Report

by Rhiannon Gallacher

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TATA STEEL

TATA

BSc (Hons) Electrical & Electronic Engineering

Major Project - PSDE6019

Upgrading of X-ray Coating Gauge Systems

FINAL

Interim Report

TATA Steel

Rhiannon Gallacher

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Abstract

This project is the development of a prototype upgrade for the x-ray coating gauges used across the plant in TATA steel Trostre. The existing systems used specialized components which are outdated, spares are unavailable and, if a complete new system was installed it would cost around £80,000. The purpose of the project is to use industry standard equipment which could be maintained by engineering staff with easily available spares. The chosen prototype solution was the Siemens S7 1500 PLC with HMI screens costing around £13,000. However, the final cost per system would be less with future installations. The prototype was designed, and successfully tested and performs all the functions of the existing system. Installing the completed version online would reduce downtime as in-house knowledge of component parts would be greater. The system is completed and ready to be installed on plant. The prototype has been designed so it will replace the existing electronics cabinet, the computer screens, the motor and the encoder. The existing x-ray generators, source heads and O frame remain unchanged.

Acknowledgements

The completion of this project would not have been possible without the kind support and help of many individuals. I would like to extend my deepest thanks to all individuals involved. Specifically, I would like to thank Mr. Ian Hierons for trusting me to undertake this project and securing the budget. I would like to show my personal gratitude to Mr. Leigh Norman for helping to get the initial project underway, along with Jason Thomas for offering support, guidance and ordering parts. I would like to express my special gratitude to Mr. Joshua Coles for helping with the practical build of the O frame.

Finally, I would like to thank the lectures of the Coleg Sir Gar engineering department for the consistent and continued level of support they have offered throughout not only this project, but for the entirety of my degree.

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1.0 – Introduction

This project is the design and development of a prototype which will be used to demonstrate the potential future upgrade of the plant wide x-ray coating systems.

The coating gauges are found on many lines within the Tata Steel plant in Trostre. The gauges are used on the lines to give an indication to the thickness of the tin coating that has been applied to the strip. The coating gauge is used as a quality assurance check; this enables Tata Steel to confidently tell the buyer the thickness of the coating and gives the customer peace of mind that their product will be of high quality. The thickness of tin is important to both the company and the customer, too much tin coating will mean that the company will be losing money on the excess tin, if the tin coating was put on too thin, any product made from the material would be substandard and this would damage the reputation of both the customers and TATA steel.

The main aim of the project would be to demonstrate a reliable, cost effective upgrade system. The prototype must resemble the coating gauges used on plant as much as reasonably practicable.

2.0 - Background Research and Literature Review

The existing gauge system uses non-contact ionizing radiation. There are two heads, (top and bottom), which use x-rays to determine the weight of the tin coating.

The shutter, which covers the x-ray beam when not in use, has a micro switch which tells the system which state the shutter is in. Currently, the system uses a chart recorder to record the data from the gauge. It would be desirable to use a computer-based system to record the readings.

The existing gauge has a few different operating modes. All of which would need to be incorporated in the new system. The modes are;

1. Scan – This is the most common mode. The gauge will traverse across the strip measuring continuously.
2. Dwell – Three-point check, both edges and the center of the strip are measured.
3. Static – The gauge is positioned in the center of the strip to measure.

The system has interlocks and limit switches to ensure the safety of employees and equipment. As radiation is involved, no access must be available whilst the shutter is open.

2.1 - Principle of Operation

The backscatter principle with x-ray fluorescence radiation is used for the measurement. With this technique, the intensity of the radiation scattered back into the detector increases with rising material thickness.

A signal is generated by the radiation entering the gauge head, amplified and fed to the evaluation electronics for processing. There was initially a touch screen within the system, however, it did not work and now a standard computer is used. (DMC, 1984)

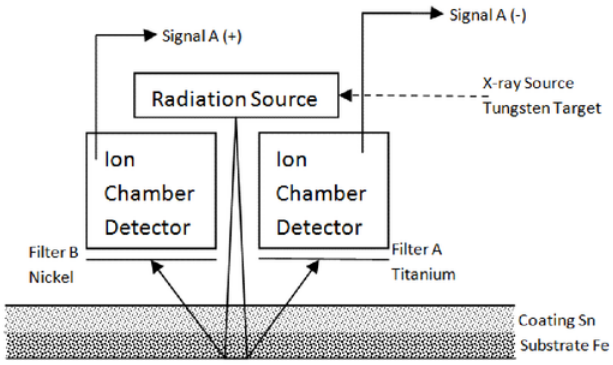


Figure 1 - Illustration showing the top head of the X-ray coating gauge

No reference made to this figure in the text

2.2 - Tin coating weight gauge

The x-rays are generated by a heated filament. The electrons are accelerated towards the tungsten target travelling through a potential difference of 20KV. This causes each electron to gain energy of up to 20KeV as the tungsten target is struck.

In normal operating conditions the gauge is operated with the x-ray source providing a spectrum of primary x-rays that have a maximum of 20KeV. The filament current is set at 2mA. Decreasing the filament current would cause less primary x-rays. The power the tube is operated at is 40W; this is the product of the tube voltage and the filament current. To remove the generated heat, water is pumped through the x-ray tube.

The generated x-rays are directed through the annular ionization chamber towards the strip. This is where the characteristic x-rays of the Fe substrate are fluoresced. (DMC, 1984)

The generated x-rays are directed towards the detector. The detector is a gas filled twin ionizing chamber. Here the x-rays ionize the gas atoms and give rise to an electric current in the associated circuitry. The amount of Fe x-rays that arrive at the detector will depend on the thickness of the coating. The higher the coating the more attenuated the Fe x-rays are. The relationship between the thickness of Tin and the number of x-rays generated is approximately exponential.

The ionizing chamber detector responds to the incoming radiations of all energies. Due to this, it is necessary to isolate the radiations that are of importance. For this reason, the detector is split into two halves. One half responds preferentially to the Fe fluorescence, both halves respond equally to all other energies. This is achieved by using filters on the detectors. The filters used to measure tin are nickel and titanium.

The titanium filter allows transmission of x-ray energies of up to 4.965KeV but attenuates the energies over 4.965 Kev.

The Nickel filter allows transmission of energies up to 8.332KeV. This filter allows the transmission of the Fe substrate fluorescence.

When the two halves are used together the electrical current detected on the titanium filter is subtracted from the current detected on the Nickel side. This gives a detector that only detects between 4.965KeV and 8.331KeV. The detector response preferentially to the Fe fluorescence which occurs at 6.404KeV (DMC, 1984)

2.3 - Detection and processing of signals

The atoms of gas are ionized when the radiation enters the pressurized vessel. The positive ions will flow from the negative electrode (-500V) and the negative ions will flow to the positive electrode (0V). This gives rise to a current which is directly proportional to the number of x-rays which are detected. The ionizing current is 0-10nA. The current is fed into a high gain current to voltage converting linear amplifier (electrometer amplifier). The amplifier will have an output of 0-10V. This voltage will be related to the number of fluorescence x-rays that are detected.

With the twin ionizing chamber there are two signals available, V_{Ni} which refers to the number of background and Fe fluorescence x-rays, whilst V_{Ti} refers to the number of background x-rays alone. (DMC, 1984)

2.4 – The Current System Electronics

The existing system uses a series 420 chassis and is based on the Z80 microcomputer which, along with a software package, is capable of measuring, displaying and controlling key variables of the gauge. The two microprocessor boards are mounted along with the DC power supplies behind the operators' panel. The boards are connected to the power supplies and the display by ribbon cable.

The microcomputer uses two Z80 microprocessors and an AMD 9511 arithmetic processor. One Z80 is dedicated to five analogue inputs and is capable of pre-processing and signal conditioning. The other Z80 along with the arithmetic processor handles the measurement computations and the input / output routines.

The series 420 will accept 5 analogue inputs, which can be linearized, scaled and conditioned as needed. Process data is available for display as both absolute values and as deviations from present targets. Display options include a color V.D.U for profiles, trends and management / roll information and a graphic printer with similar displays.

The 32 relay outputs and 8 opto-isolated outputs allow the series 420 to implement complex control strategies and target optimization, 24 isolated inputs allow the incorporation of various safety interlocks and remote command inputs such as, head online. Process data is available on the four fast analogue outputs or via one of the four RS232 serial links. The serial link also allows the series 420 to be remotely operated by a host computer.

The operator's control panel provides a digital display of operational and measurement data, and a keyboard with dedicated push buttons and data keypad to allow clear and easy selection of function, grade code and data entry. (DMC, 1984)

Figure 2 shows the setup of the existing system.

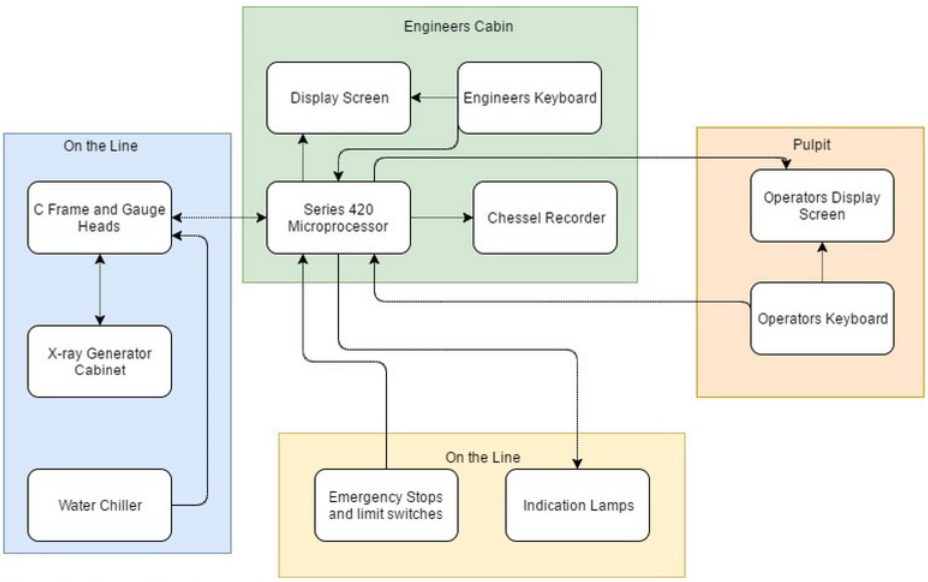


Figure 2 - Setup of existing system

2.5 – Regression Analysis

The existing system uses regression analysis to determine the coating weight from the voltage received from the head. Regression analysis is deemed the best way to calculate the relationship between two variables that have a linear relationship. The points are not all completely lined up, as can be seen in figure 3, therefore a line of best fit is used, and this is known as the regression line. The formula for the regression line is;

$$y = mx + c$$

what do each term represent ?

For an accurate regression line, and to enable a computer system or PLC to determine the line a series of calculations are required. However, according to Deborah Rumsey, 2010, the following need to be calculated first;

- The mean of the X values ($\bar{x}$)
- The mean of the Y values ($\bar{Y}$)
- The standard deviation of the X values (S_x)
- The standard deviation of the Y values(S_Y)
- The correlation between X and Y (r) $\frac{\sum a*b}{\sqrt{\sum a^2 * \sum b^2}}$

Where a = $(X - \bar{X})$ and b = $(Y - \bar{Y})$

To find the slope of the regression line the following equation is used;

$$m = r\left(\frac{S_y}{S_x}\right)$$

To find the Y intercept of the regression line the following equation is used;

$$c = \bar{Y} - m\bar{X}$$

Once the line of best fit is found, it can be used to calculate the coating equivalent to any voltage in the range.

(Deborah Rumsey, 2010)

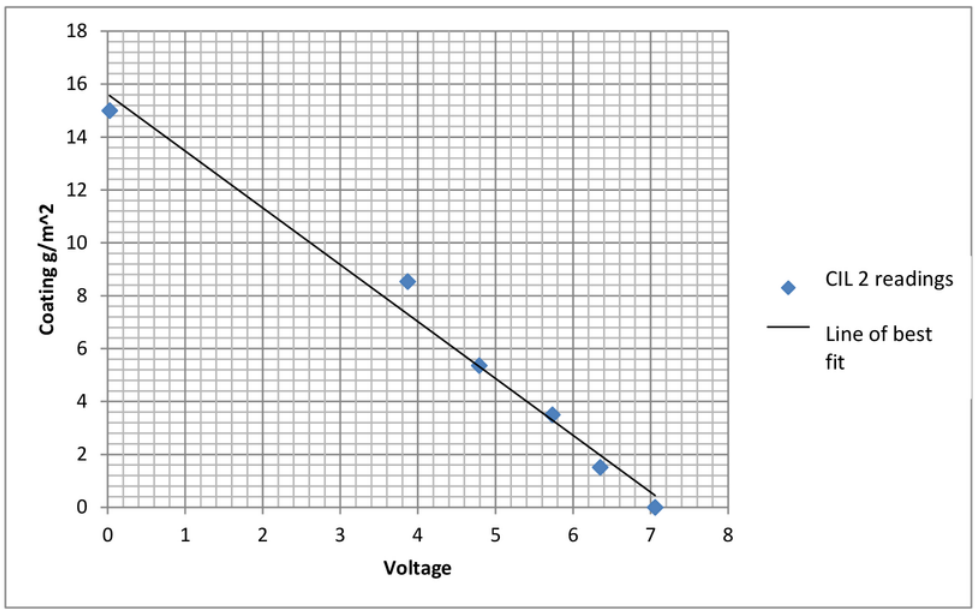


Figure 3 - Plot of example calibration samples

you could have said that y represents the coating thickness

2.6 – ABB Drive (ACS150)

ABB Drives are standard on the Trostre site and can be found running various applications. The ACS150 is a small drive capable of operating motors in the range of 0.37 kW to 4kW. The drive can be powered by single or three phases and has parameterable I/O connections. These can be altered depending on the application macro selected. The macros enable he user to decide how to operate the motor and drive, with variations to the number of speed setpoints, the option for forward and reverse control and adding inhibit bits. The application macro selected in the parameters will determine how the drive is connected to external I/O. The drive has a small LCD display along with push buttons and a potentiometer. The drive can be run in either local or remote. The potentiometer is used for controlling the speed only when in local mode. Figure 4 shows an overview of the drive connections. U1 and V1 terminals are used for a single-phase supply. (ABB, 2010)

it is not clear why the ABB drive is introduced here

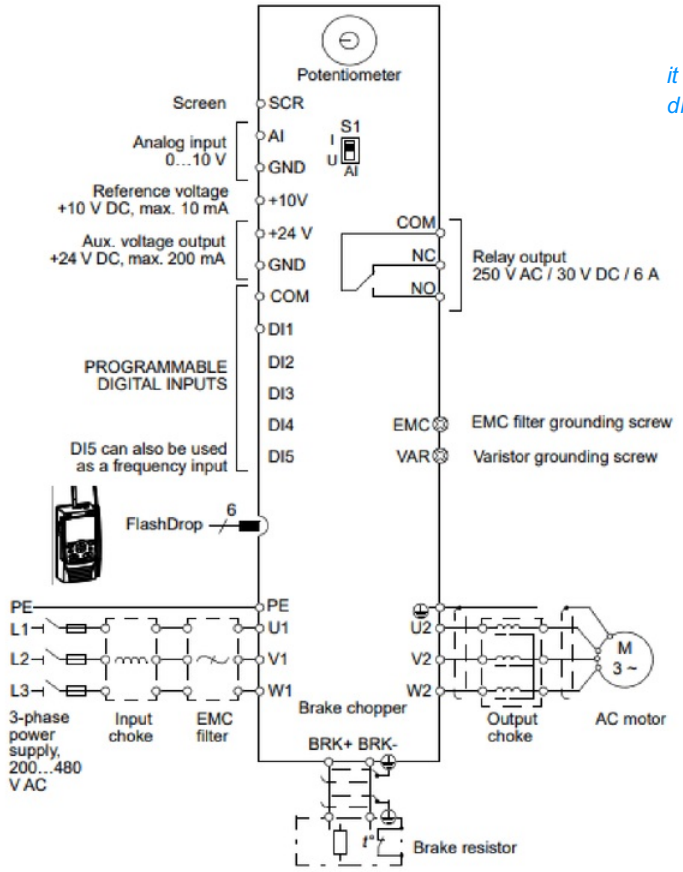


Figure 4 - Connections overview of the ACS150 - (ABB, 2010)

2.7 – Solution 1 - Arduino

Arduino has various versions available that can be used in industry such as the, Industrial 101.

2.7.1 - Industruino IND. I/O Kit

The IND-I/O model comes with all the relevant parts to make an Industruino with industrial level I/O. The parts included in the kit are;

- The top board, this will have the microcontroller and the LCD screen
- IND-I/O baseboard, this is the interface board for all the I/O signals from plant
- Mounting hardware
- Enclosure with membrane button panel

Figure shows the isolated sections of the IND_I/O.

As with the other Arduino products the kit is affordable at €110

2.7.2 - Expansion Modules

The Industruino package offers various expansion modules to offer full flexibility and ability to create many systems. For this system the Ethernet expansion would be needed. This would be connected via the 14pin IDC expansion port. (Industruino, 2017)

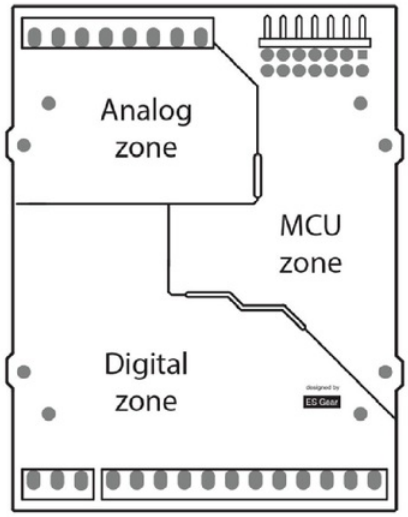


Figure 5 - Picture showing the isolation of the field sections of the Industruino IND I/O - (Industruino, 2017)

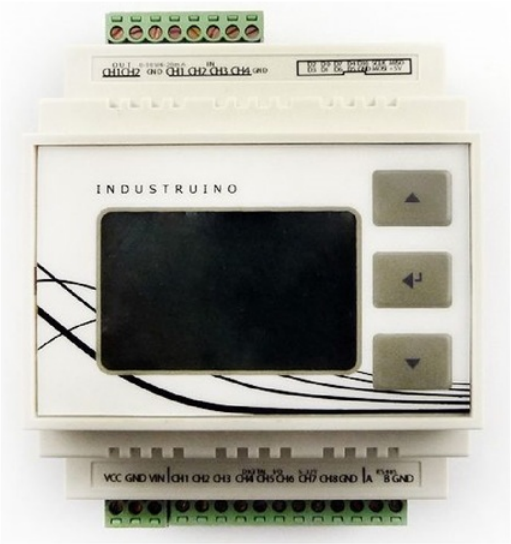


Figure 6 - Picture of the LCD screen of the Industruino IND I/O - (Industruino, 2017)

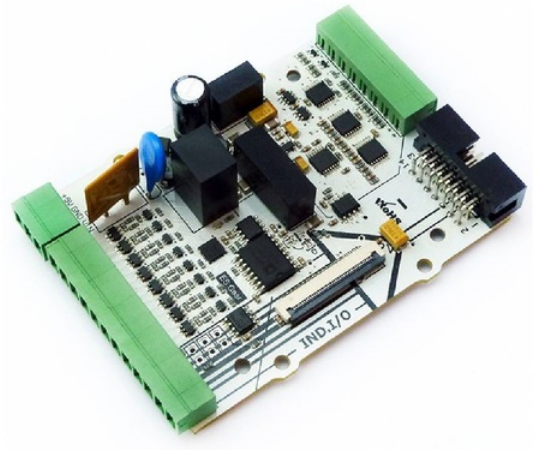


Figure 7 - Picture of the I/O board of the Industruino IND I/O - (Industruino, 2017)

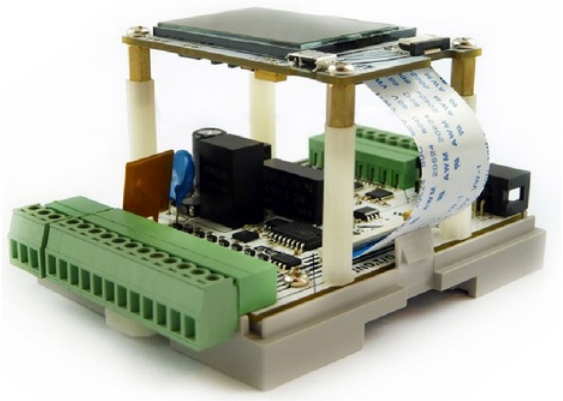


Figure 8 - Picture of the Industruino IND I/O - (Industruino, 2017)

2.8 - Arduino Custom System

The Arduino Industruino IND I/O could be used to control the processing of all signals and data. Computer screens and keyboards running LabVIEW would be used for the technician and operator stations. The estimated cost for this system would be around £1000.

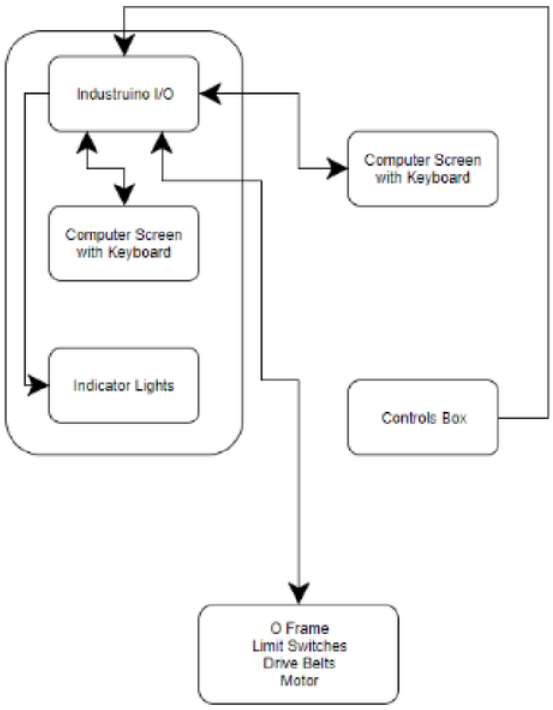


Figure 5 - Industruino I/O Solution

2.9 – Solution 2 - Raspberry Pi

The Raspberry Pi is a very small computer which was originally designed for education. The creator, Eben Upton aimed to create a low-cost device which could be used to improve programming skills and hardware understanding at pre-university level. However, due to its small size and accessible price it quickly developed into a device that was used by electronics enthusiasts for projects requiring more than the basic microcontroller such as the Arduino device. (Raspberry Pi Foundation, 2017)

The Raspberry Pi is a complete Linux computer although it runs slower that a modern laptop. It can however, still provide all the expected abilities at a low-power consumption level.

There are two models of Raspberry Pi, A and B. Models B gives the user a HDMI out, RCA video out, 2 USB ports, SD card slot, headphone jack and an Ethernet port. The board has half a gigabyte of RAM and an on-board ARM processor. Model A is similar with only one USB port no Ethernet port and a quarter of a gigabyte of RAM. Model A is available for £18 and the B model is available for £25. The Raspberry Pi uses an SD card inserted into the SD slot on the board as its hard drive. It is powered by USB and the video output gives the ability to be connected to either a traditional RCA TV set or a modern monitor, the other option is to connect to a TV set using the HDMI port. The power consumption of the Raspberry Pi is just 3 watts. (Sayer, 2017)

The REX control system enables the Raspberry Pi to become a programmable device which can run the desired algorithms. The REX control system has many features such as, the ability to program graphically, provide interface to HMI screens and connect with desired IO.

2.9.1 - LabVIEW

LabVIEW is a visual programming language developed by National Instruments. LabVIEW differs from traditional programming languages such as C and Java as these are programmed in text whilst LabVIEW uses graphical notation. LabVIEW can be run on Windows, Mac or Linux. LabVIEW has been specifically created to take measurements, analyze data and present results. The LabVIEW screen can be paired with ease via Ethernet to the Arduino PLC to create the desired system and screens. Graphical programming is quicker and presents less potential issues than text-based languages.

LabVIEW has 3 main parts, the front panel, a block diagram and an icon. The front panel is the interface that the user interacts with. This will contain push buttons graphs indication lights and other controls (user inputs) and indicators (program outputs). Data can be inputted to the screen using a keyboard and/or mouse. The block diagram is the source code; this is the actual executable program. Wires are drawn to connect the relevant objects together and define the flow between them. The icon is a pictorial representation of a VI. (Kring, 2006)

2.9.2 - Rex Control System with Raspberry Pi

The second solution would involve a REX control system with a Raspberry Pi. As shown in figure 3, there would be new operators and technicians display screens which would run LabVIEW. The two screens would be different as the operators and technicians do not need the same functions and availability, the RexCore would be used as a central hub to send and receive data.

The estimated cost for the solution would be around £2000.

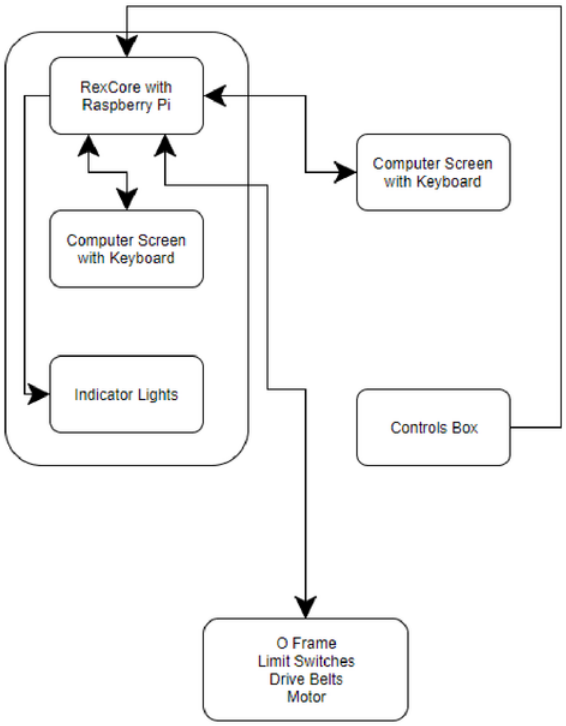


Figure 6 - RexCore Solution

2.10 – Solution 3 - Siemens S7 1500

The Siemens S7 1500 series of PLC's are equipped with an LCD screen on the front of the processor. This display gives information on the configuration and status of the system.

The 1500 series has a variety of different specifications appropriate for different uses. The 1516-3 that would be available for the prototype building has working memory of 1 MB program and 5 MB data along with 10 ns bit instruction time, PROFINET IO, supports RT/IRT, 2 ports, MRP, transport protocol TCP/IP, Web server, constant bus cycle time, routing; additional IP address for PROFINET basic services / transport protocol TCP/IP, Web server, routing; PROFIBUS DP master, constant bus cycle time, routing; 4-level protection concept, integrated technology functions: motion, closed-loop control, counting and measuring. (Siemens, 2017)

2.10.1 – Siemens HMI's

Siemens offers three classifications of HMI devices and many options within these classes. There are the basic HMI's, these are ideal for simple visualization tasks with sizes ranging from 3.6" to 15.1" and prices ranging from £180 to £3,304 (Parmley Graham, 2017)they have basic features and are priced affordably for entry-level devices. To program this screen, TIA Portal and WINCC basic are required. The second classification is the advanced HMI panel-based; this includes the comfort panel range and the mobile panels. The comfort panels are specifically designed for high-performance visualization applications. The sizes range from 4" to 22" with the prices ranging from £600 to £4,126. (Parmley Graham, 2017)To program these screens TIA Professional and WINCC Comfort is required. The mobile screens claim to put the power and safety in the hands of the user; they also offer more flexibility and convenience. The screens come with emergency stop on the top and have the same resolution and functionality of the comfort panels. The sizes range from 4.3" in 9" with price ranging from £1,024 to £3,194. (Parmley Graham, 2017)The final classification is the Advanced HMI PC-based; these are high-performance devices for data-intensive and complex visualization tasks. (Siemens, 2017)

2.10.2 - S7 PLC with SCADA Screen and IBA Logger

The third solution would involve, as shown in figure 10, using an S7 PLC with HMI screens used for the technicians and operators screen. The estimated cost for this solution would be around £10,000.

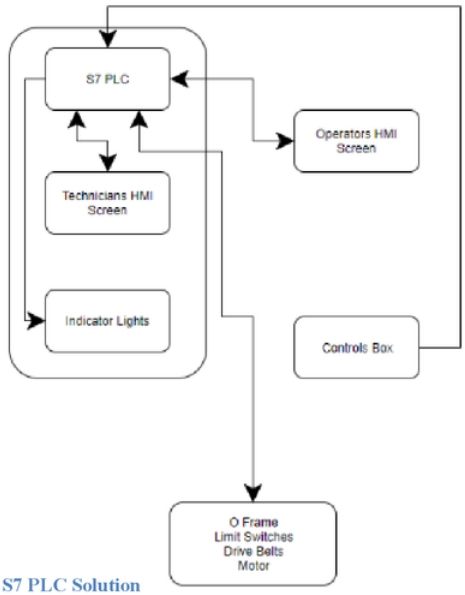


Figure 7 - S7 PLC Solution

2.11 - Justification of chosen solution

The solution chosen was the S7 PLC with a Siemens HMI comfort panel as the operator's screen, and a Siemens basic HMI panel as the technicians' screen, the system will be connected to the plant IBA data logger. The design meets both the technical and desirable specification. The desirable in-house support will be available as PLC's are widely understood at Trostre. The S7 is chosen as that is the standard PLC at the Trostre plant. This will cut down on the training costs and make the company less reliant of outside companies, as it would be if the other systems were to be used. Any faults or future development of the system can be undertaken by TATA steel employees. Should a module go faulty during normal line running it will be quick and easy using the S7 diagnostics to find the fault and replace with a module from stores. This will minimize the downtime of the line.

As for future development, should it be desirable to add on to the system with the S7 solution this can be done in-house using either existing available I/O or by adding on new modules.

PLC's are straightforward to upgrade, although they already have a good life expectancy. This is opposed to the Arduino and Raspberry Pi systems, this type of technology is developing quickly meaning that systems become obsolete quickly, furthermore as this is relatively new technology there is little in-house support, as well as very little outside support, this out of house support would reduce quickly as the system became obsolete. The issue with both Arduino and Raspberry Pi is maintenance. These types of systems are not realistically able to be maintained. They would be a black box. The electricians on plant are not programmers, whilst they do understand ladder diagrams and can find their way around sequential function charts and function block diagrams; at the TATA steel plant C programming and Linux command line are not common knowledge on site.

The S7 system is within budget, but not the cheapest solution, however it better suits the company's desire to have in-house support and knowledge. The largest possible Siemens HMI screen; 22", was selected for the operator's screen, as the graph they will be using on a day-to-day basis shows a large amount of data, if the screen was too small the operators would struggle to see all the data clearly and this would lead to potential faults. A small HMI screen from the basic group will be used for the technician's screen as they do not require the large graph or any sort of graphical display, the technician screen needs only buttons, numerical input and output fields. The basic panel is more than capable of handling this.

Further justification of the solutions can be seen in tables 1 and 2. These tables are the standard used when selecting solutions at TATA steel Trostre. Considerations are listed and weighted

from 1 – 5 depending on importance. With 1 being not very important to the overall project and 5 being very important. Each of the solutions is then rated against each of the considerations depending on how well they meet each of the considerations, this is done on a scale of 0-5. With 0 being not met at all and 5 being completely met. The individual weightings are then multiplied by the rating and the final values added together to obtain the final total.

Table 1 - Comparing the three solutions

	Price	Complexity/ Difficulty	Integration to Line Systems	Plant Knowledge to support	Spares/ Cost	IT Security	Life span of technology	Total
Rating (1-5)	**3**	**3**	**4**	**5**	**3**	**4**	**5**	
S7 1500 PLC	£10,000.00	Medium	Very Good	Very Good	Readily available medium cost	Very Good	Very Good	
Score (0-5)	**2**	**3**	**4**	**5**	**2**	**5**	**5**	**107**
Industruino IND I/O	£ 1,000.00	Medium	Good	Poor	Readily available low cost	Poor	Medium	
Score (0-5)	**5**	**3**	**3**	**2**	**5**	**2**	**3**	**76**
RexCore	£ 2,000.00	Medium	Good	Poor	Readily available low cost	Poor	Poor	
Score (0-5)	**4**	**3**	**3**	**2**	**4**	**2**	**2**	**72**

Table 2 - Comparing the three display solutions

	Price	Complexity/Difficulty	Integration to Line Systems	Plant Knowledge to support	Spares/ Cost	IT Security	Time to completion from PO	Est. delivery times	Total
Rating (1-5)	**3**	**4**	**2**	**5**	**3**	**4**	**4**	**4**	
iFix	£8,356	Low	Good	Good	Readily available low cost	Good	Off Shelf, quick development and deploy, but learning time for iFix	3 Months	
Score (0-5)	**1**	**5**	**4**	**4**	**5**	**4**	**4**	**4**	**114**
WINCC	£4,578	Low	Medium	Medium	£ 3,000.00	Good	Off Shelf, quick development and deploy	2 Months	
Score (0-5)	**3**	**5**	**3**	**3**	**4**	**4**	**5**	**5**	**118**
Custom Written HMI Inc Drivers	£300	High	Poor	Poor/Non-existent	Readily available low cost	Good	Long Development	8 Months +	
Score (0-5)	**5**	**1**	**2**	**1**	**5**	**4**	**1**	**1**	**67**
Custom Written HMI using IGS and OPC	£800	High	Poor	Poor/Non-existent	Readily available low cost	Good	Long Development	7 Months +	
Score (0-5)	**5**	**2**	**2**	**1**	**5**	**4**	**1**	**2**	**75**

3.0 - Specification & Testing Plan

3.1 - Main System

- The system must accurately measure the weight of the strip, this means taking the raw voltage data value from the x-ray heads (0-8V), manipulating the data and displaying the correct result on the HMI screen (0-20g/m^2)
- Must be able to close the shutter with the push of just one button
- Can process both analogue and digital I/O
- There must be clear, visible and accurate 'state' indicator lights and signs
- The system must have suitable safety guard interlocks and systems in place
- Move the heads to the exact position instructed by the HMI
- Measure the strip at the correct point and for the correct amount of time
- Act in the desired way depending on the mode selected by the HMI screen
- The system should provide 100 points of measurement across the strip in scan operation

3.2 - Display Screen

- Display the weight of the tin coating for the top and bottom head separately
- Display the profile of the strip along with a real-time display of where the heads are
- Allow calibrations of the system to be done with ease
- Allow all modes of operation to be selected with ease
- Display system parameters and allow these to be edited only by the PC&A technicians
- Display accurate alarms without delay

3.3 - Overall System

It is desirable that the system has in-house support and will be long lasting. Spare parts must be readily available, and training easily provide.

3.4 – Testing Planning

The system will be successful and complete when the following is true;

- The entire panel powers up when the main isolator is switched
- No movement on the O frame will be possible if;
    - The emergency stop is pressed
    - The gate limit is unhealthy
    - The control system is unhealthy
    - The ultimate limits are struck
    - X-rays are not on
    - Line running signal is not received
- Operation of system stops is the gates are open or if the ultimate limits are struck
- All pages on the technicians HMI screen can be accessed from the main page and all pages can return to the main screen
- All pages on the operator's screen can be accessed from all pages
- Necessary data can be edited and entered on both HMI screens
- Using the signal box all alarms can be simulated as being healthy / unhealthy.
- Calibration procedure can be performed easily and correctly.
- Heads move to the calibration position when requested
- Pressing the scan button on the operators HMI screen initiates the scan sequence
    - Heads move back and forth between the edges of the strip
    - Operators screen coating fields update along with the top and bottom head graphs
    - The graphs display 100 points of measurement
    - Individual bars change between red and green depending on whether the coating is in or out of tolerance
    - Stops when requested
- Pressing the dwell button on the operators HMI screen initiates the dwell sequence
    - Heads move between the edges and center of the strip, stopping for 5 seconds at each point
    - The six dwell graphs update as expected
    - The output fields for the dwell coating update as the system is running
    - Stops when requested

- Pressing standby in any mode and any position resets the system and bring the heads back to the park position
- Pressing standardize on either of the HMI screen will initiate the standardize sequence, driving the heads to the zero position, waiting for 5 seconds, moving to the infinity position, waiting for 5 seconds and then moving back to the park position.
- The control switch should inhibit the operation of the system depending on the position.
- Altering the voltage on the variable power supply unit should alter the voltage on the technicians screen, this should then intern display the corresponding coating weight on both the technicians and operators HMI screens.
- The indication LEDs on the control panel should correspond to the state of the shutter and the state of the x-rays.

A detailed testing plan will be generated and used in the testing section to ensure that all possible functions and operations are functional.

The budget allocated to the project was £20,000, the timescale given for the prototype was to be completed no later than March 31st. The predicted and actual Gantt charts can be seen in appendix 1.

4.0 - Safety, Sustainability, environment, professionalism, maintenance and reliability

4.1 - Health and safety

The following are a list of requirements to ensure that the final system is safe and employees cannot be exposed to radiation;

- Shutter must be closable by one shutter press
- Shutter must close if the gate opens
- Shutter must close, and gauge must stop scanning if the line stops
- Shutter must close if power is lost
- No person should be able to access any moving parts whilst in operation

The following points have been considered to further improve the health and safety of the system;

- A line override switch is currently used when performing the calibrations; this gives full operation to the gauge. For safety reasons, it was decided to write the program so that with the line override switch the gauge will only move within the calibration area. This will prevent the gauge going online and it will become clear quickly if the override switch has been left on when the line is started.
- A laser distance sensor is being used to tell the system where in the O frame the heads are, however if an object should fall in front of the laser it is possible that the heads would continue to drive and not stop at the correct point, to avoid damage to the equipment, ultimate limit switches are mounted on the edge of the frame which will cut power to the system if stuck.
- A class 2 laser is being used which means that there is a maximum power output of 1 milliwatt. If an employee was to be exposed to this class of laser they will be protected by the natural involuntary response of blinking or turning their heads. (England, 2017)
- Warning labels need to be placed on the panel to ensure employees are aware of the dangers within the panel.
- Once the panel is open there is an IP20 rating. Meaning that fingers cannot touch any live components however, there is no protection from liquids.

4.2 - Sustainability

By changing the DC motor for an AC motor, the need to clean and change brushes on the final system will be eliminated. A laser distance sensor has been selected to be used in place of an encoder. As there are no moving or touching parts involved, the lifespan of this as opposed to typical encoders will be increased. None of the components or devices in this solution require changing regularly as they have a long-expected life this makes the project sustainable as resources are not being used up.

4.3 - Environment

During the project there was various waste which required disposing off. If the waste was electrical it was covered by; The Waste Electrical and Electronic Equipment Regulations 2006 and was disposed of in the WEEE skip. All other was disposed of using the recycling skips on the TATA steel plant. The system does not give off any harmful gases or vapors and the noise level is below 85 decibels which means hear protection is not required.

4.4 - Professionalism

The regulations that were considered for this project were Ionizing Radiation Regulations 1999 (IRR99), The Radiation Emergency Preparedness and Public Information Regulations (REPPIR), The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 (RIDDOR). From these rules it was decided that the prototype would not contain an actual x-ray source and the signal would be simulated from a variable power supply.

Further regulations that needed referring to were EN60204 electrical safety standards and the essential healthy and safety regulation (EHSR). This covers all aspects of how the machinery should be designed and built, from the colour of the push buttons to the safety features required.

To ensure risk was kept as low as reasonably practicable, a new and modified plant risk assessment was completed. The assessment for the prototype build can be seen in appendix 10.4. Furthermore, whilst the work was being undertaken one-minute risk assessments were completed when necessary and no work was completed whilst system was live.

incorrect appendix number

During the project there were regular discussions with the Process Control & Automation (PC&A) engineers to ensure that the project was being undertaken in the best viable way and to address any issues that may have arisen. There are also detailed comments on the PLC program to ensure that the system can be handed to the PC&A department and these comments will help with the installation process and with any maintenance fault finding that is to come.

4.5 – Maintenance

Once the system is installed on the line, maintenance will be undertaken every six weeks. This is done to ensure the calibrations remain within the quality assurance guidelines. During the maintenance time, the system will be cleaned thoroughly by the PC&A technicians and a set calibration will be performed.

The alarms page on the technicians HMI screen which displays common issues which can inhibit the operation of the system.

4.6 – Reliability

To make this solution as reliable as possible, off the shelf parts have been used as these are tested and guaranteed by the manufacturers. All equipment is also suitable for use in an industrial environment. All components and devices were sourced from reputable companies and are CE related and this can be seen in the relevant datasheets in appendix 10.2. The system was tested multiple times and the results were always consistent, proving the system is reliable.

5.0 – Project Design

5.1 - PLC Program

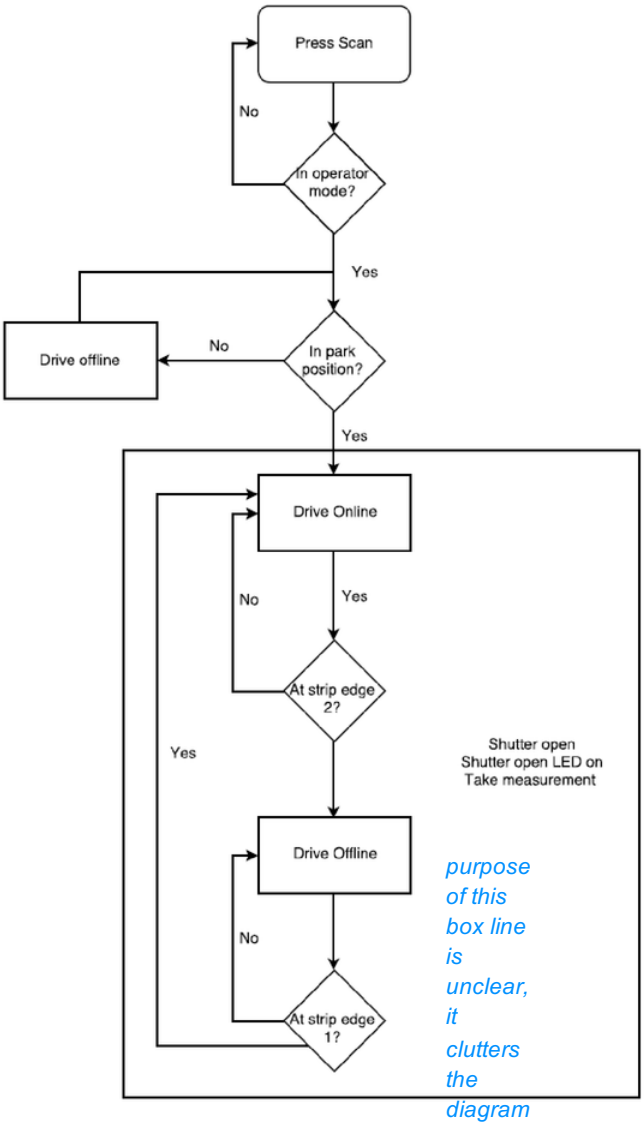
A complete PLC program needed to be designed and written. The main sections include;

- Indicator lamps; required by regulation, lights indicate the status of the x-rays and the shutter
- Modes of operation; this controls the various modes of operation including static, dwell and scan
- Regression analysis, this is used to find the correlation between the voltage received from the head and the coating weight
- Calibration Sequence, used to take the known sample readings, these readings are used by the regression program to find the correlation
- Running weight calculation, this is the y = mx + c calculation that is created by the regression program and used to identify the current coating thickness.
- Operators standardize, for the operators to adjust the zero and infinity readings, this is needed in case the readings start to drift.

Figure 8 shows the basic flow diagram for the scan function. The scan button is accessible from the operator's screen. If the stop button is pressed at any time during the scan function all movement should stop, and all PLC bits should reset. When the heads are scanning the shutter will be open, this means the LED on the front of the control panel for the shutter open will be illuminated, and the shutter state indicator on the operator's screen will be red.

Figure 9 shows the flow diagram for the static function, the static position is entered on the operators HMI screen, the heads will be driven online until it reaches this point and then stop at this point and measure continuously.

Figure 10 shows the block diagram of the dwell function, for this function to operate the operator must enter the strip width on the HMI screen, in this operation the heads will move between each of the strip edges and the strip center, the heads will stop at each point to take a measurement.



purpose of this box line is unclear, it clutters the diagram

Figure 8 - Scan function flow diagram

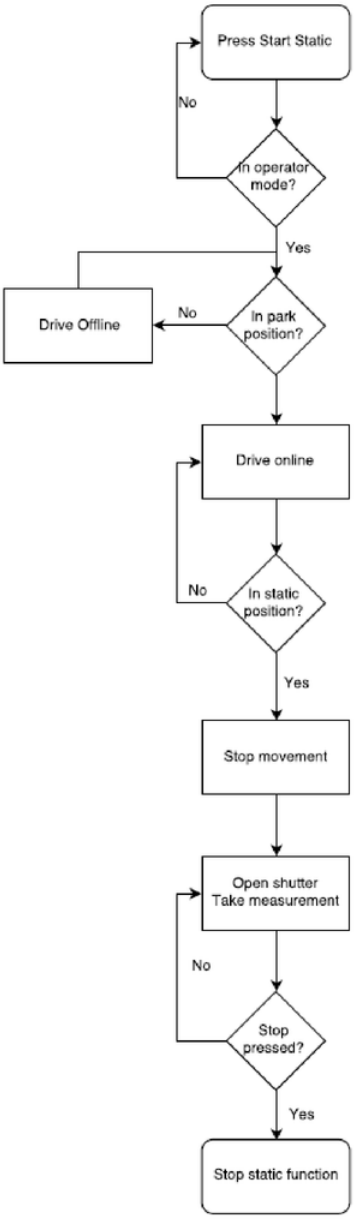


Figure 9 - Static function flow diagram

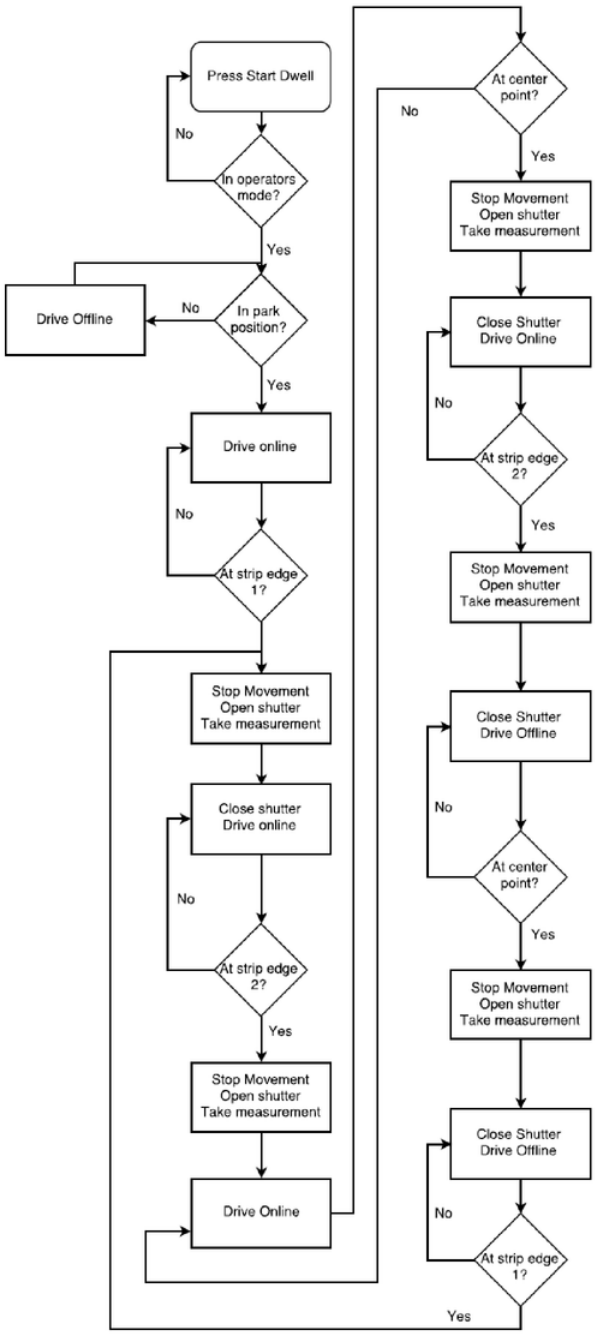


Figure 10 - Dwell function block diagram

5.2 – HMI Screens

There are two HMI screens, one in the pulpit for the operators and one in the room with the PLC which is for the technicians. The screens are each slightly different as the operators do not need access to all the screens as the technicians. The screens are different sizes, with the operator's screen being the larger of the two as the operators require more detail on the main screen which is not required by the technicians. The screens needed to be designed and created to include; buttons for closing the shutter on every screen, a settings screen for adjusting and viewing gain and calibration data, a main page which displays the head position and the coating weight, a screen that allows the various modes of operation to be selected and one screen that shows the status of the gauge along with any alarms.

5.3 – Motor and Distance Sensor

The existing system uses a DC motor and encoder. The prototype uses an AC motor and a laser distance sensor.

5.4 - The Prototype

The prototype of the system was built in the PC&A rolling end workshop. For health and safety reasons no x-ray sources were used in the prototype however, a dual variable power supply was used to simulate the voltage signal from both heads this is fed directly into the analogue input card of the PLC. For every other aspect the aim was to create the system to be as similar to the final system as possible. An O frame was built which includes, the motor, drive belts source head boxes and limit switches along with the control panel, indication lamps and both HMI screens. The input signals that would normally be received from the line such as, the line run signal and the air pressure OK signal is generated using a signal box.

5.5 – Power & Control Circuit

The circuit diagram shown in appendix 10.5 shows the design of the power and control circuit. incorrect appendix number
Power is completely removed from the system by an isolator. Fuses are the next device in the line, this offers circuit protection. Once power is on the circuit the 240V AC is split, one branch continues through the power circuit, this energises the LC_1 contactor and powers the drive, MC_1 would not yet be energised. The other branch goes to a 240V AC to 110V AC transformer, this transformer powers the PLC power supply unit along with the 110V AC to 24V DC power supply unit. This PSU powers the PLC I/O cards and the control circuit. If the emergency stop button is pressed or the overload is tripped the power will be removed from the control circuit. With these healthy, both the gate relay and control relay push buttons require pressing, this will

energise the gate and control relays, closing the CR and GR contacts in the circuit. Closing these contacts will energise MC_1. The circuit will then be waiting for the run signal from the PLC for the motor to be energised. Occurrences which will cause the control circuit to drop out are;

- The drive becoming unhealthy
- The gate limit becoming unhealthy
- Either of the edge limits being struck
- The overload tripping
- The emergency stop being pressed

Manual push button are in place which can be used to override the limit switches, this is done only to move the heads back off the limits.

6.0 – Project Implementation

6.1 - PLC Program

The PLC program was written in Siemens TIA Portal. It was written in a combination of ladder and graph.

You should always begin with a program structure showing the block tree and also the I/O list and the PLC tag list

Figure 11 shows the scale block used to convert the raw 4-20mA signal from the laser sensor into 0-1640mm. This is used for identifying the position of the heads on the O frame.

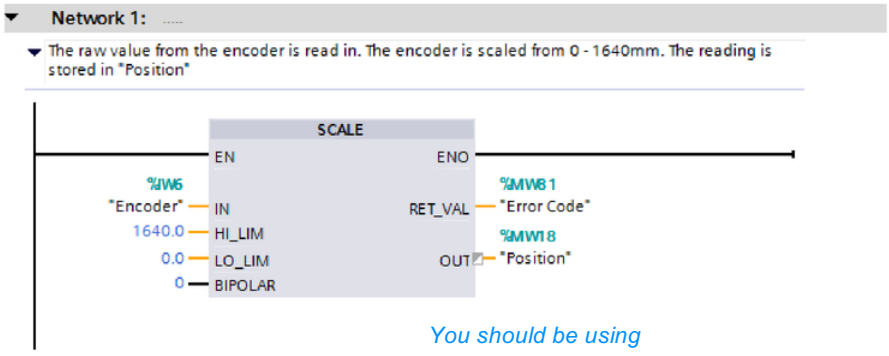


Figure 11 - Encoder processing program

You should be using MD rather than MW to avoid overwriting data, TIA is indicating this by the half shaded box.

Figure 12 shows the control for the indication lamps which indicate whether the shutter is open or closed. If the system is receiving both signals the system will show that the shutter is open as a cautionary measure.

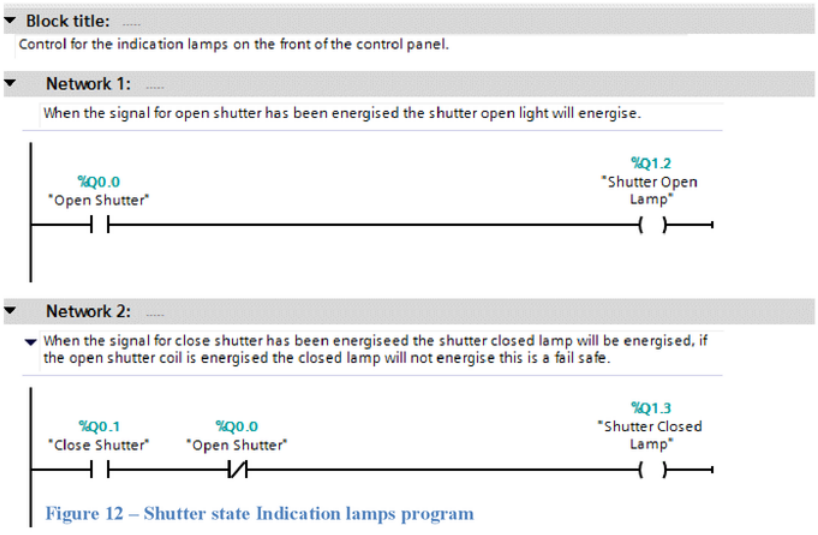


Figure 12 – Shutter state Indication lamps program

Figure 13 shows the control for the x-rays on/off indication lamps. If either of the x-ray heads are on the x-ray on lamp will energise. Both heads need to be off to show that the x-rays are off.

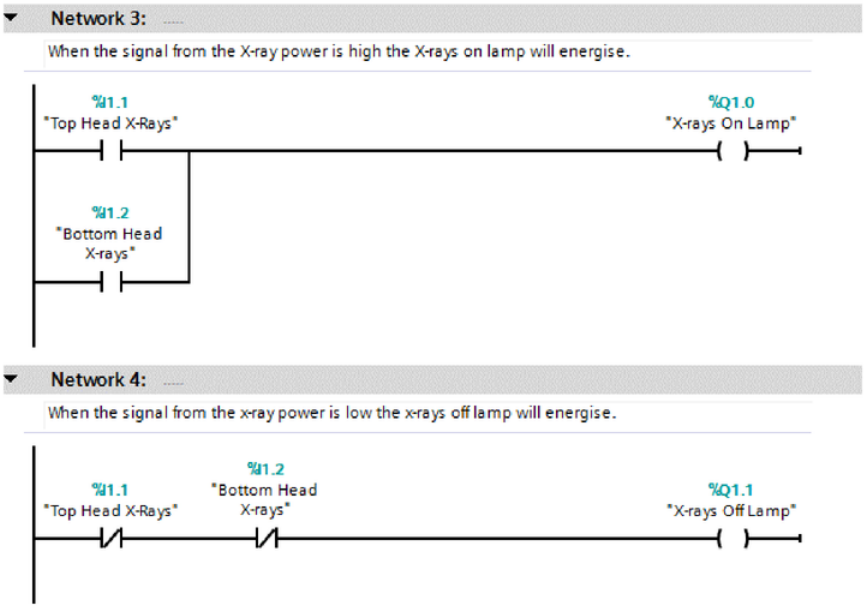


Figure 13 - X-ray Indication Lamps program

Figures 14 through 20 show the blocks used for performing regression analysis on the system. Figure 14 shows the mean of the coating weights being calculated. The calculate block receives the required input, an equation is entered into the OUT field and the solution to the equation is outputted from the block. The equation used for calculating the mean of the Y values can be seen in figure 15.

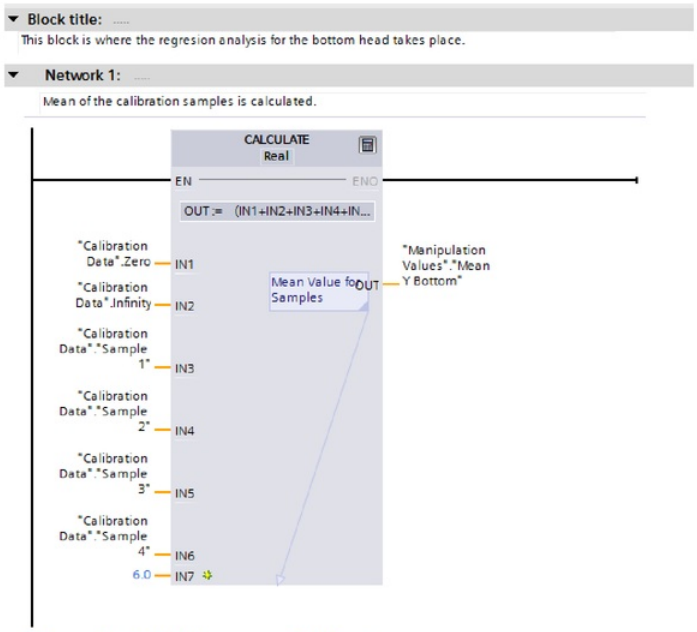


Figure 14 - Calculating mean of calibration



Figure 15 – Y mean calculation

Figure 16 shows the mean of the sample voltages being calculated. Figure 17 shows the calculations used in the OUT field.

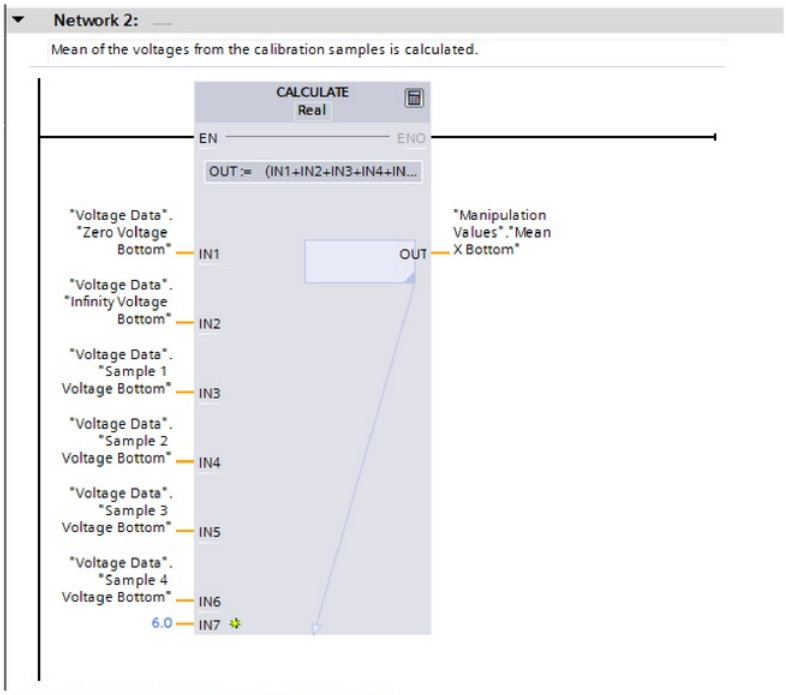


Figure 16 – Calculating the mean Voltage data

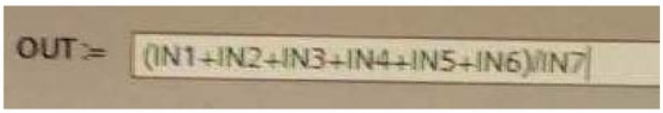


Figure 17 – Y mean calculation

Figure 18 shows the standard deviation between the calibration samples being calculated. Figure 19 shows the calculation used in the OUT field for the intail part of the standard diviation calculation.

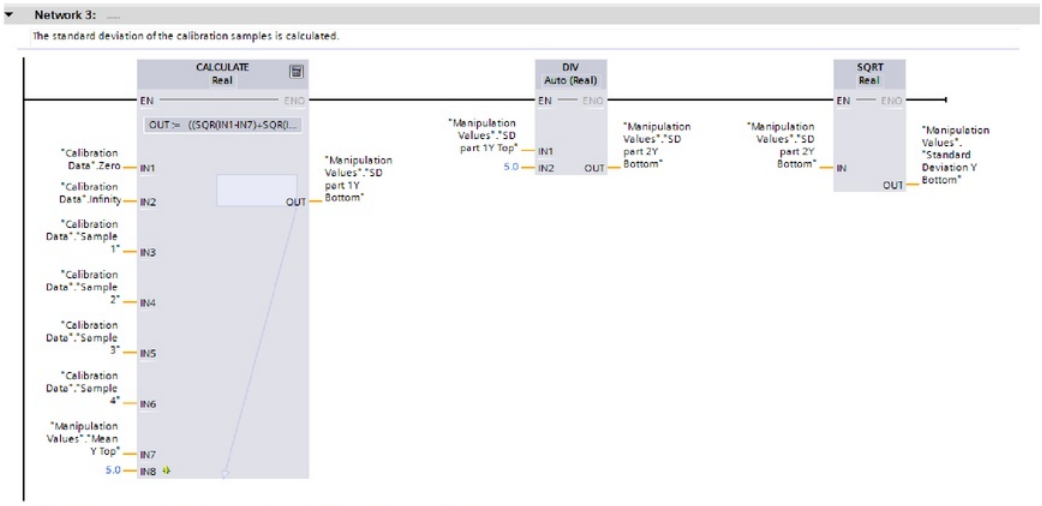


Figure 18 - Standard deviation of calibration values

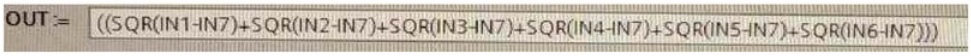


Figure 19 – Standard deviation of calibration values

Figure 20 shows the standard deviation for the sample voltages being calculated. Figure 21 shows the calculation used in the OUT field for the intail part of the standard diviation calculation.

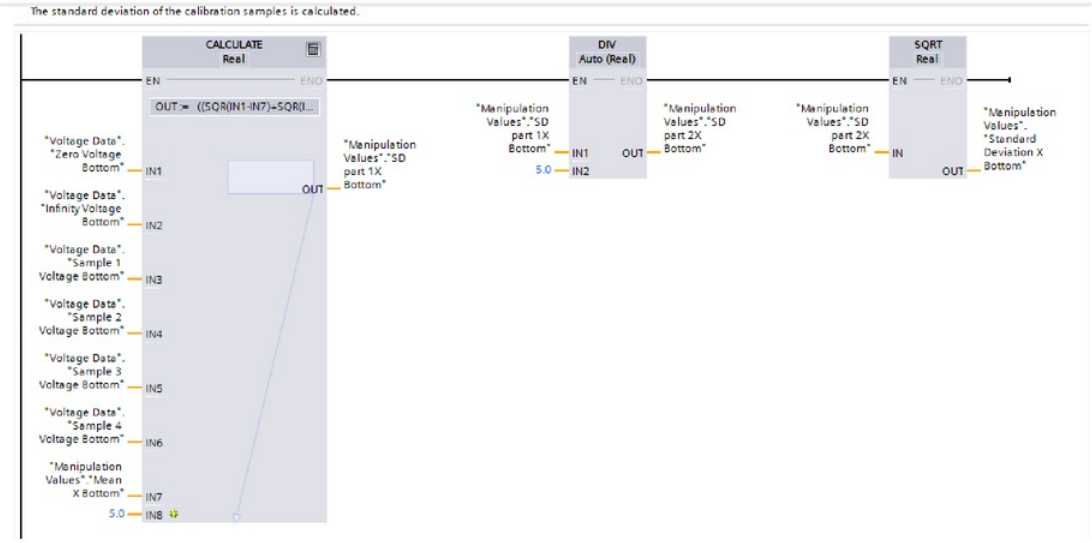


Figure 20 - Standard deviation of voltage values



Figure 21 - Standard deviation calculation

Figure 22 show the correlation between the sample coatings and the sample voltages being calculated. Figure 23 shows the calculation entered into the OUT field.

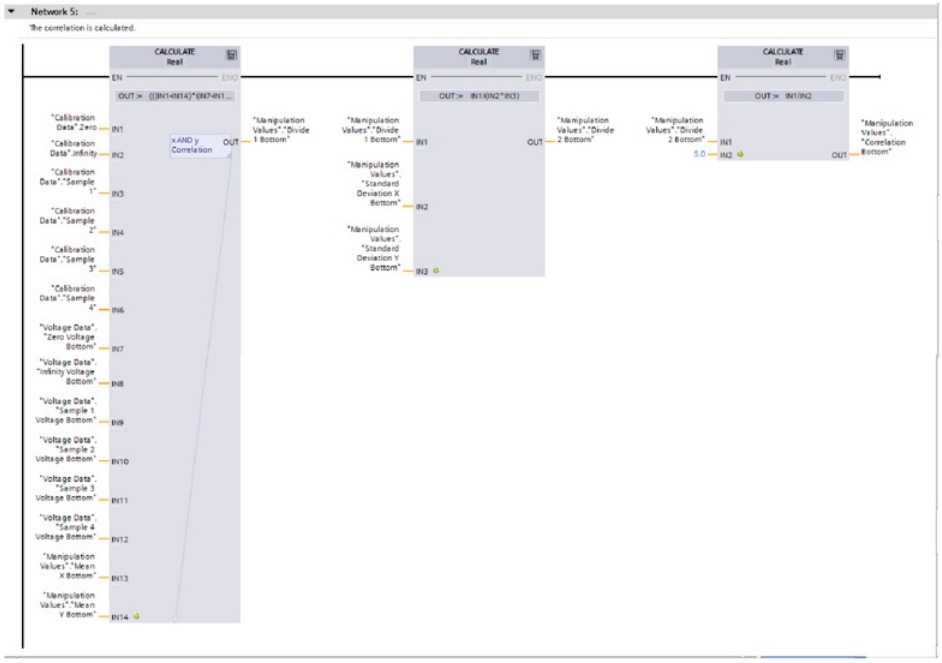


Figure 22 - Correlation between calibration values and voltage values calculated



Figure 23 - Correlation calculation

Figure 24 shows the slope being calculated.

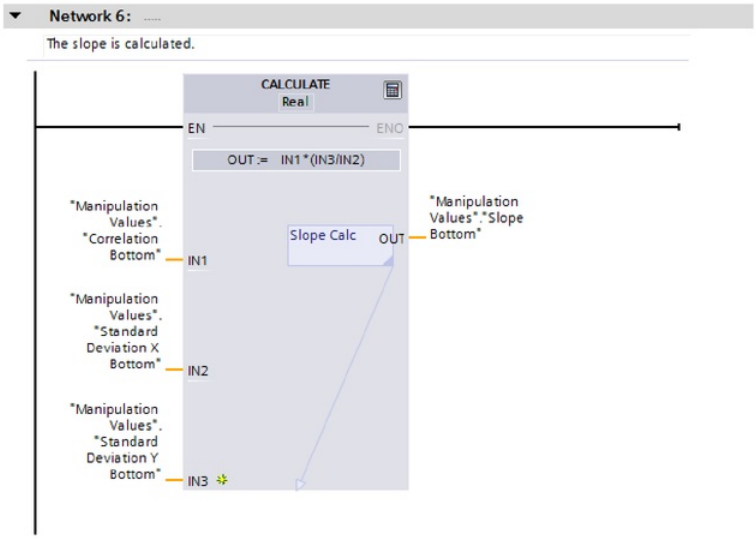


Figure 24 - Slope calculation

Figure 25 shows the Y intercept being calculated.

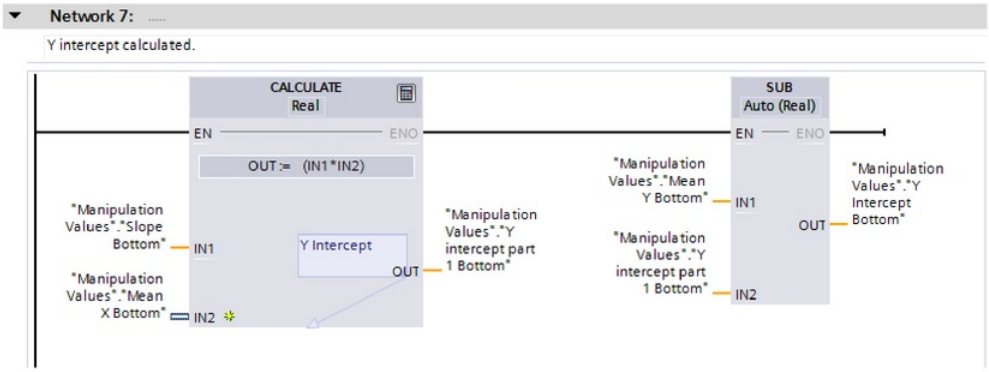


Figure 25 - Y intercept calculation

The following figures show the calculations required to perform regression analysis for the top head. The same equations were used for the bottom head. The full program can be seen in appendix 10.3. *should be appendix 10.8*

The solutions from these calculations are used in the formula $y = mx + c$.

Figure 26 shows the voltage from the variable power supply. This simulates the 0-10v signal from the x-ray heads. This range was specified in the specification.

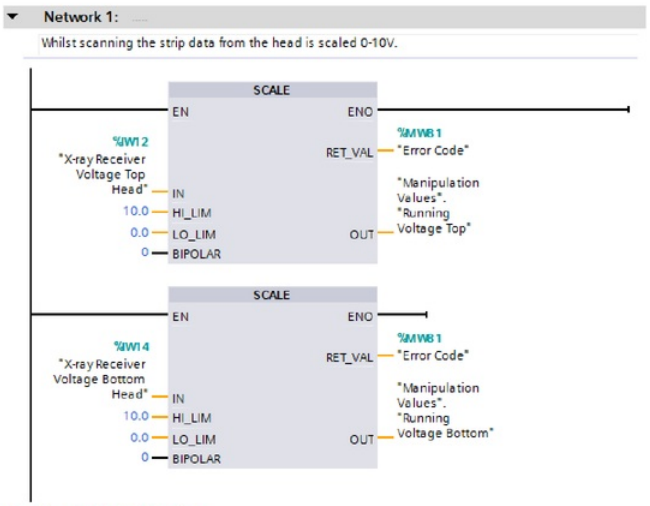


Figure 26 – Voltage Scaling

Figure 27 shows the y = mx + c calculation being performed. The running voltage is multiplied by the slope, the result of this is then added to the y intercept. The third block gives the option to add a percentage gain, this value is entered on the technicians HMI screen in the settings page. This value can be added to the coating reading to alter the calibration line if requred. This is needed if the generated voltage initailly sent to the heads is too high or too low.

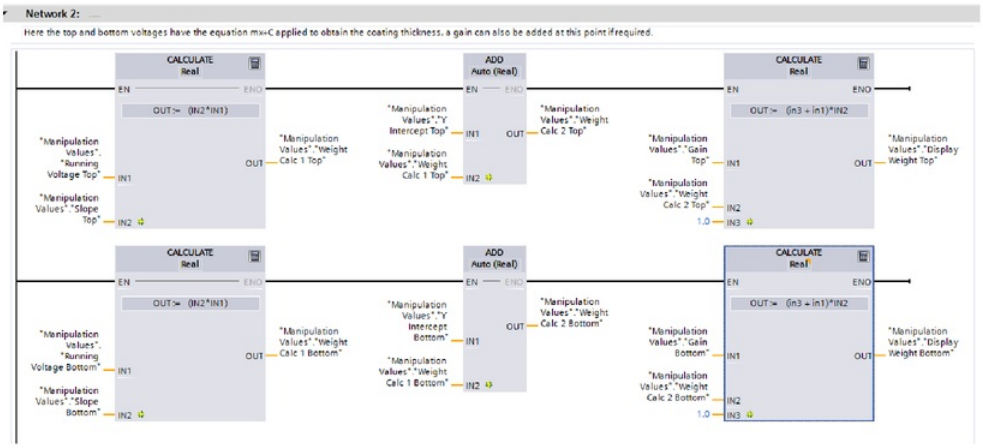


Figure 27 - y = mx + c calculation

Spelling

Figure 28 shows the the top and bottom calculated coatings being added together to enable the total coating to be displayed.

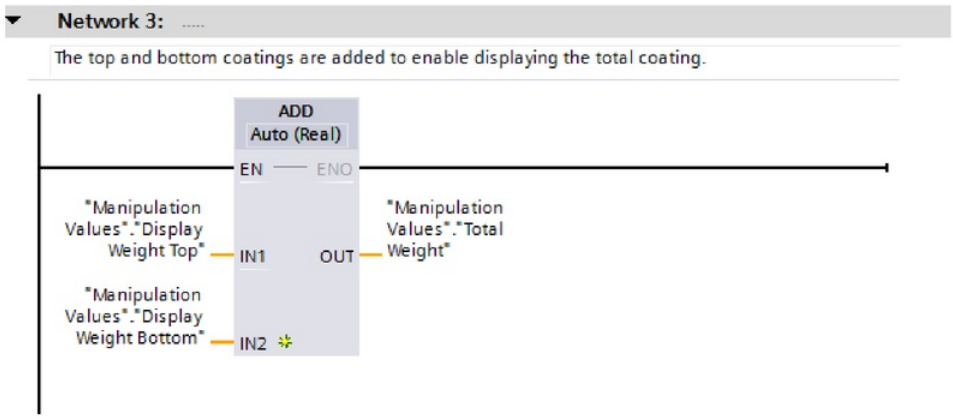


Figure 28 - y = mx + c calculation

Figure 29 shows the blocks used to calculate the variance between the desired coatings which are entered on the HMI screens and the actual reading which is calculated.

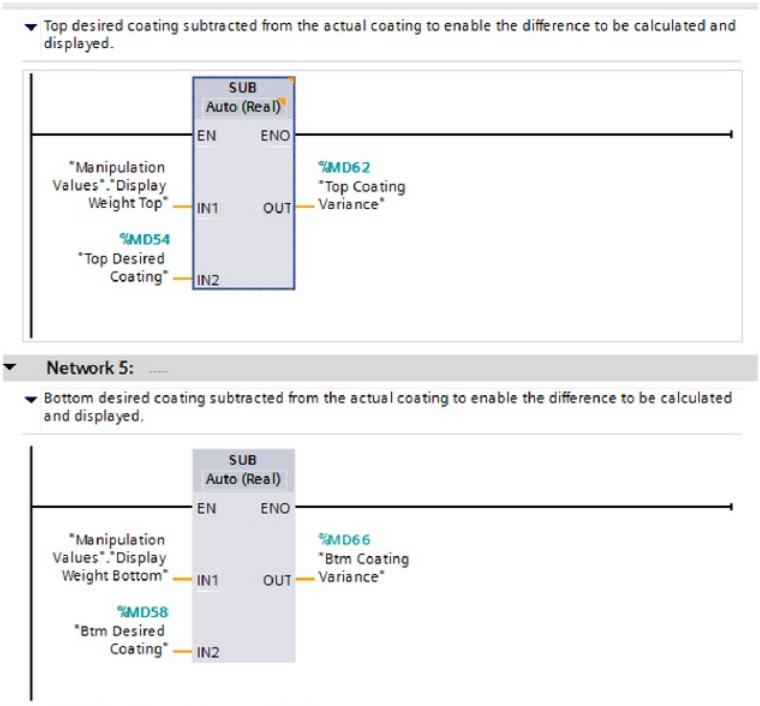


Figure 29 - Coating variance calculations

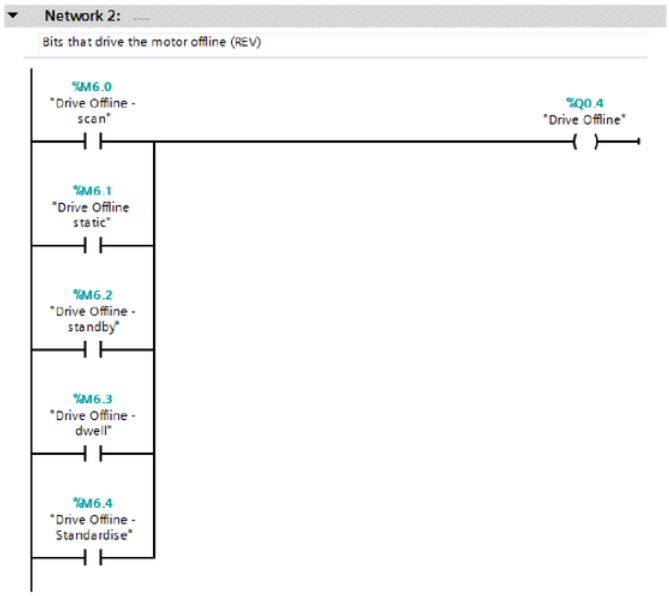


Figure 30 - Drive offline output

To avoid conflict and easily identify where the signal was coming from, all bits that drive inputs were programmed separately and then paralleled to that output. Figure 30 shows the drive offline output. Figure 31 shows the drive online output. Figure 32 shows the open shutter output and figure 33 shows the close shutter output.

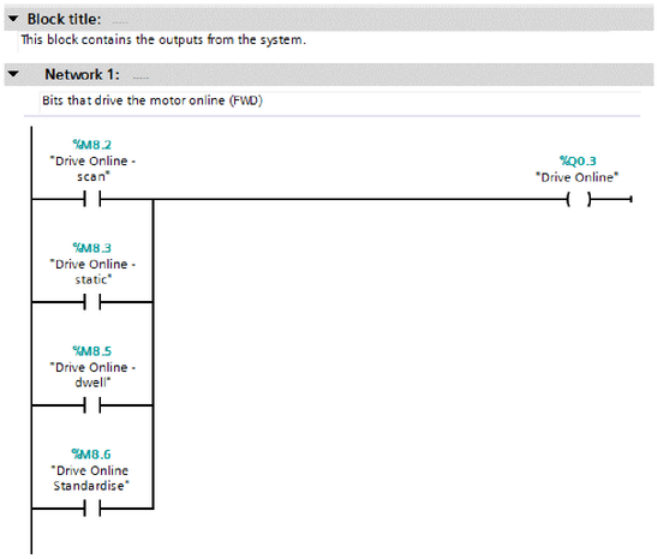


Figure 31 - Drive online output

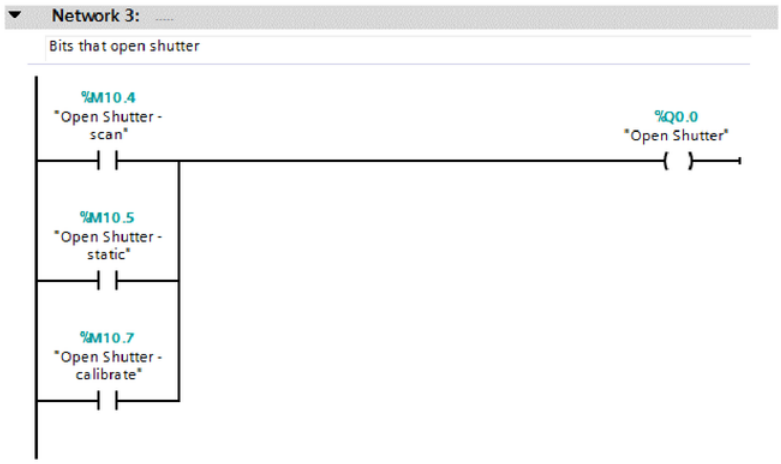


Figure 32 - Open shutter output

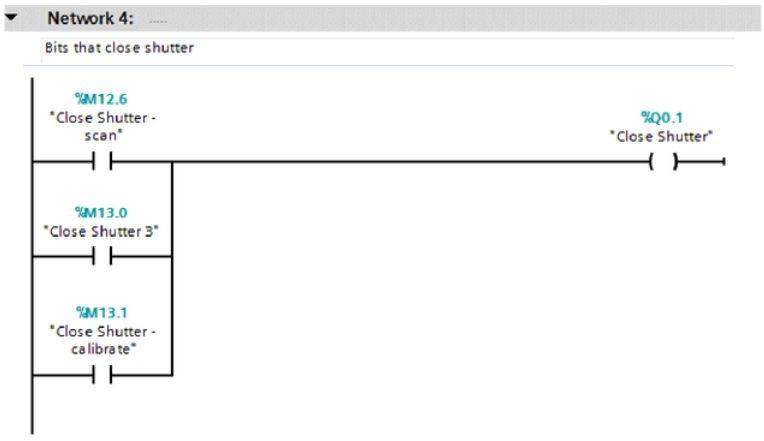


Figure 33 - Close shutter output

The dwell HMI screen has 3 graphs for the top head and 3 for the bottom head. To display the coating reading from the correct point on the strip, the code in figures 35 through 37 is used. The bit "dwell drive side edge" is enabled in the dwell sequence shown in figure 35. When this bit is made the value from the coating reading at that point in time will be moved into the dwell readings data block and display on the corresponding graph. The same pattern can be seen for center and op side in figures 36 and 37.

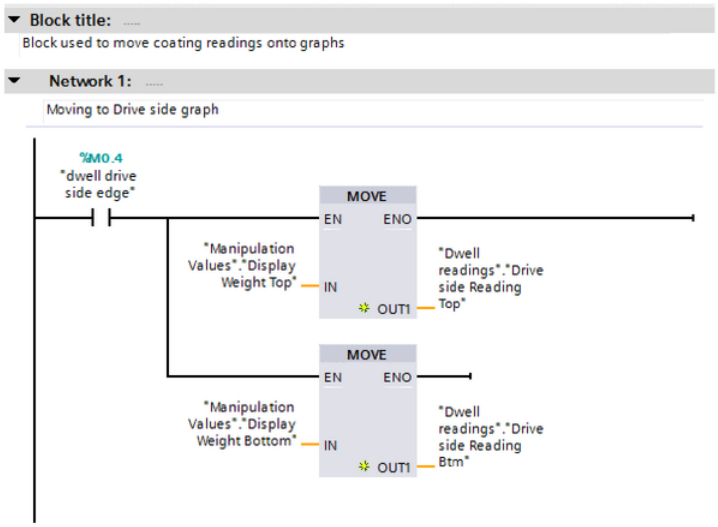


Figure 34 – Drive side edge dwell readings

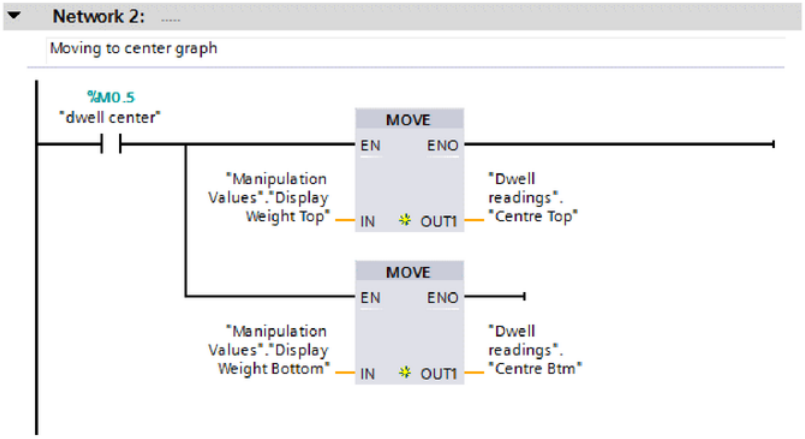


Figure 35 - Center edge dwell reading

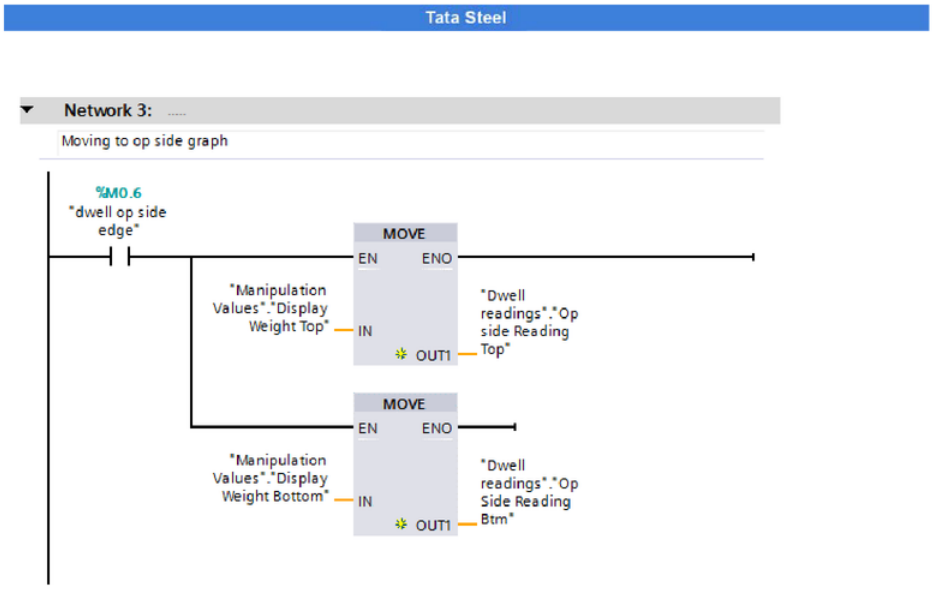


Figure 36 - Operators side dwell readings

Figure 37 shows the compact version of the GRAPH program used to program the calibration and standardise sequences.

Figures 38 through 51 show the expanded verison of the sequence.

Spelling

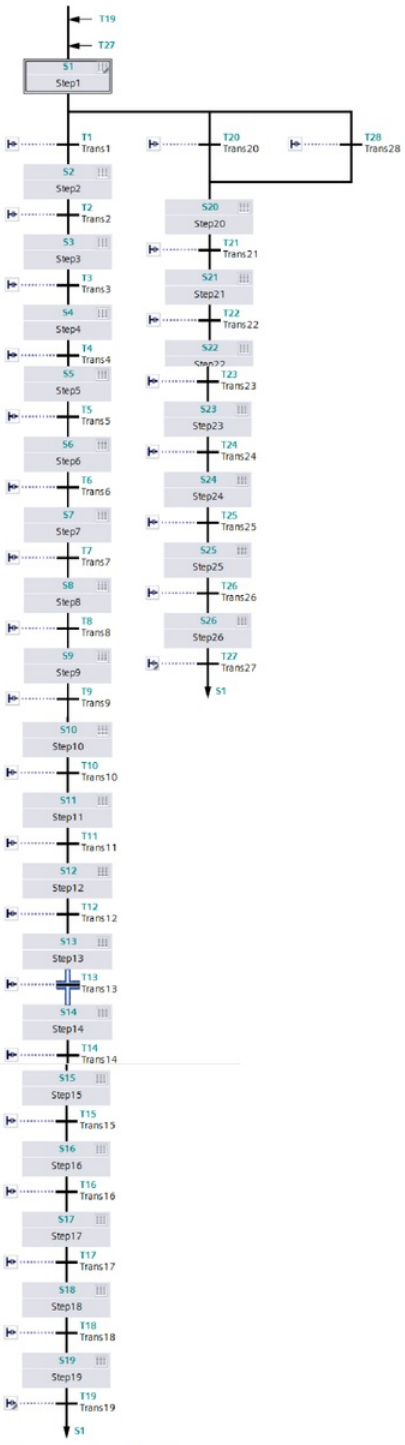


Figure 37 - Calibrate and standardize sequence

Figure 38 shows the initial step, if the safety requirements are made, and the calibrate button is pressed, the motor will drive offline.

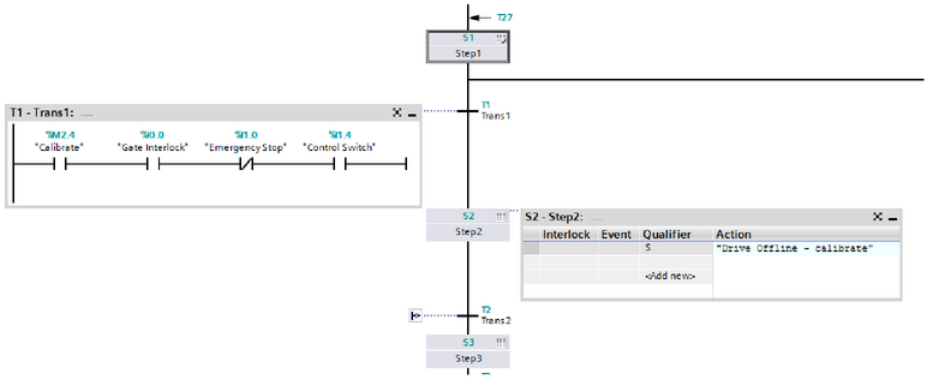


Figure 38 - Start calibration

Figure 39 shows that the heads will be driving offline until the position becomes less than 560mm, this is the home position. Once position becomes less than 560mm the heads will stop driving offline and start driving online.

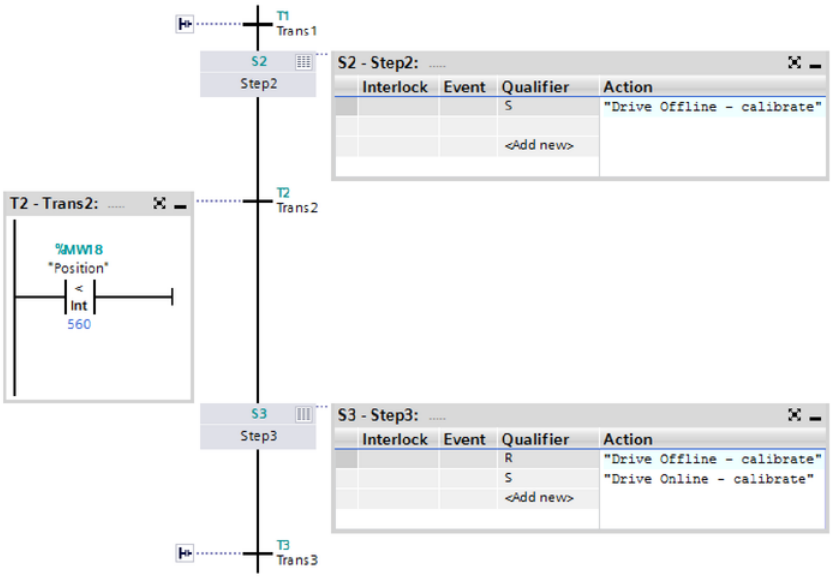


Figure 39 - Calibrate drive to park position

Figure 40 shows that the heads will be driven online until position becomes greater than 580mm, this is the calibrate position, once this distance is met the heads will stop driving online.

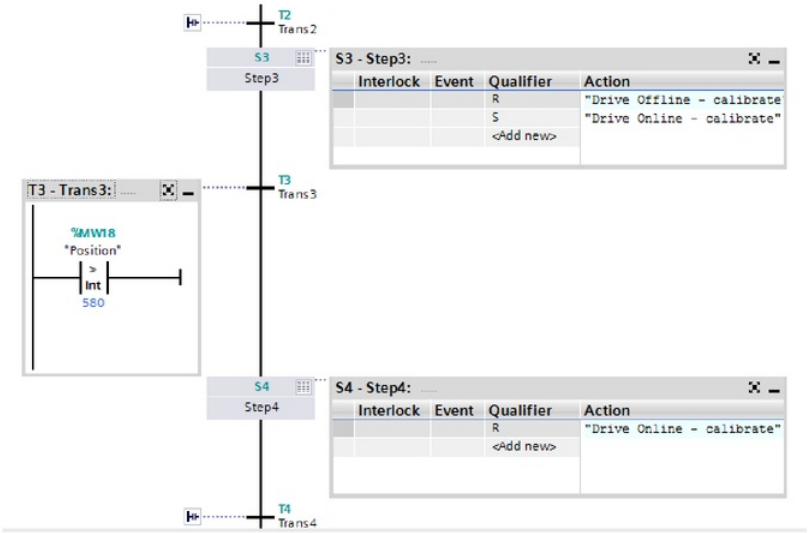


Figure 40 - Drive to calibrate position

Figure 41 shows that the system is now waiting for the sample 1 inserted button on the operators HMI, once this button is pressed the shutter will open and the start timing bit is set.

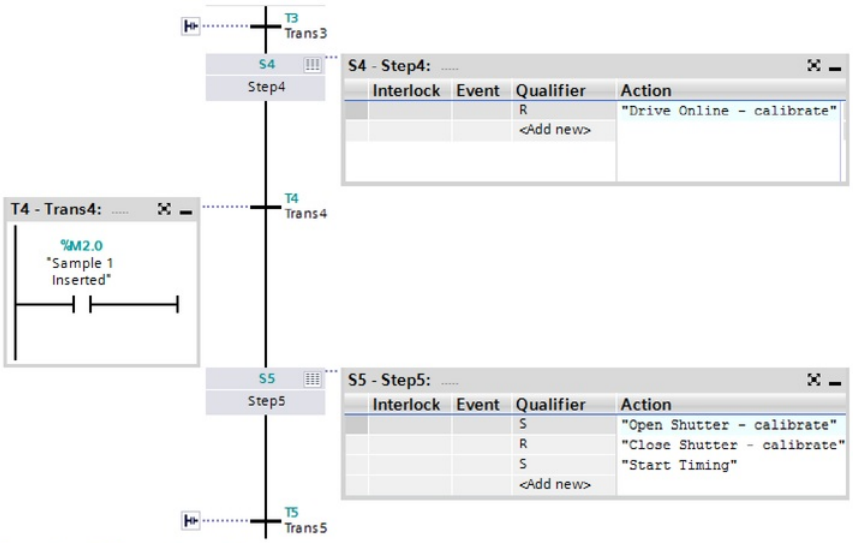


Figure 41 - Calibrate, Sample 1 operation

Figure 42 shows that the system is now waiting for the output of IEC Timer 0 to be energised. This is a timer that will have counted for 5 seconds once the start timing bit was set. Once IEC timer 0 is energised the shutter will be closed, heads will be driven offline and the start timing bit will be reset to enable use later on in the program sequence.

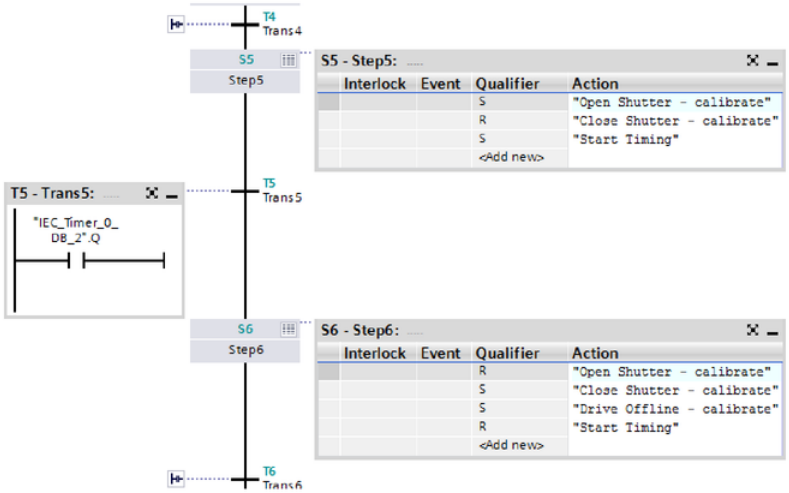


Figure 42 - Calibrate, Sample 1 measure

Figure 43 shows that the head will be driven offline until position reads less than 560mm, once this becomes true the heads will stop driving offline. This is done as during the calibration process technicians are required to change samples, by driving the heads offline between each sample change, it is ensured that the heads are out of the technicians working area. The sequence will then repeat for samples 2 through 4 once sample 4 is completed the heads will drive home and the sequence will return to step 1. The full program can be seen in appendix 10.3.

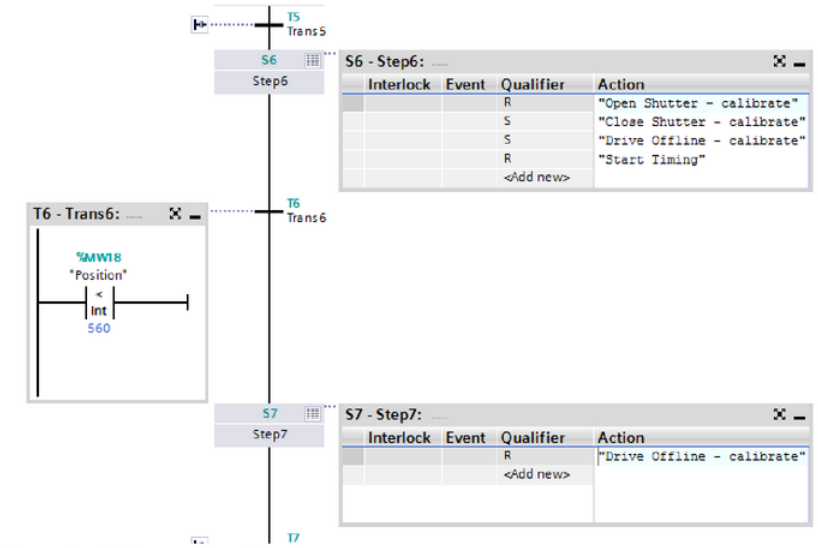


Figure 43 - Calibrate, drive offline

Figure 44 shows the alternative path from step 1. From this it can also be seen that there are two potential paths from this point. The path depends on the position of the control switch, this is in place to ensure that only one of the HMI screens can have control at any one time. Again, the safety requirements must be met. Pressing standardize on either of the screens if the control switch is in the corresponding position will start the standardize sequence.

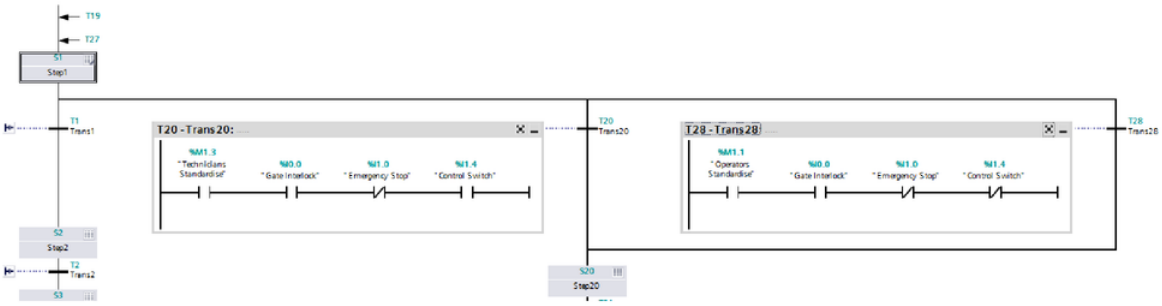


Figure 44 - Start standardise

Figure 45 shows that the first step is to drive the heads offline.

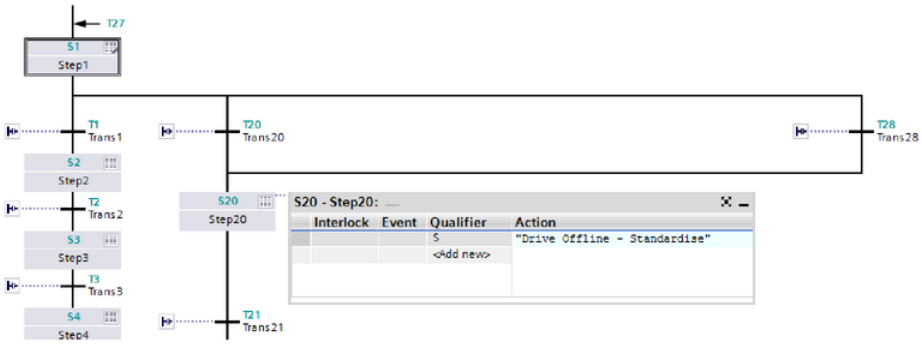


Figure 45 - Standardize, Drive offline

Figure 46 shows that the heads will be driven offline until position is less than 560mm. Once this is true the heads will stop driving offline and drive online.

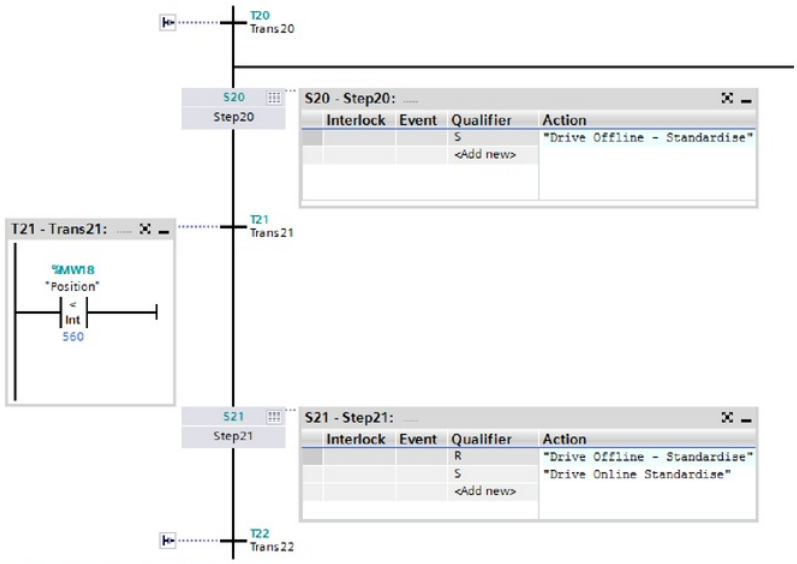


Figure 46 - Standardise, drive offline

Figure 47 shows the heads will drive online until the position is greater than 580mm. This is the zero measurement point. Once this position is true the heads will stop driving online and the start timing bit will be set.

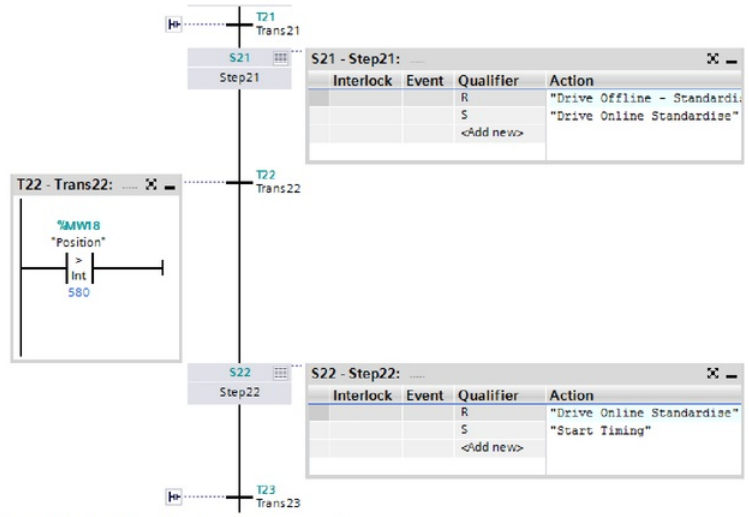


Figure 47 - Standardise, drive to zero position

Figure 48 shows that the system is waiting for the output of the 5 second IEC timer 0 to become energised, once this happens the heads will once again be driven online, and the start timing bit will be reset.

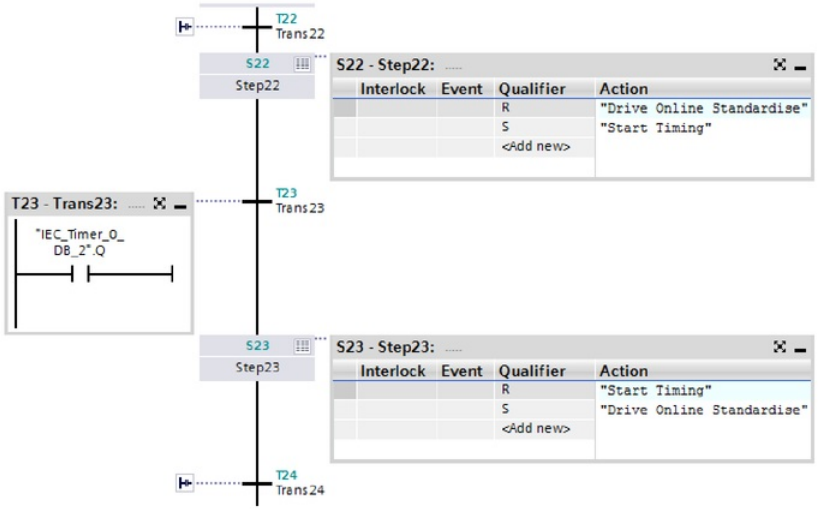


Figure 48 - Standardise, measure zero

Figure 49 shows the heads will drive online until position reads 620mm, this is the infinity measurement point. Once this point has been reached the heads will stop driving online and the start timer bit is set.

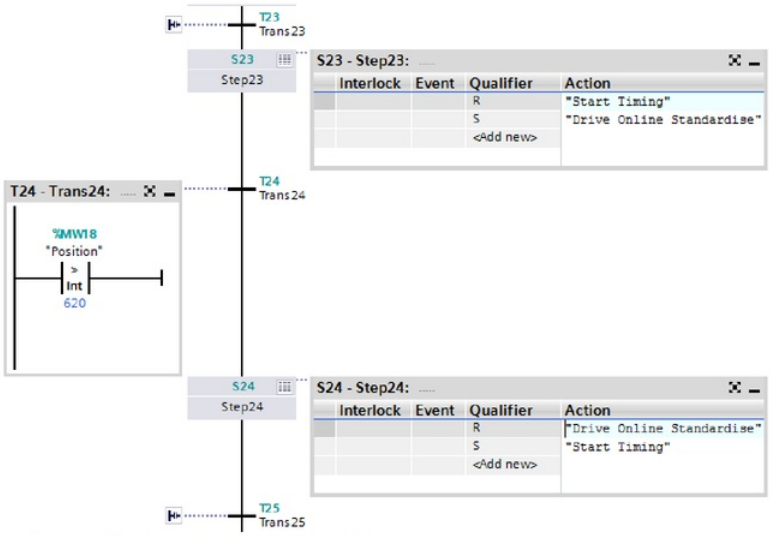


Figure 49 - Standardise, Drive to infinity position

Figure 50 shows that once the start timing bit is set the system is waiting for the 5 second IEC timer 0 output to be energised, once this happens the heads will be driven offline and the start timing bit will be reset.

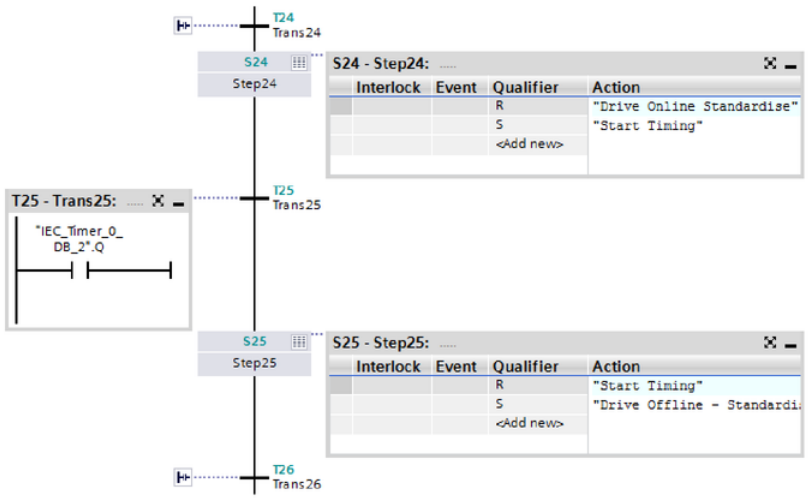


Figure 50 - Standardise, Measure at infinity position

Figure 51 shows that the heads will drive offline until position reads less than 560mm. Once this is true the heads will stop driving offline and the standardize buttons will be reset.

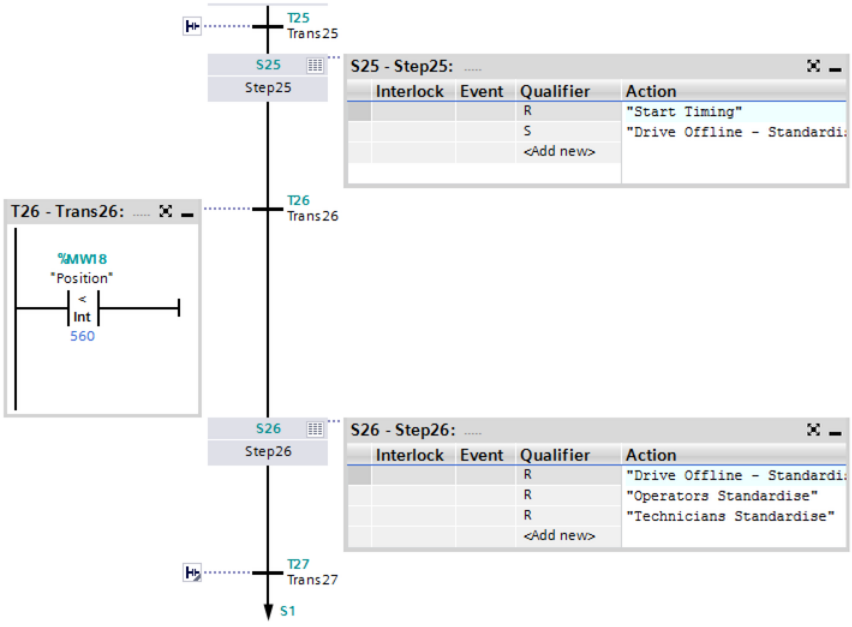


Figure 51 - Standardise, Drive offline

Figure 52 shows the compact view of the GRAPH program for the modes of operation sequences.

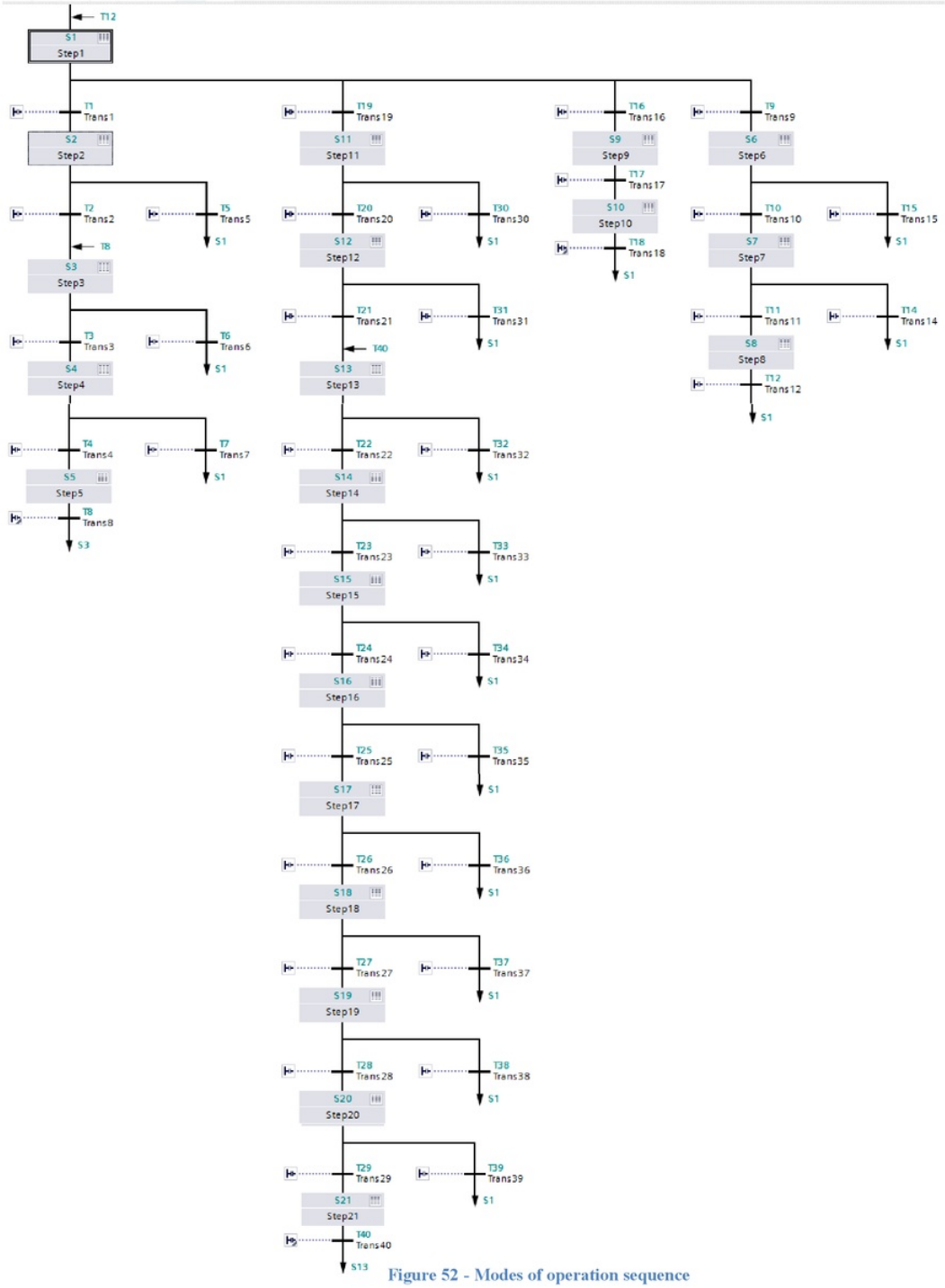


Figure 52 - Modes of operation sequence

Figure 53 shows the bits set and reset in step 1. This is the step that all sequences come back to once they are either complete or they are stoped. This blcok makes everything safe. It can be seen that all mode button are reset, drive online and offline are reset and the shutter is closed.

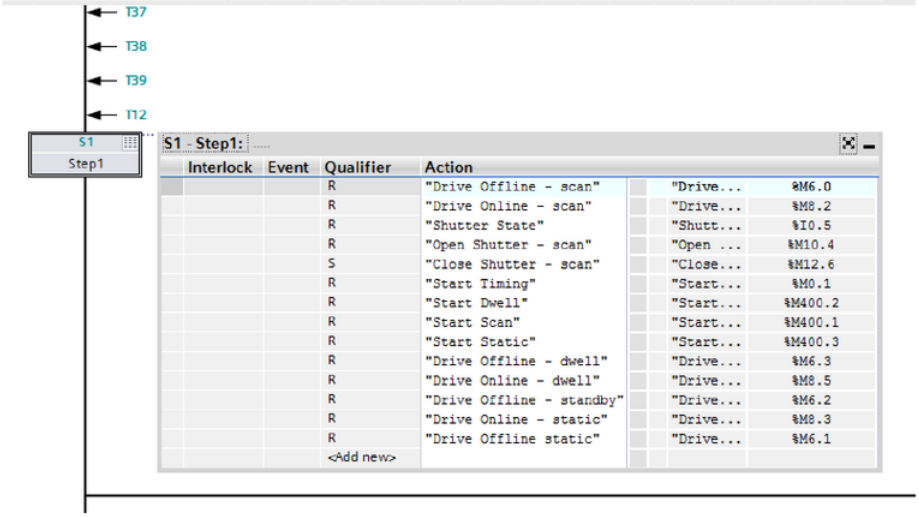


Figure 53 - Modes of operation, step 1

Figure 54 shows the first potential branch from step 1. Before any operation can be performed the gate must be closed, the line must be running, the emergency stop must not be pressed, the control switch must be in the PC&A position and both x-rays must be on. Once the start scan button is pressed on the operators HMI screen the sequence will begin. This means the heads will be driven online and the shutter will be opened.

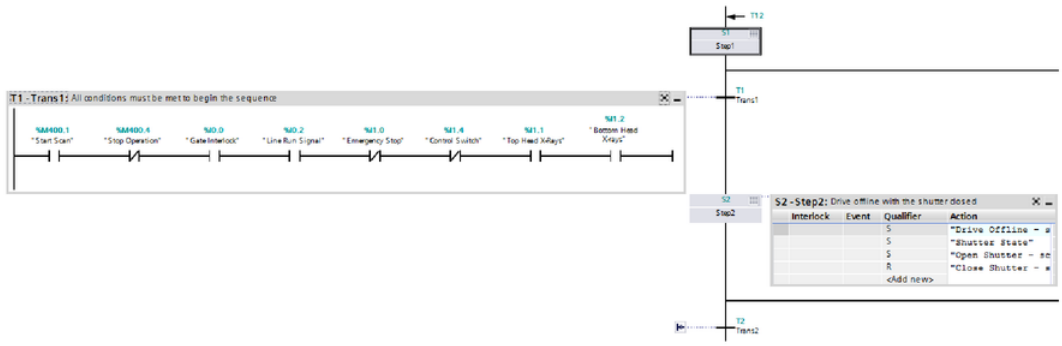


Figure 54 - Start scan operation

Figure 55 shows that the heads will drive offline until position is less than 560mm. Once this is true the heads will stop driving offline and start driving online. If the stop operation button is pressed on the HMI screen it can be seen that the sequence will jump back to step 1. This is true for all steps in the system. This will reset all bits. It can also be seen that the sequence jumps back to step 3 from transition 8.

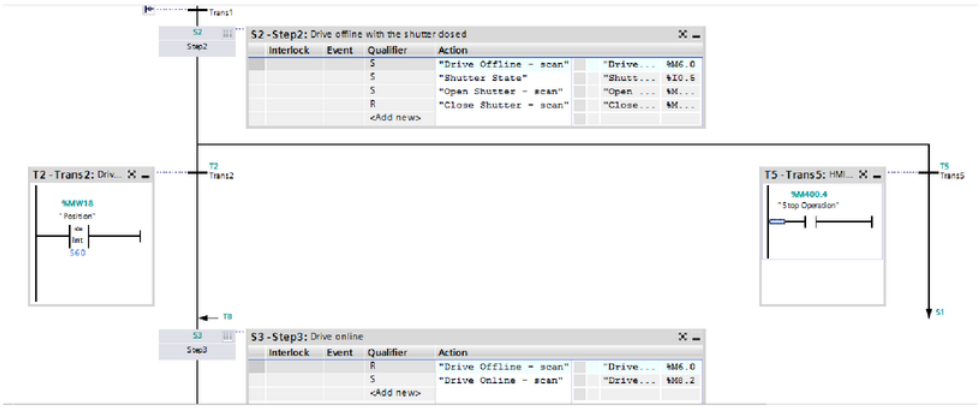


Figure 55 - Scan, Drive offline

Figure 56 shows the heads will drive online until position is greater than strip edge 2. Once this is true, the heads will stop driving online and will drive offline.

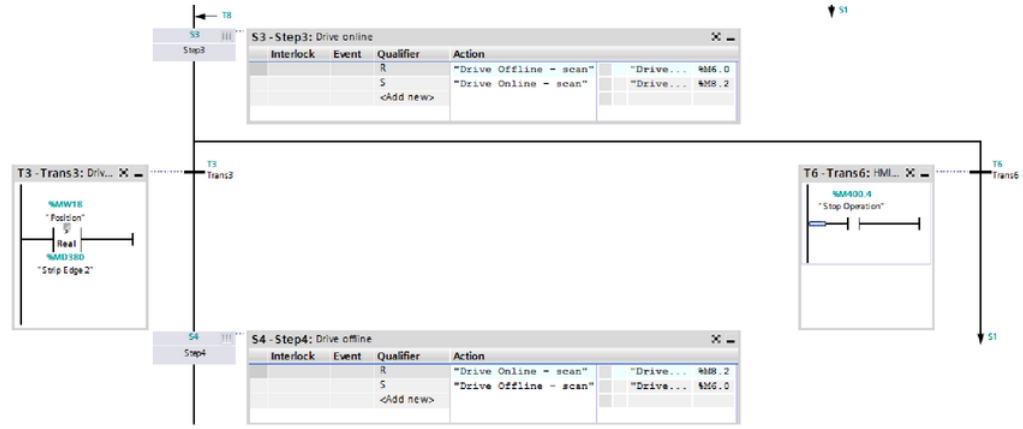


Figure 56 - Scan, Drive to strip edge 2

Figure 57 shows that the heads will be driven offline until position becomes less than strip edge 1. Once this is true the heads will stop being driven offline.

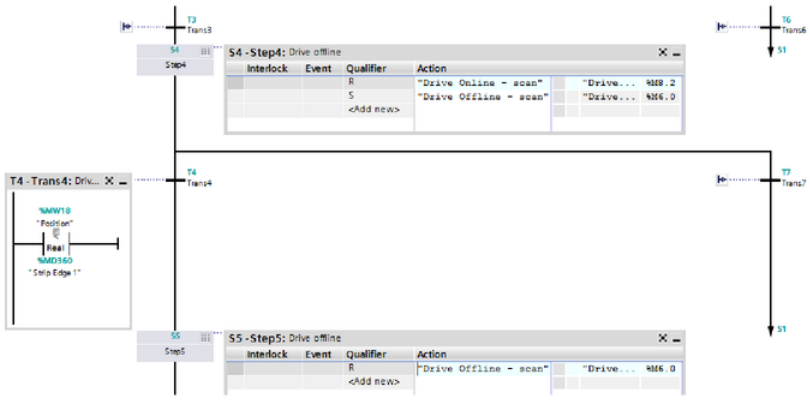


Figure 57 - Scan, Drive to strip edge 1

Figure 58 shows that once step 6 has been completed the sequence will jump to step 3. This will then repeat the scan sequence until the stop button is pressed.



Figure 58 - Restart scan

Figure 59 shows the second branch from step 1. Pressing the start dwell button on the HMI screen whilst all other conditions are met will start the sequence by driving the heads offline.

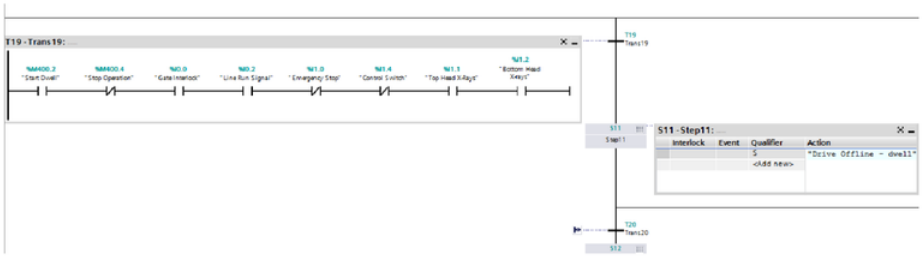


Figure 59 - Start dwell

Figure 60 shows the heads will drive offline until position becomes less than 560mm. The heads will then stop being driven offline and start driving online. If the stop button is pressed at any time during the sequence the sequence will jump back to step 1.

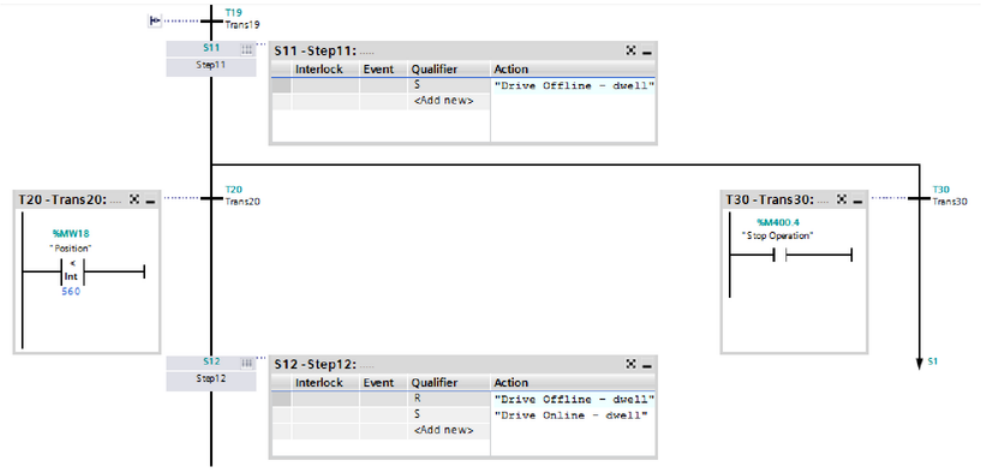


Figure 60 - Dwell, Drive offline

Figure 61 shows that the heads will be driven online until position becomes greater than strip edge 1. Once this is true, the heads will stop being driven online, the start timing bit will be set along with the dwell drive side edge bit. This bit sends the coating data from this bit into the correct database.

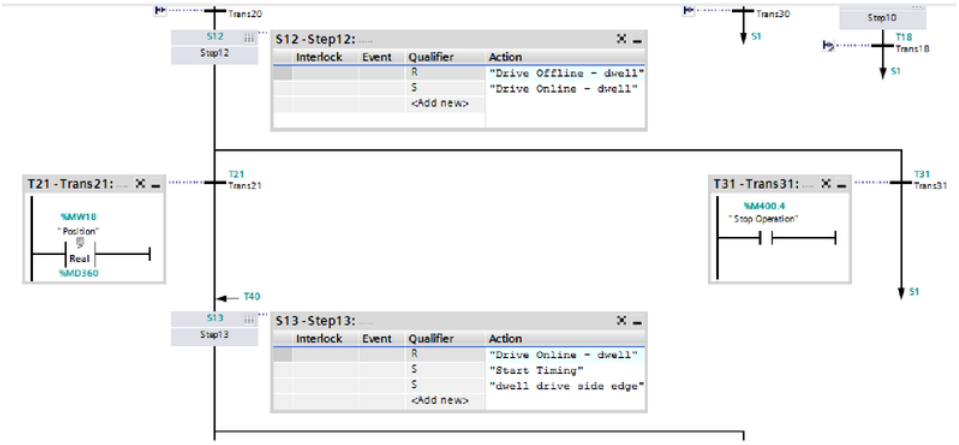


Figure 61 - Dwell, Stop at strip edge 1

This will cause the system to take measurements for 5 seconds until the output of IEC timer 0 is energised. Once this is true the start timing bit and dwell drive side bit will be reset, and the heads will be driven online. This process is repeated for the center and operators side strip edge as can be seen in figures 62 through 70.

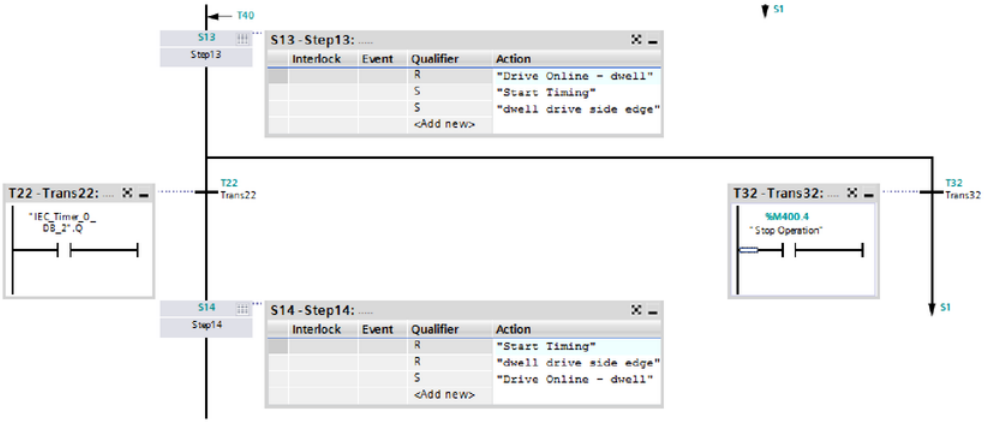


Figure 62 - Dwell, Measure at strip edge 1

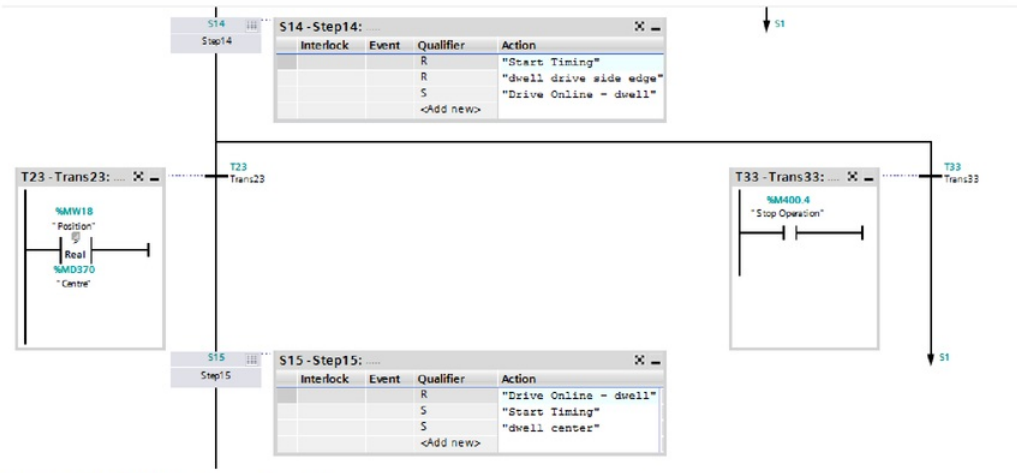


Figure 63 - Dwell, Drive to center position

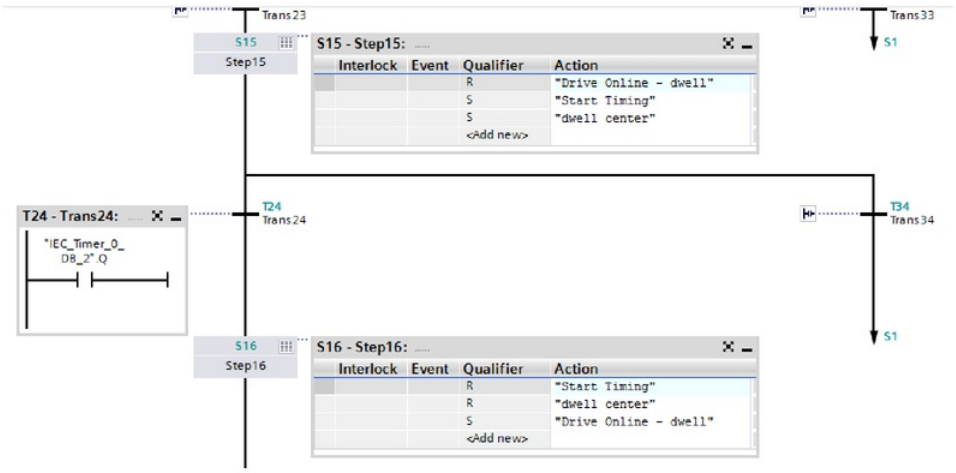


Figure 64 - Dwell, Measure at center position

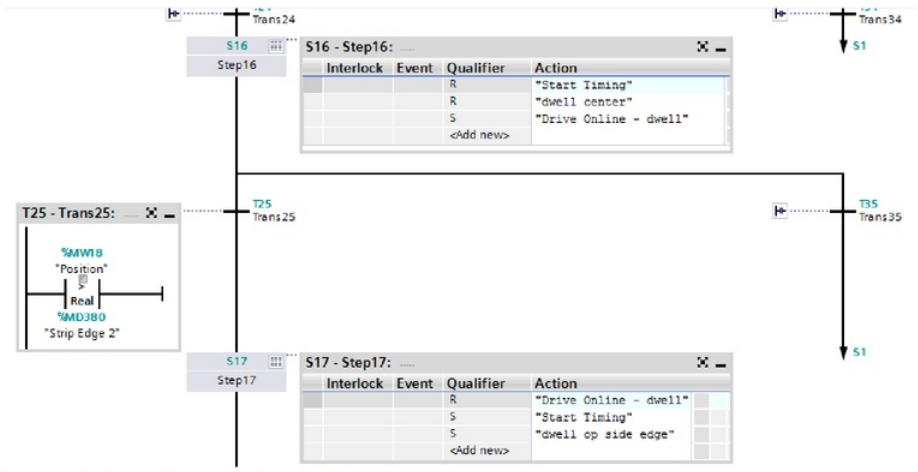


Figure 65 - Dwell, Drive online to strip edge 2

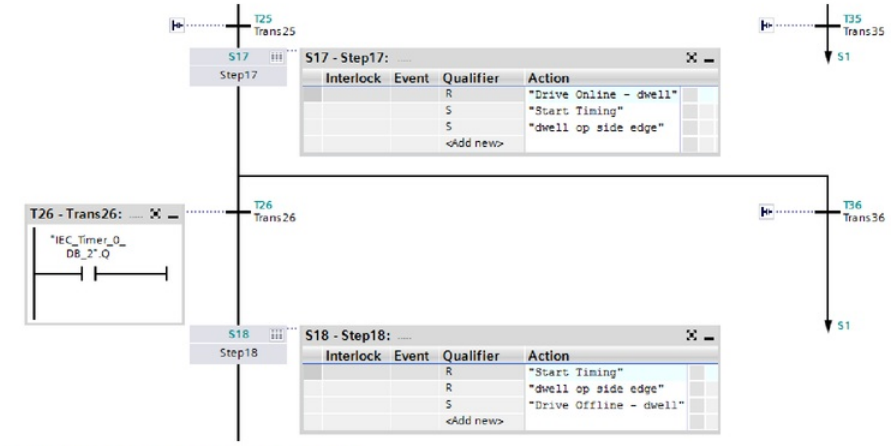


Figure 66 - Dwell, Measure at strip edge 2

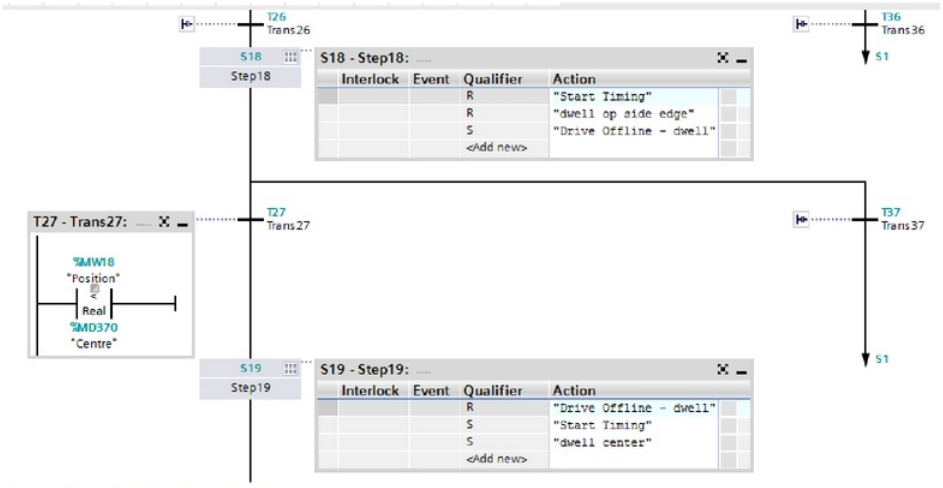


Figure 67 - Dwell, Drive offline to center

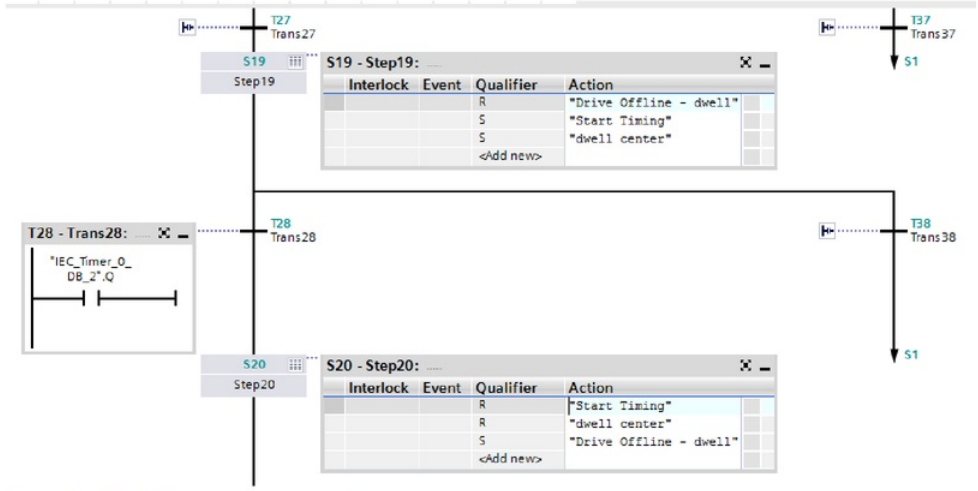


Figure 68 - Dwell, Measure at center position



Figure 70 - Dwell, drive offline to strip edge 1

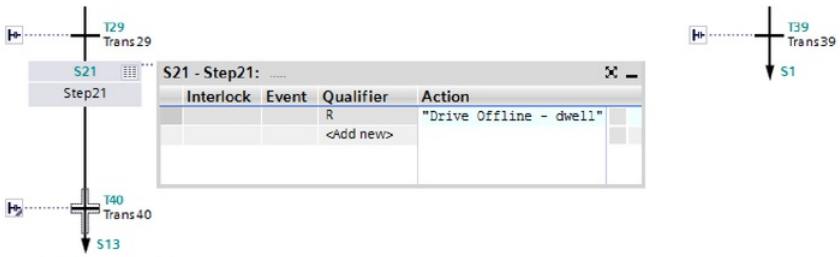


Figure 69 – Restart dwell sequence

Figure 71 shows the third branch. If the standby button is pressed on the HMI screen whilst all other necessary conditions are met the standby function will begin. Once initiated the heads will be driven offline.

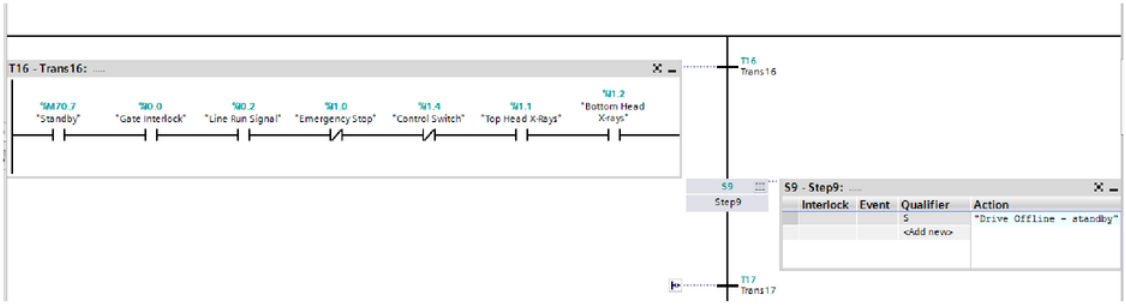


Figure 71 - Start standby

Figure 72 shows that the heads will be driven offline until position reads less than 560mm. Once this is true the heads will stop being driven offline, the standby button will be reset, and the shutter will be closed. This ends the sequence and the system will jump back to step 1 as shown in figure 73.

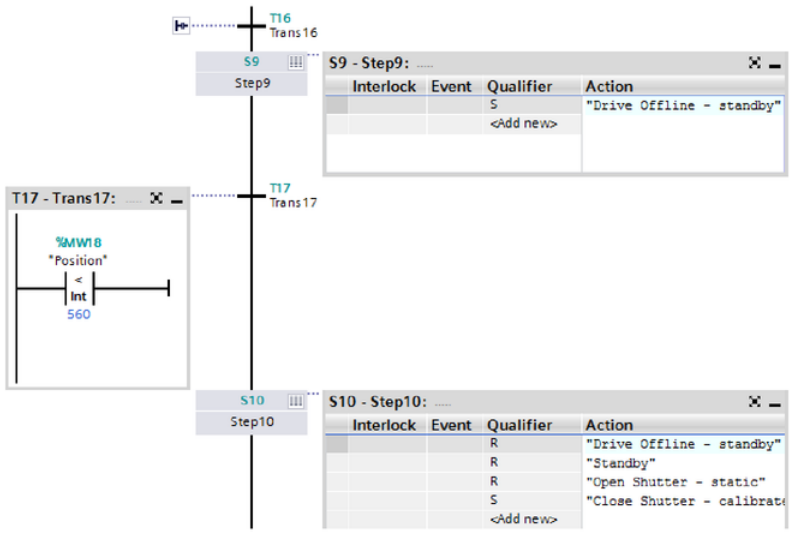


Figure 72 - Standby, Drive offline

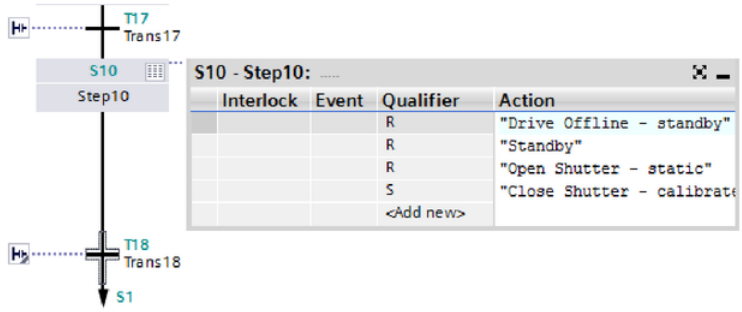


Figure 73 - Standby, jump to step 1

Figure 74 shows the forth branch of the sequence. If the start static button is pressed when all other conditions are met the static sequence will begin by driving offline

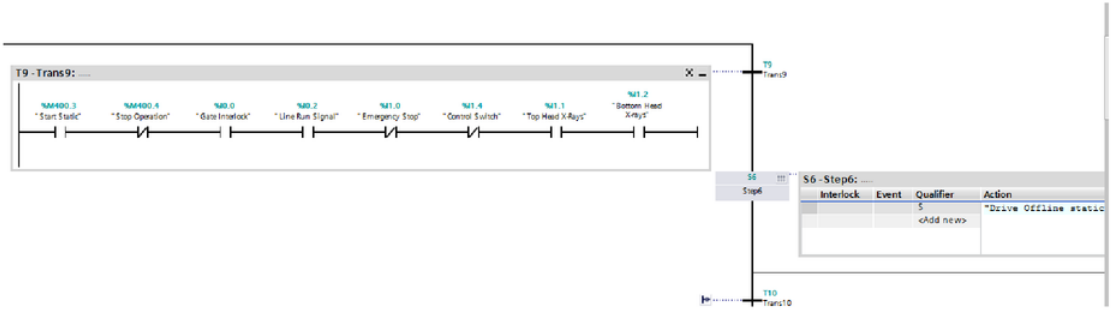
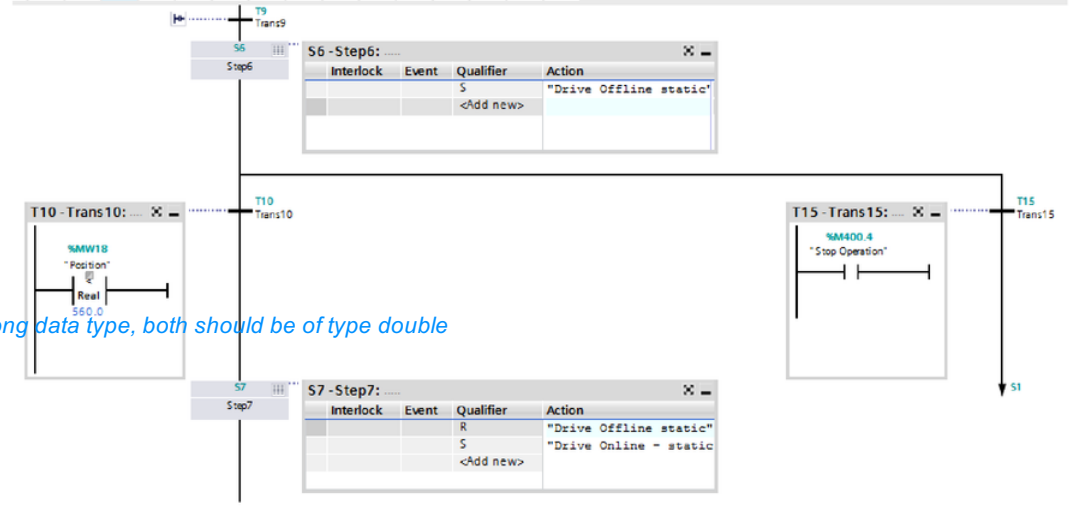


Figure 74 - Start static

Figure 75 shows that the heads will be driven offline until position becomes less than 560mm, once this is true the heads will stop driving offline and will drive online. If the stop operation button is pressed on the HMI screen the sequence will jump be to step 1 which will reset the system.



wrong data type, both should be of type double

Figure 75 - Static, Drive offline

Figure 76 shows the heads will drive online until position becomes greater than actual desired static, this value is entered by the operator on the HMI screen. Once this has become true the heads will stop being driven online and the shutter will open.

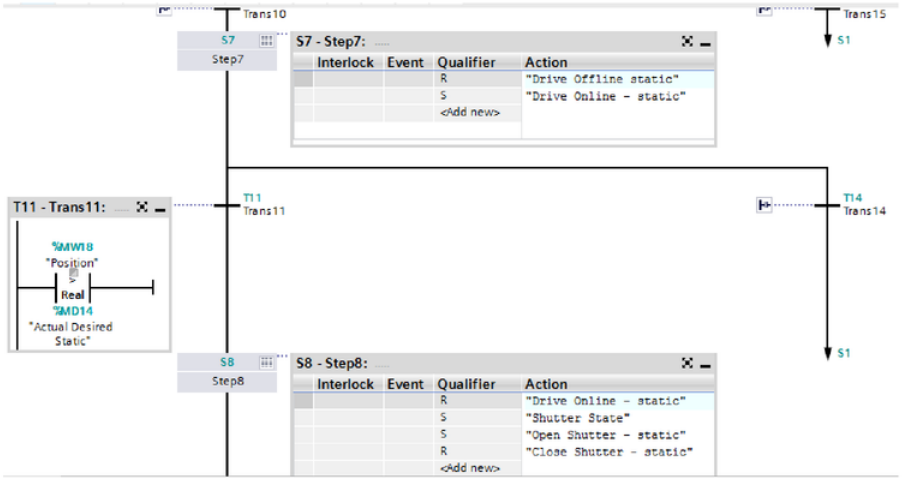


Figure 76 - Static, drive online to target position

Figure 77 shows that the heads will sit in this position until the stop operation button is pressed, pressing this button will cause the sequence to jump to step 1 which will reset the system.

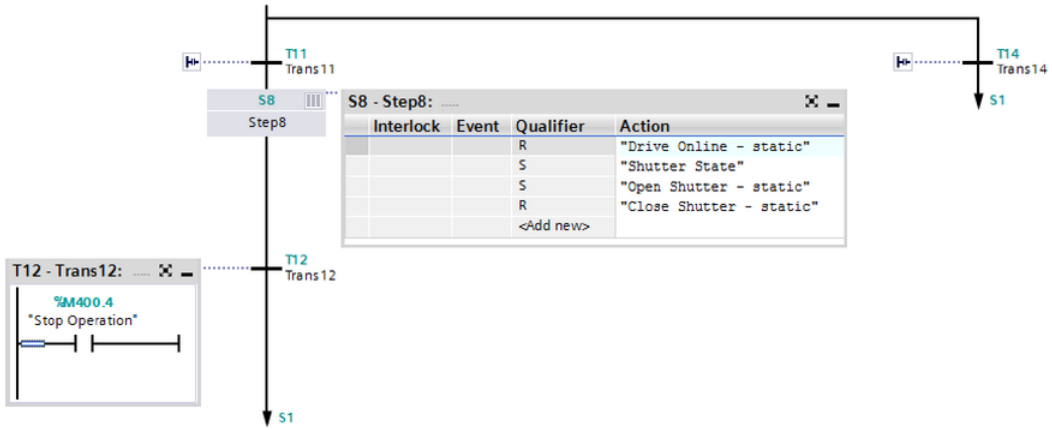


Figure 77 - Static, Stop operation

6.2 - Control Panel

Figure 78 shows the completed control panel. The extent to which the panel complies to the EN60204 electrical safety standards and the essential healthy and safety regulation (EHSR) can be seen in appendix 10.7 and 10.8. The panel has 240V AC coming into the isolator from a fused spur, with this isolator in the off position there is no power on the panel at all. All cable ends are labeled and ferruled. The labels match that of the drawing that can be seen in appendix 10.5. All cables are colour coded depending on the voltage, there are 3 voltages in the panel 240V AC (black), 110V AC (red) and 24V DC (Blue). The main power coming in is 240V AC, this supplies the main contactor, and the control circuit of the motor and drive, the 240V AC is feed to the transformer which outputs 110V AC. The 100V AC supplies the PLC and the 24V DC power supply unit. This PSU is then used to supply the PLC I / O cards, the control circuit devices and the HMI screens.

The control panel is hardwired to incorporate safety, power is taken off the control circuit if, the emergency stop is pressed, the gate limit is deactivated or if either of the limit switches are activated.

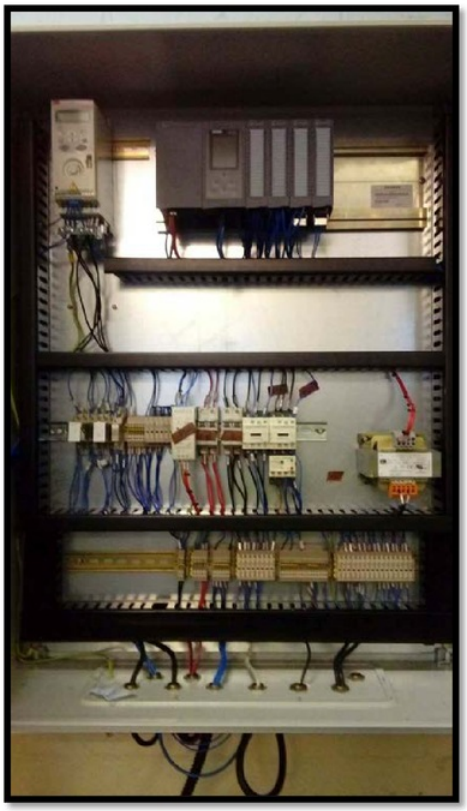


Figure 78 - Completed Control Panel

The recommended operating temperatures of the devices used within the panel were less than 45ºC. Figure 79 shows a thermal image that was taken of the panel after a day of operation. The maximum temperature in the panel is 28.6ºC, with the average temperature being 19.7ºC this is within the manufactures recommendations. Full pictures can be seen in appendix 10.6.

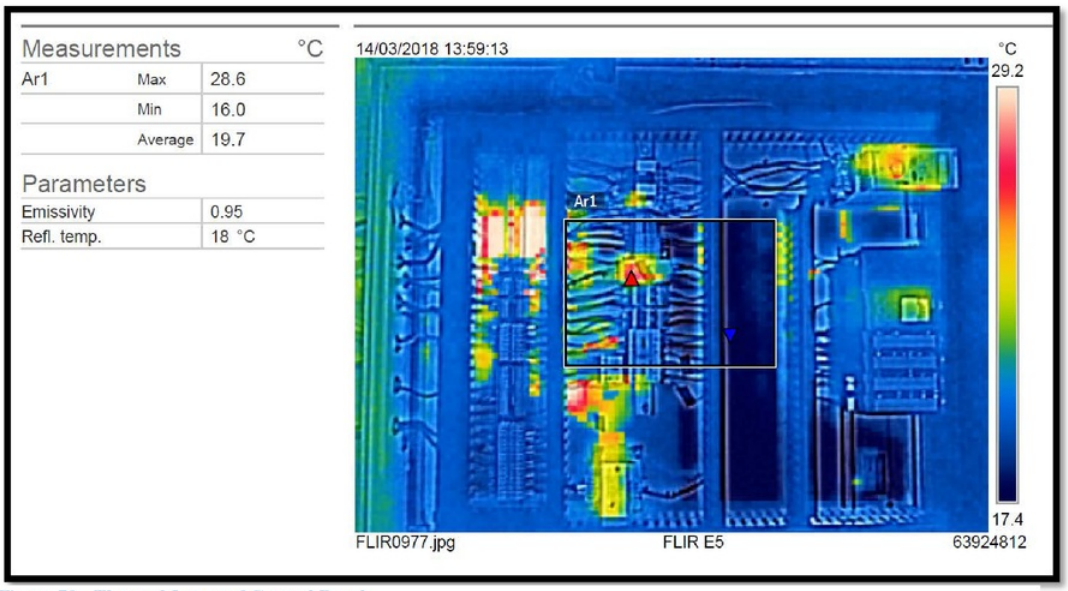


Figure 79 - Thermal Image of Control Panel

excellent idea, testing temperature shows possible future failures

6.3 - ABB Drive

The ABB drive was configured using the built-in keypad and screen. The drive was initially setup with the details of the motor. Parameter 9902; Application macro was selected as the alternate macro. The full I/O connections for this macro can be seen in appendix 10.2. The forward and reverse signals are sent from the digital output card of the PLC. There are two options for constant speed selection. The speeds are preset in the drive and selected when needed via the PLC program.

6.4 - O-Frame

The main frame was constructed from Unistrut and fastened with spring channel nuts and 8mm bolts. The frame is bolted to the floor using Unistrut legs. Two Unistrut arms extend from the frame and attach to the wall using L brackets. Within the frame two lengths of rail were mounted on additional sections of Unistrut. The rails house runners which the belts are connected to. These sections were bolted in the channel of the Unistrut; this was done to enable the rails to be moved up and down which enables the tension on the belts to be adjusted. In each of the four corners of the frame metal plates are mounted, these plates are used to mount the pulleys; the belts are then run across these pulleys. A small tensioning wheel was used to add tension to the upright belt.

The motor was mounted to the floor using a motor frame and welded Unistrut and earthed to the main frame.

A Unistrut arm extending to the left of the frame houses the laser distance sensor, this was mounted to line up with the bottom head. Ultimate limit switches are mounted on the bottom head rail, the ultimate limits were used so in the event of an object falling in front of the laser the heads would stop and not continue to try and run.

All cables are run through the Unistrut channels and into wall trunking, all of which is capped. The x-ray heads are demonstrated using small sections of Unistrut. Figure 80 shows the O frame that was built to demonstrate functionality. Figure 80 shows the completed O frame.

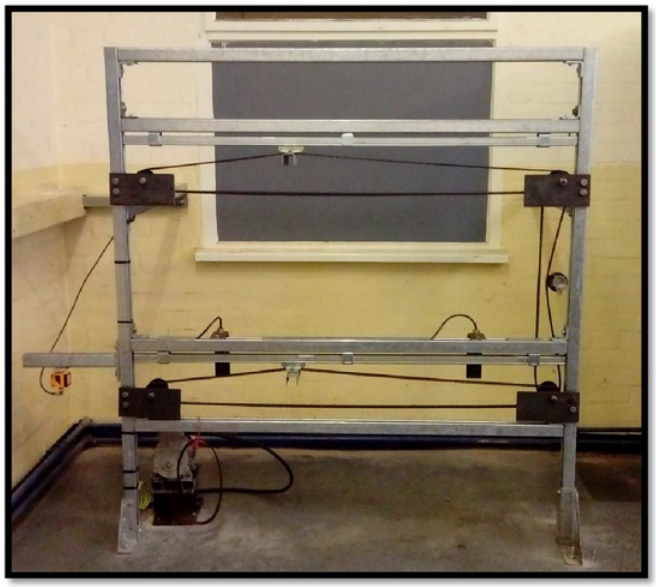


Figure 80 - Prototype O Frame

6.5 - Signal Box

The signal box was made purely to demonstrate the external factors that needed to be included to demonstrate the fullest functionality of the system. The signal box consists of two pole switches that are wired into the digital input of the PLC. Most of the switches are simply used to demonstrate that the alarms section works. However, the line run switch and the x-rays on / off switches can inhibit the operation of the system. If either of the x-rays are in the off position or if the line is simulated as not running the system will not enable the operators to run the gauge in any mode of operator or allow standardisation or calibrations to be performed. Figure 81 shows the completed signal box



Figure 81 – Signal Box

6.6- Technicians HMI Screen

The technician's screens are significantly smaller that the operator screen due to the lack of graphical displays. The technician's screens offer more technical features than the operators screen. The main page, figure 82 displays the time and date in the top right-hand corner and displays the top, bottom and total coating. The buttons are used to navigate to other screens. Pressing standardize will run the standardize sequence, this will not navigate onto a separate page, simply change to read "standardizing".

Pressing calibrate will navigate to the calibration screen, figure 83 This page gives all the buttons required to perform a full calibration, the I/O fields are used to display the head position and the current coating and voltage readings. Pressing F1 will navigate back to the main page, F2 will open the shutter and F3 will close the shutter.

Pressing settings will navigate to the page shown in figure 84. This page enables the coating weight values to be edited, this would only be done when new samples are created. The screen is also used to insert gain and tolerance values. The F keys are the same as previously mentioned.

Pressing the alarms button will navigate to the screen seen in figure 85. This screen displays all alarms, these will flash red when the alarm becomes unhealthy, the writing will also change to match the state of the alarm, for example, when healthy "Water flow healthy" would be displayed in white and black. When unhealthy, "Water flow Unhealthy" would be displayed in flashing red and white. F keys as mentioned.

Pressing calibration values will navigate to the screen shown in figure 86. This screen shows the coating and voltage readings of the most recent calibration.

Figure 82 - Technicians Home Screen

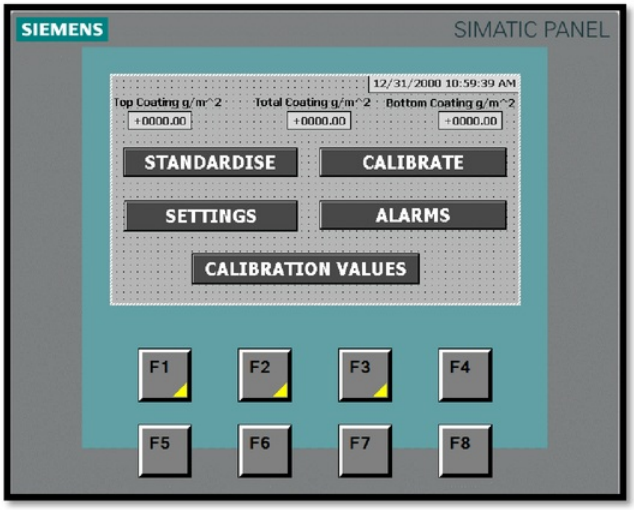


Figure 83 - Technicians Calibrate screen

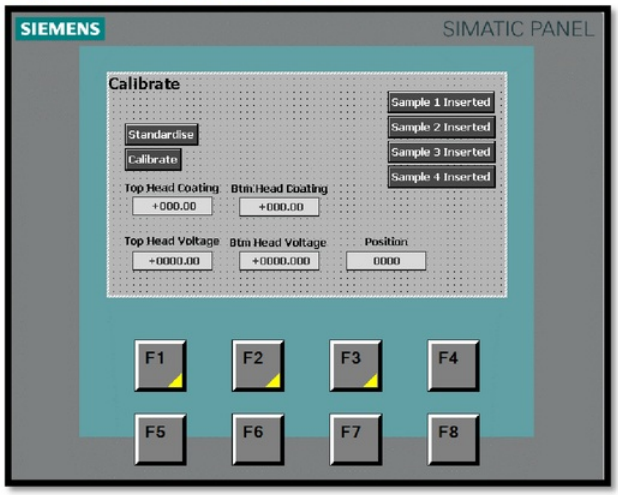


Figure 84 - Technicians Settings screen

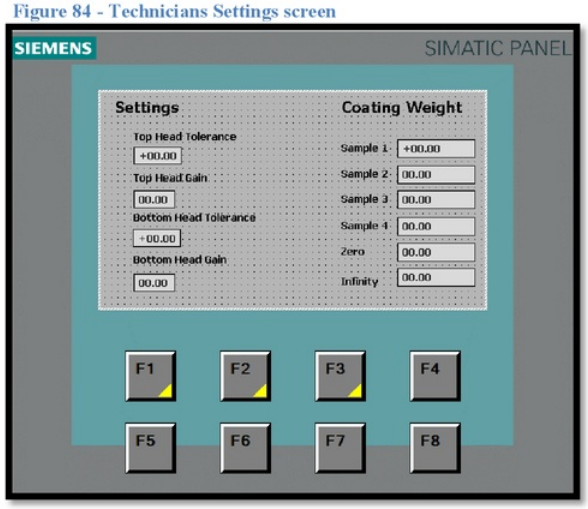


Figure 85 - Technicians Alarms screen

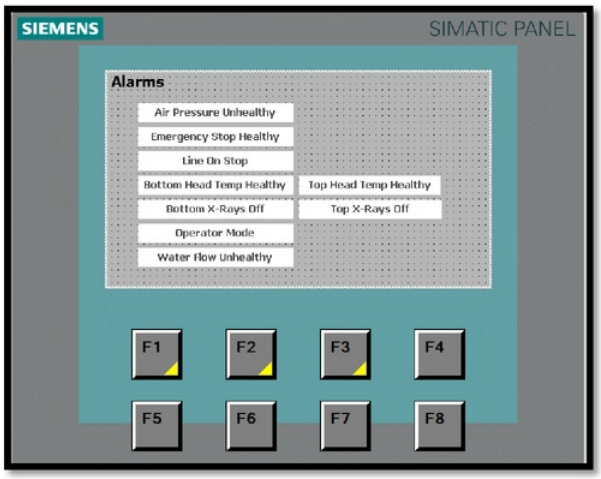
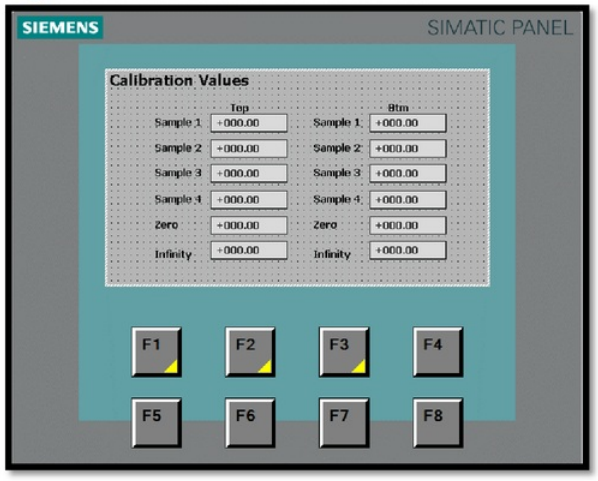


Figure 86 - Technicians Calibration Values screen



6.7 - Operators HMI screens

The HMI screens for the operators were designed to be as user friendly as possible. This meant limiting the number of screens they had to swap between. There are three operator's screens. The layout for the three screens are very similar. The three screens can be seen in figures 87 through 89 The buttons for performing operations and swapping between screens are in the top left and the time and date can be viewed in the top right. The right-hand side of all three screens is used to display all alarms that the operators need to be aware of. These alarms are PLC signals and will flash red when they become unhealthy. All screens have a shutter state indicator which will turn red when the shutter is open and green when the shutter is closed. The I/O fields for target coating and strip width are in place for the operator to input the data. The I/O field for head position is an output from the PLC to show where on the frame the heads are. The buttons on the bottom right are used for starting and stopping the operation and closing the shutter.

The scan screen shown in figure 87. Has I/O fields showing the actual top, bottom and total coating. Along with this is the scan graph. This graph was created using 100 individual bar graphs. These are linked to an array in the PLC. Each bar corresponds to a position in the array which is linked to a position on the strip. The graph displays deviation from the set point, on a scale of +1 g/m^2 and -1g/m^2. A tolerance can be set for the coating, if the actual coating is inside the set tolerance the bars will be green and if the coating is outside the tolerance the individual bars outside the tolerance will turn red.

The dwell screen shown in figure 89 has I/O fields which show the coating values of the top and bottom from the two edges and the center of the strip. On this screen there are three separate line graphs for the top and bottom, one graph for each of the reading points.

The static screen shown in figure 88 has the addition of a target position, this is inputted by the operator and it the position they wish to measure, inserting a value into this input field will send to the PLC and this is the position heads will move too. There are two line graphs, top and bottom. The graphs show the actual coating reading against time.

The standardize button will put maximum and minimum voltage into the system, this can be used between full calibrations to alter the coating readings if they are drifting. The standby button will move the gauge heads to the park position.

Figure 87 - Operators Scan screen

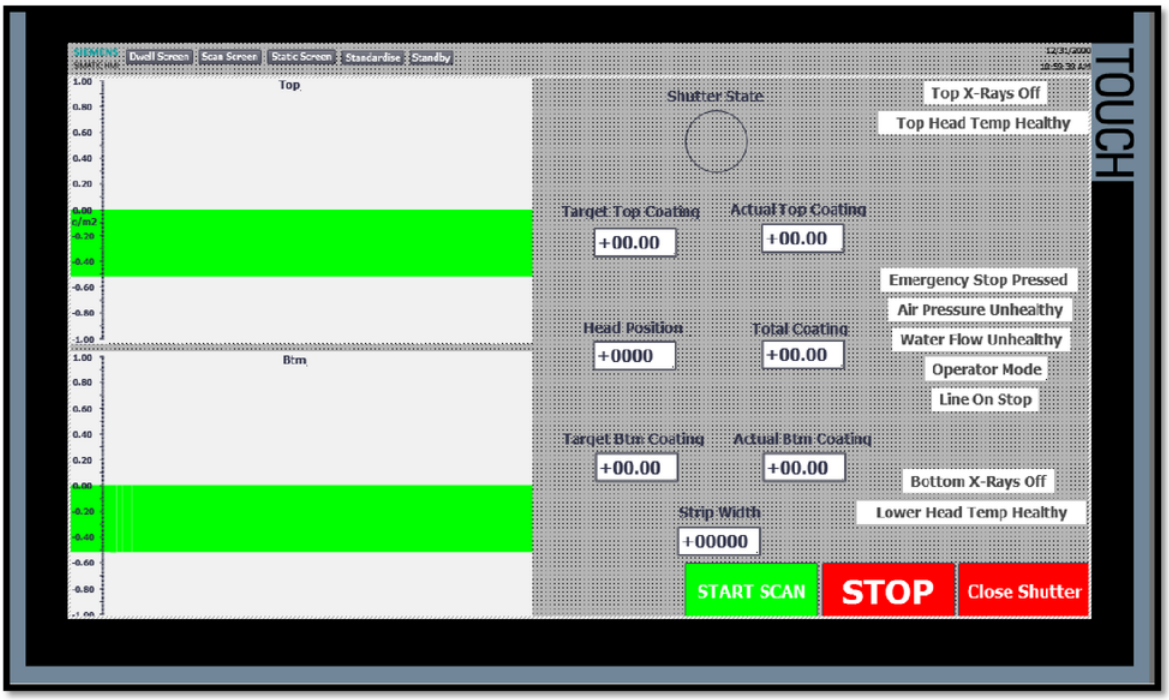


Figure 88 - Operators Static screen

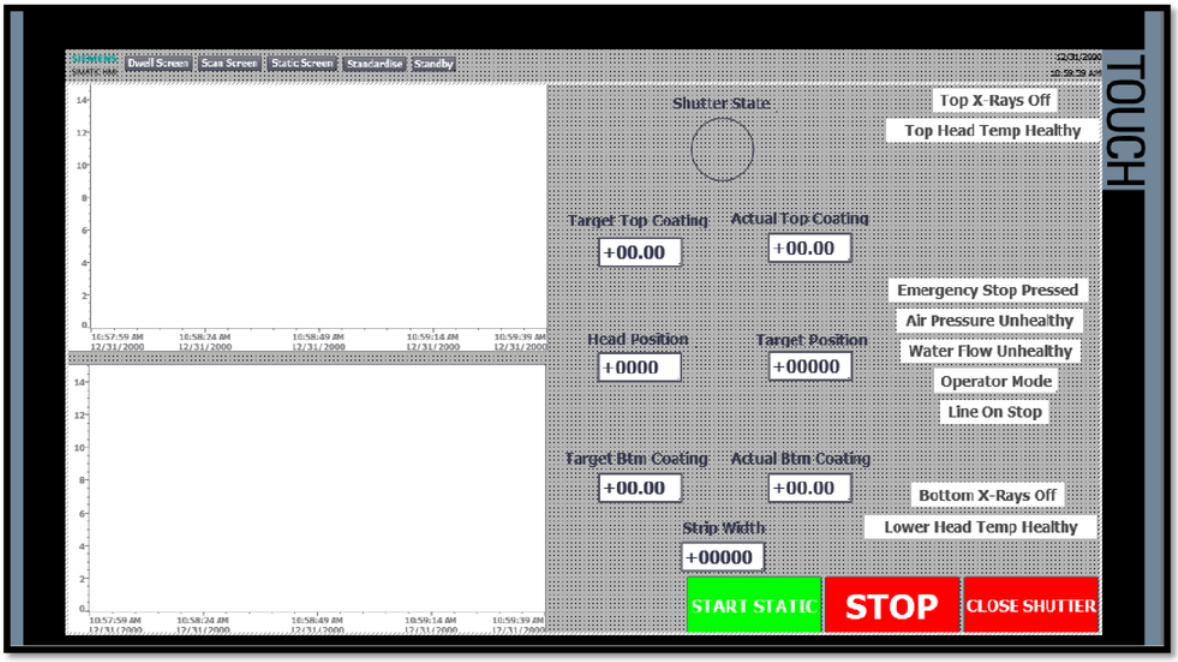
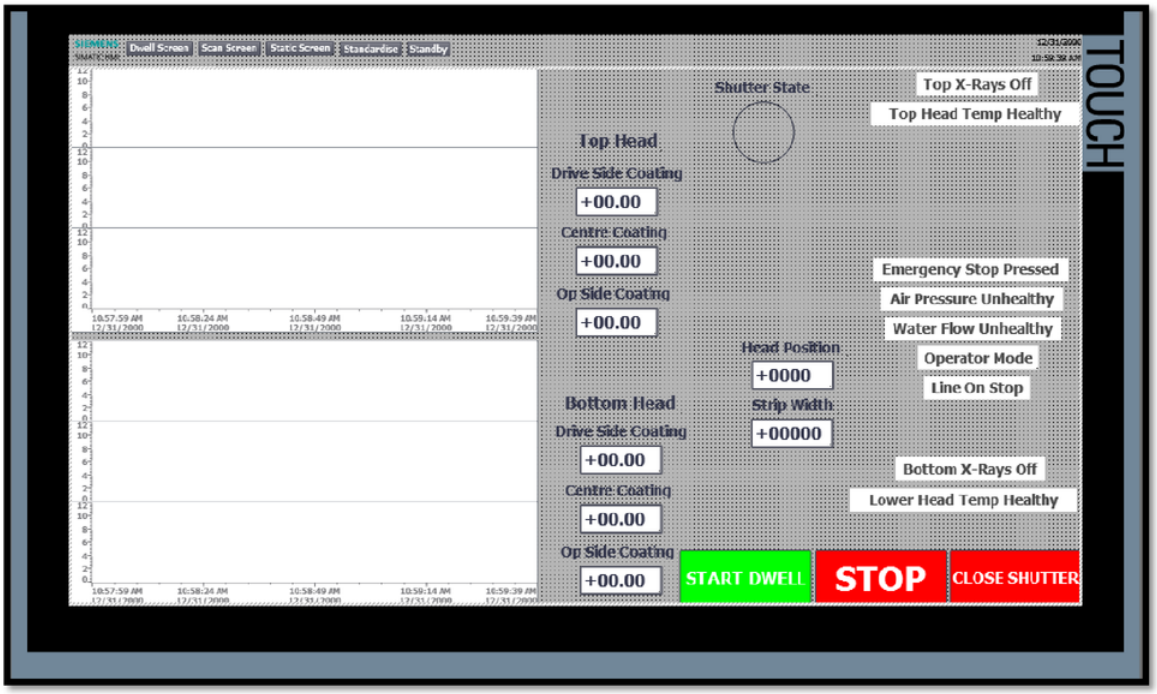


Figure 89 - Operators Dwell screen



7.0 – Project Testing and Evaluation

Tables 1 through 13 show the results from the final tests that were performed on the completed system. The tests demonstrate every aspect of the system being tested. The safety system was tested and passed, every mode of operation was tested and passed and every button on all screens was also tested and passed.

Table 3 - Testing Plan - Power Up

Action	Expected Result	Pass / Fail	Comments
Switch Fused Spur	No visible changes	P	
Switch main isolator	Panel Powers up	P	
	Power on PLC	P	
	Power on drive	P	
	Power on HMI screens	P	Few seconds to start up
	LCR energised	P	
	Power on LED's	P	One of each set
	No movement of heads	P	
Press gate reset	Gate relay energise	P	
Press control reset	Control relay energised	P	
	Main contactor energised	P	

Table 4 - Testing Plan - Safety

Action	Expected Result	Pass / Fail	Comments
Press emergency stop once system is powered up	Gate and control relay de-energise	P	
	Main contactor drops out	P	This can be heard
Press reset gate and control relays whilst emergency stop is pressed	No change	P	
Reset emergency stop and press gate and control reset	System resets	P	
Deactivate gate limit whilst system is healthy	Gate and control relays de-energise	P	
	Main contactor drops out	P	
Press gate and control reset whilst gate limit is deactivated	No change	P	

Press gate limit, press gate and control reset	System resets	P	

Table 5 - Testing Plan - Powering up of Operators screen

Action	Expected Result	Pass / Fail	Comments
Just powered up, no buttons pressed	Scan screen displayed	P	
	Shutter State coloured green	P	This matches the panel LED
	Graph not updating	P	
	Actual readings displayed are from the last run	P	
	Zeros shown in target coatings	P	
	Zero shown in strip width	P	
	Head position correctly displayed	P	
	Some alarms flashing	P	X-rays on flashing

Table 6 - Testing Plan - Powering up Technicians HMI screen

Action	Expected Result	Pass / Fail	Comments
Just powered up, no buttons pressed	Main screen shown.	P	
	Coating readings from last run will be displayed	P	Head positions also shown

Table 7 - Testing Plan - Operators HMI buttons

Action	Expected Result	Pass / Fail	Comments
Press static when on Scan screen	Static screen now displayed	P	
Press scan when on static screen	Scan screen now displayed	P	
Press dwell when on static screen	Dwell screen now displayed	P	
Press static when on dwell page	Static screen now displayed	P	
Press dwell when on scan page	Dwell screen now displayed	P	
Press scan when on dwell page	Scan page now displayed	P	
Press strip width on scan page	Numerical keypad appears on screen	P	
Enter numbers on keypad	Input field updates with numbers	P	
Press strip width on static page	Numerical keypad appears on screen	P	
Enter numbers on keypad	Input field updates with numbers	P	
Press strip width on dwell page	Numerical keypad appears on screen	P	
Enter numbers on keypad	Input field updates with numbers	P	
Press target position on the static screen	Numerical keypad appears on screen	P	
Enter numbers on keypad	Input field updates with numbers	P	
Press top target coating on scan page	Numerical keypad appears on screen	P	
Enter numbers on keypad	Input field updates with numbers	P	
Press bottom target coating on scan page	Numerical keypad appears on screen	P	
Enter numbers on keypad	Input field updates with numbers	P	
Press top target coating on static page	Numerical keypad appears on screen	P	
Enter numbers on keypad	Input field updates with numbers	P	
Press bottom target coating on static page	Numerical keypad appears on screen	P	

Enter numbers on keypad	Input field updates with numbers	P	
Press Standardise on Static page	Standardise sequence begins	P	
Press standby on static page whilst heads are not in home position	Heads move to home position	P	
Press Standardise on dwell page	Standardise sequence begins	P	
Press standby on dwell page whilst heads are not in home position	Heads move to home position	P	

Table 8 - Testing Plan - Technicians Screen Buttons

Action	Expected Result	Pass / Fail	Comments
Using the arrow keys move between buttons on main page	Buttons should have a dotted white line when available to be pressed	P	Up / down / left / right keys function correctly
	Coating weight fields should be populated	P	Showing start values set in PLC
Press standardise on main page	Writing changes to read, standardising	P	
	Standardise sequence starts	P	Zero, Infinity and home
	Once complete write reverts to read standardise	P	
Press settings on main page	Settings page should display	P	
Press arrow keys up and down	Tolerance and gain fields should be selected	P	
Enter numbers on keypad whilst input fields are selected	Numbers should populate screens	P	Checked on PLC and numbers changed to match
Press F1	Return the main page	P	
Press Alarms on main page	Display alarms page	P	Some alarms flashing
Press F1	Return the main page	P	
Press Calibration Values	Display calibration values page	P	
	Calibration values should be populated	P	Start values from PLC
Press F1	Return the main page	P	
Press Calibrate	Display calibration page	P	
Using the arrow keys move between buttons on calibrate page	Buttons should have a dotted white line when available to be pressed	P	
Press F1	Return the main page	P	

Table 9 - Testing Plan - Alarm Pages and Signal box

Action	Expected Result - Both HMI Screens	Pass / Fail - Tech	Pass / Fail - Op	Comments
Toggle, Top x-rays on / off	Colour changes to flash red and grey and displays top x-rays on	P	P	1 on – Red LED 2 on – Red LED 1 off – Red LED 2 off – Green LED
	Colour changes to just white and displays top x-rays off	P	P	
Toggle, Bottom x-rays on / off	Colour changes to flash red and grey and displays bottom x-rays on	P	P	
	Colour changes to just white and displays bottom x-rays off	P	P	
Toggle, Top head temp ok	Colour changes to flash red and grey and displays top head temp unhealthy	P	P	
	Colour changes to just white and displays top head temps healthy	P	P	
Toggle, Top head temp ok	Colour changes to flash red and grey and displays bottom head temp unhealthy	P	P	
	Colour changes to just white and displays bottom head temps healthy	P	P	
Toggle, Air pressure	Colour changes to flash red and grey and displays air pressure unhealthy	P	P	
	Colour changes to just white and displays air pressure healthy	P	P	
Toggle, water flow	Colour changes to flash red and grey and displays water flow unhealthy	P	P	
	Colour changes to just white and displays water flow healthy	P	P	
Toggle, line run	Colour changes to flash red and grey and displays line on stop	P	P	

	Colour changes to just white and displays line running	P	P	
Toggle, control switch	Colour changes to flash red and grey and displays PC&A mode	P	P	
	Colour changes to just white and displays operators mode	P	P	

Table 10 - Testing Plan - Calibrate Sequence

Action	Expected Result - Hardware	Operators screen	Technicians Screen	Pass / Fail Op	Pass / Fail Tech	Comments
Press calibrate on operators HMI screen	Drive offline to home position	Head position field changes to reflect position	Head position field changes to reflect position	P	P	
	Drive online to calibrate position	Head position field changes to reflect position	Head position field changes to reflect position	P	P	
Press Sample 1 inserted	Green LED turns off	Shutter state changes from green to red		P	p	LED changes on panel to match
	Red LED turns on			P	P	
	Wait for 5 seconds			P	P	
	Red LED turns off	Shutter state changes from red to green		P	P	Panel LED matches
	Green LED turns on			P	P	
	Drive offline to home position	Head position field changes to reflect position	Head position field changes to reflect position	P	P	
Press Sample 2 inserted	Drive online to calibrate position	Head position field changes	Head position field changes to	P	P	

		to reflect position	reflect position			
	Green LED turns off	Shutter state changes from green to red		P	P	Panel LED matches
	Red LED turns on			P	P	
	Wait for 5 seconds		Voltage and coating fields change to reflect readings	P	P	
	Red LED turns off	Shutter state changes from red to green		P	P	Panel LED matches
	Green LED turns on			P	P	
	Drive offline to home position	Head position field changes to reflect position	Head position field changes to reflect position	P	P	
Press Sample 3 inserted	Drive online to calibrate position	Head position field changes to reflect position	Head position field changes to reflect position	P	P	
	Green LED turns off	Shutter state changes from green to red		P	P	Panel LED matches
	Red LED turns on			P	P	
	Wait for 5 seconds		Voltage and coating fields change to reflect readings	P	P	
	Red LED turns off	Shutter state changes from red to green		P	P	Panel LED matches
	Green LED turns on			P	P	
	Drive offline to home position			P	P	

Press Sample 4 inserted	Drive online to calibrate position	Head position field changes to reflect position	Head position field changes to reflect position	P	P	
	Green LED turns off	Shutter state changes from green to red		P	P	Panel LED matches
	Red LED turns on			P	P	
	Wait for 5 seconds		Voltage and coating fields change to reflect readings	P	P	
	Red LED turns off	Shutter state changes from red to green		P	P	Panel LED matches
	Green LED turns on			P	P	
	Drive offline to home position	Head position field changes to reflect position	Head position field changes to reflect position	P	P	

Table 11 - Testing Plan - Scan Sequence

Action	Expected Result - Hardware	Operators screen	Pass / Fail	Comments
Press Strip width on HMI screen	No change	Numerical keypad appears on screen	P	
Insert value between 1 and 550	No change	Value updates in I / O field	P	500 entered
Press start scan on HMI screen	Move to park position		P	
	Drive online to strip edge 1	Shutter state changes from green to red	P	Panel LED matches
	No change	Head position output field changes to reflect position	P	
	Drive online to strip edge 2	Graph begins to update as the head moves, bars are all red and at maximum value	P	
	Drive offline to strip edge 1	Graph continues to update	P	
	Drives online and repeats.	Graph continues to update.	P	
Insert tolerance for top and bottom heads on technicians HMI screen	No change	No change	P	
Insert top and bottom head target coatings close to the actual readings	No change	Bars begin to change to green and read the difference in deviation from the target	P	
Alter the voltage on the variable power supply	No change	Bars change to show the deviation, bars that are out of tolerance turn red, if in	P	

		tolerance remain green.		
Drive side ultimate limit struck	Heads stop moving	Shutter state changes from red to green	P	
	Gate and control relays de-energise	Graph stops updating	P	
	Main contactor drops out		P	
Press start scan on HMI screen, whilst system is unhealthy	No change	No change	P	
Press gate and control reset	No change	No change	P	
Move heads away from limit, press start scan on Operators HMI screen	No change	No change	P	
Press gate and control reset	Gate and control relays de-energise	No change	P	
	Main Contactor energises	No Change	P	
Press Start scan	Heads move to park position	Head position output field changes to reflect position	P	
	Starts scan sequence	Shutter state changes from green to red	P	
		Graph starts updating	P	
Press Stop scan on Operators HMI screen	Heads stop moving	Graph stops moving	P	
		Shutter state changes from red to green	P	
Press Start scan on Operators screen	Heads move to park position	Head position output field changes to reflect position	P	

Starts scan sequence	Shutter state changes from green to red	P	

Table 12 - Testing Plan - Static Sequence

Action	Expected Result – Hardware	Operators screen	Pass / Fail	Comments
Press Strip width on HMI screen	No change	Numerical keypad appears on screen	P	
Insert value between 1 and 550	No change	Value updates in I / O field	P	500 entered
Press target position in HMI screen	No change	Numerical keypad appears on screen	P	200 entered
Insert value between 1 and the strip width	No change	Value updates in I / O field	P	
Press start static on HMI screen	Move to park position	Head position output field changes to reflect position	P	
	Drive online to static position	Head position output field changes to reflect position	P	
	Stop in static position	Shutter state changes from green to red	P	
		Coating value fields will update	P	
		Graphs will update	P	
Insert tolerance for top and bottom heads on technicians HMI screen	No change	Tolerance lines on graphs will move	P	
Alter the voltage on the variable power supply	No change	Line on graph will alter to display the new coating reading	P	
Ultimate limit struck	Heads stop moving	Shutter state changes from red to green	P	
	Gate and control relays de-energise	Graph stops updating	P	
	Main Contactor drops out		P	
Press start static on HMI screen, whilst	No change	No change	P	

system is unhealthy				
Press gate and control reset	No change	No change	P	
Move heads away from limit, press start static on Operators HMI screen	No change	No change	P	
Press gate and control reset	Gate and control relays de-energise	No change	P	
	Main Contactor energises	No Change	P	
Press Start static	Heads move to park position	Head position output field changes to reflect position	P	
	Starts scan sequence	Shutter state changes from green to red	P	
		Graph starts updating	P	
Press Stop scan on Operators HMI screen	Heads stop moving	Graph stops moving	P	
		Shutter state changes from red to green	P	
Press Start static on Operators screen	Heads move to park position	Head position output field changes to reflect position	P	
	Starts scan sequence	Shutter state changes from green to red	P	

Table 13 - Testing Plan - Dwell Sequence

Action	Expected Result - Hardware	Operators screen	Pass / Fail	Comments
Press Strip width on HMI screen	No change	Numerical keypad appears on screen	P	
Insert value between 1 and 550	No change	Value updates in I / O field	P	500 entered
Press start dwell on HMI screen	Move to park position	Head position output field changes to reflect position	P	

Move online to strip edge 1	Head position output field changes to reflect position	P	
Stop at strip edge 1	Shutter state changes from green to red	P	Moved to 850mm
	Drive side coating fields will update	P	
	Drive side coating graphs will update	P	
Move online to center	Shutter state changes from red to green	P	Panel LED matches
	Head position output field changes to reflect position	P	Moved to 1100mm
Stop at center	Shutter state changes from green to red	P	
	Centre coating fields will update	P	
	Centre coating graphs will update	P	
Move online to strip edge 2	Shutter state changes from red to green	P	
	Head position output field changes to reflect position	P	Panel LED matches
Stop at strip edge 2	Shutter state changes from green to red	P	Moved to 1350mm
	Op side coating fields will update	P	
	Op side coating graphs will update	P	
Move offline to center	Shutter state changes from red to green	P	
	Head position output field changes to reflect position	P	

	Stop at center	Shutter state changes from green to red	P	
		Centre coating fields will update	P	
	Move offline to strip edge 1	Shutter state changes from red to green	P	
		Head position output field changes to reflect position	P	
	Stop at strip edge 2	Shutter state changes from green to red	P	
		Drive side coating fields will update	P	
		Drive side coating graphs will update	P	
Alter the voltage on the variable power supply	No change	Relevant output fields will update	P	
		Relevant graphs will update	P	
Drive side ultimate limit struck	Heads stop moving	Shutter state changes from red to green	P	
	Gate and control relays de-energise	Graph stops updating	P	
	Main Contactor drops out		P	
Press start dwell on HMI screen, whilst system is unhealthy	No change	No change	P	
Press gate and control reset	No change	No change	P	
Move heads away from limit, press start dwell on Operators HMI screen	No change	No change	P	
Press gate and control reset	Gate and control relays de-energise	No change	P	
	Main Contactor energises	No Change	P	

Press Start dwell	Move to park position	Head position output field changes to reflect position	P	
	Start dwell sequence	Graphs and I/O update	P	
Press Stop dwell on Operators HMI screen	Heads stop moving	Graphs and I/O stop updating	P	
Press Start dwell on Operators screen	Move to park position	Head position output field changes to reflect position	P	
	Start dwell sequence	Graphs and I/O update	P	

Table 14 - Testing Plan - Standby

Action	Expected Result – Hardware	Operators screen	Pass / Fail	Comments
Press standby on HMI screen	Move to park position	Shutter state should be green	P	

Table 15 - Testing Plan - Standardize

Action	Expected Result – Hardware	Operators screen	Technicians screen	Pass / Fail	Comments
Press Standardize (Change control switch position for each)	Move to park position	Head position output field changes to reflect position	Writing on screen displays standardizing	P	
	Move to Zero position	Head position output field changes to reflect position		P	
	Stop at Zero position	Shutter state changes from green to red	Shutter state changes from green to red	P	
	Move to infinity position	Shutter state changes from red to green	Shutter state changes from red to green	P	
		Head position output field changes to reflect position		P	
	Stop at Infinity position	Shutter state changes from green to red	Shutter state changes from green to red	P	
	Move back to park position	Shutter state changes	Shutter state changes	P	

	from red to green	from red to green		
	Head position output field changes to reflect position	Writing on screen displays standardise	P	

Table 16 - Testing Plan - Voltage to coating results

Voltage	Expected result	Actual Result	Error
8	0	-0.49	-0.49
7.2	1.37	1.41	+0.04
6.4	3.21	3.65	+0.44
4.4	8.49	8.85	+0.36
3.8	11.1	10.5	-0.6
0	20	20.09	+0.09

7.1 - Evaluation

Table 14 shows the results that were obtained from the HMI screens indicating the calculated coating value. There are slight errors in the readings, however this is most likely since the zero and infinity voltage reading were "ideal" values and the four sample readings were actual values, this could potentially cause the line of best fit to be slightly out. On a typical coating gauge at Trostre the zero and infinity readings would never be exactly 8 and 0, therefore once the system is receiving real data it is expected that the voltage readings will be slightly different, and the coating readings will be more accurate.
It is also possible to alter the gain of the system and potentially add an offset. These are variants that the existing coating gauges already have and are used. These values alter the final value of the coating if it is seen as too high or too low.

To address the specification the following can be said;

- *The system must accurately measure the weight of the strip, this means taking the raw voltage data value from the x-ray heads (0-8V), manipulating the data and displaying the correct result on the HMI screen (0-20g/m^2)* – This has been mostly achieved with only slight variations as addressed above, this will be an area to work on when the system is installed on the line with no major changes or issues predicted.
- *Must be able to close the shutter with the push of just one button* – This has been achieved by placing a "close shutter" button on all technician and operators HMI screens, these buttons have been tested and work as expected.
- *Can process both analogue and digital I/O* – This has been achieved as the PLC I/O cards can process all types of I/O

- *There must be clear, visible and accurate 'state' indicator lights and signs* – This has been achieved by placing LED's on the front of the control panel, along with visual display of the state of both the shutter and the x-rays on each page of the operators HMI
- *The system must have suitable safety guard interlocks and systems in place* – For the prototype it was decided that full safety guarding was not required, however, a gate interlock was connected to the system to demonstrate the function was available for the full system, furthermore, the system is inhibited should the gate system not be healthy, the emergency stop be pressed, the control switch is in the wrong position, if either of the ultimate edge limits are made and if the x-rays are deemed as being unhealthy.
- *Move the heads to the exact position instructed by the HMI* – This has been proven by testing.
- *Measure the strip at the correct point and for the correct amount of time* – This has been proven by testing
- *Act in the desired way depending on the mode selected by the HMI screen* – Proven in testing section
- *The system should provide 100 points of measurement across the strip in scan operation* - This has been met, however it is not as smooth as it will be on the full system, this is due to the prototype being a quarter of the size of the full system. Therefore, on the prototype to measure at 100 points across the width of the strip the system must produce a reading for every 10 mm on the full system to produce 100 reading it only requires taking readings every 40mm.

7.2 - Display Screen

- *Display the weight of the tin coating for the top and bottom head separately* – This was achieved by using separate output fields on the HMI screens.
- *Display the profile of the strip along with a real-time display of where the heads are* – This was achieved by using line and bar graphs along with an output fields which displays the head position. The position of head is known by using a laser distance sensor.
- *Allow calibrations of the system to be done with ease* – There is clear access to the calibrations page from the main technicians screen, calibration is then completed by using the clearly labelled buttons on the HMI screen

- *Allow all modes of operation to be selected with ease* – All modes can be accessed from all pages using the clearly marked buttons on the top of the pages.
- *Display system parameters and allow these to be edited only by the PC&A technicians* – This was achieved by only have data that was completely necessary on the operators HMI's, all other data and parameters can be accessed on the technicians HMI which is in a locked room.
- *Display accurate alarms without delay* – All operators screens have the alarms displayed on the right-hand side of the page, meaning any and all alarms will be immediately noticeable.

7.3 - Overall System

It is desirable that the system has in-house support and will be long lasting. Spare parts must be readily available, and training easily provide – This last point has been achieved by;

- Using PLC's, the programming for which is widely understood on plant
- Using Siemens S7 as this is being standardised on plant therefore there are universal spares in the works stores
- All development was completed in-house, this means training documents can be generated and training can be given to Tata employees in-house, eliminating the cost of external companies being paid for training

7.4 - Timing and Budget

Table 17 shows the components and devices that were ordered from external companies to build the prototype. The total cost of these items was £10,012.62.

Table 17 - Ordered parts

	Item	Supplier	Part Number	Price
PLC CPU	CPU 1516-3 PN/DP	Parmley Graham	6ES75163AN010AB0	£ 3,346.00
PLC Power module	SIMATIC PM 1507 24V/8A	Parmley Graham	6EP13334BA00	£ 159.00
Digital Input card	DI 32 x 24V DC HF	Parmley Graham	6ES75211BL000AB0	£ 286.00
Digital Output card	DI 32 x 24V DC HF	Parmley Graham	6ES75221BL010AB0	£ 407.00
Analogue Input card	AI 8 x U/I/RTD/TC ST	Parmley Graham	6ES75317KF000AB0	£ 551.00
Analogue Output Card	AQ 4 x U/I ST	Parmley Graham	6ES75325HD000AB0	£ 468.00
Technicians HMI Screen	KP400 Basic PN - 4.3" Colour + 8 keys	Parmley Graham	6AV66470AJ113AX0	£ 381.00
Operators HMI Screen	TP2200 Comfort - 22" Colour Touch	Parmley Graham	6AV21240XC020AX1	£ 4,126.00
LC Relay	Omron SPDT Non-Latching Relay PCB Mount, 24V dc Coil, 10 A	RS Components	G2R-1-SN 24DC(S)	£ 6.61
Relay Socket	Relay Socket for use with G2R-2-S Relays 250V ac	RS Components	353-966	£ 5.93
AAB Drive	ACS 150 Inverter Drive0.75kW	RS Components	621-1206	£ 131.00
Plunger limit	IP66, IP67 Snap Action Limit Switch, Lever, Plastic, NO/NC, 240V	RS Components	447-3395	£ 46.88
Pullies	Steel Timing Belt Pulley, 20mm Belt Width x 8mm Pitch, 24 Tooth, Maximum Bore Dia. 30mm	RS components	183-928	£ 98.21

Below are a list of components which were stores stock items;

- Push Buttons
- Emergency stop
- Green LED's
- Red LED's
- Ethernet Cables
- Trunking

- Eaton Isolator
- Transformer
- Overload
- Contactor
- Relays
- Fuses
- Blue, Red and Black crimps
- 1mm Blue Cable
- 1mm Red Cable
- 1mm Earth Cable
- 2.5mm Earth Cable
- Unistrut
- Sliding Rail
- Rail Brackets
- Unistrut L brackets
- Zebedee's
- Motor
- Panel
- Unistrut feet
- Panel
- Metal Plates
- Steel Wire Armor Cable
- Wall Bolts
- 12mm Nuts, bolts and Washers
- Stuffing Glands
- Motor Stand
- Unistrut Capping
- Switches

The estimated cost of the above items is around £3000. This brings the total cost of building the prototype to £13,012. This is within the allocated budget of £20,000.
Appendix 10.1 shows the Gantt chart of the project. The blue shows the expected running time of the project and the green shows the actual running time. There were delays in the

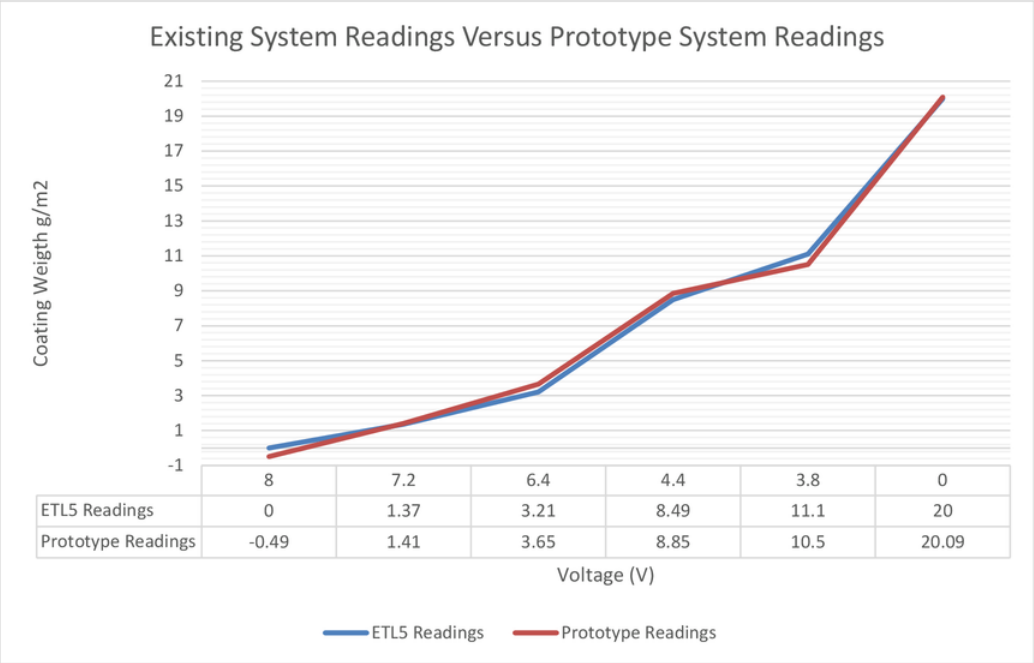
process of completing the project. Delay 1, shown on the chart was due to unforeseen issue on plant and the contractor assigned to build the panel being put on the issue. This delayed the work being completed. This delay caused a knock-on effect and delayed starting the testing. The testing took longer than expected due to a faulty drive and discovering a more suitable way of programing the sequences of the program. Delays 3 and 4 were knock-on effects from the previous delays. The final delay was a delay in proving the system to my supervisors. This was due to a change in working pattern. Due to the contingency weeks that had been left in the planning of the project the system was still completed by the end of March as expected.

8.0 – Conclusions, Recommendations and Reflection

8.1 – Conclusion

The conclusion of this project is that the prototype developed can perform the process currently undertaken by the existing x-ray coating gauges. The PLC is capable of processing all required inputs and outputs and performing the calculations required. By using the programming language GRAPH the sequences of the system are easily understood and followed. The technician's HMI screen can perform standardizations and full calibrations, the screens also offer pages to alter settings and view alarms aiding in fault finding. The operator's screens are user friendly and clearly display all information required by the operators.

All specifications set out have been met by the prototype, except for the coating reading conversions. These readings are very close to what was expected, as seen in figure 90. The errors have been put down to the fact that actual values have not been used for the zero and infinity. Once installed on the line and the system is being fed actual readings from the x-ray generator units, it is expected that the error in these readings will be reduced.



	8	7.2	6.4	4.4	3.8	0
ETL5 Readings	0	1.37	3.21	8.49	11.1	20
Prototype Readings	-0.49	1.41	3.65	8.85	10.5	20.09

Figure 90 - Existing system Versus Prototype Readings

The main aims set out have also been met as, the system has been developed completely in-house with no external support required, meaning any future installation, developments and maintenance can also be undertaken in-house as requested. Furthermore, the technology has long term support as the devices are standard and the spares are readily available on-site.

8.2 – Recommendations

There are, however, a few recommendations have come in hindsight of the project;

1. The Siemens 1500 has three Ethernet ports, two of these are on the same subnet and the third is on a different subnet, which means it is not possible to program the system with all three are on the same subnet. This means that the Ethernet cable needed to be connected directly into the device that needed downloading to. Therefore, it would be advantageous to use a SCALANCE switch to enable programming from the PC to the HMI via the PLC. If this switch were to be used it would be possible to connect all devices into this and then talk to them all when needed without swapping any cables. This would make monitoring and changing the program and HMI screens on the line easier and more practical.

2. The pushbuttons that were used on the prototype panel were used do not comply with the EN 60204 standards but were available in the onsite stores. When the system gets installed on the line the colours will be changed, the colours of the HMI buttons will also be reassessed. In accordance with standard IEC 60204-1: 1997, 'Safety of Machinery', section 10 paragraph 10.2.1 and table 2 Page 50, the following colors would be used;

    - Start / On – White, grey or black (Preferably white)
    - Stop / Off – Black, grey or white (Preferably black)
    - Jog buttons – White, grey or Black
    - Reset push buttons – Blue, white, grey or black
    - Emergency stop buttons – Red

    (International Electrotechnical Commission, 1997)

3. In the alarms section of both screens it would be desirable to add a visual indication that the ultimate limit switches have been made. This would give instant confirmation of what has happened with the system without needing to go to the line first.

4. It would be desirable to add screens to the technicians HMI, for the use of maintenance. The screens would display the steps for the various sequences used in the system. It would be possible to view which step the system was in, and any problems inhibiting the system from running. Another consideration for these screens would be to add the ability to manually step through the sequences, this would however need to be investigated thoroughly to ensure it complied with safety regulations.

8.3 – Reflection

There were a few issues during the course of the project which, had they been handled differently would have made the project run smoother.

- Faulty Siemens drive: when the drive did not work I assumed it was an error on my part and I persisted in trying to solve the issue. Had I asked for help earlier, I would have discovered that the drive was faulty sooner and I would have been able to move ahead with buying a new drive and completing the project earlier.
- Building the O frame: the O frame should have been built by mechanically biased employees, who have the experience and tools to undertake the job.
- Fully investigating devices: The GRAPH language offered by the Siemens S7 1500 was discovered part way through the project, discovering this earlier would have limited the time spent programming and fault finding
- Ensuring all parts are ordered: I focused too much on the large devices required and neglected the smaller items required such as ferrules and crimps. This resulted in more time being used waiting for orders to be approved and deliveries to arrive.

9.0 – Citation List

ABB, 2010. *User's Manual ACS150 Drives.* s.l.:ABB.
Campbell, G., 2011. *The complete idiots guide to project management.* Fifth ed. New York: Alpha Books.

Deborah Rumsey, P., 2010. *Statistic Essentials for Dummies.* 1st ed. Indiana: Wiley Publishing, Inc.

Department for Environmental, F. a. R. A., 2006. *Guidance on Best Available Treatment Recovery and Recycling Techniques (BATRRT) and treatment of Waste Electrical and Electronic Equipment (WEEE),* London: Department for Environmental, Food and Rural Affairs.

Department for Environmental, F. a. R. A., 2014. *Waste Legislation and Regulations.* [Online] Available at: https://www.gov.uk/guidance/waste-legislation-and-regulation [Accessed 24 August 2017].

DMC, 1984. *Coating Gauge Weight Gauge Manual for British Steel.* s.l.:DMC.
England, P. H., 2017. *Laser radiation: safety advice.* [Online] Available at: https://www.gov.uk/government/publications/laser-radiation-safety-advice/laser-radiation-safety-advice
[Accessed 23 April 2018].

Industruino, 2017. *About Industruino.* [Online] Available at: https://industruino.com/page/home [Accessed 3 August 2017].

International Electrotechnical Commission, 1997. *IEC 60204-1: 1997, Safety of Machinery,* s.l.: International Electrotechnical Commission.
Kring, J. T. a. J., 2006. *LabVIEW for everyone: Graphical Programming Made Easy and Fun.* 3rd ed. s.l.:Prentice Hall.

Parmley Graham, 2017. *HMI.* [Online] Available at: https://www.parmley-graham.co.uk/automation/siemens/hmi [Accessed 4 August 2017].

Raspberry Pi Foundation, 2017. *Buy a Raspberry Pi.* [Online] Available at: https://www.raspberrypi.org/products/compute-module-io-board-v3/ [Accessed 3 June 2016].

Sayer, P., 2017. Raspberry Pi's new computer for industrial applications goes on sale. *PC World from IDG*, 16 January.

Seshagiri, F. O. a. A., 2014. Creativity Unleashed, With the Help of a Little Pi. *The New York Times*, 25 June.
Siemens, 2017. *Operator Device.* [Online] Available at: http://w3.siemens.com/mcms/human-machine-interface/en/operator-devices/Pages/Default.aspx
[Accessed 4 August 2017].

10.0 – Appendix

10.1 – Gantt chart

10.2 – Datasheets

10.3 – Risk Assessment

10.4 – Circuit Diagram

10.5 – Thermal Imaging Pictures

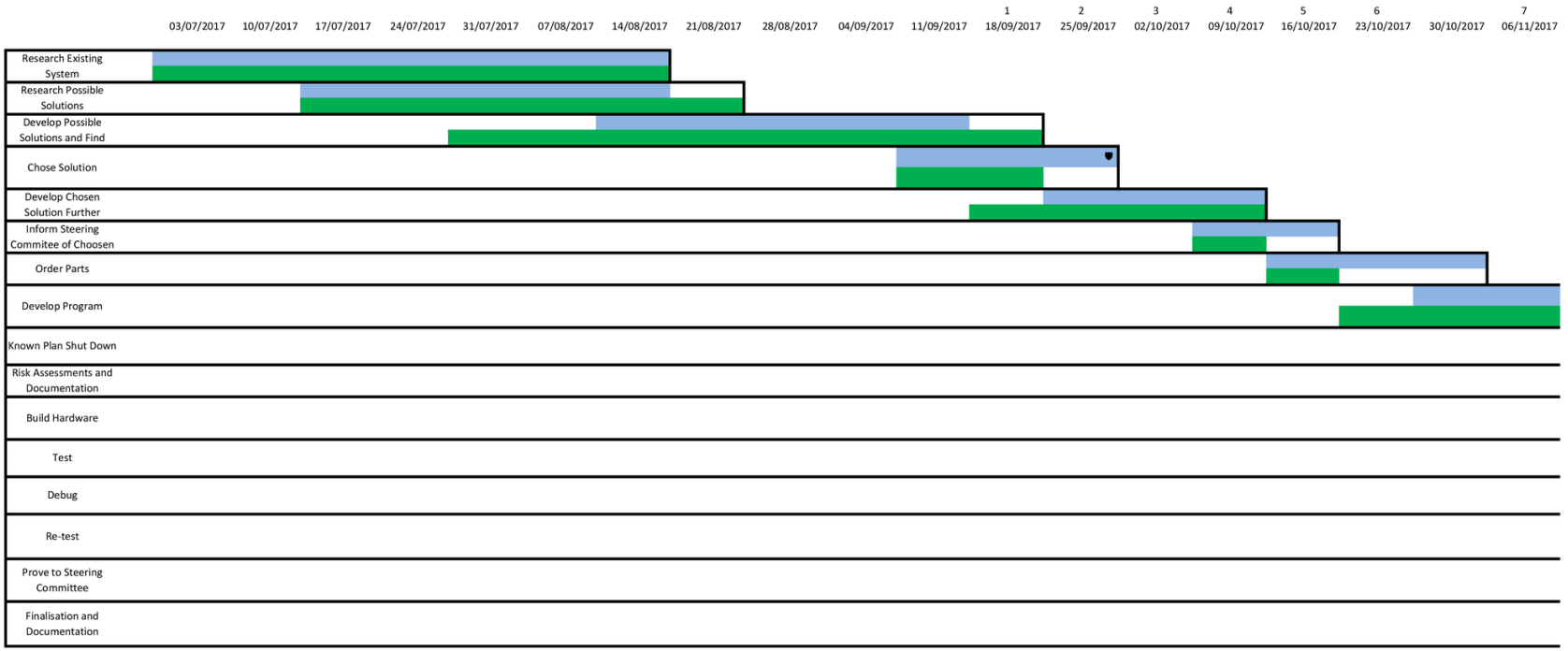
10.6 – EN60204 Checklist

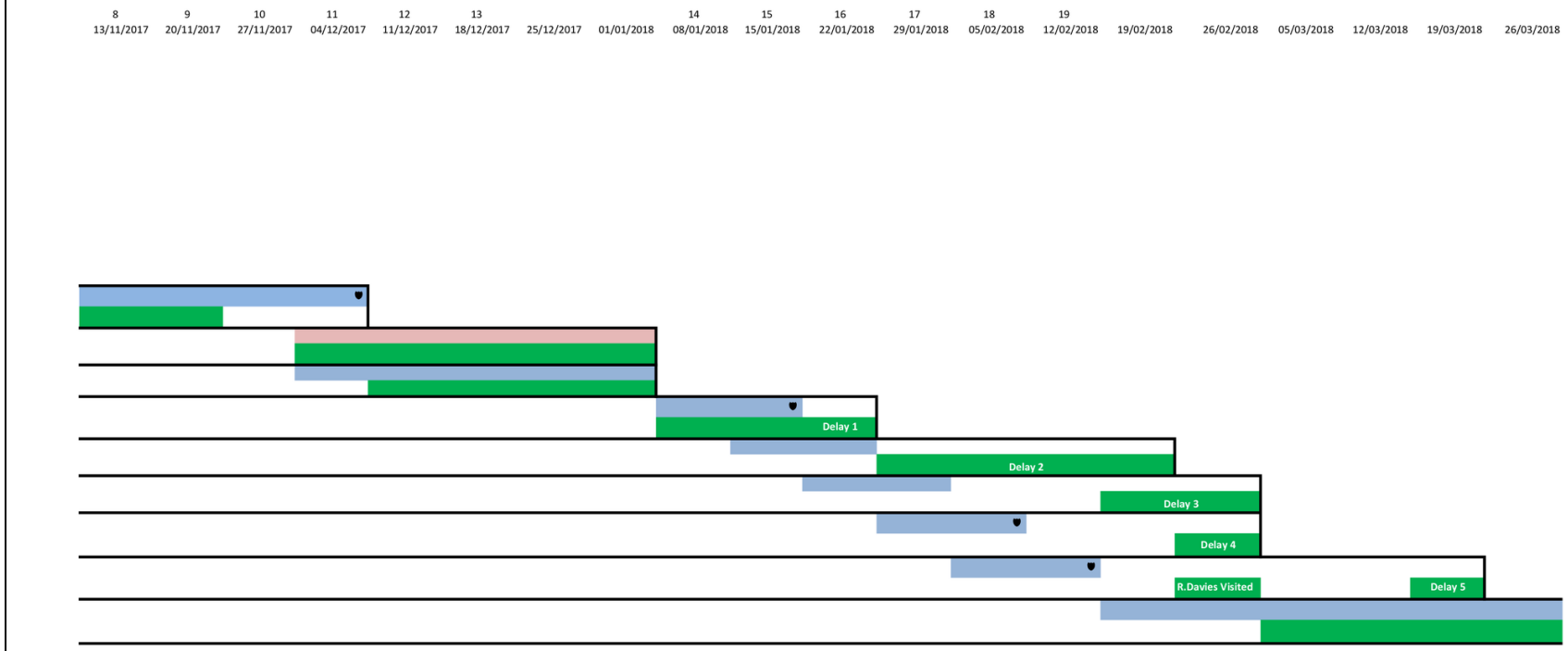
10.7 – EHSR Checklist

10.8 – Full PLC program & Prototype Demonstration Videos (Attached Disk)

Coating Gauge Project
Gantt Chart

Key
Planned Work
Actual Work
Mile Stone




8
13/11/2017
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20/11/2017
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12/02/2018
19/02/2018
26/02/2018
05/03/2018
12/03/2018
19/03/2018
26/03/2018
Delay 1
Delay 2
Delay 3
Delay 4
R.Davies Visited
Delay 5


02/04/2018
09/04/2018
16/04/2018
23/04/2018

SIEMENS

Data sheet 6ES7531-7KF00-0AB0



SIMATIC S7-1500, Analog input module AI 8xU/I/RTD/TC ST, 16 bit resolution, Accuracy 0.3%, 8 channels in groups of 8, 4 channels for RTD measurement, "Common mode voltage 10 V; diagnostics; Hardware interrupts incl. infeed element, Shield bracket and shield terminal

General information	
Product type designation	AI 8xU/I/RTD/TC ST
HW functional status	FS01
Firmware version	V2.0.0
• FW update possible	Yes
Product function	
• I&M data	Yes; I&M0 to I&M3
• Measuring range scalable	No
• Scalable measured values	No
• Adjustment of measuring range	No
Engineering with	
• STEP 7 TIA Portal configurable/integrated as of version	V12 / V12
• STEP 7 configurable/integrated as of version	V5.5 SP3 / -
• PROFIBUS as of GSD version/GSD revision	V1.0 / V5.1
• PROFINET as of GSD version/GSD revision	V2.3 / -
Operating mode	
• Oversampling	No
• MSI	Yes

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CiR – Configuration in RUN	
Reparameterization possible in RUN	Yes
Calibration possible in RUN	Yes
Supply voltage	
Rated value (DC)	24 V
permissible range, lower limit (DC)	20.4 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Input current	
Current consumption, max.	240 mA; with 24 V DC supply
Encoder supply	
24 V encoder supply	
• Short-circuit protection	Yes
• Output current, max.	20 mA; Max. 47 mA per channel for a duration < 10 s
Power	
Power available from the backplane bus	0.7 W
Power loss	
Power loss, typ.	2.7 W
Analog inputs	
Number of analog inputs	8
• For current measurement	8
• For voltage measurement	8
• For resistance/resistance thermometer measurement	4
• For thermocouple measurement	8
permissible input voltage for voltage input (destruction limit), max.	28.8 V
permissible input current for current input (destruction limit), max.	40 mA
Technical unit for temperature measurement adjustable	Yes; °C/°F/K
Input ranges (rated values), voltages	
• 0 to +5 V	No
• 0 to +10 V	No
• 1 V to 5 V	Yes
• Input resistance (1 V to 5 V)	100 kΩ
• -1 V to +1 V	Yes
• Input resistance (-1 V to +1 V)	10 MΩ
• -10 V to +10 V	Yes
• Input resistance (-10 V to +10 V)	100 kΩ

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• -2.5 V to +2.5 V	Yes
• Input resistance (-2.5 V to +2.5 V)	10 MΩ
• -25 mV to +25 mV	No
• -250 mV to +250 mV	Yes
• Input resistance (-250 mV to +250 mV)	10 MΩ
• -5 V to +5 V	Yes
• Input resistance (-5 V to +5 V)	100 kΩ
• -50 mV to +50 mV	Yes
• Input resistance (-50 mV to +50 mV)	10 MΩ
• -500 mV to +500 mV	Yes
• Input resistance (-500 mV to +500 mV)	10 MΩ
• -80 mV to +80 mV	Yes
• Input resistance (-80 mV to +80 mV)	10 MΩ
Input ranges (rated values), currents	
• 0 to 20 mA	Yes
• Input resistance (0 to 20 mA)	25 Ω; Plus approx. 42 ohms for overvoltage protection by PTC
• -20 mA to +20 mA	Yes
• Input resistance (-20 mA to +20 mA)	25 Ω; Plus approx. 42 ohms for overvoltage protection by PTC
• 4 mA to 20 mA	Yes
• Input resistance (4 mA to 20 mA)	25 Ω; Plus approx. 42 ohms for overvoltage protection by PTC
Input ranges (rated values), thermocouples	
• Type B	Yes
• Input resistance (Type B)	10 MΩ
• Type C	No
• Type E	Yes
• Input resistance (Type E)	10 MΩ
• Type J	Yes
• Input resistance (type J)	10 MΩ
• Type K	Yes
• Input resistance (Type K)	10 MΩ
• Type L	No
• Type N	Yes
• Input resistance (Type N)	10 MΩ
• Type R	Yes
• Input resistance (Type R)	10 MΩ
• Type S	Yes
• Input resistance (Type S)	10 MΩ
• Type T	Yes
• Input resistance (Type T)	10 MΩ
• Type TXK/TXK(L) to GOST	No
Input ranges (rated values), resistance thermometer	

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• Cu 10	No
• Cu 10 according to GOST	No
• Cu 50	No
• Cu 50 according to GOST	No
• Cu 100	No
• Cu 100 according to GOST	No
• Ni 10	No
• Ni 10 according to GOST	No
• Ni 100	Yes; Standard/climate
• Input resistance (Ni 100)	10 MΩ
• Ni 100 according to GOST	No
• Ni 1000	Yes; Standard/climate
• Input resistance (Ni 1000)	10 MΩ
• Ni 1000 according to GOST	No
• LG-Ni 1000	Yes; Standard/climate
• Input resistance (LG-Ni 1000)	10 MΩ
• Ni 120	No
• Ni 120 according to GOST	No
• Ni 200 according to GOST	No
• Ni 500	No
• Ni 500 according to GOST	No
• Pt 10	No
• Pt 10 according to GOST	No
• Pt 50	No
• Pt 50 according to GOST	No
• Pt 100	Yes; Standard/climate
• Input resistance (Pt 100)	10 MΩ
• Pt 100 according to GOST	No
• Pt 1000	Yes; Standard/climate
• Input resistance (Pt 1000)	10 MΩ
• Pt 1000 according to GOST	No
• Pt 200	Yes; Standard/climate
• Input resistance (Pt 200)	10 MΩ
• Pt 200 according to GOST	No
• Pt 500	Yes; Standard/climate
• Input resistance (Pt 500)	10 MΩ
• Pt 500 according to GOST	No
Input ranges (rated values), resistors	
• 0 to 150 ohms	Yes
• Input resistance (0 to 150 ohms)	10 MΩ
• 0 to 300 ohms	Yes

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• Input resistance (0 to 300 ohms)	10 MΩ
• 0 to 600 ohms	Yes
• Input resistance (0 to 600 ohms)	10 MΩ
• 0 to 3000 ohms	No
• 0 to 6000 ohms	Yes
• Input resistance (0 to 6000 ohms)	10 MΩ
• PTC	Yes
• Input resistance (PTC)	10 MΩ
Thermocouple (TC)	
Temperature compensation	
— parameterizable	Yes
— internal temperature compensation	Yes
— external temperature compensation via RTD	Yes
— Compensation for 0 °C reference point temperature	Yes; fixed value can be set
— Reference channel of the module	Yes
Cable length	
• shielded, max.	800 m; for U/I, 200 m for R/RTD, 50 m for TC
Analog value generation for the inputs	
Integration and conversion time/resolution per channel	
• Resolution with overrange (bit including sign), max.	16 bit
• Integration time, parameterizable	Yes
• Integration time (ms)	2,5 / 16,67 / 20 / 100 ms
• Basic conversion time, including integration time (ms)	9 / 23 / 27 / 107 ms
— additional conversion time for wire-break monitoring	9 ms (to be considered in R/RTD/TC measurement)
— additional conversion time for resistance measurement	150 ohm, 300 ohm, 600 ohm, Pt100, Pt200, Ni100: 2 ms, 6000 ohm, Pt500, Pt1000, Ni1000, LG-Ni1000, PTC: 4 ms
• Interference voltage suppression for interference frequency f1 in Hz	400 / 60 / 50 / 10 Hz
• Time for offset calibration (per module)	Basic conversion time of the slowest channel
Smoothing of measured values	
• parameterizable	Yes
• Step: None	Yes
• Step: low	Yes
• Step: Medium	Yes
• Step: High	Yes
Encoder	
Connection of signal encoders	

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• for voltage measurement	Yes
• for current measurement as 2-wire transducer	Yes
— Burden of 2-wire transmitter, max.	820 Ω
• for current measurement as 4-wire transducer	Yes
• for resistance measurement with two-wire connection	Yes; Only for PTC
• for resistance measurement with three-wire connection	Yes; All measuring ranges except PTC; internal compensation of the cable resistances
• for resistance measurement with four-wire connection	Yes; All measuring ranges except PTC

Errors/accuracies	
Linearity error (relative to input range), (+/-)	0.02 %
Temperature error (relative to input range), (+/-)	0.005 %/K; With TC type T 0.02 ± % / K
Crosstalk between the inputs, max.	-80 dB
Repeat accuracy in steady state at 25 °C (relative to input range), (+/-)	0.02 %
Temperature error of internal compensation	±6 °C
Operational error limit in overall temperature range	
• Voltage, relative to input range, (+/-)	0.3 %
• Current, relative to input range, (+/-)	0.3 %
• Resistance, relative to input range, (+/-)	0.3 %
• Resistance thermometer, relative to input range, (+/-)	Ptxxx standard: ±1.5 K, Ptxxx climate: ±0.5 K, Nixxx standard: ±0.5 K, Nixxx climate: ±0.3 K
• Thermocouple, relative to input range, (+/-)	Type B: > 600 °C ±4.6 K, type E: > -200 °C ±1.5 K, type J: > -210 °C ±1.9 K, type K: > -200 °C ±2.4 K, type N: > -200 °C ±2.9 K, type R: > 0 °C ±4.7 K, type S: > 0 °C ±4.6 K, type T: > -200 °C ±2.4 K
Basic error limit (operational limit at 25 °C)	
• Voltage, relative to input range, (+/-)	0.1 %
• Current, relative to input range, (+/-)	0.1 %
• Resistance, relative to input range, (+/-)	0.1 %
• Resistance thermometer, relative to input range, (+/-)	Ptxxx standard: ±0.7 K, Ptxxx climate: ±0.2 K, Nixxx standard: ±0.3 K, Nixxx climate: ±0.15 K
• Thermocouple, relative to input range, (+/-)	Type B: > 600 °C ±1.7 K, type E: > -200 °C ±0.7 K, type J: > -210 °C ±0.8 K, type K: > -200 °C ±1.2 K, type N: > -200 °C ±1.2 K, type R: > 0 °C ±1.9 K, type S: > 0 °C ±1.9 K, type T: > -200 °C ±0.8 K
Interference voltage suppression for f = n x (f1 +/- 1 %), f1 = interference frequency	
• Series mode interference (peak value of interference < rated value of input range), min.	40 dB
• Common mode voltage, max.	10 V
• Common mode interference, min.	60 dB

Isochronous mode

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Isochronous operation (application synchronized up to terminal)	No
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Alarms	
• Diagnostic alarm	Yes
• Limit value alarm	Yes; two upper and two lower limit values in each case
Diagnostic messages	
• Monitoring the supply voltage	Yes
• Wire-break	Yes; Only for 1 to 5 V, 4 to 20 mA, TC, R, and RTD
• Overflow/underflow	Yes
Diagnostics indication LED	
• RUN LED	Yes; Green LED
• ERROR LED	Yes; Red LED
• Monitoring of the supply voltage (PWR-LED)	Yes; Green LED
• Channel status display	Yes; Green LED
• for channel diagnostics	Yes; Red LED
• for module diagnostics	Yes; Red LED
Potential separation	
Potential separation channels	
• between the channels	No
• between the channels, in groups of	8
• between the channels and backplane bus	Yes
• between the channels and the power supply of the electronics	Yes
Permissible potential difference	
between the inputs (UCM)	20 V DC
Between the inputs and MANA (UCM)	10 V DC
Isolation	
Isolation tested with	707 V DC (type test)
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	0 °C
• horizontal installation, max.	60 °C
• vertical installation, min.	0 °C
• vertical installation, max.	40 °C
Decentralized operation	
Prioritized startup	No
Dimensions	
Width	35 mm

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Height	147 mm
Depth	129 mm

Weights	
Weight, approx.	310 g

Other	
Note:	Additional basic error and noise for integration time = 2.5 ms: Voltage: ±250 mV (±0.02%), ±80 mV (±0.05%), ±50 mV (±0.05%); resistance: 150 ohms ±0.02%; resistance thermometer: Pt100 climate: ±0.08 K, Ni100 climate: ±0.08 K; thermocouple: Type B, R, S: ±3 K, type E, J, K, N, T: ±1 K
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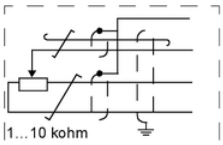
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Alternate macro

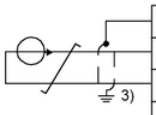
This macro provides an I/O configuration adapted to a sequence of DI control signals used when alternating the rotation direction of the drive. To enable the macro, set the value of parameter *9902* to 3 (ALTERNATE).

For the parameter default values, see section *Default parameter values with different macros* on page *65*. If you use other than the default connections presented below, see section *I/O terminals* on page *34*.

Default I/O connections



Alternative connection for AI1. If used, switch IU selector to U (0...10 V voltage signal).



I/O connection [4]

SCR	Signal cable shield (screen)
AI	**Frequency reference**: 0...20 mA
GND	Analog input circuit common
+10V	Reference voltage: +10 VDC, max. 10 mA
+24V	Auxiliary voltage output: +24 VDC, max. 200 mA
GND	Auxiliary voltage output common
DCOM	Digital input common
DI1	**Start forward**: If DI1 = DI2, the drive stops.
DI2	**Start reverse**
DI3	**Constant speed selection** [1]
DI4	**Constant speed selection** [1]
DI5	**Acceleration and deceleration selection** [2]

Relay connection [5]

COM	Relay output
NC	**No fault [Fault (-1)]**
NO	

[1] See parameter group *12 CONSTANT SPEEDS*:

DI3	DI4	Operation (parameter)
0	0	Set speed through integrated potentiometer
1	0	Speed 1 (*1202*)
0	1	Speed 2 (*1203*)
1	1	Speed 3 (*1204*)

[2] 0 = ramp times according to parameters *2202* and *2203*.
1 = ramp times according to parameters *2205* and *2206*.

[3] 360 degree grounding under a clamp.

[4] Tightening torque = 0.22 N·m / 2 lbf. in.

[5] Tightening torque = 0.5 N·m / 4.4 lbf. in.

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Data sheet 6ES7522-1BL01-0AB0

SIMATIC S7-1500, Digital output module DQ 32x24 V DC/0.5A HF; 32 channels in groups of 8; 4 A per group; Single-channel diagnostics; Substitute value



General information	
Product type designation	DQ 32x24VDC/0.5A HF
HW functional status	FS01
Firmware version	V1.0.0
Product function	
• I&M data	Yes; I&M0 to I&M3
Engineering with	
• STEP 7 TIA Portal configurable/integrated as of version	V13 SP1 / -
• PROFIBUS as of GSD version/GSD revision	V1.0 / V5.1
• PROFINET as of GSD version/GSD revision	V2.3 / -
Operating mode	
• DQ	Yes
• DQ with energy-saving function	No
• PWM	No
• Oversampling	No
• MSO	Yes
Supply voltage	

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Rated value (DC)	24 V
permissible range, lower limit (DC)	20.4 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes; through internal protection with 7 A per group
Input current	
Current consumption, max.	60 mA
Output voltage	
Rated value (DC)	24 V
Power	
Power available from the backplane bus	1.1 W
Power loss	
Power loss, typ.	3.5 W
Digital outputs	
Type of digital output	Transistor
Number of digital outputs	32
Current-sourcing	Yes
Short-circuit protection	Yes; Clocked electronically
• Response threshold, typ.	1 A
Limitation of inductive shutdown voltage to	L+ (-53 V)
Controlling a digital input	Yes
Switching capacity of the outputs	
• with resistive load, max.	0.5 A
• on lamp load, max.	5 W
Load resistance range	
• lower limit	48 Ω
• upper limit	12 kΩ
Output voltage	
• for signal "1", min.	L+ (-0.8 V)
Output current	
• for signal "1" rated value	0.5 A
• for signal "1" permissible range, max.	0.5 A
• for signal "0" residual current, max.	0.5 mA
Output delay with resistive load	
• "0" to "1", max.	100 µs
• "1" to "0", max.	500 µs
Parallel switching of two outputs	
• for logic links	Yes
• for uprating	No
• for redundant control of a load	Yes
Switching frequency	

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• with resistive load, max.	100 Hz
• with inductive load, max.	0.5 Hz; According to IEC 60947-5-1, DC-13
• on lamp load, max.	10 Hz
Total current of the outputs	
• Current per channel, max.	0.5 A; see additional description in the manual
• Current per group, max.	4 A; see additional description in the manual
• Current per module, max.	16 A; see additional description in the manual
Cable length	
• shielded, max.	1 000 m
• unshielded, max.	600 m

Isochronous mode	
Isochronous operation (application synchronized up to terminal)	Yes
Execution and activation time (TCO), min.	70 µs
Bus cycle time (TDP), min.	250 µs

Interrupts/diagnostics/status information	
Diagnostics function	Yes
Substitute values connectable	Yes
Alarms	
• Diagnostic alarm	Yes
Diagnostic messages	
• Monitoring the supply voltage	Yes
• Wire-break	Yes
• Short-circuit	Yes
• Group error	Yes
Diagnostics indication LED	
• RUN LED	Yes; Green LED
• ERROR LED	Yes; Red LED
• Monitoring of the supply voltage (PWR-LED)	Yes; Green LED
• Channel status display	Yes; Green LED
• for channel diagnostics	Yes; Red LED
• for module diagnostics	Yes; Red LED

Potential separation	
Potential separation channels	
• between the channels	No
• between the channels, in groups of	8
• between the channels and backplane bus	Yes

Isolation	
Isolation tested with	707 V DC (type test)

Decentralized operation

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Prioritized startup	Yes

Dimensions	
Width	35 mm
Height	147 mm
Depth	129 mm

Weights	
Weight, approx.	280 g

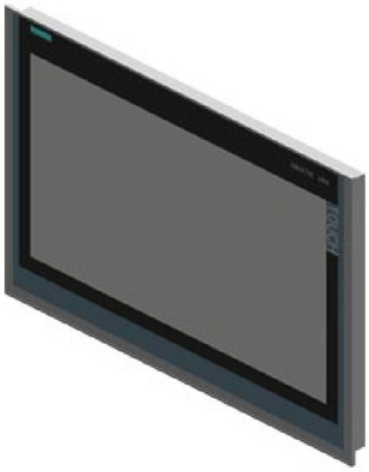
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Data sheet 6AV2124-0XC02-0AX1

SIMATIC HMI TP2200 Comfort, Comfort Panel, Touch operation, 22" widescreen TFT display, 16 million colors, PROFINET interface, MPI/PROFIBUS DP interface, 24 MB configuration memory, WEC 2013, configurable from WinCC Comfort V14 SP1 with HSP



General information	
Product type designation	TP2200 Comfort
Display	
Design of display	TFT
Screen diagonal	21.5 in
Display width	475.2 mm
Display height	267.3 mm
Number of colors	16 777 216
Resolution (pixels)	
• Horizontal image resolution	1 920 Pixel
• Vertical image resolution	1 080 Pixel
Backlighting	
• MTBF backlighting (at 25 °C)	30 000 h
• Backlight dimmable	Yes; 0-100 %
Control elements	
Keyboard fonts	
• Function keys	
— Number of function keys	0

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• Keys with LED	No
• System keys	No
• Numeric keyboard	Yes; Onscreen keyboard
• alphanumeric keyboard	Yes; Onscreen keyboard
Touch operation	
• Design as touch screen	Yes
Expansions for operator control of the process	
• Direct keys (touch buttons as S7 input I/O)	40

Installation type/mounting	
Mounting position	vertical
Mounting in portrait format possible	Yes
Mounting in landscape format possible	Yes
maximum permissible angle of inclination without external ventilation	35°

Supply voltage	
Type of supply voltage	DC
Rated value (DC)	24 V
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V

Input current	
Current consumption (rated value)	1.7 A
Starting current inrush I^2t	0.5 $A^2 \cdot s$

Power	
Active power input, typ.	41 W

Processor	
Processor type	X86

Memory	
Flash	Yes
RAM	Yes
Memory available for user data	24 Mbyte

Type of output	
Info LED	No
Power LED	No
Error LED	No
Acoustics	
• Buzzer	No
• Speaker	Yes

Time of day	
Clock	
• Hardware clock (real-time)	Yes

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• Software clock	Yes
• retentive	Yes; Back-up duration typically 6 weeks
• synchronizable	Yes

Interfaces	
Number of industrial Ethernet interfaces	2; 2 ports (switch) + independent port
Number of RS 485 interfaces	1; RS 422/485 combined
Number of RS 422 interfaces	0; together with RS485
Number of RS 232 interfaces	0
Number of USB interfaces	2; USB 2.0
Number of 20 mA interfaces (TTY)	0
Number of parallel interfaces	0
Number of other interfaces	0
Number of SD card slots	2
With software interfaces	No
Industrial Ethernet	
• Industrial Ethernet status LED	3
• Number of ports of the integrated switch	2

Protocols	
PROFINET	Yes
Supports protocol for PROFINET IO	Yes
IRT	Yes
MRP	Yes
PROFIBUS	Yes
MPI	Yes
Protocols (Ethernet)	
• TCP/IP	Yes
• DHCP	Yes
• SNMP	Yes
• DCP	Yes
• LLDP	Yes
WEB characteristics	
• HTTP	Yes
• HTTPS	Yes
• HTML	Yes
• XML	Yes
• CSS	Yes
• Active X	Yes
• JavaScript	Yes
• Java VM	No
Further protocols	
• CAN	No

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• EtherNet/IP	Yes
• MODBUS	Yes
Interrupts/diagnostics/status information	
Diagnostic messages	
• Diagnostic information readable	Yes; S7 controller
EMC	
Emission of radio interference acc. to EN 55 011	
• Limit class A, for use in industrial areas	Yes
• Limit class B, for use in residential areas	No
Degree and class of protection	
IP (at the front)	IP65
Enclosure Type 4 at the front	Yes
Enclosure Type 4x at the front	Yes
IP (rear)	IP20
Standards, approvals, certificates	
CE mark	Yes
cULus	Yes
RCM (formerly C-TICK)	Yes
KC approval	Yes
EAC (formerly Gost-R)	Yes
Marine approval	
• Germanischer Lloyd (GL)	No
• American Bureau of Shipping (ABS)	No
• Bureau Veritas (BV)	No
• Det Norske Veritas (DNV)	No
• Korean Register of Shipping (KRS)	No
• Lloyds Register of Shipping (LRS)	No
• Nippon Kaiji Kyokai (Class NK)	No
• Polski Rejestr Statkow (PRS)	No
• Chinese Classification Society (CCS)	No
Use in hazardous areas	
• ATEX Zone 2	No
• ATEX Zone 22	No
• IECEx Zone 2	No
• IECEx Zone 22	No
• cULus Class I Zone 1	No
• cULus Class I Zone 2, Division 2	No; Available soon
• cULus Class II Division 2	No; Available soon
• FM Class I Division 2	No; Available soon
• FM Class II Division 2	No; Available soon

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Ambient conditions	
Suited for indoor use	Yes
Suited for outdoor use	No
Ambient temperature during operation	
• Operation (vertical installation)	
— For vertical installation, min.	0 °C
— For vertical installation, max.	45 °C
• Operation (max. tilt angle)	
— At maximum tilt angle, min.	0 °C
— At maximum tilt angle, min.	40 °C
• Operation (vertical installation, portrait format)	
— For vertical installation, min.	0 °C
— For vertical installation, max.	40 °C
• Operation (max. tilt angle, portrait format)	
— At maximum tilt angle, min.	0 °C
— At maximum tilt angle, min.	35 °C
Ambient temperature during storage/transportation	
• min.	-20 °C
• max.	60 °C
Relative humidity	
• Operation, max.	90 %; no condensation

Operating systems	
proprietary	No
pre-installed operating system	
• Windows CE	Yes; Windows Embedded Compact 2013

Configuration	
Message indicator	Yes
Alarm system (incl. buffer and acknowledgment)	Yes
Process value display (output)	Yes
Process value default (input) possible	Yes
Recipe management	Yes
Configuration software	
• STEP 7 Basic (TIA Portal)	No
• STEP 7 Professional (TIA Portal)	No
• WinCC flexible Compact	No
• WinCC flexible Standard	No
• WinCC flexible Advanced	No
• WinCC Basic (TIA Portal)	No
• WinCC Comfort (TIA Portal)	Yes; V14 SP1 HSP and higher
• WinCC Advanced (TIA Portal)	Yes; V14 SP1 HSP and higher
• WinCC Professional (TIA Portal)	Yes; V14 SP1 HSP and higher

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Languages	
Online languages	
• Number of online/runtime languages	32
Project languages	
• Languages per project	32

Functionality under WinCC (TIA Portal)	
Libraries	Yes
Applications/options	
• Web browser	Yes
• Pocket Word	Yes
• Pocket Excel	Yes
• PDF Viewer	Yes
• Media Player	Yes
• SIMATIC WinCC Sm@rtServer	Yes
• SIMATIC WinCC Audit	Yes
Number of Visual Basic Scripts	Yes
Task planner	
• time-controlled	Yes
• task-controlled	Yes
Help system	
• Number of characters per info text	320
Message system	
• Number of alarm classes	32
• Bit messages	
— Number of bit messages	6 000
• Analog messages	
— Number of analog messages	200
• S7 alarm number procedure	Yes
• System messages HMI	Yes
• System messages, other (SIMATIC S7, Sinumerik, Simotion, etc.)	Yes
• Number of characters per message	80
• Number of process values per message	8
• Acknowledgment groups	Yes
• Message indicator	Yes
• Message buffer	
— Number of entries	1 024
— Circulating buffer	Yes
— retentive	Yes
— maintenance-free	Yes
Recipe management	

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• Number of recipes	500
• Data records per recipe	1 000
• Entries per data record	2 000
• Size of internal recipe memory	4 Mbyte
• Recipe memory expandable	Yes
Variables	
• Number of variables per device	4 096
• Number of variables per screen	400
• Limit values	Yes
• Multiplexing	Yes
• Structures	Yes
• Arrays	Yes
Images	
• Number of configurable images	750
• Permanent window/default	Yes
• Global image	Yes
• Pop-up images	Yes
• Slide-in images	Yes
• Image selection by PLC	Yes
• Image number in the PLC	Yes
Image objects	
• Number of objects per image	600
• Text fields	Yes
• I/O fields	Yes
• Graphic I/O fields (graphics list)	Yes
• Symbolic I/O fields (text list)	Yes
• Date/time fields	Yes
• Switches	Yes
• Buttons	Yes
• Graphic display	Yes
• Icons	Yes
• Geometric objects	Yes
Complex image objects	
• Number of complex objects per screen	40
• Alarm view	Yes
• Trend view	Yes
• User view	Yes
• Status/control	Yes
• Sm@rtClient view	Yes
• Recipe view	Yes
• f(x) trend view	Yes

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• System diagnostics view	Yes
• Media Player	Yes
• HTML browser	Yes
• PDF display	Yes
• IP camera display	Yes
• Bar graphs	Yes
• Sliders	Yes
• Pointer instruments	Yes
• Analog/digital clock	Yes
Lists	
• Number of text lists per project	500
• Number of entries per text list	500
• Number of graphics lists per project	500
• Number of entries per graphics list	500
Archiving	
• Number of archives per device	50
• Number of entries per archive	50 000
• Message archive	Yes
• Process value archive	Yes
• Archiving methods	
— Sequential archive	Yes
— Short-term archive	Yes
• Memory location	
— Memory card	Yes
— USB memory	Yes
— Ethernet	Yes
• Data storage format	
— CSV	Yes
— TXT	Yes
— RDB	Yes
Security	
• Number of user groups	50
• Number of user rights	32
• Number of users	50
• Password export/import	Yes
• SIMATIC Logon	Yes
Logging through printer	
• Alarms	Yes
• Report (shift log)	Yes
• Hardcopy	Yes
• Electronic print to file	Yes; PDF, HTML

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Character sets	
• Keyboard fonts	
— US English	Yes
Transfer (upload/download)	
• MPI/PROFIBUS DP	Yes
• USB	Yes
• Ethernet	Yes
• using external storage medium	Yes
Process coupling	
• S7-1200	Yes
• S7-1500	Yes
• S7-200	Yes
• S7-300/400	Yes
• LOGO!	Yes
• WinAC	Yes
• SINUMERIK	Yes; With SINUMERIK option package as from WinCC V15 or higher
• SIMOTION	Yes
• Allen Bradley (EtherNet/IP)	Yes
• Allen Bradley (DF1)	Yes
• Mitsubishi (MC TCP/IP)	Yes
• Mitsubishi (FX)	Yes
• OMRON (FINS TCP)	No
• OMRON (LINK/Multilink)	Yes
• Modicon (Modbus TCP/IP)	Yes
• Modicon (Modbus)	Yes
• OPC UA Client	Yes
• OPC UA Server	Yes
Service tools/configuration aids	
• Backup/Restore manually	Yes
• Backup/Restore automatically	Yes
• Simulation	Yes
• Device switchover	Yes

Peripherals/Options	
Peripherals	
• Printer	Yes
• SIMATIC HMI MM memory card: Multi Media Card	Yes; Up to 128 MB
• SIMATIC HMI SD memory card: Secure Digital memory card	Yes; Up to 2 GB
• SIMATIC HMI CF memory card Compact Flash Card	No

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• USB memory	Yes
• SIMATIC IPC USB Flashdrive (USB stick)	Yes; Up to 16 GB
• SIMATIC HMI USB stick	Yes; Up to 8 GB
• Network camera	Yes

Mechanics/material	
Enclosure material (front)	
• Plastic	No
• Aluminum	Yes
• Stainless steel	No

Dimensions	
Width of the housing front	560 mm
Height of housing front	380 mm
Mounting cutout, width	542 mm
Mounting cutout, height	362 mm
Overall depth	75 mm

Weights	
Weight without packaging	6.7 kg

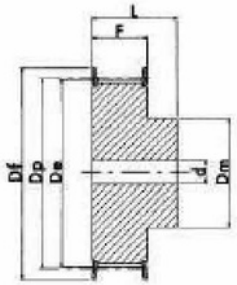
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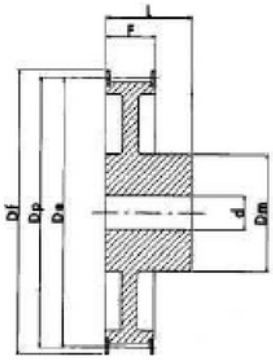
ENGLISH

Timing Pulleys HTD8M-20

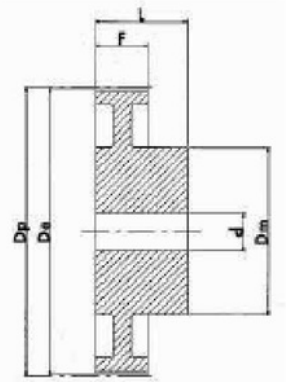
8mm pitch for 20mm wide belt
Centre drilled or Pilot Bore
in Steel or Cast Iron with Zinc plated Steel Flanges



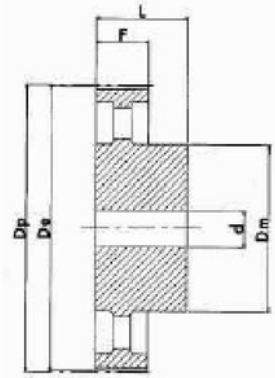
EXECUTION 1F



EXECUTION 2F



execution 3



execution 4

Dimensions

Mat'l	Code	No. Teeth	Type	Dp	De	Df	Dm	F	L	Bore	No. Flanges
St.	P22-8M-20F	22	1F	56.02	54.65	60	43	28	38	12	2
St.	P24-8M-20F	24	1F	61.12	59.75	66	45	28	38	12	2
St.	P26-8M-20F	26	1F	66.21	64.85	70	48	28	38	12	2
St.	P28-8M-20F	28	1F	71.3	70.08	75	50	28	38	15	2
St.	P30-8M-20F	30	1F	76.39	75.13	82.5	55	28	38	15	2
St.	P32-8M-20f	32	1F	81.49	80.16	87	60	28	38	15	2
St.	P34-8M-20F	34	1F	86.58	85.22	91	66	28	38	15	2
St.	P36-8M-20F	36	1F	91.67	90.3	97	70	28	38	15	2
St.	P38-8M-20F	38	1F	96.77	95.39	102	75	28	38	15	2
St.	P40-8M-20F	40	1F	101.86	100.49	106	75	28	38	15	2
St.	P44-8M-20F	44	1F	112.05	110.67	120	75	28	38	15	2
St.	P48-8M-20F	48	1F	122.23	120.86	128	75	28	38	15	2
St.	P56-8M-20F	56	2F	142.6	141.23	150	80	28	38	15	2
St.	P64-8M-20F	64	2F	162.97	161.6	168	80	28	38	15	2
St.	P72-8M-20F	72	2F	183.35	181.97	192	80	28	38	15	2
C.I.	P80-8M-20	80	3	203.72	202.35	-	90	28	38	15	-
C.I.	P90-8M-20	90	3	229.18	227.81	-	90	28	38	15	-
C.I.	P112-8M-20	112	4	285.21	283.83	-	90	28	38	18	-
C.I.	P144-8M-20	144	4	366.69	365.32	-	90	28	38	20	-
C.I.	P168-8M-20	168	4	427.81	426.44	-	100	28	38	20	-
C.I.	P192-8M-20	192	4	488.92	487.55	-	100	28	38	20	-

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Data sheet 6ES7516-3AN01-0AB0



SIMATIC S7-1500, CPU 1516-3 PN/DP, Central processing unit with Work memory 1 MB for program and 5 MB for data, 1st interface: PROFINET IRT with 2-port switch, 2nd interface: PROFINET RT, 3rd interface: PROFIBUS, 10 ns bit performance, SIMATIC Memory Card required

General information	
Product type designation	CPU 1516-3 PN/DP
HW functional status	FS03
Firmware version	V2.5
Engineering with	
• STEP 7 TIA Portal configurable/integrated as of version	V15 (FW V2.5) / V13 SP1 Update 4 (FW V1.8) or higher
Configuration control	
via dataset	Yes
Display	
Screen diagonal [cm]	6.1 cm
Control elements	
Number of keys	6
Mode selector switch	1
Supply voltage	
Type of supply voltage	24 V DC
permissible range, lower limit (DC)	19.2 V

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permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Mains buffering	
• Mains/voltage failure stored energy time	5 ms
• Repeat rate, min.	1/s
Input current	
Current consumption (rated value)	0.85 A
Inrush current, max.	2.4 A; Rated value
I^2t	0.02 $A^2 \cdot s$
Power	
Infeed power to the backplane bus	12 W
Power consumption from the backplane bus (balanced)	6.7 W
Power loss	
Power loss, typ.	7 W
Memory	
Number of slots for SIMATIC memory card	1
SIMATIC memory card required	Yes
Work memory	
• integrated (for program)	1 Mbyte
• integrated (for data)	5 Mbyte
Load memory	
• Plug-in (SIMATIC Memory Card), max.	32 Gbyte
Backup	
• maintenance-free	Yes
CPU processing times	
for bit operations, typ.	10 ns
for word operations, typ.	12 ns
for fixed point arithmetic, typ.	16 ns
for floating point arithmetic, typ.	64 ns
CPU-blocks	
Number of elements (total)	6 000; Blocks (OB, FB, FC, DB) and UDTs
DB	
• Number range	1 ... 60 999; subdivided into: number range that can be used by the user: 1 ... 59 999, and number range of DBs created via SFC 86: 60 000 ... 60 999
• Size, max.	5 Mbyte; For non-optimized block accesses, the max. size of the DB is 64 KB
FB	
• Number range	0 ... 65 535
• Size, max.	1 Mbyte

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FC	
• Number range	0 ... 65 535
• Size, max.	1 Mbyte
OB	
• Size, max.	1 Mbyte
• Number of free cycle OBs	100
• Number of time alarm OBs	20
• Number of delay alarm OBs	20
• Number of cyclic interrupt OBs	20; With minimum OB 3x cycle of 250 µs
• Number of process alarm OBs	50
• Number of DPV1 alarm OBs	3
• Number of isochronous mode OBs	2
• Number of technology synchronous alarm OBs	2
• Number of startup OBs	100
• Number of asynchronous error OBs	4
• Number of synchronous error OBs	2
• Number of diagnostic alarm OBs	1
Nesting depth	
• per priority class	24

Counters, timers and their retentivity	
S7 counter	
• Number	2 048
Retentivity	
— adjustable	Yes
IEC counter	
• Number	Any (only limited by the main memory)
Retentivity	
— adjustable	Yes
S7 times	
• Number	2 048
Retentivity	
— adjustable	Yes
IEC timer	
• Number	Any (only limited by the main memory)
Retentivity	
— adjustable	Yes

Data areas and their retentivity	
Retentive data area (incl. timers, counters, flags), max.	512 kbyte; In total; available retentive memory for bit memories, timers, counters, DBs, and technology data (axes): 472 KB
Extended retentive data area (incl. timers, counters, flags), max.	5 Mbyte; When using PS 60W 24/48/60V DC HF

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Flag	
• Number, max.	16 kbyte
• Number of clock memories	8; 8 clock memory bits, grouped into one clock memory byte
Data blocks	
• Retentivity adjustable	Yes
• Retentivity preset	No
Local data	
• per priority class, max.	64 kbyte; max. 16 KB per block
Address area	
Number of IO modules	8 192; max. number of modules / submodules
I/O address area	
• Inputs	32 kbyte; All inputs are in the process image
• Outputs	32 kbyte; All outputs are in the process image
per integrated IO subsystem	
— Inputs (volume)	8 kbyte
— Outputs (volume)	8 kbyte
per CM/CP	
— Inputs (volume)	8 kbyte
— Outputs (volume)	8 kbyte
Subprocess images	
• Number of subprocess images, max.	32
Hardware configuration	
Number of distributed IO systems	64; A distributed I/O system is characterized not only by the integration of distributed I/O via PROFINET or PROFIBUS communication modules, but also by the connection of I/O via AS-i master modules or links (e.g. IE/PB-Link)
Number of DP masters	
• integrated	1
• Via CM	8; A maximum of 8 CMs/CPs (PROFIBUS, PROFINET, Ethernet) can be inserted in total
Number of IO Controllers	
• integrated	2
• Via CM	8; A maximum of 8 CMs/CPs (PROFIBUS, PROFINET, Ethernet) can be inserted in total
Rack	
• Modules per rack, max.	32; CPU + 31 modules
• Number of lines, max.	1
PtP CM	
• Number of PtP CMs	the number of connectable PtP CMs is only limited by the number of available slots
Time of day	
Clock	

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• Type	Hardware clock
• Backup time	6 wk; At 40 °C ambient temperature, typically
• Deviation per day, max.	10 s; Typ.: 2 s
Operating hours counter	
• Number	16
Clock synchronization	
• supported	Yes
• to DP, master	Yes
• in AS, master	Yes
• in AS, slave	Yes
• on Ethernet via NTP	Yes

Interfaces	
Number of PROFINET interfaces	2
Number of PROFIBUS interfaces	1

1. Interface	
Interface types	
• Number of ports	2
• integrated switch	Yes
• RJ 45 (Ethernet)	Yes; X1
Functionality	
• IP protocol	Yes; IPv4
• PROFINET IO Controller	Yes
• PROFINET IO Device	Yes
• SIMATIC communication	Yes
• Open IE communication	Yes
• Web server	Yes
• Media redundancy	Yes; MRP Automanager according to IEC 62439-2 Edition 2.0
PROFINET IO Controller	
Services	
— PG/OP communication	Yes
— S7 routing	Yes
— Isochronous mode	Yes
— Open IE communication	Yes
— IRT	Yes
— MRP	Yes; As MRP redundancy manager and/or MRP client; max. number of devices in the ring: 50
— MRPD	Yes; Requirement: IRT
— PROFIenergy	Yes
— Prioritized startup	Yes; Max. 32 PROFINET devices
— Number of connectable IO Devices, max.	256; In total, up to 1 000 distributed I/O devices can be connected via AS-i, PROFIBUS or PROFINET

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— Of which IO devices with IRT, max.	64
— Number of connectable IO Devices for RT, max.	256
— of which in line, max.	256
— Number of IO Devices that can be simultaneously activated/deactivated, max.	8; in total across all interfaces
— Number of IO Devices per tool, max.	8
— Updating times	The minimum value of the update time also depends on communication share set for PROFINET IO, on the number of IO devices, and on the quantity of configured user data
Update time for IRT	
— for send cycle of 250 µs	250 µs to 4 ms; Note: In the case of IRT with isochronous mode, the minimum update time of 500 µs of the isochronous OB is decisive
— for send cycle of 500 µs	500 µs to 8 ms
— for send cycle of 1 ms	1 ms to 16 ms
— for send cycle of 2 ms	2 ms to 32 ms
— for send cycle of 4 ms	4 ms to 64 ms
— With IRT and parameterization of "odd" send cycles	Update time = set "odd" send clock (any multiple of 125 µs: 375 µs, 625 µs ... 3 875 µs)
Update time for RT	
— for send cycle of 250 µs	250 µs to 128 ms
— for send cycle of 500 µs	500 µs to 256 ms
— for send cycle of 1 ms	1 ms to 512 ms
— for send cycle of 2 ms	2 ms to 512 ms
— for send cycle of 4 ms	4 ms to 512 ms
PROFINET IO Device	
Services	
— PG/OP communication	Yes
— S7 routing	Yes
— Isochronous mode	No
— Open IE communication	Yes
— IRT	Yes
— MRP	Yes
— MRPD	Yes; Requirement: IRT
— PROFIenergy	Yes
— Shared device	Yes
— Number of IO Controllers with shared device, max.	4
— Asset management record	Yes; Per user program
2. Interface	
Interface types	

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• Number of ports	1
• integrated switch	No
• RJ 45 (Ethernet)	Yes; X2
Functionality	
• IP protocol	Yes; IPv4
• PROFINET IO Controller	Yes
• PROFINET IO Device	Yes
• SIMATIC communication	Yes
• Open IE communication	Yes
• Web server	Yes
• Media redundancy	No
PROFINET IO Controller	
Services	
— PG/OP communication	Yes
— S7 routing	Yes
— Isochronous mode	No
— Open IE communication	Yes
— IRT	No
— MRP	No
— PROFIenergy	Yes
— Prioritized startup	No
— Number of connectable IO Devices, max.	32; In total, up to 1 000 distributed I/O devices can be connected via AS-i, PROFIBUS or PROFINET
— Number of connectable IO Devices for RT, max.	32
— of which in line, max.	32
— Number of IO Devices that can be simultaneously activated/deactivated, max.	8; in total across all interfaces
— Number of IO Devices per tool, max.	8
— Updating times	The minimum value of the update time also depends on communication share set for PROFINET IO, on the number of IO devices, and on the quantity of configured user data
Update time for RT	
— for send cycle of 1 ms	1 ms to 512 ms
PROFINET IO Device	
Services	
— PG/OP communication	Yes
— S7 routing	Yes
— Isochronous mode	No
— Open IE communication	Yes
— IRT	No
— MRP	No

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— MRPD	No
— PROFIenergy	Yes
— Prioritized startup	No
— Shared device	Yes
— Number of IO Controllers with shared device, max.	4
— Asset management record	Yes; Per user program

3. Interface	
Interface types	
• Number of ports	1
• RS 485	Yes; X3
Functionality	
• PROFIBUS DP master	Yes
• PROFIBUS DP slave	No
• SIMATIC communication	Yes

Interface types	
RJ 45 (Ethernet)	
• 100 Mbps	Yes
• Autonegotiation	Yes
• Autocrossing	Yes
• Industrial Ethernet status LED	Yes
RS 485	
• Transmission rate, max.	12 Mbit/s

Protocols	
Number of connections	
• Number of connections, max.	256; via integrated interfaces of the CPU and connected CPs / CMs
• Number of connections reserved for ES/HMI/web	10
• Number of connections via integrated interfaces	128
• Number of S7 routing paths	16
SIMATIC communication	
• S7 communication, as server	Yes
• S7 communication, as client	Yes
• User data per job, max.	See online help (S7 communication, user data size)
Open IE communication	
• TCP/IP	Yes
— Data length, max.	64 kbyte
— several passive connections per port, supported	Yes

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• ISO-on-TCP (RFC1006)	Yes
— Data length, max.	64 kbyte
• UDP	Yes
— Data length, max.	2 kbyte; 1 472 bytes for UDP broadcast
— UDP multicast	Yes; Max. 5 multicast circuits
• DHCP	No
• SNMP	Yes
• DCP	Yes
• LLDP	Yes
Web server	
• HTTP	Yes; Standard and user pages
• HTTPS	Yes; Standard and user pages
PROFIBUS DP master	
• Number of connections, max.	48; for the integrated PROFIBUS DP interface
Services	
— PG/OP communication	Yes
— S7 routing	Yes
— Data record routing	Yes
— Isochronous mode	Yes
— Equidistance	Yes
— Number of DP slaves	125; In total, up to 1 000 distributed I/O devices can be connected via AS-i, PROFIBUS or PROFINET
— Activation/deactivation of DP slaves	Yes
OPC UA	
• Runtime license required	Yes
• OPC UA Server	Yes; Data access (read, write, subscribe), method call, custom address space
— Application authentication	Yes
— Security policies	Available security policies: None, Basic128Rsa15, Basic256Rsa15, Basic256Sha256
— User authentication	"anonymous" or by user name & password
Further protocols	
• MODBUS	Yes; MODBUS TCP
Media redundancy	
• Switchover time on line break, typ.	200 ms; For MRP, bumpless for MRPD
• Number of stations in the ring, max.	50

Isochronous mode	
Isochronous operation (application synchronized up to terminal)	Yes; With minimum OB 6x cycle of 375 µs
Equidistance	Yes

S7 message functions	
Number of login stations for message functions, max.	32

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Program alarms	Yes
Number of configurable program alarms	10 000
Number of simultaneously active program alarms	
• Number of program alarms	600
• Number of alarms for system diagnostics	200
• Number of alarms for motion technology objects	160
Test commissioning functions	
Joint commission (Team Engineering)	Yes; Parallel online access possible for up to 8 engineering systems
Status block	Yes; Up to 8 simultaneously (in total across all ES clients)
Single step	No
Number of breakpoints	8
Status/control	
• Status/control variable	Yes
• Variables	Inputs/outputs, memory bits, DBs, distributed I/Os, timers, counters
• Number of variables, max.	
— of which status variables, max.	200; per job
— of which control variables, max.	200; per job
Forcing	
• Forcing, variables	Peripheral inputs/outputs
• Number of variables, max.	200
Diagnostic buffer	
• present	Yes
• Number of entries, max.	3 200
— of which powerfail-proof	500
Traces	
• Number of configurable Traces	4; Up to 512 KB of data per trace are possible
Interrupts/diagnostics/status information	
Diagnostics indication LED	
• RUN/STOP LED	Yes
• ERROR LED	Yes
• MAINT LED	Yes
• Connection display LINK TX/RX	Yes
Supported technology objects	
Motion Control	Yes; Note: The number of axes affects the cycle time of the PLC program; selection guide via the TIA Selection Tool or SIZER
• Number of available Motion Control resources for technology objects (except cam disks)	2 400
• Required Motion Control resources	
— per speed-controlled axis	40

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— per positioning axis	80
— per synchronous axis	160
— per external encoder	80
— per output cam	20
— per cam track	160
— per probe	40
• Positioning axis	
— Number of positioning axes at motion control cycle of 4 ms (typical value)	7
— Number of positioning axes at motion control cycle of 8 ms (typical value)	14
Controller	
• PID_Compact	Yes; Universal PID controller with integrated optimization
• PID_3Step	Yes; PID controller with integrated optimization for valves
• PID-Temp	Yes; PID controller with integrated optimization for temperature
Counting and measuring	
• High-speed counter	Yes

Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	0 °C
• horizontal installation, max.	60 °C; Display: 50 °C, at an operating temperature of typically 50 °C, the display is switched off
• vertical installation, min.	0 °C
• vertical installation, max.	40 °C; Display: 40 °C, at an operating temperature of typically 40 °C, the display is switched off
Ambient temperature during storage/transportation	
• min.	-40 °C
• max.	70 °C

Configuration	
Programming	
Programming language	
— LAD	Yes
— FBD	Yes
— STL	Yes
— SCL	Yes
— GRAPH	Yes
Know-how protection	
• User program protection/password protection	Yes
• Copy protection	Yes
• Block protection	Yes
Access protection	
• Password for display	Yes

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• Protection level: Write protection	Yes
• Protection level: Read/write protection	Yes
• Protection level: Complete protection	Yes
Cycle time monitoring	
• lower limit	adjustable minimum cycle time
• upper limit	adjustable maximum cycle time

Dimensions	
Width	70 mm
Height	147 mm
Depth	129 mm

Weights	
Weight, approx.	845 g

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Data sheet 6AV6647-0AJ11-3AX0



SIMATIC HMI KP400 Basic Color PN, Basic Panel, key operation, 4" widescreen TFT display, 256 colors, PROFINET interface, configurable from WinCC Basic V11 SP2/ STEP 7 Basic V11 SP2, contains open-source software, which is provided free of charge see enclosed CD

General information	
Product type designation	KP400 Basic color PN
Display	
Design of display	TFT
Screen diagonal	4.3 in
Display width	95 mm
Display height	53.8 mm
Number of colors	256
Resolution (pixels)	
• Horizontal image resolution	480 Pixel
• Vertical image resolution	272 Pixel
Backlighting	
• MTBF backlighting (at 25 °C)	50 000 h
• Backlight dimmable	No
Control elements	
Keyboard fonts	
• Function keys	
— Number of function keys	8

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• Keys with LED	No
• System keys	Yes; 26
• Numeric keyboard	Yes; Keyboard
• alphanumeric keyboard	Yes; similar to mobile phone
Touch operation	
• Design as touch screen	No
Installation type/mounting	
Mounting position	vertical
Mounting in portrait format possible	No
Mounting in landscape format possible	Yes
maximum permissible angle of inclination without external ventilation	35°
Supply voltage	
Type of supply voltage	DC
Rated value (DC)	24 V
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V
Input current	
Current consumption (rated value)	0.1 A
Starting current inrush I^2t	0.5 $A^2 \cdot s$
Power	
Active power input, typ.	2 W
Processor	
Processor type	RISC 32-bit
Memory	
Flash	Yes
RAM	Yes
Memory available for user data	1 Mbyte
Type of output	
Acoustics	
• Buzzer	No
• Speaker	No
Time of day	
Clock	
• Hardware clock (real-time)	No
• Software clock	Yes
• retentive	No
• synchronizable	Yes
Interfaces	

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Number of industrial Ethernet interfaces	1
Number of RS 485 interfaces	0
Number of RS 422 interfaces	0
Number of RS 232 interfaces	0
Number of USB interfaces	0
Number of 20 mA interfaces (TTY)	0
Number of parallel interfaces	0
Number of other interfaces	0
Number of SD card slots	0
With software interfaces	No
Industrial Ethernet	
• Industrial Ethernet status LED	2

Protocols	
PROFINET	Yes
Supports protocol for PROFINET IO	No
IRT	No
PROFIBUS	No
MPI	No
Protocols (Ethernet)	
• TCP/IP	Yes
• DHCP	Yes
• SNMP	Yes
• DCP	Yes
• LLDP	Yes
WEB characteristics	
• HTTP	No
• HTML	No
Further protocols	
• CAN	No
• EtherNet/IP	Yes
• MODBUS	Yes; Modicon (MODBUS TCP/IP)

EMC	
Emission of radio interference acc. to EN 55 011	
• Limit class A, for use in industrial areas	Yes
• Limit class B, for use in residential areas	No

Degree and class of protection	
IP (at the front)	IP65
Enclosure Type 4 at the front	Yes
Enclosure Type 4x at the front	Yes
IP (rear)	IP20

Standards, approvals, certificates

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CE mark	Yes
cULus	Yes
RCM (formerly C-TICK)	Yes
KC approval	Yes
Marine approval	
• Germanischer Lloyd (GL)	No
• American Bureau of Shipping (ABS)	No
• Bureau Veritas (BV)	No
• Det Norske Veritas (DNV)	No
• Lloyds Register of Shipping (LRS)	No
• Nippon Kaiji Kyokai (Class NK)	No
• Polski Rejestr Statkow (PRS)	No
Use in hazardous areas	
• ATEX Zone 2	No
• ATEX Zone 22	No
• cULus Class I Zone 1	No
• cULus Class I Zone 2, Division 2	No
• FM Class I Division 2	No

Ambient conditions	
Ambient temperature during operation	
• Operation (vertical installation)	
— For vertical installation, min.	0 °C
— For vertical installation, max.	50 °C
• Operation (max. tilt angle)	
— At maximum tilt angle, min.	0 °C
— At maximum tilt angle, min.	40 °C
Ambient temperature during storage/transportation	
• min.	-20 °C
• max.	60 °C
Relative humidity	
• Operation, max.	90 %; no condensation

Operating systems	
proprietary	Yes
pre-installed operating system	
• Windows CE	No

Configuration	
Message indicator	Yes
Alarm system (incl. buffer and acknowledgment)	Yes
Process value display (output)	Yes
Process value default (input) possible	Yes
Recipe management	Yes

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Configuration software	
• STEP 7 Basic (TIA Portal)	Yes; via integrated WinCC Basic (TIA Portal)
• STEP 7 Professional (TIA Portal)	Yes; via integrated WinCC Basic (TIA Portal)
• WinCC flexible Compact	No
• WinCC flexible Standard	No
• WinCC flexible Advanced	No
• WinCC Basic (TIA Portal)	Yes
• WinCC Comfort (TIA Portal)	Yes
• WinCC Advanced (TIA Portal)	Yes
• WinCC Professional (TIA Portal)	Yes

Languages	
Online languages	
• Number of online/runtime languages	5
Project languages	
• Languages per project	32

Functionality under WinCC (TIA Portal)	
Libraries	Yes
Task planner	
• time-controlled	No
• task-controlled	Yes
Help system	Yes
• Number of characters per info text	320
Message system	
• Number of alarm classes	32
• Bit messages	
— Number of bit messages	200
• Analog messages	
— Number of analog messages	15
• System messages HMI	Yes
• Number of characters per message	80
• Number of process values per message	8
• Message indicator	Yes
• Message buffer	
— Number of entries	256
— Circulating buffer	Yes
— retentive	Yes
— maintenance-free	Yes
Recipe management	
• Number of recipes	5
• Data records per recipe	20
• Entries per data record	20

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• Size of internal recipe memory	40 kbyte
• Recipe memory expandable	No
Variables	
• Number of variables per device	500
• Number of variables per screen	30
• Limit values	Yes
• Multiplexing	Yes
• Structures	No
• Arrays	Yes
Images	
• Number of configurable images	50
• Permanent window/default	Yes; No permanent window can be configured
• Global image	Yes
• Image selection by PLC	Yes
• Image number in the PLC	Yes
Image objects	
• Number of objects per image	30
• Text fields	Yes
• I/O fields	Yes
• Graphic I/O fields (graphics list)	Yes
• Symbolic I/O fields (text list)	Yes
• Date/time fields	Yes
• Switches	Yes
• Buttons	Yes
• Graphic display	Yes
• Icons	Yes; Predefined screen objects
• Geometric objects	Yes
Complex image objects	
• Number of complex objects per screen	5
• Alarm view	Yes
• Trend view	Yes
• User view	Yes
• Status/control	No
• Sm@rtClient view	No
• Recipe view	Yes
• f(x) trend view	No
• System diagnostics view	No
• Media Player	No
• Bar graphs	Yes
• Sliders	No
• Pointer instruments	No

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• Analog/digital clock	No
Lists	
• Number of text lists per project	150
• Number of entries per text list	30
• Number of graphics lists per project	100
• Number of entries per graphics list	30
Archiving	
• Number of archives per device	0
Security	
• Number of user groups	50
• Number of user rights	32
• Number of users	50
• Password export/import	No
• SIMATIC Logon	No
Character sets	
• Keyboard fonts	
— US English	Yes
Transfer (upload/download)	
• MPI/PROFIBUS DP	No
• USB	No
• Ethernet	Yes
• using external storage medium	No
Process coupling	
• S7-1200	Yes
• S7-1500	Yes
• S7-200	Yes
• S7-300/400	Yes
• LOGO!	Yes
• WinAC	No
• SINUMERIK	No
• SIMOTION	No
• Allen Bradley (EtherNet/IP)	Yes
• Allen Bradley (DF1)	No
• Mitsubishi (MC TCP/IP)	Yes
• Mitsubishi (FX)	No
• OMRON (FINS TCP)	No
• OMRON (LINK/Multilink)	No
• Modicon (Modbus TCP/IP)	Yes
• Modicon (Modbus)	No
Service tools/configuration aids	
• Backup/Restore manually	Yes

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• Backup/Restore automatically	No
• Simulation	Yes
• Device switchover	Yes

Peripherals/Options	
Peripherals	
• Printer	No
• SIMATIC HMI MM memory card: Multi Media Card	No
• SIMATIC HMI SD memory card: Secure Digital memory card	No
• USB memory	No

Mechanics/material	
Enclosure material (front)	
• Plastic	Yes
• Aluminum	No
• Stainless steel	No

Dimensions	
Width of the housing front	162 mm
Height of housing front	189 mm
Mounting cutout, width	135 mm
Mounting cutout, height	171 mm
Overall depth	33 mm

Weights	
Weight without packaging	0.51 kg
Weight incl. packaging	0.66 kg

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Product datasheet
Characteristics

xckp2118p16

limit switch XCKP - thermoplastic roller lever - 1NC+1NO - snap - M16



Main

Range of product	OsiSense XC
Series name	Standard format
Product or component type	Limit switch
Device short name	XCKP
Sensor design	Compact form A conforming to CENELEC EN 50047
Body type	Fixed
Head type	Rotary head
Material	Plastic
Body material	Plastic
Head material	Zamak
Fixing mode	By the body
Movement of operating head	Rotary
Type of operator	Spring return roller lever thermoplastic
Type of approach	Lateral approach 2 directions
Number of poles	2
Contacts type and composition	1 NC + 1 NO
Contacts operation	Snap action

Complementary

Tracks	24/40 mm
Switch actuation	By 30° cam
Electrical connection	Screw-clamp terminals, clamping capacity: 1 x 0.34...2 x 1.5 mm²
Cable entry	1 entry tapped for M16 x 1.5 cable gland, cable outer diameter: 4...8 mm
Contacts insulation form	Zb
Positive opening	With
Positive opening minimum torque	0.25 N.m
Minimum torque for tripping	0.1 N.m
Maximum actuation speed	1.5 m/s
Repeat accuracy	0.1 mm on the tripping points with 1 million operating cycles
Contact code designation	, AC-15 (Ue = 240 V, Ie = 3 A) , Ithe = 10 A conforming to EN/IEC 60947-5-1 appendix A , DC-13 (Ue = 250 V, Ie = 0.27 A) conforming to EN/IEC 60947-5-1 appendix A
[Ui] rated insulation voltage	500 V degree of pollution 3 conforming to IEC 60947-1 300 V conforming to UL 508 300 V conforming to CSA C22.2 No 14
Resistance across terminals	<= 25 MOhm conforming to IEC 60255-7 category 3
[Uimp] rated impulse withstand voltage	6 kV conforming to IEC 60664 6 kV conforming to IEC 60947-1
Short circuit protection	10 A by gG cartridge fuse
Electrical durability	5000000 cycles, DC-13, 120 V, 4 W, operating rate: <= 60 cyc/mn, load factor: 0.5 conforming to IEC 60947-5-1 appendix C 5000000 cycles, DC-13, 24 V, 10 W, operating rate: <= 60 cyc/mn, load factor: 0.5 conforming to IEC 60947-5-1 appendix C 5000000 cycles, DC-13, 48 V, 7 W, operating rate: <= 60 cyc/mn, load factor: 0.5 conforming to IEC 60947-5-1 appendix C
Mechanical durability	10000000 cycles
Width	31 mm
Height	65 mm

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein.
This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications.
It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof.
Neither Schneider Electric Industries SAS nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein.

Depth	30 mm
Product weight	0.135 kg
Terminals description ISO n°1	(13-14)NO (21-22)NC

Environment

Shock resistance	50 gn (duration = 11 ms) conforming to IEC 60068-2-27
Vibration resistance	25 gn (f = 10...500 Hz) conforming to IEC 60068-2-6
IP degree of protection	IP66 conforming to IEC 60529 IP67 conforming to IEC 60529
IK degree of protection	IK04 conforming to EN 50102
Class of protection against electric shock	Class II conforming to IEC 61140 Class II conforming to NF C 20-030
Ambient air temperature for operation	-25...70 °C
Ambient air temperature for storage	-40...70 °C
Protective treatment	TC
Product certifications	CCC CSA UL
Standards	EN 60204-1 EN 60947-5-1 IEC 60204-1 IEC 60947-5-1 UL 508 CSA C22.2 No 14

Offer Sustainability

Sustainable offer status	Green Premium product
RoHS	Compliant - since 1002 - Schneider Electric declaration of conformity
Product environmental profile	Available
Product end of life instructions	Available

Upgrading of X-ray coating gauges

Assessment Team:

Rhiannon Gallacher – Project Manager – PC&A Technician

	N/A	YES	NO	ACTION
1. Is machinery guarding adequate?		X		
2. Are personnel safe from:-				
a) Entrapment?		X		
b) Laceration?		X		
c) Contact with substances?		X		
d) In-running nips?		X		
3. Is there an emergency stop nearby?		X		
4. Does the Machinery 'Fail Safe'?		X		
5. Is the modified area in view of a person who can stop the line?		X		
6. Is there adequate access and egress?		X		
7. Is the existing Safe Working Procedure adequate?	X			
8. Are operators provided with sufficient information and training?	X			Training not required for the building of the prototype
9. Are there adequate warning notices of hazards?		X		
10. Have all substances been properly assessed?	X			
11. Are COSHH Assessments available to operators?	X			
12. Are personnel free from risk from:-				
a) Biological Agents?		X		
b) Ionising Radiation?		X		
c) Compressed Air?		X		
d) Gases?		X		
e) Explosion?		X		
f) Electricity?		X		
g) Stored Energy -(Hydraulics, Pneumatics etc.)		X		
		X		
13. Do normal electrical isolation procedures apply?		X		
14. Has there been adequate communication with those personnel that:-				
a) Maintain the equipment?	X			
b) Clean the equipment?	X			

If the answer to any of the above questions (1-14) are NO, then the item(s) must be addressed.

	N/A	YES	NO	ACTION
15. Are there additional risks associated with:- a) Maintaining the equipment? b) Cleaning the equipment?			 X X	
16. Are there particular risks associated with the equipment in a break down situation?			X	
17. Is there a need for additional manual handling?			X	
18. Is there the need for additional PPE?			X	
19. Is there the need for additional Safety Equipment?			X	
20. Do 'Confined Spaces & Dangerous Atmospheres' procedures apply?			X	
21. Is there a requirement to isolate from stored energy?			X	
22. Will there be increased E.O.T. Crane activity?			X	
23. Will there be additional vehicle activity?			X	
24. Is there an increased risk of fire?			X	
25. Is there an increased risk to personnel from falls:- a) Over 2 metres? b) Less than 2 metres? c) On the same level?			 X X X	
26. Is there an increased risk from objects falling from a height?			X	
27. Is there a risk of being struck by a moving object?			X	

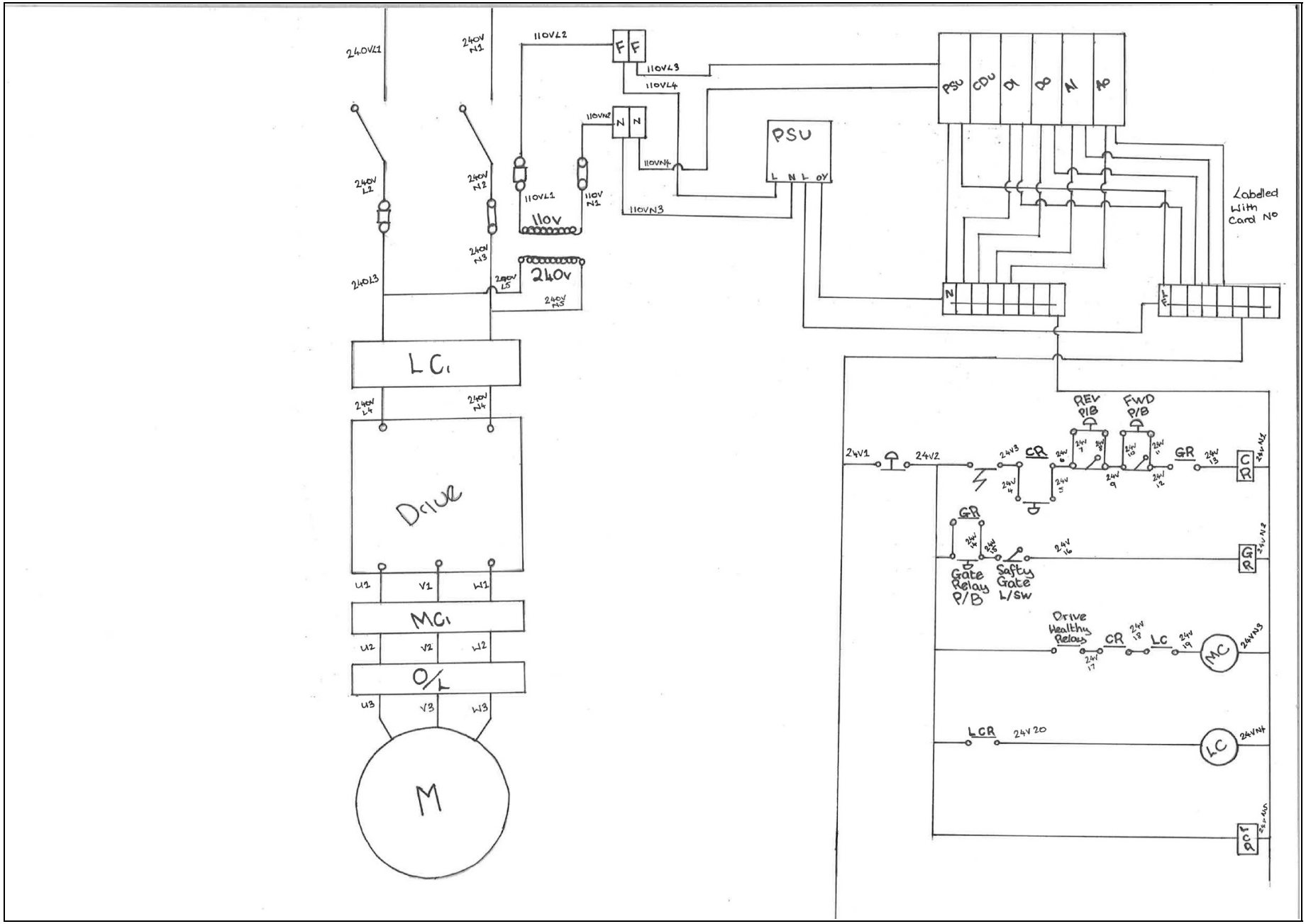
If the answer to any of the above questions (15-27) are YES, then the item(s) must be addressed.

	N/A	YES	NO	ACTION
28. Will there be adverse changes to:- a) Temperature? b) Ventilation? c) Lighting? d) Drainage? e) Noise Levels?			 X X X X X	
29. Will the work environment be affected by adverse weather?			X	
30. Will the modification adversely affect maintaining good housekeeping standards?			X	
31. Will the modification create the potential for damage to this line or any other TATA property?			X	
32. Are there any potential hazards or risks which are not specifically covered in this assessment?			X	
33. Is it necessary to fire seal any cabling in relation to this modification?			X	

If the answer to any of the above questions (28-33) are YES, then the item(s) must be addressed.

Upon completion of this form, should it be necessary to review and amend either the modification, training of personnel, issue of equipment etc. then a re-assessment must be made and a fresh form completed.

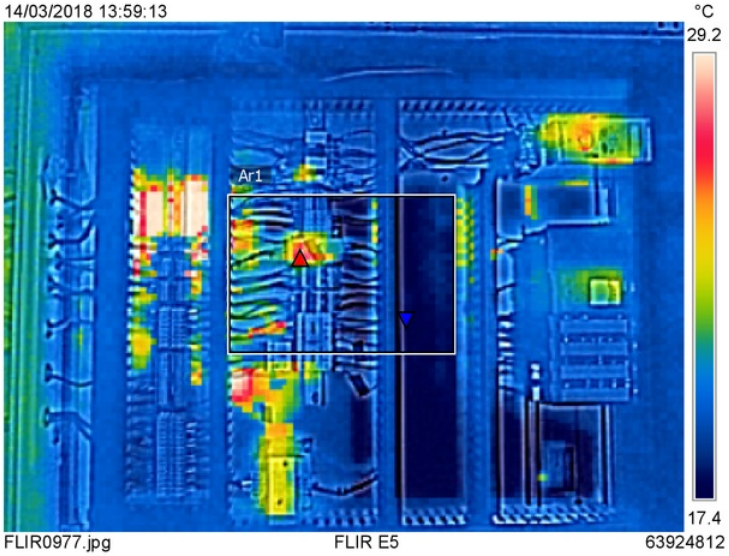
It is recommended that consultation takes place with those involved with any modified or new plant prior to completing this assessment form.


240VL1
240V N1
110VL2
F F
110VL3
110VL4
110VN2
N N
110VN4
110VN3
PSU
L N L 0V
PSU CDU D1 D0 N A0
Labelled With Card No
240V L2
240V N2
110VL1
110V
110V N2
240V N3
240V L3
240V
240V N3
240VL3
LC1
240V L4
240V N4
Drive
U1 V1 W1
MC1
U2 V2 W2
O/L
U3 V3 W3
M
REV P/B
FWD P/B
24V1
24V2
24V3
CR
GR
24V N2
Gate Relay P/B
Safty Gate L/sw
Drive Healthy Relay
LC
MC
24V N3
LCR
24V 20
24V N4
PCF

Measurements		°C
Ar1	Max	28.6
	Min	16.0
	Average	19.7

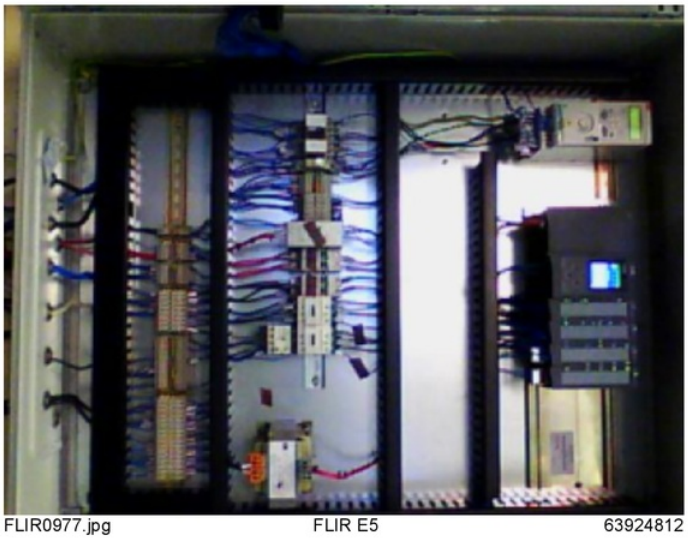
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Emissivity	0.95
Refl. temp.	18 °C

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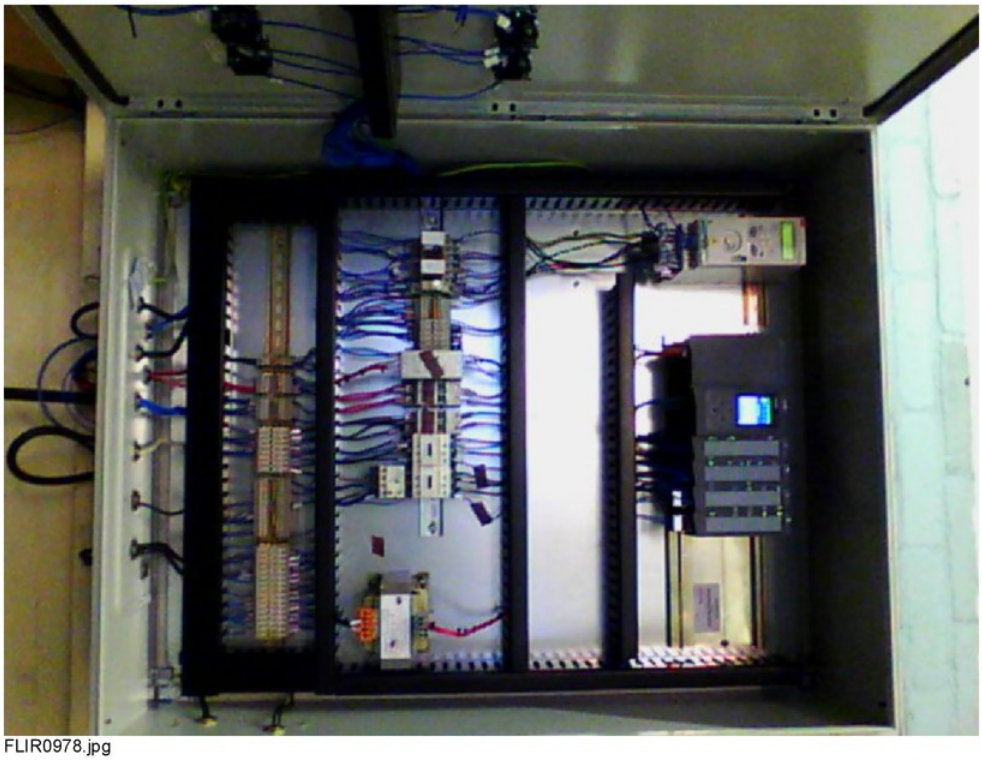
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FLIR0978.jpg

Measurements °C

Ar1	Max	28.7
	Min	16.1
	Average	19.6

Parameters

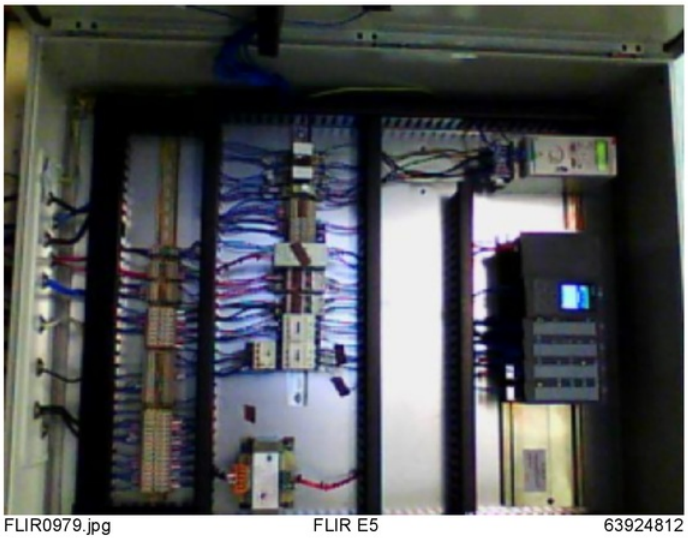
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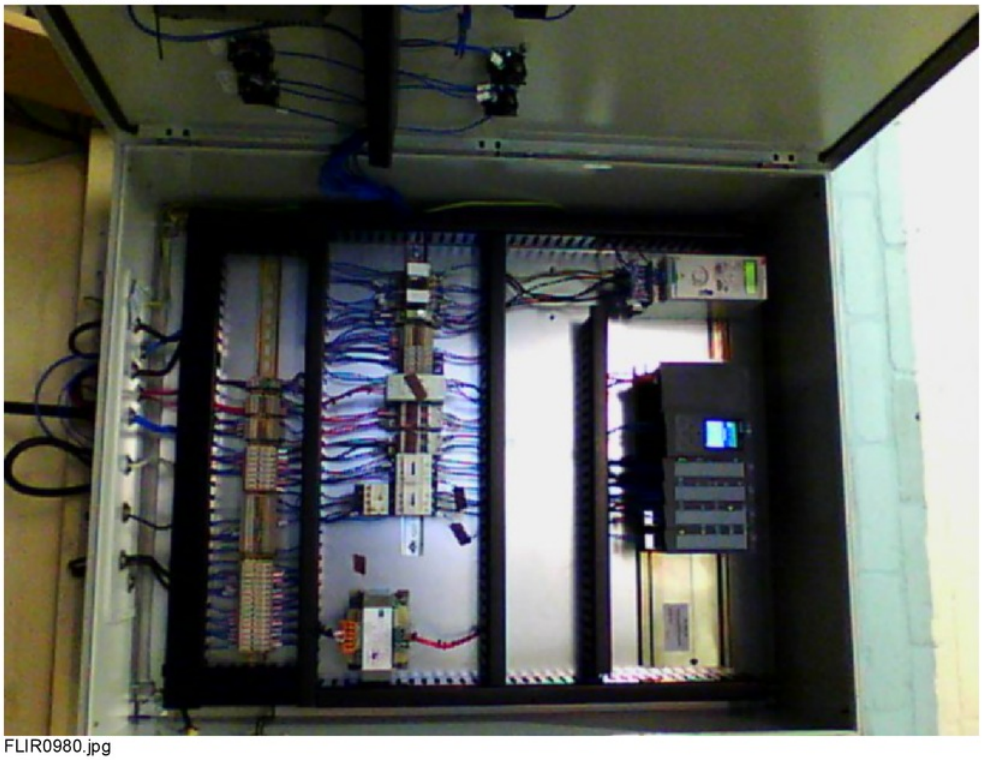
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FLIR0980.jpg

Measurements		°C
Ar1	Max	23.4
	Min	18.2
	Average	20.8

Parameters	
Emissivity	0.95
Refl. temp.	18 °C

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FLIR0982.jpg

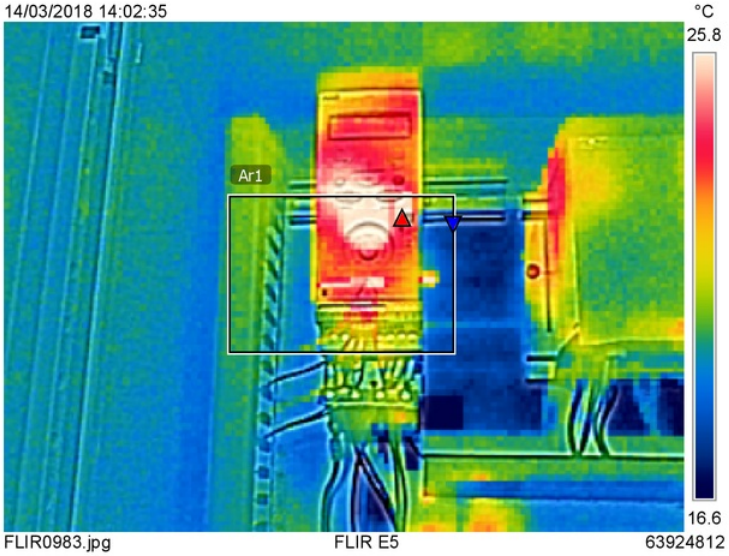
Measurements °C

Ar1	Max	30.5
	Min	17.8
	Average	21.5

Parameters

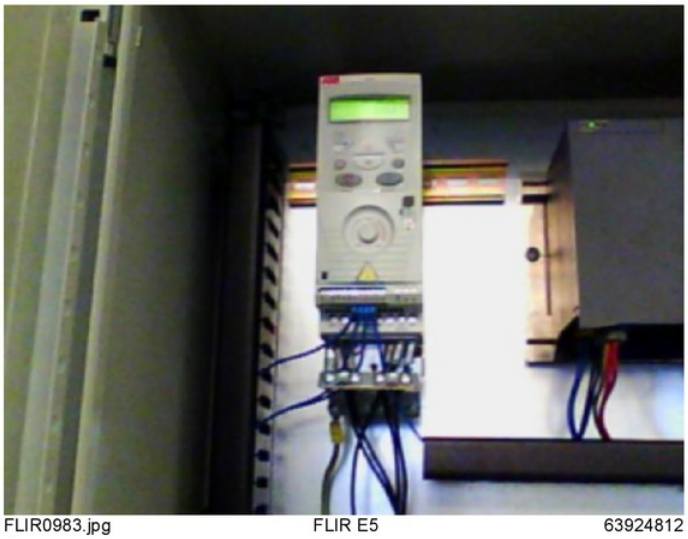
Emissivity	0.95
Refl. temp.	18 °C

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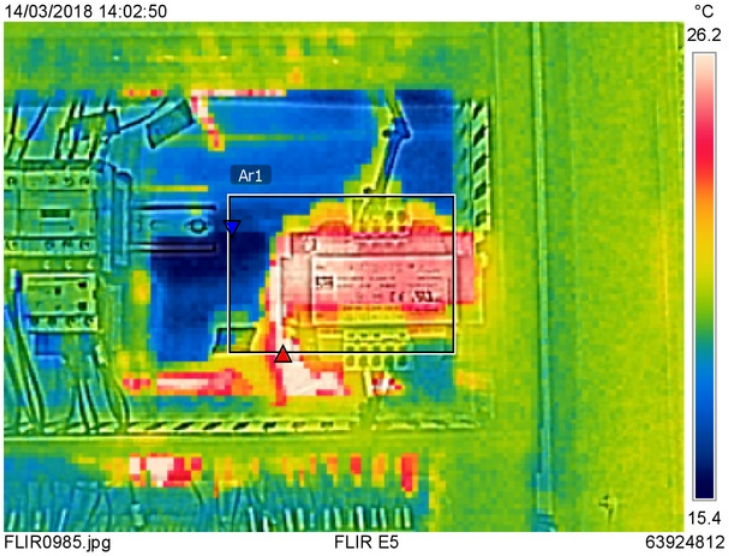


FLIR0984.jpg

Measurements		°C
Ar1	Max	31.0
	Min	15.7
	Average	22.3

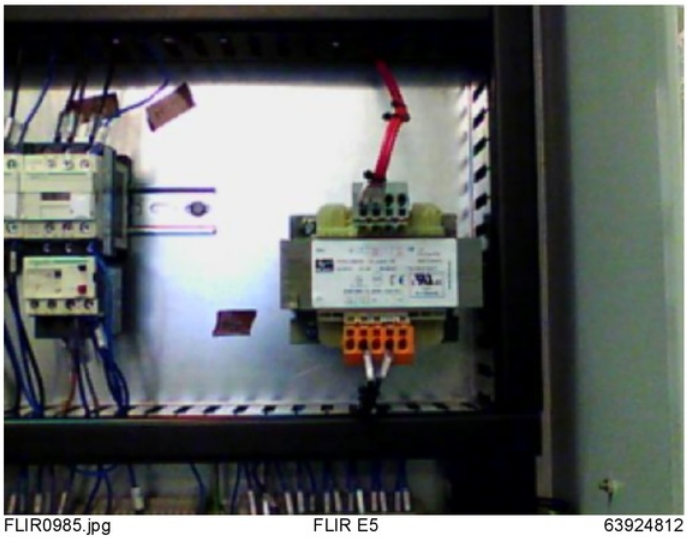
Parameters	
Emissivity	0.95
Refl. temp.	18 °C

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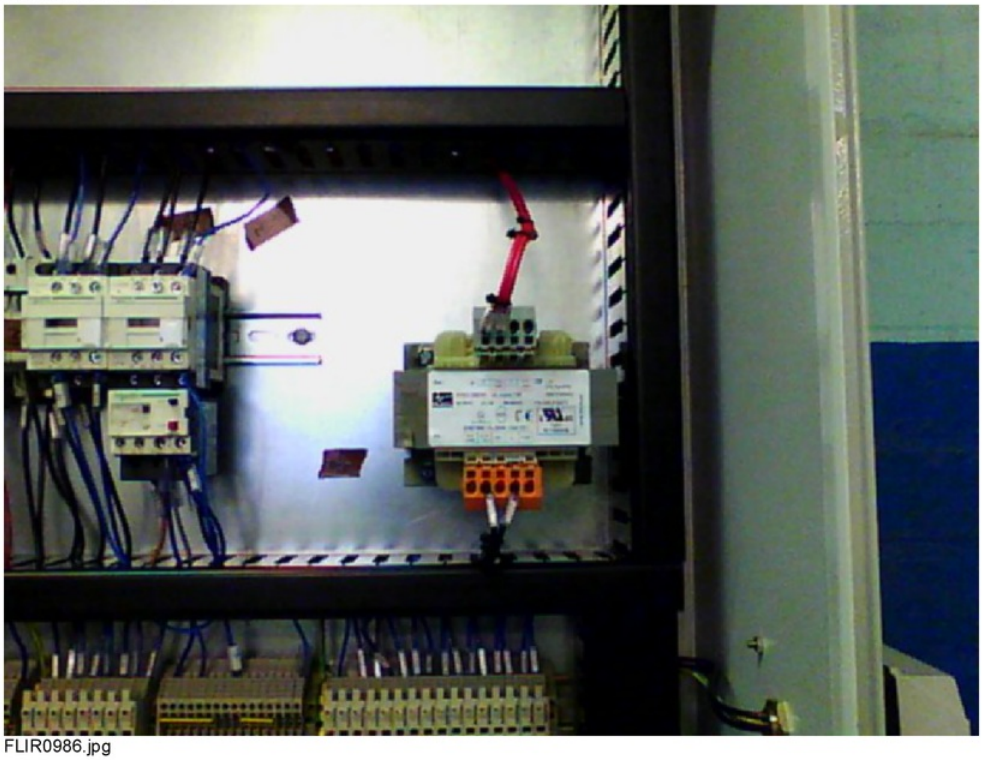
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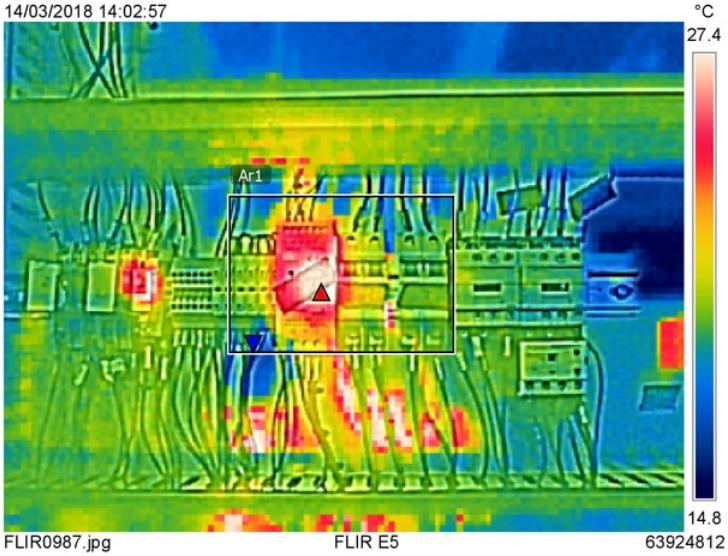


FLIR0986.jpg

Measurements		°C
Ar1	Max	30.8
	Min	16.5
	Average	21.6

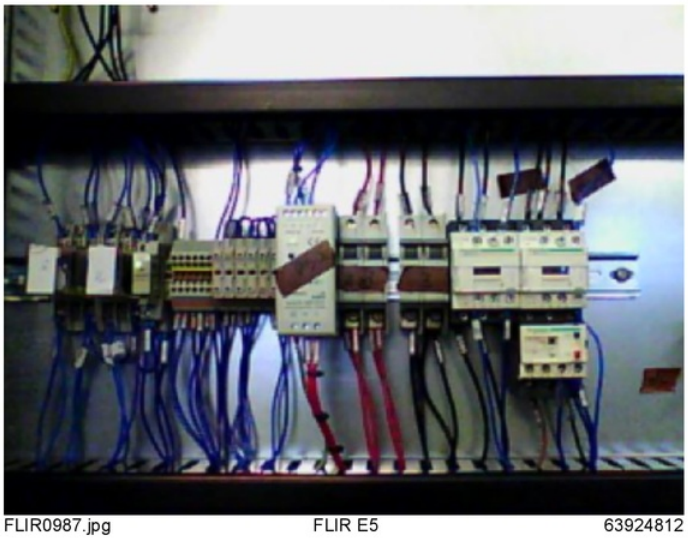
Parameters	
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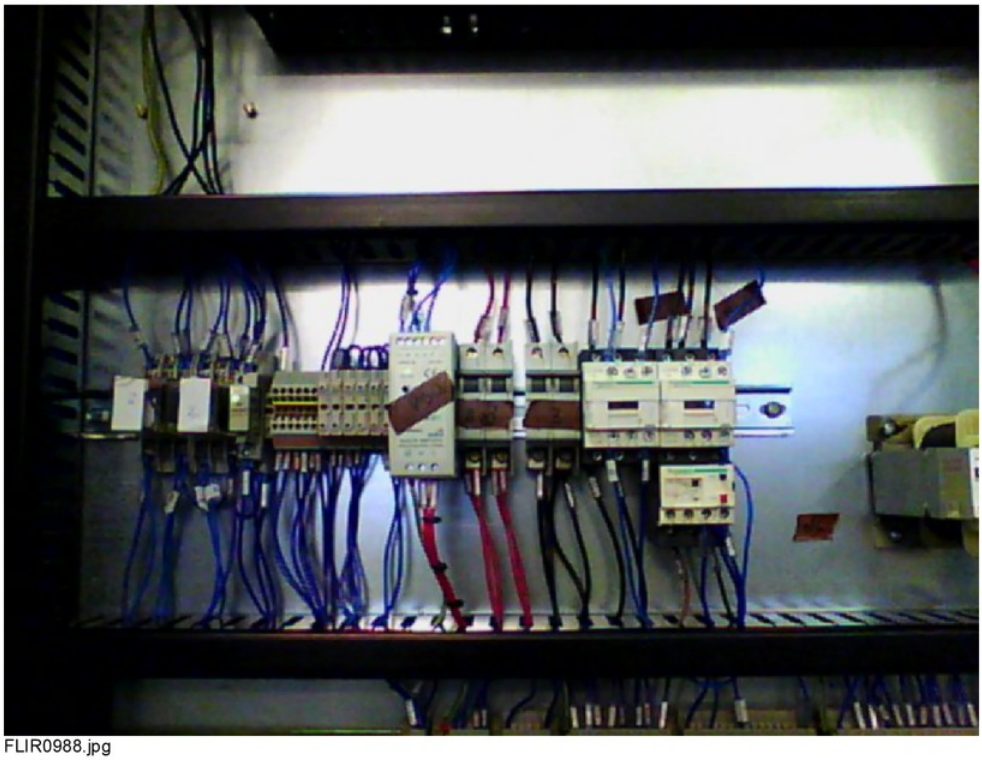
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FLIR0987.jpg FLIR E5 63924812

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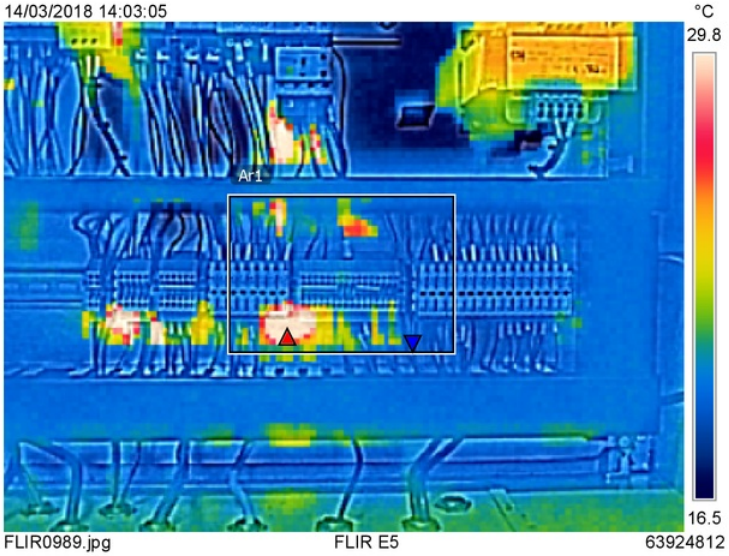


FLIR0988.jpg

Measurements		°C
Ar1	Max	32.6
	Min	19.0
	Average	20.9

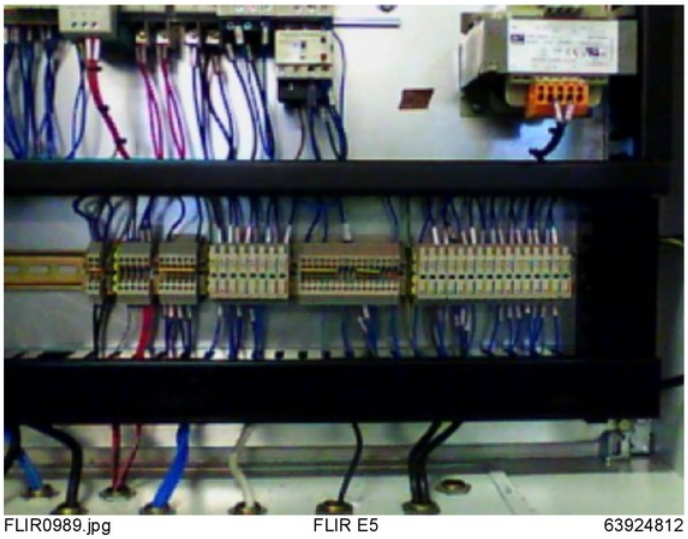
Parameters	
Emissivity	0.95
Refl. temp.	18 °C

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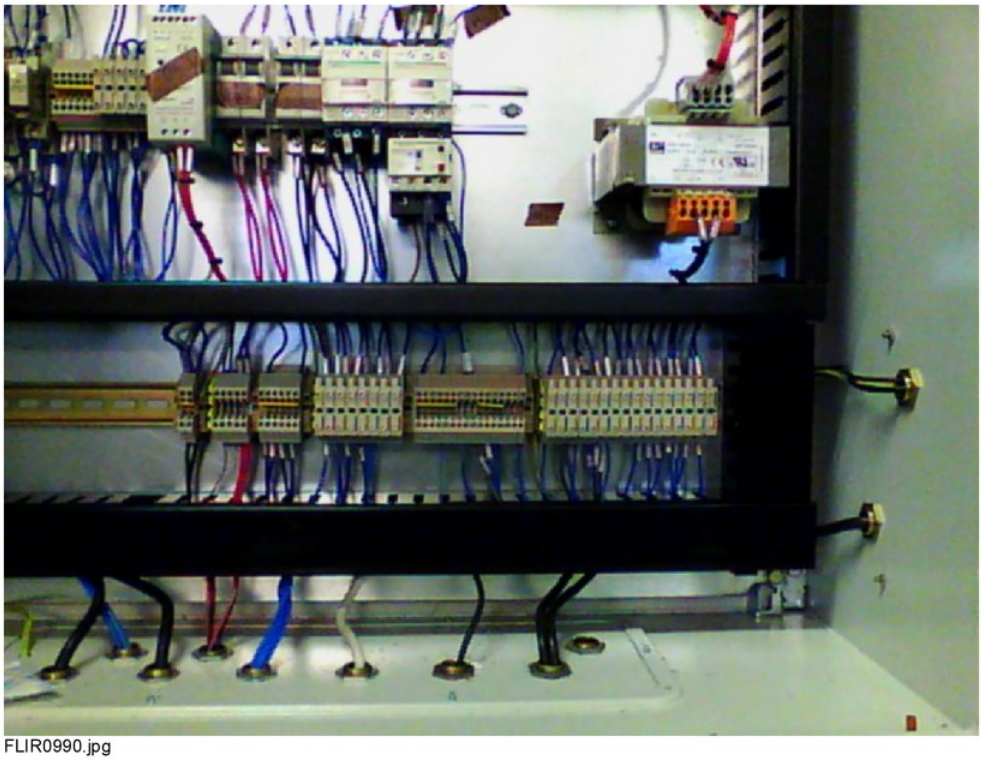
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FLIR0990.jpg

Measurements		°C
Ar1	Max	24.2
	Min	19.8
	Average	20.7

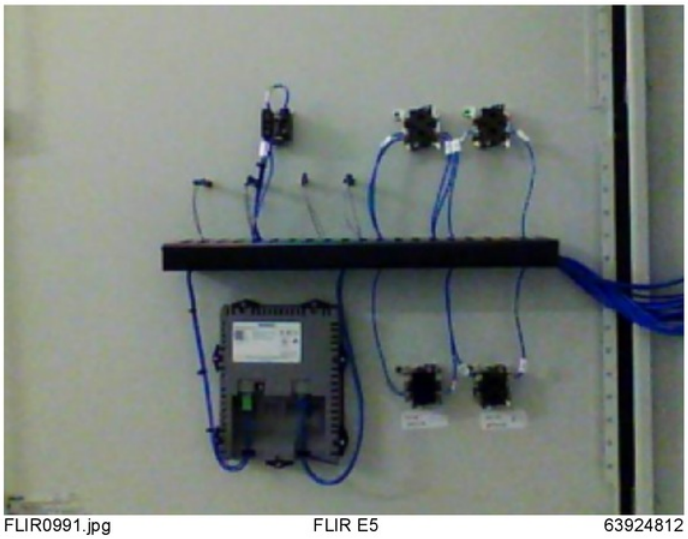
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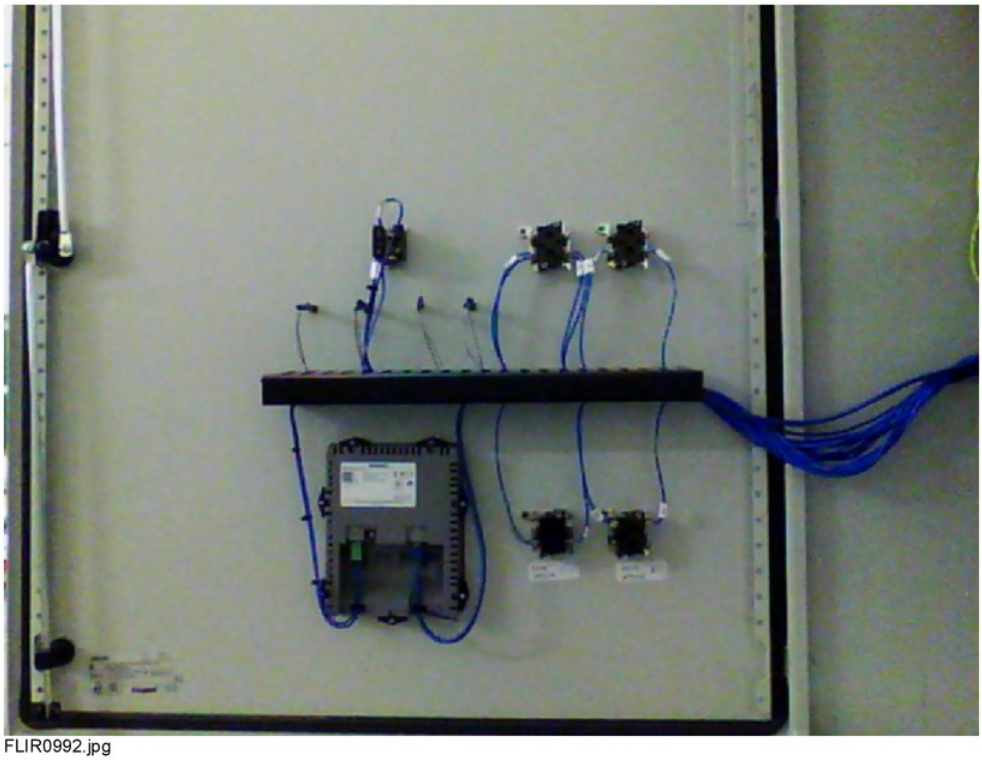
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FLIR0992.jpg

Section	Question	Ref	Status		Comments
Section 1 - Scope					
Section: 1 Scope	Does the machine operate with a nominal supply voltage less than 1000VAC, 1500VDC?	1	✓	Pass	Voltages used are 240VAC, 110VAC and 24VDC
Section: 1 Scope	Is all the electrical equipment suitable for use, the equipment is not intended for use where any special requirements may be deemed necessary, such as operation in an ATEX environment, to be used outside or are hoisting machines or part of their associated control?	1	✓	Pass	Operating in a workshop environment.
Section 4 - General Requirements					
Section: 4.1 General Requirements	Have all potential hazards relevant to the electrical equipment been assessed and adequate risk reduction and or protective measures been put in place?	4.1	✓	Pass	
Section: 4.2 Selection of Equipment	Are all components suitable for their intended use, conform to relevant IEC standards and been applied in accordance with the manufacturers instructions?	4.2.1	✓	Pass	Datasheets for all components used can be found in the technical file.
Section: 4.3 Electrical Supply	Has the equipment been designed to operate correctly with the conditions of the mains supply?	4.3	✓	Pass	
Section: 4.4 Physical environment and operating conditions	Are electrical components EMC Compliant and have they been installed by the best practice methodology recommended by the manufacturer?	4.4.2	✓	Pass	
Section: 4.4 Physical environment and operating conditions	Is the ambient temperature between +5°C and +40°C. Average temperature <35°C?	4.4.3	✓	Pass	
Section: 4.4 Physical environment and operating conditions	Will the equipment be operated at a suitable temperature range (i.e. not above 70°C)?	4.4.3	✓	Pass	This can be tested further by using a termal camera during normal operation.
Section: 4.4 Physical environment and operating conditions	Does the unit operate within a relative humidity range of 30% to 90% (non-condensing)?	4.4.4	!	Query	This is expected to be true, however should be tested to be proven
Section: 4.4 Physical environment and operating conditions	Is the unit protected against the ingress of solid bodies and liquids? IP rating e.g. IP 54/55?	4.4.6, 11.3	✓	Pass	
Section: 4.4 Physical environment and operating conditions	Is the equipment protected against the effect of contaminants that it may be potentially exposed to such as acids, dusts, oil laden environment, caustic chemicals etc.?	4.4.6	✓	Not App	
Section: 4.4 Physical environment and operating conditions	Is the equipment protected against radiation where appropriate?	4.4.7	✓	Not App	

Section	Question	Ref	Status		Comments
Section: 4.4 Physical environment and operating conditions	Is the equipment protected against vibration, shock and bump effects?	4.4.8	✓	Not App	
Section: 4.5 Transportation and storage	Is the machine designed to withstand the effects of transportation and storage conditions, including humidity, vibration, shock and temperature variations?	4.5	✓	Pass	This system is not intended to be moved, it is stored in a workshop which has a controlled temperature.
Section: 4.6 Provisions for handling	Is heavy equipment provided with means for handling?	4.6, 14.4.6	✓	Not App	
Section: 4.7 Installation	Has the unit been or will it be installed and operated in accordance with the suppliers instructions?	4.7	✓	Not App	
Section 5 - Incoming Supply Conductor Terminations and Devices for Disconnecting and Switching Off					
Section: 5.1 Incoming Supply conductor terminations	Is the machine connected to a single power supply?	5.1	✓	Pass	
Section: 5.1 Incoming Supply conductor terminations	Is the main supply to be terminated at the supply disconnecting device?	5.1	✓	Pass	The supply can be disconnected using the isolator, once this is disconnected there is no power in the panel at all.
Section: 5.1 Incoming Supply conductor terminations	Are all mains connection terminals clearly marked?	5.1	✓	Pass	
Section: 5.1 Incoming Supply conductor terminations	If there is a requirement for a Neutral Supply is it clearly identified with its own separate insulated terminal? (Ensure that there is no connection within the panel between Neutral and PE)	5.1	✓	Pass	
Section: 5.2 Terminal for connection to the external protective earthing system	Is the external protective earthing terminal close to the assigned mains supply terminals?	5.2	✓	Pass	
Section: 5.2 Terminal for connection to the external protective earthing system	Does the external protective conductor have the correct Cross Sectional Area?	5.2	!	Query	Provide proof of this
Section: 5.2 Terminal for connection to the external protective earthing system	Has the external protective conductor terminal been identified with the letters PE?	5.2	✓	Pass	
Section: 5.2 Terminal for connection to the external protective earthing system	Have all other protective bonding terminals been identified by the preferred graphical symbol 604172-IEC-5019 or the letters PE or by use of Green / Yellow combination?	5.2	✓	Pass	
Section: 5.3 Supply disconnecting (isolating) device	Is there a hand-operated supply-disconnecting device provided for incoming supply, if there is more than one are they cross interlocked ?	5.3.1	✓	Pass	One hand-operated device for disconnection.

Section	Question	Ref	Status		Comments
Section: 5.3 Supply disconnecting (isolating) device	If a disconnector or a switch disconnector is used does it comply with EN60947-3 ?	5.3.2	!	Query	Check datasheet and provide in the technical file.
Section: 5.3 Supply disconnecting (isolating) device	If a circuit breaker is used does it comply with EN60947-2 when used for isolation?	5.3.2	!	Query	Check datasheet and provide in the technical file.
Section: 5.3 Supply disconnecting (isolating) device	If connection to mains is by a plug and socket is the current below 16Amps and the power rating less than 3KW?	5.3.2	✓	Not App	
Section: 5.3 Supply disconnecting (isolating) device	Does the supply-disconnecting device isolate the equipment from the supply and have one "ON" position marked "I" and one "OFF" position marked "O"?	5.3.3	✓	Pass	See datasheet in technical file
Section: 5.3 Supply disconnecting (isolating) device	Unless it is intended to be used as an emergency switching off device, is the supply-disconnecting device external operating handle, black or grey?	5.3.3, See 10.7.4&10.8.4.	!	Query	Red and yellow????? Check reasoning
Section: 5.3 Supply disconnecting (isolating) device	Does the supply-disconnecting device have a means for locking in the OFF position?	5.3.3	✓	Pass	Place available for padlock to be inserted.
Section: 5.3 Supply disconnecting (isolating) device	Does the supply-disconnecting device disconnect all live conductors from its power supply circuit?	5.3.3	✓	Pass	
Section: 5.3 Supply disconnecting (isolating) device	Does the supply-disconnecting device have a breaking capacity sufficient to interrupt any fault current?	5.3.3	!	Query	
Section: 5.3 Supply disconnecting (isolating) device	Is the disconnection device situated between 0.6m and 1.9m above floor level?. 1.7M is recommended.	5.3.4	!	Query	This is passed however, measure and take photograph for evidence.
Section: 5.3 Supply disconnecting (isolating) device	For circuits not requiring to be disconnected by the main supply-disconnecting device (Excepted Circuits) is there adequate information in the maintenance manual?	5.3.5	✓	Not App	
Section: 5.3 Supply disconnecting (isolating) device	Are permanently live circuits (Excepted Circuits) marked on the equipment, are these circuits wired with orange insulated cabling?	5.3.5	✓	Not App	
Section: 5.3 Supply disconnecting (isolating) device	Are the excepted circuits in accordance with the standard e.g. only used for lighting, maintenance plugs and sockets, undervoltage protection, measuring or parameter storage devices or control circuit interlocking etc.?	5.3.5	✓	Not App	
Section: 5.4 Devices for switching off for prevention of unexpected startups	Are devices fitted for `switching off` for the prevention of unexpected start up?	5.4	!	Query	
Section: 5.5 Devices for disconnecting electrical equipment	Are devices fitted for local isolation of electrical equipment, if so they should be appropriate and conveniently located, suitably placed and readily identifiable?	5.5	✓	Pass	

Section	Question	Ref	Status		Comments
Section: 5.6 Protection against unauthorised, inadvertent and/or mistaken connection	Is protection provided against unauthorised mistaken or inadvertent connection for the two devices identified above in 5.4 and 5.5?	5.6	✓	Pass	Padlock of isolation switch will prevent system from being powered on.
Section 6 - Protection Against Electric Shock					
Section: 6.2 Protection against direct contact	Are live parts located inside an enclosure with controlled access by, appropriate persons, allowed only by means of a key or a tool?	6.2.2	✓	Pass	Panel can only be openned using a key.
Section: 6.2 Protection against direct contact	If a key or a tool is not required to gain access, is it possible to disconnect all live parts inside the enclosure before it is opened?	6.2.2	✓	Not App	
Section: 6.2 Protection against direct contact	If opening without the use of a key or tool and without disconnection of live parts is allowable, are all live parts protected by at least IP2X?	6.2.2	✓	Not App	
Section: 6.2 Protection against direct contact	If live parts are protected by insulation, can the insulation only be removed by destroying it?	6.2.3	✓	Pass	
Section: 6.2 Protection against direct contact	Following disconnection are all live parts discharged to less than 60v after 5 seconds or 1 second for plugs?	6.2.4	!	Query	How long does it take for the drive to discharge?
Section: 6.3 Protection against indirect contact	Is protection against indirect contact provided to prevent hazardous conditions in the event of an insulation failure between live parts and exposed conductive parts? I.E. Through earthing or class 2 equipment.	6.3	✓	Pass	
Section: 6.3 Protection against indirect contact	Is automatic disconnection of the supply possible after an insulation failure, (e.g. RCD`s and Bonding)?	6.3.3	✓	Pass	
Section: 6.4 Protection by the use of PELV	Is there protection by the use of "protective extra low voltage" (PELV) 25Vac / 60Vdc?	6.4	!	Query	
Section: 6.4 Protection by the use of PELV	Are the PELV sources referenced to the protective bonding circuit?	6.4.1	!	Query	
Section: 6.4 Protection by the use of PELV	Are live parts of the PELV circuit electrically separated from other live circuits?	6.4.1	!	Query	
Section: 6.4 Protection by the use of PELV	Are plug and socket outlets of PELV sources incompatible with other voltage systems?	6.4.1	!	Query	
Section: 6.4 Protection by the use of PELV	Is the PELV derived from an isolating transformer or similar device, battery, or electronic power supply?	6.4.2	!	Query	

Section	Question	Ref	Status		Comments
Section 7 - Protection of Equipment					
Section: 7.2 Overcurrent protection	Is overcurrent protection provided where conductors and / or components are not rated for the potential overcurrent?	7.2.1	✓	Pass	
Section: 7.2 Overcurrent protection	Does the installation documentation state the data required to allow the installation overcurrent protective devices required on the supply conductors to the machine to be calculated?	7.2.2	!	Query	Provide proof of this
Section: 7.2 Overcurrent protection	Has overcurrent detection been applied to all live conductors?	7.2.3	!	Query	Provide proof of this
Section: 7.2 Overcurrent protection	Are control circuits protected against over current?	7.2.4	!	Query	Provide proof of this
Section: 7.2 Overcurrent protection	Has overcurrent detection been provided for general purpose power outlet sockets?	7.2.5	✓	Not App	Provide proof of this
Section: 7.2 Overcurrent protection	Do overcurrent detection devices protect local lighting circuits and are these separate from all other circuits?	7.2.6	!	Query	Provide proof of this
Section: 7.2 Overcurrent protection	Are transformers protected by over current protection and are they suitably rated including for inrush?	7.2.7	!	Query	Provide proof of this
Section: 7.2 Overcurrent protection	Are overcurrent protective devices located at the point where the conductor to be protected is connected to its supply?	7.2.8	!	Query	Provide proof of this
Section: 7.2 Overcurrent protection	Taking into account the prospective fault current, and any other currents at the point of installation, do protection devices have sufficient breaking capacity to disconnect a fault current?	7.2.9	!	Query	Provide proof of this
Section: 7.2 Overcurrent protection	Is the rated current or setting of any protective device been selected as low as practically possible but adequate for any anticipated overcurrents such as motor starting etc.	7.2.10	!	Query	Provide proof of this
Section: 7.3 Protection of motors against overheating	Has overload protection (e.g. overload, temperature and current limiting devices) been provided for each motor rated above 0.5kW?	7.3	!	Query	Provide proof of this
Section: 7.3 Protection of motors against overheating	If automatic interruption of the motor, under overload conditions, is unacceptable does the overload detector give a warning to the operator?	7.3	!	Query	Provide proof of this
Section: 7.3 Protection of motors against overheating	Has overload protection been provided in each live conductor?	7.3	!	Query	Provide proof of this
Section: 7.3 Protection of motors against overheating	If overload protection is achieved by switching off, are all Live conductors switched off?	7.3	!	Query	Provide proof of this
Section: 7.3 Protection of motors against overheating	If in-built thermal protection is used on the motor, can protection under stalled rotor or loss of phase conditions be achieved?	7.3	!	Query	Provide proof of this

Section	Question	Ref	Status		Comments
Section: 7.3 Protection of motors against overheating	Where a hazardous condition may occur has the automatic restarting of the motor been prevented following the operation of the overload protection device?	7.3	!	Query	Provide proof of this
Section: 7.4 Abnormal Temperature protection	Is over temperature detection provided for circuits that may reach abnormal temperatures such as resistance heating etc.?	7.4	!	Query	Provide proof of this
Section: 7.5 Protection against supply interruption, voltage reduction and subsequent restoration	Is there protection provided for mains failure or voltage reduction?	7.5	!	Query	Provide proof of this
Section: 7.5 Protection against supply interruption, voltage reduction and subsequent restoration	Has the automatic or unexpected restarting of the machine been prevented when the power is restored?	7.5.	!	Query	Provide proof of this
Section: 7.6 Motor overspeed protection	Is motor overspeed protection provided?	7.6	!	Query	Provide proof of this
Section: 7.7 Earth Fault / Residual current protection	Have RCD`s been used to protect equipment from damage due to low earth fault currents?	7.7	!	Query	Provide proof of this
Section: 7.8 Phase Sequence Protection	Has protection been provided to avoid a hazardous condition when the phase sequence of the supply to the machine is incorrect?	7.8	!	Query	Provide proof of this

Section	Question	Ref	Status		Comments
Section 8 - Equipotential Bonding					
Section: 8.2 Protective Bonding Circuit	Is continuity of the protective bonding circuits and metal parts achieved by connection to PE?	8.2.1	✓	Pass	
Section: 8.2 Protective Bonding Circuit	Are all protective bonding conductors copper?	8.2.2	✓	Pass	
Section: 8.2 Protective Bonding Circuit	Are all exposed conductive parts connected to the protective bonding circuit?	8.2.3	✓	Pass	
Section: 8.2 Protective Bonding Circuit	If conductive parts are removed for maintenance purposes, will the protective bonding circuit remain uninterrupted?	8.2.3	✓	Pass	
Section: 8.2 Protective Bonding Circuit	Are all bonding points free from mechanical, chemical or electromechanical damage and corrosion?	8.2.3	✓	Pass	
Section: 8.2 Protective Bonding Circuit	Are metal ducts and cable sheaths connected to the protective bonding circuit only and not used as protective conductors?	8.2.3	✓	Pass	
Section: 8.2 Protective Bonding Circuit	Are appropriate measures taken to ensure that the continuity of exposed or trailing cables is maintained?	8.2.3	✓	Not App	
Section: 8.2 Protective Bonding Circuit	For plug and socket connections: Do protective earthing contacts break after the other conductors?	8.2.6	✓	Not App	
Section: 8.2 Protective Bonding Circuit	Is there an earthing facility provided to connect other components?	8.2.7	✓	Pass	
Section: 8.2 Protective Bonding Circuit	Is there only one earth connection per terminal?	8.2.7, 13.1.1	!	Query	
Section: 8.2 Protective Bonding Circuit	Is bonding to a common reference potential provided, marked with earth symbol or coloured green/yellow?	8.2.6	✓	Pass	
Section: 8.2 Protective Bonding Circuit	Has protection been provided to avoid unintended operation as a result of insulation failure?	8.3.	!	Query	
Section: 8.2 Protective Bonding Circuit	Has the configuration of the bonding circuit taken into account the effects of electrical disturbances?	8.2.8	!	Query	

Section	Question	Ref	Status		Comments
Section 9 - Control Circuits and Control Functions					
Section: 9.1 Control Circuits	Is the supply of the control circuits derived through a transformer?	9.1.1	✓	Pass	
Section: 9.1 Control Circuits	If the control circuit is fed by a transformer is it under 277V?	9.1.2	✓	Pass	The transformer used is 240V to 110V
Section: 9.2 Control Functions	Is the stop function one of the three described? I.E. Cat 0, Cat 1, Cat 2	9.2.2	!	Query	
Section: 9.2 Control Functions	If a hazardous condition can result from mode selection is access to the mode selector restricted?	9.2.3	✓	Not App	
Section: 9.2 Control Functions	If safeguards are overridden do they comply with the requirements EN 60204 9.2.4? E.G. lockable mode switch / limited speed, limit movement or hold to run switch?	9.2.4	✓	Not App	
Section: 9.2 Control Functions	Is the start operation only possible when all safeguards are in place and functional?	9.2.5.2	✓	Pass	The safety systems are hardwired in to prevent operation when system is unsafe. The PLC system also reflects this.
Section: 9.2 Control Functions	Do Category 0 and Category 1 stop controls operate regardless of the operating mode?	9.2.5.3	!	Query	
Section: 9.2 Control Functions	Where used, does the Category 0 stop have priority over start function?	9.2.5.3	!	Query	
Section: 9.2 Control Functions	Is the Emergency Stop function Category 0 - power removed immediately?	9.2.5.4.2	✓	Pass	
Section: 9.2 Control Functions	Is the Emergency Stop function Category 1 - controlled stop?	9.2.5.4.2	!	Query	
Section: 9.2 Control Functions	Where used, is the Category 0 Emergency Stop hardwired using electromechanical components to remove the power from the machine?	9.2.5.4.2	!	Query	
Section: 9.2 Control Functions	Where used, does the Category 1 Emergency Stop rely upon electromechanical components for the final removal of power to the machine?	9.2.5.4.2	!	Query	
Section: 9.2 Control Functions	Has Emergency Switching off been provided where there is a risk of electric shock or another risk caused by electricity?	9.2.5.4.3	✓	Not App	
Section: 9.2 Control Functions	Are parts of machinery, the movement or action of which may lead to a hazardous condition monitored?	9.2.5.5	✓	Not App	
Section: 9.2 Control Functions	If monitoring is not possible have other means of safeguarding (e.g. overtravel limiters, motor over speed detection etc) been implemented?	9.2.5.5	✓	Pass	Ultimate limit switches are used to prevent the heads from being driven off the frame.
Section: 9.2 Control Functions	Is continuous actuation during hazardous conditions required for hold to run devices?	9.2.6.1 & EN 574	✓	Not App	
Section: 9.2 Control Functions	Is the two-hand control type 1 - Continuous concurrent actuation by both hands, releasing either control stops the machine?	9.2.6.2 & EN 574	✓	Not App	
Section: 9.2 Control Functions	Is the two-hand control Type 2 - As type 1 but requiring both actuation devices to be released before restarting?	9.2.6.2 & EN 574	✓	Not App	

Section	Question	Ref	Status		Comments
Section: 9.2 Control Functions	Is the two-hand control Type 3 - As type 2 but requiring concurrent actuation of the controls within 0.5s of each other?	9.2.6.2 & EN 574	✓	Not App	
Section: 9.2 Control Functions	Has an enabling device been fitted which allows motion when actuated in one position only?	9.2.6.3	!	Query	
Section: 9.2 Control Functions	If an enabling device is fitted, is it connected as a cat 0 or 1 stop and have ergonomic principles been taken into account?	9.2.6.3,& 9.2.5.3.	!	Query	
Section: 9.2 Control Functions	Do combined stop and start controls act as a secondary function?	9.2.6.4	!	Query	
Section: 9.2 Control Functions	Does the machine use a cableless control system (I.e. infra red, radio)?	9.2.7.1	✓	Not App	
Section: 9.2 Control Functions	Has means been provided to readily remove the power to the cableless control station?	9.2.7.1	✓	Not App	
Section: 9.2 Control Functions	Has unauthorised use of the cableless control station been prevented by the use of key operated switched or access codes?	9.2.7.1	✓	Not App	
Section: 9.2 Control Functions	Does the cableless control station carry an indicator showing which machine is to be controlled?	9.2.7.1	✓	Not App	
Section: 9.2 Control Functions	Have measures been taken to ensure that the machine will only respond to the signals from the intended cableless control station?	9.2.7.2	✓	Not App	
Section: 9.2 Control Functions	Does the cableless control station include a separate stop control that is not identified as an Emergency Stop?	9.2.7.3	✓	Not App	
Section: 9.2 Control Functions	Does the machine, which has a cableless control station, have means of automatically stopping the machine or preventing a hazardous situation if either a stop signal is received, a fault is detected or a valid signal is not received within a specified time period?	9.2.7.3	✓	Not App	
Section: 9.2 Control Functions	If the safety related control functions rely upon radio communication, can the error detection method cope with up to 3 errors?	9.2.7.3	✓	Not App	
Section: 9.2 Control Functions	If there is more than one cableless control station associated with the machine, has an enabling device been fitted to allow the operation of one control station at a time	9.2.7.4	✓	Not App	
Section: 9.2 Control Functions	If the cableless control station is battery powered have measures been taken to avoid a hazardous condition should a large variation in supply voltage occur?	9.2.7.5	✓	Not App	
Section: 9.3 Protective Interlocks	After closing or resetting an interlocked safeguard is further operator intervention required before motion or operation of the machine can be initiated?	9.3.1	✓	Not App	

Section	Question	Ref	Status		Comments
Section: 9.3 Protective Interlocks	Where an over travel can cause a hazardous condition has a position sensor or limit switch been provided to initiate appropriate control action?	9.3.2	✔	Pass	An unltimate limit switch has been used for both sides of the O-frame. This cuts all power the the O-frame and closes the shutter. The guage would require manual resetting. This is done to ensure that the operators need to call a technician and they do not continue to run with a fault.

Section	Question	Ref	Status		Comments
Section: 9.3 Protective Interlocks	Have devices been fitted to ensure the correct operation of auxiliary functions (e.g. coolant supplies, swarf removal)?	9.3.3	✓	Not App	
Section: 9.3 Protective Interlocks	Are control devices (e.g. contactors, relays etc) interlocked against incorrect operation?	9.3.4	!	Query	
Section: 9.3 Protective Interlocks	Where reverse current breaking in a motor is used are measures taken to avoid motor starting in the opposite direction?	9.3.5	✓	Not App	
Section: 9.4 Control Functions in the event of failure	Where a failure or disturbance in the electrical equipment can cause a hazardous condition have measures been implemented to minimise the probability of occurrence of failure or disturbance (Fail Safe)?	9.4.1	✓	Pass	
Section: 9.4 Control Functions in the event of failure	In the event of failure of the electrical equipment has the use of proven circuit techniques and components been adopted?	9.4.2.1	!	Query	
Section: 9.4 Control Functions in the event of failure	In the event of a single fault in the electrical equipment, has redundancy been provided to reduce the probability of a hazardous condition?	9.4.2.2	✓	Not App	
Section: 9.4 Control Functions in the event of failure	Has diversity been provided in the control circuits to reduce the probability of hazards under fault conditions?	9.4.2.3	!	Query	
Section: 9.4 Control Functions in the event of failure	Are functional tests carried out either automatically by the control system or manually at start up and at predetermined intervals?	9.4.2.4	!	Query	
Section: 9.4 Control Functions in the event of failure	If an earth fault occurs on a control circuit, has protection been provided to: a) prevent unintentional starting and hazardous motions; b) not prevent stopping of the machine?	9.4.3.1	!	Query	
Section: 9.4 Control Functions in the event of failure	Where the control system uses memory devices, has non-volatile memory been used to prevent malfunction in the event of a power failure?	9.4.3.2	✓	Pass	The PLC has a memory card in which the program is stored on. The drive has non-volatile memory which stores when turned off.
Section: 9.4 Control Functions in the event of failure	Have appropriate measures been taken to prevent a hazardous condition in a situation where the continuity of the safety related control system relies upon sliding contacts?	9.4.3.3	✓	Not App	

Section	Question	Ref	Status		Comments
Section 10 - Operator Interface and Machine Mounted Control Devices					
Section: 10.1 Operator interface and machine - mounted control devices - General	Are machine mounted control devices accessible for normal use, but mounted in such a way as to prevent damage from activities such as material handling??	10.1.2	✓	Pass	
Section: 10.1 Operator interface and machine - mounted control devices - General	Does protection against foreign influence control devices have an IP rating of at least IP 54 but IP 55 is desirable?	10.1.3	!	Query	
Section: 10.1 Operator interface and machine - mounted control devices - General	Are position sensors arranged such that they will not be damaged in the event of over travel?	10.1.4	✓	Pass	
Section: 10.1 Operator interface and machine - mounted control devices - General	Are control devices on pendants and portable control stations selected to minimise the possibility of inadvertent operation caused by shock or vibration?	10.1.5	✓	Not App	
Section: 10.2 Push Button	Are push buttons colour coded in accordance with table 2	10.2,(10.2.1) Table 2	✗	Fail	The push buttons used for the prototype are incorrect. These colours would be corrected when the system is rolled out plant wide.
Section: 10.2 Push Button	Are push buttons marked with the recommended IEC symbols according to Table 3 EN60204 ?	10.2.2	✗	Fail	This will be corrected for the final install
Section: 10.3 Indicator lights and displays	Are the indicators correctly coloured according to table 4 EN 60204?	10.3.2	!	Query	
Section: 10.3 Indicator lights and displays	Are displays visible from the normal position of the operator?	10.3	✓	Pass	
Section: 10.3 Indicator lights and displays	If the display is used as a warning device, does it flash (or rotate) and is it accompanied by an audible warning device?	10.3	!	Query	At present the alarms flash, look into wether audible alarms can be added to the HMI screens.
Section: 10.4 Illuminated push buttons	Have illuminated push buttons been colour coded in accordance with tables 2 and 3 of EN 60204?	10.4	✓	Not App	
Section: 10.5 Rotary Devices	Are rotary control devices mounted in such a way as to prevent rotation of the non-rotary part of the device?	10.5	✓	Pass	
Section: 10.6 Start Devices	Are start devices mounted to minimise inadvertent operation?	10.6	!	Query	

Section	Question	Ref	Status		Comments
Section: Emergency Stop Devices	Are emergency stop devices easily accessible?	10.7.1	!	Query	Ensure table is not in the way of the E-stop.
Section: Emergency Stop Devices	Are all emergency stop devices self- latching with positive operation?	10.7.2	✓	Pass	
Section: Emergency Stop Devices	Is it possible to restore the emergency stop circuit only after the emergency stop device has been manually reset?	10.7.3	✓	Pass	
Section: Emergency Stop Devices	Do the emergency stop devices have a red actuator (palm or mushroom head for pushbuttons) with a yellow background?	10.7.3	✗	Fail	No yellow background present.
Section: 10.8 Emergency Switching of devices	If the supply disconnecting device is to be operated as an emergency stop does it meet the requirements of EN 60204 5.3.2 (sub clause a, b, or c), 10.8.1 and 10.8.4?	10.8	!	Query	Check these and provide evidence in the technical file.
Section: 10.8 Emergency Switching of devices	Is it possible to restore the emergency switching off circuit only after the emergency switching off device has been manually reset?	10.8.3	✓	Pass	
Section: 10.8 Emergency Switching of devices	Do the emergency switching off devices have a red actuator (palm or mushroom head for pushbuttons) with a yellow background?	10.8.3	✗	Fail	No yellow background present.
Section: 10.8 Emergency Switching of devices	If the supply disconnecting device is to be operated as an emergency switching off device does it meet the requirements of EN 60204 10.7.1 and 10.8.4?	10.8	!	Query	Check these and provide evidence in the technical file.

Section	Question	Ref	Status		Comments
Section 11 - Controlgear - Location, Mounting and Enclosures					
Section: 11.2 Location and mounting	Is the status of all digital inputs and outputs provided for all electronic equipment?	11.2	✓	Pass	
Section: 11.2 Location and mounting	Where applicable are all input / output racks, processor racks and power supplies bonded together in accordance with the suppliers specifications and bonded to the protective bonding circuit?	11.2	✓	Pass	
Section: 11.2 Location and mounting	Is electronic equipment used compliant with European Standards?	11.2	✓	Pass	See datasheets in the technical file.
Section: 11.2 Location and mounting	Have means been provided to prevent unauthorised alterations to the memory of programmable devices?	11.2	✓	Pass	The PLC and HMI screens can be password protected to protect against unauthorised alterations.
Section: 11.2 Location and mounting	Have means been provided to verify that the software on re-programmable logic is in accordance with the relevant program documentation?	11.2	!	Query	
Section: 11.2 Degrees of protection	Are all items of control gear easily identifiable without moving them or the wiring?	11.2	✓	Pass	
Section: 11.2 Degrees of protection	Is all control gear mounted so that it is easily operated and maintained from the front?	11.2	✓	Not App	
Section: 11.2 Degrees of protection	Are devices that require regular maintenance and adjustment positioned between 0.4m and 2.0m above the servicing level?	11.2	✓	Pass	On the prototype the belts and pullies will require monitoring. These are easily accessible.
Section: 11.2 Degrees of protection	Are there no other devices except those for operating, indicating, measuring, and cooling mounted on the enclosure door or on the normally removable access covers of enclosures.?	11.2	✓	Pass	
Section: 11.2 Degrees of protection	Where control devices are connected through plug in arrangements, has their association been made clear by markings, polarisation or both?	11.2	✓	Pass	The plugs that are removable and marked and the plugs can only be plugged in, in one direction.
Section: 11.2 Degrees of protection	Where plug in devices are handled during normal operation have they been provided with non interchangeable features to prevent malfunction?	11.2	✓	Not App	
Section: 11.2 Degrees of protection	Where plug and socket arrangements are used during normal operation, have they been located and mounted so as to provide unobstructed access?	11.2	✓	Not App	
Section: 11.2 Degrees of protection	Where test points have been provided are they: a) Mounted to provide unobstructed access, b) clearly marked in accordance with the documentation, c) adequately insulated, d) sufficiently spaced for connection of the test equipment?	11.2	✓	Not App	
Section: 11.2 Degrees of protection	Are all non-electrical parts and devices, that are not directly associated with the electrical equipment, located outside of the enclosure containing control gear (Solenoid valves should be in a separate compartment)?	11.2	✓	Not App	

Section	Question	Ref	Status		Comments
Section: 11.2 Degrees of protection	Have control devices that are connected to the supply voltage and those that are connected to control voltages only been grouped separately?	11.2	✓	Pass	
Section: 11.2 Degrees of protection	Have creepage and clearance distances, specified by the manufacturer, for all devices been maintained?	11.2	✗	Fail	This has not been met. The drive reqires 75cm clearance above and below. As the drive was retrofitted this clearance was not possible. When the system is rolled out this clearance will need to be taken into concideration.
Section: 11.2 Degrees of protection	Are heat generating components located so that the temperature of each component in the vicinity remains within the required limit?	11.2	✓	Pass	Acceptable temperature is proven in apprendix 10.6
Section: 11.3 Degrees of protection	Has all control gear been protected against the ingress of foreign solid objects and liquids, taking into account the potential location and environmental conditions where the machine will be in use?	11.3 & EN 60529	✓	Pass	
Section: 11.4 Enclosures, doors and openings.	Are enclosures suitable for the environment in which they are to be located?	11.4	✓	Pass	
Section: 11.4 Enclosures, doors and openings.	Are enclosures, doors and openings hinged or fixed?	11.4	✓	Pass	
Section: 11.4 Enclosures, doors and openings.	If windows are used for viewing internal indicating devices, is the material suitable to withstand mechanical and chemical stresses?	11.4	✓	Not App	
Section: 11.4 Enclosures, doors and openings.	Once the door of the enclosure is closed, is the degree of protection required for the machine maintained by the enclosure?	11.4	✓	Pass	
Section: 11.4 Enclosures, doors and openings.	Are all enclosures containing electrical equipment and compartments containing coolant, lubricating and hydraulic fluids etc sealed from each other?	11.4	✓	Not App	Only one cabinet
Section: 11.4 Enclosures, doors and openings.	If equipment can attain a surface temperature that may cause fire or harmful effects is it located in an enclosure that will withstand the heat and either be positioned away from adjacent equipment to allow heat dissipation or screened by material that will withstand the heat?	11.4	✓	Not App	
Section: 11.5 Enclosures, doors and openings.	Are doors in gangways and for access to electrical operating areas at least 0.7m wide by 2m high, do they open outwards and have means of opening from the inside without the use of a tool?	11.5	✓	Not App	

Section	Question	Ref	Status		Comments
Section 12 - Conductors and Cables					
Section: 12.1 Conductors and Cables	Are conductors and cables suitable for operating conditions?	12.1	✓	Pass	
Section: 12.2 Conductors and Cables	Do conductors made of a material other than copper have a minimum cross sectional area to meet the requirements of table 5 of EN 60204 (Mechanical Strength)	12.2	✓	Not App	
Section: 12.3 Conductors and Cables	Are types of insulation in accordance with EN 60204 12.3?	12.3	✓	Pass	
Section: 12.4 Conductors and Cables	Do conductors have adequate current carrying capacity in accordance with EN 60204? (Example table section 12.4)	12.4	✓	Pass	
Section: 12.5 Conductors and Cables	Have calculations or measurements been made to ensure that the voltage drop in the conductors between the point of supply and the load does not exceed 5% of the nominal voltage under normal operating conditions?	12.5	✓	Pass	This will be entered into the technical file
Section: 12.6 Conductors and Cables	Are flexible cables constructed of class 5 or class 6 conductors (Very fine strands)?	12.6	!	Query	
Section: 12.6 Conductors and Cables	Are cables which are subjected to severe duties protected against abrasion, kinking and stressing?	12.6	✓	Not App	
Section: 12.6 Conductors and Cables	Are machine cable handling systems designed so that the tensile stress of the conductors is less than 15N/mm2?	12.6	✓	Not App	
Section: 12.6 Conductors and Cables	If cables are wound on drums, is the CSA of the cable sufficient not to allow the maximum allowable conductor temperature to be exceeded under normal load conditions?	12.6	✓	Not App	
Section: 12.7 Conductor wires, bars and slip-ring assemblies.	Has protection against direct contact with collector wires, collector bars and slip ring assemblies been provided?	12.7	✓	Not App	
Section: 12.7 Conductor wires, bars and slip-ring assemblies.	Where collector wires, collector bars and slip ring assemblies form part of the protective bonding circuit, have then been installed so that they do not carry current under normal conditions?	12.7	✓	Not App	
Section: 12.7 Conductor wires, bars and slip-ring assemblies.	Are protective conductor current collectors shaped so that they are not interchangeable with other current collectors?	12.7	✓	Not App	
Section: 12.7 Conductor wires, bars and slip-ring assemblies.	Where removable current collectors have a disconnector function, are they designed so that the protective conductor is disconnected after the live conductors and reconnected before the live conductors?	12.7	✓	Not App	

Section	Question	Ref	Status		Comments
Section: 12.7 Conductor wires, bars and slip-ring assemblies.	Are clearance distances between conductors, and between adjacent systems, of collector wires, collector bars, slip-ring assemblies and their current collectors suitable for operation in pollution degree 3 conditions?	12.7	!	Query	
Section: 12.7 Conductor wires, bars and slip-ring assemblies.	Are creepage distances between conductors, and between adjacent systems, of collector wires, collector bars, slip-ring assemblies and their current collectors suitable for operation in pollution degree 3 conditions?	12.7	!	Query	
Section: 12.7 Conductor wires, bars and slip-ring assemblies.	Where isolated sections are required, are collector wires and collector bars arranged to prevent the energisation of adjacent sections by the current collectors themselves?	12.7	!	Query	
Section: 12.7 Conductor wires, bars and slip-ring assemblies.	Are collector wires, collector bars and slip rings assemblies, used for power circuits, grouped separately from those used for control circuits?	12.7	!	Query	
Section: 12.7 Conductor wires, bars and slip-ring assemblies.	Are collector wires, collector bars and slip ring assemblies capable of withstanding mechanical forces and thermal effects of short-circuit currents?	12.7	!	Query	
Section: 12.7 Conductor wires, bars and slip-ring assemblies.	Are removable covers for underground / under floor collector wire and collector bar systems designed so that they cannot be opened without the use of a tool?	12.7	!	Query	
Section: 12.7 Conductor wires, bars and slip-ring assemblies.	Where collector bars are installed in a common metal enclosure are the individual sections of the enclosure bonded together and connected to earth?	12.7	!	Query	
Section: 12.7 Conductor wires, bars and slip-ring assemblies.	Do underground / under floor collector bar ducts have drainage facilities?	12.7	✓	Not App	

Section	Question	Ref	Status		Comments
Section 13 - Wiring Practices					
Section: 13.1 Connection and Routing.	Are all connections secured against accidental loosening, especially the protective grounding system?	13.1.1	✓	Pass	
Section: 13.1 Connection and Routing.	Are terminals suitable for the cross sectional area of the conductor being terminated?	13.1.1	✓	Pass	
Section: 13.1 Connection and Routing.	Have multiple connections been made only to terminals that are designed for that purpose?	13.1.1	✓	Pass	
Section: 13.1 Connection and Routing.	Has only one protective conductor been connected to one terminal connecting point?	13.1.1	!	Query	
Section: 13.1 Connection and Routing.	Are soldered connections made on terminals suitable for soldering?	13.1.1	✓	Pass	
Section: 13.1 Connection and Routing.	Are terminals and identification tags legible, permanent and do they correspond to the circuit diagrams?	13.1.1	✗	Fail	Some labelled are temporarily semi-permanent as permanent labels are on order
Section: 13.1 Connection and Routing.	Are conductor strands retained when conductors are terminated at devices or terminals not equipped with this facility?	13.1.1	✓	Not App	
Section: 13.1 Connection and Routing.	Does the installation of conductors and cables run from terminal to terminal without splices or joints?	13.1.2	✓	Pass	
Section: 13.1 Connection and Routing.	Are terminations of cables supported to prevent mechanical stress on the conductors?	13.1.2	✓	Pass	Looped and cable-tied where required
Section: 13.1 Connection and Routing.	Are conductors, that are laid side by side or in the same duct, insulated to the highest voltage to which any of the conductors in that duct can be subjected?	13.1.3	!	Query	Provide proof of this
Section: 13.2 Identification and conductors.	Are conductors identifiable at each termination in accordance with the technical documentation?	13.2.1	✓	Pass	Identifiable as in appendix 10.5
Section: 13.2 Identification and conductors.	Are protective conductors readily distinguishable by shape, location, marking or colour (i.e. Green and Yellow)?	13.2.2	✓	Pass	
Section: 13.2 Identification and conductors.	Where the neutral conductor is identified by colour, is the colour light blue?	13.2.3	✓	Not App	Not identified by colour
Section: 13.2 Identification and conductors.	Are other conductors identified by coloured stripes, number, alphanumeric or a combination. If by colour do the colours correspond to the guidelines in 13.2.4	13.2.4	!	Query	Colours used are works standard, and colours correspond to voltages
Section: 13.3 Wiring inside enclosures	Is wiring inside enclosures supported?	13.3	✓	Pass	Trunking used
Section: 13.3 Wiring inside enclosures	Are conductors making connections to devices mounted on doors or other movable parts anchored to the fixed part and to the movable part independently of the electrical connection?	13.3	✓	Pass	
Section: 13.4 Wiring outside enclosures.	Is wiring outside of enclosures mechanically protected?	13.4	✓	Pass	

Section	Question	Ref	Status		Comments
Section: 13.4 Wiring outside enclosures.	Has the protection degree of the enclosure remained unaltered by the introduction of cables or ducts with bushings and glands etc?	13.4.1	✓	Pass	Stuffing glands used
Section: 13.4 Wiring outside enclosures.	Are conductors and their connections external to the electrical enclosure enclosed in suitable ducts or of a type of cable able to withstand the duty required?	13.4.2	✓	Not App	
Section: 13.4 Wiring outside enclosures.	Is connection to moving parts made with conductors suitable for flexing?	13.4.3	✓	Not App	
Section: 13.4 Wiring outside enclosures.	Are all cables that are subjected to movement suitably supported to prevent straining and sharp flexing?	13.4.3	✓	Pass	
Section: 13.4 Wiring outside enclosures.	Are all bending radii of cables controlled in accordance with the EN 60204 13.4.3 so that they do not cause damage to the cable?	13.4.3	!	Query	This should be checked and corrected at final instal if needed
Section: 13.4 Wiring outside enclosures.	Are connections between several machine mounted switching devices made through terminals forming intermediate test points as recommended in EN 60204?	13.4.4	✓	Not App	
Section: 13.4 Wiring outside enclosures.	Are plug and socket combinations of such a size, contact pressure and wiping action to ensure electrical continuity?	13.4.5	✓	Not App	
Section: 13.4 Wiring outside enclosures.	Are clearance distances between contacts on plug and socket combinations adequate for the voltages used, and are these distances maintained during insertion and removal of the connectors?	13.4.5	✓	Not App	
Section: 13.4 Wiring outside enclosures.	Is unintentional contact with live parts, during insertion and removal of the plug and socket combination, prevented?	13.4.5	✓	Not App	
Section: 13.4 Wiring outside enclosures.	Has the plug and socket combination been designed so that the protective bonding circuit connection is made before the live connections are made and remains until all live connections are disconnected?	13.4.5	✓	Not App	
Section: 13.4 Wiring outside enclosures.	Are all plug and socket combinations, that are rated above 16A, of the retaining type?	13.4.5	✓	Not App	
Section: 13.4 Wiring outside enclosures.	Are all plug and socket combinations, that are rated above 63A, interlocked with a switch allowing disconnection only when the switch is in the off position?	13.4.5	✓	Not App	
Section: 13.4 Wiring outside enclosures.	Are multiple plug and socket combinations on one machine clearly identifiable and configured to prevent incorrect insertion?	13.4.5	✓	Not App	
Section: 13.4 Wiring outside enclosures.	Have terminals or plug and socket combinations been provided where it is necessary that wiring be disconnected for shipment?	13.4.6	✓	Not App	
Section: 13.4 Wiring outside enclosures.	If additional conductors have been provided for maintenance or repair, have they been connected to terminals or isolated to prevent contact with live parts.	13.4.7	✓	Not App	

Section	Question	Ref	Status		Comments
Section: 13.5 Ducts, connection boxes and other boxes.	Are sharp edges in ducts and fittings removed?	13.5.1	✔	Pass	Sharp edges filed and covered where needed

Section	Question	Ref	Status		Comments
Section: 13.5 Ducts, connection boxes and other boxes.	Are ducts and cable trays rigidly supported and positioned away from moving parts to prevent damage and wear?	13.5.1	✔	Pass	
Section: 13.5 Ducts, connection boxes and other boxes.	Do fill percentages of ducts, based on straightness and length of duct and the flexibility of the conductors, allow additional cables to be installed?	13.5.2	✔	Pass	
Section: 13.5 Ducts, connection boxes and other boxes.	Are rigid metal conduit and fittings of galvanised steel, or of corrosion resistant material, no dissimilar metals to be connected together?	13.5.3	✔	Not App	
Section: 13.5 Ducts, connection boxes and other boxes.	Are flexible metal conduits consisting of flexible metal tubing or woven armour suitable for the environment?	13.5.4	✔	Not App	
Section: 13.5 Ducts, connection boxes and other boxes.	Is flexible non-metallic conduit resistant to kinking and have suitable physical characteristics similar to those of the sheath of multi-conductor cables?	13.5.5	✔	Not App	
Section: 13.5 Ducts, connection boxes and other boxes.	Are cable trunking systems rigidly supported and clear of all moving or contaminating portions of the machine?	13.5.6	✔	Pass	
Section: 13.5 Ducts, connection boxes and other boxes.	Where the cable trunking systems are jointed, do the joints between the sections fit tightly?	13.5.6	✔	Pass	
Section: 13.5 Ducts, connection boxes and other boxes.	Are all compartments isolated from coolant or oil reservoirs and fully enclosed?	13.5.7	✔	Not App	
Section: 13.5 Ducts, connection boxes and other boxes.	Are connection boxes readily accessible for maintenance purposes?	13.5.8	✔	Pass	Motor connect box is accessable from the top of the motor
Section: 13.5 Ducts, connection boxes and other boxes.	Are connection boxes protected to the same IP rating as the machine?	13.5.8	!	Query	
Section: 13.5 Ducts, connection boxes and other boxes.	Do motor connection boxes contain connections for the motor and motor mounted devices only?	13.5.9	✔	Pass	

Section	Question	Ref	Status		Comments
Section 14 - Electric Motors and Associated Equipment					
Section: 14.1 General Requirements.	Do electric motors conform to EN 60034-1?	14.1	✓	Pass	Datasheets for all components used can be found in the technical file.
Section: 14.2 Motor enclosures.	Is motor enclosure according to EN60034-5?	14.2	!	Query	Motor does not have an enclosure as such - check requirements
Section: 14.2 Motor enclosures.	Is the degree of protection provided by the motor at least IP23?	14.2	✓	Pass	
Section: 14.4 Motor mounting and components.	Is the motor mounted so inspection, maintenance adjustment and alignment, lubrication and replacement is possible?	14.4	✓	Pass	
Section: 14.4 Motor mounting and components.	Is the motor mounted so that proper cooling is ensured and that the temperature rise remains within the limits of the insulation class?	14.4	✓	Pass	
Section: 14.4 Motor mounting and components.	Has the motor been located so that there is no opening between the motor compartment and any other compartment that does not meet the motor requirements?	14.4	✓	Pass	
Section: 14.5 Criteria for motor selection.	Are electric motors and associated devices suitable for use within the expected physical environment?	14.5	✓	Pass	
Section: 14.6 Protective devices for mechanical breaks.	Does the operation of the overload and overcurrent protective devices for mechanical brake actuators initiate the simultaneous de-energisation of the associated machine actuators?	14.6	!	Query	Provide proof of this
Section 15 - Accessories and Lighting					
Section: 15.1 Accessories	If socket outlets have been provided, do they conform to IEC 60309-1 or are they marked with voltage and current ratings?	15.1	✓	Not App	
Section: 15.1 Accessories	Is there continuity of the protective bonding circuit to the socket outlets?	15.1	✓	Not App	
Section: 15.1 Accessories	Are all unearthed socket conductors protected against overcurrent and overload?	15.1	✓	Not App	
Section: 15.2 Local lighting of the machine and equipment.	Has local (non stroboscopic) lighting been supplied and if so is it bonded to the protective bonding circuit and is the ON/OFF switch mounted away from the lamp holder?	15.2.1	✓	Not App	
Section: 15.2 Local lighting of the machine and equipment.	Is the supply voltage below 250v (preferably less than 50v)?	15.2.2	✓	Not App	
Section: 15.2 Local lighting of the machine and equipment.	Has the lighting been supplied via an isolating transformer with means to disconnect the supply on the primary side and overcurrent protection on the secondary side?	15.2.2	✓	Not App	
Section: 15.2 Local lighting of the machine and equipment.	Are the lighting fittings suitable for the environment and are they protected against direct contact with hazardous parts?	15.2.4	✓	Not App	

Section	Question	Ref	Status		Comments
Section 16 - Marking, Warning Signs and Reference Designations					
Section: 16.0 Marking, warning signs and reference designations.	Warning signs or labels are manufactured to be suitably durable to withstand the operating environment and remain legible throughout its intended working life.	16.1	✓	Pass	As the syste is a prototype the labels are printed, these will be made of plastic for the final system
Section: 16.0 Marking, warning signs and reference designations.	Where it is not clear that an enclosure contains electrical devices, has an electrical warning been fitted on the enclosure door and if there potentially any hot surfaces are they clearly labelled as such ?	16.2	!	Query	Electrical warnings to be placed on control cabinet
Section: 16.0 Marking, warning signs and reference designations.	Are control devices used in man-machine interface marked clearly and durably in relation to their function either on or adjacent to the unit?	16.3	✗	Fail	This will be required for the final system
Section: 16.0 Marking, warning signs and reference designations.	Has a nameplate been fitted to the machine detailing the following information : Supplier name, serial name, rated voltage, number of phases, frequency, full load current, short circuit interrupting capacity of the overcurrent devices and reference to the electrical drawings?	16.4	✗	Fail	This is required
Section: 16.0 Marking, warning signs and reference designations.	Have all enclosures, assemblies, control devices and components been plainly identified with the same reference designation as shown in the machine documentation?	16.5	✓	Pass	
Section 17 - Technical Documentation					
Section: 17 Technical documentation.	Is technical documentation provided with each item and available?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Is documentation provided for installation, operation and maintenance?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include a description of the equipment?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include electrical supply requirements.	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include information on the physical environment?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include a system (block) diagram where appropriate?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include a circuit diagrams?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include information on programming?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include information on the sequence of operation?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include information on frequency of inspection?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include information on the frequency and method of functional testing?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include instruction for adjustment, maintenance and repair?	17.2	!	Query	This will be provided once the technical file is completed

Section	Question	Ref	Status		Comments
Section: 17 Technical documentation.	Does the technical information include a description of protective devices?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include a description (including interconnection diagrams) of the safeguards, interlocking functions, and interlocking of guards for potentially hazardous motions, particularly for machines operating in a co-ordinated manner?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include safeguarding and the means provided for suspending the safeguarding where required?	17.2	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Have all documents been listed with document numbers and titles?	17.3	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include information for site installation?	17.4	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include an installation diagram giving all information necessary for setting up the machine and preparing for use?	17.5	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include current diagrams where required?	17.6	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include an operating manual?	17.7	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include a maintenance manual detailing procedures for adjustment, servicing and preventative inspection and repair?	17.8	!	Query	This will be provided once the technical file is completed
Section: 17 Technical documentation.	Does the technical information include a spare parts list?	17.9	!	Query	This will be provided once the technical file is completed
Section 18 - Verification					
Section: 18.1 Technical documentation.	Does the technical information include testing and reports as per EN60204? (Standard : EN 60204 18.1)	18.1	!	Query	This will be provided once the technical file is completed

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Section - 1.1 GENERAL REMARKS				
Section - 1.1.2 Principles of safety integration				
Machinery must be designed and constructed so that it is suitable for its function, and can be operated, adjusted and maintained without putting persons at risk when these operations are carried out under the conditions foreseen but also taking into account any reasonably foreseeable misuse thereof. The aim of measures taken must be to eliminate any risk throughout the foreseeable lifetime of the machinery including the phases of transport, assembly, dismantling, disabling and scrapping.	The machinery has been designed to minimize risk at all stages of its use.	✔	Pass	
In selecting the most appropriate methods, the manufacturer or his authorised representative must apply the following principles, in the order given: a) eliminate or reduce risks as far as possible (inherently safe machinery design and construction), b) take the necessary protective measures in relation to risks that cannot be eliminated, c) inform users of the residual risks due to any shortcomings of the protective measures adopted, d) indicate whether any particular training is required and specify any need to provide personal protective equipment.	The Risk Assessment in the Technical File shows how this has been done.	✔	Pass	Warning signs in place and guarding considered
When designing and constructing machinery and when drafting the instructions, the manufacturer or his authorised representative must envisage not only the intended use of the machinery but also any reasonably foreseeable misuse thereof. The machinery must be designed and constructed in such a way as to prevent abnormal use if such use would engender a risk. Where appropriate, the instructions must draw the user's attention to ways - a) which experience has shown might occur -b) in which the machinery should not be used.	The Risk Assessment includes an assessment of reasonably foreseeable misuse and measures taken to minimize the risk from it.	✔	Pass	Locked isolated when not being used by the developer, only to be under sevelopers supervison.
Machinery must be designed and constructed to take account of the constraints to which the operator is subject as a result of the necessary or foreseeable use of personal protective equipment.	The Risk Assessment includes an assessment of measures to allow for the constraints cause by foreseeable use of PPE.	✔	Pass	
Machinery must be supplied with all the special equipment and accessories essential to enable it to be adjusted, maintained and used safely.	No special equipment required. / The following special equipment is required./ Refer to operation manual section.....	✔	Pass	

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Section - 1.1.3 Materials and products				
The materials used to construct machinery or products used or created during its use must not endanger persons' safety or health. In particular, where fluids are used, machinery must be designed and constructed to prevent risks due to filling, use, recovery or draining.	Normal engineering materials and products are used which present small and well understood risks.	✔	Pass	Materials are from reputable suppliers and are well known on site
Section - 1.1.4 Lighting				
Machinery must be supplied with integral lighting suitable for the operations concerned where the absence thereof is likely to cause a risk despite ambient lighting of normal intensity. Internal parts requiring frequent inspection and adjustment, and maintenance areas must be provided with appropriate lighting.	Ambient lighting is sufficient. / The following lighting is provided	✔	Pass	Lighting in workshop is sufficient
Machinery must be designed and constructed so that there is no area of shadow likely to cause nuisance, that there is no irritating dazzle and that there are no dangerous stroboscopic effects on moving parts due to the lighting.	The machine has been designed so there are no areas of shadow and no risk of stroboscopic effects.	✔	Not App	
Internal parts requiring frequent inspection and adjustment, and maintenance areas must be provided with appropriate lighting.	No lighting required for maintenance or internal parts./ The following lighting is provided.	✔	Pass	Lighting in workshop is sufficient

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Section - 1.1.5 Design of machinery to facilitate its handling				
Machinery, or each component part thereof, must: a) be capable of being handled and transported safely, b) be packaged or designed so that it can be stored safely and without damage.	The machine is designed so it can be stored, handled and transported safely.	✔	Not App	Machine is not meant to be moved
During the transportation of the machinery and/or its component parts, there must be no possibility of sudden movements or of hazards due to instability as long as the machinery and/or its component parts are handled in accordance with the instructions.	The machine and its components can be transported without risk of sudden movements or hazards due to instability.	✔	Not App	
Where the weight, size or shape of machinery or its various component parts prevents them from being moved by hand, the machinery or each component part must: a) either be fitted with attachments for lifting gear, or b) be designed so that it can be fitted with such attachments, or c) be shaped in such a way that standard lifting gear can easily be attached.	The machinery is fitted with suitable arrangements for mechanical lifting. These are indicated on the machine and are described in the manual.	✔	Not App	
Where machinery or one of its component parts is to be moved by hand, it must: a) either be easily moveable, or b) be equipped for picking up and moving safely.	Machinery and components are not to be moved by hand.	✔	Not App	
Special arrangements must be made for the handling of tools and/or machinery parts which, even if lightweight, could be hazardous.	No tools or parts which require special handling	✔	Not App	
Section - 1.1.6 Ergonomics				
Under the intended conditions of use, the discomfort, fatigue and physical and psychological stress faced by the operator must be reduced to the minimum possible, taking into account ergonomic principles such as: a) allowing for the variability of the operator's physical dimensions, strength and stamina, b) providing enough space for movements of the parts of the operator's body, c) avoiding a machine-determined work rate, d) avoiding monitoring that requires lengthy concentration, e) adapting the man/machinery interface to the foreseeable characteristics of the operators.	Considered in the design. Discuss if necessary.	✔	Not App	As a prototype, this achine will not be used for long periods of time

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Section - 1.1.7 Operating positions				
The operating position must be designed and constructed in such a way as to avoid any risk due to exhaust gases and/or lack of oxygen.	No significant risks due to exhaust fumes or lack or oxygen.	✔	Pass	
If the machinery is intended to be used in a hazardous environment presenting risks to the health and safety of the operator or if the machinery itself gives rise to a hazardous environment, adequate means must be provided to ensure that the operator has good working conditions and is protected against any foreseeable hazards.	Not for use in a hazardous environment.	✔	Pass	
Where appropriate, the operating position must be fitted with an adequate cabin designed, constructed and/or equipped to fulfil the above requirements. The exit must allow rapid evacuation. Moreover, when applicable, an emergency exit must be provided in a direction which is different from the usual exit.	No operator cabin necessary / Current cabin is utilised.	✔	Pass	
Section - 1.1.8 Seating				
Where appropriate and where the working conditions so permit, work stations constituting an integral part of the machinery must be designed for the installation of seats. If the operator is intended to sit during operation and the operating position is an integral part of the machinery, the seat must be provided with the machinery.	No integral work stations where seating can be used. / Conventional seating can be used at the operator position. / Seating is installed.	✔	Pass	Chair available if needed
The operator's seat must enable him to maintain a stable position. Furthermore, the seat and its distance from the control devices must be capable of being adapted to the operator.	No seat required or discuss how seating can be adjusted.	✔	Pass	
If the machinery is subject to vibrations, the seat must be designed and constructed in such a way as to reduce the vibrations transmitted to the operator to the lowest level that is reasonably possible. The seat mountings must withstand all stresses to which they can be subjected. Where there is no floor beneath the feet of the operator, footrests covered with a slip-resistant material must be provided.	No seat required / or discuss how vibration is reduced and seating is fit for purpose.	✔	Not App	
Section - 1.2 CONTROL SYSTEMS				

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Section - 1.2.1 Safety and reliability of control systems				
Control systems must be designed and constructed in such a way as to prevent hazardous situations from arising. Above all, they must be designed and constructed in such a way that: a) they can withstand the intended operating stresses and external influences, b) a fault in the hardware or the software of the control system does not lead to hazardous situations, c) errors in the control system logic do not lead to hazardous situations, d) reasonably foreseeable human error during operation does not lead to hazardous situations.	The control system is well designed and constructed so it will not lead to hazardous situations	✔	Pass	Hardware and software interlocks used
Particular attention must be given to the following points: a) the machinery must not start unexpectedly, b) the parameters of the machinery must not change in an uncontrolled way, where such change may lead to hazardous situations, c) the machinery must not be prevented from stopping if the stop command has already been given, d) no moving part of the machinery or piece held by the machinery must fall or be ejected, e) automatic or manual stopping of the moving parts, whatever they may be, must be unimpeded, f) the protective devices must remain fully effective or give a stop command, g) the safety-related parts of the control system must apply in a coherent way to the whole of an assembly of machinery and/or partly completed machinery.	The control system is well designed and constructed so it will not lead to hazardous situations	✔	Pass	Isolator used, emergency stos in place, programmed to be fail safe.
For cable-less control, an automatic stop must be activated when correct control signals are not received, including loss of communication.	No Cable-less control / The cable less control scheme has a suitably rated emergency stop signal and this is incorporated into the main machine emergency stop scheme.	✔	Not App	

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Section - 1.2.2 Control devices				
Control devices must be clearly visible and identifiable, using pictograms where appropriate.	Control devices are clearly visible and identifiable.	✗	Fail	
Control devices must be positioned in such a way as to be safely operated without hesitation or loss of time and without ambiguity, designed in such a way that the movement of the control device is consistent with its effect.	Control devices can be safely operated and function is clear and consistent with effect.	✓	Pass	The above is also a pass (Error with document)
Control devices must be located outside the danger zones, except where necessary for certain control devices such as an emergency stop or a teach pendant and positioned in such a way that their operation cannot cause additional risk.	All control devices are outside danger zones.	✓	Pass	
Control devices must be designed or protected in such a way that the desired effect, where a hazard is involved, can only be achieved by a deliberate action.	Operation is only possible by deliberate action.	✓	Pass	Push to start buttons not easily acessed by accident
Control devices must be made in such a way as to withstand foreseeable forces; particular attention must be paid to emergency stop devices liable to be subjected to considerable forces.	Control devices are strong enough for foreseen use.	✓	Pass	Emergency stop bought from repuatable supplier
Where a control device is designed and constructed to perform several different actions, namely where there is no one-to-one correspondence, the action to be performed must be clearly displayed and subject to confirmation, where necessary. Control devices must be so arranged that their layout, travel and resistance to operation are compatible with the action to be performed, taking account of ergonomic principles.	Control devices are well designed and fit for purpose. The means of operation is clear and ergonomics are considered.	✓	Pass	
Machinery must be fitted with indicators as required for safe operation. The operator must be able to read them from the control position.	All Indicators necessary for safe operation are provided and visible from the control position.	✓	Pass	LED's used for indication, All parts labelled
From each control position, the operator must be able to ensure that no-one is in the danger zones, or the control system must be designed and constructed in such a way that starting is prevented while someone is in the danger zone. If neither of these possibilities is applicable, before the machinery starts, an acoustic and/or visual warning signal must be given. The exposed persons must have time to leave the danger zone or prevent the machinery starting up.	The operator can see the danger zones. / A start-up alarm is provided.	✓	Pass	
If necessary, means must be provided to ensure that the machinery can be controlled only from control positions located in one or more predetermined zones or locations.	Control position is fixed / Discuss other solutions.	✓	Not App	
Where there is more than one control position, the control system must be designed in such a way that the use of one of them precludes the use of the others, except for stop controls and emergency stops.	Only one control position / discuss multi control solution	✓	Pass	Control switch used to switch between operator and technican mode, only possible to be in one mode at a time.
When machinery has two or more operating positions, each position must be provided with all the required control devices without the operators hindering or putting each other into a hazardous situation.	Only one control position / discuss multi control solution	✓	Pass	
Section - 1.2.3 Starting				
It must be possible to start machinery only by voluntary actuation of a control device provided for the purpose. The same requirement applies when restarting the machinery after a stoppage, whatever the cause, when effecting a significant change in the operating conditions.	Starting is only by voluntary action in these cases.	✓	Pass	Isolator and reset buttons required for startup

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
However, the restarting of the machinery or a change in operating conditions may be effected by voluntary actuation of a device other than the control device provided for the purpose, on condition that this does not lead to a hazardous situation.	No other control devices which restart the machine. (An example could be closing in interlocked guard)	✔	Pass	Must press reset button after making system heathly to restart operation
For machinery functioning in automatic mode, the starting of the machinery, restarting after a stoppage, or a change in operating conditions may be possible without intervention, provided this does not lead to a hazardous situation.	Not automatic machinery / Interlocked guarding prevents risks due to automatic restarting	✔	Not App	
Where machinery has several starting control devices and the operators can therefore put each other in danger, additional devices must be fitted to rule out such risks. If safety requires that starting and/or stopping must be performed in a specific sequence, there must be devices which ensure that these operations are performed in the correct order.	Only one operator control position / Discuss Multi Positions	✔	Pass	
Section - 1.2.4.1 Normal Stop				
Machinery must be fitted with a control device whereby the machinery can be brought safely to a complete stop.	Describe where this control is fitted.	!	Query	Normal stop buttons and emergency stops are in place - Are these controlled enough?
Each workstation must be fitted with a control device to stop some or all of the functions of the machinery, depending on the existing hazards, so that the machinery is rendered safe.	Describe any such controls / No Workstations	✔	Pass	
The machinery's stop control must have priority over the start controls.	The stop control has priority over start controls. Confirm by Test	✔	Pass	The stop command overrides and resets all other functions
Once the machinery or its hazardous functions have stopped, the energy supply to the actuators concerned must be cut off.	Energy supply to actuators is cut after stop. Confirm by Test	✔	Pass	System must be reset after being stopped
Section - 1.2.4.2 Operational Stop				
Where, for operational reasons, a stop control that does not cut off the energy supply to the actuators is required, the stop condition must be monitored and maintained.	Energy supply to actuators is cut after stop. (An example where this is not the case could be a drive fitted with an STO device)	✔	Not App	
Section - 1.2.4.3 Emergency Stop				
Machinery must be fitted with one or more emergency stop devices to enable actual or impending danger to be averted.	Machine is fitted with emergency stops at the following locations …./ No emergency stop, if so detail case.	✔	Pass	One emergency stop fitted
The following exceptions apply:- the machinery in which an emergency stop device would not lessen the risk, either because it would not reduce the stopping time or because it would not enable the special measures required to deal with the risk to be taken, or it is portable hand-held and/or hand-guided machinery.	Not applicable here / Describe why this is the case / If it is detail the case.	✔	Not App	

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
The device must:- a) have clearly identifiable, clearly visible and quickly accessible control devices, b) stop the hazardous process as quickly as possible, without creating additional risks, c) where necessary, trigger or permit the triggering of certain safeguard movements.	Emergency stops meet these requirements / No emergency stops	✔	Pass	Emergency stop easily accessable and obvious
Once active operation of the emergency stop device has ceased following a stop command, that command must be sustained by engagement of the emergency stop device until that engagement is specifically overridden; it must not be possible to engage the device without triggering a stop command; it must be possible to disengage the device only by an appropriate operation, and disengaging the device must not restart the machinery but only permit restarting.	Emergency stops meet these requirements / No emergency stops	✔	Pass	After emergency stop has been pressed the system will require a full reset
The emergency stop function must be available and operational at all times, regardless of the operating mode.	Emergency stops meet these requirements / No emergency stops. Circuit to be tested.	✔	Pass	Emergency stop overrides all other functions and commands / Emergency stop is hardwired into the circuit and removes power completely
Emergency stop devices must be a back-up to other safeguarding measures and not a substitute for them.	All necessary other safeguarding measures have been taken. Circuit to be tested.	!	Query	This should be double checked on final system
Section - 1.2.4.4 Stopping an Assembly of Machines				
In the case of machinery or parts of machinery designed to work together, the machinery must be designed and constructed in such a way that the stop controls, including the emergency stop devices, can stop not only the machinery itself but also all related equipment, if its continued operation may be dangerous.	Not an assembly of machinery / Describe stopping arrangements for related equipment.	✔	Pass	
Section - 1.2.5 Selection of control or operating modes				
The control or operating mode selected must override all other control or operating modes, with the exception of the emergency stop.	No mode selector / Mode selector overrides other controls except emergency stop. Test to Confirm.	✔	Pass	Check if applicable
If machinery has been designed and constructed to allow its use in several control or operating modes requiring different protective measures and/or work procedures, it must be fitted with a mode selector which can be locked in each position. Each position of the selector must be clearly identifiable and must correspond to a single operating or control mode.	No mode selector / Same protective measures for all control modes / Mode selector can be locked in position. Example could be an automated machine with reduced speed mode with guard open.	✔	Not App	Same safety requirements for both modes of operation
The selector may be replaced by another selection method which restricts the use of certain functions of the machinery to certain categories of operator.	No mode selector / Mode selector switch / Describe mode selection Example. From Computer screen	✔	Pass	Mode selector for chosing between operator and technician mode
If, for certain operations, the machinery must be able to operate with a guard displaced or removed and/or a protective device disabled, the control or operating mode selector must simultaneously: a) disable all other control or operating modes, b) permit operation of hazardous functions only by control devices requiring sustained action, c) permit the operation of hazardous functions only in reduced risk conditions while preventing hazards from linked sequences, d) prevent any operation of hazardous functions by voluntary or involuntary action	Machine does not operate with guard open / With guard removed describe measures taken to meet each of the requirements above. Test to Confirm	✔	Pass	Guard limit switch is hardwired into power circuit, switch being open removes all power

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Section - 1.2.6 Failure of the power supply				
The interruption, the re-establishment after an interruption or the fluctuation in whatever manner of the power supply to the machinery must not lead to dangerous situations. Particular attention must be given to the following points:- a) the machinery must not start unexpectedly, b) the parameters of the machinery must not change in an uncontrolled way when such change can lead to hazardous situations, c) the machinery must not be prevented from stopping if the command has already been given, d) no moving part of the machinery or piece held by the machinery must fall or be ejected, e) automatic or manual stopping of the moving parts, whatever they may be, must be unimpeded, f) the protective devices must remain fully effective or give a stop command.	Re-establishment of the power supply does not lead to dangerous situations Test to Confirm	✔	Pass	If power is removed system will require resetting before being able to operate
Section - 1.3 PROTECTION AGAINST MECHANICAL HAZARDS				
Section - 1.3.1 Risk of loss of stability				
Machinery and its components and fittings must be stable enough to avoid overturning, falling or uncontrolled movements during transportation, assembly, dismantling and any other action involving the machinery. If the shape of the machinery itself or its intended installation does not offer sufficient stability, appropriate means of anchorage must be incorporated and indicated in the instructions.	Stable in all cases / Describe measures taken to ensure stability	✔	Pass	Control panel bolted to wall using 12mm wall bolts. O frame is bolted to floor and attached to the walls using braces
Section - 1.3.2 Risk of break-up during operation				
The various parts of machinery and their linkages must be able to withstand the stresses to which they are subject when used. The durability of the materials used must be adequate for the nature of the working environment foreseen by the manufacturer or his authorised representative, in particular as regards the phenomena of fatigue, ageing, corrosion and abrasion.	The machine has been designed to withstand the stresses from foreseen use. The materials used are adequately durable.	!	Query	As this is a prototype it was not designed to be used for prolonged periods of time.
The instructions must indicate the type and frequency of inspections and maintenance required for safety reasons. They must, where appropriate, indicate the parts subject to wear and the criteria for replacement.	The maintenance and inspection instructions are adequate.	!	Query	What are the requirements for this?
Where a risk of rupture or disintegration remains despite the measures taken, the parts concerned must be mounted, positioned and/or guarded in such a way that any fragments will be contained, preventing hazardous situations.	No parts with risk of rupture which require guarding / Adequate guards are provided. INCLUDE INFORMATION ABOUT HOW THE GUARDS ARE SHOWN TO BE ADEQUATE	!	Query	
Both rigid and flexible pipes carrying fluids, particularly those under high pressure, must be able to withstand the foreseen internal and external stresses and must be firmly attached and/or protected to ensure that no risk is posed by a rupture.	No Rigid or flexible pipes / The pneumatic/hydraulic system meets the requirements of EN4413 (hydraulics) EN4414 (pneumatics) / Pipes carrying pressurized fluids are able to withstand foreseen stresses.	✔	Not App	No fluids being used
Where the material to be processed is fed to the tool automatically, the following conditions must be fulfilled to avoid risks to persons:- a) when the workpiece comes into contact with the tool, the latter must have attained its normal working condition, b) when the tool starts and/or stops (intentionally or accidentally), the feed movement and the tool movement must be coordinated.	No automatic material feed / Feed, tool and workpiece are coordinated	✔	Not App	

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Section - 1.3.3 Risks due to falling or ejected objects				
Precautions must be taken to prevent risks from falling or ejected objects.	No risks from falling or ejected objects / Describe measures taken to reduce risks.	✔	Pass	
Section - 1.3.4 Risks due to surfaces, edges or angles				
Insofar as their purpose allows, accessible parts of the machinery must have no sharp edges, no sharp angles and no rough surfaces likely to cause injury.	No edges or surfaces likely to cause injury.	✔	Pass	
Section - 1.3.5 Risks related to combined machinery				
Where the machinery is intended to carry out several different operations with manual removal of the piece between each operation (combined machinery), it must be designed and constructed in such a way as to enable each element to be used separately without the other elements constituting a risk for exposed persons. For this purpose, it must be possible to start and stop separately any elements that are not protected.	Not combined machinery / The risks have been evaluated and are detailed in the MTA.	✔	Not App	
Section - 1.3.6 Risks related to variations in operating conditions				
Where the machinery performs operations under different conditions of use, it must be designed and constructed in such a way that selection and adjustment of these conditions can be carried out safely and reliably.	No changes in conditions of use./Describe means of selection and adjustment.	✔	Not App	
Section - 1.3.7 Risks related to moving parts				
The moving parts of machinery must be designed and constructed in such a way as to prevent risks of contact which could lead to accidents or must, where risks persist, be fitted with guards or protective devices.	Adequate guards are fitted.	✔	Pass	Guards to be fitted
All necessary steps must be taken to prevent accidental blockage of moving parts involved in the work. In cases where, despite the precautions taken, a blockage is likely to occur, the necessary specific protective devices and tools must, when appropriate, be provided to enable the equipment to be safely unblocked. The instructions and, where possible, a sign on the machinery shall identify these specific protective devices and how they are to be used.	No likelihood of blockage./ Equipment can be unblocked safely and there are adequate instructions and labelling.	!	Query	The laser and edge limits will prevent issue to a certain extent - Does this need more work?
Section - 1.3.8.1 Moving transmission parts				
Guards designed to protect persons against the hazards generated by moving transmission parts must be:- a) either fixed guards as referred to in section 1.4.2.1, or b) interlocking movable guards as referred to in section 1.4.2.2. Interlocking movable guards should be used where frequent access is envisaged.	No moving transmission parts / Describe any guarding arrangements for moving transmission parts	✔	Pass	Guards will stop all access
Section - 1.3.8.2 Moving parts involved in the process				
Guards or protective devices designed to protect persons against the hazards generated by moving parts involved in the process must be:- a) either fixed guards as referred to in section 1.4.2.1, or b) interlocking movable guards as referred to in section 1.4.2.2, or c) protective devices as referred to in section 1.4.3, or d) a combination of the above.	No moving parts involved in the process / Describe the guarding arrangements. It may be better to refer to a section of the risk assessment or a separate document.	✔	Pass	Interlocking movable guards

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
However, when certain moving parts directly involved in the process cannot be made completely inaccessible during operation owing to operations requiring operator intervention, such parts must be fitted with:- a) fixed guards or interlocking movable guards preventing access to those sections of the parts that are not used in the work, and b) adjustable guards as referred to in section 1.4.2.3 restricting access to those sections of the moving parts where access is necessary.	No access required./ Describe guarding arrangements.	✔	Not App	
Section - 1.3.9 Risks of uncontrolled movements				
When a part of the machinery has been stopped, any drift away from the stopping position, for whatever reason other than action on the control devices, must be prevented or must be such that it does not present a hazard.	Machine does not drift when stopped.	✘	Fail	
Section - 1.4 REQUIRED CHARACTERISTICS OF GUARDS AND PROTECTIVE DEVICES				
Section - 1.4.1 General requirements				
Guards and protective devices must:- a) be of robust construction, b) be securely held in place, c) not give rise to any additional hazard, d) not be easy to by-pass or render non-operational, e) be located at an adequate distance from the danger zone, f) cause minimum obstruction to the view of the production process, and g) enable essential work to be carried out on the installation and/or replacement of tools and for maintenance purposes by restricting access exclusively to the area where the work has to be done, if possible without the guard having to be removed or the protective device having to be disabled. In addition, guards must, where possible, protect against the ejection or falling of materials or objects and against emissions generated by the machinery.	Describe guarding arrangements and how they meet these requirements. Reference can be made to other sections of the technical file.	✔	Pass	Guarding bolted in place, made of mesh pattern which allows a view of the machine.
Section - 1.4.2.1 Fixed guards				
Fixed guards must be fixed by systems that can be opened or removed only with tools. Their fixing systems must remain attached to the guards or to the machinery when the guards are removed. Where possible, guards must be incapable of remaining in place without their fixings.	Fixed Guards meet these requirements.	✔	Pass	
Section - 1.4.2.2 Interlocking movable guards				
Interlocking movable guards must:- a) as far as possible remain attached to the machinery when open, b) be designed and constructed in such a way that they can be adjusted only by means of an intentional action.	Interlocking moveable guards meet these requirements.	✔	Pass	Hinges used
Interlocking movable guards must be associated with an interlocking device that:- a) prevents the start of hazardous machinery functions until they are closed and b) gives a stop command whenever they are no longer closed.	Interlocking moveable guards meet these requirements.	✔	Pass	Hardwired into power system
Where it is possible for an operator to reach the danger zone before the risk due to the hazardous machinery functions has ceased, movable guards must be associated with a guard locking device in addition to an interlocking device that:- a) prevents the start of hazardous machinery functions until the guard is closed and locked, and b) keeps the guard closed and locked until the risk of injury from the hazardous machinery functions has ceased.	Interlocking moveable guards meet these requirements.	✔	Pass	
Interlocking movable guards must be designed in such a way that the absence or failure of one of their components prevents starting or stops the hazardous machinery functions.	Interlocking moveable guards meet these requirements.	✔	Pass	

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Section - 1.4.2.3 Adjustable guards restricting access				
Adjustable guards restricting access to those areas of the moving parts strictly necessary for the work must be:- a) adjustable manually or automatically, depending on the type of work involved, and b) readily adjustable without the use of tools.	No adjustable guards restricting access / Adjustable guards meet these requirements.	✔	Not App	
Section - 1.4.3. Special requirements for protective devices				
Protective devices must be designed and incorporated into the control system in such a way that:- a) moving parts cannot start up while they are within the operator's reach, b) persons cannot reach moving parts while the parts are moving, and c) the absence or failure of one of their components prevents starting or stops the moving parts.	Add description of protective devices and compliance with EN13855 safety distances if required	!	Query	
Protective devices must be adjustable only by means of an intentional action.	As Above / Conforming devices will have this feature built in.	!	Query	
Section - 1.5 RISKS DUE TO OTHER HAZARDS				
Section - 1.5.1 Risk due to electricity supply				
Where machinery has an electricity supply, it must be designed, constructed and equipped in such a way that all hazards of an electrical nature are or can be prevented. The safety objectives set out in Directive 2006/95/EC shall apply to machinery. However, the obligations concerning conformity assessment and the placing on the market and/or putting into service of machinery with regard to electrical hazards are governed solely by this Directive.	The equipment meets the requirements of EN60204-1:2006 Electrical Equipment of Industrial Machines	!	Query	See Appendix 10.7
Section - 1.5.2 Risk due to static electricity				
Machinery must be designed and constructed to prevent or limit the build-up of potentially dangerous electrostatic charges and/or be fitted with a discharging system.	No significant hazard from static electricity. Machine body is grounded.	✔	Pass	Control panel, devices and frame is grounded
Section - 1.5.3 Energy supply other than electricity				
Where machinery is powered by source of energy other than electricity, it must be so designed, constructed and equipped as to avoid all potential risks associated with such sources of energy.	No other sources of energy./ Describes measures to avoid potential risks (This refers to power from external sources. It does not refer to for example a hydraulic system powered from a pump within the machine)	✔	Not App	
Section - 1.5.4 Errors of fitting				
Errors likely to be made when fitting or refitting certain parts which could be a source of risk must be made impossible by the design and construction of such parts or, failing this, by information given on the parts themselves and/or their housings. The same information must be given on moving parts and/or their housings where the direction of movement needs to be known in order to avoid a risk. Where necessary, the instructions must give further information on these risks. Where a faulty connection can be the source of risk, incorrect connections must be made impossible by design or, failing this, by information given on the elements to be connected and, where appropriate, on the means of connection.	No errors of fitting likely. / Describe measures taken to reduce risks	✔	Not App	

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Section - 1.5.5 Extreme temperatures				
Steps must be taken to eliminate any risk of injury arising from contact with or proximity to machinery parts or materials at high or very low temperatures.	No parts or materials at high or low temperatures./ No risk of contact with parts or materials at high or low temperatures/ Describe measures taken to reduce risks.	✔	Not App	
The necessary steps must also be taken to avoid or protect against the risk of hot or very cold material being ejected.	No hot or cold material ejected	✔	Not App	
Section - 1.5.6 Fire				
Machinery must be designed and constructed in such a way as to avoid any risk of fire or overheating posed by the machinery itself or by gases, liquids, dust, vapours or other substances produced or used by the machinery.	No fire risk / Fire protection described in other section of tech file	✔	Not App	
Section - 1.5.7 Explosion				
Machinery must be designed and constructed in such a way as to avoid any risk of explosion posed by the machinery itself or by gases, liquids, dust, vapours or other substances produced or used by the machinery.	No risk of explosion	✔	Not App	
Machinery must comply, as far as the risk of explosion due to its use in a potentially explosive atmosphere is concerned, with the provisions of the specific Community Directives.	The machinery is not designed for use in explosive atmospheres	✔	Not App	
Section - 1.5.8 Noise				
Machinery must be designed and constructed in such a way that risks resulting from the emission of airborne noise are reduced to the lowest level, taking account of technical progress and the availability of means of reducing noise, in particular at source. The level of noise emission may be assessed with reference to comparative emission data for similar machinery.	Measures have been taken to reduce noise emissions to the lowest practicable level.	✔	Not App	
Section - 1.5.9 Vibrations				
Machinery must be designed and constructed in such a way that risks resulting from vibrations produced by the machinery are reduced to the lowest level, taking account of technical progress and the availability of means of reducing vibration, in particular at source. The level of vibration emission may be assessed with reference to comparative emission data for similar machinery.	Measures have been taken to reduce vibrations to the lowest practicable level.	✔	Pass	O frame bolted to wall and floor
Section - 1.5.10 Radiation				
Undesirable radiation emissions from the machinery must be eliminated or be reduced to levels that do not have adverse effects on persons.	No hazardous radiation from the machine (Radiation may include light and heat)	✔	Pass	Radiation not used for prototype demostration
Any functional ionising radiation emissions must be limited to the lowest level which is sufficient for the proper functioning of the machinery during setting, operation and cleaning. Where a risk exists, the necessary protective measures must be taken.	No functional ionizing radiation emissions	✔	Not App	

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Any functional non-ionising radiation emissions during setting, operation and cleaning must be limited to levels that do not have adverse effects on persons.	No hazardous non-ionising radiation emissions from the machine.	✔	Not App	
Section - 1.5.11 External radiation				
Machinery must be designed and constructed in such a way that external radiation does not interfere with its operation.	The machine has been assessed for compliance with the EMC Directive 2004/108/EC so this requirement should be met.	!	Query	Check against this directive
Section - 1.5.12 Laser radiation				
Where laser equipment is used, the following should be taken into account:- a) laser equipment on machinery must be designed and constructed in such a way as to prevent any accidental radiation b) laser equipment on machinery must be protected in such a way that effective radiation, radiation produced by reflection or diffusion and secondary radiation do not damage health c) optical equipment for the observation or adjustment of laser equipment on machinery must be such that no health risk is created by laser radiation.	No laser equipment./ Describe measures taken to reduce risk	✔	Pass	Laser is class 2b and mounted fair below eye level
Section - 1.5.13 Emissions of hazardous materials and substances				
Machinery must be designed and constructed in such a way that risks of inhalation, ingestion, contact with the skin, eyes and mucous membranes and penetration through the skin of hazardous materials and substances which it produces can be avoided. Where a hazard cannot be eliminated, the machinery must be so equipped that hazardous materials and substances can be contained, evacuated, precipitated by water spraying, filtered or treated by another equally effective method. Where the process is not totally enclosed during normal operation of the machinery, the devices for containment and/or evacuation must be situated in such a way as to have the maximum effect.	No emissions of hazardous materials or substances./ Describe measures taken to reduce hazards.	✔	Pass	No emissions
Section - 1.5.14 Risk of being trapped in a machine				
Machinery must be designed, constructed or fitted with a means of preventing a person from being enclosed within it or, if that is impossible, with a means of summoning help.	No risk of being trapped in machine./ Describe means of escape.	✔	Pass	No risk of being trapped
Section - 1.5.15 Risk of slipping, tripping or falling				
Parts of the machinery where persons are liable to move about or stand must be designed and constructed in such a way as to prevent persons slipping, tripping or falling on or off these parts. Where appropriate, these parts must be fitted with handholds that are fixed relative to the user and that enable them to maintain their stability.	The area in which the operator stands is not covered in this assessment. / Describe measures taken to reduce risks.	✔	Not App	
Section - 1.5.16 Lightning				
Machinery in need of protection against the effects of lightning while being used must be fitted with a system for conducting the resultant electrical charge to earth.	No need for protection against the effects of lightning / Describe any special measures taken	✔	Not App	

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Section - 1.6 MAINTENANCE				
Section - 1.6.1 Machinery maintenance				
Adjustment and maintenance points must be located outside danger zones. It must be possible to carry out adjustment, maintenance, repair, cleaning and servicing operations while machinery is at a standstill. If one or more of the above conditions cannot be satisfied for technical reasons, measures must be taken to ensure that these operations can be carried out safely (see section 1.2.5).	Adjustment and maintenance points are outside danger zones./ Explain measures to allow safe adjustment and maintenance.	✔	Pass	System to be isolated for maintenance
In the case of automated machinery and, where necessary, other machinery, a connecting device for mounting diagnostic fault-finding equipment must be provided.	Not automated machinery. / A connecting device is provided. (EXAMPLE PLC COMMUNICATION PORT)	✔	Pass	PLC communication ports available
Automated machinery components which have to be changed frequently must be capable of being removed and replaced easily and safely. Access to the components must enable these tasks to be carried out with the necessary technical means in accordance with a specified operating method.	No such components./ Components can be changed easily (MENTION WHICH COMPONENTS ARE CONSIDERED)	✔	Pass	No such componets
Section - 1.6.2 Access to operating positions and servicing points				
Machinery must be designed and constructed in such a way as to allow access in safety to all areas where intervention is necessary during operation, adjustment and maintenance of the machinery.	Safe access is possible.	✔	Pass	
Section - 1.6.3 Isolation of energy sources				
Machinery must be fitted with means to isolate it from all energy sources. Such isolators must be clearly identified. They must be capable of being locked if reconnection could endanger persons. Isolators must also be capable of being locked where an operator is unable, from any of the points to which he has access, to check that the energy is still cut off. In the case of machinery capable of being plugged into an electricity supply, removal of the plug is sufficient, provided that the operator can check from any of the points to which he has access that the plug remains removed.	Suitable means of isolation is provided. (DESCRIBE ISOLATORS. CAN THEY BE LOCKED?)	✔	Pass	Isolator has locking point
After the energy is cut off, it must be possible to dissipate normally any energy remaining or stored in the circuits of the machinery without risk to persons.	No significant risk from stored energy./ Stored energy can be dissipated. (DESCRIBE HOW ENERGY CAN BE DISSIPATED)	✔	Pass	Energy dissipated completely after 1 minute
As an exception to the requirement laid down in the previous paragraphs, certain circuits may remain connected to their energy sources in order, for example, to hold parts, to protect information, to light interiors, etc. In this case, special steps must be taken to ensure operator safety.	Give detailed description or refer to MTA or section within Technical File.	✔	Not App	
Section - 1.6.4 Operator intervention				

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Machinery must be so designed, constructed and equipped that the need for operator intervention is limited. If operator intervention cannot be avoided, it must be possible to carry it out easily and safely.	The need for operator intervention is limited./ Operator intervention can be carried out safely. DESCRIBE THE INTERVENTION REQUIRED AND SAFETY MEASURES TAKEN	✔	Pass	Operator intervention not required
Section - 1.6.5 Cleaning of internal parts				
The machinery must be designed and constructed in such a way that it is possible to clean internal parts which have contained dangerous substances or preparations without entering them; any necessary unblocking must also be possible from the outside. If it is impossible to avoid entering the machinery, it must be designed and constructed in such a way as to allow cleaning to take place safely.	Cleaning can be carried out safely. DESCRIBE CLEANING REQUIRED AND MEASURES TO ALLOW IT TO BE DONE SAFELY	✔	Pass	Any cleaning required can be done when isolated
Section - 1.7 INFORMATION				
Section - 1.7.1 Information and warnings on the machinery				
Information and warnings on the machinery should preferably be provided in the form of readily understandable symbols or pictograms. Any written or verbal information and warnings must be expressed in an official Community language or languages, which may be determined in accordance with the Treaty by the Member State in which the machinery is placed on the market and/or put into service and may be accompanied, on request, by versions in any other official Community language or languages understood by the operators.	Information and warnings on the machinery are suitable and are described elsewhere in the technical file.	✔	Pass	
Section - 1.7.1.1 Information and information devices				
The information needed to control machinery must be provided in a form that is unambiguous and easily understood. It must not be excessive to the extent of overloading the operator. Visual display units or any other interactive means of communication between the operator and the machine must be easily understood and easy to use.	Information provided to the operator is unambiguous and easily understood. DESCRIBE THE INFORMATION IF IT IS NOT OBVIOUS	!	Query	The information is yet to be written, it is planned to to be a series of flow diagrams and labled pictures
Section - 1.7.1.2 Warning devices				
Where the health and safety of persons may be endangered by a fault in the operation of unsupervised machinery, the machinery must be equipped in such a way as to give an appropriate acoustic or light signal as a warning.	Not unsupervised machinery./ A warning is given DESCRIBE EVENTS WHICH REQUIRE WARNING	✔	Not App	
Where machinery is equipped with warning devices these must be unambiguous and easily perceived. The operator must have facilities to check the operation of such warning devices at all times.	Warning devices are unambiguous and easily perceived.	✔	Pass	Warnings and alarms are displayed on all operators pages
The requirements of the specific Community Directives concerning colours and safety signals must be complied with.	Warning devices meet EU standards./ No warning devices.	!	Query	These will need addressing when the final system is installed
Section - 1.7.2 Warning of residual risks				

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Where risks remain despite the inherent safe design measures, safeguarding and complementary protective measures adopted, the necessary warnings, including warning devices, must be provided	Residual risks and the appropriate warnings are described in the risk assessment.	✔	Not App	
Section - 1.7.3 Marking of machinery				
All machinery must be marked visibly, legibly and indelibly with the following minimum particulars:- *a)* the business name and full address of the manufacturer and, where applicable, his authorised representative - *b)* designation of the machinery - *c)* the CE Marking (see Annex III) - *d)* designation of series or type - *e)* serial number, if any,- *f)* the year of construction, that is the year in which the manufacturing process is completed. It is prohibited to pre-date or post-date the machinery when affixing the CE marking. Furthermore, machinery designed and constructed for use in a potentially explosive atmosphere must be marked accordingly. Machinery must also bear full information relevant to its type and essential for safe use. Such information is subject to the requirements set out in section 1.7.1. Additionaly where a machine part must be handled during use with lifting equipment, its mass must be indicated legibly, indelibly and unambiguously.	All necessary markings are provided. See Technical File contents checklist.	!	Query	This will need to be done with the final system
Section - 1.7.4 Instructions				
All machinery must be accompanied by instructions in the official Community language or languages of the Member State in which it is placed on the market and/or put into service. The instructions accompanying the machinery must be either 'Original instructions' or a 'Translation of the original instructions', in which case the translation must be accompanied by the original instructions. By way of exception, the maintenance instructions intended for use by specialised personnel mandated by the manufacturer or his authorised representative may be supplied in only one Community language which the specialised personnel understand. The instructions must be drafted in accordance with the principles set out in the subsequent paragraphs.	Original instructions are provided in English language.	✘	Fail	
Section - 1.7.4.1 General principles for the drafting of instructions				
(a) The instructions must be drafted in one or more official Community languages. The words 'Original instructions' must appear on the language version(s) verified by the manufacturer or his authorised representative. (b) Where no 'Original instructions' exist in the official language(s) of the country where the machinery is to be used, a translation into that/those language(s) must be provided by the manufacturer or his authorised representative or by the person bringing the machinery into the language area in question. The translations must bear the words 'Translation of the original instructions'. (c) The contents of the instructions must cover not only the intended use of the machinery but also take into account any reasonably foreseeable misuse thereof. (d) In the case of machinery intended for use by non-professional operators, the wording and layout of the instructions for use must take into account the level of general education and acumen that can reasonably be expected from such operators.	The instructions are suitable. See Technical File contents.	!	Query	This work is yet to be completed
Section - 1.7.4.2 Contents of the instructions				

Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
Each instruction manual must contain, where applicable, at least the following information: (a) the business name and full address of the manufacturer and of his authorised representative; (b) the designation of the machinery as marked on the machinery itself, except for the serial number (see section 1.7.3); (c) the EC declaration of conformity, or a document setting out the contents of the EC declaration of conformity, showing the particulars of the machinery, not necessarily including the serial number and the signature; (d) a general description of the machinery; (e) the drawings, diagrams, descriptions and explanations necessary for the use, maintenance and repair of the machinery and for checking its correct functioning; (f) a description of the workstation(s) likely to be occupied by operators; (g) a description of the intended use of the machinery; (h) warnings concerning ways in which the machinery must not be used that experience has shown might occur; (i) assembly, installation and connection instructions, including drawings, diagrams and the means of attachment and the designation of the chassis or installation on which the machinery is to be mounted; (j) instructions relating to installation and assembly for reducing noise or vibration; (k) instructions for the putting into service and use of the machinery and, if necessary, instructions for the training of operators; (l) information about the residual risks that remain despite the inherent safe design measures, safeguarding and complementary protective measures adopted; (m) instructions on the protective measures to be taken by the user, including, where appropriate, the personal protective equipment to be provided; (n) the essential characteristics of tools which may be fitted to the machinery; (o) the conditions in which the machinery meets the requirement of stability during use, transportation, assembly, dismantling when out of service, testing or foreseeable breakdowns; (p) instructions with a view to ensuring that transport, handling and storage operations can be made safely, giving the mass of the machinery and of its various parts where these are regularly to be transported separately;		✗	Fail	
(q) the operating method to be followed in the event of accident or breakdown; if a blockage is likely to occur, the operating method to be followed so as to enable the equipment to be safely unblocked; (r) the description of the adjustment and maintenance operations that should be carried out by the user and the preventive maintenance measures that should be observed; (s) instructions designed to enable adjustment and maintenance to be carried out safely, including the protective measures that should be taken during these operations; (t) the specifications of the spare parts to be used, when these affect the health and safety of operators.		✗	Fail	

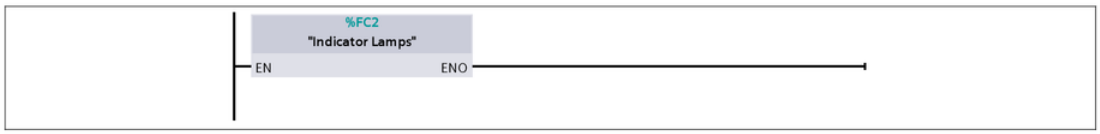
Regulation (Annex 1 of the Machinery Directive 2006)	Guideline / Observation	Status		Comments
The Contents must contain the following information on airborne noise emissions: a) the A-weighted emission sound pressure level at workstations, where this exceeds 70 dB(A); where this level does not exceed 70 dB(A), this fact must be indicated, b) the peak C-weighted instantaneous sound pressure value at workstations, where this exceeds 63 Pa (130 dB in relation to 20 ?Pa), c) the A-weighted sound power level emitted by the machinery, where the A-weighted emission sound pressure level at workstations exceeds 80 dB(A). These values must be either those actually measured for the machinery in question or those established on the basis of measurements taken for technically comparable machinery which is representative of the machinery to be produced. In the case of very large machinery, instead of the A-weighted sound power level, the A-weighted emission sound pressure levels at specified positions around the machinery may be indicated. Where the harmonised standards are not applied, sound levels must be measured using the most appropriate method for the machinery. Whenever sound emission values are indicated the uncertainties surrounding these values must be specified. The operating conditions of the machinery during measurement and the measuring methods used must be described. Where the workstation(s) are undefined or cannot be defined, A-weighted sound pressure levels must be measured at a distance of 1 metre from the surface of the machinery and at a height of 1,6 metres from the floor or access platform. The position and value of the maximum sound pressure must be indicated. Where specific Community Directives lay down other requirements for the measurement of sound pressure levels or sound power levels, those Directives must be applied and the corresponding provisions of this section shall not apply.		!	Query	This work is yet to be completed
Where machinery is likely to emit non-ionising radiation which may cause harm to persons, in particular persons with active or non-active implantable medical devices, information concerning the radiation emitted for the operator and exposed persons.		✔	Not App	

Main [OB1]

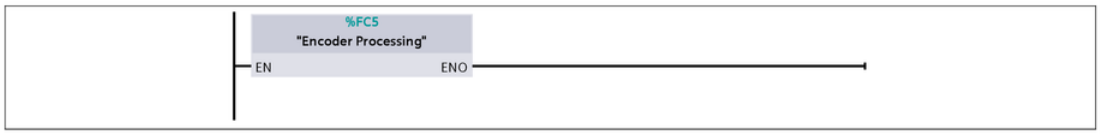
Main Properties					
General					
Name	Main	**Number**	1	**Type**	OB
Language	LAD	**Numbering**	automatic		
Information					
Title	"Main Program Sweep (Cycle)"	**Author**		**Comment**	
Family		**Version**	0.1	**User-defined ID**	

Name	Data type	Default value
▼ Input		
Initial_Call	Bool	
Remanence	Bool	
Temp		
Constant		

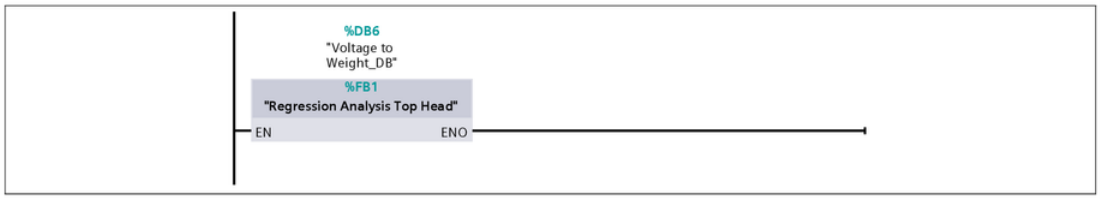
Network 1:



Network 2:



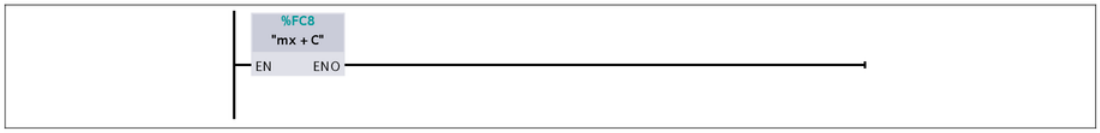
Network 3:



Network 4:



Network 5:



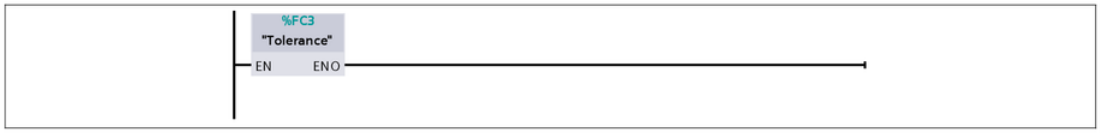
Network 6:



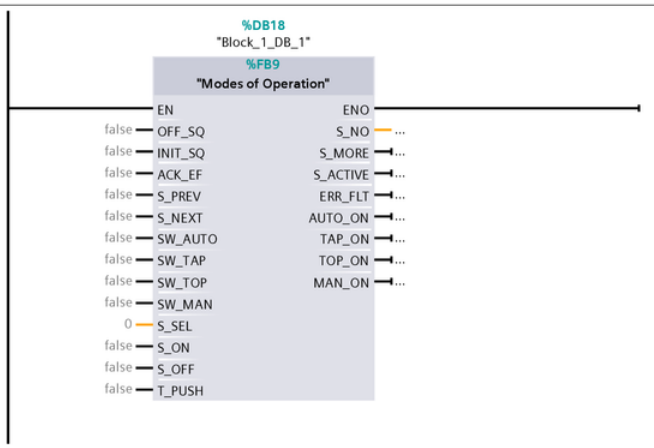
Network 7:



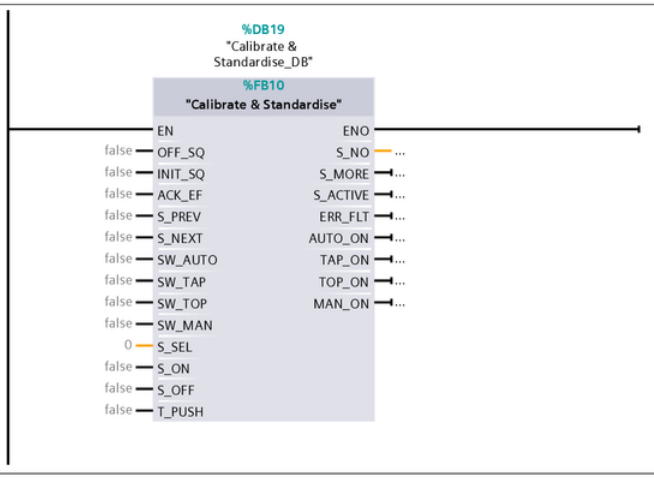
Network 8:



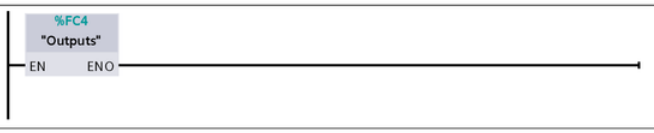
Network 9:



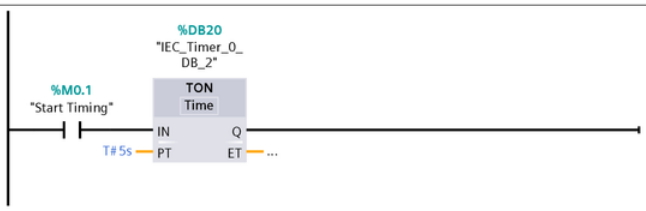
Network 10:



Network 11:



Network 12:


%DB20
"IEC_Timer_0_
DB_2"
%M0.1
"Start Timing"
TON
Time
IN
Q
T#5s
PT
ET
...

Network 13:


%DB21
"Dwell Graph_DB"
%FB11
"Dwell Graph"
EN
ENO

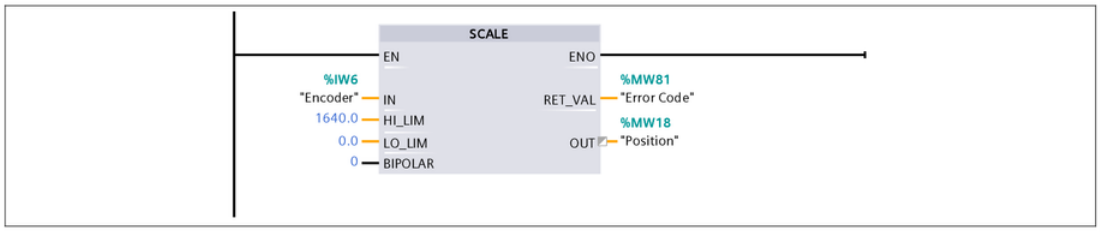
Encoder Processing [FC5]

Encoder Processing Properties					
General					
Name	Encoder Processing	**Number**	5	**Type**	FC
Language	LAD	**Numbering**	automatic		
Information					
Title		**Author**		**Comment**	
Family		**Version**	0.1	**User-defined ID**	

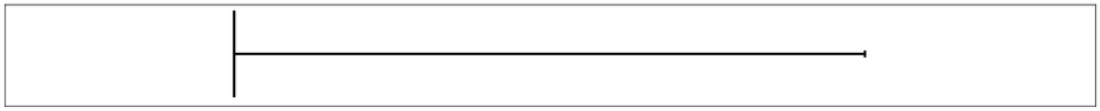
Name	Data type	Default value
Input		
Output		
InOut		
Temp		
Constant		
▼ Return		
Encoder Processing	Void	

Network 1:

The raw value from the encoder is read in. The encoder is scaled from 0 - 4000mm. The reading is stored in "Position"



Network 2:



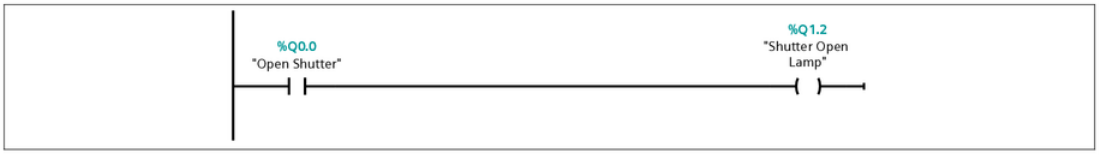
Indicator Lamps [FC2]

Indicator Lamps Properties					
General					
Name	Indicator Lamps	**Number**	2	**Type**	FC
Language	LAD	**Numbering**	automatic		
Information					
Title		**Author**		**Comment**	
Family		**Version**	0.1	**User-defined ID**	

Name	Data type	Default value
Input		
Output		
InOut		
Temp		
Constant		
▼ Return		
Indicator Lamps	Void	

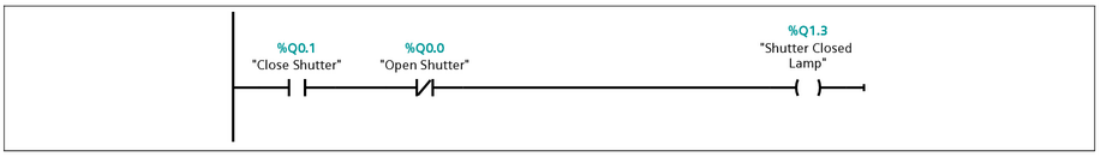
Network 1:

When the shutter microswitch is open, the shutter open lamp will energise. This is fail safe.



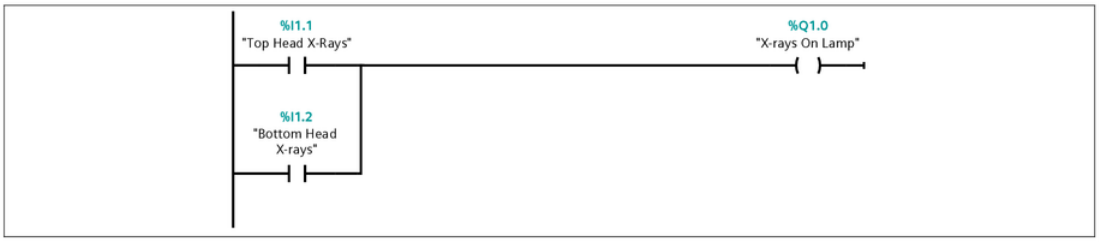
Network 2:

When the shutter microswitch is closed, the shutter closed lamp will energise.



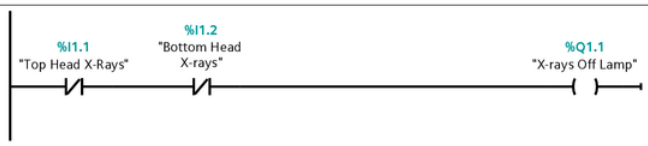
Network 3:

When the signal from the X-ray power is high the X-rays on lamp will energise.



Network 4:

When the signal from the x-ray power is low the x-rays off lamp will energise.


%I1.1
"Top Head X-Rays"
%I1.2
"Bottom Head
X-rays"
%Q1.1
"X-rays Off Lamp"

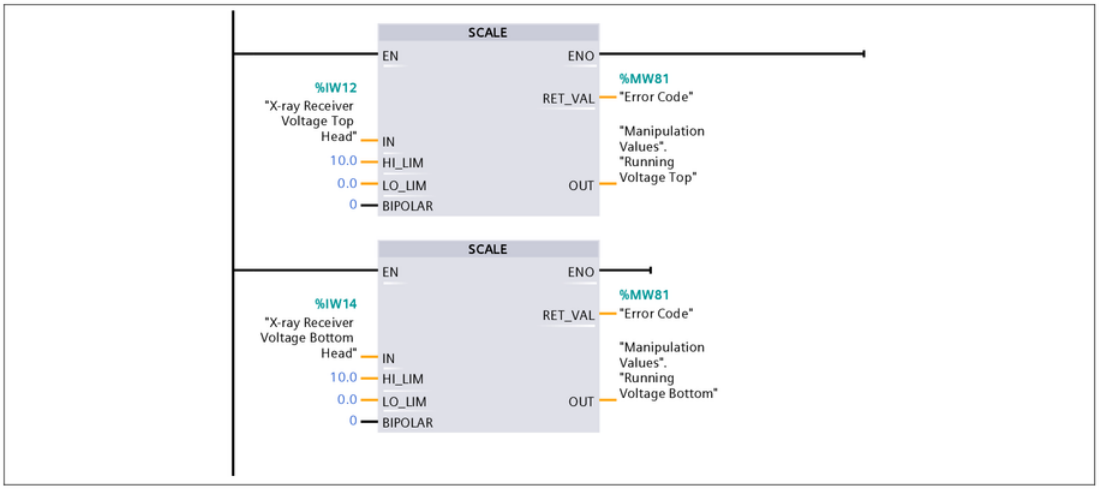
mx + C [FC8]

mx + C Properties					
General					
Name	mx + C	**Number**	8	**Type**	FC
Language	LAD	**Numbering**	automatic		
Information					
Title		**Author**		**Comment**	
Family		**Version**	0.1	**User-defined ID**	

Name	Data type	Default value
Input		
Output		
InOut		
Temp		
Constant		
▼ Return		
mx + C	Void	

Network 1:

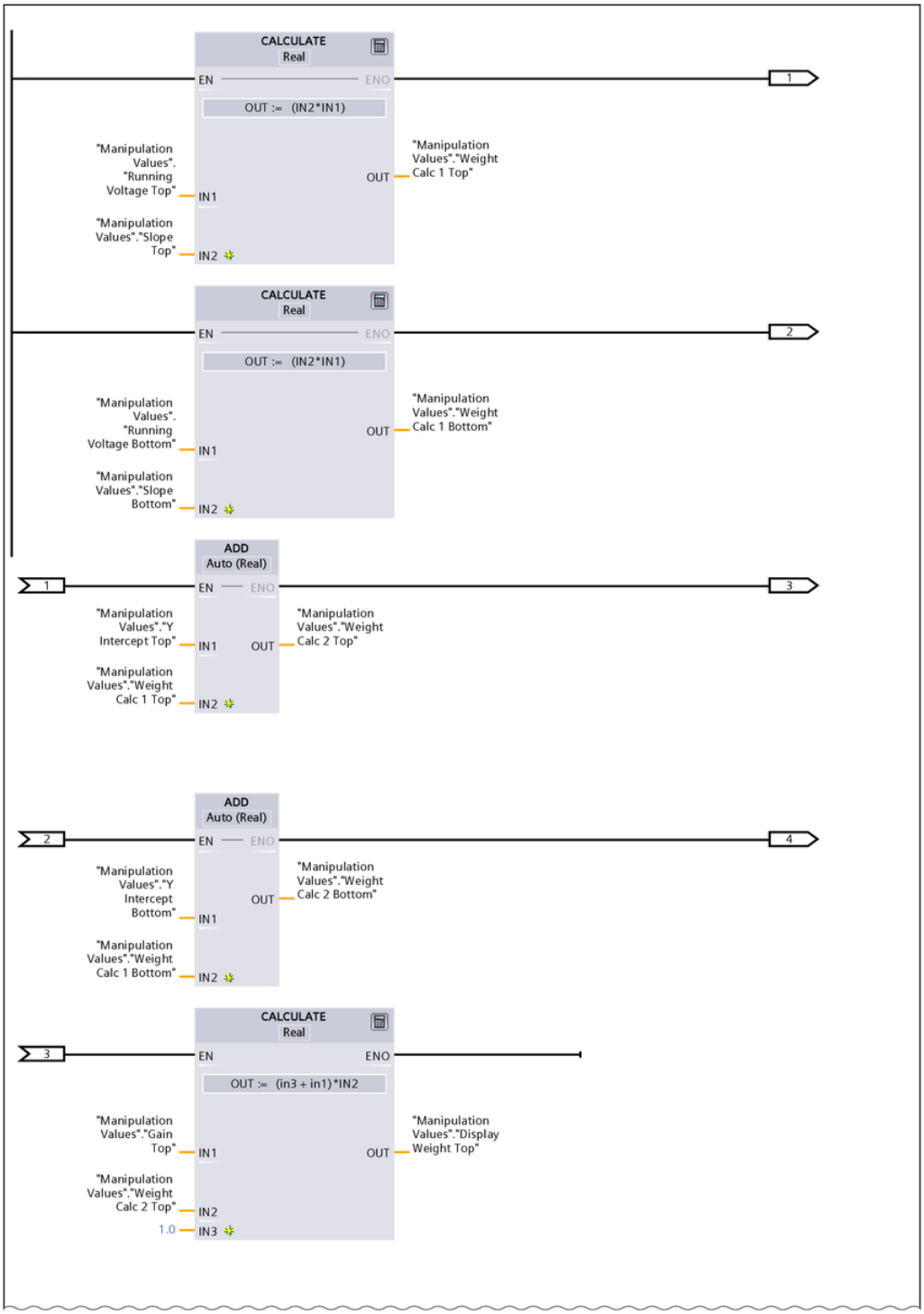
Whilst scanning the strip data from the head is scaled 0-10V.



Network 2:

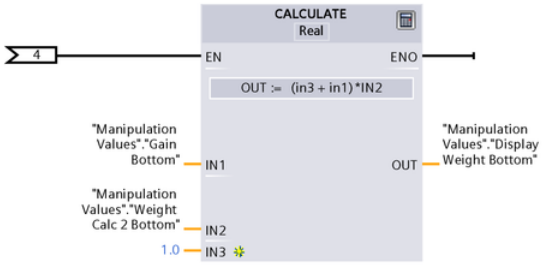
Here the top and bottom voltages have the equation mx+C applied to obtain the coating thickness, a gain can also be added at this point if required.

Network 2: (1.1 / 2.1)



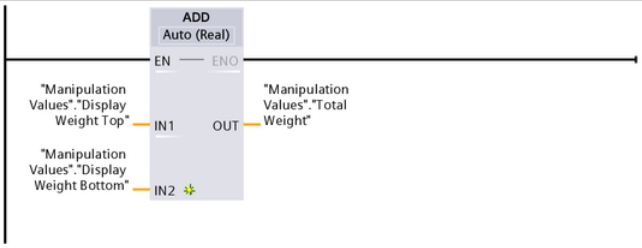
Network 2: (2.1 / 2.1)

1.1 (Page4 - 2)



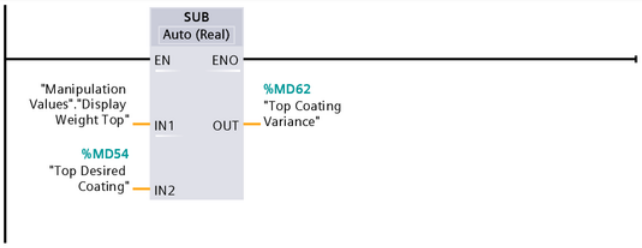
Network 3:

The top and bottom coatings are added to enable displaying the total coating.



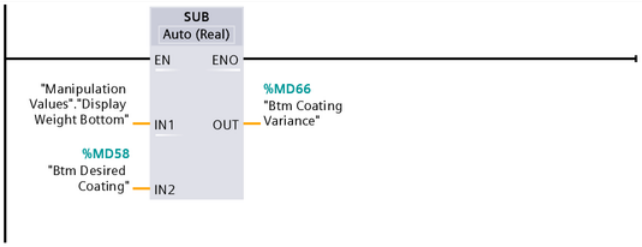
Network 4:

Top desired coating subtracted from the actual coating to enable the difference to be calculated and displayed.



Network 5:

Bottom desired coating subtracted from the actual coating to enable the difference to be calculated and displayed.



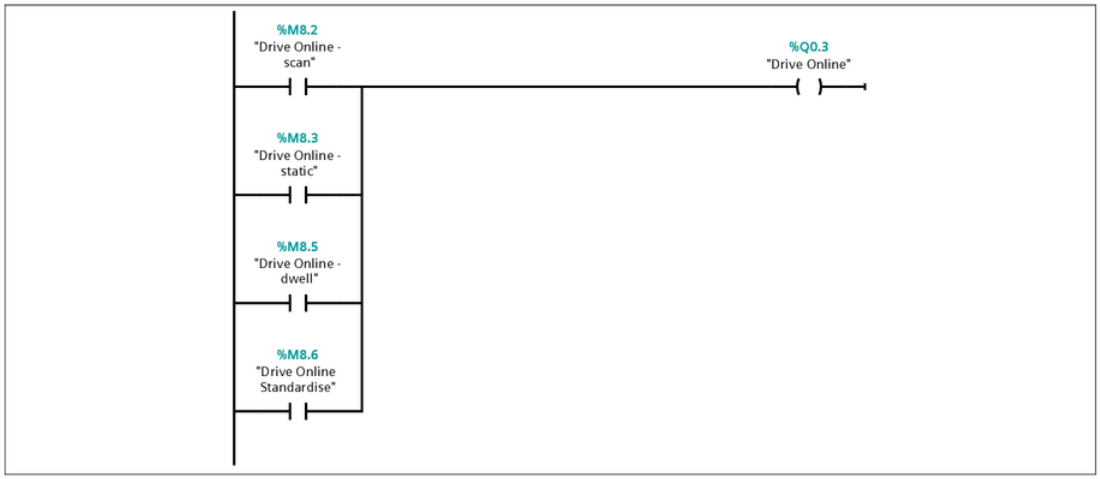
Outputs [FC4]

Outputs Properties					
General					
Name	Outputs	**Number**	4	**Type**	FC
Language	LAD	**Numbering**	automatic		
Information					
Title		**Author**		**Comment**	This block contains the outputs from the system.
Family		**Version**	0.1	**User-defined ID**	

Name	Data type	Default value
Input		
Output		
InOut		
Temp		
Constant		
▼ Return		
Outputs	Void	

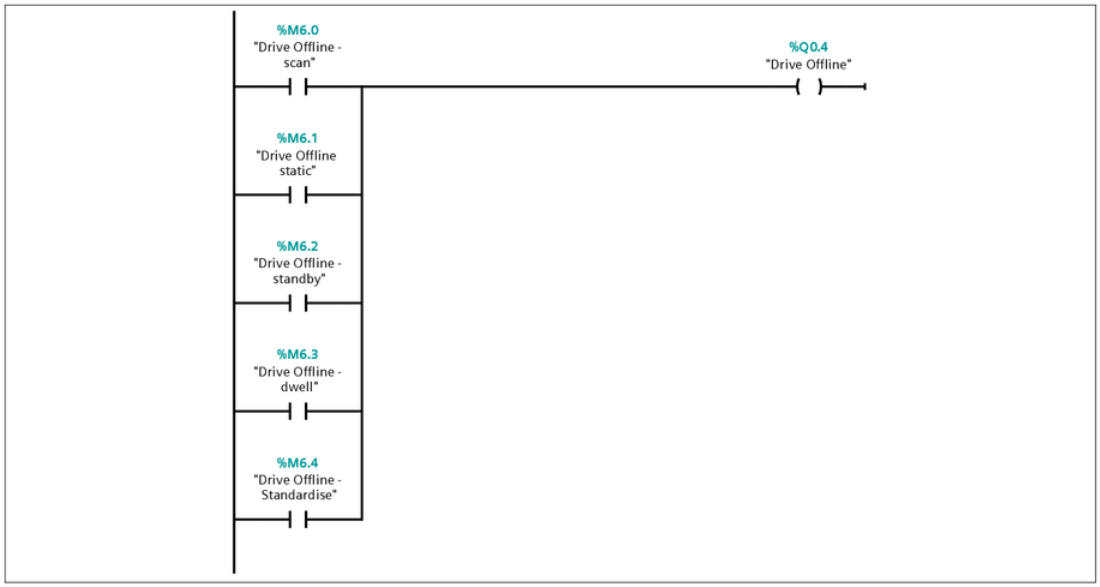
Network 1:

Bits that drive the motor online (FWD)



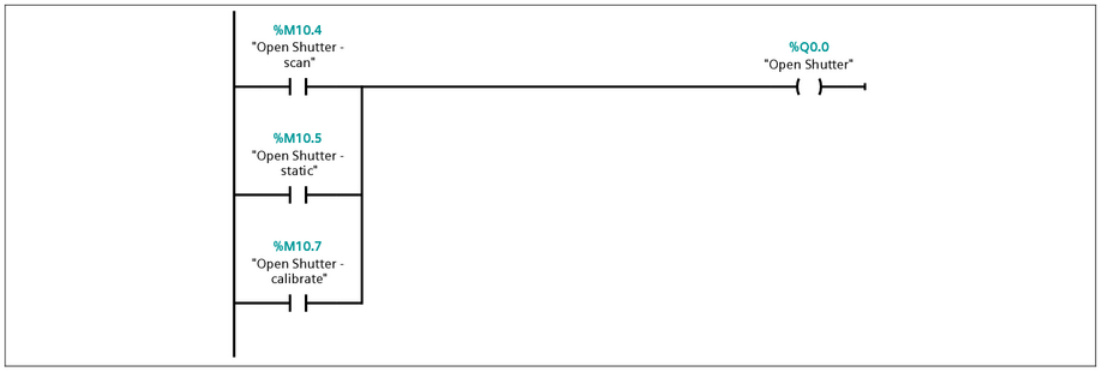
Network 2:

Bits that drive the motor offline (REV)



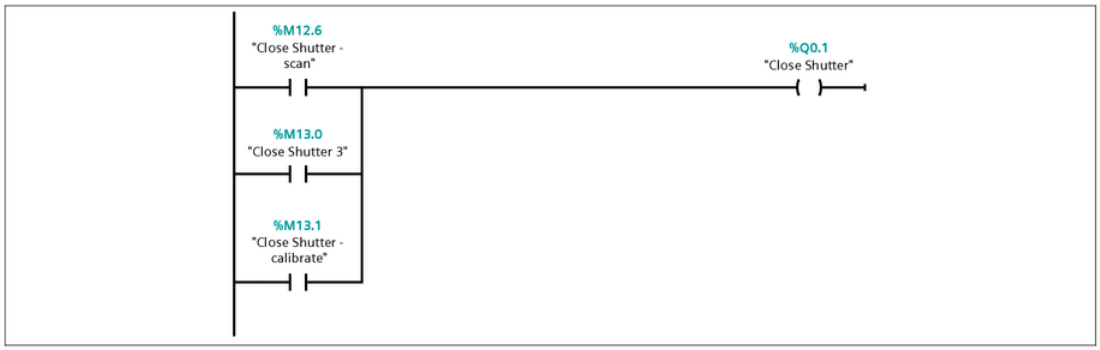
Network 3:

Bits that open shutter

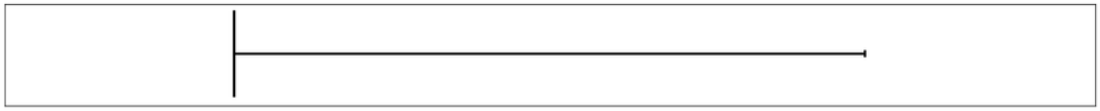


Network 4:

Bits that close shutter



Network 5:

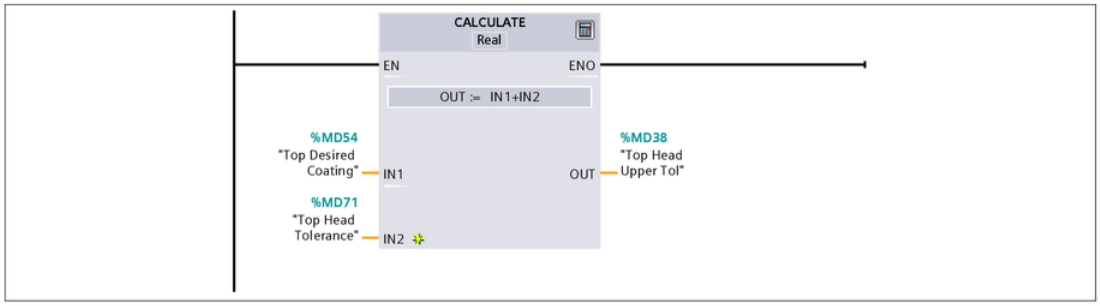


Tolerance [FC3]

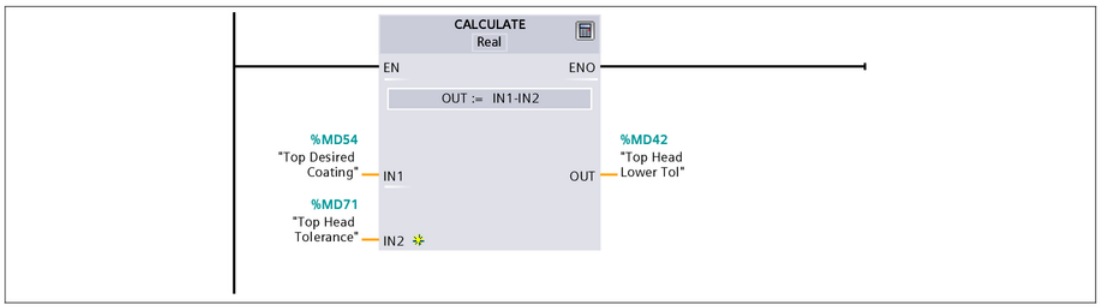
Tolerance Properties					
General					
Name	Tolerance	**Number**	3	**Type**	FC
Language	LAD	**Numbering**	automatic		
Information					
Title		**Author**		**Comment**	
Family		**Version**	0.1	**User-defined ID**	

Name	Data type	Default value
Input		
Output		
InOut		
Temp		
Constant		
▼ Return		
Tolerance	Void	

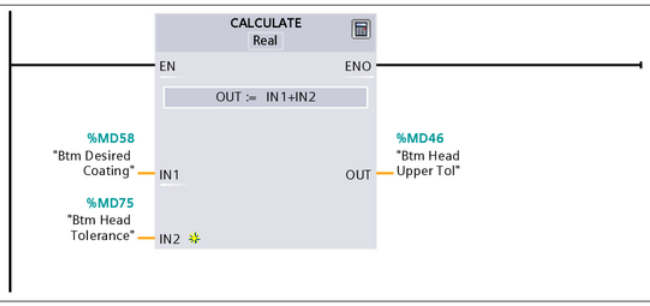
Network 1:



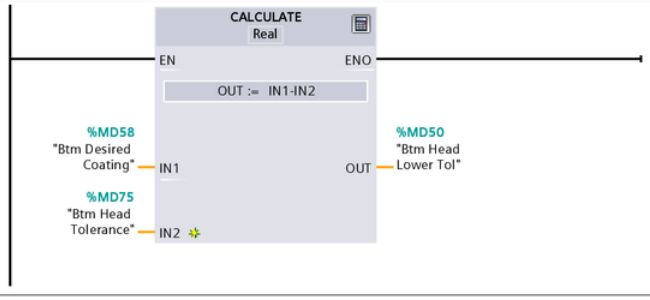
Network 2:



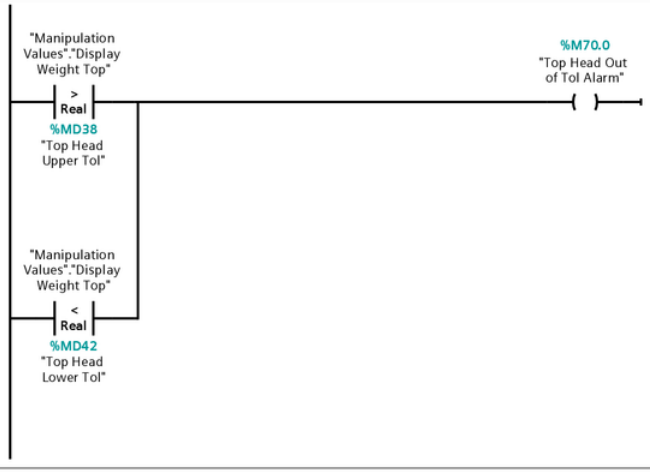
Network 3:



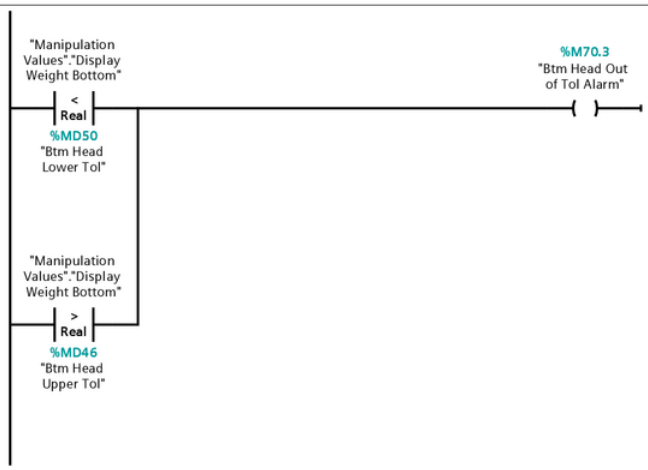
Network 4:



Network 5:



Network 6:


"Manipulation Values"."Display Weight Bottom"
<
Real
%MD50
"Btm Head Lower Tol"
"Manipulation Values"."Display Weight Bottom"
>
Real
%MD46
"Btm Head Upper Tol"
%M70.3
"Btm Head Out of Tol Alarm"

Calibrate & Standardise [FB10]

Calibrate & Standardise Properties					
General					
Name	Calibrate & Standardise	**Number**	10	**Type**	FB
Language	GRAPH	**Numbering**	automatic		
Information					
Title		**Author**		**Comment**	
Family		**Version**	0.1	**User-defined ID**	

Name	Data type	Default value	Retain
▼ Input			
OFF_SQ	Bool	false	Non-retain
INIT_SQ	Bool	false	Non-retain
ACK_EF	Bool	false	Non-retain
S_PREV	Bool	false	Non-retain
S_NEXT	Bool	false	Non-retain
SW_AUTO	Bool	false	Non-retain
SW_TAP	Bool	false	Non-retain
SW_TOP	Bool	false	Non-retain
SW_MAN	Bool	false	Non-retain
S_SEL	Int	0	Non-retain
S_ON	Bool	false	Non-retain
S_OFF	Bool	false	Non-retain
T_PUSH	Bool	false	Non-retain
▼ Output			
S_NO	Int	0	Non-retain
S_MORE	Bool	false	Non-retain
S_ACTIVE	Bool	false	Non-retain
ERR_FLT	Bool	false	Non-retain
AUTO_ON	Bool	false	Non-retain
TAP_ON	Bool	false	Non-retain
TOP_ON	Bool	false	Non-retain
MAN_ON	Bool	false	Non-retain
InOut			
▼ Static			
▼ RT_DATA	G7_RTDataPlus_V2		Non-retain
S_DISPLAY	Int	0	Non-retain
S_SEL_OLD	Int	0	Non-retain
S_DISPIDX	USInt	255	Non-retain
T_DISPIDX	USInt	255	Non-retain
▼ MOP_EDGE	G7_MOPPlus_V2		Non-retain
AUTO	Bool	false	Non-retain
MAN	Bool	false	Non-retain
TAP	Bool	false	Non-retain
TOP	Bool	false	Non-retain
ACK_S	Bool	false	Non-retain
REG_S	Bool	false	Non-retain
T_PREV	Bool	false	Non-retain
T_NEXT	Bool	false	Non-retain

Name	Data type	Default value	Retain
LOCK	Bool	false	Non-retain
SUP	Bool	false	Non-retain
ACKREQ	Bool	false	Non-retain
SSKIP	Bool	false	Non-retain
OFF	Bool	false	Non-retain
INIT	Bool	false	Non-retain
HALT	Bool	false	Non-retain
TMS_HALT	Bool	false	Non-retain
OPS_ZERO	Bool	false	Non-retain
SACT_DISP	Bool	false	Non-retain
SEF_DISP	Bool	false	Non-retain
SALL_DISP	Bool	false	Non-retain
S_PREV	Bool	false	Non-retain
S_NEXT	Bool	false	Non-retain
S_SELOK	Bool	false	Non-retain
S_ON	Bool	false	Non-retain
S_OFF	Bool	false	Non-retain
T_PUSH	Bool	false	Non-retain
REG	Bool	false	Non-retain
ACK	Bool	false	Non-retain
IL_PERM	Bool	false	Non-retain
T_PERM	Bool	false	Non-retain
ILP_MAN	Bool	false	Non-retain
LMODE	Bool	false	Non-retain
▼ MOP	G7_MOPPlus_V2		Non-retain
AUTO	Bool	true	Non-retain
MAN	Bool	false	Non-retain
TAP	Bool	false	Non-retain
TOP	Bool	false	Non-retain
ACK_S	Bool	false	Non-retain
REG_S	Bool	false	Non-retain
T_PREV	Bool	false	Non-retain
T_NEXT	Bool	false	Non-retain
LOCK	Bool	true	Non-retain
SUP	Bool	true	Non-retain
ACKREQ	Bool	true	Non-retain
SSKIP	Bool	false	Non-retain
OFF	Bool	false	Non-retain
INIT	Bool	true	Non-retain
HALT	Bool	false	Non-retain
TMS_HALT	Bool	false	Non-retain
OPS_ZERO	Bool	false	Non-retain
SACT_DISP	Bool	true	Non-retain
SEF_DISP	Bool	false	Non-retain
SALL_DISP	Bool	false	Non-retain
S_PREV	Bool	false	Non-retain
S_NEXT	Bool	false	Non-retain
S_SELOK	Bool	false	Non-retain
S_ON	Bool	false	Non-retain
S_OFF	Bool	false	Non-retain
T_PUSH	Bool	false	Non-retain
REG	Bool	false	Non-retain

Name	Data type	Default value	Retain
ACK	Bool	false	Non-retain
IL_PERM	Bool	false	Non-retain
T_PERM	Bool	false	Non-retain
ILP_MAN	Bool	false	Non-retain
LMODE	Bool	false	Non-retain
TIME_DELTA	Time	T#0ms	Non-retain
▼ SQ_FLAGS	G7_SQFlags-Plus_V2		Non-retain
ERR_FLT	Bool	false	Non-retain
ERROR	Bool	false	Non-retain
FAULT	Bool	false	Non-retain
RT_FAIL	Bool	false	Non-retain
NO_SNO	Bool	false	Non-retain
NF_OFL	Bool	false	Non-retain
SA_OFL	Bool	false	Non-retain
TV_OFL	Bool	false	Non-retain
MSG_OFL	Bool	false	Non-retain
NO_SWI	Bool	false	Non-retain
CYC_OP	Bool	false	Non-retain
AS_MSG	Bool	false	Non-retain
AS_SEND	Bool	false	Non-retain
SQ_BUSY	Bool	false	Non-retain
SA_BUSY	Bool	false	Non-retain
AS_SIG	Bool	false	Non-retain
PRE_CNT	USInt	1	Non-retain
POST_CNT	USInt	1	Non-retain
SQ_CNT	USInt	1	Non-retain
S_CNT	USInt	26	Non-retain
LOCK_CNT	USInt	0	Non-retain
SUP_CNT	USInt	0	Non-retain
T_CNT	USInt	28	Non-retain
SQ_PART_CNT	USInt	3	Non-retain
MAX_TVAL	USInt	4	Non-retain
MAX_SACT	USInt	1	Non-retain
AS_MSG	Byte	16#F	Non-retain
▼ EXEC_BITS	Array[0..249] of Bool		Non-retain
EXEC_BITS[0]	Bool	false	Non-retain
EXEC_BITS[1]	Bool	false	Non-retain
EXEC_BITS[2]	Bool	false	Non-retain
EXEC_BITS[3]	Bool	false	Non-retain
EXEC_BITS[4]	Bool	false	Non-retain
EXEC_BITS[5]	Bool	false	Non-retain
EXEC_BITS[6]	Bool	false	Non-retain
EXEC_BITS[7]	Bool	false	Non-retain
EXEC_BITS[8]	Bool	false	Non-retain
EXEC_BITS[9]	Bool	false	Non-retain
EXEC_BITS[10]	Bool	false	Non-retain
EXEC_BITS[11]	Bool	false	Non-retain
EXEC_BITS[12]	Bool	false	Non-retain
EXEC_BITS[13]	Bool	false	Non-retain
EXEC_BITS[14]	Bool	false	Non-retain
EXEC_BITS[15]	Bool	false	Non-retain

Name	Data type	Default value	Retain
EXEC_BITS[16]	Bool	false	Non-retain
EXEC_BITS[17]	Bool	false	Non-retain
EXEC_BITS[18]	Bool	false	Non-retain
EXEC_BITS[19]	Bool	false	Non-retain
EXEC_BITS[20]	Bool	false	Non-retain
EXEC_BITS[21]	Bool	false	Non-retain
EXEC_BITS[22]	Bool	false	Non-retain
EXEC_BITS[23]	Bool	false	Non-retain
EXEC_BITS[24]	Bool	false	Non-retain
EXEC_BITS[25]	Bool	false	Non-retain
EXEC_BITS[26]	Bool	false	Non-retain
EXEC_BITS[27]	Bool	false	Non-retain
EXEC_BITS[28]	Bool	false	Non-retain
EXEC_BITS[29]	Bool	false	Non-retain
EXEC_BITS[30]	Bool	false	Non-retain
EXEC_BITS[31]	Bool	false	Non-retain
EXEC_BITS[32]	Bool	false	Non-retain
EXEC_BITS[33]	Bool	false	Non-retain
EXEC_BITS[34]	Bool	false	Non-retain
EXEC_BITS[35]	Bool	false	Non-retain
EXEC_BITS[36]	Bool	false	Non-retain
EXEC_BITS[37]	Bool	false	Non-retain
EXEC_BITS[38]	Bool	false	Non-retain
EXEC_BITS[39]	Bool	false	Non-retain
EXEC_BITS[40]	Bool	false	Non-retain
EXEC_BITS[41]	Bool	false	Non-retain
EXEC_BITS[42]	Bool	false	Non-retain
EXEC_BITS[43]	Bool	false	Non-retain
EXEC_BITS[44]	Bool	false	Non-retain
EXEC_BITS[45]	Bool	false	Non-retain
EXEC_BITS[46]	Bool	false	Non-retain
EXEC_BITS[47]	Bool	false	Non-retain
EXEC_BITS[48]	Bool	false	Non-retain
EXEC_BITS[49]	Bool	false	Non-retain
EXEC_BITS[50]	Bool	false	Non-retain
EXEC_BITS[51]	Bool	false	Non-retain
EXEC_BITS[52]	Bool	false	Non-retain
EXEC_BITS[53]	Bool	false	Non-retain
EXEC_BITS[54]	Bool	false	Non-retain
EXEC_BITS[55]	Bool	false	Non-retain
EXEC_BITS[56]	Bool	false	Non-retain
EXEC_BITS[57]	Bool	false	Non-retain
EXEC_BITS[58]	Bool	false	Non-retain
EXEC_BITS[59]	Bool	false	Non-retain
EXEC_BITS[60]	Bool	false	Non-retain
EXEC_BITS[61]	Bool	false	Non-retain
EXEC_BITS[62]	Bool	false	Non-retain
EXEC_BITS[63]	Bool	false	Non-retain
EXEC_BITS[64]	Bool	false	Non-retain
EXEC_BITS[65]	Bool	false	Non-retain
EXEC_BITS[66]	Bool	false	Non-retain
EXEC_BITS[67]	Bool	false	Non-retain

Name	Data type	Default value	Retain
EXEC_BITS[68]	Bool	false	Non-retain
EXEC_BITS[69]	Bool	false	Non-retain
EXEC_BITS[70]	Bool	false	Non-retain
EXEC_BITS[71]	Bool	false	Non-retain
EXEC_BITS[72]	Bool	false	Non-retain
EXEC_BITS[73]	Bool	false	Non-retain
EXEC_BITS[74]	Bool	false	Non-retain
EXEC_BITS[75]	Bool	false	Non-retain
EXEC_BITS[76]	Bool	false	Non-retain
EXEC_BITS[77]	Bool	false	Non-retain
EXEC_BITS[78]	Bool	false	Non-retain
EXEC_BITS[79]	Bool	false	Non-retain
EXEC_BITS[80]	Bool	false	Non-retain
EXEC_BITS[81]	Bool	false	Non-retain
EXEC_BITS[82]	Bool	false	Non-retain
EXEC_BITS[83]	Bool	false	Non-retain
EXEC_BITS[84]	Bool	false	Non-retain
EXEC_BITS[85]	Bool	false	Non-retain
EXEC_BITS[86]	Bool	false	Non-retain
EXEC_BITS[87]	Bool	false	Non-retain
EXEC_BITS[88]	Bool	false	Non-retain
EXEC_BITS[89]	Bool	false	Non-retain
EXEC_BITS[90]	Bool	false	Non-retain
EXEC_BITS[91]	Bool	false	Non-retain
EXEC_BITS[92]	Bool	false	Non-retain
EXEC_BITS[93]	Bool	false	Non-retain
EXEC_BITS[94]	Bool	false	Non-retain
EXEC_BITS[95]	Bool	false	Non-retain
EXEC_BITS[96]	Bool	false	Non-retain
EXEC_BITS[97]	Bool	false	Non-retain
EXEC_BITS[98]	Bool	false	Non-retain
EXEC_BITS[99]	Bool	false	Non-retain
EXEC_BITS[100]	Bool	false	Non-retain
EXEC_BITS[101]	Bool	false	Non-retain
EXEC_BITS[102]	Bool	false	Non-retain
EXEC_BITS[103]	Bool	false	Non-retain
EXEC_BITS[104]	Bool	false	Non-retain
EXEC_BITS[105]	Bool	false	Non-retain
EXEC_BITS[106]	Bool	false	Non-retain
EXEC_BITS[107]	Bool	false	Non-retain
EXEC_BITS[108]	Bool	false	Non-retain
EXEC_BITS[109]	Bool	false	Non-retain
EXEC_BITS[110]	Bool	false	Non-retain
EXEC_BITS[111]	Bool	false	Non-retain
EXEC_BITS[112]	Bool	false	Non-retain
EXEC_BITS[113]	Bool	false	Non-retain
EXEC_BITS[114]	Bool	false	Non-retain
EXEC_BITS[115]	Bool	false	Non-retain
EXEC_BITS[116]	Bool	false	Non-retain
EXEC_BITS[117]	Bool	false	Non-retain
EXEC_BITS[118]	Bool	false	Non-retain
EXEC_BITS[119]	Bool	false	Non-retain

Name	Data type	Default value	Retain
EXEC_BITS[120]	Bool	false	Non-retain
EXEC_BITS[121]	Bool	false	Non-retain
EXEC_BITS[122]	Bool	false	Non-retain
EXEC_BITS[123]	Bool	false	Non-retain
EXEC_BITS[124]	Bool	false	Non-retain
EXEC_BITS[125]	Bool	false	Non-retain
EXEC_BITS[126]	Bool	false	Non-retain
EXEC_BITS[127]	Bool	false	Non-retain
EXEC_BITS[128]	Bool	false	Non-retain
EXEC_BITS[129]	Bool	false	Non-retain
EXEC_BITS[130]	Bool	false	Non-retain
EXEC_BITS[131]	Bool	false	Non-retain
EXEC_BITS[132]	Bool	false	Non-retain
EXEC_BITS[133]	Bool	false	Non-retain
EXEC_BITS[134]	Bool	false	Non-retain
EXEC_BITS[135]	Bool	false	Non-retain
EXEC_BITS[136]	Bool	false	Non-retain
EXEC_BITS[137]	Bool	false	Non-retain
EXEC_BITS[138]	Bool	false	Non-retain
EXEC_BITS[139]	Bool	false	Non-retain
EXEC_BITS[140]	Bool	false	Non-retain
EXEC_BITS[141]	Bool	false	Non-retain
EXEC_BITS[142]	Bool	false	Non-retain
EXEC_BITS[143]	Bool	false	Non-retain
EXEC_BITS[144]	Bool	false	Non-retain
EXEC_BITS[145]	Bool	false	Non-retain
EXEC_BITS[146]	Bool	false	Non-retain
EXEC_BITS[147]	Bool	false	Non-retain
EXEC_BITS[148]	Bool	false	Non-retain
EXEC_BITS[149]	Bool	false	Non-retain
EXEC_BITS[150]	Bool	false	Non-retain
EXEC_BITS[151]	Bool	false	Non-retain
EXEC_BITS[152]	Bool	false	Non-retain
EXEC_BITS[153]	Bool	false	Non-retain
EXEC_BITS[154]	Bool	false	Non-retain
EXEC_BITS[155]	Bool	false	Non-retain
EXEC_BITS[156]	Bool	false	Non-retain
EXEC_BITS[157]	Bool	false	Non-retain
EXEC_BITS[158]	Bool	false	Non-retain
EXEC_BITS[159]	Bool	false	Non-retain
EXEC_BITS[160]	Bool	false	Non-retain
EXEC_BITS[161]	Bool	false	Non-retain
EXEC_BITS[162]	Bool	false	Non-retain
EXEC_BITS[163]	Bool	false	Non-retain
EXEC_BITS[164]	Bool	false	Non-retain
EXEC_BITS[165]	Bool	false	Non-retain
EXEC_BITS[166]	Bool	false	Non-retain
EXEC_BITS[167]	Bool	false	Non-retain
EXEC_BITS[168]	Bool	false	Non-retain
EXEC_BITS[169]	Bool	false	Non-retain
EXEC_BITS[170]	Bool	false	Non-retain
EXEC_BITS[171]	Bool	false	Non-retain

Name	Data type	Default value	Retain
EXEC_BITS[172]	Bool	false	Non-retain
EXEC_BITS[173]	Bool	false	Non-retain
EXEC_BITS[174]	Bool	false	Non-retain
EXEC_BITS[175]	Bool	false	Non-retain
EXEC_BITS[176]	Bool	false	Non-retain
EXEC_BITS[177]	Bool	false	Non-retain
EXEC_BITS[178]	Bool	false	Non-retain
EXEC_BITS[179]	Bool	false	Non-retain
EXEC_BITS[180]	Bool	false	Non-retain
EXEC_BITS[181]	Bool	false	Non-retain
EXEC_BITS[182]	Bool	false	Non-retain
EXEC_BITS[183]	Bool	false	Non-retain
EXEC_BITS[184]	Bool	false	Non-retain
EXEC_BITS[185]	Bool	false	Non-retain
EXEC_BITS[186]	Bool	false	Non-retain
EXEC_BITS[187]	Bool	false	Non-retain
EXEC_BITS[188]	Bool	false	Non-retain
EXEC_BITS[189]	Bool	false	Non-retain
EXEC_BITS[190]	Bool	false	Non-retain
EXEC_BITS[191]	Bool	false	Non-retain
EXEC_BITS[192]	Bool	false	Non-retain
EXEC_BITS[193]	Bool	false	Non-retain
EXEC_BITS[194]	Bool	false	Non-retain
EXEC_BITS[195]	Bool	false	Non-retain
EXEC_BITS[196]	Bool	false	Non-retain
EXEC_BITS[197]	Bool	false	Non-retain
EXEC_BITS[198]	Bool	false	Non-retain
EXEC_BITS[199]	Bool	false	Non-retain
EXEC_BITS[200]	Bool	false	Non-retain
EXEC_BITS[201]	Bool	false	Non-retain
EXEC_BITS[202]	Bool	false	Non-retain
EXEC_BITS[203]	Bool	false	Non-retain
EXEC_BITS[204]	Bool	false	Non-retain
EXEC_BITS[205]	Bool	false	Non-retain
EXEC_BITS[206]	Bool	false	Non-retain
EXEC_BITS[207]	Bool	false	Non-retain
EXEC_BITS[208]	Bool	false	Non-retain
EXEC_BITS[209]	Bool	false	Non-retain
EXEC_BITS[210]	Bool	false	Non-retain
EXEC_BITS[211]	Bool	false	Non-retain
EXEC_BITS[212]	Bool	false	Non-retain
EXEC_BITS[213]	Bool	false	Non-retain
EXEC_BITS[214]	Bool	false	Non-retain
EXEC_BITS[215]	Bool	false	Non-retain
EXEC_BITS[216]	Bool	false	Non-retain
EXEC_BITS[217]	Bool	false	Non-retain
EXEC_BITS[218]	Bool	false	Non-retain
EXEC_BITS[219]	Bool	false	Non-retain
EXEC_BITS[220]	Bool	false	Non-retain
EXEC_BITS[221]	Bool	false	Non-retain
EXEC_BITS[222]	Bool	false	Non-retain
EXEC_BITS[223]	Bool	false	Non-retain

Name	Data type	Default value	Retain
EXEC_BITS[224]	Bool	false	Non-retain
EXEC_BITS[225]	Bool	false	Non-retain
EXEC_BITS[226]	Bool	false	Non-retain
EXEC_BITS[227]	Bool	false	Non-retain
EXEC_BITS[228]	Bool	false	Non-retain
EXEC_BITS[229]	Bool	false	Non-retain
EXEC_BITS[230]	Bool	false	Non-retain
EXEC_BITS[231]	Bool	false	Non-retain
EXEC_BITS[232]	Bool	false	Non-retain
EXEC_BITS[233]	Bool	false	Non-retain
EXEC_BITS[234]	Bool	false	Non-retain
EXEC_BITS[235]	Bool	false	Non-retain
EXEC_BITS[236]	Bool	false	Non-retain
EXEC_BITS[237]	Bool	false	Non-retain
EXEC_BITS[238]	Bool	false	Non-retain
EXEC_BITS[239]	Bool	false	Non-retain
EXEC_BITS[240]	Bool	false	Non-retain
EXEC_BITS[241]	Bool	false	Non-retain
EXEC_BITS[242]	Bool	false	Non-retain
EXEC_BITS[243]	Bool	false	Non-retain
EXEC_BITS[244]	Bool	false	Non-retain
EXEC_BITS[245]	Bool	false	Non-retain
EXEC_BITS[246]	Bool	false	Non-retain
EXEC_BITS[247]	Bool	false	Non-retain
EXEC_BITS[248]	Bool	false	Non-retain
EXEC_BITS[249]	Bool	false	Non-retain
▼ OFFSETS	G7_OffsetsPlus_V2		Non-retain
SINI_OFFSET	UInt	0	Non-retain
LSTT_OFFSET	UInt	2	Non-retain
ATAJ_OFFSET	UInt	30	Non-retain
ATAB_OFFSET	UInt	58	Non-retain
PSTT_OFFSET	UInt	86	Non-retain
NSTT_OFFSET	UInt	114	Non-retain
ASSJ_OFFSET	UInt	142	Non-retain
ASSB_OFFSET	UInt	168	Non-retain
PTTS_OFFSET	UInt	194	Non-retain
NTTS_OFFSET	UInt	220	Non-retain
SW_SQTS_OFFSET	UInt	246	Non-retain
SWITCH_OFFSET	UInt	272	Non-retain
TVX_OFFSET	UInt	274	Non-retain
TTX_OFFSET	UInt	279	Non-retain
TSX_OFFSET	UInt	284	Non-retain
S00X_OFFSET	UInt	286	Non-retain
SOFFX_OFFSET	UInt	288	Non-retain
SONX_OFFSET	UInt	290	Non-retain
SAX_OFFSET	UInt	292	Non-retain
SERRX_OFFSET	UInt	294	Non-retain
SMX_OFFSET	UInt	321	Non-retain
S0X_OFFSET	UInt	348	Non-retain
S1X_OFFSET	UInt	375	Non-retain
THRESHOLD_SUP	USInt	0	Non-retain
THRESHOLD_WARN	USInt	0	Non-retain

Name	Data type	Default value	Retain
Trans1	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	1	Non-retain
Trans2	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	2	Non-retain
Trans3	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	3	Non-retain
Trans4	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	4	Non-retain
Trans5	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	5	Non-retain
Trans6	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	6	Non-retain
Trans7	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	7	Non-retain
Trans8	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	8	Non-retain
Trans9	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	9	Non-retain

Name	Data type	Default value	Retain
Trans10	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	10	Non-retain
Trans11	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	11	Non-retain
Trans12	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	12	Non-retain
Trans13	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	13	Non-retain
Trans14	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	14	Non-retain
Trans15	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	15	Non-retain
Trans16	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	16	Non-retain
Trans17	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	17	Non-retain
Trans18	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	18	Non-retain

Name	Data type	Default value	Retain
Trans19	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	19	Non-retain
Trans20	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	20	Non-retain
Trans21	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	21	Non-retain
Trans22	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	22	Non-retain
Trans23	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	23	Non-retain
Trans24	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	24	Non-retain
Trans25	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	25	Non-retain
Trans26	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	26	Non-retain
Trans27	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	27	Non-retain

Name	Data type	Default value	Retain
Trans28	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	28	Non-retain
Step1	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	1	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
Step2	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	2	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain

Name	Data type	Default value	Retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
Step3	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	3	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
Step4	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	4	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain

Name	Data type	Default value	Retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step5	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	5	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step6	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	6	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain

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Name	Data type	Default value	Retain
▼ Step7	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	7	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step8	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	8	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step9	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain

Name	Data type	Default value	Retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	9	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step10	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	10	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step11	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain

Name	Data type	Default value	Retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	11	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step12	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	12	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step13	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain

Name	Data type	Default value	Retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	13	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step14	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	14	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step15	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain

Name	Data type	Default value	Retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	15	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step16	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	16	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step17	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain

Name	Data type	Default value	Retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	17	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step18	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	18	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step19	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain

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Name	Data type	Default value	Retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	19	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step20	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	20	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step21	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain

Name	Data type	Default value	Retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	21	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step22	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	22	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step23	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain

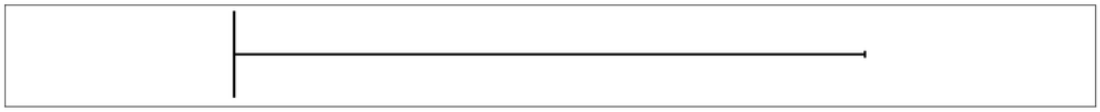
Name	Data type	Default value	Retain
VS	Bool	false	Non-retain
SNO	Int	23	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step24	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	24	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step25	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	25	Non-retain

Name	Data type	Default value	Retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step26	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	26	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
Temp			
Constant			

Alarms			
Enable alarms	True	**Acknowledge interlock alarms**	True
Interlock template	GRAPH7_INTERLOCK_ERROR<CPU name><FB name><FB number><instance DB name><instance DB number><step name><step number><step-specific text>	**Acknowledge supervision alarms**	True
Supervision template	GRAPH7_SUPERVISION_FAULT<CPU name><FB name><FB number><instance DB name><instance DB number><step name><step number><step-specific text>		

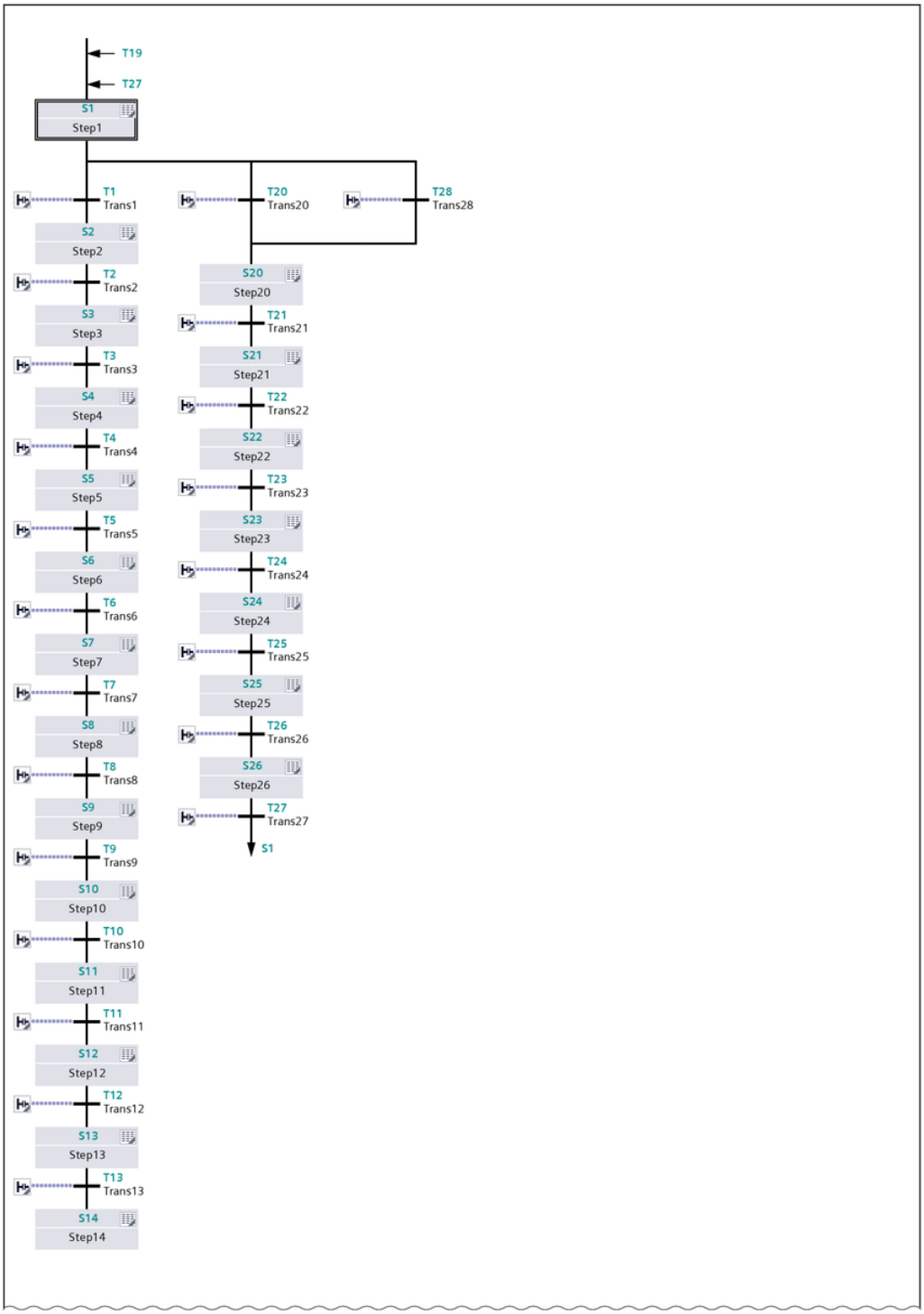
Permanent pre-instructions

1:



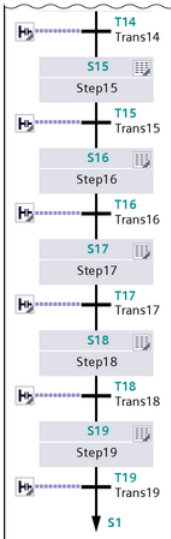
1:

1: (1.1 / 2.1)


T19
T27
S1
Step1
T1
Trans1
S2
Step2
T2
Trans2
S3
Step3
T3
Trans3
S4
Step4
T4
Trans4
S5
Step5
T5
Trans5
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T26
Trans26
S26
Step26
T27
Trans27
S1

1: (2.1 / 2.1)

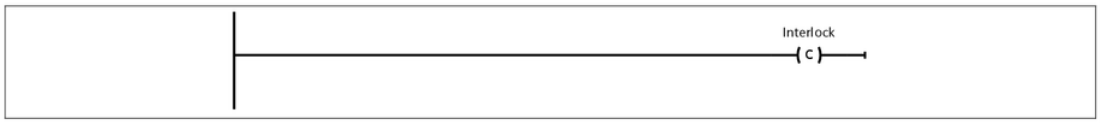
1.1 (Page7 - 26)



S1 - [Initial step]:Step1

Interlock -(c)-:

Interlock alarm	
Alarm text	



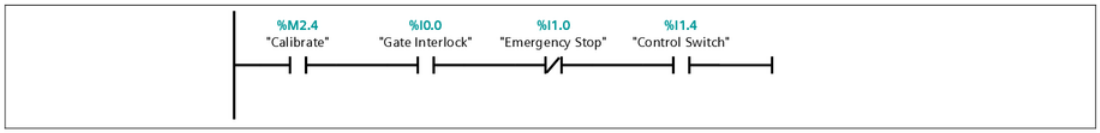
Supervision -(v)-:

Supervision alarm	
Alarm text	

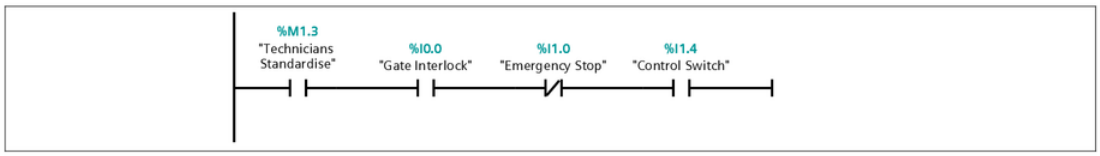


Actions:			
Interlock	Event	Qualifier	Action

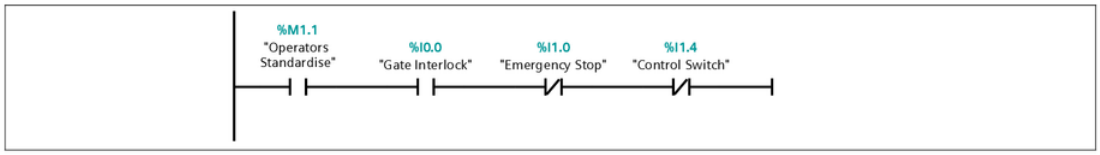
T1:Trans1



T20:Trans20



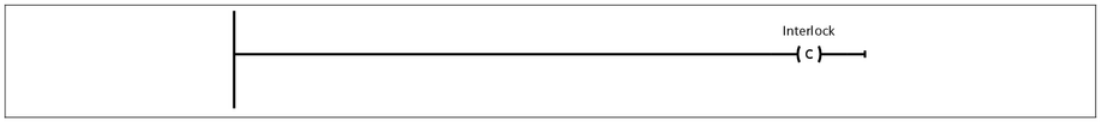
T28:Trans28



S2:Step2

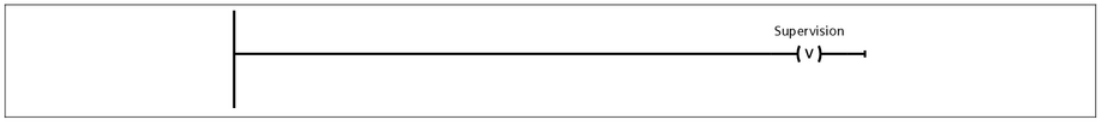
Interlock -(c)-:

Interlock alarm	
Alarm text	



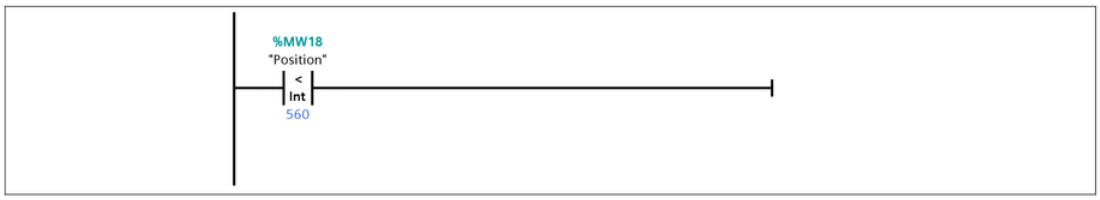
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		S	"Drive Offline - calibrate"

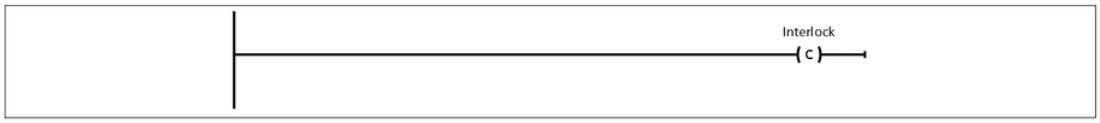
T2:Trans2



S3:Step3

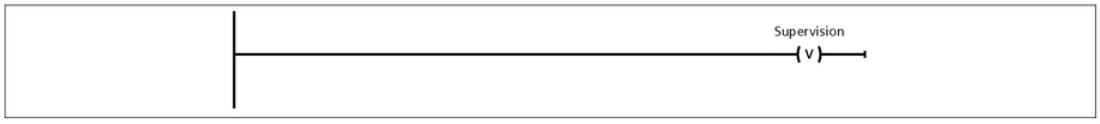
Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

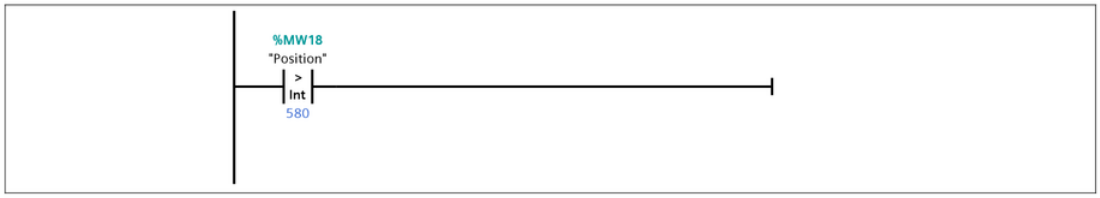
Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - calibrate"

Interlock	Event	Qualifier	Action
		S	"Drive Online - calibrate"

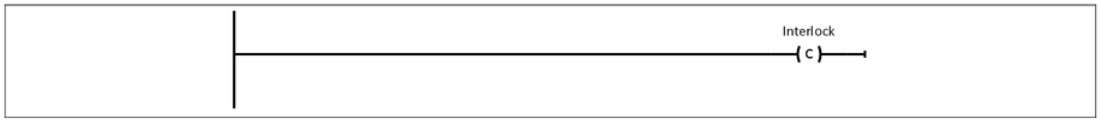
T3:Trans3



S4:Step4

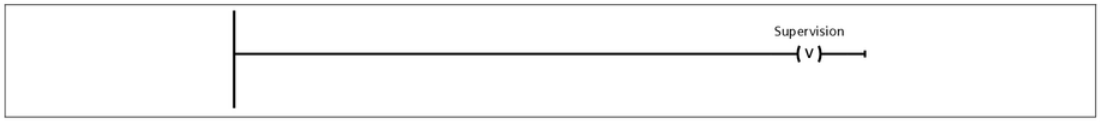
Interlock -(c)-:

Interlock alarm	
Alarm text	



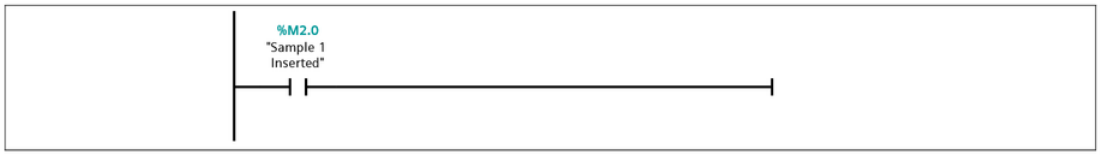
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Online - calibrate"

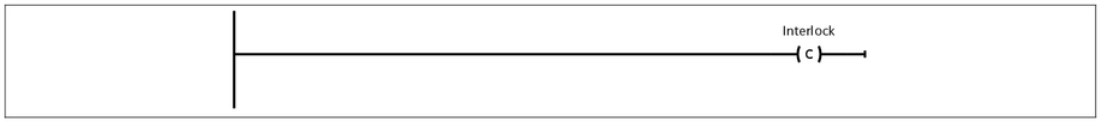
T4:Trans4



S5:Step5

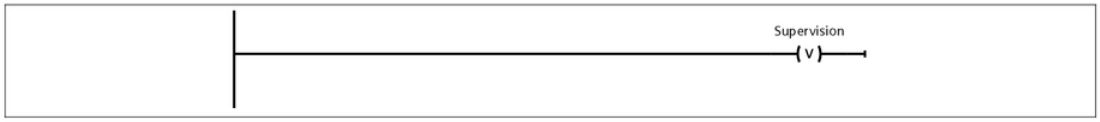
Interlock -(c)-:

Interlock alarm	
Alarm text	



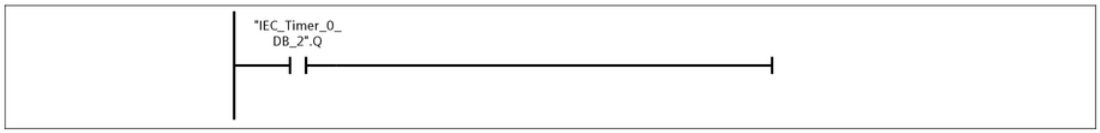
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		S	"Open Shutter - calibrate"
		R	"Close Shutter - calibrate"
		S	"Start Timing"

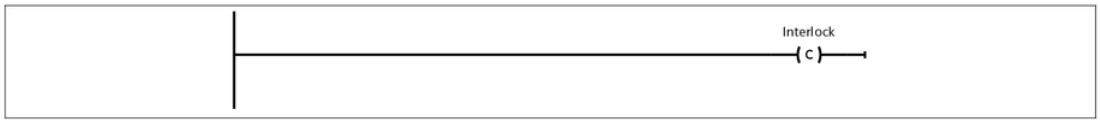
T5:Trans5



S6:Step6

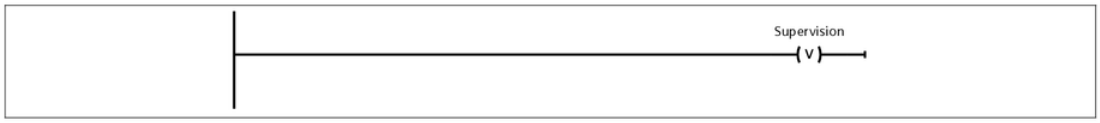
Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Open Shutter - calibrate"

Interlock	Event	Qualifier	Action
		S	"Close Shutter - calibrate"
		S	"Drive Offline - calibrate"
		R	"Start Timing"

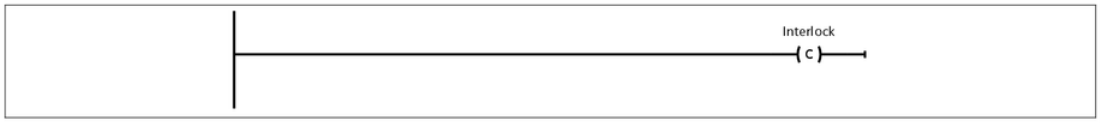
T6:Trans6



S9:Step9

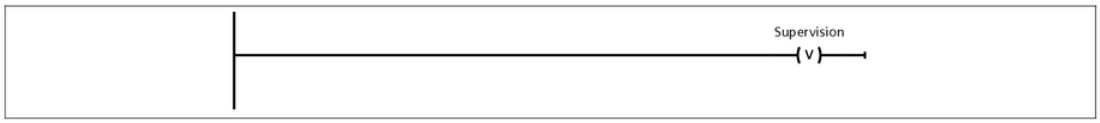
Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

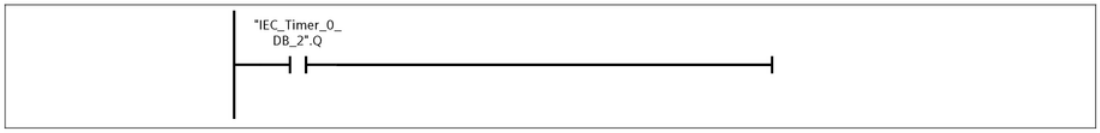
Supervision alarm	
Alarm text	



Actions:

Interlock	Event	Qualifier	Action
		S	"Open Shutter - calibrate"
		R	"Close Shutter - calibrate"
		R	"Drive Online - calibrate"
		S	"Start Timing"

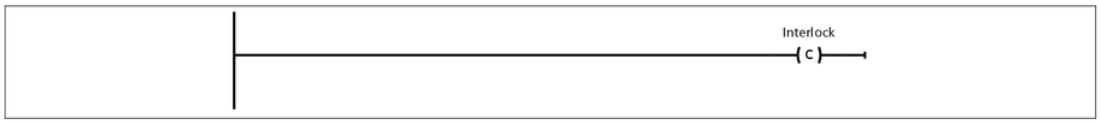
T9:Trans9



S10:Step10

Interlock -(c)-:

Interlock alarm	
Alarm text	



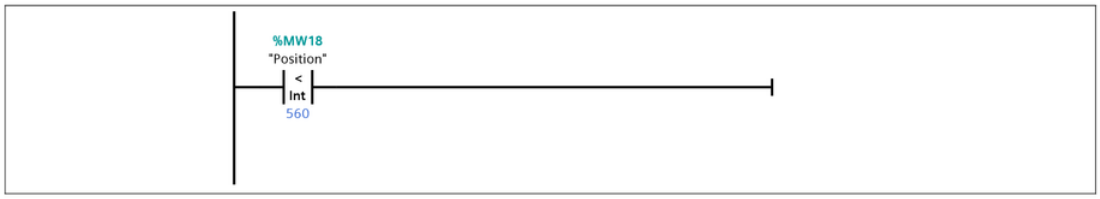
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Open Shutter - calibrate"
		S	"Close Shutter - calibrate"
		R	"Start Timing"
		S	"Drive Offline - calibrate"

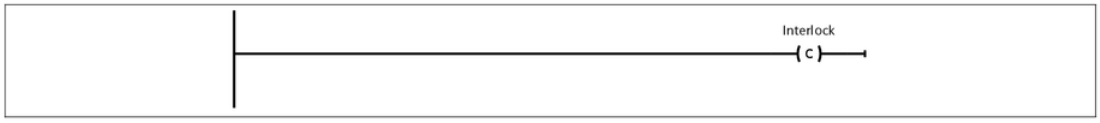
T10:Trans10



S12:Step12

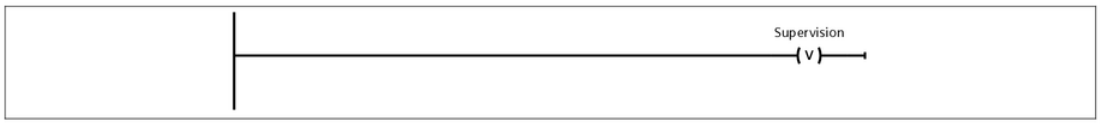
Interlock -(c)-:

Interlock alarm	
Alarm text	



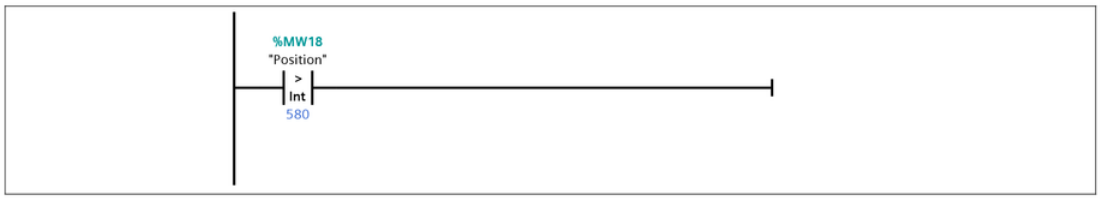
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		S	"Open Shutter - calibrate"
		R	"Close Shutter - calibrate"
		S	"Drive Online - calibrate"

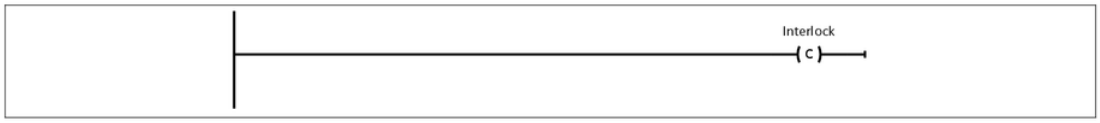
T12:Trans12



S14:Step14

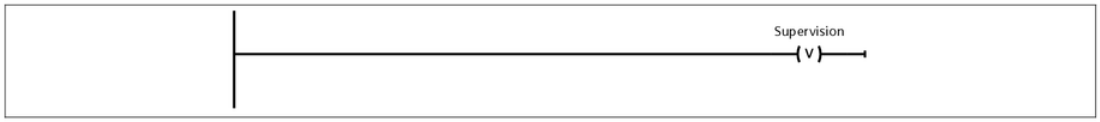
Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Open Shutter - calibrate"
		S	"Close Shutter - calibrate"

Interlock	Event	Qualifier	Action
		R	"Start Timing"
		S	"Drive Offline - calibrate"

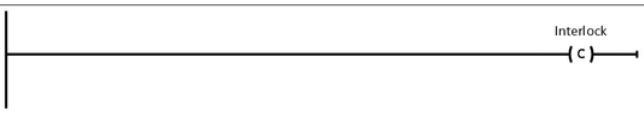
T14:Trans14



S16:Step16

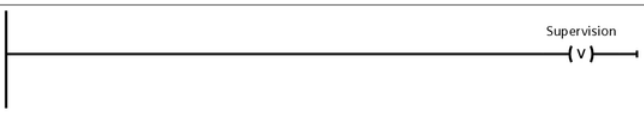
Interlock -(c)-:

Interlock alarm	
Alarm text	



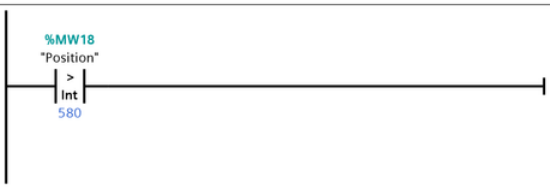
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	**Event**	**Qualifier**	**Action**
		S	"Open Shutter - calibrate"
		R	"Close Shutter - calibrate"
		S	"Drive Online - calibrate"

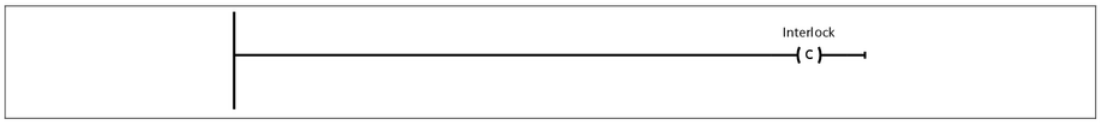
T16:Trans16



S18:Step18

Interlock -(c)-:

Interlock alarm	
Alarm text	



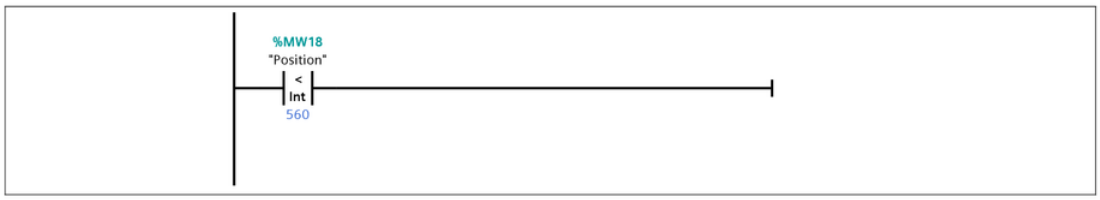
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Open Shutter - calibrate"
		S	"Close Shutter - calibrate"
		R	"Start Timing"
		S	"Drive Offline - calibrate"

T18:Trans18



S19:Step19

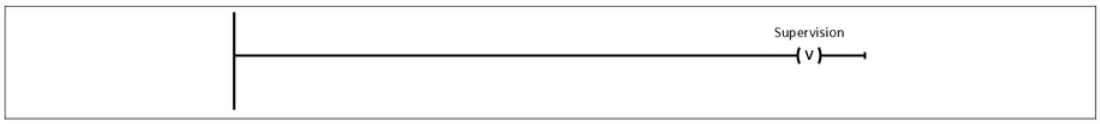
Interlock -(c)-:

Interlock alarm	
Alarm text	



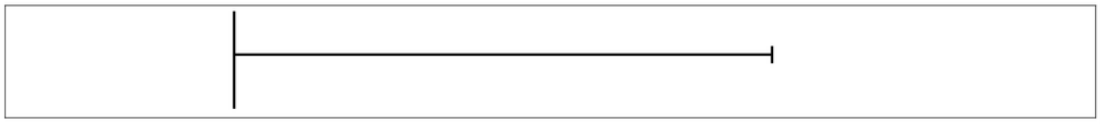
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - calibrate"
		R	"Calibrate"
		R	"Sample 1 Inserted"
		R	"Sample 2 Inserted"
		R	"Sample 3 Inserted"
		R	"Sample 4 Inserted"

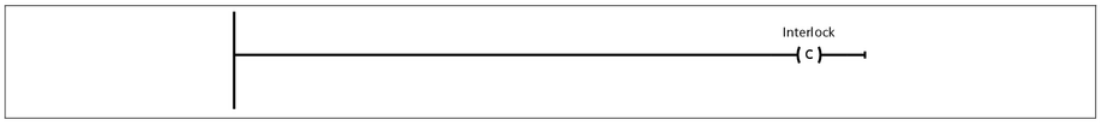
T19:Trans19



S8:Step8

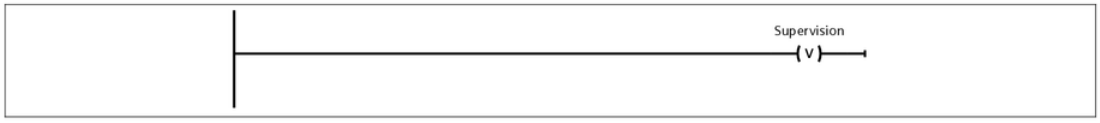
Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

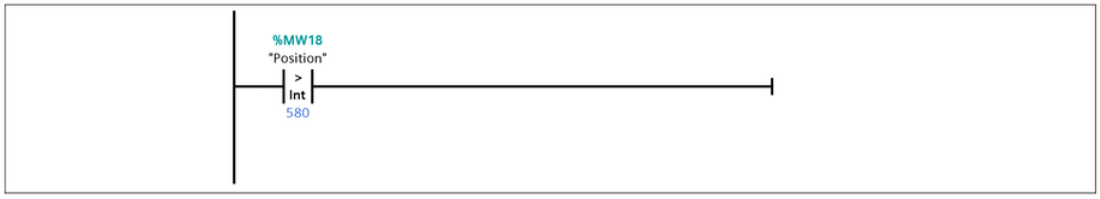
Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		S	"Drive Online - calibrate"

Interlock	Event	Qualifier	Action

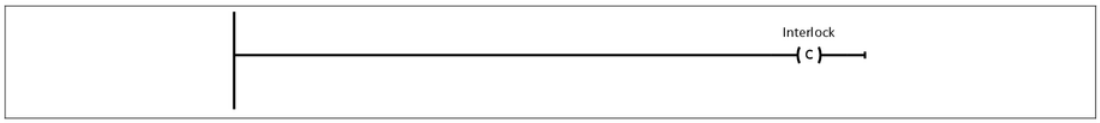
T8:Trans8



S7:Step7

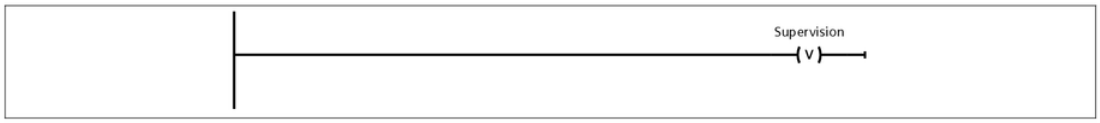
Interlock -(c)-:

Interlock alarm	
Alarm text	



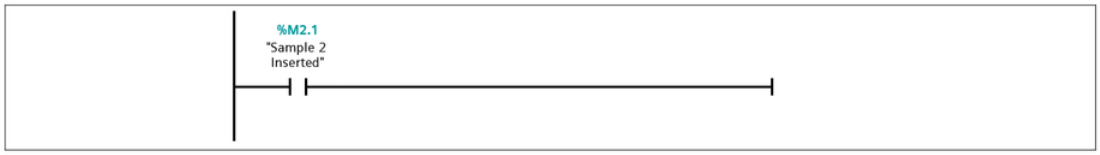
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - calibrate"

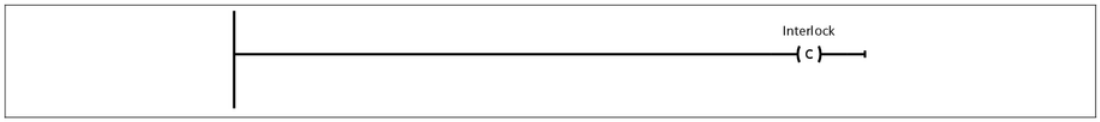
T7:Trans7



S11:Step11

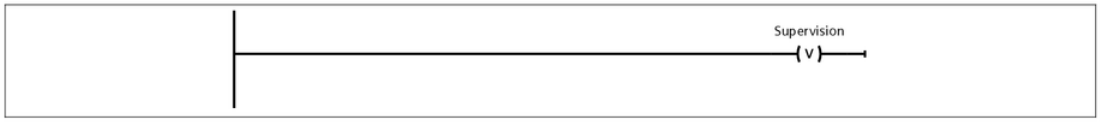
Interlock -(c)-:

Interlock alarm	
Alarm text	



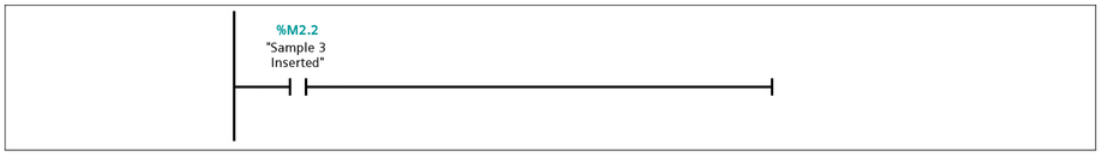
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - calibrate"

T11:Trans11



S13:Step13

Interlock -(c)-:

Interlock alarm	
Alarm text	



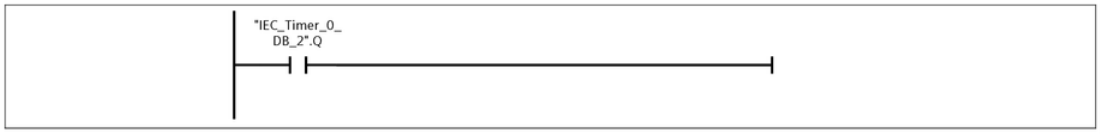
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Online - calibrate"
		S	"Start Timing"

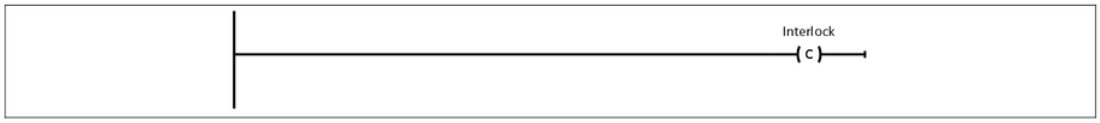
T13:Trans13



S15:Step15

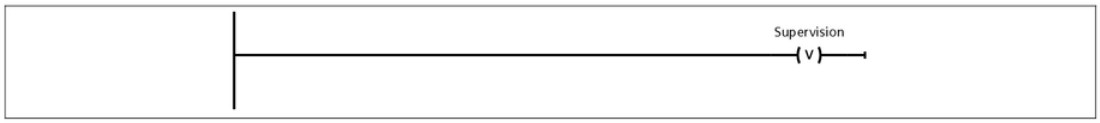
Interlock -(c)-:

Interlock alarm	
Alarm text	



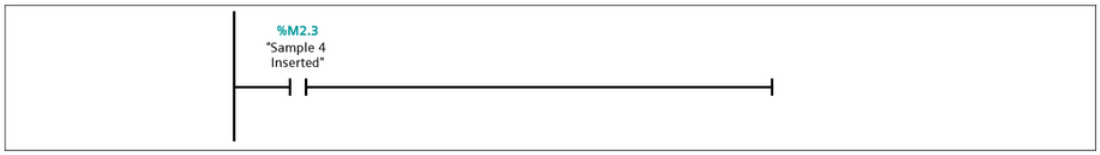
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - calibrate"

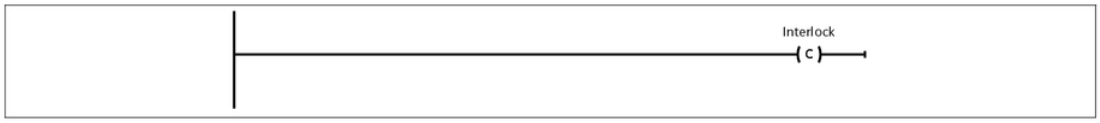
T15:Trans15



S17:Step17

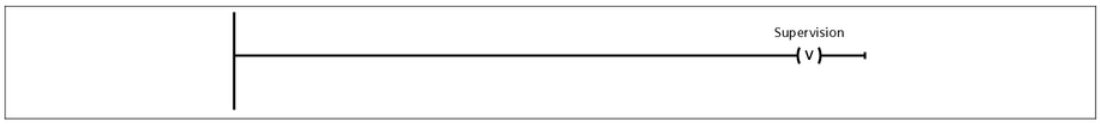
Interlock -(c)-:

Interlock alarm	
Alarm text	



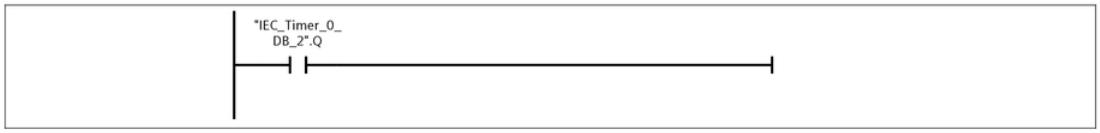
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Online - calibrate"
		S	"Start Timing"

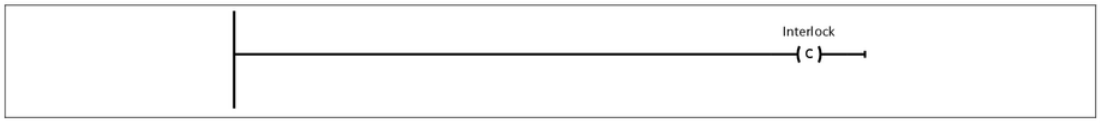
T17:Trans17



S20:Step20

Interlock -(c)-:

Interlock alarm	
Alarm text	



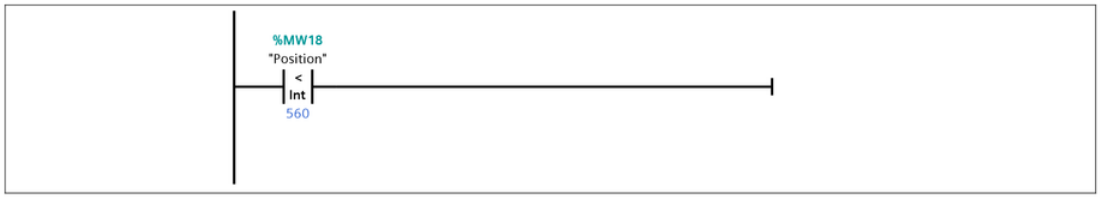
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		S	"Drive Offline - Standardise"

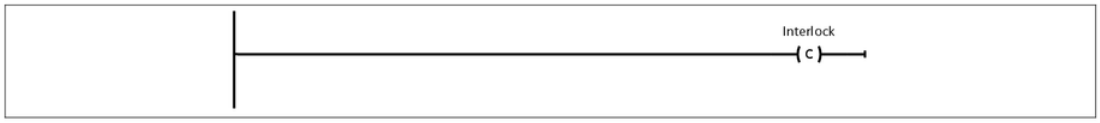
T21:Trans21



S21:Step21

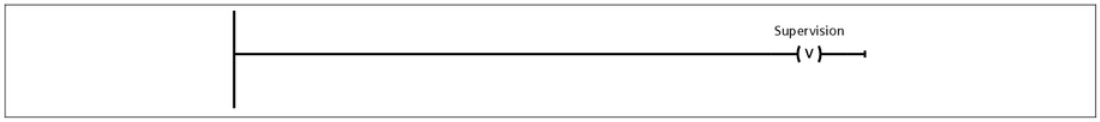
Interlock -(c)-:

Interlock alarm	
Alarm text	



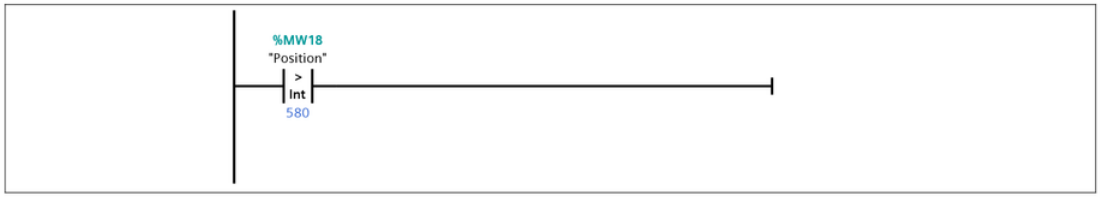
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - Standardise"
		S	"Drive Online Standardise"

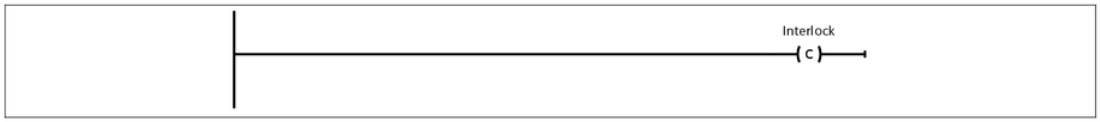
T22:Trans22



S22:Step22

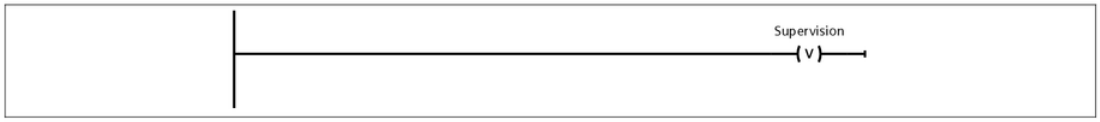
Interlock -(c)-:

Interlock alarm	
Alarm text	



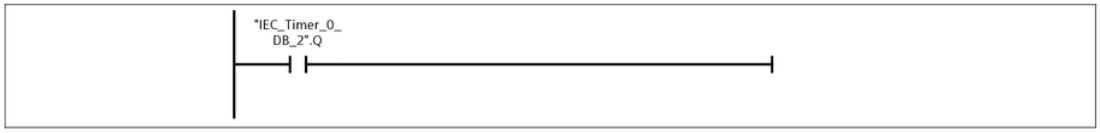
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Online Standardise"
		S	"Start Timing"

T23:Trans23



S23:Step23

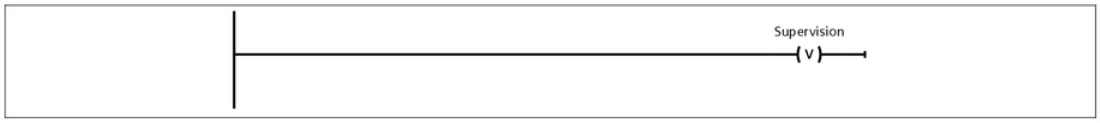
Interlock -(c)-:

Interlock alarm	
Alarm text	



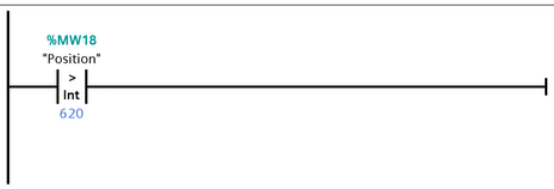
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Start Timing"
		S	"Drive Online Standardise"

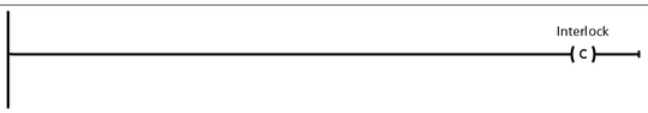
T24:Trans24



S24:Step24

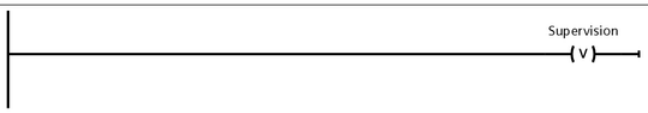
Interlock -(c)-:

Interlock alarm	
Alarm text	



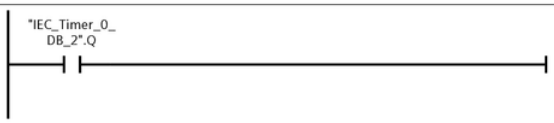
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Online Standardise"
		S	"Start Timing"

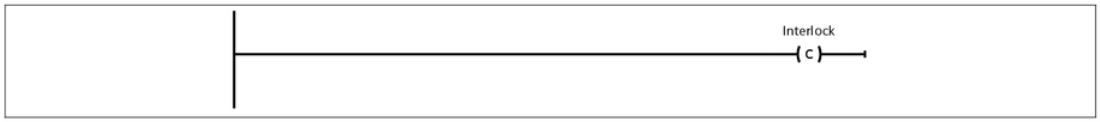
T25:Trans25



S25:Step25

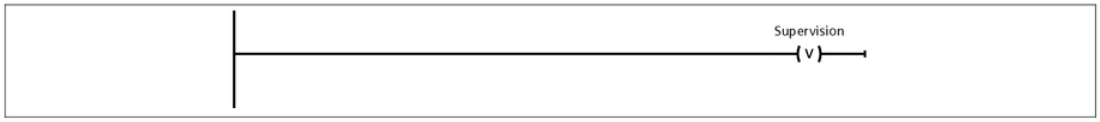
Interlock -(c)-:

Interlock alarm	
Alarm text	



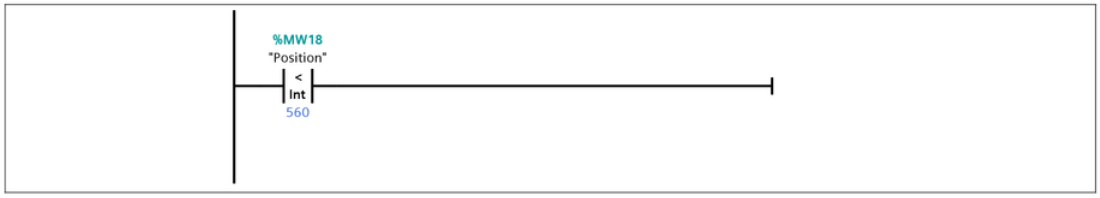
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Start Timing"
		S	"Drive Offline - Standardise"

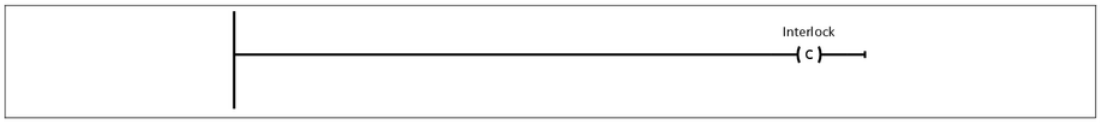
T26:Trans26



S26:Step26

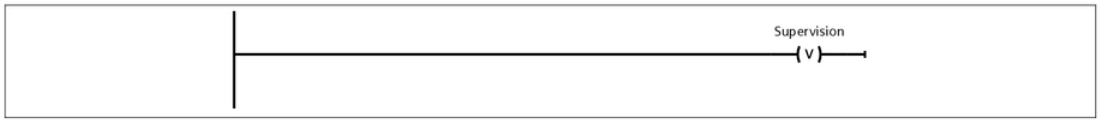
Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

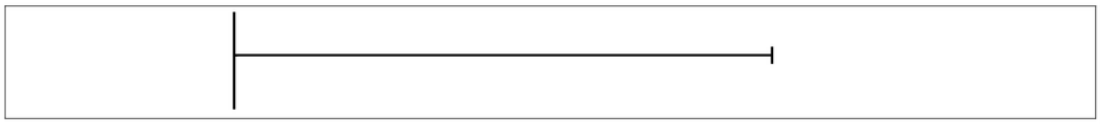
Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - Standardise"

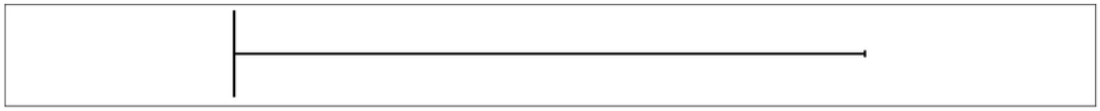
Interlock	Event	Qualifier	Action
		R	"Operators Standardise"
		R	"Technicians Standardise"

T27:Trans27



Permanent post-instructions

1:



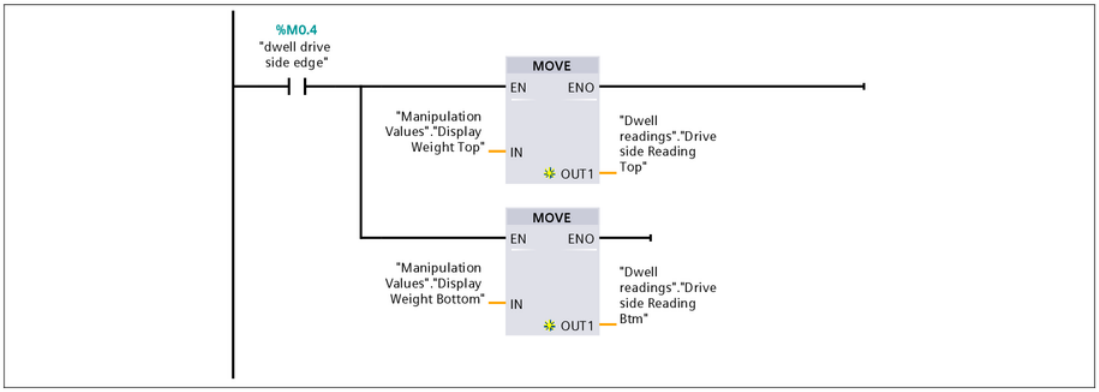
Dwell Graph [FB11]

Dwell Graph Properties					
General					
Name	Dwell Graph	**Number**	11	**Type**	FB
Language	LAD	**Numbering**	automatic		
Information					
Title		**Author**		**Comment**	Block used to move coating readings onto graphs
Family		**Version**	0.1	**User-defined ID**	

Name	Data type	Default value	Retain
Input			
Output			
InOut			
Static			
Temp			
Constant			

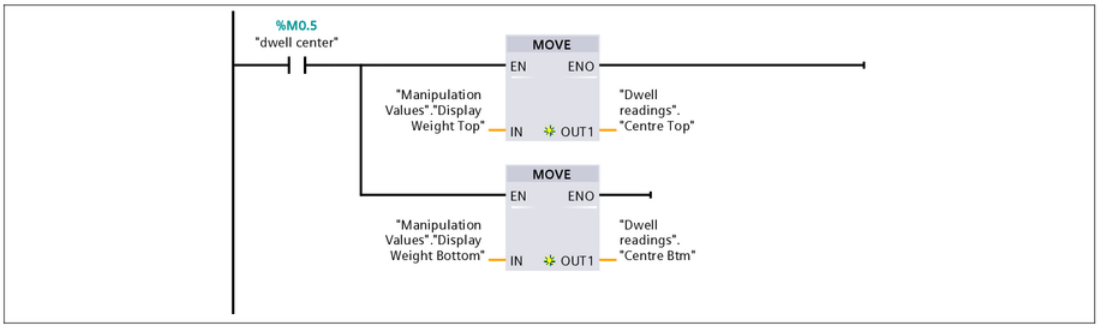
Network 1:

Moving to Drive side graph



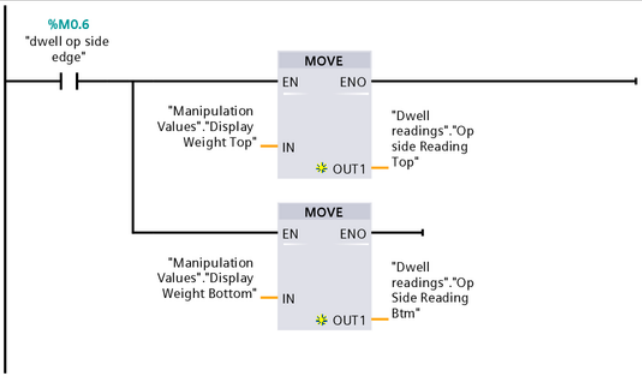
Network 2:

Moving to center graph



Network 3:

Moving to op side graph



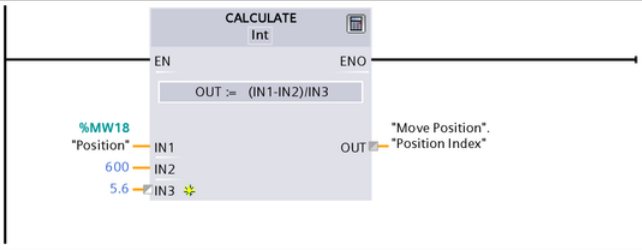
Graphical Display [FB7]

Graphical Display Properties					
General					
Name	Graphical Display	**Number**	7	**Type**	FB
Language	LAD	**Numbering**	automatic		
Information					
Title		**Author**		**Comment**	This block is used for creating arrays which run the scan graph on the HMI screen
Family		**Version**	0.1	**User-defined ID**	

Name	Data type	Default value	Retain
Input			
Output			
InOut			
Static			
Temp			
Constant			

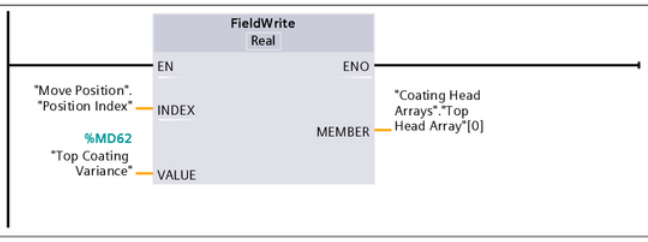
Network 1:

The position reading is divided by a set value in order to create sections of measurement across the width of the strip. This is then stored in the position index.



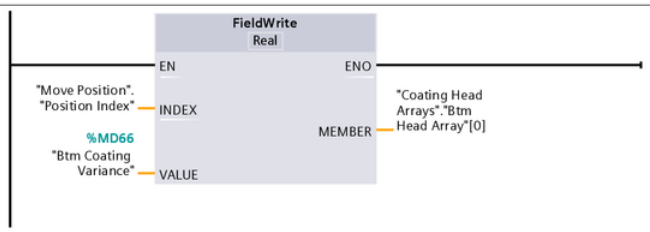
Network 2:

The value from the top head variance is taken along with the position index and stored in the array.



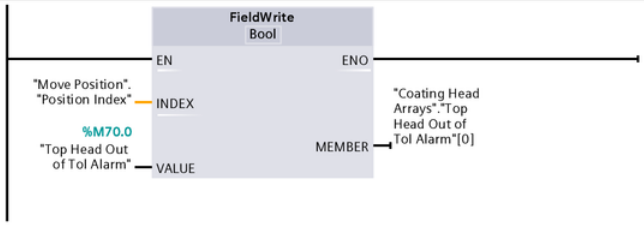
Network 3:

The value from the bottom head variance is taken along with the position index and stored in the array.



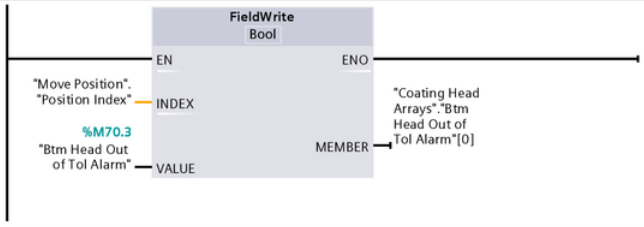
Network 4:

The state of the top head out of tolerance alarm is moved with th eposition index into an array



Network 5:

The state of the top head out of tolerance alarm is moved with th eposition index into an array



Modes of Operation [FB9]

Modes of Operation Properties					
General					
Name	Modes of Operation	**Number**	9	**Type**	FB
Language	GRAPH	**Numbering**	automatic		
Information					
Title		**Author**		**Comment**	
Family		**Version**	0.1	**User-defined ID**	

Name	Data type	Default value	Retain
▼ Input			
OFF_SQ	Bool	false	Non-retain
INIT_SQ	Bool	false	Non-retain
ACK_EF	Bool	false	Non-retain
S_PREV	Bool	false	Non-retain
S_NEXT	Bool	false	Non-retain
SW_AUTO	Bool	false	Non-retain
SW_TAP	Bool	false	Non-retain
SW_TOP	Bool	false	Non-retain
SW_MAN	Bool	false	Non-retain
S_SEL	Int	0	Non-retain
S_ON	Bool	false	Non-retain
S_OFF	Bool	false	Non-retain
T_PUSH	Bool	false	Non-retain
▼ Output			
S_NO	Int	0	Non-retain
S_MORE	Bool	false	Non-retain
S_ACTIVE	Bool	false	Non-retain
ERR_FLT	Bool	false	Non-retain
AUTO_ON	Bool	false	Non-retain
TAP_ON	Bool	false	Non-retain
TOP_ON	Bool	false	Non-retain
MAN_ON	Bool	false	Non-retain
InOut			
▼ Static			
▼ RT_DATA	G7_RTDataPlus_V2		Non-retain
S_DISPLAY	Int	0	Non-retain
S_SEL_OLD	Int	0	Non-retain
S_DISPIDX	USInt	255	Non-retain
T_DISPIDX	USInt	255	Non-retain
▼ MOP_EDGE	G7_MOPPlus_V2		Non-retain
AUTO	Bool	false	Non-retain
MAN	Bool	false	Non-retain
TAP	Bool	false	Non-retain
TOP	Bool	false	Non-retain
ACK_S	Bool	false	Non-retain
REG_S	Bool	false	Non-retain
T_PREV	Bool	false	Non-retain
T_NEXT	Bool	false	Non-retain

Name	Data type	Default value	Retain
LOCK	Bool	false	Non-retain
SUP	Bool	false	Non-retain
ACKREQ	Bool	false	Non-retain
SSKIP	Bool	false	Non-retain
OFF	Bool	false	Non-retain
INIT	Bool	false	Non-retain
HALT	Bool	false	Non-retain
TMS_HALT	Bool	false	Non-retain
OPS_ZERO	Bool	false	Non-retain
SACT_DISP	Bool	false	Non-retain
SEF_DISP	Bool	false	Non-retain
SALL_DISP	Bool	false	Non-retain
S_PREV	Bool	false	Non-retain
S_NEXT	Bool	false	Non-retain
S_SELOK	Bool	false	Non-retain
S_ON	Bool	false	Non-retain
S_OFF	Bool	false	Non-retain
T_PUSH	Bool	false	Non-retain
REG	Bool	false	Non-retain
ACK	Bool	false	Non-retain
IL_PERM	Bool	false	Non-retain
T_PERM	Bool	false	Non-retain
ILP_MAN	Bool	false	Non-retain
LMODE	Bool	false	Non-retain
▼ MOP	G7_MOPPlus_V2		Non-retain
AUTO	Bool	true	Non-retain
MAN	Bool	false	Non-retain
TAP	Bool	false	Non-retain
TOP	Bool	false	Non-retain
ACK_S	Bool	false	Non-retain
REG_S	Bool	false	Non-retain
T_PREV	Bool	false	Non-retain
T_NEXT	Bool	false	Non-retain
LOCK	Bool	true	Non-retain
SUP	Bool	true	Non-retain
ACKREQ	Bool	true	Non-retain
SSKIP	Bool	false	Non-retain
OFF	Bool	false	Non-retain
INIT	Bool	true	Non-retain
HALT	Bool	false	Non-retain
TMS_HALT	Bool	false	Non-retain
OPS_ZERO	Bool	false	Non-retain
SACT_DISP	Bool	true	Non-retain
SEF_DISP	Bool	false	Non-retain
SALL_DISP	Bool	false	Non-retain
S_PREV	Bool	false	Non-retain
S_NEXT	Bool	false	Non-retain
S_SELOK	Bool	false	Non-retain
S_ON	Bool	false	Non-retain
S_OFF	Bool	false	Non-retain
T_PUSH	Bool	false	Non-retain
REG	Bool	false	Non-retain

Name	Data type	Default value	Retain
ACK	Bool	false	Non-retain
IL_PERM	Bool	false	Non-retain
T_PERM	Bool	false	Non-retain
ILP_MAN	Bool	false	Non-retain
LMODE	Bool	false	Non-retain
TIME_DELTA	Time	T#0ms	Non-retain
▼ SQ_FLAGS	G7_SQFlags-Plus_V2		Non-retain
ERR_FLT	Bool	false	Non-retain
ERROR	Bool	false	Non-retain
FAULT	Bool	false	Non-retain
RT_FAIL	Bool	false	Non-retain
NO_SNO	Bool	false	Non-retain
NF_OFL	Bool	false	Non-retain
SA_OFL	Bool	false	Non-retain
TV_OFL	Bool	false	Non-retain
MSG_OFL	Bool	false	Non-retain
NO_SWI	Bool	false	Non-retain
CYC_OP	Bool	false	Non-retain
AS_MSG	Bool	false	Non-retain
AS_SEND	Bool	false	Non-retain
SQ_BUSY	Bool	false	Non-retain
SA_BUSY	Bool	false	Non-retain
AS_SIG	Bool	false	Non-retain
PRE_CNT	USInt	1	Non-retain
POST_CNT	USInt	1	Non-retain
SQ_CNT	USInt	1	Non-retain
S_CNT	USInt	21	Non-retain
LOCK_CNT	USInt	0	Non-retain
SUP_CNT	USInt	0	Non-retain
T_CNT	USInt	39	Non-retain
SQ_PART_CNT	USInt	20	Non-retain
MAX_TVAL	USInt	35	Non-retain
MAX_SACT	USInt	1	Non-retain
AS_MSG	Byte	16#F	Non-retain
▼ EXEC_BITS	Array[0..249] of Bool		Non-retain
EXEC_BITS[0]	Bool	false	Non-retain
EXEC_BITS[1]	Bool	false	Non-retain
EXEC_BITS[2]	Bool	false	Non-retain
EXEC_BITS[3]	Bool	false	Non-retain
EXEC_BITS[4]	Bool	false	Non-retain
EXEC_BITS[5]	Bool	false	Non-retain
EXEC_BITS[6]	Bool	false	Non-retain
EXEC_BITS[7]	Bool	false	Non-retain
EXEC_BITS[8]	Bool	false	Non-retain
EXEC_BITS[9]	Bool	false	Non-retain
EXEC_BITS[10]	Bool	false	Non-retain
EXEC_BITS[11]	Bool	false	Non-retain
EXEC_BITS[12]	Bool	false	Non-retain
EXEC_BITS[13]	Bool	false	Non-retain
EXEC_BITS[14]	Bool	false	Non-retain
EXEC_BITS[15]	Bool	false	Non-retain

Name	Data type	Default value	Retain
EXEC_BITS[16]	Bool	false	Non-retain
EXEC_BITS[17]	Bool	false	Non-retain
EXEC_BITS[18]	Bool	false	Non-retain
EXEC_BITS[19]	Bool	false	Non-retain
EXEC_BITS[20]	Bool	false	Non-retain
EXEC_BITS[21]	Bool	false	Non-retain
EXEC_BITS[22]	Bool	false	Non-retain
EXEC_BITS[23]	Bool	false	Non-retain
EXEC_BITS[24]	Bool	false	Non-retain
EXEC_BITS[25]	Bool	false	Non-retain
EXEC_BITS[26]	Bool	false	Non-retain
EXEC_BITS[27]	Bool	false	Non-retain
EXEC_BITS[28]	Bool	false	Non-retain
EXEC_BITS[29]	Bool	false	Non-retain
EXEC_BITS[30]	Bool	false	Non-retain
EXEC_BITS[31]	Bool	false	Non-retain
EXEC_BITS[32]	Bool	false	Non-retain
EXEC_BITS[33]	Bool	false	Non-retain
EXEC_BITS[34]	Bool	false	Non-retain
EXEC_BITS[35]	Bool	false	Non-retain
EXEC_BITS[36]	Bool	false	Non-retain
EXEC_BITS[37]	Bool	false	Non-retain
EXEC_BITS[38]	Bool	false	Non-retain
EXEC_BITS[39]	Bool	false	Non-retain
EXEC_BITS[40]	Bool	false	Non-retain
EXEC_BITS[41]	Bool	false	Non-retain
EXEC_BITS[42]	Bool	false	Non-retain
EXEC_BITS[43]	Bool	false	Non-retain
EXEC_BITS[44]	Bool	false	Non-retain
EXEC_BITS[45]	Bool	false	Non-retain
EXEC_BITS[46]	Bool	false	Non-retain
EXEC_BITS[47]	Bool	false	Non-retain
EXEC_BITS[48]	Bool	false	Non-retain
EXEC_BITS[49]	Bool	false	Non-retain
EXEC_BITS[50]	Bool	false	Non-retain
EXEC_BITS[51]	Bool	false	Non-retain
EXEC_BITS[52]	Bool	false	Non-retain
EXEC_BITS[53]	Bool	false	Non-retain
EXEC_BITS[54]	Bool	false	Non-retain
EXEC_BITS[55]	Bool	false	Non-retain
EXEC_BITS[56]	Bool	false	Non-retain
EXEC_BITS[57]	Bool	false	Non-retain
EXEC_BITS[58]	Bool	false	Non-retain
EXEC_BITS[59]	Bool	false	Non-retain
EXEC_BITS[60]	Bool	false	Non-retain
EXEC_BITS[61]	Bool	false	Non-retain
EXEC_BITS[62]	Bool	false	Non-retain
EXEC_BITS[63]	Bool	false	Non-retain
EXEC_BITS[64]	Bool	false	Non-retain
EXEC_BITS[65]	Bool	false	Non-retain
EXEC_BITS[66]	Bool	false	Non-retain
EXEC_BITS[67]	Bool	false	Non-retain

Name	Data type	Default value	Retain
EXEC_BITS[68]	Bool	false	Non-retain
EXEC_BITS[69]	Bool	false	Non-retain
EXEC_BITS[70]	Bool	false	Non-retain
EXEC_BITS[71]	Bool	false	Non-retain
EXEC_BITS[72]	Bool	false	Non-retain
EXEC_BITS[73]	Bool	false	Non-retain
EXEC_BITS[74]	Bool	false	Non-retain
EXEC_BITS[75]	Bool	false	Non-retain
EXEC_BITS[76]	Bool	false	Non-retain
EXEC_BITS[77]	Bool	false	Non-retain
EXEC_BITS[78]	Bool	false	Non-retain
EXEC_BITS[79]	Bool	false	Non-retain
EXEC_BITS[80]	Bool	false	Non-retain
EXEC_BITS[81]	Bool	false	Non-retain
EXEC_BITS[82]	Bool	false	Non-retain
EXEC_BITS[83]	Bool	false	Non-retain
EXEC_BITS[84]	Bool	false	Non-retain
EXEC_BITS[85]	Bool	false	Non-retain
EXEC_BITS[86]	Bool	false	Non-retain
EXEC_BITS[87]	Bool	false	Non-retain
EXEC_BITS[88]	Bool	false	Non-retain
EXEC_BITS[89]	Bool	false	Non-retain
EXEC_BITS[90]	Bool	false	Non-retain
EXEC_BITS[91]	Bool	false	Non-retain
EXEC_BITS[92]	Bool	false	Non-retain
EXEC_BITS[93]	Bool	false	Non-retain
EXEC_BITS[94]	Bool	false	Non-retain
EXEC_BITS[95]	Bool	false	Non-retain
EXEC_BITS[96]	Bool	false	Non-retain
EXEC_BITS[97]	Bool	false	Non-retain
EXEC_BITS[98]	Bool	false	Non-retain
EXEC_BITS[99]	Bool	false	Non-retain
EXEC_BITS[100]	Bool	false	Non-retain
EXEC_BITS[101]	Bool	false	Non-retain
EXEC_BITS[102]	Bool	false	Non-retain
EXEC_BITS[103]	Bool	false	Non-retain
EXEC_BITS[104]	Bool	false	Non-retain
EXEC_BITS[105]	Bool	false	Non-retain
EXEC_BITS[106]	Bool	false	Non-retain
EXEC_BITS[107]	Bool	false	Non-retain
EXEC_BITS[108]	Bool	false	Non-retain
EXEC_BITS[109]	Bool	false	Non-retain
EXEC_BITS[110]	Bool	false	Non-retain
EXEC_BITS[111]	Bool	false	Non-retain
EXEC_BITS[112]	Bool	false	Non-retain
EXEC_BITS[113]	Bool	false	Non-retain
EXEC_BITS[114]	Bool	false	Non-retain
EXEC_BITS[115]	Bool	false	Non-retain
EXEC_BITS[116]	Bool	false	Non-retain
EXEC_BITS[117]	Bool	false	Non-retain
EXEC_BITS[118]	Bool	false	Non-retain
EXEC_BITS[119]	Bool	false	Non-retain

Name	Data type	Default value	Retain
EXEC_BITS[120]	Bool	false	Non-retain
EXEC_BITS[121]	Bool	false	Non-retain
EXEC_BITS[122]	Bool	false	Non-retain
EXEC_BITS[123]	Bool	false	Non-retain
EXEC_BITS[124]	Bool	false	Non-retain
EXEC_BITS[125]	Bool	false	Non-retain
EXEC_BITS[126]	Bool	false	Non-retain
EXEC_BITS[127]	Bool	false	Non-retain
EXEC_BITS[128]	Bool	false	Non-retain
EXEC_BITS[129]	Bool	false	Non-retain
EXEC_BITS[130]	Bool	false	Non-retain
EXEC_BITS[131]	Bool	false	Non-retain
EXEC_BITS[132]	Bool	false	Non-retain
EXEC_BITS[133]	Bool	false	Non-retain
EXEC_BITS[134]	Bool	false	Non-retain
EXEC_BITS[135]	Bool	false	Non-retain
EXEC_BITS[136]	Bool	false	Non-retain
EXEC_BITS[137]	Bool	false	Non-retain
EXEC_BITS[138]	Bool	false	Non-retain
EXEC_BITS[139]	Bool	false	Non-retain
EXEC_BITS[140]	Bool	false	Non-retain
EXEC_BITS[141]	Bool	false	Non-retain
EXEC_BITS[142]	Bool	false	Non-retain
EXEC_BITS[143]	Bool	false	Non-retain
EXEC_BITS[144]	Bool	false	Non-retain
EXEC_BITS[145]	Bool	false	Non-retain
EXEC_BITS[146]	Bool	false	Non-retain
EXEC_BITS[147]	Bool	false	Non-retain
EXEC_BITS[148]	Bool	false	Non-retain
EXEC_BITS[149]	Bool	false	Non-retain
EXEC_BITS[150]	Bool	false	Non-retain
EXEC_BITS[151]	Bool	false	Non-retain
EXEC_BITS[152]	Bool	false	Non-retain
EXEC_BITS[153]	Bool	false	Non-retain
EXEC_BITS[154]	Bool	false	Non-retain
EXEC_BITS[155]	Bool	false	Non-retain
EXEC_BITS[156]	Bool	false	Non-retain
EXEC_BITS[157]	Bool	false	Non-retain
EXEC_BITS[158]	Bool	false	Non-retain
EXEC_BITS[159]	Bool	false	Non-retain
EXEC_BITS[160]	Bool	false	Non-retain
EXEC_BITS[161]	Bool	false	Non-retain
EXEC_BITS[162]	Bool	false	Non-retain
EXEC_BITS[163]	Bool	false	Non-retain
EXEC_BITS[164]	Bool	false	Non-retain
EXEC_BITS[165]	Bool	false	Non-retain
EXEC_BITS[166]	Bool	false	Non-retain
EXEC_BITS[167]	Bool	false	Non-retain
EXEC_BITS[168]	Bool	false	Non-retain
EXEC_BITS[169]	Bool	false	Non-retain
EXEC_BITS[170]	Bool	false	Non-retain
EXEC_BITS[171]	Bool	false	Non-retain

Name	Data type	Default value	Retain
EXEC_BITS[172]	Bool	false	Non-retain
EXEC_BITS[173]	Bool	false	Non-retain
EXEC_BITS[174]	Bool	false	Non-retain
EXEC_BITS[175]	Bool	false	Non-retain
EXEC_BITS[176]	Bool	false	Non-retain
EXEC_BITS[177]	Bool	false	Non-retain
EXEC_BITS[178]	Bool	false	Non-retain
EXEC_BITS[179]	Bool	false	Non-retain
EXEC_BITS[180]	Bool	false	Non-retain
EXEC_BITS[181]	Bool	false	Non-retain
EXEC_BITS[182]	Bool	false	Non-retain
EXEC_BITS[183]	Bool	false	Non-retain
EXEC_BITS[184]	Bool	false	Non-retain
EXEC_BITS[185]	Bool	false	Non-retain
EXEC_BITS[186]	Bool	false	Non-retain
EXEC_BITS[187]	Bool	false	Non-retain
EXEC_BITS[188]	Bool	false	Non-retain
EXEC_BITS[189]	Bool	false	Non-retain
EXEC_BITS[190]	Bool	false	Non-retain
EXEC_BITS[191]	Bool	false	Non-retain
EXEC_BITS[192]	Bool	false	Non-retain
EXEC_BITS[193]	Bool	false	Non-retain
EXEC_BITS[194]	Bool	false	Non-retain
EXEC_BITS[195]	Bool	false	Non-retain
EXEC_BITS[196]	Bool	false	Non-retain
EXEC_BITS[197]	Bool	false	Non-retain
EXEC_BITS[198]	Bool	false	Non-retain
EXEC_BITS[199]	Bool	false	Non-retain
EXEC_BITS[200]	Bool	false	Non-retain
EXEC_BITS[201]	Bool	false	Non-retain
EXEC_BITS[202]	Bool	false	Non-retain
EXEC_BITS[203]	Bool	false	Non-retain
EXEC_BITS[204]	Bool	false	Non-retain
EXEC_BITS[205]	Bool	false	Non-retain
EXEC_BITS[206]	Bool	false	Non-retain
EXEC_BITS[207]	Bool	false	Non-retain
EXEC_BITS[208]	Bool	false	Non-retain
EXEC_BITS[209]	Bool	false	Non-retain
EXEC_BITS[210]	Bool	false	Non-retain
EXEC_BITS[211]	Bool	false	Non-retain
EXEC_BITS[212]	Bool	false	Non-retain
EXEC_BITS[213]	Bool	false	Non-retain
EXEC_BITS[214]	Bool	false	Non-retain
EXEC_BITS[215]	Bool	false	Non-retain
EXEC_BITS[216]	Bool	false	Non-retain
EXEC_BITS[217]	Bool	false	Non-retain
EXEC_BITS[218]	Bool	false	Non-retain
EXEC_BITS[219]	Bool	false	Non-retain
EXEC_BITS[220]	Bool	false	Non-retain
EXEC_BITS[221]	Bool	false	Non-retain
EXEC_BITS[222]	Bool	false	Non-retain
EXEC_BITS[223]	Bool	false	Non-retain

Name	Data type	Default value	Retain
EXEC_BITS[224]	Bool	false	Non-retain
EXEC_BITS[225]	Bool	false	Non-retain
EXEC_BITS[226]	Bool	false	Non-retain
EXEC_BITS[227]	Bool	false	Non-retain
EXEC_BITS[228]	Bool	false	Non-retain
EXEC_BITS[229]	Bool	false	Non-retain
EXEC_BITS[230]	Bool	false	Non-retain
EXEC_BITS[231]	Bool	false	Non-retain
EXEC_BITS[232]	Bool	false	Non-retain
EXEC_BITS[233]	Bool	false	Non-retain
EXEC_BITS[234]	Bool	false	Non-retain
EXEC_BITS[235]	Bool	false	Non-retain
EXEC_BITS[236]	Bool	false	Non-retain
EXEC_BITS[237]	Bool	false	Non-retain
EXEC_BITS[238]	Bool	false	Non-retain
EXEC_BITS[239]	Bool	false	Non-retain
EXEC_BITS[240]	Bool	false	Non-retain
EXEC_BITS[241]	Bool	false	Non-retain
EXEC_BITS[242]	Bool	false	Non-retain
EXEC_BITS[243]	Bool	false	Non-retain
EXEC_BITS[244]	Bool	false	Non-retain
EXEC_BITS[245]	Bool	false	Non-retain
EXEC_BITS[246]	Bool	false	Non-retain
EXEC_BITS[247]	Bool	false	Non-retain
EXEC_BITS[248]	Bool	false	Non-retain
EXEC_BITS[249]	Bool	false	Non-retain
▼ OFFSETS	G7_OffsetsPlus_V2		Non-retain
SINI_OFFSET	UInt	0	Non-retain
LSTT_OFFSET	UInt	2	Non-retain
ATAJ_OFFSET	UInt	41	Non-retain
ATAB_OFFSET	UInt	80	Non-retain
PSTT_OFFSET	UInt	119	Non-retain
NSTT_OFFSET	UInt	158	Non-retain
ASSJ_OFFSET	UInt	197	Non-retain
ASSB_OFFSET	UInt	218	Non-retain
PTTS_OFFSET	UInt	239	Non-retain
NTTS_OFFSET	UInt	260	Non-retain
SW_SQTS_OFFSET	UInt	281	Non-retain
SWITCH_OFFSET	UInt	302	Non-retain
TVX_OFFSET	UInt	352	Non-retain
TTX_OFFSET	UInt	388	Non-retain
TSX_OFFSET	UInt	424	Non-retain
S00X_OFFSET	UInt	426	Non-retain
SOFFX_OFFSET	UInt	428	Non-retain
SONX_OFFSET	UInt	430	Non-retain
SAX_OFFSET	UInt	432	Non-retain
SERRX_OFFSET	UInt	434	Non-retain
SMX_OFFSET	UInt	456	Non-retain
S0X_OFFSET	UInt	478	Non-retain
S1X_OFFSET	UInt	500	Non-retain
THRESHOLD_SUP	USInt	0	Non-retain
THRESHOLD_WARN	USInt	0	Non-retain

Name	Data type	Default value	Retain
Trans1	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	1	Non-retain
Trans2	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	2	Non-retain
Trans3	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	3	Non-retain
Trans4	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	4	Non-retain
Trans5	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	5	Non-retain
Trans6	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	6	Non-retain
Trans7	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	7	Non-retain
Trans8	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	8	Non-retain
Trans9	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	9	Non-retain

Name	Data type	Default value	Retain
Trans10	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	10	Non-retain
Trans11	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	11	Non-retain
Trans12	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	12	Non-retain
Trans14	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	14	Non-retain
Trans15	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	15	Non-retain
Trans16	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	16	Non-retain
Trans17	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	17	Non-retain
Trans18	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	18	Non-retain
Trans19	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	19	Non-retain

Name	Data type	Default value	Retain
Trans20	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	20	Non-retain
Trans21	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	21	Non-retain
Trans22	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	22	Non-retain
Trans23	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	23	Non-retain
Trans24	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	24	Non-retain
Trans25	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	25	Non-retain
Trans26	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	26	Non-retain
Trans27	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	27	Non-retain
Trans28	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	28	Non-retain

Name	Data type	Default value	Retain
Trans29	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	29	Non-retain
Trans30	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	30	Non-retain
Trans31	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	31	Non-retain
Trans32	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	32	Non-retain
Trans33	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	33	Non-retain
Trans34	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	34	Non-retain
Trans35	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	35	Non-retain
Trans36	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	36	Non-retain
Trans37	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	37	Non-retain

Name	Data type	Default value	Retain
Trans38	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	38	Non-retain
Trans39	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	39	Non-retain
Trans40	G7_Transition-Plus_V2		Non-retain
TV	Bool	false	Non-retain
TT	Bool	false	Non-retain
TS	Bool	false	Non-retain
TNO	Int	40	Non-retain
Step1	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	1	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
Step2	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain

Name	Data type	Default value	Retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	2	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step3	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	3	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step4	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain

Name	Data type	Default value	Retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	4	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step5	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	5	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step6	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain

Name	Data type	Default value	Retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	6	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step7	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	7	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step8	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain

Name	Data type	Default value	Retain
VS	Bool	false	Non-retain
SNO	Int	8	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step9	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	9	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step10	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	10	Non-retain

Name	Data type	Default value	Retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step11	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	11	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step12	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	12	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain

Name	Data type	Default value	Retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step13	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	13	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step14	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	14	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain

Name	Data type	Default value	Retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
Step15	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	15	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
Step16	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	16	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain

Name	Data type	Default value	Retain
H_SV_FLT	Byte	16#0	Non-retain
Step17	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	17	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
Step18	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	18	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
Step19	G7_StepPlus_V2		Non-retain

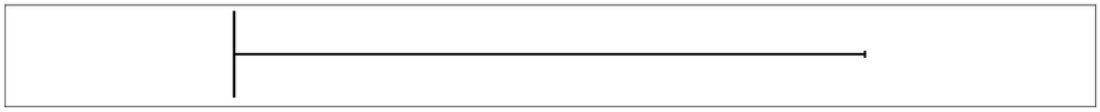
Name	Data type	Default value	Retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	19	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step20	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	20	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
▼ Step21	G7_StepPlus_V2		Non-retain
S1	Bool	false	Non-retain
L1	Bool	false	Non-retain

Name	Data type	Default value	Retain
V1	Bool	false	Non-retain
R1	Bool	false	Non-retain
A1	Bool	false	Non-retain
S0	Bool	false	Non-retain
L0	Bool	false	Non-retain
V0	Bool	false	Non-retain
X	Bool	false	Non-retain
LA	Bool	false	Non-retain
VA	Bool	false	Non-retain
RA	Bool	false	Non-retain
AA	Bool	false	Non-retain
SS	Bool	false	Non-retain
LS	Bool	false	Non-retain
VS	Bool	false	Non-retain
SNO	Int	21	Non-retain
T	Time	T#0ms	Non-retain
U	Time	T#0ms	Non-retain
T_MAX	Time	T#10S	Non-retain
T_WARN	Time	T#7S	Non-retain
SM	Bool	false	Non-retain
H_IL_ERR	Byte	16#0	Non-retain
H_SV_FLT	Byte	16#0	Non-retain
Temp			
Constant			

Alarms			
Enable alarms	True	**Acknowledge interlock alarms**	True
Interlock template	GRAPH7_INTERLOCK_ERROR<CPU name><FB name><FB number><instance DB name><instance DB number><step name><step number><step-specific text>	**Acknowledge supervision alarms**	True
Supervision template	GRAPH7_SUPERVISION_FAULT<CPU name><FB name><FB number><instance DB name><instance DB number><step name><step number><step-specific text>		

Permanent pre-instructions

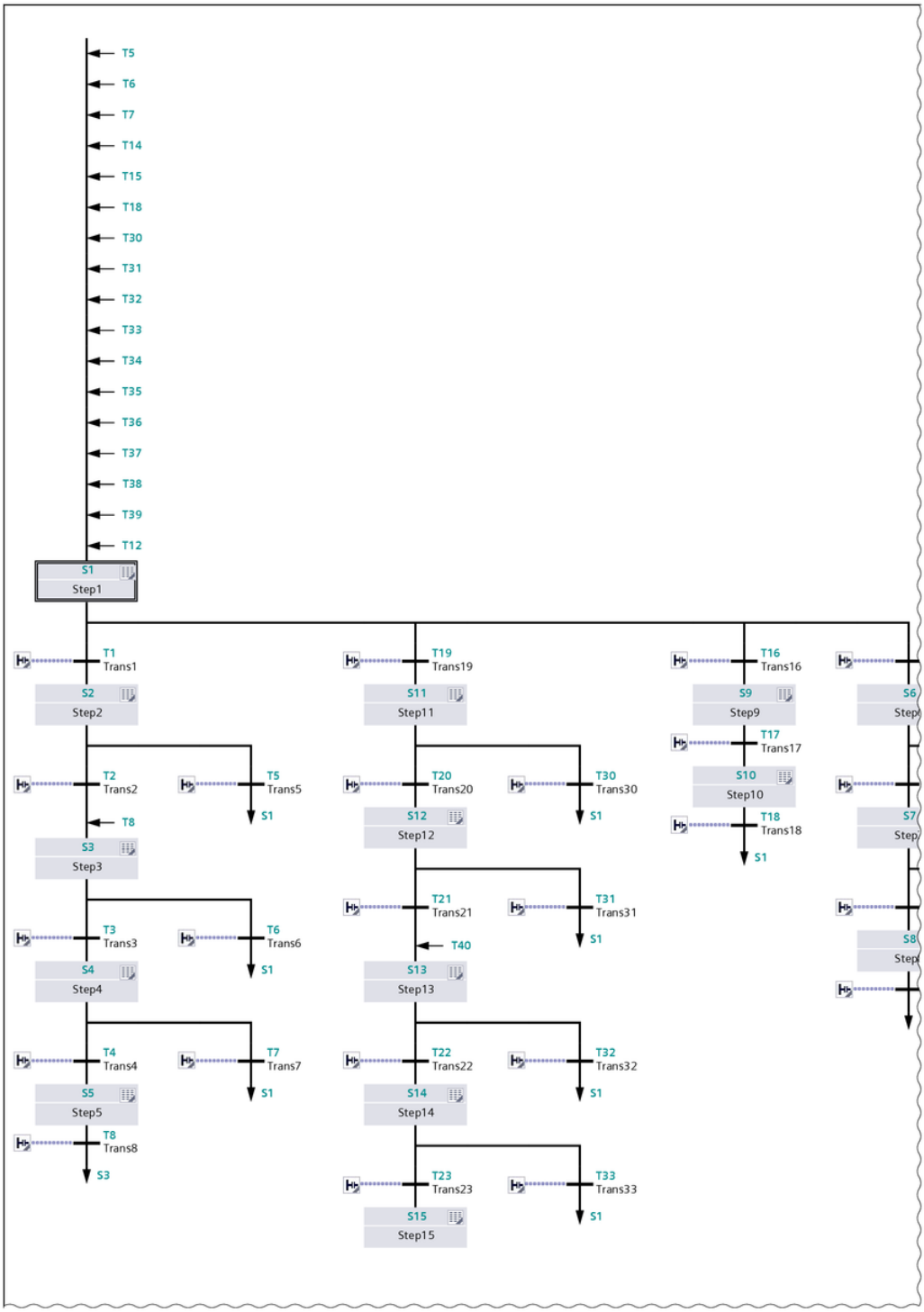
1:



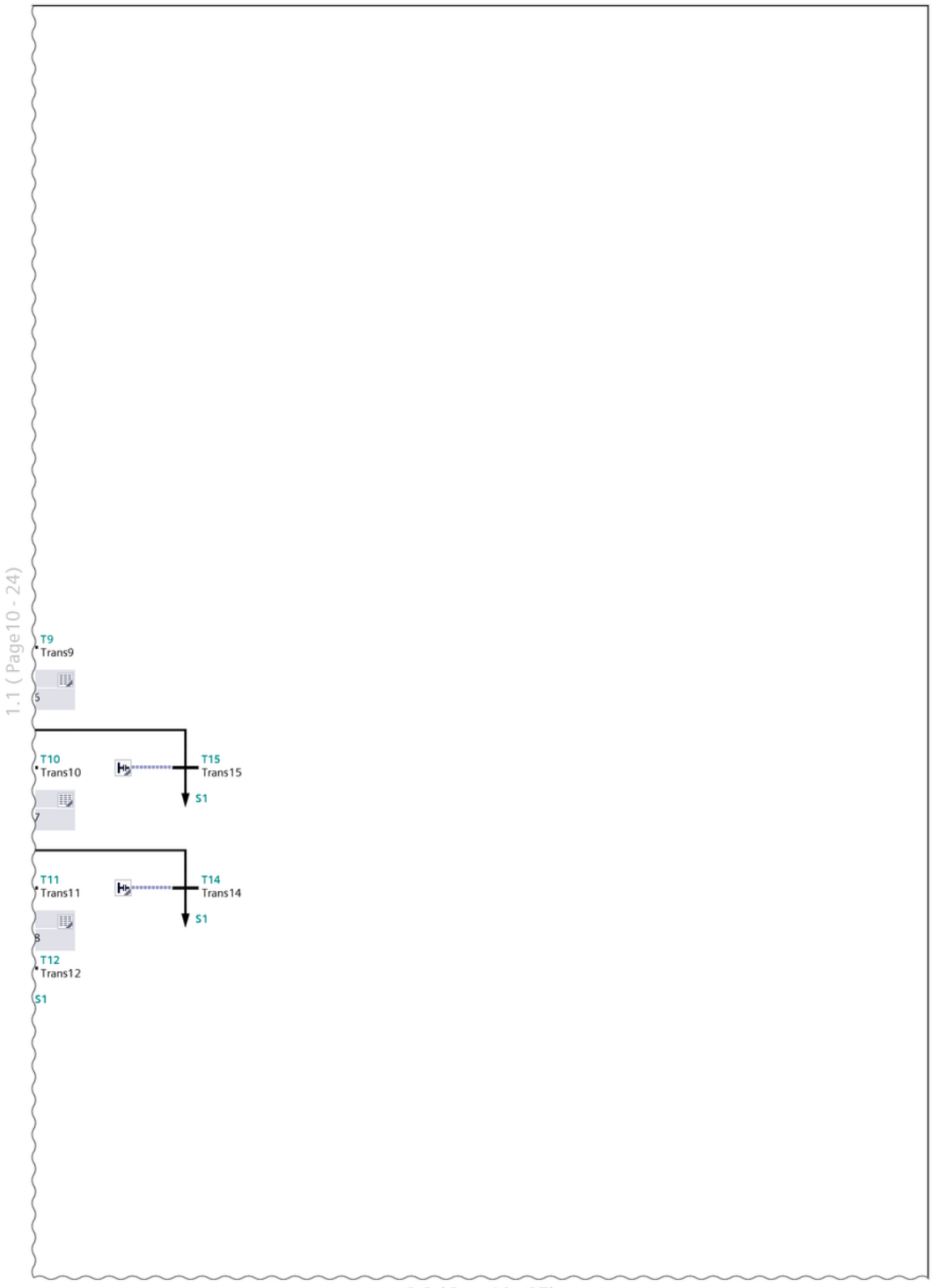
1:Modes of operation

This section contains the modes of operation; scan, dwell, static and standby. These all loop back to step 1 which resets all states.

1:Modes of operation (1.1 / 2.2)

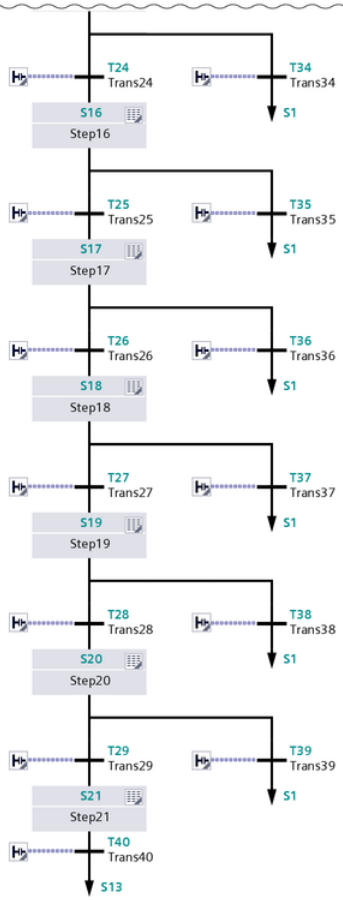


1:Modes of operation (1.2 / 2.2)



1:Modes of operation (2.1 / 2.2)

1.1 (Page10 - 24)



2.2 (Page10 - 27)

1:Modes of operation (2.2 / 2.2)

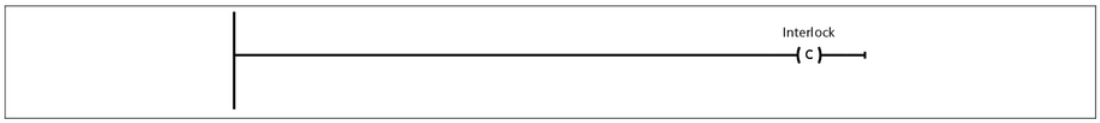
1.2 (Page10 - 25)

2.1 (Page10 - 26)

S1 - [Initial step]:Step1

Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

Supervision alarm	
Alarm text	

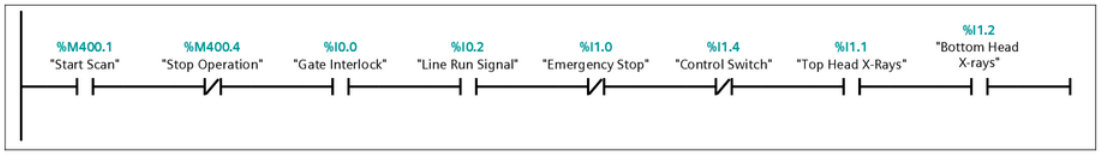


Actions:

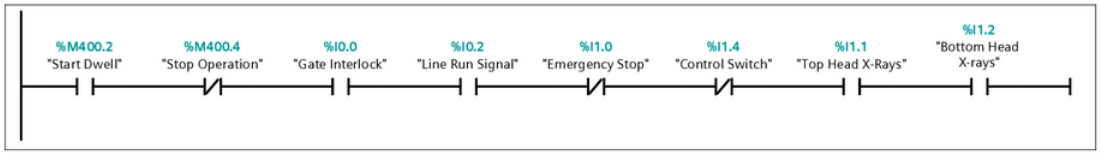
Interlock	Event	Qualifier	Action
		R	"Drive Offline - scan"
		R	"Drive Online - scan"
		R	"Shutter State"
		R	"Open Shutter - scan"
		S	"Close Shutter - scan"
		R	"Start Timing"
		R	"Start Dwell"
		R	"Start Scan"
		R	"Start Static"
		R	"Drive Offline - dwell"
		R	"Drive Online - dwell"
		R	"Drive Offline - standby"
		R	"Drive Online - static"
		R	"Drive Offline static"

T1:Trans1

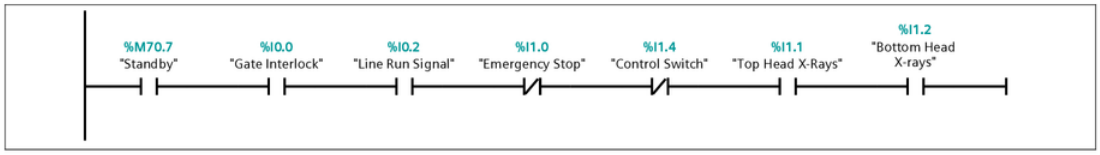
All conditions must be met to begin the sequence



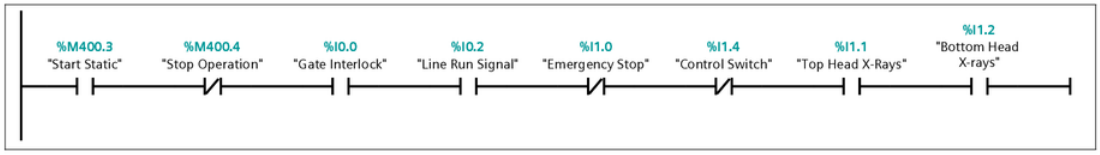
T19:Trans19



T16:Trans16



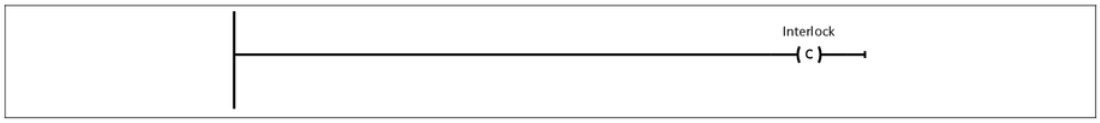
T9:Trans9



S2:Step2

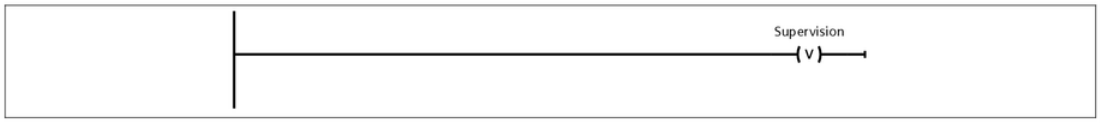
Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

Supervision alarm	
Alarm text	

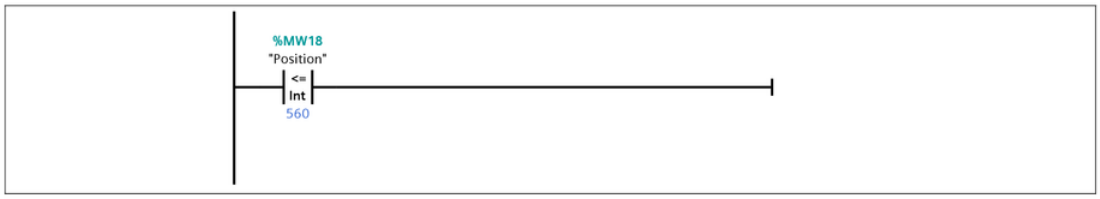


Actions:			
Interlock	Event	Qualifier	Action
		S	"Drive Offline - scan"
		S	"Shutter State"

Interlock	Event	Qualifier	Action
		S	"Open Shutter - scan"
		R	"Close Shutter - scan"

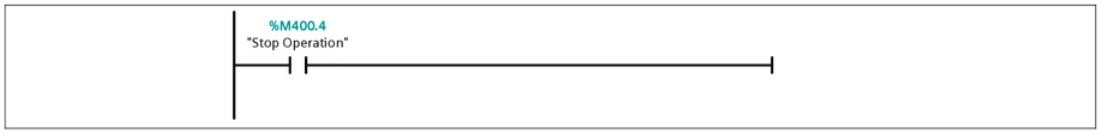
T2:Trans2

Drive to the park position



T5:Trans5

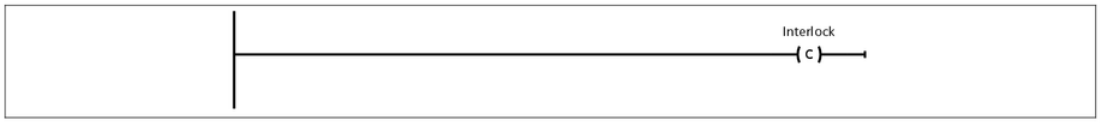
HMI stop operation button



S3:Step3

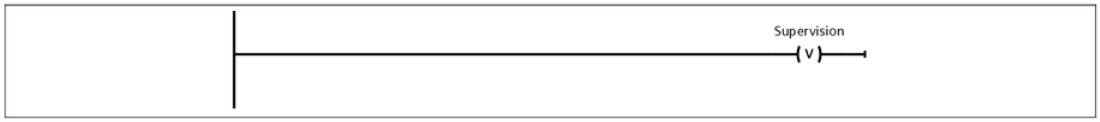
Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

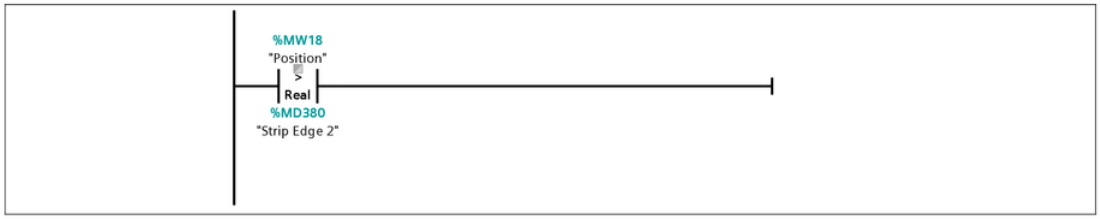
Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - scan"
		S	"Drive Online - scan"

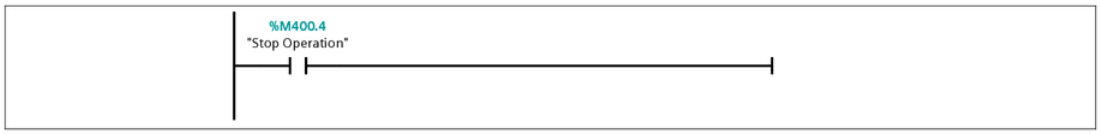
T3:Trans3

Drive to the furthest strip edge



T6:Trans6

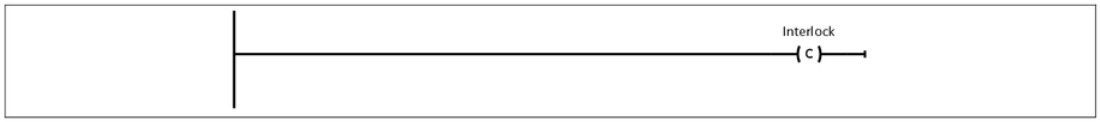
HMI stop operation button



S4:Step4

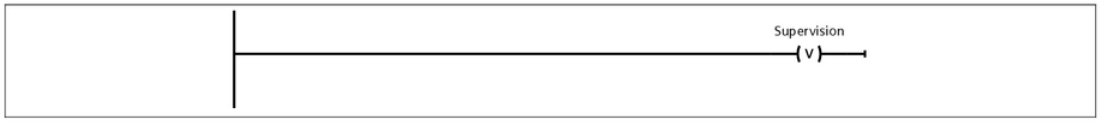
Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

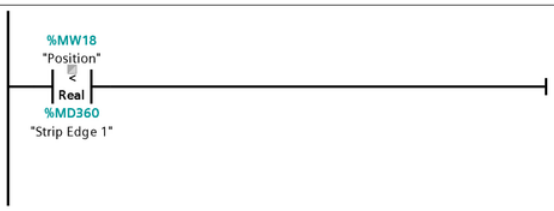
Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Online - scan"
		S	"Drive Offline - scan"

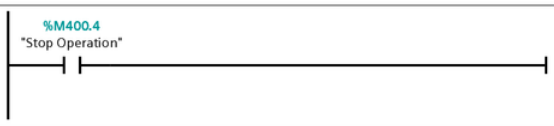
T4:Trans4

Drive back to the first strip edge



T7:Trans7

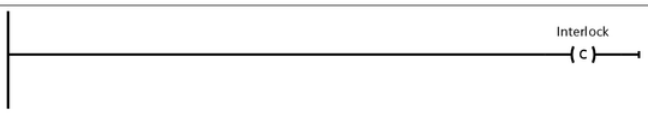
HMI stop operation button



S5:Step5

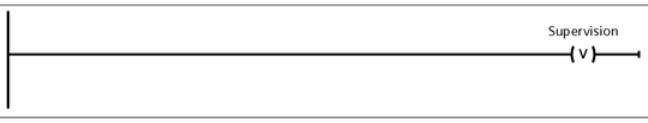
Interlock -(c)-:

Interlock alarm	
Alarm text	



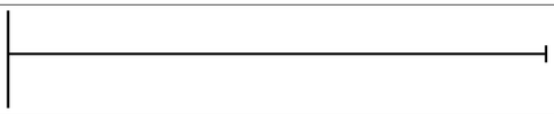
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - scan"

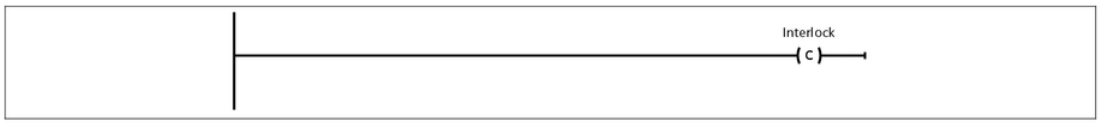
T8:Trans8



S6:Step6

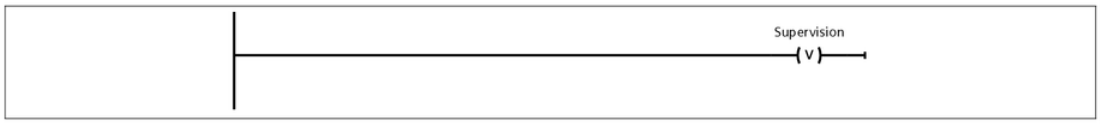
Interlock -(c)-:

Interlock alarm	
Alarm text	



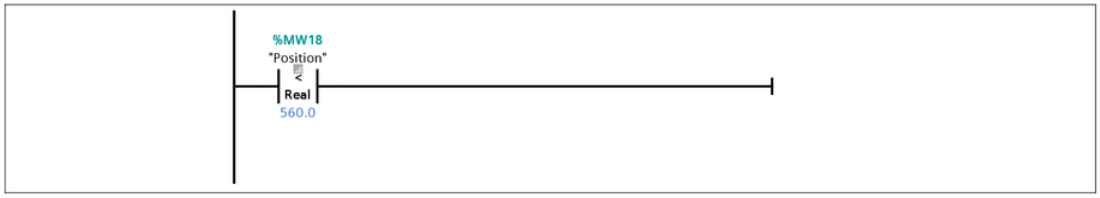
Supervision -(v)-:

Supervision alarm	
Alarm text	

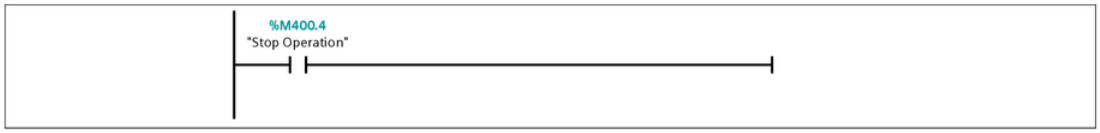


Actions:			
Interlock	Event	Qualifier	Action
		S	"Drive Offline static"

T10:Trans10



T15:Trans15



S7:Step7

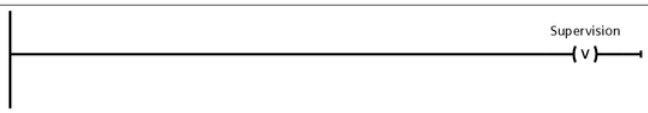
Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

Supervision alarm	
Alarm text	

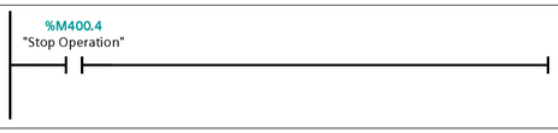


Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline static"
		S	"Drive Online - static"

T11:Trans11



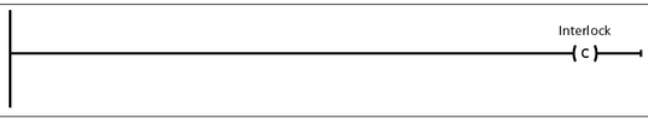
T14:Trans14



S8:Step8

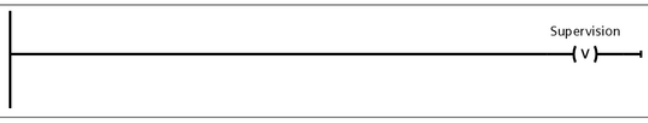
Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

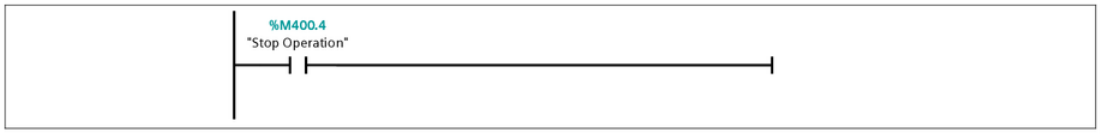
Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Online - static"

Interlock	Event	Qualifier	Action
		S	"Shutter State"
		S	"Open Shutter - static"
		R	"Close Shutter - static"

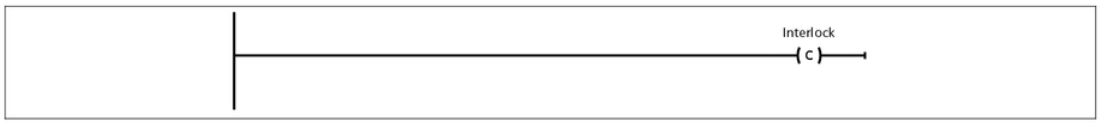
T12:Trans12



S9:Step9

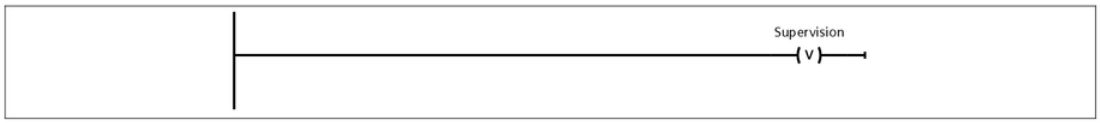
Interlock -(c)-:

Interlock alarm	
Alarm text	



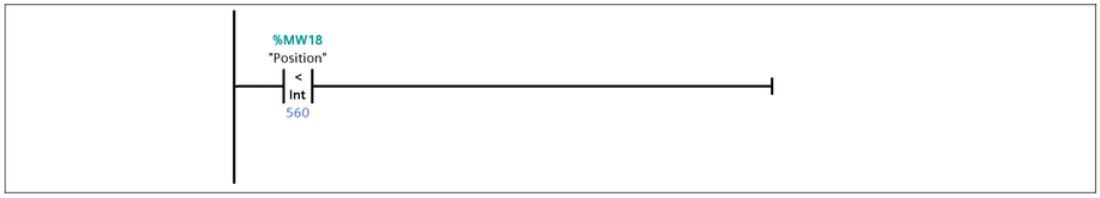
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		S	"Drive Offline - standby"

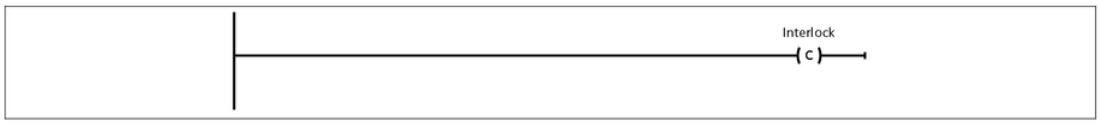
T17:Trans17



S10:Step10

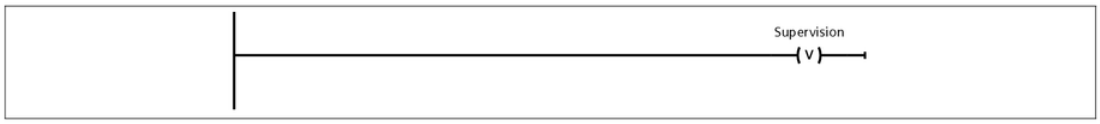
Interlock -(c)-:

Interlock alarm	
Alarm text	



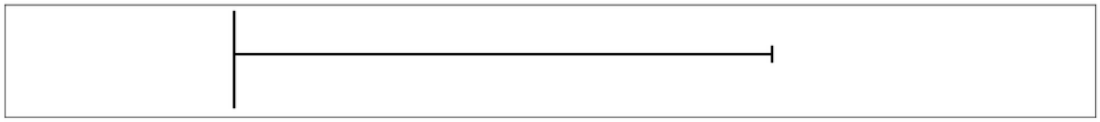
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - standby"
		R	"Standby"
		R	"Open Shutter - static"
		S	"Close Shutter - calibrate"

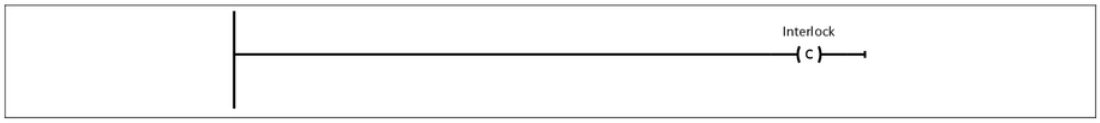
T18:Trans18



S11:Step11

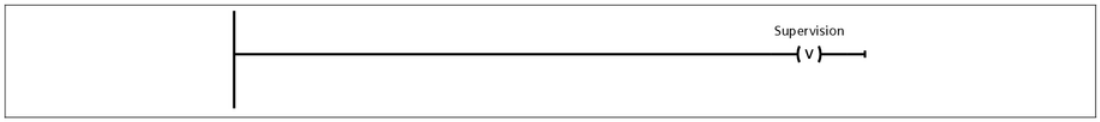
Interlock -(c)-:

Interlock alarm	
Alarm text	



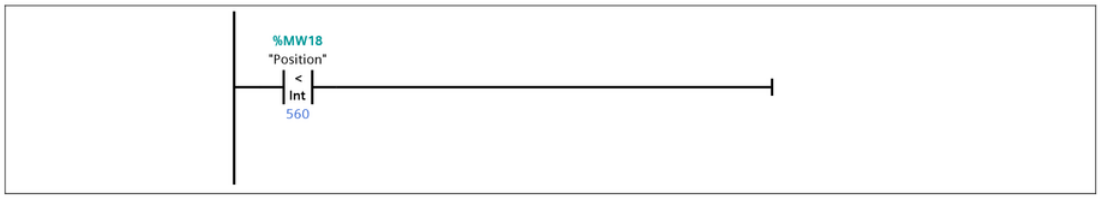
Supervision -(v)-:

Supervision alarm	
Alarm text	

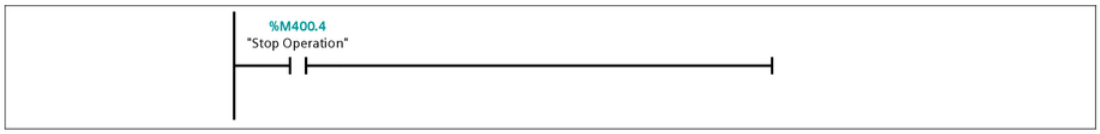


Actions:			
Interlock	Event	Qualifier	Action
		S	"Drive Offline - dwell"

T20:Trans20



T30:Trans30



S12:Step12

Interlock -(c)-:

Interlock alarm	
Alarm text	



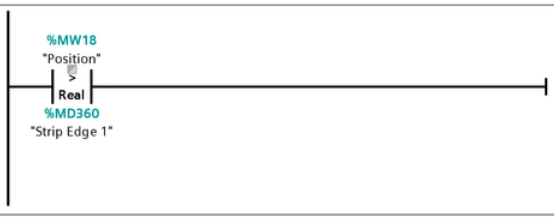
Supervision -(v)-:

Supervision alarm	
Alarm text	

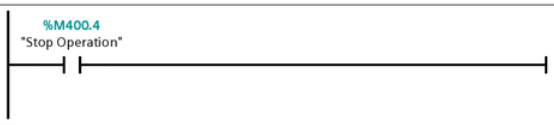


Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - dwell"
		S	"Drive Online - dwell"

T21:Trans21



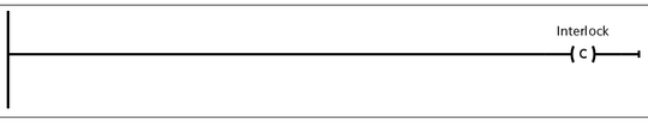
T31:Trans31



S13:Step13

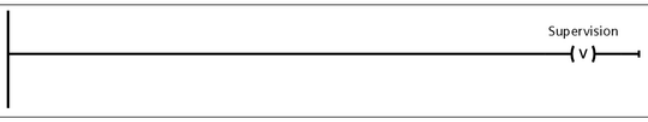
Interlock -(c)-:

Interlock alarm	
Alarm text	



Supervision -(v)-:

Supervision alarm	
Alarm text	

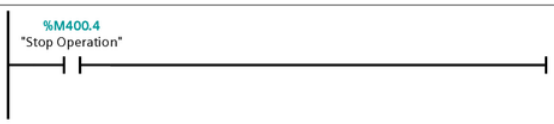


Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Online - dwell"
		S	"Start Timing"
		S	"dwell drive side edge"

T22:Trans22



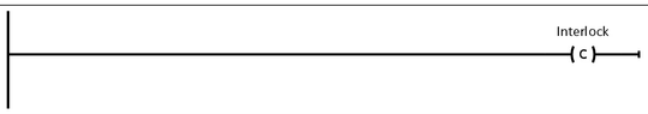
T32:Trans32



S14:Step14

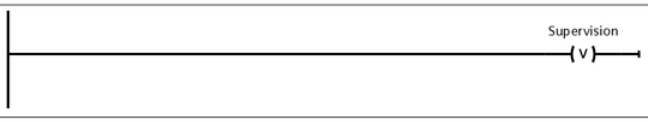
Interlock -(c)-:

Interlock alarm	
Alarm text	



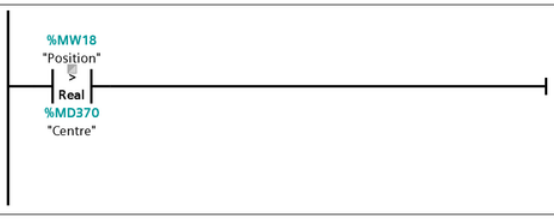
Supervision -(v)-:

Supervision alarm	
Alarm text	



Actions:			
Interlock	Event	Qualifier	Action
		R	"Start Timing"
		R	"dwell drive side edge"
		S	"Drive Online - dwell"

T23:Trans23



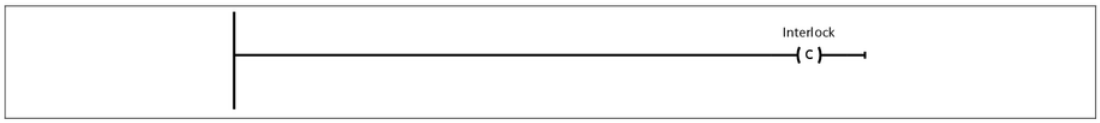
T33:Trans33



S15:Step15

Interlock -(c)-:

Interlock alarm	
Alarm text	



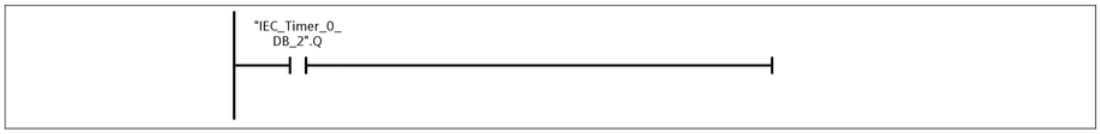
Supervision -(v)-:

Supervision alarm	
Alarm text	

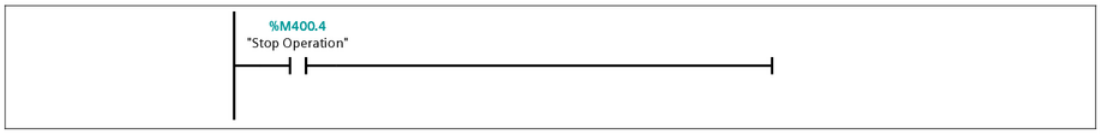


Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Online - dwell"
		S	"Start Timing"
		S	"dwell center"

T24:Trans24



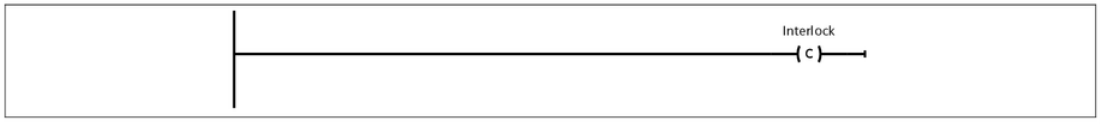
T34:Trans34



S16:Step16

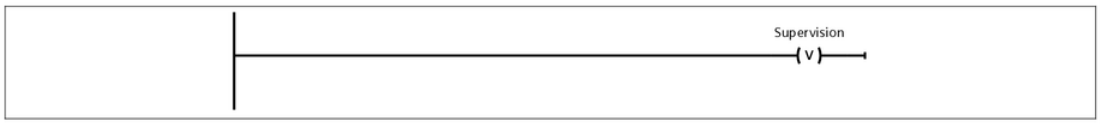
Interlock -(c)-:

Interlock alarm	
Alarm text	



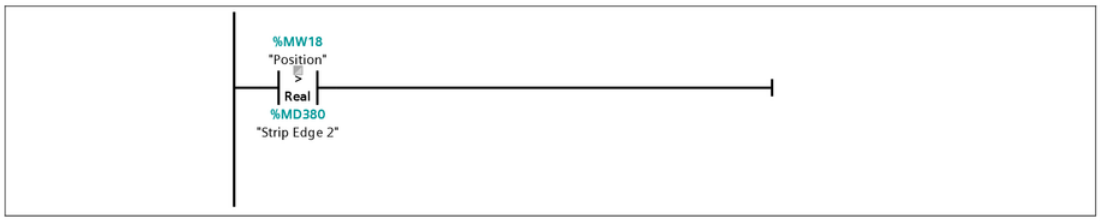
Supervision -(v)-:

Supervision alarm	
Alarm text	

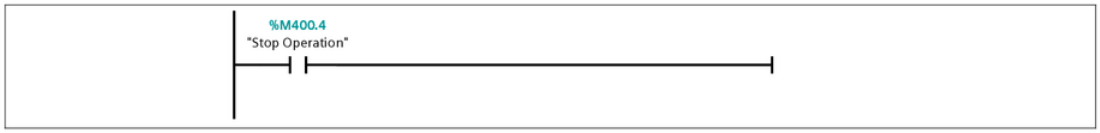


Actions:			
Interlock	Event	Qualifier	Action
		R	"Start Timing"
		R	"dwell center"
		S	"Drive Online - dwell"

T25:Trans25



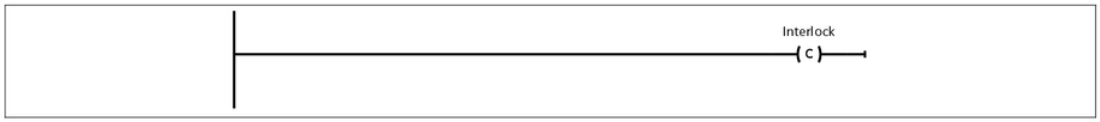
T35:Trans35



S17:Step17

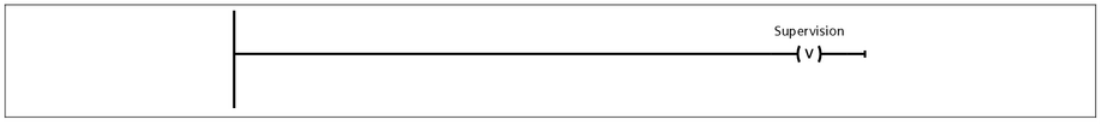
Interlock -(c)-:

Interlock alarm	
Alarm text	



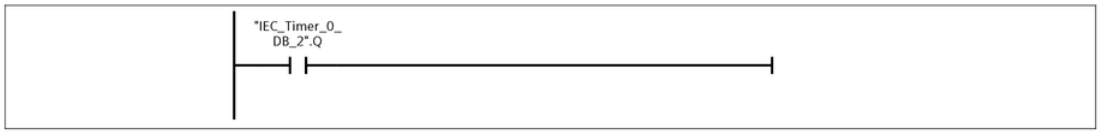
Supervision -(v)-:

Supervision alarm	
Alarm text	

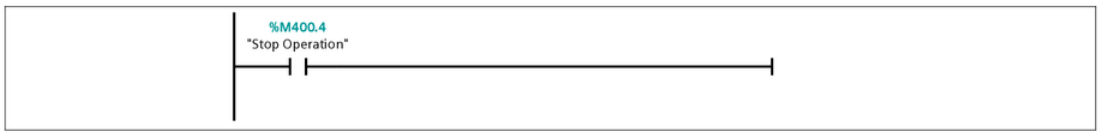


Actions:			
Interlock	**Event**	**Qualifier**	**Action**
		R	"Drive Online - dwell"
		S	"Start Timing"
		S	"dwell op side edge"

T26:Trans26



T36:Trans36



S18:Step18

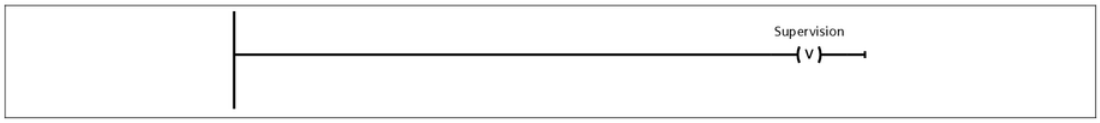
Interlock -(c)-:

Interlock alarm	
Alarm text	



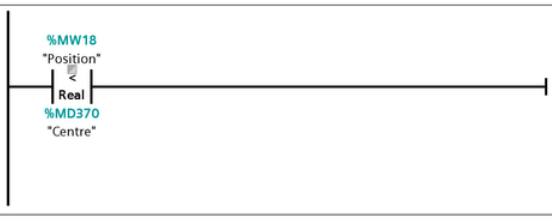
Supervision -(v)-:

Supervision alarm	
Alarm text	

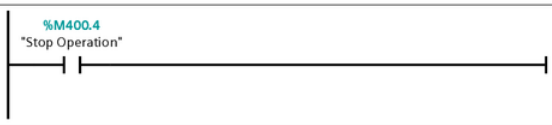


Actions:			
Interlock	**Event**	**Qualifier**	**Action**
		R	"Start Timing"
		R	"dwell op side edge"
		S	"Drive Offline - dwell"

T27:Trans27



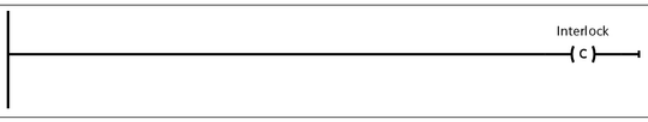
T37:Trans37



S19:Step19

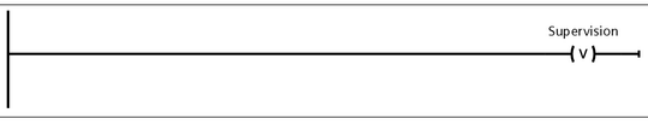
Interlock -(c)-:

Interlock alarm	
Alarm text	



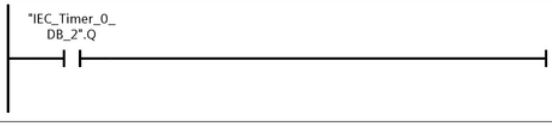
Supervision -(v)-:

Supervision alarm	
Alarm text	

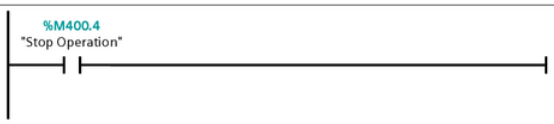


Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - dwell"
		S	"Start Timing"
		S	"dwell center"

T28:Trans28



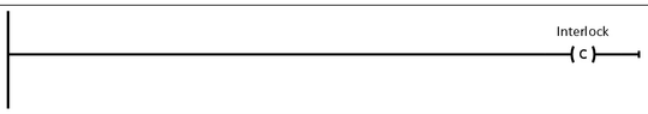
T38:Trans38



S20:Step20

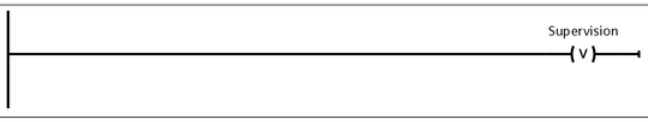
Interlock -(c)-:

Interlock alarm	
Alarm text	



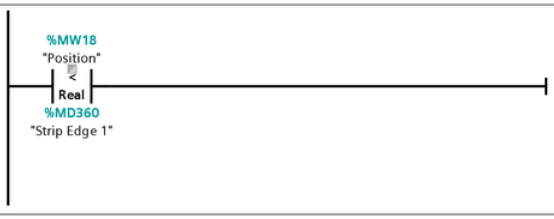
Supervision -(v)-:

Supervision alarm	
Alarm text	

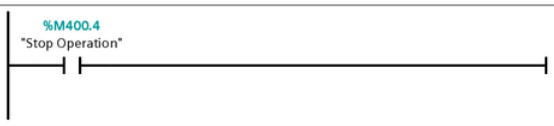


Actions:			
Interlock	Event	Qualifier	Action
		R	"Start Timing"
		R	"dwell center"
		S	"Drive Offline - dwell"

T29:Trans29



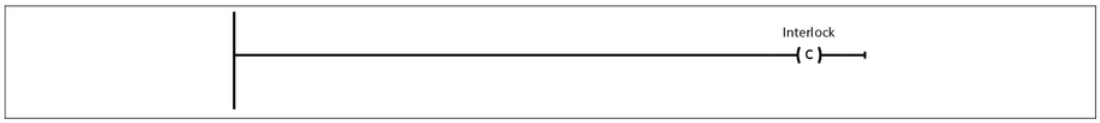
T39:Trans39



S21:Step21

Interlock -(c)-:

Interlock alarm	
Alarm text	



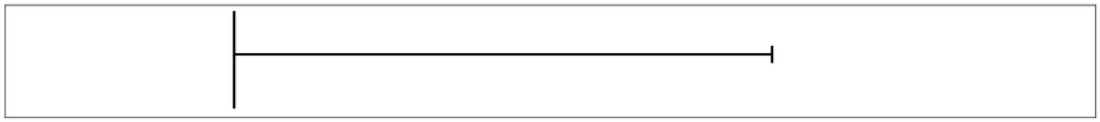
Supervision -(v)-:

Supervision alarm	
Alarm text	



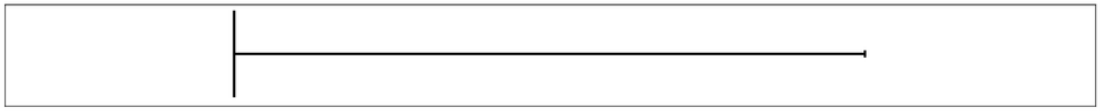
Actions:			
Interlock	Event	Qualifier	Action
		R	"Drive Offline - dwell"

T40:Trans40



Permanent post-instructions

1:



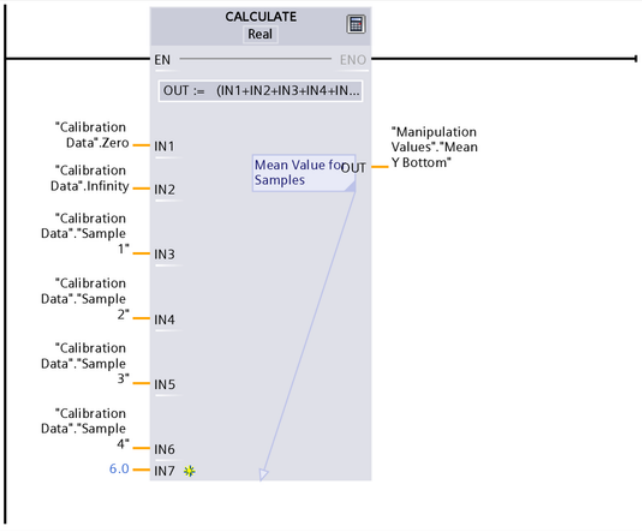
Regression Analysis Bottom Head [FB3]

Regression Analysis Bottom Head Properties					
General					
Name	Regression Analysis Bottom Head	**Number**	3	**Type**	FB
Language	LAD	**Numbering**	automatic		
Information					
Title		**Author**		**Comment**	This block is where the regresion analysis for the bottom head takes place.
Family		**Version**	0.1	**User-defined ID**	

Name	Data type	Default value	Retain
Input			
Output			
InOut			
Static			
Temp			
Constant			

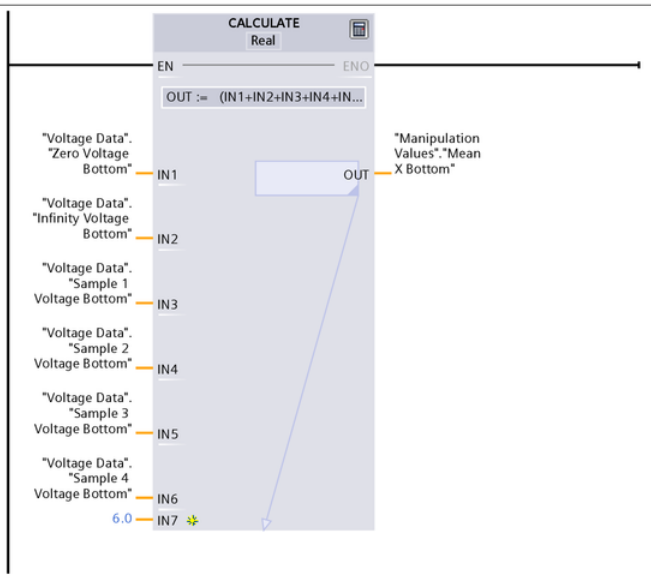
Network 1:

Mean of the calibration samples is calculated.



Network 2:

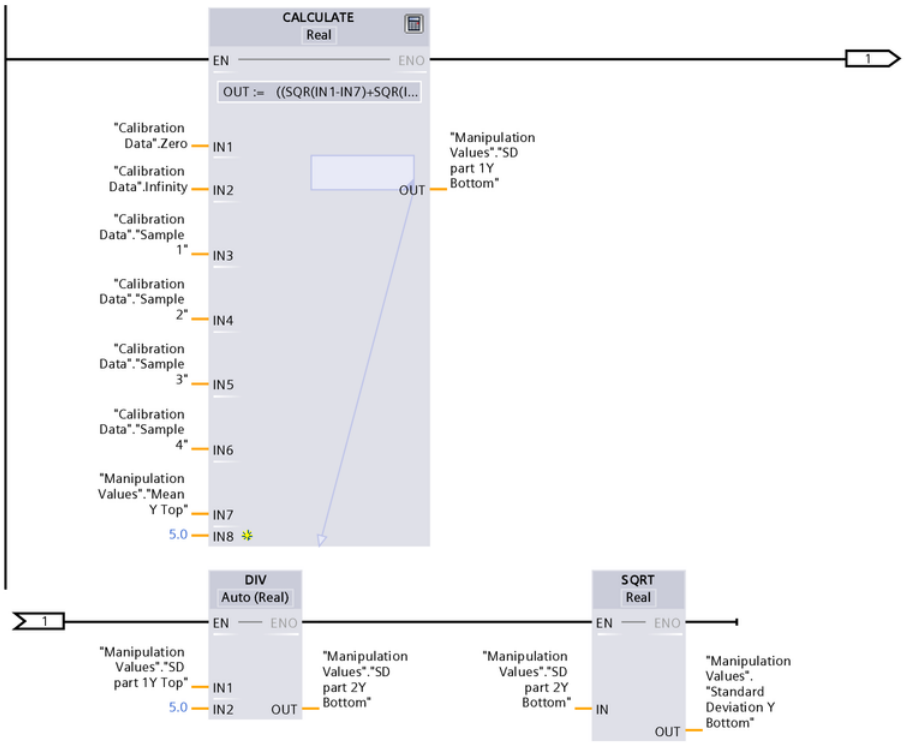
Mean of the voltages from the calibration samples is calculated.



Network 3:

The standard deviation of the calibration samples is calculated.

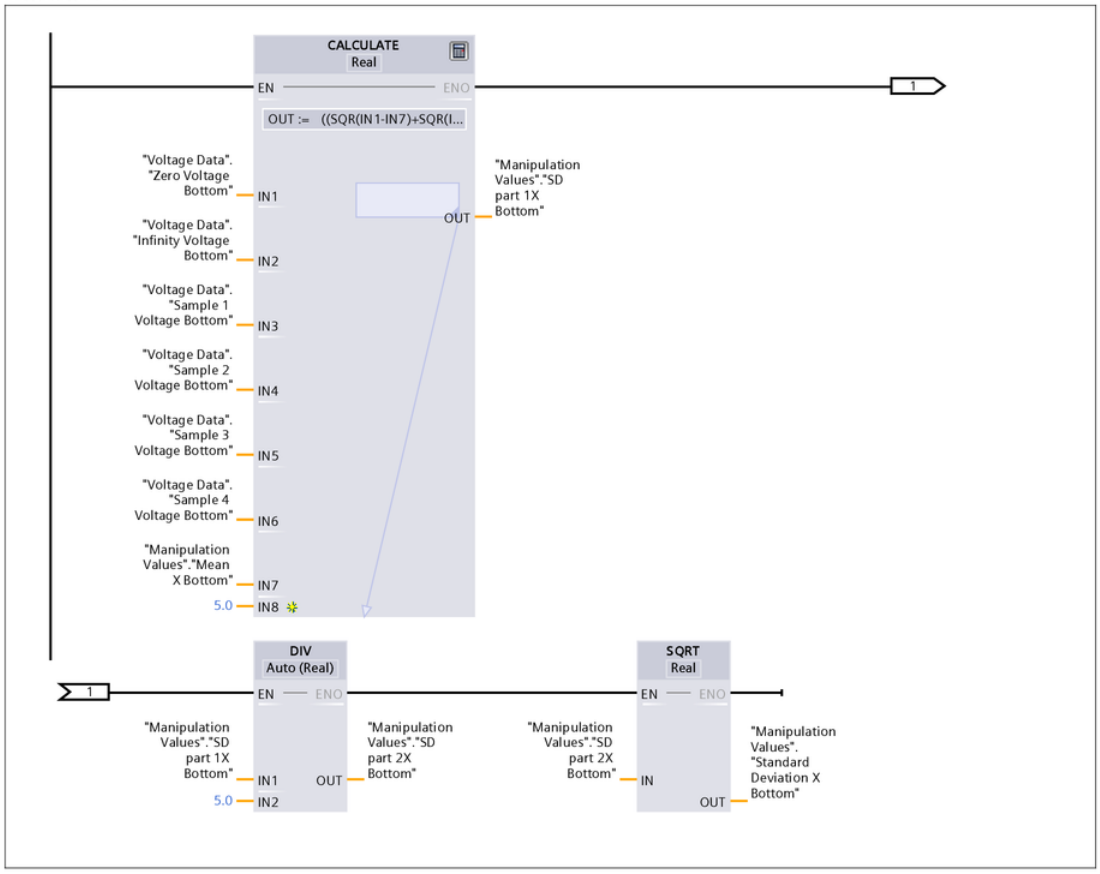
Network 3:



Network 4:

The standard deviation of the calibration samples is calculated.

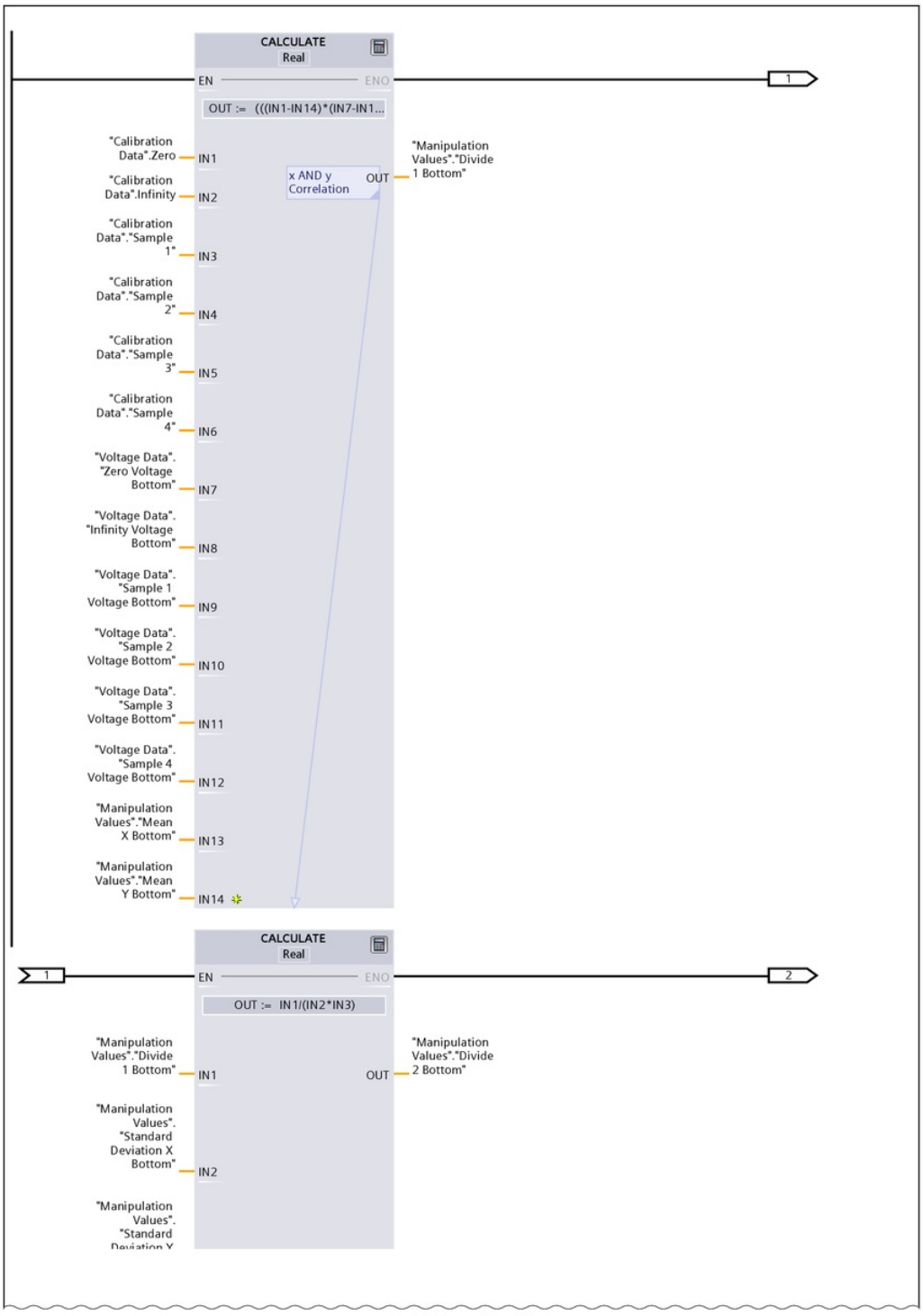
Network 4:



Network 5:

The correlation is calculated.

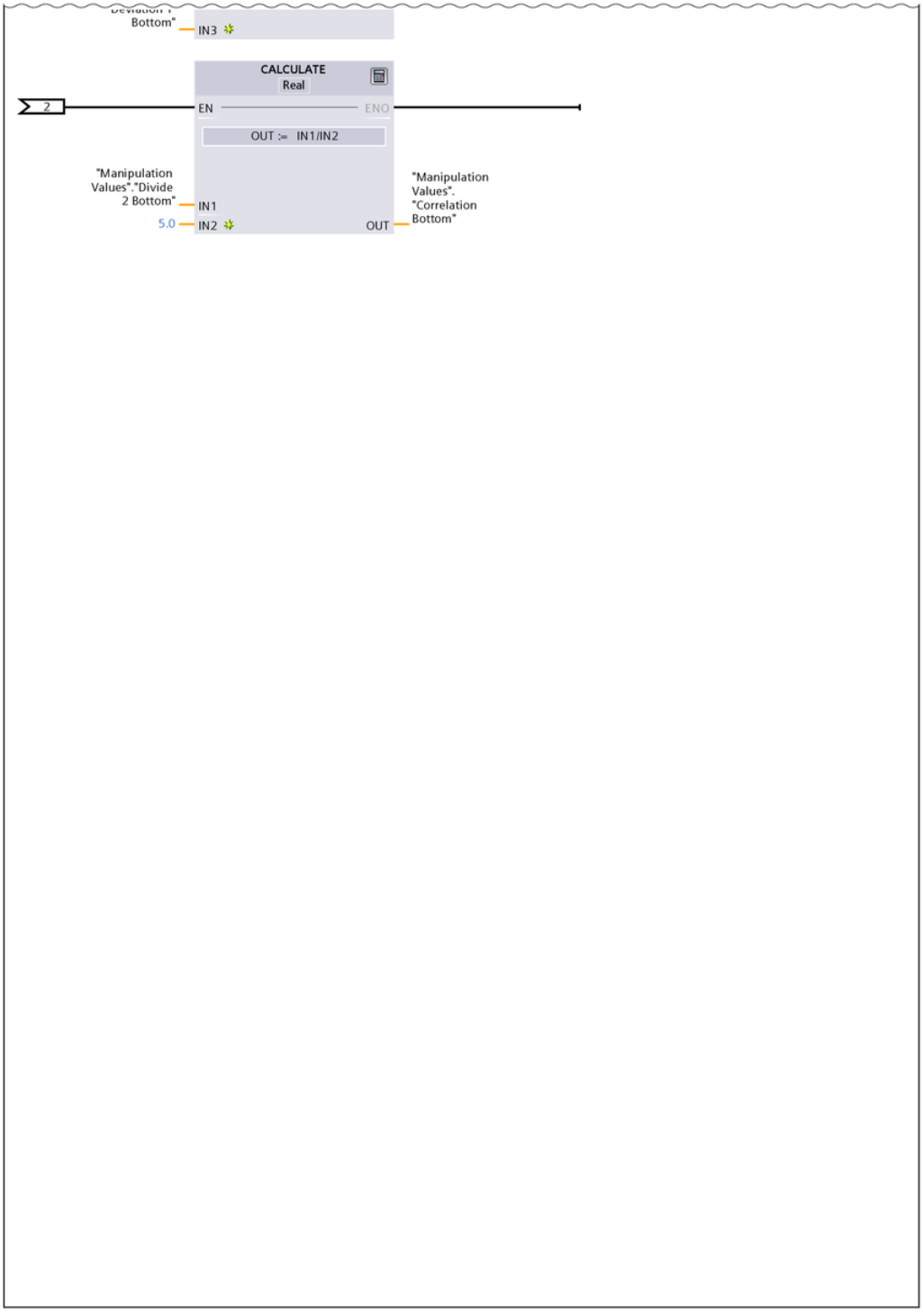
Network 5: (1.1 / 2.1)



2.1 (Page11 - 5)

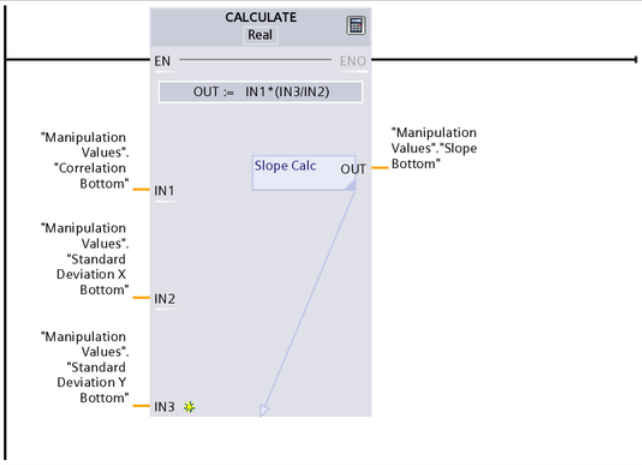
Network 5: (2.1 / 2.1)

1.1 (Page11 - 4)



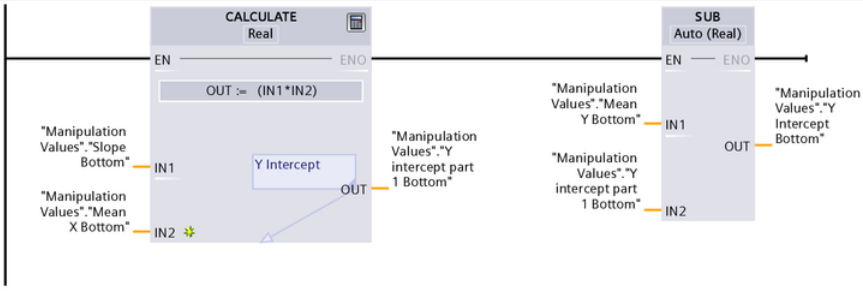
Network 6:

The slope is calculated.

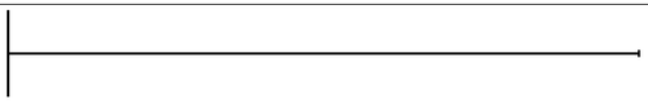


Network 7:

Y intercept calculated.



Network 8:

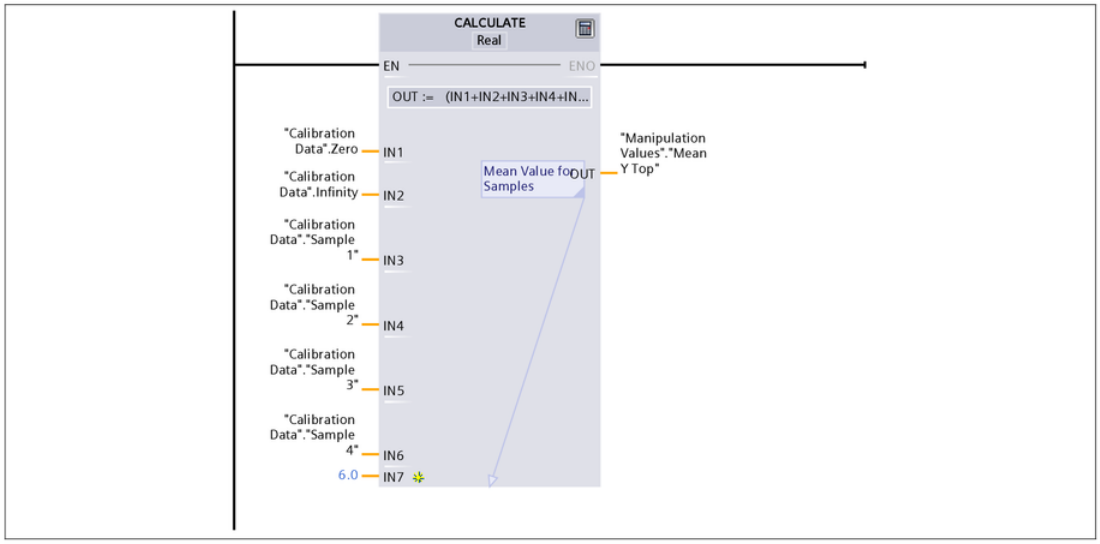


Regression Analysis Top Head [FB1]

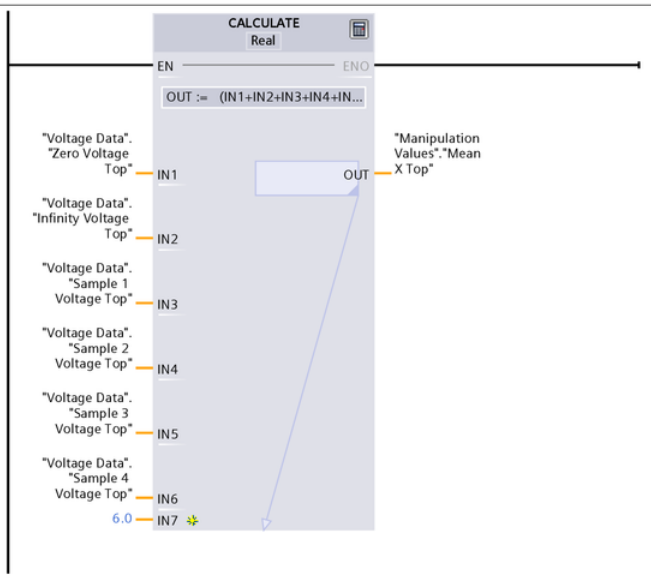
Regression Analysis Top Head Properties					
General					
Name	Regression Analysis Top Head	**Number**	1	**Type**	FB
Language	LAD	**Numbering**	automatic		
Information					
Title		**Author**		**Comment**	
Family		**Version**	0.1	**User-defined ID**	

Name	Data type	Default value	Retain
Input			
Output			
InOut			
Static			
Temp			
Constant			

Network 1:

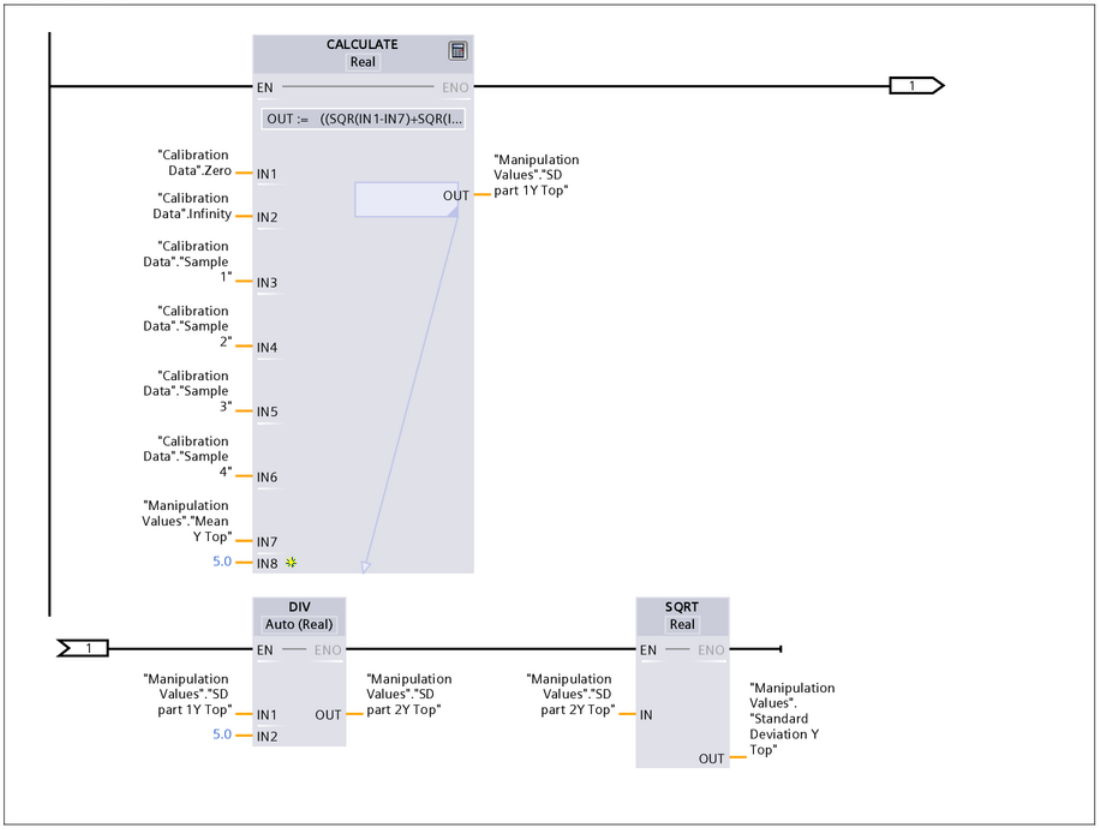


Network 2:



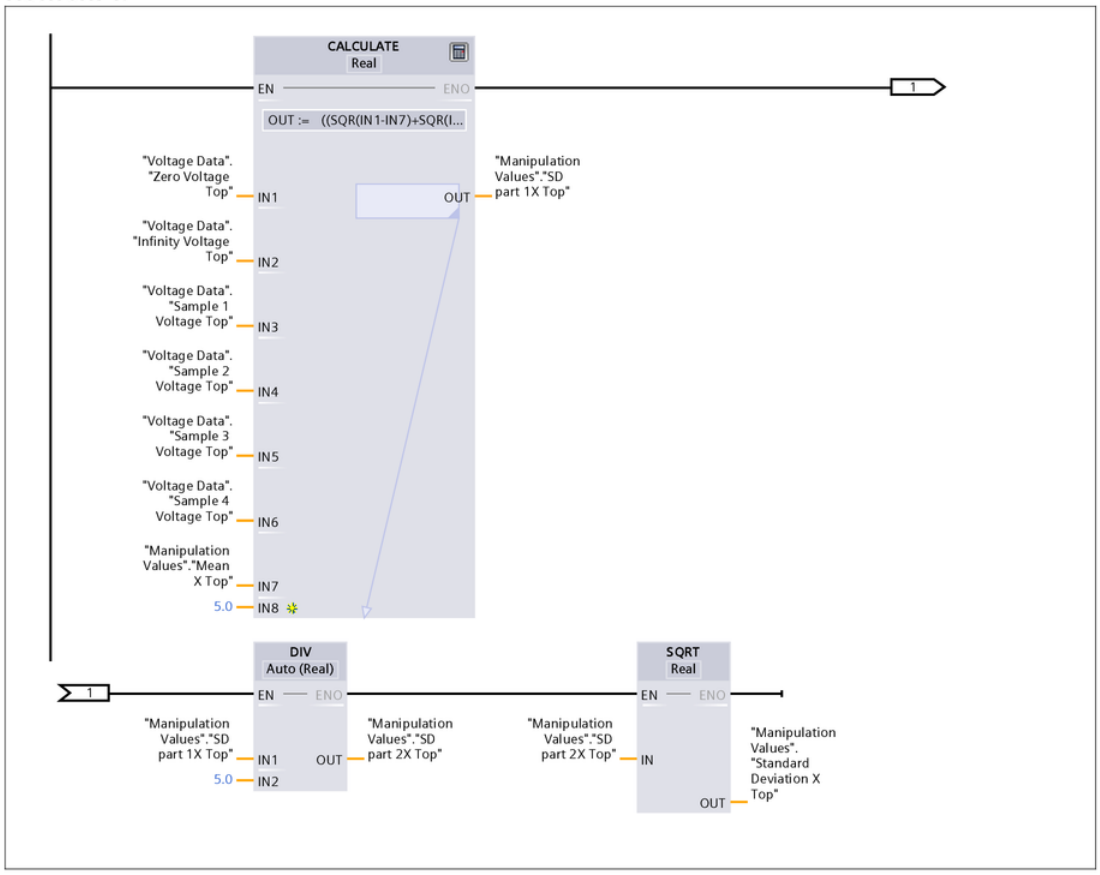
Network 3:

Network 3:



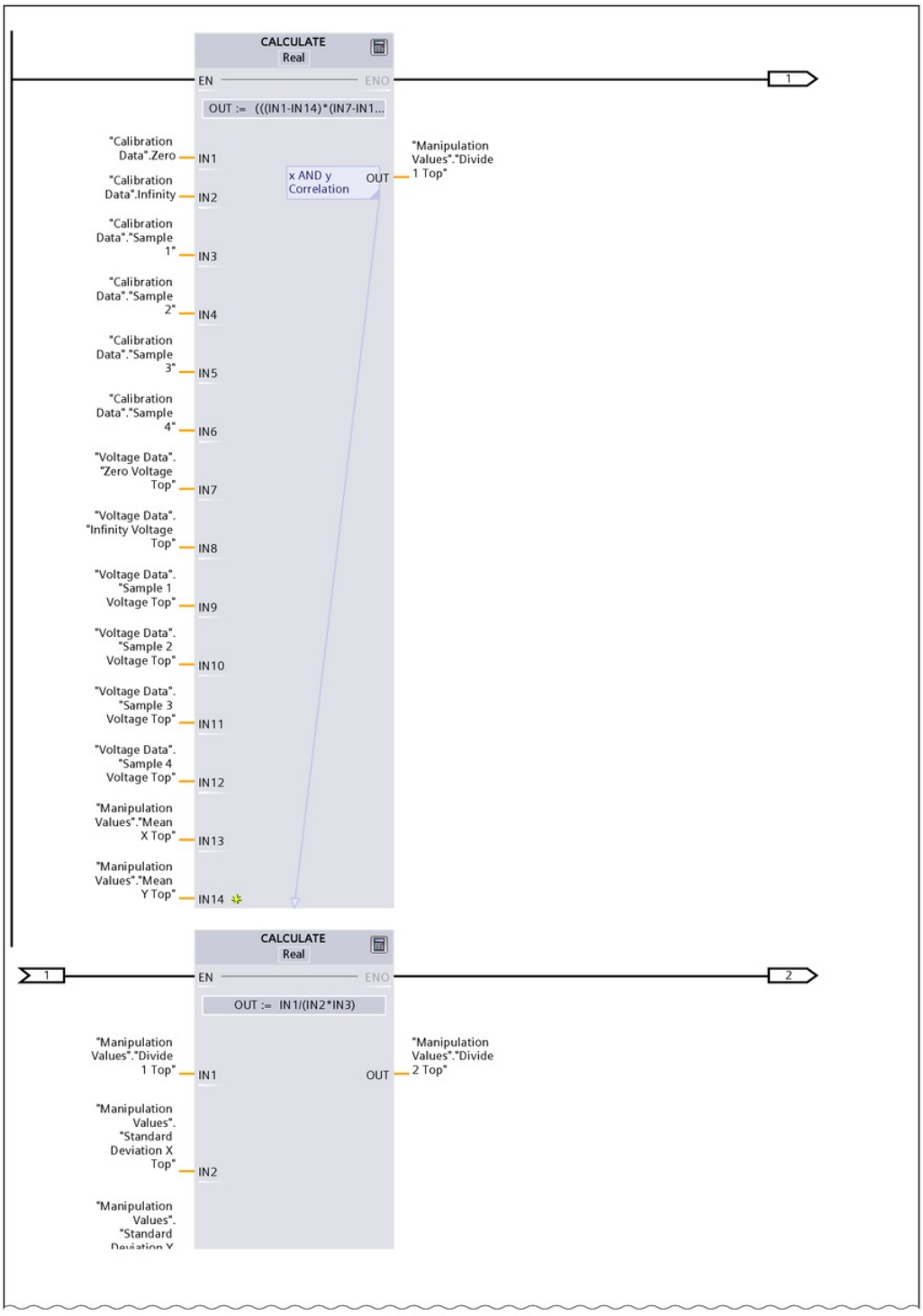
Network 4:

Network 4:



Network 5:

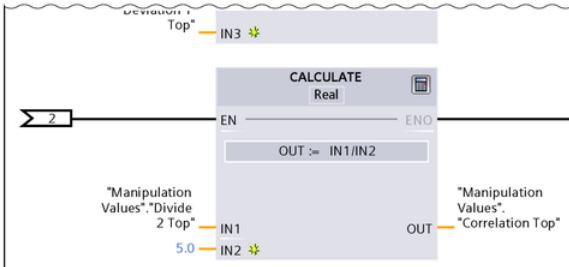
Network 5: (1.1 / 2.1)



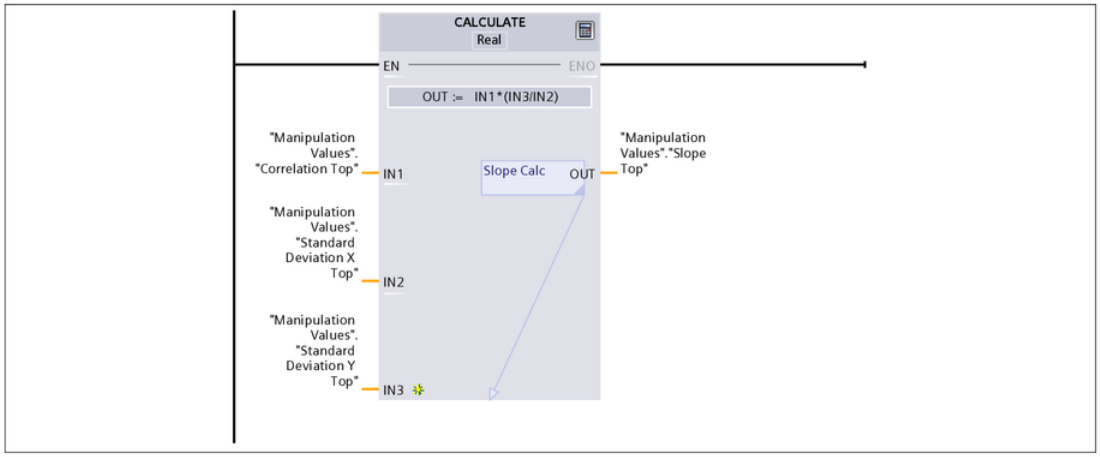
2.1 (Page12 - 5)

Network 5: (2.1 / 2.1)

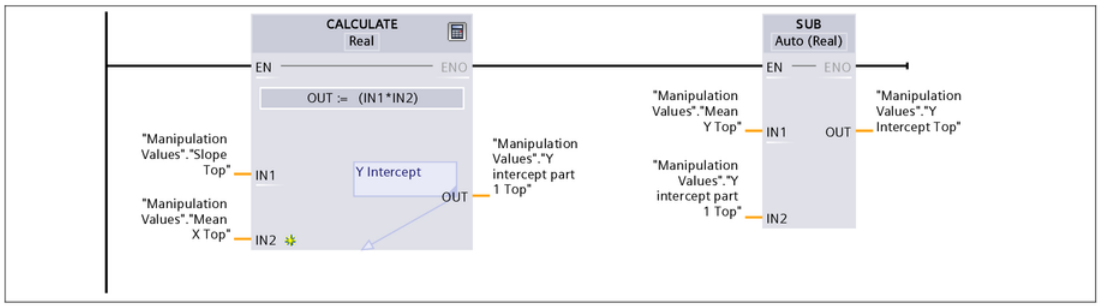
1.1 (Page12 - 4)



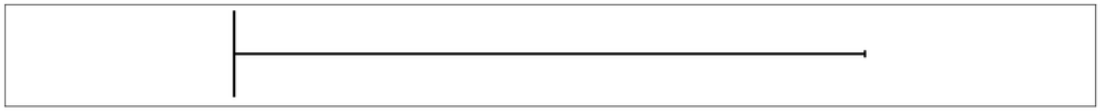
Network 6:



Network 7:



Network 8:



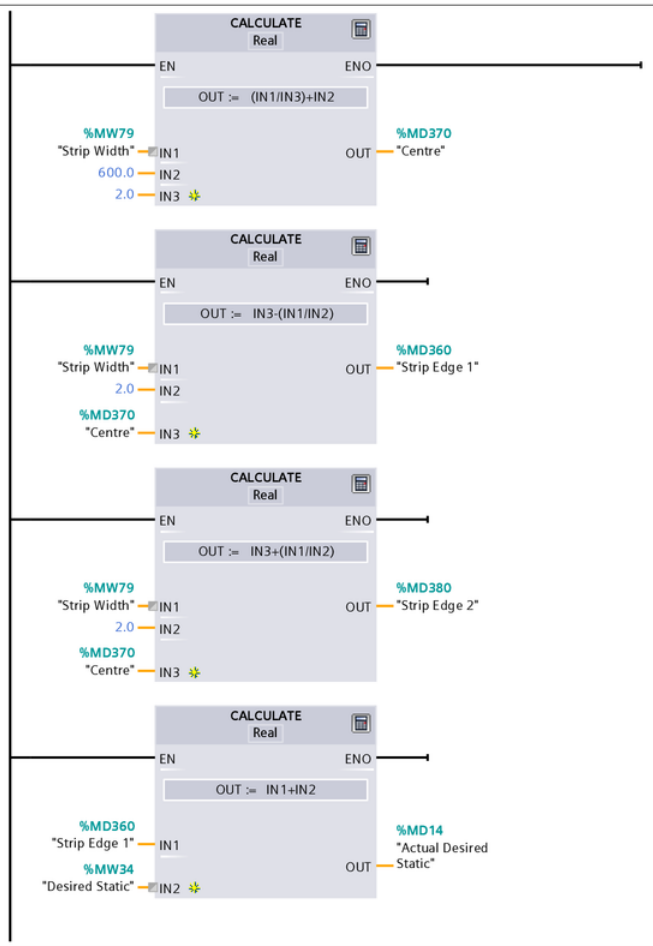
Strip Width Program [FB6]

Strip Width Program Properties					
General					
Name	Strip Width Program	**Number**	6	**Type**	FB
Language	LAD	**Numbering**	automatic		
Information					
Title		**Author**		**Comment**	Strip width program
Family		**Version**	0.1	**User-defined ID**	

Name	Data type	Default value	Retain
Input			
Output			
InOut			
Static			
Temp			
Constant			

Network 1:

Used to determine where the center and edge of the strip is. 600 is the minimum point at which the strip can be.


CALCULATE
Real
EN
ENO
OUT := (IN1/IN3)+IN2
%MW79
"Strip Width"
IN1
600.0
IN2
2.0
IN3
OUT
%MD370
"Centre"
CALCULATE
Real
EN
ENO
OUT := IN3-(IN1/IN2)
%MW79
"Strip Width"
IN1
2.0
IN2
%MD370
"Centre"
IN3
OUT
%MD360
"Strip Edge 1"
CALCULATE
Real
EN
ENO
OUT := IN3+(IN1/IN2)
%MW79
"Strip Width"
IN1
2.0
IN2
%MD370
"Centre"
IN3
OUT
%MD380
"Strip Edge 2"
CALCULATE
Real
EN
ENO
OUT := IN1+IN2
%MD360
"Strip Edge 1"
IN1
%MW34
"Desired Static"
IN2
OUT
%MD14
"Actual Desired
Static"

Report

GRADEMARK REPORT

FINAL GRADE

74/100

GENERAL COMMENTS

Instructor

PAGE 1

Text Comment. FINAL

PAGE 2

PAGE 3

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PAGE 8

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PAGE 10

Text Comment. No reference made to this figure in the text

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

Text Comment. what do each term represent ?

PAGE 16

Text Comment. you could have said that y represents the coating thickness

PAGE 17

Text Comment. it is not clear why the ABB drive is introduced here

PAGE 18

PAGE 19

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PAGE 31

QM

Spelling

Spelling error

PAGE 32

QM

Spelling

Spelling error

QM

Punctuation Error

Punctuation error

QM

Punctuation Error

Punctuation error

PAGE 33

PAGE 34

Text Comment. incorrect appendix number

PAGE 35

PAGE 36

PAGE 37

Text Comment. purpose of this box line is unclear, it clutters the diagram

PAGE 38

PAGE 39

PAGE 40

Text Comment. incorrect appendix number

PAGE 41

PAGE 42

Text Comment. You should always begin with a program structure showing the block tree and also the I/O list and the PLC tag list

Text Comment. You should be using MD rather than MW to avoid overwriting data, TIA is indicating this by the half shaded box.

PAGE 43

PAGE 44

PAGE 45

PAGE 46

QM

Spelling

Spelling error

PAGE 47

QM

Spelling

Spelling error

PAGE 48

PAGE 49

Text Comment. should be appendix 10.8

PAGE 50

QM

Spelling

Spelling error

PAGE 51

QM

Spelling

Spelling error

PAGE 52

PAGE 53

PAGE 54

PAGE 55

QM

Spelling

Spelling error

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PAGE 76

Text Comment. wrong data type, both should be of type double

PAGE 77

PAGE 78

PAGE 79

Text Comment. excellent idea, testing temperature shows possible future failures

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GRADING FORM: MAJOR PROJECT 2017_18

RHIANNON GALLACHER	**74**

RESEARCH (20%)

Research Informed Literature: 1. Abstract, acknowledgements, introduction and setting out of aims and objectives. (/20) 2. Background research, setting the context of the project, statement of user or customer needs. (/30) 3. Literature review, solutions considered and choice made. (/40) 4. Use of Harvard Referencing for citing and listing sources. (/10)

1. Clearly written abstract and acknowledgement sections. Introduction sets out the aims and **13.4**

objectives of the project. (15) 2. Well researched, good background and very clear statement of customer needs. Interesting regression analysis explanation. However, you could have set the project in context with photos of existing machine for the sake of your reader. (18) 3. Good block diagrams and comparison chart for solutions. One item (ABB drive) discussed without a clear reason. (29) 4. A good range of sources cited and listed correctly. (5)

KNOWLEDGE (20%)

Knowledge & Understanding of Subject: 1. Specification, design requirements and project outcomes, time and financial constraints. (/30) 2. Test planning and procedures. (/20) 3. Formal project planning and identification of milestones. (/25) 4. Consideration of maintenance and reliability. (/25)



1. Specification is clearly and briefly stated with the design requirements and project outcomes. (22) 2. Report contains a good section on test planning and procedures. (17) 3. Detailed evidence provided of project planning with milestones identified (though more detail could have been given for each milestone). (18) 4. Briefly considered in section 4 but in evidence in the design and testing. (18)

15

ANALYSIS (20%)

Analysis: 1. Evaluation of Implementation stage, monitoring of progress and milestone activities. (/20) 2. Testing & test results. (/30) 3. Comparison of project outcomes to specification. (/20) 4. Conclusions, recommendations and reflections. (/30)



1. Good evidence provided in section 7.4 and on the Gantt charts. (16) 2. Excellent testing table.

15

However, there is little photographic evidence provided to support results to show the screen working but there are heat photos to show reliability. (16) 3. Excellent evaluation of project outcomes with comparison to specification. (19) 4. Very good with helpful recommendations. (24)

PRACTICAL APPLICATION (20%)

Practical Application & Deployment: 1. Quality, innovation and creativity of design solution. (/20) 2. Implementation stage, working independently with limited supervision. (/30) 3. Meeting customer or user needs, fitness of solution to purpose, working within time and financial constraints. (/20) 4. Log book. (/30)

1. High quality design, innovation and good evidence of creativity in design of panel, PLC program and HMI screens. However, the electrical drawing could have been done on CAD. (18) 2. The project has been well executed with limited assistance and supervision from college supervisor. Other sources of assistance have been acknowledged in the beginning of the report. However, that assistance seems to be significant. (18) 3. Clear evidence presented that customer needs have been met and the system is fit for purpose, completed on time and within budget. However, there are some issues highlighted e.g. use of colours for TATA's standard. (19) 4. Very detailed log book with excellent evidence showing development.(25)

16

PROFESSIONAL PRACTICE (20%)

Skills for Professional Pracice: 1. Professionalism and ethical conduct. (/25) 2. Health and safety, assessment of risk. (/25) 3. Sustainability and environmental protection.. (/25) 4. Presentation and organisational quality of report. (/25)

1. Good evidence presented, following TATA Steel procedures. (18) 2. A clear section presents good evidence. (22) 3. Good consideration given in section 4. (15) 4. Very good structure and presentation quality and mostly well written. However, there are several spelling errors and the title page has the wrong report name, it should say final not interim report. (18)

14.6