

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Programmable controllers –
Part 1: General information

Automates programmables –
Partie 1: Informations générales

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PROGRAMMABLE CONTROLLERS –**Part 1: General information**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61131-1 has been prepared by subcommittee 65B: Devices, of IEC technical committee 65: Industrial-process measurement and control.

This second edition of IEC 61131-1 cancels and replaces the first edition published in 1992 and constitutes a technical revision.

This bilingual version (2012-05) corresponds to the monolingual English version, published in 2003-05.

The text of this standard is based on the following documents:

FDIS	Report on voting
65B/484/FDIS	65B/487/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 61131 consists of the following parts under the general title: *Programmable controllers*.

Part 1: General information

Part 2: Equipment requirements and tests

Part 3: Programming languages

Part 4: User guidelines

Part 5: Communications

Part 6: Reserved

Part 7: Fuzzy-control programming

Part 8: Guidelines for the application and implementation of programming languages for programmable controllers

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

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INTRODUCTION

This Part of IEC 61131 constitutes Part 1 of a series of standards on programmable controllers and their associated peripherals and should be read in conjunction with the other parts of the series.

Where a conflict exists between this and other IEC standards (except basic safety standards), the provisions of this standard should be considered to govern in the area of programmable controllers and their associated peripherals.

The purposes of this standard are:

Part 1 establishes the definitions and identifies the principal characteristics relevant to the selection and application of programmable controllers and their associated peripherals;

Part 2 specifies equipment requirements and related tests for programmable controllers (PLC) and their associated peripherals;

Part 3 defines, for each of the most commonly used programming languages, major fields of application, syntactic and semantic rules, simple but complete basic sets of programming elements, applicable tests and means by which manufacturers may expand or adapt those basic sets to their own programmable controller implementations;

Part 4 gives general overview information and application guidelines of the standard for the PLC end-user;

Part 5 defines the communication between programmable controllers and other electronic systems;

Part 6 is reserved;

Part 7 defines the programming language for fuzzy control;

Part 8 gives guidelines for the application and implementation of the programming languages defined in Part 3.

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PROGRAMMABLE CONTROLLERS –

Part 1: General information

1 Scope

This Part of IEC 61131 applies to programmable controllers (PLC) and their associated peripherals such as programming and debugging tools (PADTs), human-machine interfaces (HMIs), etc., which have as their intended use the control and command of machines and industrial processes.

PLCs and their associated peripherals are intended to be used in an industrial environment and may be provided as open or enclosed equipment. If a PLC or its associated peripherals are intended for use in other environments, then the specific requirements, standards and installation practices for those other environments must be additionally applied to the PLC and its associated peripherals.

The functionality of a programmable controller can be performed as well on a specific hardware and software platform as on a general-purpose computer or a personal computer with industrial environment features. This standard applies to any products performing the function of PLCs and/or their associated peripherals. This standard does not deal with the functional safety or other aspects of the overall automated system. PLCs, their application programme and their associated peripherals are considered as components of a control system.

Since PLCs are component devices, safety considerations for the overall automated system including installation and application are beyond the scope of this Part. However, PLC safety as related to electric shock and fire hazards, electrical interference immunity and error detecting of the PLC-system operation (such as the use of parity checking, self-testing diagnostics, etc.), are addressed. Refer to IEC 60364 or applicable national/local regulations for electrical installation and guidelines.

This Part of IEC 61131 gives the definitions of terms used in this standard. It identifies the principal functional characteristics of programmable controller systems.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61131-2, *Programmable controllers – Part 2: Equipment requirements and tests*

IEC 61131-3:2003, *Programmable controllers – Part 3: Programming languages*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

application programme or user programme

logical assembly of all the programming language elements and constructs necessary for the intended signal processing required for the control of a machine or process by a PLC-system

3.2

automated system

control system beyond the scope of IEC 61131, in which PLC-systems are incorporated by or for the user, but which also contains other components including their application programmes

3.3

field device

catalogued part to provide input and/or output interfaces or to provide data pre-processing/post-processing to the programmable controller system. A remote field device may operate autonomously from the programmable controller system. It can be connected to the programmable controller using a field bus

3.4

ladder diagram or relay ladder diagram

one or more networks of contacts, coils, graphically represented functions, function blocks, data elements, labels, and connective elements, delimited on the left and (optionally) on the right by power rails

3.5

programmable (logic) controller (PLC)

digitally operating electronic system, designed for use in an industrial environment, which uses a programmable memory for the internal storage of user-oriented instructions for implementing specific functions such as logic, sequencing, timing, counting and arithmetic, to control, through digital or analogue inputs and outputs, various types of machines or processes. Both the PLC and its associated peripherals are designed so that they can be easily integrated into an industrial control system and easily used in all their intended functions

NOTE The abbreviation PLC is used in this standard to stand for programmable controllers, as is the common practice in the automation industry. The use of PC as an abbreviation for programmable controllers leads to confusion with personal computers.

3.6

programmable controller system or PLC-system

user-built configuration, consisting of a programmable controller and associated peripherals, that is necessary for the intended automated system. It consists of units interconnected by cables or plug-in connections for permanent installation and by cables or other means for portable and transportable peripherals

3.7

programming and debugging tool (PADT)

catalogued peripheral to assist in programming, testing, commissioning and troubleshooting the PLC-system application, programme documentation and storage and possibly to be used as HMIs. PADTs are said to be pluggable when they may be plugged or unplugged at any time into their associated interface, without any risk to the operators and the application. In all other cases, PADTs are said to be fixed

3.8 remote input/output station (RIOS)

manufacturer's catalogued part of a PLC-system including input and/or output interfaces allowed to operate only under the hierarchy of the main processing unit (CPU) for I/O multiplexing/demultiplexing and data pre-processing/post-processing. The RIOS is the only permitted limited autonomous operation, for example, under emergency conditions such as breakdown of the communication link to the CPU or of the CPU itself, or when maintenance and troubleshooting operations are to be performed

4 Functional characteristics

4.1 Basic functional structure of a programmable controller system

The general structure with main functional components in a programmable controller system is illustrated in Figures 1, 2 and 3. These functions communicate with each other and with the signals of the machine/process to be controlled.

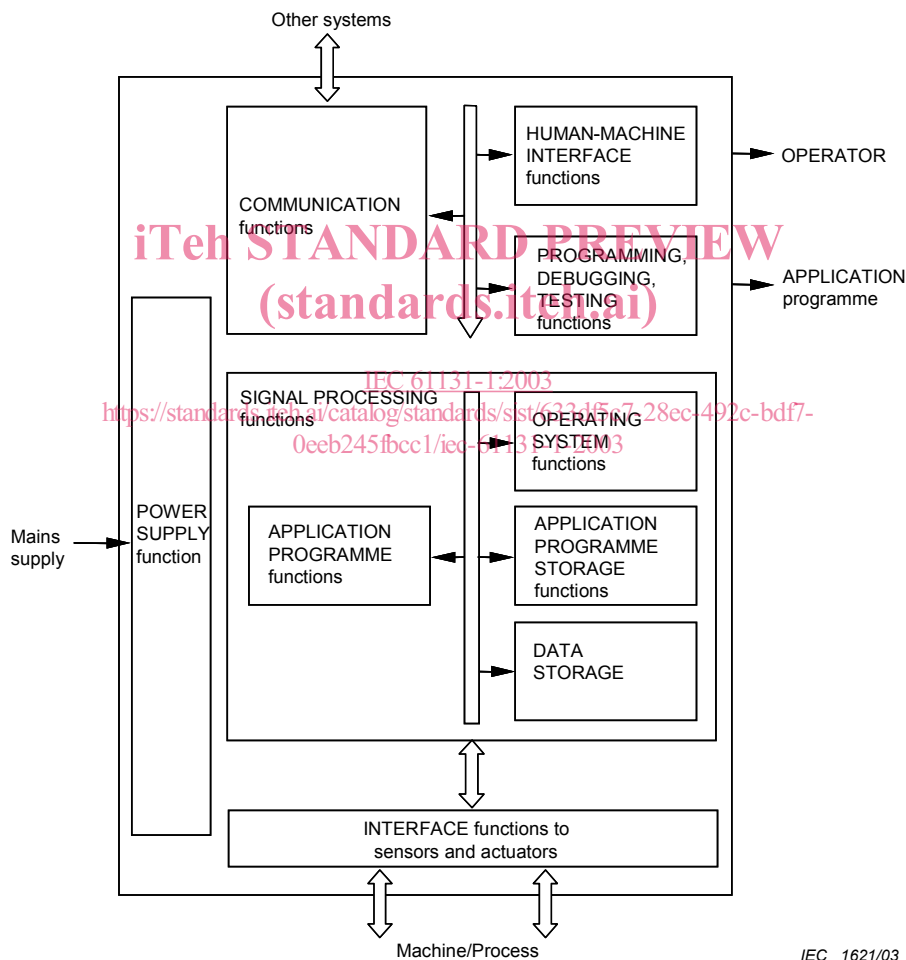
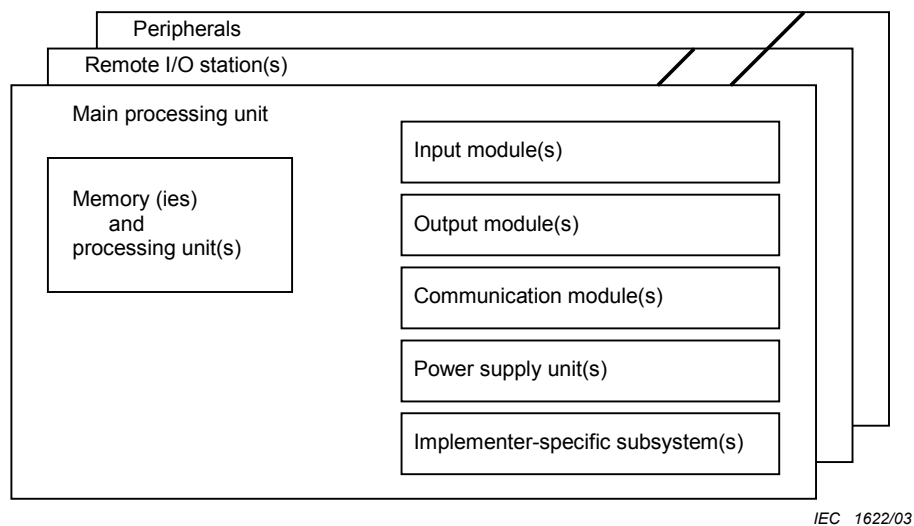


Figure 1 – Basic functional structure of a PLC-system

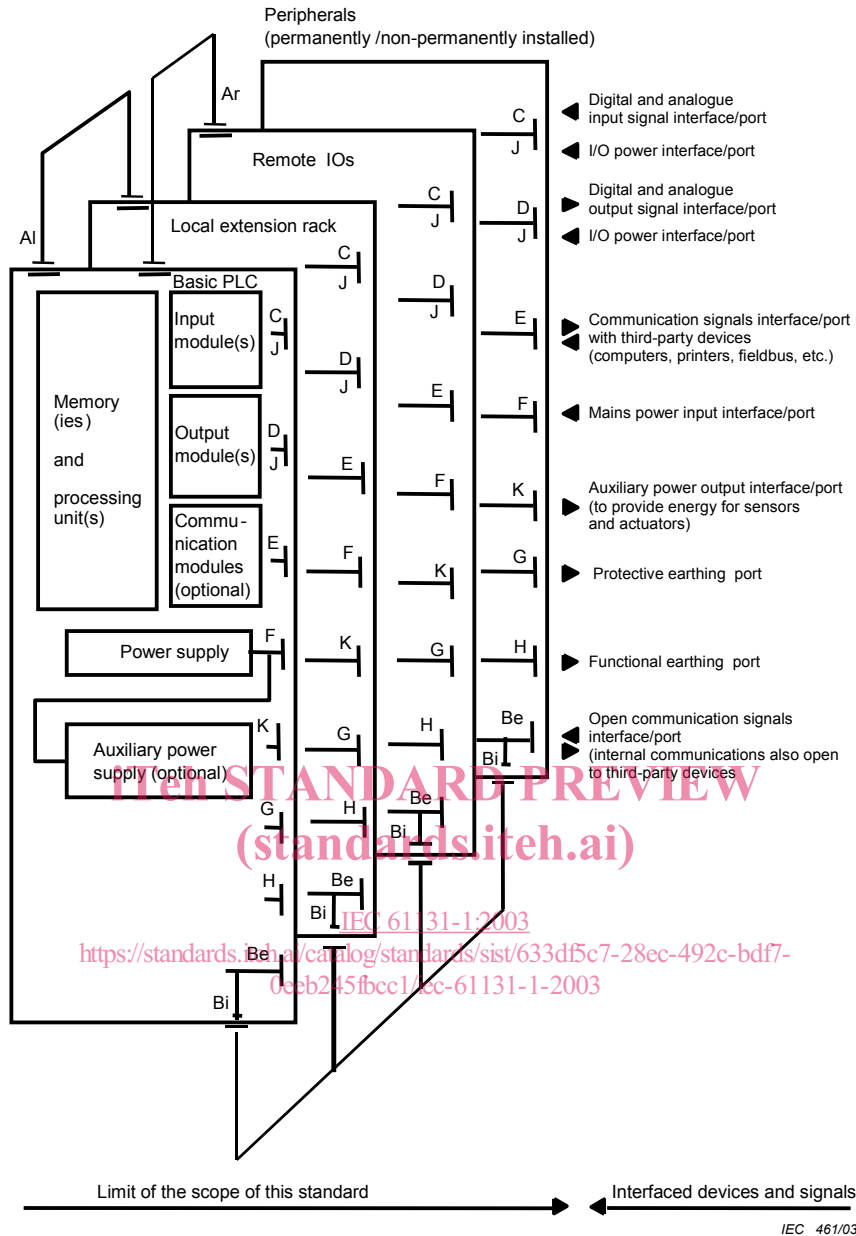


**Figure 2 – Programmable controller hardware model
(from IEC 61131-5)**

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Key

- Al Communication interface/port for local I/O
- Ar Communication interface/port for remote I/O station
- Be Open-communication interface/port also open to third-party devices (for example, personal computer used for programming instead of a PADT)
- Bi Internal communication interface/port for peripherals
- C Interface/port for digital and analogue input signals
- D Interface/port for digital and analogue output signals
- E Serial or parallel communication interfaces/ports for data communication with third-party devices
- F Mains power interface/port. Devices with F ports have requirements on keeping downstream devices intelligent during power-up, power-down and power interruptions.
- G Port for protective earthing
- H Port for functional earthing
- J I/O power interface/port used to power sensors and actuators
- K Auxiliary power output interface/port

Figure 3 – Typical interface/port diagram of a PLC-system (from IEC 61131-2)

The CPU function consists of the application programme storage, the data storage, the operating system, and the execution of the application programme functions.

The CPU processes signals obtained from sensors as well as internal data storage and generates signals to actuators as well as internal data storage in accordance with the application programme.

- **Interface function to sensors and actuators**

The interface function to sensors and actuators converts

- the input signals and/or data obtained from the machine/process to appropriate signal levels for processing;
- the output signals and/or data from the signal processing function to appropriate signal levels to drive actuators and/or displays.

The input/output signals to the interface functions may be coming from special modules which pre-process external sensor signals according to the defined functions contained in the special modules themselves. Examples of such special modules include PID module, fuzzy-control module, high-speed counter module, motion modules and others.

- **Communication function**

The communication function provides data exchange with other systems (third-party devices) such as other PLC-systems, robot controllers, computers, etc.

- **Human-machine interface (HMI) function**

The HMI function provides for interaction between the operator, the signal processing function and the machine/process.

- **Programming, debugging, testing and documentation functions**

These functions provide for application programme generation and loading, monitoring, testing and debugging as well as for application programme documentation and archiving.

- **Power-supply functions**

The power-supply functions provide for the conversion and isolation of the PLC-system power from the mains supply.

4.2 Characteristics of the CPU function

4.2.1 Summary

The capabilities of the programmable controllers are determined by programmable functions which are summarized in Table 1. They are subdivided for ease of use into application-oriented groups.