

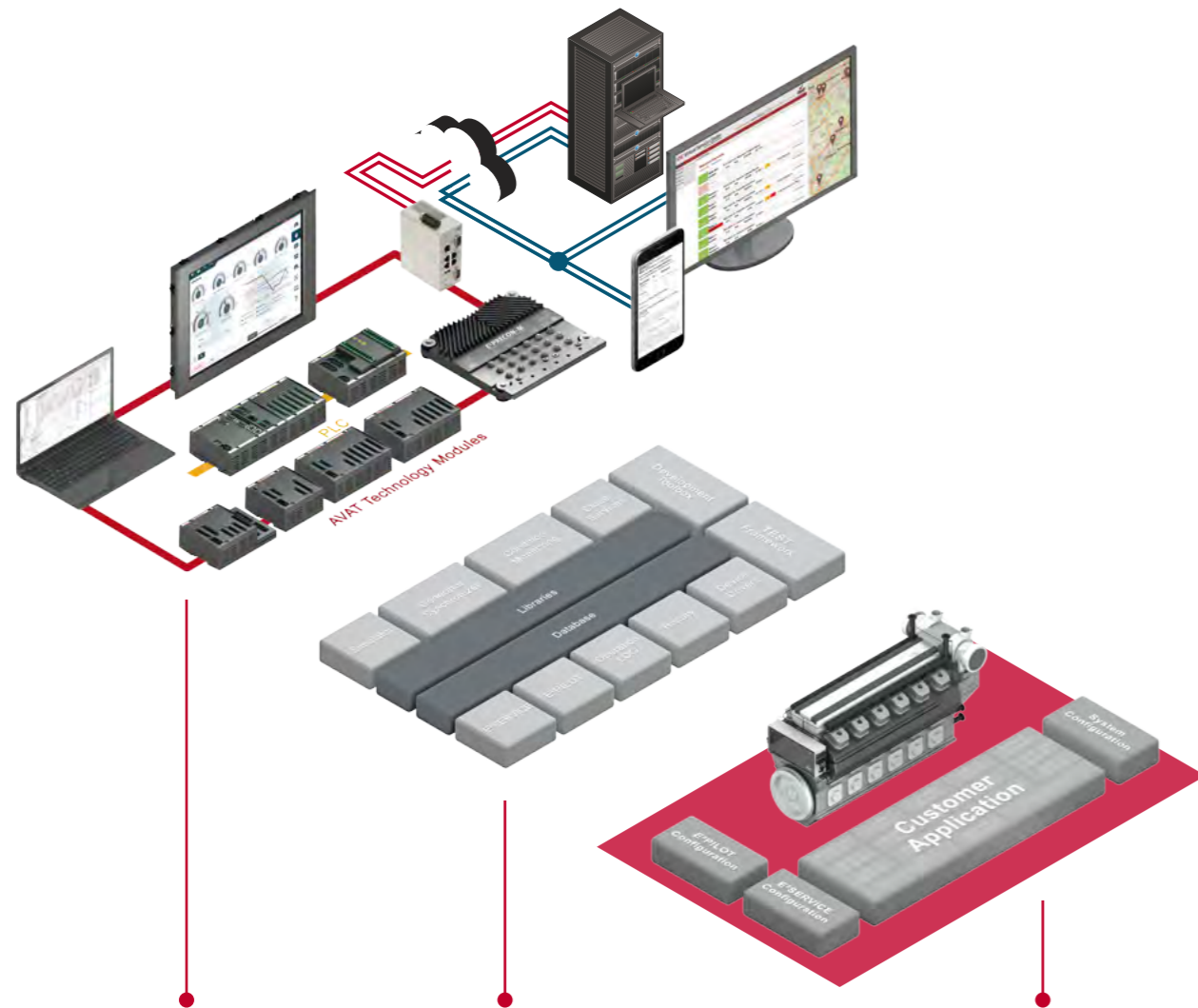


# openECS

The highly flexible modular system for the control of gas and dual fuel engines

## ONE FITS ALL – THE NEXT GENERATION ENGINE CONTROL SYSTEM

The further development of gas engines and new plant operating concepts require flexible controls that on one hand regulate safe operation at the mechanical limits of the engine and on the other fully integrate the engine into the plant and interface with other plants. Based on openECS, our modular system of flexible hardware and software components, controls for almost all engines, gas types, application areas and plant sizes can be implemented. Functions, modules and subsystems form one unit together with a powerful user interface. Your engine control grows with your requirements. Thanks to the open application layer, you also have the option of carrying out additional developments or integrating third-party components.



### TECHNOLOGY MODULES

The best of two worlds: The combination of an industrial controller and AVAT technology modules results in a future-proof and highly flexible engine control system.

### SOFTWARE PLATFORM

The AVAT software platform provides a library of tools and building blocks and can accelerate your application development significantly.

### CUSTOMER APPLICATION

Whether you develop yourself or buy a ready-tailored AVAT controller. What controls and monitors your engine is already provided in the engine control template.

## THE openECS PRINCIPLE: YOU DECIDE HOW MUCH WE DELIVER

In openECS, all controllers, sequences and functions that control and monitor the behaviour of the engine and its periphery are part of the application layer. You have full access to this layer and can see and change all the details yourself. Means: 80 % preconfigured standard, 20 % individualization. In that way you start at a high level of development. Whether you build up your own know-how or we further engineer for you – in the end you receive a modular and anytime-extendable control system tailored to your individual needs.



### AVAT Standard Applications

Our standard applications cover already 80 % of your requirements and are available for different engine types.



### Make the system fit your engine

Simply edit our standard specification. Adapt the system yourself or let our development engineers do it for you.



### Ready for production in short time

Business is more than a running engine. We assist in any issue from staff training to documentation and classification.



### OPEN

Open to new requirements. Open to include third-party components. Open to develop your own software.

### HIGH PERFORMANCE PARTNER

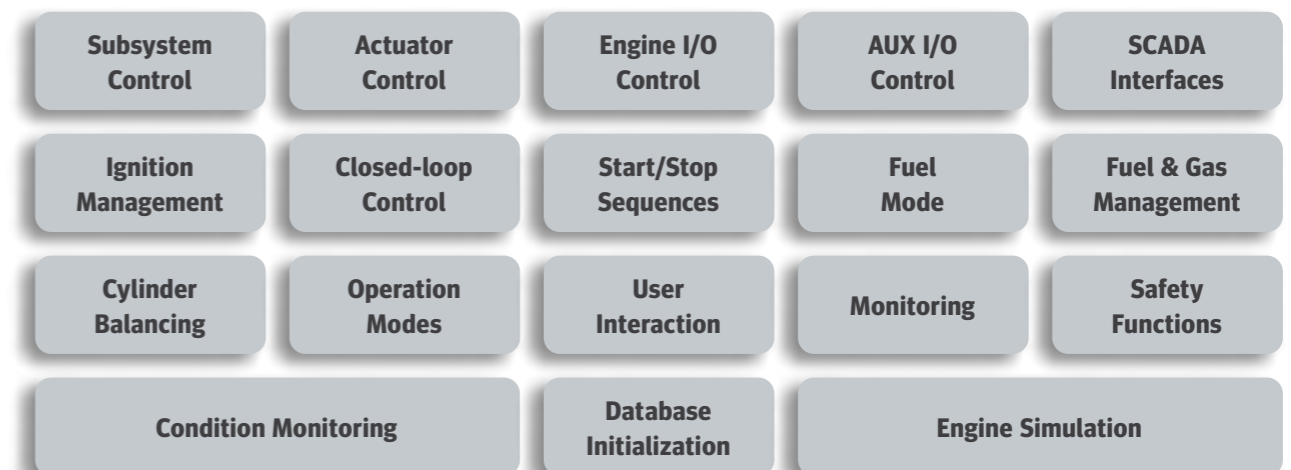
We have been a trusted partner to the gas engine industry for more than 25 years and also the manufacturer of TEM-Evo engine controllers – deployed in thousands of cogeneration plants.

- Technology leader in control systems for large gas engines and cogeneration plants
- Extensive experience gained from projects with a total exceeding 12,500 MW installed electric power
- Smart solutions featuring process and control automation for multiple commodities – for sustainable energy generation and distribution

Our experienced team of engineers and technicians are constantly at your disposal to support your projects.

- Electrical engineering, production of switch cabinets
- Tuition for users and developers
- Qualified Service Hotline
- Fast spare parts shipping

### FUNCTIONS OF THE APPLICATION LAYER





## GET THE BEST OUT OF IT – WITH THE AVAT TECHNOLOGY MODULES

Why choose between special engine control units and a modular industrial controller? Exactly this combination gives you a future-proof and highly flexible engine control system. You implement engine, generator and auxiliary control as well as SCADA systems with the same system building blocks. That way you create an integrated system for a complete engine portfolio: from compact 200 kW gas engines up to 20 MW dual fuel engines for marine applications.

### THE BASIS

Thanks to their wide range of interfaces, modular industrial PLCs become the ideal control center for the integration of all types of 3rd party components. Professional development tools specifically for engineers and global, pan-manufacturer programming standards make them the ideal choice for automation tasks.

Our openECS modular system is based on the M1 industrial controller from Bachmann electronic. But it is our software that makes it a flexible and modular system for all reliable engine and CHP controllers.

### CPU

- CPU for engine and peripherals control
- Programmable according to manufacturer-independent PLC standard IEC 61131-3
- All subsystems integrated via CAN
- Ethernet interface for visualization and SCADA system

### I/O Modules

- Analogue and digital inputs and outputs
- Interface to sensors, engine and peripherals
- Interface to the auxiliary control devices (pumps, valves, fans)
- Signals from and to the management system (master control system)

### Grid Connection

- Grid and generator monitoring
- Measurement of U, I, f, P and  $\cos \varphi$
- Integrated functions for grid protection



### E<sup>2</sup>SERVICE

Engine operation in test beds or in field applications like power stations or vessel creates huge volumes of data showing results of the engine performance. Our service software E<sup>2</sup>SERVICE is the perfect tool to handle this data for configuration purpose and performance optimization. E<sup>2</sup>SERVICE provides visualization functionality and enables continuous remote access to all openECS based engine control systems from any location.

- One compact overview for the genset status with option for manual operation
- Reasonable grouped list of parameters for an easy access
- Electronic operation log as event journal containing all events, messages, alarms or faults
- Well-arranged display of all measured values including recording of the values
- Graphical display of data history or trending
- Snapshot to store complete "live" state information for e.g. offline examination
- Combined views of parameters, characteristics and maps
- Parameter set comparison and restoring
- Signal or actuators check by manual test or activation
- Search and filter function for a quick selection of information
- Export of stored data in an open file format

### E<sup>2</sup>PILOT

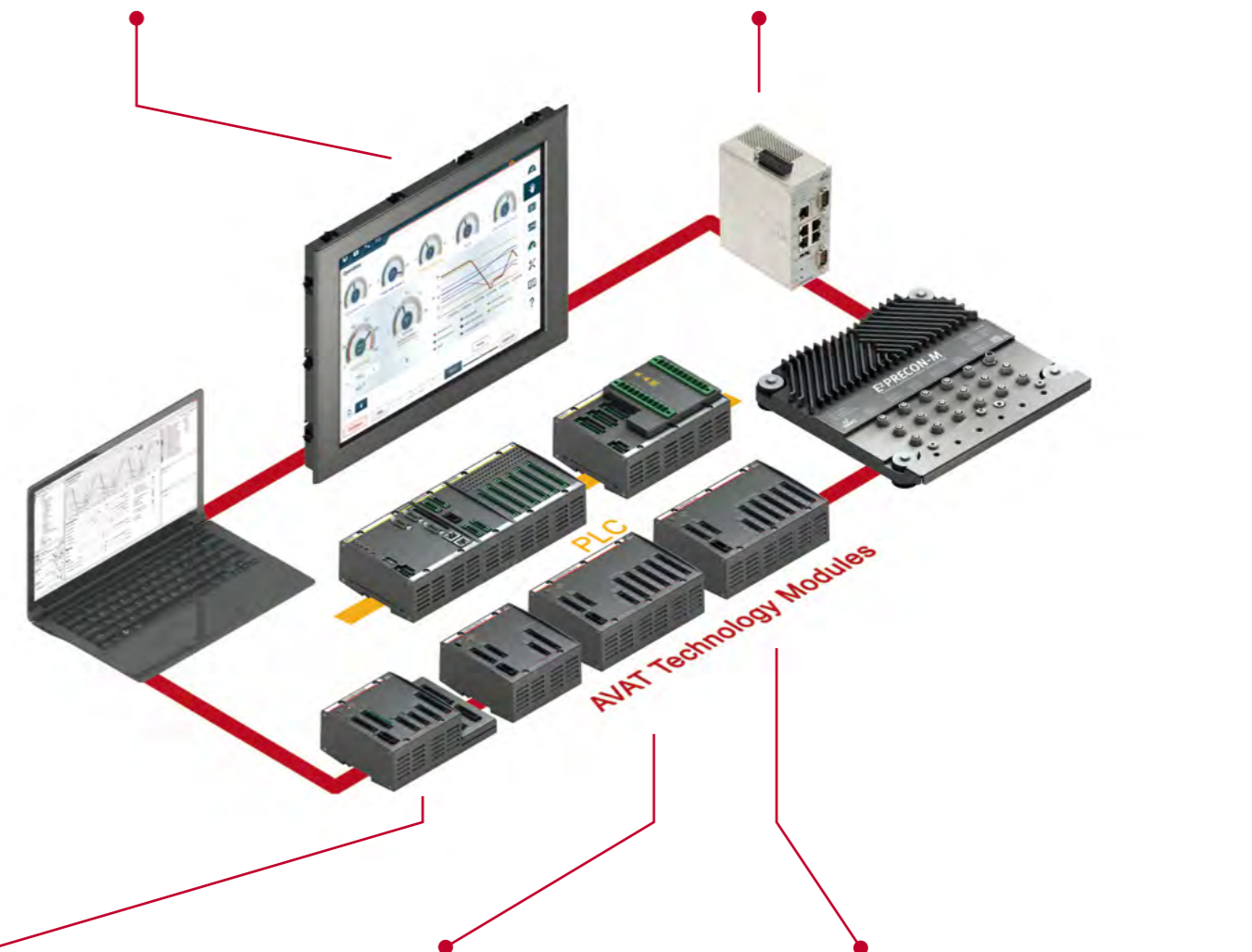
User terminal with 15" capacitive touchscreen, adapted to the plant operator's needs.

- Rapid overview of engine and peripherals
- Interactive operating log and configurable trending function
- Snapshot function saves all control data in one file with a single touch

### AVAT VPN-ROUTER

Our industrial VPN-ROUTERS guarantee fast and secure remote access via the Internet for the easy implementation of remote maintenance, reporting and smart phone-based alarm management.

- For remote access and maintenance as well as cloud and virtual services
- Internet access via broadband connection or direct via the mobile network (LTE)



### E<sup>2</sup>CORE-control

Highly dynamic multi-variable controller with direct actuator drive.

- Independent controller: speed/power/gas mixture
- Controls throttle valves and wastegate actuators
- Stepper motor driver for gas mixer control
- Interface for up to 2 lambda probes

### E<sup>2</sup>KNOCKCON

Reliably detects knocking and misfiring from the signals of common piezo knock sensors.

- Cylinder-individual knock control and misfire detection
- CAN interface to the engine controller
- Available for up to 20 cylinders per module

### E<sup>2</sup>PRECON

Cylinder-individual calculation of combustion key figures in real time.

- Cylinder pressure based combustion control
- Balancing, knock and misfire detection
- CAN interface to the engine control
- Available for up to 20 cylinders per module

## THE AVAT SOFTWARE PLATFORM: A SOLID BASIS FOR YOUR APPLICATIONS

With openECS data is the key factor. You notice this from the fact that once openECS is configured you can forget about a lot of interfacing aspects. Information arrives automatically where it is needed: in the operation log, in the history, in the visualization, in the connected SCADA system or on the cloud server. All functions access the same data and even the external interface documentation is automatically generated. Everything from a single source – lean and simple.



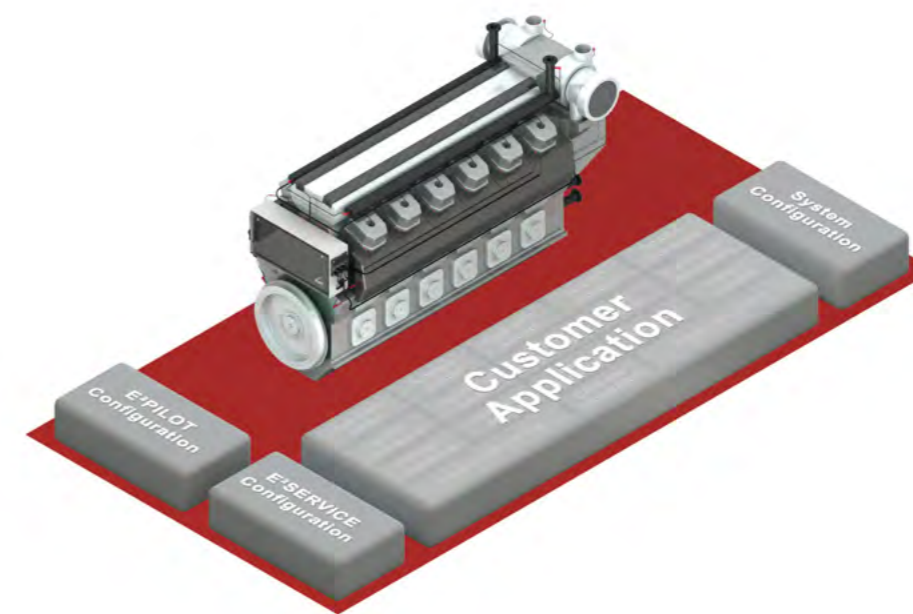
### THE BACKBONE OF THE SYSTEM

Our software platform makes tools and building blocks available which significantly accelerate application development.

- Libraries of engine-typical functions (e.g. balancers, speed / power / mixture controls).
- Functions for generator protection and synchronization are provided in the comprehensive library in openECS.
- Condition monitoring functions access directly on the data-base, either on-system or offline in the cloud.
- Cloud services: establishing time-controlled or event-triggered transmission of encrypted data packets to a cloud server is just a matter of a few lines of code.
- The E²SERVICE and E²PILOT packages include application templates and a set of smart GUI elements.
- The diagnosis tools consist of a well-structured operation log, automatic history recording in the background and the appropriate user interfaces.
- openECS provides a set of specific device interfaces to integrate AVAT technology modules or third party devices.

## OPEN APPLICATION LAYER FOR YOUR OWN ENGINE AND PERIPHERY MANAGEMENT

openECS means that you have total access to the engine control template of the open application layer and can therefore view and change all details that control and monitor the behaviour of the engine or peripherals. Thanks to a program configuration that can be changed dynamically, sliding monitoring or complex release conditions are possible. This achieves uniform functionality across all levels and simplified testability.



### SIMULATION

openECS supports various forms of simulation.

#### Software-in-the-Loop (SiL):

The method of choice for testing control strategies based on detailed engine models

#### Hardware-in-the-Loop (HiL):

Simulators are best for the verification of the complete system

#### Model-on-the-Target (MoT):

An engine-plant model runs directly on the controller (special feature of openECS)

### PROGRAMMING IN 3 STEPS

#### 1. Application Database

Data points, addresses, units, texts and all monitoring functions are centrally configured. All functions access the same data source and you always keep your overview.

#### 2. Application Code

Programming relies on the widely accepted, non-proprietary PLC Standard IEC 61131-3. In conjunction, openECS employs the proven development environment of the Bachmann M1 system. Configuration tools, editors, compilers and debuggers are integrated and work together perfectly. Optionally, code generated from MATLAB/SIMULINK can be embedded.

#### 3. User Interface Configuration

User interfaces are configured directly in our service tool E²SERVICE. You import all the data points and their properties from the data-base with a single mouse click. In this way you guarantee that everything fits together. The screens are assembled from growing library of smart GUI elements. E²SERVICE and E²PILOT take care of everything else automatically.

