ControlWave®
Process Automation Controller (PAC)

Emerson's ControlWave® PAC is a highly adaptable Process Automation Controller with exceptional networking capability. Designed with an emphasis on scalability and modularity, the ControlWave PAC can be configured to maximize the performance of a wide range of control systems. Emerson has developed this innovative controller to provide cost-effective solutions by minimizing the time required for installation and configuration.

The ControlWave PAC combines the elements of a PLC and an RTU without compromising the unique features and capabilities of each device. The ControlWave PAC provides a modular architecture, expandable I/O capacity, and Ethernet networking capability that introduces the possibilities of open architecture for emerging communication standards and provides a simple solution for existing networks.

Features

- Powerful, high-performance processor
- Up to three 10/100 MB Ethernet ports
- Up to four serial communication ports
- 4- and 8-slot I/O base unit
- Hot-swappable I/O
- Security key-lock
- Analog outputs maintain last/preset value on CPU watchdog
- Discrete outputs maintain last or zero value on CPU watchdog
- Wide temperature range (-40 to +70°C)
- Class I, Div. 2 hazardous location and CE approval
- Open industry standards for programming, configuration, and communication

Base Unit

The ControlWave PAC base unit is constructed of an aluminum housing that contains the CPU, power supply, and is available with a 4 or 8 I/O slots. These slots are used to add optional I/O modules.

CPU Options

The ControlWave PAC has a 100 MHz CPU module that contains 2 MB of SRAM, 64 MB of SDRAM, and 32 MB of flash memory. The CPU module is available with the following on-board communication port configurations:

- One Ethernet port and two RS-232 ports
- One Ethernet port, three RS-232 ports, and one RS-485 port
- Three Ethernet ports, three RS-232 ports, and one RS-485 port
- Three Ethernet ports, two RS-232 ports, and two RS-485 ports

Power Modules

The power module is installed in the first slot of the ControlWave PAC base unit and provides power to the rest of the device. Two power modules are available including:

- 24-volt input power supply sequencer module
- 24-volt redundant power supply sequencer module

Open Network Connectivity

By embracing the open systems network technologies available through TCP/IP, Ethernet, OPC, and Microsoft DNA (as well as pseudo standards such as Modbus and Open Modbus) the ControlWave PAC provides a total process automation management solution for in-plant LAN-based and wide area network SCADA systems. Access to real-time data and operating conditions, historical data, maintenance, and performance data stored in the ControlWave PAC is available to the global network.

ControlWave PAC

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Communications

The ControlWave PAC supports up to seven communication ports. The base CPU module has two RS-232 serial ports and one Ethernet port. Two additional RS-232 or RS-485 serial ports and two additional Ethernet ports are optional.

Communication Protocols

ControlWave PAC supports BSAP (Bristol Standard Asynchronous Protocol), Modbus, DF1, CIP, DNP3, and serial ASCII communication protocols as standard features. ControlWave PAC also supports the following Modbus protocols:

- Modbus serial and TCP/IP Open Modbus (Ethernet)
- Master and Slave
- Modbus RTU and ASCII
- Function Codes 1–7, 8, 15, and 16
- Integer and IEEE 4-byte floating point

Inputs and Outputs

Input and output (I/O) modules are designed to maximize usability while minimizing installation, maintenance, and system down-time costs. A pull-down door provides front panel wiring terminal access for technicians. The bezel and the terminations can be easily removed from the I/O module to make wiring even easier. In addition, a wide range of applications is supported by the availability of both local terminations and remote DIN-rail terminations.

To minimize field wiring and eliminate the need for marshalling strips, the analog input (AI) and discrete input (DI) modules are capable of supplying loop power to two-wire transmitters and dry contacts.

Status indicators offer instant visual notification of I/O conditions. Each I/O module has a two-color Pass/Fail LED that displays the online diagnostic status. Discrete I/O modules provide status LEDs for each point on the module. AI modules provide two LEDs on each input point to indicate input under/over range conditions.

The ControlWave PAC supports a wide variety of I/O modules. Available I/O modules include:

- Analog Input (AI) module with 8 or 16 points
- Analog Output (AO) module with 8 points
- Discrete Input (DI) module with 16 or 32 points
- Discrete Output (DO) module with 16 or 32 points
- Resistance Temperature Detector (RTD) module with 4 points
- Thermocouple (TC) module with 6 points
- UDI Counter module with 6 points

Note: Modules are hot-swappable. All I/O is frozen for 300 milliseconds when any module is replaced.

Remote Termination Modules

The remote termination option for the ControlWave PAC modules provides a convenient alternative to the standard direct connect termination. All remote termination modules are standard DIN-rail mountable, and connect to the I/O module with pre-wired connector cables. To simplify installation, all I/O modules use the same cable.

I/O Expansion Rack

The I/O Expansion Rack allows for the addition of I/O modules to multiple local and remote mounted racks. The I/O Expansion Rack consists of a 4- or 8-slot ControlWave chassis. This chassis contains an Ethernet communication engine dedicated to communications between the main processor and the I/O Expansion Rack. The communication engine also supports battery backed RAM to retain output values during short power outages.

The I/O Expansion Rack is connected to the main ControlWave via an Ethernet physical link using TCP/IP. The process control application program resides in the main ControlWave. The main ControlWave controls both local I/O as well as the I/O located in the I/O Expansion Rack.

ControlWave Redundant Systems

Redundant systems are ideal for use in critical processes and harsh applications that require maximum operational readiness and system availability. The ControlWave PAC redundant systems are designed to prevent a single point of failure from shutting down the entire system. Two types of redundant systems are available for the ControlWave PAC: the redundant process control and communications system, and the redundant input/output (I/O) system. For more information on the ControlWave PAC redundant systems, refer to *Product Data Sheet CWPAC: RDN*.

Key Switch

The ControlWave PAC is available with a three-position front panel key switch. The front panel key switch provides a high level of manual security by controlling three modes of operation.

In Run Mode, the ControlWave PAC rejects any attempt to download or modify the running program, either locally or over the network.

In Remote Mode, the ControlWave PAC allows downloading and online program modification through the network provided the security access requirements have been met. Local download and online modification of the running program is prohibited.

In Local Mode, the ControlWave PAC allows download and online modification through either the network connection or through a local serial communication port provided the security access requirements have been met.

Multi-User Security Access

The ControlWave PAC employs a user name/password access system protected by a 56-bit encryption technique through the TCP connection. There can be up to 240 users who sign in with their user name and password. Both the user name and the password can be up to sixteen characters in length.

You can customize the security level for each user based on 64 access rights including the ability to read and write data values and files via FTP, access and configure historical and audit data information, edit configuration, run internal diagnostics, and read and reset system status.

Data Reliability

The ControlWave PAC is designed to provide the optimum level of data reliability using a distributed database architecture. All data, including time stamped alarms, alarm limits, and historical data is stored locally in non-volatile flash memory in each ControlWave PAC.

When historical data is collected from the ControlWave PAC, it is converted and appended to a .CSV and ODBC compliant database. The original historical data is not changed and is stored in the device flash memory.

Historical Data Collection

The ControlWave Historical Data Collection system provides time-stamped historical data storage in ControlWave flash memory. The historical data is collected through OpenBSI software on a scheduled or on-demand basis. After the data is collected, it is converted to CSV and ODBC compliant file formats for use in spreadsheets and reports. If any data is missed due to a communication failure, it is collected and the PC historical database is backfilled when the communication is reestablished. This distributed historical database architecture provides data reliability and integrity during communication or PC failure.

Another important historical feature is the audit system. The audit logs are files stored in ControlWave flash memory that contain significant events and time-stamped alarms. In addition to the real-time alarm reporting system, the alarms stored in the audit alarm log provide a reportable historical alarm archive.

These files are collected through OpenBSI software and presented as text files in the PC. This functionality is extremely useful in providing an event trail during communication interruption, PC downtime, or other system problem.

OpenBSI

Emerson's OpenBSI (Open Bristol System Interface) is an optional set of network setup, communication, diagnostic, and data viewing software utilities for use with ControlWave RTUs, flow computers, and controllers. At the core of OpenBSI is the communication interface. The interface is written as a Windows communication server API through which other client applications communicate. OpenBSI supports both serial BSAP protocol and Ethernet IP communication to ControlWave devices.

ControlWave Designer

ControlWave Designer is an optional, fully IEC 61131-3 compliant programming environment for the ControlWave PAC. ControlWave Designer includes all five IEC 61131-3 process languages for batch, continuous, and discrete control. These languages are: Function Block Diagram, Structured Text, Sequential Function Chart, Ladder Logic Diagram, and Instruction List.

ControlWave Designer includes an extensive library of more than 200 basic IEC 61131-3 functions and function blocks common to many IEC 61131-3 based products. These include:

- Flip-flops, counters, and timers
- Ladder diagram functions – coils and contacts, etc.
- Numerical, arithmetic, and Boolean functions – Sine, Cosine, Add, Sub, Square Root, And, Or, etc.
- Selection and comparison – Min, Max, Greater Than, Equal, Less Than, etc.
- Type conversions – Integer to Real, Boolean to Word, etc.

ACCOL III

In addition to the basic functions and function blocks, ControlWave Designer brings the benefit of over twenty years of SCADA and plant control experience in Emerson's ACCOL III function block library. ACCOL III includes over sixty function blocks valuable for use in oil and gas, water and waste, and process measurement and control applications. ACCOL III is designed to take full advantage of the significant features offered by ControlWave.

The library consists of many function blocks including:

- Average, Compare, Totalize
- Scheduling and Sequencing
- PID and Lead/Lag
- AGA Gas Flow and Liquids Calculations
- File Handling

ObjectServer

ObjectServer is an optional OPC-compliant server that provides direct communication to the ControlWave family of controllers, RTUs, PLCs, and flow computers through the OpenBSI Communications Interface. ObjectServer supports serial multi-drop, remote telemetry, and Ethernet communication networks. Unlike traditional OPC servers, ObjectServer provides reliable access to RTUs that are connected via low-bandwidth, high-latency, and poor-quality networks such as radio, satellite, and cellular modems.

ControlWave PAC

CPU Module		
Processor	Type	586 CPU, 100 MHz
Memory	Boot	512 kB
	Flash	32 MB on-board
	SRAM	2 MB, battery backed
	SDRAM	64 MB (66MHz SDRAM coupled to a 32-bit bus)
Clock	Accuracy	2 second/day at 25°C
Communications		
COM1	Type	RS-232
	Connector	PC/AT 9-pin male D-sub
	Baud	Up to 115.2 KB
COM2	Type	RS-232
	Connector	PC/AT 9-pin male D-sub
	Baud	Up to 115.2 KB
COM3 (optional)	Type	RS 232 or RS 485
	Connector	RJ45
	Baud	Up to 115.2 KB
	Isolation	500 Vdc (RS-485 only)
COM4 (optional)	Type	RS-485
	Connector	PC/AT 9-pin male D-sub
	Isolation	500 Vdc
Ethernet Port 1	Type	10/100 Base-T Ethernet port
	Connector	RJ45
	Isolation	500 Vdc
Inputs/Outputs		
I/O Modules	AI	8 or 16 AI with local or remote automations. For more information, refer to *Product Data Sheet CWPAC:AIO*
	AO	4 or 8 AO with local or remote automations. For more information, refer to *Product Data Sheet CWPAC:AIO*
	AO with Read-Back (for redundant I/O systems only)	8 AO with local or remote automations. For more information, refer to *Product Data Sheet CWPAC:AIO*
	DI	16 or 32 DI with local or remote automations. For more information, refer to *Product Data Sheet CWPAC:DIO*
	DO	16 or 32 DI with local or remote automations. For more information, refer to *Product Data Sheet CWPAC:DIO*

	DO with Read-Back (for redundant I/O systems only)	16 DI with local or remote automations. For more information, refer to *Product Data Sheet CWPAC:DIO*	
	Universal Digital Input Module and Counter (UDI)	6 or 12 DI with local or remote automations. For more information, refer to *Product Data Sheet CWPAC:DIO*	
	RTD	4 DI with local or remote automations. For more information, refer to *Product Data Sheet CWPAC:TEMP*	
	Thermocouple	6 DI with local or remote automations. For more information, refer to *Product Data Sheet CWPAC:TEMP*	
Remote Terminal Blocks	AI and AO	Number of Channels	AI, 4 channels; AO, 2 channels; TC, 8 channels
		Dimensions	89.7 mm H x 45 mm W x 67.1 mm D (3.53 in. H x 1.77 in. W x 2.64 in. D)
	DI and DO	Number of Channels	8 channels
		Dimensions	89.7 mm H x 55.9 mm W x 65.5 mm D (3.53 in. H x 2.2 in. W x 2.58 in. D)
		Relay	99 mm H x 82.6 mm W x 94 mm D (3.9 in. H x 3.25 in. W x 3.7 in. D)
	UDI	Number of Channels	4 channels
		Dimensions	89.7 mm H x 45 mm W x 67.1 mm D (3.53 in. H x 1.77 in. W x 2.64 in. D)
	Cable Lengths	0.46 m (18 in.) 1.0 m (39 in.) 2.0 m (6.5 ft.) 4.0 m (13 ft.)	

Power			
Input Voltage	22.1 – 30.0 Vdc		
Isolation	500 Vdc		
Status Indication	Active, Fail, and Power OK		

Physical			
Dimensions	4 I/O Slot Chassis	Panel Mount	300.73 mm W by 177.03 mm H by 125.98 mm D (11.84 in. W by 6.97 in. H by 4.96 in. D)
	8 I/O Slot Chassis	Panel Mount or 19-inch Rack Mount	481.58 mm W by 177.03 mm H by 125.98 mm D (18.96 in. W by 6.97 in. H by 4.96 in. D)
Weight	4 I/O Slot Chassis	3.18 kg (7 lbs.)	
	8 I/O Slot Chassis	5.9 kg (13 lbs)	
Wiring	Up to 14 American Wire Gauge (AWG)		

Environmental	
Operating Temperature	−40 °C to 70 °C (−40 °F to 158 °F)
Storage Temperature	−40 °C to 85 °C (−40 °F to 185 °F)
Operating Humidity	5 to 95% non-condensing
Conformal Coating	All circuit boards are conformal coated to meet IPC-A-610 Class 3
Vibration	1.0 g acceleration over 10 to 150 Hz; 0.5 g acceleration over 150 to 2000 Hz
Immunity	3 V/m – 80 MHz to 1000Mhz (EN50082-2)
Electro-Static Discharge	IEC-1000-4-2-EVT
Radiated Emissions	EN-55011-EVT
Surge Suppression	IEEE 472 - 1974

Approvals		
Product Markings for Hazardous Locations	UL CUL	Class I, Division 2, Groups A, B, C, and D T4A
	CE	CE_{0081}
Certification Standard	UL Standards	UL 1604-1994 UL 508-2008 CSA C22.2 No. 213-M1987 CSA C22.2 No. 142-M1987
	EMC Standards	EN 55011 (Emissions) EN 61000-4-2 (Electrostatic Discharge Immunity) EN 61000-4-3 (Electromagnetic Field Immunity) EN 61000-4-4 (Electrical Fast Transients Immunity) EN 61000-4-5 (Surge Immunity) EN 61000-4-6 (Conducted Immunity)
Miscellaneous Approval	RoHS2	RoHS (2) EU Directive 2011/65/EU: This product may be considered out-of-scope when used for the intended design purpose in a Large Scale Fixed Installation (LSFI). Consult https://www.emerson.com/compliance for up-to-date product information.
	RoHS (China)	

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