ULSTEIN®

ULSTEIN IAS™
ULSTEIN AMS™

– POWERED BY X-CONNECT™

JUNE 28, 2022

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Prepare your ship for a digital future

New technologies can radically improve the efficiency of how a ship is operated. The future is about embracing these possibilities, developing products for safer and more efficient operations.

This is at the core of product development in X-CONNECT. With our effort on offering products and systems that utilize digital possibilities, you can offer ship intelligence that make your business smarter, safer and greener.

Prepare your ship with solutions utilizing digital opportunities.

1 Alarm & Monitoring Systems / Integrated Automation Systems

Ship Alarm and Monitoring System (AMS) is a corner stone for the safe operation of ships. The main responsiblity of AMS systems is to inform, detect and alert ship officers and engineers on status and critical conditions on the ship and helping them managing them safely and in accordance with rules and regulations.

An AMS consist of different hardware and software components to collect, process, store, distribute and present ship system information. An essential property of the system is its ability to continously provide trusted information to ship personell so that they always can respond and act appropriatelly. Alarms and information are normally displayed with grapic displays on operator stations located in the Engine Control Room (ECR) and with optional location on the bridge.

Typically an AMS integrates information from many different ship systems and equipments such as power, engine, propulsion, stability and cargo systems. Information is presented live in dedicated systems mimics using extensive symbolism and interactivity to enhance the user experience. The ability to present historic information and alarms is a common feature in an AMS.

For ships with unattended machinery spaces, an Extension Alarm System (EAS) is also included in the AMS. The EAS system includes visual and audio alarm indicators and watch call panels to alert ship engineers on critical conditions when machinery spaces are unattended. EAS panels are located on the bridge, in cabins and in public spaces onboard the ship.

By adding system and equipment control, system functionality and automation to the AMS system, it becomes an Integrated Automation System (IAS). IAS is normally a more complex and large system, and often with other rules and regulations to comply with.

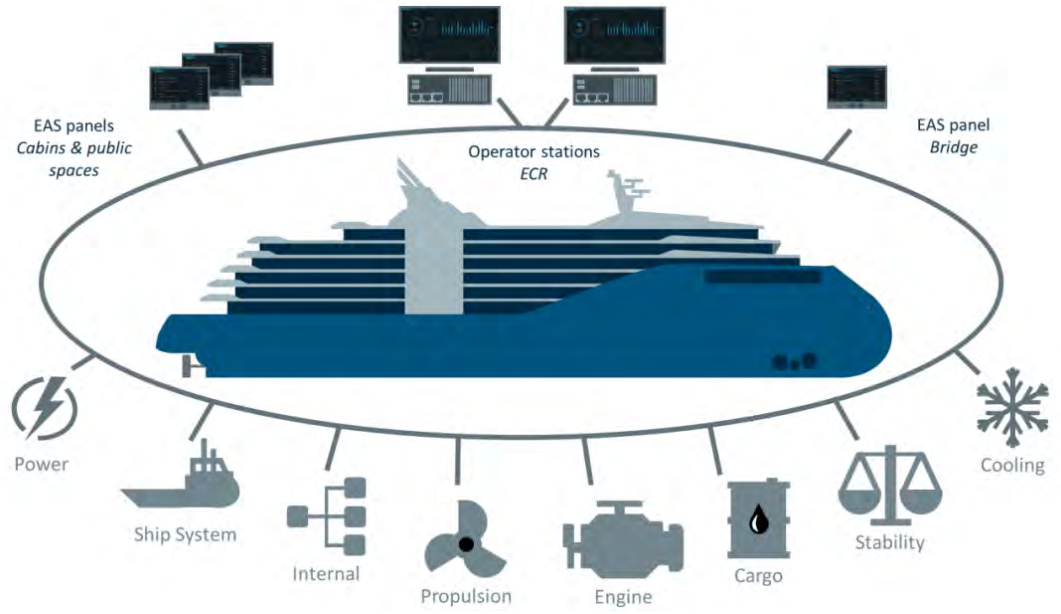


Figure 1: AMS and IAS for monitoring and controlling ship systems

2 ULSTEIN AMS™

ULSTEIN AMS™is the advanced alarm and monitoring system for monitoring ship systems based on the universal user friendly integration platform X-CONNECT™. ULSTEIN AMS™is a fully distributed and decentralized system integrating multi-gateway IO collection, control and processing, efficient data distribution, history data logging and intuitive graphical displays for monitoring and control in one system. The systems meets relevant rules and regulations. It uses marine type approved hardware and the reliability can easily be increased by using system segmentation, dual powering and network link.

The AMS

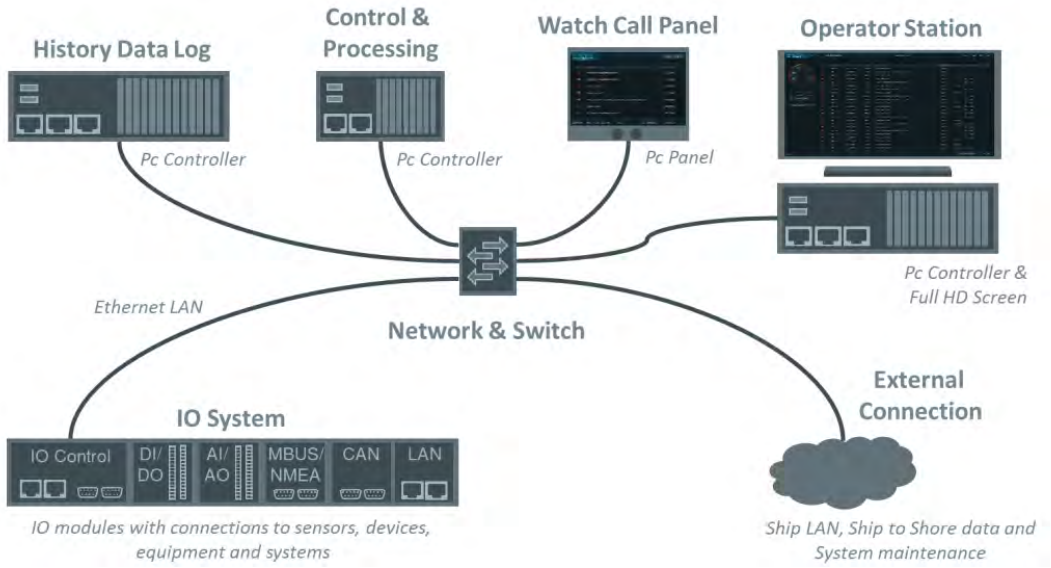


Figure 2: ULSTEIN AMS™- Infrastructure with components

The main parts of ULSTEIN AMS™are:

- AMS Control and Processing controller running the alarm system including internal system alarming, Extension Alarm System (EAS) and Deadman System (DMS).
- IO System with efficient and flexible multi-gateway IO interfacing. The system can have one or more IO units with IO controller and IO modules.
- Internal system data distribution using Ethernet network and switches with rich event based data communication for high system efficiency.
- History Data controller with software and database for logging of alarms and signals.
- 1 or more operator stations with full HD graphical displays for the efficient monitoring and control of the system.
- Rich and intuitive graphical user interface that incorporates standard views and mimics with optional custom mimics based on a library with standard symbols and graphical features.

- Watch call panels with buzzer and rich graphical display for presenting EAS alarms.
- Buttons, lights, siren's and buzzers for indicating alarms.
- Connection to external systems is supported enabling remote maintenance or vessel performance monitoring.

3 ULSTEIN IAS™

ULSTEIN IAS™is the advanced integrated automation system for controlling and automating ship systems processes based on the universal user friendly integration platform X-CONNECT™. ULSTEIN IAS™fully integrates the functionality of the ULSTEIN IAS™but also incorporates remote system control from the user interface with possible automation functionality. The systems meets relevant rules and regulations. It uses marine type approved hardware and meets requirements on single point of failure with system segmentation, dual powering and network link.

The IAS

The main parts of ULSTEIN IAS™are:

- Segmented control system with 2 or more controllers running control software. Each segment represents a defined part of the system with logics and signals that run independently. One segment is always dedicated the alarm system, see AMS.
- Segmented IO System with efficient and flexible multi-gateway IO interfacing. The system will have 2 or more independent IO system units with IO controller and IO modules. At a minimum one IO unit is always dedicated the alarm system, see AMS.
- Internal system data distribution using a dual Ethernet network and switches for link redundancy. All data communication is based on rich event based data for high system efficiency.
- History Data controller with software and database for logging of alarms and signals.
- 2 or more operator stations with rich intuitive full HD graphical displays for the efficient monitoring and control of the system.
- Command transfer system, tanks sounding system, running hours and more is available.
- Configurable logical components such as starters, valves, tanks, breakers and generators for interfacing ballast, bilge, cargo and power management systems.
- Watch call panels with buzzer and rich graphical display for presenting EAS alarms.
- Lights, siren's and buzzers for indicating alarms.
- Connection to external systems is supported enabling remote maintenance and performance monitoring.

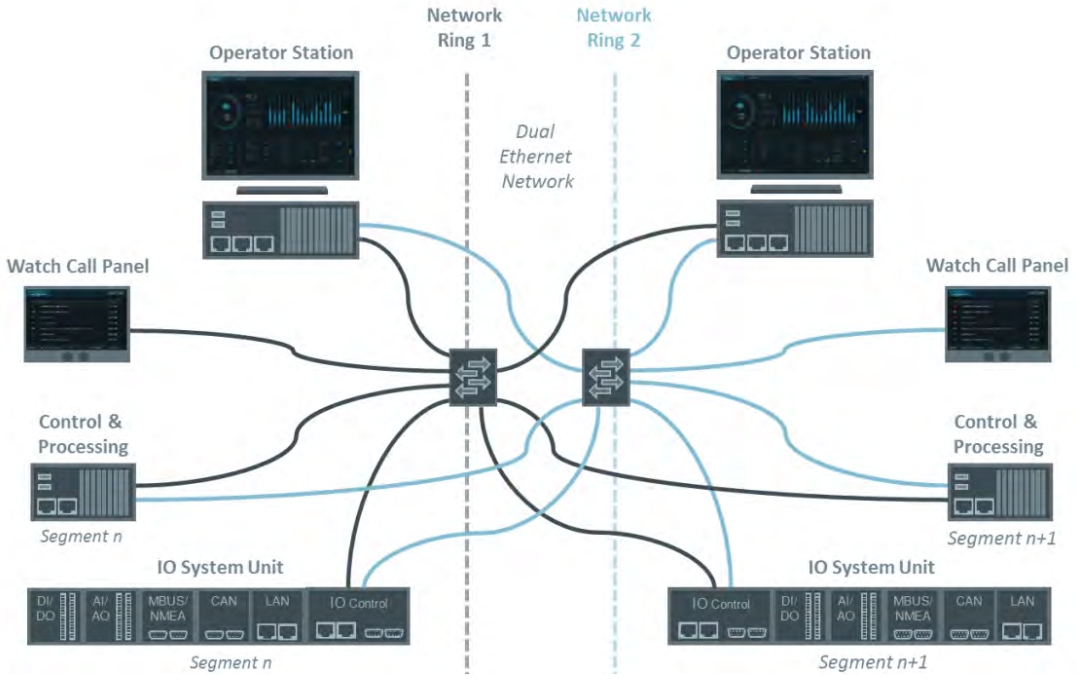


Figure 3: ULSTEIN IAS™- Infrastructure with dual network link, segmented control and IO system units

4 The automation platform X-CONNECT™

ULSTEIN AMS™and ULSTEIN IAS™are based on the X-CONNECT™automation platform. X-CONNECT™combines open industrial computer hardware and configurable software, efficient data communication, multi-gateway IO interface, tooling and high definition monitors with rich intuitive graphical user interfaces designed with the user in focus. The modular design of X-CONNECT™makes ULSTEIN AMS™and ULSTEIN IAS™very scaleable and flexible. The design can easily meet different requirements without compromising performance, reliability or efficiency. The platform enables both cost effective large and small systems.

Distributed system

Traditionally, control and monitoring systems has been based on centralised system designs where a central component exercises control over the whole system. X-CONNECT™has a different approach using a highly flexible and scaleable distributed peers to peers system architecture. Distributed systems can be described as a group of networked computers with software applications that communicate and coordinate their actions by passing data over a network. In operation, software applications automatically discover each other and receives, computes, and shares data. Together the different independent software's acts as one system.

Benefits

Distributed systems are very stable and little sensitive to single failures. They are highly scaleable and made for diversity. The modular and distributed design makes it easy divide both IO collection and control functionality in many parts and run them independently. This reduces the consequences of failures and increases the reliability of the system. If one part of the system goes down, the rest will continue to work, e.g. if a controller handling cargo system goes down, the IO system will not automatically go down. The signals from the cargo system will still be available to the signal list on the operator stations. Dividing large systems can also help segmenting the system to meet class requirements or to distribute computing tasks evenly across the system to make it more balanced and cost effective. Generally, distribution and modularity makes it easy to extend, remove content or adjust the system when needed.

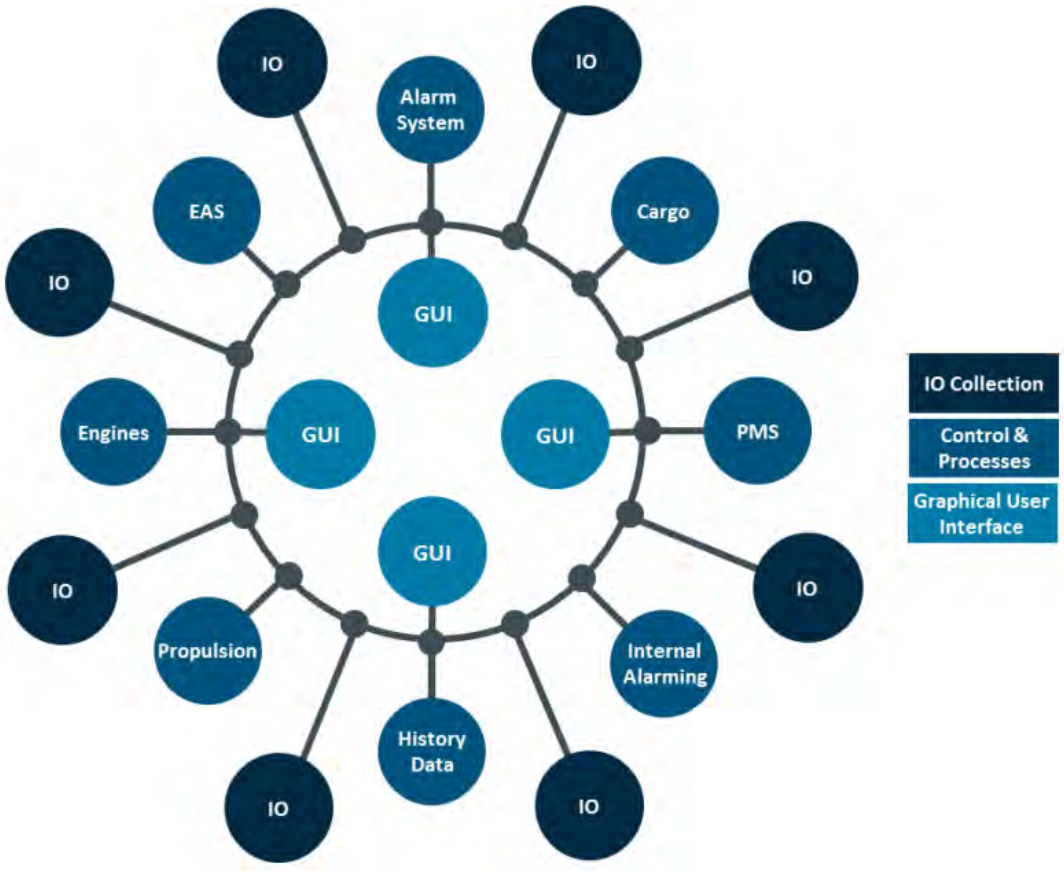


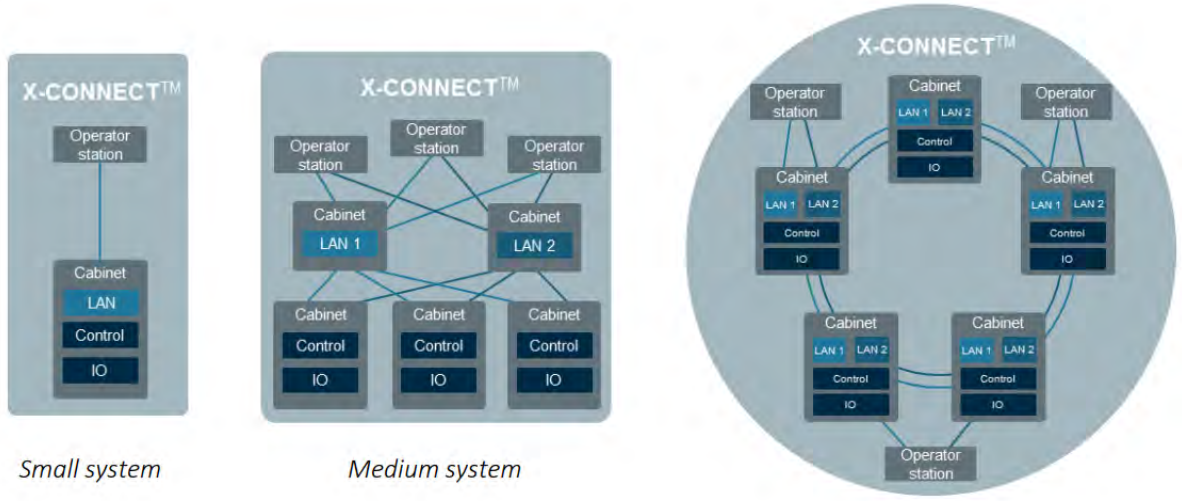
Figure 4: X-CONNECT™- a modular and distributed automation platform

5 Customizable Systems

ULSTEIN AMS™and ULSTEIN IAS™are highly customizable systems that fits different operational requirements. Due to the distributed design and its seamless connectivity, the systems are flexible and scaleable, enabling efficient and optimized solutions for different use cases and demands.

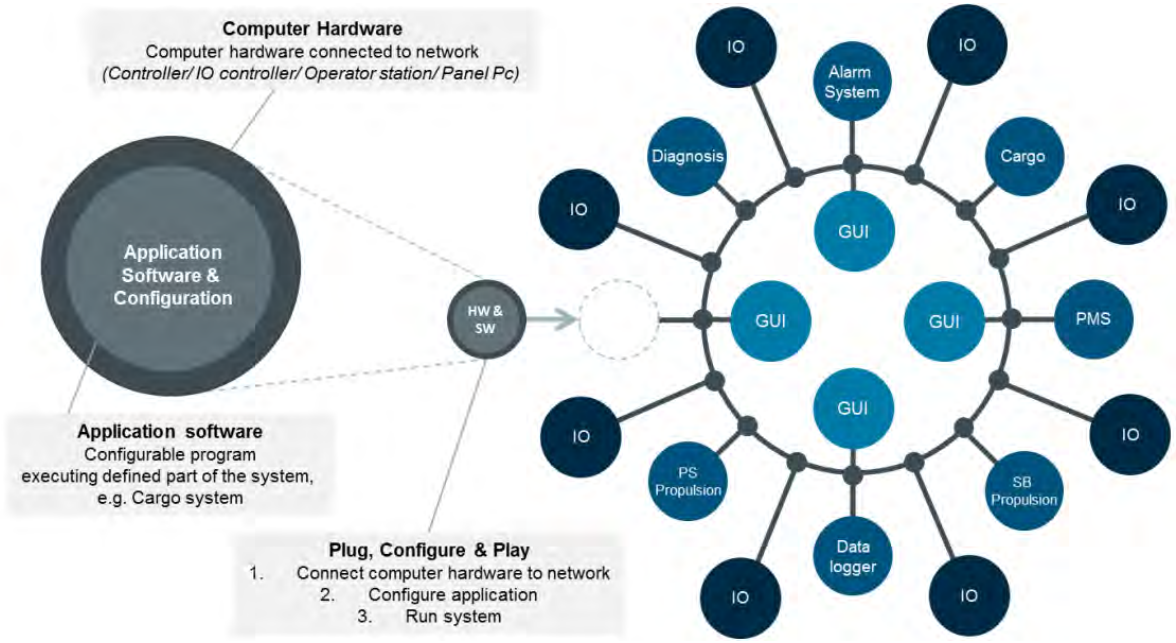
Flexibility

A system built on X-CONNECT™can be assembled in different combinations and number of components, with different network solutions and scope of functionality and data. The configurable software is easy to configure for different assembly scenarios by using the configuration tools.



Scaleability

Whether it is in the delivery phase or if the system is in operation, it is easy to scale the number of system components or change the scope of the system. The procedure to scale the system is very much "*configure, plug and play*" and is managed from the production tools.



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6 In Accordance with Rules

The system complies with relevant rules and regulations of today and tomorrow. The system design has been developed in close cooperation with class societies. Computer and network hardware used in the system are marine approved in accordance with IEC 60945. Dual redundant link network is supported to meet single point of failure tolerance requirements. The alarm system follows relevant guidelines on functionality, visualisation and internal system alarming. System segmentation can be used to manage requirements related to single point of failure in IAS systems.

7 System Segmentation Concepts

To manage ship safety requirement related to single point of failure, class societies requires various system segmentation setups for IAS systems that control safety critical systems. Requirements on segmentation often involves a complex set of factors to be taken care of such as class notations, class society rules and interpretations, ship type, ship systems and ship operator specifications.

In practice segmentation requirements differs from case to case and will depend on the class. Typically, system segmentation will be based on the identification of safety critical systems and the categorisation of them. Common categories are alarm system and controlled systems, with the later further categorised in main and essential systems and redundancy groups.

Main systems

Main systems are IAS controlled ship systems that are safety critical and therefore requires segmentation. On a strict level main system requires separation of IO and control from other main systems. This means that a main system requires at a minimum one dedicated controller and one IO unit to handle control logics and signals of the segment. Bilge, ballast and anchor systems are examples of main systems.

Essential systems

Essential systems are main systems that are critical for the maneuvering of the ship such as power generation, propulsion and steering systems. On a strict level, essential systems may not mix IO signals from any other part of the IAS or run other IAS systems logics.

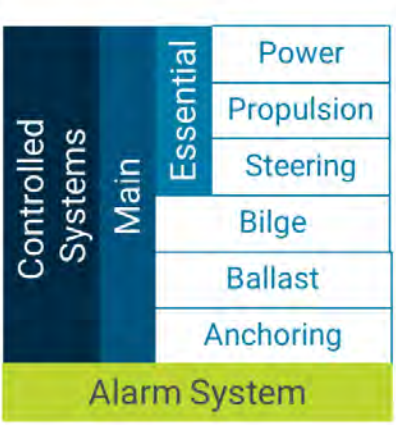


Figure 5: System categories and segments

Redundancy groups

To meet certain requirements on safety such as safe ship to port or DP, segmentation of essential systems may also involve dividing systems in redundancy groups. Typical redundancy grouping is to divide power or propulsion system in a port side and a starboard side segment.

8 X-CONNECT™Segmentation

Due to the distributed nature of the X-CONNECT™, system segmentation in ULSTEIN IAS™is easy to achieve. Software segmentation is managed from the configurator tool. It is easy to define segments and manage what signals, components and systems belongs to them. At a minimum a segment requires one dedicated controller and one dedicated IO unit with IO controller and IO modules.System segmentation influence the number and location of cabinets, number of controller and IO units and the configuration of the system software.

9 Configure To Order

All system software is fully configurable and easy to deploy and commission using a set of production tools.

Configuration tool - X-CONNECT™Studio

The whole process setting up the system, managing changes, adding or removing functionality is done in a dedicated Configuration tool. The Configuration tool produces a configuration file that describes the whole system including all system hardware and software. All software signals, alarms and functionality with descriptions and parameterization, and custom user interface mimics are described with all necessary details in the file. The Configuration tool has an easy to use user interface with a tree structure to navigate and setup the system. IO lists based on a predefined template can be imported.

The tool can export the configuration to different predefined reports such as BOM (Bill Of Material), alarm and signal list, component list, etc.

Component Builder

The Component Builder tool (part of X-CONNECT™Studio) is used for creating custom versions of available general system components and make them available in the Configuration tool. For example a general starter component can be supplied by different vendors and manufactures with individual properties. With the Component Builder tool it is easy to create custom components with custom properties. Both hardware and software components can be customised in any number.

Mimic Editor

The Mimic Editor tool is used for arranging the content of custom mimics. The content with symbols and signal tagging is done in the Configuration tool. The Mimic Editor has functionality to arrange symbols and graphical features in the mimic. Pipes for pipe animations between symbols can be drawn in the tool. Various static drawing objects can be added to the mimic.

Deploy Tool

The Deploy tool is used for deploying software and configuration files to system computer hardware and for starting up the system. The tool is easy to use and handles initialization of the system by setting IP addresses of network components and make sure the system works on a basic level. For existing running system the Deploy tool can be used to read back the running configuration.

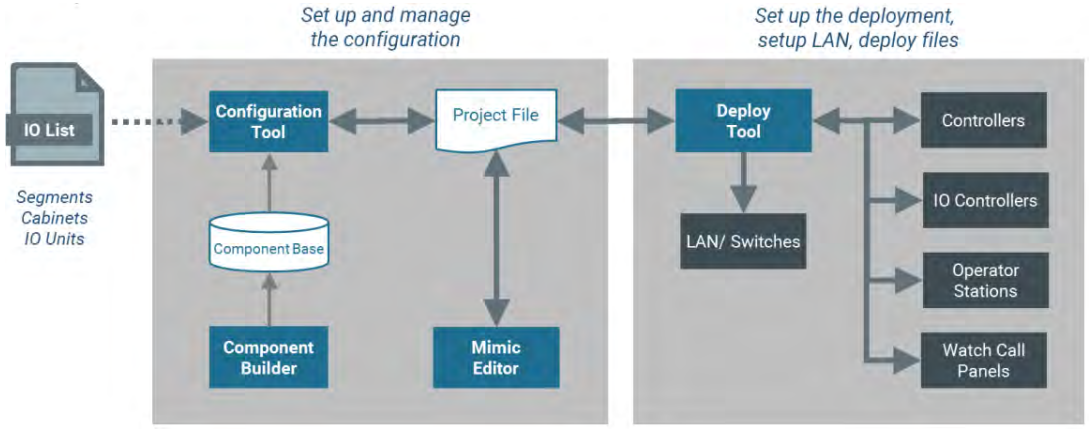


Figure 6: The Configure-to-order process

10 Alarm System

The alarm system is a central part of a control, monitoring and automation system. The alarm system in ULSTEIN AMS™ and ULSTEIN IAS™ is comprehensive and advanced with the purpose to detect and alert ship crew on critical conditions in machinery spaces and in the engine control room.

Figure 7: Alarm system indication

Alarm system overview

The alarm system supports the detection of critical conditions related to sensor data, equipment, systems, auto functions or the internal AMS system. Alarms are presented with audible or visual indicators such as rotating lights, buzzer's and siren's, and as indications on the operator stations and watch call panels user interfaces.

The system has a wide range of functionality for presenting and managing alarms. The user interface of the operator stations contains a set of standard views with features that are easy to use and gives the user the necessary overview and details. Logging of alarms is an integrated part of the alarm system enabling the user to trend and analyze historical alarms.

The alarm system is configurable and easy to setup and to commission. Alarms are related to signals, components, custom auto functionality or systems. Any number of custom alarm objects related to digital or analog signals can be added when setting up the system.

Alarm system components

The main components of the alarm system are:

- Alarm controller software application running the alarm system including Extension Alarm System (EAS) and Deadman System (DMS)
- Internal alarming for alarming of failures and critical conditions in the running AMS system
- Alarm log for retrieving, trending and analyzing alarm history with custom storage time
- Graphical user interfaces for presenting and managing alarms
- Watch call panels for presenting EAS alarms
- Buttons, lights, siren's and buzzers for indicating alarms

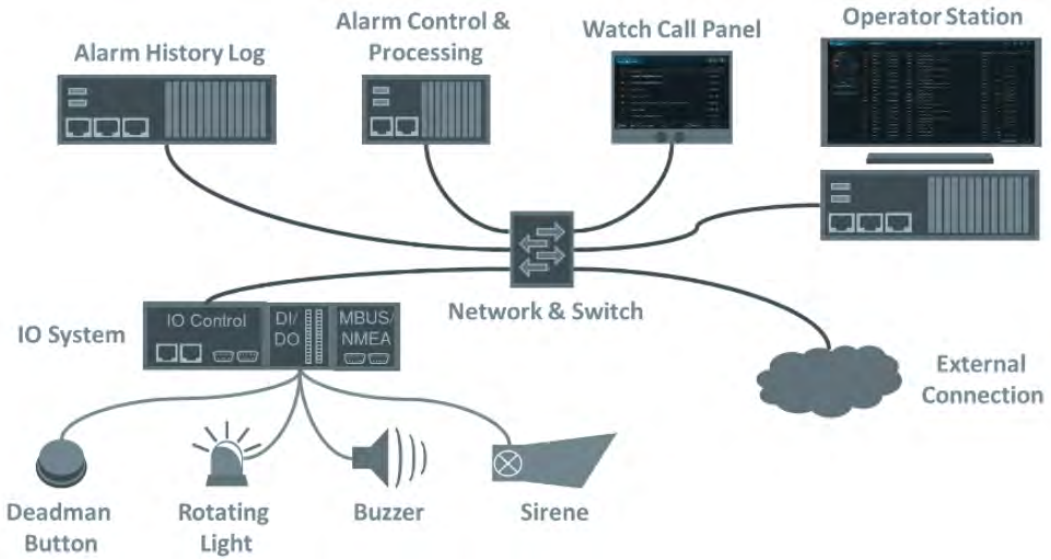


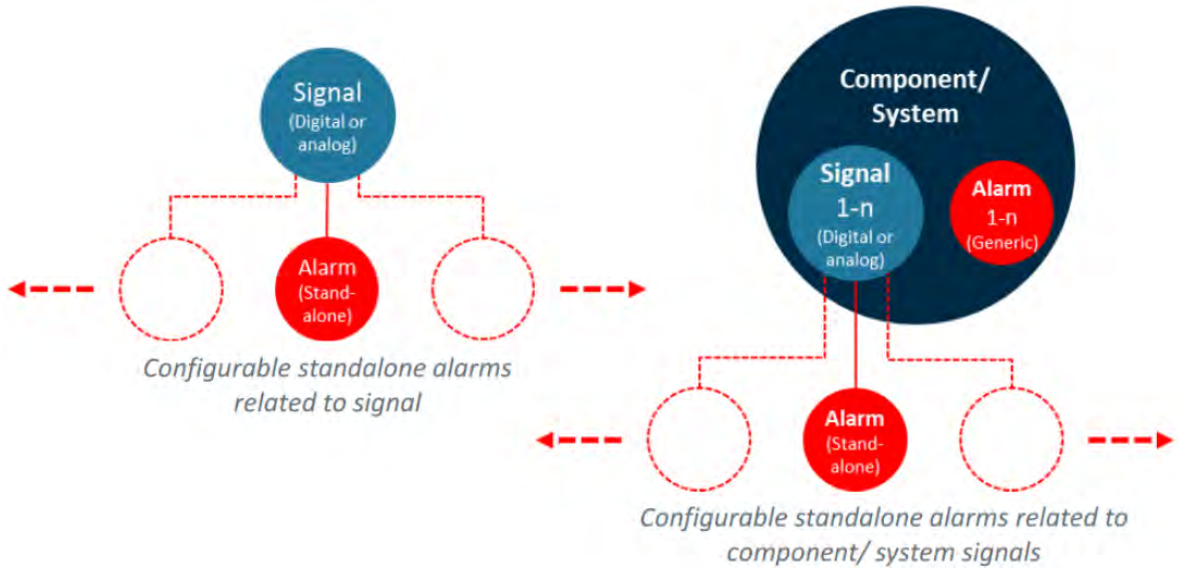
Figure 8: Alarm system components

11 Alarms

The system contains configurable software alarm objects that are activated when a predefined alarm criteria is met. Active alarms are presented to system operators with audible or visual indicators such as rotating lights, buzzer's and siren's, and as indications on the operator stations and watch call panels user interfaces.

Alarms are related to signals, components, custom auto functionality or systems, each of which can have any number of alarms defined. An alarm object has a wide range of available properties such as description, alarm criteria, priority, tag, group and activation, deactivation and acknowledgement time. Alarm events and changes to alarm parameters are saved to the Alarm History database.

Alarms are either standalone customizable digital or analog alarm objects related to signals and components, or generic alarm objects integrated in components or systems. Standalone alarms are easy to create and configure in the X-CONNECT™Studio (the configuration tool). Any number of alarms can be added to a signal or to a component or system. Activation time delay and dynamic alarm criteria's are supported as well as alarm suppression for cases with multiple alarm conditions and dependencies.



Alarm functionality available in the user interface are:

- Presentation and acknowledgement of active alarms
- Filtering of active alarms in accordance to sector
- Shelving of alarms and management of shelved alarms
- Changing alarm properties at runtime
- Alarm groups, e.g. EAS and DMS alarms, internal alarms, sector, mimic and systems alarms

- Navigation between alarms and signals in user interface
- Alarm indications in top bar, navigation menu, mimics, symbols, etc.
- Custom cathegorization of alarms in 3 priorities with different coloring.

Configurable and scaleable

Due to the efficient configurable software and the decentralized and event based nature of X-CONNECT™, a very large number of alarms can be configured and handled with little effect on system performance. Any number and combinations of control system functionality, systems, operator stations, audible or visual indicators are supported.

12 Extension Alarm System

The Extension Alarm System (EAS), is the extension of the alarm system to the engineers cabins, public spaces and the navigation bridge. The EAS system is in operation when the engine room is unattended in accordance to E0 class requirements. The EAS system is an integrated part of the alarm system and integrates the Engineers alarm system, Watch transfer and Deadman system in one system.

The purpose of the EAS system is to notify the duty engineer and navigation bridge when there are alarms in an unattended engine room. The EAS system presents alarms as individual and/or group alarms in accordance with regulations. EAS alarms are presented with audible and visual indicators using buzzer's and watch call-panels. Buzzer's can be silenced locally from the respective watch call-panel.

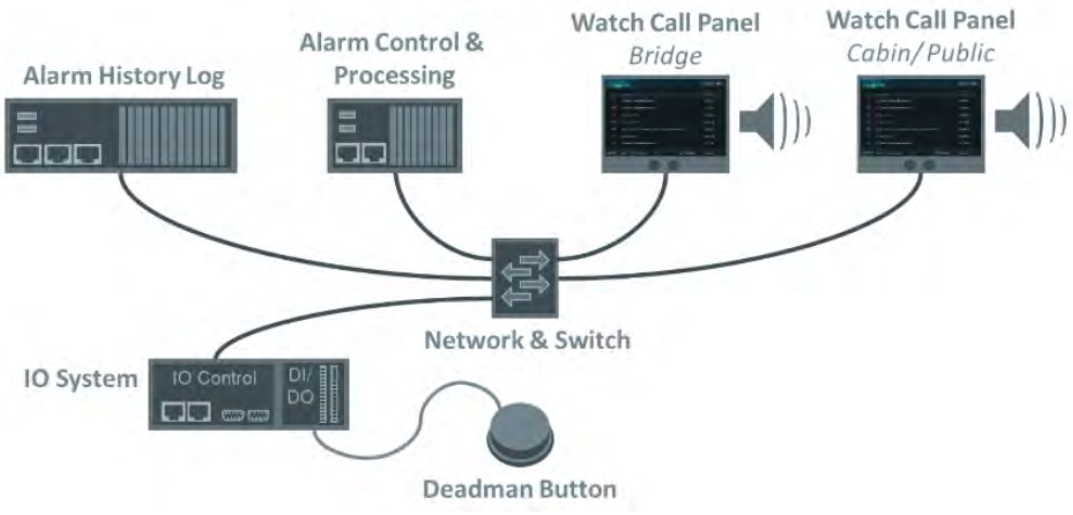


Figure 9: Extension Alarm System (EAS) components

13 Internal Alarm System

Internal system alarms are an integrated part of the alarm system ensuring that the ship crew is alarmed on failures and critical conditions related to the running system. Status of running system components such as software, computer hardware components, network components and network traffic, IO system are all automatically monitored. If a system component is failing or reaches a critical condition, an alarm will be activated.

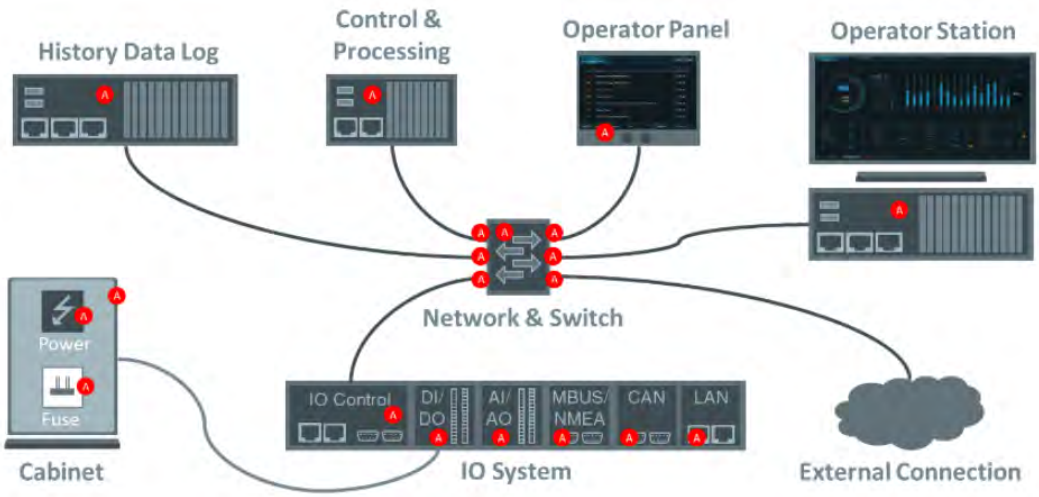


Figure 10: Internal alarming

14 System Hardware Components

As a standard, the system features hardware components to facilitate network and data traffic, control system, IO interface and operator user interface. The system is designed for variable complexity and is flexible with regards to number of and combinations of hardware and software. Components can be connected to any network node in the system. The system can have either single or redundant dual network for internal data distribution where all system components are connected to both networks. Hardware in the system is easy to install and service, and are compact and type approved for demanding marine environments.

Controllers

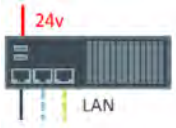
Controllers run system functionality and processes such as alarm system, EAS system, deadman systems, various systems and components such as pumps, valves and tanks. The controller software runs on compact standard marine approved fan-less computer for DIN rail mounting. The system is flexible with regards to number of controllers connected to the AMS system. As a standard, controllers in the AMS system have single network connection while IAS systems have redundant dual link connections.

Operator stations

Operator stations are used by the operators to monitor and control the system using rich interactive graphic displays. Mouse and keyboard is standard for interacting with the graphic displays, touch is optional. The operator station runs the operator station software on compact standard marine approved fan-less computers with one full HD 1080p screen, keyboard and mouse. The system is flexible with regards to number of operator stations connected to the system. As a standard operator stations in an AMS system have a single network connection while IAS systems have redundant dual link connection. Two monitors per operator station and HD SXGA monitors are optional.

History Data logger

Logging of system data is an integrated part of the AMS and IAS systems enabling the user to trend and analyze stored history data. The data logger software and database runs on a standard marine approved fan-less computer with data storage space for at a minimum 30 days storage of data. Instant retrieval of data is provided for signal and alarm trending and analysis. Automatic data rotation to keep data within configurable time retention limits is provided. As a standard the history data logger in the AMS and IAS systems have single power and network interface. Additional data storage, automatic logging of data to readable files, redundant dual link connection is optional.

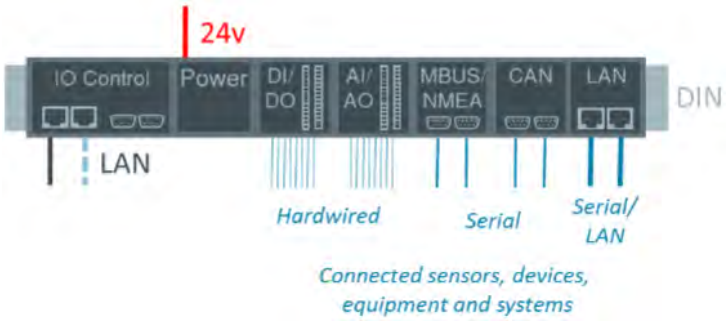


Watch call panels

Watch call panels are part of the Extension Alarm System (EAS) for presenting EAS alarms on bridge, in cabins or in public spaces in case of unattended engine room. The watch call panels runs the watch call panel software and shows EAS alarms in a rich graphical user interface with touch interaction. The watch call panels are based on compact standard marine approved fan-less panel pc's with WVGA graphical resolution. The system is flexible with regards to number of watch call panels connected to the system. As a standard panels have single network connection.

15 IO System

The IO system includes IO controllers, IO modules and configurable IO software that handles data transport between the Field and the AMS or IAS system. The solution is truly multi-gateway and supports a range of hardwired signals and serial field buses. All IO system hardware is DIN rail mounted and has marine approval and are easy to install, commission and service.



IO controller

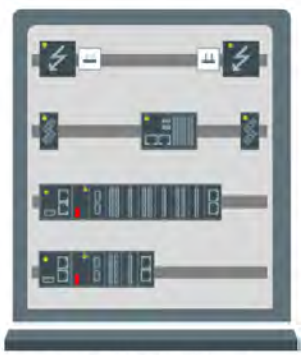
The IO controller is the gateway processor module of the IO system with internal processing of data traffic to and from connected IO modules. Use of robust and compact standard marine approved IO controller and IO modules for DIN rail mounting is standard.

The IO controller used in the system provides an open platform and a programmable interface enabling the configurable IO software to run and interact with the IO system. The configurable IO software takes IO data and process it to system signals and vice versa. The IO data process includes setting engineering value, alarming on signal set points levels and the handling of event based signal exchange to and from the system. The IO controller can be connected to any network port in the system. As a standard the IO system has a dedicated power module for the powering of the IO controller and modules. As a standard IO controllers in AMS systems have a single network connection while IAS systems have redundant dual connection.

15.1 IO modules

The system supports a range of different IO modules for handling hardwired and serial signals that are going in and out of the system. Modules for handling digital and analog hardwired signals, counters, temperature measurements are supported. Supported field buses are NMEA, NMEA 450, ModBus RTU, ModBus UDP and ModBus TCP for LAN based ModBus. Case specific CANBus implementations are supported. All supported IO modules are part of the system configuration. Other field buses and formats is optional or can be provided on request.

16 Hardware Assemblies


800x1000 cabinet layout

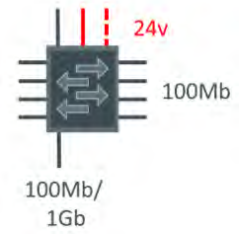
System hardware such as controllers, IO components and switches are all marine type approved in accordance with The IEC 60945 maritime standard. This means that the components are rated for high temperature, high humidity and vibrations. The components works in environment with temperature ranges of -40° to +70° C allowing them to work in various harsh environments. All components are fanless. Except for operator stations and panel, most components are prepared for DIN rail attachment and are thus well suited for cabinet assemblies.

17 Network

Data communication within the system operates on a standard Ethernet based network. 100Mb for connecting network components and 100Mb or 1Gb fiber connection between switches and routers is supported. The system is flexible on network topology, ring and star network topology is supported.

Switches

Use of a robust and compact marine type approved managed Ethernet network switch for DIN rail mounting is standard. The standard switch has 10 network ports, 2 ports supports 1Gb or 100Mb with either fiber or copper connection. 8 ports supports 100Mb copper connection.The standard switch is easy to setup. The use of managed network switches makes controlled routing of data to selected sections of the network possible. This can be helpful when there is a need to optimize the network load. As a standard, switches are single powered, redundant powering is optional. Other switches than the standard is optional and can be adapted the system on request.



Routers

The standard router has identical casing, port arrangement and approval rating as the standard switch. The router is a layer 3 industrial router with a configurable internal router software with VLAN and firewall functionality. As a standard, routers are single powered, redundant powering is optional. Other routers than the standard is optional and can be adapted the system on request.

Network Diagnosis

As a standard, SNMP is used for enabling remote diagnostics of the standard switches and routers, and network traffic. The solution is an integrated part of the system.

Remote Access

The standard router enables safe remote access to the system. Remote connection is easy to setup and operate and is based on a VPN tunnel service integrated in the standard router. The router provides a VPN subscription concept with VPN clients on the router and a cloud based VPN service to connect to the system. Other remote access concepts are optional and can be adapted the system on request.

Data export

Sending data online from the system is optional. Data can be sent either directly on an Ethernet connection as DDS or OPC data using the router or a dedicated 3 network card on a PC, or via

the IO system as serial data.

18 Data Communication

Efficient, fast and reliable data communication within a control and monitoring system is a must. The distributed system of X-CONNECT™offers an efficient and reliable data communication between the system component based on DDS and standard Ethernet network. Real time exchange is an option. The system framework combined with DDS, event based data exchange, standardised rich data structures, data prioritisation, configurable data filters and managed network traffic pattern, results in a system with high data capacity, resilience and efficiency.

Data

In operation, large amounts of data is produced and handled by the system. Data is used for different purposes and have different priorities and formats. Example of data are signals and alarms, SQL queries and log files, SNMP messages and messages for internal system control and network management. In general AMS and IAS specific data have higher priority than internal system control data.

DDS

Data sent within the system is exchanged between distributed and independent software applications known as system participants. Communication between the participants is based on the open Data Distribution Services (DDS) machine to machine data communication standard. With DDS, system participants cooperate with each other in a seamless, configurable and predefined way by publishing and subscribing to data using the DDS data bus.

Data structures

Data in the system are object oriented and are thus communicated as data structures including both data value and properties. Communicating data as data structures helps improve overall system performance by serving the data consumer with more information at a time. The drawback is that a lot of property data increases the network load. Most often value data, such as analog signals, changes much more frequently than property data. Therefore the system automatically differentiates between value and property changes. When the value is changed the system only sends value data, when properties are changed all data including value and properties are sent.

Event based data

The system optimize network load by using event based data. Event based data means that data is sent only on change. Event based data brings down data traffic considerably compared to traditional systems where data is sent continuously independent of change.

Signals

The majority of data in the system are signals related to the AMS and IAS. Signals are data objects including signal value, signal properties and parameters. Signals can be related to IO, to functional components or to auto functions.

Signals that are related to IO and with its origin in the IO system, can have 5 different formats, analog in or out, digital in or out, or text. The signal can be independent or related to a function component. IO signals are configurable and related to IO channel, module and IO controller. IO signals are easy to define and configure. Virtual, or software signals, are predefined and related to systems and components.

19 Control System Functionality

The system has a set of functionality that is integrated in the control system and operator stations.

Command transfer

Command transfer is required for IAS systems with remote controlled systems and with more than one operator station location on the ship. In accordance to rules, control over a system must only be possible from one operator station at a time. The command transfer system makes it possible to transfer control over a system from one operator station to another. In the IAS system, right to control a system is configurable and related to mimics. Typical operator station locations in an IAS system are the engine control room and the navigation bridge. Command transfer is operated from the bottom bar.

Running hours

Running hours is about counting component running hours, i.e. activity time, how much it has been running. Activity time for components such as starters and generators are supported. Running hours comes with a running hours view. The view is part of the operator station user interface and lists all components with activity time. Running hours is optional functionality.

Tank sounding

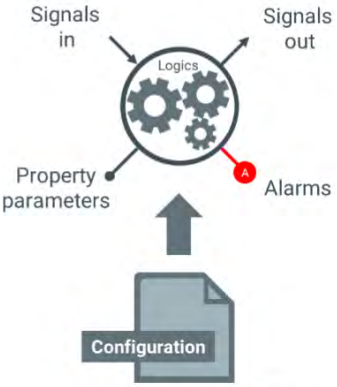
Tank sounding is about calculating tank content volume. Calculation is done tank-wise and is based on tank tables. Tank sounding includes a tank summary view that is part of the operator station user interface. The view has 2 view modes, one view mode listing all tanks with volume and tank content information, the other view mode listing summed tank content. Tank sounding is optional functionality. The tank tables used are based on a readable and predefined format. Other formats is optional and can be supported on request.

20 Control System Components

The control system integrates configurable logical control components for remote control of various interfaced physical equipment such as motor starters, flow controllers (valves), generators and circuit breakers. Control system components are typically part of ballast, bilge, cargo and power management systems.

Configurable logical components

Physical components such as starters or valves often varies in the way they are controlled or how they behave. Therefore several variants are supported with dedicated logical components the system. Typically each component embeds predefined logics, in and out signals, alarms and property parameters. All different components are configurable and are easy to select, connect to IO and to parameterize in the configuration tool. In addition to the type specific logics, signals and alarms, a component can have supplier specific information related to it such as name, description and additional signals or alarms. The user can select a supplier specific component in the configuration tool.



Configurable control system component

Safety and auto function

Control system components can be configured to include automatic safety functionality to interlock the component using signal states. It is also possible to have component signals part of signal automation, e.g. let other signals control the component or making a command signal control the behaviour of other components.

Operator control

Control system components are run by the controller software application on a controller. The component is controlled manually from the operator station graphical user interface and is visualised with a interactive symbol. The component is easy to operate by clicking the symbol and operate it using operation pop overs. The status of the component is both visualised on the symbol with tags and alarm indicators and with more detailed information in the property pop over.

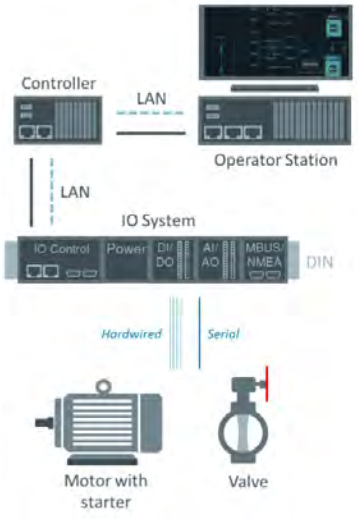


Figure 11: System for remote control of motor starters and valves

21 Motor Starter Components

Motor starter components are configurable logical control system components for the remote control of interfaced physical motor starters. Several standard starter types are supported and implemented in the system.

Interface and properties

Starter signals are typically commands for starting and stopping, setting direction and speed, or feedback on running status, speed and if the starter is in local or remote control. Most starter components have several properties that can be configured such as maximum time to start and stop, manual or automatic remote startup mode, or if in automatic or safe mode. Starter components typically have predefined alarms to alert on different errors such as failure on starting or stopping, or if feedback is missing.

User interface

The starter component is visualised with a starter symbol and is easy to operate using operation pop overs. The system supports several starter symbol visualisations such as pumps, compressors, air dryer and fan.

Pump symbol

Compressor symbol

Air dryer/ Fan symbol

Starter types

Standard supported starter types are:

- **DOL starter, one direction, one speed**
  - Start, stop commands
  - Running and remote feedback
- **DOL starter, one direction, one speed**
  - Combined start/ stop command
  - Running and local feedback
- **DOL starter, bidirectional, one speed**
  - Start, stop, set reverse commands
  - Running, remote, and reverse feedback
- **VSD starter, bidirectional, variable speed**
  - Combined start/ stop, set reverse, set speed commands
  - Running, reverse, remote, speed, load feedback
- **Other starter types on request**

Starter operation pop over

22 Valve Components

Valve components are configurable logical control system components for the remote control of interfaced physical actuators for flow control. Several standard valve types are supported and implemented in the system.

Interface and properties

Valve signals are typically commands to open and close the valve, setting direction and position, or feedback on opening and closing status and position. Most valve component have several properties that can be configured such as remote startup mode, maximum time to open and close and acceptable delay times. Valves components typically have predefined alarms to alert on different errors such as failure on opening or closing the physical valve, or if feedback on opening or closing is missing.

User interface

The valve component is visualised with a valve symbol and is easy to operate using operation pop overs.

Valve symbol

Valve symbol with bar graph indicating position

Valve types

Standard supported valve types are:

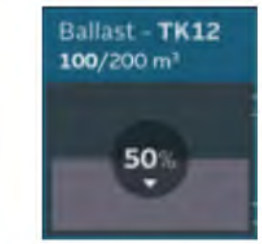
- **Feedback only valve**
  - Opening, closing, opened and closed feedback
- **Dual action on/ off valve**
  - Open, close commands
  - Opened and closed feedback
- **Spring return, single acting/ fail open valve**
  - Open and OpenFV command
  - Opened and closed feedback
- **Spring return, single acting/ fail close valve**
  - Close and CloseFV command
  - Opened and closed feedback
- **Electrical positioning valve (ELTORQUE)**
  - Set position, go to, step close and open, open and close commands

  - Position, stopped, closing, opening, closed and open feedback

- **Other valve types on request**

23 Tank Components

Tank components are configurable control system components for monitoring tank level, volume and content. Several tank types are supported and implemented in the system.



Normal tank symbol

Interface and properties

Tank signals are typically based on sensor pressure data used for calculating level and volume, and to indicate if the level is under or over minimum or maximum limits.

Tank components have several properties that can be configured such as content description, density, tank height, maximum level, sensor type configuration, link to tank table if tank sounding and many more. Tank components typically have predefined alarms to alert on if the tank level is under or over a limit.

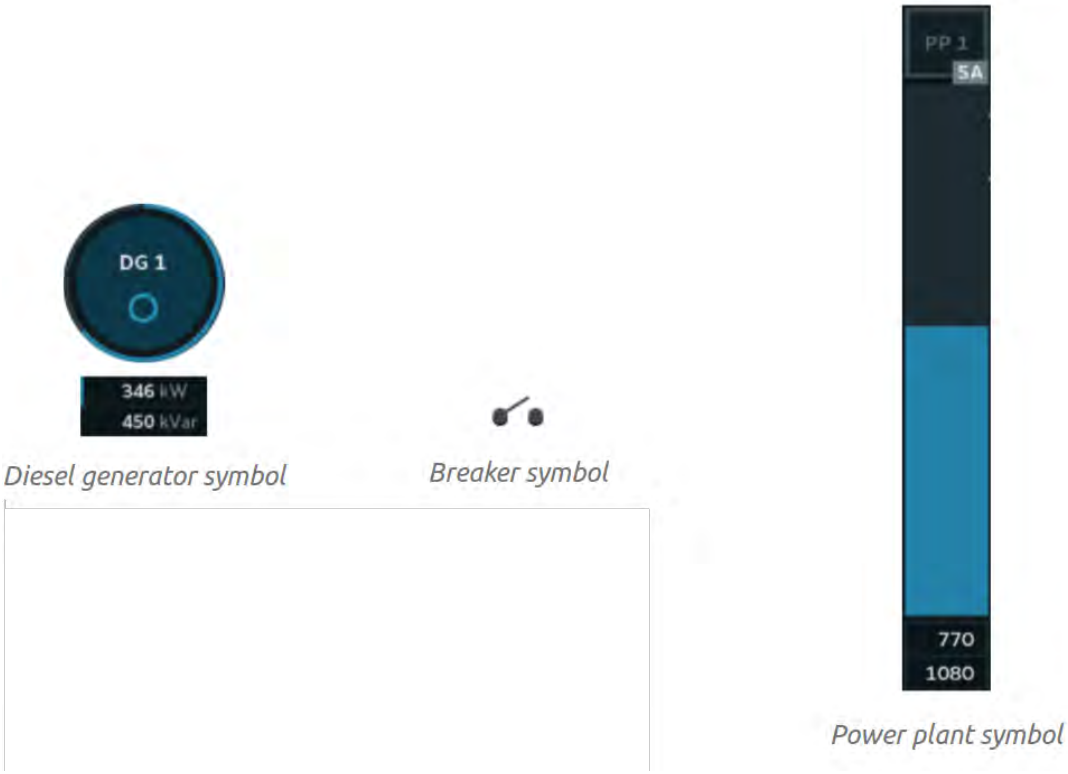
User interface

The tank component is visualised with a tank symbol. Two types of tank symbols are supported, normal and bulk tank. The tank symbol indicates the tank level and have tick marks to in dictate limits. By interacting with the tank symbol a pop over is opened showing tank information.

Bulk tank symbol

24 PMS Components

PMS components are configurable logical control system components such as power plant, generator and circuit breakers for the remote control of interfaced Power Management System (PMS). The PMS components are visualised with dedicated interactive symbols and have operation and property pop-overs.



Diesel generator symbol *Breaker symbol*

Power plant symbol

25 Integrated Auto Functions

Duty standby or anti-heeling are configurable auto functions that are integrated in the system.

Duty Standby component

The duty standby function is a component with duty standby logics that can easily be attached to the duty standby starters in the configuration tool. The duty standby functionality is fully seamless integrated with starter components. When a starter is standby its symbol is automatically tagged with an «S»

Anti-heeling system

The anti heeling system is a configurable system for automatic compensation for heel angle deviation, draft deviation, ship height deviation and tank level. Heel, draft and ship height deviation compensation is done independently. The system can include 3 or more ballasting tanks and

includes load and ship motion calculation, compensation logics and automatic cargo transfer between the tanks.

Heel compensation is done by transfer water from port-side to starboard tanks or vice versa. Draft compensation is done by pumping to or from all the available tanks.

The system includes user interface controls to monitor and control the system.

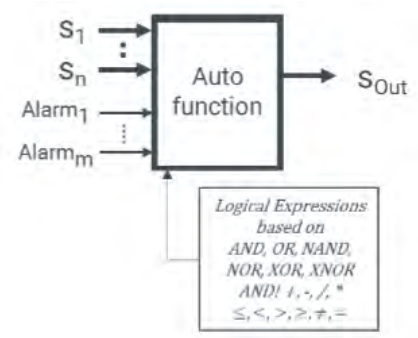
26 Custom Auto Functions

Auto functions – Custom expressions

The system includes a system to create custom expressions to make calculations based on boolean and arithmetic logics on input values to set output values. Input values can be hard-coded values, property values, alarms, digital or analog signals. Any IO related or software signal can be used. Expressions evaluates to either true or false and can be modularized, several modules can be linked as a series. Several parallel series can also be constructed. Output values can be digital or analog signals.

- Logic operators: AND, OR, NAND, NOR, XOR, XNOR
- Arithmetical operators: +, -, /, *
- Comparator operator: ==

Custom auto functions can be used for many purposes such as starting a pump based on a temperature value or the state of a system. The tool has an integrated editor for creating expressions.



Configurable signal processing

The system includes a set of configurable signal operator components for average calculations, deviation calculation, math operations, scaling and comparisons of/on signals.

The system also includes a configurable PID regulator component to regulate signals.

27 Graphical User Interface

The system includes a rich, consistent and user-centric graphical user interface based on the X-CONNECT design guide and is used on operator stations and watch call panels. The user interface is intuitive to use, is designed to minimize visual interruptions, to enhance efficiency before clarity and with information on demand. The user interface design and content meets all relevant rules and regulations.

Framework

The user interface has a standard fixed layout composition with information bars on the top and on the bottom part of the screen with the main work space for views and mimics in the middle.

Navigating the system is easy and efficient by using a large mega menu with links to all views and mimics in one place. To enhance the user efficiency and system transparency, short cut links between logically related objects such as components, signals and alarm are provided. Custom navigation links is also supported and can be added to mimics.

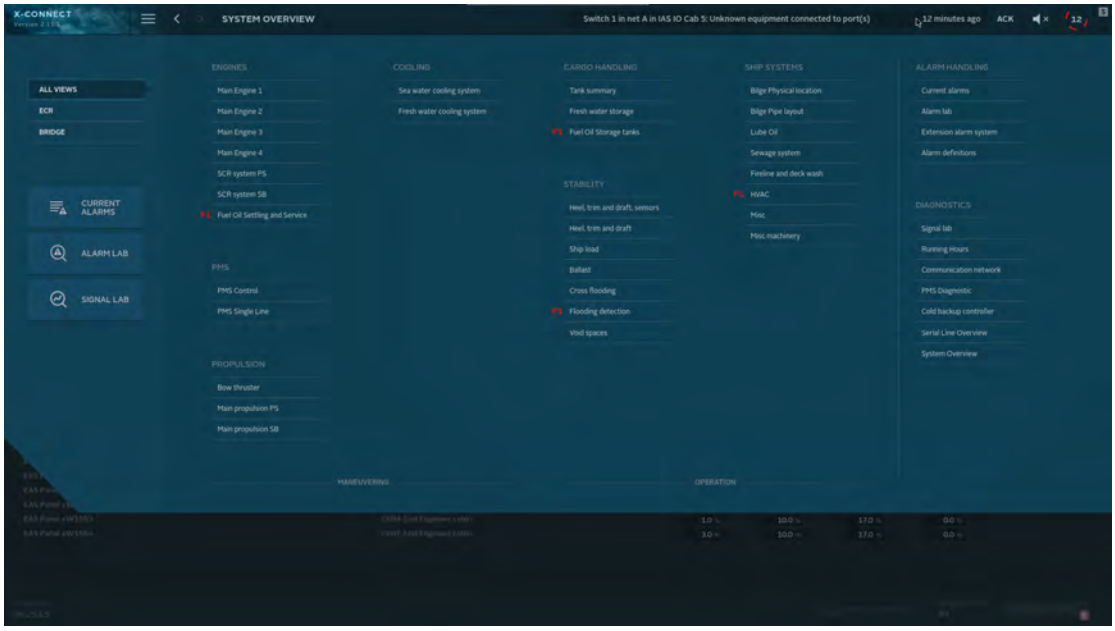


Figure 12: Mega menu for navigating to system views and mimics from one place

Standard views

The user interface is always delivered with a set of standard system list views for monitoring and managing alarms and signals. By default list views contains headers, filters and sorting functionality. Lists are easy to browse by using paging and scrolling.

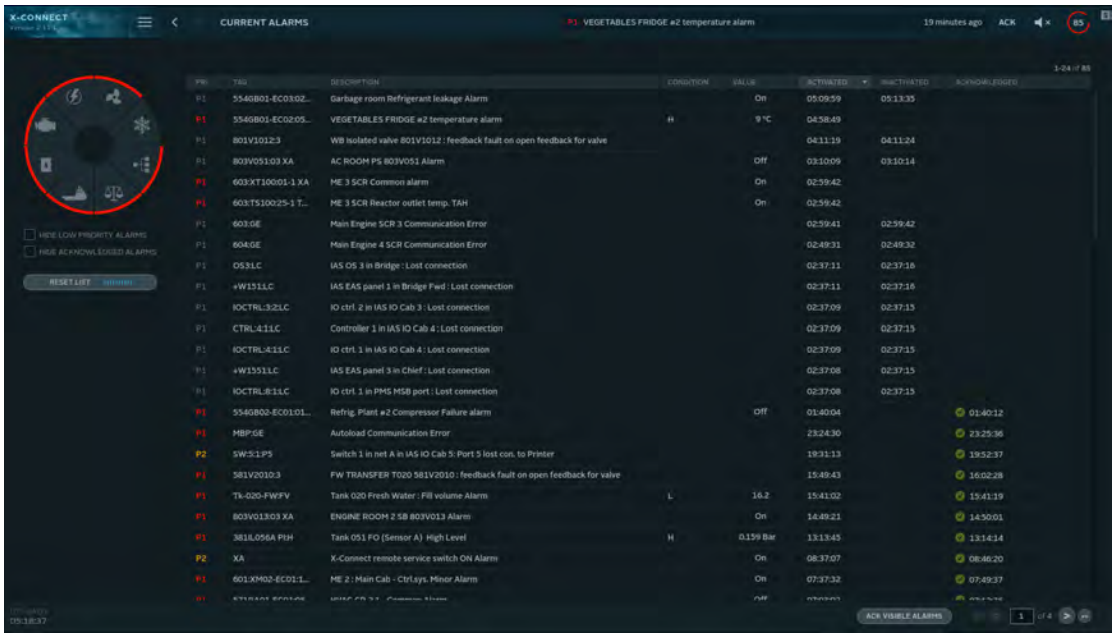


Figure 13: *Current Alarms* view - presentation and acknowledgement of active and unacknowledged alarms

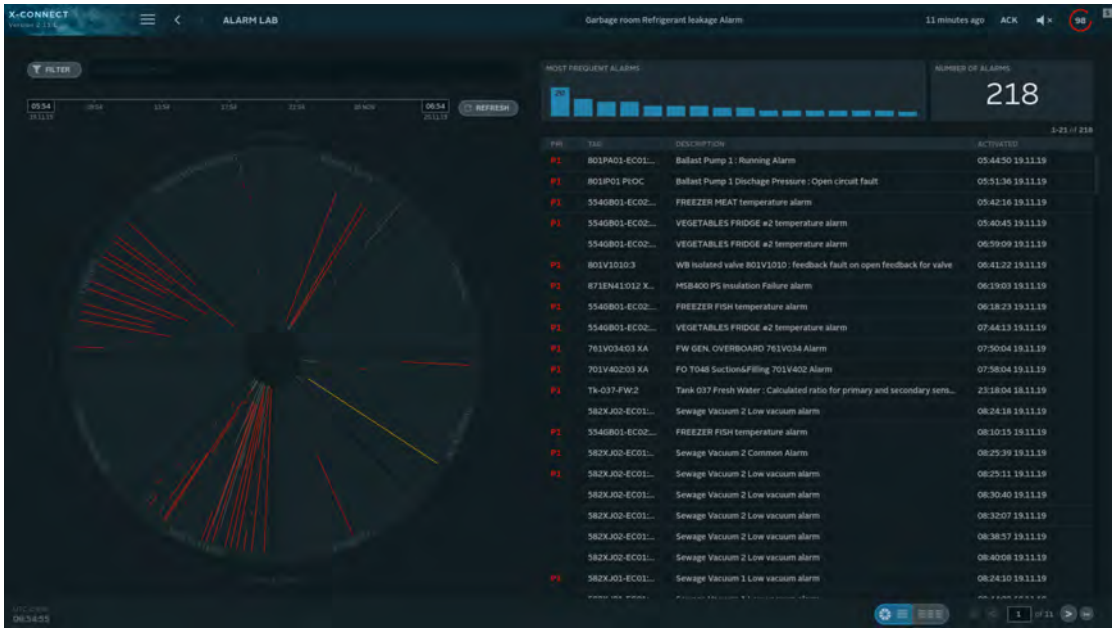


Figure 14: *Alarm Lab* view - presentation of historic alarm

Standardized mimics

Some systems such as engine, propulsion and PMS, are presented with standardised mimics with predefined content and look. The standard views are easy and fast to configure, thus reducing valuable engineering work.

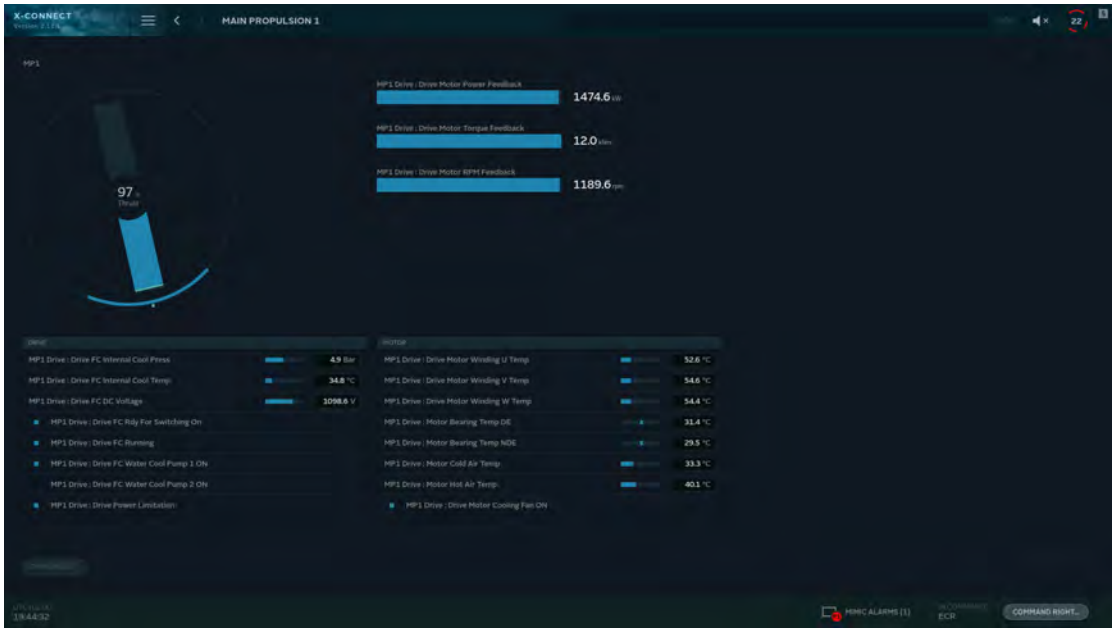


Figure 15: *Main propulsion* view - propulsor animation, bar graph representation of signal list

Figure 16: *Main engine* view - engine cylinder animation, bar graph representation of signal list

Custom mimics

Any number of custom system mimics with interactive symbols and animated pipes can easily be configured to the system. Arrangement of symbols and pipes is managed in a dedicated mimic editor tool. All data connections to the mimic content are defined in the system configuration, and configuration changes will automatically be updated in the mimic.

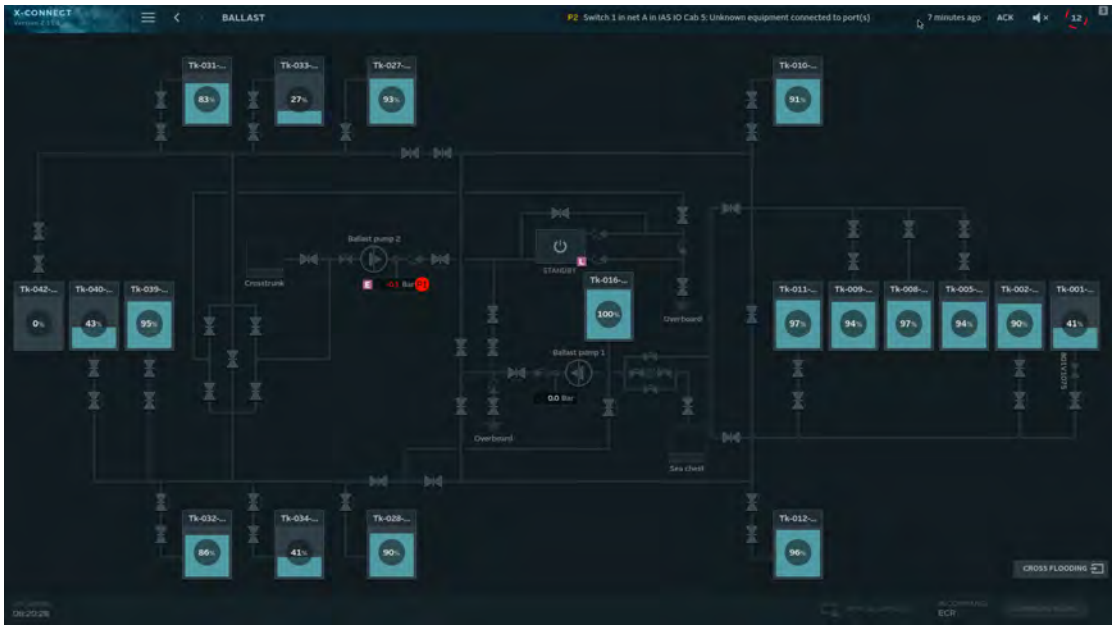


Figure 17: Custom ballastsm mimic with dynamic and interactive tank-, pump- and valve symbols, animated piping and static symbols

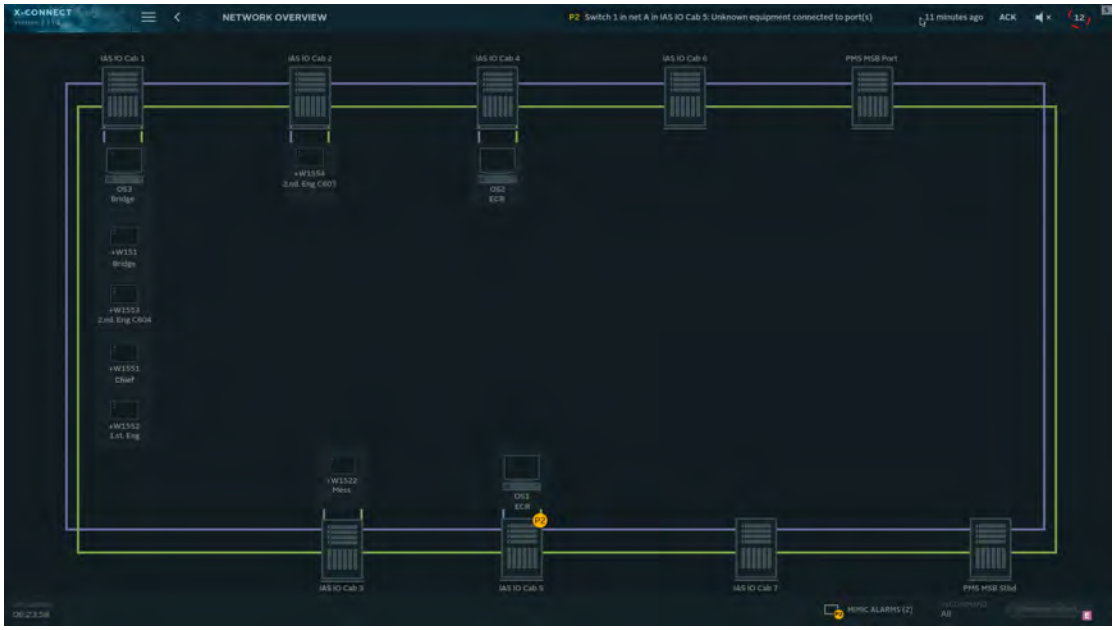


Figure 18: Network overview for system diagnostic purposes. Clickable cabinet symbols with link to dedicated cabinet mimic

28 Symbol library

The system contains a large symbol library for creating content in custom mimics. The library contains interactive symbols for specific components, general dynamic symbols and static symbols. Component symbols are highly interactive and the symbol visualisation will change when the user interacts with it with the mouse. Clicking the symbol opens up operation and configuration pop up controls.

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