PLC PLANT PROCESS REMOTE MONITORING AND USER FRIENDLY GUI USING LABVIEW

by

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Final Report submitted in partial fulfilment of

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CERTIFICATION OF APPROVAL

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Approved by,

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TRONOH, PERAK

December 2010

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

MUHAMAD SYAFIQ BIN ABD JALIL

ABSTRACT

This project focused on the development of PLC remote monitoring software to control and remotely monitor a pick and place loader. Object Linking and Embedding for Process Control (OPC) is used as a standard interface between programmable logic controller (PLC) and LabVIEW's remote monitoring application. The interface utilized Component Object Model (COM) to communicate and permits a protocol for real-time information exchange between LabVIEW and PLC via a RS-232 serial cable. PLC remote monitoring is used widely in automotive industry, escalator and elevator, railway signalling and also various domestic applications. Remote monitoring can solve machine discrepancies without endangering any personnel. It also helped maintenance activities and provides useful data for future maintenance activities. Several problems arise from the use of today's remote monitoring software such as its effectiveness in helping maintenance personnel, compatibility with older technology and the ability to transmit information in real time during its peak operation. The aim of this project is to create a more reliable remote monitoring system with user friendly interface and assist maintenance activities. Equipped with a mean time between failure (MTBF) and failure rate estimator, this software can have faster problem detection thus increasing the productivity of the system by lowering its downtime rate. Accidents can also be avoided as workers and maintenance personnel can have their job done remotely. This will greatly reduce employees' health care costs and at the same time increase their self-esteem as they would never have to risk their health to these unjustified conditions.

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Thank you.

Muhamad Syafiq Bin Abd Jalil

EE 9107

Electrical and Electronics Engineering Programme

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LIST OF ABBREVIATIONS

AS...Automation Studio
COM..Component Object Model
GUI.. Graphical User Interface
HMI...Human-Machine Interface
HTML...HyperText Markup Language
IEC..International Electrotechnical Commission
LabVIEW.............Laboratory for Virtual Instruments Engineering Workbench
NI...National Instruments
MTBF..Mean Time Between Failure
OLE...Object Linking and Embedding
OPC...OLE for Process Control
PLC...Programmable Logic Controller
PHP..Hypertext Preprocessor
RTU...Remote Terminal Unit
VT-MMS................Vertical Transportation Maintenance Management System
XML...Extensible Markup Language

CHAPTER 1

INTRODUCTION

1.1 Background Of Study

The project will focus on Programmable Logic Controller **(**PLC) remote monitoring. PLC is a digital computer used for automation of electromechanical processes. It has the ability to interact with digital and analog devices and was also designed to withstand extreme temperature, resistance to electrical noise, impact and vibration.

The rigidity and its ability to withstand the harsh industrial environment had saves time, money and skills for many important industries. Nonetheless, downtime still occurred, mainly caused by the components controlled by PLC. The reliability of the PLC makes people tends to overlook its input and output components thus making the system vulnerable to unnecessary downtime caused by these malfunctioned components.

Communication between PLC had been done by various ways [1]. PLCs have built in communications ports, usually 9-pin RS-232, but optionally EIA-485 or Ethernet. Modbus, BACnet or DF1 is more often than not included as one of the communications protocols. Other options include various field buses such as DeviceNet or Profibus. This project will utilize the 9-pin RS-232 communication port to communicate with LabVIEW remote monitoring application using Object Linking and Embedding for Process Control (OPC) protocol. OPC is suitable for domestic and industrial usage as it can reduce the need for expensive custom devices or interfaces to access the data efficiently in real time environment.

1.2 Problem Statement

In large plant where automation processes rely on different types of PLCs, troubleshooting any discrepancies can become a big problem.In many cases, when it comes to checking the condition of a machine, it is necessary to dispatch maintenance personnel to the site. Sometimes the dangerous condition of the surrounding and hazardous chemicals can endanger the person. Furthermore, in larger plant, different PLC package from different manufacturers are expected to be use and it is really hard when it comes to interpreting any discrepancies. The lack of data to perform preventive maintenance also contributed to the causes of breakdown and accident in the industry.

1.2.1 Problem Identification

Some maintenance activities can endanger the maintenance personnel. They are exposed to extremely loud noises, dangerous chemical fumes and many more unsafe conditions. The remote monitoring can provide remote access for the personnel to solve the discrepancies without exposing themselves to these dangerous conditions. Another problem arises in plant which is having machines that is controlled by PLC from different manufacturers. Even with the same model from the same manufacturer, it may not be directly compatible with each other. To overcome this, remote monitoring software must be compatible with all PLC packages. The skills of the personnel who is handling or maintaining the machine should also be taken into consideration.

1.3 Objectives & Scope of Study

This project will be focusing on assisting maintenance activities in determining the critical faults during a machine breakdown and pin point its location.

The project will also focuses in reducing the exposure of working in a hazardous workplace for the maintenance personnel by remotely solving the problem instead of going to the actual workplace. By doing so, accidents can be avoided, maintenance activities can be done quicker and the productivity of the company will be increased.

The project will evolve around programmable logic controller (PLC) using ladder logic to control a plant process (i.e. conveyor). Knowledge in programming will definitely be tested to ensure the program able to fulfil safety requirements, equipment protection, smooth operation and ability to be monitor.

Besides that, LabVIEW software will be used to create the remote monitoring software. LabVIEW, short for Laboratory Virtual Instrumentation Engineering Workbench is a platform and development environment for a visual programming language from National Instruments. The graphical language named "G", is a dataflow programming language [2]. LabVIEW is commonly use for data acquisition, instrument control, and automation in many industries nowadays.

CHAPTER 2

LITERATURE REVIEW

2.1 Ladder Logic Programming Language

Ladder logic is a graphical programming language that represents a program based on the circuit diagrams. It is used mainly in Programmable Logic Controllers (PLCs) for industrial automation applications. The name is based on the observation that programs in this language resemble ladders, with two vertical rails and a series of horizontal rungs between them [3].

Ladder logic can be understood as a set of connection between input and output (coils). If a set of inputs in one rung are energized, the output coil will set a Boolean bit 1. Any un-energized input will disconnect the path to energize the output coil. This input is called contacts. Each coil or contact represents a single bit in the PLC's memory and can referred anywhere and anytime in the ladder logic program.

In real world, these contacts or coils is referring to physical inputs to the programmable controller from physical mechanism such as push buttons and limit switches. The output coil, however, represent a different function. It can be another internal coil, a timer and even a physical output connected to the programmable controller such as motor and magnetic contactor.

2.2 PLC Memory Usage

For this particular remote monitoring project, there are only a few commands that are commonly used. Ayoka Systemsmentioned that these commands allows for the remote monitoring software to retrieve the values for a range of memory addresses. The values returned by the PLC can be parsed and reveal the current status of the control system at the customer's facility. An example of this would be the current electrical usage of a motor being stored in memory range 0xd379 – 0xd37c [4]. To get the information from this memory range, the remote monitoring software would send a command packet to request this memory range from the PLC, listen for a valid response, and interpret/store the returned information as necessary.

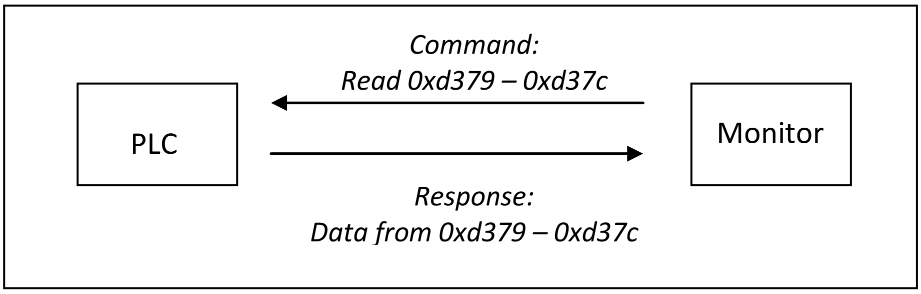

Figure 1: Memory usage

2.3 Component Object Model (COM)

COM is a collection of different OLE features such as visual editing, linking, embedding, drag and drop and automation. OLE 2.0 [5] includes mostly user-interface oriented features based on usability, application integration, and automation of tasks. All of these features are implemented by means of specific interfaces on different objects and defined sequences of operation in both clientsand servers and their relationships and dependencies on the lower level infrastructure ofCOM is shown in Figure 2.

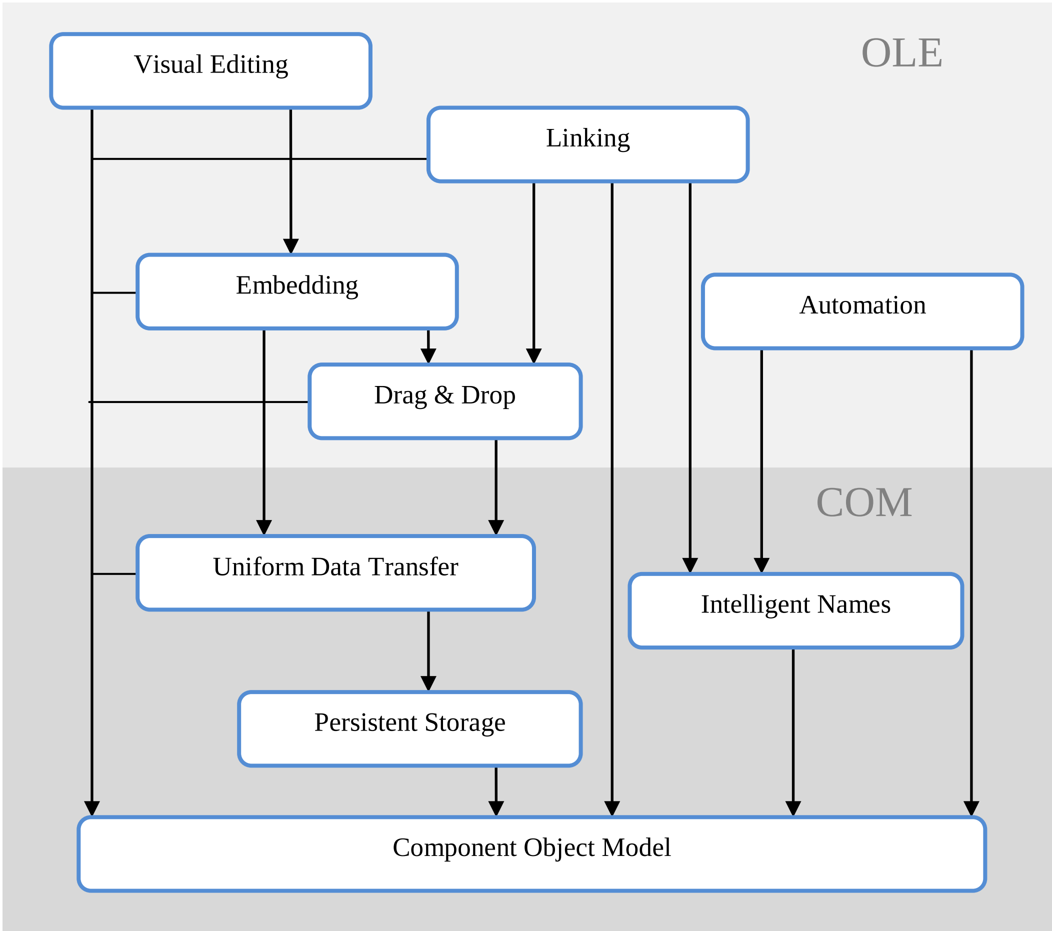

Figure 2: OLE builds its features on COM

2.4 Object Linking and Embedding (OLE)

Object Linking and Embedding (OLE) is a technology developed by Microsoft that allows embedding and linking to documents and other objects. OLE has the capability to pull out a part of a document to another document that does not have the capability to do so. One of the main benefits of OLE is to display visualization of data from other document or program to your current document or program.

It is called ‘linking’ where the data imported will act as a reference to the original source. Any changes made in the imported data will be updated to the original source. The term ‘embedding’ is more widely used in multimedia application where users tends to embed multimedia files such as video, flash and audio within a HTML, PHP or XML documents (web page).COM is a neutral language that can be use across machine platform. Several custom applications can also be built using other programming languages like Visual Basic, Delphi and Power Builder. Microsoft had designed the OLE and COM to comply those programming languages, thus enabling OPC to be utilized by custom programs written in those languages [6].

2.5 Object Linking and Embedding for Process Control (OPC)

According to OPC Foundation, OPC will provide many benefits to industries that utilized remote monitoring application. Among the benefits are:

- Only one set of software components needed in industrial application and utilization.
- Software engineer will not have to reconfigure and rewrite the driver for additional hardware added to the system.
- No additional hardware and cost needed if any modification, addition and enhancement were made to the system environment. [7]

The concept of OLE for Process Control (OPC) is simple yet flexible. The system consists of OPC server (hardware side) and OPC client (software side) as shown in Figure 3 [8].

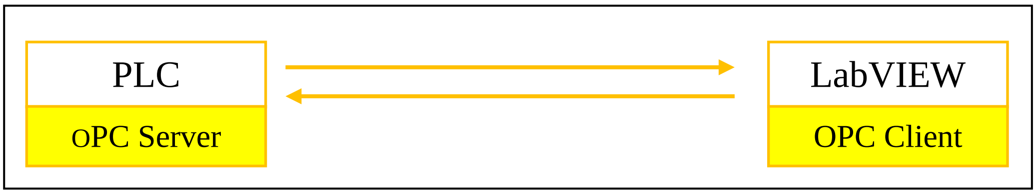

Figure 3: OPC System Overview

Additional LabVIEW module called ‘Data logging and Supervisory Control Module’ is needed to initiate the communication process [9]. National Instruments’ OPC Servers version 2009 evaluation copy and LabVIEW Shared Variables function is used to retrieve the data for the communication process [9].

2.6 Recent Applications of PLC Remote Monitoring

2.6.1 Remote Monitoring System for Tunnel Boring Machine [10]

The operation panel of a tunnel boring machine is equipped witha PLC for controlling the machine. This PLC is used to output operation commands to the individual actuators and to input information obtained by the sensors that are installed in themachine. The tunnel machine is also equipped with a measuring and linearity control system for measuring the current excavation position. This information is also input to the PLC. These pieces of information about excavation are transmitted via a modem from the PLC to the personal computer for excavation control installed in the construction office on the ground several kilometers away from the tunnel construction site so that they can be monitored on a real-timebasis. In the construction office, they collect relevant data and control the excavation work and machine condition. All this is the way the conventional control system works at a tunnel construction site.

At first, the excavation control program was obtaining machine data serially from the PLC every one second and reproducing and displaying the entire screen at that timing.When remote monitoring was put into effect, the operational performance of the excavation control personal computer declined (i.e., slowdown in speed of movement of the mouse pointer, display of dialogs, etc.).In addition, at the remote monitoring personal computer, the time interval of screen display (renewal) increased to more than 10 seconds, showing no real-time capability [10].

2.6.2 Remote Monitoring of Elevators and Escalators

The possibility of remote monitoring of elevators has recently become a reality for many manufacturers of elevators. The primary drawback has been that this monitoring has been designed for new equipment only. Reliable and affordable monitoring for multiple manufacturers and vintages is not wide spread. Escalator monitoring is virtually unheard of [11].

Many public properties have many types of elevators and escalators. Some authorities have difficulty determining if their equipment is running or not. Relying on complaints from the public or a station manager can be a frustrating method of managing elevators and escalators whether using outsource maintenance or not [11]. To solve this problem, the Vertical Transportation Maintenance Management System is used to remotely monitor Allen Bradley SLC 5/03 PLCs using Remote Terminal Unit and software supplied by Rockwell Automation. This system however, only available to escalator and elevator that uses Allen Bradley PLC and DeviceNET communication protocols.

2.6.3 Intelligent Condition Monitoring of Railway Signalling Equipment

Remote monitoring software use in railway signalling system records the condition of the system for post-incident analysis and fault diagnosis purposes. Currently relays are used as the main component in control circuitry within railway signalling [12]. However, the use of PLC in railway signalling is considered as cheaper, more reliable and more flexible substitute than relay. Various user friendly remote monitoring software packages have been developed to display the information to the engineers in graphical format to ease visualization. Remote monitoring is crucial to monitor several failure modes such as power source interruptions, low rail to rail resistance or any break in the connection during track maintenance. This is important to ensure the safety of the train.

CHAPTER 3

METHODOLOGY

3.1 Procedure Identification

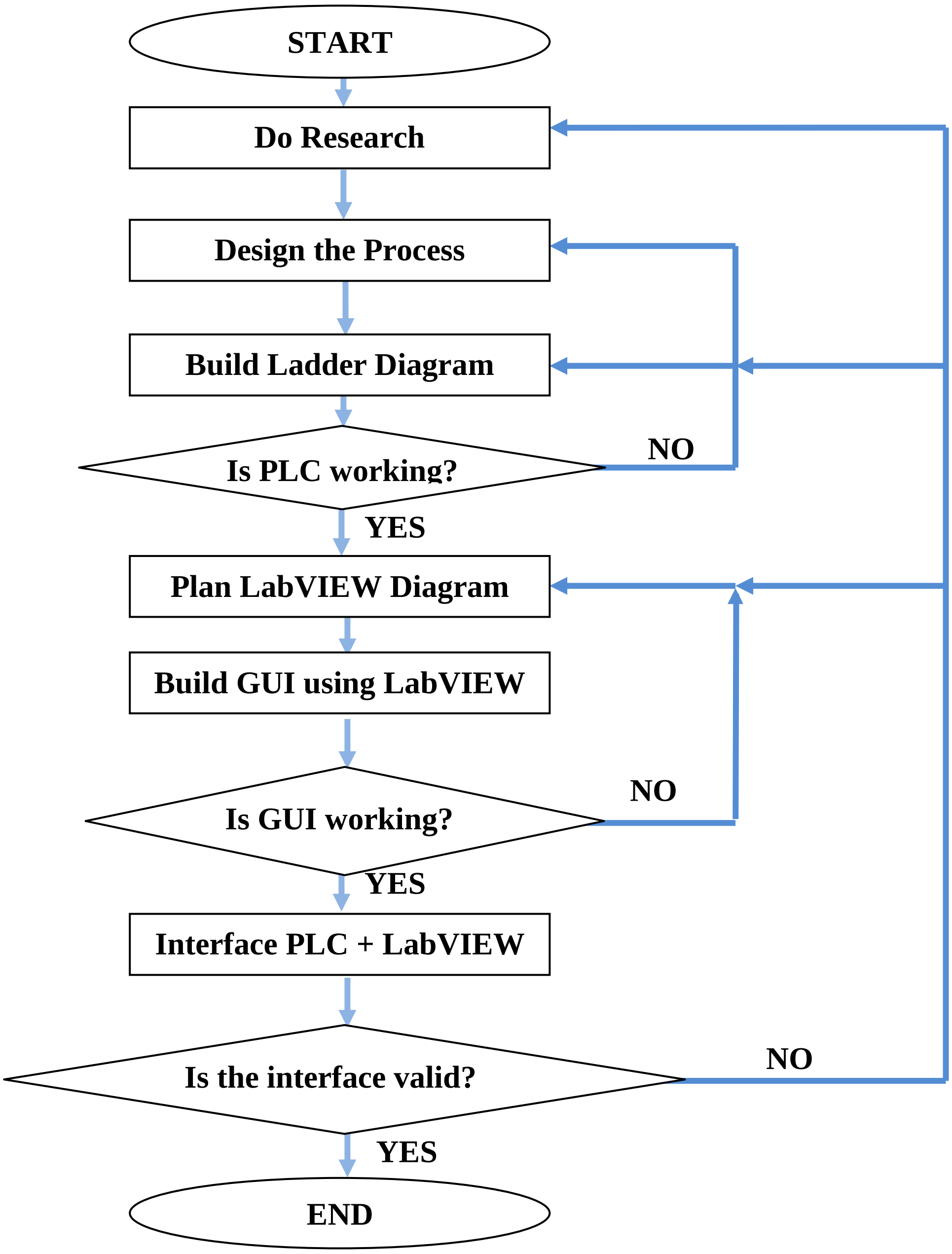

Figure 4:Procedure identification

To conduct this project, preliminary research is done using resources such as library books, web sites and technical papers from the internet. This includes learning LabVIEW tutorials which is really helps in understanding the software itself. After that, a plant process is created using equipment available in the lab. The next step is performing a full simulation of the system using Automation Studio to ensure that the system works smoothly before making the actual connection in the lab.

Next, ladder logic programming is developed using CX Programmer to control the plant process. This step is relatively the same programming used in the simulation using Automation Studio, however the addressing for the coils and contacts of the PLC input and output need to be referred to the respective PLC unit which is CQM1H. Lastly a series of software development, trial and improvements is made regularly to perfecting the remote monitoring software using LabVIEW. The procedure identification for this project is shown in Figure 4.

3.2 Gantt Chart Semester 1

No.	Detail/ Week	1	2	3	4	5	6	7		8	9	10	11	12	13	14
1	Selection of Project Topic	■	■						Mid-semester break							
2	Preliminary Research Work		■	■	■											
3	Submission of Preliminary Report		●													
4	Project Work					■	■	■								
5	Submission of Progress Report									●						
6	Seminar										●					
7	Project work continues										■	■	■	■		
8	Submission of Interim Report Final Draft														●	
9	Oral Presentation															●

● Milestone

■ Process

3.3 Gantt Chart Semester 2

No.	Detail/ Week	1	2	3	4	5	6	7		8	9	10	11	12	13	14
1	Project work continue	■	■	■	■	■	■	■	Mid-semester break							
2	Progress report 1		■	■	■ ●											
3	Progress report 2					■	■	■		■ ●						
4	Pre EDX													●		
5	EDX									●					●	
6	Project work continues									■	■	■	■			
7	Dissertation draft														■	■
8	Submission Report Final Draft															●

● Milestone

■ Process

3.4 PLC Elements

The elements of a programmable controller is referred to number of input and output that a plant process has, which is connected either directly or indirectly to the programmable controller. For this simple plant process, a pick & place loader system is used as shown in Figure 5.

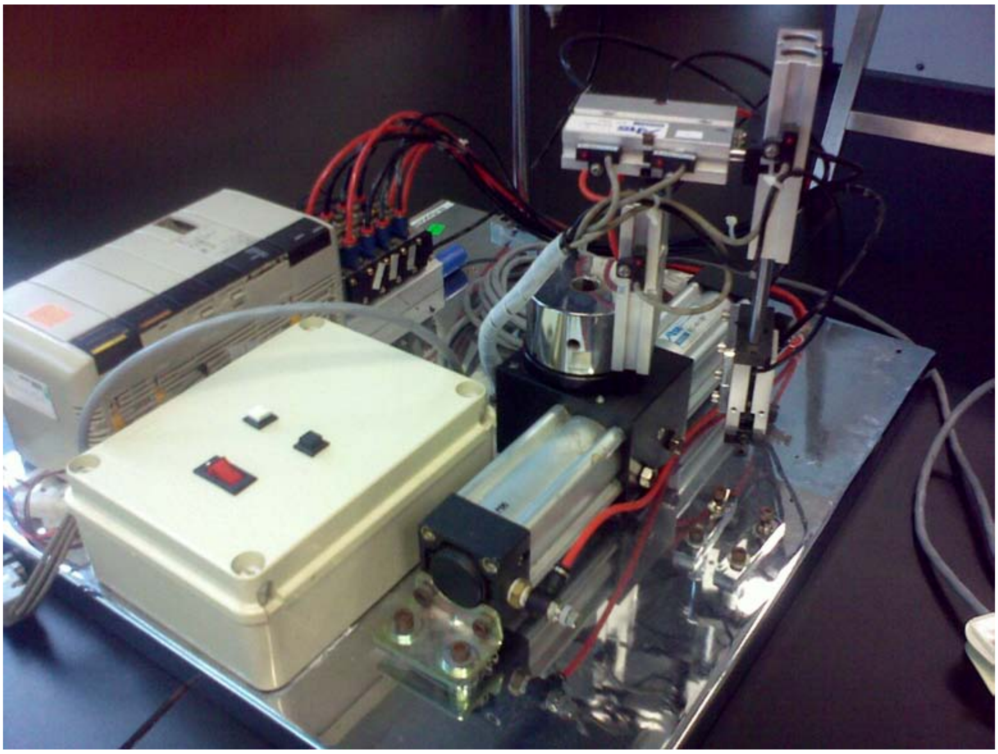

Figure 5: Pick & place loader

As seen in the figure, this is an electro pneumatic system which has seven inputs and six outputs as above. Two push buttons will give a command to stop or start the machine cycle. Five other inputs are proximity switches that determine the position of the cylinder.

The outputs of the system consist of five pneumatic cylinder including one rotary cylinder and one buzzer. This output will move according to the specified program which was uploaded earlier. Additional inputs and outputs such as push buttons and LEDs can be created using virtual instruments which will be mentioned later in this report.

The system is controlled using Omron CQM1H CPU 21 programmable logic controller with one input and one output card. Such modular type PLC is flexible as user can fit any additional module directly without having to pay any extra cost.

Mechanical and pneumatic functions are controlled using 5/2 solenoid valves. These valves response to the 24 volts DC signal send by the PLC to energize the coil. The movement of the valve will distribute the air pressure (pneumatic) to the cylinder. Air pressure can be regulated at each port using a manual air regulator. This will determine the speed of retract and return of the cylinder.

3.4 Software and Tools

There are several software and tools that are used to throughout the development of this project. The software assisted in preparing the ladder diagram, process simulation and software development while the hardware helps in running the actual testing and simulation.

3.4.1 CX Programmer 3.0

This software is used to develop the ladder logic programming for Omron CQM1H CPU 51 programmable logic controller.

3.4.2 Automation Studio 5.0

Simulation for the process and the ladder logic programming is done using automation studio. This software is capable of simulating pneumatic, hydraulic, virtual system, electro pneumatic, electro hydraulic and PLC circuits.

3.4.3 LabVIEW 8.6 Evaluation

Remote monitoring software is programmed and built using LabVIEW 8.6. Several toolkits such as Data logging and Supervisory Control (DSC) module and OPC Server also needed to complete the interfacing between PLC and LabVIEW.

3.4.4 Omron CQM1H CPU 51 PLC Training Kit

Real simulation and testing are done using CQM1H programmable logic controller. This training kit also includes pneumatic and electro pneumatic circuits which are needed to simulate the process defined in this project.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Ladder Diagram

During the ladder diagram programming process, some problem had occurred. Omron PLCs are very confusing in term of the addressing of the input, output and the internal relays. However throughout the experiment, the instructions list for Omron PLC retrieved from CX-Programmer really help in solving the problems. The programming error can be easily detected after compiling where a status window will define specifically the error and where it occurs in the program. Figure 6 shows an abstract from the full ladder diagram.

Figure 6:Ladder Diagram

4.2 Object Linking and Embedding For Process Control

To test if our linking process is functional, a new VI is created and Variable1 was dragged into the VI window. If we toggle the input to bit 1, the variable1 will turn the green light on. It means that linking OPC server with OPC client is linked successfully. Figure 7 is a simple test done to check its functionality

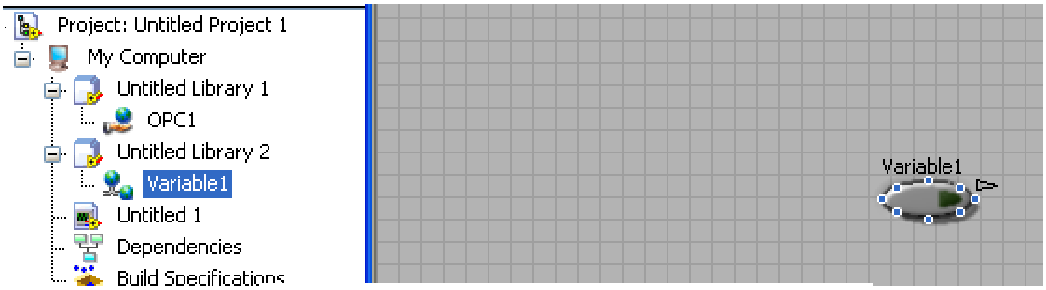

Figure 7: Testing linking functionality

4.3 EPROBOT Mini Programmable Board

To make sure the viability of the project for presentational purposes, a new system have been selected as the programmable board for monitoring purpose. This mobile board consists of Omron CQM1H CPU21, a junction box, four 5/2 directional valves, single rotary cylinder and four pneumatic cylinder. The full system is show in Figure 8 below.

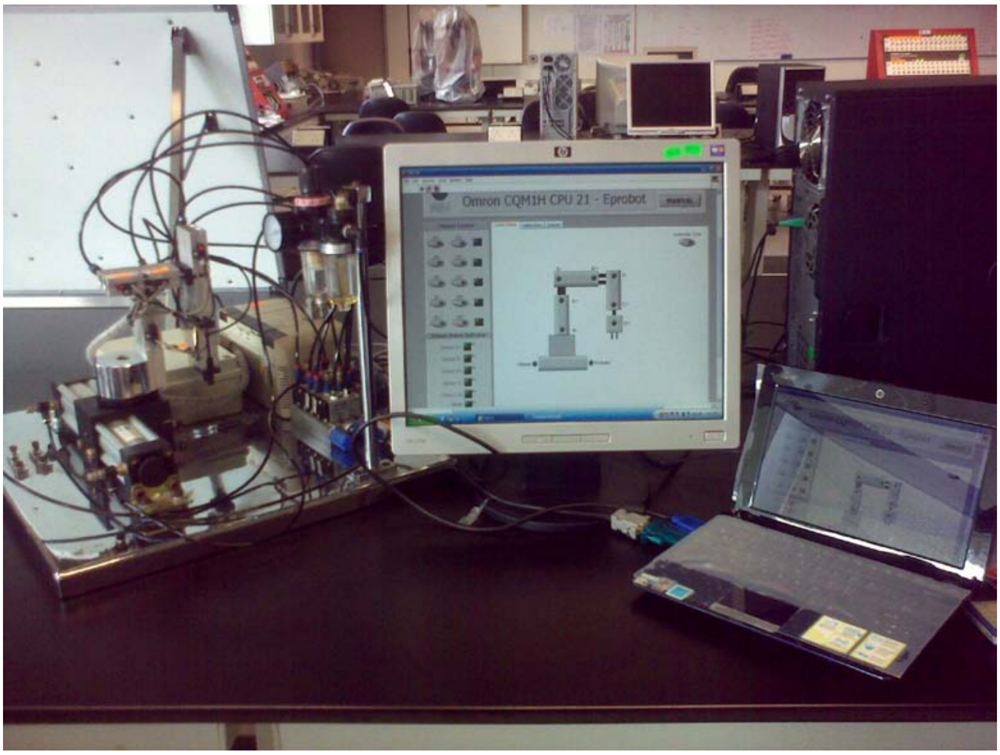

Figure 8: Eprobot

The EPROBOT is a training kit available in the lab that has not been used for quite some time. Rapid deterioration on all pneumatic tubing is visibly seen. Some of the fittings (connectors between tubing and actuator) also need to be replaced. Apart from all the problems, the PLC seems to be working perfectly. By replacing the tubing and connectors, the system were up and running again.

4.4 EPROBOT Simulation

Before any actual programming was made, a process simulation was simulated using Automation Studio. This will assist the actual programming in the future. The simulation involves simulating all inputs and outputs as in the actual system to create an actual program. After building the circuit in figure 9, those controlled element are connected to a virtual PLC I/O card and a virtual ladder diagram was also written in the same sheet and linked to each input and output.

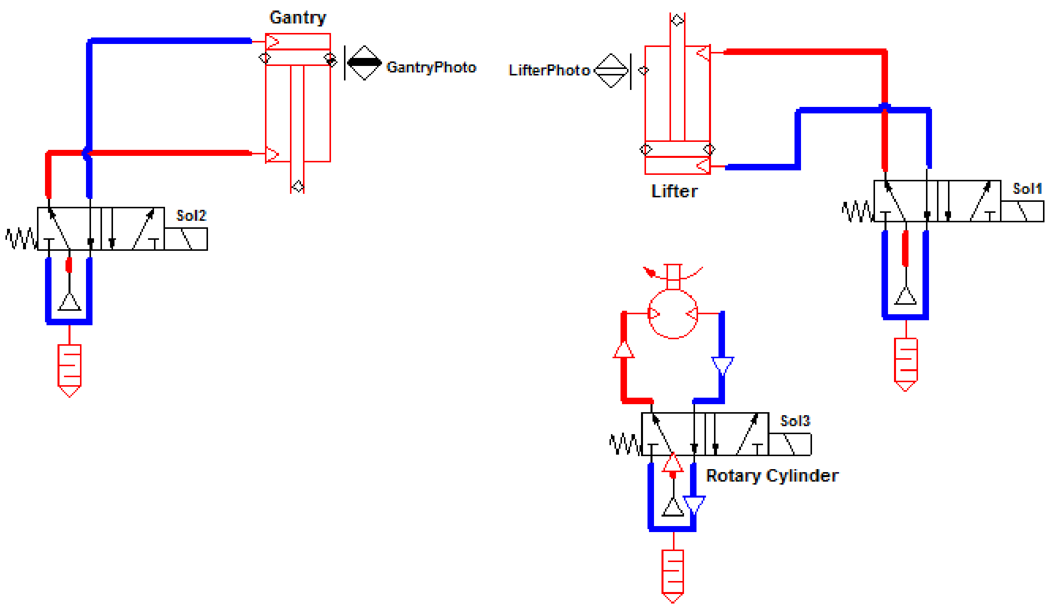

Figure 9: Simulation circuit

4.5Mean Time Between Failure (MTBF)

Mean Time Between Failure is the predicted period between inherent failures of a system during operation. MTBF helps to determine estimation between each system failure. This function in the software will help determine a general MTBF for the system in the future. This function can be seen in figure 10.

Failures may include wear and tear of the mechanical parts, deterioration of pneumatic tubing and electrical parts. A specific MTBF for each criterion can be done to get a precise estimation for the MTBF. By estimating MTBF, costs of maintenance can be reduce significantly where problems can be corrected before it damages the equipment. The calculation involves simple mathematical equation as seen below:

$$FR(\%) = \frac{Number\ of\ Failures}{Number\ of\ Units\ Tested} \times 100 \qquad [1]$$

$$FR(N) = \frac{Number\ of\ Failures}{Number\ of\ Unit - hours\ of\ operation\ time} \qquad [2]$$

$$MTBF = \frac{1}{FR(N)} \qquad [3]$$

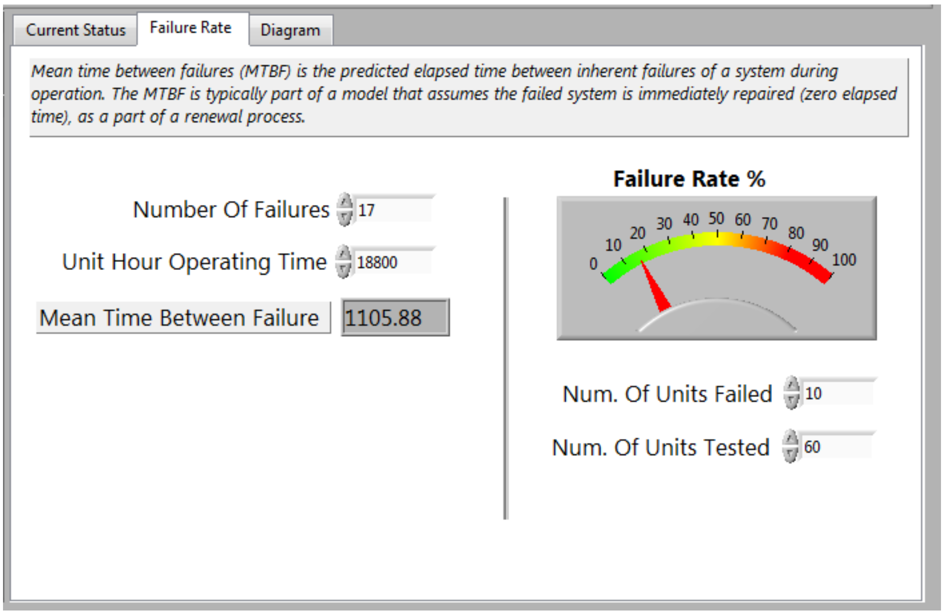

Figure 10: MTBF and failure rate

4.6Final Interface

The final interface seen in figure 11 below is the finished interface that had been done. This interface include an automatic cycle button to trigger a continuous cycle similar to a physical push button at the Eprobot but unlike the push button, the this button only need to be push once to run an unlimited cycle. An emergency is use to cut the cycle.

A manual control column is necessary to set and reset the condition of a cylinder. Once the main manual button is pressed, all the functions in this column will be activated. The current state diagram indicates the current location of the system. To detect the condition of the sensors, a sensor status indicator will lit as soon as it is triggered.

Any error will be detected when the system is not responding to any inputs at the interface. To aid wiring in the future, a system diagram showing the proper connection of the PLC is included in the Diagram tab.

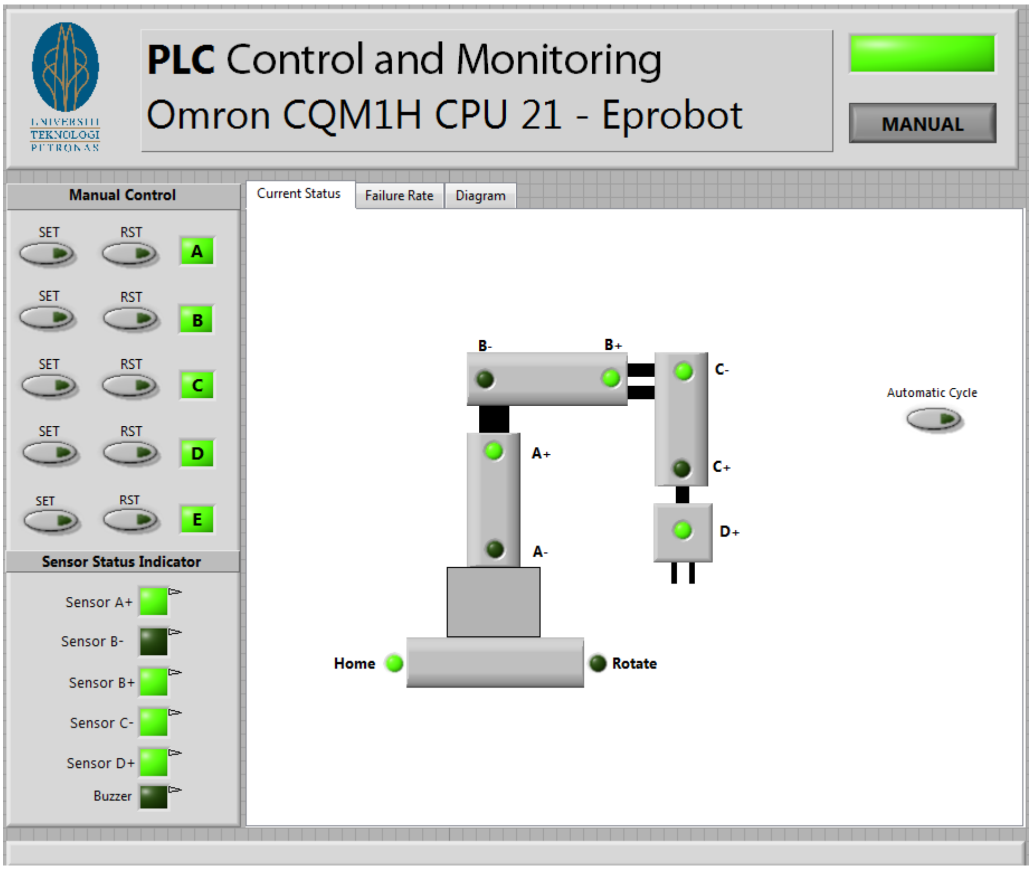

Figure 11: Graphical User Interface

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The contributions of this project are creating a user friendly interface to remotely monitor and control a PLC system by generating a LabVIEW-compatible PLC ladder logic programming. This project also manipulates Omron Host Link to be coupled with OPC and LabVIEW. The knowledge of reading and writing the PLC memory through LabVIEW graphical programming language is crucial in order to control the functions.

The main objectives of this project had been successfully achieved. It is capable of assisting maintenance activities through faster problem detection. A broken mechanical part will cause the manual set reset button become unusable. Faster problem detection and MTBF estimation also led to lower downtime rate thus increasing the productivity of the system.

Remote control and monitoring software reduces the health and safety risk in industrial environment. Lower accidents can bring down the cost of employees' health care costs and increase their morale by avoiding the accidents from happening.

Last but not least, the system also possessed all the advantages of a PC-based control system. By creating a virtual PLC or controlling it remotely, the PLC can manipulate the unlimited PC memory, processing speed and multitasking capabilities that a superior personal computer (PC) has.

5.2 Recommendations

The GUI developed for this project can be further improved in the future. It can be enhanced with a user authentication that only allowed certified personnel to control it. It also needs to have a data trending system that can store data and faults as it can be very useful for future references.

The user may want to change the ladder diagram in the PLC using the same software, so this GUI needs to come up with its own programming language that is far easier to use than a ladder diagram. This can make the GUI more user friendly in the future.

A major achievement of this project is when it is viable to be implemented into the real industrial process. A more advance programming may include an integration of inputs to control the PLC. This may include Plug-and-Play features for the software to be ready any time for any type of PLC.

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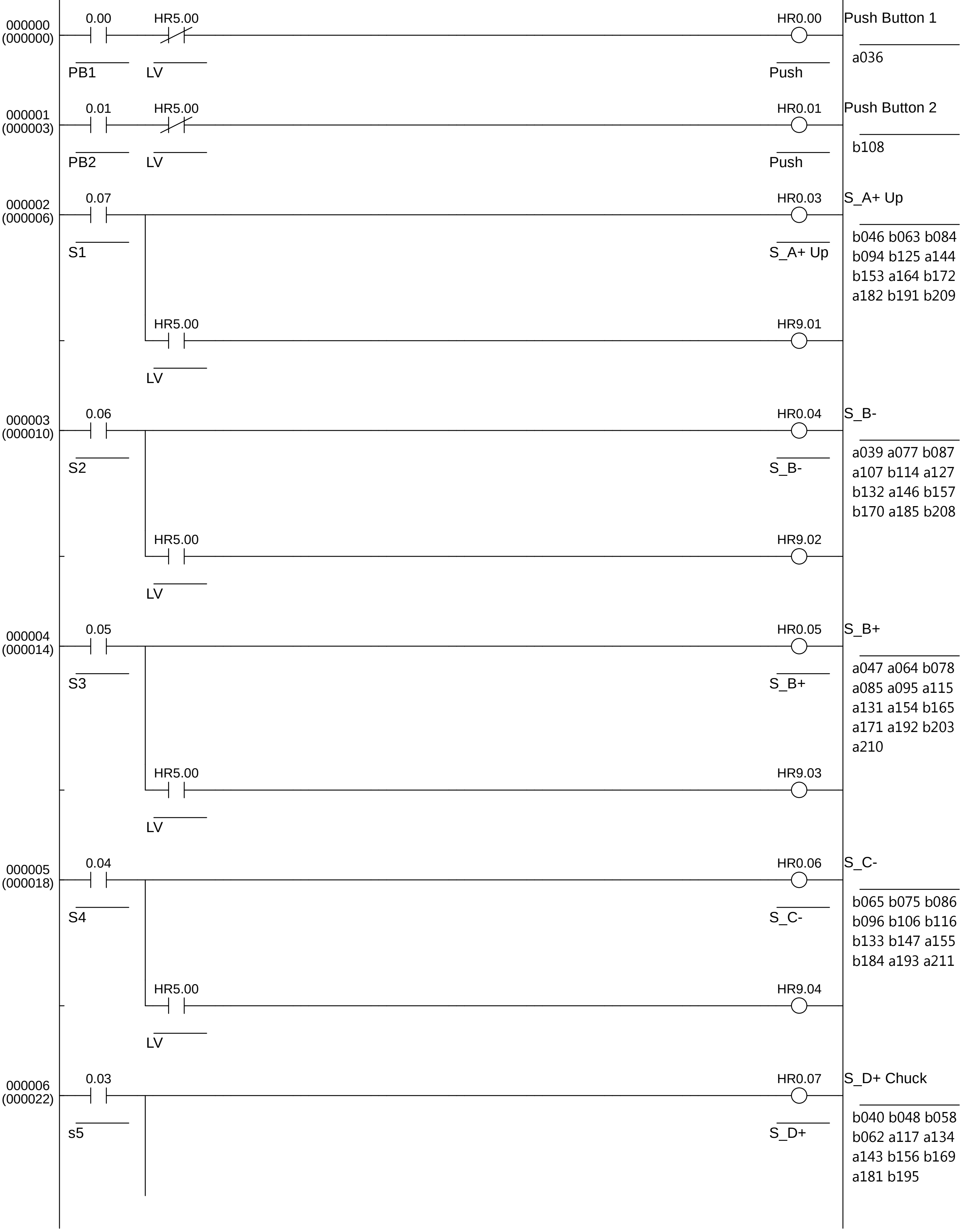
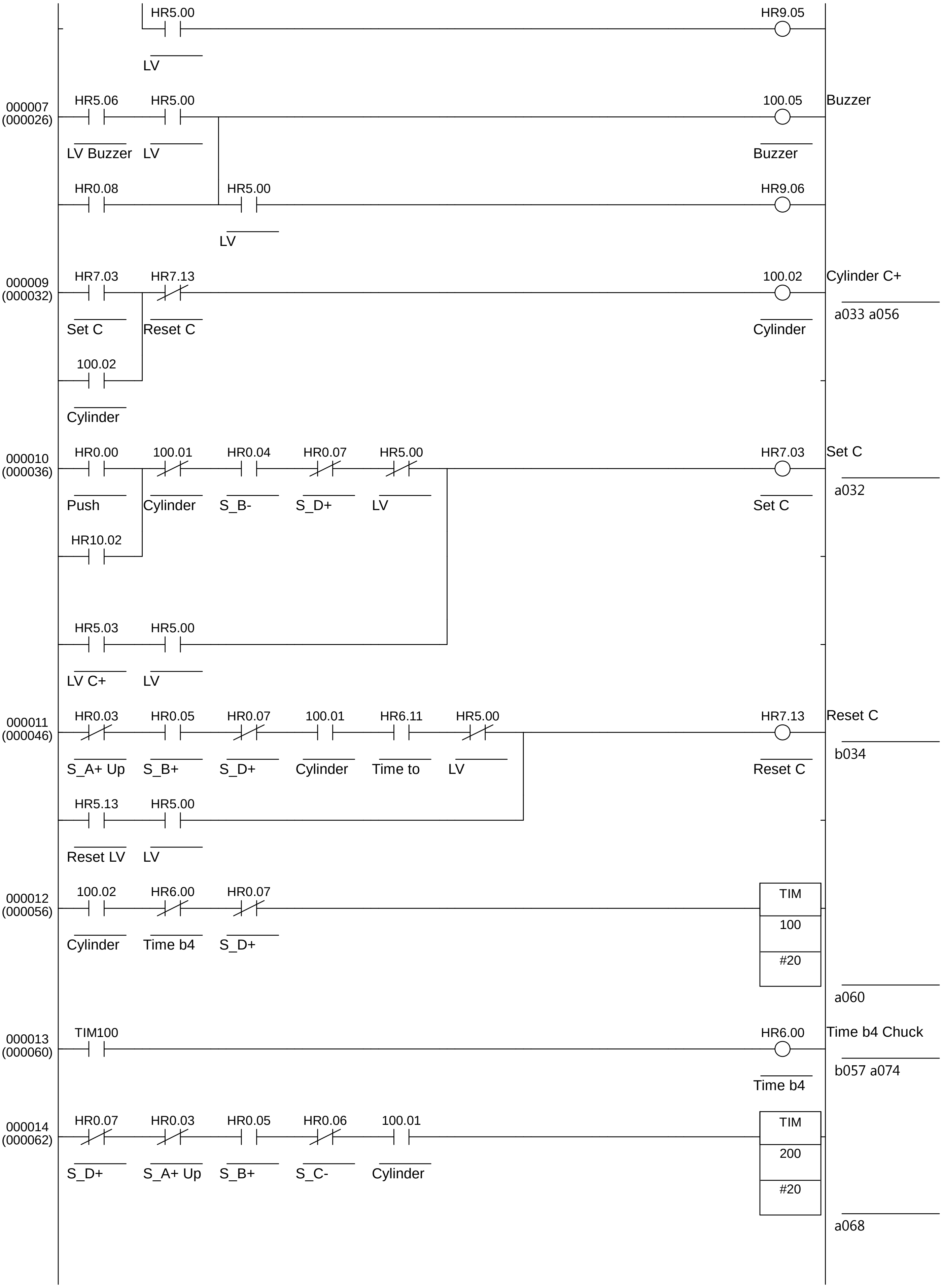
APPENDICES

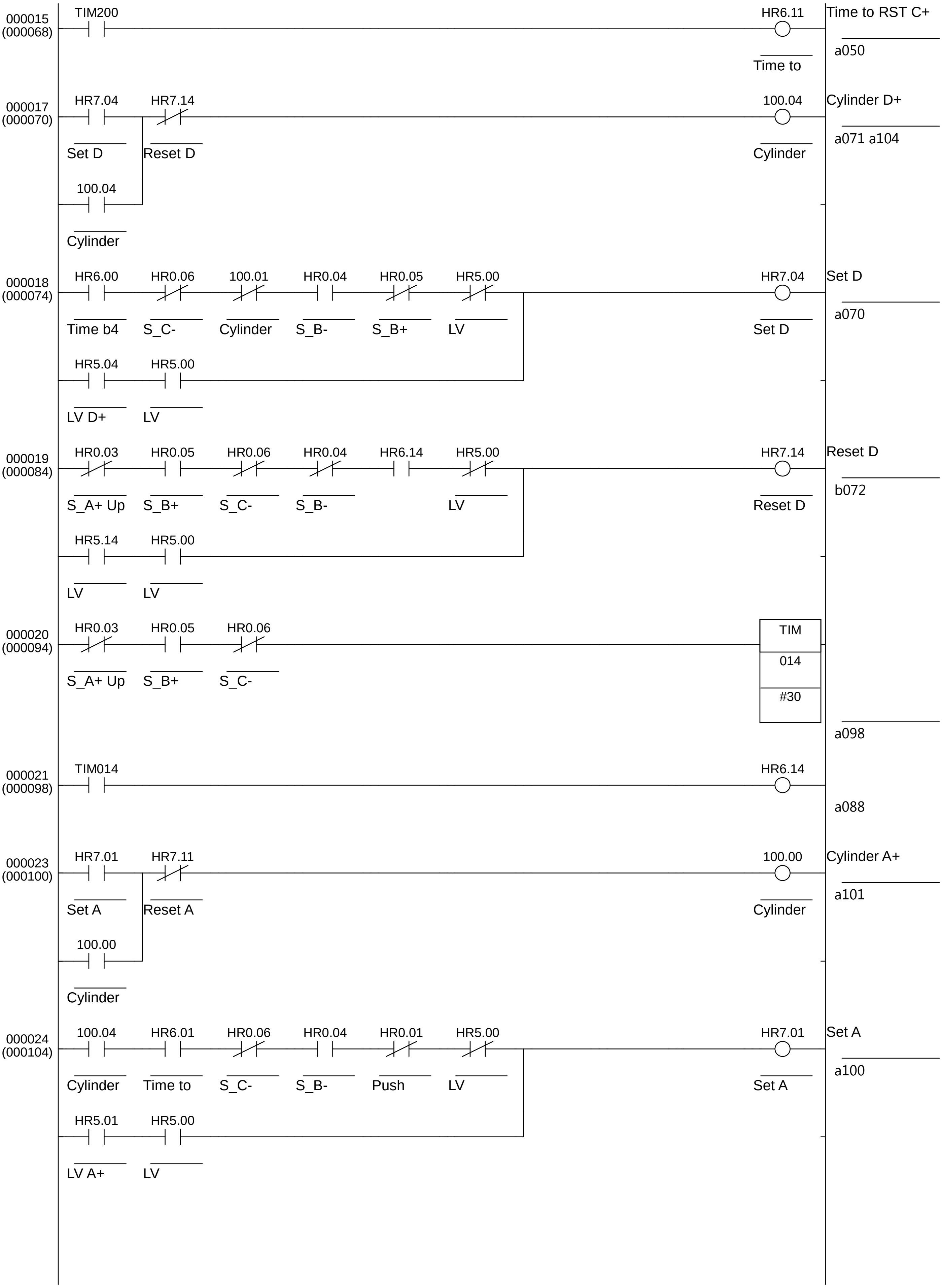
[Program Name : Section1]

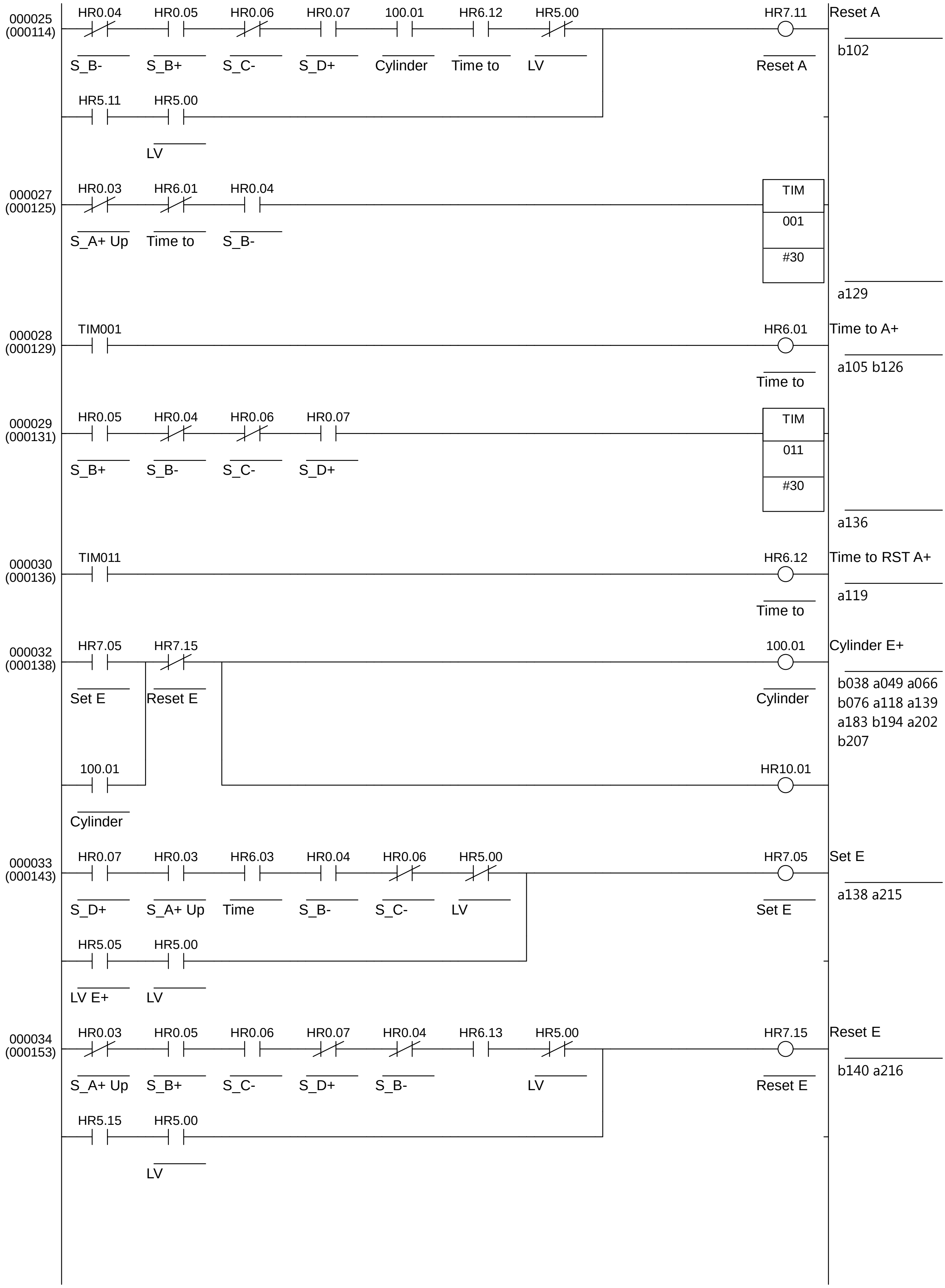
[Section Name : Section1]

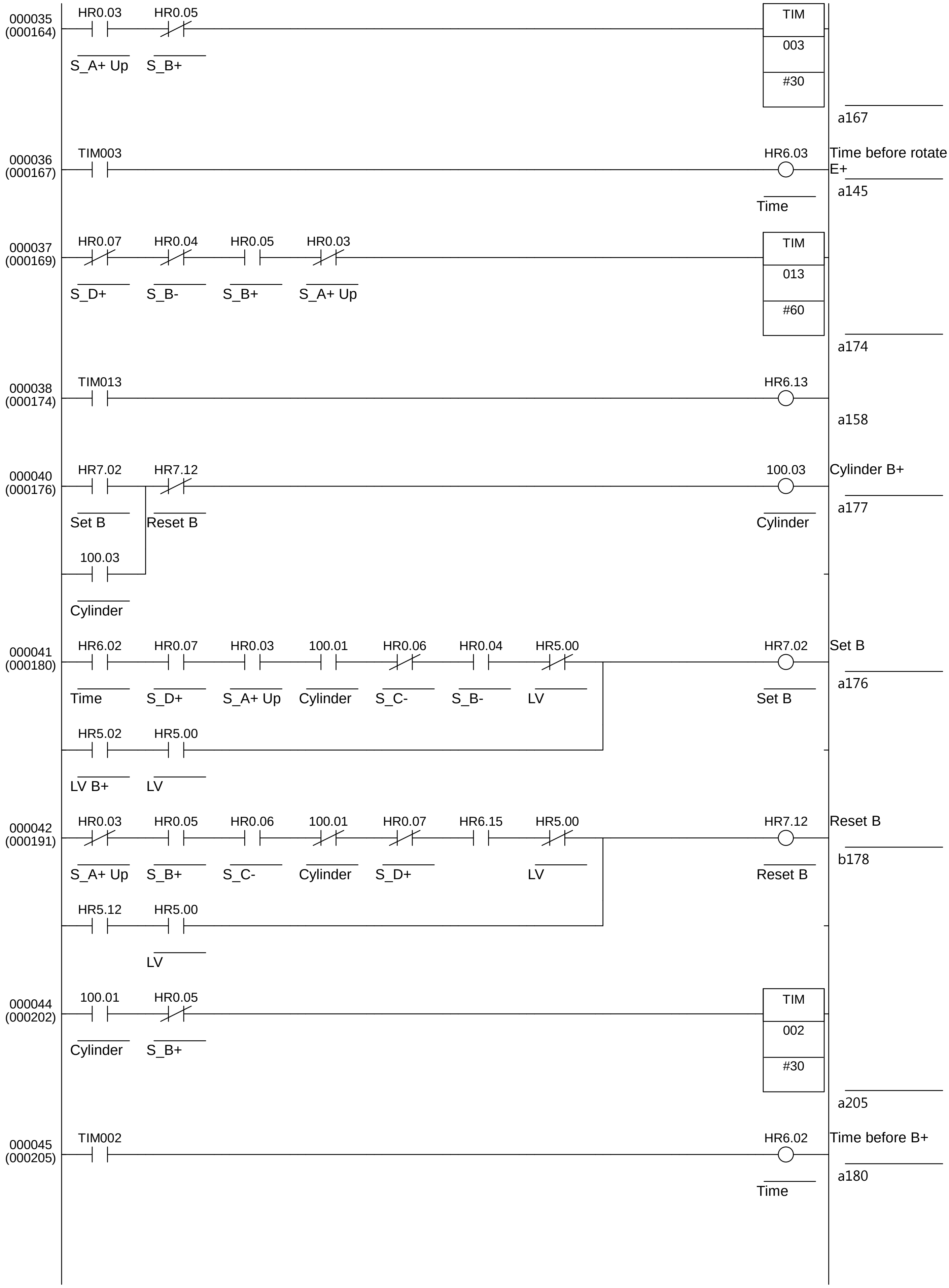




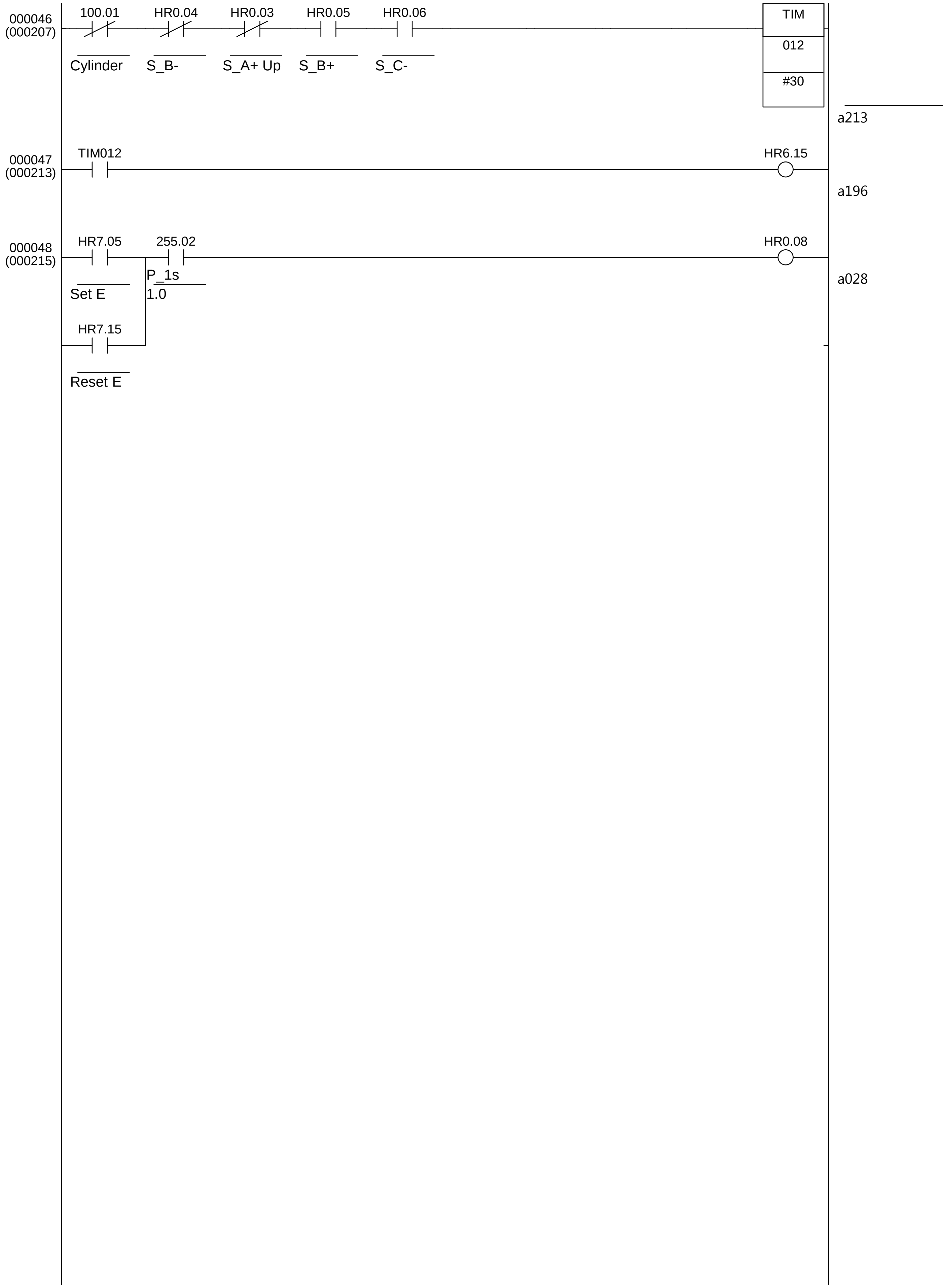
HR5.00
LV
HR9.05
000007
(000026)
HR5.06
LV Buzzer
HR5.00
LV
100.05
Buzzer
Buzzer
HR0.08
HR5.00
LV
HR9.06
000009
(000032)
HR7.03
Set C
HR7.13
Reset C
100.02
Cylinder
Cylinder C+
a033 a056
100.02
Cylinder
000010
(000036)
HR0.00
Push
100.01
Cylinder
HR0.04
S_B-
HR0.07
S_D+
HR5.00
LV
HR7.03
Set C
Set C
a032
HR10.02
HR5.03
LV C+
HR5.00
LV
000011
(000046)
HR0.03
S_A+ Up
HR0.05
S_B+
HR0.07
S_D+
100.01
Cylinder
HR6.11
Time to
HR5.00
LV
HR7.13
Reset C
Reset C
b034
HR5.13
Reset LV
HR5.00
LV
000012
(000056)
100.02
Cylinder
HR6.00
Time b4
HR0.07
S_D+
TIM
100
#20
a060
000013
(000060)
TIM100
HR6.00
Time b4
Time b4 Chuck
b057 a074
000014
(000062)
HR0.07
S_D+
HR0.03
S_A+ Up
HR0.05
S_B+
HR0.06
S_C-
100.01
Cylinder
TIM
200
#20
a068

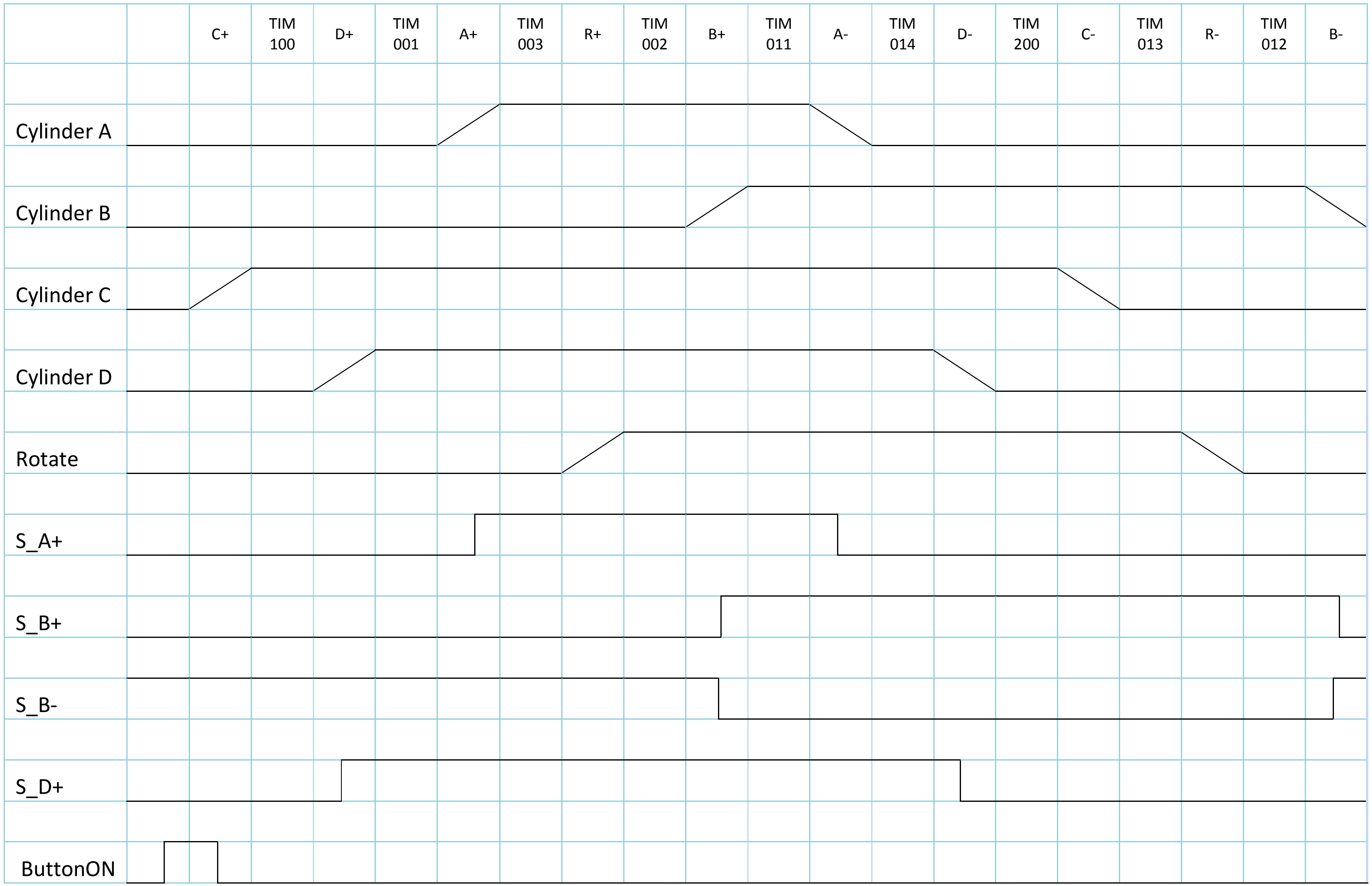

000015 (000068)
TIM200
HR6.11
Time to
Time to RST C+
a050
000017 (000070)
HR7.04
Set D
HR7.14
Reset D
100.04
Cylinder
100.04
Cylinder
Cylinder D+
a071 a104
000018 (000074)
HR6.00
Time b4
HR0.06
S_C-
100.01
Cylinder
HR0.04
S_B-
HR0.05
S_B+
HR5.00
LV
HR5.04
LV D+
HR5.00
LV
HR7.04
Set D
Set D
a070
000019 (000084)
HR0.03
S_A+ Up
HR0.05
S_B+
HR0.06
S_C-
HR0.04
S_B-
HR6.14
HR5.00
LV
HR5.14
LV
HR5.00
LV
HR7.14
Reset D
Reset D
b072
000020 (000094)
HR0.03
S_A+ Up
HR0.05
S_B+
HR0.06
S_C-
TIM
014
#30
a098
000021 (000098)
TIM014
HR6.14
a088
000023 (000100)
HR7.01
Set A
HR7.11
Reset A
100.00
Cylinder
100.00
Cylinder
Cylinder A+
a101
000024 (000104)
100.04
Cylinder
HR6.01
Time to
HR0.06
S_C-
HR0.04
S_B-
HR0.01
Push
HR5.00
LV
HR5.01
LV A+
HR5.00
LV
HR7.01
Set A
Set A
a100

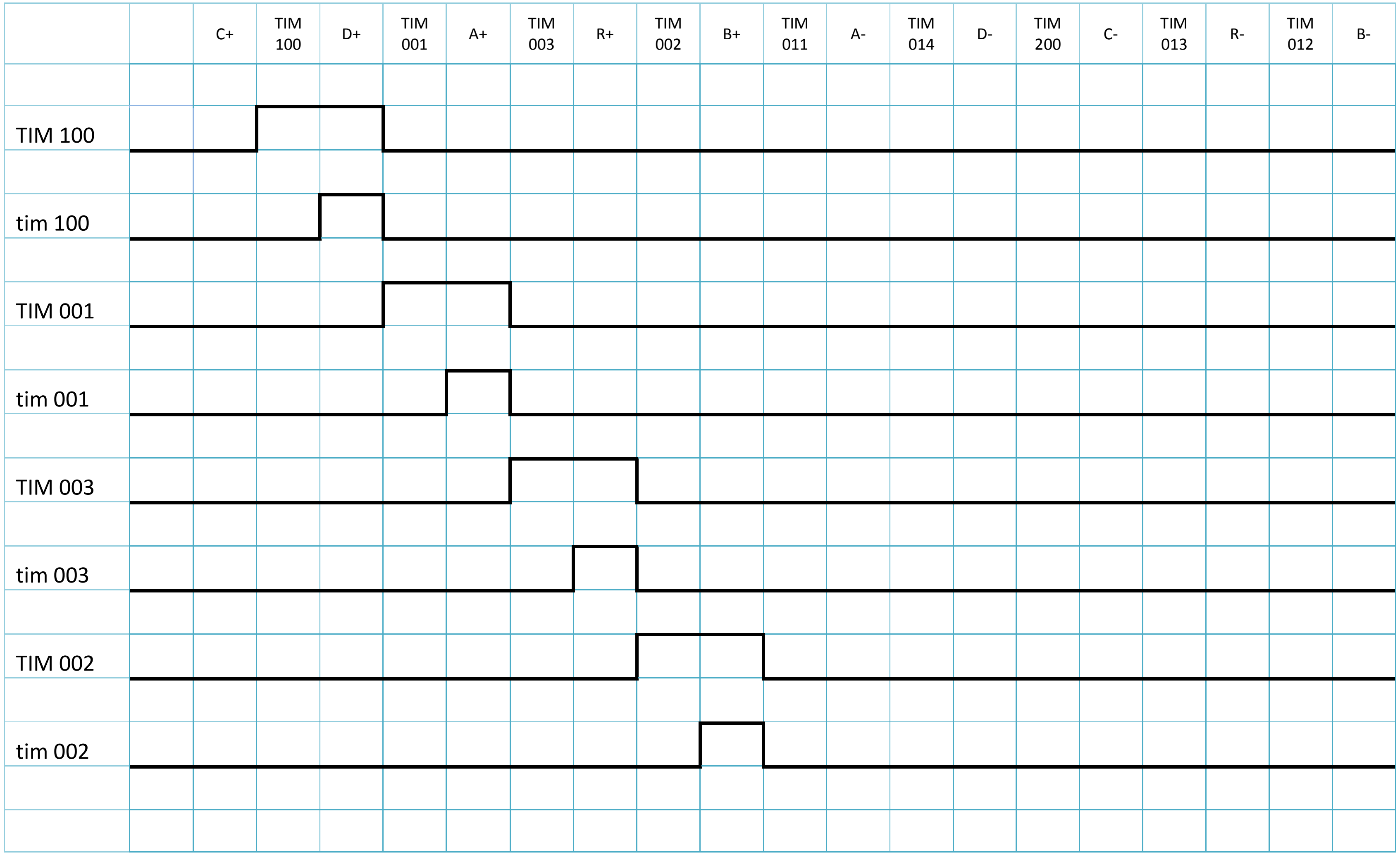

000025
(000114)
HR0.04 S_B-
HR0.05 S_B+
HR0.06 S_C-
HR0.07 S_D+
100.01 Cylinder
HR6.12 Time to
HR5.00 LV
HR7.11 Reset A
Reset A
b102
HR5.11
HR5.00 LV
000027
(000125)
HR0.03 S_A+ Up
HR6.01 Time to
HR0.04 S_B-
TIM
001
#30
a129
000028
(000129)
TIM001
HR6.01 Time to
Time to A+
a105 b126
000029
(000131)
HR0.05 S_B+
HR0.04 S_B-
HR0.06 S_C-
HR0.07 S_D+
TIM
011
#30
a136
000030
(000136)
TIM011
HR6.12 Time to
Time to RST A+
a119
000032
(000138)
HR7.05 Set E
HR7.15 Reset E
100.01 Cylinder
Cylinder E+
b038 a049 a066
b076 a118 a139
a183 b194 a202
b207
100.01 Cylinder
HR10.01
000033
(000143)
HR0.07 S_D+
HR0.03 S_A+ Up
HR6.03 Time
HR0.04 S_B-
HR0.06 S_C-
HR5.00 LV
HR7.05 Set E
Set E
a138 a215
HR5.05 LV E+
HR5.00 LV
000034
(000153)
HR0.03 S_A+ Up
HR0.05 S_B+
HR0.06 S_C-
HR0.07 S_D+
HR0.04 S_B-
HR6.13
HR5.00 LV
HR7.15 Reset E
Reset E
b140 a216
HR5.15
HR5.00 LV

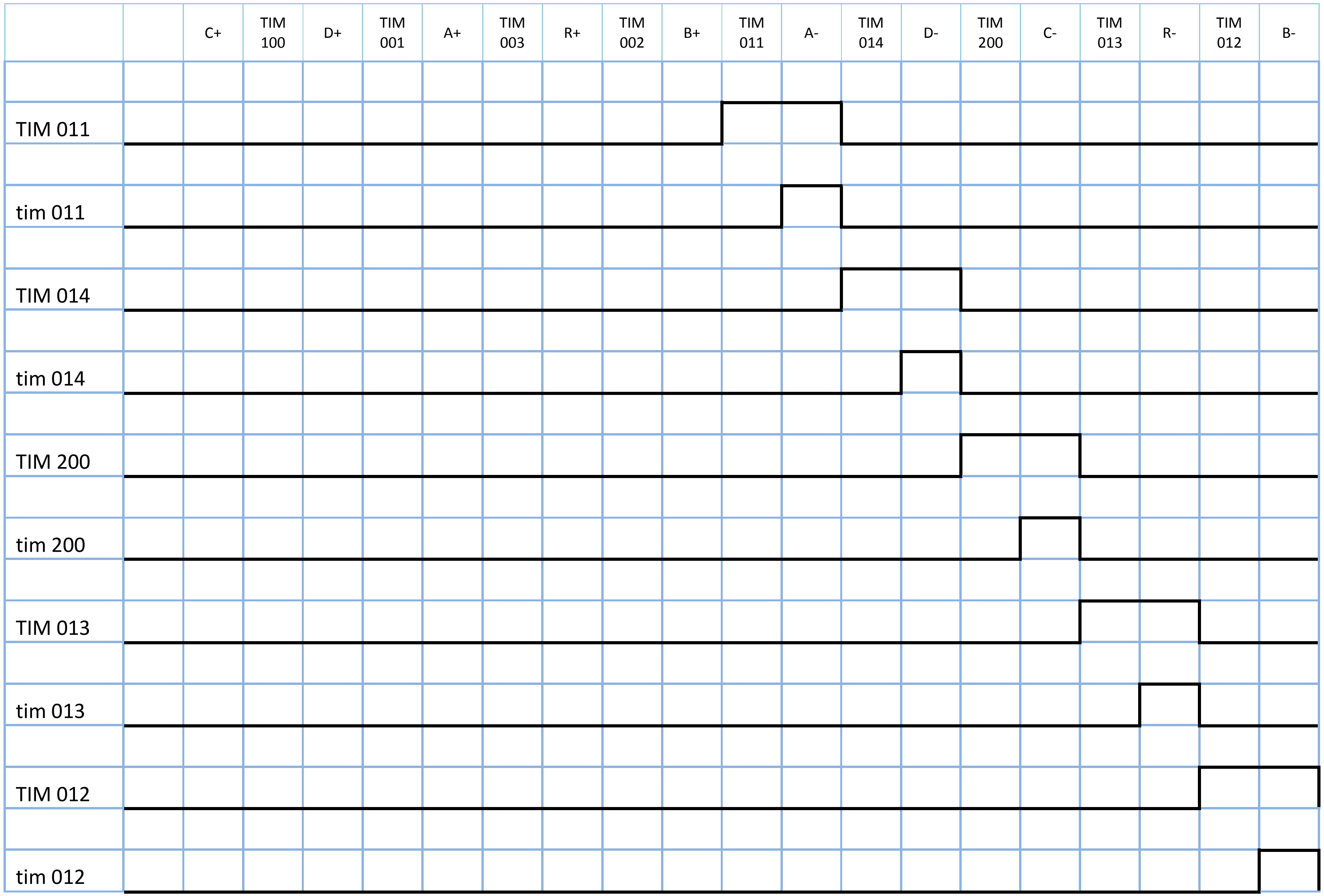


000035 (000164)
HR0.03 S_A+ Up
HR0.05 S_B+
TIM 003 #30
a167
000036 (000167)
TIM003
HR6.03 Time
Time before rotate E+
a145
000037 (000169)
HR0.07 S_D+
HR0.04 S_B-
HR0.05 S_B+
HR0.03 S_A+ Up
TIM 013 #60
a174
000038 (000174)
TIM013
HR6.13
a158
000040 (000176)
HR7.02 Set B
HR7.12 Reset B
100.03 Cylinder
Cylinder B+
a177
100.03 Cylinder
000041 (000180)
HR6.02 Time
HR0.07 S_D+
HR0.03 S_A+ Up
100.01 Cylinder
HR0.06 S_C-
HR0.04 S_B-
HR5.00 LV
HR7.02 Set B
Set B
a176
HR5.02 LV B+
HR5.00 LV
000042 (000191)
HR0.03 S_A+ Up
HR0.05 S_B+
HR0.06 S_C-
100.01 Cylinder
HR0.07 S_D+
HR6.15
HR5.00 LV
HR7.12 Reset B
Reset B
b178
HR5.12
HR5.00 LV
000044 (000202)
100.01 Cylinder
HR0.05 S_B+
TIM 002 #30
a205
000045 (000205)
TIM002
HR6.02 Time
Time before B+
a180


000046
(000207)
100.01
HR0.04
HR0.03
HR0.05
HR0.06
Cylinder
S_B-
S_A+ Up
S_B+
S_C-
TIM
012
#30
a213
000047
(000213)
TIM012
HR6.15
a196
000048
(000215)
HR7.05
255.02
HR0.08
Set E
P_1s
1.0
a028
HR7.15
Reset E


C+
TIM 100
D+
TIM 001
A+
TIM 003
R+
TIM 002
B+
TIM 011
A-
TIM 014
D-
TIM 200
C-
TIM 013
R-
TIM 012
B-
Cylinder A
Cylinder B
Cylinder C
Cylinder D
Rotate
S_A+
S_B+
S_B-
S_D+
ButtonON


C+
TIM 100
D+
TIM 001
A+
TIM 003
R+
TIM 002
B+
TIM 011
A-
TIM 014
D-
TIM 200
C-
TIM 013
R-
TIM 012
B-
TIM 100
tim 100
TIM 001
tim 001
TIM 003
tim 003
TIM 002
tim 002


C+
TIM 100
D+
TIM 001
A+
TIM 003
R+
TIM 002
B+
TIM 011
A-
TIM 014
D-
TIM 200
C-
TIM 013
R-
TIM 012
B-
TIM 011
tim 011
TIM 014
tim 014
TIM 200
tim 200
TIM 013
tim 013
TIM 012
tim 012

OPC Variable Tags (CSV file format)

Tag Name	Address	Data Type	Respect Da	Client Acce	Scan Rate	Scaling	Raw Low	Raw High	Scaled Low	Scaled High	Scaled Data	Clamp Low	Clamp High	Eng Units	Description
Buzzer	HR005.06	Boolean	1	R/W	100										Buzzer
Buzzer Ind	HR009.06	Boolean	1	R/W	100										Buzzer Indicator
Cond E	HR010.01	Boolean	1	R/W	100										Condition of E
Cylinder A+	HR005.01	Boolean	1	R/W	100										Cylinder A Retracts
Cylinder B+	HR005.02	Boolean	1	R/W	100										Cylinder B Retracts
Cylinder C+	HR005.03	Boolean	1	R/W	100										Cylinder C Retracts
Cylinder D-	HR005.04	Boolean	1	R/W	100										Cylinder D Retracts
Manual	HR005.00	Boolean	1	R/W	100										Determines The Manual Mode is selected
Remote Au	HR010.02	Boolean	1	R/W	100										Automatic Continuous Cycle
Rotary Cyli	HR005.05	Boolean	1	R/W	100										Rotary Cylinder rotates
RST A	HR005.11	Boolean	1	R/W	100										Cylinder A Reset
RST B	HR005.12	Boolean	1	R/W	100										Cylinder B Reset
RST C	HR005.13	Boolean	1	R/W	100										Cylinder C Reset
RST D	HR005.14	Boolean	1	R/W	100										Cylinder D Reset
RST E	HR005.15	Boolean	1	R/W	100										Cylinder E Reset
Sensor A+	HR009.01	Boolean	1	R/W	100										S_A+
Sensor B-	HR009.02	Boolean	1	R/W	100										S_B-
Sensor B+	HR009.03	Boolean	1	R/W	100										S_B+
Sensor C-	HR009.04	Boolean	1	R/W	100										S_C-
Sensor D+	HR009.05	Boolean	1	R/W	100										S_D+