1 Program Summary

XC series PLC as the controllers, accept the signal and execute the program in the controller, to fulfill the requirements from the users. In this chapter, we start with the program forms, introduce the main features, the supported two program languages etc.

1-1. Program Controller's Features

Program Language

XC series PLC support two kinds of program languages, instruction list and ladder, the two languages can convert to the other;

Security of the Program

To avoid the stolen or wrong modifying of user program, we encrypt the program. When uploading the encrypted program, it will check in the form of password. This can maintain the user's copyright; meantime, it limits the download, to avoid the modification with the program spitefully.

Program's comments

When the user program is too long, adding comments to the program and its soft components is necessary.

Offset Function

Add offset appendix (like X3[D100]、M10[D100]、D0[D100]) behind coils, data registers can realize indirect addressing. For example, when D100=9, X3[D100]=X14; M10[D100]=M19, D0[D100]=D9

Rich Basic Functions

- XC series PLC offers enough basic instructions, can fulfill basic sequential control, data moving and comparing, arithmetic operation, logic control, data loop and shift etc.
- XC series PLC also support special compare, high speed pulse, frequency testing, precise time, PID control, position control etc for interruption, high speed counter (HSC).

C Language Function Block

XC series PLC support C language function block, users can call the edited function block freely. This function reduces the program quantity greatly.

Stop when power ON Function

XC series PLC support “Stop when power on PLC” function. With this function, when there is a serious problem during PLC running, use this method to stop all output immediately. Besides, with this method, connect PLC when parameters are set wrongly.

Communication Function

XC series PLC support many communication formats, like basic Modbus communication, CABBUS communication, free format communication. Besides, via special network module, connect to Ether net, GPRS net.

1-2. Program Language

1-2-1. Type

XC series PLC support two types of program language:

Instruction List

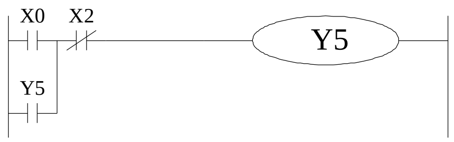
Instruction list inputs in the form of “LD”, “AND”, “OUT” etc. This is the basic input form of the programs, but it’s hard to read and understand;

E.g.:	Step	Instruction	Soft Components
	0	LD	X000
	1	OR	Y005
	2	ANI	X002
	3	OUT	Y005

Ladder

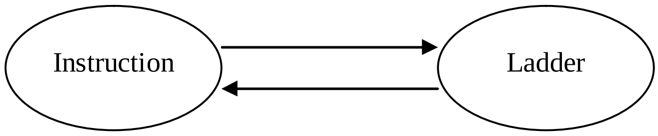
With sequential control signal and soft components, draw the sequential control graph on program interface, this method is called “Ladder”. This method use coil signs etc. to represent sequential circuit, so it’s easier to understand the program. Meantime, monitor PLC with the circuit’s status.

E.g.:



1-2-2. Alternation

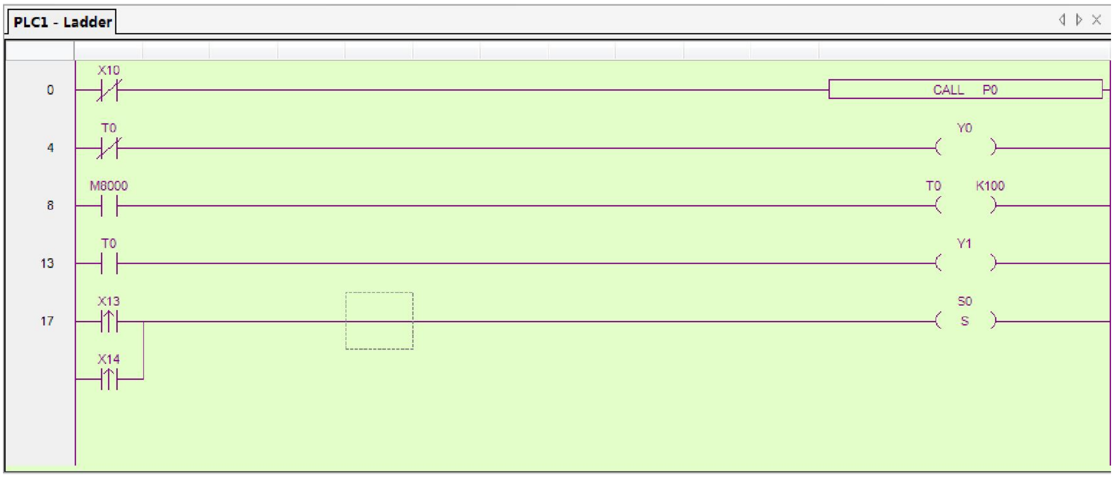
Convert the above two methods freely:



1-3. Program Format

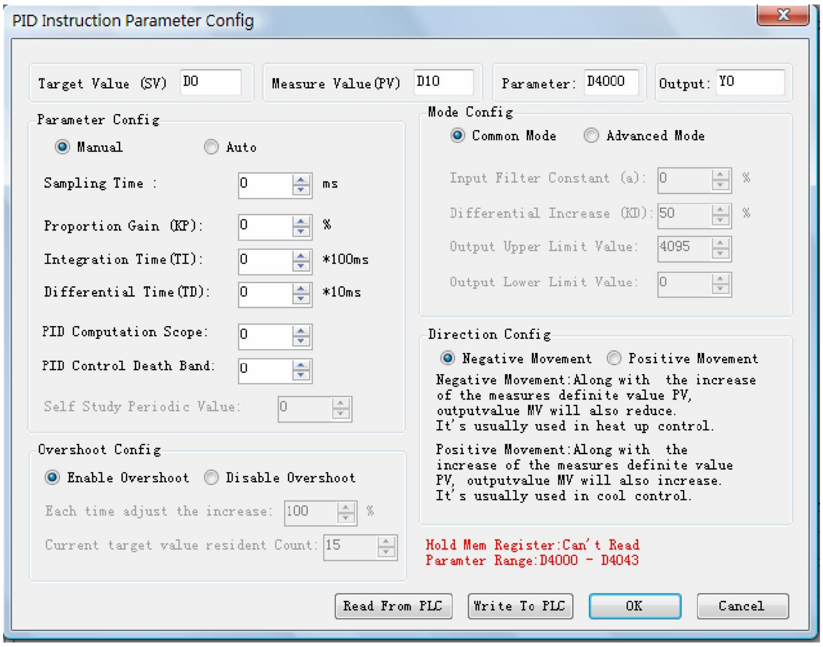
Direct Input

The above two program methods can input in the correspond interface separately, especially in the ladder window, there is a instruction hint function, which improves the program efficiency greatly;



Panel Configuration

As in XC series PLC, there are many instructions which has complicate usage and many using methods, like pulse output instruction, main unit PID etc. XCPPro also support the configure interface for these special instructions. In the correcpond configure interface, input the parameters and ID according to the requirements will be ok;



For the details of panel configuration, please refer《XC series PLC user manual【software part】》

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

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)

- Usage of the input relays

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

- Address Specify Principle
  - 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)
  - 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.
- Points to pay attention when using
  - For the input relay's input filter, we use digital filter. Users can change the filter parameters via relate settings.
  - 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）

- Usage of the output relays

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

- Address Assignment Principle
  - In each basic unit，assign the ID of output relays in the form of Y000~Y007，Y010~Y017… this octal format.
  - 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）

- Usage of Auxiliary Relays

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

- Address assignment principle

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

- Points to note
  - This type of relays are different with the input/output relays, they can't get external load, can only use in program;
  - Retentive relays can keep its ON/OFF status in case of PLC power OFF;

Status Relays（S）

- Usage of status relays

  Used as relays in Ladder, represent with “S”
- Address assignment principle

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

- 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”

- 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.

- 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;

- 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:

- For internal count (for general using/power off retentive usage)
  - 16 bits counter: for increment count, the count range is 1~32,767
  - 32 bits counter: for increment count, the count range is 1~2,147,483,647
  - These counters can be used by PLC’s internal signal. The response speed is one scan cycle or longer.
- For High Speed Count (Power off retentive)
  - 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.

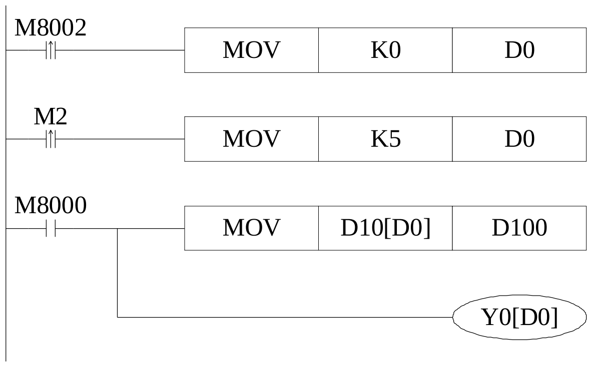
2-2. Structure of Soft Components

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)
  - Form: Dn[Dm]、Xn[Dm] 、Yn[Dm] 、Mn[Dm] etc.



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.

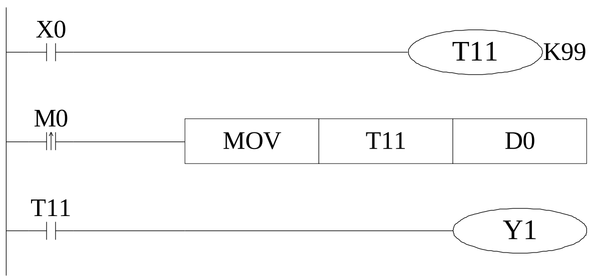
Therein, D10[D0]=D[10+D0]，Y0[D0]=Y[0+D0]。

  - The word offset combined by bit soft components: DXn[Dm] represents DX[n+Dm]。
  - 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.



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

LD T11, T11 represents bit register.

FlashROM Register FD

- For power off retentive usage, 16 bits
- For power off retentive usage, 16 bits, (via combine two sequential 16 bits registers)
- For special usage, occupied by the system, can’t be used as common instruction’s parameters

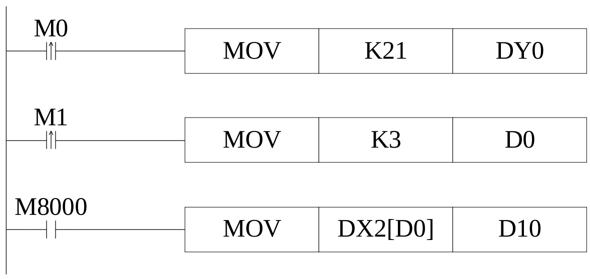
Expansion’s internal register ED

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

Bit soft components combined to be register

- For common usage, 16 bits, (via combine two sequential 16 bits registers)
- The soft components which can be combined to be words are: X、Y、M、S、T、C
- Format: add “D” in front of soft components, like DM10, represents a 16 bits data from M10~M25
- Get 16 points from DXn, but not beyond the soft components range;
- The word combined by bit soft components can’t realize bit addressing;

  E.g.:



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

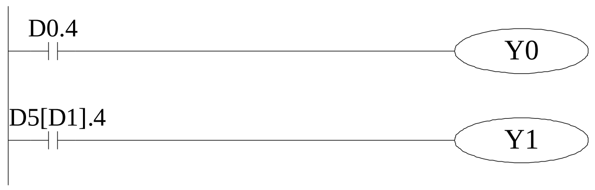
Relay

- 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 means when the Nr.4 bit of D0 is 1, set Y0 ON .
  - D5[D1].4 means bit addressing with offset, if D1=5, then D5[D1] means the Nr.4 bit of D10

2-3. Soft Components List

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 ※5M8000~M8079				128			
		For Special Usage ※5M8120~M8139							
		For Special Usage ※5M8170~M8172							
		For Special Usage ※5M8238~M8242							
		For Special Usage ※5M8350~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 ※5D8000~D8029				138			
		For Special Usage ※5D8060~D8079							
		For Special Usage ※5D8120~D8179							
		For Special Usage ※5D8240~D8249							
		For Special Usage ※5D8306~D8313							
		For Special Usage ※5D8460~D8469							
FD	FlashROM	FD0~FD411				412			

	Register※6	For Special Usage ※5FD8000~FD8011	98
		For Special Usage ※5FD8202~FD8229	
		For Special Usage ※5FD8306~FD8315	
		For Special Usage ※5FD8323~FD8335	
		For Special Usage ※5FD8350~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※5M8000~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※5D8000~D8511				612			

		For Special Usage※5D8630~D8729	
FD	FLASH Register	FD0~FD127	128
		For Special Usage※5FD8000~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※5M8000~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※5D8000~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※5FD8000~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※5M8000~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※5D8000~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;

2-3-2. Power Off Retentive Zone

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.

2-4. Input/output relays（X、Y）

Number List

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

Series	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
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

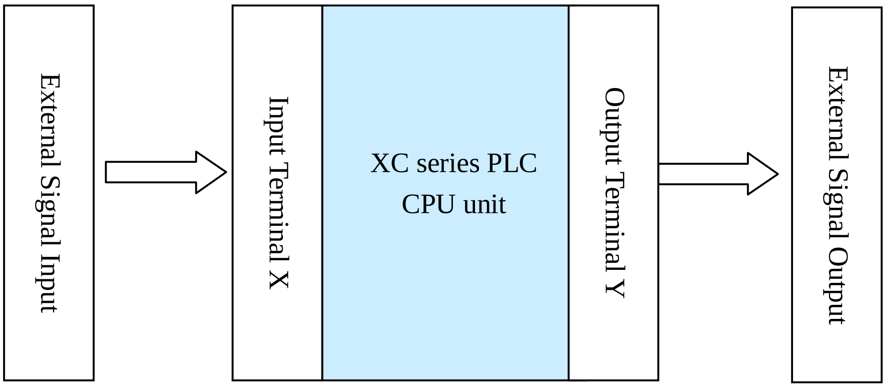
Series	Name	Range				Points			
		14 I/O	16 I/O	24/32 I/O	48/60 I/O	14 I/O	16 I/O	24/32 I/O	48/60 I/O
XC2	X	X0~X7	X0~X7	X0~X15 X0~X21	X0~X33 X0~X43	8	8	14/18	28/36
	Y	Y0~Y5	Y0~Y7	Y0~Y11 Y0~Y15	Y0~Y23 Y0~Y27	6	8	10/14	20/24

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

Function



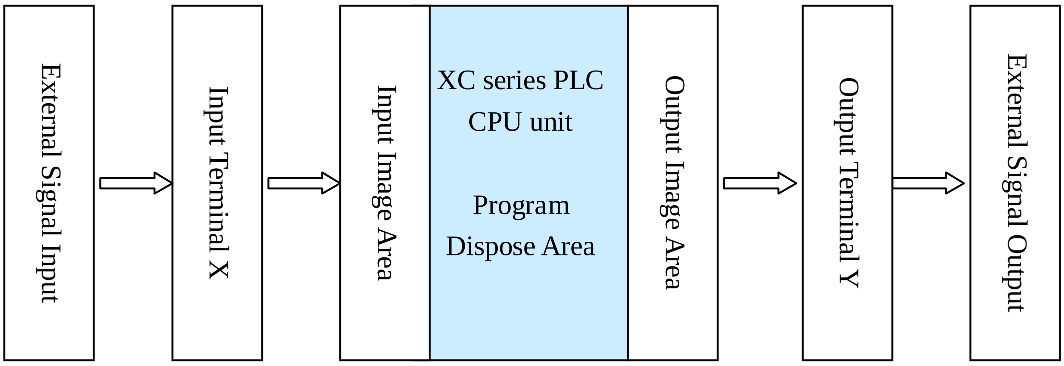
Input Relay X

- 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



- Input Disposal
  - Before PLC executing the program, read every 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.
- 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 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.

- For common use
  - 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.
  - Common usage relays can't be used for power off retentive, but the zone can be modified;

- For Power Off Retentive Use
  - The auxiliary relays for power off retentive usage, even the PLC is OFF, they can keep the ON/OFF status before power OFF.
  - Power off retentive zone can be modified by the user;
  - 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;

- For Special Usage
  - Special relays refer some relays which are defined with special meanings or functions, start from M8000.
  - 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"
  - Special auxiliary relays can't be used as normal relay M;

2-6. Status Relay (S)

Address List

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;

- For common use

  After shut off the PLC power, this type of relays will be OFF status;
- For Power Off Retentive Use
  - The status relays for power off retentive usage, even the PLC is OFF, they can keep the ON/OFF status before power OFF.
  - Power off retentive zone can be modified by the user;
- The status relays also have countless "normally ON/OFF" contactors. So users can use them freely in the program;

2-7．Timer (T)

Address List

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

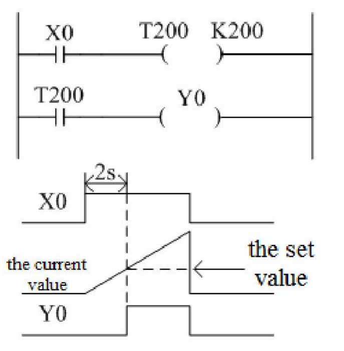
SERIES	NAME	RANGE	
		FOR COMMON USE	POINTS
XC1	T	T0~T23: 100ms not accumulation	80
		T100~T115: 100ms accumulation	
		T200~T223: 10ms not accumulation	
		T300~T307: 10ms accumulation	
		T400~T403: 1ms not accumulation	
		T500~T503: 1ms accumulation	
XC2 XC3 XC5 XCM	T	T0~T99: 100ms not accumulation	640
		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	

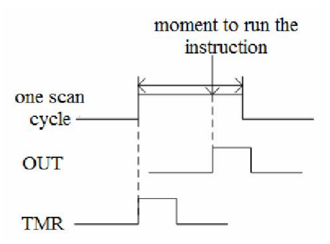
Function

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

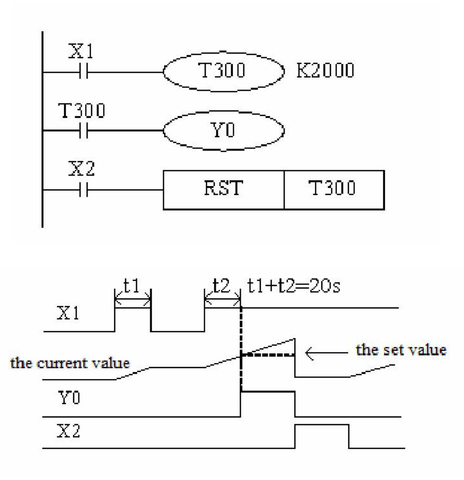




- If X0 is ON, then T200 accumulate 10ms clock pulse based on the current value; when the accumulation value reaches the set value K200, the timer's output contact activates. I.e. the output contact activates 2s later. If X0 breaks, the timer resets, the output contact resets;

- 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



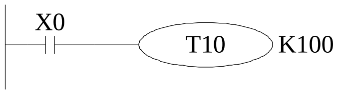
If X001 is ON, then T300 accumulate 10ms clock pulse based on the current value; when the accumulation value reaches the set value K2000, the timer's output contact activates. I.e. the output contact activates 2s later.

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;

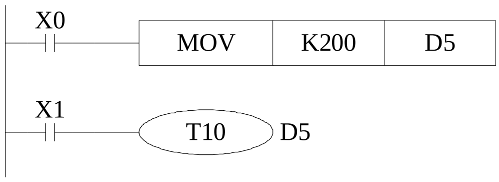
Specify the set value

《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.

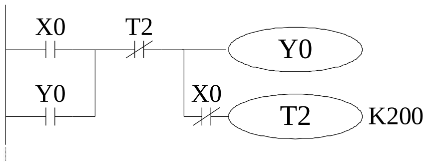
If set as the retentive register, make sure the battery voltage is enough, or the value will be unstable.

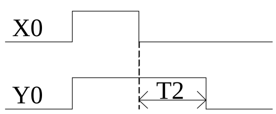
Timer Value

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》

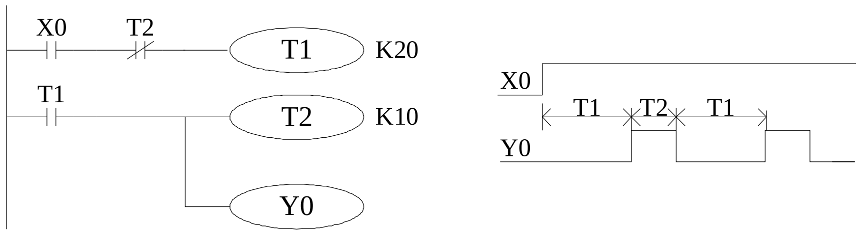




When X000 is ON, output Y000;

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:

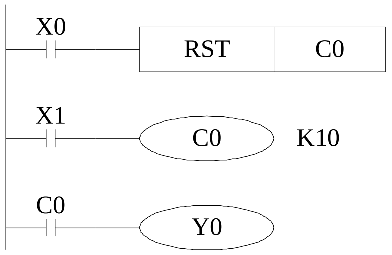
Items	16 bits counter	32 bits counter
Count direction	Positive	Positive/negative
The set value	1~32,767	-2,147,483,648~+2,147,483,647
The assigned set value	Constant K or data register	Same as the left, but data register must be in a couple
Changing of the current value	Change after positive count	Change 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

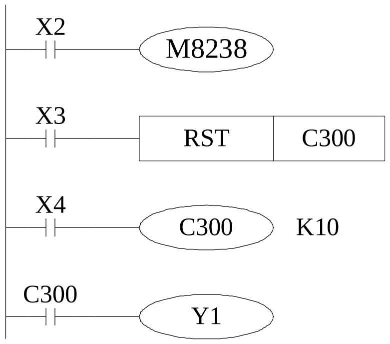


If cut the PLC power supply, the normal counter value become zero, the retentive counter can store the value, it can accumulate the value of last time.

- 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 counter normal/retentive type

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



- If M8238=1, it is decrease mode; M8238=0, it is increase mode.
- Set the count value in K or D, if set in D0 register, D0 and D1 will be seemed as one 32bits value.
- X004 is ON, C300 starts to count.

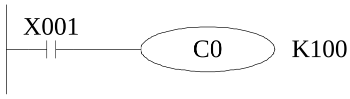
- If X003 is ON, reset the counter and C300 output.
- If use retentive counter, the count value will be stored in PLC.
- 32 bits counter can be used as 32 bits register.

Set the count value

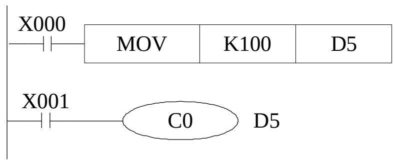
It includes 16 bits and 32 bits count value.

- 16 bits counter

《set as constant K》

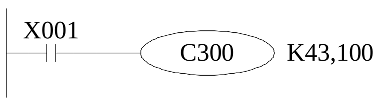


《set in D register》

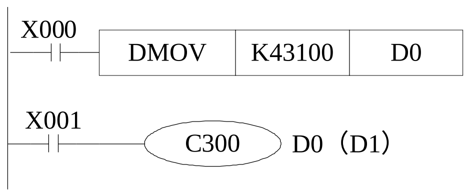


- 32 bits counter

《set as constant K》



《set in D register》



Count value

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)

Address list

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

<table>
<tr><th rowspan="2">SERIES</th><th rowspan="2">NAME</th><th colspan="4">RANGE</th></tr>
<tr><th>FOR COMMON USE</th><th>FOR POWER OFF RETENTIVE USE</th><th colspan="2">FOR SPECIAL USE</th></tr>
<tr><td rowspan="6">XC1</td><td rowspan="6">D</td><td rowspan="6">D0~D99</td><td rowspan="6">D100~D149</td><td>D8000~D8029</td><td rowspan="6">138</td></tr>
<tr><td>D8060~D8079</td></tr>
<tr><td>D8120~D8179</td></tr>
<tr><td>D8240~D8249</td></tr>
<tr><td>D8306~D8313</td></tr>
<tr><td>D8460~D8469</td></tr>
<tr><td rowspan="2">XC2</td><td rowspan="2">D</td><td rowspan="2">D0~D999</td><td rowspan="2">D4000~D4999</td><td>D8000~D8511</td><td rowspan="2">612</td></tr>
<tr><td>D8630~D8729</td></tr>
<tr><td>XC3
XC5</td><td>D</td><td>D0~D3999</td><td>D4000~D7999</td><td>D8000~D9023</td><td>1024</td></tr>
<tr><td>XCM</td><td>D</td><td>D0~D2999</td><td>D3000~D4999</td><td>D8000~D9023</td><td>1024</td></tr>
</table>

Structure

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)

16 bits

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

	D0(16 bits)																
b15	0	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	b0

Sign bit
0：positive
1：negative

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

32 bits

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

High bit	D1(16 bits)																D0(16 bits)																Low bit
b31	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	b0

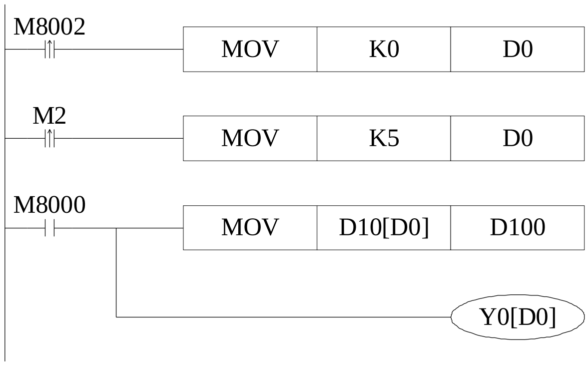
Sign bit
0：positive
1：negative

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

  - When PLC from RUN to STOP or power off, the value in the register will be retained.
  - The retentive register range can be set by user.
- Special type
  - Special register is used to set special data, or occupied by the system.
  - Some special registers are initialized when PLC is power on.
  - Please refer to the appendix for the special register address and function.
- Used as offset (indirect appoint)
  - Data register can be used as offset of soft element.
  - Format : Dn[Dm]、Xn[Dm]、Yn[Dm]、Mn[Dm].
  - Word offset: DXn[Dm] means DX[n+Dm].
  - The offset value only can be set as D register.



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

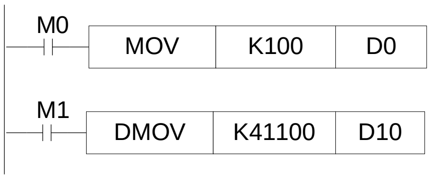
When M2 is from OFF→ON, D0=5, D100=D15, Y5 is ON.

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.

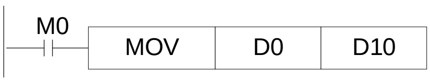
- Data storage



When M0 is ON, write 100 into D0.(16 bits value)

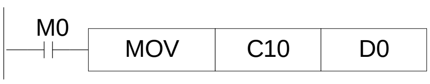
When M1 is ON, write 41100 into D11,D10 (32bits value)

- Data transfer



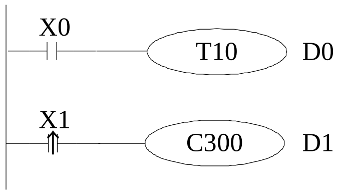
When M0 is ON, transfer the value of D10 to D0

- Read the timer and counter



When M0 is ON, move the value of C10 to D0.

- As the set value of timer and counter



When X0 is ON, T10 starts to work, the time is set in D0.

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

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

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

- BCD: BINARY CODE DECIMAL
  - 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

- 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.

- 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.

- 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

- 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

<table>
<tr><th rowspan="3">SERIES</th><th rowspan="3">NAME</th><th colspan="4">RANGE</th></tr>
<tr><th colspan="3">FOR EXTERNAL INTERRUPTION</th><th rowspan="2">For time interruption</th></tr>
<tr><th>Input terminals</th><th>Rising edge interruption</th><th>Falling edge interruption</th></tr>
<tr><td rowspan="3">XC2</td><td rowspan="3">I</td><td>X2</td><td>I0000</td><td>I0001</td><td rowspan="3">There are 10 channels time interruption, the represent method is: I40**~I49**. (“**” represents interruption time, the unit is mm)</td></tr>
<tr><td>X5</td><td>I0100</td><td>I0101</td></tr>
<tr><td>X10</td><td>I0200</td><td>I0201</td></tr>
</table>

<table>
<tr><th rowspan="3">SERIES</th><th rowspan="3">NAME</th><th rowspan="3">I/O</th><th colspan="4">RANGE</th></tr>
<tr><th colspan="3">FOR EXTERNAL INTERRUPTION</th><th rowspan="2">For time interruption</th></tr>
<tr><th>Input terminals</th><th>Rising edge interruption</th><th>Falling edge interruption</th></tr>
<tr><td rowspan="7">XC3</td><td rowspan="7">I</td><td>14</td><td>X7</td><td>I0000</td><td>I0001</td><td rowspan="7">There are 10 channels time interruption, the represent method is: I40**~I49**. (“**” represents interruption time, the unit is mm)</td></tr>
<tr><td rowspan="3">24
32</td><td>X2</td><td>I0000</td><td>I0001</td></tr>
<tr><td>X5</td><td>I0100</td><td>I0101</td></tr>
<tr><td>X10</td><td>I0200</td><td>I0201</td></tr>
<tr><td rowspan="3">19
48
60</td><td>X10</td><td>I0000</td><td>I0001</td></tr>
<tr><td>X7</td><td>I0100</td><td>I0101</td></tr>
<tr><td>X6</td><td>I0200</td><td>I0201</td></tr>
</table>

<table>
<tr><th rowspan="3">SERIES</th><th rowspan="3">NAME</th><th rowspan="3">I/O</th><th colspan="4">RANGE</th></tr>
<tr><th colspan="3">FOR EXTERNAL INTERRUPTION</th><th rowspan="2">For time interruption</th></tr>
<tr><th>Input terminals</th><th>Rising edge interruption</th><th>Falling edge interruption</th></tr>
<tr><td rowspan="8">XC5</td><td rowspan="8">I</td><td rowspan="5">24
32</td><td>X2</td><td>I0000</td><td>I0001</td><td rowspan="8">There are 10 channels time interruption, the represent method is: I40**~I49**. (“**” represents interruption time, the unit is mm)</td></tr>
<tr><td>X5</td><td>I0100</td><td>I0101</td></tr>
<tr><td>X10</td><td>I0200</td><td>I0201</td></tr>
<tr><td>X11</td><td>I0300</td><td>I0301</td></tr>
<tr><td>X12</td><td>I0400</td><td>I0401</td></tr>
<tr><td rowspan="3">48
60</td><td>X2</td><td>I0000</td><td>I0001</td></tr>
<tr><td>X5</td><td>I0100</td><td>I0101</td></tr>
<tr><td>X10</td><td>I0200</td><td>I0201</td></tr>
</table>

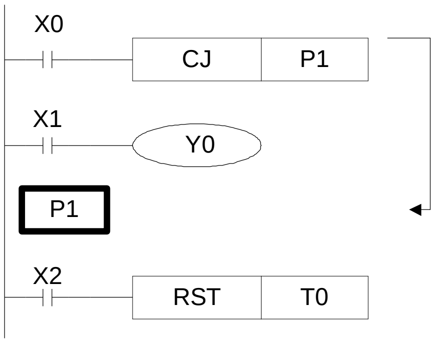
<table>
<tr><th rowspan="3">SERIES</th><th rowspan="3">NAME</th><th rowspan="3">I/O</th><th colspan="4">RANGE</th></tr>
<tr><th colspan="3">FOR EXTERNAL INTERRUPTION</th><th rowspan="2">For time interruption</th></tr>
<tr><th>Input terminals</th><th>Rising edge interruption</th><th>Falling edge interruption</th></tr>
<tr><td rowspan="2">XCM</td><td rowspan="2">I</td><td rowspan="2">24
32</td><td>X2</td><td>I0000</td><td>I0001</td><td rowspan="2">There are 10 channels time interruption, the represent method is: I40**~I49**.</td></tr>
<tr><td>X5</td><td>I0100</td><td>I0101</td></tr>
</table>

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

Tag P

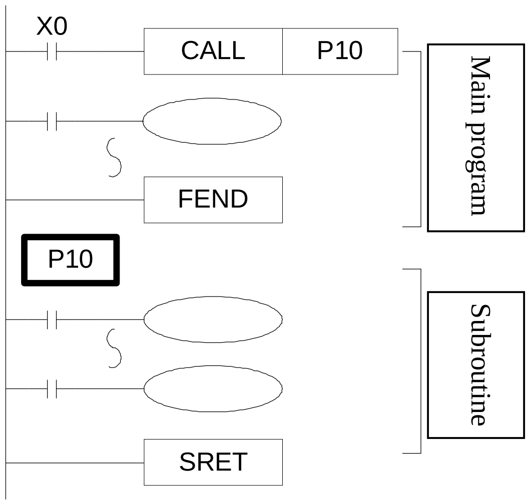
Tag P is usually used in flow, it is used with CJ (condition jump)、CALL (subroutine call)etc.

- Condition Jump CJ



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;

- Call the subroutine (CALL)



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);

- 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.
- Time interruption
  - Ø Execute the interruption subroutine at each specified interruption loop time. Use

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

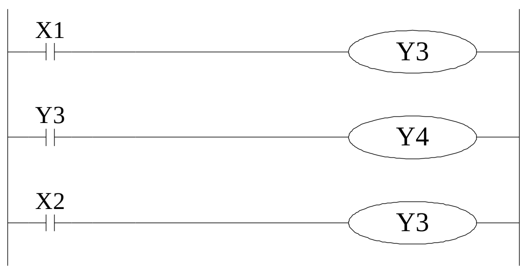
- Action order of input/output relays and response delay
  - Input disposal
    Before PLC executing the program, read all the input terminal's ON/OFF status of PLC to the image area. In the process of executing the program, even the input changed, the content in the input image area will not change.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

- **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.

- **Dual output（Dual coils）action**



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

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.

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

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

3 Basic Program Instructions

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

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

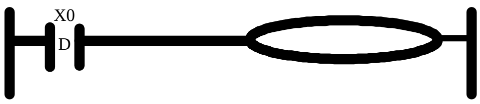
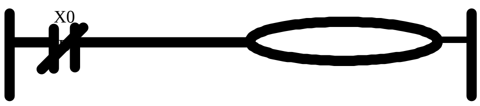
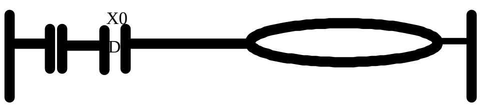
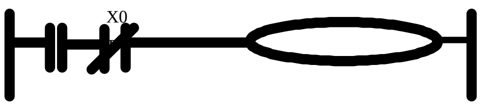
3-14． [NOP], [END]

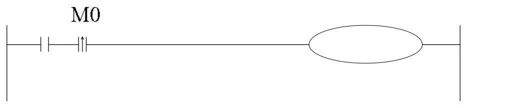
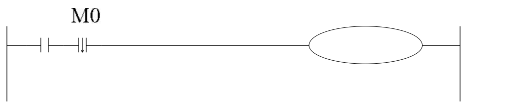
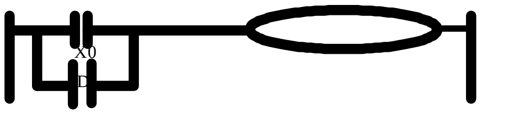
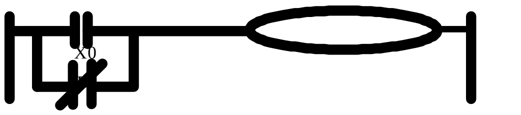
3-15． [GROUP], [GROUPE]

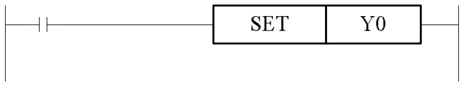
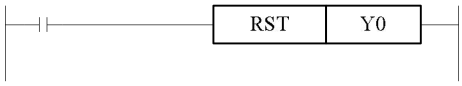
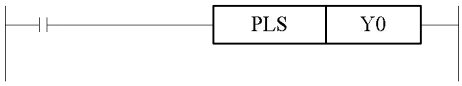
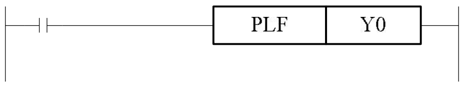
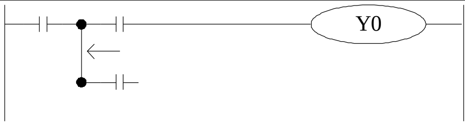
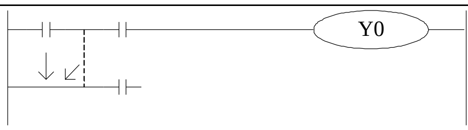
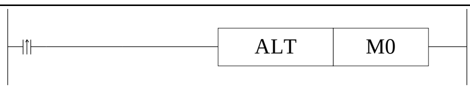
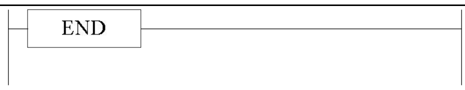
3-16． Items to be attended when programming

3-1. Basic Instructions List

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

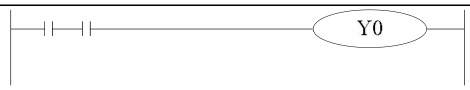
Mnemonic	Function	Format and Device	**Chapter**
LD (LoaD)	Initial logical operation contact type NO (normally open)	 X、Y、M、S、T、C、Dn.m、FDn.m	3-2
LDD (LoaD Directly)	Read the status from the contact directly	 X	3-6
LDI (LoaD Inverse)	Initial logical operation contact type NC (normally closed)	 X、Y、M、S、T、C、Dn.m、FDn.m	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	 X、Y、M、S、T、C、Dn.m、FDn.m	3-5
ANDF (AND Falling pulse)	Serial connection of falling/trailing edge pulse	 X、Y、M、S、T、C、Dn.m、FDn.m	3-5
OR (OR)	Parallel connection of NO (normally open) contacts	 X、Y、M、S、T、C、Dn.m、FDn.m	3-4
ORD	Read the status from the contact directly	 X	3-6
ORI (OR Inverse)	Parallel connection of NC (normally closed) contacts	 X、Y、M、S、T、C、Dn.m、FDn.m	3-4
ORDI	Read the normally closed contact directly	 X	3-6
ORP (OR Pulse)	Parallel connection of rising edge pulse	 X、Y、M、S、T、C、Dn.m、FDn.m	3-5
ORF (OR Falling pulse)	Parallel connection of falling/trailing edge pulse	 X、Y、M、S、T、C、Dn.m、FDn.m	3-5
ANB (ANd Block)	Serial connection of multiply parallel circuits	 None	3-8
ORB (OR Block)	Parallel connection of multiply parallel circuits	 None	3-7
OUT (OUT)	Final logic operation type coil drive	 Y、M、S、T、C、Dn.m	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

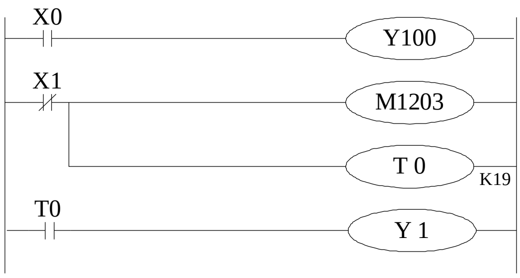
Statement

- 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

Program




```
LD    X0
OUT   Y100
LDI   X1
OUT   M1203
OUT   T0     K19
LD    T0
OUT   Y1
```

3-3．[AND] , [ANI]

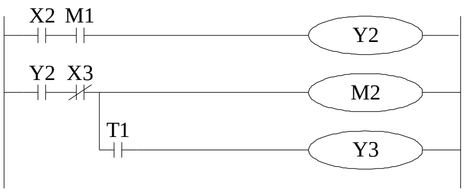
Mnemonic and Function

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

- 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.
- 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.

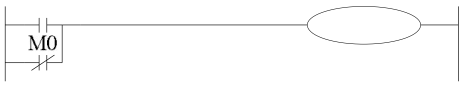
Program



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

3-4. [OR] , [ORI]

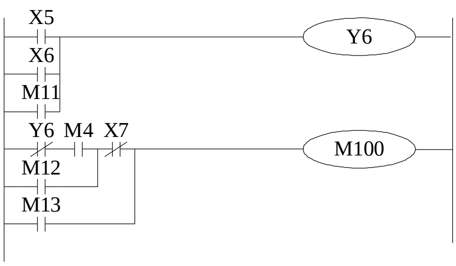
Mnemonic and Function

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

Statements

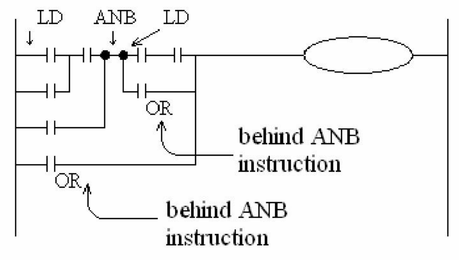
- Use the OR and ORI instructions for parallel connection of contacts. To connect a block that contains more than one contact connected in series to another circuit block in parallel, use an ORB instruction, which will be described later;
- OR and ORI start from the instruction's step, parallel connect 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]

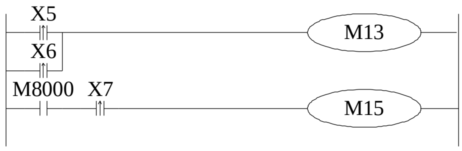
Mnemonic and Function

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

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.

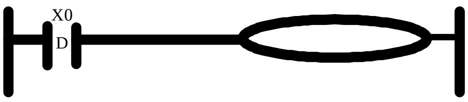
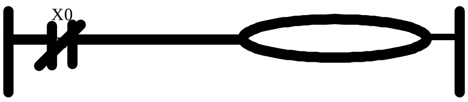
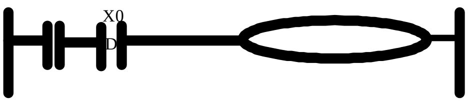
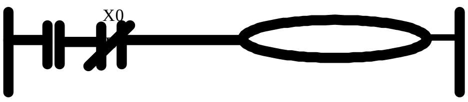
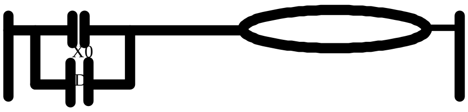
Program

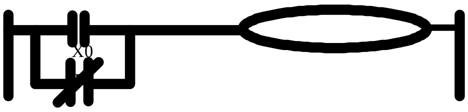


LDP	X5
ORP	X6
OUT	M13
LD	M8000
ANDP	X7
OUT	M15

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

Mnemonic and Function

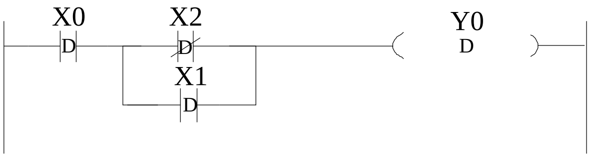
Mnemonic	Function	Format and Operands
LDD	Read the status from the contact directly	 Devices: X
LDDI	Read the normally closed contact directly	 Devices: X
ANDD	Read the status from the contact directly	 Devices: X
ANDDI	Read the normally closed contact directly	 Devices: X
ORD	Read the status from the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

		Devices: X
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.

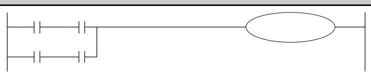
Program




```
LDD     X0
LDDI    X2
ORD     X2
ANB
OUTD    Y0
```

3-7. [ORB]

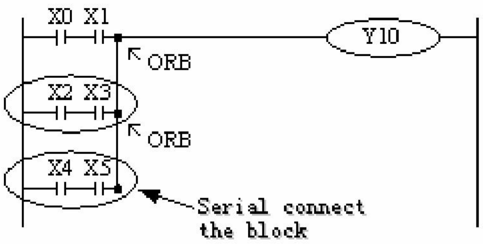
Mnemonic and Function

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
```

3-8．[ANB]

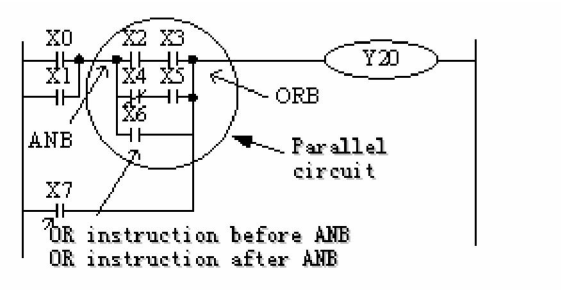
Mnemonic and Function

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]

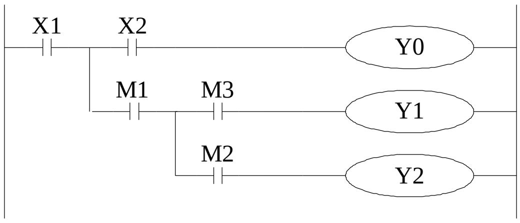
Mnemonic and Function

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.

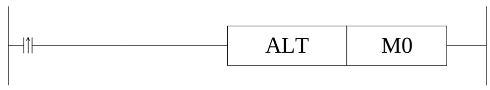
Program



LD	X1	
MCS		Bus line starts
LD	X2	
OUT	Y0	
LD	M1	
MCS		Bus line nest
LD	M3	
OUT	Y1	
LD	M2	
OUT	Y2	
MCR		
MCR		Bus line back

3-10．[ALT]

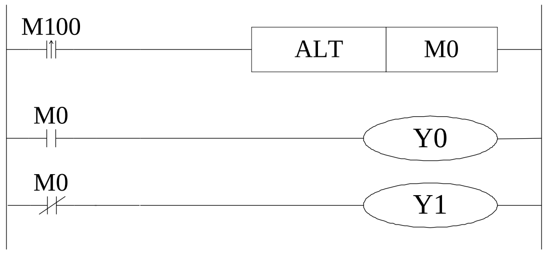
Mnemonic and Function

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.

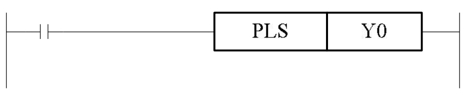
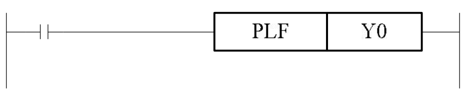
Program



LDP	M100
ALT	M0
LD	M0
OUT	Y0
LDI	M0
OUT	Y1

3-11．[PLS] , [PLF]

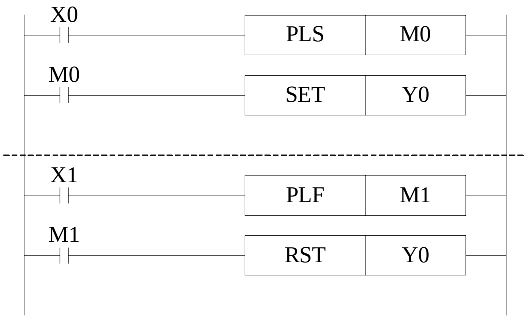
Mnemonic and Function

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

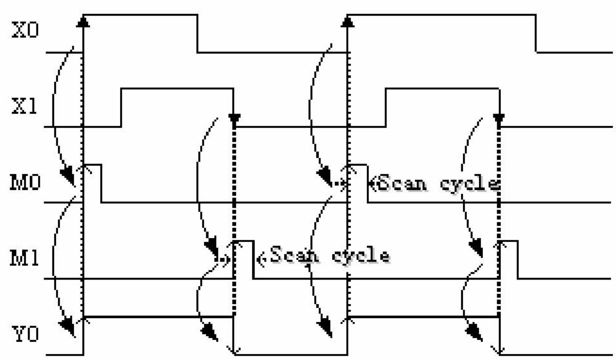
Statements

- 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

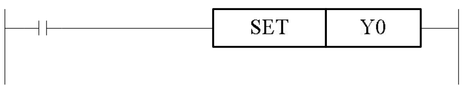
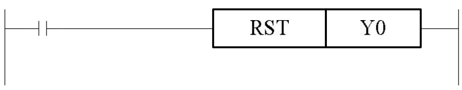



```
LD    X0
PLS   M0
LD    M0
SET   Y0
----------------------
LD    X1
PLF   M1
LD    M1
RST   Y0
```



3-12．[SET] , [RST]

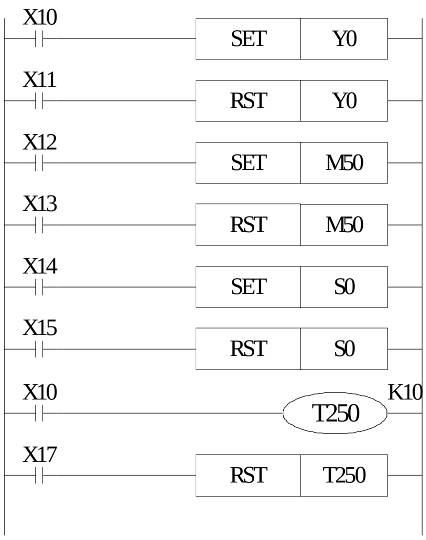
Mnemonic and Function

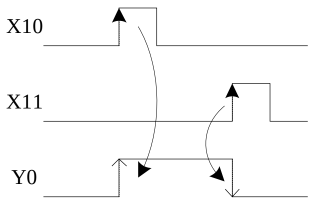
Mnemonic	Function	Format and Devices
SET（Set）	Set a bit device permanently ON	 Devices： Y、M、S、T、C、Dn.m
RST(Reset)	Reset a bit device permanently OFF	 Devices： Y、M、S、T、C、Dn.m

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

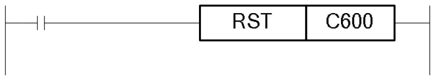




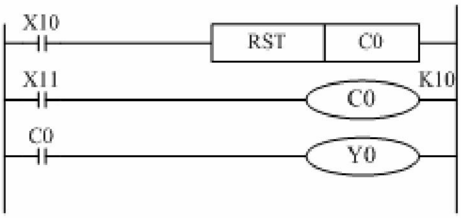
LD	X10	
SET	Y0	
LD	X11	
RST	Y0	
LD	X12	
SET	M50	
LD	X13	
RST	M50	
LD	X14	
SET	S0	
LD	X15	
RST	S0	
LD	X10	
OUT	T250	K10
LD	X17	
RST	T250	

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

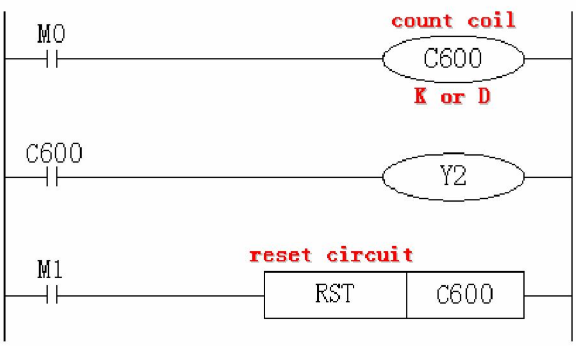


Counter used for power cut retentive. Even when power is cut, hold the current value and output contact's action status and reset status.

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



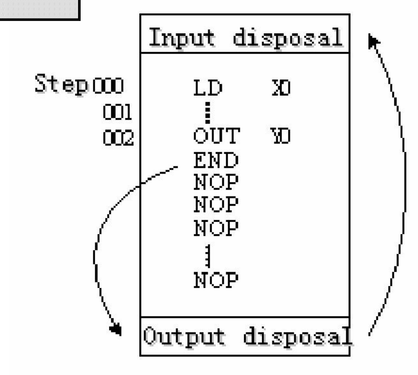
- In the preceding example, when M0 is ON, carry on positive count with OFF→ON of X0.
- Counter's current value increase, when reach the set value (K or D), the output contact is reset.
- When M1 is ON, counter's C600 output contact is reset, counter's current value turns to be 0.

3-14. [END]

Mnemonic and Function

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

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.)

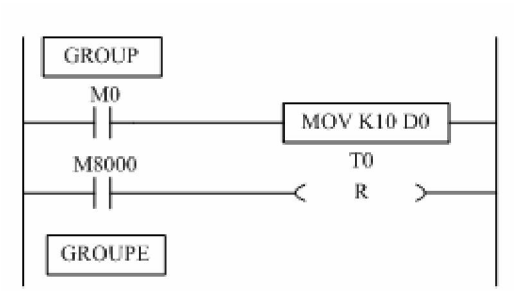
3-15. [GROUP] , [GROUPE]

Mnemonic and Function

Mnemonic	Function	Format and Device
GROUP	GROUP	GROUP Devices: None
GROUPE	GROUP END	GROUPE Devices: None

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.

3-16. Items To Note When Programming

1、Contacts' structure and step number

Even in the sequencial 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.

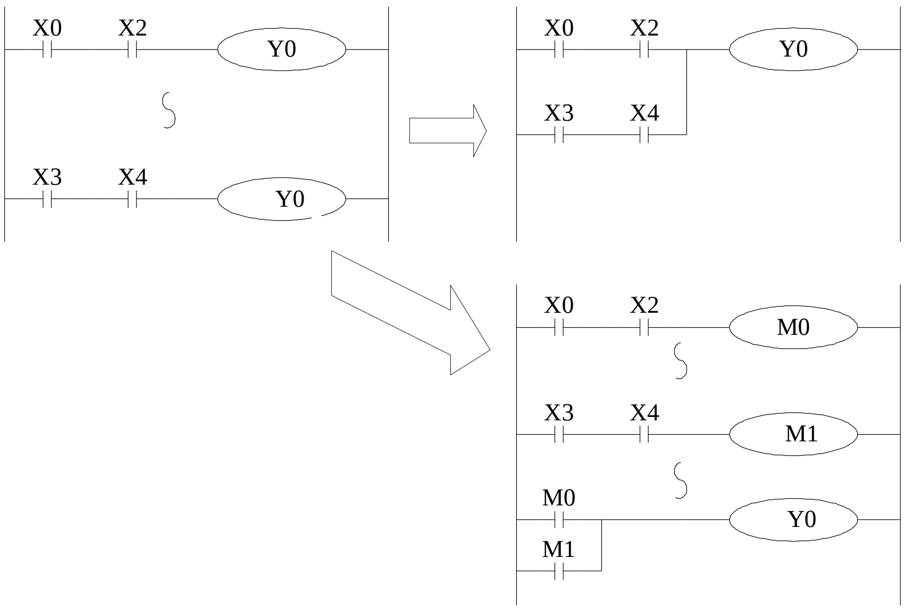
2、Program's executing sequence

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

Sequencial 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 sequencial 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.

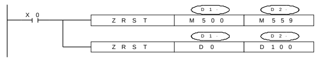
4 Applied Instructions

In this chapter, we describe applied instruction’s function of XC series PLC.

4-1. Applied Instruction List

Mnemonic	Function	Ladder chart	Chapter
Program Flow			
CJ	Condition jump	CJ Pn	4-3-1
CALL	Call subroutine	CALL Pn	4-3-2
SRET	Subroutine return	SRET	4-3-2
STL	Flow start	STL Sn	4-3-3
STLE	Flow end	S 1 ·	4-3-3
SET	Open the assigned flow, close the current flow	S ·	4-3-3
ST	Open the assigned flow, not close the current flow	D ·	4-3-3
FOR	Start a FOR-NEXT loop	D ·	4-3-4
NEXT	End of a FOR-NEXT loop	D ·	4-3-4
FEND	Main program END	D ·	4-3-5
END	Program END	END	4-3-5
Data Compare			
LD＝	LD activates if (S1) = (S2)	S ·	4-4-1
LD＞	LD activates if (S1) > (S2)	D ·	4-4-1
LD＜	LD activates if (S1) =< (S2)	D ·	4-4-1
LD＜＞	LD activates if（S1）≠（S2）	D ·	4-4-1
LD＜＝	LD activates if（S1）≤（S2）	D ·	4-4-1
LD＞＝	LD activates if（S1）≥（S2）	LD＞= S1 S2	4-4-1
AND＝	AND activates if (S1）＝（S2）	AND＝ S1 S2	4-4-2

AND＞	AND activates if (S1) ＞ (S2)	AND> | S1 | S2	4-4-2
AND＜	AND activates if (S1) ＜ (S2)	AND< | S1 | S2	4-4-2
AND＜＞	AND activates if (S1) ≠ (S2)	AND<> | S1 | S2	4-4-2
AND＜＝	AND activates if (S1) ≤ (S2)	AND<= | S1 | S2	4-4-2
AND＞＝	AND activates if (S1) ≥ (S2)	X1 BMOV | D10 | D9 | K3 X2 BMOV | D10 | D11 | K3	4-4-2
OR＝	OR activates if (S1) ＝ (S2)	OR= | S1 | S2	4-4-3
OR＞	OR activates if (S1) ＞ (S2)	X0 PMOV | D5 (S·) | D10 (D·) | K3 (n)	4-4-3
OR＜	OR activates if (S1) ＜ (S2)	OR＜ | S1 | S2	4-4-3
OR＜＞	OR activates if (S1) ≠ (S2)	OR＜＞ | S1 | S2	4-4-3
OR＜＝	OR activates if (S1) ≤ (S2)	X0 DFMOV | D0 (S·) | D10 (D·) | K3 (n)	4-4-3
OR＞＝	OR activates if (S1) ≥ (S2)	OR＞= | S1 | S2	4-4-3
Data Move			
CMP	Compare the data	CMP | S1 | S | D	4-5-1
ZCP	Compare the data in certain area	X2 FWRT | D0 (S·) | FD0 (D1·) | K3 (D2·)	4-5-2
MOV	Move	MOV | S | D	4-5-3
BMOV	Block move	X0 MSET | M10 (D1·) | M120 (D2·)	4-5-4
PMOV	Transfer the Data block	D 2 ·	4-5-5
FMOV	Multi-points repeat move	D 1 ·	4-5-6
FWRT	Flash ROM written	D 2 ·	4-5-7
MSET	Zone set	D 1 ·	4-5-8
ZRST	Zone reset	D 2 ·	4-5-9
SWAP	Swap the high and low byte	D 1 ·	4-5-10

XCH	Exchange two values		4-5-11
Data Operation			
ADD	Addition	D 2 ·	4-6-1
SUB	Subtraction	D 1 ·	4-6-2
MUL	Multiplication	D 2 ·	4-6-3
DIV	Division	D 1 ·	4-6-4
INC	Increment	D 1 ·	4-6-5
DEC	Decrement	D 2 ·	4-6-5
MEAN	Mean	D 1 ·	4-6-6
WAND	Word And	WAND S1 S2 D	4-6-7
WOR	Word OR	WOR S1 S2 D	4-6-7
WXOR	Word exclusive OR	WXOR S1 S2 D	4-6-7
CML	Compliment	CML S D	4-6-8
NEG	Negative	NEG D	4-6-9
Data Shift			
SHL	Arithmetic Shift Left	SHL D n	4-7-1
SHR	Arithmetic Shift Right	SHR D n	4-7-1
LSL	Logic shift left	LSL D n	4-7-2
LSR	Logic shift right	LSR D n	4-7-2
ROL	Rotation shift left	ROL D n	4-7-3
ROR	Rotation shift right	ROR D n	4-7-3
SFTL	Bit shift left	SFTL S D n1 n2	4-7-4

SFTR	Bit shift right	SFTR S D n1 n2	4-7-5
WSFL	Word shift left	WSFL S D n1 n2	4-7-6
WSFR	Word shift right	WSFR S D n1 n2	4-7-7
Data Convert			
WTD	Single word integer converts to double word integer	WTD S D	4-8-1
FLT	16 bits integer converts to float point	FLT S D	4-8-2
DFLT	32 bits integer converts to float point	DFLT S D	4-8-2
FLTD	64 bits integer converts to float point	FLTD S D	4-8-2
INT	Float point converts to integer	INT S D	4-8-3
BIN	BCD converts to binary	BIN S D	4-8-4
BCD	Binary converts to BCD	BCD S D	4-8-5
ASCI	Hex. converts to ASCII	ASCI S D n	4-8-6
HEX	ASCII converts to Hex.	HEX S D n	4-8-7
DECO	Coding	DECO S D n	4-8-8
ENCO	High bit coding	ENCO S D n	4-8-9
ENCOL	Low bit coding	ENCOL S D n	4-8-10
Float Point Operation			
ECMP	Float compare	ECMP S1 S2 D	4-9-1
EZCP	Float Zone compare	EZCP S1 S2 D1 D2	4-9-2
EADD	Float Add	EADD S1 S2 D	4-9-3
ESUB	Float Subtract	ESUB S1 S2 D	4-9-4

EMUL	Float Multiplication	EMUL S1 S2 D	4-9-5
EDIV	Float division	EDIV S1 S2 D	4-9-6
ESQR	Float Square Root	ESQR S D	4-9-7
SIN	Sine	SIN S D	4-9-8
COS	Cosine	COS S D	4-9-9
TAN	Tangent	TAN S D	4-9-10
ASIN	Floating Sine	ASIN S D	4-9-11
ACOS	Floating Cosine	ACOS S D	4-9-12
ATAN	Floating Tangent	ATAN S D	4-9-13
Clock Operation			
TRD	Read RTC data	TRD D	4-10-1
TWR	Write RTC data	TWR D	4-10-2

4-2. Reading Method of Applied Instructions

In this manual, the applied instructions are described in the following manner.

1.Summary

ADDITION [ADD]			
16 bits	ADD	32 bits	DADD
Execution condition	Normally ON/OFF, Rising/Falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2.Operands

Operands	Function	Data Type
S1	Specify the augend data or register	16 bits/32 bits, BIN
S2	Specify the summand data or register	16 bits/32 bits, BIN
D	Specify the register to store the sum	16 bits/32 bits, BIN

3.Suitable Soft Components

Word

operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●	●	●	●	●	●		
S2	●	●		●	●	●	●	●	●	●		
D	●	●		●	●		●	●	●			

Bit

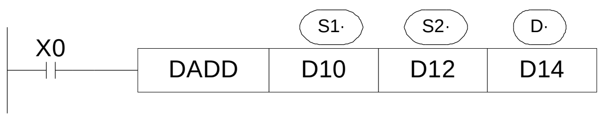
Operands	System						
	X	Y	M	S	T	C	Dn.m

Description

<16 bits instruction>

(D10) + (D12) → (D14)

<32 bits instruction>



(D11D10) + (D13D12) → (D15D14)

- The data contained within the two source devices are combined and total is stored in the specified destination device. Each data's highest bit is the sign bit, 0 stands for positive, 1 stand for negative. All calculations are algebraic processed. (5+(-8)= -3).

- If the result of a calculations is "0", the "0' flag acts. If the result exceeds 323,767(16 bits limit) or 2,147,483,648 (32 bits limit), the carry flag acts. (refer to the next page). If the result exceeds -323,768 (16 bits limit) or -2,147,483,648 (32 bits limit) , the borrow flag acts (Refer to the next page)
- When carry on 32 bits operation, word device's 16 bits are assigned, the device follow closely the preceding device's ID will be the high bits. To avoid ID repetition, we recommend you assign device's ID to be even ID.
- The same device may be used a source and a destination. If this is the case then the result changes after every scan cycle. Please note this point.

Related flag

Flag	Name	Function
M8020	Zero	ON：the calculate result is zero OFF：the calculate result is not zero
M8021	Borrow	ON：the calculate result is over 32767(16bits) or 2147483647(32bits) OFF：the calculate result is not over 32767(16bits) or 2147483647(32bits)
M8022	Carry	ON：the calculate result is over 32767(16bits) or 2147483647(32bits) OFF：the calculate result is not over 32767(16bits) or 2147483647(32bits)

The related description

- The assignment of the data

  The data register of XC series PLC is a single word (16 bit) data register, single word data only engross one data register which is assigned by single word object instruction. The disposal bound is: Dec. –327,68~327,67, Hex. 0000~FFFF.

Single word object instruction D(NUM)

Instruction	D(NUM)	→	Object data

Double word（32 bit）engrosses two data register, it's composed by two consecutive data registers, the first one is assigned by double word object instruction. The dispose bound is: Dec. -214,748,364,8~214,748,364,7, Hex. 00000000~FFFFFFFF.

Double word object instruction D(NUM+1) D(NUM)

Instruction	D(NUM)	→	Object data	Object data

- The denote way of 32 bits instruction

  If an instruction can not only be 16 bits but also be 32 bits, then the denote method for 32 bits instruction is to add a "D" before 16 bits instruction.

  E.g：ADD D0 D2 D4 denotes two 16 bits data adds；

  DADD D10 D12 D14 denotes two 32 bits data adds

※1：Flag after executing the instruction. Instructions without the direct flag will not display.

※2：S· Source operand, its content won't change after executing the instruction

※3：D· Destinate operand, its content changes with the execution of the instruction

※4：Tell the instruction's basic action, using way, applied example, extend function, note items etc.

4-3．Program Flow Instructions

Mnemonic	Instruction's name	Chapter
CJ	Condition Jump	4-3-1
CALL	Call subroutine	4-3-2
SRET	Subroutine return	4-3-2
STL	Flow start	4-3-3
STLE	Flow end	4-3-3
SET	Open the assigned flow, close the current flow (flow jump)	4-3-3
ST	Open the assigned flow, not close the current flow (Open the new flow)	4-3-3
FOR	Start of a FOR-NEXT loop	4-3-4
NEXT	End of a FOR-NEXT loop	4-3-4
FEND	First End	4-3-5
END	Program End	4-3-5

4-3-1. Condition Jump [CJ]

1.Summary

As used to run a part of program, CJ shorten the operation cycle and using the dual coil

Condition Jump [CJ]			
16 bits	CJ	32 bits	-
Execution condition	Normally ON/OFF coil	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2.Operands

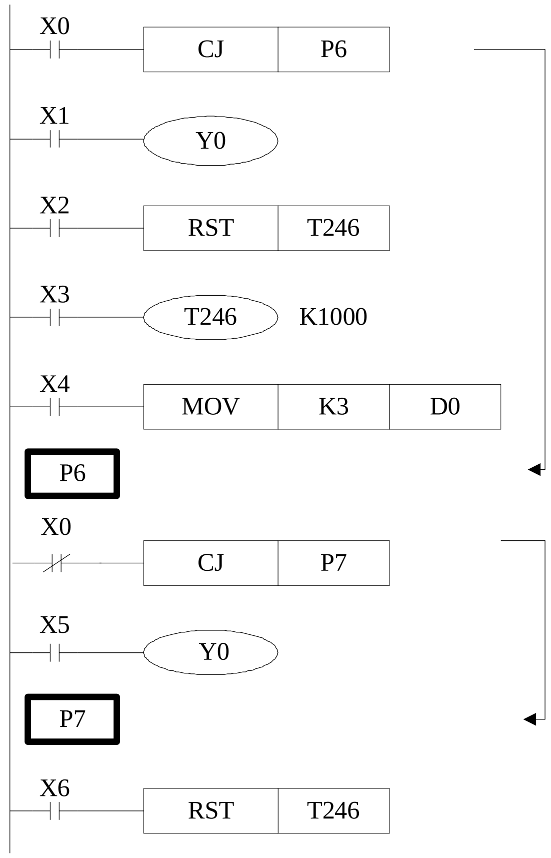
Operands	Function	Data Type
Pn	Jump to the target (with pointer Nr.) P (P0~P9999)	Pointer's Nr.

3.Suitable Soft Components

Other	Pointer	
	P	I
	●	

Description

In the below graph, if X000 is "ON", jump from the first step to the next step behind P6 tag. If X000 "OFF", do not execute the jump construction;



- In the left graph, Y000 becomes to be dual coil output, but when X000=OFF, X001 activates; when X000=ON, X005 activates
- CJ can’t jump from one STL to another STL;
- After driving time T0~T640 and HSC C600~C640, if execute CJ, continue to work, the output activates.

4-3-2. Call subroutine **[CALL]** and Subroutine return **[SRET]**

1.Summary

Call the programs which need to be executed together, decrease the program's steps;

Subroutine Call [CALL]			
16 bits	CALL	32 bits	-
Execution condition	Normally ON/OFF, Rising/Falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-
Subroutine Return [SRET]			
16 bits	SRET	32 bits	-
Execution condition	-	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

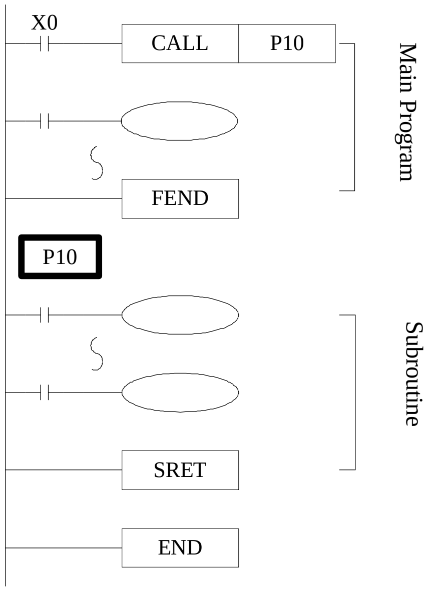
2.Operands

Operands	Function	Data Type
Pn	Jump to the target (with pointer Nr.) P (P0~P9999)	Pointer's Nr.

3.Suitable Soft Components

Others	Pointer	
	P	I
	●	

Description



- If X000= “ON”, execute the call instruction and jump to the step tagged by P10. after executing the subroutine, return the original step via SRET instruction.Program the tag with FEND instruction (will describe this instruction later)
- In the subroutine 9 times call is allowed, so totally there can be 10 nestings.

4-3-3. Flow [SET].[ST] .[STL]. [STLE]

1、Summary

Instructions to specify the start, end, open, close of a flow;

Open the specified flow, close the local flow [SET]			
16 bits	SET	32 bits	-
Execution condition	Normally ON/OFF, Rising/Falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-
Open the specified flow, not close the local flow [ST]			
16 bits	ST	32 bits	-
Execution condition	Normally ON/OFF, Rising/Falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-
Flow starts [STL]			
16 bits	STL	32 bits	-

Execution condition	-	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-
Flow ends [STLE]			
16 bits	STLE	32 bits	-
Execution condition	-	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2.operands

Operands	Function	Data Type
Sn	Jump to the target flow S	Flow ID

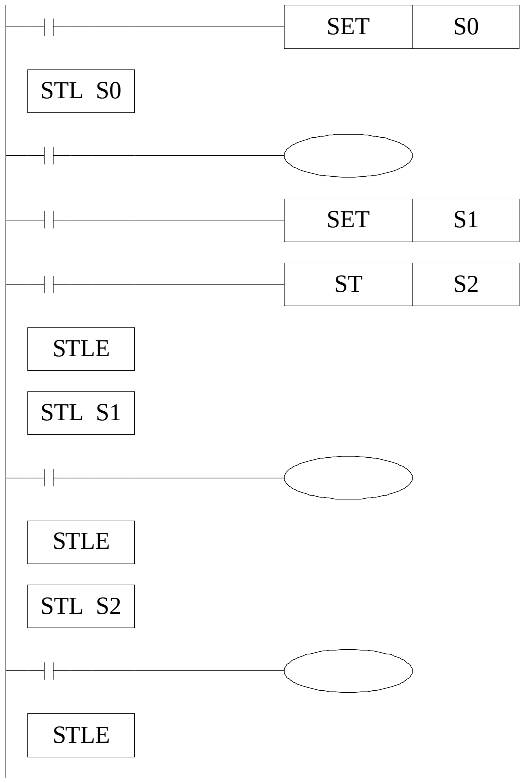
3.Suitable Soft Components

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
Sn				●			

Description

- STL and STLE should be used in pairs. STL represents the start of a flow, STLE represents the end of a flow.
- After executing of **SET Sxxx** instruction, the flow specified by these instructions is ON.
- After executing **RST Sxxx** instruction, the specified flow is OFF.
- In flow S0, SET S1 close the current flow S0, open flow S1.
- In flow S0, ST S2 open the flow S2, but don’t close flow S0.
- When flow turns from ON to be OFF, reset OUT、PLS、PLF、not accumulate timer etc. which belongs to the flow.
- ST instruction is usually used when a program needs to run more flows at the same time.
- After executing of **SET Sxxx** instruction, the pulse instructions will be closed (including one-segment, multi-segment, relative or absolute, return to the origin)


SET
S0
STL S0
SET
S1
ST
S2
STLE
STL S1
STLE
STL S2
STLE

4-3-4. [FOR] and [NEXT]

1.Summary

Loop execute the program between **FOR** and **NEXT** with the specified times;

Loop starts [FOR]			
16 bits	FOR	32 bits	-
Execution condition	Rising/Falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-
Loop ends [NEXT]			
16 bits	NEXTs	32 bits	-
Execution condition	Normally ON/OFF, Rising/Falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2.Operands

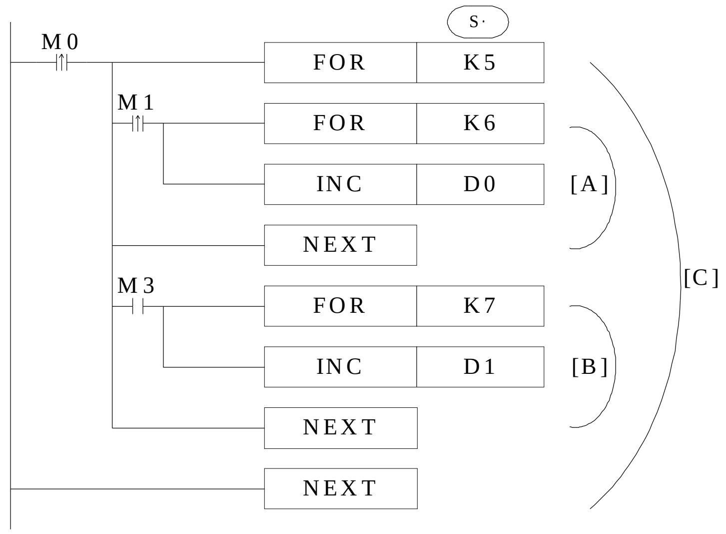
Operands	Function	Data Type
S	Program's loop times between FOR~NEXT	16 bits, BIN

3.Suitable Soft Components

Word	Operands	System									Constant	Module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	S	●									●		

Description

- FOR.NEXT instructions must be programmed as a pair. Nesting is allowed, and the nesting level is 8.
- Between FOR/NEXT, LDP.LDF instructions are effective for one time. Every time when M0 turns from OFF to ON, and M1 turns from OFF to ON, [A] loop is executed 6 times.
- Every time if M0 turns from OFF to ON and M3 is ON, [B] loop is executed 5×7=35 times.
- If there are many loop times, the scan cycle will be prolonged. Monitor timer error may occur, please note this.
- If NEXT is before FOR, or no NEXT, or NEXT is behind FENG,END, or FOR and NEXT number is not equal, an error will occur.
- Between FOR~NEXT, CJ nesting is not allowed, also in one STL, FOR~NEXT must be programmed as a pair.



4-3-5. [FEND] and [END]

1.Summary

FEND means the main program ends, while END means program ends;

main program ends [FEND]			
Execution condition	-	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-
program ends [END]			
Execution condition	-	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2.Operands

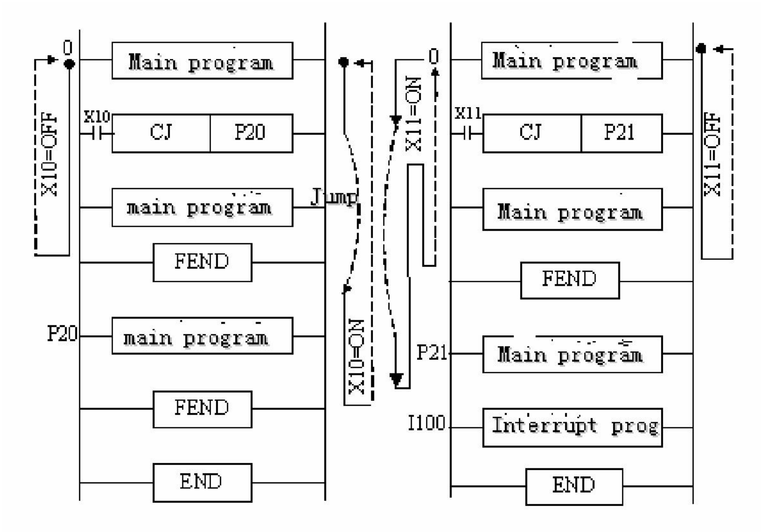
Operands	Function	Data Type
None	-	-

3.Suitable Soft Components

None

Description

Even though [FEND] instruction represents the end of the main program, if execute this instruction, the function is same with END. Execute the output/input disposal, monitor the refresh of the timer, return to the 0th step.



- If program the tag of CALL instruction behind FEND instruction, there must be SRET instruction. If the interrupt pointer program behind FEND instruction, there must be IRET instruction.
- After executing CALL instruction and before executing SRET instruction, if execute FEND instruction; or execute FEND instruction after executing FOR instruction and before executing NEXT, then an error will occur.
- In the condition of using many FEND instruction, please compile routine or subroutine between the last FEND instruction and END instruction.

4-4. Data compare function

Mnemonic	Function	Chapter
LD＝	LD activates when (S1)＝ (S2)	4-4-1
LD＞	LD activates when (S1)＞ (S2)	4-4-1
LD＜	LD activates when (S1)＜ (S2)	4-4-1
LD＜＞	LD activates when (S1)≠ (S2)	4-4-1
LD＜＝	LD activates when (S1)≤ (S2)	4-4-1
LD＞＝	LD activates when (S1)≥ (S2)	4-4-1
AND＝	AND activates when (S1)＝ (S2)	4-4-2
AND＞	AND activates when (S1)＞ (S2)	4-4-2
AND＜	AND activates when (S1)＜ (S2)	4-4-2
AND＜＞	AND activates when (S1)≠ (S2)	4-4-2
AND＜＝	AND activates when (S1)≤ (S2)	4-4-2
AND＞＝	AND activates when (S1)≥ (S2)	4-4-2

OR＝	OR activates when （S1)＝（S2)	4-4-3
OR＞	OR activates when （S1)＞（S2)	4-4-3
OR＜	OR activates when （S1)＜（S2)	4-4-3
OR＜＞	OR activates when （S1)≠（S2)	4-4-3
OR＜＝	OR activates when （S1)≤（S2)	4-4-3
OR＞＝	OR activates when （S1)≥（S2)	4-4-3

4-4-1．LD Compare [LD□]

1. Summary

LD□ is the point compare instruction connected with the generatrix.

LD Compare [LD□]			
16 bits	As below	32 bits	As below
Execution condition	-	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2.Operands

Operands	Function	Data Type
S1	Specify the Data (to be compared) or soft component's address code	16/32bits, BIN
S2	Specify the comparand's value or soft component's address code	16/32 bits, BIN

3.Suitable soft components

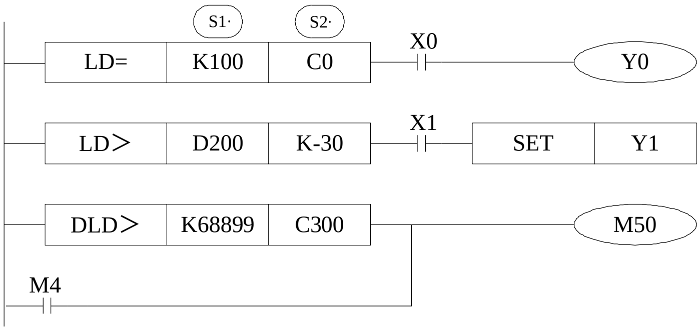
Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●	●	●	●	●	●		
S2	●	●		●	●	●	●	●	●	●		

Description

16 bits instruction	32 bits instruction	Activate Condition	Not Activate Condition
LD＝	DLD＝	（S1)＝（S2)	（S1)≠（S2)
LD＞	DLD＞	（S1)＞（S2)	（S1)≤（S2)

LD<	DLD<	(S1)< (S2)	(S1)≥ (S2)
LD<>	DLD<>	(S1)≠ (S2)	(S1)= (S2)
LD<=	DLD<=	(S1)≤ (S2)	(S1)> (S2)
LD>=	DLD>=	(S1)≥ (S2)	(S1)< (S2)



Note Items

- When the source data's highest bit (16 bits：b15，32 bits：b31) is 1，use the data as a negative.
- The comparison of 32 bits counter (C300~) must be 32 bits instruction. If assigned as a 16 bits instruction, it will lead the program error or operation error.

4-4-2．AND Compare [AND□]

1.Summary

AND□: The compare instruction to serial connect with the other contactors.

AND Compare [AND□]			
16 bits	As Below	32 bits	As Below
Execution condition	Normally ON/OFF coil	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2.Operands

Operands	Function	Data Type
S1	Specify the Data (to be compared) or soft component's address code	16/32bit,BIN
S2	Specify the comparand's value or soft component's address code	16/32bit,BIN

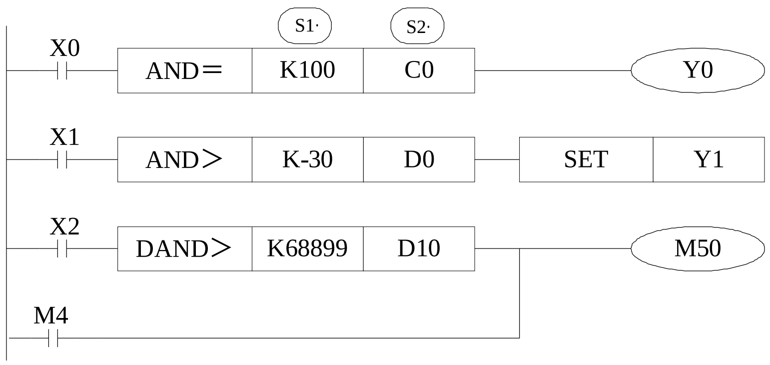
3.suitable soft components

Word

Operands	System									Konstant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●	●	●	●	●	●		
S2	●	●		●	●	●	●	●	●	●		

Description

16 bits instruction	32 bits instruction	Activate Condition	Not Activate Condition
AND＝	DAND＝	(S1)＝ (S2)	(S1)≠ (S2)
AND＞	DAND＞	(S1)＞ (S2)	(S1)≤ (S2)
AND＜	DAND＜	(S1)＜ (S2)	(S1)≥ (S2)
AND＜＞	DAND＜＞	(S1)≠ (S2)	(S1)＝ (S2)
AND＜＝	DAND＜＝	(S1)≤ (S2)	(S1)＞ (S2)
AND＞＝	DAND＞＝	(S1)≥ (S2)	(S1)＜ (S2)



Note Items

- When the source data’s highest bit (16 bits：b15，32 bits：b31) is 1，use the data as a negative.
- The comparison of 32 bits counter (C300~) must be 32 bits instruction. If assigned as a 16 bits instruction, it will lead the program error or operation error.

4-4-3．Parallel Compare [OR□]

1. Summary

OR□ The compare instruction to parallel connect with the other contactors

Parallel Compare [OR□]			
16 bits	As below	32 bits	As below
Execution	-	Suitable	XC1.XC2.XC3.XC5.XCM

condition		Models	
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S1	Specify the Data (to be compared) or soft component's address code	16/32 bit,BIN
S2	Specify the comparand's value or soft component's address code	16/32 bit,BIN

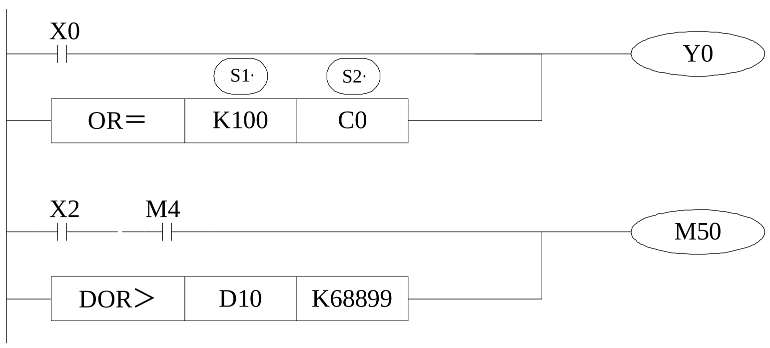
3. suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●	●	●	●	●	●		
S2	●	●		●	●	●	●	●	●	●		

Description

16 bits instruction	32 bits instruction	Activate Condition	Not Activate Condition
OR＝	DOR＝	(S1)＝ (S2)	(S1)≠ (S2)
OR＞	DOR＞	(S1)＞ (S2)	(S1)≤ (S2)
OR＜	DOR＜	(S1)＜ (S2)	(S1)≥ (S2)
OR＜＞	DOR＜＞	(S1)≠ (S2)	(S1)＝ (S2)
OR＜＝	DOR＜＝	(S1)≤ (S2)	(S1)＞ (S2)
OR＞＝	DOR＞＝	(S1)≥ (S2)	(S1)＜ (S2)



Note Items

- When the source data's highest bit (16 bits：b15，32 bits：b31) is 1，use the data as a negative.
- The comparison of 32 bits counter (C300~) must be 32 bits instruction. If assigned as a 16 bits instruction, it will lead the program error or operation error.

4-5．Data Move

Mnemonic	Function	Chapter
CMP	Data compare	4-5-1
ZCP	Data zone compare	4-5-2
MOV	Move	4-5-3
BMOV	Data block move	4-5-4
PMOV	Data block move (with faster speed)	4-5-5
FMOV	Fill move	4-5-6
FWRT	FlashROM written	4-5-7
MSET	Zone set	4-5-8
ZRST	Zone reset	4-5-9
SWAP	The high and low byte of the destinated devices are exchanged	4-5-10
XCH	Exchange	4-5-11

4-5-1. Data Compare [CMP]

1. Summary

Compare the two specified Data, output the result.

Data compare [CMP]			
16 bits	CMP	32 bits	DCMP
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S1	Specify the data (to be compared) or soft component's address code	16 bit,BIN
S	Specify the comparand's value or soft component's address code	16 bit,BIN
D	Specify the compare result's address code	bit

3. Suitable soft component

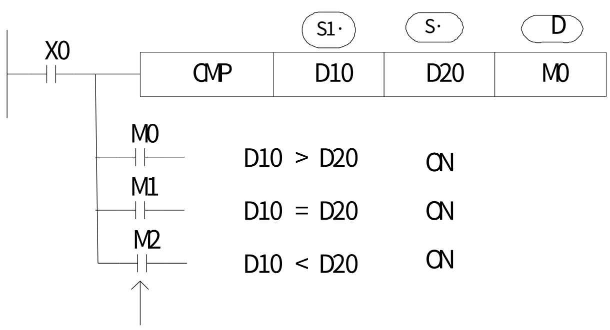
Word

Operands	System								Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●	●	●	●	●	●		
S	●	●		●	●	●	●	●	●	●		

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
D		●	●	●			

Description



Even X000=OFF to stop ZCP instruction, M0~M2 will keep the original status

- Compare data S1· and S· , output the three points' ON/OFF status (start with D·) according to the value l D·, D· +1, D· +2 : the three point's on/off output according to the valve

4-5-2. Data zone compare [ZCP]

1. Summary

Compare the two specify Data with the current data, output the result.

Data Zone compare [ZCP]			
16 bits	ZCP	32 bits	DZCP
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S1	Specify the down-limit Data (of the compare stand) or soft component's address code	16 bit, BIN
S2	Specify the Up-limit Data (of the compare stand) or soft component's address code	16 bit, BIN
S	Specify the current data or soft component's address code	16 bit, BIN
D	Specify the compare result's data or soft component's address code	bit

3.Suitable soft components

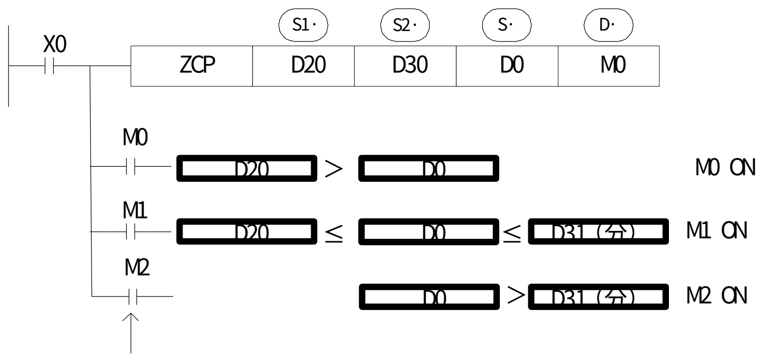
Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●	●	●	●	●	●		
S2	●	●		●	●	●	●	●	●	●		
S	●	●		●	●	●	●	●	●	●		

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
D		●	●	●			

Description



Even X000=OFF stop ZCP instruction，M0~M2 will keep the original status

- Compare S· data with S1 and S2 , D· output the three point's ON/OFF status according to the zone size.
- D· , D· ＋1, D· ＋2 : the three point's ON/OFF output according to the result

4-5-3．MOV [MOV]

1. Summary

Move the specified data to the other soft components

MOV [MOV]			
16 bits	MOV	32 bits	DMOV
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

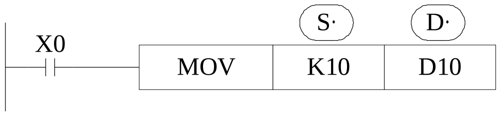
Operands	Function	Data Type
S	Specify the source data or register's address code	16 bit/32 bit, BIN
D	Specify the target soft component's address code	16 bit/32 bit, BIN

3. Suitable soft component

Word

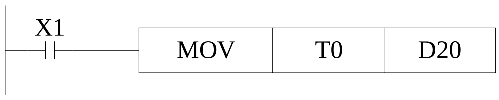
Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	•	•	•	•	•	•	•	•	•	•		
D	•		•	•	•		•	•	•			

Description



- Move the source data to the target
- When X000 is off, the data keeps same
- Convert constant K10 to be BIN code automatically

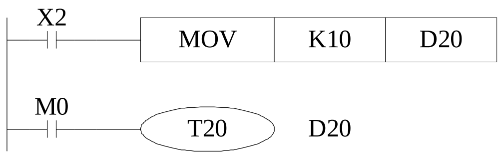
<read the counter’s or time’s current value>



(The current value of T0)→(D20)

The same as counter

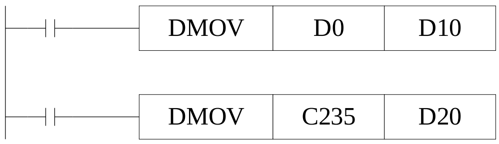
<indirectly specify the counter’s ,time’s set value>



(K10) (D10)

D20=K10

< Move the 32bits data >



(D1，D0)→(D11，D10)

(the current value of C235)→(D21，D20)

Please use DMOV when the value is 32 bits, such as MUL instruction, high speed counter…

4-5-4. Data block Move [BMOV]

1. Summary

Move the specified data block to

Data block move [BMOV]			
16 bits	BMOV	32 bits	-
Execution condition	Normally ON/OFF coil	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S	Specify the source data block or soft component address code	16 bits, BIN; bit
D	Specify the target soft components address code	16 bits, BIN; bit
n	Specify the move data’s number	16 bits, BIN;

3. Suitable soft components

Word

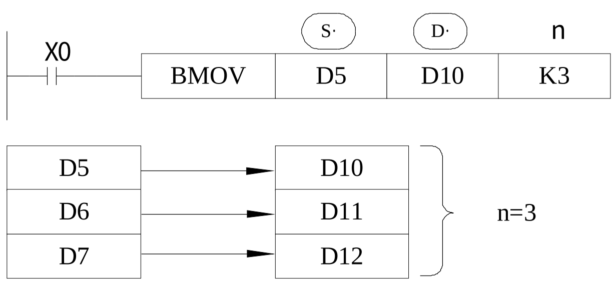
Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●	●	●	●	●	●	●	●			
D	●		●	●	●		●	●	●			
n	●			●	●	●		●	●	●		

Bit

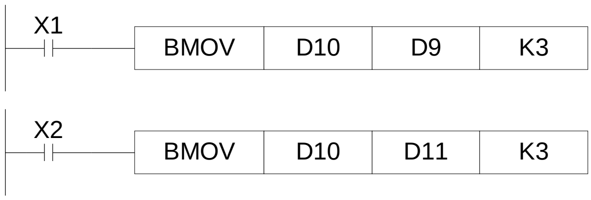
Operands	System						
	X	Y	M	S	T	C	Dn.m
S	●	●	●				
D	●	●	●				

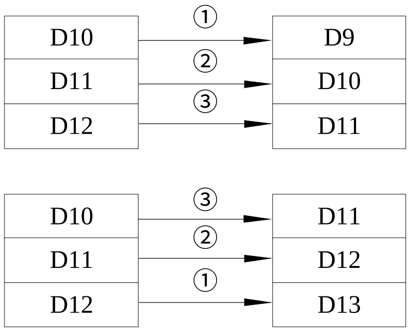
Description

l Move the specified “n” data to the specified “n” soft components in the form block.



- As the following picture, when the data address overlapped, the instruction will do from 1 to 3.





4-5-5．Data block Move [PMOV]

1. Summary

Move the specified data block to the other soft components

Data block mov[PMOV]			
16 bits	PMOV	32 bits	-
Execution condition	Normally ON/OFF coil	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S	Specify the source data block or soft component address code	16 bits, BIN; bit
D	Specify the target soft components address code	16 bits, BIN; bit
n	Specify the move data’s number	16 bits, BIN;

3. Suitable soft components

Word

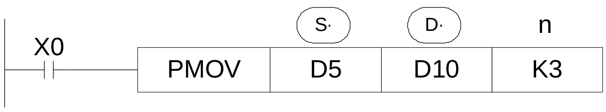
Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●	●	●	●	●	●	●	●			
D	●		●	●	●		●	●	●			
n	●			●	●		●	●	●	●		

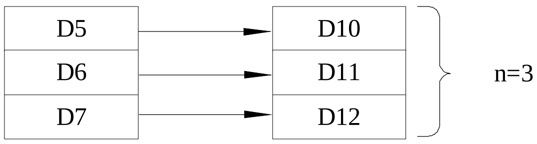
Bit

Operands	system						
	X	Y	M	S	T	C	Dn.m
S	●	●	●				
D	●	●	●				

Description

l Move the specifed “n” data to the specified “n” soft components in form of block





- The function of PMOV and BMOV is mostly the same, but the PMOV has the faster speed
- PMOV finish in one scan cycle, when executing PMOV , close all the interruptions
- Mistake many happen, if there is a repeat with source address and target address

4-5-6. Fill Move [FMOV]

1. Summary

Move the specified data block to the other soft components

Fill Move [FMOV]			
16 bits	FMOV	32 bits	DFMOV
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	DFMOV need above V3.0	Software requirement	-

2. Operands

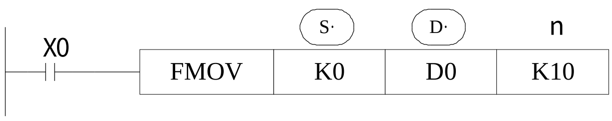
Operands	Function	Data Type
S	Specify the source data block or soft component address code	16 bits, BIN; bit
D	Specify the target soft components address code	16 bits, BIN; bit
n	Specify the move data’s number	16 bits, BIN;

3. Suitable soft component

Word	Operands	System									Constant	Module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	S	●	●	●	●	●	●	●	●	●	●		
	D	●		●	●	●		●	●	●			
	n	●			●	●		●	●	●	●		

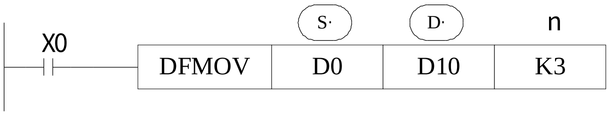
Description

<16 bits instruction>



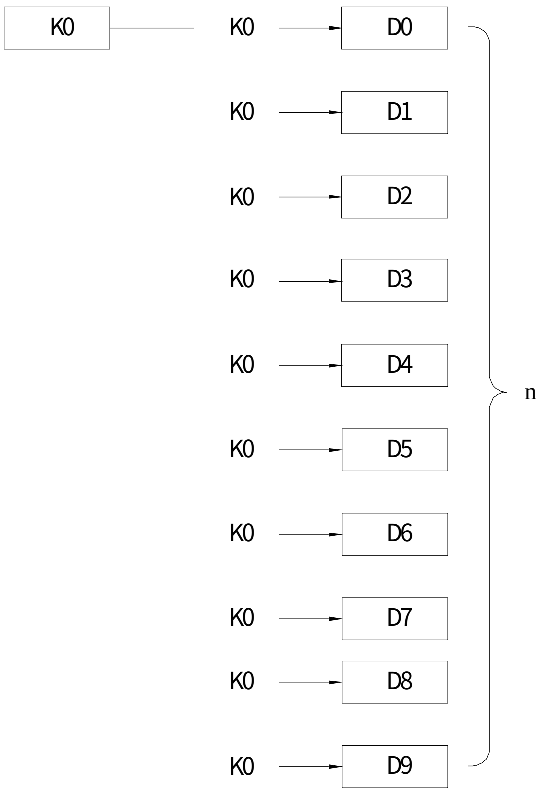
- Move K0 to D0~D9, copy a single data device to a range of destination device
- The data stored in the source device (S) is copied to every device within the destination range, The range is specified by a device head address (D) and a quantity of consecutive elements (n).
- If the specified number of destination devices (n) exceeds the available space at the destination location, then only the available destination devices will be written to.

<32 bits instruction >

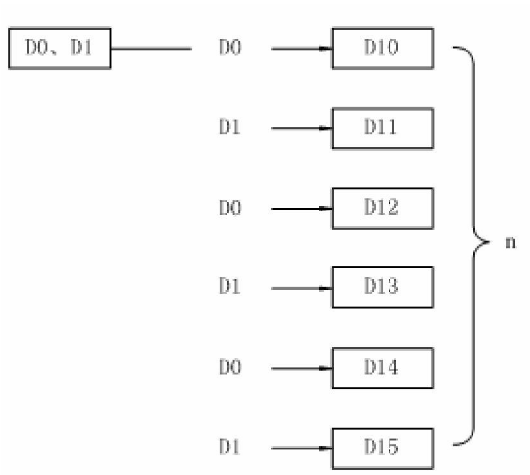


- Move D0.D1 to D10.D11:D12.D13:D14.D15.

<16 bits Fill Move >



<32 bits Fill move>



4-5-7．FlashROM　Write [FWRT]

1. Summary

Write the specified data to other soft components

FlashROM Write [FWRT]			
16 bits	FWRT	32 bits	DFWRT
Execution condition	rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

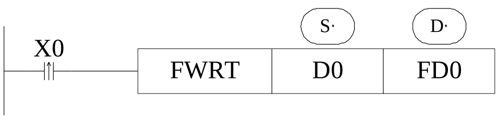
Operands	Function	Data Type
S	The data write in the source or save in the soft element	16 bits/32 bits, BIN
D	Write in target soft element	16 bits/32 bits, BIN
D1	Write in target soft element start address	16 bits/32 bits, BIN
D2	Write in data quantity	bit

3. Suitable soft components

Word	Operands	System									Constant	Module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	S	●	●		●	●	●	●	●	●	●		
	D		●										
	D1		●										
	D2	●			●	●	●	●	●	●	●		

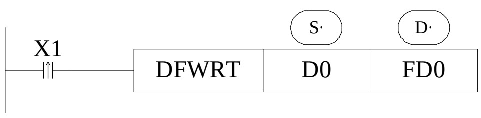
Description

< Written of a word >



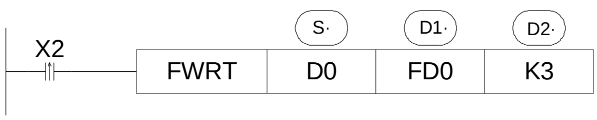
Write value in D0 into FD0

<Written of double word>



Write value in D0,D1 into FD0,FD1

<Written of multi-word>



Write value in D0,D1,D2 into FD0,FD1,FD2

※1：FWRT instruction only allow to write data into FlashRom register. In this storage, even battery drop, data could be used to store important technical parameters

※2：Written of FWRT needs a long time, about 150ms, so frequently operate this operate this operate operation is recommended

※3：The written time of Flshrom is about 1,000,000 times. So we suggest using edge signal (LDP, LDF etc.) to trigger.

※4：Frequently written of FlashROM

4-5-8．Zone set [MSET]

1. Summary

Set or reset the soft element in certain range

Multi-set [MSET]			
16 bits	MSET.ZRST	32 bits	-
Execution condition	Normally ON/OFF	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

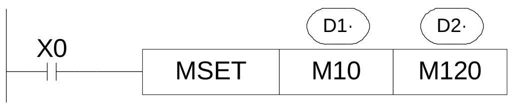
Operands	Function	Data Type
D1	Start soft element address	bit
D2	End soft element address	bit

3. Suitable soft components

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
D1	●	●	●	●	●	●	
D2	●	●	●	●	●	●	

Description



Zone set unit M10~M120

- D1· D2· Are specified as the same type of soft units, and D1· < D2·
- When D1· > D2· ，will not run Zone set, set M8004.M8067，and D8067=2。

4-5-9．Zone reset [ZRST]

1. Summary

Reset the soft element in the certain range

Multi-reset [ZRST]			
16 bits	ZRST	32 bits	-
Execution condition	Normally ON/OFF	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
D1	Start address of soft element	Bit:16 bits,BIN
D2	End address of soft element	Bit:16 bits,BIN

3. Suitable soft components

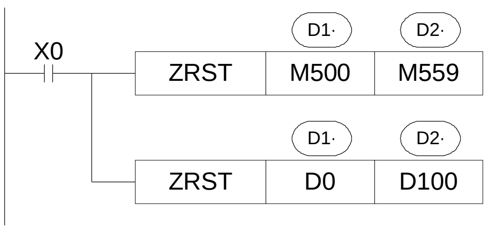
Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
D1	●					●	●	●				
D2	●				●	●	●	●				

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
D1	●	●	●	●	●	●	
D2	●	●	●	●	●	●	

Description



Zone reset bits M5 00~M559。

Zone reset words D0~D100

- D1· D2· Are specified as the same type of soft units, and D1· < D2·
- When D1· > D2· only reset the soft unit specified in D1· , and set M8004.M8067，D8067=2。

Other Reset Instruction

- As soft unit’s separate reset instruction, RST instruction can be used to bit unit Y, M, S and word unit T, C, D
- As fill move for constant K0, 0 can be written into DX, DY, DM, DS, T, C, D.

4-5-10. Swap the high and low byte [SWAP]

1. Summary

Swap the high and low byte

High and low byte swap [SWAP]			
16 bits	SWAP	32 bits	-
Execution condition	Normally ON/OFF	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

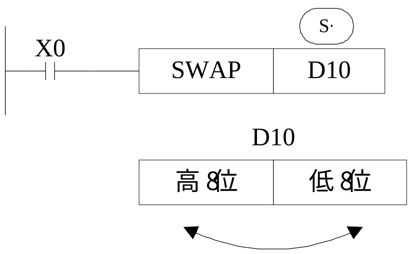
Operands	Function	Data Type
S	The address of the soft element	16 bits: BIN

3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●			●	●							

Description



- Low 8 bits and high 8 bits change when it is 16 bits instruction.
- If the instruction is a consecutive executing instruction, each operation cycle should change.

4-5-11．Exchange [XCH]

1. Summary

Exchange the data in two soft element

Exchange [XCH]			
16 bits	XCH	32 bits	DXCH
Execution condition	Normally ON/OFF	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

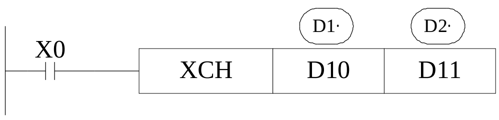
Operands	Function	Data Type
D1	The soft element address	16 bits, BIN
D2	The soft element address	16 bits, BIN

3. Suitable soft component

Word	Operands	System									Constant	Module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	D1	●			●	●		●	●	●			
	D2	●			●	●		●	●	●			

Description

<16 bits instruction>

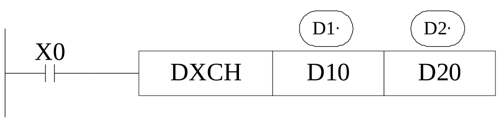


Before（D10）=100 →After （D10）=101

（D11）=101 （D11）=100

- The contents of the two destination devices D1 and D2 are swapped,
- When drive input X0 is ON, each scan cycle should carry on data exchange, please note.

<32 bits instruction >



- 32 bits instruction [DXCH] swaps value composed by D10、D11 and the value composed by D20、D21.

4-6. Data Operation Instructions

Mnemonic	Function	Chapter
ADD	Addition	4-6-1
SUB	Subtraction	4-6-2
MUL	Multiplication	4-6-3
DIV	Division	4-6-4
INC	Increment	4-6-5
DEC	Decrement	4-6-5
MEAN	Mean	4-6-6
WAND	Logic Word And	4-6-7
WOR	Logic Word Or	4-6-7
WXOR	Logic Exclusive Or	4-6-7
CML	Compliment	4-6-8
NEG	Negation	4-6-9

4-6-1 Addition [ADD]

1. Summary

Add two numbers and store the result

Add [ADD]			
16 bits	ADD	32 bits	DADD
Execution condition	Normally ON/OFF	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

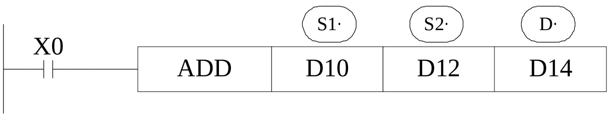
Operands	Function	Data Type
S1	The number address	16 bit/32 bit, BIN
S2	The number address	16 bit/32bit, BIN
D	The result address	16 bit/32bit, BIN

3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●	●	●	●	●	●		
S2	●	●		●	●	●	●	●	●	●		
D	●			●	●		●	●	●			

Description



（D10）＋（D12）→（D14）

- The data contained within the two source devices are combined and the total is stored in the specified destination device. Each data’s highest bit is the sign bit, 0 stands for positive、1 stands for negative. All calculations are algebraic processed.（5+（-8）=-3）
- If the result of a calculation is “0”, the “0” flag acts. If the result exceeds 323，767（16 bits limit）or 2,147,483,647（32 bits limit）, the carry flag acts.（refer to the next page）. If the result exceeds –323,768（16 bits limit）or –2,147,483,648（32 bits limit）, the borrow flag acts（Refer to the next page。
- When carry on 32 bits operation, word device’s low 16 bits are assigned, the device following closely the preceding device’s ID will be the high bits. To avoid ID repetition, we recommend you assign device’s ID to be even ID.
- The same device may be used as a source and a destination. If this is the case then the result changes after every scan cycle. Please note this point.

Related flag

Flag meaning

Flag	Name	Function
M8020	Zero	ON：the calculate result is zero OFF：the calculate result is not zero
M8021	Borrow	ON：the calculate result is less than -32768(16 bit) or -2147483648(32bit) OFF：the calculate result is over -32768(16 bit) or -2147483648(32bit)
M8022	Carry	ON：the calculate result is over 32768(16 bit) or 2147483648(32bit) OFF：the calculate result is less than 32768(16 bit) or 2147483648(32bit)

4-6-2．Subtraction [SUB]

1. Summary

Sub two numbers, store the result

Subtraction [SUB]			
16 bits	SUB	32 bits	DSUB
Execution condition	Normally ON/OFF	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2.Operands

Operands	Function	Data Type
S1	The number address	16 bits /32 bits,BIN
S2	The number address	16 bits /32 bits,BIN
D	The result address	16 bits /32 bits,BIN

3.Suitable soft component

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●	●	●	●	●	●		
S2	●	●		●	●	●	●	●	●	●		
D	●			●	●		●	●	●			

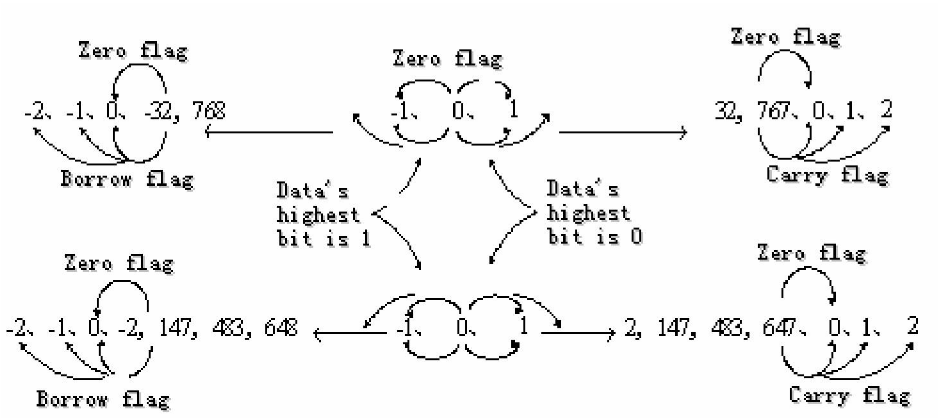
Description

X0	SUB	D10 (S1·)	D12 (S2·)	D14 (D·)

(D10) — (D12) → (D14)

- S1· appoint the soft unit's content, subtract the soft unit's content appointed by S2· in the format of algebra. The result will be stored in the soft unit appointed by D·. (5-(-8)=13)
- The action of each flag, the appointment method of 32 bits operation's soft units are both the same with the preceding ADD instruction.
- The importance is: in the preceding program, if X0 is ON, SUB operation will be executed every scan cycle

The relationship of the flag's action and vale's positive/negative is shown below:



4-6-3. Multiplication [MUL]

1. Summary

Multiply two numbers, store the result

Multiplication [MUL]			
16 bits	MUL	32 bits	DMUL
Execution condition	Normally ON/OFF	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S1	The number address	16 bits/32bits,BIN
S2	The number address	16 bits/32bits,BIN
D	The result address	16 bits/32bits,BIN

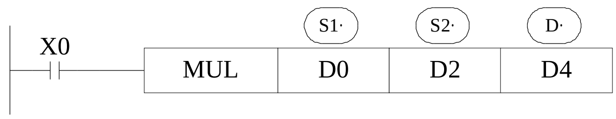
3. Suitable soft component

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●	●	●	●	●	●		
S2	●	●		●	●	●	●	●	●	●		
D	●			●	●		●	●	●			

Description

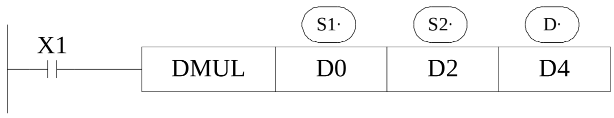
<16 bits Operation>



BIN		BIN		BIN
(D0)	×	(D2)	→	(D5，D4)
16 bits		16 bits	→	32 bits

- The contents of the two source devices are multiplied together and the result is stored at the destination device in the format of 32 bits. As in the upward chart: when (D0)=8、(D2)=9, (D5, D4) =72.
- The result’s highest bit is the symbol bit: positive (0)、negative (1).
- When be bit unit, it can carry on the bit appointment of K1~K8. When appoint K4, only the result’s low 16 bits can be obtained.

<32 bits Operation >



BIN		BIN		BIN
(D1，D0)	×	(D3，D2)	→	(D7，D6，D5，D4)
32 bits		32 bits	→	64 bits

- When use 2 bits Operation ,the result is stored at the destination device in the format of 64 bits.
- Even use word device, 64 bits results can’t be monitored at once.

4-6-4．Division [DIV]

1. Summary

Divide two numbers and store the result

Division [DIV]			
16 bits	DIV	32 bits	DDIV
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S1	The number address	16 bits / 32 bits, BIN
S2	The number address	16 bits /32 bits, BIN

D	The result address	16 bits /32 bits, BIN

3.Suitable soft components

Word	Operands	System									Constant	Module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	S1	●	●		●	●	●	●	●	●	●		
	S2	●	●		●	●	●	●	●	●	●		
	D	●			●	●		●	●	●			

Description

<**16 bits operation** >

		S1·	S2·	D·
X0	DIV	D0	D2	D4

Dividend		Divisor		Result		Remainder
BIN		BIN		BIN		BIN
(D0)	÷	(D2)	→	D4)	···	(D5)
16 bits		16 bits		16 bits		16 bits

- S1· appoints the device's content be the dividend, S2· appoints the device's content be the divisor, D· appoints the device and the next one to store the result and the remainder.
- In the above example, if input X0 is ON, devision operation is executed every scan cycle.

<**32 bits operation** >

		S1·	S2·	D·
X1	DDIV	D0	D2	D4

Dividend		Divisor	Result		Remainder
BIN		BIN	BIN		BIN
(D1,D0)	÷	(D3,D2)	(D5,D4)	···	(D7,D6)
32 bits		32 bits	32 bits		32 bits

- The dividend is composed by the device appointed by S1· and the next one. The divisor is composed by the device appointed by S2· and the next one. The result and the remainder are stored in the four sequential devices, the first one is appointed by D·
- If the value of the divisor is 0, then an operation error is executed and the operation of the DIV instruction is cancelled
- The highest bit of the result and remainder is the symbol bit (positive:0, negative: 1). When any of the dividend or the divisor is negative, then the result will be negative. When the dividend is negative, then the remainder will be negative.

4-6-5. Increment [INC] & Decrement [DEC]

1. Summary

Increase or decrease the number

Increment 1[INC]			
16 bits	INC	32 bits	DINC
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-
Increment 1[DEC]			
16 bits	DEC	32 bits	DDEC
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
D	The number address	16 bits / 32bits,BIN

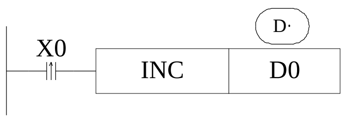
3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
D	●			●	●		●	●	●			

Description

< Increment [INC]>



(D0) +1→(D0)

- On every execution of the instruction the device specified as the destination (D·) has its current value incremented (increased) by a value of 1.
- In 16 bits operation, when +32,767 is reached, the next increment will write -32,767 to the destination device. In this case, there's no additional flag to identify this change in the counted value.

<Decrement [DEC]>

(D0) −1 → (D0)

- On every execution of the instruction the device specified as the destination (D·) has its current value decremented (decreased) by a value of 1.
- When -32，768 or -2，147，483，648 is reached, the next decrement will write +32，767 or +2，147，483，647 to the destination device.

4-6-6．Mean [MEAN]

1. Summary

Get the mean value of numbers

Mean [MEAN]			
16 bits	MEAN	32 bits	DMEAN
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

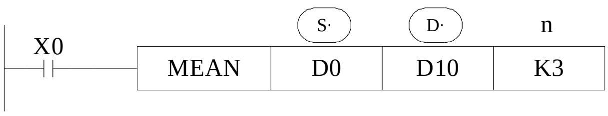
Operands	Function	Data Type
S	The head address of the numbers	16 bits, BIN
D	The mean result address	16 bits, BIN
n	The number quantity	16 bits, BIN

3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	•	•		•	•		•	•	•			
D	•			•	•		•	•	•			
n										•		

Description



$$\frac{(D0) + (D1) + (D2)}{3} \longrightarrow (D10)$$

- The value of all the devices within the source range is summed and then divided by the number of devices summed, i.e. n.. This generates an integer mean value which is stored in the destination device (D) The remainder of the calculated mean is ignored.
- If the value of n is specified outside the stated range (1 to 64) an error is generated.

4-6-7. Logic AND [WAND] , Logic OR[WOR], Logic Exclusive OR [WXOR]

1. Summary

Do logic AND, OR, XOR for numbers

Logic AND [WAND]			
16 bits	WAND	32 bits	DWAND
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-
Logic OR[WOR]			
16 bits	WOR	32 bits	DWOR
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-
Logic Exclusive OR [WXOR]			
16 bits	WXOR	32 bits	DWXOR
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S1	The soft element address	16bit/32bit,BIN
S2	The soft element address	16bit/32bit,BIN
D	The result address	16bit/32bit,BIN

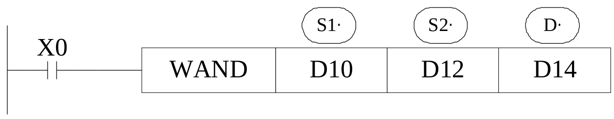
3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	•	•		•	•	•	•	•	•			
S2	•	•		•	•	•	•	•	•			
D	•			•	•		•	•	•			

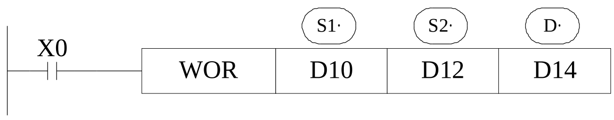
Description

- < Execute logic AND operation with each bit>



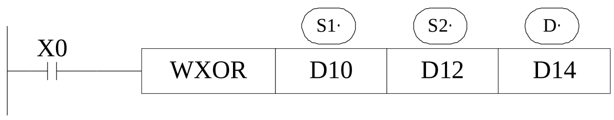
0&0=0 0&1=0
1&0=0 1&1=1

< Execute logic OR operation with each bit >



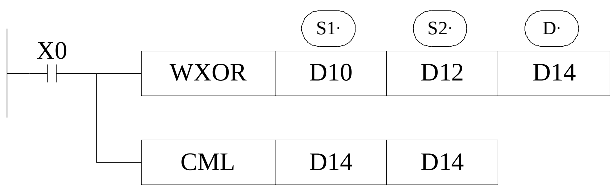
0 or 0=0 0 or 1=1
1 or 0=1 1 or 1=1

< Execute logic Exclusive OR operation with each bit >



0 xor 0=0 0 xor 1=1
1 xor 0=1 1 xor 1=0

If use this instruction along with CML instruction, XOR NOT operation could also be executed.



4-6-8. Converse [CML]

1. Summary

Converse the phase of the numbers

Converse [CML]			
16 bits	CML	32 bits	DCML
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

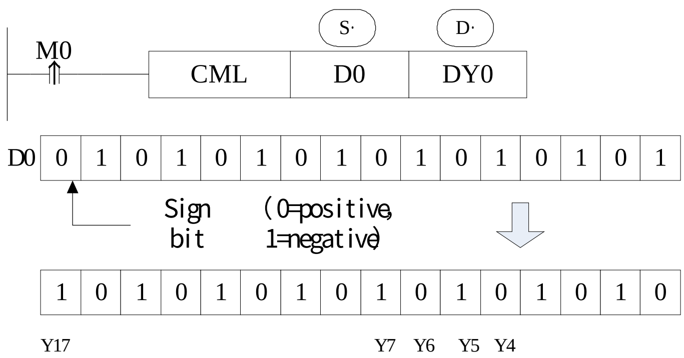
2. Operands

Operands	Function	Data Type
S	Source number address	16 bits/32 bits, BIN
D	Result address	16 bits/32 bits, BIN

3. Suitable soft components

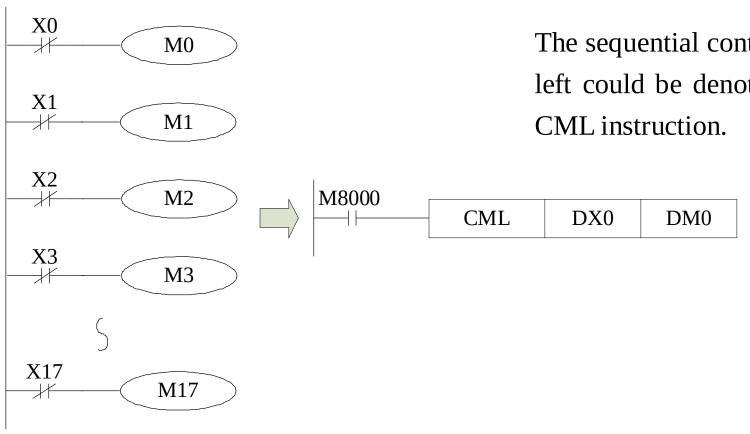
	Operands	System									Constant	Module	
Word		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	S1	●	●		●	●	●	●	●	●	●		
	D	●			●	●		●	●	●			

Description



- Each data bit in the source device is inverted (1→0，0→1) and sent to the destination device. If use constant K in the source device, it can be auto convert to be binary.
- It's available when you want to inverted output the PLC's output

< Reading of inverted input >



The sequential control instruction in the left could be denoted by the following CML instruction.

4-6-9. Negative [NEG]

1. Summary

Get the negative number

Negative [NEG]			
16 bits	NEG	32 bits	DNEG
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC1.XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

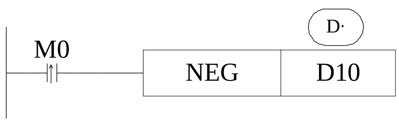
2. Operands

Operands	Function	Data Type
D	The source number address	16 bits/ bits, BIN

3. Suitable soft components

Word	Operands	System									Constant	Module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	D	●			●	●		●	●	●			

Description



$\overline{(D10)}$ +1 → (D10)

- The bit format of the selected device is inverted, I.e. any occurrence of a "1' becomes a "0" and any occurrence of "0" becomes "1", when this is complete, a further binary 1 is added to the bit format. The result is the total logic sigh change of the selected devices contents.

4-7. Shift Instructions

Mnemonic	Function	Chapter
SHL	Arithmetic shift left	4-7-1
SHR	Arithmetic shift right	4-7-1
LSL	Logic shift left	4-7-2
LSR	Logic shift right	4-7-2
ROL	Rotation left	4-7-3
ROR	Rotation right	4-7-3
SFTL	Bit shift left	4-7-4
SFTR	Bit shift right	4-7-5
WSFL	Word shift left	4-7-6
WSFR	Word shift right	4-7-7

4-7-1. Arithmetic shift left [SHL], Arithmetic shift right [SHR]

1. Summary

Do arithmetic shift left/right for the numbers

Arithmetic shift left [SHL]			
16 bits	SHL	32 bits	DSHL
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-
Arithmetic shift right [SHR]			
16 bits	SHR	32 bits	DSHR
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
D	The source data address	16bit/32bit,BIN
n	Shift left or right times	16bit/32bit,BIN

3. Suitable soft components

Word

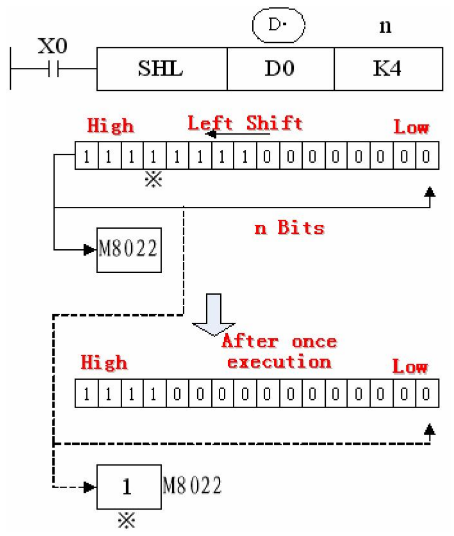
Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
D	●			●	●		●	●	●			
n										●		

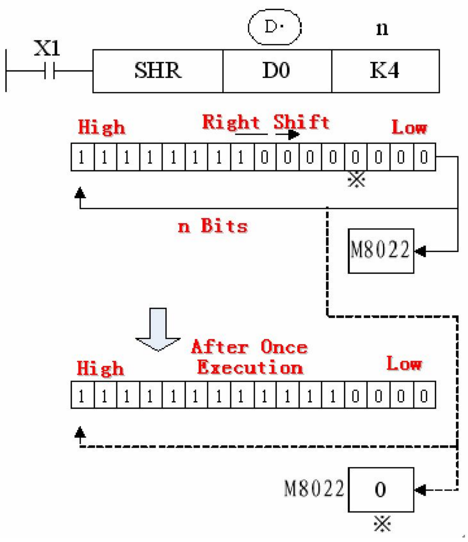
Description

- After once execution, the low bit is filled in 0, the final bit is stored in carry flag.
- After once execution, the high bit is same with the bit before shifting, the final bit is stored in carry flag.

< Arithmetic shift left >

< Arithmetic shift right >





4-7-2． Logic shift left [LSL]， Logic shift right [LSR]

1. Summary

Do logic shift right/left for the numbers

Logic shift left [LSL]			
16 bits	LSL	32 bits	DLSL
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-
Logic shift right [LSR]			
16 bits	LSR	32 bits	DLSR
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
D	Source data address	16 bits/32 bits, BIN
n	Arithmetic shift left/right times	16 bits/32bits, BIN

3. Suitable soft components

Word

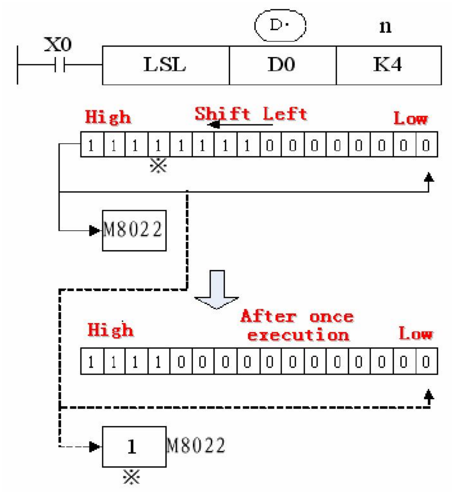
Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
D	●			●	●		●	●	●			
n										●		

Description

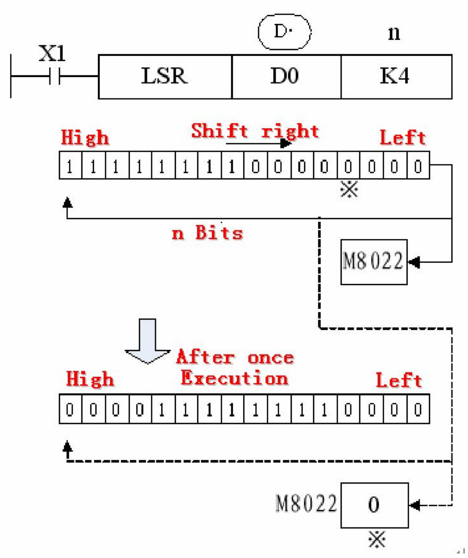
- After once execution, the low bit is filled in 0, the final bit is stored in carry flag.
- LSL meaning and operation are the same as SHL.
- After once execution, the high bit is same with the bit before shifting, the final bit is stored in carry flag。

- LSR and SHR is different, LSR add 0 in high bit when moving, SHR all bits are moved.

< Logic shift left >



< Logic shift right >



4-7-3. Rotation shift left **[ROL]** , Rotation shift right **[ROR]**

1. Summary

Continue and cycle shift left or right

Rotation shift left [ROL]			
16 bits	ROL	32 bits	DROL
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-
Rotation shift right [ROR]			
16 bits	ROR	32 bits	DROR
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type

D	Source data address	16 bits/32 bits, BIN
n	Shift right or left times	16 bits/32 bits, BIN

3. Suitable soft components

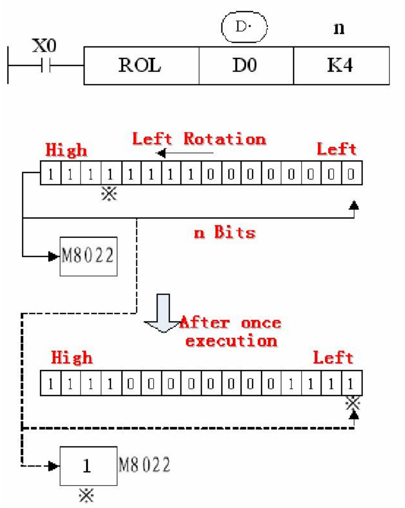
Word

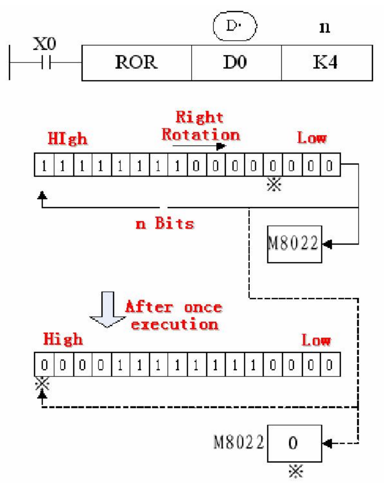
Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
D	●			●	●		●	●	●			
n										●		

Description

- The bit format of the destination device is rotated n bit places to the left on every operation of the instruction.

< Rotation shift left > < Rotation shift right >





4-7-4. Bit shift left [SFTL]

1. Summary

Bit shift left

Bit shift left [SFTL]			
16 bits	SFTL	32 bits	DSFTL
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Types
S	Source soft element head address	bit
D	Target soft element head address	bit

n1	Source data quantity	16 bits /32 bits, BIN
n2	Shift left times	16 bits/32 bits, BIN

3. Suitable soft components

Word

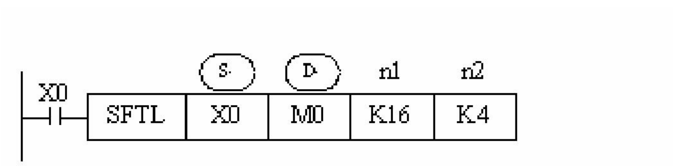
Operands	System								Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
n1	●			●	●	●	●	●	●	●		
n2	●			●	●	●	●	●	●	●		

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
S	●	●	●	●	●	●	
D		●	●	●	●	●	

Description

- The instruction copies n2 source devices to a bit stack of length n1. For every new addition of n2 bits, the existing data within the bit stack is shifted n2 bits to the left/right. Any bit data moving to the position exceeding the n1 limit is diverted to an overflow area.
- In every scan cycle, loop shift left action will be executed



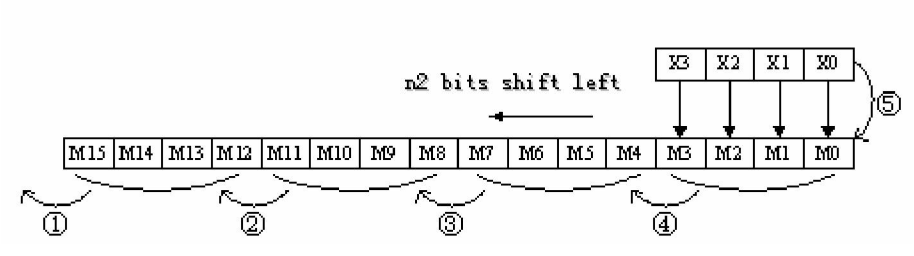
① M15~M12→Overflow

② M11~M 8→M15~M 12

③ M 7~M 4→M11~M8

④ M 3~M 0→M7~M4

⑤ X 3~X 0→M3~M0



4-7-5. Bit shift right [SFTR]

1. Summary

Bit shift right

Bit shift right [SFTR]			
16 bits	SFTR	32 bits	DSFTR
Execution	rising/falling edge	Suitable	XC2.XC3.XC5.XCM

condition		Models	
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S	Source soft element head address	bit
D	Target soft element head address	bit
n1	Source data quantity	16 bits/32 bits, BIN
n2	Shift right times	16 bits/32 bits, BIN

3. Suitable soft components

Word

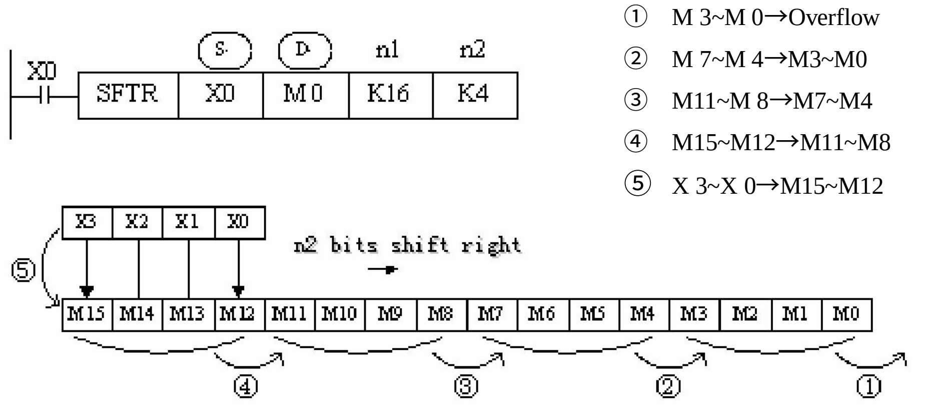
Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
n1	●			●	●	●	●	●	●	●		
n2	●			●	●	●	●	●	●	●		

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
S	●	●	●	●	●	●	
D		●	●	●	●	●	

Description

- The instruction copies n2 source devices to a bit stack of length n1. For every new addition of n2 bits, the existing data within the bit stack is shifted n2 bits to the left/right. Any bit data moving to the position exceeding the n1 limit is diverted to an overflow area.
- In every scan cycle, loop shift right action will be executed



① M 3~M 0→Overflow
② M 7~M 4→M3~M0
③ M11~M 8→M7~M4
④ M15~M12→M11~M8
⑤ X 3~X 0→M15~M12

4-7-6. Word shift left [WSFL]

1. Summary

Word shift left

Word shift left [[WSFL]			
16 bits	WSFL	32 bits	-
Execution condition	rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S	Source soft element head address	16 bits/32 bits, BIN
D	Target soft element head address	16 bits /32 bits, BIN
n1	Source data quantity	16 bits /32 bits, BIN
n2	Word shift left times	16 bits /32 bits, BIN

3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●		●	●	●	●	●	●			
D	●			●	●		●	●	●			
n1	●			●	●		●	●	●	●		
n2	●			●	●		●	●	●	●		

Description

- The instruction copies n2 source devices to a word stack of length n1. For each addition of n2 words, the existing data within the word stack is shifted n2 words to the left. Any word data moving to a position exceeding the n1 limit is diverted to an overflow area.
- In every scan cycle, loop shift left action will be executed.

① D25~D22→Overflow

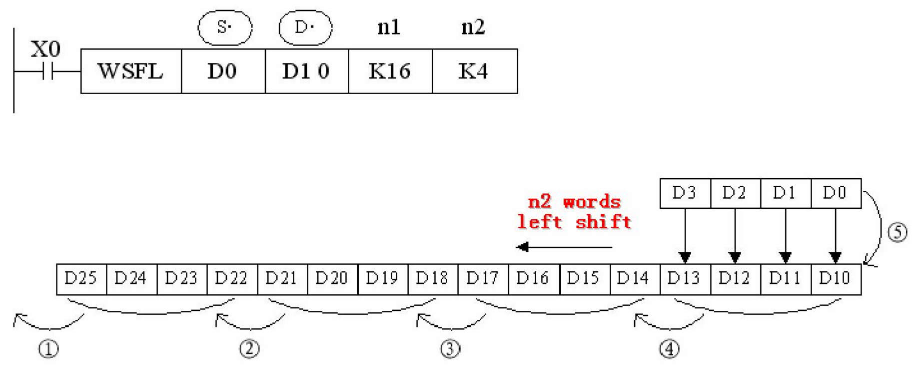
② D21~D18→D25~D22

③ D17~D14→D21~D18

④ D13~D10→D17~D14

⑤ D 3~D 0→D13~D10

n2 word shift left



4-7-7. Word shift right[WSFR]

1. Summary

Word shift right

Word shift right [WSFR]			
16 bits	WSFR	32 bits	-
Execution condition	rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S	Source soft element head address	16 bits/32 bits, BIN
D	Target soft element head address	16 bits/32 bits, BIN
n1	Source data quantity	16 bits/32 bits, BIN
n2	Shift right times	16 bits/32 bits, BIN

3. Suitable soft components

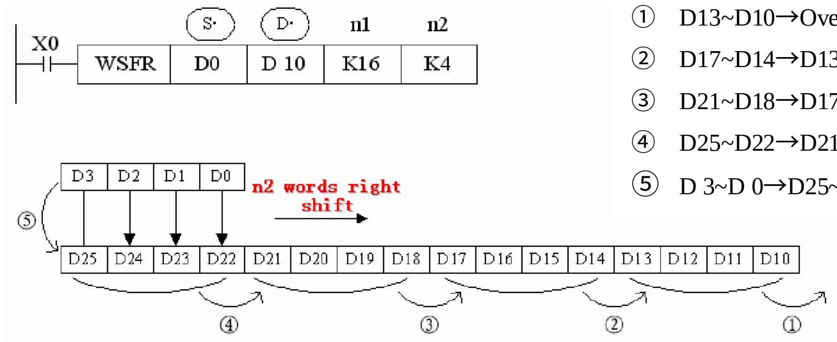
Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●		●	●	●	●	●	●			
D	●			●	●		●	●	●			
n1	●			●	●		●	●	●	●		
n2	●			●	●		●	●	●	●		

Description

- The instruction copies n2 source devices to a word stack of length n1. For each addition of n2 words, the existing data within the word stack is shifted n2 words to the right. Any word data moving to a position exceeding the n1 limit is diverted to an overflow area.

- In every scan cycle, loop shift right action will be executed



① D13~D10→Overflow

② D17~D14→D13~D10

③ D21~D18→D17~D14

④ D25~D22→D21~D18

⑤ D 3~D 0→D25~D22

4-8. Data Convert

Mnemonic	Function	Chapter
WTD	Single word integer converts to double word integer	4-8-1
FLT	16 bits integer converts to float point	4-8-2
DFLT	32 bits integer converts to float point	4-8-2
FLTD	64 bits integer converts to float point	4-8-2
INT	Float point converts to integer	4-8-3
BIN	BCD convert to binary	4-8-4
BCD	Binary converts to BCD	4-8-5
ASCI	Hex. converts to ASCII	4-8-6
HEX	ASCII converts to Hex.	4-8-7
DECO	Coding	4-8-8
ENCO	High bit coding	4-8-9
ENCOL	Low bit coding	4-8-10

4-8-1. Single word integer converts to double word integer [WTD]

1. Summary

Single word integer converts to double word integer [WTD]			
16 bits	WTD	32 bits	-
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

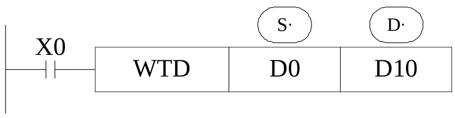
Operands	Function	Data Type
S	Source soft element address	16 bits, BIN
D	Target soft element address	32 bits, BIN

3.Suitable soft components

Word

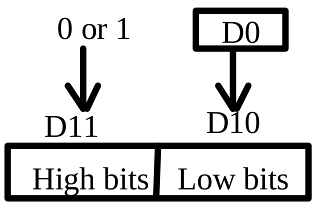
Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●		●	●	●	●	●	●			
D	●			●	●		●	●	●			

Description



(D0) → (D11, D10)

Single Word Double



- When single word D0 is positive integer, after executing this instruction, the high bit of double word D10 is 0.
- When single word D0 is negative integer, after executing this instruction, the high bit of double word D10 is 1.

4-8-2. 16 bits integer converts to float point [FLT]

1. Summary

16 bits integer converts to float point [FLT]					
16 bits	FLT	32 bits	DFLT	64 bits	FLTD
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM		
Hardware requirement	-	Software requirement	-		

2. Operands

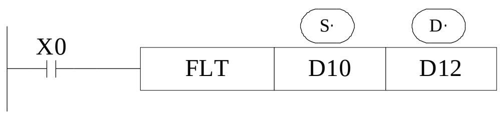
Operands	Function	Data Type
S	Source soft element address	16 bits/32 bits/64 bits,BIN
D	Target soft element address	32 bits/64 bits,BIN

3. Suitable soft components

Word	Operands	System									Constant	Module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	S	●	●								●		
	D	●											

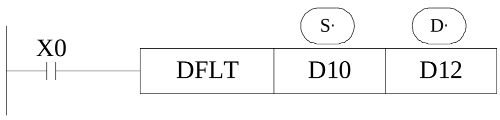
Description

<16 bits>



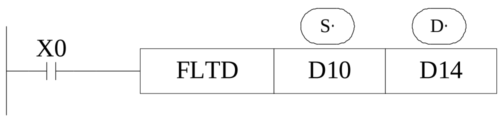
(D10) → (D13,D12)
BIN integer Binary float point

<32 bits >



(D11,D10) → (D13,D12)
BIN integer Binary float point

<64 bits>



(D13,D12,D11,D10) → (D17,D16,D15,D14)
BIN integer Binary float point

- Convert BIN integer to binary float point. As the constant K ,H will auto convert by the float operation instruction, so this FLT instruction can’t be used.
- The instruction is contrary to INT instruction

4-8-3. Float point converts to integer [INT]

1. Summary

Float point converts to integer [INT]			
16 bits	INT	32 bits	DINT
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S	Source soft element address	16 bits/32 bits, BIN
D	Target soft element address	16 bits/32 bits, BIN

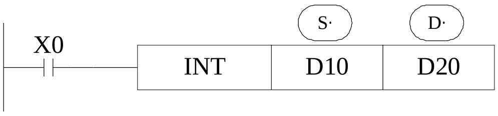
3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●										
D	●											

Description

<16 bits>

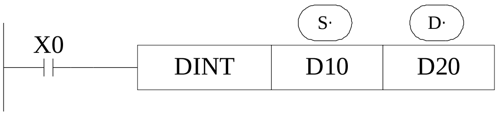


(D11,D10) → (D20)

Binary Float BIN integer

Give up the data after the decimal dot

<32 bits>



(D11,D10) → (D20,D21)

Binary Float BIN integer

Give up the data after the decimal dot

- The binary source number is converted into a BIN integer and stored at the destination device. Abandon the value behind the decimal point.
- This instruction is contrary to FLT instruction.
- When the result is 0, the flag bit is ON

  When converting, less than 1 and abandon it, zero flag is ON.

  The result is over below data, the carry flag is ON.

  16 bits operation: -32,768~32,767

  32 bits operation: -2,147,483,648~2,147,483,647

4-8-4. BCD convert to binary [BIN]

1. Summary

BCD convert to binary [BIN]			
16 bits	BIN	32 bits	-
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S	Source soft element address	BCD
D	Target soft element address	16 bits/32 bits, BIN

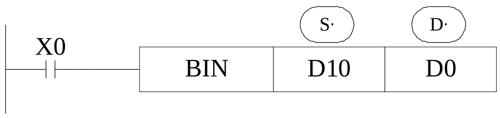
3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●		●	●	●	●	●	●			
D	●			●	●		●	●	●			

Description

Convert and move instruction of Source (BCD) → destination (BIN)



- When source data is not BCD code, M8067（Operation error）, M8004 (error occurs)
- As constant K automatically converts to binary, so it’s not suitable for this instruction.

4-8-5. Binary convert to BCD [BCD]

1. Summary

Binary convert to BCD [BCD]			
16 bits	BCD	32 bits	-
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

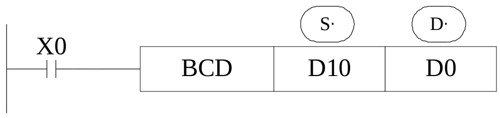
Operands	Function	Data Type
S	Source soft element address	16 bits/32 bits, BIN
D	Target soft element address	BCD code

3. Suitable soft components

Word	Operands	System									Constant	Module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	S	●	●		●	●	●	●	●	●			
	D	●			●	●		●	●	●			

Description

Convert and move instruction of source (BIN)→destination (BCD)



l This instruction can be used to output data directly to a seven-segment display.

4-8-6. Hex. converts to ASCII [ASCI]

1. Summary

Hex. convert to ASCII [ASCI]			
16 bits	ASCI	32 bits	-
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S	Source soft element address	2 bits, HEX
D	Target soft element address	ASCII code
n	Transform character quantity	16 bits, BIN

3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	•	•		•	•	•	•	•	•			
D	•			•	•		•	•	•			
n	•			•	•		•	•	•	•		

Description

X0		S·	D·	n
─┤├─	ASCI	D100	D200	K4

Convert each bit of source's (S) Hex. format data to be ASCII code, move separately to the high 8 bits and low 8 bits of destination (D). The convert alphanumeric number is assigned with n.

D· is low 8 bits, high 8 bits, store ASCII data.

The convert result is this

n D	K1	K2	K3	K4	K5	K6	K7	K8	K9
D200 down	[C]	[B]	[A]	[0]	[4]	[3]	[2]	[1]	[8]
D200 up		[C]	[B]	[A]	[0]	[4]	[3]	[2]	[1]
D201 down			[C]	[B]	[A]	[0]	[4]	[3]	[2]
D201 up				[C]	[B]	[A]	[0]	[4]	[3]
D202 down					[C]	[B]	[A]	[0]	[4]
D202 up						[C]	[B]	[A]	[0]
D203 down							[C]	[B]	[A]

Assign start device：
(D100)=0ABCH
(D101)=1234H
(D102)=5678H

D203 up		[C]	[B]
D204 down			[C]

[0]=30H [1]=31H
[5]=35H [A]=41H
[2]=32H [6]=36H
[B]=42H [3]=33H
[7]=37H [C]=43H
[4]=34H [8]=38H

4-8-7．ASCII convert to Hex.[HEX]

1. Summary

ASCII converts to Hex. [HEX]			
16 bits	HEX	32 bits	-
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Date type
S	Source soft element address	ASCII
D	Target soft element address	2 bits, HEX
n	Character quantity	16 bits, BIN

3. Suitable soft components

Word	Operands	System									Constant	Module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	S	•	•		•	•	•	•	•	•			
	D	•			•	•		•	•	•			
	n										•		

Description

X0	HEX	D200 (S·)	D100 (D·)	K4 (n)

Convert the high and low 8 bits in source S· to HEX data. Move 4 bits every time to destination D· . The convert alphanumeric number is assigned by n.

The convert of the upward program is the following：

(S・)	ASCII Code	HEX Convert
D200 down	30H	0
D200 up	41H	A
D201 down	42H	B
D201 up	43H	C
D202 down	31H	1
D202 up	32H	2
D203 down	33H	3
D203 up	34H	4
D204 down	35H	5

n (D・)	D102	D101	D100
1	Not change to be 0		··· 0H
2			·· 0AH
3			· 0ABH
4			0ABCH
5		··· 0H	ABC1H
6		·· 0AH	BC12H
7		· 0ABH	C123H
8		0ABCH	1234H
9	··· 0H	ABC1H	2345H

n=k4

D200	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0
	41H? [A]								30H? [0]							
D201	0	1	0	0	0	0	1	1	0	1	0	1	0	0	1	0
	43H? [C]								42H? [B]							
D100	0	0	0	0	1	0	1	0	1	0	1	1	1	1	0	0
	0				A				B				C			

4-8-8. Coding [DECO]

1. Summary

Transform the ASCII code to Hex numbers.

Coding [DECO]			
16 bits	DECO	s	-
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S	Source soft element address	ASCII
D	Target soft element address	2 bits HEX
n	The coding soft element quantity	16bits, BIN

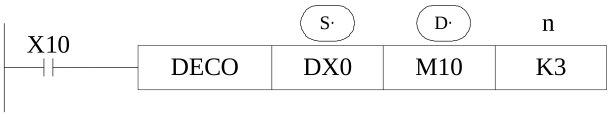
2. Suitable soft components

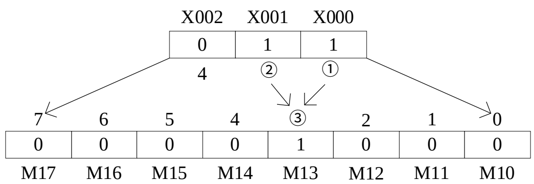
Word	Operands	System									Constant	Module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	S	●	●		●	●	●	●	●	●			
	n										●		

Bit	Operands	System						
		X	Y	M	S	T	C	Dn.m
	D	●	●	●	●	●	●	

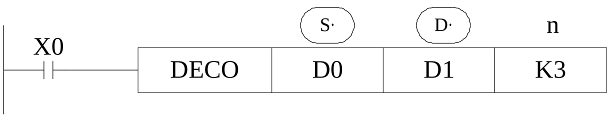
Description

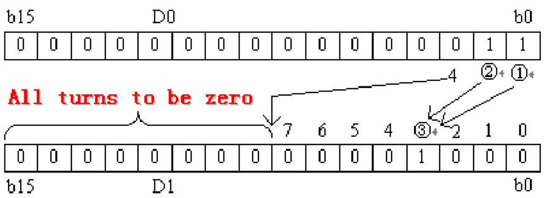
< When D· is bit unit > n≤16





- The source address is 1+2=3，so starts from M10, the number 3 bit (M13) is 1. If the source are all 0, M10 is 1.
- When n=0, no operation, beyond n=0~16, don't execute the instruction.
- When n=16, if coding command D· is soft unit, it's point is 2^16=65536。
- When drive input is OFF, instructions are not executed, the activate coding output keep on activate.





- Low n bits(n≤4) of source address is decoded to target address. n≤3, the high bit of target address all become 0.
- When n=0, no operation, beyond n=0~14, don't execute the instruction.

4-8-9. High bit coding [ENCO]

1. Summary

Transform the ASCII code to hex numbers

High bit coding [ENCO]			
16 bits	ENCO	32 bits	-
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S	data address need coding	16 bits, BIN; bit
D	Coding result address	16 bits, BIN
n	soft element quantity to save result	16 bits, BIN

3. Suitable soft components

Word

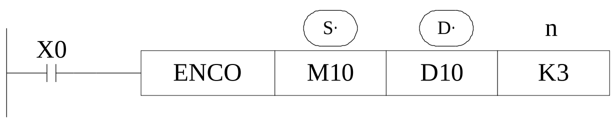
Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●		●	●	●	●	●	●			
D	●			●	●		●	●	●			
n										●		

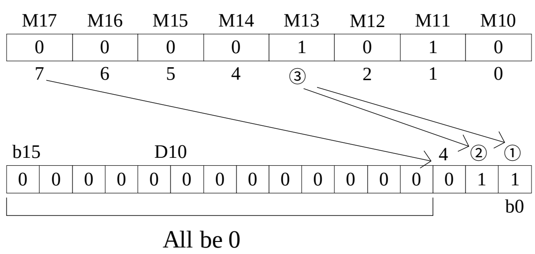
Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
S	●	●	●	●	●	●	

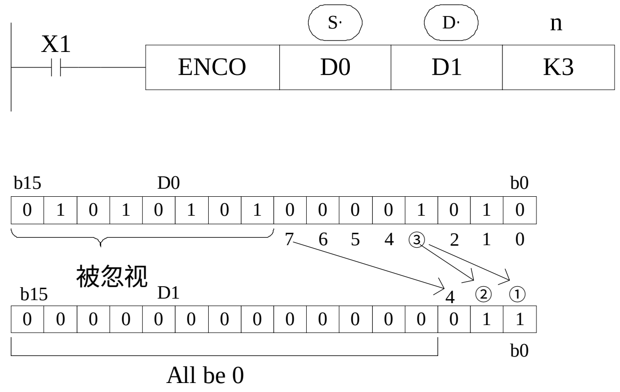
Description

< When S· is bit device > n≤16





< When S· is word device > n≤4



- If many bits in the source ID are 1, ignore the low bits. If source ID are all 0, don't execute the instructions.
- When drive input is OFF, the instruction is not executed, encode output don't change.
- When n=8, if encode instruction's "S" is bit unit, it's point number is 2^8=256

4-8-10．Low bit coding [ENCOL]

1. Summary

Transform the ASCII to hex numbers.

Low bit coding [ENCOL]			
16 bits	ENCOL	32 bits	-
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S	Soft element address need coding	16bit,BIN；bit
D	Soft element address to save coding result	16bit,BIN
n	The soft element quantity to save result	16bit,BIN

3. Suitable soft components

Word

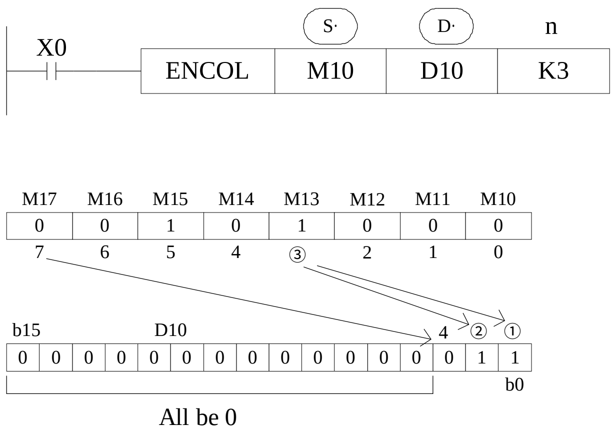
Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●		●	●	●	●	●	●			
D	●			●	●		●	●	●			
n										●		

Bit

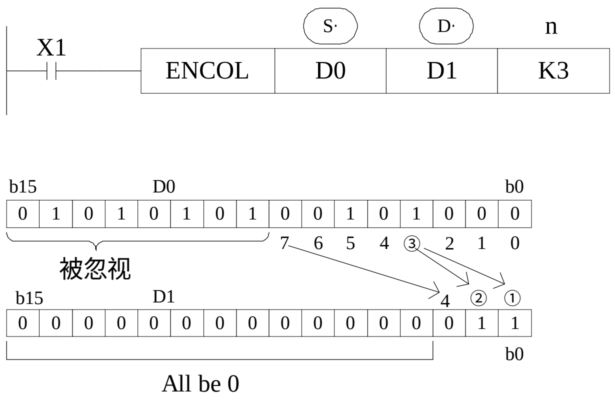
Operands	System						
	X	Y	M	S	T	C	Dn.m
S	●	●	●	●	●	●	

Description

<if S· is bit device > n≤16



< if S· is word device> n≤4



- If many bits in the source ID are 1, ignore the high bits. If source ID are all 0, don’t execute the instructions。
- When drive input is OFF, the instruction is not executed, encode output don’t change
- When n=8, if encode instruction’s S· is bit unit, it’s point number is 2^8=256

4-9．Floating Operation

Mnemonic	Function	Chapter
ECMP	Float Compare	4-9-1
EZCP	Float Zone Compare	4-9-2
EADD	Float Add	4-9-3
ESUB	Float Subtract	4-9-4
EMUL	Float Multiplication	4-9-5
EDIV	Float Division	4-9-6
ESQR	Float Square Root	4-9-7
SIN	Sine	4-9-8
COS	Cosine	4-9-9
TAN	Tangent	4-9-10
ASIN	ASIN	4-9-11
ACOS	ACOS	4-9-12
ATAN	ATAN	4-9-13

4-9-1. Float Compare [ECMP]

1. Summary

Float Compare [ECMP]			
16 bits	-	32 bits	ECMP
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S1	Soft element address need compare	32 bits, BIN
S2	Soft element address need compare	32 bits, BIN
D	Compare result	bit

3. Suitable soft components

Word

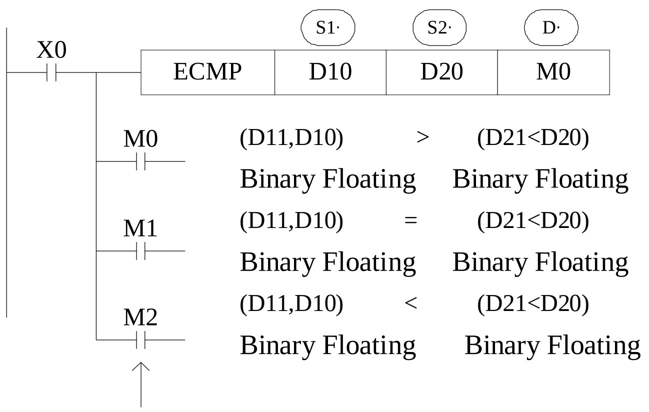
Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●				●	●	●	●	●		
S2	●	●				●	●	●	●	●		

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
D		●	●	●			

Description

(D11,D10) : (D21,D20) → M0,M1,M2
Binary Floating Binary Floating



The status of the destination device will be kept even if the ECMP instruction is deactivated.

- The binary float data of S1 is compared to S2. The result is indicated by 3 bit devices specified with the head address entered as D
- If a constant K or H used as source data, the value is converted to floating point before the addition operation.

X0

ECMP	K500	D100	M10

（K500）： （D101，D100）→M10,M11,M12

Binary converts to floating Binary floating

4-9-2．Float Zone Compare [EZCP]

1. Summary

Float Zone Compare [EZCP]			
16 bits	-	32 bits	EZCP
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S1	Soft element address need compare	32 bits, BIN
S2	Upper limit of compare data	32 bits, BIN
S3	Lower limit of compare data	32 bits, BIN
D	The compare result soft element address	bit

3.Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●				●	●	●	●	●		
S2	●	●				●	●	●	●	●		
S3	●	●				●	●	●	●	●		

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
D		●	●	●			

Description

Compare a float range with a float value..

X0

	S1·	S2·	S3·	D·
EZCP	D10	D20	D0	M3

M3 (D1,D0) < (D11,D10) ON

Binary Floating Binary Floating

M4 (D11,D10) ≤ (D1,D0) ≤ (D21，D20) ON

Binary Floating Binary Floating Binary Floating

M5 (D1,D0) > (D21,D20) ON

Binary Floating Binary Floating

The status of the destination device will be kept even if the EZCP instruction is deactivated.

- The data of S1 is compared to the data of S2. The result is indicated by 3 bit devices specified with the head address entered as D.
- If a constant K or H used as source data, the value is converted to floating point before the addition operation.

X0

EZCP	K10	K2800	D5	M0

(K10) ： [D6,D5]： (K2800) → M0，M1，M2

Binary converts to Floating Binary Floating Binary converts to Floating

Please set S1<S2, when S2>S1, see S2 as the same with S1 and compare them

4-9-3. Float Add[EADD]

1. Summary

Float Add [EADD]			
16 bits	-	32 bits	EADD
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

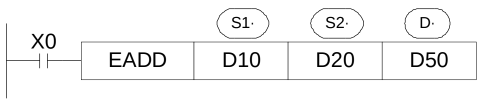
Operands	Function	Data Type
S1	Soft element address need to add	32 bits, BIN
S2	Soft element address need to add	32 bits, BIN
D	Result address	32 bits, BIN

3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●				●	●	●	●	●		
S2	●	●				●	●	●	●	●		
D	●						●	●	●			

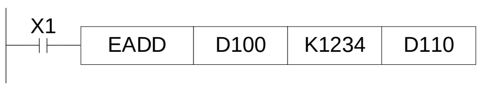
Description



(D11,D10) + (D21,D20) → (D51,D50)

Binary Floating Binary Floating Binary Floating

- The floating point values stored in the source devices S1 and S2 are algebraically added and the result stored in the destination device D.
- If a constant K or H used as source data, the value is converted to floating point before the addition operation.



(K1234) + (D101,D100) → (D111,D110)

Binary converts to Floating Binary Floating Binary Floating

- The same device may be used as a source and as the destination. If this is the case then, on continuous operation of the EADD instruction, the result of the previous operation will be used as a new source value and a new result calculated. This will happen every program scan unless the pulse modifier or an interlock program is used.

4-9-4. Float Sub[ESUB]

1. Summary

Float Sub [ESUB]			
16 bits	-	32 bits	ESUB
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S1	Soft element address need to subtract	32 bits, BIN
S2	Soft element address need to subtract	32 bits, BIN
D	Result address	32 bits, BIN

3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●				●	●	●	●	●		
S2	●	●				●	●	●	●	●		
D	●						●	●	●			

Description

X0		S1·	S2·	D·
⊣⊢	ESUB	D10	D20	D50

(D11,D10) − (D21,D20) → (D51,D50)

Binary Floating Binary Floating Binary Floating

- The floating point value of S2 is subtracted from the floating point value of S1 and the result stored in destination device D.
- If a constant K or H used as source data, the value is converted to floating point before the addition operation。

X1				
⊣⊢	ESUB	K1234	D100	D110

（K1234） − (D101,D100) → (D111,D110)

Binary converts to Floating Binary Floating Binary Floating

- The same device may be used as a source and as the destination. If this is the case then, on continuous operation of the EADD instruction, the result of the previous operation will be used as a new source value and a new result calculated. This will happen every program scan unless the pulse modifier or an interlock program is used.

4-9-5. Float Mul[EMUL]

1. Summary

Float Multiply [EMUL]			
16 bits	-	32 bits	EMUL
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S1	Soft element address need to multiply	32 bits, BIN
S2	Soft element address need to multiply	32 bits, BIN
D	Result address	32 bits, BIN

3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●				●	●	●	●	●		
S2	●	●				●	●	●	●	●		
D	●						●	●	●			

Description

X0		S1·	S2·	D·
─┤├─	EMUL	D10	D20	D50

(D11，D10) × (D21,D20) → (D51,D50)

Binary Floating Binary Floating Binary Floating

- The floating value of S1 is multiplied with the floating value point value of S2. The result of the multiplication is stored at D as a floating value
- If a constant K or H used as source data, the value is converted to floating point before the addition operation.

X1				
─┤├─	EMUL	K100	D100	D110

(K100) × (D101,D100) → (D111,D110)

Binary converts to Floating Binary Floating Binary Floating

4-9-6．Float Div[EDIV]

1. Summary

Float Divide [EDIV]			
16 bits	-	32 bits	EDIV
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

Operands	Function	Data Type
S1	Soft element address need to divide	32 bits, BIN
S2	Soft element address need to divide	32 bits, BIN
D	Result address	32 bits, BIN

3. Suitable soft components

word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●				●	●	●	●	●		
S2	●	●				●	●	●	●	●		
D	●						●	●	●			

Description

X0

	S1·	S2·	D·
EDIV	D10	D20	D50

(D11,D10) ÷ (D21,D20) → (D51,D50)

Binary Floating   Binary Floating   Binary Floating

- The floating point value of S1 is divided by the floating point value of S2. The result of the division is stored in D as a floating point value. No remainder is calculated.
- If a constant K or H used as source data, the value is converted to floating point before the addition operation

X1

EDIV	D100	K100	D110

(D101,D100) ÷ (K100) → (D111,D110)

Binary converts to Floating   Binary Floating   Binary Floating

If S2 is 0, the calculate is error, the instruction can not work

4-9-7. Float Square Root [ESQR]

1. Summary

Float Square Root [ESQR]			
16 bits	-	32 bits	ESQR
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

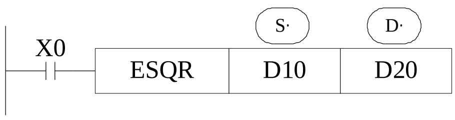
Operands	Function	Data Type
S	The soft element address need to do square root	32 bits, BIN
D	The result address	32 bits, BIN

3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●				●	●	●	●	●		
D	●						●	●	●			

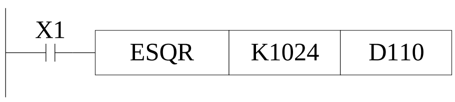
Description



(D11,D10) → (D21,D20)

Binary Floating   Binary Floating

- A square root is performed on the floating point value in S the result is stored in D
- If a constant K or H used as source data, the value is converted to floating point before the addition operation.



(K1024) → (D111，D110)

Binary converts to Floating   Binary Floating

- When the result is zero, zero flag activates.
- Only when the source data is positive will the operation be effective. If S is negative then an error occurs and error flag M8067 is set ON, the instruction can't be executed.

4-9-8. Sine[SIN]

1. Summary

Float Sine[SIN]			
16 bits	-	32 bits	SIN
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

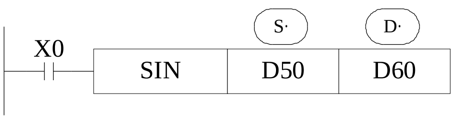
2. Operands

Operands	Function	Data Type
S	The soft element address need to do sine	32 bits, BIN
D	The result address	32 bits, BIN

3. Suitable soft components

Word	Operands	System									Constant	Module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	S	●	●				●	●	●	●	●		
	D	●						●	●	●			

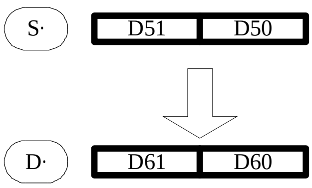
Description



(D51,D50) → (D61,D60)SIN

Binary Floating Binary Floating

- This instruction performs the mathematical SIN operation on the floating point value in S (angle RAD). The result is stored in D.



RAD value (angle× π/180)

Assign the binary floating value

SIN value

Binary Floating

4-9-9. Cosine[SIN]

1. Summary

Float Cosine[COS]			
16 bits	-	32 bits	COS
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

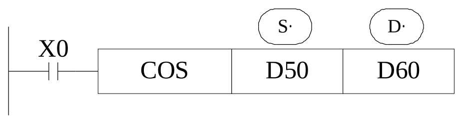
Operands	Function	Data Type
S	Soft element address need to do cos	32 bits, BIN
D	Result address	32 bits, BIN

3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●				●	●	●	●	●		
D	●						●	●	●			

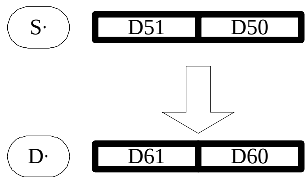
Description



(D51,D50)RAD → (D61,D60)COS

Binary Floating Binary Floating

- This instruction performs the mathematical COS operation on the floating point value in S (angle RAD). The result is stored in D。



RAD value (angle×π/180)

Assign the binary floating value

COS value

Binary Floating

4-9-10. TAN [TAN]

1. Summary

TAN [TAN]			
16 bits	-	32 bits	TAN
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	-	Software requirement	-

2. Operands

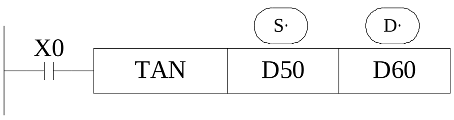
Operands	Function	Data Type
S	Soft element address need to do tan	32bit,BIN
D	Result address	32bit,BIN

3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●				●	●	●	●	●		
D	●						●	●	●			

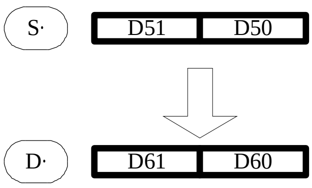
Description



(D51,D50)RAD → (D61,D60)TAN

Binary Floating Binary Floating

- This instruction performs the mathematical TAN operation on the floating point value in S. The result is stored in D.



RAD value (angle×π/180)

Assign the binary floating value

TAN value

Binary Floating

4-9-11. ASIN [ASIN]

1. Summary

ASIN [ASIN]			
16 bits	-	32 bits	ASIN
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	V3.0 and above version	Software requirement	-

2. Operands

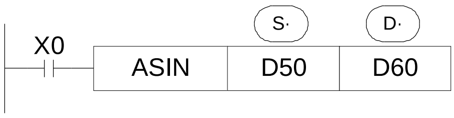
Operands	Function	Data Type
S	Soft element address need to do arcsin	32 bits, BIN
D	Result address	32 bits, BIN

3. Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●				●	●	●	●	●		
D	●						●	●	●			

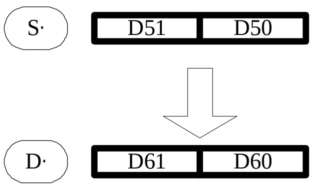
Description



(D51,D50)ASIN → (D61,D60)RAD

Binary Floating　　Binary Floating

- This instruction performs the mathematical ASIN operation on the floating point value in S. The result is stored in D.



ASIN value

Binary Floating

RAD value (angle×π/180)

Assign the binary floating value

4-9-12. ACOS [ACOS]

1. Summary

ACOS [ACOS]			
16 bits	-	32 bits	ACOS
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	V3.0 and above	Software requirement	-

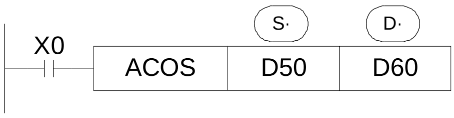
2. Operands

Operands	Function	Data Type
S	Soft element address need to do arccos	32 bits, BIN
D	Result address	32 bits, BIN

3. Suitable soft components

Word	Operands	System									Constant	Module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	S	●	●				●	●	●	●	●		
	D	●						●	●	●			

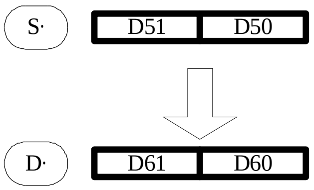
Description



(D51,D50)ACOS → (D61,D60)RAD

Binary Floating Binary Floating

- Calculate the arcos value(radian), save the result in the target address



TCOS value

Binary Floating

RAD value (angle× π/180)

Assign the binary floating value

4-9-13．ATAN [ATAN]

1. Summary

ATAN [ATAN]			
16 bits	-	32 bits	ACOS
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	V3.0 and above	Software requirement	-

2. Operands

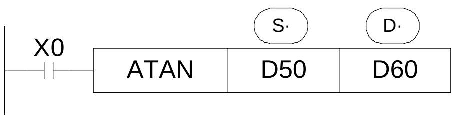
Operands	Function	Data Type
S	Soft element address need to do arctan	32 bit, BIN
D	Result address	32 bit, BIN

3.Suitable soft components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●				●	●	●	●	●		
D	●						●	●	●			

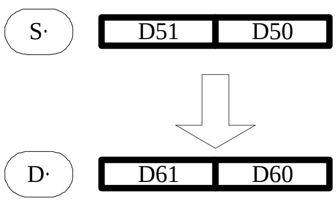
Description



(D51,D50)ATAN → (D61,D60)RAD

Binary Floating Binary Floating

- Calculate the arctan value (radian), save the result in the target address



ATAN value

Binary Floating

RAD value (angle×π/180)

Assign the binary floating value

4-10． RTC Instructions

Mnemonic	Function	Chapter
TRD	Clock data read	4-10-1
TWR	Clock data write	4-10-2

※1: To use the instructions, The Model should be equipped with RTC function;

4-10-1. Read the clock data [TRD]

1. Instruction Summary

Read the clock data:

Read the clock data: [TRD]			
16 bits	TRD	32 bits	-
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	V2.51 and above	Software requirement	-

2. Operands

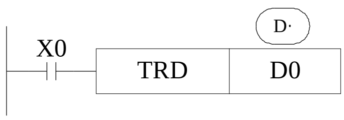
Operands	Function	Data Type
D	Register to save clock data	16 bits, BIN

3. Suitable Soft Components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
D	●			●	●							

Functions And Actions



The current time and date of the real time clock are read and stored in the 7 data devices specified by the head address D.

- Read PLC's real time clock according to the following format.
  The reading source is the special data register (D8013~D8019) which save clock data.

Special data register for real time clock t

Unit	Item	Clock data
D8018	Year	0-99
D8017	Month	1-12
D8016	Date	1-31
D8015	Hour	0-23
D8014	Minute	0-59
D8013	Second	0-59
D8019	Week	0 (Sun.)-6 (Sat.)

Unit	Item
D0	Year
D1	Month
D2	Date
D3	Hour
D4	Minute
D5	Second
D	Week

4-10-2．Write Clock Data [TWR]

1. Instruction Summary

Write the clock data:

Write clock data [TRD]			
16 bits	-	32 bits	TRD
Execution condition	Normally ON/OFF, rising/falling edge	Suitable Models	XC2.XC3.XC5.XCM
Hardware requirement	V2.51 and above	Software requirement	-

2. Operands

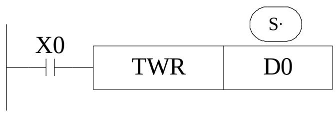
Operands	Function	Data Type
S	Write the clock data to the register	16 bits, BIN

3. Suitable Soft Components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●		●	●	●	●	●	●			

Functions And Actions



The 7 data devices specified with the head address S are used to set a new current value of the real time clock.

- Write the set clock data into PLC’s real time clock.
  In order to write real time clock, the 7 data devices specified with the head address S· should be pre-set.

Data for clock setting

Unit	Item	Clock data
D10	Year	0-99
D11	Month	1-12
D12	Date	1-31
D13	Hour	0-23
D14	Minute	0-59
D15	Second	0-59
D16	Week	0 (Sun.)-6 (Sat.)

Special data register for real time clock t

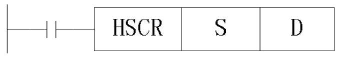
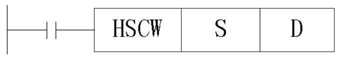
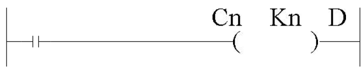
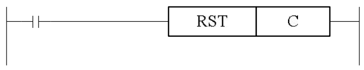
Unit	Item
D8018	Year
D8017	Month
D8016	Date
D8015	Hour
D8014	Minute
D8013	Second
D8019	Week

After executing TWR instruction, the time in real time clock will immediately change to be the new set time. So, when setting the time it is a good idea to set the source data to a time a number of minutes ahead and then drive the instruction when the real time reaches this value.

5 HIGH SPEED COUNTER (HSC)

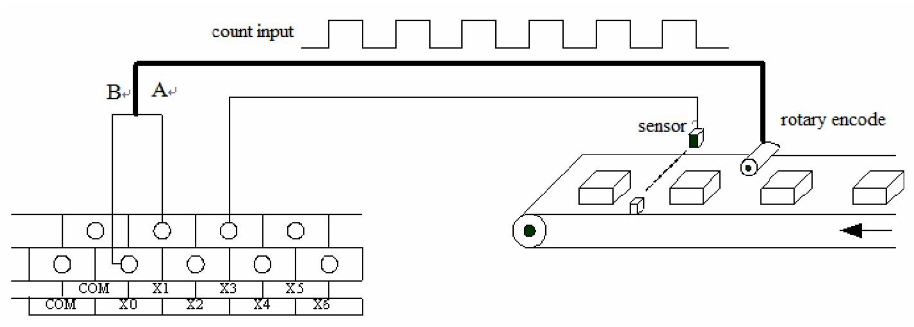
In this chapter we tell high speed counter’s functions, including high speed count model, wiring method, read/write HSC value, reset etc.

Instructions List for HSC

MNEMONIC	FUNCTION	CIRCUIT AND SOFT COMPONENTS	CHAPTER
READ/WRITE HIGH SPEED COUNTER			
HSCR	Read HSC		5-6-1
HSCW	Write HSC		5-6-2
OUT	HSC (High Speed Counter)		3-13
OUT	24 segments HSC Interruption		5-10
RST	HSC Reset		3-13

5-1. Functions Summary

XC series PLC has HSC (High Speed Counter) function which is independent with the scan cycle. Via choosing different counter, test the high speed input signals with detect sensors and rotary encoders. The highest testing frequency can reach 80KHz.

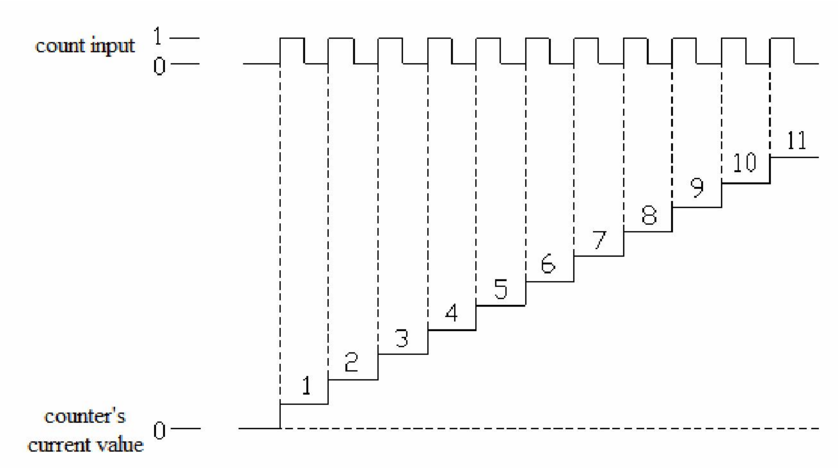


5-2. HSC Mode

XC series high speed counter's function has three count modes: Increment Mode, Pulse+Direction Mode and AB phase Mode;

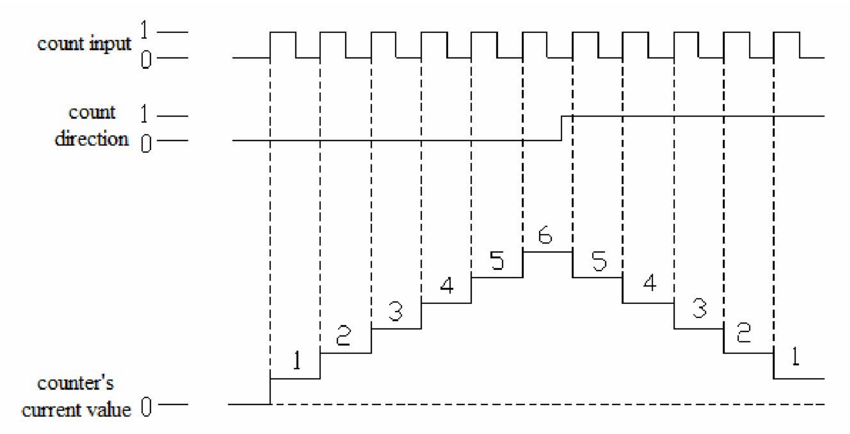
Increment Mode

Under this mode, count and input the pulse signal, the count value increase at each pulse's rising edge;



Pulse+Direction Mode

Under this mode, the pulse signal and direction signal are all inputted, the count value increase or decrease with the direction signal's status. When the count signal is OFF, the count input's rising edge carry on plus count; When the count signal is ON, the count input's rising edge carry on minus count;

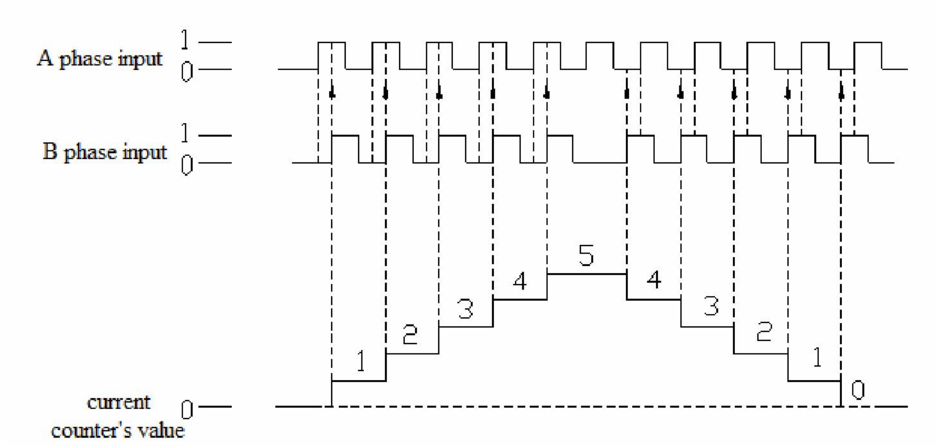


AB Phase Mode

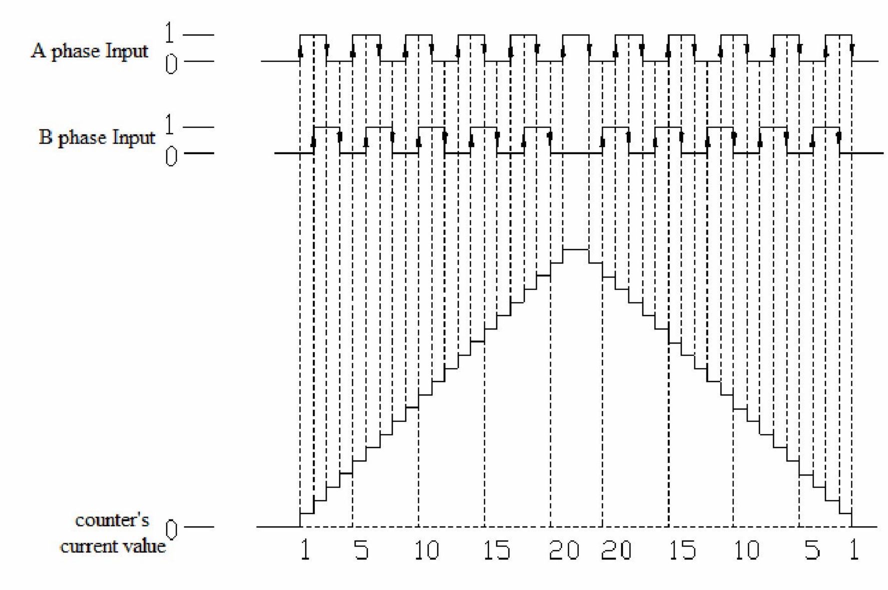
Under this mode, the HSC value increase or decrease according to two differential signal (A phase and B phase). According to the multiplication, we have 1-time frequency and 4-time frequency two modes, but the default count mode is 4-time mode.

1-time frequency and 4-time frequency modes are shown below:

- **1-time Frequency**



- **4-time Frequency**



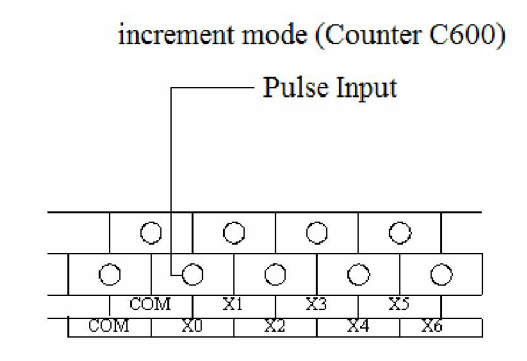
5-3. HSC Range

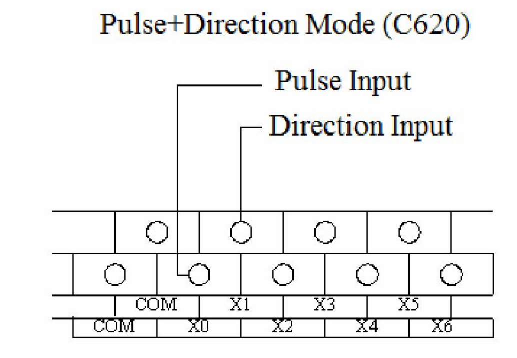
HSC's count range is: K-2,147,483,648 ~ K+2,147,483,647. If the count value overflows this range, then up flow or down flow appears;

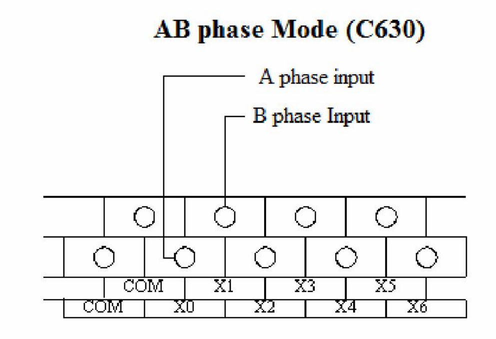
For "up flow", it means the count value jumps from K+2,147,483,647 to be K-2,147,483,648, then continue to count; For "down flow", it means the count value jumps from K-2,147,483,648 to be K+2,147,483,647 then continue to count.

5-4. HSC Input Wiring

For the counter's pulse input wiring, things differ with different PLC model and counter model; several typical input wiring are shown below: (take XC3-48 as the example):







5-5. HSC ports assignment

Each letter's Meaning:

U	Dir	A	B
Pulse input	Count Direction Judgment (OFF=increment, ON=decrement)	A phase input	B phase input

Normally, X0 and X1 can accept 80KHz frequency under single phase mode and AB phase mode. Other terminals can accept only 10KHz under single phase mode, 5KHz under AB phase mode. X can use as normal input terminals when they are not used as high speed input. The detailed assignment is shown as below:

XC2 series PLC																		
	Increment										Pulse+Dir Input					AB Phase Mode		
	C600	C602	C604	C606	C608	C610	C612	C614	C616	C618	C620	C622	C624	C626	C628	C630	C632	C634
Max.F	80K	80K	10K	10K	10K						80K	10K				80K	5K	
4-times F																√		
Count Interrupt	√	√	√	√	√						√					√		
X000	U										U					A		
X001		U									Dir					B		
X002																		

X003			U									U					A	
X004												Dir					B	
X005																		
X006				U														
X007					U													
X010																		
X011																		
X012																		

XC3-14 PLC

	Increment										Pulse+Dir Input					AB Phase Mode		
	C600	C602	C604	C606	C608	C610	C612	C614	C616	C618	C620	C622	C624	C626	C628	C630	C632	C634
*Max.F	10K	10K	10K	10K							10K	10K				5K		
4-times F																		
Count Interrupt	√	√	√	√								√						
X000	U										U					A		
X001											Dir					B		
X002		U																
X003			U															
X004																		
X005				U														

* C600、C620、C630 can support 80KHz with special requirement

XC3-19AR-E

	Increment										Pulse+Dir Input					AB Phase Mode		
	C600	C602	C604	C606	C608	C610	C612	C614	C616	C618	C620	C622	C624	C626	C628	C630	C632	C634
Max.F	10K	10K	10K	10K							10K	10K				5K	5K	
4-times F																	√	
Count Interrupt	√	√	√	√								√					√	
X000	U										U					A		
X001											Dir					B		
X002		U										U					A	
X003												Dir					B	
X004			U															
X005				U														

XC3-24、32 PLC and XC5-48、60 PLC

	Increment										Pulse+Dir Input					AB Phase Mode		
	C600	C602	C604	C606	C608	C610	C612	C614	C616	C618	C620	C622	C624	C626	C628	C630	C632	C634

Max.F	80K	80K	10K	10K	10K	10K					80K	10K	10K			80K	5K	5K
4-times F																√		√
Count Interrupt	√	√	√	√	√	√					√					√		
X000	U										U					A		
X001		U									Dir					B		
X002																		
X003			U									U					A	
X004												Dir					B	
X005																		
X006				U									U					A
X007													Dir					B
X010																		
X011					U													
X012						U												

XC3-48、60 PLC

	Increment										Pulse+Dir Input					AB Phase Mode		
	C600	C602	C604	C606	C608	C610	C612	C614	C616	C618	C620	C622	C624	C626	C628	C630	C632	C634
Max.F	80K	80K	10K	10K							80K	80K				80K	80K	
4-times F																	√	
Count Interrupt	√	√	√	√								√					√	
X000	U										U					A		
X001											Dir					B		
X002		U										U					A	
X003												Dir					B	
X004			U															
X005				U														

XC5-24/32 PLC、XCM-24/32 PLC

	Increment										Pulse+Dir Input					AB Phase Mode		
	C600	C602	C604	C606	C608	C610	C612	C614	C616	C618	C620	C622	C624	C626	C628	C630	C632	C634
Max.F	80K	10K									80K					80K		
4-times F																√		
Count Interrupt	√	√									√					√		
X000	U										U					A		
X001											Dir					B		
X002																		
X003		U																

X004																		
X005																		
X006																		

5-6. Read/Write HSC value

All high speed counters support read instruction [HSCR] and write instruction [HSCW], but users need to use hardware V3.1c and above.

5-6-1. Read HSC value [HSCR]

1、Instruction Summary

Read HSC value to the specified register;

Read from HSC [HSCR]/ write to HSC [HSCW]			
16 bits Instruction	-	32 bits Instruction	HSCR
Execution condition	Normally ON/OFF, rising/falling edge	Suitable models	XC2、XC3、XC5、XCM
Hardware requirement	V3.1c and above	Software requirement	-

2、Operands

Operands	Function	Type
S	Specify HSC code	32 bits, BIN
D	Specify the read/written register	32 bits, BIN

3、Suitable Soft Components

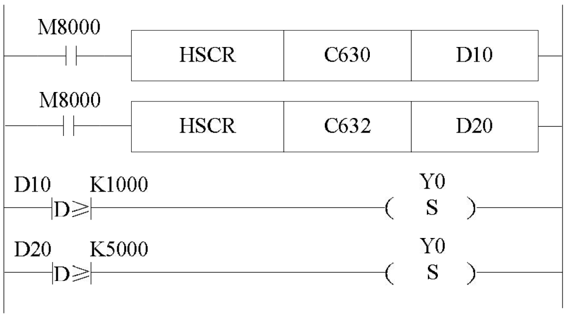
word

operands	system									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S					●							
D	●											

FUNCTIONS AND ACTIONS

- When the activate condition is true, read the HSC value in C630 (DWORD) into D10 (DWORD)
- Instruction HSCR read the HSC value into the specified register, improve HSC value's precision.

Sample Program:



5-6-2. Write HSC value [HSCW]

1、Instruction Summary

Write the specified register value into HSC;

Write HSC value [HSCW]			
16 bits Instruction	-	32 bits Instruction	HSCW
Execution condition	Normally ON/OFF, rising/falling edge	Suitable models	XC2、XC3、XC5、XCM
Hardware requirement	V3.1c and above	Software requirement	-

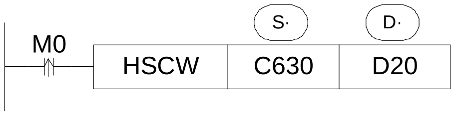
2、operands

Operands	Function	Type
S	Specify HSC code	32 bits, BIN
D	Specify the read/written register	32 bits, BIN

3、suitable soft components

word	operands	system									constant	module	
		D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
	S					●							
	D	●											

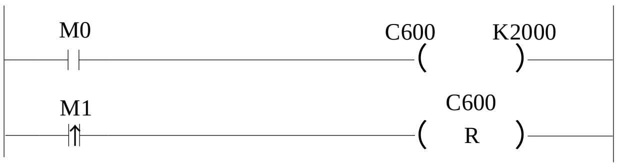
FUNCTIONS AND ACTIONS



- When the activate condition is true, write the value in D20 (DWORD) into C630 (DWORD), the original value is replaced;
- We suggest the users to apply high speed counter only with HSCR and HSCW, not with other instructions like DMOV, LD>, DMUL etc. and users must run after converting HSC to be other registers.

5-7. HSC Reset Mode

Reset HSC via software:



In the above graph, when M0 is ON, C600 starts to count the input pulse on X0; when M1 changes from OFF to be ON, reset C600, clear the count value

5-8. AB Phase counter multiplication setting

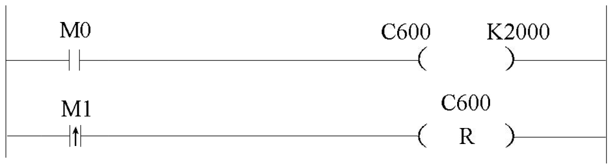
About AB phase counter, modify the frequency multiplication value via setting FLASH data register FD8241, FD8242, FD8243. If the value is 1, it is 1-time frequency, if it is 4, it is 4-time frequency.

Register	Function	Set Value	Meaning
FD8241	Frequency multiplication of C630	1	1-time frequency
		4	4-time frequency
FD8242	Frequency multiplication of C632	1	1-time frequency
		4	4-time frequency
FD8243	Frequency multiplication of C634	1	1-time frequency
		4	4-time frequency

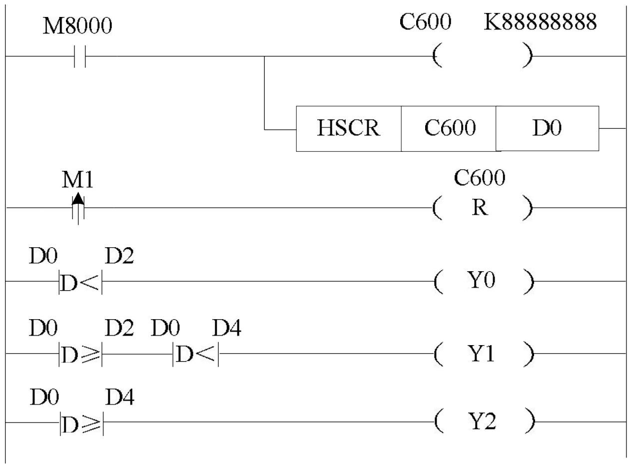
5-9. HSC Example

Below, we take XC3-60 PLC as the example, to introduce HSC's program form;

Increment Mode

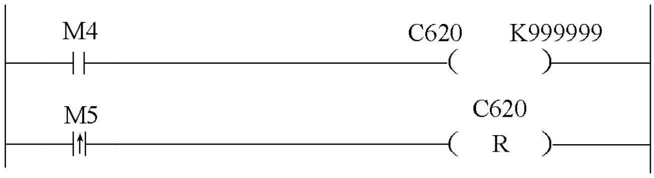


- When M0 is ON, C600 starts the HSC with the OFF→ON of X000;
- When comes the rising edge of M1, reset HSC C600



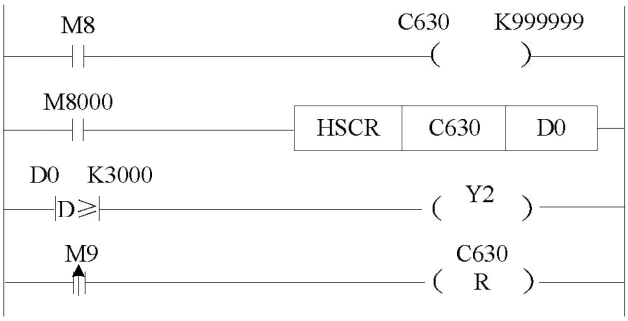
- When normally ON coil M8000 is ON, set the value of C600, the set value is K888888888, read the HSC value (DWORD) into data register D0 (DWORD).
- If the value in C600 is smaller than value in D2, set the output coil Y0 ON; If the value in C600 equals or be larger than value in D2, and smaller than value in D4, set the output coil Y1 ON; If the value in C600 equals or be larger than value in D4, set the output coil Y2 ON;
- When comes the rising edge of M1, reset HSC C600 and stop counting.

Pulse+Dir Mode

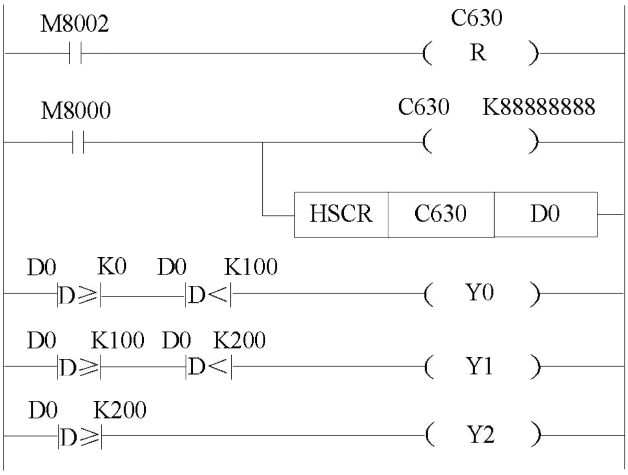


- When M4 is ON, C620 starts the HSC with the OFF→ON of X000; judge the count direction according to the input X001 status (OFF or ON). If X001 is OFF, it's increment count; if X001 is ON, it's decrement count;
- When comes the rising edge of M5, reset HSC C620 and stop counting.

AB phase mode



- When M8 is ON, C630 starts to count immediately. Count input via X000 (B Phase)、X001 (A Phase)
- When the count value exceeds K3000, output coil Y2 is ON;
- When comes the rising edge of M9, reset HSC C630



- When therising edge of initial positive pulse coil M8002 comes, i.e. Each scan cycle starts, HSC C630 reset and clear the count value.
- When set coil M8000 ON, C630 starts to count, the count value is set to be K8888888。
- If the count value is greater than K0 but smaller than K100, the output coil Y0 set ON; If the count value is greater thanK100 but smaller than K200 时，the output coil Y1 set ON; If the count value is greater thanK200, the output coilY2 set ON;

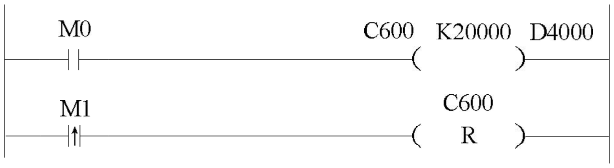
5-10. HSC Interruption

To XC series PLC, each HSC channels has 24 segments 32-bit pre-set value. When the HSC difference value equals the correspond 24-segment pre-set value, then interruption occures according to the interruption tag;

To use this function, please use hardware V3.1c or above;

5-10-1. Instruction Description

（for the program about interruption, please refer chapter 5-10-4)




```
LD      M0                        //HSC activate condition M0 (interruption count condition)
OUT     C600    K20000   D4000    //HSC value and set the start ID of 24-segment
LDP     M1                        //activate condition reset
RST     C600                      //HSC and 24-segment reset (interruption reset)
```

As shown in the above graph, data register D4000 is the start ID of 24-segment pre-set value area. Behind it, save each pre-set value in DWORD form. Please pay attention when using HSC:

- If certain pre-set value is 0, it means count interruption stops at this segment;
- Set the interruption pre-set value but not write the correspond interruption program is not allowed;
- 24-segment interruption of HSC occurs in order. I.e. If the first segment interruption doesn't happen, then the second segment interruption will not happen;
- 24-segment pre-set value can be specified to be relative value or absolute value. Meantime, users can specify the et value to be loop or not. But the oop mode can't be used together with absolute value.

5-10-2. Interruption tags to HSC

In the below table, we list each counter's 24-segment pre-set value to its interruption tag. E.e.: 24-segment pre-set value of counter C600 correspond with the interruption pointer: I1001、I1002、I1003、…I1024.

Increment mode

Counter	Interruption tag
C600	I1001~I1024
C602	I1101~I1124
C604	I1201~I1224
C606	I1301~I1324
C608	I1401~I1424

pulse+direction mode

Counter	Interruption tag
C620	I2001~I2024
C622	I2101~I2124
C624	I2201~I2224
C626	I2301~I2324
C628	I2401~I2424

AB phase mode

Counter	Interruption tag
C630	I2501~I2524
C632	I2601~I2624
C634	I2701~I2724
C636	I2801~I2824
C638	I2901~I2924

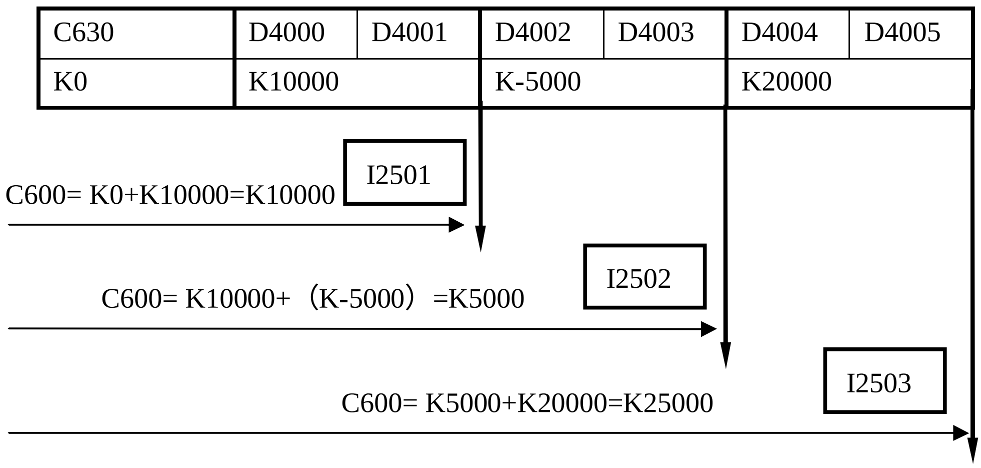
C610	I1501~I1524
C612	I1601~I1624
C614	I1701~I1724
C616	I1801~I1824
C618	I1901~I1924

Define the presetvalue

HSC 24-segment pre-set value is the difference value, the count value equals the counter's current value plus the preset value, generate the interruption. N interruption tags correspond with N interruptionpreset values. The (N+1) preset value is 0;

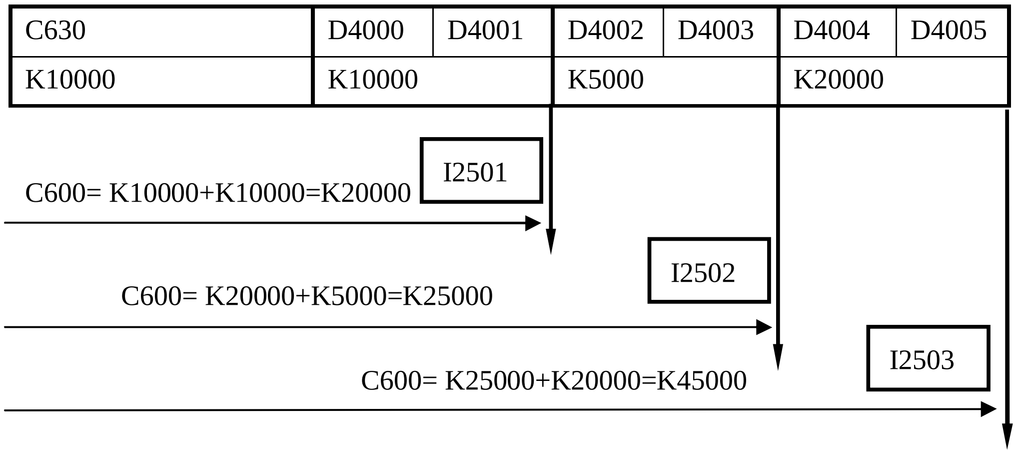
E.g. 1, the current value is C630 is 0, the first preset value is 10000, the preset value in segment 2 is －5000, the preset value in segment 3 is 20000. When start to count, the counter's current value is 10000, generate first interruption I2501; When start to count, the counter's current value is 5000, generate first interruption I2502；When start to count, the counter's current value is 25000, generate first interruption I2503.

See graph below:



E.g. 2, the current value is C630 is 10000, the first preset value is 10000, the preset value in segment 2 is 5000, the preset value in segment 3 is 20000. When start to count, the counter's current value is 20000, generate first interruption I2501; When start to count, the counter's current value is 25000, generate first interruption I2502；When start to count, the counter's current value is 45000, generate first interruption I2503.

See graph below:



5-10-3. Loop mode of HSC Interruption

Mode 1: Unicycle (normal mode)

Not happen after HSC interruption ends. The conditions below can re-start the interruption:

(1) reset the HSC

(2) Reboot the HSC activate condition

Mode 2: Continuous loop

Restart after HSC interruption ends. This mode is especially suitable for the following application:

(1) continous back-forth movement

(2) Generate cycle interruption according to the defined pulse

Via setting he special auxiliary relays, users can set the HSC interruption to be unicycle mode or continous loop mode. The loop mode is only suitable with the relative count. The detailed assignment is show below:

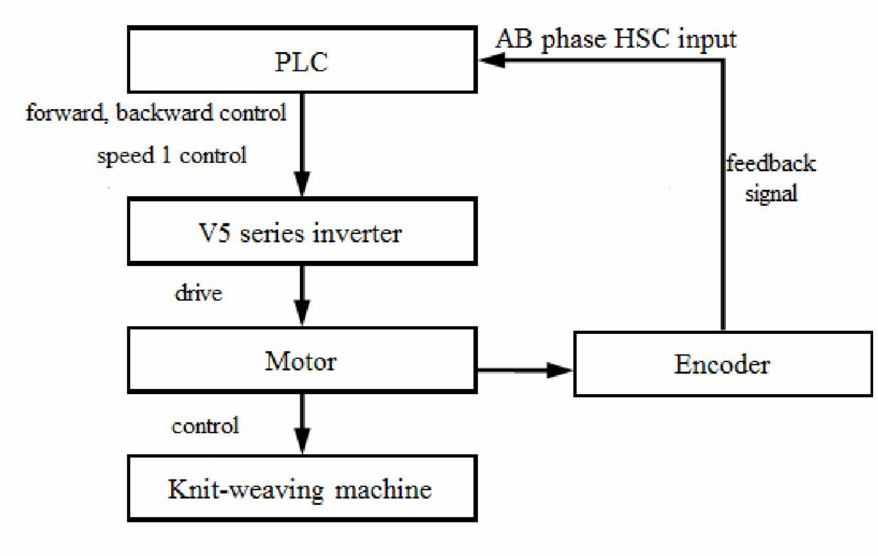
ID	HSC ID	Setting
M8270	24 segments HSC interruption loop (C600)	OFF: unicycle mode ON: continous loop mode
M8271	24 segments HSC interruption loop (C602)	
M8272	24 segments HSC interruption loop (C604)	
M8273	24 segments HSC interruption loop (C606)	
M8274	24 segments HSC interruption loop (C608)	
M8275	24 segments HSC interruption loop (C610)	
M8276	24 segments HSC interruption loop (C612)	
M8277	24 segments HSC interruption loop (C614)	
M8278	24 segments HSC interruption loop (C616)	
M8279	24 segments HSC interruption loop (C618)	
M8280	24 segments HSC interruption loop (C620)	

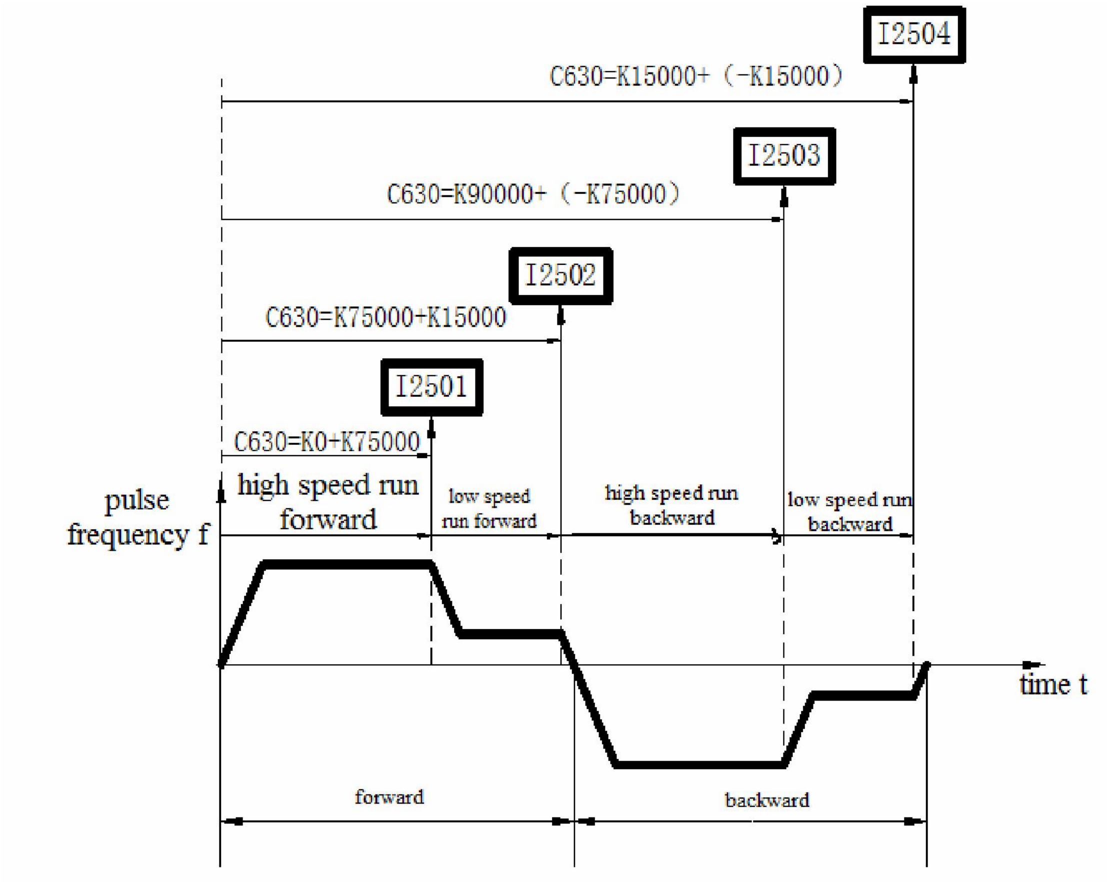
M8281	24 segments HSC interruption loop (C622)	
M8282	24 segments HSC interruption loop (C624)	
M8283	24 segments HSC interruption loop (C626)	
M8284	24 segments HSC interruption loop (C628)	
M8285	24 segments HSC interruption loop (C630)	
M8286	24 segments HSC interruption loop (C632)	
M8287	24 segments HSC interruption loop (C634)	

5-10-4. Example of HSC Interruption

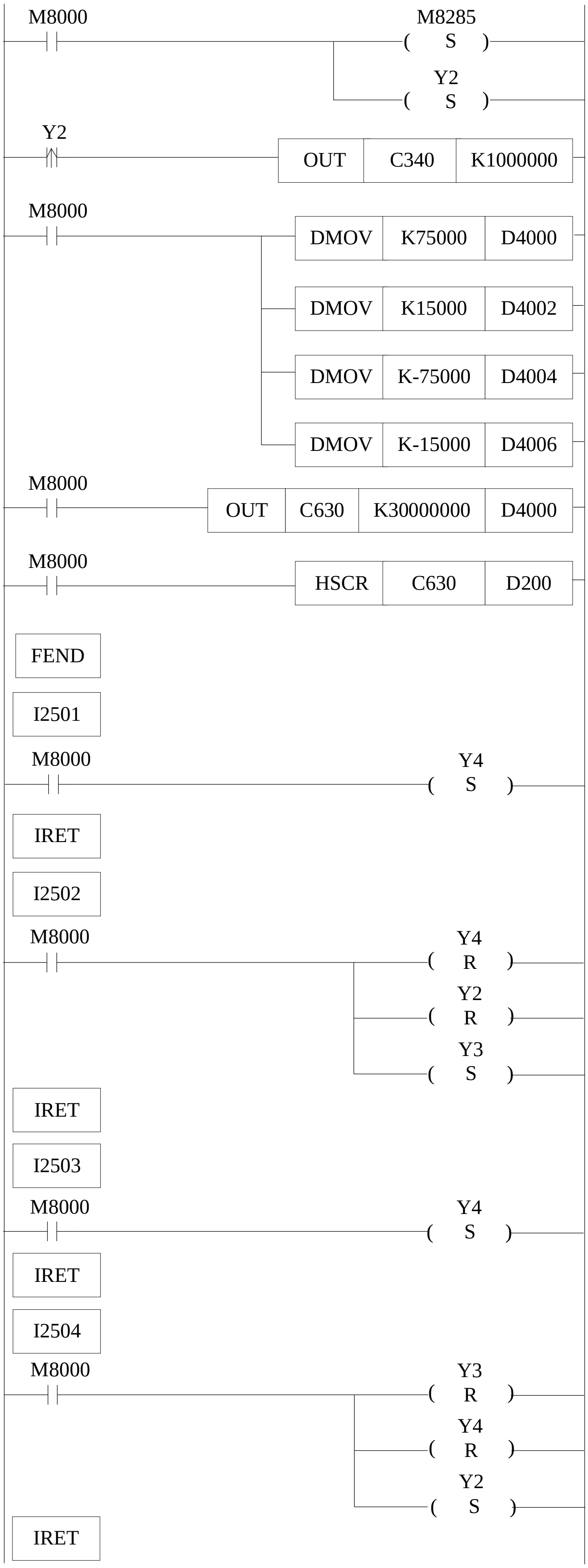
E.g.2：Application on knit-weaving machine (continous loop mode)

The system theory is shown as below: Control the inverter via PLC, thereby control the motor. Meantime, via the feedback signal from encoder, control the knit-weaving machine and realize the precise position.





Below is PLC program: Y2 represents forward output signal; Y3 represents backward output signal; Y4 represents output signal of speed 1; C340: Back-forth times accumulation counter; C630: AB phase HSC;


M8000
M8285
S
Y2
S
Y2
OUT
C340
K1000000
M8000
DMOV
K75000
D4000
DMOV
K15000
D4002
DMOV
K-75000
D4004
DMOV
K-15000
D4006
M8000
OUT
C630
K30000000
D4000
M8000
HSCR
C630
D200
FEND
I2501
M8000
Y4
S
IRET
I2502
M8000
Y4
R
Y2
R
Y3
S
IRET
I2503
M8000
Y4
S
IRET
I2504
M8000
Y3
R
Y4
R
Y2
S
IRET

Instruction List Form:

```
LD   M8002                          //M8002 is initial positive pulse coil
SET M8285                           //special auxiliary relay set ON, to enable C630 continuous loop
SET Y2                              //set output coil Y2 (i.e. Start run forth)
LDP Y2      //knit-weaving machine back-forth times counter's activate condition Y2 (forth rising edge activate)
OUT     C340     K1000000           //counter C340 starts to count
LD   M8000                          //M8000 is normally ON coil
DMOV    K75000   D4000              //set segment-1 ID D4000 to be K75000，
DMOV    K15000   D4002              //set segment-2 D4002 to be K15000，
DMOV    K-75000  D4004              //set segment-3 D4004 to be K-75000，
DMOV    K-15000  D4006              //set segment-4 D4004 to be K-15000，
LD   M8000                          //M8000 is normally ON coil
OUT    C630    K30000000    D4000   //HSC and start ID of 24-segment
LD   M8000                          //M8000 is normally ON coil
HSCR     C630      D200             //read the HSC value of C630 to D200
FEND                                //main program end
I2501                               //interruption tag of segment 1
LD   M8000                          //M8000 is normally ON coil
SET       Y4                        //output coil Y4 set (low-speed run with speed 1)
IRET                                //interruption return tag
I2502                               ///interruption tag of segment 2
LD   M8000                          //M8000 is normally ON coil
RST Y4                              //output coil Y4 reset (low-speed run stop)
RST Y2                              //output coil Y2 reset (run forward stops)
SET Y3                              //output coil Y3 set (back running)
IRET                                //interruption return tag
I2503                               ///interruption tag of segment 3
LD   M8000                          //M8000 is normally ON coil
SET Y4                              //output coil Y4 set (low-speed run with speed 1)
IRET                                //interruption return tag
I2504                               ///interruption tag of segment 4
LD   M8000                          //M8000 is normally ON coil
RST Y3                              //output coil Y3 reset (back running stop)
RST Y4                              //output coil Y4 reset (low-speed run stop)
SET Y2                              //output coil Y2 set (run forward)
IRET                                //interruption return tag
```

6 PULSE OUTPUT

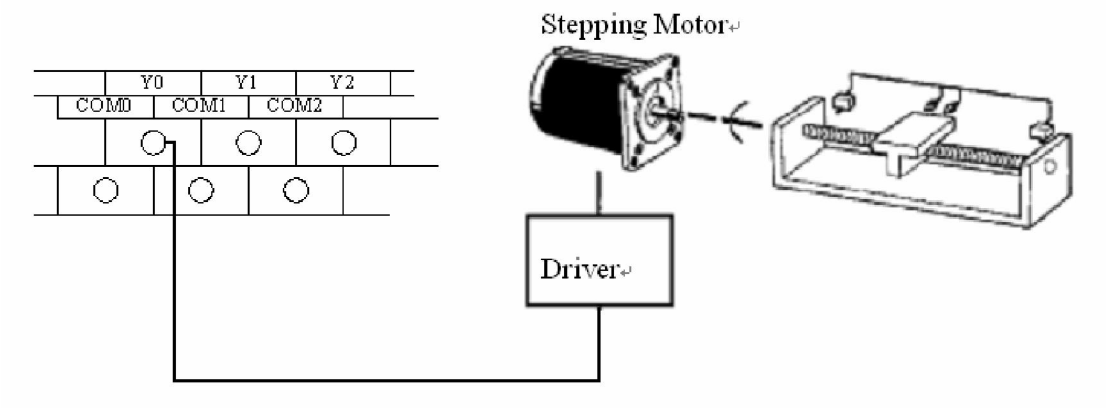
In this chapter we tell the pulse function of XC series PLC. The content includes pulse output instructions, input/output wiring, items to note and relate coils and registers etc.

Pulse Output Instructions List

Mnemonic	Function	Circuit And Soft Device	Chapter
PULSE OUTPUT			
PLSY	Unidirectional ration pulse output without ACC/DEC time change	PLSY S1 S2 D	6-2-1
PLSF	Variable frequency pulse output	PLSF S D	6-2-2
PLSR	Ration pulse output with ACC/DEC speed	PLSR S1 S2 S3 D	6-2-3
PLSNEXT/ PLSNT	Pulse Section Switch	PLSNT S	6-2-4
STOP	Pulse Stop	STOP S	6-2-5
PLSMV	Refresh Pulse Nr. immediately	PLSMV S D	6-2-6
ZRN	Original Return	ZRN S1 S2 S3 D	6-2-7
DRVI	Relative Position Control	DRVI S1 S2 S3 D1 D2	6-2-8
DRVA	Absolute Position Control	DRVA S1 S2 S3 D1 D2	6-2-9
PLSA	Absolute Position multi-section pulse control	PLSA S1 S2 D	6-2-10

6-1. Functions Summary

Generally, XC3 and XC5 series PLC are equipped with 2CH pulse output function. Via different instructions, users can realize unidirectional pulse output without ACC/DEC speed; unidirectional pulse output with ACC/DEC speed; multi-segments, positive/negative output etc., the output frequency can reach 400K Hz.



※1: To use pulse output, please choose PLC with transistor output, like XC3-14T-E or XC3-60RT-E etc.

※2: XC5 series 32I/O PLC has 4CH (Y0、Y1、Y2、Y3) pulse output function.

6-2. Pulse Output Types and Instructions

6-2-1. Unidirectional ration pulse output without ACC/DEC time change [PLSY]

1、Instruction Summary

Instruction to generate ration pulse with the specified frequency;

Unidirectional ration pulse output without ACC/DEC time change [PLSY]			
16 bits instruction	PLSY	32 bits instruction	DPLSY
Execution condition	Normally ON/OFF coil	Suitable models	XC2、XC3、XC5、XCM
Hardwarere quirement	-	Software requirements	-

2、Operands

Operands	Function	Type
S1	Specify the frequency’s value or register ID	16 bits/32 bits, BIN
S2	Specify the pulse number or register’s ID	16 bits /32 bits, BIN
D	Specify the pulse output port	bit

3、Suitable soft components

Word

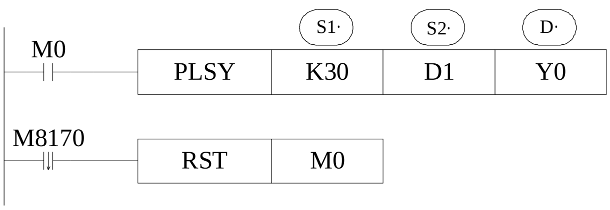
operands	system									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●					●		

Bit

operands	system						
	X	Y	M	S	T	C	Dn.m
D		●					

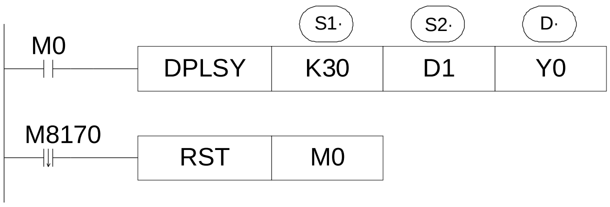
Functions And Actions

《16 bits instruction》



- Frequency Range: 0~400KHz；
- Pulse Quantity Range:　0~K32767；
- Pulse output from Y000 or Y001 only;
- When M0 is ON, PLSY instruction output 30Hz pulse at Y0, the pulse number is decided by D1, M8170 is set ON only when sending the pulse. When the output pulse number reaches the set value, stop sending the pulse, M8170 is set to be OFF, reset M0;

《32 bits instruction》

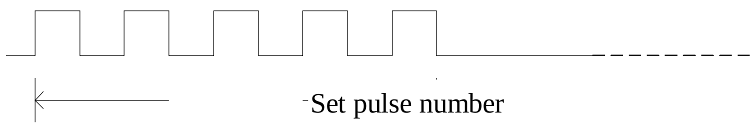


- Frequency Range: 0~400KHz；
- Pulse Quantity Range:　0~K2147483647；
- Pulse output from Y000 or Y001 only;
- When M0 is ON, DPLSY instruction output 30Hz pulse at Y0, the pulse number is decided by D2D1, M8170 is set ON only when sending the pulse. When the output pulse number reaches the set value, stop sending the pulse, M8170 is set to be OFF, reset M0;

Output Mode

《continuous or limited pulse number》

Limited pulse output



When finish sending the set pulse number, stop outputting automatically

Items to Note

If the control object is stepping/servo motor, we recommend users not use this instruction, to avoid the motor losing synchronism. PLSR is available.

6-2-2. Variable Pulse Output [PLSF]

1、Instruction Summary

Instruction to generate continuous pulse in the form of variable frequency

Variable Pulse Output [PLSF]			
16 bits Instruction	PLSF	32 bits Instruction	DPLSF
Execution condition	Normally ON/OFF coil	Suitable Models	XC2、XC3、XC5、XCM
Hardware requirement	-	Software requirement	-

2、Operands

Operands	Function	Type
S	Specify the frequency or register ID	16 bits/32 bits, BIN
D	Specify pulse output port	bit

3、suitable soft components

Word

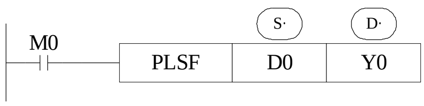
operands	system									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●		●	●					●		

Bit

operands	system						
	X	Y	M	S	T	C	Dn.m
D		●					

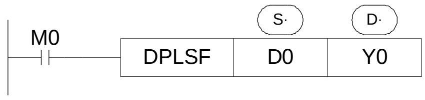
Functions And Actions

《16 bit instruction form》



- Frequency range: 6Hz~400KHz (when the set frequency is lower than 200Hz, output 200Hz)
- Pulse can only be output at Y000 or Y001.
- With the changing of setting frequency in D0, the output pulse frequency changes at Y0
- Accumulate pulse number in register D8170 (DWord)

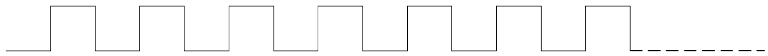
《32 bit instruction form》



- Frequency range: 6Hz~400KHz (when the set frequency is lower than 200Hz, output 200Hz)
- Pulse can only be output at Y000 or Y001.
- With the changing of setting frequency in D0, the output pulse frequency changes at Y0
- Accumulate pulse number in register D8170 (DWord)

Output Mode

Sequential pulse output



Sequential output pulse with the set frequency till stop outputvia the instruction

6-2-3．Multi-segment pulse control at relative position [PLSR]

PLSR/DPLSR instruction has two control modes. Below we will instroduce one by one;

Ø **Mode 1: segment uni-directional pulse output PLSR**

1、Instruction Summary

Generate certain pulse quantity (segmented) with the specified frequency and acceleration/deceleration time

Segmented uni-directional pulse output [PLSR]			
16 bits Instruction	PLSR	32 bits Instruction	DPLSR
Execution condition	Normally ON/OFF coil	Suitable Models	XC2、XC3、XC5、XCM
Hardware requirement	-	Software requirement	-

2、Operands

Operands	Function	Type
S1	Specify the soft component's start ID of the segmented pulse parameters	16 bit/ 32 bit, BIN
S2	Specify acceleration/deceleration time or soft component's ID	16 bit/ 32 bit, BIN
D	Specify the pulse output port	Bit

3、suitable soft components

Word

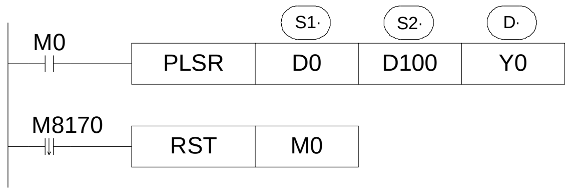
operands	system									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●							
S2	●	●		●	●					●		

Bit

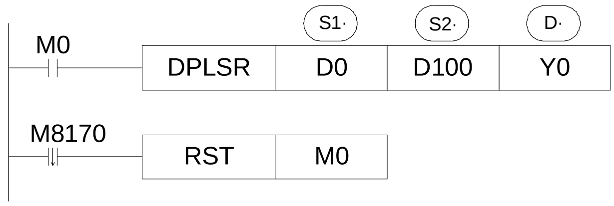
operands	system						
	X	Y	M	S	T	C	Dn.m
D		●					

Functions And A

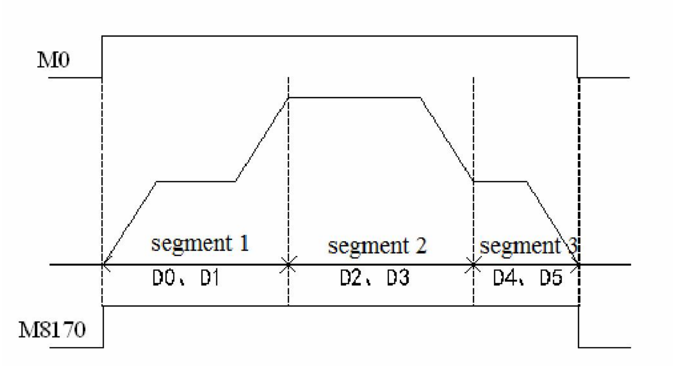
《16 bit instruction form》



《32 bit instruction form》



- The parameters' address is a section starts from **Dn** or **FDn**. In the above example (16bit instruction form): **D0** set the first segment pulse's highest frequency、**D1** set the first segment's pulse number，**D2** set the second segment pulse's highest frequency、**D3** set the second segment's pulse number，…… if the set value in **Dn**、**Dn+1** is 0, this represents the end of segment, the segment number is not limited.
- To 32 bit instruction **DPLSR**, **D0**、**D1** set the first segment pulse's highest frequency、**D2**、**D3** set the first segment's pulse number, **D4**、**D5** set the second segment pulse's highest frequency、**D6**、**D7** set the second segment's pulse number……
- Acceleration/deceleration time is the time from the start to the first segment's highest frequency. Meantime, it defines the slope of all segment's frequency to time. In this way the following acceleration/deceleration will perform according to this slope.
- Pulse can be output at only Y000 or Y001
- Frequency range: 0~400KHz;
- Pulse number range: 0~K32,767 (16 bits instruction)、0~K2,147,483,647 (32 bits instruction)
- Acceleration/deceleration time : below 65535 ms



Ø **Mode 2: segmented dual-directional pulse output PLSR**

1、Instruction Summary

Generate certain pulse quantity with the specified frequency、acceleration/deceleration time and pulse direction ;

Segmented dual-directional pulse output [PLSR]			
16 bits Instruction	PLSR	32 bits Instruction	DPLSR
Execution condition	Normally ON/OFF coil	Suitable Models	XC2、XC3、XC5、XCM
Hardware requirement	-	Software requirement	-

2、Operands

Operands	Function	Type
S1	Specify the soft component's start ID of the segmented pulse parameters	16 bit/ 32 bit, BIN
S2	Specify acceleration/deceleration time or soft component's ID	16 bit/ 32 bit, BIN
D1	Specify the pulse output port	Bit
D2	Specify the pulse output direction's port	Bit

3、suitable soft components

Word

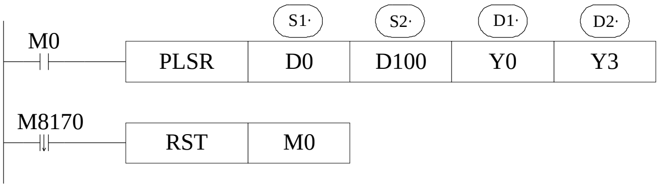
operands	system								constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●							
S2	●	●		●	●					K		

Bit

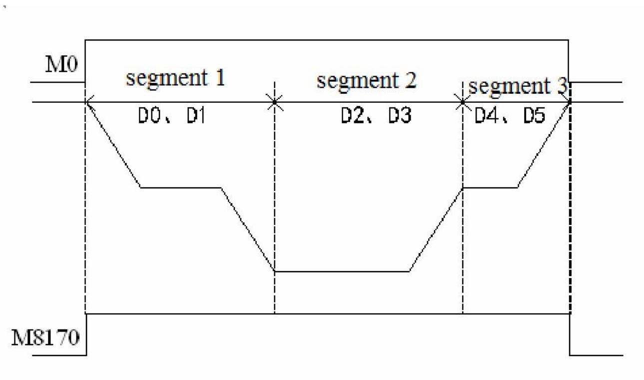
operands	system						
	X	Y	M	S	T	C	Dn.m
D1		●					
D2		●					

Functions And Actions

《16 bit instruction form》



- The parameters' address is a section starts from **Dn** or **FDn**. In the above example: **D0** set the first segment pulse's highest frequency、**D1** set the first segment's pulse number，**D2** set the second segment pulse's highest frequency、**D3** set the second segment's pulse number，…… if the set value in **Dn**、 **Dn+1** is 0, this represents the end of segment, the segment number is not limited.
- Acceleration/deceleration time is the time from the start to the first segment's highest frequency. Meantime, it defines the slope of all segment's frequency to time. In this way the following acceleration/deceleration will perform according to this slope.
- Pulse can be output at only Y000 or Y001
- Y for Pulse direction can be specified freely. E.g.: if in S1 (the first segment) the pulse number is positive, Y output is ON; if the pulse number is negative, Y output is OFF; Note: in the first segment's pulse output, the pulse direction is only decided by the pulse number's nature (positive or negative) of the first segment.
- Frequency range: 0~400KHz;
- Pulse number range: 0~K32,767 (16 bits instruction)、0~K2,147,483,647 (32 bits instruction)
- Acceleration/deceleration time : below 65535 ms



6-2-4. Pulse Segment Switch [PLSNEXT]/[PLSNT]

1、Instruction Summary

Enter the next pulse output;

Pulse segment switch [PLSNEXT]/[PLSNT]			
16 bits Instruction	PLSNEXT/PLSNT	32 bits Instruction	-

Execution condition	Rising/falling edge	Suitable Models	XC2、XC3、XC5、XCM
Hardware requirement	-	Software requirement	-

2、Operands

Operands	Function	Type
D	Specify the pulse output port	Bit

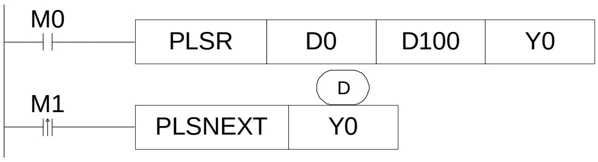
3、suitable soft components

Bit

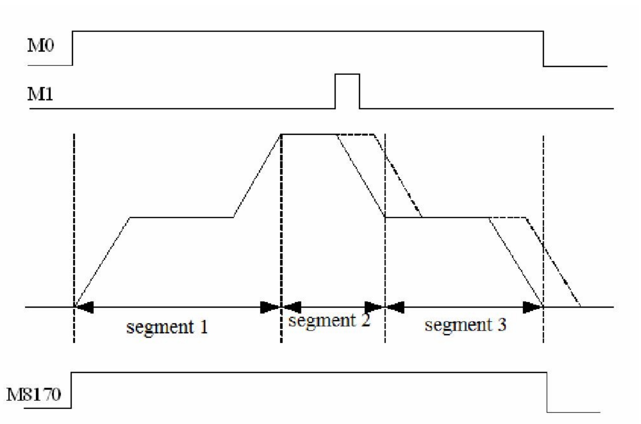
operands	system						
	X	Y	M	S	T	C	Dn.m
D		●					

Functions And Actions

《16 bit instruction form》



- If the pulse output reaches the highest frequency at the current segment, and output steadily at this frequency; when M1 changes from OFF to ON, then enter the next pulse output with the acceleration/deceleration time;
- Run the instruction within the acceleration/deceleration time is invalid;



--------(the dashed line represents the original pulse output

6-2-5．Pulse Stop [STOP]

1、Instruction Summary

Stop pulse output immediately;

Pulse stop [STOP]			
16 bits Instruction	STOP	32 bits Instruction	-
Execution condition	Rising/falling edge	Suitable Models	XC2、XC3、XC5、XCM
Hardware requirement	-	Software requirement	-

2、Operands

Operands	Function	Type
D	Specify the port to stop pulse output	Bit

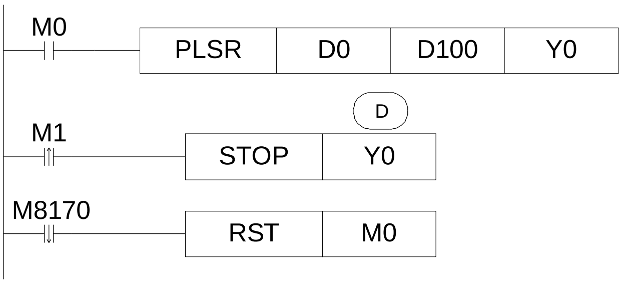
3、suitable soft components

Bit

operands	system						
	X	Y	M	S	T	C	Dn.m
D		●					

Functions And Actions

《16 bit instruction form》



- When M000 changes from OFF to be ON, PLSR output pulse at Y000. D0 specify the frequency, D001 specify the pulse number, D100 specify the acceleration/deceleration time; when the output pulse number reaches the set value, stop outputting the pulse; on the rising edge of M001, STOP instruction stops outputting the pulse at Y000;

6-2-6. Refresh the pulse number at the port [PLSMV]

1、Instruction Summary

Refresh the pulse number at the port;

Refresh the pulse number at the port [PLSMV]			
16 bits Instruction	-	32 bits Instruction	PLSMV
Execution condition	Normally ON/OFF coil	Suitable Models	XC2、XC3、XC5、XCM
Hardware requirement	-	Software requirement	-

2、Operands

Operands	Function	Type
S	Specify the pulse number or soft components' ID	32bit, BIN
D	Specify the port to refresh the pulse	Bit

3、suitable soft components

Word

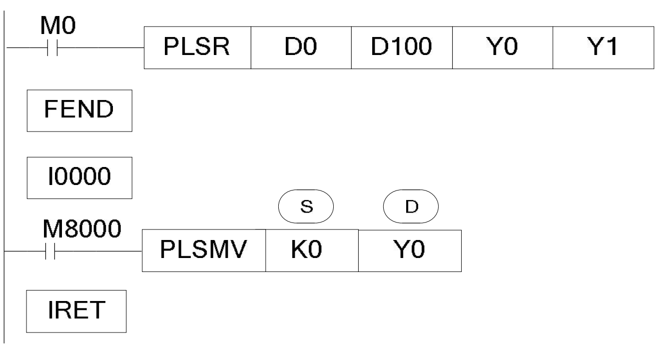
operands	system									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S	●	●		●	●					●		

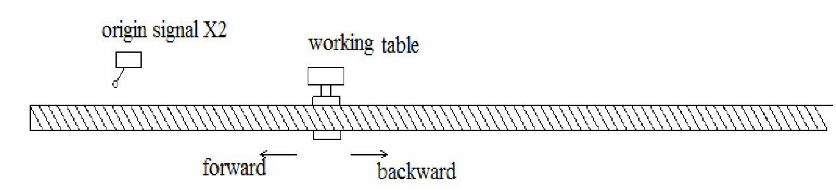
Bit

operands	system						
	X	Y	M	S	T	C	Dn.m
D		●					

Functions And Actions

《32 bit instruction form》





- When the working table is moving backward, it gets the origin signal X2, execute the external interruption, PLSMV command run immediately, not effected by the scan cycle. Refresh the pulse number from Y0 and send to D8170;
- This instruction is used remove the accumulation difference caused in pulse control;

6-2-7. Back to the Origin [ZRN]

1、Instruction Summary

Back to the Origin

Back to the Origin [ZRN]			
16 bits Instruction	ZRN	32 bits Instruction	DZRN
Execution condition	Normally ON/OFF coil	Suitable Models	XC2、XC3、XC5、XCM
Hardware requirement	-	Software requirement	-

2、Operands

Operands	Function	Type
S1	Specify the backward speed or soft components' ID	16/32bit, BIN
S2	Specify the creeping speed or soft components' ID	16/32 bit, BIN
S3	Specify the soft components' ID of the close point's signal	Bit
D	Specify the pulse output port	Bit

3、suitable soft components

Word

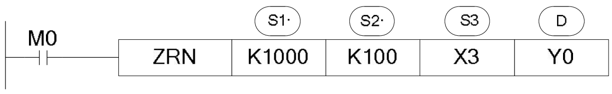
operands	system									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	•	•		•	•					•		
S2	•	•		•	•					•		

Bit

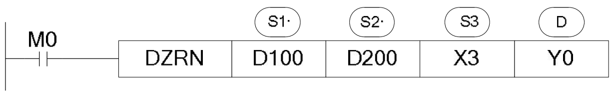
operands	system						
	X	Y	M	S	T	C	Dn.m
S3	•		•				
D		•					

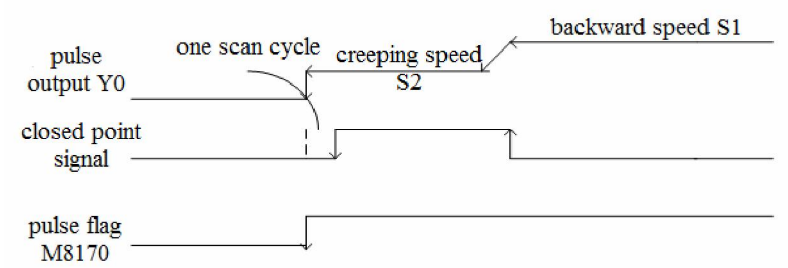
Functions And Actions

《16 bit instruction form》



《32 bit instruction form》





- Pulse output address: Y0 or Y1 only;
- S1 and S2 direction is same and the absolute value of S1 is greater than S2;
- After driving the instruction, move with the origin return speed S1;
- When the closed point signal turns from OFF to be ON, decrease the speed to be S2;
- When the closed point signal turns from ON to be OFF, write to registers (Y0:[D8171,D8170],Y1:[D8174,D8173]) when stopping pulse output;
- The decrease time can be specified by D8230~D8239; please refer to chapter 6-6 for details;

6-2-8. Relative position uni-segment pulse control [DRVI]

1、Instruction Summary

Relative position uni-segment pulse control;

Relative position uni-segment pulse control [DRVI]			
16 bits Instruction	DRVI	32 bits Instruction	DDRVI
Execution condition	Normally ON/OFF coil	Suitable Models	XC2、XC3、XC5、XCM
Hardware requirement	-	Software requirement	-

2、Operands

Operands	Function	Type
S1	Specify the output pulse value or soft components ID	16/32bit, BIN
S2	Specify the output pulse frequency or soft components ID	16/32 bit, BIN
D1	Specify the pulse output port	Bit
D2	Specify the pulse output direction port	Bit

3、suitable soft components

Word

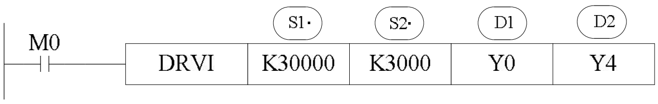
operands	system									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●					●		

Bit

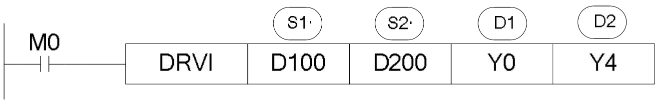
operands	system						
	X	Y	M	S	T	C	Dn.m
D1		●					
D2		●					

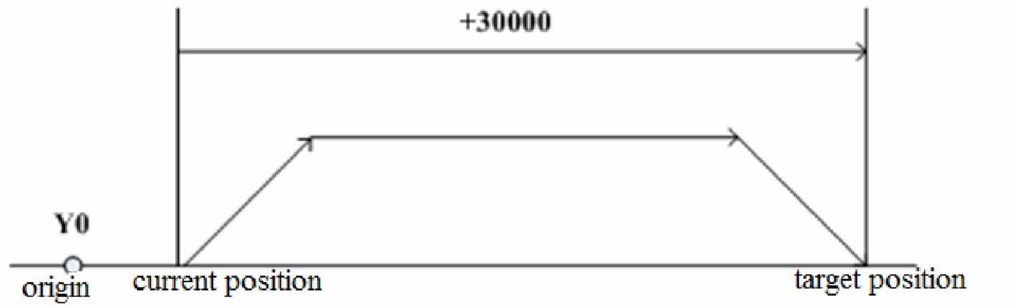
Functions And Actions

《16 bit instruction form》



《32 bit instruction form》





- Pulse output ID: only Y0 or Y1;
- Pulse output direction can specify any Y;
- Acceleration/deceleration time is specified by D8230 (single word)
- The relative drive form means: move from the current position;

6-2-9. Absolute position uni-segment pulse control [DRVA]

1、Instruction Summary

Absolute position uni-segment pulse control

Absolute position uni-segment pulse control [DRVA]			
16 bits Instruction	DRVA	32 bits Instruction	DDRVA
Execution	Normally ON/OFF coil	Suitable	XC2、XC3、XC5、XCM

condition		Models	
Hardware requirement	-	Software requirement	-

2、Operands

Operands	Function	Type
S1	Specify the output pulse value or soft components ID	16/32bit, BIN
S2	Specify the output pulse frequency or soft components ID	16/32 bit, BIN
D1	Specify the pulse output port	Bit
D2	Specify the pulse output direction port	Bit

3、suitable soft components

Word

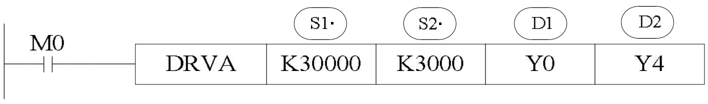
operands	system									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●					●		

Bit

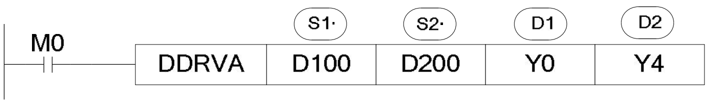
operands	system						
	X	Y	M	S	T	C	Dn.m
D1		●					
D2		●					

Functions And Actions

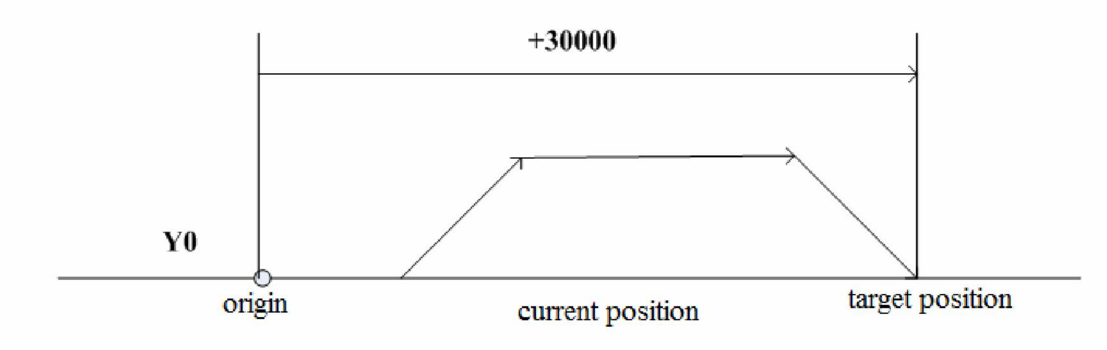
《16 bit instruction form》



《32 bit instruction form》



(Y0:[D8171,D8170],Y1:[D8174,D8173])



- Pulse output ID: only Y0 or Y1;
- Pulse output direction can specify any Y;
- Acceleration/deceleration time is specified by D8230 (single word)
- The relative drive form means: move from the origin position;
- Target position means S1, correspond with the following current value register as the absolute position

6-2-10. Absolute position multi-segment pulse control [PLSA]

PLSA/DPLSA has two control modes, below we will introduce one by one;

Ø Mode 1: uni-directional pulse output PLSA

1、Instruction Summary

Generate absolute position segmented pulse with the specified frequency, acceleration/deceleration time and pulse direction;

Absolute position multi-segment pulse control [PLSA]			
16 bits Instruction	PLSA	32 bits Instruction	DPLSA
Execution condition	Normally ON/OFF coil	Suitable Models	XC2、XC3、XC5、XCM
Hardware requirement	-	Software requirement	-

2、Operands

Operands	Function	Type
S1	Specify the soft component's number to output the pulse parameters	16/32bit, BIN
S2	Specify the acceleration/deceleration time or soft component's number	16/32 bit, BIN
D	Specify the pulse output port	Bit

3、suitable soft components

Word

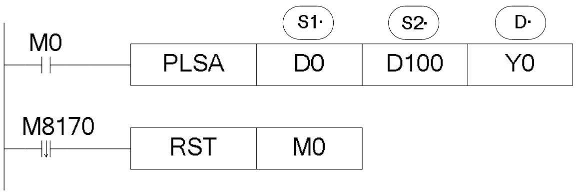
operands	system									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●							
S2	●	●		●	●					K		

Bit

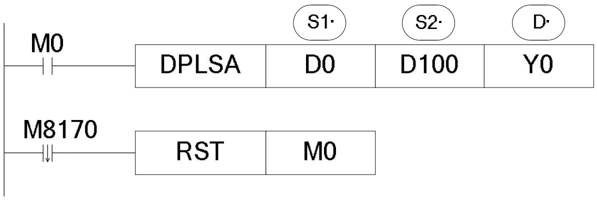
operands	system						
	X	Y	M	S	T	C	Dn.m
D1		●					

Functions And Actions

《16 bit instruction form》



《32 bit instruction form》



- The parameters' address is a section starts from **Dn** or **FDn**. In the above example: **D0** set the first segment pulse's highest frequency、**D1** set the first segment's absolute position，**D2** set the second segment pulse's highest frequency、**D3** set the second segment's absolute position，…… if the set value in **Dn**、**Dn+1** is 0, this represents the end of segment, we can set 24 segments in total;
- Acceleration/deceleration time is the time from the start to the first segment's highest frequency. Meantime, it defines the slope of all segment's frequency to time. In this way the following acceleration/deceleration will perform according to this slope.
- Pulse can be output at only Y000 or Y001

Ø Mode2: dual-directional pulse output PLSA

1、Instruction Summary

Generate absolute position pulse with the specified frequency, acceleration/deceleration time and pulse direction;

Absolute position multi-segment pulse control [PLSA]			
16 bits Instruction	PLSA	32 bits Instruction	DPLSA
Execution condition	Normally ON/OFF coil	Suitable Models	XC2、XC3、XC5、XCM
Hardware requirement	-	Software requirement	-

2、Operands

Operands	Function	Type
S1	Specify the soft component's number to output the pulse parameters	16/32bit, BIN
S2	Specify the acceleration/deceleration time or soft component's number	16/32 bit, BIN
D1	Specify the pulse output port	Bit
D2	Specify the pulse direction port	Bit

3、suitable soft components

Word

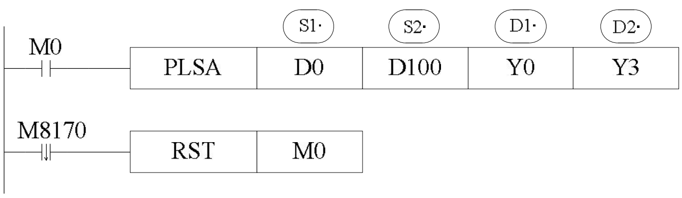
operands	system									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●							
S2	●	●		●	●					K		

Bit

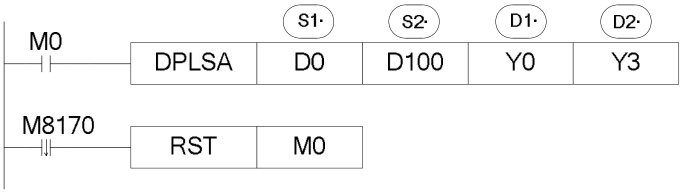
operands	system						
	X	Y	M	S	T	C	Dn.m
D1		●					
D2		●					

Functions And Actions

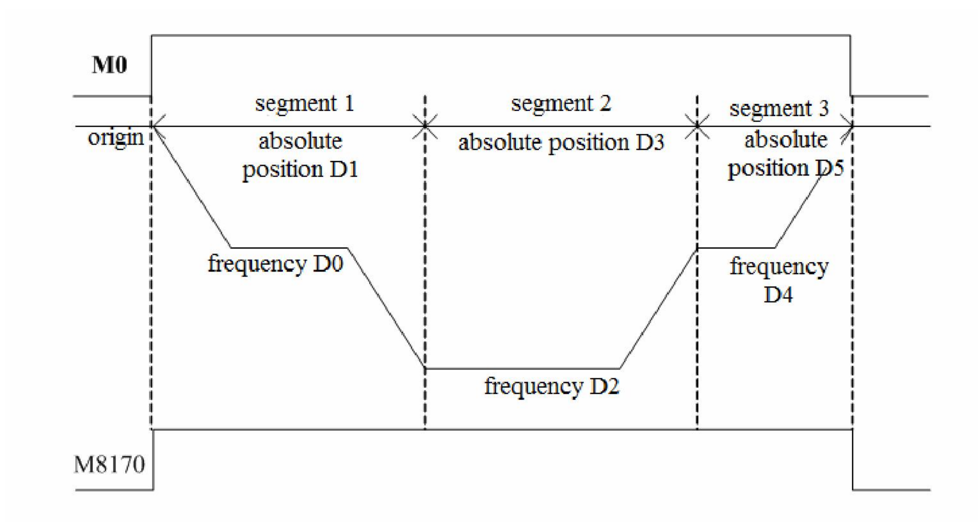
《16 bit instruction form》



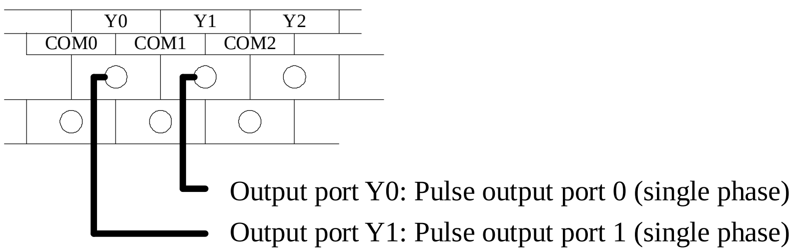
《32 bit instruction form》



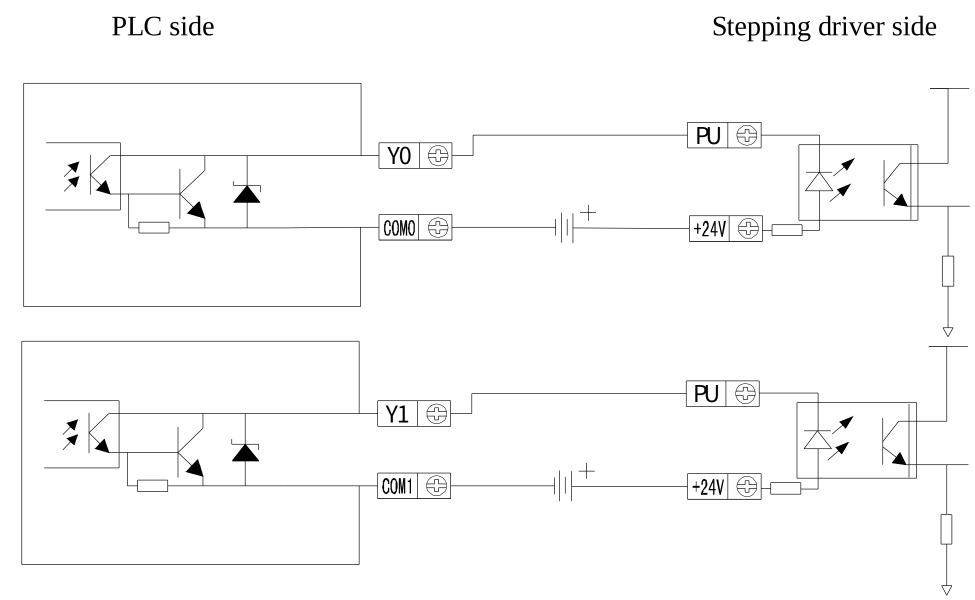
- The parameters’ address is a section starts from **Dn** or **FDn**. In the above example: **D0** set the first segment pulse’s highest frequency、**D1** set the first segment’s absolute position，**D2** set the second segment pulse’s highest frequency、**D3** set the second segment’s absolute position，…… if the set value in **Dn**、**Dn+1** is 0, this represents the end of segment, we can set 24 segments in total;
- Acceleration/deceleration time is the time from the start to the first segment’s highest frequency. Meantime, it defines the slope of all segment’s frequency to time. In this way the following acceleration/deceleration will perform according to this slope.
- Pulse can be output at only Y000 or Y001
- The Y port to output the pulse direction can be set freely;



6-3．Output Wiring

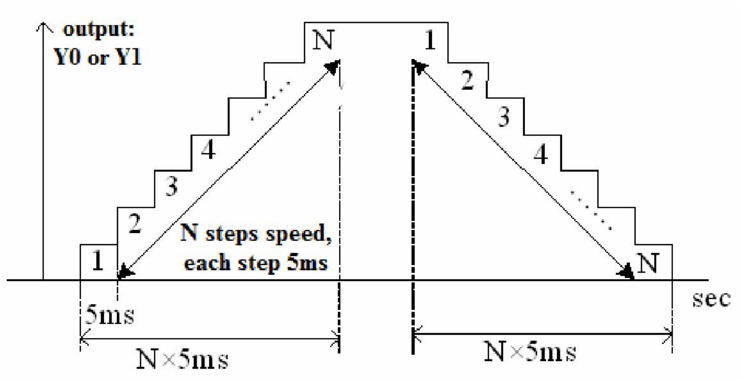


Below is the graph to show the output terminals and stepping driver wiring:



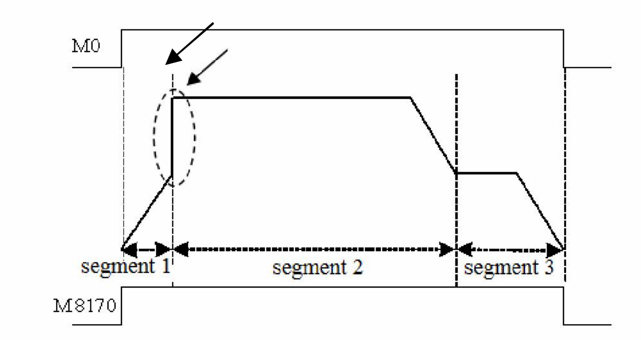
6-4. Items to Note

1、Concept of Step Frequency



- During ACC/DEC, each step time is 5ms, this time is fixed and not changeable.
- The minimum step frequency (each step's rising/falling time) is 10Hz. If the frequency is lower than 10Hz, calculate as 10Hz; the maximum step frequency is 15Hz. If the frequency is larger than 15Hz, calculate as 15Hz;
- In case of frequency larger than 200Hz, please make sure each segment's pulse number no less than 10, if the set value is less than 10, send as 200Hz;

2、frequency jump in segment pulse output



- When outputting the segmented pulse, if the current segment's pulse has been set out, while meantime it doesn't reach the highest frequency, then from the current segment to the next pulse output segment, pulse jump appears, see graph above;

3、 dual pulse output is invalid

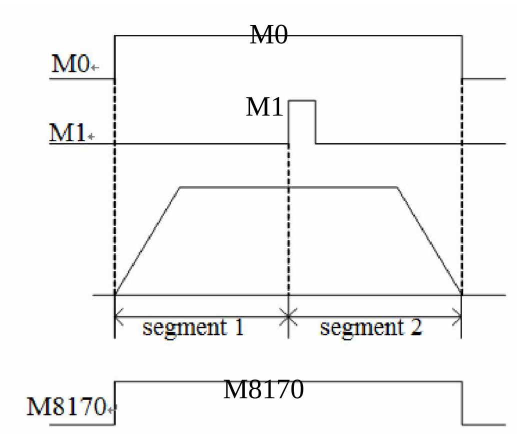
- In one main program, users can't write two or more pulse output instructions with one output port Y;
- The below sample is wrong;

M0	PLSR	D0	D100	Y0
M1	PLSR	D200	D1000	Y0

6-5. Sample Programs

E.g.1: Stop at certain length

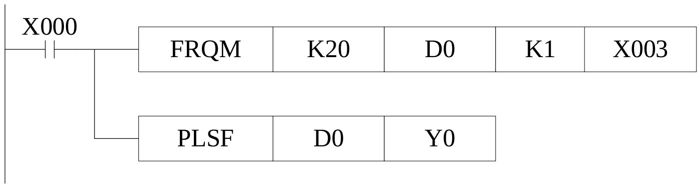
With instruction [PLSR] and [PLSNEXT], realize this "stop at certain length" function;



Take the sample program as the example, set two segments pulse output in D0、D1 and D2，D3, with the same frequency value; In second segment pulse output, set pulse number D3 as the output pulse number after receive M1 signal. This will realize "stop at certain length" function. See graph by the left side;

E.g.2: follow function

In this sample, the pulse frequency from Y0 equals with the frequency tested from X003. If the frequency tested from X003 changes, the pulse frequency from Y0 changes;



6-6． Relative coils and registers of pulse output

Some flags of pulse output are listed below:

ID	Pulse ID	Function	specification
M8170	PULSE_1	“sending pulse” flag	Being ON when sending the pulse,
M8171		overflow flag of “32 bits pulse sending”	When overflow, Flag is on
M8172		Direction flag	1 is positive direction, the correspond direction port is on
M8173	PULSE_2	“sending pulse” flag	Being ON when sending the pulse,
M8174		overflow flag of “32 bits pulse sending”	When overflow, Flag is on
M8175		Direction flag	1 is positive direction, the correspond direction port is on
M8176	PULSE_3	“sending pulse” flag	Being ON when sending the pulse,
M8177		overflow flag of “32 bits pulse sending”	When overflow, Flag is on
M8178		Direction flag	1 is positive direction, the correspond

			direction port is on
M8179	PULSE_4	“sending pulse” flag	Being ON when sending the pulse,
M8180		overflow flag of “32 bits pulse sending”	When overflow, Flag is on
M8181		Direction flag	1 is positive direction, the correspond direction port is on
M8210	PULSE_1	Pulse alarm flag (frequency change suddenly)	**1** is alarm, **0** is correct
M8211		Neglect the alarm or not	When flag is 1, stop sending alarm
M8212	PULSE_2	Pulse alarm flag (frequency change suddenly)	**1** is alarm, **0** is correct
M8213		Neglect the alarm or not	When flag is 1, stop sending alarm
M8214	PULSE_3	Pulse alarm flag (frequency change suddenly)	**1** is alarm, **0** is correct
M8215		Neglect the alarm or not	When flag is 1, stop sending alarm
M8216	PULSE_4	Pulse alarm flag (frequency change suddenly)	**1** is alarm, **0** is correct
M8217		Neglect the alarm or not	When flag is 1, stop sending alarm
M8218	PULSE_5	Pulse alarm flag (frequency change suddenly)	**1** is alarm, **0** is correct
M8219		Neglect the alarm or not	When flag is 1, stop sending alarm

Some special registers of pulse output are listed below:

ID	Pulse ID	Function	Specification
D8170	PULSE_1	The low 16 bits of accumulated pulse number	
D8171		The high 16 bits of accumulated pulse number	
D8172		The current segment (means Nr.n segment)	
D8173	PULSE_2	The low 16 bits of accumulated pulse number	
D8174		The high 16 bits of accumulated pulse number	
D8175		The current segment (means Nr.n segment)	
D8176	PULSE_3	The low 16 bits of accumulated pulse number	
D8177		The high 16 bits of accumulated pulse number	
D8178		The current segment (means Nr.n segment)	
D8179	PULSE_4	The low 16 bits of accumulated pulse number	
D8180		The high 16 bits of accumulated pulse	

		number	
D8181		The current segment (means Nr.n segment)	
D8190	PULSE_1	The low 16 bits of the current accumulated current pulse number	
D8191		The high 16 bits of the current accumulated current pulse number	
D8192	PULSE_2	The low 16 bits of the current accumulated current pulse number	
D8193		The high 16 bits of the current accumulated current pulse number	
D8194	PULSE_3	The low 16 bits of the current accumulated current pulse number	Only XC5-32RT-E (4PLS) model has
D8195		The high 16 bits of the current accumulated current pulse number	
D8196	PULSE_4	The low 16 bits of the current accumulated current pulse number	
D8197		The high 16 bits of the current accumulated current pulse number	
D8210	PULSE_1	The error pulse segment's position	
D8212	PULSE_2	The error pulse segment's position	
D8214	PULSE_3	The error pulse segment's position	
D8216	PULSE_4	The error pulse segment's position	
D8218	PULSE_5	The error pulse segment's position	

Absolute position/relative position/back to origin;

ID	Pulse	Function	Description
D8230	PULSE_1	Rising time of the absolute/relation position instruction (Y0)	
D8231		Falling time of the origin return instruction (Y0)	
D8232	PULSE_2	Rising time of the absolute/relation position instruction (Y1)	
D8233		Falling time of the origin return instruction (Y1)	
D8234	PULSE_3	Rising time of the absolute/relation position instruction (Y2)	
D8235		Falling time of the origin return instruction (Y2)	
D8236	PULSE_4	Rising time of the absolute/relation position instruction (Y3)	
D8237		Falling time of the origin return instruction (Y3)	

D8238	PULSE_5	Rising time of the absolute/relation position instruction	
D8239		Falling time of the origin return instruction	

7 Communication Function

This chapter mainly includes: basic concept of communication, Modbus communication, free communication and CAN-bus communication;

Relative Instructions:

Mnemonic	Function	Circuit and Soft Components	Chapter
MODBUS Communication			
COLR	Coil Read	COLR S1 S2 S3 D1 D2	7-2-3
INPR	Input coil read	INPR S1 S2 S3 D1 D2	7-2-3
COLW	Single coil write	COLW D1 D2 S1 S2	7-2-3
MCLW	Multi-coil write	MCLW D1 D2 D3 S1 S2	7-2-3
REGR	Register read	REGR S1 S2 S3 D1 D2	7-2-3
INRR	Input register read	INRR S1 S2 S3 D1 D2	7-2-3
REGW	Single register write	REGW D1 D2 S1 S2	7-2-3
MRGW	Multi-register write	MRGW D1 D2 D3 S1 S2	7-2-3
Free Communication			
SEND	Send data	SEND S1 S2 n	7-3-2
RCV	Receive data	RCV S1 S2 n	7-3-2
CAN-bus Communication			
CCOLR	Read coil	CCOLR S1 S2 S3 D	7-4-4
CCOLW	Write coil	CCOLW D1 D2 D3 S	7-4-4
CREGR	Read register	CREGR S1 S2 S3 D	7-4-4
CREGW	Write register	CREGW D1 D2 D3 S	7-4-4

7-1．Summary

XC2-PLC, XC3-PLC, XC5-PLC main units can fulfill your requirement on communication and network. They not only support simple network (Modbus protocol、free communication protocol), but also support those complicate network. XC2-PLC, XC3-PLC, XC5-PLC offer communication access, with which you can communicate with the devices (such as printer, instruments etc.) that have their own communication protocol.

XC2-PLC, XC3-PLC, XC5-PLC all support Modbus protocol、free protocol these communication function, XC5-PLC also have CANbus function.

7-1-1．COM port

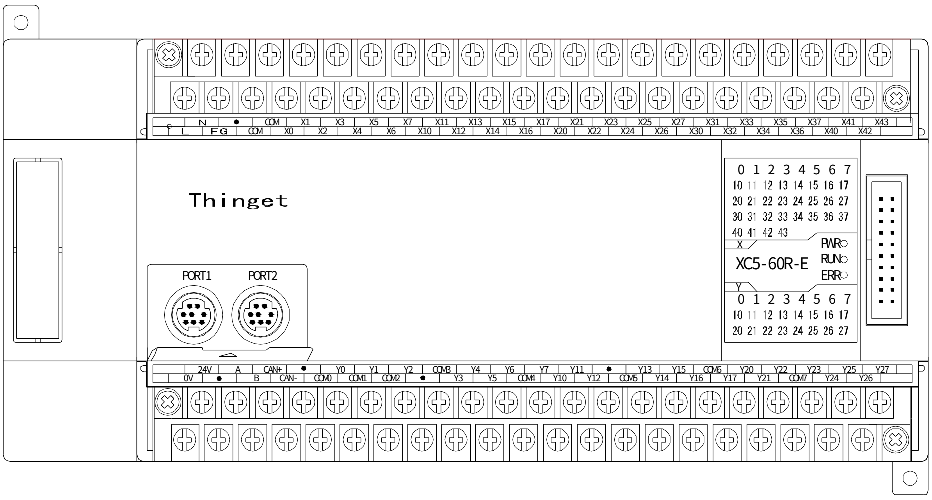
COM Port

There are 2 COM ports (Port1、Port2) on XC3 series PLC basic units, while there are 3 COM ports on XC5 series PLC main units. Besides the same COM ports (COM1、COM2), they have also CAN COM port.

COM 1 (Port1) is the program port, it can be used to download the program and connect with the other devices. The parameters (baud rate, data bit etc.) of this COM port are fixed, can't be re-set.

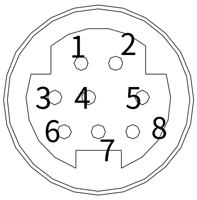
COM 2 (Port2) is communication port, it can be used to download program and connect with the other devices. The parameters (baud rate, data bit etc.) of this COM port can be re-set via software.

Via BD cards, XC series PLC can expend other COM ports. These COM ports can be RS232 and RS485.



1、RS232 COM Port

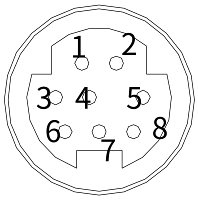
l **COM1** **Pin Definition:**



2：PRG
4：RxD
5：TxD
6：VCC
8：GND

Mini Din 8 pin female

COM2 **Pin Definition:**



4：RxD
5：TxD
8：GND

Mini Din 8 pin female

2、RS485 COM port:

About RS485 COM port, A is “+” signal、B is “-“ signal.

The A, B terminals (RS485) on XC series PLC comes from COM2, so, you can’t only use two at the same time.

3、CAN COM port:

CAN port can be used to realize CANbus communication. The pin terminals are “CAN+”, “CAN-“

For the detailed CAN communication functions, please refer to “6-8．CAN bus function (XC5 series)”

7-1-2．Communication Parameters

Communication Parameters

Station	Modbus Station number: 1~254、255 (FF) is free format communication
Baud Rate	300bps~115.2Kbps
Data Bit	8 bits data、7 bits data
Stop Bit	2 stop bits、1 stop bit
Parity	Even、Odd、No check

The default parameters of COM 1:

Station number is 1、baud rate is 19200bps、8 data bit、1 stop bit、Even

Parameters Setting

Set the parameters with the COM ports on XC series PLC;

	Number	Function	Description
COM 1	FD8210	Communication mode	255 is free format， **1~254 bit is Modbus station number**
	FD8211	Communication format	Baud rate, data bit, stop bit, parity
	FD8212	ASC timeout judgment time	Unit: ms，if set to be 0, it means no timeout waiting
	FD8213	Reply timeout judgment time	Unit: ms，if set to be 0, it means no timeout waiting
	FD8214	Start symbol	High 8 bits invalid
	FD8215	End symbol	High 8 bits invalid
	FD8216	Free format setting	8/16 bits cushion, with/without start bit, with/without stop bit

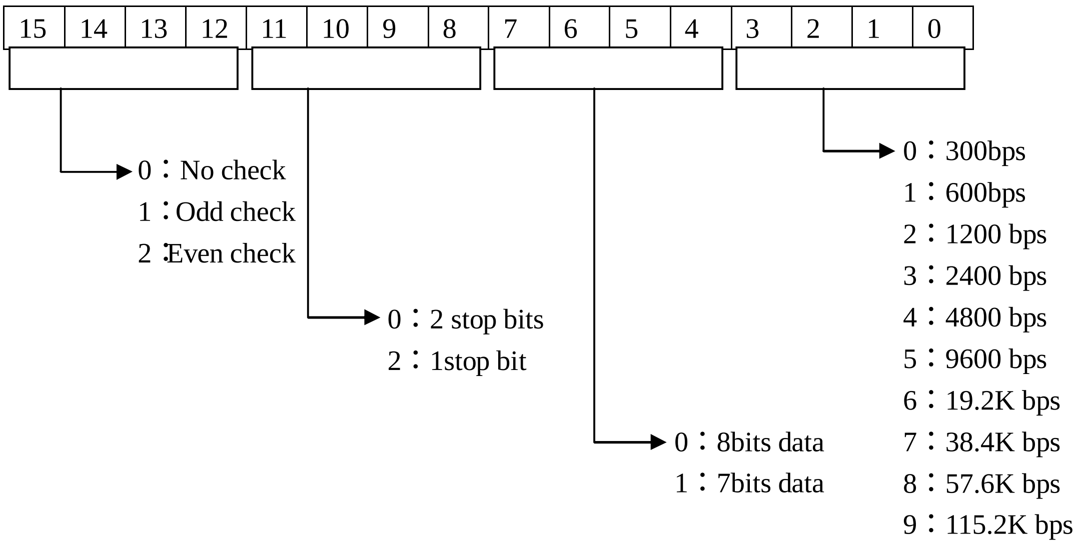
COM 2	FD8220	Communication mode	255 is free format， **1~254 bit is Modbus station number**
	FD8221	Communication format	Baud rate, data bit, stop bit, parity
	FD8222	ASC timeout judgment time	Unit: ms，if set to be 0, it means no timeout waiting
	FD8223	Reply timeout judgment time	Unit: ms，if set to be 0, it means no timeout waiting
	FD8224	Start symbol	High 8 bits invalid
	FD8225	End symbol	High 8 bits invalid
	FD8226	Free format setting	8/16 bits cushion, with/without start bit, with/without stop bit
COM 3	FD8230	Communication mode	255 is free format， **1~254 bit is Modbus station number**
	FD8231	Communication format	Baud rate, data bit, stop bit, parity
	FD8232	ASC timeout judgment time	Unit: ms，if set to be 0, it means no timeout waiting
	FD8233	Reply timeout judgment time	Unit: ms，if set to be 0, it means no timeout waiting
	FD8234	Start symbol	High 8 bits invalid
	FD8235	End symbol	High 8 bits invalid
	FD8236	Free format setting	8/16 bits cushion, with/without start bit, with/without stop bit

※1: The PLC will be Off line after changing the communication parameters, use “stop when reboot” function to keep PLC online;

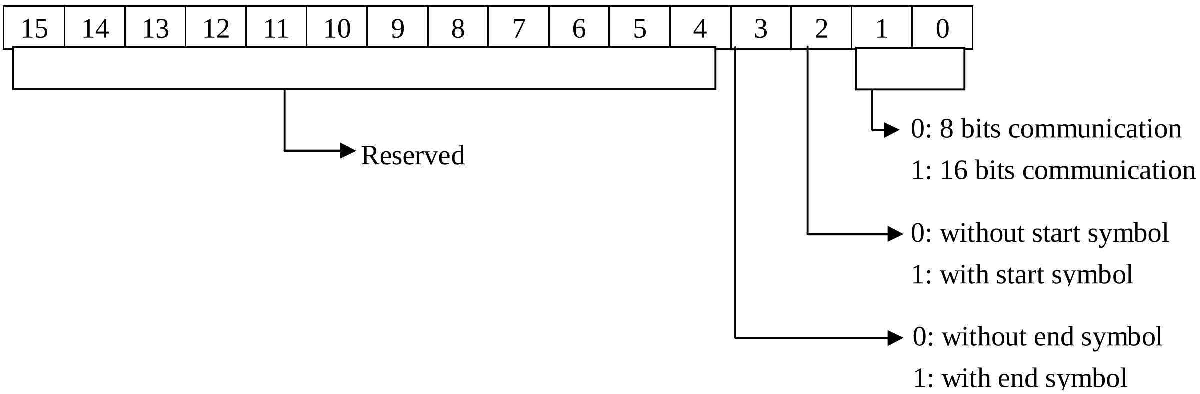
※2: After modifying the data with special FLASH data registers, the new data will get into effect after reboot;

	Set the communication parameters:

FD8211 (COM1)/FD8221 (COM2)/FD8231 (COM3)



FD8216 (COM1)/FD8226 (COM2)/FD8236 (COM3)



7-2．MODBUS Communication

7-2-1．Function

XC series PLC support both Modbus master and Modbus slave

Master format: When PLC is set to be master, PLC sends request to other slave devices via Modbus instructions, other devices response the master.

Slave format: when PLC is set to be slave, it can only response with other master devices.

The default status of XC-PLC is Modbus slave.

7-2-2．Address

For the soft component's number in PLC which corresponds with Modbus address number, please see the following table:

Coil Space: (Modbus ID prefix is “0x”)

Bit ID	**ModbusID (decimal K)**	**Modbus ID (Hex. H)**
M0~M7999	0~7999	0~1F3F
X0~X1037	16384~16927	4000~421F
Y0~Y1037	18432~18975	4800~4A1F
S0~S1023	20480~21503	5000~53FF
M8000~M8511	24576~25087	6000~61FF
T0~T618	25600~26218	6400~666A
C0~C634	27648~28282	6C00~6E7A

Register Space: (Modbus ID prefix is “4x”)

Word ID	**ModbusID (decimal K)**	**Modbus ID (Hex. H)**
D0~D7999	0~7999	0~1F3F
TD0~TD618	12288~12906	3000~326A
CD0~CD634	14336~14970	3800~3A7A
D8000~D8511	16384~16895	4000~41FF
FD0~FD5000	18432~23432	4800~5B88
FD8000~FD8511	26624~27135	6800~69FF

※1: Bit soft components X、Y are in Octal form, the left are in decimal form;

7-2-3．Communication Instructions

Modbus instructions include coil read/write, register read/write; below, we describe these instructions in details:

Ø Coil Read [COLR]

1、Instruction Summary

Read the specified station’s specified coil status to the local PLC;

Coil read [COLR]			
16 bits instruction	COLR	32 bits instruction	-
Execution Condition	Normally ON/OFF coil	Suitable Models	XC2、XC3、XC5、XCM
Hardware Requirement	-	Software Requirement	-

2、Operands

Operands	Function	Type
S1	Specify the remote communication station or soft component's ID	16bits, BIN
S2	Specify the remote coil's start ID or soft component's ID	16bits, BIN
S3	Specify the coil number or soft component's ID	16bits, BIN
D1	Specify the start ID of the local receive coils	bit
D2	Specify the serial port's number	16bits, BIN

3、suitable soft components

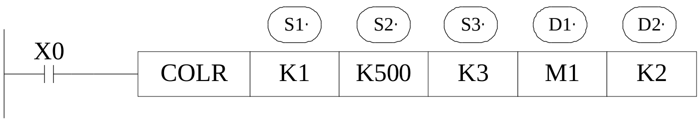
Word

Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●					●		
S3	●	●		●	●					●		
D2										K		

Bit

Operands	Operands						
	X	Y	M	S	T	C	Dn.m
D1	●	●	●	●	●	●	

Function



- Read coil instruction, Modbus code is 01H。
- Serial Port: K1~K3

Ø Input Coil Read [INPR]

1、Instruction

Read the specified station's specified input coils into local coils:

Input coil read [INPR]			
16 bits instruction	INPR	32 bits instruction	-
Execution Condition	Normally ON/OFF、rising edge	Suitable Models	XC2、XC3、XC5、XCM

Hardware Requirement	-	Software Requirement	-

2、Operands

Operands	Function	Type
S1	Specify the remote communication station or soft component's ID	16bits, BIN
S2	Specify the remote coil's start ID or soft component's ID	16bits, BIN
S3	Specify the coil number or soft component's ID	16bits, BIN
D1	Specify the start ID of the local receive coils	bit
D2	Specify the serial port's number	16bits, BIN

3、Suitable Soft Components

Word

Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●					●		
S3	●	●		●	●					●		
D2										K		

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
D1	●	●	●	●	●	●	

Function

X0		S1·	S2·	S3·	D1·	D2·
─┤├─	INPR	K1	K500	K3	M1	K2

- Instruction to read the input coil, Modbus code is 02H
- Serial port: K1~K3
- When X0 is ON, execute COLR or INPR instruction, set communication flag after execution the instruction; when X0 is OFF, no operation. If error happens during communication, resend automatically. If the errors reach 3 times, set the communication error flag. The user can check the relative registers to judge the error;

Ø single coil write [COLW]

1、summary

Write the local coil status to the specified station's specified coil;

Single coil write [COLW]			
16 bits instruction	COLW	32 bits instruction	-
Execution Condition	Normally ON/OFF、rising edge	Suitable Models	XC2、XC3、XC5、XCM
Hardware Requirement	-	Software Requirement	-

2、Operands

Operands	Function	Type
D1	Specify the remote communication station or soft component's ID	16bits, BIN
D2	Specify the remote coil's start ID or soft component's ID	16bits, BIN
S1	Specify the start ID of the local receive coils	bit
S2	Specify the serial port's number	16bits, BIN

3、suitable soft components

Word

Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
D1	●	●		●	●					●		
D2	●	●		●	●					●		
S2										K		

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
S1	●	●	●	●	●	●	

Function

X0

	D1·	D2·	S1·	S2·
COLW	K1	K500	M1	K2

- Write the single coil, Modbus code is 05H
- Serial port: K1~K3

Ø multi-coil write [MCLW]

1、Summary

Write the local multi-coil status into the specified station's specified coil;

Multi-coil write [MCLW]

16 bits instruction	MCLW	32 bits instruction	-
Execution Condition	Normally ON/OFF、rising edge	Suitable Models	XC2、XC3、XC5、XCM
Hardware Requirement	-	Software Requirement	-

2、Operands

Operands	Function	Type
D1	Specify the remote communication station or soft component's ID	16bits, BIN
D2	Specify the remote coil's start ID or soft component's ID	16bits, BIN
D3	Specify the coil number or soft component's ID	16bits, BIN
S1	Specify the start ID of the local receive coils	bit
S2	Specify the serial port's number	16bits, BIN

3、Suitable soft components

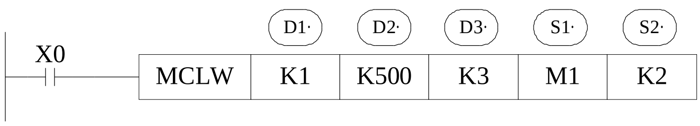
Word

Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
D1	●	●		●	●					●		
D2	●	●		●	●					●		
D3	●	●		●	●					●		
S2										K		

Bit

Operands	System					
	X	Y	M	S	T	C	Dn.m
S1	●	●	●	●	●	●	

Function



- Instruction to write the multiply coils, Modbus code is 0FH
- Serial port: K1~K3
- When X0 is ON, execute COLW or MCLW instruction, set communication flag after execution the instruction; when X0 is OFF, no operation. If error happens during communication, resend automatically. If the errors reach 4 times, set the communication error flag. The user can check the relative registers to judge the error;

Ø Register Read [REGR]

1、Summary

Read the specified station’s specified register to the local register;

Register read [REGR]			
16 bits instruction	REGR	32 bits instruction	-
Execution Condition	Normally ON/OFF、rising edge	Suitable Models	XC2、XC3、XC5、XCM
Hardware Requirement	-	Software Requirement	-

2、Operands

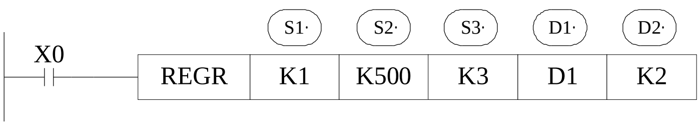
Operands	Function	Type
S1	Specify the remote communication station or soft component’s ID	16bits, BIN
S2	Specify the remote coil’s start ID or soft component’s ID	16bits, BIN
S3	Specify the coil number or soft component’s ID	16bits, BIN
D1	Specify the start ID of the local receive coils	bit
D2	Specify the serial port’s number	16bits, BIN

3、Suitable soft components

Word

Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●					●		
S3	●	●		●	●					●		
D1	●											
D2										K		

Function



- Instruction to read the REGISTERS, Modbus code is 03H
- Serial port: K1~K3

Ø Read Input Register [INRR]

1、Summary

Read the specified station's specified input register to the local register

Read Input Register [INRR]			
16 bits instruction	INRR	32 bits instruction	-
Execution Condition	Normally ON/OFF、rising edge	Suitable Models	XC2、XC3、XC5、XCM
Hardware Requirement	-	Software Requirement	-

2、Operands

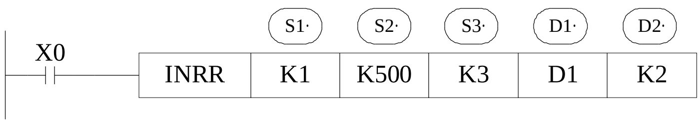
Operands	Function	Type
S1	Specify the remote communication station or soft component's ID	16bits, BIN
S2	Specify the remote coil's start ID or soft component's ID	16bits, BIN
S3	Specify the coil number or soft component's ID	16bits, BIN
D1	Specify the start ID of the local receive coils	bit
D2	Specify the serial port's number	16bits, BIN

3、Suitable soft components

Word

Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●					●		
S3	●	●		●	●					●		
D1	●											
D2										K		

Function



- Instruction to read the input registers, Modbus code is 04H
- Serial port: K1~K3
- When X0 is ON, execute REGR or INRR instruction, set communication flag after execution the instruction; when X0 is OFF, no operation. If error happens during communication, resend automatically. If the errors reach 4 times, set the communication error flag. The user can check the relative registers to judge the error;

Ø Single register write [REGW]

1、summary

Instruction to write the local specified register into the specified station's specified register;

Single register write [REGW]			
16 bits instruction	REGW	32 bits instruction	-
Execution Condition	Normally ON/OFF、rising edge	Suitable Models	XC2、XC3、XC5、XCM
Hardware Requirement	-	Software Requirement	-

2、Operands

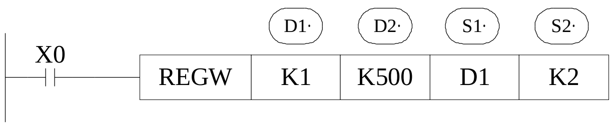
Operands	Function	Type
D1	Specify the remote communication station or soft component's ID	16bits, BIN
D2	Specify the remote coil's start ID or soft component's ID	16bits, BIN
S1	Specify the start ID of the local receive coils	16bits, BIN
S2	Specify the serial port's number	16bits, BIN

3、Suitable soft components

Word

Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
D1	●	●		●	●					●		
D2	●	●		●	●					●		
S1	●											
S2										K		

Function



- Write the single register, Modbus code is 06H
- Serial port: K1~K3

Ø Multi-register write [MRGW]

1、Summary

Instruction to write the local specified register to the specified station's specified register;

Multi-register write [MRGW]			
16 bits instruction	MRGW	32 bits instruction	-
Execution Condition	Normally ON/OFF 、 rising edge	Suitable Models	XC2、XC3、XC5、XCM
Hardware Requirement	-	Software Requirement	-

2、Operands

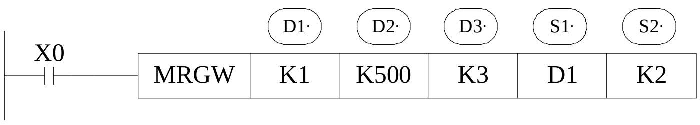
Operands	Function	Type
D1	Specify the remote communication station or soft component's ID	16bits, BIN
D2	Specify the remote coil's start ID or soft component's ID	16bits, BIN
D3	Specify the coil number or soft component's ID	16bits, BIN
S1	Specify the start ID of the local receive coils	bit
S2	Specify the serial port's number	16bits, BIN

3、Suitable soft components

Word

Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
D1	●	●		●	●					●		
D2	●	●		●	●					●		
S1	●											
S2										K		

Function



- Instruction to write the multiply registers, Modbus code is 10H
- Serial port: K1~K3
- When X0 is ON, execute REGW or MRGW instruction, set communication flag after execution the instruction; when X0 is OFF, no operation. If error happens during communication, resend automatically. If the errors reach 4 times, set the communication error flag. The user can check the relative registers to judge the error;

7-3. FREE FORMAT COMMUNICATION

7-3-1. Communication mode

Free format communication transfer data in the form of data block, each block can transfer 128 bytes at most. Meanwhile each block can set a start symbol and stop symbol, or not set.

Communication Mode:

Start Symbol (1 byte)	Data Block (max. 128 bytes)	End Symbol (1 byte)

- Port1、Port2 or Port3 can realize free format communication
- Under free format form, FD8220 or FD8230 should set to be 255 (FF)
- Baud Rate: 300bps~115.2Kbps
- Data Format
  Data Bit: 7bits、8bits
  Parity: Odd、Even、No Check
  Stop bit: 1 bit、2 bits
- Start Symbol: 1 bit
  Stop Symbol: 1 bit
  User can set a start/stop symbol, after set the start/stop symbol, PLC will automatically add this start/stop symbol when sending data; remove this start/stop symbol when receiving data.
- Communication Format: 8 bits、16 bits
  If choose 8 bits buffer format to communicate, in the communication process, the high bytes are invalid, PLC only use the low bytes to send and receive data.
  If choose 16 bits buffer format to communicate, when PLC is sending data, PLC will send low bytes before sending higher bytes

7-3-2. Instruction form

Ø Send data [SEND]

1、Summary

Write the local specified data to the specified station's specified ID;

Send data [SEND]			
16 bits instruction	SEND	32 bits instruction	-
Execution Condition	Normally ON/OFF、rising edge	Suitable Models	XC2、XC3、XC5、XCM
Hardware Requirement	-	Software Requirement	-

2、Operands

Operands	Function	Type

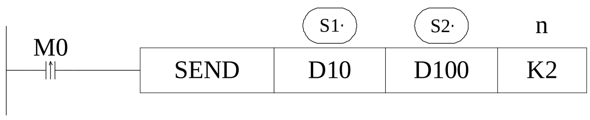
S1	Specify the start ID of local PLC	16bits, BIN
S2	Specify the ASC number to send or soft component's ID	16bits, BIN
n	Specify the COM port Nr.	16bits, BIN

3、Suitable soft components

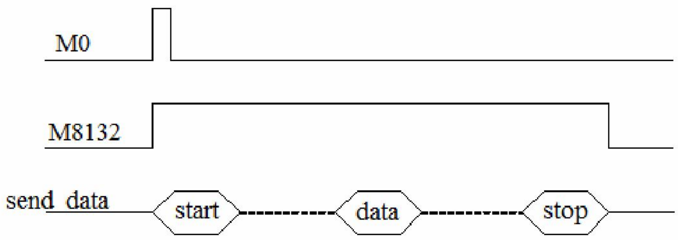
Word

Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●							
S2	●	●		●	●					●		
n	●									K		

Function



- Data send instruction, send data on the rising edge of M0;
- Serial port: K2~K3
- When sending data, set "sending" flag M8132 (COM2) ON



Ø Receive Date [RCV]

1、Summary

Write the specified station's data to the local specified ID;

Receive data [RCV]			
16 bits instruction	RCV	32 bits instruction	-
Execution Condition	Normally ON/OFF 、 rising edge	Suitable Models	XC2、XC3、XC5、XCM
Hardware Requirement	-	Software Requirement	-

2、Operands

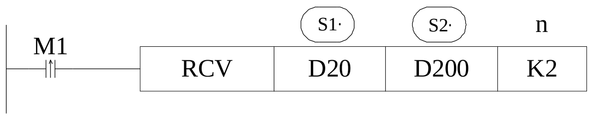
Operands	Function	Type
S1	Specify the start ID of local PLC	16bits, BIN
S2	Specify the ASC number to receive or soft component's ID	16bits, BIN
n	Specify the COM port Nr.	16bits, BIN

3、Suitable soft components

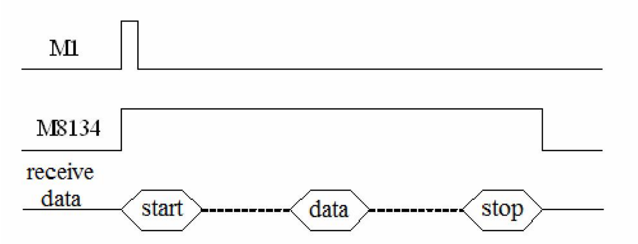
Word

Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●							
S2	●	●		●	●					●		
n										●		

Function



- Data receive instruction, receive data on the rising edge of M0;
- Serial port: K2~K3
- When receiving data, set "receiving" flag M8134(COM2) ON

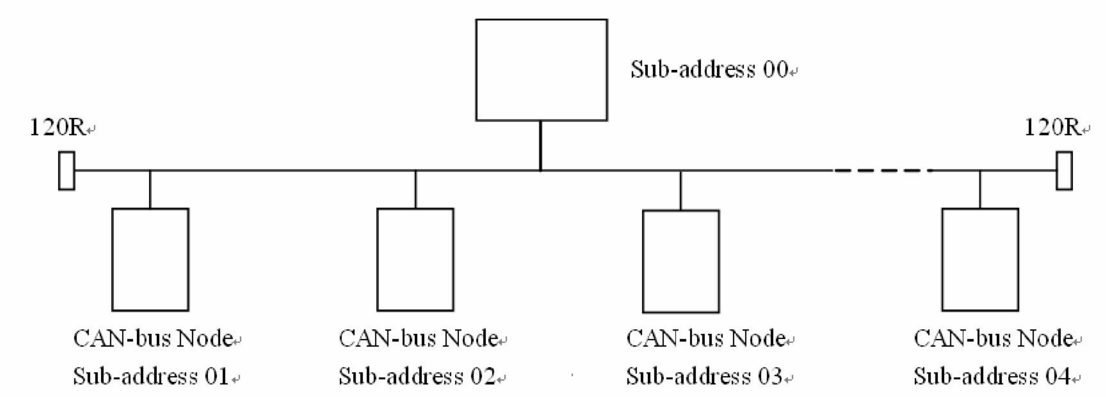


※1: If you require PLC to receive but not send, or receive before send, you need to set the communication timeout as 0ms

7-4. CAN Bus Functions

7-4-1. Brief Introduction of CAN-bus

XC5 series PLC support CANbus bus function. Below we will give some basic concept on CANbus;



CAN (Controller Area Network) belongs to industrial area bus category. Compared with common communication bus, CAN bus data communication has performance of outstanding dependability、real time ability and flexibility.

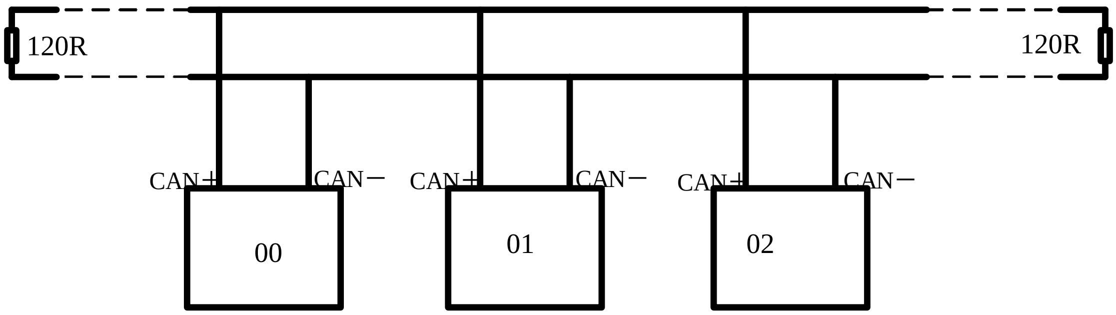
CAN controller works under multi-master format. In the network, each node can send data to bus according to the bus visit priority. These characters enable each node in CAN bus network to have stronger data communication real time performance, and easy to construct redundant structure, improve the system's dependability and flexibility.

In CANBUS network, any node can initiatively send message at any time to any other node, no master and no slave. Flexibility communication, it's easy to compose multi-device backup system, distributing format monitor, control system. To fulfill different real time requirement, the nodes can be divided to be different priority level. With non-destroy bus arbitrament technology, when two nodes send message to the network at the same time, the low level priority node initiatively stop data sending, while high level priority node can continue transferring data without any influence. So there is function of node to node, node to multi-node, bureau broadcasting sending/receiving data. Each frame's valid byte number is 8, so the transfer time is short, the probability ratio is low.

7-4-2. External Wiring

CAN-Bus Communication Port: CAN＋、CAN－

The wiring among each node of CAN bus is shown in the following graph; at the two ends, add 120 ohm middle-terminal resistors.



7-4-3．CAN Bus Network Form

There are two forms of CAN bus network: one is instructions communication format; the other is internal protocol communication format. These two forms can work at the same time

Ø Instructions communication format

This format means, in the local PLC program, via CAN-bus instructions, execute bit or word reading/writing with the specified remote PLC.

Ø Internal protocol communication format

This format means, via setting of special register, via configure table format, realize allude with each other among PLC's certain soft component's space. In this way, realize PLC source sharing in CAN-bus network.

7-4-4．CAN-bus Instructions

Ø Read Coil [CCOLR]

1、Instruction Description

Function：Read the specified station's specified coil status into the local specified coil.

Read Coil [CCOLR]			
16 bits instruction	CCOLR	32 bits instruction	-
Execution Condition	Normally ON/OFF, rising edge activates	Suitable Models	XC5
Hardware Requirement	-	Software Requirement	-

2、Operands

Operands	Function	Type
S1	Specify remote communication station ID or soft component's number;	16bits, BIN
S2	Specify the remote coil's start ID or soft component's number;	16bits, BIN
S3	Specify the coil number or soft component's number;	16bits, BIN
D	Specify the local receive coil's start ID	bit

3、Suitable Soft Components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●					●		
S3	●	●		●	●					●		

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
D	●	●	●	●	●	●	

Function

X0		S1·	S2·	S3·	D·
─┤↑├─	CCOLR	K2	K20	K4	M20

- Execute CCOLR instruction when X0 changes from OFF to ON; read the four coils data of remote station 2th, coil's start ID K20 to local M20～M23.

Ø Write the Coil [CCOLW]

1、Summary

Write the local specified multi-coils status into the specified station's specified coils;

Write the coil [CCOLW]			
16 bits instruction	CCOLW	32 bits instruction	-
Execution Condition	Normally ON/OFF 、 rising edge	Suitable Models	XC5
Hardware Requirement	-	Software Requirement	-

2、Operands

Operands	Function	Type
D1	Specify remote communication station ID or soft component's number;	16 bit, BIN
D2	Specify the remote coil's start ID or soft component's number;	16 bit, BIN
D3	Specify the coil number or soft component's number;	16 bit, BIN
S	Specify the local receive coil's start ID	bit

3、Suitable soft components

Word												
Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●					●		
S3	●	●		●	●					●		

Bit							
Operands	System						
	X	Y	M	S	T	C	Dn.m
D	●	●	●	●	●	●	

Function

X0		D1·	D2·	D3·	S·
⊣↑⊢	CCOLW	K2	K20	K4	M20

- Execute CCOLW instruction when X0 changes from OFF to ON; write the local M20～M23 to the remote station 2th, coil's start ID K20.

Ø Read Register [CREGR]

1、Summary

Read the specified station's specified register to the local specified register;

Read register [CREGR]			
16 bits instruction	CREGR	32 bits instruction	-
Execution Condition	Normally ON/OFF、rising edge	Suitable Models	XC5
Hardware Requirement	-	Software Requirement	-

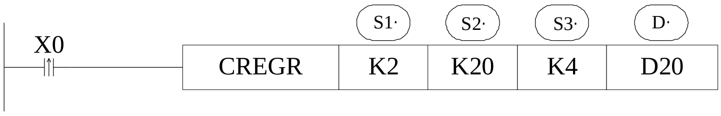
2、Operands

Operands	Function	Type
D1	Specify remote communication station ID or soft component's number;	16bits, BIN
D2	Specify the remote register's start ID or soft component's number;	16bits, BIN
D3	Specify the register number or soft component's number;	16bits, BIN
S	Specify the local receive coil's start ID	16bits, BIN

3、Suitable soft components

Word												
Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●					●		
S3	●	●		●	●					●		
D	●			●	●							

Function



- Execute CREGR instruction when X0 changes from OFF to ON; read the remote station 2th, coil's start ID K20 to the local D20～D23

Ø Write the Register [CREGW]

1、Summary

Write the specified local input register to the specified station's specified register;

Write the register [CREGW]			
16 bits instruction	CREGW	32 bits instruction	-
Execution Condition	Normally ON/OFF、rising edge	Suitable Models	XC5
Hardware Requirement	-	Software Requirement	-

2、Operands

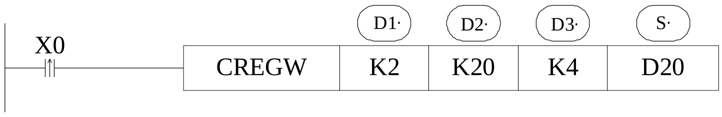
Operands	Function	Type
D1	Specify remote communication station ID or soft component's number;	16bits, BIN
D2	Specify the remote register's start ID or soft component's number;	16bits, BIN
D3	Specify the register number or soft component's number;	16bits, BIN
S	Specify the local receive coil's start ID	16bits, BIN

3、Suitable soft components

Word

Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●					●		
S3	●	●		●	●					●		
D	●			●	●							

Function



- Execute CREGW instruction when X0 changes from OFF to ON; write the local D20～D23 to the remote station 2th, coil's start ID K20.

7-4-5．Communication Form of Internal Protocol

Function

- Open/close the internal protocol communication function
  Set the value in register FD8350:
  0: do not use CAN internal protocol communication;
  1: use CAN internal protocol communication
  CAN internal protocol communication is default to be closed;
- Set the communication parameters

See the setting methods with baud rate, station number, sending frequency etc. in the below table:

Define the configure items:

Internal protocol communication is to communicate via setting the configure items;

The configure items include: read the bit, read the word, write the bit, write the word;

The configure form:

Step 1、add the four configure items number separately: FD8360—read the bit items、FD8361—read the word items、FD8362—write the bit items、FD8363—write the word items

Step 2、set each configure item's communication object, each item includes four parameter: remote node's station、remote node's object ID、local object's ID、number; the correspond register ID is: FD8370~FD8373 represents Nr.1 item;、FD8374~FD8377 represents Nr.2 item、……FD9390~FD9393 represents Nr.256 item；totally we can set 256 items; see table below:

Communication Setting

Nr.	Function	Description
FD8350	CAN communication mode	0 represents **not use**; 1 represents internal protocol
FD8351	CAN baud rate	See CAN baud rate setting table
FD8352	Self CAN station	For CAN protocol use (the default value is 1)
FD8354	Configured sending frequency	The set value's unit is **ms**, represents "send every **ms**" if set to be 0, it means send every cycle, the default value is 5ms

FD8360	Read bit number	-
FD8361	Read word number	
FD8362	write bit number	
FD8363	write word number	
FD8370	Remote node's ID	The Nr.1 item's configuration
FD8371	Remote node's object ID	
FD8372	Local object's ID	
FD8373	Number	
……	……	……
FD9390	Remote node's ID	The Nr.256 item's configuration
FD9391	Remote node's object ID	
FD9392	Local object's ID	
FD9393	Number	

Status Flag

M8240	CAN self check error flag	Set 1 if error; set 0 if correct
M8241	Error flag of CAN configure	Set 1 if error; set 0 if correct
M8242	Automatically recover the control after CAN bus error	If set to be 1, then recover after error happens; If set to be 1, then CAN stops working after error happens; The default value is 1, this flag is not power-off retentive

Baud Rate Setting

FD8351 value	Baud Rate (BPS)
0	1K
1	2K
2	5K
3	10K
4	20K
5	40K
6	50K
7	80K
8	100K
9	150K
10	200K
11	250K
12	300K
13	400K
14	500K
15	600K
16	800K
17	1000K

Register Status

D8240	CAN error information	0: no error 2: initialize error 30: bus error 31: error alarm 32: data overflow
D8241	The configure item's Nr. which has error	Show the first number of error configure item
D8242	Data package number sent every second	-
D8243	Data package number received every second	-
D8244	CAN communication error count	-

7-4-6．CAN Free Format Communication

Ø CAN Sending [CSEND]

1、Instructions Summary

Write the specified data from the unit to a specified address (data transfer in one unit)

CAN Sending [CSEND]			
16bits instruction	CSEND	32bits instruction	-
Executing Condition	Normally ON/OFF、Rising edge	Suitable Models	XC5
Hardware Requirement	-	Software Requirement	-

2、Operands

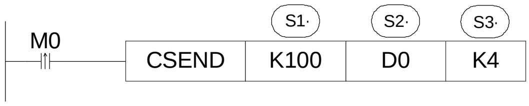
Operands	Function	Type
S1	specify the ID number to send the data package	16bits, BIN
S2	specify the first ID number of sent data or soft component locally	16bits, BIN
S3	specify the byte number of sent data	16bits, BIN

3、Suitable soft components

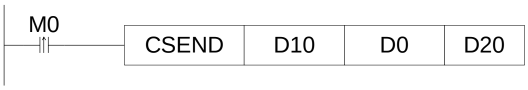
Word type

Operands	System									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●							
S3	●	●		●	●					●		

Functions and Actions



- Instruction to enable data sending, send data at every rising edge of M0
- ID number of sending data package is 100, 4 bytes data, the first ID is in D0
- 8 bits data transfer: the transferred data is: D0L、D1L、D2L、D3L (D0L means the low byte of D0)
- 16 bits data transfer: the transferred data is: D0L、D0H、D1L、D1H (D0H means the high byte of D0)



- The ID of sending data package is specified by D10, the data number is specified by D20, the first ID is in D0;
- 8 bits data transfer: the transferred data is: D0L、D1L、D2L、D3L(D0L means the low byte of D0)
- 16 bits data transfer: the transferred data is: D0L、D0H、D1L、D1H (D0H means the high byte of D0)
- Standard Frame: the valid bits of the data package ID number that is specified by D10 is the low 11 bits, the left bits are invalid;
- The expansion frame: the valid bits of the data package ID number that is specified by D10 is the low 29 bits, the left bits are invalid;
- The maximum data bits specified by D20 is 8, if exceeds 8, the instruction will send only 8 bits;

Ø CAN Receive [CRECV]

1、Instructions Summary

Write the specified data in one unit to a specified address in another unit (data transfers between different units)

CAN Receive [CRECV]			
16 bits instruction	CRECV	32 bits instruction	-
Executing Condition	Normally ON/OFF、Rising edge	Suitable Models	XC5
Hardware Requirement	-	Software Requirement	-

2、Operands

Operands	Function	Type

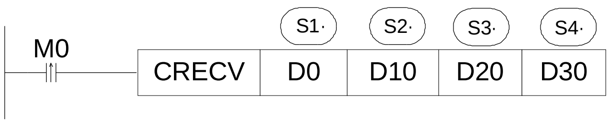
S1	specify the ID number to receive the data package	16bits, BIN
S2	specify the first ID number of received soft component locally	16bits, BIN
S3	specify the byte number of received data	16bits, BIN
S4	specify the soft component's start ID number of ID filter code	16bits, BIN

3、Suitable soft components

Word Type

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●							
S2	●	●		●	●							
S3	●	●		●	●							
S4	●											

Functions and Actions



- The 32 bits memory combined by [D1, D0] (D0 is low byte, D1 is high byte) is used to stock ID number of the received data package. The received data length is stored in D20. The data content is stored in registers start from D10. D30 specifies the received ID filter code; if the received data doesn't fit the filter codes, then it will keep the RECV status;
- ID filter code: D30 specifies the start address of ID filter codes; the instruction specifies two groups of filter codes, occupy D30~D37 zone;

Filter Code	Memory	Description	Example
The first group	D31, D30	D30 low bytes, D31 high bytes, they compose a 32 bits mask code	D30=0xFFFF, D31=0x0000, then the mask code is 0x0000FFFF D30=0x1234, D31=0x0000, then filter value is 0x00001234 If ID and 0x0000FFFF equals 0x00001234, the pass the first group of filter. If the ID pass any of two groups, the allow the reception
	D33, D32	D32 low bytes, D33 high bytes, they compose a 32 bits filter value	
The first group	D35, D34	D34 low bytes, D35 high bytes, they compose a 32 bits mask code	
	D37, D36	D36 low bytes, D37 high bytes, they compose a 32 bits filter	

		value	

- Standard/ expansion frame: the setting of FD8358 has no effect to reception. If the data frame fulfills ID mask codes, the standard frame and the expansion frames can be all received. When receive the standard frame, the ID bits is 11, but will still occupy the 32 bits memory combined by [D1,D0]
- 8 bits data transfer: the transfer data is: D0L、D1L、D2L、D3L……(D0L means the low byte of D0)
- 16 bits data transfer: the transfer data is: D0L、D0H、D1L、D1H……(D0H means the high byte of D0)

Ø Relate Special Soft Components List

1、 System FD8000 Setting

ID	Function	Description
FD8350	CAN Mode	0: not usable 1: XC-CAN network 2: Free format **FREE**
FD8351	CAN baud rate	0, 1KBPS initial value, actual is 5KBPS. 1, 2KBPS initial value, actual is 5KBPS. 2, 5KBPS initial value 3, 10KBPS initial value 4, 20KBPS initial value 5, 40KBPS initial value 6, 50KBPS initial value 7, 80KBPS initial value 8, 100KBPS initial value 9, 150KBPS initial value 10, 200KBPS initial value 11, 250KBPS initial value 12, 300KBPS initial value 13, 400KBPS initial value 14, 500KBPS initial value 15, 600KBPS initial value 16, 800KBPS initial value 17, 1000KBPS initial value
FD8358	CAN free format mode	low 8 bits: 0-standard frame . low 8 bits: 1-expansion frame high 8 bits: 0-8 bits data store high 8 bits: 1-16 bits data store
FD8359	CAN accept timeout time	for free format using, unit: ms
	CAN send timeout time	fixed to be 5ms

2、System M8000 flag

ID	Function	Description
M8240	CAN error flag	ON: error happens OFF: normal if set M8242 as ON, and manually set M8240 as ON, this will enable CAN reset
M8241	CAN node dropped off flag	XC-CAN mode valid ON: certain node/nodes are dropped off OFF: Normal
M8242	do reset or not if CAN error happens	ON: CAN reset automatically when error happens OFF: take no operation when error happens
M8243	CAN send/accept finished flag	FREE mode valid ON: receive/accept finish reset ON automatically when starting to send/accept
M8244	CAN send/accept timeout flag	FREE mode valid ON: send/accept timeout Set OFF automatically when starting to send/accept

3、System D8000

ID	Function	Description
D8240	CAN error information	0: no error 2: initializing error 30: CAN bus error 31: error alarm 32: data overflow
D8241	configure item number when error happens	XC-CAN valid
D8242	data package number sent every second	both XC-CAN and FREE modes are valid
D8243	data package number accepted every second	both XC-CAN and FREE modes are valid
D8244	CAN communication error counter	correspond with M8240 at every CAN error, M8240 will be set ON one time, D8244 increase 1

8 PID Control Function

In this chapter, we mainly introduce the applications of PID instructions for XC series PLC basic units, including: call the instructions, set the parameters, items to notice, sample programs etc.

8-1. Brief Introductions of The Functions

PID instruction and auto tune function are added into XC series PLC basic units (Version 3.0 and above). Via auto tune method, users can get the best sampling time and PID parameters and improve the control precision.

The previous versions can not support PID function on basic units unless they extend analog module or BD cards. PID instruction has brought many facilities to the users.

1. The output can be data form **D** and on-off quantity **Y**, user can choose them freely when program.
2. Via auto tune, users can get the best sampling time and PID parameters and improve the control precision.
3. User can choose positive or negative movement via software setting. The former is used in heating control, the later is used in cooling control.
4. PID control separates the basic units with the expansions, this improves the flexibility of this function.

8-2. Instruction Forms

1、Brief Introductions of the Instructions

Execute PID control instructions with the data in specified registers.

PID control [PID]			
16 bits instruction	PID	32 bits instruction	-
Executing Condition	Normally ON/normally closed coil activates	Suitable Models	XC2、XC3、XC5、XCM
Hardware Condition	V3.0 or above	Software Condition	V3.0 or above

2、Operands

Operands	Usage	Type
S1	set the ID Nr. of the target value (SV)	16bits, BIN
S2	set the ID Nr. of the tested value (PV)	16 bits, BIN
S3	set the first ID Nr. of the control parameters	16 bits, BIN
D	the ID Nr. of the operation resule (MV) or output port	16 bits, BIN

3、Suitable soft components

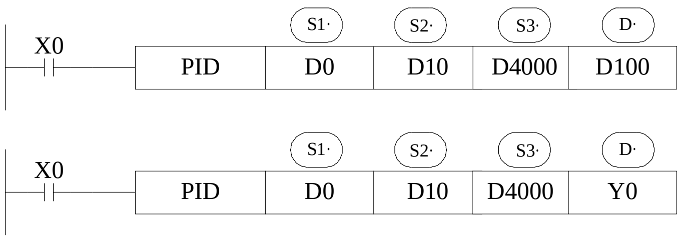
Word Type

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●									●		
S2	●										●	
S3	●											
D	●											●

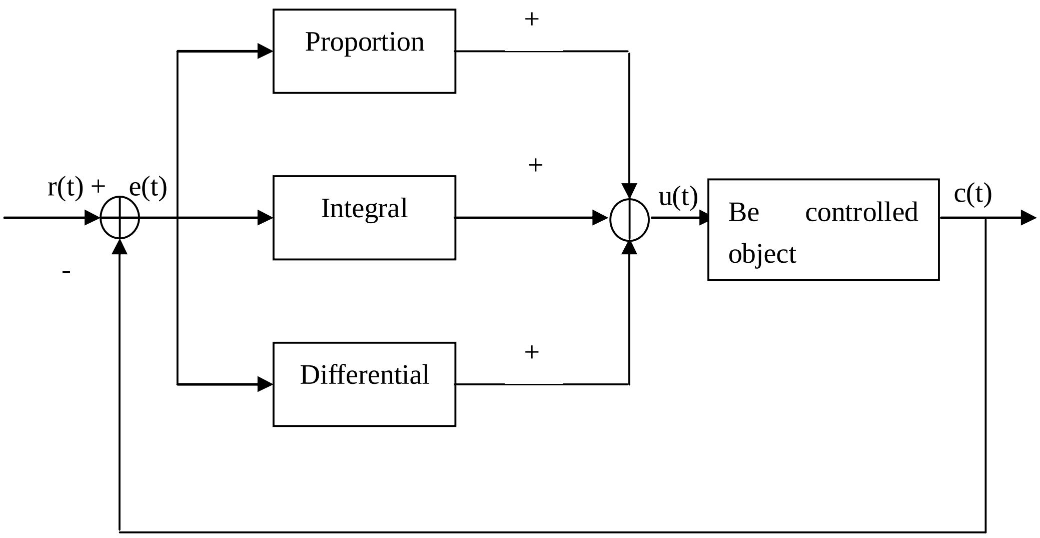
Bit Type

Operands	System						
	X	Y	M	S	T	C	Dn.m
D		●	●	●	●	●	

Functions and Actions



- S3~ S3+ 43 will be occupied by this instruction, so please don’t use them as the common data registers.
- This instruction executes when each sampling time interval comes.
- To the operation result **D**, the data registers are used to store PID output values; the output points are used to output the occupy ratio in the form of ON/OFF.
- PID control rules are shown as below:



$$e(t) = r(t) - c(t) \qquad (1\text{-}1)$$

$$u(t) = Kp\left[e(t) + 1/Ti\int e(t)dt + TD\, de(t)/dt \right] \qquad (1\text{-}2)$$

Here, e(t) is warp, r(t) is the given value, c(t) is the actual output value, u(t) is the control value;

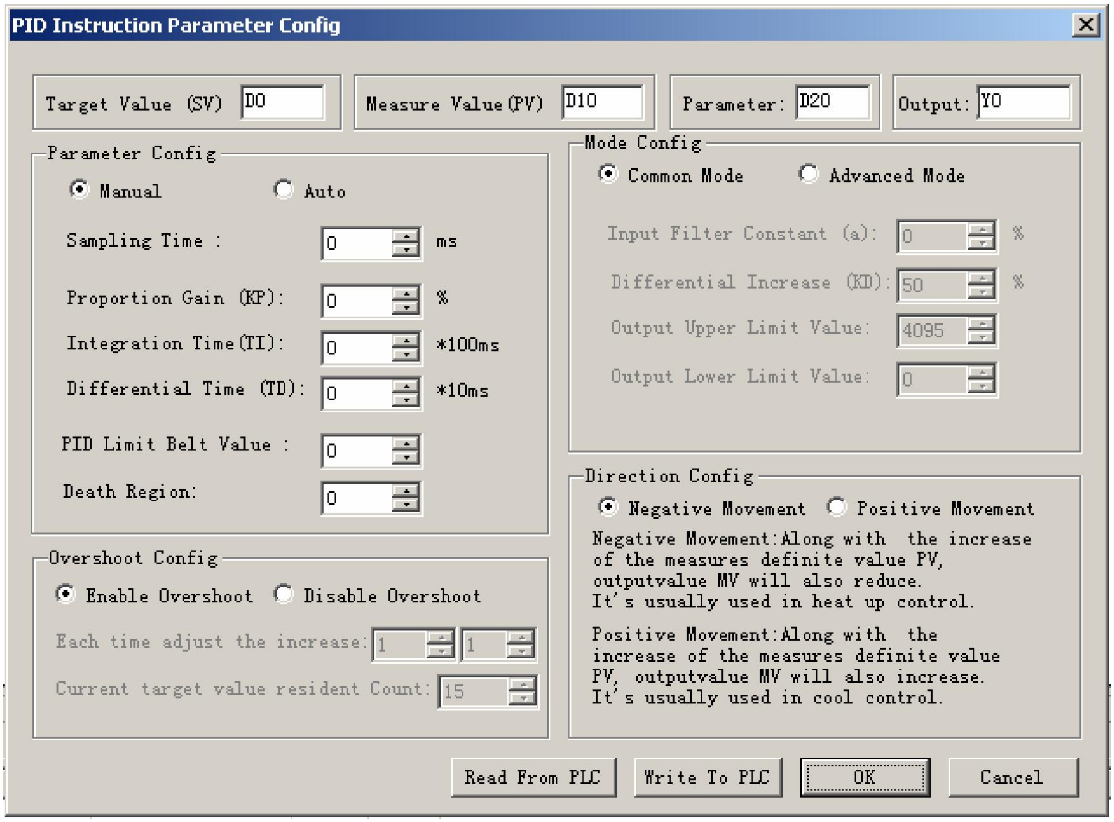
In function (1-2), Kp is the proportion coefficient, Ti is the integration time coefficient, and TD is the differential time coefficient.

The result of the operation:

1. Analog output: MV= digital form of u (t), the default range is 0 ~ 4095.
2. Digital output: Y=T*[MV/PID output upper limit]. Y is the output's activate time within the control cycle. T is the control cycle, equals to the sampling time. PID output upper limit default value is 4095.

8-3. Parameters Setting

Users can call PID instruction in XCP Pro software directly and set the parameters in the window (see graph below), for the details please refer to XCPPro user manual. Users can also write the parameters into the specified registers by MOV instructions before PID operation.



8-3-1. Registers and their functions

For PID control instruction's relative parameters ID, please refer to the below table:

ID	Function	Description	Memo
S3	sampling time	32 bits without sign	Unit: ms
S3+1	sampling time	32 bits without sign	Unit: ms
S3+2	mode setting	bit0: 0: Negative; 1 Negative; bit1～bit6 not usable bit7: 0: Manual PID; 1: auto tune PID bit8: 1: auto tune successful flag bit9～bit14 not usable bit15: 0: regular mode; 1: advanced mode	
S3+3	Proportion Gain (Kp)	Range: 1～32767[%]	
S3+4	Integration time (TI)	0～32767[*100ms]	0 is taken as no integral.
S3+5	Differential time (TD)	0～32767[*10ms]	0 is taken as no differential.
S3+6	PID operation zone	0～32767	PID adjustment band width value.
S3+7	control death zone	0～32767	PID value keeps constant in death zone
S3+8	PID auto tune cycle varied value	full scale AD value *（0.3~1%）	
S3+9	PID auto tune overshoot permission	0: enable overshoot 1:disable overshoot	
S3+10	current target value adjustment percent in auto tune finishing transition stage		
S3+11	current target value resident count in auto tune finishing transition stage		
S3+12~ S3+39	occupied by PID operation's internal process		
Below is the ID of advanced PID mode setting			
S3+40	Input filter constant (a)	0～99[%]	0: no input filter
S3+41	Differential gain (KD)	0～100[%]	0: no differential gain
S3+42	Output upper limit value	-32767～32767	
S3+43	Output lower limit value	-32767～32767	

8-3-2. Parameters Description

- **Movement Direction:**

Ø Positive movement: the output value MV will increase with the increasing of the detected value PV, usually used for cooling control.

Ø Negative movement: the output value MV will decrease with the increasing of the detected value PV, usually used for heating control.

- **Mode Setting**

Ø Common Mode:

The parameter's register zone is from **S3** to **S3**+43, **S3** to **S3**+11 needs to be set by users. **S3+12** to **S3**+43+12 are occupied by the system, users can't use them.

Ø Advanced Mode

The parameter's register zone is from **S3** to **S3**+43, **S3** to (**S3**+11) and (**S3+40)** to (**S3**+43) need to be set by users. (**S3+12)** to (**S3**+**39)** are occupied by the system, users can't use them.

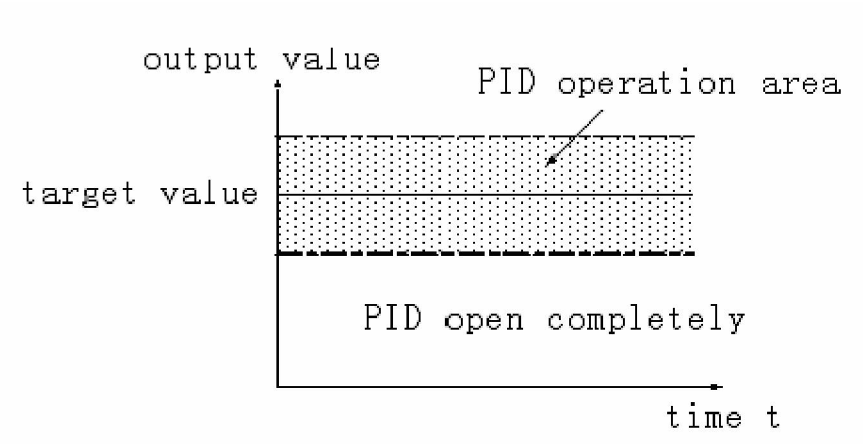
- **Sample Time [S3]**

The system samples the current value according to certain time interval and compare them with the output value. This time interval is the sample time **T**. There is no requirement for **T** during **AD** output. **T** should be larger than one PLC scan period during port output. **T** value should be chosen among 100~1000 times of PLC scan periods.

- **PID Operation Zone [S3+6]**

PID control is entirely opened at the beginning and close to the target value with the highest speed (the defaulted value is 4095), when it entered into the PID computation range, parameters Kp, Ti, TD will be effective.

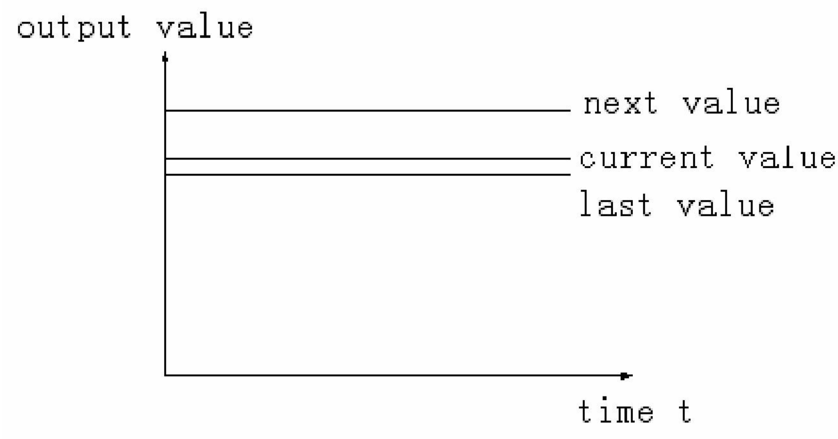
See graph below:



If the target value is 100, PID operation zone is 10, then the real PID's operation zone is from 90 to 110.

- **Death Region [S3+7]**

If the detected value changed slightly for a long time, and PID control is still in working mode, then it belongs to meanless control. Via setting the control death region, we can overcome this condition. See graph below:



Suppose: we set the death region value to be 10. Then in the above graph, the difference is only 2 comparing the current value with the last value. It will not do PID control. The difference is 13 (more than death region 10) comparing the current value with the next value, this difference value is larger than control death region value, it will do the PID control with 135.

8-4．Auto Tune Mode

If users do not know how to set the PID parameters, they can choose auto tune mode which can find the optimal control parameters (sampling time, proportion gain **Kp**, integral time **Ti**, differential time **TD**) automatically.

l Auto tune mode is suitable for these objectives: temperature, pressure; not suitable for liquid level and flow.

l Users can set the sampling cycle to be 0 at the beginning of the auto tune process then modify the value manually in terms of practical needs after the auto tune process is completed.

l Before doing auto tune, the system should be under the no-control steady state. Take the temperature for example, the detected temperature should be the same as the environment temperature.

To enter the auto tune mode, please set bit7 of (**S3+ 2)** to be 1 and turn on PID working condition.

If bit8 of (**S3+ 2)** turn to 1, it means the auto tune is successful.

l PID auto tune period value **[S3+ 8]**

Set this value in **[S3+ 8]** during auto tune.
This value decides the auto tune performance, in a general way, set this value to be the AD result corresponding to one standard detected unit. The default value is 10. The suggested setting range:
full-scale AD result × 0.3 ~ 1%.
User don’t need to change this value. However, if the system is interfered greatly by outside, this value should be increased modestly to avoid wrong judgment for positive or negative movement. If this value is too large, the PID control period (sampling time) got from the auto tune process will be too long. As the result do not set this value too large.

※1: if users have no experience, please use the defaulted value 10, set PID sampling time (control period) to be 0ms then start the auto tune.

- PID auto tune overshooting permission setting **[S3+ 9]**

If set 0, overshooting is permitted, the system can study the optimal PID parameters all the time. But in self-study process, detected value may be lower or higher than the target value, safety factor should be considered here.

If set 1, overshooting is not permitted. For these objectives which have strict safety demand such as pressure vessel, set **[S3+ 9]** to be 1 to prevent from detected value seriously over the target value. In this process, if **[S3+ 2]** bit8 changes from 0 to 1, it means the auto tune is successful and the optimal parameters are got; if **[S3+ 2]** is always 0 until **[S3+ 2]** bit7 changes from 1 to 0, it means the auto tune is completed but the parameters are not the best and need to be modified by users.

- Every adjustment percent of current target value at auto tune process finishing transition stage **[S3+10]**

This parameter is effective only when **[S3+ 9]** is 1.

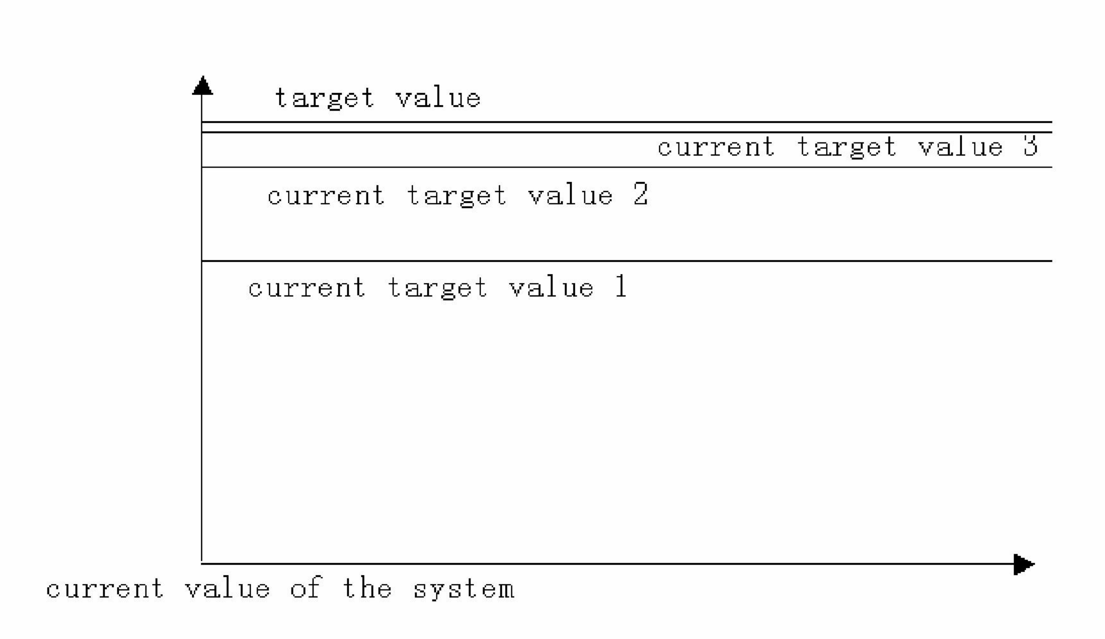
If doing PID control after auto tune, small range of overshooting may be occurred. It is better to decrease this parameter to control the overshooting. But response delay may occur if this value is too small. The defaulted value is 100% which means the parameter is not effective. The recommended range is 50~80%.

Cutline Explanation:

Current target value adjustment percent is 2/3 (**S3 + 10** = 67%), the original temperature of the system is 0 ºC, target temperature is 100 ºC, the current target temperature adjustment situation is shown as below:

Next current target value = current target value + (final target value – current target value) × 2/3;

So the changing sequence of current target is 66 ºC, 88 ºC, 96 ºC, 98 ºC, 99 ºC, 100 ºC.



- The stay times of the current target value at auto tune process finishing transition stage **[S3+11]**

This parameter is valid only when **[S3+9]** is 1;
If entering into PID control directly after auto tune, small range of overshoot may occur. It is good for preventing the overshoot if increasing this parameter properly. But it will cause response lag if this value is too large. The default value is 15 times. The recommended range is from 5 to 20.

8-5. Advanced Mode

Users can set some parameters in advanced mode in order to get the better effect of PID control.
Enter into the advanced mode, please set **[S3+2]** bit 15 to be 1, or set it in the XCP Pro software.

- Input Filter constant
  It will smooth the sampling value. The default value is 0% which means no filter.
- Differential Gain

The low pass filtering process will relax the sharp change of the output value. The default value is 50%, the relaxing effect will be more obviously if increasing this value. Users do not need to change it.

- Upper-limit and lower-limit value

Users can choose the analog output range via setting this value.
Default value: lower- limit output= 0
Upper -limit= 4095

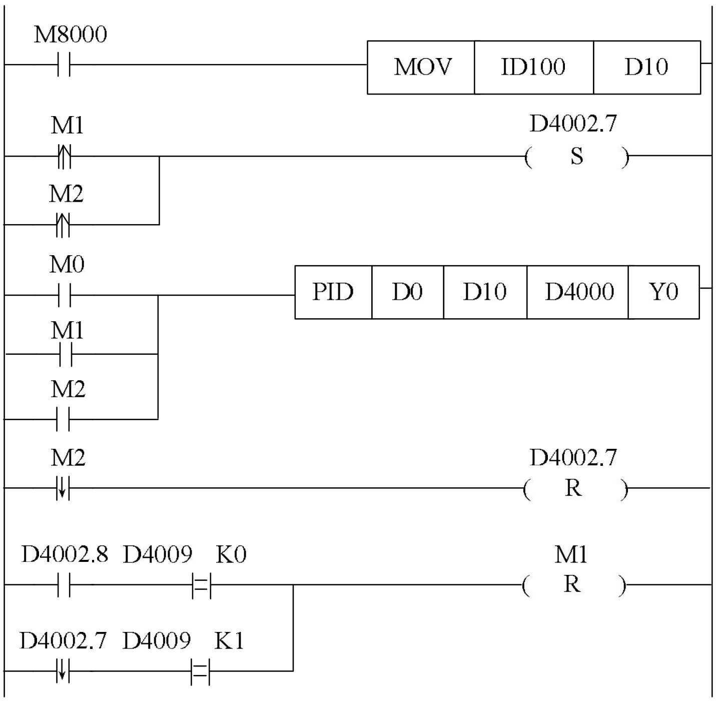
8-6. Application Outlines

- Under the circumstances of continuous output, the system whose effect ability will die down with the change of the feedback value can do self-study, such as temperature or pressure. It is not suitable for flux or liquid level.
- Under the condition of overshoot permission, the system will get the optimal PID parameters from self-study.
- Under the condition of overshoot not allowed, the PID parameters got from self-study is up to the target value, it means that different target value will produce different PID parameters which are not the optimal parameters of the system and for reference only.
- If the self-study is not available, users can set the PID parameters according to practical experience. Users need to modify the parameters when debugging. Below are some experience values of the control system for your reference:

> - Temperature system:
>
> P (%) 2000 ~ 6000, I (minutes) 3 ~ 10, D (minutes) 0.5 ~ 3
> - Flux system: P (%) 4000 ~ 10000, I (minutes) 0.1 ~ 1
> - Pressure system: P (%) 3000 ~ 7000, I (minutes) 0.4 ~ 3
> - Liquid level system: P (%) 2000 ~ 8000, I (minutes) 1 ~ 5

8-7. Program Example

PID Control Program is shown below:



// Move ID100 content into D10

// convert PID mode to be auto tune at the beginning of auto tune control starts or auto tune finish

// start PID, D0 is target value, D10 is detected value, from D4000 the zone is PID parameters area; output PID result via Y0

// PID control finish, close auto tune PID mode

// if auto tune is successful, and overshoot is permitted, close auto tune control bit, auto tune finish;
If auto tune turns to be manual mode, and auto tune is not permitted, close auto tune control bit

Soft components function comments:
D4000.7: auto tune bit
D4002.8: auto tune successful sign
M0: normal PID control
M1: auto tune control
M2: enter into PID control after auto tune

9 C Language Function Block

In this chapter, we focus on C language function block's specifications, edition, instruction calling, application points etc. we also attach the common Function list.

9-1. Summary

This is the new added function in XCPPro software. This function enable the customers to write function blocks with C language in XCPPo; and call the function blocks at any necessary place. This function supports most of C language functions, strength the program's security. As users can call the function at many places and call different functions, this function increase the programmer's efficiency greatly.

9-2. Instruction Format

1、Instruction Summary

Call the C language Func Block at the specified place

Call the C language Func Block [NAME_C]			
16 bits Instruction	NAME_C	32 bits Instruction	-
Execution Condition	Normally ON/OFF, Rising/Falling Edge activation	Suitable Models	XC1、XC2、XC3、XC5、XCM
Hardware Requirement	V3.0C and above	Software Requirement	V3.0C and above

2、Operands

Operands	Function	Type
S1	name of C Func Block, defined by the user	String
S2	Correspond with the start ID of word **W** in C language Function	16bits, BIN
S3	Correspond with the start ID of word **B** in C language Function	16bits, BIN

3、Suitable Soft Components

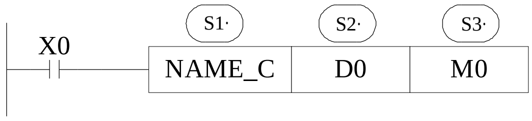
Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S2	●											

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
S3			●				

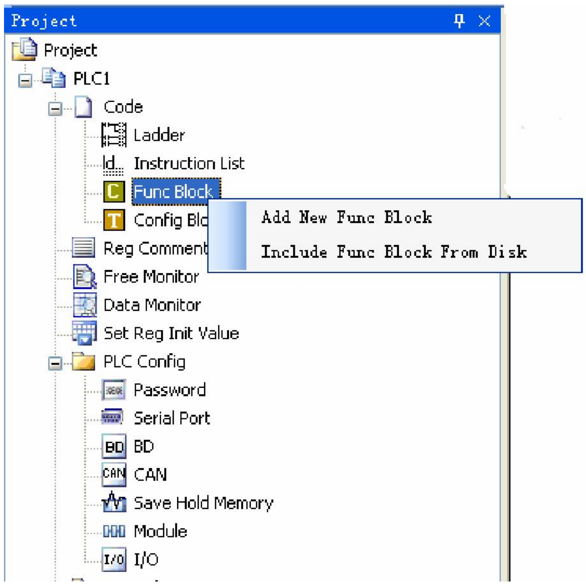
Functions and Actions



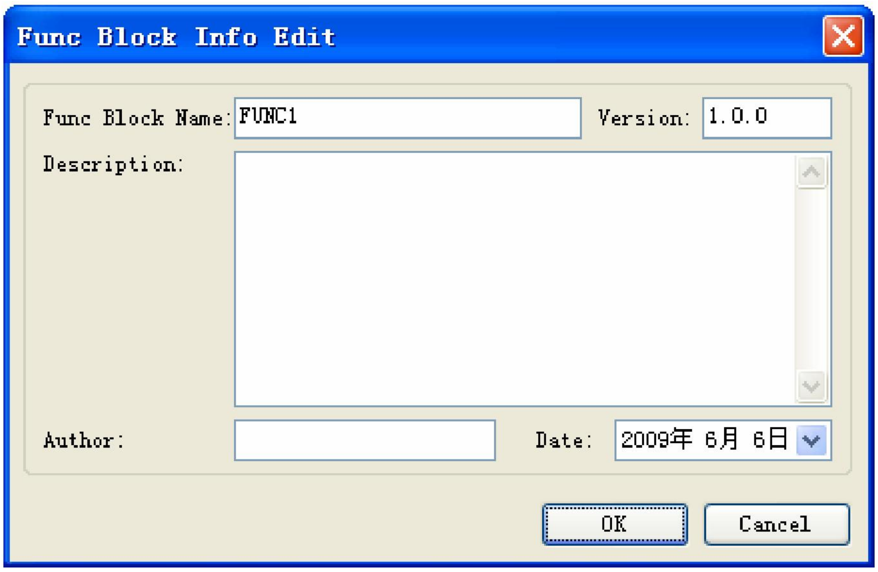
- The name is composed by numbers, letters and underlines, the first character can't be numbers, the name's length shouldn't longer than 8 ASC.
- The name can't be same with PLC's self instructions like LD,ADD,SUB,PLSR etc.
- The name can't be same with the func blocks exist in current PLC;

9-3. Operation Steps

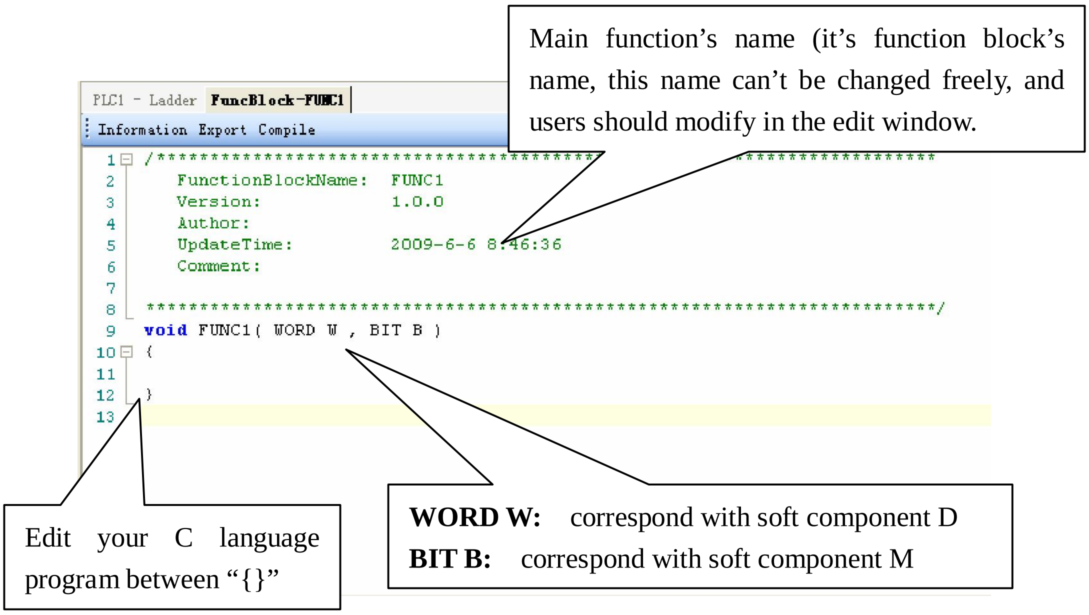
1、Open PLC edit tool, in the left "Project" toolbar, choose "Func Block", right click it and choose"Add New Func Block"



2、 See graph below, fill in the information of your function;



3、After new create the Func Block, you can see the edit interface as shown below:



- Parameters' transfer format: if call the **Func Block** in ladder, the transferred D and M is the start ID of W and B. Take the above graph as the example, start with D0 and M0, then W[0] is D0, W[10] is D10, B［0 is M0, B［10］ is M10. If in the ladder the used parameters are D100, M100, then W[0] is D100, B［0］ is M100. So, word and bit component's start address is defined in PLC program by the user.
- Parameter W: represent **Word** soft component, use in the form of data group. E.g. W[0]=1;W[1]=W[2]+W[3]; in the program, use according to standard C language

rules.

- Parameter B: represent **Bit** soft component, use in the form of data group. Support **SET** and **RESET**. E.g: B[0]=1;B[1]=0; And assignment, for example B[0]=B[1]。
- Double-word operation: add **D** in front of **W**, e.g. DW[10]=100000, it means assignment to the double-word W[10]W[11]
- Floating Operation: Support the definition of floating variable in the function, and execute floating operation;
- Function Library: In **Func Block**, users can use the Functions and Variables in function library directly. For the Functions and Variables in function library, see the list in Appendix.
- The other data type supported:

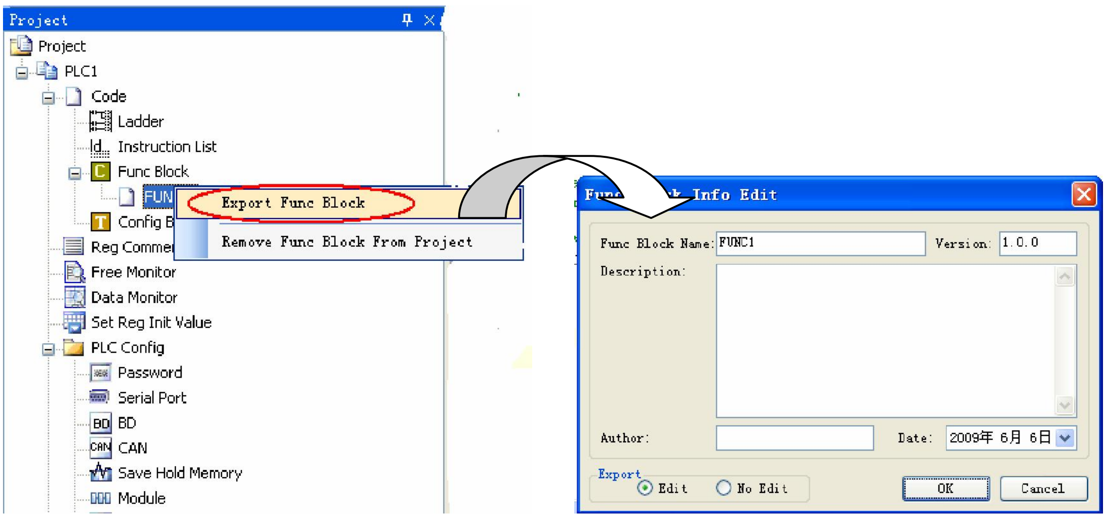
BOOL; //BOOL Quantity
INT8U; //8 bits unsigned integral
INT8S; //8 bits signed integral
INT16U //16 bits unsigned integral
INT16S //8 bits signed integral
INT32U //32 bits unsigned integral
INT32S //32 bits signed integral
FP32; //Single precision Floating
FP64; // Doubleprecision Floating

- Predefined Marco #define true 1
#define false 0
#define TRUE 1
#define FALSE 0

9-4. Import and Export the Functions

1、Export

(1) Function: export the function as the file, then other PLC program can import to use;



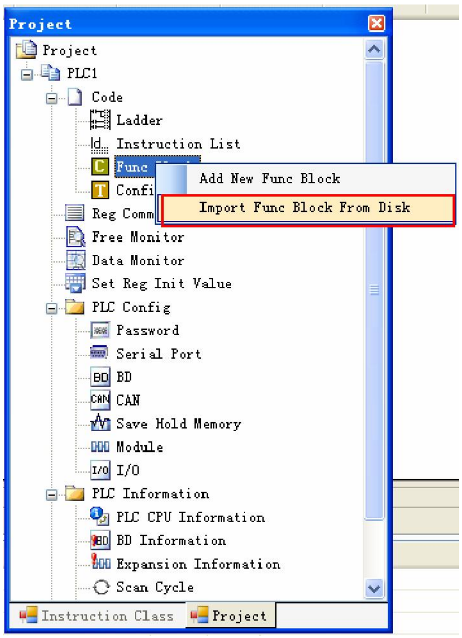
(2) Export Format

a) Editable; export the source codes out and save as a file. If import again, the file is editable;

b) Not editable: don’t export the source code, if import the file, it’s not editable;

2、Import

Function; Import the exist **Func Block** file, to use in the PLC program;



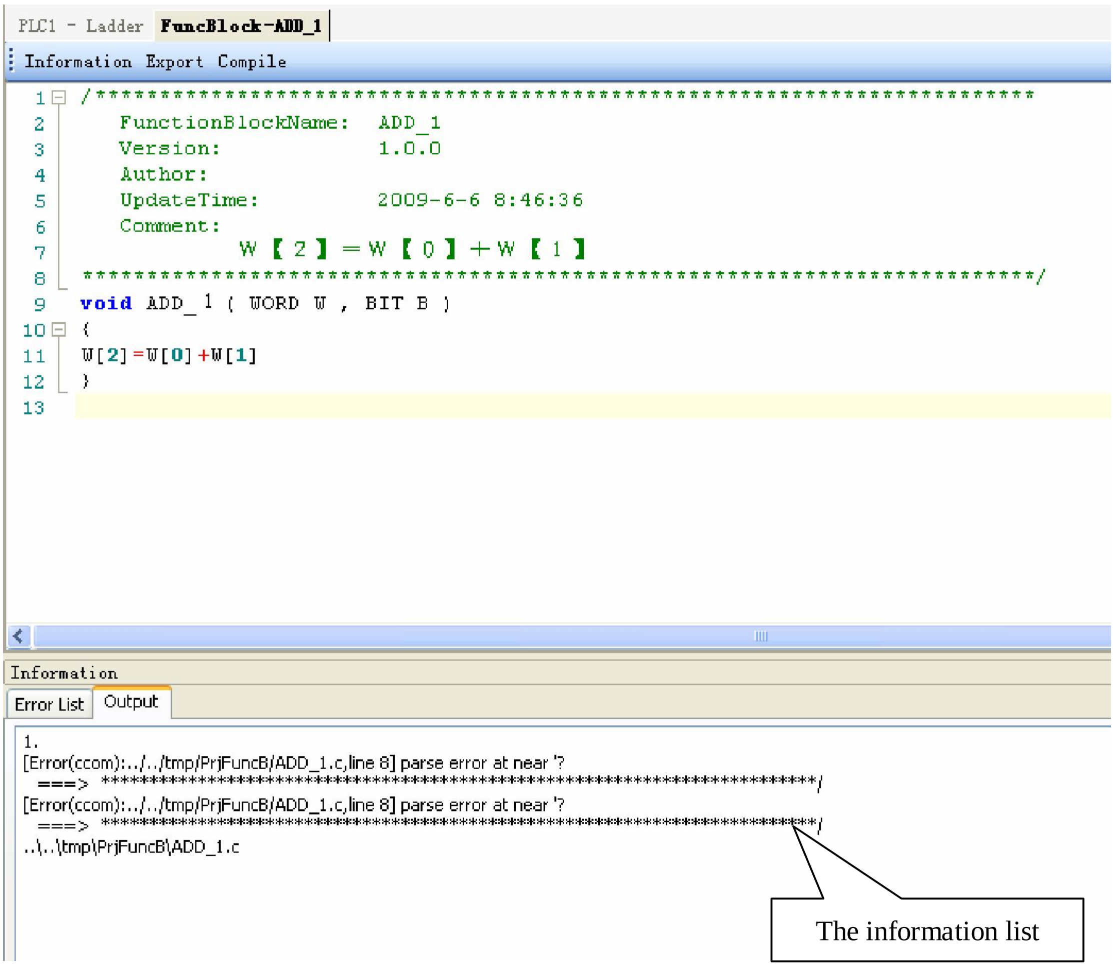
Choose the **Func Block**, right click “Import Func Block From Disk”, choose the correct file, then click OK.

9-5. Edit eh Func Blocks

Example: Add D0 and D1 in PLC’s registers, then assign the value to D2;

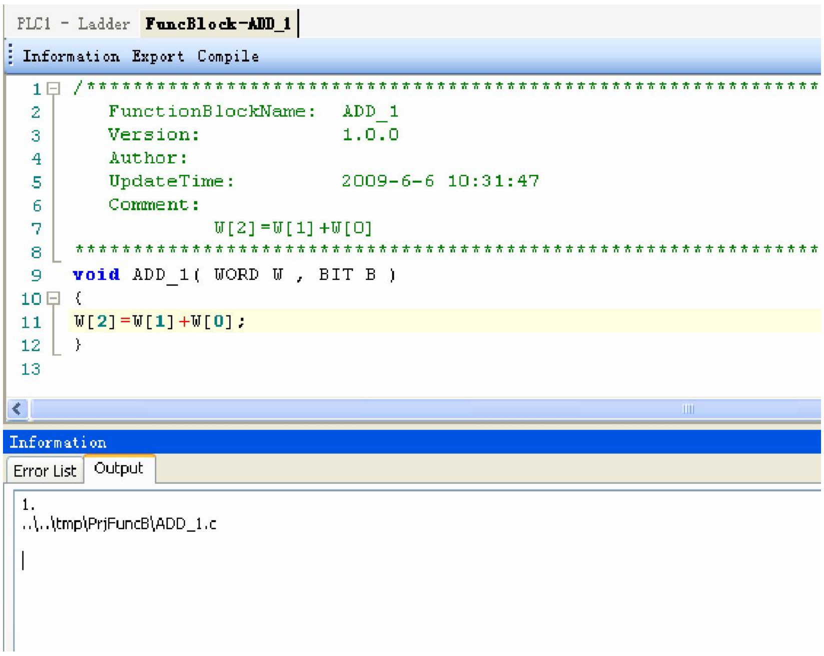
(1) In “Project” toolbar, new create a **Func Block**, here we name the **Func Block** as **ADD_2**, then edit C language program;

(2) Click **compile** after edition



According to the information shown in the output blank, we can search and modify the grammar error in C language program. Here we can see that in the program there is no “**;**” sign behind W[2]=W[0]+W[1];

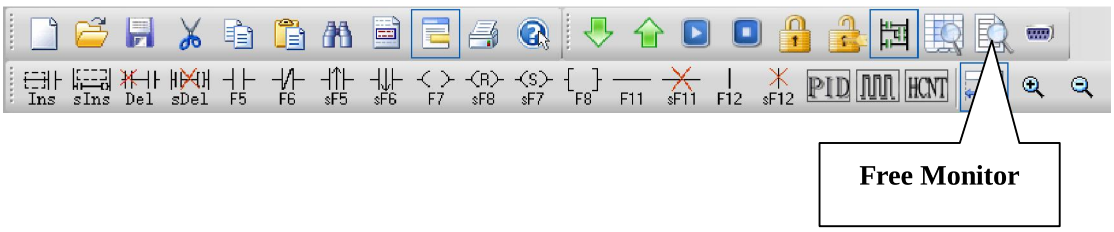
Compile the program again after modify the program. In the information list, we can corfirm that there is no grammar error in the program;



(3) Write PLC program, assign value 10 and 20 into registers D0, D1 separately, then call Func Block ADD_2, see graph below:

(4) Download program into PLC, run PLC and set M0.

(5) From Free Monitor in he toolbar, we can see that D2 changes to be 30, it means the assignment is successful;



9-6. Program Example

- Function: calculate CRC parity value via Func Block
- CRC calculation rules:

(1) Set 16 bits register (CRC register) = FFFF H

(2) XOR (Exclusive OR) 8 bits information with the low byte of the 16 bits CRC register.

(3) Right shift 1 bit of CRC register, fill 0 in the highest bit.

(4) Check the right shifted value, if it is 0, save the new value from step3 into CRC register; if it is not 0, XOR the CRC register value with A001 H and save the result into the CRC register.

(5) Repeat step3&4 until all the 8 bits have been calculated.

(6) Repeat step2~5, then calculate the next 8 bits information. Until all the information has been calculated, the result will be the CRC parity code in CRC register.

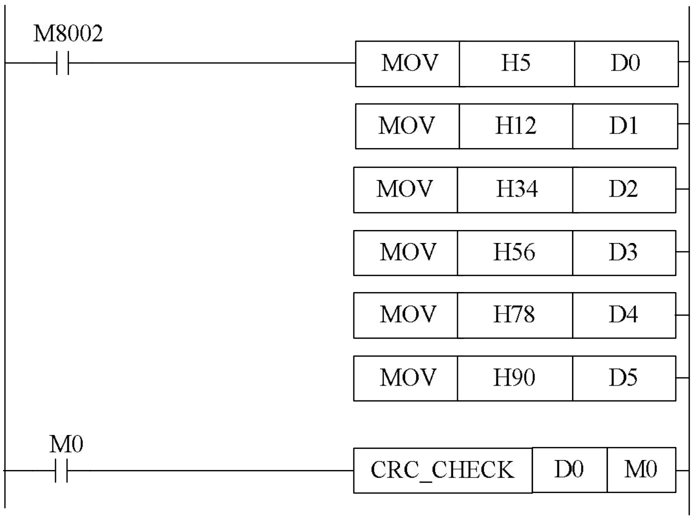
- Edit C language Func Block program, see graph below:

```
void CRC_CHECK( WORD W , BIT B )
{
        int i,j,m,n;
        unsigned int reg_crc=0xffff,k;

        for( i = 0 ; i < W[0] ; i++ )
                {
                reg_crc^=W[i+1];
                for(j=0;j<8;j++)
                {
                if(reg_crc&0x01)
                        reg_crc=(reg_crc>>1)^0xa001;
                else
                        reg_crc=reg_crc>>1;
                }
                }

                m=W[0]+1;
                n=W[0]+2;
                k=reg_crc&0xff00;
                W[m] = k>>8;
                W[n]=reg_crc&0xff;
              }
```

- Edit PLC ladder program,

D0: Parity data byte number;

D1~D5: Parity data's content, see graph below:



- Download to PLC, then RUN PLC, set M0, via Free Monitor, we can find that values in D6 and D7 are the highest and lowest bit of CRC parity value;

9-7. Application Points

- When upload the PLC program in which there are some Func Blocks, the Func Blocks can’t be uploaded, there will be an error say: There is an unknown instruction;
- In one Func Block file, you can write many subsidry functions, can call each other;
- Each Func Block files are independent, they can’t call its owned functions;
- Func Block files can call C language library functions in form of floating, arithmetic like sin, cos, tan etc.

9-8. Function Table

The default function library

Constant	Data	Description
_LOG2	(double)0.693147180559945309417232121458	Logarithm of 2
_LOG10	(double)2.302585092994045901093613792909	Logarithm of 10
_SQRT2	(double)1.414213562373095048801688724 21	Radical of 2
_PI	(double)3.14159265358979323846264338327 95	PI
_PIP2	(double)1.570796326794896619231321691639 75	PI/2
_PIP2x3	(double)4.71238898038468985769396507491925	PI*3/2

String Function	Description
void * memchr(const void *s, int c, size_t n);	Return the first **c** position among **n** words before **s** position
int memcmp(const void *s1, const void *s2, size_t n);	Compare the first **n** words of position **s1** and **s2**
void * memcpy(void *s1, const void *s2, size_t n);	Copy **n** words from position **s2** to s1and return **s1**
void * memset(void *s, int c, size_t n);	Replace the **n** words start from **s** position with word **c**, and return position **s**
char * strcat(char *s1, const char *s2);	Connect string **ct** behind string **s**
char * strchr(const char *s, int c);	Return the first word **c** position in string **s**
int strcmp(const char *s1, const char *s2);	Compare string s1 and s2
char * strcpy(char *s1, const char *s2);	Copy string s1 to string s2

Double-precision math function	Single-precision math function	Description
double acos(double x);	float acosf(float x);	Inverse cosine function.
double asin(double x);	float asinf(float x);	Inverse sine function
double atan(double x);	float atanf(float x);	Inverse tangent function
double atan2(double y, double x);	float atan2f(float y, float x);	Inverse tangent value of parameter (y/x)
double ceil(double x);	float ceilf(float x);	Return the smallest double integral which is greater or equal with parameter **x**
double cos(double x);	float cosf(float x);	Cosine function
double cosh(double x);	float coshf(float x);	Hyperbolic cosine function cosh(x)=(e^x+e^(-x))/2.
double exp(double x);	float expf(float x);	Exponent (e^x) of a nature data
double fabs(double x);	float fabsf(float x);	Absolute value of parameter x

double floor(double x);	float floorf(float x);	Return the largets dounble integral which is smaller or equals with **x**
double fmod(double x, double y);	float fmodf(float x, float y);	If **y** is not zero, return the reminder of floating **x/y**
double frexp(double val, int _far *exp);	float frexpf(float val, int _far *exp);	Break floating data **x** to be mantissa and exponent **x** = m*2^exp, return the mantissa of m, save the logarithm into **exp**.
double ldexp(double x, int exp);	float ldexpf(float x, int exp);	X multipy the (two to the power of n) is x*2^n.
double log(double x);	float logf(float x);	Nature logarithm logx
double log10(double x);	float log10f(float x);	logarithm (log10x)
double modf(double val, double *pd);	float modff(float val, float *pd);	Break floating data X to be integral part and decimal part, return the decimal part, save the integral part into parameter ip.
double pow(double x, double y);	float powf(float x, float y);	Power value of parameter **y** (x^y)
double sin(double x);	float sinf(float x);	sine function
double sinh(double x);	float sinhf(float x);	Hyperbolic sine function, sinh(x)=(e^x-e^(-x))/2.
double sqrt(double x);	float sqrtf(float x);	Square root of parameter X
double tan(double x);	float tanf(float x);	tangent function.
double tanh(double x);	float tanhf(float x);	Hyperbolic tangent function, tanh(x)=(e^x-e^(-x))/(e^2+e^(-x)).

10 SEQUENCE BLOCK

This chapter will introduce the sequence block instruction and the application.

Block instruction:

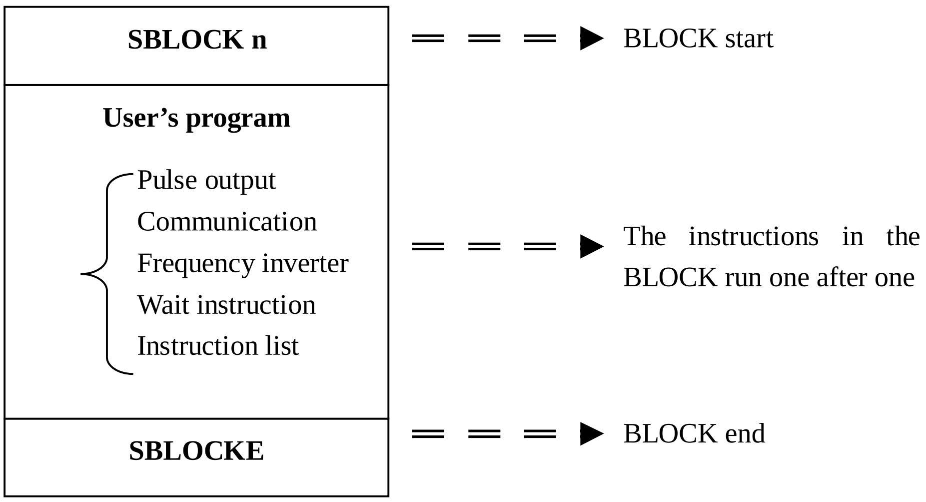
Instruction	**Function**	**Ladder chart**	**Chapter**
Block			
BSTOP	Stop the BLOCK	BSTOP S1 S2	10-6-1
BGOON	Continue running the BLOCK	BGOON S1 S2	10-6-1

10-1．Concept of the BLOCK

10-1-1．BLOCK summarization

Sequence block, which is also called block, is a program block can realize certain function. Block is a special flow, all the instructions run in order; this is the difference from other flows. BLOCK starts from SBLOCK and ends by SBLOCKE, you can write program between them. If there are many pulse output instructions (or other instructions), they will run one after one according to the condition. After one pulse outputting over then the next pulse will output.

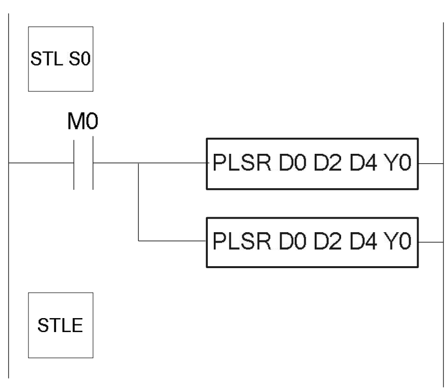
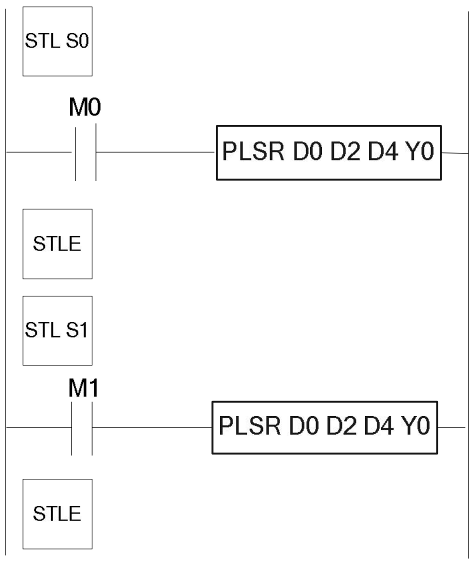
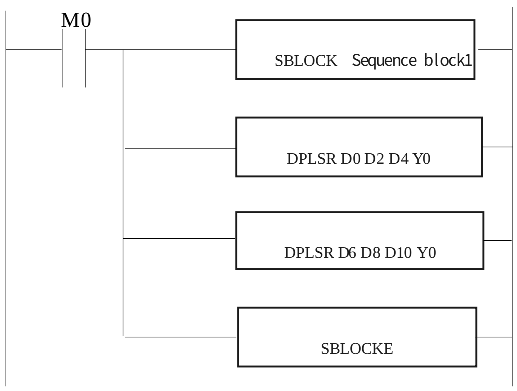
The construction of the block is as the following:



10-1-2. The reason to use BLOCK

To optimize the editing method of pulse and communication instruction in the process

In former program, XC series PLC can not support many pulse or communication instructions in one process, but BLOCK can support this and the instructions will run in sequence.

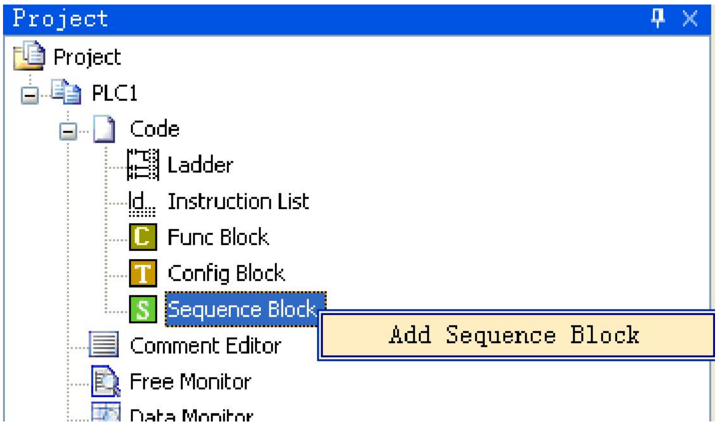
<table>
<tr><th></th><th>Unavailable (×)</th><th>Available (√)</th></tr>
<tr><td>Former</td><td></td><td></td></tr>
<tr><td>After using block</td><td></td><td></td></tr>
</table>

10-2. Call the BLOCK

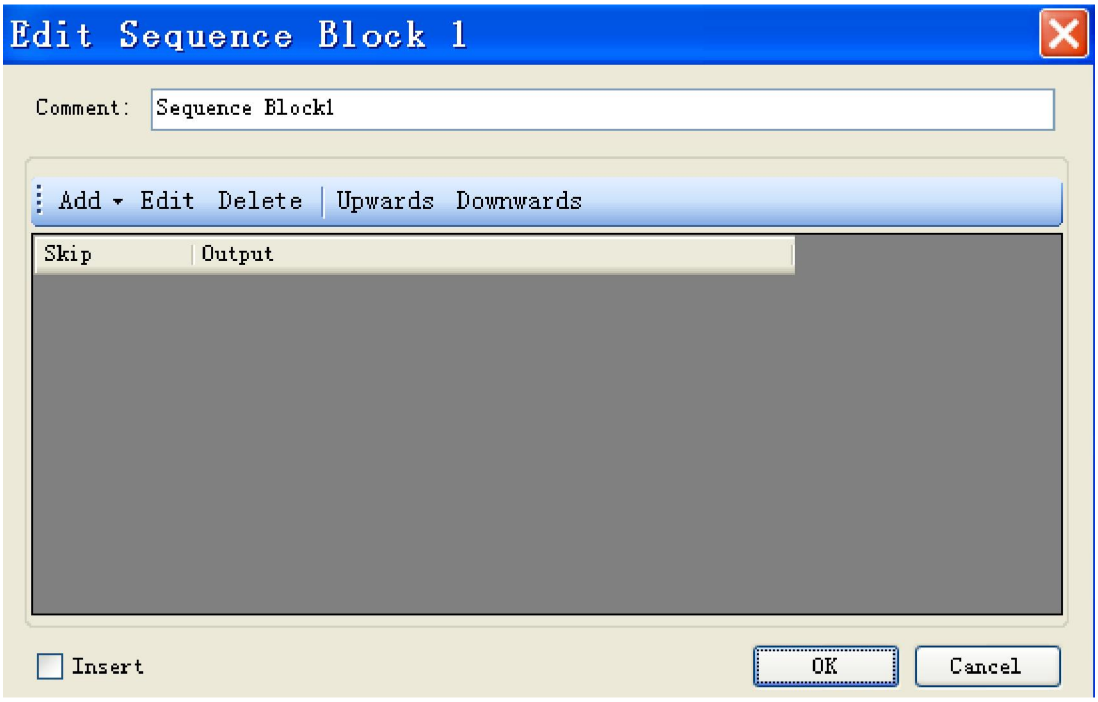
In one program file, it can call many BLOCK; the following is the method to add BLOCK in the program.

10-2-1. Add the BLOCK

Open XCPpro software, right click the sequence block in the project bar:

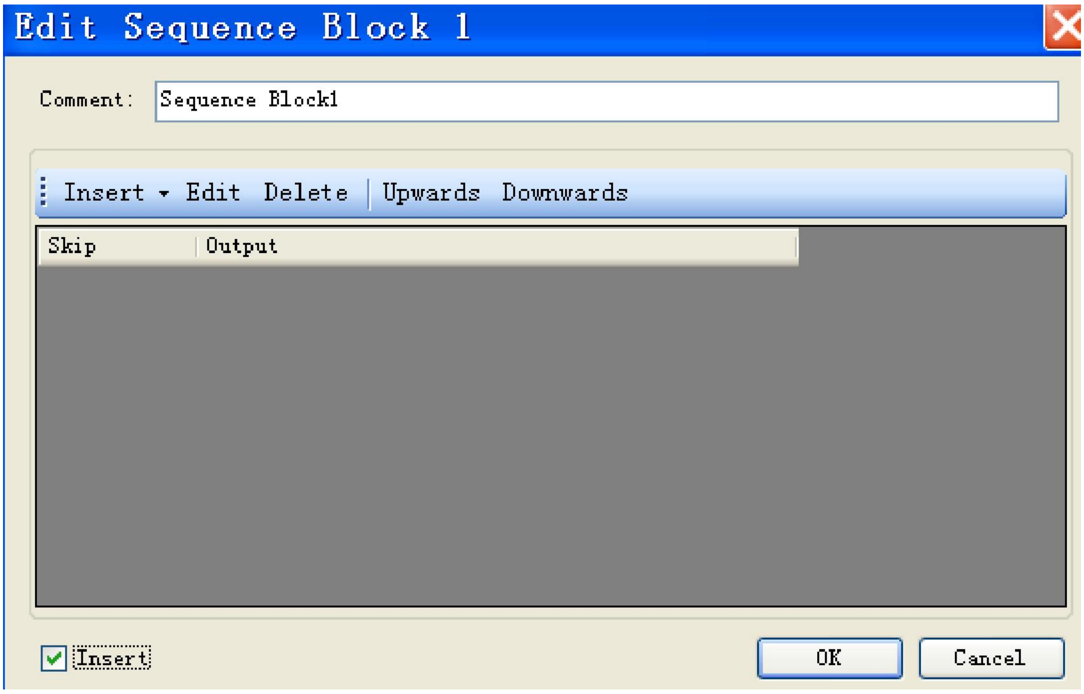


Click “add sequence block” will show below window:



You can edit the program in this window. Upwards and downwards are used to change the position of the instruction in the block.

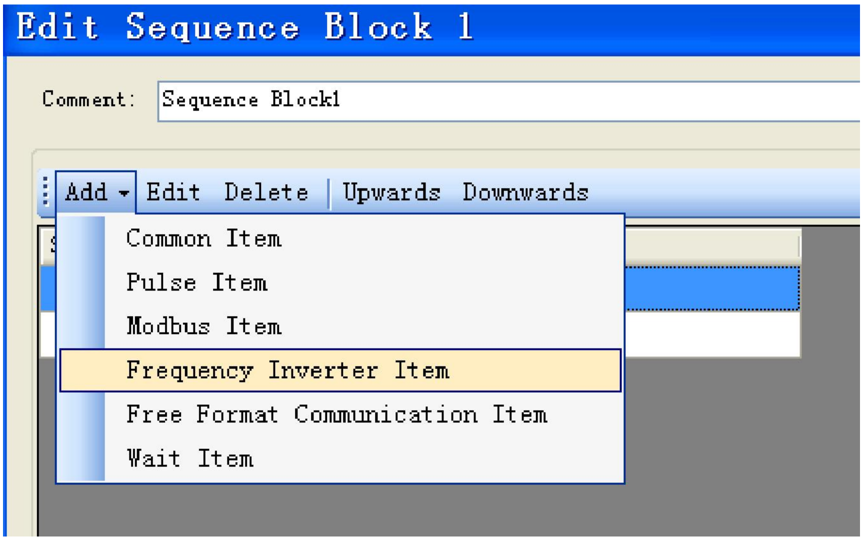
There is a “Insert” choice on the bottom left of the window, when selecting it, the add button will become insert:



The difference between insert and add:

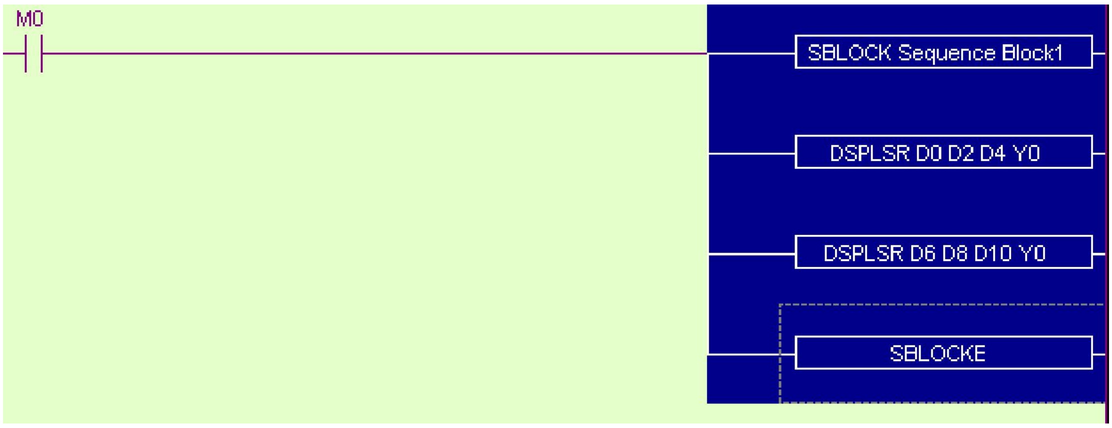
Add is to add instructions in the end of the block; insert can add instruction in any place in the block.

Click add button, you will see the instructions can be added in the block.

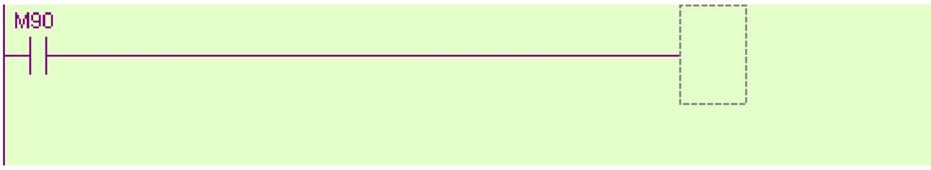


10-2-2. Move the BLOCK

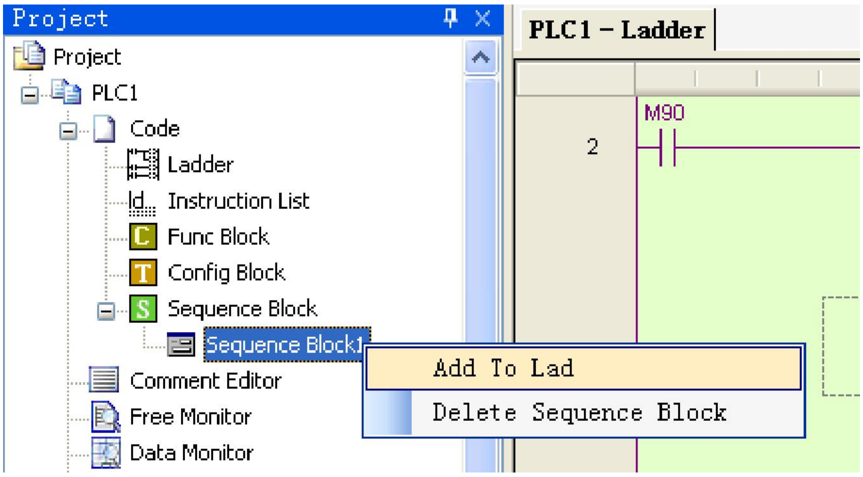
If you want to move the block to other position, you have to select the former block and delete it.



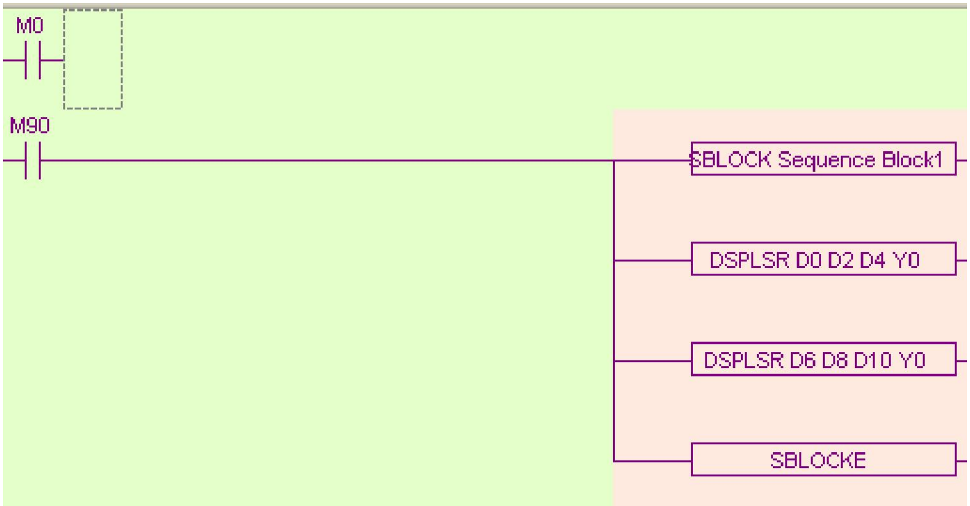
Then put the cursor in the place you want to move:



Right click the “add to lad” in the project bar:

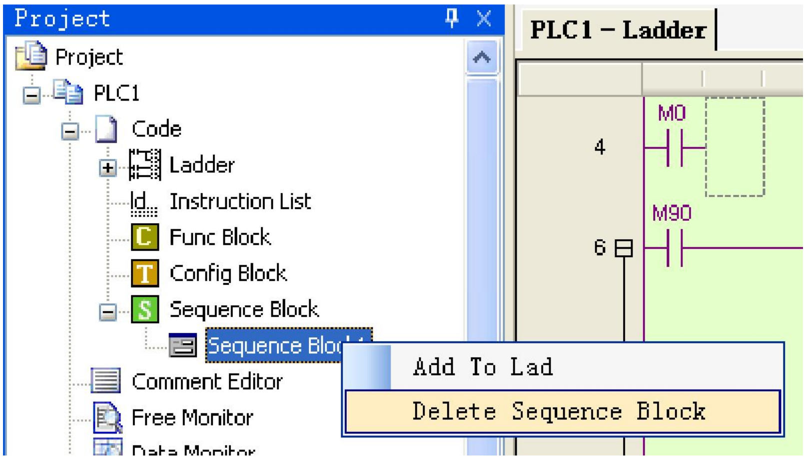


Now the block is moved to the new place:



10-2-3. Delete the BLOCK

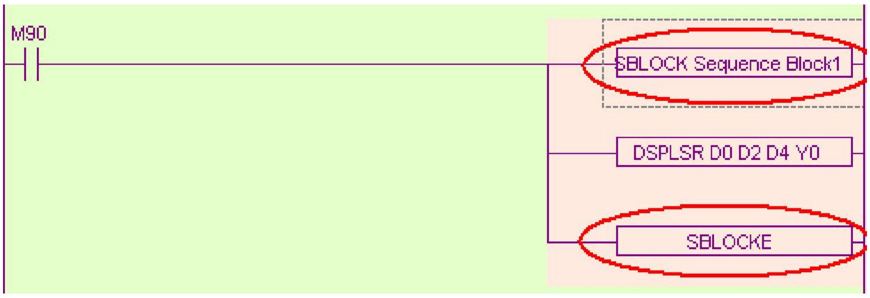
You can select the whole block and delete it. If you want to delete the block forever, please right click the block you want to delete in the project bar and select “delete sequence block”. After this operation, you can not call this block anymore.

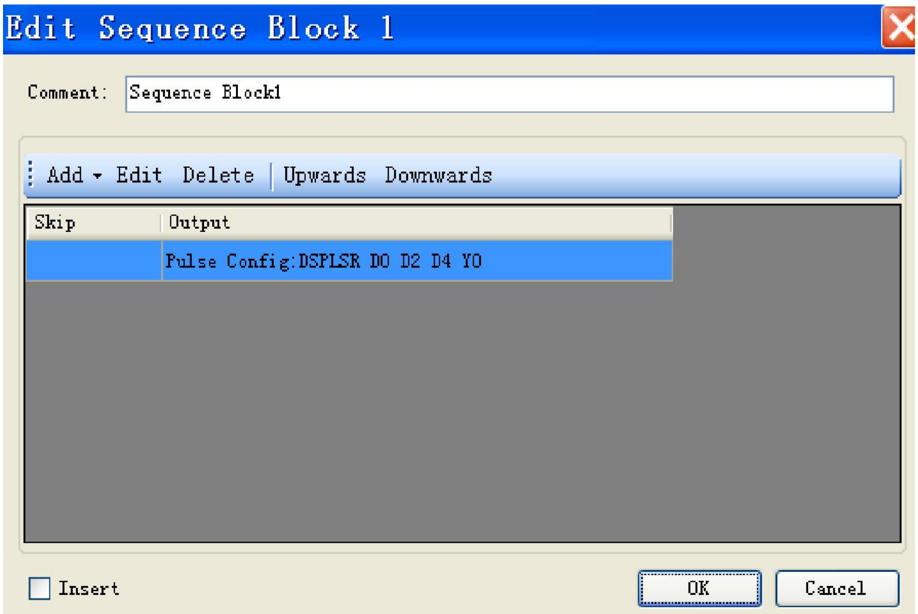


10-2-4. Modify the BLOCK

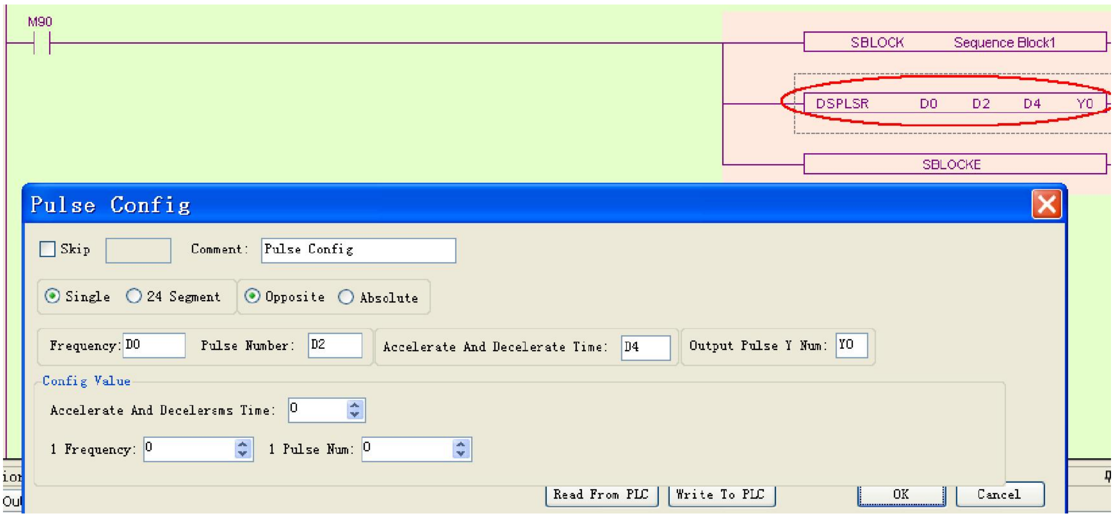
There are two methods to modify the block.

（A） double click the start or end instruction to modify all the instructions in the block.





(B) double click one instruction in the block to modify it:

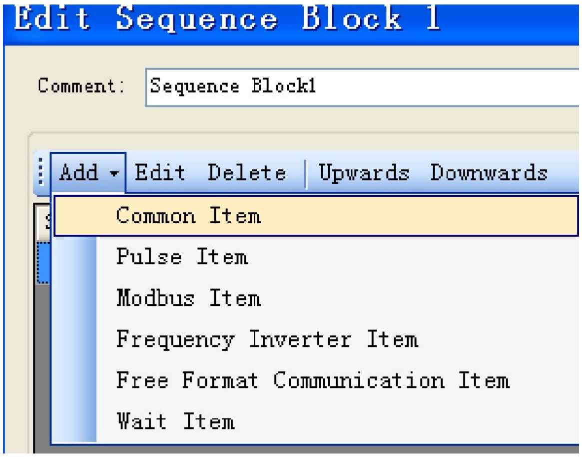


10-3. Edit the instruction inside the BLOCK

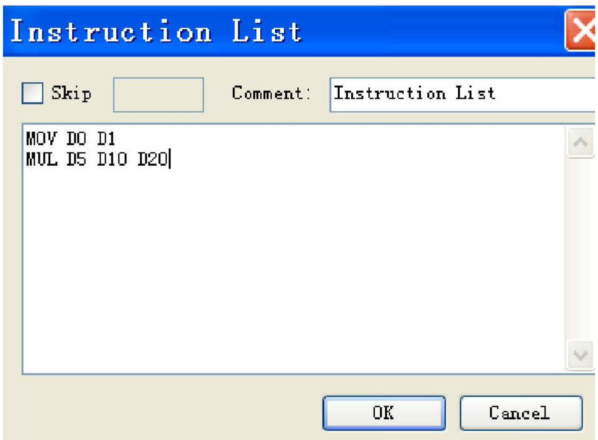
10-3-1. Common item

Use command to edit the program.

Open the block editing window, click add/common item:



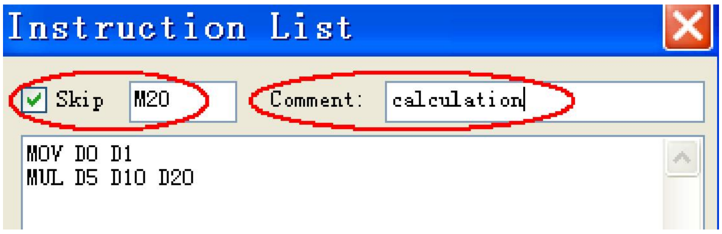
It will show the editing window:



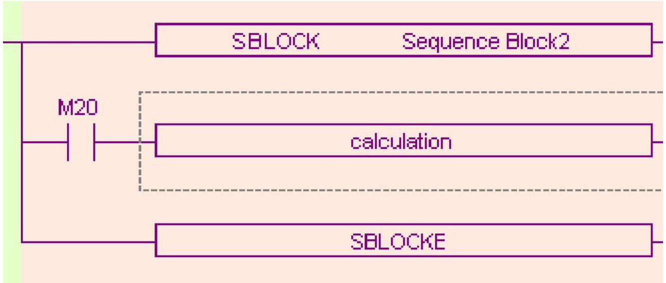
User can add instructions in this window.

SKIP condition: can control the stop and running of the instructions. When select skip and enter coil in it, if the coil is ON, the instructions will stop.

Comment: can modify the note for this instruction.

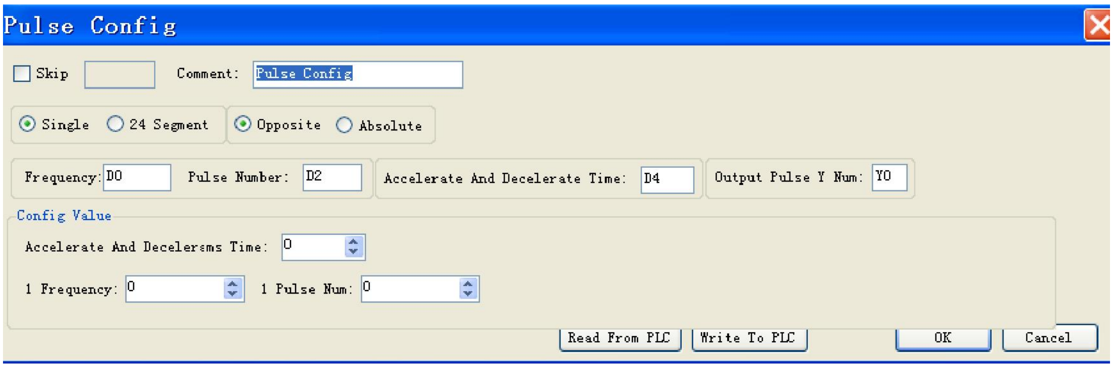


After setting, the block will be changed as the following:

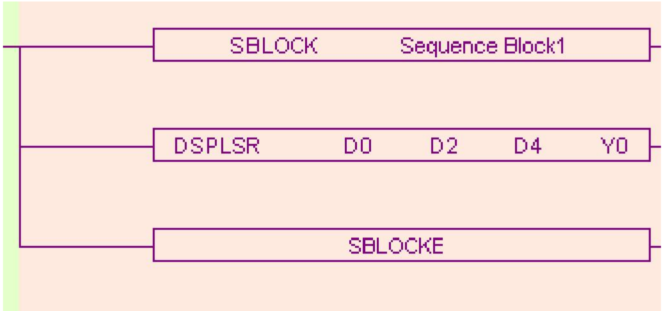


10-3-2. Pulse item

Open the pulse item window:



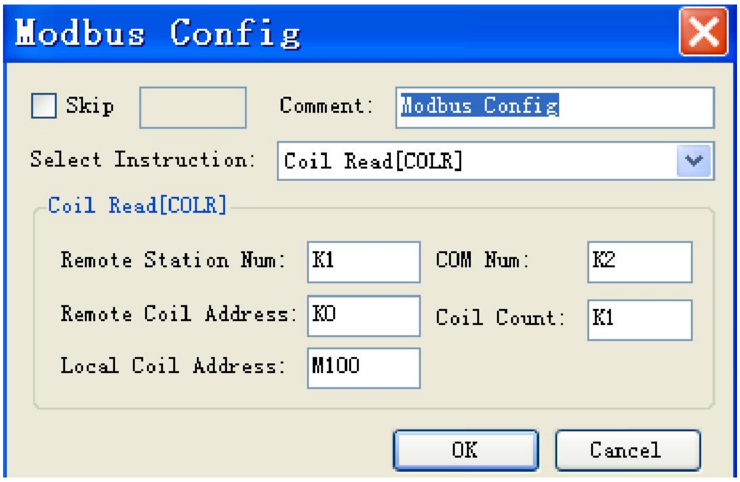
Set the pulse output frequency, numbers, output terminals, accelerate/decelerate time and so on. Then add the pulse instruction in the block:



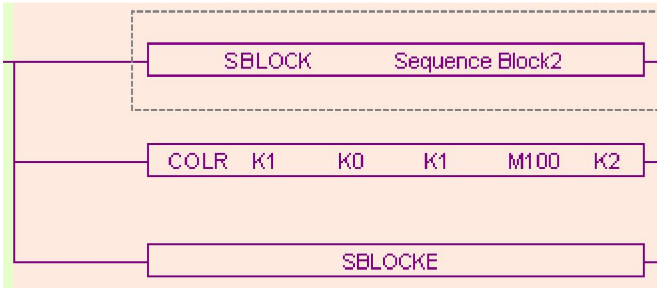
※1：the pulse output instructions are all 32bits.

10-3-3．Modbus item

Open the modbus item window:



Select the modbus instructions, set the address and com port, then software will build an instruction.



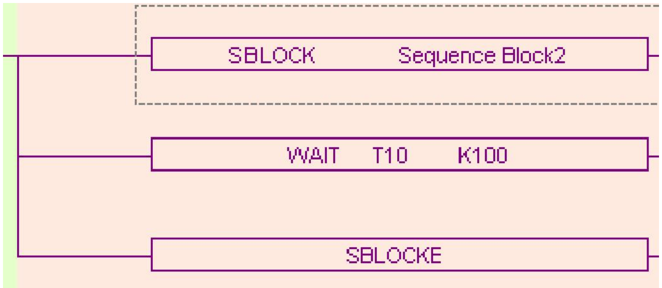
10-3-4．Wait item

There are two modes to wait.

(A) flag bit

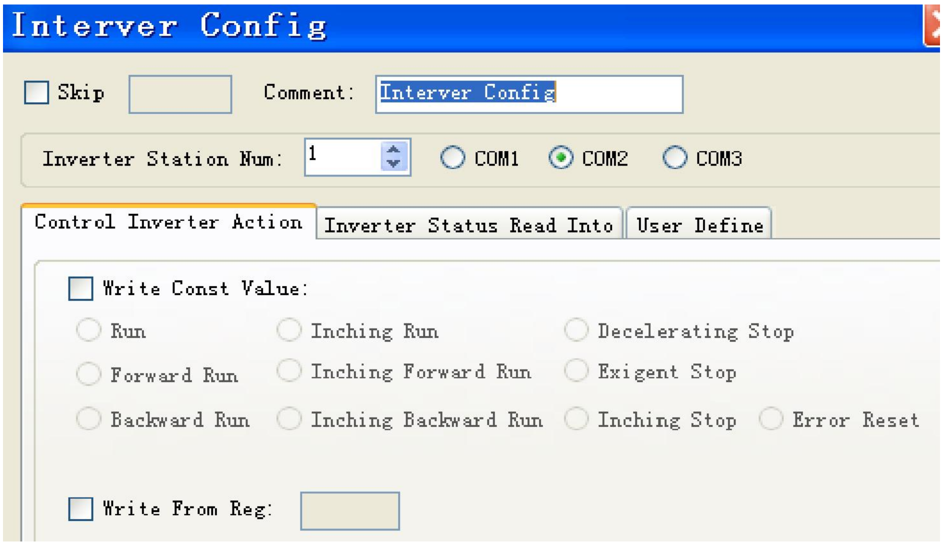
(B) timer wait

The ladder chart is as the following:



10-3-5. Frequency inverter item

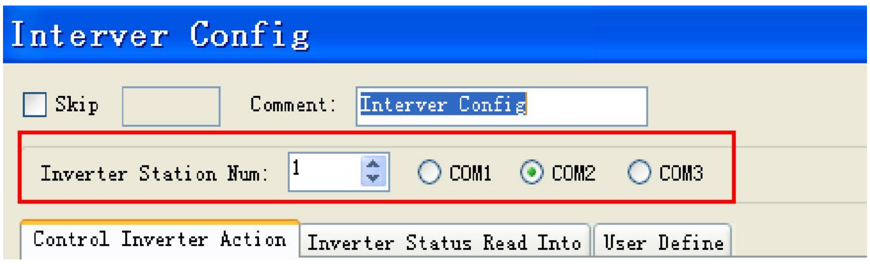
Users only have to set the parameters in below window, the PLC will communicate with the frequency inverter.



There are four areas in the window, the following will introduce one by one:

(A) Inverter station number and serial number

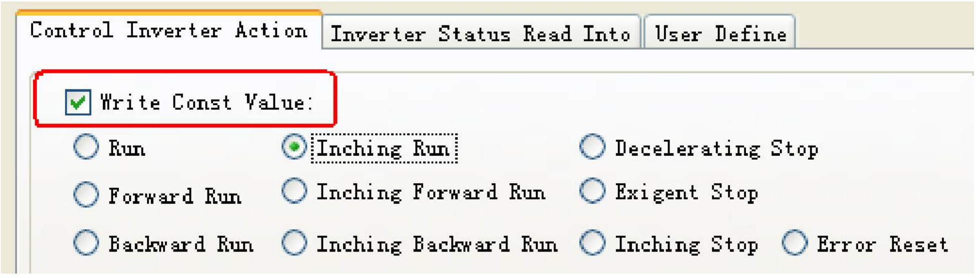
Set the station number of the frequency inverter and the PLC serial port:



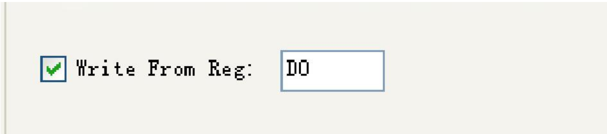
(B) Control inverter action

There are two modes to set parameters.

First one is write constant value:

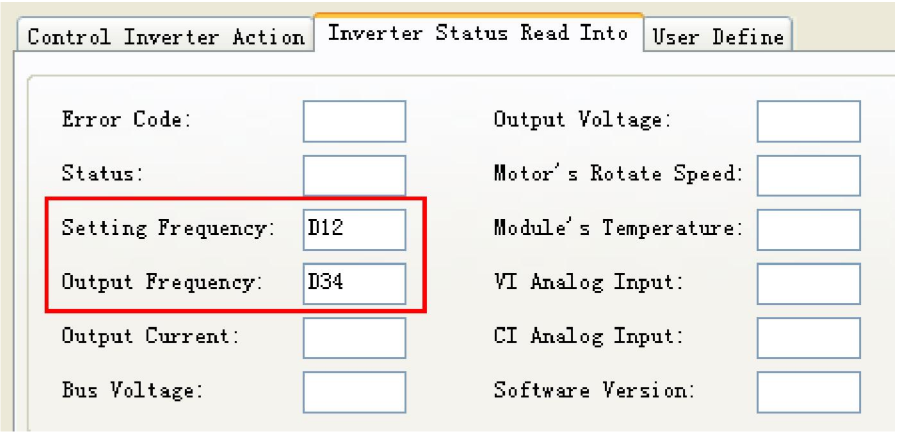


Second one is to set the parameters in register:



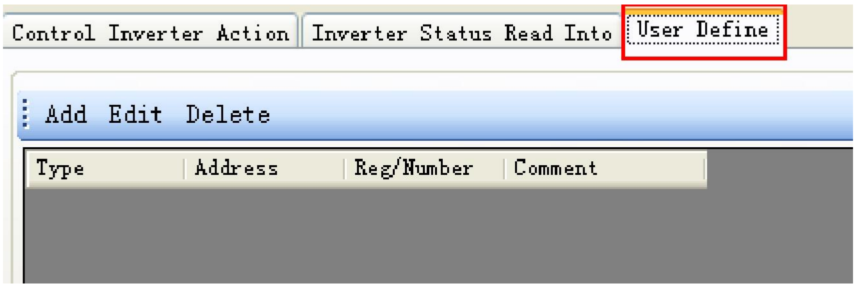
(C) Inverter status read into

To read the status from the frequency inverter to the PLC register.

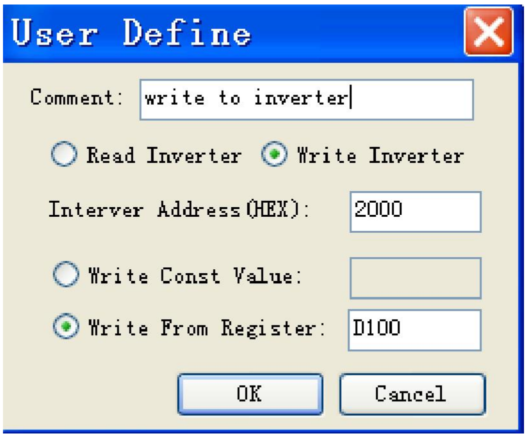


(D) User define

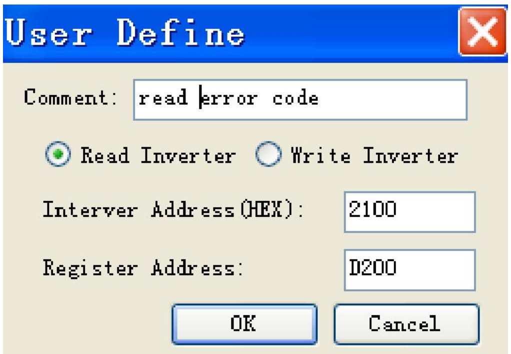
To write or read the frequency inverter address flexible.



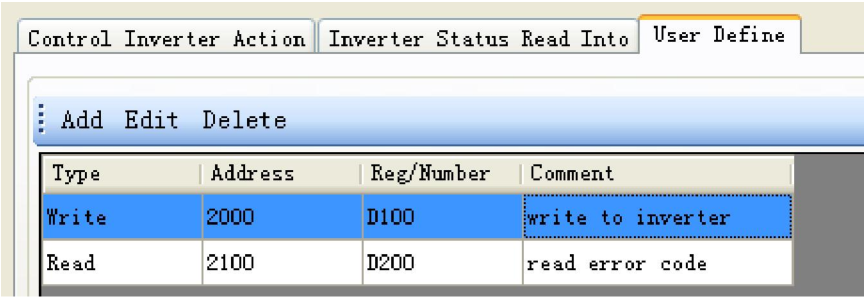
For example, add a writing inverter instruction:



Add a reading inverter instruction:



The result after adding:

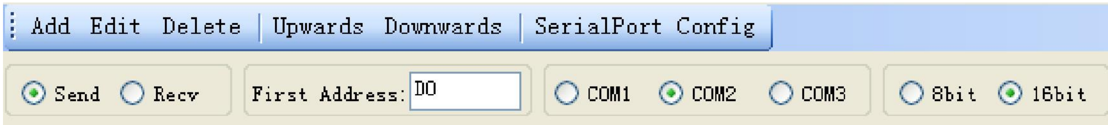


※1：Frequency inverter instructions will not expand in the block.

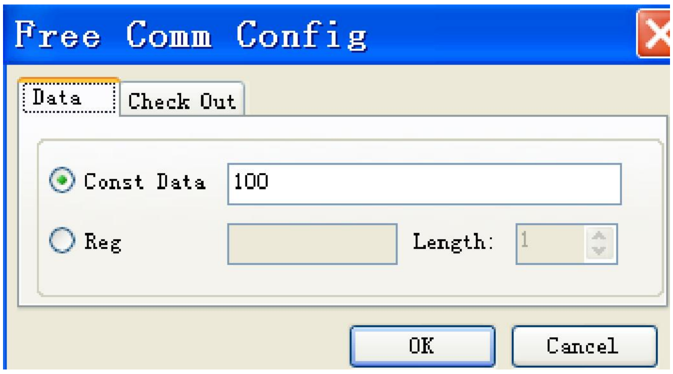
10-3-6. Free format communication item

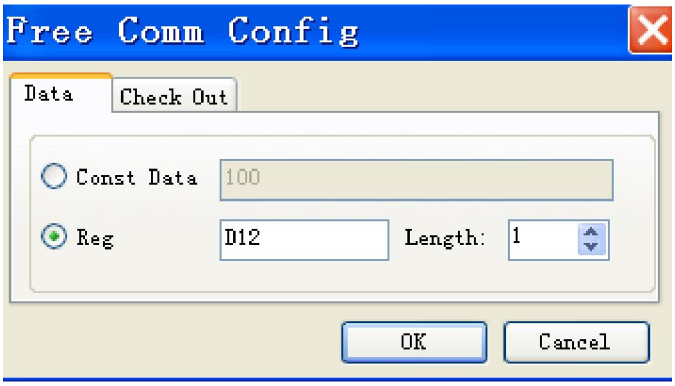
Add free format communication instructions in the block.

For example, select “send” instruction, first address set to D0, serial port is 2, 16 bits.

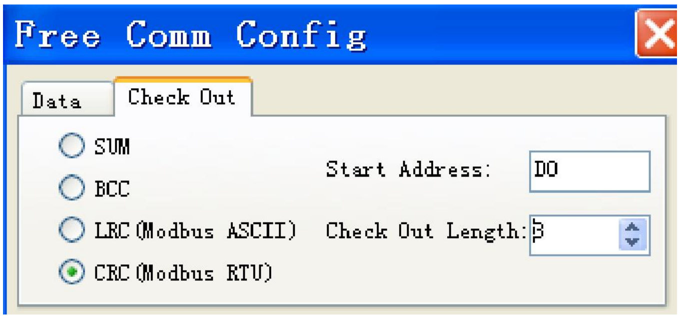


There are two methods to set the data. Const data is to set the value directly. Reg is to set the value via register.

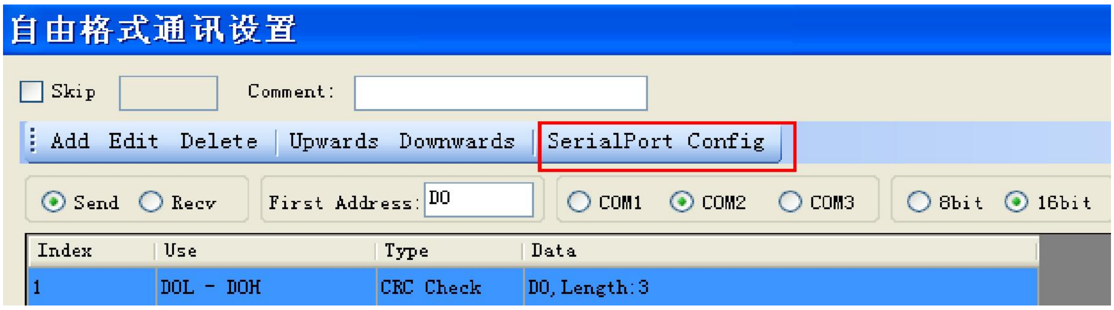




Change to check out tab, select the checking mode.



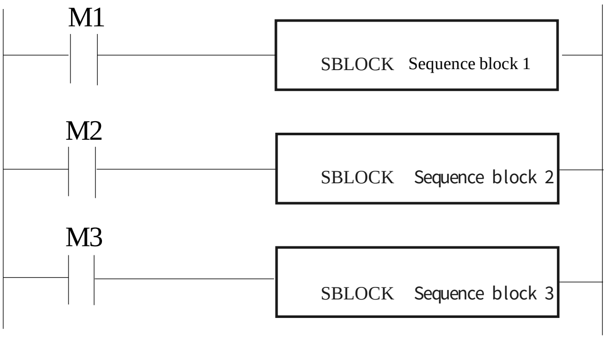
Besides, it needs to set the communication parameters. Click “serial port config”:

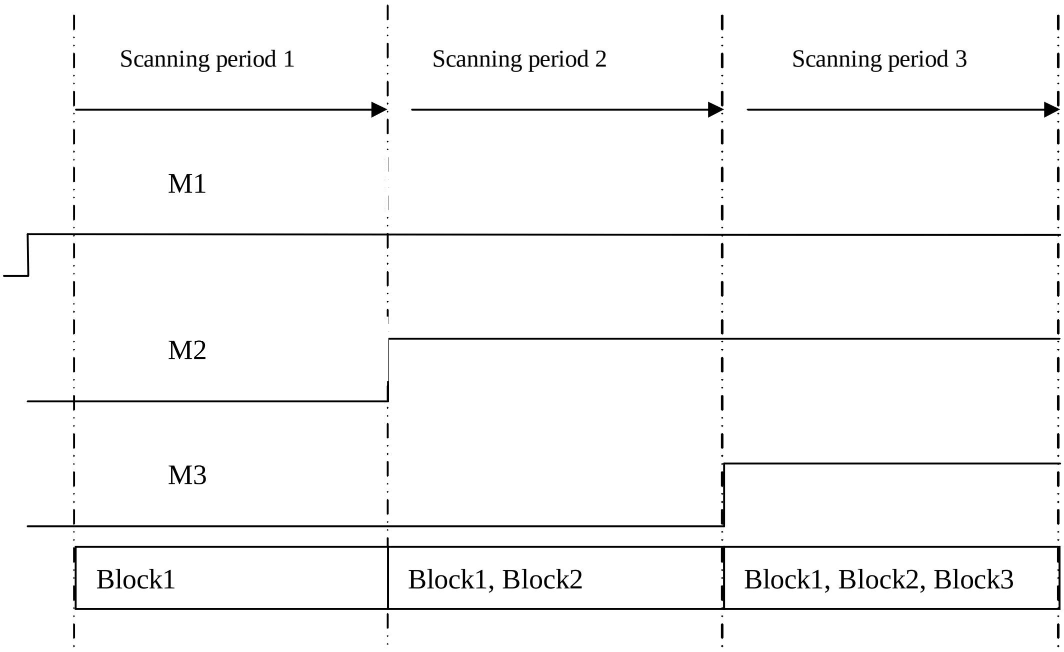


10-4. Running form of the BLOCK

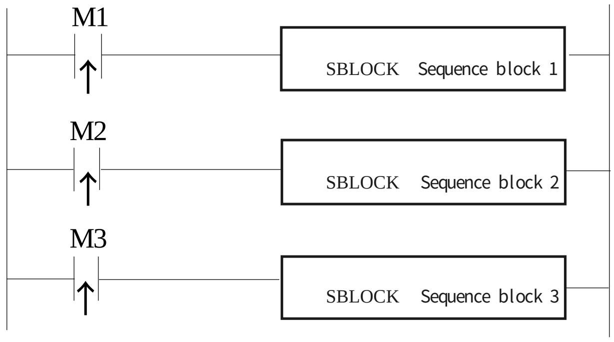
1、If there are many blocks, they run as the normal program. The block is running when the condition is ON.

(A) the condition is normal ON, normal OFF coil





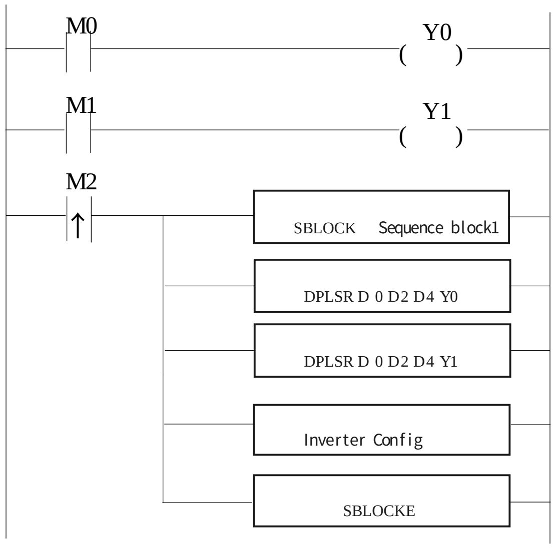
（B）the condition is rising or falling edge of pulse



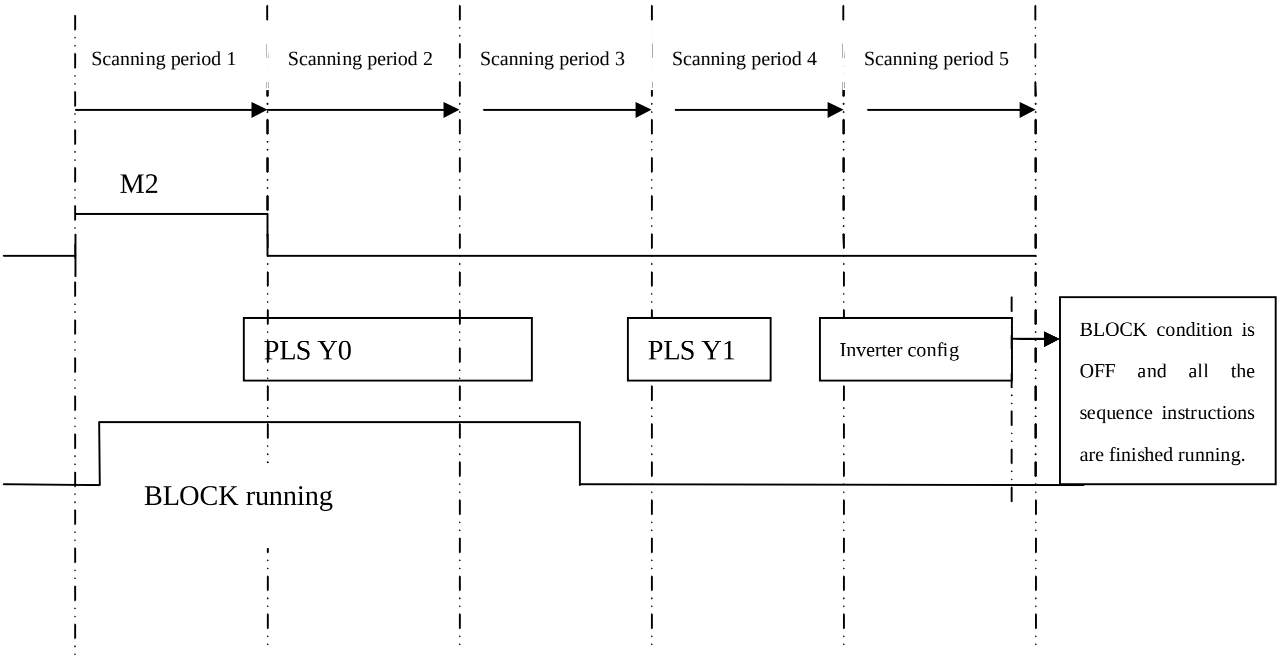
When M1, M2, M3 is from OFF to ON, all these blocks will run once.

2、The instructions in the block run in sequence according to the scanning time. They run one after another when the condition is ON.

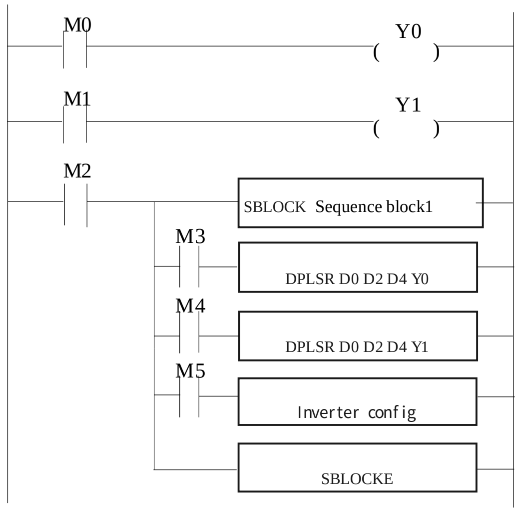
（A）Without SKIP condition



The instructions running sequence in block 1 is shown as below:



（B）With SKIP condition



Explanation:

A) When M2 is ON, block 1 is running.

B) All the instructions run in sequence in the block.

C) M3, M4, M5 are the sign of SKIP, when they are ON, this instruction will not run.

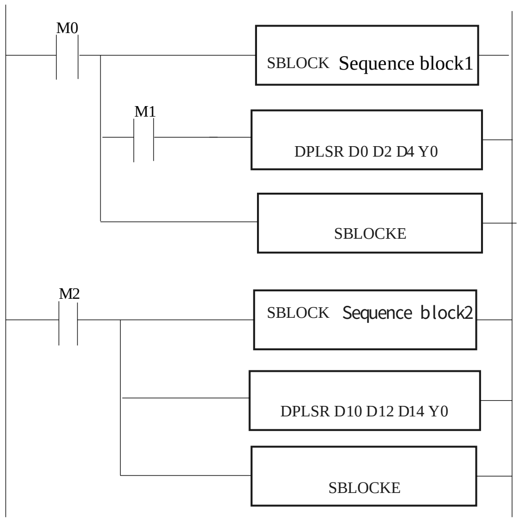
D) When M3 is OFF, if no other instructions use this Y0 pulse , DPLSR D0 D2 D4 Y0 will run; if not, the DPLSR D0 D2 D4 Y0 will run after it is released by other instructions.

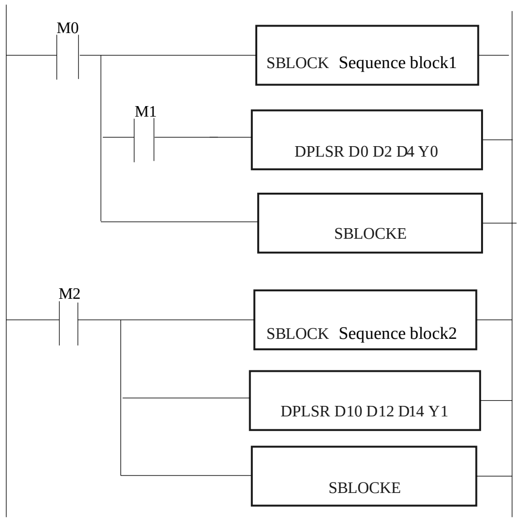
E) After “DPLSR D0 D2 D4 Y0” is over, check M4. If M4 is OFF, check “DPLSR D0 D2 D4 Y1”, if M4 is ON, check M5. If M5 is OFF, “inverter config” will run.

10-5. BLOCK instruction editing rules

In the BLOCK, the instruction editing should accord with some standards.

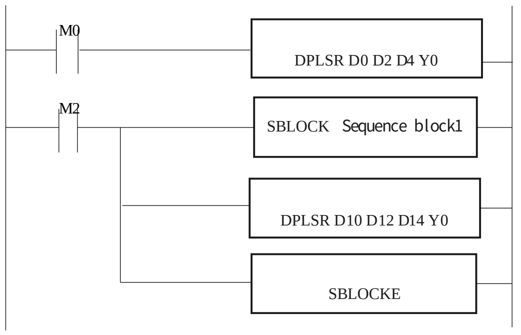
1、Do not use the same pulse output terminal in different BLOCK.

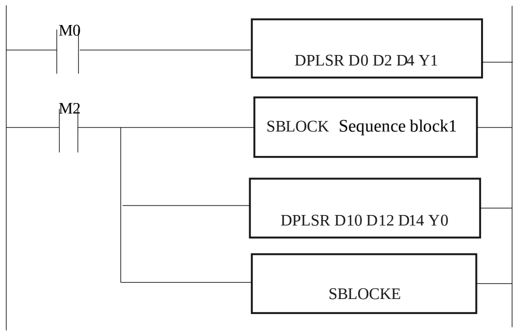
<table>
<tr><th>NO (×)</th><th>YES (√)</th></tr>
<tr><td>


</td><td>


</td></tr>
</table>

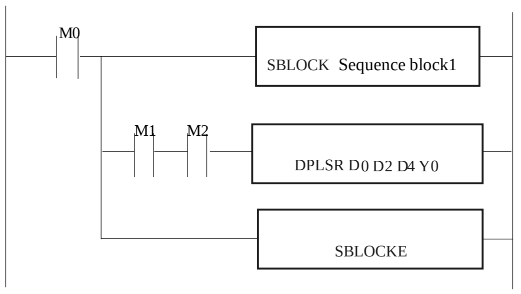
2、Do not use the same pulse output terminal in BLOCK and main program.

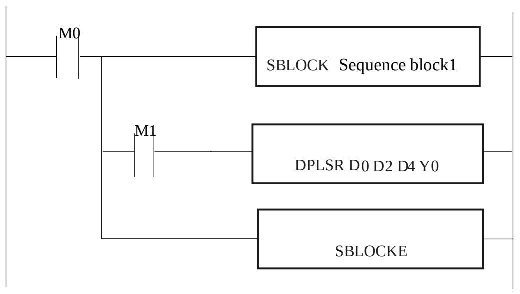
<table>
<tr><th>NO (×)</th><th>YES (√)</th></tr>
<tr><td>


</td><td>


</td></tr>
</table>

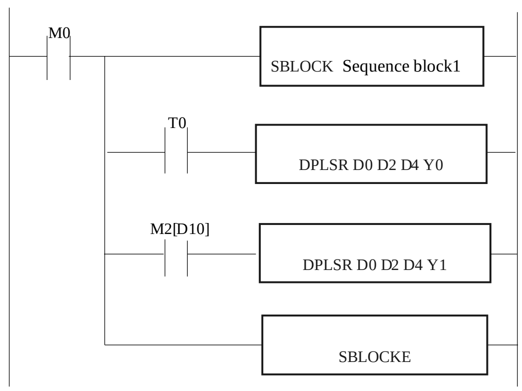
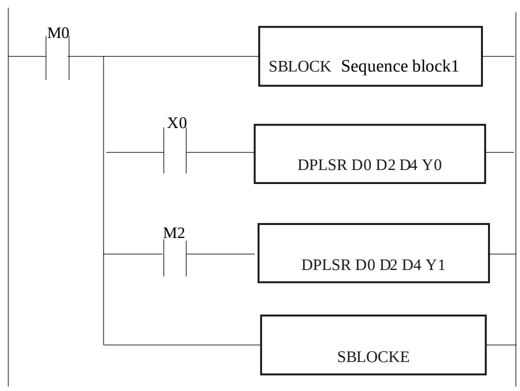
3、There only can be one SKIP condition for one BLOCK instruction.

<table>
<tr><th>NO (×)</th><th>YES (√)</th></tr>
<tr><td>


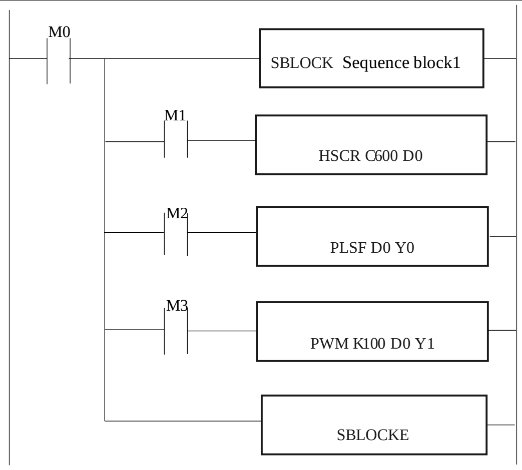
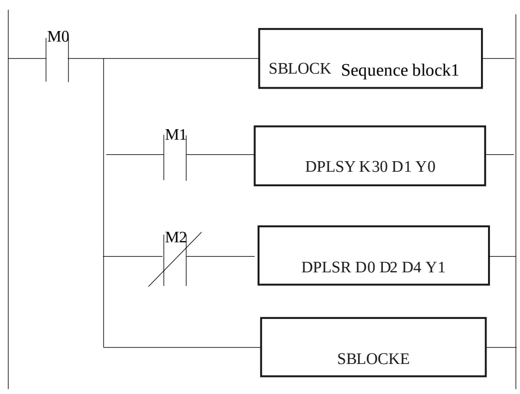
</td><td>


</td></tr>
</table>

4、The SKIP condition only can use M, X, can not use other coil or register.

NO （×）	**YES** （√）
	

5、The output instructions can not be HSC, PLSF, PWM, FRQM.

NO （×）	**YES** （√）
	

6、LabelKind type can not be used in the block

Sign P, I can not be used in block. Even they can be added in block, but they do not work in fact.

10-6. BLOCK related instructions

10-6-1. Instruction explanation

Ø stop running the BLOCK [BSTOP]

1、Summarization

Stop the instructions running in the block

[BSTOP]			
16 bits	BSTOP	32 bits	-
Condition	NO,NC coil and pulse edge	Suitable types	XC1、XC2、XC3、XC5、XCM
Hardware	V3.1i and above	Software	V3.1h and above

2、Operand

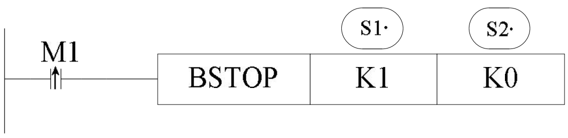
Operand	Function	Type
S1	The number of the BLOCK	16 bits, BIN
S2	The mode to stop the BLOCK	16 bits, BIN

3、Suitable component

Word component

Operand	Register									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●									●		
S2										K		

Function



l S2 is the mode to stop BLOCK, operand K1, K2

K0: stop the BLOCK slowly, if the pulse is outputting, the BLOCK will stop after the pulse outputting is finished.

K1: stop the BLOCK immediately; stop all the instructions running in the BLOCK.

Ø Continue running the BLOCK[BGOON]

1、Summarization

This instruction is opposite to BSTOP. To continue running the BLOCK.

[BGOON]			
16 bits	BGOON	32 bits	-
Condition	Pulse edge	Suitable types	XC1、XC2、XC3、XC5、XCM
Hardware	V3.1i and above	Software	V3.1h and above

2、Operand

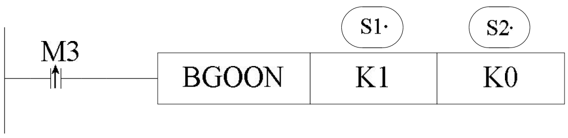
Operand	Function	Type
S1	The number of the BLOCK	16 bits, BIN
S2	The mode to continue running the BLOCK	16 bits, BIN

3、Suitable component

Word Component

Operand	Register									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●									●		
S2										K		

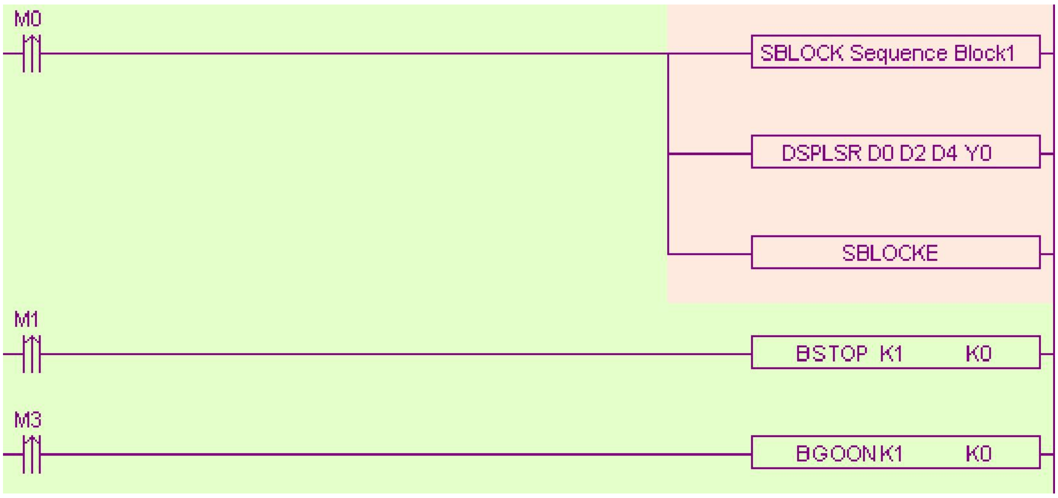
Function

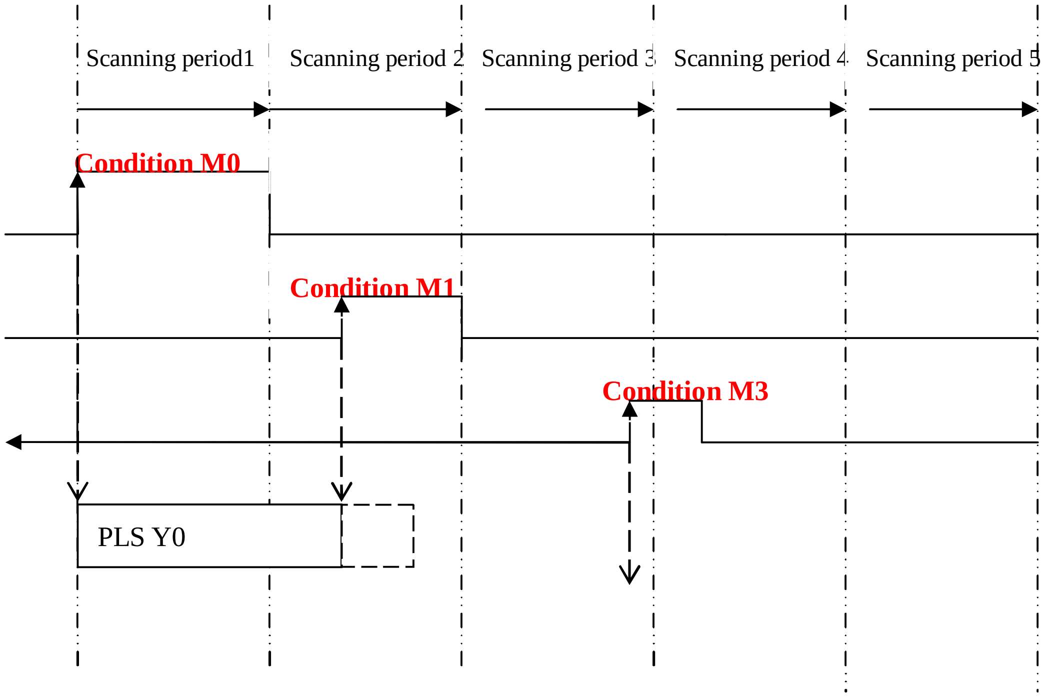


- S2 is the mode to continue running the BLOCK. Operand: K0, K1. K0: continue running the instructions in the BLOCK. For example, if pulse outputting stopped last time, BGOON will continue outputting the rest pulse. K1: continue running the BLOCK, but abandon the instructions have not finished last time. Such as the pulse output instruction, if the pulse has not finished last time, BGOON will not continue outputting this pulse but go to the next instruction in the BLOCK.

10-6-2．The timing sequence of the instructions

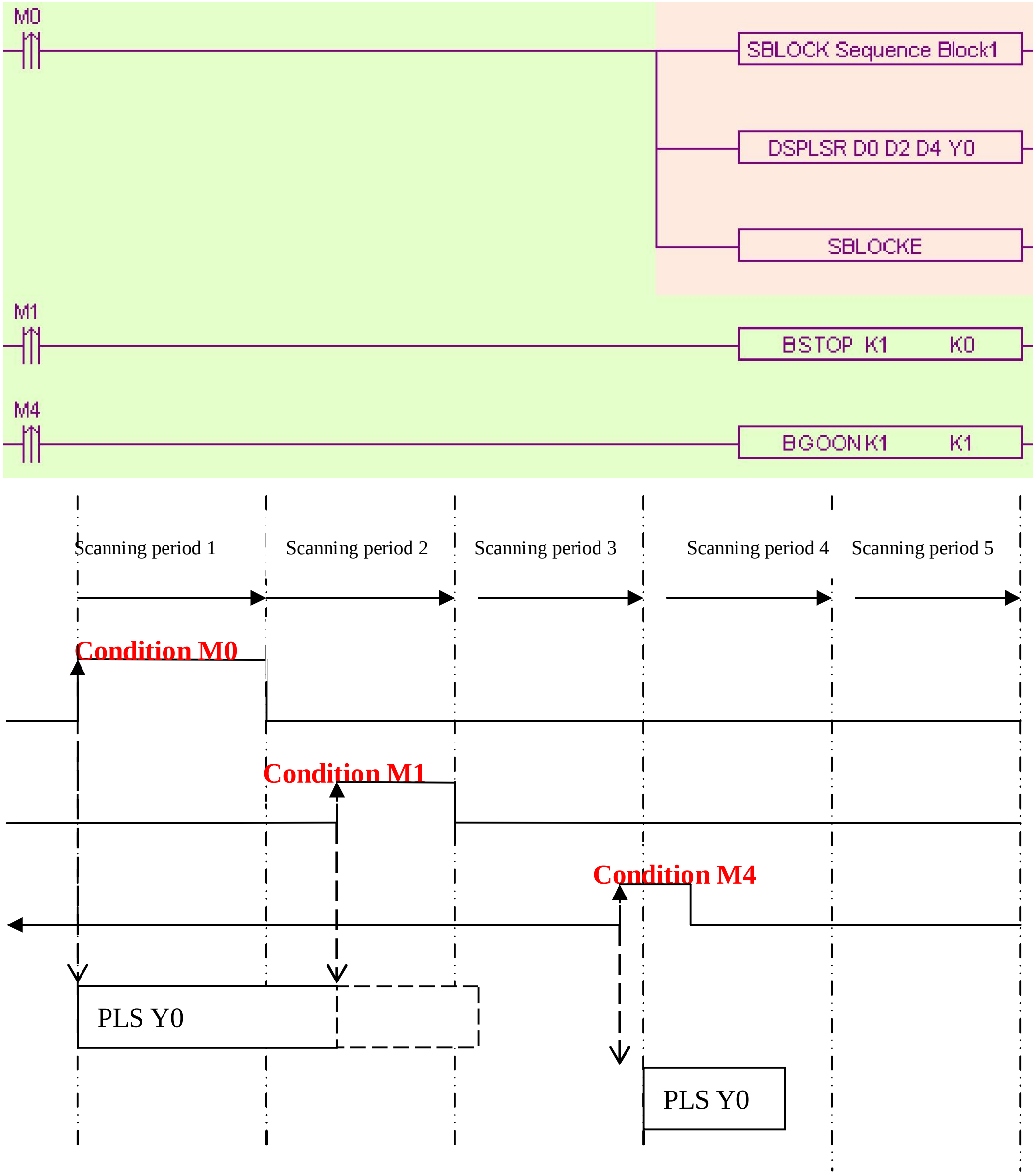
1、BSTOP（K1 K0）+BGOON（K1 K0）





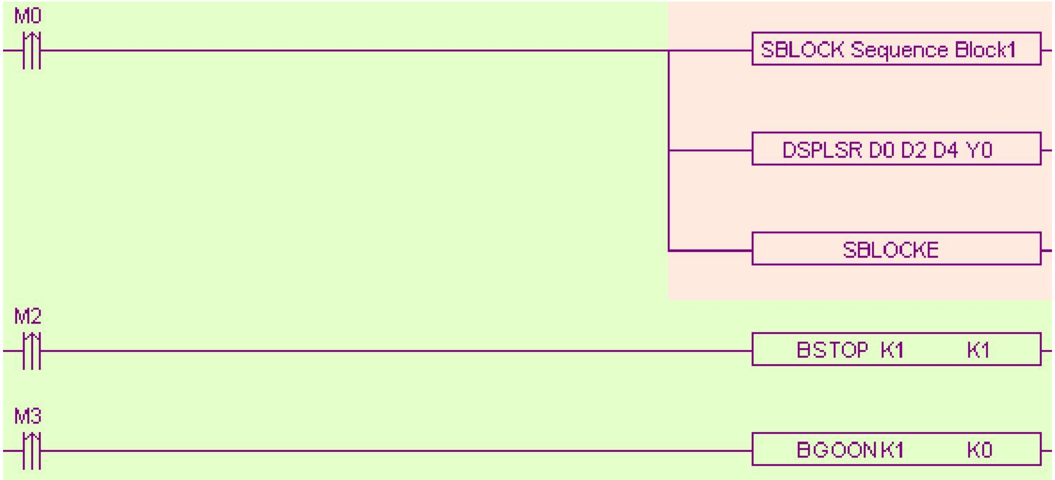
When M0 is from OFF→ON, run “DSPLSR D0 D2 D4 Y0” in the BLOCK to output the pulse; when M1 is from OFF→ON, the BLOCK stops running, pulse outputting stops at once; when M3 is from OFF→ON, abandon the rest pulse.

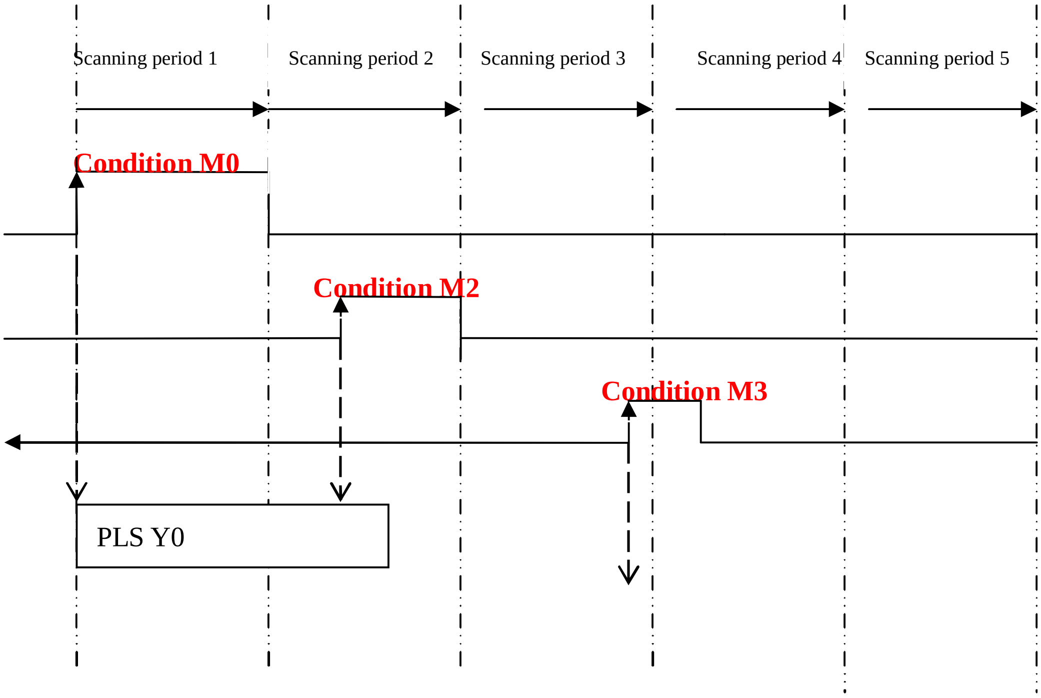
2、BSTOP（K1 K0）+BGOON（K1 K1）



When M0 is from OFF→ON, run “DSPLSR D0 D2 D4 Y0” in the BLOCK to output the pulse; when M1 is from OFF→ON, the BLOCK stops running, the pulse outputting stops at once; when M4 is from OFF→ON, output the rest pulses.

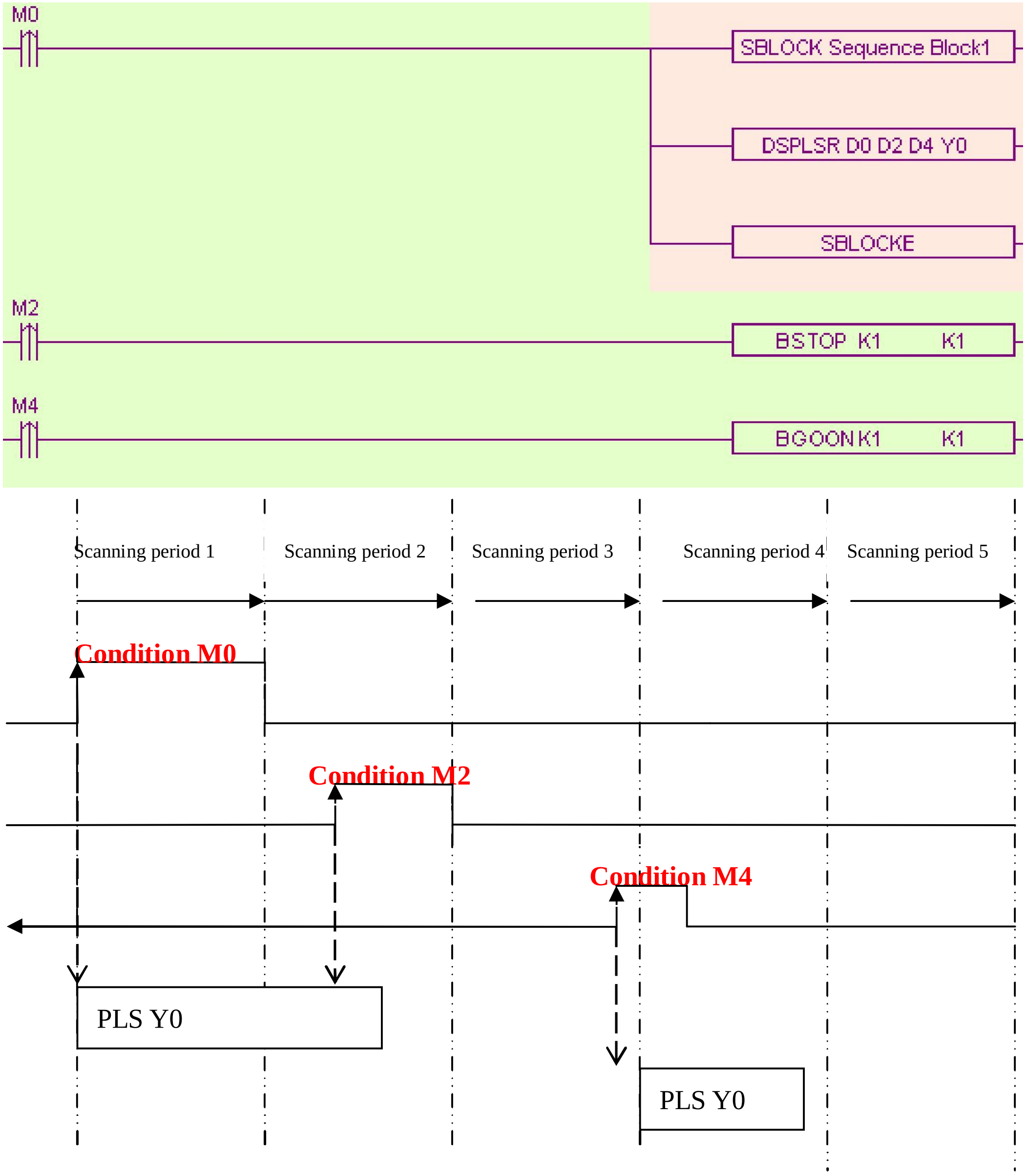
3、BSTOP（K1 K1）+BGOON（K1 K0）





When M0 is from OFF→ON, run “DSPLSR D0 D2 D4 Y0” in the BLOCK to output the pulse; when M2 is from OFF→ON, stop the BLOCK, the pulse will stop slowly with slope, when M3 is from OFF→ON, abandon the rest pulses.

4、BSTOP（K1 K1）+BGOON（K1 K1）



When M0 is from OFF→ON, run “DSPLSR D0 D2 D4 Y0” in the BLOCK to output the pulse; when M2 is from OFF→ON, stop running the BLOCK, the pulse will stop slowly with slope; when M4 is from OFF→ON, output the rest pulses.

Please note that though the BSTOP stops the pulse with slope, there maybe still some pulses; in this case, if run BGOON K1 K1 again, it will output the rest of the pulses.

10-7．BLOCK flag bit and register

1、BLOCK flag bit:

Address	Function	Explanation
M8630		1: running 0: not running
M8631	BLOCK1 running flag	
M8632	BLOCK2 running flag	
…….	…….	
……..	…….	
M8730	BLOCK100 running flag	

2、BLOCK flag register

Address	Function	Explanation
D8630		BLOCK use this value when monitoring
D 8631	BLOCK1 current running instruction	
D8632	BLOCK2 current running instruction	
…….	…….	
……..	…….	
D8730	BLOCK10 current running instruction	

10-8. Program example

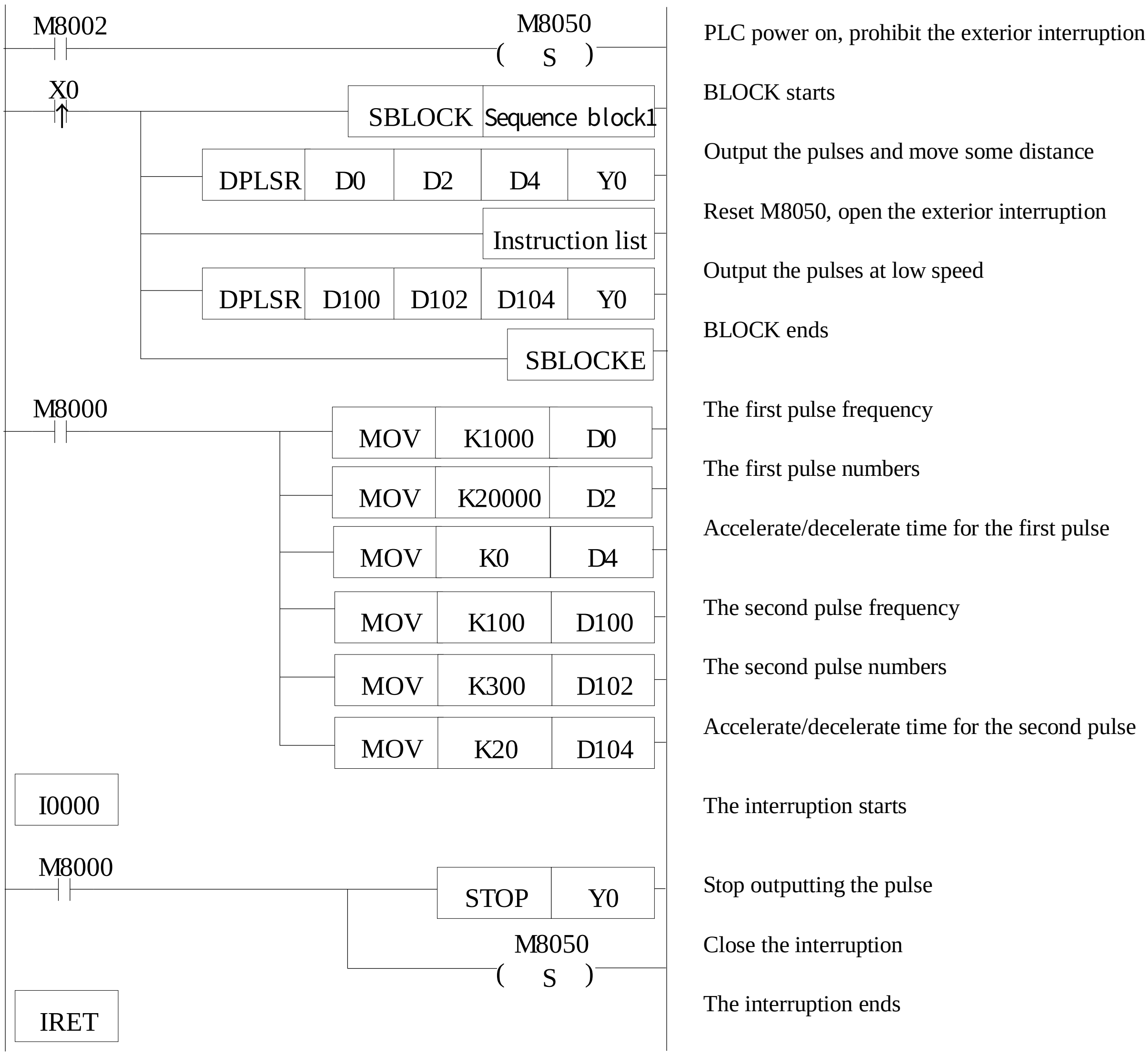
Example:

This example is used in the tracking system. The process is like this:

Output some pulses and prohibit the exterior interruption.

Continue outputting the pulse but at low speed, and open the exterior interruption. When checked the exterior cursor signal, stop the pulse outputting and machine running.

Ladder chart:



The instruction list content:

RST M8050

Notes:

M8050: prohibit the exterior interruption

11 Special Function Instructions

In this chapter, we mainly introduce PWM pulse width modulation, frequency detect, precise time, interruption etc;

Mnemonic	Function	Circuit and soft components	Chapter
Pulse Width Modulation, Frequency Detection			
PWM	Output pulse with the specified occupied ratio and frequency	PWM S1 S2 D	11-1
FRQM	Frequency Detection	FRQM S1 D S2 S3	11-2
Time			
STR	Precise Time	STR D1 D2	11-3
STRR	Read Precise Time Register	STRR S	11-3
STRS	Stop Precise Time	STRS S	11-3
Interruption			
EI	Enable Interruption	EI	11-4-1
DI	Disable Interruption	DI	11-4-1
IRET	Interruption Return	IRET	11-4-1

11-1．PWM Pulse Width Modulation

1、Instruction’s Summary

Instruction to realize PWM pulse width modulation

PWM pulse width modulation [PWM]			
16 bits instruction	PWM	32 bits instruction	-
execution condition	normally ON/OFF coil	suitable models	XC1、XC2、XC3、XC5、XCM
hardware requirement	-	software requirement	-

2、Operands

Operands	Function	Type
S1	specify the occupy ratio value or soft component’s ID number	16 bits, BIN
S2	specify the output frequency or soft component’s ID number	16 bits, BIN
D	specify the pulse output port	bit

3、Suitable Soft Components

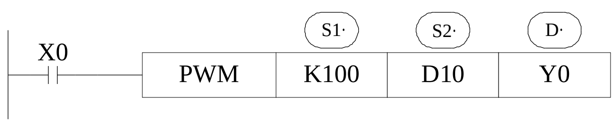
Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●	●		●	●					●		
S2	●	●		●	●					●		

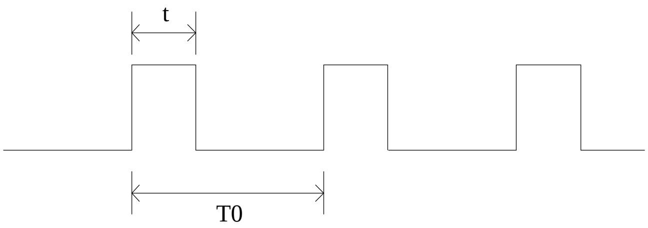
Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
D		●					

Function and Action



- The occupy ratio **n**: 1~255
- Output pulse **f**: 0~72KHz
- Pulse is output at Y000 or Y001 (Please use transistor output)
- The output occupy/empty ratio of PMW =n /256×100%
- PWM output use the unit of 0.1Hz, so when set (S2) frequency, the set value is 10 times of the actual frequency (i.e. 10f). E.g.：to set the frequency as 72KHz, then set value in (S2) is 720000.
- When X000 is ON, output PWM wave；when X000 is OFF, stop output. PMW output doesn't have pulse accumulation.



In the left graph: T0=1/f
T/T0=n/256

11-2．Frequency Testing

1、Instruction's Summary

Instruction to realize frequency testing

frequency testing [FRQM]			
16 bits instruction	FRQM	32 bits instruction	-
execution condition	normally ON/OFF coil	suitable models	XC1、XC2、XC3、XC5、XCM
hardware requirement	-	software requirement	-

2、Operands

Operands	Function	Type
S1	Specify the sampling pulse number or soft component's ID number	16 bits, BIN
S2	Specify the frequency division choice's number	16 bits, BIN
S3	Specify the pulse input port	bit
D	specify the tested result's soft component's number	16 bits, BIN

3、Suitable Soft Components

Word

Operands	System									Constant	Module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
S1	●			●	●					●		
S2										●		
D	●			●	●							

Bit

Operands	System						
	X	Y	M	S	T	C	Dn.m
S3	●						

FUNCTIONS AND ACTIONS

X000		S1·	D·	S2·	S3·
─┤├─	FRQM	K20	D100	K1	X003

- S1: sampling pulse number: the number to calculate the pulse frequency
- D: tested result, the unit is Hz.
- S2: Frequency division choice. It can be K1 or K2;

When the frequency division is K1, the range is: no less than 9Hz, precision range: 9~18KHz.

When the frequency division is K2, the range: no less than 300Hz, precision range: 300~400KHz.

- In frequency testing, if choose frequency division as K2, the frequency testing precision is higher than frequency division K1.
- When X000 is ON, FRQM will test 20 pulse cycles from X003 every scan cycle. Calculate the frequency's value and save into D100. Test repeatedly. If the tested frequency's value is smaller than the test bound, then return the test value as 0.

The pulse output to X number:

Model		X Number
XC2 series	14/16/24/32/48/60 I/O	X1、X6、X7
XC3 series	14 I/O	X2、X3
	24/32 I/O	X1、X11、X12
	48/60 I/O、XC3-19AR-E	X4、X5
XC5 series	24/32 I/O	X3
	48/60 I/O	X1、X11、X12
XCM series	24/32 I/O	X3

11-3．Precise Time

1、Instruction List

Read and stop precise time when execute precise time;

precise time [STR]			
16 bits instruction	-	32 bits instruction	STR
execution condition	edge activation	suitable models	XC1、XC2、XC3、XC5、XCM
hardware requirement	-	software requirements	-
read precise time [STRR]			
16 bits instruction	-	32 bits instruction	STRR
execution condition	edge activation	suitable models	XC1、XC2、XC3、XC5、XCM
hardware requirement	V3.0e and above	software requirements	-
stop precise time [STRS]			
16 bits instruction	-	32 bits instruction	STRS
execution condition	edge activation	suitable models	XC1、XC2、XC3、XC5、XCM
hardware requirement	V3.0e and above	software requirements	-

2、Operands

Operands	Function	Type
D	Timer's Number	bit
D1	Timer's Number	bit
D2	specify timer's value or soft component's ID number	16 bits, BIN

3、Suitable Soft Components

Word

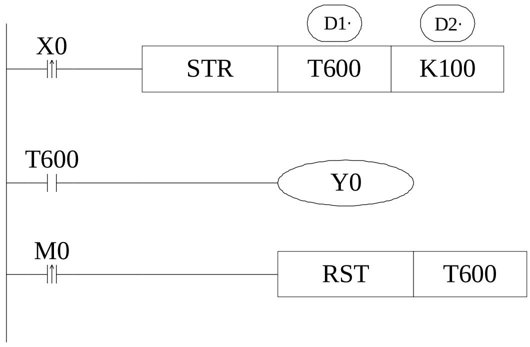
operands	system									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
D2	●	●		●	●					●		

Bit

operands	system						
	X	Y	M	S	T	C	Dn.m
D					●		
D1					●		

FUNCTIONS AND ACTIONS

《Precise Time》

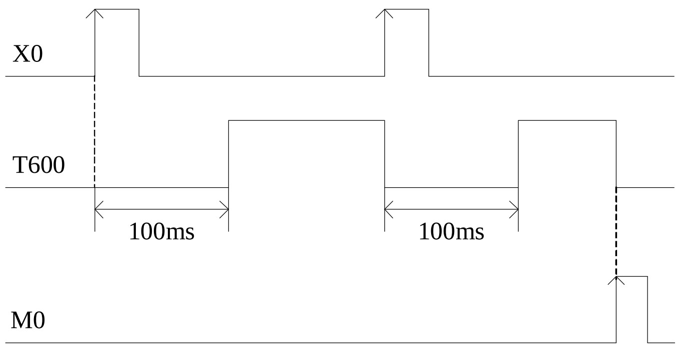


D1: Timer's number. Range: T600~T618 (T600、T602、T604…T618, the number should be even)

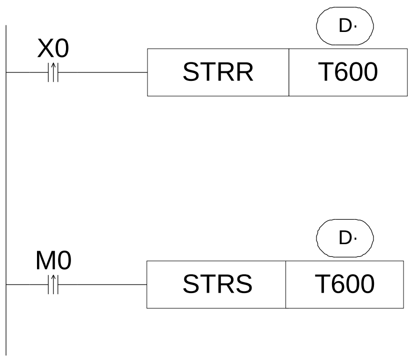
D2: Time Value

- The precise timer works in form of 1ms
- The precise timer is 32 bits, the count range is 0~+2,147,483,647.
- When X000 turns from OFF to ON, timer T600 starts to time, when time accumulation reaches 100ms, set T600; if X000 again turns from OFF to ON, timer T600 turns from ON to OFF，restart to time, when time accumulation reaches 100ms, T600 again reset. See graph below:
- When run STR instruction, reset the timer, then start to time;

See time graph below:



《read the precise time》、《stop precise time》

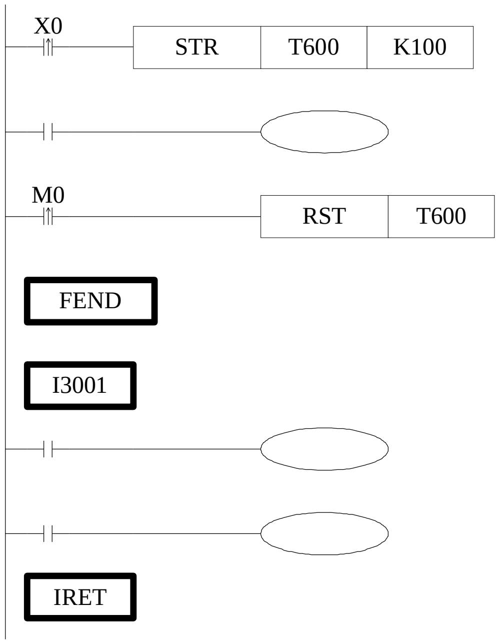


- When X000 changes from OFF to ON, move the current precise time value into TD600 immediately, no relate to the scan cycle;

- When M000 changes from OFF to ON, execute STRS instruction immediately, stop precise time and refresh the count value in TD600. No relate to the scan cycle;

Precious Time Interruption

- When the precise time reaches the count value, generate a correspond interruption tag, execute some interruption subroutines.
- Start the precise time in precise time interruption;
- Every precise timer has its own interruption tag, see table below:



When X000 changes from OFF to be ON, timer T600 starts to time. When time accumulates to 100ms, set T600; meantime, generate an interruption, the program jumps to interruption tag I3001 and execute the subroutine.

Interruption Tag correspond with the Timer

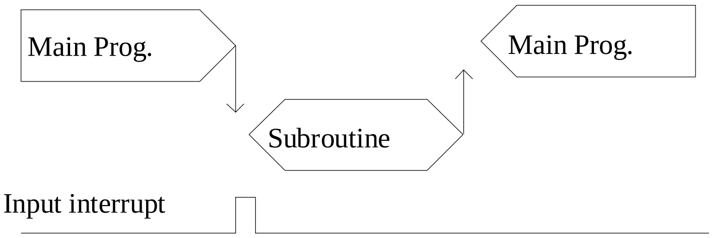
Timer’s Nr.	Interruption Tag
T600	I3001
T602	I3002
T604	I3003
T606	I3004
T608	I3005
T610	I3006
T612	I3007
T614	I3008
T616	I3009
T618	I3010

11-4. Interruption

XC series PLC are equipped with interruption function. The interruption function includes external interruption and time interruption. Via interruption function we can dispose some special programs. This function is not effected by the scan cycle.

11-4-1. External Interruption

The input terminals X can be used to input external interruption. Each input terminal corresponds with one external interruption. The input's rising/falling edge can activate the interruption. The interruption subroutine is written behind the main program (behind FEND). After interruption generates, the main program stops running immediately, turn to run the correspond subroutine. After subroutine running ends, continue to execute the main program.



External Interruption's Port Definition

XC3-14

Input Terminal	Pointer Nr.		Disable the interruption instruction
	Rising Interruption	Falling Interruption	
X7	I0000	I0001	M8050

XC2 series、XC3-24/32、XC5-48/60

Input Terminal	Pointer Nr.		Disable the interruption instruction
	Rising Interruption	Falling Interruption	
X2	I0000	I0001	M8050
X5	I0100	I0101	M8051
X10	I0200	I0201	M8052

XC3-48/60、XC3-19AR-E

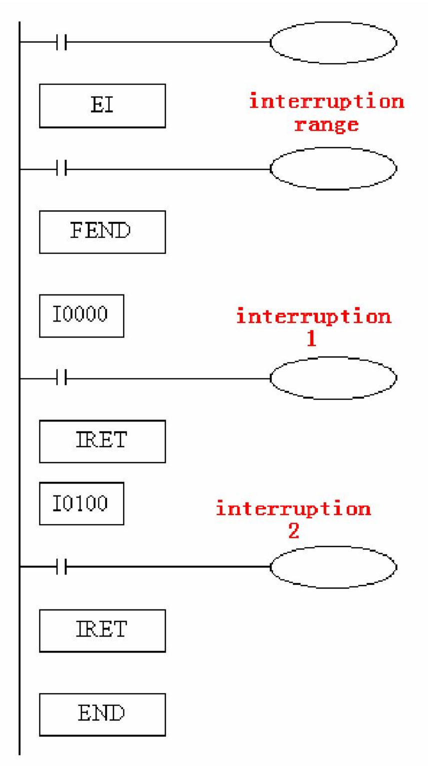
Input Terminal	Pointer Nr.		Disable the interruption instruction
	Rising Interruption	Falling Interruption	
X10	I0000	I0001	M8050
X7	I0100	I0101	M8051
X6	I0200	I0201	M8052

XC5-24/32、XCM-24/32-

Input Terminal	Pointer Nr.		Disable the interruption instruction
	Rising Interruption	Falling Interruption	
X2	I0000	I0001	M8050
X5	I0100	I0101	M8051
X10	I0200	I0201	M8052
X11	I0300	I0301	M8053
X12	I0400	I0401	M8054

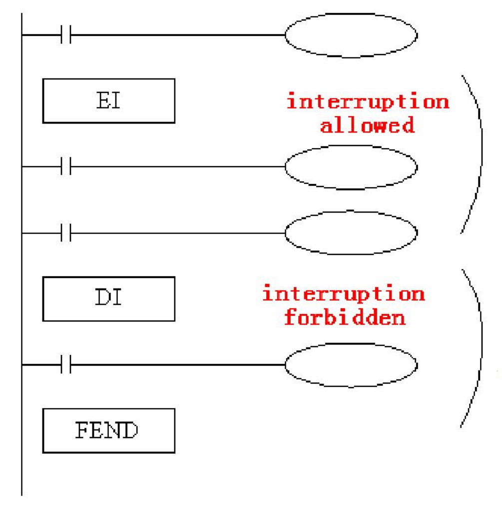
Interruption Instruction

Enable Interruption [EI]、Disable Interruption [DI]、Interruption Return [IRET]



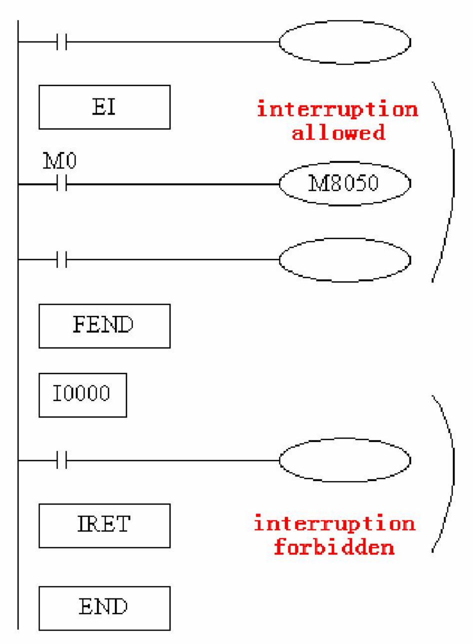
- If use EI instruction to allow interruption, then when scanning the program, if interruption input changes from OFF to be ON, then execute subroutine①、②, return to the original main program;
- Interruption pointer (I****) should be behind FEND instruction;
- PLC is default to allow interruption

Interruption's Range Limitation



- Via program with DI instruction, set interruption forbidden area;
- Allow interruption input between EI~DI
- If interruption forbidden is not required, please program only with EI, program with DI is not required.

Disable The Interruption



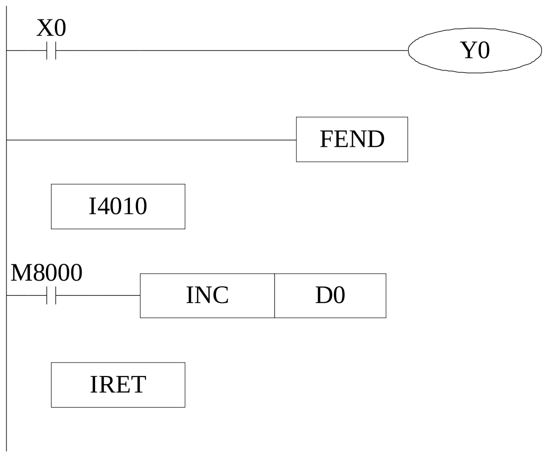
- Every input interruption is equipped with special relay (M8050~M8052) to disable interruption;

- In the left program, if use M0 to set M8050 “ON”, then disable the interruption input at channel 0.

11-4-2. Time Interruption

FUNCTIONS AND ACTIONS

In the condition of main program's execution cycle long, if you need to handle a special program; or during the sequential scanning, a special program needs to be executed at every certain time, time interruption function is required. This function is not affected by PLC's scan cycle, every Nm, execute time interruption subroutine.



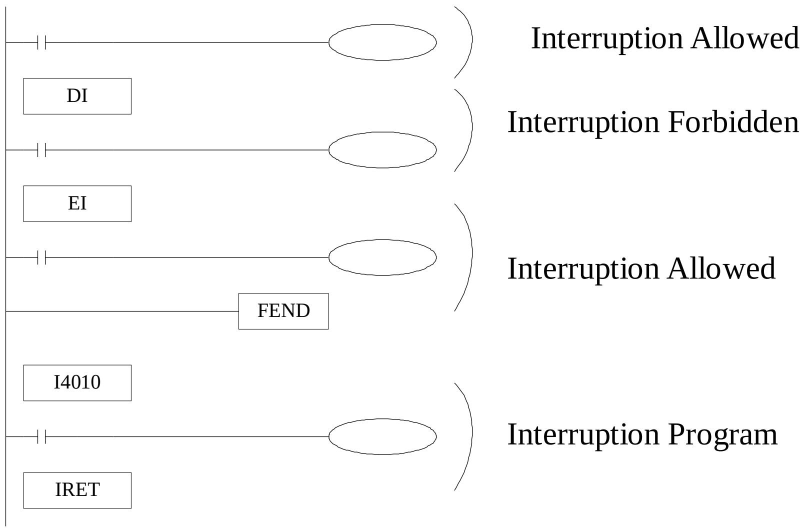
- Time interruption is default in open status, time interruption subroutine is similar with other interruption subroutine, it should be written behind the main program, starts with I40xx, ends with IRET.
- There are 10CH time interruptions. The represent method is I40**~I49** ("**" means time interruption's time, unit is ms. For example, I4010 means run one channel time interruption every 10ms.

Interruption Nr.

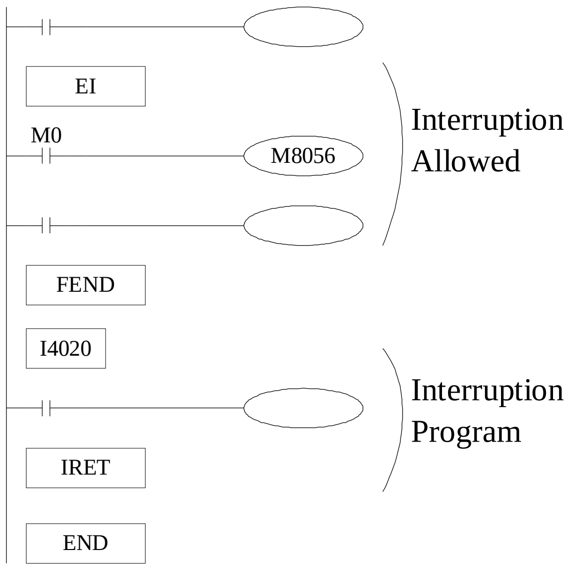
Interruption Nr.	Interruption Forbidden Instruction	Description
I40**	M8056	"**" represents time interruption's time, range from 1 to 99, unit is ms.
I41**	M8057	
I42**	M8058	
I43**	-	
I44**	-	
I45**	-	
I46**	-	
I47**	-	
I48**	-	
I49**	-	

Interruption range's limitation

- Normally time interruption is in "allow" status
- With EI、DI can set interruption's allow or forbidden area. As in the above graph, all time interruptions are forbidden between DI~EI, and allowed beyond DI~EI.



Interruption Forbidden



- The first 3CH interruptions are equipped with special relays (M8056~M8059) to forbid interrupt

- In the left example program, if use M0 to enable M8056 "ON", the forbid 0CH's time interruption.

12 Application Program Samples

In this chapter, we make some samples about pulse output instruction, Modbus communication instructions and free format communication instructions etc.

12-1. Pulse Output Application

Example: below is the example program to send high/low pulse in turn

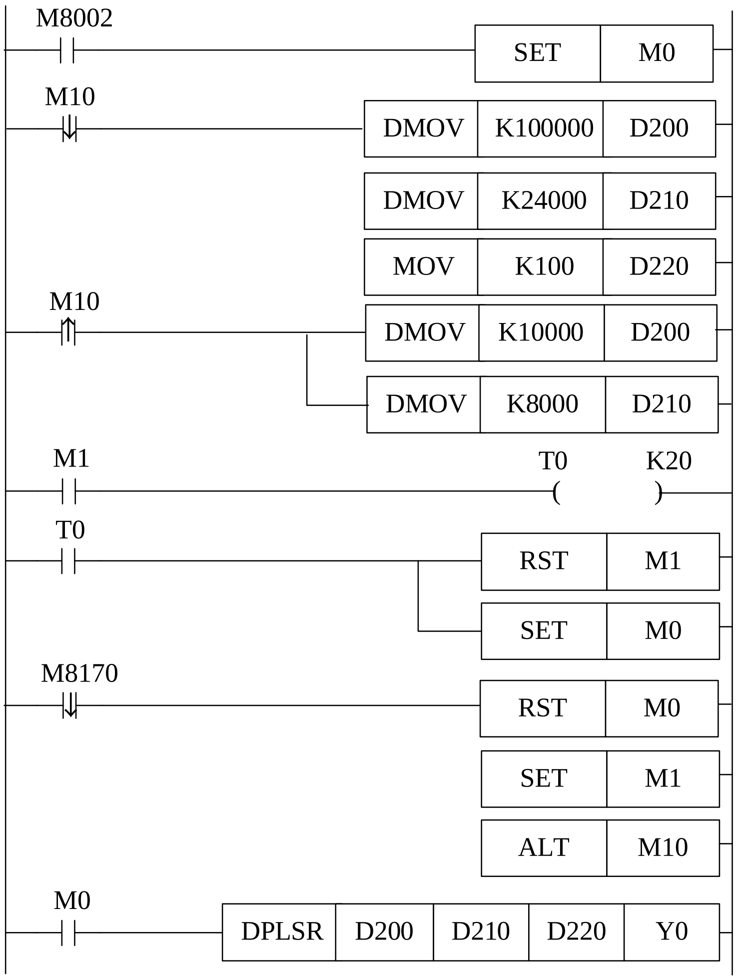
Each Parameter:

Stepping motor parameters: step angle= 1.8 degrees/step, scale=40, pulse number per rotate is 8000

High frequency pulse: maximum frequency is 100KHz, total pulse number is 24000 (3 rotates)

Low frequency pulse: maximum frequency is 10KHz, total pulse number is 8000 (1 rotates)

Ladder Program:



Instruction List:

LD	M8002		//initial positive pulse coil
SET	M0		//set M0 ON
LDF	M10		//M10 falling edge activate condition
OR	M8002		//Initial data
DMOV	K100000	D200	//move decimal data 100000 into DWORD D200
DMOV	K24000	D210	// move decimal data 24000 into DWORD D210
MOV	K100	D220	// move decimal data 100 into DWORD D220
LDP	M10		//M10 rising edge activate condition
DMOV	K10000	D200	// move decimal data 10000 into DWORD D200

```
DMOV     K8000     D210                    // move decimal data 8000 into DWORD D210
LD       M1                                //M1 status activate condition
OUT      T0   K20                          //100ms timer T0, time 2 seconds
LD       T0                                //T0 status activate condition
RST      M1                                //reset M1
SET      M0                                //set M0
LDF      M8170                             //M8170 falling edge activate condition
RST      M0                                //reset M0
SET      M1                                //set M1
ALT      M10                               //M10 status NOT
LD       M0                                //M0 status activate condition
DPLSR    D200    D210    D220    Y0        //value in D200 is frequency、value in D210 is pulse
         number、 value is D220 is acceleration/deceleration time, send pulse via Y0;
```

Explanation:

When PLC changes from STOP to be RUN, M8002 gets a scan cycle; set the high frequency pulse parameters into D200、D210, set the acceleration/deceleration speed to D220, set M0, the motor starts to run 3 rounds with high frequency. Meantime M8170 sets; the motor runs 3 rounds and decelerate, stop, coil M8170 reset; then reset M0, set M1, **NOT** M10; set the low frequency pulse parameters into D200、D210; the timer time lags 2sec, when time reaches, reset M1; set M0, the motors starts to run 1 round with low frequency; after this starts to run with high frequency. Repeat this alternation time by time;

12-2. MODBUS COMMUNICATION SAMPLES

E.g.1: realize Modbus read/write among one master and three slaves

Operation: (1) write content in D10~D14 to D10~D14 of 2# slave;

(2) read D15~D19 of the slaves to D15~D19 of the mater; anyhow, write the first five registers' content to the slaves, the left five registers are used to store the content from the slaves;

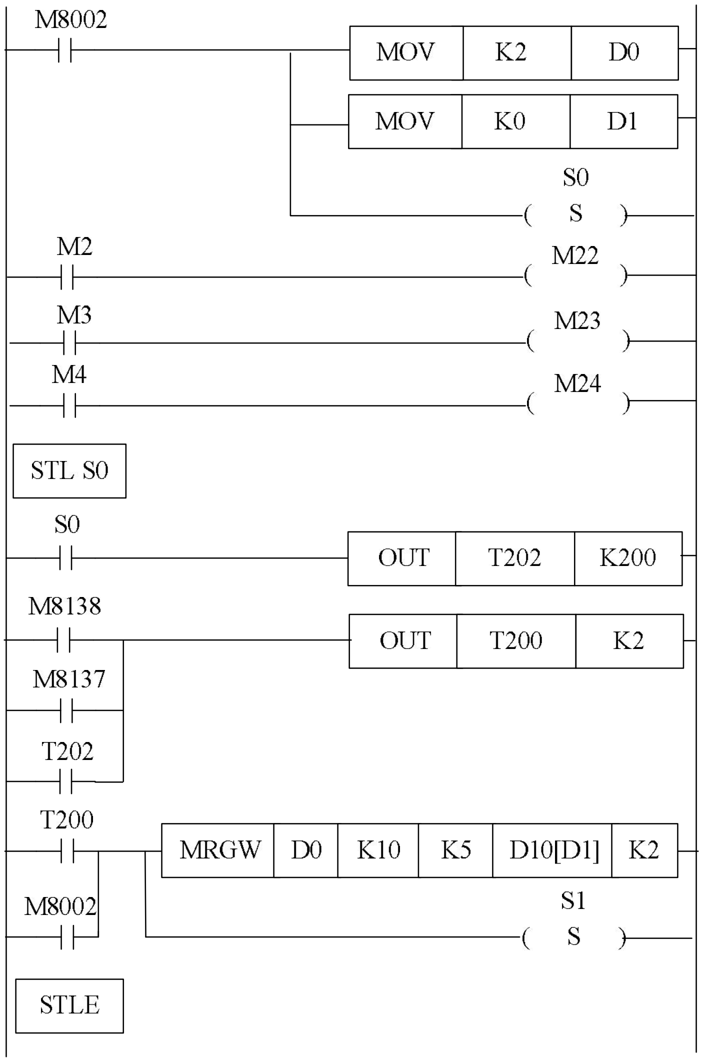
(3) 3# 、4# slaves are similar;

Soft component's comments:

D0: communication station number
D1: offset
M2: 2# communication error
M3: 3# communication error
M4: 4# communication error
M8137: COM2 communication error end signal
M8138: COM2 communication correct end signal

S0: write the target station
S1: read the target station
S2: judge the communication status
S3: offset the communication ID
T200: communication interval 1
T201: communication interval 2
T202: self reset 1 of communication error
T203: self reset 2 of communication error

Ladder



In PLC's first scan cycle, evaluate the "communication station" to be 2;

Evaluate the "offset" to be 0

2# communication error reset

3# communication error reset

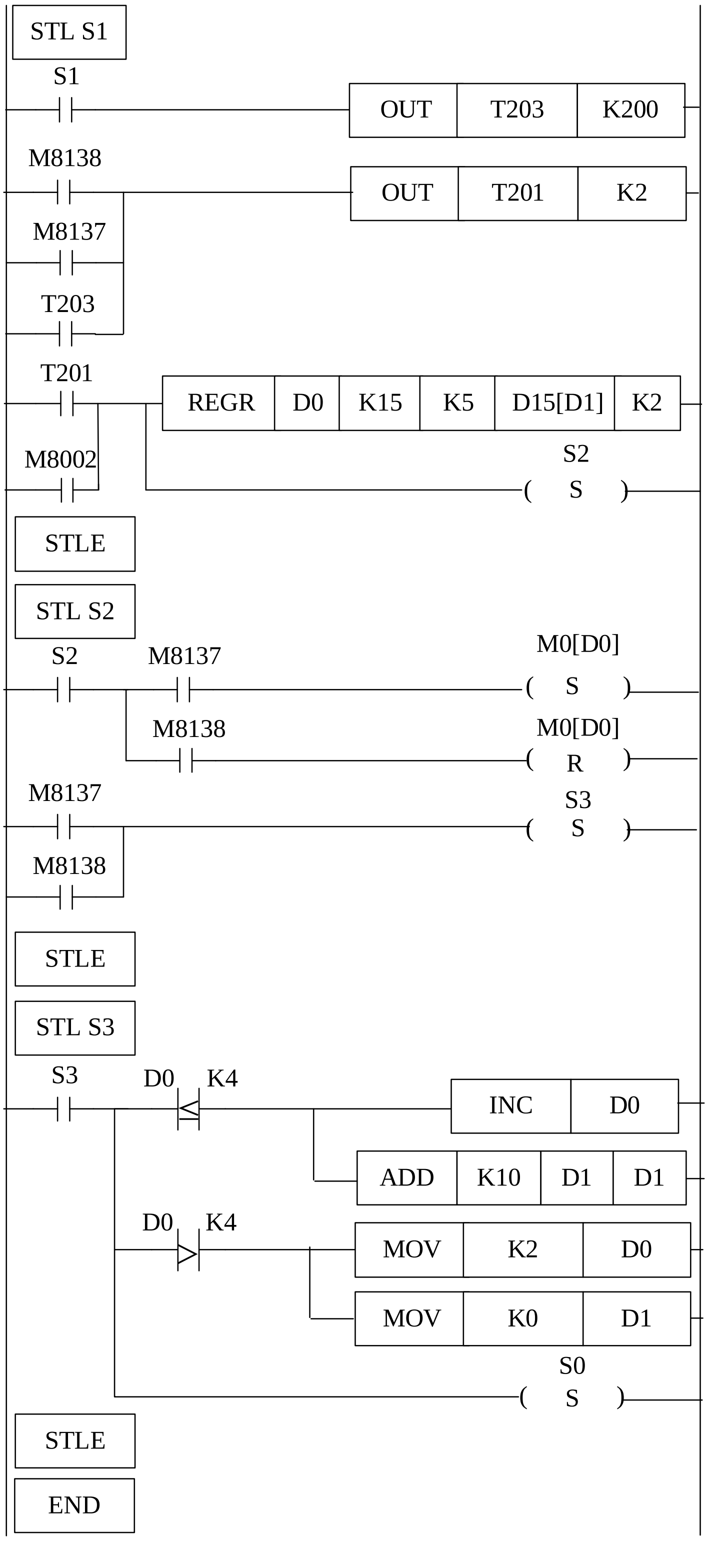
4# communication error reset

S0 starts, T202 counts 2S, which is the communication wait time

When the communication wait time reaches, no matter the communication succeeds or not, T200 time 20ms, this time is used start the next communication

T200 time reaches, or on the power up, execute the RUN operation to the target station

Open the flow S1



S0 starts, T203 time 2s, which is the communication waiting time

When communication waiting time reaches, no matter the communication succeeded or not, T201 counts 20ms, this time is used to start the next communication.

T201 times reach, or on the power up, execute the read operation with the target stations

Open flow S2

Flow S2 is used to judge the communication status. Failure will set the correspond coil; success will reset the correspond coil;

If the station number is not larger than 4, the station register add 1, the offset add 10

If the station number is larger than 4, evaluate the station register 1; clear the offset register

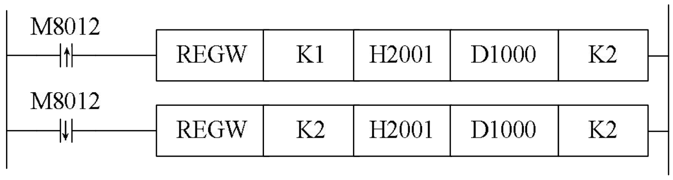
Open flow S0

Program Explanation:

When PLC turns from STOP to RUN, M8002 gets a scan cycle. S0 flow open, write the master's D10——D14 to slave 2# D10——D14. no matter the communication is success or not, turn to S1 flow; check the previous communication written condition. After certain time delay, continue to read D15~D19 data from 2#. After this reading entr S2 flow, check if the communication is success. If failed, set M23, enter alarming. After finishing the communication with 2#, enter S3, then flow S3 will judge with the station number. If the station number is less than 1, the offset add 10; or else start from 2# again.

e.g. 2: Below is the sample of XINJE XC series PLC with two of XINJE inverters, they communicate via Modbus communication, XC series PLC write the frequency to the two inverters;

set the first inverter’s station to be 1; set the second inverter’s station to be 2; store the frequency’s set value in D1000 and D2000. execute the frequency setting order via COM ports;



Program Description:

On the rising edge of M8012, write frequency to the first inverter; on the falling edge of M8012, write frequency to the second inverter;

12-3. Free Format Communication Example

In this example, we use DH107/DH108 series instruments;

1、Interface Specifications

DH107/DH108 series instruments use asynchronous serial communication interface, the interface level fits RS232C or RS485 standard. The data format is: 1 start bit, 8 data bits, no parity, one/two stop bit. The baud rate can be 1200~19200bit/s .

2、Communication Instruction Format

DH107/108 instruments use Hex data form to represent each instruction code and data;

Read/write instructions:

Read: address code +52H (82) +the para.(to read) code +0+0+CRC parity code

Write: address code +43H（67）+ the para.(to write) code +low bytes of the wrote data + high bytes of the wrote data +CRC parity code

The read instruction's CRC parity code is: the para. (to read) code *256+82+ADDR

ADDR is instrument's address para., the range is 0~100 (pay attention not to add 80H). CRC is the remainder from the addition of the above data (binary 16bits integral). The reminder is 2 bytes, the high byte is behind the low byte;

The write instruction's CRC parity code is: the para. (to write) code *256+67+ the para. value (to write) +ADDR

The para. to write represents with 16 bits binary integral;

No matter to write or read, the instrument should return data as shown below:

The test value PV+ given value SV+ output value MV and alarm status +read/write parameters value +CRC parity code

Among in, PV、SV and the read parameters are all in integral form, each occupies two bytes, MV occupies one byte, the value range is 0~220, alarm status occupies one byte, CRC parity code occupies two bytes, totally 10 byes.

CRC parity code is the reminder from the result of PV+SV+ (alarm status *256+MV)+ para. value +ADDR;

(for details, please refer to AIBUS communication description)

3、Write the program

After power on the PLC, the PLC read the current temperature every 40ms. During this period, the user can write the set temperature.

Data zone definition: buffer area of sending data D10~D19

buffer area of accepting data D20~D29

instruction's station number: D30

read command's value: D31=52 H

write command's value: D32=43 H

parameter's code: D33

temperature setting: D34

CRC parity code: D36

Temperature display: D200,D201

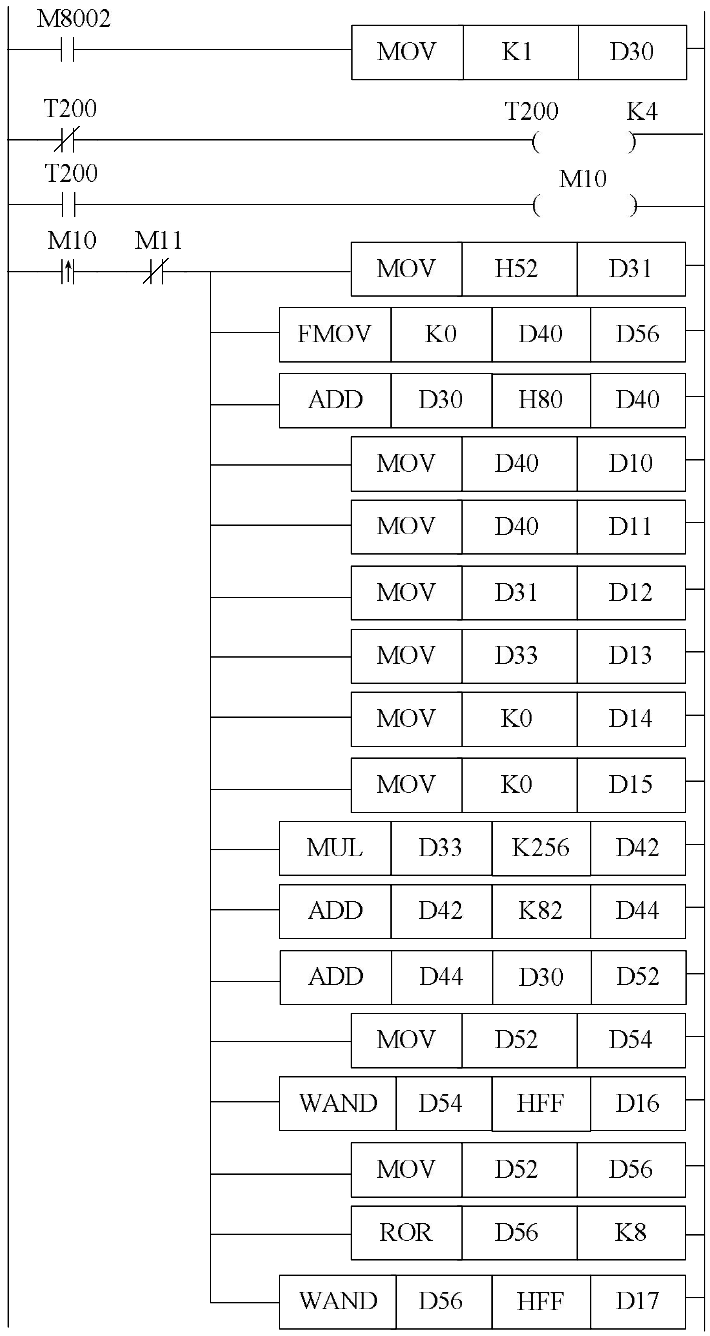
The send data form: 81H 81H 43H 00H c8H 00H 0cH 01H (current temperature display)

Communication parameters setting: baud rate: 9600, 8 data bits, 2 stop bits, no parity

Set FD8220=255; FD8221=5

(the hardware and software must be V2.4 or above)

Ladder:



Write instrument's station Nr. K1 in to D30

Time 40ms

Output M10

Write the read code 52H into D31

Clear registers D40-D56

D30 add H80 to get value 81H

move D40 (81H) to D10

move D40 (81H) to D11

move D31 (read code 52H) to D12

move D33 (para. code) to D13

write zero to D14

write zero to D15

below is to calculate CRC parity;

D33 multiply K256, the result is saved in D42

D42 add K82, the result is stored in D44

D44 add D30 (instrument's station), the result is saved in D52

Move D52 into D54

Logic AND D54 with HFF, save the result in D16

Move D52 into D56

Right shift 8 bits with D56 (convert the high 8bits to the low 8 bits)

Logic AND D56 with HFF, save the result in D17

Contact	Instruction	Operand 1	Operand 2	Operand 3	Comment
M11 ↑, M10 -/-	MOV	H43	D32		Write code H43 into D32
	FMOV	K0	D40	D56	Clear registers D40-D56
	ADD	D30	H80	D40	D30 (station Nr.) add H80, save the result in D40
	MOV	D40	D10		Move D40 to D10
	MOV	D40	D11		Move D40 to D11
	MOV	D32	D12		Move D32 (write code H43) to D12
	MOV	D33	D13		Move D33 (para .code) to D13
	MOV	D34	D42		Move D34 (temp. set) to D42
	WAND	D42	HFF	D14	Logic and D42 with HFF, save data in D14
	MOV	D34	D44		Move D34 (temp. set) to D44
	ROR	D44	K8		D44 right shift 8 bits
	WAND	D44	HFF	D15	Logic and D44 with HFF, save data in D15
					Below is to calculate CRC parity:
	MUL	D33	K256	D46	D33 (para. code) multiply K256, save result in D46
	ADD	D46	K67	D48	D46 add K67, save data in D48
	ADD	D48	D34	D50	D48 add D34, save data in D50
	ADD	D50	D30	D52	D50 add D30, save data in D52
	MOV	D52	D54		Move D52 to D54
	WAND	D54	HFF	D16	Logic and D54 with HFF, save result in D16
	MOV	D52	D56		Move D52 to D56
	ROR	D56	K8		Right shift 8 bits with D56
	WAND	D56	HFF	D17	Logic and D56 with HFF, save result in D17
M10 ↑ or M11 ↑	SEND	D10	K8	K2	Send data D10-D17 out
M8132 ↓	RCV	D20	K10	K2	Read the returned data and save in D20-D29
M8134 ↓	BMOV	D20	D100	K10	Move the returned data to D100~109
	ROL	D101	K8		Left shift 8 bits with D101
	WOR	D101	D100	D200	Logic OR D101 with D100, save result in D200
	ROL	D103	K8		Left shift 8 bits with D103
	WOR	D102	D103	D201	Logic OR D102 with D103, save result in D201

Program Description:

The above program is written according to DH instrument's communication protocol, the soft component's functions are listed below:

Relationship of sent (SEND) data string and registers:

	D10	D11	D12	D13	D14	D15	D16	D17
Read	Address code	Address code	Read code 52H	Parameters code	0	0	CRC low bytes	CRC high bytes
Write	Address code	Address code	Write code 42H	Parameters code	low bytes of the written data	high bytes of the written data	CRC low bytes	CRC high bytes

Relationship of received (RCV) data (data returned by the instrument) and the registers:

D20	D21	D22	D23	D24	D25	D26	D27	D28	D29
PV low bytes	PV high bytes	SV low bytes	SV high bytes	Output value	Alarm status	Read/write low bytes	Read/write high bytes	CRC low bytes	CRC high bytes

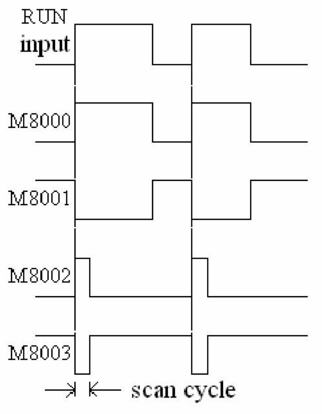
So, if write data string according to the communication objects' protocol, use SEND and RCV commands from free format communication, user will get the communication with the objects.

Appendix 1 Special soft device list

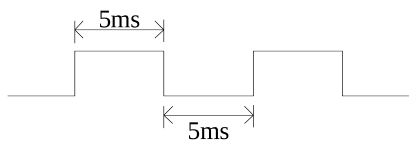
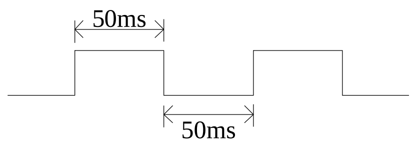
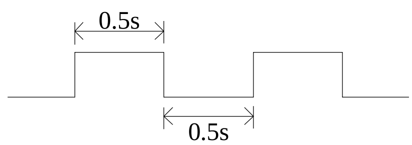
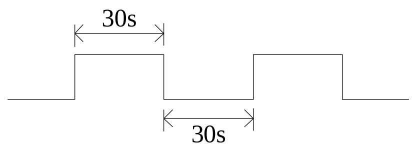
Here we mainly introduce the functions of special soft device, data register and FlashROM, and introduce the address of expansion. Users can scan fast.

Appendix 1-1. Special Auxiliary Relay List

PC Status (M8000-M8003)

ID	Function	Description	
M8000	Normally ON coil when running		M8000 keeps being ON status when PLC is running
M8001	Normally OFF coil when running		M8001 keeps being OFF status when PLC is running
M8002	Initial positive pulse coil		M8002 be ON in first scan cycle
M8003	Initial negative pulse coil		M8003 be OFF in first scan cycle

Clock (M8011-M8014)

ID	Function	Description
M8011	Shake with the cycle of 10ms	
M8012	Shake with the cycle of 100ms	
M8013	Shake with the cycle of 10sec	
M8014	Shake with the cycle of 1min	

Flag (M8020-M8029)

ID	Function	Description
M8020	Zero	The plus/minus operation result is 0
M8021	Borrow	“borrow” occurs in minus operation
M8022	Carry	When carry occurs in plus operation or overflow occurs in bit shift operation
M8023		
M8026	RAMP Mode	
M8029		

PC Mode (M8030-M8038)

ID	Function	Description
M8030	PLC initializing	
M8031	Non-retentive register reset	When driving this M, ON/OFF mapping memory of Y, M, S, TC and the current values of T, C, D are all reset to be 0
M8032	Retentive register reset	
M8033	Registers keep stopping	When PLC changes from RUN to STOP, leave all content in mapping registers and data registers
M8034	All output forbidden	Set PC’s all external contacts to be OFF status
M8038	Parameter setting	Set communication parameters flag

Stepping Ladder (M8041-M8046)

ID	Function	Description
M8041		
M8045	All output reset forbidden	When shifting the mode, all outputs reset functions are forbidden
M8046	STL status activate	When M8047 activating, act when any device of S0~S999 turns to be ON

Interruption (**M8050-M8059)**

ID	Function	Description
M8050 I000□	Forbid the input interruption 0	After executing EI instruction, even the interruption is allowed, but if M acts at this time, the correspond input interruption couldn’t act separately E.g.：when M8050 is ON, interrupt I000□ is forbidden
M8051 I010□	Forbid the input interruption 1	
M8052 I020□	Forbid the input interruption 2	
M8053 I030□	Forbid the input interruption 3	
M8054 I040□	Forbid the input interruption 4	
M8055 I050□	Forbid the input interruption 5	
M8056 I40□□	Forbid the time interruption 0	After executing EI instruction, even the interruption is allowed, but if M acts at this time, the correspond time interruption couldn’t act separately
M8057 I41□□	Forbid the time interruption 1	
M8058 I42□□	Forbid the time interruption 2	
M8059	Forbid the interruption	Forbid all interruption

Error Testing (M8067-M8072)

ID	Function	Description
M8067	Operation error	happen when calculating
M8070	Scan time out	
M8071	No user program	Internal codes parity error
M8072	User program error	execution codes or configure table parity error

Communication (M8120-M8148)

	ID	Function	Description
COM1	M8120		
	M8121	Waiting to send via RS232	
	M8122	“sending by RS232” flag	
	M8123	“RS232 receiving finish” flag	
	M8124	RS232 receiving flag	
	M8125	“Receive incomplete” flag	acceptance ends normally, but the accepted data number is less than the required number
	M8126	Global signal	
	M8127	“Accept error” flag	
	M8128	“ Accept correct” flag	
	M8129		
COM2	M8130		
	M8131	Waiting to send via RS232	
	M8132	“sending by RS232” flag	
	M8133	“RS232 receiving finish” flag	
	M8134	RS232 receiving flag	
	M8135	“Receive incomplete” flag	acceptance ends normally, but the accepted data number is less than the required number
	M8136	Global signal	
	M8137	“Accept error” flag	
	M8138	“ Accept correct” flag	
	M8139		
COM3	M8140		
	M8141	Waiting to send via RS232	
	M8142	“sending by RS232” flag	
	M8143	“RS232 receiving finish” flag	
	M8144	RS232 receiving flag	
	M8145	“Receive incomplete” flag	acceptance ends normally, but the accepted data number is less than the required number
	M8146	Global signal	
	M8147	“Accept error” flag	
	M8148	“ Accept correct” flag	
	M8149		

“High Speed Counter Interruption Finished” Flag (M8150-M 8169)

ID	Counter ID	Function	Description
M8150	C600	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8151	C602	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8152	C604	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8153	C606	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8154	C608	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8155	C610	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8156	C612	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8157	C614	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8158	C616	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8159	C618	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8160	C620	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8161	C622	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8162	C624	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8163	C626	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8164	C628	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8165	C630	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8166	C632	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8167	C634	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8168	C636	“Count Interruption Finished” Flag	Set flag ON when count interruption finish
M8169	C638	“Count Interruption Finished” Flag	Set flag ON when count interruption finish

Pulse output (M8170~M8238)

ID	Pulse ID	Function	specification
M8170	PULSE_1	“sending pulse” flag	Being ON when sending the pulse,
M8171		overflow flag of “32 bits pulse sending”	When overflow, Flag is on
M8172		Direction flag	1 is positive direction, the correspond direction port is on
M8173	PULSE_2	“sending pulse” flag	Being ON when sending the pulse,
M8174		overflow flag of “32 bits pulse sending”	When overflow, Flag is on
M8175		Direction flag	1 is positive direction, the correspond direction port is on
M8176	PULSE_3	“sending pulse” flag	Being ON when sending the pulse,
M8177		overflow flag of “32 bits pulse	When overflow, Flag is on

		sending”	
M8178		Direction flag	1 is positive direction, the correspond direction port is on
M8179	PULSE_4	“sending pulse” flag	Being ON when sending the pulse,
M8180		overflow flag of “32 bits pulse sending”	When overflow, Flag is on
M8181		Direction flag	1 is positive direction, the correspond direction port is on

absolute、relative bit:

ID	function	specification	
M8190	C600 (24 segments)	**1** is absolute, **0** is relative	
M8191	C602 (24 segments)	**1** is absolute, **0** is relative	
M8192	C604 (24 segments)	**1** is absolute, **0** is relative	
M8193	C606 (24 segments)	**1** is absolute, **0** is relative	
M8194	C608 (24 segments)	**1** is absolute, **0** is relative	
M8195	C610 (24 segments)	……	
M8196	C612 (24 segments)		
M8197	C614 (24 segments)		
M8198	C616 (24 segments)		
M8199	C618 (24 segments)		
M8200	C620 (24 segments)		
M8201	C622 (24 segments)		
M8202	C624 (24 segments)		
M8203	C626 (24 segments)		
M8204	C628 (24 segments)		
M8205	C630 (24 segments)		
M8206	C632 (24 segments)		
M8207	C634 (24 segments)		
M8208	C636 (24 segments)		
M8209	C638 (24 segments)		
M8210	Pulse alarm flag (frequency change suddenly)	**1** is alarm, **0** is correct	PULSE_1
M8211	Neglect the alarm or not	When flag is 1, stop sending alarm	PULSE_1
M8212	Pulse alarm flag (frequency change suddenly)	**1** is alarm, **0** is correct	PULSE_2
M8213	Neglect the alarm or not	When flag is 1, stop sending alarm	PULSE_2
M8214	Pulse alarm flag (frequency change suddenly)	**1** is alarm, **0** is correct	PULSE_3
M8215	Neglect the alarm or not	When flag is 1, stop sending alarm	PULSE_3
M8216	Pulse alarm flag (frequency change suddenly)	**1** is alarm, **0** is correct	PULSE_4

M8217	Neglect the alarm or not	When flag is 1, stop sending alarm	PULSE_4
M8218	Pulse alarm flag (frequency change suddenly)	**1** is alarm, **0** is correct	PULSE_5
M8219	Neglect the alarm or not	When flag is 1, stop sending alarm	PULSE_5

Positive/negative count

ID	Counter Nr.	Function	Specification
M8238	C300~C498	Positive/negative counter control	**0** is increment counter, **1** is decrement counter, default is 0

24 segments HSC interruption loop (M8270~M8289)

ID	Counter ID	Specification	
M8270	24 segments HSC interruption loop (C600)	if set it to be 1, then loop executing the interruption; or else execute only one time interruption;	
M8271	24 segments HSC interruption loop (C602)		
M8272	24 segments HSC interruption loop (C604)		
M8273	24 segments HSC interruption loop (C606)		
M8274	24 segments HSC interruption loop (C608)		
M8275	24 segments HSC interruption loop (C610)		
M8276	24 segments HSC interruption loop (C612)		
M8277	24 segments HSC interruption loop (C614)		
……	……		
M8279	24 segments HSC interruption loop (C618)		
M8280	24 segments HSC interruption loop (C620)	if set it to be 1, then loop executing the interruption; or else execute only one time interruption;	
M8281	24 segments HSC interruption loop (C622)		
……	……		
M8284	24 segments HSC interruption loop (C628)		
M8285	24 segments HSC interruption loop (C630)	if set it to be 1, then loop executing the interruption; or else execute only one time interruption;	
……	……		
M8289	24 segments HSC interruption loop (C638)		

Read &Write the Expansions (M8340~M8341)

ID	Function	Specification
M8340	Read the expansion error flag (**read** instruction)	
M8341	Write the expansion error flag (**write** instruction)	

BLOCK Execution (M8630~M8730)

ID	Function	Specification
M8630		
M8631	BLOCK1 is running flag	
M8632	BLOCK2 is running flag	
……	……	……
……	……	……
……	……	……
M8730	BLOCK100 is running flag	

Appendix 1-2. List of special memory and special data register

Clock (D8010-D8019)

ID	Function	Specification
D8010	The current scan cycle	Unit:0.1ms
D8011	The min. scan time	Unit:0.1ms
D8012	The max. scan time	Unit:0.1ms
D8013	Second (clock)	0~59 (BCD code)
D8014	minute (clock)	0~59 (BCD code)
D8015	hour (clock)	0~23 (BCD code)
D8016	day (clock)	0~31 (BCD code)
D8017	month (clock)	0~12 (BCD code)
D8018	year (clock)	2000~2099 (BCD code)
D8019	week (clock)	0 (Sunday)~6 (Saturday) (BCD code)

Flag (D8021-D8029)

ID	Function	Specification
D8021	Model	Low byte
	Series number	High byte
D8022	Compatible system's version number	Low byte
	System's version number	High byte
D8023	Compatible model's version number	Low byte
	Model's version number	High byte
D8024	Model's information	Max 5 characters +"\0"
D8025		
D8026		
D8027	Suitable program software version	
D8028		
D8029		

Error check（D8067-D8098）

ID	Function	Specification
D8067	Operation error code's Nr.	The error of divide zero
D8068	lock the Nr. of error code	
D8069		
D8070	exceeded scan time	Unit 1ms
D8074	Nr. of offset registers D	
D8097		
D8098		

Communication (D8120-D8149)

	ID	Function	specification
Com 1	D8120		
	D8121		
	D8122	the left data RS232 should send	
	D8123	Data number RS232 received	
	D8126		
	D8127	Communication error code	7: hardware error 8: CRC Parity error 9: station number error 10: no start code 11: no end code 12: communication time out
	D8128	Modbus communication error (the replied message from slaves when the master send errors)	0: correct 1: don't support function ID 2: address error (overrun address) 3: Data error (the number of data) 8: saving data error (rewrite Flash)
	D8129		
Com2	D8130		
	D8131		
	D8132	the left data RS232 should send	
	D8133	Data number RS232 received	
	D8136		

	D8137	Communication error code	7: hardware error 8: CRC check error 9: station number error 10: no start sign 11: no end sign 12: communication time out
	D8138	Modbus communication error (the replied message from slaves when the master send errors)	0：correct 1: don’t support function ID 2: address error(overrun address) 3: Data error (the number of data) 8：saving data error (rewrite Flash)
	D8139		
Com 3	D8140		
	D8141		
	D8142	the left data RS232 should send	
	D8143	Data number RS232 received	
	D8146		
	D8147	Communication error code	7: hardware error 8: CRC check error 9: station number error 10: no start sign 11: no end sign 12: communication time out
	D8148	Modbus communication error (the replied message from slaves when the master send errors)	0：correct 1: don’t support function ID 2: address error(overrun address) 3: Data error (the number of data) 8：saving data error (rewrite Flash)
	D8149		

HSC Interruption Station (D8150-D8169)

ID	Counter ID	function	specification
D8150	C600	The current segment (**No.n** segment)	
D8151	C602	The current segment	
D8152	C604	The current segment	
D8153	C606	The current segment	
D8154	C608	The current segment	
D8155	C610	The current segment	
D8156	C612	The current segment	
D8157	C614	The current segment	

D8158	C616	The current segment	
D8159	C618	The current segment	
D8160	C620	The current segment	
D8161	C622	The current segment	
D8162	C624	The current segment	
D8163	C626	The current segment	
D8164	C628	The current segment	
D8165	C630	The current segment	
D8166	C632	The current segment	
D8167	C634	The current segment	
D8168	C636	The current segment	
D8169	C638	The current segment	

Pulse output (D8170-D8220)

ID	Pulse ID	function	specification
D8170	PULSE_1	The low 16 bits of accumulated pulse number	
D8171		The high 16 bits of accumulated pulse number	
D8172		The current segment (means Nr.n segment)	
D8173	PULSE_2	The low 16 bits of accumulated pulse number	
D8174		The high 16 bits of accumulated pulse number	
D8175		The current segment (means Nr.n segment)	
D8176	PULSE_3	The low 16 bits of accumulated pulse number	Only XC5-32RT-E (4PLS) model has
D8177		The high 16 bits of accumulated pulse number	
D8178		The current segment (means Nr.n segment)	
D8179	PULSE_4	The low 16 bits of accumulated pulse number	
D8180		The high 16 bits of accumulated pulse number	
D8181		The current segment (means Nr.n segment)	
D8190	PULSE_1	The low 16 bits of the current accumulated current pulse number	
D8191		The high 16 bits of the current accumulated current pulse number	
D8192	PULSE_2	The low 16 bits of the current accumulated current pulse number	

D8193		The high 16 bits of the current accumulated current pulse number	
D8194	PULSE_3	The low 16 bits of the current accumulated current pulse number	Only XC5-32RT-E (4PLS) model has
D8195		The high 16 bits of the current accumulated current pulse number	
D8196	PULSE_4	The low 16 bits of the current accumulated current pulse number	
D8197		The high 16 bits of the current accumulated current pulse number	

ID	Pulse ID	Function	Description
D8210	PULSE_1	Error segment number	PULSE_1
D8212	PULSE_2	Error segment number	PULSE_2
D8214	PULSE_3	Error segment number	PULSE_3
D8216	PULSE_4	Error segment number	PULSE_4
D8218	PULSE_5	Error segment number	PULSE_5
D8220	Frequency Testing Precision	indicate the bit Nr. Behind the decimal dot, **1** means ***10**, **2** means ***100**	

Absolute Positioning/Relative Positioning/the Origin Return (D8230-D8239)

ID	Pulse	Function	Description
D8230	PULSE_1	Rising time of the absolute/relation position instruction (Y0)	
D8231		Falling time of the origin return instruction (Y0)	
D8232	PULSE_2	Rising time of the absolute/relation position instruction (Y1)	
D8233		Falling time of the origin return instruction (Y1)	
D8234	PULSE_3	Rising time of the absolute/relation position instruction (Y2)	
D8235		Falling time of the origin return instruction (Y2)	
D8236	PULSE_4	Rising time of the absolute/relation position instruction (Y3)	
D8237		Falling time of the origin return instruction (Y3)	
D8238	PULSE_5	Rising time of the absolute/relation position instruction	
D8239		Falling time of the origin return instruction	

Read/Write the Expansion (D8315-D8316)

ID	Function	Description
D8315	Read the expansion's error type	
D8316	Write the expansion's error type	

Sequential Function Block (D8630-D8730)

ID	Function	Description
D8630		
D8631	The current executing instruction of **BLOCK1**	The value is used when **BLOCK** is monitoring
D8632	The current executing instruction of **BLOCK2**	The value is used when **BLOCK** is monitoring
……	……	……
……	……	……
……	……	……
D8730	The current executing instruction of **BLOCK100**	The value is used when **BLOCK** is monitoring

Error information of the Expansions (D8600-D8627)

ID	Function	specification	Expansion ID
D8600	Read the expansion's error times		Expansion 1
D8601	Read the expansion's error	1. expansion's CRC parity error 2. expansion's address error 3. expansion's accepted data length error 4. expansion's accept buffer zone overflow 5. expansion's timeout error 6. CRC parity error when PLC is accepting data 7. unknown error	
D8602	write the expansion's error times		
D8603	write the expansion's error	……	
D8604	Read the expansion's times		Expansion 2
D8605	Read the expansion's error	……	
D8606	write the expansion's error times		
D8607	write the expansion's error	……	
D8608	Read the expansion's times		Expansion 3
D8609	Read the expansion's error	……	
D8610	write the expansion's error times		
D8611	write the expansion's error	……	

D8612	Read the expansion's times		Expansion 4
D8613	Read the expansion's error	……	
D8614	write the expansion's error times		
D8615	write the expansion's error	……	
……	……	……	……
……	……	……	……
D8624	Read the expansion's times		Expansion 7
D8625	Read the expansion's error	……	
D8626	write the expansion's error times		
D8627	write the expansion's error	……	

Appendix 1-3. ID List of the Expansions

Take the first expansion module as the example:

Channel	**AD signal**	**DA signal**	**PID Output value**	**PID run/stop bit**	**Set value**	PID parameter: **Kp, Ki, Kd,** control range **Diff**、Death range **death**
XC-E8AD						
0CH	ID100	-	ID108	Y100	QD100	Kp-----QD108 Ki------QD109 Kd-----QD110 Diff----QD111 Death--QD112
1CH	ID101	-	ID109	Y101	QD101	
2CH	ID102	-	ID110	Y102	QD102	
3CH	ID103	-	ID111	Y103	QD103	
4CH	ID104	-	ID112	Y104	QD104	
5CH	ID105	-	ID113	Y105	QD105	
6CH	ID106	-	ID114	Y106	QD106	
7CH	ID107	-	ID115	Y107	QD107	
XC-E4AD2DA						
0CH	ID100	-	ID104	Y100	QD102	Kp-----QD106 Ki------QD107 Kd-----QD108 Diff----QD109 Death--QD110
1CH	ID101	-	ID105	Y101	QD103	
2CH	ID102	-	ID106	Y102	QD104	
3CH	ID103	-	ID107	Y103	QD105	
0CH	-	QD100	-	-	-	
1CH	-	QD101	-	-	-	

XC-E4DA

CH Nr.	**Exp. 1**	**Exp. 2**	**Exp. 3**	**Exp. 4**	**Exp. 5**	**Exp. 6**	**Exp. 7**
0CH	QD100	QD200	QD300	QD400	QD500	QD600	QD700
1CH	QD101	QD201	QD301	QD401	QD501	QD601	QD701
2CH	QD102	QD202	QD302	QD402	QD502	QD602	QD702
3CH	QD103	QD203	QD303	QD403	QD503	QD603	QD703

XC-E2DA

CH Nr.	**Exp. 1**	**Exp. 2**	**Exp. 3**	**Exp. 4**	**Exp. 5**	**Exp. 6**	**Exp. 7**
0CH	QD100	QD200	QD300	QD400	QD500	QD600	QD700
1CH	QD101	QD201	QD301	QD401	QD501	QD601	QD701

XC-E6PT-P/ XC-E6TC-P

CH Nr.	Current temp.	Set temp.	PID run/stop bit	The first 3CH PID value	The last 3CH PID value
0CH	ID100	QD100	Y100	Kp：QD106 Ki：QD107 Kd：QD108 Diff：QD109	Kp：QD110 Ki：QD111 Kd：QD112 Diff：QD113
1CH	ID101	QD101	Y101		
2CH	ID102	QD102	Y102		
3CH	ID103	QD103	Y103		
4CH	ID104	QD104	Y104		
5CH	ID105	QD105	Y105		

XC-E6TCA-P

RELATIVE PARAMETERS	COMMENTS AND DESCRIPTIONS				
	CH	Ch0	Ch1		Ch5
Display temperature (unit: 0.1℃)	module 1	ID100	ID101	ID10×	ID105
PID output (X input which returns to main unit)	module 1	X100	X101	X10×	X105
Thermocouple's connecting status (0 is connect, 1 is disconnect)	module 1	X110	X111	X11×	X115
PID auto tune error bit (0 is normal, 1 is parameters error)	module 1	X120	X121	X12×	X125
Enable channel's signal	module 1	Y100	Y101	Y10×	Y105
Auto tune PID control bit	Auto tune activate signal, enter auto tune stage if being set to be 1; when auto turn finish, PID parameters and temperature control cycle value are refreshed, reset this bit automatically. Users can also read its status; 1 represents auto tune processing; 0 represents no atto tune or auto tune finished				
PID output value (operation value)	Digital output value range: 0～4095 If PID output is analogue control (like steam valve open scale or thyistor ON angle), transfer this value to the analogue output module to realize the control requirements				
PID parameters (P、I、D)	Via PID auto tune to get the best parameters; If the current PID control can't fulfill the control requirements, users can also write the PID parameters according to experience. Modules carry on PID control according to the set PID parameters.				
PID operation range (Diff) (unit: 0.1℃)	PID operation activates between ±Diff range. In real temperature control environments, if the temperature is lower than $T_{\text{set temp.}} - T_{Diff}$, PID output the max value; if the temperature is higher than $T_{\text{set temp.}} + T_{Diff}$, PID output the mini value;				

Temperature difference δ (unit: 0.1℃)	(sample temperature+ Temperature difference δ)/10=display temperature value. Then temperature display value can equal or close to the real temperature value. This parameter has sign (negative or positive). Unit is 0.1℃, the default value is 0.
The set temperature value(unit: 0.1℃)	Control system's target temperature value. The range is 0～1000℃, the precision is 0.1℃.
Temperature control cycle (unit: 0.1s)	Control cycle's range is 0.5s～200s, the minimum precision is 0.1s. the write value is the real temperature control cycle multiply 10. i.e. 0.5s control cycle should write 5, 200s control cycle should write 2000.
Adjust environment temperature value (unit: 0.1℃)	If users think the environment temperature is different with the display temperature, he can write in the known temperature value. At the moment of value written in, calculate the temperature difference δ and save. Calculate the temperature difference value δ=adjust environment temperature value－sample temperature value. Unit: 0.1℃. E.g.: under heat balance status, user test the environmental temperature as 60.0℃ with mercurial thermometer, the display temperature is 55.0℃ (correspond sample temperature is 550), temperature difference δ=0. at this time, users write this parameters with 600，temperature difference δ is re-calculated to be 50 (5℃), then the display temperature = (sample temperature＋temperature difference δ）/10 =60℃。 **Note: when users write the adjust temperature value, make sure that the temperature is same with the environment temperature value. This value is very important, once it's wrong, temperature difference δ will be wrong, then effect the display temperature
Auto tune output value	The output when auto tune, use % as the unit, 100 represents 100% of full scale output. 80 represents 80% of full scale output.

XC-E3AD4PT2DA

CH Nr.	**AD signal**	**PID output value**	**PID run/stop bit**	**Set value**	PID parameters: **Kp**、**Ki**、**Kd**、control range **Diff**、death range **Death**
0CH	ID100	ID107	Y100	QD102	Kp------- QD109 Ki------- QD110 Kd------- QD111 Diff------ QD112 Death---- QD113
1CH	ID101	ID108	Y101	QD103	
2CH	ID102	ID109	Y102	QD104	
CH Nr.	**PT signal**	**PID output value**	**PID run/stop bit**	**Set value**	
3CH	ID103	ID110	Y103	QD105	
4CH	ID104	ID111	Y104	QD106	
5CH	ID105	ID112	Y105	QD107	
6CH	ID106	ID113	Y106	QD108	
CH Nr.	**DA signal**	-	-	-	-
0CH	QD100	-	-	-	

1CH	QD101	-	-	-	

XC-E2AD2PT2DA

RELATIVE PARAMETERS	COMMENTS AND DESCRIPTIONS				
	CH	PT0（0.01℃）	PT1（0.01℃）	AD0	AD1
Display temperature (unit: 0.1℃)	module 1	ID100	ID101	ID102	ID103
PID output (X input which returns to main unit)	module 1	X100	X101	X102	X103
Connecting status (0 is connect, 1 is disconnect)	module 1	X110	X111	X112	X113
PID auto tune error bit (0 is normal, 1 is parameters error)	module 1	X120	X121	X122	X123
Enable channel's signal	module 1	Y100	Y101	Y102	Y103
Auto tune PID control bit	Auto tune activate signal, enter auto tune stage if being set to be 1; when auto turn finish, PID parameters and temperature control cycle value are refreshed, reset this bit automatically. Users can also read its status; 1 represents auto tune processing; 0 represents no atto tune or auto tune finished				
PID output value (operation value)	Digital output value range: 0～4095 If PID output is analogue control (like steam valve open scale or thyistor ON angle), transfer this value to the analogue output module to realize the control requirements				
PID parameters (P、I、D)	Via PID auto tune to get the best parameters; If the current PID control can't fulfill the control requirements, users can also write the PID parameters according to experience. Modules carry on PID control according to the set PID parameters.				
PID operation range (Diff) (unit: 0.1℃)	PID operation activates between ±Diff range. In real temperature control environments, if the temperature is lower than $T_{\text{set temp.}} - T_{Diff}$, PID output the max value; if the temperature is higher than $T_{\text{set temp.}} + T_{Diff}$, PID output the mini value;				
Temperature difference δ (unit: 0.1℃)	(sample temperature+ Temperature difference δ)/10=display temperature value. Then temperature display value can equal or close to the real temperature value. This parameter has sign (negative or positive). Unit is 0.1℃, the default value is 0.				
The set temperature value(unit: 0.1℃)	Control system's target temperature value. The range is 0～1000℃, the precision is 0.1℃.				

Temperature control cycle (unit: 0.1s)	Control cycle's range is 0.5s～200s, the minimum precision is 0.1s. the write value is the real temperature control cycle multiply 10. i.e. 0.5s control cycle should write 5, 200s control cycle should write 2000.
Real value (unit: 0.1℃)	If users think the environment temperature is different with the display temperature, he can write in the known temperature value. At the moment of value written in, calculate the temperature difference δ and save. Calculate the temperature difference value δ=adjust environment temperature value－sample temperature value. Unit: 0.1℃. E.g.: under heat balance status, user test the environmental temperature as 60.0℃ with mercurial thermometer, the display temperature is 55.0℃ (correspond sample temperature is 550), temperature difference δ=0. at this time, users write this parameters with 600，temperature difference δ is re-calculated to be 50 (5℃), then the display temperature = (sample temperature＋temperature difference δ）/10 =60℃。 **Note: when users write the adjust temperature value, make sure that the temperature is same with the environment temperature value. This value is very important, once it's wrong, temperature difference δ will be wrong, then effect the display temperature
Auto tune output value	The output when auto tune, use % as the unit, 100 represents 100% of full scale output. 80 represents 80% of full scale output.

Appendix 1-4．Special Flash Register List

1、 I filter

ID	Function	Initial Value	Description
FD8000	input filter time of **X** port	10	Unit: ms
FD8002		0	
FD8003		0	
……		0	
FD8009		0	

2、 I mapping

ID	Function	Initial value	Description
FD8010	**X00** corresponds with **I****	0	X0 corresponds with number of input image I**
FD8011	**X01** corresponds with **I****	1	Initial values are all decimal
FD8012	**X02** corresponds with **I****	2	
……	……		
FD8073	**X77** corresponds with **I****	63	

3、 O mapping

ID	Function	Initial value	Description
FD8074	**Y00** corresponds with **I****	0	Y0 corresponds with the number of output image O**

FD8075	**Y01** corresponds with **I****	1	Initial value are all decimal
FD8076	**Y02** corresponds with **I****	2	
……	……		
FD8137	**Y77** corresponds with **I****	63	

4、 I property

ID	function	Initial value	Description
FD8138	X00 property	all be 0	0: positive logic; others: negative logic
FD8139	X01 property		
FD8140	X02 property		
……	……		
FD8201	X77 property		

5、 power-off retentive area of soft components

ID	Function	Initial Value
FD8202	Start tag of **D** power off retentive area	4000
FD8203	Start tag of **M** power off retentive area	3000
FD8204	Start tag of **T** power off retentive area	640
FD8205	Start tag of **C** power off retentive area	320
FD8206	Start tag of **S** power off retentive area	512
FD8207	Start tag of E**D** power off retentive area	0
FD8209	Pulse director and pulse delay time setting	50ms

6、 Communication

	ID	Function	Initial	Description
COM1	FD8210	Communicate Mode (station number)	1	255 (FF) is free mode， 1~254 is modbus station number
	FD8211	Communicate format	8710	Baud rate, Data bit, stop bit, parity
	FD8212	Judgment time of ASC timeout	3	Unit ms, if set to be 0, it means no timeout waiting
	FD8213	Judgment time of reply timeout	300	Unit ms, if set to be 0, it means no timeout waiting
	FD8214	Start ASC	0	High 8 bits invalid
	FD8215	End ASC	0	High 8 bits invalid
	FD8216	Free format setting	0	8/16 bits buffer; With/without start bit， With/without stop bit
COM2	FD8220	Communicate Mode (station number)	8710	255 (FF) is free mode， 1~254 is modbus station number
	FD8221	Communicate format	3	Baud rate, Data bit, stop bit, parity

	FD8222	Judgment time of ASC timeout	300	Unit ms, if set to be 0, it means no timeout waiting
	FD8223	Judgment time of reply timeout	0	Unit ms, if set to be 0, it means no timeout waiting
	FD8224	Start ASC	0	High 8 bits invalid
	FD8225	End ASC	0	High 8 bits invalid
	FD8226	Free format setting	8710	8/16 bits buffer; With/without start bit， With/without stop bit
COM3	FD8230	Communicate Mode (station number)	8710	255 (FF) is free mode， 1~254 is modbus station number
	FD8231	Communicate format	3	Baud rate, Data bit, stop bit, parity
	FD8232	Judgment time of ASC timeout	300	Unit ms, if set to be 0, it means no timeout waiting
	FD8233	Judgment time of reply timeout	0	Unit ms, if set to be 0, it means no timeout waiting
	FD8234	Start ASC	0	High 8 bits invalid
	FD8235	End ASC	0	High 8 bits invalid
	FD8236	Free format setting	8710	8/16 bits buffer; With/without start bit， With/without stop bit

7、 Subsection Power-off Retentive Zone of Timer T

Nr.	Function	Initial Value
FD8323	Set the retentive zone’s start tag of 100ms non-accumulation timer	
FD8324	Set the retentive zone’s start tag of 100ms accumulation timer	
FD8325	Set the retentive zone’s start tag of 10ms non-accumulation timer	
FD8326	Set the retentive zone’s start tag of 10ms accumulation timer	
FD8327	Set the retentive zone’s start tag of 1ms non-accumulation timer	
FD8328	Set the retentive zone’s start tag of 1ms accumulation timer	
FD8329	Set the retentive zone’s start tag of 1ms precise timer	

8、 Subsection power-off retentive zone of counter C

Nr.	Function	Initial Value
FD8330	Set the retentive zone’s start tag of 16 bits positive counter	
FD8331	Set the retentive zone’s start tag of 32 bits positive/negative counter	
FD8332	Set the retentive zone’s start tag of single-phase HSC	
FD8333	Set the retentive zone’s start tag of dual-phase HSC	
FD8334	Set the retentive zone’s start tag of AB-phase HSC	

※1：If you change special FLASH memory, it will take into effect after restart the PLC

Appendix 2 Instructions List

In this chapter, we will list all the instructions XC series PLC support. These instructions include: basic instructions, application instructions, special function instructions and motion control instructions. Also, we declare each instruction’s application range.

This part enables the users to check the instruction’s functions much faster. For the detailed application, please refer to《XC Series Programmable Controller【Instruction Part】》。

Appendix 2-1． Basic Instructions List

Mnemonic	Function
LD	Initial logical operation contact type NO (normally open)
LDI	Initial logical operation contact type NC (normally closed)
OUT	Final logic operation type coil drive
AND	Serial connection of NO
ANI	Serial connection of NC
OR	Parallel connection of NO
ORI	Parallel connection of NC
LDP	Rising edge pulse
LDF	Falling edge pulse
ANDP	Serial connection of rising edge pulse
ANDF	Serial connection of falling edge pulse
ORP	Parallel connection of rising edge pulse
ORF	Parallel connection of falling edge pulse
LDD	Read the point
LDDI	Read NC
ANDD	Read the point and serial connection
ANDDI	Read NC and serial connection
ORD	Read the point and parallel connection
ORDI	Read NC and parallel connection
OUTD	Output the point
ORB	Parallel connection of parallel multiply parallel circuit
ANB	Serial connection of parallel multiply parallel circuit
MCS	New bus line start
MCR	Bus line return
ALT	Alternate state
PLS	Rising edge pulse
PLF	Falling edge pulse
SET	Set a bit device permanently on
RST	Reset a bit device permanently off
OUT	Output counter coil
RST	Output reset, and current data reset to zero
END	I/O process and return to step0
GROUP	Instruction block fold start
GROUPE	Instruction block fold end
TMR	Time

Appendix 2-2. Applied instruction list

Sort	Mnemonic	Function	Suit Model				
			XC1	XC2	XC3	XC5	XCM
Program flow	CJ	Condition Jump	√	√	√	√	√
	CALL	Call subroutine	√	√	√	√	√
	SRET	Subroutine return	√	√	√	√	√
	STL	Flow start	√	√	√	√	√
	STLE	Flow end	√	√	√	√	√
	SET	Open the assigned flow, close the current flow	√	√	√	√	√
	ST	Open the assigned flow, not close the current flow	√	√	√	√	√
	FOR	Start of a FOR-NEXT loop	√	√	√	√	√
	NEXT	END of a FOR-NEXT loop	√	√	√	√	√
	FEND	End of main program	√	√	√	√	√
Data compare	LD=[※1]	LD activate if (S1)= (S2)	√	√	√	√	√
	LD>[※1]	LD activate if (S1)> (S2)	√	√	√	√	√
	LD<[※1]	LD activate if (S1)< (S2)	√	√	√	√	√
	LD<>[※1]	LD activate if(S1)≠(S2)	√	√	√	√	√
	LD>=[※1]	LD activate if(S1) >= (S2)	√	√	√	√	√
	LD<=[※1]	LD activate if(S1) <= (S2)	√	√	√	√	√
	AND=[※1]	AND activate if (S1)= (S2)	√	√	√	√	√
	AND>[※1]	AND activate if (S1)> (S2)	√	√	√	√	√
	AND<[※1]	AND activate if (S1)< (S2)	√	√	√	√	√
	AND<>[※1]	AND activate if(S1)≠(S2)	√	√	√	√	√
	AND>=[※1]	AND activate if(S1) >= (S2)	√	√	√	√	√
	AND<=[※1]	AND activate if(S1) <= (S2)	√	√	√	√	√
	OR=[※1]	OR activate if (S1)= (S2)	√	√	√	√	√
	OR>[※1]	OR activate if (S1)> (S2)	√	√	√	√	√
	OR<[※1]	OR activate if (S1)< (S2)	√	√	√	√	√
	OR<>[※1]	OR activate if(S1)≠(S2)	√	√	√	√	√
	OR>=[※1]	OR activate if(S1) >= (S2)	√	√	√	√	√
	OR<=[※1]	OR activate if(S1) <= (S2)	√	√	√	√	√
Data move	CMP[※1]	Data compare	√	√	√	√	√
	ZCP[※1]	Data zone compare	√	√	√	√	√
	MOV[※1]	Move	√	√	√	√	√
	BMOV	Block move	√	√	√	√	√
	FMOV[※1]	Fill move	√	√	√	√	√
	FWRT[※1]	FlashROM Written	√	√	√	√	√
	MSET	Zone set	√	√	√	√	√
	ZRST	Zone reset	√	√	√	√	√
	SWAP	The high bytes and low bytes exchange	√	√	√	√	√
	XCH[※1]	Data exchange	√	√	√	√	√
Sort	**Mnemonic**	**function**	**Suit model**				
			XC1	**XC2**	**XC3**	**XC5**	**XCM**
Data Operation	ADD[※1]	addition	√	√	√	√	√
	SUB[※1]	subtraction	√	√	√	√	√
	MUL[※1]	multiplication	√	√	√	√	√
	DIV[※1]	division	√	√	√	√	√
	INC[※1]	Increment	√	√	√	√	√
	DEC[※1]	decrement	√	√	√	√	√
	MEAN[※1]	mean	√	√	√	√	√
	WAND[※1]	Word and	√	√	√	√	√
	WOR[※1]	Word or	√	√	√	√	√
	WXOR[※1]	Word exclusive or	√	√	√	√	√
	CML[※1]	**Complement**	√	√	√	√	√
	NEG[※1]	Negative	√	√	√	√	√
Data shift	SHL[※1]	Arithmetic shift left		√	√	√	√
	SHR[※1]	Arithmetic shift right		√	√	√	√

	LSL※1	Logic shift left		√	√	√	√
	LSR※1	Logic shift right		√	√	√	√
	ROL※1	Rotation shift lift		√	√	√	√
	ROR※1	Rotation shift right		√	√	√	√
	SFTL※1	Bit shift left		√	√	√	√
	SFTR※1	Bit shift right		√	√	√	√
	WSFL	Word shift left		√	√	√	√
	WSFR	Word shift right		√	√	√	√
Data convert	WTD	Single word integer convert to double word integer		√	√	√	√
	FLT※1	16 bits integer convert to float		√	√	√	√
	FLTD※1	64 bits integer convert to float		√	√	√	√
	INT※1	Float convert to integer		√	√	√	√
	BIN	BCD convert to binary		√	√	√	√
	BCD	Binary convert to BCD		√	√	√	√
	ASCI	Hex convert to ASCⅡ		√	√	√	√
	HEX	ASCⅡ convert to Hex		√	√	√	√
	DECO	Coding		√	√	√	√
	ENCO	High bit coding		√	√	√	√
	ENCOL	Low bit coding		√	√	√	√

Sort	**Mnemonic**	**function**	**Suit Model**				
			XC1	**XC2**	**XC3**	**XC5**	**XCM**
Float Operation	ECMP※2	Float compare		√	√	√	√
	EZCP※2	Float zone compare		√	√	√	√
	EADD※2	Float addition		√	√	√	√
	ESUB※2	Float subtraction		√	√	√	√
	EMUL※2	Float multiplication		√	√	√	√
	EDIV※2	Float division		√	√	√	√
	ESQR※2	Float square root		√	√	√	√
	SIN※2	Sine		√	√	√	√
	COS※2	Cosine		√	√	√	√
	TAN※2	tangent		√	√	√	√
	ASIN※2	Float arcsin		√	√	√	√
	ACOS※2	Float arccos		√	√	√	√
	ATAN※2	Float arctan		√	√	√	√
Clock	TRD	Read RTC data		√	√	√	√
	TWR	Set RTC data		√	√	√	√

※1：All the instructions are 16bits except the instructions with ※1 which has 32bits. 32bits instructions are added D in front of its 16bits instruction. Such as ADD(16bits) / DADD(32bits).

※2: These instructions are 32bits, and have no 16bits format.

※3: √ means this series support the instruction.

Appendix 2-3． Special Instructions List

Sort	Mnemonic	Function	Suitable type				
			XC1	XC2	XC3	XC5	XCM
pulse	PLSY※1	Single segment no accelerate/decelerate pulse output		√	√	√	√
	PLSR※1	Relative position multi-segment pulse control		√	√	√	√
	PLSF※1	Changeable frequency pulse output		√	√	√	√
	PLSA※1	Absolute position multi-segment pulse control		√	√	√	√
	PLSNEXT/ PLSNT	change the pulse segment		√	√	√	√
	PLSMV※2	Save the pulse number in the register		√	√	√	√
	STOP	Pulse stop		√	√	√	√
High Speed Counter (HSC)	HSCR※2	Read high speed counter value		√	√	√	√
	HSCW※2	Write high speed counter value		√	√	√	√
MODBUS communication	COLR	MODBUS coil read		√	√	√	√
	INPR	MODBUS input coil read		√	√	√	√
	COLW	MODBUS single coil write		√	√	√	√
	MCLW	MODBUS multi coil write		√	√	√	√
	REGR	MODBUS register read		√	√	√	√
	INRR	MODBUS input register write		√	√	√	√
	REGW	MODBUS single register write		√	√	√	√
	MRGW	MODBUS multi register write		√	√	√	√
Free format communication	SEND	Free format data send		√	√	√	√
	RCV	Free format data receive		√	√	√	√
CANBUS communication	CCOLR	CANBUS coil read				√	
	CCOLW	CANBUS coil write				√	
	CREGR	CANBUS register read				√	
	CREGW	CANBUS register write				√	
Precision time	STR	Precision time		√	√	√	√
	STRR	Read precision time register		√	√	√	√
	STRS	Stop precision time		√	√	√	√
interrupt	EI	Enable interruption		√	√	√	√
	DI	Disable interruption		√	√	√	√
	IRET	Interruption return		√	√	√	√
BLOCK	BSTOP	Stop the block		√	√	√	√
	BGOON	Continue running the block		√	√	√	√
	WAIT	Wait		√	√	√	√
Read/write expansion	FROM	Read the module		√	√	√	√
	TO	Write the module		√	√	√	√
others	FRQM	Frequency measurement		√	√	√	√
	PWM	Pulse width modulation		√	√	√	√
	PID	PID control		√	√	√	√

※1：All the instructions are 16bits except the instructions with ※1 which has 32bits. 32bits instructions are added D in front of its 16bits instruction. Such as ADD(16bits) / DADD(32bits).

※2: These instructions are 32bits, and have no 16bits format.

※3: √ means this series support the instruction.

Appendix 2-4. MOTION CONTROL INSTRUCTIONS LIST

Mnemonic	FUNCTION	SUITABLE MODELS				
		XC1	XC2	XC3	XC5	XCM
ZRN※1	Origin return		√	√	√	√
DRVA※1	Absolute position		√	√	√	√
DRVI※1	Relative position		√	√	√	√
ABS	Absolute address					√
CCW※2	Circular anticlockwise interpolation					√
CHK	Servo end check					√
CW※2	Circular clockwise interpolation					√
DRV※2	High speed					√
DRVR	Electrical zero return					√
DRVZ	Machine zero return					√
FOLLOW※2	Follow movement instruction					√
INC	Incremental address					√
LIN※2	Linear interpolation positioning					√
PLAN※2	Plane selection					√
TIM※2	Delayed time					√
SETR	Set electrical zero					√
SETP※2	Set reference frame					√

※1: The instructions with ※1 sign have 32 bits form; generally 32 bits instructions are represented as adding D before 16 bits instructions, like this 32 bits ADD instructions is DADD;

※2: The instructions with ※2 sign are 32 bits form; they don’t have 16 bits form;

Appendix 3 Version for special function

Generally, the functions and instructions described in this manual don't have software and hardware requirements. But for some special functions, we have software and hardware versions requirement. Below, we list these requirements for the special functions;

function	Hardware version	Software version
Fill move 32 bits instruction DFMOV	V3.0 and above	V3.0 and above
Anti-trigonometric Operation	V3.0 and above	V3.0 and above
Read/write clock	V2.51 and above	V3.0 and above
Read/write high speed counter	V3.1c and above	V3.0 and above
Interrupt high speed counter	V3.1c and above	V3.0 and above
Read precise time	V3.0e and above	V3.0 and above
Stop precise time	V3.0e and above	V3.0 and above
C program block function	V3.0c and above	V3.0 and above
PID function	V3.0 and above	V3.0 and above
Block	V3.1i and above	V3.1h and above
Connect T-BOX	V3.0g and above	V3.0 and above
Connect G-BOX	V3.0i and above	V3.0 and above
Read/write XC-E6TCA-P、XC-E2AD2PT3DA、XC-E2AD2PT2DA	V3.1f and above	V3.1b and above
Expand register ED	V3.0 and above	V3.0 and above

Appendix 4 PLC Configuration List

This part is used to check each model's configurations. Via this table, we can judge the model easily;

○ selectable ×Not support √support

Models	clock	communication			expansion	BD board	NO. of high speed counter			No. of Pulse (T model/RT model)	External interrupt
		CAN	Modbus	Free			Increase	Pulse + director	AB phase		
XC1 Series											
XC1-10	×	×	×	×	×	×	×	×	×	×	×
XC1-16	×	×	×	×	×	×	×	×	×	×	×
XC1-24	×	×	√[※2]	×	×	×	×	×	×	×	×
XC1-32	×	×	√[※2]	×	×	×	×	×	×	×	×
XC2 Series											
XC2-14	○	×	○	○	×	×	5	2	2	2	3
XC2-16	○	×	×	×	×	×	5	2	2	2	3
XC2-24	○	×	√	√	×	√	5	2	2	2[※1]	3
XC2-32	○	×	√	√	×	√	5	2	2	2[※1]	3
XC2-48	○	×	√	√	×	√	5	2	2	2[※1]	3
XC2-60	○	×	√	√	×	√	5	2	2	2[※1]	3
XC3 Series											
XC3-14	×	×	○	○	×	×	4	2	2	2	1
XC3-24	○	×	√	√	√	√	6	3	3	2[※1]	3
XC3-32	○	×	√	√	√	√	6	3	3	2[※1]	3
XC3-48	○	×	√	√	√	√	4	2	2	2	3
XC3-60	○	×	√	√	√	√	4	2	2	2	3
XC3-19AR-E	○	×	√	√	×	×	4	2	2	2	3
XC5 Series											
XC5-24	○	×	√	√	√	√	2	1	1	4[※1]	5
XC5-32	○	×	√	√	√	√	2	1	1	4[※1]	5
XC5-48	○	√	√	√	√	√	6	3	3	2[※1]	3
XC5-60	○	√	√	√	√	√	6	3	3	2[※1]	3
XCM Series											
XCM-24	○	×	√	√	√	√	2	1	1	4[※1]	5
XCM-32	○	×	√	√	√	√	2	1	1	4[※1]	5

※1：If use BD board , Y1 can’t be used for pulse

※2：it just can be used for Modbus slave.

Appendix 5 common question A&Q

The following are the common questions may happen when using the PLC.

Q1：why the coil is not set when the condition is satisfied?

A1：the probable reasons:

(1) use one coil for many times, double coils output, the later coil has priority.

(2) some conditions reset the coil, please use monitor function to find the reset point and modify the program.

Q2： set on the pulse output instruction, the pulse doesn't output?

A2： there are many pulse output instructions in the program.

Q3：why connect the high speed counter but no counter value?

A3：the probable reasons:

(1) make sure the PLC has high speed counter photo-couplers.

(2) when the PLC hardware version is 2.5 and software version is 3.0, it is not available to use HSC, please update the hardware version to 3.0.

Q4：What's the difference between com1 and com2?

A4： the communication parameters of com1 and com2 can set by users. The difference is com1 can return to default parameters by stop PLC after power on.

Q5：Why free format communication is failure?

A5：check the communication parameters, if use com2, please set the FD8220 to HFF, FD8221 set to corresponding parameters.

Q6：why the real time clock(RTC) can not work?

A6： XC3-14 and XP1 do not have RTC function.

Q7：why PLC can not communicate with other device?

A7：the probable reasons:

(1) communication parameters: PLC com port and device parameters must be the same.

(2) communication cable: connection correct and good.

(3) communication serial port: check the serial port, download the PLC program, if download successful the serial port is no problem.

(4) ask manufacturer for help.

Q8：how long can the PLC battery be used?

A8： for 3-5 years.

Q9：why the temperature fluctuates serious under normal temperature when connecting the thermocouple with the temperature module?

A9：the probable reasons:

（1） check if the thermocouple cold point is short with the outside cover. If short, please change another thermocouple.

（2） the weak electricity such as outside interference, thermocouple, temperature module should separate from the strong electricity, make sure there is certain distance between them. If the device has motor, inverter, make sure to connect the ground correctly.