2. Function Description of Component

2-1 Component Tables

2-1-1 M Series PLC Component Table

Item	Description
Input at X	X0 ~ X777, 512 points, Numbered by octal.
Output at Y	Y0 ~ Y777, 512 points, Numbered by octal.

Auxiliary Relay (M)	General	M0 ~ M1999, 2000 points	
	Latched	M2000 ~ M5119, 3120 points	
	Special	M9000 ~ M9255, 256 points	
Step Relay (S)	Initial	S0 ~ S9, 10 points	
	General	S10 ~ S499, 490 points	
	Latched	S500 ~ S899, 400 points	
	For Annunciating	S900 ~ S999, 100 points, Latched	
Timer (T)	100 ms	T0 ~ T199, 200 points, for Subroutine T192 ~ T199	
	10 ms	T200 ~ T245, 46 points	
	1 ms (Retentive)	T246 ~ T249, 4 points, Latched	
	100 ms (Retentive)	T250 ~ T255, 6 points, Latched	
Counter (C)	16-bit Up	C0 ~ C99, 100 points	
		C100 ~ C199, 100 points, Latched	
	32-bit Up/Down	C200 ~ C219, 20 points	
		C220 ~ C234, 15 points, Latched	
High Speed Counter (C)	32-bit Up/Down, Latched	C235 ~ C245, 11 points, 1-Phase Counter	Total: 6 points Max.
		C246 ~ C250, 5 points, 2-Phase Counter	
		C251 ~ C255, 5 points, A/B Phase Counter	
Data Register (D)	General	D0 ~ D6999, 7000 points	
	Latched	D7000 ~ D8191, 1192 points	
	File Register	D1000 ~ D7999, 500 points for each unit, 7000 points Max.	
	Special	D9000 ~ D9255, 256 points	
Index Registers (V), (Z)		V0 ~ V7, Z0 ~ Z7, 16 points	
Branch Level (P)		P0 ~ P255, 256 points, for CJ, CALL use	
Interrupt Level (I)	External Interrupt	I00□ ~ I50□ , 6 points	
	Timer Interrupt	I6□ □ ~ I8□ □ , 3 points	
	Counter Interrupt	I010 ~ I060, 6 points	
Nest Level (N)		N0 ~ N7, 8 points, for MC and MCR	

Decimal Constants (K)	16 bits	-32,768 ~ 32,767
	32 bits	-2,147,483,648 ~ 2,147,483,647
Hexadecimal Constants (H)	16 bits	0H ~ FFFFH
	32 bits	0H ~ FFFFFFFFH

2-1-2 VB Series PLC Component Table

Item	Description	
Input at X	VB0 Series	X0 ~ X77, 64 points, ASCII
	VB1 Series	X0 ~ X177, 128 points, ASCII
	VB2 Series	X0 ~ X377, 256 points, ASCII
Output at Y	VB0 Series	Y0 ~ Y77, 64 points, ASCII
	VB1 Series	Y0 ~ Y177, 128 points, ASCII
	VB2 Series	Y0 ~ Y377, 256 points, ASCII

Auxiliary Relay (M)	General	M0 ~ M1999 and M4000 ~ M5119, Total 3120 points	
	Latched	M2000 ~ M3999, 2000 points	
	Special	M9000 ~ M9255, 256 points	
Step Relay (S)	Initial	S0 ~ S9, 10 points	
	General	S10 ~ S499, 490 points	
	Latched	S500 ~ S899, 400 points	
	For Annunciating	S900 ~ S999, 100 points, Latched	
Timer (T)	100mS	T0 ~ T199, 200 points, for Subroutine T192 ~ T199	
	10mS	T200 ~ T245, 46 points	
	1 ms (Retentive)	T246 ~ T249, 4 points, Latched	
	100 ms (Retentive)	T250 ~ T255, 6 points, Latched	
Counter (C)	16-bit Up	C0 ~ C99, 100 points	
		C100 ~ C199, 100 points, Latched	
	32-bit Up/Down	C200 ~ C219, 20 points	
		C220 ~ C234, 15 points, Latched	
High Speed Counter (C)	32-bit Up/Down, Latched	C235 ~ C245, 11 points, 1-Phase Counter	Total: 6 points Max.
		C246 ~ C250, 5 points, 2-Phase Counter	
		C251 ~ C255, 5 points, A/B Phase Counter	
Data Register (D)	General	D0 ~ D6999 and D7512 ~ D8191, Total 7680 points	
	Latched	D7000 ~ D7511, 512 points	
	File Register	D1000 ~ D7999, 500 points for each unit, 7000 points Max.	
	Special	D9000 ~ D9255, 256 points	
Index Registers (V), (Z)		V0 ~ V7, Z0 ~ Z7, 16 points	
Branch Level (P)		P0 ~ P255, 256 points, for CJ, CALL use	
Interrupt Level (I)	External Interrupt	I00□ ~ I50□ , 6 points	
	Timer Interrupt	I6□ □ ~ I8□ □ , 3 points	
	Counter Interrupt	I010 ~ I060, 6 points	
Nest Level (N)		N0 ~ N7, 8 points, for MC and MCR	

Decimal Constants (K)	16 bits	-32,768 ~ 32,767
	32 bits	-2,147,483,648 ~ 2,147,483,647
Hexadecimal Constants (H)	16 bits	0H ~ FFFFH
	32 bits	0H ~ FFFFFFFFH

2-1-3 VH Series PLC Component Table

Item	Description
Input at X	X0 ~ X77, 64 points, Numbered by octal.
Output at Y	Y0 ~ Y77, 64 points, Numbered by octal.

Auxiliary Relay (M)	General	M0 ~ M383, 384 points	
	Latched	M384 ~ M511, 128 points	
	Special	M9000 ~ M9255, 256 points	
Step Relay (S)	Initial	S0 ~ S9, 10 points, Latched	
	Latched	S10 ~ S127, 118 points	
Timer (T)	100 ms	T0 ~ T62, 63 points	
	10 ms	T32 ~ T62, 31 points (When M9028=ON)	
	1 ms	T63, 1 point	
Counter (C)	16-bit Up	C0 ~ C15, 16 points	
		C16 ~ C31, 16 points, Latched	
High Speed Counter (C)	32-bit Up/Down, Latched	C235 ~ C245, 11 points, 1-Phase Counter	Total: 6 points Max.
		C246 ~ C250, 5 points, 2-Phase Counter	
		C251 ~ C254, 4 points, A/B Phase Counter	
Data Register (D)	General	D0 ~ D127, 128 points	
	Latched	D128 ~ D255, 128 points	
	Special	D9000 ~ D9255, 256 points	
Index Registers (V), (Z)		V0 ~ V7, Z0 ~ Z7, 16 points	
Branch Level (P)		P0 ~ P63, 64 points, for CJ, CALL use	
Interrupt Level (I)	External Interrupt	I00□ ~ I50□ , 6 points	
	Timer Interrupt	I6□ □ ~ I8□ □ , 3 points	
	Counter Interrupt	I010 ~ I060, 6 points	
Nest Level (N)		N0 ~ N7, 8 points, for MC and MCR	

Decimal Constants (K)	16 bits	-32,768 ~ 32,767
	32 bits	-2,147,483,648 ~ 2,147,483,647
Hexadecimal Constants (H)	16 bits	0H ~ FFFFH
	32 bits	0H ~ FFFFFFFFH

2-2 Input Point X and Output Point Y

2-2-1 Input Point (X devices)

A PLC via Input Points to read the external status (switches or detectors ON/OFF signals) for the PLC operation.

2-2-2 Output Point (Y devices)

The coil of Output Points may direct drives external appliance. Via Output Relays or Transistors transmit the PLC operation result to the external devices. These contacts of coils are available set as either “normally open”(NO) or “normally closed”(NC) configuration, which handle various loads (Ex: motors, electromagnetic valves, and electromagnetic contactor .... etc.) to execute the control actions.

2-2-3 The Assigned I/O Point Identify Numbers of M Series

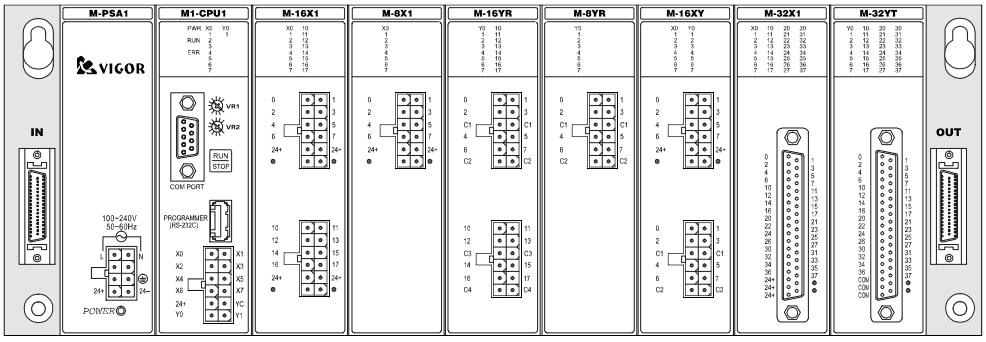
- The assigned identify numbers of Input Points use the ASCII codes, there will be 512 points available maximally. The ranges are: X0 ~ X7, X10 ~ X17,....., X770 ~ X777
- The assigned identify numbers of Output Points use the ASCII codes, there will be 512 points available maximally. The ranges are: Y0 ~ Y7, Y10 ~ Y17,....., Y770 ~ Y777
- The CPU module (M1-CPU1) will takes 16 input points and 16 output points; the X/Y assigned identify numbers are described as below:

Input (X)	Real accessible input points	X0 ~ X7
	Reserved for the system	X10 ~ X17
Output (Y)	Real accessible output points	Y0 and Y1
	Reserved for the system	Y2 ~ Y7,Y10 ~ Y17

- The X/Y assigned identify numbers of I/O module are arrange in order from left to right, start by the nearest CPU module. Here are the example diagrams below:

Ex1:

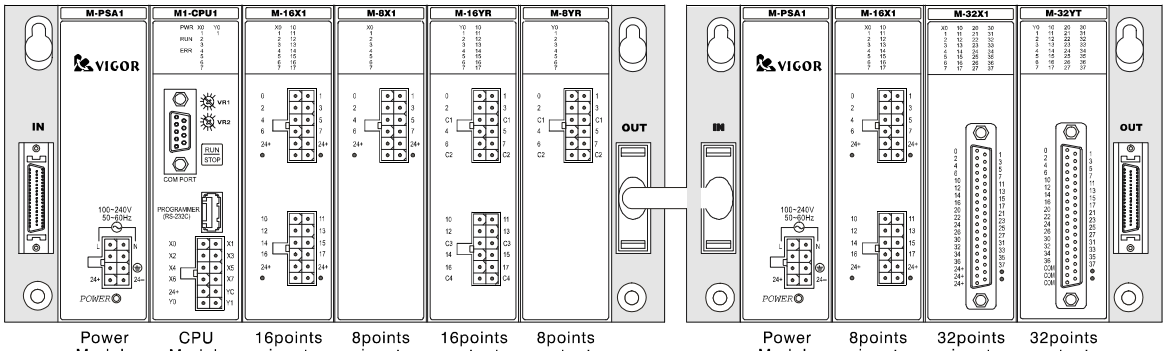
The CPU module and other I/O module installed in the M-8BS base



Ex2:

The CPU module and other I/O module installed in a M-5BS base

The expanding I/O module in a M-3BS base

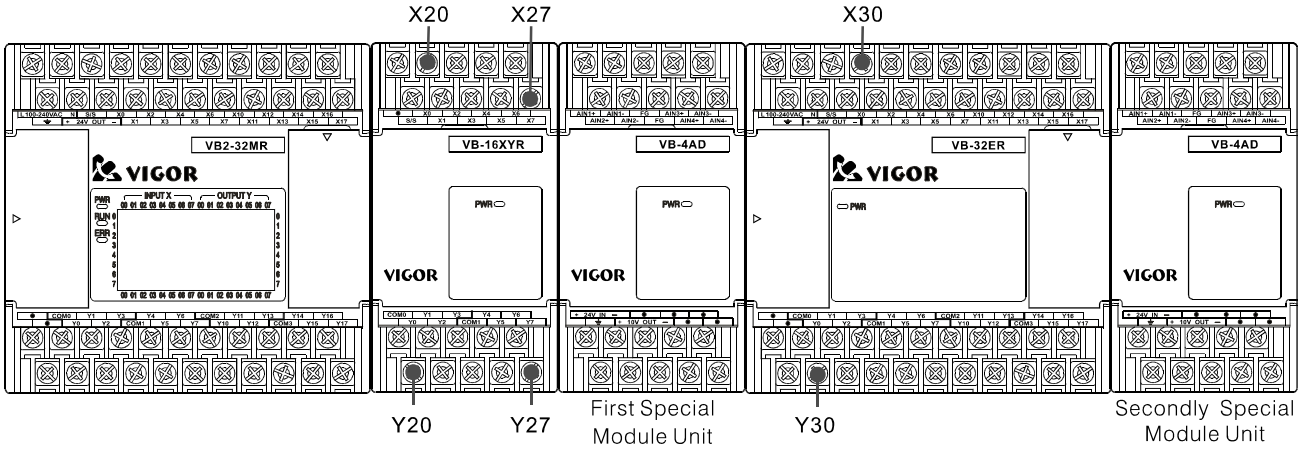


2-2-4 The Assigned I/O Point Identify Numbers of VB Series

- The assigned identify numbers of Input/Output Points use the octal number code.
- The X/Y assigned identify numbers for the VB series Main Unit are described as below:

Models	VB0-14M	VB0-20M	VB0-28M	VB0-32M	VB1-14M	VB1-24M	VB1-32M	VB2-16M	VB2-32M
Input (X)	X0 ~ X7 (8 points)	X0 ~ X13 (12 points)	X0 ~ X17 (16 points)	X0 ~ X17 (16 points)	X0 ~ X7 (8 points)	X0 ~ X15 (14 points)	X0 ~ X17 (16 points)	X0 ~ X7 (8 points)	X0 ~ X17 (16 points)
Output (Y)	Y0 ~ Y5 (6 points)	Y0 ~ Y7 (8 points)	Y0 ~ Y13 (12 points)	Y0 ~ Y17 (16 points)	Y0 ~ Y5 (6 points)	Y0 ~ Y11 (10 points)	Y0 ~ Y17 (16 points)	Y0 ~ Y7 (8 points)	Y0 ~ Y17 (16 points)

- The X/Y assigned identify numbers diagram and descriptions for VB series Expansion Units



- The X/Y assigned identify numbers for the VB series Main Unit are X0 ~ X17/Y0 ~ Y17 without exception. So, the first Expansion Module assigned I/O identify numbers will start at X20/Y20.
- The X/Y assigned identify numbers for the VB series Special Modules are K1 ~ K6, and they would not occupy any I/O port.
- The modules using BFM (BUFFER Memory see P.189) to communicate with the Main Unit, which defined as Special Modules. The VB-PWR is a power extend module, it would not occupy the Special Module assigned identify numbers.
- The VB-8XY Expansion Module would occupy 8 input points and 8 output points.
- The maximum Input/Output points: VB0 series 128 points X0 ~ X77, Y0 ~ Y77
  VB1 series 256 points X0 ~ X177, Y0 ~ Y177
  VB2 series 512 points X0 ~ X377, Y0 ~ Y377
- The maximum available Special Modules: VB0 series 4 Special Modules Max.
  VB1 series 8 Special Modules Max.
  VB2 series 16 Special Modules Max.
- A Main Unit to use its I/O Expansion Slot connected with Expansion Units, Expansion Modules and Special Modules is available up to 31 units.
- The statement about I/O expand

  The VB series PLC Main Unit and Expansion Unit included a power supply unit, but the Expansion Module and Special Module does not have a power unit, those module needs a power source to get power (for example from a Main Unit, Expansion Unit or VB-PWR Power Expansion Unit).

  The statement of available modules amount with a Main Unit, Expansion Unit or VB-PWR Power Expansion Unit:

  Two important connecting limits from a Main Unit to Expansion Modules:

  (1) [(The amount of Expansion Modules)+(The amount of Special Modules)×2]≦4

  (2) All equipments using power form the Main Unit (including itself & Modules), the output points [(The amount of "ON" status relays×6)+(The amount of "ON" status transistors)]≦192

  Two important connecting limits from an Expansion Unit to Expansion Modules:

  (1) [(The amount of Expansion Modules)+(The amount of Special Modules)×2]≦12

  (2) All equipments using power form the Unit (including itself & Modules), the output points [(The amount of "ON" status relays×6)+(The amount of "ON" status transistors)]≦192

  Two important connecting limits from a VB-PWR Power Expansion Unit to Expansion Modules:

  (1) [(The amount of Expansion Modules)+(The amount of Special Modules)×2]≦12

  (2) All equipments using power form the VB-PWR Power Expansion Unit, the output points [(The amount of "ON" status relays×6)+ (The amount of "ON" status transistors)]≦288

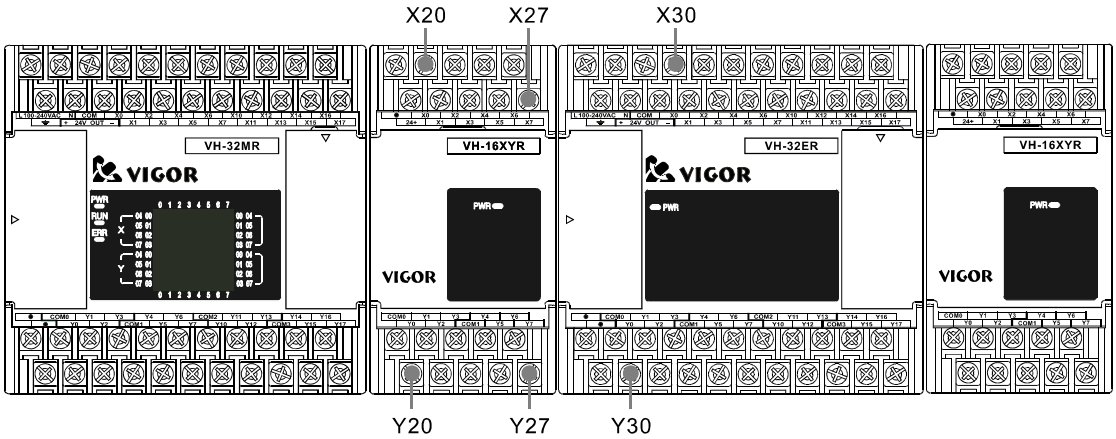
2-2-5 The Assigned I/O Point Identify Number of VH Series

- The assigned identify numbers of Input/Output Points use the octal number code.
- The X/Y assigned identify numbers for the VB series Main Unit are described as below:

Models	VH-10MR	VH-14MR	VH-20MR	VH-24MR	VH-28MR	VH-32MR	VH-40MR	VH-60MR
Input (X)	X0 ~ X5 (6 points)	X0 ~ X7 (8 points)	X0 ~ X13 (12 points)	X0 ~ X15 (14 points)	X0 ~ X17 (16 points)	X0 ~ X17 (16 points)	X0 ~ X27 (24 points)	X0 ~ X43 (36 points)
Output (Y)	Y0 ~ Y3 (4 points)	Y0 ~ Y5 (6 points)	Y0 ~ Y7 (8 points)	Y0 ~ Y11 (10 points)	Y0 ~ Y13 (12 points)	Y0 ~ Y17 (16 points)	Y0 ~ Y17 (16 points)	Y0 ~ Y27 (24 points)

- The VH-40MR is assemble from a VH-32MR Main Unit and a VH-8X Expand Module.
- The VH-60MR is assemble from a VH-32MR Main Unit and a VH-28XYR Expand Module.

- The X/Y assigned identify numbers diagram and descriptions for VH series Expansion Units



- The VH-10MR or VH-14MR Main Unit is not available to use expand functions.
- The VH-20MR, VH-24MR, VH-28MR and VH-32MR Main Unit assigned I/O identify numbers are X0 ~ X17/Y0 ~ Y17. So, the first Expansion Module assigned I/O identify numbers will start at X20/Y20.
- The VH-40MR Main Unit assigned I/O identify numbers are X0 ~ X27/Y0 ~ Y17.
- The VH-60MR Main Unit assigned I/O identify numbers are X0 ~ X47/Y0 ~ Y27.
- The VH-8XYR Expansion Module would occupy 8 input points and 8 output points.
- The VB-28XYR Expansion Module would occupy 24 input points and 8 output points.
- The maximum Input/Output points: 64 input points, X0 ~ X77
  64 output points, Y0 ~ Y77
- The statement about I/O expand

  The VH series PLC Main Unit and Expansion Unit included a power supply unit, but the Expansion Module and Special Module does not have a power unit, those modules need a power source to get power (from a Main Unit or Expansion Unit).

  Two important connecting limits from a Main Unit or Expansion Unit to Expansion Modules:

  (1) The amount of Expansion Modules $\leqq 6$

  (2) All equipments using the power form the power source unit (including the power source unit itself and Expansion Modules), the amount of "ON" status relays $\leqq 32$

2-3 Auxiliary Coil/Flag (M)

The PLC includes considerable internal Auxiliary Coils/Flags (M), the function of Auxiliary Coil/Flag (M) is a status (ON/OFF) storage, which provided data for the processing demand. The method of operate the Auxiliary Coils/Flags (M) is the same way to operate the Output Coils (Y), but the contact of Auxiliary Coil/Flag (M) can not directly drive an external load. The assigned Auxiliary Coil/Flag (M) identify number uses a decimal number and there are three functions to make the differentiation, the functions are list below :

(1) General Stable Auxiliary Coil/Flag

During the PLC operation (the power is "ON") the General Stable Auxiliary Coils will storage status, but all data in the coils will disappear when turn off the power or a power failure occurs. After the power retrieved, all data will be reset as initial status (OFF) in the coils.

(2) Latched Auxiliary Coil/Flag

During the PLC operation the Latched Auxiliary Coils will storage status, and all data in the coils will not disappear when turn off the power or a power failure occurs. After the power retrieved, the coils still kept the data as the moment before power failure occurs. Using a new status to overwrite the old status is the only way to change status in a Latched Auxiliary Coil.

(3) Special Diagnostic Auxiliary Coil/Flag

Every single Special Diagnostic Auxiliary Coil has its special function. Some of the assigned Special Diagnostic Auxiliary Coil only has a contact but without a output coil which is used the same identified number, it can not drive the coil in a program. Do not use any indefinite Special Diagnostic Auxiliary Coil. As regards the detail of the Special Diagnostic Auxiliary Coil, please refer to Section 2-13 "Special Coil and Special Register".

Series	General Stable Auxiliary Coil/Flag	Latched Auxiliary Coil/Flag	Special Diagnostic Auxiliary Coil/Flag
M	M0 ~ M1999, Total 2000 points	M2000 ~ M5119, Total 3120 points	M9000 ~ M9255, Total 256 points
VB	M0 ~ M1999, M4000 ~ M5119, Total 2000 points	M2000 ~ M3999, Total 2000 points	M9000 ~ M9255, Total 256 points
VH	M0 ~ M383, Total 384 points	M0 ~ M1999, Total 2000 points	M9000 ~ M9255, Total 256 points

2-4 State Coil (S)

The State Coil (S) is the basic component of the STL (STep Ladder chart). The assigned State Coil (S) identify number uses a decimal number and there are four functions to make the differentiation, the functions are list below :

(1) Initial State Coil

The Initial State Coil is used for initiation of a SFC (Sequential Function Chart).

(2) General Stable State Coil

It is the State Coils used in a SFC for the general purpose. During the PLC operation, all data in the coils will be returned to invalidity when turn off the power or a power failure occurs.

(3) Latched State Coils

When a power failure occurs during the PLC operation, all data in the Latched State Coils will be retained.

(4) Annunciator Flags

The Annunciator Flags feature Latched function, driving the instruction ANS (FNC 46) as the contact for an annunciator, which is used to record relevant alert messages so that troubleshooting can be performed.

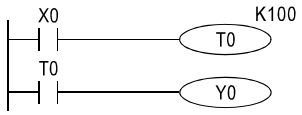
Series	Initial State Coil	General Stable State Coil	Latched State Coils	Annunciator Flags
M	S0 ~ S9, 10 points	S10 ~ S499, 490 points	S500 ~ S899, 400 points	S900 ~ S999, 100 points
VB	S0 ~ S9, 10 points	S10 ~ S499, 490 points	S500 ~ S899, 400 points	S900 ~ S999, 100 points
VH	S0 ~ S9, 10 points	—	S100 ~ S127, 118 points	—

2-5 Timer (T)

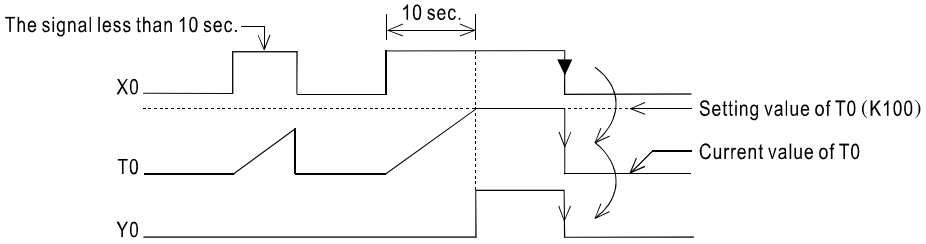
- The timers count the time by counting clock pulses.
  When the Current value = Setting value (the value designated to a Timer), the Timer contact will be activated (ON).
- To set the real Setting value of a Timer = Timer resolution × Designated number
- Timers can be set either directly by using the constant (K) to specify the maximum duration or indirectly by using the data stored in a Data Register (D). (Excluding the Special Data Registers D9000 ~ D9255)

Series	Non-retentive Timer					Retentive Timer	
	100 ms Timer 0.1 ~ 3276.7 sec.	M9028=OFF 100 ms Timer 0.1 ~ 3276.7 sec.	M9028=ON 10 ms Timer 0.01 ~ 327.67 sec.	10 ms Timer 0.01 ~ 327.67 sec.	1 ms Timer 0.001 ~ 32.767 sec.	1 ms Timer 0.001 ~ 32.767 sec.	100 ms Timer 0.1 ~ 3276.7 sec.
M	T0 ~ T199, 200 points	—	—	T200 ~ T245, 46 points	—	T246 ~ T249, 4 points	T250 ~ T255, 6 points
VB	T0 ~ T199, 200 points	—	—	T200 ~ T245, 46 points	—	T246 ~ T249, 4 points	T250 ~ T255, 6 points
VH	T0 ~ T31, 32 points	T32 ~ T62, 31 points		—	T63, 1 point	—	—

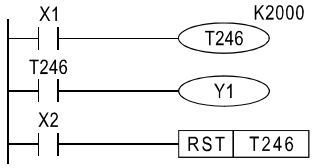
2-5-1 Non-retentive Timer



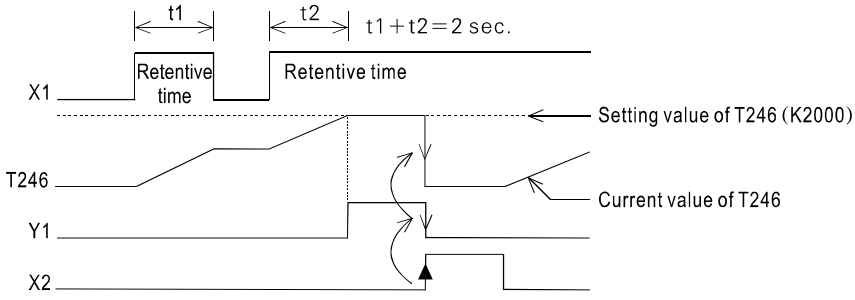
- When input contact X0 = "ON", the Current value of Timer T0 starts to count clock pulses (by 100ms), if the value reaches the Setting value K100 (10 sec.), the T0 contact will activated (ON).
- When input contact X0 = "OFF" or the power failure, the Current value of Timer will return to "0" and the contact will become "OFF".



2-5-2 Retentive Timer



- When input contact X1 = "ON", the Current value of Timer T246 starts to count clock pulses (by 1ms), if the Current value reaches the Setting value K2000 (2 sec.), the contact will activated (ON).
- During the counting time, T246 will stop counting if input contact X1 becomes "OFF" or PLC power failure. The current value will not be changed until the time when power reverted and input X1 received "ON" signal. When T246 resumes counting, the Current value will be retentively increased until Current value = Setting value K2000 (2 sec), and then the contact will become "ON".
- When input contact X2 = ON, the Current value of T246 will reset to "0" and the contact will become "OFF".

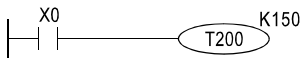


2-5-3 Attentions for Using Timer in Subroutine

For subroutines or inserted interruption subroutines, please use Timer T192 ~ T199. The timing action is updated once at the point when an "END" instruction is executed. The output contact is activated when a coil instruction or an "END" instruction is processed once the timers Current value has reached the Setting (maximum duration) value.

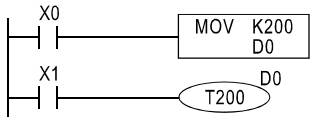
2-5-4 Specific Method for Setting Value

- Direct setting by a constant K



- T200 is a timer using a 10ms as the time unit resolution.
- If the Setting parameter = K150, then 10ms × 150 = 1500ms = 1.5 sec. , so the Timer T200 = 1.5 sec.

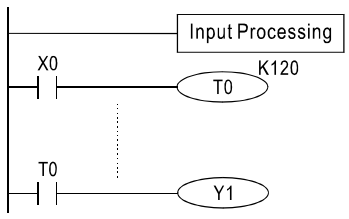
- Direct setting by a constant K

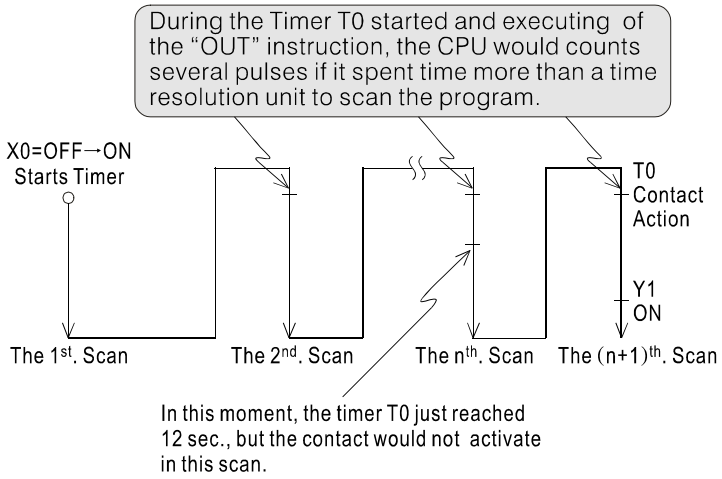


- T200 is a timer using a 10ms as the time unit resolution.
- T200 = 2 sec. if D0 = 200.
- T200 = 10 sec if D0 = 1000
- Counted time of T200 can be modified by changing the value of D0.

2-5-5 Timer Explicit Action and Accuracy

The action procedures of a timer (except the M, VB series T245 ~ T249 and VH series T63) is shown below:





From the action procedures above, the accuracy of the action, since the loop started to the contact "ON", is described as in the following:

$$T \begin{matrix} +Ts \\ -\alpha \end{matrix}$$

α : 0.01 sec. or 0.1 sec. for the timers 10ms or 100ms resolution
T : Setting time of Timer (sec.)
Ts : Scanning time (sec.)

- If in the program, the timer contact appears before the timer coil, the maximum timing error would extra 2Ts. If the setting value of the timer is "0", the output contact will starts the action in the next scan.
- For the interrupt timer (the M, VB series T245 ~ T249 and VH series T63), it starts to count time with 1ms Timer resolution pulse.

2-6 Counter (C)

- When the pulse input signal in a counter turned from "OFF" to "ON", the Current value of the counter will increases (+1 in a up count) / decreases (-1 in a down count) each time. If the Current value = Setting value, the output contact is activated and the coil turned "ON".
- Counters can be set either directly by using the constant (K) or indirectly by using the data stored in a Data Register (D). (Excluding the Special Data Registers D9000 ~ D9255)
- The characteristics of 16-bit and 32-bit Counters are displayed in the following table.

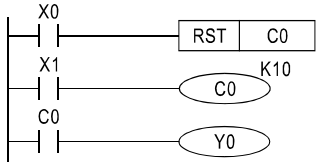
Item	16-bit Counter	32-bit Counter
Count Direction	Up Count	Convertible bi-directional, Up / Down Count
Available Setting Value Ranges	1 ~ 32,767 (1, if the Setting value exceeds beyond the range)	-2,147,483,648 ~ +2,147,483,647
Specified Setting Value	Constant K or Data Register	Same as left column, but each 32-bit value would occupy 2 Data Registers.
Change of Current Value	The Current value will not change when it reaches Setting value.	The Current value will continue to change when it reaches Setting value.
Output Contact	Retains "ON" when it reaches the Setting value	"ON", when Up Count reaches Setting value; "OFF", when Down Count reaches Setting value.
Reset Action	When the instruction RST is executed, the Current value will reset to "0" and the contact will return to "OFF".	
Current Value Register	16-bit	32-bit

- The assigned Counter identify numbers:

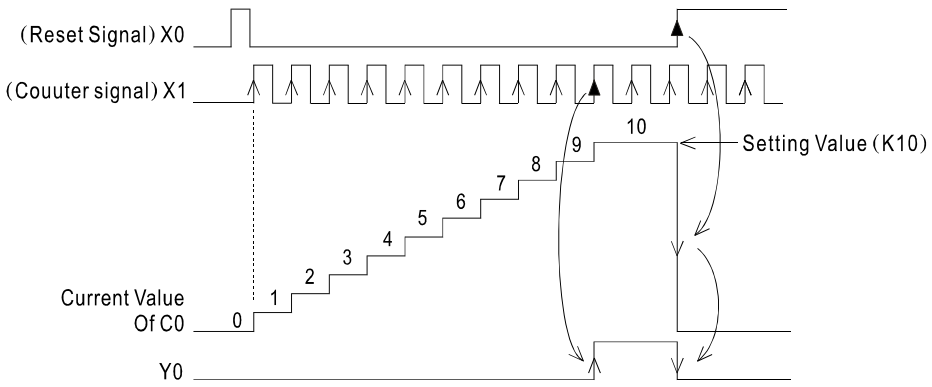
Series	16-bit Counter		32-bit Counter	
	General	Latched	General	Latched
M	C0 ~ C99, 100 points	C100 ~ C199, 100 points	C200 ~ C219, 20 points	C220 ~ C234, 15 points
VB	C0 ~ C99, 100 points	C100 ~ C199, 100 points	C200 ~ C219, 20 points	C220 ~ C234, 15 points
VH	C0 ~ C15, 16 points	C16 ~ C31, 16 points	—	—

2-6-1 16-bit Counter

- When the PLC power failed, the Current value in General Counters will be reset. But, the Latched Counters are able to retain the Current value, even after the PLC has been power failure, and the Current value will be accumulated right after the power is retrieved.

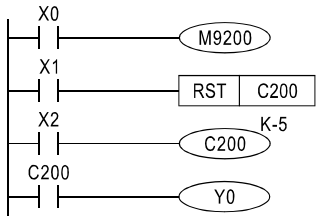


- If the input contact X1 turns OFF → ON once, the Current value of Counter C0 will increase "1". The value of Counter C0 is depend on input Counter Signal X1, the output contact C0 is activated (OFF → ON) when the Current value = 10. After this, the Current value remains unchanged (=10).
- If the input contact X0 = "ON", the instruction "RST" will executes, the Current value of C0 will reset to "0", and the contact will turn "OFF".

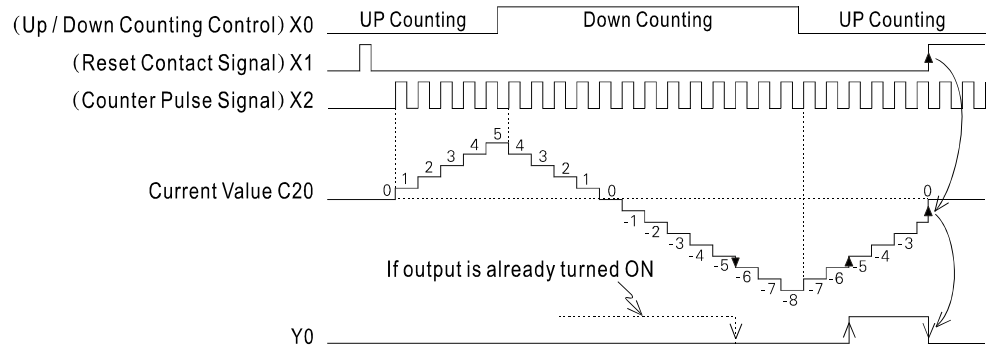


- The Counter's Setting value can using a Constant (K) or a Data Register (D).
- When the instruction "MOV" is used to transfer a value, which is greater than the counter Setting value, to the Current value Register. Until the input signal turning "ON", therefore the contact turns "ON" and the Counter's Current value would rewrites as the Setting value.

2-6-2 32-bit Counter



- X0 drives the Special Auxiliary Coil M9200 to define the Up/Down Count of C200, “OFF” is define as Up Count and “ON” as Down Count.
- When the input Counter Signal X2 = OFF → ON, the Counter C200 will
- When the C200’s Current value turns from “-6” into “-5”, the output contact will shift from “OFF” to “ON”. When the Current value turns from “-5” into “-6”, the output contact will shift from “ON” to “OFF”.
- When the Reset contact X0 = “ON”, the instruction RST will executes, the Current value of C200 will resets to “0” and the contact will turns “OFF”.

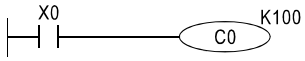


- Because the range of a 32-bit Counter value is between -2,147,483,647 to +2,147,483,647, if a counter counts beyond +2,147,483,647 the Current value will automatically change to -2,147,483,647. Similarly, counting below -2,147,483,647 will result in the current value in the Current value changing to +2,147,483,647. This type of counting technique is typical for “ring counters”.
- The Latched Counter is able to retain the Current value and contact status, even after the PLC has been power failure.
- A 32-bit Counter can be used as a 32-bit Data Register.
- When the instruction “DMOV” is used to transfer a value, which is greater than the counter Setting value, to the Current value Register. The next input pulse signal will be counted to Current value but the contact status will not be changes.
- The 32-bit UP/Down Counters C200 ~ C234 are using the Special Auxiliary Coils M9200 ~ M9234 to define as the Up/Down Count. The C200 is using M9200 to determine the direction as a Up/Down count, the C201 is using M9201,.... and so forth. Where if the Special Auxiliary Coil for the Counter is turned “ON”, the counter will be a Down counter; conversely, “OFF” for the Up counting.
- Counters can be set using either constants (K) or the data stored in Data Registers (D), and the value can be either positive or negative integer numbers. If using Data Registers, each 32-bit value would occupy 2 contiguous Data Registers.

2-6-3 The Appoint Method to Specify Setting Value

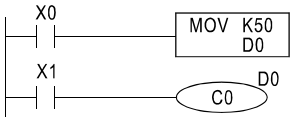
16-bit Counter

- Direct set by using constant (K)



- C0 becomes a Up Counter with 100 counts.

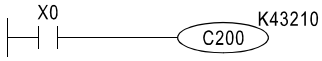
- Indirect set by using Data Register (D)



- C0 becomes a Counter with 50 counts, when D0=50.
- C0 becomes a Counter with 200 counts, when D0=200. To modify the count number of C0 by appointing the value of D0.

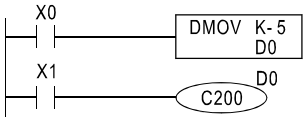
32-bit Counter

- Direct set by using constant (K)



- C200 becomes a UP/Down counter, and the Setting value is K43,210.

- Indirect set by using Data Register (D)



- Using the D1 and D0 to compose a 32-bit Register (D1 is for Up 16-bit; D0 is for Down 16-bit). When the value same as K-5, the C200 becomes a Up/Down Counter and the setting value is (-5).
- To modify the count number of C200 by appointing the value of D1 and D0.

2-7 High Speed Counter

There are 8 input points (X0 ~ X7) in the M series CPU module and VB, VH Series Main Unit. These 8 points have high speed input function such as High Speed Counter, External Interrupt Insertion and Speed Detection. If X0 ~ X7 are not applied to high speed input, they still can be used as common input points.

High Speed Counter receives high speed pulse inputs, it operates by the principle of inset interrupts to perform the purpose of high speed counting. All of the High Speed Counters are 32-bit Up/Down count devices, which provide latched function and can classified into 3 type of counters. The characteristics are shown as in the table below:

Assigned Counter ID No.	Counter Type	Count Direction	Default Range
C235 ~ C245	1-Phase High Speed Counter	Uses M9235 ~ M9245 to determine the direction of Up/Down count. "OFF" is for Up counting, and "ON" is for Down counting.	− 2,147,483,648 ~ +2,147,483,647
C246 ~ C250	2-Phase High Speed Counter	Up/Down count has its individual input point, which count direction can be observed by M9246 ~ M9250. "OFF" means Up counting, otherwise "ON" means Down counting.	
C251 ~ C255 (the VH series only provide C251 ~ C254)	A/B-Phase High Speed Counter	A/B-Phase input signal order determines the direction of Up/Down count. Up count: when the A-Phase signal is "ON", and then the B-Phase signal from "OFF" turns to "ON". Down count: when the A-Phase signal is "ON", and then the B-Phase signal from "ON" turns to "OFF". The count direction can be observed by M9251 ~ M9255, "OFF" is for Up counting, and "ON" is for Down counting.	

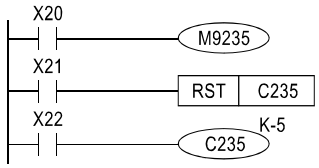
The following table lists the corresponding relationship between each high speed counter and X0 ~ X7 input points.

Input	1-Phase Counter											2-Phase Counter					A/B-Phase Counter					External interrupt insertion	Speed Detect
	C235	C236	C237	C238	C239	C240	C241	C242	C243	C244	C245	C246	C247	C248	C249	C250	C251	C252	C253	C254	C255		
X0	U/D						U/D			U/D		U	U		U		A	A		A		I00□	○
X1		U/D					R			R		D	D		D		B	B		B		I10□	○
X2			U/D					U/D			U/D		R		R			R		R		I20□	○
X3				U/D				R			R			U		U			A		A	I30□	○
X4					U/D				U/D					D		D			B		B	I40□	○
X5						U/D			R					R		R			R		R	I50□	○
X6										S					S					S			
X7											S					S					S		

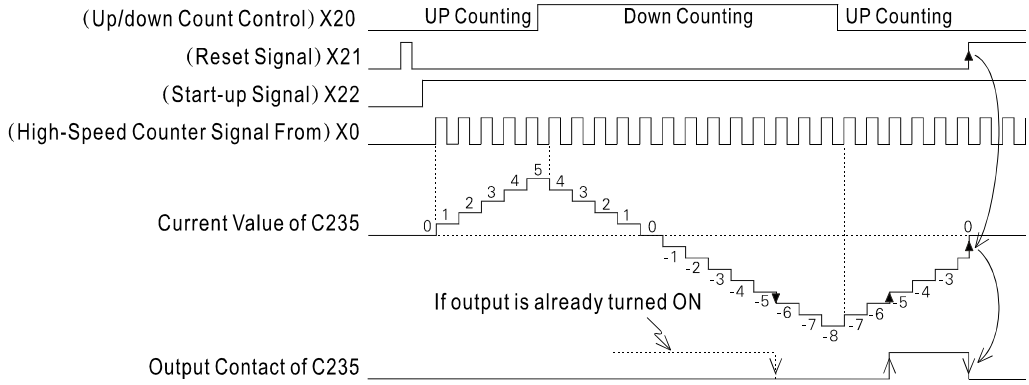
U: Up Counter Input; D: Down Counter input; A: A-Phase Counter Input; B: B-Phase Counter Input ;
U/D: Up / Down Count Input; R: Reset Counter Input; S: Start-up Counter Input

- In the table, C235 will occupies X0 input point, so if C235 is used, then other High-Speed Counters are driven by X0 (as listed in the table: C241, C244, C246, C247, C249, C251, C252 and C254) can not be used. And also, because the input X0 is occupied, the interrupt insertion and speed detection corresponding for X0 are useless .
- Since there is only X0 ~ X7 8 points high speed input, when some of the input points among X0 ~ X7 are occupied, other corresponding high-speed input functions can not repeated using same input point. Users must plan the system cautiously and operate the input points of X0 ~ X7 properly.
- The brief instruction in this page is only presented for High-Speed Counter. The actual planning should be referred to all functions of related high speed input point X0 ~ X7 and be considered altogether lest interference should occur.

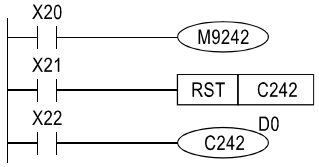
2-7-1 1-Phase High Speed Counter



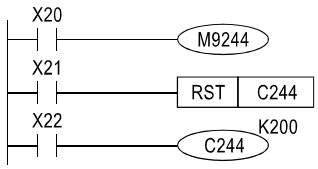
- X20 drives the special coil M9235 to determine the direction of Up/Down count to C235.
- When X22="ON", C235 is activation. From the previous counter table, the corresponding counted input for C235 is X0. Therefor C235 counts signal from X0 input point.
- When contact X21="ON", the instruction RST will be executed, the current value of C235 will be reset to "0", and the output contact will turn "OFF".
- C235 ~ C240 are 1-phase high speed counters featuring Software Startup Control and Software Return Control.



- When Start-up Signal X22="ON" and Pulse enters from X0 input point, the current value of C235 will be computed its Up/Down count.
- When the current value of the counter from -6 increased to -5 , the output contact will turn from "OFF" into "ON"; when the current value of the counter from -5 decreased to -6, the output contact will turn from "ON" into "OFF".
- If a counter counts beyond +2,147,483,647 the Current value will automatically change to -2,147,483,647. Similarly, counting below -2,147,483,647 will result in the current value in the Current value changing to +2,147,483,647. This type of counting technique is typical for "ring counters"
- When contact X21="ON", the instruction RST will be executed, the current value of C235 will be reset to "0", and the output contact will turn "OFF".
- The 1-Phase High Speed Counter C235 ~ C245 uses M9235 ~ M9245 to determine the direction of Up/Down count. "OFF" is for Up counting, and "ON" is for Down counting.

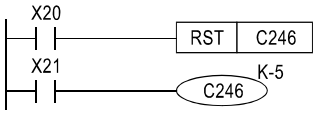


- X20 drives the special coil M9242 to determine the direction of Up/Down count to C242.
- When X22="ON", C242 is activation. From the previous counter table, the corresponding counted input for C242 is X2. Therefor C242 counts signal from X2 input point.
- When contact X21="ON", the instruction RST will be executed, the current value of C242 will be reset to "0", and the output contact will turn "OFF". If C242 is not reset by Software, the instruction RST may not be written.
- When X3="ON" (X3 is a hardware reset counter signal), the current value of C242 will be reset to "0", and its contact will turn "OFF".
- The setting value of C242 is configured depending on the contents of Data Registers D1 and D0
- C241 ~ C243 are 1-phase high speed counters featuring Software Start-up Control and Software/Hardware Reset Control.

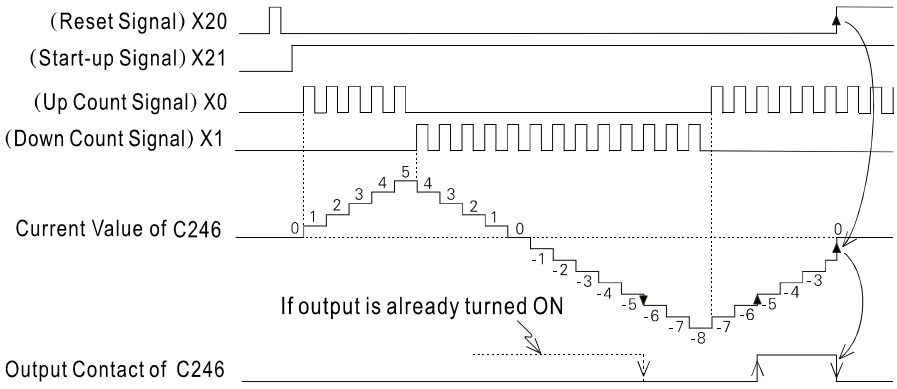


- X20 drives the special coil M9244 to determine the direction of Up/Down count to C244.
- When X22="ON" and X6="ON" (X6 is a hardware start counter signal), C244 is activation. From the previous counter table, the corresponding counted input for C244 is X0. Therefor C244 counts signal from X0 input point.
- When contact X21="ON", the instruction RST will be executed, the current value of C244 will be reset to "0", and the output contact will turn "OFF". If C244 is not reset by Software, the instruction RST may not be written.
- When X1="ON" (X1 is a hardware reset counter signal), the current value of C244 will be reset to "0", and its contact will turn "OFF".
- C244 ~ C245 are 1-phase high speed counters featuring Software/Hardware Start-up Control and Software/Hardware Return Control.

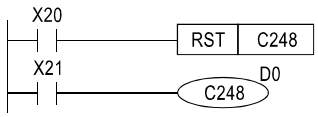
2-7-2 1-Phase High Speed Counter



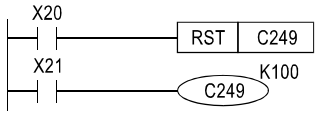
- When X21="ON", C246 is activation. Therefor C246 counts signal from X0 and X1 input points.
- When contact X20="ON", the instruction RST will be executed, the current value of C246 will be reset to "0", and the output contact will turn "OFF".
- C246 is a 2-phase high speed counters featuring Software Start-up Control and Software Reset Control.



- When Start-up Signal X21= "ON" and Pulse signal enters from X0 or X1 input point, the current value of C246 will be computed its Up/Down count.
  When X0= "OFF" → "ON", the current value of C246 will increase "1".
  When X1= "OFF" → "ON", the current value of C246 will decrease "1".
- When the current value of the counter from -6 increased to -5 , the output contact will turn from "OFF" into "ON" ; when the current value of the counter from -5 decreased to -6, the output contact will turn from "ON" into "OFF".
- If a counter counts beyond +2,147,483,647 the Current value will automatically change to -2,147,483,647. Similarly, counting below -2,147,483,647 will result in the current value in the Current value changing to +2,147,483,647. This type of counting technique is typical for "ring counters".
- The 2-Phase High Speed Counter C246 ~ C250 uses M9246 ~ M9250 to monitor the Up/Down count direction. "OFF" is Up counting, and "ON" is Down counting.



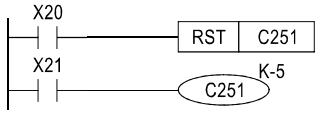
- When X21＝“ON”, C248 is activation. From the previous counter table, the corresponding counted input for C248 is X3 and X4. Therefor C248 counts signal from X3 and X4 input point.
  When X3＝“OFF”→“ON”, the current value of C248 will increase “1”.
  When X4＝“OFF”→“ON”, the current value of C248 will decrease “1”.
- When contact X20＝ “ON”, the instruction RST will be executed,the current value of C248 will be reset to “0”, and the output contact will turn “OFF”. If C248 is not reset by Software, the instruction RST may not be written.
- When X5＝ “ON” (X5 is a hardware reset counter signal), the current value of C248 will be reset to “0”, and its contact will turn “OFF”.
- The setting value of C248 is configured depending on the contents of Data Registers D1 and D0.
- C247 ~ C248 are 2-phase high speed counters featuring Software Start-up Control and Software/Hardware Reset Control.



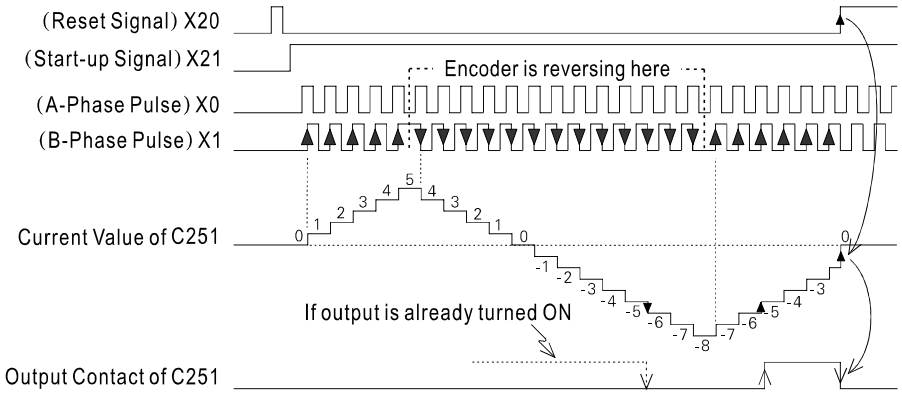
- When X21＝“ON” and X6＝ “ON” (X6 is a hardware start counter signal), C249 is activation. From the previous counter table, the corresponding counted input for C249 is X0 and X1. Therefor C249 counts signal from X0 and X1 input points.
  When X0＝ “OFF”→“ON”, the current value of C249 will increase “1”.
  When X1＝ “OFF”→“ON”, the current value of C249 will decrease “1”.
- When contact X20＝”ON”, the instruction RST will be executed, the current value of C249 will be reset to “0”, and the output contact will turn “OFF”. If C249 is not reset by Software, the instruction RST may not be written.
- When X2＝ “ON” (X2 is a hardware reset counter signal), the current value of C249 will be reset to “0”, and its contact will turn “OFF”.
- C249 ~ C250 are 2-phase high speed counters featuring Software/Hardware Start-up Control and Software/Hardware Return Control.

2-7-3 A/B-Phase High Speed Counter

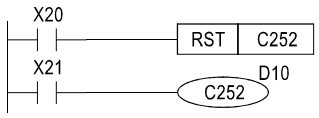
A/B-Phase High Speed Counter is used exclusively as the high speed counter receiving Rotary Encoder's A/B-Phase Pulse.



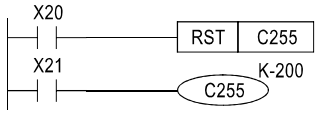
- When X21= "ON", C251 is activation and calculates the ON/OFF events of input X0 (the A Phase input) and input X1 (the B Phase input), and by the relationship of input signal sequence to execute Up/Down count.
- When contact X20= "ON", the instruction RST will be executed, the current value of C251 will be reset to "0", and the output contact will turn "OFF".
- C251 is a A/B-phase high speed counters featuring Software Start-up Control and Software Reset Control.



- When Start-up Signal X21= "ON" and A/B-Phase Pulse signal enters from X0 and X1 input point, the current value of C251 will be computed its Up/Down count.
  When X0 (A-Phase state)= "ON" and X1 (B-Phase state)= "OFF" → "ON", the current value of C251 will increase "1".
  When X0 (A-Phase state)= "ON" and X1 (B-Phase state)= "ON" → "OFF", the current value of C251 will decrease "1".
- The A/B-Phase High Speed Counter C251 ~ C255 uses M9251 ~ M9255 to monitor the Up/Down count direction. "OFF" is Up counting, and "ON" is Down counting.
- When a Rotary Encoder connected to a motor shaft, it will according to motor status (forward or reverse) to produce A/B-phase pulse signal. And then, the signal is transferred to the A/B-phase input points of C251, the current value of C251 will be increasing or decreasing correspond to motor runs forwarding or reversing.



- When X21="ON", C252 is activation and calculates A/B-Phase signal from X0 and X1 input points.
  When X0= "ON" and X1= "OFF" → "ON", the current value of C252 will increase "1".
  When X0= "ON" and X1= "ON" → "OFF", the current value of C252 will decrease "1".
- When contact X20= "ON", the instruction RST will be executed, the current value of C252 will be reset to "0", and the output contact will turn "OFF". If C252 is not reset by Software, the instruction RST may not be written.
- When X2= "ON" (X2 is a hardware reset counter signal), the current value of C252 will be reset to "0", and its contact will turn "OFF". The setting value of C252 is configured depending on the contents of Data Registers D111 and D10.
- C252 ~ C253 are A/B-phase high speed counters featuring Software Start-up Control and Software/Hardware Reset Control.

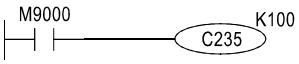


- When X21＝“ON” and X7＝”ON”(X7 is a hardware start counter signal), C255 is activation and calculates A/B-Phase signal from X3 and X4 input points.
  When X3＝ “ON” and X4＝ “OFF” → “ON”, the current value of C255 will increase “1”.
  When X3＝ “ON” and X4＝ “ON” → “OFF”, the current value of C252 will decrease “1”.
- When contact X20＝ “ON”, the instruction RST will be executed, the current value of C255 will be reset to “0”, and the output contact will turn “OFF”. If C255 is not reset by Software, the instruction RST may not be written.
- When X5＝ “ON” (X5 is a hardware reset counter signal), the current value of C255 will be reset to “0”, and its contact will turn “OFF”.
- C254 ~ C255 are A/B-phase high speed counters featuring Software/Hardware Start-up Control and Software/Hardware Return Control.

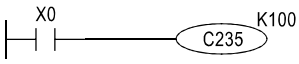
2-7-4 Precautions for Using High Speed Counteroutine

To activate High Speed Counter

- In the program, the conditional input contacts for activate High Speed Counters are NOT used to drive the counter coils. This is because the counter coils need to keep in status "ON" continuously to reserve the associated high speed input signals. Therefor, a normal non-high speed drive contact should be used to drive the high speed counter coil. If using non-high speed contacts direct drive the counters, it will cause wrong calculation.
- Ideally the special auxiliary contact M9000 should be used for activate. However, this is not compulsory.

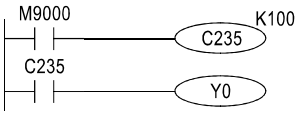


Correct program



Wrong program

The output of High Speed Counter



High Speed Counters receive high speed pulse inputs, they operate by the principle of inset interrupts to perform the purpose of high speed counting, they are irrelevant to Scan Time. So when the counter's Current value = Setting value, the counter's output contact (the status inside the memory) will be changed right away. But the status of Y0 as the chart above will be actually transferred to the output point only when the instruction END is executed. Which is still relevant to Scan Time and not a real-time transference. If a real-time output is desirable, users must use the high speed comparison instructions FNC53 (DHSCS), FNC54 (DHSCR) and FNC55 (DHSZ) exclusive for High Speed Counter.

Response Speed of High Speed Counter

- When a High Speed Counter is used in a program, the input point corresponding to the counter will be changed to a high speed input point (50μs response speed) automatically.
- When the instruction SPD is used in a program, the external input point specified by the instruction will be changed to a high speed input point (50μs response speed) automatically.
- The highest input count frequency of 1-Phase and 2-Phase High Speed Counter is up to 10 kHz. And the A/B-Phase High Speed Counter is up to 5 kHz.
- The highest count frequency accepted by the instruction SPD is up to 10 kHz.
- All count pulses of High Speed Counters and the instruction SPD is performed by interrupt insertion, where the total of the highest interrupt inserted frequency should not exceed 20 kHz (M, VB and VH series).

The calculation method of the total interrupt inserted frequency:

(Total 1-Phase Count Frequency) + (Total 2-Phase Count Frequency) + (Total A/B-Phase Count Frequency) × 2 + SPD Input Pulse Frequency = Total Interrupt Inserted Frequency (the value should not exceed 20 kHz)

2-8 Data Register (D)

A Data Register is a storage device capable of storing numeric data in 16/32-bit patterns. A single data unit contains 16 bits, while the MSB (Most Significant Bit) is used to indicate the data has a positive (0) or negative (1) bias, where the data ranging from -32,768 to +32,767 can be stored. However, two consecutive 16-bit registers can be used as a 32-bit register. The last 16 bits is defined as "lower" 16 bits and the first 16 bits is defined as "higher" 16 bits, while the MSB will always be found in the first higher 16 bits to given the positive (0) or negative (1) bias, where the data ranging from -2,147,483,648 to +2,147,483,647 can be stored.

The Data Register functions are list below :

(1) General Register

- When the PLC is turned from "RUN" to "STOP" or power failure occur, all of the general data registers have their current contents overwritten with a "0". If the special auxiliary coil M9033= "ON" and PLC is switched from "RUN" to "STOP", data can be retained in the general registers. But, power failure will still clear all contents to "0".
- When M and VB series PLC is in the operation mode of Parallel connection (VH series does not have this function), D499 ~ D509 is used as the data transference area.

(2) Latched Register

- During the PLC operation the Latched Register will storage data, and all data in the Register will not disappear when turn off the power or a power failure occurs. It still kept the data as the moment before power failure occurs.
- Using the instructions RST and ZRST to reset the data in the Latched Register.
- It is available to add a Data Bank Expansion Card to extend the Latched Register size.

M series Data Bank Expansion Card: M-DB1

M series PLC provide a slot for M-DB1 Data Bank Expansion Card. To install a M-DB1 can add 64K Words Latched storage space. Using the Data Bank rewrite instruction DBWR (FNC91) and Data Bank read instruction DBRD (FNC90) to transfer data between Data Register and Data Bank.

Since the M-DB1 is using the Flash ROM technique to storage data, the rewrite operate limited is 10,000 times. So, when the program using the instruction DBWR to rewrite data into M-DB1, better change it to the instruction DBWRP. The DBWRP can avoid useless operate of rewrite, and then extend the lifespan of the Flash ROM.

VB series Data Bank Expansion Card: VB-DB1R

VB series PLC provide a slot for VB-DB1R Data Bank Expansion Card. To install a VB-DB1R can add 128K Words Latched storage space. Using the Data Bank rewrite instruction DBWR (FNC91) and Data Bank read instruction DBRD (FNC90) to transfer data between Data Register and Data Bank.

Since the VB-DB1R is using the SRAM technique plus Lithium battery to storage data, the rewrite operate times is unlimited. But the Lithium battery lifespan is around 5 years, must pay attention on the maintenance of data storage.

(3) File Register

Please refer to Section 2-9, the instruction on "File Register" for details.

(4) Special Diagnostic Register

Each Special Diagnostic Register has its specific purpose of use. Mostly it is used for storing the system status, error messages, monitoring status. The details are described in Section 2-13 "Special Coil and Special Register".

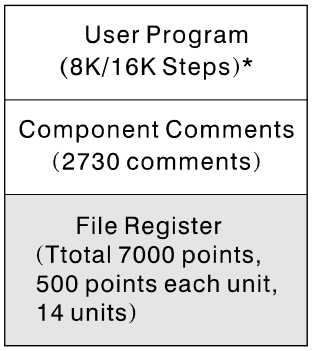
Series	General Register	Latched Register	File Register	Special Diagnostic Register
M	D0 ~ D6999, 7000 points	D7000 ~ D8191, 1192 points	D1000 ~ D7999, 7000 points	D9000 ~ D9255, 256 points
VB	D0 ~ D6999, D7512 ~ D8191, 7680 points	D7000 ~ D7511, 512 points	D1000 ~ D7999, 7000 points	D9000 ~ D9255, 256 points
VH	D0 ~ D127, 128 points	D128 ~ D255, 128 points	–	D9000 ~ D9255, 256 points

2-9 File Register (D)

The File Registers of M and VB Series PLC have 8192 points (D0 ~ D8191), where 7000 points (D1000 ~ D7999) can be planned and assigned as the identify numbers for File Register. The planning work is performed by peripherals (such as Ladder Master). The functions and characteristics of File Register are described below.

2-9-1 Structure and Characteristics of File Register

① Instruction on Program Memory



A sketch of the Program Memory

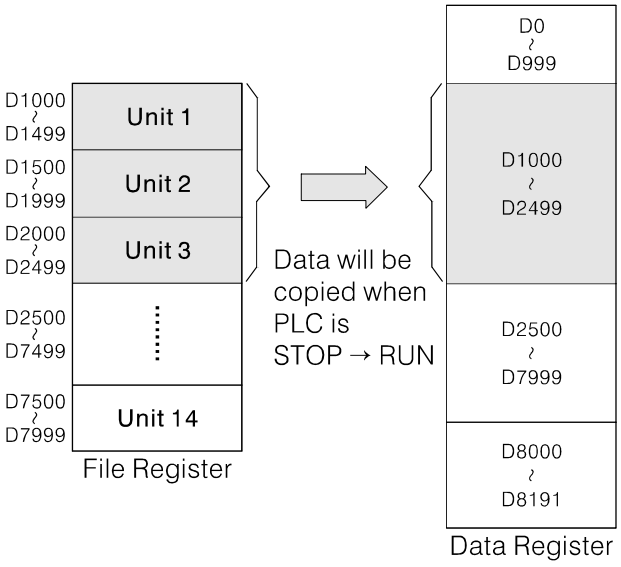
- Program Memory is using the built-in Flash ROM of CPU/Main Unit, or the Flash Rom in the Memory Card (if it is installed).
- Program Memory consists 8K/16K* Steps user program, 2730 component comments and 7000 points of File Register.
- A complete program will contains those three components of Program Memory. Thus, when the program is stored, retrieved, upload, downloaded or processed to copy the data in the memory card, the aforementioned components shall be included.
- In the File Register, there are totally 7000 points, which are split into 14 units, 500 register points for each unit.

* M series: 8K Steps, VB0 series: 8K Steps, VB2 series: 16K Steps

② Characteristics of File Register

- Since the File Register's content value is stored in the Non-Volatile component – Flash Rom, the data will not disappear when the power failure occurs.
- The relationship between Program and File Register is interdependent. File Register is a part of User Program, and the File Register's content will be influenced when the program is stored or retrieved. Accordingly, File Register is suitable for saving the system setting data; The Data Register is the data process and storage area during the program running, its content varies from time to time. Its characteristics are significantly different to the File Register.
- During the program processing, all the data under read or write operation are directed to Data Register. File Register write (M series only) and read (M and VB series) operations shall be directed by the instruction FNC15 (BMOV), which will be explained in Section 2-9-2.

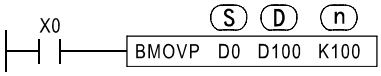
③ Relationship between File Register and Data Register



- The left chart explains the correlation between File Register and Data Register.
- The Ladder Master provides planning File Register and writing data functions.
- When users are planning the File Register, must divide D1000 ~ D7999 into 14 units (500 File Registers each). Beginning from the D1000, D1000 ~ D1499 is Unit1, D1500 ~ D1999 is Unit2 and so on. So if we are planning a 3-unit register, the range shall be D1000 ~ D2499 and there will be 1500 registers.
- Whenever PLC is STOP → RUN, the content value of File Register will be automatically copied into the correlated Data Register.

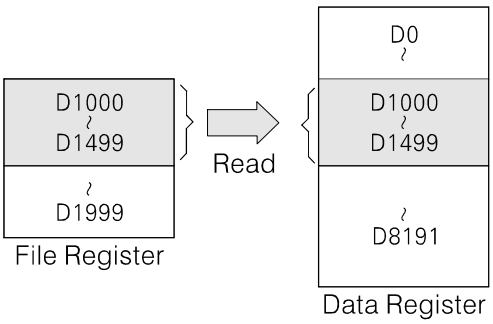
2-9-2 File Register's Write/Read Operation

- The description below, all the File Register is hypothesized to be planned as 2-unit register, from D1000 ~ D1999 (1000 registers).
- File Register Write/Read Operation is implemented via the instruction FNC15 (BMOV). The M series provides File Register writing function, the VB series does not.
- The Special Coil M9024 is a control flag for the transfer direction of the instruction BMOV. The status (ON/OFF) of M9024 could designate the data transfer direction of the instruction BMOV.

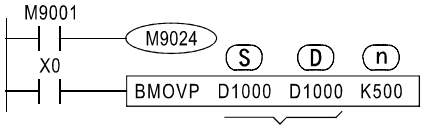


When M9024= "OFF" (S → D) D0 ~ D99 → D100 ~ D199
When M9024= "ON" (S ← D) D0 ~ D99 ← D100 ~ D199

Reading from the File Register



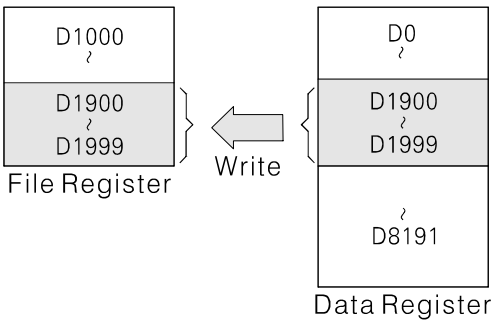
M9001: Always "OFF" Contact



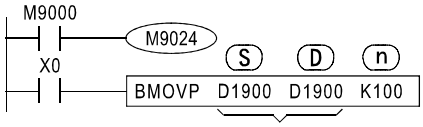
S and D assigned the same identify number of the File Register

- When appointed S and D using the same identified number of the File Register, which indicates the File Register via the instruction BMOV can do Write/Read Operation. As M9024= "OFF" in the example above, the transfer direction of BMOV will be S → D to execute Read operation of the File Register.

Writing to the File Register (the VB series does not have the Writing operation)

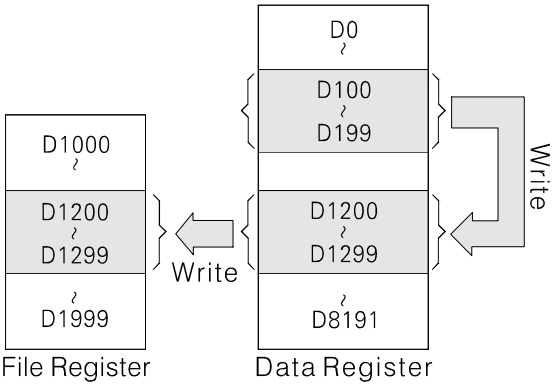


M9000: Always "ON" Contact

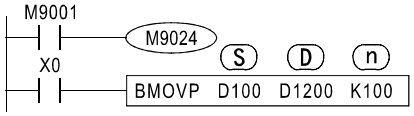


S and D assigned the same identify number of the File Register

- When appointed S and D using the same identified number of the File Register, which indicates the File Register via the instruction BMOV can do Write/Read Operation. As M9024= "ON" in the example above, the transfer direction of BMOV will be S ← D to execute Write operation of the File Register.



M9001: Always "OFF" Contact



- When X0= OFF → ON, the data in Data Register D100 ~ D199 will be transferred into the Data Register D1200 ~ D1299, and also written into File Register D1200 ~ D1299. But, if the Write operation of the File Register is not accessible, the Write operation to the Data Register will be executed.

- When appointed S and D using the same identified number of the File Register, the range is specified by "n", it can not exceed the range of File Register. Once it exceeds the range, which will deem as an instruction operational error, the instruction will not be executed.

2-9-3 Precautions for Using File Register

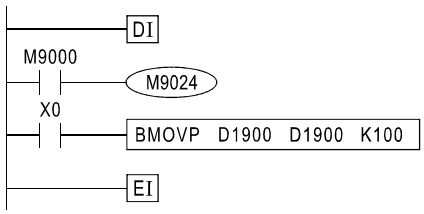
① Only the M series provided the File Register's Writing operation function, VB series can not write into the File Register.

② The File Register using Flash ROM memory to storage data, it is available to write more than 10,000 times, but still has the write times limited. When the program using the instruction DBWR to rewrite data into the File Register, better change it to the instruction DBWRP. The DBWRP can avoid useless operate of rewrite, and then extend the lifespan of the Flash ROM.

③ If the CPU module installed a Memory Card and in the program has a write operation for the File Register, must put the protective switch in “Writable” position at the card.

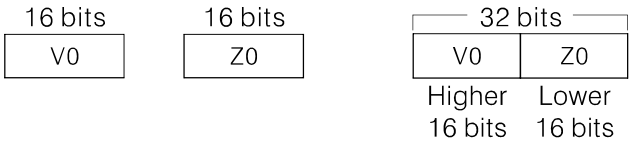
④ When the File Register’s Write operation is executed, every 64 points of File Register will spend 10ms to execute. And at the time the running program will be interrupted temporarily and the Watch Dog’s timing will be reset automatically.

⑤ Any interrupt insertion occurred during the File Register’s write operation, may cause errors to the execution results. So this is a suggestion: the interrupt insertion is prohibited to use when the write operation is executing. The chart shows below is using “DI” (Disable Interrupt) insertion to prohibited interrupts when the write operation is executing, after that using the “EI” (Enable Interrupt) insertion to regain interrupt.



2-10 Index Register (V) and (Z)

- The Index Register is a 16-bit register, the identified numbers are V0 ~ V7 and Z0 ~ Z7 (total 16 points).
- It's available to combine a Register V with a Register Z become a 32-bit Register. In the 32-bit applied instruction, V and Z can be assigned as a pair of register (V0, Z0) (V1, Z1)…(V7, Z7). Simply assign the Register Z, it can be assign the Operation Unit.



- Index Register can be used to decorate the Operand devices in the applied instruction. It can be used to modify the following devices under certain conditions; X, Y, M, S, P, T, C, D, K, H, K*n*X, K*n*Y, K*n*M and K*n*S.
- The use of Index Register will be explained in the Section 5-3 "General Principles of Applied Instructions".

2-11 Pointer (P) and Interrupt Pointer (I)

2-11-1 Pointer (P)

- The purpose of Pointer (P) is used to mark up a specific point in a program, and it is usually used to mark the destination of the CJ instruction or the start position of the CALL instruction's subroutine.
- The assigned numbers for the Pointers (P)

Series	Pointers (P)	Annotations
M	P0 ~ P255, 256 points	The Pointer P255 equals the position of END in a program.
VB	P0 ~ P255, 256 points	The Pointer P255 equals the position of END in a program.
VH	P0 ~ P63, 64 points	The Pointer P63 equals the position of END in a program.

2-11-2 Interrupt Pointer (I)

- The purpose of Interrupt Pointer (I) is used to mark up the start position of the interrupt subroutine of a program.
- The assigned numbers for the Interrupt Pointer (I):

Input Interrupt		Timer Interrupt	High Speed Counter Interrupt
External Input Terminal	Interrupt Pointer	Interrupt Pointer	Interrupt Pointer
X0	I00 □	3 points: I6□□ I7□□ I8□□	6 Points: I010 I020 I030 I040 I050 I060
X1	I10 □		
X2	I20 □		
X3	I30 □		
X4	I40 □		
X5	I50 □		
□ = 1, indicates the interrupt during the rising □ = 0, indicates the interrupt during the falling		□□ = 01 ~ 99 indicate Timer Interrupt interval length, where the time interval will be 1 ~ 99ms	With the instruction FNC53 (DHSCS) to make a interrupt signal

- Interrupt Points can be discriminated into three types by functions: Input Interrupt, Timer Interrupt and High Speed Counter Interrupt.

①Input Interrupt: The rising or falling signal from the specific input terminal (X0 ~ X5) will produces A interrupt signal, it caused a interrupt to the running program, and jumps to the assigned Interrupt Pointer (I00□ ~ I50□) to execute the corres pondingly interrupted subroutine.

②Timer Interrupt: When the Timer Interrupt (I6□□ ~ I8□□) is written in the program, the PLC will automatically interrupt the running program at regular time (assigned by□□ of Timer Interrupt), and will jump to the assigned Interrupt Pointer to execute the correspondingly interrupted subroutine.

③High Speed Counter Interrupt: The FNC53 (DHSCS) High Speed Counter compare instruction's results can be assigned to execute the correspondingly interrupted subroutine. When the instruction DHSCS is assigned to process the interrupted subroutine (I010 ~ I060) and if the comparative results are equivalent to each other, the PLC will jump to the assigned Interrupt Pointer to execute the interrupted subroutine. Please consult the reference resources about the instruction FNC53 (DHSCS) for more detals.

- The application of Interrupt Pointer and the concepts of the interrupted subroutine will have detailed describe in the instructions IRET, EI and DI.

2-12 Numerical System

(1) Binary Number (BIN)

The value in PLC is operated and stored used the binary system. The binary number and relative terminology are given as follows:

① Bit: the basic of the binary number, each value of a Bit must be either “0” or “1”.

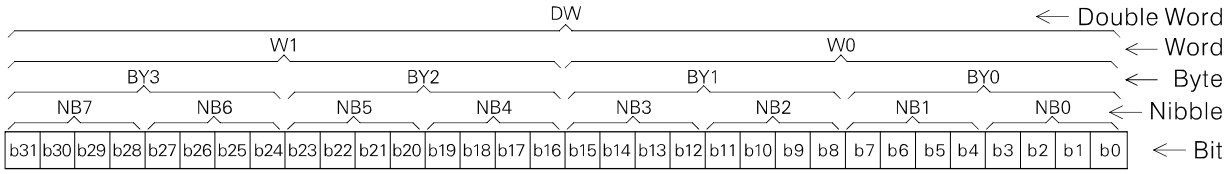
② Nibble: composed of 4 sequential bits.
Ex. b3 ~ b0 can express an one-Nibble hex value: 0 ~ F.

③ Byte: composed of 8 sequential bits.
Ex. b7 ~ b0 can express a two-Nibble hex value: 00 ~ FF.

④ Word: composed of 2 sequential bytes or 16 sequential bits.
Ex. b15 ~ b0 can express a four-Nibble hex value: 0000 ~ FFFF.

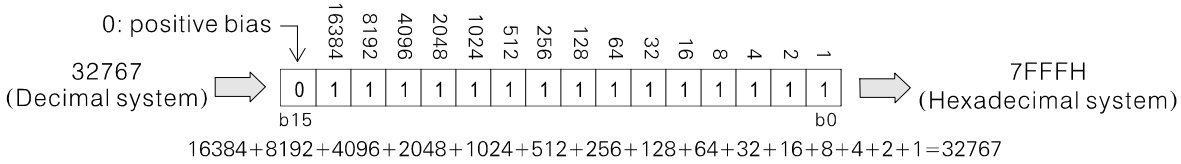
⑤ Double Word: composed of 2 sequential words, 4 sequential bytes or 32 sequential bits.
Ex. b31 ~ b0 can express an eight-Nibble hex value: 00000000 ~ FFFFFFFF.

⑥ The relations between every binary Bit, Nibble, Byte, Word and Double Word:



⑦ Expression of the value

For Word (16 bits) or Double Word (32 bits), the Most Significant Bit (MSB), e.g. The b15 of a Word or the b31 of a Double Word, gives the value positive or negative bias, where “0” for positive and “1” for negative. The rest bits, e.g. b14~b0 or b30 ~ b0, express the value size. It is a 16-bit value shows below.



⑧ Range of the value

The maximum range of the value expressed by 16 bits and 32 bits:

16 bits	-32,768 ~ 32,767
32bits	-2,147,483,648 ~ 2,147,483,647

(2) Binary Number (BIN)

The assigned numbers of PLC’s external input and output terminals are displayed by the octal system. Ex.
external input ports: X0 ~ X7, X10 ~ X17
external output ports: Y0 ~ Y7, Y10 ~ Y17

(3) Decimal Number (DEC)

Decimal Number is the value system which people are familiar with. In PLC, a decimal number is always headed with a “K” in front of the value. Ex. K123 indicates a decimal number where the value is 123.
Application occasions of Decimal Number:

① Used as the setting value of T, C, for example, K10

② Used as the component number of M, S, T and C, for example, M9, S10, etc.

③ Used as an Operand device in the applied instruction, for example, MOV K1 D1.

(4) Binary Code Decimal (BCD)

BCD is to express a Decimal digit unit with a Nibble or 4 bits. Sequential 16 bits can express 4 Decimal digits. BCD is mainly used to read the input value of the Digital Switch (Thumbwheel input) or export the data to the 7-Segment Displayer for displaying the value.

(5) Hexadecimal Number (HEX)

In PLC, a Hex number is always headed with an “H”, for example, H123 represents a Hex number and is valued 123.

(6) Bits of the numerical system and the numerical conversion table:

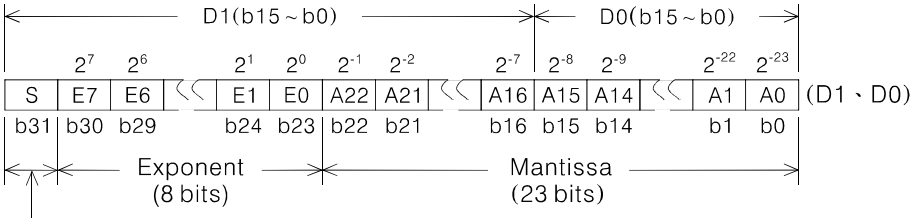
OCT	DEC	HEX	BIN		BCD	
0	0	00	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
1	1	01	0 0 0 0	0 0 0 1	0 0 0 0	0 0 0 1
2	2	02	0 0 0 0	0 0 1 0	0 0 0 0	0 0 1 0
3	3	03	0 0 0 0	0 0 1 1	0 0 0 0	0 0 1 1
4	4	04	0 0 0 0	0 1 0 0	0 0 0 0	0 1 0 0
5	5	05	0 0 0 0	0 1 0 1	0 0 0 0	0 1 0 1
6	6	06	0 0 0 0	0 1 1 0	0 0 0 0	0 1 1 0
7	7	07	0 0 0 0	0 1 1 1	0 0 0 0	0 1 1 1
10	8	08	0 0 0 0	1 0 0 0	0 0 0 0	1 0 0 0
11	9	09	0 0 0 0	1 0 0 1	0 0 0 0	1 0 0 1
12	10	0A	0 0 0 0	1 0 1 0	0 0 0 1	0 0 0 0
13	11	0B	0 0 0 0	1 0 1 1	0 0 0 1	0 0 0 1
14	12	0C	0 0 0 0	1 1 0 0	0 0 0 1	0 0 1 0
15	13	0D	0 0 0 0	1 1 0 1	0 0 0 1	0 0 1 1
16	14	0E	0 0 0 0	1 1 1 0	0 0 0 1	0 1 0 0
17	15	0F	0 0 0 0	1 1 1 1	0 0 0 1	0 1 0 1
20	16	10	0 0 0 1	0 0 0 0	0 0 0 1	0 1 1 0
⋮	⋮	⋮	⋮		⋮	
143	99	63	0 1 1 0	0 0 1 1	1 0 0 1	1 0 0 1

(7) Floating Point

The PLC was provided with Floating Point instructions therefore the PLC can calculate decimal numbers. The decimal numbers are storage and calculated in a PLC using two different pattern formats: Binary Floating Point Number and Decimal Floating Point Number. The expositions are showed below.

① Binary Floating Point Number

- Inside of the PLC, the Floating Point calculates and decimal number storages are using Binary Floating Point Numbers. A Binary Floating Point Number's value storage format is composed of 2 sequential registers. It is an example, using (D1,D0) to explain a format of a Binary Floating Point Number.



Binary Floating Point Number's value

$=\pm(2^0+A22\times2^{-1}+A21\times2^{-2}+.....+A1\times2^{-22}+A0\times2^{-23})$

$\times2^{(E7\times2^7+E6\times2^6+.....+E1\times2^1+E0\times2^0)}/2^{127}$

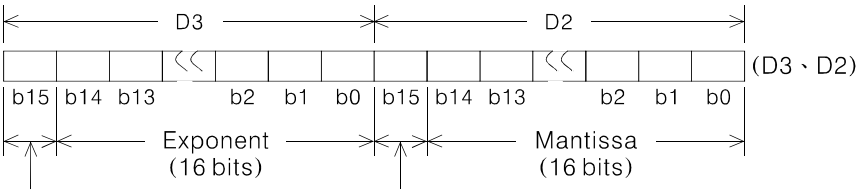
- If S=0, A22=1, A21=1, A20～A0=0
  E7=1, E6～E0=0

  Therefor, the Binary Floating Point Number's value storage in the register (D1,D0) is equal to
  $(2^0+1\times2^{-1}+1\times2^{-2}+.....+0\times2^{-23})\times2^{(1\times2^7+0\times2^6+.....+0\times2^0)}/2^{127}$
  $=1.75\times2^{128}/2^{127}=1.75\times2^1$

- A Binary Floating Point Number's value limit:
  Maximum modulus: 1.175×10^{-38} Minimum modulus: 3.402×10^{38}

② Decimal Floating Point Number

- A Decimal Floating Point Number's value storage format is also composed of 2 sequential registers. It is an example, using (D3,D2) to explain a format of a Decimal Floating Point Number.



Decimal Floating Point Number's value= (Mantissa) $\times10^{(Exponent)}$

Mantissa $=\pm(1000\sim9999)$ Exponent= $-41\sim+35$

- If D2=1234, D3=-1

  Therefor, the Decimal Floating Point Number's value storage in the register (D3,D2) is equal to$1234\times10^{-1}=123.4$

- A Decimal Floating Point Number's value limit:
  Maximum modulus: 1175×10^{-41} Minimum modulus: 3402×10^{35}

- The Binary Floating Point Number and Decimal Floating Point Number can use the instructions to convert the value:

  FNC118 (DEBCD): To convert from a Binary Floating Point Number to a Decimal Floating Point Number.

  FNC119 (DEBIN): To convert from a Decimal Floating Point Number to a Binary Floating Point Number.

2-13 Special Coil and Special Register

In the tables below, the symbol "■" represents that itis not allowed to use a instruction to drive the coil or write the data to the program. And if the special coil or the special register is not listed in this table, which is reserved for the system and can not be used to drive the coil or write the data to the program either.

2-13-1 Table of Special Coil

Coil ID. No.	Instruction of Function		Series		
PLC Operation Status			M	VB	VH
■ M9000	An always "ON", "a" Contact, M9000 is "ON" during the running PLC.		○	○	○
■ M9001	An always "OFF", "a" Contact, M9001 is "OFF" during the running PLC.		○	○	○
■ M9002	Initial Pulse , "a" Contact, M9002 will be "ON" for a Scan Time when the moment PLC is STOP → RUN.		○	○	○
■ M9003	Initial Pulse , "b" Contact, M9003 will be "OFF" for a Scan Time when the moment PLC is STOP → RUN.		○	○	○
■ M9004	Error occurred. When one or more of the error flags M9060, M9063, M9066, M9067 are "ON", M9004= "ON" .		○	○	○
Clock Pulse			M	VB	VH
■ M9011	Oscillates 10ms cycles Pulse. "ON" 5ms/ "OFF" 5ms Pulse		○	○	○
■ M9012	Oscillates 100ms cycles Pulse. "ON" 50ms/ "OFF" 50ms Pulse		○	○	○
■ M9013	Oscillates 1sec. cycles Pulse. "ON" 0.5Sec/ "OFF" 0.5Sec Pulse		○	○	○
■ M9014	Oscillates 1min. cycles Pulse. "ON" 30Sec/ "OFF" 30Sec Pulse		○	○	○
System Status			M	VB	VH
■ M9005	M9005="ON" when the battery power of the Real Time Clock (RTC) is insufficient.		○	○	○
■ M9018	M9018="ON" when RTC is installed in the CPU module/Main Unit.		○	○	○
M9028	When M9028="OFF", T32 ~ T62 become an 100ms counter. When M9028="ON", T32 ~ T62 become an 10ms counter.				○
M9031	Clear the Non-Latched area memory.	Current device settings are reset at next "END". All Coils Y, M, S, T, C are "OFF" and the current values of T, C, D become "0"; BUT except Special Coils M and D, which are not varied.	○	○	○
M9032	Clear the Latched area memory.		○	○	○
M9033	When M9033="ON" and RUN → STOP, the current value and statuses of T, C, D are retained.		○	○	○
M9034	All the outputs are disable. When M9034="ON", PLC's all external outputs are "OFF" but the program still operates normally.		○	○	○
M9039	Constant Scan Time duration. When M9039="ON", the PLC within a constant scan duration and defaulted by D9039.		○	○	○
M9083	For VB2 series only, to select the display range of I/O status. When M9083="OFF", shows the first 256 points; M9083="ON" shows the last 256 points.			○	
Flag			M	VB	VH
■ M9020	Zero Flag. M9020= "ON" when the result of an addition (ADD) or subtraction (SUB) is "0".		○	○	○
■ M9021	Borrow Flag. M9021= "ON" if any "Borrow" occurred to the result of the addition (ADD) or subtraction (SUB).		○	○	○
M9022	Carry Flag. M9022="ON" when any "Carry" occurred to the result of the addition (ADD) and subtraction (SUB).		○	○	○
■ M9029	Instruction execution completed flag. M9029="ON" when the executions of some applied instructions are completed (please refer to the relevant instructions).		○	○	○
■ M9131	Instruction execution completed flag for the identifies of instruction HSZ Multiple points comparison table has been processed.		○	○	
■ M9133	Instruction execution completed flag for the identifies of the instructions HSZ and PLSY (Pulse Y output at a set frequency) have been processed.		○	○	
■ M9199	Instruction execution completed flag for the identifies of instruction LINK (FNC80) has been processed.		○	○	
Assigning Specification of Applied Operation Instructions Mode			M	VB	VH
M9024	BMOV moves direction assigned. When M9024="OFF", S → D; Otherwise when M9024="ON", S ← D.		○	○	○
M9025	External HSC resets input mode. When M9025="OFF" and an external reset occurs, only the current value of HSC will be reset; when M9025="ON" and an external reset occurs, not only the current value of HSC will be reset but also the execution of relevant instructions will be restarted.		○	○	○
M9026	RAMP hold mode assigned. When M9026="OFF", a series of signals will be ramped by RAMP; Otherwise when M9026="ON", only one signal will be ramped by RAMP.		○	○	○
M9027	PR mode assigned. Please refer to PR (FNC 77) Instruction for details.		○	○	
M9130	Assigned the instruction HSZ to execute Multiple points compare mode.		○	○	
M9132	Assigned the instructions HSZ and PLSY to execute pulse variation frequency mode.		○	○	
M9161	Assigned an 8/16-bit process mode. When M9161="OFF" for a 16-bit process mode; and M9161="ON" for an 8-bit process mode		○	○	○

Note: Common alternatives are "a" and "b" identifiers for Normally Open (NO) ,Normally closed (NC) states.

Coil ID. No.	Instruction of Function	Series		
Assigning Specification of Applied Operation Instructions Mode		M	VB	VH
M9167	HKY mode assigned. When M9167=“OFF” for a “DEC” numeric mode, and M9167=“ON” for a “HEC” numeric mode	○	○	
M9168	SMOV mode assigned. When M9168=“OFF” for a “DEC” numeric mode, and M9168=“ON” for a “HEC” numeric mode	○	○	○
Step Ladder Instruction Correlated Flags		M	VB	VH
M9040	STL transfer is prevented. When M9040=“ON”, the STL state transfer function is disabled.	○	○	○
■ M9046	STL state is ON. When M9047=“ON” and any coil of S0 ~ S899=“ON” than M9046=”ON”.	○	○	○
M9047	STL monitoring is enable. D9040 ~ D9047 will be active only when M9047=“ON”.	○	○	○
■ M9048	The annunciator monitoring has been enabled. When M9049=“ON”and any coil of S900 ~ S999=“ON”, than M9048=“ON”.	○	○	
M9049	Enable annunciator monitoring. D9049 will be effective only when M9049=“ON”.	○	○	
Interrupt Prevented		M	VB	VH
M9050	Input interrupt I00□ is prevented.	○	○	○
M9051	Input interrupt I10□ is prevented.	○	○	○
M9052	Input interrupt I20□ is prevented.	○	○	○
M9053	Input interrupt I30□ is prevented.	○	○	○
M9054	Input interrupt I40□ is prevented.	○	○	○
M9055	Input interrupt I50□ is prevented.	○	○	○
M9056	Timer interrupt I6□□ is prevented.	○	○	○
M9057	Timer interrupt I7□□ is prevented.	○	○	○
M9058	Timer interrupt I8□□ is prevented.	○	○	○
M9059	High Speed Counter interrupt I010 ~ I060 is prevented.	○	○	○
Error Message		M	VB	VH
■ M9019	Real Time Clock setting error.	○	○	○
■ M9060	The M series I/O configuration error. When CPU detects a wrong I/O configuration, the PLC will stop, M9060= “ON” and the “ERR” LED of the CPU module will flash (1Hz).	○		
■ M9063	Wrong Parallel Link operation or wrong RS communication has been detected, M9063= “ON” but the PLC will keep running.	○	○	○
■ M9066	Program CHECK SUM error. PLC will stop, M9066= “ON” and the “ERR” LED of the CPU/Main module will flash (2Hz).	○	○	○
■ M9067	Operation error. If operation error occurs during program execution, then M9067=“ON” but PLC will keep running.	○	○	○
M9068	Operation error latch. When M9068= “ON” and operation error occurs, the step number where operation errors occur will be latched in D9068.	○	○	○
Parallel Link Operation		M	VB	VH
■ M9070	When the Module is assigned as the Master station in a Parallel Link application, M9070= “ON”.	○	○	
■ M9071	When the Module is assigned as the Slave station in a Parallel Link application, M9071= “ON”.	○	○	
■ M9072	When the Parallel Link is operating, M9072= “ON”.	○	○	
■ M9162	When the Parallel Link is operating in the High-speed transfer mode, M9162= “ON”. This flag is based on the Master station’s M9162 status.	○	○	
VB Series DIP Switch Status		M	VB	VH
■ M9080	The 2nd DIP switch status in the Main Unit.		○	
■ M9081	The 3rd DIP switch status in the Main Unit.		○	
■ M9082	The 4th DIP switch status in the Main Unit.		○	
VB Series Multi-Functional Display Setting Mode		M	VB	VH
M9084	Monitor function.		○	
M9085	Setting function.		○	
M9086	Progressive adding (+) function.		○	
M9087	Progressive subtracting (-) function.		○	
■ M9088	Error flag.		○	

Coil ID. No.	Instruction of Function	Series		
CP2 MODEM Dial-Up		M	VB	VH
M9100	CP2 Dial-Up start up flag.	○	○	
■ M9101	CP2 Dial-Up unsuccessful.	○	○	
RS Instruction		M	VB	VH
M9122	RS Data transmission flag.	○	○	○
M9123	RS Data receive completed.	○	○	○
■ M9124	M9124 will show up the "CD" signal when PLC's CP2 COM Port is connected with a MODEM.	○	○	
M9129	RS Data transmission Time-Out flag.	○	○	○
CPU LINK		M	VB	VH
■ M9183	CPU LINK communication unsuccessful (Master Station).	○	○	
■ M9184	CPU LINK communication unsuccessful (1^{st} Slave Station).	○	○	
■ M9185	CPU LINK communication unsuccessful (2^{nd} Slave Station).	○	○	
■ M9186	CPU LINK communication unsuccessful (3^{rd} Slave Station).	○	○	
■ M9187	CPU LINK communication unsuccessful (4^{th} Slave Station).	○	○	
■ M9188	CPU LINK communication unsuccessful (5^{th} Slave Station).	○	○	
■ M9189	CPU LINK communication unsuccessful (6^{th} Slave Station).	○	○	
■ M9190	CPU LINK communication unsuccessful (7^{th} Slave Station).	○	○	
The 32-bit Counter Count Direction Control		M	VB	VH
M9200 ~ M9234	When M92□□ = "OFF", the C2□□ is operated as a up counter. When M92□□ = "ON", the C2□□ is operated as a down counter.	○	○	
Controlling and Monitoring of High Speed Counter Count Direction		M	VB	VH
M9235 ~ M9245	When M92□□ = "OFF", the C2□□ is operated as a up counter. When M92□□ = "ON", the C2□□ is operated as a down counter.	○	○	○
■ M9246 ~ ■ M9255	When C2□□ is operated a up count, M92□□ = "OFF". When C2□□ is operated a down count, M92□□ = "ON".	○	○	○
The VB1 series position control instructions' relative flags (for VB1 series only)		M	VB	VH
M9140	If M9140="ON", the clear signal is sent to the servo when the return to zero point is complete.		○	
M9145	Y0 pulse output stop immediately.		○	
M9146	Y1 pulse output stop immediately.		○	
M9147	Y2 pulse output stop immediately.		○	
M9148	Y3 pulse output stop immediately.		○	
■ M9149	Y0 pulse output monitor, "ON"=busy.		○	
■ M9150	Y1 pulse output monitor, "ON"=busy.		○	
■ M9151	Y2 pulse output monitor, "ON"=busy.		○	
■ M9152	Y3 pulse output monitor, "ON"=busy.		○	
The VB1 series hardware high speed counters' relative flags (for VB1 series only)		M	VB	VH
M9194	To activate the interrupt I050 for HHSC1. When (present value)=(setting value) of the HHSC1, no interrupt if M9194="OFF"; otherwise the interrupt routine will process immediately if M9194="ON".		○	
M9195	To activate the interrupt I060 for HHSC2. When (present value)=(setting value) of the HHSC2, no interrupt if M9195="OFF"; otherwise the interrupt routine will process immediately if M9195="ON".		○	
■ M9196	The counting direction of HHSC1, M9196="OFF"=counts up; M9196="ON"=counts down.		○	
■ M9197	The counting direction of HHSC2, M9197="OFF"=counts up; M9197="ON"=counts down.		○	

2-13-2 Instruction Table of Special Register

Register ID	Instruction of Function		Series		
PLC Operation Status			M	VB	VH
D9000	Time Setting of Watch Dog Timer. The WDT default value is 200ms and it can be changed by writing D9000, which is transferred from Program system when PLC power is "ON". (unit: 1ms)		○	○	○
■ D9004	Error coil ID number. When M9004= "ON", the content value may be 9060, 9063, 9066 or 9067 to indicate the error coil identification.		○	○	○
■ D9010	Current operation scan time (unit: 1ms)		○	○	○
■ D9011	Min. scan time (unit: 1ms)		○	○	○
■ D9012	Max. scan time (unit: 1ms)		○	○	○
System Status			M	VB	VH
■ D9001	Display the PLC's model and version.	Model: M1 Series：01 / VB0 Series：20 / VB1 Series：22 / VB2 Series：24 / VH Series：21 ; 0 1 1 0 0 ; Version:V1.00	○	○	○
■ D9002	Capacity size of Memory. "16" indicates 16K Steps, "8" indicates 8K Steps, "2" indicates 2K Steps		○	○	○
■ D9003	Type of Memory. 00H indicates a built-in 8K Steps Flash Memory of PLC. 10H indicates an extend 8K Steps Flash Memory Card.		○	○	○
D9020	Input points (X0 ~ X7) filter response time setting. (unit: 1ms) The default value is 10ms and the available range for M and VB series is 0 ~ 60ms, VH series is 0 ~ 15ms.		○	○	○
D9039	Constant Scan Time duration. The default value is 0ms and it can be changed by setting D9039, which is transferred from Program system when PLC power is "ON". (Unit: 1ms)		○	○	○
Time Value of Real Time Clock			M	VB	VH
D9013	Seconds value. (0 ~ 59)		○	○	○
D9014	Minute value. (0 ~ 59)		○	○	○
D9015	Hour value. (0 ~ 23)		○	○	○
D9016	Day value. (1 ~ 31)		○	○	○
D9017	Month value. (1 ~ 12)		○	○	○
D9018	Year value: 1990 ~ 2089 (4 digits)		○	○	○
D9019	Weekday value: 0 (Sun.) ~ 6 (Sat.)		○	○	○
Step Ladder Instruction Correlated			M	VB	VH
■ D9040	1st (the lowest) active STL step	When M9047= "ON", the step point ID numbers which are in action, they will be stored in D9040 ~ D9047. Where the D9040 will be stored the lowest ID number, the second lowest one will be stored in D9041 and so forth.	○	○	○
■ D9041	2nd active STL step		○	○	○
■ D9042	3rd active STL step		○	○	○
■ D9043	4th active STL step		○	○	○
■ D9044	5th active STL step		○	○	○
■ D9045	6th active STL step		○	○	○
■ D9046	7th active STL step		○	○	○
■ D9047	8th active STL step		○	○	○
■ D9049	When M9049= "ON", it stores the lowest currently active Annunciator in D9049.		○	○	
Error Message			M	VB	VH
■ D9063	Error code identifying Parallel link or RS communication error.		○	○	○
■ D9067	Error code identifying Operation error.		○	○	○
D9068	Latched the step address number of Operation error.		○	○	○
■ D9069	Step address number of Operation error.		○	○	○
Multi-Functional Display Functions			M	VB	VH
D9080	VB series: Multi-Functional Display mode setting. Please refer to Ch. 2-13-4 "VB Series Multi-Functional Display". VH series: Error Code Display function. Please refer to Ch. 2-13-5 "VH Series Error Code Display Function".			○	○
D9081	VB series Multi-Functional Display operation Auxiliary Register. Please refer to Ch. 2-13-4 "VB Series Multi-Functional Display".			○	
D9082				○	
D9083				○	
D9084				○	

Register ID	Instruction of Function		Series		
CP2 Communication Port			M	VB	VH
D9110 ~ D9113	Dial-Up number Registers. To store numbers for the MODEM to execute the Dial-Up function.		○	○	
D9121	The local station number for the CP2 to execute Computer Link.		○	○	○
■ D9122	The amount of residual data to be transferred by the instruction RS.		○	○	○
■ D9123	The amount of the data already received by the instruction RS.		○	○	○
D9124	To setting the Data Header code of instruction RS.		○	○	○
D9125	To setting the Data Terminator code of instruction RS.		○	○	○
D9129	To setting the data network "time-out" timer value of instruction RS.		○	○	○
High Speed Process Instruction			M	VB	VH
■ D9130	Used as a Counter to contain the number of the current record being processed in the HSZ comparison table.		○	○	
■ D9131	Used as a Counter to contain the number of the current record being processed in the HSZ comparison table when the PLAY operation has been enabled.		○	○	
■ D9132	Lower 16 bits	Used as a Register to contain the source (output pulse frequency) data for the PLSY instruction when used with the HSZ comparison table.	○	○	
■ D9133	Higher 16 bits				
■ D9134	Lower 16 bits	Used as a Register to contain a copy of value for current comparison when the HSZ comparison table and combined PLSY out put are used.	○	○	
■ D9135	Higher 16 bits				
■ D9136	Lower 16 bits	Used as a counter to contain the total number of pulses that have been output using the PLSY instruction. (NOT for VB1 series)	○	○	○
■ D9137	Higher 16 bits				
■ D9140	Lower 16 bits	Used as a counter to contain the total number of pulses that have been output to Y0 using the PLSY instruction.(NOT for VB1 series)	○	○	○
■ D9141	Higher 16 bits				
■ D9142	Lower 16 bits	Used as a counter to contain the total number of pulses that have been output to Y1 using the PLSY instruction.(NOT for VB1 series)	○	○	
■ D9143	Higher 16 bits				
CPU LINK			M	VB	VH
■ D9172	The time of communication "Time Out".		○	○	
■ D9177	The number of Slave Station in the network.		○	○	
■ D9178	The domain of components for transferred.		○	○	
■ D9179	The retry times for communication.		○	○	
■ D9201	Current network operation scan time.		○	○	
■ D9202	Max. network operation scan time.		○	○	
■ D9203	A counter to record the communication error occurred at the Master station.		○	○	
■ D9204	A counter to record the communication error occurred at the 1st Slave station.		○	○	
■ D9205	A counter to record the communication error occurred at the 2nd Slave station.		○	○	
■ D9206	A counter to record the communication error occurred at the 3rd Slave station.		○	○	
■ D9207	A counter to record the communication error occurred at the 4th Slave station.		○	○	
■ D9208	A counter to record the communication error occurred at the 5th Slave station.		○	○	
■ D9209	A counter to record the communication error occurred at the 6th Slave station.		○	○	
■ D9210	A counter to record the communication error occurred at the 7th Slave station.		○	○	
■ D9212	The communication error code of the 1st Slave station.		○	○	
■ D9213	The communication error code of the 2nd Slave station.		○	○	
■ D9214	The communication error code of the 3rd Slave station.		○	○	
■ D9215	The communication error code of the 4th Slave station.		○	○	
■ D9216	The communication error code of the 5th Slave station.		○	○	
■ D9217	The communication error code of the 6th Slave station.		○	○	
■ D9218	The communication error code of the 7th Slave station.		○	○	

Register ID	Instruction of Function		Series		
Index Register V, Z			M	VB	VH
D9180	Z0 Index Register		○	○	○
D9181	V0 Index Register		○	○	○
D9182	Z1 Index Register		○	○	○
D9183	V1 Index Register		○	○	○
D9184	Z2 Index Register		○	○	○
D9185	V2 Index Register		○	○	○
D9186	Z3 Index Register		○	○	○
D9187	V3 Index Register		○	○	○
D9188	Z4 Index Register		○	○	○
D9189	V4 Index Register		○	○	○
D9190	Z5 Index Register		○	○	○
D9191	V5 Index Register		○	○	○
D9192	Z6 Index Register		○	○	○
D9193	V6 Index Register		○	○	○
D9194	Z7 Index Register		○	○	○
D9195	V7 Index Register		○	○	○
The VB1 series position control instructions' relative special registers (for VB1 series only)			M	VB	VH
D9140	Lower 16 bits	Current value registers of output pulse number (32-bit) from Y0		○	
D9141	Upper 16 bits				
D9142	Lower 16 bits	Current value registers of output pulse number (32-bit) from Y1		○	
D9143	Upper 16 bits				
D9144	Lower 16 bits	Current value registers of output pulse number (32-bit) from Y2		○	
D9145	Upper 16 bits				
D9146	Lower 16 bits	Current value registers of output pulse number (32-bit) from Y3		○	
D9147	Upper 16 bits				
D9149	Bias speed setting for the ZRN, DRVI or DRVA instruction is operating. If the setting value > (D9151,D9150) / 10, then D9149 = (D9151,D9150) / 10			○	
D9150	Lower 16 bits	Maximum speed setting for ZRN, DRVI and DRVA instructions are operating, the default value = 200,000 Hz, the available range is 10~200,000 Hz. When the setting value exceeds acceptable value, it will equal to the largest acceptable value.		○	
D9151	Upper 16 bits				
D9152	Acceleration/Deceleration time setting for ZRN, DRVI or DRVA instruction is operating, the default value = 100 mS, the available range is 50 ~ 5,000 mS.			○	
The VB1 series hardware high speed counters' relative special registers (for VB1 series only)			M	VB	VH
D9224	The operating type of HHSC1. T0 input "0" = disable the function of HHSC1, "1" ~ "18" are 18 different counting modes.			○	
D9225	The operating type of HHSC2. To input "0" = disable the function of HHSC2, "1" ~ "18" are 18 different counting modes.			○	
D9226	Lower 16 bits	The present value of HHSC1.		○	
D9227	Upper 16 bits				
D9228	Lower 16 bits	The present value of HHSC2.		○	
D9229	Upper 16 bits				
D9230	Lower 16 bits	The setting value of HHSC1.		○	
D9231	Upper 16 bits				
D9232	Lower 16 bits	The setting value of HHSC2.		○	
D9233	Upper 16 bits				

2-13-3 Error Message/Code Description

Error Message

Coil ID. Number.	Title	The Time of Detecting Error Message	PLC Status	Status of the ERR LED
M9060	The M series I/O configuration error.	When Power is "OFF" → "ON" and "STOP" → "RUN"	STOP	Flash with 1Hz
M9063	Wrong Parallel Link operation or RS communication	When the paired stations signal is received	RUN	OFF
M9066	Check Sum Error	When Power is "OFF" → "ON" and "STOP" → "RUN"	STOP	Flash with 2 Hz
M9067	Operation Error	During the running program	RUN	OFF

Operation Error Code (the contains of D9067)

Error Code	Detail
0	No error message
6702	More than 5 Level of Call instruction have been nested together.
6703	More than 2 Level of Interrupt Insert have been nested together.
6704	More than 5 Level of FOR / NEXT have been nested together.
6705	An incompatible device has been specified as an operand for an applied instruction.
6706	An device has been specified exceed of the allowable range for an applied instruction operand.
6708	Error FROM / TO instruction

RS Communication Instruction Error Code (the contains of D9063)

Error Code	Detail
0	No error message.
6301	Parity，framing error.

CPU Link Communication Error Code (the contains of D9212 ~ D9218)

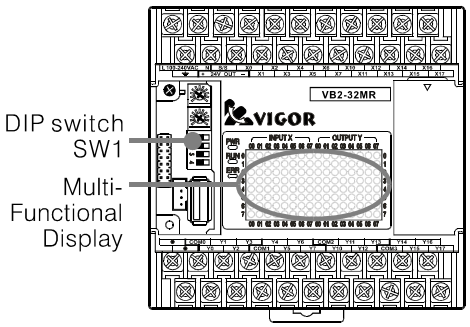
Error Code	Detail
00H	No error message.
01H	The communication has been Time Out.
05H	The communication has Check Sum Error.

MEMO

2-13-4 VB Series Multi-Functional Display

On the Main Unit of VB series PLC, it built-in a 16×8 points matrix LED Multi-Functional Display. When it conjugations with the user program can be used as a brief monitor of Human Machine Interface.

Inside of the left side cap, the second jumper of the DIP switch (SW1-2) isused to control the Multi-Functional Display. When the SW1-2= "OFF", the screen will display the I/O status; When the SW1-2= "ON", the screen will become the Multi-Functional Display.



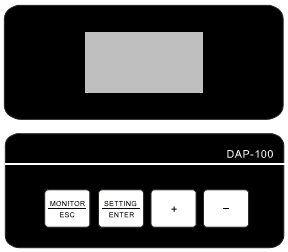
When the SW1-2="OFF", the screen will display the I/O status; When the SW1-2="ON", the screen will become the Multi-Functional Display.
By way of M9083 and SW1-3 , To select the indicate area : (when the SW1-2="OFF")

M9083="OFF"		M9083="ON"	
SW1-3="OFF" (VB0,VB1,VB2)	SW1-3="ON" (VB1,VB2)	SW1-3="OFF" (VB2)	SW1-3="ON" (VB2)
X0～X77 ; Y0～Y77	X100～X177 ; Y100～Y177	X200～X277 ; Y200～Y277	X300～X377 ; Y300～Y377

The Multi-Functional Display provides 8 mode types (Mode 0 ~ 7) and the operation setting is depend on the content of D9080. Changes the content of D9080 during the running program will change the display mode of the Multi-Functional Display.

Mode	D9080	D9081	Function	Content of the screen
Mode 0	K0	Disable	I/O status monitor	I/O points "ON"/ "OFF" status
Mode 1	K1	Indicator (K_n)	Value, word, chart display	The bit of D_n～D_{n+7} "ON"/ "OFF" status
Mode 2	K2	Indicator (K_n)	Error Code display	"E"+a 3-digit number of D_n
Mode 3	K3	Indicator (K_n)	A 4-digit number (0000 ~ 9999) display	A 4-digit number of D_n
Mode 4	K4	Indicator (K_n)	Two of 2-digit numbers (00 ~ 99) display	2-digit number of D_{n+1} & 2-digit number of Dn
Mode 5	K5	Indicator (K_n)	One word and a 3-digit number display	A word of D_{n+1} and a 3-digit number of Dn
Mode 6	K6	See the reference	The mode is for Data Access Panel	A word and a 3-digit number
Mode 7	K7	Indicator (K_n)	A 5-digit number (0 ~ 32,767) display	A 5-digit number of D_n

The Data Access Panel DAP-100 is a useful accessory, which is designed to join with the Multi-Functional Display together, become a simplified Human Machine Interface. They have the best economic effect because combine the Display and DAP-100.

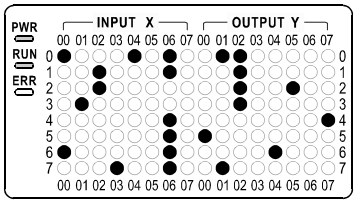


Item	Specification
Components	Display screen cover + 4 keys setting board
Material of surface	Smooth PC plastic, 0.254mm thickness
Key specification	12×12 TACT SWITCH
Key lifespan	500,000 Times
PLC interface	4 Input points of the PLC
Type of connect	European P.C.B. Terminal
Facade size (W)×(H)	Both the display screen cover and 4 keys setting board are 110mm×45mm

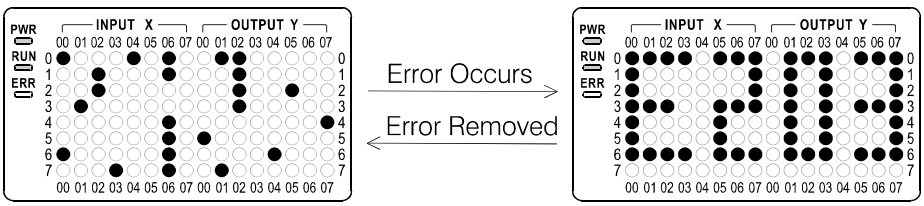
(1) Display Mode 0: I/O Status Monitor

This mode will post the I/O status at the screen. The function as same as when the SW1-2 put in "OFF" position.

D9080 = 0 (Display Mode 0)
The screen displays "ON"/ "OFF" status of I/O

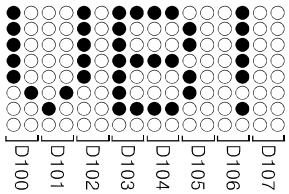


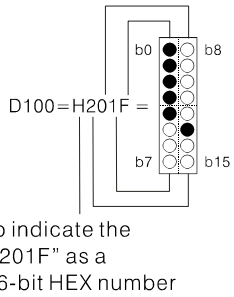
The main function of this mode is joined with other display mode to make the display screen more flexible. For example: Set the screen at mode 0, it will display the I/O status. But when the error occurs, than the screen will become the error code Display.



(2) Display Mode 1: Value, Numbers, Letters and Chart Display

This mode is assigned the D9081 as a Indicator Register, and its content value (Kn) will channeled the indicator to the Register Dn. And the contents of Dn~ Dn+7 are 8 Registers total (16×8=128 bits), which will be used the bit type to display in the screen (128 points LED).

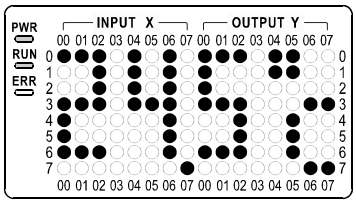




D9080 = K1 (Mode1)
D9081 = K100 (Display the contents of D100 ~ D107)
D100 = H201F
D101 = H2040
D102 = H001F
D103 = H497F
D104 = H4949
D105 = H0036
D106 = H5F00
D107 = H0000

- The example for display a temperature value:

  As the program chart below, the program will be used the content value number of D0 (pickup the last 3 digits and the unit is 0.1 ℃) to display in the left side of screen and in the right side of the screen will be showed the "℃" symbol.




```
M9002
 |  MOV K1 D9080      To assign the display at Mode 1.
 |  MOV K2 D9081      Let the indicator channeled to D2.
M9002
 |  DMOV H007F417F D1000   The chart for digit "0"
 |  DMOV H00007F00 D1002   The chart for digit "1"
 |  DMOV H004F4979 D1004   The chart for digit "2"
 |  DMOV H007F4949 D1006   The chart for digit "3"
 |  DMOV H007F080F D1008   The chart for digit "4"
 |  DMOV H0079494F D1010   The chart for digit "5"
 |  DMOV H0079497F D1012   The chart for digit "6"
 |  DMOV H007F0101 D1014   The chart for digit "7"
 |  DMOV H007F497F D1016   The chart for digit "8"
 |  DMOV H007F494F D1018   The chart for digit "9"
```

The Registers D1000 ~ D1018 are used to setup the dot charts of numbers 0 ~ 9. This block of program could replace by the function of"Tools \Edit Display Graph..."in the Ladder Master. When using the table, this block could skip.

```
M9000
 |  SMOV D0 K3 K1 D10 K1   To pick up the value of 3rd (hundreds) position digit from D0.
 |  MUL D10 K2 D12
 |  MOV D12 Z0             Let the chart of 3rd digit value to display in the screen of
 |  DMOV D1000Z0 D2        hundreds digit place.
M9000
 |  SMOV D0 K2 K1 D10 K1   To pick up the value of 2nd (tens) position digit from D0.
 |  MUL D10 K2 D12
 |  MOV D12 Z0             Let the chart of 2nd digit value to display in the screen of tens
 |  DMOV D1000Z0 D4        digit place.
 |  WOR D5 H8000 D5        To crate the decimal point in the screen.
M9000
 |  SMOV D0 K1 K1 D10 K1   To pick up the value of 1st (units) position digit from D0.
 |  MUL D10 K2 D12
 |  MOV D12 Z0             Let the chart of 1st digit value to display in the screen of units
 |  DMOV D1000Z0 D6        digit place.
M9000
 |  DMOV H88887303 D8      To crate the "℃" chart in the screen.
```

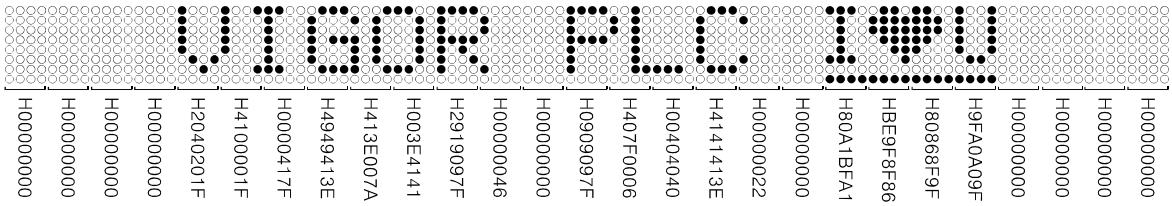
- Uses the “Rolling Chart ” to display information

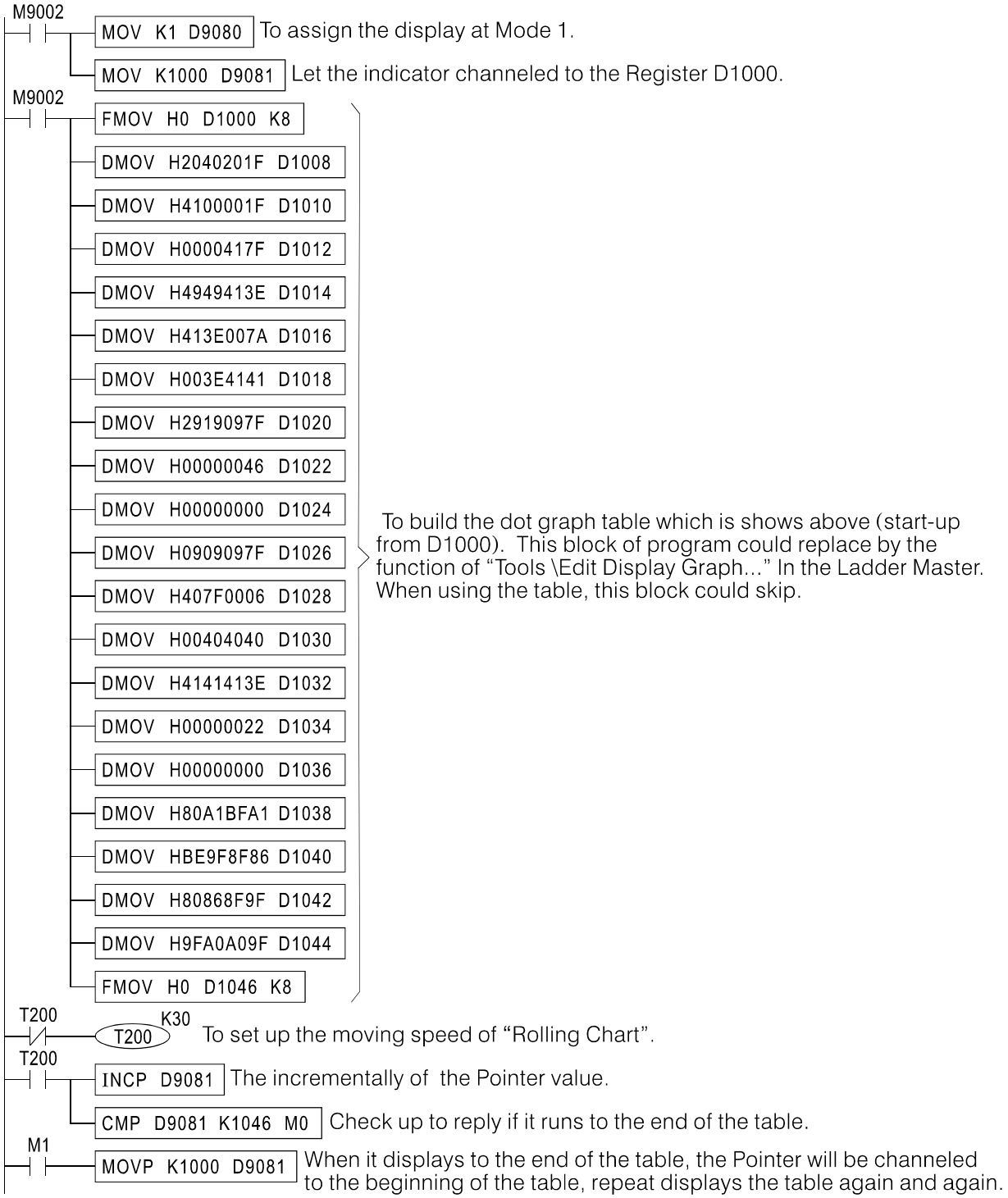
  ① Build the chart table, and then let the content of D9081 channeled to the beginning of the table.

  ② Use a given specific timing alternate (around 0.3 sec.) increased the content of D9081.

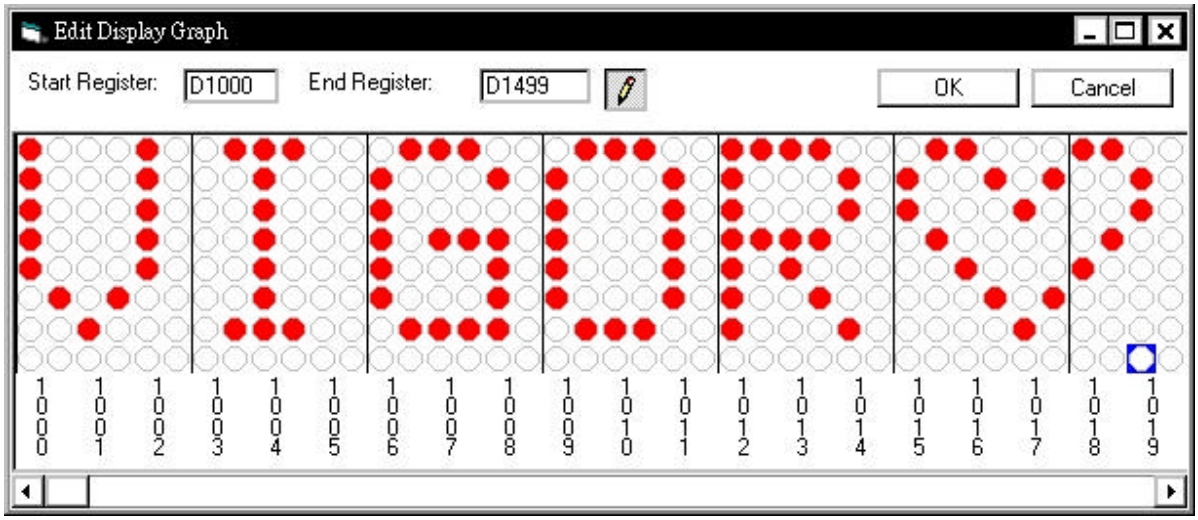
  ③ The chart table will be showed in the screen.

- The example for display a “Moving sign” :



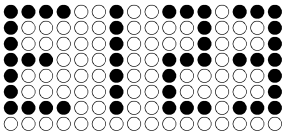


- The programming tool software iLadder Masteriprovide the tool: “Tools \Edit Display Graph...”, that is for to create the display chart easily. It can be edit the graph of letters, numbers and symbols from keyboard directly. Also, it is possible to use cursor to create an individual graph.
- This edit function will create and store data into the corresponding File Register, and the it is a part of user program. So, cleverly to use the Edit Display Graph function could save the the user program size for create the graph and it is easy to maintain.
  For more detail about the File Register, please reference the section “2-9 File Register (D)”.



(3) Display Mode 2: Error Code Display

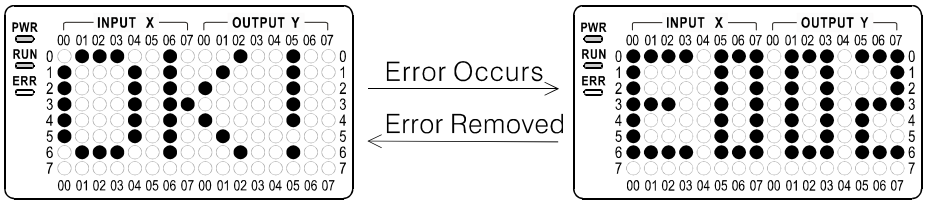
This mode is assigned the D9081 as a Indicator Register, and its content value (Kn) will channeled the indicator to the Register Dn. The last 3 digits number of content in Dn will be displayed in right side of the screen and the left side of the screen will display an "E" symbol to indicate it displaying an error code.

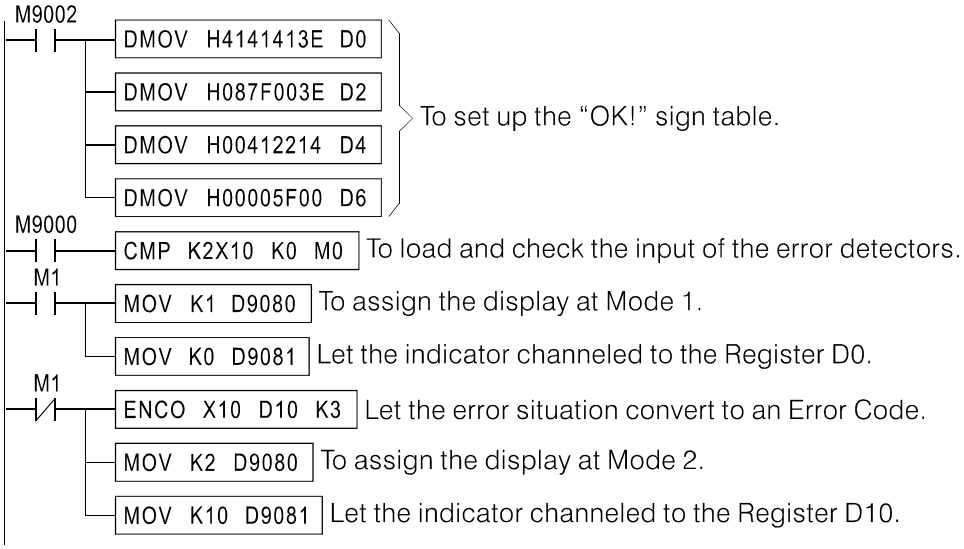


D9080 = K2 (Mode 2)
D9081 = K100 (To display the last 3 digits number of content in D100)
D100 = K123

- The example for display an "Error Code" :

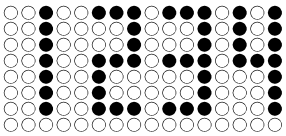
We assume the PLC input points X10 ~ X17 connect with 8 error detectors (ex. Motor over load, Over the limits...) When the error occurs, it will be showed the corresponding error code in the screen; Otherwise it will be showed an "OK !" sign in the the screen.





(4) Display Mode 3: To display a 4-digit number(0000 ~ 9999)

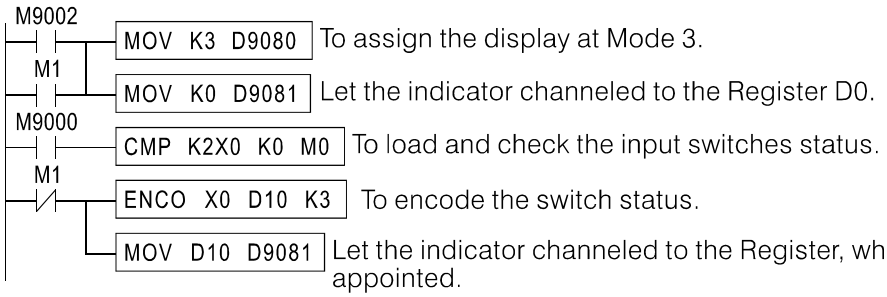
This mode is assigned the D9081 as a Indicator Register, and its content value (K*n*) will channeled the indicator to the Register D*n*. The last 4 digits number of content in D*n* will be displayed in the screen.



D9080 = K3 (Mode 3)
D9081 = K100 (To display the last 4 digits number of content in D100)
D100 = K1234

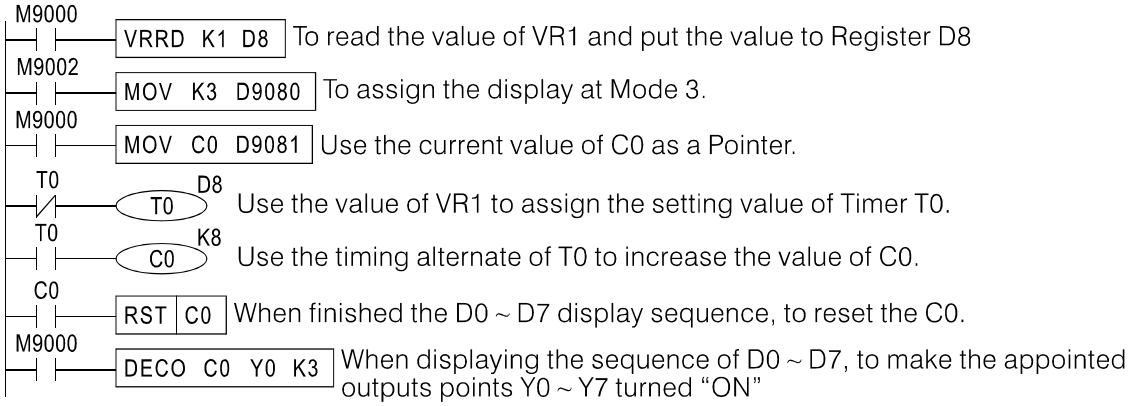
- Example 1:

We assume the PLC input points X0 ~ X7 connect with 8 switch contacts. When the the contact of X0= "ON", it will display the content value of D0 in the screen; When the the contact of X1= "ON", it will display the content value of D1 in the screen, and so forth.



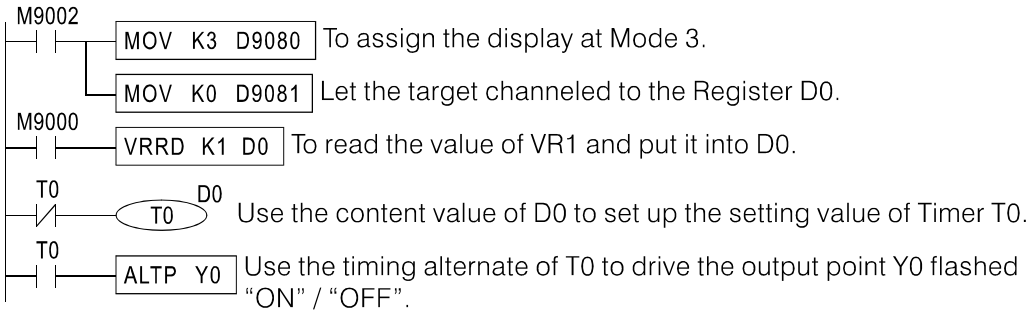
- Example 2:

We use the program to display the contents of D0~D7 in the screen and also the appointed output points Y0 ~ Y7 will be turned "ON" as indicant. Use the Analog Potentiometer VR1 to give a value for display timing alternate.



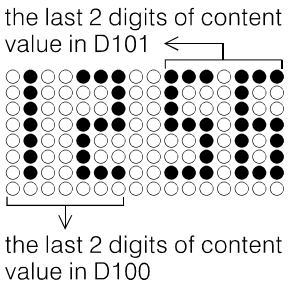
- Example 3:

We use the program to display the value of Analog Potentiometer VR1 in the screen, and assigned the value as the setting value of T0.
Usually, using the value of VR1 and VR2 to setting the Timers, only depend on intuition without real measure. Since the VB series provided the Multi-Functional Display, to adjust the Analog Potentiometer VR1 and VR2 become clear and definite.
This program example is to make a description of VR1 and VR2 combine with Multi-Functional Display.



(5) Display Mode 4: To display two 2-digit numbers (00 ~ 99)

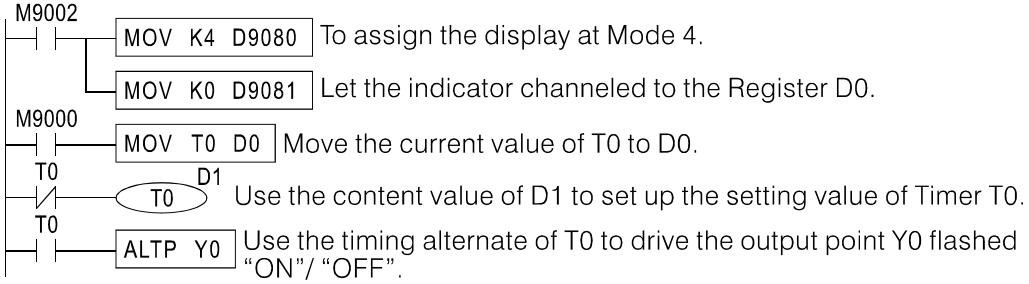
This mode is assigned the D9081 as a Indicator Register, and its content value (Kn) will channeled the indicator to the Register Dn. The last 2 digits number of content in Dn will be displayed in left side of the screen and the right side of the screen will be displayed the last 2 digits number of content in D$n+1$.



D9080 = K4 (Mode 4)
D9081 = K100 (To display the last 2 digits of content value in D100 and D101)
D100 = K56
D101 = K12

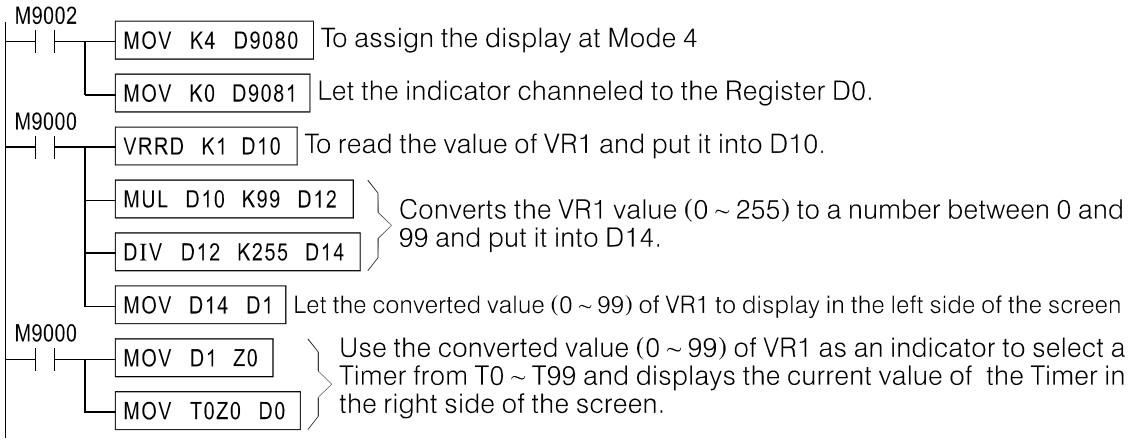
- Example 1:

This program will display the setting value of T0 in the left side of screen and put the current value in the right side.



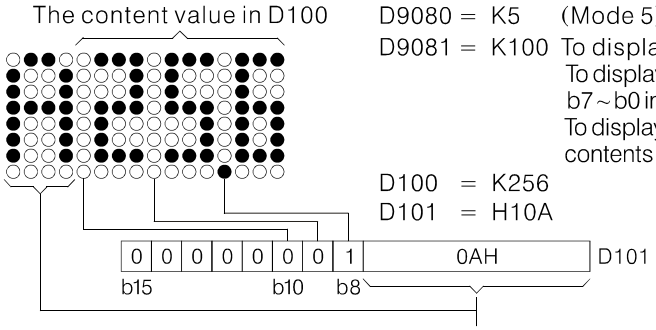
- Example 2:

This program will select a current value from T0 ~ T99 and display the value in the screen. Use the value of VR1 to pick up a corresponding Timer from T0 ~ T99 and displays the ID number of the Timer has been selected in the left side of screen, displays the current value of the Timer in the right side.



(6) Display Mode 5: To display a letter and a 3-digit number

This mode is assigned the D9081 as a Indicator Register, and its content value (Kn) will channeled the indicator to the Register Dn. The last 3 digits number of content in Dn will be displayed in right side of the screen and a letter is specified by b7 ~ b0 of D$n+1$, on the left side of the screen. The location of decimal point shows is specified by b10 ~ b8 of D$n+1$. Please refer to the following example for details.



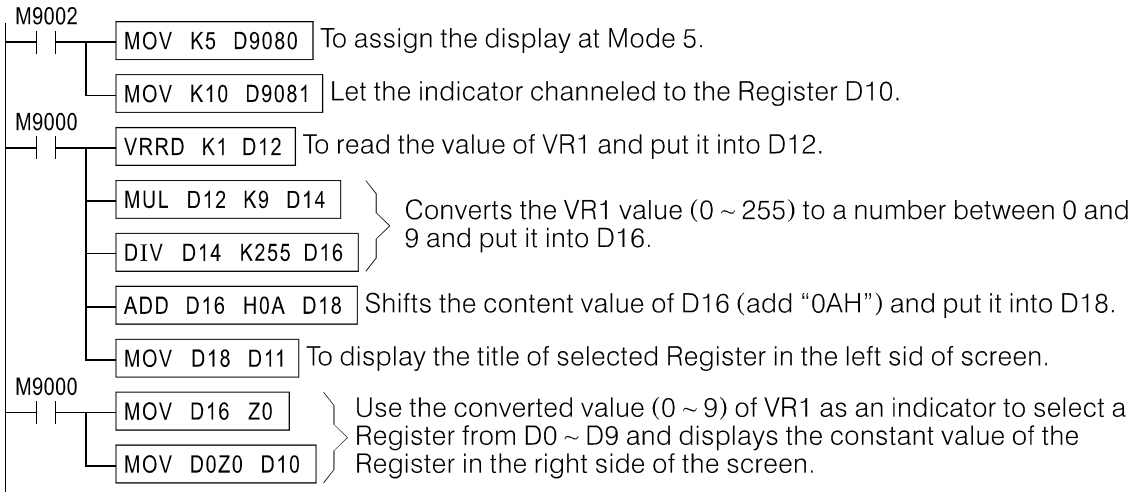
The convert table between the number code and the letter to display

Number code	Display letter	Number code	Display letter	Number code	Display letter	Number code	Display letter
00H	0	10H	G	20H	W	30H	m
01H	1	11H	H	21H	X	31H	n
02H	2	12H	I	22H	Y	32H	o
03H	3	13H	J	23H	Z	33H	p
04H	4	14H	K	24H	a	34H	q
05H	5	15H	L	25H	b	35H	r
06H	6	16H	M	26H	c	36H	s
07H	7	17H	N	27H	d	37H	t
08H	8	18H	O	28H	E	38H	u
09H	9	19H	P	29H	f	39H	v
0AH	A	1AH	Q	2AH	g	3AH	w
0BH	B	1BH	R	2BH	h	3BH	x
0CH	C	1CH	S	2CH	i	3CH	y
0DH	D	1DH	T	2DH	j	3DH	z
0EH	E	1EH	U	2EH	k		
0FH	F	1FH	V	2FH	l		

- This mode can be applied to a multi-data display, where the data title is shown on the left side and the data content is shown on the right.

- Example :

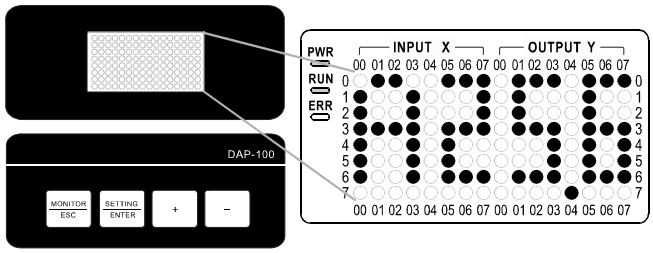
This program will select a content value from D0 ~ D9 and display the value in the screen. Let the title of D0 ~ D9 are A ~ J. And use the value of VR1 to pick up a corresponding Register from D0 ~ D9 and displays the title of the Register has been selected in the left side of screen, displays the current value of the Register in the right side.



(7) Display Mode 6: Data Programmer Mode

This mode is design to collocate with a Data Access Panel (DAP-100) for setting and watching the argument and data in the program (the contents of Data Registers).

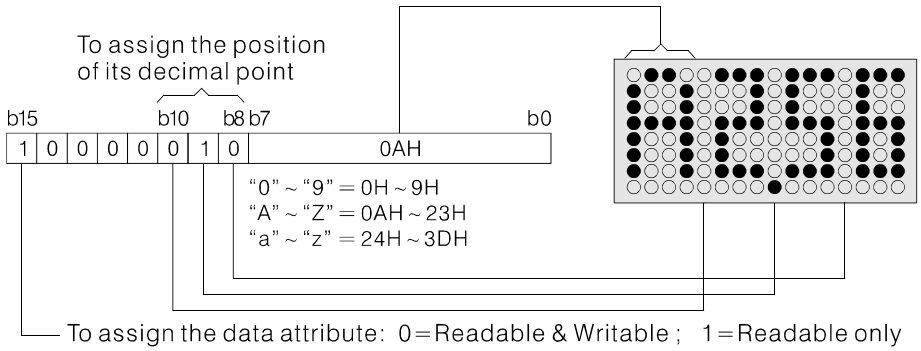
This mode shows the same screen as displayed in Mode 5. Read the instructions on Mode 5 before reading the instructions in this section. This mode can set multiple sets of data with 4 push-button switches.



The Special Register and the Special Coil used in this mode are explained as below:

<1> D9080: To indicate the Mode (D9080 = K6)

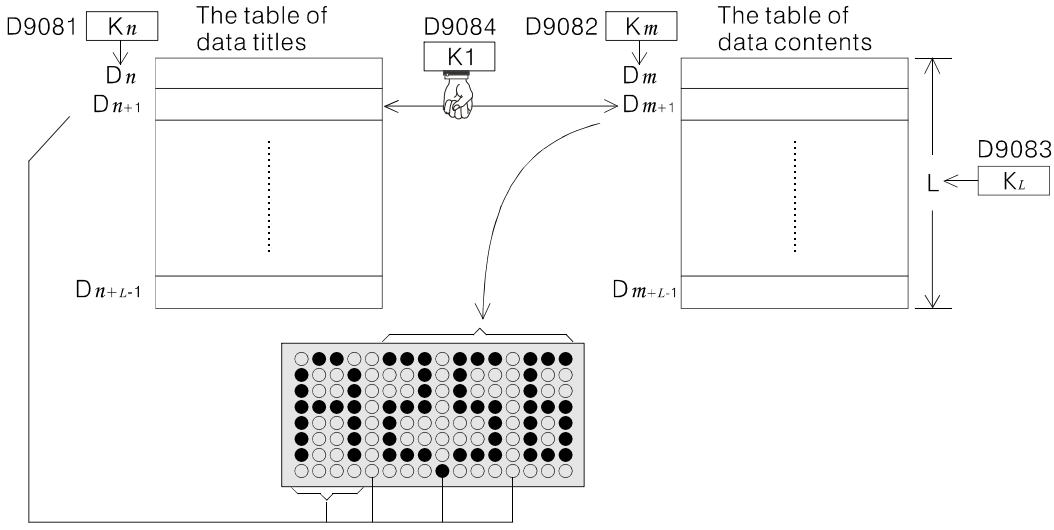
<2> D9081: The Indicator Register for the table of data titles. Its content value (Kn) will channeled the indicator to the Register Dn, where the Dn is the beginning Register for the table of data titles, and the table-length is decided by D9083(L). Each Register in this table can assign a data title, the position of its decimal point, and the data attribute (R/RW).



<3> D9082: The Indicator Register for the table of data titles. Its content value (Km) will channeled the indicator to the Register Dm, where the Dm is the beginning Register for the table of data titles, and the table-length is decided by D9083(L). Each Register in this table can store a 3-digit number (0 ~ 999).

<4> D9083: Use the Register to assign the table-length. Its content value (KL) designates the table-length (the table of data titles and the table of data contents).

<5> D9084: Use the Register as a task indicator. Its content value Kp (=K0 ~ K[L-1]) will channeled the indicator to the table of data titles and the table of data contents, and displays the constant value of the corresponding table in the screen.



<6> The numbers monitoring/programming functions of the Data Programmer Mode are Performed with 5 Special Coils (such 5 Special Coils only perform the corresponding functions in this mode). This mode is available to use external input signals to drive the corresponding Special Coils, and it fulfills the practical application from simple external operation.

M9084: Monitoring function. When this contact turns "ON", the screen shows the table Contents, which is directed by D9084.

M9085: Setting function. When the contact turns "ON", the data setting function is Accessed.

M9086: Increasing function (+).

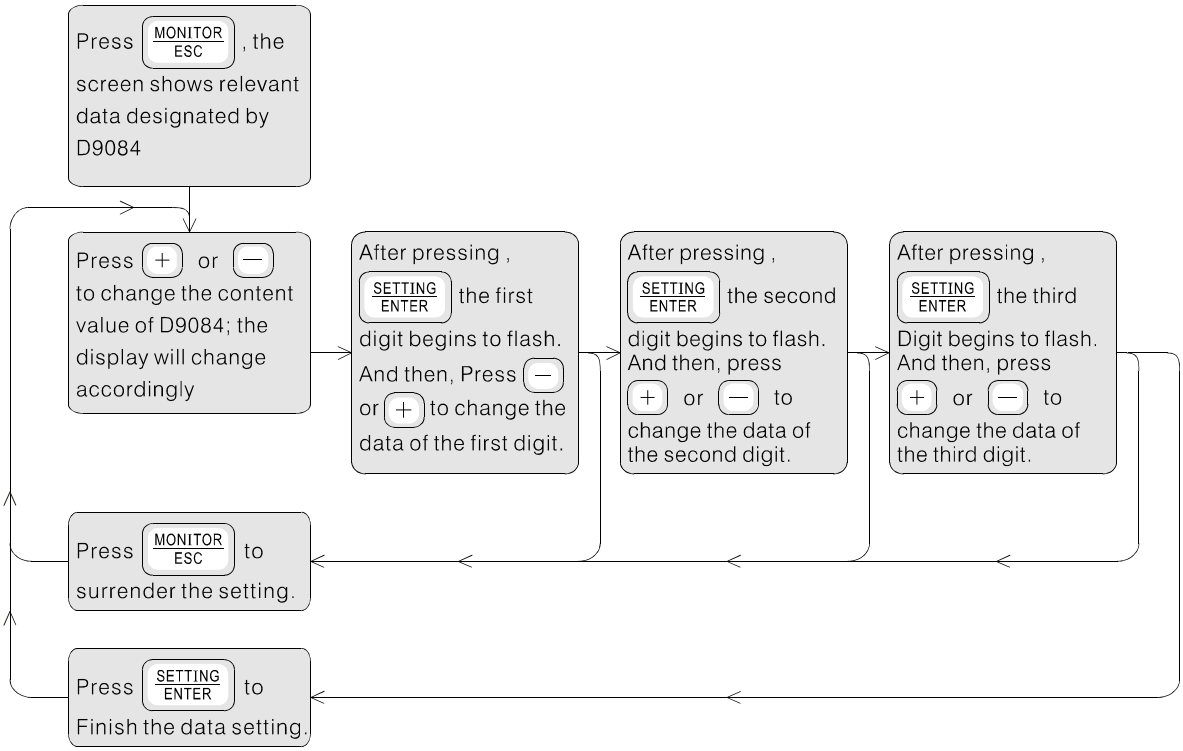
M9087: Decreasing function (-).

M9088: The error signals output. When the data attribute is set to be readable only, and the setting or writing function is to be performed, then M9088 will become "ON" for a scan time.

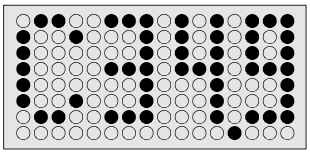
Assume the Special Coils (M9084 ~ M9087) are driven by the external push-button switches.

M9084 [MONITOR ESC] M9085 [SETTING ENTER] M9086 [+] M9087 [—]

The operation process of the mode is shown as follows:



- Example :



D9080 = K6 (Mode 6)
D9081 = K7000 The beginning Register for the table of data titles is D7000 (latched).
D9082 = K7010 The beginning Register for the table of data contents is D7010 (latched).
D9083 = K3 The table-length is “3”, indicating there are 3 sets of data.
D9084 = K0 As the content value of the current task indicatorIs “0”, The first set of data in the table will be displayed in the screen.

Data Title	Displayed Value	Data Attribute
C	34.9	Readable &Writable
R	128	Readable only
H	1.00	Readable &Writable

The table of data titles

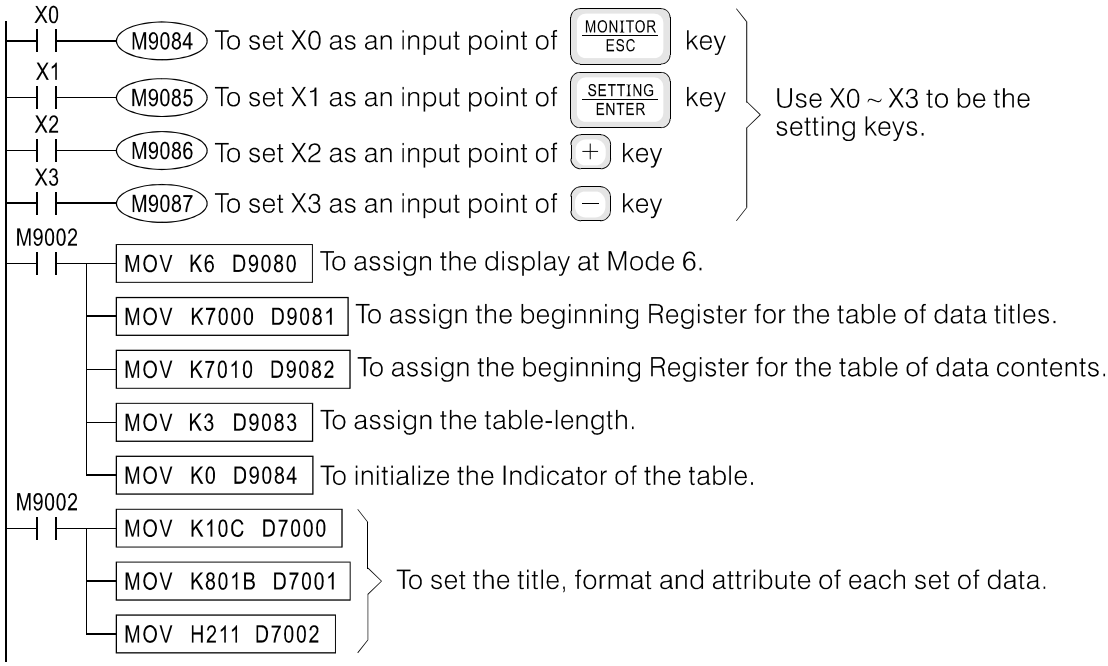
D7000	10CH
D7001	801BH
D7002	211H

D9084 K0

Table of data contents

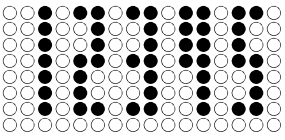
D7010	349
D7011	128
D7012	100

Stepladder Chart program



(8) Display Mode 7: To display a 5-digit number (0 ~ 32767)

This mode is assigned the D9081 as a Indicator Register, and its content value (Kn) will channeled the indicator to the Register Dn. The content in Dn will be displayed in the screen.



D9080 = K7 (Mode 6)
D9081 = K100 (To display the content of D100)
D100 = K12345

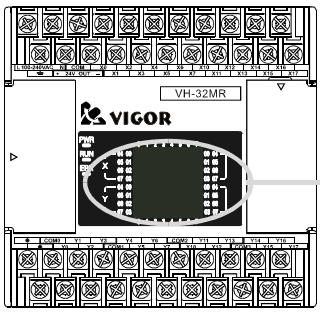
- The function and operation of this mode are as same as mode 3, please refer to mode 3 for the examples.

MEMO

2-13-5 VH Series Error Code Display Function

The VH series PLC Main Unit (exclude VH-10MR and VH-14MR) built-in an 8×8 points matrix LED screen, which is not only displaying the I/O status, also has 109 error codes (01 ~ 99 and E0 ~ E9) display function.

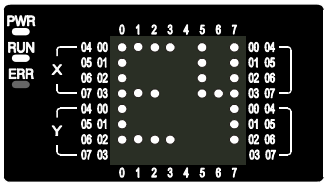
The error code display function helps to display the condition of machine error, and then increases the maintenance effect. It is a very useful and economical function.

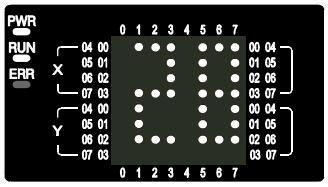


The VH series PLC using D9080 Special Register to control the display function.

Contents of D9080	The contents in the screen
0	To display the I/O status*
1 ~ 99	To display the number 01 ~ 99
100 ~ 109	To display the error code E0 ~ E9

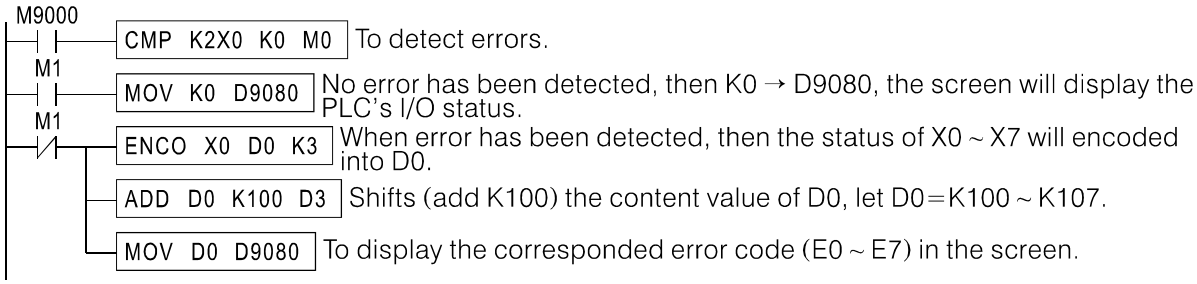
* When SW1-2 = "OFF", it will indicate the status of X0 ~ X37 and Y0 ~ Y37; When SW1-2 = "ON", it will indicate the status of X40 ~ X77 and Y40 ~ Y77





- Example :

  We assume the PLC input points X0 ~ X7 connect with 8 error sensors (ex. Motor overload, out the limitations,.....) When error occurs, the screen will display the corresponded error code (E0 ~ E7). Otherwise, if there is no error has been detected, the screen will display the PLC's I/O status.



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