PROGRAMMABLE LOGIC CONTROLLERS
ASSIGNMENT No. 2
OUTCOME 2 INFORMATION AND COMMUNICATION TECHNIQUES.

In order to complete this assignment you will need to study the following from your notes, textbooks, technical journals, catalogues and any other suitable source.

PART 1 USING ANALOGUE and DIGITAL SIGNALS WITH A PLC

1A. Analogue signals

Analogue electrical signals are used to represent process variables such as pressure, speed, temperature, flow rate and so on. The instruments produce electrical outputs that are processed into a standard form so that standard equipment can be connected to it such as analogue to digital converters and meters. The modern standard is 4 – 20 mA or 0 – 10 V. If you examine the Mitsubishi A/D module, you will see that it is capable of using both standards. Study your notes on A/D and find out about the resolution of analogue signals. A/D converters commonly use 9, 10 or 12 bits to represent the analogue signal.You should have completed the worksheet where you programmed and tested the A/D and D/A modules of the Mitsubishi PLC.

1. Find and describe briefly at least two industrial analogue sensors that would be used with the 4 – 20 mA A/D channel.
2. Explain why 4 mA represents the minimum value and not 0 mA.
3. Find out and describe briefly at least two industrial analogue instrument that would be used with the 0 – 10V analogue channel.
4. Find and describe briefly at least two industrial analogue devices (e.g. standard indicating meter but don't use this one) that would be used with the 4 – 20 mA D/A channel.
5. A/D modules may have different word lengths giving different resolutions. Calculate the resolution of a 4 bit and a 12 bit A/D module.
6. Suggest an application that might need fine resolution.

1B. Digital signals

Many modern instruments have an analogue to digital converter built into them or are designed to produce a digital signal in the first place. The process variable is then transmitted as a digital signal. Many output devices are controlled directly from a digital input.

1. Describe briefly the principle of an ***OPTICAL SHAFT ENCODER*** and explain why the output is inherently digital in form.

2. Describe briefly how the rotation of a stepper motor may be controlled by a digital signal.

1C. Numbering Systems

Study your notes on numbering systems and find out about decimal, binary, octal, hexadecimal and BCD.

1. Give an example of the use of octal numbers in a PLC.

2. Give an example of the use of hexadecimal numbers in a PLC.

3. Write down the following decimal number in binary, octal and hexadecimal. _____

4. Find an example of the use of BCD.

5. What is the binary pattern for the following number using BCD? _____

PART 2 PROTOCOLS AND NETWORKING

Computers communicate with other computers and with various parts of an engineering system such as logic controllers. The computers or the PLCs may interrogate other equipment such as counters, timers, flow meters, temperature sensors and level gauges. They may also send signals to other hardware items such as a bank of pneumatic valves or a pipeline controller.

PART 2A PROTOCOLS

Find out as much as you can about the following protocols and write out a full definition explaining where they might be used or considered in a manufacturing enterprise. Consider the advantages and disadvantages of the different options. ***Say where you found your information.***

PROTOCOLS

i. RS232
ii. IEE488
iii. RS422
iv. 20 mA

PART 2B NETWORKING

Computers and PLC type equipment are often connected to each other and to digital equipment by a communication network. The terms listed below are used with networking standards. Describe the meaning of each. ***Say where you found your information.***

i. Master to slave.
ii. Peer to peer.
iii. ISO
iv. IEE
v. MAP logic functions

PART 3 SIMPLE LADDER PROGRAMS

Complete the worksheets based on the Bytronics software Ladsim. Get each worksheet verified and attach them as a file.

List of worksheets

1. Timers
2. Counters
3. Registers
4. Car park problem
5. Traffic Light problem

You must complete this assignment within 4 weeks of issue.

BYTRONICS WORKSHEET 1 TIMERS

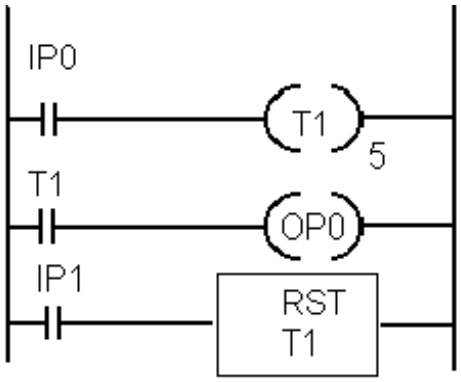
STUDENT NAME _____DATE _____

On completion of this assignment you should be able to programme a simple timer sequence into a PLC. This will be done with the Bytronics simulation software.

Consider a machine which has to insert a component into a heat treatment oven for a fixed time and then remove it.

Let the timer used be T1
Let the input used to start the timer be IP0
Let the input used to reset the timer be IP1
Let the output be OP0

LADDER DIAGRAM



EXPLANATION

When IP0 is closed the timer starts running. After 5 seconds the timer contact closes and switches on output OP0. If IP1 is closed, the timer is reset.

STUDENT EXERCISE

Enter the above programme into your PLC and test it using the DEBUGGER under simulation. When you are satisfied, have it verified by your tutor on the accompanying verification sheet. Enter the details in your folio.

Note that the timer stays on until reset. In other types of PLCs the timer may be automatically reset by opening the contacts of IP0. Demonstrate that this does not happen here.

Verification

Signature of tutor _____ Date _____

BYTRONICS WORKSHEET 2 COUNTERS

STUDENT NAME _____ DATE _____

On completion of this assignment you should be able to enter a simple counter programme into a PLC. This will be done with the Bytronics simulation software.

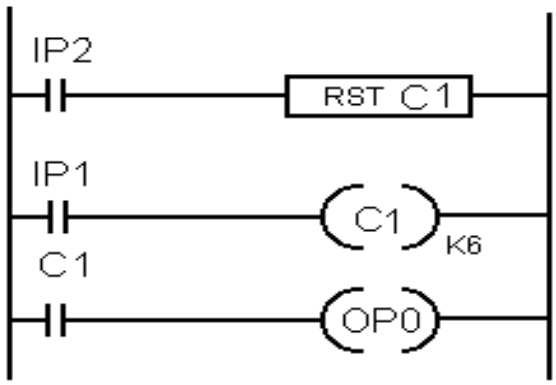
A counter might be used to count up or count down and then activate a contact. Note that when entering the counter data you must choose up or down and enter the number of counts.

When counting down, you must also enter a number in the accumulator equal to or smaller than the count. The contacts close when the accumulator is decremented to zero.

When counting up, you should have zero in the accumulator and the contacts close when the accumulator is incremented to the same value as the number of preset counts.

Let the counter used be C1
Let the input used to reset the counter be IP1
Let the input used to count components be IP2
Let the output used to start the packaging routine be OP0.

LADDER DIAGRAM



EXPLANATION

When contact IP2 is closed the counter is reset to zero. Each time contact IP1 is closed the count is decremented or incremented by 1 depending on whether you set the counter as an up counter or a down counter. When the count is completed, the counter contacts close. When the counter contact closes, OP0 is switched on.

STUDENT EXERCISE

Enter the above programme into your PLC and test it by running the DEBUGGER. Observe the count and accumulator numbers as you open and close IP1. When the accumulator Observe closing IP2 resets the counter. When you are satisfied, have it verified by your tutor to sign below.

Verification

Signature of tutor _____ Date _____

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BYTRONICS WORKSHEET 3 REGISTERS

STUDENT NAME _____DATE _____

On completion of this assignment you should be able to

- programme a register into a PLC and shift the register.
- monitor the contents of the register.
- understand how a pattern represents a 3 digit binary decimal coded number (BCD)

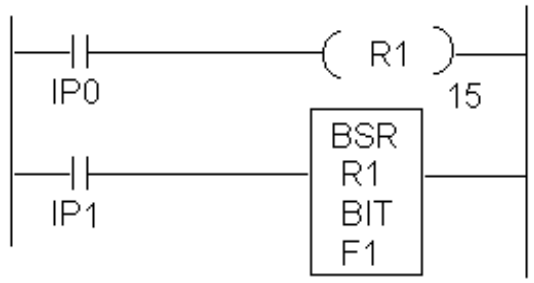
You will use the Bytronics simulation software.

REGISTERS

Typical Uses

Converting a pattern into a BCD and performing numeric operations. See typical examples in the PLC manual.

EXPLANATION



Rung 1 shows contact IP0 connected to a register. You must specify the bit to change when IP0 is closed. In this case bit 15 which is the MSB. If IP0 is closed bit 15 is high, if open it is low.
Rung 2 shows IP1 followed by a command BSR (Bit Shift Right). Every time IP1 is closed all the bits are shifted right.

The LSB falls off the end and the MSB is replaced by a 1 or a 0 depending on the state of IP0. Each time a right shift is done with bit 15 being replaced by a 0, the binary number is divided by two.

If BSL is used (Bit Shift Left), all the bits are shifted left with the LSB being replaced by a zero, the binary value is doubled.

Enter the above programme and run the DEBUGGER. Observe the register contents as you open and close IP0 and IP1. When you are satisfied, have it verified by your tutor to sign below.

Verification

Signature of tutor _____ Date _____

BYTRONICS WORKSHEET 4 CAR PARK

STUDENT NAME _____DATE _____

Using the Bytronics software, produce a ladder logic programme for the car park simulation.

You will need to use

- Timers.
- Up counters.
- Down counters.
- Latches.

Demonstrate the system working.

Produce a printout of the ladder diagram.

Get your tutor to verify the prigramme by signing below.

Verification Signature of tutor _____ Date _____

FEED BACK COMMENTS

_____

_____

_____

_____

_____

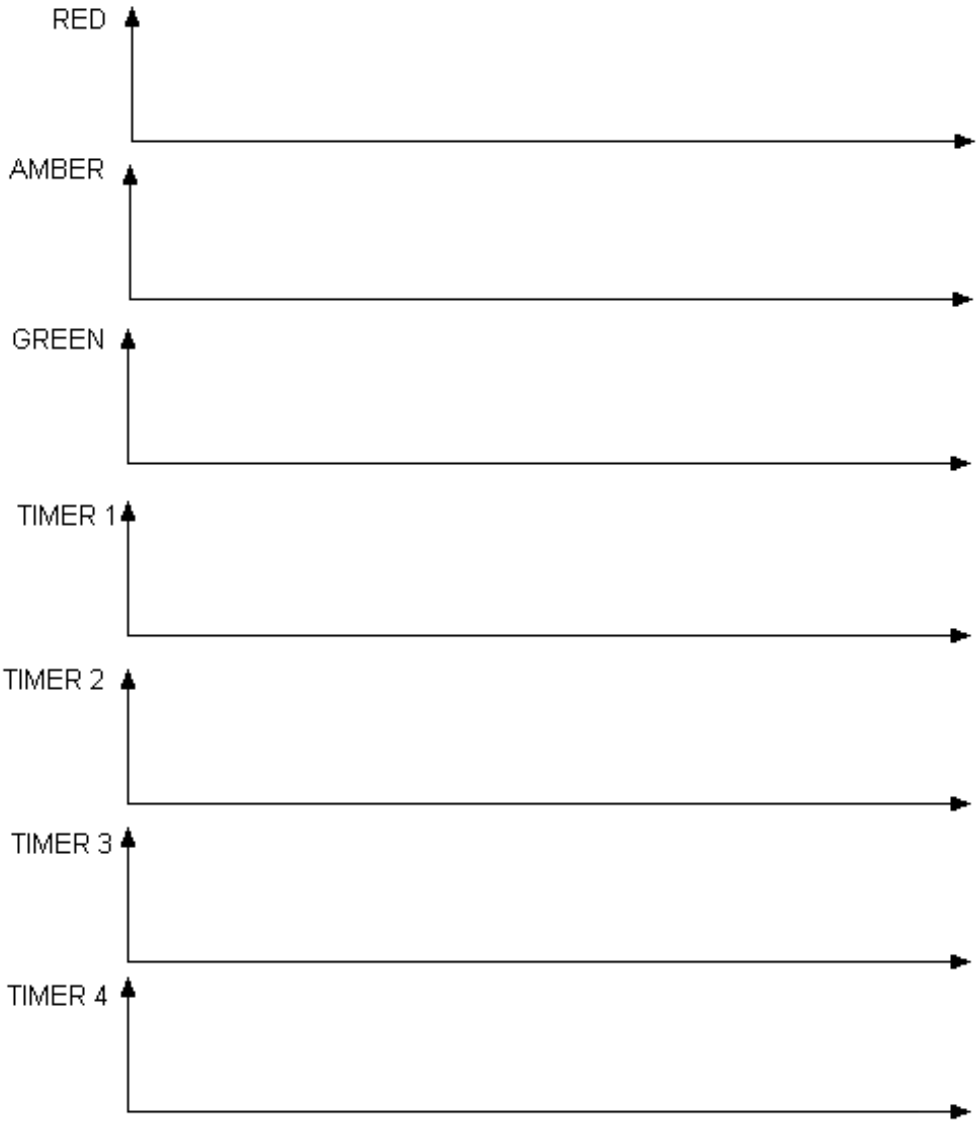
_____

_____

BYTRONICS WORKSHEET 5 TRAFFIC LIGHTS

STUDENT NAME _____DATE _____

Using the Bytronics software, produce a ladder logic programme for the TRAFFIC LIGHT SIMULATION. Use only timers to produce the control. ***Produce a neat timing diagram below and explain your method fully.***



Verification

Signature of tutor _____ Date _____