Symphony Plus
S+ Control: AC 870P
Continuous productivity improvements and increased profitability are the driving force behind the selection of today’s automation system. Furthermore, systems must support users with the power to react quickly and flexibly to ever rising demands from the markets they serve. Traditionally, production facilities maintained many controller subsystems, each of which had to meet specific plant needs. However, as business goals have changed, using a scalable controller platform that possesses multifunctional capabilities, adaptability to changing requirements, openness and maximum availability, is paramount to success.

Symphony™ Plus S+ Control AC 870P controllers, communication interfaces and I/O modules meet the most challenging requirements in each of these areas.

Thanks to their modular design, AC 870P controllers can be adapted to a wide variety of plant types and sizes, especially in the power generation and water industries. Supported by an efficient engineering workbench, Symphony Plus contributes to a higher return on assets by improving overall production control, maximizing process availability, and minimizing maintenance.

Features and benefits

Flexible, cost-effective assembly
Decentralized, rail-mounted controller assembly can be combined with local or remote I/Os.

Comprehensive I/O system
A wide range of local and remote I/O types is available with integrated intrinsic safety design and transmitter power supply options. Features such as sequence of events (SOE) time stamping (1 ms resolution), monitoring, filtering, as well as HART and PROFIBUS communication are supported with a wide range of I/Os such as AC 870P local I/O, ABB’s S800 and S900, and other remote PROFIBUS I/Os.

Distributed capability
ABB’s S800 and S900 remote I/O and AC 870P local I/O are connected via high-speed serial communication buses. Local I/O offers a high packing density to reduce mounting space to a minimum, whereas remote I/O fully supports distributed system configurations.

Efficient field device integration
Standardized field device tool/device type manager (FDT/DTM) interfaces enable plug-and-play integration of field devices.

Easy to configure
Module configuration and service is executed using S+ Engineering Composer Melody and its unrivaled library of fully tested and field-proven powerful function blocks.

Inherent redundancy design
System-integrated redundancy options for power supply, hardware and communication networks provide the highest level of availability.

High performance modular network
Symphony Plus uses a redundant, high-speed serial communication network with inherent capability for remote communication. The network is easy to expand without requiring routing configuration.

Overview
S+ Control AC 870P includes a series of compact DIN rail-mounted controllers, a wide range of I/O modules and modern, standardized fieldbus interfaces. These modules offer all the functions required for data acquisition and signal conditioning, as well as powerful open loop and closed loop control, sequence control and monitoring. All process management tasks are executed on the basis of integrated complex control strategies. Without the need for configuration, AC 870P’s inherent redundancy design – including integrated redundancy concepts for power supply, communication and I/O – provides the highest level of availability.
Key features include:

- A wide range of I/O interfaces with optionally integrated intrinsic safety (EEx-i) design and transmitter power supply. Features such as time stamping with a 1 ms resolution, monitoring, filtering and HART communication are implemented directly in the I/O modules.
- PROFIBUS interfaces provide connections to ABB’s S800 and S900 remote I/O stations in EEx and non-EEx versions, as well as other PROFIBUS devices.
- IEC 61850 interface to intelligent electronic devices (IEDs) for the integration of electrical subsystems.
- AC 870P control network uses a redundant, high-speed serial communication network with inherent capability for remote communication. The network is easy to handle, without requiring routing configuration.
- Flexible mounting alternatives such as cabinet, DIN rail or 19” rack mounting. All three can be combined in one project. This allows optimal adaptation to all plant structures and supports flexible upgrades of existing installations.
- An unrivaled high packing density in the system cabinets saves installation space.
- Controller time synchronization based on a time precision of 0.5 msec.
- Sequence of events (SOE) time stamping with a resolution of 1 ms is implemented in the controller and local I/O module level.

The control subsystem (as shown in figure 2) includes flexible communication options to I/O and intelligent field devices via system buses. HART as well as PROFIBUS information, including configuration and diagnostic information, is communicated via the control network. This information is available to system controllers and system level applications such as asset optimization and device management. The comprehensive bus concept of the system controller allows for the easy integration of HART and PROFIBUS field devices as well as of PROFIBUS and IEC 61850 electrical assets.

Scalable control stations
AC 870P control stations are conveniently set up according to project needs and are made up of modular AC 870P controllers and I/Os. Depending on the scope of the automation task, the controller is extended with I/O modules or communication interfaces (see figure 3).

The controllers are connected via the control network (Cnet) to ensure reliable, high speed and system wide real-time signal exchange with other control stations, with S+ Operations, with system level applications and with S+ Engineering Composer Melody.

Each node on the control network operates autonomously. Acting as its own communication manager, the system requires no traffic directors. The controller’s associated I/O modules are connected using the high-speed redundant serial field network or PROFIBUS DP (DPV1 as well as DPV2).

The controller’s fieldbus connection also allows communication with intelligent field devices.

The AC 870P controller includes all the functions required for data acquisition, monitoring, closed loop and open loop control of plant processes including complex control strategies.
The AC 870P controller

AC 870P controllers are designed for maximum computing power and modular scalability.

Each controller can handle up to 2,000 analog and/or digital I/O points from the local I/O, and additionally 6,000 analog and/or digital I/O points connected via PROFIBUS DP. In addition to the standard tasks such as signal processing, loop and logic control, the AC 870P controller also performs complex computations such as sequential, batch and advanced controls.

Diagnostic routines periodically check the hardware and firmware integrity. Any abnormal conditions are automatically routed to the HMI or other alarm or message collecting software.

The redundant design of AC 870P provides an automatic one-to-one backup, thus ensuring high system availability. If the primary controller is faulty, the hot standby controller, executing the same control strategy and process data, immediately takes over control.

Key features of the AC 870P include:
- Large variety of powerful functions available in tested libraries
- Easy configuration, service and commissioning with S+ Engineering
- Inherent redundancy without configuration/wiring costs
- Real-time multitasking operating system
- Up to 16 different cycle times
- Comprehensive monitoring and diagnostic functions
- Interface for radio clock connection
- Downloadable firmware and application programs (no EPROMs)
- Data security:
  - Firmware stored in flash memory
  - Configuration data buffered in RAM with dual battery backup
  - Production and operating data stored in NVRAM

The range of available function blocks extends from simple control and individual drive functions to complex recipes based on S88 and NAMUR using sequential function charts based on IEC 61131-3.

Function blocks may also be used to set up customer-specific libraries in S+ Engineering (see figure 4).

AC 870P process interface modules

The controller sets new standards for user convenience with industrial process interface modules. A large variety of I/O modules can be combined to form an optimal automation solution.

The main components of the AC 870P control station are the I/O modules and a high-speed, redundant serial field network (F-Net). Together they operate as a subsystem dedicated to the AC 870P controller.

Local I/O types

The following local I/O types are available:
- Analog input (CAI) EEx and non-EEx
- Temperature input (CTI)
- Analog output (CAO) EEx and non-EEx
- Digital input (CBI) EEx and non-EEx
- Digital output (CBO)
- Controller output/Individual drive output (CAC/CBC)
- Frequency input (CFI)
- Serial communication interfaces (CCF)

Redundant modular power supply is an option.

All process signals are accessible from the front panel. The field cables are connected to cable termination units. For I/O redundancy, associated termination units are used. With these termination units, it is possible to replace defective modules without disconnecting the field cable and without field interruption, thus providing maximum availability.
Local I/O features

- A processor in each I/O module provides advanced functions such as event detection and alarm generation, time stamping with 1 ms resolution and system diagnostics
- Downloadable firmware eliminates the need for PROM changes
- Local I/O modules provide integrated transmitter power supply, integrated intrinsic safety and HART communication
- Distribution of I/O modules reduces cable and installation costs.
- A high-speed serial communication bus (Fnet) that is designed for long distances combined with flexible cabinet mounting options enables both centralized and remote I/O locations
- Simplified user configuration eliminates the need for calibration or onboard jumper settings
- Maximum availability through inherent redundancy design including redundant communications via Fnet and optionally redundant I/O modules
- All local I/O can be reconfigured and extended online with new I/O module while in full normal operation
- Each input or output can go to a pre-defined value in case of disturbed values or communication loss

Control modules

The following control I/O modules are used for closed loop and open loop control especially in the power generation industry.

The drive control (CBC 11-P) modules are used for:
- On/off actuators
- Motor drives
- Solenoid valves
- Hardwired individual control stations

The closed loop output (CAC 10-P) is used for:
- Continuous controller
- PI step controller
- Current signal output to I/P converter for pneumatic actuators
- Three-position step controller with PI behavior
- Three-point switch as positioning circuit, or
- Hardwired individual control station

Both modules operate independently of the AC 870P controller.

PROFIBUS interface

The AC 870P controller integrates PROFIBUS-DP communication, thus enabling system level engineering of devices and device communications. In addition to communication with the system engineering environment, fault and diagnostic messages are displayed at the S+ Operations workplace or other ABB operator console. Features include:

- PROFIBUS-DP (DPV1 and DPV2)
- Two PROFIBUS lines per controller
- Redundancy
- Transfer rate adjustable in steps from 9.6 kbit/s to 12 Mbit/s
- PROFIBUS-DP/PA converter

Remote I/O

S800 I/O family

AC 870P remote I/O is accomplished by using ABB’s S800 I/O connected via PROFIBUS. S800 I/O features include:

- Comprehensiveness: The S800 I/O family covers virtually all conceivable signal types and ranges. From basic analog and digital inputs and outputs to pulse counters and intrinsically safe I/O
- Flexible configuration: Redundancy solutions are available at all levels including power supply, communication interfaces and I/O circuits
- Flexible installation: Three mechanical designs are available:
  - Compact (plug-in modules with a basic I/O signal termination area)
  - Extended (plug-in modules with ample space for I/O cable termination and jumpering), and
  - S800L (all-in-one modules and bases with detachable screw terminal blocks for I/O signals) for installations that do not require hot-swap capabilities
- Easy to set up: Once station numbers have been allocated and set, all other settings can be made using the S+Engineering Composer tools. A pass-through feature makes it possible to configure and examine all HART-compliant field devices in a similar way
Additional solutions for specific applications are available:

**Field housing:** For wall mounting and field mounting in Zone 1 installations with system approval fully certified in accordance with ATEX. The high-grade steel housing is prepared for wall mounting with facility for insulated screen rails or terminals.

**CB220 compact box:** S900 in compact form (with up to four I/O modules). Suitable for use in applications such as temperature multiplexers, solenoid valve circuits and others.

**Key S900 benefits include:**

- Flexibility for a large number of different applications, not only various hazardous area applications but also standard non-hazardous area applications
- Good price/performance ratio because external barriers have been removed and costs are reduced in terms of cabling, installation, hardware and maintenance
- High reliability thanks to smooth automatic transfer of data and auto-diagnostics
- Easy configuration using either FDT/DTM or by means of GSD files, allowing easy integration with Symphony Plus process control systems
- High availability of the plant thanks to redundancy and hot-swap capability of all components during operation
Network and communication

Network
AC 870P’s control network is subdivided with respect to hierarchy and functionality.

The network is adapted to the plant size according to a hierarchical grouping into stations, plant areas and the entire plant. Hierarchical grouping supports automatic data transfer between the Melody stations.

Functional subdivision of the network is effected in the control buses and operation buses.

With respect to process visualization, configuration and maintenance of the system, all information is routed via the operation bus.

This division of tasks permits control loops to be closed via control buses and protective signals to be transmitted. No influx of messages, irrespective of their size, impedes the automation of the process.

Communication
Without additional configuration, a signal marshalling function automatically establishes the bus interconnection of the conditioned measured value (signal source) with all subsequent processing functions (signal sinks) throughout the system.

For each established interconnection, the active signal is cyclically and spontaneously transmitted individually from a signal source to a signal sink.

Decentralized assembly system
Common features include:
- Modules with 7 height units
- Front panel width 8 or 16 graduations
- Light emitting diodes for fault signaling
- Selective module protection

The assembly system of Melody is designed for decentralized applications. The following variants are available:
- **CPU housing**: The housings are mounted on standard rails. The controllers are easily connected via redundant interfaces. Each controller provides two redundant PROFIBUS DP interfaces, which may be used independently (see figure 9)
- **Extension housing**: In addition to the redundant controller, up to eight local I/O interfaces may be added to the extension housings. Furthermore, the redundant Fnet may be attached to the field via repeaters (coaxial or fiber optic cable), in order to connect additional AC 870P controllers. Thus, the housings may be used with the proven local I/O as cost-efficient remote I/O, without the need for additional CPU (see figure 10)