AI -200

Product Description

The AL-2004 CPU is used for the supervision and control of processes managing up to 8.192 digital I/O points. It has a RS-232C serial interface for programming and ALNET I network and an ALNET II multi-master network communication. 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. This CPU is compatible with AL-2002 and AL-2003 CPUs. The programs already developed for these, although can not be directly executed in AL-2004, can be converted using MasterTool software. To achieve this, it is just necessary to read the AL-2002 or AL-2003 program and save it as for AL-2004. This operation takes just a few seconds.



Main features:

- Floating point operations, IEEE 754 representation as single precision
- · Integer operations with 32 bits signed operands
- · Operations with 16 bits PID functions and advanced functions of control
- Up to 8.192 digital I/O points when used with AL-2005
- Parallel processing for higher performance
- 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
- 1 Mbyte Flash memory for application program
- Connectivity to fieldbuses MODBUS (AL-2005 or AL-3414) and PROFIBUS (AL-3406 or AL-3416)
- Supervision though Ethernet 10 or 100 Mbps when used with AL-3412 or AL-3414
- Implements CPUs redundant systems through AL-2017 coprocessor
- Assisted serial communication port
- · Coprocessor for network processing
- Ladder diagram and logic blocks programming language
- · Hot swap of modules, individually or by bus
- Synchronization network functions with maximum error of 1 ms
- Compatible with Quark and AL-3000 I/O modules
- · LEDs showing the CPU status on the front panel

Purchase Data

Components

The package contains the following items:

• CPU AL-2004

Product Code

The following code should be used for purchasing this product:

Code	Name
AL-2004	CPU with 2.048 digital I/O points - 1 Mbyte Flash

Related Products

The following products may be acquired separately if necessary:

Code	Name	
AL-1342	CMDB9-CFDB9 (Laptop/CP) cable	
AL-1343	CFDB25-CMDB9 (IBM PC/CP) cable	
AL-1344	CMDB25-CMDB9 (Modem/CP) cable	
AL-1422	GPS Synchronism Generator	
AL-2017	Redundancy Coprocessor	
AL-2300	CPU/AL-2600 branch cable	
AL-2305	(CMDB9 - RS-485) branch cable	
AL-2405/232	RS-232 Serial module	
AL-2405/485I	Isolated EIA 485 serial module	
AL-2600	Branch and termination for Network	
AL-2700	Arithmetical functions for PCs	
AL-2702	ALNET I Master Comunication Functions	
AL-2711	Power Measurement Comunication Function	
AL-3406	PROFIBUS Master Interface	
AL-3411	Bus interface for AL-2002/AL-2003/AL-2004	
AL-3412	Ethernet 10/100 Mbits/s Interface	
AL-3414	Redundant MODBUS TCP Ethernet Interface	
AL-3416	PROFIBUS Slave Interface	
AL-3511	Double Euro Power Supply 80 W Input 24-48 Vdc	
AL-3512	Double Euro Power Supply 80 W Input 93-253Vac	
AL-3631	Rack PS, CPU and 4 Smart Cards	
AL-3634	Rack for PS, CPU and 16 Modules	
AL-3635	Rack PS, CPU and 8 Smart Cards	
AL-3640	Rack for Redundant PS, CPU and 6 Modules	
MT4100	MasterTool Programming MT4100	

Notes

AL-1342: This cable has a DB9 RS232 male and a DB9 RS232 female serial connector IBM/PC standard. May be used on the ALNET I and COM interfaces for:

- · Connection to MMIs with compatible IBM/PC standard connectors for local supervision of processes
- Connection to IBM/PC standard computers with supervision software.
- Connection to IBM/PC standard computers with MasterTool Software for CPU programming

AL-1343 This cable has a DB9 RS232 male and a DB25 RS232 female serial connector IBM/PC standard. May be used on the ALNET I and COM interfaces for:

- · Connection to MMIs with compatible IBM/PC standard connectors for local supervision of processes
- Connection to IBM/PC standard computers with supervision software.
- Connection to IBM/PC standard computers with MasterTool Software for CPU programming

AL-1344: This cable has a DB9 RS232 male and a DB25 RS232 female serial connector Modem standard. May be used on the ALNET I and COM interfaces for:

- Connection to Modem
- Connection to Radio Modem

AL-1422: This module permits synchronism distribution and time signals from a GPS receptor to Hádron remotes or microcomputers. The module uses a RS-422 standard port to communicate with GPS and converting its format to RS-232C to connect to local or remote network. Besides, it contains a RS-232 port to permit configuration and diagnosis through a microcomputer.



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AL-2017: This coprocessor is used in redundant configurations with AL-2004 CPU, using single or redundant PROFIBUS I/O. The two coprocessors (one for each CPU) are connected through two synchronism channels and a control panel, which permits operation control and state visualization of the redundant system.

AL-2300: This cable has a DB9 RS232 connector DB9 connector at one end and individual pins at the other. It is used on the ALNET II interface for connection with AL-2600.

AL-2305: This cable has a DB9 RS232 connector DB9 connector at one end and individual pins at the other. It is used on the COM interface using AL-2405/485I for connection with AL-2600.

AL-2600: This module is designed to easily connect a RS485 standard network (AL-2301 cable) to AL-2305 cable. This module is totally passive, with branch connectors and selectable termination resistors for networks.

AL-2711: Function module that configures CPU AL-2004 auxiliary channel to communicate with power measurement equipment, through Distribution Committee - CODI defined protocol.

AL-3406: This interface allows the connection of AL-2004 CPU to open networks that follow PROFIBUS standard, and permits access by the UCP, as a master of the network, to any fieldbus slave compatible with this protocol. Has also two ports to connect Quark Series modules, allowing CPU to connect up to two racks with 16 modules each. In this case the AL-3406 is able to substitute half AL-3411 module.

AL-3411: This bus interface connects the AL-2004 CPU to I/O sub-systems modules that use the Quark Series standard bus. It permits to connect up to four racks with 16 modules each, powered by QK2511 or QK2512 supplies.

AL-3412: This interface allows the connection of Altus' CLPs to open networks that follow TCP/IP standard. It permits the communication between Altus' CLPs (AL Series) and other equipment that communicate through Ethernet TCP/IP protocol with ALNET II application level.

AL-3414: This interface allows the connection of Altus' CLPs to open networks that follow TCP/IP standard. It permits the communication between Altus' CLPs (AL Series) and other equipment that communicate through Ethernet TCP/IP protocol with ALNET II or MODBUS application levels. Besides that, this interface offers support to redundant communication, conferring to the CPU a new characteristic: network or interface fault tolerance.

AL-3416: This interface allows the connection of AL-2004 CPU to open networks that follow PROFIBUS standard, and permits that any fieldbus master compatible with this protocol can access the UCP as a slave of the network.

AL-2004

Features

AL-2004 CPU present the following features:

	AL-2004
Module Type	CPU
Hot swap	Yes, for modules with hot swap capacity or for buses
Capability of connection to fieldbuses	Yes, through field buses interfaces and coprocessors
Average runtime time for processing 1024 contact instructions	1,6 ms
RS232 serial port(ALNET I)	TX, RX, RTS and CTS with ALNET I slave
Serial expansion interface (COM)	Yes, permits an extra serial port by adding one AL-2405 card (RS232 or RS485)
Synchronism Network through ALNET II	Yes
Synchronism with GPS	Yes, using AL-1422
Real-time clock	Yes
Events register	1 ms resolution, using AL-313X
Watchdog	Yes
Battery backup for operands memory retention	Located in the PS, hot swap
Status indication	LEDs EX, PG, ER, WD, TX (ALNET I), RX (ALNET I), TX (ALNET II), RX (ALNET II)
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 RH2 level
Weight	packed: 570 g
	Unpacked: 420 g
Supply voltages received from backplane	+5 Vcc
	+15 Vcc
	-15 Vcc
	+5 Vbb
Consumption	530 mA @ +5 Vcc
	50 mA @ +15 Vcc
	30 mA @ -15 Vcc
	70 mA @ +5 Vbb
	70 $\mu A @$ battery, when the system is not powered
Module dissipation	4,2 W
Standards Compliance	IEC 1131 and electrical area

Software Features

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	AL2004
Programming Language	ladder diagram and logic blocks, structured in modules with functions and sub-routines
Online Programming	Through ALNET I, ALNET II, COM and Ethernet
Total Input type (I) or Output type (O) operands	2048
Total Auxiliary type operands	4096 (512 octets)
Total capacity of the application program	1,12 Mbytes organized into:
	RAM: 128 Kbytes always present
	Flash EPROM: 1 Mbyte
Number of Memory type (M) operands:	Up to 9984
Value stored in16 bits, 2's complement format	
Number of Decimal Memory type (D) operands:	Up to 9984
Value stored in 32 bits, BCD format with signal	
Number of Table of Memories type (TM) operands:	Up to 96 tables with up to 255 positions each
Same format as M operand	
Number of Table of Decimals type (TD) operands:	Up to 48 tables with up to 255 positions each
Same format as D operand	
Memory Constant (KM):	Stored in the application program
Value stored in 16 bits, 2's complement format	
Decimal Constant (KD):	Stored in the application program
Value stored in 32 bits, BCD format with signal	
Real Constant (KF):	Stored in the application program
32 bits value, IEEE 754	
Memory Constant (KI):	Stored in the application program
Value stored in 32 bits, 2's complement format	
Average memory occupation per contact instruction	7 bytes
Memory for retentive operands	48 Kbytes
Memory retention	Configured for S, A, M, D, F, I operands through the programming software
	Always active for TM, TD, TF and TI
File instruction	Permits the storage of great amounts of data in blocks up to 32 Kbytes

- The total number of 2048 I/O points includes digital inputs and outputs from local and remote buses, therefore, the sum of the number of points in operands I with O must be less than or equal to this limit.
- All numeric operands (KM, KD, KF, M, D, F, I, TM, TD, TF e TI) allow for arithmetic signal in the representation of values. The number of simple operands and tables (M, D, F, I, TM, TD, TF e TI) 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.
- %I e %TI operands are compatible with AL-2004 version 2.10 or greater and programmable with MasterTool 3.83 or grater.

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ALNET II Network

The AL-2004 CPU incorporates a high speed network interface, allowing for the connection of up to 31 nodes into the same sub-network (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 repeater: 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, multi-master
- Physical standard: EIA 485 with galvanic insulation
- · Broadcast and multicast communication capacity
- Automatic control of retransmission and error check
- Up to 31 nodes per sub-network
- Up to 63 sub-networks
- 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)

Network Connections

The AL-2004 CPU has the capability to be connected to other devices through fieldbuses. There are four connectors on the front panel of the CPU.

These connections are also possible through communication modules added in the bus.

The following table shows some possible connections through the front panel.

Function	Panel conector
ALNET I Slave	ALNET I or COM (using AL-2405)
ALNET II	ALNET II
Syncronism Network	SINC + ALNET II
GPS (NMEA)	SINC and COM
Power measurement	COM (with AL-2711)

The following table shows some possible connections through communication modules added in the bus.

Function	Bus Module
ALNET I Slave	AL-2005 + AL-2732
ALNET I Master	AL-2005 + AL-2732
TCP/IP 10/100 Mbps	AL-3412 or AL-3414
MODBUS Slave	AL-2005 + AL-2734
MODBUS Master	AL-2005 + AL-2734
MODBUS TCP	AL-3414
Power measurement	AL-2711
PROFIBILIS Slove	AL-3416
PROFIBUS Slave	QK1404
	AL-3406
FROFIDUS Master	QK1405

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- ALNET I: Master-slave network based on RS232 or RS 485 serial communication. Used for monitoring, supervision, programming and maintenance. It also permits the connection between CPU and MMI or even between CPUs. It is possible the use of modems and gateways with ALNET II network.
- ALNET II: 1 Mbit multi-master network. Used for monitoring, supervision, programming and maintenance. Allows either electric
 or fiber optic physical media.
- TCP/IP 10/100 Mbps: Has the same features than ALNET II, using Ethernet physical media, allowing the use of architectures and devices of Ethernet local networks. Through AL-3414 interface, the MODBUS TCP application protocol is also available for the CPU. The AL-2004 CPU supports only one Ethernet interface with ALNET II application protocol in his bus, but up to eight interfaces with MODBUS TCP protocol.
- PROFIBUS: Open network for data acquisition at high speed (12 Mbits) and in big amounts of data, access to I/O points is deterministic.
- MODBUS: Master-slave open network based on RS232 or RS 485 serial communication. Used for monitoring, supervision and data acquisition.
- Synchronism Network: Together with ALNET II is used for the synchronization of PCs with up to 1 ms resolution.
- GPS (NMEA): Used with the synchronism network to get global time. It is also possible to synchronize PCs that do not have synchronism network or even those with great distances between them.
- **Power Measurement**: Using AL-2711 it is possible to connect to ELO power-meters, allowing demand control. These are the main communication drivers, for others, please contact Support or Sales representatives.

Real-time Clock and Synchronization

The AL-2004 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.

Physical Dimensions

