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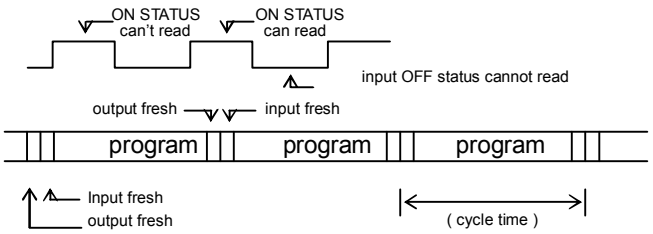
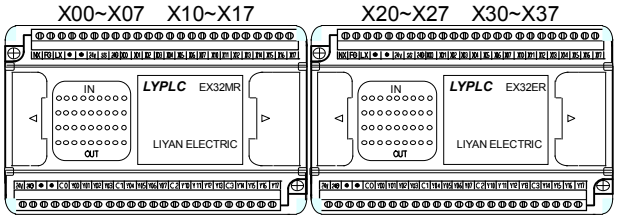
◎ Input Relays (X) & Output Relays (Y)

- ♦ Input Relay (X000 – X177) octal 128 points receive external switch signal, photo coupler isolation, and connect to input terminal directly.
- ♦ Output Relay (Y000 – Y177) octal 128 points output the signal to drive load, relay or photo coupler isolation and connect to output terminal directly.

◎ The timing of Input (X) & Output (Y)



◎ The number of Input (X) & Output (Y)



◎ Auxiliary Relay (M)

- ♦ Latch auxiliary relay (M000~ M499) decimal 500 points
- ♦ General auxiliary relay (M500~M1535) decimal
- ♦ Special auxiliary relay (M8000~M8255) decimal 256 points
- ♦ Please do not use undefined special auxiliary replay.
- ♦ This type of relay can not drive load directly.

◎ State Relay (Mnemonic S)

- ♦ State relay (S000~S499) decimal for latched.
- ♦ State relay (S500~S999) decimal for general.
- ♦ This type of relay is for SFC used.

◎ Pointer (Mnemonic P,I)

- ♦ The pointer (P00-P63) decimal 64 points
- ♦ The pointer (P) is for CJ, CALL branch used.
- ♦ The number of pointer can't use duplicate.
- ♦ The pointer (I) is for interrupt used.

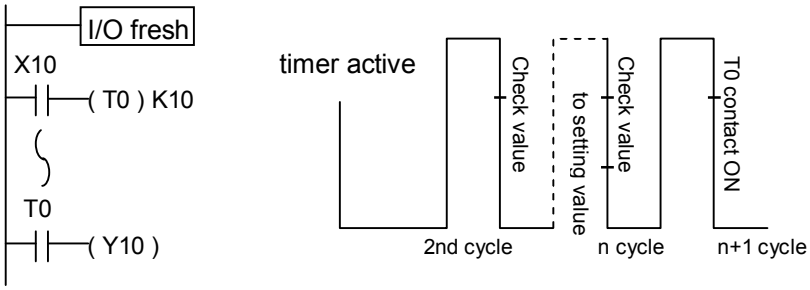
◎ Constant (Mnemonic K/H)

- ♦ Decimal constant (K) range
  16 bits: -32,768 ~ +32,767.
  32 bits: -2,147,483,648 ~ +2,147,483,647
- ♦ Hexadecimal constant (H) data range
  16 bits: 0000 ~ FFFF.
  32 bits: 00000000 ~ FFFFFFFF

◎ Timer (Mnemonic T) T000 ~ T255

- ♦ All of timers belong to count up internal clock pulse (10ms,100ms). When count data reaches the setting value, the contacts activated.
- ♦ When the drive condition OFF, the current value reset to “0” and the contact OFF, except integration Timer.
- ♦ Setting value of timers can constant K or can use using data register (D) indirectly.
- ♦ 100ms Timer: T000 ~ T199 (200 points) setting range: 0.1 ~ 3,276.7 seconds
- ♦ 10ms Timer : T200 ~ T245 (46 points) setting range: 0.01 ~ 327.67 seconds
- ♦ 1ms integration Timer : T246 ~ T249 (4 points) setting range: 0.001 ~ 32.767 seconds
- ♦ 100ms integration Timer : T250 ~ T255 (6 points) setting range: 0.1 ~ 3276.7 seconds

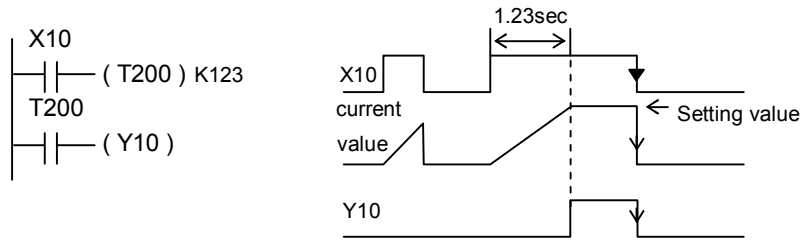
◎ Timer contact active condition and accuracy



- ♦ From above diagram, if the timer contact position put before timer coil, then the bad accuracy is “+2t”.

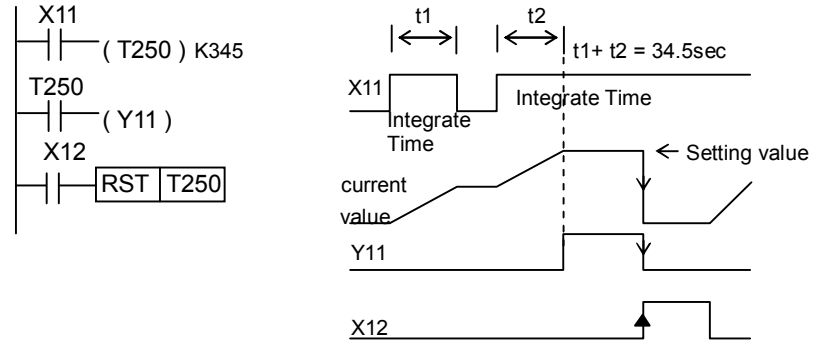
◎ The timing of Timer detailed action

- ♦ The timing of unlatched timer (General)



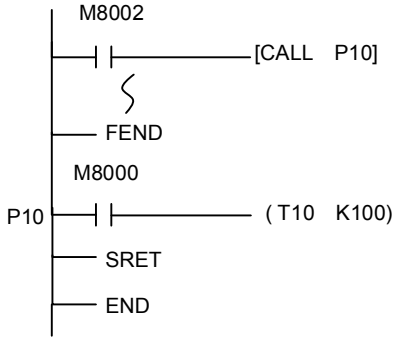
When input contact X10 ON, T200 start to count by 100ms counting method. When count value reaches to setting value, the contact act.
When count in the midway, input contact X10 OFF, the count current value will clear to “0”.
When count reaches to input contact X10 OFF, the current value of count will clear to “0” and contact returns.

- ♦ The timing of latched timer (Integration)



When input contact X11 ON, T250 count by 100ms counting method. When counting value reaches to setting value, the contact act.
When count in the midway, input contact X11 OFF, the unchanged current value of timer (t1) input to contact and then ON, then from current value to count up until to setting value, and contact act.
Integration timer needs to use RST instruction to clear the content and the contact.

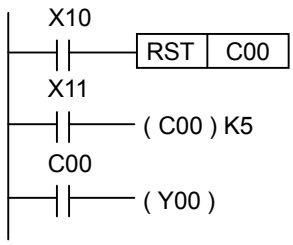
- ♦ Circular Timer



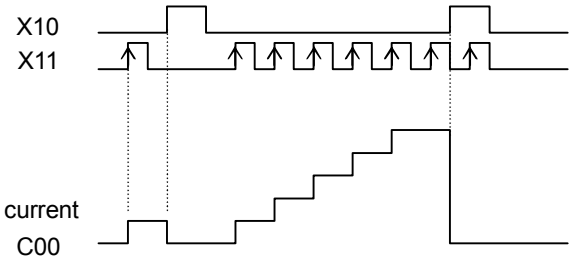
The program starts, enable T10 start to count, i.e. not count time to check if setting value reaches.
At this time, timer will become to circular timer, circulating count by 0 → 32767 → 65535 → 0

◎ Counter (Mnemonic C) C000 ~ C255

◎ 16 bits up counter (C000~ C199, range: 1 ~ 32,767)

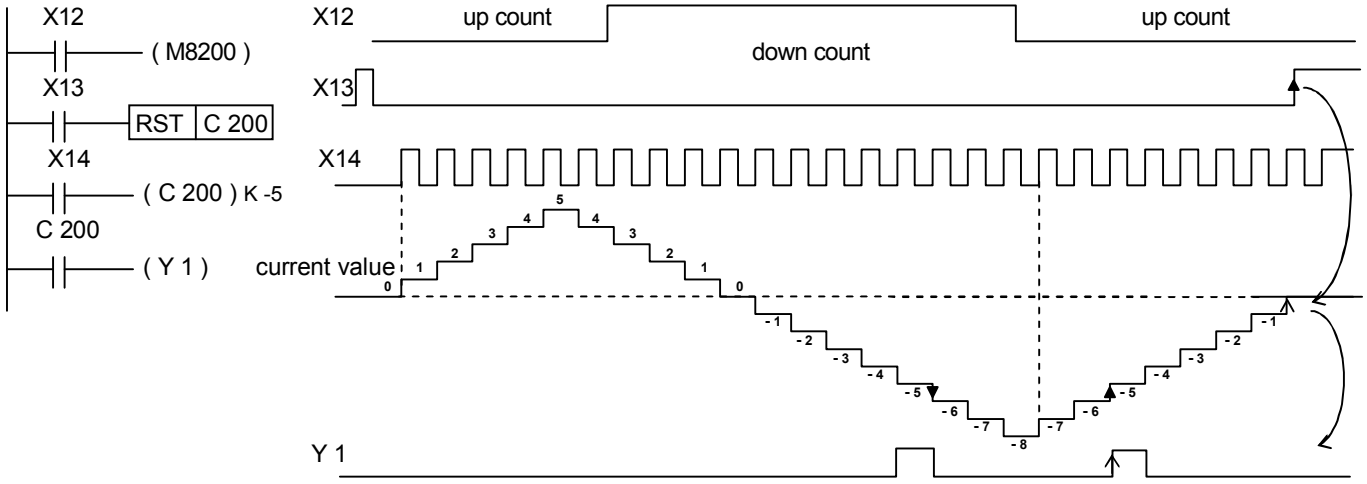


LD	X	10
RST	C	00
LD	X	11
OUT	C	00
	K	5
LD	C	00
OUT	Y	00



- ♦ The counter can be reset by RST at any time, value of counter is set to “0”, and contact signal is OFF.
- ♦ When X10 ON, clear C00 current value to “0” and contact turned OFF.
- ♦ When counter count the pulse (OFF→ON) number of X11, and when current value to the setting value, then the contact turned ON, and keep the current value.
- ♦ Counters can be set directly by using constant K or indirectly by using data register (D).
- ♦ Use data registers or special data registers to let content of data register become to setting value for the counter.
- ♦ The counter input signal ON or OFF must greater than program scan cycle time.
- ♦ If use other instruction to write a data which is greater than setting value to current value register, then when next count input is ON, counter output contact act and current value register will become to setting value.
- ♦ High Speed Counter operated by the principle of interrupt; this means they are event triggered and independent of cycle time.

◎ 32 bits up/down counter (C200~ C234) range: (-2,147,483,648 ~ +2,147,483,647)



- ♦ Through X14 count input to drive C200’s coil one time, the current value of counter will be increment or decrement. When the current value from ”-6” increase to “-5” or from “-4” decrease to “-5”, the output contact set to ON. If from ”-5” decrease to “-6” or from “-5” increase to “-4”, then output contact OFF ;i.e., current value = setting value ON, others are OFF.
- ♦ If the current value is +2,147,483,647, when increment by “1” will change to -2,147,483,648.
  If the current value is -2,147,483,648, when decrement by “1” will change to +2,147,483,647.
  This counter we called it to circular counter.
- ♦ The counting direction assigned by special auxiliary relay M8200 - M8234. If M8xxx ON, then belong to down counter. If M8xxx OFF, then belong to up counter.
- ♦ If use other instruction to write a data which is greater than setting value to current value register, then when next count input, counter will still count as usual, but output contact will not be changed.

◎ High Speed Counter (C235~ C255) (High speed counter operated by interrupt and independent cycle time)

♦♦♦ 32 bits up/down latched counter ♦♦♦

ITEM	1 phase 1 direction	1 phase bi-direction	2 phase bi-direction
Counter number	C235 ~ C245	C246 ~ C250	C251 ~ C255
Counter direction	According to ON/OFF by M8235 ~M8245 to decided direction	According different input point to decided up count or down count	When A-phase ON, B-phase: 0→1: Up, 1→0:Down
Direction monitor	- - -	Monitor M8246 ~ M8255 status, then can know counter direction	

♦♦♦ Difference of the 16 bit / 32 bit counters ♦♦♦

ITEM	16 bit counter	32 bit counter
Direction	Up counter	Up / down counter direction can be change
Value range	0 ~ 32,767	-2,147,483,648 ~ +2,147,483,647
Setting method	Constant (16 bit) or data register	Constant (32 bit) or a pair of register
Current value	No change to maximum value	Change to maximum value (ring counter)
Output contact	To maximum value set and keep status	Up counter: keep status, down counter: reset
reset	When RST instruction be driven, the value of counter reset to zero and output contact OFF	

◎ NOTE

♦ The input signal of high speed counter cannot be higher than counting speed.

♦ If an input is already being used by a high speed counter, it cannot be used for any other high speed counters or for any other purpose, like as an interrupt input.

♦♦♦ Device Table of High Speed Counter ♦♦♦

Input		X0	X1	X2	X3	X4	X5	X6	X7	Note
1 Phase without start/reset	C235	U/D								
	C236		U/D							
	C237			U/D						
	C238				U/D					
	C239					U/D				
	C240						U/D			
1 Phase with start/reset	C241	U/D	R							
	C241(M8025=1)	C	d							
	C242			U/D	R					
	C242(M8025=1)			C	d					
	C243					U/D	R			
	C243(M8025=1)					C	d			
	C244	U/D	R					S		
	C244(M8025=1)							U/D		Note*2
	C245			U/D	R				S	
	C245(M8025=1)								U/D	Note*2
1 Phase bi-direction	C246	U	D							
	C247	U	D	R						
	C248				U	D	R			
	C248(M8025=1)				U	D				
	C249	U	D	R				S		
	C250				U	D	R		S	
A-B Phase counter	C251	A	B							
	C252	A	B	R						
	C253				A	B	R			
	C253(M8025=1)				A	B				
	C254	A	B	R				S		
	C254(M8025=1)			A			B			Note*1
	C255				A	B	R		S	
	C255(M8025=1)							A	B	Note*2

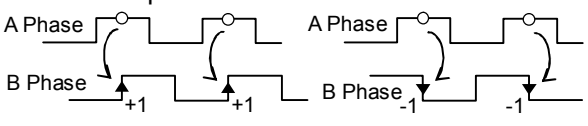
U: up counter input, D: Down counter input, A: A-phase input, B: B-phase input, R: Reset input, S: Start input, d: DIR, C: Counter input

Note*1 : J1n no this function. Note*1 : J2n MR-Type only. M8025 has to be set first, and then execute HSC function.

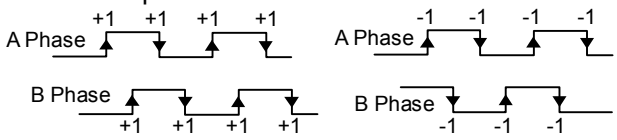
♦ Inputs X0 ~X7 cannot be used for more than one counter. For example:
If C235 is used the following counters (C241, C244, C246, C247, C249, C251, C252, C254, I0xx & SPD X0 [S2] [D]) cannot be used.

♦♦Following is 2 Phase Encoder Forward & Reverse Pulse Conduction, have to use AB Phase Counter ♦♦

♦one-fold pulse count mode

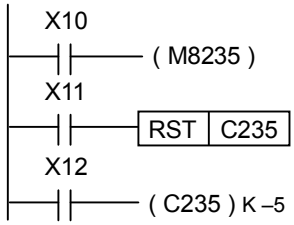


♦four-fold pulse count mode



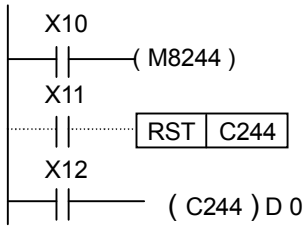
◎ 1 Phase High Speed Counter (High speed counter operated by interrupt and independent cycle time)

◎ 1 Phase 1 Input without start/reset C235~C240 (control M8xxx ON/OFF status, then can set Cxxx counting direction)



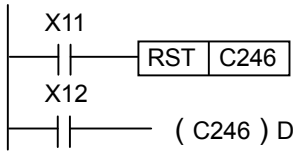
♦This example used X10 control C235 counting direction, X00 is counting input.
♦When X12 ON, C235 start counting the input pulse (OFF→ON) of X00.
♦When X11 ON, reset C235 current value to ”0”, and the contact turned OFF.

◎ 1 Phase 1 Input with start/reset C241~C245 (control M8xxx ON/OFF status, then can set Cxxx counting direction)



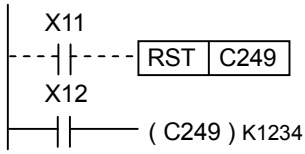
♦X10 control counting direction, X00 counting input, X01 reset input, X06 start input.
♦When X12 ON and X06 ON, C244 start counting the input pulse (OFF→ON) of X00.
♦When X11 or X01 ON, reset C244 current value to ”0”, and the contact turned OFF.
♦This line instruction can ignored, because can used X01 reset C244.
♦This example the content of (D1, D0) is the setting value.

◎ 1 Phase 2 Input without start/reset C246 (monitor M8xxx ON/OFF status, then can know Cxxx counting direction)



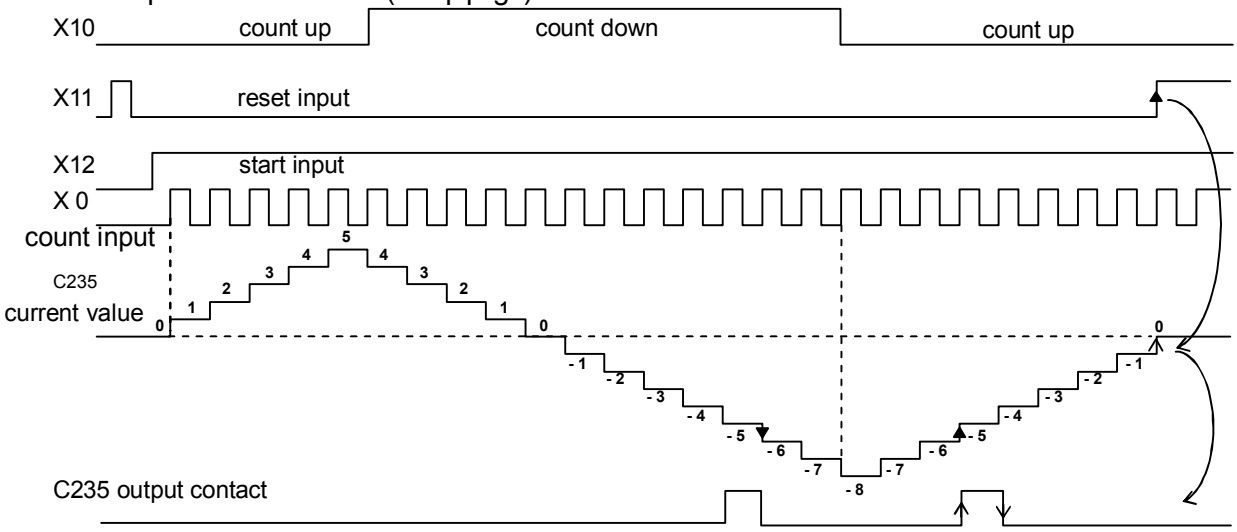
♦X00 as count up input point, X01as count down input point.
♦When X12 ON, C246 start counting the input pulse (OFF→ON) of X00 and X01.
♦When X11 ON, reset C246 current value to ”0”, and the contact turned OFF.

◎ 1 Phase 2 Input with start/reset C247~C250 (monitor M8xxx ON/OFF status, then can know Cxxx counting direction)



♦X00 count up input point, X01 count down input point, X02 reset input,X06 start input.
♦When X12 and X06 ON, C249 counting the input pulse (OFF→ON) of X00 and X01.
♦When X11 or X02 ON, reset C249 current value to ”0”, and the contact turned OFF.

◎ 1 Phase 1 Input without start/reset (ex. up page)



♦ C235 use X000 as the interrupt pulse input point. (X12 is not pulse input point. Just as enable signal)

♦ Through X00 count input to drive C235 one time, current value of counter will be increment or decrement. When current value from ”-6” increase to “-5” or from “-4” decrease to “-5”, output contact is ON. If from ”-5” decrease to “-6” or from “-5” increase to “-4”, output contact is OFF ;i.e., current value = setting value ON, other OFF.

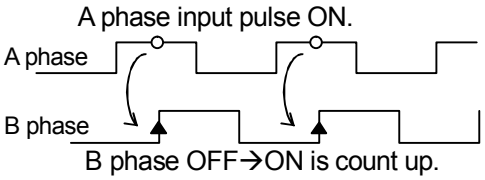
♦ If the current value is +2,147,483,647, when increment by “1” will change to -2,147,483,648.
If the current value is -2,147,483,648, when decrement by “1” will change to +2,147,483,647.
This counter we called it to circular counter.

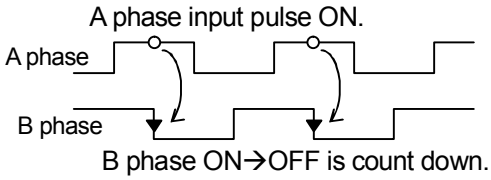
♦ The counting direction assigned by special auxiliary relay M8235 - M8240.(i.e. X10 control counting direction)

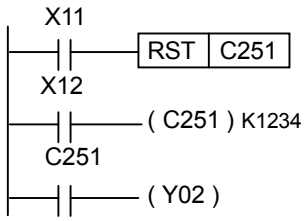
♦ When the reset input to X11 is ON, C235 current value reset to ”0”, and contact turned OFF.

◎ 2 (A-B) Phase 2 Input High Speed Counter (This counter operated by interrupt and independent cycle time)

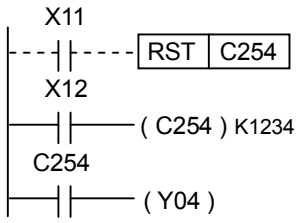
- ♦ EX-serial can use 2 point 2 phase 32 bits up/down counter at the same time.
- ♦ Monitor M8xxx ON/OFF status, then can know the counting direction of Cxxx.
- ♦ The counting direction of this type counter are decided by A phase and B phase, when the input pulse is ON of A phase, and when B phase input pulse is OFF→ON, then is up counter, when B phase ON→OFF then is down counter.







- ♦ This example use X00 as A phase input, X01 as B phase input, without start/rest.
- ♦ When X11 ON, reset C251 current value to ”0”, and the contact turned OFF.
- ♦ When X12 ON, enable the C251 start counting.
- ♦ Whether count up or count down, when current value = setting value, Y02 ON, other OFF.



- ♦ X00 as A phase input, X01 as B phase input, X02 as reset input, X06 as start input.
- ♦ When X11 or X02 ON, reset C254 current value to ”0”, and the contact turned OFF.
- ♦ When X12 ON, enable the C254 start counting.
- ♦ Whether count up or count down, when current value = setting value, Y04 ON, other OFF

◎ Data Register (D)

◎ Latched Data Register (D000 – D255) 256 Points

◎ General Data Register (D256 – D3999) : General data register can be used as same as file register

♦ All of data register are 16 bits (the msb is sign), also can pair of any one to 32 bits data.

◎ Special Data Register (D8000 – D8255) 256 Points

♦ The special data register is used to control or monitor the programmable logic controller internal status.
♦ When the power OFF→ON, all of the data register are set to initial value.

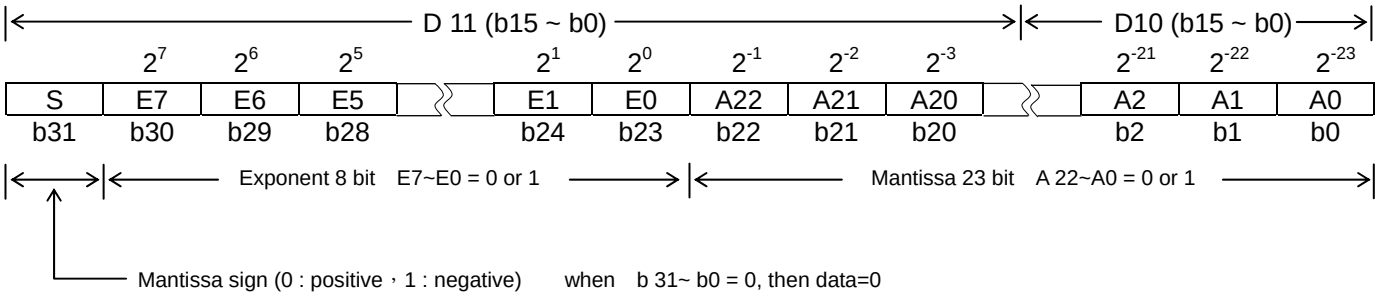
◎ Index Register (V, Z)

♦ 16 bits operation mode V & Z all is 16 bits register. 32 bits operation mode pair of (V, Z) as 32 bits register
V is upper word, Z is lower word.
♦ Sometime the use of multiple index registers V & Z is necessary in larger program or the program need handle large quantities of data.
For Example : MOV D0Z,D100
Just change index Z value, then can move the content of D00~D99 to D100.
♦ Following instruction format can modified by index V,Z
KnXxxZ, KnYxxZ, KnMxxZ, KnSxxZ, TxxZ, CxxZ, DxxZ
♦ Following is error instruction format
KnZMxx (index register V,Z can't connect to Kn directly)
♦ Example

```
MOV   K10, Z          ; index Z=10
ADD   D0, D2, D100Z   ; D0+D2 → D110
```

◎ Binary Floating Data

Binary floating data is a data register which use an continuous serial number, for example (D11, D10).



Binary floating data = $\pm (2^0+A22\times2^{-1}+A21\times2^{-2}+\ldots\ldots+A0\times2^{-23}) \times2^{(E7\times2^7+E6\times2^6+\ldots\ldots+E0\times2^0)}/2^{127}$
(Example) D11,D10=1 11000001 0110000 , 0000000000000000
S=1，E7=1，E6=1，E5~E1=0，E0=1 ， A22=0，A21=1，A20=1，A19~A0=0

Binary floating data = $-(2^0+0\times2^{-1}+1\times2^{-2}+1\times2^{-3}+\ldots\ldots+0\times2^{-23}) \times2^{(1\times2^7+0\times2^6+\ldots\ldots+1\times2^0)}/2^{127}$
$= -1.375\times2^{193}/2^{127} = -1.375\times2^{66}$

positive and negative sign is decided by b31, can't use negation.

♦ Binary floating data range : 1.18×10^{-38} to 3.40×10^{38}
♦ The using of zero flag(M8020), negative flag(M8021), carry flag(M8022), the flag action of floating operation as follows,
Zero flag : when result is 0, then it is 1.
Negative flag : when result not reach minimum unit, when it is not 0, then it is 1.
Carry flag : when result more than absolute value using range, then it is 1.