~T499: 1ms not accumulation			
		T500~T599: 1ms accumulation			
		T600~T639: 1ms precise time			
C	COUNTER	C0~C299: 16 bits forward counter		640	
		C300~C599: 32 bits forward/backward counter			
		C600~C619: single-phase HSC			
		C620~C629: double-phase HSC			
		C630~C639: AB phase HSC			
D	DATA REGISTER	D0~D3999 D4000~D7999 [4]		8000	
		For Special Usage [5]D8000~D9023		1024	
FD	FlashROM	FD0~FD5119		5120	

	REGISTER [6]	For Special Usage [5]FD8000~FD9023	1024
ED [7]	EXPANSION'S INTERNAL REGISTER	ED0~ED36863	36864

XCM Series

Mnemonic	Name	I/O range		Points	
		24/32 I/O	48 I/O	24/32 I/O	48 I/O
I/O Points [1]	Input Points	X0~X15 X0~X21	X0~X33	14/18	28
	Output Points	Y0~Y11 Y0~Y15	Y0~Y23	10/14	20
X [2]	Internal Relay	X0~X1037		544	
Y [3]	Internal Relay	Y0~Y1037		544	
M	Internal Relay	M0~M2999 M3000~M7999 [4]		8000	
		For Special Usage [5]M8000~M8767		768	
S	Flow	S0~S511 S512~S1023 [4]		1024	
T	TIMER	T0~T99: 100ms not accumulation		640	
		T100~T199: 100ms accumulation			
		T200~T299: 10ms not accumulation			
		T300~T399: 10ms accumulation			
		T400~T499: 1ms not accumulation			
		T500~T599: 1ms accumulation			
		T600~T639: 1ms precise time			
C	COUNTER	C0~C299: 16 bits forward counter		640	
		C300~C599: 32 bits forward/backward counter			
		C600~C619: single-phase HSC			
		C620~C629: double-phase HSC			
		C630~C639: AB phase HSC			
D	DATA REGISTER	D0~D2999 D4000~D4999 [4]		4000	
		For Special Usage [5]D8000~D9023		1024	
FD	FlashROM	FD0~FD63		64	

	REGISTER [6]	For Special Usage ^{5}FD8000~FD8349	460
		For Special Usage ^{5}FD8890~FD8999	
ED [7]	EXPANSION'S INTERNAL REGISTER	ED0~ED36863	36864

1: I/O points, means the terminal number that users can use to wire the input, output

2: X, means the internal input relay, the X beyond Input points can be used as middle relay;

3: Y, means the internal output relay, the Y beyond Output points can be used as middle relay;

4: The memory zone in   is power off retentive zone, soft components D M S T C can change the retentive area via setting. Please refer to 2-3-2 for details;

5: for special use, means the special registers occupied by the system, can't be used for other purpose. Please refer to Appendix 1.

6: FlashROM registers needn't set the power off retentive zone, when power is off (no battery), the data will not lose

7: Expansion's internal register ED, require PLC hardware V3.0 or above

8: Input coils output relays are in octal form, the other registers are in decimal form;

9: The I/O that are not wired with external device can be used as fast internal relays;

10: for the soft components of expansion devices, please refer to relate manuals;

The power off retentive area of XC series PLC are set as below, this area can be set by user again;

	Soft components	SET AREA	FUNCTION	System's default value	Retentive Zone
XC1 Series	D	FD8202	Start tag of D power off retentive zone	100	D100~D149
	M	FD8203	Start tag of M power off retentive zone	200	M200~M319
	T	FD8204	Start tag of T power off retentive zone	640	Not set
	C	FD8205	Start tag of C power off retentive zone	320	C320~C631
	S	FD8206	Start tag of S power off retentive zone	512	S0~S31
XC2 Series	D	FD8202	Start tag of D power off retentive zone	4000	D4000~D4999
	M	FD8203	Start tag of M power off retentive zone	3000	M3000~M7999
	T	FD8204	Start tag of T power off retentive zone	640	Not set
	C	FD8205	Start tag of C power off retentive zone	320	C320~C639
	S	FD8206	Start tag of S power off retentive zone	512	S512~S1023
XC3 Series	D	FD8202	Start tag of D power off retentive zone	4000	D4000~D7999
	M	FD8203	Start tag of M power off retentive zone	3000	M3000~M7999
	T	FD8204	Start tag of T power off retentive zone	640	Not set
	C	FD8205	Start tag of C power off retentive zone	320	C320~C639
	S	FD8206	Start tag of S power off retentive zone	512	S512~S1023
	ED	FD8207	Start tag of ED power off retentive zone	0	ED0~ED16383
XC5 Series	D	FD8202	Start tag of D power off retentive zone	4000	D4000~D7999
	M	FD8203	Start tag of M power off retentive zone	4000	M4000~M7999
	T	FD8204	Start tag of T power off retentive zone	640	Not set
	C	FD8205	Start tag of C power off retentive zone	320	C320~C639
	S	FD8206	Start tag of S power off retentive zone	512	S512~S1023
	ED	FD8207	Start tag of ED power off retentive zone	0	ED0~ED36863
XCM Series	D	FD8202	Start tag of D power off retentive zone	4000	D4000~D4999
	M	FD8203	Start tag of M power off retentive zone	3000	M3000~M7999
	T	FD8204	Start tag of T power off retentive zone	640	Not set
	C	FD8205	Start tag of C power off retentive zone	320	C320~C639

	S	FD8206	Start tag of S power off retentive zone	512	S512~S1023
	ED	FD8207	Start tag of ED power off retentive zone	0	ED0~ED36863

For timer T, we can set not only retentive zone, but also set certain timer's retentive zone

Soft Components	Set area	Function	Retentive Zone
T	FD8323	Set the start tag of 100ms not accumulation timer's retentive zone	The set value ~T99
	FD8324	Set the start tag of 100ms accumulation timer's retentive zone	The set value~T199
	FD8325	Set the start tag of 10ms not accumulation timer's retentive zone	The set value~T299
	FD8326	Set the start tag of 10ms accumulation timer's retentive zone	The set value~T399
	FD8327	Set the start tag of 1ms not accumulation timer's retentive zone	The set value~T499
	FD8328	Set the start tag of 1ms accumulation timer's retentive zone	The set value~T599
	FD8329	Set the start tag of 1ms precise timer's retentive zone	The set value~T639

For counter C, we can set not only retentive zone, but also set certain counter's retentive zone

Soft Components	Set area	Function	Retentive Zone
C	FD8330	Set the start tag of 16 bits positive counter's retentive zone	The set value~C299
	FD8331	Set the start tag of 32 bits positive/negative counter's retentive zone	The set value~C599
	FD8332	Set the start tag of single phase HSC's retentive zone	The set value~C619
	FD8333	Set the start tag of dual direction HSC's retentive zone	The set value~C629
	FD8334	Set the start tag of AB phase HSC's retentive zone	The set value~C639

---

1 if the whole power off retentive zone is smaller than the segment's retentive area, then the segment's area is invalid. If the total counter's set range is T200~T640, FD8324 value is 150, then the 100ms accumulate timer's retentive area T150~T199 is invalid.

Number List

XC series PLC's input/output are all in octal form, each series numbers are listed below:

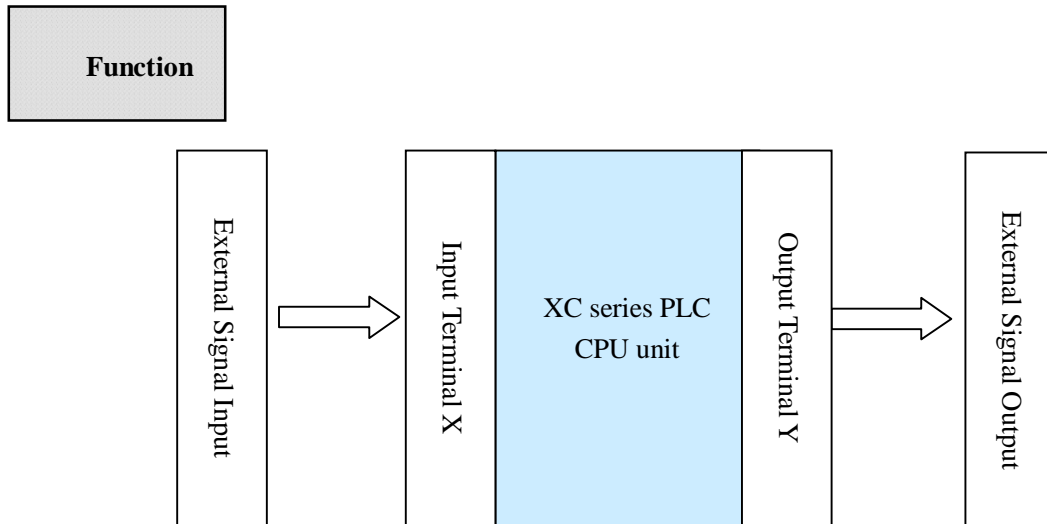| Series	Name	Range				Points			
		10 I/O	16 I/O	24 I/O	32 I/O	10 I/O	16 I/O	24 I/O	32 I/O
XC1	X	X0~X4	X0~X7	X0~X13	X0~X17	5	8	12	16
	Y	Y0~Y4	Y0~Y7	Y0~Y13	Y0~Y17	5	8	12	16

Series	Name	Range				Points			
		14 I/O	16 I/O	24/32 I/O	48/60 I/O	14 I/O	16 I/O	24/32 I/O	48/60 I/O
XC2	X	X0~X7	X0~X7	X0~X15 X0~X21	X0~X33 X0~X43	8	8	14/18	28/36
	Y	Y0~Y5	Y0~Y7	Y0~Y11 Y0~Y15	Y0~Y23 Y0~Y27	6	8	10/14	20/24

Series	Name	Range			Points		
		14 I/O	24/32 I/O	48/60 I/O	14 I/O	24/32 I/O	48/60 I/O
XC3	X	X0~X7	X0~X15 X0~X21	X0~X33 X0~X43	8	14/18	28/36
	Y	Y0~Y5	Y0~Y11 Y0~Y15	Y0~Y23 Y0~Y27	6	10/14	20/24

Series	Name	Range		Points	
		24/32 I/O	48/60 I/O	24/32 I/O	48/60 I/O
XC5	X	X0~X15 X0~X21	X0~X33 X0~X43	14/18	28/36
	Y	Y0~Y11 Y0~Y15	Y0~Y23 Y0~Y27	10/14	20/24

Series	Name	Range			Points		
		24 I/O	32 I/O	48 I/O	24 I/O	32 I/O	48 I/O
XCM	X	X0~X15	X0~X21	X0~X33	14	18	28
	Y	Y0~Y11	Y0~Y15	Y0~Y23	10	14	20

External Signal Input	→	Input Terminal X	XC series PLC CPU unit	Output Terminal Y	→	External Signal Output

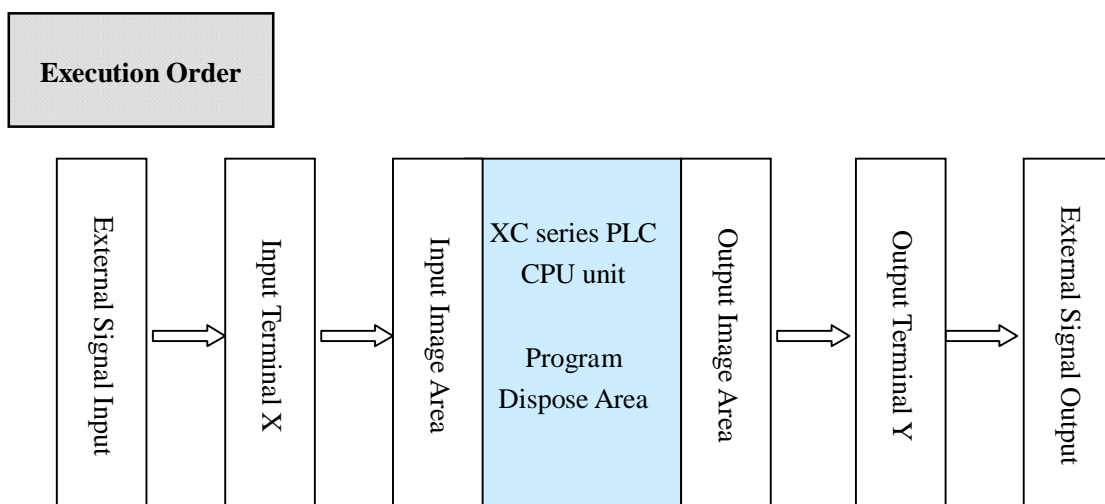## Input Relay X

| PLC's input terminals are used to accept the external signal input, while the input relays are a type of optical relays to connect PLC inside and input terminals;

| The input relays have countless normally ON/OFF contactors, they can be used freely;

| The input relays which are not connected with external devices can be used as fast internal relays;

Output Relay Y

| PLC's output terminals can be used to send signals to external loads. Inside PLC, output relay's external output contactors (including relay contactors, transistor's contactors) connect with output terminals.

| The output relays have countless normally ON/OFF contactors, they can be used freely;

| The output relays which are not connected with external devices can be used as fast internal relays;

Execution Order

External Signal Input	→	Input Terminal X	→	Input Image Area	XC series PLC CPU unit Program Dispose Area	Output Image Area	→	Output Terminal Y	→	External Signal Output

- Input Disposal
  - Ø Before PLC executing the program, read every input terminal's ON/OFF status of PLC to the image area.
  - Ø In the process of executing the program, even the input changed, the content in the input image area will not change. However, in the input disposal of next scan cycle, read out the change.
- Output Disposal
  - Ø Once finish executing all the instructions, transfer the ON/OFF status of output Y image area to the output lock memory area. This will be the actual output of the PLC.
  - Ø The contacts used for the PLC's external output will act according to the device's response delay time.

2-5　Auxiliary Relay (M)

Number List

The auxiliary relays M in XC series PLC are all in decimal form, please refer the details from tables below:

SERIES	NAME	RANGE		
		FOR COMMON USE	FOR POWER-OFF RETENTIVE USE	FOR SPECIAL USE
XC1	M	M000~M199	M200~M319	M8000~M8079
				M8120~M8139
				M8170~M8172
				M8238~M8242
				M8350~M8370

SERIES	NAME	RANGE		
		FOR COMMON USE	FOR POWER-OFF RETENTIVE USE	FOR SPECIAL USE
XC2	M	M000~M2999	M3000~M7999	M8000~M8767

SERIES	NAME	RANGE		
		FOR COMMON USE	FOR POWER-OFF RETENTIVE USE	FOR SPECIAL USE
XC3	M	M000~M2999	M3000~M7999	M8000~M8767

SERIES	NAME	RANGE

		FOR COMMON USE	FOR POWER-OFF RETENTIVE USE	FOR SPECIAL USE
XC5	M	M000~M3999	M4000~M7999	M8000~M8767

SERIES	NAME	RANGE		
		FOR COMMON USE	FOR POWER-OFF RETENTIVE USE	FOR SPECIAL USE
XCM	M	M000~M2999	M3000~M7999	M8000~M8767

Function

In PLC, auxiliary relays M are used frequently. This type of relay's coil is same with the output relay. They are driven by soft components in PLC;

auxiliary relays M have countless normally ON/OFF contactors. They can be used freely, but this type of contactors can't drive the external loads.

l   For common use
  Ø   This type of auxiliary relays can be used only as normal auxiliary relays. I.e. if power supply suddenly stop during the running, the relays will disconnect.
  Ø   Common usage relays can't be used for power off retentive, but the zone can be modified;

l   For Power Off Retentive Use
  Ø   The auxiliary relays for power off retentive usage, even the PLC is OFF, they can keep the ON/OFF status before power OFF.
  Ø   Power off retentive zone can be modified by the user;
  Ø   Power off retentive relays are usually used to memory the status before stop the power, then when power the PLC on again, the status can run again;

l   For Special Usage
  Ø   Special relays refer some relays which are defined with special meanings or functions, start from M8000.
  Ø   There are two types of usages for special relays, one type is used to drive the coil, the other type is used to the specified execution;
      E.g.: M8002 is the initial pulse, activates only at the moment of start
          M8033 is "all output disabled"
  Ø   Special auxiliary relays can't be used as normal relay M;

2-6 Status Relay (S)

XC series PLC's status relays S are addressed in form of decimal; each subfamily's ID are listed below:

SERIES	NAME	RANGE	
		FOR COMMON USE	FOR POWER-OFF RETENTIVE USE
XC1	S	S000~S031	-

SERIES	NAME	RANGE	
		FOR COMMON USE	FOR POWER-OFF RETENTIVE USE
XC2	S	S000~S511	S512~S1023

SERIES	NAME	RANGE	
		FOR COMMON USE	FOR POWER-OFF RETENTIVE USE
XC3	S	S000~S511	S512~S1023

SERIES	NAME	RANGE	
		FOR COMMON USE	FOR POWER-OFF RETENTIVE USE
XC5	S	S000~S511	S512~S1023

SERIES	NAME	RANGE	
		FOR COMMON USE	FOR POWER-OFF RETENTIVE USE
XCM	S	S000~S511	S512~S1023

Function

Status relays are very import in ladder program; usually use them with instruction "STL". In the form on flow, this can make the program's structure much clear and easy to modify;

l   For common use

   After shut off the PLC power, this type of relays will be OFF status;

l   For Power Off Retentive Use

   Ø   The status relays for power off retentive usage, even the PLC is OFF, they can keep the ON/OFF status before power OFF.

   Ø   Power off retentive zone can be modified by the user;

l   The status relays also have countless "normally ON/OFF" contactors. So users can use them freely in the program;

Address List	XC series PLC's timers T are addressed in form of decimal; each subfamily's ID are listed below:

SERIES	NAME	RANGE	
		FOR COMMON USE	POINTS
XC1	T	T0~T23: 100ms not accumulation	80
		T100~T115: 100ms accumulation	
		T200~T223: 10ms not accumulation	
		T300~T307: 10ms accumulation	
		T400~T403: 1ms not accumulation	
		T500~T503: 1ms accumulation	
XC2 XC3 XC5 XCM	T	T0~T99: 100ms not accumulation	640
		T100~T199: 100ms accumulation	
		T200~T299: 10ms not accumulation	
		T300~T399: 10ms accumulation	
		T400~T499: 1ms not accumulation	
		T500~T599: 1ms accumulation	
		T600~T639: 1ms with precise time	

Function	The timers accumulate the 1ms, 10ms, 10ms clock pulse, the output contactor activates when the accumulation reaches the set value;

We use OUT or TMR instruction to time for the **normal** timers. We use constant (K) to set the value, or use data register (D) to indirect point the set value;
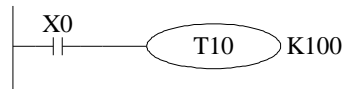

Normal Type
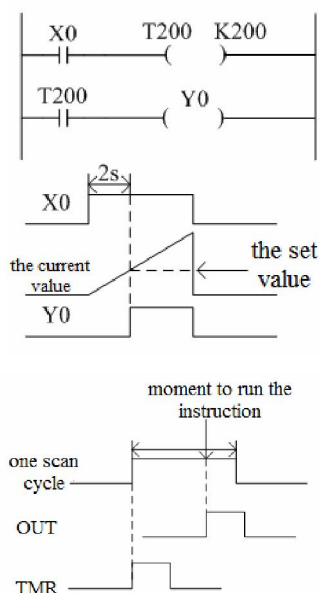
I If X0 is ON, then T200 accumulate 10ms clock pulse based on the current value; when the accumulation value reaches the set value K200, the timer's output contact activates. I.e. the output contact activates 2s later. If X0 breaks, the timer resets, the output contact resets;

I Both OUT and TMR can realize the time function. But if use OUT, the start time is 0; if use TMR, the start time is 1 scan cycle
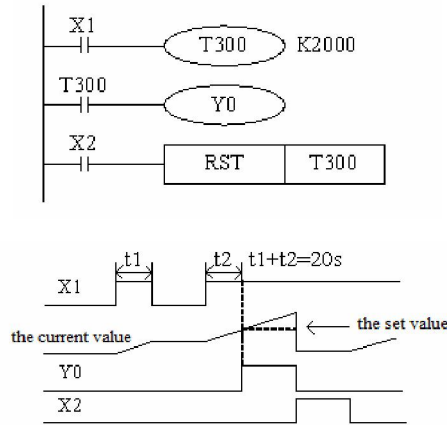
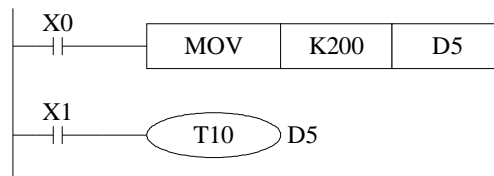|		
Accumulation Type		If X001 is ON, then T300 accumulate 10ms clock pulse based on the current value; when the accumulation value reaches the set value K2000, the timer's output contact activates. I.e. the output contact activates 2s later. Even if X0 breaks, the timer will continue to accumulation on re-starting. The accumulation time is 20ms; If X002 is ON, the timer will be reset, the output contacts reset;

Specify the set value	Constant (K) 	T10 is the timer with 100ms as the unit. Specify 100 as the constant, then 0.1s*100=10s timer works;
	Register (D) 	Write the value of indirect data register in the program or input by value switch. If set as the retentive register, make sure the battery voltage is enough, or the value will be unstable.

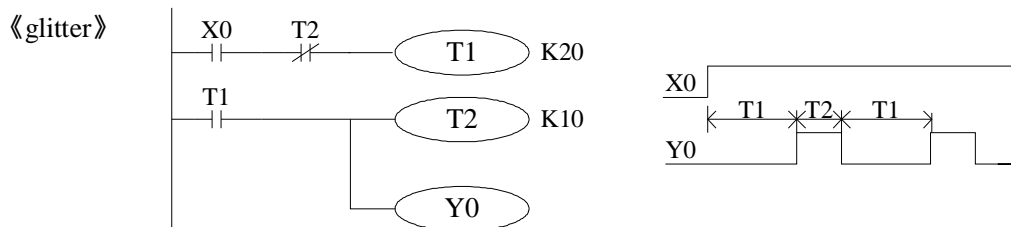|	
Timer Value	Timer T0~T599 is 16 bits linear increment mode (0~K32767), when the timer's value reaches the max value K32767, it stops timing. The timer's status keeps still;

Action Example	output delay OFF timer When X000 is ON, output Y000; When X000 from ON to OFF, delay T2(20s), then output Y000 is OFF.
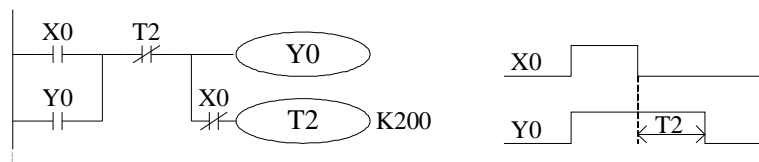
glitter

When X000 is ON, Y000 starts to glitter.

T1 controls the OFF time of Y000, T2 controls the ON time of Y000.

2-8　Counter (C)

Number list

XC series PLC counters' number are all decimal, please see the following table for all the counter numbers.

SERIES	NAME	RANGE	
		FOR COMMON USE	POINTS
XC1	C	C0~C23: 16 bits forward counter	48
		C300~C315: 32 bits forward/backward counter	
		C600~C603: single-phase HSC	
		C620~C621	
		C630~C631	
XC2 XC3 XC5 XCM	C	C0~C299: 16 bits forward counter	640
		C300~C599: 32 bits forward/backward counter	
		C600~C619: single-phase HSC	
		C620~C629: double-phase HSC	
		C630~C639: AB phase HSC	

All the counters number meaning:

TYPE	DESCRIPTION
16 bits forward counter	C0~C299
32 bits forward/backward counter	C300~C599　(C300,C302...C598)(each occupies 2 counters number) the number should be even
HSC (High Speed Counter)	C600~C634(C600,C602...C634)((each occupies 2 counters number) the number should be even

1: Please see chapter 5 for high speed counter.

Counter characteristics
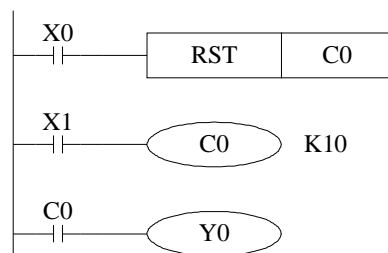
The characteristics of 16 bits and 32 bits counters:

Items	16 bits counter	32 bits counter
Count direction	Positive	Positive/negative
The set value	1~32,767	-2,147,483,648~+2,147,483,647
The assigned set value	Constant K or data register	Same as the left, but data register must be in a couple
Changing of the current value	Change after positive count	Change after positive count (Loop counter)
Output contact	Hold the action after positive count	Hold the action after positive count, reset if negative count
Reset activates	When executing RST command, counter's current value is 0, output contacts recover	
The current value register	16 bits	32 bits

Function The assignment of common use counters and power off retentive counters, can me changed via FD parameters from peripheral devices;

16 bits counter normal/retentive type

16 bits binary increment counters, the valid value is K1~K32,767 (decimal type constant). The set value K0 and K1 has the same meaning. i.e. the output contact works on the first count starts

```
      X0
      ─┤├──      ┌─────────┬─────────┐
                 │   RST   │   C0    │
                 └─────────┴─────────┘
      X1
      ─┤├──         (  C0  )  K10

      C0
      ─┤├──         (  Y0  )
```

If cut the PLC power supply, the normal counter value become zero, the retentive counter can store the value, it can accumulate the value of last time.

| When X001 is ON once, the counter increases 1. When the counter value is 10, its output is activated. After, when the X001 is ON again, the counter continues increasing 1.

| If X000 is ON, reset counter, the counter value becomes zero.

| It also can set the counter value in D register. For example, D10=123 is the same as K123.

32 bits increase/decrease count range is +2147483648 ~ - 2147483647. Set the increase or decrease count mode in M8238.

```
X2
─┤├──────( M8238 )

X3
─┤├──────┤ RST │ C300 │

X4
─┤├──────( C300 )  K10

C300
─┤├──────( Y1 )
```
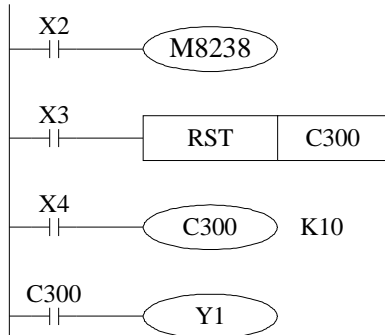
l   If M8238=1, it is decrease mode; M8238=0, it is increase mode.

l   Set the count value in K or D, if set in D0 register, D0 and D1 will be seemed as one 32bits value.
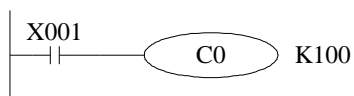
l   X004 is ON, C300 starts to count.

l   If X003 is ON, reset the counter and C300 output.

l   If use retentive counter, the count value will be stored in PLC.

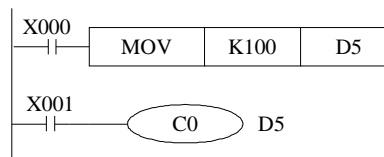l   32 bits counter can be used as 32 bits register.

Set the count value

It includes 16 bits and 32 bits count value.

ʊ   16 bits counter

set as constant K

```
X001
─┤├──────( C0 )  K100
```
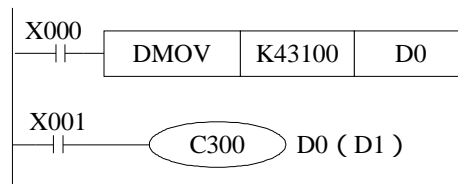
set in D register

```
X000
─┤├──────┤ MOV │ K100 │ D5 │

X001
─┤├──────( C0 )  D5
```

ʊ   32 bits counter

set as constant K

```
X001
─┤├──────( C300 )  K43,100
```

set in D register

```
X000
─┤├──────┤ DMOV │ K43100 │ D0 │

X001
─┤├──────( C300 )  D0   D1
```

C0~C299 are 16 bits linear increase counter (0~32767), when the counter value reaches 32767, it will stop count and keep the state.

C300~C599 are 32 bits linear increase/decrease counter (-2147483648~+2147483647), when the counter value reaches 2147483647, it will become -2147483648, when the counter value reaches -2147483648, it will become 2147483647, the counter state will change as the count value.

2-9 Data register (D)

XC series PLC data register D address is shown as below:

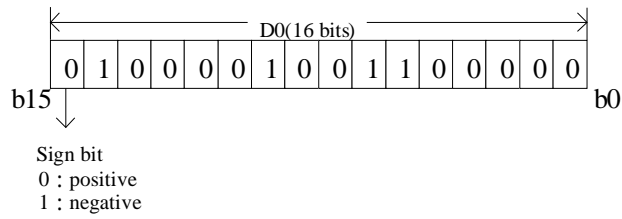| SERIES	NAME	RANGE		
		FOR COMMON USE	FOR POWER OFF RETENTIVE USE	FOR SPECIAL USE
XC1	D	D0~D99	D100~D149	D8000~D8029 / D8060~D8079 / D8120~D8179 / D8240~D8249 / D8306~D8313 / D8460~D8469 — 138
XC2	D	D0~D999	D4000~D4999	D8000~D8511 / D8630~D8729 — 612
XC3 XC5	D	D0~D3999	D4000~D7999	D8000~D9023 — 1024
XCM	D	D0~D2999	D3000~D4999	D8000~D9023 — 1024

Data register is soft element which used to store data, it includes 16 bits and 32 bits. (32 bits contains two registers, the highest bit is sign bit)
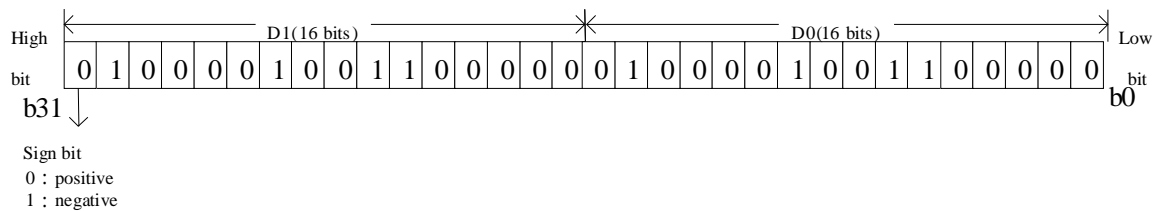
<table>
<tr><td rowspan="2">**16 bits**</td><td>

16 bits register range is -32,768 ~ +32,767

D0(16 bits)

| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

b15   b0

Sign bit
0   positive
1   negative
</td></tr>
</table>

Use the applied instruction to read and write the register data. Or use other devices such as HMI.

<table>
<tr><td rowspan="2">**32 bits**</td><td>

32 bits value is consisted of two registers. The range is -2147483648 ~ 2147483647.

High   D1(16 bits)   D0(16 bits)   Low

bit | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | bit

b31   b0

Sign bit
0   positive
1   negative
</td></tr>
</table>

When appoint the 32bits register, if set D0, the PLC will connect the next register D1 as the high bits. Generally, we often appoint even address register.

Function

| **Normal type**
  Ø   When write a new value in the register, the former value will be covered.
  Ø   When PLC from RUN to STOP or STOP to RUN, the value in the register will be cleared.
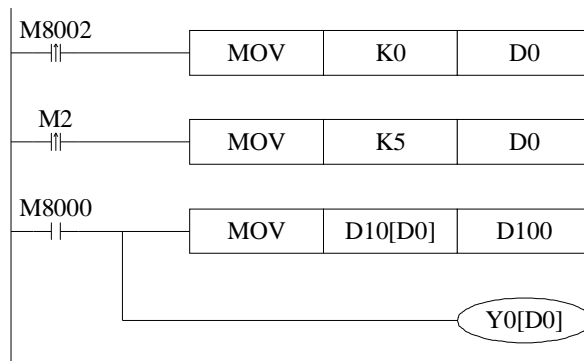| **Retentive type**

- Ø When PLC from RUN to STOP or power off, the value in the register will be retained.
- Ø The retentive register range can be set by user.

| Special type
- Ø Special register is used to set special data, or occupied by the system.
- Ø Some special registers are initialized when PLC is power on.
- Ø Please refer to the appendix for the special register address and function.

| Used as offset (indirect appoint)
- Ø Data register can be used as offset of soft element.
- Ø Format : Dn[Dm] Xn[Dm] Yn[Dm] Mn[Dm].
- Ø Word offset: DXn[Dm] means DX[n+Dm].
- Ø The offset value only can be set as D register.

```
M8002
 ─┤↑├──────────[ MOV    K0      D0 ]

M2
 ─┤↑├──────────[ MOV    K5      D0 ]

M8000
 ─┤├────┬──────[ MOV   D10[D0]  D100 ]
        │
        └──────────────────( Y0[D0] )
```

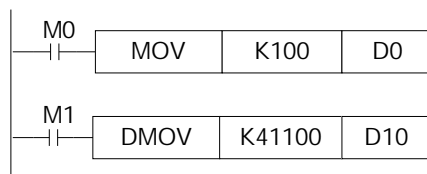When D0=0, D100=D10, Y0 is ON;

When M2 is from OFF   ON,   D0=5, D100=D15, Y5 is ON.

D10[D0]=D[10+D0], Y0[D0]=Y[0+D0].

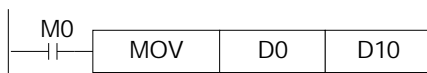| **Example** | Data register D can deal with many kinds of data and realize various controls. |

| Data storage

```
M0
─┤├──[ MOV   K100   D0 ]
```
When M0 is ON, write 100 into D0.(16 bits value)

```
M1
─┤├──[ DMOV  K41100  D10 ]
```
When M1 is ON, write 41100 into D11,D10 (32bits value)

| Data transfer

```
M0
─┤├──[ MOV   D0   D10 ]
```
When M0 is ON, transfer the value of D10 to D0

| Read the timer and counter
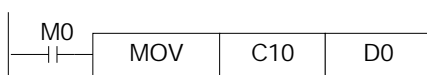
```
M0
─┤├──[ MOV   C10   D0 ]
```
When M0 is ON, move the value of C10 to D0.

❘ As the set value of timer and counter
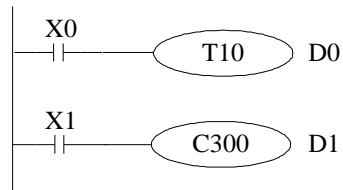
```
   X0
───┤├───────( T10 )── D0          When X0 is ON, T10 starts to work, the time is set in D0.

   X1
───┤├───────( C300 )── D1         When X1 is ON once, C300 increase 1, when C300 value=D1,
                                  C300 coil outputs.
```

| 2-10   Constant |

Data process   XC series PLC use the following 5 number systems.

❘ DEC: DECIMAL NUMBER
   Ø   The preset number of counter and timer (constant K)
   Ø   The number of Auxiliary relay M, timer T, counter C, state S.
   Ø   Set as the operand value and action of applied instruction (constant K)

❘ HEX: HEXADECIMAL   NUMBER
   Ø   Set as the operand value and action of applied instruction (constant K)

❘ BIN: BINARY   NUMBER
   Ø   Inside the PLC, all the numbers will be processed by binary. But when monitoring on
        the device, all the binary will be transformed into HEX or DEC.

❘ OCT: OCTAL   NUMBER
   Ø   XC series PLC I/O relays are addressed in OCT. Such as [0-7, 10-17,….70-77,100-107].

l BCD: BINARY CODE DECIMAL
  Ø BCD uses 4 bits binary number to display decimal number 0-9. BCD can be used in 7 segments LED and BCD output digital switch

l Other numbers (float number)

XC series PLC can calculate high precision float numbers. It is calculated by binary numbers, and display by decimal numbers.

Display	PLC program should use K, H to process values. K means decimal numbers, H means hex numbers. Please note the PLC input/output relay use octal address.

l Constant K

K is used to display decimal numbers. K10 means decimal number 10. It is used to set timer and counter value, operand value of applied instruction.

l Constant H

H is used to display hex numbers. H10 means hex number 10. It is used to set operand value of applied instruction.

2-11   PROGRAM PRINCIPLE

l Tag P   I

Tag P   I are used in branch division and interruption.

Tag for branch (P) is used in condition jump or subroutine's jump target;

Tag for interruption (I) is used to specify the e input interruption, time interruption;

The tags P   I are both in decimal form, each coding principle is listed below:

SERIES	NAME	RANGE
XC1 XC2 XC3 XC5 XCM	P	P0~P9999

SERIES	NAME	RANGE			
		FOR EXTERNAL INTERRUPTION			For time interruption
		Input terminals	Rising edge interruption	Falling edge interruption	
XC2	I	X2	I0000	I0001	There are 10 channels time interruption, the represent method is: I40**~I49**. ("**" represents interruption time, the unit is mm)
		X5	I0100	I0101	
		X10	I0200	I0201	

SERIES	NAME	I/O	RANGE			
			FOR EXTERNAL INTERRUPTION			For time interruption
			Input terminals	Rising edge interruption	Falling edge interruption	
XC3	I	14	X7	I0000	I0001	There are 10 channels time interruption, the represent method is: I40**~I49**. ("**" represents interruption time, the unit is mm)
		24 32	X2	I0000	I0001	
			X5	I0100	I0101	
			X10	I0200	I0201	
		19 48 60	X10	I0000	I0001	
			X7	I0100	I0101	
			X6	I0200	I0201	

SERIES	NAME	I/O	RANGE			
			FOR EXTERNAL INTERRUPTION			For time interruption
			Input terminals	Rising edge interruption	Falling edge interruption	
XC5	I	24 32	X2	I0000	I0001	There are 10 channels time interruption, the represent method is: I40**~I49**. ("**" represents interruption time, the unit is mm)
			X5	I0100	I0101	
			X10	I0200	I0201	
			X11	I0300	I0301	
			X12	I0400	I0401	
		48 60	X2	I0000	I0001	
			X5	I0100	I0101	
			X10	I0200	I0201	
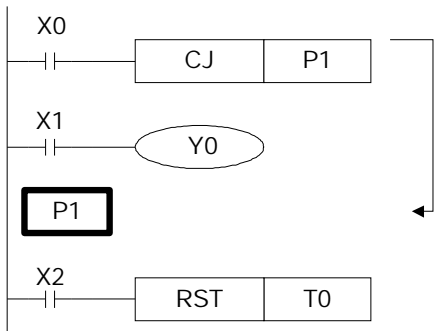
SERIES	NAME	I/O	RANGE			
			FOR EXTERNAL INTERRUPTION			For time interruption
			Input terminals	Rising edge interruption	Falling edge interruption	
XCM	I	24 32	X2	I0000	I0001	There are 10 channels time interruption, the represent method is: I40**~I49**.
			X5	I0100	I0101	

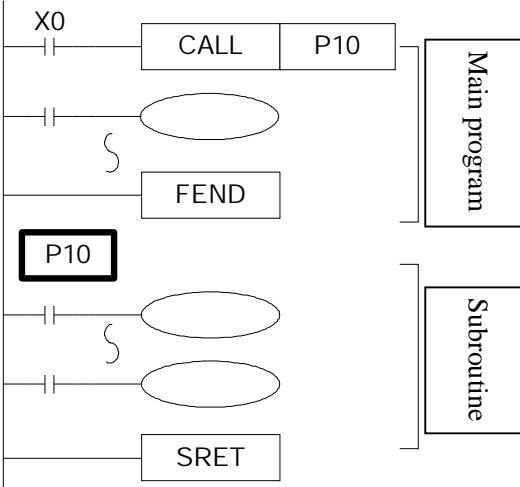|			X10	I0200	I0201	("**" represents interruption time, the
			X11	I0300	I0301	unit is mm)
			X12	I0400	I0401	

Tag P

Tag P is usually used in flow, it is used with CJ (condition jump) CALL (subroutine call)etc.

l   Condition Jump CJ

```
    X0
    ┤├────┤ CJ  │ P1 ├┐
    X1                │
    ┤├────( Y0 )      │
    ┌──┐              │
    │P1│              │◄
    └──┘              
    X2
    ┤├────┤ RST │ T0 │
```

If coil X0 gets ON, jump to the step behind tag P1;
If the coil X0 is not ON, do not execute jump action, but run with the original program;

l   Call the subroutine (CALL)

```
    X0
    ┤├────┤ CALL │ P10 ├─┐
                         │ Main program
    ┤├────(     )        │
          ∫              │
    ──────┤ FEND │       │
    ┌───┐
    │P10│                ┐
    └───┘                │
    ┤├────(     )        │ Subroutine
          ∫              │
    ┤├────(     )        │
    ──────┤ SRET │       ┘
```

If X0 gets ON, jump to the subroutine from the main program;
If the coil is not ON, run with the original program;

After executing the subroutine, return to the main program;

Tag I

Tag I is usually used in interruption, including external interruption, time interruption etc. use with IRET (interruption return)   EI (enable interruption)   DI (disable interruption);

l   External interruption
   Ø   Accept the input signal from the special input terminals, not effected by the scan cycle. Activate the input signal, execute the interruption subroutine.
   Ø   With external interruption, PLC can dispose the signal shorter than scan cycle; So it can be used as essential priority disposal in sequence control, or used in short time pulse control.
l   Time interruption
   Ø   Execute the interruption subroutine at each specified interruption loop tine. Use

this interruption in the control which requires it to be different with PLC's operation cycle;

l   Action order of input/output relays and response delay

    Ø   Input disposal

       Before PLC executing the program, read all the input terminal's ON/OFF status of PLC to the image area. In the process of executing the program, even the input changed, the content in the input image area will not change. However, in the input disposal of next scan cycle, read out the change.

    Ø   Output disposal

       Once finish executing all the instructions, transfer the ON/OFF status of output Y image area to the output lock memory area. This will be the actual output of the PLC. The contacts used for the PLC's exterior output will act according to the device's response delay time.

When use this input/output format in a batch, the drive time and operation cycle of input filter and output device will also appear response delay.

l   **Not accept narrow input pulse signal**

PLC's input ON/OFF time should be longer than its loop time. If consider input filter's response delay 10ms, loop time is 10ms then ON/OFF time needs 20 ms separately. So, up to 1 000/(20+20)=25Hz input pulse can't be disposed. But, this condition could be improved when use PLC's special function and applied instructions.

l   **Dual output Dual coils action**
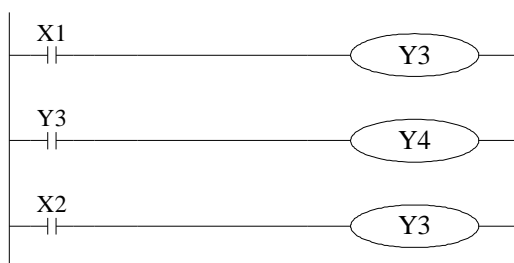
As shown in the left map, please consider the things of using the same coil Y003 at many positions:

E.g. X001=ON X002=OFF

At first, X001 is ON, its image area is ON, output Y004 is also ON.

When executing dual output (use dual coil), the back side act in prior.

But, as input X002 is OFF, the image area of Y003 is OFF.

So, the actual output is: Y003=OFF, Y004= ON.