Foundation Fieldbus Interoperability Test, System Configuration and Loop Design-(EMERSON)

by

Syaza Othman

Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Engineering (Hons)
(Electrical and Electronics Engineering)

DECEMBER 2009

Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

FOUNDATION Fieldbus Interoperability Testing (FFIT). System Configuration and Loop Design

by

Syaza Othman

A project dissertation submitted to the
Electrical and Electronics Engineering
Universiti Teknologi PETRONAS
in partial fulfilment of the requirement for the
BACHELOR OF ENGINEERING (Hons)
(ELECTRICAL AND ELECTRONICS ENGINEERING)

Approved by,

(Dr. Nordin b Saad)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

DECEMBER 2009

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.

SYAZA OTHMAN (7659)

ABSTRACT

This report discusses the progress work that has been done Foundation Fieldbus Interoperability Test (FFIT) System Configuration and Loop Design for Emerson Host. In this report, several researches on fieldbus system and the needs of interoperability testing and loop design are briefly discussed as well as the continuation of testing work from FYP 1(Basic Test).

This project is aligned with the FFIT SKG 14th team project from PETRONAS. All the standard testing procedures and results is documented for future review. This project requires a deep understanding on the fieldbus technology which includes the study on fieldbus technology architecture, wiring, control system and communication network. From the testing, Foundation Fieldbus system for Emerson Host is found to be interoperability which means the system can communicate not just within it self but also with instruments from other vendors. The results of the testing are discussed briefly in Chapter 4.

ACKNOWLEDGEMENT

Thank you God Almighty for the successfulness of this project. First of all, I would like to express my deepest gratitude to my supervisor, AP Dr. Nordin Saad for the trust and support that he gave throughout completing this Final Year Project and to my beloved family for the understanding, thank you.

I would like to thank all the PETRONAS GTS Engineers for the respective professionalism and contribution in making this project a success. My deepest appreciation to all the Universiti Teknologi PETRONAS lab technologies for the helps and ideas especially to the Electrical and Electronics department, and the university as the whole for the opportunity that have been given. Not to be forgotten, my great appreciation to all the vendors and manufacturers especially form Emerson, Yokogawa, Honeywell and Foxboro for the knowledge that they shared.

I would also like to take this opportunity to thank everyone for their continuous support especially my colleagues and fellow friends. These elements have successfully assisted me to do my best and effort in upholding the individual learning spirit during my final year in UTP. Thank you once again to everyone involved.

TABLE OF CONTENTS

CERTIFICATION..ii

ABSTRACT..iv

ACKNOWLEDGEMENT.. v

CHAPTER 1:	**INTRODUCTION**	2
	1.1 Background of Study	2
	1.2 Problem Statement	3
	1.3 Significant of Project	3
	1.4 Objective and Scope of Study	4
CHAPTER 2:	**LITERATURE REVIEW**	5
	2.1 What is Fieldbus?	5
	2.2 FOUNDATION Filedbus	6
	2.3 The Type of Test	12
CHAPTER 3:	**METHODOLOGY/PROJECT WORKS**	14
	3.1 Methodology	14
	3.2 Tools and Equipment	16

CHAPTER 4: **RESULT AND DISCUSSION**.................................19

4.1 Basic Test...19

4.1.1 Device Commissioning.............................19

4.1.2 Online Device Replacement.........................21

4.1.3 Calibration Function Check.........................23

4.2 Loop Design...25

CHAPTER 5: **CONCLUSION AND RECOMMENDATION**..............26

5.1 Conclusion...26

5.2 Recommendation...27

REFERENCES..29

APPENDICES..30

LIST OF FIGURES

Figure 1: Home Run Cable..6
Figure 2: Fieldbus Cable...6
Figure 3: Foundation Fieldbus Topology..7
Figure 4: The Communication Layers of FOUNDATION Fieldbus...................9
Figure 5: Methodology of Basic Test...13
Figure 6: The Methodology in Designing Control Loop................................14
Figure 7: External Instruments Assembly Layout at Building 23......................15
Figure 8: Network Architecture of Fieldbus System at UTP............................17
Figure 9: Device Status before Partial Download...18
Figure 10: Pop-up Wizard While Downloading the Segment...........................19
Figure 11: Alarm While Downloading the Segment..19
Figure 12: Device Status after Partial Download...21
Figure 13: Fieldbus Device Replacement Wizard..21
Figure 14: Loop Design for Level and Flow Control Plant..............................25

LIST OF TABLE

Table 1: Segment 1 Instrumentation List....16

Table 2: Segment 2 Instrumentation List....16

Table 3: Summary of Alarm Warning During Device Commissioning....20

Table 4: Summary of Online Device Replacement....22

Table 5: Calibration Function Check Using Host....24

Table 6: Calibration Function Check Using 375 Communicator....25

CHAPTER 1

INTRODUCTION

1.1 Background of Study

In a process control system, 4-20 mA technology is widely used which needs each device connects to computer control via its own cable and communication point at the controller level. In this recent year, Fieldbus technology has emerged and will be replacing the previous 4-20 mA technology. Fieldbus is an industrial network system for real-time distributed control which used microprocessor based control. It is two ways multi-drop communication among the intelligent and control devices and automation and display system. The idea of fieldbus was proposed to solve problems such as proprietary protocols, slow transmission rate and different data formats. With Fieldbus technology, various devices from different manufacturers and vendors can communicate via the same language.

Thus, the need of Interoperability Testing is to ensure that the end used will not faced any difficulties or problem regarding to communication between devices from various manufacturer/ vendor such as Emerson, Yokogawa, Honeywell or Foxboro. This project also aims to provide a simple loop design using EMERSON configuration for brief familiarization to the fieldbus system for scientific researchers and engineers, as foundation for further development for either laboratory or industrial applications and testing. Because of several tests need to be carried out, Foundation Fieldbus system have been installed in Universiti Teknologi Petronas (UTP) process lab. All testing and maintenance of the system will be performed in UTP (together with vendors, contractors and SKG 14 team projects). All FFTF equipment confirms to IEC 801, EN 50081-2 and EN 50083-2 requirements for Electromagnetic Compatibility (EMC) [1] [2] [3].

1.2 Problem Statement

The interoperability of FOUNDATION Fieldbus is a communication between different devices to host from several manufacturers or vendors. Fieldbus technology is claimed to be interoperability and can replaced the recent 4-20 mA technology [8]. Furthermore since the main objective of fieldbus technology is to overcome the problem in current computer connection in term of the slow speed of transmission rate, propriety protocol and data format, several testing need to be done to ensure the real performance of this system. The design loop will be introduced in this project that might be beneficial to author to understand the whole system and also beneficial for further research.

The outcome of the tests will become the reference to the production of a PETRONAS approved list for FOUNDATION Fieldbus system and field devices. This will involve verification of open standard using several tests

1.3 Significance of Project

Upon completion of the research and testing, the final results would be used as reference in formulating test procedures and standard for implementation in PETRONAS Group-wide. The testing and calculation will determine the performance of the Foundation Fieldbus system.

This project is a continuation of previous testing and performance evaluation on the Fieldbus Interoperability Test (FFIT). However, for this project, new design loop will be introduced and tried. A comprehensive technical report on the FFIT will be the outcome of this project.

1.4 Objective and Scope of Study

Objective

1. To assist the SKG 14 in developing the test methodology (on Stress Test- the second testing). The scope of testing will cover the interoperability test using the EMERSON's host.

2. To design a new loop system for better understanding of the project and might be beneficial for further research.

3. To monitor and discuss the system performance and issues especially the communication between devices and host.

Scope of Study

The seeking of understanding on FOUNDATION Fieldbus must first be achieved in completing this project. The scope of study consists of:

1. The detail approach in designing, configuring and implementing a fieldbus test rig from the various loose field devices, controllers and actuators, and the software development tool.

2. The familiarization with vendor Distributed Control System (DCS) especially on EMERSON Delta V System.

3. The study on Basic Interoperability Testing and its methodology which consist of Stress test and Diagnostic test.

CHAPTER 2

LITERATURE REVIEW

2.1 What is Fieldbus?

Fieldbus is an industrial network system for real-time distributed control which used microprocessor based control. It is digital, bi-directional, multi-drop, serial-bus, communications to link isolated field devices, such as controllers, transducers, actuators and sensors. The Fieldbus technology is a data resource that can provide maintenance information for field instruments on-line [7]. This information capability can assist the maintenance work and reduce the costs.

Fieldbus is actually a technique to connect instruments in a manufacturing plant and replacing the previous computer connection by which only 2 devices could communicate at a certain time. This would be equivalent to a current widely used 4-20 mA communication scheme that needs each device connects to computer control via its own cable and communication point at the controller level. However, the Fieldbus connection is equivalent to current Local Area Network (LAN) connections, which mean it requires only one communication path for hundreds of analogue and digital devices. Thus, all devices can be connected at the same time via the same port connection which means fieldbus connection reduces both the length of the cable required and the number of cables required[6][8].

Each field device has low cost computing power installed in it, making each device a 'smart' device. Each device will be able to execute simple functions on its own such as diagnostic, control, and maintenance functions as well as providing bi-directional communication capabilities. With these devices not only will the engineer be able to access the field devices, but they are also able to communicate with other field devices [5].

2.2 FOUNDATION Fieldbus

Unlike proprietary network protocols, FOUNDATION fieldbus is neither owned by any individual company, nor regulated by a single nation or standards body. The technology is controlled by the Fieldbus Foundation, a not-for-profit organization consisting of more than 100 of the world's leading controls and instrumentation suppliers and end users. [5]

FOUNDATION fieldbus retains many of the desirable features of the 4-20 mA analog system, such as a standardized physical interface to the wire, bus-powered devices on a single wire, and intrinsic safety options, it offers a host of additional benefits to users.

In FOUNDATION Fieldbus, there are two related implementations of have been introduced. These two implementations use different physical media and communication speeds to meets with the process control environment needs.

- **H1** works at 31.25 Kbps and generally connects to field devices. It provides communication and power over standard twisted-pair wiring. H1 is currently the most common implementation [5].
- **Ethernet** works at 100 Mbps and generally connects input/output subsystems, host systems, linking devices, gateways, and field devices using standard Ethernet cabling. It doesn't currently provide power over the cable, although work is under way to address this [5].

Figures below show the difference between home run cables (usually 4-20 mA) to Fieldbus.

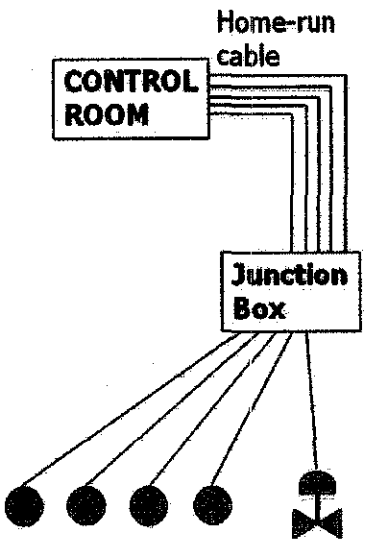


Figure 1: Home Run Cable [5]

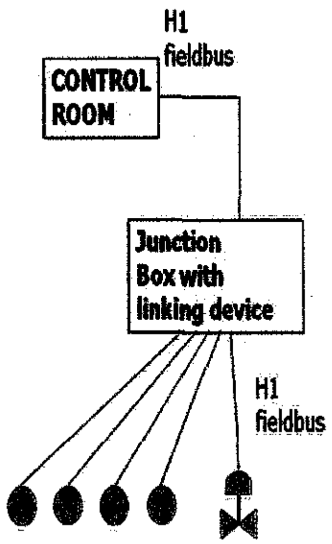


Figure 2: Fieldbus Cable [5]

The above figures show the different of the length and amount of cable used by current system and fieldbus system. FOUNDATION Fieldbus' use of existing wiring and multi-drop connections provides significant savings in network installation costs. This includes reductions in intrinsic safety barrier termination and cable costs, particularly in areas where wiring is already in place.

Figure below shows the FOUNDATION Fieldbus topology. On top of the hierarchy, there is Human Machine Interface (HMI) where an operator can monitor or operate the system. Hubs and switches provide a means to connect multiple nodes. Hubs serve as a connection point and rejuvenate the electrical signal as messages are forwarded on the control network.

HMI is typically linked to a middle layer of programmable logic controllers (PLC) via a non time critical communications system (e.g. Ethernet). At the bottom of the control chain is the fieldbus which links the PLCs to the components which actually do the work such as sensors, actuators, electric motors, console lights, switches, valves and contactors.

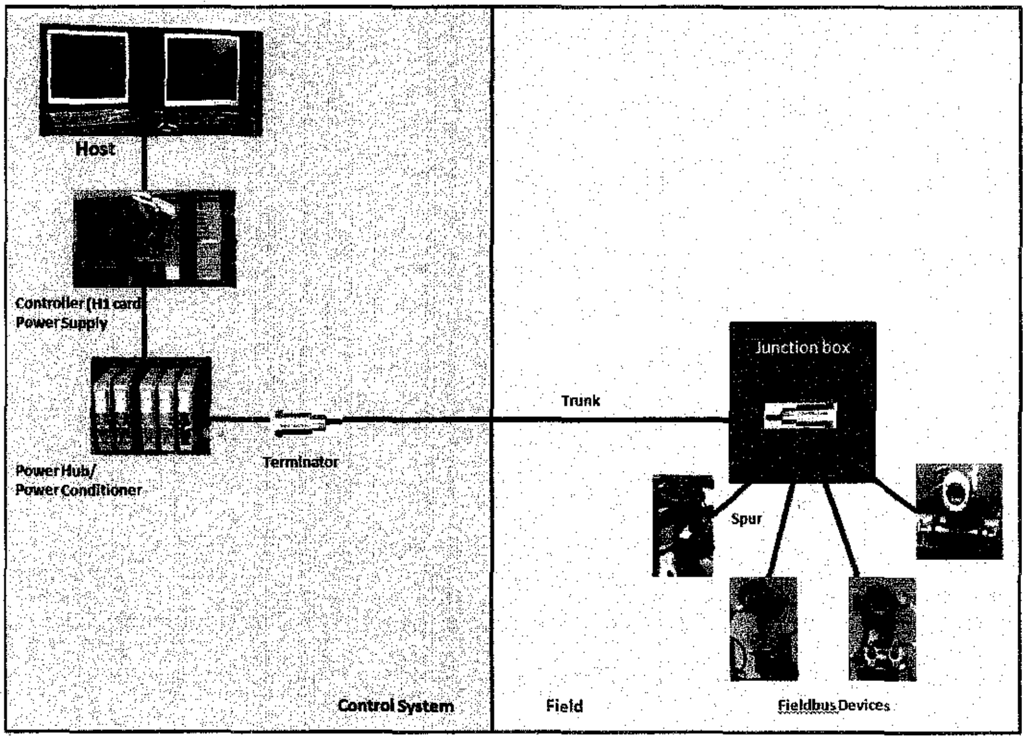


Figure 3: FOUNDATION Fieldbus Topology [2]

Furthermore, FOUNDATION Fieldbus will also improve safety by providing operators with earlier notification and warning of pending and current hazardous conditions. Since process production plant plants are heterogeneous and complex in many aspects such as long cables distributed across buildings and floors also many different types of instrument such as transmitter and sensors, limiting the amount of energy in explosion hazardous area is crucial [2] [9].

Process production plants are heterogeneous and complex in many respects where field devices of very different types are mounted alongside conventional motors and simple digital sensors. Sites place requirements for long cable lengths distributed across buildings and floors, with installation in safe and explosion-hazardous areas with their stringent safety regulations. In short, a typical plant layout consists of practically any type of application, and this has to be taken into consideration when designing and installing fieldbus systems. To validate the overall intrinsic safety it is required to compile all field devices' and cables' safety parameters, and match them against the power source. In the beginning this effort and the very low amount of energy initially available prohibited application of fieldbus in hazardous areas. Today the market is able to look back on a respectable and rapid development of intrinsically safe fieldbus implementation [2].

- ***Fieldbus Concept (HI Concept)***

Since we shall be using the H1 in the project, the study was mainly done for the H1 concept only. There are six conceptual parts to a Fieldbus network: links, devices, blocks and parameters, linkages, loops, and schedules.

- ***Four Fieldbus Layers***

FOUNDATION Fieldbus communication layers consists of the physical layer, the communication stack, and the user layer.

Figure 3 shows a diagram of the Fieldbus layers compared to the Open Systems Interconnect (OSI) layered communication model. Notice that the OSI model does not define a user layer [7].

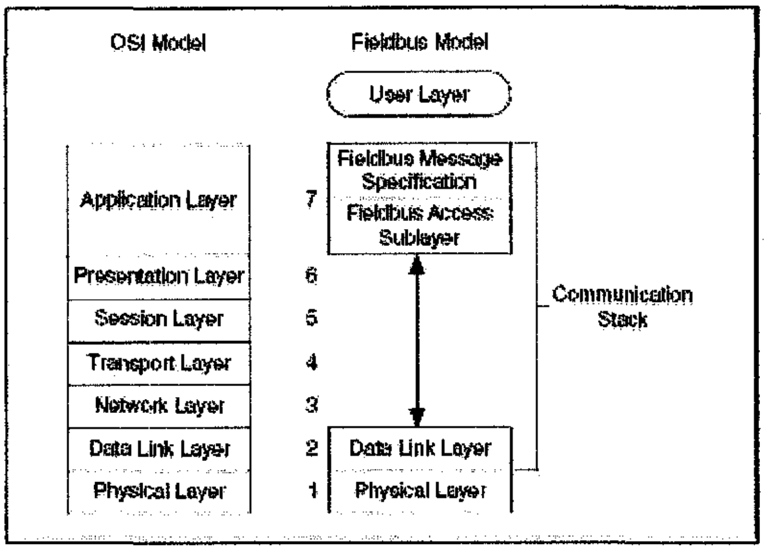


Figure 4: The Communication Layers of FOUNDATION Fieldbus [7]

FOUNDATION Fieldbus does not implement layers three, four, five, and six of the OSI model because the services of these layers are not required in a process control application. A very important part of Foundation Fieldbus is the defined user layer, often referred to as layer eight [7].

The physical layer converts digital fieldbus messages from the communication stack to physical signals on the fieldbus transmission medium and vice versa. It performs the services required to interface the user layer to the physical layer. The communication stack consists of three layers: the Fieldbus Message Specification, the Fieldbus Access Sub layer, and the Data Link Layer. It encodes and decodes user layer messages and ensures efficient and accurate message transfer [6] [2].

The Data Link Layer manages access to the fieldbus through the Link Active Scheduler by splitting data into frames to send on the physical layer, receiving acknowledgment frames, and re-transmitting frames if they are not received correctly. It also performs error checking to maintain a sound virtual channel to the next layer. The Fieldbus Access Sub layer provides an interface between the Data Link Layer and the Fieldbus Message Specification layer. Within the Fieldbus Messaging Specification layer are two management layers called System Management and Network Management. System Management assigns addresses and physical device tags, maintains the function block schedule for the function blocks in that device, and distributes application time. The device can be located through System management [10]

The user layer provides the interface for user interaction with the system. It uses the device description to tell the host system about device capabilities. It defines blocks and objects that represent the functions and data available in a device. Rather than interfacing to a device through a set of commands, like most communication protocols, FOUNDATION Fieldbus lets user interacts with devices through a set of blocks and objects that define device capabilities in a standardized way. The user layer for one device consists of the resource block, and one or more transducer blocks and function blocks [3] [2]

A key objective for Foundation Fieldbus is interoperability, the ability to build systems comprised of devices from a variety of manufacturers. Instead of requiring that device manufacturers use only a given set of functions in a device to ensure that a system can always communicate with a new device, Foundation Fieldbus uses device descriptions, which describe all the functions in a device. They allow manufacturers to add features beyond the standard Foundation Fieldbus interface without fearing loss of interoperability [8] [7].

2.3 The Type of Tests

Fieldbus technology is one of process application that widely used in process control application. It is a digital, two ways, multi drop communication mechanism that will connect host systems, field devices and other automation systems on a network [1]. Fieldbus is the equivalent of the current LAN type connections, which require only one communication at the controller level and allow multiple of analog and digital points to be connected at the same time thus reducing both the length of the cable required, and the number of cables required [2]. The testing for the FOUNDATION Fieldbus consists of two main tests, the reliability test and the interoperability test [1].

- ***The Basic Interoperability Test***

The reliability test consists of three tests. The Basic Interoperability test which perform during the device commissioning. The test should show the effect of the device beforehand, the interoperability between different host and field device, the online device replacement, the bus health inspection and the device firmware upgrade [3].

- ***Stress Test***

The second test is the Stress Test. This test should involve the fully loaded segment which confirm the maximum number of devices that could be used, the power failure recovery, communication integrity soak test, back up of LAS (Link Active Scheduler), the control in field and the test of maximum cable length and different cable type [3].

- ***Diagnostic***

The third test is the diagnostic capability which involves the verification operation of advance function blocks, the device health check, the verification interoperability between different vendor devices and host and the ease of calibration check and trims [4].

- ***Full Interoperability Test***

The other main test which is the interoperability test involves the host communication test and the full system test. The host communication test will check only the control system from the HI interface cards to the operator workstations without connecting all the field instrument devices. A single field instrument device will connect to the HI interfaces one by one and check the basic communication between a device and the interface. The full system test will verify the system hardware and configuration data downloaded to the field devices. This approach has the benefit that all control functions, including the field devices, are checked and problems solved before arrival at site [5].

CHAPTER 3

METHODOLGY / PROJECT WORK

3.1 Methodology

There are four vendors taking part in this project that is; Emerson, Foxboro, Honeywell and Yokogawa. Each of them provides different Distributed Control System (DCS) for fieldbus system and architecture. For these two semesters, this project will be covering the **Basic Test** also a design for loop control using Emerson Delta V System will be introduced.

The following are the scope of Basic Interoperability Test that will be conducted throughout this project:

3.1.2 Basic Tests

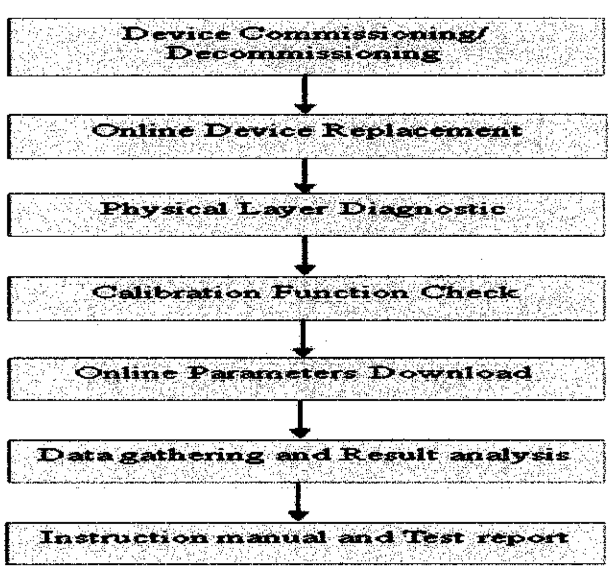


Figure 5: Methodology of Basic test

3.1.2 Control Loop Design

Flow chart below shows the method in designing the control loop using Emerson Delta V System.

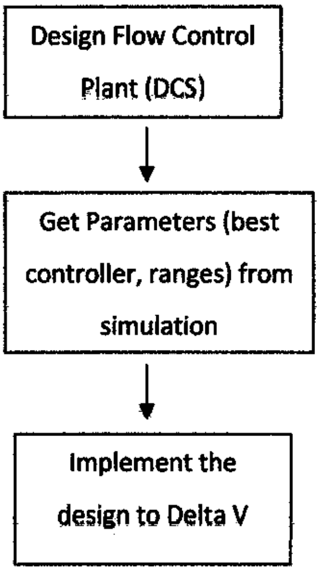


Figure 7: The Methodology in Designing Control Loop

3.2 Tools and Equipment

For this project, all equipment and tools are provided by vendors which are Emerson, Yokogawa, Foxboro and Honeywell. Figure below shows the external instrument assembly layout in the FOUNDATION Fieldbus lab at Universiti Teknologi PETRONAS.

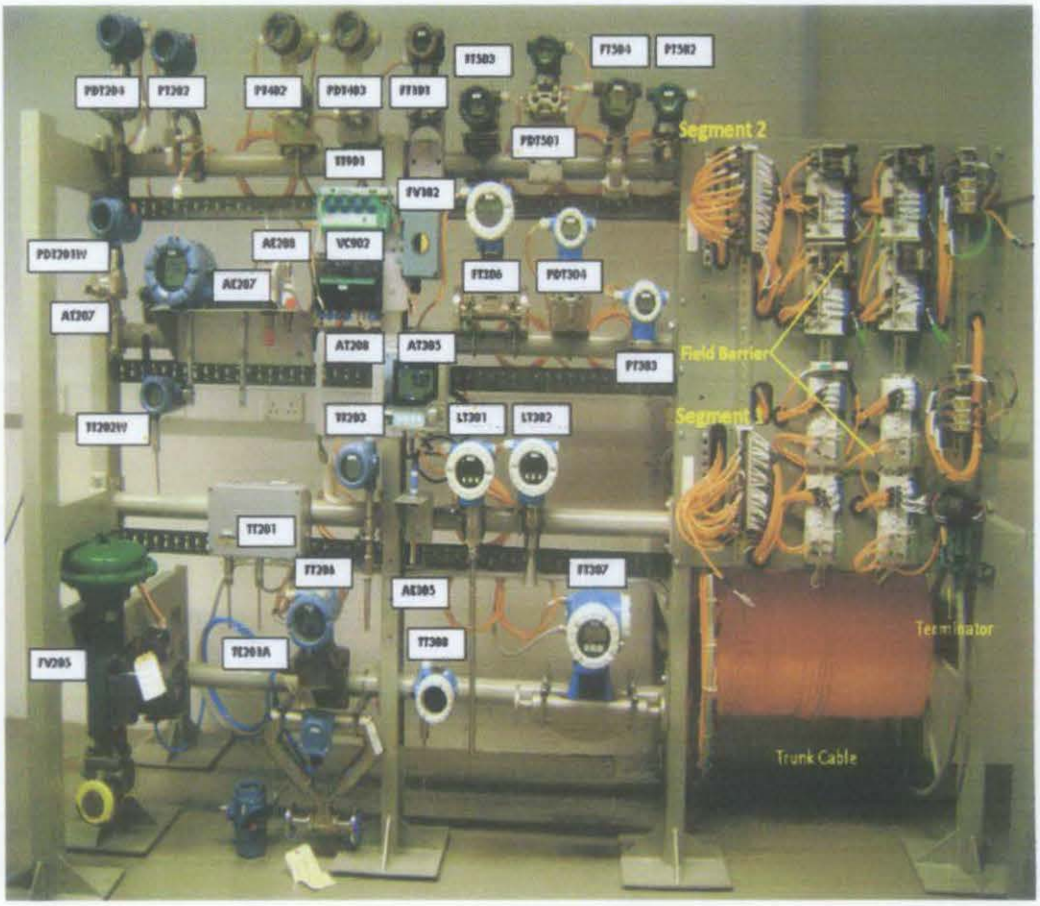


Figure 8: External Instrument Assembly Layout at Building 23

There are two segments of devices which Segment 1 contains 14 instruments and segment 2 contains 13 instruments. Segment 1 is power up by PNF power supply while segment 2 using MTL.

Below are the tables of instrumentations of each segment. There are 14 various Fieldbus devices connected to segment 1 and 13 devices connected to segment 2.

Table 1: Segment 1 Instrumentations List

TAG NO.	ADDRESS	MANUFACTURES	TYPE
AT 207	28	Rosemount Analytical Inc.	
AT 208	29	Rosemount Analytical Inc.	Xmt-CT FF Fieldbus Transmitter
FT 206	27	Micro Motion Inc.	2000
FV 205	26	Fisher Controls	Fisher DVC 6000f
PDT 204	25	Rosemount Analytical Inc.	5051 Fieldbus Pressure Transmitter
PDT 501	30	Yokogawa Electric	EJX
PT 202	23	Rosemount Analytical inc.	3051 Filedbus Pressure Transmitter
PT 502	31	Yokogawa Electric	EJX
TT 201	22	Rosemount Analytical Inc.	848 Fieldbus temperature Device
TT203	24	Rosemount Analytical Inc.	3144 Foundation Fieldbus temperature Transmitter
TT 503	32	Yokogawa Electric	YT A 320
TT901	34	Peppel + Tuchs	Temperature Multiplexer
VC902	35	Peppel + Tuchs	FD-0-VC-EX4. Foundation Fieldbus
FT 504	33	Yokogawa Electric	DYF/LCI

Table 2: Segment 2 Instrumentation List

TAG NO.	ADDRESS	MANUFACTURES	TYPE
AT 305	26	Endress+Hauser GMbH.	Liquiline MCM 42pH/ORP
FT 101	33	Invensys Process System	SRD 991
FT 306	27	Endress+Hauser GmbH	Prowirl 73
FT 307	28	Endress+Hauser GmbH	Promass 83
FV 102	34	Invensys Process System	SRD 991
LT 301	22	Endress+Hauser GmbH	Level Flex M
LT 302	23	Endress+Hauser GmbH	Micropilot M
PDT 304	25	Endress+Hauser GmbH	Deltabar m
PDT 403	32	Honeywell	PT
PT 303	24	Endress+Hauser GmbH	Cerabar S
PT 402	31	Honywell	PT
TT 308	29	Endress+Hauser GmbH	TMT 162

Figure below shows the network architecture of FOUNDATION Fieldbus. As mentioned earlier, there are four hosts involve. However, for this project Emerson will be the host. Emerson as the host provides their own equipment.

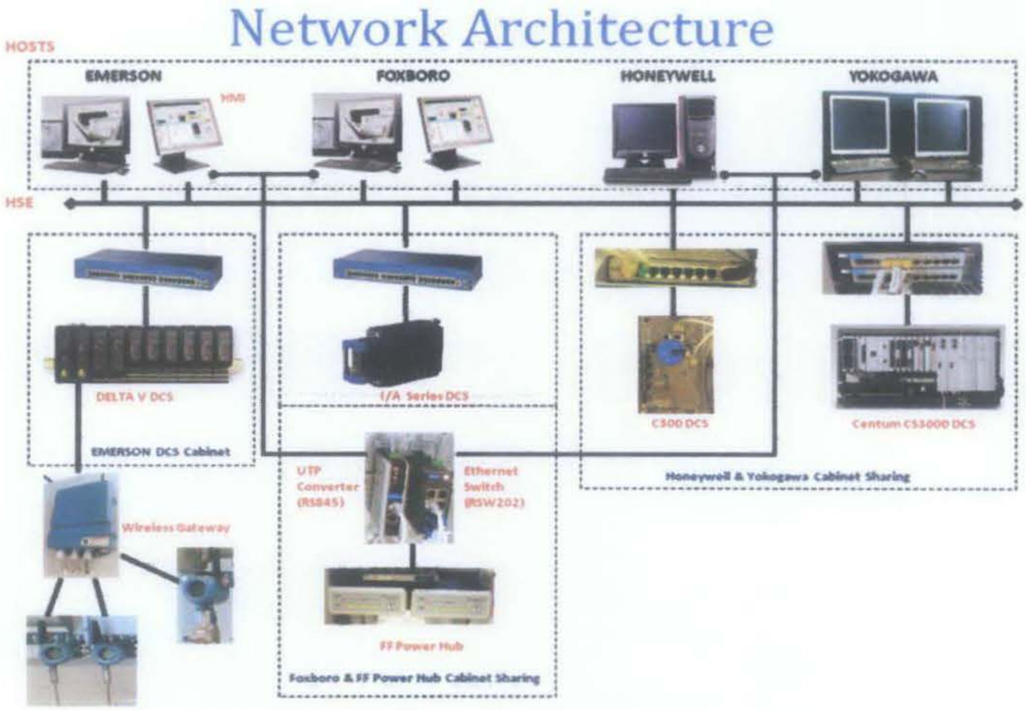


Figure 9: Network Architecture of Fieldbus System at UTP [3]

EMERSON has 2 main stations that are called PROPLUS and Asset Management System (AMS). The PROPLUS acts as an engineering workstation which consist of 2 main softwares, DeltaV Operate and DeltaV Explore. The DeltaV Operate is for the operator to do the monitoring while the DeltaV Explore is functioning more for the configuration and maintenance purposes [9] [10].

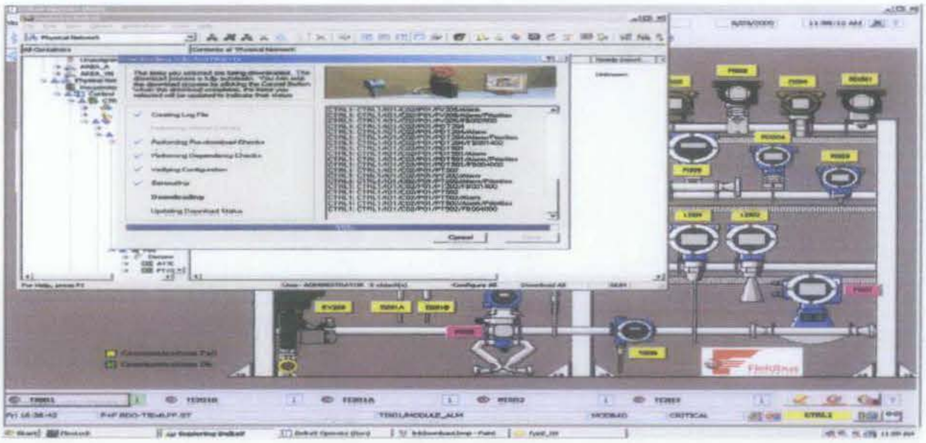


Figure 11: Pop-up Wizard While Downloading the Segment

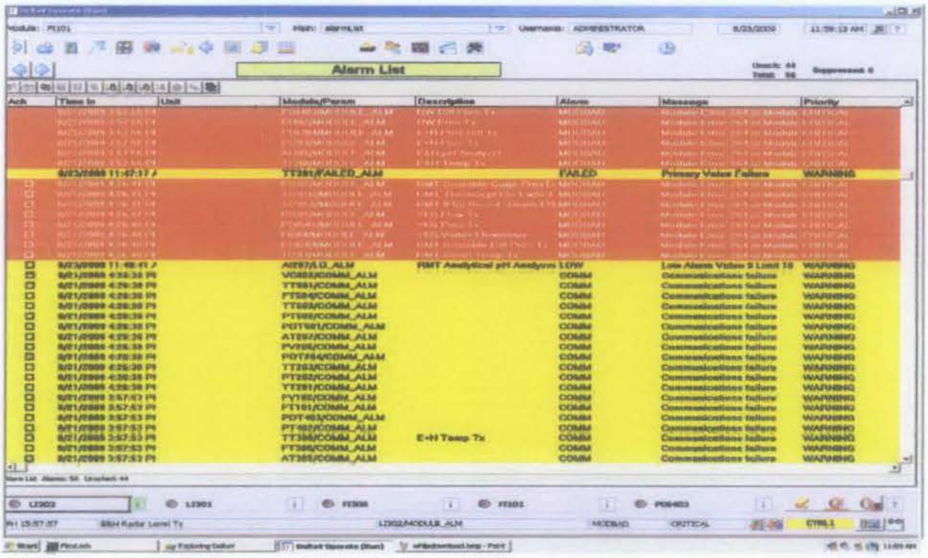


Figure 12: Alarm While Downloading the Segment

Table 3: Summary on Alarm Warning During Device Commissioning

ALARM	ERROR	DESCRIPTION
PI 402	IO Input Error	Function Block Bad Active
PDI 403	IO Input Error	Function Block Bad Active
TI 503	IO Input Error	Function Block Bad Active
VI 902	IO Input Error	Function Block Bad Active
PDI 304	IO Input Error	Input Transfer Error
PI 303	IO Input Error	Input Transfer Error
AI 208	Input Error	Function Block Bad Active
TI 203	Input error	Function Block Bad Active
AI 305	IO Input Error	Function Block Bad Active
FI 206	IO Input Error	Function Block Bad Active
TI 308	IO Input Error	Function Block Bad Active
TI 307	IO Input Error	Function Block Bad Active

After the alarms had been acknowledged, the most of the devices show function properly except for Temperature Transmitter 308, Analyzer Transmitter 208 and Flow Transmitter 206. These three devices are suspected has been disconnected from the Fieldbus network.

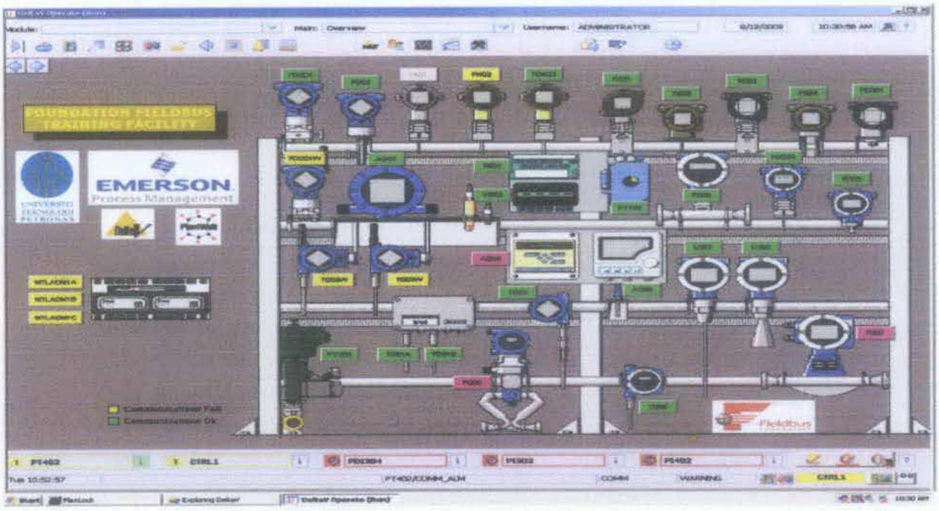


Figure 13: Device Status after Partial Download

4.2 Online Device Replacement

The Online device Replacement testing is to observe the response of fieldbus network when a device is replaced while the system is online. The related device will be removed from fully functioning device system and will be reconnecting again to replace the device. Fieldbus replacement Wizard will guide the user to perform the procedures.

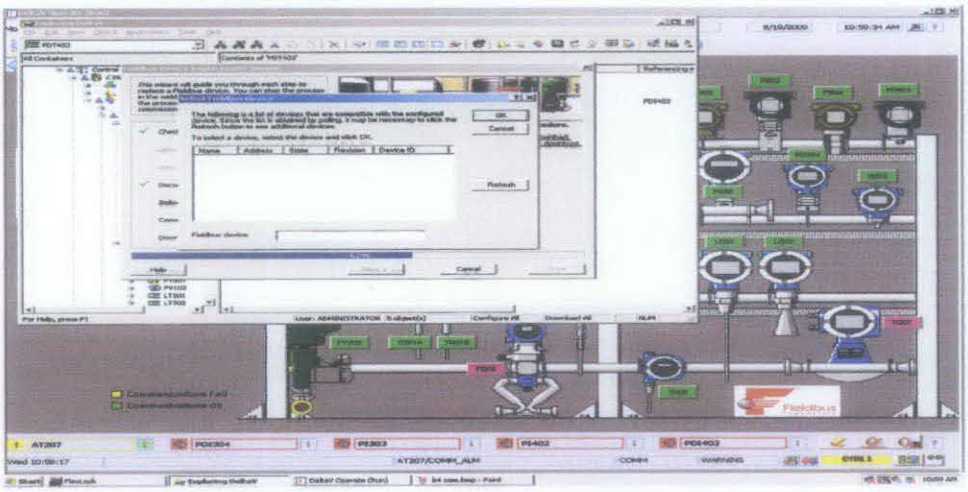


Figure 14: Fieldbus Device Replacement Wizard

CHAPTER 4

RESULT AND DISCUSSION

4.0 Basic Test

4.1 Device Commissioning

Initial download (partial download) on both segments need to be performed first before the commissioning begin. The initial download took about 10-15 minutes. It is likely that some devices need to performed individual device download when partial download on those devices is unsuccessful. Individual device commissioning took about 5 minutes and built in wizard is available to assist the user.

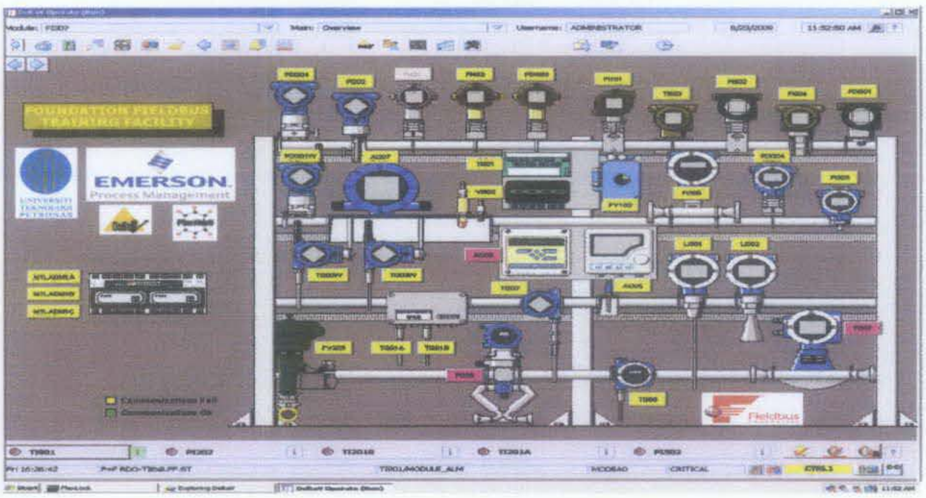


Figure 10: Device Status before Partial Download

Table 4: Summary of Online device replacement

PORT 1	Time(s)	Notes	PORT 2	TIME	Notes
AT 207		Alarm at AT 207	AT 305	38.2	-
AT 504	23.6	-	FT 101	29.1	-
FV 205	20.2	-	FT 306	23.1	-
PDT 204	32.7	-	FV 102	25.8	-
PDT 501	29.7	-	FT 301	55.5	-
PT 202	29.6	-	LT 302	1.00	-
PT 502	26.1	-	PDT 304	52.5	-
PT 201	23.0	-	PDT 403	20.8	-
TT 203	24.4	Alarm at PT 201	PT 303	42.4	-
TT 503	35.2	-	TT 402	29.7	-
TT 901	42.2	-	TT 308	21.9	-
VC 902	33.3	-			-

Figure above shows the time taken for each device to be commissioned again after being reconnected from the network. Mostly, there is no alarm occur during the online replacement which can be concluded that online device replacement on one device at site will not affect the communication of other device.

However, when AT 207 is being replaced, there is alarm occur and online replacement at this device cannot be performed successfully. There is also alarm occur at PT 201 when TT 203 is replaced. This might caused by the cable conflict bus, this alarm does not affect the device performance.

4.3 Calibration Function Check

Fieldbus device range value can be changed while in Out Of Service (OOS) mode. For basic test purposes, the parameter download is limited to change the range of the device using Host and 375 HART/FF Communicator. Rescale cannot be performed using Emerson AMS(iAMS)Asset Management System.

Summary Method:

1. Change the mode of respective device to OOS.
2. Change the range XD_scale and OUT_scale
3. Change back the mode to Auto. Record the response
4. Repeat the steps using 375 Communicator.

4.3.1 Using Host

The range of XD_scale and OUT_scale are edited at Control Studio. The Auto mode is changed to OOS at AI Block. When the mode is changed back to Auto, the new value of range is updated automatically by the device.

Table 5: Calibration Function Check using Host

Device	Message
FT 101	Alarm occurs if the data XD_scale and OUT_scale is not the same.
FT 306	• Alarm occurs at AI 305 when the mode is changed from Auto to OOS • The communication of others not affected. Alarm can be acknowledged.
PT 402	Range is changed successfully
PT 207	• Alarm occurs at PT 402 • The range between XD_Scale and OUT_scale must be the same • Status: Function Block Problem
FT 504	Alarm occur when change to OOS and can be acknowledge
Ti 901	Range of XD_scale and OUT_scale must be the same
PI 202	Alarm occur and can be acknowledge

4.3.2 Using 375 Communicator

The range change using the communicator is sent to the device and updated at the system. However at some devices, 375 Communicator failed to extract the device information. Thus, it failed to change the range. This is due to missing DD file and mostly affected a number of Endress + Hauser Transmitters.

Table 6: Function calibration Check Using 375 Communicator

Tag	Device Type	Files in Device	Files in 375	Match	Error message
LT 301	Level FlixM	Dev Rev 4 DD Rev 1	Dev Rev 3 Dev Rev 3	Mismatch	Communicator can scan device but unable to view more information
LT 302	Micropilot M	Dev Rev 5 DD Rev 1	Dev Rev 3 Dev Rev 3	Mismatch	Communicator can scan device but unable to view more information
PT 303	Carebar	Dev Rev 5 DD Rev 1	Dev Rev 5 DD Rev 2	Match	Able to view the function block and information Unable to change parameter
PDT 304	Deltabar S	Dev Rev 5 DD Rev 1	Dev Rev 5 DD Rev 2	Match	Able to view the function block and information Unable to change parameter
AT 305	Liquillin	Dev rev 1 DD Rev 1	N/A		Can view information Success to make change in parameter
FT 306	Prowill 73	Dev Rev 1 DD Rev 1	Dev Rev 1 DD Rev 1	Match	Ok
FT 307	Promass 83	Dev rev 3 DD Rev 1	Dev Rev 2 DD Rev 1	Missmatch	Can scan device but unable to view information
TT308	TMT 162	Dev Rev 1	N/A		Device Offline. Unable to test

Output range trim can be done via system at control studio and via 375 communicator and usually at site. The changes done also will be automatically update once the device mode is changed back to auto.

4.1 Control Loop Design and System Configuration

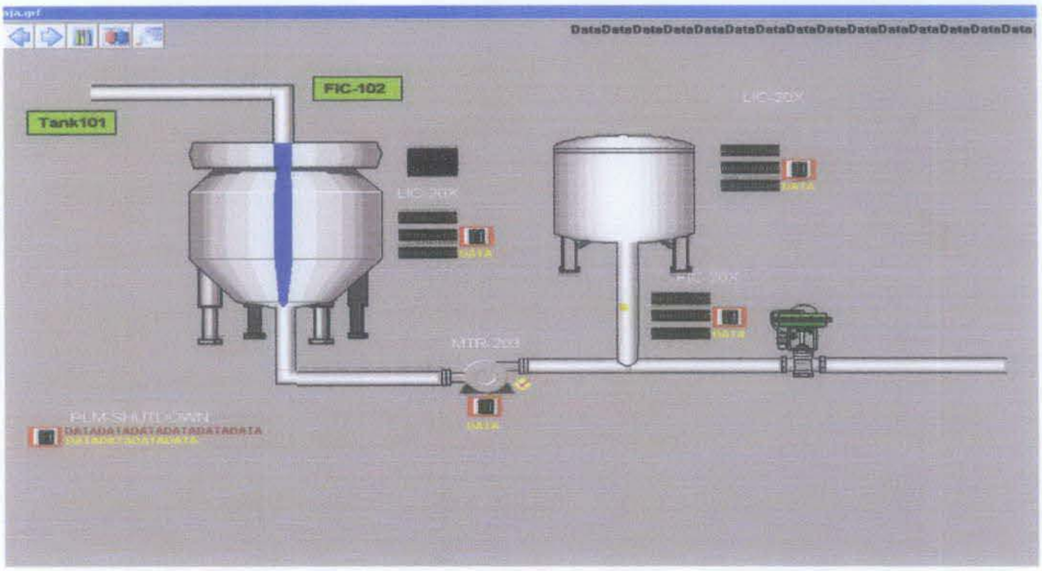


Figure 15: Loop Design for Level and Flow Control Plant

Figure above showed a simple plant design. Tank 101 will receive a reactant A from the incoming and will pass the reactant A to tank 102. Here, the reactant A will be mixed- up with Reactant B to produce reactant C. The reactant C will then be sent to another tank. The original design will be a loop design however, the simple plant need to be connected to the real devices available in the lab before a redesign the simple system to a complicated process flow

There are several transmitters and controller to control the performance of the system. Valve and pump as the final element will take an appropriate decision if the system varies from actual point. The controller used for this system is proportional and integral (PI).

CHAPTER 5

CONCLUSION

5.1 Conclusion

The basic test which is the first test of Foundation Fieldbus Interoperability Testing has been completed within the range of time. The virtual plant also has been designed using Delta V system.

As conclusion, upon completing this project, a comprehensive technical report on the Foundation Fieldbus Interoperability Testing (FFIT) will be emerged after carrying out an intensive testing and research of the Foundation Fieldbus system. Generally, two main testing will be done which are the stress test and diagnostic capability test. A control loop design will be implemented on Delta V for better understanding on system and its configuration and for further researches.

The main outputs of this project are:

1. Perform basic test which including Device Commissioning, Online Device Replacement and Calibration Function Check.
2. Design a control loop using Delta V software. The objective is to model the plant using Delta V and implement on the real device. However due to some limitation of the system capability that Delta V only allow certain function, the real plant implementation cannot be conducted.

REFERENCES

[1] PETRONAS E-Learning Modules 3 (Plant Monitoring Control System) and Modules 4 (Process Control Theory)

[2]Foundation Fieldbus Interoperability Testing – Terms of Reference, SKG 14, PETRONAS.

[3] Hisashi Sato, Journal of *'The Recent Movement of FOUNDATION Fieldbus Engineering'*, SICE Annual Conference in Fukui, August 4-6, 2003

[4]Technical Support and Professional Services, National Instruments, May 2003 Edition.

[5] Fieldbus Org, Citing Internet source URL http://www.fieldbus.org

[6] FOUNDATION Fieldbus , Citing Internet sources

URL http://www.foundationfieldbus.com

[7] Emerson, Citing Internet source URL http://www.emerson.com

[8] EMERSON Fieldbus Tutorial Book and manuals

[9]Yologawa, Citing Internet source URL http:// www.yokogawa.com

[10]William Stallings, "Data and Computer Communication", Eight Edition: Pearson Education International Publishing, 2007.

APPENDIX

Appendix 2

DeltaV Component Electrical Specification

DeltaV System Power Supply will supply power to all DeltaV controller and I/O Module on the installed carrier. It converts an incoming 24VDCsupply to 12VDC (isolates)

Item	Specification
Model no	VE5006
Input 12 VDC 24 VDC	 11.4 VDC to 12.6 VDC 21.6 VDC to 26.4 VDC
Inrush (soft start)	12 A peak maximum for 5 ms over the 12 VDC input range (excluding 12 VDC output) 20 A peak maximum for 5 ms over the 24 VDC input range (including 12 VDC outputs)
Output rating	+ 12 VDC at 13.0 A (12 VDC input) + 12 VDC at 4.5 A (24 VDC input) + 5 VDC at 2.0 A 3.3 VDC at 2.0 A
Output power	10 W total at 60ºC (combined outputs of 5 VDC and 3.3 VDC)
Input protection	Internally fused, non-replaceable fuses
Overvoltage protection	Output protected at 110% to 120%
Hold-up time	Output remains within 5% of nominal at full load and minimum input voltage for 5 ms (excluding 12 VDC current with 12 VDC input)
Mounting	On either slot of 2-wide power/controller carrier
External connectors:	
Primary power Alarm contacts Alarm relay contact rating	DC input, 2-wire 2-wire normally open relays; relays are closed when 3.3 and 5 VDC outputs are within +/-4% of nominal 30 VDC at 2.0 A, 250 VAC at 2.0 A

Appendix 3

DeltaV Series 2 Serial Card, 2 Ports, RS232/RS485

DeltaV Series 2 Serial Card, 2 Ports, RS232/RS485

The DeltaV Serial Card provides an interface to a variety of serial devices that use the Modbus RTU or ASCII protocol. With the DeltaV Explorer, it is possible to configure each of the two ports provided on the serial card to support RS232, RS422/485 half duplex, or RS422/485 full duplex signals and you can configure the baud rate of each port. The serial card requires a DeltaV Serial Terminal Block to provide terminations for wiring.

If the RS422/485 ports are used, the shield must also provide the ground reference for the port. Connect the cable shield to the corresponding ground (GND) terminal on the serial terminal block.

Item	Specification
Model	VE4036P2
Number of serial ports	Two
Port types	RS232, RS422/485 half duplex, RS422/485 full duplex (configurable with the DeltaV Explorer)
Isolation	Each port is optically isolated from the system and from each other and factory tested to 1500 VDC. The ports must be grounded via the external device.
Baud rate	Configurable with the DeltaV Explorer
Maximum cable lengths	RS232: 15 m (50 ft) RS422/485: 610 m (2000 ft)
LocalBus current (12 VDC nominal), per card	200 mA typical, 300 mA maximum
Field circuit power, per card	None
Mounting	Assigned slot of I/O carrier

Appendix 4

HI Card Specification

Item	Specification
Model	VE4037P0
Number of Ports	Two
Port Type	Foundation Fieldbus H1 - 31.25 Kbit/second
Isolation	Each channel is optically isolated from the system and from each other and factory tested to 1500 VDC.
Localbus current (12VDC nominal), per card	400 mA typical, 600 mA maximum Series 2: 200 mA typical 300 mA maximum
Field circuit power, per card	None.
Fieldbus power (for Series 2 card)	9 to 32 VDC, 12 mA per port
Mounting	Assigned slot of I/O carrier

Appendix 5

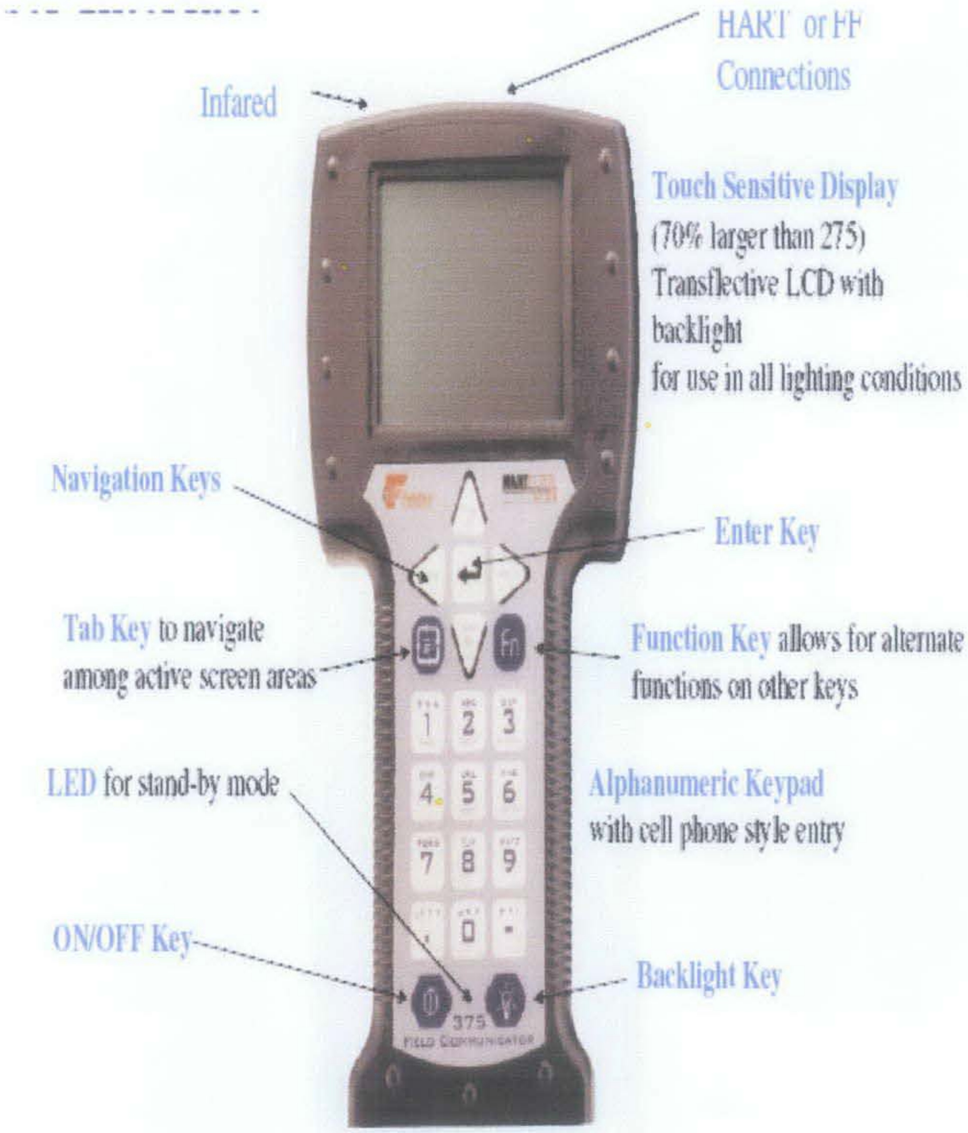
375 Communicator Foundation Fieldbus Application- Features

375 Field Communicator

- Supports all HART / Ff devices
- Intrinsically Safe
  - ⇨ATEX compliant
  - ⇨FISCO compliant
- User upgradable on-site!
- Designed for use in the Plant
- Fieldbus network Diagnostics
- Supports HART Rev. 6
- Interfaces with AMS 6.2
- Supports device-specific applications

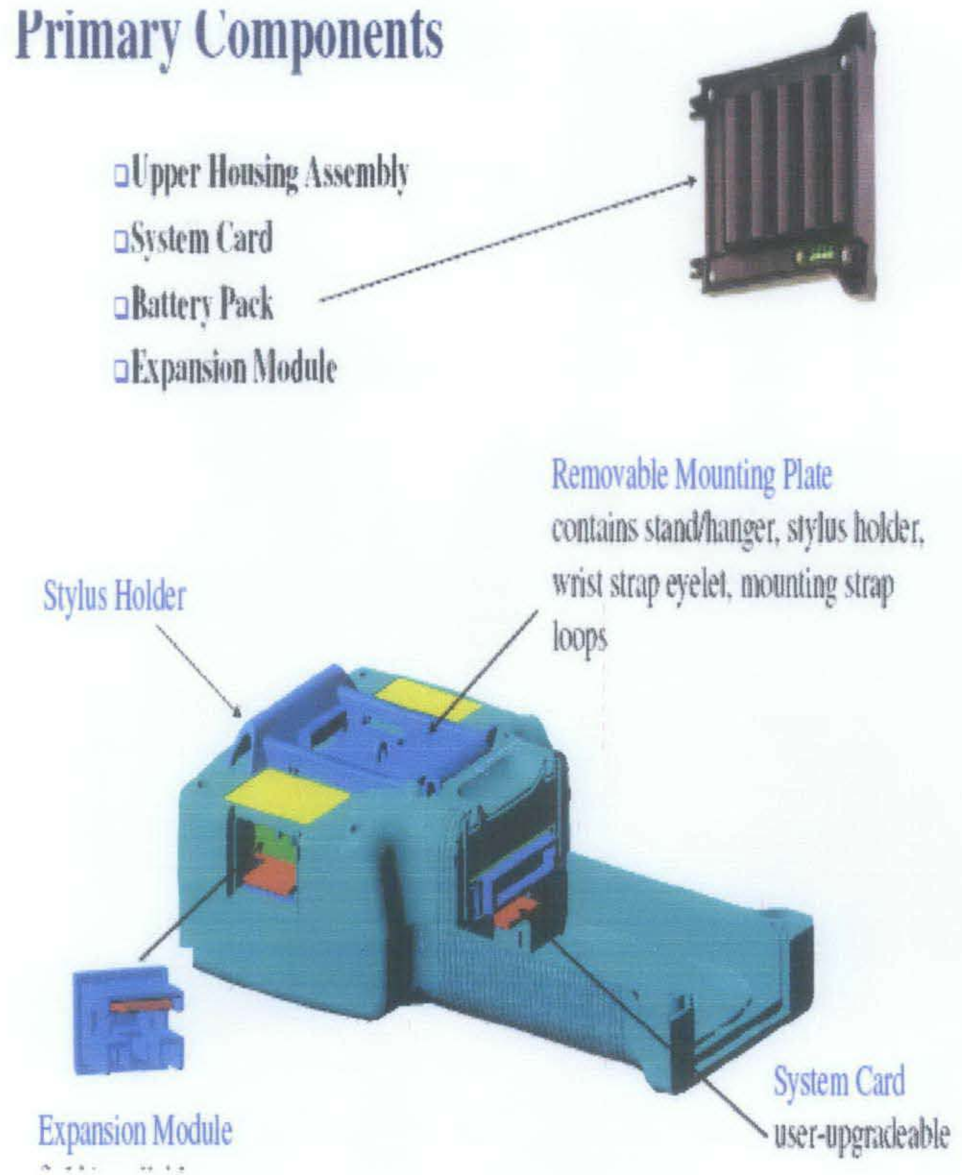
Appendix 6

375 Communicator Foundation Fieldbus Application- Functions.



Appendix 7

375 Communicator Foundation Fieldbus Application- Primary Component



Appendix 8

375 Communicator Foundation Fieldbus Application-Wiring

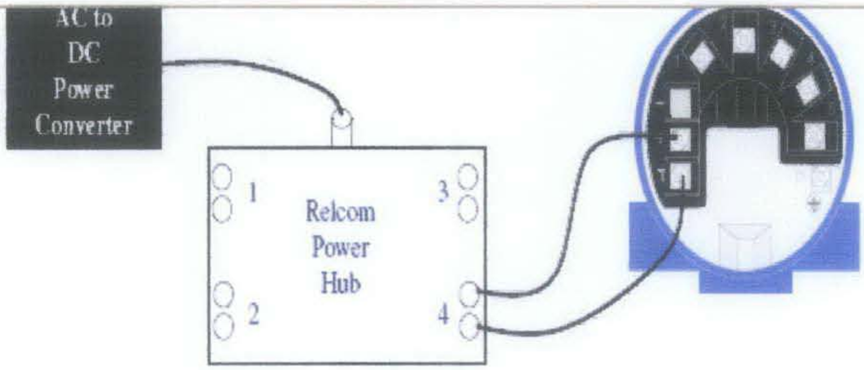


Diagram of Relcom Power Hub/Conditioner