CÔNG TY TNHH CƠ ĐIỆN TỰ ĐỘNG NHẤT TÍN

ĐC: 68B/2 TỔ 8, KP3, P TÂN HIỆP, TP. BIÊN HÒA, T. ĐỒNG NAI

Website: http://tudonghoadongnai.com hoặc: http://tudonghoadongnai.com.vn

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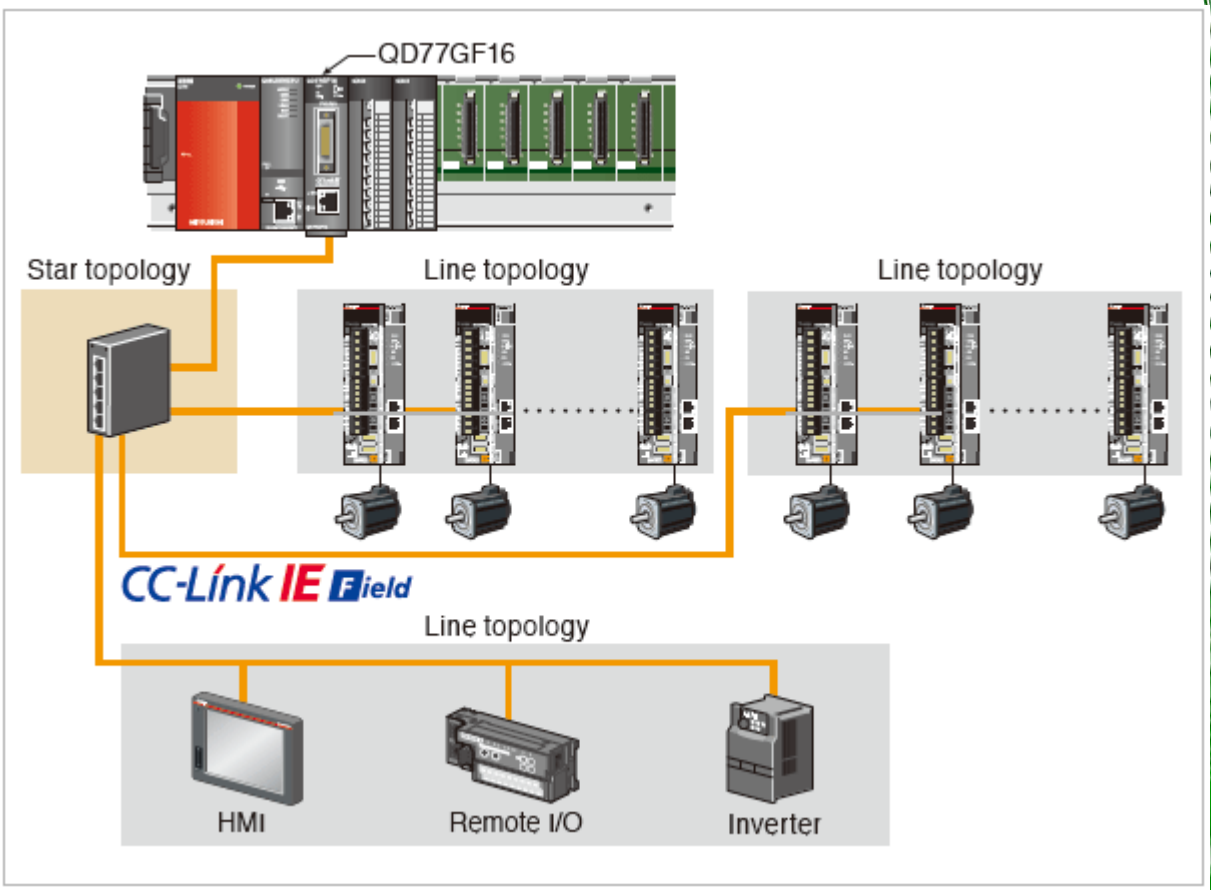
ĐT: 0945791177

GIÁO TRÌNH

PLC MITSUBISHI QCPU - INVERTER - HMI

(This manual is for internal circulation only)



Biên soạn:

Ths. Lê Xuân Quang

January 25, 2020

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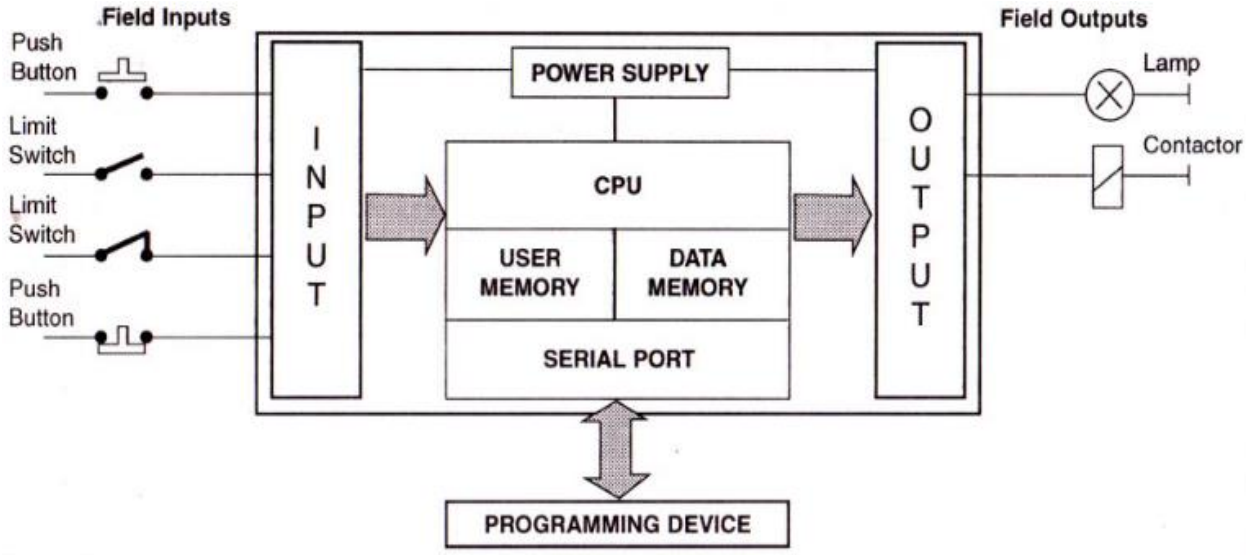
Part I. Overview of PLC Mitsubishi and Software Programming

1.1. Hardware structure of PLC set

1.1.1. Hardware structure of a PLC



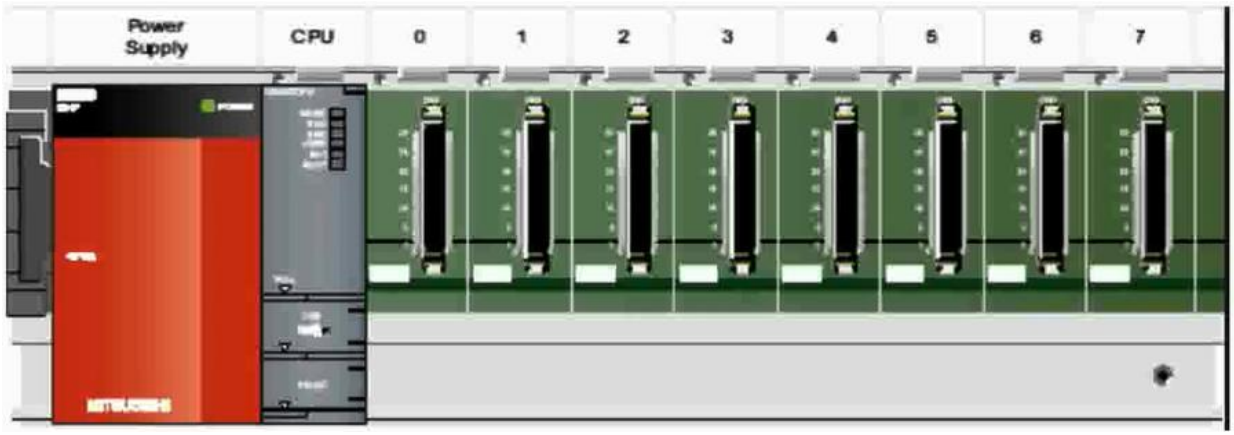
Principle of PLC: **Principle** of Programmable Logic Controller:

Programmable Logic Controllers are used for continuously monitoring the input values from sensors and produces the outputs for the operation of actuators based on the program. Every **PLC** system comprises these three modules: CPU module.

Hardware structure QCPU

1.2.1. Base unit: Q33B, Q33B-E, Q35B, Q35B-E, Q38B, Q38B-E, Q312B, Q312B-E, Q35DB, Q38DB, Q312DB, Q32SB, Q32SB-E, Q33SB, Q33SB-E, Q35SB, Q35SB-E, Q38RB, Q38RB-E, Q35BL, Q35BL-E, Q38BL, Q38BL-E, Q35BLS, Q35BLS-D, Q38BLS,...

for example **Base unit:** Q38B



1.2.2. Power supply: Q61P-A1, Q61P-A2, Q61P, Q62P, Q63P, Q64PN , Q64P, Q61P-D, Q61SP, Q64RPN, Q64RP, Q63RP,...

For Example Power Supply: Q61P

Rated input voltage 100 to 240VAC

Variable input voltage range 85 to 264VAC (-15% to +10% of rated input voltage)

Input frequency 50/60Hz+/-5%

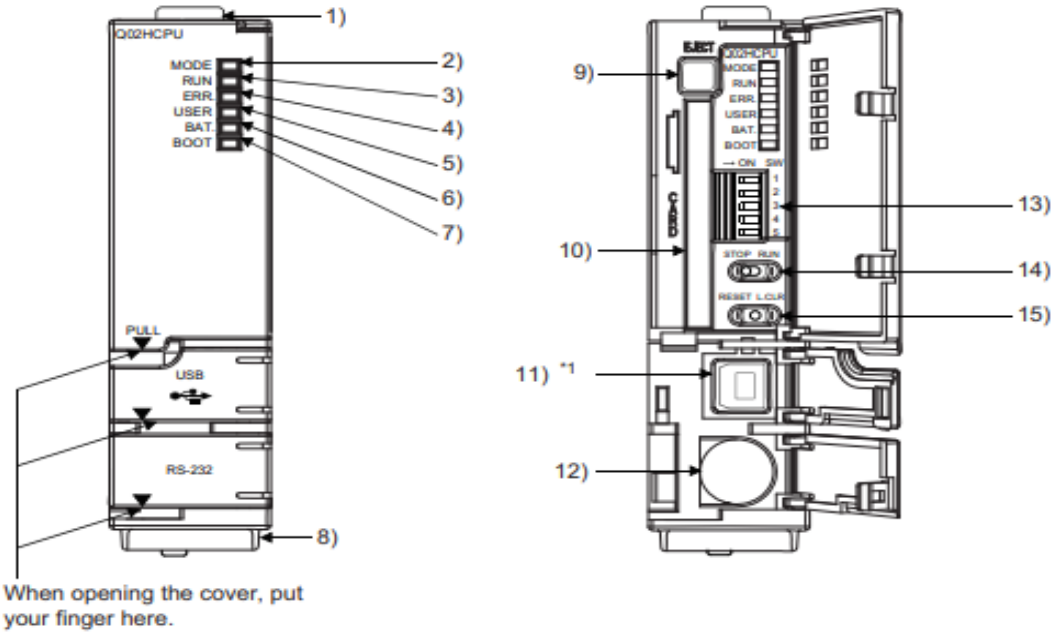
Allowable momentary power failure period Within 20msec

Inrush current 20A 8msec or lower

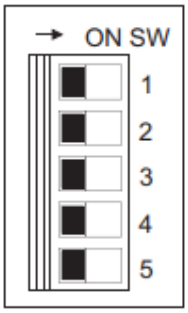
Max input apparent power 130VA or lower

1.2.3. CPU unit: Q00JCPU, Q00CPU, Q01CPU, Q02CPU, Q02HCPU, Q06HCPU, Q12HCPU, Q25HCPU, Q12PHCPU, Q25PHCPU,...

for example: Q02CPU, Q02HCPU, Q06HCPU, Q12HCPU, Q25HCPU, Q02PHCPU, Q06PHCPU, Q12PHCPU, Q25PHCPU



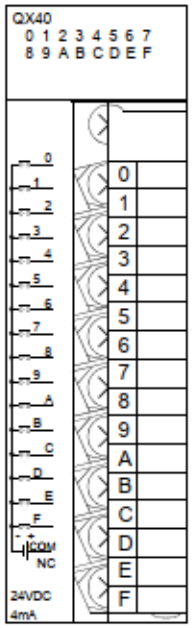
1) Module fixing hook, 2) MODE LED, 3) RUN LED, 4) ERR. LED, 5) USER LED, 6) BAT. LED, 7) BOOT LED, 8) Serial number, 9) Memory card EJECT button Used to eject the memory card from the CPU module, 10)Memory card installing connector, 11) USB connector, 12) RS-232 connector

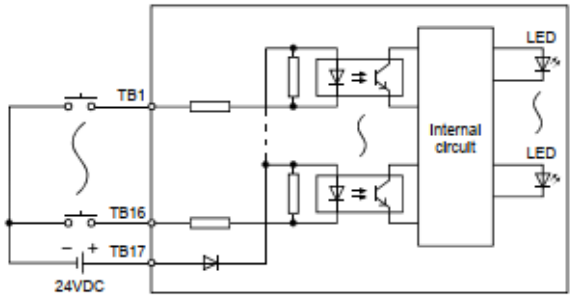
<table>
<tr><th>No.</th><th>Name</th><th>Application</th></tr>
<tr><td rowspan="5">13)</td><td rowspan="5">DIP switches*2
 
</td><td>Used to set the items for operation of the CPU module.
For the system protection and the valid parameter drives of the DIP switches, refer to the following.
Qn(H)/QnPH/QnPRHCPU User's Manual (Function Explanation, Program Fundamentals)</td></tr>
<tr><td>SW1 : Used to set system protection. Inhibits all the writing and control instructions to the CPU module. (Factory-default is off)
Off: No protection
On: Protection</td></tr>
<tr><td>SW2, SW3 : Used to specify parameter-valid drive.
(Both SW2 and SW3 are preset to off as factory default)
<table><tr><th>SW2</th><th>SW3</th><th>Parameter Drive</th></tr><tr><td>OFF</td><td>OFF</td><td>Program memory (Drive 0)</td></tr><tr><td>ON</td><td>OFF</td><td>SRAM card (Drive 1)</td></tr><tr><td>OFF</td><td>ON</td><td>Flash card/ATA card (Drive 2)</td></tr><tr><td>ON</td><td>ON</td><td>Standard ROM (Drive 4)</td></tr></table>(Parameters cannot be stored in standard RAM (Drive 3).)</td></tr>
<tr><td>SW4: Must not be used. Normally off. (Factory default: Off)</td></tr>
<tr><td>SW5: Must not be used. Normally off. (Factory default: Off)</td></tr>
</table>

14) RUN/STOP, 15) RESET/L, 15) RESET/L. CLR Used to turn "Off"

1.2.4. Input Module Specifications: QX10 AC Input Module, QX28 AC Input Module, QX40 DC Input Module (Positive Common Type), QX40-S1 DC Input Module (Positive Common Type), QX41 DC Input Module (Positive Common Type), QX41-S1 DC Input Module (Positive Common Type),...

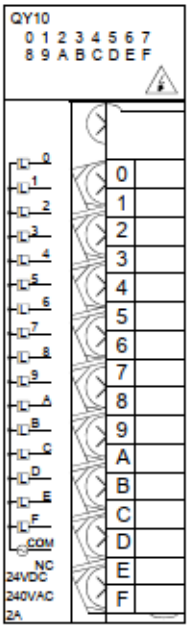
For example QX40 DC Input Module

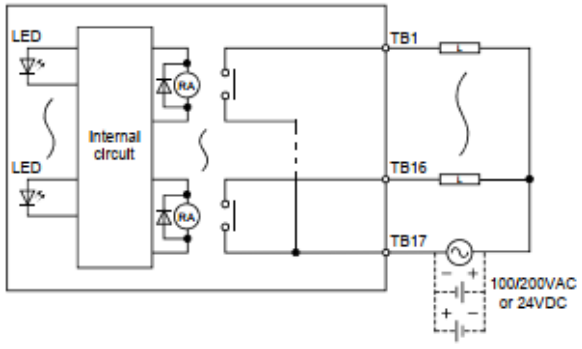
Specifications \ Type		DC Input Module (Positive Common Type)	
		QX40	Appearance
Number of input points		16 points	
Isolation method		Photocoupler	
Rated input voltage		24VDC (+20/-15%, ripple ratio within 5%)	
Rated input current		Approx. 4mA	
Input derating		No	
ON voltage/ON current		19V or higher/3mA or higher	
OFF voltage/OFF current		11V or lower/1.7mA or lower	
Input impedance		Approx. 5.6kΩ	
Response time	OFF to ON	1ms/5ms/10ms/20ms/70ms or less (CPU parameter setting) ＊1 Initial setting is 10ms.	
	ON to OFF	1ms/5ms/10ms/20ms/70ms or less (CPU parameter setting) ＊1 Initial setting is 10ms.	
Dielectric withstand voltage		560VAC rms/3 cycles (altitude 2000m (6557.38ft.))	
Insulation resistance		10MΩ or more by insulation resistance tester	
Noise immunity		By noise simulator of 500Vp-p noise voltage, 1μs noise width and 25 to 60Hz noise frequency	
		First transient noise IEC61000-4-4: 1kV	
Protection of degree		IP2X	
Common terminal arrangement		16 points/common (common terminal: TB17)	
Number of I/O points		16 (I/O allocation is set as a 16-points input module)	
Operation indicator		ON indication (LED)	
External connections		18-point terminal block (M3×6 screws)	
Applicable wire size		0.3 to 0.75mm^2 core (2.8mm (0.11in.) OD max.)	
Applicable crimping terminal		R1.25-3 (sleeved crimping terminals cannot be used.)	
5VDC internal current consumption		50mA (TYP. all points ON)	
Weight		0.16kg	

External Connections	Terminal Block Number	Signal Name
	TB1	X00
	TB2	X01
	TB3	X02
	TB4	X03
	TB5	X04
	TB6	X05
	TB7	X06
	TB8	X07
	TB9	X08
	TB10	X09
	TB11	X0A
	TB12	X0B
	TB13	X0C
	TB14	X0D
	TB15	X0E
	TB16	X0F
	TB17	COM
	TB18	Vacant

1.2.5. Output Module Specifications: QY10 Contact Output Module, QY22 TRIAC Output Module, QY40P Transistor Output Module (Sink Type), QY41P Transistor Output Module (Sink Type), QY68 Transistor Output Module (All Points Independent, Sink/Source Type),QY80 Transistor Output Module (Source Type), QY81P Transistor Output Module (Source Type),...

For example QY10 Contact Output Module

Specifications \ Type		Contact Output Module	Appearance
		QY10	
Number of output points		16 points	
Isolation method		Relay	
Rated switching voltage, current		24VDC 2A (resistive load) 240VAC 2A (cos ϕ =1) /point, 8A/common	
Minimum switching load		5VDC 1mA	
Maximum switching load		264VAC 125VDC	
Response time	OFF to ON	10ms or less	
	ON to OFF	12ms or less	
Life	Mechanical	20 million times or more	
	Electrical	Rated switching voltage/current load More than 100 thousand times or more	
		200VAC 1.5A, 240VAC 1A (COS ϕ =0.7) 100 thousand times or more 200VAC 0.4A, 240VAC 0.3A (COS ϕ =0.7) 300 thousand times or more	
		200VAC 1A, 240VAC 0.5A (COS ϕ =0.35) 100 thousand times or more 200VAC 0.3A, 240VAC 0.15A (COS ϕ =0.35) 300 thousand times or more	
		24VDC 1A, 100VDC 0.1A (L/R=7ms) 100 thousand times or more 24VDC 0.3A, 100VDC 0.03A (L/R=7ms) 300 thousand times or more	
Maximum switching frequency		3600 times/hour	
Surge suppressor		No	
Fuse		No	
Dielectric withstand voltage		2830VAC rms/3 cycles (altitude 2000m (6557.38ft.))	
Insulation resistance		10MΩ or more by insulation resistance tester	
Noise immunity		By noise simulator of 1500Vp-p noise voltage, 1 μs noise width and 25 to 60Hz noise frequency	
		First transient noise IEC61000-4-4: 1kV	
Protection of degree		IP1X	
Common terminal arrangement		16 points/common (common terminal: TB17)	
Number of I/O points		16 (I/O allocation is set as a 16-points output module)	
Operation indicator		ON indication (LED)	
External connections		18-point terminal block (M3×6 screws)	
Applicable wire size		0.3 to 0.75mm^2 core (2.8mm (0.11in.) OD max.)	
Applicable crimping terminal		R1.25-3 (sleeved crimping terminals cannot be used.)	
5VDC internal current consumption		430mA (TYP. all points ON)	
Weight		0.22kg	

External Connections	Terminal Block Number	Signal Name
	TB1	Y00
	TB2	Y01
	TB3	Y02
	TB4	Y03
	TB5	Y04
	TB6	Y05
	TB7	Y06
	TB8	Y07
	TB9	Y08
	TB10	Y09
	TB11	Y0A
	TB12	Y0B
	TB13	Y0C
	TB14	Y0D
	TB15	Y0E
	TB16	Y0F
	TB17	COM
	TB18	Vacant

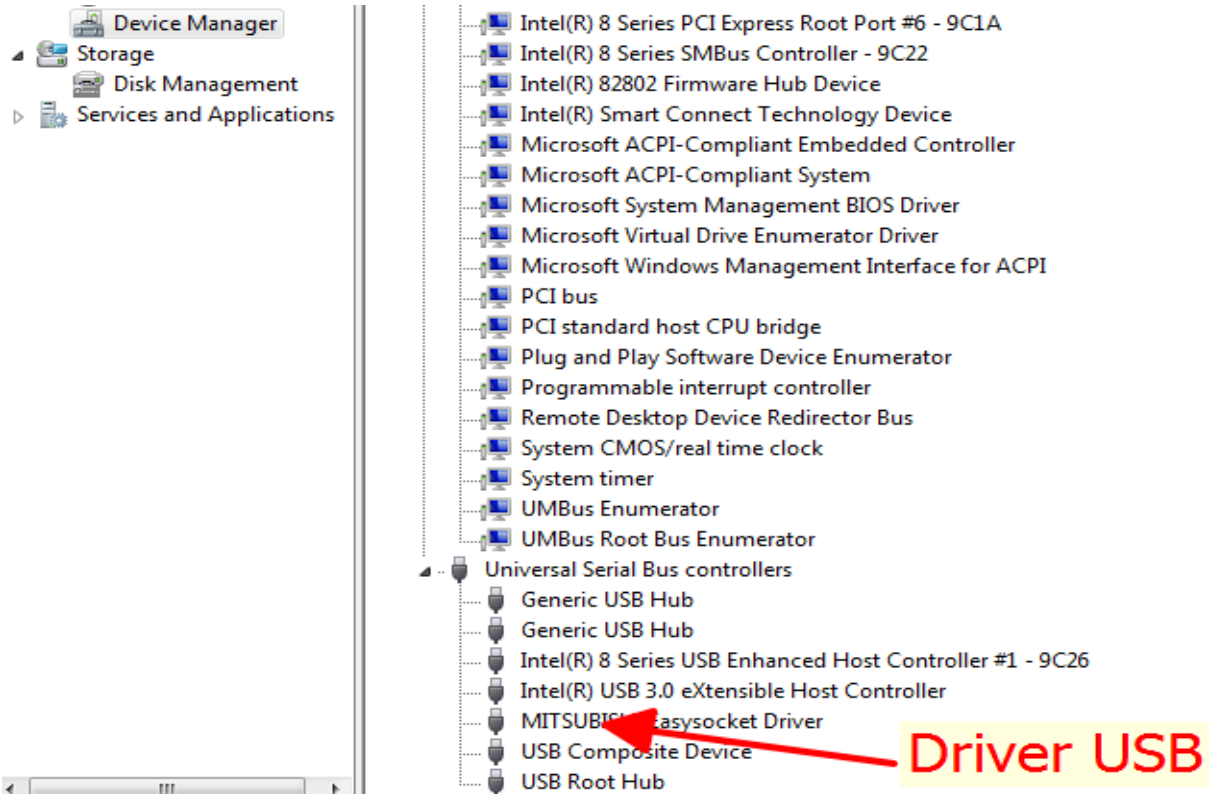
1.2. GX **work2 software and installing**

(Practice guide on the computer)

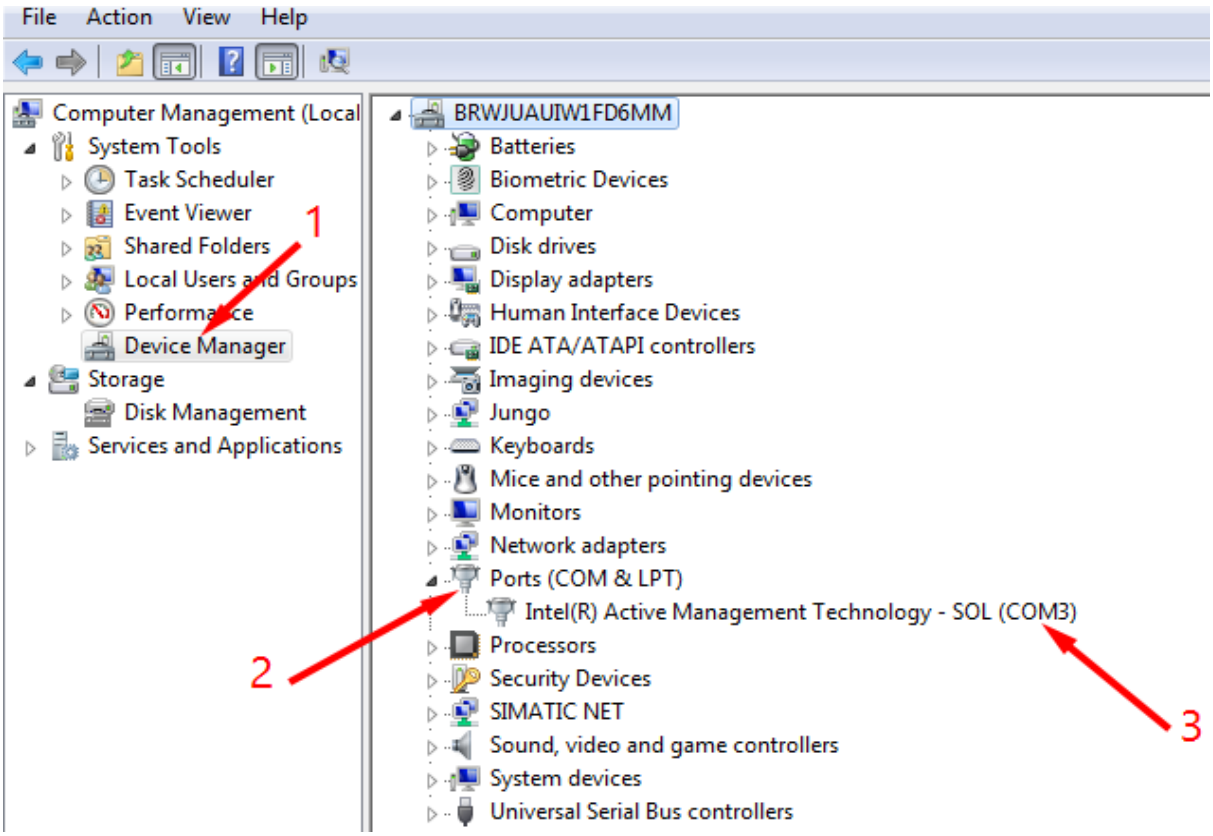
1.3. Connection with GX Works2 (PC) to PLC

- Checking driver

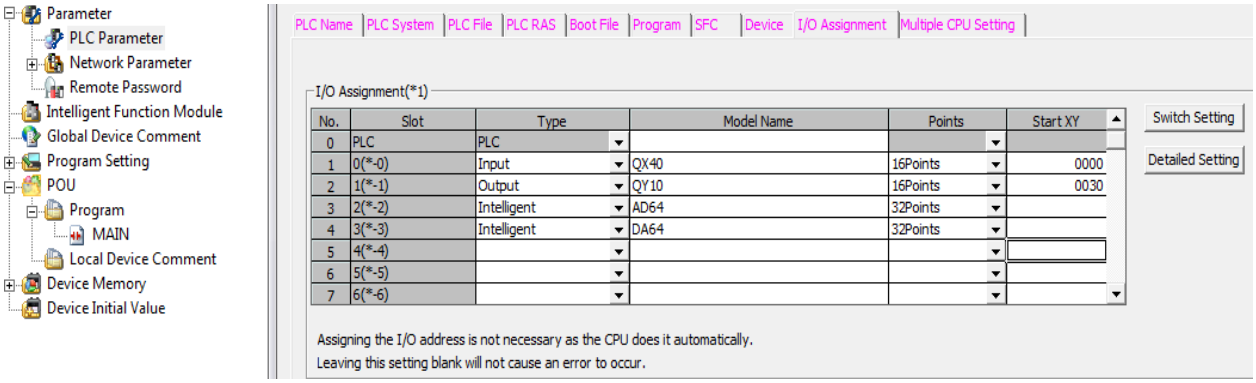
Using usb connector



Using RS-232 connector



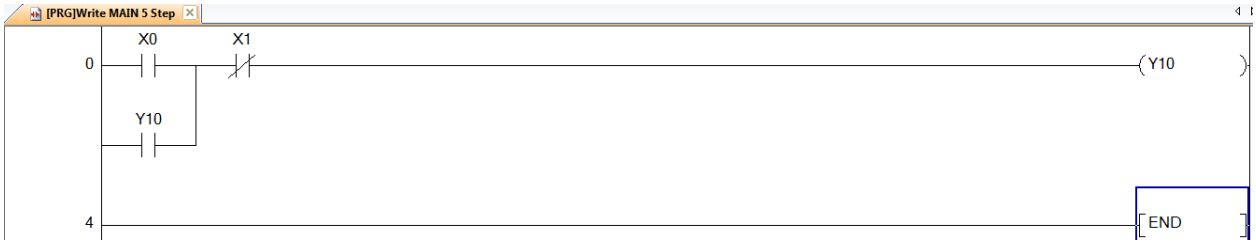
1.5. Parameter setting, assignment and System Configuration.



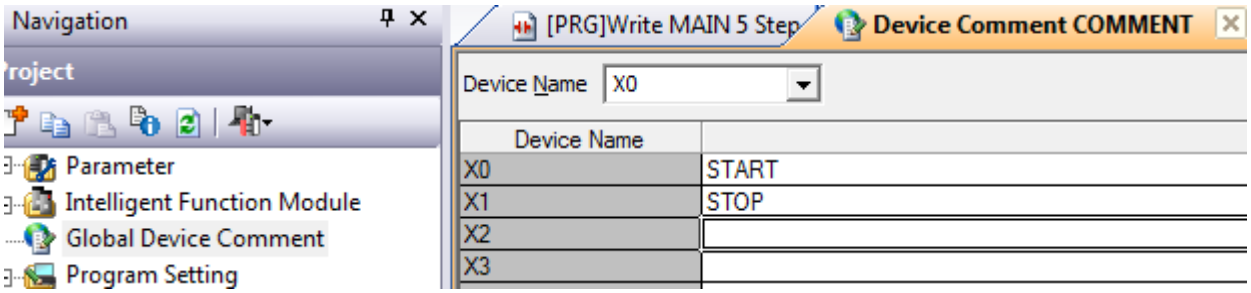
Part II. Create a lader program, connect I / O PLC to devices

2.1. Download/upload a programe to PLC (practice).

2.2. Create a program with I/O basic.



- Write comments



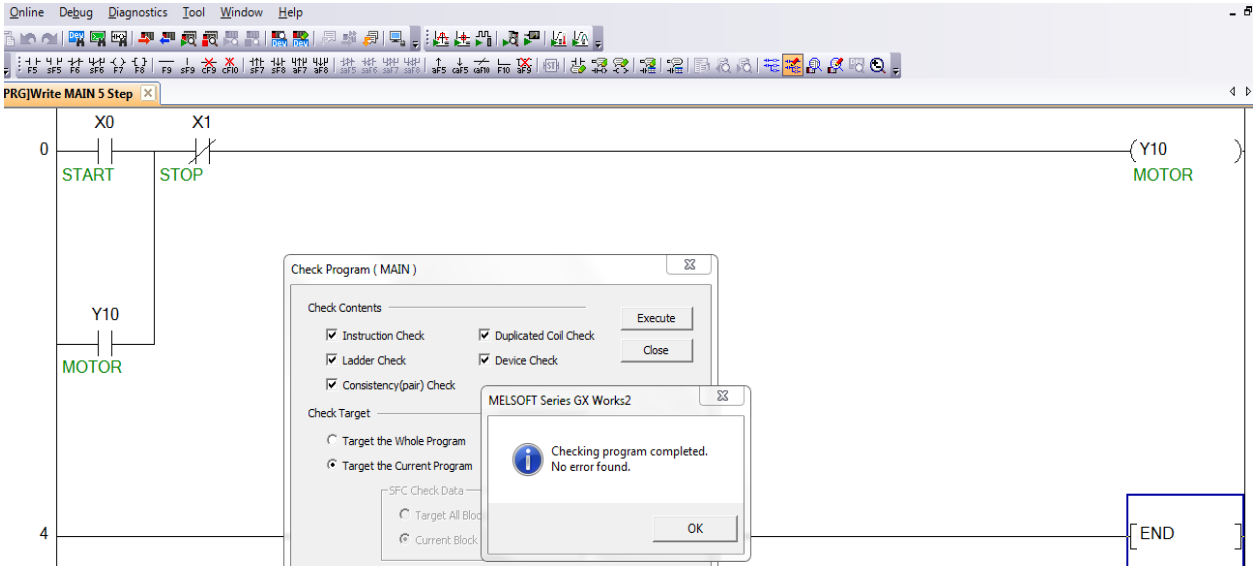
- Check program / Running simulator / Test - Timing chart display

Shortcuts to fast program: F2 = Write mode; F3 = Monitor mode…

Click view => Toolbar => click mouse to choose tools to appear on screen.

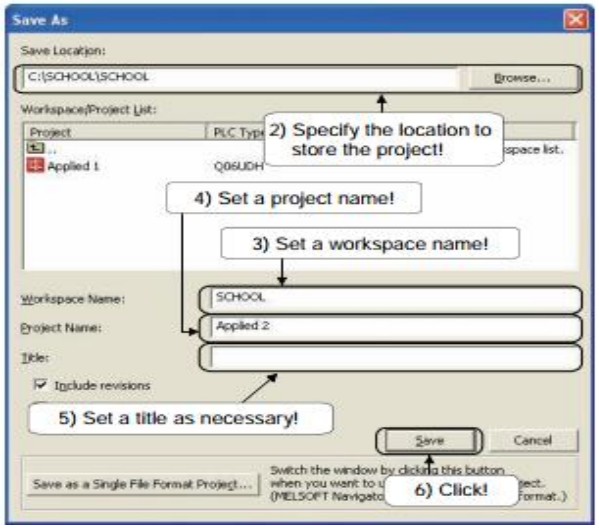
2.3. Check programe in PLC

Chose Tool



2.4. Saving a project with another name

1) Click [Project] → [Save as].



2) Specify the location to store the project.

3) Set a workspace name.
(Set the name to "SCHOOL".)

4) Set a project name.
(Set the name to "Applied 2".)

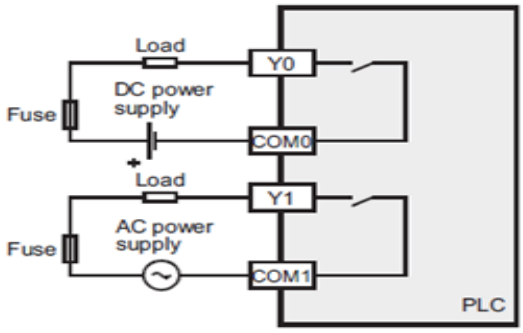
5) Set a title as necessary.

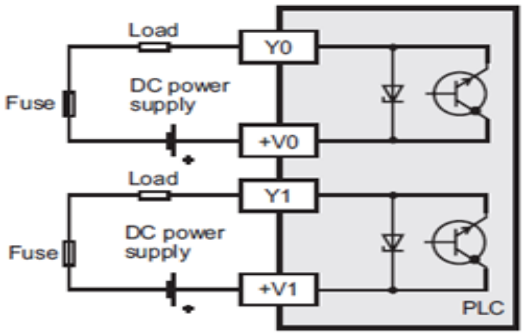
6) Click the [Save] button to accept the entry.

2.5. Connect relays to PLC outputs.

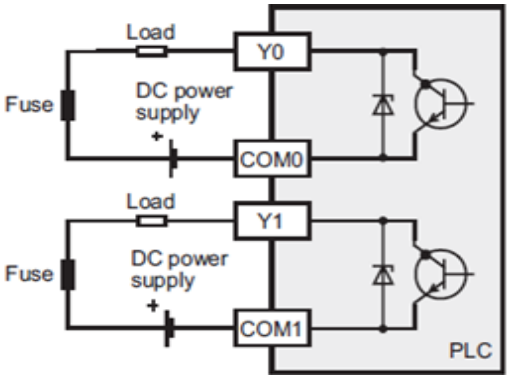
Types of output PLC

RELAY OUTPUT: SOURCE OUTPUT:

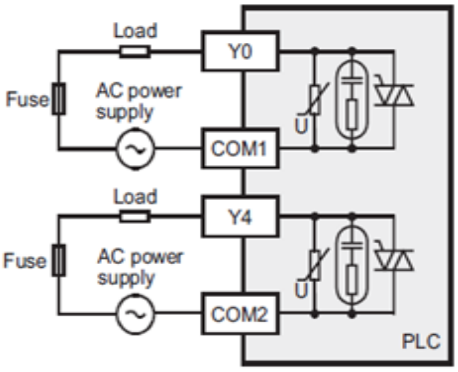




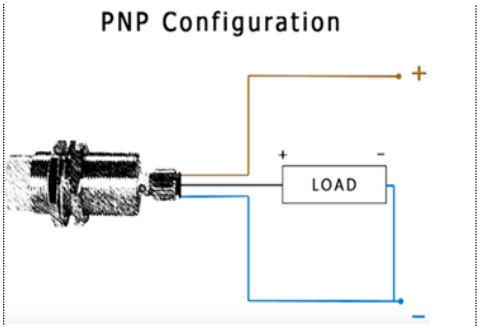
SINK OUTPUT:

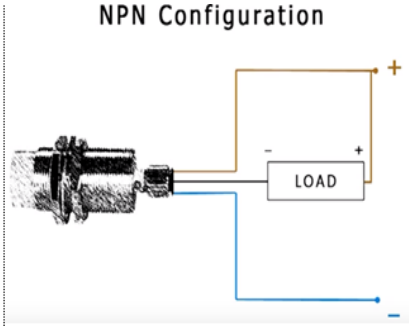


TRIAC OUTPUT:

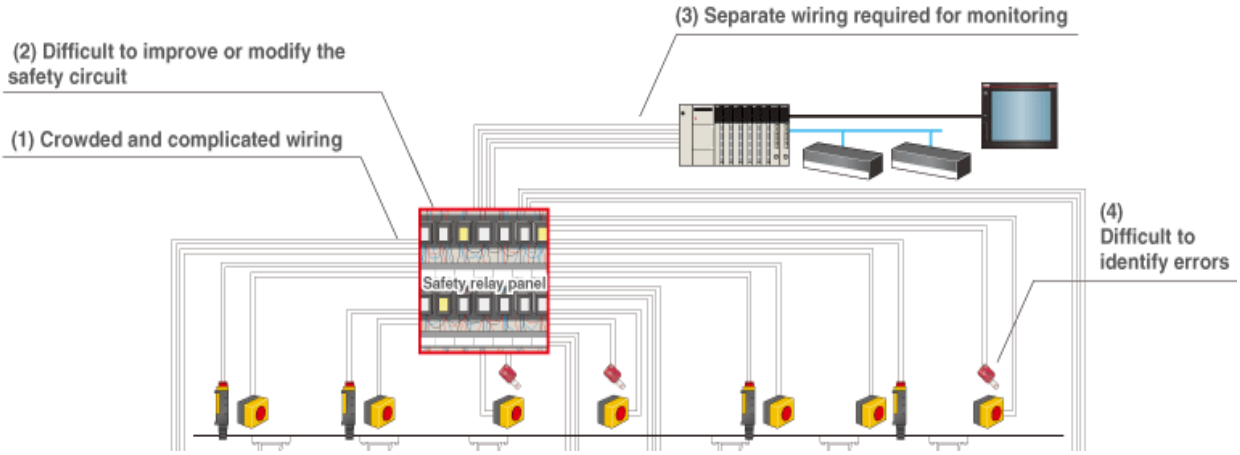


2.6. Connect sensors NPN and PNP to PLC input.





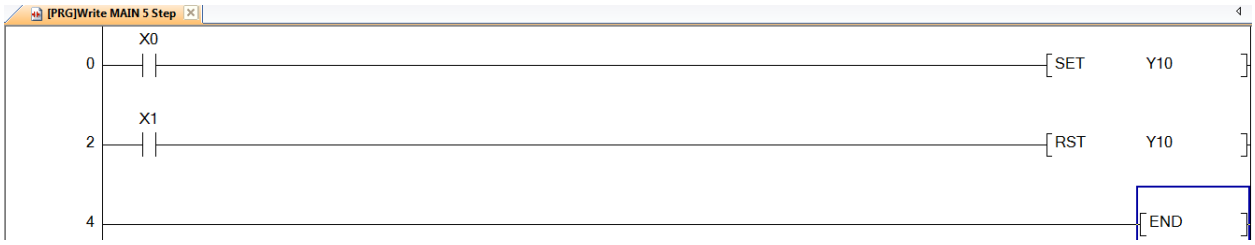
Input wiring



Part III. Programming Guide, check and handle the errors in the PLC

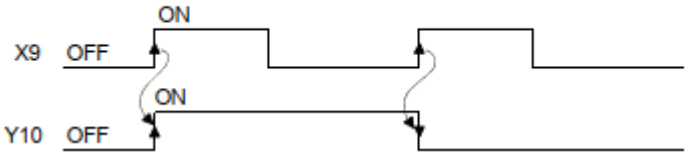
3.1. SET and RESET instructions

Sample

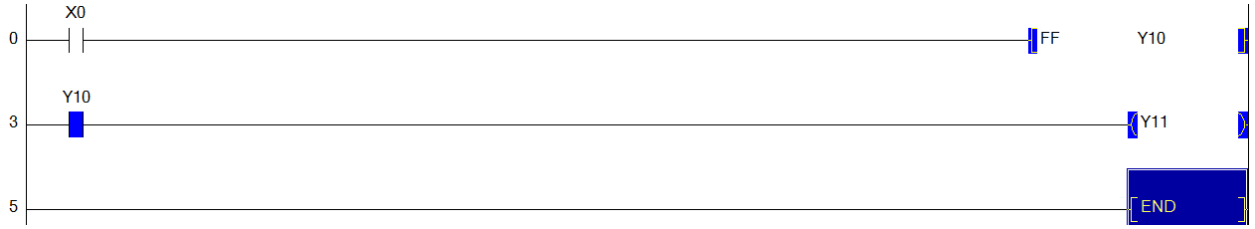


3.2. Bit device output reverse (FF)

[Timing Chart]



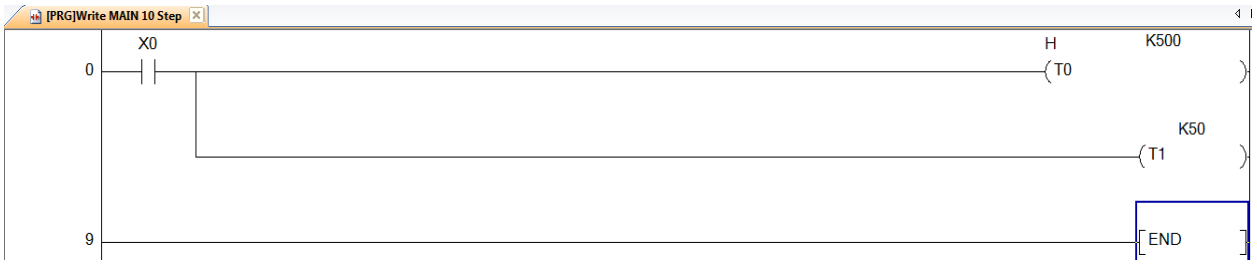
Program Example



3.3. TIMER instruction

OUT T, OUTH T (High-speed timer and Low-speed timer)

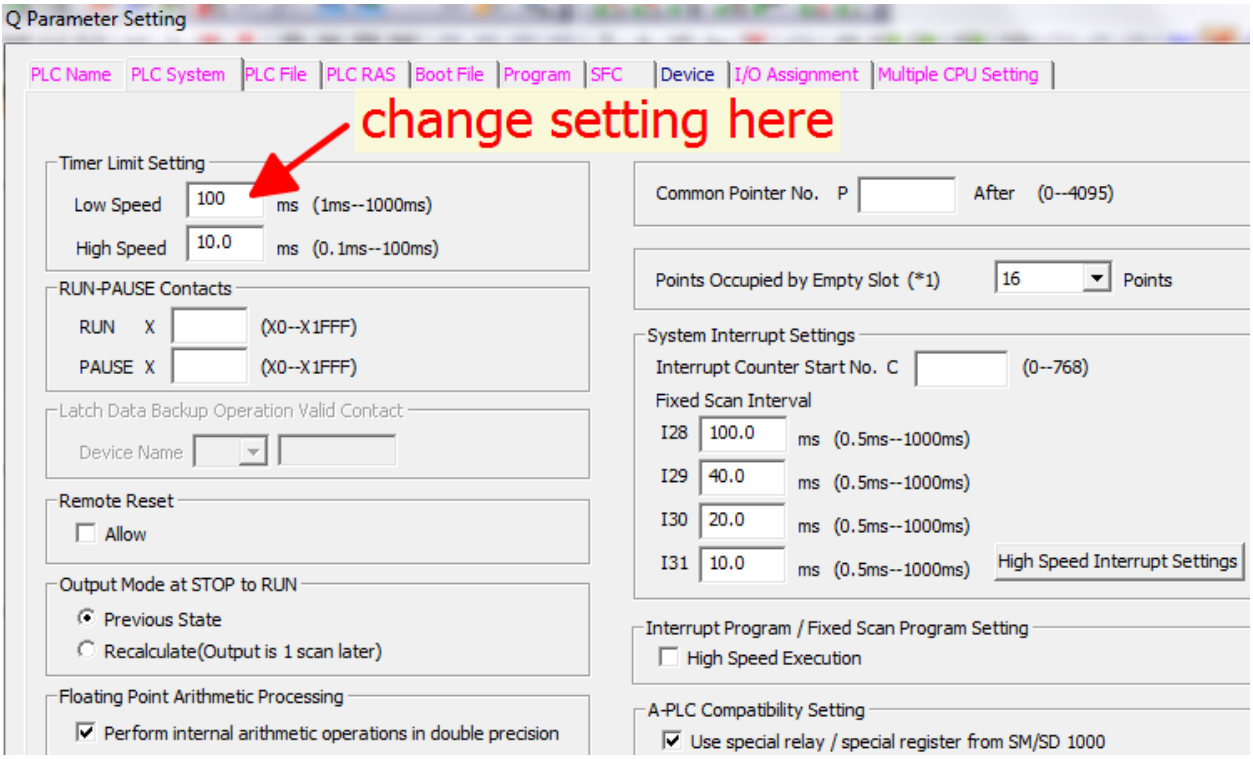
Sample

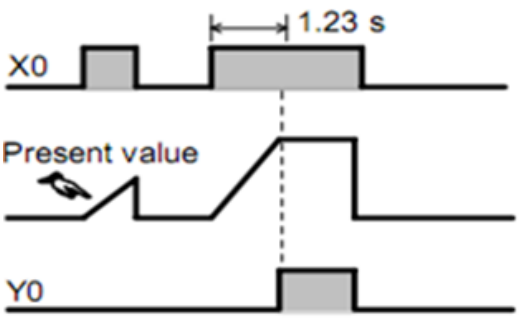


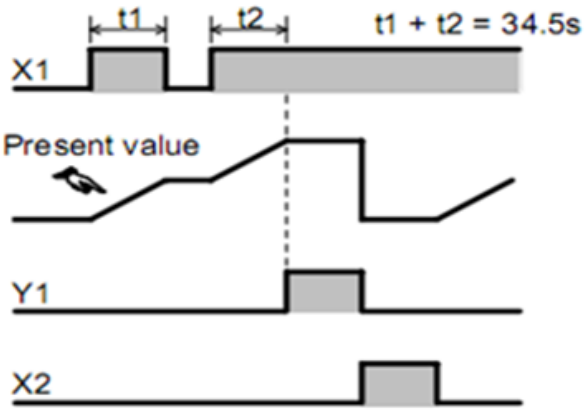
Timing chart:

OUT ST, OUTH ST (High-speed retentive timer and Low-speed retentive timer)

Change timer setting:



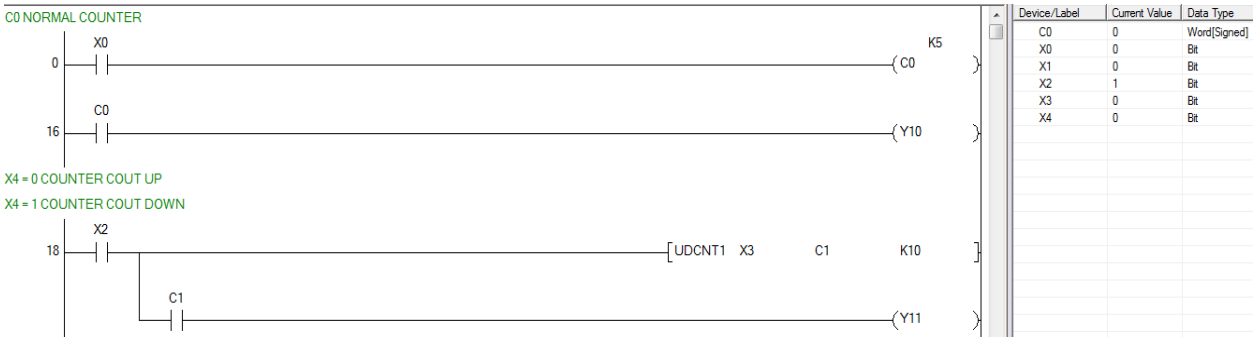




3.4. COUNTER instruction and applications

3.4.1. Normal Counter

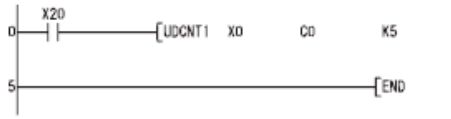
3.4.2. Counter Up/Down



Program Example

This program uses C0 (Up/Down counter) to count the number of times X0 goes from OFF to ON after X20 has gone ON.

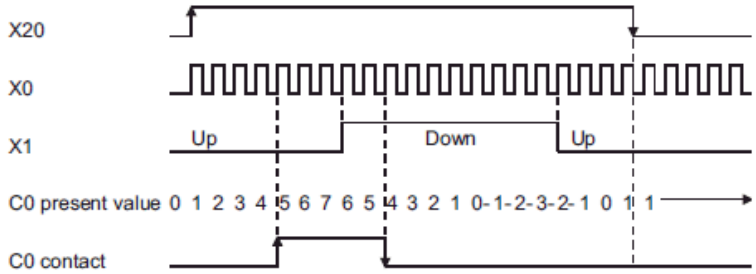
[Ladder Mode]



[List Mode]

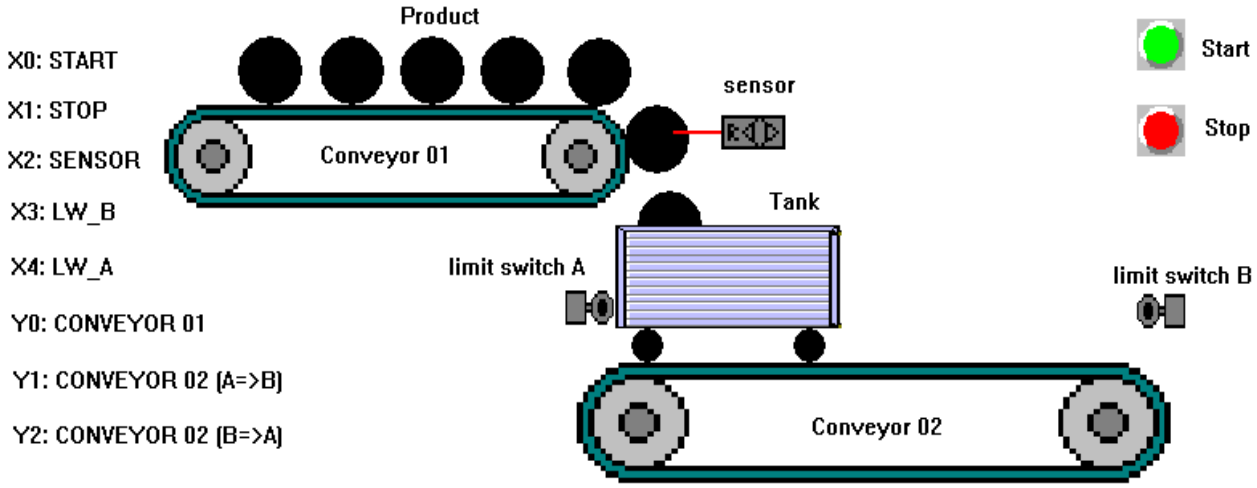
Step	Instruction	Device
0	LD	X20
1	UDCNT1	X0 C0 K5
5	END	

[Operation]



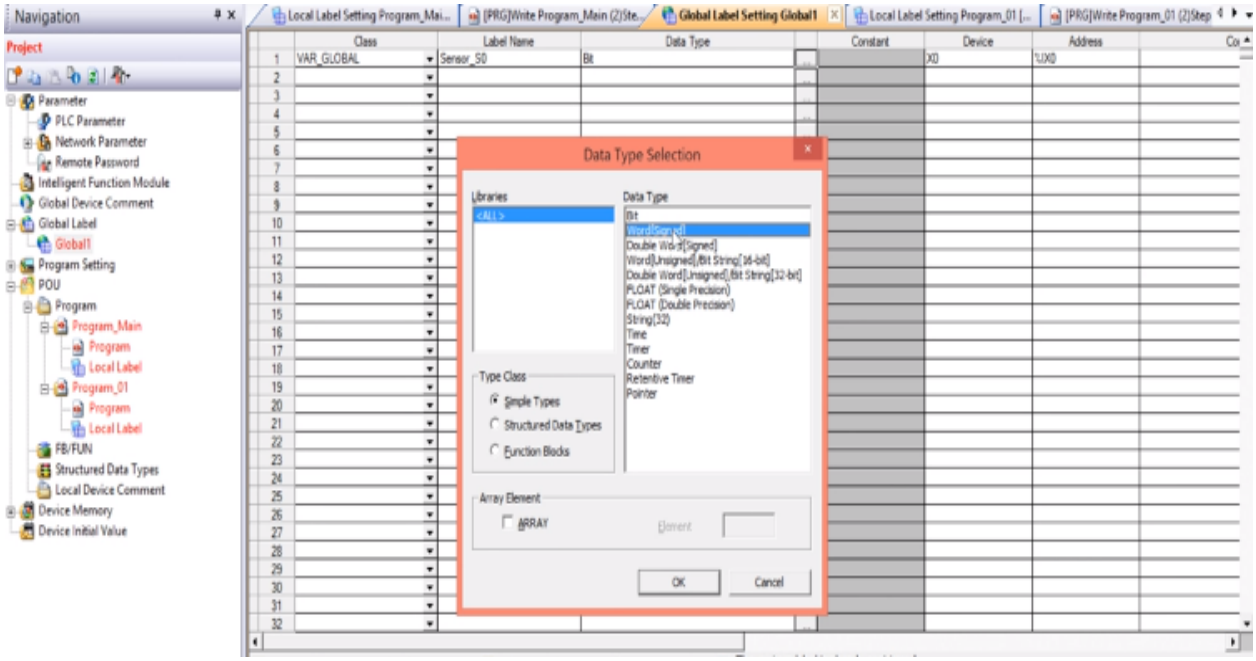
EXERCISES

EXERCISE 01 (USING TIMER AND COUNTER)



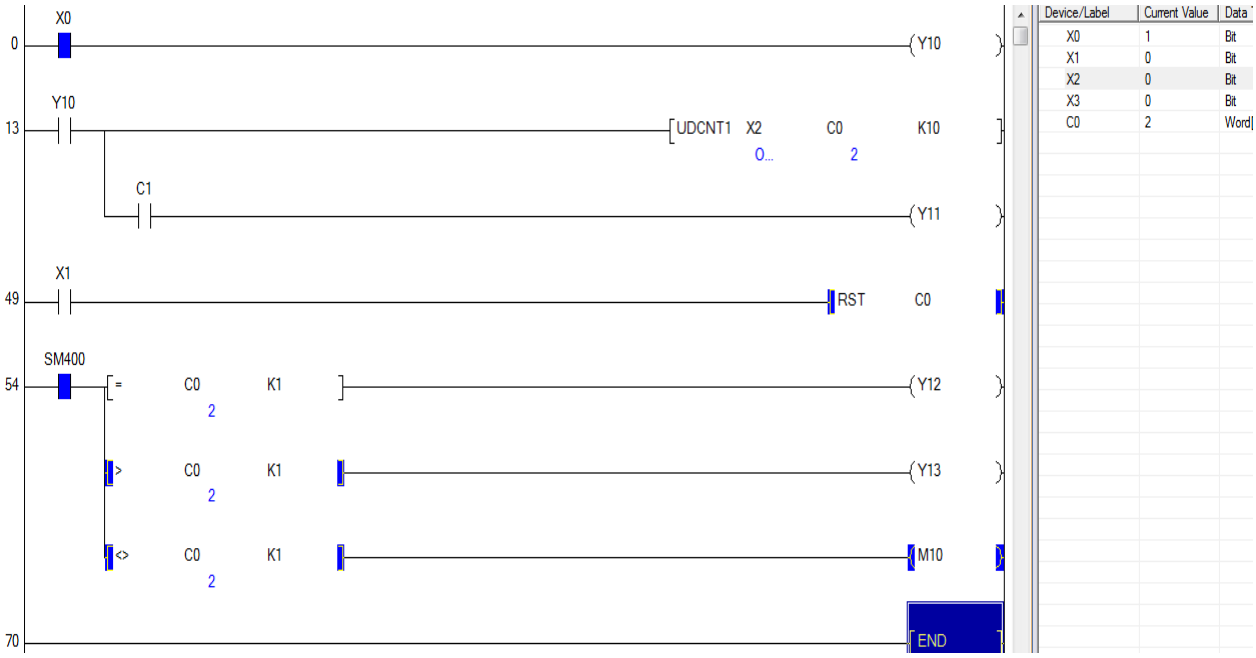
Comman Input/Output,...

Global device comment and local device comment

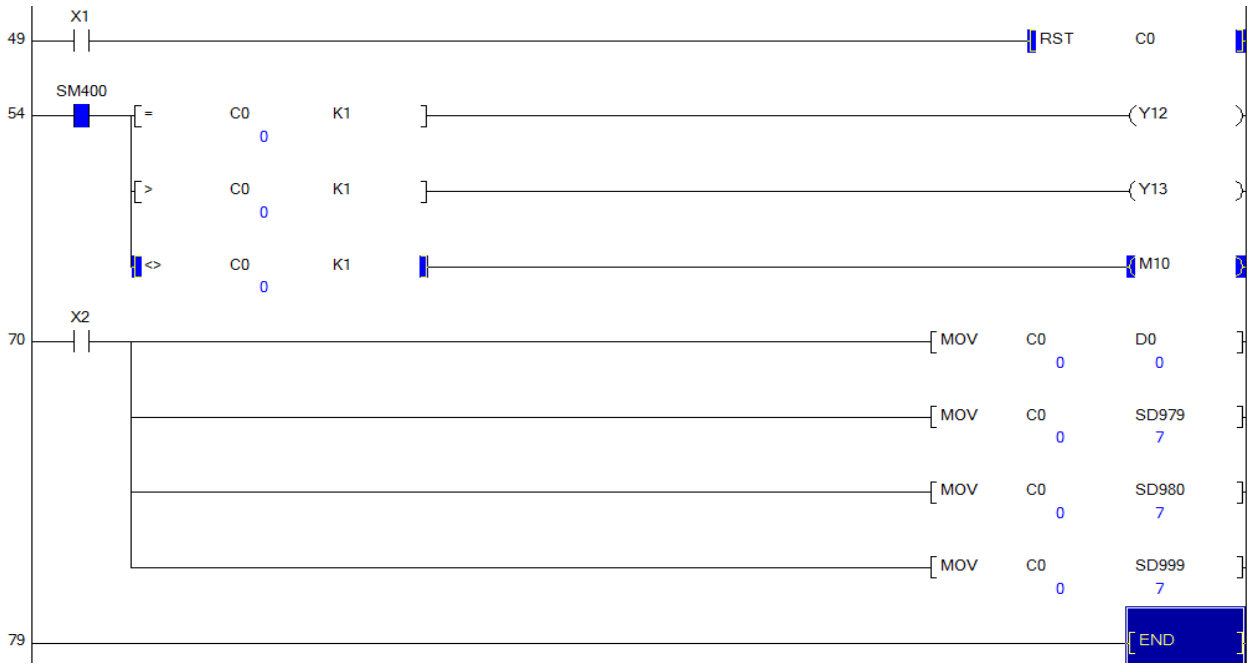


3.5. COMPARATOR instruction

3.5.1. Counter comparison



Exercise: explain the program below

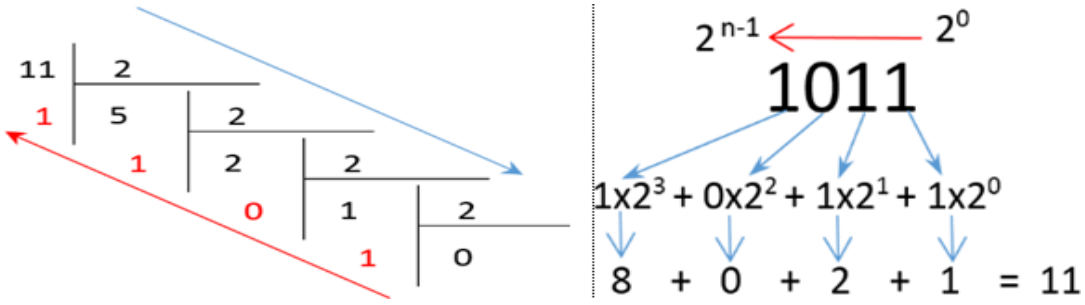


3.5.2. Timer comparison (do exercises)

3.6. MOVE instruction and applications

3.6.1. Change DEC into BIN

DECIMAL (DEC)	BINARY (BIN)	DECIMAL (DEC)	BINARY (BIN)
0	0000	8	1000
1	0001	9	1001
2	0010	10	1010
3	0011	11	1011
4	0100	12	1100
5	0101	13	1101
6	0110	14	1110
7	0111	15	1111



The ways to change DEC <-> BIN

3.6.2. Application examples:

Symbol [MOV K5 k1Y0]

K5 is the value which is exchanged from binary number 0101

K1Y0 is the value contains 4 bits starting at Y0; K1Y1 is the value contains 4 bits starting at Y1;

K1Y3 is the value contains 4 bits starting at Y3; K2Y0 is the value contains 8 bits starting at Y0; K2Y1 is the value contains 8 bits starting at Y2; K3Y0 is the value contains 12 bits starting at Y0; Similar K4Y0,1,2,3 is the value contains 16 bits …

Samples for mov bits and mov words

3.7. Conversion instructions

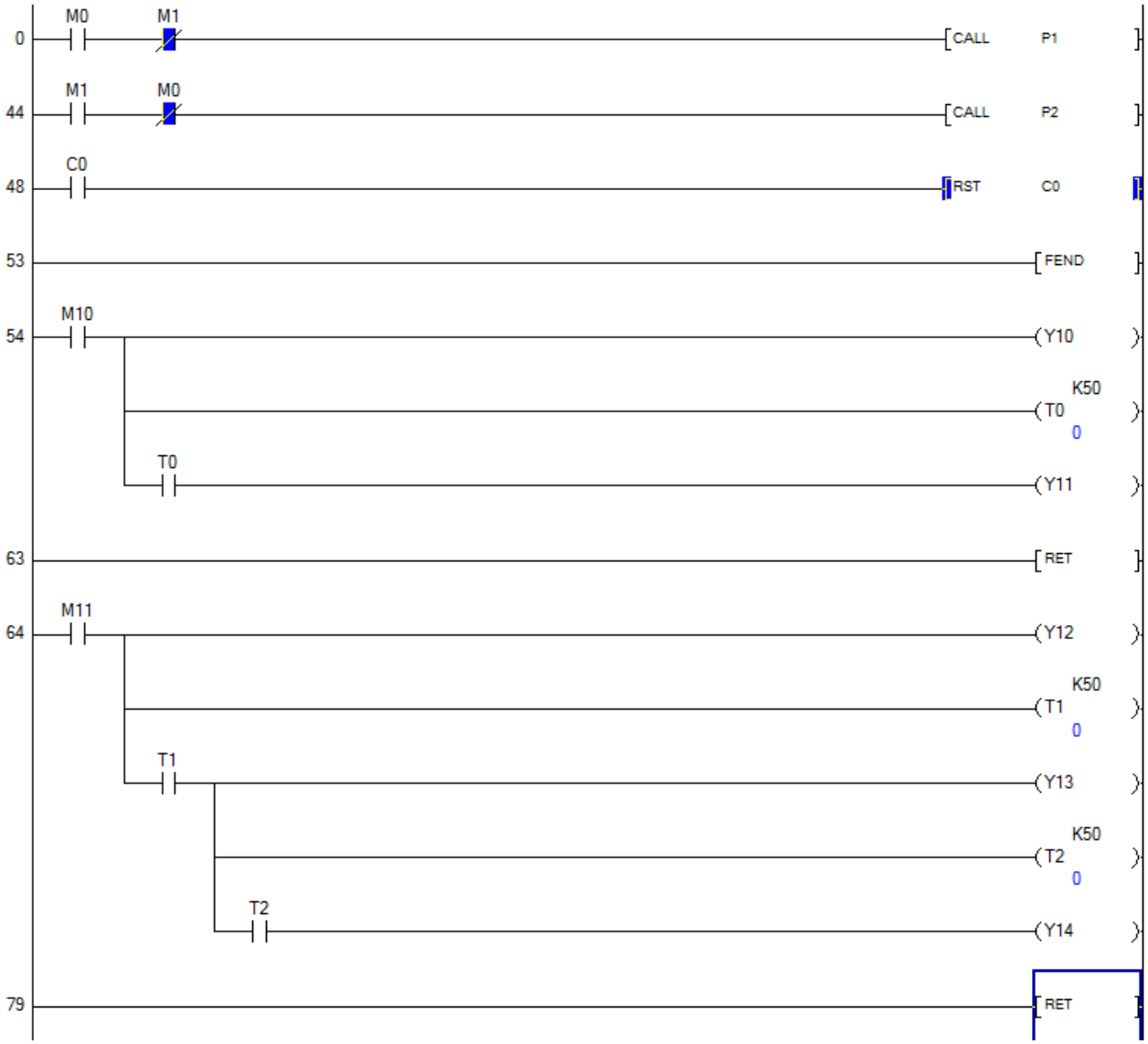
Decimal	Binary	BCD	Hexadecimal
0	0	0000	0
1	1	0001	1
2	1	0010	2
3	11	0011	3
4	100	0100	4
5	101	0101	5
6	110	0110	6
7	111	0111	7
8	1000	1000	8
9	1001	1001	9
10	1010	0001 0000	A
11	1011	0001 0001	B
12	1100	0001 0010	C
13	1101	0001 0011	D
14	1110	0001 0100	E
15	1111	0001 0101	F
16	1 0000	0001 0110	10
17	1 0001	0001 0111	11
18	1 0010	0001 1000	12

Example

3.8. Call Subroutine

Create a main program first => Create subroutines

EXAMPLE



3.9. Real time programming

Ⓓ : Head number of the devices where the read clock data will be stored (BIN 16 bits)

Setting Data	Internal Devices		R, ZR	J□\□		U□\G□	Zn	Constants	Other
	Bit	Word		Bit	Word				
Ⓓ	—	○		—					

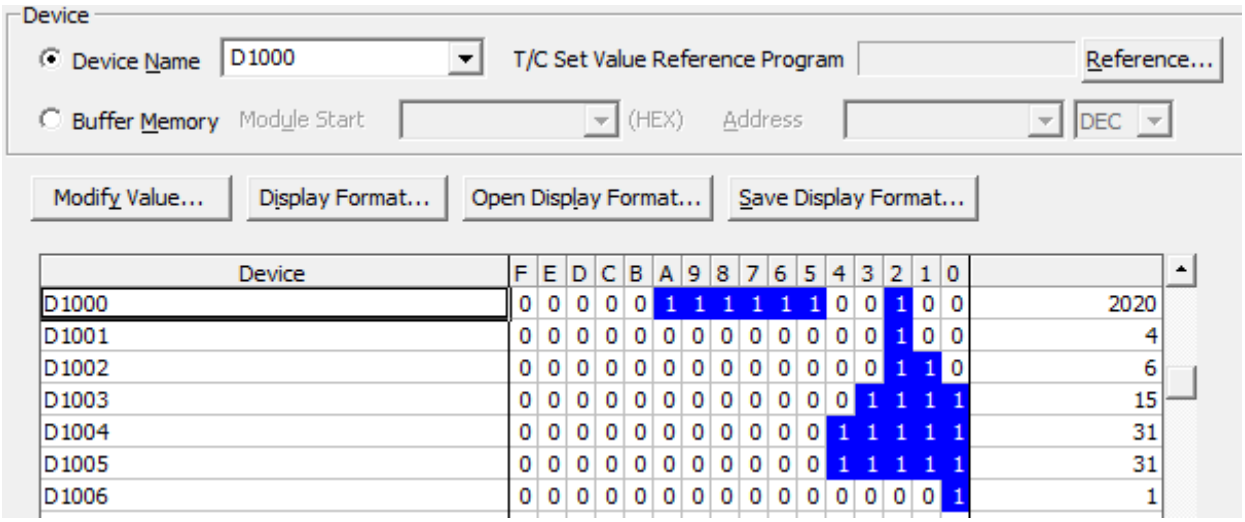
Function

(1) Reads "year, month, day, hour, minute, second, and day of week" from the clock element of the CPU module and stores

Clock element			
	Ⓓ	Year	(1980 to 2079)
	Ⓓ+1	Month	(1 to 12)
	Ⓓ+2	Day	(1 to 31)
	Ⓓ+3	Hour (24-hour clock)	(0 to 23)
	Ⓓ+4	Minute	(0 to 59)
	Ⓓ+5	Second	(0 to 59)
	Ⓓ+6	Day of week	(0 to 6)

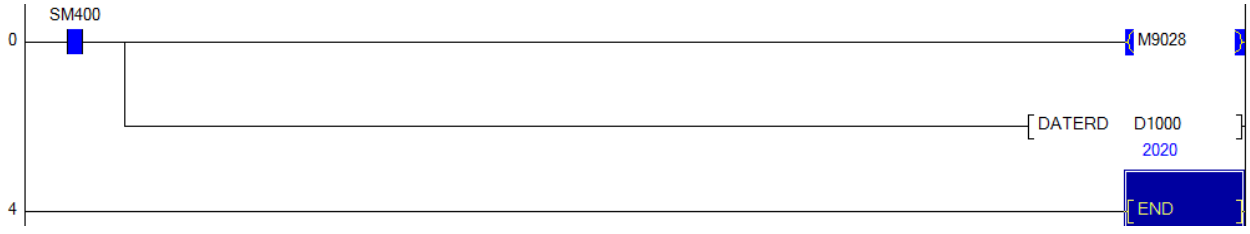
(2) The "year" at Ⓓ is stored as 4-digit year indication.

Registers and time memory in PLC mitsubishi Q srier

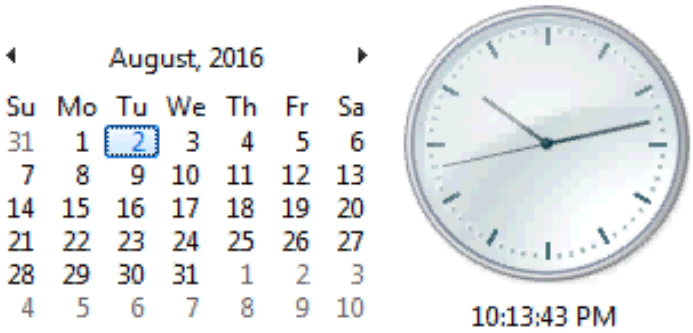


Device	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	
D1000	0	0	0	0	0	1	1	1	1	1	1	0	0	1	0	0	2020
D1001	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4
D1002	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	6
D1003	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	15
D1004	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	31
D1005	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	31
D1006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1

Using DATED instruction to reads real time in registers, result is stored in D1000 for example:



More example



Exercises:

Programming controller alarms working hours automatically for the company upon request:

8h 30s the bell rings began working time

11:30 the bell rings 15s for break lunch

13h the bell rings 30s for work

16h30 the bell rings 45s for the end of working hours

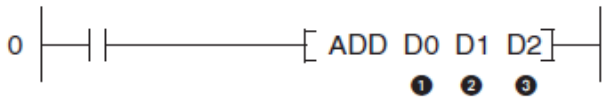
The program only works from Monday to Friday every week, and do not work on holidays, 30/4, 01/5, ...

Note! We should use Move instruction to erase the data in registers first…

3.9. Mathematics instructions

3.9.1. ADD instruction

Symbol



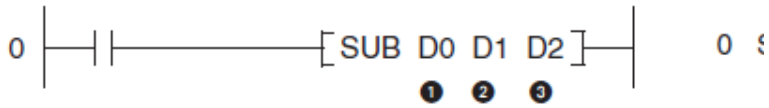
❶ First source device or constant

❷ Second source device or constant

❸ Device in which the result of the addition is stored

3.9.2. SUB instruction

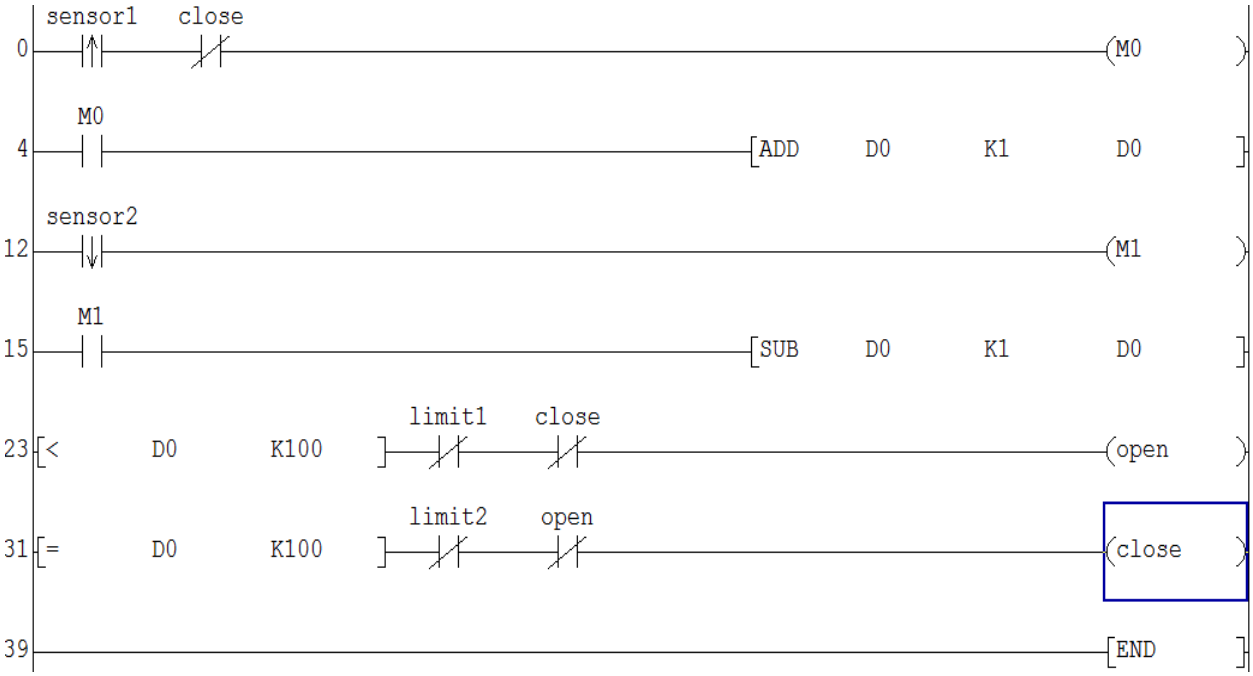
Symbol



❶ Minuend (the subtrahend is subtracted from this value)
❷ Subtrahend (this value is subtracted from the minuend)
❸ Difference (result of the subtraction)

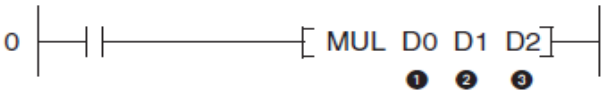
Application exercises:

Program to cotrol close and open a garage gate



3.9.3. MUL instruction

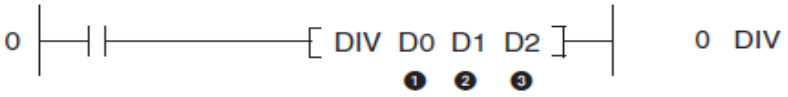
Symbol



❶ Multiplicand
❷ Multiplier
❸ Product (Multiplicand x Multiplier = Product)

3.9.4. DIV instruction

Symbol



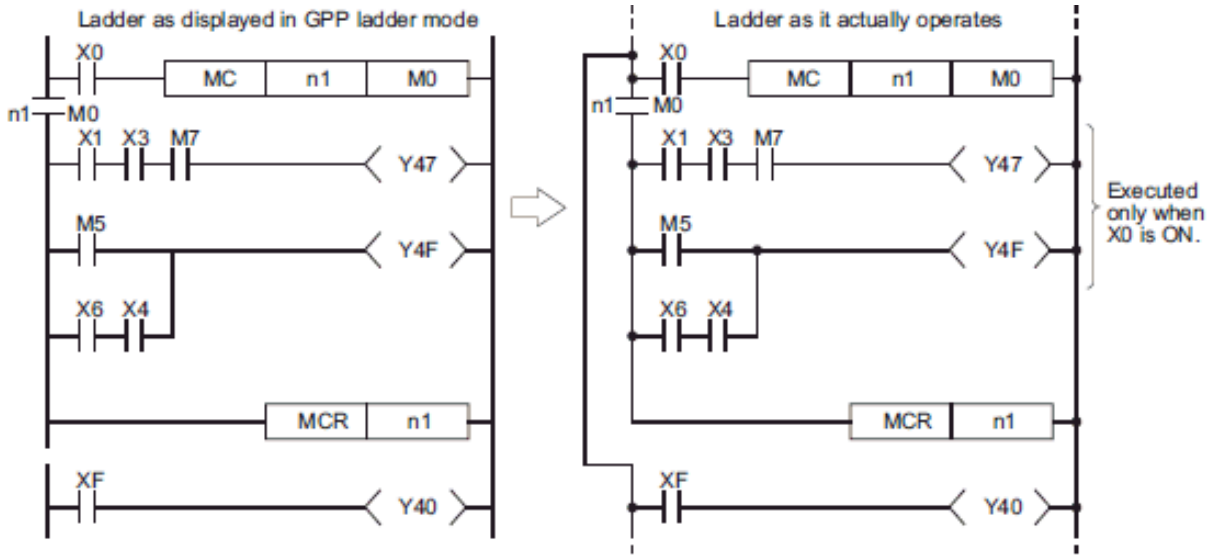
❶ Dividend

❷ Divisor

❸ Quotient (result of the division, dividend ÷ divisor = quotient)

3.10. Master control and master **control** reset instructions (MC/MCR)

The master control instruction is used to enable the creation of highly efficient ladder switching sequence programs, through the opening and closing of a common bus for ladders. A ladder using the master control is as follows:



(1) MC (master control instruction) for public contacts connected in series.

After the implementation of MC, left bus behind the MC contacts.

(2) MCR (master control reset instruction) it is MC reset instruction, the MCR instruction bus left of the restore location.

a set of circuit total switches. And contacts must be connected to the master contact LD or LDI instruction.

3) MC command input contact is disconnected, the accumulation in the MC and MCR timer, counter, reset/set command-driven component state before remain

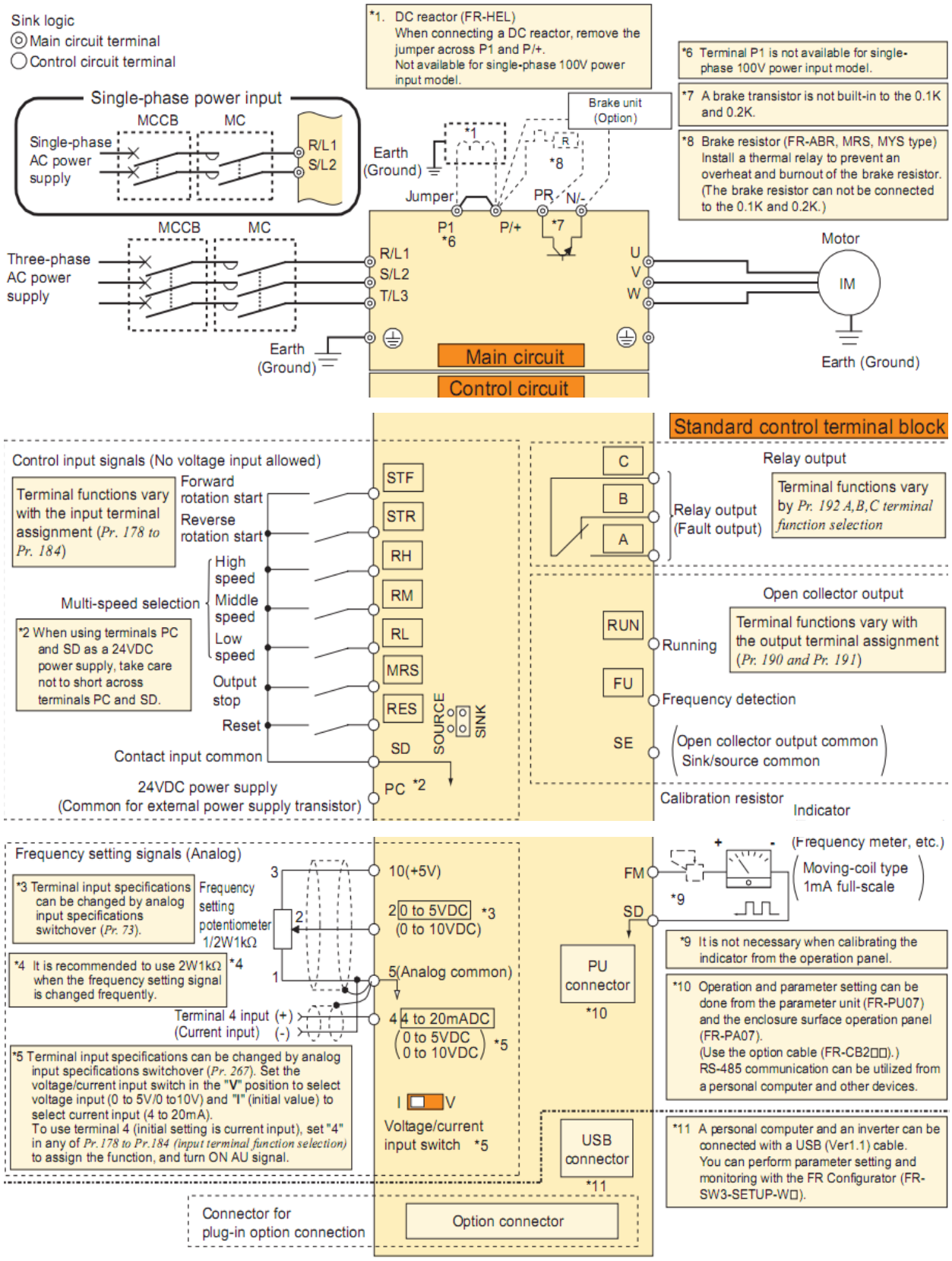
3.11. Set password AND Unlock password

Steps to set password in Q CPU Mitsubishi.

Below is the complete chart to proceed with above steps

Part IV. INVERTER MITSUBISHI FR-E720-0.75K

4.1 Wiring inverter

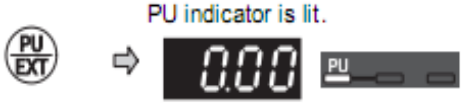
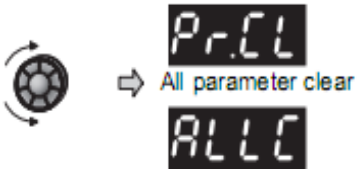


4.2. Clear all parameter

Parameter clear/all parameter clear

POINT

- Set "1" in *Pr.CL Parameter clear, ALLC all parameter clear* to initialize all parameters. (Parameters are not cleared when "1" is set in *Pr. 77 Parameter write selection.*)
- Refer to the extended parameter list of *the Instruction Manual (Applied)* for parameters cleared with this operation.

Operation	Display
1. Screen at power-ON The monitor display appears.	
2. Press PU/EXT to choose the PU operation mode.	PU indicator is lit. 
3. Press MODE to choose the parameter setting mode.	PRM indicator is lit.  (The parameter number read previously appears.)
4. Turn ◎ until PrCL (ALLC) appears.	Parameter clear 
5. Press SET to read the currently set value. "0"(initial value) appears.	
6. Turn ◎ to change it to the set value "1".	
7. Press SET to set.	Parameter clear  **Flicker ··· Parameter setting complete!!**

- Turn ◎ to read another parameter.
- Press SET to show the setting again.
- Press SET twice to show the next parameter.

RESET ALL PARAMETERS

1, SET P0 (starting torque) = 6% default.

2, SET P1= 50 HZ (Maximum Frequency)

3, SET P2 = 0 HZ (Minimum Frequency)

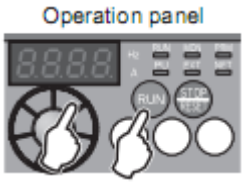
4, SET P3 = 50 HZ (Base Frequency)

5, SET P80 (P79=0) = = 200W = 0.2 KW (0.20). (Motor Capacity (Max))

6, SET P81 = 4 (Motor Pole)

7, SET P83 = 220V (Rated Motor Voltage).

4.3. Control inverter on keypad



4.3.1. Setting the frequency by the operation panel

Operation example Operate at 30Hz.

Operation

1.	Screen at power-ON The monitor display appears.
2.	Operation mode change Press PU/EXT to choose the PU operation mode. PU indicator is lit.
3.	Frequency setting Turn the dial to show the frequency "30.00" (30.00Hz) you want to set. The frequency flickers for about 5s. While the value is flickering, press SET to set the frequency. "F" and "30.00" flicker alternately. After about 3s of flickering, the indication of the value goes back to "0.00" (0.00Hz) (monitor display). (If SET is not pressed, the indication of the value goes back to "0.00" (0.00Hz) after about 5s of flickering. In that case, turn the dial again, and set the frequency.)
4.	Start → acceleration → constant speed Press RUN to start operation. The frequency value on the indication increases in *Pr. 7 Acceleration time*, and "30.00" (30.00Hz) appears. (To change the set frequency, perform the operation in above step 3. The previously set frequency is displayed at first.)
	Deceleration → stop

5. Press STOP RESET to stop. The frequency value on the indication decreases in *Pr. 8 Deceleration time*, and the motor stops rotating with "0.00" (0.00Hz) displayed.

REMARKS

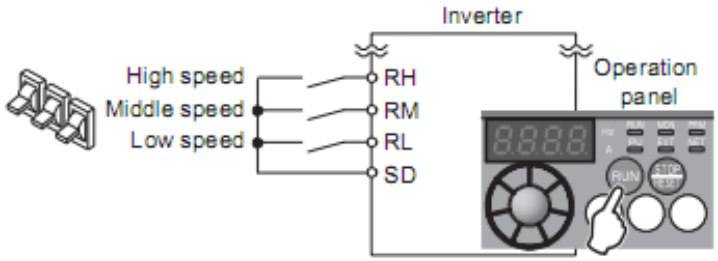
- can also be used like a potentiometer to perform operation. (*Refer to Chapter 4 of the Instruction Manual (Applied).)*
- When you always operate in the PU operation mode at power-ON, set *Pr.79 Operation mode selection* = "1" to choose the PU operation mode always.

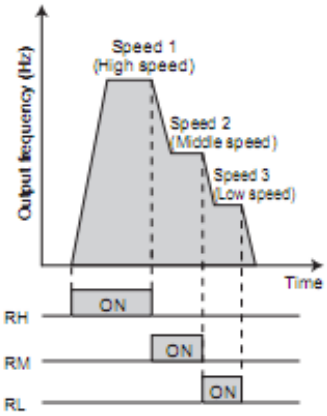
4.3.2. Setting the frequency by switches (Three-speed setting) (Pr. 4 to Pr. 6)

POINT

- Use the operation panel (RUN) to give a start command.
- Switch ON the RH, RM, or RL signal to give a frequency command.
- Set "4" (External/PU combined operation mode 2) in *Pr. 79 Operation mode selection.*

[Connection diagram]





Operation example at low speed (10Hz)

1. Screen at power-ON

The monitor display appears.

2. Easy operation mode setting

Press PU/EXT and MODE for 0.5s. "Pr. - - " appears, and the [PRM] indicator flickers.

3. Operation mode selection

Turn the dial until "Pr. 4" appears. [PU] and [PRM] indicators flicker.

4. Operation mode setting

Press SET to enter the setting. (Set "4" in *Pr.79*.)

"Pr. 4" and "Pr. - - " flicker alternately. [PU] and [EXT] indicators are lit.

5. Start

Turn ON the low-speed switch (RL).

6. Acceleration → constant speed

Press RUN to start running.

The frequency value on the indication increases in *Pr. 7 Acceleration time*, and " 10.00 " (10.00Hz) appears.

[RUN] indicator is lit during forward rotation operation and flickers slowly during reverse rotation operation.

7. Deceleration

Press STOP/RESET to stop.

The frequency value on the indication decreases in *Pr. 8 Deceleration time*, and the motor stops rotating with " 0.00 " (0.00Hz) displayed.

8. Stop

Turn OFF the low-speed switch (RL).

REMARKS

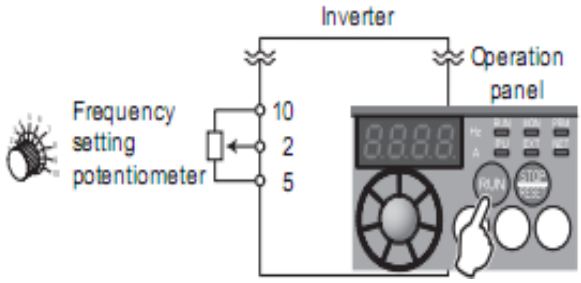
- The initial values of the terminals RH, RM, RL are 60Hz, 30Hz, and 10Hz. (Use *Pr. 4*, *Pr. 5* and *Pr. 6* to change.)
- In the initial setting, when two or three of multi-speed settings are simultaneously selected, priority is given to the set frequency of the lower signal.
  For example, when the RH and RM signals turn ON, the RM signal *(Pr. 5)* has a higher priority.
- Maximum of 15-speed operation can be performed. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*

4.3.3. Setting the frequency by analog input (voltage input)

POINT

- Use the operation panel (RUN) to give a start command.
- Use the (frequency setting) potentiometer to give a frequency command.
- Set "4" (External/PU combined operation mode 2) in *Pr. 79 Operation mode selection*.

[Connection diagram]
(The inverter supplies 5V power to the frequency setting potentiometer. (terminal 10))



Operation example Operate at 60Hz.

	Operation
1.	Screen at power-ON The monitor display appears.
2.	Easy operation mode setting Press PU/EXT and MODE for 0.5s. "79 - -" appears, and the [PRM] indicator flickers.
3.	Operation mode selection Turn the dial until "79 - 4" appears. [PU] and [PRM] indicators flicker.
4.	Operation mode setting Press SET to enter the setting. (Set "4" in *Pr.79*.) "79 - 4" and "79 - -" flicker alternately. [PU] and [EXT] indicators are lit.
5.	Start Press RUN. [RUN] flickers fast as no frequency command is given.
6.	Acceleration → constant speed Turn the potentiometer clockwise slowly to full. The frequency value on the indication increases in *Pr. 7 Acceleration time*, and "60.00" (60.00Hz) appears. [RUN] indicator is lit during forward rotation operation and flickers slowly during reverse rotation operation.
7.	Deceleration Turn the potentiometer counterclockwise slowly to full. The frequency value on the indication decreases in *Pr. 8 Deceleration time*, and the motor stops rotating with "0.00" (0.00Hz) displayed. [RUN] flickers fast.
8.	Stop Press STOP/RESET. [RUN] indicator turns OFF.

REMARKS

- The frequency at the full clockwise turn of the potentiometer (frequency setting potentiometer) (maximum potentiometer setting) is 60Hz in the initial setting. (To change the setting, use *Pr.125.*) *(Refer to page 27.)*

4.4. External operation

4.4.1. Start and stop using terminals

POINT

From where is the frequency command given?

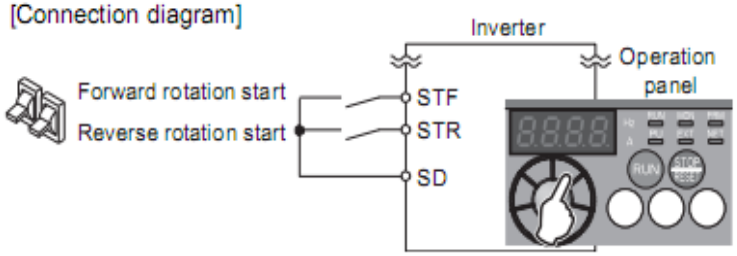
- **Operation at the frequency set in the frequency setting mode of the operation panel** ☞ *refer to 5.2.1 (Refer to page 24)*
- **Give a frequency command by switch (multi-speed setting)** ☞ *refer to 5.2.2 (Refer to page 25)*
- **Perform frequency setting by a voltage input signal** ☞ *refer to 5.2.3 (Refer to page 26)*
- **Perform frequency setting by a current input signal** ☞ 🕮 *refer to Chapter 4 of the Instruction Manual (Applied)*

Setting the frequency by the operation panel (Pr. 79 = 3)

POINT

- Switch ON the STF(STR) signal to give a start command.
- Use the operation panel ( ) to give a frequency command.
- Set "3" (External/PU combined operation mode 1) in *Pr. 79*.

[Connection diagram]

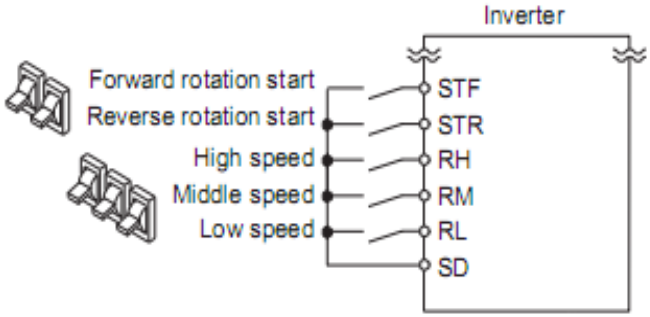


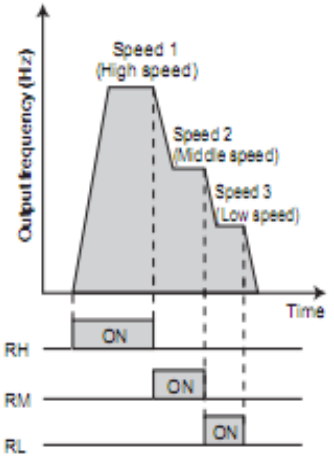
4.4.2. Setting the frequency by switches (three-speed setting) (Pr. 4 to Pr. 6)

POINT

- Switch ON the STF (STR) signal to give a start command.
- Switch ON the RH, RM, or RL signal to give a frequency command.

[Connection diagram]





Operation example | Operation at high speed (60Hz)

Operation

1. Screen at power-ON
The monitor display appears.

2. Start
Turn ON the high-speed switch (RH).

3. Acceleration → constant speed
Turn ON the start switch (STF or STR). The frequency value on the indication increases in *Pr. 7 Acceleration time*, and "60.00" (60.00Hz) appears.
[RUN] indicator is lit during forward rotation operation and flickers during reverse rotation operation.
- When RM is turned ON, 30Hz is displayed. When RL is turned ON, 10Hz is displayed.

4. Deceleration
Turn OFF the start switch (STF or STR). The frequency value on the indication decreases in *Pr. 8 Deceleration time*, and the motor stops rotating with "0.00" (0.00Hz) displayed. [RUN] turns OFF.

5. Stop
Turn OFF the high-speed switch (RH)

REMARKS

- Initial values of terminals RH, RM, and RL are 60Hz, 30Hz, and 10Hz. (To change, set *Pr. 4*, *Pr. 5* and *Pr. 6*.)
- In the initial setting, when two or three of multi-speed settings are simultaneously selected, priority is given to the set frequency of the lower signal.
  For example, when the RH and RM signals turn ON, the RM signal *(Pr. 5)* has a higher priority.
- Maximum of 15-speed operation can be performed. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*

Operation example | Operate at 30Hz.

Operation

1. Screen at power-ON
The monitor display appears.

2. Easy operation mode setting
Press PU/EXT and MODE for 0.5s. "Pr. - -" appears, and the [PRM] indicator flickers.

3. Operation mode selection
Turn the dial until "Pr. 3" appears. [EXT] and [PRM] indicators flicker.

4. Operation mode setting
Press SET to enter the setting. (Set "3" in *Pr.79*.)
"Pr. 3" and "Pr. - -" flicker alternately. [PU] and [EXT] indicators are lit.

5. Frequency setting
Turn the dial to show the frequency "30.00" you want to set. The frequency flickers for about 5s. While the value is flickering, press SET to set the frequency. "F" and "30.00" flicker alternately. After about 3s of flickering, the indication of the value goes back to "0.00" (monitor display). (If SET is not pressed, the indication of the value goes back to "0.00" (0.00Hz) after about 5s of flickering. In that case, turn the dial again, and set the frequency.)

6. Start → acceleration → constant speed
Turn the start switch (STF or STR) ON.
The frequency value on the display increases in *Pr. 7 Acceleration time*, and "30.00" (30.00Hz) appears.
[RUN] indicator is lit during forward rotation operation and flickers during reverse rotation operation.
(To change the set frequency, perform the operation in above step 5. Starting from the previously set frequency.)

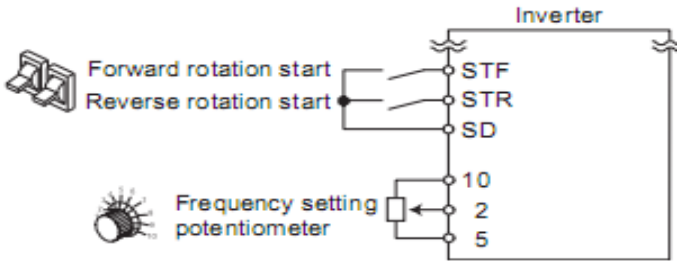
7. Deceleration → stop
Turn OFF the start switch (STF or STR). The frequency value on the indication decreases in *Pr. 8 Deceleration time*, and the motor stops rotating with "0.00" displayed. [RUN] turns OFF.

4.4.3. Setting the frequency by analog input (voltage input)

POINT

- Switch ON the STF(STR) signal to give a start command.
- Use the potentiometer (frequency setting potentiometer) to give a frequency command.

[Connection diagram]
(The inverter supplies 5V power to the frequency setting potentiometer. (terminal 10))



Note: Setting the frequency by the operation panel (**Pr.79 = 2**)

Operation example | Operate at 60Hz.

Operation

1. Screen at power-ON
   The monitor display appears.
2. Start
   Turn the start switch (STF or STR) ON.
   [RUN] flickers fast because the frequency command is not given.
3. Acceleration → constant speed
   Turn the potentiometer (frequency setting potentiometer) clockwise slowly to full.
   The frequency value on the display increases in *Pr. 7 Acceleration time*, and "60.00" (60.00Hz) appears.
   [RUN] indicator is lit during forward rotation operation and flickers slowly during reverse rotation operation.
4. Deceleration
   Turn the potentiometer (frequency setting potentiometer) counterclockwise slowly to full.
   The frequency value on the display decreases in *Pr. 8 Deceleration time*, and the motor stops rotating with "0.00" (0.00Hz) displayed. [RUN] flickers fast.
5. Stop
   Turn the start switch (STF or STR) OFF.
   [RUN] turns OFF.

REMARKS

- The frequency at the full clockwise turn of the potentiometer (frequency setting potentiometer) (maximum potentiometer setting) is 60Hz in the initial setting. (To change the setting, use *Pr.125.*) *(Refer to page 27.)*

4.4.4. Set for 8 speeds

Set Pr 79 = 0 To set parameters

Parameter Number	Name	Initial Value	Initial Signal
180	**RY4 function selection**	0	RL (low-speed operation command)
181	**RY3 function selection**	1	RM (middle speed operation command)
182	**RY2 function selection**	2	RH (high-speed operation command)

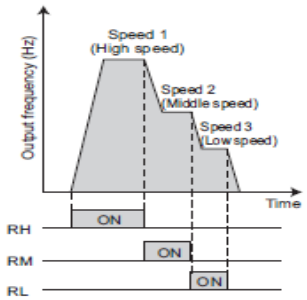
Set Pr 179 = 8 (STR => STX second fuction)

Set to 3 Groups P4 – P6; P24 – P27; P232 – P239

RH	RM	RL
2	1	0

STX	RH	RM	RL
3	2	1	0

Parameter Number	Name	Initial Value	Setting Range	Description
4	Multi-speed setting (high speed)	60Hz	0 to 400Hz	Frequency when RH turns ON
5	Multi-speed setting (middle speed)	30Hz	0 to 400Hz	Frequency when RM turns ON
6	Multi-speed setting (low speed)	10Hz	0 to 400Hz	Frequency when RL turns ON
24 *	Multi-speed setting (speed 4)	9999	0 to 400Hz, 9999	Frequency from 4 speed to 15 speed can be set according to the combination of the RH, RM, RL and REX signals. 9999: not selected
25 *	Multi-speed setting (speed 5)	9999	0 to 400Hz, 9999	
26 *	Multi-speed setting (speed 6)	9999	0 to 400Hz, 9999	
27 *	Multi-speed setting (speed 7)	9999	0 to 400Hz, 9999	
232 *	Multi-speed setting (speed 8)	9999	0 to 400Hz, 9999	
233 *	Multi-speed setting (speed 9)	9999	0 to 400Hz, 9999	
234 *	Multi-speed setting (speed 10)	9999	0 to 400Hz, 9999	
235 *	Multi-speed setting (speed 11)	9999	0 to 400Hz, 9999	
236 *	Multi-speed setting (speed 12)	9999	0 to 400Hz, 9999	
237 *	Multi-speed setting (speed 13)	9999	0 to 400Hz, 9999	
238 *	Multi-speed setting (speed 14)	9999	0 to 400Hz, 9999	
239 *	Multi-speed setting (speed 15)	9999	0 to 400Hz, 9999	

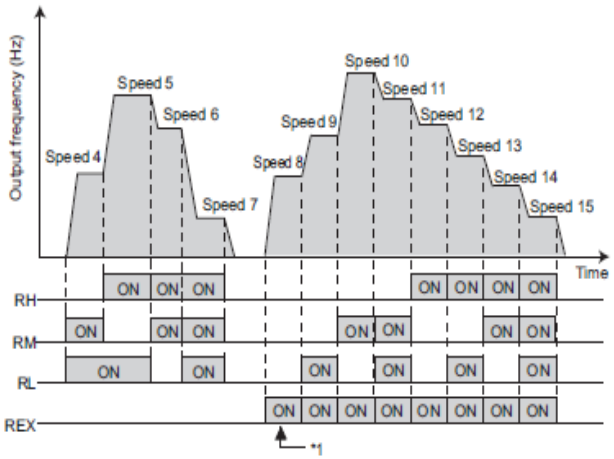


(1) Multi speed setting for 3 speeds *(Pr. 4 to Pr. 6)*

•The inverter operates at frequencies set in *Pr. 4* when RH signal is ON, *Pr. 5* when RM signal is ON and *Pr. 6* when RL signal is ON.

(2) Multi-speed setting for 4 or more speeds *(Pr. 24 to Pr. 27, Pr. 232 to Pr. 239)*

- Frequency from 4 speed to 15 speed can be set according to the combination of the RH, RM, RL and REX signals. Set the running frequencies in *Pr. 24 to Pr. 27, Pr. 232 to Pr. 239*. (In the initial value setting, speed 4 to speed 15 are invalid.)
- To input the REX signal to a virtual terminal of CC-Link communication, set "8" in one of *Pr.180 to Pr.184 (input terminal function selection)*.



*1 When "9999" is set in *Pr. 232 Multi-speed setting (speed 8)*, operation is performed at frequency set in *Pr. 6* when RH, RM and RL are turned OFF and REX is turned ON.

4.5. Using PLC to CONTROL Inverter

4.5.1 Control relays

4.5.2 Control the speeds from analog modules.

Using voltage input (V0: Terminal 5 and 2)

Set Pr 73 = 0 or 10 to choose a voltage range at terminal 2 and 5 is 0 to 10v

Using current input (I): Terminal 5 and 4 (**Pr = 10 => To Input 10V**)

Set Pr 267 = 0 and switch the switch to I then Set "4" in any of *Pr. 178 to Pr. 184*

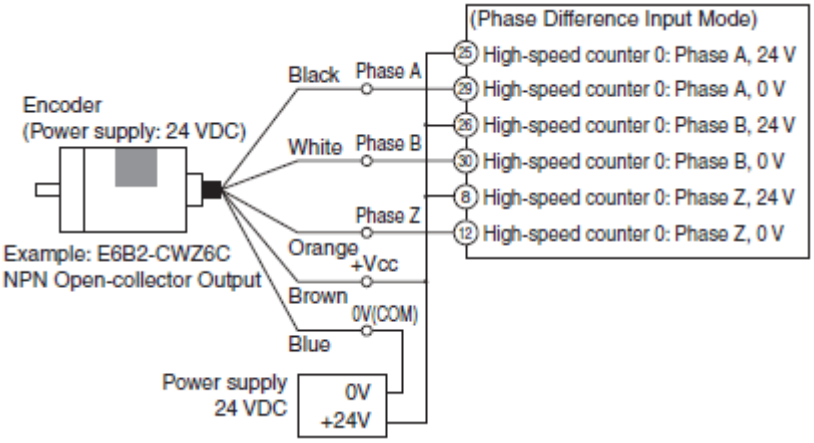
Parameter Number	Name	Initial Value	Setting Range	Description		
73	Analog input selection	1	0	Terminal 2 input 0 to 10V		Without reversible operation
			1	Terminal 2 input 0 to 5V		
			10	Terminal 2 input 0 to 10V		With reversible operation
			11	Terminal 2 input 0 to 5V		
267	Terminal 4 input selection	0		Voltage/current input switch		Description
				Standard control circuit terminal model	Safety stop function model	
			0			Terminal 4 input 4 to 20mA
			1			Terminal 4 input 0 to 5V
			2			Terminal 4 input 0 to 10V

Part V. HIGH-SPEED COUNTER PROCESSING

5.1. Encoder and application

5.1.1. The constructing principle of an Encoder

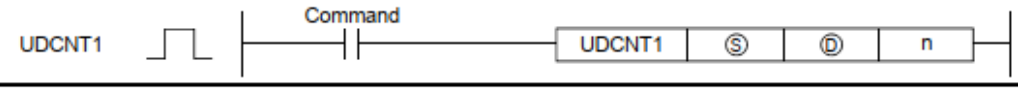
5.1.2. Wiring to PLC



5.2. Instructions to Process counter

5.2.1. Count 1-phase input up or down (UDCNT1)

[Instruction Symbol] [Execution Condition]



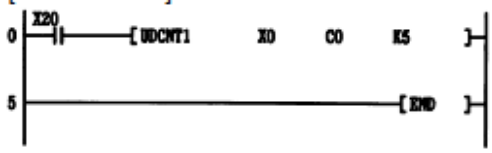
[Set Data]

Set Data	Meaning	Data Type
Ⓢ	• Ⓢ +0: Input number for count input • Ⓢ +1: For setting count upper down • OFF : Count up (add numbers when counting) • ON : Count down (subtract numbers when counting)	Bit
Ⓓ	• Number of counter that will perform count on UDCNT1 instruction	Word
n	• Set value	BIN16

[Program Example]

(1) This program uses C0 (up and down counter) to count the number of times X0 goes from off to ON after X20 has gone ON.

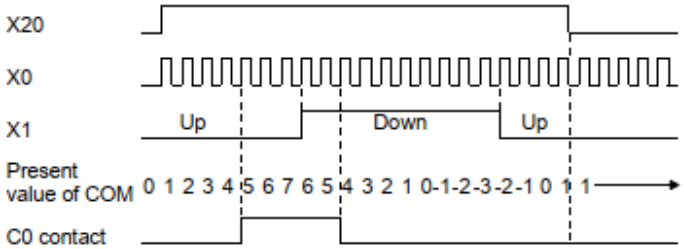
[Ladder Mode]



[List Mode]

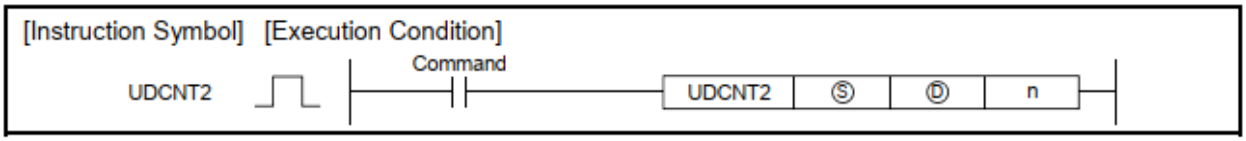
Steps	Instruction	Device
0	LD	X20
1	UDCNT1	X0
		C0
		K5
5	END	

[Operation]



5.2.2. Count 2-phase input up or down (UDCNT2)

[Instruction Symbol] [Execution Condition]



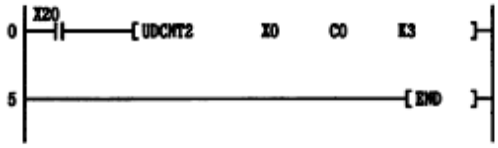
[Set Data]

Set Data	Meaning	Data Type
Ⓢ	• Input number for count input: Ⓢ +0 (A phase pulse) • Input number for count input: Ⓢ +1 (B phase pulse)	Bit
Ⓓ	• Number of counter that will perform count onUDCNT2 instruction	Word
n	• Set value	BIN16

[Program Example]

(1) The following program performs a count operation as instructed by C0 (count up or down) on the status of X0 and X1 after X20 has gone ON.

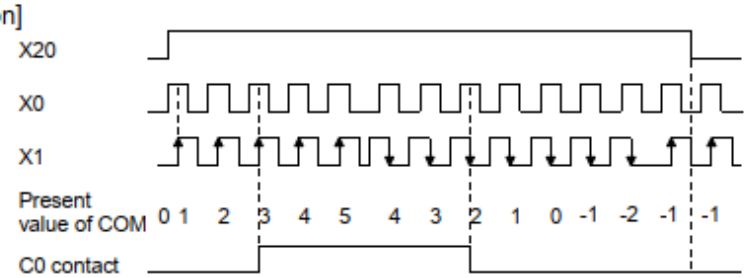
[Ladder Mode]



[List Mode]

Steps	Instruction	Device
0	LD	X20
1	UDCNT2	X0
		C0
		K3
5	END	

[Operation]



5.3. Application Encoder and high speed counter

5.3.1. Programing for 1 phase counter

5.3.2. Programing for 2 phase counter

PART VI. ANALOG

6.1. SPECIAL FUNCTION BLOCK DA:

Q62DAN -Q62DA -Q64DAN -Q64DA -Q68DAVN -Q68DAV -Q68DAIN -Q68DAI

6.1.1. OVERVIEW

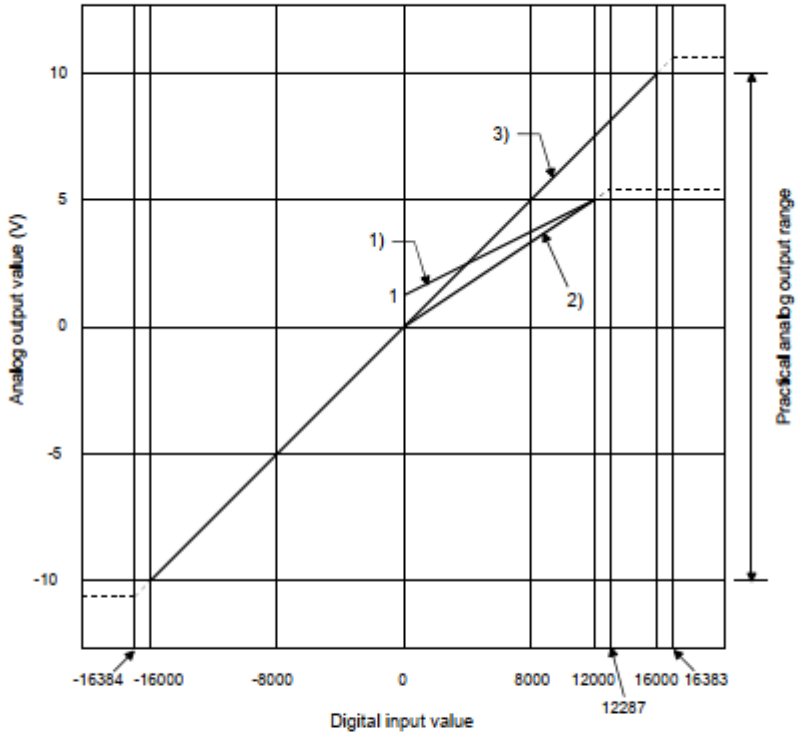
Resolution

Item \ Model name		Q62DAN	Q64DAN	Q68DAVN	Q68DAIN
Number of analog output points		2 points (2 channels)	4 points (4 channels)	8 points (8 channels)	
Digital input		16-bit signed binary (normal resolution mode: -4096 to 4095, high resolution mode: -12288 to 12287, -16384 to 16383)			
Analog output	Voltage	–10 to 10 V DC (External load resistance value: 1 kΩ to 1MΩ)			—
	Current	0 to 20 mA DC (External load resistance value: 0Ω to 600Ω)		—	0 to 20 mA DC (External load resistance value: 0Ω to 600Ω)

I/O characteristics, Maximum resolution

Analog output range		Normal resolution mode		High resolution mode	
		Digital input value	Maximum resolution	Digital input value	Maximum resolution
Voltage	0 to 5V	0 to 4000	1.25 mV	0 to 12000	0.416 mV
	1 to 5V		1.0 mV		0.333 mV
	-10 to 10V	-4000 to 4000	2.5 mV	-16000 to 16000	0.625 mV
	User range setting		0.75 mV	-12000 to 12000	0.333 mV
Current	0 to 20 mA	0 to 4000	5 μA	0 to 12000	1.66 μA
	4 to 20 mA		4 μA		1.33 μA
	User range setting	-4000 to 4000	1.5 μA	-12000 to 12000	0.83 μA

(b) Voltage output characteristic in high resolution mode
Figure 3.2 shows a graph of the voltage output characteristic in high resolution mode.



Number	Output range setting	Offset value	Gain value	Digital input value	Maximum resolution
1)	1 to 5 V	1 V	5 V	0 to 12000	0.333 mV
2)	0 to 5 V	0 V	5 V		0.416 mV
3)	–10 to 10 V	0 V	10 V	–16000 to 16000	0.625 mV
—	User range setting	*1	*1	–12000 to 12000	0.333 mV

Figure 3.2 Voltage output characteristic in high resolution mode

Table 3.6 List of I/O signal

Signal direction	D/A converter module → CPU module	Signal direction	CPU module ← D/A converter module
Device No	Signal name	Device No.	Signal name
X0	Module ready	Y0	Use prohibited ＊1
X1	Use prohibited ＊1	Y1	CH1 Output enable/disable flag
X2		Y2	CH2 Output enable/disable flag
X3		Y3 ＊2	CH3 Output enable/disable flag
X4		Y4 ＊2	CH4 Output enable/disable flag
X5		Y5 ＊2	CH5 Output enable/disable flag
X6		Y6 ＊2	CH6 Output enable/disable flag
X7		Y7 ＊2	CH7 Output enable/disable flag
X8	High resolution mode status flag	Y8 ＊2	CH8 Output enable/disable flag
X9	Operating condition setting completed flag	Y9	Operating condition setting request
XA	Offset/gain setting mode flag	YA	User range writing request
XB	Channel change completed flag	YB	Channel change request
XC	Set value change completed flag	YC	Set value change request
XD	Synchronous output mode flag	YD	Synchronous output request
XE	Use prohibited ＊1	YE	Use prohibited ＊1
XF	Error flag	YF	Error clear request

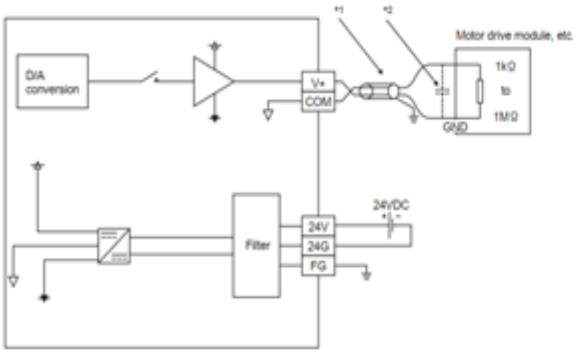
POINT

＊1 The Use prohibited signal cannot be used by the user since they are used by the system. If these are turned on/off by the sequence program, the functioning of the D/A converter module cannot be guaranteed.

＊2 For the Q62DAN and Q62DA, Y3 to Y8 Use prohibited.
For the Q64DAN and Q64DA, Y5 to Y8 Use prohibited.

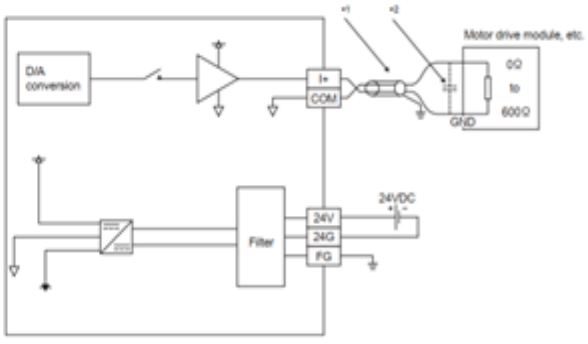
6.1.2. External wiring

(1) For voltage output of the Q62DAN, Q64DAN, or Q68DAVN



＊1 Use a twisted two core shielded wire for the power wire.
＊2 If there is noise or ripples in the external wiring, connect a 0.1 to 0.47μF 25V capacitor between the V+ terminal and COM.

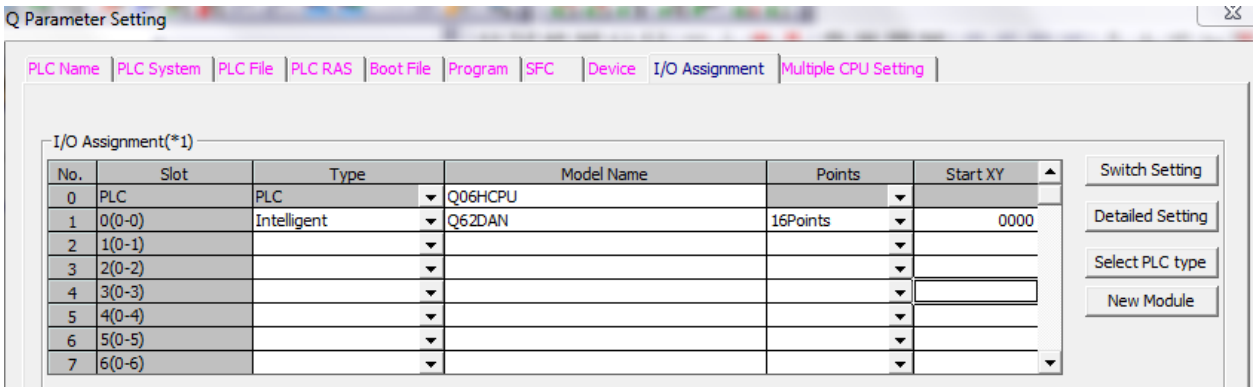
(2) For current output of the Q62DAN, Q64DAN, or Q68DAIN



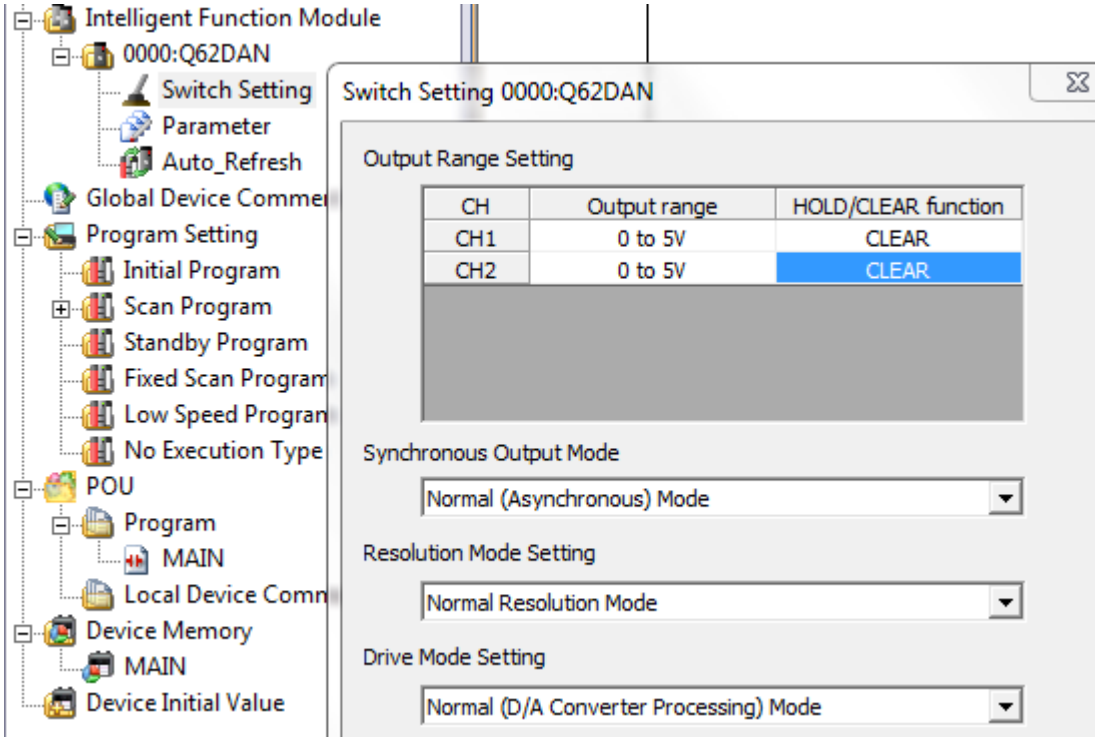
＊1 Use a twisted two core shielded wire for the power wire.
＊2 If there is noise or ripples in the external wiring, connect a 0.1 to 0.47μF 25V capacitor between the I+ terminal and COM.

6.1.3. CONFIGURATION

1) I/O ASSIGNMENT

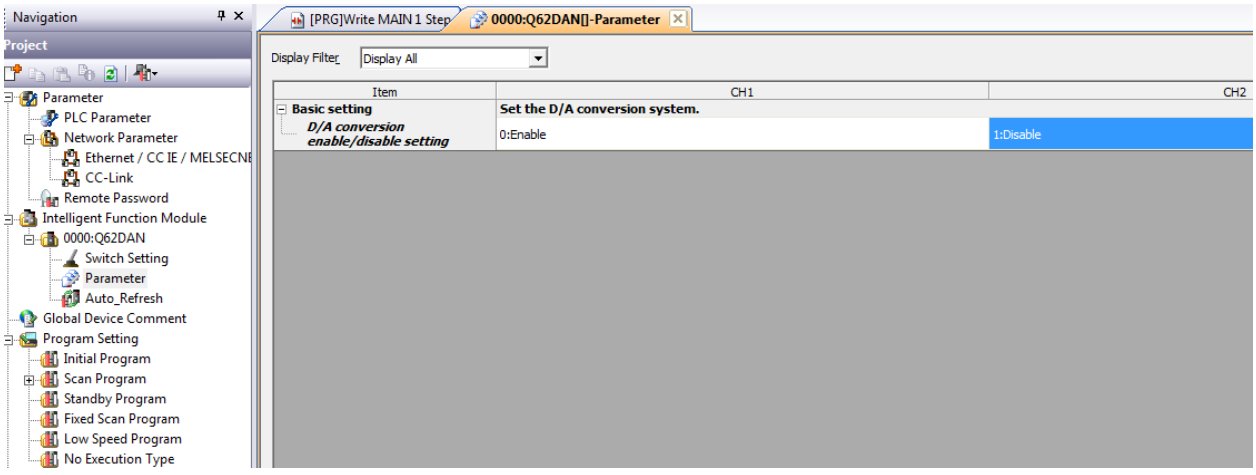


2) SWITCH SETTING

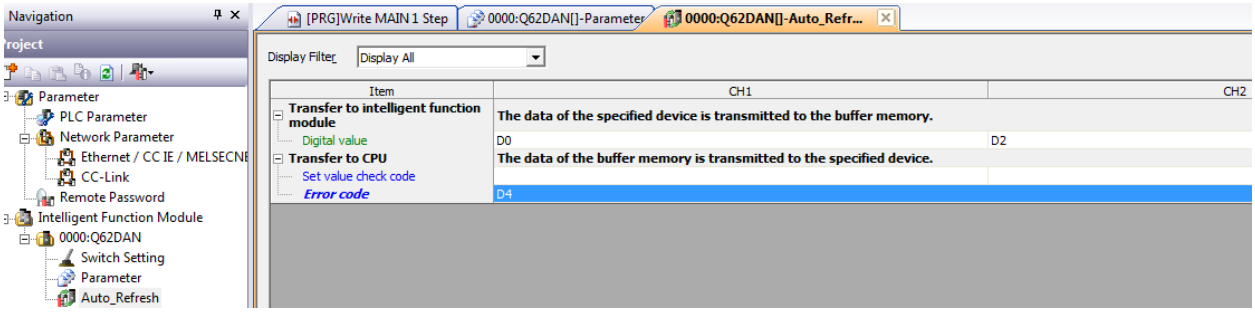


3) PARAMETER

SET ENABLE



4) AUTO_REFRESH



6.2. SPECIAL FUNCTION BLOCK DA:

Q64AD -Q68ADV -Q68ADI

6.2.1. OVERVIEW

Signal direction CPU ← A/D converter module		Signal direction CPU → A/D converter module	
Device No. (Input)	Signal name	Device No. (Output)	Signal name
X0	Module READY	Y0	Use prohibited ＊1
X1	Temperature drift compensation flag	Y1	
X2	Use prohibited ＊1	Y2	
X3		Y3	
X4		Y4	
X5		Y5	
X6		Y6	
X7		Y7	
X8	High resolution mode status flag	Y8	
X9	Operating condition setting completed flag	Y9	Operating condition setting request
XA	Offset/gain setting mode flag	YA	User range writing request
XB	Channel change completed flag	YB	Channel change request
XC	Use prohibited ＊1	YC	Use prohibited ＊1
XD	Maximum value/minimum value reset completed flag	YD	Maximum value/minimum value reset request
XE	A/D conversion completed flag	YE	Use prohibited ＊1
XF	Error flag	YF	Error clear request

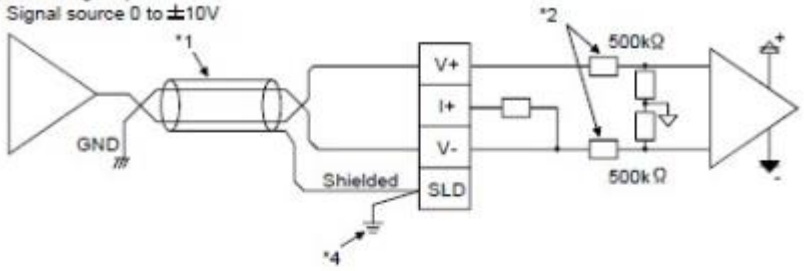
POINT

＊1 These signals cannot be used by the user since they are for system use only. If these are turned on/off by the sequence program, the functioning of the A/D converter module cannot be guaranteed.

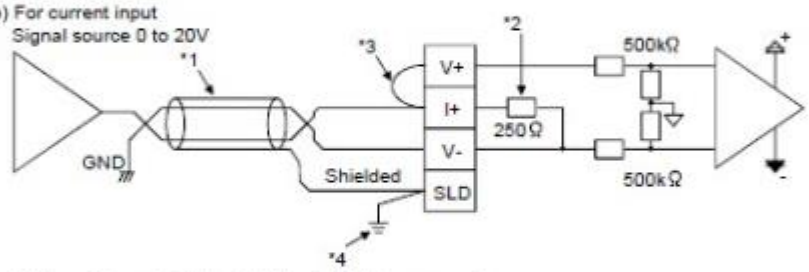
6.2.2. WIRING

(1) Q64AD-GH

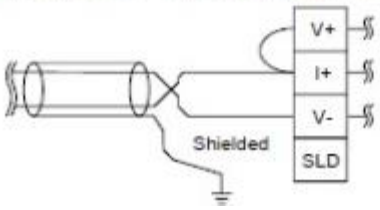
(a) For voltage input
Signal source 0 to ±10V



(b) For current input
Signal source 0 to 20V



*1 Use a 2-core twisted shielded wire for the power wire.
*2 Shows input resistance.
*3 For current input, be sure to connect to (V+) and (I+) terminals.
*4 Be sure to ground the shield wire of each channel.
The SLD terminal can be used when grounding, however it has not been wired inside the board.
Ground it as shown in the diagram shown above or below.
In addition, ground the FG of the power supply module.



6.2.3. CONFIGURATION

6.3. INC (increase) and DEC (decrease) instructions

Acceleration and deceleration using for output analog

Combination positional control and the speed accelerates

Combination positional control, forward reverse and the speed accelerates

Advanced exercises:

6.4 Do exercises

PART VII. HUMAN-MACHINE INTERFACES_HMI

7.1. Overview of GOT (Graphic Operation Terminal)

7.2. Technical details.

7.3. Connection Diagram.

7.4. Install software and programing.

7.4.1. Install software

7.4.2. Upload/download

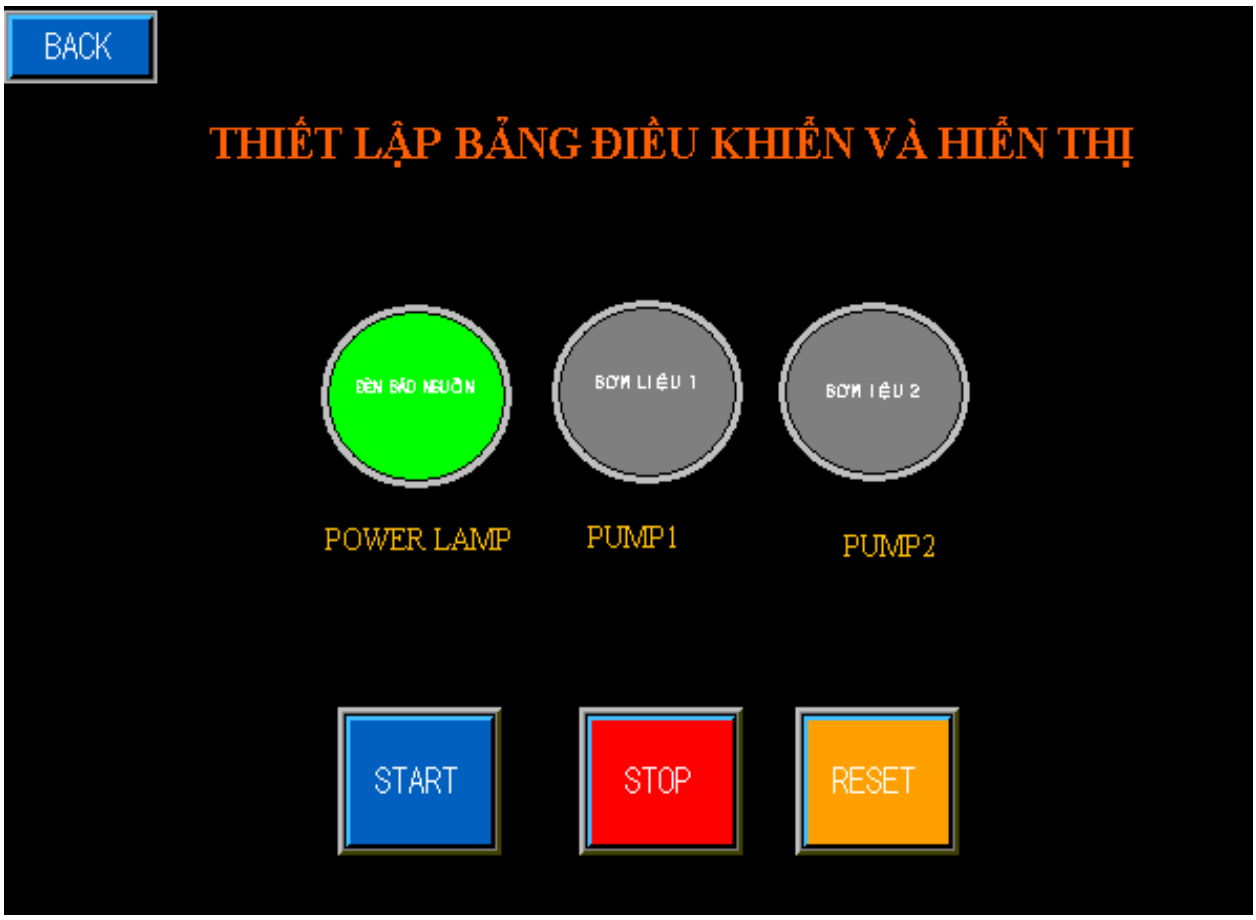
7.4.3. Programming

SAMPLE 01

Screen1

Screen2

Screen3

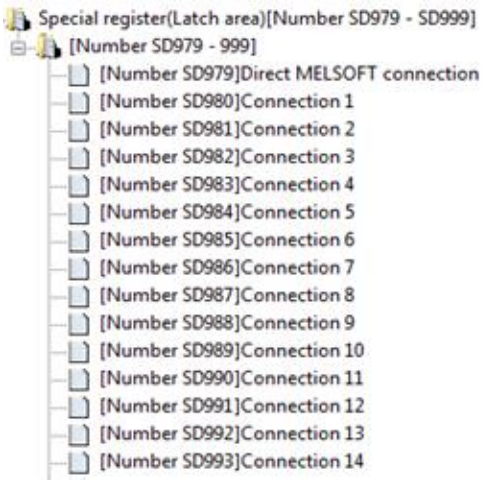


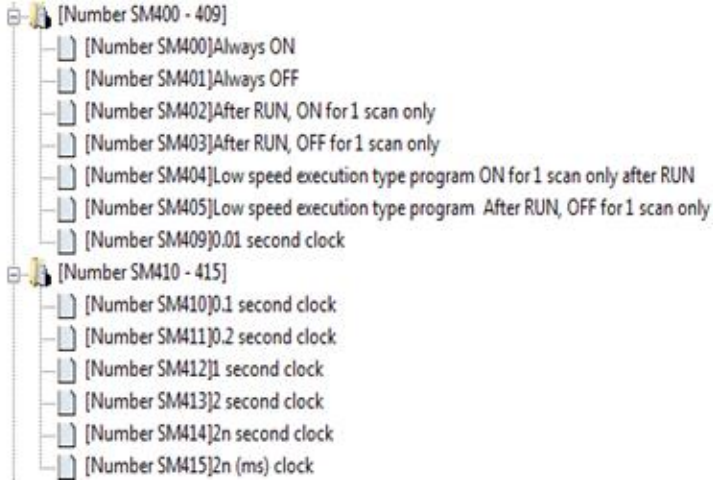
Screen4

Make Alarm History

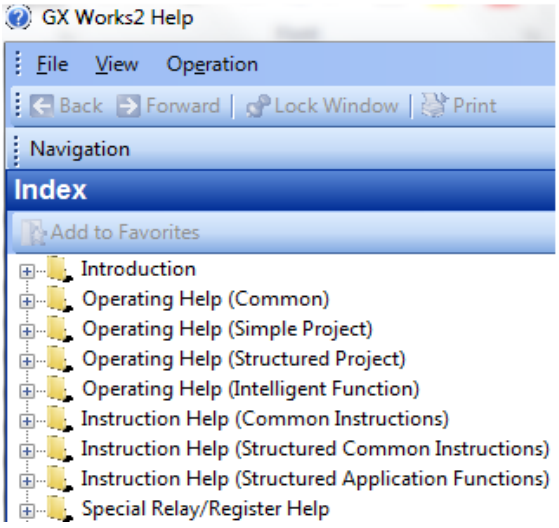
APPENDIX

Some devices





Special auxiliary relays



Compile and coach by M.S. Le Xuan Quang, Master of Automation

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Email: lequangtdh@gmail.com