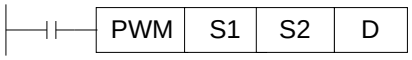
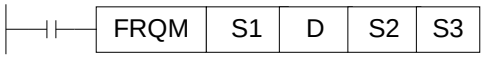
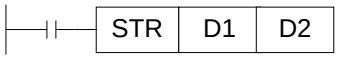
11 Special Function Instructions

In this chapter, we mainly introduce PWM pulse width modulation, frequency detect, precise time, interruption etc;

Instructions List

Mnemonic	Function	Circuit and soft components	Chapter
Pulse Width Modulation, Frequency Detection			
PWM	Output pulse with the specified occupied ratio and frequency		11-1
FRQM	Frequency Detection		11-2
Time			
STR	Precise Time		11-3
STRR	Read Precise Time Register		11-3
STRS	Stop Precise Time		11-3
Interruption			
EI	Enable Interruption		11-4-1
DI	Disable Interruption		11-4-1
IRET	Interruption Return		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

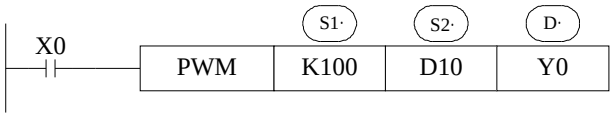
Word

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

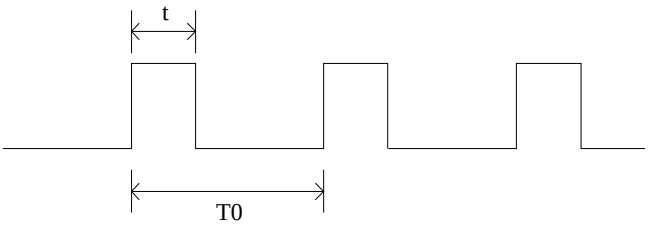
Bit

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

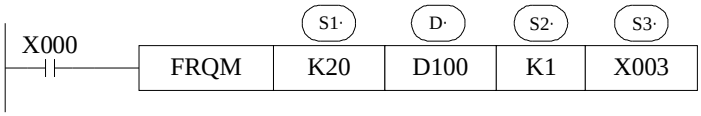
Word

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



- 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

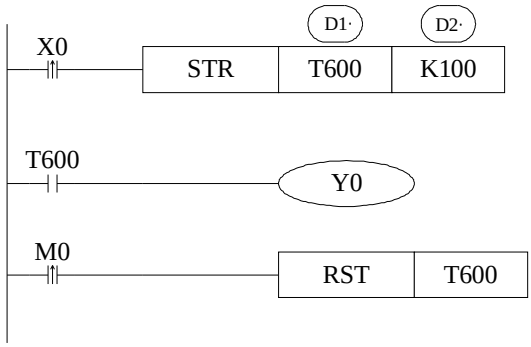
operands	system									constant	module	
	D	FD	ED	TD	CD	DX	DY	DM	DS	K/H	ID	QD
D2	●	●		●	●					●		

Bit

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

FUNCTIONS AND ACTIONS

《Precise Time》

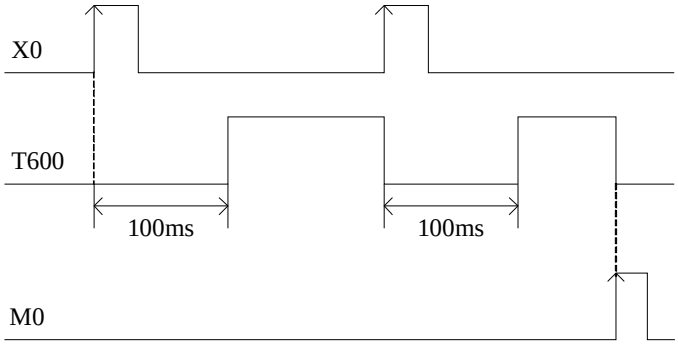


D1: Timer's number. Range: T600~T618 (T600、T602、T604…T618, the number should be even)

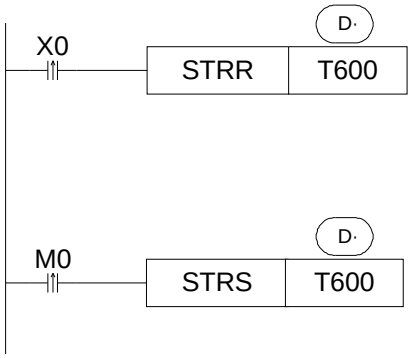
D2: Time Value

- 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:



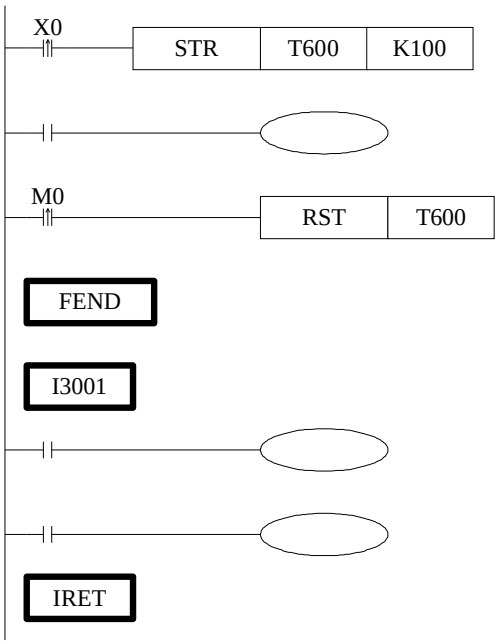
《read the precise time》、《stop precise time》



- 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

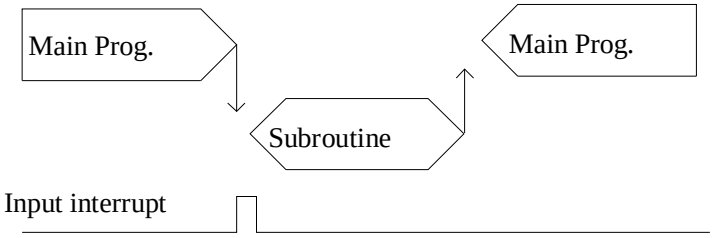
Timer's Nr.	Interruption Tag
T600	I3001
T602	I3002
T604	I3003
T606	I3004
T608	I3005
T610	I3006
T612	I3007
T614	I3008
T616	I3009
T618	I3010

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

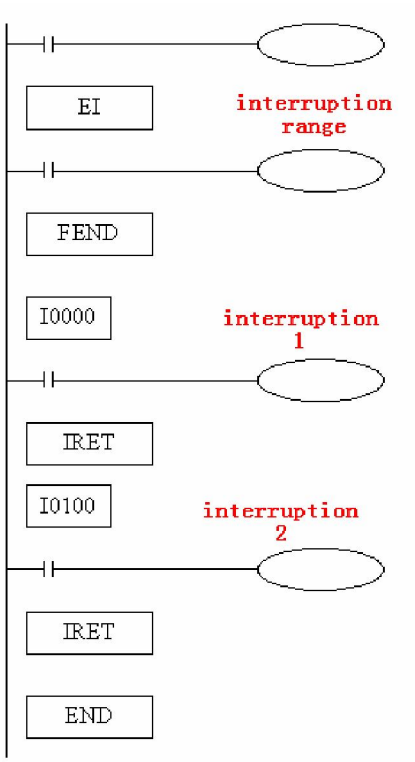
Input Terminal	Pointer Nr.		Disable the interruption instruction
	Rising Interruption	Falling Interruption	
X10	I0000	I0001	M8050
X7	I0100	I0101	M8051
X6	I0200	I0201	M8052

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

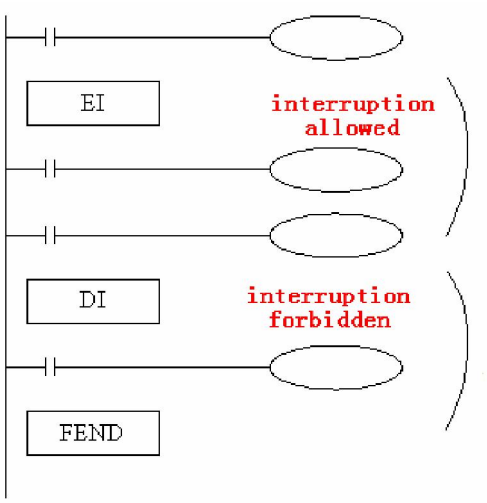
Interruption Instruction

Enable Interruption [EI]、Disable Interruption [DI]、Interruption Return [IRET]



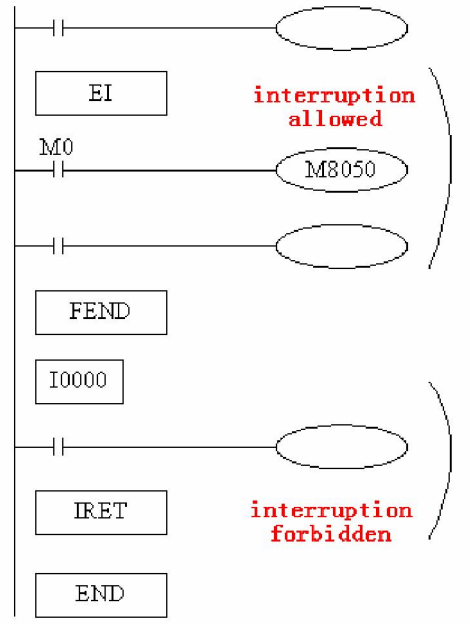
- If use EI instruction to allow interruption, then when scanning the program, if interruption input changes from OFF to be ON, then execute subroutine①、②, return to the original main program;
- Interruption pointer (I****) should be behind FEND instruction;
- PLC is default to allow interruption

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

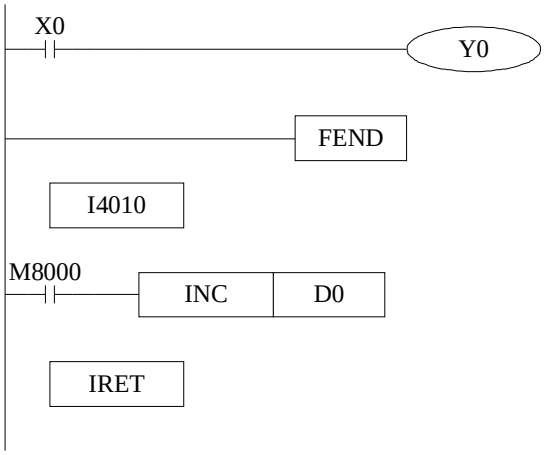


- Every input interruption is equipped with special relay (M8050~M8052) to disable interruption;
- In the left program, if use M0 to set M8050 “ON”, then disable the interruption input at channel 0.

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.



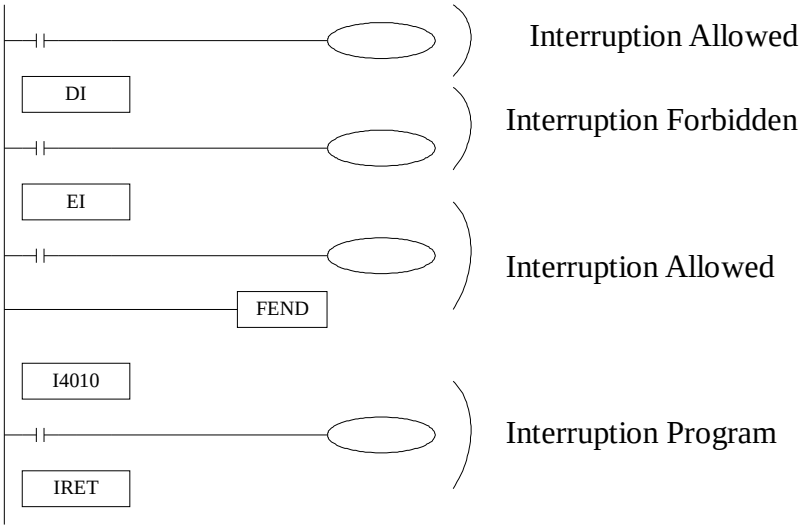
- Time interruption is default in open status, time interruption subroutine is similar with other interruption subroutine, it should be written behind the main program, starts with I40xx, ends with IRET.
- There are 10CH time interruptions. The represent method is I40**~I49** ("**" means time interruption's time, unit is ms. For example, I4010 means run one channel time interruption every 10ms.

Interruption Nr.

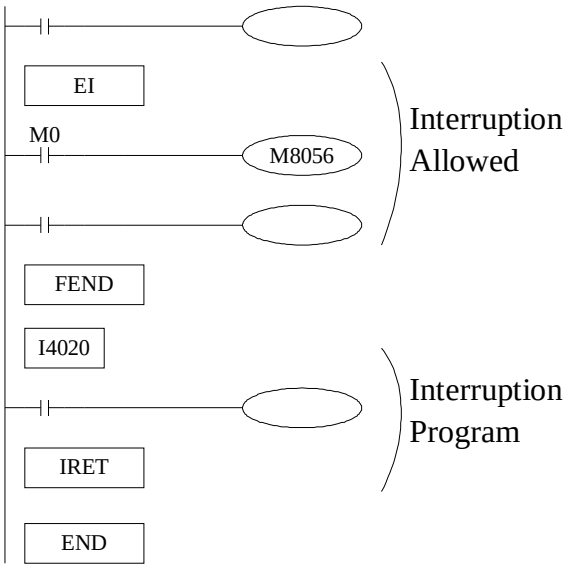
Interruption Nr.	Interruption Forbidden Instruction	Description
I40**	M8056	"**" represents time interruption's time, range from 1 to 99, unit is ms.
I41**	M8057	
I42**	M8058	
I43**	-	
I44**	-	
I45**	-	
I46**	-	
I47**	-	
I48**	-	
I49**	-	

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.