DVP-*PLC* Application Examples of Programming

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Foreword

Industrial Automation Business Unit (IABU) of Delta Electronics focuses our expertise on "Drive, Motion and Control" with our knowledge and experience in automation control. Our R&D teams continue researching and developing key technologies, producing innovative products in industrial automation; for example many OEM's use our automation products for processing machines used in the food industry, textile industry, chemical industry, electronics industry, metal industry and plastic industry. Our automation equipment is also used in the pharmaceutical industry, printing industry, as well as for energy saving air-conditioning and water treatment facilities. In recent years, we have integrated our industrial automation products, developed industrial control networks, and offered integration services to our clients around the world.

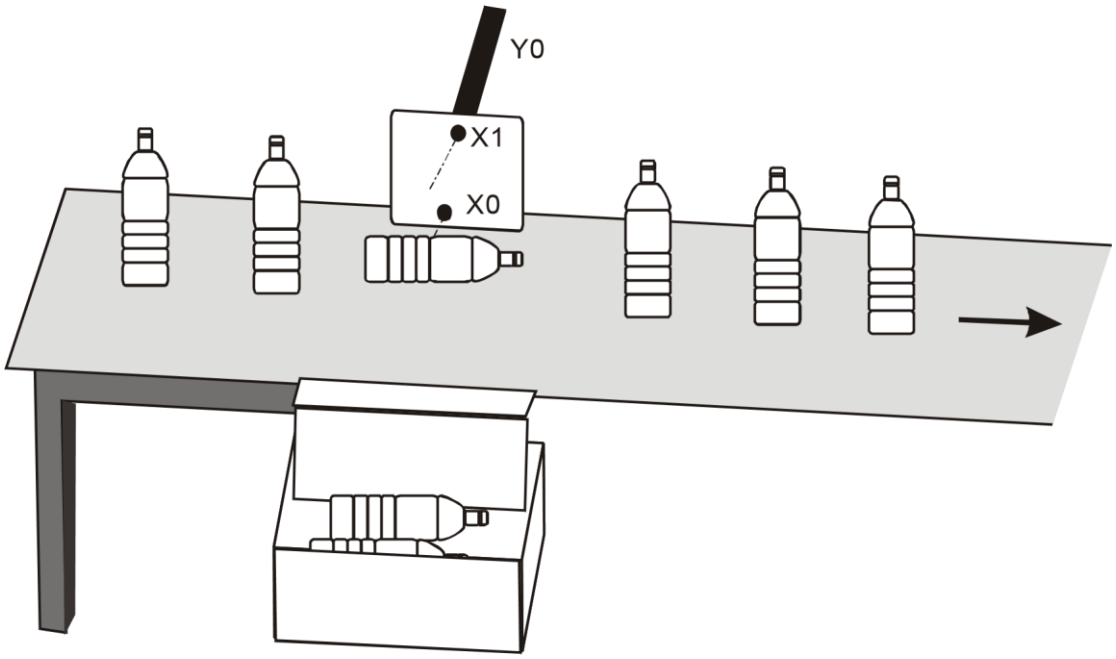
Delta's DVP series high-speed, stable and highly reliable PLCs are applied in various automation machines. In addition to its fast logic operations, abundant instructions, various extension cards and cost-effectiveness, DVP series PLCs support many communication protocols, seamlessly integrating the industrial automation control system as a whole.

To meet users' needs for DVP-PLC programming examples, we provide examples of basic instructions including sequential/position control, timed counting and input/output control in ***DVP-PLC Application Examples***. In addition, in this manual we also provides examples of advanced instructions including elementary arithmetic operations, data processing, high speed input/output control, network connection, and PLC communication(AC motor drive / temperature controller / servo motor). ***DVP-PLC Application Examples*** includes most common applications in automation control, such as parking lot entry/exit control, material mixing, stock monitoring, level monitoring, traffic lights control, and conveyer belt control. This manual explains methods for applying basic instructions as well as advanced instructions of DVP-PLC to accomplish the field application purposes. Users can easily understand how DVP-PLC features in automation applications through this manual. By referring to our ***DVP-PLC Application Manual-【Programming】***, users can also apply DVP-PLC efficiently on particular purposes and fulfill various control requirements in industrial automation.

DVP-PLC Application Examples

C O N T E N T S

1.1 Normally Closed Contact in Series Connection



Control Purpose:

⌘ Detecting the standing bottles on the conveyor and pushing the fallen bottles out **Devices:**

Device	Function
X0	X0 = ON when the detected input signal from the bottle-bottom is sheltered.
X1	X1 = ON when the detected input signal from the bottle-neck is sheltered.
Y0	Pneumatic pushing pole

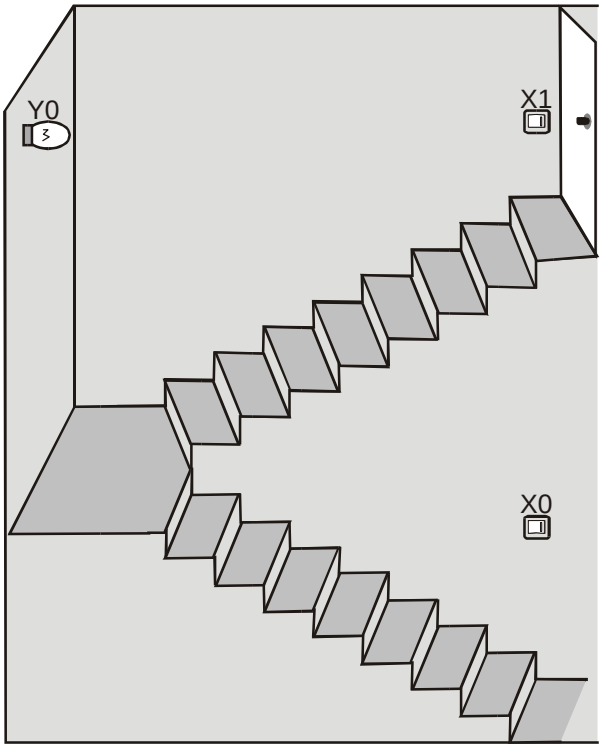
Control Program:

Program Description:

⌘ If the bottle on the conveyor belt is upstanding, the input signal from monitoring photocell at both bottle-bottom and bottle-neck will be detected. In this case, X0 = ON, and X1 = ON. The normally open (NO) contact X0 will be activated as well as the normally closed (NC) contact X1. Y0 remains OFF and pneumatic pushing pole will not perform any action.

⌘ If the bottle from the conveyor belt is down, only the input signal from monitoring photocell at the bottle-bottom will be detected. In this case, X0 = ON, X1 = OFF. The state of output YO will be ON because the NO contact X0 activates and the NC contact X1 remains OFF. The pneumatic pushing pole will push the fallen bottle out of the conveyor belt.

1.2 Block in Parallel Connection



Control Purpose:

⌘ Setting up a lighting system for users to switch on/off the light whether they are at the bottom or the top of the stairs. **Devices:**

Device	Function
X0	X0 turns ON when the bottom switch is turned to the right
X1	X1 turns ON when the top switch is turned to the right.
Y1	Stair light

Control Program:

Program Description:

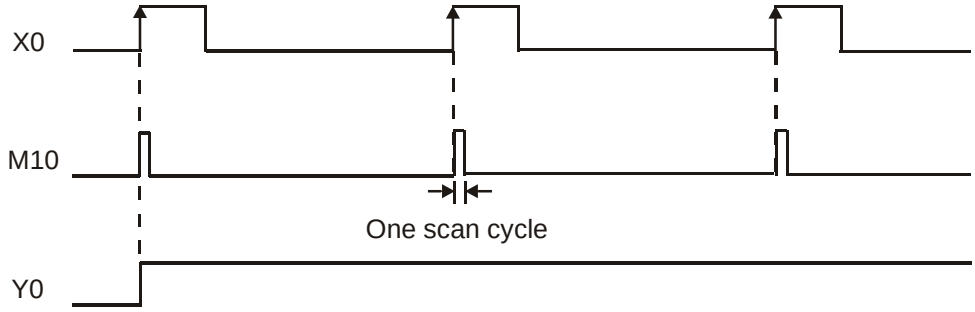
⌘ If the states of the bottom switch and the top switch are the same, both ON or OFF, the light will be ON. If different, one is ON and the other is OFF, the light will be OFF.

⌘ When the light is OFF, users can turn on the light by changing the state of either top switch at the bottom switch of the stairs. Likewise, when the light is ON, users can turn off the light by changing the state of one of the two switches..

1.3 Rising-edge Pulse Output for One Scan Cycle

Control Purpose:

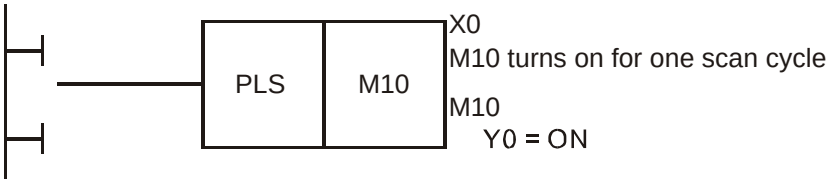
⌘ Creating a pulse of one program scan cycle as the condition to trigger the indicator or other devices when the switch (X0) is turned on.



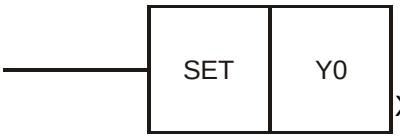
Devices:

Device	Function
X0	Switch (OFF→ON)
M10	Creating a trigger pulse for one program scan cycle
Y0	Indicator

Control Program:



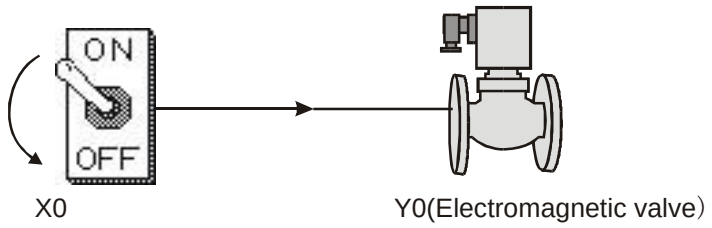
Program Description:

⌘ When 

X0 is turned on (Rising-edge triggered), PLS instruction will be executed, and M10 will send a pulse for one program scan cycle.

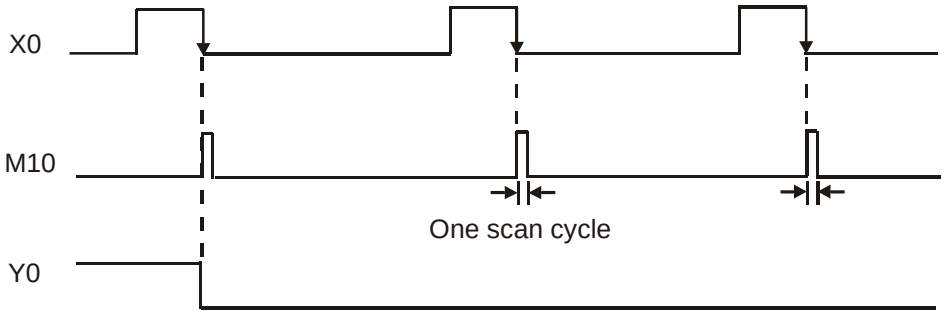
⌘ When M10 = ON, [SET Y0] instruction will be executed and Y0 will be ON. In this case, the indicator will be lighted, and other devices will be activated as well.

1.4 Falling-edge Pulse Output for One Scan Cycle



Control Purpose:

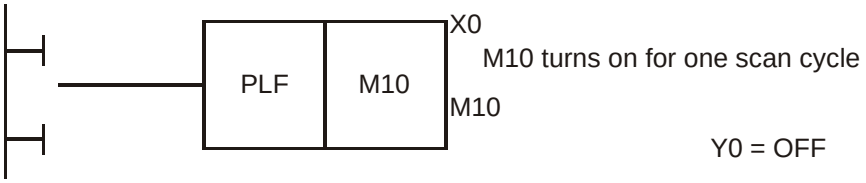
⌘ Creating a pulse of one program scan cycle as the condition to trigger the electromagnetic valve or other devices when the switch is turned off.

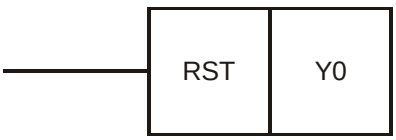


Devices:

Device	Function
X0	Switch(ON→OFF)
M10	Creating a trigger pulse for one program scan cycle
Y0	Electromagnetic valve

Control Program:



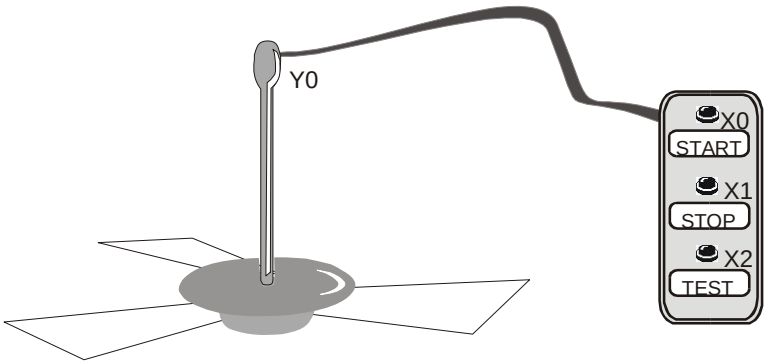


Program Description:

⌘ When X0 is turned on (Falling-edge triggered), PLF instruction will be executed, and M10 will send a pulse for one program scan cycle. ⌘

When M10 = ON, [RST Y0] instruction will be executed and Y0 will be OFF. In this case, the electromagnetic valve will be shut down.

1.5 Latching Control Circuit



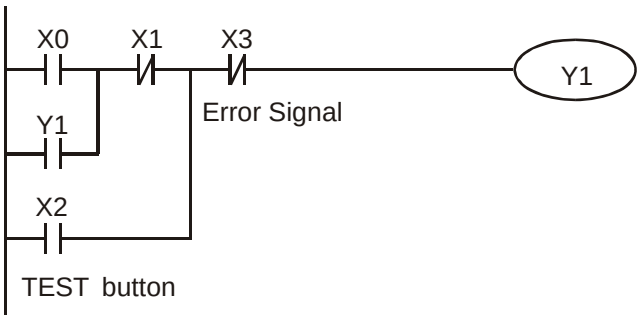
Control Purpose:

⌘ Controlling the running state of the ceiling-fan by pressing START and STOP.

⌘ Checking if the ceiling-fan is running normally by pressing TEST. **Devices:**

Device	Function
X0	Press START, X0 = ON.
X1	Press STO, X1 = ON.
X2	Press TEST, X2 = ON.
X3	Error signal
Y1	Ceiling-fan motor control signal

Control Program:

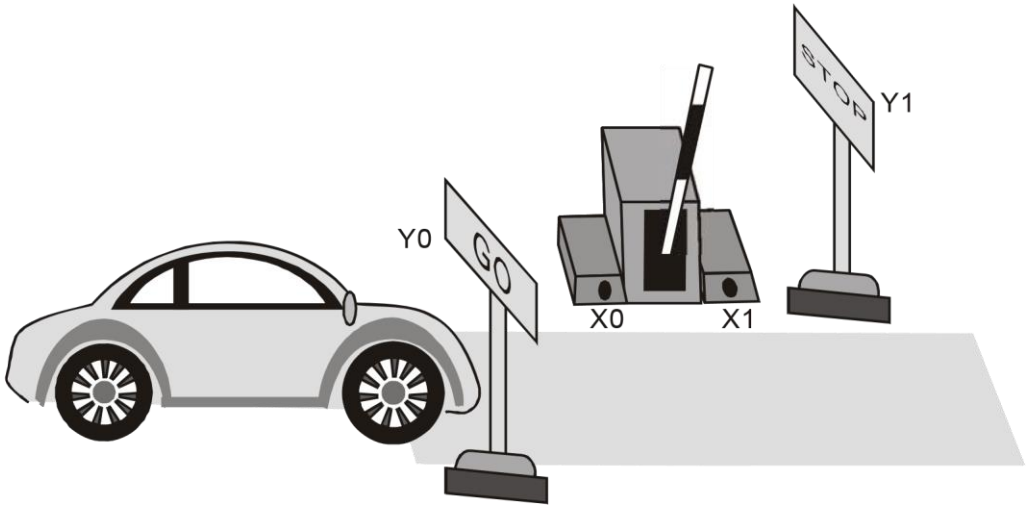


Program Description:

⌘ Press START lightly and X0 = ON. The ceiling-fan will keep running if no error occurred (X3 = OFF). The action can be practiced by a latching circuit which takes output Y1 as one of the input condition to keep the fan running even if the START button is not pressed. ⌘ When STOP is pressed, X1 = ON and Y1 = OFF. The ceiling-fan will stop running. ⌘ If error occur (X3 = ON), Y1 will be OFF and the ceiling-fan will stop running.

⌘ When TEST is pressed (X2 = ON), Y1 = ON. The ceiling-fan will start running if no error occurred (X3 = OFF). On the contrary, when TEST is released, the ceiling-fan will stop running. The testing function is performed by this process.

1.6 Interlock Control Circuit

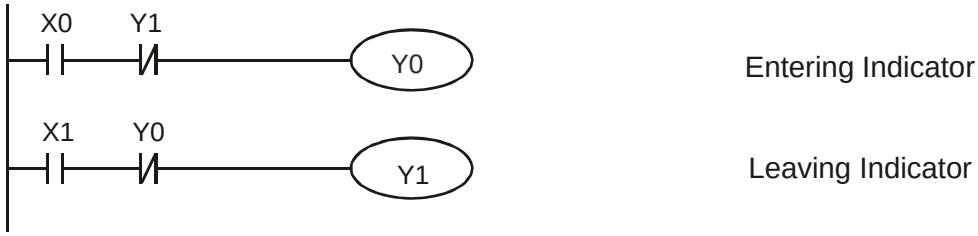


Control Purpose:

⌘ The Entry/Exit of the parking lot is a single lane passage. By controlling the indicators, the program ensures that only one car can pass through the Entry/Exit so as to prevent car accident between entering and leaving cars **Devices:**

Device	Function
X0	Car entering sensor. When a car passes through the sensor, X0 = ON.
X1	Car leaving sensor. When a car passes through the sensor, X1 = ON.
Y0	Entering car indicator（ON means “GO”, OFF means “STOP”）
Y1	Leaving car indicator（ON means “GO”, OFF means “STOP”）

Control Program



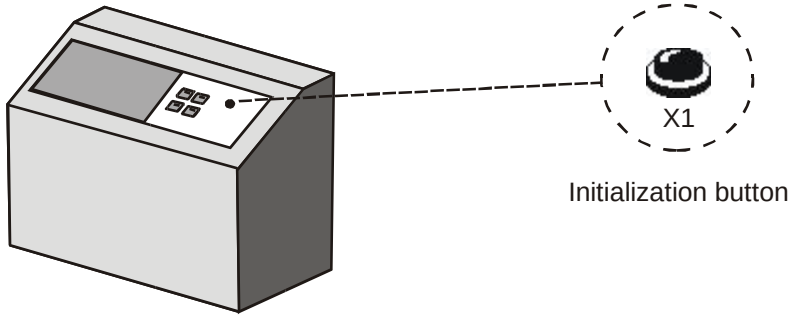
Program Description:

⌘ In the parking lot, there are two indicators individually directing the entering and leaving cars. By the interlock control circuit, only one indicator will show “GO” signal and the car accident will thus be prevented.

⌘ When an entering car draws near the vehicle control barrier, X0 will be ON and so will Y0. The entering car indicator will show “GO”. At the same time, the leaving car indicator will show “STOP.” Car entering is allowed but leaving is prohibited in this case.

⌘ When a leaving car draws near the vehicle control barrier, X1 will be ON and so will Y1. The leaving car indicator will show “GO” and the entering car indicator will show “STOP.”

1.7 Automatic Parameter Initialization When Powered Up



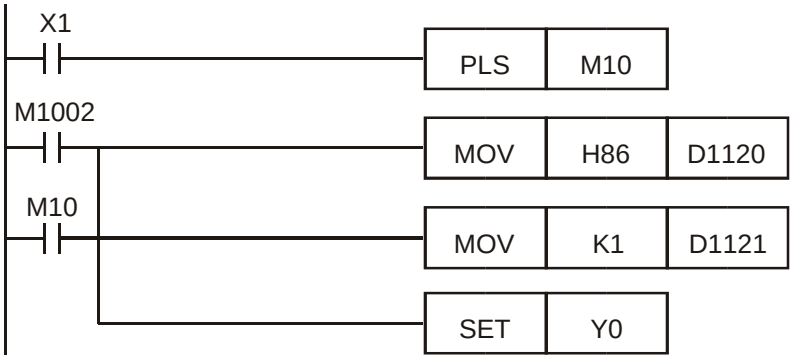
Control Purpose:

⌘ When the machine is powered up, all the parameters will be initialized automatically and the machine will be ready. Users don’t need to set the parameters manually.

⌘ Users can initialize parameters by pressing Initialization button at any time when the machine is running. **Devices:**

Device	Function
X1	Initialization button. X1 will be ON when pressed
M1002	Creating a pulse when PLC is powered on
M10	Creating a trigger pulse for one scan cycle
D1120	PLC COM2 communication protocol
D1121	PLC communication address
Y0	Parameter initialization completed signal

Control Program:



Program Description:

⌘ When PLC begins running, M1002 will be ON once and create a pulse with the width of one scan cycle. This action will be executed for just once during the PLC running process and is generally used to initialize devices such as D (data register), C (counter) and S (step point)

⌘ By pressing X1, users can initialize parameters at any time during the program running process, that is, setting PLC Slave ID as No. 1, COM2 communication format as 9600, 7, E, 1 and Y0 to be ON.

1.8 Common Latched Circuit and SET/RST Instructions Application

Control Purpose:

⌘ Turn on the switch, the light will be ON; turn off the switch, the light will be OFF.

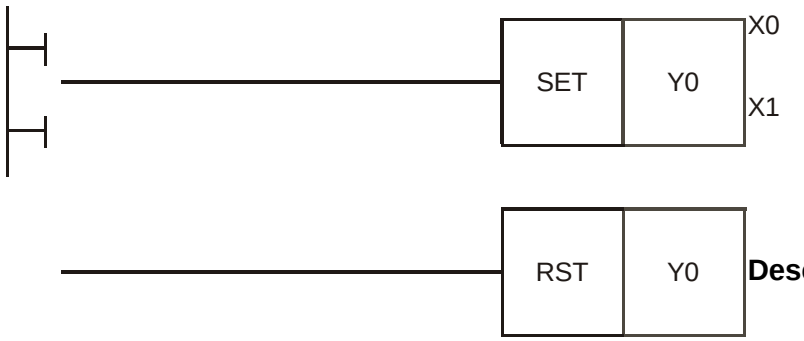
Devices:

Device	Function
X0	Switch-on button. X0 will be ON when pressed
X1	Switch-off button. X1 will be ON when pressed
Y0	Indicator

Control Program:

⌘ Common Latched Circuit

⌘ Latched Circuit for SET/RST Instructions

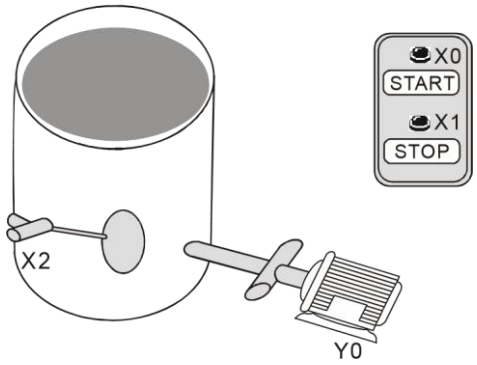


Program Description:

⌘ In the above examples, when X0 goes from OFF to ON, Y0 will stay in ON state. When X1 goes from OFF to ON, Y1 will stay in OFF state

⌘ When X0 and X1 are enabled at the same time, it will be “Stop First”, that is, Y1 and the indicator will be OFF.

1.9 SET/RST - Latched and Unlatched Circuit

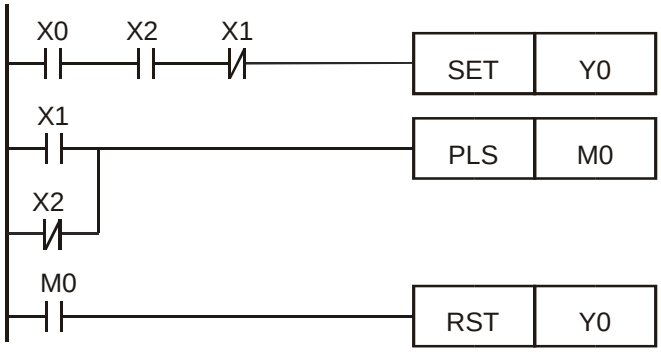


Control Purpose:

⌘ Press START, the pump begins to pump out the water; press STOP or when the water is empty, the pump stops working. **Devices:**

Device	Function
X0	START button. X0 will be ON when pressed
X1	STOP button. X1 will be ON when pressed
X2	Level detector. X2 will be ON if there is water in the container
M0	Trigger pulse for one scan cycle
Y0	Pump motor

Control Program:



Program Description:

⌘ X2 will be ON If there is water in the container. When START is pressed, X0 = ON, and SET instruction will be executed. Y0 will be set, and the pump motor begins pumping the water. ⌘ There are two situations for stopping the motor. First, when STOP is pressed, X1 = ON. PLS

instruction will be executed and M0 will be ON for one scan cycle. RST instruction will thus be executed, and Y0 will be reset to stop pumping. Second, when the water in the container is empty, X2 will be OFF and PLS instruction will be executed to trigger M0 for resetting Y0. In this case, the pump motor will stop pumping as well.

1.10 Alternate Output Circuit (With Latched Function)

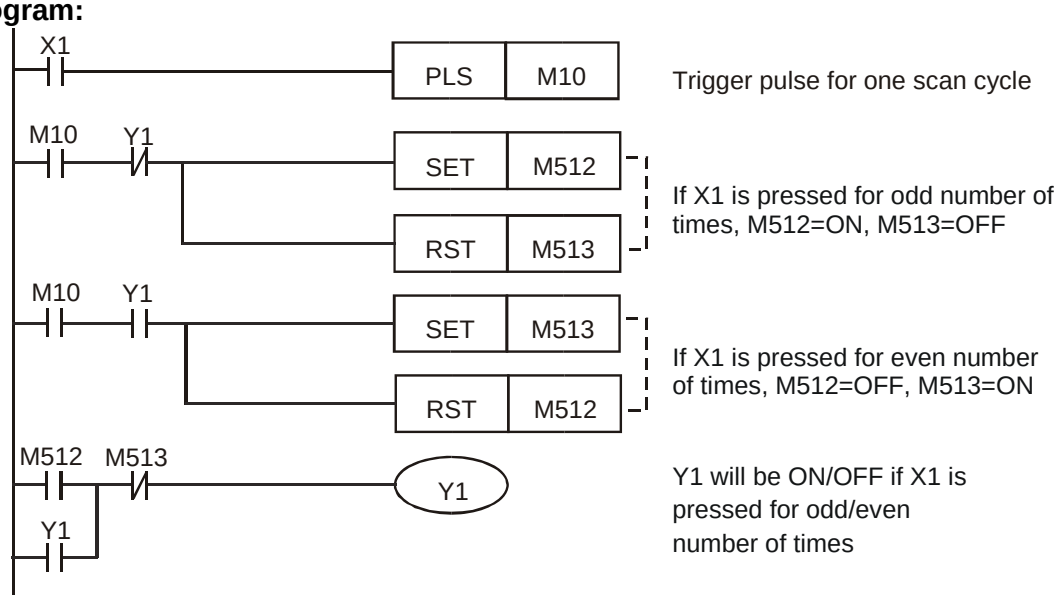
Control Purpose:

- ⌘ Setting the light ON by pressing the switch for the 1st time, the 3rd time, 5th time, etc.; setting the light OFF by pressing the switch for the 2nd time, 4th time, 6th time, etc.
- ⌘ Restoring the indicator to the state before power off when the device is powered up again.

Devices:

Device	Function
X1	Light switch. X1 will be ON when the button is pressed
M10	Trigger pulse for one scan cycle
M512	If X1 is pressed for odd number of times, M512 ON, M513 = OFF.
M513	If X1 is pressed for even number of times, M512 = OFF, M513 = ON.
Y1	Indicator

Control Program:



Program Description:

- ⌘ Pressing X1 for the 1st time (or odd number of times):

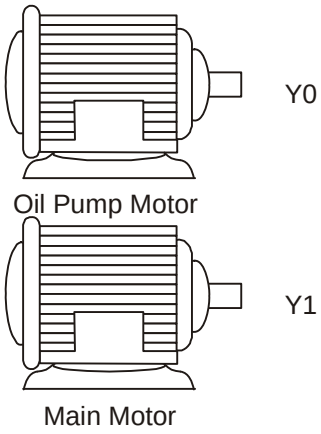
When the switch X1 is pressed, X1 will be ON and the [PLS M10] instruction will be executed for triggering M10 to be ON for one scan cycle. In this case, M10 is ON and Y1 is OFF, SET and RST instructions at line 2 will thus be executed. On the contrary, SET and RST instructions at line 3 will not be executed due to the open loop of Y1. At line 4, coil Y1 is ON because of the results of Line 2: M512 is ON and M513 is OFF. When the 2nd scan cycle is started, SET/RST at both line 2 and line 3 will not be executed because M10 is OFF in this scan cycle. As a result, the light will be ON until the switch is pressed next time.

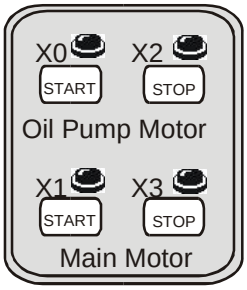
⌘ Pressing X1 for the 2nd time (or even number of times):

When the switch X1 is pressed again, X1 will be ON and M10 will be ON for one scan cycle. According to the result of pressing X1 for the first time, the state of Y1 has been ON. SET/RST instructions at line 3 will thus be executed. In addition, SET/RST instructions at line 2 won't be executed due to the open loop of Y1. In this case, M513 will be ON and M512 will be OFF. When the 2nd scan cycle is started, SET/RST at both line 2 and line 3 will not be executed because M10 is OFF in this scan cycle. As a result, the light will remain OFF until the switch is pressed next time.

⌘ Alternate output(ON/OFF) function can also be performed by using API 66 ALT instruction

1.11 Conditional Control Circuit





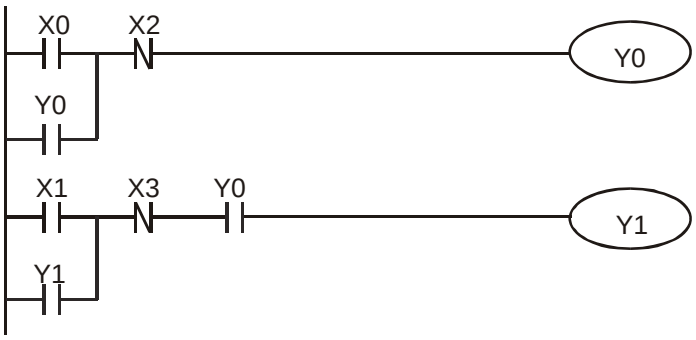
Control Purpose:

⌘ Providing lube for the gear box before the lathe spindle starts to run which aims to ensure that the oil pump motor starts first and the main motor starts subsequently.

Devices:

Device	Content
X0	Oil pump START button. X0 will be ON when pressed.
X1	Main motor START button. X0 will be ON when pressed.
X2	Oil pump STOP button. X2 will be ON when pressed.
X3	Main motor STOP button. X3 will be ON when pressed.
Y0	Oil pump motor
Y1	Main motor

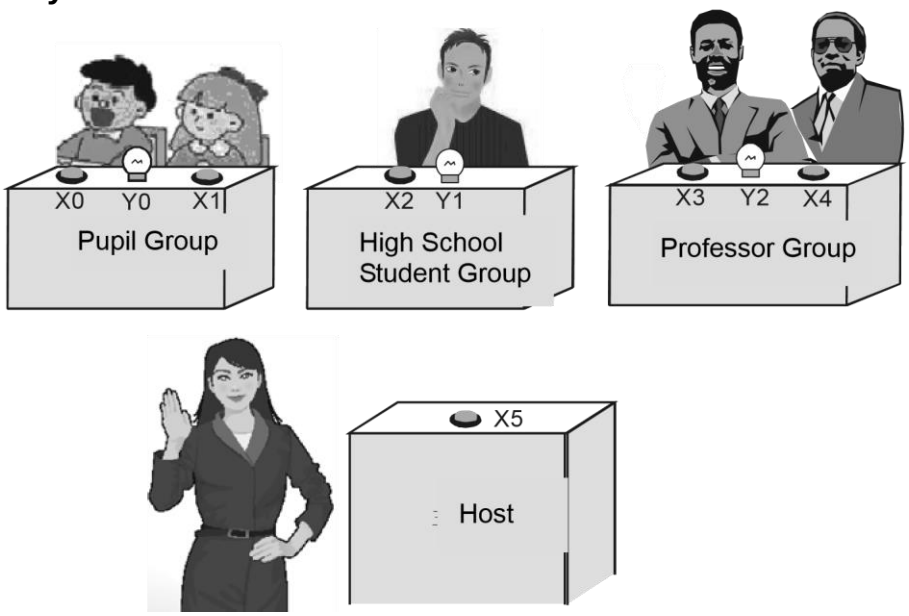
Control Program:



Program Description:

- ⌘ This program is a typical application of the conditional control circuit. Y0 = ON when Oil Pump START button is pressed. Therefore, the oil pump will start to provide lube for the gear box of main motor(Y1)
- ⌘ Under the precondition of the operating state of the Oil pump, the main motor (Y1) will be ON when the Main motor START button is pressed.
- ⌘ During the operation of main motor (Y1), oil pump (Y0) needs to provide lube continuously.
- ⌘ The oil pump will be stopped when Oil pump STOP button X2 is activated, and the main motor will be stopped when Main motor STOP button X3 is activated.

1.12 First-in Priority Circuit



Control Purpose:

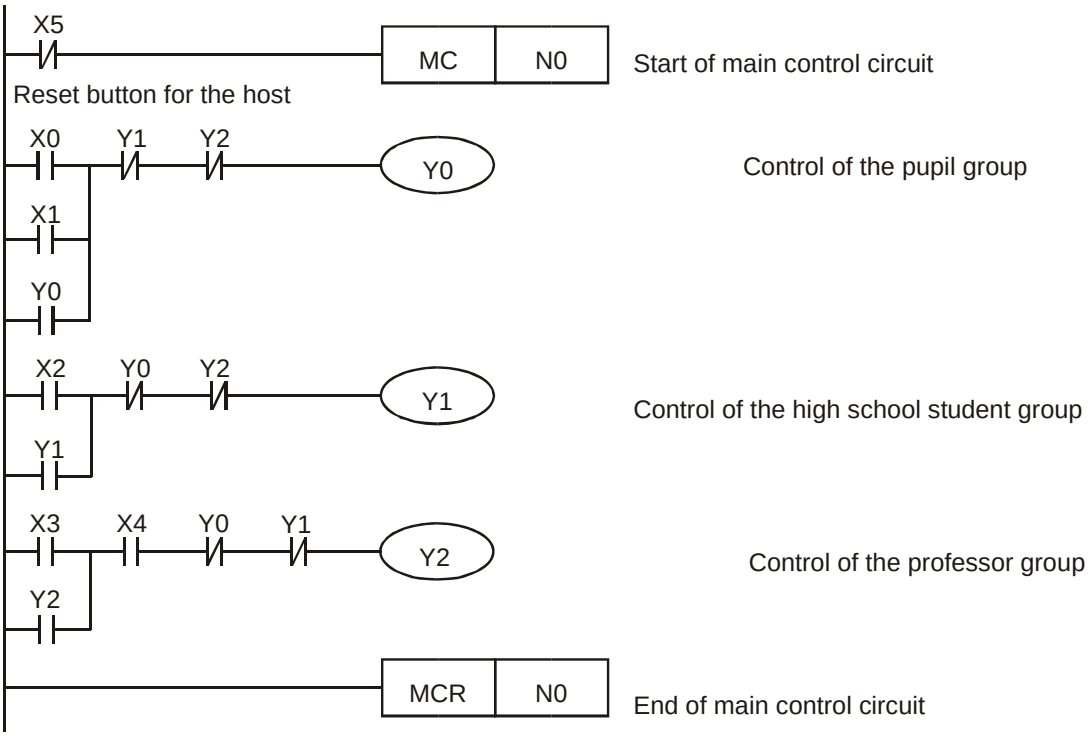
- ⌘ There are 3 groups participating in the quiz game: pupils, high school students and professors. If they want to get the chance of answering the question from the host, they must press the answer button on their table first**.** Other groups' pressing will be invalid if any group gets the chance successfully
- ⌘ There are 2 answer buttons for the pupil group and professor group and 1 answer button for the high school student group. In order to give preferential treatment to the pupil group, Y0 will be ON if any one of X0 or X1 is pressed. However, in order to limit the professor group,

Y2 will be ON when X3 and X4 are pressed at the same time. For the high school student group, Y1 will be ON when X2 is pressed.

⌘ If the host presses X5 (Reset button), Y0, Y1 and Y2 will be OFF. **Devices:**

Device	Function
X0	Answer button for pupil group
X1	Answer button for pupil group
X2	Answer button for high school student group
X3	Answer button for professor group
X4	Answer button for professor group
X5	Reset button for host
Y0	Indicator for pupil group
Y1	Indicator for high school student group
Y2	Indicator for professor group

Control Program:



Program Description:

- ⌘ If the host didn't press the reset button X5, [MC N0] instruction will be executed and the program between MC and MCR will also be executed normally.
- ⌘ The answer buttons are connected in parallel connection for the pupil group, and in series connection for the professor group. For the high school student group, there is only one answer button. If one group presses the answer button successfully, its indicator will form a latching circuit, that is, the indicator will be ON even the button is released.
- ⌘ Through the interlock circuit, any other button pressings will be invalid as long as one indicator is ON
- ⌘ When the host presses the reset button, X5 = ON. [MC N0] instruction and the program between MC and MCR will not be executed. Y0, Y1 and Y2 will be out of power, and all the indicators for the 3 groups will be OFF. When the host releases the button, X5 = OFF. The program between MC and MCR will be executed normally again, and the new round will begin as well.

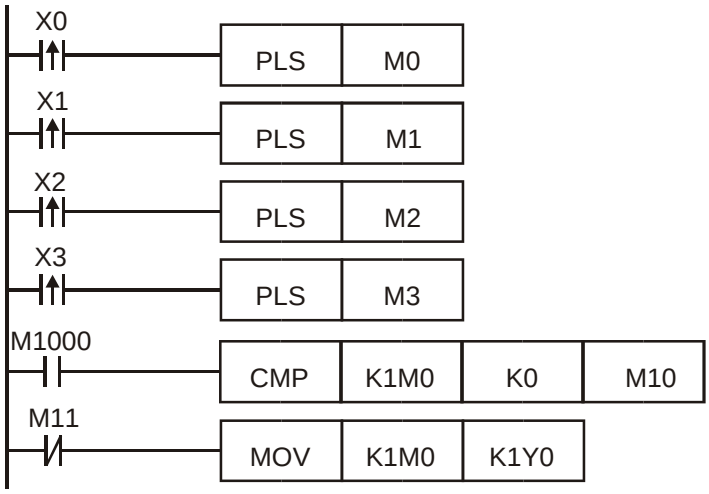
1.13 Last-in Priority Circuit

Control Purpose:

⌘ There are 4 buttons corresponding to 4 indicators. The program is to turn on the indicators corresponding to pressed buttons and to turn off the previous ON indicators. **Devices:**

Device	Function
X0	Button 1. X0 will go from OFF to ON when pressed
X1	Button 2. X1 will go from OFF to ON when pressed
X2	Button 3. X2 will go from OFF to ON when pressed
X3	Button 4. X3 will go from OFF to ON when pressed
Y0	Indicator 1
Y1	Indicator 2
Y2	Indicator 3
Y3	Indicator 4

Control Program:

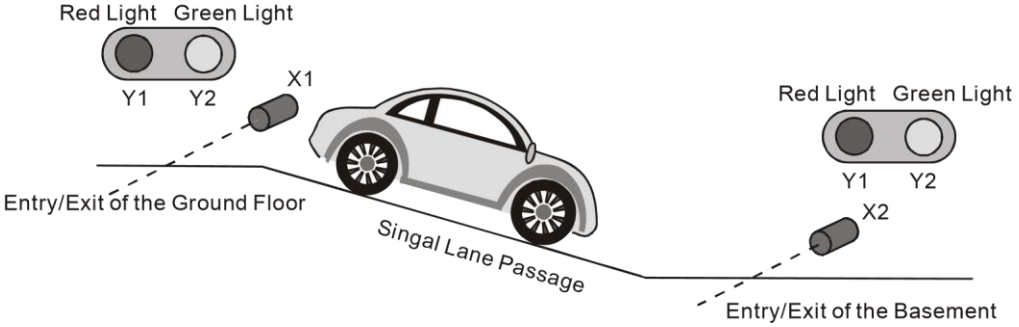


Program Description:

⌘ When a button is pressed, the corresponding device X will go from OFF to ON. In this scan cycle, PLS instruction is executed, and the corresponding internal relay M is enabled as well. CMP instruction will be executed and the compared result is K1M0>0 which makes M10 ON but M11 OFF. [MOV K1M0 K1Y0] instruction will then be executed and sent out the state of M to its corresponding output Y. At the same time, the previous ON indicator(Y) will be turned off.

⌘ When it comes to the 2nd scan cycle, PLS instructions will not be executed and the value of M0~M3 will be 0. Therefore, the CMP instruction will be executed and set M11 to be ON (K1M0 = 0). [MOV K1M0 K1Y0] instruction will not be executed, and the 0 state of device M will not be sent out, either. In this case, Output Y will remain its original state until any other button is pressed next time.

1.14 Entry/Exit Control of the Underground Car Park



Control Purpose:

⌘ The entry/exit of the underground car park is a single lane passage which needs the traffic lights to control the cars. Red lights prohibit cars entering or leaving while green lights allow cars to enter or leave.

⌘ When a car enters the passage from the entry of the ground floor, the red lights both on the ground floor and the basement will be ON, and the green lights will be OFF. Any car entering or leaving is prohibited during the process till the car passes through the passage

completely. When the passage is clear, the green lights will be ON again and allow other cars entering from the ground floor or the basement.

⌘ Similarly, when a car leaves the basement and enters the passage, any other car entering or leaving is prohibited till the car passes from the passage to the ground completely.

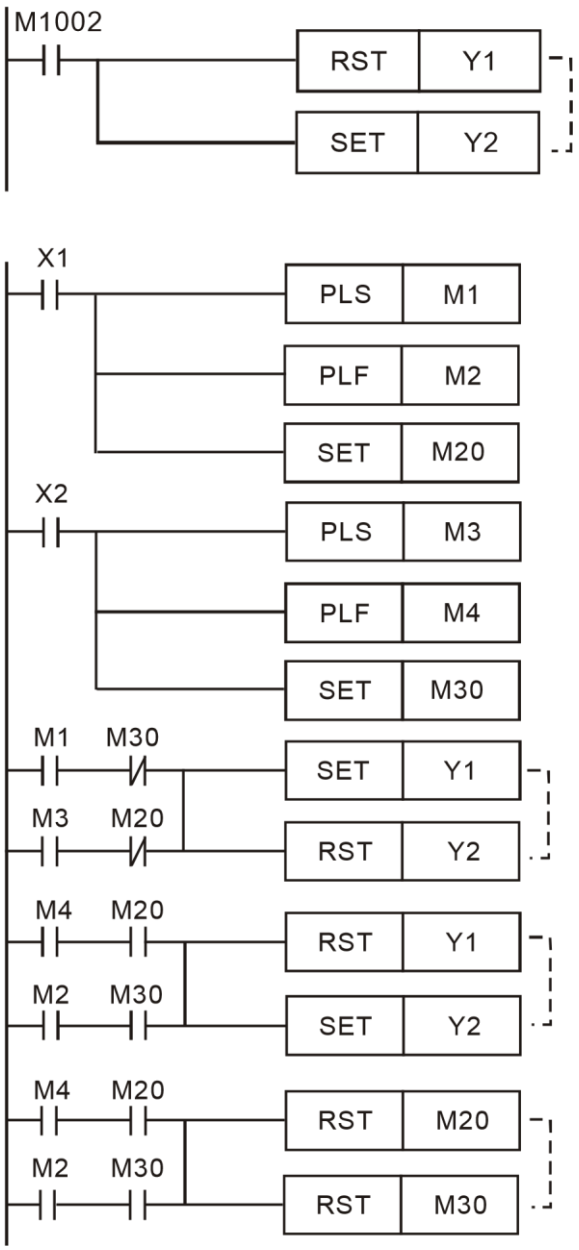
⌘ When PLC runs, the initial setting of traffic lights will be green lights ON and red lights OFF.

Devices:

Device	Function
X1	Photoelectric switch at the ground floor entry/exit. X1 will be ON when a car passes.
X2	Photoelectric switch at the basement entry/exit. X2 will be ON when a car passes.
M1	M1 will be ON for one scan cycle when a car from the ground floor passes X1.
M2	M2 will be ON for one scan cycle when a car from the basement passes X1.
M3	M3 will be ON for one scan cycle when a car from the basement passes X2.
M4	M4 will be ON for one scan cycle when a car from the ground floor passes X2
M20	M20 = ON during the process of a car entering the passage from the ground floor.
M30	M30 = ON during the process of a car entering the passage from the basement.
Y1	Red lights at the entry/exit of the ground floor and the basement
Y2	Green lights at the entry/exit of the ground floor and the basement

Control Program:

The green lights will be ON and the red lights will be OFF when the program is started



M1 will be ON for one scan cycle when a car from the ground floor passes X1.

M2 will be ON for one scan cycle when a car from the basement passes X1.

M20=ON during the process of a car entering the passage from the ground floor.

M3 will be ON for one scan cycle when a car from the basement passes X2.

M4 will be ON for one scan cycle when a car from the ground floor passes X2.

M30=ON during the process of a car entering the passage from the basement.

When a car runs in the passage, the red lights will be ON and green lights will be OFF.

When a car leaves the passage, the red lights will be OFF and green lights will be ON.

When a car leaves the passage, M20 and M30 will be reseted.

Program

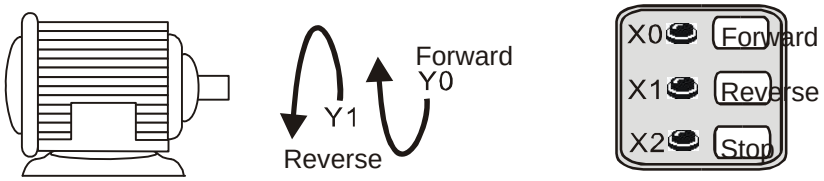
Description:

⌘ The ground floor and the basement share the same red light signal Y1 and green light signal Y2.

⌘ The key of the program is to identify that the car is entering or leaving the passage at the ground floor entry/exit when M1 is ON to activate Y1 because [PLS M1] will be executed in both entering and leaving conditions. Therefore, the confirming signal M20 is required for confirming that the car is entering the passage from the ground floor.

⌘ Also, it needs to identify that the car is entering or leaving the passage at the basement entry/exit when M3 is ON because [PLS M3] will be executed in both entering and leaving conditions. Therefore, the confirming signal M30 is required for confirming that the car is entering the passage from the basement.

1.15 Forward/Reverse Control for the Three-Phase Asynchronous Motor

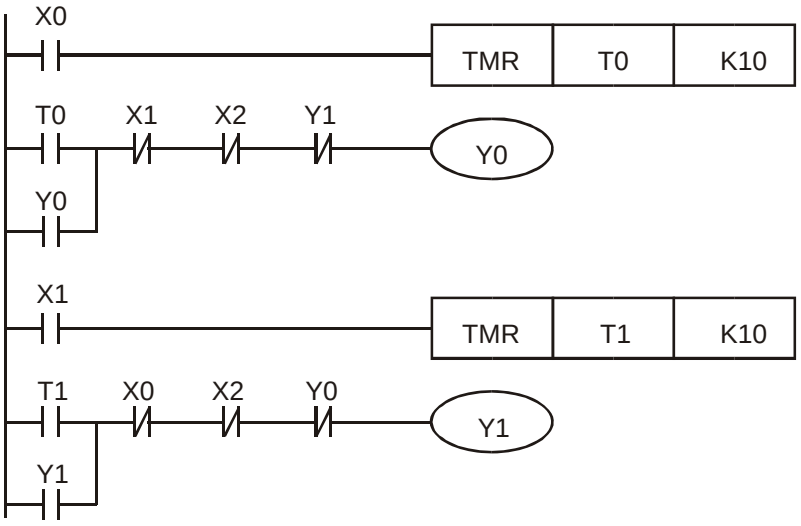


Control Purpose:

⌘ Controlling the motor to run forward when Forward is pressed, run reverse when Reverse is pressed and stop when Stop is pressed. **Devices:**

Device	Function
X0	Forward button of the motor. X0 will be ON when pressed
X1	Reverse button of the motor. X1 will be ON when pressed
X2	Stop button. X2 will be ON when pressed.
T1	1 sec timer
T2	1 sec timer
Y0	Forward contactor
Y1	Reverse contactor

Control Program:

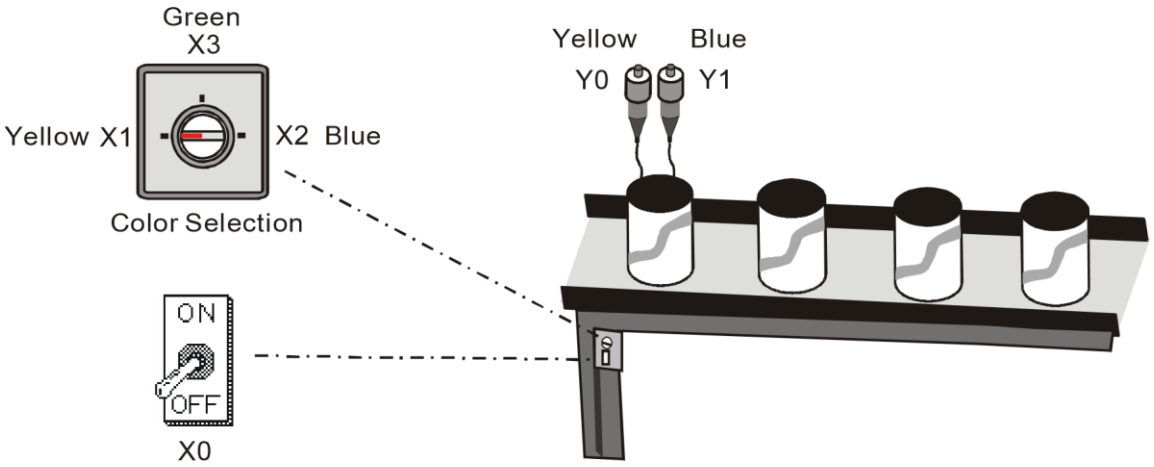


Program Description:

⌘ X0 = ON when Forward is pressed. After 1 second, contactor Y0 will be enabled, and the motor begins to run forward. On the other hand, X1 = ON when Reverse is pressed. After 1 second, contactor Y1 will be enabled, and the motor begins to run reverse. Besides, Y0 and Y1 will be disabled and the motor will stop running when X2 is pressed.

⌘ The two timers in the program are used to avoid the interphase short-circuit when the motor changes its running mode. The short circuit may occur if another contactor is enabled instantly while the electric arc in the disabled contactor still exists.

1.16 Selective Execution of Programs



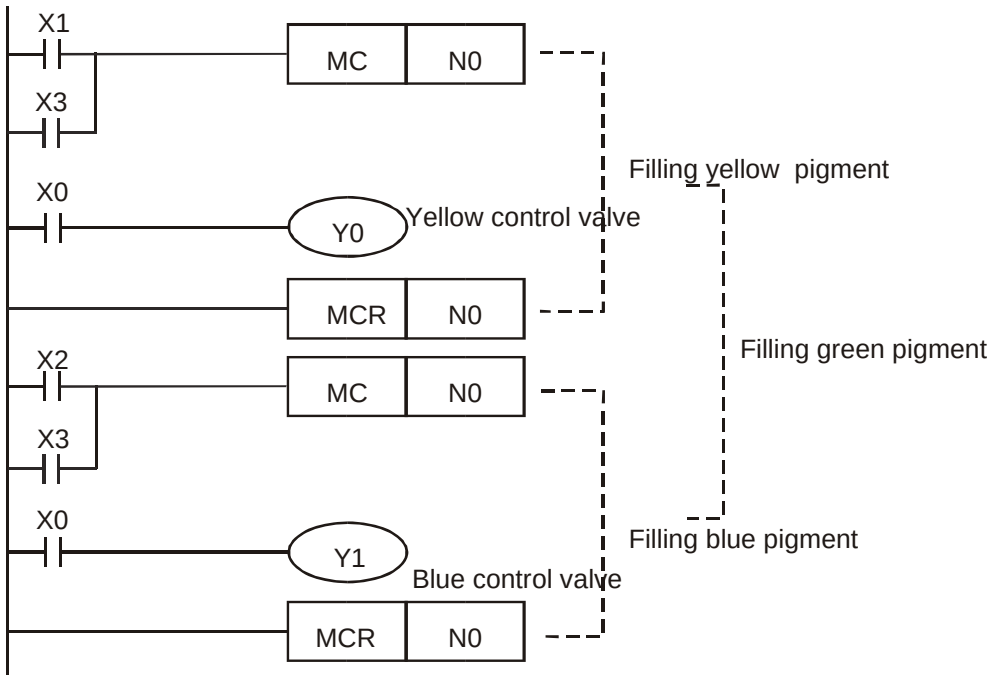
Control Purpose:

⌘ There are pigments of 3 colors. By controlling different switches, operators can fill the cans with corresponding pigments.

Devices:

Device	Function
X0	Filling Start switch. X0 will be ON when turned on.
X1	Yellow control switch. X1 will be ON when turned on.
X2	Blue control switch. Turn it on, X2 will be On
X3	Green (mixing of yellow and blue) control switch. X3 will be ON when turned on
Y0	Yellow control valve
Y1	Blue control valve

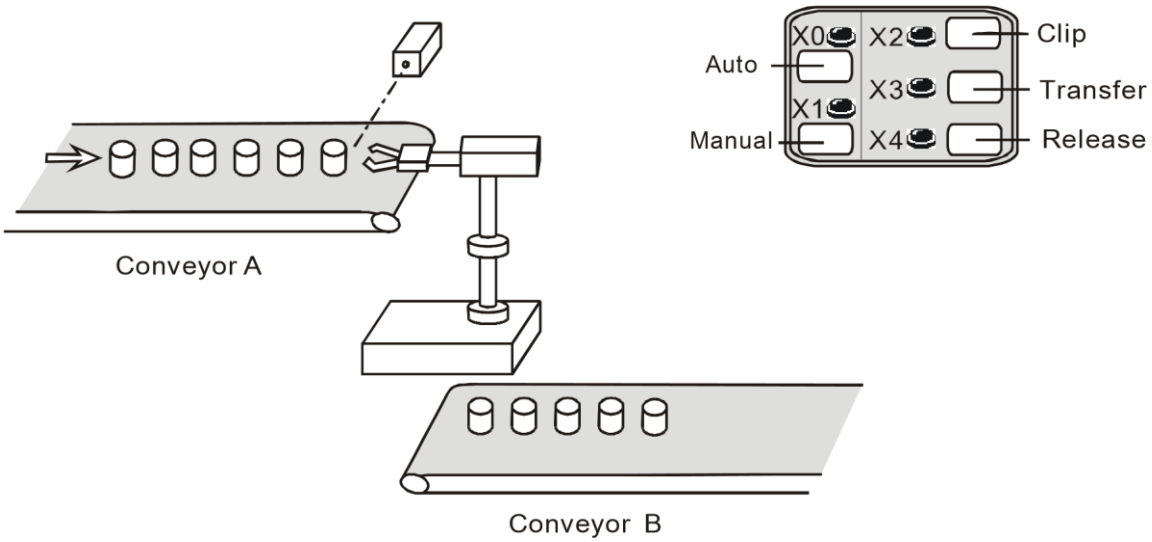
Control Program



Program Description:

- ⌘ The master switch of filling control needs to be turned on (X0 = ON) before filling started. When both yellow and blue are filled at the same time, it will become green.
- ⌘ When the switch of filling yellow pigment is turned on, X1 = ON. The first MC ~ MCR instruction will be executed. Y0 = ON, and the system begins to fill the yellow color. ⌘ When the switch of filling blue pigment is turned on, X2 = ON. The second MC ~ MCR instruction will be executed. Y1 = ON, and the system begins to fill the blue color.
- ⌘ When the switch of filling green pigment is turned on, X3 = ON, both of the two MC ~ MCR instructions will be executed, and the system begins to fill the green color.

1.17 MC/MCR - Manual/Auto Control



Control Purpose:

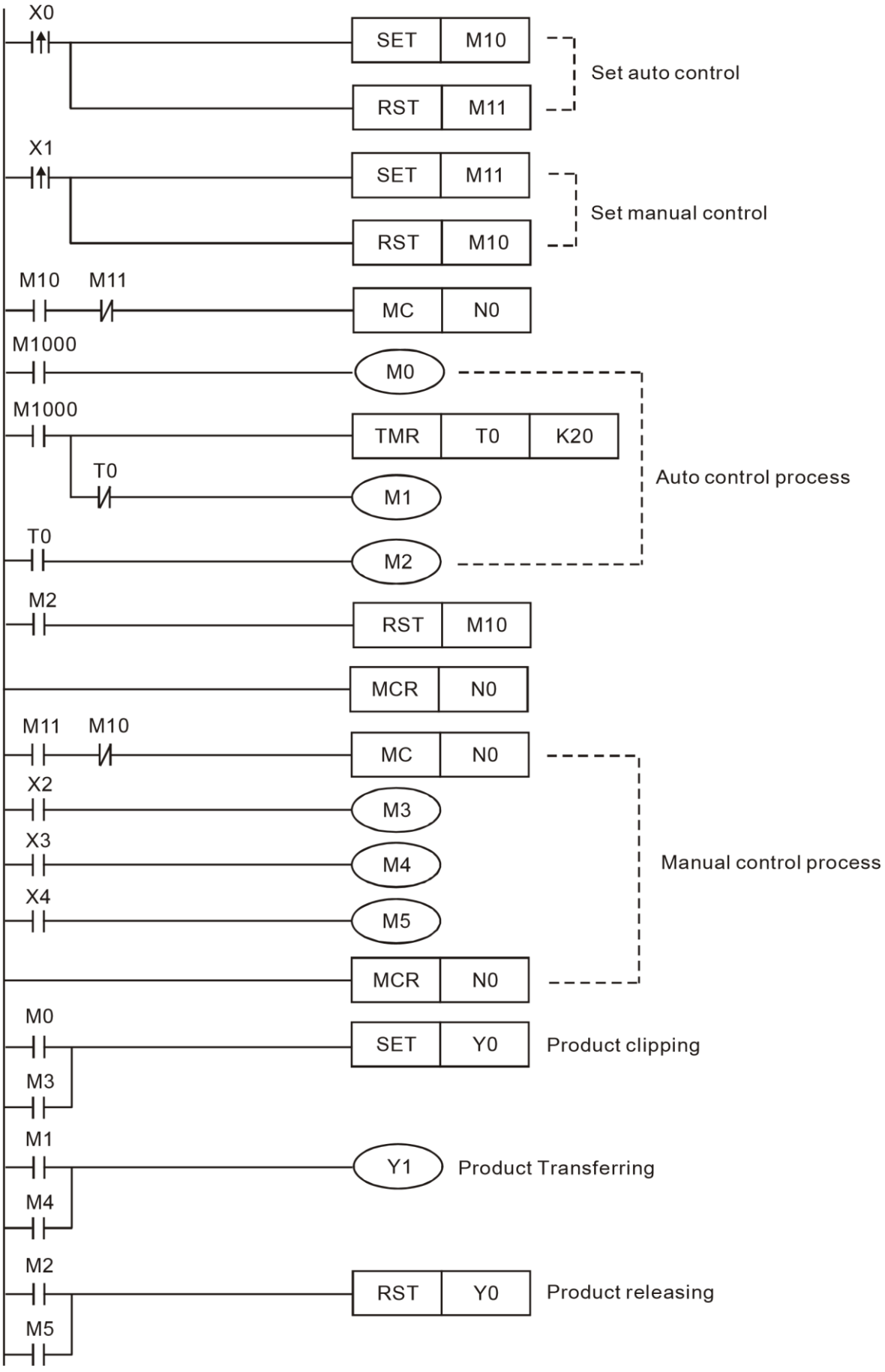
- ⌘ When the button Manual is pressed, the robotic arm will begin to execute the manual control process: pressing Clip to clip the product from conveyor A, pressing Transfer to move the product to the conveyor B, and pressing Release to release the product and send it away by conveyor B.
- ⌘ When the button Auto is pressed, the robotic arm will begin to execute the auto control process once: clip product (keep holding this product before releasing) → transfer product (the action takes 2 sec) → release the product. Auto control process can be performed one more time if the button Auto is pressed again.
- ⌘ Manual control process and auto control process are interlocked.

Devices:

Device	Function
X0	Auto button. X0 goes from OFF to ON when pressed.
X1	Manual button. X1 goes from OFF to ON when pressed
X2	Clip button. X2 will be ON when pressed.
X3	Transfer button. X3 will be ON when pressed.
X4	Release button. X4 will be ON when pressed.
M0~M2	Auto control process
M3~M5	Manual control process
M10	Auto control selection
M11	Manual control selection

T0	2 sec timer
Y0	Product clipping/releasing. Y0 is ON/OFF when clipping/releasing the product.
Y1	Product transferring

Control Program:

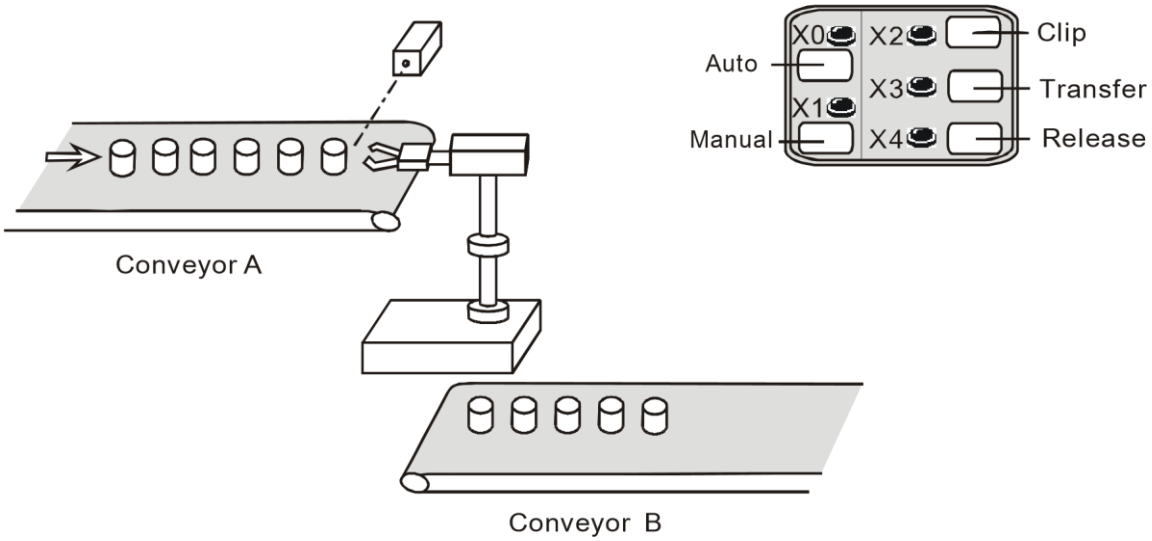


Program Description:

⌘ When X0 goes from OFF to ON, the auto control process will be executed once, whereas when X1 goes from OFF to ON, the manual control process will be executed. In the manual control, the clipping and releasing actions require pressing the corresponding button for one time. However, the button Transfer should be pressed for 2 sec during the moving process till the product is moved to Conveyor B.

⌘ X0 and X1 are interlocked. When the auto control process is executed, the robotic arm will perform the following actions: first “clipping”, then “transferring” (for 2 sec.), and “releasing.” When the manual control process is executed, the controlling actions will be performed by 3 corresponding buttons: clipping product by turning on Y0, transferring product by pressing Y1 and releasing product by turning off Y0.

1.18 STL Manual/Auto Control



Control Purpose:

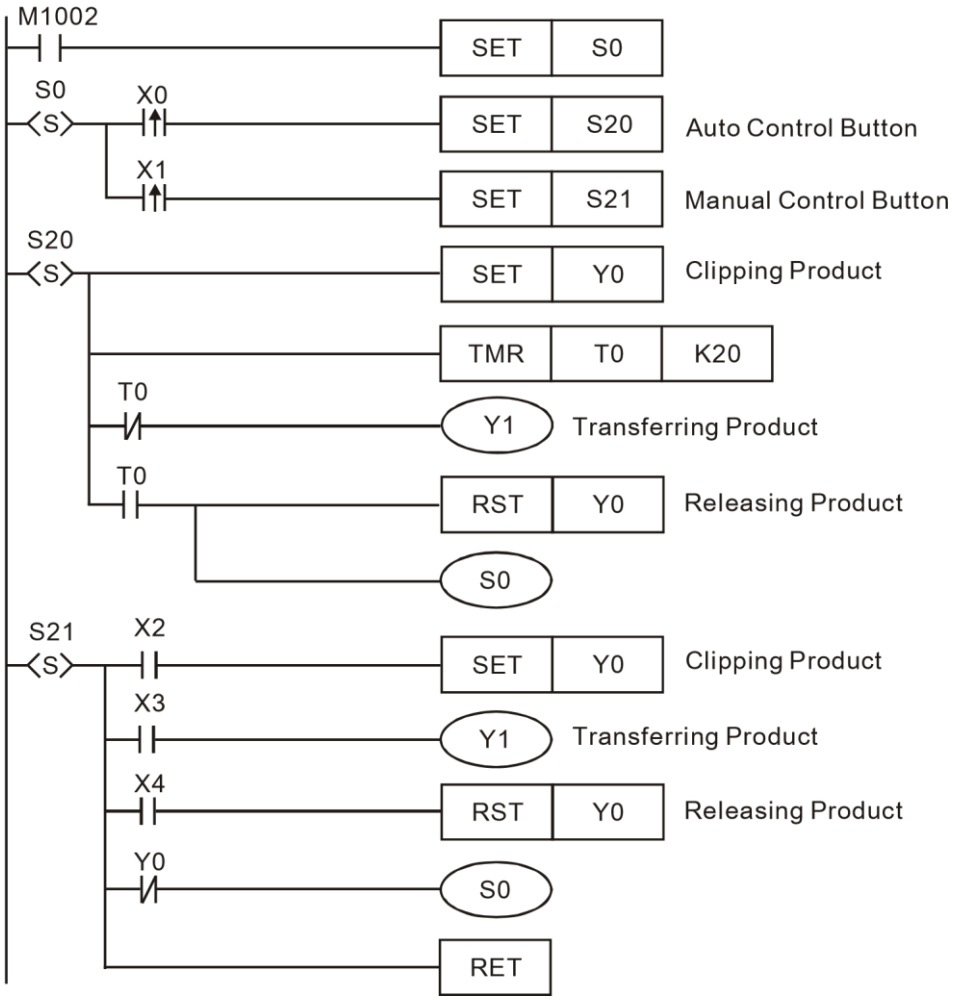
- ⌘ When the button Manual is pressed, the robotic arm will begin to execute the manual control process: pressing Clip to clip the product from conveyor A, pressing Transfer to move the product to the conveyor B, and pressing Release to release the product and send it away by conveyor B.
- ⌘ When the button Auto is pressed, the robotic arm will begin to execute the auto control process once: clip product (keep holding this product before releasing) → transfer product (the action takes 2 sec) → release the product. Auto control process can be performed one more time if the button Auto is pressed again.
- ⌘ Manual control process and auto control process are interlocked.

Devices:

Device	Function
X0	Auto button. X0 goes from OFF to ON when pressed.
X1	Manual button. X1 goes from OFF to ON when pressed
X2	Clip button. X2 will be ON when pressed.
X3	Transfer button. X3 will be ON when pressed.
X4	Release button. X4 will be ON when pressed.
S0	Initial step
S20	Auto control step
S21	Manual control step

T0	2 sec timer
Y0	Product clipping/releasing. Y0 is ON/OFF when clipping/releasing the product
Y1	Product transferring

Control Program:



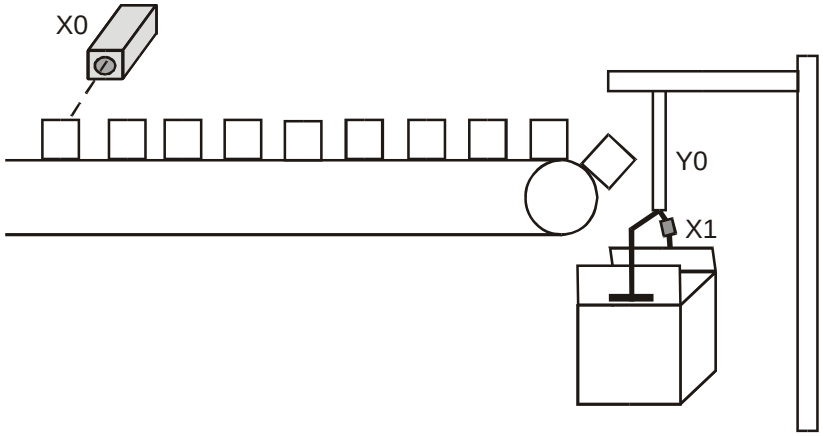
Program Description:

- ⌘ When X0 goes from OFF to ON, the step S20 will be set to execute auto control process one time, and the manual control process will be prohibited at the same time. Auto control process can be performed one more time if the button Auto is pressed again.
- ⌘ The auto control process performed by the robotic arm: clipping product when X0 = ON (keep holding this product before releasing) → transferring product when Y1 = ON (the action takes 2 sec) → releasing the product when Y0 = OFF.
- ⌘ When X1 goes from OFF to ON, the step S21 will be set to execute manual control process one time, and the auto control process will be prohibited at the same time.

⌘ The manual control process performed by the robotic arm: pressing Clip(X2) to clip the product from conveyor A, pressing Transfer(X3) to move the product to the conveyor B, and pressing Release(X4) to release the product and send it away by conveyor B.

MEMO

2.1 Product Mass Packaging



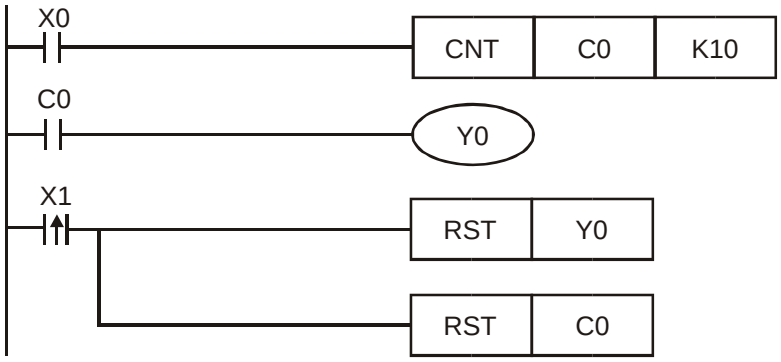
Control Purpose:

⌘ Once the photoelectric sensor detects 10 products, the robotic arm will begin to pack up. When the action is completed, the robotic arm and the counter will be reset.

Devices:

Device	Function
X0	Photoelectric sensor for counting products. X0 = ON when products are detected.
X1	Robotic arm action completed sensor. X1 = ON when packing is completed.
C0	Counter: 16-bit counting up (general purpose)
Y0	Robotic arm for packing

Control Program:



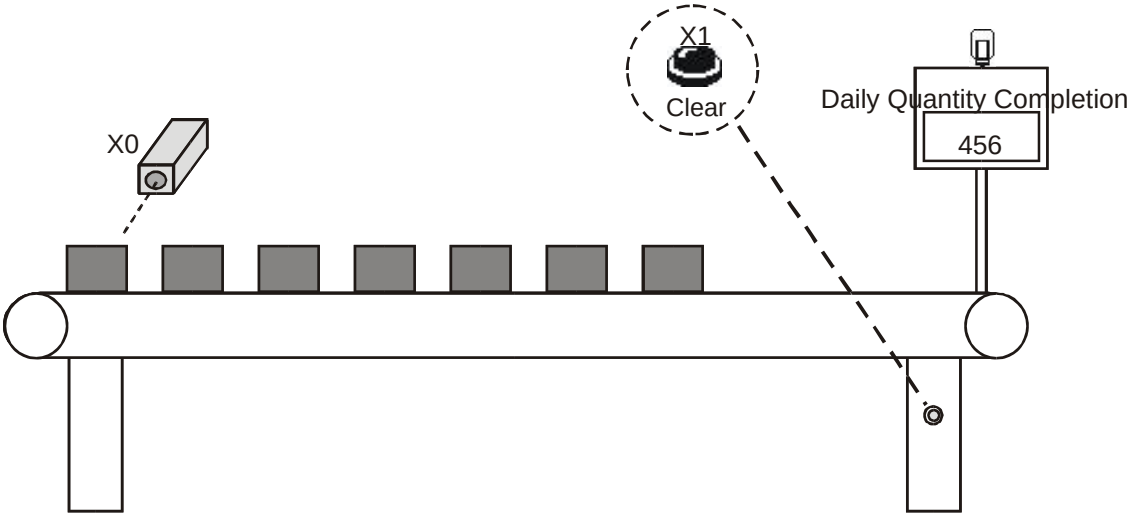
Program Description:

⌘ Once the photoelectric sensor detects a product, X0 will go from OFF to ON once, and C0 will count for one time.

⌘ When the present value in C0 reaches 10, the Normally Open contact C0 will be closed. Y0 = ON, and the robotic arm will begin to pack.

⌘ When the packing is completed, the robotic arm action completed sensor will be enabled. X1 will go from OFF to ON and RST instruction will be executed. Y0 and C0 will be reset for the next packing task.

2.2 Daily Production Record (16-bit Counting Up Latched Counter)



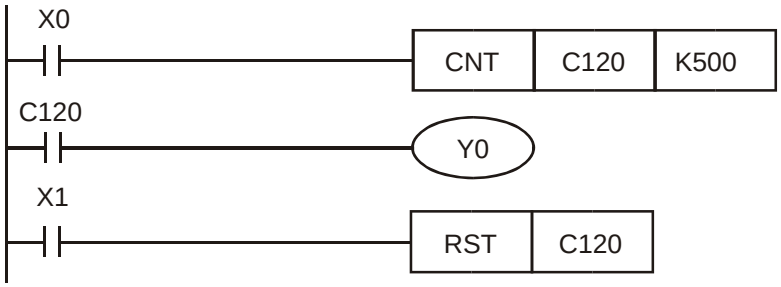
Control Purpose:

- ⌘ The production line may be powered off accidentally or turned off for noon break. The program is to control the counter to retain the counted number and resume counting after the power is ON again.
- ⌘ When the daily production reaches 500, the target completed indicator will be ON to remind the operator for keeping a record.
- ⌘ Press the Clear button to clear the history records. The counter will start counting from 0 again.

Devices:

Device	Function
X0	Photoelectric sensor. Once detecting the products, X0 will be ON.
X1	Clear button
C120	Counter: 16-bit counting up (latched)
Y0	Target completed indicator

Control Program:



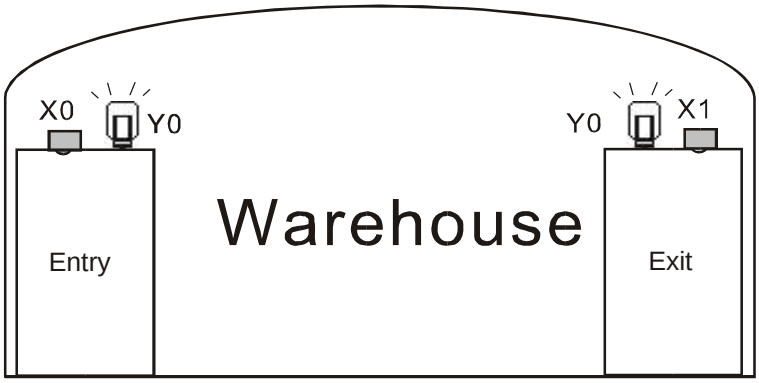
Program Description:

- ⌘ The latching counter is demanded for the situation of retaining data when power-off. ⌘ When a product is completed, C120 will count for one time. When the number reaches 500,

target completed indicator Y0 will be ON.

⌘ For different series of DVP-PLC, the setup range of 16-bit latching counter is different. C112 ~ C127 for ES/EX/SS series, C96 ~ C199 for SA/SX/SC series and C100 ~ C199 for EH series.

2.3 Products Amount Calculation (32-bit Counting Up/Down Counter)



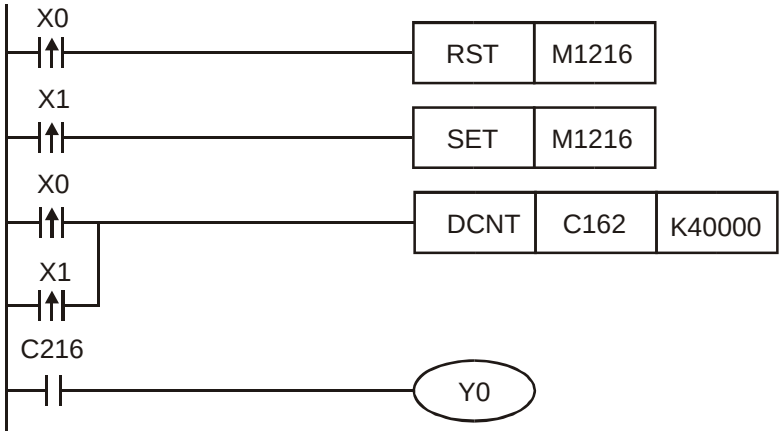
Control Purpose:

⌘ This program is used for monitoring the product amount in the warehouse by photoelectric sensors at both entry and exit. When the amount reaches 40,000, the alarm will be enabled.

Devices:

Device	Function
X0	Photoelectric sensors for monitoring incoming goods. X0 = ON when incoming detected.
X1	Photoelectric sensors for monitoring outgoing goods. X1 = ON when outgoing detected.
M1216	Counting mode of C216(ON: counting down)
C216	32-bit counting up/down counter
Y0	Alarm

Control Program:

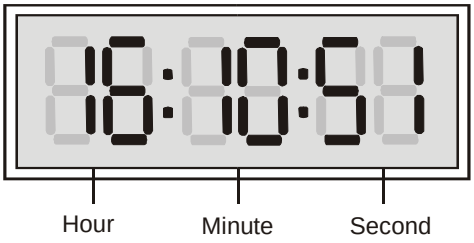


Program Description:

⌘ The key of this example is using the 32-bit addition/subtraction flag M1216 to control the counting up/ down of C216. When X0 goes from OFF to ON, M1216 = OFF, and C216 will count up; when X1 goes from OFF to ON, M1216 = ON, C216 will count down.

⌘ When the present value of C216 reaches 40,000, C216 = ON, and the alarm Y0 will be enabled.

2.4 24-hour Clock Operated by 3 Counters



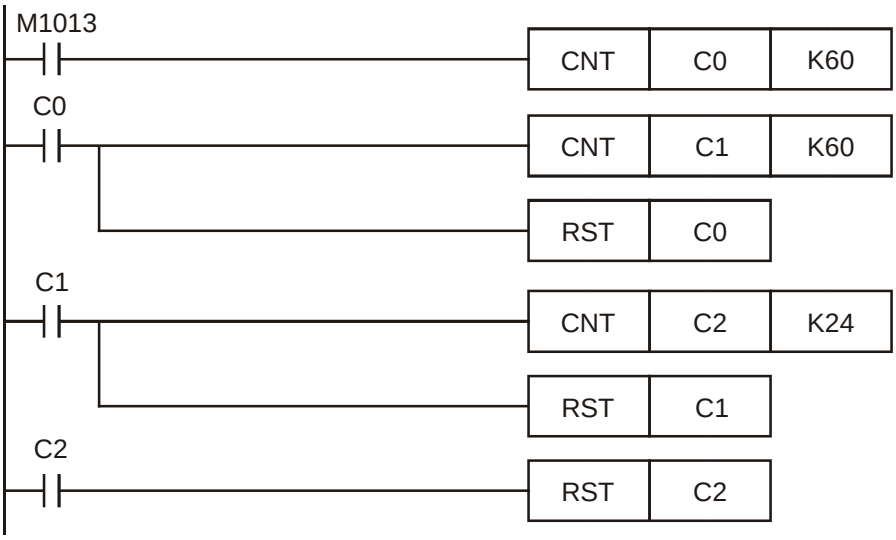
Control Purpose:

⌘ Using 3 counters together with the flag of M1013 (1s clock pulse) to operate a 24-hour clock.

Devices:

Device	Function
C0	count per second
C1	count per minute
C2	count per hour
M1013	1s clock pulse

Control Program:



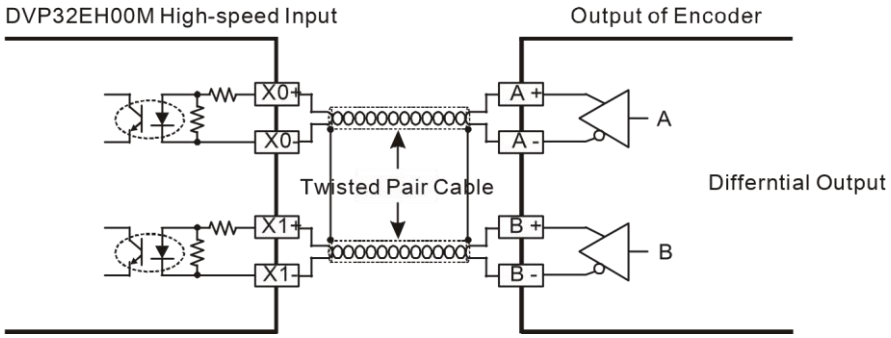
Program Description:

⌘ The key of operating a 24-hour clock is to use M1013 (1s clock pulse). When the program is executed, C0 will count once per second. When the counted number reaches 60(1 minute), C0 = ON. C1 will count once, and C0 will be reset at the same time; similarly, when the counted number in C1 reaches 60(1 hour), C1 = ON. C2 will count once, and C1 will be reset at the same time. Furthermore, when the present value in C2 reaches 24, C2 will be reset, and the 24-hour counting process will start again.

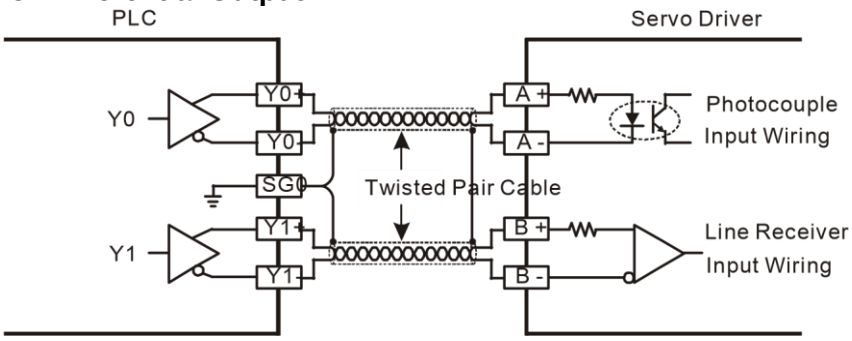
⌘ The 24-hour clock operates by using C0 to count “second”, C1 to count “minute” and C2 to count “hour.” In this clock, the value of “second”, “minute” and “hour” can be read by C0, C1 and C2 correspondingly. When the set value of C2 is 12, the clock will be a 12-hour clock.

2.5 A B-phase Pulse High-speed Counter

⌘ **Wiring for Differential Input（high-speed, high-noise condition）**



⌘ **Wiring for Differential Output**



Control Purpose:

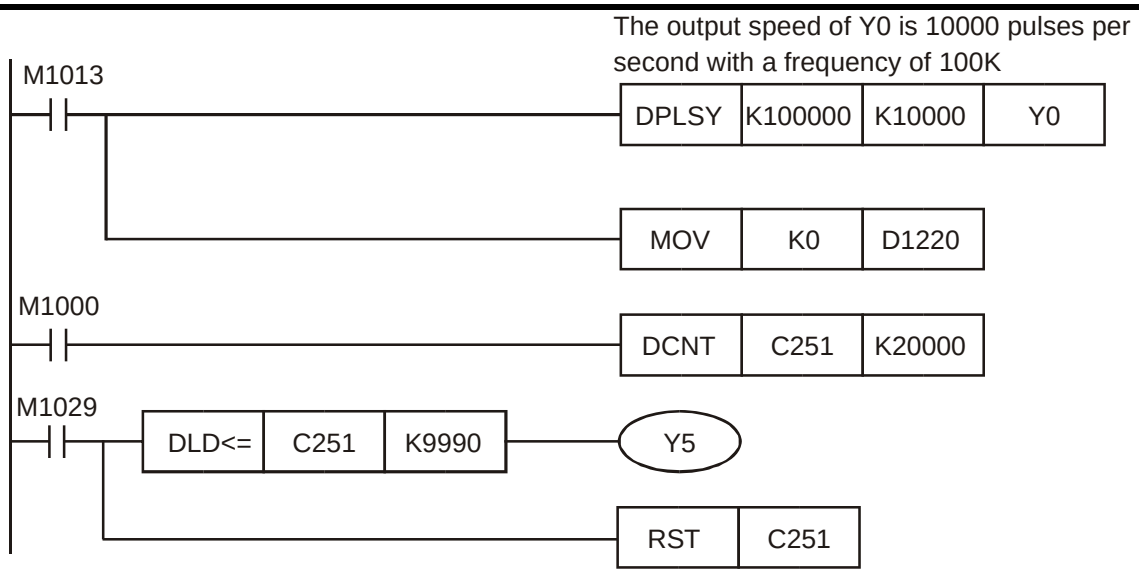
⌘ DVP32EH00M sends AB-phase pulse to control the servo at a speed of 10,000 pulses per second. The motor rotation will be encoded by the encoder and the result will be transferred to the input points (differential input) of PLC high-speed counter. If the counted value in PLC high-speed counter is different from the number of pulse sent by the MPU, the alarm will be enabled.

Devices:

Device	Function
Y0	100KHz pulse output
Y5	Alarm indicator
M1013	1s clock pulse
M1029	Pulse output completed flag
D1220	Setting the first group output phase, CH0(Y0, Y1)
C251	High-speed counter

2. Counter Designing Example

Control Program:



Program Description:

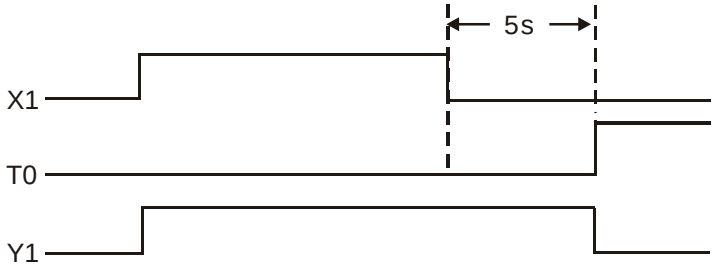
- ⌘ In this example, M1013 is used to control PLC for sending pulses. D1220 = K0 activates Y0 to output pulses and transfer the encoded feedback signal of servo motor from the encoder to the high-speed inputs (X0, X1). X0 and X1 are corresponded to high-speed counter C251, whose max counting frequency is 200 kHz.
- ⌘ When pulse sending is completed, M1029 = ON. The Load Compare instruction DLD<= will be executed. If the difference between the value of C251 and the number of pulses is above 10(C251 value≦K9990), the alarm Y5 will be enabled.
- ⌘ When M1029 = ON, [RST C251] will be executed. The value of C251 will be cleared to ensure that C251 will start counting from 0 next time.
- ⌘ Since the output signal of servo encoder is differential signal, the example requires DVP32EH00M model which supports differential signal input with its input terminal X0, X1, X4, and X5.

MEMO

3.1 Delay OFF Program

Control Purpose:

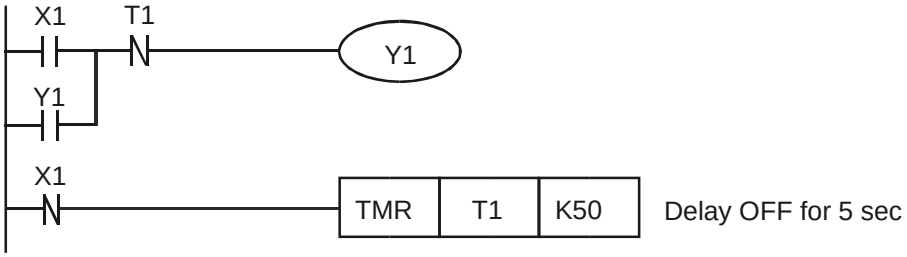
⌘ Enabling the indicator to be ON immediately and OFF after a 5 sec delay by the switch



Devices:

Device	Function
X1	X1 = OFF when the switch is turned off
T1	5 sec timer. Time base = 100ms
Y1	Output indicator

Control Program:



Program Description:

⌘ X1 = ON when the switch is turned on. The NC (Normally Closed) contact X1 will be activated, and TMR instruction will not be executed. Coil T1 will be OFF and so will the NC contact T1. Because X1 = ON, the indicator Y1 will be ON and latched.

⌘ X1 = OFF when the switch is turned off. The NC contact X1 will not be activated, which makes TMR instruction executed. Indicator Y1 will remain ON by the latched circuit until T1 reaches its set value.

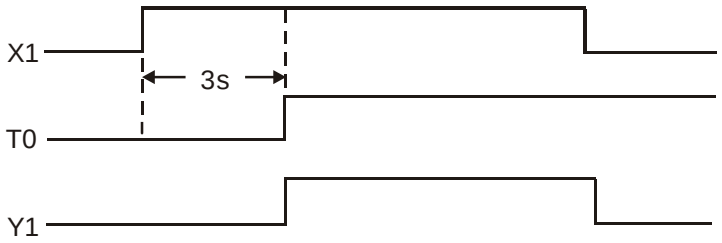
⌘ When timer T1 reaches its set value of 5 seconds, coil T1 will be ON. The NC contact T1 will be activated, which makes the indicator Y1 OFF.

⌘ Delay OFF function can also be performed by using API 65 STMR instruction.

3.2 Delay ON Program

Control Purpose:

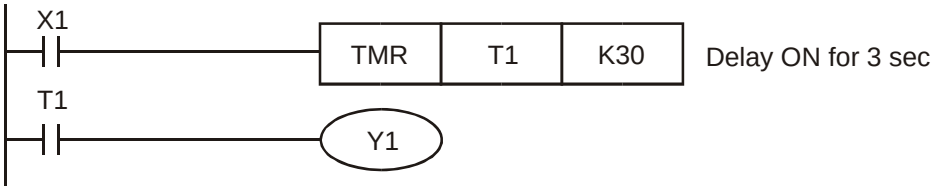
⌘ Enabling the indicator to be ON after a 3 sec delay and OFF immediately by the switch



Devices:

Device	Function
X1	X1 = ON when the switch is turned on
T1	3 sec timer, time base = 100ms
Y1	Output indicator

Control Program:



Program Description:

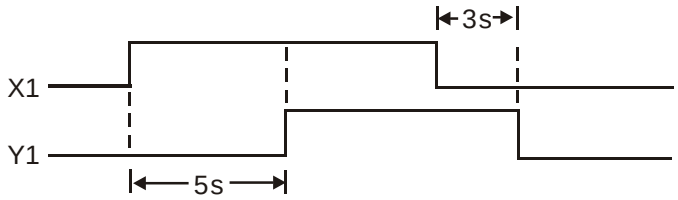
⌘ When X1 = ON, TMR instruction will be executed. Timer T1 will be ON and start counting for 3 sec. When T1 reaches its set value, the NO (Normally Open) contact T1 will be activated and indicator YI will be ON.

⌘ When X1 = OFF, TMR instruction will not be executed. Timer T1 will be OFF and so will NO contact T1. Therefore, the indicator Y1 will be OFF.

3.3 Delay ON/OFF Program

Control Purpose:

⌘ Enabling the indicator to be ON after a 5 sec delay and OFF after a 3 sec delay by the switch

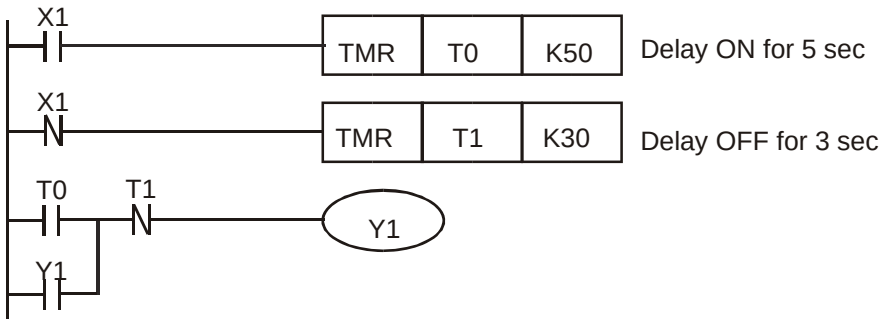


Devices:

Device	Function

X1	X1 = ON when the switch is turned on.
T0	5 sec timer, time base = 100ms
T1	3 sec timer, time base = 100ms
Y1	Output indicator

Control Program:

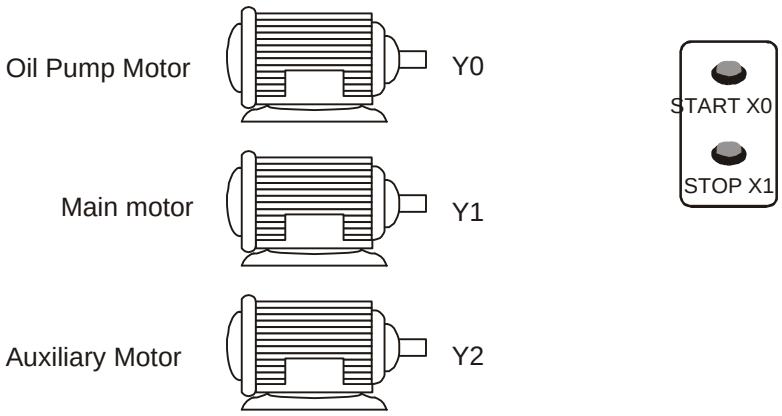


Program Description:

⌘ When X1 = ON, T0 will start counting for 5 sec. When T0 reaches its set value, the NO contact T0 will be ON while NC contact T1 will remain OFF, which makes the indicator Y1 to be ON and latched.

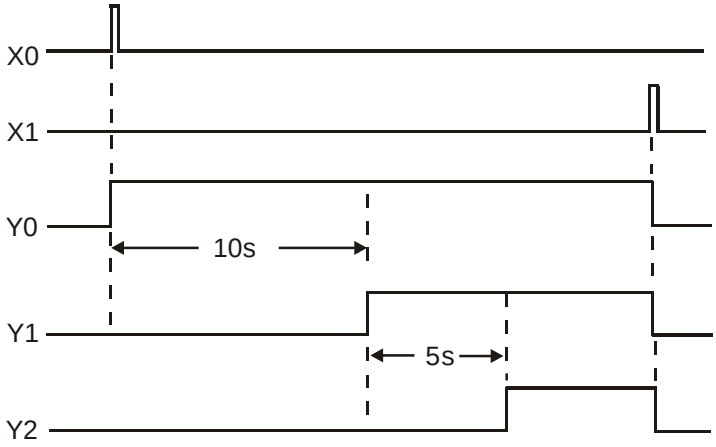
⌘ When X1 = OFF, T1 will start counting for 3 sec. When T1 reaches its set value, the NC contact T1 will be activated while the NO contact T0 will remain OFF, which makes the indicator Y1 to be OFF.

3.4 Sequential Delay Output (Starting 3 Motors Sequentially)



Control Purpose:

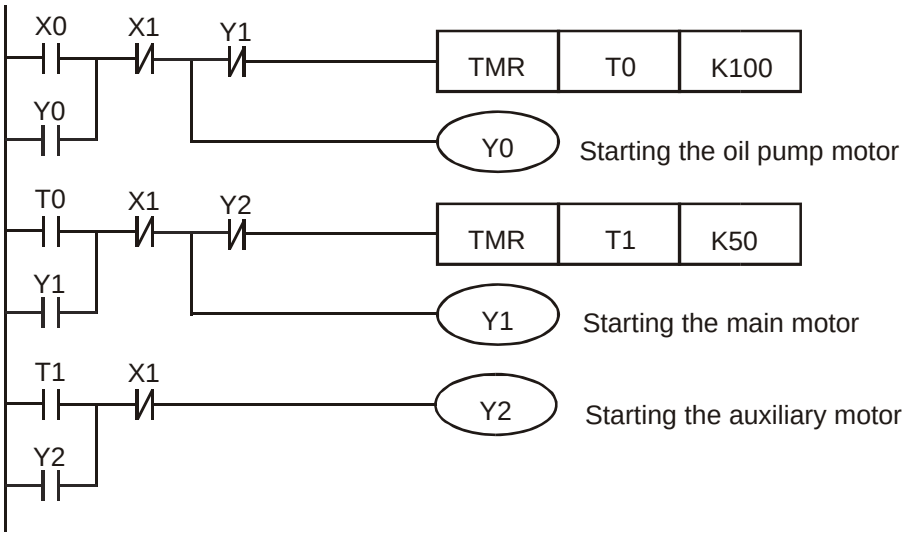
⌘ Starting the oil pump motor immediately when START is pressed. The main motor will be started after a 10 sec delay and then the auxiliary motor after a 5 sec delay. In addition, stopping all motors immediately when STOP is pressed.



Devices:

Device	Function
X0	X0 = ON when START is pressed.
X1	X1 = ON when STOP is pressed.
T0	10 sec timer. Time base: 100ms
T1	5 sec timer. Time base: 100ms
Y0	Starting the oil pump motor
Y1	Starting the main motor
Y2	Starting the auxiliary motor

Control Program:



Program Description:

⌘ When START is pressed, the NO contact X0 will be activated, which makes Y0 to be ON and latched. The oil pump motor will start the lube system. At the same time, [TMR T0

K100] instruction will be executed. When T0 reaches its set value of 10 sec, the NO contact T0 will be ON.

⌘ When the NO contact T0 is ON, Y1 will be ON and latched, which starts the main motor and stops timer T0. At the same time, [TMR T1 K50] is executed, and the NO contact T1 will be ON when timer T1 reaches its set value.

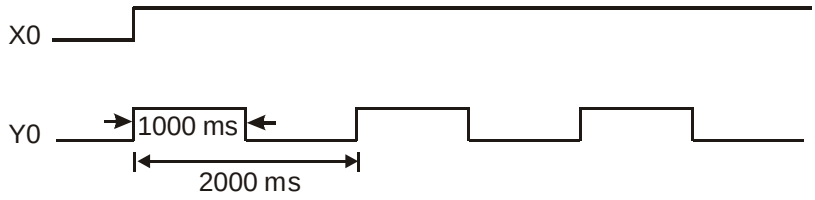
⌘ When the NO contact T1 is ON, Y2 will be ON and latched, which starts the auxiliary motor and stops T1.

⌘ When STOP is pressed, the NC contact X1 will be activated, which makes Y0, Y1 and Y2 OFF. The oil pump motor, main motor and auxiliary motor will stop working.

3.5 Pulse-Width Modulation

Control Purpose:

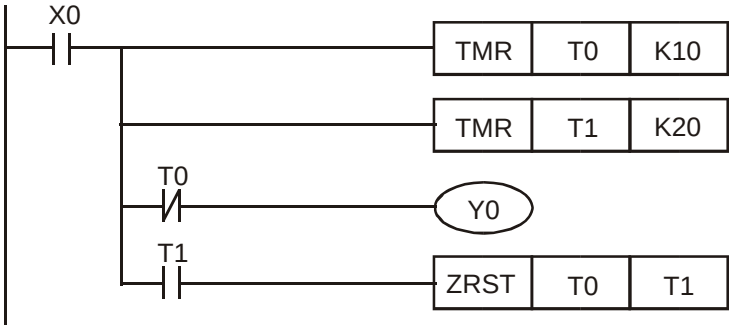
⌘ Performing Pulse Width Modulation function by changing the set value of the timer in the program. The oscillating pulse is as below: (Y0 = ON for 1 sec. The cycle = 2 sec)



Devices:

Device	Function
X0	X0 = ON when the switch is turned on
T0	1 sec timer. Time base: 100ms
T1	2 sec timer. Time base: 100ms
Y0	Oscillating pulse output

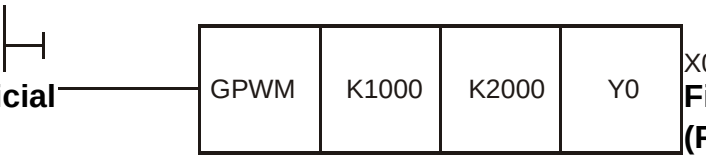
Control Program:



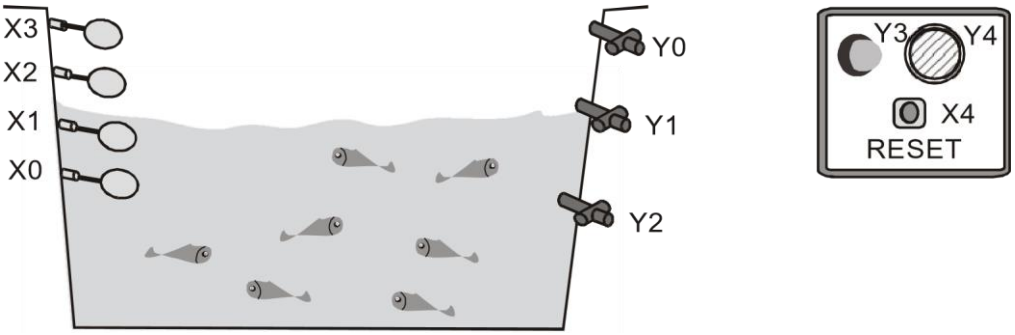
Program Description:

⌘ When X0 = ON, timer T0/T1 will be activated. Y0 will be ON until timer T0 reaches its set value. When timer T1 reaches its set value, T0/T1 will be reset. Therefore, Y0 will output the above oscillating pulse continuously. When X0 = OFF, the output Y0 will be OFF as well.

⌘ Pulse Width Modulation function can be modified by changing the set value of the timer in the program. ⌘ Pulse Width Modulation function can also be performed by using API 144 GPWM instruction.



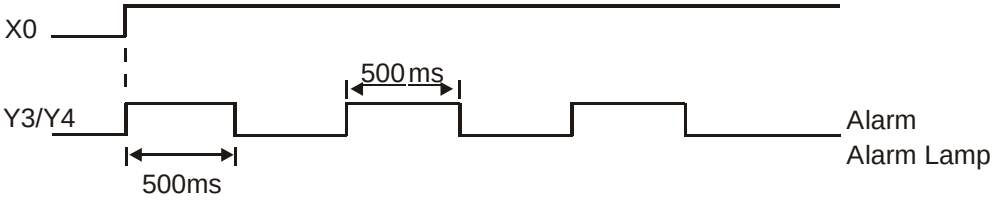
3.6 Artificial Fishpond Water Level Monitoring System (Flashing Circuit)



Control Purpose:

⌘ Feeding or draining water automatically when the water level of artificial fishpond is not at the normal level. In addition to feeding / draining water, enabling the alarm and alarm lamp when the water is above or below the alarm level.

⌘ Stopping the alarm when RESET is pressed.

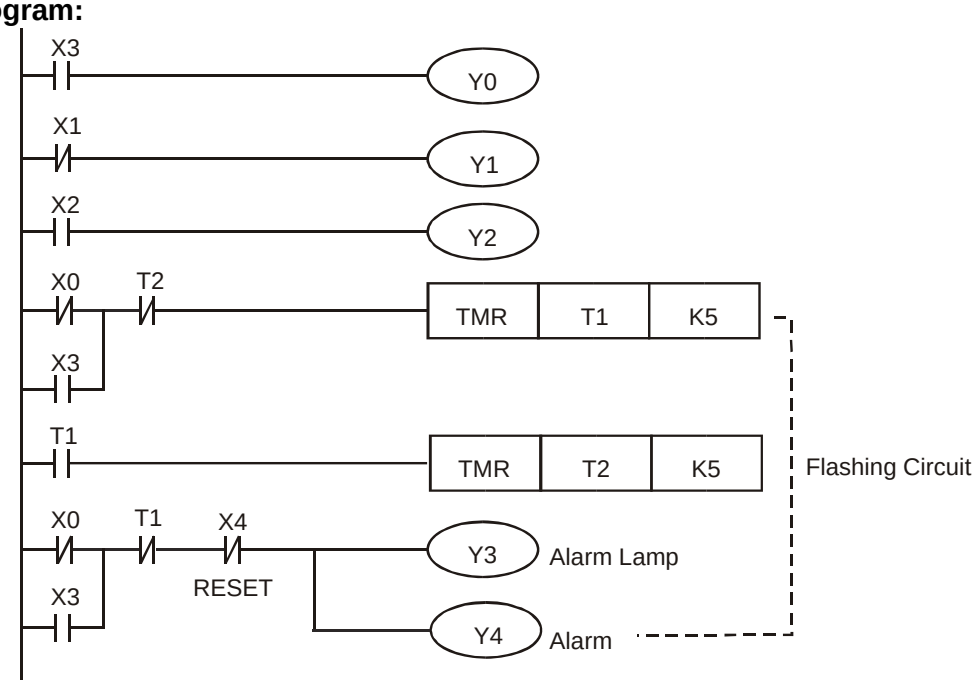


Devices:

Device	Function
X0	X0 = ON when the water is above the lowest level of alarm level.
X1	X1 = ON when the water is above the lowest level of normal level.
X2	X2 = ON when the water is above the highest level of normal level.
X3	X3 = ON when the water is above the highest level of alarm level.

X4	X4 = ON when RESET is pressed.
T1	500ms timer. Time base: 100ms.
T2	500ms timer. Time base: 100ms.
Y0	1# drainage pump
Y1	Feeding pump
Y2	2# drainage pump
Y3	Alarm lamp
Y4	Alarm

Control Program:



Program Description: ⌘ When the water is at normal level: X0 = ON, X1 = ON, X2 = OFF and X3 = OFF. Therefore, Y0 and Y2 will be OFF. Both the drainage pump and the feeding pump will not work.

⌘ When the water is lower than the normal level, X0 = ON, X1 = OFF, X2 = OFF and X3 = OFF.

Because X1 = OFF, Y1 will be ON. The feeding pump will start working.

⌘ When the water is below the lowest of alarm level, X0 = OFF, X1= OFF, X2 = OFF and X3 = OFF. Because X1 = OFF, Y1 will be ON. The feeding pump will start working. In addition, because X0 = OFF, the flashing circuit will be activated, which makes Y3 = ON and Y4 = ON, The alarm lamp will flash and the alarm will ring.

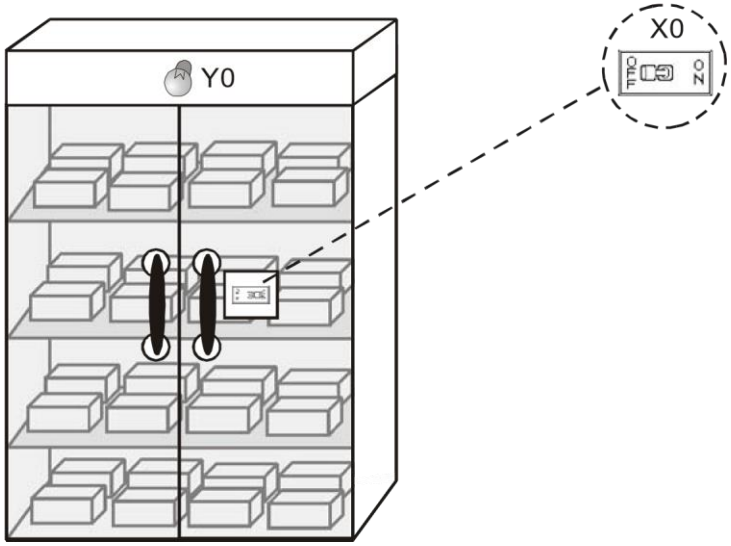
⌘ When the water is above the normal level, X0 = ON, X1 = ON, X2 = ON, X3 = OFF. Because X2 = ON, Y2 will be ON. 2# drainage pump will drain water from the fishpond.

⌘ When the water is above the highest of alarm level, X0 = ON, X1 = ON, X2 = ON, X3 = ON. Because X2 = ON, Y2 will be ON. 2# drainage pump will work. In addition, because X3 = ON, Y0 will be ON. 2# drainage pump will work. Besides, the alarm circuit will be executed, which makes Y3 = ON and Y4 = ON. The alarm lamp will flash and the alarm will ring.

⌘ When Reset is pressed, the NC contact X4 will be activated. Y3 = OFF and Y4 = OFF. Both the alarm and the alarm lamp will stop working.

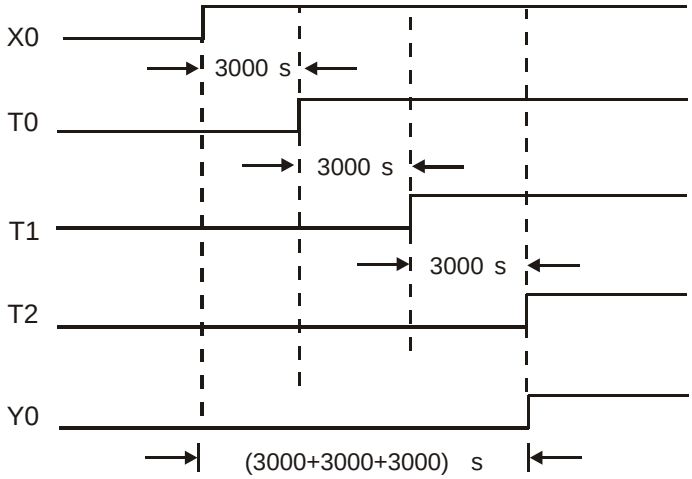
3-8

3.7 Burn-in Test System (Timing Extension)



Control Purpose:

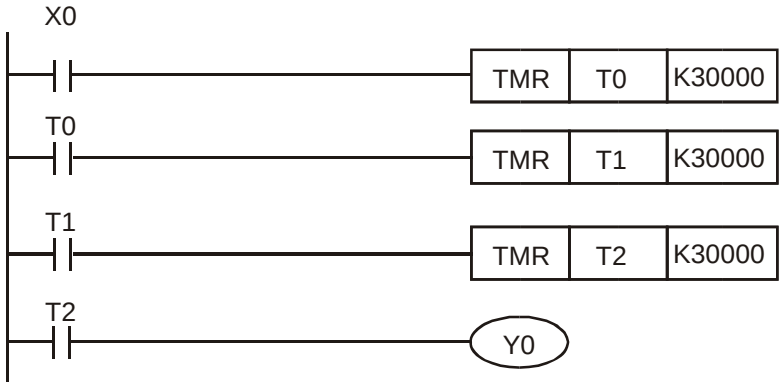
⌘ Warning the operator to take out PLC from the burn-in room by the test completed indicator after 2.5 hours burn-in process.



Devices:

Device	Function
X0	When X0 = ON, the burn-in test starts
T0	3,000 sec timer. Time base: 100ms
T1	3,000 sec timer. Time base: 100ms
T2	3,000 sec timer. Time base: 100ms
Y0	Burn-in test completed indicator

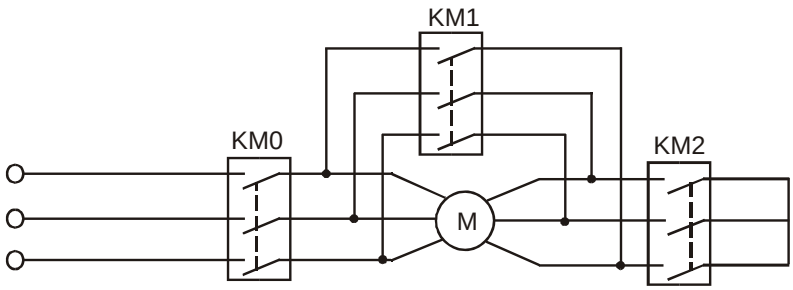
Control Program:



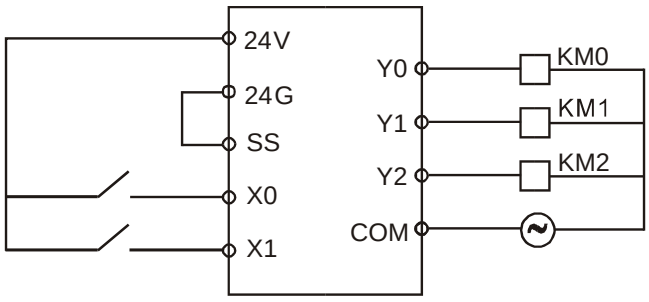
Program Description:

- ⌘ The upper bound value for a 16-bit timer is 100ms × 32767 = 3276.7s, so it needs several timers to work together for a timing extension application which is more than 1 hour (3600 sec.) The total time is the sum of each timer's set value.
- ⌘ When the burn in test is started, X0 = ON. The timer T0 will start to count for 100ms × 30000 = 3000sec. When T0 reaches its set value, the NO contact T0 will be ON and T1 will start to count for another 100ms × 30000 = 3000sec. When T1 reaches its set value, T2 will count one more 3000 sec and turn on the NO contact T2. Finally, the burn-in test completed indicator Y0 will be ON. The total time of the test is 3000s + 3000s + 3000s = 9000s = 150min = 2.5h.
- ⌘ The timing extension function can also be performed by using API 169 HOUR instruction.

3.8 Star-Delta Reduced Voltage Starter Control



Reduced Voltage Starting Main Circuit



PLC External Wiring

Control Purpose:

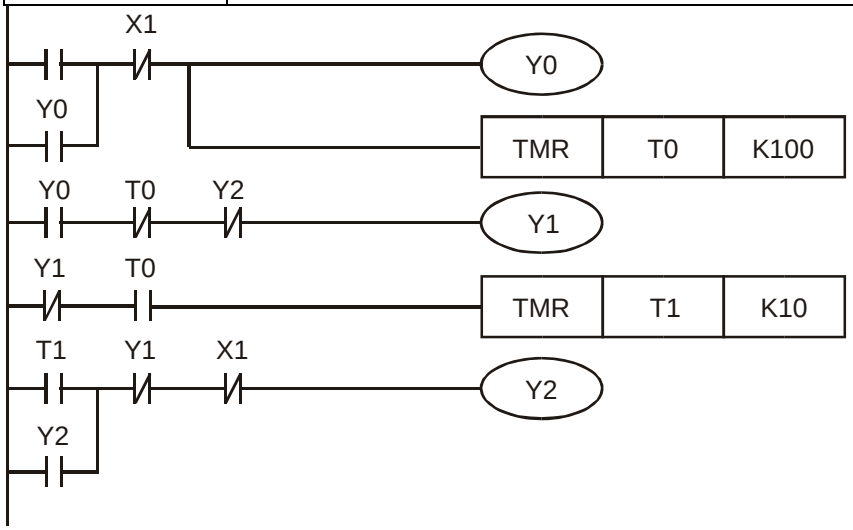
⌘ Usually the starting current of the three-phase AC asynchronous motor is 5 ~7 times larger than the rated current. To reduce the effect of the starting current on the electrified wire fence, a star-delta reduced voltage starter should be applied.

⌘ Starting process of a star-delta reduced voltage starter:

When the switch is turned on, the contactors of both motor starter and "Star Reduced Voltage Starter" will be enabled first. After a 10 sec delay, the contactor of "Star Reduced Voltage Starter" will be disabled. Finally, the contactor of "Delta Reduced Voltage Starter" will be enabled after 1 sec, which operates the main motor circuit normally. The control purpose in this process is to assure the contactor of "Star Reduced Voltage Starter" is disabled completely before the contactor of "Delta Reduced Voltage Starter" is enabled.

Devices:

Device	Function
X0	X0 = ON when START is pressed.
X1	X1 = ON when STOP is pressed.
T1	10 sec timer. Time base: 100ms
T2	1 sec timer. Time base: 100ms
Y0	Motor starting contactor KM0
Y1	"Star Reduced Voltage Starter" contactor KM1
Y2	"Delta Reduced Voltage Starter" conntactor KM2



Program Description:

⌘ X0 = ON when START is pressed. Y0 will be ON and latched. The motor starting contactor KM0 will be ON and the timer T0 will start to count for 10 sec. At the same time, because Y0 = ON, T0 = OFF and Y2 = OFF, Y1 will be ON. The "Star Reduced Voltage Starter" contactor KM1 will be activated.

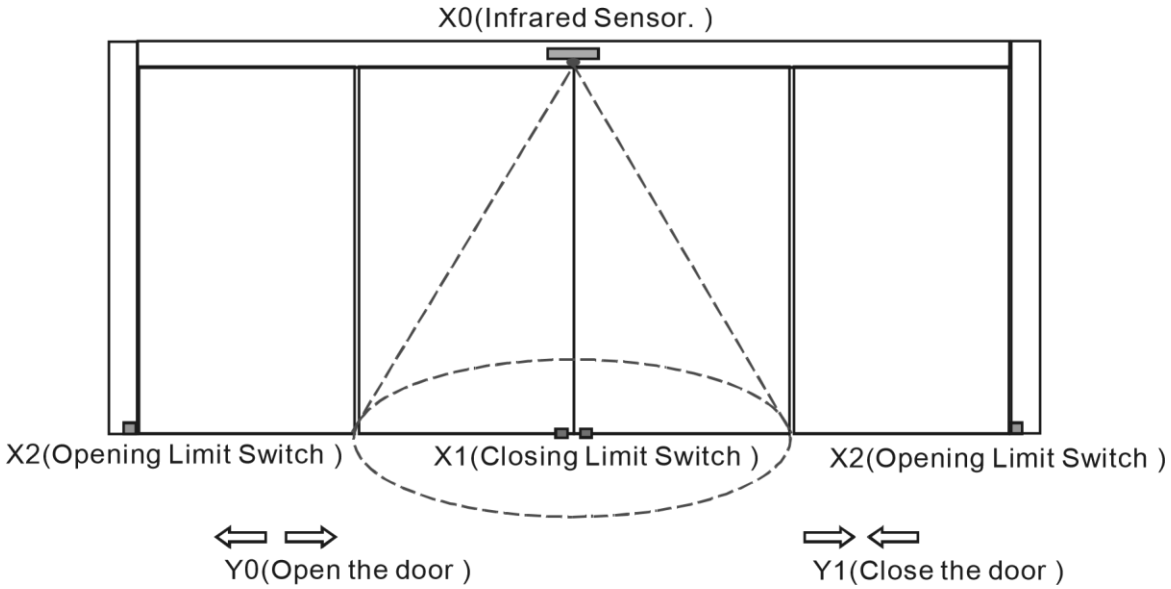
Control Program:

X0

⌘ When timer T0 reaches its set value, T0 will be ON and Y1 will be OFF. Timer T1 will start to count for 1 sec. After 1 sec, T1 = ON and Y2 = ON. “Delta Reduced Voltage Starter” contactor KM2 will be activated.

⌘ X1 = ON when STOP is pressed. Y0, Y1 and Y2 will be OFF and the motor will stop running no matter it is in starting mode or running mode.

3.9 Automatic Door Control

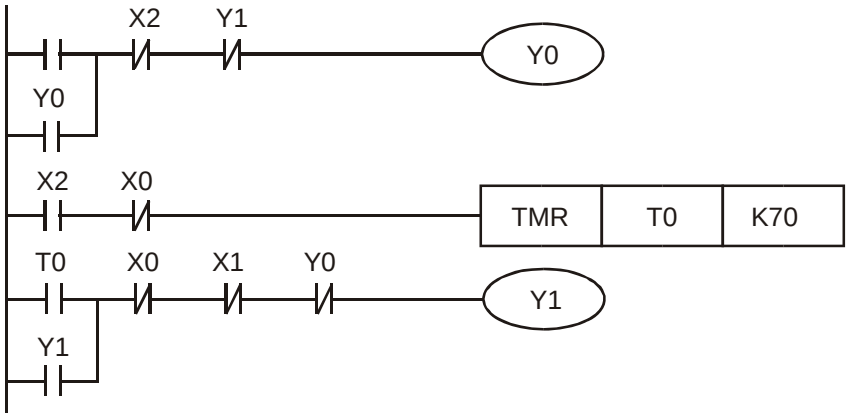


Control Purpose:

⌘ When someone enters the infrared sensing field, opening motor starts working to open the door automatically till the door touches the opening limit switch ⌘ If the door touches the opening limit switch for 7 sec and nobody enters the sensing field, the closing motor starts working to close the door automatically till the closing limit switch touched together. ⌘ Stop the closing action immediately if someone enters the sensing field during the door closing process.

Devices:

Device	Function
X0	X0 = ON when someone enters the sensing field.
X1	Closing limit switch. X1 = ON when 2 switches touched together.
X2	Opening limit switch. X2 = ON when the door touched the switches.
T0	7 sec timer. Time base: 100ms
Y0	Opening motor
Y1	Closing motor

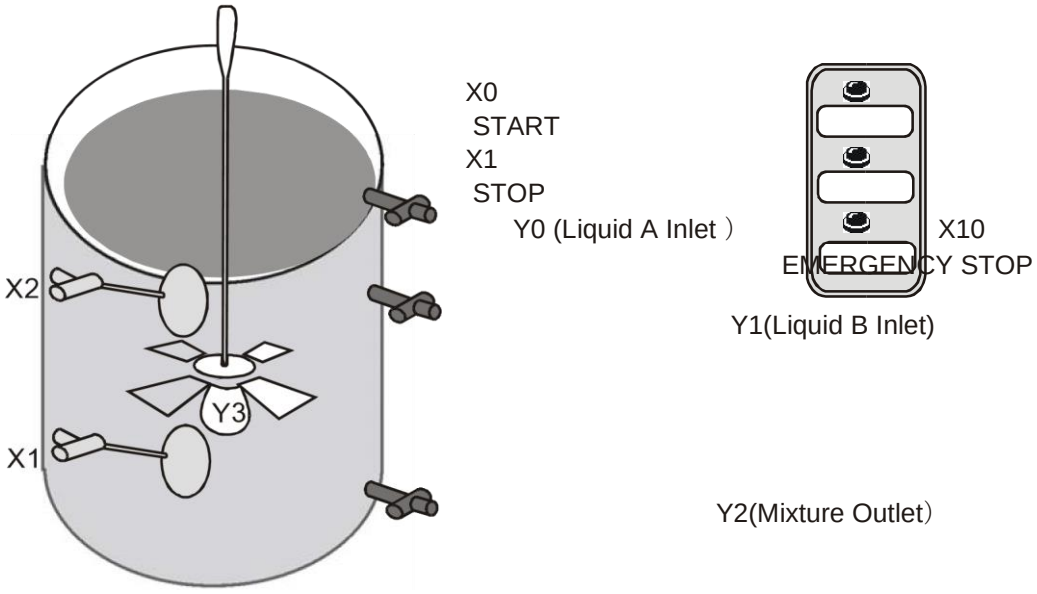


Program Description:

⌘ X0 = ON if someone enters the sensing field of the infrared sensor. Y0 will be ON and latched, and the door will be opened as long as the opening limit switches X2 = OFF. ⌘ When the door touches the opening limit switches, X2 = ON. The timer T0 will start to count for 7 sec if no one enters the sensing field (X0 = OFF). After 7 sec., Y1 will be ON and latched and the door will be closed.

⌘ During the closing process, X0 = ON if someone enters the sensing field. The NC contact X0 will be activated to turn Y1 off. Because X0 = ON, X2 = OFF and Y1 = OFF, Y0 will be ON and the door will be opened once again.

3.10 Automatic Liquids Mixing Control System



Control Purpose:

⌘ Automatically infusing the container with liquids A and B in order when START is pressed. When it reaches the set level, mix the two liquids evenly then open the valve to let out the mixture.

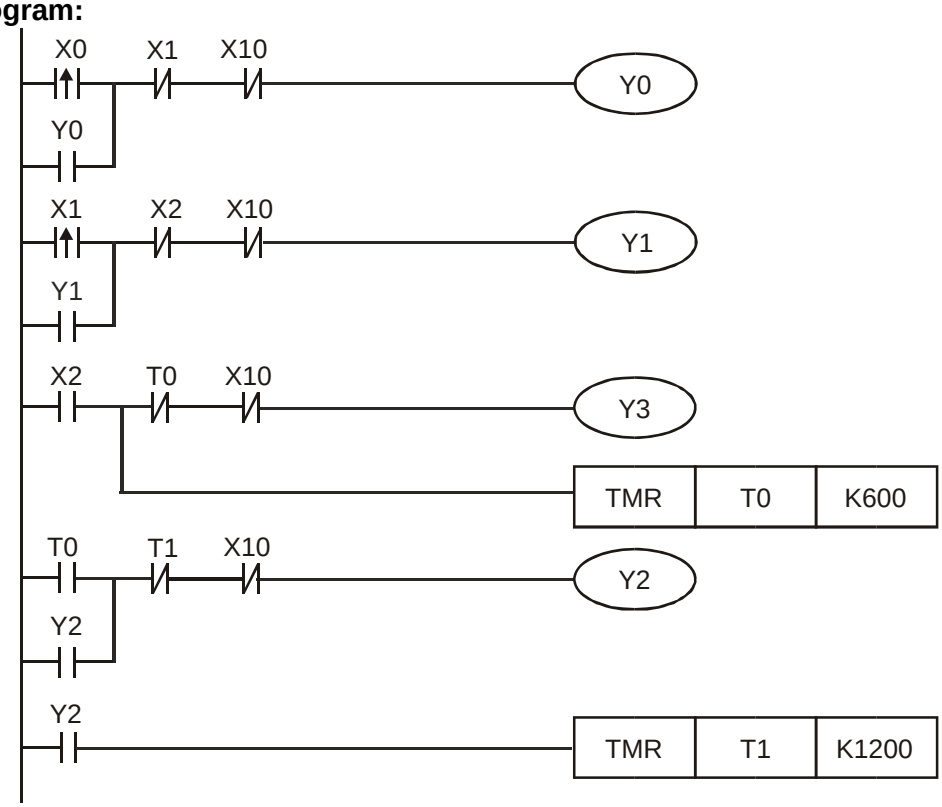
Devices:

Control Program:

X0

Device	Function
X0	X0 = ON when START is pressed.
X1	Low level float sensor. X1 = ON when the liquid level reaches X1.
X2	High level float sensor. X2 = ON when the liquid level reaches X2.
X10	EMERGENCY STOP button. X10 = ON when the button is pressed.
T0	60 sec timer. Time base: 100ms
T1	120 sec timer. Time base: 100ms
Y0	Liquid A inlet
Y1	Liquid B inlet
Y2	Mixture outlet
Y3	Agitator

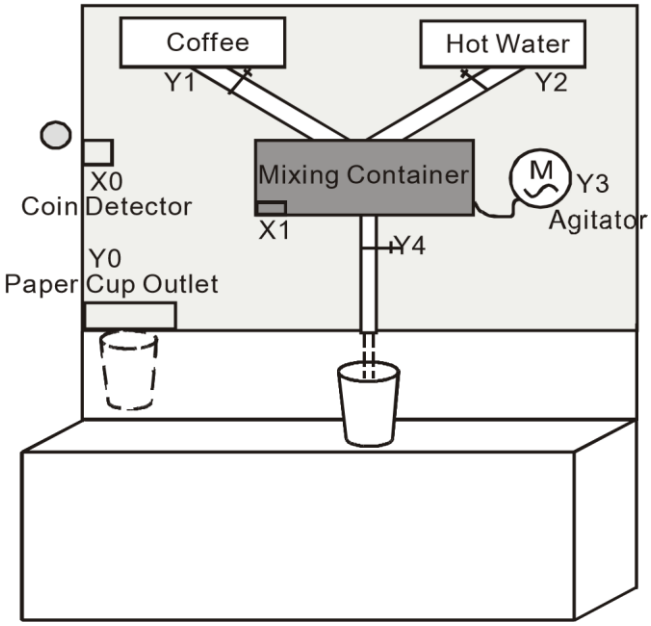
Control Program:



Program Description:

- ⌘ X0 = ON when START is pressed. Y0 will be ON and latched, and the valve will be opened for infusing liquid A until the level reaches the low-level float sensor.
- ⌘ X1 = ON when the level reaches the low-level float sensor. Y1 will be ON and latched, and the valve will be opened for infusing liquid B until the level reaches the high-level float sensor.
- ⌘ X2 = ON when the level reaches the high-level float sensor. Y3 will be ON and activates the agitator. Also, timer T0 will start to count for 60 sec. After 60 sec, T0 will be ON, and the agitator motor Y3 will stop working. Y2 will be ON and latched, and the mixture will drain out of the container.
- ⌘ When Y2 = ON, timer T1 will start to count for 120 sec. After 120 sec, T1 will be ON and Y2 will be OFF. The draining process will be stopped.
- ⌘ When an error occurs, press EMERGENCY STOP button X10. The NC contact X10 will be ON to disable all the outputs. The system will then stop running.

3.11 Automatic Coffee Maker



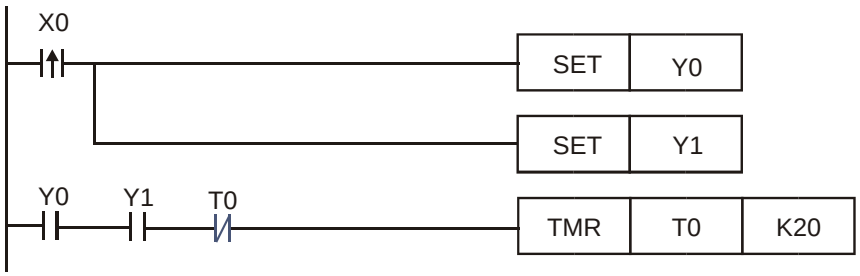
Control Purpose:

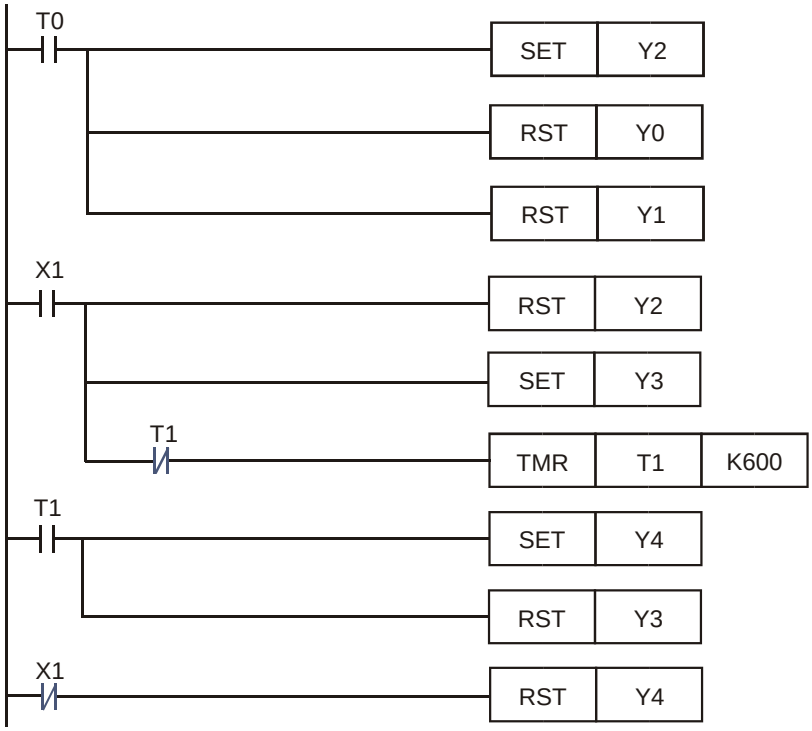
⌘ Making the paper cup come out of the outlet when a coin is inserted. At the same time, the coffee pours in the mixing container. After 2 sec, the hot water pours in. 60 sec later, the ready-made coffee will be pouring out from the coffee outlet.

Devices:

Device	Function
X0	Coin detector. X0 = ON when a coin is inserted.
X1	Pressure detector. X1 = ON when the liquid in the container reaches a certain amount of pressure.
T0	2 sec timer. Time base: 100ms
T1	60 sec timer. Time base: 100ms
Y0	Paper cup outlet
Y1	Coffee outlet
Y2	Hot water outlet
Y3	Agitator
Y4	Ready-made coffee outlet

Control Program:





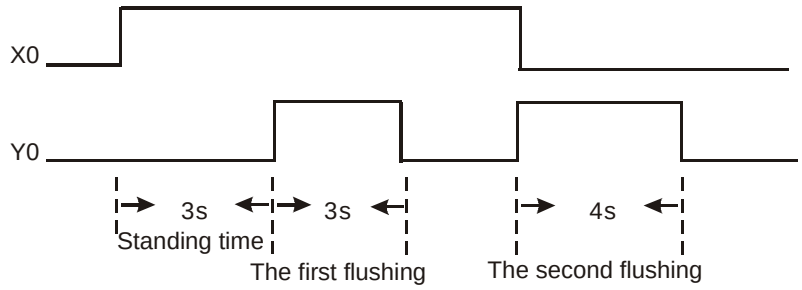
Program Description:

- ⌘ X1 = ON when a coin is inserted. Y0 and Y1 will be ON and latched. A paper cup will be sent out, and a certain amount of coffee will be poured into the container at the same time.
  ⌘ Y0 and Y1 will be ON for 2 sec which is the set value of timer T0. When NO contact T0 is ON, Y2 will be activated and the hot water will be poured in the container. At the same time, the outlets of both paper cup and coffee will be closed.
- ⌘ When the liquid in the container reaches a certain amount of pressure, X1 = ON. Therefore, the hot water outlet Y2 will be reset, and the agitator Y3 will be ON for 60 sec. After 60 sec, NO contact T1 will be ON. Y4 will be ON and latched, and Y3 will be reset at the same time. The agitator will stop working, and the ready-made coffee will be pouring out from the outlet.
- ⌘ When the coffee is poured into the paper cup completely, X1 will be OFF and Y4 will be reset. The ready-made coffee outlet will be closed.

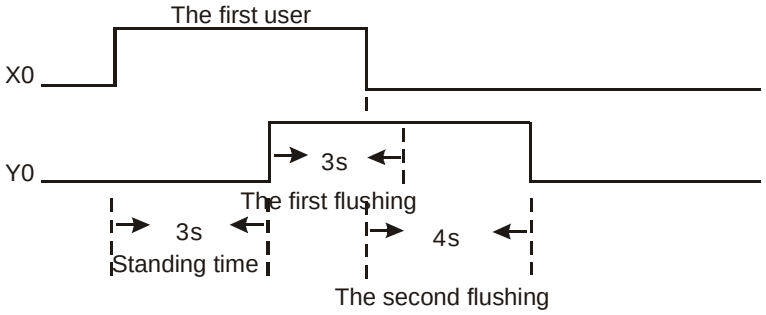
3.12 Automatic Urinal Flushing Control Program

Control Purpose:

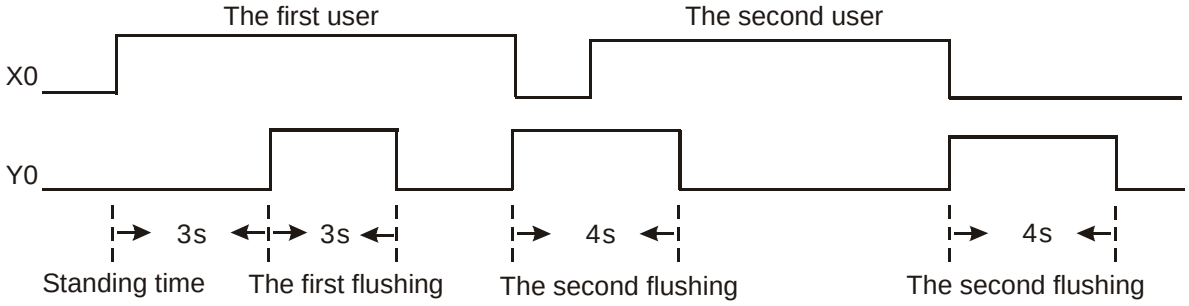
- ⌘ If a user stands in front of the urinal for more than 3 sec, the flushing control device will flush the urinal for 3 sec (the first flushing). When the user leaves the urinal, flush for another 4 sec then stop automatically (the second flushing).



⌘ Stopping the first flushing and starting the second flushing if the first user leaves the urinal during the first flushing process.



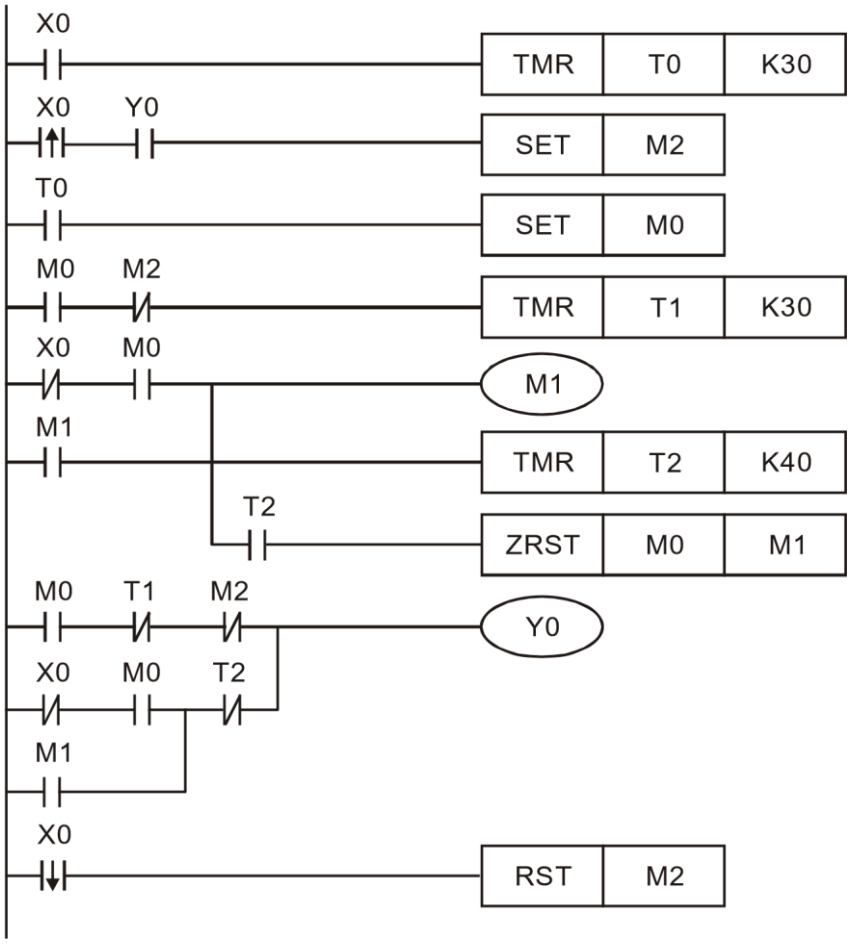
⌘ If the second user comes before the finishing of the 4 sec flushing, the flusher will finish the 4 sec flushing process and skip the first 3 sec flushing process. When the second user leaves the urinal, the flusher will perform another 4 sec flushing.



Devices:

Device	Function
X0	Infrared sensor. X0 = ON when a user is detected.
M0 ~ M2	Internal auxiliary relay
T0	3 sec timer. Time base: 100ms
T1	3 sec timer. Time base: 100ms
T2	4 sec timer. Time base: 100ms
Y0	Flushing valve

Control Program:



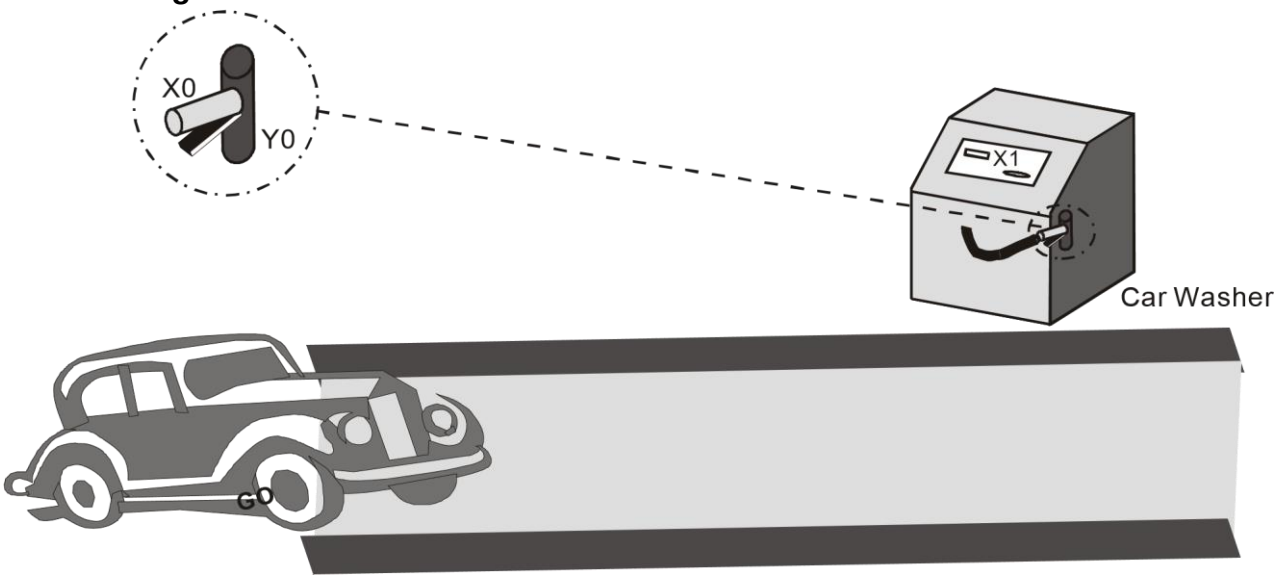
Program Description:

⌘ When a user is detected, infrared sensor X0 will be ON. In this case, T0 will be ON and start to count for 3 sec. If the user leaves in 3 sec, X0 = OFF, and T0 will be OFF. No action will be performed. If the user stands for more than 3 sec, the NO contact T0 will be activated, which turns on M0. The first flushing will start (Y0 = ON).

⌘ M1 is latched in this program. If the user leaves after 3 sec, which means the NO contact M0 = ON and the NC contact X0 is OFF, M1 will be ON and latched. The second flushing will then be started. After 4 sec, both the NO contact and the NC contact of T2 will be activated.

Therefore, Y0 will be OFF, and the flushing will be stopped. M0 and M1 will be reset. Because M1 is latched, the second flushing process will certainly be executed whether X0 changes its state or not.

3.13 Performing Accumulative Function with Normal Timer



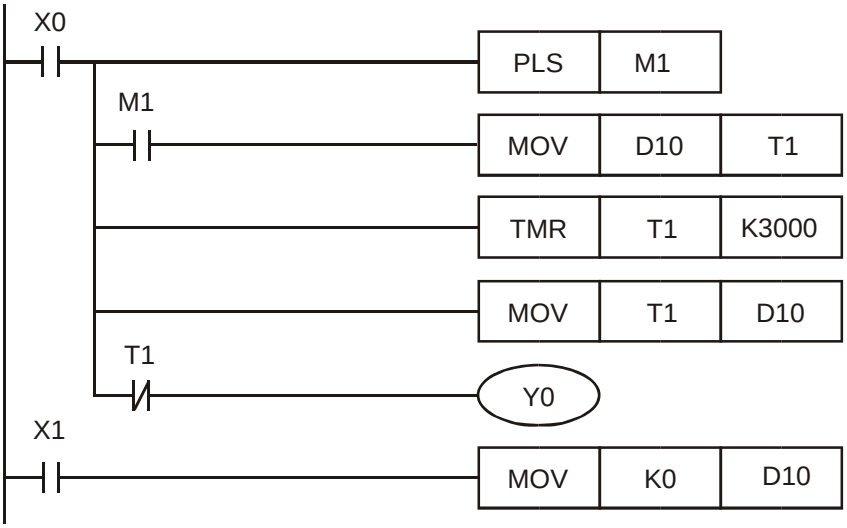
Control Purpose:

⌘ Ensuring that the customers wash their cars for entire 5 minutes no matter how many times the sprayer valve stops. .

Devices:

Device	Function
X0	Sprayer valve switch. X0 = ON when the sprayer handle is held on tightly.
X1	Coin detector. X1 = ON when an inserted coin is detected.
M1	Creating a trigger pulse for one program scan cycle
T1	Timer. Time base: 100ms
D10	Storing present value of T1
Y0	Sprayer valve

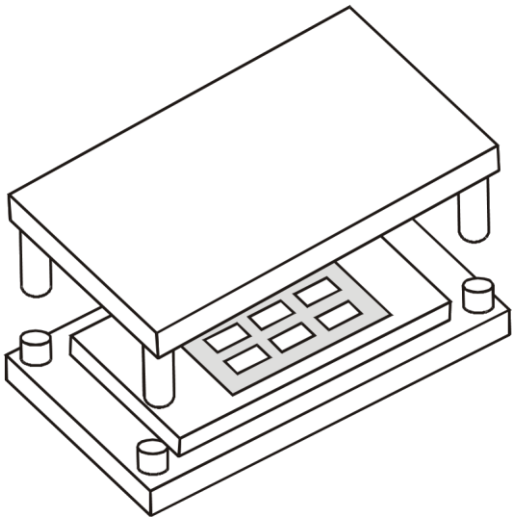
Control Program:

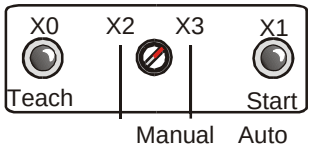


Program Description:

- When customers insert coins in the slot, X1 = ON. The time value of D10 will be cleared.
- When customers compress the sprayer handle, X0 = ON. PLS instruction will be executed. M1 will be ON for one program scan cycle, which starts T1 to count from 0 to 5 min (T1 = K3000). In this case, Y0 = ON, and the sprayer valve is open.
- If the sprayer handle is released, the timer will stop counting. The present value in the timer will be saved and the water spraying will be interrupted.
- When customers compress the sprayer handle again, the timer will start to count from the value saved in D10. Because the present value of T1 is sent to D10 and saved when T1 is working, the saved value will be sent to T1 as its present value when T1 is activated again. Therefore, even if there are some interruptions of the sprayer valve in the washing process, the program assures customers of entire 5 minutes car washing service.

3.14 Performing Teaching Function with Normal Timer





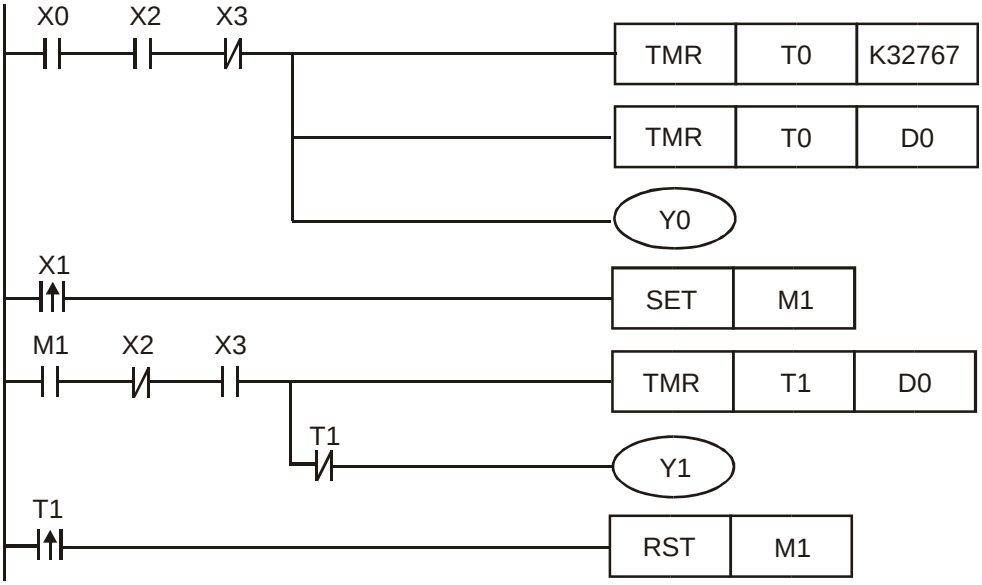
Control Purpose:

- ⌘ In Manual mode, the engineers should adjust stamping time according to their experience. The stamping time depends on the time of pressing Teach.
- ⌘ In Auto mode, if Start is pressed, the machine will perform stamping process once according to the time value saved by Teach process.

Devices:

Device	Function
X0	Teach Button. X0 = ON when the button Teach is pressed.
X1	Start button. X1 = ON when the button Start is pressed.
X2	Manual mode
X3	Auto mode
M1	Start trigger in auto mode
T0	Timer. Time base: 100ms
T1	Timer. Time base: 100ms
D0	Data register. Saving the time value of stamping
Y0	Starting the punch when Teach is pressed
Y1	Starting the punch when Start is pressed in Auto mode

Control Program:



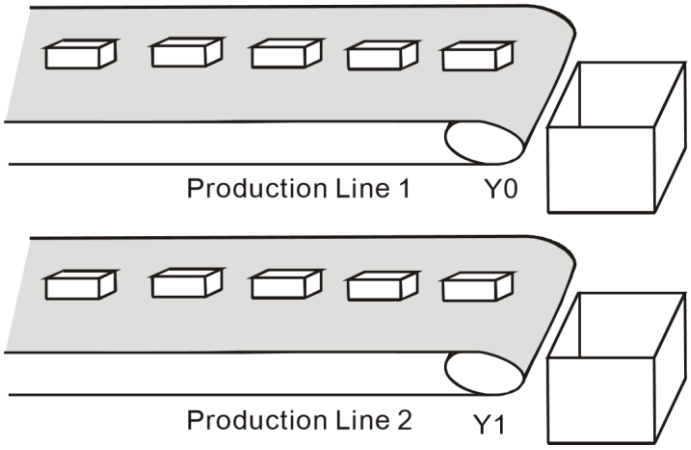
Program Description:

⌘ X2 = ON when the switch is turned to Manual mode. X0 = ON when Teach is pressed. In this case, coil Y0 will be ON and start the stamping process. At the same time, T0 will be executed and its present value will be sent to D0. Release the button Teach when the stamping process is completed. Y0 will be OFF, and the stamping process will be stopped.

⌘ X3 = ON when the switch is turned to Auto mode. Each time when X1 is pressed, Y1 will be ON and the stamping process will be executed. At the same time, T1 will be activated to count until it achieves the target value (the saved value in T0). When the stamping time is achieved, the NC contact T1 and the rising edge trigger T1 will be activated and enable both M1 and Y1 to be OFF. The stamping process will thus be stopped. When the button Start is pressed again, M1 will be ON and repeats the same stamping process.

⌘ The timer teaching function can also be performed by using API 64 TTMR instruction.

3.15 Auto Interruption Timer



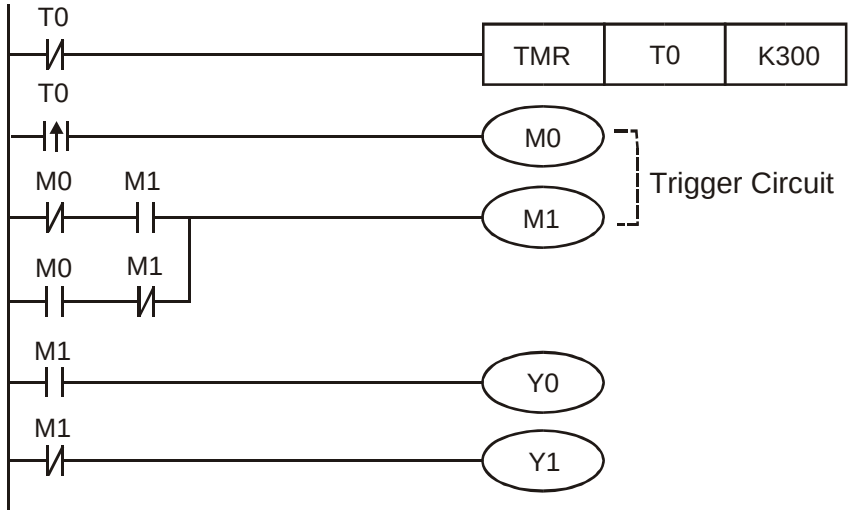
Control Purpose:

⌘ In PLC production lines, an operator should be in charge of packing products on two conveyor belts into 2 boxes. For ensuring that operators have sufficient time for packing, the program is designed to control two conveyor belts to be running alternatively: stops one conveyor after 30 sec running and then starts another conveyor for 30 sec running.

Devices:

Device	Function
T0	30 sec timer. Time base: 100ms
M0	Controlling the trigger circuit
M1	Alternating the conveyor belt
Y0	Executing the production line 1
Y1	Executing the production line 2

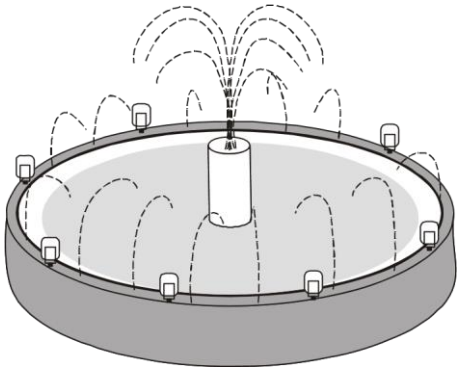
Control Program:

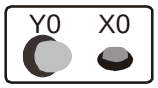


Program Description:

- ⌘ This program uses the NC contact T0 as the executing condition of the timer T0. When T0 reaches its set value, 30 sec, it will be activated. The trigger circuit will be executed to change the state of M1. Production line 1 will then start working.
- ⌘ After 30 sec counting, T0 turns ON. The NC contact T0 will be activated. At the same time, timer T0 will thus be OFF, which makes the NC contact T0 to be OFF again. In the next scan period, because the NC contact T0 is OFF, timer T0 will start counting. After 30 sec counting, T0 will be activated and so will the trigger circuit. In this case, M1 changes its state again. Production line 1 will be stopped and production line 2 will start working.
- ⌘ By using the trigger circuit to activate Y0 and Y1 alternatively, the program makes the two production lines to convey products alternatively.

3.16 Interesting Fountain





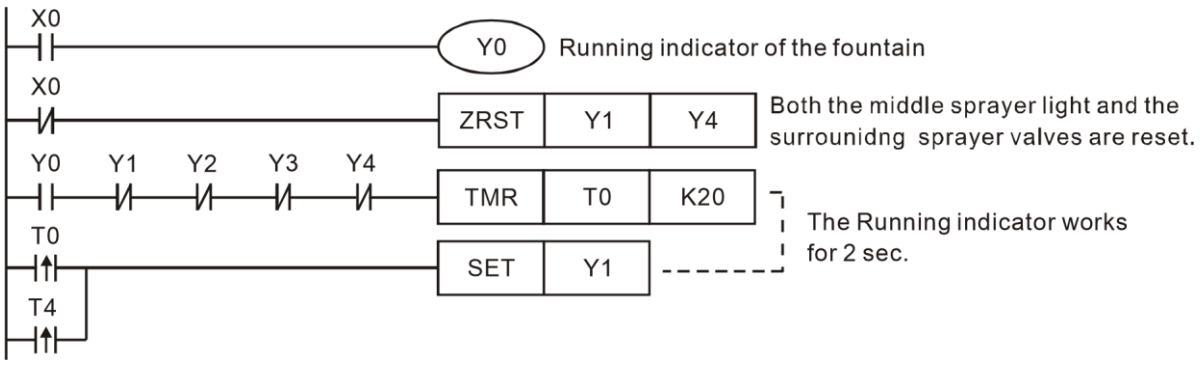
Control Purpose:

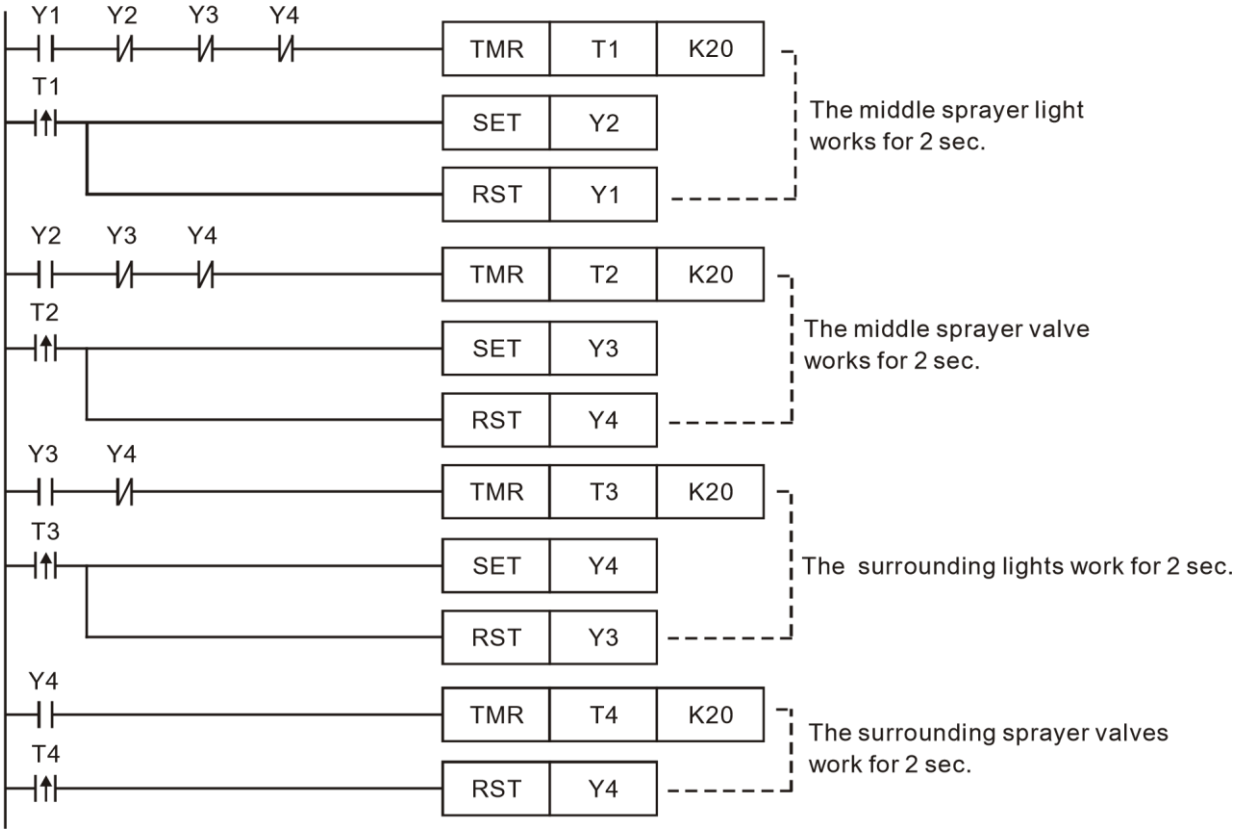
- ⌘ Keeping the Running indicator in ON state when the Start button is pressed.
- ⌘ Enabling the following devices to start in order after Running indicator is ON for 2 sec: middle sprayer light **>** middle sprayer valve **>** surrounding lights **>** surrounding sprayer valves. Each of them will be ON for 2 sec.

Devices:

Device	Function
X0	X0 = ON when the Start button of the fountain is pressed.
T0	2 sec timer. Time base: 100ms
T1	2 sec timer. Time base: 100ms
T2	2 sec timer. Time base: 100ms
T3	2 sec timer. Time base: 100ms
T4	2 sec timer. Time base: 100ms
Y0	Running indicator of the fountain
Y1	Middle sprayer light
Y2	Middle sprayer valve
Y3	Surrounding lights
Y4	Surrounding sprayer valves

Control Program:



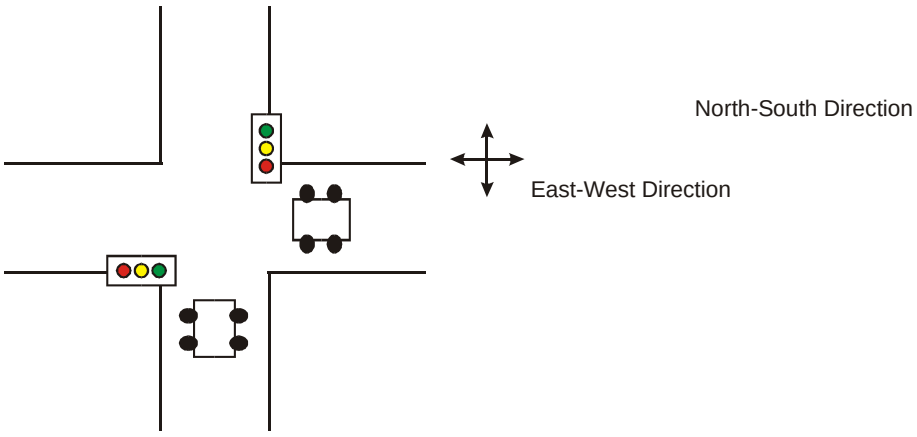


Program Description:

- ⌘ X0 = ON when the button Start is pressed. Coil Y0 will be ON to activate the Running indicator. Y0 = ON is used as the executing condition for the timer T0. After 2 sec counting down, T0 goes from OFF to ON and executes [SET Y1] instruction. The middle sprayer light Y1 will be ON. The Running indicator Y0 will be kept in ON state through the whole working process.
- ⌘ Likewise, Y1 = ON is used as the executing condition for the timer T1, and so does Y2 = ON for the timer T2 as well as Y3 = ON for the timer T3. The executions will be assured in the following order: Y1, Y2, Y3, and Y4.
- ⌘ The middle sprayer light, middle sprayer valve, surrounding lights, and surrounding sprayer valves need to be started in order. Therefore, when T1, T2 and T3 go from OFF to ON and set the next execution, they also reset the present execution. In addition, the NC contacts of Y1, Y2, Y3 and Y4 are used for turning off timers T0, T1, T2 and T3. ⌘ After the completion of the last execution, the rising edge switch T4 will reset Y4 and set Y1.

  The second round of fountain display will then be started again.
- ⌘ When X0 = OFF, coil Y0 will be OFF to turn off the Running indicator. In addition, ZRST instruction will be executed at the same time. Y1, Y2, Y3 and Y4 will be reset and all the valves and lights in the fountain will be stopped immediately.

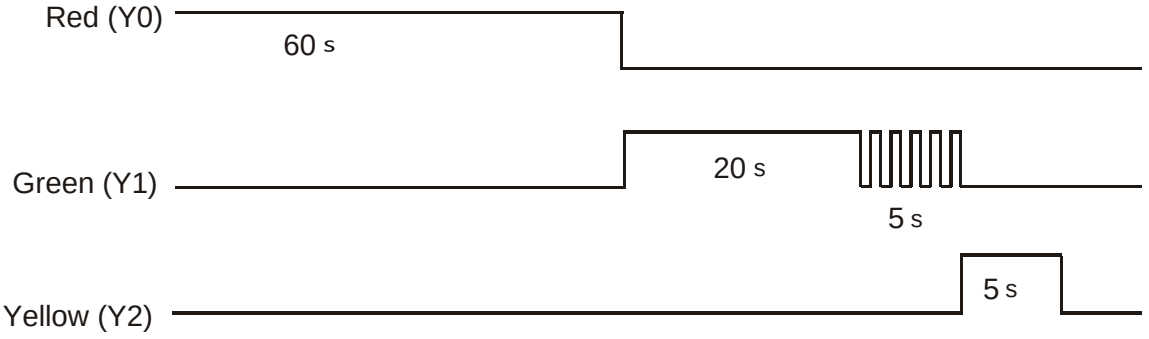
3.17 Traffic Lights Control



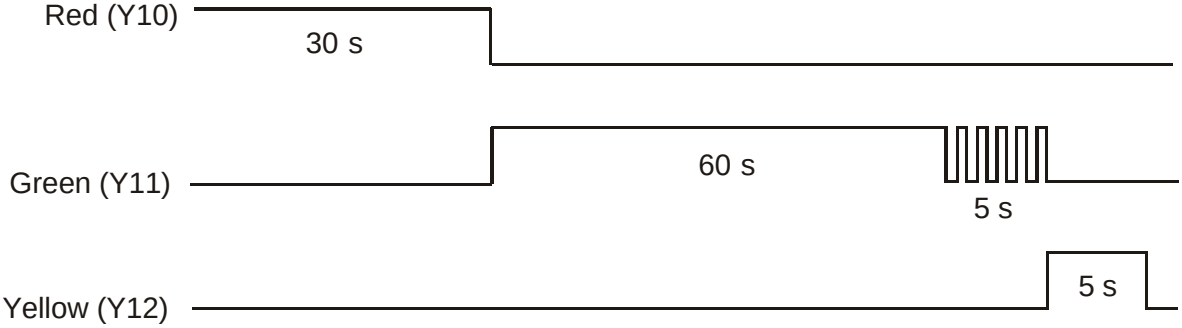
Control Purpose:

- ⌘ Enabling the traffic lights to work by Start button X0 and to stop by Stop button X1.
- ⌘ Setting the time of red light in East-West direction as 60 sec and North-South direction with a heavier traffic as 30 sec.
- ⌘ The time of red light in East-West direction equals to the time of “green light + green light flashing + yellow light” in North-south direction, and vice versa.
- ⌘ When yellow light is ON, cars and pedestrians should not cross the road, and yellow light will last for 5 sec for the crossing cars and pedestrians to pass safely.

⌘ Timing diagram of traffic lights in East-West direction:



⌘ Timing diagram of traffic lights in North-South direction:

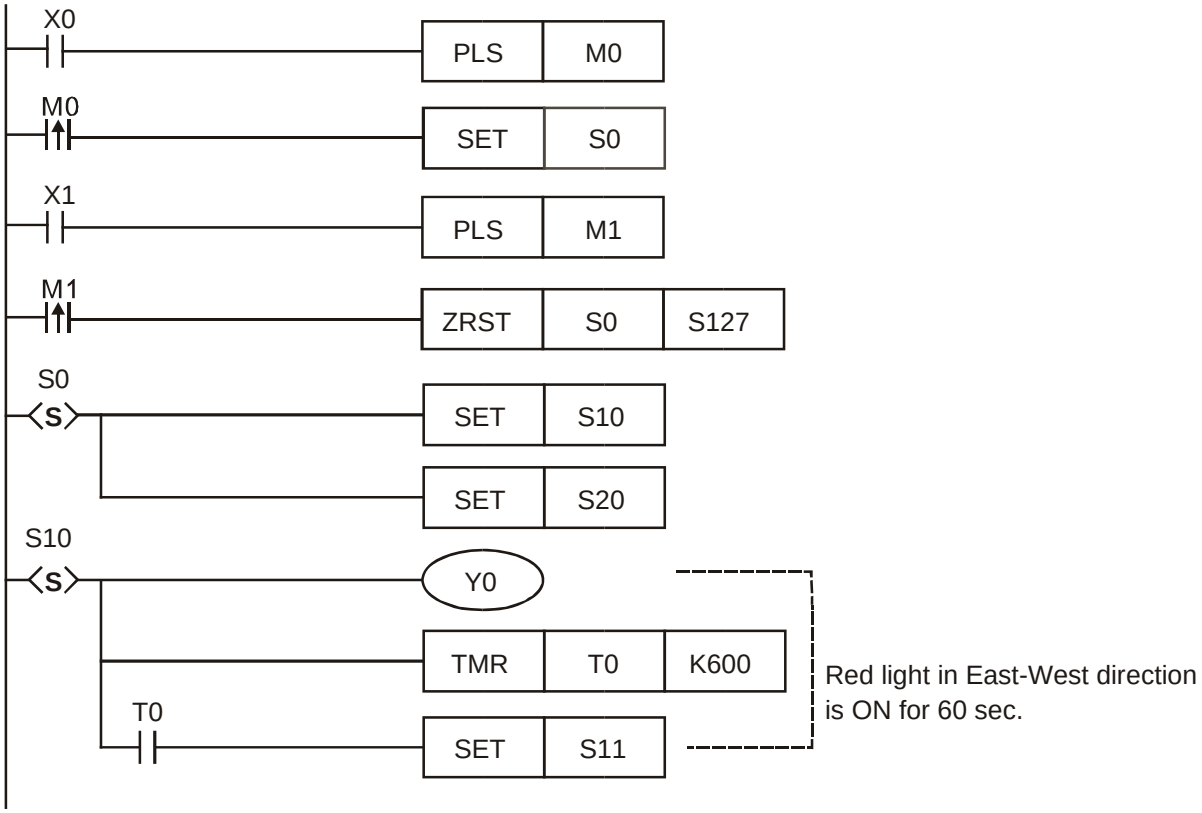


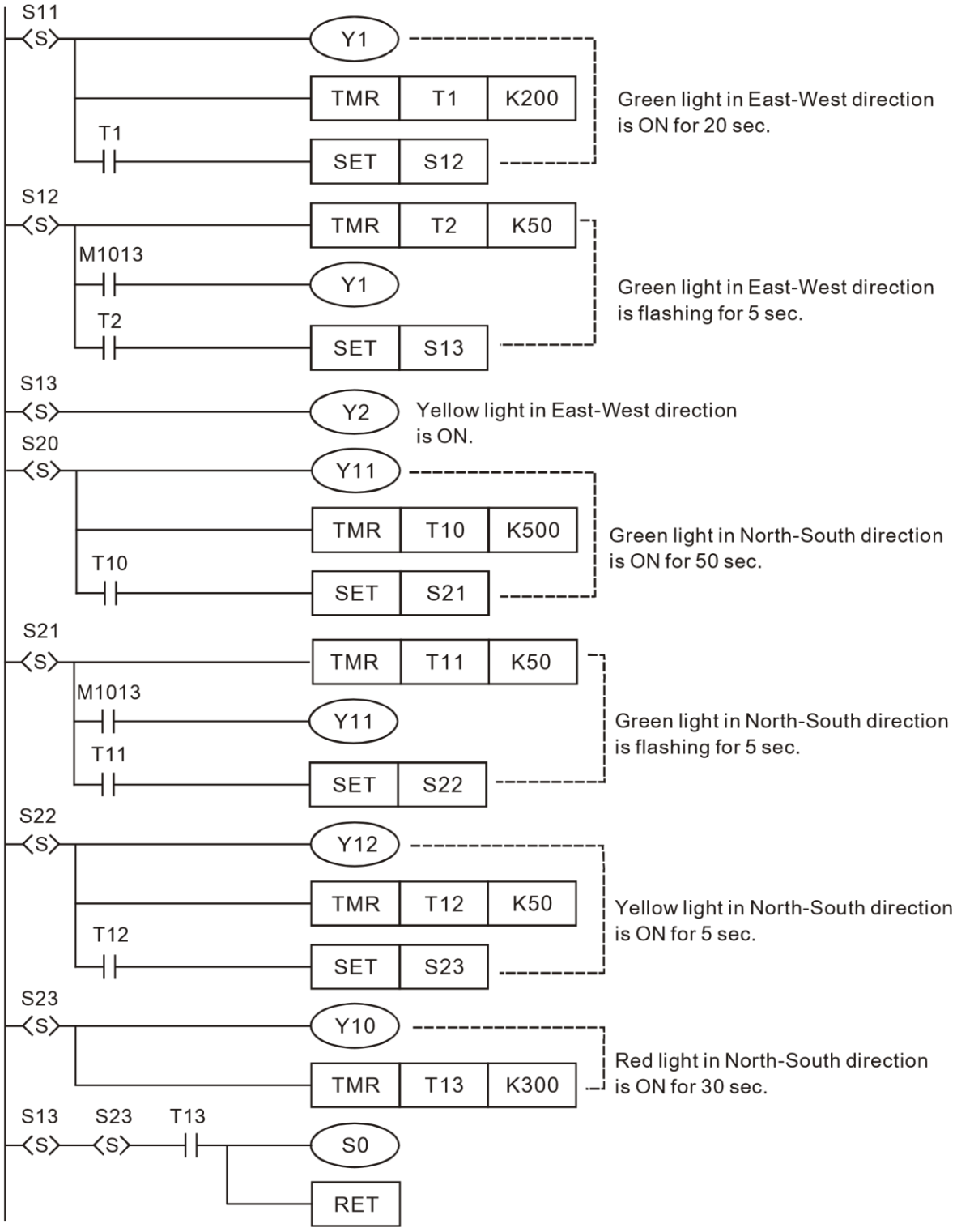
Devices:

Device	Function

X0	Start button
X1	Stop button
T0	60 sec timer. Time base: 100ms
T1	20 sec timer. Time base: 100ms
T2	5 sec timer. Time base: 100ms
T10	50 sec timer. Time base: 100ms
T11	5 sec timer. Time base: 100ms
T12	5 sec timer. Time base: 100ms
T13	30 sec timer. Time base: 100ms
S0	Initial step
S10 ~ S13	Controlling the Traffic lights in East-West direction
S20 ~ S23	Controlling the Traffic lights in North-South direction
Y0	Red light in East-West direction
Y1	Green light in East-West direction
Y2	Yellow light in East-West direction
Y10	Red light in North-South direction
Y11	Green light in North-South direction
Y12	Yellow light in North-South direction

Control Program:





Program Description:

- ⌘ When Start is pressed, X0 = ON. PLS instruction will be executed, and M0 will create a rising-edge pulse to set T0. The program will enter the step ladder process.
- ⌘ When Stop is pressed, X1 = ON. PLS instruction will be executed, and M1 will create a rising-edge pulse to execute [ZRST S0 S127] instruction. All steps will be reset and all traffic lights will be OFF.

- ⌘ This example is designed by the application of the simultaneous divergence sequence. The two sequences running simultaneously are East-West direction and North-South direction.
- ⌘ When the red light of East-West direction is ON, the corresponding state of North-South direction will be the sequence of “Green ON”, “Green Flashing” and “Yellow ON.”
- ⌘ When the East-West direction sequence is finished (the yellow light is OFF), the North-South direction sequence will be finished as well (the red light is OFF). The program will return to the initial step S0.
- ⌘ When a step is transferred from one sequence to another sequence, the former sequence will be reset including the step and output point Y.
- ⌘ The time of yellow light in East-West direction (Y2) is not controlled by a timer because when the red light in North-South direction is OFF, the yellow light in North-South direction will be reset at the same time. In this case, T13 is ON to redirect the program to initial step S0, and the outputs (Y2 and Y10) corresponding to S13 and S23 will thus be reset.