BECKHOFF New Automation Technology

PC-based Control
for Shipbuilding

Automation

Central or local control
of all systems.

IPC

Control Panel: Operating
and display devices.

Scalable
Industrial PCs
as control
platform.

I/O

I/O systems for
integrating sensors
and actuators.

PC-based control
from Beckhoff …

For over 35 years, Beckhoff has been implementing automation solutions on the basis
of PC-based control technology, tried and tested worldwide in a vast range of industries
and applications. One of these sectors is shipbuilding, where Beckhoff technology has
been used successfully for many years in numerous applications ranging from yachts to
cargo ships and cruise liners. These vessels employ a modular Beckhoff automation system
consisting of powerful PC-based control hardware, TwinCAT automation software, I/O and
fieldbus components, and the EtherCAT communication system. The modular components
are finely scalable in terms of price and performance, forming a comprehensive toolkit
which shipbuilders can configure into an integrated automation system that serves a wide
range of control and measurement tasks.

Passenger ships

© Fotolia - Supply Vessel 1, Photo Alan Smillie

Cargo ships

© Fotolia - Luxury cruise ship, Photo Faraways

Offshore ships

© Fotolia - World Cruise, Photo Proffurthi

Sailing ships/Yachts

© Fotolia - Cargo container ship, Photo Federico Rostagno

… realises all automation tasks in one system.

Ships require solutions to complex automation tasks, depending on the application type and required features: This includes engine room monitoring, pumping of various liquids, lighting, HVAC control, individual room control on passenger ships, as well as loading and unloading of cargo using cranes on freighters. The challenge is to facilitate these different automation tasks with the smallest possible number of different control systems. Thanks to its high performance, open interfaces and the fact that it is based on open communication standards, the PC-based automation platform from Beckhoff is ideally suited for integrated control in these applications. In addition to the PLC, it integrates visualisation, measurement technology, engine monitoring and condition monitoring, and can be used for central or local control.

▶ **www.beckhoff.com/shipbuilding**

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Lighting

The Beckhoff Bus Terminal I/O toolkit offers modules for all common lighting types, including LED lighting, universal dimmers up to 600 VA or light switching up to 16 A per output. Lighting control via DALI, DMX, EIB/KNX or LON is also possible using communication terminals. TwinCAT includes extensive software components for tasks such as constant lighting or automatic control. (see page 8/9)

Heating, ventilation, air conditioning

Bus Terminals are available for temperature measurement, weather sensors, actuators, valves, pressure measurement or integration of HVAC sensors via M-Bus, MP-Bus, LON or EIB/KNX. BACnet or Modbus can be used to integrate peripheral devices such as actuators for flow control, volume flow display and alarm messages into the control platform. (see page 12)

Individual room control

The Beckhoff system enables configuration of modular Bus Terminal stations to match the application and task at hand. The compact BC9191 single room controller offers a cost-effective alternative for individual room control. It features pre-installed standard functionalities covering all the functions required for individual room control, thereby simplifying commissioning. (see page 12)

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Bacterial ballast
tank cleaning

Beckhoff offers compact control solutions for manufacturers of ballast tank cleaning systems, consisting of an Embedded Controller with fieldbus interface or integrated Bus Terminal interface. The system enables the realisation of all the required measuring and control tasks, including measurement/logging of the water conditions, and control of disinfectant draining, among other functions. (see page 8/9)

Machine monitoring

Machine control requires monitoring of numerous process parameters. The corresponding data points are logged via decentralised Bus Terminal stations and transferred to the central controller through the fieldbus. Alternatively, the EtherCAT plug-in modules of the EJ series from Beckhoff are available for series applications involving large production quantities. (see page 10)
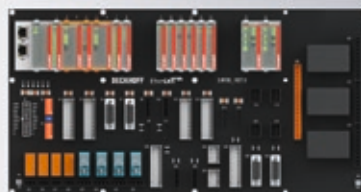
Pumping liquids

Ships also require pumping and transportation of a wide range of liquids such as water or heavy oil. Here too, the Beckhoff automation toolkit offers ideal solutions, for example to control conventional or proportional valves, measurement of fill levels and the flow rate, or variable-speed pumps, as well as the monitoring of tanks for leaks. (see page 8/9)

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CX9020: Embedded PC with
ARM Cortex™ A8 processor

CX5020: Embedded PC with
Intel® Atom™ processor

CX5130: Embedded PC with
Intel® Atom™ processor, 2 cores

C6930: compact control cabinet
Industrial PC

Scalable and modular
hardware and software …

Embedded PCs offer compact, DIN rail-mountable control with directly attached I/O connection. They offer scalable performance with up to four processor cores (CX5140) and cover the entire range of control applications for the medium performance class and in the lower price range. The CX9020 with multi-option interface, for example, enables integration with all common fieldbus and industrial Ethernet systems. The control package is rounded out by C69xx series control cabinet Industrial PCs and multi-touch Control Panels which offer advanced operator comfort in the control room or on the bridge. TwinCAT, the robust automation platform from Beckhoff, integrates an engineering environment and control runtime in a single solution. Feature-filled PLC libraries reduce engineering time, and reliable connection to higher-level process control systems is assured via communication standards such as Ethernet or OPC-UA.

CP2911: multi-touch built-in Control Panel
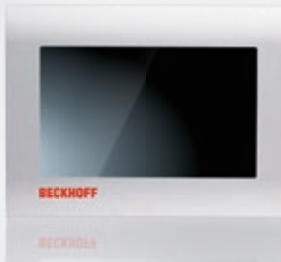
CP6606: compact 7-inch Panel PC as
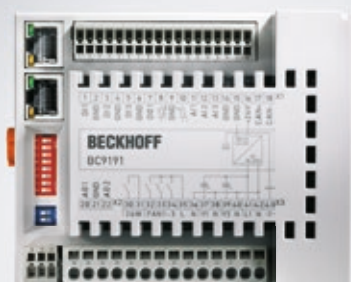all-in-one controller

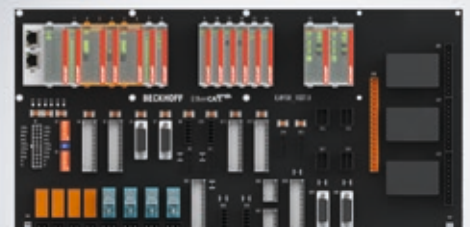EtherCAT I/Os: broad I/O
spectrum in IP 20 and IP 67

TwinCAT: software for engineering
and runtime

BC9191: compact building automation
Room Controller
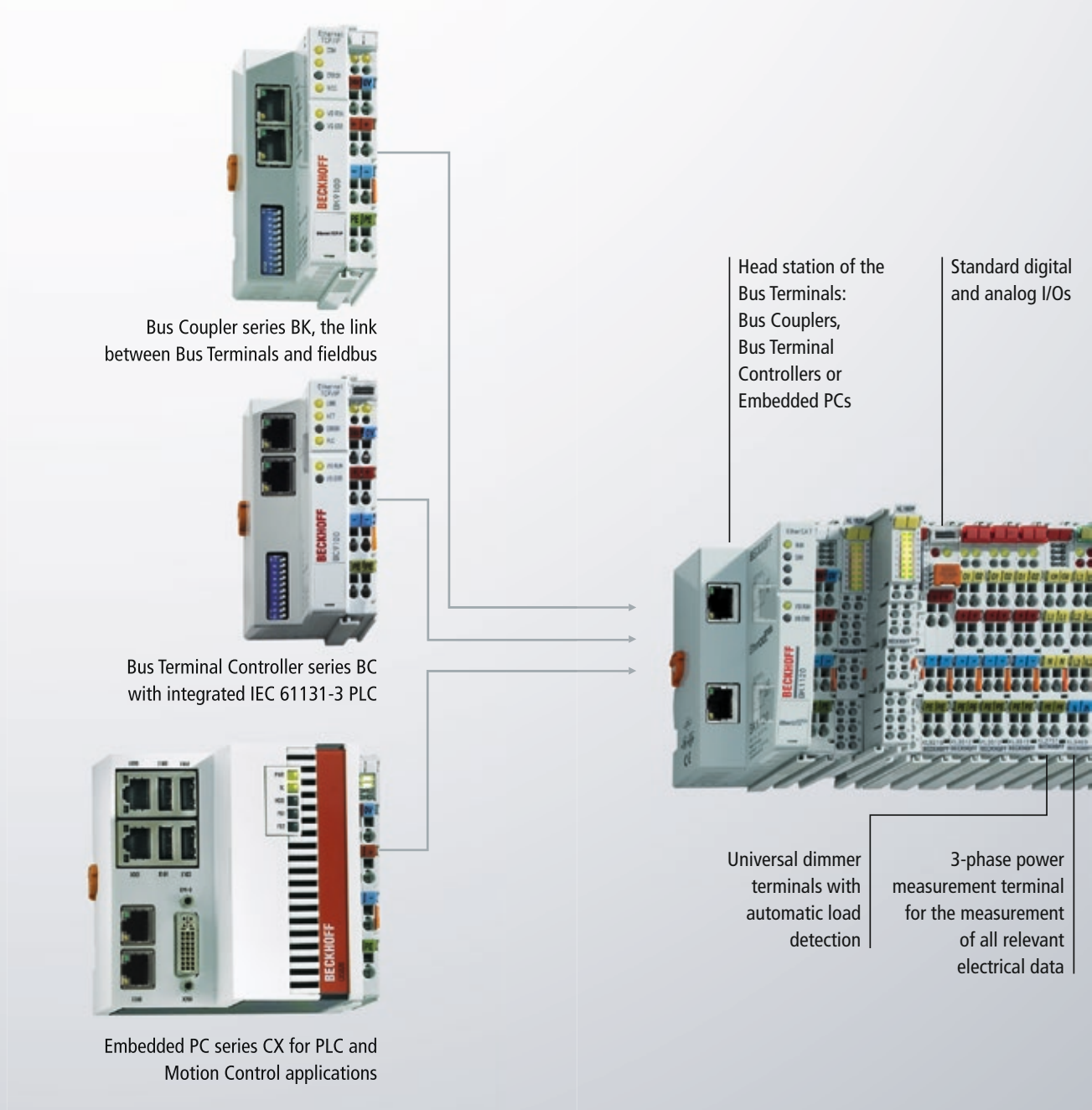
EtherCAT plug-in modules: I/O solution
for standard applications

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We reserve the right to make technical changes.
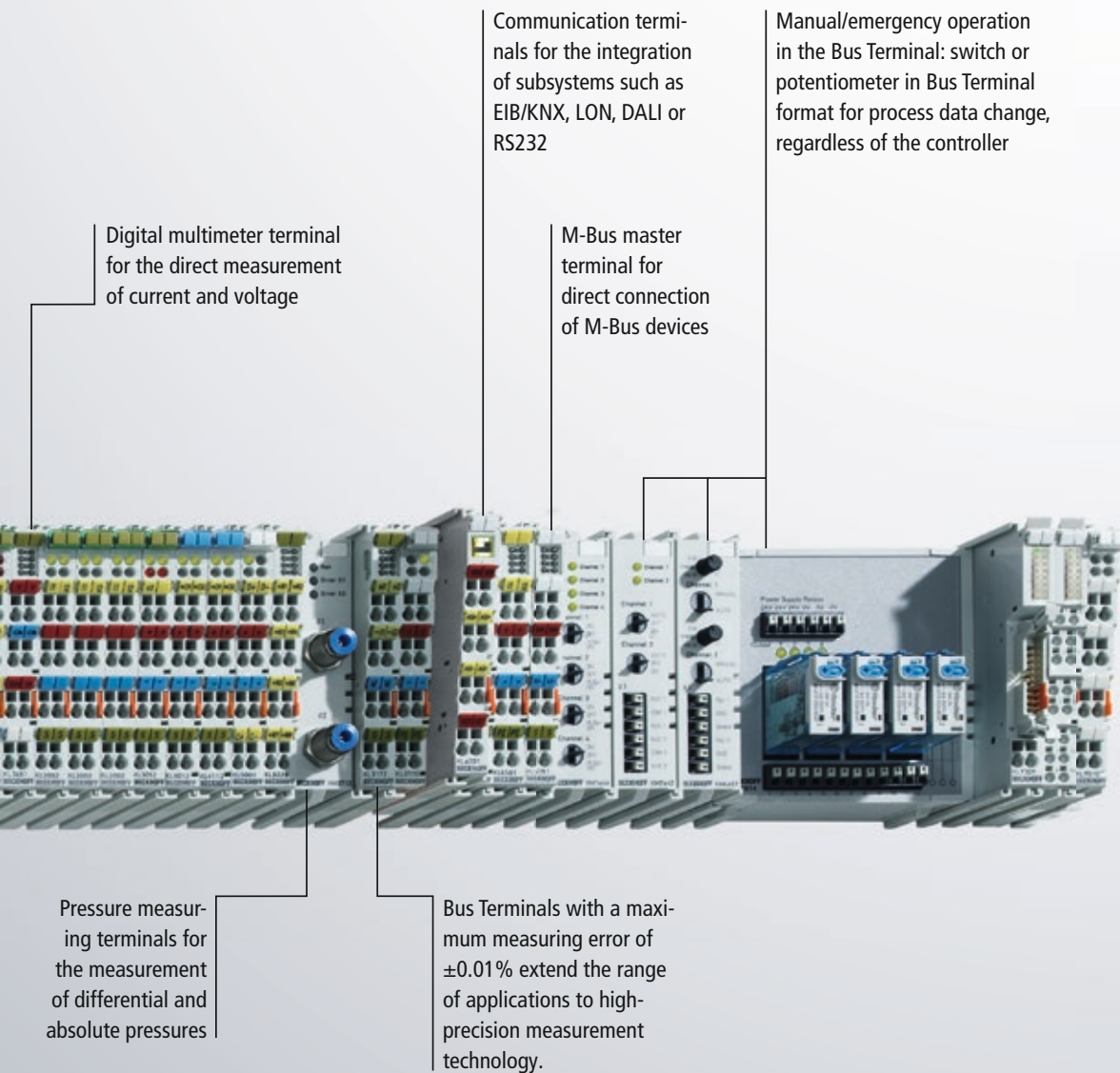
… the Beckhoff automation toolkit

The modular Bus Terminal system covers the complete range of digital and analog signals. Bus Couplers are available for all relevant bus systems via the open and bus-neutral I/O system, from Ethernet and EtherCAT through to PROFIBUS and other legacy fieldbuses. Cable redundancy is easy to implement using the EtherCAT ring topology with copper or fibre-optic cables. To supplement the modular I/O portfolio, Beckhoff has developed the EtherCAT distribution board with EtherCAT I/O plug-in modules for series applications (EJxxxx). The compact BC9191 Room Controller is suitable for the price-sensitive area of individual cabin control. It is equipped with pre-installed standard functions and can be used as a stand-alone control system or as a local controller.

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Bus Coupler series BK, the link
between Bus Terminals and fieldbus

Head station of the
Bus Terminals:
Bus Couplers,
Bus Terminal
Controllers or
Embedded PCs

Standard digital
and analog I/Os

Bus Terminal Controller series BC
with integrated IEC 61131-3 PLC

Universal dimmer
terminals with
automatic load
detection

3-phase power
measurement terminal
for the measurement
of all relevant
electrical data

Embedded PC series CX for PLC and
Motion Control applications

The modular Beckhoff I/O system offers …

The modular Beckhoff I/O system consists of electronic terminal blocks for direct sensor/actuator wiring and a
Bus Coupler, Bus Terminal Controller or Embedded PC to interface with bus systems commonly found in ship-
building – including EtherCAT, Ethernet TCP/IP, EtherNet/IP, Modbus TCP/RTU, PROFIBUS, PROFINET and RS232/
RS422/RS485. With over 400 signal types, all common sensors and actuators can be seamlessly integrated into
the controller. All areas of application, from drive control to measuring equipment, are also covered. The finely-
granular design with 1 to 16 channels per terminal enables users to tailor the system exactly to their application
needs. The use of standard components ensures economical, yet complete solutions, as well as seamless integra-
tion into existing systems.

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Communication termi-
nals for the integration
of subsystems such as
EIB/KNX, LON, DALI or
RS232

Manual/emergency operation
in the Bus Terminal: switch or
potentiometer in Bus Terminal
format for process data change,
regardless of the controller

Digital multimeter terminal
for the direct measurement
of current and voltage

M-Bus master
terminal for
direct connection
of M-Bus devices

Pressure measur-
ing terminals for
the measurement
of differential and
absolute pressures

Bus Terminals with a maxi-
mum measuring error of
±0.01% extend the range
of applications to high-
precision measurement
technology.

… customised solutions for shipbuilding.

PC-based automation integrates extensive measurement and control technology on a universal platform,
enabling decentralised acquisition and storage of all process data. These process data, such as fill levels, temper-
atures, pressure, volume flow, voltage, performance, position, velocity, acceleration, speed, torque and direction
of rotation, are recorded by the Bus Terminals and processed in the Embedded PC or the higher-level process
control system. The integrated Beckhoff control solution not only has the advantage of a compact design, it also
impresses through lower system costs, simplified engineering and flexibility. Decentralised I/O stations can be
connected via Ethernet, fieldbus or radio to enable remote access.

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EtherCAT
Coupler

Safety plug-in
modules

Colour coding
signal type

Digital and analog
plug-in modules

Motion modules

Status and diagnostic LEDs

BECKHOFF EtherCAT. EJ8930_1027.0

Additional functions,
e.g. relays or DIP switches

Machine-specific
connection level

Signal distribution board

Design example
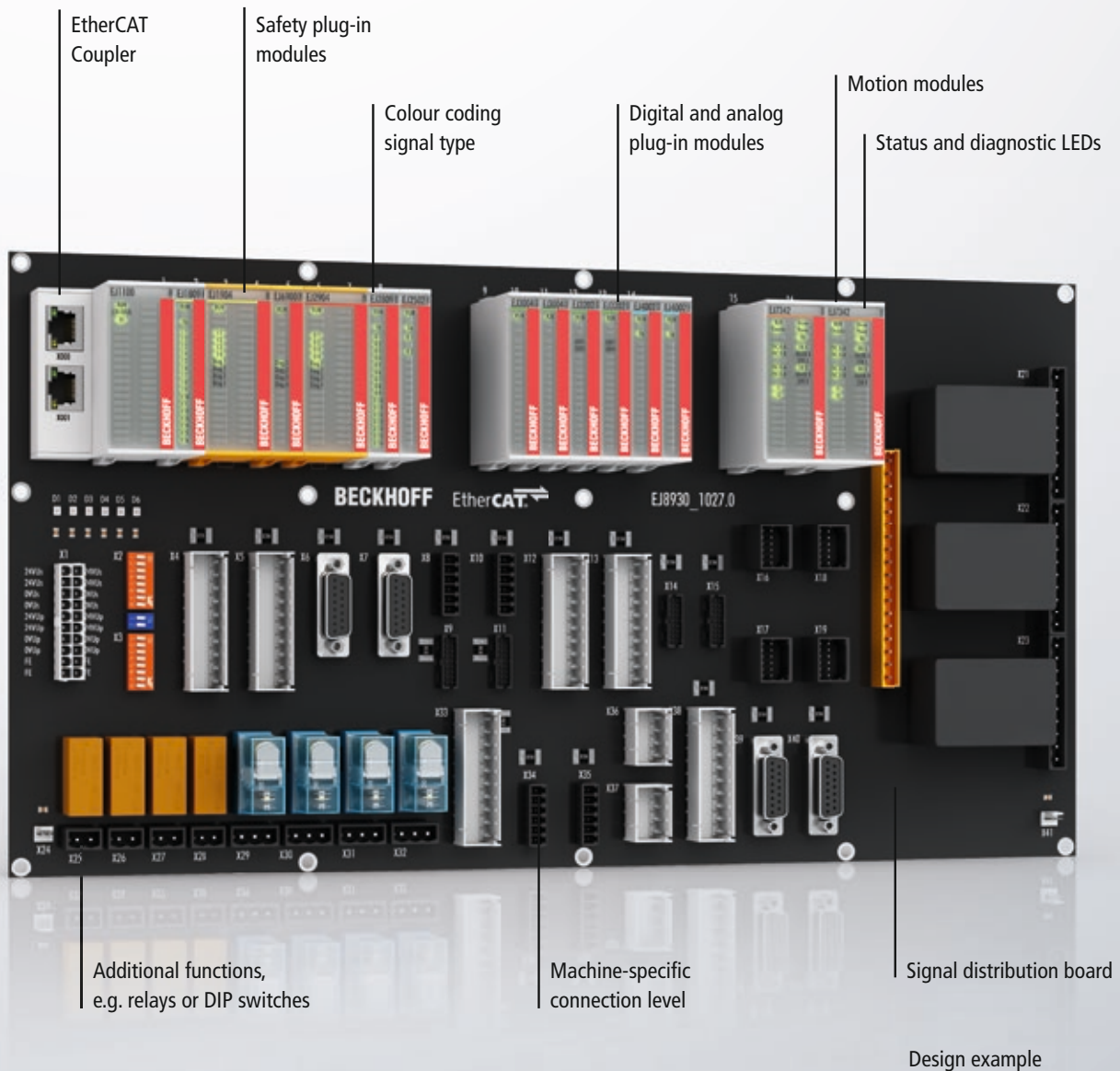
# EtherCAT plug-in modules and signal distribution board …

The EtherCAT plug-in modules (EJ series) are electronically based on the tried and tested EtherCAT I/O system from Beckhoff and are designed to plug directly into a PCB. The PCB serves as the application-specific signal distribution board, which then distributes the signals and power supply to individual plug connectors and links the controller with further modules. Complex manual wiring of individual wires between I/Os and the plug connector level, which is common in conventional control cabinet construction, is superseded by attaching industrial-grade, pre-assembled cable harnesses.

… the efficient and space-saving I/O solution for series production

EJ modules enable efficient implementation of series production applications involving a large number of identical parts, while retaining customisation options. The application-specific distribution board can be manufactured by the user or by Beckhoff. Thanks to the plug-in design, it is possible to offer options that are only used on-demand. In addition, the ultra-compact design of the EJ modules reduces the footprint required in the control cabinet and is therefore particularly suitable for space-constrained applications. A further advantage of distribution boards is increased process safety, since the risk of incorrect wiring is reduced to a minimum through the use of clearly coded components.

9	9
Machine module 1	Machine module 2
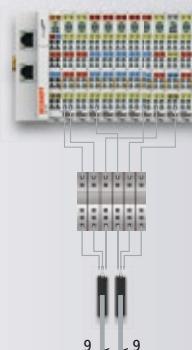
Signal distribution via single-core wiring

9	9
Machine module 1	Machine module 2
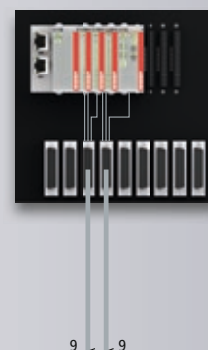
Signal distribution via signal distribution board

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Perfect synergy: Beckhoff control platform integrates digital Danfoss actuator …

Advanced cabin automation requires that exceptional passenger comfort, simple operation and energy efficiency all go hand in hand. For this purpose, Beckhoff offers the compact BC9191 Room Controller, which features standard functionalities such as lighting, HVAC and blind control. The TwinCAT Building Automation software, in conjunction with the new eXtendable Room Box, offers system integrators a complete solution that significantly reduces engineering time while offering maximum flexibility. TwinCAT Building Automation enables convenient configuration of the control functions and automated arrangement of the hardware components. The openness of PC-based control also facilitates integration of external devices, such as the intelligent NovoCon™ actuator from Danfoss for flow control, volume flow display and alarm messages.

… to ensure optimum comfort and energy savings.

The software library for controlling the intelligent actuator was developed in close cooperation between Beckhoff and Danfoss. The CP6606 Panel PC from Beckhoff with compact 7-inch touchscreen serves as the all-in-one HMI and control unit. The communication takes place via BACnet or Modbus. Thanks to full system automation, NovoCon™ is able to detect faults immediately, report them to the control room via the fieldbus and rectify them via remote maintenance. In conjunction with the AB-QM valve from Danfoss, the actuator enables control, monitoring and hydraulic synchronisation of HVAC systems via the building management system. The flow rate can be adjusted to the demand, thereby achieving precise temperature control, optimum pump speed and higher efficiency of the cooling equipment. This ensures optimum comfort while at the same time reducing the energy consumption for climate control on a passenger ship by around 25 percent, which constitutes around 30 to 40 percent of the total energy consumption.

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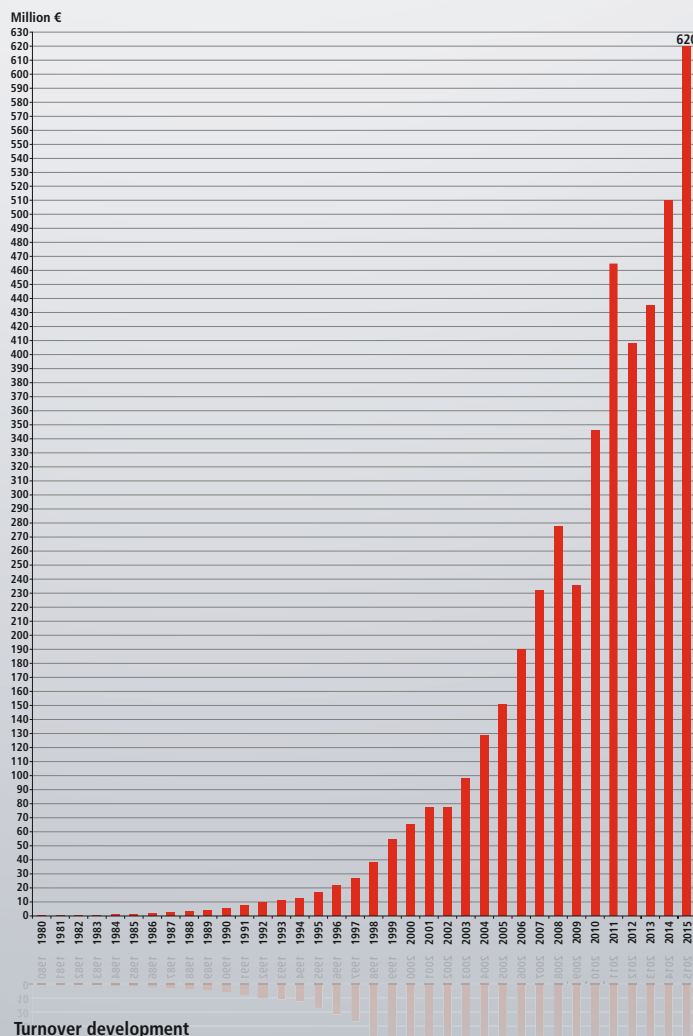
Beckhoff – New Automation Technology

Beckhoff implements open automation systems on the principle of PC-based control technology. „New Automation Technology" from Beckhoff stands for universal and industry-independent control and automation solutions, used worldwide in a large variety of different applications that range from CNC-controlled machine tools to wind turbines to intelligent building control. Beckhoff's constant technological development, economic growth, considerable product depth and production capacities are guarantors for the robustness, long-term availability and delivery reliability of PC-based control solutions.

▶ **www.beckhoff.com**

Beckhoff at a glance

- Headquarters: Verl, Germany
- Sales 2015: 620 million € (+22 %)
- Staff worldwide: 3,000
- Branch Offices Germany: 14
- Subsidiaries/Branch Offices worldwide: 34
- Distributors worldwide: in more than 75 countries

(As of 4/2016)

Million €

620

Seattle
Minneapolis
London
Detroit Toronto Montreal
Milwaukee
Chicago
Rochester Boston
Denver
Cleveland Mechanicsburg
San Jose
NORTH AMERICA
Nashville
Los Angeles
Rogers Raleigh
San Diego Phoenix
Charlotte
Dallas
Austin Atlanta
Houston

San Luis Potosí

Bogotá

Quito

Lima

Santiago

Turnover development

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We reserve the right to make technical changes.

Worldwide presence
on all continents

Thanks to Beckhoff's presence in more than 75 countries, globally active Beckhoff customers benefit from fast service worldwide and technical support in the local language. In addition, Beckhoff regards geographic proximity to the customer as a prerequisite for a profound understanding of the technical challenges that face customers.

Further information

The Beckhoff webpage "PC-based Control for Shipbuilding" contains additional information and solutions.
▶ **www.beckhoff.com/shipbuilding**
All Beckhoff catalogs and flyers are available for download from our website.
▶ **www.beckhoff.com/media**

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