

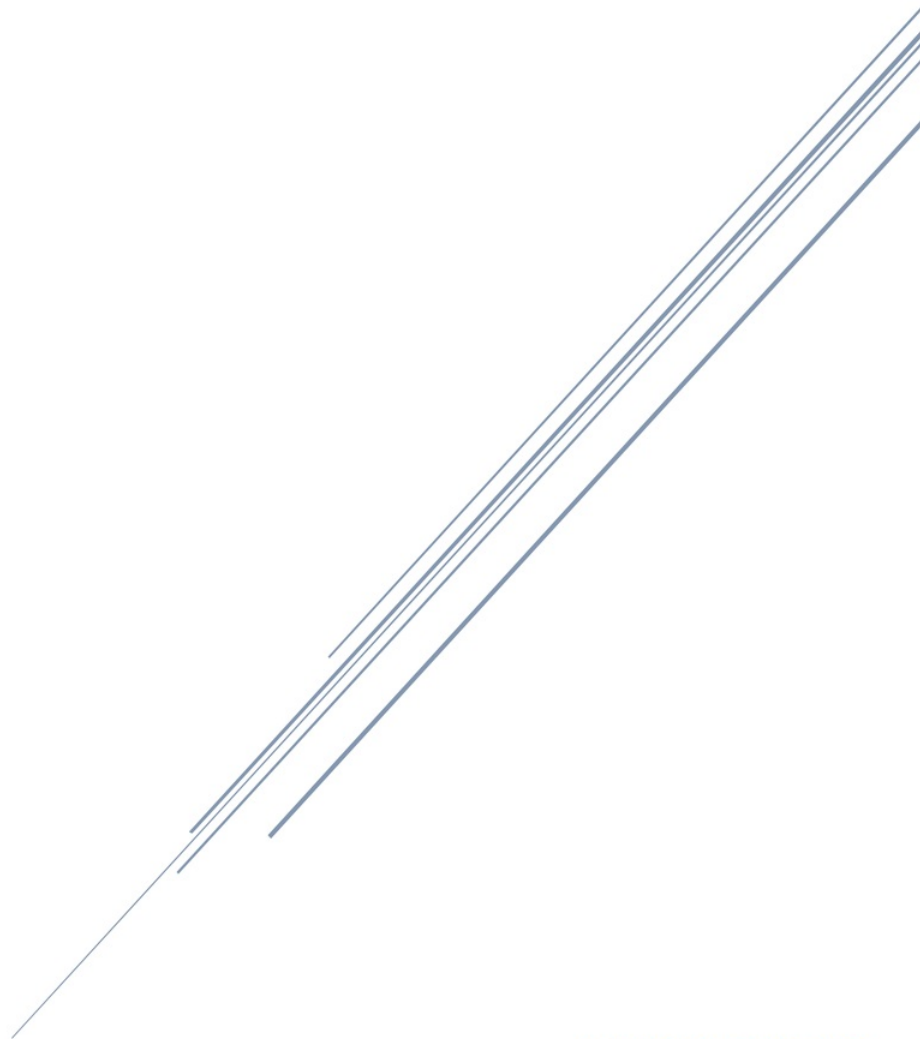
final report

by Trystan Daniels

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HNC ELECTRICAL AND ELECTRONIC ENGINEERING PROJECT

PSDE 5007-ASSIGNMENT – Final Report



TRYSTAN DANIELS

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contents
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Project proposal

This project will be located at DUNBIA (Felinfach). Dunbia is a multinational food company specialising in the production of beef, pork, and lamb. Dunbia Felinfach processes and packs beef for Sainsbury's.

The purpose for the conveyor is to transport meat from a freezer to a cutting machine. The current conveyor is run on an isolator where the conveyor must be manually switched off and on. The company require a system which starts and stops the conveyor automatically as the meat comes to the end of the conveyor and require an emergency stop circuit. The control panel must be waterproof as it will have been pressure washed every night. The panel must comply with food standards.

I have a budget of £3,000 on this project. The project will be built, tested and commissioned at the workplace during work hours. The project will require looking into different solution which will include different plc models and systems.

During the project a log book will run, recording down the activity's carried out each week. A gantt chart will be designed to keep the project on track with time. All recording and some of the research will be carried out during collage hours.

Signature:	Date:
Lecturer Signature:	Date:
Manager Signature:	Date:

Issue to be solved

Overtime as machines have been moved around and even off site for new machines therefore the lines have been disconnected from themselves, therefore a new system needs to replace the current out of day unsafe system.

The purpose for the conveyor is to transport meat from a freezer to a cutting machine. The current conveyor is run on an isolator where the conveyor must be manually switched off and on. The company require a system which starts and stops the conveyor automatically as the meat comes to the end of the conveyor and require an emergency stop circuit. The control panel must be waterproof as it will have been pressure washed every night. The panel must comply with food standards.

During the night the conveyors must be able to run during wash-down, also the emergency stops must work during this time to ensure safety to the cleaners. Therefore there must be an automatic and manual mode, so cleaners can switch to manual when cleaning allowing them to turn the conveyors on bypassing the sensors however not bypassing the emergency stop system.

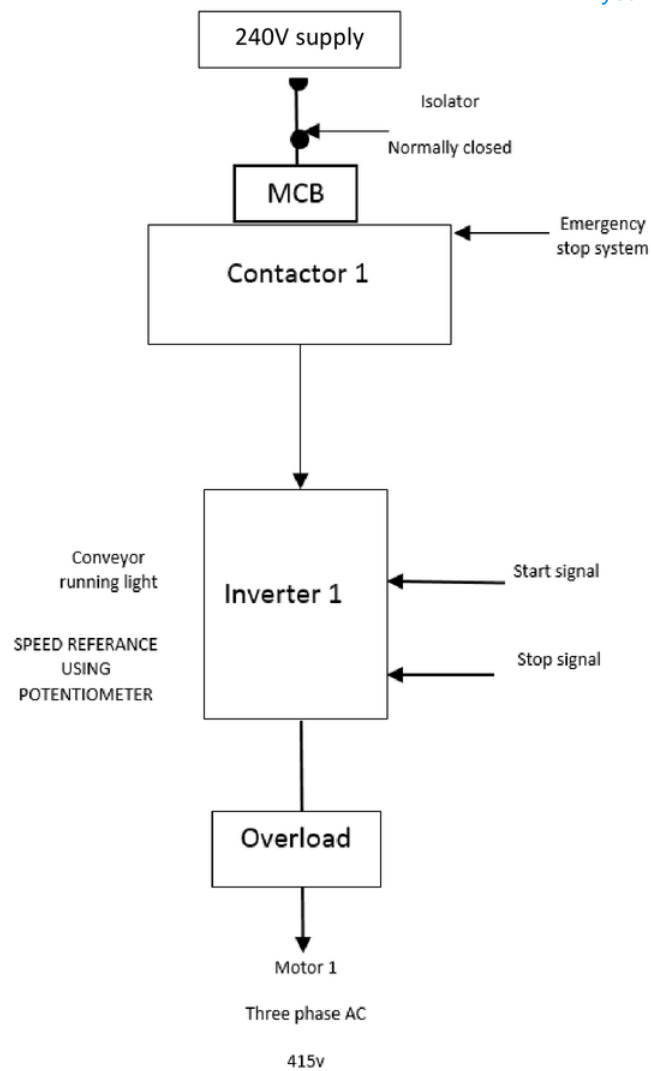
One issue with this project is getting time to commission the project as the factory runs 7days a week with cleaning in the night.

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Background research and solutions

Solution 1

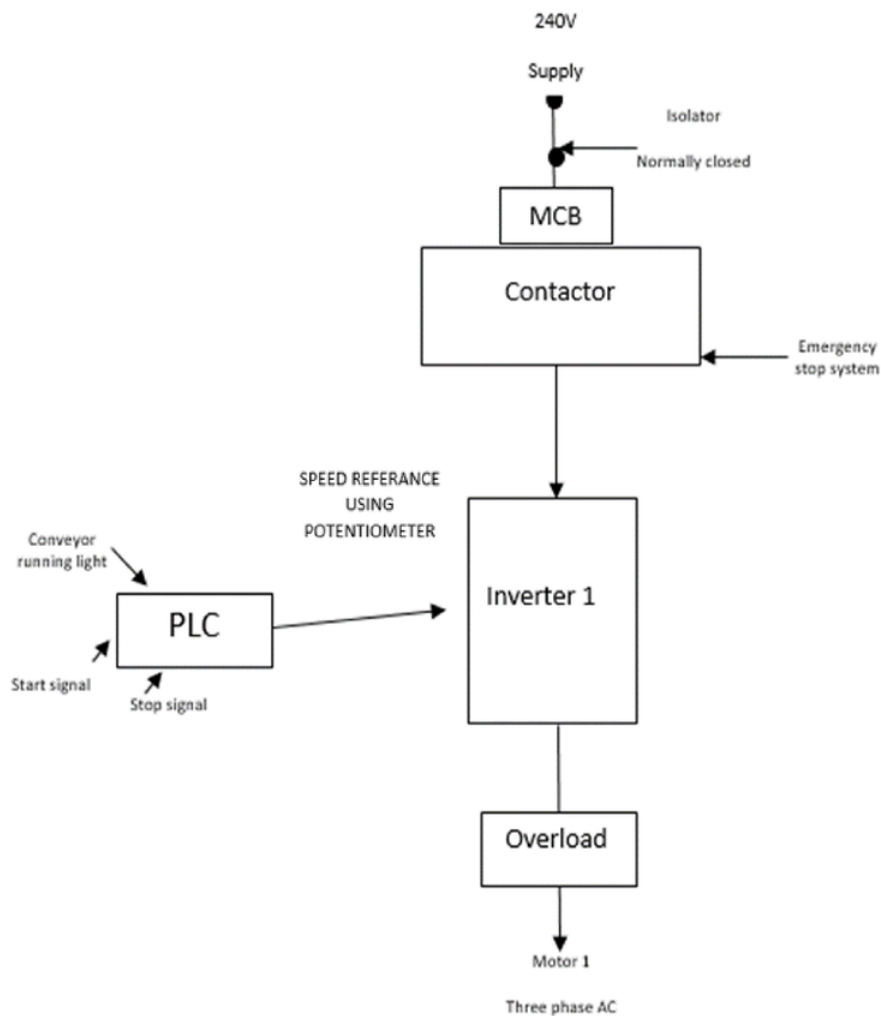
There should be some background and explanation to a similar system here so that there is a reference for your solution.



Cost	£1,443
Maintenance + Reliability	****
Ease of use	*****
Safety	****
Availability	*****

Solution 1 is the simplest of all solution, only costing £1,443. With a supply of 240V AC to a MCB then on through to the contactor. The emergency stop system will be linked to the contactor so if the safety relay isn't giving the contactor and output, the contactor won't pull in. From the contactor it goes to the inverter. The inverter is connected to a start and stop buttons. Also connected to the inverter will be speed reference using a potentiometer, and a conveyor running light. If the start button is pressed and the contactor is pulled in, the inverter should send a three phase supply down through the overload unit, then down to the three phase motor.

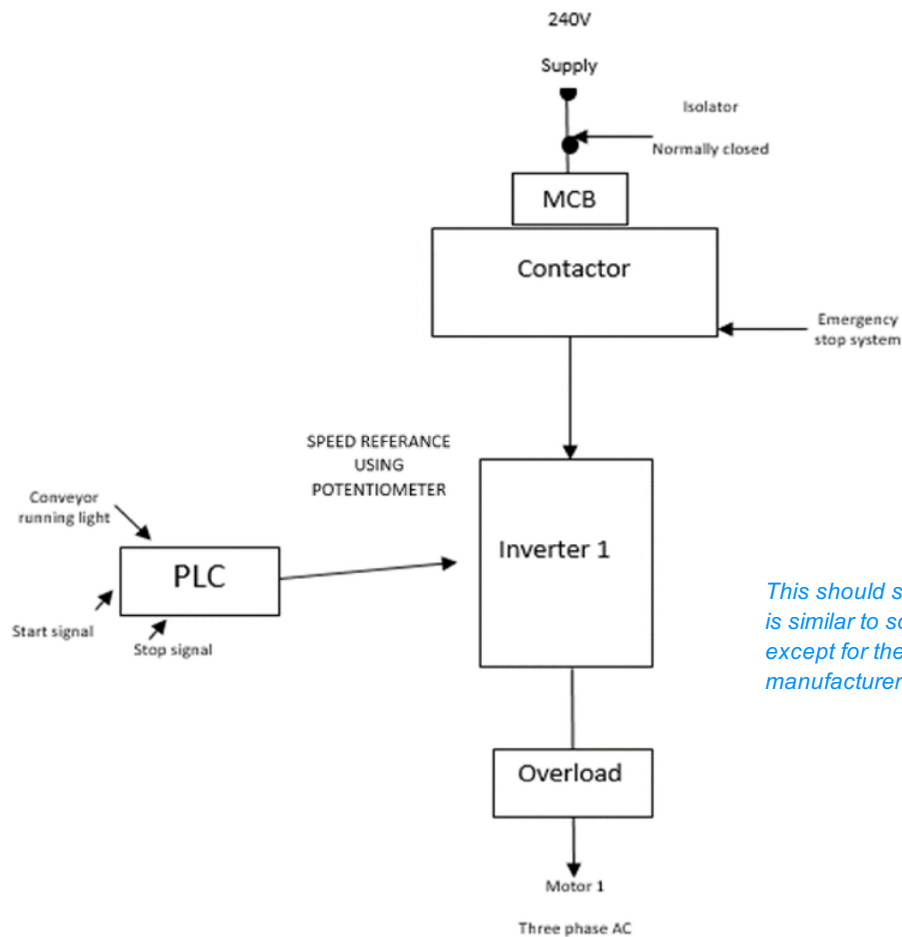
Solution 2



Cost	£3,543
Maintenance + Reliability	*****
Ease of use	**
Safety	****
Availability	**

Solution 2 uses a Siemens PLC, with a total cost of £3,543. With a supply of 240V AC to a MCB then on through to the contactor. The emergency stop system will be linked to the contactor or PLC so if the safety relay isn't giving the contactor or PLC an output, the contactor won't pull in. From the contactor it goes to the inverter. The inverter will be controlled by the PLC. Also connected to the inverter will be speed reference using a potentiometer. If the start button is pressed and the contactor is pulled in, the inverter should send a three phase supply down through the overload unit, then down to the three phase motor.

Solution 3



This should state that this is similar to solution 1 except for the PLC manufacturer.

Cost	£2,500
Maintenance + Reliability	*****
Ease of use	**
Safety	****
Availability	****

Solution 3 uses a Omron PLC, with a total cost of £2,500. With a supply of 240V AC to a MCB then on through to the contactor. The emergency stop system will be linked to the contactor or PLC so if the safety relay isn't giving the contactor or PLC an output, the contactor won't pull in. From the contactor it goes to the inverter. The inverter will be controlled by the PLC. Also connected to the inverter will be speed reference using a potentiometer. If the start button is pressed and the contactor is pulled in, the inverter should send a three phase supply down through the overload unit, then down to the three phase motor.

Chosen solution

The chosen solution is solution 3, this solution uses Omron PLC. An advantage of this is that some basic training has been already given to some of the engineers, so will give a good understanding of the PLC and programming if any faults occur.

Another advantage of using Omron is that the company do keep at least 1 in stock if one day it would go faulty it would be simple to replace and reprogram. The company do also have the correct software and cables to connect to this PLC already. For the future this solution can be easily modified to either add or remove motors from its control, which gives flexibility in the future. Using a 2 channel emergency stop system will also cover the requirements.

This is an improvement and update rather than using contactors and relays to control systems such as solution 1.

With solution 2 the company don't see enough of a benefit from the Siemens package for this project so cannot justify the extra cost.

Research

The components used in this project are mostly chosen to follow what is already installed at Dunbia. This is to reduce downtime by having spares available and knowledge around the system.

The panel chosen is a stainless steel panel of IP67 rating as for the ease to clean and be rust free. Also to protect the components inside from water ingress. The panel had to be brought from new as the existing system's panel was in such bad state.

Similar circumstance with the isolate being high rated to protect from water ingress.

PLC

The omron sysmac CMP2A PLC was chosen due to already have the software and most of the engineers have had training on omron systems. The CMP2A is widely available in 20, 30, 40 and 60I/o. These systems can be expanded widely to a maximum of 120I/O. An analogue module can be added using 4-20mA reading. (RSCOMPONENTS, 2018)

*The
research
is
limited.
There
should
be more
with it*

VSD

The VSD used was from commander sk drives which are widely used throughout the site. These VSD have multiple functions such as ramp up, ramp down, motor rating, rpm set to set speeds. The speed can be capped to ensure its not turned down too much or turned up too far. The VSD are rated up to 0.75KW where the motor used are well within being 0.55kw. (motorcontrolwarehouse, 2018)

Power supply

The 24v power supply used was DRA240, a commonly used on site.

Safety relay

The GuardMaster MSR127T was the safety relay chosen which is used on other control panel systems at dunbia.

Specification

This project is based in industry.

The aim of the project is to reduce downtime and the calling out of engineers to change the speed of the conveyors. The conveyors will simply be transporting meat from the start of the line, where it is unpacked, down the line into the first machine's conveyor which is a crust freezer. The speed of the crust freezer's conveyors varies for different products.

The control panel must drive two 3 phase motors (one for each conveyor). The conveyors must be capable of moving up to 40kg of meat down the line, it will have a three phase AC supply of 415V. It must also include an emergency stop circuit. The conveyor's speed must be capable of being varied for different products. The control panel must be able to operate in a room which will be kept at 5°C.

The control panel must be made of stainless steel and be waterproof (IP66). On the panel it must have the following features:

- green start button
- red stop button
- reset button
- emergency stop button
- isolator
- Device to set the speed of each conveyors.

This system must have the following functions:-

- Variable speed. It must be able to vary from 10m/min to 20m/min.
- Two channel emergency stop system.
- Isolator: - this will isolate the power to control panel when isolated.

Supply: - three phase 415V

The 3 phase motors must pass the insulation test of a 100megohms.

There will be no environmental impact from this project.

The project must adhere to the Food Safety Act 1990. Also it must adhere to the 17th edition of the IET regulations.

Preventative maintenance should be carried out on this conveyor weekly. The control panel should be checked with an infra camera to check the components aren't overheating. Also the control panel should be checked for water ingress. The 3 phase motors will be protected from overheating by the addition of an overload unit. The push buttons, lights and emergency stop system should be tested on a weekly preventative maintenance to ensure reliability during production.

The budget for this project is £3,000.

Project plan

After choosing the best solution for the specification, the first step will be to draw the electrical drawings which will be critical for the project will be a success. This has taken me up to week 3 to ensure the electrical drawings are correct.

From the electrical drawings and the specification, the parts was ordered. This is by going through the stores administer who orders all parts. This process was spread through week 2 to week 4. Once all the parts are delivered and the layout of components has to been designed, the construct will start in the workshop.

For this task I made sure I follow the safety orders given to me by my health and safety advisor and wear all PPE which I will be given. For example, safety steel toe cap boots, ear plugs, hard hat, hi-viz jacket, overalls and gloves. This is in accordance with HASAWA 1974

The first job was to mount the DIN rail onto the back plate of the control panel. When drilling safety glasses was worn. Also, holes was drilled for cable glands on the bottom of the box and for the light and push buttons on the front of the panel. Next, the components can be mounted on the din rail in according to the layout designed.

Cable trunking must be put in the control panel to keep the cabling neat. Next, I wired the components up using my electric drawings, while complying with BS EN 60204, Safety of machinery, and electrical equipment of machines.

Once the control panel is all wired up I will mount it near the conveyor and connect up the three phase motors. Then I will connect the panel to a three phase supply.

Finally the control panel will be tested to ensure it meets the specification. If successful, the panel will be installed and commissioned out on the line.

Testing plan

Test 1 (see figure 1)	PASS/FAIL	PASS/FAIL	PASS/FAIL
Capability of moving up to 40KG?			

Test 2 (see figure 2)	PASS/FAIL	PASS/FAIL	PASS/FAIL
Variable speed form 10m/min to 20m/min			

Test 3 (see figure 3)	PASS/FAIL	PASS/FAIL	PASS/FAIL
3 phase motor insulation test?			

Test 4	PASS/FAIL	PASS/FAIL	PASS/FAIL
Includes the following features: Green start button, red stop button.			

Test 5	PASS/FAIL	PASS/FAIL	PASS/FAIL
Test emergency stop and reset buttons			

Test 6	PASS/FAIL	PASS/FAIL	PASS/FAIL
Isolator			

Test 7	PASS/FAIL	PASS/FAIL	PASS/FAIL
Device to set the speed of conveyors			

Above is a testing table to carry out to ensure the project meets its requirements and safety, these tests must be carried out three times with 100% pass rate for the project to continue to

Does this colour code mean anything? There should be a key for the pass fail state.

commissioning. These tests have been carried out on the test board as well as when commissioned on line. See figures below related to the tests above.

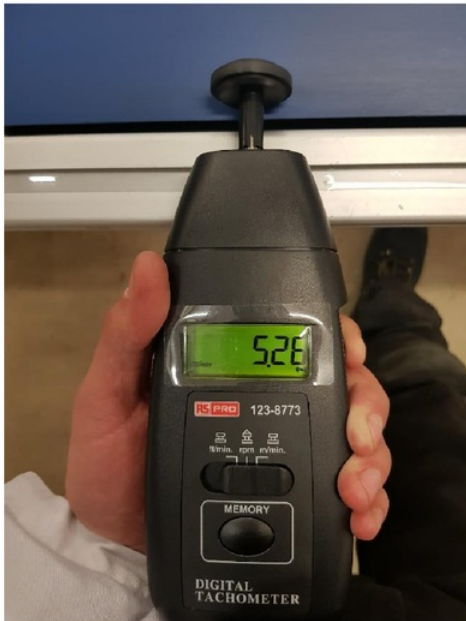


Figure 1

Figure 1 above relates to test 2, the speed variable test. From figure 1 and 2, it can be seen that the conveyor can be varied from 5m/per min to 50m/per min which is within specified.

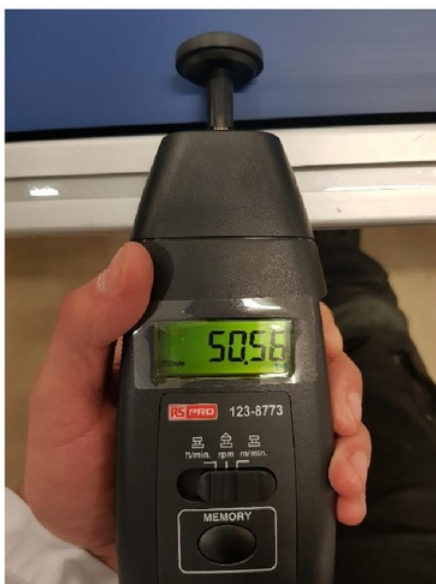


Figure 2



Figure 3

Figure 3 shows the specified features on the panel as required in test 4.



Figure 4

Figure 4 shows the system start button working on the test board before commissioning.



Figure 6

Figure 5 shows the stop system button working on the test board.



Figure 5

Figure 5 shows the reset button activated on the training board.

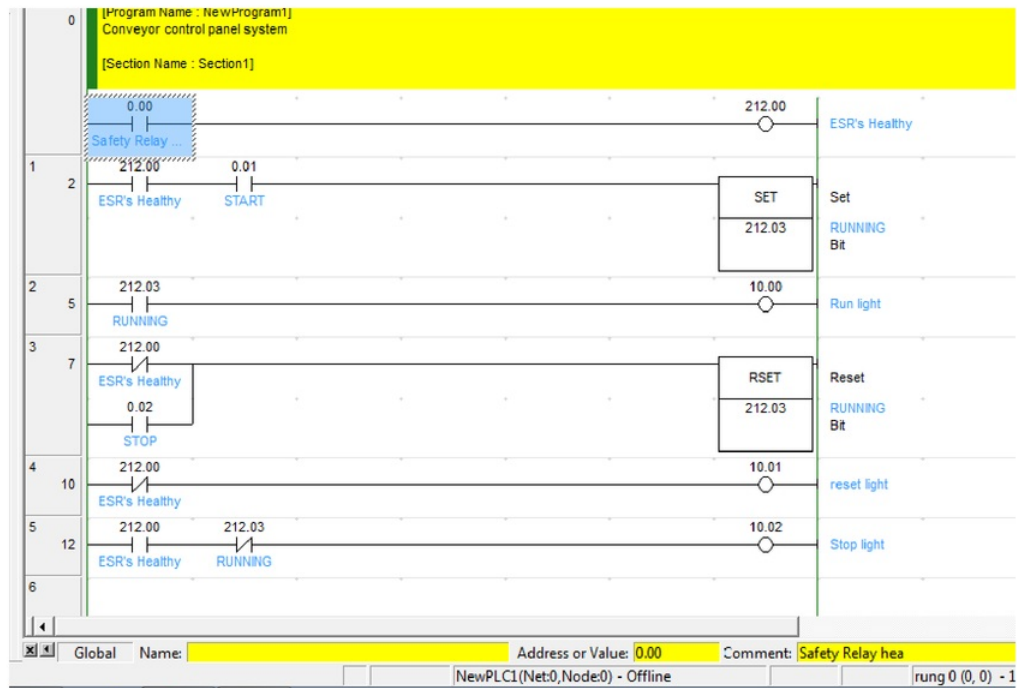


Figure 7



Figure 8

From figure 7 and 8 it can be seen that the start button gives the PLC an input as it should on input 0CH .01. Also it may be seen that the PLC gives an output 10CH .01 to the run light.



Figure 9

From figure 9 the PLC inputs and outputs when the whole system is running can be seen. Outputs 11CH .00, 11CH .01, 11CH .02 and 11CH .03 are on which give the inverters the signal to run.

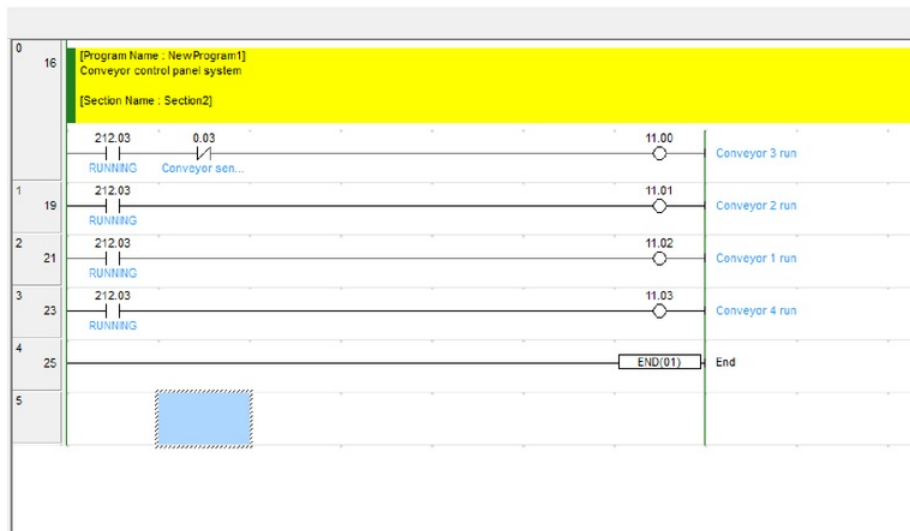


Figure 10

Figure 10 shows the outputs section of program. Here are all the outputs to start the conveyors.

This is good here and



Figure 11

Figure 11 shows the system in emergency stop mode, without any inputs and only one output to the reset button light.



Figure 12

Figure above shows the system in stop mode with the emergency stop system giving an ok input but the operator hasn't pressed start yet, only giving one output to the stop button light.



Figure 13

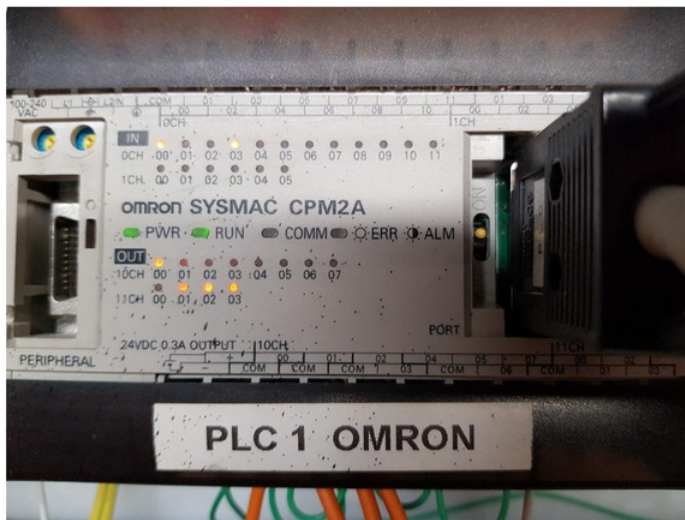


Figure 14

Figure 13 and 14 are the tests for the product stop sensor. This worked giving an input to the PLC and turning an output to the VSD of the conveyor. (11CH.00)

Test	Description	PASS/FAIL
1	Power to the main isolator (230v)	
2	24v power supply power up and correct voltage	
3	Safety relay powered up	
4	PLC powered up	
5	System function buttons communicate with PLC	
6	Emergency stops stop the system instantly	
7	Emergency stop system communicates with PLC	
8	Product sensor stops and starts conveyor 1	
9	System starts and stops efficiently	
10	Speed variable on conveyors.	

Does
this
mean
the
tests
have all
passed
because
of the
green
colour
code.

See gantt chart below.

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13
Electrical Circuit Diagrams													
Order Parts													
Mechanical construction													
Electrical circuit construction													
Testing													
Install													
commission													

The below gantt chart is the actual events that happened during the project.

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13
Electrical Circuit Diagrams		1											
Order Parts		2											
Mechanical construction			3										
Electrical circuit construction					4								
Testing									5				
Install											6		
commission													7

Key	Planned	
	Actual	

Plan looks good and indicates the comparison.

Conclusion

The project on the whole was a success meeting the specification after testing and improving the system. Throughout the project there were many delays due to the demands of other work in the factory meaning the project was behind on the plan most of the time. This was down to a lot of maintenance weeks and line moves making it near impossible to get time to carry out project work. However when the time was allocated, progress was efficient. It was a big learning curve with the omron software package however through using ladder and testing on the training board a program could be written. Most tests passed first time other than some VSD min and max speeds had to be adjusted to get the required m/per minute speed as specified. The belt speeds were read using a tachometer. The program for the system was basic however the system could be modified in the future for any changes with minimal work. All in all the system was efficient and simple to diagnose for minimal downtime in the future. A weekly maintenance was put in to check the bearings and belt condition, grease and inspect the panel for water ingress and damage buttons and emergency stops. If this would be kept on top the system would cause no or hardly any downtime in the future.

*Need to
use
paragrap
hs and
watch
your
grammar.*

References

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RSCOMPONENTS. (2018, 05 01). *RS COMPONENTS*. Retrieved from PLC: <https://uk.rs-online.com/web/p/plc-cpus/3651134/>

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*This should
be at least
10 in
number.*

final report

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

40/100

PAGE 1

PAGE 2

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PAGE 3

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PAGE 5

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PAGE 6

PAGE 7

Text Comment. This should state that this is similar to solution 1 except for the PLC manufacturer.

PAGE 8

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PAGE 9

PAGE 10

PAGE 11

PAGE 12

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fail state.

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

Text Comment. This is good here and explains the testing process.

PAGE 18

PAGE 19

PAGE 20

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PAGE 21

Text Comment. Plan looks good and indicates the comparison.

PAGE 22

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PAGE 23

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GRADING FORM: CSG-RUBIC

TRYSTAN DANIELS

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RESEARCH-INFORMED LITERATURE



Limited research outside of the main project area.-
4/10 Limited reference sources used. - 3/10

7/20

KNOWLEDGE AND UNDERSTANDING



There is a definite understanding demonstrated here with the solutions offered for the problem. The solutions do meet the requirements of the specification. Specification is fairly detailed for this type of project.- 6/10 Solutions considered are basic but they do meet the specification requirements.- 5/10 The solutions do not go far outside the chosen solution here.

11/20

ANALYSIS



Test plan is implemented although the colour codes are not explained. Testing and results - 5/10
Conclusion does not contain much detail of the outcome apart from the specification was met, but there is a conclusion of sorts- 4/10

9/20

PRACTICAL APPLICATION AND DEP.



There are three solutions considered and briefly explained. One of these should have been at least part tested and results compared to the specification to see if the solution alternative would suffice. Solutions considered - 2/5 Final solution chosen due to company policy - 5.5/10 No real argument other than policy. Quality of work could be better organised and more attention to detail at this level. - 2/5

9/20

SKILLS FOR PROFESSIONAL PRAC.



Report could be better. - 4/10 Presentation - ?

4/20