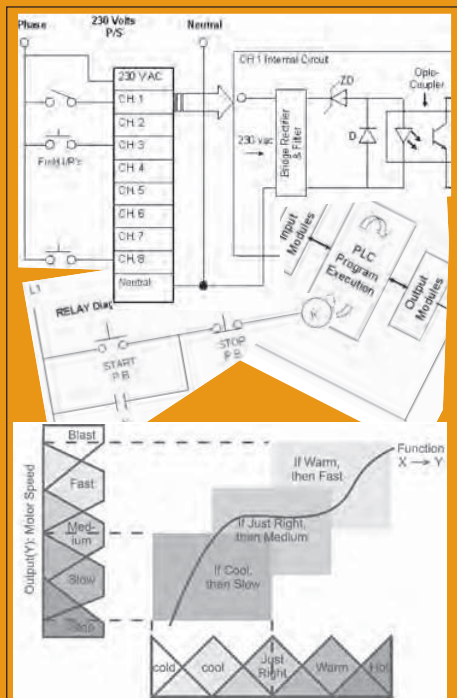


# PRACTICAL PROGRAMMABLE LOGIC CONTROLLERS (PLCs) FOR AUTOMATION AND PROCESS CONTROL



## YOU WILL LEARN HOW TO:

- Specify PLC hardware and installation criteria
- Describe PLC software structure
- Write medium level PLC programs (using ladderlogic)
- Troubleshoot a typical PLC system
- Specify PLC systems

## WHO SHOULD ATTEND:

- Process control operators
- Shift electricians
- Trades staff working with or near PLCs
- Instrumentation and control engineers
- Electrical engineers
- Design engineers
- Consulting engineers
- Instrumentation technicians
- Process control engineers
- Engineering managers
- DCS personnel



## The Workshop

This workshop is designed to benefit you with practical up-to-date information on the application of PLCs for the automation and process control of plants and factories. It is suitable for people who have little or no exposure to PLCs, but expect to become involved in some or all aspects of PLC installation. It aims to give practical advice from experts in the field, to assist you to correctly plan, program and install a PLC with a shorter learning curve and more confidence.

While the workshop is ideal for electricians, technicians and engineers who are new to PLCs, much of the workshop and additional material in the extensive manual will be of value to those who already have some basic skills, but need a wider perspective for larger and more challenging tasks ahead. The accompanying manual includes contributions from a number of experts and will become a valuable reference in your work. The information contained in this workshop advances from the basics to challenge even the most experienced engineer in the industry today.

### Pre-requisites

A basic electrical knowledge would be useful but is not essential.

## Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.



## The Program

### DAY ONE

#### INTRODUCTION

- Introduction to PLCs
- A brief history of PLCs
- Alternative control systems – where do PLCs fit in?
- Why PLCs have become so widely accepted
- Lingering concerns about PLCs

#### FUNDAMENTALS OF PLC HARDWARE

- Block diagram of typical PLC
- PLC processor module – memory organisation
- Input / output section – module types
- Power supplies

#### FUNDAMENTALS OF PLC SOFTWARE

- Methods of representing logic
  - Boolean algebra
  - Instruction code
  - Graphical presentation: functional logic diagrams, ladder logic
- Fundamental ladder logic instruction set
- Comparison of different manufacturers
  - Memory and data representation
  - Instruction code

#### USING LADDERLOGIC FOR SIMPLE DIGITAL FUNCTIONS

- The basic rules
- Comparison with relay ladder diagrams
- The concept of the “scan” and how to apply it
- Infinite fan-out
- Contact “normal” states
- Positive and negative logic
- Basic boolean functions
- The usefulness of De Morgan’s Law

#### USING REGISTERS (WORDS)

- Number systems
- Types of register data
- Timers
- Counters
- Bit shift / rotate
- Table functions
- Register (matrix) logic functions

#### *Practical Session*

#### GOOD PROGRAMMING HABITS

- Keeping track of addresses and data used
- Looking ahead – how will programs be maintained
- Practical methods to improve program quality
  - Organisation of code
  - Through documentation
  - Simplifying changes

#### *Practical Session*

#### GOOD INSTALLATION PRACTICE

- Location of hardware
- Good wiring practice
  - Cable spacing
  - Power distribution
  - Wire numbering
- Reducing noise and interference
- Screening and shielding
- Earthing and grounding

#### *Practical Session*

### DAY TWO

#### ADVANCED CONTROL WITH PLCs

- The concept of reusable logic - examples: drive logic, alarm handling
- Use of advanced programming functions
- Matrix logic
- Table functions and indirect addressing
- Examples: simple display driver

#### BATCH PROCESSES AND SEQUENTIAL CONTROL

- Remembering the program state
- Creating a “stepper”
- Step advance
- Fault detection and recovery
- Operator intervention
- Multiple recipes or alternate paths
- Sequential function charts

#### PID CONTROL

- The importance of timing and scan time
- When PID is not always appropriate:
  - Intermittent measurements
  - Long transport delays

#### SAFETY PROGRAMMABLE SYSTEMS

- Why regular PLCs should not be used for safety functions
- Programmable electronic logic solvers
- Safety certification
- Certified programming systems
- Application examples
- Growth of networked safety devices and certified networks
- Integrated safety systems

#### DATA COMMUNICATIONS

- Interface standards, RS-232, RS-422/423, RS-485
- Protocols, Modbus and DH+
- Local area networks, Ethernet and token bus
- Monitoring communication links and simple watchdog timers

#### INTRODUCTION TO IEC 61131-3

- Concepts
- Common elements
- Programming languages: structured text
- Function block diagrams
- Ladder diagrams
- Instruction list
- Sequential function chart

#### OPC

- Introduction to OPC
- What is OPC?
- Architecture

#### SYSTEM CHECKOUT AND TESTING

- Development and verification of code
- Factory acceptance testing
- Testing procedures
- Emulating missing hardware
- Emulating process responses

#### SUMMARY, OPEN FORUM AND CLOSING