

1. Product Description

The AL-2003 CPU is one of the CPU models of the AL-2000 series of programmable controllers, and allows the control of up to 8,192 digital I/O points, aside from analog points. Parallel processing is used to provide high performance. Thanks to its modified Harvard architecture, with 32 bits of internal registers for instruction codes and data, it is possible to achieve high performance in the main processing, combined with the high capacity of an additional network processor. It has an advanced software structure, in which programming is organized into modules. It incorporates a processor dedicated to the ALNET II communications network and a real-time clock, with a synchronizing capacity with maximum error of 1 ms through a network especially designed for this kind of application. The two processors that make up this CPU (application and network/synchronization) work in parallel using different communications techniques between processes. The product is compatible with I/O modules of the AL-1000, QK2000 and AL-3000 series. Although the programs already implemented to the AL-2002 are not directly executable on the AL-2003, they can be easily converted in the Master Tool programmer, for which the user just needs to read the AL-2002 program and save it again, an operation that can be carried out in a few seconds.

This document is valid from version 1.00 of the AL-2003 executive program.

The AL-2002 and the AL-2003 CPUs are compared as follows:

| | AL-2003 | AL-2002 |
|---|--------------|-------------|
| Number of I/O points | 8,192 | 512 |
| Number of A operands | 512 | 96 |
| Memory for numeric operands (M, D, TM, TD) | 48 Kbytes | 15,5 Kbytes |
| Flash memory per application program | 1,024 Kbytes | 128 Kbytes |
| Average processing time per 1024 contact instructions | 1.6 ms | 5 ms |
| Serial communications interfaces | 2 | 1 |

2. Components

The package contains the following items:

- AL-2003 CPU
- Installation guide

3. Functional features

3.1. General features

- Number of I/O digital points:
 - 2,048 with local I/O
 - 8,192 with remote I/O
- Maximum number of local I/O modules: 142
- Number of analog I/O points, aside from the digital points, limited by the maximum number of modules
- Possibility of up to 100,000 contact instructions in the application program
- 100 ms of processing per 64,000 contact instructions
- Interface for integrated high speed communication network, multimaster, ALNET II protocol. Network processor incorporated into the module
- RS-232C main serial communications interface with ALNET I protocol
- Auxiliary serial communications interface with ALNET I protocol or other protocols, through the loading of appropriate

F modules. It uses the AL-2405 module, which allows for RS-232C or EIA485 standards.

- Hot swap of I/O modules, individually or by bus
- Main processor with three-stage pipeline architecture that allows high performance in the execution of control programs
- Real-time clock and synchronization control incorporated in the module
- Watchdog supervising circuit
- Storage of the application program:
 - RAM and Flash EPROM
- Operands memory retention implemented in the CPU (battery backup for operands RAM)
- Capacity to operate with processing modules:
 - AL-2005 (Real-Time Multitask Processor)
 - AL-2006 "Brother" (Processor for Redundancy and/or remote I/O)
 - AL-3405 (Ethernet Interface)
 - AL-3406 (PROFIBUS DP master interface)
 - AL-2008 (DSP high performance coprocessor)
- LEDs showing the CPU status on the front panel
- Capacity to operate with the AL-3130, AL-3132, AL-3138, AL-3201, AL-3202, AL-3150, AL-3151, AL-3116 and AL-3117 I/O modules in the main rack.
- Operating temperature: 0 to 60 °C
exceeds IEC 1131 standard
- Storage temperature: -25 to 75 °C
according to IEC 1131 standard
- Relative humidity: 5 to 95 % non-condensing
according to IEC 1131 standard, RH2 level
- MTBF: 18,000 hours @ 40 °C
calculated according to MIL-HDBK-217E standard
- Weight:
 - packed: 570 g
 - unpacked: 420 g

3.2. Electrical Features

- Supply voltages received from backplane:
 - +5 Vcc ±5 %
 - +15 Vcc ±5 %
 - 15 Vcc ±5 %
 - +5 Vbb ±10 % (battery voltage)
- Consumption:
 - 530 mA @ +5 Vcc
 - 50 mA @ +15 Vcc
 - 30 mA @ -15 Vcc
 - 70 mA @ +5 Vbb
 - 70 µA @ battery, when the system is not powered
- Module dissipation: 4.2 W
- Compliant with IEC 1131 and electrical area standards

3.3. Software Features

- Programming language: ladder diagram and logic blocks, structured in modules with functions and sub-routines
- MasterTool Programmer
- Total capacity of the application program: 1.12 Mbytes, organized into:
 - RAM: 128 Kbytes always present
 - Flash EPROM: 1 Mbyte
- Load of program modules during execution ("on line programming")
- Operands for digital processing (1 bit):
 - Input (E): up to 2,048 input relays
 - Output (S): up to 2,048 output relays
 - Auxiliary (A): up to 4,096 auxiliary relays

The total number of 2048 points includes digital inputs and outputs of local bus simultaneously, i.e., the sum of the number of points at the operands E with S must be less than or equal to that limit.

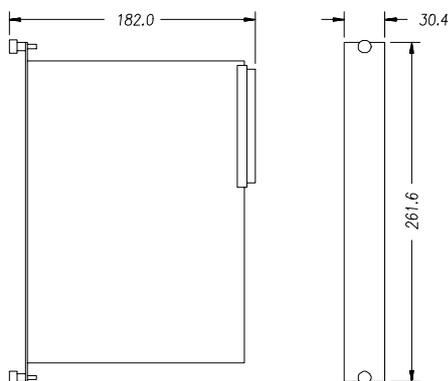
- Operands for numerical processing:
 - Constants:
 - memory constant (KM): value stored in 16 bits, 2's complement.
 - decimals constant (KD): value stored in 32 bits, BCD format with signal
 - Simple operands:
 - memories (M): up to 9,984 operand (M0000 to M9983), value stored in 16 bits, 2's complement
 - decimals (D): up to 9,984 operands (D0000 to D9983), value stored in 32 bits, BCD format with signal
 - Table operands:
 - table of memories (TM): up to 255 operands (TM000 to TM254), with up to 255 positions in each one, each position with the same format as an M operand.
 - table decimals (TD): up to 255 operands (TD000 to TD254), with up to 255 positions in each one, each position with the same format as a D operand.

All numeric operands (KM, KD, M, D, TM and TD) allow for arithmetic signal in the representation of values. The number of simple operands and tables (M, D, TM, TD) is configured by each program, and is limited by the available memory capacity of operands (48 Kbytes).

The feature of memory retention can be attributed to the operands S, A, M and D through the programmer. The retentive operands have their values preserved during power outage, whereas the non-retentive operands have their values zeroed. The table operands are always retentive.

- Memory capacity for simple operands and table operands: 48 Kbytes
- Average runtime: 1.6 ms / 1,024 contact instructions
- Average memory occupation per contact instructions: 7 bytes

4. Physical Dimensions



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5. ALNET II Network

The AL-2003 CPU incorporates a high speed network interface, allowing for the connection of up to 31 nodes into the same subnetwork (a node can be a controller, gateway or bridge) and making a series of applications possible with excellent cost-effectiveness. The network interface works totally in parallel with the application program, ensuring high communication performance without changing the features of the application control link.

The basic features include:

- Bus topology
- Maximum reach without repetitor: 2 km with RS-485, 4 km with optical fiber
- Programmable data rate from 25 Kbit/s to 1 Mbit/s
- Method of access: deterministic, multimaster
- Physical standard: EIA 485 with galvanic insulation
- Broadcast and multicast communication capacity
- Automatic control of retransmission and error check
- Up to 31 nodes per subnet
- Up to 63 subnets
- Capacity of use with optical fiber, through fiber-optic modem, with greater rate and distance
- Interface with the application program with transmission and reception instructions (ECR and LTR), allowing the transfer of information blocks directly between CPs, with no need of net managers. Unsolicited messages to supervisory systems are also allowed by ECR instruction.
- Load of program over the network (ALNET I, ALNET II or Ethernet TCP/IP)

6. Real-time Clock and Synchronization

The AL-2003 CPU has real-time clock and synchronization control implemented through a dedicated processor.

Many applications in complex systems, with event recording, demand that the clocks in the several CPUs in the system be synchronized. Through the special signals from the synchronization network, time keeping in the several controllers is made with a 1 ms precision from the clock of a master CPU.

The synchronization clock of the master CPU may follow the time reference provided by external and high-precision systems, such as GPS (Global Positioning System) equipment.

7. User's Guides

For further information on technical details, installation, programming and user's safety, refer to the following guides:

- AL-2003 User's Guide
- PC Technical Specifications Guide
- MasterTool User's Guide
- MasterTool Programming Guide
- ALNET II Network User's Guide

8. Purchase Data

8.1. Product

| Name | |
|---------|---|
| AL-2003 | CPU MSP 1M FLASH, 142 I/O Modules, 2,048 digital I/O points |

8.2. Related Items

| Cables | Interconnected Equipment | | Length |
|---------|--------------------------|----------------------------|--------|
| AL-1342 | AL-2003 | Laptop or AL-3904 (DB9) | 3 m |
| AL-1343 | AL-2003 | Micro IBM-PC® (DB25) | 3 m |
| AL-1344 | AL-2003 | RS-232C standard modem | 3 m |
| AL-1345 | Micro IBM-PC® (DB25) | RS-232C standard modem | 3 m |
| AL-1346 | Laptop or AL-3904 (DB9) | RS-232C standard modem | 3 m |
| AL-1397 | AL-2003 | AL-1413 | 3 m |
| AL-2300 | AL-2003 | AL-2600 (ALNET II network) | 3 m |

| Other | Name | Function |
|--------------|-------------------------------|---|
| MT4000 | MasterTool programmer | Programming software for Windows-based PCs, Windows 3.1x,95,98 |
| MT4100 | MasterTool programmer | Programming software for Windows-based PCs, Windows NT or 2000 |
| AL-2300 | Branch Cable | Cable used for connection of the CPU and the AL-2600 branch |
| AL-2301 | EIA 485 cable | Physical medium used for ALNET II network |
| AL-2600 | Branch and termination | Module used for connecting of the ALNET II physical medium to the CPU |
| AL-2405/232 | RS-232C serial module | Interface for the second serial channel on the RS-232C standard |
| AL-2405/485I | Isolated EIA 485serial module | Interface for the second serial channel on the EIA 485 standard |