INTELLIGENT MONITORING, FAULT ANALYSIS AND CONTROL OF INDUSTRIAL PROCESS USING PROGRAMMABLE LOGIC CONTROLLER (PLC)

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CERTIFICATION OF APPROVAL

Intelligent Monitoring, Fault Analysis and Control of Industrial Process Using Programmable Logic Controller (PLC)

By

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Approved by,

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TRONOH, PERAK
January 2005

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 the specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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ABSTRACT

This work has been conducted to study a Programmable Logic Controller based (PLC-based) system used for monitoring, controlling and performing fault analysis. This system provides high reliability, high efficiency and cost effective which are important for today's industrial application. This is essential to ensure the smooth flow of the production process and reduces losses.

PLC has gaining its popularity on the factory floor. Its effectiveness, flexibility and reliability make PLC a big preference over other control system.

This project is basically focusing on replicating or to imitate a system in a real industrial processes. As such, the study was carried based on the existing system used in Centralised Utility Facilities, Gebeng (CUFG) Kuantan. The main objective is to propose a method that are capable of providing a reliable and efficient monitoring and control.

This report summarizes the methodologies and processes that had been taken throughout this project. The approach used is viable in the context of this study and has the potential to be applied on other similar type of systems used in industry.

ACKNOWLEDGEMENTS

Firstly, I would like to express my utmost gratitude to Allah Almighty for giving me the chance and strengths to face the odds and obstacles in completing this Final Year Project paper.

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I also want to express my appreciation and gratitude to plant personnel at Centralised Utility Facilities in Gebeng Kuantan, Pahang for their cooperation and guidance on my understanding the current PLC system used in the industrial plant.

I also would like to thanks my parents, siblings, relatives and friends who are in this course with me, sharing time of difficulties and helping me through this project period. Their concern and compassion for me during this project period was greatly appreciated, and I could not have endured this period without them.

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ABBREVIATIONS AND NOMENCLATURES

1. CUFG : Centralised Utility Facilities, Gebeng Kuantan
2. DCIS : Data Collector for Intelligent System
3. ESD : Emergency Stop Device
4. EWB : Electronic Workbench
5. GUI : Graphic User Interface
6. LV : Low voltage
7. MMI PC : Man Machine Interface
8. NC : Normally Close
9. NO : Normally Open
10. I/O : Input Output
11. PLC : Programmable Logic Controller
12. SCADA : Supervisory Control and Data Acquisition
13. UTP : Universiti Teknologi PETRONAS

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CHAPTER 1
INTRODUCTION

1.0 INTRODUCTION

The project title is "Intelligent Monitoring, Fault Analysis and Control of Plant Process using Programmable Logic Controller". The project is conducted to propose a reliable system for monitoring and controlling plant process. Throughout this project, the activities that the student has involved is as follow: programming the ladder logic for PLC program, programming the Graphic User Interface (GUI), working with relays, interfacing the PLC with MMI PC and building a simple indication circuit.

1.1 Background of Study

The system studied is a system that is used for do monitoring, controlling and performing fault analysis. This system provides high reliability, high efficiency and very cost effective that is important for today's industrial application. This is essential to ensure the smooth flowing of the process and to reduce losses.

This project is basically focusing on replicating or to imitate a system in a real industrial process. For this purpose, a case study has been conducted on the current system used in Centralised Utility Facilities, Gebeng (CUFG) Kuantan. The main focus of this study is to observe the functions of PLC in the process field and to construct a model base on the system. The aim is to propose a method that able to provide reliable and efficient monitoring and control.

Specifically, the main function of this intelligent system is to provide the necessary monitoring for low voltage (LV) system. The system comprises of two identical PLC linked to a PC that provides feedback and control, and to an indicator circuit that becomes the model of a plant to be controlled.

Two independent OMRON PLCs that is synchronised together using communication link. The two PLC will be the communication gateway allowing the PC to monitor various intelligent elements in the system. The necessary data (faults and alarms) are passed to the PC for further investigation on the trends.

1.2 Problem Statement

Nowadays, a more reliable and efficient monitoring system is needed for a processing plant to produce quality and desirable products. The intelligent system should be able to monitor and also analysed faults, and provide means of control to the plant. This means that instead of purchasing several controllers to do the different functions, it is preferable to have a single product that can do all the functions simultaneously.

This is accomplished by using two independent PLCs connected in a Master/Slave configuration. The PLCs should have a self monitoring function that enables them to interchange automatically in response to a fault. A Main Machine Interface (MMI) PC is stipulated to provide monitoring, faults analysis and controlling of the process.

PLC has been gaining popularity on the factory floor and will probably remains predominant for some time to come. This may be due to the advantages they offers, which includes:

- Cost effective for controlling complex systems.
- Flexible and can be reapplied to control other systems quickly and easily.
- Computational abilities allow more sophisticated control.
- Trouble shooting aids make programming easier and reduce downtime.
- Reliable components make these likely to operate for years before failure.

1.3 Objective and Scope of Study

1.3.1 Objectives

This aim of the project is to develop a model of monitoring, fault analysis and controlling similar to the architecture of the system in the Centralised Utility Facilities, Gebeng (CUFG) Kuantan and to propose a viable approach for monitoring, controlling and performing fault analysis. The focus is to build a reliable monitoring and control system for a low voltage system. The objectives of this project include:

a) building a dual redundant PLC system that can independently monitor the status of the industrial process
b) building and program a Graphic User Interface (GUI) system into PC
c) building a small scale simple plant process indication circuit
d) providing interfaces between all the main components of the project
e) providing venue for the student to handle important tasks in completing a project.

1.3.2 Scope of Study

In doing this project the student has to apply the knowledge and experiences gained during the study in UTP as well as during the eight months industrial attachment in the industrial plant. The student has programmed two units of OMRON PLCs to build a reliable monitoring, control and fault analysis system. During that stage, the student had done an extensive researches on the current system used in CUFG as well as to understand the system that needs to be monitored and controlled.

The second phase of the project work focuses on building an indication circuit that mimicked the plant process and a changeover circuit that will be used for changing the master status of the PLC. The master status of the PLC is an important aspect of the system since it will be communication gateway between the circuits as well as for the MMI PC. This will ensure that the reliable monitoring can be achieved.

The third phase involved the understanding and learning the steps in programming a Graphic User Interface (GUI). This GUI program will be loaded up in the MMI PC to provide the necessary control and feedback of the system.

The final phase requires the interfacing between all the main components of the project and confirms the validity of the system. This phase mainly involve interfacing of the communication links and network protocols. It requires understanding on available protocols and to select the protocols that are applicable with the components used. This is done to ensure the validity and smooth operation of the system built.

CHAPTER 2
LITERATURE REVIEW

2.0 LITERATURE REVIEW

To achieve the aim and objectives of the project, two PLCs will be connected and is required to work simultaneously. The PLC will adopt the 'Master/Slave' configuration which means one would become the Master and one would be the Slave. Both PLC could interchange automatically in response to a fault.

The Single Line Diagram of this project system overview is shown in Figure 2.1.

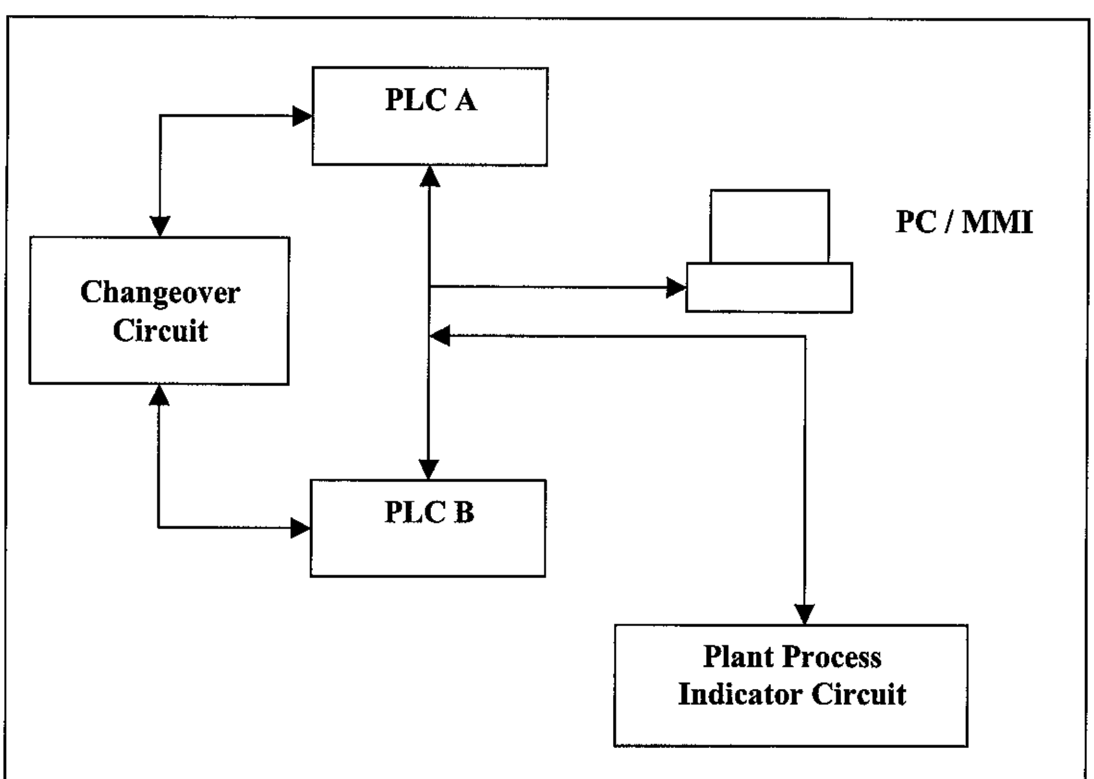


Figure 2.1 – System Overview

As shown in the diagram, two PLCs are connected to changeover circuit (consists of relays) to enable them to use the 'Master/Slave' configuration. The changeover circuit will communicate will both PLC to check the status of the Master PLC. If the Master has any problem or failure, the circuit will be energized/de-energized and will switch the Master status to the other PLC.

Besides the above configuration, the two PLCs are required to be connected to the Man Machine Interface PC (MMI) workstation. The computer is equipped with a Graphic Used Interface (GUI). Using GUI, the MMI PC can do all the necessary monitoring, fault analysis and control of the process. The MMI PC can issue control to the process through the PLC, and the PLC will initiate the equipment to be controlled. The communication between the equipments is both ways which means that the PC can control and get feedback from the process. In addition to the above, the PLC is connected to an indication circuit that constitutes the plant process that needed to be control and monitored.

The PLC programming techniques, ladder diagram construction, methods of implementation and simulations of the above architecture must be understood and studied. The need of a good GUI requires detailed understanding on the whole subject matter. The final step involves is to integrate all the components via networking and protocols. The basic of the whole project work requires understanding in the software and programming tools involved.

CHAPTER 3
METHODOLOGY/PROJECT WORK

3.0 METHODOLOGY/PROJECT WORK

In this project, the student had followed a procedure on project work flow and management. The few steps identified were used as a guide on completing the project flow of the whole process. This is important as to ensure successful outcome of the project.

3.1 Procedure Identification

The following procedure had been used:

a) Research on the project – interface, programming PLC, suitable protocols, relays and etc.
b) Built up the PLC ladder logic program
c) Built indication circuit that mimicked the plant process
d) Built a changeover circuit
e) Built a GUI program into the PC
f) Interface all the main parts of the project – software and hardware

It is important for the student to divide the above tasks between the two semesters of the Final Year Project. This is to ensure a successful outcome of the project. The process flow of the project is depicted in Figure 3.1 below.

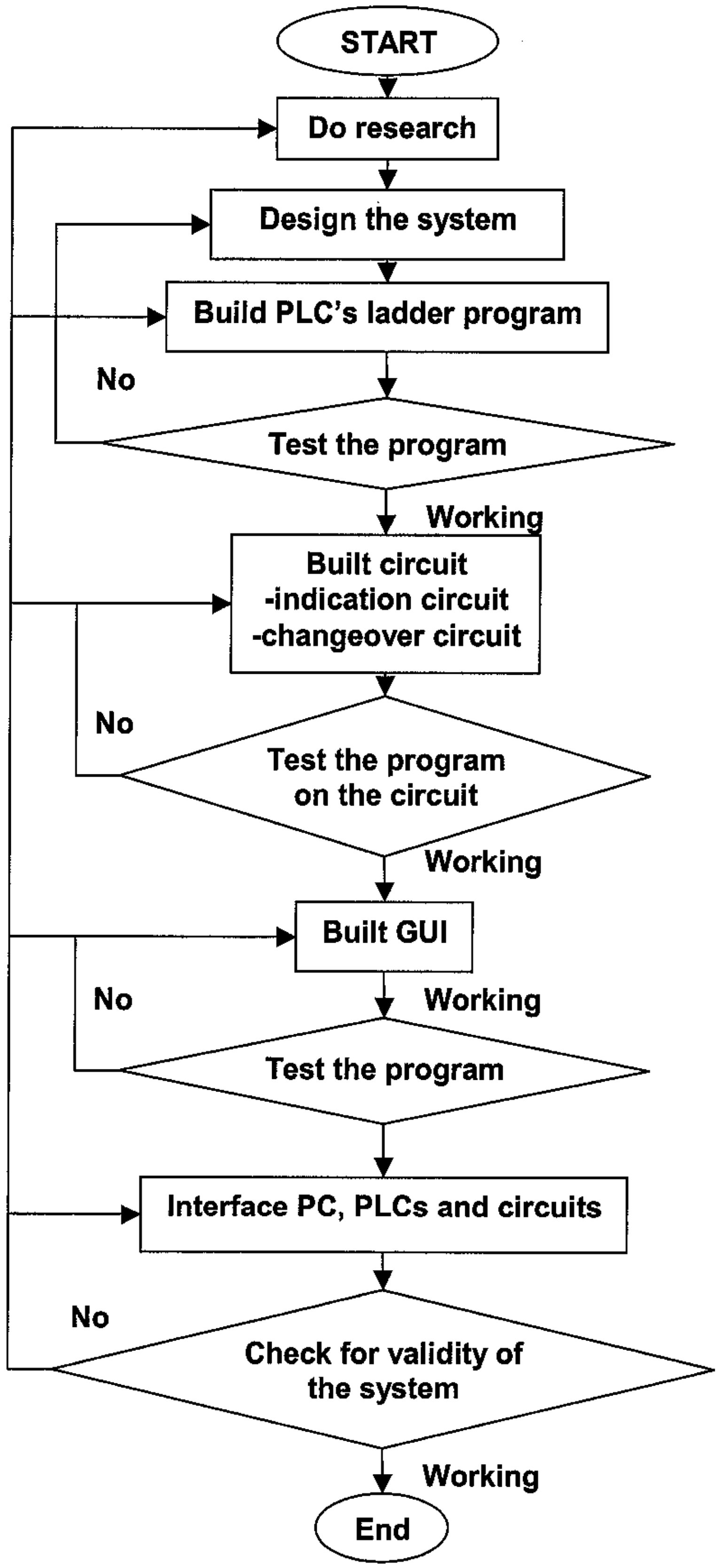


Figure 3.1 – Process Flow

3.2 Tools required

To be mentioned on this section are the software and hardware being used in this project. These software and hardware are the most commonly used applications in an education based simulation.

3.2.1 Software

a) CX-Programmer
b) Electronic Workbench (EWB)
c) Visual Basic 6.0

3.2.2 Hardware

a) Two Omron PLC modules
b) Changeover circuit (Relays)
c) Indication Circuit (Pilot Lamps, toggle switches and etc)
d) MMI PC
e) RS232C cables/adapters (minimum 2)
    i. One for interface between PLC A and PLC B
    ii. One for interface between PLC with MMI PC

CHAPTER 4
RESULT AND DISCUSSION

4.0 RESULT AND DISCUSSION

The results and findings are described further in this section. This includes the findings, observations and results of the project. Still this is not the final version which means that there are rooms for improvement.

4.1 C Series OMRON PLC - CPM 1A

In an automated system, the PLC is commonly regarded as the heart of the control system. This statement is a suitable statement for this project since the main part of the project is the dual redundant PLC system. Proper planning and studying of the PLC system will ensure the success of the end product. In this regard, the study is focuses on the use of OMRON's CPM 1A type PLC modules since their capability to be connected as the master/slave arrangement have never been done before, at least in UTP.

CPM 1A is a compact PLC with twenty (20) IO terminals built into the CPU. This allows a number of twelve (12) inputs and eight (8) outputs which serve well for the purpose of this project (5 inputs; up to 2 output(s)).

This CPM 1A module can be programmed using a programming console or computer software (SYSWIN / CX-programmer). For this project, CX-programmer is used for programming purposes. CX-programmer provides comprehensive programming environment, testing and debugging of any automation system which is a necessary tool for engineers. On line capabilities are also available such as program uploading and downloading, monitoring and multi rung editing. Furthermore, the computer systems (used for PLC purposes) in UTP are using CX-Programmer and CX-server. CX server is a software used to assist the uploading of the program to the PLC memory. All these distinctiveness of the CX Programmer makes it suitable for the implementation of the project.

Through out the two semesters, data has been gathered and translated into a PLC ladder diagram. In a real industrial system, the inputs and outputs that a single PLC needs to handle are up to hundreds, but for the simulation purposes of this project, the system is a scaled down model that handle a single motor. This scaled down system has been developed which will cater five (5) inputs and up to two (2) outputs.

Using the CX programmer, the ladder diagram for the PLC program was constructed (refer to Appendix I). However this is not the complete version of the scale down operation. The program can be further improved for future purposes. Basically, the ladder diagram attached, is a working system.

For this particular project, the ladder diagram consists of 5 rungs with seven (7) I/O modules. For this project purposes, only the basic of a control system is used to fully utilize the OMRON PLC usage. This PLC ladder program was uploaded into the CPM 1A PLC modules and tested for verification of the program. The success of the program can be observed by observing the pilot lamps that had been assigned to a particular output. The basic program of the ladder diagram is further discussed in the next section.

4.2 Basic Programming of the PLC

This section discusses the ladder diagram program that has been developed throughout the two semesters. The programming of the PLC ladder diagram is summarized in Figure 4.1 below.

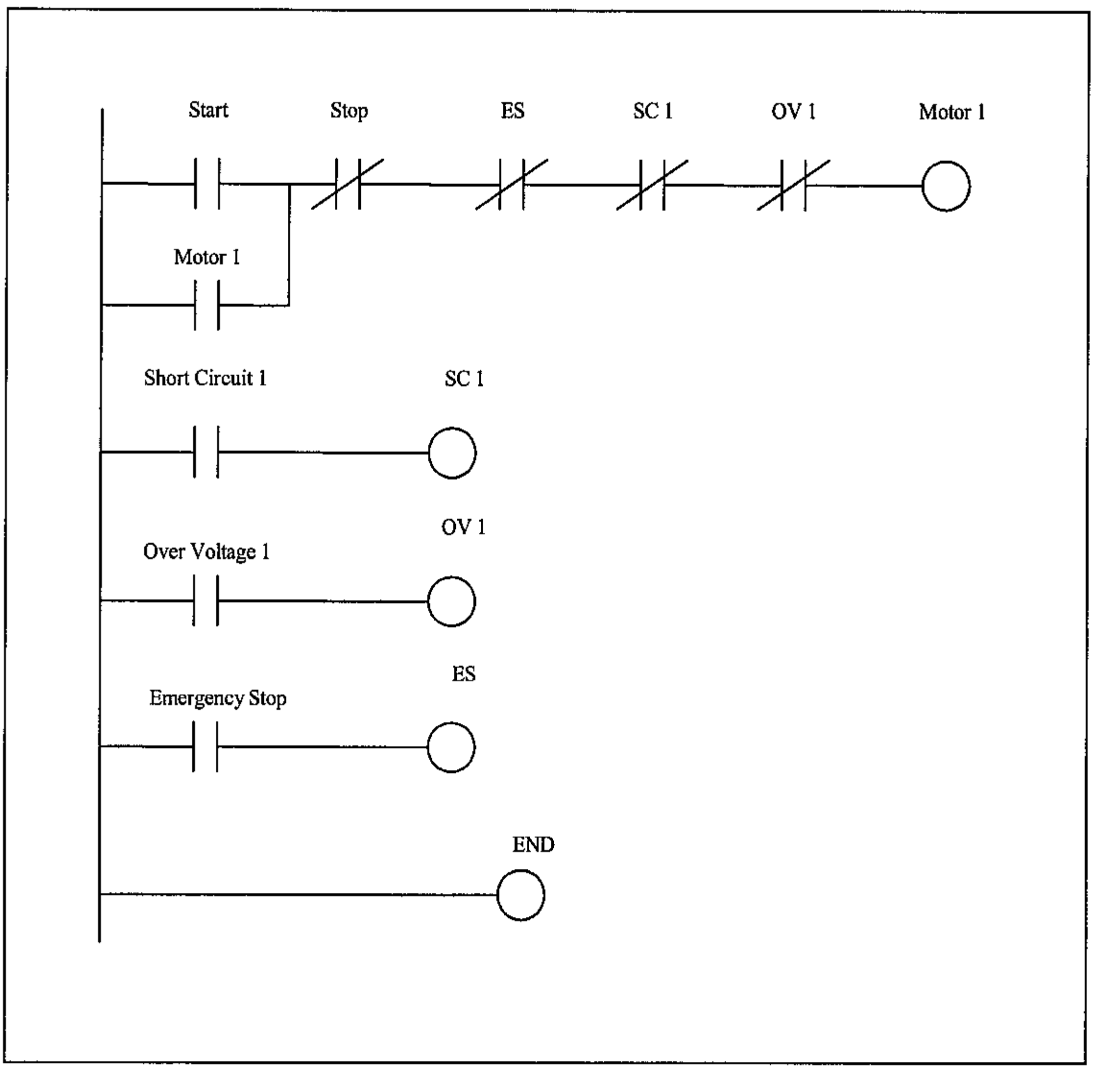


Figure 4.1 – Ladder Diagram

The ladder diagram program has been developed to follow the following requirement: a START command initiate the sequence and a STOP command to reset the sequence. This means that the motor will run when there is a START command and the STOP command and faults are clear. It implies that the program would check for a START command. Then it will check for any STOP command and any faults associated to the motor. When all is clear, the motor can be operated smoothly. Note that the program is using a self holding circuit. This enables the motor to keep running despite the status of the triggering START command. The START command can be toggled to the OFF position once the motor starts running.

Each of the START and the STOP commands as well as the faults has been assigned to a specific toggle switch that would be used to trigger an indication circuit. The inputs and outputs also would be indicated by pilot lamps to show the status of the I/Os.

It is important to note that this program is a basic PLC program specifically used in this project. The actual program would be more complicated since the PLCs are using a MASTER/SLAVE configuration. Further modification to the program is required when it is to be used in the real system. This is to ensure that the program can cater to the numerous inputs and outputs used in industrial plant. The actual program with regards to the execution of the project is attached in Appendix I.

4.3 Changeover Circuit

The PLC requires a changeover circuit that would served the purpose of changing the Master status to the other PLC is case of any failure of the Master PLC. This is important as to provide a reliable monitoring, control and fault analysis of the system. This function of the intelligent system, ensure continuous communication to the MMI PC of the plant process. In this matter, the student had chosen to make use of relays.

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be turned ON or OFF. Relays can have two switch positions arranged as double throw (changeover) switches.

Advantages of relays:

- Relays can perform as, AC and DC switch
- Relays can switch high voltages.
- Relays are a better choice for switching large currents (> 5A).
- Relays can switch many contacts at once.

In this project, the relays are connected to one of the inputs and one output of the PLCs. The relays used are 24V DC relays. This is because the input and output of the PLC is a 24V DC signals. Figure 4.2 shows the schematics of the changeover circuit used for the project.

This changeover circuit consisted of a six 24V DC relays. As stated before, the used of 24V DC relays are due to the fact that the 24V DC signals are used in the PLC as well as the indication circuit. The input and output signals for the OMRON CPM 1A PLC is fixed to be a 24V DC signal. It is important that the student make used of the 24V signal since most manufactured PLC also used 24V DC signal as its input and output signals.

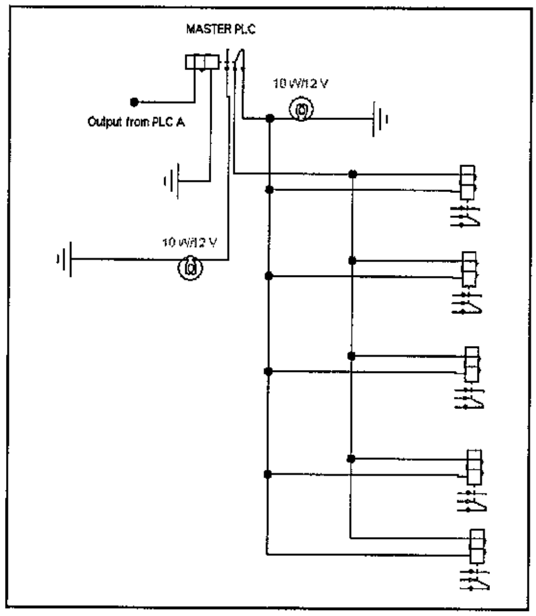


Figure 4.2 – Changeover Circuit

In this changeover circuit, one of the relay will act as the Master Relay. This master relay will control the other five relays. When the Master Relay is energized, PLC A would control the communication with the indicator circuit and when it de-energizes, PLC B would take over the communication. Basically, the circuit checks for the status of PLC A. If PLC A is healthy, PLC A would control the communication. If not, the back up PLC (PLC B) would be in charged of the communication. The other five relays are used to provide input and outputs to and from the indicator circuit.

Referring to Figure 4.2, the normally open (NO) port of the Master Relay is connected to a pilot lamp that is used to indicate that the PLC A is the Master and is controlling the communication. While the normally closed (NC) port of the Master Relay is also connected to a pilot lamp which indicates that PLC B is handling the communication.

This particular pilot lamp is connected in parallel with the coils of the other five relays. The common ports of this Master relay, is connected to a 24V DC power supply.

The NC ports of the other five relays were connected to I/O ports of PLC A while the NO ports of the relay were connected to I/O ports of PLC B. The common ports of these relays are connected to the indication circuit.

This circuit provides the rationale of the changeover functions to the PLCs. When the Master Relay energizes, it energizes the other relays as well and the communication are from PLC A. Thus the relay would take and send signals to and from PLC A. When the Master Relay de-energizes, it would de-energized the other relay as well and PLC B would take charge of the communication.

The changeover circuit was first simulated using in Electronic Workbench (EWB) software. When it is proven to be working, the hardware is built. The circuit was tested using a 24V DC signals power supply and is proven to be working perfectly. Figure 4.3 shows the finished product of the changeover circuit.

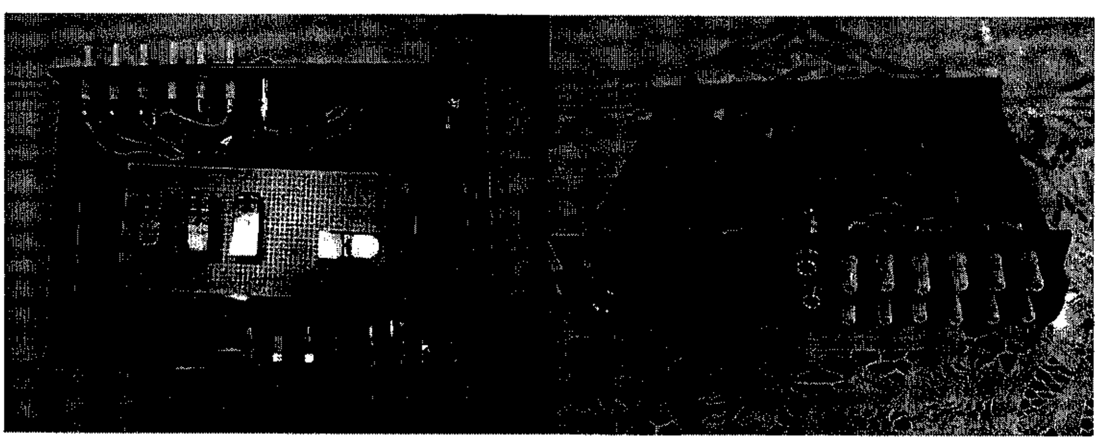


Figure 4.3 – Changeover Circuit Box

4.4 Indicator Circuit

The necessity of an indicator circuit is to further verify that the system is working as desired. Figure 4.4 shows the schematic diagram of the indicator circuit that is used in this project.

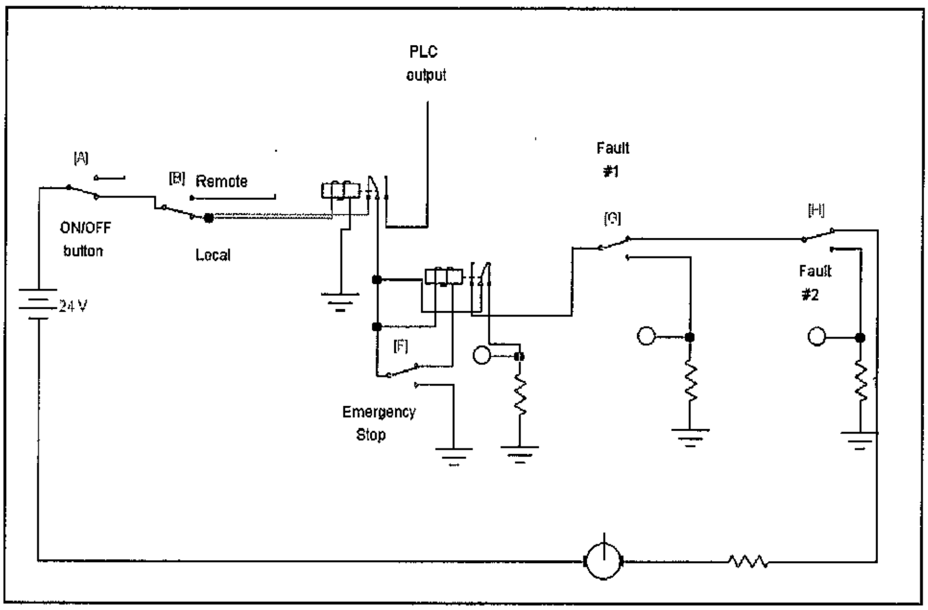


Figure 4.4 – Indicator Circuit

The circuit consists of:

1. A dc power supply
2. Remote/Local selector switch
3. ON/OFF pushbutton
4. Emergency stop button
5. Relay
6. Fault indicator circuits (using toggle switches and pilot lamps) and
7. Motor.

This indication circuit would function to provide the control means to the PLC as well as feedback. This means that the inputs and outputs of the PLC were connected at a few points in the circuit.

This circuit is a simple scaled down model of a system that is used in the actual industrial plant. This circuit would have two control means. One is for Local Control and one is for Remote control. Local control means that the motor would be controlled at the station itself. While the remote control gives a control mean from remote places such as control room that can be realizable via networking. This type of control method is achieved by using a REMOTE/LOCAL selector switch.

The REMOTE/LOCAL selector switch is actually using a two way toggle switch. This REMOTE/LOCAL selector switch would give the desirable output outcome with the help of a 24V DC relay. The coil of the relay is connected to the LOCAL path. This means that if the selector switch is put to Local, the relay would use the signal from the power supply. If it is put into remote, it would take up the signal from the output of the PLC. Both signals from the power supply and the PLC are 24V DC signals.

The circuit also has an emergency stop button that would break the circuit while ignoring the position of the selector switch. This emergency stop button is usually being used in case of any accidents of mishaps, or if the motor fails to stop. In a real industrial plant, emergency stop button (commonly refer as Emergency Stop Device (ESD)) is a crucial part of a system: it provides the necessary circuit breaking when there is any failure. This is to prevent any damage and losses to equipments as well as to prevent any accident to personnel.

The indication circuit is also equipped with fault simulations circuits. This is achieved via toggle switches. There are two faults that can be simulated, Fault 1 and Fault 2. These two fault circuits are used to show that the PLC could received the input and inform the output of a computer to show the associate fault.

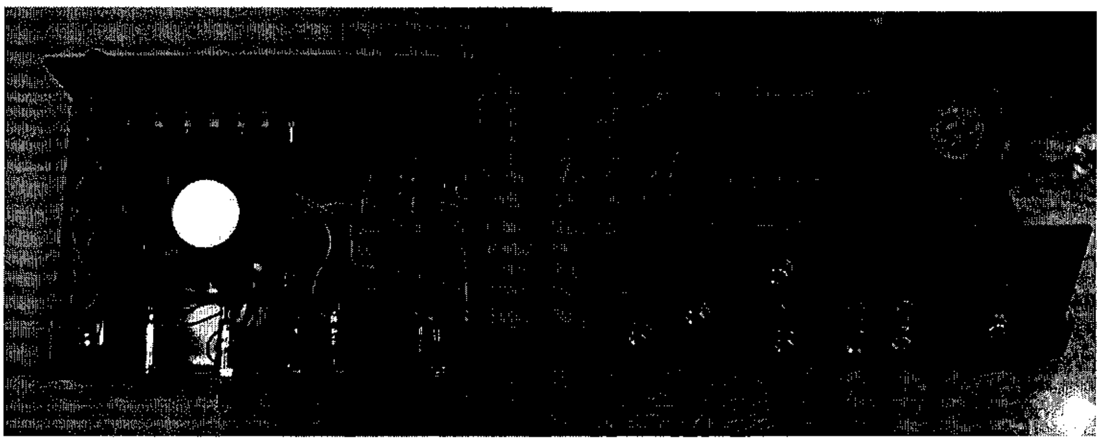


Figure 4.5 – Inner view of the Indication Circuit Box

Similar to what have been done earlier for the changeover circuit, the circuit was first simulated in EWB software. When the simulation is successful, the indication circuit was then built up into a control box. The circuit was tested and proven to be working. The end product of the indication is as shown in Figure 4.5.

4.5 Graphics User Interface (GUI)

As discussed before, the MMI PC will be equipped with a Graphic User Interface, used to interact with the PLC. This interaction includes issuing control as well as getting feedback from the PLC. After further discussing with the project supervisor, the student was encouraged to used Visual Basic 6.0 (VB) programming to build the software to be used in the MMI computer.

The main objective of this stage is to build a GUI that can interact between the PC with PLC. This can be done using VB and be interfaced with OMRON's CX programmer. It is important to state here that this section will only be discussing the VB GUI programming techniques but not the interfacing.

4.5.1 Visual Basic

Visual Basic (VB) is a tool that allows the user to develop Windows (Graphic User Interface - GUI) applications. The applications have a familiar appearance to the user. Visual Basic is an event-driven, meaning code remains idle until called upon to respond to some event (button pressing, menu selection and etc.) Visual Basic is governed by an event processor. Nothing will happen until an event is detected. Once an event is detected, the code corresponding to that event (event procedure) is executed. Program control is then returned to the event processor.

Features of Visual Basic include:

- Full set of objects - the user 'draw' the application
- Lots of icons and pictures for user's use

- Response to mouse and keyboard actions
- Clipboard and printer access
- Full array of mathematical, string handling, and graphics functions
- Can handle fixed and dynamic variable and control arrays
- Sequential and random access file support
- Useful debugger and error-handling facilities
- Powerful database access tools
- ActiveX support
- Package & Deployment Wizard makes distributing your applications simple

Application (Project) in VB is made up of:

- **Forms** - Windows that is used for create the user interface
- **Controls** - Graphical features drawn on forms to allow user interaction (text boxes, labels, scroll bars, command buttons, etc.) (Forms and Controls are **objects**.)
- **Properties** - Every characteristic of a form or control is specified by a property. Example properties include names, captions, size, color, position, and contents. Visual Basic applies default properties. You can change properties at design time or run time.
- **Methods** - Built-in procedure that can be invoked to impart some action to a particular object.
- **Event Procedures** - Code related to some object. This is the code that is executed when a certain event occurs.
- **General Procedures** - Code not related to objects. This code must be invoked by the application.
- **Modules** - Collection of general procedures, variable declarations, and constant definitions used by application.

Provided these features are available by using single VB software, the student had chosen to use VB as the software to develop the project's GUI application. The next section discusses in the extent of programming the GUI application.

4.5.2 GUI Programming

In this design step, the GUI designer needs to come out with the basic outlook of the interface. The initial design must be created based on the requirement of the application that needs to be designed. Thus, for this particular project, the requirement is to provide feedback and control to the plant process indication circuit.

Referring to the project objectives, this particular stage in the designing process of the project is to develop an interface for PC. This interface will be providing operator/user to monitor as well as controlling the plant process. As we know, PC will provide a remote control of the plant process. It means that the control and monitoring of the process can be done without the operator to be at the actual station.

Basically the GUI will provide user with three interface window. The first interface window is shown in Figure 4.6. In the main this particular window is a welcoming interface for the system. It provides the user a particular introduction to the software. For example name of the software is Data Collector for Intelligent System (DCIS), for which company it is being issued (UTP) and other relevant information.

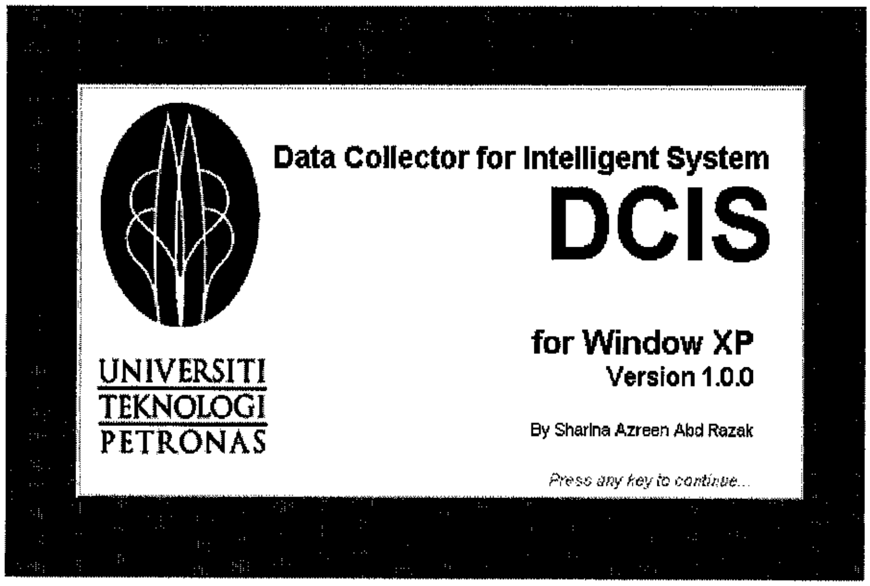


Figure 4.6 – First Window Interface

The next interface is opened when the user press any one of the keyboard keys. This tells the status of the monitor form. It will shows whether the motor is running or whether there is any indication of faults to the particular motor. This second interface is shown in Figure 4.7. As notice below, this interface also provide the control means of starting and stopping of the motor.

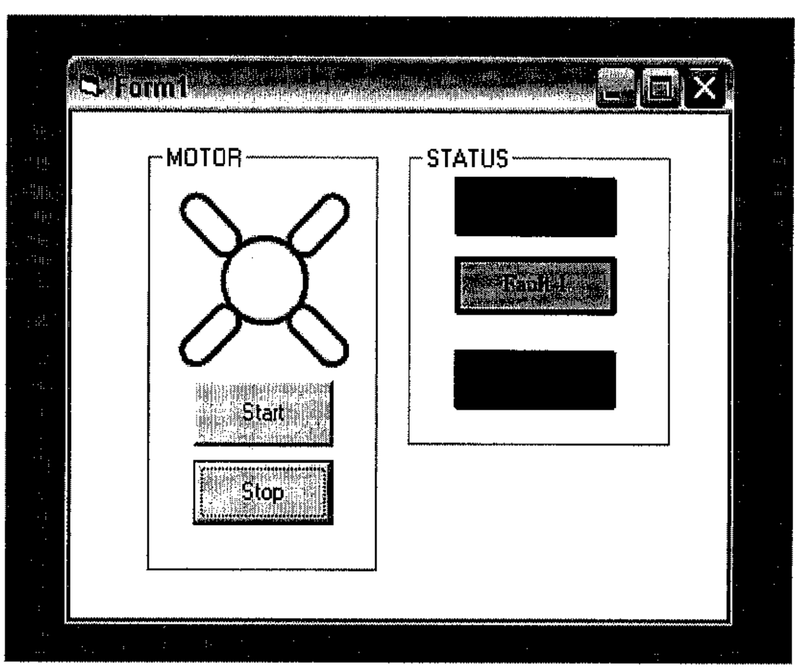


Figure 4.7 – Second Window Interface

The monitoring of the motor can be done by observing the STATUS frame to the right of the window interface. The motor status is indicated by using a Motor box. This box can change between red and green. Red will indicate that the motor is offline and green indicates that the motor is online.

As mention before, there are two faults that can be associates with the motor, Fault 1 and Fault 2. In Figure 4.7, these faults are represented by two different boxes namely Fault 1 and Fault 2. These boxes can change between red and grey colour. Red indicates that the there is a fault and need immediate attention while grey indicates all faults are clear. This two fault boxes work independently, which means that each boxes will refer to one particular fault input.

The MOTOR frame provides the control to the plant process. It allows the operator the option to START or STOP the motor. But for safety reason, the control of the motor need to be equipped with a password protection system. This is to avoid any mishaps or access by unauthorized person. When the START and STOP button is pressed, automatically the third window interface would automatically popped up this interface in the password verification form. This form is shown below in Figure 4.8(a).

To START or STOP the motor, the user will first be asked to input the right user name and password. The program then would checked for the validity of the inputted password and user name. Figure 4.8(b) shows a pop up window when the user name and password is invalid. Figure 4.8(c) shows a pop up window when the user name and password is applicable with the ones saved in the system. This pop up window is a double checking scheme to ensure that the user does wish to operate the motor.

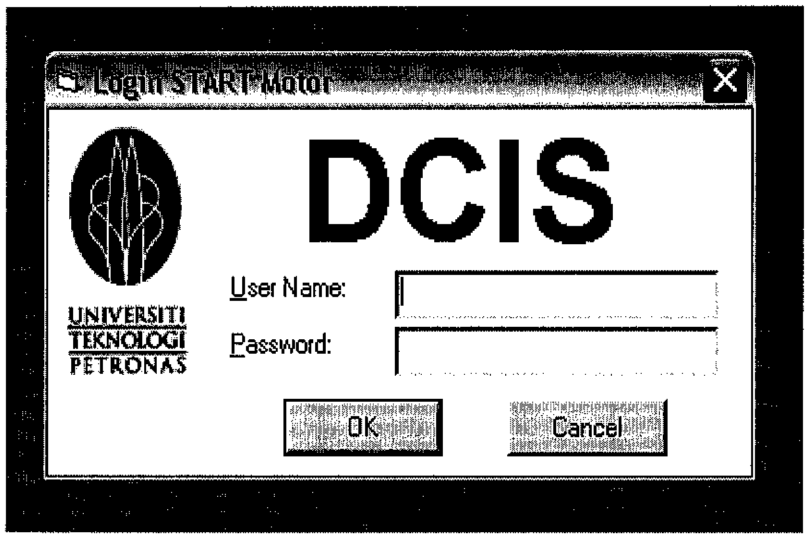
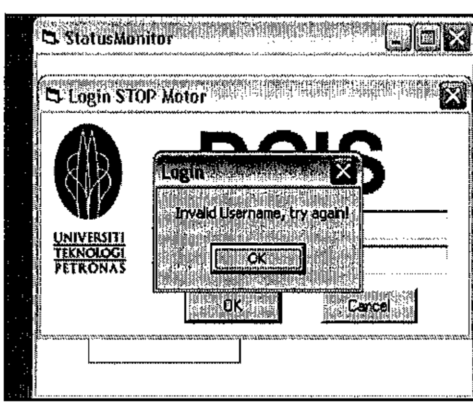


Figure 4.8 (a) – Password Verification Interface



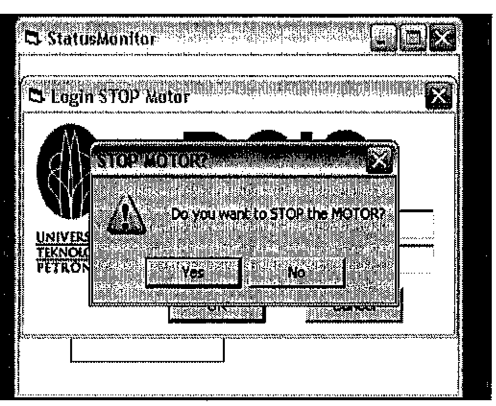


Figure 4.8 (b) *Figure 4.8 (c)*

Full focus on this stage is essential in order to obtain a working GUI application. The entire main interface had been programmed accordingly to achieve a workable GUI. Thus, the programming job does not end at the VB programming technique only.

It should be noted that the GUI program must be implemented to the PLC system. This means that proper syntax and coding is used to be able to integrate both GUI and PLC. Therefore, in order to complete this stage, two essential skills that needs to be acquired are VB programming and the PLC addressing technique. This is to ensure that the PLC address will suit the GUI syntax.

Once the addressing mode of the PLC is understood, the coding for the GUI would be much easier to understand and programmed. The coding of the GUI with the right programming syntax are attached to Appendix II.

This GUI application can be further improved. It can be enhanced with a data trending system that can store data and faults that can be used for future reference on trending. Other area that can be improved is the safety and integrity of the GUI application. It is important to the GUI to permit limited access especially when it is used for critical operations.

4.6 PC-Based System Set-Up

At this stage, the focus is to use a particular software to link the MMI PC with the PLC. This linking stage is done to provide a PC-based system which means that the control and monitor can be done at the PC. Mainly, the system consists of two mechanisms. The first mechanism would connect the PLC with the PC and the other mechanism is to link the GUI with the PLC. All these are done in order to provide a control mean for the PC to manage the PLC.

Generally there are three main software involve namely: SYSMAC Compolet, FINS Gateway and Visual Basic. Each one of this software plays its own role in the architecture of a PC based system.

As has been discussed earlier, Visual Basic is used to construct the GUI application. FINS Gateway works as the communication software between the PC and PLC. It establishes the communication interface between these two components. This window bases software is suitable for most of OMRON PLC system. Thus, it is applicable for this particular project.

The third software, which is SYSMAC Compolet plays the role of a communication bridge or translator. It establishes the communication between the GUI applications with the PLC system. Without this software, the GUI cannot interact with the PLC memory area even though the correct programming syntax is used. SYSMAC Compolet utilizes the ActiveX control for Window to allow user to read and write to the PLC freely.

4.7 Interface

Interface is done to enable two or more components or equipments to interact with each other. In this project, the student had selected two types of interface that need to be used for integration of the main parts of the projects. The interface that have been selected are RS232 and RS422. RS232 is used to interface between the two OMRON CPM 1A PLCs, while RS422 for interface between both PLCs with the MMI PC.

4.7.1 RS232

RS232 is a popular communications interface for connecting modems and data acquisition devices to computers. RS232 devices can be plugged straight into the computer's serial port (also known as the COM or Comms port). Examples of data acquisition devices include GPS receivers, electronic balances, data loggers, temperature interfaces and other measurement instruments.

Today, RS232 interfaces are supported in more equipment that any other port and have the largest number of independent suppliers. Most testing equipment controls, etc. can be operated without any problems at today's standard data transfer rates and there is virtually no task that cannot be handled at the lowest level as regards complexity and costs with the RS232:

RS232 devices can be connected directly to PCs, modems and event to notebooks or calculators, which offer only very few options for connection. The market offers low-cost ISDN adapter, and RS232 data can be directly written to PC disks. Conversion into all other serial standards (RS422, 423, 485, 20mA and into all field busses) is very easy. Fiber-optic cables are closely related to RS232, and transition is therefore extremely simple.

RS232 is simple, universal, well understood and supported but it has some serious shortcomings as a data interface. The standards are up to 256kbps or less and line lengths of 15M (50 ft) or less.

Though it seems that RS232 have few shortcomings as data interface, but it still can be used in many applications. It might therefore be appropriate to see RS232 as base interface for this project. This is because RS232 is universally applied, there are no conversion issues and the cost is very low, provided that every device is equipped with this interface.

From the researched done, it is further clarify that RS232 is a suitable interface for this project. Furthermore, the CPM 1A modules that are provided by UTP are already equipped with RS232 adapters which further simplify the protocol issue.

4.7.2 RS422

RS422 is a balanced serial interface for the transmission of digital data. The advantage of a balanced signal is the greater immunity to noise. RS422 is an interface for point-to-point connections. The different of these RS422 systems to RS232 is that it does not implement the hardware handshake lines often found in RS232 systems due to the cost of running additional conductors over long distances.

RS422 system software differs little from the familiar point-to-point RS232 communication systems. RS422 is often used to simply extend the distance between nodes over the capabilities of RS232. RS422 can also be used as the master node in a master-slave network. A master-slave type system has one node that issues commands to each of the "slave" nodes and processes responses. Slave nodes will not typically transmit data without a request from the master node, and do not communicate with each other.

RS422 were designed for greater distances and higher Baud rates than RS232. In its simplest form, a pair of converters from RS232 to RS422 (and back again) can be used to form an "RS232 extension cord".

From the researched done, it can be said that RS422 is a suitable interface for this connecting the PC with the PLC. This is because the PC will be placed at a remote station for example control room. So, it would be advisable to use RS422 protocol since it supports transmission over long distance. But unfortunately, during the testing purpose project, the validity of this particular interface cannot be done since RS422 adapters and cables are not available at the lab. Purchasing has been planned, however the supplier was unable to supply it.

4.8 The Block Diagram for the System

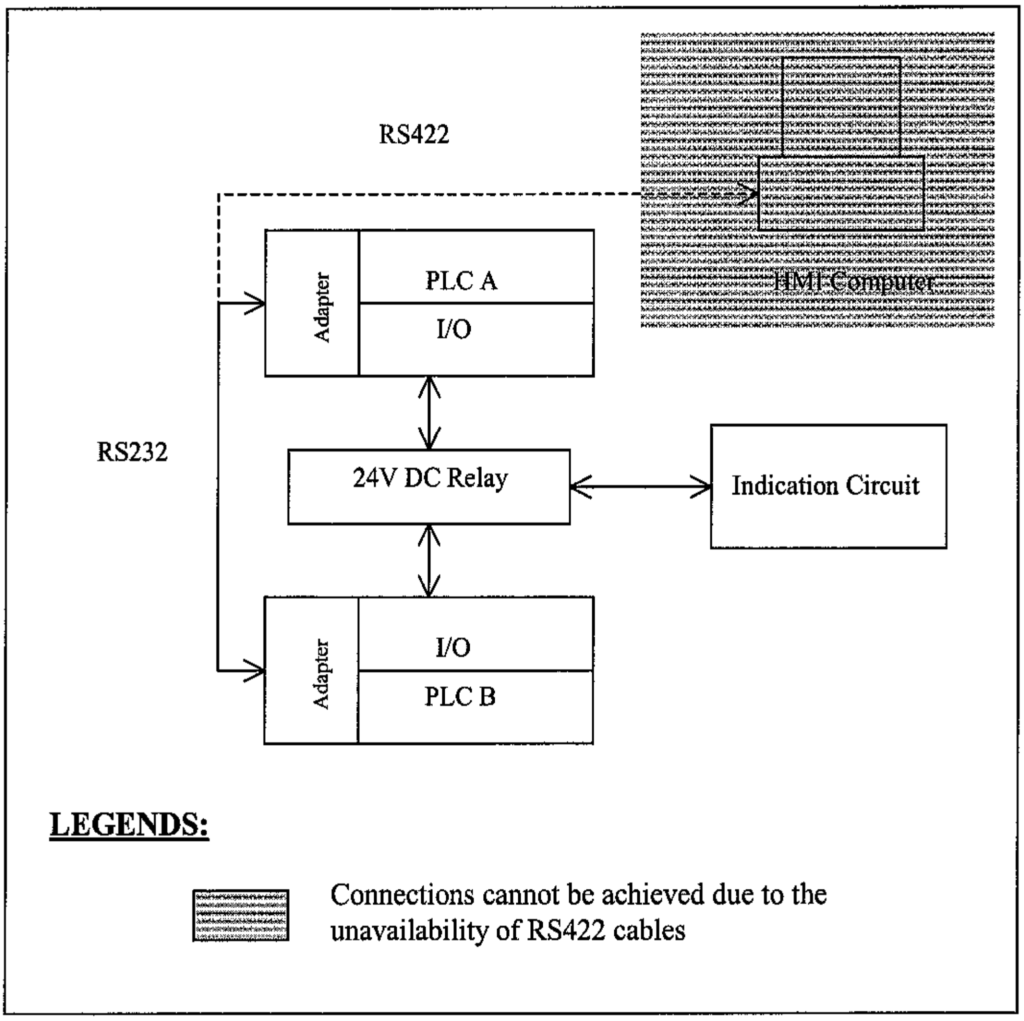


Figure 4.9 – Block Diagram Connections of the System

Figure 4.9 shows the block diagram connections for the system. The connection between the two PLCs is using a RS232 cables with one PLC will be Host (MASTER) and the other one as set as NT (SLAVE). The connection between the PLCs with the MMI PC would most likely using RS422 cables and adapter. But since RS422 cables and adapter is not available at hand, the connection is using a RS232 connector.

A single output from PLC A is connected to the coil of a 24V DC relay that act as a Master relay in a changeover circuit. This relay will be energized when PLC A in the Master status and de-energized when PLC B in the Master status. Other inputs and outputs of both PLCs are connected to NC and NO ports of the other relays in changeover circuit. In general, the changeover will take place when PLC A fails to provide output to the changeover circuit.

Next, the changeover circuit is connected to the indication circuit. The inputs from the indication circuit are connected to the common ports of the relays in the changeover circuit. This means that there would not be any interruption to the indication circuit despite which PLC is taking the MASTER status.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.0 CONCLUSION AND RECOMMENDATION

The development a model using PLC system based on the architecture of the PLC system in Centralised Utility Facilities, Gebeng (CUFG) Kuantan has been discussed. The focus is to achieve a reliable monitoring and control system for a low voltage system application.

This project has exposed the student to build a reliable monitoring and controlling system for plant process. It provides the student with the opportunity to interfacing the devices as well as working with protocols. Apart from that, the student had gained additional knowledge on software development and application.

Furthermore, this project and research has exposed the student to the new development of the plant process control system and at the same time gain some knowledge on how to design and network a multiple layer system. It provides venue for the student to be exposed to become a good system and design engineer.

5.1 CONCLUSION

The main objectives of this project had been successfully achieved. The main contributions of this work are as follows:

- Built building a dual redundant PLC system that can independently monitor the status of the industrial process

- Developed a program for a Graphic User Interface (GUI) system for used with a PC
- Built a small scale simple plant process indication circuit
- Interfaced all the main components of the project
- Handled important tasks in proposing a project up until the completion process.

The essence of this project is the ability to grasp the knowledge on related hardware and software. It requires also knowledge on the integration process of the hardware and software. Thus, it is important to have good understanding on the structure of the software and hardware. CX-programmer is the tools to develop the ladder diagram for the PLC program. Correct addressing mode is a crucial factor. Moreover, the address must comply with the syntax that is used in Visual Basic which is the GUI programming software.

The main part of the interfacing stage is the understanding of the communication mechanism that is used between the equipments. For the PC-PLC mechanism, FinsGateway is the software that support and establish the communication link. While SYSMAC Compolet is the software which integrates the function of GUI and the PLC program. The operation of the SYSMAC Compolet and the correct setting must be fully comprehended.

As time goes by, PLC system will face bigger challenge from time to time and it is important for the system to be able to coup with the rapidly moving industrial technology. Thus, more people with the right knowledge and experience with PLC platform system will be needed.

5.2 RECOMMENDATION

Although this project has partially achieves its objectives which include constructing the proper PLC programming, GUI constructions and PC based system platform, it still has a long way to go. This project can be a good starting point for remote system development. There are a lot of aspects that can be further improved.

Good understanding on all the software and hardware used is the essence of the project. The project is mainly about integrating various components using relevant software and hardware. For example the integration between the PLC with the MMI PC using relevant software and hardware which act as the connection platform.

For an instance, the connection between PLC and PC needs to be further clarifies. This is because RS422 adapters and cable which is important for a 1-to-2 connection is not available at hand when this project is done. This means that the student need to make used of RS232 cables and adapters available. The RS232 cable can only cater to a 1-to-1 connection. This means that the student can only make connection between both PLCs or between the MMI PC with a single PLC module using RS232 cables. Though it is proven to be working, the system can be further improved. This is important since the aspect of this project is to provide a reliable monitoring of the plant process.

The GUI that has been developed for this project can be further improved. This GUI application is not the finalized version. It can be enhanced with a data trending system that can store data and faults that can be used for future reference on trending. Other area that can be improved is the safety and integrity of the GUI application. It is important to the GUI to permit limited access especially when it is used for critical operations. Besides, the GUI must be able to cope with future expansion of the operation system. Thus, it is important that the GUI system source code is available and can be altered to suit the purpose of the future system.

The major achievement of this project is when it is viable to be implemented into the real industrial process. Thus, in future, the important part of the project should focus on understanding the real world Supervisory Control and Data Acquisition (SCADA) system and how the integration was done with the various field equipments. To successfully achieve this requirement, a lot of effort need to be put in, the relevance software must be fully comprehend, and the hardware especially the PLC must be able to cater with the real industrial standard.

CHAPTER 6

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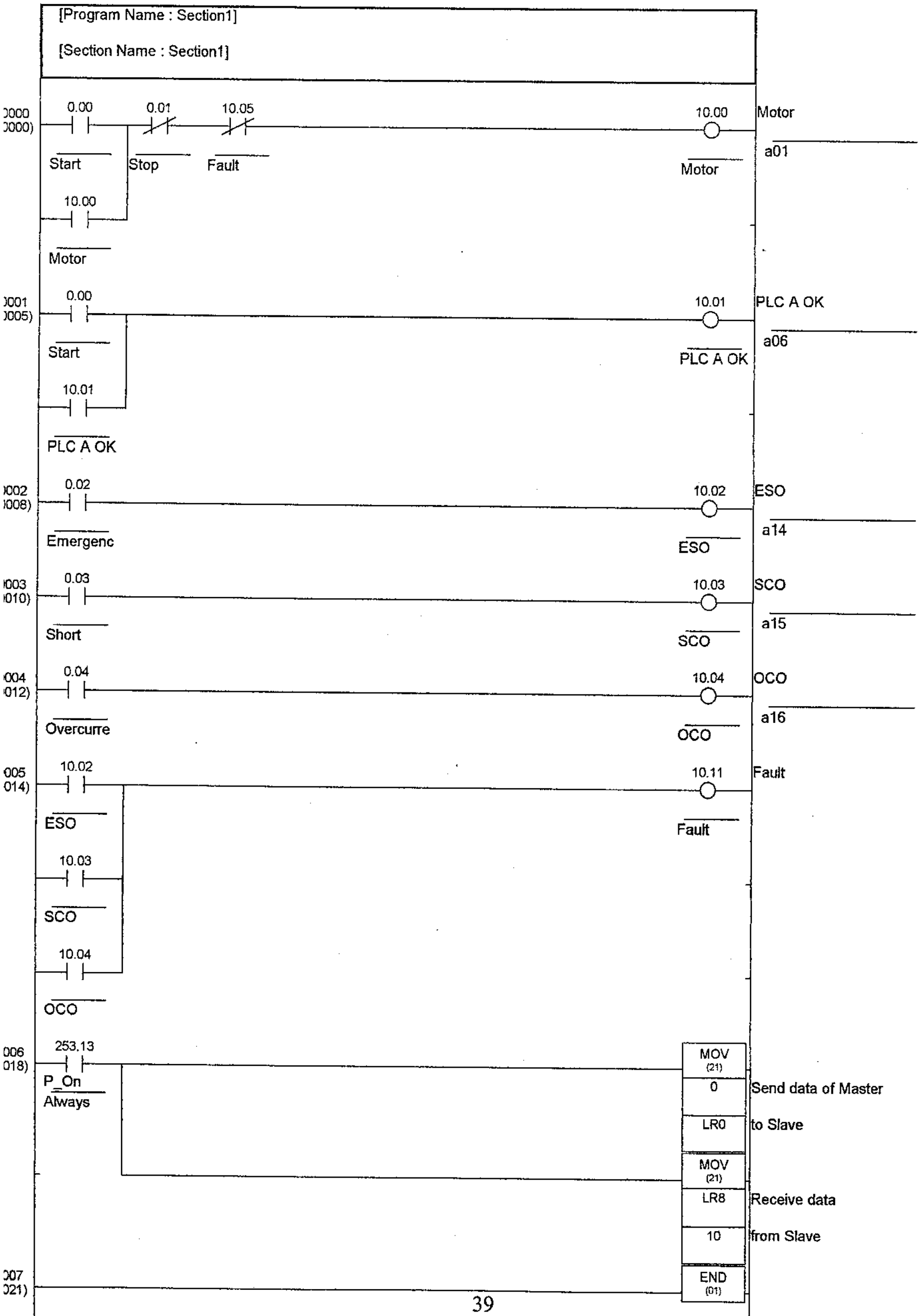
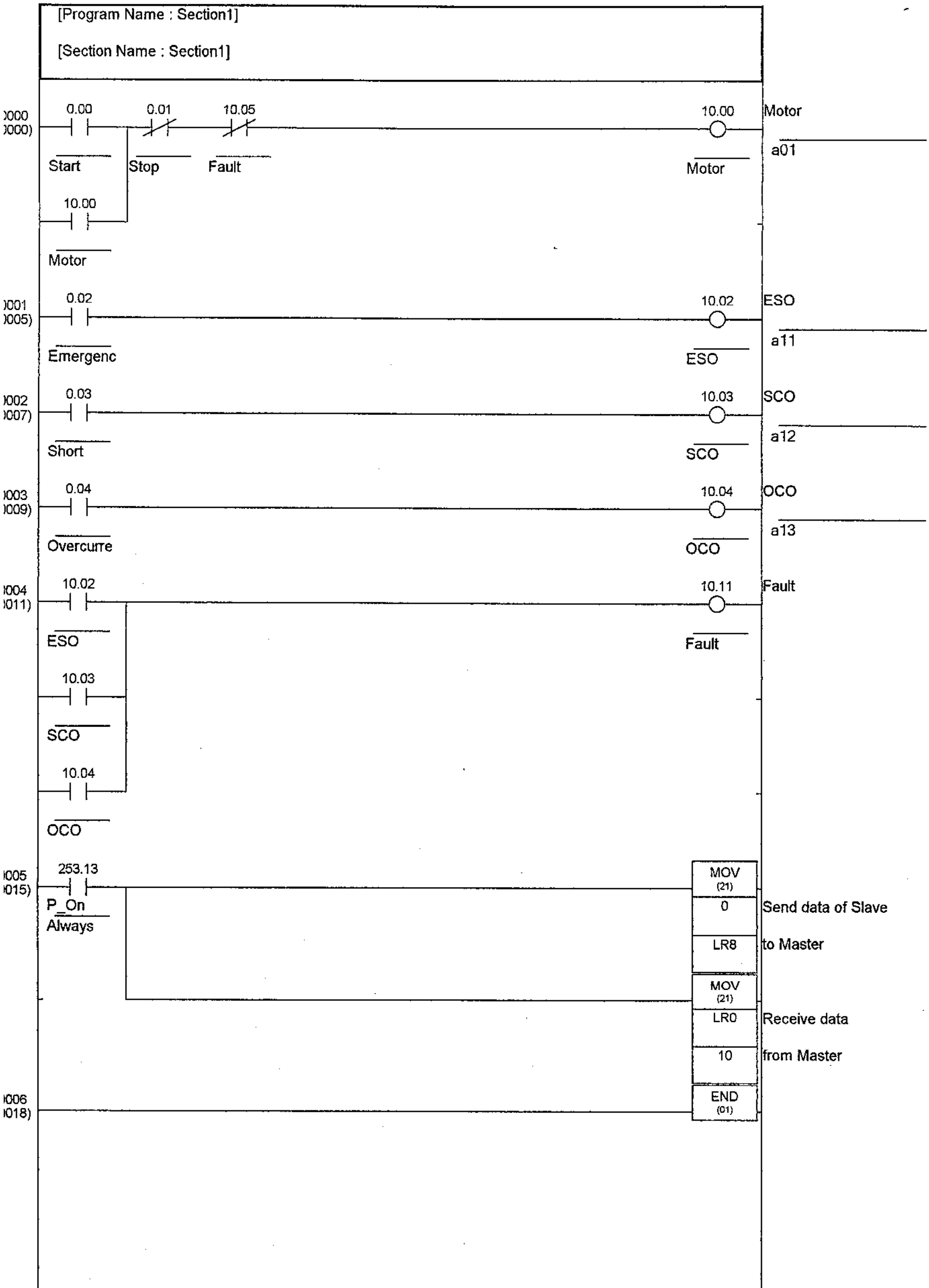
APPENDIX I
LADDER DIAGRAM


[Program Name : Section1]
[Section Name : Section1]
)000
)000)
0.00
Start
0.01
Stop
10.05
Fault
10.00
Motor
Motor
a01
10.00
Motor
)001
)005)
0.00
Start
10.01
PLC A OK
PLC A OK
a06
10.01
PLC A OK
)002
)008)
0.02
Emergenc
10.02
ESO
ESO
a14
)003
)010)
0.03
Short
10.03
SCO
SCO
a15
)004
)012)
0.04
Overcurre
10.04
OCO
OCO
a16
)005
)014)
10.02
ESO
10.03
SCO
10.04
OCO
10.11
Fault
Fault
)006
)018)
253.13
P_On
Always
MOV
(21)
0
LR0
Send data of Master
to Slave
MOV
(21)
LR8
10
Receive data
from Slave
)007
)021)
END
(01)


[Program Name : Section1]
[Section Name : Section1]
)000
)000)
0.00
Start
0.01
Stop
10.05
Fault
10.00
Motor
Motor
a01
10.00
Motor
)001
)005)
0.02
Emergenc
10.02
ESO
ESO
a11
)002
)007)
0.03
Short
10.03
SCO
SCO
a12
)003
)009)
0.04
Overcurre
10.04
OCO
OCO
a13
)004
)011)
10.02
ESO
10.03
SCO
10.04
OCO
10.11
Fault
Fault
)005
)015)
253.13
P_On
Always
MOV
(21)
0
LR8
Send data of Slave
to Master
MOV
(21)
LR0
10
Receive data
from Master
)006
)018)
END
(01)

APPENDIX II
GRAPHIC USER INTERFACE (GUI)
PROGRAM

1st Window

```
Option Explicit

Private Sub Form_KeyPress(KeyAscii As Integer)
   Unload Me
   StatusMonitor.Show
End Sub

Private Sub Form_Load()
   lblVersion.Caption = "Version " & App.Major & "." & App.Minor & "." &
App.Revision

End Sub
```

2nd Window

```
Option Explicit

Public LoginSucceeded As Boolean

Private Sub Command2_Click()
   LoginStart.Show
End Sub

Private Sub Command1_Click()
  LoginStop.Show
End Sub
```

3rd Window

```
Option Explicit

Public LoginSucceeded As Boolean

Private Sub cmdCancel_Click()
   'set the global var to false
   'to denote a failed login
   LoginSucceeded = False
   Me.Hide
End Sub

Private Sub cmdOK_Click()
   'check for correct password
   If txtUserName = "Administrator" Then
      If txtPassword = "password" Then
         'place code to here to pass the
         'success to the calling sub
         'setting a global var is the easiest
         LoginSucceeded = True
         'Me.Hide
         Dim Response As Integer
         Response = MsgBox("Do you want to START the MOTOR?", vbYesNo +
vbExclamation + vbDefault + vbApplicationModal, "START MOTOR?")
         If Response = vbYes Then
            StatusMonitor.Show
         Else

         End If
```

```
        Else
          MsgBox "Invalid Password, try again!", , "Login"
          txtPassword.SetFocus
          SendKeys "{Home}+{End}"
        End If
    Else
          MsgBox "Invalid Username, try again!", , "Login"
          txtPassword.SetFocus
          SendKeys "{Home}+{End}"
    End If
End Sub
```

4th Window

```
Option Explicit

Public LoginSucceeded As Boolean

Private Sub cmdCancel_Click()
    'set the global var to false
    'to denote a failed login
    LoginSucceeded = False
    Me.Hide
End Sub

Private Sub cmdOK_Click()
    'check for correct password
    If txtUserName = "Administrator" Then
        If txtPassword = "password" Then
```

```
        'place code to here to pass the
        'success to the calling sub
        'setting a global var is the easiest
        LoginSucceeded = True
        'Me.Hide
        Dim Response As Integer
        Response = MsgBox("Do you want to STOP the MOTOR?", vbYesNo +
vbExclamation + vbDefault + vbApplicationModal, "STOP MOTOR?")
        If Response = vbYes Then
          StatusMonitor.Show
        Else

        End If
      Else
        MsgBox "Invalid Password, try again!", , "Login"
        txtPassword.SetFocus
        SendKeys "{Home}+{End}"
      End If
    Else
        MsgBox "Invalid Username, try again!", , "Login"
        txtPassword.SetFocus
        SendKeys "{Home}+{End}"
    End If
End Sub
```

APPENDIX III
GANTT CHARTS

Gantt Chart for First Semester of FYP **Gantt Chart**

No.	Detail/ Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Date	19– 24 July	26 – 30 July	2 – 6 Aug	9 – 13 Aug	16 – 20 Aug	23 – 27 Aug	30 Aug – 3 Sep	13 – 17 Sept	20 – 24 Sept	27 Sep – 1 Oct	4 – 8 Oct	11 – 15 Oct	18 – 22 Oct	25 – 29 Oct	1 – 5 Nov
1	Selection of Project Topic		♣													
	- Submission of Project Proposal		♣													
2	Preliminary Research Work				♣											
3	Submission of Preliminary Report				♣											
4	Research															
	-Reference/Literature															
5	Prepare Progress Report								♣							
	Submission of Progress Report								♣							
6	Project work continue															
	-Practical/Laboratory Work															
7	Interim Report Final (Draft)												♣			
8	Submission of Interim Report														♣	
9	Oral Presentation															♣

Legends: ♣ Completed ◆ Suggested milestone Process

Gantt Chart for Second Semester of FYP

No.	Detail/ Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
	Date	24 – 28 Jan	31 Jan – 4 Feb	7 – 11 Feb	14 – 18 Feb	21 – 25 Feb	28 Feb – 4 Mar	7 – 11 Mar	21 – 25 Mac	28 Mac – 1 Apr	4 – 8 Apr	11 – 15 Apr	18 – 22 Apr	25 – 29 Apr	2- 6 May	9 – 13 May	6 – 8 Jun	24 Jun
1	Project Work Continue																	
	-Practical/Laboratory Work																	
2	Prepare Progress Report 1				♣													
3	Research																	
4	Progress Report 2								♣									
5	Project work continue																	
	-Practical/Laboratory Work																	
6	Interim Report Final (Draft)													♣				
7	Interim Report (Soft Cover)															♣		
8	Technical Report															♣		
9	Oral Presentation																♦	
10	Interim Report (Hard Bound Cover)																	♦

Legends: ♣ Completed ♦ Suggested milestone Process

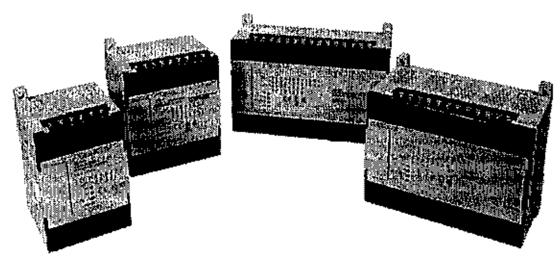
APPENDIX IV
CPM 1A DATA SHEET

omron

Micro Programmable Controller

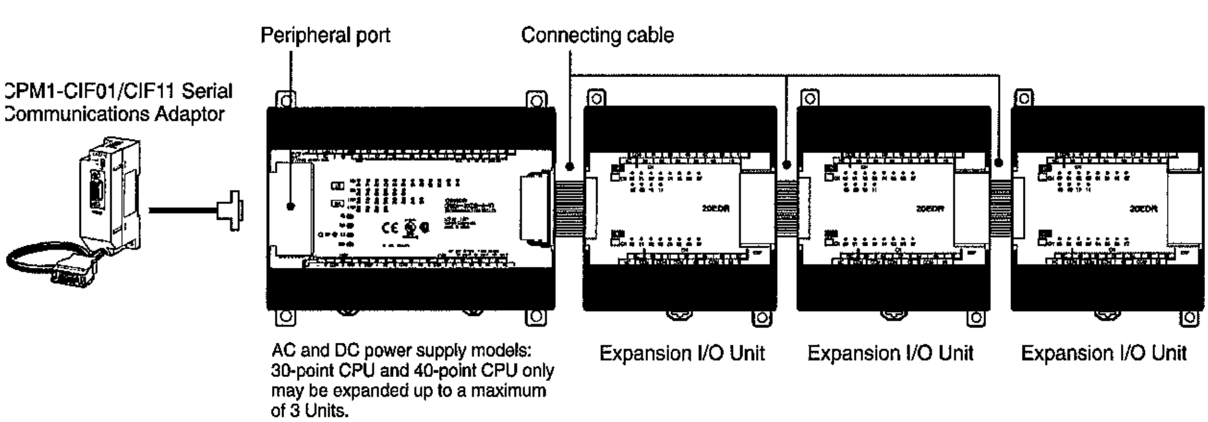
CPM1A

'he CPM1A series micro controllers solve both ıasic and semi-complex applications. The brick ;tyle models include DC inputs/transistor or elay outputs to meet your design equirements. The base I/O for the CPUs anges from 10, 20, 30, and 40 I/O points with naximum expansion to 100 I/O. Specialized ›xpansion modules include mixed analog I/O, əmperature sensor inputs and serial ommunications.



- 10, 20, 30 and 40 point I/O CPUs
- Expandable up to 100 I/O points
- Peripheral communications port built in
- DC input models
- Analog expansion modules available
- Temperature sensor input expansion modules available
- Auxiliary 24 VDC supply (AC type only)
- Relay or Transistor outputs
- UL, CSA, CE approvals

3asic Configuration



Ordering Information

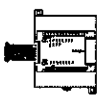
■ CPU

Stock Note: Shaded models are normally stocked.

Number of I/O terminals	Inputs	Outputs	Power supply	Part number		
				Relay output	**Transistor output**	
					Sink type	**Source type**
10	6 DC points	4 points	AC	CPM1A-10CDR-A-V1	CPM1A-10CDT-A-V1	CPM1A-10CDT1-A-V1
			DC	CPM1A-10CDR-D-V1	CPM1A-10CDT-D-V1	CPM1A-10CDT1-D-V1
20	12 DC points	8 points	AC	CPM1A-20CDR-A-V1	CPM1A-20CDT-A-V1	CPM1A-20CDT1-A-V1
			DC	CPM1A-20CDR-D-V1	CPM1A-20CDT-D-V1	CPM1A-20CDT1-D-V1
30	18 DC points	12 points	AC	CPM1A-30CDR-A-V1	CPM1A-30CDT-A-V1	CPM1A-30CDT1-A-V1
			DC	CPM1A-30CDR-D-V1	CPM1A-30CDT-D-V1	CPM1A-30CDT1-D-V1
40	24 DC points	16 points	AC	CPM1A-40CDR-A-V1	CPM1A-40CDT-A-V1	CPM1A-40CDT1-A-V1
			DC	CPM1A-40CDR-D-V1	CPM1A-40CDT-D-V1	CPM1A-40CDT1-D-V1

■ EXPANSION I/O MODULES

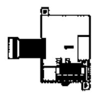
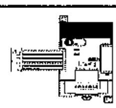
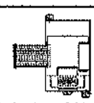
Stock Note: Shaded models are normally stocked.

Description	Max. number of modules	Inputs	Outputs	Part number
20 I/O points 12 inputs, 8 outputs 	3 max. (See Note.)	24 VDC	Relays	CPM1A-20EDR1
		24 VDC	Sinking transistors	CPM1A-20EDT
		24 VDC	Sourcing transistors	CPM1A-20EDT1
8 inputs 		24 VDC	—	CPM1A-8ED
8 outputs 		—	Relays	CPM1A-8ER
		—	Sinking transistors	CPM1A-8ET
		—	Sourcing transistors	CPM1A-8ET1

Note: A maximum of 3 expansion modules can be used with the following CPUs: 30-point and 40-point with DC inputs.

■ DEDICATED I/O MODULES

Stock Note: Shaded models are normally stocked.

Description		Max. number of modules	Inputs	Outputs	**Part number**
Analog I/O Module 2 analog inputs (2 words) 1 analog output (1 word) 		3 max.	2 analog inputs	1 analog output	CPM1A-MAD01 CPM1A-MAD11
Temperature Sensor Input Modules 	Thermocouple inputs	3 max.	2 inputs (Types J and K)	—	CPM1A-TS001
		1 max. (See Note.)	4 inputs (Types J and K)		**CPM1A-TS002**
	Platinum resistance thermometer inputs	3 max.	2 inputs (Pt100, JPt100)		**CPM1A-TS101**
		3 max.	2 inputs (Pt100, JPt100)	1 analog output	**CPM1A-TS101-DA**
		1 max. (See Note.)	4 inputs (Pt100, JPt100)	—	CPM1A-TS102
CompoBus/S I/O Link Module 8 inputs and 8 outputs 		3 max.	8 bits (Inputs from the Master.)	8 bits (Outputs to the Master.)	CPM1A-SRT21
		Flat cable, 4-core, 0.75 mm^2; 100 m length			**SCA1-4F10**
		Twisted pair cable, 2-core, 0.75 mm^2; available commercially			Belden #9409 cable
DeviceNet I/O Link Module 32 inputs and 32 outputs 		3 max.	32 bits (Inputs from the Master.)	32 bits (Outputs to the Master.)	CPM1A-DRT21
		Omron connector with screws (included with DeviceNet I/O Link Module).			XW4B-05C1-H1-D
		Omron Connector for multidrop connections using thick cables.			**XW4B-05C4-TF-D**
Profibus-DP Slave Module 16 inputs and 16 outputs 		3 max.	16 bits (Inputs from the Master.)	16 bits (Outputs to the Master.)	**CPM1A-PRT21**
		Shielded twisted pair cable, available commercially			Belden #3079A cable

Note: Only one CPM1A-TS002/TS102 Temperature Sensor Input Module can be connected to the CPU. If a CPM1A-TS002/102 is connected to the CPU, only one additional Special I/O Module (other than a CPM1A-TS002/102) or one Expansion I/O Module can be connected to the CPU.

■ PERIPHERAL DEVICES

Stock Note: Shaded models are normally stocked.

Product	Description	**Part number**
Programming console	Hand-held programming console with cable attached, 2 m length	CQM1-PRO01-E
	Hand-held programming console with back light (cable not included)	C200H-PRO27-E
Connecting cable	Connects C200H programming console to peripheral port, 2 m length	C200H-CN222
	Connects C200H programming console to peripheral port, 4 m length	C200H-CN422

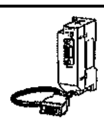
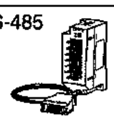
■ SUPPORT SOFTWARE

Stock Note: Shaded models are normally stocked.

Product	Functions	**Part number**
CX-Programmer Jr.	Windows-based programming software; reduced instruction set and networking commands.	WS02-CXPC1-EJ-V_
CX-Programmer	Full programming software package programs micro, small and larger controllers.	WS02-CXPC1-E-V_

■ COMMUNICATIONS ADAPTERS AND CABLES

Stock Note: Shaded models are normally stocked.

Description	Function		Part number
RS-232C adapter 	Converts data communications from peripheral port for RS-232C devices.		CPM1-CIF01
RS-232C cable	RS-232C to RS-232C; PC connection for program download; cable length 2 m		C200H-CN229-EU
			CBL-202*
	RS-232C to RS-232C for PLC communication; cable length 2 m		C200H-CN320-EU
			CBL-804*
	Communication cable for NT31C (port B only)	50 cm	NT31C-CN510-EU
		3 m	NT31C-CN320-EU
		5 m	NT31C-CN520-EU
RS-422/RS-485 adapter 	Converts data communications from peripheral port for RS-422/RS-485 devices.		CPM1-CIF11

* Available in Canada only.

■ PROGRAM TRANSFER EQUIPMENT

Stock Note: Shaded models are normally stocked.

Product	Description	Part number
Expansion Memory Unit	Uploads and downloads program and setup memory areas to and from the controller.	CPM1-EMU01-V1
EEPROM (256 kbits)	Used with the Expansion Memory Unit	**EEPROM-CPM1-EMU01**

■ MANUALS

Product	Description	Part number
Operation manual	CPM1A programmable controllers operation manual	**W317**
Programming manual	CPM1/CPM1A/CPM2A/CPM2C/SRM1(-V2) programming manual	**W353**

Specifications

■ GENERAL SPECIFICATIONS

Input type		DC input			
CPU type		10-point I/O	20-point I/O	30-point I/O	40-point I/O
Power supply voltage/frequency	AC power supply	100 to 240 VAC, 50/60 Hz			
	DC power supply	24 VDC			
Operating voltage range	AC power supply	85 to 264 VAC			
	DC power supply	20.4 to 26.4 VDC			
Power consumption	AC power supply	30 VA max.		60 VA max.	
	DC power supply	6 W max.		20 W max.	
Inrush current		30 A max.		60 A max.	
External power supply (AC only)	Power supply voltage	24 VDC			
	Power supply output capacity	200 mA		300 mA	
Insulation resistance		20 MΩ min. at 500 VDC between the AC terminals and the protective earth terminal.			
Dielectric strength		2,300 VAC at 50/60 Hz for one minute with a leakage current of 10 mA max. between all the external AC terminals and the protective earth terminal.			
Noise resistance		Conforms to IEC61000-4-4, 2 kV (power lines) 1500 Vp-p, pulse width 0.1 to 1 μs, rise time: 1 ns (via noise simulation)			
Vibration resistance		10 to 57 Hz with an amplitude of 0.075 mm, and 57 to 150 Hz with an acceleration of 1.5 G in the X, Y, and Z directions for 10 sweeps of minutes each.			
Shock resistance		147 m/s² in the X, Y and Z directions 3 times each.			
Ambient temperature	Operating	0°C to 55°C (32°F to 131°F)			
	Storage	-20°C to 75°C (-4°F to 167°F)			
Ambient humidity	Operating	10% to 90% RH no condensation			
Ambient environment	Operating	With no corrosive gas			
Terminal screw size		M3			
Power supply holding time		10 ms min. for AC models, and 2 ms min. for DC models			
CPU Weight	AC models	400 g max.	500 g max..	600 g max..	700 g max.
	DC models	300 g max.	400 g max.	500 g max.	600 g max.
Expansion Weight		Units with 20 I/O points:			300 g max.
		Units with 8 output points:			250 g max.
		Units with 8 input points:			200 g max.
		MAD01 Analog I/O unit:			150 g max.
		MAD11 Analog I/O unit:			250 g max.
		Temperature sensor units:			250 g max.
		CompoBus/S I/O link unit:			200 g max.
		DeviceNet I/O link unit:			200 g max.
		Profibus-DP slave unit:			125 g

■ CHARACTERISTICS

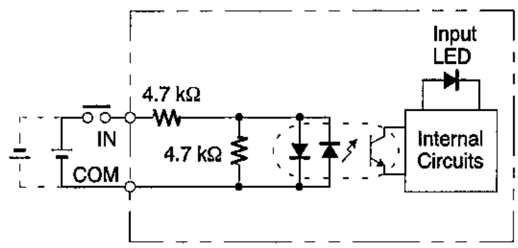
Input type		DC input			
CPU type		10-point I/O	20-point I/O	30-point I/O	40-point I/O
Control method		Stored program method			
I/O control method		Combination of the cyclic scan and immediate refresh processing methods.			
Programming language		Ladder diagram			
Instruction word		1 step per instruction, 1 to 5 words per instruction			
Types of instructions	Basic instructions	14 types			
	Special instructions	79 types, 139 instructions			
Instruction execution time	Basic instructions	0.72 to 16.2 μs			
	Special instructions	MOV instruction = 16.3 μs			
Program capacity		2,048 words			
User data memory		1,024 words			
Maximum I/O points	CPU only	10 points (6 input/ 4 output points)	20 points (12 input/ 8 output points)	30 points (18 input/ 12 output points)	40 points (24 input/ 16 output points)
	With Expansion I/O Module	—	—	Up to 90 points (54 input/ 36 output points)	Up to 100 points (60 input/ 40 output points)
Memory protection		Maintains the contents of the HR, AR, Counter and Data Memory Areas.			
Memory backup		Flash memory: User program, data memory (Read only) and PLC setup area are backed up without a battery. Super capacitor: Data memory (Read/Write), holding bits, auxiliary memory bits, counter values, error log area are backed up by a capacitor for 20-days at an ambient temperature of 25°C.			
Self-diagnostic function		CPU error (watchdog timer), memory errors, I/O bus errors			
Program check		No END instruction programming errors (constantly checked during operation)			
Pulse output		1 point: 2 kHz			
High-speed counter		1 point: Single phase at 5 kHz or two-phase at 2.5 kHz (linear counting method) Incremental mode: 0 to 65535 (16-bit) Decremental mode: -32767 to 32767 (16-bit)			
Quick-response inputs		Together with the external interrupt input (minimum pulse width of 0.2 ms)			
Input time constant		Can be set at 1 ms, 2 ms, 4 ms, 8 ms, 16 ms, 32 ms, 64 ms, or 128 ms.			
Interrupt processing: External interrupt		2 points (Response time of 0.3 ms max.)	4 points (Response time of 0.3 ms max.)		
Analog settings		2 points: (0 to 200 BCD)			

■ I/O ALLOCATION

Input bits		00000 to 00915; words not used for input or output bits can be used for work bits.
Output bits		01000 to 01915; words not used for input or output bits can be used for work bits.
Work bits (IR Area)		512: IR 20000 to IR 23115 (IR 200 to IR 231)
Special bits (SR Area)		384: SR 23200 to SR 25515 (SR 232 to SR 255)
Temporary bits (TR Area)		8: TR 0 to TR 7
Holding bits (HR Area)		320: HR 0000 to HR 1915 (HR 00 to HR 19)
Auxiliary bits (AR Area)		256: AR 0000 to AR 1515 (AR 00 to AR 15)
Link bits (LR Area)		256: LR 0000 to LR 1515 (LR 00 to LR 15)
Timers/Counters		128: TIM/CNT 000 to 127 100-ms timer: TIM 000 to TIM 127 10-ms timer: TIM 000 to TIM 127 Decremental counter, reversible counter
Data memory	Read/Write	1,024 words (DM 0000 to DM 1023)
	Read only	512 words (DM 6144 to DM 6655)

I/O SPECIFICATIONS

CPU DC Input

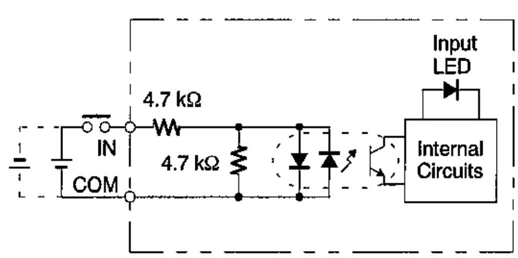
Item	Specifications	Circuit
Input voltage	24 VDC $^{+10\%}/_{-15\%}$	 Note: The polarity of the input power supply can be either positive or negative.
Input impedance	IN0000 to IN0002: 2 kΩ Others: 4.7 kΩ	
Input current (typical)	IN0000 to IN0002: 12 mA Others: 5 mA	
ON voltage	14.4 VDC min.	
OFF voltage	5.0 VDC max.	
ON delay (See Note 1)	1 to 128 ms max. (default: 8 ms) (See Note 1)	
OFF delay (See Note 1)	1 to 128 ms max. (default: 8 ms) (See Note 1)	

Note: 1. The actual ON/OFF delay includes an input constant of 1, 2, 4, 8, 16, 32, 64, or 128 ms (default: 8 ms).

2. When IN0000 to IN0006 are used for the high-speed counter inputs, the delays are as shown below:

Input	Increment mode	Differential phase mode
IN0000 (A-phase)	5 kHz	2.5 kHz
IN0001 (B-phase)	Normal input	
IN0002 (Z-phase)	ON: 100 μs max. OFF: 500 μs max.	
IN0003 to IN0006	0.3 ms max. (From the time of input ON until the interrupt subroutine is executed.)	

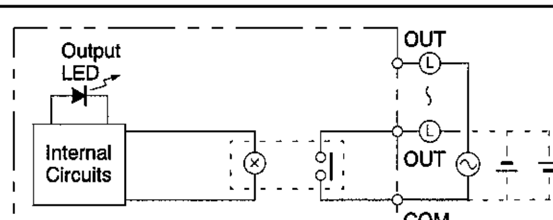
Expansion I/O Unit

Item	Specifications	Circuit
Input voltage	24 VDC, $^{+10\%}/_{-15\%}$	 Note: The polarity of the input power supply can be either positive or negative.
Input impedance	4.7 kΩ	
Input current (typical)	5 mA	
ON voltage	14.4 VDC min.	
OFF voltage	5.0 VDC max.	
ON delay	1 to 128 ms max. (default: 8 ms) (See Note)	
OFF delay	1 to 128 ms max. (default: 8 ms) (See Note)	

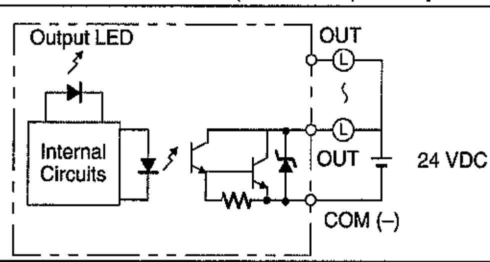
Note: The actual ON/OFF delay includes an input constant of 1, 2, 4, 8, 16, 32, 64, or 128 ms (default: 8 ms).

OUTPUT SPECIFICATIONS (CPU AND EXPANSION I/O MODULES)

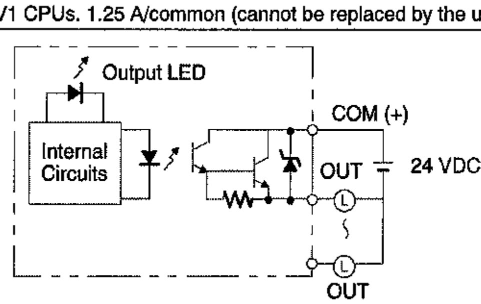
Relay Output

Item			Specifications	Circuit
Maximum switching capacity			2 A, 250 VAC (cos ϕ =1) 2 A, 24 VDC (4 A/common)	 Maximum 250 VAC: 2 A 24 VDC: 2 A
Minimum switching capacity			10 mA, 5 VDC	
Relay service life	Electrical	Resistance load	150,000 times	
		Inductive load	100,000 times	
	Mechanical		20 million times	
ON delay			15 ms max.	
OFF delay			15 ms max.	

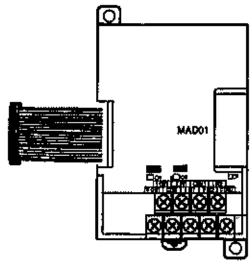
Transistor Outputs (Sinking)

Item	Specifications					
	CPM1A-10CDT-□(-V1)	CPM1A-20CDT-□(-V1)	CPM1A-30CDT-□(-V1)	CPM1A-40CDT-□(-V1)	CPM1A-20EDT	CPM1A-8ET
Max. switching capacity	24 VDC $^{+10\%}/_{-15\%}$, 0.3 A/point (See note)					4.5 to 30 VDC 0.2 A (See note 2.) 0.3 A (See note 3.)
	0.9 A/Unit	0.9 A/common 1.8 A/Unit	0.9 A/common 2.7 A/Unit	0.9 A/common 3.6 A/Unit	0.9 A/common 1.8 A/Unit	
Leakage current	0.1 mA max.					
Residual voltage	1.5 V max.					
ON delay	0.1 ms max.					
OFF delay	OUT01000/01001: 0.2 ms max. (load current: 100 to 300 mA) 0.5 ms max. (load current: 5 to 100 mA) Other than OUT01000/01001: 1 ms max. (load current 5 to 300 mA)				1 ms max. (24 VDC $^{+10\%}/_{-15\%}$, 5 to 300 mA)	
Fuse	V1 CPUs: No fuse Expansion I/O Units and Pre-V1 CPUs. 1.25 A/common (cannot be replaced by the user)					
Circuit configuration						

Transistor Outputs (Sourcing)

Item	Specifications					
	CPM1A-10CDT1-□(-V1)	CPM1A-20CDT1-□(-V1)	CPM1A-30CDT1-□(-V1)	CPM1A-40CDT1-□(-V1)	CPM1A-20EDT1	CPM1A-8ET1
Max. switching capacity	24 VDC $^{+10\%}/_{-15\%}$, 0.3 A/point (See note)					4.5 to 30 VDC 0.2 A (See note 2.) 0.3 A (See note 3.)
	0.9 A/Unit	0.9 A/common 1.8 A/Unit	0.9 A/common 2.7 A/Unit	0.9 A/common 3.6 A/Unit	0.9 A/common 1.8 A/Unit	
Leakage current	0.1 mA max.					
Residual voltage	1.5 V max.					
ON delay	0.1 ms max.					
OFF delay	OUT01000/01001: 0.2 ms max. (load current: 100 to 300 mA) 0.5 ms max. (load current: 5 to 100 mA) Other than OUT01000/01001: 1 ms max. (load current 5 to 300 mA)				1 ms max. (24 VDC $^{+10\%}/_{-5\%}$, 5 to 300 mA)	
Fuse	V1 CPUs: No fuse Expansion I/O Units and Pre-V1 CPUs. 1.25 A/common (cannot be replaced by the user)					
Circuit configuration						

Note: When using the OUT01000 or OUT01001 as a pulse output, connect dummy resistors as required to set the load current to 0.1 to 0.2 A. If the load current is below 0.1 A, the ON-to-OFF response time will become longer and high-speed pulse will not be output. On the other hand, if the load current is above 0.2 A, the transistor may generate heat and components may be damaged.

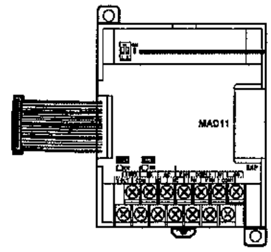


■ ANALOG I/O MODULE

CPM1A-MAD01 Specifications

Item		Specification	
Model		CPM1A-MAD01	
I/O type		Voltage	Current
Analog inputs	Number of inputs	2	
	Input signal range	0 to 10 V or 1 to 5 V	4 to 20 mA
	Maximum rated input	±15 V	±30 mA
	External input impedance	1 MΩ min.	250 Ω rated
	Resolution	1/256	
	Overall precision	1.0% of full scale	
	Converted A/D data	8-bit binary	
Analog output (See Note 1.)	Number of outputs	1	
	Output signal range	0 to 10 V or -10 to 10 V	4 to 20 mA
	External output max. current	5 mA	—
	External output allowed load resistance	—	350 Ω
	Resolution	1/256 (1/512 when the output signal range is -10 to 10 V.)	
	Overall precision	1.0% of full scale	
	Data setting	8-bit binary with sign bit	
Conversion time (See Note 2.)		10 ms/Unit max.	
Isolation method		Photocoupler isolation between I/O terminals and PC (There is no isolation between the analog I/O signals.)	

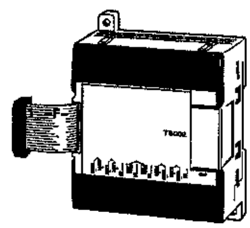
Note: 1. The voltage output and current output can be used at the same time, but the total output current cannot exceed 21 mA.
2. The conversion time is the total time for 2 analog inputs and 1 analog output.



CPM1A-MAD11 Specifications

Item			Specification	
Model			CPM1A-MAD11	
I/O type			Voltage	Current
Analog inputs	Number of inputs		2 inputs (2 words allocated)	
	Input signal range		0 to 5 VDC, 1 to 5 VDC 0 to 10 VDC, -10 to 10 VDC	0 to 20 mA or 4 to 20 mA
	Maximum rated input		±15 V	±30 mA
	External input impedance		1 MΩ min.	250 Ω
	Resolution		1/6000 (full scale)	
	Overall accuracy	25°C	0.3% full scale	0.4% full scale
		0 to 55°C	0.6% full scale	0.8% full scale
	Converted A/D data		16-bit binary (4-digit hexadecimal) Full scale for -10 to 10 V: F448 to 0BB8 Hex Full scale for other ranges: 0000 to 1770 Hex	
	Averaging function		Supported (Settable for individual inputs via DIP switch)	
	Open-circuit detection function		Supported	
Analog output	Number of outputs		1 output (1 word allocated)	
	Output signal range		1 to 5 VDC, 0 to 10 VDC, or -10 to 10 VDC	0 to 20 mA or 4 to 20 mA
	Allowable external output load resistance		1 kΩ min.	600 Ω max.
	External output impedance		0.5 Ω max.	—
	Resolution		1/6000 (full scale)	
	Overall accuracy	25°C	0.4% full scale	
		0 to 55°C	0.8% full scale	
	Set data (D/A conversion)		16-bit binary (4-digit hexadecimal) Full scales for -10 to 10 V: F448 to 0BB8 Hex Full scale for other ranges: 0000 to 1770 Hex	
Conversion time			2 ms/point (6 ms/all points)	
Isolation method			Photocoupler isolation between analog I/O terminals and internal circuits. No isolation between analog I/O signals.	

■ TEMPERATURE SENSOR MODULES



3y connecting a Temperature Sensor Module CPM1A-TS001/TS002/TS101/TS101A/TS102) to the CPM1A, nputs can be received from thermocouples or temperature-esistance thermometers. Inputs converted to binary data (4-digit ıexadecimal) and stored in the IR area.

Specifications

Item	Specification		
Model	CPM1A-TS001/TS002	CPM1A-TS101/TS102	CPM1A-TS101-DA
Number of inputs	TS001: 2; TS002: 4	TS101: 2; TS102: 4	2
Input types (See Note 1)	Thermocouple types K or J, selectable	Platinum resistance thermometer types Pt100 and JPt1100, selectable	
Input resolution	0.1°C in 2's complement format	0.1°C in 2's complement format	
Input accuracy	±0.5% or ±2% of the stored value whichever is larger ±1 digit max. (See Note 2)	±0.5% or ±1% of the stored value whichever is larger ±1 digit max. (See Note 2)	1.0% max. full scale
Number of outputs	None	None	1
Output types	—	—	Voltage or current output
Output resolution	—	—	1/256 (0 to 10 V) 1/512 (-10 to +10 V) 1/256 (4 to 20 mA)
Output accuracy	—	—	1.0% max. full scale
Conversion cycle	250 ms for all points		60 ms max. for all points
Converted temperature data	Binary data (4-digit hexadecimal)		Binary data (8-digit hexadecimal)
Isolation method	Photocoupler isolation between I/O terminals and the PLC		

lote: 1. The same input type must be used for all inputs.
2. Accuracy for K thermocouples at temperatures less than -100°C: ±4°C ± 1 digit max.

ıput Temperature Ranges for CPM1A-TS001/TS002

he rotary switch can be used to make of the following range and input type settings for CPM1A-TS001/002 models.

Thermocouple input	Range (°C)	Range (°F)
Type K	-200 to 1300	-300 to 2300
	0.0 to 500.0	0.0 to 900.0
Type J	-100 to 850	-100 to 1500
	0.0 to 400.0	0.0 to 750.0

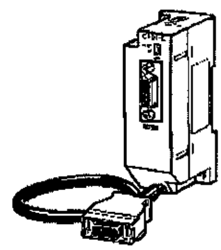
ıput Temperature Ranges for CPM1A-TS101/TS101DA/TS102

he rotary switch can be used to make of the following range and input type settings for CPM1A-TS101/102 models.

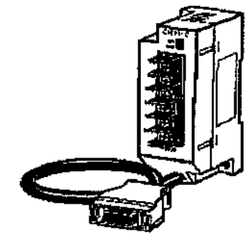
Platinum RTD input	Range (°C)	Range (°F)
Pt100	-200.0 to 650.0	-300 to 1200.0
JPt100	-200.0 to 650.0	-300 to 1200.0

■ COMMUNICATIONS ADAPTER

RS-232C Adapter and RS-422 Adapter



CPM1-CIF01

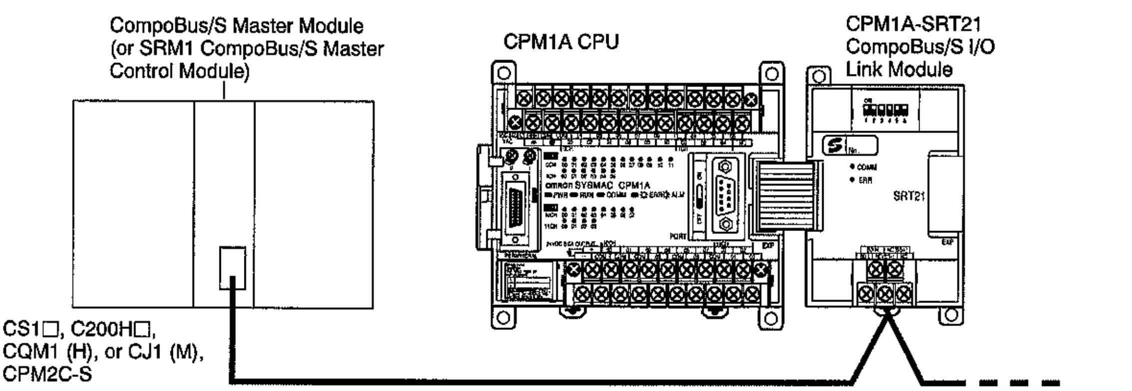


CPM1-CIF11

Model		CPM1-CIF01	CPM1-CIF11
Functions		Level conversion between the CMOS level (CPU side) and the RS-232C (peripheral device side)	Level conversion between the CMOS level (CPU side) and the RS-422 (peripheral device side)
Insulation		The RS-232C (peripheral device side) is insulated by a DC/DC converter and photocoupler.	The RS-422 (peripheral device side) is insulated by a DC/DC converter and photocoupler.
Power supply		Power is supplied by the CPU.	
Power consumption		0.3 A max.	
Transmission speed		38.4 kbits/s max.	
Vibration resistance		10 to 57 Hz with an amplitude of 0.075 mm, and 57 to 150 Hz with an acceleration of 1 G in the X, Y and Z directions for 80 minutes each (i.e. for 8 minutes each, 10 times).	
Shock resistance		1.5 G in the X, Y and Z directions 3 times each.	
Ambient temperature	Operating	0°C to 55°C (32°F to 131°F)	0°C to 55°C (32°F to 131°F)
	Storage	-20°C to 75°C (-4°F to 167°F)	-20°C to 75°C (-4°F to 167°F)
Ambient humidity	Operating	10% to 90% RH (with no condensation)	
Ambient environment	Operating	With no corrosive gas	
Weight		200 g max.	

■ COMPOBUS/S I/O LINK MODULE

The CPM1A controller can function as a Slave to a CompoBus/S Master Module (or SRM1 CompoBus/S Master Control Module) when a CPM1A-SRT21 CompoBus/S I/O Link Module is connected. The CompoBus/S I/O Link Module establishes an I/O link of 8 inputs and 8 outputs between the Master Module and the CPM1A. Up to 3 Expansion I/O Modules or Expansion Modules can be connected to a CPM1A CPU.



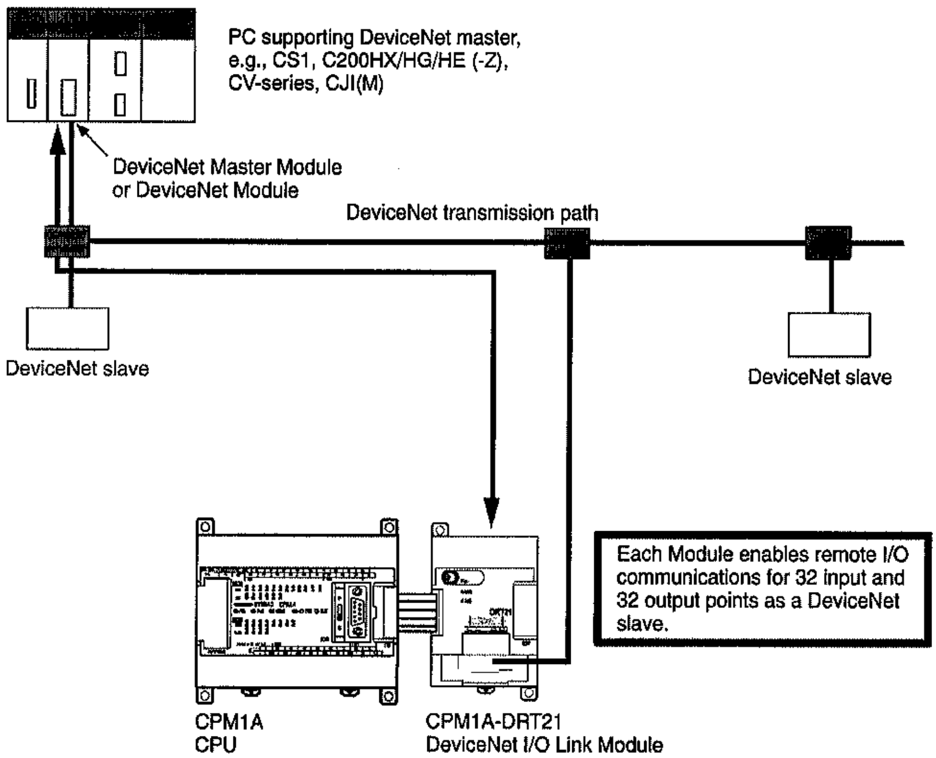
Specifications

Model	CPM1A-SRT21
Master/Slave	CompoBus/S Slave
Number of I/O bits	8 input bits, 8 output bits
Number of words occupied in CPM2A I/O memory	1 input word, 1 output word (Allocated in the same way as other Expansion I/O Modules or Expansion Modules)
Node number setting	Set using the DIP switch.

Note: See the CompoBus/S section of Omron's *Remote I/O and Wiring Solutions Catalog (GC RIO1)* for more details on CompoBus/S communications.

■ DEVICENET I/O LINK MODULE

The CPM1A controller can function as slaves to a DeviceNet Master when a DeviceNet I/O Link Module is connected. The DeviceNet I/O Link Module establishes an I/O link of 32 inputs and 32 outputs between the master and the controller. A maximum of 3 DeviceNet I/O Link Modules can be connected to a CMP1A to create I/O Links for up to 192 points (96 inputs and 96 outputs).

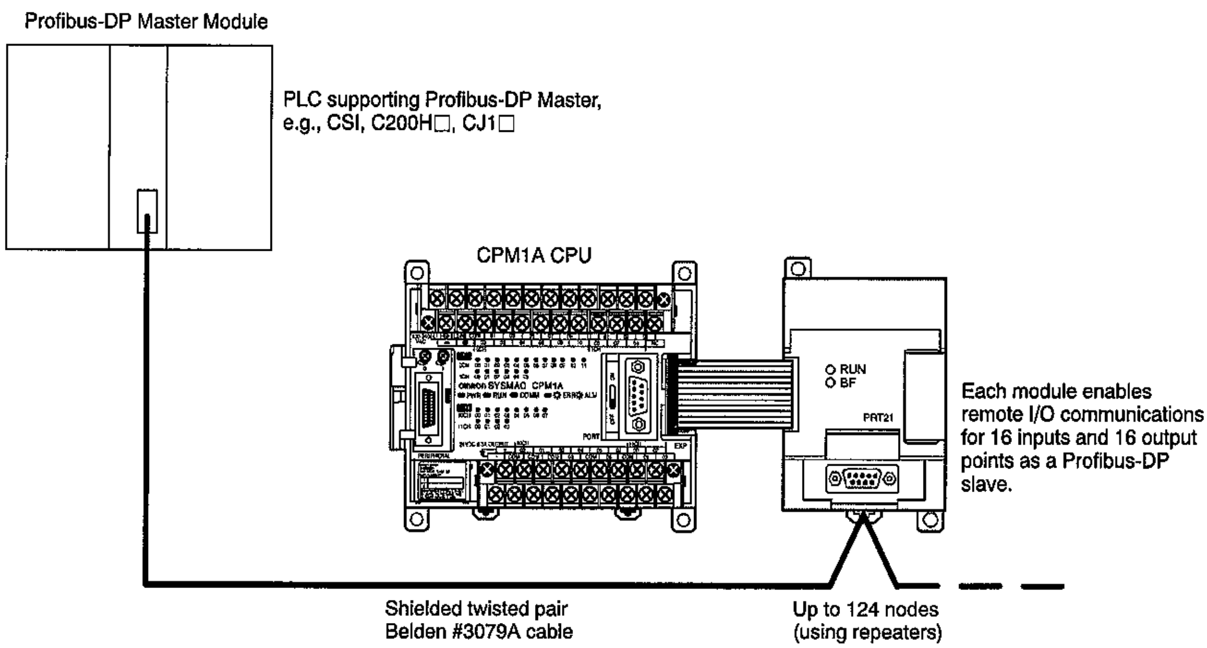


Specifications

Item	Specification
Model number	CPM1A-DRT21
Master/slave	DeviceNet Slave
Number of I/O points	32 input points, 32 output points
Number of words allocated in CPU Unit I/O memory	2 input words, 2 output words (Allocated in the same way as Expansion I/O Units and other Expansion Units)
Node number setting	Set using the rotary switches (Set before turning ON the CPU's power supply.)

■ PROFIBUS-DP SLAVE MODULE

The CPM1A-V1 controller can function as a slave to a Profibus-DP Master Module when a CMP1A-PRT Profibus-DP Slave Module is connected. The Profibus-DP Slave Module establishes an I/O link of 16 inputs and 16 outputs between the master and the controller. A maximum of 3 Profibus-DP Slave Modules can be connected to a CPM1A or CPM2A to create I/O links for up to 96 points (48 inputs and 48 outputs).



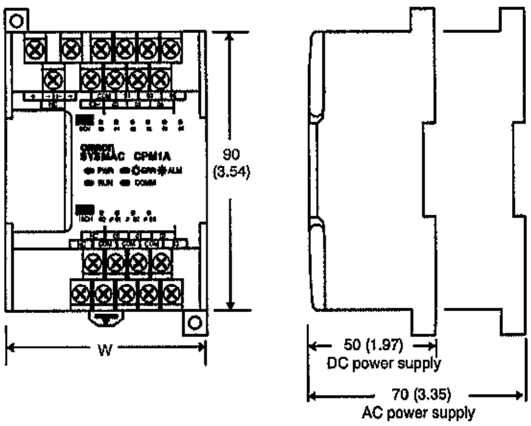
Specifications

Storage temperature	-20 to +75°C
Ambient temperature	0 to +55°C
Ambient humidity	10 to 90% (non-condensing)
EMC compliance	EN 50081-2, EN 61131-2
Current consumption	100 mA from the PLC I/O bus
Weight	125 g (typical)
Control data	From CPU to unit: none
Status data	From unit to CPU: none
I/O data (in bytes)	2 bytes input, 2 bytes output

Dimensions

Unit: mm (inch)

■ CPU, EXPANSION I/O AND SPECIAL I/O MODULES

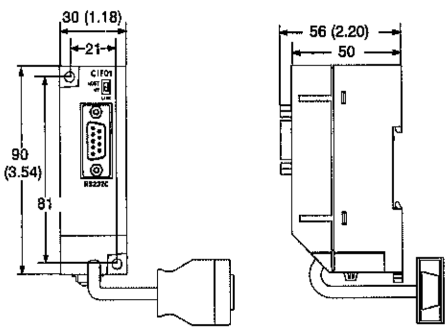


Model	W
CPM1A-10CD□-A/D-V1	66 (2.60)
CPM1A-20CD□-A/D-V1	86 (3.39)
CPM1A-30CD□-A/D-V1	130 (5.12)
CPM1A-40CD□-A/D-V1	150 (5.91)
CPM1A-20ED□	86 (3.39)
CPM1A-8E□	66 (2.60)
CPM1A-SRT21	66 (2.60)
CPM1A-MAD01	66 (2.60)
CPM1A-TS□□□	86 (3.39)
CPM1A-MAD11	86 (3.39)
CPM1A-DRT21	66 (2.60)
CPM1A-PRT21	66 (2.60)

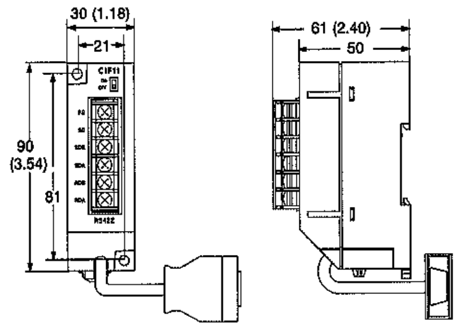
Unit: mm (inch)

■ COMMUNICATION ADAPTER MODULES

CPM1-CIF01

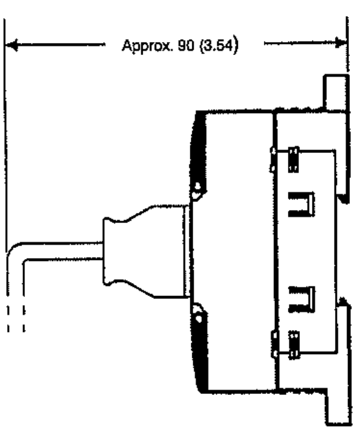


CPM1-CIF11

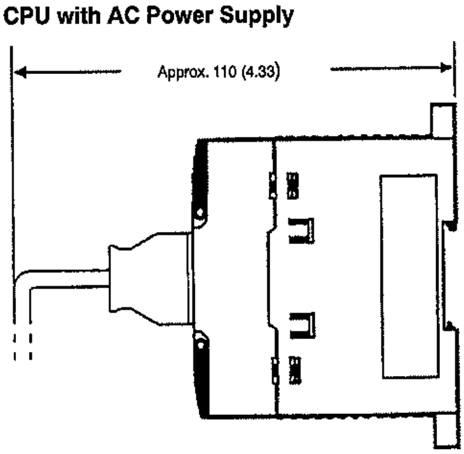


■ DIMENSIONS WITH PERIPHERAL DEVICES ATTACHED

CPU with DC Power Supply



CPU with AC Power Supply



Functions

■ CONFIGURATION

The CPM1A CPUs feature a compact, one-piece construction that includes 10, 20, 30 or 40 built-in I/O terminals. Three output models are available: Relay outputs, sinking (NPN) transistor output and sourcing (PNP) transistor output.

Expansion

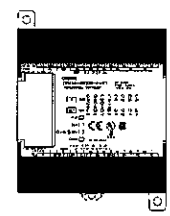
Up to three Expansion I/O Modules can be connected to a 30-point or 40-point CPU to add an extra 8 or 20 I/O points for each, for a maximum of up to 100 I/O points.

Dedicated I/O Modules

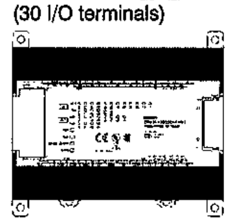
Up to 3 Analog I/O Modules or Temperature Sensor Input Modules can be used with 30-point and 40-point CPUs. Each analog I/O module provides 2 analog inputs and 1 analog output, so a maximum of 6 analog inputs and 3 analog outputs can be achieved by connecting 3 Analog I/O Modules. Each Temperature Sensor Module provides two temperature sensor inputs from either thermocouples or platinum resistance thermometers. Up to 6 inputs can be connected.

CPM1A-10CD□-□-V1
(10 I/O terminals)

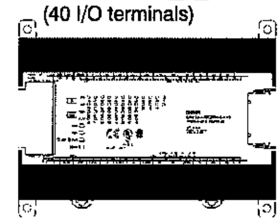
CPM1A-20CD□-□-V1
(20 I/O terminals)



CPM1A-30CD□-□-V1
(30 I/O terminals)



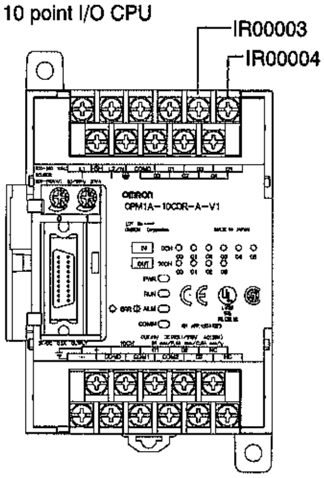
CPM1A-40CD□-□-V1
(40 I/O terminals)



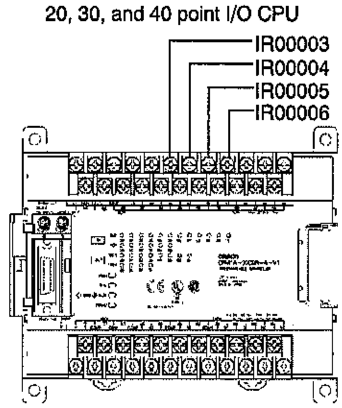
■ INTERRUPT INPUTS

There are two input interrupts in the CPM1A 10-point I/O CPU and four in the 20-, 30-, and 40-point I/O CPUs. Input interrupts are available in two modes. In addition to normal interrupt inputs, the CPM1A has a counter mode that counts high-speed input signals and triggers interrupts at fixed count multiples.

10 point I/O CPU



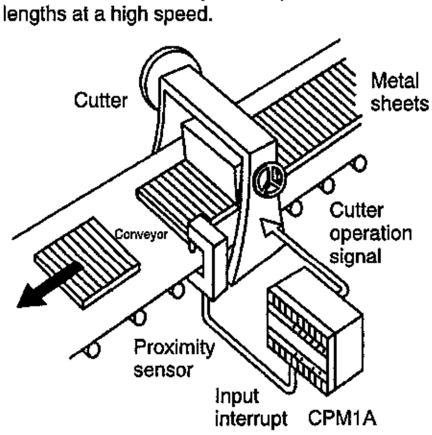
20, 30, and 40 point I/O CPU



Application Example:

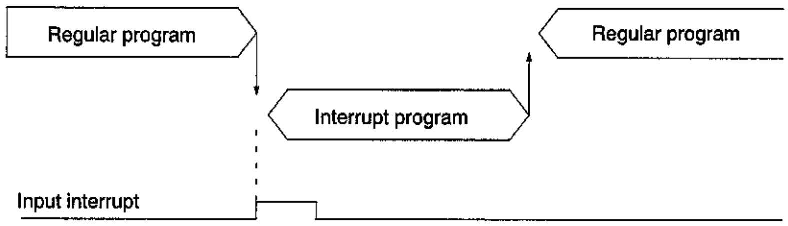
Cutting Metal Sheets to Specified Lengths

The proximity sensor detects the edge of a metal plate to operate the cutter. Metal sheets can be cut continuously to the specified lengths at a high speed.



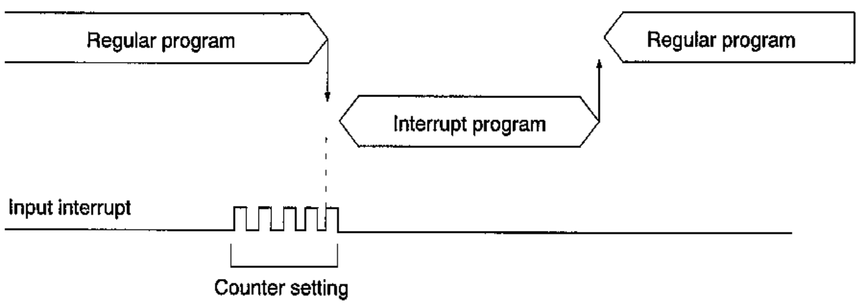
Input Interrupt Mode

If an input interrupt occurs, the regular program shuts down irrelevant of the cycle time, and the interrupt processing program is executed immediately.



Counter Mode

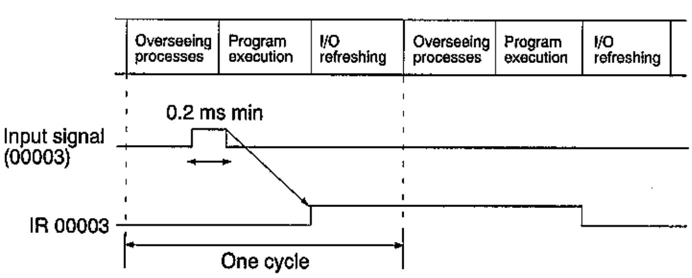
When the number of external signals counted at high speed reaches a specified number of counts, the regular program shuts down, and the interrupt processing program is executed at fixed counts. The count can be set between 0 and 65535.



■ QUICK-RESPONSE INPUTS

Quick-response inputs can detect input signals with a pulse width as short as 0.2 ms regardless of their timing during the scan cycle. Quick-response inputs and interrupt inputs use the same input terminals.

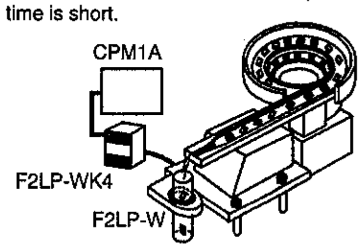
CPU	Input no.	Minimum input pulse width
10 point I/O CPU	00003 to 00004	0.2 ms
20 point, 30 point, 40 point I/O CPU	00003 to 00006	



Application Example:

Calculating the Number of Chips

The metal sensor counts the number of parts that have passed. Steady counting can be achieved even when the input-ON time is short.

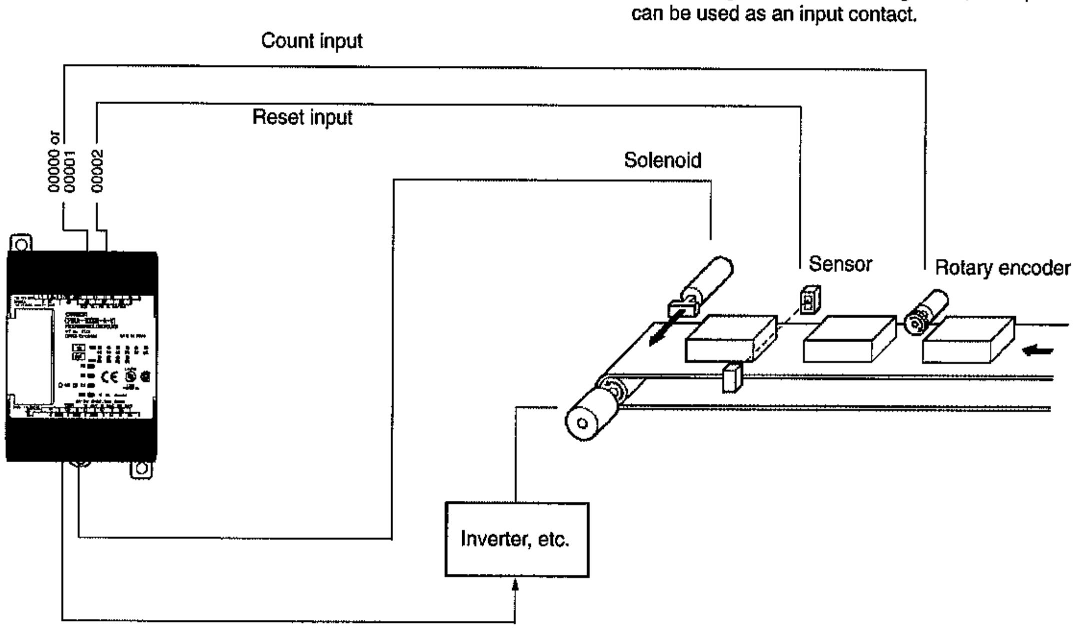


■ HIGH-SPEED COUNTER

The CPM1A has a high-speed counter function that can be used in the incrementing and up/down mode. Using this function together with the input interrupts enables zone comparison control or target value control irrelevant of the cycle time.

Counting mode		Incrementing mode	Up/Down mode
Input no.	00000	Count input	A-phase input
	00001	—	B-phase input
	00002	Reset input	Z-phase input
Input method		Single-phase input	Phase-difference, 4x inputs
Count frequency		5.0 kHz	2.5 kHz
Count range		0 to 65535	-32767 to 32767

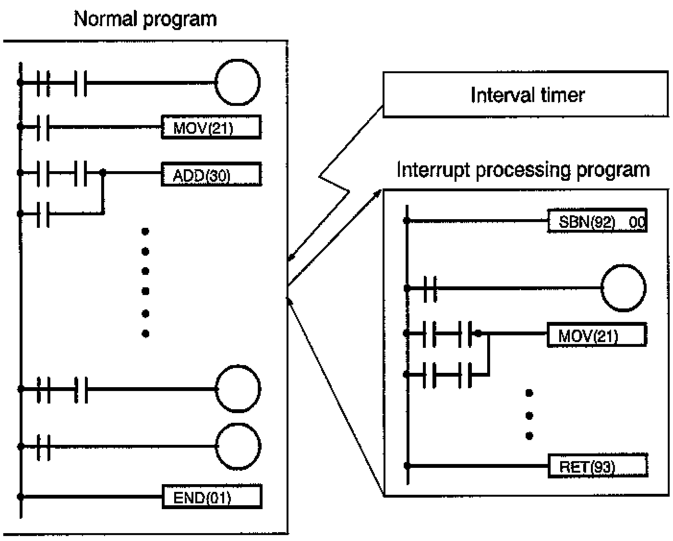
Note: When using in the incrementing mode, the input 00001 can be used as an input contact.



■ INTERVAL TIMER INTERRUPTS

The CPM1A has one interval timer. The interval timer shuts down the regular program regardless of the point in the cycle once the time is up, and immediately executes an interrupt processing program. Interval timers are used in the following two modes.

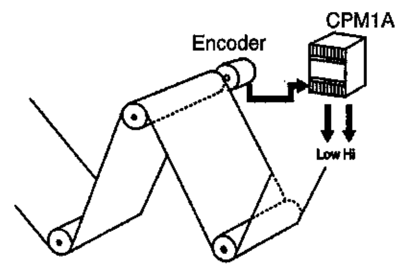
Item	One-shot mode	Scheduled interrupt mode
Operation	An interrupt is executed only once when the time is up.	Interrupts are executed repeatedly at fixed periods.
Setting time	0.5 ms to 319,968 ms (0.1-ms units)	



Application Example:

Computing the Sheet Speed

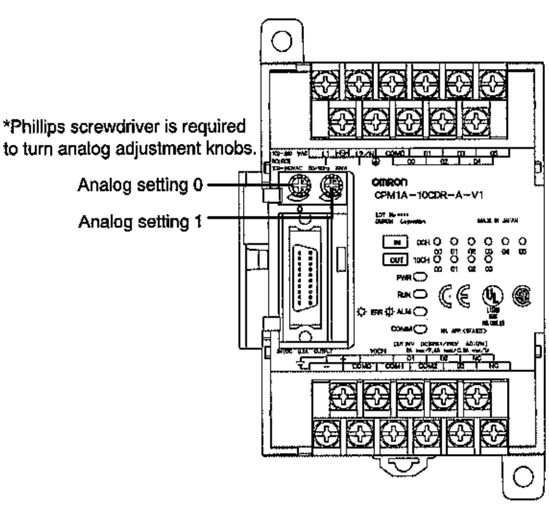
The number of pulse inputs is computed in the interrupt mode at a fixed time to calculate the speed.



■ ANALOG SETTING

The CPM1A contains two analog setting controls that can be used for a broad range of analog timer and counter settings. Turning the setting control stores values of 0 to 200 (BCD data) in the SR area.

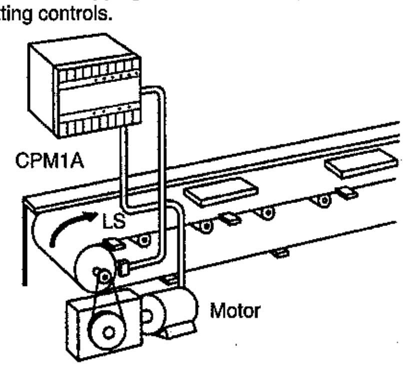
Analog setting	Storage area	Setting value (BCD)
Analog setting 0	SR 250	0000 to 0200
Analog setting 1	SR 251	



Application Example:

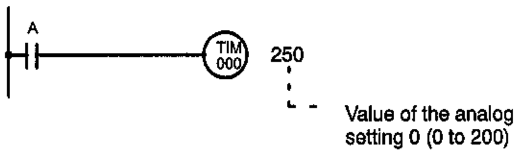
Tact Operation Control of Conveyor Lines

A conveyor can be stopped temporarily as required for assembly processes. When the timer function and limit switches are used in a combination, conveyors can be stopped for a fixed time or can be run at a constant speed for a fixed distance. Fine adjustment of the stopping time can be easily done by using the analog setting controls.

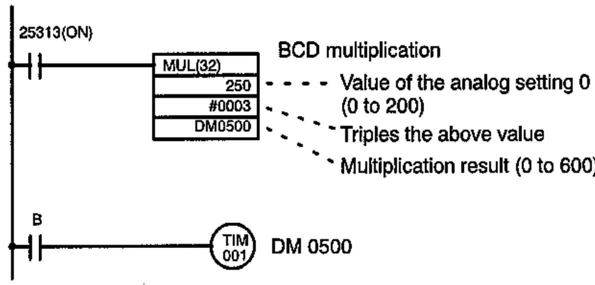


Program Example

1. Analog timer for 0.0 to 20.0 seconds



2. Analog timer for 0.0 to 60.0 seconds



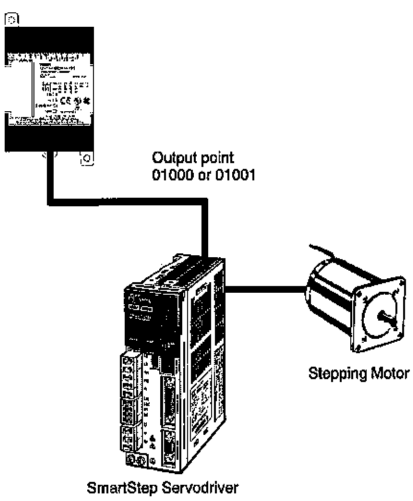
■ PULSE OUTPUT FUNCTION

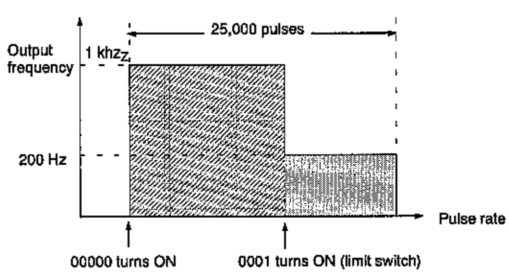
The CPM1A transistor output models have an output function capable of outputting a pulse of 20 Hz to 2 kHz (single-phase output).

When used in combination with a Stepping Driver or SmartStep Servodriver, positioning can be easily performed.

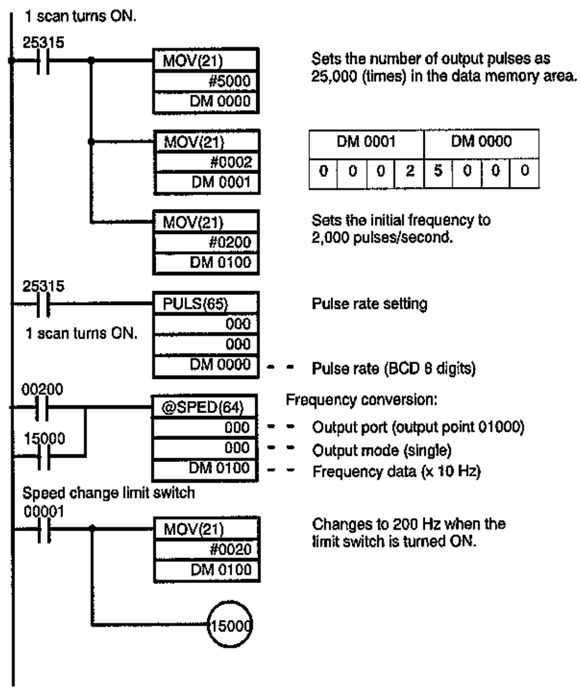
Application Example

Changing the speed of the Stepping Motor.





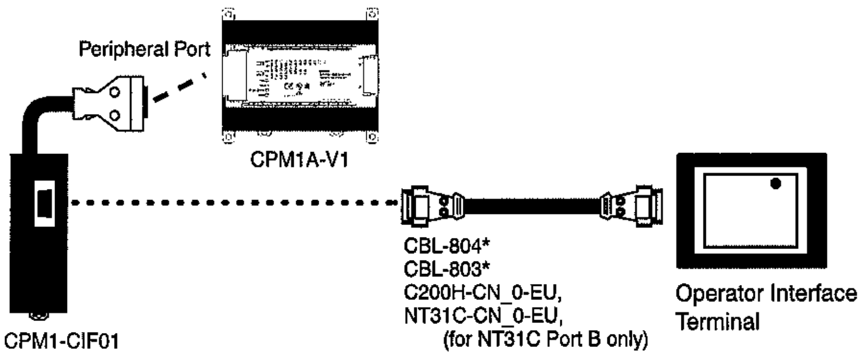
Program Example



Communications

NT LINK FOR PROGRAMMABLE TERMINALS

Use Omron's high-speed NT Link for real-time communications between the CPM1A and a Programmable Terminal.

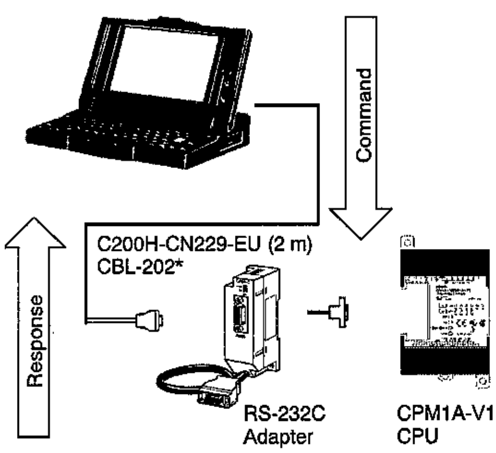


* Available in Canada only.

HOST LINK COMMUNICATIONS

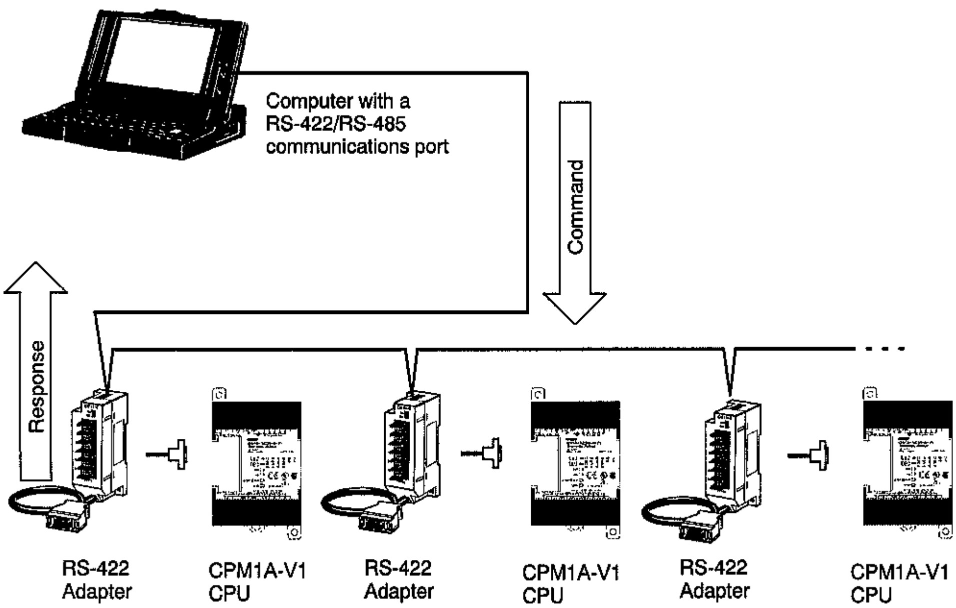
CPM1A Host Link communications consist of interactive procedures whereby the CPM1A returns a response to a command sent from the IBM PC/AT or compatible computer. These communications allow the IBM PC/AT or compatible computer to read and write in the CPM1A's I/O Areas and Data Memory Areas as well as in areas containing the status of various settings.

1:1 Host Link Communications



* Available in Canada only.

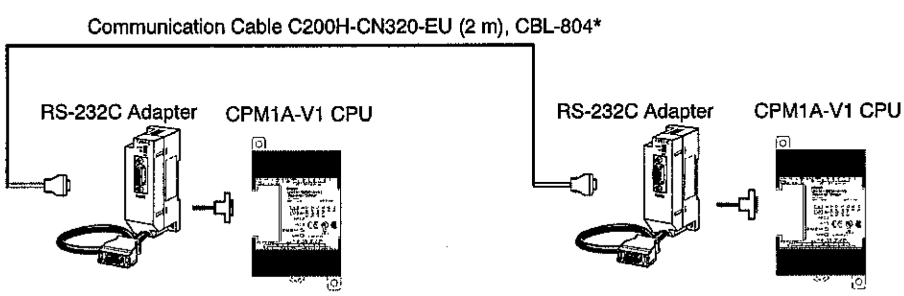
1:N Host Link Communications



■ 1:1 CONNECTIONS FOR DATA EXCHANGE

With a 1:1 Link, two CPM1As or a CPM1A and CQM1 or C200H□ are connected 1:1 with one side as the Master and the other as the Slave to provide an I/O link of a maximum of 256 points (LR 0000 to LR 1515).

Example of a 1:1 Link between CPM1As



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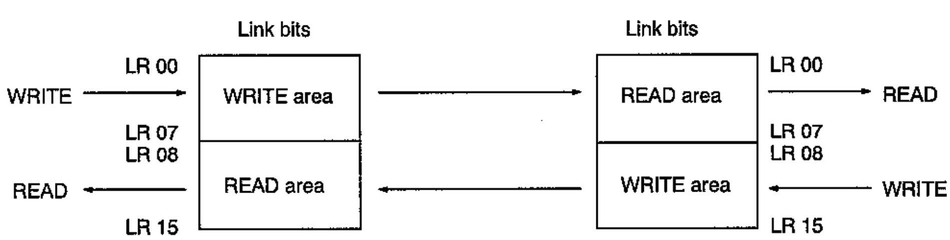
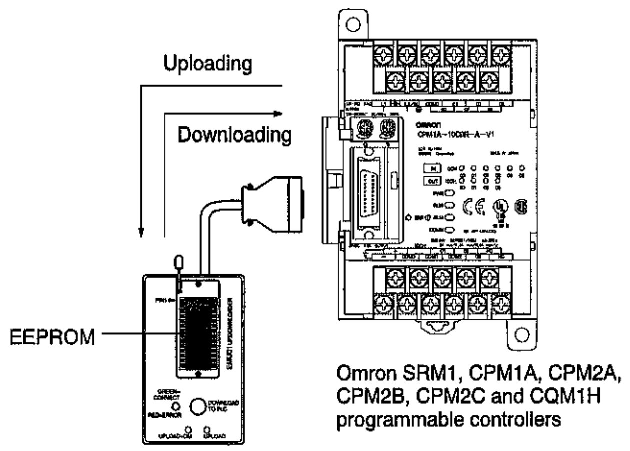


Limitations of the CPM1A 1:1 Link

CPM1A I/O links are limited to 16 words (LR 00 to LR 15). Therefore, use these 16 words (LR 00 to LR 15) on the CQM1 or C200H□ side when forming 1:1 links with a CQM1 or C200H□.

■ PROGRAM TRANSFER UNIT

Jse Omron's EEPROM program transfer unit to update programs in machines or program multiple controllers with the same program.
The CPM1-EMU01-V1 Expansion Memory Unit connects to the peripheral port of micro and small PLCs.



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c. All sales and shipments of Goods shall be FOB shipping point (unless otherwise stated in writing by Seller), at which point title to and all risk of loss of the Goods shall pass from Seller to Buyer, provided that Seller shall retain a security interest in the Goods until the full purchase price is paid by Buyer;
d. Delivery and shipping dates are estimates only.
e. Seller will package Goods as it deems proper for protection against normal handling and extra charges apply to special conditions.

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