

# Aperio 6

## Integrated Control and Monitoring System

**Aperio is the overall versatile system solution developed by Emerson for integrated control and monitoring of any marine automated process. Offering confident management with high performance and safe accessibility.**

**The Aperio ICMS is the platform for several subsystems and is tailor-made for monitor and control of tank content, fuel consumption, valves, machinery and many other auxiliary systems.**

**The system also contains alarm functions to ensure a safe environment and to secure your control over cargo handling and vessel.**



- Fully automatized with intelligent controllers and IO modules with well proven software applications installed in powerful controllers
- Decentralized control and supervision with Ethernet as the backbone
- The workstation, operator and alarm panels mirror the controller and IO modules to facilitate fast access and control
- Based on standard hardware modules and several tailor-made well tested software applications, specifically designed for marine applications
- Intuitive interface allows for fast and easy comprehension of the processes and the interaction with the different systems onboard
- The hardware modules and software applications process the necessary functionality, which only needs to be configured to each individual system
- High performance with quick and safe implementation of new projects and changes to existing projects

## Introduction

Aperio is a general automation system developed to solve any automation task onboard a ship or an offshore installation. The development of the system started back in 1985. At that time the first computer-based tank contents computer was launched.

Subsequently the concept was extended to include valve and pump control together with monitoring, control and alarm handling of other systems onboard. Today thousands of vessels are in service worldwide and ongoing development of the systems has led to today's system.

The Aperio ICMS (Integrated Control and Monitoring System) is a marine automation platform for onboard subsystems with control, monitor and alarm functionality assuring operational certainty and safety for both crew and vessel. The Aperio ICMS system is tailor-made to master various operations / systems onboard (see more on the following pages).



## Combines Many Solutions Into One Single Key Offering

### ▪ Valve Operation

Includes functionality such as ValveManager that keeps track of and limit the amount of valves in operation and ultimately will help keep the power consumption down.

The valves can be remotely and automatically controlled within the Aperio Vision Workstation Functionality (see page 18).

### ▪ Ballast, Bilge and Service Tank System

Level and contents gauging, temperature and pressure measurement, remote control on pumps and valves and many more functions needed for a complete control on any tank (see page 20).

### ▪ Pump Operation

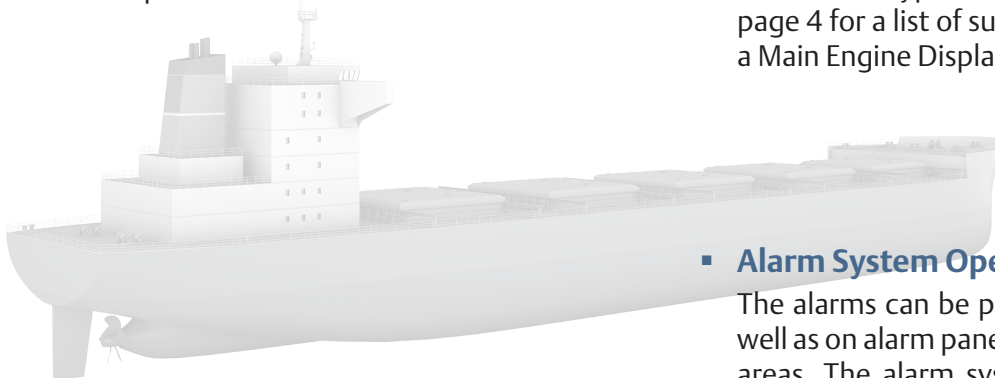
Monitor and control all pumps connected to the Aperio ICMS. Status, speed and stop/start functions are some of the operations available for the setup.

### ▪ Cargo System

Level, pressure, temperature and tank contents gauging, high level and overflow alarm management, trend logging, tank and product component settings are some of the functions offered with the cargo system (see page 22).

- **Draft, Trim and Heel System**

Measures and indicates draft, trim and heel used for compensation of raw values.



- **Machinery and Service System**

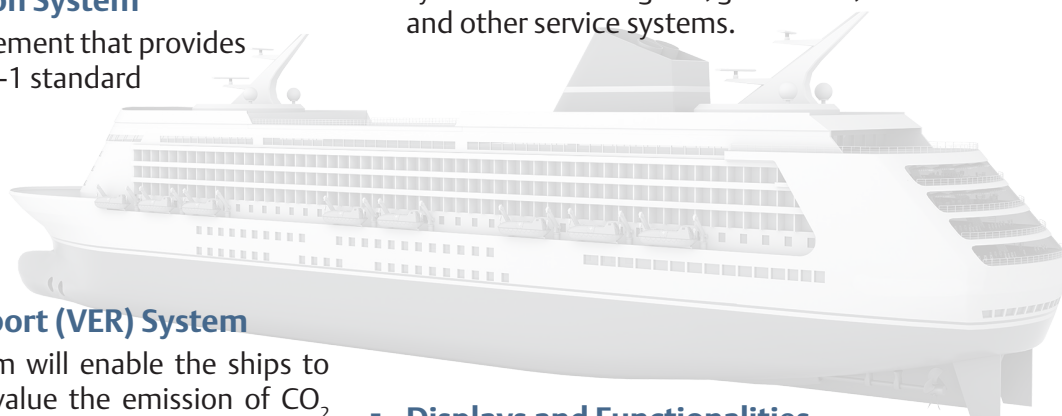
The marine automation system supervises and controls all types of sub systems on-board. See page 4 for a list of subsystems and an example of a Main Engine Display.

- **Alarm System Operation**

The alarms can be presented on workstations as well as on alarm panels in accomodation or public areas. The alarm system is commonly used for systems such as engines, generators, switchboard and other service systems.

- **Fuel Oil Consumption System**

Fuel efficiency measurement that provides calculation to SO 3046-1 standard (See page 24).



- **Vessel Emission Report (VER) System**

The Aperio VER system will enable the ships to measure, report and value the emission of CO<sub>2</sub> and their consumption data, which ultimately will assist in following EU's regulation and policy for reducing domestic green house gas emissions.

- **Displays and Functionalities**

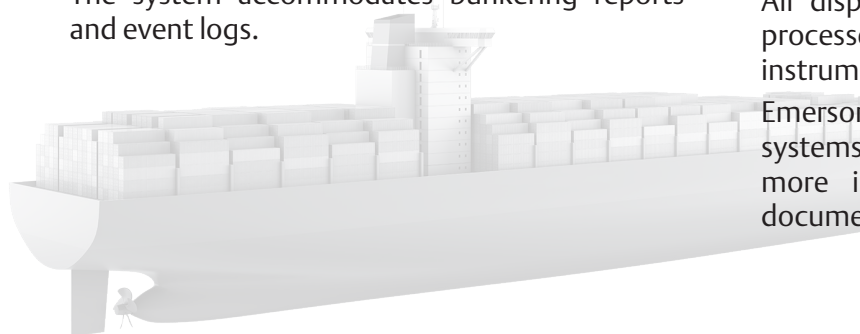
Most of Aperio Vision Workstation Functionality displays comprehends one or more of the above mentioned operations and systems. This will give you a complete control of the systems included in the Aperio ICMS directly from one and the same view.

- **Bunkering System**

The system accommodates bunkering reports and event logs.

All displays will give you easy access to the processes and status of the vessels operation and instrumentation conditions.

Emerson offers complete and customized systems in connection to the ICMS offer. For more information see following pages and documentation as referred.



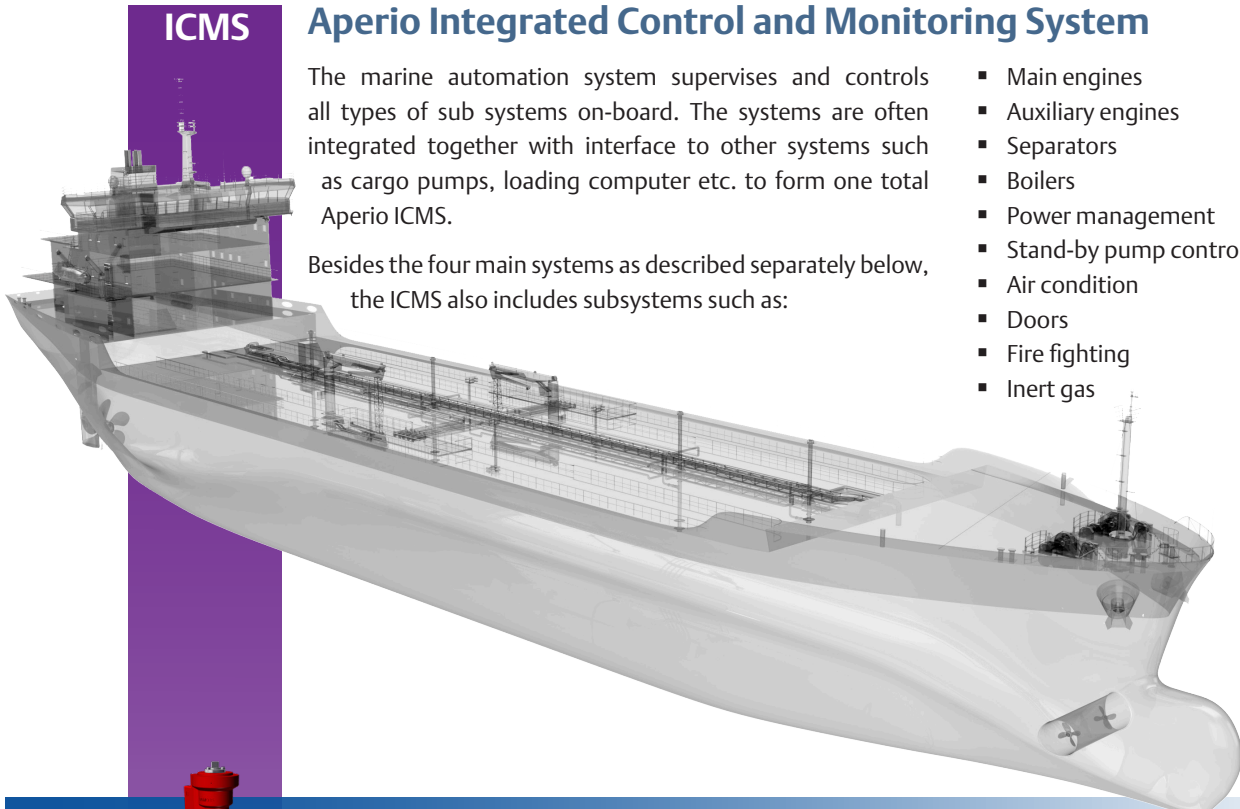
**ICMS**

**Aperio Integrated Control and Monitoring System**

The marine automation system supervises and controls all types of sub systems on-board. The systems are often integrated together with interface to other systems such as cargo pumps, loading computer etc. to form one total Aperio ICMS.

Besides the four main systems as described separately below, the ICMS also includes subsystems such as:

- Main engines
- Auxiliary engines
- Separators
- Boilers
- Power management
- Stand-by pump control
- Air condition
- Doors
- Fire fighting
- Inert gas



**VRC**



**Valve Remote Control**

Hydraulic and electro-hydraulic valve actuation with high quality, robust design and compact actuators providing high torque in any conditions.

**TLG**



**Tank Level Gauging**

A variety of radar, pressure and electro-pneumatic based transmitters for measurements in all types of ballast/service tanks and for draft measurements and void space monitoring. All easy to install and maintain.

**CMS**



**Cargo Monitoring System**

A robust radar-based cargo monitoring system enhancing the operational visibility and effectiveness. Measuring tank contents with high precision offering independent high level and overfill alarm systems additional to a variety of customizations with high standards.

**FMS**



**Fuel Monitoring System**

Fuel monitoring system with both fuel bunkering and fuel consumption application to assure compliance with environmental regulations, get accurate real-time baseline data to obtain an overview of fuel, engine and vessel performance.

## Inside Aperio - Display Overview and Examples

Aperio Vision Workstation Functionality holds a variety of displays that gives full control over a number of sub-systems and functionalities. Each display can be tailor-made to view the needs for your specific systems, either in several views or combined together in one and the same view. Products and components are visualized with icons and symbols that instantly gives a fast overview with status and processes of every sub-system contained within your Aperio ICMS. Alarms are both visible and audible from your system and can be setup and designed after your needs.

The displays on the following pages are examples on how sub-systems within Aperio can be shown together with a list of additional functionalities in connection to the system. Depending on vessel and cargo these displays can be interfaced with almost any combination to fulfill all the necessary operations, and safety controls as visualized from one single source.

### Alarm Display and Setup

Alarm status is always visible from the upper right corner in every display. A list of the latest active alarms can also be shown in the bottom of the display. Alarms can be setup with different alarm management functions, such as filtering, grouping and presentation.

### Events

Events are also commonly used within almost every display. The event is a list of all that has happened in the system, for example when an alarm is activated and accepted or when interaction with the system such as open/close valve. All events are normally grouped and logged in the system.

### Trends

Different components and data can be logged and viewed as trends. Trends can be setup, started and stopped and processed when needed.

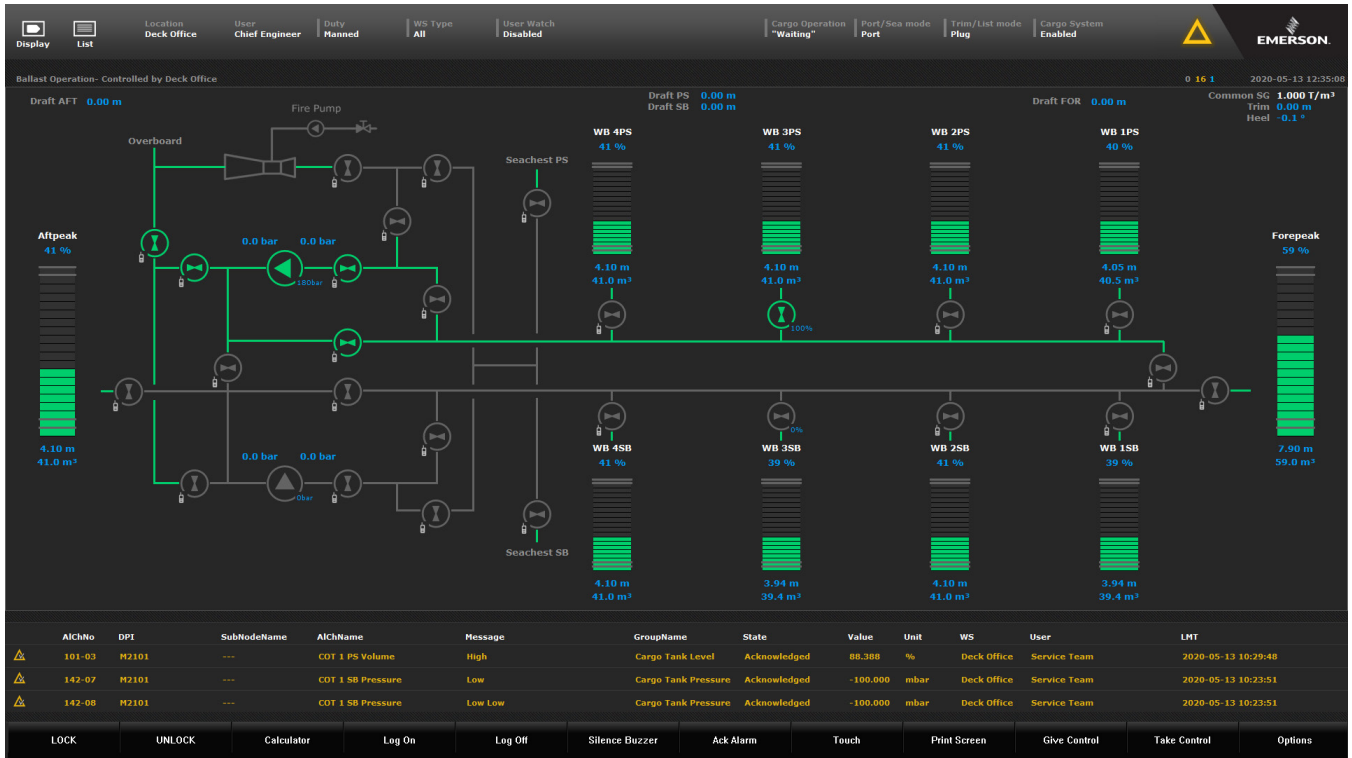
### SafeGards and Interlocks

Safeguards are warnings emerging as a dialog box each time a control is opened, reminding the operator what special precautions should be taken if the control is activated.

Interlock is a feature that allows the control over the components possible from one location at a time.



# Ballast Display



The above picture shows a typical ballast tank system display.

In the Aperiio Workstation Functionality the ballast, bilge and service tank systems can include the following features:

- Level and tank contents gauging by using electronic level sensor (Rosemount 520) or electro pneumatic sensors (LevelMaster)
- Remote control of pumps and valves
- Draft, trim and heel gauging
- Temperature gauging
- Tank heating control
- Level, contents, pressure and temperature alarms
- Automatically control of pumps and valves
- Interlock between several workstations
- Dynamic coloring of pipelines, valves, pumps and tanks
- Transfer of tank contents information to loading and stability computer

# Cargo Operation Display



The cargo system can include the following features:

- Level and tank contents gauging by means of radar based sensors (Rosemount TankRadar)
- Tank top pressure gauging
- Temperature gauging
- Level, contents, pressure and temperature alarms
- Tank heating control
- Remote control of pumps and valves
- Automatic control of pumps and valves
- Interlock between more workstations
- Dynamic coloring of pipelines, valves, pumps and tanks
- Safeguards (Information which is shown each time e.g. a valve is operated)
- Conditional warnings (when operating e.g. a valve it is only shown when a certain condition is present)
- Transfer of tank contents information to loading and stability computer

# Main Engine Display



The Main Engine is grouped under Machinery and Service systems and can include:

- Main engines
- Auxiliary engines (exhaust, cooling, heating, lubricating etc.)
- Separators
- Boilers
- Power management
- Stand-by pump control
- Propulsion
- Ventilation
- Air condition
- Doors
- Fire fighting
- Inert gas
- Light

# Fuel Monitoring Display



The Fuel Monitoring Display can include:

- Fuel Efficiency Measurement
- Diesel Generator
- Boiler and Emulsion
- Specific Fuel Oil Consumption (SFOC)
- Vessel Emission Reports (VER)
- Bunkering
- Bunker reports
- Meter Confidence
  - Zero Verification
  - System Verification
  - Calibration Verification
- Data logging
- Event logging
- Alarm handling

## Structure and Architecture

The Aperio system is very flexible and can be tailored to fit any kind and size of vessel with variously automation needs; from a simple serial connection of a sub-system to a third-party system to a total automation solution covering all the systems described on previous page and in more detail on following pages.

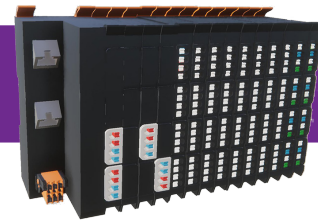
Typically, a system will consist of more interface panels to save installation cost or a single centralized cabinet, workstations, operator or alarm panels interconnected by a redundant real time Ethernet ring.

IO modules are installed in the interface panels for data acquisition from various sensors e.g. level, pressure and

temperature sensors and for control of various components such as valves, pumps, horn and light.

Controllers are also installed in the interface panels for handling of input and output signals. They include various applications for e.g. valve control, tank contents gauging, draft gauging, flow gauging, alarm call and other automatic functions.

Various applications for graphic display and operation of the total system are installed on the workstations, operator or alarm panels. Also alarms for the various sub systems and logged data can be displayed in historical and trend windows.



### Aperio Vision Workstation

The Vision workstations come in different sizes and are offered as listed:

- Vision 10"
- Vision 19" and 24"
- Vision CPU

### Aperio Vision Workstation Functionality

The Aperio Vision workstation functionality is the software designed to mirror every system with intuitive and instructive interface as developed and configured by our software engineers.

### Aperio Controllers and IO Modules

The Aperio UC20 Controllers and UR20 IO Modules are robust and of high quality design. They are placed in cabinets and are easy to install and maintain.

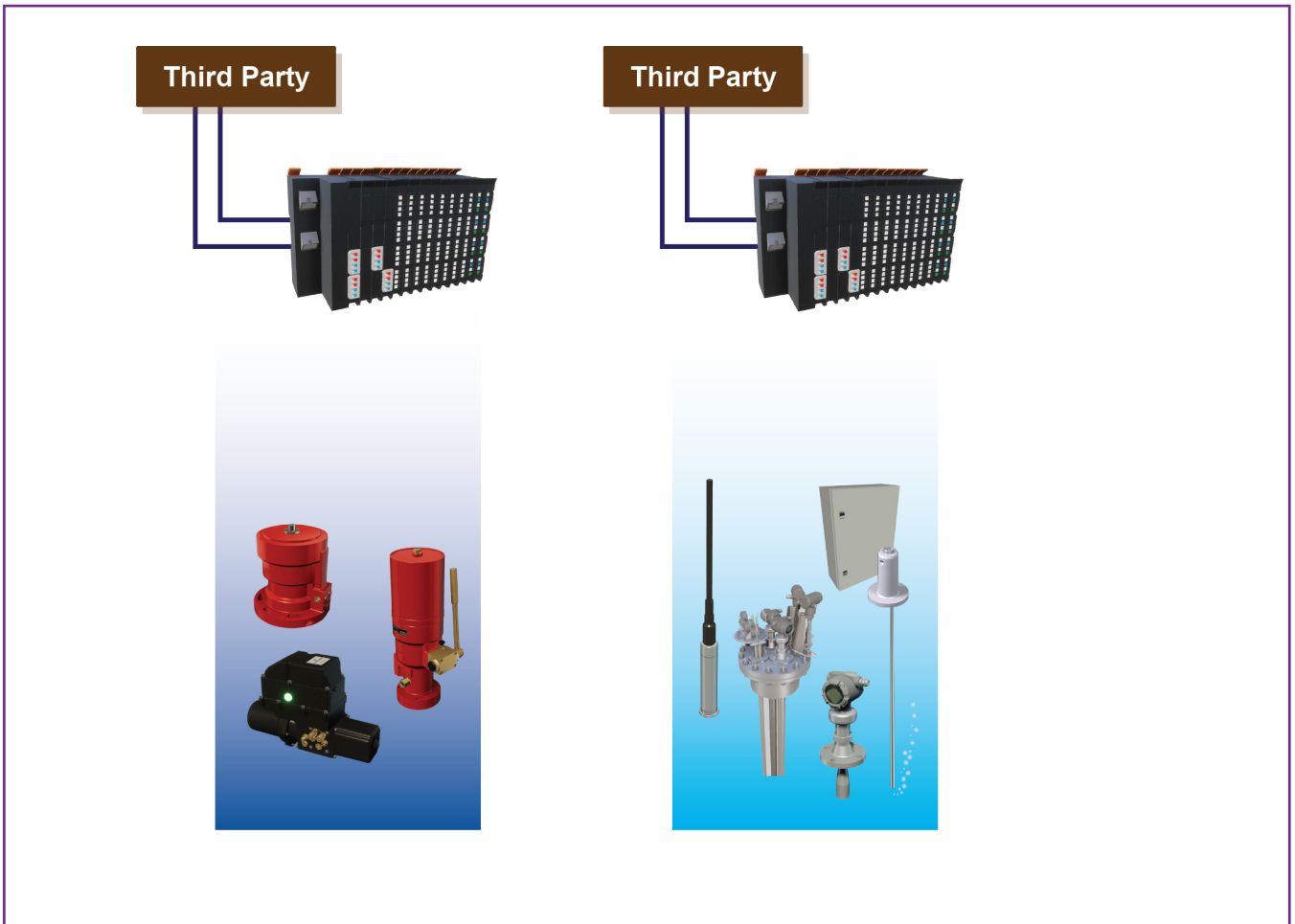
### Automation Solutions

To meet the very different possibilities within Aperio Automation Platform the system solutions are divided into four major groups:

- Aperio Terminal Solution
- Aperio Conventional Solution
- Aperio Core Solution
- Aperio Premium Solution

Examples of the various types of automation solutions are described on the following pages.

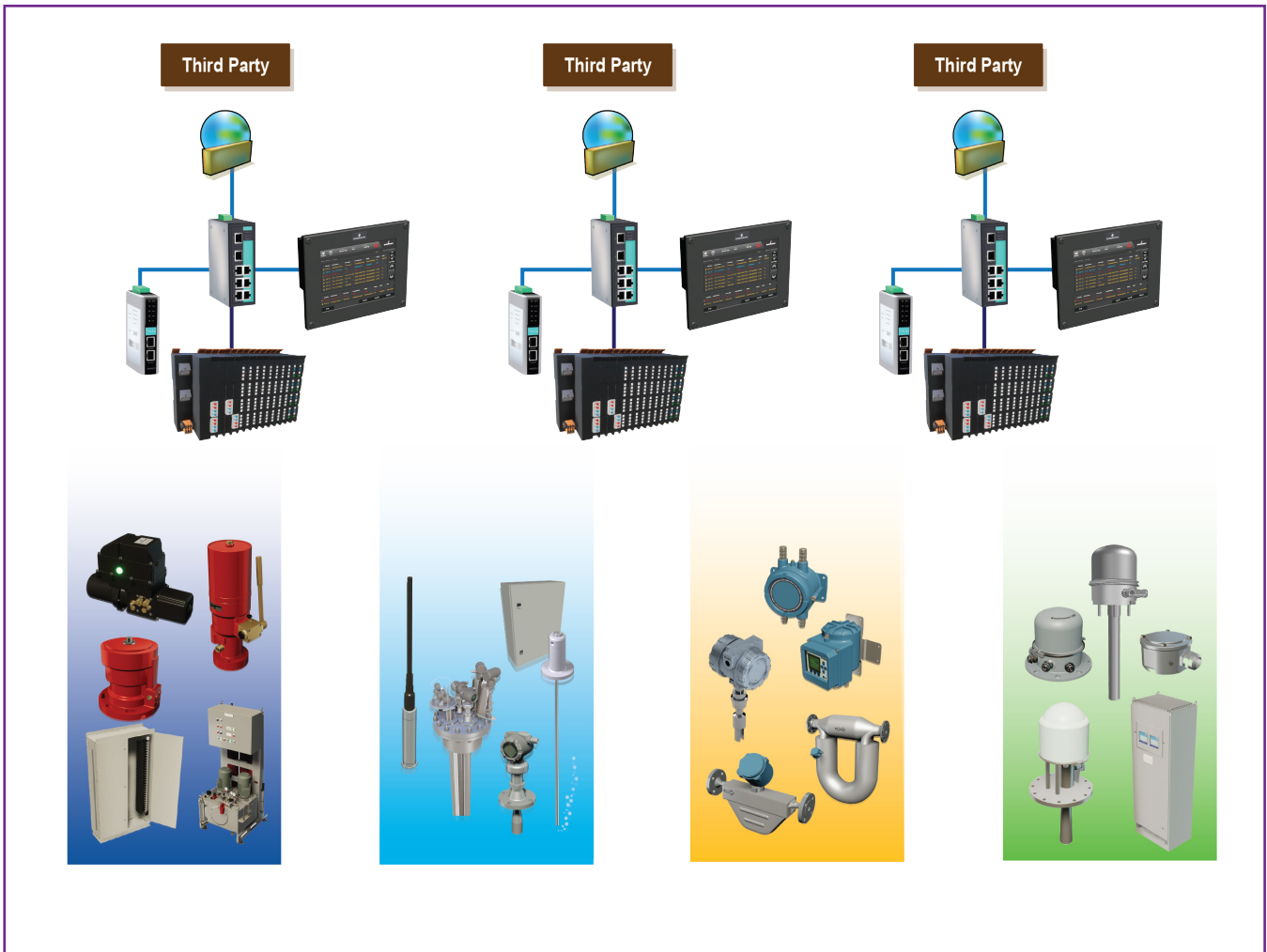
# Aperio Terminal Solution



The Aperio Terminal Solution is used on vessels where the third-party automation supplier prefers to control the Valve Remote Control system or collect information from the intelligent tank level transmitters or tank radar themselves, but want the benefits of using the Aperio IO system.

Various types of communication interfaces to third-party ICMS / IAS systems can be offered.

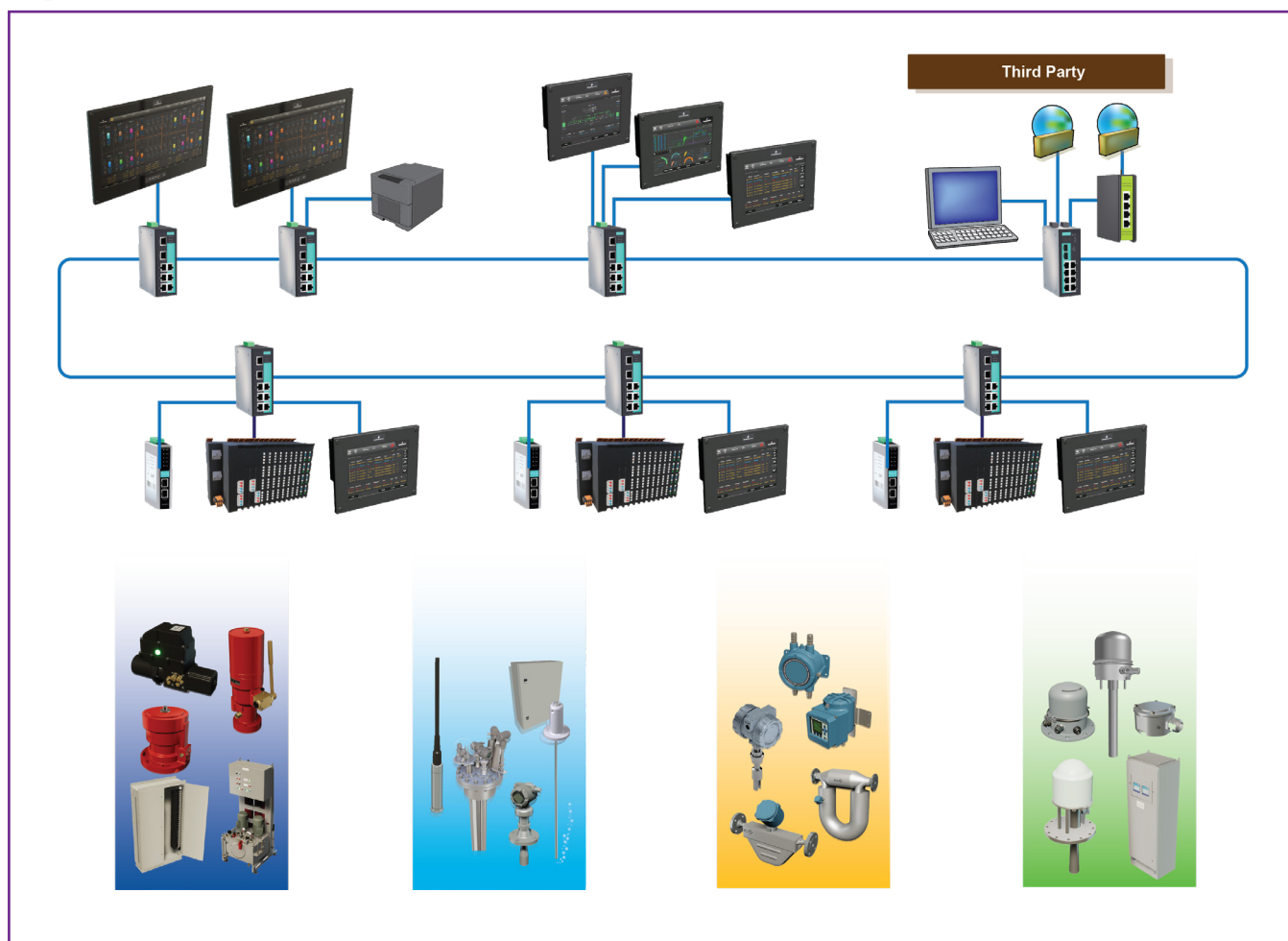
# Aperio Conventional Solution



The Aperio Conventional Solution is used on vessels where the shipowner has a preference for another ICMS / IAS system, but still wants to have the benefit of using the Aperio ICMS as the sub-system with all the safety built into the control and quality into the calculations.

As the scope is typically limited to a single standalone sub-system the HMI is typically realized in lists of components instead of mimic displays. Furthermore, the alarm functionality, logging, interlock, safeguards etc. will also be limited to be used as local / emergency operator panel.

# Aperio Core Solution



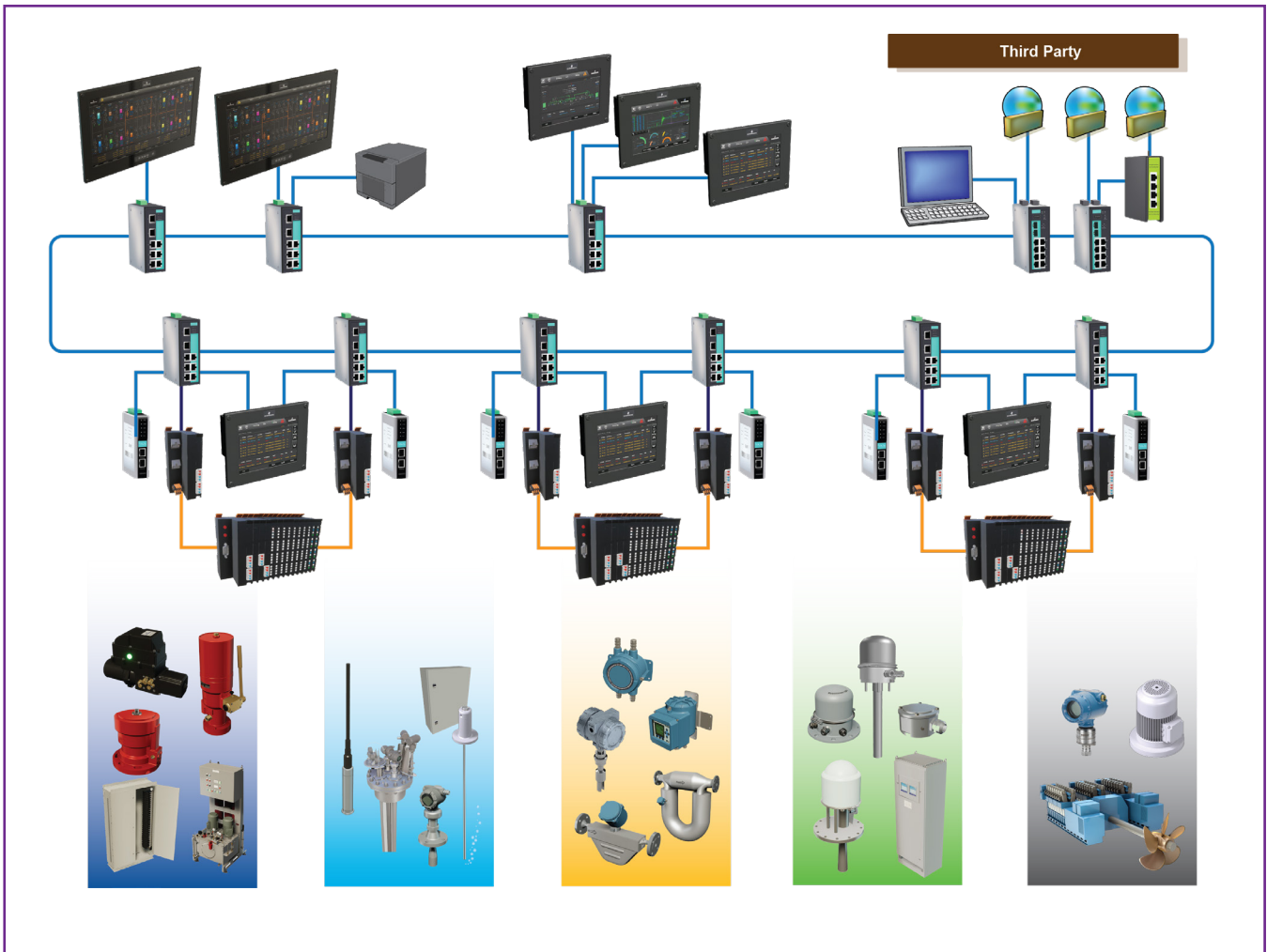
The Aperio Core Solution is used on vessels where the crew want to have an optimal survey of the all sub-systems onboard. The scope is typically limited to a few sub-systems onboard, like valve remote control, tank level gauging in ballast, service and cargo tanks.

The HMI (human machine interface) is developed for marine automation and together with the advanced alarm filtering built into the workstation, local control and accommodation alarm panels, will give the crew a smooth and safe operation of the vessel.

The HMI consist of standard features like Alarm Group , Alarm Group List, Alarm List, Event List, Display Groups and Tank Groups. Furthermore, several sub-systems with specific mimic displays are incorporated to give the crew an optimal overview of the status of all equipment and machinery onboard.

All the benefits from the Aperio Terminal Solution are available.

# Aperio Premium Solution



The Aperio Premium Solution is used on vessels with very high requirements to safety and demands of redundant controllers and communication to the third-party systems. Typically, the Aperio Premium Solution will be the main ICMS system onboard handling all the sub-systems and automation tasks.

All the benefits from the Aperio Core Solution are available.

# Component Description

This section holds a description of the components used to build the Aperio Automation system to solve the individual needs for any type of vessel.



## Aperio Vision Workstation

Integrated Control and Monitoring becomes clear and actionable with the Aperio Vision Workstation.

The Workstation consist of a 19" or 24" Vision Monitor and Vision CPU. The Vision Monitors are easily mountable to console or desk. The Vision CPU integrates as a free-standing unit or mounted on back of Vision Monitors. Touch screen option useful where a trackball or keyboard will not fit. Vision Monitors equipped with wide angle view and full dimming. The Vision CPU has no moving parts and needs no fan.

For local operation or alarm management a 10" Workstation with integrated CPU Vision can be used.

### Marine Approvals

LR, DNV, BV, ABS, RINA, KR, NK, CCS

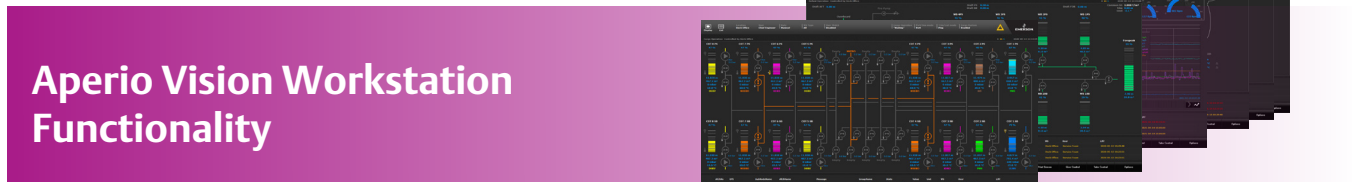
### Read More

Product Data Sheet: Vision 19/24 - SD 9001-2EXX

Product Data Sheet: Vision 10 - SD 9010-2EXX

Product Data Sheet: Vision WS - SD 9020-2EXX

Product Data Sheet: Vision CPU - SD 9030-2EXX



## Aperio Vision Workstation Functionality

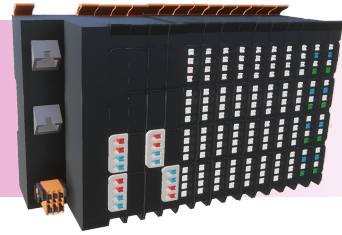
Operational continuity is key for your ship's long-term success. With Aperio Vision Workstation functionality you get a single point overview of your ship's systems, which improves your ability to plan, control, monitor and react to alarms. It's designed to manage a variety of stand-alone systems for tank monitoring, valve and pump control fuel management and alarm acquisition.

The Aperio Vision Workstation Functionality is highly scalable and flexible with customizing capabilities for most any combination of tasks, for most any size of vessel.

### Read More

User Manual: Aperio - UM 9000-30-001-XX

## Aperio UC20 Controllers and UR20 IO Modules



You have everything automation technology needs with the powerful UC20 Controllers combined with the modular flexibility of the UR20 IO Modules to provide unmatched supervision and control of all automation tasks on board to secure a seamless operation of the vessel.

The UC20 Controller hold dedicated marine tailored application for Valve Remote Control, Tank Level Gauging, Cargo Monitoring, Fuel Monitoring and Alarm Management Systems. There is a large selection of different UR20 IO Modules for collecting data from sensors and for controlling devices for the various systems on board. The UC20 Controller and UR20 IO Modules are mounted on a DIN rail, communication and power is automatically enabled through the backplane interface.

It is possible to provide a centralized solution where the UR20 Controllers and UR20 IO Modules are built into a single panel. Decentralized solutions can also be offered, where all the UR20 Controllers and UR20 IO Modules are distributed on several panels, which reduces installation costs.

UC20 Controllers and UR IO Modules can work independently of the Aperio Vision Workstations to carry out essential functions.

### Marine Approvals

LR, DNV, BV, ABS, RINA, KR, NK, CCS

### Read More

[Weidmüller.com](http://Weidmüller.com)

Supported Parts	
Conventional, Core and Premium Tier	
Type	Weidmüller Article
Controller	UC20-SL2000-OLAC-EC-CAN
Bus Coupler - CAN	UR20-FBC-CAN
Communication Module (Used for NMEA0183)	UR20-1COM-232-485-422
IO Modules - Digital	UR20-16DI-P UR20-16DO-P
IO Modules - Analog	UR20-4AI-UI-12 UR20-4AI-UI-16-DIAG UR20-4AI-R-HS-16-DIAG UR20-4AI-RTD-DIAG UR20-4AI-I-HART UR20-4AO-UI-16-M-DIAG
IO Modules - Support	UR20-PF-I UR20-PF-O UR20-ES
Terminal Tier	
Type	Weidmüller Article
Bus Coupler - Modbus	UR20-FBC-MOD-TCP-V2
Bus Coupler - Profibus	UR20-FBC-PB-DP-V2
IO Moduls	See above

## Switches – EDS-405A/408A/416 Series

To connect the ship’s workstations, controllers to each other, a redundant Ethernet ring is used, where the individual units are connected to several switches.

Moxa Turbo Ring Functionality is used to establish the network redundancy.

**Marine Approval**

DNV

**Read More**

Moxa.com



## Firewall – EDR-810 Series

Moxa’s EDR Series industrial secure routers protect the control networks of critical facilities while maintaining fast data transmission. They are specifically designed for automation networks and are integrated cybersecurity solutions that combine an industrial firewall, VPN, router, and L2 switching functions into a single product that protects the integrity of remote access and critical devices.

Moxa Turbo Ring Functionality is used to establish the network redundancy.

**Marine Approval**

DNV

**Read More**

Moxa.com



## Modbus Converter – MGate M3170/MB3270

The MGate MB3170 and MB3270 are 1 and 2-port Modbus gateways, respectively, that convert between Modbus RTU and TCP communications protocols. The gateways provide both serial-to-Ethernet communication and serial (master) to serial (slave) communications. In addition, the gateways support simultaneously connecting serial and Ethernet masters with serial Modbus devices.

**Marine Approval**

DNV

**Read More**

Moxa.com



## Remote Access – Site Manager 1529

SiteManager is the advanced IoT edge gateway component of the Secomea Solution which enables both industrial remote access and machine data collection with edge computing functions in a single unit.

SiteManager ensures seamless and secure remote connectivity to your industrial equipment and IIoT devices while allowing you to collect data from multiple devices and send that data to different cloud solutions for further analysis. The SiteManager IoT Edge Gateway is available as a robust, industrial, graded DIN-mountable device.

**Approval:**

CE (EU), FCC/UL (US), cUL (CA), RCM (AU), Giteki (JP)

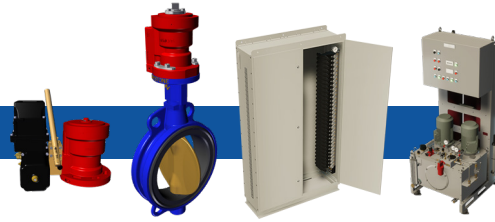
**Read More**

Secomea.com



# Valve Remote Control

## VRC



## Aperio Vision Workstation Functionality

This section contains highlights of the operation of the Valve Remote Control System.

### Displays

The operation of the Valve Remote Control System is very safe and easy to use by the crew. If the Valve Remote Control System is used as stand-alone system with interface to a third-party ICMS (Integrated Control and Monitoring System) the valves are typically grouped in lists format. If the Valve Remote Control System is combined with a Tank Level Gauging System for ballast and service tanks or a Cargo Monitoring System, advanced mimic displays are tailor-made to the specific vessel. A number of special designed components (icons) for valves, pumps and tanks are added and can be interconnected by means of pipelines.

### Valve Component

The valve component and belonging operator dialog give the crew the exact status of the valve. Besides of the valve basic information like closed, closing, opening, open and number of sub icons are showed like alarm, module error, emergency shut down, locked, local, pending, settling, queued, learning, maintenance are showed. When opening the operator dialog detailed information like alarms and maintenance information are available.

### Alarms

The system continuously supervises the operation of the valves and alert the crew if an unwanted situation occurs.

### Safety

Several built-in safety measurements help the crew to protect the cargo and the vessel.

Interlocking between several workstations secure that it is only possible to operate the system in one location at a time.

It is possible to add a Safeguard which pop-up to alert the crew before a valve is operated. The Safeguard can always be shown, or it can be implemented as an Operational Warning dependent on the actual condition of the vessel. When performing maintenance on the system, the crew has the option to block valves.

It is possible to connect the tanks, manifolds, valves and pumps by means of pipelines, which dynamic change color as the products flow into the system. Different colors are added to the different types of cargo. The dynamic coloring feature gives the crew an optimal overview of the system especially in cargo systems carrying different types of cargo.

The dynamic coloring feature can be implemented in ballast, oil and other service systems onboard.

To protect that different types of cargo are not mixed due to a wrong operation by the crew, the built-in warning system constantly ensures one valve separation (OVS) and two valve separation (TVS) between two types of different cargo.

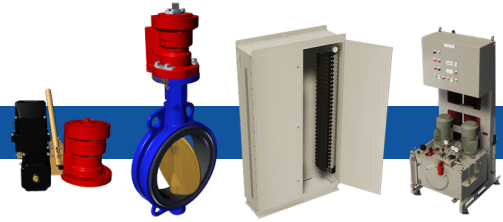
### Logging

All alarms and crew interactions can be logged into an event log to document the operation of the vessel.

#### Read More

User Manual: Aperio - UM 9000-30-001-XX

VRC



## Aperio UC20 Controllers and UR20 IO Modules

### Valve Application

It is possible to control the following valve types:

SV - Solenoid Valves	LPU V3 - Local Power Unit
4/3 Double Acting On/Off	Basic Double Acting On/Off
4/3 Double Acting Continuous	Basic Double Acting Continuous
4/2 (Detent) Double Acting On/Off	Basic Single Acting (FC / FO) On/Off
4/2 Single Acting (FC / FO) On/Off	Basic Single Acting (FC / FO) Continuous
	Plus Double Acting On/Off
	Plus Single Acting On/Off
	Plus Single Acting (FC/FO) On/Off
	Elite Double Acting On/Off
	Elite Double Acting Continuous
	Elite Single Acting On/Off
	Elite Single Acting (FC/FO) On/Off
	Elite Single Acting Continuous
	Elite Single Acting (FC/FO) Continuous

The built-in valve manager handles the power management, so a limited number of valves only are active simultaneously.

The build-in learning function is used during the commissioning of the valve and secures that the right valve parameters are automatically set.

For SV and LPU Basic the valve application handles all the necessary logic to control the valves in a safe way. The valves are continuously supervising, and alarms are generated if an abnormal situation occur.

For LPU Plus and Elite the main valve application is handled locally in the unit itself enabling local open/close functionality and warnings send to the Aperio application e.g. operational status or sensors/alarms like low voltage, low current or oil tank level.

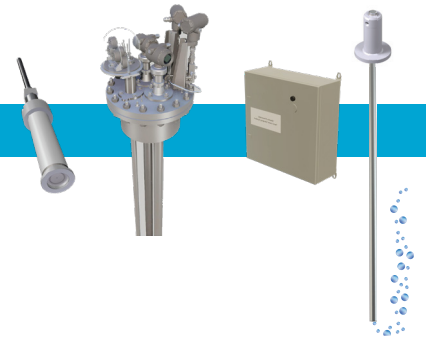
## Aperio Switch, Firewall and Modbus Converter Modules

### Third-Party System Communication

The Modbus TCP or RTU (RS485) is used to exchange operating status, valve status and command.

# Tank Level Gauging

## TLG



## Aperio Vision Workstation Functionality

This section contains highlight of the use of the Tank Level Gauging System.

### Displays

Tank level gauging in the ballast and service tanks can be grouped into dedicated displays which give the crew a good overview of the conditions onboard.

If the Tank Level Gauging System is used as stand-alone system with interface to a third-party ICMS (Integrated Control and Monitoring System) the tanks are typically grouped in lists format.

When the tank level gauging is combined with the Valve Remote Control System, advanced mimic displays are tailor-made to the specific vessel. A number of special designed components (icons) for valves, pumps and tanks are added and can be interconnected by means of pipelines.

### Tank Component

The tank component is a very advanced bargraf which can be configured to show various parameters for the ballast and service tanks to suit the actual need for readout. Tank contents alarms together with various possibilities for color control can be added.

When opening the operator dialog detailed information like tank contents information e.g. level, volume, volume %, weight is shown. Furthermore, it is possible to manually key-in density and various alarm levels.

### Tank Groups

In systems with many tanks the crew have the possibility to add the desired tanks to a single tank group display. This gives the crew a good overview e.g. of the active tanks during a loading or unloading of the vessel. The setup is very flexible and up to sixteen tank group displays are available.

### Alarms

The system continuously supervises the tank contents and alert the crew if an unexpected situation occurs.

### Safety

It is possible to connect the tanks, manifolds, valves and pumps by means of pipelines, which dynamically change color as the ballast water flow into the system. This feature can also be applied to the other service systems on board.

### Logging

All alarms and crew interactions can be logged into an event log to document the operation of the vessel.

### Read More

User Manual: Aperio - UM 9000-30-001-XX

## TLG



## Aperio UC20 Controllers and UR20 IO Modules

### Tank Monitoring Application

The radar-based Rosemount 5408 and Rosemount 5300, and the pressure-based Rosemount 520 and the Electro-pneumatic system are used as basis for level measurement in ballast and service tanks.

The field of applications furthermore includes streamlined solutions for alternative fuels such as LNG and LPG/ammonia. The solutions are fit for installation on a variety of different tank designs, including but not limited to vacuum, single shell and membrane tanks.

For very demanding installations e.g. multipurpose vessels or offshore installations, where there is a requirement for redundant measurement in each tank, it is possible to connect two level gauging sensors. If the two sensors deviate from each other, the system gives a deviation alarm and the user has the option of choosing which sensor to use.

The tank monitoring application handles all necessary calculations to get a reliable measurement of the contents in the tanks:

- Density compensation
- Location of the sensor inside the tank
- Trim and heel correction
- Convert the level into contents using tank sounding table
- Innage / ullage calculation in volume and weight actual and in percent

It is also possible to add the tank to a tank group e.g. cargo, ballast water, drinking water, heavy fuel oil, marine diesel oil, lubricating oil and get the picture of the contents onboard.

### Draft, Trim and Heel Application

The application can handle up to four draft sensors mounted forward, after, starboard and portside.

The application handles all necessary calculations to get a reliable read-out of the draft of the vessel:

- Seawater density compensation
- Compensate or the location of the sensors
- Calculate the draft on the ships draft marks

The draft measurement shall only be used onshore during loading / unloading the vessel as the calculation are not accurate enough when the vessel is at sea due to dynamic influences.

The draft sensors need to be combined with a dual-axis inclinometer for trim and heel measurement.

The inclinometer will also work when the ship is at sea and can therefore be used for continuously trim and heel, compensating the tank contents measurement during a voyage.

## Aperio Switch, Firewall and Modbus Converter Modules

### Third-Party System Communication

The Modbus TCP (Ethernet) or RTU (RS485) is utilized to exchange tank monitoring data.

# Cargo Monitoring System

## CMS



## Aperio Vision Workstation Functionality

This section contains highlight of the use of the Cargo Monitoring System.

### Displays

The cargo tanks can be grouped into dedicated displays which give the crew a good overview of the conditions onboard.

When the Cargo Monitoring System is combined with the Valve Remote Control System, advanced mimic displays are tailor-made to the specific vessel. A number of special designed components (icons) for valves, pumps and tanks are added and can be interconnected by means of pipelines.

### Tank Component

The tank component is a very intuitive bargraf which can be configured to show various parameters for the cargo tanks to suit the actual need for readout. Tank content alarms together various possibilities for color control can be added.

When opening the operator dialog detailed information like tank contents information e.g. level, volume, volume %, weight, temperature and vapor pressure is showed. Furthermore, it is possible to manually key-in density and various alarm levels for the measurement.

### Tank Groups

In systems with many tanks the crew have the possibility to add the desired tanks to a single tank group display. This gives the crew a good overview e.g. of the active tanks during a loading/unloading of the vessel. The setup is very flexible and up to sixteen tank group displays are available.

### Alarms

The system continuously supervises the tank contents, temperatures and vapor gas pressure and alert the crew if an unexpected situation occurs.

### Safety

It is possible to connect the tanks, manifolds, valves and pumps by means of pipelines, which dynamically change color as the different cargo flow into the system.

### Logging

All alarms and crew interaction can be logged into an event log to document the operation of the vessel.

### Read More

User Manual: Aperio - UM 9000-30-001-XX

## CMS



## Aperio UC20 Controllers and UR20 IO Modules

### Tank Monitoring Application

The Rosemount Marine tank radars are used to measure the level, temperatures and vapor gas pressure in the cargo tanks.

The tank monitoring application handles all necessary calculations to get a reliable measurement of the contents and supervision of the temperatures and vapor pressure in the cargo tanks:

- Location of the transmitter at the cargo tank
- Trim and heel correction
- Convert the level into contents using tank sounding table
- Density compensation ASTM 54A (Generalized Crude Oils) and ASTM 54B (Generalized Products)
- Steel expansion compensation
- Innage / ullage calculation in volume and weight actual and in percent
- Innage level a Center of Gravity
- Ullage level compensated to Plug or Center of Gravity
- Mean temperature of sensors in liquid

It is also possible to add the tank to a tank group e.g. cargo, ballast water, drinking water, heavy fuel oil, marine diesel oil, lubricating oil and get the picture of the contents on board.

## Aperio Switch, Firewall and Modbus Converter Modules

### Third-Party System Communication

The Modbus TCP (Ethernet) or RTU (RS485) is utilized to exchange tank monitoring data.

# Fuel Monitoring System

## FMS



## Aperio Vision Workstation Functionality

This section contains highlights of the use of the Fuel Monitoring System.

The Fuel Monitoring System includes the following features:

- Displays
- Zero Verification
- System Verification
- Calibration Verification
- Diagnostics Values
- Bunkering Report
- VER (Vessel Emission Report)

### Displays

The Fuel Monitoring System is showed on mimic displays, which are tailor-made to the specific vessel. The displays give the crew a good overview of the conditions onboard of the flows and other associated parameters. Information from other devices like liquid detectors, valves, weather station, GPS and interface to torch meter / power management system can also be integrated into the mimic displays.

A meter component especially developed for displaying the actual flow is used to give the crew a clear overview of the actual flow or other readings.

The trend log component is used to show important flow parameters as a function of time.

### Zero Verification

Zero verification is a check that the flow meters “Flow verification zero” value is within a certain limit (depends on the flow meter size) when there is no flow in the flow meter.

Each meter in the setup has the possibility to use the zero verification. Before the zero verification is executed, it is important that there is fuel in the flow meter and that the fuel is not in flux (i.e. not in flow). This is secured by a Safeguard that tells what to do prior to the verification.

### System Verification

System verification is a check that the flow meter measurements are within a certain limit when the fuel is circulated over a stopped engine, and the flow of the supply and return meters is expected to be the same.

Each engine in the setup have the possibility to use the system verification. Before the system verification is executed it is important the engine is stopped, and the fuel is circulating over the engine.

This is secured by a Safeguard that tells what to do prior to the verification.

### Calibration Verification

Calibration verification is a check that none of the eight different calibration constants in the meter has been changed during operation.

It is possible to perform the calibration verification to each meter in the setup. The calibration verification can be executed whenever necessary, it is not dependent on stopping of engines nor flows etc.

### Diagnostics Values

Each flowmeter has all readings displayed in the list “Display groups”. The readings in the “Display groups” include diagnostic reading as well such as: Raw Tube Frequency, Left/Right pickup amplitude, drive gain etc.

### Bunkering Display / Report

The Bunkering display shows the most important values for the mass flow meter and the bunkering operations. Bunkering loggings are automatically started and displayed. The logs can be printed and saved by using the report viewer window.

## FMS



### VER (Vessel Emission Report)

The VER is used to create reports for fuel consumption systems to be used for EU MRV (Monitoring, Reporting and Verification) and IMO DCS regulation, based on Micro Motion mass flow meters and the Aperio software package.

The Aperio VER system complies with the Amendments to MARPOL Annex VI on Data collection system for fuel oil consumption of ships, adopted by resolution MEPC.278(70), entered into force on 1 March 2018. Please refer to this regulation for more information and validation regarding your ship requirements and statements.

The Aperio VER system will enable the ship to measure, report and value the emission of CO<sub>2</sub> and other consumption data which ultimately will assist in following EU's regulation and policy for reducing domestic greenhouse gas emissions.

### Alarms

The system continuously supervises the Micro Motion mass flow meters together with other devices and alert the crew if an unexpected situation occurs.

### Logging

All alarms and crew interaction can be logged into an event log to document the operation of the vessel.

#### Read More

User Manual: Aperio - UM 9000-30-001-XX

## Aperio UC20 Controllers and UR20 IO Modules

### Meter Confidence Application

The Meter Confidence application handle Zero, System and Calibration verification.

### SFOC Application

The SFOC (Specific Fuel Oil Consumption) application is used to calculate the mass of fuel consumed per unit time to produce per KW.

## Aperio Switch, Firewall and Modbus Converter Modules

### Third-Party System Communication

The Modbus TCP (Ethernet) or RTU (RS485) is used to exchange flow information.

## Features

<b>Aperio Vision Workstation Functionality</b>	<b>Terminal</b>	<b>Conventional</b>	<b>Core</b>	<b>Premium</b>
Alarm Group		X	X	(X)
Alarm List		X	X	(X)
Alarm - Advanced Filtering			X	(X)
Event List		X	X	(X)
Display Groups		X	X	(X)
Tank Groups		X	X	(X)
Data Logging / Trend Displays			X	(X)
Tailor-made Mimic Displays (Advanced graphic)			X	(X)
Tailor-made List Displays		X		
Dynamic Colouring of Tanks, Valves, Pump and Pipelines			X	(X)
One Valve / Two Valve Separation Warnings			X	(X)
Safeguards		X	X	(X)
Operational Warnings		X	X	(X)
Interlocks			X	(X)
Vessel Emission Report (MRV and IMO)			(X)	(X)
Bunkering Report			(X)	(X)
Workstation Redundancy		X	X	(X)
<b>Aperio UC20 Controllers and UR20 IO Modules</b>	<b>Terminal</b>	<b>Conventional</b>	<b>Core</b>	<b>Premium</b>
Alarm		X	X	(X)
Valve Control		X	X	(X)
Pump Control		X	X	(X)
Tank Monitoring		X	X	(X)
Draft, Trim and Heel		X	X	(X)
Automation Task Codesys IEC-61131-3		X	X	(X)
Mass Flow Meter Confidence		(X)	(X)	(X)
Mass Flow Meter SFOC Non-ISO / ISO		(X)	(X)	(X)
UC20 Controller Redundancy				(X)

CONT...

(X) Coming Soon

<b>Third-Party Communication</b>	<b>Terminal</b>	<b>Conventional</b>	<b>Core</b>	<b>Premium</b>
Modbus TCP Client (Master)		X	X	(X)
Modbus TCP Server (Slave)	X	X	X	(X)
Modbus RTU Master (MGate 3170)		X	X	(X)
Modbus RTU Slave (MGate 3170)		X	X	(X)
NMEA0183 (UR20-1COM-322-485-422)		(X)	(X)	(X)
NMEA2000 (CAN Open)		(X)	(X)	(X)
Profibus DP	X			
Communication Redundancy		X	X	(X)
Individual Communication		X	X	(X)
Firewall		X	X	(X)
Cable Redundancy from IO System (Modbus RTU)	X			
<b>System Layout</b>	<b>Terminal</b>	<b>Conventional</b>	<b>Core</b>	<b>Premium</b>
Local / Emergency Operation Display		X	X	(X)
Single Cabinet Resilient		X	X	(X)
Ethernet Ring Redundancy			X	(X)

(X) Coming Soon

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## **About Emerson's Marine Solutions**

Emerson is a world-leading provider of marine solutions with engineering excellence, decades of industry experience and global presence supporting any ship anywhere. All marine systems and solutions are designed especially for the harsh marine environments, engineered and manufactured in-house by our skilled teams of marine engineers. Emerson is well-known in the industry and has more than 50 years' experience with a large installed base and covers well-known marine brands such as Rosemount, Micro Motion and Damcos. Supporting marine customers from a global network of sales and service hubs along the maritime highway.

To learn more about Emerson's marine solutions, visit [\*\*Emerson.com/marine\*\*](https://www.emerson.com/marine)

To contact Emerson's marine experts, visit [\*\*Emerson.com/marinecontacts\*\*](https://www.emerson.com/marinecontacts)

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