Report on PLC-Fundamentals & PLC -Advanced

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Venue :EEE Simulation LAB Organized By **APSSDC**

Programmable logic controller (PLC)

A Programmable Logic Controller (PLC), also referred to as programmable controller, is the name given to a type of computer commonly used in commercial and industrial control applications. PLCs differ from office computers in the types of tasks that they perform and the hardware and software they require to perform these tasks.

While the specific applications vary widely, all PLCs monitor inputs and other variable values, make decisions based on a stored program, and control outputs to automate a process or machine. This course is meant to supply you with basic information on the functions and configurations of PLCs with emphasis on the S7-200 PLC family.

Basic PLC operation

The basic elements of a PLC include input modules or points, a Central Processing Unit (CPU), output modules or points, and a programming device. The type of input modules or points used by a PLC depend upon the types of input devices used. Some input modules or points respond to digital inputs, also called discrete inputs, which are either on or off. Other modules or inputs respond to analog signals.

These analog signals represent machine or process conditions as a range of voltage or current values. The primary function of a PLC's input circuitry is to convert the signals provided by these various switches and sensors into logic signals that can be used by the CPU. The CPU evaluates the status of inputs, outputs, and other variables as it executes a stored program. The CPU then sends signals to update the status of outputs. The programming device is used to enter or change the PLC's program or to monitor or change stored values.

Once entered, the program and associated variables are stored in the CPU. In addition to these basic elements, a PLC system may also incorporate an operator interface device of some sort to simplify monitoring of the machine or process.

In the simple example shown below, pushbuttons (sensors) connected to PLC inputs, are used to start and stop a motor connected to a PLC output through a motor starter (actuator).

PLC Basics

The Most Unconventional Guide to PLCs on the Internet

Since the late 1960's, the Programmable Logic Controller (or PLC) has become an essential aspect of any automated manufacturing process. In recent times there have been contenders to replace the PLC but the priniciples and popularity of those early PLC's functions and concepts

have continued unabated. It is essential for many people from the technician to the engineer to understand these essential pieces of equipment.

PLC Dev has developed this instruction manual "PLC Basics" in hopes it will serve the beginner to the advanced user. Our goal is to make it comprehensive as possible, providing not only the generic principles in all PLCs, but to give practical examples from many different PLC manufacturers. To this end you are welcome to comment on each section by registering as a user and clicking the "add a comment" link at the bottom of the page.

Introduction to Programmable Controllers

It's always good to get an overview of where designs have been and they are going. To do this it's essential to get a bird's eye view of the concepts and processes that make the PLC so valuable in industrial control.

What is a PLC?

A Programmable Logic Controller, or PLC for short, is simply a special computer device used for industrial control systems. The basic units have a CPU (a computer processor) that is dedicated to run one program that monitors a series of different inputs and logically manipulates the outputs for the desired control. They are meant to be very flexible in how they can be programmed while also providing the advantages of high reliability (no program crashes or mechanical failures), compact and economical over traditional control systems.

The Original Challenge

The early history of the PLC is fascinating. Imagine if you will a fifty foot long cabinet filled with relays whose function in life is to control a machine. Wires run in and out of the system as the relays click and clack to the logic.

The Race is On

This was a tall order in 1968 but four companies took on the challenge.

1. Information Instruments, Inc. (fully owned by Allen-Bradley a year later).
2. Digital Equipment Corp. (DEC)
3. Century Detroit
4. Bedford Associates

Bedford Associates, run by Richard Morley, won the contract and quickly formed a new company around the technology called MODICON after Modular Digital Control. By June of 1969 they were selling the first viable Programmable Controller the "084" (their 84th project) which sold over one thousand units. These early experiences gave birth to their next model the "184" in 1973 which set MODICON as the early leader in programmable controllers.

By 1971 Odo Struger and Ernst Dummermuth had begun to develop a new concept known as the Bulletin 1774 PLC which would make them successful for years to come.

Advanced automation training topics can vary greatly depending on what industry you are in and your current employers equipment, will determine what specific advanced automation training you will need. Because it is difficult for any one person to learn all advanced automation

topics, it is recommended you be actively working in the field before deciding which fit your needs best. But in the interim, you can start with learning more about advanced PLC and PAC instructions, like PID and user defined memory arrays and instructions. All along your adjectives should be to select subject most commonly used and those used in your equipment. The choices will be different for example you may be seeking advanced industrial automation training, or you may be seeking advanced building automation training.

The PID course we recommend below is a great example. Learning all 60 algorithms can be dry and you may never run into most of them. So the course below simplifies by providing the PID basics, like the 3 categories for PID algorithms (ideal, series/dependant and parallel/independent), then while teaching the most common algorithms, with interactive simulations, teaches you how to simplify PID tuning. This simplified approach will be adequate for most people in most circumstances.

- PID
- Intro to Python programming language
- Intro to SQL database queries

PLC Components

PLCs have grown throughout industrial control applications because of the ease they bring to creating a controller: ease of programming, ease of wiring, ease of installation, and ease of changing. All PLCs have the same basic components. These components work together to bring information into the PLC from the field, evaluate that information, and send information back out to various field. Without any of these major components, the PLC will fail to function properly. PLCs span a wide range of sizes, but all contain six basic components.

Power supply
Input module
Output module
Processor (CPU)
Rack or mounting assembly
Programming unit (software)
Proportional Integral and Derivative PID Processor Module

A PID module combines analog input, analog output, and a control program of a typical single loop controller. A PID module is a smart module. This means that it has an on-board microprocessor and program. The module carries out loop control without the use of the CPU in the PLC. These modules do communicate with the CPU for non-routine functions such as alarm reporting and programming changes.

Controls and Indicators

Most processor modules have front panel lights or indications to provide the user with status indications of PLC operation. These lights are very useful in troubleshooting. Also provided on most processor modules is a switch used to change the module mode of operation

from RUN to PROGRAM. Additional connections are also usually provided to allow the connection of a terminal for programming the PLC and a port for connections to external I/O.

Scanning

The processor module controls the PLC by executing the software program. During program execution, the processor reads all the inputs and uses the values, in accordance with the control logic, to energize or de-energize the outputs, thus solving the ladder network. Once all the logic is solved, the processor updates all outputs. The process of reading the inputs, executing the program, and updating the outputs is known as a scan. The time required to make a single scan varies from 1 msec to 100 msec.

The scan is normally a continuous and sequential process of reading the status of inputs, evaluating the control logic, and updating outputs. The common scan method of monitoring the inputs at the end of each scan is inadequate for reading certain rapid inputs. Some PLCs provide software instructions that will allow the interruption of the continuous program scan to immediately receive an input or update an output. These immediate instructions are very useful when the PLC must instantaneously react to a critical input or output.

User Program

The user program memory is an area reserved in the application memory for the storage of the control logic. All the PLC instructions that control the machine or process are stored here. The addresses of inputs and outputs, whether real or internal, are specified in this section of memory. When the processor is in the run mode and the program is executed, the processor interprets the user program memory locations and controls the bits of the data table that correspond to real or internal outputs. The interpretation of the user program is accomplished by the processors execution of the executive program.

The maximum amount of available user program memory is normally a function of the processor size (i.e., I/O capacity). In medium and large controllers, the user program area is normally flexible by altering the size of the data table so that it meets the minimum data storage requirements. In small processors, however, the user program area is normally fixed.

Number Systems

The earliest number or counting system known to man was developed to help determine a quantity for a collection of possessions. As daily activities became more complex, numbers became more important in trade, time, distance, and all other aspects of human life. Numbers are extremely important in everyday life. As such, a more complex system was required than counting everything on ones fingers and toes.

Ever since the necessity to count objects was discovered, man has been looking for easier ways to count them. The abacus, developed by the Chinese, is one of the earliest known methods for counting. The simple system of beads and wires arranged within a frame provided an early means for calculation. The apparatus proved helpful and is still used in some parts of the world today.

Computers are used wherever repeated calculations or the processing of large amounts of data is necessary. Some of the greatest applications are found in the military, scientific, and

commercial fields. These fields have applications ranging from manufacturing processes to engineering design, to the identification and destruction of enemy targets. The advantages of digital computers include speed, accuracy, and labor savings. Often, computers are used to manage routine jobs, allowing personnel to perform other tasks, which may require a human touch.

People and computers normally do not speak the same language. However, methods of translating information into forms that are understood and used by both are necessary. Humans generally speak in words and numbers expressed in the decimal number system, while computers only understand coded electronic pulses that represent digital information.

PLC Communication Protocols

Today, most manufacturers of PLC systems have developed their own proprietary communication protocol, making it difficult to combine PLC components from different manufacturers. Communication protocols set the standards for data representation, signaling, authentication, and error detection required to send information over a communications channel. MODBUS is currently the most common protocol used by PLC manufacturers.