

## Features

- Secure, reliable and mission-critical control capability providing “bumpless” automatic fail-over between redundant controllers.
- Fast processor for increased productivity
- One-step data acquisition functionality through the definition of the I/O database
- Small footprint with low power requirements and fanless operation
- Interfaces to Ovation and WDPF I/O, both local and remote
- Integral interface to digital busses through Ovation I/O modules
- Integrated virtual I/O capability for third-party OEM systems over Ethernet protocols.
- Non-volatile storage of application software, point database, configuration information, and operating tuning constants
- Managed by a commercial, real-time operating system which supports multi-tasking and preemptive task scheduling to POSIX1003.1b open system standards
- Integrated sequence of events capability with 1 millisecond resolution
- Meets IEC 61131-3 Standards
- Achilles Level 1 Certified

## Ovation Controller

Emerson Process Management’s (Emerson) Ovation™ expert control system incorporates a powerful controller for secure, mission-critical operations such as those of power and water plants.

The Ovation Controller executes simple or complex modulating and sequential control strategies, performs data acquisition functions, and interfaces to the Ovation Network and various I/O sub-systems. It has the capability to originate up to 32,000 points.



Ovation redundant controller shown with four local Ovation I/O modules installed on two I/O branches. Modular controller design provides quick I/O installation and maintenance.

## Process Applications

The Ovation Controller is designed to meet the demanding requirements of a wide range of process applications. It performs numerous functions, including:

- Continuous (PID) control
- Boolean logic
- Advanced Control
- Special logic and timing functions
- Data acquisition
- Sequence of events processing
- Cold junction compensation
- Process point sensor/limit checking
- Process point alarm processing

- Process point conversion to engineering units
- Process point database storage
- Local and remote I/O interface
- Process point tagout

## Standard Controller Functions

### Control Execution

The Ovation Controller, with an Intel®-based processor, is capable of simultaneously executing as many as five process control tasks at loop speeds ranging from 10 milliseconds to 30 seconds. Each control task is comprised of I/O process point input scan, the control scheme execution followed by an output scan. Two of the control tasks loop speeds are predefined at one-second and 100 milliseconds. The other three control tasks can have user-selectable loop speeds. Individual control sheets are user-assigned to one of these tasks, allowing control execution loop times to be appropriate to the functions being controlled.

### Control Scheme

The control scheme executed by the Ovation Controller is defined by control modules using an extensive set of standard algorithms developed specifically for the power generation, water treatment, and wastewater treatment industries. The control modules, also referred to as control sheets, provide the basis for execution, documentation, and automatic creation of control tuning diagrams that assist users during the commissioning and optimization of the control scheme. On average, the controller can execute in excess of 1000 control sheets.

The Ovation Controller also incorporates support for the implementation of advanced applications such as fuzzy controllers, smart sootblowing, software modeling, and programmable blocks. Ovation's embedded advanced algorithms and proven industry-specific control routines assure optimized operations for maximized efficiency, productivity, and profitability.

### Sequence of Events

Integral sequence of events (SOE) processing capability is provided via the Ovation and Q-Line I/O subsystems and standard controller software. With a resolution of one millisecond,

the SOE subsystem records the sequence in which a user-defined set of digital input conditions occurred. In addition to the higher resolution time tag, the SOE points are usable in control schemes like any other I/O point including limit checking and alarming.

### Alarm Processing

Based on each process point database definition, the Ovation Controller performs all of the limit and alarm processing functions typically associated with a data acquisition system (DAS). During the input scan associated with the control execution or the default one-second DAS scan. The status (including alarm status) of all points in the controller are updated and broadcast onto the Ovation Network.

Extensive information is included within the status information broadcast. For example, the status may indicate a point has either:

- Exceeded the range of the sensor
- Exceeded the user-defined limits
- Changed state
- Passed an incremental limit

If desired, the alarm reporting can be delayed on a per-point basis by a user-specified time period. When coupled with a workstation, the Ovation Controller has the capability to report six independent alarm thresholds, defined as:

- Four high limits
- User-defined high limit
- Highest plus incremental limits
- Four low limits
- User-defined low limit
- Lowest plus incremental limits

The workstation has the capability to sort alarms based on a user-selected alarm significance level. Alarms specified will be denoted as either alert or information when displayed on the alarm screen.

### Operator Interface Processing

The Ovation Controller performs the entire limit and alarm processing based on the database configuration for each point. However, the controller's operator interface capability allows these functions to be suspended as necessary by the process state or operator action which is also logged.

These include scan remove, alarm cutout, enter valve, alarm and limit checking suspension and similar functions, which are also under the Ovation security functionality.

### Controller Types

The Ovation Controller can provide additional capabilities with add-on software licenses for simulation, advanced control, or both. Another licensed controller type is an Ovation Virtual Controller used primarily in Ovation Simulators.

The simulator controller is a standard controller that has the ability to be directed to use simulated I/O instead of the actual hardware I/O system. This capability allows the control schemes to be interfaced with a process model or simulation. A basic factory acceptance test process model allows the controller to be tested by simulating the basic I/O functions such as value and direction. The simulator controller capability can also be used with high-fidelity process plant models.

An advanced controller is an additional licensed software capability that provides the ability to run advanced functionality algorithms. These licensed algorithms include sootblowing, fuzzy logic, MPC, DMX, and other advanced algorithms which can use the redundant reliable execution environment provided by the Ovation Controller.

The Ovation Virtual Controller is a software licensed capability which recreates the Ovation hardware controller with RTOS on a Windows PC platform. It is used primarily in Ovation Simulation solutions which use non-redundant virtual controllers to decrease the hardware footprint. The virtual controller has most of the interface attributes of a standard, simulation or advanced controller except for hardware I/O support.

### Redundancy

The Ovation Controller is designed to accommodate multiple levels of redundancy for key components, including:

- Ovation Network interface
- Functional processor, memory, and network controller

- Processor power supply
- I/O interfaces
- Input power feed
- I/O power supply
- Auxiliary power supply
- Remote I/O communications media

The standard hardware configuration for controller redundancy is a passive backplane base on which both a primary and a backup controller are installed. Redundant 24V power is connected to the unit which is individually distributed to the controllers. Each controller consists of two modules, one providing the processor, memory, Ovation networking, and additional networking connections. The other module provides the interface to both local and remote Ovation and Q Line I/O, plus internal powering.

Fully redundant pairs of controllers are equipped with:

- Dual Intel functional processors
- Dual network interfaces
- Dual processor power supplies
- Dual I/O power supplies
- Dual auxiliary power supplies
- Dual input power feeds
- Dual I/O interfaces

Each functional processor in the redundant pair executes the same application program, although only one accesses the I/O and runs in the control mode at a time. The partner processor runs in the backup, configure, or off-line modes with differences between them alarmed.

### Control Mode

In the control mode, the primary processor functions as it would in a non-redundant controller. It has direct access to the I/O to read, write, and execute both data acquisition and control functions. In addition, the primary processor monitors the status and health of its backup partner's processor and network.

### Backup Mode

In the backup mode, the backup processor performs diagnostics and monitors the status and health of the primary processor. The backup processor maintains up-to-date data by polling

the control processor's database memory and receiving all of the information that the control processor sends over the Ovation Network, including: process point values, algorithm tuning constants, and variable point attributes.

### Automatic Failover Control

The redundancy function of the Ovation Controller is equipped with automatic failover control; if the processor in control mode fails, watchdog detection circuitry disables the I/O interface of the primary processor and informs the backup processor of the failure. The backup processor then begins to execute the process control application program and broadcast information over the Ovation Network.

Ovation Controllers use a continual process of control memory updating to keep both the control and backup processors synchronized. This allows the algorithms to track the output values, pass the information upstream, and apply the data during the first pass of execution. The result is a bumpless failover, even in the case of a malfunction.

A full range of events can trigger automatic failover, including:

- Control processor failure
- Network controller failure
- I/O interface failure
- Removal of power from the control processor
- Control processor reset

Once the control is passed to the backup processor, the failed processor may be powered down, repaired, and powered back up with no harmful effects on the executing control strategy. On restart, the repaired processor will detect that its partner is in control and assume the backup role. The processor in control will detect the presence of the backup processor and adjust for redundant operation.

### Data Pass-Through

The Ovation Controller is equipped with the ability to pass smart field device information to any workstation on the Ovation Network. Users can take advantage of asset management solutions, such as Emerson's AMS™ Suite, that

enable remote management of intelligent field devices.

### Open Architecture

The open architecture of the Ovation Controller uses a powerful real-time operating system running on CompactPCI® bus PC architecture. This design allows rapidly advancing technology to be easily integrated into the system—protecting your investment in software.

### Real-Time Operating System Functions

The Ovation Controller processes data for real-time control and communication functions using a commercially available, multi-tasking, real-time operating system (RTOS). It executes and coordinates the control of multiple application areas by using multi-tasking with preemptive priority scheduling. It communicates with the Ovation Network and other systems via TCP/IP protocol, and some basic routing functions and offers general resource management within the controller.

### Ovation Controller Hardware

The Ovation Controller is built to open industry standards using Intel Processors and CompactPCI bus technology. The advantage is that as newer technologies evolve they can be incorporated while retaining your investment in Ovation controller software is protected.

This foundation also provides the portability so that Ovation Controller software can be run on other available platforms and operating systems. The Ovation Virtual Controller used in Ovation Simulator systems runs on a standard Windows OS on standard PC hardware and does not require actual I/O interfaces.

The hardware platform and the operating systems for the Ovation Controller, based on industry standards, offer the following advantages:

- Minimal cost and complexity of hardware and software upgrades.
- Increased ability to track advances in technology.

## Controller Specifications

Item	Capability
Bus Structure	CompactPCI standard
Originated Points	Up to 32,000, dependent on controller processor and memory
Process Control Tasks	Up to 5 each with a different loop execution rate.
Control Task Loop Execution Rates	Two of the above 5 tasks are predefined @1S and @ 100mS. The other three are user definable, with each task individually defined to execute at a rate between 10 ms and 30 seconds in increments of 10mS.
Processor	Intel Atom Z510@ 1.1GHz
Memory	128MB Flash & 256MB RAM
NIC Ports	4 x 10/100 MB Ethernet Three options (i) 4 x RJ45, (ii) 1 x RJ45 + 3 SFP Fiber, or (iii) 4 x RJ45.
Temp (Refer to (i) and (ii) above)	(i) 0-60 deg. C (ii) 0-50 deg. C (iii) 0-60 deg. C
Power	24V DC 40W
Humidity	0-95% RH
Size	20"w x 8"h x 7"d
CE Mark	Certified to be CE Mark when installed in a CE Mark cabinet
BootROM	(i) OCR1100 only (ii) OCR1100 only (iii) OCR400 Replacement/OCR1100
Achilles Certification	Model No. OCR1100 Hardware version OCR1100 G01 Software version 3.5.1 Patch OVA351005 Category Embedded Device

The Ovation Controller hardware platform has evolved over time. Specifications for the latest model, OCR1100, are detailed in the above table. It shares the same packaging concept as the preceding model, the OCR400, while the original OCR161 model serves as a testament to the evolutionary capabilities built into all Ovation Controllers. Controls and databases developed for the original module can be migrated to the latest module, preserving your investments.

Further development of the OCR1100 platform (iii) allows the hardware to provide backward compatibility and be used as an OCR400 while retaining the ability to provide capability as a full

OCR1100 when installed in an Ovation system release which supports them i.e. Ov 3.5 and above.

## Controller I/O Capabilities

The Ovation controller supports several I/O systems concurrently, dependent on the model used. Like the controller, the I/O system continues to evolve, including new support for increased channel capacity modules.

Refer to the controller hardware manual and the I/O reference manual for additional details on the available models, capacities, module capabilities, and termination types.

Item	Capability
Local Ovation I/O	2 sets of up to 8 independent branches of 8 modules per branch for a total of 128 modules.
Local Q-Line I/O	1 node of 48 Q Cards
Local Q-Line I/O	1 additional node of 48 Q cards
Remote Ovation I/O	Up to 8 nodes of 8 branches of 8 modules for a total of 64 modules/node
Remote Q-Line I/O	Up to 8 nodes of 48 cards
Smart Device Capability	FOUNDATION™ fieldbus PROFIBUS DeviceNet
Virtual I/O capability via Ethernet TCP/IP and standard protocols	Allen-Bradley PLCs DF-1, GE Mark V/VI GSM Modbus/TCP GE Genius I/O Toshiba Turbine Control MHI Turbine Control External Ovation Network

## Ovation Controller Cabinets

Ovation Controllers and I/O modules are all DIN rail mountable which leads to a layout flexibility to match the process requirements: locations, environments and space availability.

The normal configuration is to mount these DIN rail items on plates which can then be installed in existing or new cabinet enclosures. Top and bottom entry is possible for I/O cables. This allows flexibility in enclosure features as required for meeting specifications.

A number of types of controller and I/O cabinets are available. One basic controller cabinet

houses a chassis for single or redundant controllers, and two I/O branches on the front of the plate. Mounted on the rear of the plate is a redundant power supply, power distribution module, and two additional I/O branches for a total of 32 I/O modules since each I/O branch can hold up to eight I/O modules.

Another expansion cabinet type houses up to an additional 32 I/O modules in four branches and a transition panel for connection to the controllers. It can also provide additional space for mounting redundant power supplies (when required), and a power distribution module.

### Controller Cabinet Specifications

	Standard Controller Cabinet	Expansion Cabinet
Size	h x w x d 79 x 24 x 24 in 2006.6x 609.6x609.6 mm	h x w x d 79 x 24 x 24 in 2006.6x609.6x60 9.6 mm
Weight (fully configured)	426.25 lbs 191.81 kg.	396.25 lbs 178.31 kg.
Operating Ambient Temperature <small>(Refer to NIC Ports above)</small>	0-50 deg. C (i) 4x RJ45 ports  0-40 deg. C (ii) 1 RJ45, 3x SFP ports	0-60 deg. C
Storage Ambient Temperature	-40 to 70 deg. C	-40 to 70 deg. C
Operating Humidity	0-95% non condensing	0-95% non condensing
Storage Humidity	0-95% non condensing	0-95% non condensing
Capacity	Redundant. 32 I/O modules 2 power supplies	Space for spare equipment. 32 I/O modules 2 power supplies
Rating	NEMA 12 with NEMA 4 optionally available. CE Mark is IP53	NEMA 12 with NEMA 4 optionally available. CE Mark is IP53

Ovation uses a standard cabinet system and structure described above which assume front and rear access but can be front access only. However other custom or OEM cabinet enclosure are optionally available which have various configurations including plate sizes, cabinet sizes, construction materials,

environmental ratings, cabinet interior and exterior accessories, termination options, and marshaling cabinets.

### IEC 61131-3 Compliant

The International Electrotechnical Committee of the ISO organization created a set of standards in an effort to achieve uniform mechanisms to configure and program control system from different vendors. Part 3 of the IEC 61131 directly relates to the standard programming languages recommended to adhere to this standard.

The concept of this standard is to specify the syntax and semantics of a unified suite of programming languages, including the software model and a structuring language. The standard can be summarized and described under two main categories: Common Elements and Programming Languages. Refer to the Ovation Compliance to IEC 61131-3 data sheet for detailed information of the Ovation system compliance to this international standard.

### Achilles Certified

Achilles® Communications Certification provides an industry-leading benchmark for the secure development of the applications, devices, and systems found in critical infrastructure. The certification process is designed to assess the network robustness of industrial devices and certify that they meet a comprehensive set of requirements. It provides device manufacturers with an independently verified result to communicate their product security to customers, while providing the operators of control systems with the most complete, accurate, and trustworthy information possible about the network resilience of their deployed products.

Enhancements incorporated into Ovation's 3.5.1 controller software added reliability and security features in preparation for Achilles testing. In 2014, The Ovation OCR1100 Controller was found to be in compliance with the requirements set forth by Achilles Level 1 Certification. Specifically the certification applies to Ovation Model OCR1100, hardware level G01, software version 3.5.1 patch OVA351005 for the embedded device category.

## Summary

The Ovation Controller achieves maximum plant process availability while executing simple or complex modulating and sequential control strategies, performing data acquisition functions, and incorporating full bumpless redundancy for mission critical applications.

The Ovation Controller provides the capabilities to control a variety of applications in an adaptable, flexible, and cost-effective manner. With industry-standard hardware and software platforms, the controller is easy to upgrade throughout a plant life cycle.

From the fully compliant, open-system RTOS kernel to the Intel processor, the controller is portable. This flexibility facilitates migration to newer and improved platforms over time and provides inexpensive operation and maintenance. All of these features make the Ovation Controller one of the most powerful in the industry.

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<sup>i</sup> Ovation is a mark of Emerson Process Management. All other marks are property of their respective owners.