

Lab4Schools
Lab Activity “Elevator”



PLC

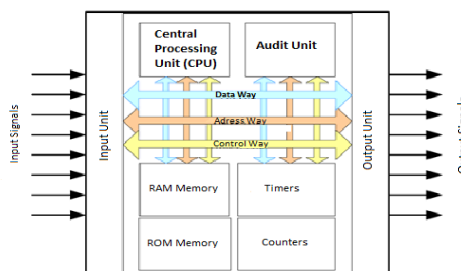
A programmable Logic Controller (PLC: Programmable Logic Controller) is an industrial computer operating under an operating system suitable for industrial control structure, equipped with input-output and communication interfaces suitable for realizing command and control circuits of industrial automation systems.

The most common areas where PLCs are used are industrial automation systems' command and control circuits. As is known, conventional control circuits are circuits that are realized with an element/device such as a contactor, auxiliary relay, timer and counter. Today, such circuits have been replaced by control systems with PLC. Except for a few small-sized PLC models, many PLC brands and models on the market have powerful command support that allows performing all the arithmetic and logical operations required to write a control algorithm. Also, the use of a PLC as a digital controller in feedback control systems is provided with input-output units by converting analogue signals to digital values (ADC) and digital values to analogue signals (DAC).

PLCs naturally resemble personal computers' structure and operation in terms of overall structure and operation. Because all the main components that make up a computer (MIB, RAM, EPROM, IO units, etc.) are also available in PLCs. However, it is desired to compare the PLCs with microprocessors (6802, Z80) or microcontrollers (PIC, ATMEL). These products have completely different purposes and places of use. It is theoretically possible that many operations that can be done with PLCs can also be done with microcontrollers (and vice versa). But the obvious differences between PLCs and processors depend on the system and design to be used as briefly summarized below.

1. PLCs are industrial products. They need certain standards to be established. There are many peripheral and communication interfaces such as an operator panel, analogue input-output module etc. that can be used with PLCs.
2. PLCs are susceptible to work in difficult conditions such as electrical noise, electromagnetic interference, mechanical vibrations, high temperatures, etc.
3. Using the software and hardware of PLCs does not require much electronic knowledge compared to microprocessors. The program design of these products, which are already ready in terms of hardware, is made on the computer screen and the program results can be checked by examining the simulation on the screen.
4. Many devices used in industrial environments don't have standard infrastructures that enable them to be used and communicated together (AS-i BUS, Profibus, CAN-BUS etc.). Most of the devices used in this field are produced ready to support such communication protocols.
5. PLCs can be programmed directly on them, as well as via the network infrastructure (RS485, Ethernet) closely or remotely.

BASIC STRUCTURE AND OPERATION OF PLCS



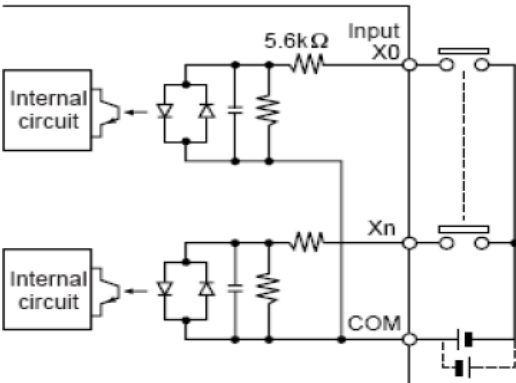
Central Processing Unit (CPU): The central processing unit inside the PLC executes the user program and enables the PLC to serve the desired purpose.

RAM (Random Access Memory): Random access memory is the part that can be written and read. It is a temporary memory unit. The information written to this memory is lost when the power of the PLC is cut off.

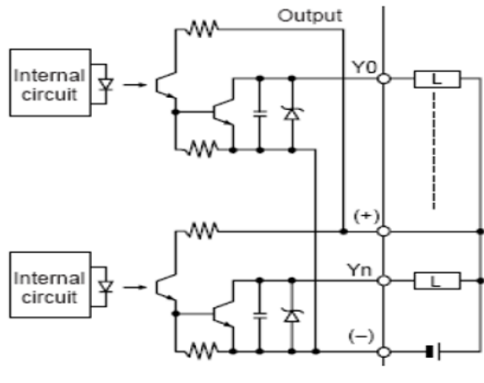
EPROM and EEPROM: Information written to ROM-type memories is not deleted even if the system is powered off.

Counter: They are independent units that work independently of the PLC program and count in the ascending or descending direction with internal or external clock pulses. For example, the number of objects passing in front of the sensor connected to the input of a PLC can be counted with these counters. There are 44 counters (C100-C143) in the Panasonic FP0 series PLC in our experiment set.

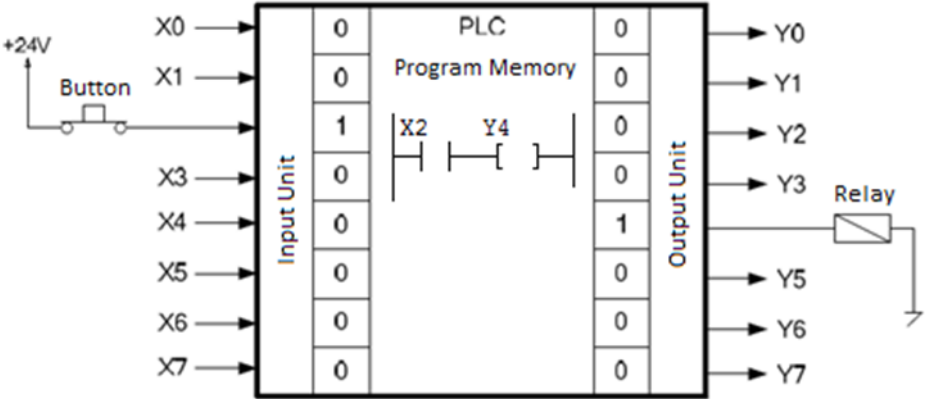
Timer: They are used for time-dependent applications with PLC. Timers make their outputs SET or RESET according to the time determined during programming. There are a total of 100 timers (T100-T143) in the Panasonic FP0 series PLC in our experiment set.



Panasonic Nais PLC External Input



Panasonic Nais PLC External Output



Input-output connections of a simple application prepared for PLC

Control unit		C10 series (Relay output type only)	C14 series (Relay output type only)	C16 series (Transistor output type only)	C32 series (Transistor output type only)	S-LINK type	T32 series (Transistor output type only)
Control method		Relay symbol/Cyclic operation					
Number of I/O points		Relay symbol/Cyclic operation					
Number of I/O points	No expansion	Total: 10 (Input: 6, Output: 4)	Total: 14 (Input: 8, Output: 6)	Total: 16 (Input: 8, Output: 8)	Total: 32 (Input: 16, Output: 16)	S-LINK section: max.128points (Input: 64, Output: 64)	Total: 32 (Input:16, Output: 16)
	W/expansion 1 *Same type of control and expansion unit	Max. 58	Max. 62	Max. 112	Max. 128	Expansion section: max.96 points	Max. 128
	W/expansion 2 *Mix type of relay transistor unit	Max. 106	Max. 110	Max. 112	Max. 128		Max. 128
Program memory		EEP-ROM(No back-up battery required)					
Program capacity		2.7K steps			5K steps		10K steps
Kinds of instruction	Basic	83					
	High-level	115					
Operation speed(central value/step)		0.9μ(Basic instruction)					
Memory for execution	Relay	1,008 points					
	Internal relay (R)	144 points					
	Timer/Counter (T/C)	1,660 words					
Memory area	Data register (DT)	1,660 words			6,144 words		16,384 words
	Index register(IX,IY)	2 words					
Master control relay(MCR)		32 points					
Number of labels(JMP+LOOP)		64 labels					255 labels
Differential points		Unlimited number of points					
Number of step ladder		128 stages					704 stages
Number of subroutines		16 subroutines					100 subroutines
Special functions	High speed counter	1 phase/4 points (10kHz in total) or 2 phases / 2 points (2 kHz in total)*				Not available	Available(same as 32 points series)
	Pulse output	Not available			2 points(10 kHz* in total),enable to control 2 channels individually*	Not available	Available (same as 32 points series)
	PWM output	None			0.15Hz to 1kHz	Not available	Available(same as 32 points series)
	Pulse catch input/interrupt input	6 points(with high speed counter)				Not available	Available(same as 32 points series)
	Interrupt program	7 programs (external 6 points, internal 1 point)				1 program (internal 1 point)	Available(same as 32 points series)
	Periodical interrupt	0.5 ms to 30s					
	Constant scan	Available					
RS232C port		One RS232C port is mounted on each of the models C10CR, C14CR,C16CT, C32CT, T32CT and SLI type (3P terminal block) Transmission speed (Baud rate) :300 to 19200 bit/s Communication method: half duplex Transmission distance :3m 9.843 ft					
Maintenance	Memory back up	Program and system register	Stored program and system register in EEPROM				Backup is provided by secondary battery. The holding range for the timers, counters, internal relays, and data registers are specified with the programming tool.
		Operation memory	Stored fixed area in EEPROM Counter: 4 points Internal relay: 32 points Data register: 8 words		Stored fixed area in EEPROM Counter: 16 points Internal relay: 128 points Date register: 32 words		
	Self-diagnosis functions		Watchdog timer, program syntax checking				
	Clock/calender function		Not available				Available
	Other functions		Runtime editing, password setting				

PANASONIC NAIS FP0 series PLC Specifications List (Our PLC C32 Series)

■ Input Specification (As for the limitation on the number of parallel-ON points, please refer to the manual.)

Item	Description	
Rated input voltage	24 V DC	
Operating voltage range	21.6 to 26.4 V DC	
Rated input current	Approx. 4.3 mA (at 24 V DC)	
Input impedance	Approx. 5.6 kΩ	
Input points per common	±common 4 points/common (E8RS/E8RM) 6 points/common (C10RS/C10RM), 8 points/common (C14RS/C14RM, C16T, E16T, E16R, E8X), 16 points/common (C32T/E32T/E16X)	
Min. ON voltage/ON current	19.2 V / 3 mA	
Max. OFF voltage/OFF current	2.4 V / 1 mA	
Response time	OFF → ON	50 μs or less (at X0, X1)* (at 24 V DC and under the ambient temperature of 25°C 77°F)
		100 μs or less (at X2 to X5) (at 24 V DC and under the ambient temperature of 25°C 77°F)
	ON → OFF	2 ms or less (at X6 onward) Same as above
Insulation method	Optical coupler	

■ Output Specification

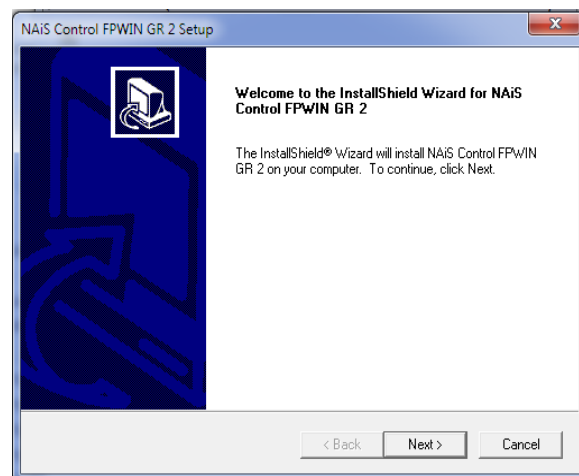
Transistor Output Type (NPN)

Item		Description
Output type		Open collector
Rated voltage range		5 to 24 V DC
Load voltage allowable		4.75 to 26.4 V DC
Max. load current		0.1 A/point (at 26.4 V DC) (1 A/common)
Max. inrush current		0.3 A
OFF state leakage current		100 μ A or less
ON state voltage drop		1.5 V or less
Response time	OFF \rightarrow ON	1 ms or less (50 μ s or less at Y0 and Y1 only)
	ON \rightarrow OFF	

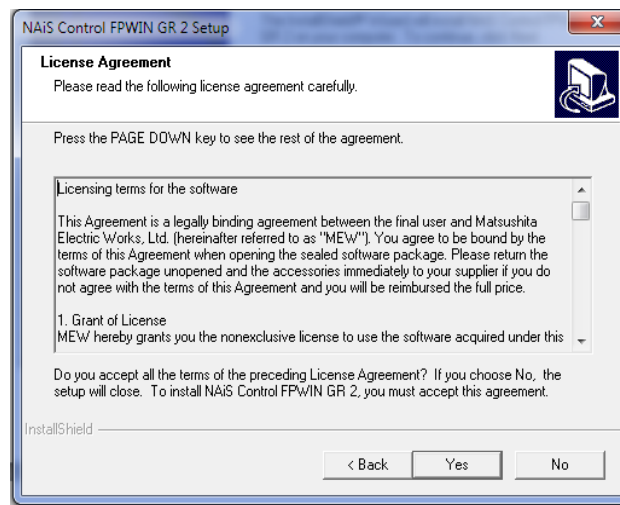
The FPWIN_GR program is used to program the Panasonic Nais FP0_C32 PLC. The installation of this program is described below.



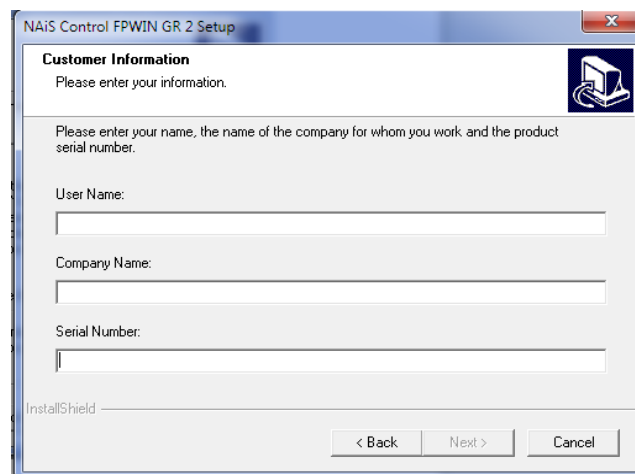
After the FPWIN_GR file is run, the following window opens to start the installation. In this window, click the **Next** button to continue the installation, and click **Cancel** to exit the installation.



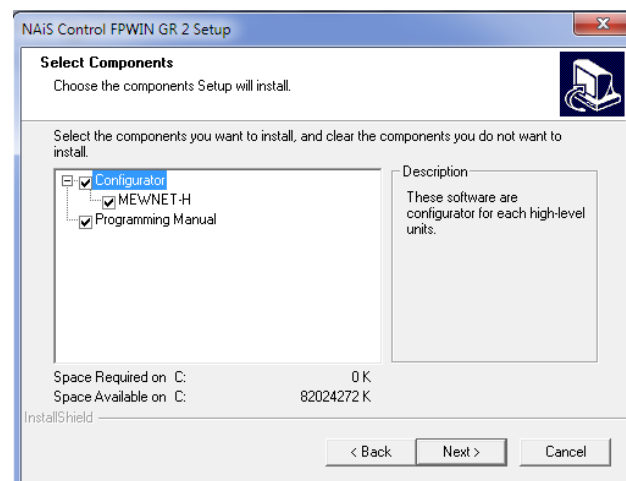
Press the **Yes** button to continue the installation, the **No** button to exit the installation, or the **Back** button to return to the previous tab.



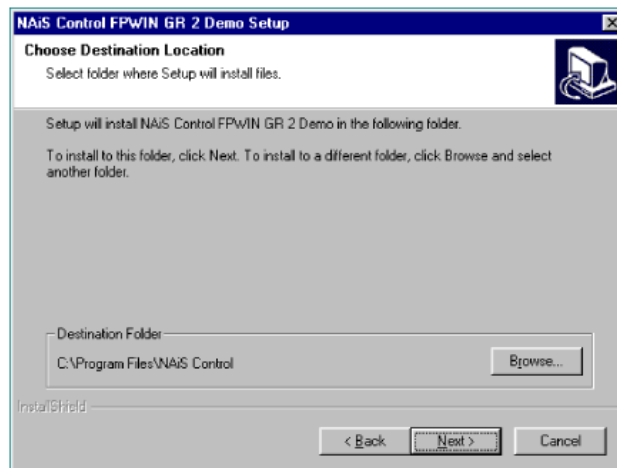
Fill in the information in this section.



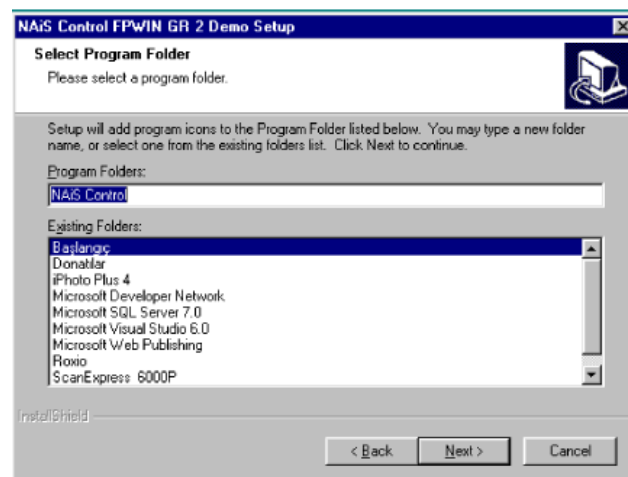
Click the **Next** button to continue, the **Cancel** button to exit the installation, and the **Back** button to return to the previous tab.



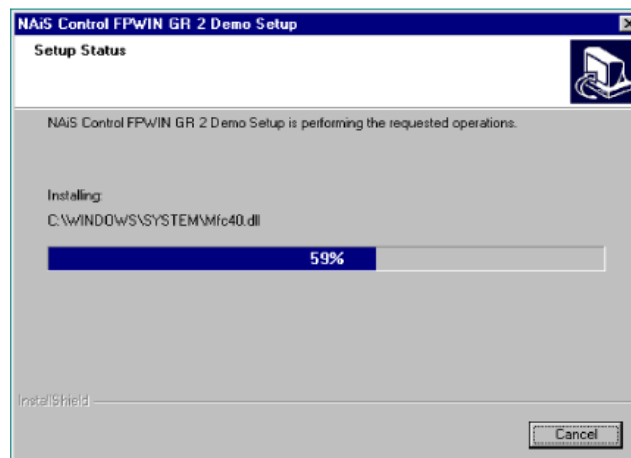
The place where the program will be installed is determined and the **Next** button is pressed.



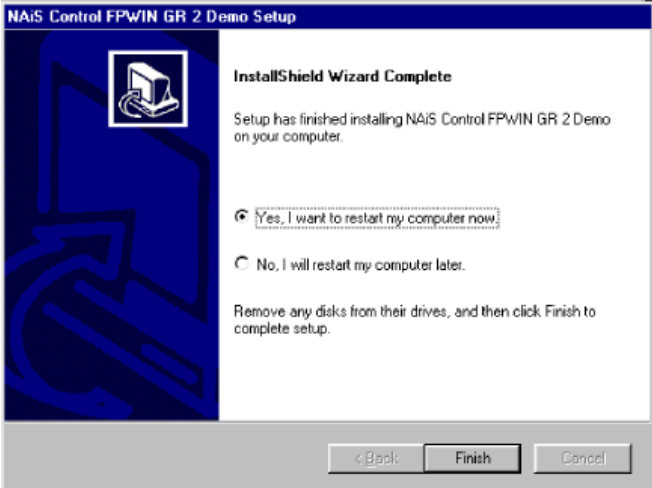
The name of the group where the program will be installed is displayed and the **Next** button is pressed.



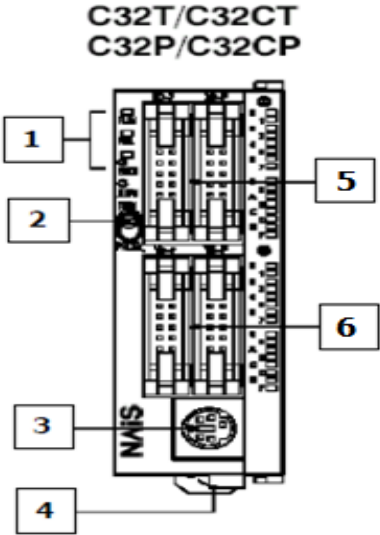
When the **Next** button is pressed, the program files begin to open and install on your computer.



The computer must be restarted after the installation is complete.



Panasonic Nais FP0-C32CT PLC 's Parts



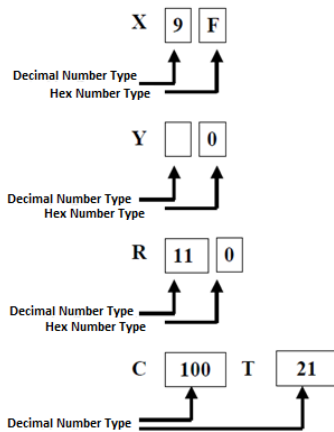
Parts of the Panasonic Nais FP0-C32CT PLC included in our PLC application set

- 1. LED showing operating modes and error messages
- 2. Switch that sets operating modes. (RUN / PROG)
- 3. Programming connector
- 4. Power supply connector
- 5. Inputs (10 pins x 2)
- 6. Outputs (10 pins x 2)

Contacts and Addressing

- 1. External Inputs (X)
- 2. External Outputs (Y)
- 3. Internal Relay (R)
- 4. Timer (T)
- 5. Counter (C)
- 6. Link (L)
- 7. Pulse (P)

External Inputs (X), External Outputs (Y) and Internal Relay (R) can use Word (16 bit)



External Input (X)

Buttons, switches, encoders or sensors connected to the PLC module from outside use these contacts. The number of these contacts varies according to the model of PLCs. In NAIS FP0 32-CT PLC, external inputs are arranged in hexadecimal 16 inputs from X0 to XF.

External Outputs (Y)

These contacts are used when it is desired to start or stop any peripheral unit (Relay, lamp, valve, Step Motor etc.) as a result of the operations performed in the PLC. In NAIS FP0 32-CT PLC, external outputs are arranged in hexadecimal, from Y0 to YF.

Internal Relay(R)

It is the internal relay contacts that start the operations in the PLC, can be used as both input and output contacts in the PLC, but do not receive input or output information from the outdoor units. The non-permanent ones are deleted when the power is cut off, the permanent ones are not deleted.

PARTS		C32T / C32P
Internal Relays	Not Permanent	880 Bit (R0 to R54) 55 Word (WR0 to WR54)
	Permanent	128 Bit (R550 to R62F) 8 Word (WR55 to WR62)

Data Registers (DT)

They are memory areas in the PLC where information is kept, transferred, copied, mathematical operations and conversions are made, and transferred to ports when necessary. They consist of 16-bit fields. The non-permanent ones are deleted when the power is cut off, the permanent ones are not deleted.

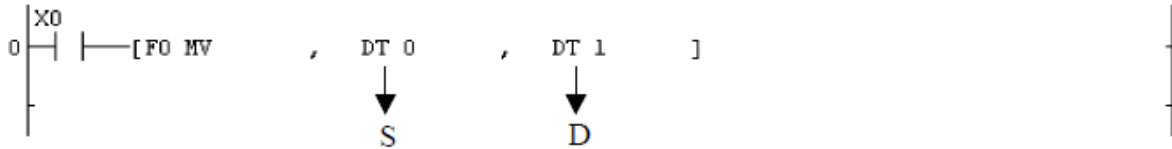
PARTS		C32T / C32P
Data Registers	Not Permanent	6112 Word (DT0 to DT6111)
	Permanent	32 Word (DT6112 to DT4143)

The commands we use in the Elevator Program

F0(MV) : 16 bit data transport

This command copies 16-bit data to another 16-bit data area.

Sample Programming



S (Source): Fixed number or data field to be copied with a length of 16 bits

D (Destination): 16-bit data field to which the copied fixed number or data field will be moved

In the sample above, the information in the DT0 field is copied to DT1 when the information in external input X0 is 1.

16-bit data Compare

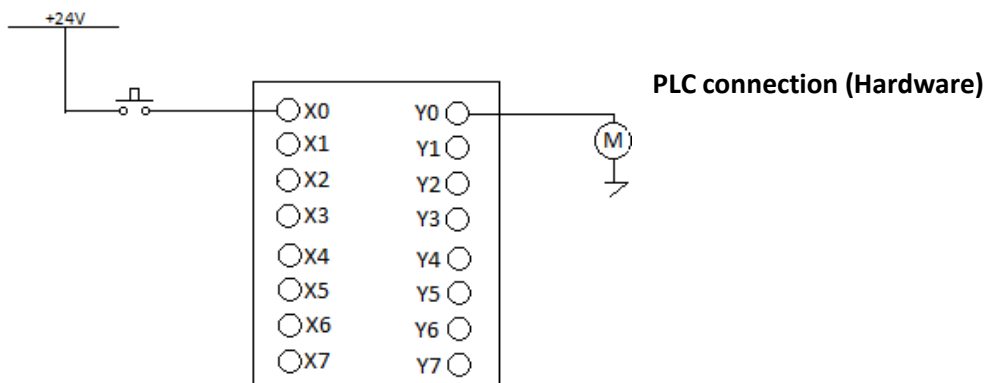
It compares data or constant numbers in two separate address spaces.

Sample Programming

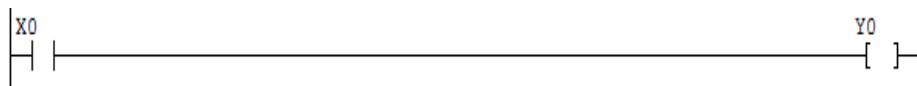


In the sample above, if the number in the DT0 field is equal to the decimal 50 number, the Y0 output will be active.

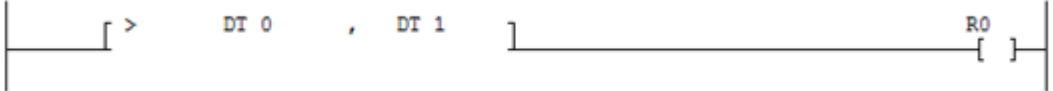
Example Program 1: When the start button connected to the X0 input of the PLC is pressed, the M contactor at the Y0 output will operate.



PLC Program (Software)



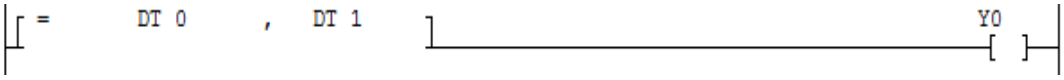
Example Program 2: If the number in the DT0 data field is greater than the number in the DT1 field, the program that makes the R0 internal relay 1.



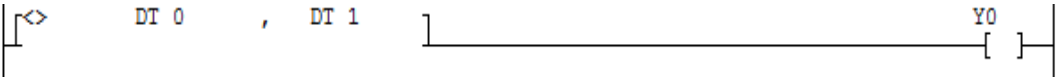
Example Program 3: The program that outputs Y0 to 1 if the number in the DT0 data field is less than the number in the DT1 field.



Example Program 4: Program that outputs Y0 to 1 if the number in the DT0 data field is equal to the number in the DT1 field.



Example Program 5: Program that outputs Y0 to 1 if the number in the DT0 data field is not equal to the number in the DT1 field.



Elevator Training Kit



It is a 4-floor laboratory model designed for electromechanical carrier class elevators. The elevator Training Kit can work at any PLC with at least 8 input/6 outputs. At the control panel of the set, there are all input and output sockets for the control of the elevator. Inductive sensors are used for the determination of the floor levels. There are control panels in the elevator and on all floors.

Cabin Buttons and Floor buttons are connected same input of PLC

Ground Floor level sensor : X0

First Floor level sensor : X1

Second Floor level sensor : X2

Third Floor level sensor : X3

Ground Floor Button : X4

First Floor Button : X5

Second Floor Button : X6

Third Floor Button : X7

