

LEVEL 4 ASSESSMENT SPECIFICATION

Student name:	Samuel Davies	Student ID number:	
Programme:	HNC Electrical/Electronic Engineering & Instrumentation Engineering		
Module:	Programmable Logic Controllers		
Module code:	PCEE4005	Contribution to Overall Module Assessment (%):	50%
Lecturer:	Jason Pointer	Internal Verifier:	Nigel Richards
Assignment Title:	Introduction to PLC Systems & Program Design	Word count (or equivalent):	2000
Submission deadline:	11/01/24	Return date of provisional marks & written feedback:	25/01/24
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 40%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		

Module Learning Outcomes (from module syllabus)

1. Demonstrate an understanding of the concepts of process control using an industry standard PLC.
2. Undertake basic PLC system design and implementation processes, comparing theoretical expectations to actual outputs ensuring correct operation and consideration of maintenance and reliability.

STUDENT FEEDBACK FORM

This section details the *extent* to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills	15	9
Engagement with a wide range of literature sources, including sources retrieved independently. Generally sound referencing, with very few inaccuracies.		
2. Knowledge and Understanding Skills	30	18.5
Task 1 achieved 55%. Task 2 achieved 70%, Task 3 achieved 60%. Generally excellent knowledge of the basic underlying concepts and principles of the work required for Task 2 and 3. Showed basic knowledge and understanding of the requirements of Task 1.		
3. Cognitive and Intellectual Skills	5	2.5
Good evaluation of the underlying concepts and principles applied to the construction of the auto drill system.		
4. Practical Application Skills	40	32
Task 4 achieved 80%. Task 5 achieved 80%. An excellent application of the software to produce fully functional programs to cover the requirements of Task 4 and 5. Required very little support in the development of these programs and was able to show full operation.		
5. Transferable Skills for Life and Professional Practice	10	6.2
Work is accurate, coherent, fluent, well-structured and organised.		

Assessment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)

Late Submission Penalties (tick if appropriate)

Up to 1 week late (40% Max)

Over 1 week late (0%)

68%

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Year 2- HNC Instrumentation Engineering



Figure 1

Samuel Davies

Level 4 HNC in Instrumentation Engineering

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Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

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INTRODUCTION

The following assignment will inform the reader about Programmable Logic Controllers (PLC's), and their construction, various types, their application and how they can be programmed to a desired function or process. The document will cover the different types of PLC's, logic diagrams, programming problems, logic gate and how timers can be utilised within programming and how automatic machinery/ processes can be programmed. The three programmes mentioned in the assignment have all been copied and submitted to the lecturer.

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TASK 1 – PROGRAMMABLE LOGIC CONTROLLERS

a)

Programmable Logic Controllers (PLC's) are a type of microprocessor-based controller, which uses a local memory to retain and act upon a set of functions, as desired by the user. In terms of build, there are two types commonly used: Modular (Rack) & Unitary (Brick). The main difference between the two types is that a modular PLC is expandable in relation to input and output modules, so can be adapted to suit applications requirements. Unitary PLCs are standalone units, with a fixed number of I/O's, usually used in a stand-alone machine or application. Nowadays, you will find PLCs in all areas of industry, but historically they were originally produced for the automotive industry, "Originally intended as relay replacement equipment for the automotive industry, the PLC can now be found in some part of virtually every type of industry imaginable", (Lipták, 1995). ✓

For the following assignment, programming has been for a Mitsubishi Alpha2 unitary PLC, see below for the specification of the unitary unit.

ALPHA Specifications

Figure 2

Base Units	AL2-10MR-A*	AL2-10MR-D*
I/O	10	10
Power Supply	100-24 VAC	24 VDC
Digital Inputs	6 (100-240 VAC)	6 (24 VDC)
Digital Inputs with Analog Capability (0-10V, 8 bits)	-	-
Outputs	4 (relay 8 A)	4 (relay 8 A)
FBs/Functions		
Dimensions (WxHxD) Inches	2.8 x 3.5 x 2.2	2.8 x 3.5 x 2.2

As figure 2 shows, both the inputs and outputs are a fixed value, and cannot be increased. In terms of application, PLC's such as this are best used in standalone machinery which do not require a lot of I/O's. Unitary PLCs are the cheapest type to purchase and setup, they are small and easily portable.

The main disadvantages are the limited capacity and the fact that should a feature fail then the whole unit has to be replaced, and this type of unit cannot communicate in terms of control so "I/O's required for operator functions, status information etc. must be included in the I/O count when sizing the unit", (Seal et al., 1998). ✓

AL2-14MR-A	AL2-14MR-D	AL2-24MR-A	AL2-24MR-D
14, expandable to 18	14, expandable to 18	24, expandable to 28	24, expandable to 28
100-240 VAC	24 VDC	100-240	24 VDC
8 (100-240 VAC)	8 (24 VDC)	15 (100-240 VAC)	15 (24 VDC)
-	8	-	8
6 (8 A)	6 (8 A)	9 (4x8 A/5x 2 A)	9 (4x8 A/5x 2 A)
4.9 x 3.5 x 2.0	4.9 x 3.5 x 2.0	4.9 x 3.5 x 2.0	4.9 x 3.5 x 2.0

Figure 3

This is not a modular PLC

Figure 3 shows the specification of the Mitsubishi Alpha2 modular expandable, and you can see the number of I/O's can be increased with expansion modules. Modular PLC's such as ✓

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this are best used in manufacturing and industries where there is a process to control, as the PLC can process multiple I/O's. *Need more information about modular PLCs.*

b)

There are many components within a PLC that make them function at rapid speeds, effectively. Figure 4 shows the overall internal build, with the various components/sections listed. The main basic function is achieved using a “processor unit, memory, power supply unit, input/output interface section, communication interface, and the programming device”, (Bolton, 2009). ✓

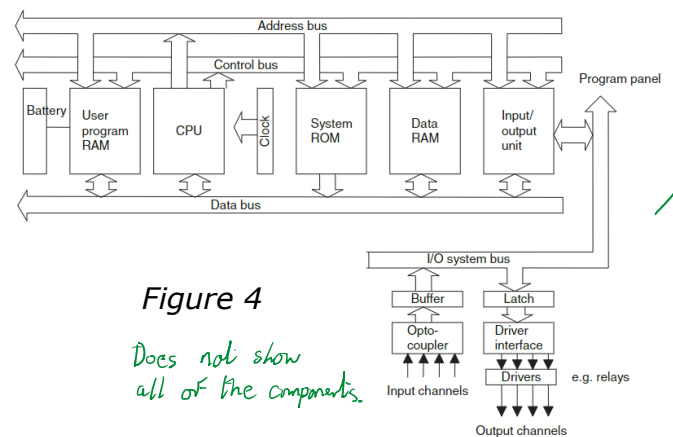


Figure 4

Does not show all of the components.

The CPU contains the processor, allowing this component to act upon input signals, based on the program stored, actuating via the output signals. The power supply component allows an AC mains voltage to be converted to the low (normally 12V/24V) DC voltage required for the microprocessor to operate. Buses are pathways that allow for communication within the PLC unit itself, transferring data in binary form. There are a couple types of memory storage within a PLC, such as data RAM, User program RAM and system ROM. A PLC requires access to the data being processed, and the program also, so it receives its instructions. Both are located in the PLC memory, easily accessible for processing. System ROM, or read-only-memory provides permanent storage for the PLC OS (operating software), and also fixed data required for the CPU. The user program RAM area is purely for the end users' program/instructions for the PLC. Data RAM, as the name suggest, is used to store the status of I/O devices, and other information such as counters and timers. ✓

What about input and output stages?

c)

As with any electrical device or equipment, you need to protect it electrically to ensure reliability and durability of the device. With PLC's, because there are a vast number of external devices connected, such as sensors, valves, actuators etc, it is vital that the I/O components are suitably protected.

We can protect both the Input and Output channels, to protect the Input connections we can use the following.

- Isolation- Use of Opto-Isolators to ensure electrical isolation between the main PLC input channel and input devices, such as sensors, switches, gauges. ✓

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- Surge Protection- Fitting of surge protection devices (voltage suppressors / surge arrestors) to protect against any spikes in voltage, can protect against potential damage caused by adverse weather conditions. ✓
- Filtering- It is advisable to filter possible EMI (electromagnetic interference) and RFI (Radio Frequency Interference), by installing input filters. ✓

To protect the Output channels, we can do the following.

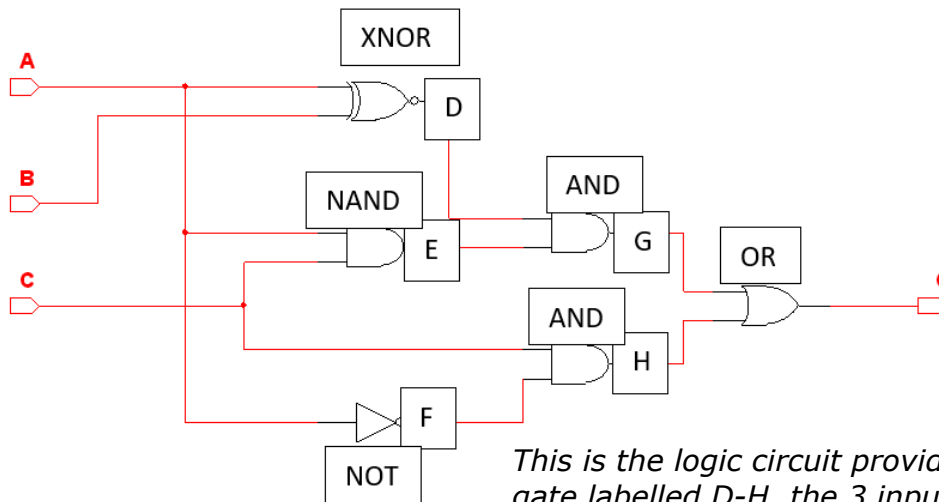
- Short Circuit Protection- Install protection mechanisms like current limiting devices or output disconnection relays, to protect the PLC in case of a short circuit. ✓
- Overcurrent Protection- Basic electrical protection devices such as MCB's (miniature circuit breakers) or fuses can protect against excessive current damaging internal components. ✓
- Correct output choice- Based on the output current, the correct type of output should be selected. Relay outputs are more durable and deal better with higher currents, while solid state outputs are quicker in switching, but prefer switching lower current loads. ✓

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TASK 2 – LOGIC DIAGRAMS & TRUTH TABLES

a)

Below is the truth table and Boolean equation from the logic circuit provided. The labelled logic circuit is below.



This is the logic circuit provided, but each gate labelled D-H, the 3 inputs are A, B and C, and the output is labelled Q.

Inputs			Gate Outputs					Output
A	B	C	D	E	F	G	H	Q
0	0	0	1	1	1	1	0	1
0	0	1	1	1	1	1	1	1
0	1	0	0	1	1	0	0	0
0	1	1	0	1	1	0	1	1
1	0	0	0	1	0	0	0	0
1	0	1	0	0	0	0	0	0
1	1	0	1	1	0	1	0	1
1	1	1	1	0	0	0	0	0

The truth table above, shows 4 output 1's from the circuit provided, it is possible to represent this as an equation;

$$Q = \bar{A} \cdot \bar{B} \cdot \bar{C} + \bar{A} \cdot \bar{B} \cdot C + \bar{A} \cdot B \cdot C + A \cdot B \cdot \bar{C}$$

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b)

To aid representation of the outputs, it is possible to simplify the above Boolean equation, as per below;

$$Q = \bar{A}.\bar{B} + \bar{A}.C + A.B.\bar{C} \quad \checkmark$$

It is made possible to simplify, by using a Karnaugh map. The Karnaugh map groups cells adjacent to each other containing 1. See below for the Karnaugh Map produced to simplify the Boolean Equation.

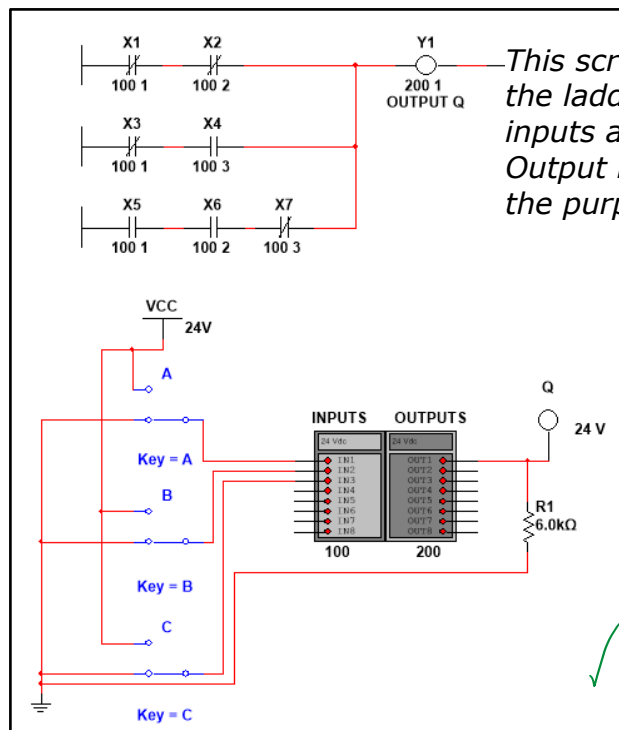
0 0 0 | 0 0 1 | 0 1 1 | 1 1 0

		BC			
A		00	01	11	10
	0	1	1	1	0
	1	0	0	0	1

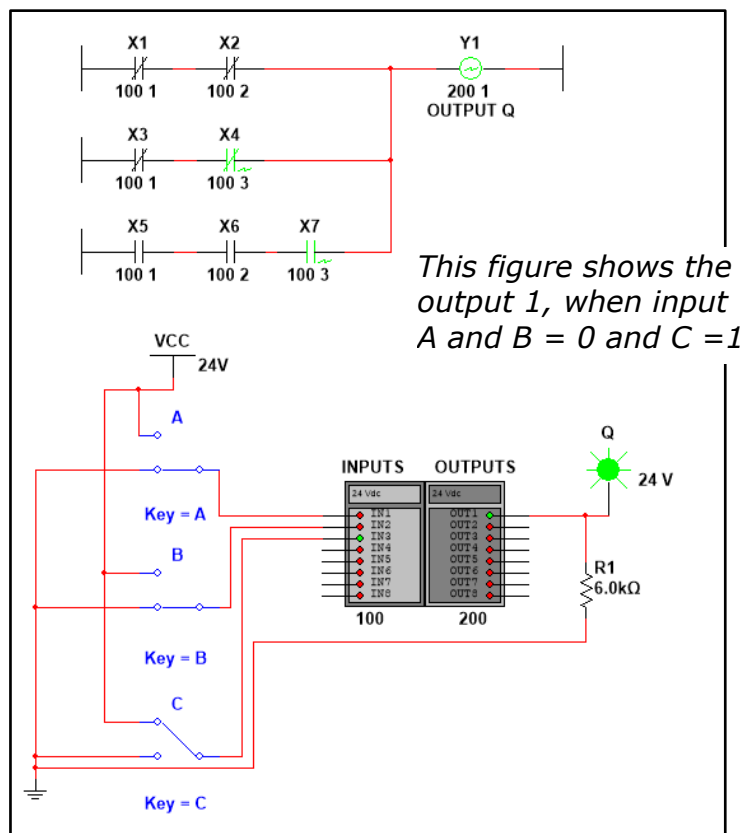
Below is the simplified Boolean Equation, and from this the ladder logic diagram has been created. It is also worth noting, that now the Boolean equation has been simplified, the logic circuit can also be simplified. By doing so, would remove excess or not needed logic gates, not only saving time when programming, but saving cost on components! $\checkmark$

$$Q = \bar{A}.\bar{B} + \bar{A}.C + A.B.\bar{C} \quad \checkmark$$

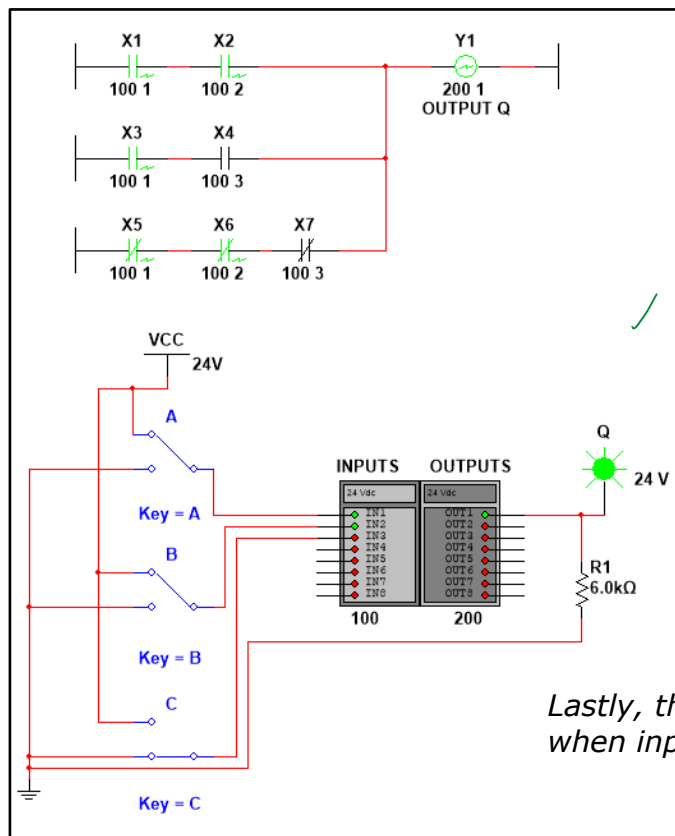
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This screengrab shows the overview of the ladder logic for the circuit above. All inputs are "X", Y1 is output Q. The Output is represented by a LED just for the purpose of illustration.



This figure shows the output 1, when input A and B = 0 and C = 1



Lastly, this screengrab shows the output 1, when input A & B = 1, and C = 0.

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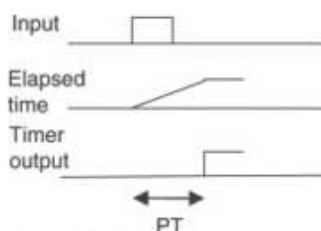
TASK 3 – TIMERS

a)

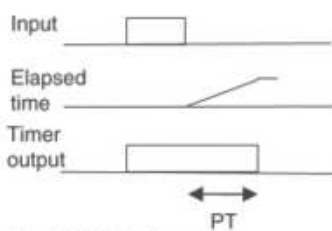
In programming, there are many functions or actions that can be incorporated that produce a desired output. An example of this is timers, a timer may be used to delay the start of an output, or to delay the stopping of the output. Using timers within programming is made possible as “PLC’s thus have timers as built in device” (Bolton, 2009). Also, using timers allow for a vast range of control as “Timers count seconds or fractions of seconds using the internal CPU clock” (Bolton, 2009).

There are varying types of timer configuration, such as an on-delay, off-delay and pulse timer. An On-delay, also referred to as TON, gives an output after a desired time set by the programmer. For example, a 15ms On-Delay would give an output after 15ms. In contrast, an Off-delay, also known as TOF, gives the desired output for a designated period of time before switching off, the time being set by the programmer. A pulse timer, or TP, varies from both of the above, as this type of timers gives the desired output for a fixed period of time, then returns to output 0 when the time has elapsed. This differs from the other two types mentioned, as the pulse timer returns to its original state before the initial energisation.

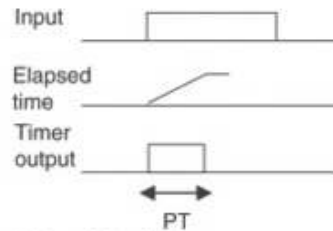
See below for the 3 varying timer diagrams.



(a) On-delay timer *Figure 5*



(b) Off-delay timer *Figure 6*



(c) Pulse timer *Figure 7*

b)

Timers such as those named above can be used within programming to produce a sequence of events, such as an input from one actuator will energise an ON delay to which energises another output after a set period of time, such as a motor, via the motor contactor. The possibilities of control are vast, and timers are used in sequential order to achieve delays or latches that isn’t possible from software programming. We also call this type of timing, cascaded timers. Cascaded timers are effectively a series of timers, for example, a conveyor

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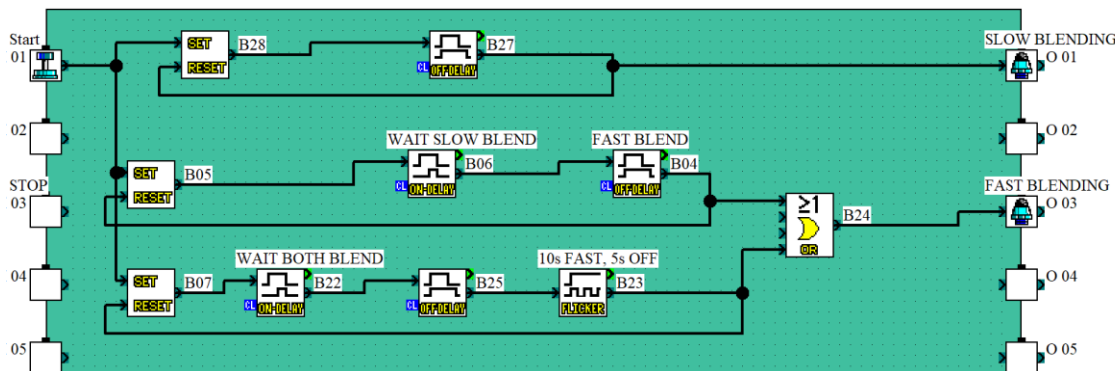
belt system has 3 belts, the time for belt A is energised and it runs, it also sends an output signal to belt B and belt C, with conveyor B having an ON-delay of 5 seconds, and conveyor C having an ON-delay of 10 seconds. This cascaded timer set up, allows the conveyor belts to run before product fills each belt, improving the efficiency of the production line. ✓

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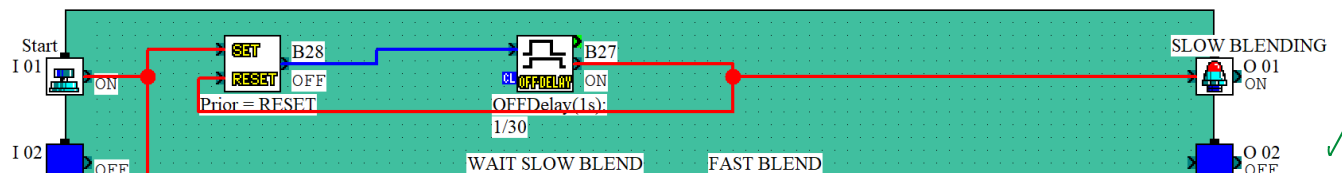
TASK 4 – PROGRAMMING PROBLEMS

Below, you will find two programs developed using the Mitsubishi Alpha programming software. The first program shows a food blender process, and the second is a coin counting system that counts 10, 20 and 50 pence coins. Using a program such as Mitsubishi Alpha to program with Functional block is accessible, conforms to regulations and is user friendly; “The graphic languages that are defined in IEC 61131-3 is Function Block Diagram (FBD) (Figure 10.1). The definitions and the graphic symbols are in conformity with the IEC 60617-12 1 standard”, (Hanssen, 2015).

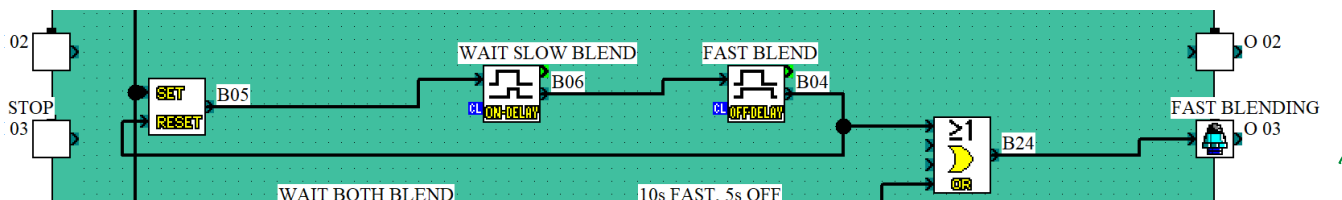
a) Food Processing Blending System



The above screenshot shows an overview of the whole program, designed to blend food at 2 differing speeds. You can see 1 input and 2 outputs, start button, and slow/fast blending being the outputs.

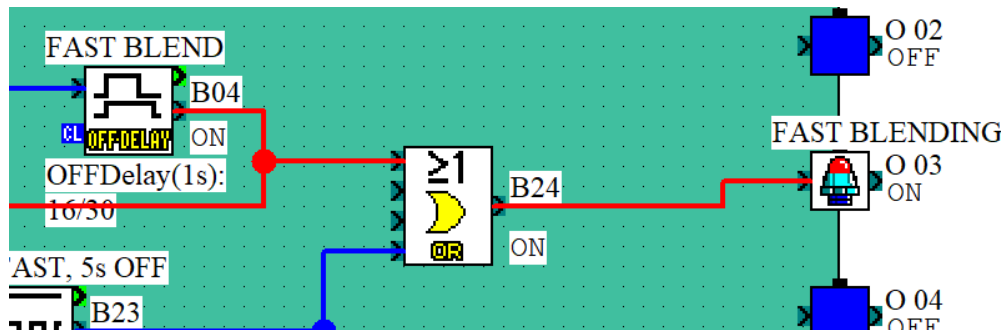


This is the first stage of blending process, 30 seconds of slow blending. An Off delay has been utilised to ensure this stage runs for 30s.

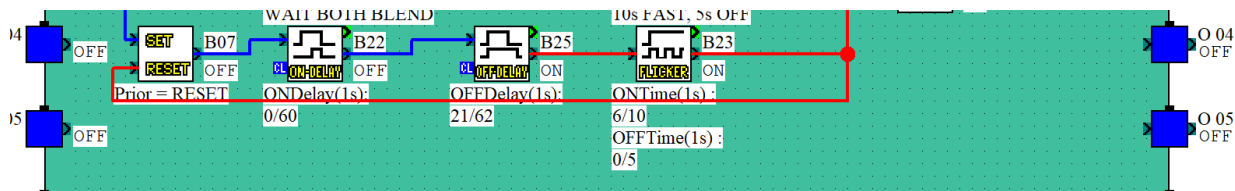


This is the second stage of the blending process, with an On-delay of 30 seconds to allow the slow blending to finish, followed by an Off-delay of 20 seconds, for the fast blending process.

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This shows the fast-blending output active. You can see an OR gate, which allows either the first fast blending stage of 20s, or the 60s of intermittent fast blending.



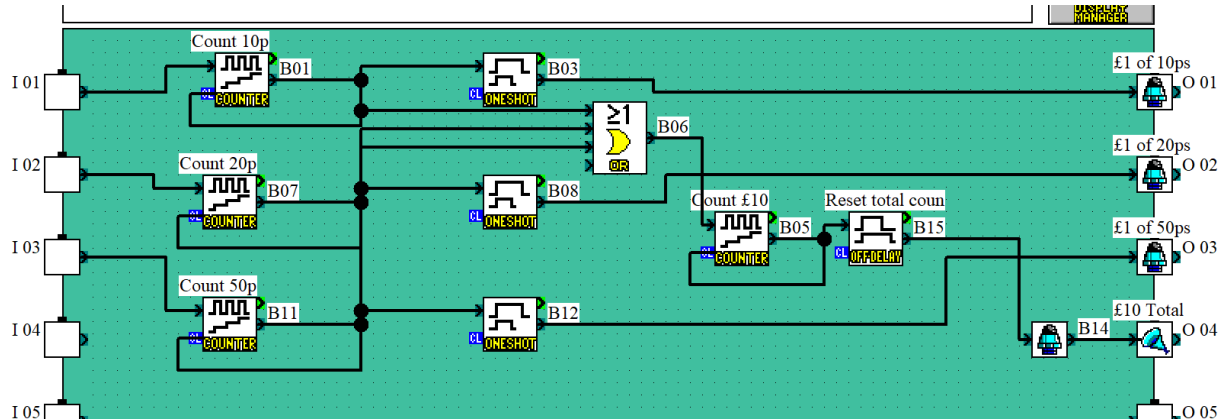
The above shows the sequence for 60s of 10s fast, 5s off blending. An On-delay of 60s allows the first two stages of blending to finish, followed by an Off-delay of 62s to allow for 60s of intermittent fast blending. To achieve the 10s on, 5s off output, a Flicker timer has been used, this allows control of 10s on, 5s off to the output.

Upon simulation of the above program, it was evident that the program runs and works as indicated, though there are some minor changes that could be made to improve operation should it be re-programmed. For example, a sequence indicator for the user would be beneficial, such as an indicator LED or dot matrix display, just to inform the user of the current stage of cycle. Also, from a safety aspect, an integrated stop button would be useful for the user, allowing them to stop the cycle at any point in case of any issues. Lastly, to ensure efficient operation of each cycle, you could incorporate feedback from the blender motor after each sequence should be complete, to ensure each blending cycle finished before the next starts. This would ensure efficient and complete blending, and an improved end product for the user.

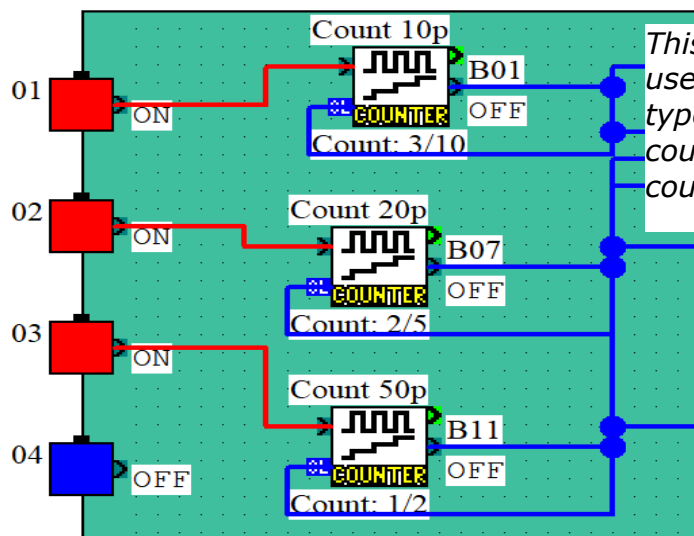
Good.

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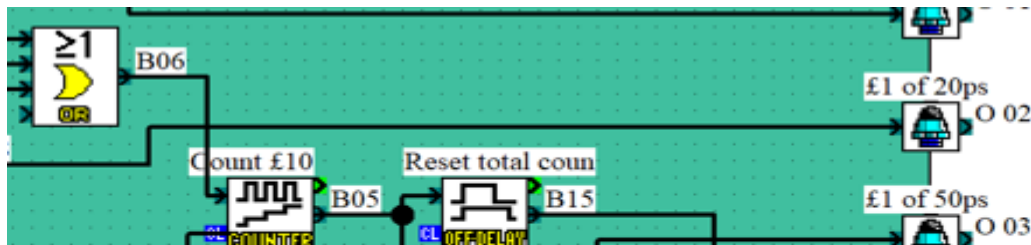
b) Coin Counting System



This screenshot shows the whole program, with the 3 inputs being a 10p coin, 20p coin and 50p coin, and the outputs being 3 led beacons, 1 for £1 of 10ps, £1 of 20ps and £1 of 50ps. There is also a 4th output which is a buzzer when the overall total reaches £10. There are counters, logic gates and delays also used in this program.



This figure shows the three counters used, to count the three differing types of input (coins). Once the counter has reached the desired count, it will give an output 1.



Here we can see the OR logic gate that all three input counters come to, the counter after this gate is used to count every £10 and energise the output. There is also a reset to clear the £10 count, to allow the system to recount. The Off-delay is used to control the output buzzer, it will operate for 10 seconds to alert the user £10 has been counted.

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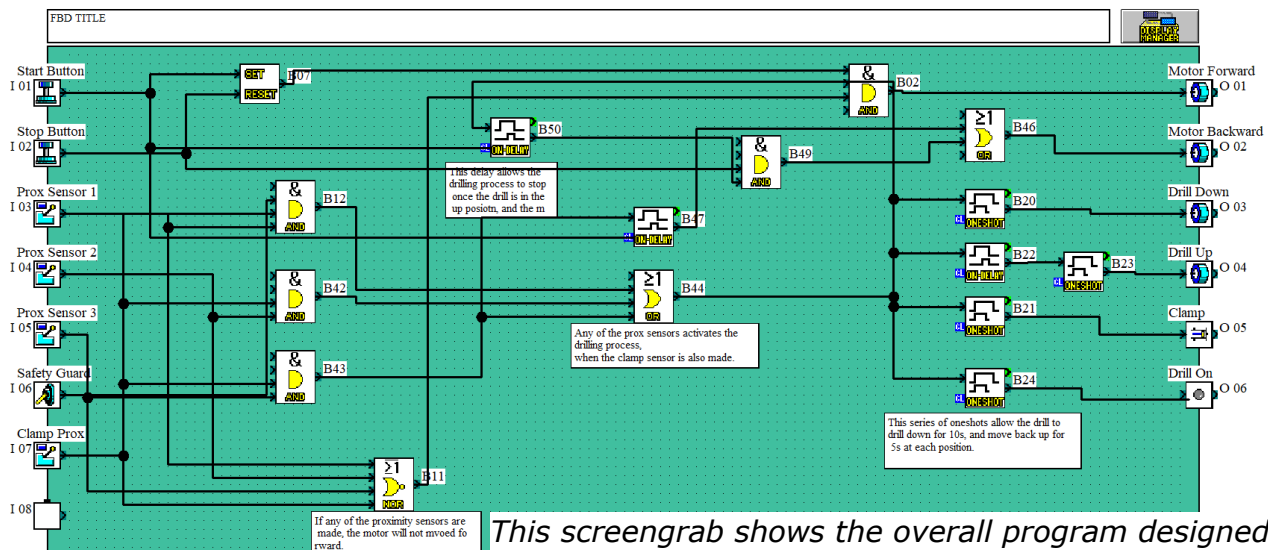
Upon review of the program, again there are some adjustments that could be made to aid use of the system. For example, all the coin counting functions could have a display such as a dot-matrix, to show how many each counter has counted. And also, the £1 outputs for each coin type could have individual indication types, such as 1 flicker for 10ps, 2 flickers for 20ps and 5 flickers for 50p for instance. This would help the user identify the ongoing count. ✓

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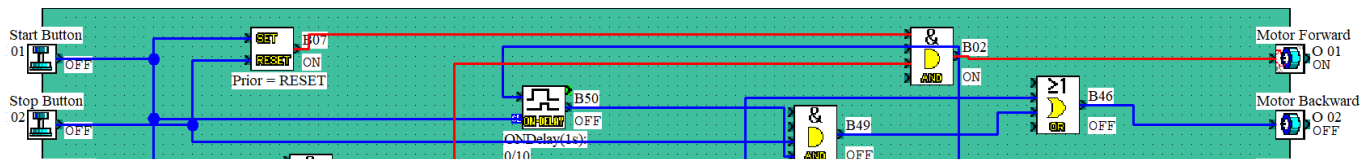
TASK 5- AUTOMATIC DRILLING SYSTEM

Below, there are screenshots showing the drilling system design by Samuel Davies, using Mitsubishi Alpha software. Here is the I/O table as per the assignment brief;

PLC I/O Connection			
Input		Output	
1	Start button	1	Motor forward
2	Stop button	2	Motor backward
3	Proximity sensor 1	3	Drill servo up control
4	Proximity sensor 2	4	Drill servo down control
5	Proximity sensor 3	5	Clamp
6	Safety Guard	6	Drill on
7	Clamp sensor		

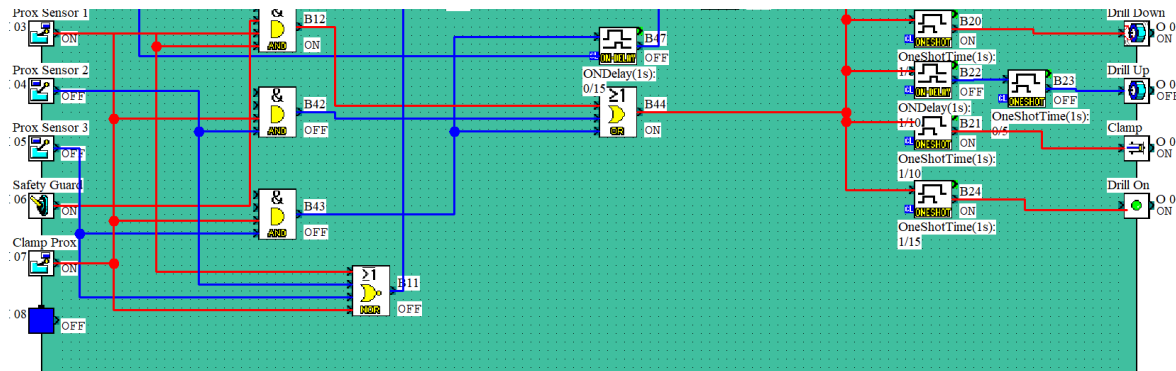


This screengrab shows the overall program designed for the drilling system. You can see the inputs and outputs on either side, with the main program in the centre. Below there are individual images showing different sections within the program.

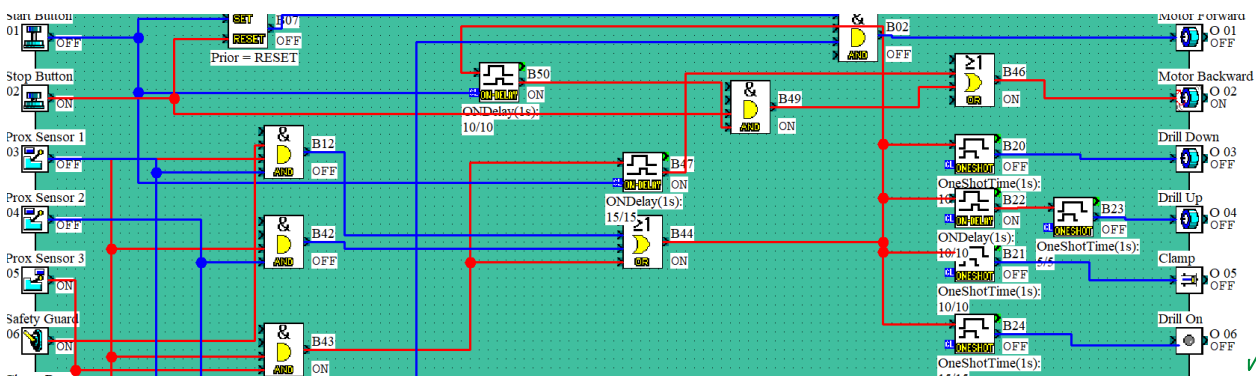


This screengrab shows the motor forward movement when the start button is pressed, where the motor moves until a proximity sensor is made.

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This screenshot shows the drilling process, when a position sensors and the clamp sensor are both made, with the drilling process ran off timers.



The above screengrab shows the motor returning to the start position if the stop button is pressed. The motor will also return to the start position after the 3rd proximity sensor drilling cycle is complete, as per the on delay seen in the centre.

During simulation of the program on multi-sim, it became apparent that if this system were to be re-designed, then there are definitely improvements to be made. These include an input device (proximity sensor), for the motor home/start position, this would allow more accurate control of when the motor moves backwards, and stop the movement when it reached its home point. Also, another improvement could be the use of position device such as an encoder, instead of the individual positioning proximity sensors. Also, as a safety feature, an indication LED beacon could be optimised to show the operator and surrounding others the status of the machine.

PROGRAMMABLE LOGIC CONTROLLERS – PCEE4005

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APPENDIX

Data Sheets

Here are the data brochures for the Mitsubishi Alpha2 series, used in this assignment.

THE MITSUBISHI ALPHA
Pioneering a New Generation in Control
ALPHA Specifications

Item	AL2-1000-1	AL2-1000-2	AL2-1000-3	AL2-1000-4	AL2-1000-5	AL2-1000-6
IO	16	16	16	16	16	16
Power Supply	100-240 VAC	24 VDC	100-240 VAC	24 VDC	100-240 VAC	24 VDC
Input Supply	100-240 VAC	24 VDC	100-240 VAC	24 VDC	100-240 VAC	24 VDC
Input Supply with Analog Capability (0-10V & 4-20mA)	-	-	-	-	-	-
Outputs	4 (0.5A @ 0.1V)	4 (0.5A @ 0.1V)	4 (0.5A @ 0.1V)	4 (0.5A @ 0.1V)	4 (0.5A @ 0.1V)	4 (0.5A @ 0.1V)
Relay Function	-	-	-	-	-	-
Relay Function (0-10V) Notes	20V/10A/100ms	20V/10A/100ms	20V/10A/100ms	20V/10A/100ms	20V/10A/100ms	20V/10A/100ms

Expansion Adapter Modules

Module	Function
AL2-1000-1	4-channel relay output (0.5A @ 0.1V) with 100mA high-speed output (HSD)
AL2-1000-2	4-channel relay output (0.5A @ 0.1V)
AL2-1000-3	4-channel relay output (0.5A @ 0.1V)
AL2-1000-4	4-channel relay output (0.5A @ 0.1V)
AL2-1000-5	4-channel relay output (0.5A @ 0.1V)
AL2-1000-6	4-channel relay output (0.5A @ 0.1V)

ALPHA family delivers unbeatable features and performance:

- Comprehensive range of ready-to-use functions
- Large program memory for up to 200 function blocks
- LCD with 8 function keys and HM functionality
- Eight analog inputs, gain function, integrated Schmitt trigger controller
- Integrated calendar/clock function supporting up to 1,000 on/off commands
- Communication capabilities for the AS1 field bus
- Fast 1MHz input in AL2-4EX expansion module
- Second serial port for published protocol and GSM modem support
- Suitable for outdoor applications down to -25°C (-13°F)
- DIN, CE, UL and cUL certifications

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Alpha2 Series
Simple Application Controllers

- Programmable Automation Controllers
- Programmable Logic Controllers
- Human Machine Interfaces
- Motion Controllers
- Servo Systems
- Variable Frequency Drives
- Robots
- Computerized Numerical Controls
- Low Voltage Switchgear

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ALPHA2

Automate your process, machines, or home with Alpha2 Series Controllers. Feature-packed and advanced technology keeps the Alpha2 controller a step ahead of its competitors. The Alpha2 provides easy, flexible and powerful control rugged enough for the factory and simple enough for the home.

APPLICATIONS

- Machine and Process Automation
- Pump Control
- Fluid Level Control in Tanks
- Pressure Monitor
- Temperature Control
- Motor Control
- Relay Replacement
- Discrete Component Replacement
- 4-20mA Bypass Valve for Variable Frequency Drives
- Shutter/Gate Control
- Security Systems
- Airports, Train Stations, Hospitals, Traffic Systems
- Testing and Measuring Equipment
- Lighting, Movement Control
- Farms, Greenhouses, Livestock Enclosures
- Temperature, Watering, Feeding Control
- Educational Materials in Schools, Lab Classes
- Residential Lighting, Security and Temperature Control

FEATURES

- Built-in Display
- Real Time Clock
- Scheduling Function
- Programming via the Front Panel Keys
- Analog/Discrete Inputs
- Transistor Outputs
- High Current Relay Outputs (up to 8 Amps)
- 20 Day Memory Backup for Data
- 20 Year Memory Backup for Programs
- Password Protection for Programs
- Broadcast Communication Function via Modem

Advanced CPU Features

- Huge Memory: 200 Function Blocks or 5000 Bytes
- Short Message Service Capability with GSM Modems
- Industrial Protocol for Data Access
- Extended Temperature Range
- PWM Command
- 37 Instructions (Function Blocks)
- Multi-Language Capability (English, Spanish, German, French, Italian, Swedish)

Advanced Display Features

- Scrolling or Flickering Text
- Screen Sequencing
- Large Backlit Display
- Bar Graph Display
- Message Flickering
- 12 Characters x 4 Lines
- Data Entry with Three Levels of Password Protection

Advanced Extension Modules

- DC Input Extension Module, AL2-4EX
- AC Input Extension Module, AL2-4EX-A2
- Output Relay Extension Module, AL2-4EX-VR
- Output Transistor Extension Module, AL2-4EX-T
- AS1 Communication Module, AL2-AS1-BD

ANALOG MODULES AND PID INSTRUCTION

AL2-3PA-ADP

- 2 channel PT100 Analog Input Adapter
- Compensated Range: -60°C to 200°C
- Analog voltage output: 0-10V
- Resolution: 0.1°C/digit
- Accuracy: $\pm 1.5\%$ for all temperature ranges, $\pm 1\%$ for 20°C
- Conversion time: 20ms per channel
- For use with DC base units only

AL2-3TC-ADP

- 2 channel K-Type Thermocouple Analog Input Adapter
- Compensated Range: -60°C to 450°C
- Analog voltage output: 0-10V
- Resolution: 1.0°C/digit
- Accuracy: $\pm 2.0\%$ for all temperature ranges, $\pm 1.5\%$ for 20°C
- Conversion time: 20ms per channel
- For use with DC base units only

AL2-2DA

- 2 channel Analog Output Module
- Analog output: 0-10V and current output: 4-20mA
- Resolution: 2.5mV/voltage output or 0.10mA
- Back Current output of 4-20mA
- Conversion time: 1 channel 10ms, 2 channels 20ms

VIEW LOGIC SOFTWARE (VLS)

Visual Logic Software provides the perfect fit for both new and experienced programmers. The preprogrammed Function Blocks, Windows-based tools and extensive mouse commands, let users quickly get up to speed on program development.

Debugging programs is fast and simple thanks to the Simulation Mode. Force inputs On/Off manually. View the Function Block operations and Output status onscreen. Eliminate program glitches before downloading!

FEATURES

- Password Protection
- User Defined Icons
- Controller Diagnostics
- On-line Editing
- Com Configuration
- Extensive Help Files
- Date Format Settings
- Remote Maintenance and Programming
- Simulation Mode
- Everything you need for fast and easy programming!

LOGIC AND FUNCTION BLOCKS

- AND
- OR
- NOT
- NAND
- XOR
- Buffer
- Relay Self-Reset
- Delay
- Alternate
- Relay Self-Reset
- Relay
- Offset
- Compare
- Counter
- Up/Down Counter
- Pulse
- Time Switch
- Time Switch (with Memo Edit)
- Schmitt Trigger
- Zone Compare
- Display
- Speed
- PWM (Pulse Width Modulation)
- Add
- Hour/Meter
- Subtract
- Multiply
- Divide
- Calculate
- Shift
- GSM SMS
- Random
- Delayed One Shot
- Delayed Alternate

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PROGRAMMABLE LOGIC CONTROLLERS – PCEE4005

Figures

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