CHAPTER FOUR

IMPLEMENTATION OF DESIGN

4.1 Introduction

The implementation of design firstly are simulated by using software program of PLC type XC series after programming by ladder diagram language.

4.2 Simulation

It used XC series programmable controller has I/O 14~60 points, Flash ROM memory inside, Real time clock with clock inside, Li battery power drop memory,

Multi-COM ports, can connect with inverters, instruments, printers and Rich instructions, convenient to program.

Use sequential control signal and soft unit's ID to draw the sequential circuit's graph on the screen, which is called ladder program. As this method uses trigger point's symbols and coil symbols to denote the sequential control circuits it is easy to understand the program's contents. At the same time, it's also available to monitor the PLC's action via the status displayed in the circuit.

Each rung of ladder language typically has one coil at the far right. Some manufacturers may allow more than one output coil on a rung.

- Rung Input Checkers (contacts)
- ✓ —[]— Normally open contact, closed whenever its corresponding coil or an input which controls it is energized. (Open contact at rest)
- ✓ —[\]— Normally closed ("not") contact, closed whenever its corresponding coil or an input which controls it is not energized. (Closed contact at rest)
- Rung Output: Actuators (coils)

- ✓ —()— Normally inactive coil, energized whenever its rung is closed. (Inactive at rest)
- ✓ —(\)— Normally active ("not") coil, energized whenever its rung is open. (Active at rest)
- ➢ The "coil" (output of a rung) may represent a physical output which operates some device connected to the programmable controller, or may represent an internal storage bit for use elsewhere in the program.
- ➢ A way to recall these is to imagine the checkers (contacts) as a push button input, and the actuators (coils) as a light bulb output. The presence of a slash within the checkers or actuators would indicate the default state of the device at rest.

➢ Logical AND

The above realizes the function: Door Motor = Key Switch 1 AND Key Switch 2This circuit shows two key switches that security guards might use to activate an electric motor on a bank vault door. When the normally open contacts of both switches close, electricity is able to flow to the motor which opens the door.

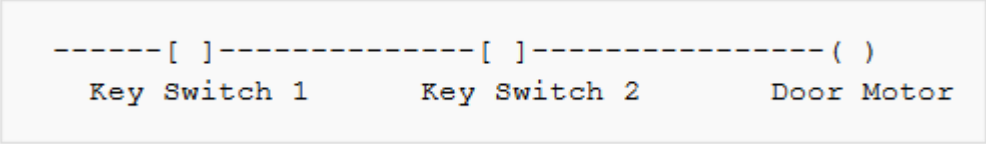

Figure 4.1: Logical AND

➢ Logical AND with NOT

The above realizes the function: Door Motor = Close door ANDNOT (Obstruction).

This circuit shows a pushbutton that closes a door, and an obstruction detector that senses if something is in the way of the closing door. When the normally open pushbutton contact closes and the normally closed obstruction detector is closed (no obstruction detected), electricity is able to flow to the motor which closes the door.

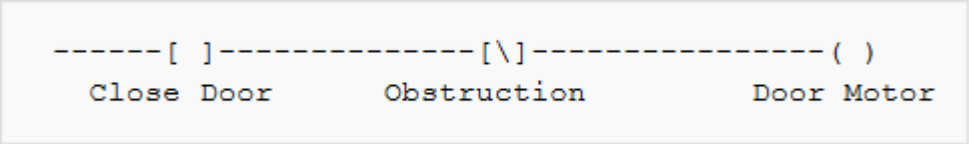

Figure 4.2: Logical AND with NOT

➢ Logical OR

The above realizes the function: Unlock = Interior Unlock OR Exterior Unlock

This circuit shows the two things that can trigger a car's power door locks. The remote receiver is always powered. The unlock solenoid gets power when either set of contacts is closed.

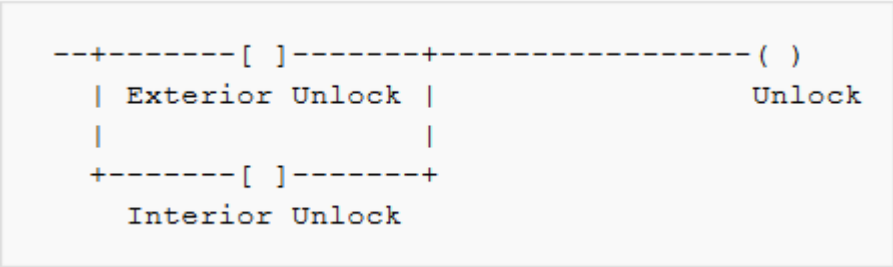

Figure 4.3:Logical OR

➢ Industrial STOP/START

In common industrial latching start/stop logic we have a "start" button to turn on a motor contactor, and a "stop" button to turn off the contactor.

When the "start" button is pushed the input goes true, via the "stop" button NC contact. When the "run" input becomes true the seal-in "run" NO contact in parallel with the "start" NO contact will close maintaining the input logic true (latched or sealed-in). After the circuit is latched the "stop" button may be pushed causing its NC contact to open and consequently the input to go false. The "run" NO contact then opens and the circuit logic returns to its inactive state.

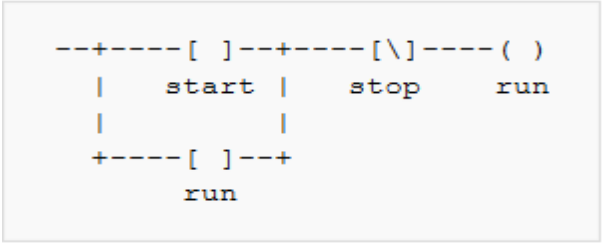

Figure 4.4:Industrial STOP/START

4.3 Every Soft Unit of PLC XC3 Series

In the programmable controller, there are many relays timers and counters they all have countless “a” contacts(Normally open contacts)and “b” contacts(Normally closed contacts) Connect these contacts and coils to constitute sequential control circuit. The following, we’ll briefly introduce each soft unit:

4.3.1 Input (X) and output（Y）Relay

In each basic unit assign the ID of input relay, output relay in the format of X000~X007，X010~X017…, Y000~Y007，Y010~Y017… this octal format.

The ID of extension is connected behind basic unit. The ID of expansion obeys the principle of channel 1 starts from X100/Y100, channel 2starts from X200/Y200… 7 expansions could be connected totally. Use digital filter in the special input filter of input relay, so you can use the program to change the sieve value. So in the high-speed receive application, you can assign this type of relay’s ID No.

4.3.2Auxiliary relay (M)

Auxiliary relay is the relay inside the programmable controller this type of output relay is different from input/output relay it can’t gain exterior input it also can’t drive exterior load it can only be used in the program.

The relay used for retentive can still save its ON/OFF status in the case of PLC power cut.

4.3.3Status (S)

Relay used as step ladder chart. When not used as working procedure No. it's the same with auxiliary relay and can be used as common contact/coil to carry on programming. Besides, it can also be signal alarm to diagnose exterior trouble.

4.3.4 Timer(T)

Timer could carry on plus operation to 1ms，10ms，100ms etc. time pulse in PLC, when reach certain set value, output contact act.T100~T199 are timers with the unit of 100ms clock pulse their current values are the accumulate values. So, even though timer coil's drive input is cut, they will still hold the current value, go on accumulating the action.

4.3.5Counter(C)

The counters can be divided into the following sorts according their usage and purpose：

[Used for interior count] Common use / power failure retentive use

16 bits 'counter Used for plus count bound: 1~32,767

32 bits' counter Used for add / minus count bound: -2,147,483,648~+2，

147,483,647

These counters are used for PLC's interior signals, usually their response speed is below10Hz.

[Used for high-speed count] For power failure retentive use

32 bits' counter: For plus / minus count, count bound: -2,147,483,648~+2,147,483,6487(Single phase plus count single phase plus/minus countable phase) allocate to the special input points.

High-speed counter can count with the frequency below 200kHz，independent with the PLC's scan cycle.

4.3.6 Data register(D)

Data register is the soft unit used by data register to save data. XC series PLC's data registers are all 16 bits (The high bit is the sign bit), Combine two registers can carry on32 bits' data disposal (The high bit is the sign bit). Just the same with other soft units, data registers can also be divided to be two types: for common use and power failure retentive use.

Table 4.1: Device's ID List

Mnemonic	Name	Bound			points		
		14 points	24\32 points	48 \60 points	14 points	24\32 points	48 \60 points
X	Input relay	X000~X007	X000~X015 X000~X021	X000~X033 X000~X043	8 points	14\18 points	28\36 points
Y	Output relay	Y000~Y005	Y000~Y011 Y000~Y015	Y000~Y023 Y000~Y027	6 points	10\14 points	20\24 points
M	Interior relay	M0~M2999【M3000~M7999】			8000		
		M8000~M8511 for special using			512		
S	Flow	S0~S511 【S512~S1023】			1024		
T	Timer	T0~T99：100ms not accumulation			620		
		T100~T199：100ms accumulation					
		T200~T299：10ms not accumulation					
		T300~T399：10ms accumulation					
		T400~T499：1ms not accumulation					
		T500~T599：1ms accumulation					
		T600~T618：1ms with interruption precise time					
C	Counter	C0~C299：16 bits forth counter			635		
		C300~C598：32 bits forth/back counter					
		C600~C634：high-speed counter					
D	Data Register	D0~D3999 【D4000~D7999】			8000		
		For special usage D8000~D8511			512		

4.3.7Contactor's Compare Instructions

The value of S1 and S2 are tested according to the comparison of the instruction. If the comparison is true, then the LD contact is active. If the comparison is false, then the LD contact is not active.

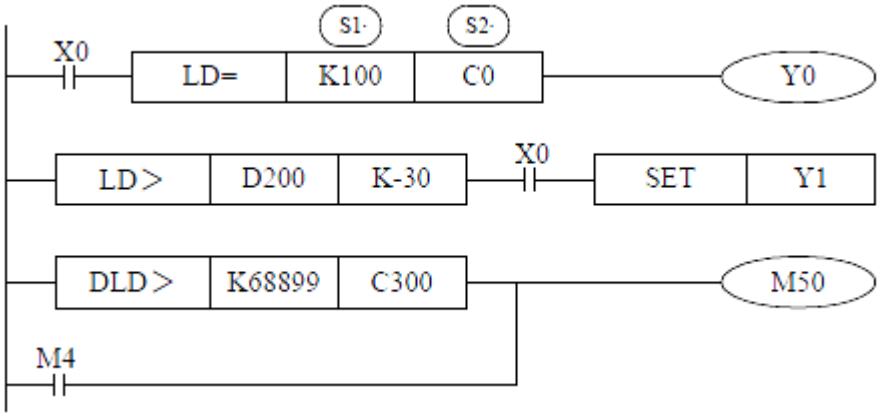

Figure 4.5: Program of companies instruction

Table 4.2 Instruction & Function

• 16 bits	• 32 bits	• Active condition	• Inactive condition
LD=	DLD=	(S1) = (S2)	(S1) ≠ (S2)
LD>	DLD>	(S1) > (S2)	(S1) ≤ (S2)
LD<	DLD<	(S1) < (S2)	(S1) ≥ (S2)
LD<>	DLD<>	(S1) ≠ (S2)	(S1) = (S2)
LD<=	DLD<=	(S1) ≤ (S2)	(S1) > (S2)
LD>=	DLD>=	(S1) ≥ (S2)	(S1) < (S2)

4.4 How system run

PLC has been link to the source device and the computer then download the code from the computer to the PLC and run it.

The temperature sensor used to read the temperature of the coil, where the temperature of coil is divided into level, when the temperature of the coil reached 60c, the temperature sensor sends a signal to PLC to program and then adopt the time delay to ensure that the temperature at 5 sec, so as to avoid any passing temperature, then the PLC send a signal to the group of fans existence in

the transformer in order to cool the coil. When the temperature reached 90c the temperature sensor sends a signal to PLC to make of 110c, the PLC send a signal to circuit breaker to separate the transformer out of services.

Another sensor temperature is existing to use in reading the temperature of oil, when the sensor read the temperature 55c send a signal to PLC and before implementing the result then control time delay to ensure that the temperature 5 sec to avoid passing temperature. then operate the group of fans, when the temperature increased to reach 85c a signal sends to plc to operate horn, and when the oil temperature is reached maximum 105c, the PLC when send a signal to C.B to separate the transformer.

Buchhloz relay is used to control the gases in oil that reached the main tank, where in Buchhloz exists two sensors, one of them send signal to the horn at accessing a quantity of gases to specific limit and the other send a signal to separate the transformer at the quantity of gases increase.

There are two sensors in the additional tank of the transformer, one of them send a signal to separate if the oil is decreased less than the specific level, and the other send signal to horn if the oil level is increased.

The pressure relief is send a signal to separate the tank of the transformer if the pressure of the gas is increased.

Isolator switch and air thing switch take signal to PLC to send to C.B to separate the transformer.

All the signals to C. B which used to separate the transformer is to be near 11kv to return the C. B for the close status, that happened manually through the PLC. also at 33kv it controls open and close of C.B when events happened manually through PLC.

When the reading of C.T and V.T change, i.e. the control value changed, then send a signal to PLC to separate the transformer.

PLC connected with a point of tap changer to control the potential change.