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DVP-2959920-01

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20120417

DVP-*PLC* Application Examples of Programming

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

CONTENTS

1. Basic Program Design Examples

2. Counter Design Examples

3. Timer Design Examples

4. Index Registers E, F Design Examples

5. Loop Instruction Design Examples

6. Data Transmission and Comparison Design Examples

7. Elementary Arithmetic Operations Design Examples

8. Rotation and Shift Design Examples

9. Data Processing Design Examples

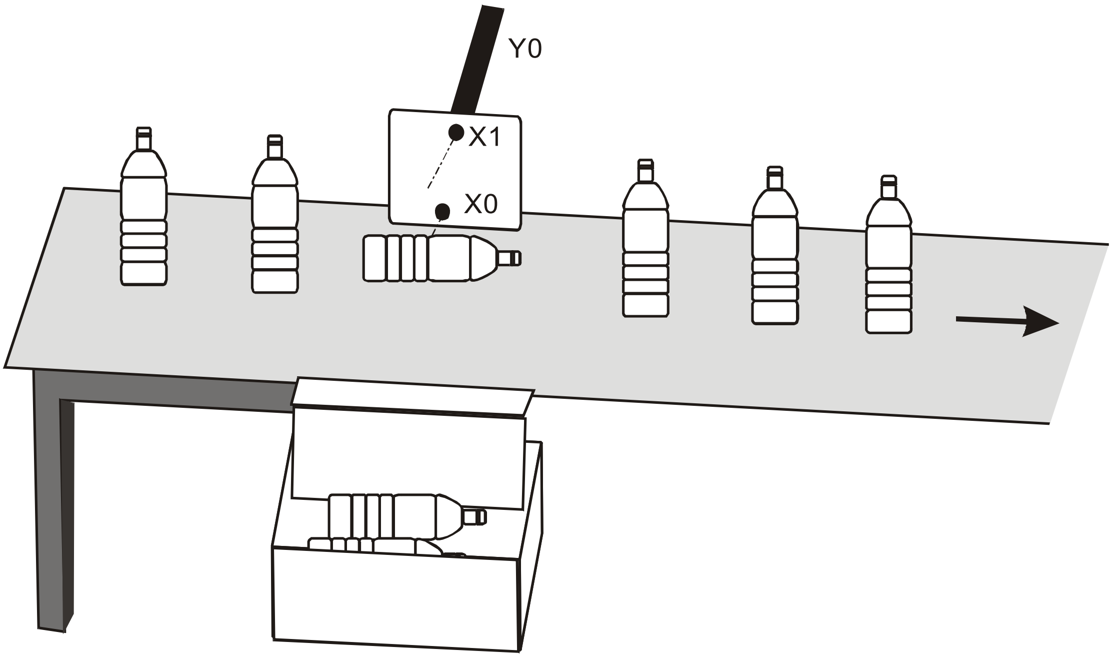
10. High-speed Input/Output Design Examples

11. Floating Point Operation Design Examples

12. Communication Design Examples

13. Real Time Calendar Time Design Examples

1.1 Normally Closed Contact in Series Connection



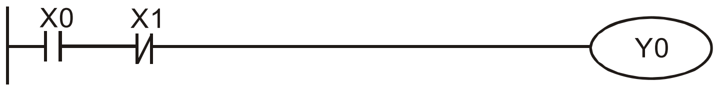
Control Purpose:

- 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

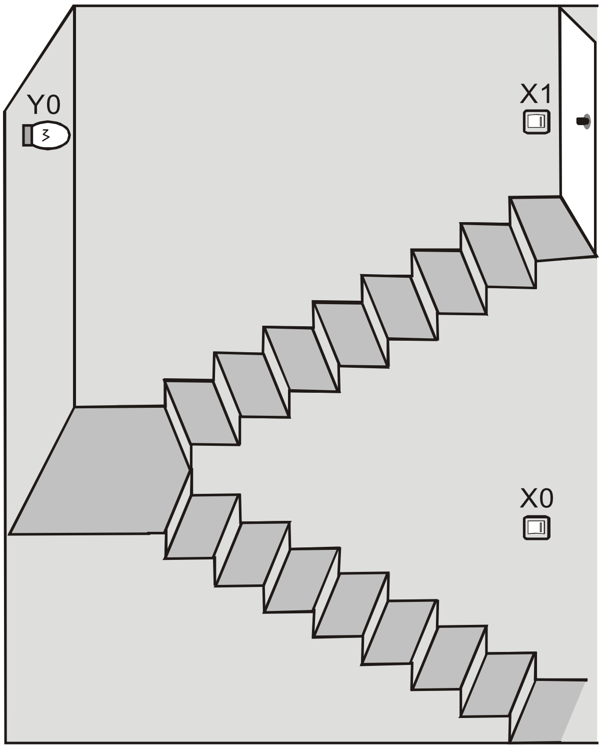
Control Program:



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



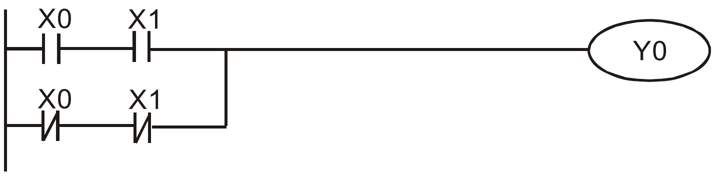
Control Purpose:

- 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:



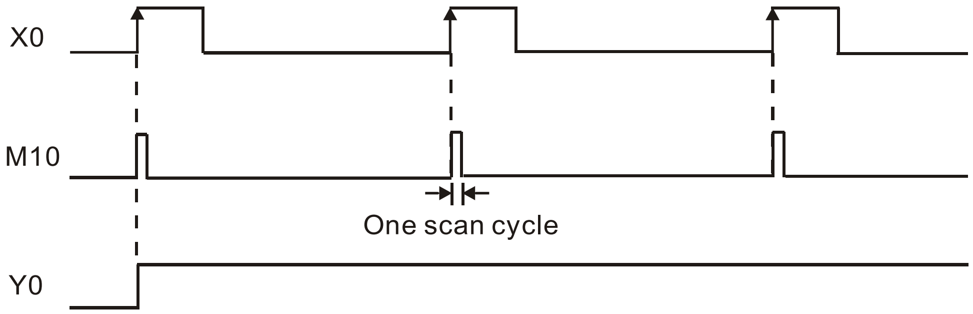
Program Description:

- 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:

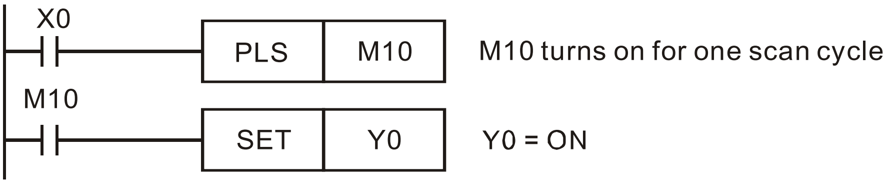
- Creating a pulse of one program scan cycle as the condition to trigger the indicator or other devices when the switch (X0) is turned on.



Devices:

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

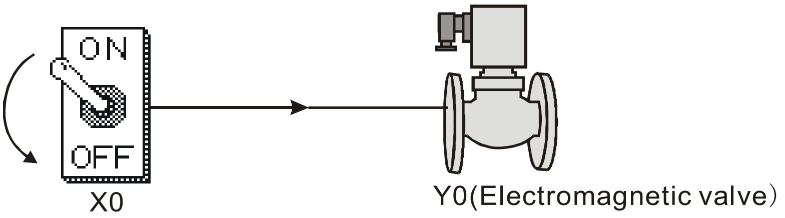
Control Program:



Program Description:

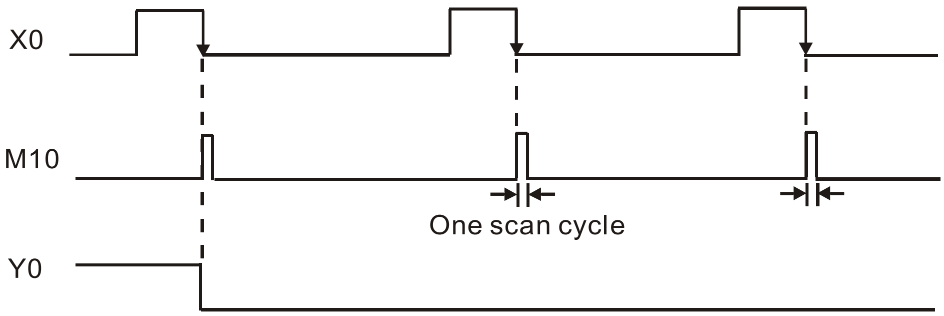
- When X0 is turned on (Rising-edge triggered), PLS instruction will be executed, and M10 will send a pulse for one program scan cycle.
- When M10 = ON, [SET Y0] instruction will be executed and Y0 will be ON. In this case, the indicator will be lighted, and other devices will be activated as well.

1.4 Falling-edge Pulse Output for One Scan Cycle



Control Purpose:

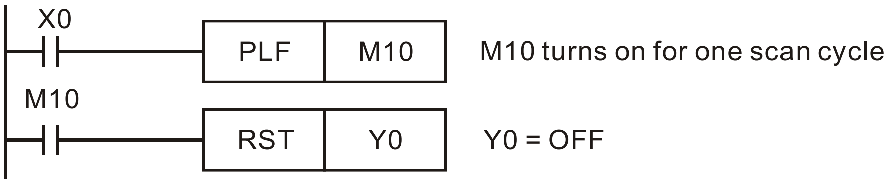
- Creating a pulse of one program scan cycle as the condition to trigger the electromagnetic valve or other devices when the switch is turned off.



Devices:

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

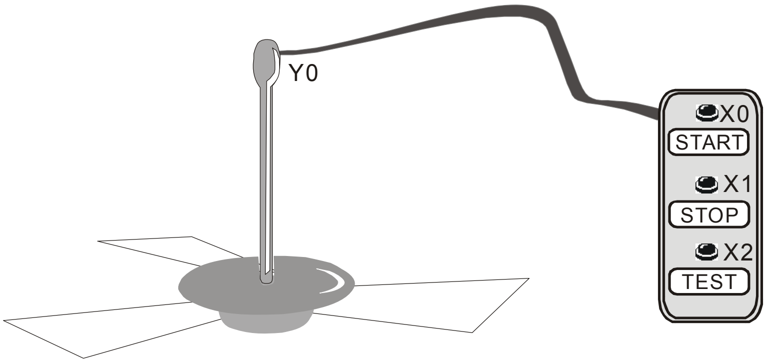
Control Program:



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



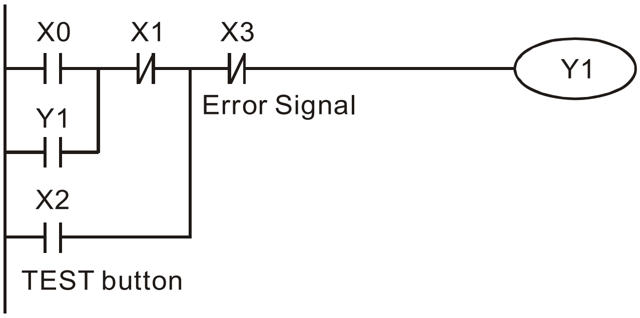
Control Purpose:

- 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

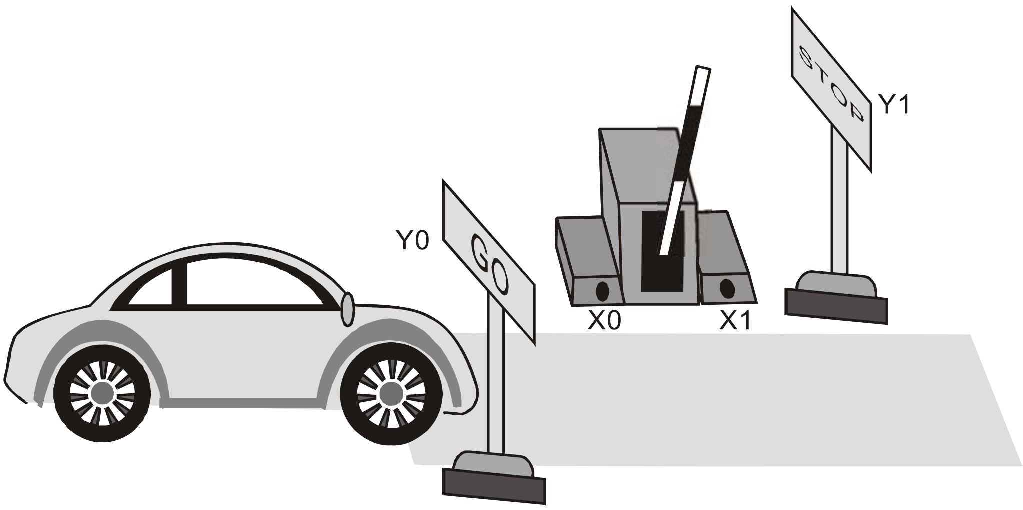
Control Program:



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



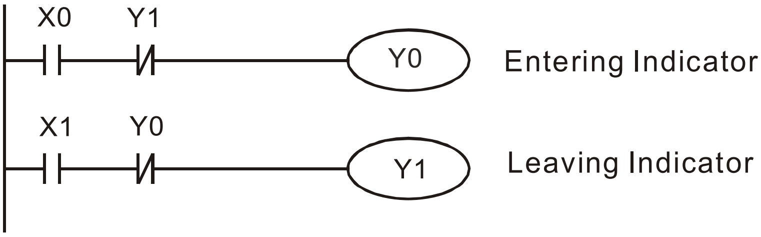
Control Purpose:

- 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”）

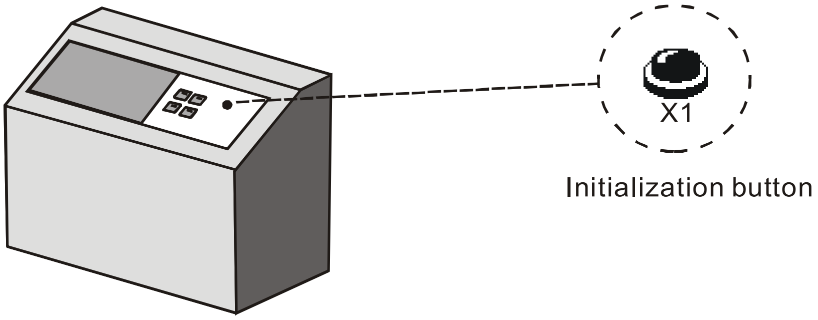
Control Program



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



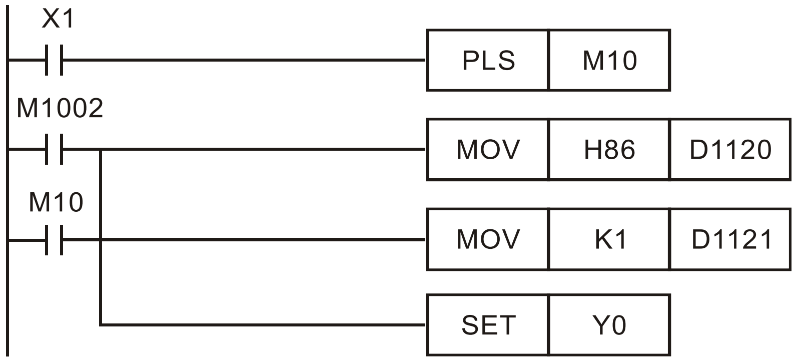
Control Purpose:

- 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:

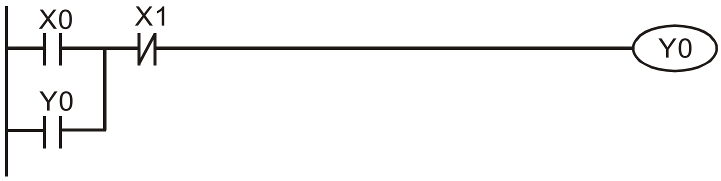
- Turn on the switch, the light will be ON; turn off the switch, the light will be OFF.

Devices:

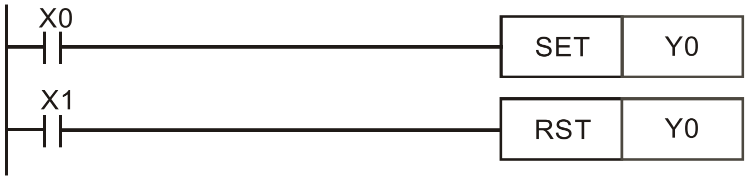
Device	Function
X0	Switch-on button. X0 will be ON when pressed
X1	Switch-off button. X1 will be ON when pressed
Y0	Indicator

Control Program:

- Common Latched Circuit



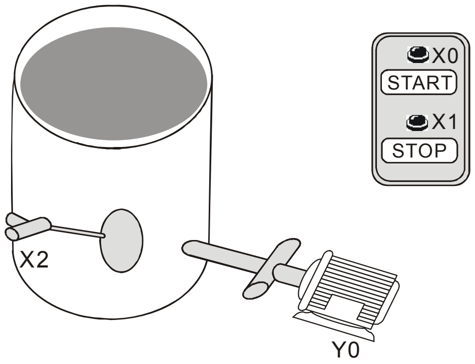
- Latched Circuit for SET/RST Instructions



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



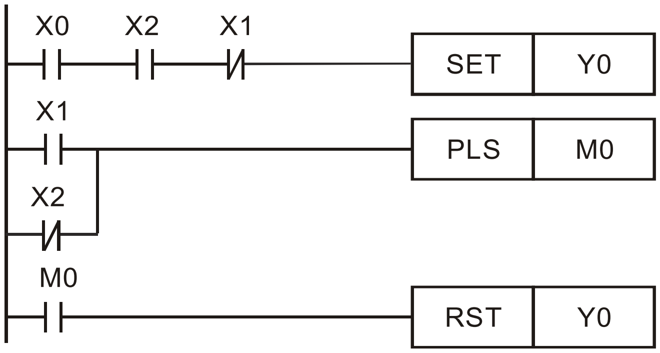
Control Purpose:

- 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)

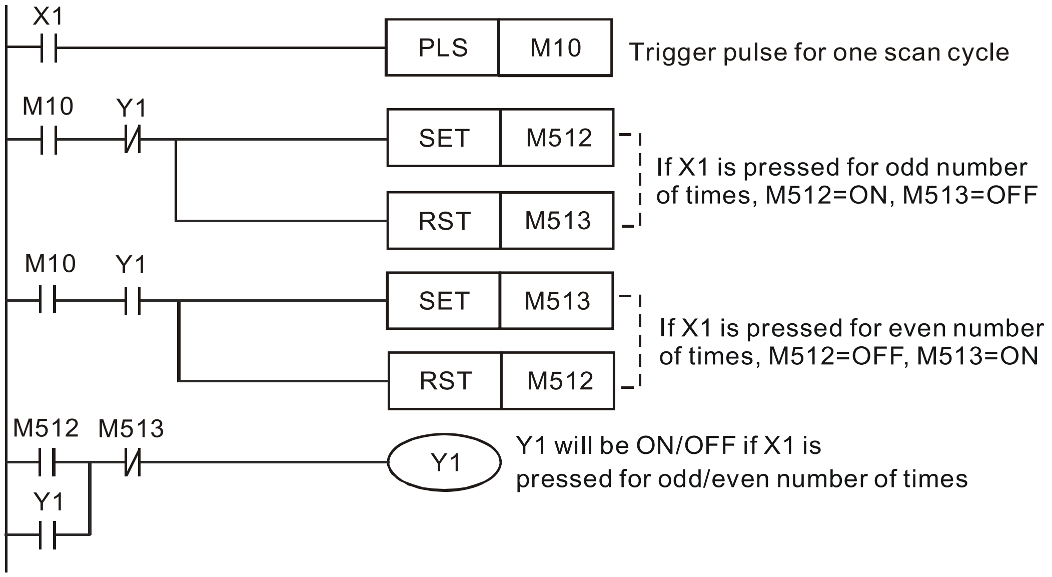
Control Purpose:

- 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:


X1
PLS
M10
Trigger pulse for one scan cycle
M10
Y1
SET
M512
RST
M513
If X1 is pressed for odd number of times, M512=ON, M513=OFF
M10
Y1
SET
M513
RST
M512
If X1 is pressed for even number of times, M512=OFF, M513=ON
M512
M513
Y1
Y1
Y1 will be ON/OFF if X1 is pressed for odd/even number of times

Program Description:

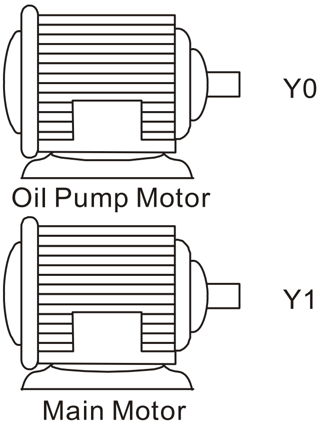
- Pressing X1 for the 1st time (or odd number of times):

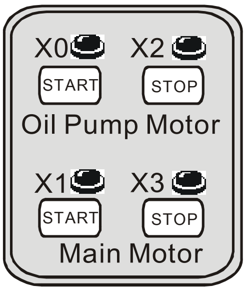
  When the switch X1 is pressed, X1 will be ON and the [PLS M10] instruction will be executed for triggering M10 to be ON for one scan cycle. In this case, M10 is ON and Y1 is OFF, SET and RST instructions at line 2 will thus be executed. On the contrary, SET and RST instructions at line 3 will not be 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





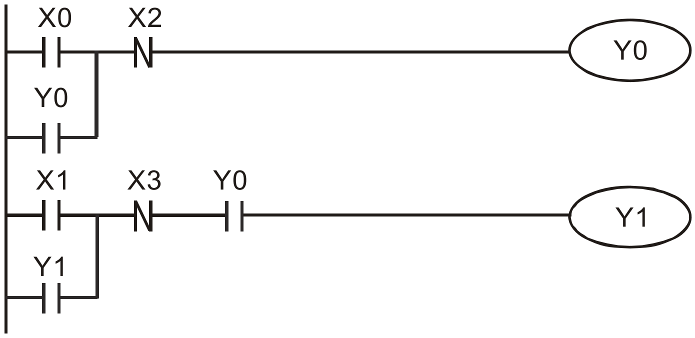
Control Purpose:

- 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

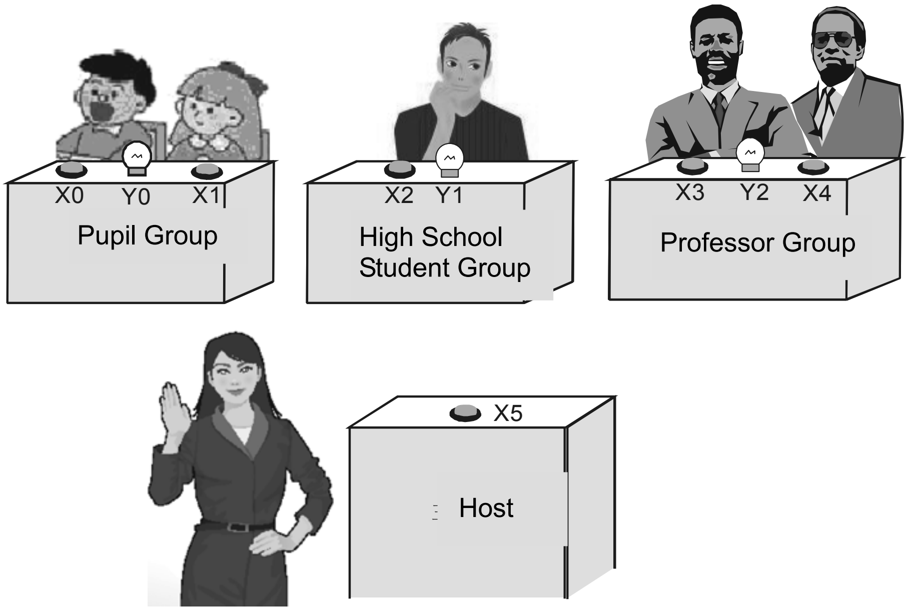
Control Program:



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



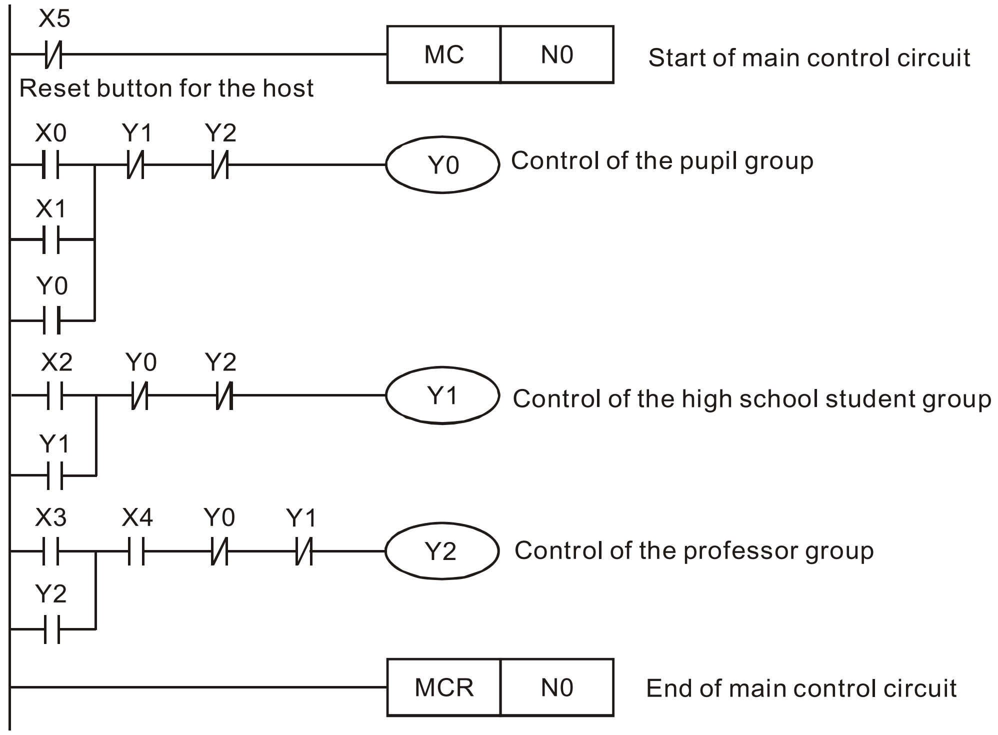
Control Purpose:

- 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:


X5
MC
N0
Start of main control circuit
Reset button for the host
X0
Y1
Y2
Y0
Control of the pupil group
X1
Y0
X2
Y0
Y2
Y1
Control of the high school student group
Y1
X3
X4
Y0
Y1
Y2
Control of the professor group
Y2
MCR
N0
End of main control circuit

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

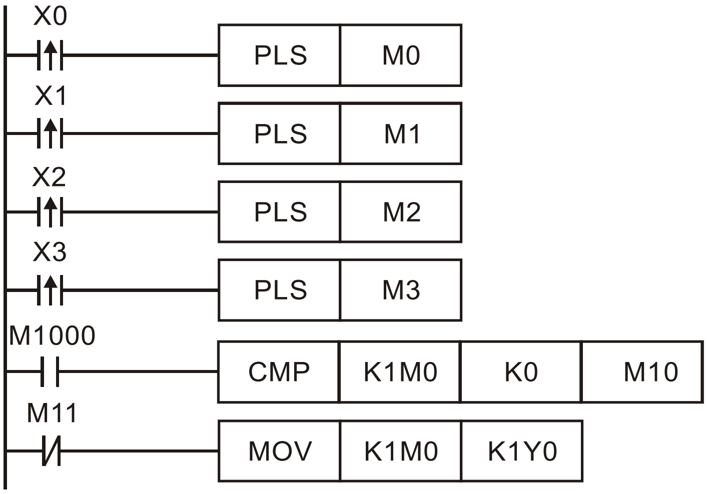
Control Purpose:

- 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

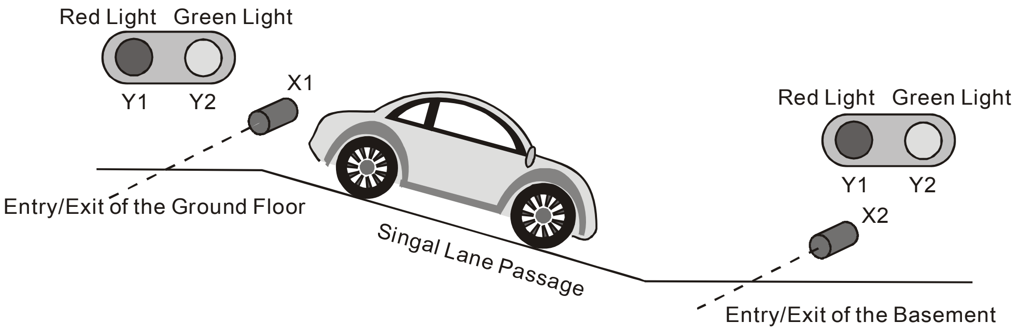
Control Program:



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



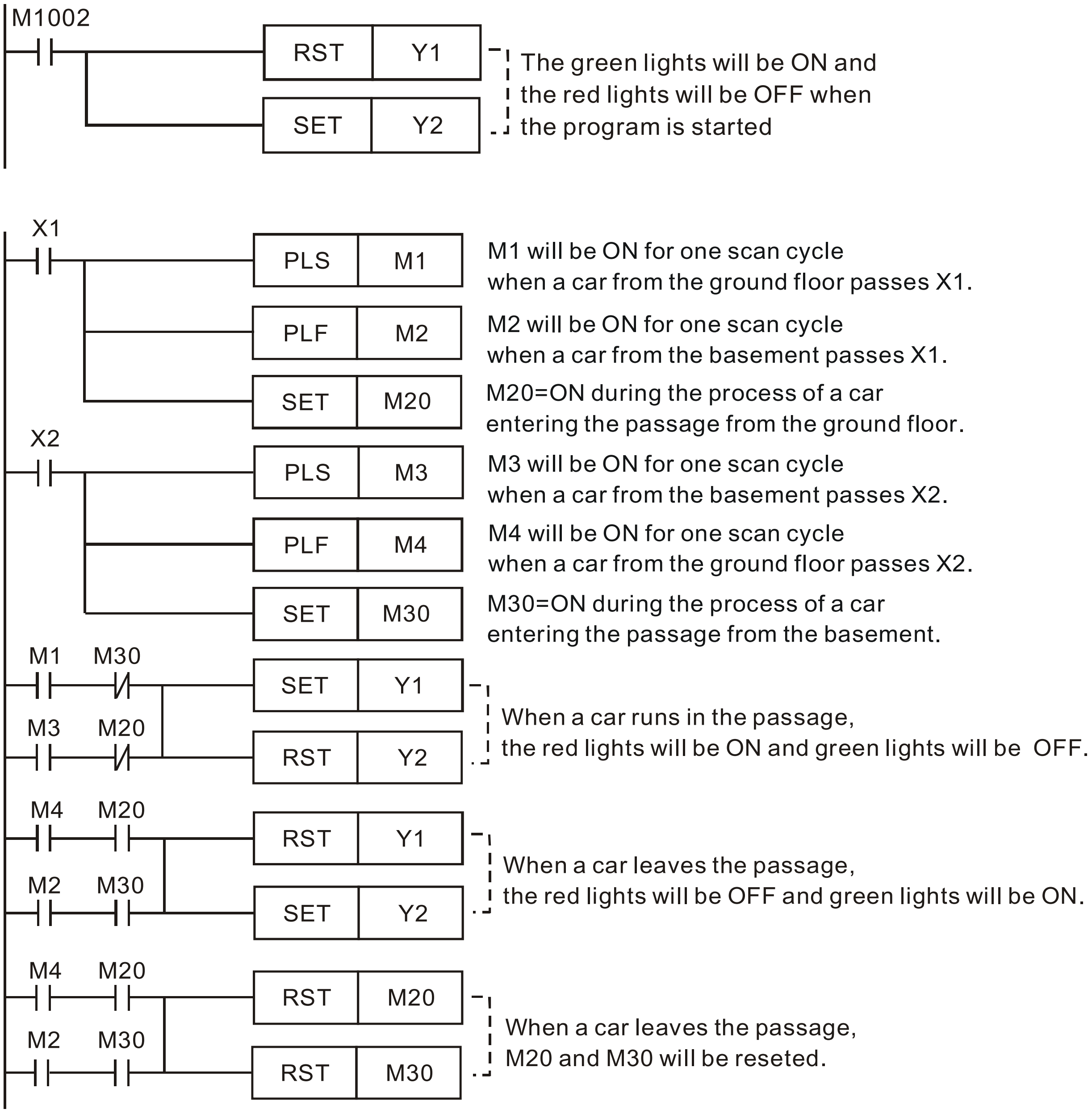
Control Purpose:

- 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.

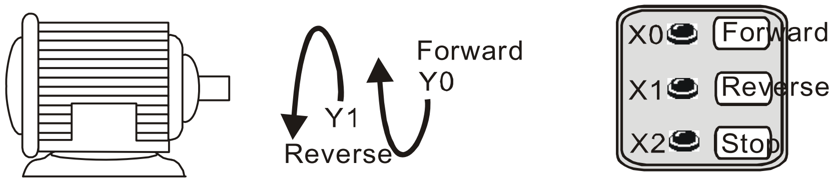
When a car leaves the passage, the red lights will be OFF and green lights will be ON.

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



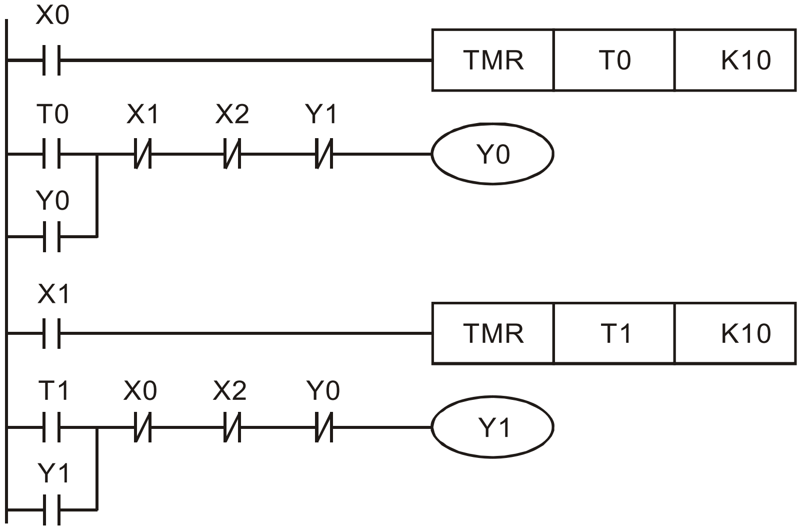
Control Purpose:

- 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

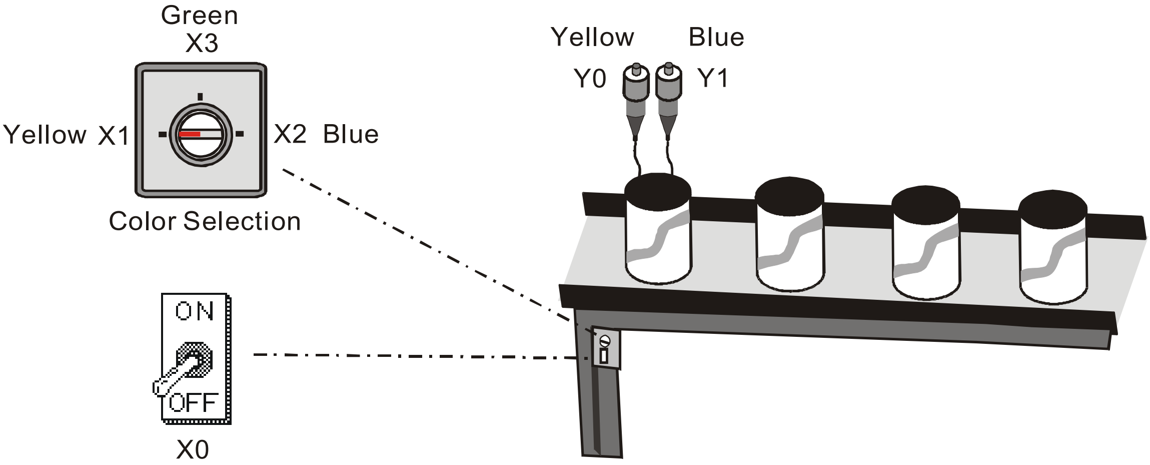
Control Program:



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



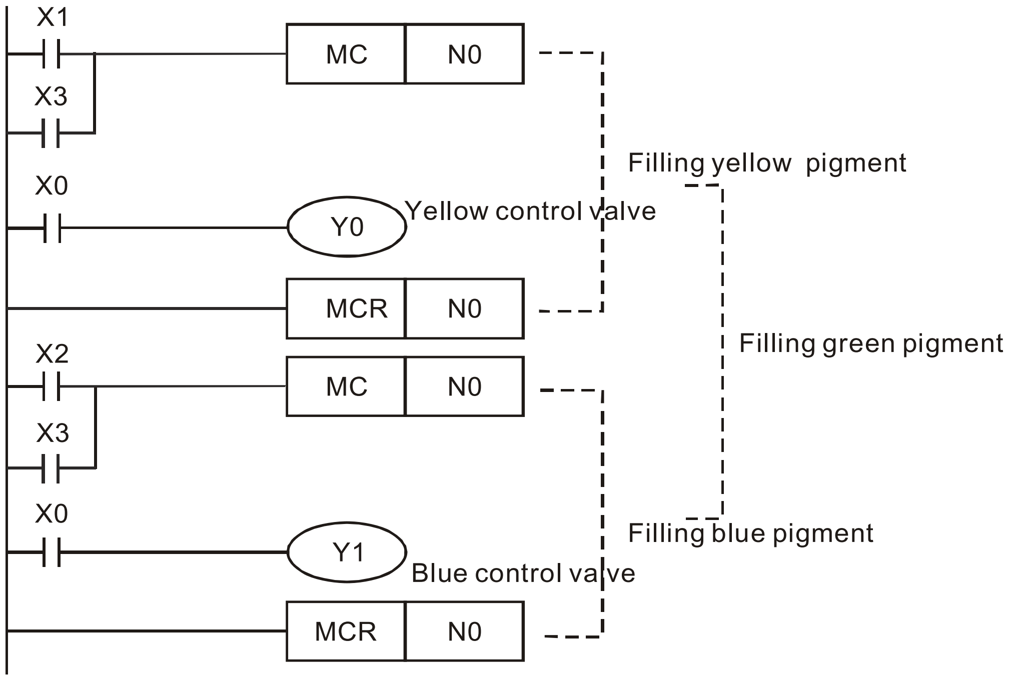
Control Purpose:

- 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

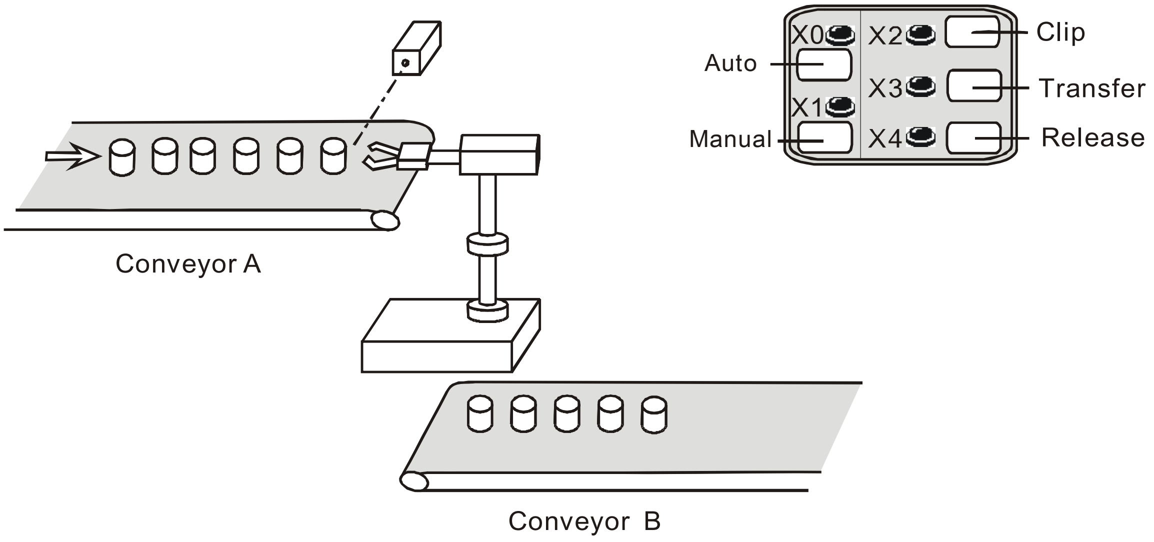
Control Program



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



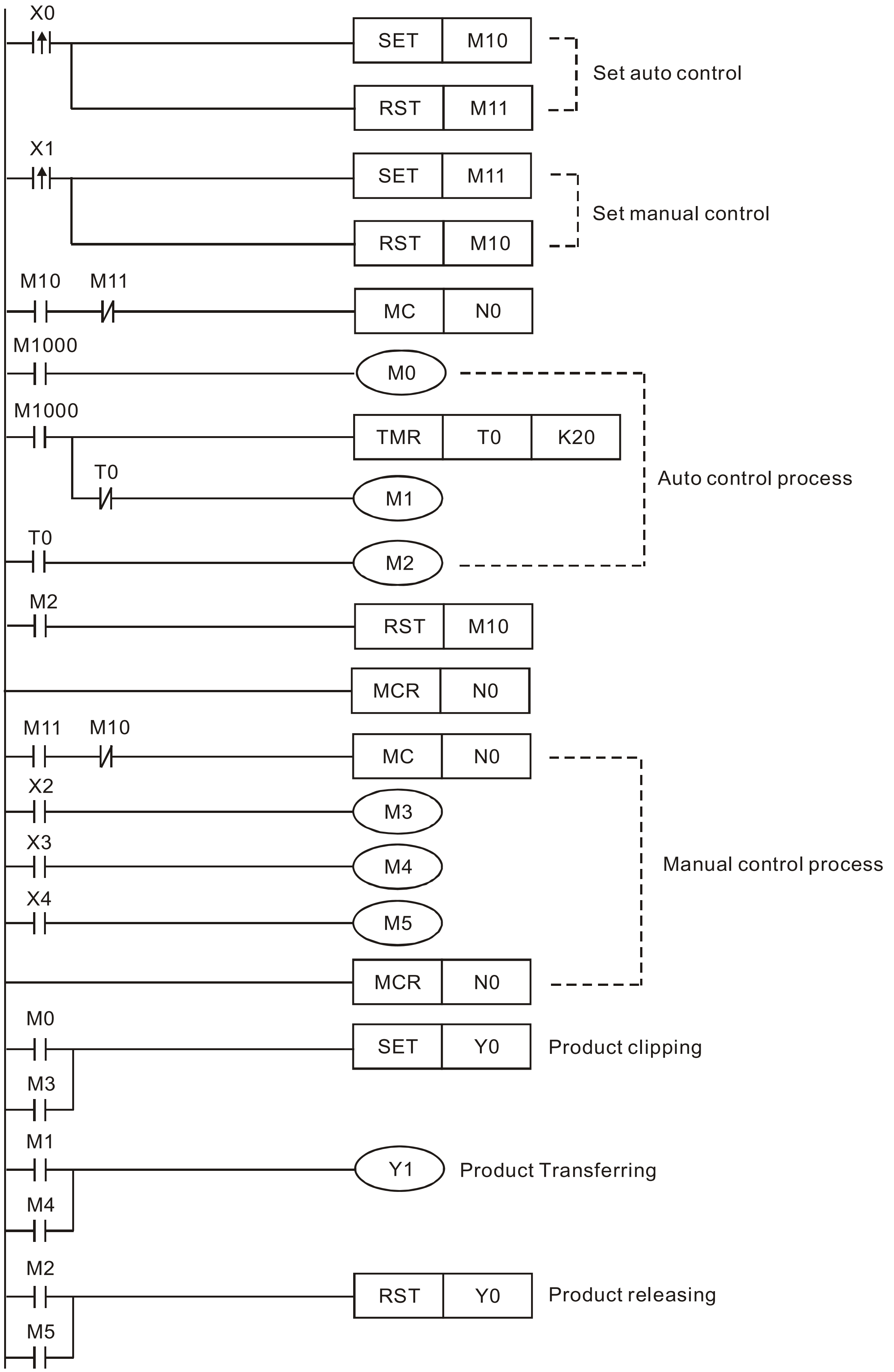
Control Purpose:

- 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

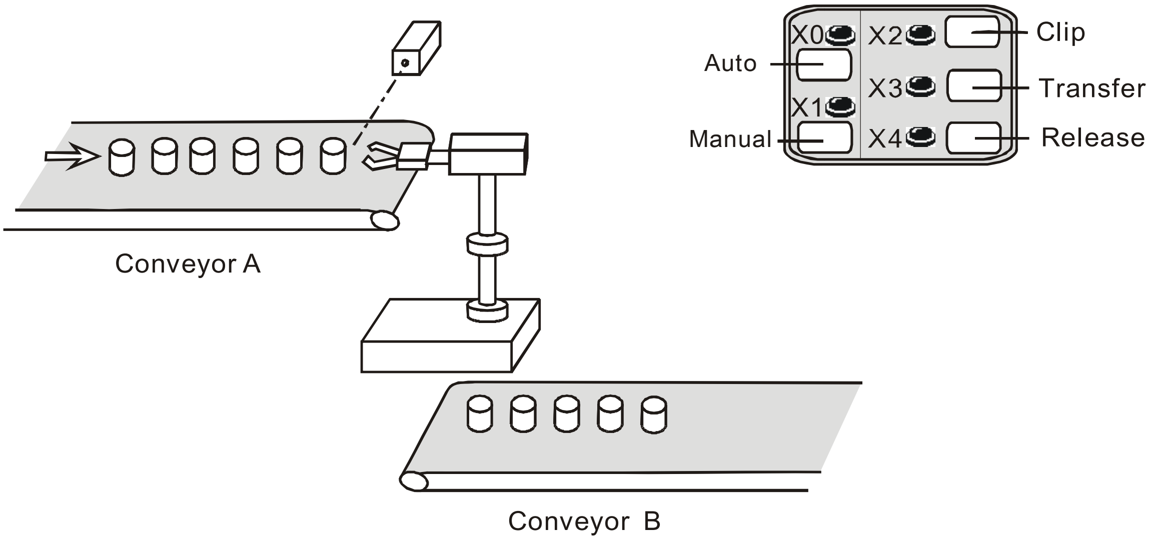
Control Program:



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



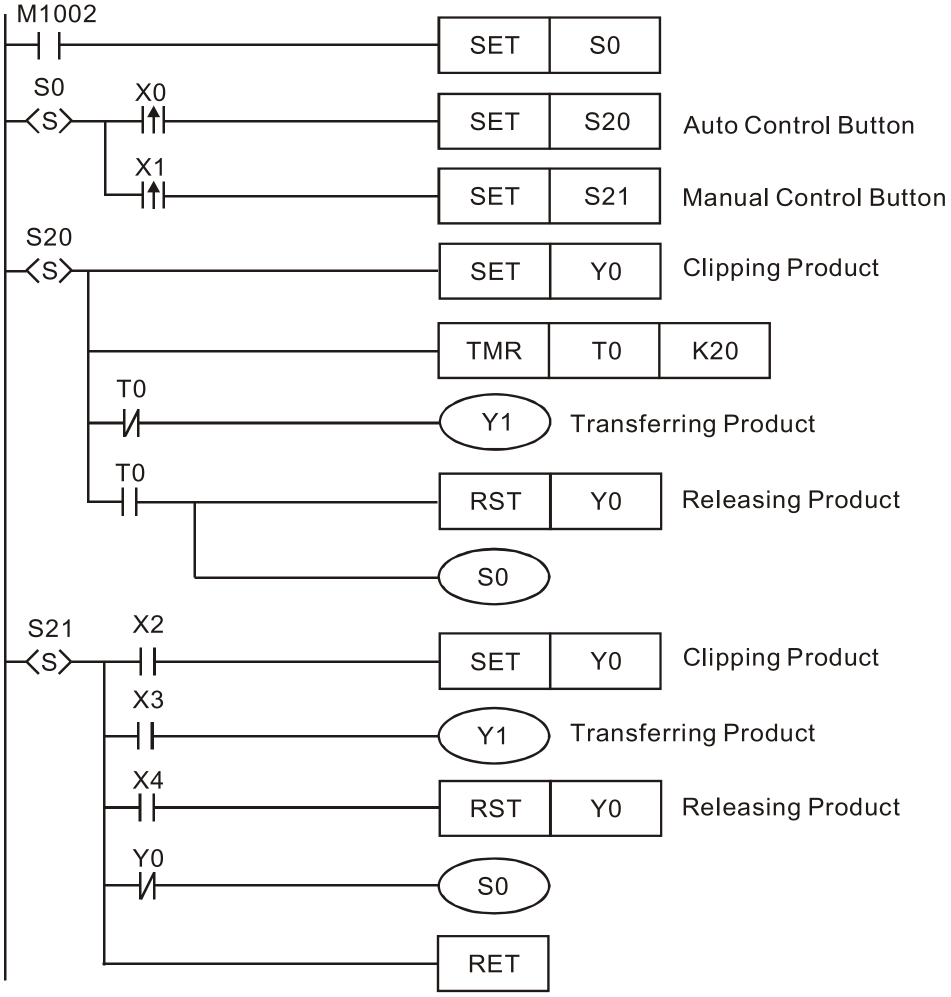
Control Purpose:

- 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:

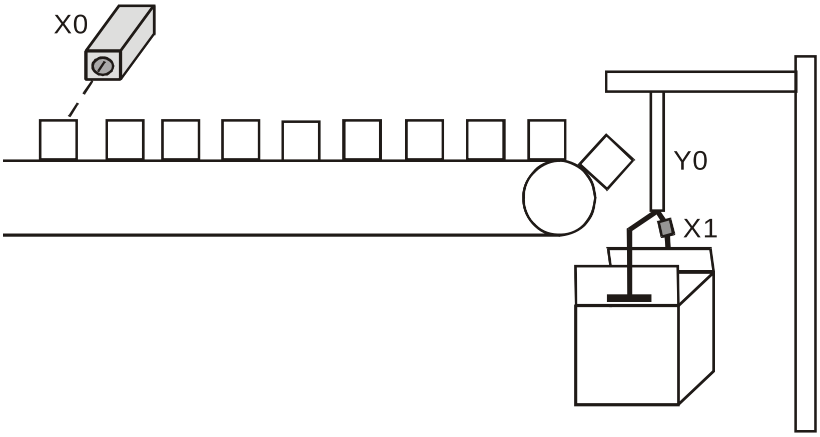


Program Description:

- 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



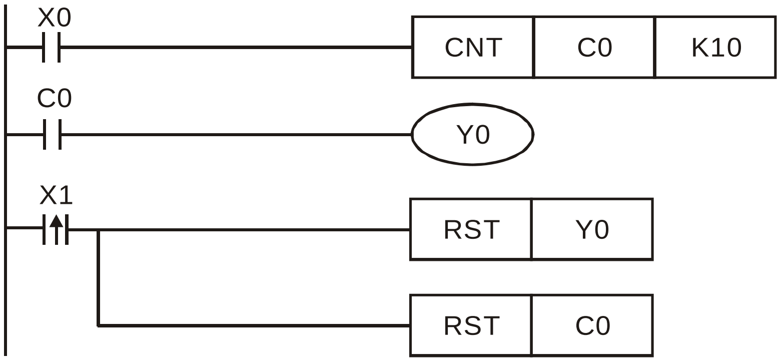
Control Purpose:

- 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

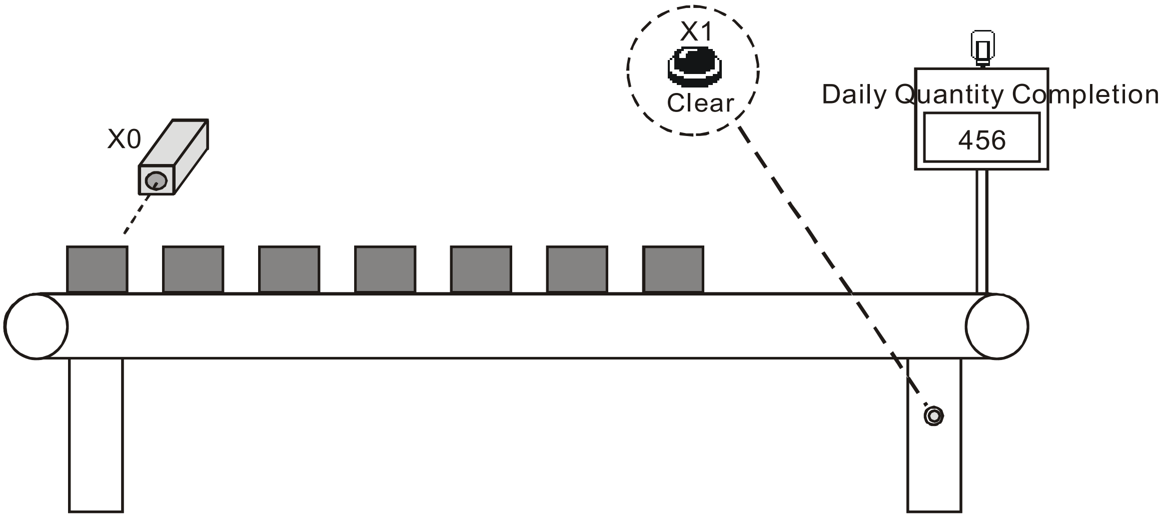
Control Program:



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)



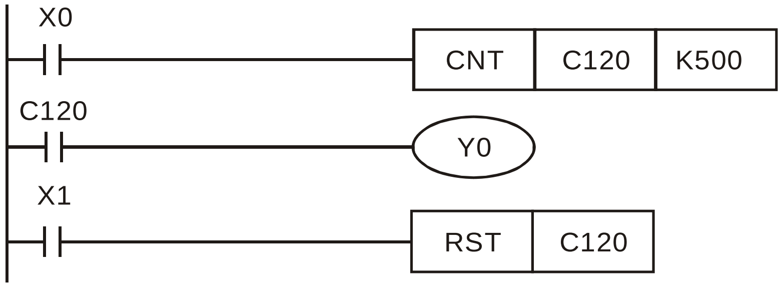
Control Purpose:

- 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:



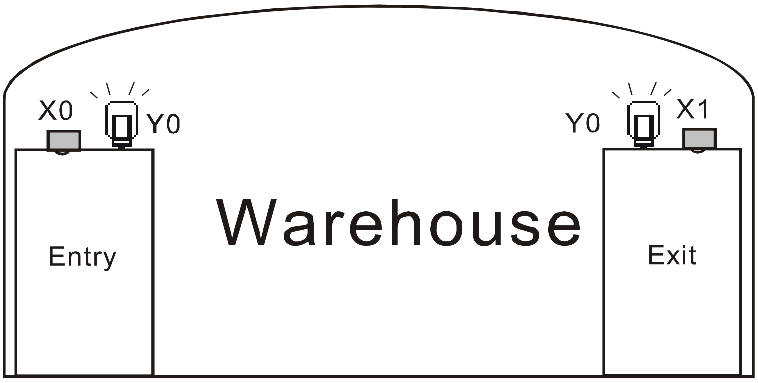
Program Description:

- 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)



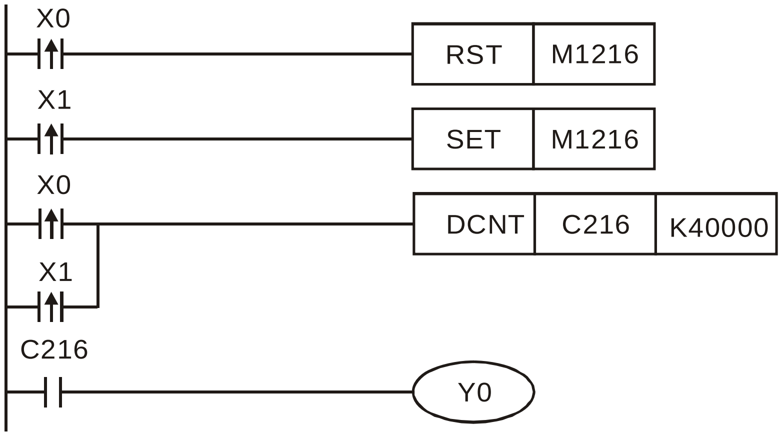
Control Purpose:

- 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

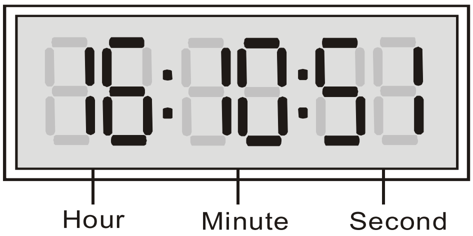
Control Program:



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



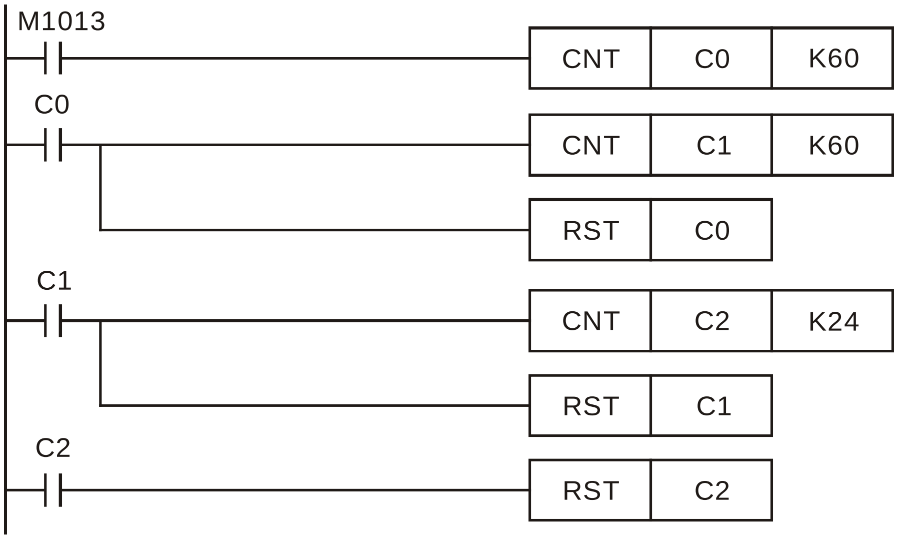
Control Purpose:

- 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:

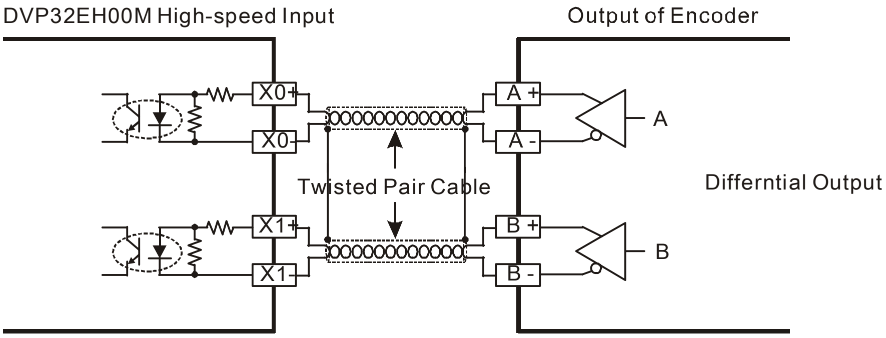


Program Description:

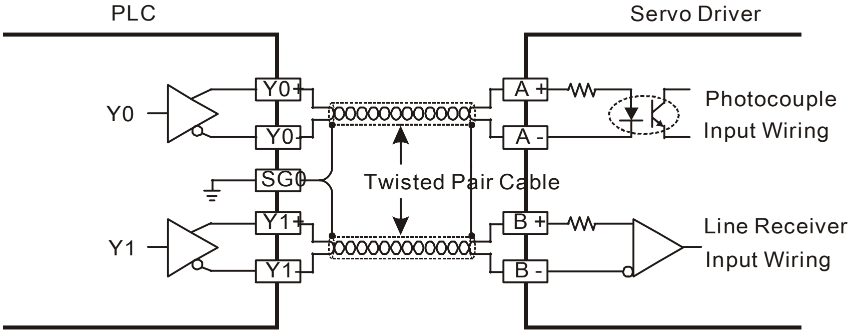
- The key of operating a 24-hour clock is to use M1013 (1s clock pulse). When the program is executed, C0 will count once per second. When the counted number reaches 60(1 minute), C0 = ON. C1 will count once, and C0 will be reset at the same time; similarly, when the counted number in C1 reaches 60(1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



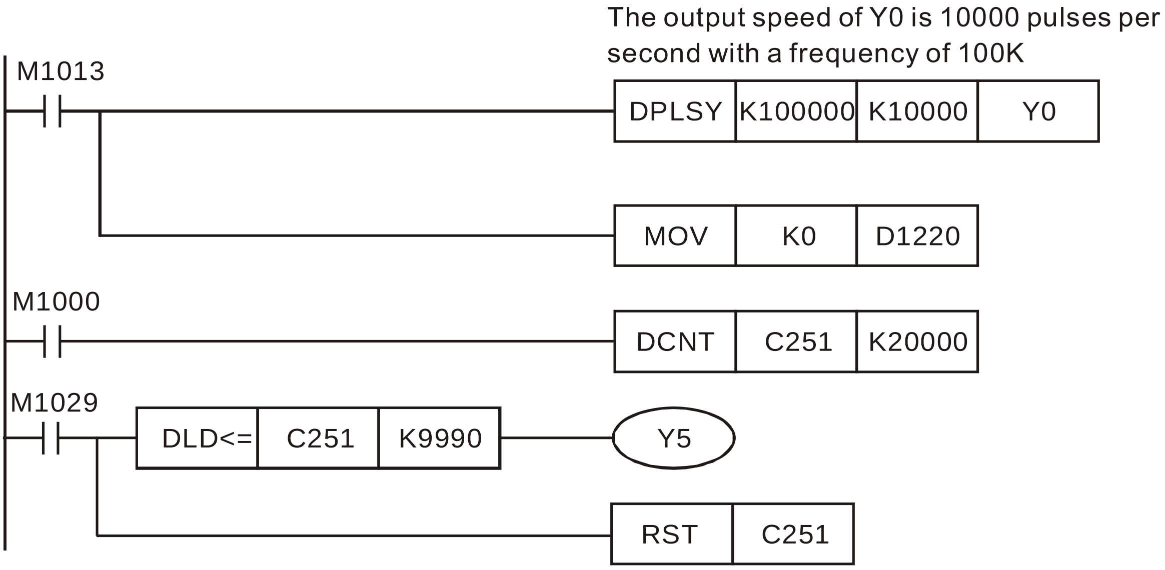
Control Purpose:

- 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

Control Program:



Program Description:

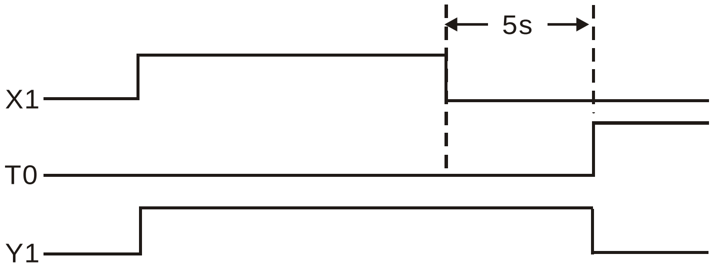
- In this example, M1013 is used to control PLC for sending pulses. D1220 = K0 activates Y0 to output pulses and transfer the encoded feedback signal of servo motor from the encoder to the high-speed inputs (X0, X1). X0 and X1 are corresponded to high-speed counter C251, whose max counting frequency 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:

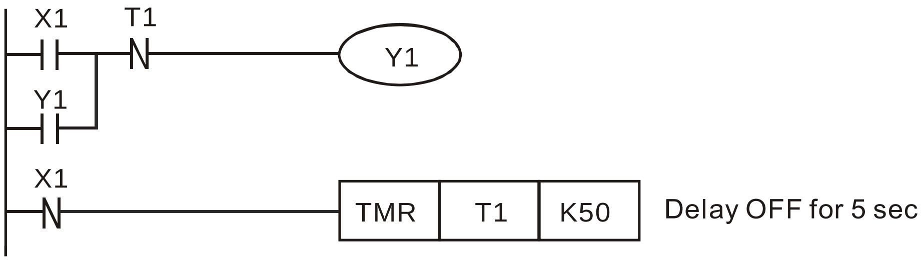
- Enabling the indicator to be ON immediately and OFF after a 5 sec delay by the switch



Devices:

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

Control Program:



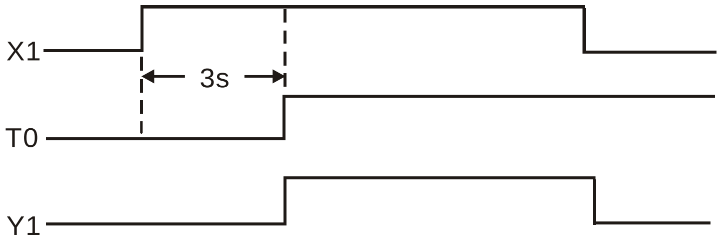
Program Description:

- 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:

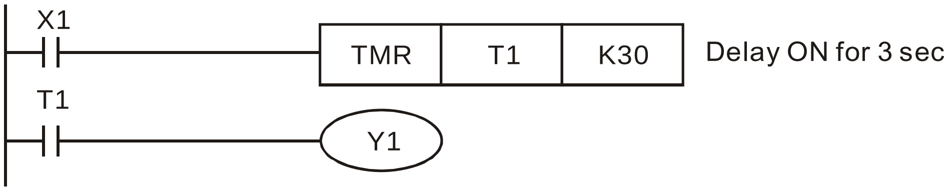
- Enabling the indicator to be ON after a 3 sec delay and OFF immediately by the switch



Devices:

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

Control Program:



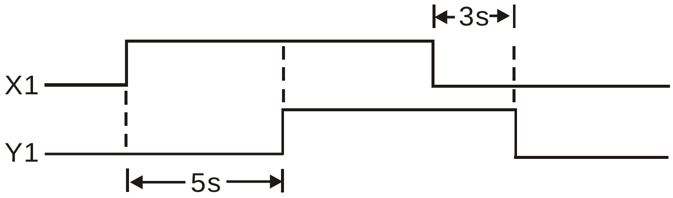
Program Description:

- 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:

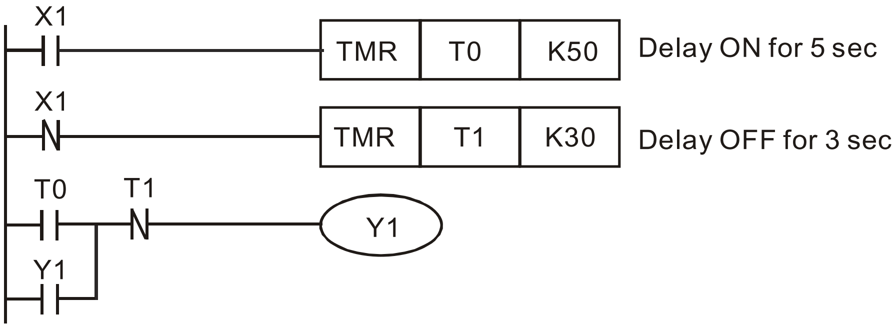
- Enabling the indicator to be ON after a 5 sec delay and OFF after a 3 sec delay by the switch



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

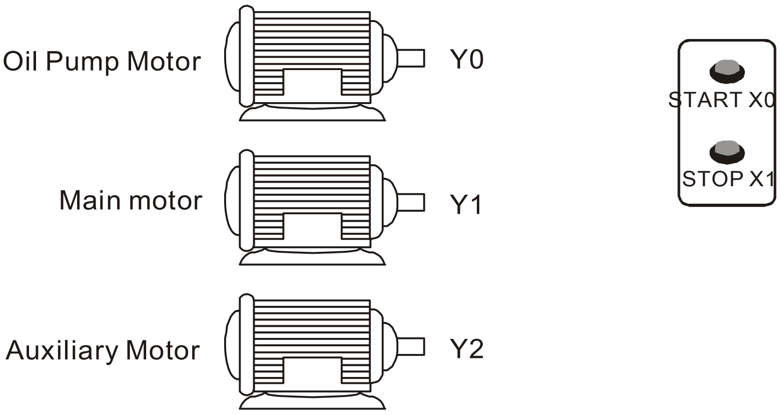
Control Program:



Program Description:

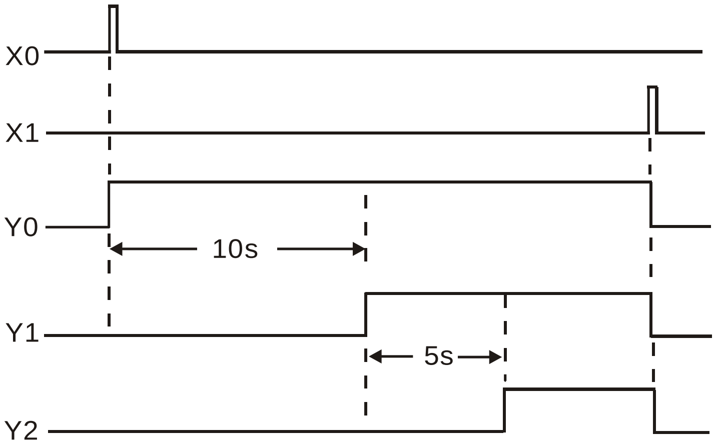
- When X1 = ON, T0 will start counting for 5 sec. When T0 reaches its set value, the NO contact T0 will be ON while NC contact T1 will remain OFF, which makes the indicator Y1 to be ON and latched.
- When X1 = OFF, T1 will start counting for 3 sec. When T1 reaches its set value, the NC contact T1 will 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:

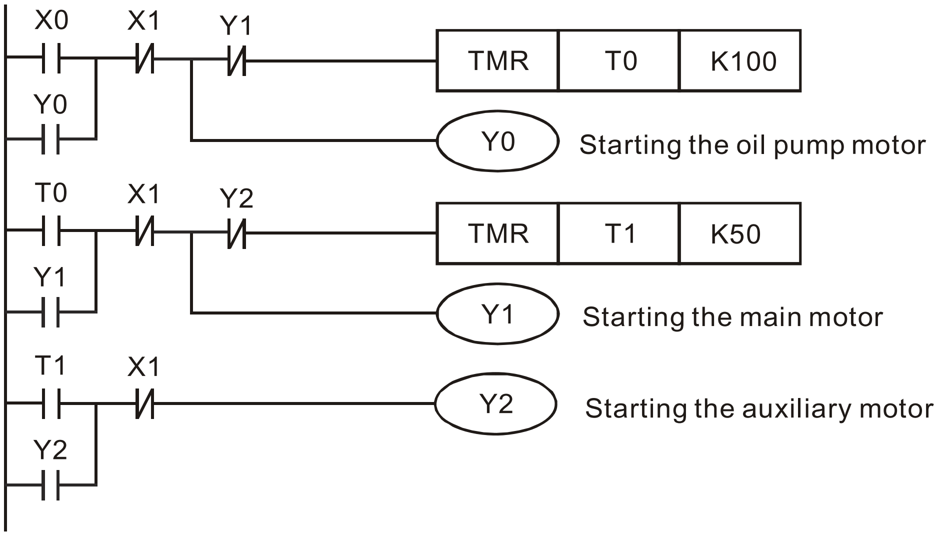
- Starting the oil pump motor immediately when START is pressed. The main motor will be started after a 10 sec delay and then the auxiliary motor after a 5 sec delay. In addition, stopping all motors immediately when STOP is pressed.



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:



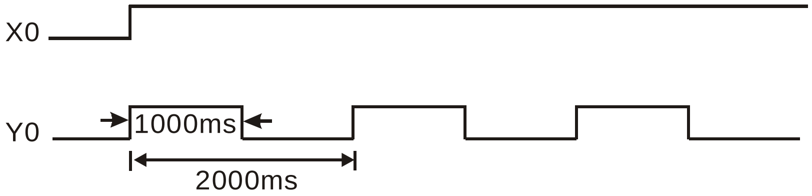
Program Description:

- 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:

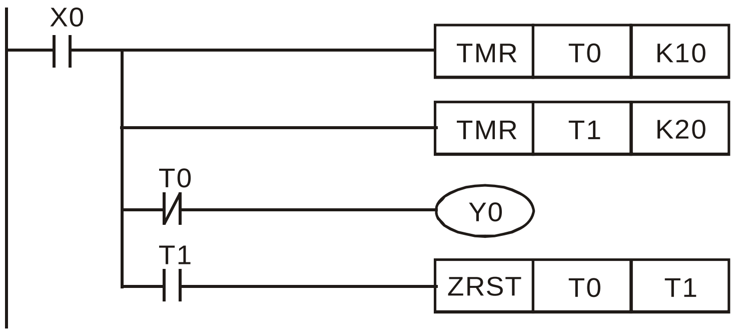
- Performing Pulse Width Modulation function by changing the set value of the timer in the program. The oscillating pulse is as below: (Y0 = ON for 1 sec. The cycle = 2 sec)



Devices:

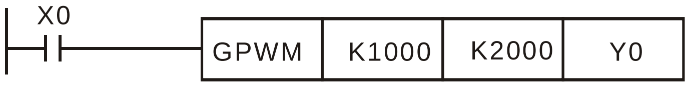
Device	Function
X0	X0 = ON when the switch is turned on
T0	1 sec timer. Time base: 100ms
T1	2 sec timer. Time base: 100ms
Y0	Oscillating pulse output

Control Program:

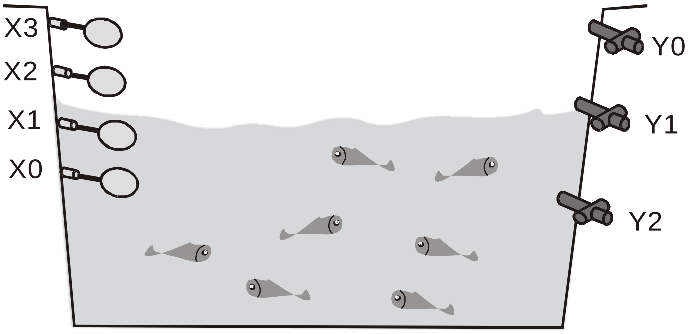


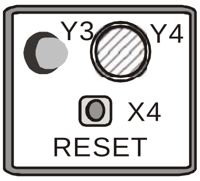
Program Description:

- 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.



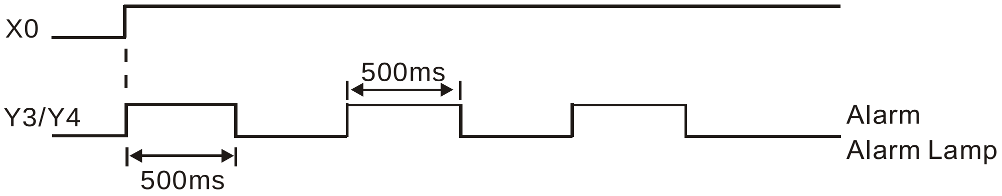
3.6 Artificial Fishpond Water Level Monitoring System (Flashing Circuit)





Control Purpose:

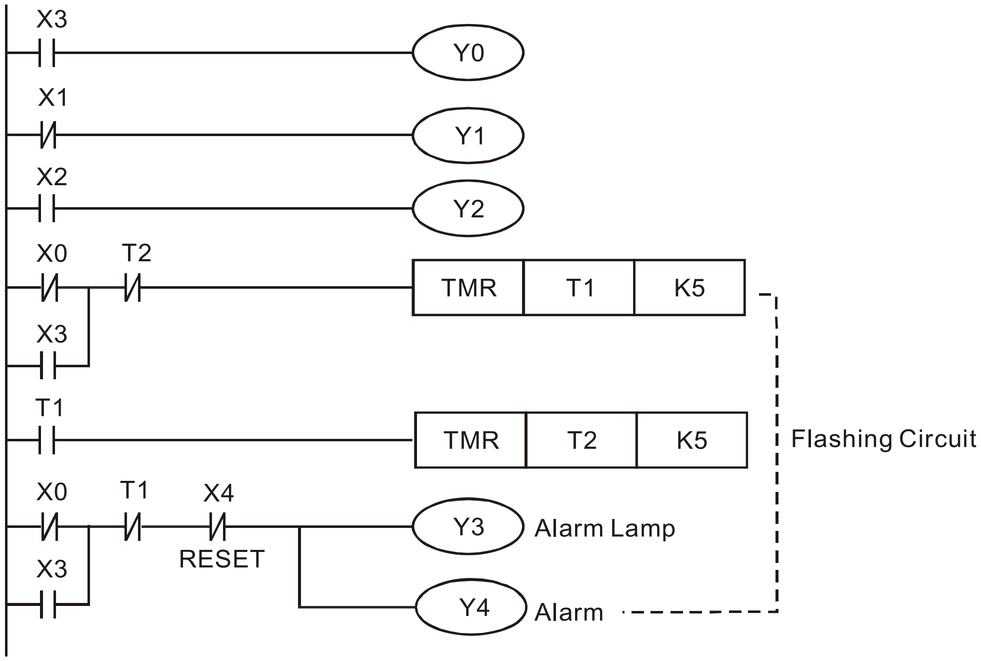
- Feeding or draining water automatically when the water level of artificial fishpond is not at the normal level. In addition to feeding / draining water, enabling the alarm and alarm lamp when the water is above or below the alarm level.
- Stopping the alarm when RESET is pressed.



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

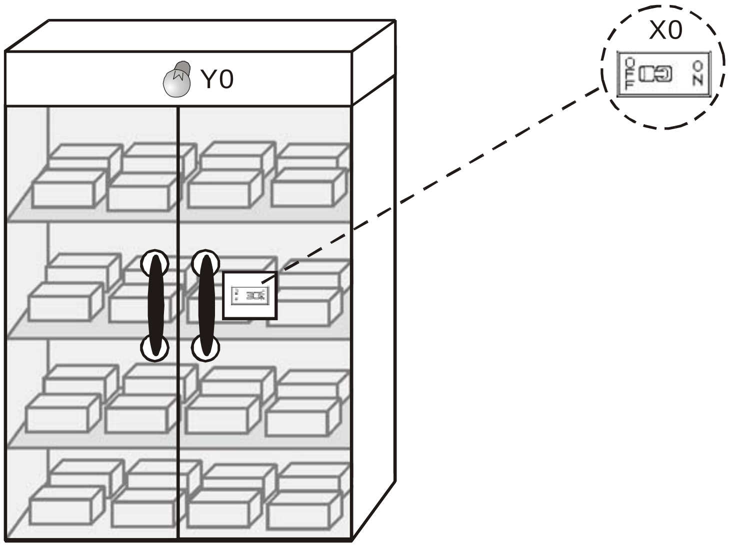
Control Program:



Program Description:

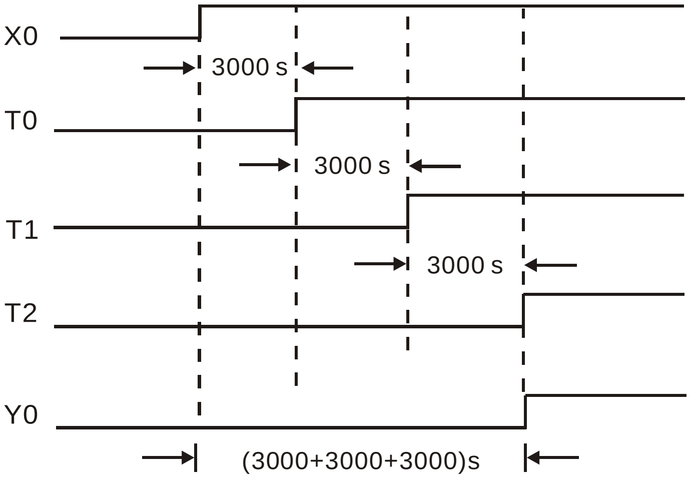
- When the water is at normal level: X0 = ON, X1 = ON, X2 = OFF and X3 = OFF. Therefore, Y0 and Y2 will be OFF. Both the drainage pump and the feeding pump will not work.
- When the water is lower than the normal level, X0 = ON, X1 = OFF, X2 = OFF and X3 = OFF. Because X1 = OFF, Y1 will be ON. The feeding 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.

3.7 Burn-in Test System (Timing Extension)



Control Purpose:

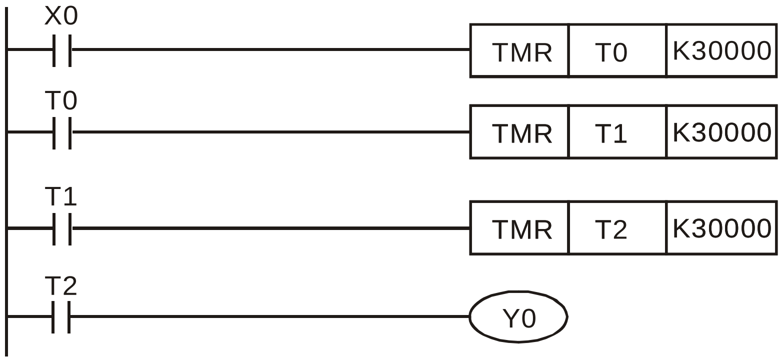
- Warning the operator to take out PLC from the burn-in room by the test completed indicator after 2.5 hours burn-in process.



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

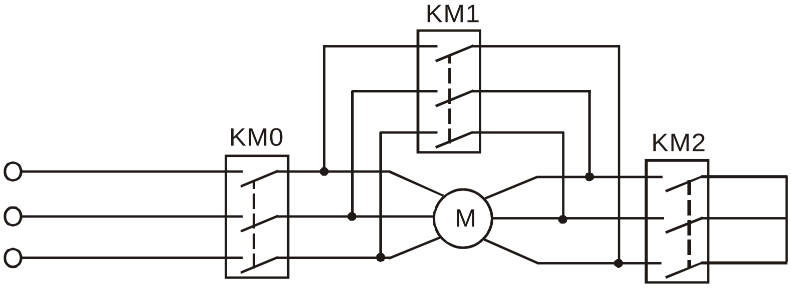
Control Program:



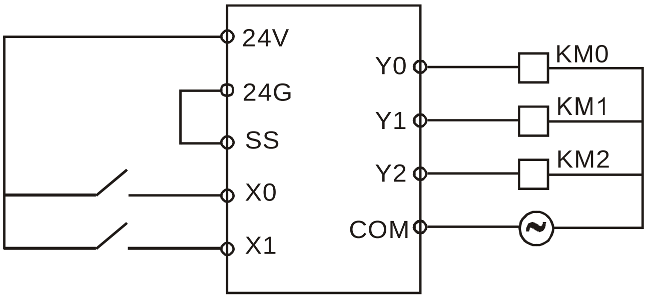
Program Description:

- 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

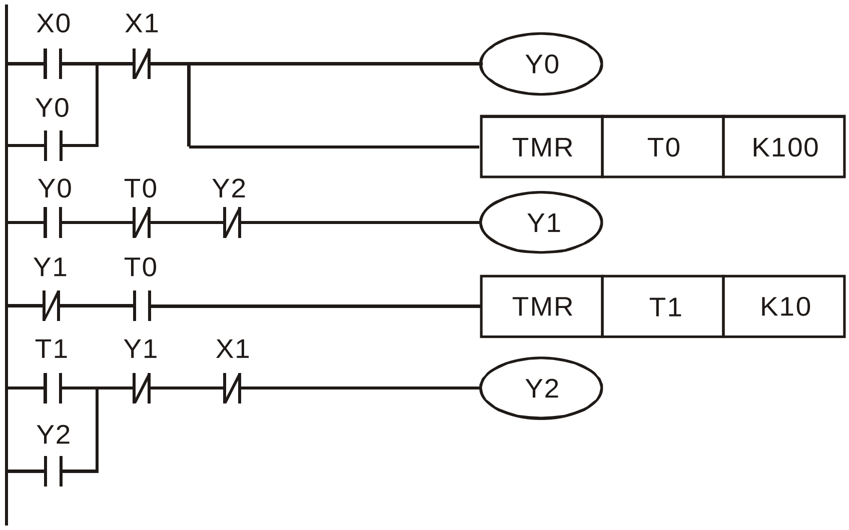
Control Purpose:

- 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

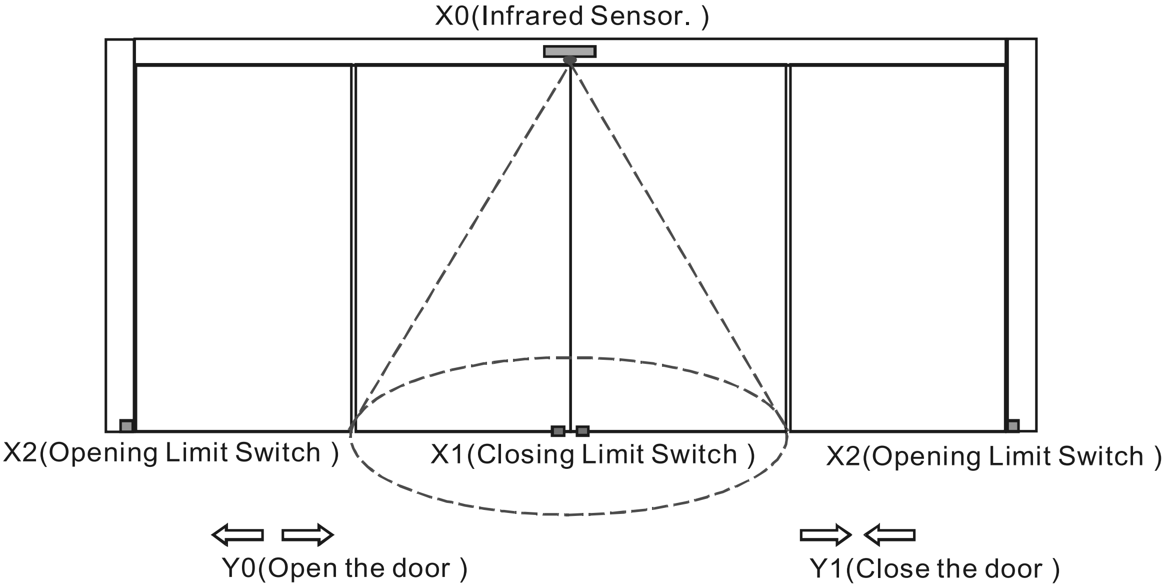
Control Program:



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.
- 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


X0(Infrared Sensor.)
X2(Opening Limit Switch)
X1(Closing Limit Switch)
X2(Opening Limit Switch)
Y0(Open the door)
Y1(Close the door)

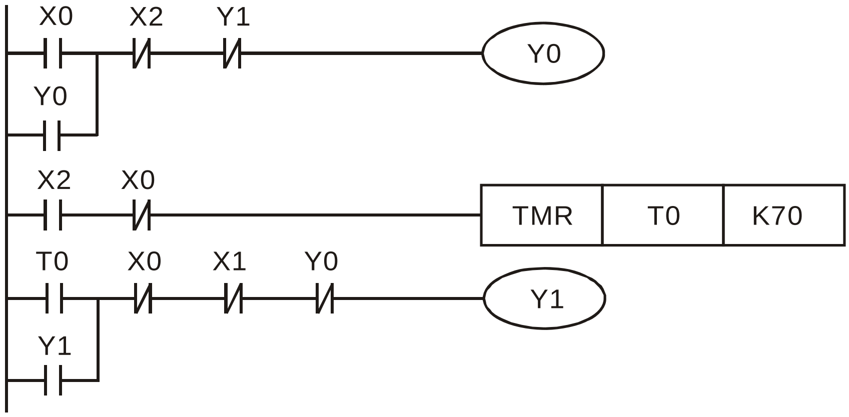
Control Purpose:

- 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

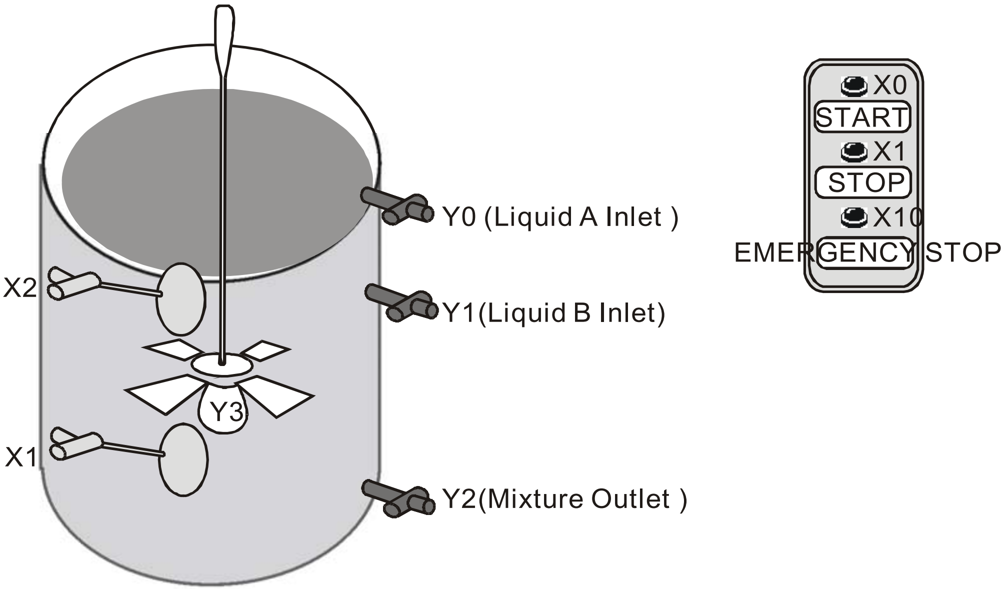
Control Program:



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



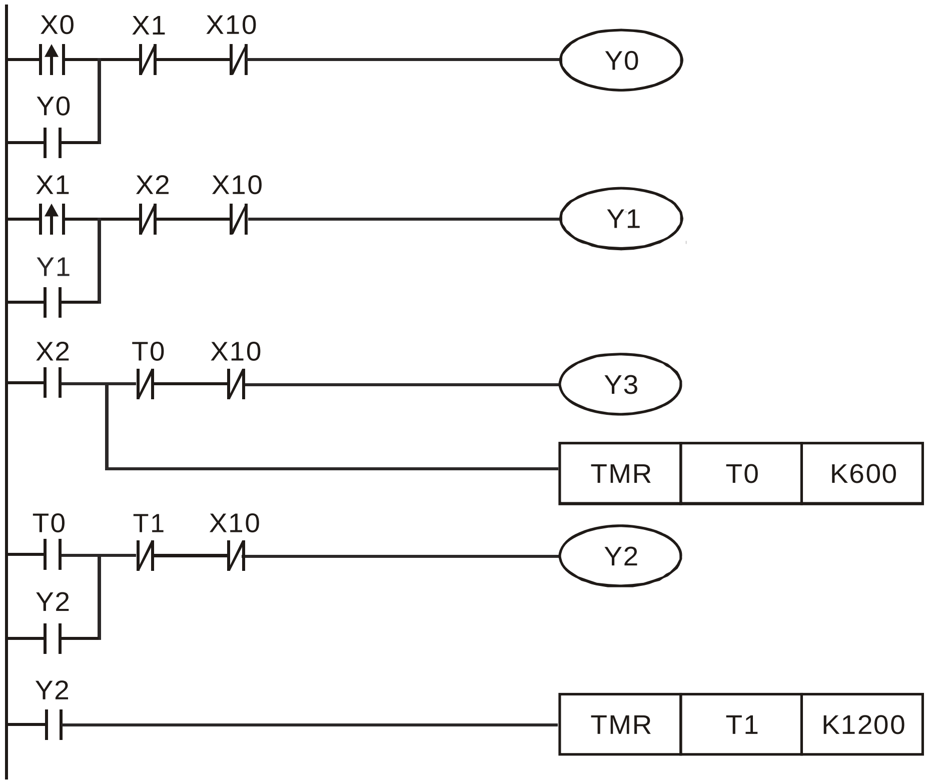
Control Purpose:

- 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:

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

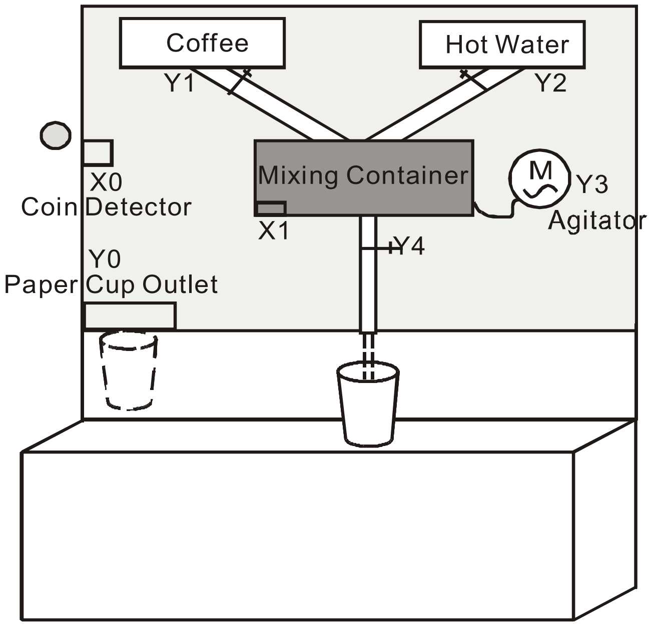
Control Program:



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



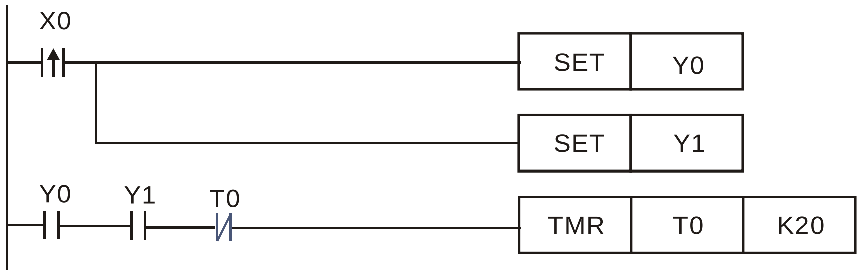
Control Purpose:

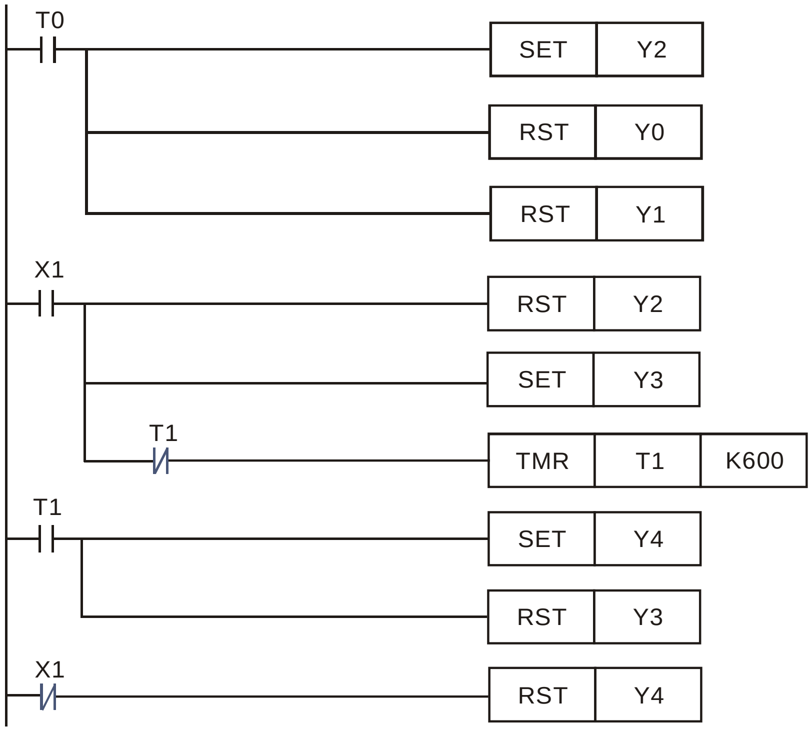
- Making the paper cup come out of the outlet when a coin is inserted. At the same time, the coffee pours in the mixing container. After 2 sec, the hot water pours in. 60 sec later, the ready-made coffee will be pouring out from the coffee outlet.

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:





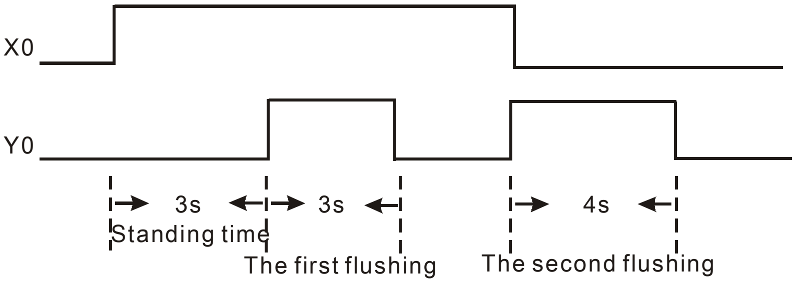
Program Description:

- 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.

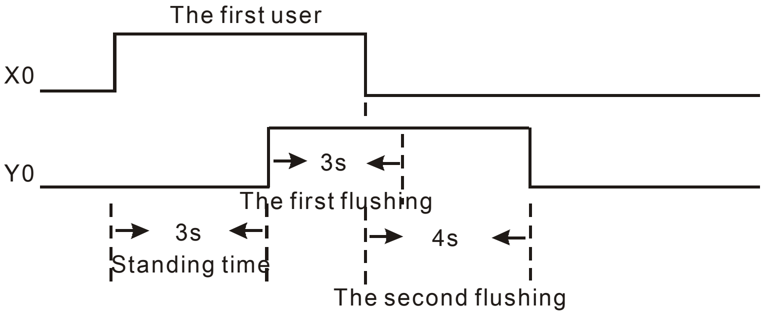
3.12 Automatic Urinal Flushing Control Program

Control Purpose:

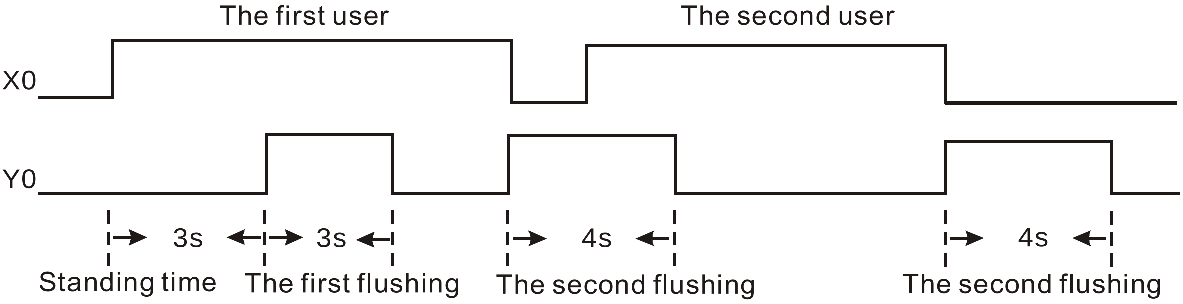
- If a user stands in front of the urinal for more than 3 sec, the flushing control device will flush the urinal for 3 sec (the first flushing). When the user leaves the urinal, flush for another 4 sec then stop automatically (the second flushing).



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



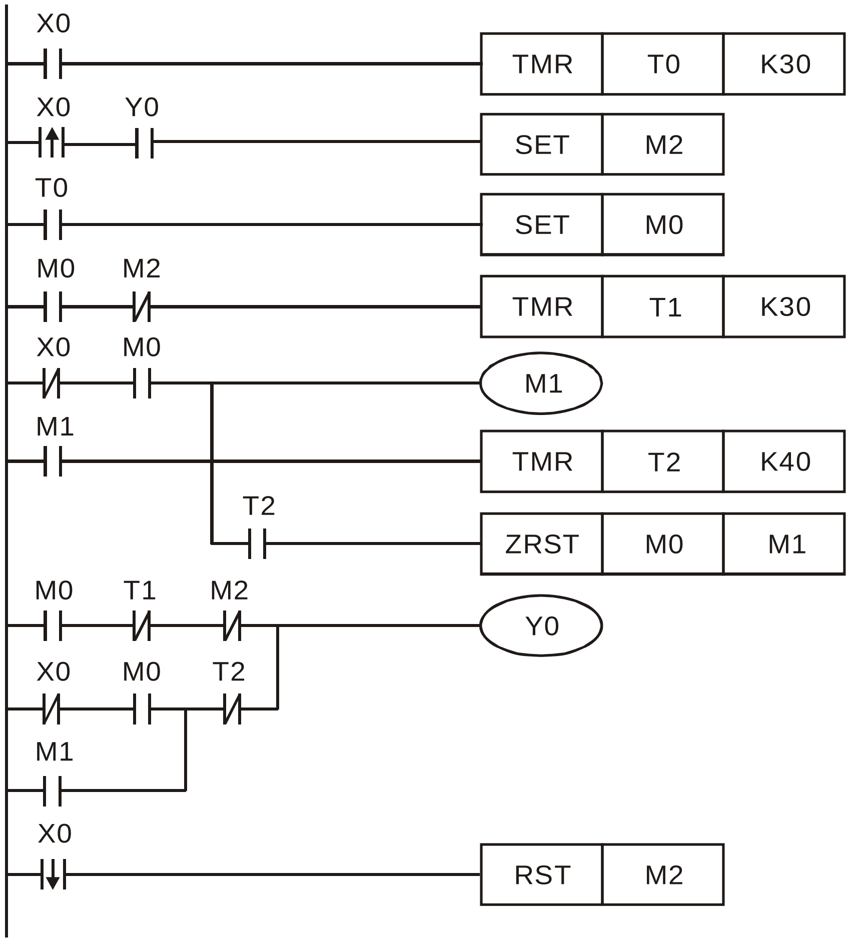
- If the second user comes before the finishing of the 4 sec flushing, the flusher will finish the 4 sec flushing process and skip the first 3 sec flushing process. When the second user leaves the urinal, the flusher will perform another 4 sec flushing.



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

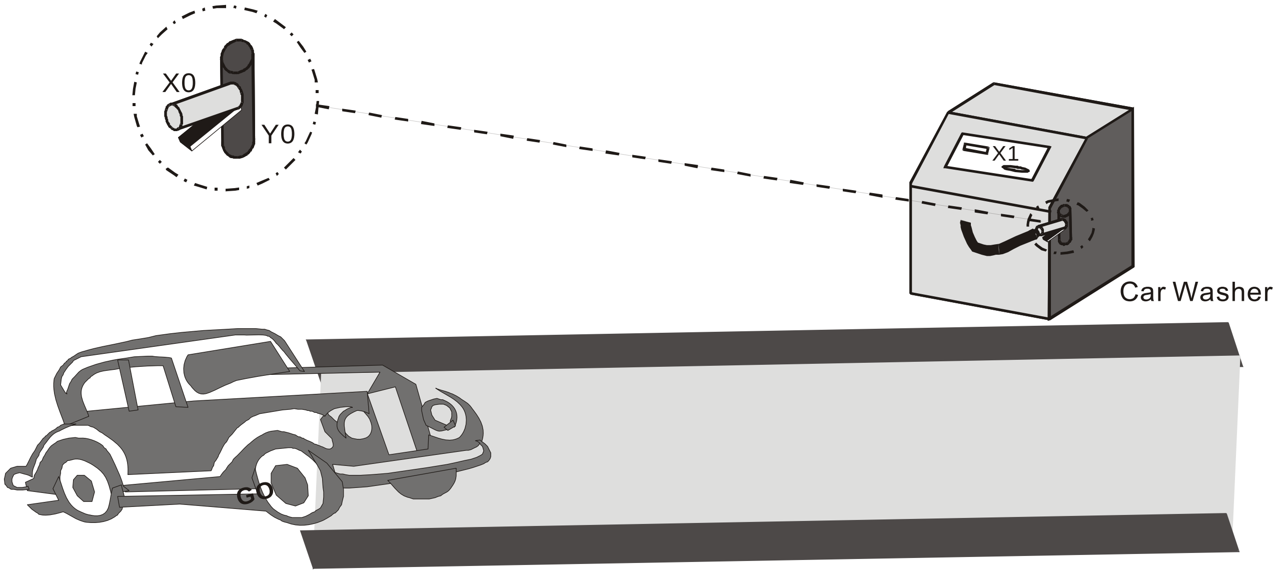
Control Program:



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



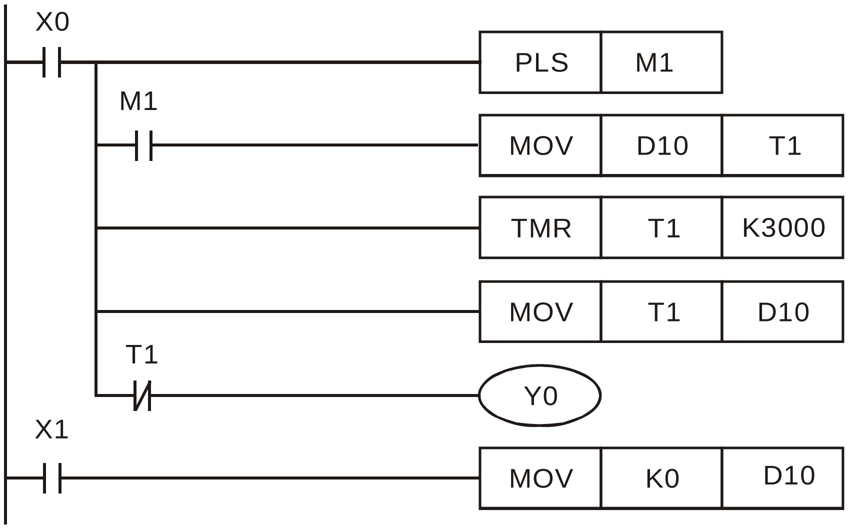
Control Purpose:

- 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

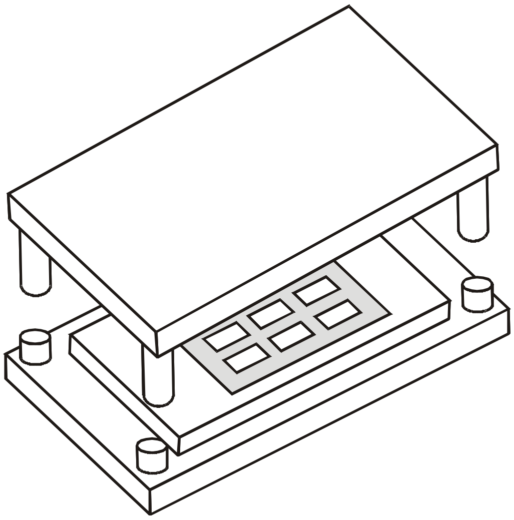
Control Program:

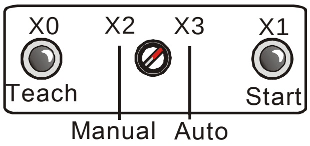


Program Description:

- 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





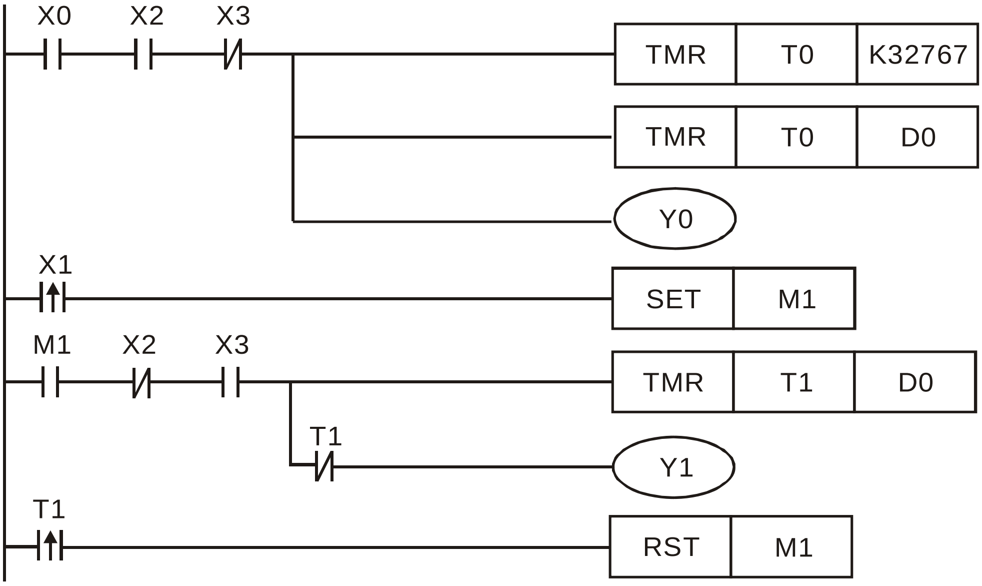
Control Purpose:

- 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

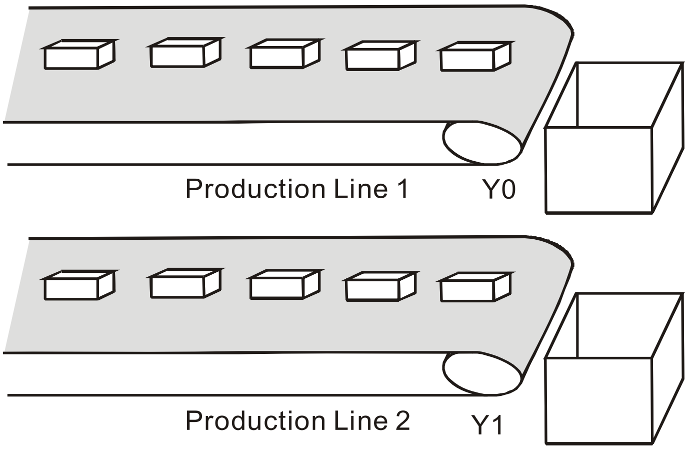
Control Program:



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



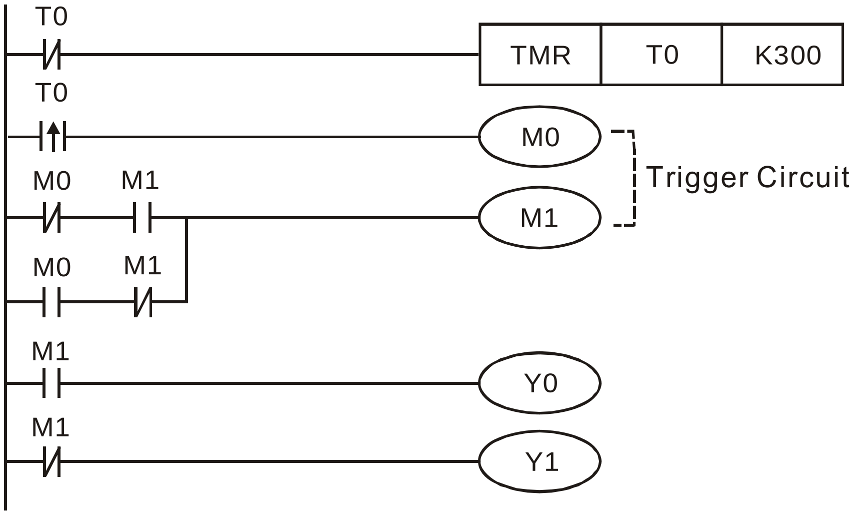
Control Purpose:

- 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

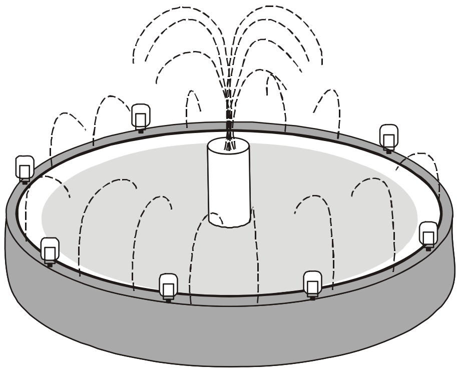
Control Program:

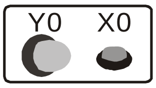


Program Description:

- 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





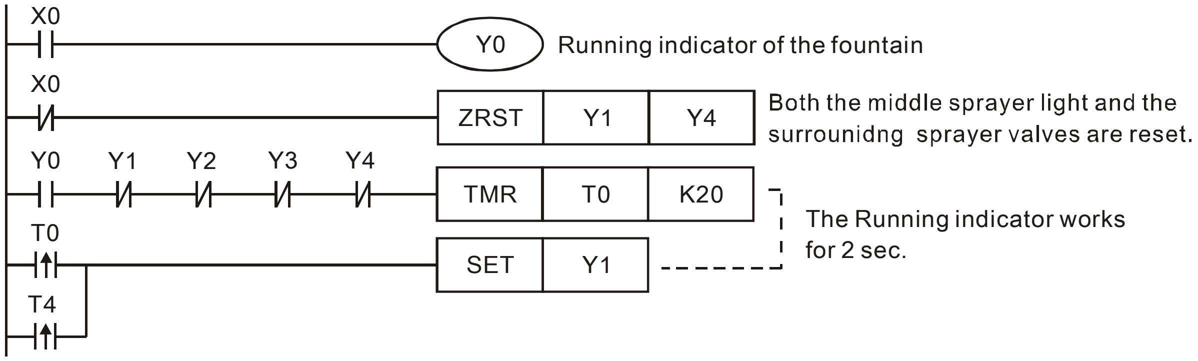
Control Purpose:

- 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

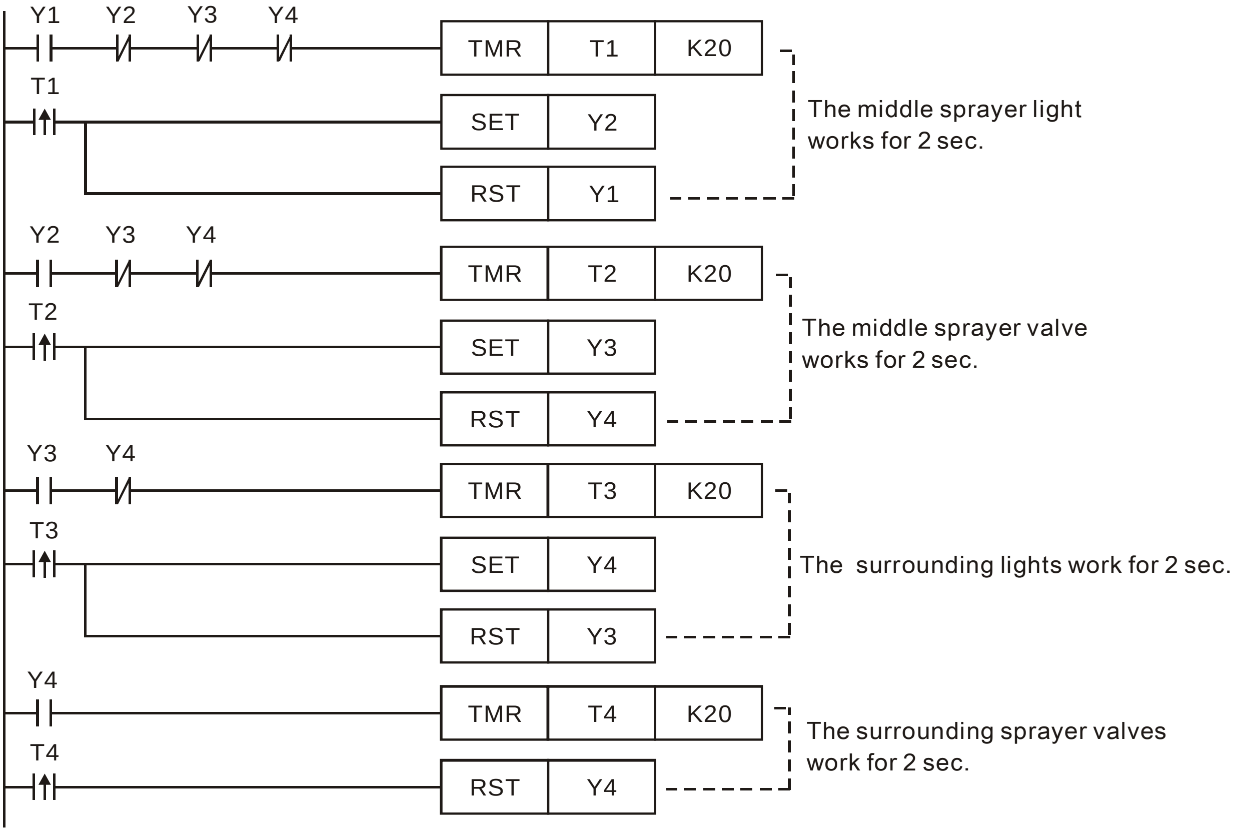
Control Program:



Running indicator of the fountain

Both the middle sprayer light and the surrounidng sprayer valves are reset.

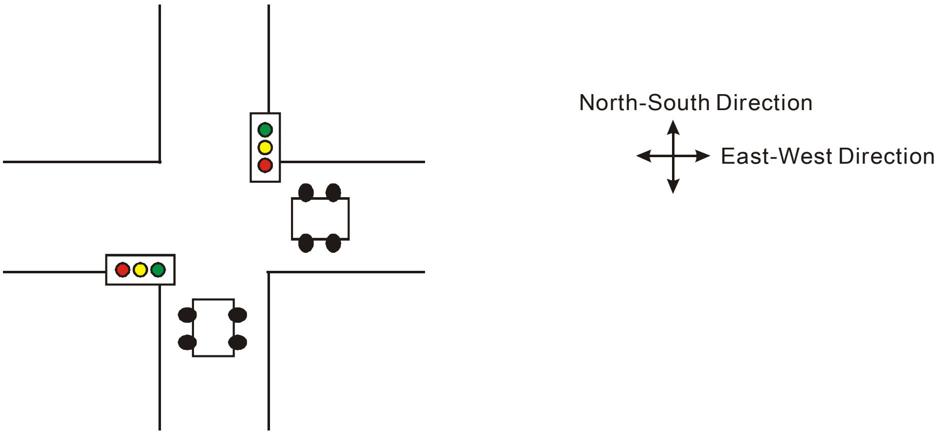
The Running indicator works for 2 sec.


Y1
Y2
Y3
Y4
TMR
T1
K20
T1
SET
Y2
RST
Y1
The middle sprayer light works for 2 sec.
Y2
Y3
Y4
TMR
T2
K20
T2
SET
Y3
RST
Y4
The middle sprayer valve works for 2 sec.
Y3
Y4
TMR
T3
K20
T3
SET
Y4
RST
Y3
The surrounding lights work for 2 sec.
Y4
TMR
T4
K20
T4
RST
Y4
The surrounding sprayer valves work for 2 sec.

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.

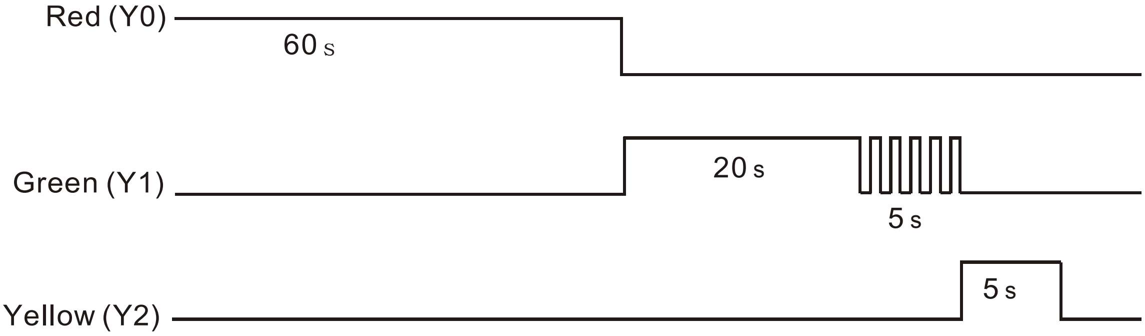
3.17 Traffic Lights Control



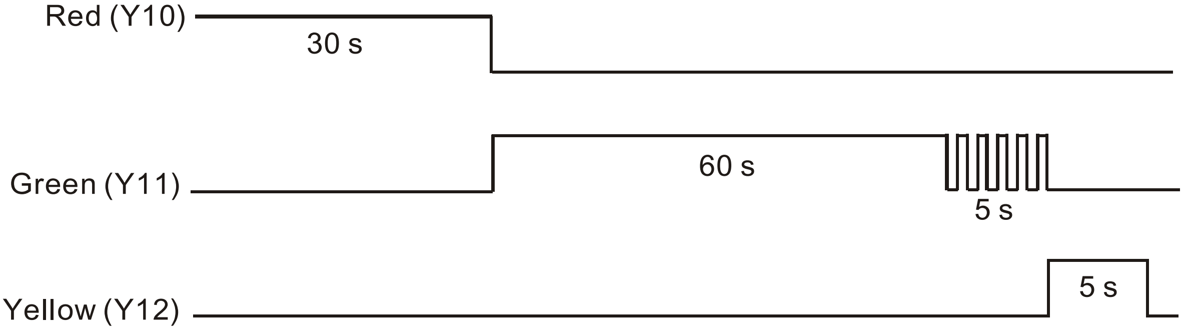
Control Purpose:

- 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:



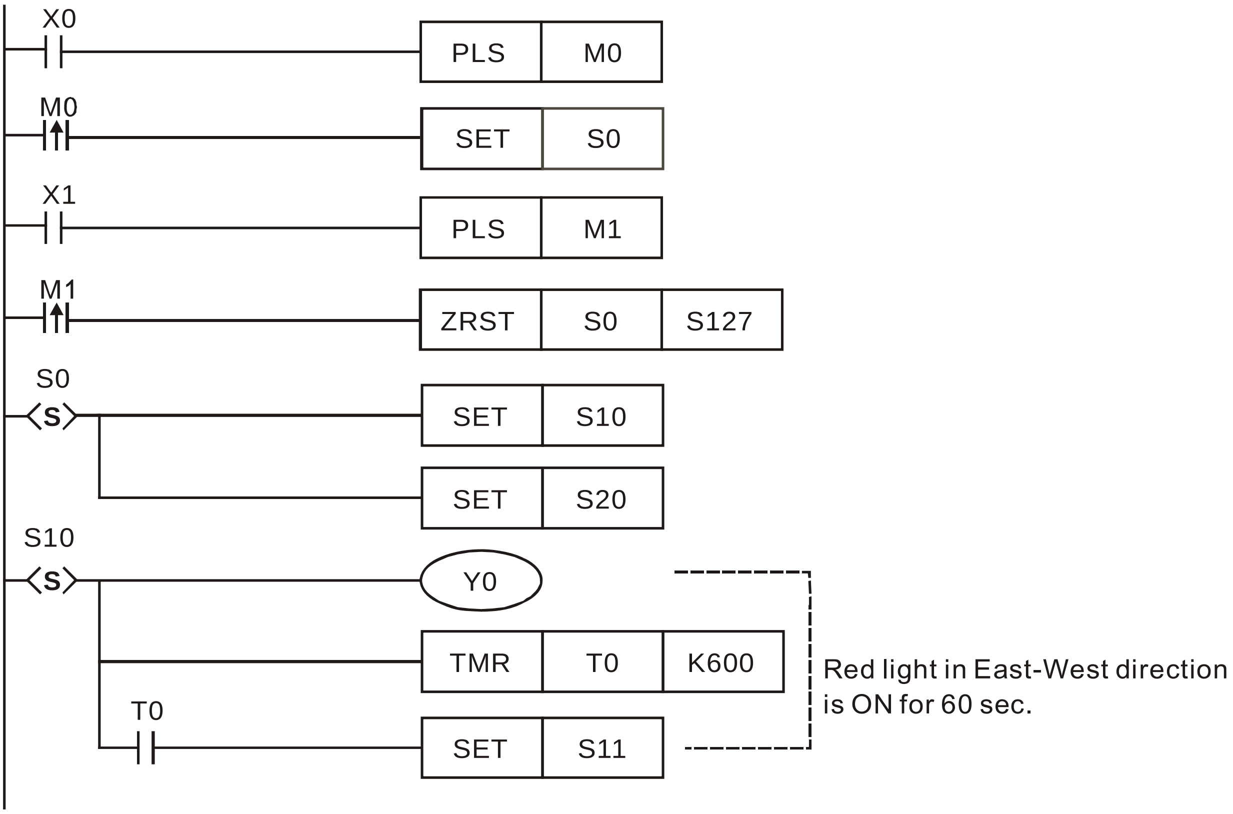
- Timing diagram of traffic lights in North-South direction:

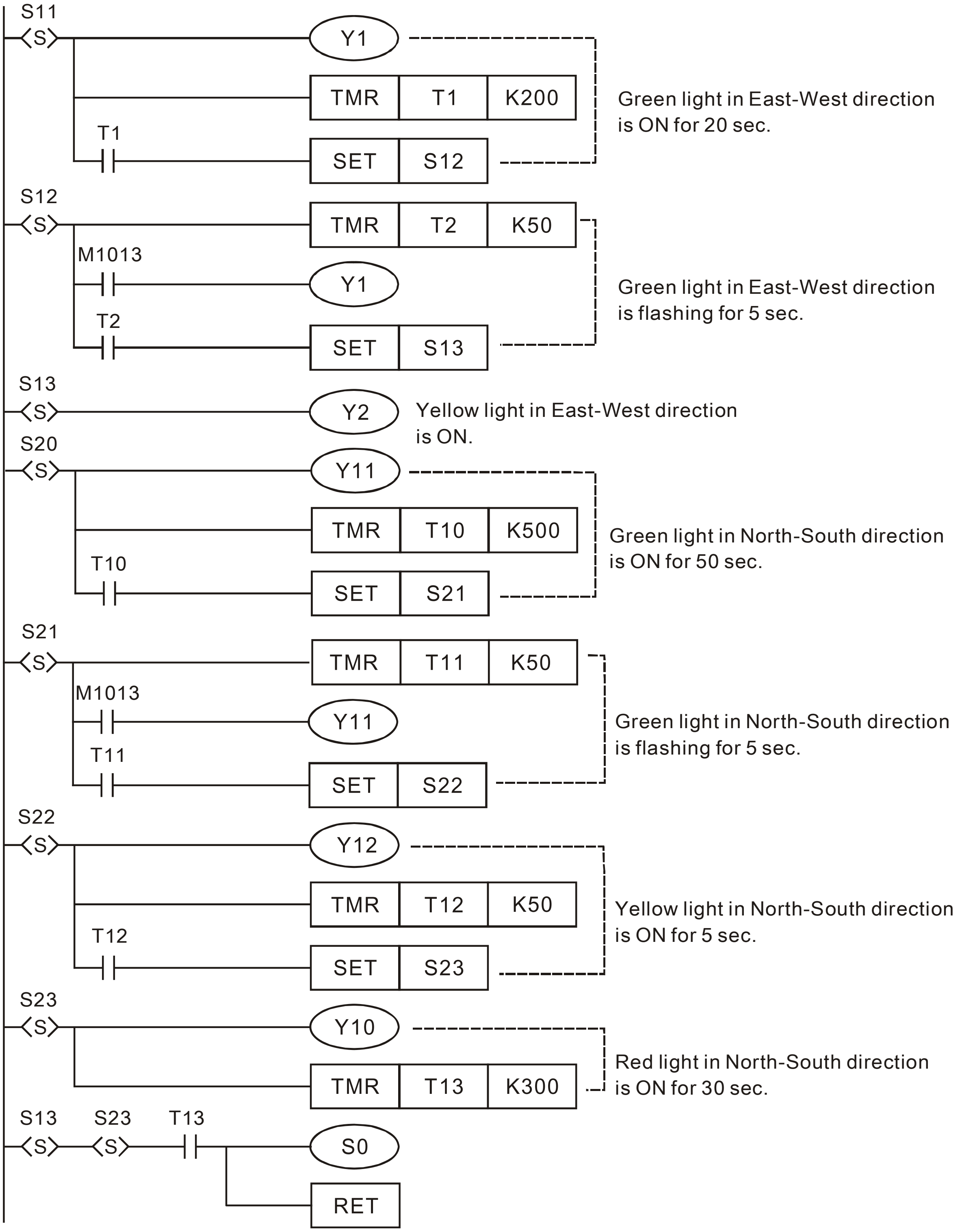


Devices:

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:




S11
Y1
TMR T1 K200
T1
SET S12
Green light in East-West direction is ON for 20 sec.
S12
TMR T2 K50
M1013
Y1
T2
SET S13
Green light in East-West direction is flashing for 5 sec.
S13
Y2
Yellow light in East-West direction is ON.
S20
Y11
TMR T10 K500
T10
SET S21
Green light in North-South direction is ON for 50 sec.
S21
TMR T11 K50
M1013
Y11
T11
SET S22
Green light in North-South direction is flashing for 5 sec.
S22
Y12
TMR T12 K50
T12
SET S23
Yellow light in North-South direction is ON for 5 sec.
S23
Y10
TMR T13 K300
Red light in North-South direction is ON for 30 sec.
S13 S23 T13
S0
RET

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.

4.1 Summation of Continuous D Registers

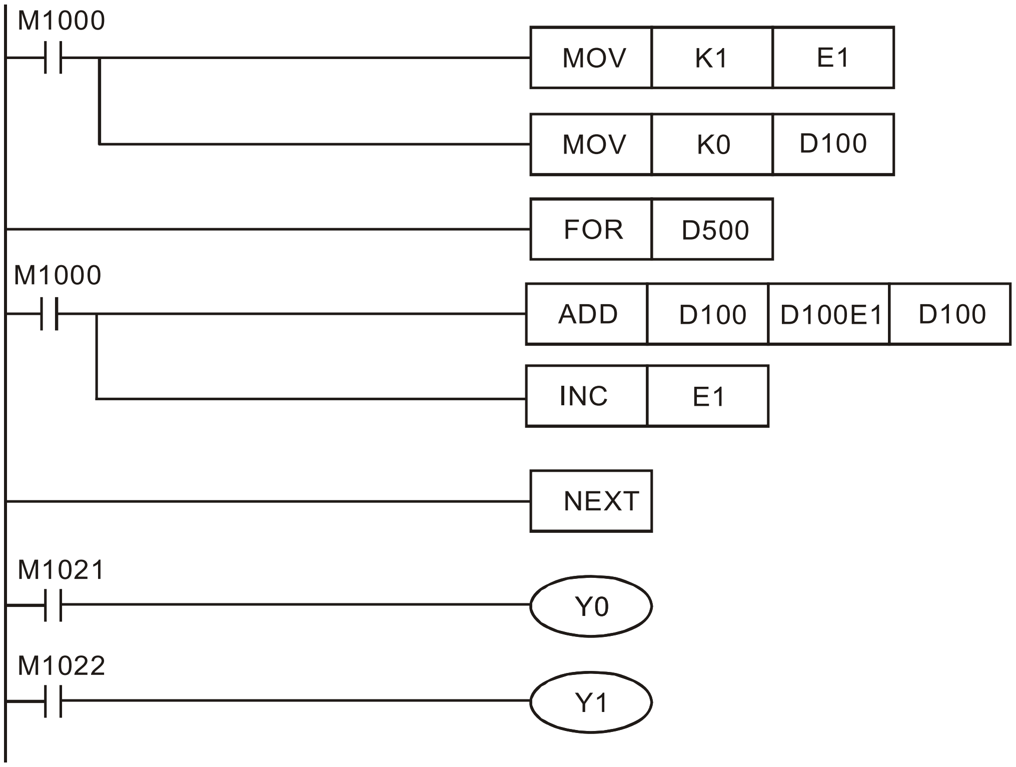
Control Purpose:

- Summing up the values of D registers from D101 to DN (the number of N is determined by users) and storing the operation result in D100. If the result < K-32768, the borrow flag = ON; if the result > K32767, the carry flag = ON.

Devices:

Device	Function
Y0	Borrow flag indicator. When the value in D100 < K-32768, Y0 = ON
Y1	Carry flag indicator. When the value in D100 > K32767, Y1 = ON
E1	Index register
D100	Storing the sum of all D registers
D500	Storing the executing times of FOR-NEXT loop

Control Program:



Program Description:

- The key of the program is to use the index register E1 together with FOR ~ NEXT loop to vary the addend D100E1. When E1 = K1, D100E1 represents D101; when E1 = K2, D100E1 represents D102. Also, when E1 = K10, D100E1 represents D110.

- The number of continuous D registers is determined by the execution times of FOR ~NEXT loop which is set by D500. If the value in D500 ≤ 1, the loop will execute 1 time. If the value in D500 = K10, the loop will execute 10 times first and then execute the instructions behind the loop.

- In the first FOR ~ NEXT loop, E1 = K1, so D100E1 represents D101. ADD instruction is executed, and the operation result of D100 plus D101 is stored in D100. Since the summand D100 = K0, the value stored in D100 equals to the value in D101. At the same time, INC instruction is executed to set E1 = K2.
- In the second FOR ~ NEXT loop, E1 = K2, so D100E1 represents D102. ADD instruction is executed, and the operation result of the values of D100 plus D102 is stored in D100. Since the summand D100 = D101, the value stored in D100 is the sum of the D101 and D102.
- According to the same process, by the 10th FOR ~ NEXT loop the value in D100 will be the sum of D101, D102, D103, D104, D105, D106, D107, D108, D109 and D110.
- If the operation result < K-32768, M1021 will be ON to activate the output coil Y0. Borrow flag indicator will be ON. On the contrary, if the operation result > K32767, M1022 will be ON to activate output coil Y1. Carry flag indicator will be ON in this case.

4.2 Parameter Setting for Product Recipe

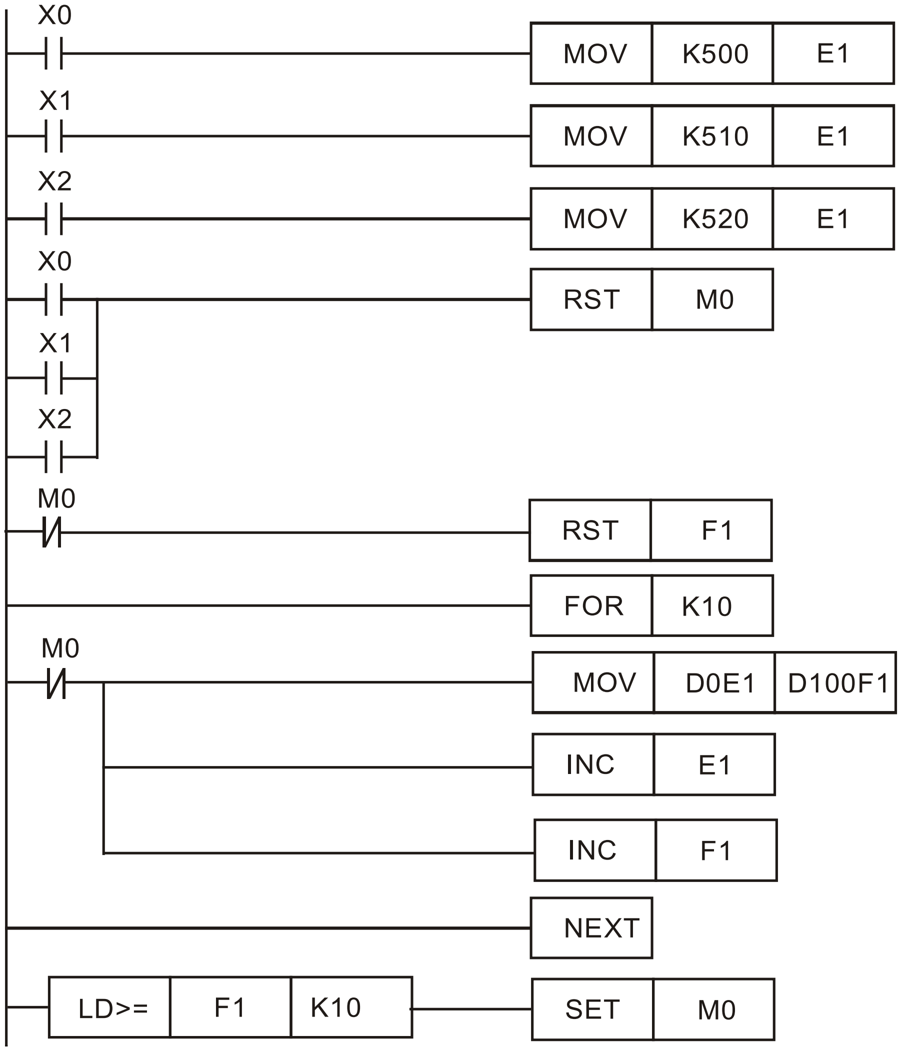
Control Purpose:

- For one product, there are 3 models which correspond to 3 sets of recipes. Each recipe includes 10 parameters. The program executes the set parameters according to the selected recipe switch.

Devices:

Device	Function
X0	Switch of the first recipe
X1	Switch of the second recipe
X2	Switch of the third recipe
D500 ~ D509	Parameters of the first group
D510 ~ D519	Parameters of the second group
D520 ~ D529	Parameters of the third group
D100 ~ D109	The present parameters

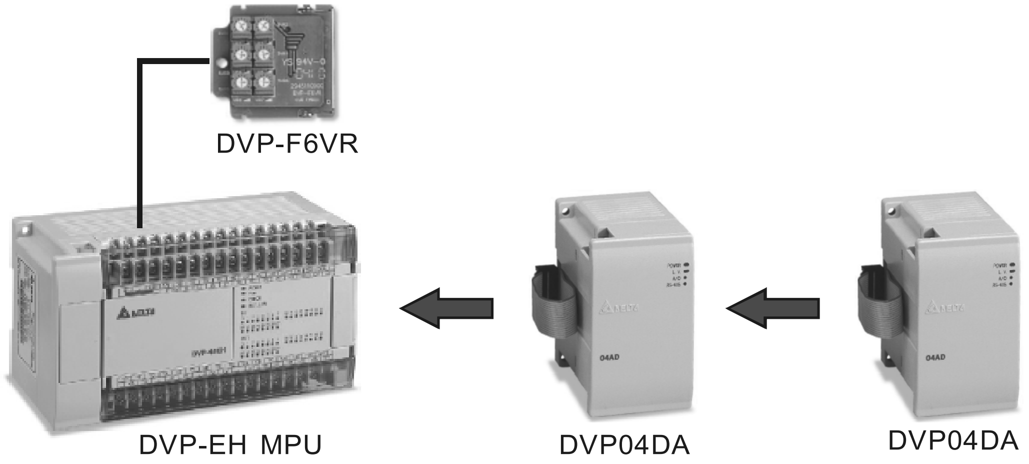
Control Program:



Program Description:

- The key to this program is to use index register E1, F1 together with FOR ~ NEXT loop to vary the numbers of D registers. In addition, the program transfers the parameters of the selected recipe to the register of present parameters
- When one recipe is selected, the corresponding switch X0, X1 or X2 will be ON. According to the selected value of E1, the number of register D0E1 would be D500, D510 or D520. [RST M0] will be executed to reset F1, and FOR ~ NEXT will be executed. Because F1 is reset as K0, D100F1 represents D100 in this case.
- The FOR ~ NEXT loop is executed for 10 times in this program. If the first recipe is selected, D0E1 will vary from D500 to D509 and D100F1 will vary from D100 to D109.
- In addition, the value of D500 will be sent to D100 in the first FOR ~ NEXT loop. The value of D501 will be sent to D101 in the second loop. By the same process, the value of D509 will be sent to D109 in the 10th loop.
- When the executing time reaches its set value, which means F1 = K10, [SET M0] instruction will be executed. The Normally Closed contact M0 will be activated to stop FOR ~ NEXT loops.
- The program performs the transferring of 10 parameters of each recipe. The numbers of parameters can easily be changed by setting the executing times of FOR ~ NEXT loop. Besides, if it requires adding more recipes, the program can also meet this requirement by adding one more MOV instruction as [MOV K530 E1].

4.3 Controlling Voltage Output of 2 DVP-04DA by 8 VRs (Variable Resistors)



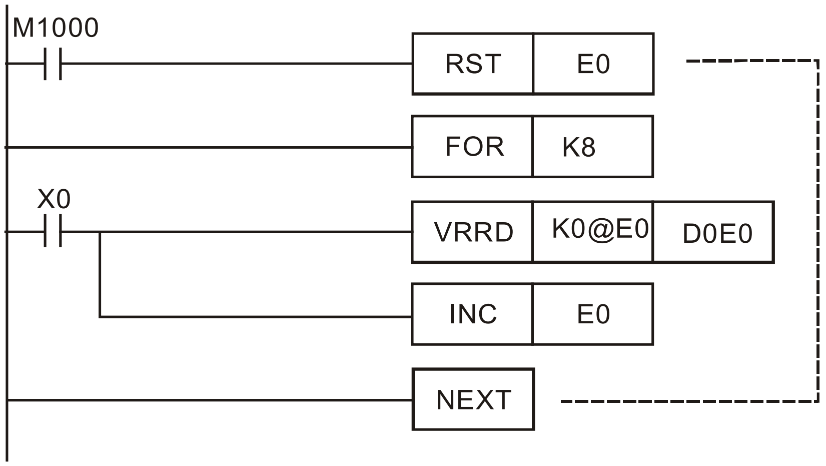
Control Purpose:

- Controlling the voltage output of 2 DVP-04DA to vary from 0 ~ 10V by adjusting 8 VRs on DVP-EH series PLC (2 VRs on the EH MPU and 6 VRs on DVP-F6VR extension unit).

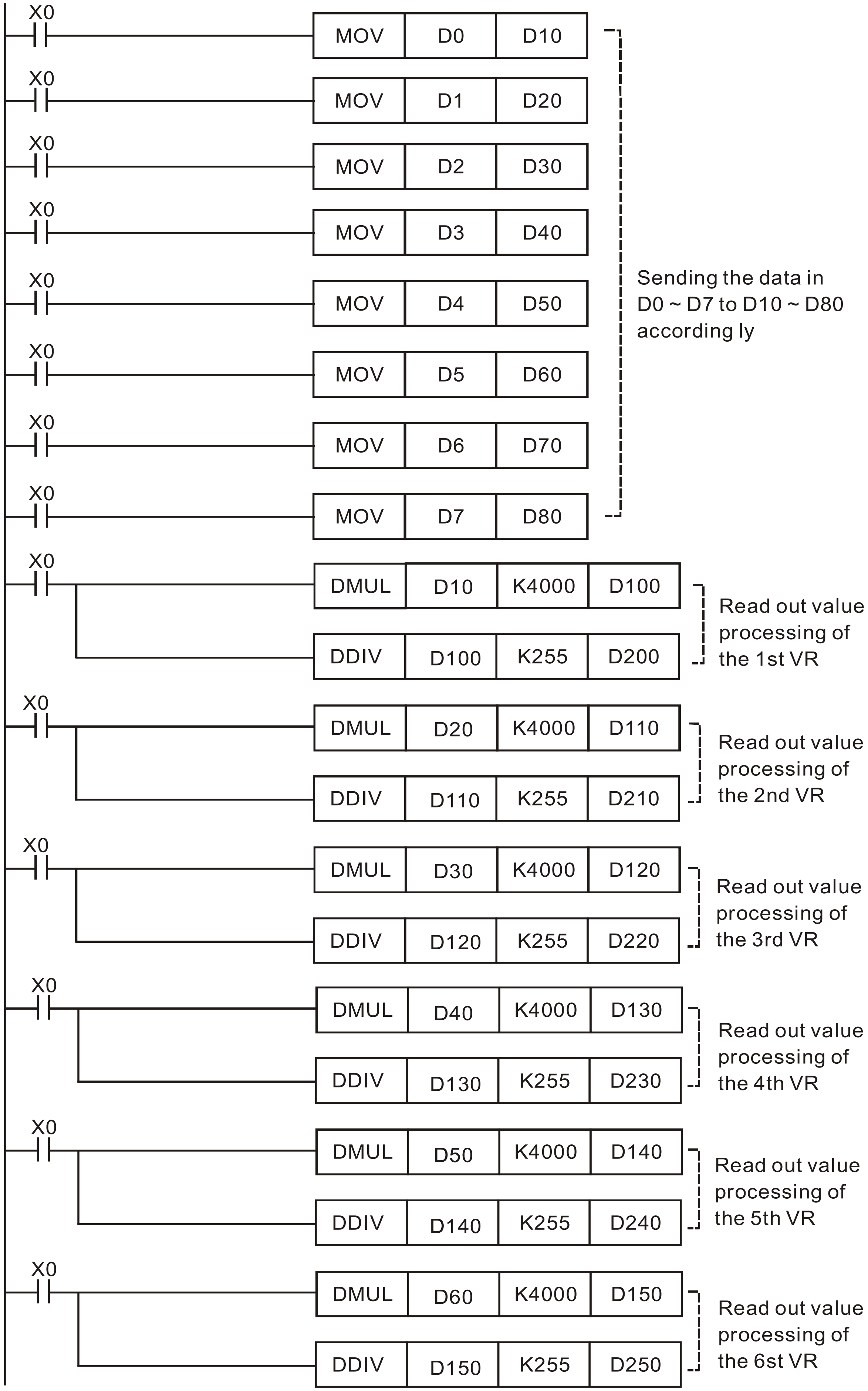
Devices:

Device	Function
X0	Start Switch of reading VR volume
X1	Writing in the value of the first DVP04DA
X2	Writing in the value of the second DVP04DA
E0	Index register

Control Program:



Reading out values of 8 VRs in order by [INC E0] and FOR ~ NEXT loop



Sending the data in D0 ~ D7 to D10 ~ D80 according ly

Read out value processing of the 1st VR

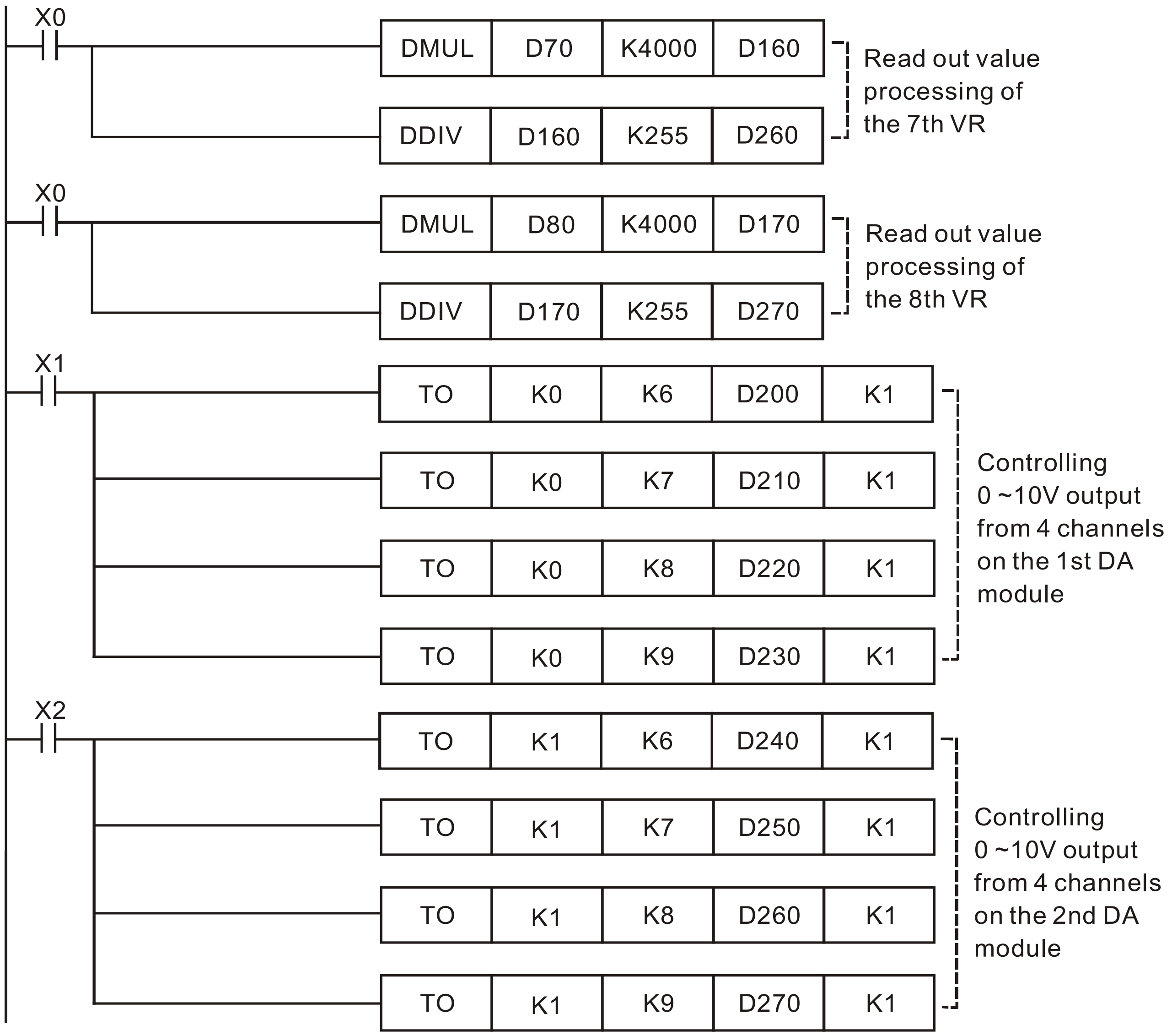
Read out value processing of the 2nd VR

Read out value processing of the 3rd VR

Read out value processing of the 4th VR

Read out value processing of the 5th VR

Read out value processing of the 6st VR

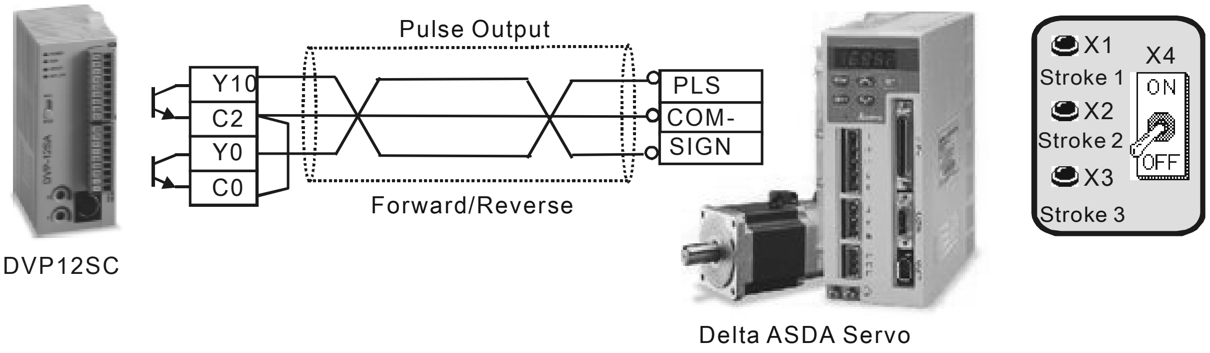


Program Description:

- The program uses index register E0 and FOR ~ NEXT loop to specify the No. of VR as well as the No. of D registers which store the read out value of VR.
- In FOR ~ NEXT loop, E0 will change from 0 to 7 because of [INC E0] instruction. In this case, K0@E0 will change from K0 to K7 and D0E0 will change from D0 to D7. Therefore, the values of 8 VRs will be read out in order as below, VR0→D0, VR1→D1 … VR7→D7.
- The value range of the VR is K0 ~ K255, and the voltage range of DVP04DA is 0 ~ 10V corresponding to K0 ~ K4000. Therefore, the program is designed to convert the VR value K0 ~ K255 into the DVP04DA value K0 ~ K4000. Through this process, the target of controlling 0 ~ 10V voltage output by adjusting the VR value can be achieved.
- The value which is converted into K0 ~ K4000 will be sent to D200, D210, D220 … D270, and will be transferred to DVP04DA by TO instruction as the voltage outputs of the corresponding channels.
- For the application of API85 VRRD instruction and API79 TO instruction, please refer to *DVP-PLC Application Manual - programming*.

MEMO

5.1 Recipe Setting by CJ Instruction



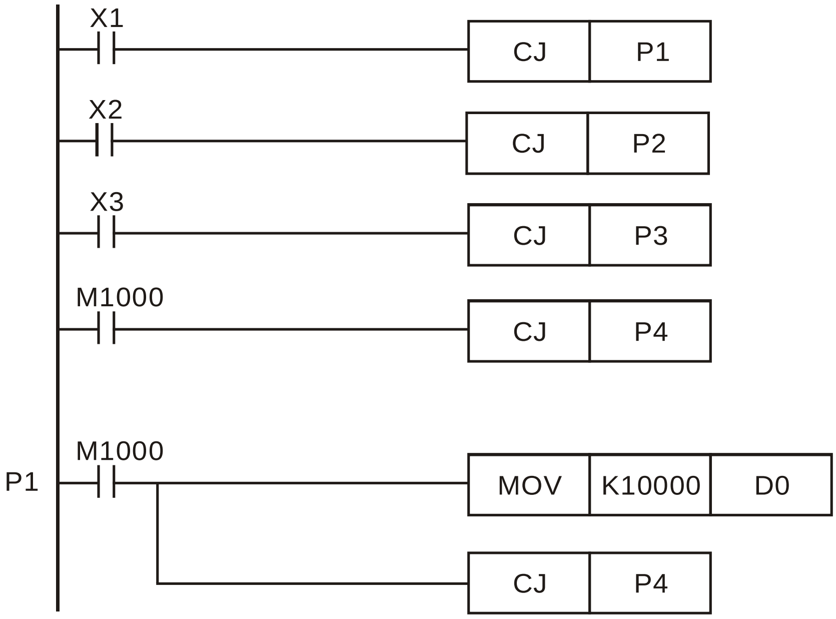
Control Purpose:

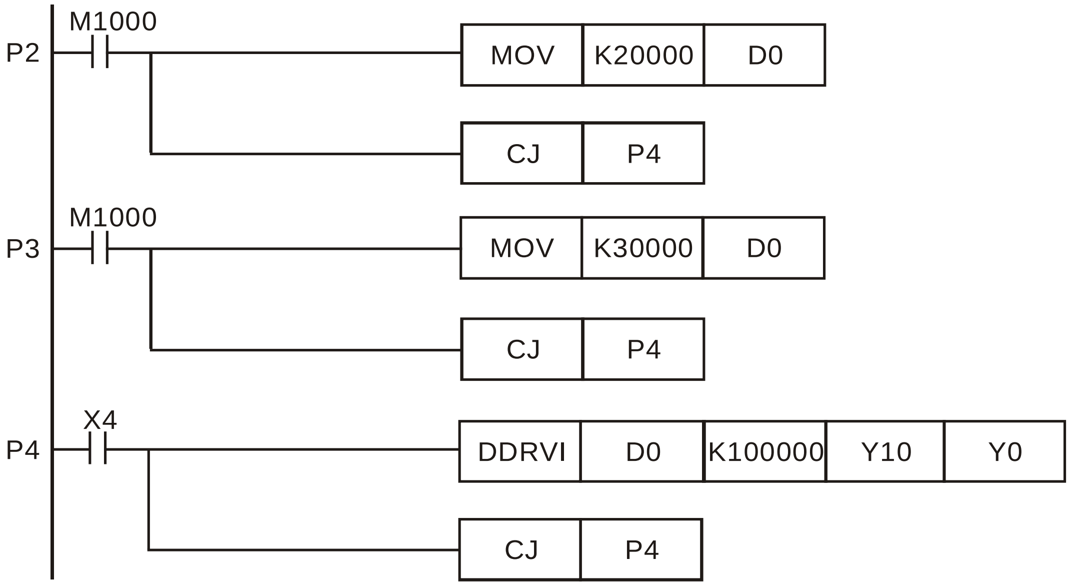
- Controlling 3 stroke distances of Delta ASDA servo by sending pulses from Delta DVP12SC PLC. Users can choose the adequate stroke distance to meet the working requirement by pressing 3 individual switches.

Devices:

Device	Function
X1	X1 = ON when the switch Stroke 1 is pressed.
X2	X2 = ON when the switch Stroke 2 is pressed.
X3	X3 = ON when the switch Stroke 3 is pressed.
X4	X4 = ON when the servo locating switch is pressed.
Y0	Pulse direction control
Y10	Pulse output point

Control Program:

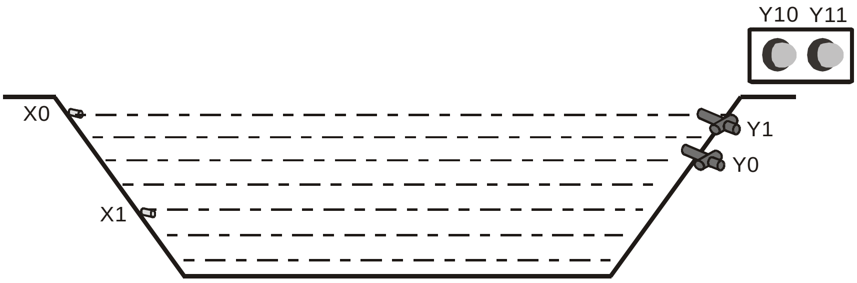




Program Description:

- When X1 = ON, X2 = OFF, X3 = OFF, the program will jump from [CJ P1] to P1 and store the constant K10000 in D0, which means the first stroke distance is selected. At the same time, the program will jump to address P4 and get ready to output pulses.
- When X2 = ON, X1 = OFF, X3 = OFF, the program will jump from [CJ P2] to P2 and store the constant K20000 in D0, which means the second stroke distance is selected. At the same time, the program will jump to address P4 and get ready to output pulses.
- When X3 = ON, X1 = OFF, X2 = OFF, the program will jump from [CJ P3] to P3 and store the constant K30000 in D0, which means the third stroke distance is selected. At the same time, the program will jump to address P4 and get ready to output pulses.
- When X1 = OFF, X2 = OFF, X3 = OFF, [CJ p4] instruction will be executed. The program will jump to pointer P4 directly and get ready to output pulses.
- When X4 = ON, [DDRVI D0 K10000 Y10 Y0] instruction will be executed; that is, Y10 will output a certain number of pulses with frequency of 100 KHz (the content in D0 is the number of the pulses), and Y0 will control the pulse direction. Since the operating distance of the servo motor is proportional to the number of the pulses, the object of controlling servo operating distance can be achieved by setting PLC output pulses.

5.2 Reservoir Level Control



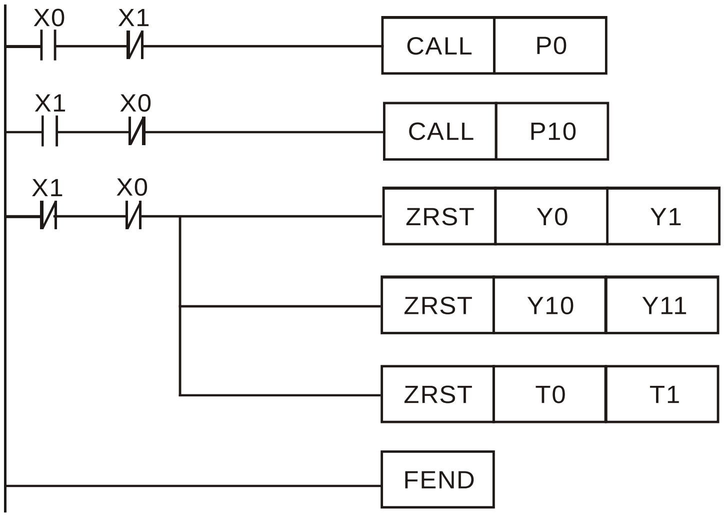
Control Purpose:

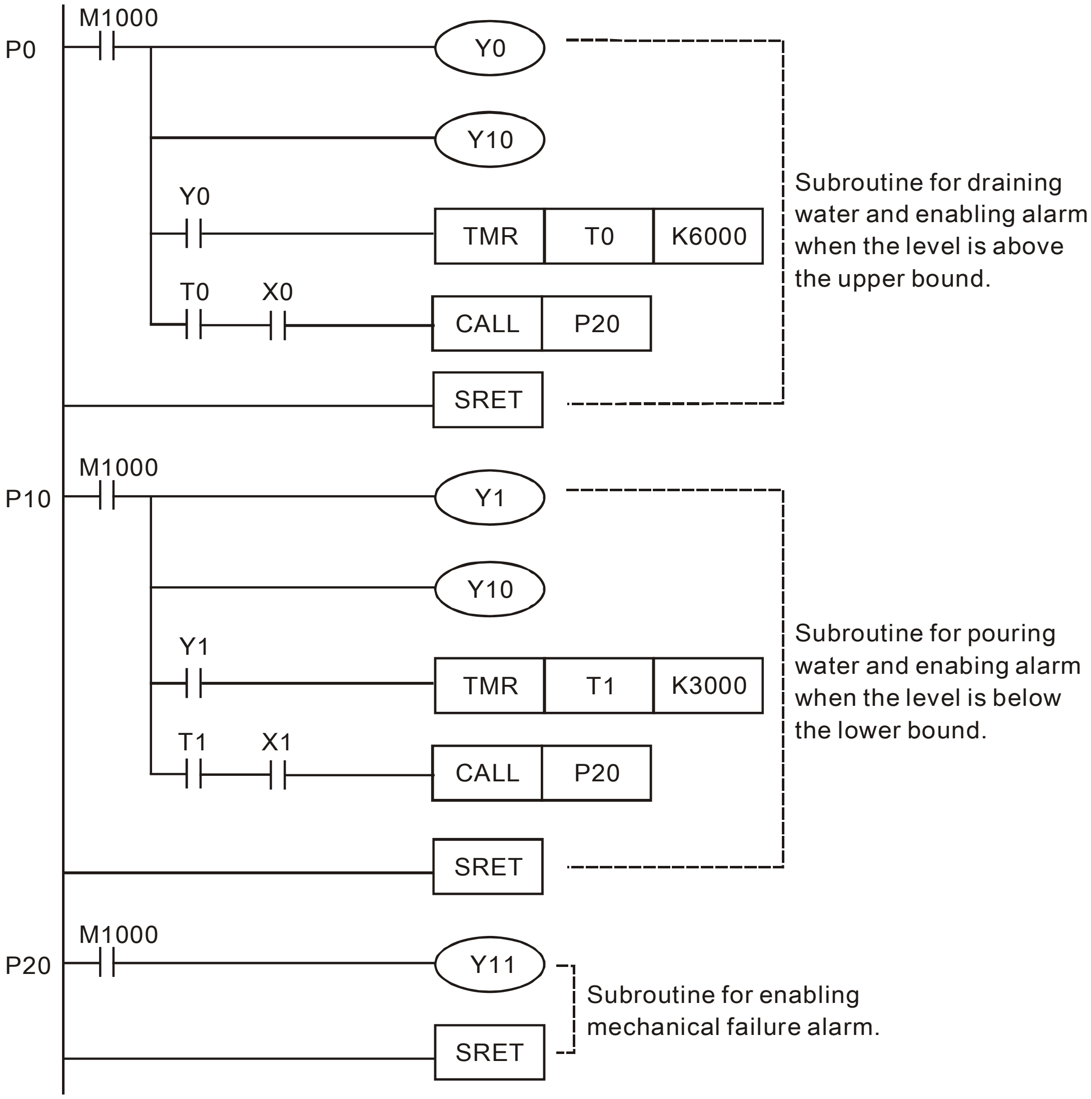
- Enabling the abnormal situation alarm and draining water from the reservoir when the level is above the upper bound.
- Enabling the abnormal situation alarm and pouring water into the reservoir when the level is below the lower bound.
- Enabling the mechanical failure alarm if the upper bound sensor X0 is still ON after draining water for 10 minutes.
- Enabling the mechanical failure alarm if the lower bound sensor X1 is still ON after pouring water for 5 minutes.
- Resetting all the alarms and valves when the level is in normal position.

Devices:

Device	Function
X0	X0 turns ON when the level reaches the upper bound.
X1	X1 turns ON when the level reaches the lower bound.
Y0	Draining valve
Y1	Pouring valve
Y10	Abnormal situation alarm
Y11	Mechanical failure alarm

Control Program:




P0
M1000
Y0
Y10
Y0
TMR
T0
K6000
T0
X0
CALL
P20
SRET
Subroutine for draining water and enabling alarm when the level is above the upper bound.
P10
M1000
Y1
Y10
Y1
TMR
T1
K3000
T1
X1
CALL
P20
SRET
Subroutine for pouring water and enabing alarm when the level is below the lower bound.
P20
M1000
Y11
SRET
Subroutine for enabling mechanical failure alarm.

Program Description:

- When the level is above the upper bound, X0 will be ON to execute [CALL P0] instruction. The abnormal situation alarm Y10 and the draining valve Y0 will start working until the level is below the upper bound.
- When the level is below the lower bound, X1 will be ON to execute [CALL P10] instruction. The abnormal situation alarm Y10 and the pouring valve Y1 will start working until the level is above the lower bound.
- CALL P20 subroutine is nested both in P0 and P10 subroutines. If the upper bound sensor is still on after draining water for 10 minutes, subroutine P20 will be executed. Coil Y11 will be ON and the mechanical failure alarm will be enabled.
- Likewise, if the lower bound sensor is still ON after pouring water for 5 minutes, subroutine P20 will be executed. Coil Y11 will be ON and the mechanical failure alarm will be enabled.
- If the level is at normal position, X0 = OFF, X1 = OFF, ZRST instruction will be executed. Y0, Y1, Y10, Y11, T0, and T1 will be reset. All valves as well as alarms will be disabled.

5.3 Fire Alarm in the Office (Interruption Application)

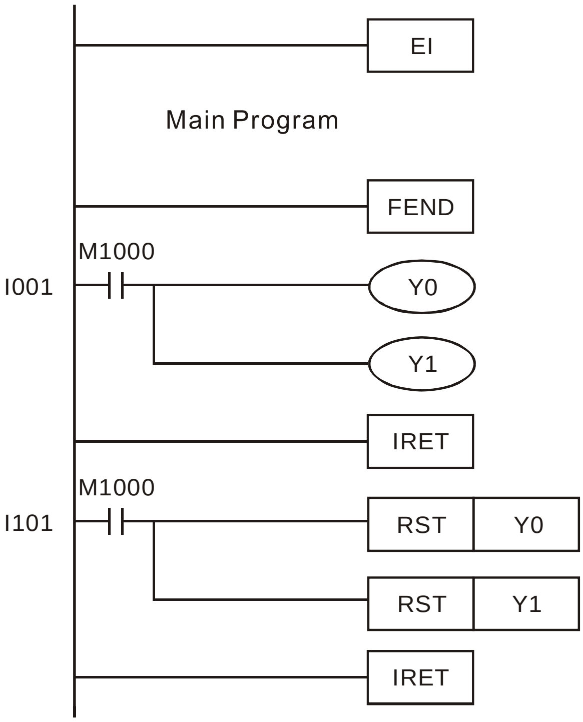
Control Purpose:

- Starting the alarm and sprayer when the temperature alarm detects high temperature.
- Stopping the alarm and sprayer when the alarm reset button is pressed.

Devices:

Device	Function
X0	Temperature alarm. X0 = ON when the temperature is too high.
X1	Alarm reset button. X1 = ON when the button is pressed.
Y0	Sprayer
Y1	Fire alarm

Control Program:

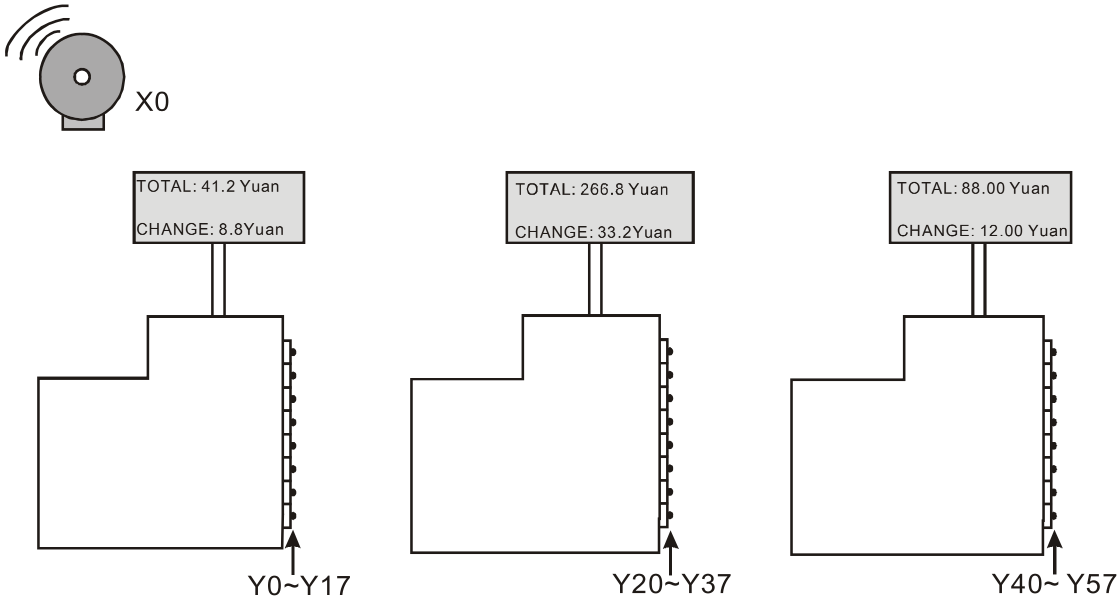


Program Description:

- In the program, the interruption pointers I001, I101 correspond to the external input points X0, X1. When X0, X1 is ON, the subroutines corresponding to I001, I101 will be executed.
- If the temperature in the office is normal, X0 = OFF. The temperature alarm will not perform any action. No interruption signal is generated, and no interruption subroutine will be executed in this case.
- If the temperature in the office is too high, X0 = ON, the temperature alarm will be enabled. The PLC will stop the main program to execute the interruption subroutine I001. In this case, sprayer valve Y0 and alarm Y1 will be enabled. After the execution of I001, the program will return to the main program and resume execution from the interruption point.

- Press the alarm reset button if the alarm situation is cleared. X1 = ON, the PLC will stop the main program to execute the interruption subroutine I101. In this case, sprayer Y0 and alarm Y1 will be shut down. After the execution of I101, the program will return to the main program and resume execution from the interruption point.

5.4 Auto Lock up system in the Supermarket (FOR ~ NEXT)



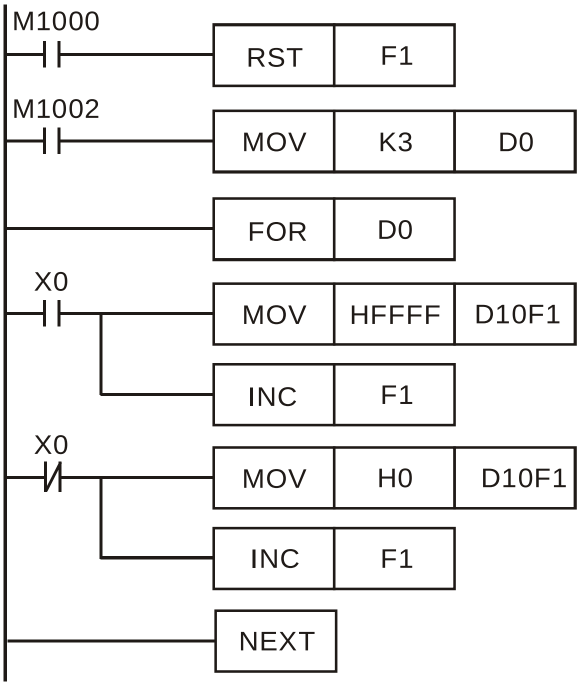
Control Purpose:

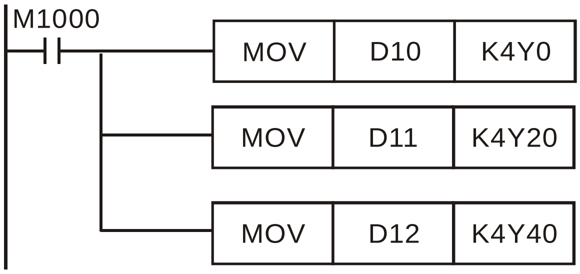
- Once fire or robbery happened in the supermarket, locking up all cash drawers until the alarm situation is cleared.

Devices:

Device	Function
X0	X0 = ON when the alarm is activated.
D0	The number of cash drawers
D10	Start address of destination register

Control Program:





Program Description:

- The execution times of FOR~NEXT loop which decide the number of controlled cash counters can be controlled by the value in D0. Each cash counter has 16 drawers. In this program, D0 = K3, which means it can control 48 cash drawers in 3 counters.
- F10 = K0, D10F1 represents D10; F10 = K1, D10F1 represents D11; F0 = K2, D10F1 represents D12; F0=K3, D10F1 represents D13.
- When the alarm rings, X0 = ON. FOR ~ NEXT loop will be executed for 3 times and HFFFF will be sent to D10 ~ D12 in order. After the execution, the value in D10 ~ D12 will be sent to the external outputs. All the outputs Y will be set to be ON in this case. The system will lock up all the cash drawers.
- When the alarm situation is cleared, X0 = OFF. FOR ~ NEXT loop will be executed for 3 times and H0 will be sent to D10 ~ D12 in order. After the execution, the value in D10 ~ D12 will be sent to the external outputs. All the outputs Y will be reset to be OFF in this case. The system will unlock all the cash drawers.
- In this program, the index register F1 is used for storing single value in a data stack (series D registers). According to different application situations, users can make use of the data stack for controlling timers or counters.

6.1 CMP - Material Mixing Machine

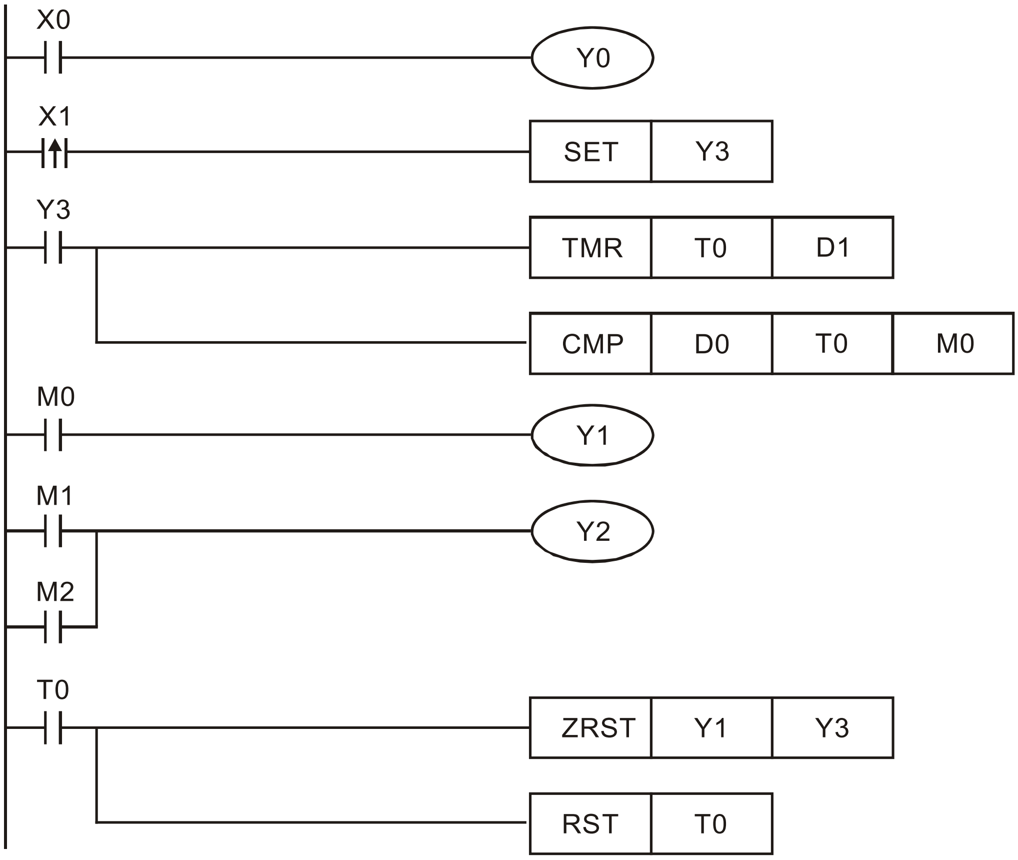
Control Purpose:

- There are materials A and B in the mixing machine. Enabling the indicator(Y0) when the Power On switch is pressed. Controlling the material A outlet (Y1) to start feeding and starting the agitator Y3 by pressing the button Process(X1). When material A feeding process reaches the set time D0, enabling the material B outlet(Y2) to start feeding while the agitator keeps working. Stopping all processes when the whole mixing time(D1) is achieved.

Devices:

Device	Function
X0	X0 = ON when the Power On switch is pressed.
X1	X1 = ON when the button Process is pressed.
Y0	Power On Indicator
Y1	Material A outlet
Y2	Material B outlet
Y3	Agitator
D0	Feeding time of material A
D1	Total feeding time of material A and B

Control Program:



Program Description:

- When the Power On switch is pressed, X0 = ON. The Power On indicator Y0 will be ON. .
- When Process button is pressed, X1 = ON. SET Y3 instruction will be executed so as to execute TMR instruction. Timer T0 will be activated in this case.
- At the same time, CMP instruction will also be executed. When the PV(present value) in T0 is smaller than the SV(set value) in D0, M0 = ON. Therefore, M0 will be ON to turn on coil Y1. Material A feeding process will start. However, when the PV in T0 ≥ the SV in D0, M1 and M2 will be ON but M0 will be OFF. Y2 will be ON in this case and the material B feeding process will start while process A is stopped.
- When the PV in T0 reaches the SV in D1, the NO(Normally Open) contact T0 will be ON to execute ZRST and RST instructions. Y1, Y2, Y3 and T0 will be reset, and the agitator will stop until the Process button is pressed again.

6.2 ZCP - Water Level Alarm Control

Control Purpose:

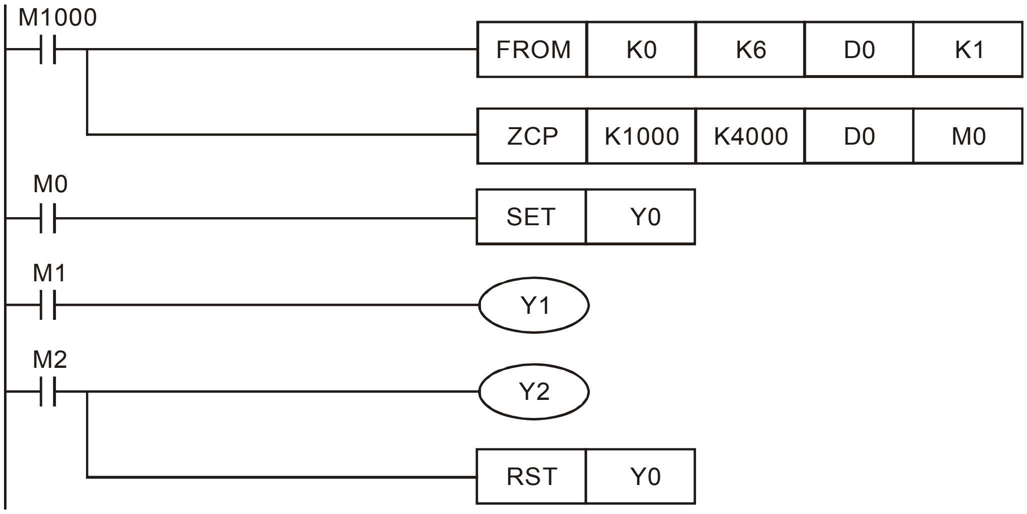
- Controlling the water level in water tower by using analogue level measuring instrument.

When the water is at normal level, enable the normal level indicator. When there is only 25% water volume in the water tower, start the feed water valve. When the level reaches the upper bound, enable the alarm and stop the feed water valve.

Devices:

Device	Function
Y0	Feed water valve. (The lower bound value = K1000)
Y1	Normal level indicator
Y2	Upper limit alarm. (The upper bound value = K4000)
D0	Data register of the measuring value(K0~K4000)

Control Program:



Program Description:

- The water level is measured by analogue level measuring instrument(Voltage output of 0~10V). Delta DVP04AD extension module converts the measured value into the value of K0~K4000 and judges the water level by the value saved in D0
- When the value in D0 < K1000(25% water volume), M0 = ON to set the feed water valve Y0.
- When the value is between K1000~K4000, M1 = ON to set the normal level indicator Y1.
- When the value > K4000(the level reaches the upper bound), M2 = ON to set the upper limit alarm Y2. At the same time, Y0 will be reset, and the feed water valve will be shut down.
- For the application of API78 FROM instruction, please refer to *DVP-PLC Application Manual – Programming.*

6.3 BMOV - Multiple History Data Backup

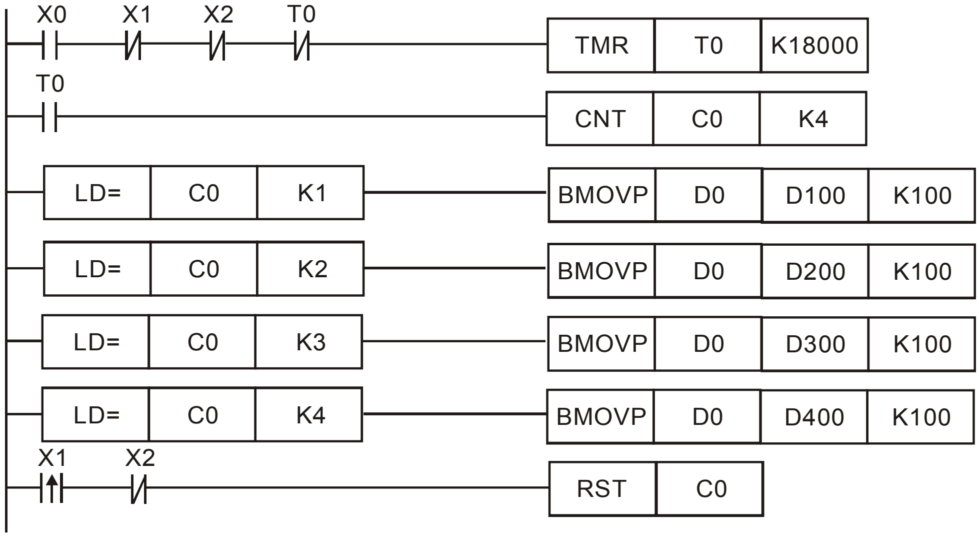
Control Purpose:

- Recording the data of the DUT(Device Under Test) in register D0~D99 on the experimental test bed first, then backup the data in other registers every 30 min by DVP-PLC so that registers D0~D99 can compile new data again. The test cycle of DUT is 2 hours.

Devices:

Device	Function
X0	X0 turns ON when START is pressed.
X1	X1 turns ON when RETEST is pressed.
X2	X2 turns ON when STOP is pressed.
D0~D99	Data compiling
D100~D499	Data backup

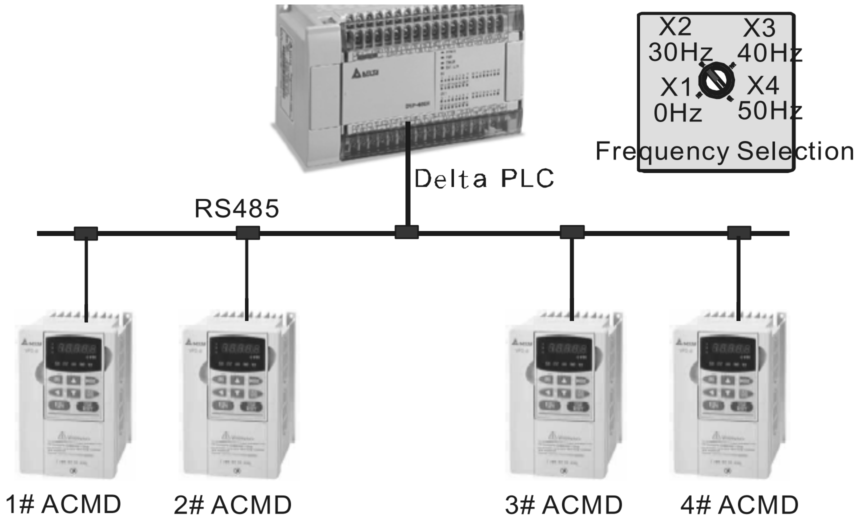
Control Program:



Program Description:

- When X0 = ON, T0 starts to count up, and the NO contact T0 will be ON every 30 minutes.
- In the program, counter C0 is used for counting the ON times of NO contact T0. When C0 = 1, the data in D0~D99 will be sent to D100~D199; when C0 = 2, the data in D0~D99 will be sent to D200~D299; when C0 = 3, the data in D0~D99 will be sent to D300~D399; when C0 = 4, the data in D0~D99 will be sent to D400~D499 and the test process ends here.
- If the operator needs to retest the DUT, just activate X1 one more time.
- When X2 = ON, the test will be stopped. In this case, no data compiling will be done on DUT by PLC, and Counter C0 will be cleared as well.

6.4 FMOV - Single Data Broadcasting



Control Purpose:

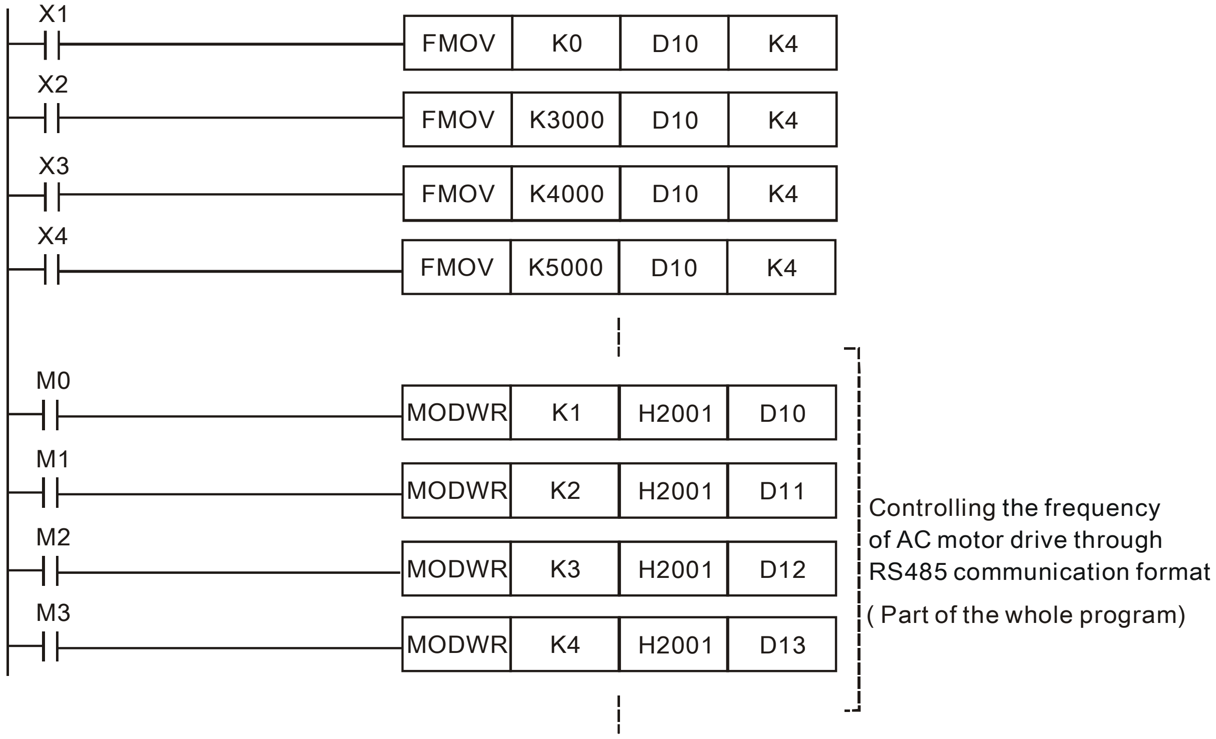
- Setting frequency of 4 ACMDs (AC Motor Drive) by selecting on the rotary switch.

In some applications users may need to set the frequency on several ACMDs to be the same when a Delta PLC is connected through RS485 communication format. The control purpose can be achieved by controlling the value in D10~D13 which corresponds to 4 frequency of four ACMDs, and then adjusting the frequency by one external rotary switch.

Devices:

Device	Function
X1	X1 = ON when the switch is turned to “0Hz”.
X2	X2 = ON when the switch is turned to “30Hz”.
X3	X3 = ON when the switch is turned to “40Hz”.
X4	X4 = ON when the switch is turned to “50Hz”.
D10	Output frequency of 1# AC motor drive
D11	Output frequency of 2# AC motor drive
D12	Output frequency of 3# AC motor drive
D13	Output frequency of 4# AC motor drive

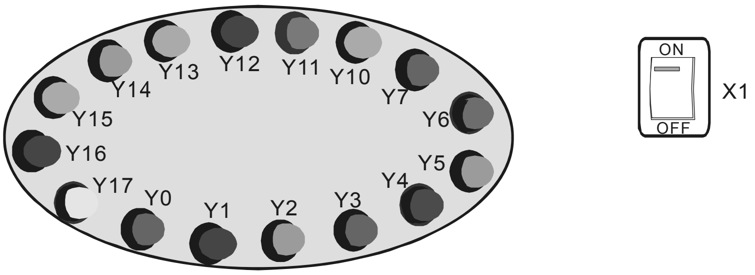
Control Program:



program Description:

- When X1 = ON, K0 will be sent to D10~D13. The output frequency of ACMD will be 0Hz.
- When X2 = ON, K3000 will be sent to D10~D13. The output frequency of ACMD will be 30Hz.
- When X3 =ON, K4000 will be sent to D10~D13. The output frequency of ACMD will be 40Hz.
- When X4 = ON, K5000 will be sent to D10~D13. The output frequency of ACMD will be 50Hz.
- The program applies MODWR instructions to set output frequency of ACMDs through RS485 communication. Please note that the 4 MODWR instructions cannot be executed at the same time due to a possible conflict in communication. For examples of multiple communication, please refer to *Chapter 12 – Communication Design Examples.*

6.5 CML - Color Lights Flashing



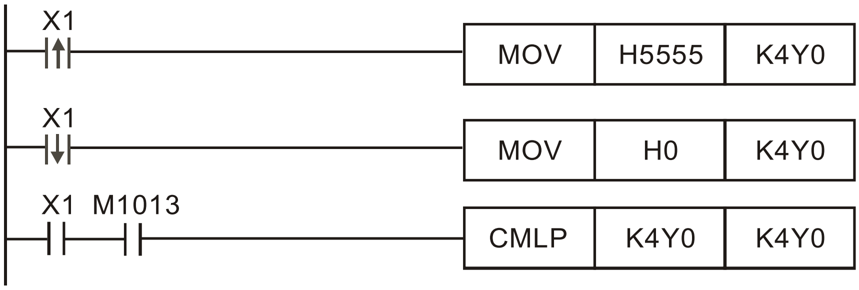
Control Purpose:

- Turning on the even-numbered lights and odd-numbered lights alternately for 1 sec when the switch is turned ON.
- Turning off all color lights when the switch is turned off.

Devices:

Device	Function
X1	Flashing control switch. X1 = ON when the switch is turned to ON.
M1013	1s clock pulse, 0.5s ON / 0.5s OFF
Y0~Y17	16 color lights

Control Program:



Program Description:

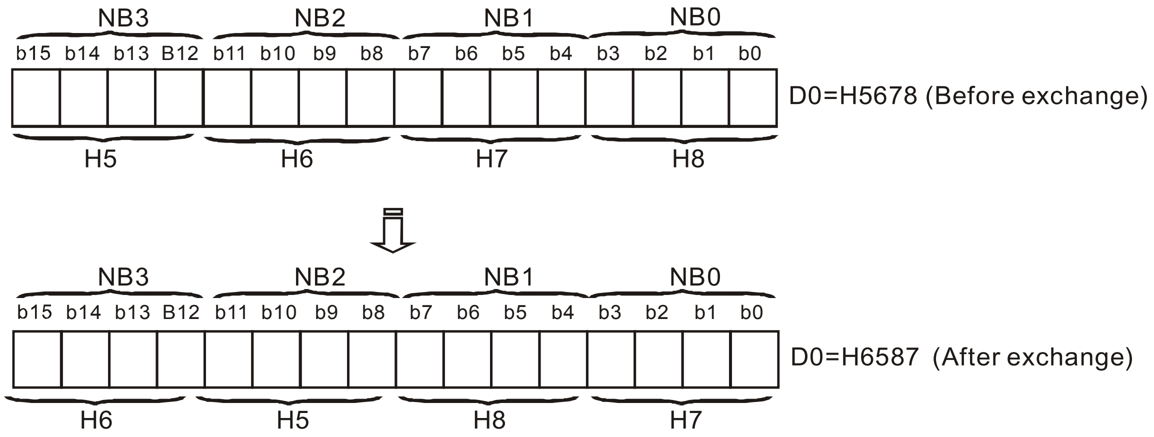
- When the switch is turned ON, K4Y0 = H5555 and the state of Y17~Y0 will be “0101 0101 0101 0101,” which means the even-numbered lights will be ON. When M1013 = On, CMLP instruction will be executed to reverse the state of K4Y0. Y17~Y0 will be “1010 1010 1010 1010,” which means the odd-numbered lights will be ON. The state will last for 1 sec.
- When M1013 is ON again, CMLP instruction will be executed and the state of K4Y0 will be reversed again. In this case, the even-numbered lights will be ON.
- Every time when M1013 is ON, the state of Y0~Y17 will be reversed and lasts for 1 sec. The lights will flash alternatively as this cycle.

6.6 XCH - Exchanging the Upper and Lower 8 bits in a Register

Control Purpose:

- Exchanging the data NB(Nibble)0 with NB1, NB2 with NB3 in a register every 1 sec.

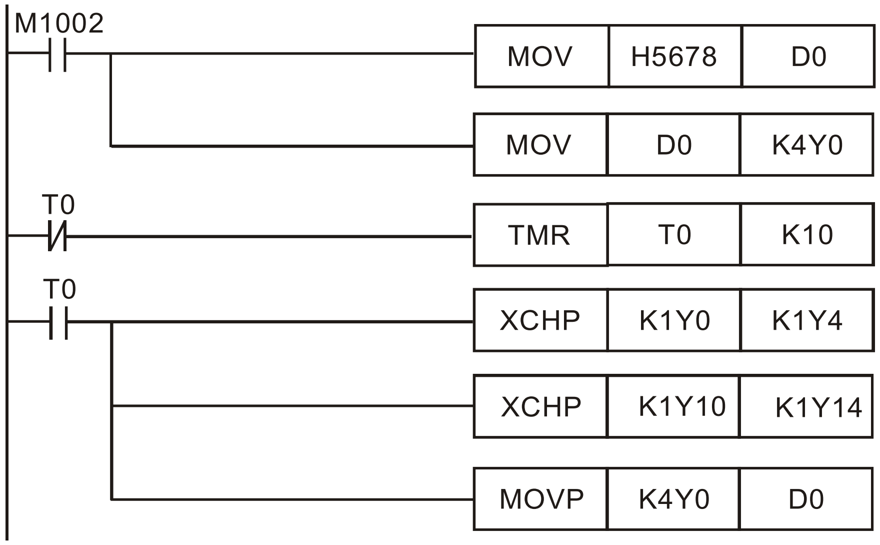
The data length of D register is Word (16 bits), and a Word is made up of 4 Nibbles.


NB3
NB2
NB1
NB0
b15 b14 b13 B12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0
D0=H5678 (Before exchange)
H5
H6
H7
H8
NB3
NB2
NB1
NB0
b15 b14 b13 B12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0
D0=H6587 (After exchange)
H6
H5
H8
H7

Devices:

Device	Function
T0	1 sec timer. Time base: 100ms
D0	Data register
Y0~Y17	Storing 4 nibbles

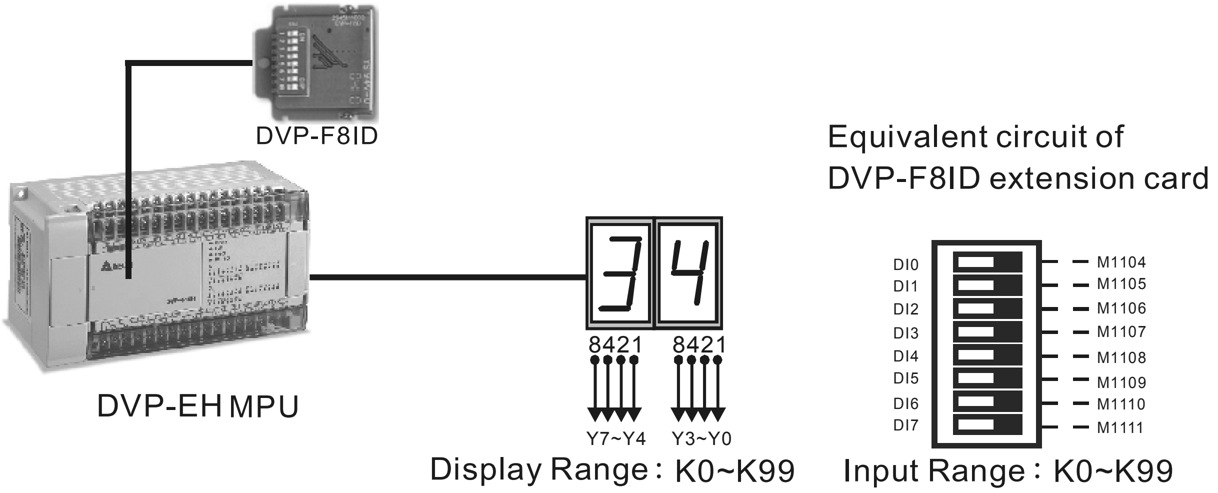
Control Program:



Program Description:

- First, the program will store the 16 bits (4 Nibbles) data in D0 to Y0~Y17. After 1 sec, the NO contact T0 will be activated to execute XCHP instruction. The data in K1Y0 will be exchanged with K1Y4 and so will K1Y10 with K1Y14. Then, these data will be sent to D0. Finally, The data exchange between NB0/NB1 and NB2/NB3 is completed.

6.7 DIP Switch Input and 7-segment Display Output



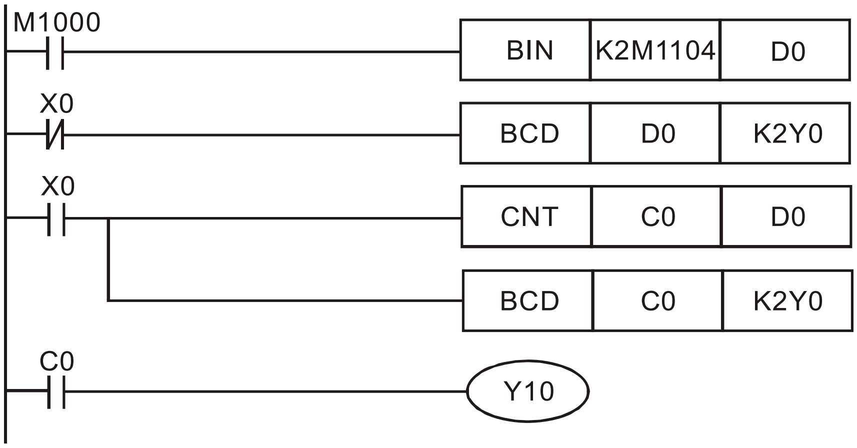
Control Purpose:

- Setting the set value of counter C0 in the range of K0~K99 by DVP-F8ID extension card and displaying the PV (K0~K99) by 7-segment decoding display.

Devices:

Device	Function
X0	Switch for starting C0
M1104~M1111	Mapping ON/OFF state of the external 8 switches
D0	Set value of C0
Y0~Y7	Displaying the PV of C0
Y10	Indicator. Y10 = ON when the counter reached its set value

Control Program:

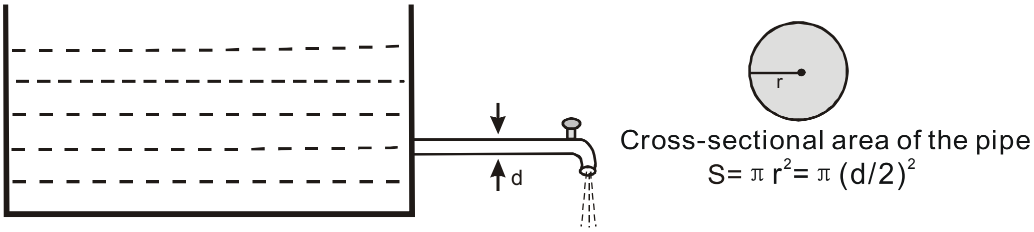


Program Description:

- When PLC runs, ON/OFF state of the external 8 DIP switches will be mapped to PLC internal auxiliary relay M1104~M1111 by DVP-F8ID extension card. 8 bits switch can perform 2 digit number input by instructions.

- When the program is executed, M1000 = ON, and the set value of counter in DVP-F8ID extension card will be stored in D0.
- When the counter is OFF, X0 = OFF, and the 2 digit number display will show the set value of C0 because of the execution of BCD instruction.
- When the counter is ON, X0 = ON. C0 will start counting and BCD instruction will be executed. The 2 digit number display will show the PV of C0.
- If the 2 digit number display shows “34” from left to right, it means the state of DI7~DI0 on DVP-F8ID extension card is “0011 0100.”
- When C0 reaches its set value D0, the NO contact C0 will be activated and Y10 will be ON.

7.1 Accurate Pipe Flow Measurement



Cross-sectional area of the pipe
$S=\pi r^2=\pi(d/2)^2$

Control Purpose:

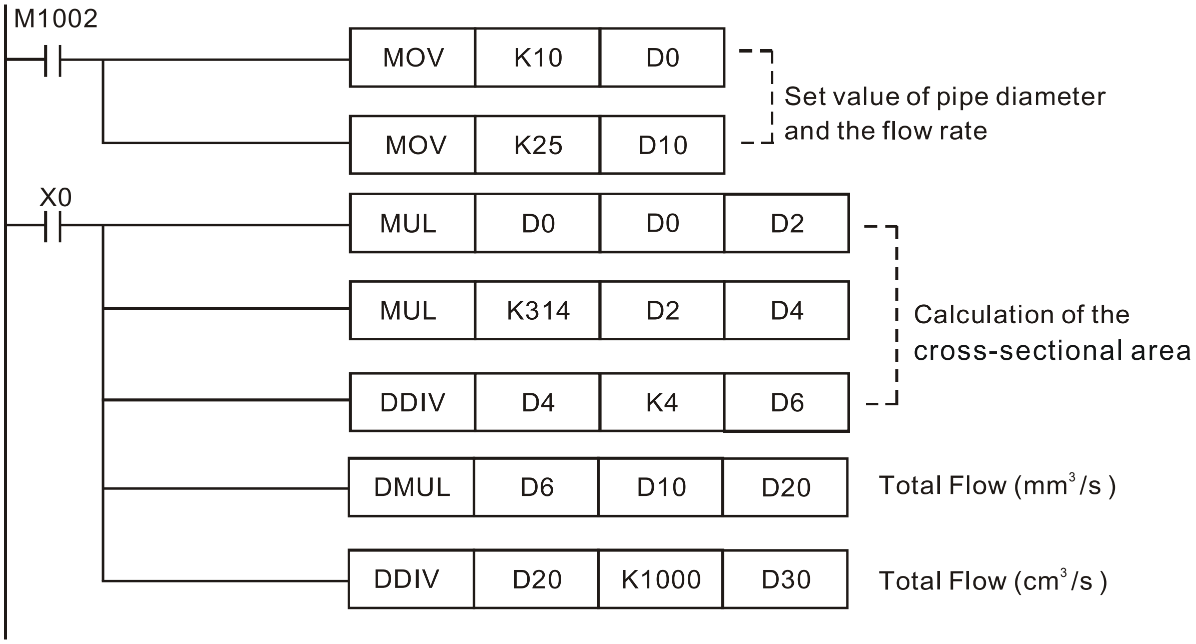
- Measuring the flow to an accuracy of 2 decimal places.

In this example, the diameter of the pipe is measured by *mm*, the flow rate is measured by *dm/s*, and the flow is measured by *cm*^{3}*/s*. The cross-sectional area of the pipe = $\pi r^2 = \pi(d/2)^2$ and the flow = cross-sectional area × flow rate.

Devices:

Device	Function
X0	Starting the measurement
D0	Diameter of the pipe (unit: *mm*; set value: 10mm)
D6	Operation result of the cross-sectional area (unit: mm^2)
D10	Flow rate (unit: dm/s; set value: 25dm/s)
D20	Operation result of the flow (unit: mm^3/s)
D30	Operation result of the flow (unit: cm^3/s)

Control Program:



```
M1002
  MOV   K10   D0
  MOV   K25   D10
X0
  MUL   D0    D0     D2
  MUL   K314  D2     D4
  DDIV  D4    K4     D6
  DMUL  D6    D10    D20
  DDIV  D20   K1000  D30
```

Set value of pipe diameter and the flow rate

Calculation of the cross-sectional area

Total Flow (mm^3/s)

Total Flow (cm^3/s)

Program Description:

- The floating point operation is usually applied to perform decimal calculation. However, it needs to be converted and is more complicated. Therefore, we use elementary arithmetic operation instructions to perform decimal calculation in this example.
- The units of *mm*, *cm* and *dm* are used in the program. For calculation requirement, the program sets these units into *mm*^{3} and then converts them into *cm*^{3}.
- *π* (π≈3.14) is required when calculating the cross-sectional area of the pipe. In order to get the calculation accuracy of 2 decimal places, the program increases *π* 100 times to be K314 instead of increasing the unit *dm/s* 100 times to be *mm/s*.
- In the end, the program divides the value in D20 (unit: *mm*^{3}*/s)* with 1000 so as to convert the unit into *cm*^{3}*/s*. (1 *cm*^{3} = 1 *ml,* 1*l* = 1000 *ml* = 1000 *cm*^{3} = 1 *dm*^{3} *)*
- .Assume the pipe diameter D0 is 10 *mm* and the flow rate D10 is 25 *dm/s*, the operation result of the total flow will be 196 *cm*^{3}*/s.*

7.2 INC/DEC - Fine Tuning by JOG Control

Control Purpose:

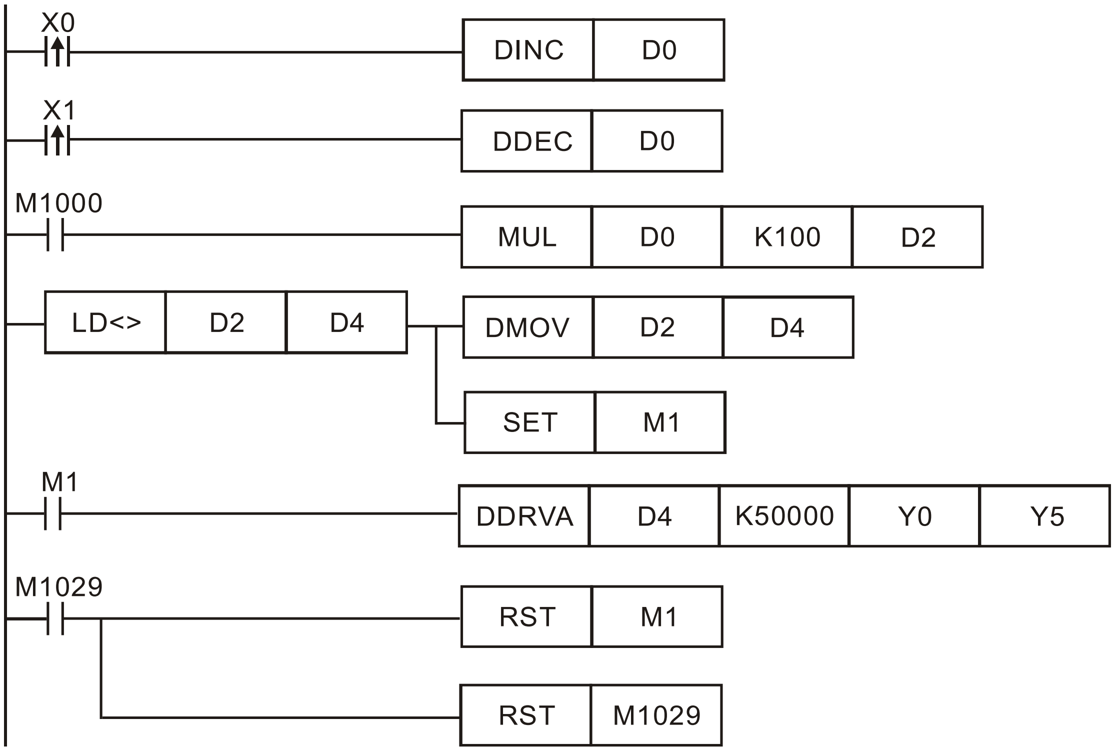
- Controlling the fine tuning by JOG left and JOG right switches.

  In this assumed position control system, the 1 *mm* fine tuning can be performed by 100 pulses sent by PLC. When X0 is pressed, JOG left for 1 *mm*; when X1 is pressed, JOG right for 1 *mm*.

Devices:

Device	Function
X0	JOG left switch
X1	JOG right switch
D0	Target position
D2	The number of pulses for target position
Y0	Pulse output point
Y5	Direction control signal output

Control Program:



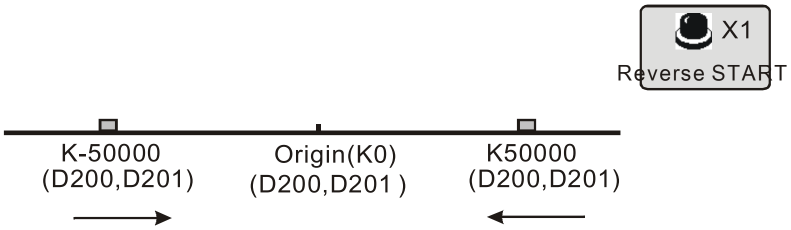
Program Description:

- When JOG left switch X0 is pressed, DINC instruction will execute to increase the value in D0; when JOG right switch X1 is pressed, DDEC instruction will execute to decrease the value in D0.
- Assume the initial value of D0 and D4 is K0. When JOG left switch is pressed, D0 will be K1

and then be multiplied with 100 as the pulse number. The pulse number will be stored in D2 then transferred to D4 as the target value of DDRVA instruction (absolute position), and M1 will be ON to execute DDRVA instruction.

- According to the execution result of DDRVA, Y0 will output 100 pulses with frequency 50kHz and the system will JOG to the target position (D4 = D2 = K100) from the initial position (D4 = K0), which means the system will JOG left for 1 *mm*.
- If X0 is pressed again, D2 will be K200 which is different to the present value in D4 (K100). The value in D2 (K200) will be sent to D4 as the target value of the absolute position. M1 will be ON to execute DDRVA instruction. The system will JOG to the target position (D4 = D2 = K200) from the last position (D4 = K100), which means the system will JOG left for another 1 *mm*.
- Likewise, the process of JOG right is similar to that of JOG left. The system will JOG right for 1 *mm* every time the JOG right switch is pressed,

7.3 NEG - Displacement Reverse Control



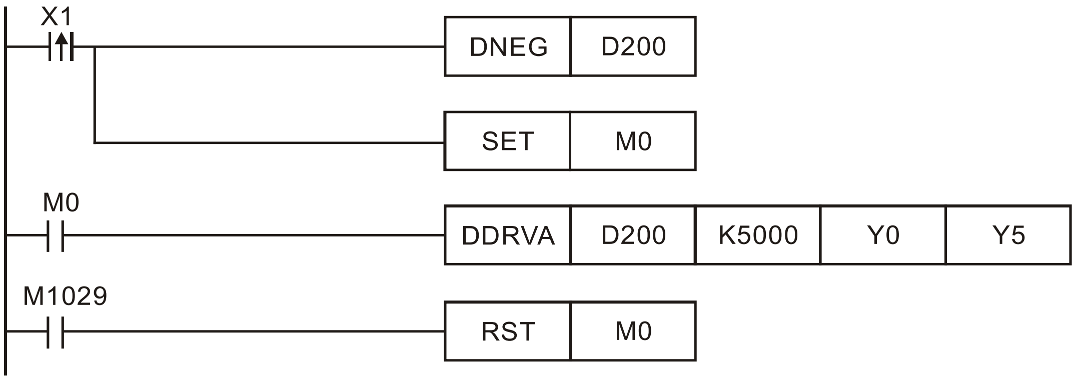
Control Purpose:

- The symmetric point in this program is the Origin (D200, D201 = K0). Controlling the displacement to shift between the left end and the right end every time X1 is pressed.

Devices:

Device	Function
X1	Reverse START button
Y0	Pulse output point
Y5	Reverse direction control
D200, D201	Storing the target value of the absolute position

Control Program:

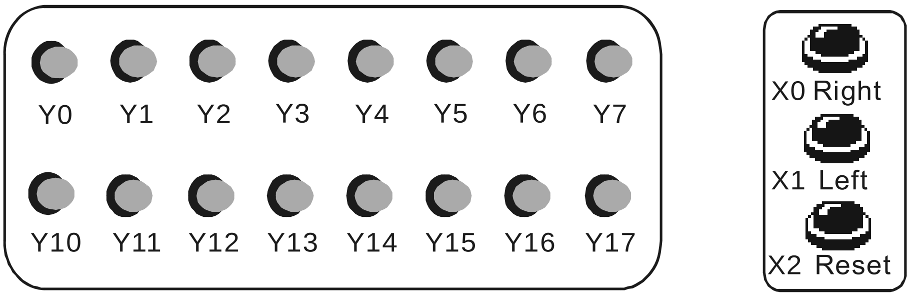


Program Description:

- Assume the 32-bit initial value of D200 and D201 is K50000. When the Reverse START button X1 is pressed, the content in D200 and D201 will become K-50000.
- In addition, M0 will be ON to execute DDRVA instruction. The program will shift the present location K50000 to the target position K-50000 with frequency 5KHZ (K5000). When the target position is reached, M1029 = ON and M0 will be reset. Y0 will stop pulse sending.
- When X1 is pressed again, the value in D200 and D201 will change from K-50000 to K50000. M0 will be ON to execute the displacement reverse control until the absolute position is reached.
- As the actions above, the program will shift from the present location to the other side of the symmetric point Origin every time when X1 is pressed.

MEMO

8.1 ROL/ROR - Neon Lamp Design



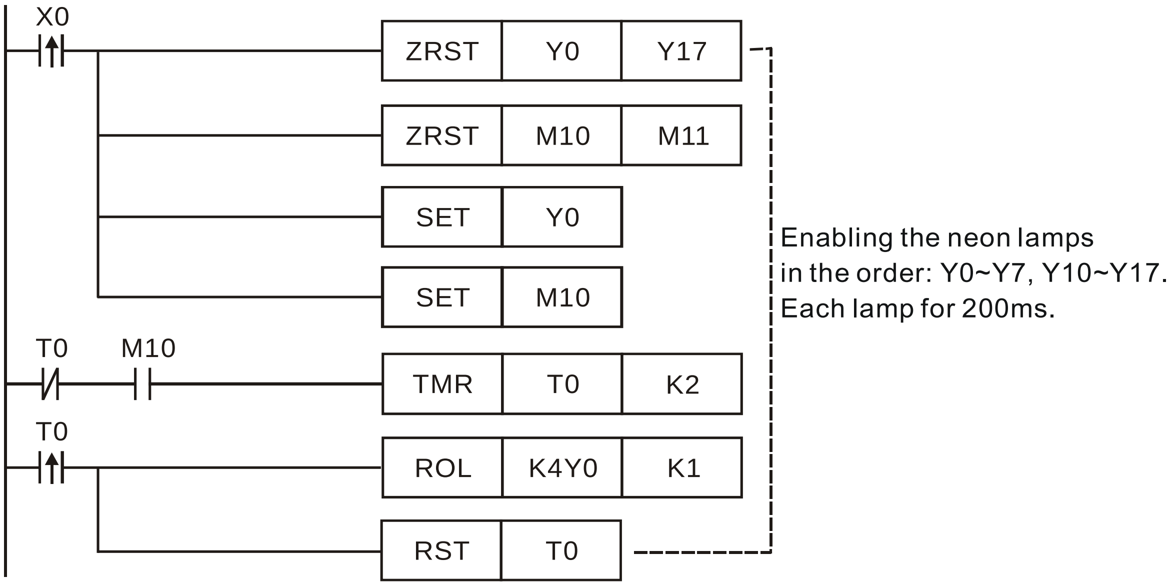
Control Purpose:

- Enabling the 16 neon lamps in the order: Y0~Y7, Y10~Y17 when Rotation Right button is pressed. Each lamp turns on for 200ms.
- Enabling the 16 neon lamps in the order: Y17~Y10, Y7~Y0 when Rotation Left button is pressed. Each lamp turns on for 200ms.
- The action of Reset is unnecessary when switching between Rotation Right and Rotation Left.
- When RESET is pressed, turn off all working neon lamps.

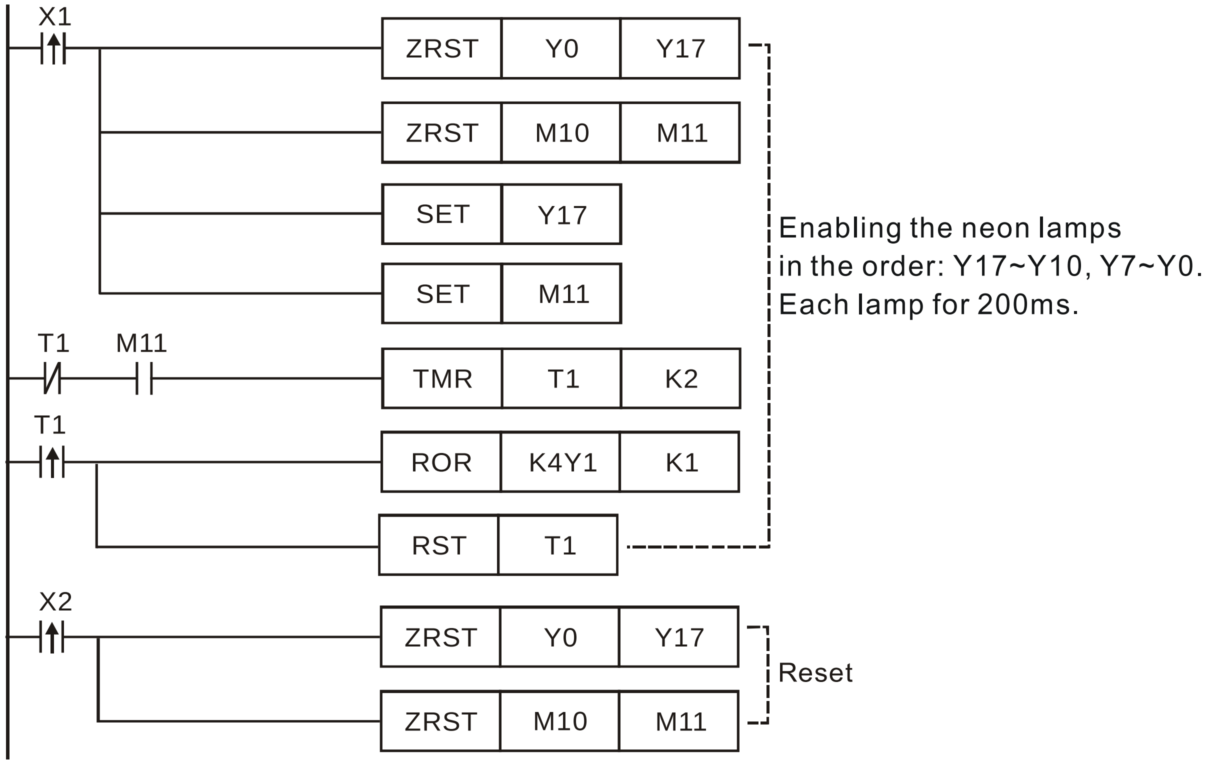
Devices:

Device	Function
X0	Rotation Right button. X0 = ON when the button is pressed.
X1	Rotation Left button. X1 = ON when the button is pressed.
X2	X2 turns ON when RESET is pressed.
T0/T1	200ms timer. Time base: 100ms.
Y0~Y17	16 neon lamps

Control Program:



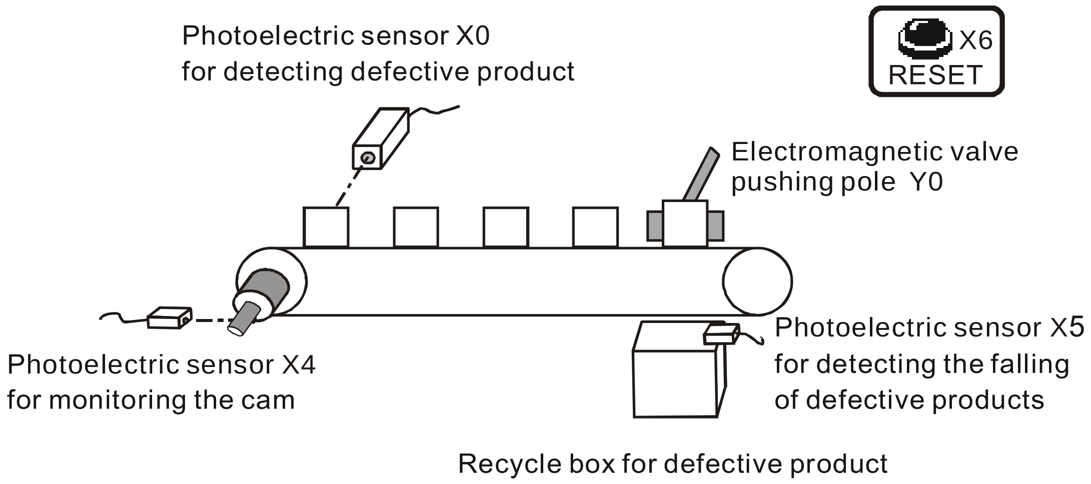
Enabling the neon lamps in the order: Y0~Y7, Y10~Y17. Each lamp for 200ms.



Program Description:

- When Rotation Right is pressed, X0 = ON to execute ZRST and SET instructions. Y0~Y17 and M10~M11 will be reset first, then Y0 and M10 will be ON. TMR instruction will be executed. After 200ms, the contact T0 will be activated once to execute ROL instruction. The ON state of Y0 will be shifted to Y1, and T0 will then be reset.
- In the next scan cycle, timer T0 starts counting again. After 200ms, ROL instruction will be executed one more time and the ON state of Y1 will be shifted to Y2. By the same process, Y0~Y17 will be ON for 200ms in order.
- The rotation left process is similar to the above process. However, the rotation right program uses ROR instruction to enable the lamps in the order: Y17~Y10, Y7~Y0
- When RESET is pressed, X2 = ON to reset Y0~Y17 and M10~M11. All neon lamps will be OFF. (Note: in this program, the purpose of placing ZRST instruction after the rising-edge contacts of X0 and X1 is to ensure that all the neon lamps start flashing from Y0 or Y17.)

8.2 SFTL - Defective Product Detect



Control Purpose:

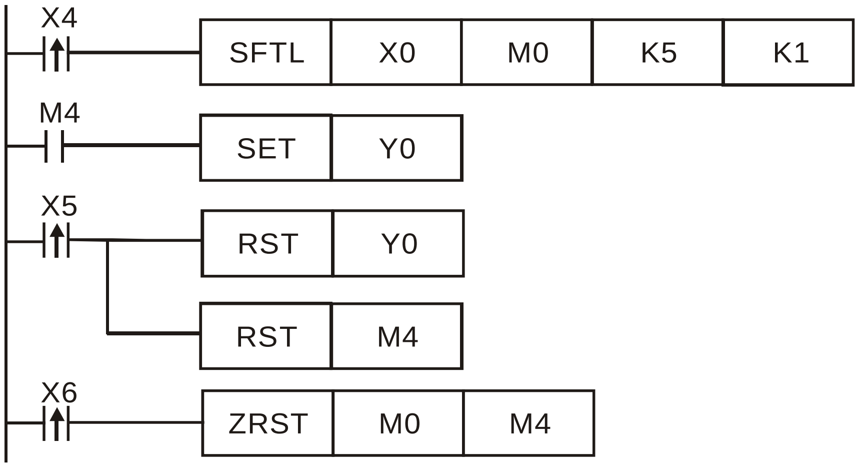
- Detecting the defective products (taller than normal dimension) on the conveyor belt by photoelectric sensor and pushing them into the recycle box at the 5th position.

The pushing pole will be reset when the falling of defective product is detected. When errors occur, the disorder memory can be cleared and the system can be restarted by pressing RESET.

Devices:

Device	Function
X0	Photoelectric sensor for detecting defective products
X4	Photoelectric sensor for monitoring the cam
X5	Photoelectric sensor for detecting the falling of defective products
X6	RESET
Y0	Electromagnetic valve pushing pole

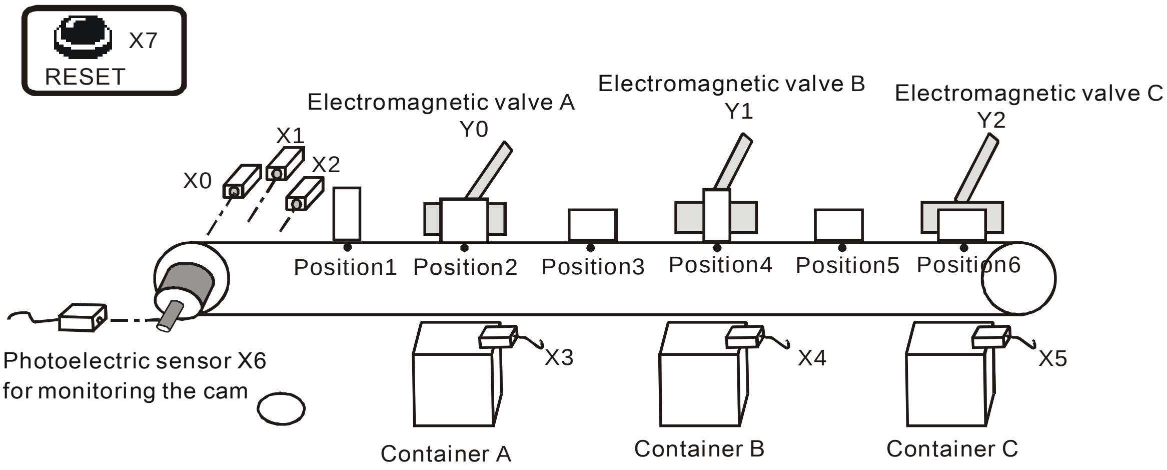
Control Program:



Program Description:

- Every time the cam rotates once, the product will be moved from one position to another position. X4 will be activated to execute SFTL instruction once. The content in M0~M4 will be shift to left for one bit and the state of X0 will be sent to M0.
- When X0 = ON (defective products detected), the value “1” will be sent to M0 and achieve the 5th position after 4 times of shift. In this case, M4 = ON and the electromagnetic valve Y0 will be ON to push the defective product into the recycle box.
- When the falling of the defective product is detected, X5 will be activated to execute [RST Y0] and [RST M4] instructions. Y0 and M4 will be reset. The electromagnetic valve will be OFF till next defective product is detected.
- When RESET is pressed, X6 will be activated to reset M0~M4, so as to ensure that the system restart the detecting process when the memory which records defective products is in disorder.

8.3 WSFL - Automatic Sorting Mixed Products



Control Purpose:

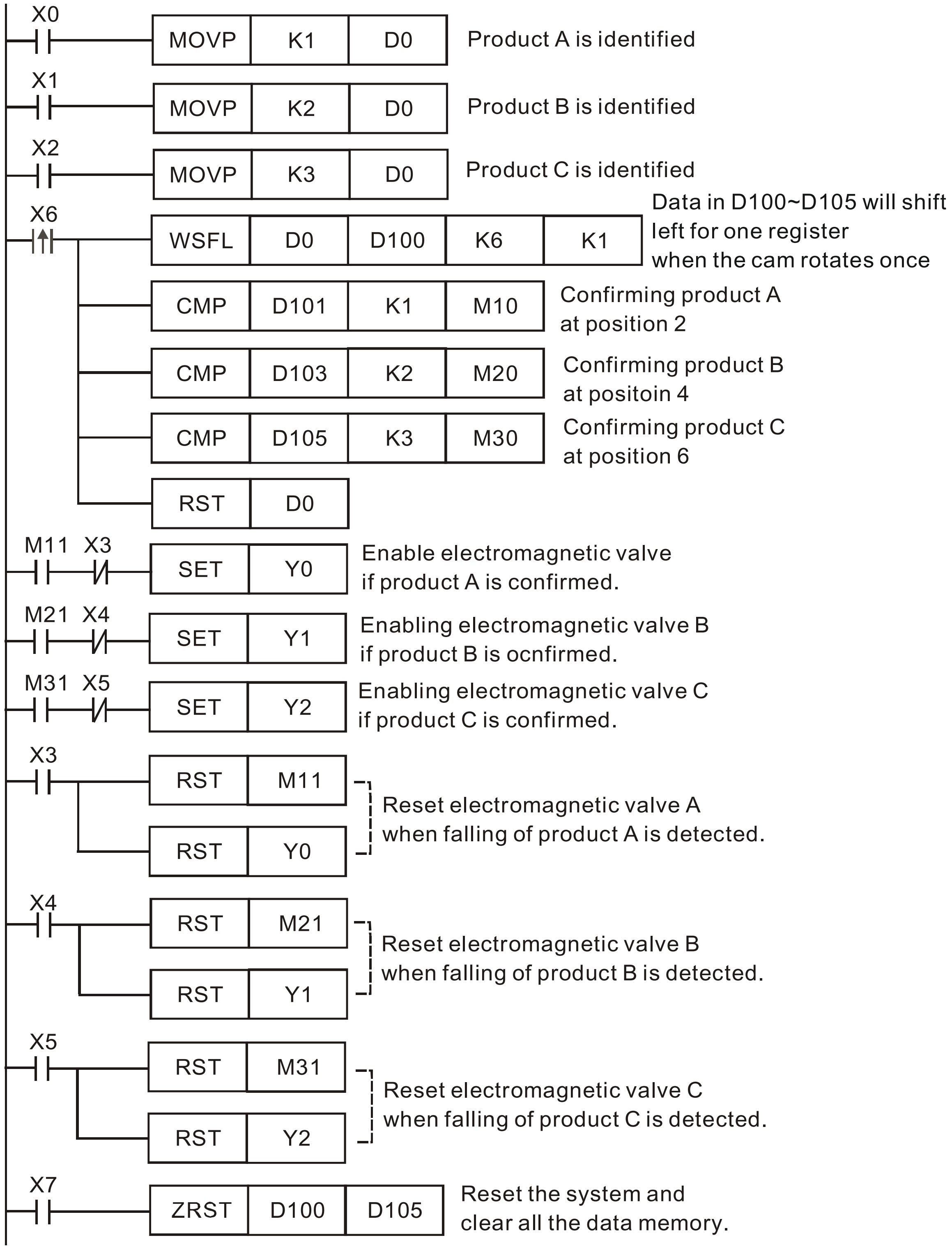
- Sorting different products on the conveyor belt and pushing each product into its corresponding container.

1. There are three kinds of products, A, B and C and 6 positions for each product are set on the conveyor. Products will move forward for one position when the cam rotates once.
2. Sorting each product by product ID (Identification) sensors. Product A will be pushed in container A at position 2. And so forth, product B in container B at position 4; product C in container C at position 6.
3. When the product falling is confirmed by sensors, the electromagnetic valve will be reset. When RESET is pressed, all memory will be cleared and the system will restart the identifying and sorting process.

Devices:

Device	Function
X0	Product A ID sensor. X0 = ON when Product A is detected.
X1	Product B ID sensor. X1 = ON when Product B is detected.
X2	Product C ID sensor. X2 = ON when Product C is detected.
X3	Product A falling sensor. X3 = ON when Product A falls in container A
X4	Product B falling sensor. X4 = ON when Product B falls in container B
X5	Product C falling sensor. X5 = ON when Product C falls in container C
X6	Sensor for the cam. X6 activates 1 time when the cam rotates once.
X7	RESET. X7 = ON when the button is pressed
Y0	Electromagnetic valve A
Y1	Electromagnetic valve B
Y2	Electromagnetic valve C

Control Program:



Product A is identified

Product B is identified

Product C is identified

Data in D100~D105 will shift left for one register when the cam rotates once

Confirming product A at position 2

Confirming product B at positoin 4

Confirming product C at position 6

Enable electromagnetic valve if product A is confirmed.

Enabling electromagnetic valve B if product B is ocnfirmed.

Enabling electromagnetic valve C if product C is confirmed.

Reset electromagnetic valve A when falling of product A is detected.

Reset electromagnetic valve B when falling of product B is detected.

Reset electromagnetic valve C when falling of product C is detected.

Reset the system and clear all the data memory.

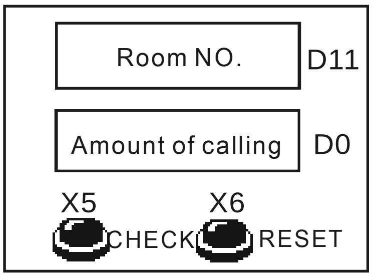
Program Description:

- When product A is identified on the conveyor belt, X0 activates for one time to execute MOVP K1 D0 instruction. The value in D0 = K1. Likewise, when product B and C is on the conveyor, the value in D0 will be K2 and K3.
- Products will move forward for one position when the cam rotates once. X6 activated one time to execute WSFL instruction. Data in D100~D105 will shift left for one register. At the

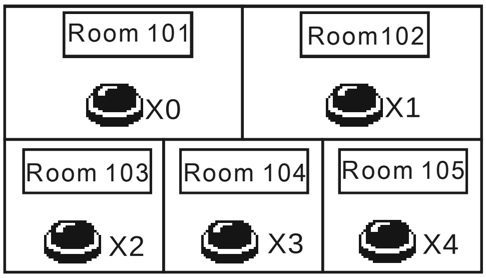
same time, CMP instructions will be executed to confirm product A at position 2 (D101), product B at position 4 (D103) and product C at position 6 (D105). After each CMP instruction, RST instruction will be executed to clear D0.

- If product A , B or C is confirmed at position 2, 4 or 6, the corresponding M11, M21 or M31 will be ON to enable electromagnetic valve A, B or C to push the products in the containers.
- When the falling of each product is detected by sensors, X3, X4 or X5 will be ON to reset electromagnetic valve A, B or C.
- When RESET is pressed, X7 = ON to execute ZRST instruction. The value in D100~D105 will be 0, which means all data memory will be cleared.

8.4 SFWR/SFRD - Room Service Call Control



Service Counter



Rooms

Control Purpose:

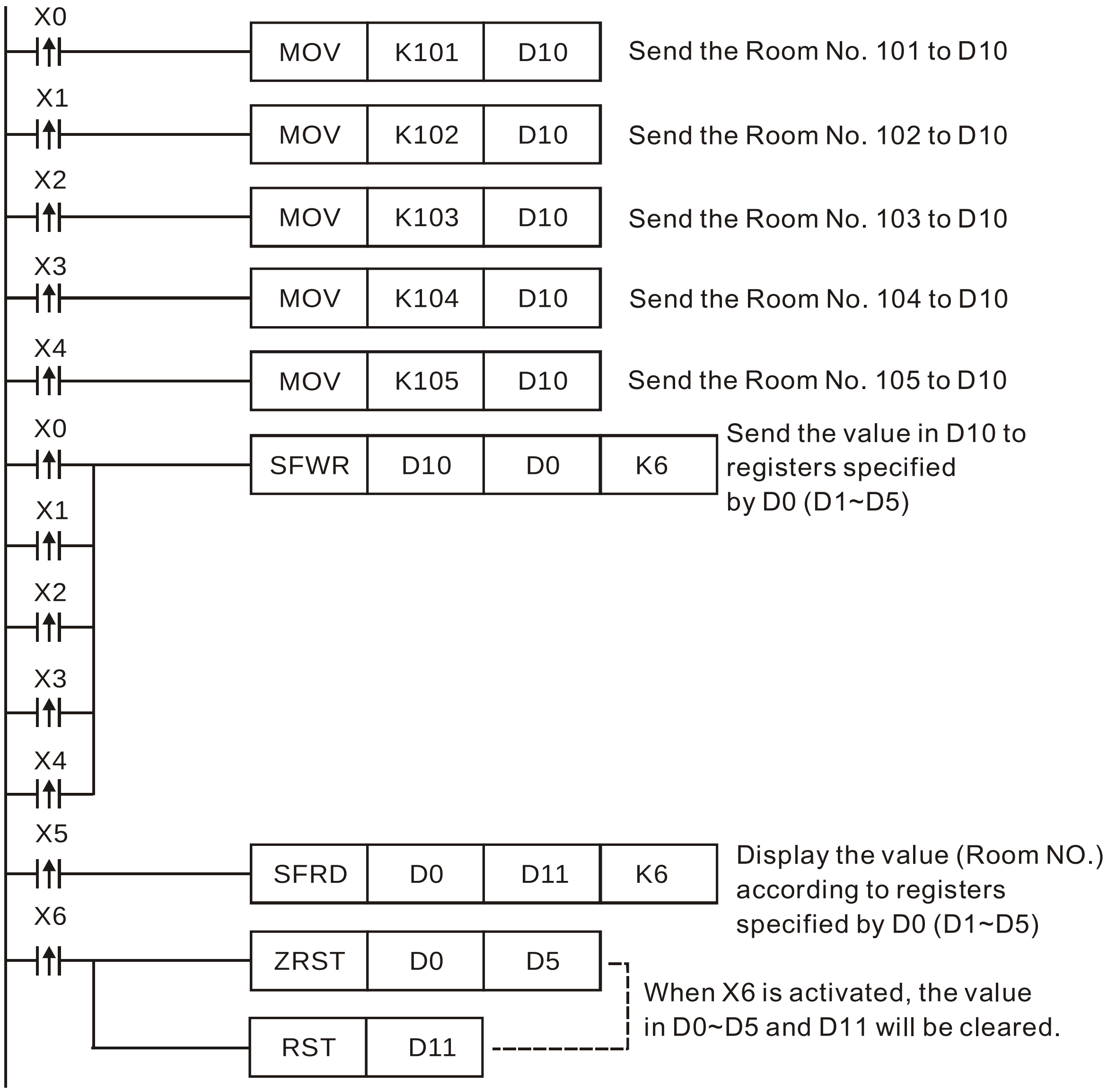
- Recording the calling room numbers and the amount of calling then checking the numbers in first-in first-out principle, which means the room first called will be first served.
- Clearing all the data memory when RESET is pressed.

The amount of calling will be increased by the pressing times of call buttons, and decreased by the checking times of CHECK button. If all room numbers are checked, the displayed amount of calling would be 0.

Devices:

Device	Function
X0	Call button of Room 101. X0 = ON when the button is pressed
X1	Call button of Room 102. X1 = ON when the button is pressed
X2	Call button of Room 103. X2 = ON when the button is pressed
X3	Call button of Room 104. X3 = ON when the button is pressed
X4	Call button of Room 105. X4 = ON when the button is pressed
X5	Check button. X5 = ON when CHECK is pressed.
X6	Reset button. X6 = ON when RESET is pressed.
D0	Displaying the amount of calls
D1 ~ D5	Storing the room numbers under check
D10	Storing the input room numbers temporarily
D11	Displaying the room number (First-in first-out)

Control Program:



Send the Room No. 101 to D10

Send the Room No. 102 to D10

Send the Room No. 103 to D10

Send the Room No. 104 to D10

Send the Room No. 105 to D10

Send the value in D10 to registers specified by D0 (D1~D5)

Display the value (Room NO.) according to registers specified by D0 (D1~D5)

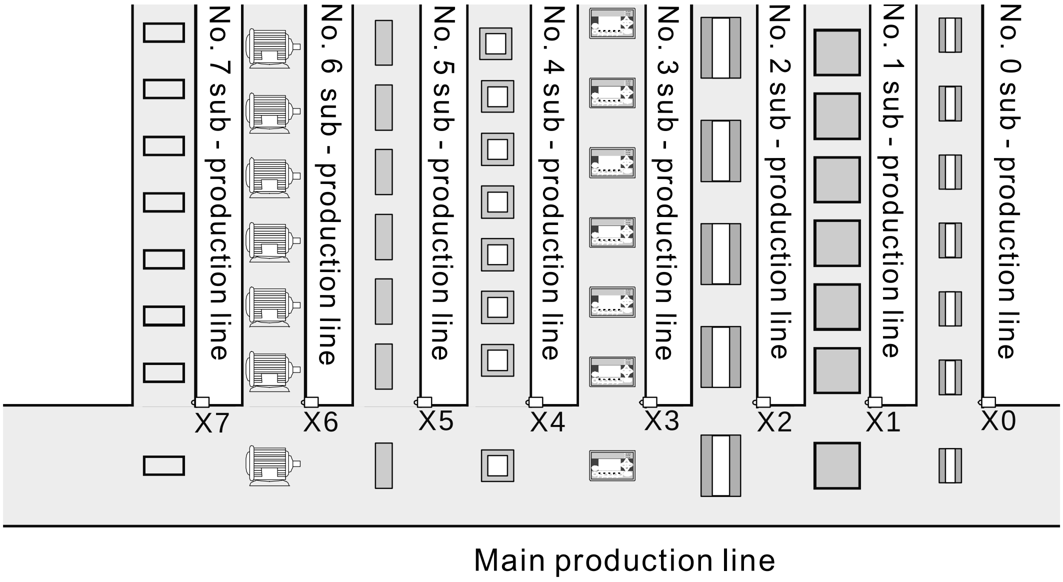
When X6 is activated, the value in D0~D5 and D11 will be cleared.

Program Description:

- By using API38 SFWR instruction together with API39 SFRD instruction, the program performs data stack writing and reading control in FIFO(first in, first out) principle. In this example, the room number first called will be first checked.
- When Call buttons are pressed, the numbers of the five rooms will be stored in D10 first and then sent to data stack D1~D5 according to the time order.
- When CHECK is pressed, the room number first called will be read to D11 first and the amount of calling will be decreased corresponding to D0. In addition, by using Delta TP04, the system can easily monitor the value of D0 (Amount of calling) and D11 (Displaying Room No.)
- The program clears D0~D5 and D11 by ZRST and RST instructions, which means Amount of calling and Room number displayed on TP04 will be 0.

MEMO

9.1 ENCO/DECO - Encoding and Decoding


No. 7 sub - production line
No. 6 sub - production line
No. 5 sub - production line
No. 4 sub - production line
No. 3 sub - production line
No. 2 sub - production line
No. 1 sub - production line
No. 0 sub - production line
X7
X6
X5
X4
X3
X2
X1
X0
Main production line

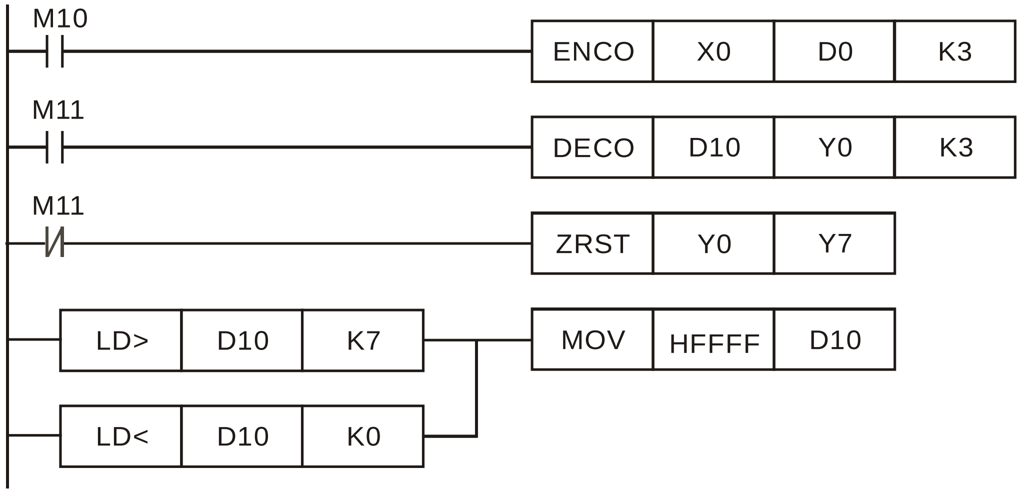
Control Purpose:

- Monitoring the entering products from sub-production lines No.0~7 to main production line by the value in D0 and disabling certain sub-production lines by setting the value in D10 as K0~K7.

Devices:

Device	Function
X0~X7	Product detecting sensor to identify each entering product.
Y0~Y7	Disabling the corresponding sub production line (No.0~7)
M10	Executing ENCO instruction
M11	Executing DECO instruction
D0	Indicating the entering product from sub-production line No.0~7
D10	Disabling the specified sub-production line

Control Program:



Program Description:

- When M10 = ON, ENCO instruction will be executed. Any product entering main production line will be encoded with its sub-production line number, and the result will be saved in D0. By monitoring the value in D0, the operator can identify the type of the entering product.
- When M11 = ON, DECO instruction will be executed to decode the specified value in D10 into Y0~Y7 so as to disable the corresponding sub-production line. For example, when D10 = K5, the decoding result will be Y5 = ON. In this case, No. 5 sub-production line will be disabled. When M11 = OFF, ZRST instruction will be executed and Y0~Y7 will be OFF. All sub-production lines will operate normally.
- If the set value in D10 is out of the range between K0~K7, HFFFF will be written in D10, so as to prevent the production line interruption due to other written value in D10.

9.2 SUM/BON - Checking and Counting the Number of "1"

Control Purpose:

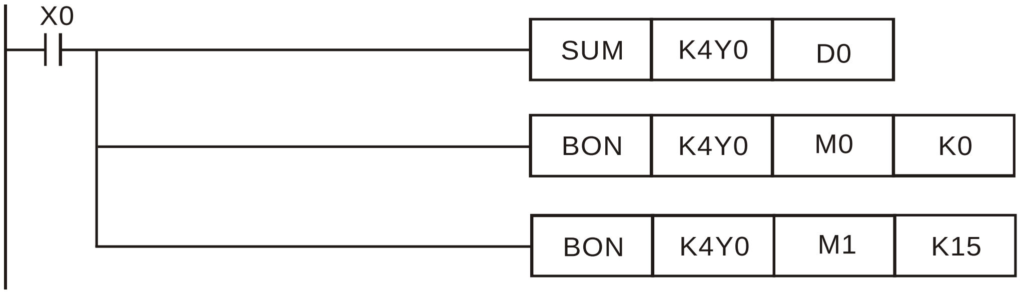
When X0 = ON,

- Executing SUM instruction to count active bits among Y0~Y17 and to store the value in D0.
- Executing BON instruction to check the ON/OFF state of LSB (Least Significant Bit) and MSB (Most Significant Bit) and to store the result in M0 and M1
- Indicating the value in D0 and the state of M0 and M1.

Devices:

Device	Function
X0	Executing SUM and BON instructions
Y0~Y17	Device for checking and counting
D0	Storing the sum of active bits among Y0~Y17
M0	Storing the ON/OFF state of LSB
M1	Storing the ON/OFF state of MSB

Control Program:



Program Description:

- When X0 = ON, the program will count the active bits (numbers of "1") among Y0~Y10 and check the active state ("1") of the LSB and MSB.

9.3 MEAN/SQR - Mean Value and Square Root

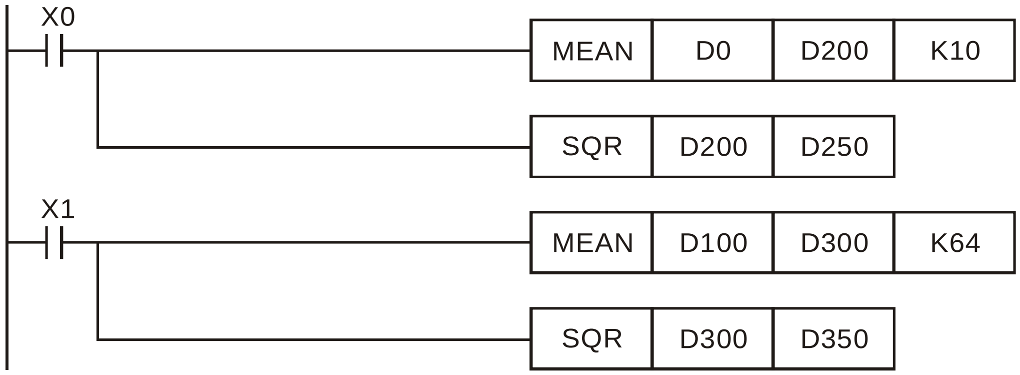
Control Purpose:

- When X0 = ON, calculate the mean of values in D0~D9 and store the value in D200; calculate the square root of D200 and save the value in D250.
- When X1 = ON, calculate the mean of values in D100~D163, store the value in D300; calculate the square root of D300 and save the value in D350.

Devices:

Device	Function
X0	Executing MEAN/SQR instruction to calculate 10 continuous data
X1	Executing MEAN/SQR instruction to calculate 64 continuous data
D0~D9	Storing historical data
D200	Storing mean value
D250	Storing square root of the mean value
D100~D163	Storing historical data
D300	Storing mean value
D350	Storing square root of the mean value

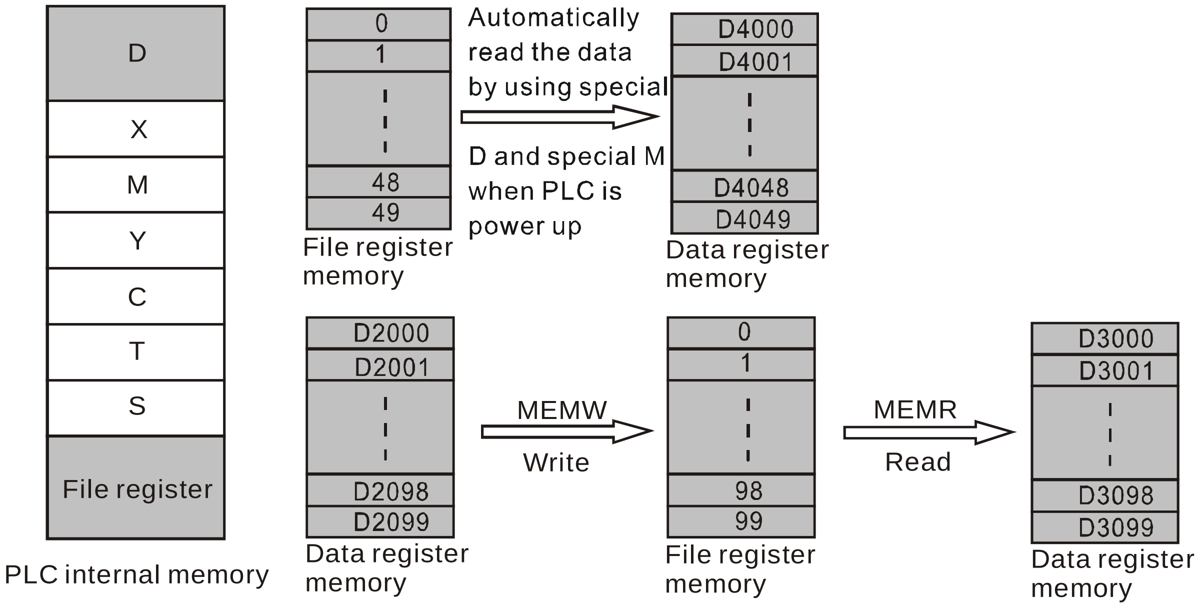
Control Program:



Program Description:

- If the data number falls out of the range between 1~64 in MEAN instruction, or if the SQR instruction specifies a negative value, PLC will regard it as an “instruction operation error.”

9.4 MEMR/MEMW - File Register Access



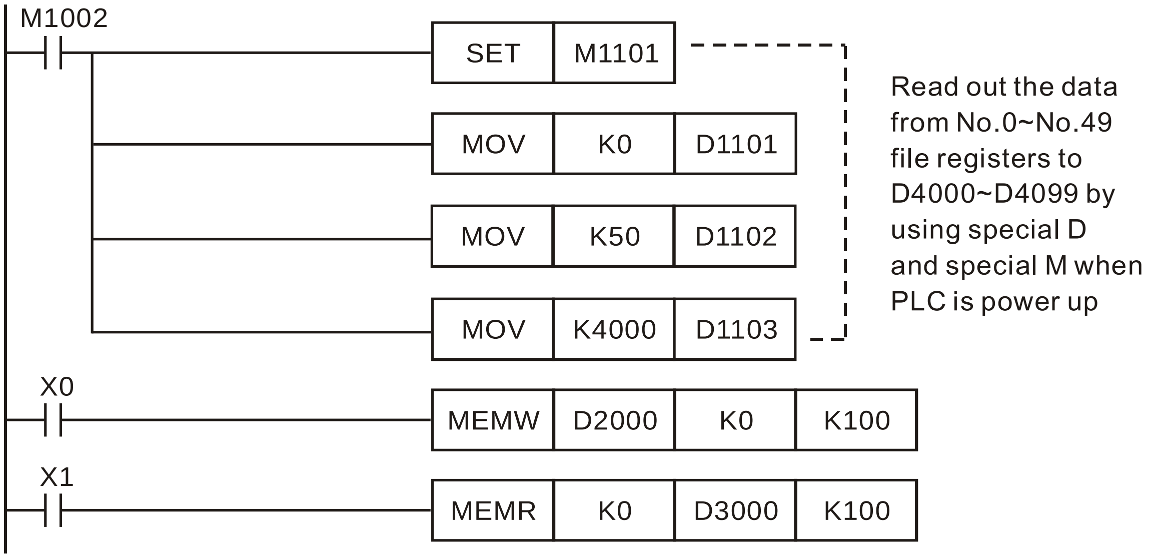
Control Purpose:

- Sending 50 data of No.0~No.49 file registers to D4000~D4049 when PLC is power up.
- Writing in 100 data of D2000~D2099 into No.0~No.99 file registers when X0 = ON.
- Reading out 100 data in No.0~No.99 file registers to D3000~D3099 when X1 = ON.

Devices:

Device	Function
X0	Write data into file registers
X1	Read data in file registers

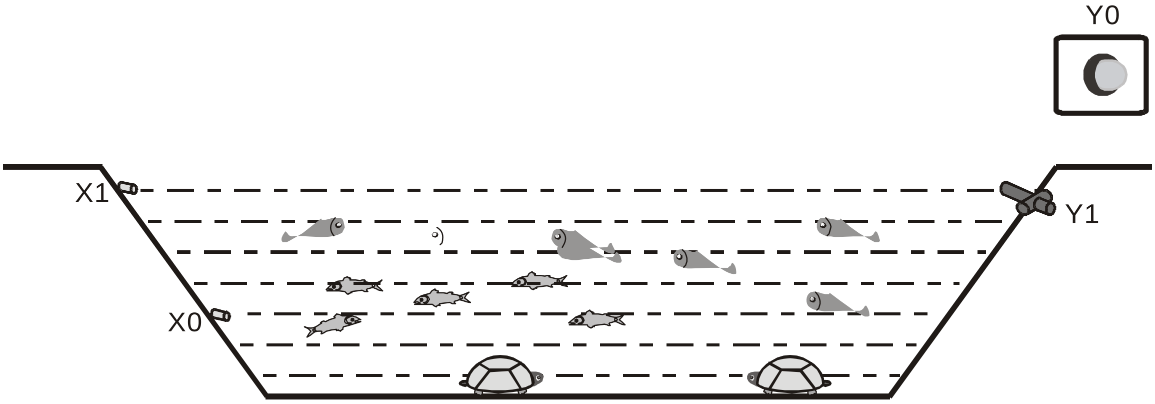
Control Program:


M1002
SET M1101
MOV K0 D1101
MOV K50 D1102
MOV K4000 D1103
Read out the data from No.0~No.49 file registers to D4000~D4099 by using special D and special M when PLC is power up
X0
MEMW D2000 K0 K100
X1
MEMR K0 D3000 K100

Program Description:

- The memory storing format of PLC internal file registers, Word, is the same as data registers. However, data in file registers can not be accessed by normal instructions such as MOV. Therefore, special instructions MEMW/MEMR are needed for accessing file registers.
- When PLC is power up (no matter RUN or STOP) and M1101 = ON, the program will read out 50 data from file register No.0~No. 49 to data register D4000~D4049. The initial register number (K0) is specified by D1101, the amount of registers to be moved (K50) by D1102, and the initial register number of target registers (D4000) by D1103. Note that the execution will be done by special M and special D only when PLC is power up.

9.5 ANS/ANR - Level Monitoring Alarm System



Control Purpose:

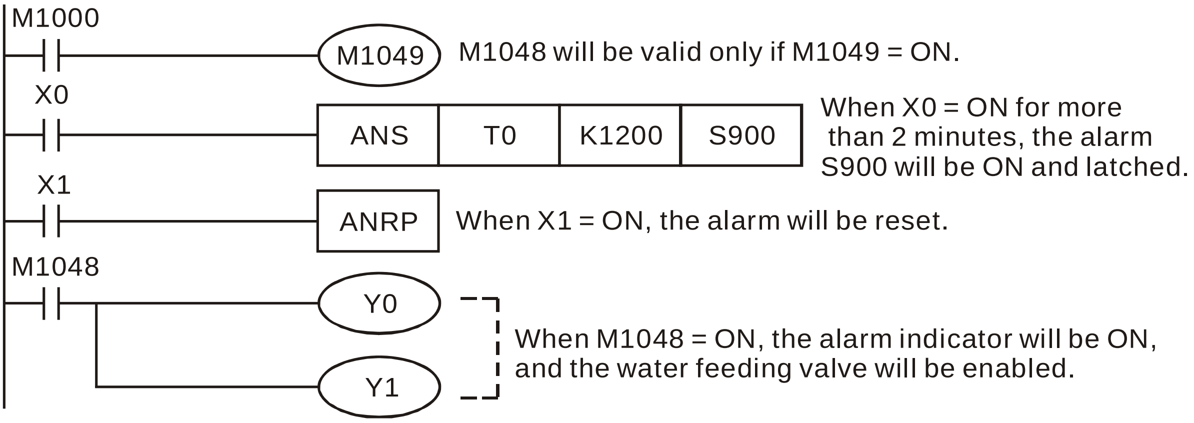
- Monitoring the water level of an aquaculture farm by alarm and indicator system.

When the level is below the lower bound for 2 minutes, the alarm and the indicator will be ON. At the same time, the water feeding valve will start working until the level is back to normal range.

Devices:

Device	Function
X0	Level lower bound sensor
X1	Normal level sensor
Y0	Alarm indicator
Y1	Water feeding valve

Control Program:



M1048 will be valid only if M1049 = ON.

When X0 = ON for more than 2 minutes, the alarm S900 will be ON and latched.

When X1 = ON, the alarm will be reset.

When M1048 = ON, the alarm indicator will be ON, and the water feeding valve will be enabled.

Program Description:

- When the level is below the lower bound (X0 = ON) for 2 minutes, Y0 and Y1 will be ON. The alarm indicator will be ON and the water feeding valve will be enabled.
- When the level reaches normal range (X1 = ON), Y0 and Y1 will be OFF. The alarm will be reset.

9.6 SORT - Sorting Acquired Data

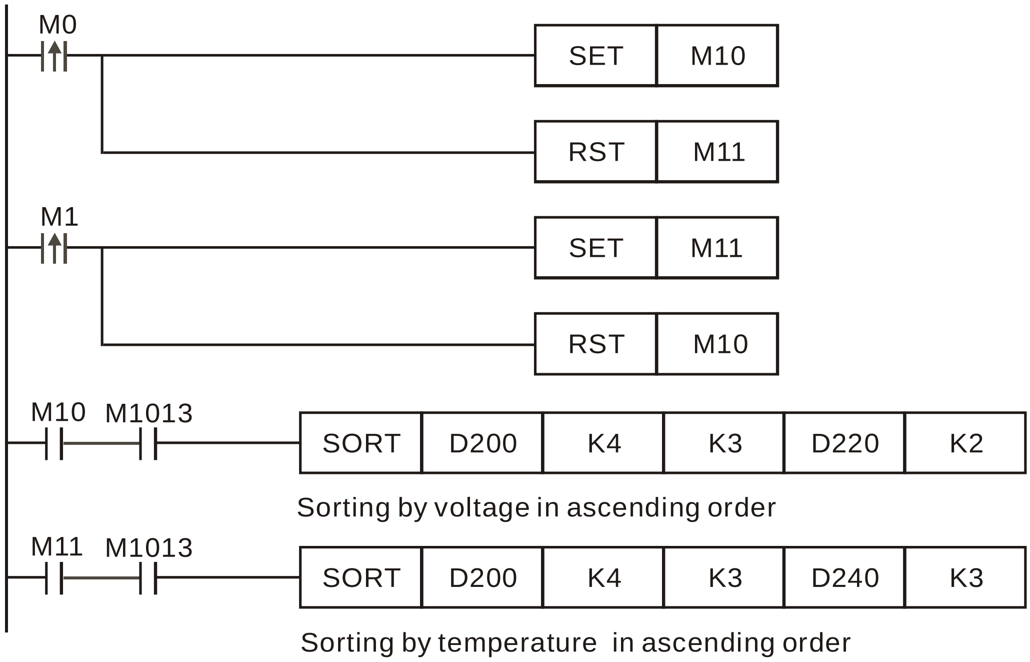
Control Purpose:

- Collecting 4 voltage data (Corresponding to frequency of AC motor) by DVP04AD-S analog module and 4 temperature data by DVP04TC-S thermocouple module.
- Sorting the 4 channels by voltage in ascending order when M0 = ON and by temperature in ascending order when M1 = ON.
- Sorting the data and displaying the sorting result.

Devices:

Device	Function
M0	Sorting voltage data
M1	Sorting temperature data
D200~D203	Numbers of channels to be sorted
D204~D207	Storing 4 voltage data
D208~D211	Storing 4 temperature data
D220~D231	Displaying voltage sorting result
D240~D251	Displaying temperature sorting result

Control Program:



Program Description:

- Acquired data before sorting:

	1	2	3
	Channel (CH1~CH4)	Voltage (DVP04AD-S)	Temp. (DVP04TC-S)
1	(D200)1	(D204)57	(D208)47
2	(D201)2	(D205)59	(D209)42
3	(D202)3	(D206)55	(D210)46
4	(D203)4	(D207)53	(D211)43

1）Sorted voltage data in ascending order when M0 = ON:

	1	2	3
	Channel (CH1~CH4)	Voltage (DVP04AD-S)	Temp. (DVP04TC-S)
1	(D220)4	(D224)53	(D228)43
2	(D221)3	(D225)55	(D229)46
3	(D222)1	(D226)57	(D230)47
4	(D223)2	(D227)59	(D231)42

The voltage sorting result is: channel 4, channel 3, channel 1, and channel 2. The minimum value is K53 and the maximum value is K59.

2）Sorted temperature data in ascending order when M1 = ON:

	1	2	3
	Channel (CH1~CH4)	Voltage (DVP04AD-S)	Temp. (DVP04TC-S)
1	(D240)4	(D244)59	(D248)42
2	(D241)1	(D245)53	(D249)43
3	(D242)2	(D246)55	(D250)46
4	(D243)3	(D247)57	(D251)47

The temperature sorting result is: channel 4, channel 1, channel 2, and channel 3. The minimum value of is K42 and the maximum value is K47.

- The purpose of using M1013 (1s clock pulse) after the drive contacts M10 and M11 is to assure that sorting result can be refreshed in 1s so as to prevent rising edge triggering M10 and M11 when SORT instruction needs to be executed one more time.
- Users can monitor the sorting result and the minimum/maximum value of voltage and temperature.

9.7 SER - Room Temperature Monitoring

Control Purpose:

- Monitoring the overall temperature condition by acquiring temp. data through air condition system from 20 rooms in the building

Compare the present temp. with the target value. If there are more rooms whose temp. match the target value, it indicates the air condition system functions well.

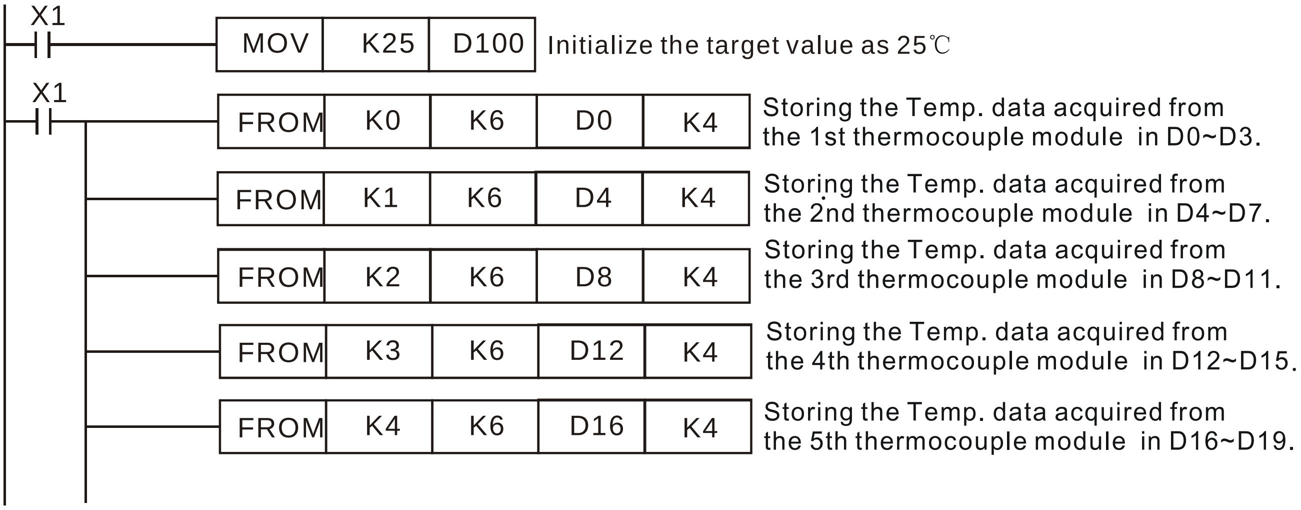
- Adjusting the air condition devices in rooms with the highest and lowest temp.

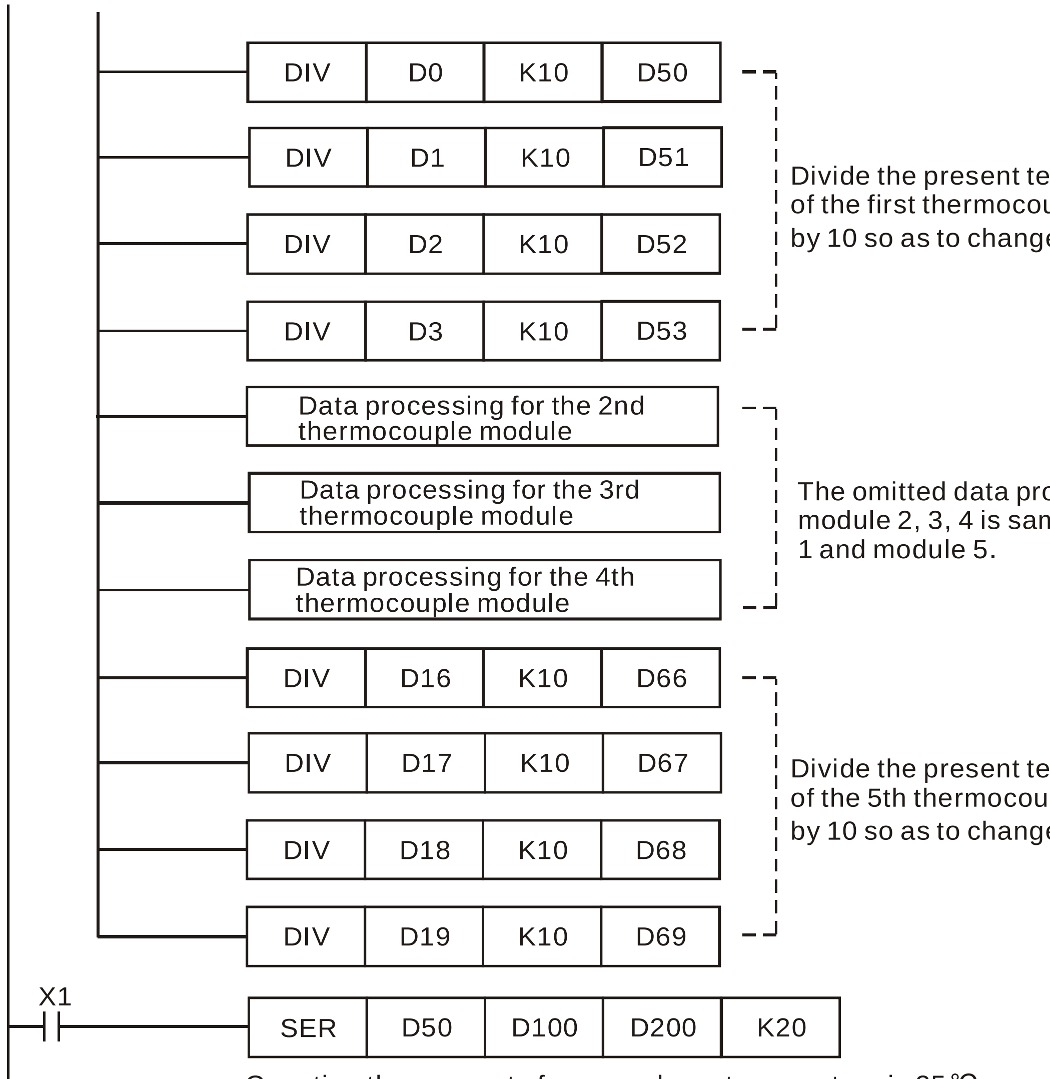
Count the amount of rooms whose temp. match the target value so as to judge the efficiency of the air condition system. In addition, search the rooms with the highest and lowest temp for adjusting immediately.

Devices:

Device	Function
X1	Executing SER instruction to search data
D50~D53	Temperature data acquisition of the 1st thermocouple module (unit: 1°C)
D54~D57	Temperature data acquisition of the 2nd thermocouple module (unit: 1°C)
D58~D61	Temperature data acquisition of the 3rd thermocouple module (unit: 1°C)
D62~D65	Temperature data acquisition of the 4th thermocouple module (unit: 1°C)
D66~D69	Temperature data acquisition of the 5th thermocouple module (unit: 1°C)
D100	Storing the target value
D200~D204	Storing the temperature search result

Control Program:


X1
MOV K25 D100
Initialize the target value as 25℃
X1
FROM K0 K6 D0 K4
Storing the Temp. data acquired from the 1st thermocouple module in D0~D3.
FROM K1 K6 D4 K4
Storing the Temp. data acquired from the 2nd thermocouple module in D4~D7.
FROM K2 K6 D8 K4
Storing the Temp. data acquired from the 3rd thermocouple module in D8~D11.
FROM K3 K6 D12 K4
Storing the Temp. data acquired from the 4th thermocouple module in D12~D15.
FROM K4 K6 D16 K4
Storing the Temp. data acquired from the 5th thermocouple module in D16~D19.


DIV D0 K10 D50
DIV D1 K10 D51
DIV D2 K10 D52
DIV D3 K10 D53
Data processing for the 2nd thermocouple module
Data processing for the 3rd thermocouple module
Data processing for the 4th thermocouple module
DIV D16 K10 D66
DIV D17 K10 D67
DIV D18 K10 D68
DIV D19 K10 D69
X1
SER D50 D100 D200 K20

Divide the present temp. value of the first thermocouple module by 10 so as to change the unit into 1℃.

The omitted data processing of module 2, 3, 4 is same as module 1 and module 5.

Divide the present temp. value of the 5th thermocouple module by 10 so as to change the unit into 1℃.

Counting the amount of rooms whose temperature is 25 ℃ and searching the room number of the highest and lowest temp.

Program Description:

- Acquired temperature data and search result of 20 rooms:

Room temp.	Target value	No.	Compare result
D50 = K24	D100 = K25	0	—
D51 = K25		1	Equal
D52 = K25		2	Equal
D53 = K25		3	Equal
D54 = K25		4	Equal
D55 = K22		5	Lowest
D56 = K25		6	Equal
D57 = K25		7	Equal
D58 = K25		8	Equal
D59 = K25		9	Equal

Search result	Content
D200 = K16	The amount of rooms with temp. of 25°C
D201 = K1	The No. of the first room with temp. of 25°C
D202 = K19	The No. of the last room with temp. of 25°C
D203 = K5	The No. of the room with lowest temp.
D204 = K11	The No. of the room with highest temp.

Room temp.	Target value	No.	Compare result
D60 = K25	D100 = K25	10	Equal
D61 = K27		11	Highest
D62 = K25		12	Equal
D63 = K25		13	Equal
D64 = K26		14	—
D65 = K25		15	Equal
D66 = K25		16	Equal
D67 = K25		17	Equal
D68 = K25		18	Equal
D69 = K25		19	Equal

10.1 REF/REFF - DI/DO Refreshment and DI Filter Time Setting

Control Purpose:

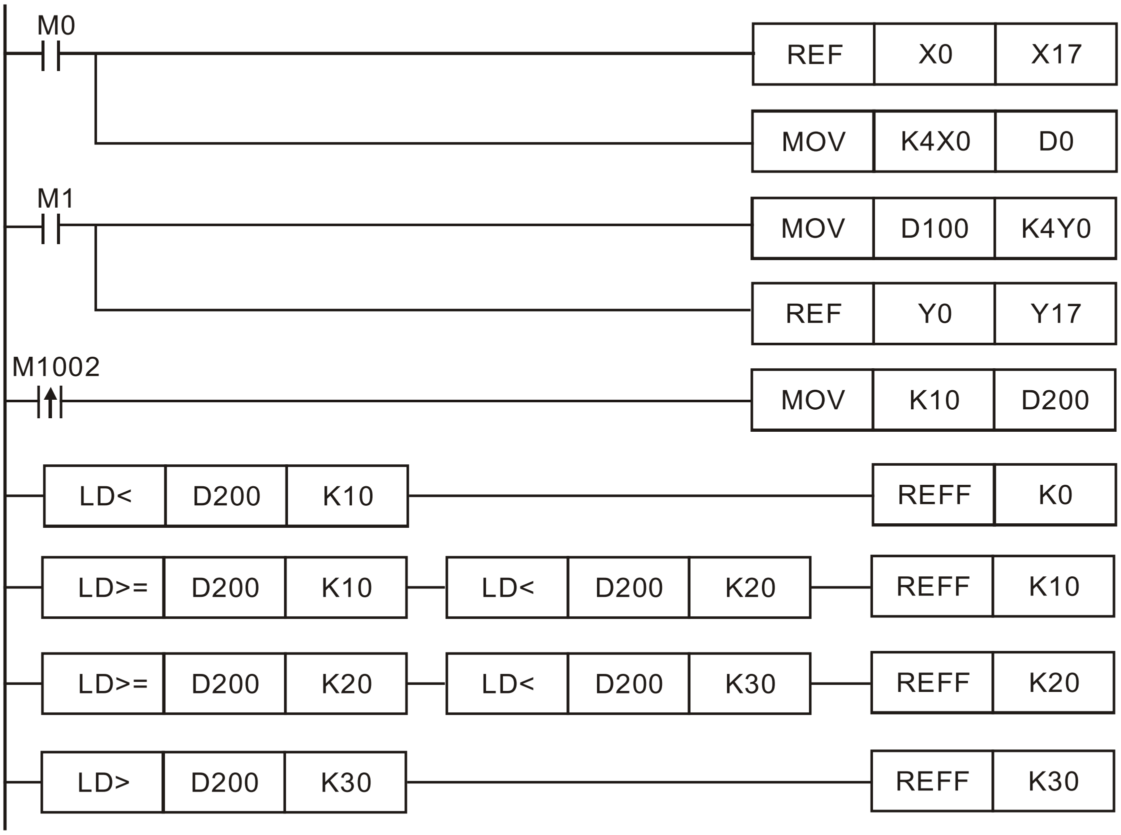
Refreshing DI/DO status immediately and setting/displaying DI filter time.

- When M0 = ON, refresh the status of input points X0~X17 and send the status to D0. When M1 = ON, transmit the value in D100 to the output points Y0~Y17 and send the output state to output terminals immediately before END instruction.
- By controlling the value in D200 according to the interference degree, users can set the filter time of DI as 0 (actual min. value = 50μs), 10ms, 20ms and 30ms.

Devices:

Device	Function
M0	Starting to refresh the status of input points X0~X17
M1	Starting to refresh the status of output points Y0~Y17
D200	Storing the filter time of the input points

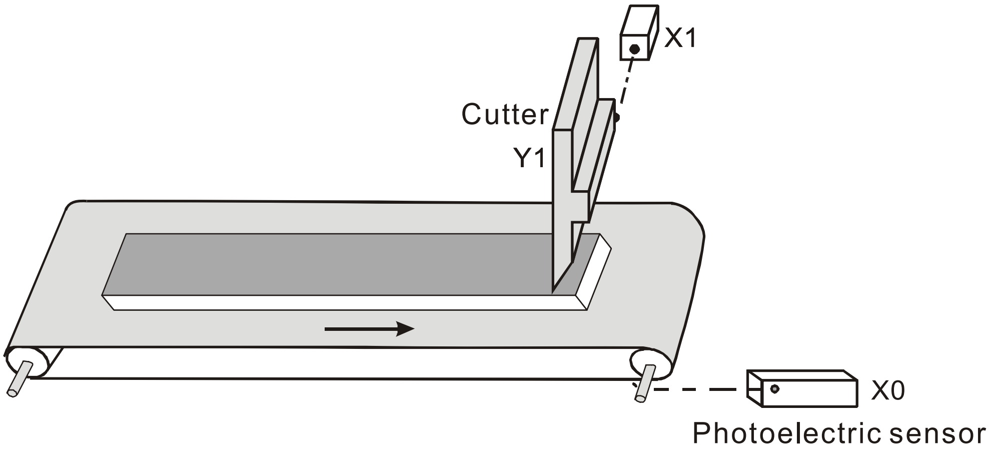
Control Program:



Program Description:

- Generally the input state (X) is refreshed at the beginning of program scan cycle, and the output state (Y) is refreshed at the end of END instruction. However, the immediate state refreshing during the program execution process can be performed by Ref instruction.
- Due to severe operating environment, PLC DI signal is frequently interfered and error operations would thus occur. Usually, the interference will not last for a long time. We can apply a filter to DI signals so that the interference would be decreased in principle.
- When D200<K10, the filter time of DI signal = 0 (Actual value = 50μs). When K10≤D200<K20, the filter time = 10ms. When K20≤D200<K30, the filter time = 20ms. When K30<D200, the filter time = 30ms. The initial setting of this program in D200 = K10, so the filter time of DI signal in this case is set as 10ms.
- Users can apply MOV instruction to transmit the filter time of DI signal to D1020 (corresponding to X0~X7) and D1021 (corresponding to X10~X17).
- The filter time changed by REFF instruction during program executing process can be modified in next program scan cycle.

10.2 DHSCS - Cutting Machine Control



Control Purpose:

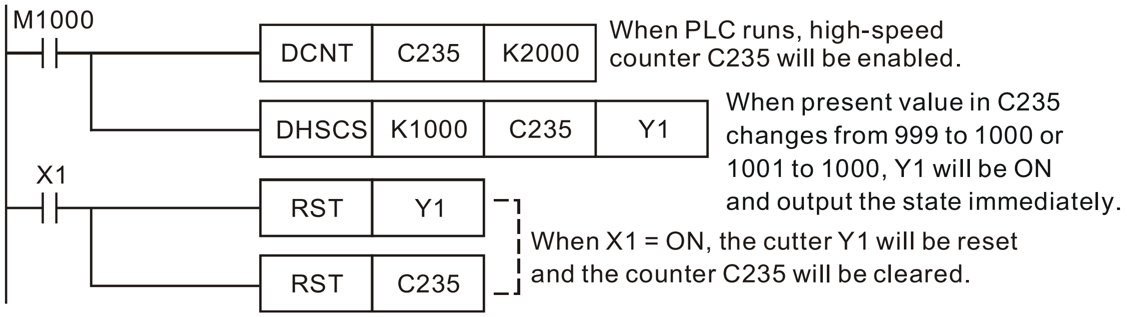
- Counting the number of rotations and controlling the cutter according to the value in C235.

X0 counts once when the axis rotates once. When C235 counts to 1000, the cutter will perform cutting process once.

Devices:

Device	Function
X0	Photoelectric sensor. X0 turns on once when the axis rotates once
X1	Photoelectric sensor. X1 = ON when cutter is released (Y1 = OFF).
Y1	Cutter
C235	Counting the number of axis rotations

Control Program:



When PLC runs, high-speed counter C235 will be enabled.

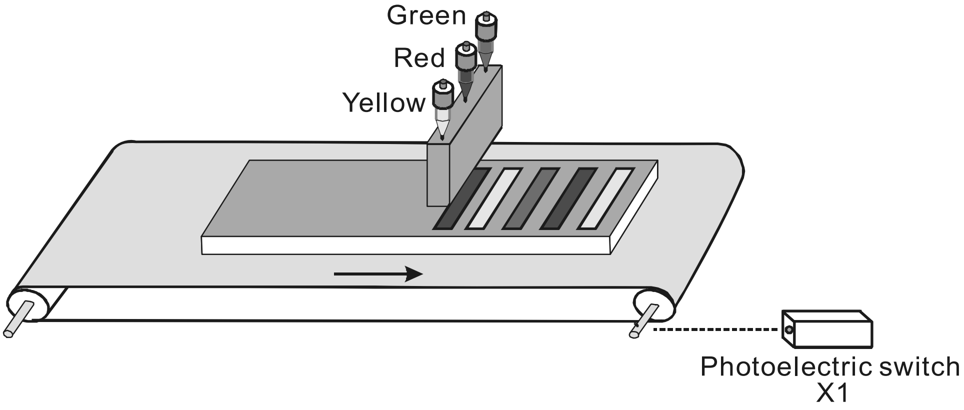
When present value in C235 changes from 999 to 1000 or 1001 to 1000, Y1 will be ON and output the state immediately.

When X1 = ON, the cutter Y1 will be reset and the counter C235 will be cleared.

Program Description:

- The photoelectric sensor X0 is the external input point of C235. X0 turns on once when the axis of conveyor belt rotates once and therefore C235 counts once.
- During the execution of DHSCS instruction, Y1 will be ON when the value in C235 reaches 1000 (Axis rotation =1000 times) and then output the state immediately to the external output terminals. Therefore, the cutter will be enabled.
- When the cutter is released, X1 = ON. C235 will be cleared and the cutter Y1 will be reset. In this case, X1 turns off. C235 will restart counting and the above process will be repeated.

10.3 DHSZ/DHSCR - Multi-segment Coater Control



Control Purpose:

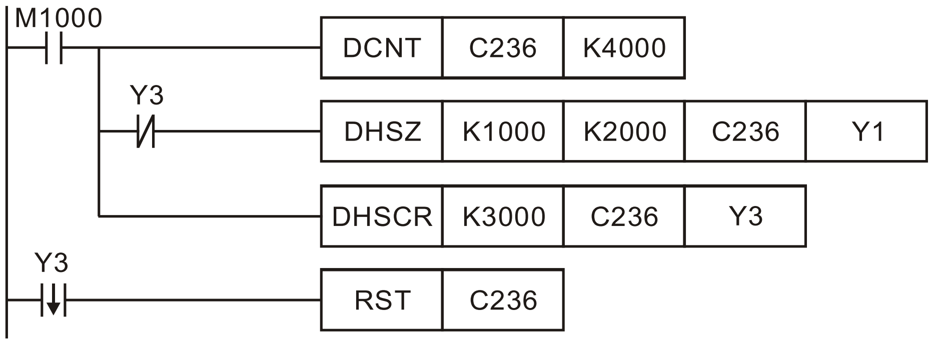
- Painting the products with pigments of three colors: red, yellow and green.

When the axis of conveyor rotates 1000 times, the pigment will be changed and therefore the painting process will be executed as the following order: red, yellow, green, red yellow, green…

Devices:

Device	Function
X1	Photoelectric sensor. X1 turns on once when the axis rotates once.
Y1	Painting red pigment
Y2	Painting yellow pigment
Y3	Painting green pigment
C236	Counting the number of axis rotations

Control Program:

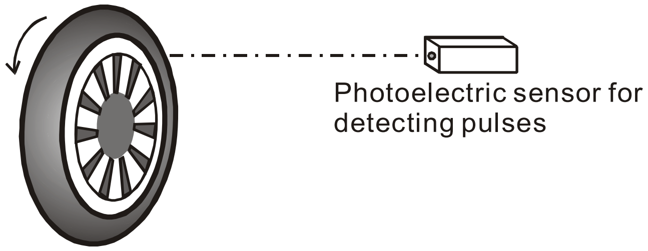


Program Description:

- The photoelectric sensor X1 is the external input point of C235. X1 turns on once when the axis of conveyor belt rotates once and therefore C236 counts once.
- When the PV (present value) in C236<K1000 (the number of axis rotations<1000), Y1 = ON and the red pigment will be painted.
- When K1000≤ PV in C236≤K2000 (1000≤axis rotations≤2000), Y1 = OFF and Y2 = ON. The yellow pigment will be painted.

- When K2000＜PV in C236＜K3000 (2000<axis rotations<3000), Y1 = Y2 = OFF and Y3 = ON. The green pigment will be painted. Because Y3 = ON, the NC (normally closed) contact Y3 is activated to disable DHSZ instruction. However, Y3 will remain ON.
- When the PV in C236 reaches K3000, DHSCR instruction will be executed and Y3 will be reset. Counter C236 will be cleared because the falling trigger of Y3. On the other hand, the NC contact Y3 is OFF and therefore the DHSZ instruction is executed again. C236 starts counting from 0 and the pigment will be painted again as the specified cycle: red, yellow, green, red, yellow, green, etc.

10.4 SPD - Wheel Rotation Speed Measurement



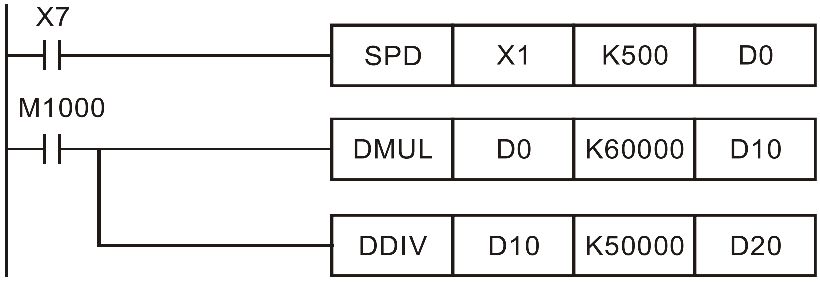
Control Purpose:

- Calculating the wheel rotation speed by the equation based on the counted input pulses

Devices:

Device	Function
X1	Photoelectric sensor for detecting pulses
X7	Executing SPD instruction

Control Program:



```
X7
SPD    X1    K500    D0
M1000
DMUL   D0    K60000  D10
DDIV   D10   K50000  D20
```

Program Description:

- When X7 = ON, SPD instruction will be executed. D2 will calculate the high-speed input pulses by X1 and stop the calculation after 500ms. The result will be stored in D0 and D1.
- The following equation is for obtaining the rotation speed of the car:

$$N = \frac{D0}{nt} \times 60 \times 10^3 (rpm)$$

N: Rotation speed (unit: rpm).

n: The number of pulses produced per rotation

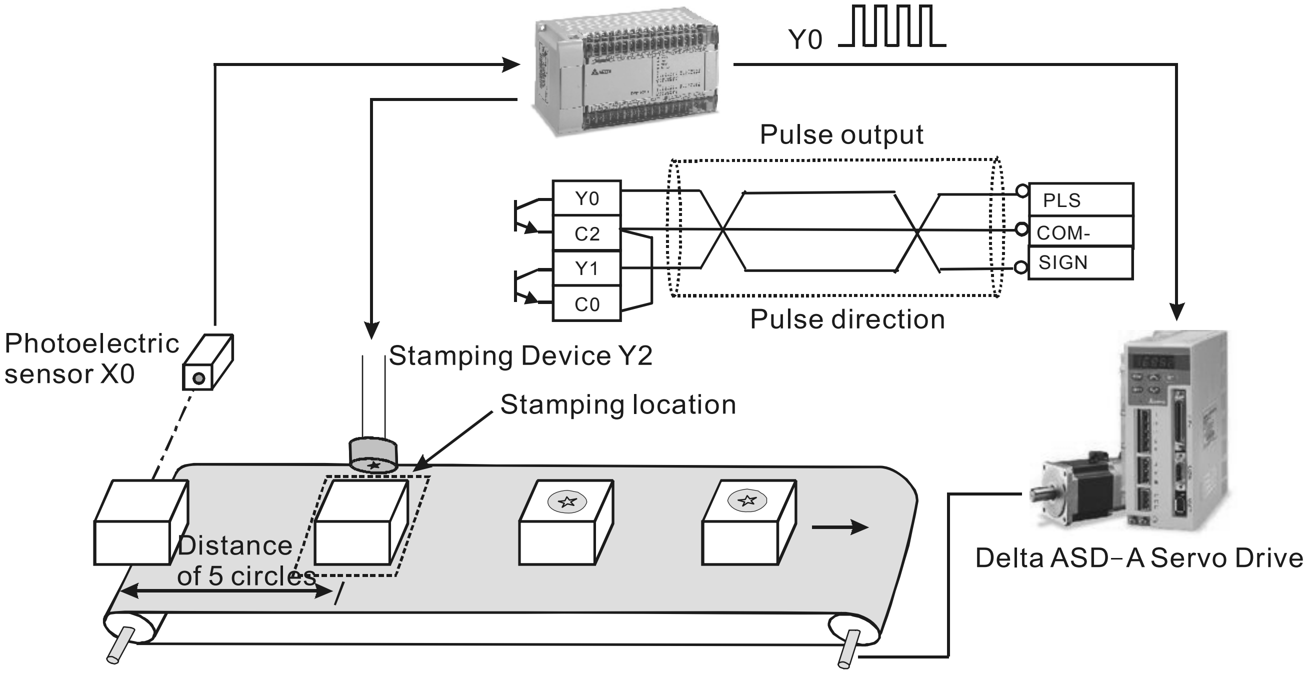
t: Pulse receiving time (ms)

If the number of pulses produced per rotation is K100 and the number of pulses within 500ms is K750, the rotation speed will be:

$$N = \frac{D0}{nt} \times 60 \times 10^3 = \frac{750 \times 60 \times 10^3}{100 \times 500} \times (rpm) = 900\, rpm$$

- The rotation speed N is stored in D20 and D21.

10.5 PLSY - Production Line Control Program



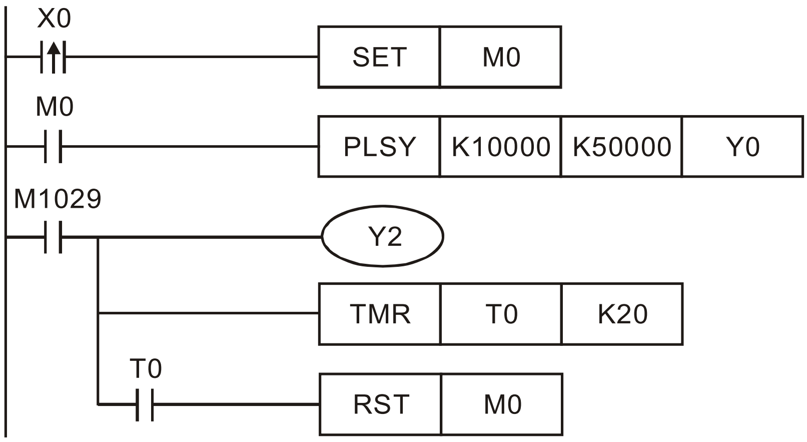
Control Purpose:

- When the photoelectric sensor detects products, the servo drive will rotates 5 circles to send the product to the stamping location and perform 2 sec stamping process.

Devices:

Device	Function
X0	Photoelectric sensor. X0 = ON when sheltered.
Y0	Pulse output
Y1	Pulse direction
Y2	Stamping
T0	Setting the stamping time

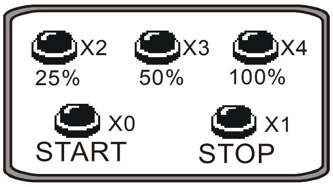
Control Program:

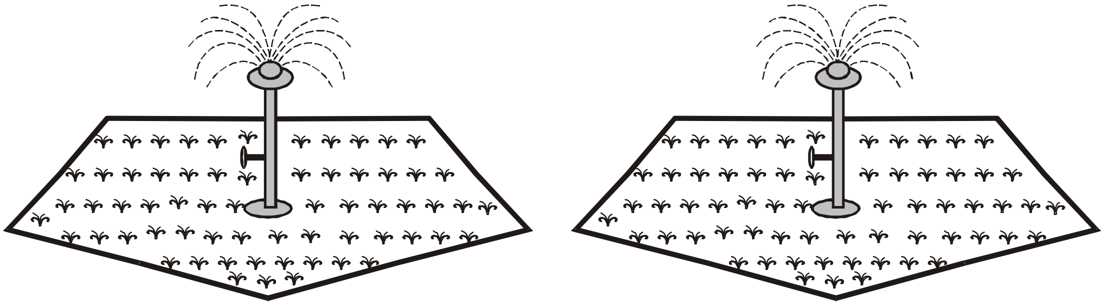


Program Description:

- When a product is detected by the photoelectric sensor X0, SET instruction will be executed for setting on M0 and PLSY instruction will thus be executed to output pulses by Y1 with frequency of 10kHz
- When the number of the output pulses reaches 50000, which means the servo drive rotates 5 circles to send the product to stamping location, M1029 will be ON to activate stamping device Y2. At the same time, timer T0 starts counting for 2 sec. After 2 sec, the NO (Normally Open) contact T0 will be activated to reset M0, which resets PLSY instruction as well as M1029 and Y2. Finally, the stamping process is completed.
- When X0 is triggered once again, PLSY will be executed again and Y0 will start to output pulses. The stamping process will be then repeated.
- Note: In this program, the timing of triggering X0 should be after the complete stamping process otherwise there would be a processing error.

10.6 PWM - Sprayer Valve Control Program





Control Purpose:

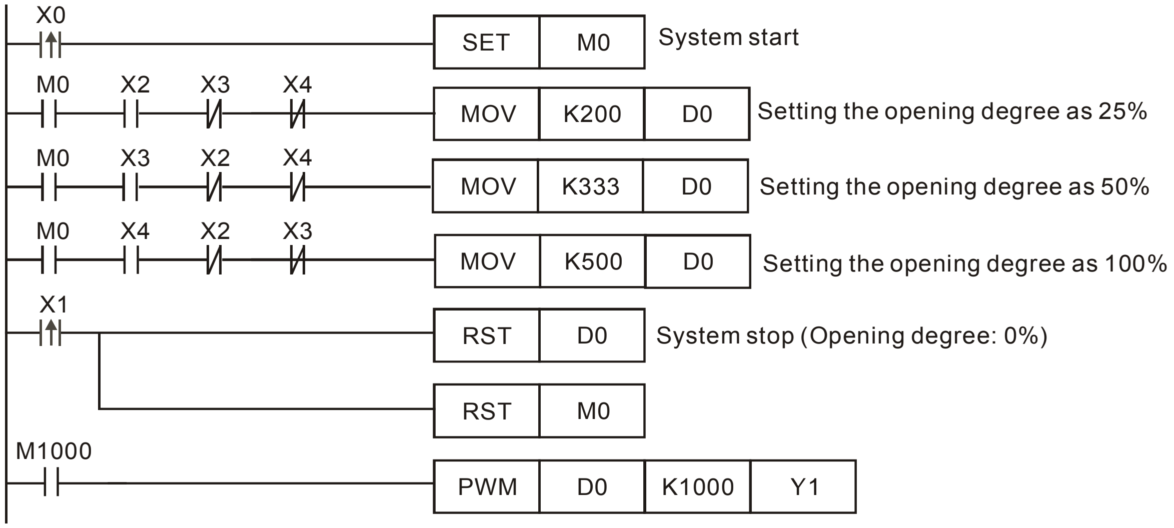
- Controlling the sprayer valve opening degree as 25%, 50% and 100% by adjusting the t_{on}/t_{off} value of PWM technique (24V).

For reducing the energy lost during the gradual shut-down/start-up process, we apply the switching method which performs immediate turn-on and turn-off of the current valve. The switching method is somewhat like cutting off the current, and is therefore called a Clipper. However, in the practical application we apply a transistor between the power and the motor for representing the function of the clipper. Pulse signal will be applied to the base of the transistor so as to yield a pulse current between the base and the emitter. The input voltage of motor is in proportion to the t_{on}/t_{off} value. Therefore, the motor voltage could be adjusted by modulating t_{on}/t_{off} value. There are various methods to modulate this value and the most common one is to adjust the ON time (t_{on}) rather than adjusting the ON times within specified time period. The method is called PWM (Pulse-Width Modulation).

Devices:

Device	Function
X0	X0 = ON when the button START is pressed
X1	X1 = ON when the button STOP is pressed.
X2	25% opening button.
X3	50% opening button.
X4	100% opening button.
Y1	Controlling the opening degree of the valve
D0	Storing the valve opening degrees

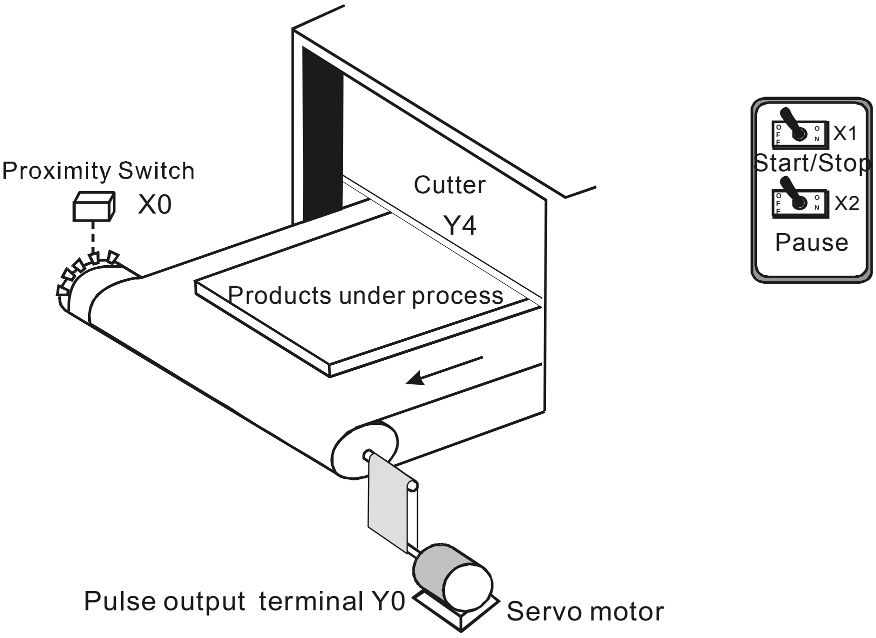
Control Program:


X0
SET M0
System start
M0 X2 X3 X4
MOV K200 D0
Setting the opening degree as 25%
M0 X3 X2 X4
MOV K333 D0
Setting the opening degree as 50%
M0 X4 X2 X3
MOV K500 D0
Setting the opening degree as 100%
X1
RST D0
System stop (Opening degree: 0%)
RST M0
M1000
PWM D0 K1000 Y1

Program Description:

- In this program, the sprayer valve opening degree is controlled by the value in D0. Opening degree = t_{on}/t_{off} = D0 / (K1000-D0)
- When START is pressed, X0 will be ON to set M0. The water spraying system will be ready and will start spraying as long as the corresponding opening degree button is pressed.
- When the button 25% is pressed (X2 = ON), the value in D0 = K200 and D0/(K1000－D0) = 0.25. The valve opening degree will be 25%.
- When the button 50% is pressed (X3 = ON), the value in D0 = K333 and D0/(K1000－D0) = 0.50. The valve opening degree will be 50%.
- When the button 25% is pressed (X4 = ON), the value in D0 = K500 and D0/(K1000－D0) = 1. The valve opening degree will be 100%.
- When STOP is pressed, X1 will be ON to clear D0 as 0 and D0/(K1000－D0) = 0. The valve opening degree = 0. At the same time, the system start flag M0 will also be reset.

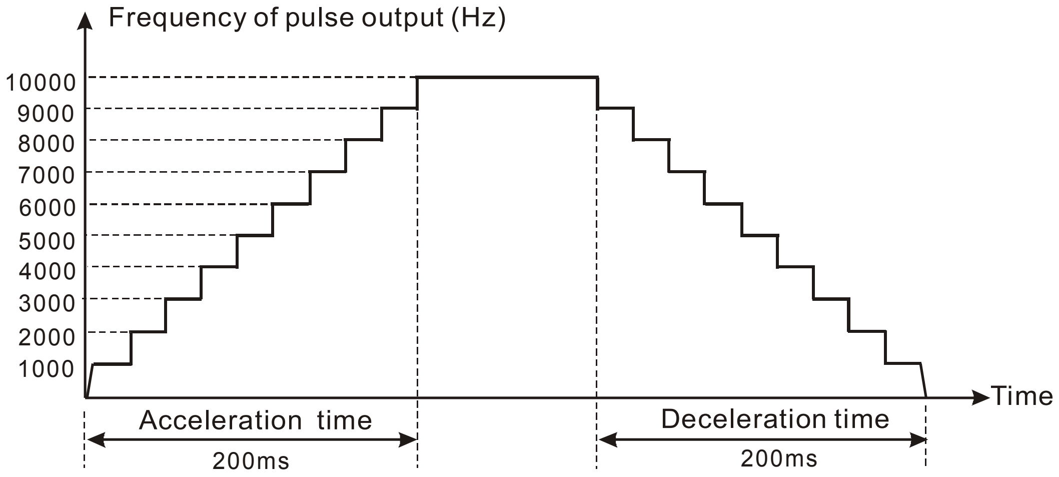
10.7 PLSR - Servo Motor Acceleration/Deceleration Control



Control Purpose:

- Counting the pulses generated by servo motor and performing cutting process when specified number of pulses is counted.

The multi-tooth cam shares same axis with the servo motor. Therefore, when the servo motor rotates once, the proximity switch will detect 10 pulses sent by the ten-teeth cam. When the servo motor rotates 10 times (100 pulses), the conveyor will be stopped and the system will perform cutting process for 1 sec. The program uses a servo motor as a rotation device. Because servo motor requires a bigger load, there should be an acceleration/deceleration process during the working of servo motor. The time for acceleration/deceleration is set as 200ms as the below diagram:

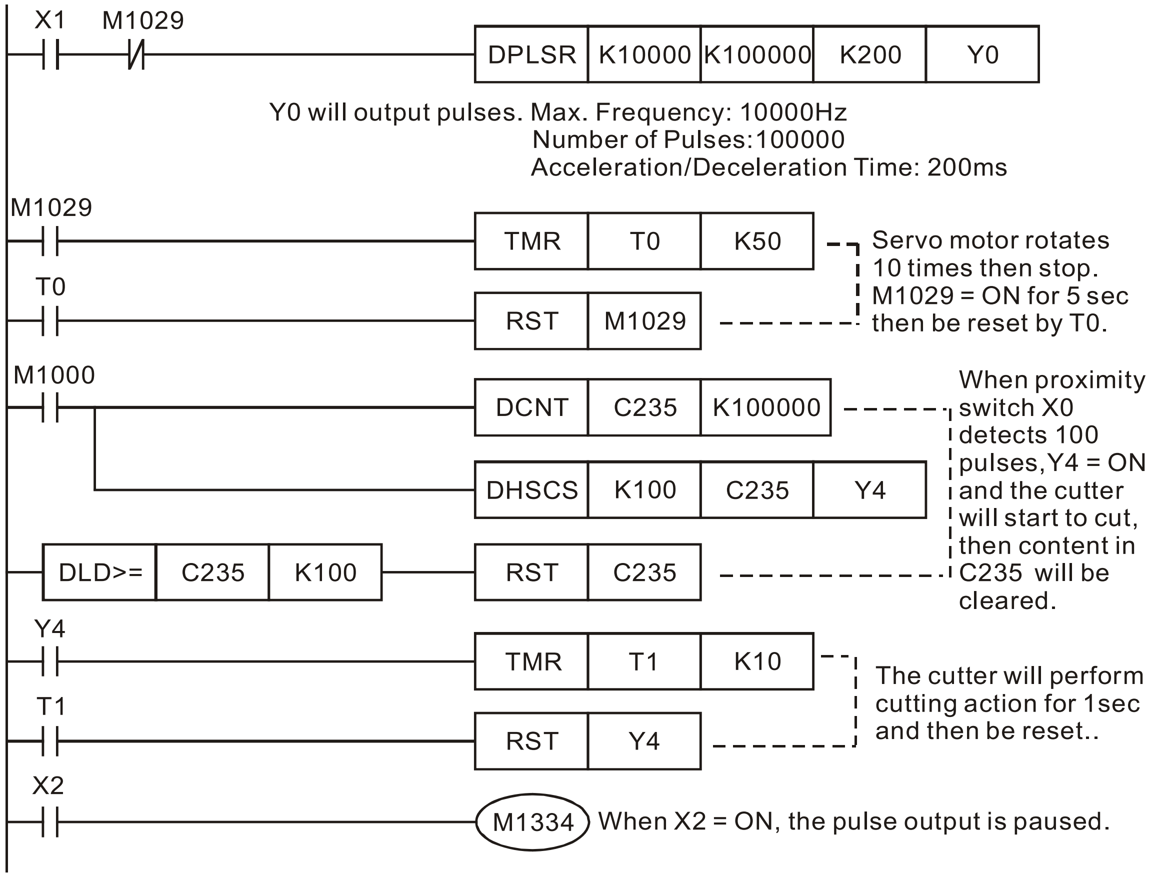


Devices:

Device	Function
X0	Proximity switch for detecting pulses created by the teeth on cam

Device	Function
X1	X1 = ON when START is pressed.
X2	X2 = ON when PAUSE is pressed.
Y0	High-speed pulse output
Y4	Cutter
C235	High-speed counter

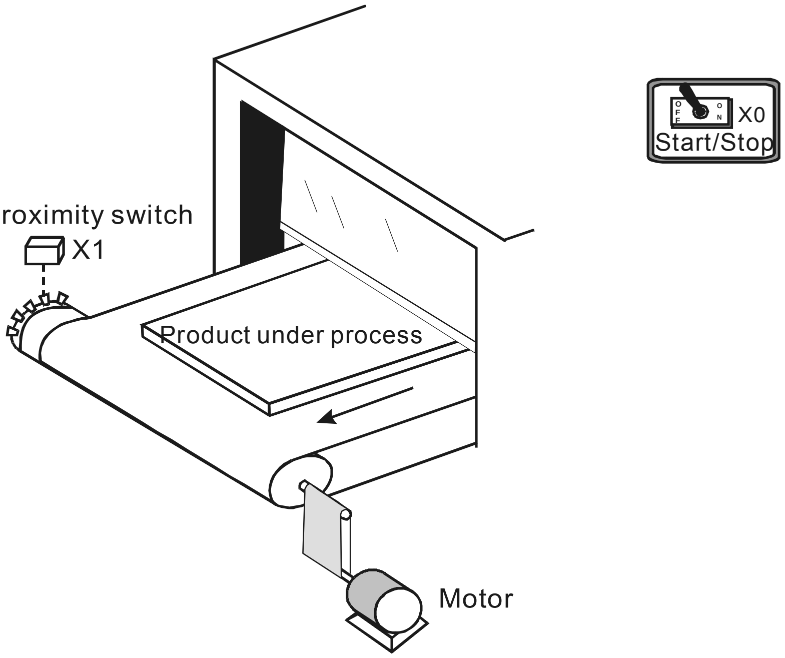
Control Program:


X1
M1029
DPLSR
K10000
K100000
K200
Y0
Y0 will output pulses. Max. Frequency: 10000Hz
Number of Pulses:100000
Acceleration/Deceleration Time: 200ms
M1029
TMR
T0
K50
Servo motor rotates 10 times then stop. M1029 = ON for 5 sec then be reset by T0.
T0
RST
M1029
M1000
DCNT
C235
K100000
When proximity switch X0 detects 100 pulses,Y4 = ON and the cutter will start to cut, then content in C235 will be cleared.
DHSCS
K100
C235
Y4
DLD>=
C235
K100
RST
C235
Y4
TMR
T1
K10
The cutter will perform cutting action for 1sec and then be reset..
T1
RST
Y4
X2
M1334
When X2 = ON, the pulse output is paused.

Program Description:

- When START is pressed (X1 = ON), the servo motor will start at the speed of 0.1 r/s (f = 1000Hz) and the speed will be increased by 0.1 r/min every 20ms. After 200ms, the speed will be 1r/s (f = 10000Hz) and then remain constant. When the set value is nearly reaching, the servo motor will decelerate and stop rotating when the set value is reached.
- When PAUSE is pressed (X2 = ON), the servo motor will stop rotating, and the PV in C235 will not be stored. When X2 = OFF, the servo motor will start rotating again and stop when set value is reached.
- When the servo motor rotates once, the proximity switch will detect 10 pulses. When the servo motor rotates 10 times (100 pulses), it will stop rotating and the system will perform cutting process for 1 sec.

11.1 Elementary Arithmetic for Integer and Floating Point



Control Purpose:

- When the production line runs, the production control engineer needs to monitor its real-time speed. The target speed is 1.8 m/s.
- The motor and the multi-tooth cam rotate with the same axis. There are 10 teeth on the cam, so the proximity switch will receive 10 pulse signals when the motor rotate once and the production line will move forward for 0.325m. The equations are as follows:

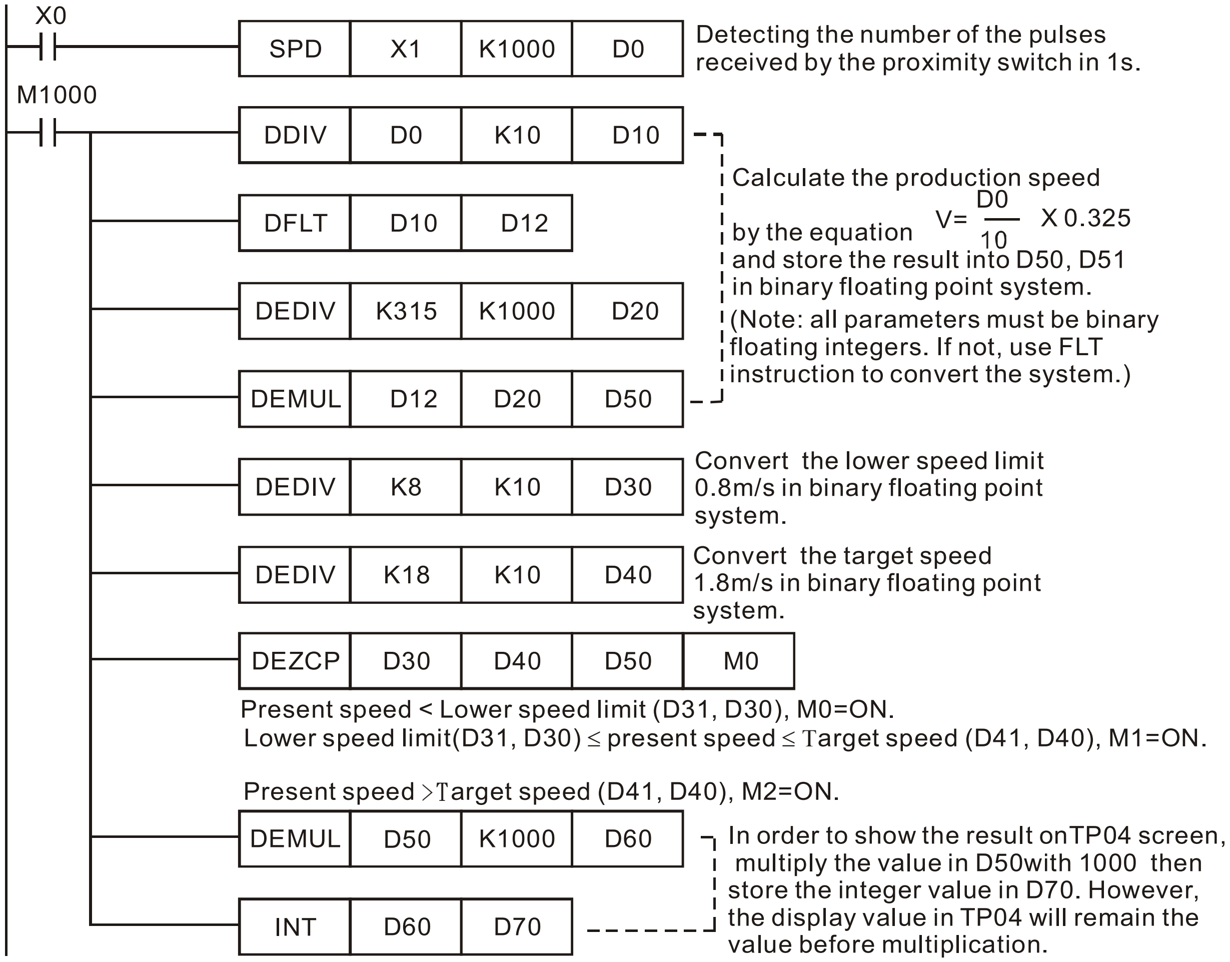
  Motor rotation speed (r/min) = the received pulses in 1 min/10

  The speed of the production line = the rotation times of motor in 1s × 0.325 = (Motor rotation speed/60) × 0.325.
- Indicator status: Production line speed < 0.8 m/s, the Speed Low indicator will be ON. 0.8 m/s ≤ production line speed ≤ 1.8m/s, the Normal indicator will be on. Production line speed >1.8m/s, the Speed High indicator will be on.
- Display the production line speed for production control engineers to monitor.

Devices:

Device	Function
X0	Pulse frequency detecting switch. X0 = ON when Start is switched on.
X1	Proximity switch. X1 creates a pulse when a tooth on cam is detected.
D0	Storing the detected pulse frequency
D50	Storing the present speed of the production line

Control Program:



Detecting the number of the pulses received by the proximity switch in 1s.

Calculate the production speed by the equation $V=\frac{D0}{10}\times 0.325$ and store the result into D50, D51 in binary floating point system. (Note: all parameters must be binary floating integers. If not, use FLT instruction to convert the system.)

Convert the lower speed limit 0.8m/s in binary floating point system.

Convert the target speed 1.8m/s in binary floating point system.

Present speed < Lower speed limit (D31, D30), M0=ON.
Lower speed limit(D31, D30) ≤ present speed ≤ Target speed (D41, D40), M1=ON.

Present speed > Target speed (D41, D40), M2=ON.

In order to show the result onTP04 screen, multiply the value in D50with 1000 then store the integer value in D70. However, the display value in TP04 will remain the value before multiplication.

Program Description:

- Calculate the motor rotation speed (r/min) by using SPD instruction to detect the pulse frequency (D0) from the proximity switch. Motor rotation speed = the receiving pulses in 1min/10 = (pulse frequency × 60)/10 = (D0×60)/10.
- The following equation is for obtaining the production line speed through D0:

$$v=\frac{N}{60}\times 0.325=\frac{D0\times 60\,/\,10}{60}\times 0.325\text{ m/s}=\frac{D0}{10}\times 0.325\text{ m/s}$$

V: Production line speed (unit: m/s)
N: Motor speed (unit: r/min)
D0: Pulse frequency

If the detected pulse frequency D0 = K50, the production line speed = $\frac{50}{10}\times 0.325$ m/s

=1.625m/s by the above equation

- The parameter of present production line speed contains decimal points during calculation, therefore the binary floating point operation instruction is needed for performing the calculation. .
- DEZCP instruction is used to compare the present speed with the upper/lower speed limits and the comparison results will be stored in M0~M2.

- There are integers and floating points mixed in the operation. If the operational parameters are not binary floating point values before calculating the production line speed, they have to be converted by FLT instruction
- For monitoring easily, the speed value is multiplied with 1000 to obtain the integer in the end of this program

11.2 Elementary Arithmetic for Floating Point

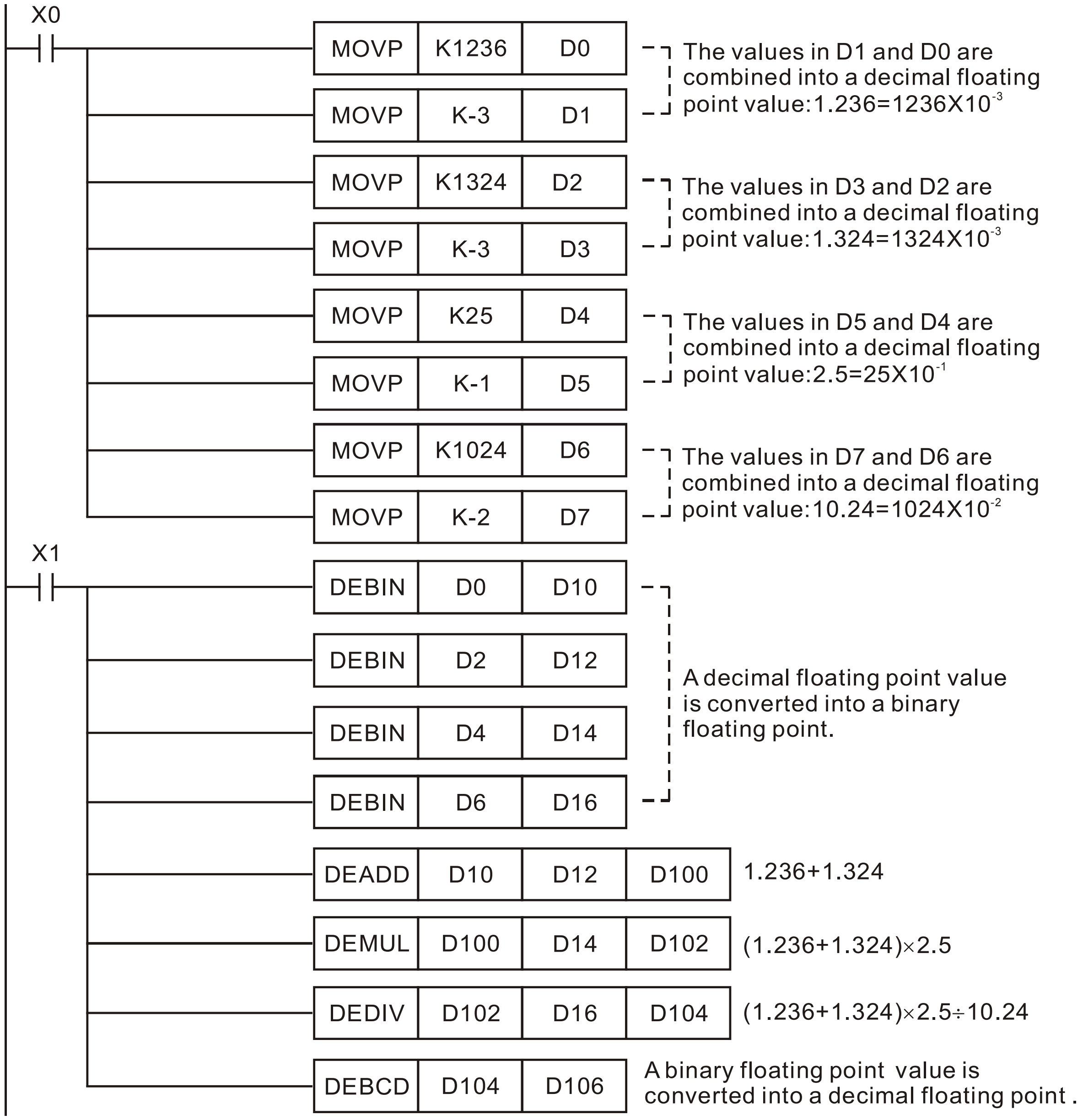
Control Purpose:

- Perform the operation (1.236+1.324)×2.5÷10.24 by Delta's binary floating point operation instruction.

Devices:

Device	Function
X0	Initialization switch
X1	Operation control switch

Control Program:


X0
MOVP K1236 D0
MOVP K-3 D1
The values in D1 and D0 are combined into a decimal floating point value:1.236=1236X10^-3
MOVP K1324 D2
MOVP K-3 D3
The values in D3 and D2 are combined into a decimal floating point value:1.324=1324X10^-3
MOVP K25 D4
MOVP K-1 D5
The values in D5 and D4 are combined into a decimal floating point value:2.5=25X10^-1
MOVP K1024 D6
MOVP K-2 D7
The values in D7 and D6 are combined into a decimal floating point value:10.24=1024X10^-2
X1
DEBIN D0 D10
DEBIN D2 D12
DEBIN D4 D14
DEBIN D6 D16
A decimal floating point value is converted into a binary floating point.
DEADD D10 D12 D100
1.236+1.324
DEMUL D100 D14 D102
(1.236+1.324)×2.5
DEDIV D102 D16 D104
(1.236+1.324)×2.5÷10.24
DEBCD D104 D106
A binary floating point value is converted into a decimal floating point .

Program Description:

- When X0 = ON, sent the values of decimal integers to D0~D7 to form 4 decimal floating points.
- When X1 = ON, elementary arithmetic operations for binary floating points will be executed.
- The binary operational results are not intuitively understandable. Therefore, the binary floating point value would generally be converted into decimal floating point value. In this program, the binary values in (D105, D104) are converted into decimal values in (D107, D106) D106 = K6250, D107 = K-4, so the decimal floating point value 6250×10^{-4} = 0.625.

MEMO

Introduction:

The wiring principles of RS-232 / RS-485 communication are keeping the connection as short as possible and keeping away from high noise source. The RS-232 communication interface is structured by one to one connections and usually with a shorter connection, so the standard cable or the cable provided by Delta is compatible for common RS- 232 applications. However, for the high-speed RS-485 with long distance connection, high communication speed, large number of stations, high signal attenuation and the possible problems of improper ground potential, mismatched terminal impedance, noise interference, and wiring methods, the inferior communication quality may occur if the above factors are not considered properly. Therefore, users should pay attention to the following notes about the wiring of RS-485 communication:

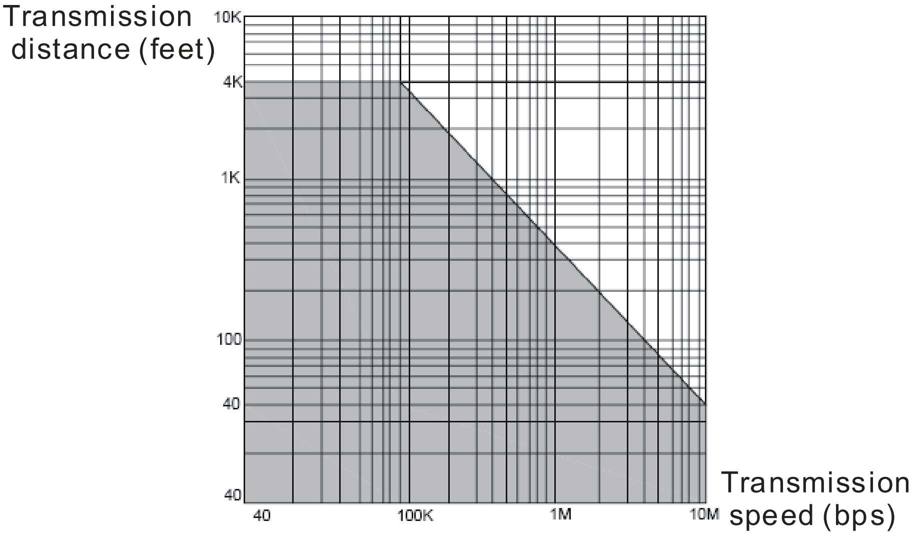
- The Limit for the Number of Stations:

  The limit for the number of stations connected to DVP-PLC is 254. For RS-485 communication, its hardware interface is compatible with max.16 stations. If more than 16 stations are required, a RS-485 repeater (IFD-8510) should be applied. Each repeater supports 16 more stations. Users can add stations by adding repeaters till the limit of 254.

- The Limit for Distance:

  In RS-485 communication, it is a function from the data signaling rate to the maximum cable length for transmission. The value of maximum cable length is generally influenced by the factors such as signal distortion and noise. The below graph of the function from signaling rate to cable length is measured by using 24AWG copper twisted pair telephone cable (diameter: 0.51mm) with the 52.5PF/M bypass capacitor and the 100Ω terminal load (please refer to GB11014-89 Appendix A). From the figure, suppose the max. acceptable signal loss is 6dBV, when data signaling rate is lower than 90Kbit/S, the limit for cable length will be 1200m (4Kft.). However, the graph is conservative and a longer cable length is accessible in practical application. Users can get different cable length by different cable diameters. For example, if the data signaling rate is 600Kbit/S and the cable is 24AWG, the maximum cable length will be 200m. If the cable is 19AWG (diameter: 0.91mm), the maximum cable length could be longer than 200m. If the cable is 28AWG (diameter: 0.32mm), the maximum cable length can only be shorter than 200m.

The relation between the transmission speed (bps) and the transmission distance (foot) for RS-485 standard communication interface:



- The Limit for Cables :

Users should choose shielded twisted pair cables for wiring because the quality of cables will greatly influence the transmission signal. If users use low quality cables (such as PVC twisted pair cables), the signal attenuation will be higher and the transmission distance will be significantly shortened. In addition, the communication could be interfered easily due to the poor noise immunity of low quality cables. Therefore, in situations of high transmission speed, long distance or high noise, the high quality twisted pair cable (such as Polyethylene twisted pair cable) should be used. However, in situations of low transmission speed and low noise, PVC twisted pair cable will be a compatible and cost saving choice though the signal loss of PVC cable could be 1,000 times bigger than high quality cable. If the transmission distance is too long to increase the signal attenuation, users can use RS-485 repeater (IFD-8510) to magnify the signal.

- Wiring Topology:

For RS-485 wiring, the nodes should be near the master cable as much as possible. Generally, daisy chain topology structure is recommended for RS-485 wiring. Topology is the link structure of the connection. The topology of RS-485 must be station-by-station structure, that is, stations should be connected from 1 to 2, 2 to 3, etc. Star and ring topological structures are not permitted.

- Signal Grounding (SG):

Though the RS-485 network can be connected by twisted cables only, it is easily to be interfered by noise and should be connected under the condition that the CMV (Common Mode Voltage) between stations should not exceed the max. allowable CMV of RS-485 transmission IC. If the CMV exceeds the working voltage range of IC, RS-485 will stop working.

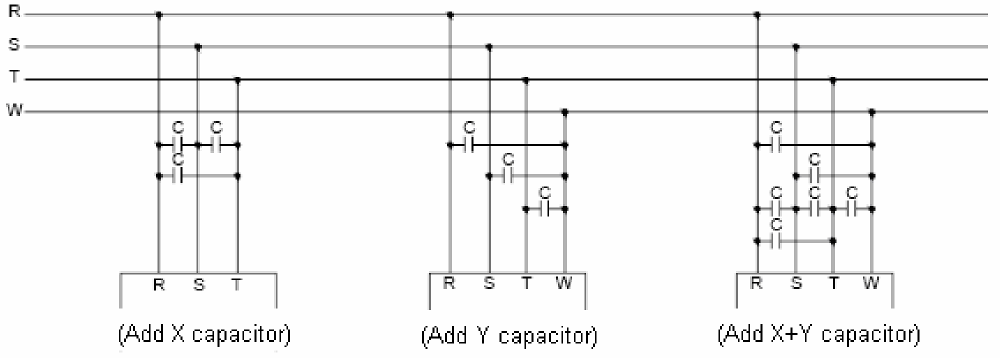
However, no matter what degree the CMV is, we suggest users connect each SG of stations (please refer to “Wiring Topology”) by using shielded twisted pair cables so as to reduce the CMV. This wiring method provides the shortest circuit for communication and improves the noise immunity as well.

- Terminal Resistor:

All cables have their own characteristic impedance (120Ω for Twisted Pair). When the signal is transferred to the terminal and the terminal impedance is different from the characteristic impedance, echo signal will occur to distort the waveform (convex or concave). This situation is not obvious for short cables but become serious when the cable length increases. In this case, a terminal resistor needs to be applied for maintaining the normal communication.

- Methods to Reduce the Noise:

When RS-485 network is connected according to the above rules and applied with a 120Ω terminator also, most of the noise interference can be reduced. If the interference continues, that means there is a strong noise source near the network. In addition to keeping the cable away from the strong noise source (such as electromagnetic valve, AC motor drive, AC servo drive, or other power equipment and their power lines), the best way to reduce the noise is to add a noise suppressor to the noise source. The figure below is the noise suppressing methods for AC motor drive, AC servo drive, and other power equipment. (To apply X capacitors, Y capacitors, or X+Y capacitors) C = 0.22μf~0.47μf/AC630V.



Generally, the RS-485 communication cable is made of twisted pair and transmits the signal by the potential difference between the twisted pair, and therefore it is called differential mode transmission. Differential mode interference is transferred between 2 cables and belongs to symmetric interference, which can be reduced by applying a stabilizing resistor to the circuit together with twisted pair cables. On the other hand, common mode interference is transferred between the communication cable and the earth, which belongs to asymmetric interference. Common mode interference can be eliminated by the following methods:

1. Use shielded twisted-pair cables and ensure it is well-grounded.
2. Use galvanized pipes to shelter the strong electric field.

3. Keep away from the high voltage line when wiring. Do not bond the high voltage power lines and the signal lines together.
4. Use linear stabilizer circuit or high quality switching power supply (ripples < 50mV).

12.1 Communication between PLC and Delta VFD-M Series AC Motor Drive (MODRD/MODWR)

Control Purpose:

- Repeatedly reading the master frequency and output frequency of VFD-M series AC motor drive then store them in D0 and D1 by MODRD instruction.
- Repeatedly setting the running direction and running frequency by MODWR instruction. For example, setting the AC motor drive to run forward in 40Hz.

Parameter Settings for VFD-M Series AC Motor Drive:

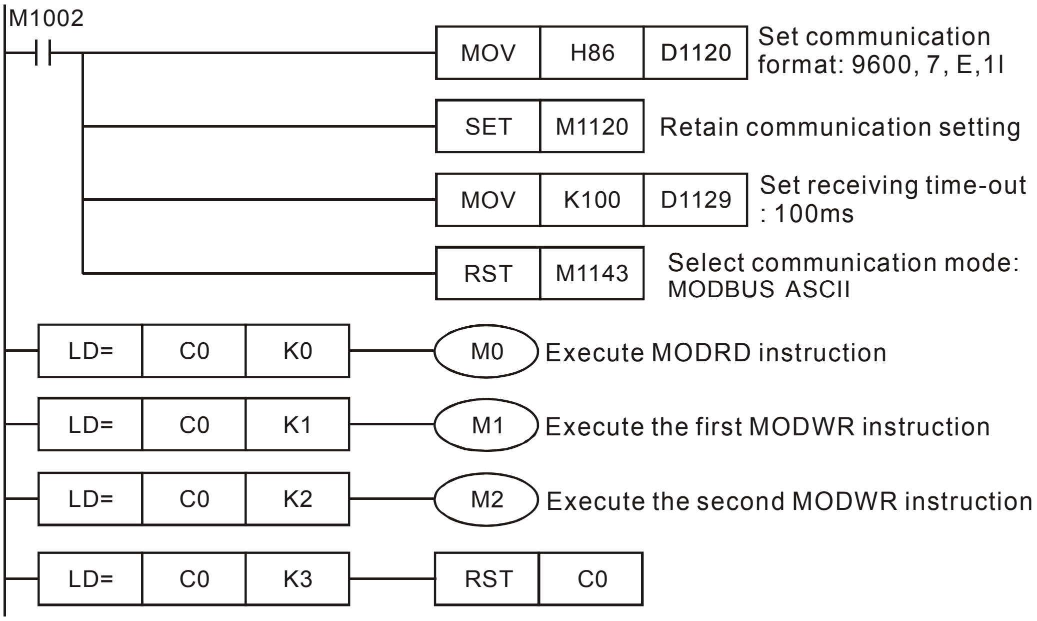
Parameter	Set value	Explanation
P00	03	Master frequency determined by RS485 com port.
P01	03	Operation determined by RS-485 com port, keypad STOP is effective.
P88	01	Communication address: 01
P89	01	Communication rate: 9600
P92	01	MODBUS ASCII mode, <7,E,1>

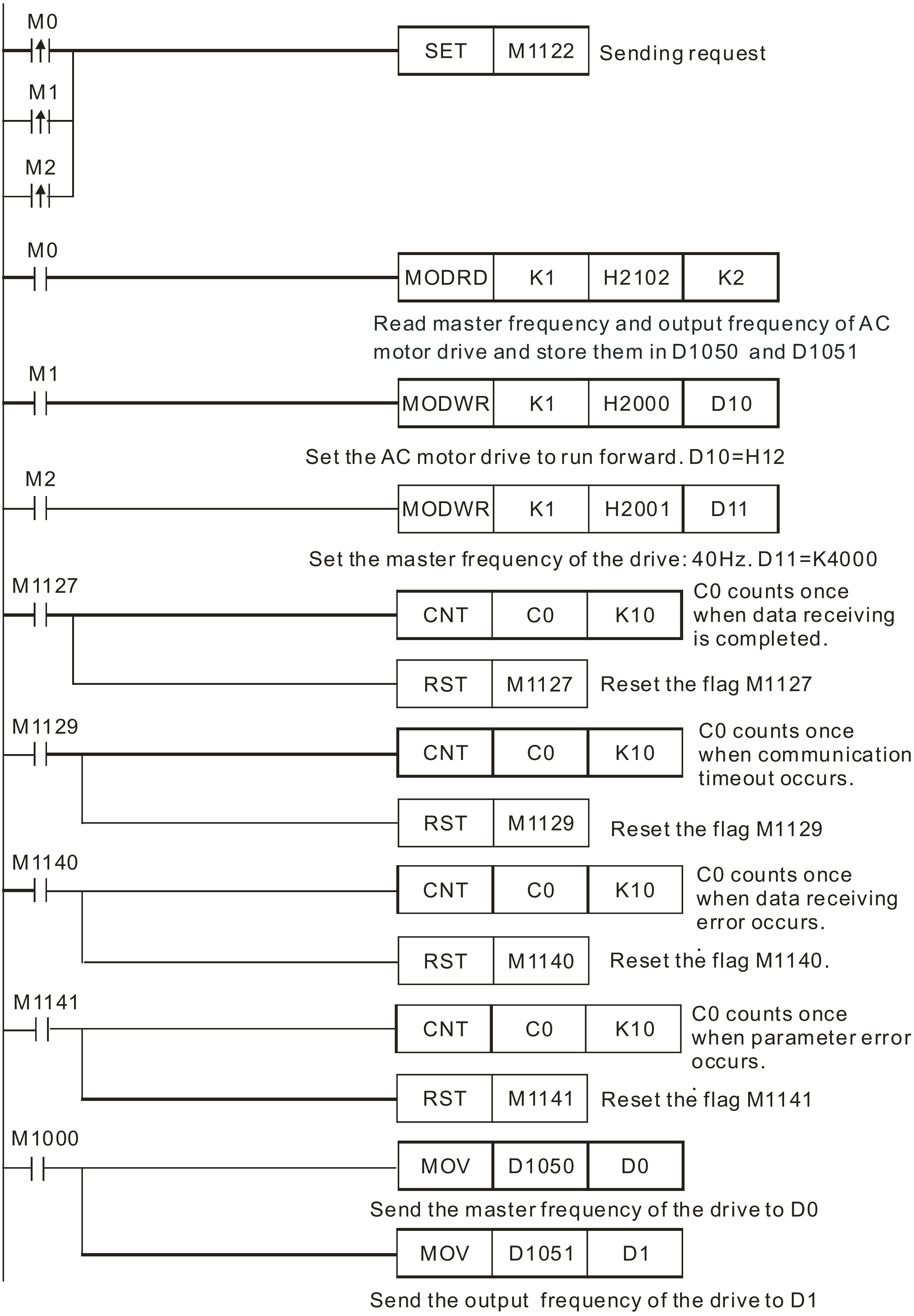
※ If AC motor drive can not run normally due to improper parameters, users can set P76 = 10 (factory defaults) and then set the parameters according to the above table.

Devices:

Device	Function
M0	Executing MODRD instruction to read master and output frequency.
M1	Executing the first MODWR instruction to set the running direction
M2	Executing the second MODWR instruction to set the running frequency
D10	Set value of the drive running direction.
D11	Set value of the drive running frequency.

Control Program:


M1002
MOV H86 D1120
Set communication format: 9600, 7, E,1l
SET M1120
Retain communication setting
MOV K100 D1129
Set receiving time-out : 100ms
RST M1143
Select communication mode: MODBUS ASCII
LD= C0 K0
M0
Execute MODRD instruction
LD= C0 K1
M1
Execute the first MODWR instruction
LD= C0 K2
M2
Execute the second MODWR instruction
LD= C0 K3
RST C0



Sending request

Read master frequency and output frequency of AC motor drive and store them in D1050 and D1051

Set the AC motor drive to run forward. D10=H12

Set the master frequency of the drive: 40Hz. D11=K4000

C0 counts once when data receiving is completed.

Reset the flag M1127

C0 counts once when communication timeout occurs.

Reset the flag M1129

C0 counts once when data receiving error occurs.

Reset the flag M1140.

C0 counts once when parameter error occurs.

Reset the flag M1141

Send the master frequency of the drive to D0

Send the output frequency of the drive to D1

Program Description:

- Initialize PLC RS-485 communication port and set the communication format as MODBUS

ASCII, 9600, 7, E, 1. The RS-485 communication format of AC motor drive should be the same with PLC.

- There are only 4 situations for MODBUS communication: flag M1127 for normal communication and M1129, M1140, M1141 for communication errors. Counter C0 counts once when any of the 4 flags is ON. Therefore, the program assures the communication reliability by monitoring the On/Off status of the 4 flags and performs 3 MODBUS instructions in order by the value in counter C0.
- When M0 = ON, [MODRD K1 H2102 K2] instruction will be executed. PLC will read the master frequency and output frequency of AC motor drive, store them in D1073~1076 in ASCII format, and automatically convert the content in D1073~1076 into hexadecimal values to D1050 and D1051.
- When M1 = ON, [MODWR K1 H2000 D10] instruction will be executed. D10 = H12 and the drive will run forward. The running direction can be changed by the content in D10.
- When M2 = ON, [MODWR K1 H2001 D11] instruction will be executed. D11 = K4000 and the drive running frequency will be 40Hz. The frequency can be changed by the content in D11.
- On the bottom of this program, [MOV D1050 D0] instruction stores the master frequency of the drive in D0, and [MOV D1051 D1] instruction stores the output frequency of the drive in D1.
- Once PLC starts running, the read/write actions for AC motor drive will be performed repeatedly according to [LD=] instructions.

12.2 Communication between PLC and Delta VFD-B Series AC Motor Drive (MODRD/MODWR)

Control Purpose:

- Repeatedly reading the master frequency and output frequency of VFD-B series AC motor drive by MODRD instruction.
- Start AC motor drive in reverse direction when Start is pressed. Increase 1Hz per second until it reaches 50Hz. Maintain the frequency at 50Hz. (MODWR instruction)
- Stop AC motor drive by when Stop is pressed. (MODWR instruction)

Parameter Settings for VFD-B Series AC Motor Drive:

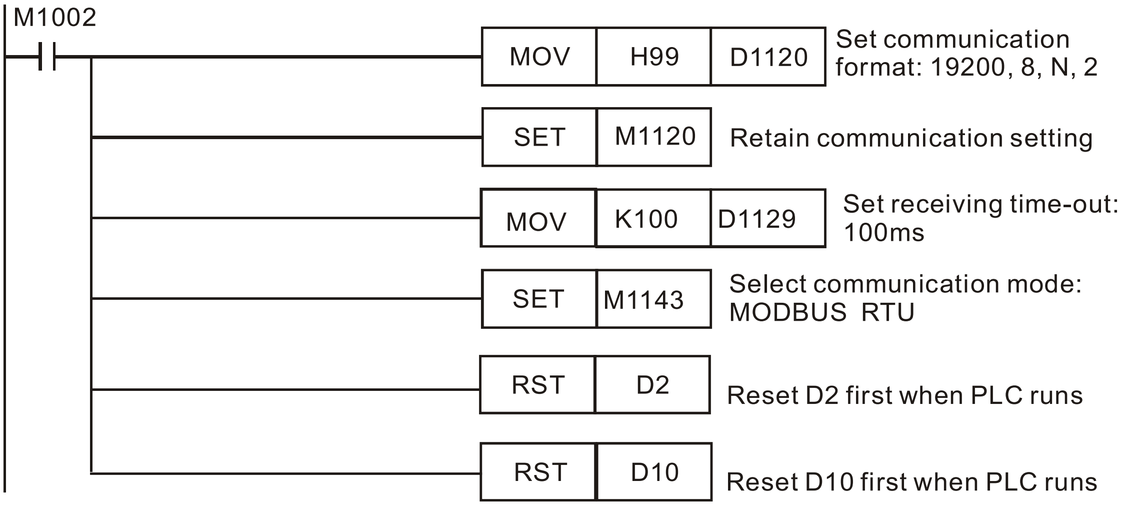
Parameter	Set value	Explanation
02-00	04	RS-485 serial communication. Last used frequency saved.
02-01	03	RS-485 serial communication. Keypad STOP/RESET enabled.
09-00	01	Communication address: 01
09-01	02	Communication baud rate: 19200.
09-04	03	MODBUS RTU mode, protocol <8,N,2>

※ If AC motor drive can not run normally due to improper parameters, users can set P00-02 = 10 (factory defaults) and then set the parameters according to the above table.

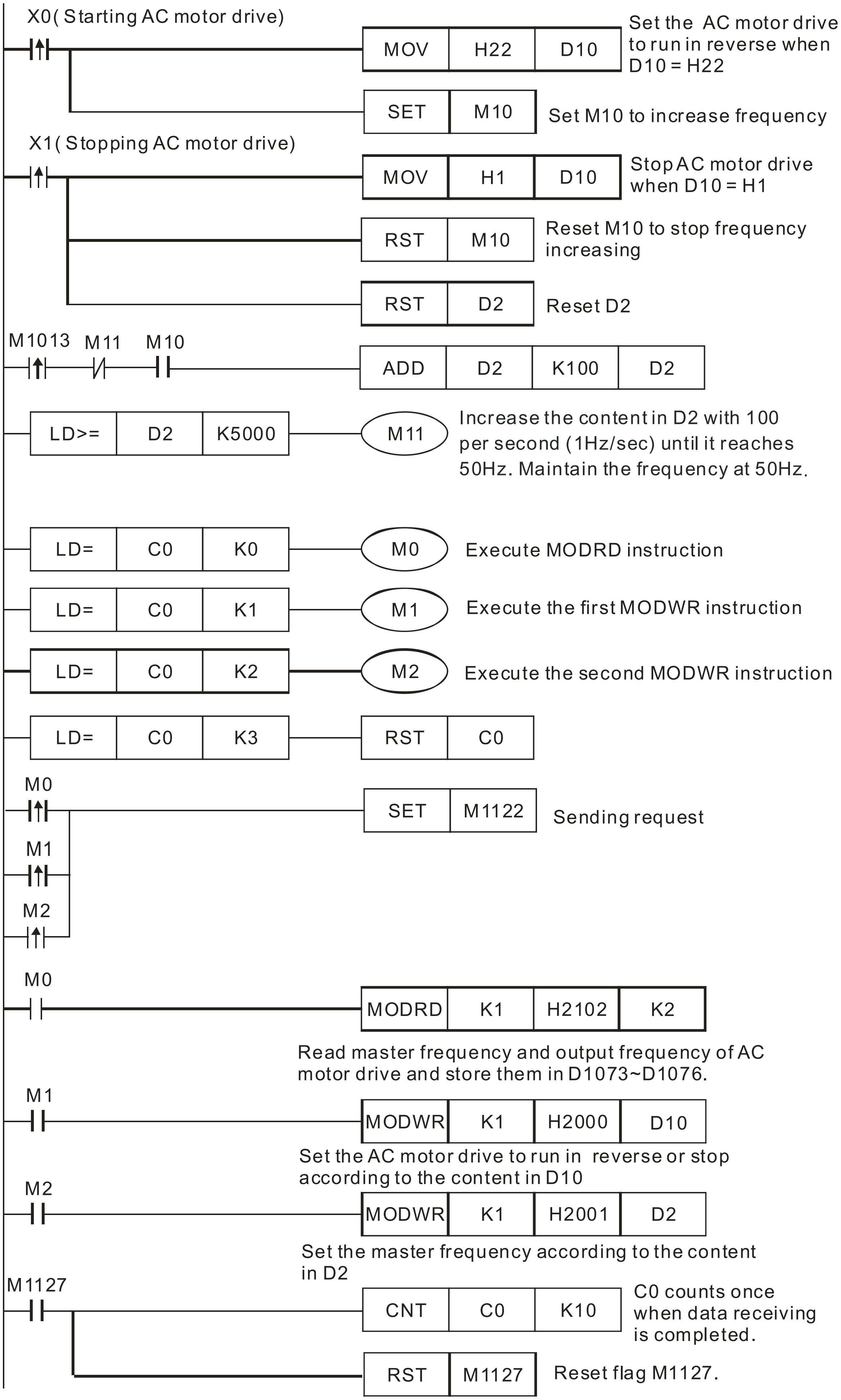
Devices:

Device	Function
X0	Start button for the drive
X1	Stop button for the drive
M0	Executing MODRD instruction to read master and output frequency
M1	Executing the first MODWR instruction to set the running direction
M2	Executing the second MODWR instruction to set the running frequency

Control Program:



```
M1002
 ─┤ ├─┬─ MOV  H99   D1120   Set communication format: 19200, 8, N, 2
      ├─ SET  M1120         Retain communication setting
      ├─ MOV  K100  D1129   Set receiving time-out: 100ms
      ├─ SET  M1143         Select communication mode: MODBUS  RTU
      ├─ RST  D2            Reset D2 first when PLC runs
      └─ RST  D10           Reset D10 first when PLC runs
```



Set the AC motor drive to run in reverse when D10 = H22

Set M10 to increase frequency

Stop AC motor drive when D10 = H1

Reset M10 to stop frequency increasing

Reset D2

Increase the content in D2 with 100 per second (1Hz/sec) until it reaches 50Hz. Maintain the frequency at 50Hz.

Execute MODRD instruction

Execute the first MODWR instruction

Execute the second MODWR instruction

Sending request

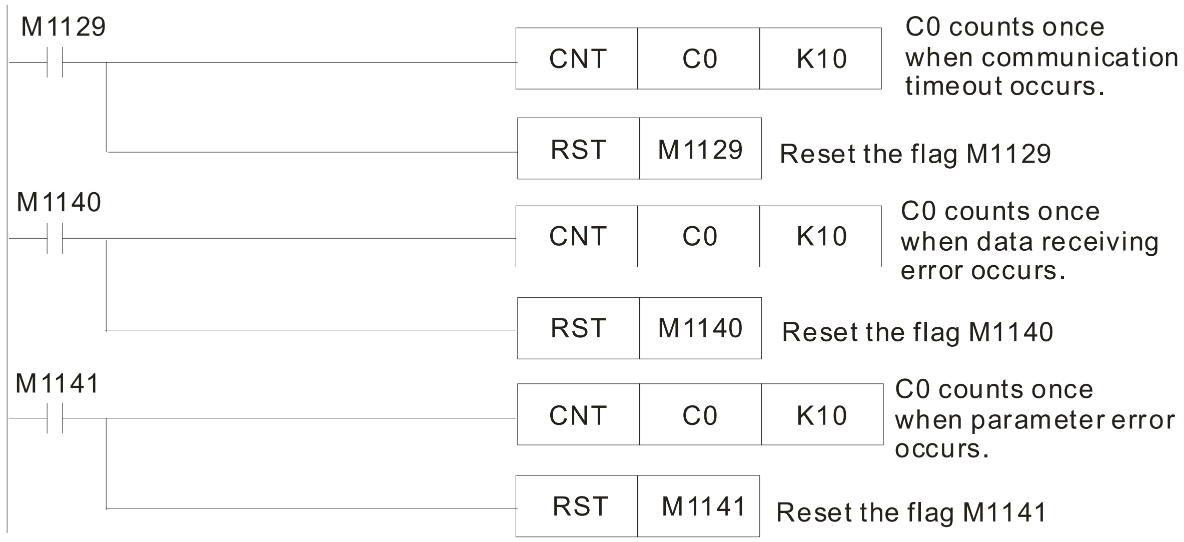
Read master frequency and output frequency of AC motor drive and store them in D1073~D1076.

Set the AC motor drive to run in reverse or stop according to the content in D10

Set the master frequency according to the content in D2

C0 counts once when data receiving is completed.

Reset flag M1127.


M1129
CNT
C0
K10
C0 counts once when communication timeout occurs.
RST
M1129
Reset the flag M1129
M1140
CNT
C0
K10
C0 counts once when data receiving error occurs.
RST
M1140
Reset the flag M1140
M1141
CNT
C0
K10
C0 counts once when parameter error occurs.
RST
M1141
Reset the flag M1141

Program Description:

- Initialize PLC RS-485 communication port and set the communication format as MODBUS RTU, 19200, 8, N, 2. The RS-485 communication format of AC motor drive should be the same with PLC.
- There are only 4 situations for MODBUS communication: flag M1127 for normal communication and M1129, M1140, M1141 for communication errors. Counter C0 counts once when any of the 4 flags is ON. Therefore, the program assures the communication reliability by monitoring the On/Off status of the 4 flags and performs 3 MODBUS instructions in order by the value in counter C0.
- When M0 = ON, [MODRD K1 H2102 K2] instruction will be executed. PLC will read the master frequency and output frequency of AC motor drive, store them in D1073~1076 in ASCII format, and automatically convert the content in D1073~1076 into hexadecimal values to D1050 and D1051.
- When M1 = ON, [MODWR K1 H2000 D10] instruction will be executed. D10 = H22 and the drive will run in reverse. If D10 = H1, the drive will be stopped.
- When M2 = ON, [MODWR K1 H2001 D2] instruction will be executed. The frequency can be changed by the content in D2.
- Once PLC starts running, the read/write actions for AC motor drive will be performed repeatedly according to [LD=] instructions.

12.3 Communication between PLC and Delta VFD-V Series AC Motor Drive (MODRD/MODWR)

Control Purpose:

- Repeatedly reading the master frequency and output frequency of VFD-V series AC motor drive by MODRD instruction.
- Setting the drive to run forward in 30Hz by MODRW instruction when X0 is pressed.
- Setting the drive to run in reverse in 20Hz by MODRW instruction when X1 is pressed.
- Stopping the drive by MODWR instruction when X2 is pressed.

Parameter Settings for VFD-V Series AC Motor Drive:

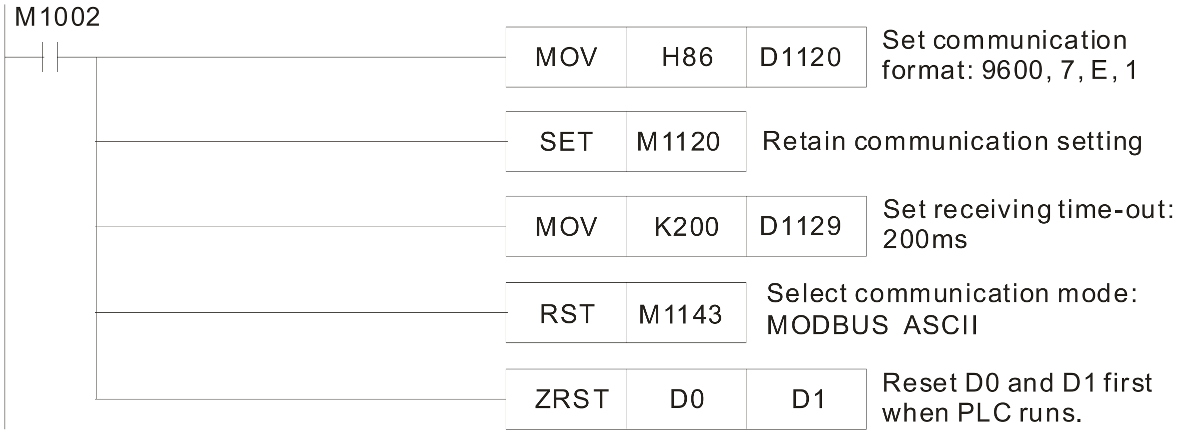
Parameter	Set value	Explanation
00-20	1	Master frequency controlled by RS-485 communication.
00-21	0	Digital keypad (KPV-CE01)
09-00	01	Communication address: 01
09-01	9.6	Communication baud rate: 9600.
09-04	02	ASCII mode. Protocol: (7, E, 1).

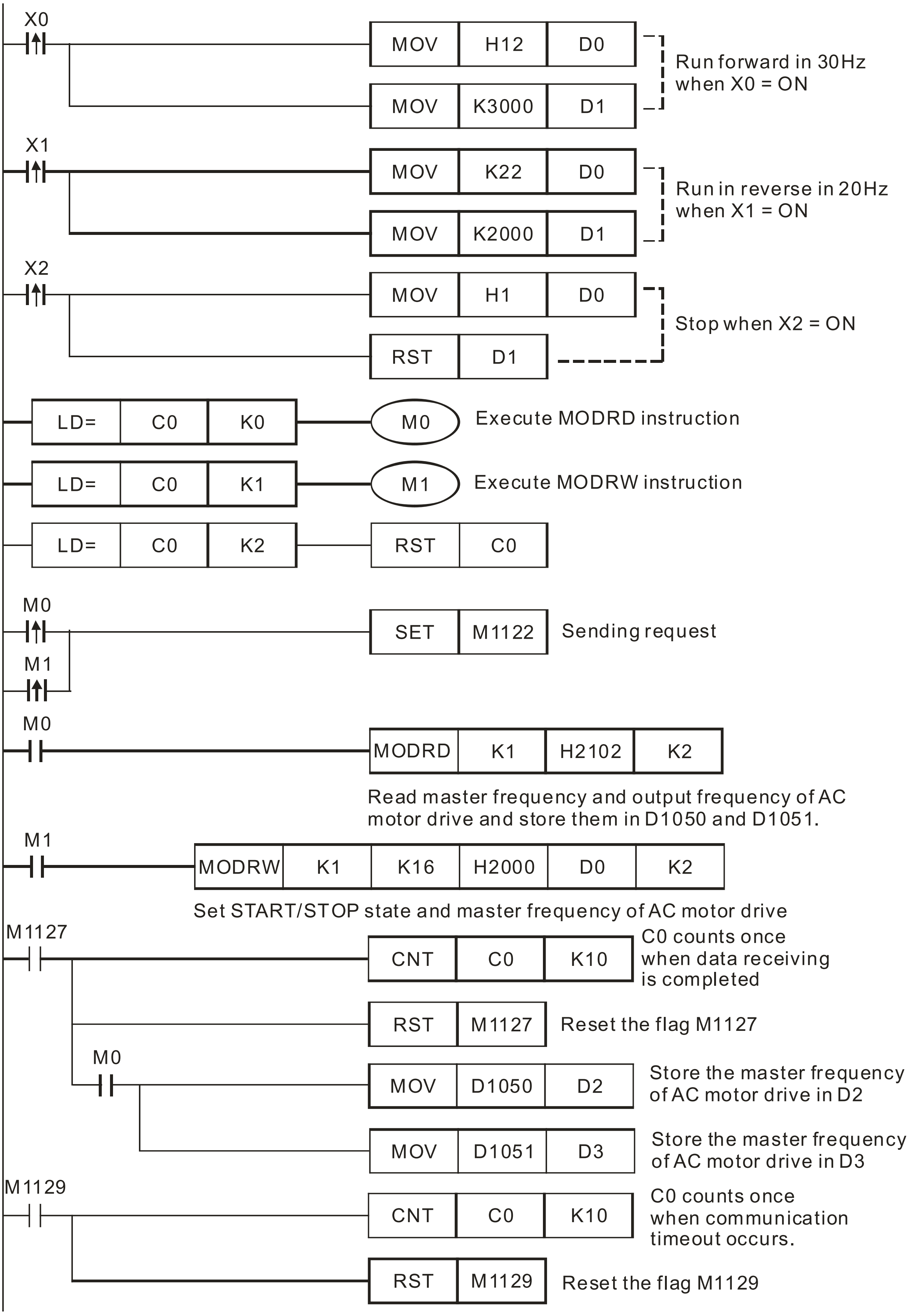
※ If AC motor drive can not run normally due to improper parameters, users can set P00-02 = 10 (factory defaults) and then set the parameters according to the above table.

Devices:

Device	Function
X0	Forward
X1	Reverse
X2	Stop
M0	Executing MODRD instruction to read master and output frequency
M1	Executing MODWR instruction to set running direction and frequency

Control Program:


M1002
MOV H86 D1120
Set communication format: 9600, 7, E, 1
SET M1120
Retain communication setting
MOV K200 D1129
Set receiving time-out: 200ms
RST M1143
Select communication mode: MODBUS ASCII
ZRST D0 D1
Reset D0 and D1 first when PLC runs.



Run forward in 30Hz when X0 = ON

Run in reverse in 20Hz when X1 = ON

Stop when X2 = ON

Execute MODRD instruction

Execute MODRW instruction

Sending request

Read master frequency and output frequency of AC motor drive and store them in D1050 and D1051.

Set START/STOP state and master frequency of AC motor drive

C0 counts once when data receiving is completed

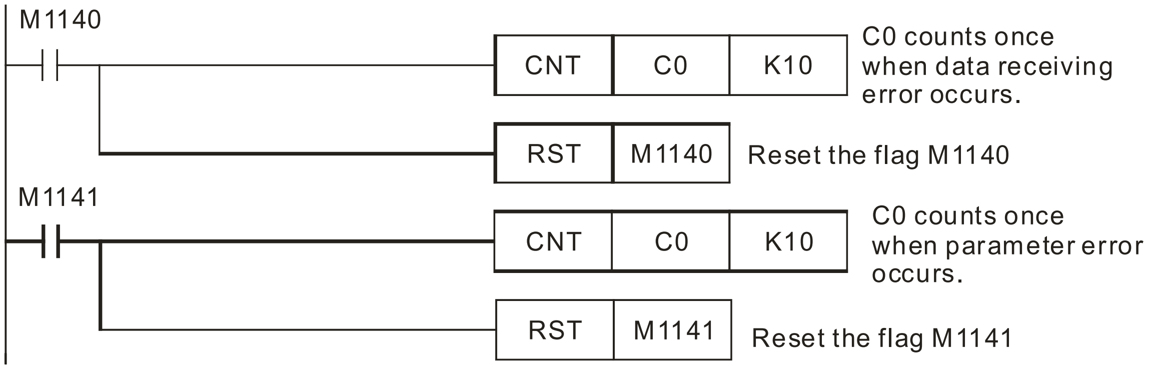
Reset the flag M1127

Store the master frequency of AC motor drive in D2

Store the master frequency of AC motor drive in D3

C0 counts once when communication timeout occurs.

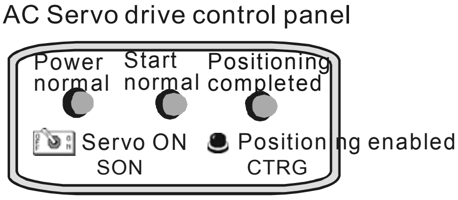
Reset the flag M1129


M1140
CNT
C0
K10
C0 counts once when data receiving error occurs.
RST
M1140
Reset the flag M1140
M1141
CNT
C0
K10
C0 counts once when parameter error occurs.
RST
M1141
Reset the flag M1141

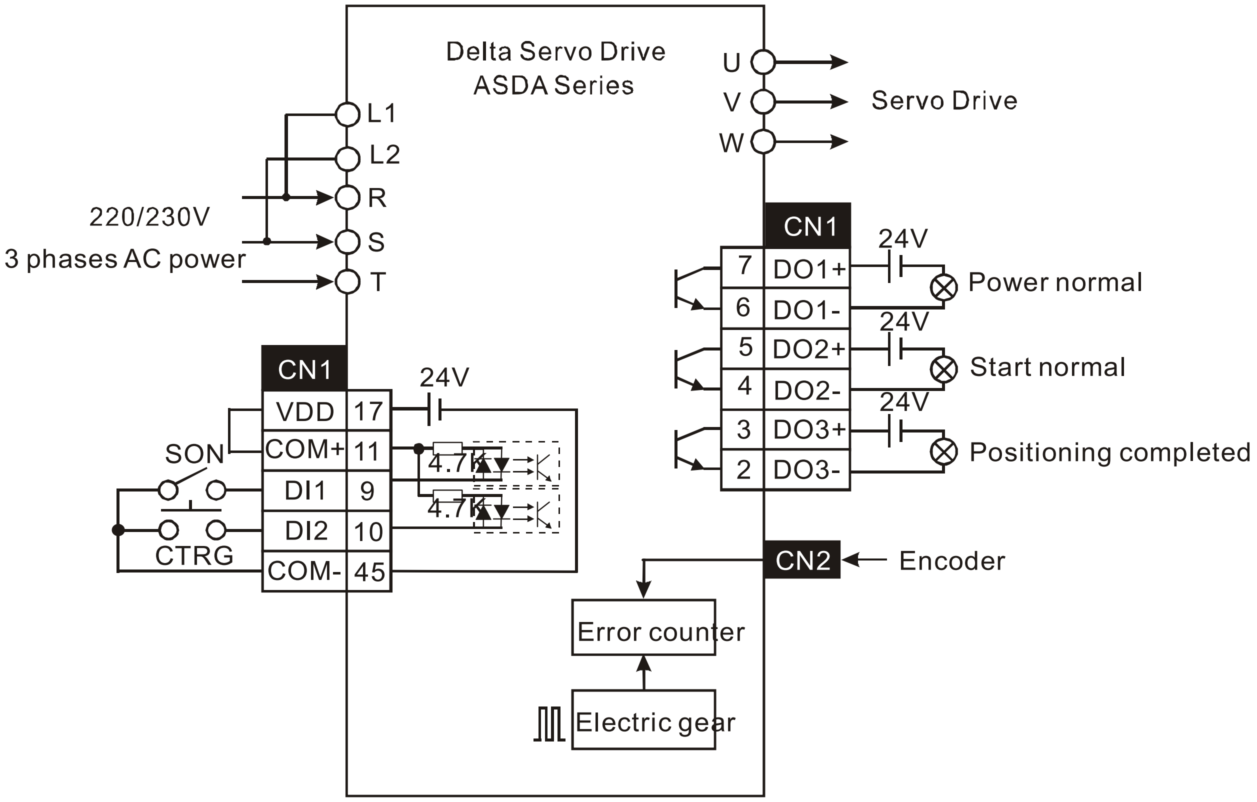
Program Description:

- Initialize PLC RS-485 communication port and set the communication format as MODBUS RTU, 19200, 8, N, 2. The RS-485 communication format of AC motor drive should be the same with PLC.
- Reset D0 and D1 when PLC is powered up so as to ensure the drive is in the Stop status
- When X0 is activated, the drive will run forward (D0 = H12) in 30Hz (D1 = 3000).
- When X1 is activated, the drive will run in reverse (D0 = H22) in 20Hz (D1 = K2000)
- When X2 is activated, the drive will stop. (D0 = H1, D1 = 0)
- There are only 4 situations for MODBUS communication: flag M1127 for normal communication and M1129, M1140, M1141 for communication errors. Counter C0 counts once when any of the 4 flags is ON. Therefore, the program assures the communication reliability by monitoring the On/Off status of the 4 flags and performs 2 MODBUS instructions in order by the value in counter C0.
- The master frequency and output frequency stored in D1050 and D1051 will be sent to D2 and D3.
- Once PLC starts running, the read/write actions for AC motor drive will be performed repeatedly according to [LD=] instructions.

12.4 Communication between PLC and Delta ASD-A Series AC Servo Drive (Positioning, MODRD/MODWR)



Wiring for Delta ASD-A Series AC Servo Drive:



Control Purpose:

- Reading the target position of AC servo drive (incremental position) by MODRD instruction.
- Setting the target position of AC servo drive (incremental position) by MODRW instruction.
- Enabling the starting and positioning actions of AC servo drive by the input points DI1~ DI2 when corresponding buttons are pressed.
- Showing the status of AC servo drive through indicators by the output points DO1~DO3

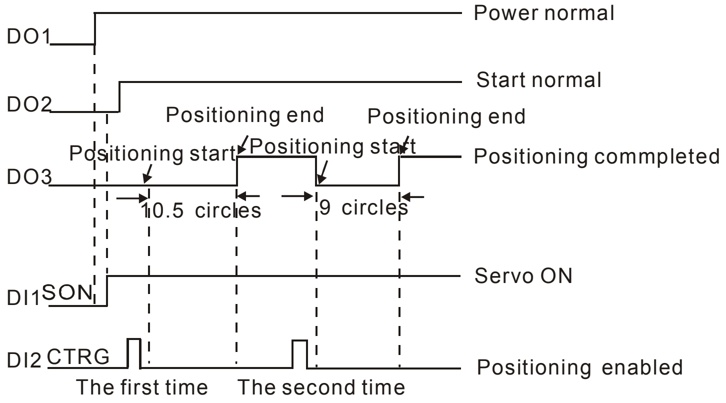
Parameter Settings for ASD-A Series AC Servo Drive:

Parameter	Set value	Explanation
P1-01	1	Control Mode and Output Direction
P1-33	1	Position Control Mode (Pr)
P2-10	101	Digital Input Terminal 1 (DI1)
P2-11	108	Digital Input Terminal 2 (DI2)

P2-15	0	Digital Input Terminal 6 (DI6)
P2-16	0	Digital Input Terminal 7 (DI7)
P2-17	0	Digital Input Terminal 8 (DI8)
P2-18	101	Digital Output Terminal 1 (DO1)
P2-19	102	Digital Output Terminal 2 (DO2)
P2-20	105	Digital Output Terminal 3 (DO3)
P3-00	1	Communication Address Setting
P3-01	1	Transmission Speed, Baud rate: 9600
P3-02	1	MODBUS ASCII mode. Data format: (7, E, 1)
P3-03	1	Warning and stopping if communication error occurred.
P3-05	2	RS-485 communication format
P3-06	0	Digital Input Communication Function

※ If AC servo drive can not run normally due to improper parameters, users can set P2-08 = 10 (factory defaults) and then set the parameters according to the above table.

- **Operation Steps:**

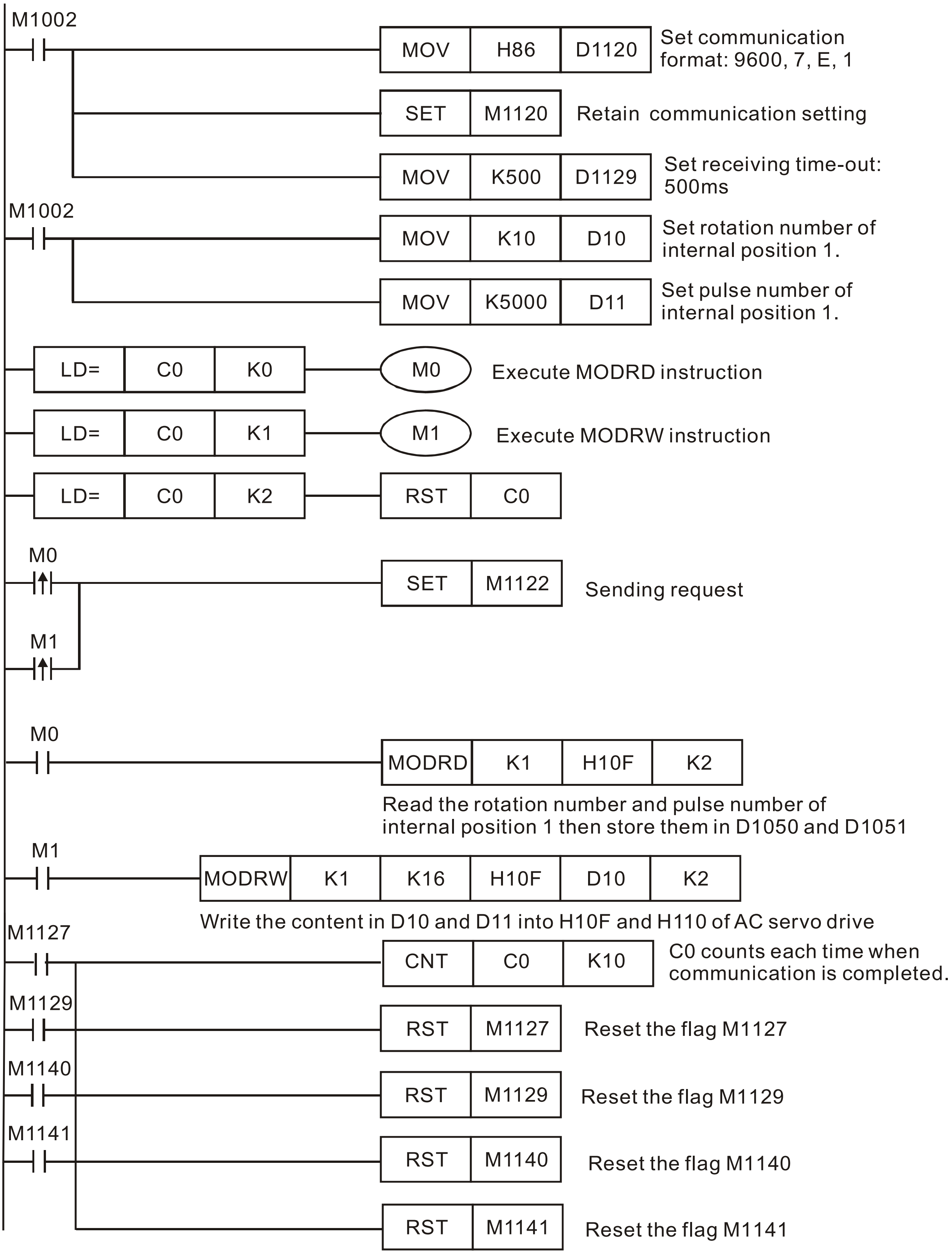


1. Set the parameters of AC servo drive then power up again. If no error occurred, “power normal” indicator (DO1) will be ON.
2. When Power normal indicator is ON, turn on SON (servo ON) to enable DI1. If no error occurred, “Start normal” indicator (DO2) will be ON.
3. When “Start normal” indicator in ON, turn on CTRG (positioning enabled) to trigger DI2. The servo motor will rotate for 10.5 cycles and then the “positioning completed” indicator (DO3) will be ON.

Devices:

Device	Function
M0	Executing MODRD instruction to read rotation number and pulse number of internal position 1
M1	Executing MODRW instruction to set rotation number and pulse number of internal position 1

Control Program:



Set communication format: 9600, 7, E, 1

Retain communication setting

Set receiving time-out: 500ms

Set rotation number of internal position 1.

Set pulse number of internal position 1.

Execute MODRD instruction

Execute MODRW instruction

Sending request

Read the rotation number and pulse number of internal position 1 then store them in D1050 and D1051

Write the content in D10 and D11 into H10F and H110 of AC servo drive

C0 counts each time when communication is completed.

Reset the flag M1127

Reset the flag M1129

Reset the flag M1140

Reset the flag M1141

Program Description:

- Initialize PLC RS-485 communication port and set the communication format as MODBUS ASCII, 9600, 7, E, 1. The RS-485 communication format of AC servo drive should be the same with PLC.
- When M0 = ON, [MODRD K1 H10F K2] instruction will be executed to read the rotation number and the pulse number of internal position 1 and store them in D1050 and D1051.
- When M1 = ON, [MODWR K1 K16 H10F D10 K2] instruction will be executed to write the content in D10 and D11 into H10F (Rotation number of internal position1) and H10 (pulse number of internal position 1).
- Both the start signal and the trigger signal are controlled by switches of AC servo drive through the external wiring. For the wiring methods, please refer to the wiring diagram.
- There are only 4 situations for MODBUS communication: flag M1127 for normal communication and M1129, M1140, M1141 for communication errors. Counter C0 counts once when any of the 4 flags is ON. Therefore, the program assures the communication reliability by monitoring the On/Off status of the 4 flags and performs 2 MODBUS instructions in order by the value in counter C0.
- Once PLC starts running, the read/write actions for AC servo drive will be performed repeatedly according to [LD=] instructions.

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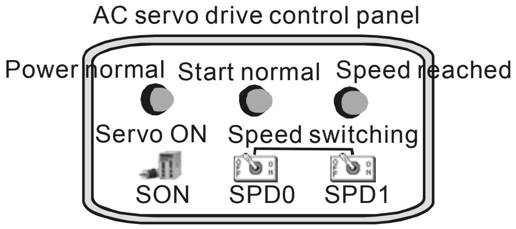
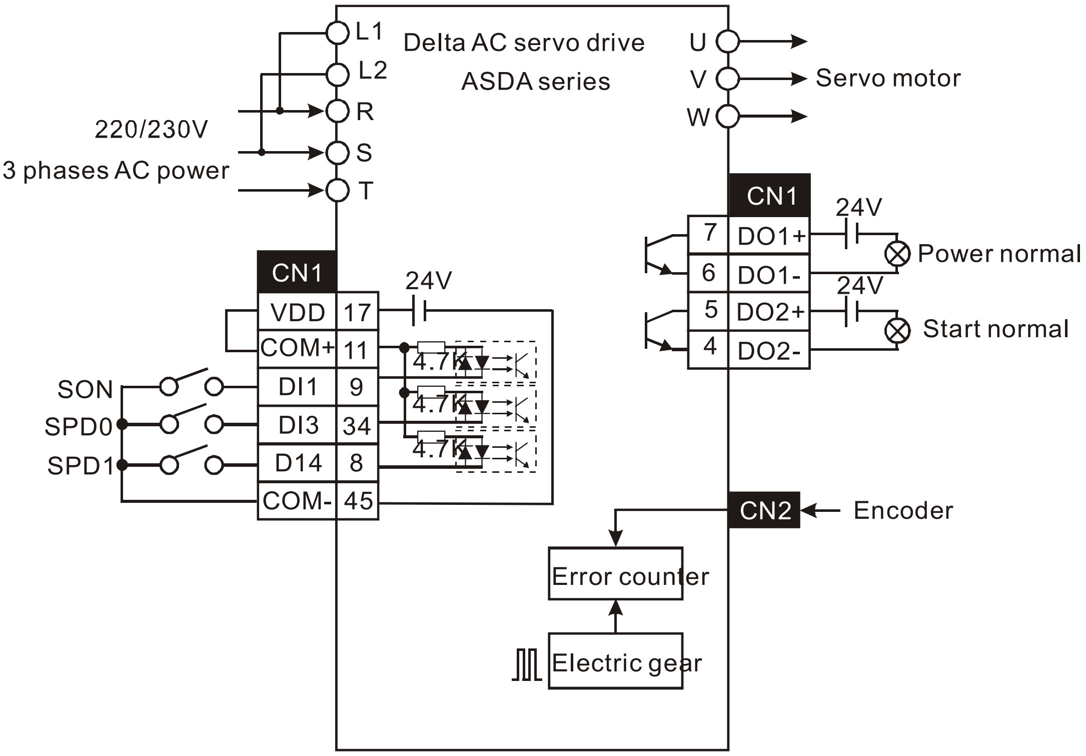
12.5 Communication between PLC and Delta ASD-A Series AC Servo Drive (Speed Control, MODRD/MODRW)



Wiring for Delta ASD-A Series AC Servo Drive:



Control Purpose:

- Reading rotation speed of servo motor and storing it in D0 by MODRD instruction.
- Controlling the motor to rotate in 2 fixed speeds or specified speed by MODRW instruction together with switches SPD0 and SPD1.
- Definitions of the speed switches of AC servo drive:

SPD0 Status	SPD1 Status	Function
ON	OFF	SPD0 ON: selecting the first speed set in P1-09 (determined by the content in D9, fixed as K1500 in this program. The rotation speed of the motor: 1500 r/min. Direction: forward.)
OFF	ON	SPD1 ON: selecting the second speed set in P1-10 (determined by the content in D10, fixed as K-1500 in this program. The rotation speed of the motor: 1500 r/min. Direction: reverse.)
ON	ON	SPD0 and SPD1 ON: selecting the third speed set in P1-11 (determined by the content in D11. The rotation speed of the motor is specified by user with the content in D11.

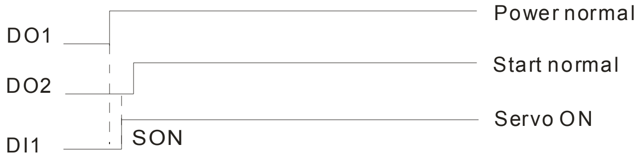
- Showing the status of AC servo drive through indicators by the output points DO1~DO3.

Parameter Settings for ASDA Series AC Servo Drive:

Parameter	Set value	Explanation
P1-01	2	Control Mode and Output Direction
P1-39	1500	Target Motor Speed: 1500rpm.
P2-10	101	Digital Input Terminal 1 (DI1)
P2-12	114	DI3: the input terminal of SPD0
P2-13	115	DI4: the input terminal of SPD1
P2-15	0	No function
P2-16	0	No function
P2-17	0	No function
P2-18	101	DO1 = ON if no error occurred after power up
P2-19	102	DO2 = ON if no error occurred after servo started
P2-20	104	DO3 = ON when target speed reached
P3-00	1	Communication Address Setting
P3-01	1	Transmission Speed, Baud rate: 9600
P3-02	1	MODBUS ASCII mode. Data format: (7, E, 1)
P3-05	2	RS-485 communication format
P3-06	0	Digital Input Communication Function

※ If AC servo drive can not run normally due to improper parameters, users can set P2-08 = 10 (factory defaults) and then set the parameters according to the above table.

- **Operation Steps:**

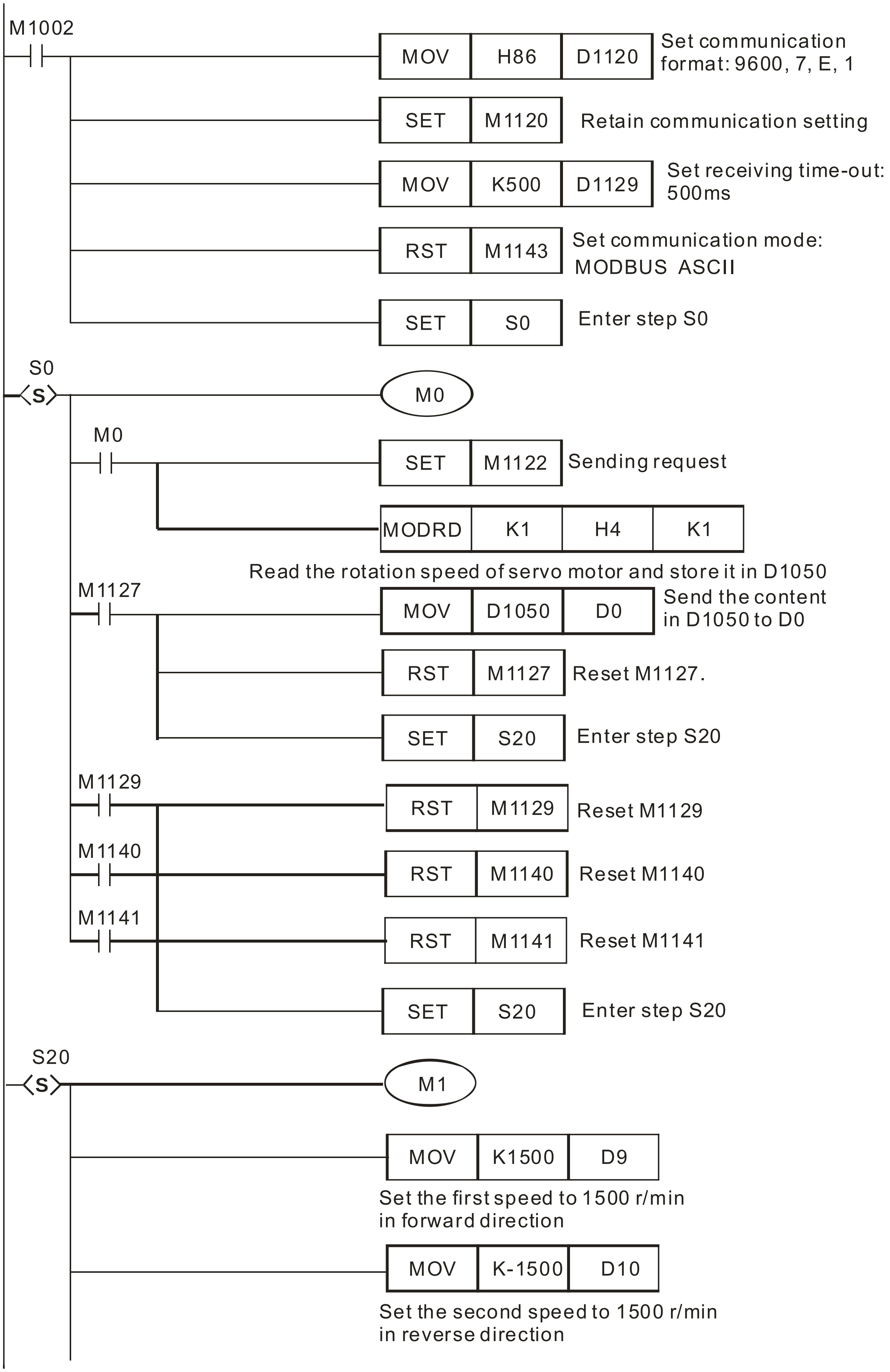


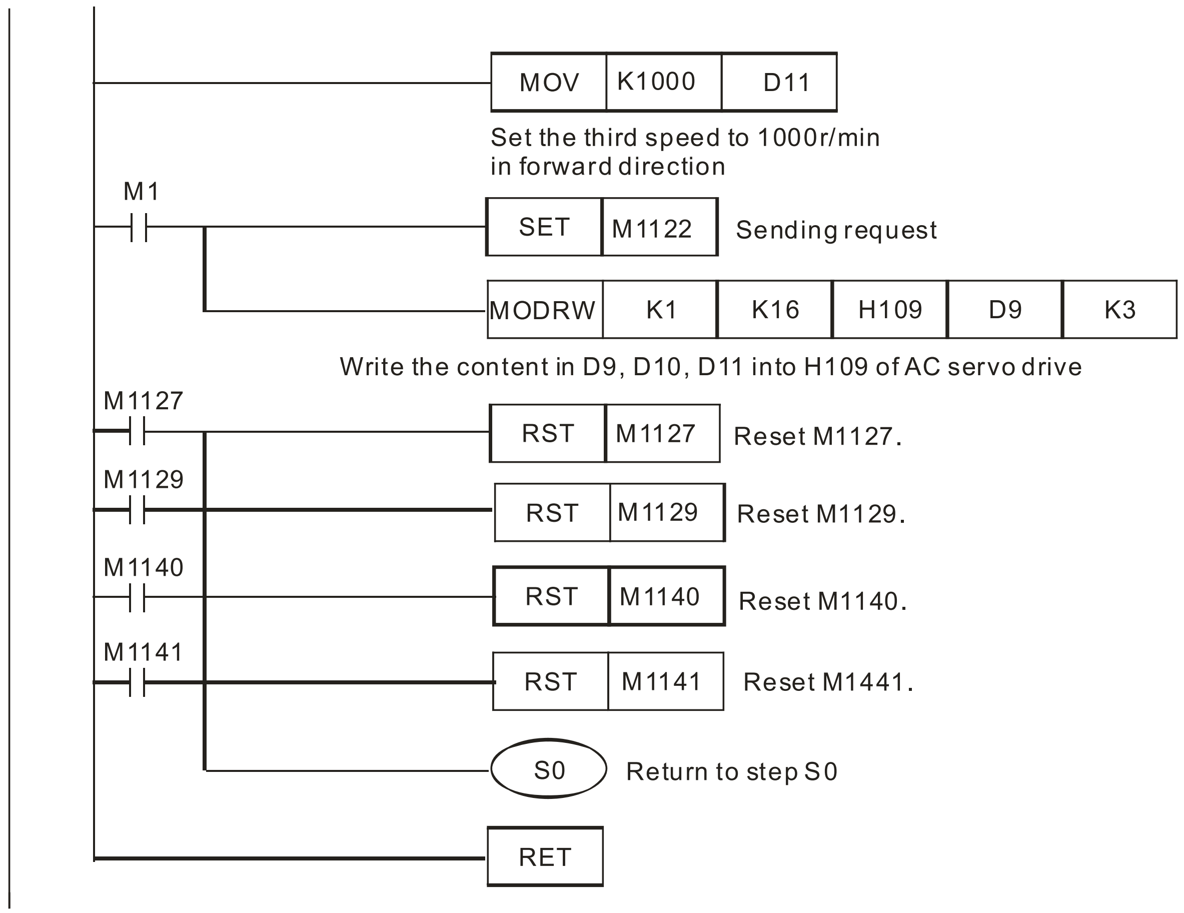
1. Set the parameters of AC servo drive then power up again. If no error occurred, “power normal” indicator (DO1) will be ON.
2. When Power normal indicator is ON, turn on SON (servo ON) to enable DI1. If no error occurred, “Start normal” indicator (DO2) will be ON.
3. Turn on “SPD0”, the speed set in parameter P1-09 will be enabled. Turn on “SPD1”, and the speed set in parameter P1-10 will be enabled. Turn on both “SPD0” and “SPD1”, the speed set in parameter P1-11 will be enabled.

Devices:

Device	Function
M0	Executing MODRD instruction to read the rotation speed of motor
M1	Execute MODWR instruction

Control Program:


M1002
MOV H86 D1120
Set communication format: 9600, 7, E, 1
SET M1120
Retain communication setting
MOV K500 D1129
Set receiving time-out: 500ms
RST M1143
Set communication mode: MODBUS ASCII
SET S0
Enter step S0
S0
S
M0
M0
SET M1122
Sending request
MODRD K1 H4 K1
Read the rotation speed of servo motor and store it in D1050
M1127
MOV D1050 D0
Send the content in D1050 to D0
RST M1127
Reset M1127.
SET S20
Enter step S20
M1129
RST M1129
Reset M1129
M1140
RST M1140
Reset M1140
M1141
RST M1141
Reset M1141
SET S20
Enter step S20
S20
S
M1
MOV K1500 D9
Set the first speed to 1500 r/min in forward direction
MOV K-1500 D10
Set the second speed to 1500 r/min in reverse direction



Program Description:

- Initialize PLC RS-485 communication port and set the communication format as MODBUS ASCII, 9600, 7, E, 1. The RS-485 communication format of AC servo drive should be the same with PLC.
- When enter into step point S0, M0 = ON, [MODRD K1 H4 K1] instruction will be executed to read the motor rotation speed and store it in D1050. Then [MOV D1050 D0] instruction will be executed for showing the rotation speed in D0.
- When enter into step S20, M1 = ON, [MODWR K1 K16 H109 D9 K3] instruction will be executed to write the content in D9, D10 and D11 into the H109, H10A and H10B as the parameters of communication address.
- The initial setting in D11 is K1000. Users can specify the value by actual application.
- When PLC starts, the program will enter step S0 then move to step S20 and return to S0. The read/write actions for AC servo drive will be performed repeatedly by this process.

12.6 Communication between PLC and Delta DTA Series Temperature Controller (MODRD/MODWR)

Control Purpose:

- Reading the target value and the set value of the temperature controller (TC). (address: H4700, MODRD instruction)
- Setting the target temperature as 24° (address H4701, MODWR instruction)
- Setting the heating/cooling control cycle. (address: H4712, MODWR instruction)
- Setting the control mode as cooling. (address: H4718, MODWR instruction)

Parameter Settings for DTA Series Temperature Controller:

Parameter	Function	Set value
CoSH	C WE: Write-in function disable/enable	ON
C-SL	C-SL: ASCII, RTU communication format selection	ASCII
C-no	C NO: Communication address setting	1
bPS	BPS: Communication baud rate setting	9600
LEn	LENGTH: Data length setting	7
PrtY	PARITY: Parity bit setting	E
StoP	STOP BIT: Stop bit setting	1
tPUn	UNIT: Temperature display unit °C or ℉	°C

※ If TC can not run normally due to improper parameters, users can set the TC to factory defaults first and then set the parameters according to the above table.

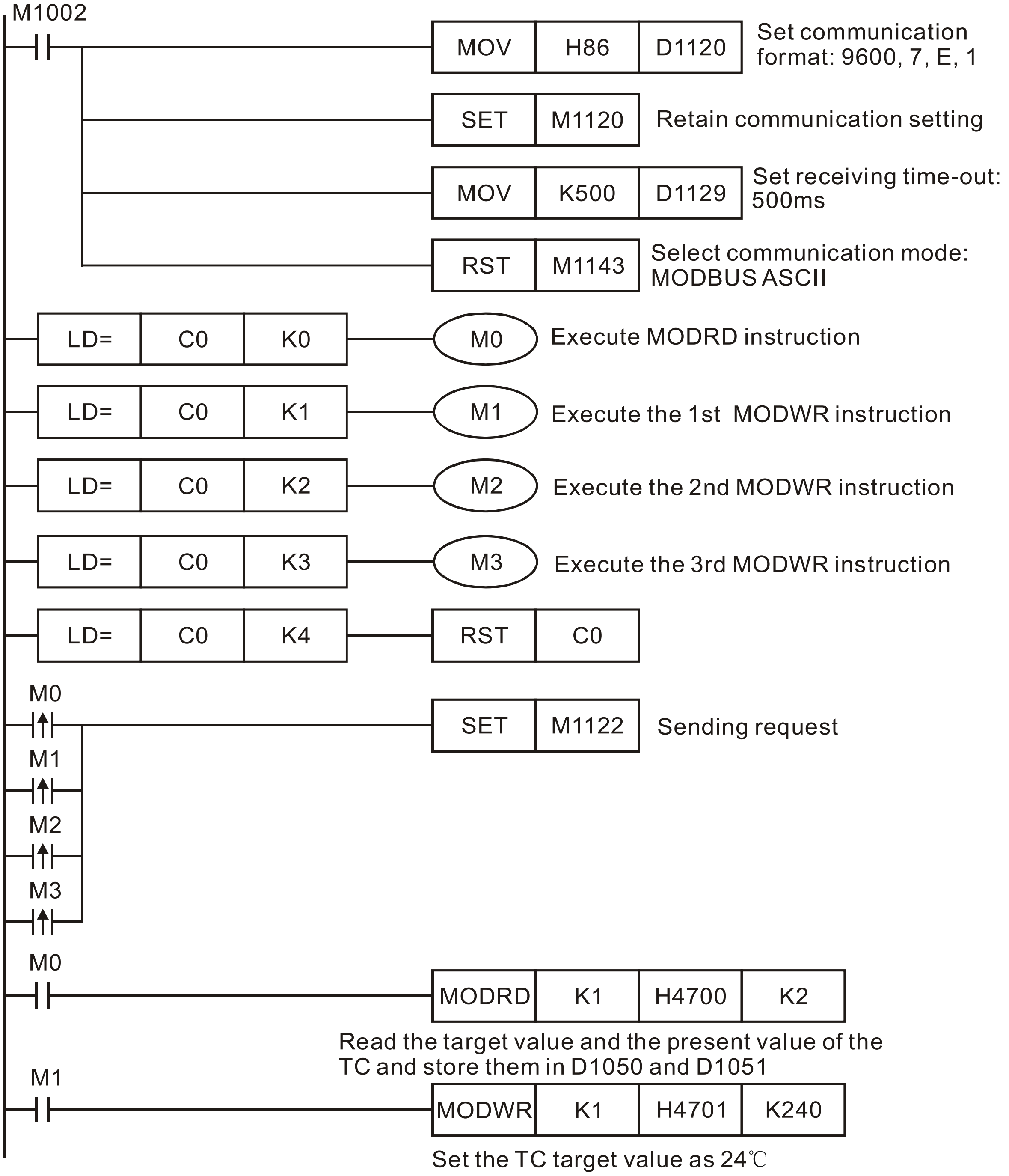
Steps of setting factory defaults:

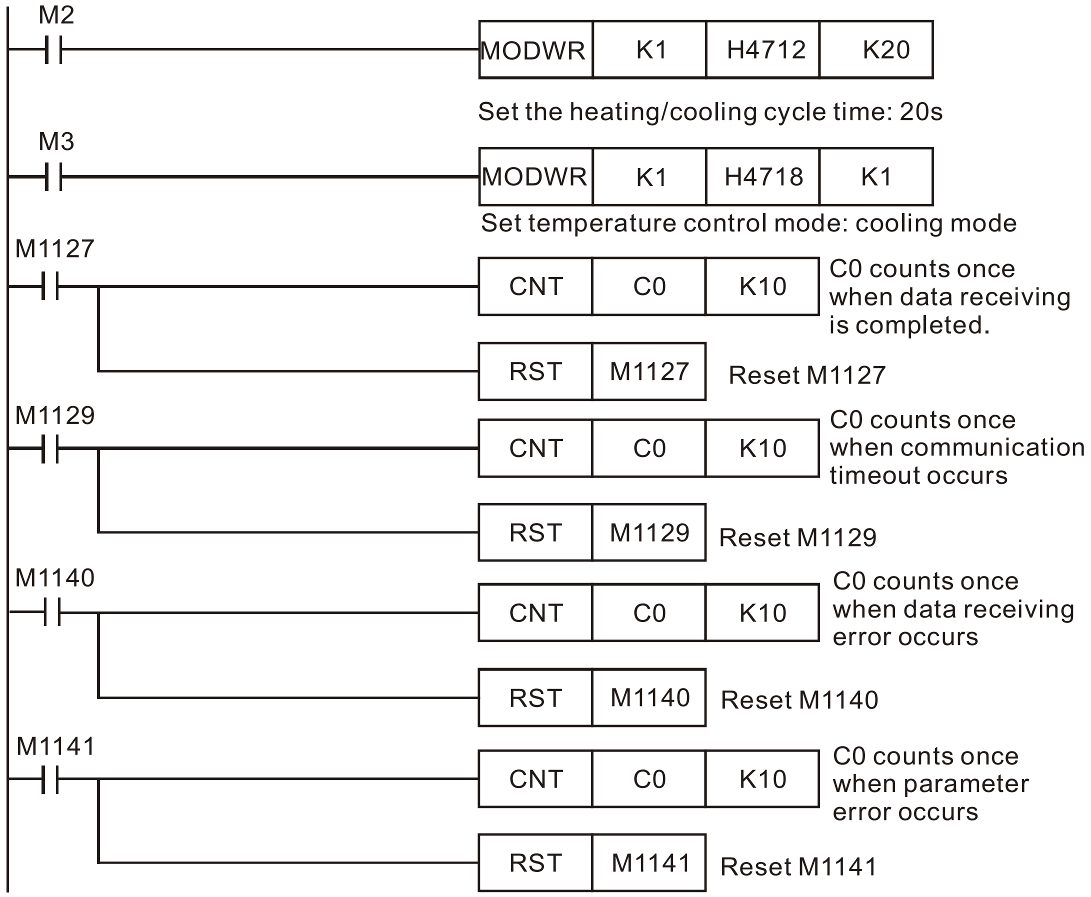
1. Press ↵ in the main screen to enter LoC oFF page. Use ▲ to select LoC LoC1. Press SET to save the setting.
2. Press both ▼ and ▲ for about 1s to enter default setting mode. (Other operation is prohibited in this mode, or setting error will occur, and the TC have to be sent back to factory for adjusting)
3. In CoLd page, press ↵ to set PASS 4321 as PASS 1357. Press SET to save the setting.
4. Turn off TC then power up again.
5. The communication protocols of DTA series TC are as follows:
   - Supporting MODBUS ASCII/RTU. Baud rate: 2400, 4800, 9600, 19200, 38400.
   - Supporting function codes: 03H (read multiple words). 06H (write 1 word). Non-supporting function code: 10H (write multiple words).
   - Non-supporting formats in ASCII mode: 7, N, 1 or 8, O, 2 or 8, E, 2.
   - Supporting formats in RTU mode: 8, N, 1 or 8, N, 2 or 8, O, 1 or 8, E, 1.
   - Available communication address: 1 to 255, 0 is broadcast address.

Devices:

Devices	Function
M0	Execute MODRD instruction to read target and current temperature.
M1	Execute the first MODWR instruction to set target temperature of TC.
M2	Execute the 2nd MODWR instruction to set the heating/cooling cycle time.
M3	Execute the 3rd MODWR instruction to set the control mode as Cooling.

Control Program:


M1002
MOV H86 D1120
Set communication format: 9600, 7, E, 1
SET M1120
Retain communication setting
MOV K500 D1129
Set receiving time-out: 500ms
RST M1143
Select communication mode: MODBUS ASCII
LD= C0 K0
M0
Execute MODRD instruction
LD= C0 K1
M1
Execute the 1st MODWR instruction
LD= C0 K2
M2
Execute the 2nd MODWR instruction
LD= C0 K3
M3
Execute the 3rd MODWR instruction
LD= C0 K4
RST C0
M0
M1
M2
M3
SET M1122
Sending request
M0
MODRD K1 H4700 K2
Read the target value and the present value of the TC and store them in D1050 and D1051
M1
MODWR K1 H4701 K240
Set the TC target value as 24℃


M2
MODWR K1 H4712 K20
Set the heating/cooling cycle time: 20s
M3
MODWR K1 H4718 K1
Set temperature control mode: cooling mode
M1127
CNT C0 K10
C0 counts once when data receiving is completed.
RST M1127
Reset M1127
M1129
CNT C0 K10
C0 counts once when communication timeout occurs
RST M1129
Reset M1129
M1140
CNT C0 K10
C0 counts once when data receiving error occurs
RST M1140
Reset M1140
M1141
CNT C0 K10
C0 counts once when parameter error occurs
RST M1141
Reset M1141

Program Description:

- Initialize PLC RS-485 communication port and set the communication format as MODBUS ASCII, 9600, 7, E, 1. The RS-485 communication format of TC should be the same with PLC.
- Since DTA series TC does not support the function code 10H (Write multiple words), the program needs 3 MODWR instructions to write 3 address data.
- There are only 4 situations for MODBUS communication: flag M1127 for normal communication and M1129, M1140, M1141 for communication errors. Counter C0 counts once when any of the 4 flags is ON. Therefore, the program assures the communication reliability by monitoring the On/Off status of the 4 flags and performs 4 MODBUS instructions in order by the value in counter C0
- Once PLC starts running, the read/write actions for TC will be performed repeatedly according to [LD=] instructions.

12.7 Communication between PLC and Delta DTB Series Temperature Controller (MODRD/MODWR/MODRW)

Control Purpose:

- Reading as well as displaying the target value and the present value of the TC by MODRD instruction.
- Setting the parameters of the TC as following data by MODWR and MODRW instructions.

Parameter	value	Communication address
Target temperature	26°C	1001H
Upper limit of temperature range	50°C	1002H
Lower limit of temperature range	0°C	1003H
Output type of alarm 1	The first alarm type	1020H
Upper-limit alarm 1	5°C	1024H
Lower-limit alarm 1	3°C	1025H

Parameter Settings for DTB Series Temperature Controller:

Parameter	Function	Set value
CoSH	C WE: Write-in function disable/enable	ON
C-SL	C-SL: ASCII, RTU communication format selection	RTU
C-no	C NO: Communication address setting	1
bPS	BPS: Communication baud rate setting	9600
LEn	LENGTH: Data length setting	8
PrtY	PARITY: Parity bit setting	N
StoP	STOP BIT: Stop bit setting	2
tPUn	UNIT: Temperature display unit °C or ℉	°C

※ If TC can not run normally due to improper parameters, users can set the TC to factory defaults first and then set the parameters according to the above table. The setting steps of DTB series are the same with DTA series TC.

※ Communication protocol of DTB series is as following:

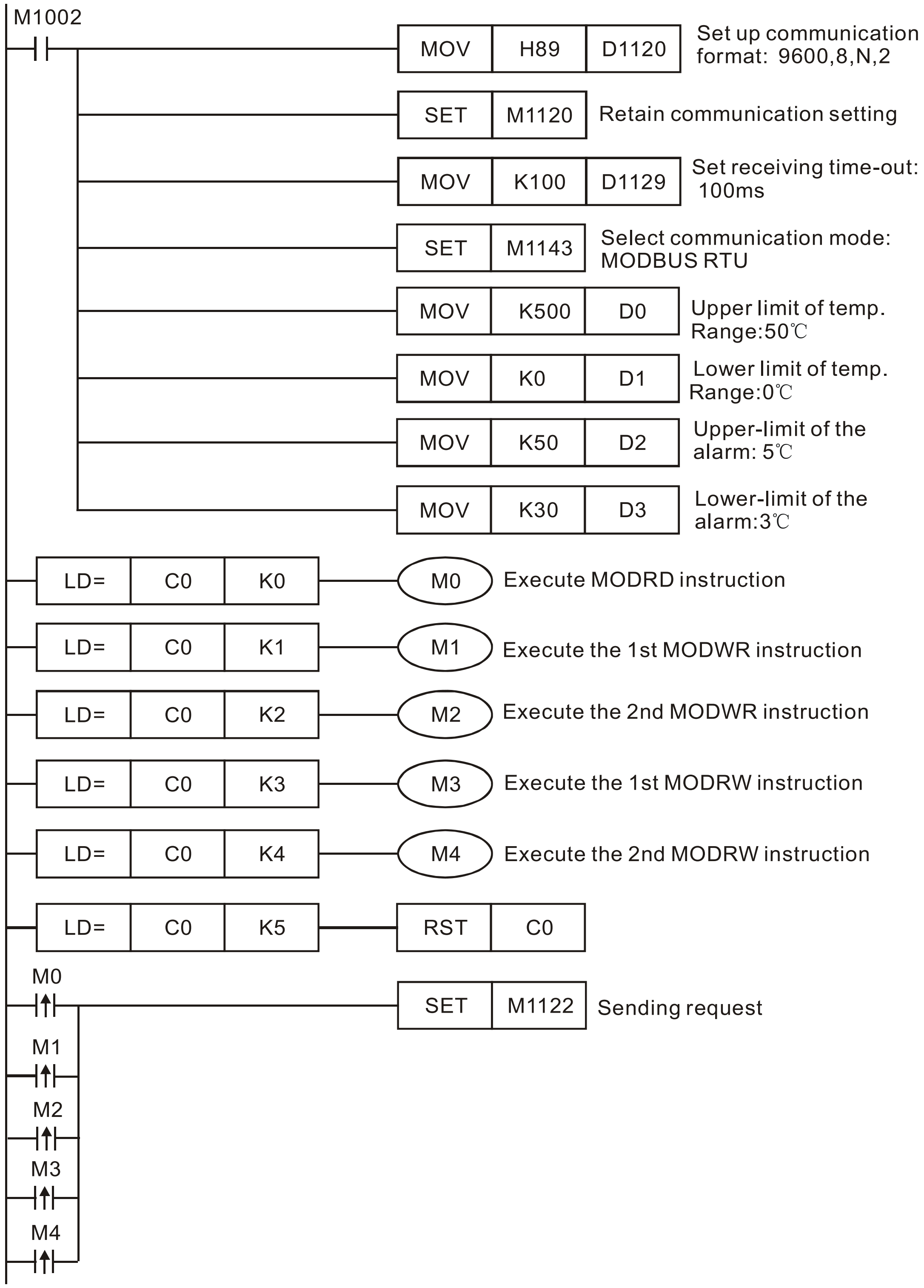
1. Supporting MODBUS ASCII/RTU communication protocol. Communication baud rate: 2400, 4800, 9600, 19200, 38400.
2. Supporting function code: 03H to read the contents of register. 06H to write 1 word into register. 10H to write many words into register.
3. Non-supported formats in ASCII mode: 7, N, 1 or 8, O, 2 or 8, E, 2
4. Formats in RTU mode: 8, N, 1 or 8, N, 2 or 8, O, 1 or 8, E, 1.
5. Available communication address: 1 to 255, 0 is broadcast address.

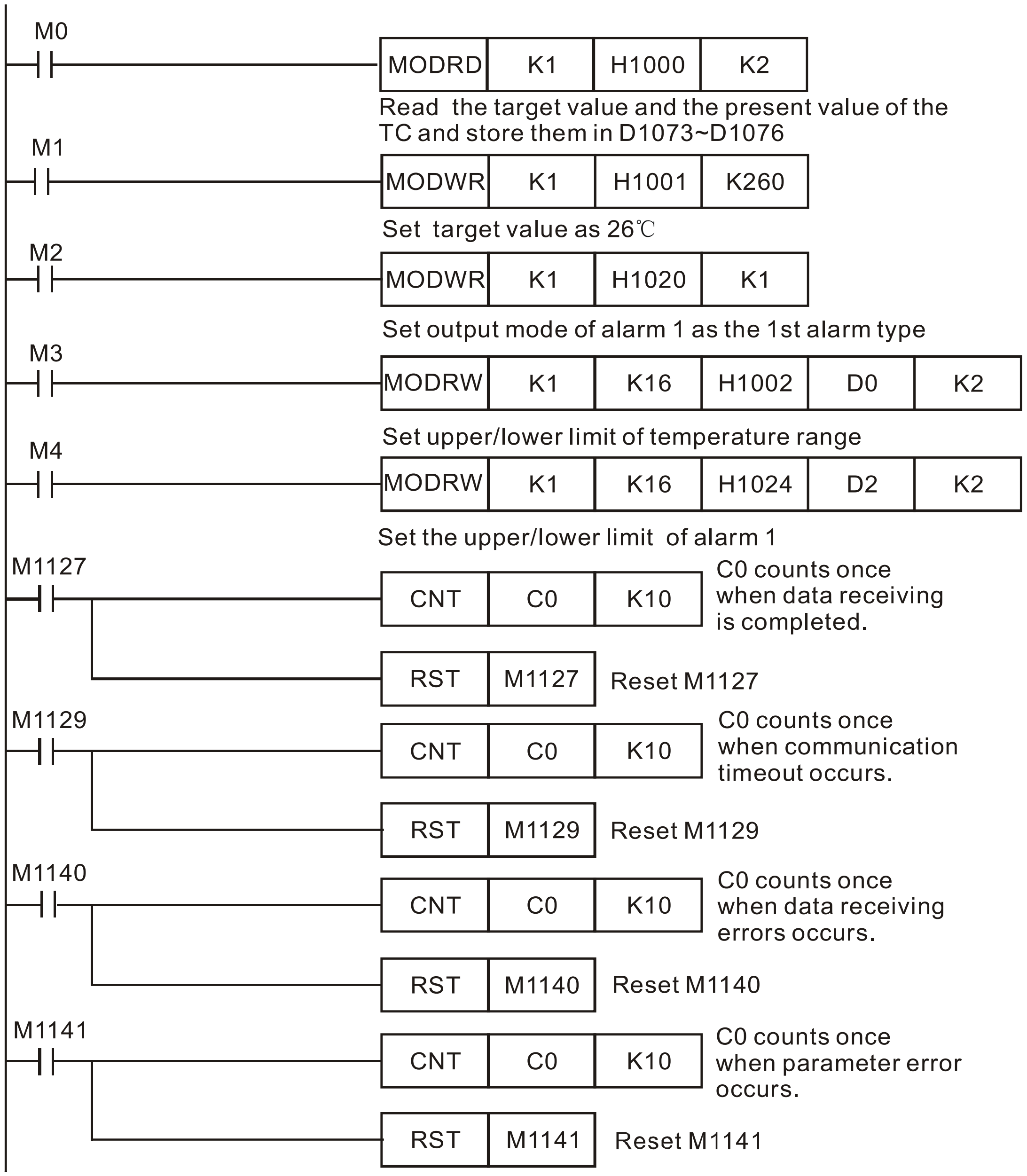
Devices:

Device	Function

Device	Function
M0	Executing MODRD instruction to read target and present temperature
M1	Executing the 1st MODWR instruction to set target temperature of TC
M2	Executing the 2nd MODWR instruction to set alarm output type
M3	Executing the 1st MODRW instruction to set the upper/lower limit of temperature range
M4	Executing the 2nd MODRW instruction to set the upper/lower limit of alarm 1

Control Program:

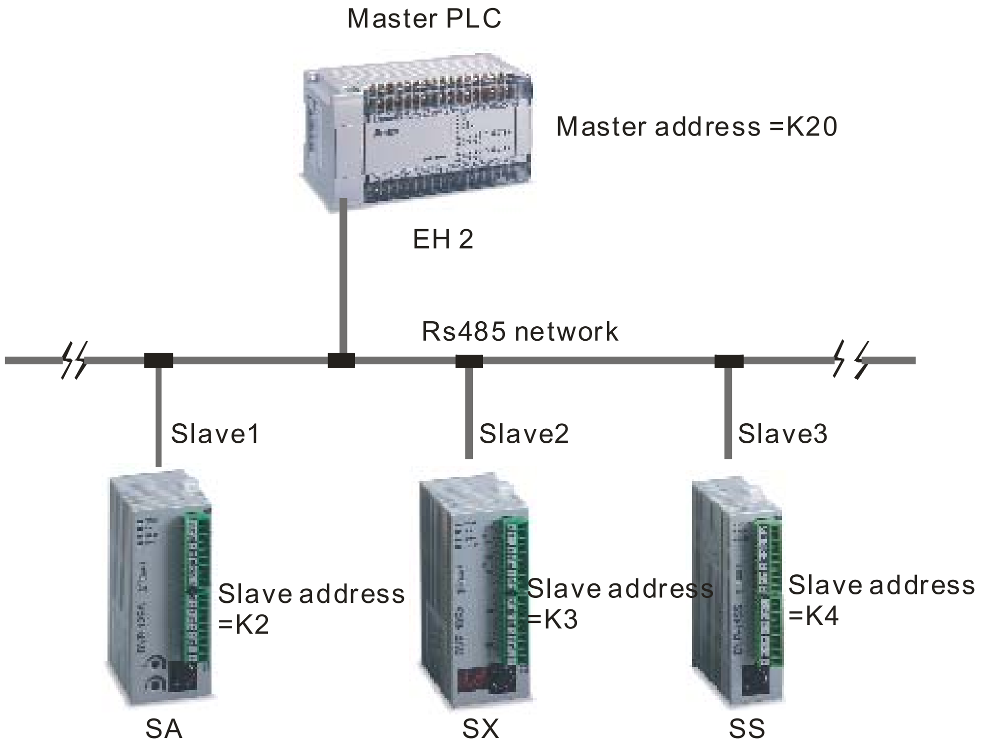

M1002
MOV H89 D1120
Set up communication format: 9600,8,N,2
SET M1120
Retain communication setting
MOV K100 D1129
Set receiving time-out: 100ms
SET M1143
Select communication mode: MODBUS RTU
MOV K500 D0
Upper limit of temp. Range:50℃
MOV K0 D1
Lower limit of temp. Range:0℃
MOV K50 D2
Upper-limit of the alarm: 5℃
MOV K30 D3
Lower-limit of the alarm:3℃
LD= C0 K0
M0
Execute MODRD instruction
LD= C0 K1
M1
Execute the 1st MODWR instruction
LD= C0 K2
M2
Execute the 2nd MODWR instruction
LD= C0 K3
M3
Execute the 1st MODRW instruction
LD= C0 K4
M4
Execute the 2nd MODRW instruction
LD= C0 K5
RST C0
M0
SET M1122
Sending request
M1
M2
M3
M4


M0
MODRD K1 H1000 K2
Read the target value and the present value of the TC and store them in D1073~D1076
M1
MODWR K1 H1001 K260
Set target value as 26℃
M2
MODWR K1 H1020 K1
Set output mode of alarm 1 as the 1st alarm type
M3
MODRW K1 K16 H1002 D0 K2
Set upper/lower limit of temperature range
M4
MODRW K1 K16 H1024 D2 K2
Set the upper/lower limit of alarm 1
M1127
CNT C0 K10
C0 counts once when data receiving is completed.
RST M1127
Reset M1127
M1129
CNT C0 K10
C0 counts once when communication timeout occurs.
RST M1129
Reset M1129
M1140
CNT C0 K10
C0 counts once when data receiving errors occurs.
RST M1140
Reset M1140
M1141
CNT C0 K10
C0 counts once when parameter error occurs.
RST M1141
Reset M1141

Program Description:

- Initialize PLC RS-485 communication port and set the communication format as MODBUS RTU, 9800, 8, N, 2. The RS-485 communication format of TC should be the same with PLC..
- There are only 4 situations for MODBUS communication: flag M1127 for normal communication and M1129, M1140, M1141 for communication errors. Counter C0 counts once when any of the 4 flags is ON. Therefore, the program assures the communication reliability by monitoring the On/Off status of the 4 flags and performs 5 MODBUS instructions in order by the value in counter C0.
- Since DTB series TC supports the function code 10H, the program uses MODRW instruction to write multiple words.
- Once PLC starts running, the read/write actions for TC will be performed repeatedly according to [LD=] instructions.

12.8 PLC LINK 16 Slaves and Read/Write 16 Data (Word)



Control Purpose:

- Performing 16 words data exchange by PLC LINK between master PLC and 3 slave PLCs.

Parameter Settings for PLC:

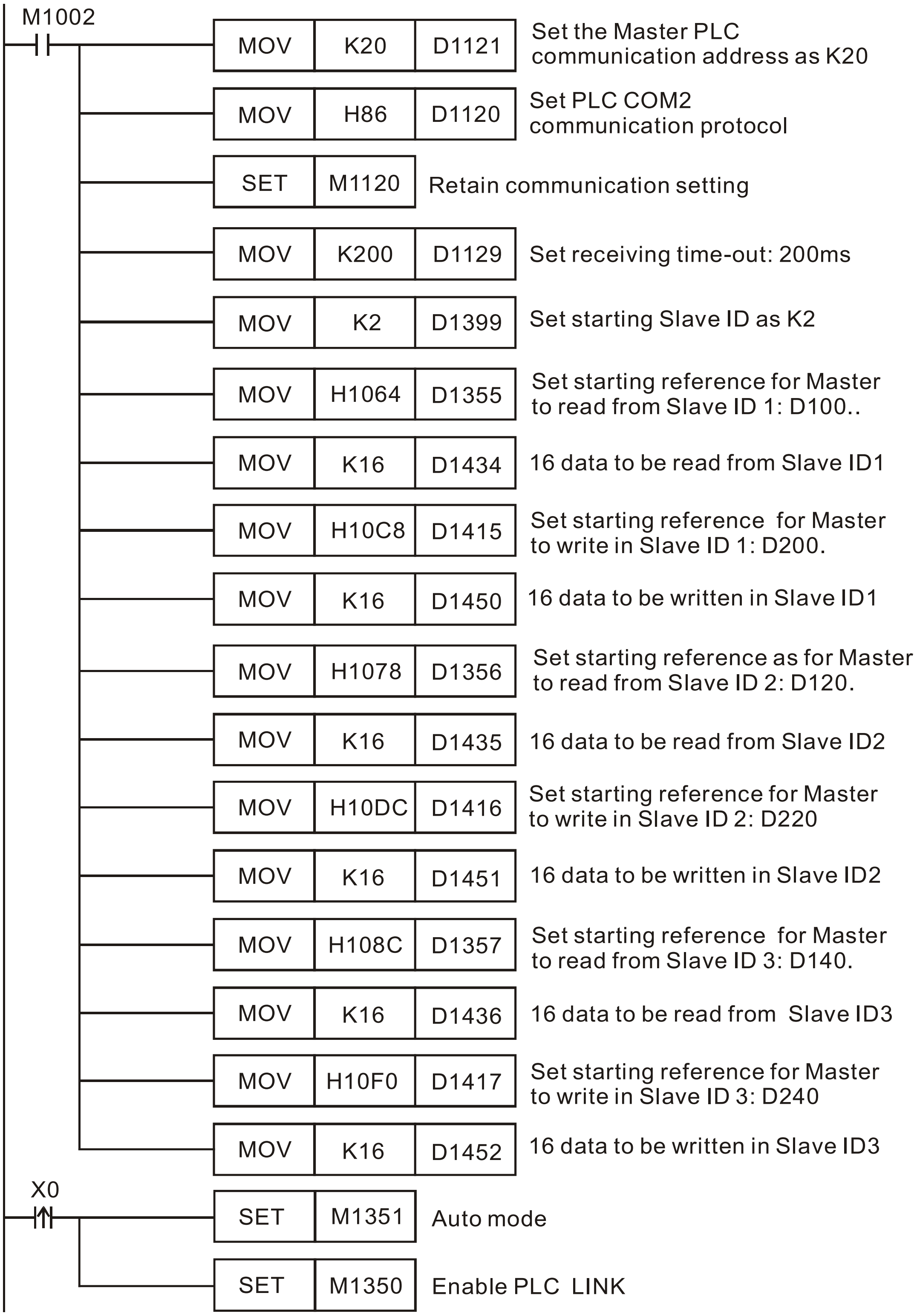
Master/Slave	Station No.	Communication format
Master PLC	K20 (D1121 = K20)	ASCII, 9600, 7, E, 1 (D1120 = H86). Communication format of all connected PLCs must be the same.
Slave 1	K2 (D1121 = K2)	
Slave 2	K3 (D1121 = K3)	
Slave 3	K4 (D1121 = K4)	

※ If PLC can not run normally due to improper parameters, users can set the PLC to factory defaults by clicking ”Communication (C)”> “Format PLC Memory” from the menu bar of WPL Soft and then set the parameters according to the above table.

Devices:

Device	Function
X0	Trigger on PLC LINK
M1350	Enabling EASY PLC LINK
M1351	Enabling auto mode on EASY PLC LINK
M1352	Enabling manual mode on EASY PLC LINK
M1353	Enable 32 slave unit linkage and up to 100 data length of data exchange
M1354	Enable simultaneous data read/write in a polling of EASY PLC LINK

Control Program:



```
M1002
  MOV   K20     D1121    Set the Master PLC communication address as K20
  MOV   H86     D1120    Set PLC COM2 communication protocol
  SET   M1120            Retain communication setting
  MOV   K200    D1129    Set receiving time-out: 200ms
  MOV   K2      D1399    Set starting Slave ID as K2
  MOV   H1064   D1355    Set starting reference for Master to read from Slave ID 1: D100..
  MOV   K16     D1434    16 data to be read from Slave ID1
  MOV   H10C8   D1415    Set starting reference  for Master to write in Slave ID 1: D200.
  MOV   K16     D1450    16 data to be written in Slave ID1
  MOV   H1078   D1356    Set starting reference as for Master to read from Slave ID 2: D120.
  MOV   K16     D1435    16 data to be read from Slave ID2
  MOV   H10DC   D1416    Set starting reference for Master to write in Slave ID 2: D220
  MOV   K16     D1451    16 data to be written in Slave ID2
  MOV   H108C   D1357    Set starting reference  for Master to read from Slave ID 3: D140.
  MOV   K16     D1436    16 data to be read from  Slave ID3
  MOV   H10F0   D1417    Set starting reference for Master to write in Slave ID 3: D240
  MOV   K16     D1452    16 data to be written in Slave ID3
X0
  SET   M1351            Auto mode
  SET   M1350            Enable PLC  LINK
```

Program Description:

- When X0 = ON, the data exchange between Master and 3 Slaves will be performed through PLC LINK by the ways explained below: the data in D100 ~ D115, D120~D135, and D140~D155 of the 3 Slaves will be read respectively into D1480 ~ D1495, D1512 ~ D1527 and D1544~ D1559 of the Master, and the data in D1496 ~ D1511, D1528 ~ D1543 and

D1560~D1575 of the Master will be written respectively into D200 ~ D215, D220~D235 and D240~D255 of the 3 Slaves.

Master PLC *1		Slave PLC *3
D1480~D1495	← Read	D100~D115 of Slave ID 2#
D1496~D1511	Write →	D200~D215 of Slave ID 2#
D1512~D1527	← Read	D120~D135 of Slave ID 3#
D1528~D1543	Write →	D220~D235 of Slave ID 3#
D1544~D1559	← Read	D140~D155 of Slave ID 4#
D1560~D1575	Write →	D240~D255 of Slave ID 4#

- Assume that the data in D for data exchange between Master and Slave before PLC LINK is enabled (M1350 = OFF) are as below:

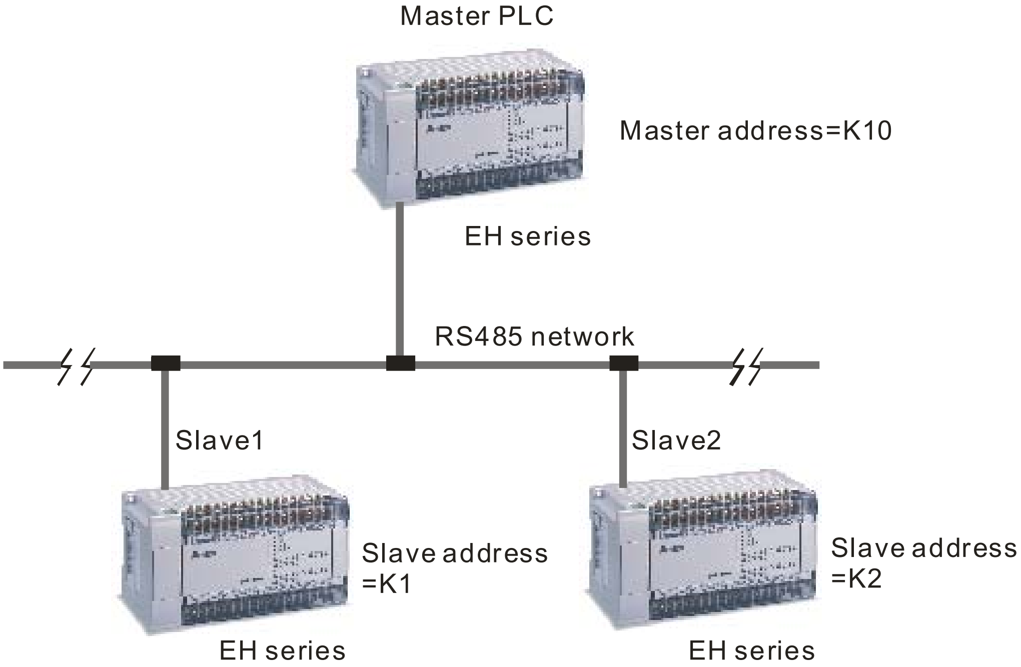
Master PLC	Set value	Slave PLC	Set value
D1480~D1495	0	D100~D115 of Slave ID 2#	1
D1496~D1511	100	D200~D215 of Slave ID 2#	0
D1512~D1527	0	D120~D135 of Slave ID 3#	2
D1528~D1543	200	D220~D235 of Slave ID 3#	0
D1544~D1559	0	D140~D155 of Slave ID 4#	3
D1560~D1575	300	D240~D255 of Slave ID 4#	0

After EASY PLC LINK is enabled (M1350 = ON), the data in D for data exchange becomes:

Master PLC	Set value	Slave PLC	Set value
D1480~D1495	1	D100~D115 of Slave ID 2#	1
D1496~D1511	100	D200~D215 of Slave ID 2#	100
D1512~D1527	2	D120~D135 of Slave ID 3#	2
D1528~D1543	200	D220~D235 of Slave ID 3#	200
D1576~D1591	3	D140~D155 of Slave ID 4#	3
D1592~D1607	300	D240~D255 of Slave ID 4#	300

- In Master PLC, set the starting Slave ID (D1399 = K2), i.e. Slave ID 2# corresponds to Slave1, Slave ID 3# corresponds to Slave2, and Slave ID 4# corresponds to Slave3.
- Station No. of Slave should be continuous and different from the station No. of Master. Only the SA/SX/SC/SV/EH/EH2 series PLC can be Master, but all DVP-PLC can be Slave.
- When X0 = ON, PLC LINK will be enabled. If enabling action is failed, M1350/M1351 will be OFF and X0 needs to be activated again.

12.9 PLC LINK 32 Slaves and Read/Write 100 Data (Word)



Control Purpose:

- Performing 100 words data exchange by PLC LINK between master PLC and 2 Slave PLCs.

Parameter Settings for PLC:

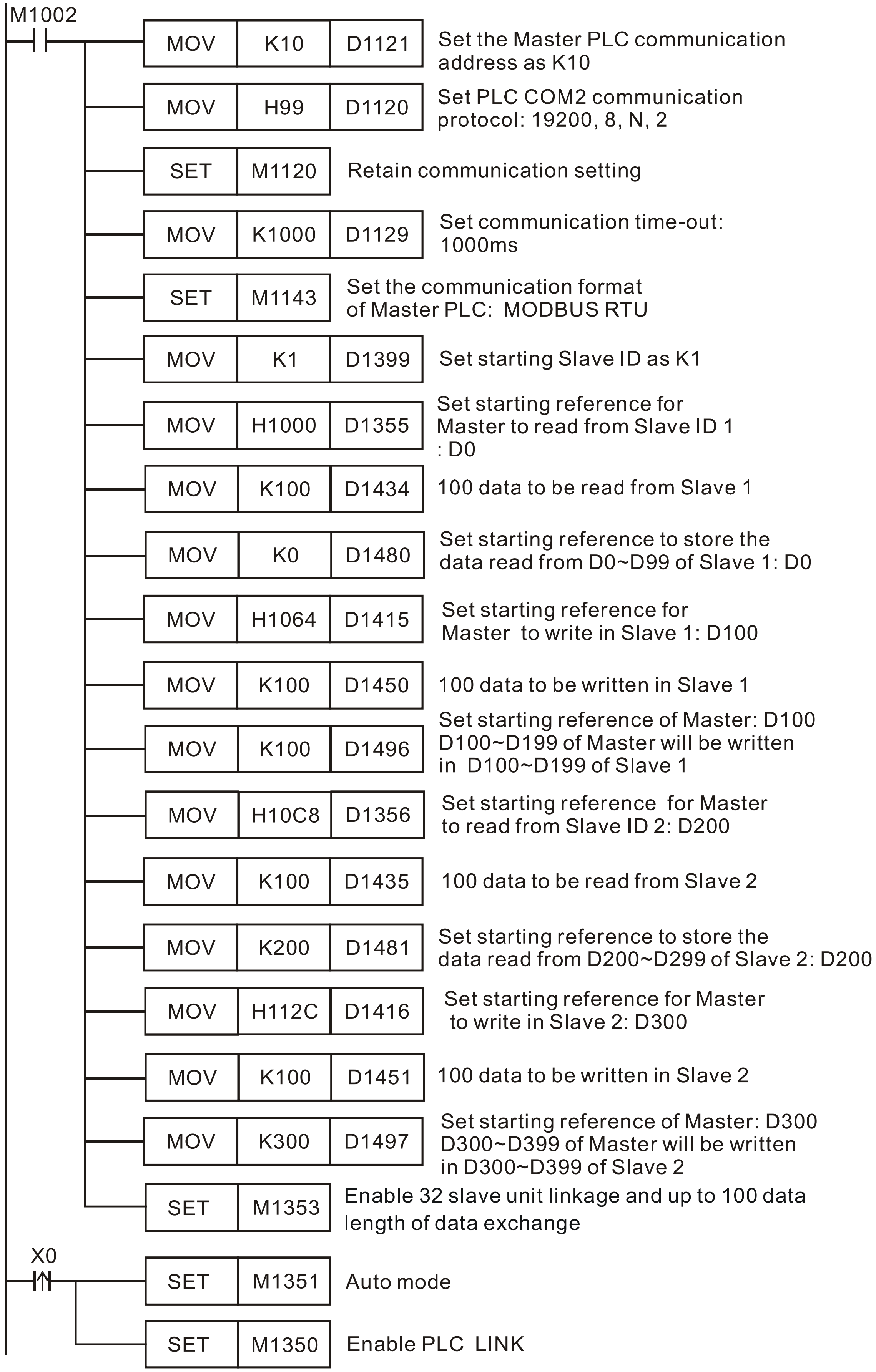
Master/Slave	Station No.	Communication format
Master PLC	K20 (D1121 = K20)	RTU, 19200, 8, N, 2(D1120=H99). Communication format of all connected PLCs must be the same.
Slave 1	K2 (D1121 = K2)	
Slave 2	K3 (D1121 = K3)	

※ If PLC can not run normally due to improper parameters, users can set the PLC to factory defaults by clicking ”Communication (C)”> “Format PLC Memory” from the menu bar of WPL Soft and then set the parameters according to the above table.

Devices:

Device	Function
X0	Trigger on PLC LINK
M1350	Enabling EASY PLC LINK
M1351	Enabling auto mode on EASY PLC LINK
M1352	Enabling manual mode on EASY PLC LINK
M1353	Enable 32 slave unit linkage and up to 100 data length of data exchange
M1354	Enable simultaneous data read/write in a polling of EASY PLC LINK

Control Program:



```
M1002
  MOV   K10     D1121   Set the Master PLC communication address as K10
  MOV   H99     D1120   Set PLC COM2 communication protocol: 19200, 8, N, 2
  SET   M1120           Retain communication setting
  MOV   K1000   D1129   Set communication time-out: 1000ms
  SET   M1143           Set the communication format of Master PLC:  MODBUS RTU
  MOV   K1      D1399   Set starting Slave ID as K1
  MOV   H1000   D1355   Set starting reference for Master to read from Slave ID 1 : D0
  MOV   K100    D1434   100 data to be read from Slave 1
  MOV   K0      D1480   Set starting reference to store the data read from D0~D99 of Slave 1: D0
  MOV   H1064   D1415   Set starting reference for Master  to write in Slave 1: D100
  MOV   K100    D1450   100 data to be written in Slave 1
  MOV   K100    D1496   Set starting reference of Master: D100 D100~D199 of Master will be written in  D100~D199 of Slave 1
  MOV   H10C8   D1356   Set starting reference  for Master to read from Slave ID 2: D200
  MOV   K100    D1435   100 data to be read from Slave 2
  MOV   K200    D1481   Set starting reference to store the data read from D200~D299 of Slave 2: D200
  MOV   H112C   D1416   Set starting reference for Master  to write in Slave 2: D300
  MOV   K100    D1451   100 data to be written in Slave 2
  MOV   K300    D1497   Set starting reference of Master: D300 D300~D399 of Master will be written in D300~D399 of Slave 2
  SET   M1353           Enable 32 slave unit linkage and up to 100 data length of data exchange
X0
  SET   M1351           Auto mode
  SET   M1350           Enable PLC  LINK
```

Program Description:

- When X0 = ON, the data exchange between Master and 3 Slaves will be performed through PLC LINK by the ways explained below: D0~D99 of Slave 1 will be read to D0~D99 of Master. D100~D199 of Master will be written in D100~D199 of Slave 1. D200~D299 of Slave 2 will be read to D200~D299 of Master. D300~D399 will be written to D300~D399 of Slave 2.

Master PLC *1		Slave PLC *2
D0~D99	Read ←	D0~D99 of Slave ID 1#
D100~D199	Write →	D100~D199 of Slave ID 1#
D200~D299	Read ←	D200~D299 of Slave ID 2#
D300~D399	Write →	D300~D399 of Slave ID 2#

- Assume that the data in D for data exchange between Master and Slave before PLC LINK is enabled (M1350 = OFF) are as below:

Master PLC	Set value	Slave PLC	Set value
D0~D99	0	D0~D99 of Slave ID 1#	1
D100~D199	100	D100~D199 of Slave ID 1#	0
D200~D299	0	D200~D299 of Slave ID 2#	2
D300~D399	200	D300~D399 of Slave ID 2#	0

After EASY PLC LINK is enabled (M1350 = ON), the data in D for data exchange becomes:

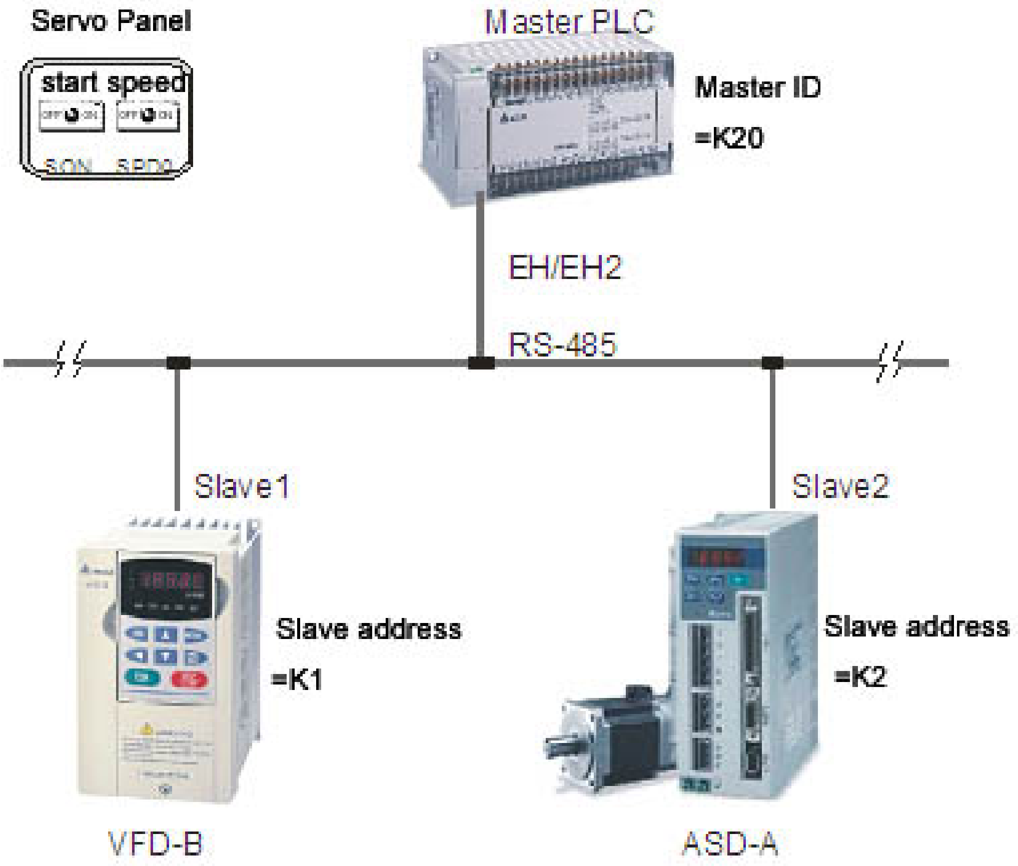
Master PLC	Set value	Slave PLC	Set value
D0~D99	1	D0~D99 of Slave ID 1#	1
D100~D199	100	D100~D199 of Slave ID 1#	100
D200~D299	2	D200~D299 of Slave ID 2#	2
D300~D399	200	D300~D399 of Slave ID 2#	200

- In Master PLC, set the starting Slave ID (D1399 = K1), i.e. Slave ID 1# corresponds to Slave1 and Slave ID 2# corresponds to Slave2.

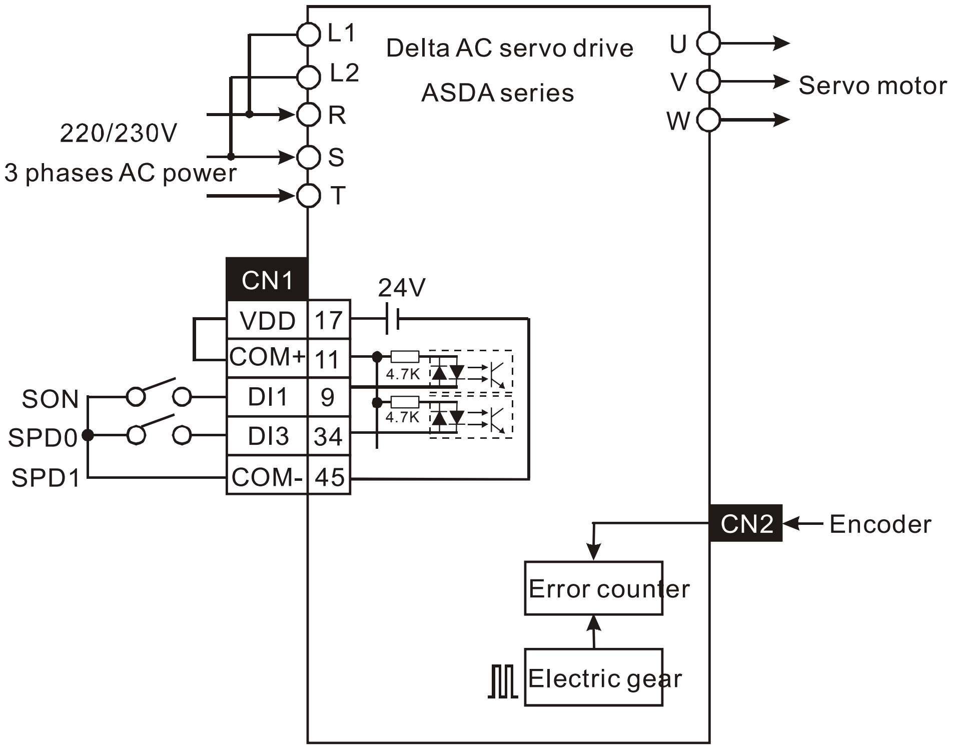
- Station No. of Slave should be continuous and different from the station No. of Master. Only the SV/EH/EH2 series PLC can be Master, but all DVP-PLC can be Slave.

- When X0 = ON, PLC LINK will be enabled. If enabling action is failed, M1350/M1351 will be OFF and X0 needs to be activated again.

12.10 LINK between PLC, Delta AC Motor Drive and AC Servo Drive



Wring for Delta ASD-A Series AC Servo drive:



Control Purpose:

- Setting and reading the frequency to control the Start/Stop and Forward/ Reverse status of AC motor drive.
- Setting and reading the rotation speed of servo motor.

Parameter Settings for AC Motor Drive:

Parameter	Set value	Explanation
02-00	04	RS-485 serial communication. Last used frequency saved.
02-01	03	RS-485 serial communication. Keypad STOP/RESET enabled.
09-00	01	Communication address: 01
09-01	01	Communication baud rate: 9600.
09-04	01	MODBUS ASCII mode, protocol <7,E,1>

※ If AC motor drive can not run normally due to improper parameters, users can set P00-02 = 10 (factory defaults) and then set the parameters according to the above table.

Parameter Settings for AC Servo Drive:

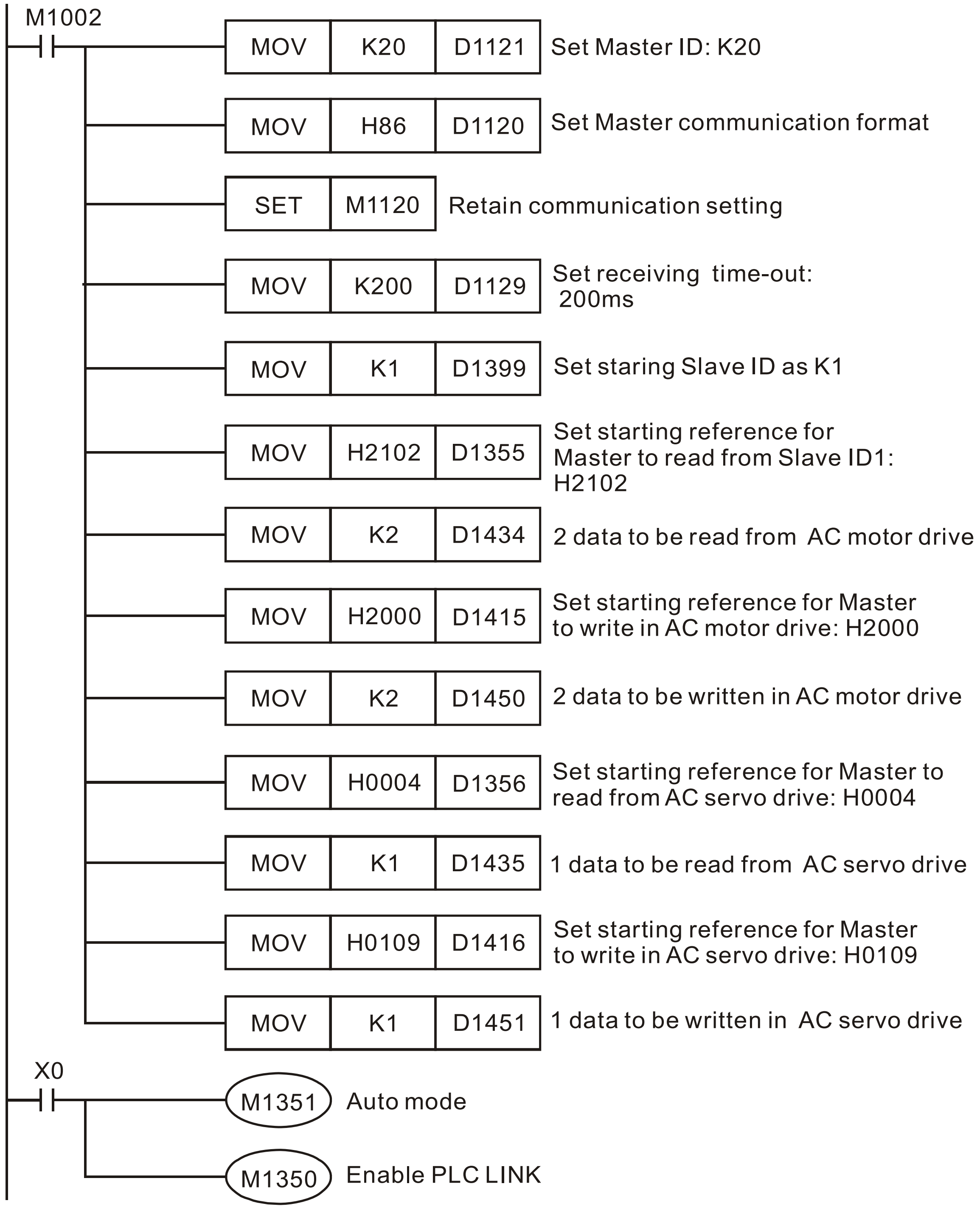
Parameter	Set value	Explanation
P0-02	6	Drive Status. Display rotation speed on servo panel
P0-04	6	Status Monitor 1. Data register for current rotation speed
P1-01	2	Control Mode and Output Direction
P2-10	101	Digital Input Terminal 1 (DI1)
P2-12	114	Digital Input Terminal 3 (DI3)
P2-15~17	0	Digital Input Terminal 6 (DI6). No function
P3-00	2	Communication Address Setting
P3-01	1	Transmission Speed, Baud rate: 9600
P3-02	1	MODBUS ASCII mode. Data format: (7, E, 1)
P3-05	2	RS-485 communication format

※ If AC servo drive can not run normally due to improper parameters, users can set P2-08 = 10 (factory defaults) and then set the parameters according to the above table

Devices:

Device	Function
X0	Trigger on PLC LINK
M1350	Enabling EASY PLC LINK
M1351	Enabling auto mode on EASY PLC LINK
M1352	Enabling manual mode on EASY PLC LINK
M1353	Enable 32 slave unit linkage and up to 100 data length of data exchange
M1354	Enable simultaneous data read/write in a polling of EASY PLC LINK

Control Program:


M1002
MOV K20 D1121
Set Master ID: K20
MOV H86 D1120
Set Master communication format
SET M1120
Retain communication setting
MOV K200 D1129
Set receiving time-out: 200ms
MOV K1 D1399
Set staring Slave ID as K1
MOV H2102 D1355
Set starting reference for Master to read from Slave ID1: H2102
MOV K2 D1434
2 data to be read from AC motor drive
MOV H2000 D1415
Set starting reference for Master to write in AC motor drive: H2000
MOV K2 D1450
2 data to be written in AC motor drive
MOV H0004 D1356
Set starting reference for Master to read from AC servo drive: H0004
MOV K1 D1435
1 data to be read from AC servo drive
MOV H0109 D1416
Set starting reference for Master to write in AC servo drive: H0109
MOV K1 D1451
1 data to be written in AC servo drive
X0
M1351
Auto mode
M1350
Enable PLC LINK

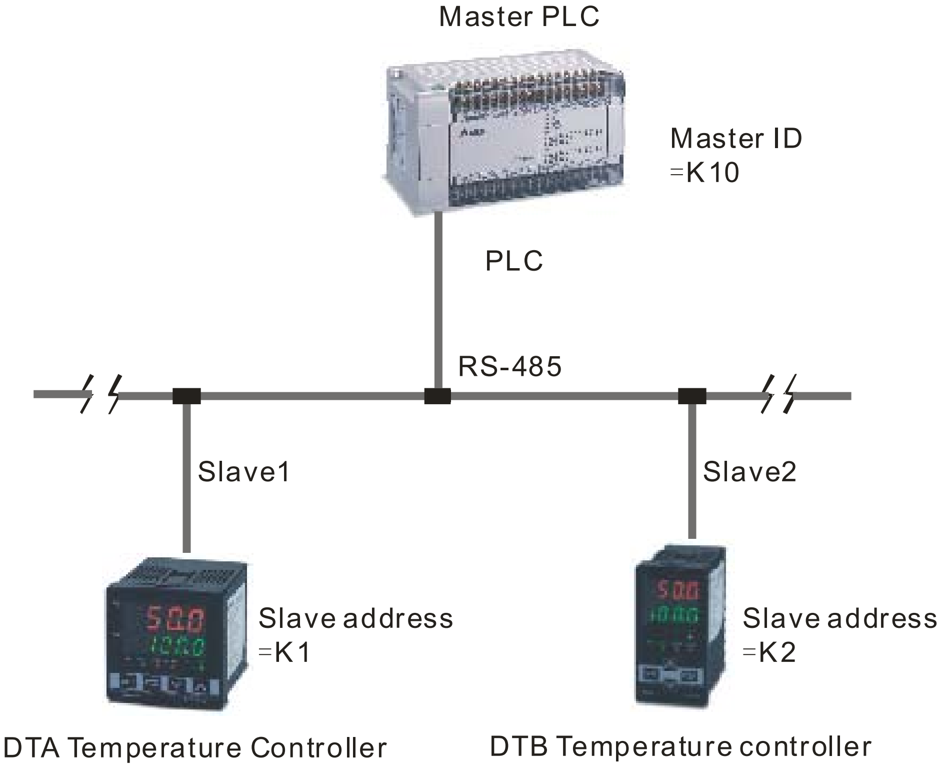
Program Description:

- Registers D1480~D1481 in PLC correspond to parameters H2102~H2103 of AC motor drive. When X0 = ON, PLC LINK will be enabled and the value of H2102~H2103 will be shown in D1480~D1481.
- Registers D1496~D1497 in PLC correspond to parameters H2000~H2001 of AC motor drive. When X0 = ON, PLC LINK will be enabled and the value in H2000~H2001 can be determined by the content in D1496~D1497.
- Status of AC motor drive can be controlled by setting the value in D1496. (D1496 = H12, AC

motor drive runs forward. D1496 = H1, AC motor drive stops.)

- Frequency of AC motor drive can be changed by setting the value in D1497. (D1497 = K4000, the frequency of AC motor drive will be 40Hz.)
- Before PLC LINK is enabled between PLC and servo motor, turn on “SON” to start servo and then turn on “SPD0” to ensure the speed mode which controlled by internal registers is enabled.
- D1512 in PLC corresponds to communication parameter H0004 of AC servo drive. When X0 = ON, PLC LINK will be enabled and the value of H0004 will be shown in D1512.
- D1528 in PLC corresponds to communication parameter H0109 of AC servo drive. When X0 = ON, PLC LINK will be enabled and the value of H0109 can be specified in D1528.
- Rotation speed of servo motor can be changed by the content in D1528. (When D1528 = K3000, the rotation speed of servo motor will be 3000 rpm.
- Station No. of Slave should be continuous and different from the station No. of Master. SA/SX/SC/SV/EH/EH2 series PLC can be Master. ES/EX/SS series can not be Master.
- When X0 = ON, PLC LINK will be enabled. If enabling action is failed, M1350/M1351 will be OFF and X0 needs to be activated again..

12.11 LINK between PLC, Delta DTA and DTB Series Temperature Controllers



Control Purpose:

- Setting the target temperature and reading the present/target temperature of DTA TC.
- Setting the target temperature, upper/lower limit of temperature range and reading the present/target temperature of DTB TC.

Parameter Settings for DTA Series Temperature Controller:

Parameter	Function	Set value
CoSH	C WE: Write-in function disable/enable	ON
C-SL	C-SL: ASCII, RTU communication format selection	ASCII
C-no	C NO: Communication address setting	1
bPS	BPS: Communication baud rate setting	9600
LEn	LENGTH: Data length setting	7
PrtY	PARITY: Parity bit setting	E
StoP	STOP BIT: Stop bit setting	1
tPUn	UNIT: Temperature display unit °C or ℉	°C

※ If TC can not run normally due to improper parameters, users can set the TC to factory defaults first and then set the parameters according to the above table. DTA TC does not support writing multiple words, so the number of the written data should set to “1 “.

Parameter Settings for DTB Series Temperature Controller:

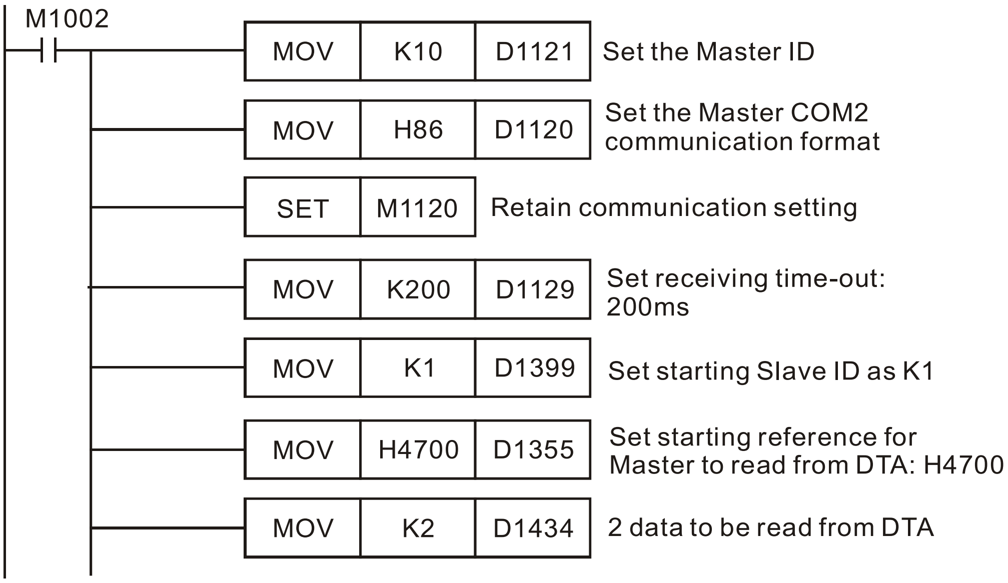
Parameter	Function	Set value
CoSH	C WE: Write-in function disable/enable	ON
C-SL	C-SL: ASCII, RTU communication format selection	ASCII
C-no	C NO: Communication address setting	2
bPS	BPS: Communication baud rate setting	9600
LEn	LENGTH: Data length setting	7
PrtY	PARITY: Parity bit setting	E
StoP	STOP BIT: Stop bit setting	1
tPUn	UNIT: Temperature display unit °C or ℉	°C

※ If TC can not run normally due to improper parameters, users can set the TC to factory defaults first and then set the parameters according to the above table.

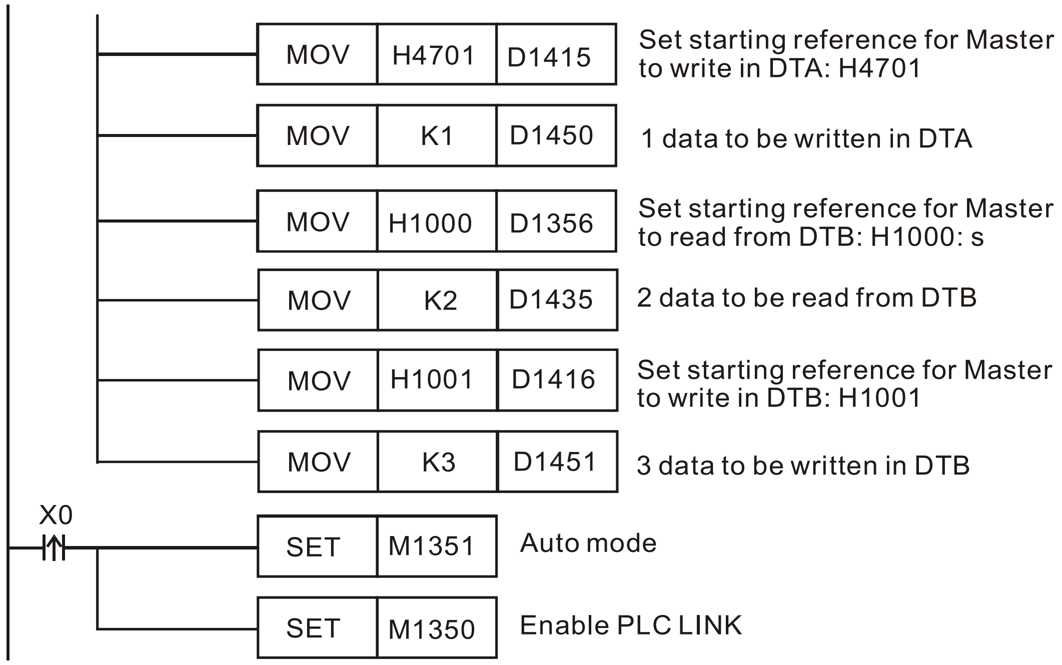
Devices:

Device	Function
X0	Trigger on PLC LINK
M1350	Enabling EASY PLC LINK
M1351	Enabling auto mode on EASY PLC LINK
M1352	Enabling manual mode on EASY PLC LINK
M1353	Enable 32 slave unit linkage and up to 100 data length of data exchange
M1354	Enable simultaneous data read/write in a polling of EASY PLC LINK

Control Program:



```
M1002
MOV  K10    D1121   Set the Master ID
MOV  H86    D1120   Set the Master COM2 communication format
SET  M1120          Retain communication setting
MOV  K200   D1129   Set receiving time-out: 200ms
MOV  K1     D1399   Set starting Slave ID as K1
MOV  H4700  D1355   Set starting reference for Master to read from DTA: H4700
MOV  K2     D1434   2 data to be read from DTA
```



Set starting reference for Master to write in DTA: H4701

1 data to be written in DTA

Set starting reference for Master to read from DTB: H1000: s

2 data to be read from DTB

Set starting reference for Master to write in DTB: H1001

3 data to be written in DTB

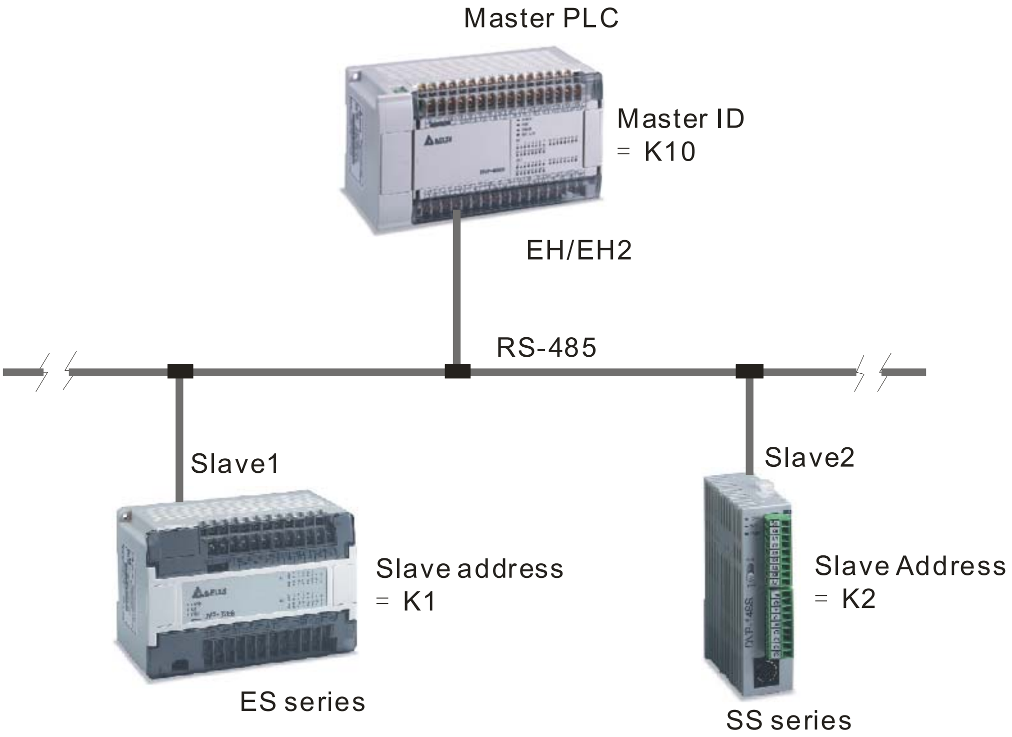
Auto mode

Enable PLC LINK

Program Description:

- Registers D1480~D1481 in PLC correspond to communication parameters H4700~H4701 of DTA TC. When X0 = ON, PLC LINK will be enabled and the value of H4700~H4701 (present and target temperature) will be shown in D1480~D1481.
- Register D1496 in PLC corresponds to communication parameter H4701 of DTA TC. When X0 = ON, PLC LINK will be enabled and the value of H4701 can be determined by the content in D1496.
- Status of DTA TC can be controlled by setting the value in D1496. (D1496 = K300, the target temperature will be 30°C.)
- Registers D1512~ D1513 in PLC correspond to communication parameters H1000~H1001 of DTB TC. When X0 = ON, PLC LINK will be enabled and the value of H1000~ H1001 (present and target temperatures) will be shown in D1512~ D1513.
- Registers D1528~D1530 in PLC correspond to communication parameters H1001~ H1003 of DTB series temperature controller. When X0 = ON, PLC LINK will be enabled and the value of H1001~ H1003 can be determined by the content in D1528~D1530.
- Target temperature of DTB can be specified by the value in D1528 (D1528 = K400, the target temperature will be 40°C.)
- Upper/lower limit of temperature range of DTB can be specified by the value in D1529~1530. (D1529 = K500 and D1530 = K10, the upper limit will be 50°C and lower limit will be 1°C.
- Station No. of Slave should be continuous and different from the station No. of Master. SA/SX/SC/SV/EH/EH2 series PLC can be Master. ES/EX/SS series can not be Master.
- When X0 = ON, PLC LINK will be enabled. If enabling action is failed, M1350/M1351 will be OFF and X0 needs to be activated again.

12.12 Controlling START/STOP of 2 DVP PLCs through Communication (RS Instruction)



Control Purpose:

- Controlling start/stop status of 2 Slave PLCs through communication by master PLC.

Parameter Settings:

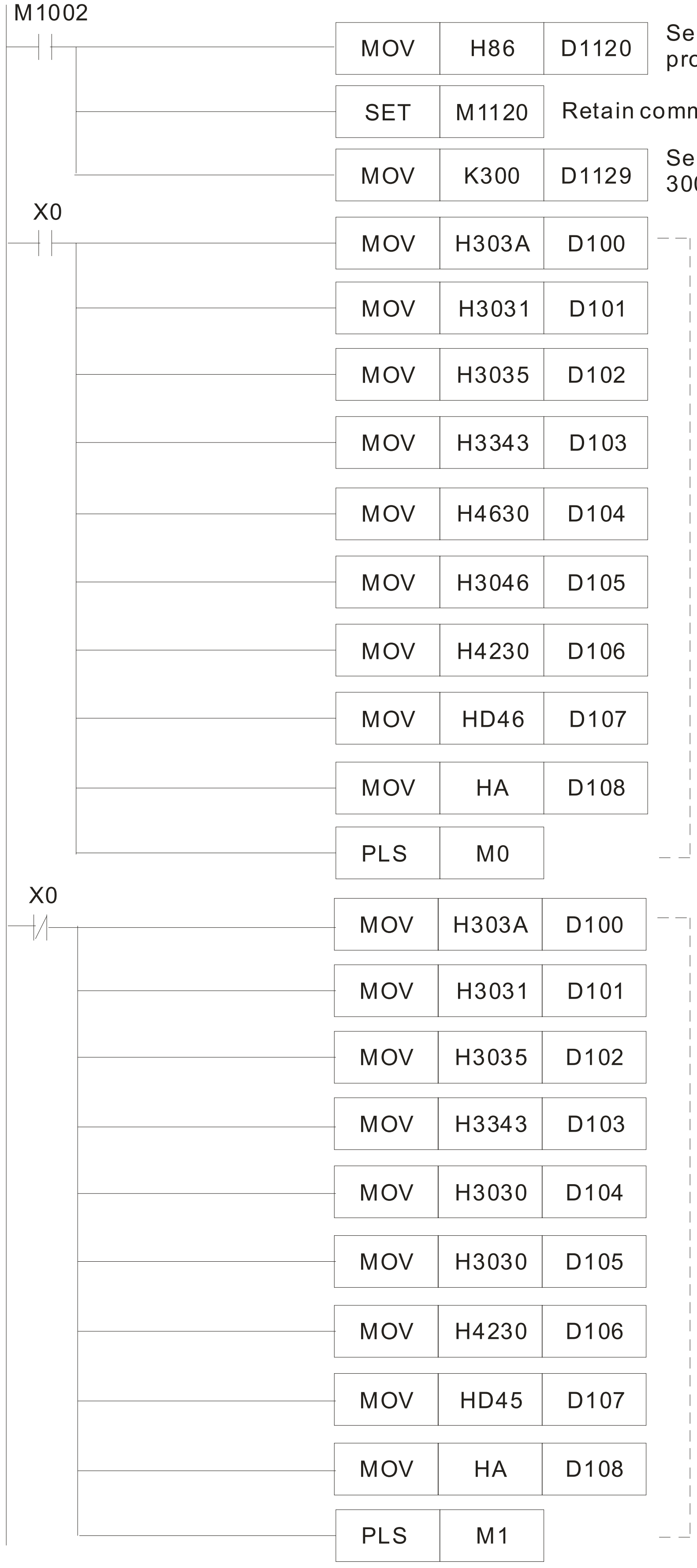
Master/Slave	Station No.	Communication format
Master PLC	K10 (D1121 = K10)	ASCII, 9600, 7, E, 1 (D1120 = H86). Communication format of all connected Slave PLCs must be the same.
Slave 1	K1 (D1121 = K1)	
Slave 2	K2 (D1121 = K2)	

※ If PLC can not run normally due to improper parameters, users can set the PLC to factory defaults by clicking ”Communication (C)”> “Format PLC Memory” from the menu bar of WPL Soft and then set the parameters according to the above table.

Devices:

Device	Function
X0	Start/stop Slave 1
X1	Start/stop Slave 2
M0	Execute the 1st RS instruction
M1	Execute the 2nd RS instruction

Control Program:



```
M1002
--| |--+-- MOV  H86   D1120
       +-- SET  M1120
       +-- MOV  K300  D1129
X0
--| |--+-- MOV  H303A D100
       +-- MOV  H3031 D101
       +-- MOV  H3035 D102
       +-- MOV  H3343 D103
       +-- MOV  H4630 D104
       +-- MOV  H3046 D105
       +-- MOV  H4230 D106
       +-- MOV  HD46  D107
       +-- MOV  HA    D108
       +-- PLS  M0
X0
--|/|--+-- MOV  H303A D100
       +-- MOV  H3031 D101
       +-- MOV  H3035 D102
       +-- MOV  H3343 D103
       +-- MOV  H3030 D104
       +-- MOV  H3030 D105
       +-- MOV  H4230 D106
       +-- MOV  HD45  D107
       +-- MOV  HA    D108
       +-- PLS  M1
```

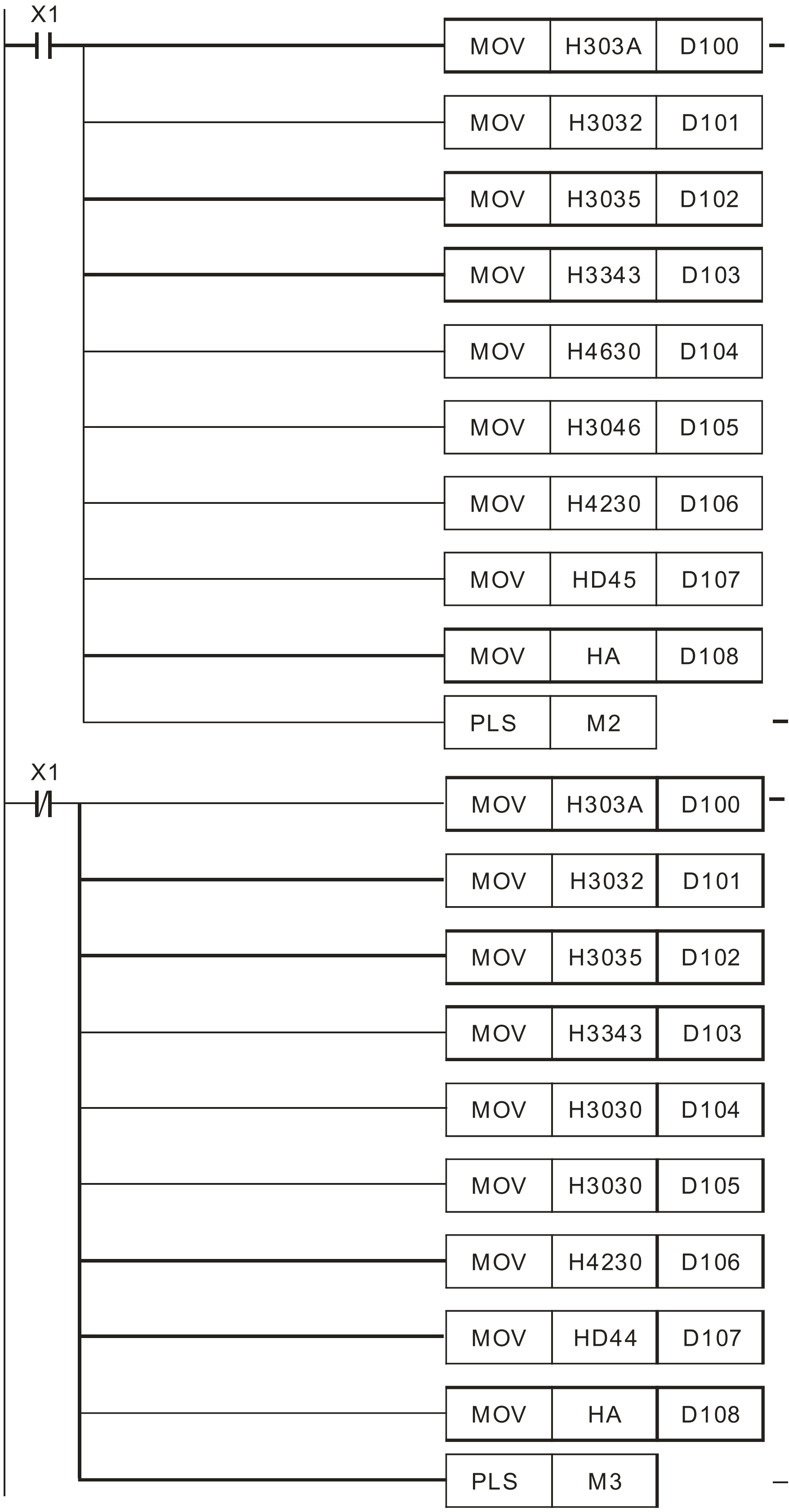
Set PLC COM2 communication protocol: 9600,7,E,1

Retain communication setting

Set receiving time-out: 300ms

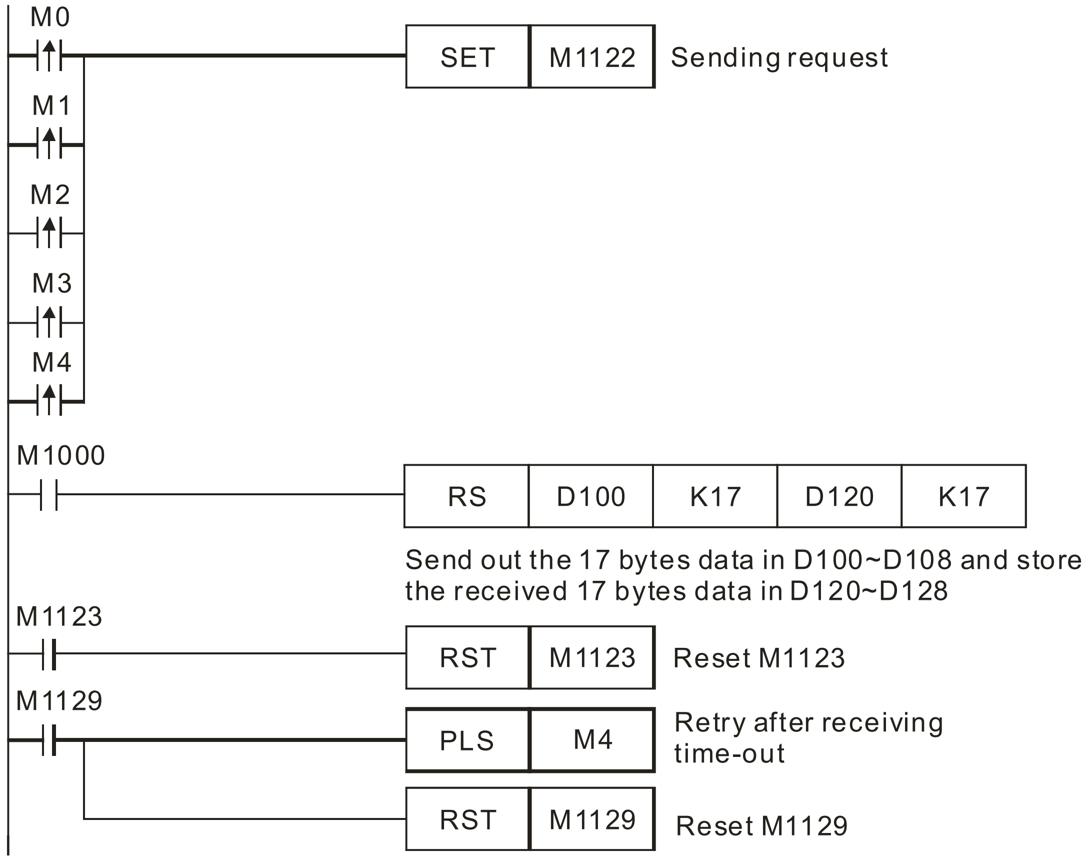
When X0 = ON, store the data which will active Slave 1 in D100~D108

When X0 = OFF, store the data which will stop Slave 1 in D100~D108



When X1 is ON, store the data which will activate Slave 2 in D100~D108

When X1 is OFF, store the data which will stop Slave 2 in D100~D108


M0
SET
M1122
Sending request
M1
M2
M3
M4
M1000
RS
D100
K17
D120
K17
Send out the 17 bytes data in D100~D108 and store the received 17 bytes data in D120~D128
M1123
RST
M1123
Reset M1123
M1129
PLS
M4
Retry after receiving time-out
RST
M1129
Reset M1129

Program Description:

- Initialize PLC RS-485 communication port and set the communication format as MODBUS ASCII, 9600, 7, E, 1. The RS-485 communication format of Slave should be the same with Master PLC.
- There are 2 situations for RS communication: M1123 for normal communication and M1129 for receiving timeout. When communication time-out occurred, M4 can be used to retry.
- When X0 = ON, Slave 1 will start running. When X0 = OFF, Slave 1 will stop.
- When X1 = ON, Slave 2 will start running. When X1 = OFF, Slave 2 will stop.

12.13 Communication between Delta PLC and Siemens MM420 Frequency Inverter (RS Instruction)

Control Purpose:

- Controlling the start/stop of Siemens MM420 series AC motor drive through communication by master PLC.

Parameter Settings for MM420 AC Motor Drive:

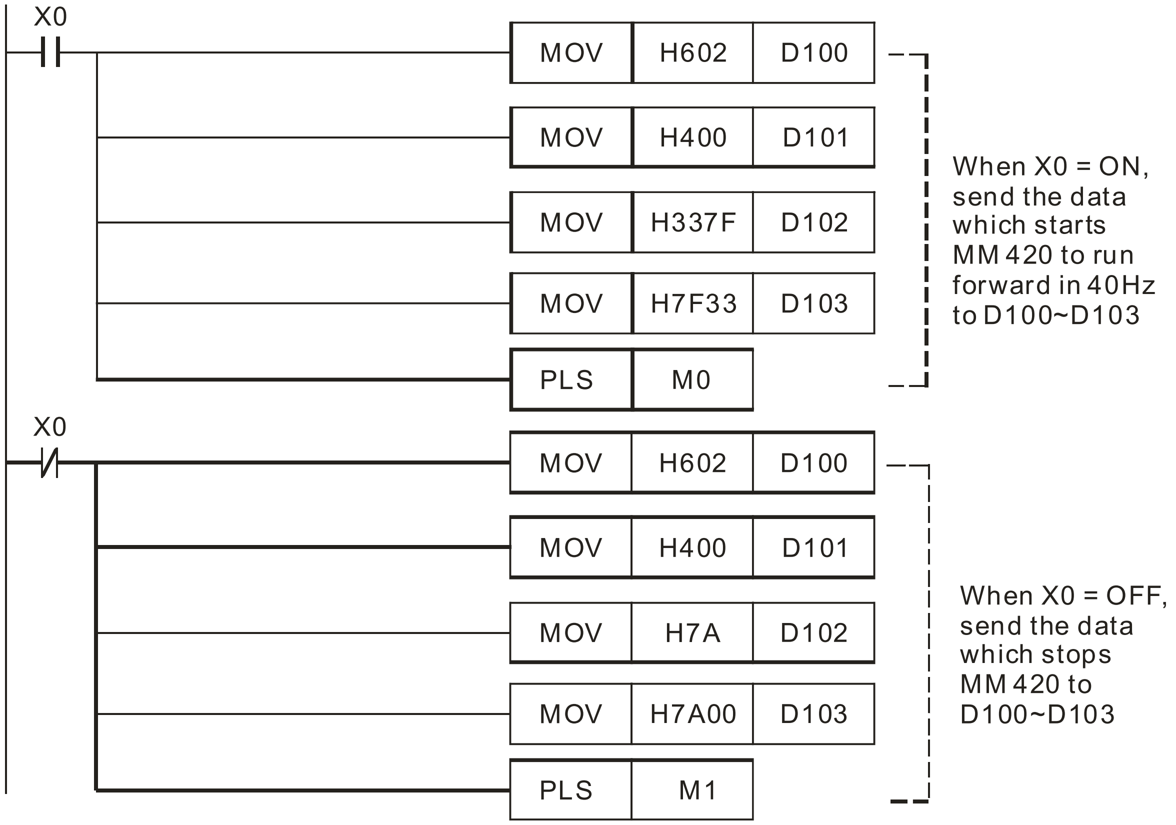
Parameter	Set value	Function
P0003	3	User access level: expert
P0700	5	Selection of command source: USS on COM link (RS-485)
P1000	5	Selection of frequency setpoint: USS on COM link (RS-485)
P2010	6	USS baud rate: 9600bps
P2011	0	USS address: 0

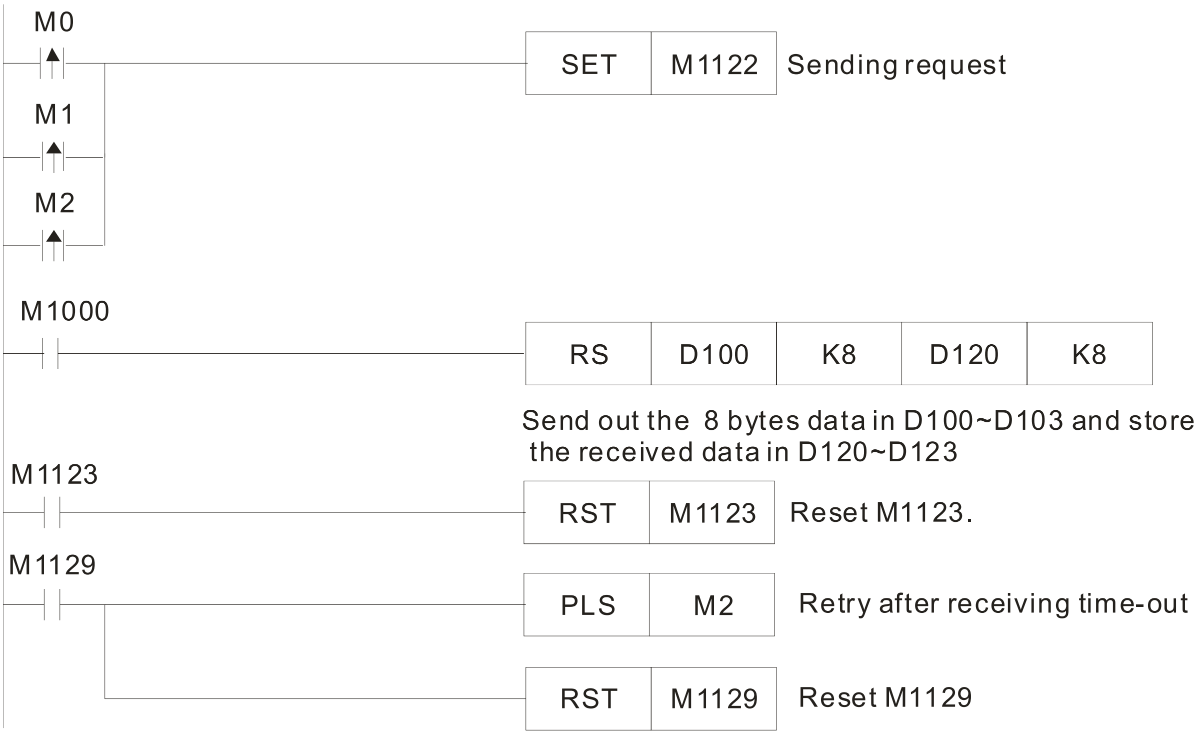
※ If Siemens MM420 can not run normally due to improper parameters, users can set MM420 to factory defaults: set P0010 = 30, P0970 = 1. Then set the parameters according to the above table.

Devices:

Device	Function
X0	Start/stop switch

Control Program:


X0
MOV H602 D100
MOV H400 D101
MOV H337F D102
MOV H7F33 D103
PLS M0
When X0 = ON, send the data which starts MM420 to run forward in 40Hz to D100~D103
X0
MOV H602 D100
MOV H400 D101
MOV H7A D102
MOV H7A00 D103
PLS M1
When X0 = OFF, send the data which stops MM420 to D100~D103


M0
M1
M2
SET
M1122
Sending request
M1000
RS
D100
K8
D120
K8
Send out the 8 bytes data in D100~D103 and store the received data in D120~D123
M1123
RST
M1123
Reset M1123.
M1129
PLS
M2
Retry after receiving time-out
RST
M1129
Reset M1129

Program Description:

- Initialize PLC RS-485 communication port and set the communication format as 9600, 8, E, 1. The RS-485 communication format of MM420 (set by P2010) should be the same with Master PLC.
- When X0 = ON, MM420 will be started to run forward in 40Hz.

  PLC⇨MM420, PLC sends: 02 06 00 047F 3333 7F
  MM420⇨PLC, PLC receives: 02 06 00 FB34 3333 CB

  Registers for sent data (PLC sends out message):

Register	DATA	Explanation
D100 low	02H	Head. Fixed as 02H. (start of the message)
D100 high	06H	The number of the following bytes
D101 low	00H	Station No. (range: 0~31, corresponding to hex 00H~1FH)
D101 high	04H	Control word (starting MM420. Refer to *Remarks* for definitions.)
D102 low	7FH	
D102 high	33H	Frequency (4000H = base frequency 50Hz, 3333H = 40Hz)
D103 low	33H	
D103 high	7FH	Tail. (XOR result of all the bytes before this byte)

  Registers for received data (MM420 responds with messages):

Register	DATA	Explanation
D120 low	02H	Head. Fixed as 02H (start of the message)
D120 high	06H	The number of the following bytes

Register	DATA	Explanation
D121 low	00H	Station No. (range: 0~31, corresponding to hex 00H~1FH)
D121 high	FBH	Status word (Refer to *Remarks* for definitions)
D122 low	34H	
D122 high	33H	Frequency (4000H = base frequency 50Hz, 3333H = 40Hz)
D123 low	33H	
D123 high	CBH	Tail. (XOR result of all the bytes before this byte)

- When X0 = OFF, MM420 will stop.

  PLC⇨MM420，PLC sends: 02 06 00 047A 0000 7A
  MM420⇨PLC，PLC receives: 02 06 00 FB11 0000 EE

  Register for sent data (PLC sends out message):

Register	DATA	Explanation
D100 low	02H	Head. Fixed as 02H (start of the message)
D100 high	06H	The number of the following bytes
D101 low	00H	Station No. (range: 0~31, corresponding to hex 00H~1FH)
D101 high	04H	Control word (Refer to *Remarks* for definitions)
D102 low	7AH	
D102 high	00H	Frequency (0000H = 0 Hz.)
D103 low	00H	
D103 high	7AH	Tail. (XOR result of all the bytes before this byte)

Register for received data (MM420 responds with messages):

Register	DATA	Explanation
D120 low	02H	Head. Fixed as 02H (start of the message)
D120 high	06H	The number of the following bytes
D121 low	00H	Station No. (range: 0~31, corresponding to hex 00H~1FH)
D121 high	FBH	Status word (Refer to *Remarks* for definitions)
D122 low	11H	
D122 high	00H	Frequency (0000H = 0 Hz.)
D123 low	00H	
D123 high	EEH	Tail. (XOR result of all the bytes before this byte)

- There are 2 situations for RS communication: M1123 for normal communication and M1129 for receiving timeout. When communication time-out occurred, M2 can be used to retry

Remarks:

- Siemens MM420 series AC motor drive uses USS communication protocol and allows maximum of one master connected with 31 slaves. Slave ID: 0~31

The structure of the communication message:

STX Head	LGE Data length	ADR Address	PKW Parameter data area	PZD Process data area	BCC Checksum
One byte	One byte	One byte	← Data area (N words) →		One byte

- For STX, LGE, ADR and BCC areas, the data length is fixed as 1 byte.
- STX is fixed as 02H, meaning the start of the message.
- LGE is the number of bytes between ADR area and BCC area.
- ADR is the USS communication address. Range: 0~31 corresponds to hex 00H ~1FH.
- Data area is divided into PKW area and PZD area. PKW area is used for reading/writing the parameters of AC motor drive and contains 0~4 word. (Usually 4 words, refer to the setting of P2013). PZD area is used for controlling AC motor drive including frequency setting and contains 0~4 word. (Usually 2 words, refer to the setting of P2012). The first word is control word for AC motor drive and the second is for setting the frequency of AC motor drive.
- PKW and PZD can be used either or both. Usually, only PZD is used for controlling the status and frequency setting of AC motor drive. This program uses PZD with the length of 2 words and the structure is as follows:

02	06	00	047F 3333	7F
STX	LGE	ADR	← DATA(PZD) →	BCC

In the above figure, 047FH is the control word for starting AC motor drive. 3333H is the frequency. Since H4000 corresponds to base frequency 50Hz, 3333H corresponds to 40Hz.

- BCC checksum: the XOR result of the bytes from STX to PZD.

  For example: 02H XOR 06H XOR 00H XOR 04H XOR 7FH XOR 33H XOR 33 = H7F
- Definition of the control word for AC motor drive in PZD area (PLC sends out messages):

Bit	Explanation	Bit status	
00	ON (ramp up enabled)/OFF1 (ramp down disabled)	0 No (OFF1)	1 Yes (ON)
01	OFF2: Coast to standstill	0 Yes	1 No
02	OFF3: Quick ramp down	0 Yes	1 No
03	Pulses enabled	0 No	1 Yes
04	RFG (ramp function generator) enabled	0 No	1 Yes
05	RFG (ramp function generator) start	0 No	1 Yes
06	Set value of frequency enabled	0 No	1 Yes
07	Fault acknowledge	0 No	1 Yes
08	JOG right	0 No	1 Yes
09	JOG left	0 No	1 Yes
10	Controlled by PLC	0 No	1 Yes
11	Reverse	0 No	1 Yes
12	Reserved	—	—

Bit	Explanation	Bit status	
13	MOP (motor potentiometer) up	0 No	1 Yes
14	MOP (motor potentiometer) down	0 No	1 Yes
15	Local/remote control	0 No	1 Yes

Note: Among the control word from by PLC to AC motor drive, bit 10 must be set as 1. If nit 10 is 0, the control word will be invalid and AC motor drive will go on running as before.

- Definition of the status word of AC motor drive in PZD area (AC motor drive responds with messages):

Bit	Explanation	Bit status	
00	Drive ready	0 No (OFF1)	1 Yes (ON)
01	Drive ready to run	0 No	1 Yes
02	Drive running	0 No	1 Yes
03	Drive fault active	0 No	1 Yes
04	OFF2 active	0 Yes	1 No
05	OFF3 enabled	0 No	1 Yes
06	Switch on inhibit active	0 No	1 Yes
07	Drive warning active	0 No	1 Yes
08	Excessive deviation	0 Yes	1 No
09	PZDI (process data) control	0 No	1 Yes
10	Maximum frequency reached	0 No	1 Yes
11	Over current alarm	0 Yes	1 No
12	Motor holding brake enabled	0 Yes	1 No
13	Motor overload	0 Yes	1 No
14	Motor running forward	0 No	1 Yes
15	Inverter overload	0 Yes	1 No

12.14 Communication between Delta PLC and Danfoss VLT6000 Series Adjustable Frequency Drive (RS Instruction)

Control Purpose:

- Controlling the start/stop status and reading out the frequency of Danfoss VLT6000 series frequency drive through communication by master PLC.

Parameter Settings for VLT6000 Series frequency drive:

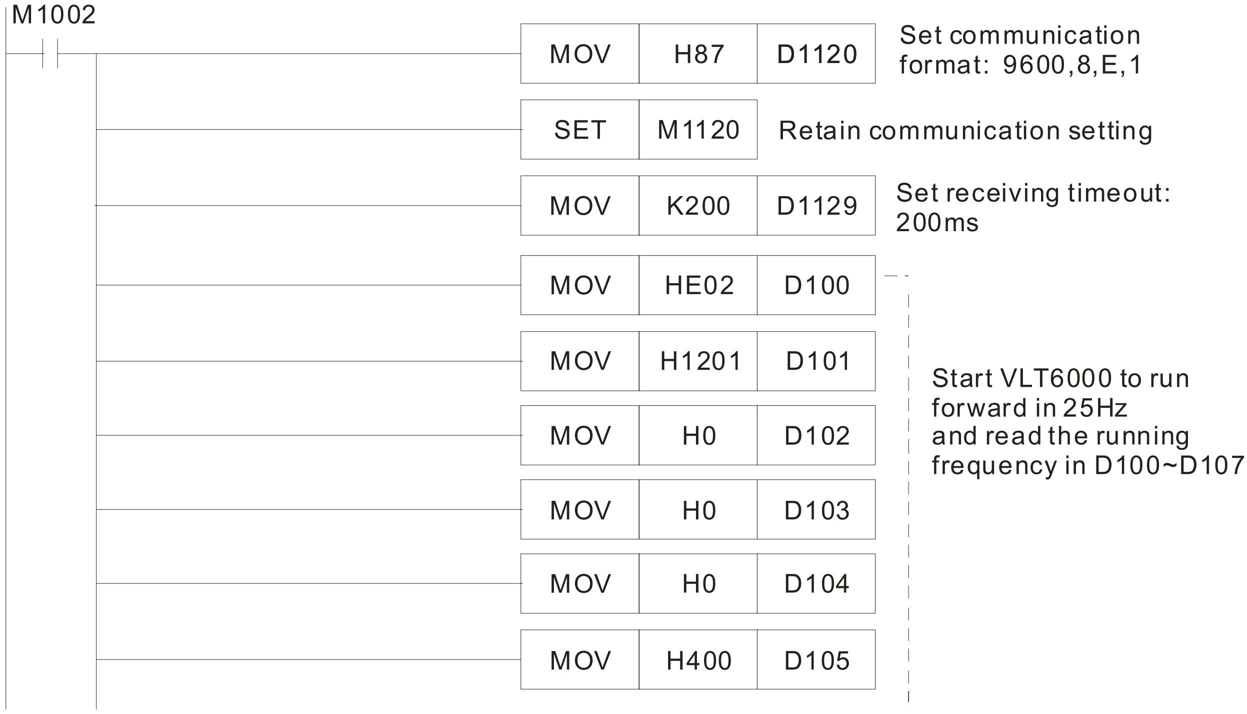
Parameter	Set value	Explanation
P500	0	FC protocol : Serial communication protocol
P501	1	FC communication address: 1
P502	5	FC communication baud rate: 9600 bps
P503	1	Coasting stop controlled by serial communication
P504	1	DC braking controlled by serial communication
P505	1	Start controlled by serial communication

※ If Danfoss VLT6000 frequency inverter can not run normally due to improper parameters, users can set VLT6000 to factory defaults: set P620 = 3 and press OK. Then set the parameters according to the above table.

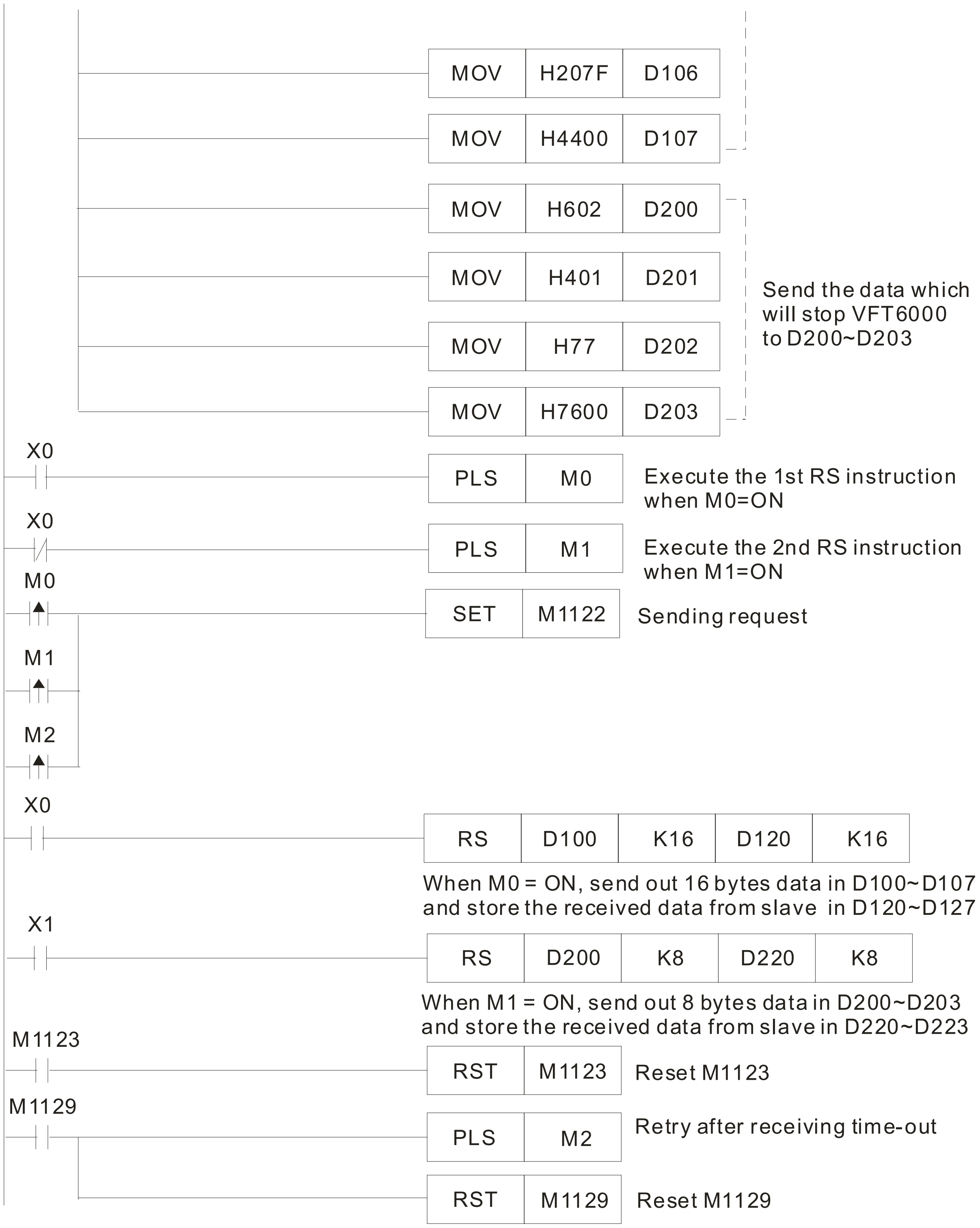
Devices:

DEVICE	Function
X0	Start/stop switch
M0	Executing the 1st RS instruction
M1	Executing the 2nd RS instruction

Control Program:



```
M1002
--| |--+--[MOV  H87    D1120]   Set communication format: 9600,8,E,1
       +--[SET  M1120]          Retain communication setting
       +--[MOV  K200   D1129]   Set receiving timeout: 200ms
       +--[MOV  HE02   D100 ]
       +--[MOV  H1201  D101 ]
       +--[MOV  H0     D102 ]   Start VLT6000 to run
       +--[MOV  H0     D103 ]   forward in 25Hz
       +--[MOV  H0     D104 ]   and read the running
       +--[MOV  H400   D105 ]   frequency in D100~D107
```



Send the data which will stop VFT6000 to D200~D203

Execute the 1st RS instruction when M0=ON

Execute the 2nd RS instruction when M1=ON

Sending request

When M0 = ON, send out 16 bytes data in D100~D107 and store the received data from slave in D120~D127

When M1 = ON, send out 8 bytes data in D200~D203 and store the received data from slave in D220~D223

Reset M1123

Retry after receiving time-out

Reset M1129

Program Description:

- Initialize PLC RS-485 communication port and set the communication format as, 9600, 8, E, 1. The RS-485 communication format of VLT6000 should be the same with Master PLC.
- When X0 = ON, VLT6000 starts to run forward in 40Hz and its output frequency will be read out.

PLC⇨VLT6000, PLC sends: 02 0E 01 1200 0000 00000000 047F 2000 44

VLT6000⇨PLC, PLC receives: 02 0E 01 1200 0000 000000FA 0F07 1FFF 0D

Register for sent data (PLC sends out messages):

Register	Data	Explanation		
D100 low	02H	Head, fixed as 02H (start of the message)		
D100 high	0EH	The number of the following bytes		
D101 low	01H	Station No. (range: 0~31, corresponding to hex 00H~1FH)		
D101 high	12H	PKW area	PKE	1H: function code for reading parameters 200H: parameter No. P512 (output frequency)
D102 low	00H			
D102 high	00H		IND	Index area (used in indexed parameters, such as P615. Not used in this program.)
D103 low	00H			
D103 high	00H		PWE high	Value: 1 (In read status: 0. In write status: high word will be read)
D104 low	00H			
D104 high	00H		PWE low	Value: 2 (In read status: 0. In write status: low word will be read)
D105 low	00H			
D105 high	04H	PCD1 area	Control word (starting VLT6000. For the definition, please refer to *Remarks*.)	
D106 low	7FH			
D106 high	20H	PCD2 area	Frequency (4000H corresponds to base frequency 50Hz and 2000H corresponds to 25Hz)	
D107 low	00H			
D107 high	44H	BCC area	Tail. (XOR result of all the bytes before this byte)	

Register for received data (VLT6000 responds with messages):

Register	Data	Explanation		
D120 low	02H	Head, fixed as 02H (start of the message)		
D120 high	0EH	The number of the following bytes		
D121 low	01H	Station No. (range: 0~31, corresponding to hex 00H~1FH)		
D121 high	12H	PKW area	PKE	1H: function code for reading parameters 200H: parameter No. P512 (output frequency)
D122 low	00H			
D122 high	00H		IND	Index area (used in indexed parameters, such as P615. This program doesn't use.)
D123 low	00H			
D123 high	00H		PWE_{high}	High word will be read
D124 low	00H			
D124 high	00H		PWE_{low}	Low word will be read (00FAH corresponds to the decimal value 250 which means the frequency of 25Hz.
D125 low	FAH			
D125 high	0FH	PCD1 area	Status word (For the definition, please refer to *Remarks*.)	
D126 low	07H			
D126 high	1FH	PCD2 area	Frequency (4000H corresponds to the base frequency 50Hz and 1FFFHZ corresponds to 25Hz)	
D127 low	FFH			
D127 high	0DH	BCC area	Tail. (XOR result of all the bytes before this byte)	

- When X0 = OFF, AC motor drive will stop. (Only PCD area is applied in this message).

  PLC⇨VLT6000, PLC sends: 02 06 01 0477 0000 76
  VLT6000⇨PLC, PLC receives: 02 06 01 0603 0000 00

  Register for sent data (PLC sends out messages):

Register	Data	Explanation
D200 low	02H	Head, fixed as 02H (start of the message)
D200 high	06H	The number of the following bytes
D201 low	01H	Station No. (range: 0~31, corresponding to hex 00H~1FH)
D201 high	04H	Control byte (starting AC motor drive. For the definition, please refer to *Remarks*.)
D202 low	77H	
D202 high	00H	Frequency (0000H corresponding to 0Hz)
D203 low	00H	
D203 high	76H	Tail. (XOR result of all the bytes before this byte)

  Register for received data (VLT6000 responds with messages):

Register	Data	Explanation
D220 low	02H	Head, fixed as 02H (start of the message)
D220 high	06H	The number of the following bytes
D221 low	01H	Station No. (range: 0~31, corresponding to hex 00H~1FH)
D221 high	06H	Status byte (starting AC motor drive. For the definition, please refer to *Remarks*.)
D222 low	03H	
D222 high	00H	Frequency (0000H corresponding to 0Hz)
D223 low	00H	
D223 high	00H	Tail. (XOR result of all the bytes before this byte)

- There are 2 situations for RS communication: M1123 for normal communication and M1129 for receiving timeout. When communication time-out occurred, M2 can be used to retry.

Remarks:

- There are 3 protocols for Danfoss VLT6000 series inverter: FC (default), Metasys N2 and LS FLN. This program uses FC protocol which is similar with USS protocol used by Siemens MM420 series inverter: allows maximum of one master connected with 31 slaves. Slave ID: 0~31.

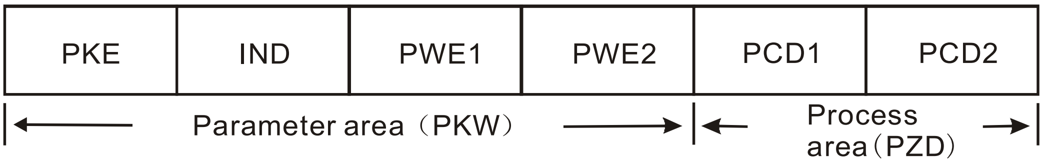
  The structure of the communication message:

STX Head	LGE Data length	ADR Address	PKW Parameter area / CH Text area	PCD Process data area	BCC Checksum
One byte	One byte	One byte	← Data area (N words) →		One byte

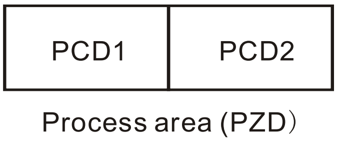
- The definitions of STX, LGE, ADR and BCC areas of FC protocol are the same as that of USS protocol. Please refer to *Remarks* in example 12.13 for description of USS protocol.

- 3 kinds of messages can be used in data area:

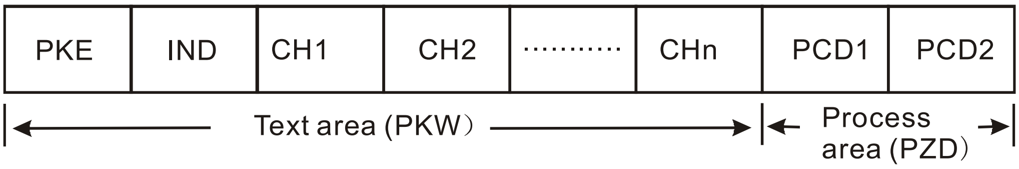
1. Includes parameter area and process area. Used for transferring parameters in master-slave system. The 6 words are as below:



2. Only process area. Consist of control word (status word) and frequency. The 2 words are as below:



3. Text area for reading/writing text through data area (used when reading/writing parameter P621-631):



- Definition of the control word for AC motor drive in PZD area:

Bit	Bit status = 0	Bit status = 1
00	-	Preset ref. lsb
01	-	Preset ref. msb
02	DC braking	-
03	Coasting stop	-
04	Quick stop	-
05	Freeze output frequency	-
06	Ramp stop	Start
07	-	Reset
08	-	JOG
09	No function	
10	Data not invalid	Data valid
11	-	Activate relay 01
12	-	Activate relay 02
13	-	Choice of setup lsb
14	-	Choice of setup msb
15	-	Reversing

- Definition of the status word for AC motor drive in PCD area

Bit	Bit status = 0	Bit status = 1
00	Trip	Control ready
01	-	Drive ready
02	-	Stand by
03	No trip	Trip
04	Not in use	
05	Not in use	
06	Not in use	
07	No warning	Warning
08	Speed≠reference	Speed = reference
09	Local operation	Serial comm. control
10	Out of frequency range	-
11	Disable operation	Operation indication
12	No function	
13	-	Voltage warning high/low
14	-	Current limit
15	-	Thermal warning

MEMO

13.1 TRD/TWR/TCMP - Office Bell Timing Control

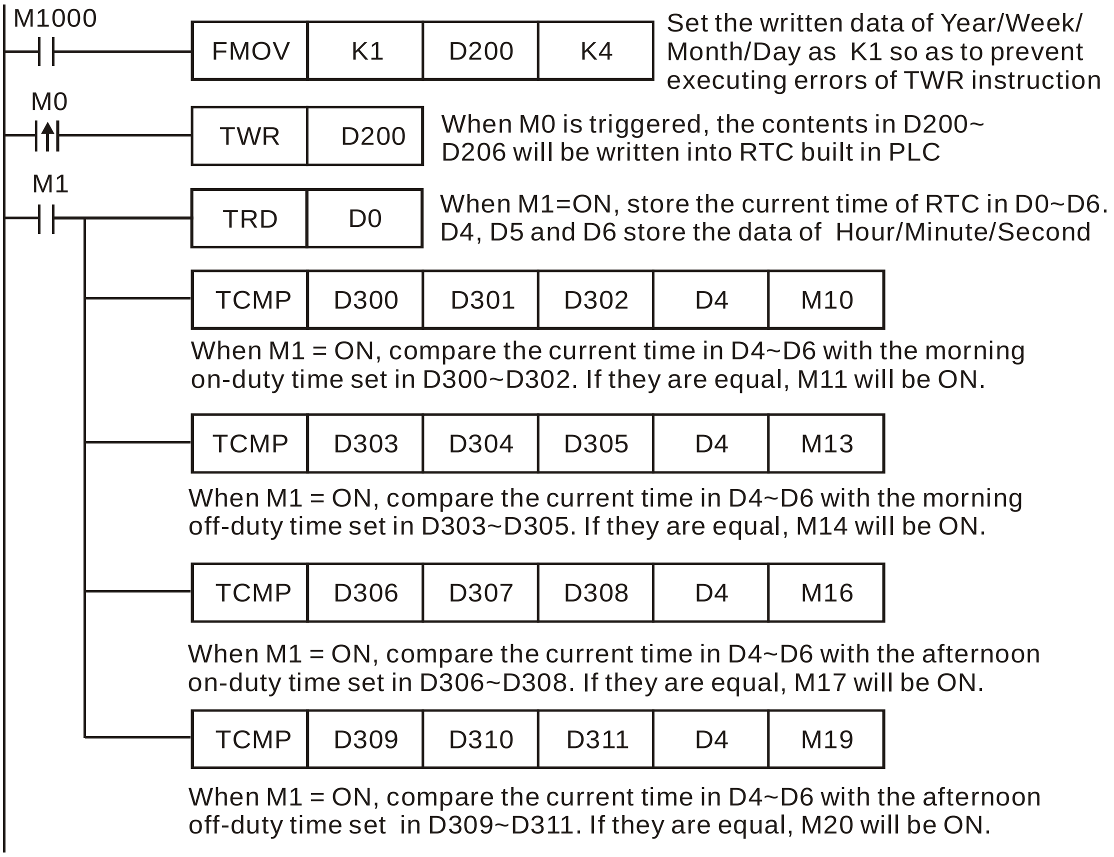
Control Purpose:

- There are 4 moments the office bell will ring: on-duty / off-duty time in the morning and on-duty / off-duty time in the afternoon. When the time is reached, the bell will ring immediately and last for 1 minute. Users can set the 4 moments and adjust the current time at any time.
- Set the ringing time and adjust the current time.

Devices:

Device	Function
M0	Adjust current time
M1	Start the office bell
Y0	Ring the office bell
D0~D6	Store the read Real Time Clock (RTC) data
D200~D206	Store the RTC data to be written in PLC
D300~D311	Store the on-duty / off-duty time

Control Program:



```
FMOV K1 D200 K4
TWR D200
TRD D0
TCMP D300 D301 D302 D4 M10
TCMP D303 D304 D305 D4 M13
TCMP D306 D307 D308 D4 M16
TCMP D309 D310 D311 D4 M19
```

Set the written data of Year/Week/Month/Day as K1 so as to prevent executing errors of TWR instruction

When M0 is triggered, the contents in D200~D206 will be written into RTC built in PLC

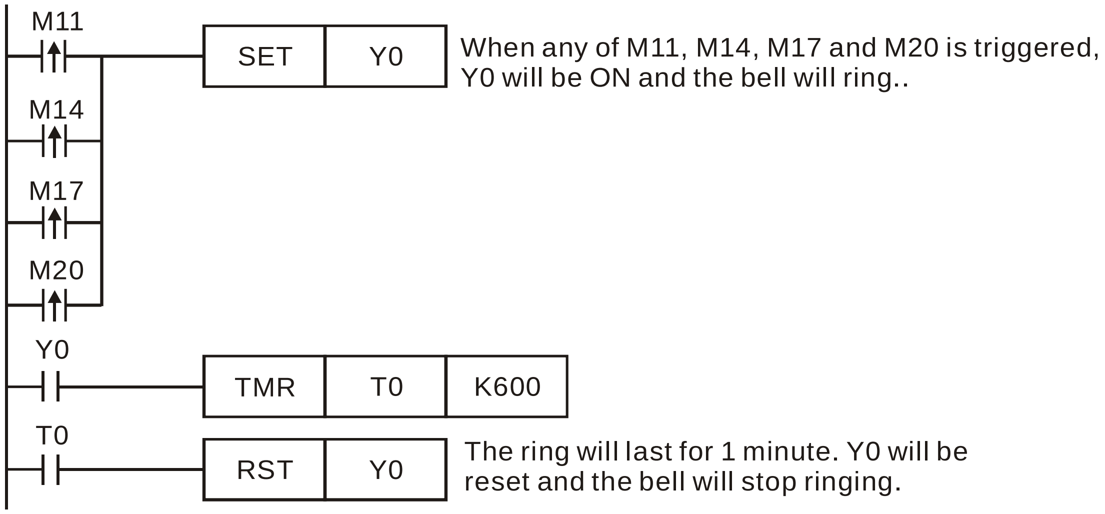
When M1=ON, store the current time of RTC in D0~D6. D4, D5 and D6 store the data of Hour/Minute/Second

When M1 = ON, compare the current time in D4~D6 with the morning on-duty time set in D300~D302. If they are equal, M11 will be ON.

When M1 = ON, compare the current time in D4~D6 with the morning off-duty time set in D303~D305. If they are equal, M14 will be ON.

When M1 = ON, compare the current time in D4~D6 with the afternoon on-duty time set in D306~D308. If they are equal, M17 will be ON.

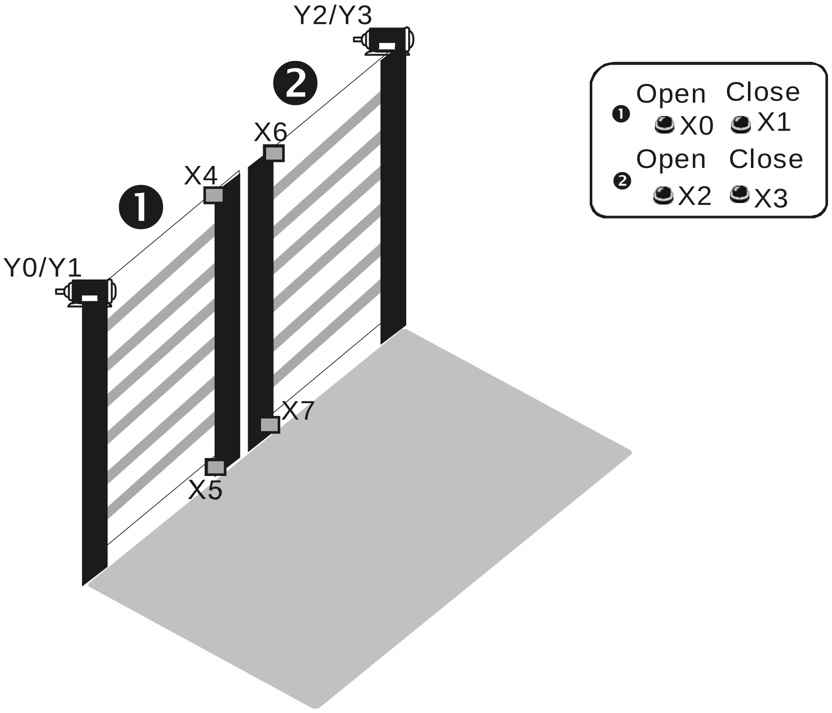
When M1 = ON, compare the current time in D4~D6 with the afternoon off-duty time set in D309~D311. If they are equal, M20 will be ON.


M11
M14
M17
M20
Y0
T0
SET
Y0
TMR
T0
K600
RST
Y0
When any of M11, M14, M17 and M20 is triggered, Y0 will be ON and the bell will ring..
The ring will last for 1 minute. Y0 will be reset and the bell will stop ringing.

Program Description:

- The value in D200~D206 and D300~D311 can be set by WPLSoft or HMI.
- To avoid the execution error of TWR instruction, the program uses [FMOV K1 D200 K4] instruction at the beginning. This program operates only the data of Hour/Minute/Second in D204~D206 but not the data of Year/Day/Month/Date in D200~D203. For TWR instruction, the setting range: 00~99 for Year, 1~7 for Day(Mon ~Sun), 1~12 for Month and 1~31 for Date. If the values in D200~D203 are out of the above range, the program will regard it as an operation error and the instruction will not be executed and the Hour/Minute/Second data can’t be written either. Therefore, the program sets the Year/Week/Month/Day to K1 to fit the above range and makes sure TWR instruction can be executed for writing in Hour/Minute/Second data.
- D4, D5 and D6 store the Hour/Minute/Second of the current time read form RTC.

13.2 TRD/TZCP - Control of Warehouse Automatic Door



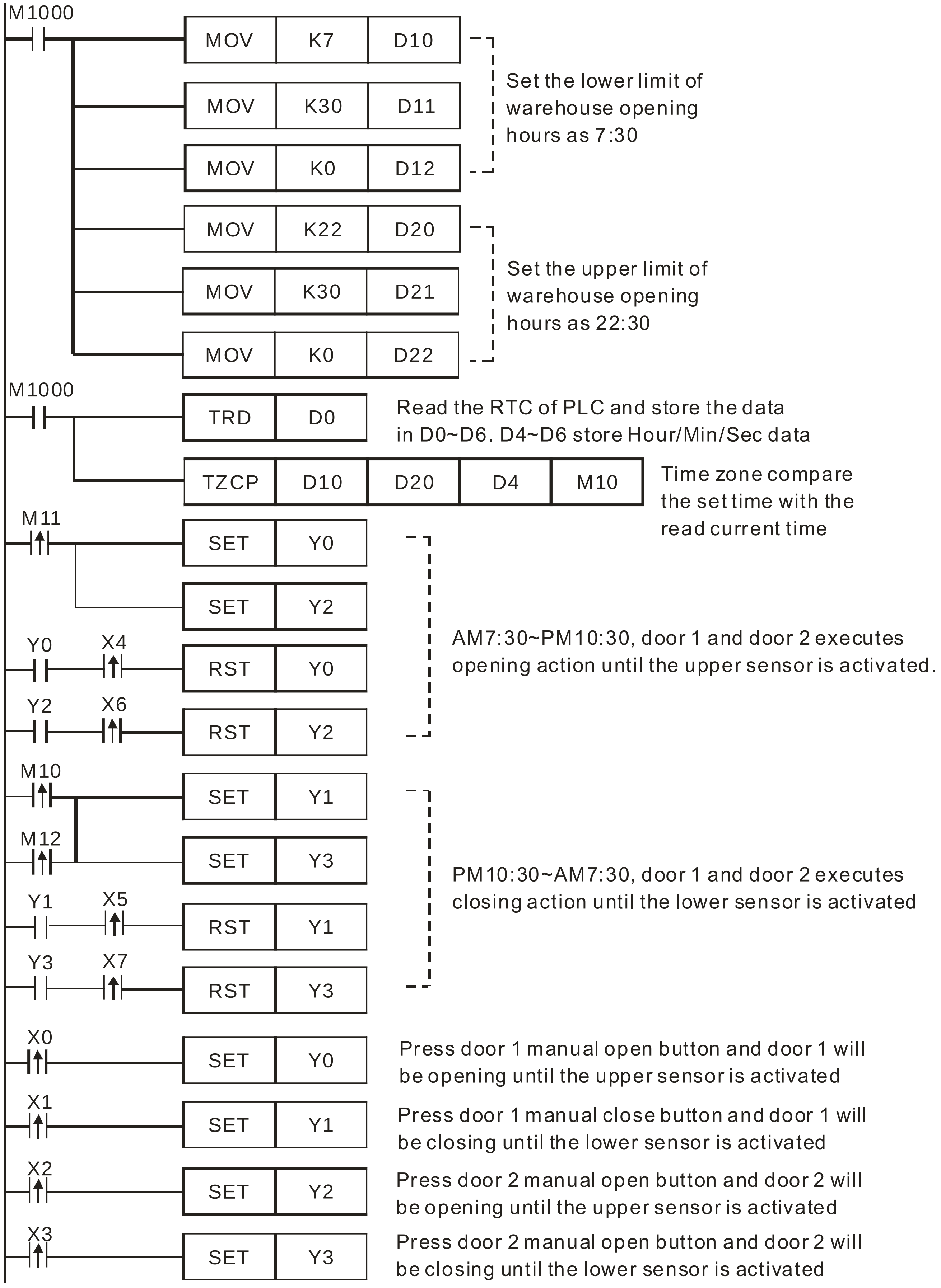
Control Purpose:

- The opening hours of the warehouse are from 7:30~22:30, so the door should open at 7:30 and close at 22:30 automatically.
- There are 2 sets of control buttons(Open/Close) in the control room for opening or closing the door manually for special situations.

Devices:

Device	Function
X0	Manual open button for door 1 .
X1	Manual close button for door 1
X2	Manual open button for door 2
X3	Manual close button for door 2
X4	Upper sensor of door 1.
X5	Lower sensor of door 1.
X6	Upper sensor of door 2.
X7	Lower sensor of door 2.
Y0	Motor of door 1 run forward to open the door
Y1	Motor of door 1 run reverse to close the door
Y2	Motor of door 2 run forward to open the door
Y3	Motor of door 2 run reverse to close the door

Control Program:



Set the lower limit of warehouse opening hours as 7:30

Set the upper limit of warehouse opening hours as 22:30

Read the RTC of PLC and store the data in D0~D6. D4~D6 store Hour/Min/Sec data

Time zone compare the set time with the read current time

AM7:30~PM10:30, door 1 and door 2 executes opening action until the upper sensor is activated.

PM10:30~AM7:30, door 1 and door 2 executes closing action until the lower sensor is activated

Press door 1 manual open button and door 1 will be opening until the upper sensor is activated

Press door 1 manual close button and door 1 will be closing until the lower sensor is activated

Press door 2 manual open button and door 2 will be opening until the upper sensor is activated

Press door 2 manual open button and door 2 will be closing until the lower sensor is activated

Program Description:

- The program performs control of warehouse automatic door by a RTC Time Zone Compare instruction (TZCP). Through the Time Read instruction (TRD), the current time in RTC can be read in D0~D6. D4, D5 and D6 store the Hour/Min/Sec data.
- When Y0 = ON, the motor of door 1will run forward to execute opening action until upper sensor is activated (X4 = ON).
- When Y1 = ON, the motor of door 1 will run reverse to execute closing action until the lower sensor in activated (X5 = ON).
- The opening and closing actions of door 2 are the same with that of door 1.
- For some special situations, the opening and closing actions of door 1 and door 2 can also be performed by pressing manual open buttons (X0/X2) and manual close buttons (X1/X3) in the control room.

13.3 HOUR - Control of Switching Motors after a Long Time Running

Control Purpose:

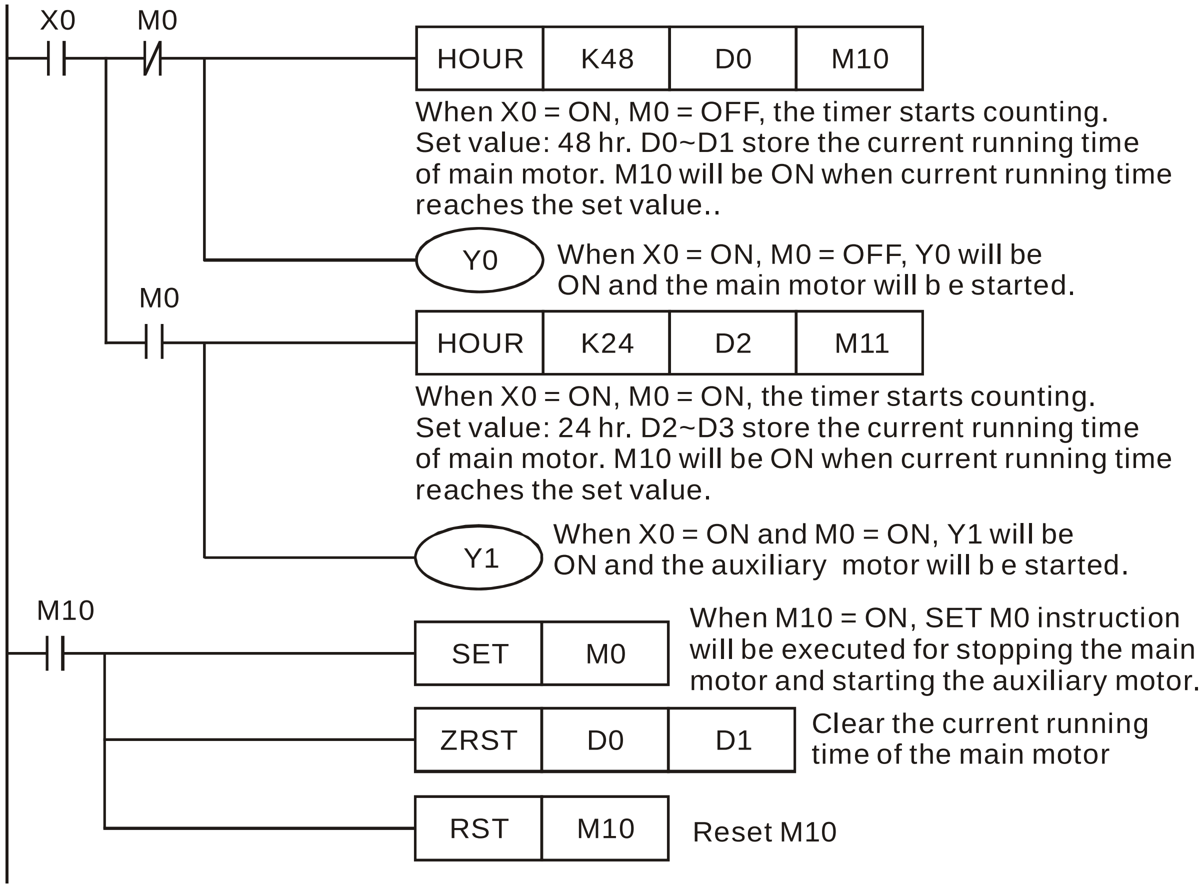
- Controlling the automatic motor switching between main motor and auxiliary motor.

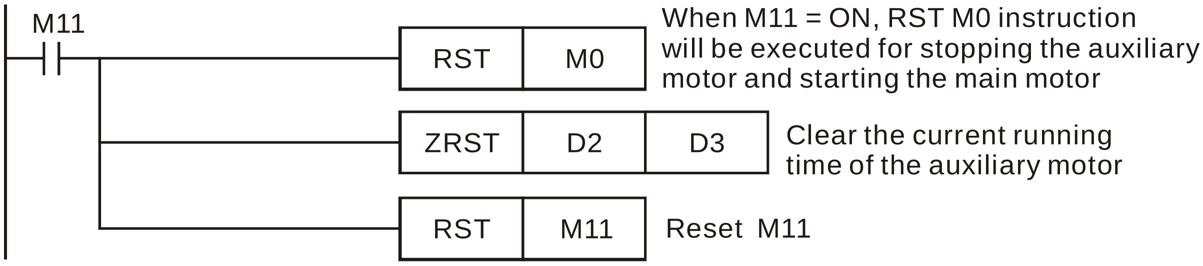
In some special applications, we use several motors running by turns to protect each motor and extend their service life. In this program, there are 2 motors running by turns in the cycle: 2 days (48 hours) for the main motor, then 1 day (24 hours) for the auxiliary motor.

Devices:

Device	Function
X0	Start/Stop of the motor
Y0	Starting the main motor
Y1	Starting the auxiliary motor
M10	M10 = ON when set time of the main motor reached
M11	M11 = ON when set time of the auxiliary motor reached
D0~D1	Storing the current running time of the main motor
D2~D3	Storing the current running time of the auxiliary motor

Control Program:


X0
M0
HOUR
K48
D0
M10
When X0 = ON, M0 = OFF, the timer starts counting. Set value: 48 hr. D0~D1 store the current running time of main motor. M10 will be ON when current running time reaches the set value..
Y0
When X0 = ON, M0 = OFF, Y0 will be ON and the main motor will b e started.
M0
HOUR
K24
D2
M11
When X0 = ON, M0 = ON, the timer starts counting. Set value: 24 hr. D2~D3 store the current running time of main motor. M10 will be ON when current running time reaches the set value.
Y1
When X0 = ON and M0 = ON, Y1 will be ON and the auxiliary motor will b e started.
M10
SET
M0
When M10 = ON, SET M0 instruction will be executed for stopping the main motor and starting the auxiliary motor.
ZRST
D0
D1
Clear the current running time of the main motor
RST
M10
Reset M10



When M11 = ON, RST M0 instruction will be executed for stopping the auxiliary motor and starting the main motor

Clear the current running time of the auxiliary motor

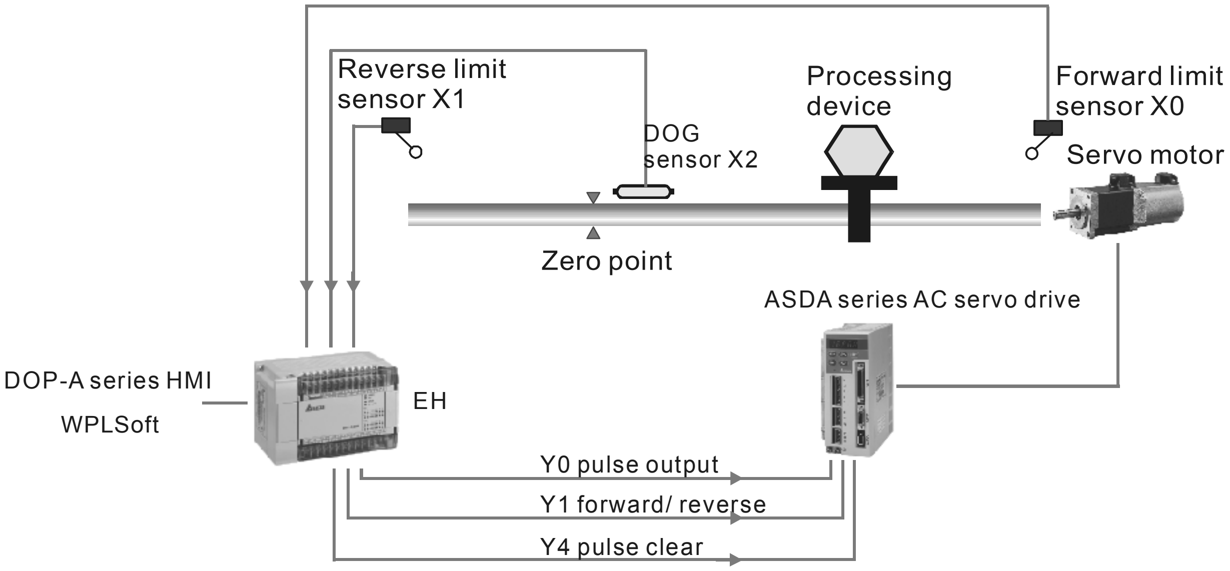
Reset M11

Program Description:

- When X0 = OFF, Y0 and Y1 = OFF, both main / auxiliary motor will not run.
- When X0 = ON, the running status of Y0 (main motor) and Y1 (aux. motor) will be decided by the ON/OFF status of M0 so as to control the two motors running in turns.
- For main motor, D0 and D1 record the current time measured in hour and the current time that is less than an hour (0~3599s). For auxiliary motor, D2 and D3 record the current time measured in hour and the current time that is less than an hour (0~3599s).
- 16-bit instruction supports the set time up to 32,767 hours and 32-bit instruction supports the set time up to 2,147,483,647 hours.
- The timer will go on timing after the set time is reached. For restart timing, users need to clear the current time stored in D0~D3 and reset flag M10 and M11.

MEMO

14.1 Simple positioning Demonstration System of Delta ASDA series AC servo Drive



Control Purpose:

- Building a simple demonstrating system of position control by the application of Delta PLC and Delta ASDA servo drive.
- Performing Zero Return, Drive to Increment and Drive to Absolute through pulse sending of PLC.

Devices:

Device	Function
M0	Zero return switch
M1	Switch of running forward for 10 rotations
M2	Switch of running reverse for 10 rotations
M3	Switch of absolute designation: 400,000
M4	Switch of absolute designation: -50,000
M10	Servo ON switch
M11	Error reset switch
M12	Switch of stopping pulse output.
M13	Switch of Emergency stop
X0	Forward limit sensor
X1	Reverse limit sensor
X2	DOG signal sensor
X3	Receiving Servo Ready signal (corresponding to M20)
X4	Receiving At Zero Speed signal (corresponding to M21)
X5	Receiving Homing Completed signal (corresponding to M22)
X6	Receiving At Positioning Completed signal (corresponding to M23)
X7	Receiving Alarm Enabled signal (corresponding to M24)

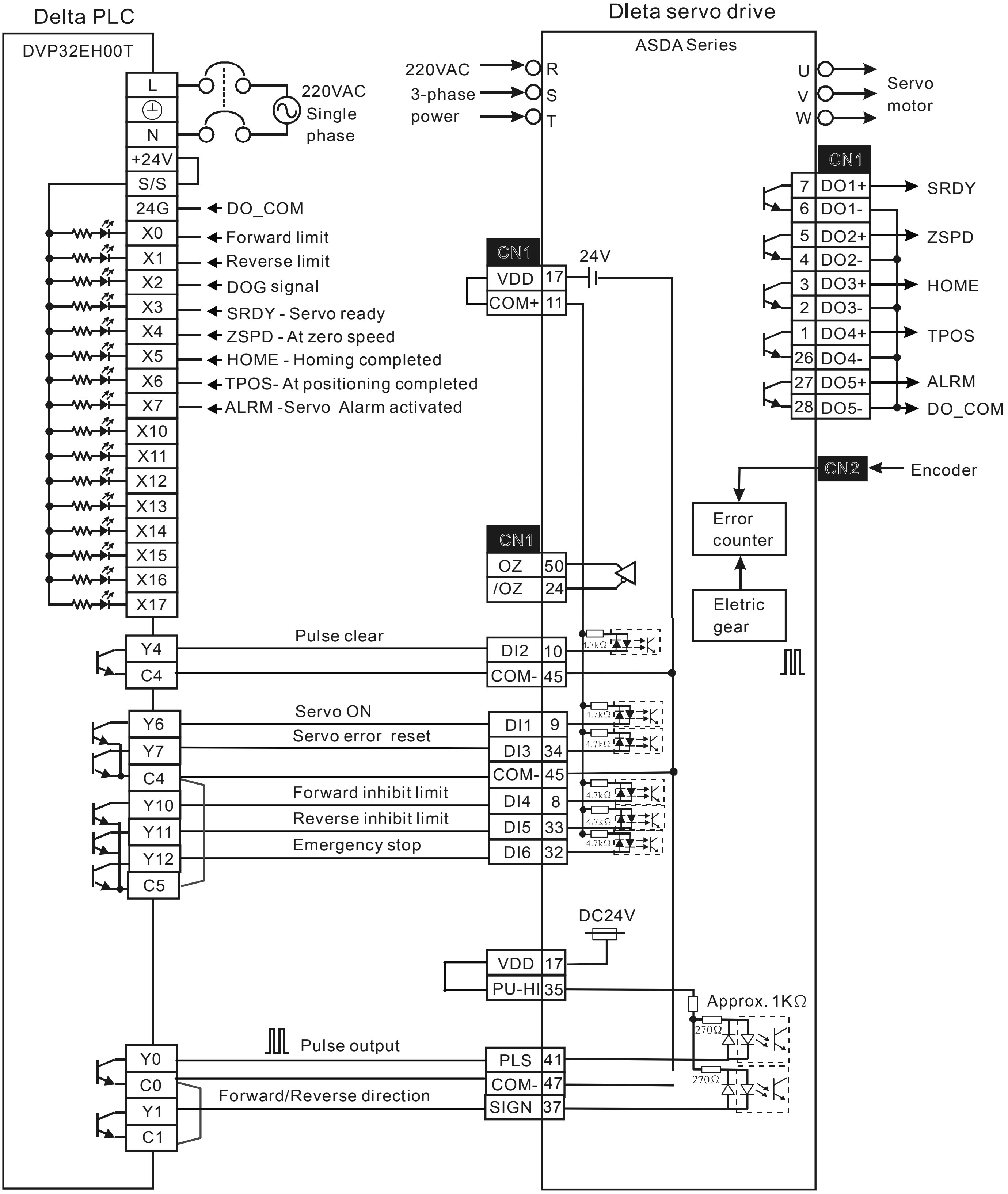
Y0	Pulse output
Y1	Forward / Reverse direction control
Y4	Clear pulse register of servo
Y6	Servo ON
Y7	Error reset
Y10	Forward inhibit limit
Y11	Reverse inhibit limit
Y12	Emergency stop
M20	Servo ready
M21	At zero speed
M22	Homing completed
M23	At positioning completed
M24	Alarm enabled

Parameter Settings for ASD-A AC Servo Drive:

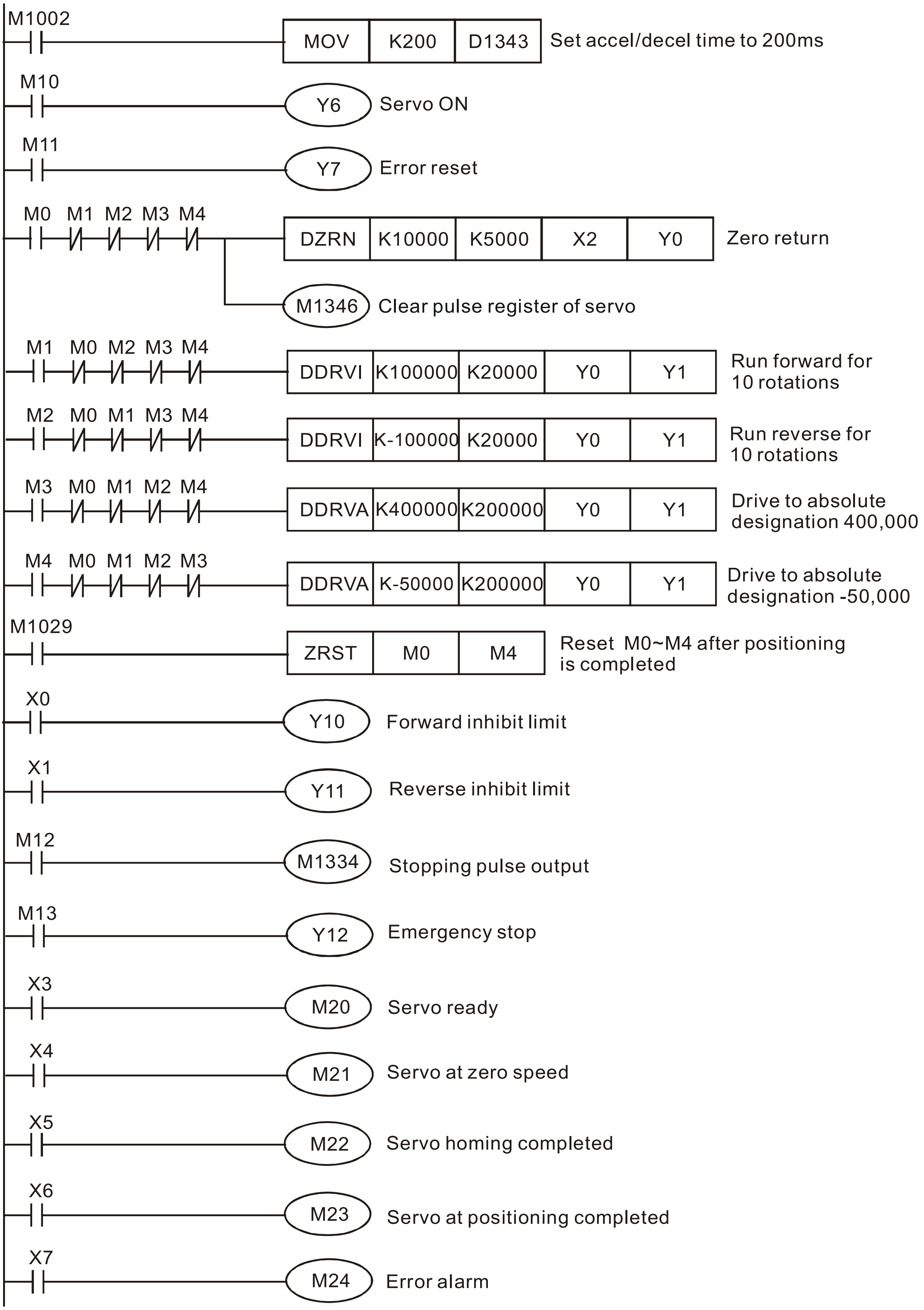
Parameter	Set value	Function
P0-02	2	Drive Status
P1-00	2	External pulse input type: Pulse+ Direction
P1-01	0	Control Mode and Output Direction
P2-10	101	Digital Input Terminal 1 (DI1)
P2-11	104	Digital Input Terminal 2 (DI2)
P2-12	102	Digital Input Terminal 3 (DI3)
P2-13	122	Digital Input Terminal 4 (DI4)
P2-14	123	Digital Input Terminal 5 (DI5)
P2-15	121	Digital Input Terminal 6 (DI6)
P2-16	0	Digital Input Terminal 7 (DI7)
P2-17	0	Digital Input Terminal 8 (DI8)
P2-18	101	Digital Output Terminal 1 (DO1)
P2-19	103	Digital Output Terminal 2 (DO2)
P2-20	109	Digital Output Terminal 3 (DO3)
P2-21	105	Digital Output Terminal 4 (DO4)
P2-22	107	Digital Output Terminal 5 (DO5)

※ If AC servo drive can not run normally due to improper parameters, users can set P2-08 = 10 (factory defaults) and then set the parameters according to the above table.

Wiring for PLC and AC Servo Drive:



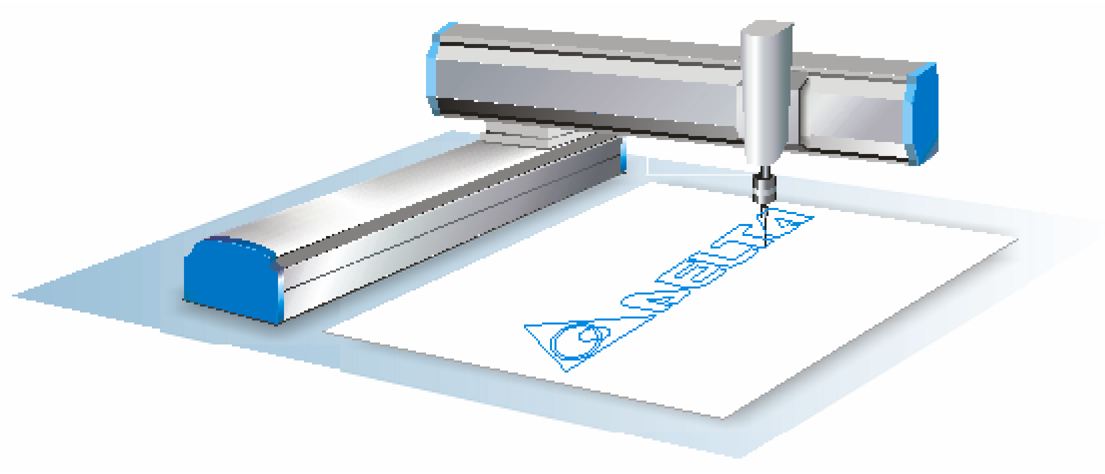
Control program:


M1002
MOV K200 D1343
Set accel/decel time to 200ms
M10
Y6
Servo ON
M11
Y7
Error reset
M0 M1 M2 M3 M4
DZRN K10000 K5000 X2 Y0
Zero return
M1346
Clear pulse register of servo
M1 M0 M2 M3 M4
DDRVI K100000 K20000 Y0 Y1
Run forward for 10 rotations
M2 M0 M1 M3 M4
DDRVI K-100000 K20000 Y0 Y1
Run reverse for 10 rotations
M3 M0 M1 M2 M4
DDRVA K400000 K200000 Y0 Y1
Drive to absolute designation 400,000
M4 M0 M1 M2 M3
DDRVA K-50000 K200000 Y0 Y1
Drive to absolute designation -50,000
M1029
ZRST M0 M4
Reset M0~M4 after positioning is completed
X0
Y10
Forward inhibit limit
X1
Y11
Reverse inhibit limit
M12
M1334
Stopping pulse output
M13
Y12
Emergency stop
X3
M20
Servo ready
X4
M21
Servo at zero speed
X5
M22
Servo homing completed
X6
M23
Servo at positioning completed
X7
M24
Error alarm

Program Description:

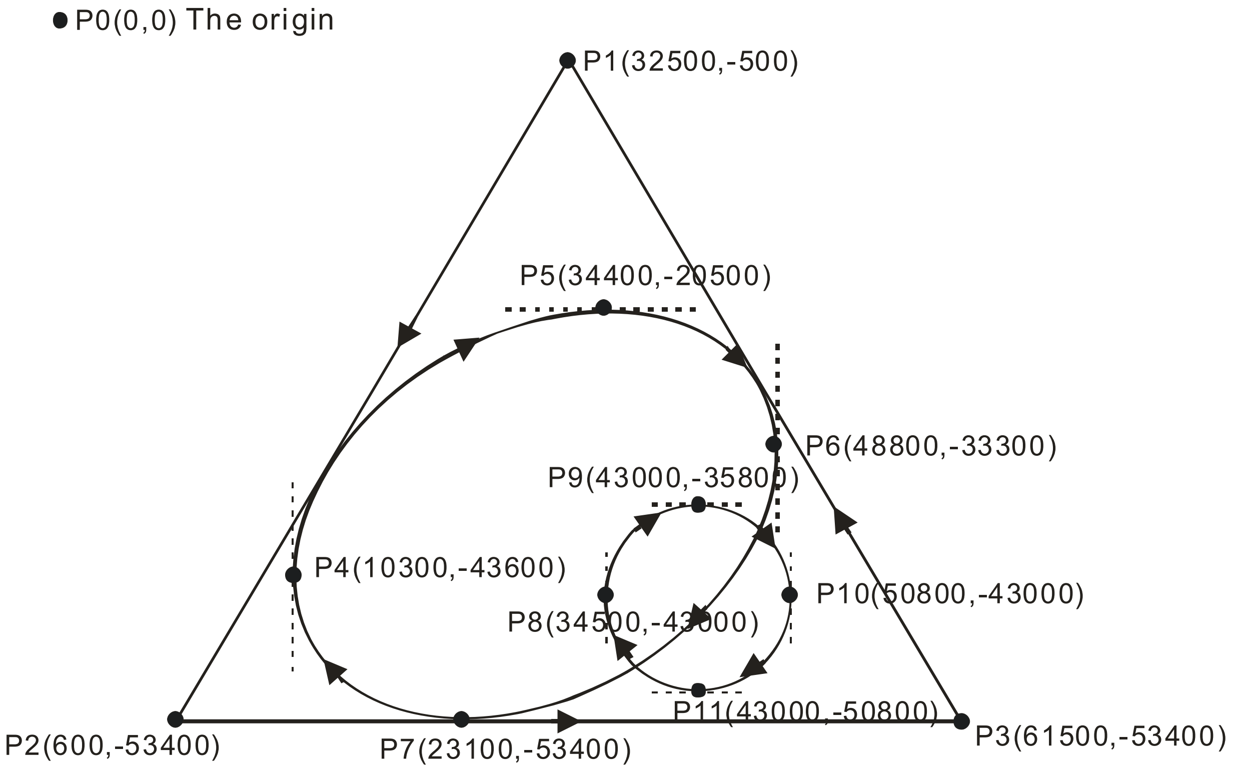
- The M devices work as switches and status display can be designed by Delta DOP-A HMI or WPLSoft program.
- Power up servo drive, X3 will be ON (servo ready) if there is no alarm signal. Press servo ON switch and M10 will be ON to activate Y6 (Servo ON)
- When zero return switch M0 = ON, servo drive will execute zero return action. When DOG signal sensor is activated, servo drive will switch the current speed to JOG speed of 5KHz. When X2 is OFF, servo motor will stop running immediately and zero return is completed.
- When the switch of 10 rotations forward is pressed (M1 = ON), servo motor will execute Drive to Increment instruction and stop after running forward for 10 rotations.
- When the switch of 10 rotations reverse is pressed (M2 = ON), servo motor will execute Drive to Increment instruction and stop after running reverse for 10 rotations.
- When the switch of absolute designation 40,0000 is pressed (M3 = ON), servo motor will execute Drive to Absolute instruction and stop after positioning completed.
- When the switch of absolute designation -50,000 is pressed (M4 = ON), servo motor will execute Drive to Absolute instruction and stop after positioning completed.
- If the processing device touches the forward limit sensor (X0 = ON, Y10 = ON), servo motor will stop and the alarm will be enabled (M24 = ON).
- If the processing device touches the reverse limit sensor (X1 = ON, Y11 = On), servo motor will stop and the alarm will be enabled (M24 = ON)..
- If servo alarm is enabled, press error reset switch M11 to clear the alarm. Once the alarm is cleared, the program can resume positioning actions.
- When the switch of stopping pulse output is ON (M12 = ON), PLC pulse output will be paused and the number of the output pulses will be stored in the register. When M12 = OFF, PLC will resume pulse output from the number of stored pulses.
- Press emergency stop switch (M13 = ON), and AC servo drive will stop immediately. When M13 = OFF, for positioning, servo drive will not complete remaining distance.
- M1346 in the program is used for clearing the pulse register after zero return is completed. When M1346 activated, Y4 of PLC will send a 20ms pulse to clear pulses so as to display 0 on the servo panel (corresponding to servo parameter: P0-02, set as 0)
- M1029 in the program is used for resetting M0~M4 to ensure that every positioning instruction can be executed properly.

14.2 Draw DELTA LOGO by 2-axis Synchronous Motion



Control Purpose:

- Executing Drive to Absolute (DDRVA) and 2-axis synchronous motion instructions (DPPMA and DPPMR) to draw DELTA LOGO.
- Executing DDRVA instruction to control the up/down movement of the pen on the 3rd axis.
- The locus is as follows:

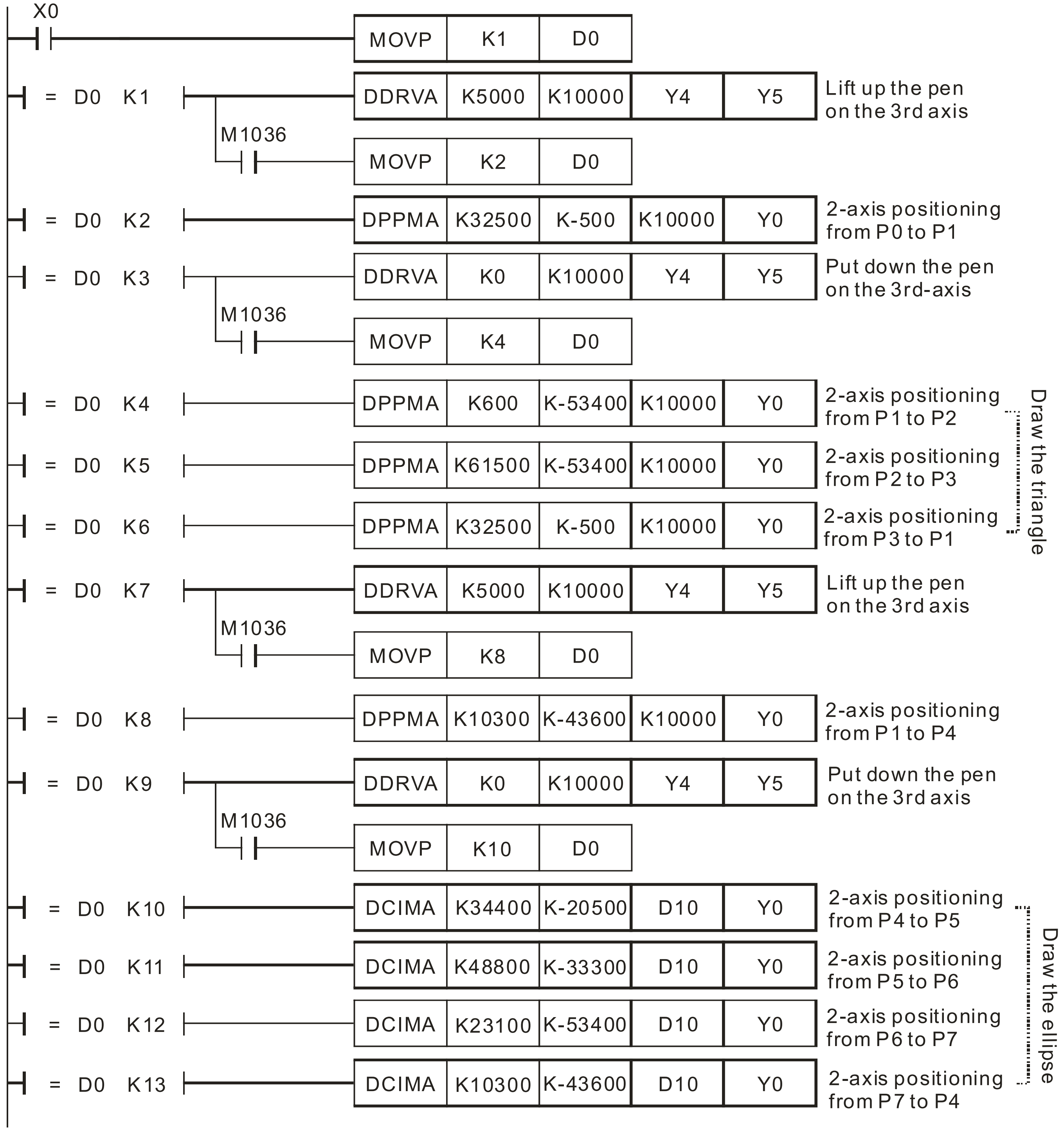


Devices:

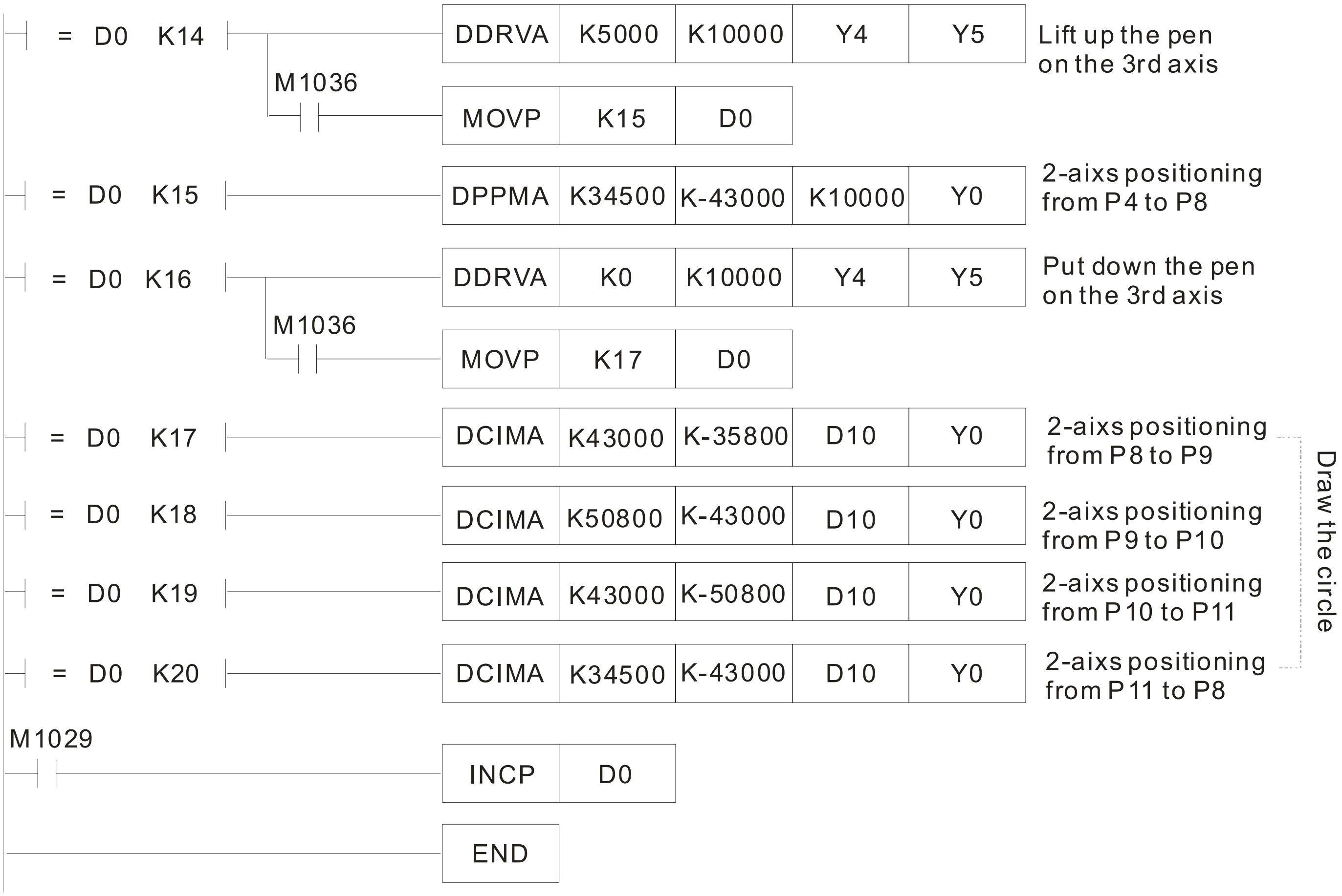
Device	Function
X0	When X0 = ON, 2-axis synchronous motion is enabled.
Y0	X axis pulse output device

Device	Function
Y1	X axis direction signal output device
Y2	Y axis pulse output device
Y3	Y axis direction signal output device
Y4	The 3rd axis pulse output device
Y5	The 3rd axis direction signal output device
D0	Drawing steps
D10	Parameter setting

Control Program:



```
X0                   MOVP   K1      D0
= D0 K1              DDRVA  K5000   K10000  Y4   Y5   Lift up the pen on the 3rd axis
      M1036          MOVP   K2      D0
= D0 K2              DPPMA  K32500  K-500   K10000  Y0   2-axis positioning from P0 to P1
= D0 K3              DDRVA  K0      K10000  Y4   Y5   Put down the pen on the 3rd-axis
      M1036          MOVP   K4      D0
= D0 K4              DPPMA  K600    K-53400 K10000  Y0   2-axis positioning from P1 to P2
= D0 K5              DPPMA  K61500  K-53400 K10000  Y0   2-axis positioning from P2 to P3
= D0 K6              DPPMA  K32500  K-500   K10000  Y0   2-axis positioning from P3 to P1
                                                         Draw the triangle
= D0 K7              DDRVA  K5000   K10000  Y4   Y5   Lift up the pen on the 3rd axis
      M1036          MOVP   K8      D0
= D0 K8              DPPMA  K10300  K-43600 K10000  Y0   2-axis positioning from P1 to P4
= D0 K9              DDRVA  K0      K10000  Y4   Y5   Put down the pen on the 3rd axis
      M1036          MOVP   K10     D0
= D0 K10             DCIMA  K34400  K-20500 D10     Y0   2-axis positioning from P4 to P5
= D0 K11             DCIMA  K48800  K-33300 D10     Y0   2-axis positioning from P5 to P6
= D0 K12             DCIMA  K23100  K-53400 D10     Y0   2-axis positioning from P6 to P7
= D0 K13             DCIMA  K10300  K-43600 D10     Y0   2-axis positioning from P7 to P4
                                                         Draw the ellipse
```


= D0 K14
M1036
DDRVA K5000 K10000 Y4 Y5
Lift up the pen on the 3rd axis
MOVP K15 D0
= D0 K15
DPPMA K34500 K-43000 K10000 Y0
2-aixs positioning from P4 to P8
= D0 K16
M1036
DDRVA K0 K10000 Y4 Y5
Put down the pen on the 3rd axis
MOVP K17 D0
= D0 K17
DCIMA K43000 K-35800 D10 Y0
2-aixs positioning from P8 to P9
= D0 K18
DCIMA K50800 K-43000 D10 Y0
2-aixs positioning from P9 to P10
= D0 K19
DCIMA K43000 K-50800 D10 Y0
2-aixs positioning from P10 to P11
= D0 K20
DCIMA K34500 K-43000 D10 Y0
2-aixs positioning from P11 to P8
Draw the circle
M1029
INCP D0
END

Program Description:

- When X0 = ON, the content in D0 = 1, 2-axis synchronous motion will be enabled to draw DELTA LOGO.

  Step 1: Lift up the pen on the 3rd-axis. Move it from P0 to P1.

  Step 2: Put down the pen at P1. Draw with the following locus: P1→ P2→ P3→ P1. Lift up the pen and the triangle is completed.

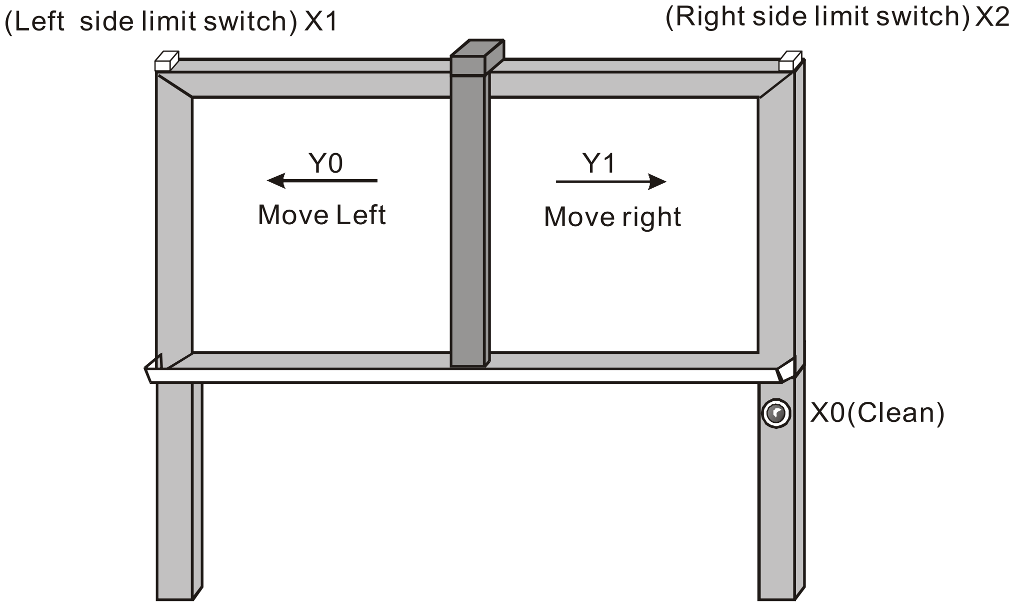
  Step 3: Move the pen from P1 to P4 and put down the pen at P4. Draw with the following locus: P4→ P5→ P6→ P7→ P4. Lift up the pen and the ellipse is completed.

  Step 4: Move the pen from P4 to P8 and put down the pen at P8. Draw with the following locus: P8→ P9→ P10→ P11→ P8. Lift up the pen and the circle is completed and DELTA logo is accomplished.

- M1036 is the flag for indicating the completion of pen movement on 3rd axis. When M1036 = ON, the program will execute next step.

- M1029 is he flag for indicating the completion of pen movement on X/Y axis. When M1029 = ON, the content in D0 will increase by 1 and the program will enter next step.

15.1 ALT - Auto Blackboard Cleaner



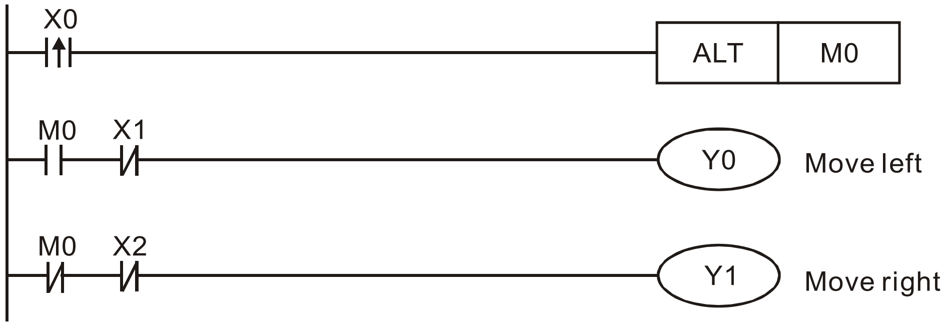
Control Purpose:

- Controlling the auto cleaner to move left / move right when Clean is pressed.
- When the auto cleaner touches the limit switches of left side or right side, the cleaner will stop. Next time when Clean is pressed again, the cleaner will move to the opposite direction.

Devices:

Device	Function
X0	X0 = ON when Clean is pressed.
X1	X1 = ON when left side limit switch is touched.
X2	X2 = ON when right side limit switch is touched.
Y0	Move left
Y1	Move right

Control Program:

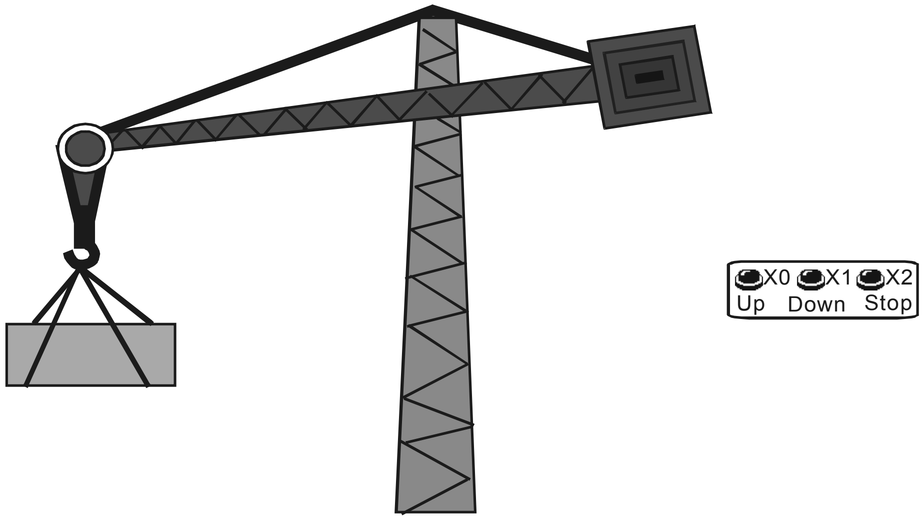


Program Description:

- When Clean is pressed, X0 will be activated one time to execute ALT instruction. M0 will be ON, the cleaner will move left until it touches the left side limit switch. X1 = ON, and Y0 will be OFF. The cleaner will stop working.

- When Clean is pressed again, X0 will be activated again to switch the ON status of M0 to be OFF. Therefore, Y1 will be ON and the cleaner will move right until it touches the right side limit switch. X2 = ON, and Y1 will be OFF. The cleaner will stop at the current position.
- Wherever the location of the cleaner is, the cleaner will move to the opposite direction every time when Clean is pressed.

15.2 RAMP - Ramp Control of Crane



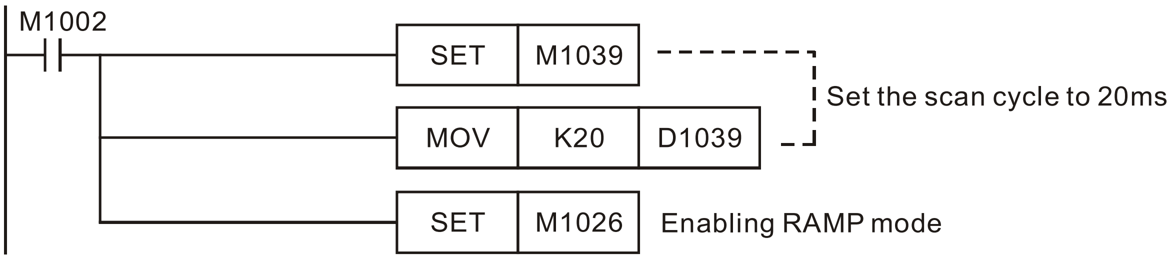
Control Purpose:

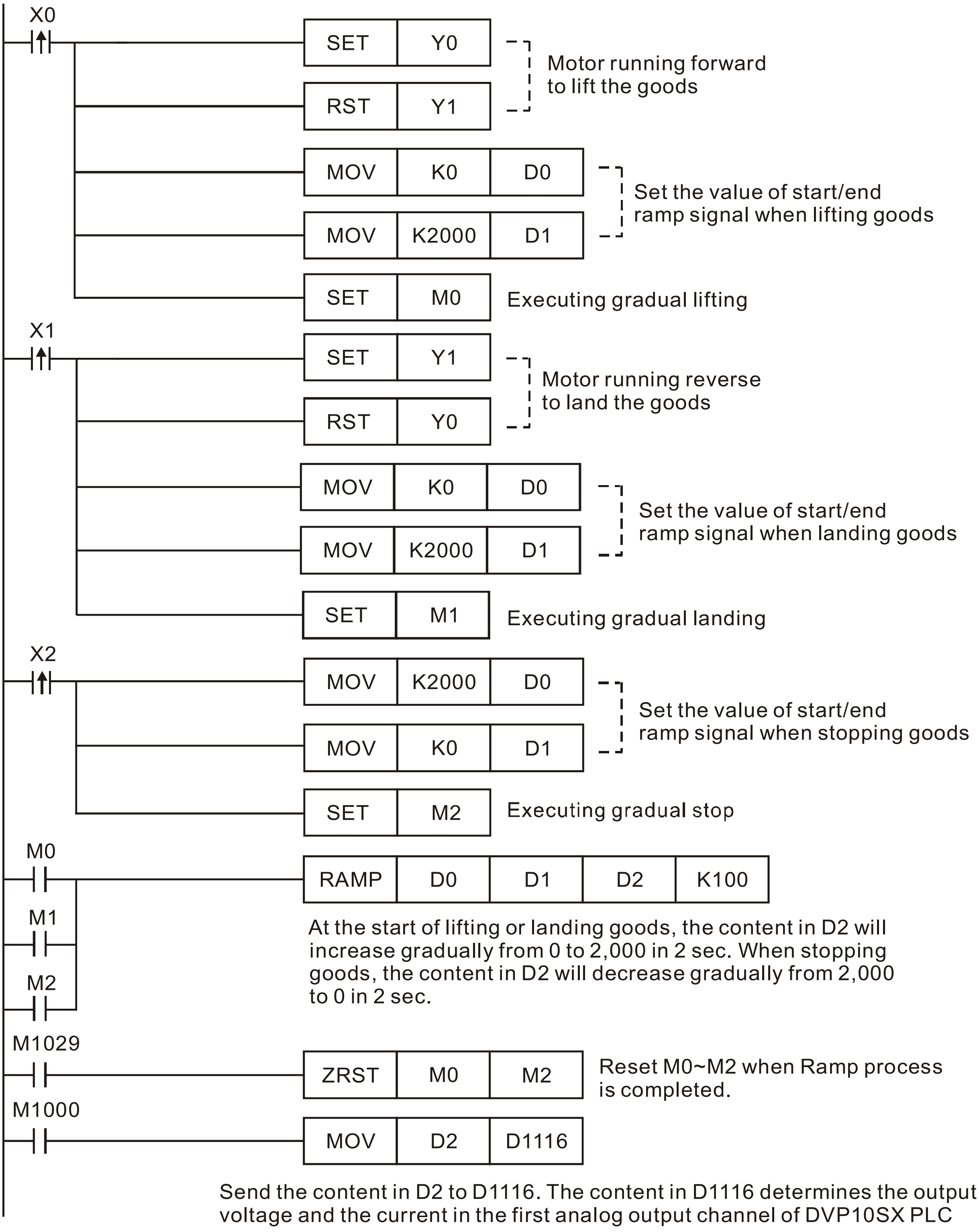
- The load of the crane is quite big, so the motor requires ramp up and ramp down control during gradual start as well as gradual stop process.
- Apply Delta analog output MPU DVP10SX to generate voltages of 0~10V for controlling the frequency of AC motor drive, and the drive will output variable frequency current to control rotation speed of the crane motor.

Devices:

Device	Function
X0	X0 = ON when Up is pressed.
X1	X1 = ON when Down is pressed.
X2	X2 = ON when Stop is pressed.
Y0	Motor running forward (Lifting goods)
Y1	Motor running reverse (Landing goods)

Control Program:





Motor running forward to lift the goods

Set the value of start/end ramp signal when lifting goods

Executing gradual lifting

Motor running reverse to land the goods

Set the value of start/end ramp signal when landing goods

Executing gradual landing

Set the value of start/end ramp signal when stopping goods

Executing gradual stop

At the start of lifting or landing goods, the content in D2 will increase gradually from 0 to 2,000 in 2 sec. When stopping goods, the content in D2 will decrease gradually from 2,000 to 0 in 2 sec.

Reset M0~M2 when Ramp process is completed.

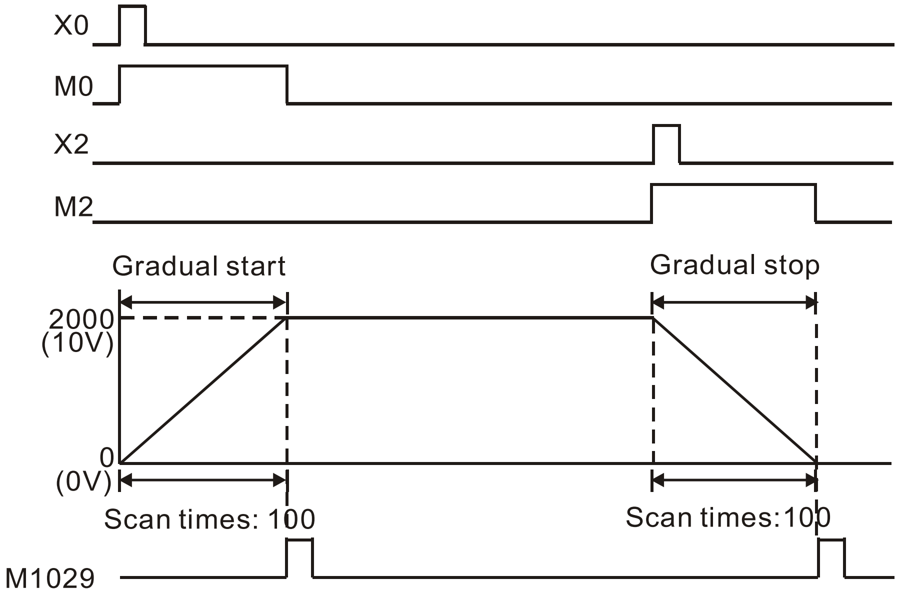
Send the content in D2 to D1116. The content in D1116 determines the output voltage and the current in the first analog output channel of DVP10SX PLC

Program Description:

- This program applies to PLCs with analog output function, such as DVP20EX and DVP10SX series MPU. In DVP10SX, when the content in D1116 changes from K0 to K2000, the output voltage of the first channel will vary from 0 to 10V.
- The parameter of RAMP instruction is directly related to the scan cycle, so users should set the scan cycle at the start of the program first, then the duration of ramp signal can be fixed.

In this program, the scan cycle is fixed as 20ms and the scan times of RAMP instruction are 100. Therefore the ramp duration is 2s.

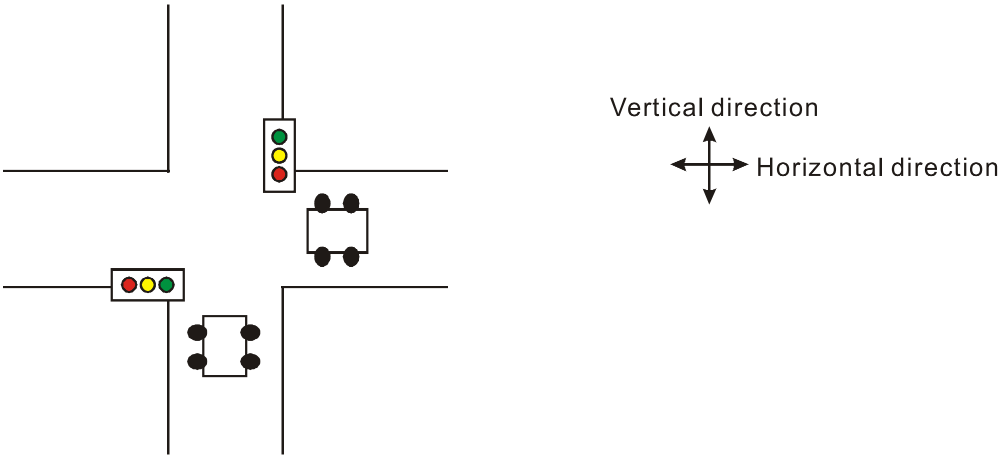
- When the button Up is pressed (M0 = ON), the crane will perform gradual start to lift goods and the voltage output will increase from 0 to 10V in 2s. When the crane reaches the target height, operator can press the button Stop (M2 = ON) to execute gradual stop. The voltage output will decrease from 10 to 0V in 2s. The process is as follows:



- The goods landing process also requires the same ramp up (gradual start) and ramp down (gradual stop) duration.

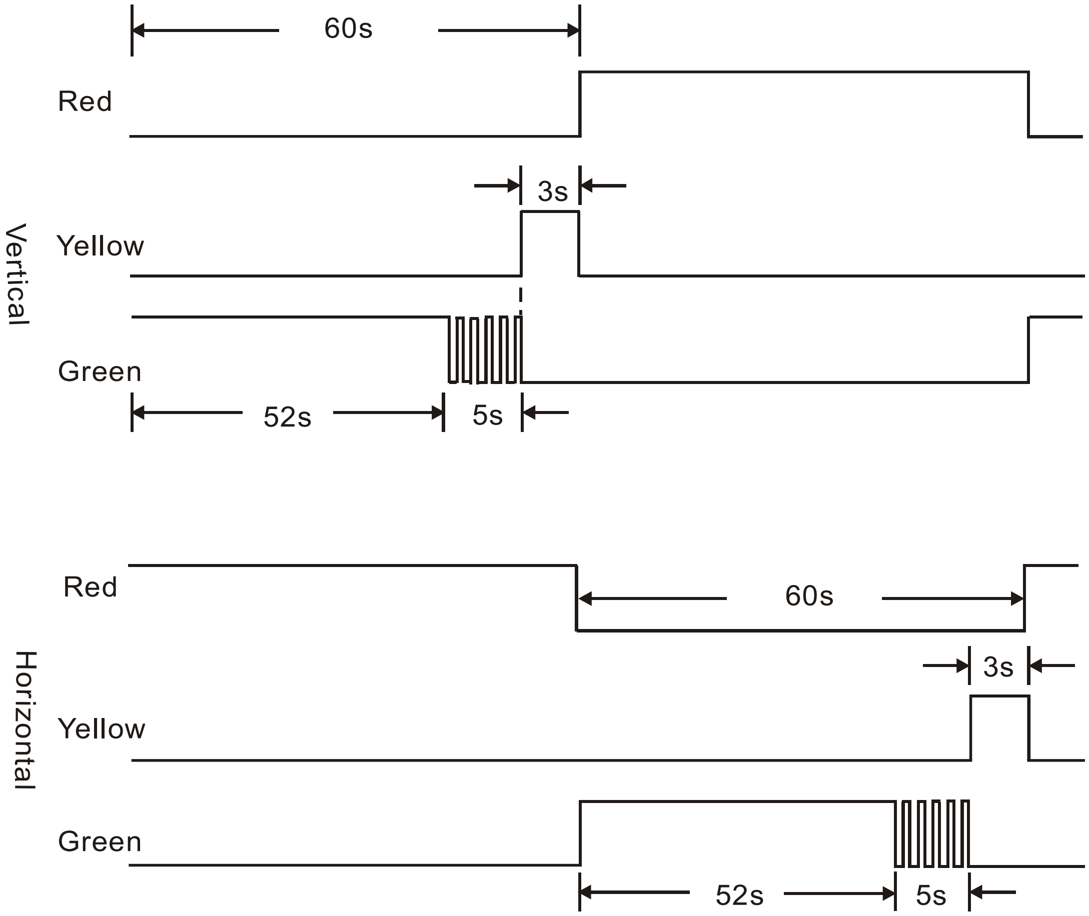
- The frequency of AC motor drive is in proportion to the output voltage of PLC. For example, the frequency of Delta VFD-M series AC motor drive varies from 0 to 60Hz while the output voltage of DVP10SX varies from 0 to 10V. In addition, the motor rotation speed is in proportion to the frequency of drive. Therefore, gradual start and gradual stop can be performed by controlling the variation of output voltage on DVP10SX.

15.3 INCD - Traffic Lights Control (Incremental Drum Sequencer)



Control Purpose:

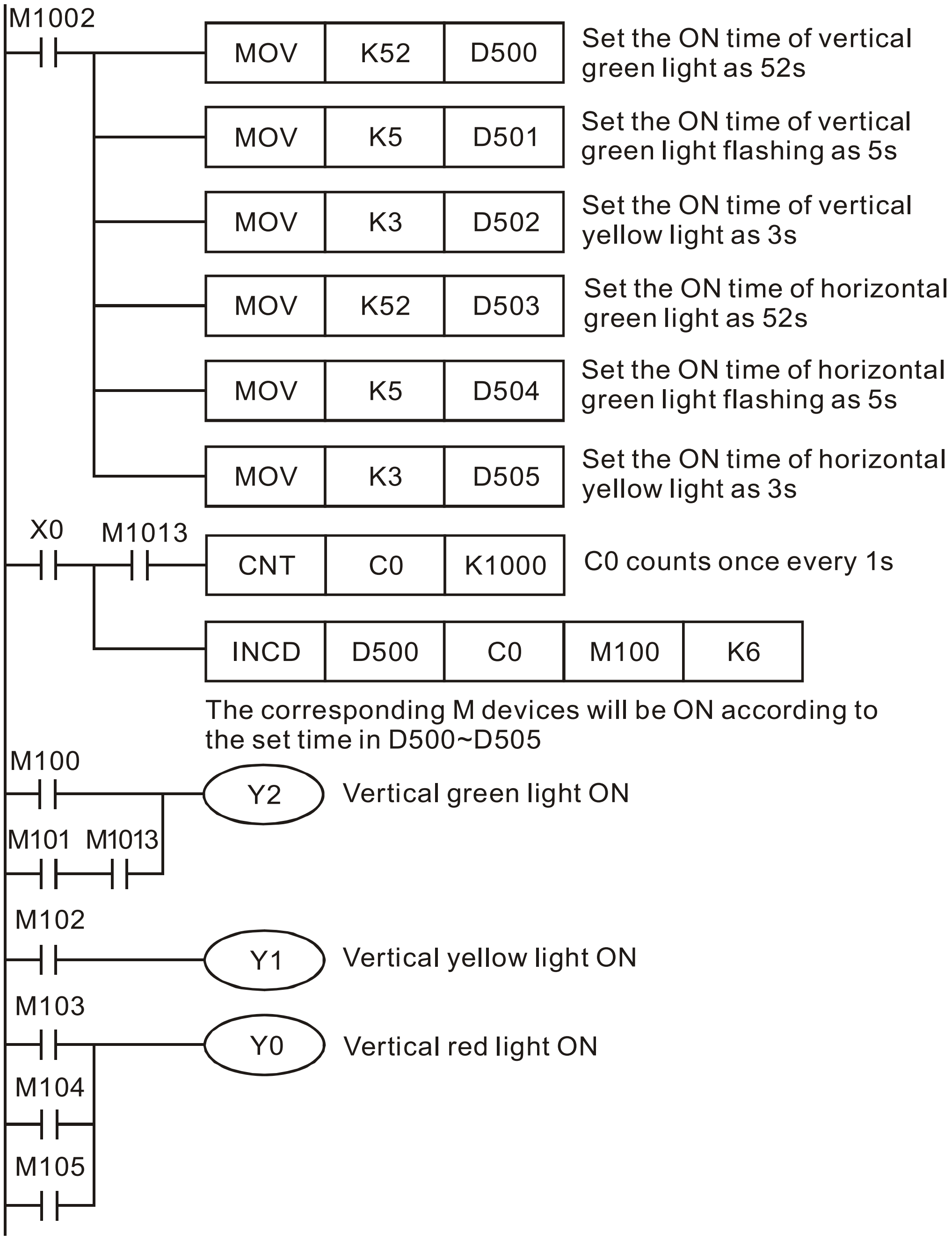
- Performing traffic lights sequence control at the intersection. In both vertical and horizontal directions, the traffic lights are set as the following sequence: Red lights ON for 60s , Yellow lights ON for 3s and green lights ON for 52s and green lights flashing for 5s.
- The timing diagrams are as follows:



Devices:

Device	Function
X1	Switch of the traffic lights control program
Y0	Red light (vertical)
Y1	Yellow light (vertical)
Y2	Green light (vertical)
Y10	Red light (horizontal)
Y11	Yellow light (horizontal)
Y12	Green light (horizontal)

Control Program:



Set the ON time of vertical green light as 52s

Set the ON time of vertical green light flashing as 5s

Set the ON time of vertical yellow light as 3s

Set the ON time of horizontal green light as 52s

Set the ON time of horizontal green light flashing as 5s

Set the ON time of horizontal yellow light as 3s

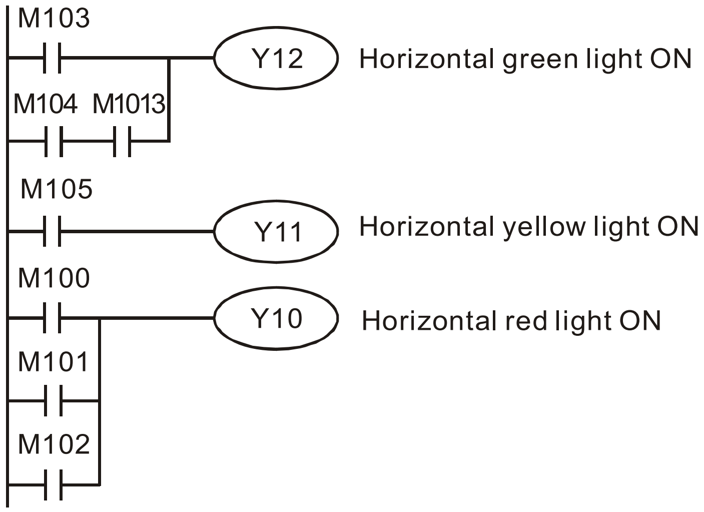
C0 counts once every 1s

The corresponding M devices will be ON according to the set time in D500~D505

Vertical green light ON

Vertical yellow light ON

Vertical red light ON



Program Description:

- “Incremental Drum Sequencer” is a concept performing repetitive step-by-step process. In this program, when present value in counter C0 reaches the set value in D 500~D505, the corresponding output devices M100~M105 will be ON and counter C0 will be reset for executing next step.
- In order to simplify the program, INCD (Incremental Drum Sequencer) instruction is used here to control the traffic lights.
- Before the execution of INCD instruction, use MOV instruction to write all the set values into D500 ~ D505 in advance.

Set value	Output device	Set value	Output device
D500 = 52	M100	D503 = 52	M103
D501 = 5	M101	D504 = 5	M104
D502 = 3	M102	D505 = 3	M105

15.4 ABSD - Adding Materials in Different Intervals (Absolute Drum Sequencer)

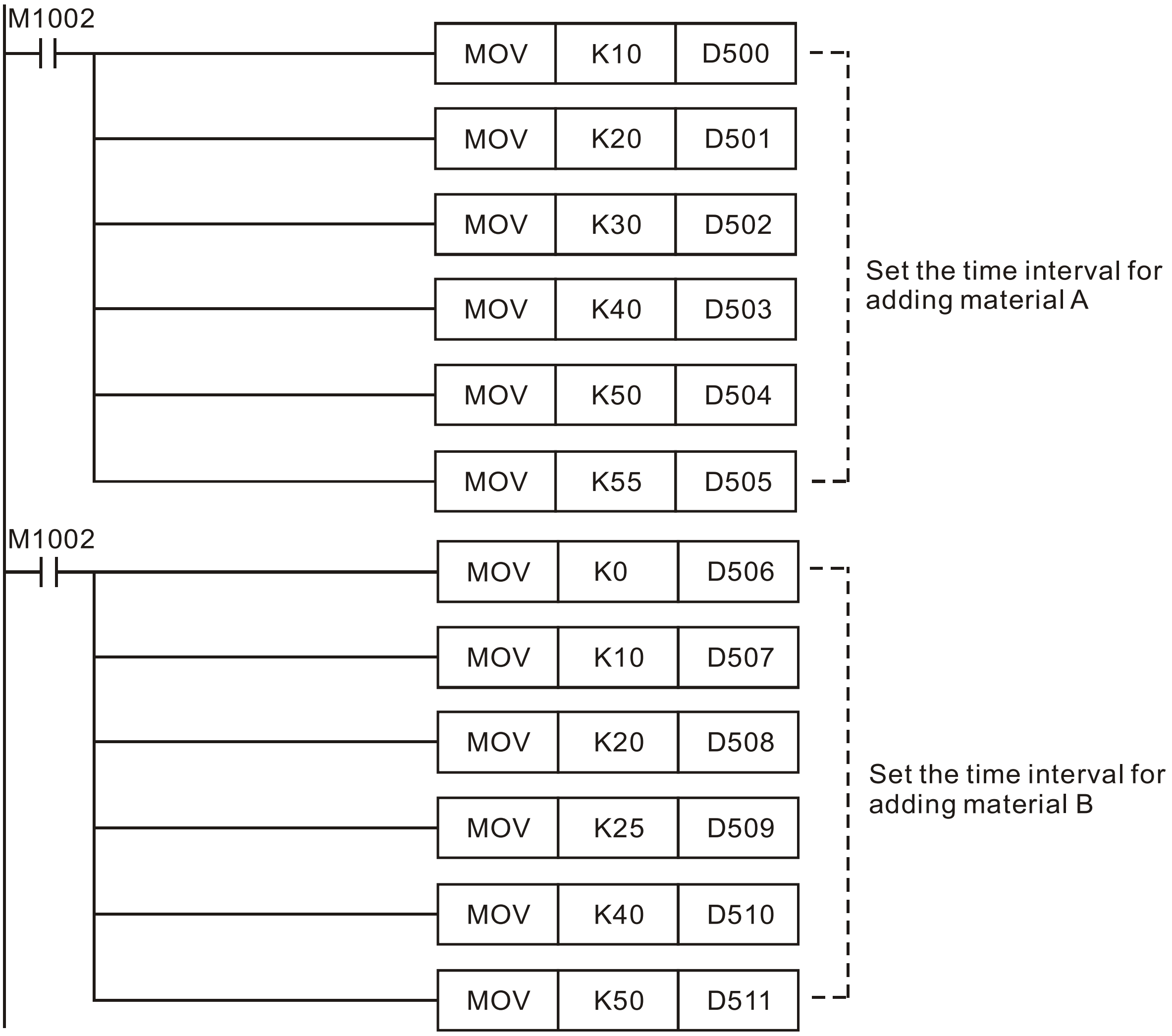
Control Purpose:

- Adding A, B, C materials for production during specified intervals within 60 sec.
- Adding material A in the intervals of 10s~20s, 30s~40s and 50~55s, material B in the interval of 0~10s, 20s~25s and 40s~50s, and material C in the interval of 20s~25s, 30s~35s and 40s~45s.

Devices:

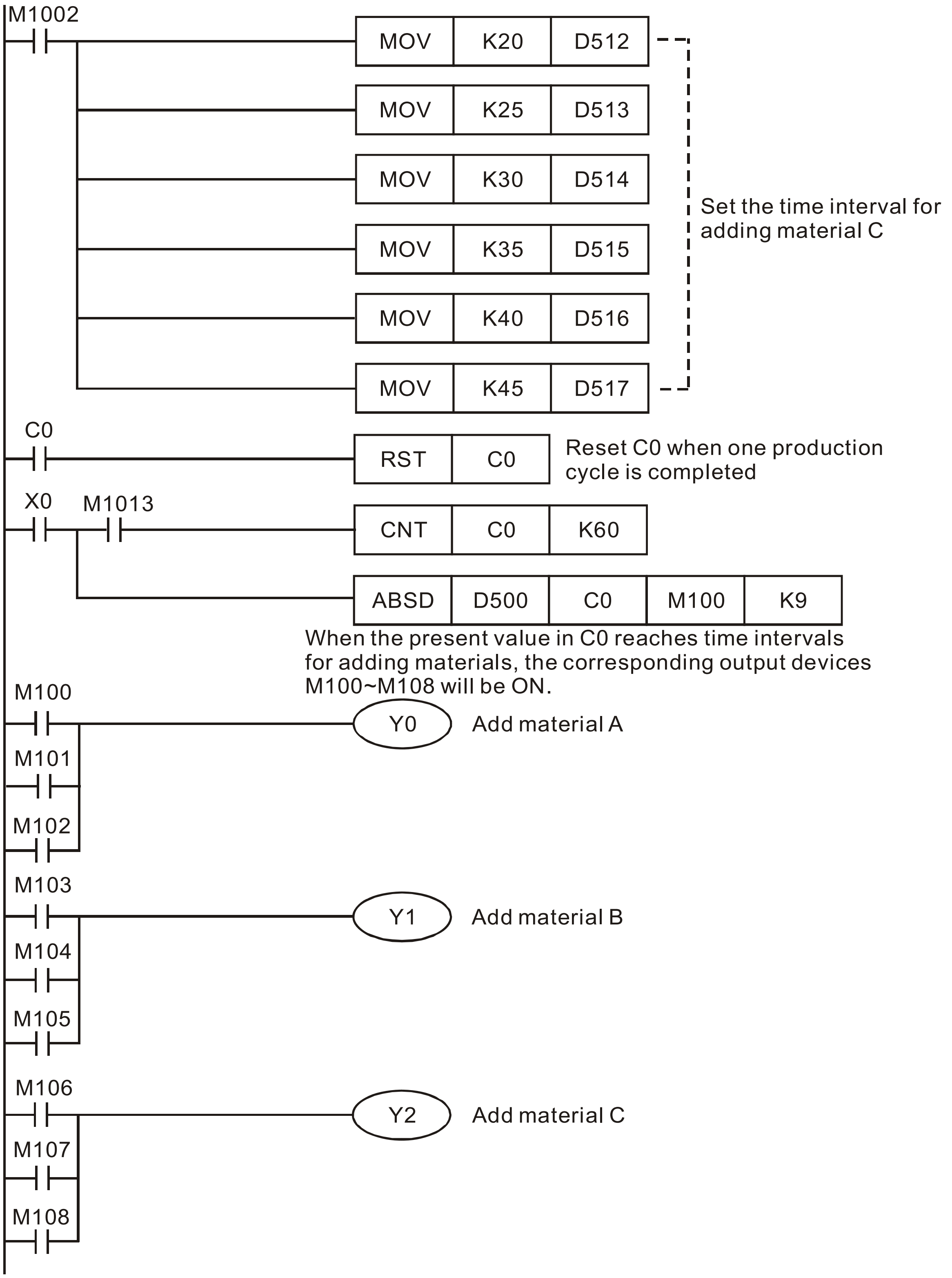
Device	Function
X0	Switch of material adding control program
Y0	Adding material A
Y1	Adding material B
Y2	Adding material C

Control Program:



Set the time interval for adding material A

Set the time interval for adding material B



Set the time interval for adding material C

Reset C0 when one production cycle is completed

When the present value in C0 reaches time intervals for adding materials, the corresponding output devices M100~M108 will be ON.

Add material A

Add material B

Add material C

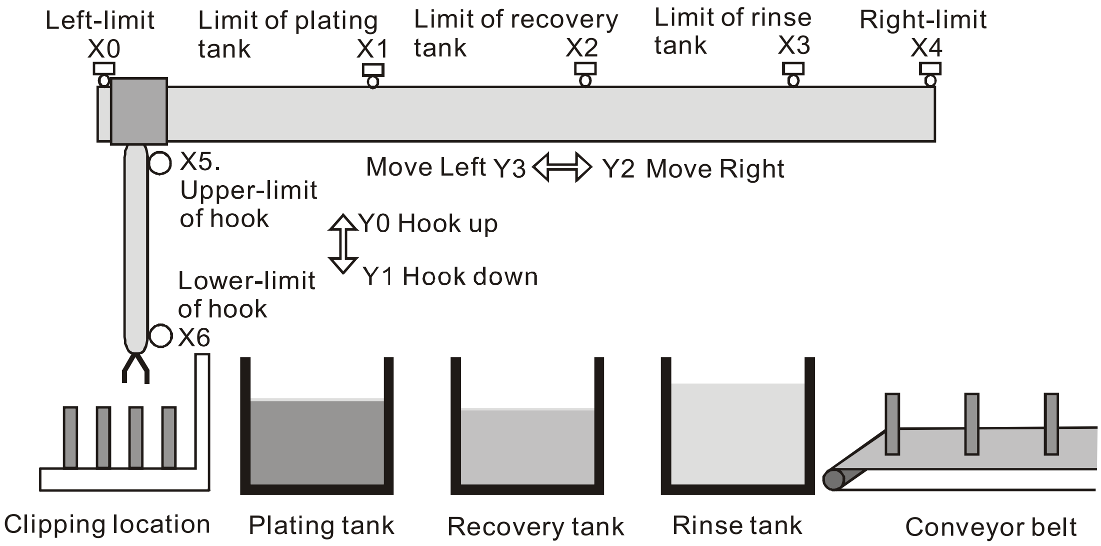
Program Description:

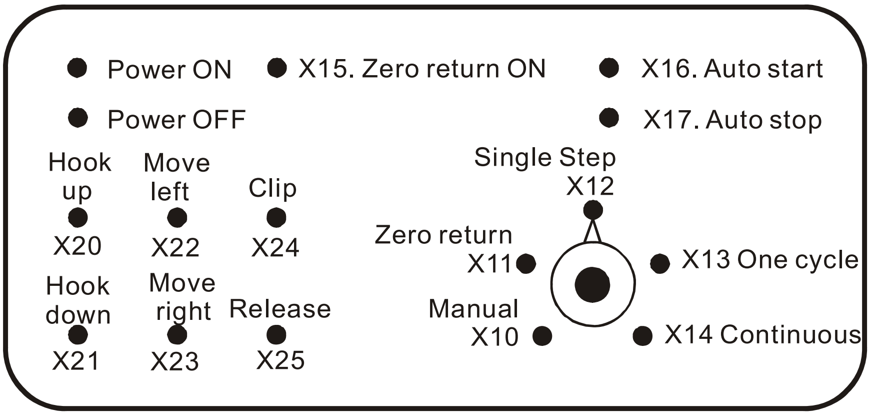
- "Absolute Drum Sequencer" is a concept performing repetitive process consists of multiple steps which could be executed in the same interval. In this program, when present value in counter C0 reaches the set value in D 500~D517, the corresponding output devices M100~M108 will be ON to execute specified actions within single interval.
- Before the execution of ABSD instruction, use MOV instruction to write all the set values into

D500 ~ D517 in advance.

Set value	Output device	Set value	Output device
D500 = 10	M100	D509 = 25	M104
D501 = 20	M100	D510 = 40	M105
D502 = 30	M101	D511 = 50	M105
D503 = 40	M101	D512 = 20	M106
D504 = 50	M102	D513 = 25	M106
D505 = 55	M102	D514 = 30	M107
D506 = 0	M103	D515 = 35	M107
D507 = 10	M103	D516 = 40	M108
D508 = 20	M104	D517 = 45	M108

15.5 IST - Electroplating Process Auto Control





Control Purpose:

- Applying PLC on auto control process of PCB electroplating. There is a traveling crane equipped with a lifting hook in the production line. The hook has a clip for clipping and releasing the workpiece. The traveling crane and the lifting hook are controlled by 2 motors and a control panel. In addition, there are plating tank, recovery tank and rinse tank in the process of plating workpiece, recycling plating solution and cleaning workpiece.
- Process:
  Clip the workpiece → Put it in the plating tank for 280 minutes → lift it to the upper-limit and stay for 28s → soak it in the recovery tank for 30 minutes → lift it to the upper-limit and stay for 15s → clean it in the rinse tank for 30s → lift it to the upper-limit and stay for 15s → put it on the conveyor belt.
- 3 operation modes:
  Manual: select manual mode (X10 = ON) and enable/disable output devices by controlling corresponding switches (X20~X25).
  Zero return: select zero return mode (X11 = ON) and press the zero return button X15 to execute this function.

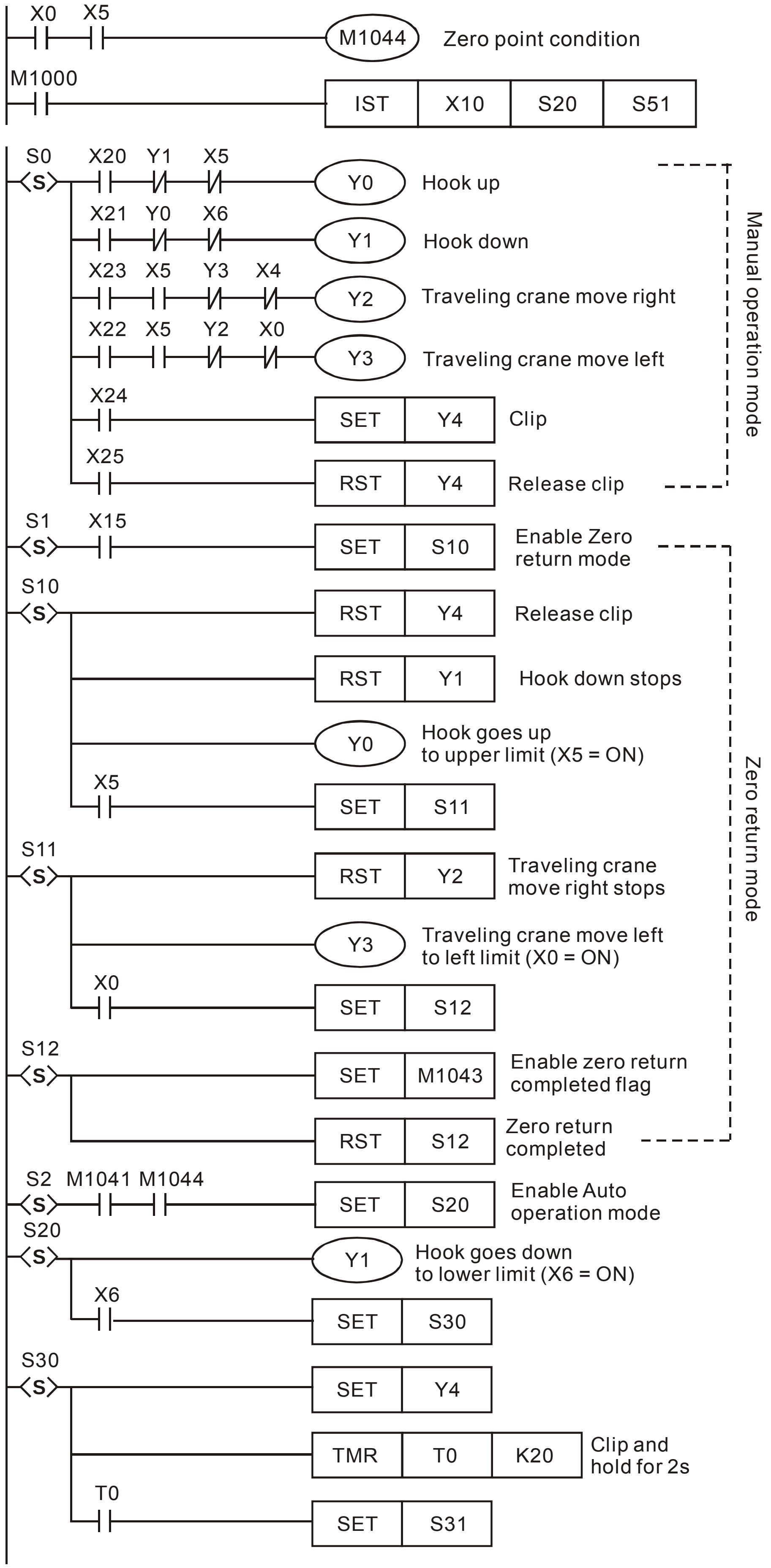
Auto: (Single step/One cycle/Continuous)

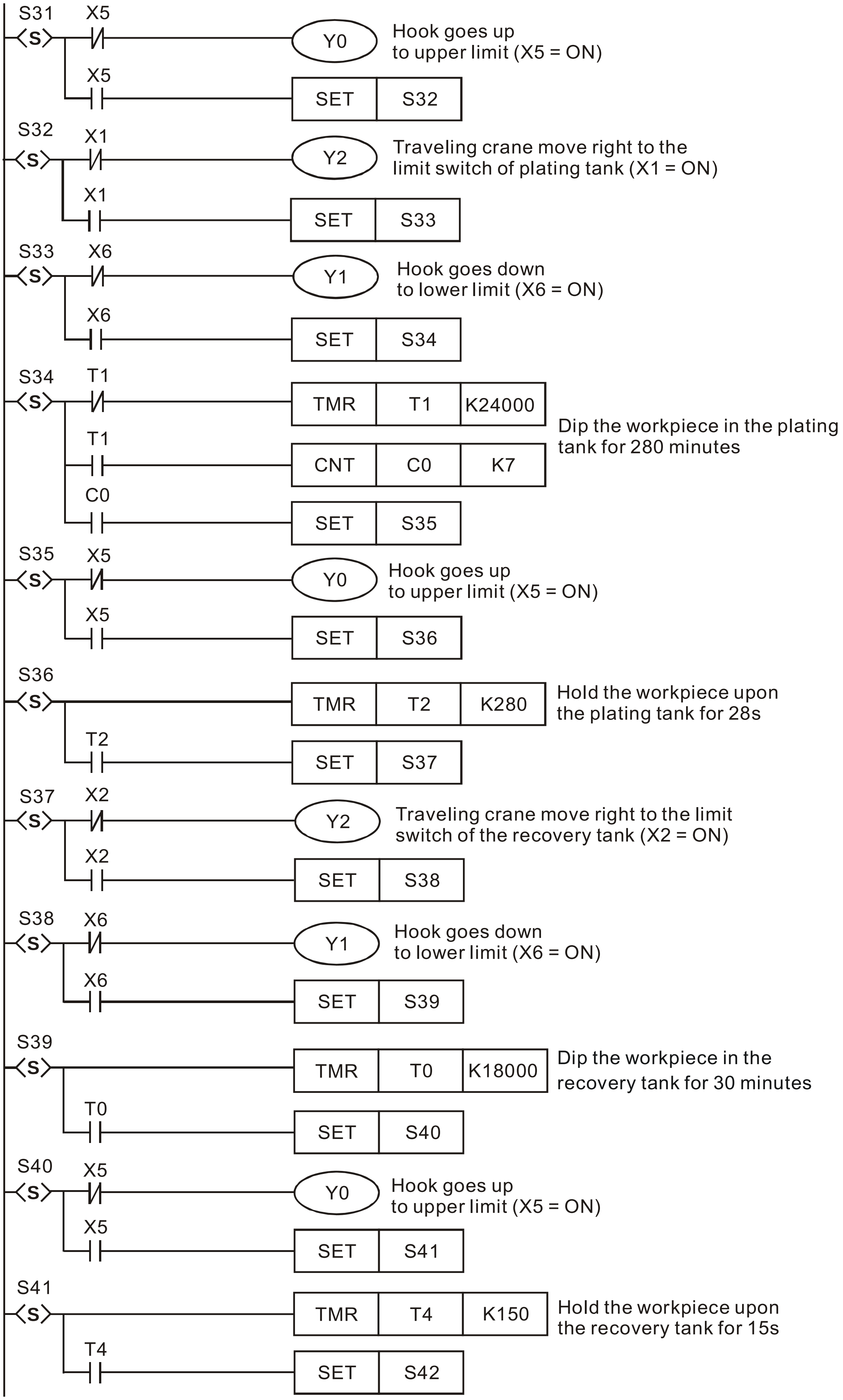
1. Single step operation: select Single step (X12 = ON). Execute one step when pushing Auto start (X16) one time.
2. One cycle operation: select One cycle (X13 = ON). Press Auto start (X16) at the zero point and the program will execute one cycle of plating process. If Auto stop (X17) is pressed, the process will be stopped. The program will continue to finish the cycle if Auto start is pressed again.
3. Continuous operation: select Continuous (X14 = ON). Press Auto start (X16) at the zero point and the program will perform continuous plating process for cycles until Auto stop (17) is pressed. If Auto stop is pressed, the program will finish the cycle and stop at zero point.

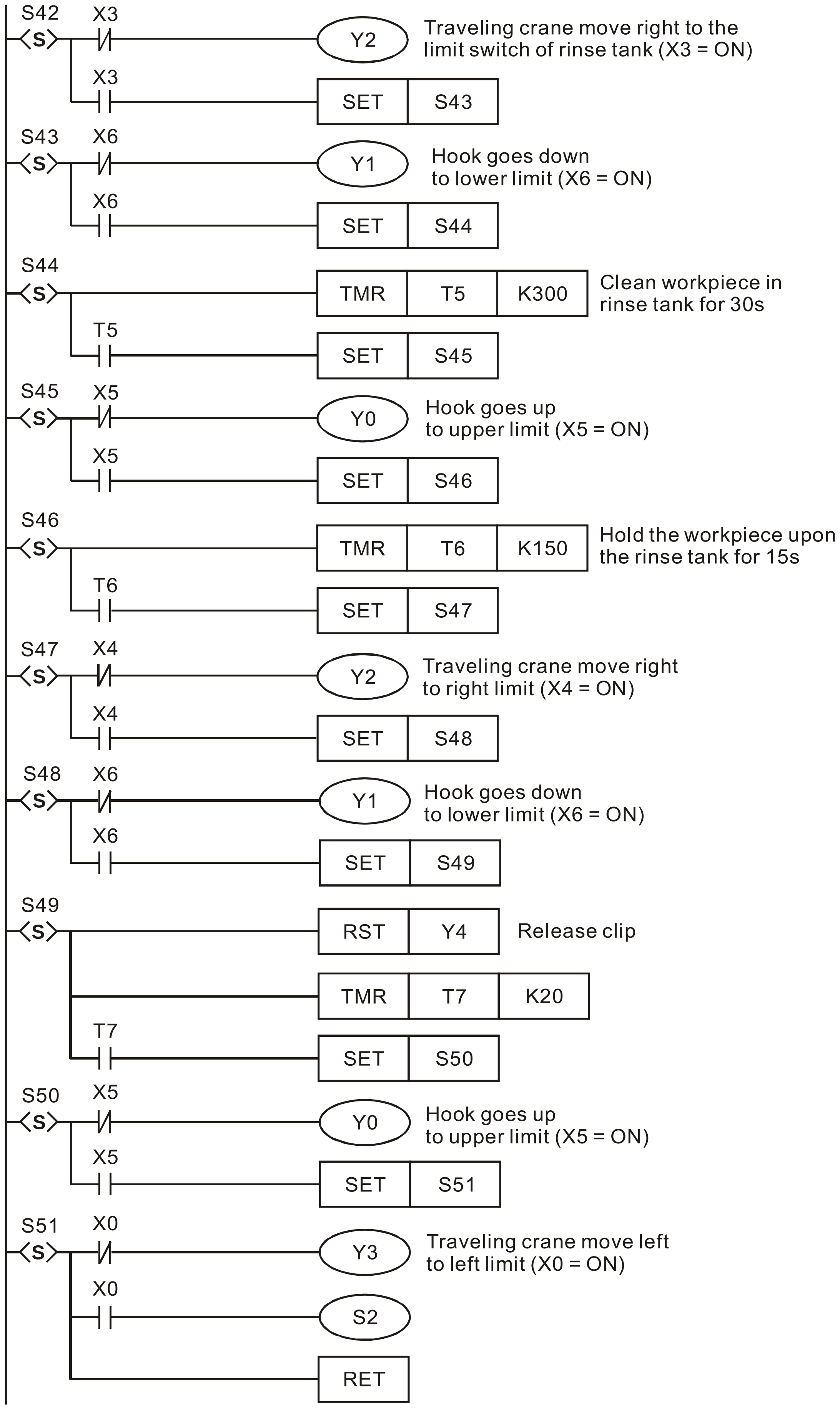
Devices:

Device	Function
X0	X0 = ON when the left-limit switch is activated.
X1	X1 = ON when the limit switch of plating tank is activated.
X2	X2 = ON when the limit switch of recovery tank is activated.
X3	X3 = ON when the limit switch of rinse tank is activated.
X4	X4 = ON when the right-limit switch is activated.
X5	X5 = ON when the upper-limit switch of lifting hook is activated.
X6	X6 = ON when the lower-limit switch of lifting hook is activated.
X10	X10 = ON when Manual mode is selected
X11	X11 = ON when Zero return mode is selected
X12	X12 = ON when Single step mode is selected
X13	X13 = ON when One cycle mode is selected
X14	X14 = ON when Continuous mode is selected
X15	X15 = ON when Zero return ON is pressed.
X16	X16 = ON when Auto start is pressed.
X17	X17 = ON when Auto stop is pressed.
X20	X20 = ON when Hook up is pressed.
X21	X21 = ON when Hook down is pressed.
X22	X22 = ON when Move left is pressed.
X23	X23 = ON when Move right is pressed.
X24	X24 = ON when Clip is pressed.
X25	X25 = ON when Release is pressed
Y0	Hook up
Y1	Hook down
Y2	Move right
Y3	Move left
Y4	Clipping

Control Program:




S31
X5
Y0
Hook goes up to upper limit (X5 = ON)
X5
SET S32
S32
X1
Y2
Traveling crane move right to the limit switch of plating tank (X1 = ON)
X1
SET S33
S33
X6
Y1
Hook goes down to lower limit (X6 = ON)
X6
SET S34
S34
T1
TMR T1 K24000
Dip the workpiece in the plating tank for 280 minutes
T1
CNT C0 K7
C0
SET S35
S35
X5
Y0
Hook goes up to upper limit (X5 = ON)
X5
SET S36
S36
TMR T2 K280
Hold the workpiece upon the plating tank for 28s
T2
SET S37
S37
X2
Y2
Traveling crane move right to the limit switch of the recovery tank (X2 = ON)
X2
SET S38
S38
X6
Y1
Hook goes down to lower limit (X6 = ON)
X6
SET S39
S39
TMR T0 K18000
Dip the workpiece in the recovery tank for 30 minutes
T0
SET S40
S40
X5
Y0
Hook goes up to upper limit (X5 = ON)
X5
SET S41
S41
TMR T4 K150
Hold the workpiece upon the recovery tank for 15s
T4
SET S42


S42
X3
Y2
Traveling crane move right to the limit switch of rinse tank (X3 = ON)
X3
SET S43
S43
X6
Y1
Hook goes down to lower limit (X6 = ON)
X6
SET S44
S44
TMR T5 K300
Clean workpiece in rinse tank for 30s
T5
SET S45
S45
X5
Y0
Hook goes up to upper limit (X5 = ON)
X5
SET S46
S46
TMR T6 K150
Hold the workpiece upon the rinse tank for 15s
T6
SET S47
S47
X4
Y2
Traveling crane move right to right limit (X4 = ON)
X4
SET S48
S48
X6
Y1
Hook goes down to lower limit (X6 = ON)
X6
SET S49
S49
RST Y4
Release clip
TMR T7 K20
T7
SET S50
S50
X5
Y0
Hook goes up to upper limit (X5 = ON)
X5
SET S51
S51
X0
Y3
Traveling crane move left to left limit (X0 = ON)
X0
S2
RET
S

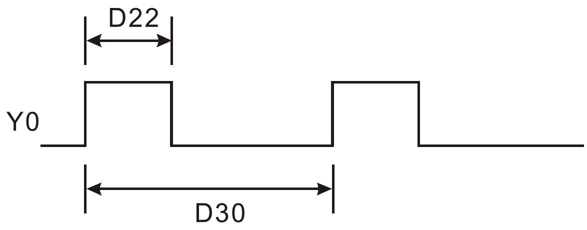
Program Description:

- The program uses Auto/Manual control instructions (IST) to perform auto control process of PCB electroplating. When IST instruction is applied, S10 ~ S19 can not be used as general step points, but only can be used for zero return. When S0 ~ S9 are in use, S0 ~ S2 are specified for manual operation mode, zero return mode and auto operation mode. Therefore, the content of the 3 steps should be designed first in this program.
- When zero return mode is selected, no zero return action will occur if any step between S10 ~ S19 is ON. When auto mode is selected, no action will occur if any step in Auto mode is ON or if M1043 is ON.

15.6 FTC - Fuzzy Temperature Control of the Oven

Control Purpose:

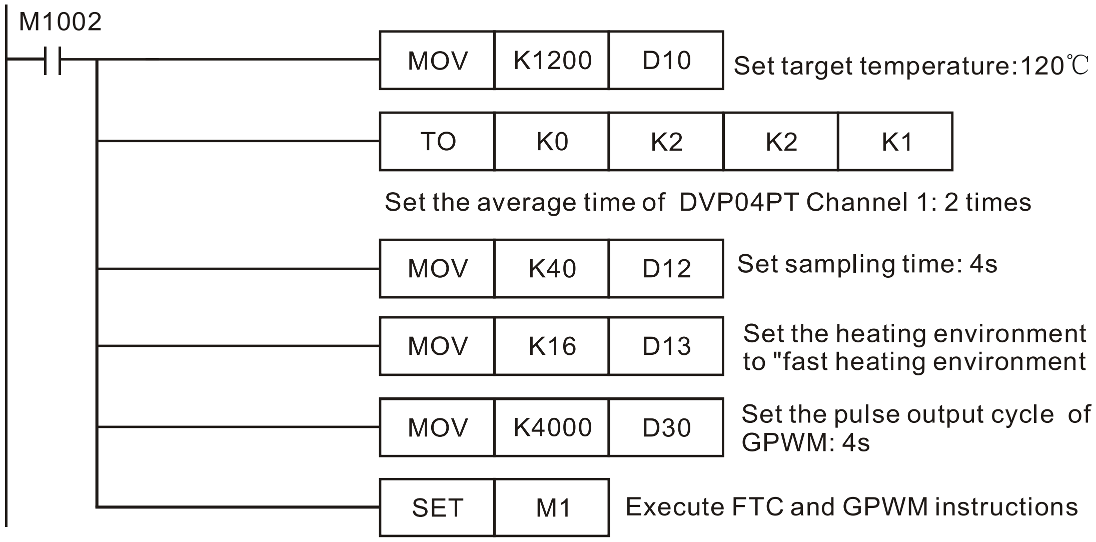
- The heating environment of the oven is “fast heating environment” (D13 = K16) and the target temperature is 120℃ (D10 = K1200). In order to get the best control results, the program uses FTC together with GPWM instructions to perform fuzzy temperature control.
- Apply DVP04PT-S temperature measurement module for measuring the present temperature of the oven and transferring the result to DVP12SA. After execution of FTC instruction, PLC outputs the operation results in D22 to the input of GPWM instruction. GPWM instruction outputs width modulatable pulses (width determined by D22) by Y0 to control the heater and fuzzy temperature control of the oven is completed.



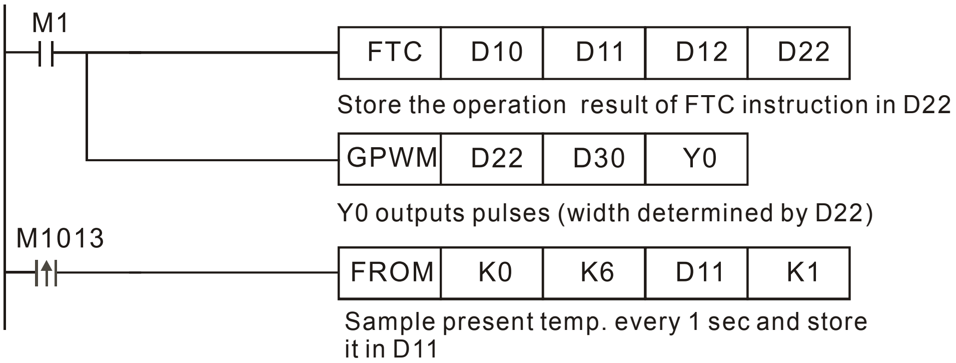
Devices:

Device	Function
M1	Enabling the execution of FTC instruction
Y0	PWM Pulse output device
D10	Storing the target temperature
D11	Storing the present temperature
D12	Storing FTC sampling time parameter
D13	Storing FTC temperature control parameter
D22	Storing the operation results of FTC instruction
D30	Storing the pulse output cycle of GPWM instruction

Control Program:



```
M1002
MOV K1200 D10        Set target temperature:120℃
TO K0 K2 K2 K1       Set the average time of  DVP04PT Channel 1: 2 times
MOV K40 D12          Set sampling time: 4s
MOV K16 D13          Set the heating environment
                     to "fast heating environment
MOV K4000 D30        Set the pulse output cycle  of
                     GPWM: 4s
SET M1               Execute FTC and GPWM instructions
```


M1
FTC
D10
D11
D12
D22
Store the operation result of FTC instruction in D22
GPWM
D22
D30
Y0
Y0 outputs pulses (width determined by D22)
M1013
FROM
K0
K6
D11
K1
Sample present temp. every 1 sec and store it in D11

Program Description:

- FTC instruction is a handy instruction exclusively designed for temperature control. Unlike the large amount of parameters required by PID instruction, users only need to set a few parameters.
- Format of FTC instruction:

FTC	S_1	S_2	S_3	D

S_1 → Set value (SV) (Range:1~5000, shown as 0.1°~500°)

S_2 → Present value (PV) (Range:1~5000, shown as 0.1°~500°)

S_3 → Parameter (Users need to set parameters S_3 and S_3＋1)

D → Output value (MV) (Range: 0 ~ S_3*100)

- Setting of S_3 and S_3＋1:

Device	Function	Range
S_3	Sampling time (Ts)	1~200 (unit: 100ms)
S_3＋1	b0: temperature unit b1: filter function b2: heating environment b3~b15: reserved	b0 = 0 means ℃; b0 = 1 means ℉
		b1 = 0 means without filter function; b1 = 1 means with filter function
		b2 = 1 Slow heating environment
		b3 = 1 General heating environment
		b4 = 1 Fast heating environment
		b5 = 1 High-speed heating environment

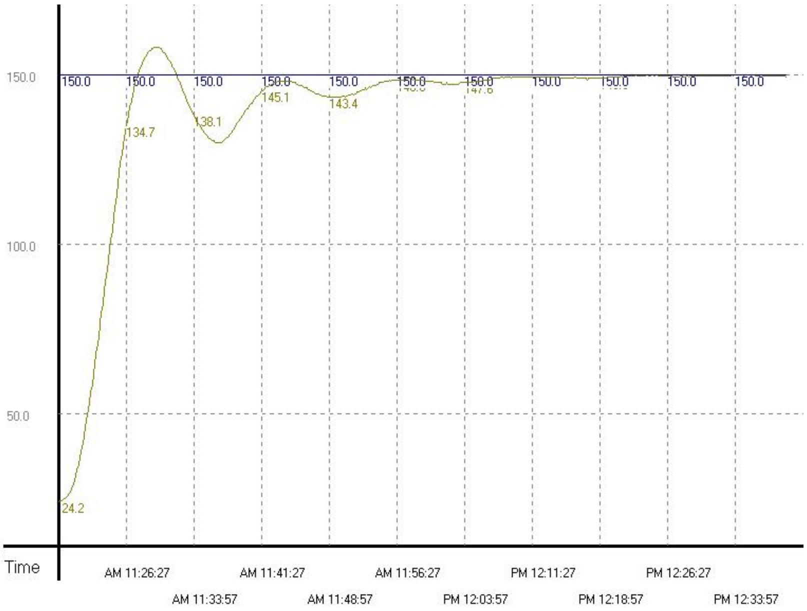
- In practical application, users usually need to adjust S_3 and S_3＋1 several times to get the best control results. The basic rules are as follows:
  1. Sampling time should be set to 2 times more than the sampling time of the temperature sensor, generally between 2s ~6s.
  2. The cycle time of GPWM instruction is the same with the sampling time of FTC instruction, but the unit for GPWM cycle time is 1ms.
  3. Properly decrease SV of the sampling time if the control duration is too long.
  4. Properly increase SV of the sampling time if the fluctuations occur frequently.
  5. “General heating environment” (b3 = 1) is the default setting for the heating

environment (bit2~bit5 of S_3＋1).

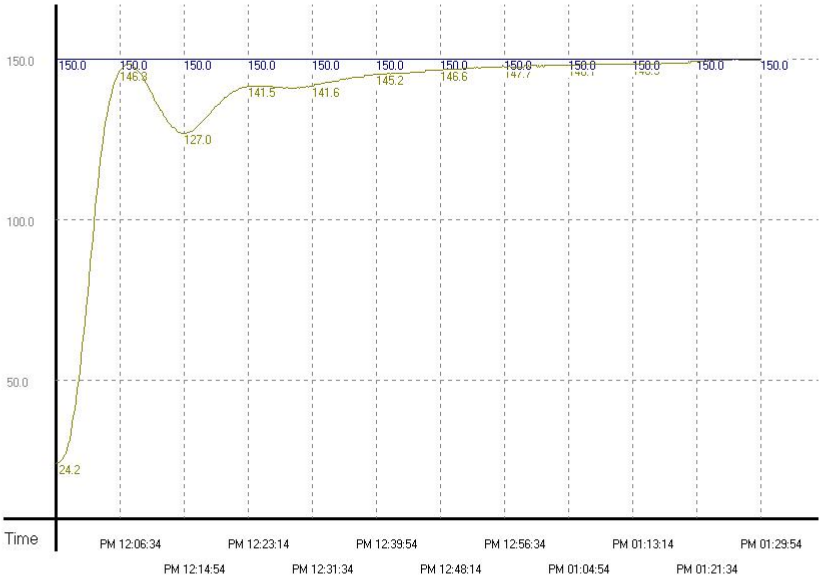
6. Select “slow heating environment” (b2 = 1) if the control duration is too long.
7. Select “fast heating environment” (b4 = 1) if overheating or fluctuations occur.

- Adjustment of parameters S_3 and S_3＋1:

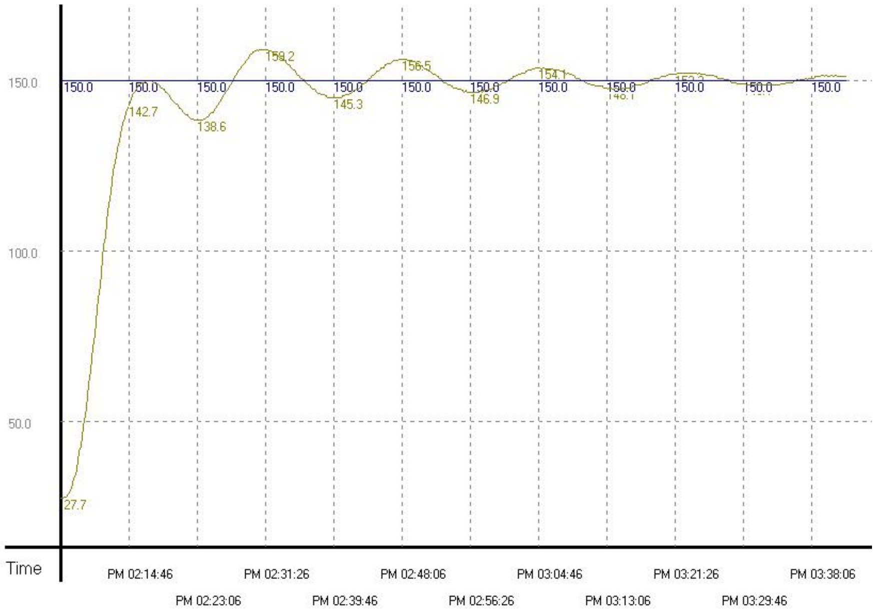
  Assume parameters S_3 and S_3＋1 of FTC instruction are set as D12 = K60 (6s), D13 = K8 (b3 = 1) and pulse output cycle time of GPWM instruction is set as D30 = K6000 (= D12*100), the curve for the control is shown as the below diagram:



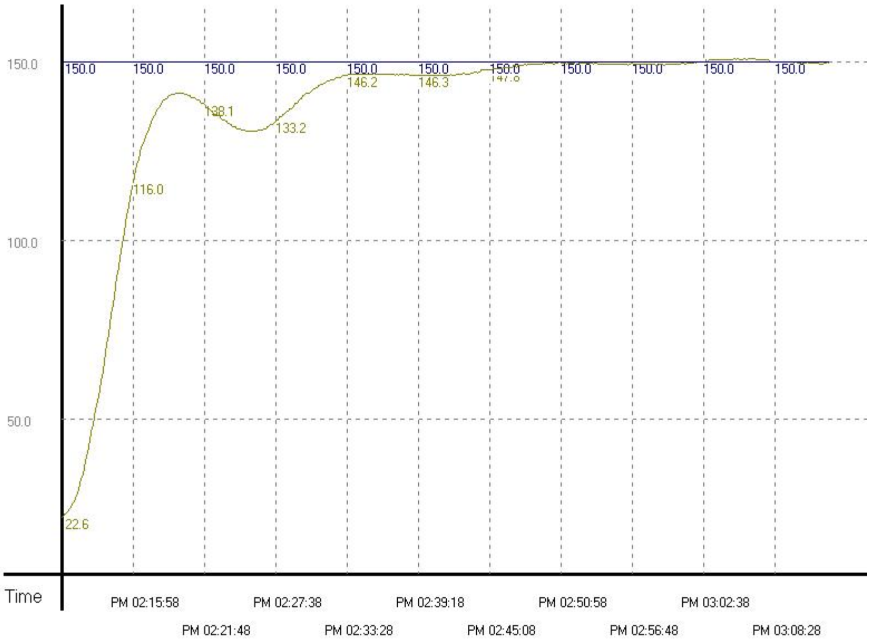
As shown in the diagram above, we can see that after about 48 minutes, the temperature is able to reach the target temperature with ±1℃ accuracy and exceed approx. 10°C of the target temperature. Due to that the temperature once exceeds the target temperature, we modify the heating environment into “fast heating environment”, i.e. D13 = K16 (b4 = 1). The results are shown in the diagram below.



From the diagram above, we see that though the temperature no longer exceeds the target temperature, it still needs to take more than 1 hour and 15 minutes to reach the target temperature with ± 1℃ accuracy. It seems that we have chosen the right environment, but the sampling time is too long, resulting in the extension of heating time. Therefore, we modify the sampling time to 2 seconds, i.e. D12 = K20 (2s) and D30 = K2000 (= D12*100). The results are shown in the diagram below.



From the diagram above, we see that the control system becomes too sensitive and leads to up and down fluctuations. Therefore, we modify the sampling time to 4s, i.e. D12 = K40 (4s) and D30 = K4000 (= D12*100). The results are shown in the diagram below.

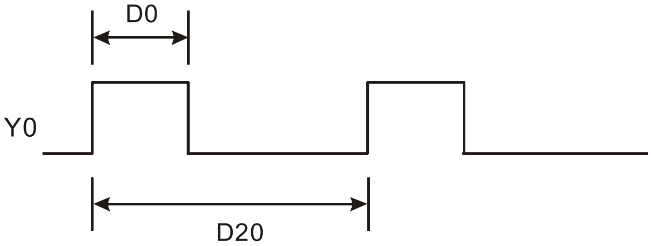


From the diagram above, we see that the overall control time has been shorten as 37 minutes and no exceeding or fluctuations occur. The basic requirements of the control system are satisfied.

15.7 PID - Oven Temperature Control (Auto-tuning for PID Temperature Control)

Control Purpose:

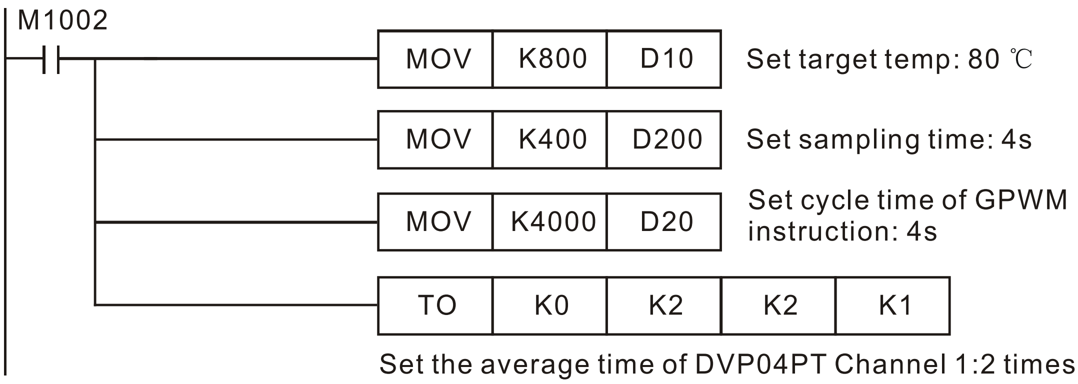
- Execute auto-tuning function of PID instruction to control the temperature of the oven when the oven is in unknown temperature environment. The target temperature is 80℃.
- Apply DVP04PT-S temperature module for measuring the present temperature of the oven and transferring the results to PLC. The PLC will execute parameter auto-tuning function (D204 = K3) to operate the best PID parameters and automatically change the control direction as “Exclusively for the adjusted temperature control” (D204 = K4).
- PLC outputs the operation results (adjusted parameter) in D0 to the input of GPWM instruction. Y0 will output PWM pulses (width determined by D0) to control the heater and PID temperature control is accomplished.

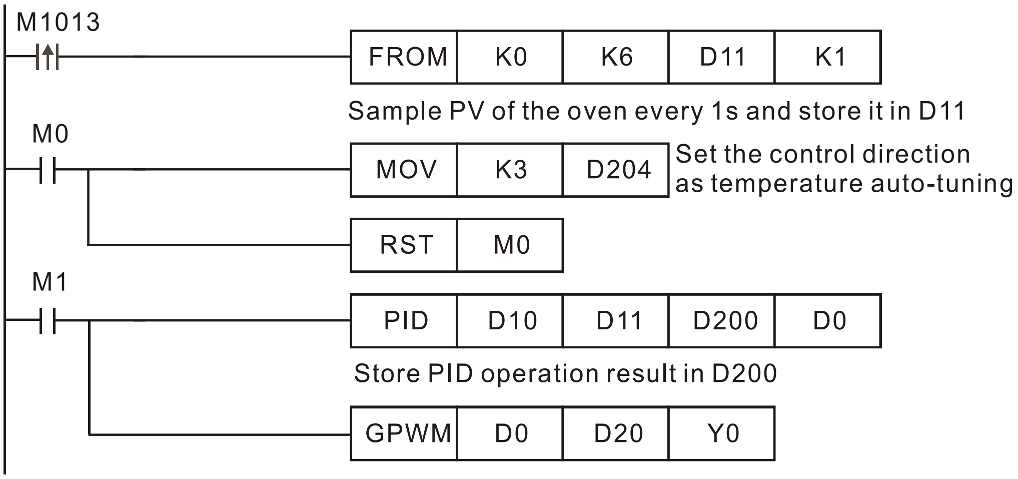


Devices:

Device	Function
M1	Executing PID instruction
Y0	Outputting adjustable pulses
D0	Storing PID operation result
D10	Storing the target temperature
D11	Storing the present temperature
D20	Storing pulse output cycle of GPWM instruction
D200	Storing PID sampling time parameter

Control Program:




M1013
FROM K0 K6 D11 K1
Sample PV of the oven every 1s and store it in D11
M0
MOV K3 D204
Set the control direction as temperature auto-tuning
RST M0
M1
PID D10 D11 D200 D0
Store PID operation result in D200
GPWM D0 D20 Y0

Program Description:

- Format of PID instruction:

PID	S_1	S_2	S_3	D

S_1 → Set value (SV)

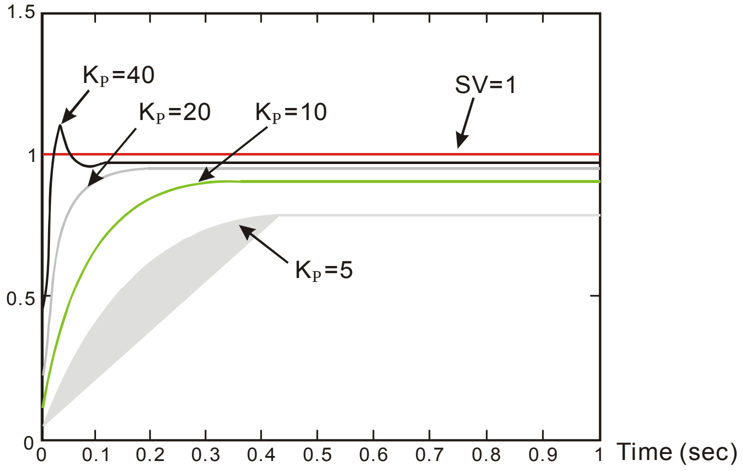
S_2 → Present value (PV)

S_3 → Parameter (Users need to set and adjust it. For the definition, refer to PID parameter table in the last part of this example)

D → Output value (MV) (D has to be the data register area with latched function)

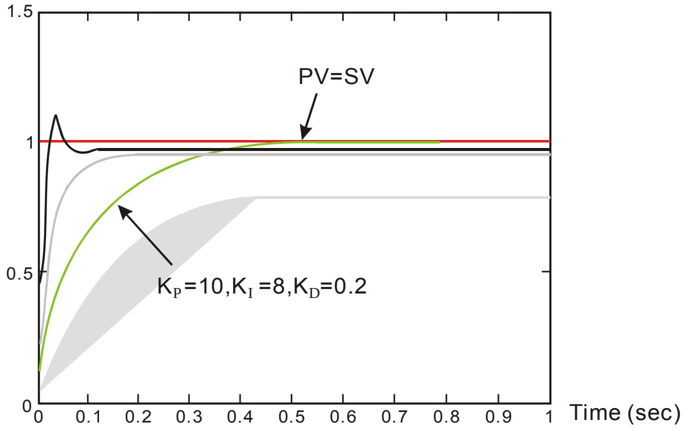
- There are a lot of circumstances where PID instruction can be applied; therefore, please choose the control functions appropriately. In this example, the parameter auto-tuning for temperature is only for the temperature control, users cannot use it in a speed or pressure control environment or errors could occur.
- Generally, adjusting control parameters of PID requires experience and repetitive tests. (except the auto-tuning function in temperature control environment) The common parameter adjusting steps are as below:

  Step 1: Set K_I and K_D as 0 and K_P as 5, 10, 20 and 40. Record the SV and PV respectively and the results are as the figure below.



Step 2: From the figure, we can see that when K_P = 40, there will be over-reaction, so we will not select it. When K_P = 20, the PV reaction curve will be close to SV and there will not be over-reaction, but due to its fast start-up with big transient MV, we will consider to put it aside. When K_P = 10, the PV reaction curve will get close to SV value more smoothly, so we will use it. Finally when K_P = 5, we will not consider it due to the slow reaction.

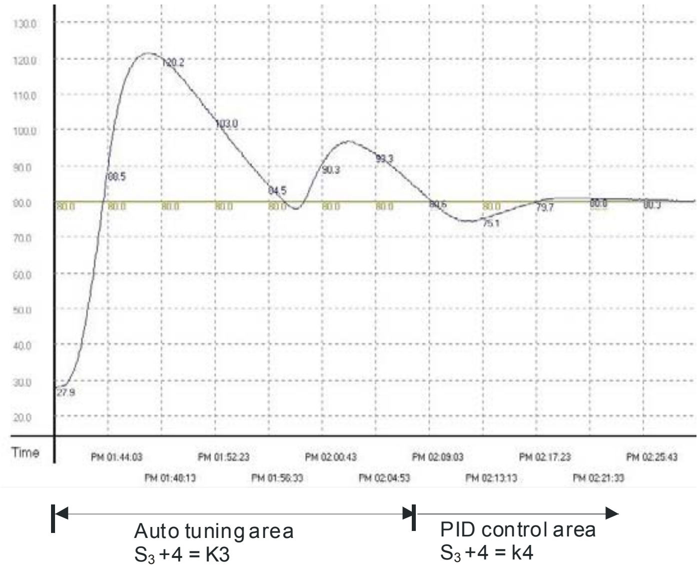
Step 3: Select K_P = 10 and adjust K_I from small to big (e.g. 1, 2, 4 to 8). K_I should not be bigger than K_P. Adjust K_D from small to big (e.g. 0.01, 0.05, 0.1 and 0.2). K_D should not exceed 10% of K_P. Finally we obtain the figure of PV and SV below.



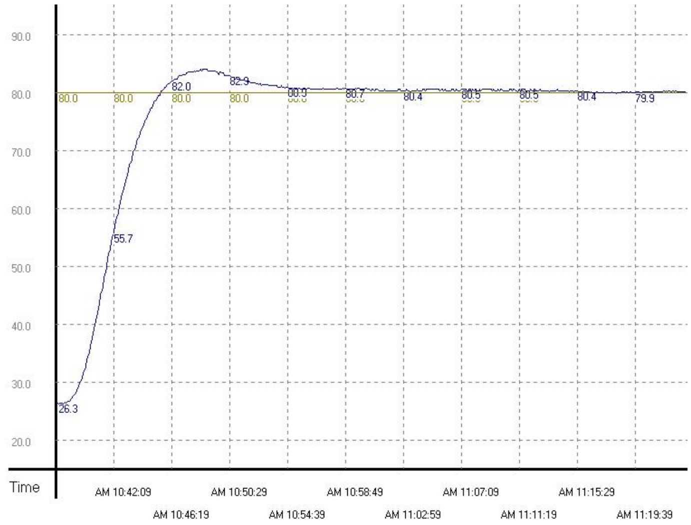
Note: This example is only for your reference. Please adjust your parameters to proper ones according to your actual condition of the control system.

- In the temperature control environment, Delta PLC provides auto-tuning on parameters of PID instruction, so users can get good control results without parameter adjusting steps . See below for the auto-tuning process in this example:

1. Initial adjustment. Operate the most suitable parameter for PID temperature control and store the result in D200~D219. See the reaction curve below:



2. Use the adjusted parameter in D200~D219 to control temperature. The curve becomes as below:



From the figure above, we can see that the temperature control after auto-tuning is working fine and we use only approximately 20 minutes for the control.

- PID sampling time should be set the same with the cycle time of GPWM instruction, but its unit is 10ms, which is different from the unit 1ms of GPWM instruction.

- Sampling time of PV should be set to 2 times more than the sampling time of PID, generally between 2s ~6s.

- PID parameter table of S3 for 16-bit instruction:

Device No.	Function	Range	Explanation
S3:	Sampling time (T_S) (unit: 10ms)	1~2,000 (unit: 10ms)	If T_S is less than 1 program scan time, PID instruction will be executed for 1 program scan time. If T_S= 0, PID instruction will not be enabled. The minimum T_S has to be longer than the program scan time.
S3 +1:	Proportional gain (K_P)	0~30,000 (%)	If SV is bigger than the max. value, the output will be the max. value.
S3 +2:	Integral gain (K_I)	0~30,000 (%)	
S3 +3:	Differential gain (K_D)	-3,000~30,000 (%)	
S3 +4:	Control direction (DIR)	0: automatic control 1: forward control (E = SV - PV) 2: inverse control (E = PV - SV) 3: Auto-tuning of parameter exclusively for the temperature control. The device will automatically become K4 when the auto-tuning is completed and be filled in with the appropriate parameter K_P, K_I and K_D (not available in the 32-bit instruction). 4: Exclusively for the adjusted temperature control (not available in the 32-bit instruction). 5: automatic control(with upper/lower bounds of integral value). Only supported by SV_V1.2 / EH2_V1.2 / SA / SA_V1.8 / SC_V1.6 or higher version PLC.	

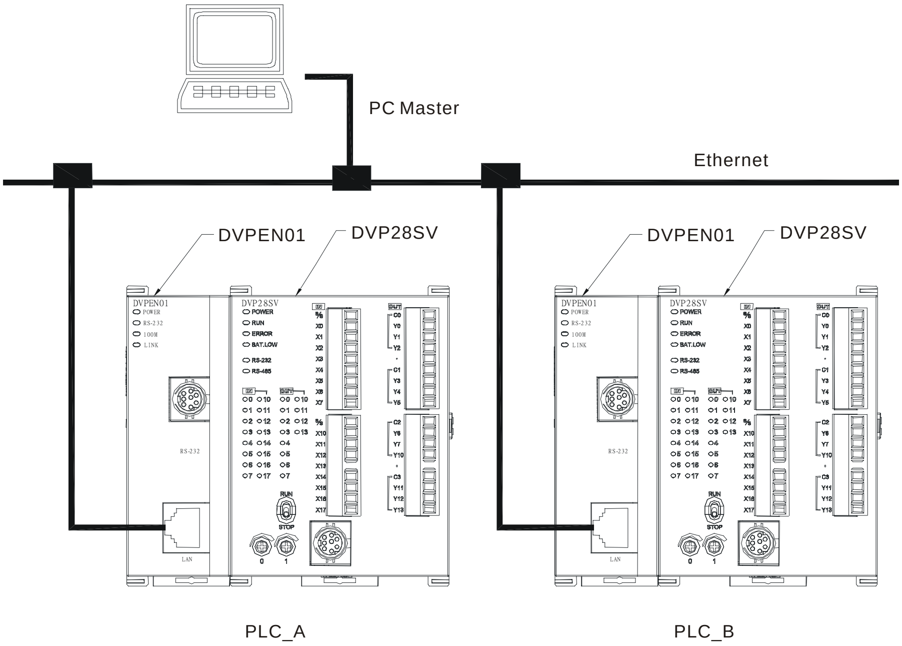
S3 +5:	The range that error value (E) doesn't work	0~32,767	Ex: when S3 +5 is set as 5, MV of E between -5 and 5 will be 0.
S3 +6:	Upper bound of output value (MV)	-32,768~ 32,767	Ex: if S3 +6 is set as 1,000, the output will be 1,000 when MV is bigger than 1,000. S3 +6 has to be bigger or equal S3 +7; otherwise the upper bound and lower bound will switch.
S3 +7:	Lower bound of output value (MV)	-32,768~ 32,767	Ex: if S3 +7 is set as -1,000, the output will be -1,000 when MV is smaller than -1,000.
S3 +8:	Upper bound of integral value	-32,768~ 32,767	Ex: if S3 +8 is set as 1,000, the output will be 1,000 when the integral value is bigger than 1,000 and the integration will stop. S3 +8 has to be bigger or equal S3 +9; otherwise the upper bound and lower bound will switch.
S3 +9:	Lower bound of integral value	-32,768~ 32,767	Ex: if S3 +9 is set as -1,000, the output will be -1,000 when the integral value is smaller than -1,000 and the integration will stop.
S3 +10,11:	Accumulated integral value	32-bit floating point	The accumulated integral value is only for reference. You can still clear or modify it (in 32-bit floating point) according to your need.
S3 +12:	The previous PV	-	The previous PV is only for reference. You can still modify it according to your need.
S3 +13: ~ S3 +19:	For system use only.		

◆ When parameter setting exceeds its range, the upper bound and lower bound will become the setting value. However, if the motion direction (DIR) exceeds the range, it will be set to 0.

◆ The maximum error of sampling time TS = - (1 scan time + 1ms) ~ + (1 scan time). When the error affects the output, please fix the scan time or execute PID instruction in the interruption subroutine of the timer.

◆ PV of PID instruction has to be stable before the execution of PID instruction. If you are to extract the input value of DVP04AD/04DA/06XA/04PT/04TC for PID operation, please be aware of the A/D conversion time of these modules.

16.1 Ethernet Connection



Control Purpose:

- Setting up network parameters of DVPEN01-SL directly on the PC
  1. (1) IP of PC executing WPLSoft: 192.168.0.3
  2. (2) Subnet mask: 255.255.255.0; Gateway: 192.168.0.1
  3. (3) Set IP of PLC_A: 192.168.0.4; PLC_B: 192.168.0.5
  4. (4) Connect the PC and DVPEN01-SL by RJ-45 cable

  Note: Both PC and DVPEN01-SL have to adopt static IP.

- Writing the time of RTC in PLC_B into D0 ~ D6 of PLC_A
  (1) Adopting static IP。

  (2) IP of PLC_A: 192.168.0.4

  (3) IP of PLC_B: 192.168.0.5

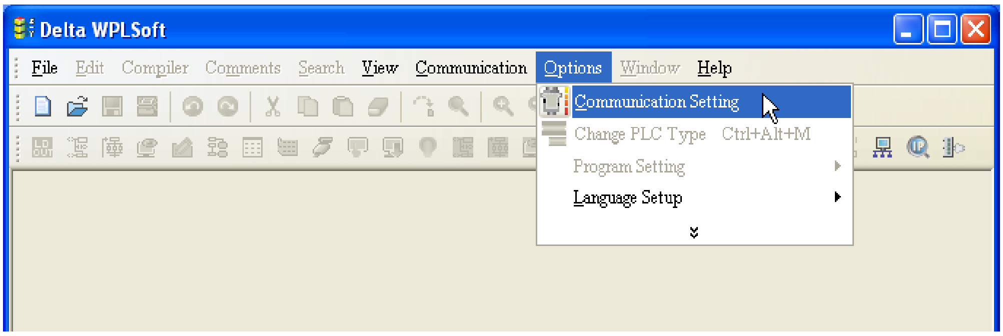
  (4) Update form PLC_B to PLC_A

Devices:

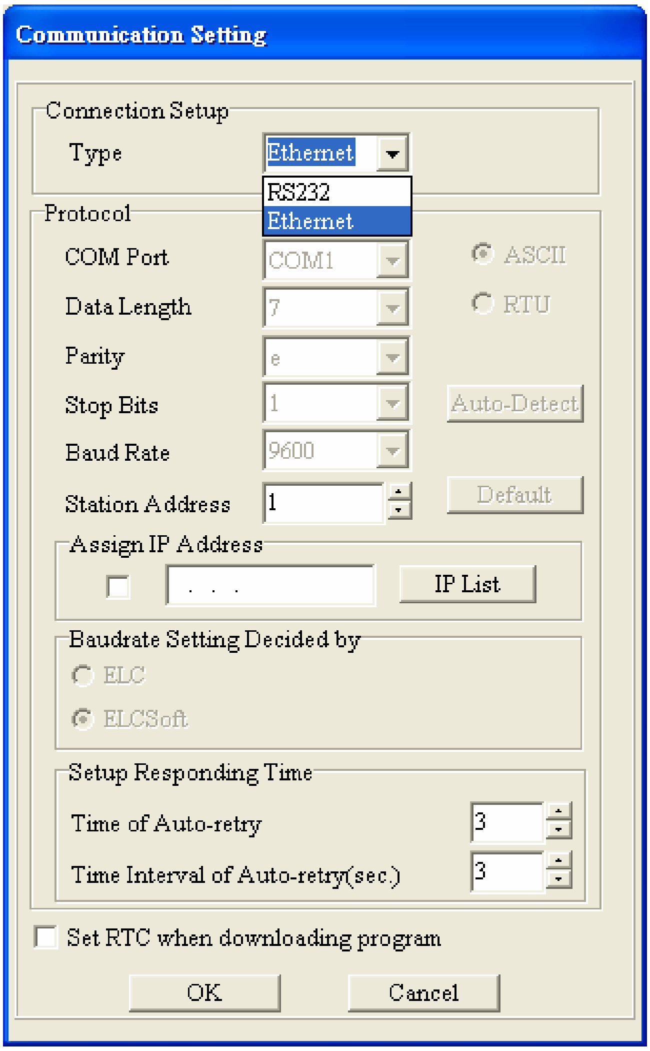
Device	Function
M1013	1s clock pulse
PLC_B M1	Write the data into DVPEN01-SL module
PLC_B M2	Check if data exchange is successfully executed.

Settings:

- Select Communication Setting in WPLSoft.



- Select Ethernet in connection setup and click OK.



Communication Setting

Connection Setup

Type: Ethernet

RS232
Ethernet

Protocol

COM Port: COM1

Data Length: 7

Parity: e

Stop Bits: 1

Baud Rate: 9600

Station Address: 1

● ASCII ○ RTU

Auto-Detect

Default

Assign IP Address

□ . . . IP List

Baudrate Setting Decided by

○ ELC

● ELCSoft

Setup Responding Time

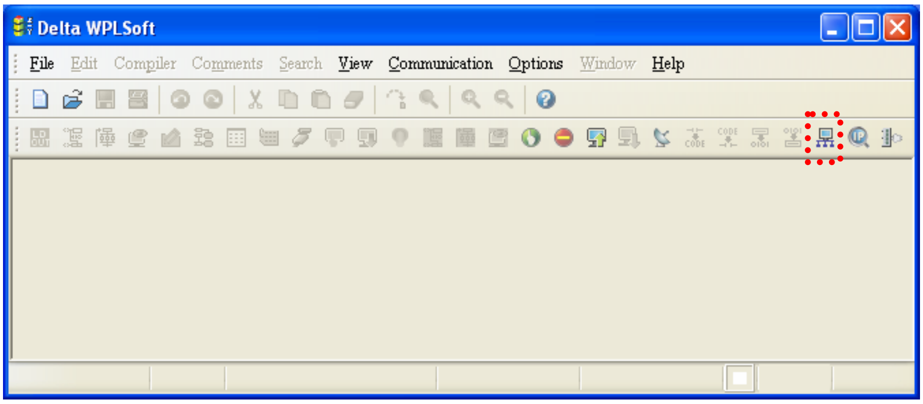
Time of Auto-retry: 3

Time Interval of Auto-retry(sec.): 3

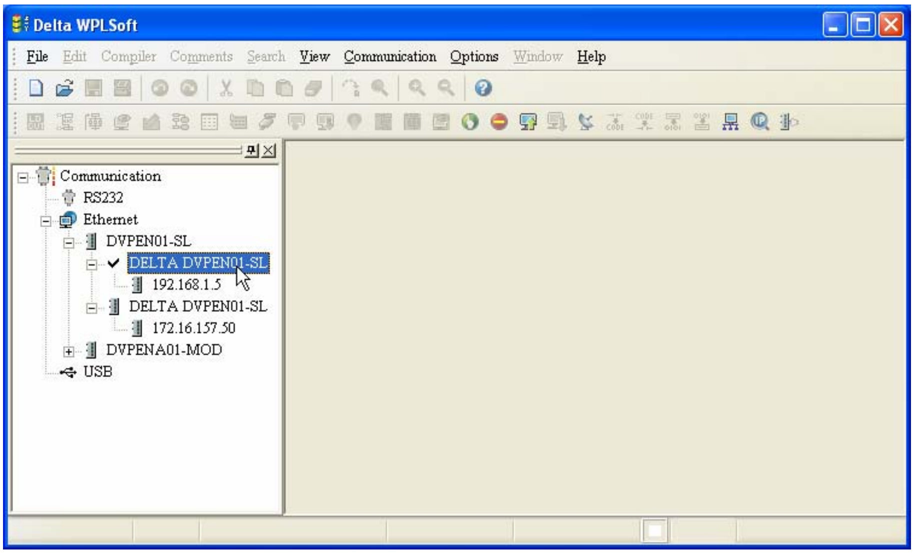
□ Set RTC when downloading program

OK Cancel

- Click Auto-Search icon to search for all DVPEN01-SL modules in the network.

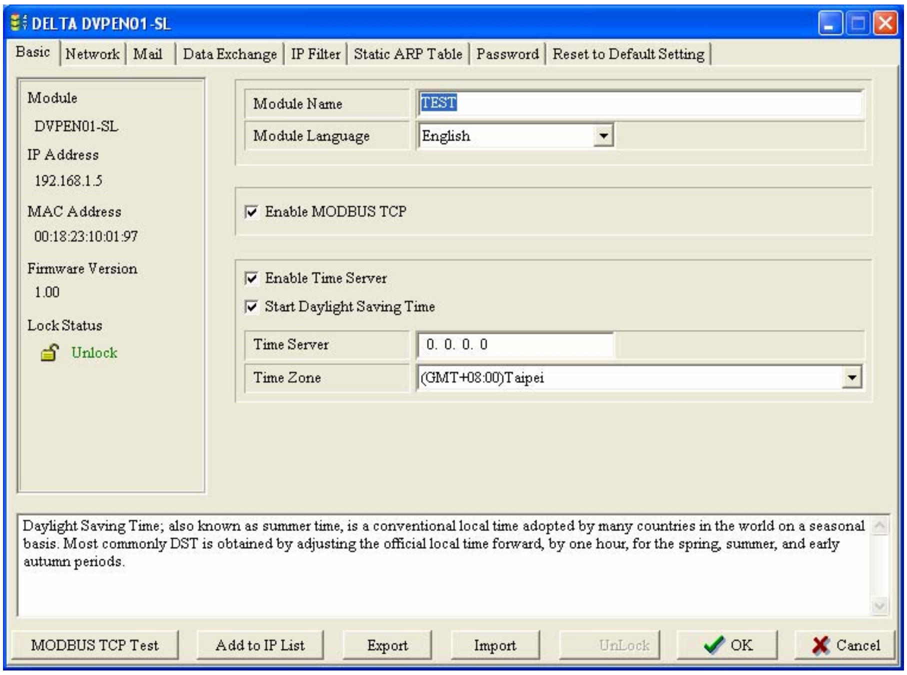

Delta WPLSoft
File Edit Compiler Comments Search View Communication Options Window Help

- Designate a DVPEN01-SL and double click to open the setup page.


Delta WPLSoft
File Edit Compiler Comments Search View Communication Options Window Help

Communication
RS232
Ethernet
DVPEN01-SL
✓ DELTA DVPEN01-SL
192.168.1.5
DELTA DVPEN01-SL
172.16.157.50
DVPENA01-MOD
USB

- The setup window will appear as below.


DELTA DVPEN01-SL
Basic | Network | Mail | Data Exchange | IP Filter | Static ARP Table | Password | Reset to Default Setting
MODBUS TCP Test | Add to IP List | Export | Import | UnLock | OK | Cancel

Module
DVPEN01-SL
IP Address
192.168.1.5
MAC Address
00:18:23:10:01:97
Firmware Version
1.00
Lock Status
Unlock

Module Name	TEST
Module Language	English

☑ Enable MODBUS TCP

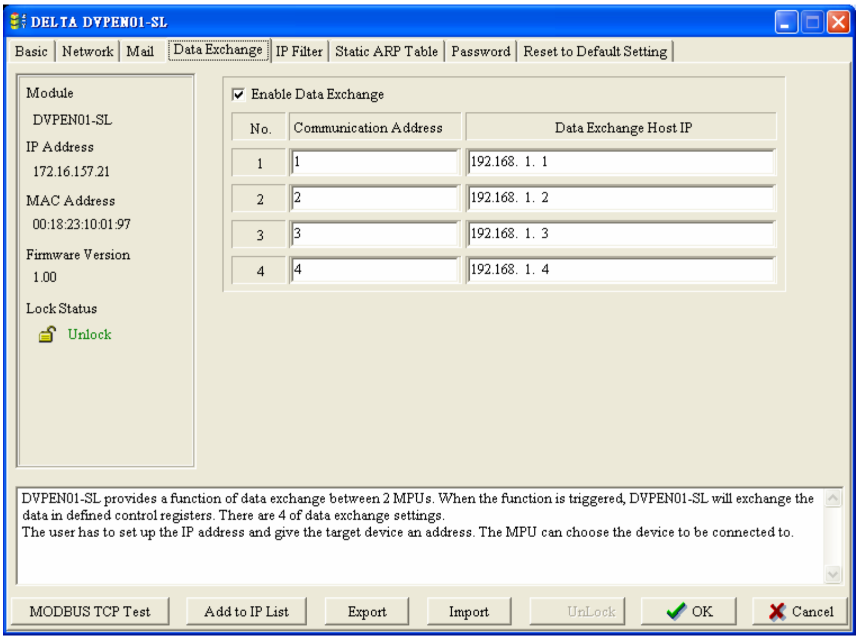
☑ Enable Time Server

☑ Start Daylight Saving Time

Time Server	0. 0. 0. 0
Time Zone	(GMT+08:00)Taipei

Daylight Saving Time; also known as summer time, is a conventional local time adopted by many countries in the world on a seasonal basis. Most commonly DST is obtained by adjusting the official local time forward, by one hour, for the spring, summer, and early autumn periods.

- Switch to Data Exchange window.


DELTA DVPEN01-SL
Basic | Network | Mail | Data Exchange | IP Filter | Static ARP Table | Password | Reset to Default Setting
MODBUS TCP Test | Add to IP List | Export | Import | UnLock | OK | Cancel

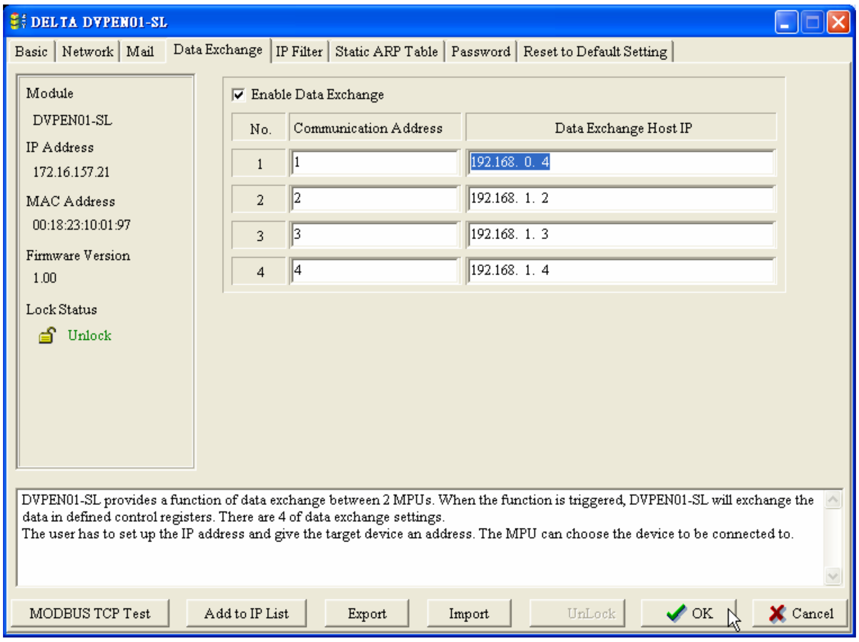
Module
DVPEN01-SL
IP Address
172.16.157.21
MAC Address
00:18:23:10:01:97
Firmware Version
1.00
Lock Status
Unlock

☑ Enable Data Exchange

No.	Communication Address	Data Exchange Host IP
1	1	192.168. 1. 1
2	2	192.168. 1. 2
3	3	192.168. 1. 3
4	4	192.168. 1. 4

DVPEN01-SL provides a function of data exchange between 2 MPUs. When the function is triggered, DVPEN01-SL will exchange the data in defined control registers. There are 4 of data exchange settings.
The user has to set up the IP address and give the target device an address. The MPU can choose the device to be connected to.

- Check Enable Data Exchange box. Enter IP address of PLC_A :192.168.0.4 in No. 1 Data Exchange Host IP column. Click OK to complete the setting.


DELTA DVPEN01-SL
Basic | Network | Mail | Data Exchange | IP Filter | Static ARP Table | Password | Reset to Default Setting
MODBUS TCP Test | Add to IP List | Export | Import | UnLock | OK | Cancel

Module
DVPEN01-SL
IP Address
172.16.157.21
MAC Address
00:18:23:10:01:97
Firmware Version
1.00
Lock Status
Unlock

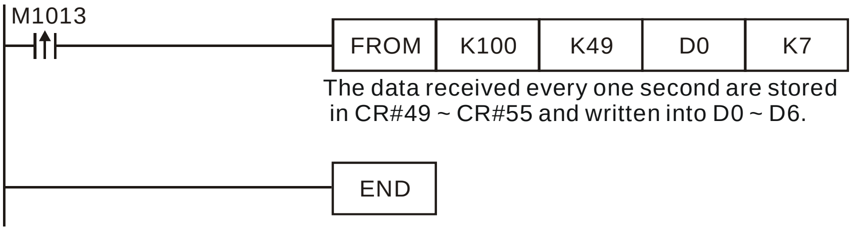
☑ Enable Data Exchange

No.	Communication Address	Data Exchange Host IP
1	1	192.168. 0. 4
2	2	192.168. 1. 2
3	3	192.168. 1. 3
4	4	192.168. 1. 4

DVPEN01-SL provides a function of data exchange between 2 MPUs. When the function is triggered, DVPEN01-SL will exchange the data in defined control registers. There are 4 of data exchange settings.
The user has to set up the IP address and give the target device an address. The MPU can choose the device to be connected to.

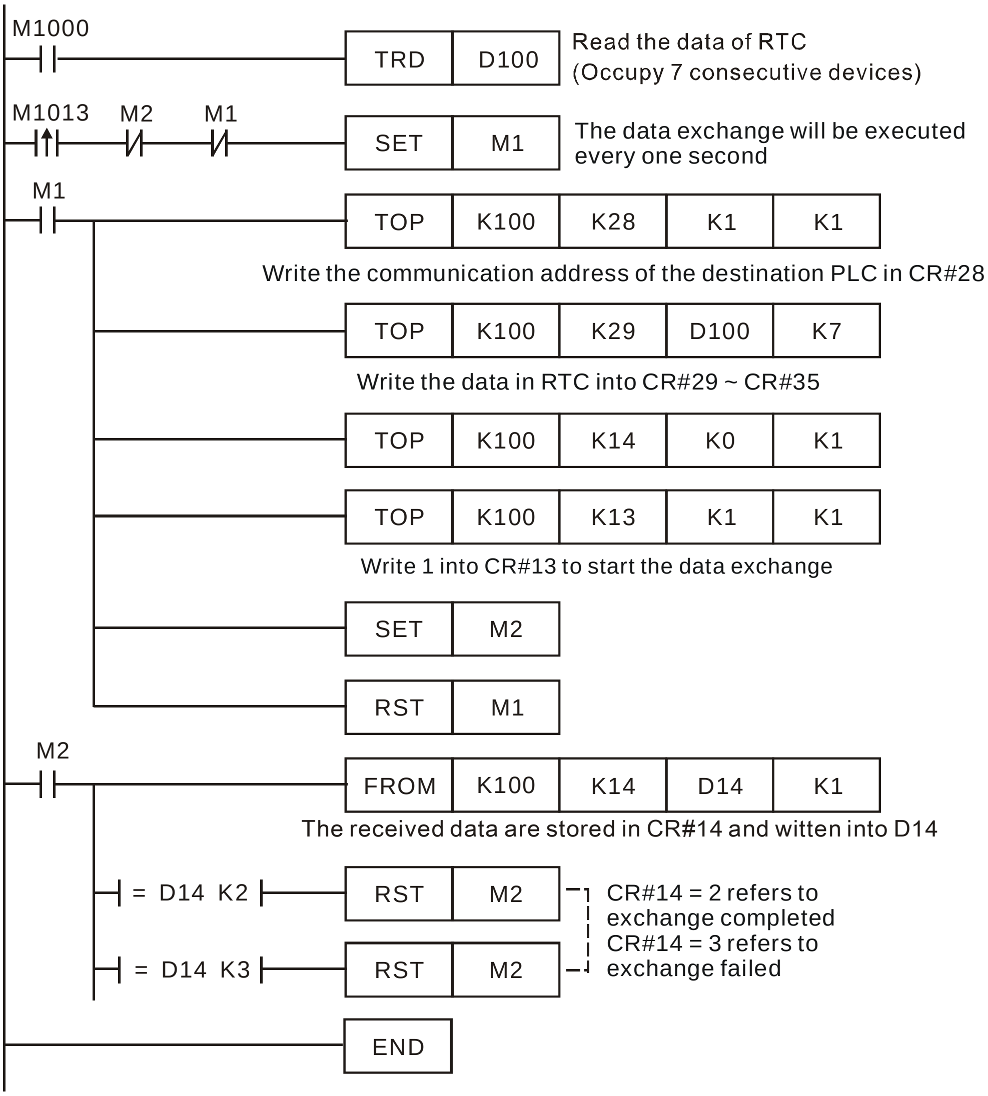
Control Program:

- Program of PLC_A:



The data received every one second are stored in CR#49 ~ CR#55 and written into D0 ~ D6.

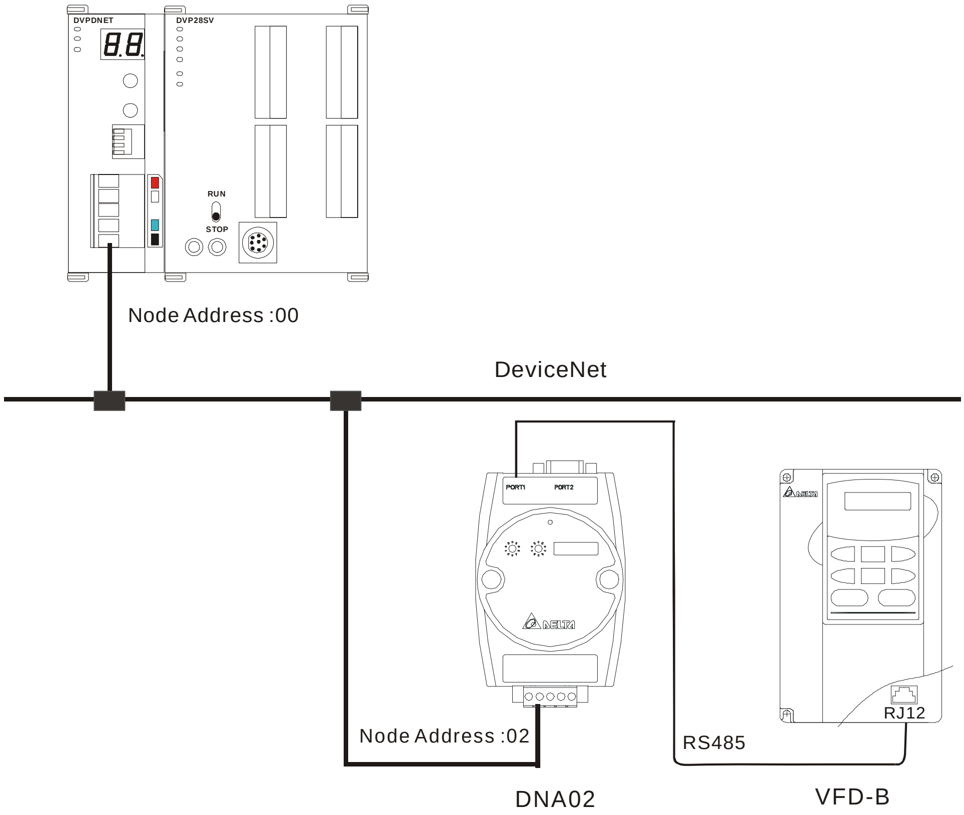
- Program of PLC_B:


M1000
TRD D100
Read the data of RTC
(Occupy 7 consecutive devices)
M1013 M2 M1
SET M1
The data exchange will be executed every one second
M1
TOP K100 K28 K1 K1
Write the communication address of the destination PLC in CR#28
TOP K100 K29 D100 K7
Write the data in RTC into CR#29 ~ CR#35
TOP K100 K14 K0 K1
TOP K100 K13 K1 K1
Write 1 into CR#13 to start the data exchange
SET M2
RST M1
M2
FROM K100 K14 D14 K1
The received data are stored in CR#14 and witten into D14
= D14 K2
RST M2
= D14 K3
RST M2
CR#14 = 2 refers to exchange completed
CR#14 = 3 refers to exchange failed
END

Program Description:

- Program of PLC_A:
  - (1) The received data are stored in CR#49 ~ CR#55.
  - (2) The data received every one second are written into D0 ~ D6.
- Program of PLC_B:
  - (1) The data exchange will be executed every one second.
  - (2) Write the communication address of the destination PLC in CR#28, and DVPEN01-SL will automatically detect by the previous setting that No. 1 IP is “192.168.0.4".
  - (3) Write the data of RTC into CR#29 ~ CR#355.
  - (4) Write “1” into CR#13 to start the data exchange.
  - (5) CR#14 = 2 refers to exchange completed. CR#14 = 3 refers to exchange failed.
- For more instructions of ethernet communication module DVPEN01-SL, please refer to DVP-PLC Application Manual: Special Modules Ⅱ

16.2 DeviceNet connection



Control Purpose:

- When M0 = ON, read the contenct of DNA02: Class 1>>Instance 1>>Attribute 1.

Devices:

- DVPDNET-SL settings:

Parameter	Set value	Explanation
Node address	00	Set the node address of DVPDNET-SL to “00”.
Baud rate	500kbps	Set communication speed of DVPDNET-SL and bus to 500kbps

- DNA02 settings:

Parameter	Set value	Explanation
Node address	02	Set the node address of DNA02 to “02".
Baud rate	500kbps	Set the communication speed of DNA02 and bus to 500kbps.

- VFD-B parameter settings:

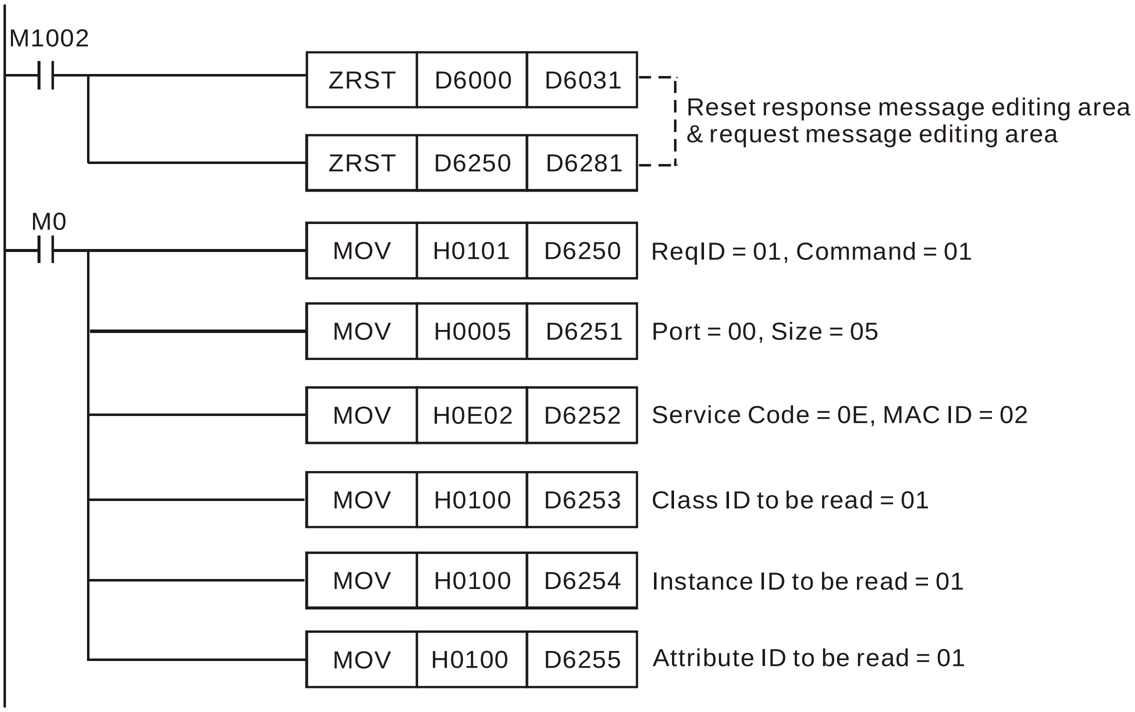
Parameter	Set value	Explanation
02-00	04	The main frequency is operated on RS-485 interface.
02-01	03	The operation commands are operated on the communication interface. Operation by keys is valid.
09-00	01	Communication address of VFD-B: 01
09-01	03	Baud rate: 38,400
09-04	03	Modbus RTU mode. Data format <8, N, 2>

- Explanations on devices:

PLC Devive		Content	Explanation															
			15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Request message editing area	D6250	0101Hex	ReqID = 01Hex								Command = 01Hex							
	D6251	0005Hex	Port = 00Hex								Size = 05Hex							
	D6252	0E02Hex	Service Code = 0EHex								MAC ID = 02Hex							
	D6253	0001Hex	High bye ot Class ID = 00Hex								Low byte of Class ID = 01Hex							
	D6254	0001Hex	High byte of Instance ID = 00Hex								Low byte of Instance ID = 01Hex							
	D6255	0001Hex	N/A								Attribute ID = 01Hex							
Response message editing area	D6000	0101Hex	ReqID = 01Hex								Status = 01Hex							
	D6001	0002Hex	Port = 00Hex								Size = 02Hex							
	D6002	8E02Hex	Service Code = 8EHex								MAC ID = 02Hex							
	D6003	031FHex	High byte of Service Data = 03Hex								Low byte of Service Data = 1FHex							

PLC device	Function
M0	When M0 = ON, DVPDNET-SL will send out request message

Control Program:

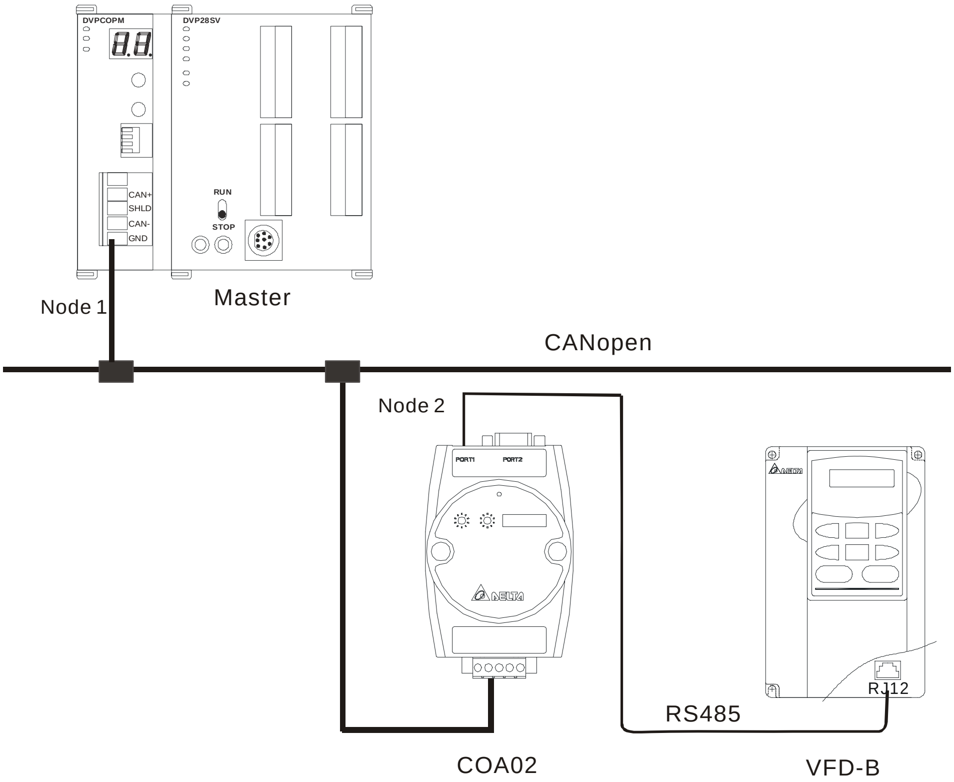


Program Description:

- In the beginning of the program, clear the response message editing area and request message editing area.
- When M0 = ON, DVPDNET-SL will send out request message, reading Class 1>>Instance 1>> Attribute 1 of the target equipment (node address: 02). If the communication of explicit message is successful, the slave will return with a response message.

- When M0 = ON, DVPDNET-SL will only send out request message once. If you would like it to send out request message again, you will have to change ReqID.
- When the reading is successful, the message responded from the target equipment will be stored in D6000 ~ D6003.
- For more instructions of DeviceNet communication module DVPDNET-SL, please refer to DVP-PLC Application Manual: Special Modules Ⅱ.

16.3 CANopen Connection



Control Purpose:

- When M0 = ON, read the content of index 2021, sub index 4 (i.e. actual output value of AC motor drive) in COA02.

Devices:

- Settings of DVPCOPM-SL:

Parameter	Setting	Explanation
Node address	01	Set the node address of DVPCOPM-SL to “01”.
Baud rate	1M bps	Set the communication speed between DVPCOPM-SL and bus to “1M bps”.

- Settings of COA02:

Parameter	Setting	Explanation
Node address	02	Set the node address of COA02 to “02”.
Baud rate	1M bps	Set the communication speed between COA02 and bus to “1M bps”.

- Settings of VFD-B:

Parameter	Setting	Explanation
02-00	04	The main frequency is operated by RS-485 interface.
02-01	03	The running command is operated by communication interface. Operation by keys is valid.
09-00	01	Communication address of VFD-B: 01

09-01	03	Baud rate: 38,400 bps
09-04	03	Modbus RTU mode, format <8, N, 2>

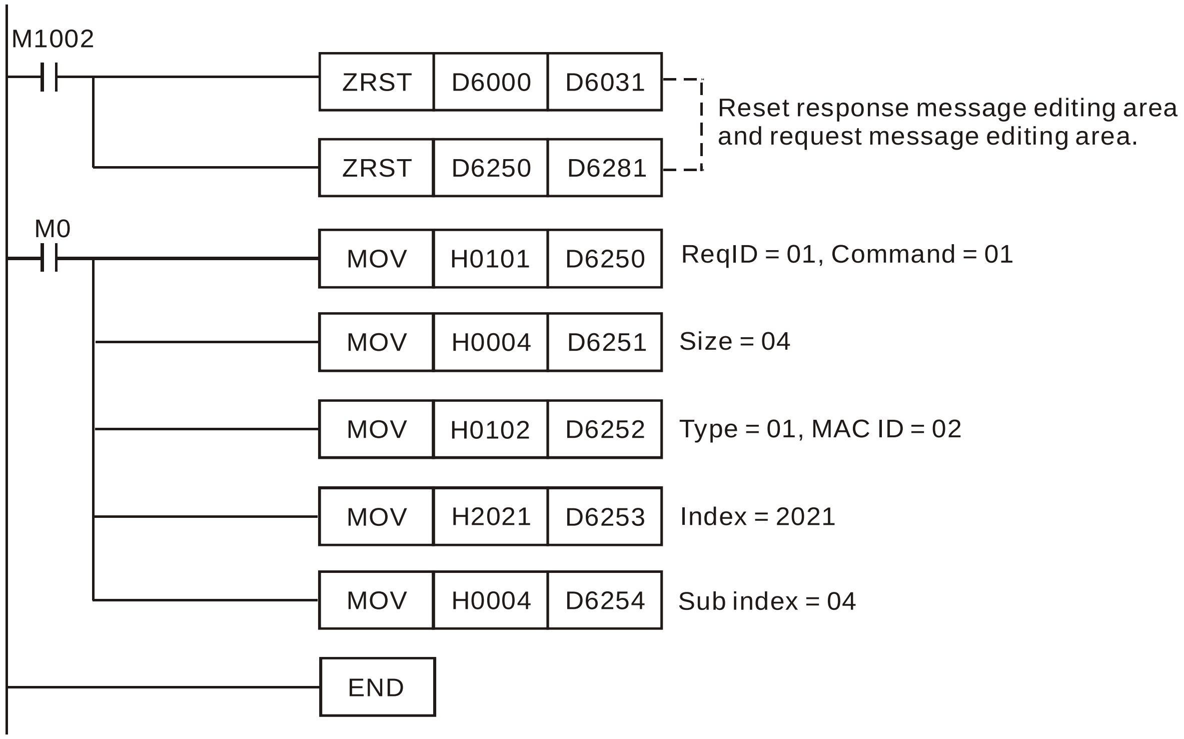
- Explanation on devices:

PLC device		content	Explanation	
			15 14 13 12 11 10 9 8	7 6 5 4 3 2 1 0
SDO request message editing area	D6250	0101Hex	ReqID = 01 Hex	Command = 01 Hex
	D6251	0004Hex	Reserved	Size = 04 Hex
	D6252	0102Hex	Type = 01 Hex	MAC ID = 02 Hex
	D6253	2021Hex	High byte of index = 20 Hex	Low byte of index = 21 Hex
	D6254	0004Hex	Reserved	Sub index = 04 Hex
SDO response message editing area	D6000	0101Hex	ReqID = 01Hex	Status = 01 Hex
	D6001	0006Hex	Reserved	Size = 06 Hex
	D6002	4B02Hex	Type = 4B Hex	MAC ID = 02 Hex
	D6003	2021Hex	High byte of index = 20 Hex	Low byte of index = 21 Hex
	D6004	0004Hex	Reserved	Sub index = 04 Hex
	D6005	0100 Hex	Datum1 = 01 Hex	Datum0 = 00 Hex

0100Hex in D6005 refers to the actual output frequency of the AC motor drive is 2.56Hz.

PLC Device	Function
M0	When M0 = ON, CANopen master will send out SDO request message

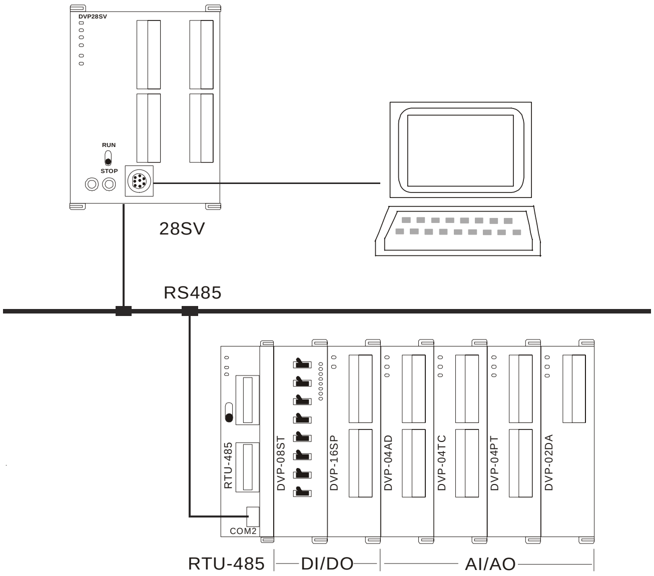
Control Program:



Program Description:

- The program first reset the SDO request message editing area and SDO response message editing area.
- When M0 = ON, CANopen master will send out SDO request message and read the contents in index 2021, sub index 4 of the target equipment (at node address 02). If the communication is successful, the slave will return with the response message.
- When M0 = ON, CANopen master will send out request message only once. If you would like it to send out messages again, you will have to change the ReqID.
- The messages returned from the target equipment are stored in D6000 ~ D6005.
- For more instructions of CANopen communication module DVPCOPM-SL, please refer to DVP-PLC Application Manual: Special Modules Ⅱ.

16.4 RTU-485 Connection



Control Purpose:

- The station No. of RTU-485 is 1. Write H'0001 into CR#6 of the 1st special module. Max connectible special modules: 8; Max. DI/DO: 128 inputs and 128 outputs.

Devices:

- Explanation on devices:

PLC Device	Function
M0	When M0 = ON, the master device will send out a request message to RTU-485
D1120	Storing COM2(RS-485) communication protocal
M1120	Retaining COM2(RS-485) protocol. Change of D1120 is invalid when M1120 = ON.
M1122	Sending request
M1127	Data receiving completed
M1129	Communication timeout
M1143	Selecting ASCII/RTU mode of COM2(RS-485). OFF: ASCII; ON: RTU

- Explanation on communication address:

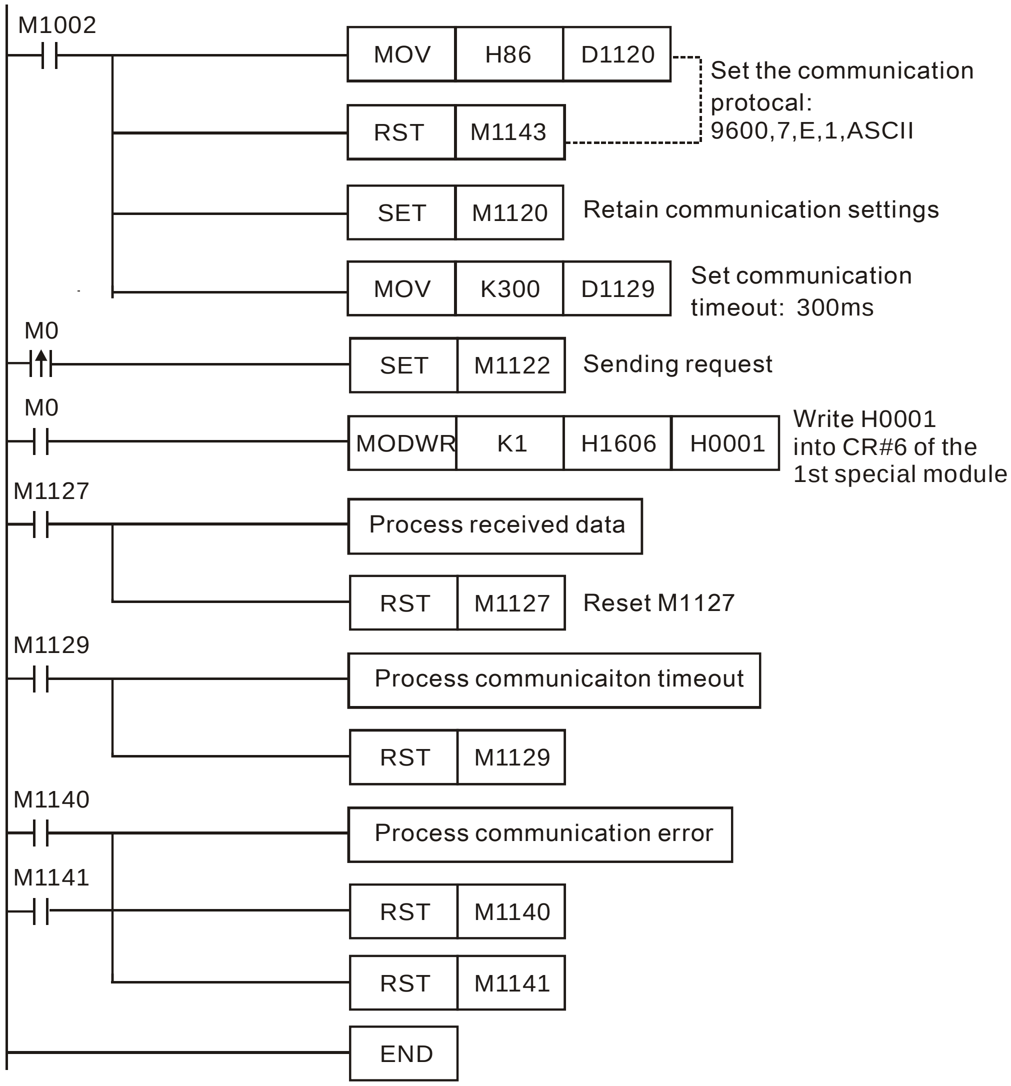
Communication address	Devices	Attribute	Data type	Length
H'1600 ~ H'1630	1st special module: CR0 ~ CR48	Please refer to the CR attribute of each special module.	word	49
H'1640 ~ H'1670	2nd special module: CR0 ~ CR48		word	49
H'1680 ~ H'16B0	3rd special module: CR0 ~ CR48		word	49
H'16C0 ~ H'16F0	4th special module: CR0 ~ CR48		word	49
H'1700 ~ H'1730	5th special module: CR0 ~ CR48		word	49
H'1740 ~ H'1770	6th special module: CR0 ~ CR48		word	49
H'1780 ~ H'17B0	7th special module: CR0 ~ CR48		word	49
H'17C0 ~ H'17F0	8th special module: CR0 ~ CR48		word	49

Note:

Maximum 8 special modules are connectible to RTU-485. The first special module connected is the nearest one on the right side of RTU-485.

Control Program:

- The station No. of RTU-485 is “1”. Write “H’0001” into CR#6 of the 1st AI/AO special module.


M1002
MOV H86 D1120
Set the communication protocal: 9600,7,E,1,ASCII
RST M1143
SET M1120
Retain communication settings
MOV K300 D1129
Set communication timeout: 300ms
M0
SET M1122
Sending request
M0
MODWR K1 H1606 H0001
Write H0001 into CR#6 of the 1st special module
M1127
Process received data
RST M1127
Reset M1127
M1129
Process communicaiton timeout
RST M1129
M1140
Process communication error
M1141
RST M1140
RST M1141
END

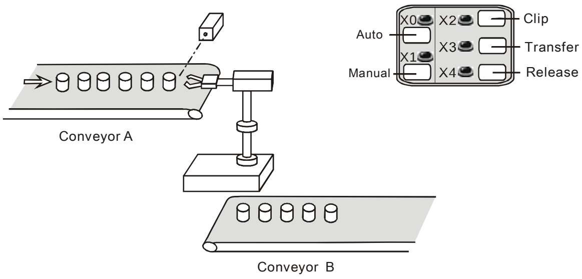
Program Description:

- Communication format should be set at the beginning of the program, and the protocal of Master and slave should be the same: 9600，7,E,1，ASCII.
- When M0 = ON, the sending request flag will be ON and the master device will send out a request message to RTU-485 and write H’0001 into CR#6 of the 1st Ai/AO special module on the right side of RTU-485.
- For more instructions of communication module RTU-485, please refer to DVP-PLC Application Manual: Special Modules Ⅱ.

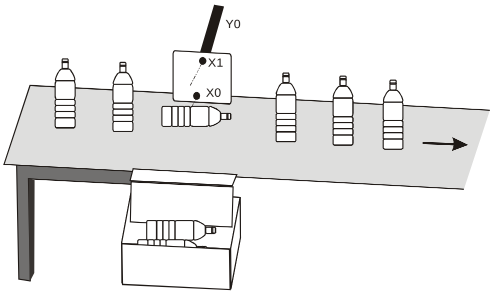
MEMO

Index

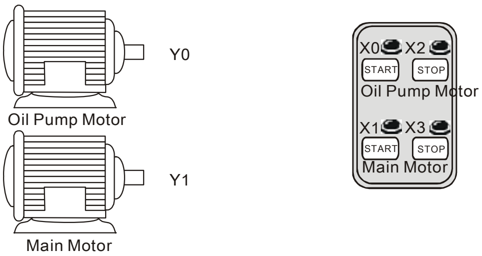
■ Production Line Control



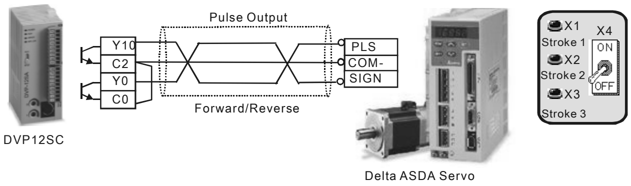
■ Production Line Control – detecting



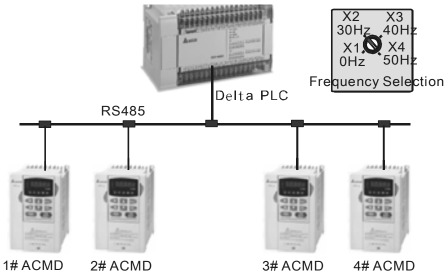
■ Motor Control



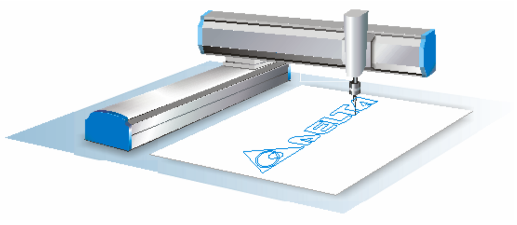
■ Servo Motor Control



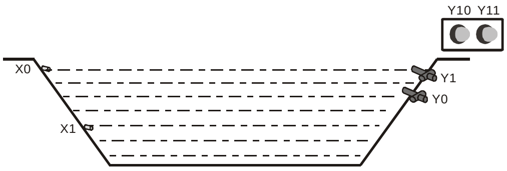
■ AC Motor Drive Control



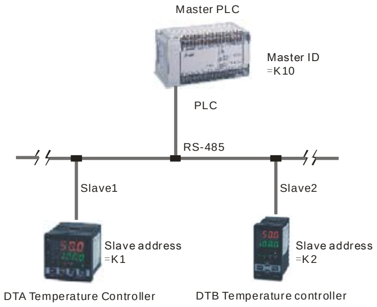
■ Positioning Control



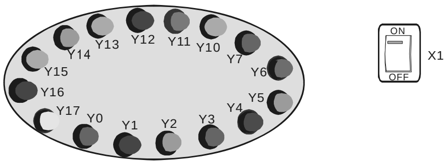
■ Level Monitoring



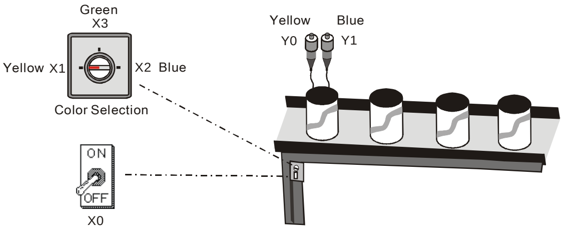
■ Temperature Control



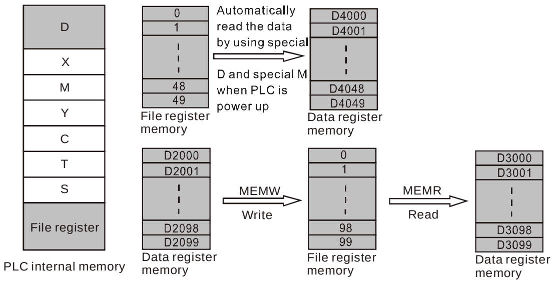
■ Indicator Control



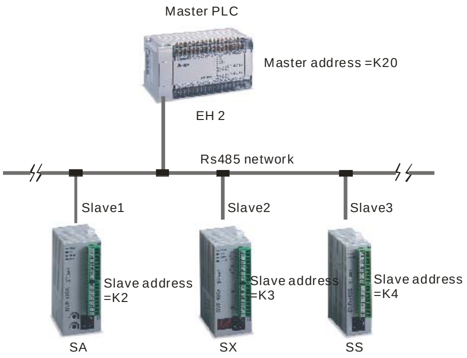
■ Material Mixing



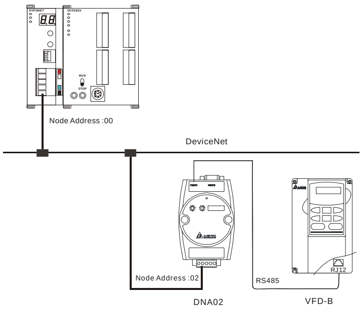
■ Data Processing



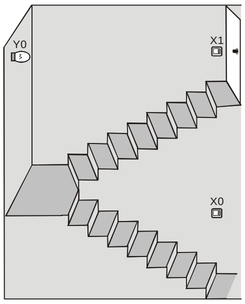
■ Communication



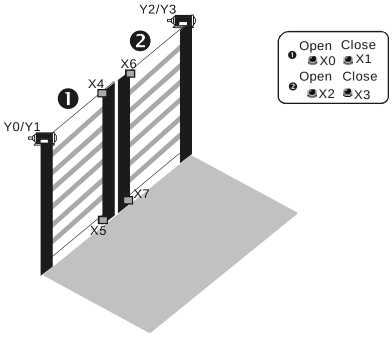
■ Network Connection



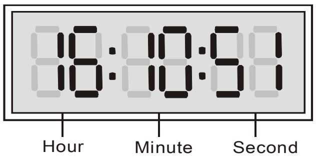
■ Light Switch Control



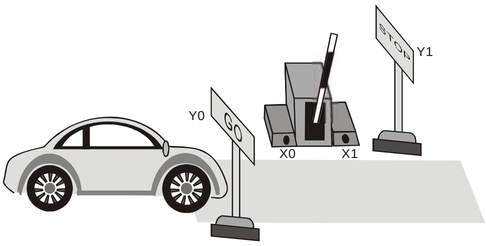
■ Automatic Door Control



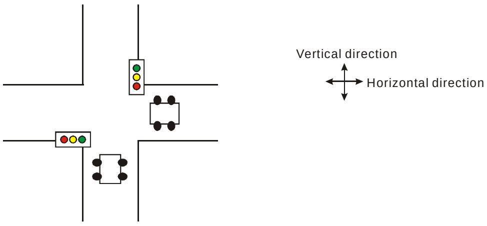
Real Time Calendar and Time Design Applications



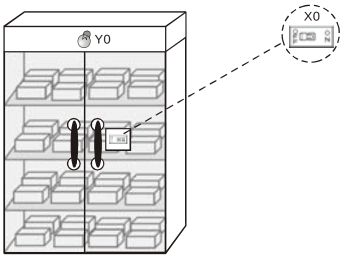
Parking Lot Entry Control



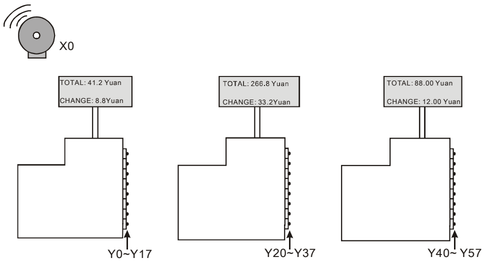
Traffic Lights Control



Product Testing Device Control



■ Alarm Control



■ Others